

Latchable Single 8-Ch/Differential 4-Ch Analog Multiplexers

DESCRIPTION

The DG528 is an 8-channel single-ended analog multiplexer designed to connect one of eight inputs to a common output as determined by a 3-bit binary address (A_0, A_1, A_2). DG529, a 4-channel dual analog multiplexer, is designed to connect one of four differential inputs to a common differential output as determined by its 2-bit binary address (A_0, A_1) logic.

These analog multiplexers have on-chip address and control latches to simplify design in microprocessor based applications. Break-before-make switching action protects against momentary shorting of the input signals. The DG528/529 are built on the improved PLUS-40 CMOS process. A buried layer prevents latchup.

The on chip TTL-compatible address latches simplify digital interface design and reduce board space in data acquisition systems, process controls, avionics, and ATE.

FEATURES

- Low $R_{DS(on)}$: 270 Ω
- 44 V Power Supply Rating
- On-Board Address Latches
- Break-Before-Make
- Low Leakage - $I_{D(on)}$: 30 pA

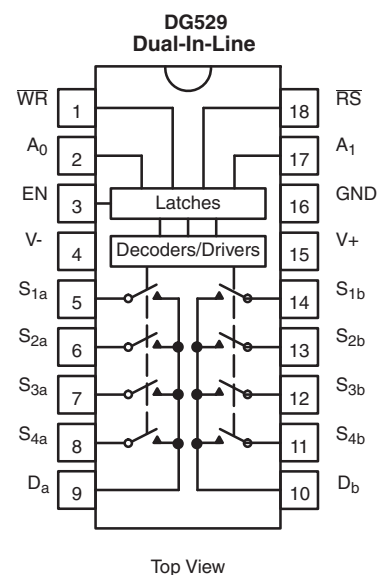
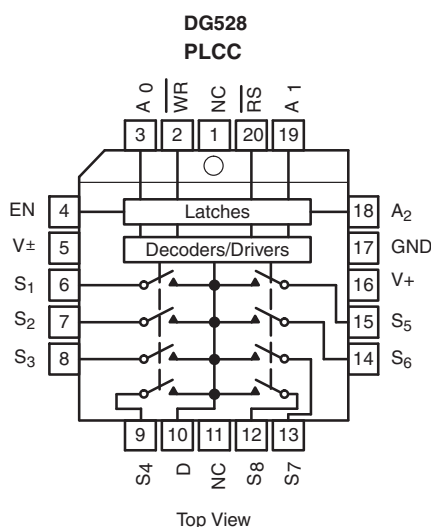
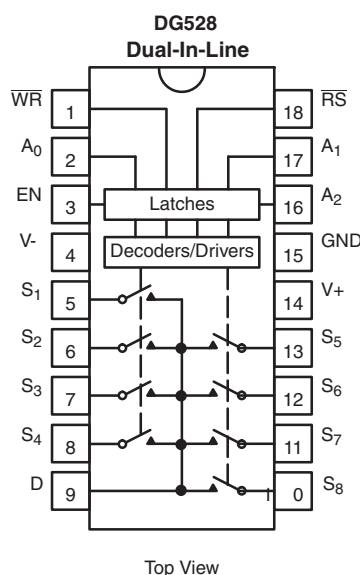
BENEFITS

- Improved System Accuracy
- Microprocessor Bus Compatible
- Easily Interfaced
- Reduced Crosstalk


APPLICATIONS

- Data Acquisition Systems
- Automatic Test Equipment
- Avionics and Military Systems
- Medical Instrumentation


FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



TRUTH TABLES AND ORDERING INFORMATION

| TRUTH TABLE - DG528 | | | | | | |
|------------------------------------|----------------|----------------|----|---|----|-------------------------------------|
| 8-Channel Single-Ended Multiplexer | | | | | | |
| A ₂ | A ₁ | A ₀ | EN | WR | RS | On Switch |
| Latching | | | | | | |
| X | X | X | X |  | 1 | Maintains previous switch condition |
| Reset | | | | | | |
| X | X | X | X | X | 0 | None (latches cleared) |
| Transparent Operation | | | | | | |
| X | X | X | 0 | 0 | 1 | None |
| 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| 0 | 0 | 1 | 1 | 0 | 1 | 2 |
| 0 | 1 | 0 | 1 | 0 | 1 | 3 |
| 0 | 1 | 1 | 1 | 0 | 1 | 4 |
| 1 | 0 | 0 | 1 | 0 | 1 | 5 |
| 1 | 0 | 1 | 1 | 0 | 1 | 6 |
| 1 | 1 | 0 | 1 | 0 | 1 | 7 |
| 1 | 1 | 1 | 1 | 0 | 1 | 8 |

