DG201HS

High-Speed Quad SPST CMOS Analog Switch

Features

- Fast Switching—t_{ON}: 38 ns
- Low On-Resistance: 25 Ω
- Low Leakage: 100 pA
- Low Charge Injection
- TTL/CMOS Logic Compatible
- Single Supply Compatibility
- High Current Rating: −30 mA

Benefits

- Faster Throughput
- Higher Accuracy
- Reduced Pedestal Error
- Upgrades Existing Designs
- Simple Interfacing
- Replaces HI201HS, ADG201HS

Applications

- Data Acquisition
- Hi-Rel Systems
- Sample-and-Hold Circuits
- Communication Systems
- Automatic Test Equipment
- Integrator Reset Circuits
- Choppers
- Gain Switching
- Avionics

Description

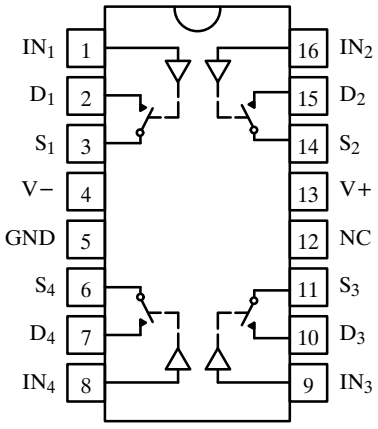
The DG201HS is an improved monolithic device containing four independent analog switches. It is designed to provide high speed, low error switching of analog signals. Combining low on-resistance (25 Ω) with high speed (t_{ON}: 38 ns), the DG201HS is ideally suited for high speed data acquisition requirements.

To achieve high voltage ratings and superior switching performance, the DG201HS is built on a proprietary high-voltage silicon-gate process. An epitaxial layer prevents latchup.

Each switch conducts equally well in both directions when on, and blocks input voltages to the supply values, when off.

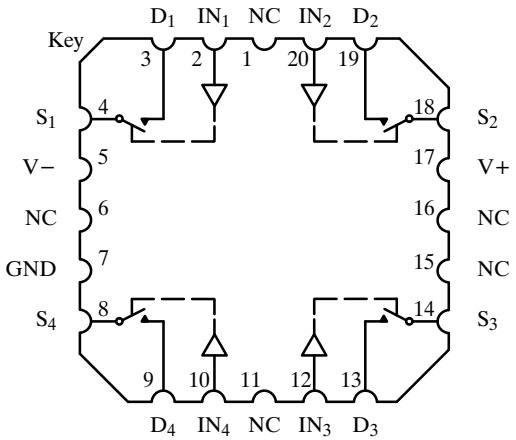
Functional Block Diagram and Pin Configuration

Dual-In-Line and SOIC



Top View

LCC



Top View

Ordering Information

Temp Range	Package	Part Number
−40 to 85°C	16-Pin Plastic DIP	DG201HSDJ
	16-Pin Narrow SOIC	DG201HSDY
−55 to 125°C	16-Pin CerDIP	DG201HSAK/883
	LCC-20	DG201HSAZ/883

Truth Table

Logic	Switch
0	ON
1	OFF

Logic "0" ≤ 0.8 V
Logic "1" ≥ 2.4 V

Switches Shown for Logic "1" Input

Absolute Maximum Ratings

V+ to V− ..... 44 V
GND to V− ..... 25 V
Digital Inputs[a] V_S, V_D ..... (V−) −4 V to (V+) +4 V
or 30 mA, whichever occurs first
Continuous Current (Any Terminal) ..... 30 mA
Current, S or D (Pulsed 1 ms, 10% duty cycle) ..... 100 mA
Storage Temperature (A Suffix) ..... −65 to 150°C
(D Suffix) ..... −65 to 125°C
Power Dissipation (Package)b
16-Pin Plastic DIP[c] ..... 470 mW
16-Pin CerDIP[d] ..... 900 mW
16−Pin Narrow Body SOIC[e] ..... 600 mW
LCC-20[d] ..... 900 mW

Notes
a. Signals on S_X, D_X, or IN_X 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 mW/°C above 75°C.
d. Derate 12 mW/°C above 75°C.
e. Derate 7.6 mW/°C above 75°C.

