TEMIC

Siliconix

DG221

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
- Compatible with Most µP Buses

Benefits

- Allows Wide Power Supply Tolerance Without Affecting TTL Compatibility
- Reduced Power Consumption
- Allows Flexibility of Design
- µP Based Systems
- Automatic Test Equipment

Applications

- 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
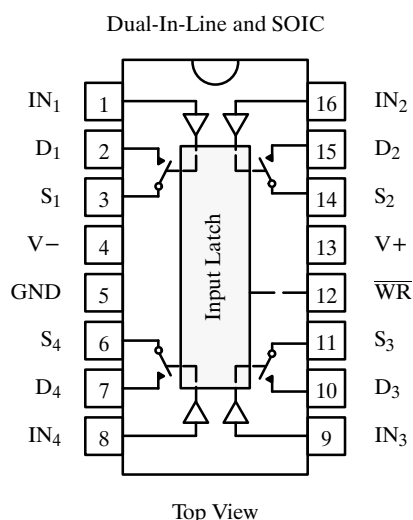
Four Latchable SPST Switches per Package

Dual-In-Line and SOIC

Top View

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" ≤ 0.8 V
Logic "1" ≥ 2.4 V

Switches Shown for Logic "1" Input

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

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

Specifications[a]

Parameter	Symbol	Test Conditions Unless Otherwise Specified $V+ = 15$ V, $V− = −15$ V $V_{IN} = 2.4, 0.8^f$ 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		Room	120	150		150		
Input Setup Time	t_S	See Figure 4	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					

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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]	
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
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.
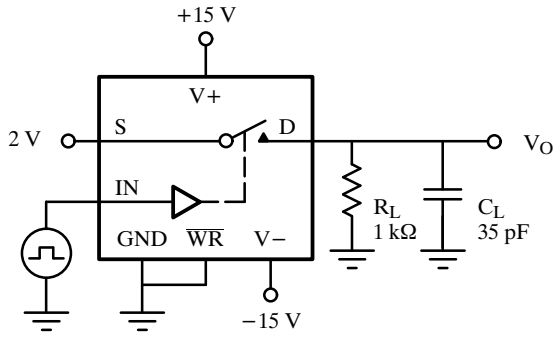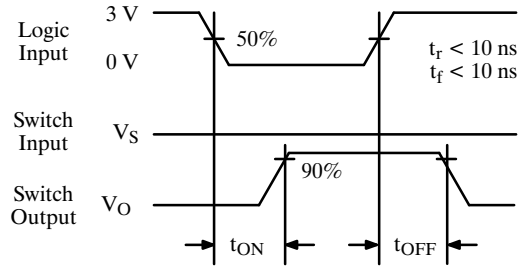
Schematic Diagram (Typical Channel)
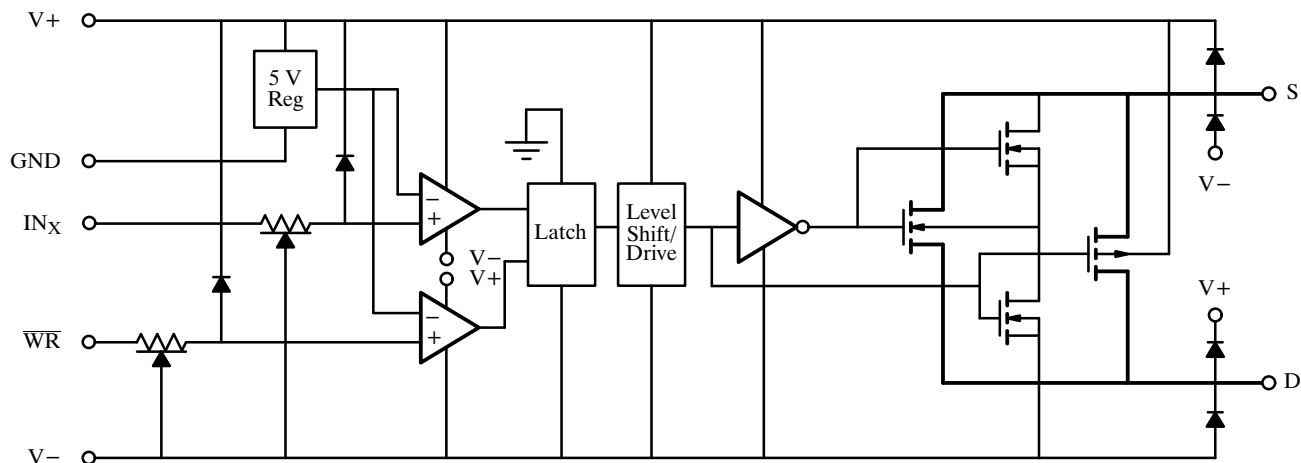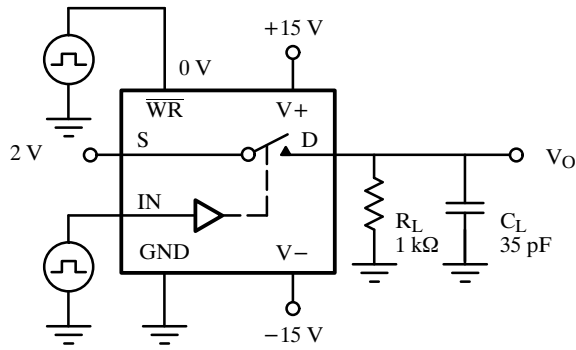

Figure 1.

