High-Speed Quad SPST CMOS Analog Switch

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.

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

Pb-free Available

RoHS* COMPLIANT

BENEFITS

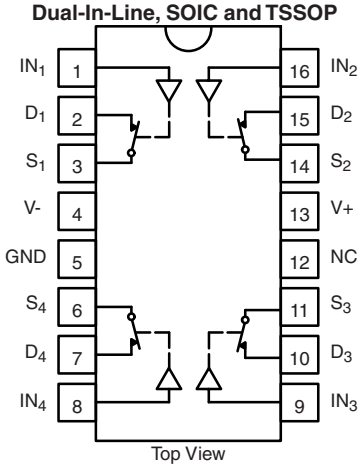
- Faster Throughput
- Higher Accuracy
- Reduced Pedestal Error
- Upgrades Existing Designs
- Simple Interfacing
- Replaces HI201HS, ADG201HS
- Space Savings (TSSOP)

APPLICATIONS

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

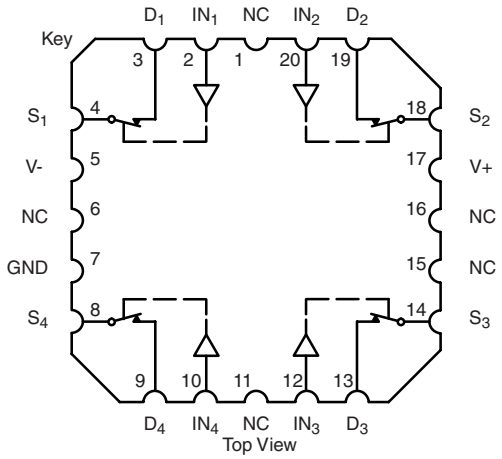
FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

Dual-In-Line, SOIC and TSSOP



Top View

LCC



Top View

TRUTH TABLE	
Logic	**Switch**
0	ON
1	OFF

Logic "0" ≤ 0.8 V
Logic "1" ≥ 2.4 V

* Pb containing terminations are not RoHS compliant, exemptions may apply

ORDERING INFORMATION		
Temp Range	**Package**	**Part Number**
- 40 to 85 °C	16-Pin Plastic DIP	DG201HSDJ DG201HSDJ-E3
	16-Pin Narrow SOIC	DG201HSDY DG201HSDY-E3 DG201HSDY-T1 DG201HSDY-T1-E3
	16-Pin TSSOP	DG201HSDQ DG201HSDQ-E3 DG201HSDQ-T1 DG201HSDQ-T1-E3

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

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.

SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

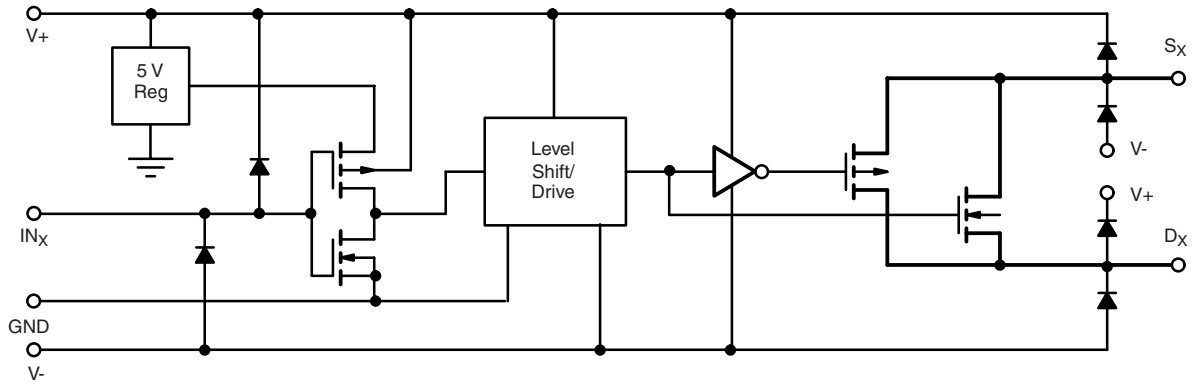


Figure 1.

SPECIFICATIONS[a]

Parameter	Symbol	Test Conditions Unless 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_{INH} or I_{INL}	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 2	Room Full	48		60 75		60 75	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 Isolation	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					
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

Notes:
a. Refer to PROCESS OPTION FLOWCHART.
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.