Specifications[a]

Parameter	Symbol	Conditions Unless Otherwise Specified V+ = 15 V, V− = −15 V V_{IN} = 3 V, 0.8 V[f]	Temp[b]	Typ[c]	A Suffix −55 to 125°C Min[d]	A Suffix −55 to 125°C Max[d]	D Suffix −40 to 85°C Min[d]	D Suffix −40 to 85°C Max[d]	Unit
Analog Switch									
Analog Signal Range[e]	V_{ANALOG}		Full		V−	V+	V−	V+	V
Drain-Source On-Resistance	$r_{DS(on)}$	I_S = −10 mA, V_D = ±8.5 V V+ = 13.5 V, V− = −13.5 V	Room Full	25		50 75		50 75	Ω
$r_{DS(on)}$ Match			Room	3					%
Switch Off Leakage Current	$I_{S(off)}$	V+ = 16.5 V, V− = −16.5 V V_D = ±15.5 V V_S = ∓15.5 V	Room Full	0.1	−1 −60	1 60	−1 −20	1 20	nA
	$I_{D(off)}$		Room Full	0.1	−1 −60	1 60	−1 −20	1 20	
Channel On Leakage Current	$I_{D(on)}$	V+ = 16.5 V, V− = −16.5 V V_S = V_D = ∓15.5 V	Room Full	0.1	−1 −60	1 60	−1 −20	1 20	
Digital Control									
Input, High Voltage	V_{INH}		Full		2.4		2.4		V
Input, Low Voltage	V_{INL}		Full			0.8		0.8	
Input Capacitance	C_{in}		Full	5					pF
Input Current	I_{INL} or I_{INH}	V_{IN} under test = 0.8 V, 3 V	Full		−1	1	−1	1	µA
Dynamic Characteristics									
Turn-On Time	t_{ON}	R_L = 1 kΩ, C_L = 35 pF V_S = ±10 V, V_{INH} = 3 V See Figure 3	Room Full	38		50 70		50 70	ns
Turn-Off Time	t_{OFF1}		Room Full	30		50 70		50 70	
	t_{OFF2}		Room	150					
Output Settling Time to 0.1%	t_s		Room	180					
Charge Injection	Q	C_L = 1 nF, V_S = 0 V V_{gen} = 0 V, R_{gen} = 0 Ω	Room	−5					pC
OFF Isloation	OIRR	R_L = 1 kΩ, C_L = 10 pF f = 100 kHz	Room	85					dB

Specifications[a] (Cont'd)

Parameter	Symbol	Conditions Unless Otherwise Specified V+ = 15 V, V− = −15 V V_{IN} = 3 V, 0.8 V[f]	Temp[b]	Typ[c]	A Suffix −55 to 125°C Min[d]	A Suffix −55 to 125°C Max[d]	D Suffix −40 to 85°C Min[d]	D Suffix −40 to 85°C Max[d]	Unit
Dynamic Characteristics (Cont'd)									
Crosstalk (Channel-to-Channel)	X_{TALK}	Any Other Channel Switches R_L = 1 kΩ, C_L = 10 pF f = 100 kHz	Room	100					dB
Source Off Capacitance	$C_{S(off)}$	V_S, V_D = 0 V, f = 1 MHz	Room	8					pF
Drain Off Capacitance	$C_{D(off)}$		Room	8					
Channel On Capacitance	$C_{D(on)}$		Room	30					
Drain-to-Source Capacitance	$C_{DS(off)}$		Room	0.5					
Power Supplies									
Positive Supply Current	I+	V+ = 15 V, V− = −15 V V_{IN} = 0 or 5 V	Room Full	4.5		10		10	mA
Negative Supply Current	I−		Room Full	3.5	−6		−6		
Power Consumption[c]	P_C		Full			240		240	mW