| ORDERING INFORMATION - DG528 | | |
|------------------------------|--------------------|----------------|
| Temp Range | Package | Part Number |
| 0 °C to 70 °C | 18-pin Plastic DIP | DG528CJ |
| | 20-pin PLCC | DG528DN |
| - 25 °C to 85 °C | 18-pin Cer DIP | DG528BK |
| - 55 °C to 125 °C | | DG528AK |
| | | DG528AK/883 |
| | | 5962-8768901VA |

| TRUTH TABLE - DG529 | | | | |
|------------------------------------|----|---|----|-------------------------------------|
| Differential 4-Channel Multiplexer | | | | |
| A ₀ | EN | WR | RS | On Switch |
| Latching | | | | |
| X | X |  | 1 | Maintains previous switch condition |
| Reset | | | | |
| X | X | X | 0 | None (latches cleared) |
| Transparent Operation | | | | |
| X | 0 | 0 | 1 | None |
| 0 | 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 2 |
| 0 | 1 | 0 | 1 | 3 |
| 1 | 1 | 0 | 1 | 4 |

Logic "0" = $V_{AL} \leq 0.8 \text{ V}$

Logic "1" = $V_{AH} \geq 2.4 \text{ V}$

X = Don't Care

| ORDERING INFORMATION - DG529 | | |
|------------------------------|--------------------|-------------|
| Temp Range | Package | Part Number |
| 0 °C to 70 °C | 18-pin Plastic DIP | DG529CJ |
| - 25 °C to 85 °C | 18-pin Cer DIP | DG529BK |
| - 55 °C to 125 °C | | DG529AK/883 |

| ABSOLUTE MAXIMUM RATINGS | | | | |
|---|---------------------------------|--|------|--|
| Parameter | Symbol | Limit | Unit | |
| Voltages Referenced to V- | V+ | 44 | V | |
| | GND | 25 | | |
| Digital Inputs ^a , V _S , V _D | | (V-) - 2 to (V+) + 2 or 30 mA, whichever occurs first | | |
| Current (Any Terminal Except S or D) | | 30 | mA | |
| Continuous Current, S or D | | 20 | | |
| Peak Current, S or D (Pulsed at 1 ms, 10 % duty cycle max) | | 40 | | |
| Storage Temperature | (AK, BK Suffix) | - 65 to 150 | °C | |
| | (CJ, DN Suffix) | - 65 to 125 | | |
| Power Dissipation (Package) ^b | 18-pin Plastic DIP ^c | 470 | mW | |
| | 18-pin CerDIP ^d | 900 | | |
| | 20-pin PLCC ^e | 800 | | |

Notes:

a. Signals on S_x, D_x or I_{Nx} exceeding V+ or V- will be clamped by internal diodes. Limit forward diode current to maximum current ratings.

b. All leads soldered or welded to PC board.

c. Derate 6.3 mW/°C above 75 °C.

d. Derate 12 mW/°C above 75 °C.

e. Derate 10 mW/°C above 75 °C.

