

Quad SPST CMOS Analog Switch with Latches

Features

- Accepts 150-ns Write Pulse Width
- 5-V On-Chip Regulator
- Built on PLUS-40 Process
- Latches Are Transparent with \overline{WR} Low
- Low On-Resistance: 60 Ω

Benefits

- Compatible with Most μ P Buses
- Allows Wide Power Supply Tolerance Without Affecting TTL Compatibility
- Reduced Power Consumption
- Allows Flexibility of Design

Applications

- μ P Based Systems
- Automatic Test Equipment
- Communication Systems
- Data Acquisition Systems
- Medical Instrumentation
- Factory Automation

Description

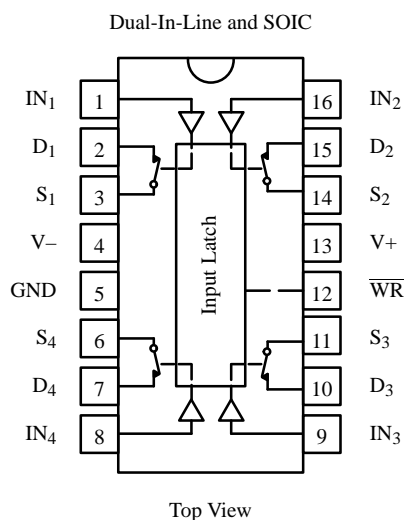
The DG221 is a monolithic quad single-pole, single-throw analog switch designed for precision switching applications in communication, instrumentation and process control systems. Featuring independent onboard latches and a common \overline{WR} pin, each DG221 can be memory mapped, and addressed as a single data byte for simultaneous switching.

Designed on the Siliconix PLUS-40 CMOS process, the

DG221 combines low power and low on-resistance (60 Ω typical) while handling continuous currents up to 20 mA. An epitaxial layer prevents latchup.

The device features true bidirectional performance in the on condition. These switches guarantee a rail-to-rail blocking capability (44 V max), in the off condition.

Functional Block Diagram and Pin Configuration



Four Latchable SPST Switches per Package

Truth Table

IN_X	\overline{WR}	Switch
0	0	ON
1	0	OFF
X		Control data latched-in, switches on or off as selected by last IN_X
X	1	Maintains previous state

Logic "0" \leq 0.8 V
Logic "1" \geq 2.4 V

Ordering Information

Temp Range	Package	Part Number
0°C to 70°C	16-Pin Plastic DIP	DG221CJ
-40°C to 85°C	16-Pin Narrow SOIC	DG221DY
-55°C to 125°C	16-Pin CerDIP	DG221AK/883

Updates to this data sheet may be obtained via facsimile by calling Siliconix FaxBack, 1-408-970-5600. Please request FaxBack document #70041.

Absolute Maximum Ratings

Voltages Referenced to V-

V+	44 V
GND	25 V
Digital Inputs ^a , V _S , V _D	(V-) -2 V to (V+) +2 V or 20 mA, whichever occurs first
Continuous Current (Any Terminal)	30 mA
Continuous Current, S or D	20 mA
Peak Current, S or D (Pulsed 1 ms, 10% duty cycle)	70 mA
Storage Temperature:	(AK Suffix) -65 to 150°C
	(CJ and DY Suffix) -65 to 125°C

Power Dissipation (Package)^b

16-Pin CerDIP ^c	900 mW
16-Pin Plastic DIP ^d	470 mW
16-Pin SOIC ^e	600 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 12 mW/°C above 75°C
- d. Derate 6.5 mW/°C above 25°C
- e. Derate 7.7 mW/°C above 75°C

Schematic Diagram (Typical Channel)