Specifications[a] for Single Supply

Parameter	Symbol	Conditions Unless Otherwise Specified V+ = 10.8 V to 16.5 V V− = GND = 0 V V_{IN} = 3 V, 0.8 V[f]	Temp[b]	Typ[c]	A Suffix −55 to 125°C Min[d]	A Suffix −55 to 125°C Max[d]	D Suffix −40 to 85°C Min[d]	D Suffix −40 to 85°C Max[d]	Unit
Analog Switch									
Analog Signal Range[e]	V_{ANALOG}		Full		0	V+	0	V+	V
Drain-Source On-Resistance	$r_{DS(on)}$	I_S = −10 mA, V_D = 8.5 V V+ = 10.8 V	Room Full	65		90 120		90 120	Ω
Switch Off Leakage Current	$I_{S(off)}$	V+ = 16.5 V, V_S = 0.5 V, 10 V V_D = 10 V, 0.5 V	Room Full	0.1	−1 −60	1 60	−1 −20	1 20	nA
	$I_{D(off)}$		Room Full	0.1	−1 −60	1 60	−1 −20	1 20	
Channel On Leakage Current	$I_{D(on)}$ + $I_{S(on)}$	V+ = 16.5 V, V_D = 0.5 V, 10 V	Room Full	0.1	−1 −60	1 60	−1 −20	1 20	
Digital Control									
Input, High Voltage	V_{INH}		Full		2.4		2.4		V
Input, Low Voltage	V_{INL}		Full			0.8		0.8	
Input Capacitance	C_{in}		Full	5					pF
Input Current	I_{INL} or I_{INH}	V+ = 16.5 V V_{IN} under test = 0.8 V, 3 V	Full		−1	1	−1	1	µA
Dynamic Characteristics									
Turn-On Time	t_{ON}	R_L = 1 kΩ, C_L = 35 pF, V_S = 2 V V= = 10.8 V, See Figure 3	Room Full			50 70		50 70	ns
Turn-Off Time	t_{OFF1}		Room Full			50 70		50 70	
	t_{OFF2}		Room	150					

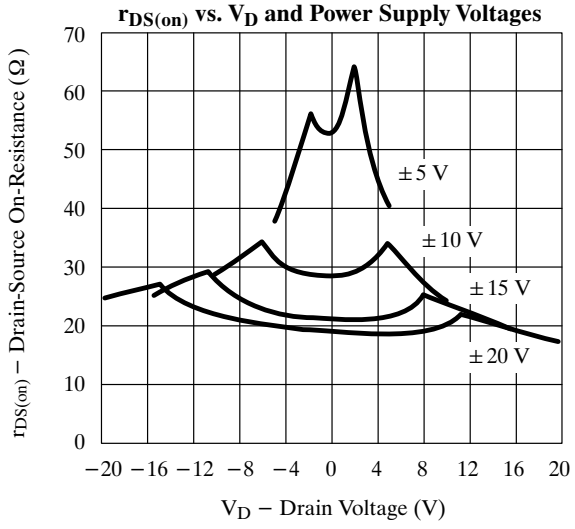
DG201HS

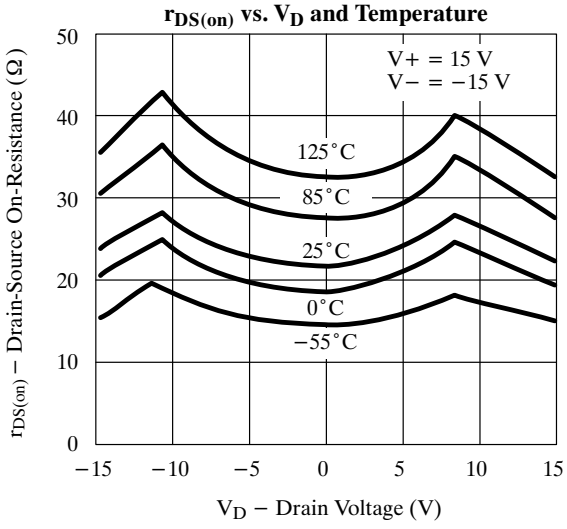
Specifications[a] for Single Supply

Parameter	Symbol	Conditions Unless Otherwise Specified V+ = 10.8 V to 16.5 V V− = GND = 0 V V_{IN} = 3 V, 0.8 V[f]	Temp[b]	Typ[c]	A Suffix −55 to 125°C Min[d]	A Suffix −55 to 125°C Max[d]	D Suffix −40 to 85°C Min[d]	D Suffix −40 to 85°C Max[d]	Unit
Dynamic Characteristics (Cont'd)									
Output Settling Time to 0.1%	t_s		Room	180					ns
Charge Injection	Q	C_L = 1 nF, V_S = 0 V V_{gen} = 0 V, R_{gen} = 0 Ω	Room	10					pC
Off Isloation	OIRR	R_L = 1 kΩ, C_L = 10 pF f = 100 kHz	Room	85					dB
Crosstalk (Channel-to-Channel)	X_{TALK}	Any Other Channel Switches R_L = 1 kΩ, C_L = 10 pF f = 100 kHz	Room	100					dB
Source Off Capacitance	$C_{S(off)}$	f = 1 MHz	Room	10					pF
Drain Off Capacitance	$C_{D(off)}$	f = 1 MHz	Room	10					pF
Channel On Capacitance	$C_{D(on)}$	V_{ANALOG} = 0 V	Room	30					pF
Power Supplies									
Positive Supply Current	I+	V+ = 15 V, V_{IN} = 0 or 5 V	Full			10		10	mA
Power Consumption[e]	P_C	V+ = 15 V, V_{IN} = 0 or 5 V	Full			150		150	mW