Test Circuits

C_L (includes fixture and stray capacitance)
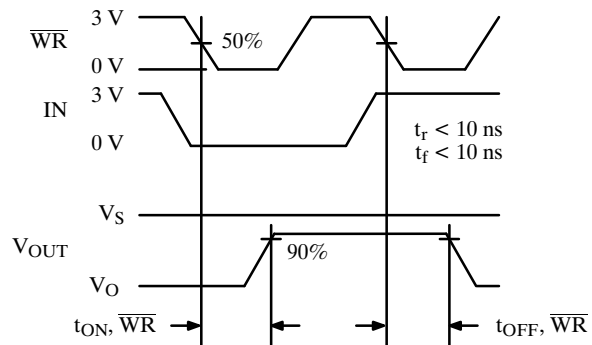
$$V_O = V_S \frac{R_L}{R_L + r_{DS(on)}}$$
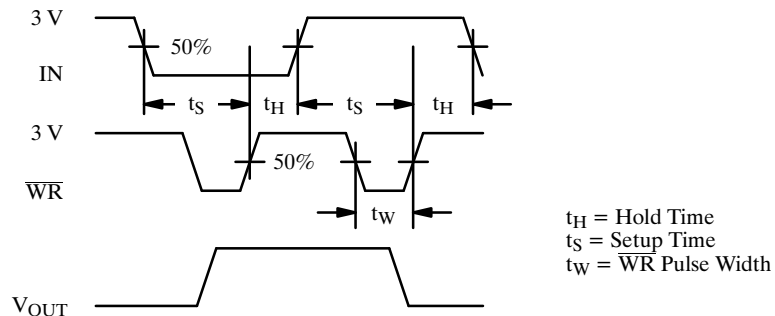
Figure 2. Switching Time

C_L (includes fixture and stray capacitance)

$$V_O = V_S \frac{R_L}{R_L + r_{DS(on)}}$$
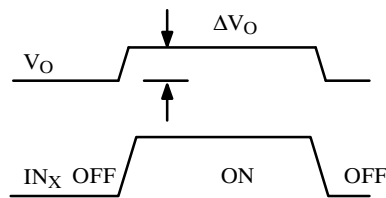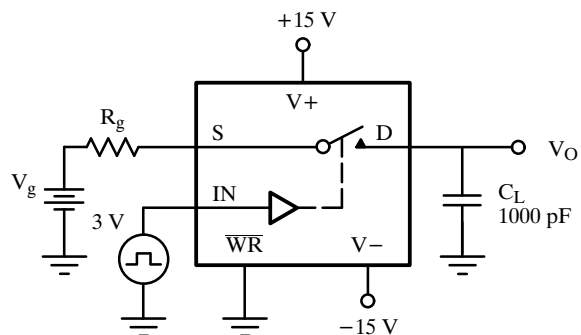
Figure 3. $\overline{WR}$ Switching Time

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 $\overline{WR}$.
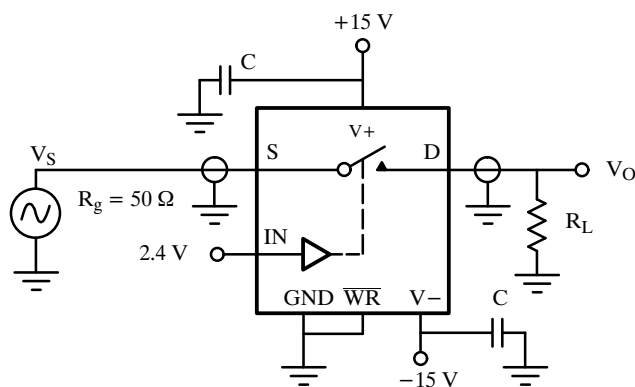
Figure 4. $\overline{WR}$ Setup Conditions

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Test Circuits (Cont'd)

Figure 5. Charge Injection

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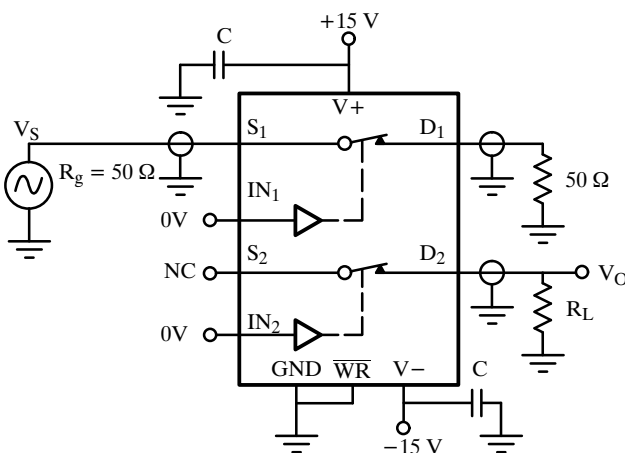The charge injection in coulombs is $Q = C_L \times \Delta V_O$

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

C = RF bypass

Figure 6. Off Isolation

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

C = RF bypass

Figure 7. Channel-to-Channel Crosstalk

## Application Hints[a]

V+ Positive Supply Voltage (V)	V− Negative Supply Voltage (V)	GND (V)	$\overline{WR}$ (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.