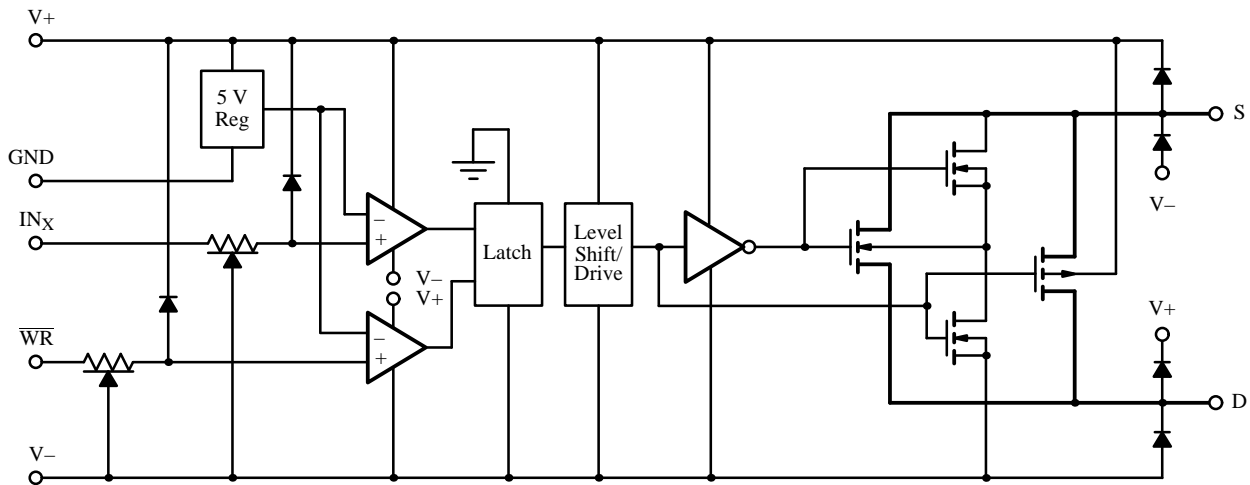


Figure 1.

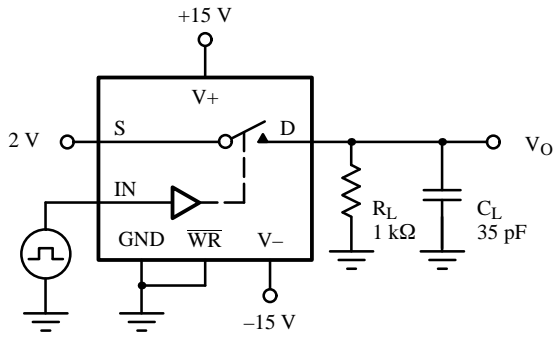
Specifications^a

Parameter	Symbol	Test Conditions Unless Otherwise Specified V ₊ = 15 V, V ₋ = -15 V V _{IN} = 2.4 V, 0.8 ^f V, \overline{WR} = 0	Temp ^b	Typ ^c	A Suffix -55 to 125°C		D Suffix -40 to 85°C		Unit
					Min ^d	Max ^d	Min ^d	Max ^d	
Analog Switch									
Analog Signal Range ^e	V _{ANALOG}		Full		-15	15	-15	15	V
Drain-Source On-Resistance	r _{DS(on)}	I _S = -10 mA, V _D = ±10 V	Room Full	60		90 135		90 135	Ω
Source Off Leakage Current	I _{S(off)}	V _S = ±14 V, V _D = ∓14 V	Room Full	±0.01	-1 -100	1 100	-5 -100	5 100	nA
Drain Off Leakage Current	I _{D(off)}		Room Full	±0.02	-1 -100	1 100	-5 -100	5 100	
Drain On Leakage Current	I _{D(on)}	V _S = V _D = ±14 V	Room Full	±0.01	-1 -200	1 200	-5 -200	5 200	
Digital Control									
Input Current	I _{INL} , I _{INH}	V _{IN} = 0 V or = 2.4 V	Room Full	-0.0004	-1 -10	1 10	-1 -10	1 10	μA
Dynamic Characteristics									
Turn-On Time	t _{ON}	See Figure 2	Room			550		550	ns
Turn-Off Time	t _{OFF}		Room			340		340	
Turn-On Time Write	t _{ON} , \overline{WR}	See Figure 3	Room			550		550	
Turn-Off Time Write	t _{OFF} , \overline{WR}		Room			340		340	
Write Pulse Width	t _W	See Figure 4	Room	120	150		150		
Input Setup Time	t _S		Room	130	180		180		
Input Hold Time	t _H		Full	0	20		20		
Charge Injection	Q	C _L = 1000 pF V _{GEN} = 0 V, R _{GEN} = 0 Ω	Room	20					pC
Source-Off Capacitance	C _{S(off)}	f = 1 MHz, V _S , V _D = 0 V	Room	8					pF
Drain-Off Capacitance	C _{D(off)}		Room	9					
Channel-On Capacitance	C _{D(on)}		Room	29					
Off Isolation	OIRR	V _S = 1 V _{p-p} , f = 100 kHz C _L = 15 pF, R _L = 1 kΩ	Room	70					dB
Interchannel Crosstalk	X _{TALK}		Room	90					
Power Supplies									
Positive Supply Current	I ₊	All Channels On or Off V _{IN} = 0 V or 2.4 V	Full	0.8		1.5		1.5	mA
Negative Supply Current	I ₋		Room	-0.4	-1		-1		