Notes
a. Refer to PROCESS OPTION FLOWCHART (Section 5 of the 1994 Data Book or FaxBack number 7103).
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.
f. V_{IN} = input voltage to perform proper function.

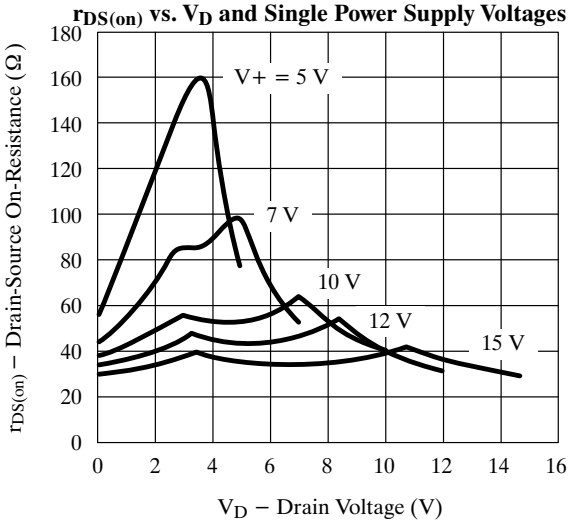
Typical Characteristics



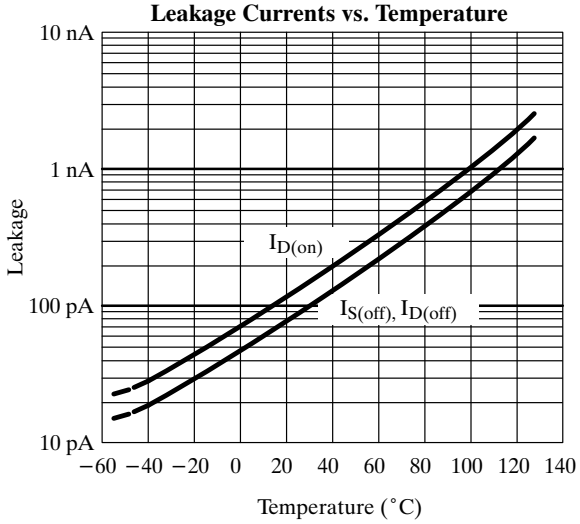


Typical Characteristics (Cont'd)

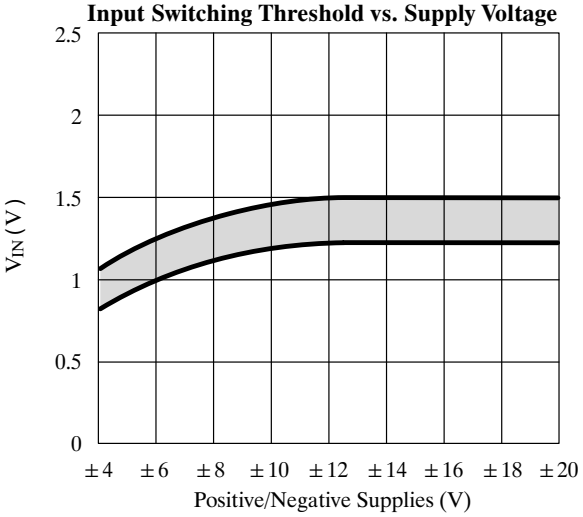
$r_{DS(on)}$ vs. V_D and Single Power Supply Voltages