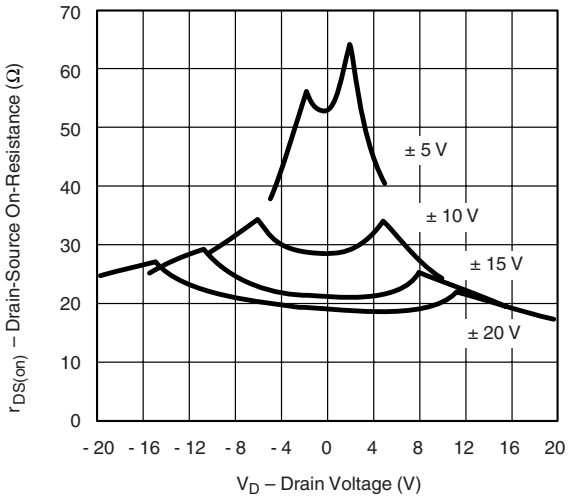
SPECIFICATIONS[a] FOR SINGLE SUPPLY

Parameter	Symbol	Test Conditions Unless 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_{INH} or I_{INL}	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 2	Room Full			50 70		50 70	ns
Turn-Off Time	t_{OFF1}		Room Full			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	10					pC
Off Isolation	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					
Source Off Capacitance	$C_{S(off)}$	f = 1 MHz	Room	10					pF
Drain Off Capacitance	$C_{D(off)}$		Room	10					
Channel On Capacitance	$C_{D(on)}$	V_{ANALOG} = 0 V	Room	30					
Power Supply									
Positive Supply Current	I+	V+ = 15 V, V_{IN} = 0 or 5 V	Full			10		10	mA
Power Consumption[c]	P_C		Full			150		150	mW

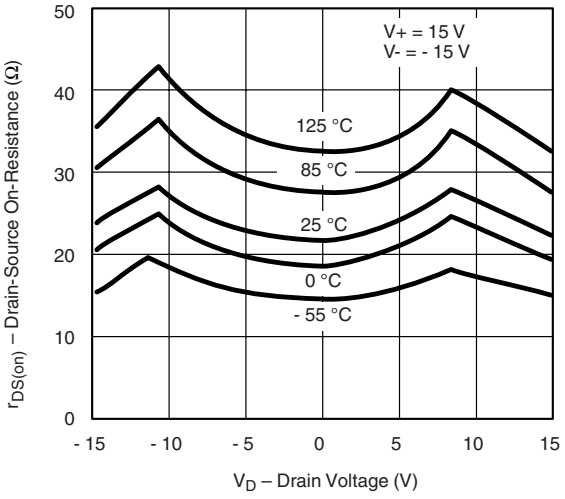
Notes:
a. Refer to PROCESS OPTION FLOWCHART.
b. Room = 25 °C, Full = as determined by the operating temperature suffix.
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
d. The algebraic convention whereby the most negative value is a minimum and the most positive 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.

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.

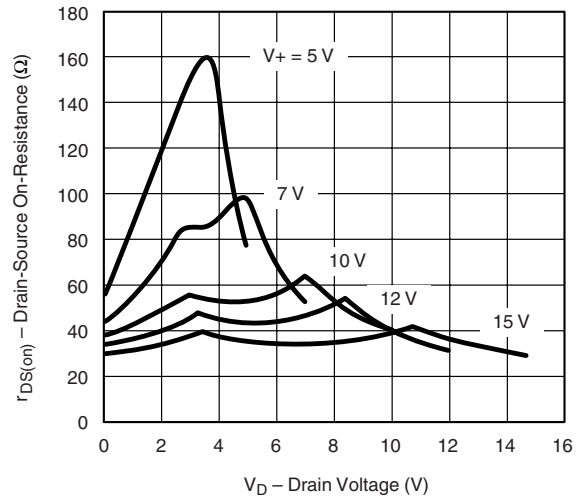
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



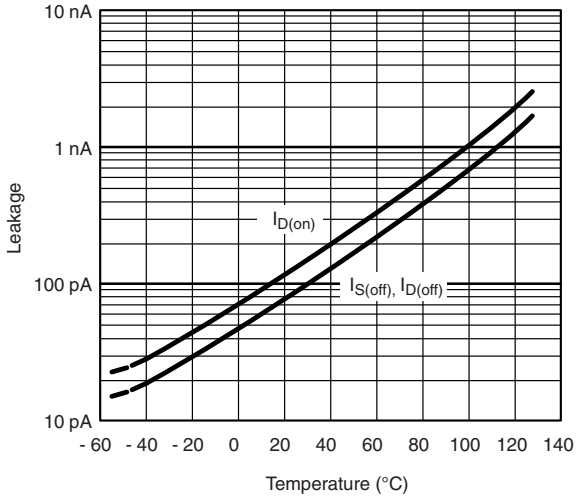
$r_{DS(on)}$ vs. V_D and Power Supply Voltages