Notes:

- Refer to PROCESS OPTION FLOWCHART.
- Room = 25°C, Full = as determined by the operating temperature suffix.
- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- Guaranteed by design, not subject to production test.
- V_{IN} = input voltage to perform proper function.

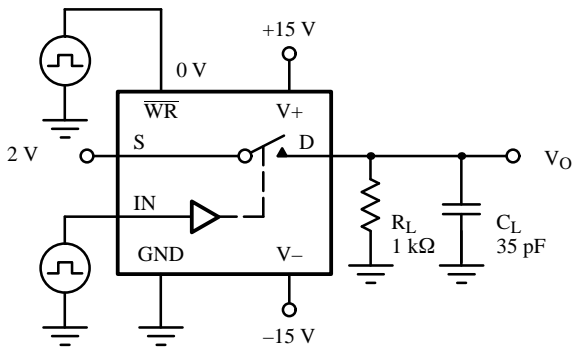
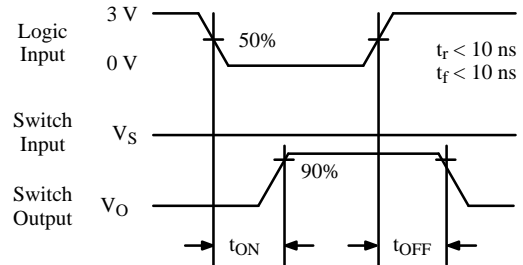
Test Circuits



C_L (includes fixture and stray capacitance)

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

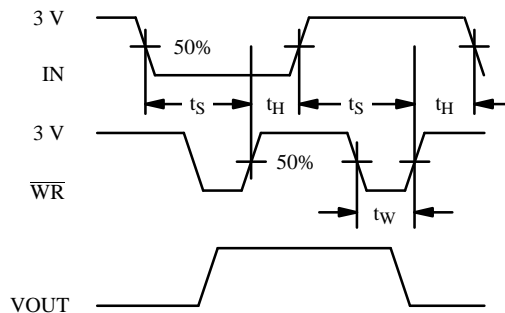
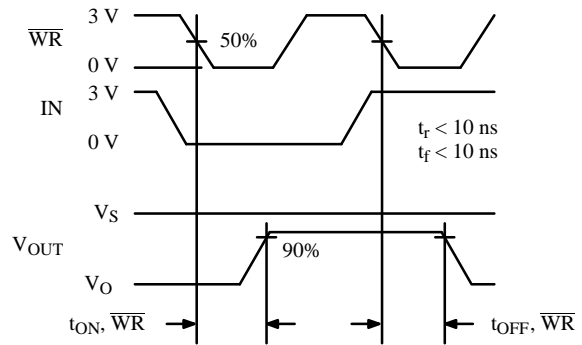
Figure 2. Switching Time



C_L (includes fixture and stray capacitance)