**SPECIFICATIONS^a**

| Parameter | Symbol | Test Conditions Unless Otherwise Specified V ₊ = 15 V, V ₋ = - 15 V, WR = 0, RS = 2.4 V, V _{IN} = 2.4 V, 0.8 μF ^f | | Temp. ^b | Typ. ^c | A Suffix - 55 °C to 125 °C | | B, C, D Suffix - 40 °C 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)} | V _D = ± 10 V, I _S = - 200 μA | | Room Full | 270 | | 400 500 | | 450 550 | Ω |
| Greatest Change in R _{DS(on)} Between Channels ^f | ΔR _{DS(on)} | - 10 V < V _S < 10 V | | Room | 6 | | | | | % |
| Source Off Leakage Current | I _{S(off)} | V _{EN} = 0 V, V _D = ± 10 V V _S = ± 10 V | | Room Full | ± 005 | - 1 - 50 | 1 50 | - 5 - 50 | 5 50 | nA |
| Drain Off Leakage Current | I _{D(off)} | V _{EN} = 0 V, V _D = ± 10 V V _S = ± 10 V | DG528 | Room Full | ± 0.015 | - 10 - 200 | 10 200 | - 20 - 200 | 20 200 | |
| | | | DG529 | Room Full | ± 0.008 | - 10 - 100 | 10 100 | - 20 - 100 | 20 100 | |
| Drain On Leakage Current | I _{D(on)} | V _S = V _D = ± 10 V V _{EN} = 2.4 V | DG528 | Room Full | ± 0.03 | - 10 - 200 | 10 200 | - 20 - 200 | 20 200 | |
| | | | DG529 | Room Full | ± 0.015 | - 10 - 100 | 10 100 | - 20 - 100 | 20 100 | |
| Digital Control | | | | | | | | | | |
| Logic Input Current | I _{AH} | V _A = 2.4 V | | Room Hot | - 0.002 | - 10 - 30 | | - 10 - 30 | | μA |
| Input Voltage High | | V _A = 15 V | | Room Hot | 0.006 | | 10 30 | | 10 30 | |
| Logic Input Current Input Voltage Low | I _{AL} | V _{EN} = 0 V, 2.4 V, V _A = 0 V RS = 0 V, WR = 0 V | | Room Hot | - 0.002 | - 10 - 30 | | - 10 - 30 | | |
| Dynamic Characteristics | | | | | | | | | | |
| Transition Time | t _{TRANS} | See Figure 5 | | Room | 0.6 | | 1 | | | μs |
| Break-Before-Make Interval | t _{OPEN} | See Figure 4 | | Room | 0.2 | | | | | |
| EN and WR Turn-On Time | t _{ON(EN,WR)} | See Figure 6 and 7 | | Room | 1 | | 1.5 | | | |
| EN and WR Turn-Off Time | t _{OFF(EN,RS)} | See Figure 6 and 8 | | Room | 0.4 | | 1 | | | |
| Charge Injection | Q | V _S = 0 V, R _y = 0 Ω, C _L = 10 μF | | Room | 4 | | | | | pC |
| Off Isolation | OIRR | V _{EN} = 0 V, R _L = 1 kΩ, C _L = 15 pF V _S = 7 V _{RMS} , f = 500 kHz | | Room | 68 | | | | | dB |
| Logic Input Capacitance | C _{in} | f = 1 MHz | | Room | 2.5 | | | | | pF |
| Source Off Capacitance | C _{S(off)} | V _{EN} = 0 V, V _D = 0 V, f = 140 kHz | | Room | 5 | | | | | |
| Drain Off Capacitance | C _{D(off)} | V _{EN} = 0 V, V _D = 0 V f = 140 kHz | DG528 | Room | 25 | | | | | |
| | | | DG529 | Room | 12 | | | | | |
| Minimum Input Timing Requirements | | | | | | | | | | |
| Write Pulse Width | t _W | | | Full | | 300 | | 300 | | ns |
| A _X , EN Data Set Up time | t _S | | | Full | | 180 | | 180 | | |
| A _X , EN Data Hold Time | t _H | | | Full | | 30 | | 30 | | |
| Reset Pulse Width | t _{RS} | V _S = 5 V, See Figure 3 | | Full | | 500 | | 500 | | |
| Power Supplies | | | | | | | | | | |
| Positive Supply Current | I ₊ | V _{EN} = V _A = 0 V | | Room | | | 2.5 | | 2.5 | mA |
| Negative Supply Current | I ₋ | | | Room | | - 1.5 | | - 1.5 | | |

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.

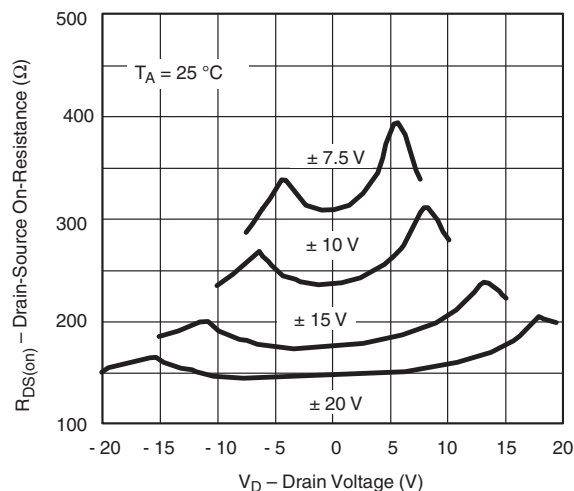
d. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.

e. Guaranteed by design, not subject to production test.