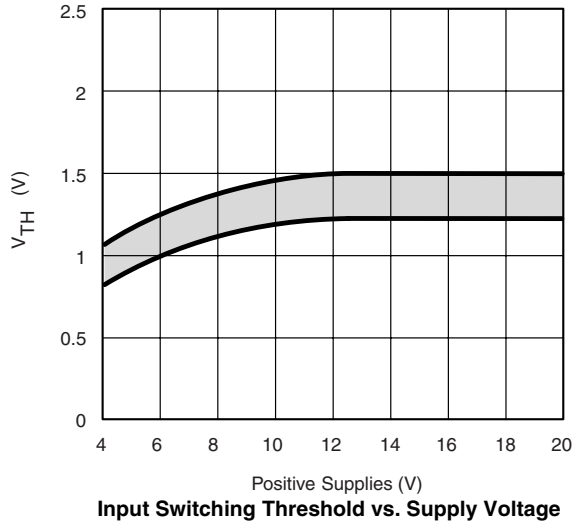
$r_{DS(on)}$ vs. V_D and Temperature



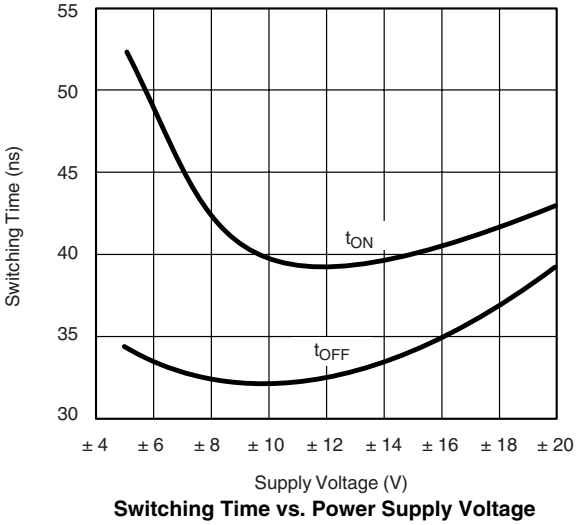
$r_{DS(on)}$ vs. V_D and Single Power Supply Voltages