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

Figure 3. \overline{WR} Switching Time

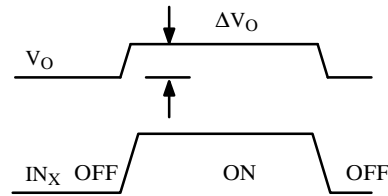
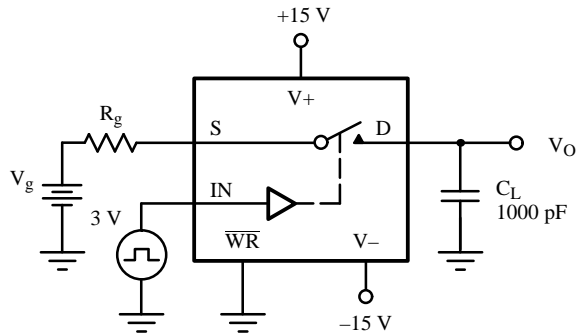


t_H = Hold Time
 t_S = Setup Time
 t_W = \overline{WR} Pulse Width

The latches are level sensitive. When \overline{WR} is held low the latches are transparent and the switches respond to the digital inputs. The digital inputs are latched on the rising edge of \overline{WR} .

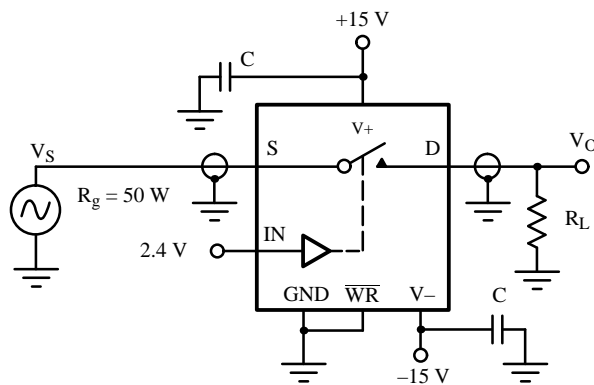
Figure 4. \overline{WR} Setup Conditions

Test Circuits (Cont'd)



ΔV_O = measured voltage error due to charge injection
The charge injection in coulombs is $Q = C_L \times \Delta V_O$

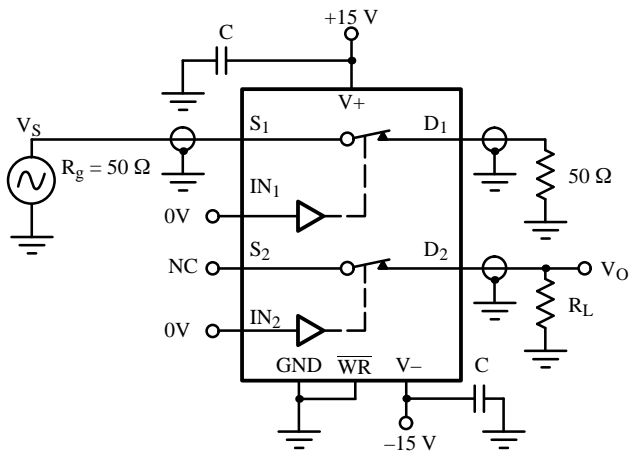
Figure 5. Charge Injection



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

C = RF bypass

Figure 6. Off Isolation



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

C = RF bypass

Figure 7. Channel-to-Channel Crosstalk

Application Hints^a

V+ Positive Supply Voltage (V)	V- Negative Supply Voltage (V)	GND (V)	WR (V)	V _{IN} Logic Input Voltage V _{INH(min)} /V _{INL(max)} (V)	V _S or V _D Analog Voltage Range (V)
15	-15	0	2.4/0.8	2.4/0.8	-15 to 15
20	-20	0	2.4/0.8	2.4/0.8	-20 to 20
10	-10	0	2.4/0.8	2.4/0.8	-10 to 10
10	-5	0	2.4/0.8	2.4/0.8	-5 to 10

Notes:

a. Application Hints are for DESIGN AID ONLY, not guaranteed and not subject to production testing.