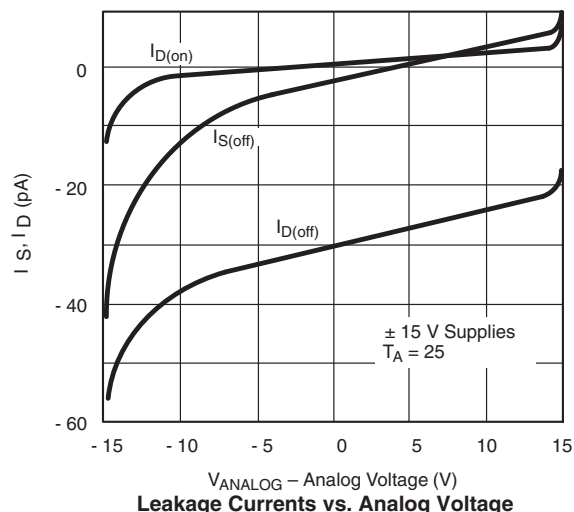
f. V_{IN} = input voltage to perform proper function.

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.

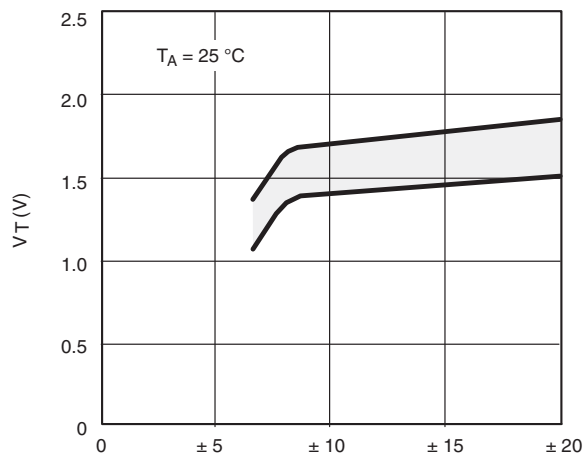
TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, unless noted)