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Applications
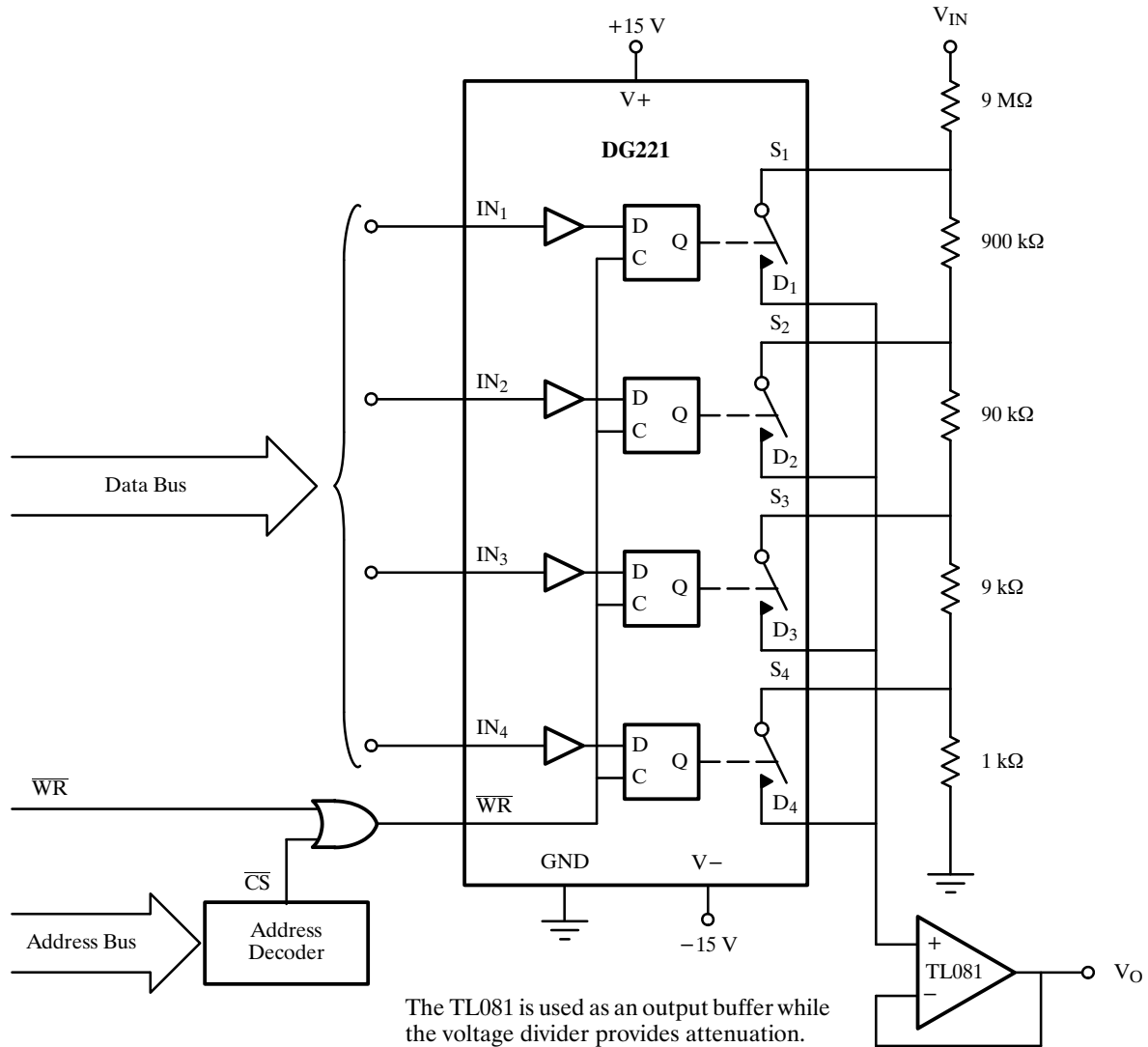
Figure 8. µP-Controlled Analog Signal Attenuator

Truth Table

IN$_1$	IN$_2$	IN$_3$	IN$_4$	$\overline{\text{WR}}$[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

$\overline{\text{WR}}$	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. $\overline{\text{WR}}$ may be held at "0" for temporary operation similar to DG201A's. With $\overline{\text{WR}}$ at "0" SW$_1$ will remain on as long as IN$_1$ is held at "0".

The TL081 is used as an output buffer while the voltage divider provides attenuation.