Applications

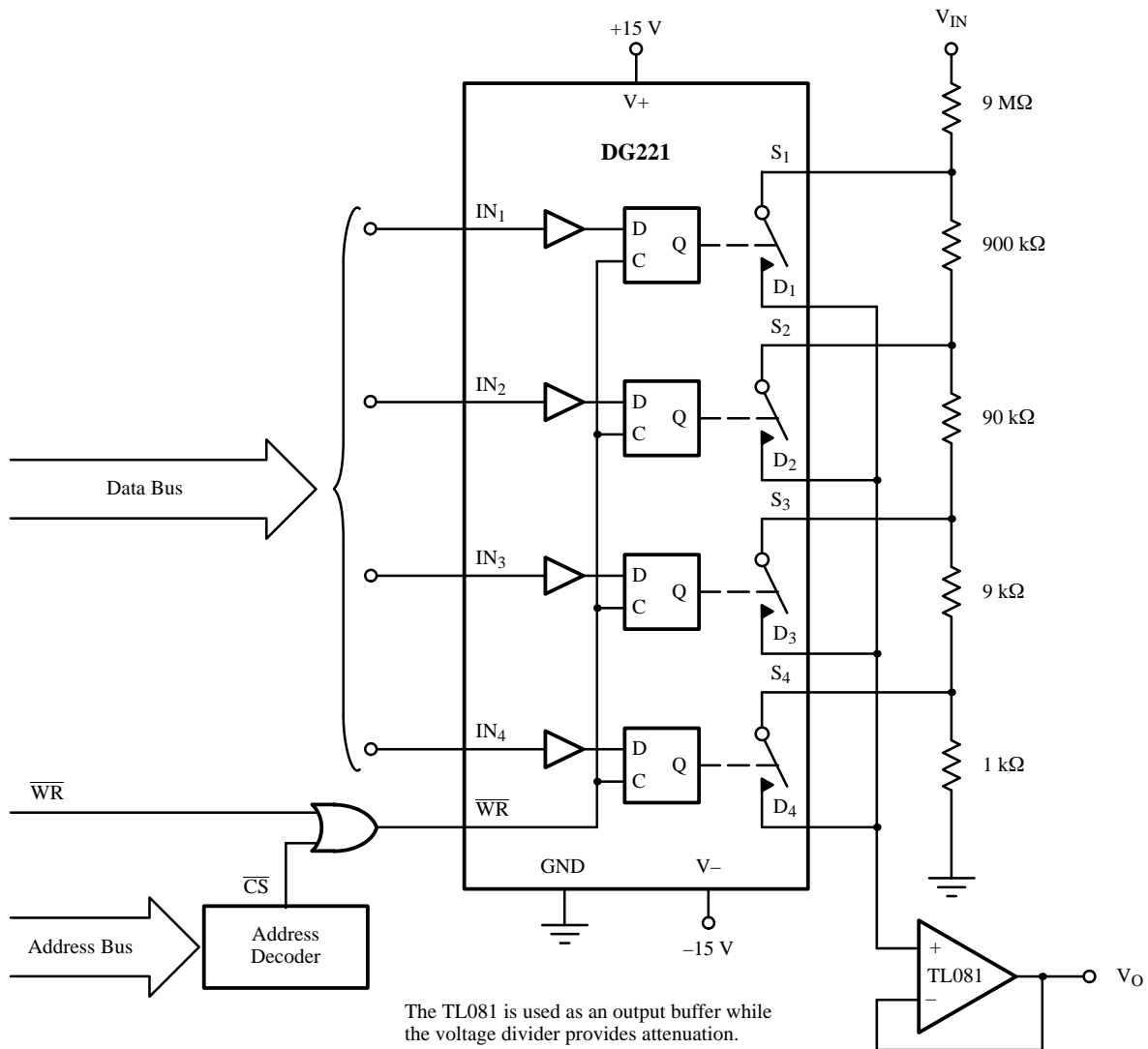


Figure 8. μ P-Controlled Analog Signal Attenuator

Truth Table

IN ₁	IN ₂	IN ₃	IN ₄	\overline{WR}^a	On Switch
0	0	0	0	0	All
1	1	1	1	0	None
0	1	1	1	0	1
1	0	1	1	0	2
1	1	0	1	0	3
1	1	1	0	0	4

Output Attenuation for Figure 8

WR	IN ₁	IN ₂	IN ₃	IN ₄	Gain
0	0	1	1	1	0.1
0	1	0	1	1	0.01
0	1	1	0	1	0.001
0	1	1	1	0	0.0001

Notes:

- a. \overline{WR} may be held at "0" for temporary operation similar to DG201A/DG201B. With \overline{WR} at "0" SW₁ will remain on as long as IN₁ is held at "0".