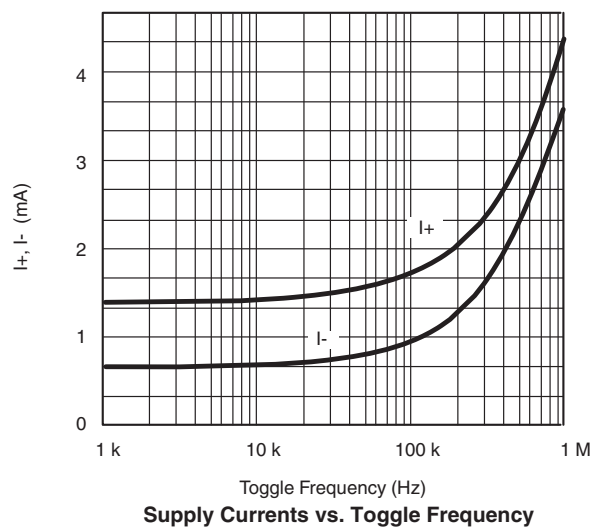
$R_{DS(on)}$ vs. V_D and Power Supply



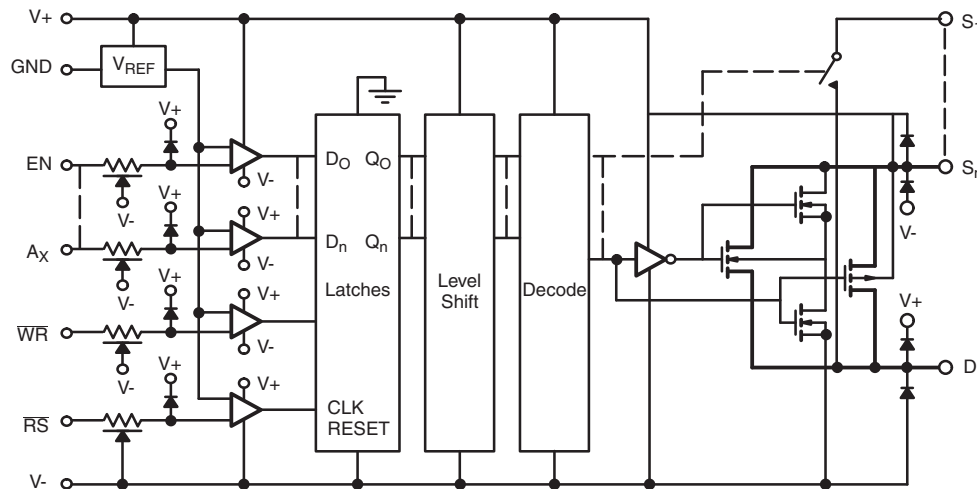
Leakage Currents vs. Analog Voltage



Input Switching Threshold vs. V_+ and V_- Supply Voltages



Supply Currents vs. Toggle Frequency

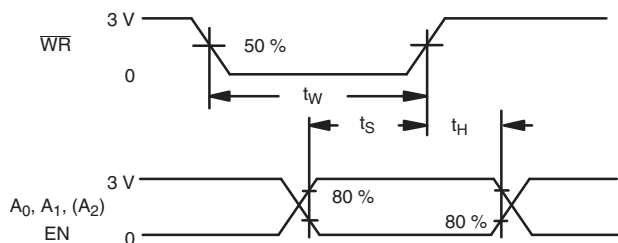
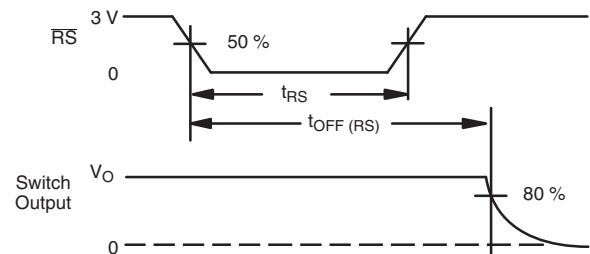
SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

Figure 1.
DETAILED DESCRIPTION

The internal structure of the DG528/DG529 includes a 5-V logic interface with input protection circuitry followed by a latch, level shifter, decoder and finally the switch constructed with parallel n- and p-channel MOSFETs (see Figure 1).

The logic interface circuit compares the TTL input signal against a TTL threshold reference voltage. The output of the comparator feeds the data input of a D type latch. The level sensitive D latch continuously places the D_X input signal on the Q_X output when the \overline{WR} input is low, resulting in transparent latch operation. As soon as \overline{WR} returns high, the latches hold the data last present on the D_X input, subject to the minimum input timing requirements.

Following the latches the Q_X signals are level shifted and decoded to provide proper drive levels for the CMOS switches. This level shifting insures full on/off switch operation for any analog signal present between the V_+ and V_- supply rails.

The EN pin is used to enable the address latches during the \overline{WR} pulse. It can be hard-wired to the logic supply or to V_+ if one of the channels will always be used (except during a reset) or it can be tied to address decoding circuitry for memory mapped operation. The \overline{RS} pin is used as a master reset. All latches are cleared regardless of the state of any other latch or control line. The \overline{WR} pin is used to transfer the state of the address control lines to their latches, except during a reset or when EN is low (see Truth Tables).


Figure 2.

Figure 3.