Leakage Currents vs. Temperature

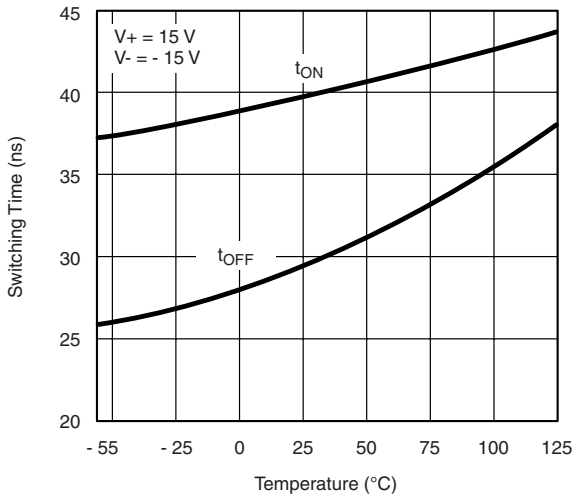


Input Switching Threshold vs. Supply Voltage

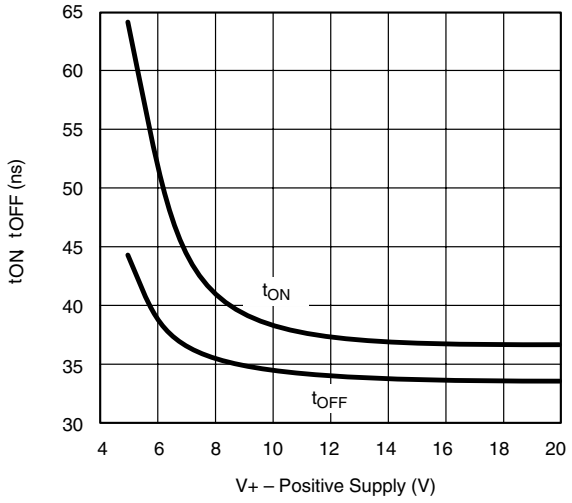


Switching Time vs. Power Supply Voltage

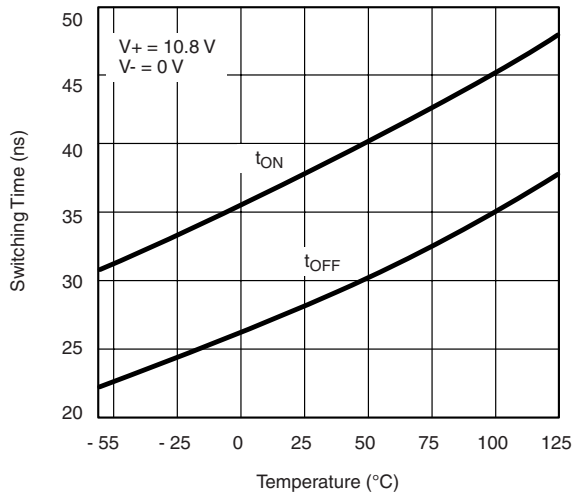
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



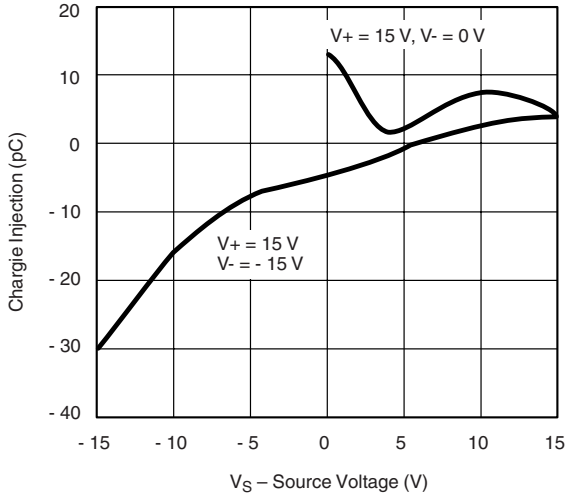
Switching Times vs. Temperature



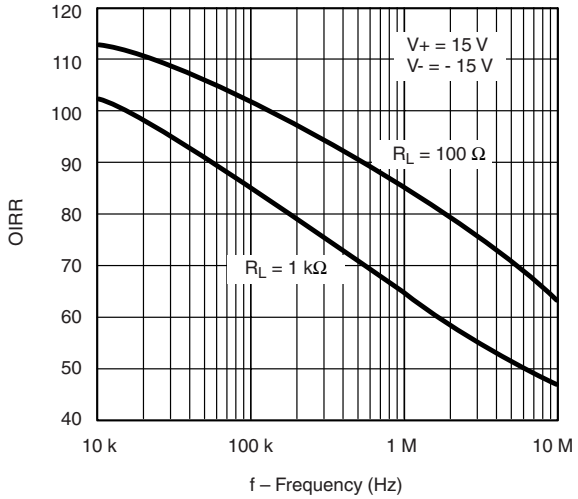
Switching Times vs. Power Supply Voltage



Switching Times vs. Temperature

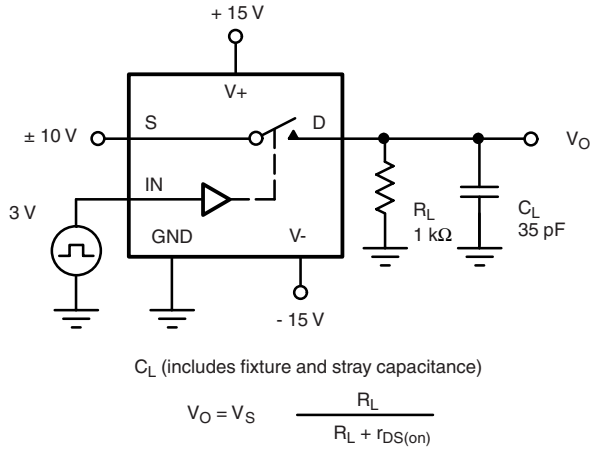


Charge Injection vs. Source Voltage



Off Isolation vs. Frequency

TEST CIRCUITS



C_L (includes fixture and stray capacitance)