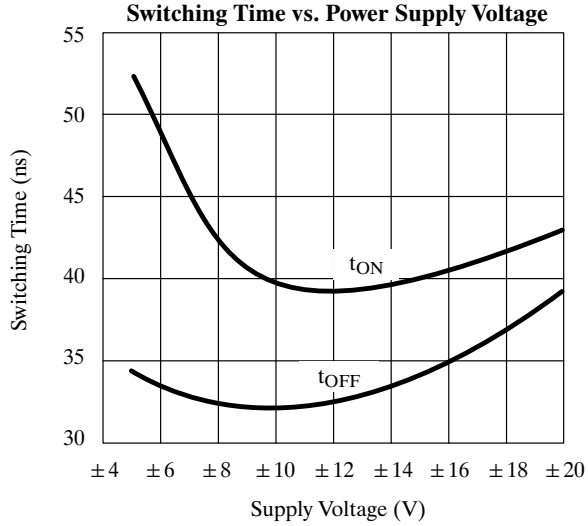
Leakage Currents vs. Temperature



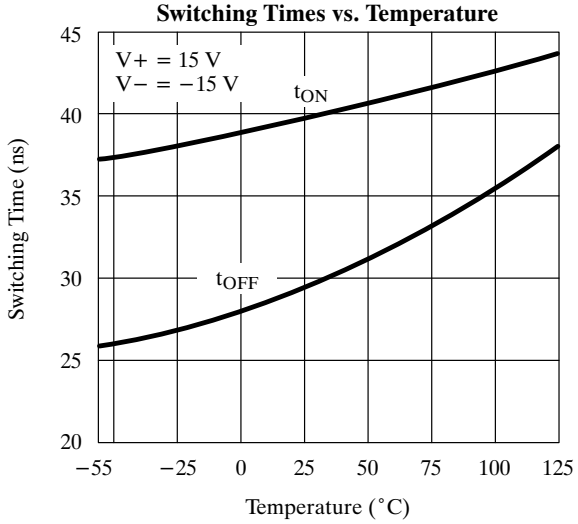
Input Switching Threshold vs. Supply Voltage