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

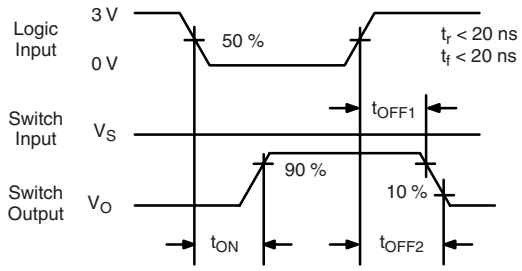
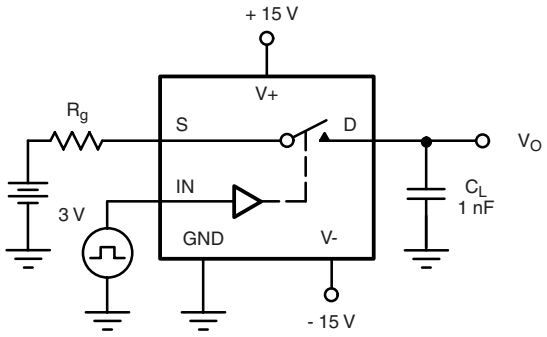
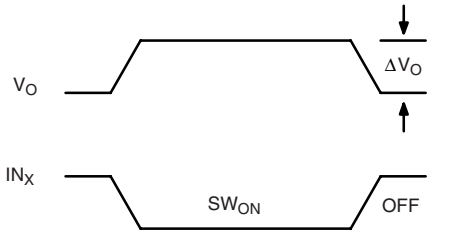


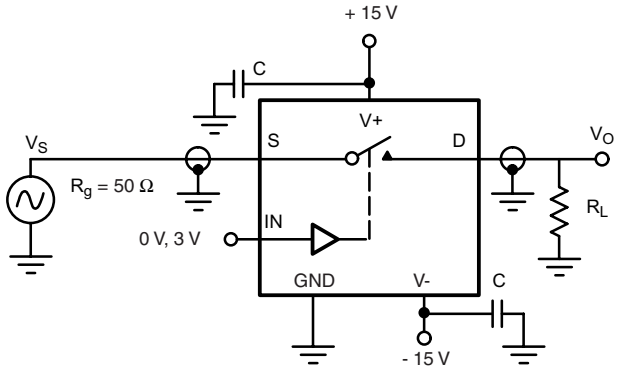
Figure 2. Switching Time





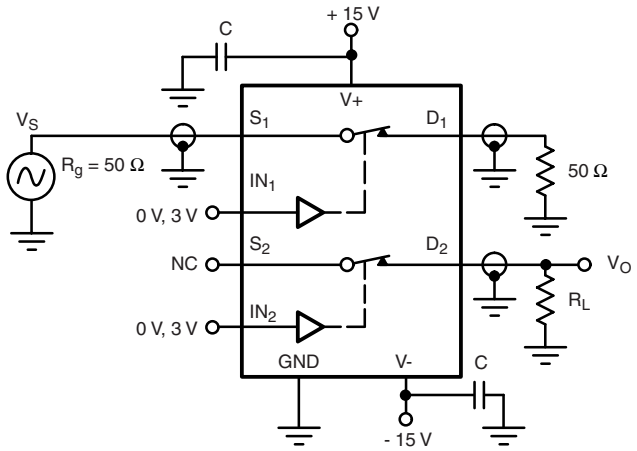
$Q = \Delta V_O \times C_L$

Figure 3. Charge Injection



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

Figure 4. Off Isolation



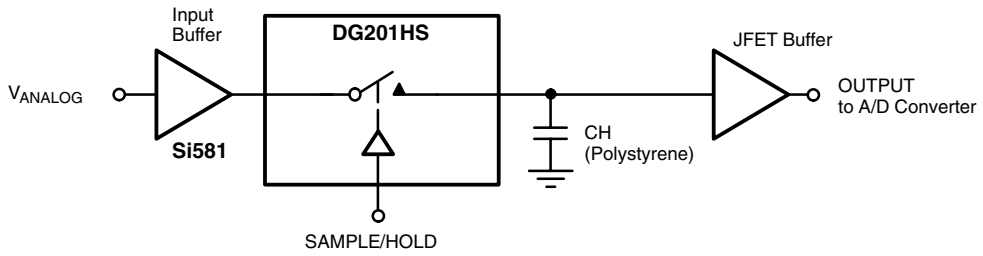
X_{TALK} Isolation = $20 \log \left| \frac{V_S}{V_O} \right|$

C = RF bypass

Figure 5. Crosstalk

APPLICATIONS

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



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DG201HSDY-T1 DG201HSDQ-T1-E3