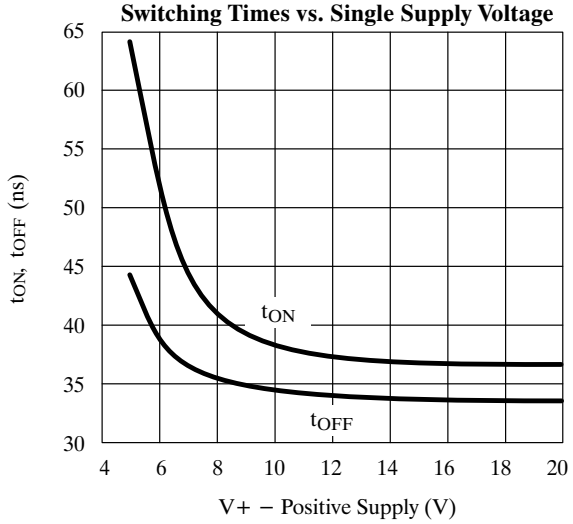
Switching Time vs. Power Supply Voltage



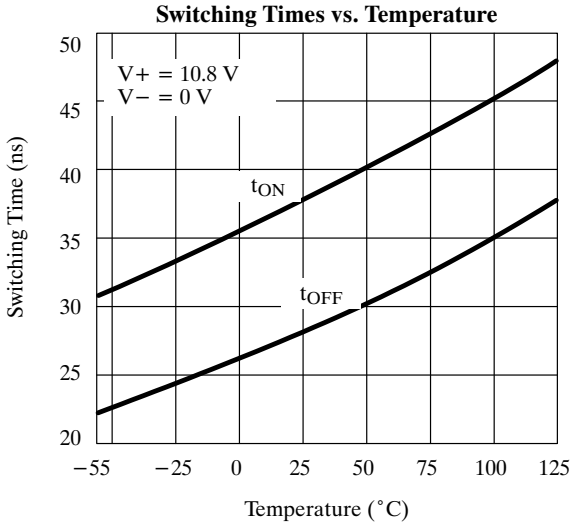
Switching Times vs. Temperature

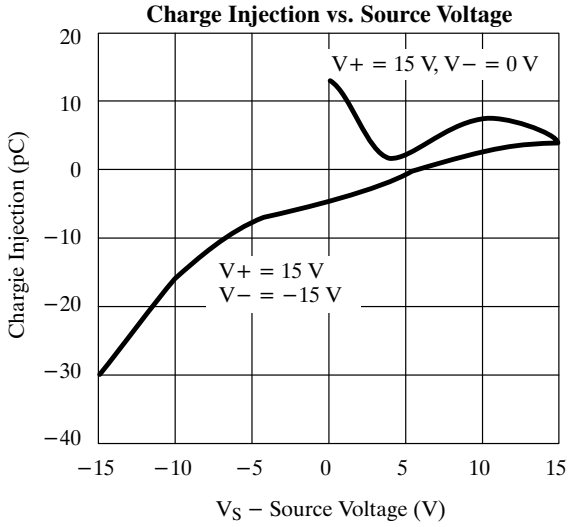


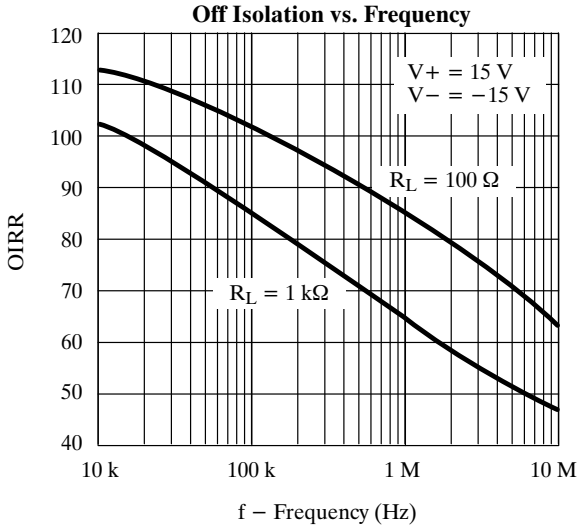
Switching Times vs. Single Supply Voltage



Typical Characteristics (Cont'd)







Test Circuits

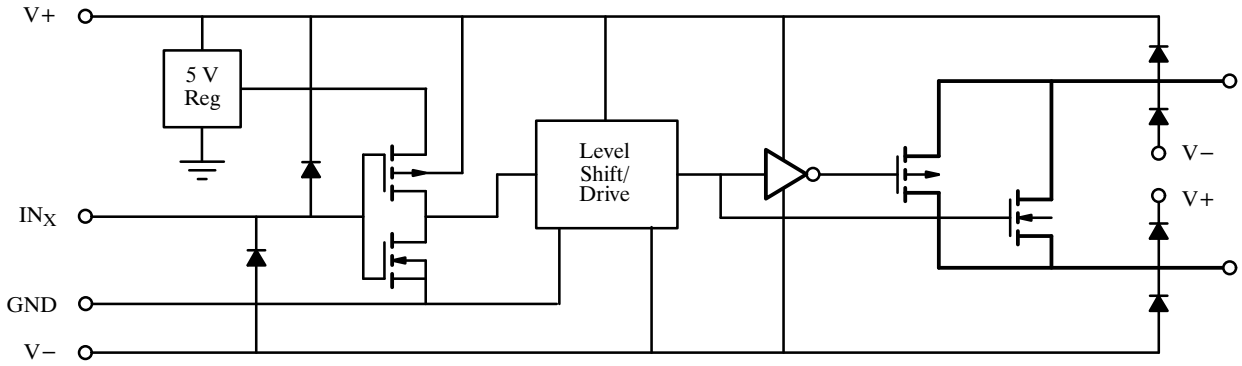
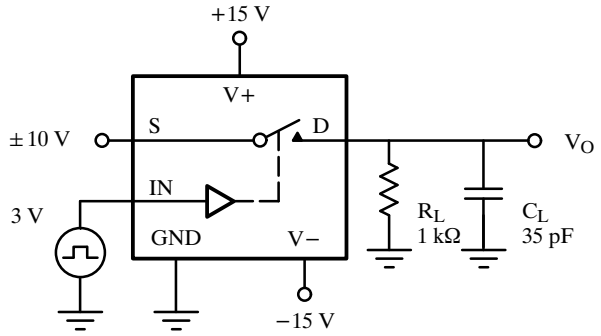
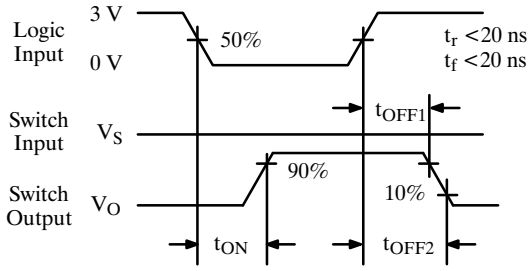


Figure 1.

Test Circuits (Cont'd)

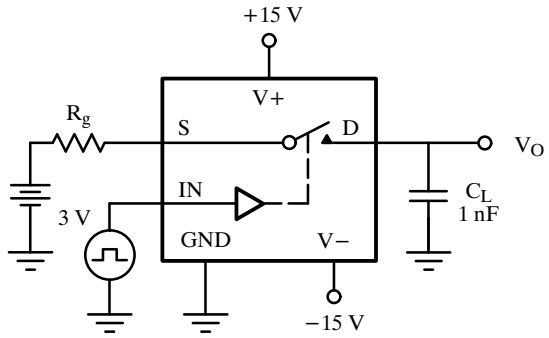


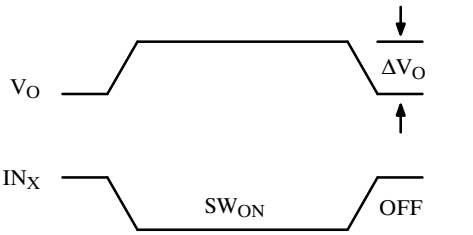


C_L (includes fixture and stray capacitance)

$$V_O = V_S \frac{R_L}{R_L + r_{DS(on)}}$$

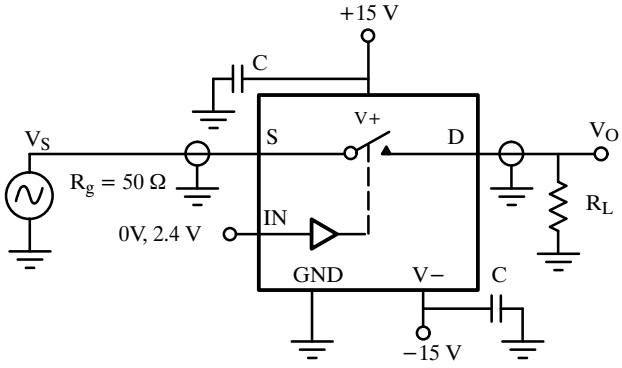
Figure 2. Switching Time





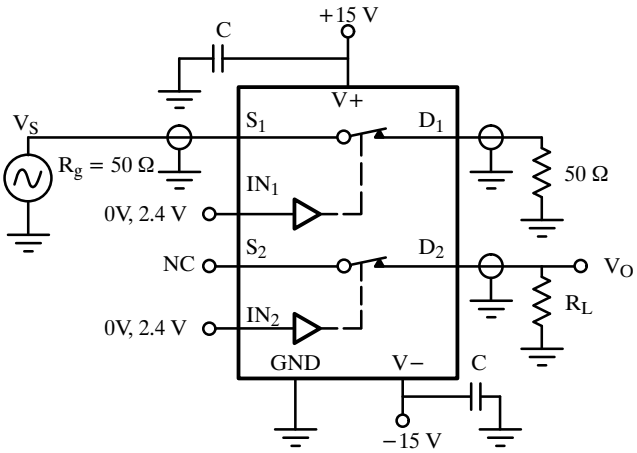
$Q = \Delta V_O \times C_L$

Figure 3. Charge Injection



$$\text{Off Isolation} = 20 \log \left| \frac{V_S}{V_O} \right|$$

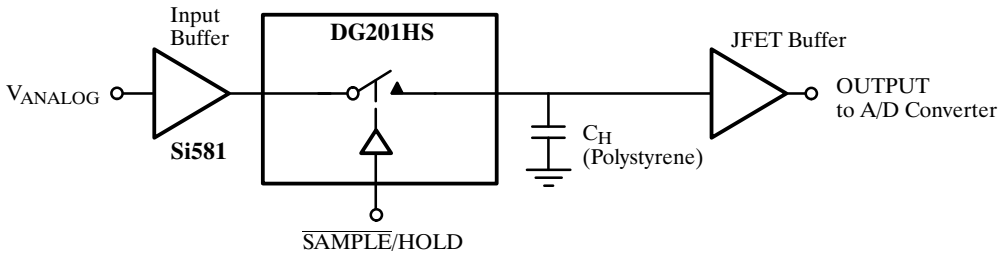
Figure 4. Off Isolation



$$X_{TALK}\ \text{Isolation} = 20 \log \left| \frac{V_S}{V_O} \right|$$

C = RF bypass

Figure 5. Crosstalk

Applications

A high-speed, low-glitch analog switch such as Siliconix's DG201HS improves the accuracy and shortens the acquisition and settling times of a sample-and-hold circuit.