TEST CIRCUITS

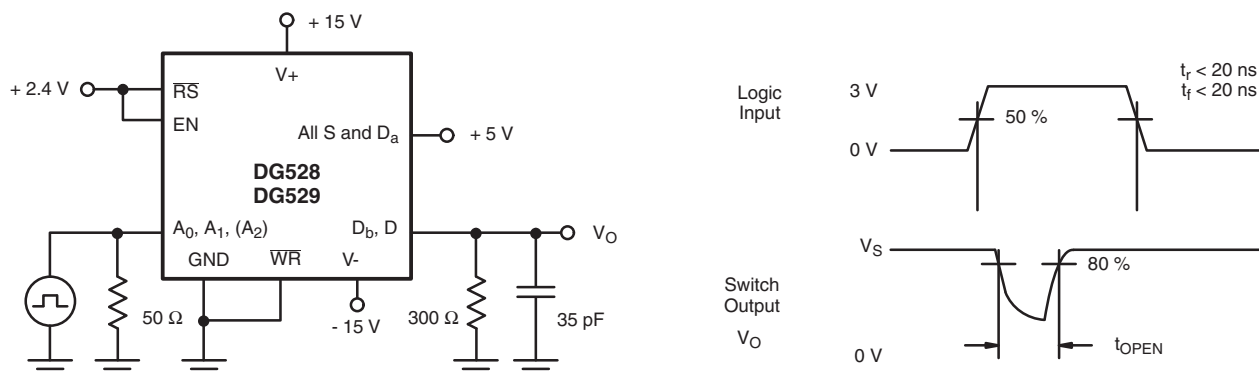


Figure 4. Break-Before-Make

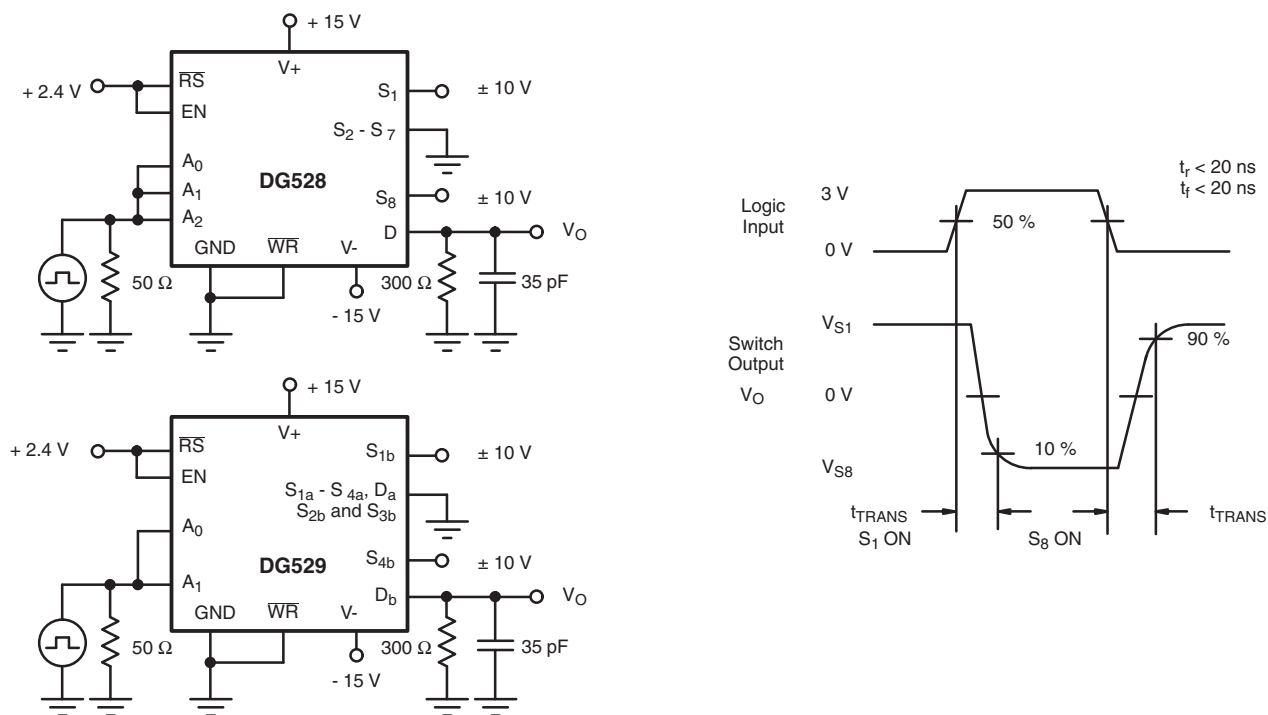
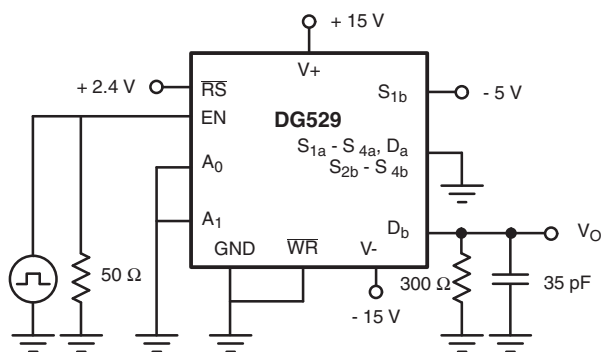
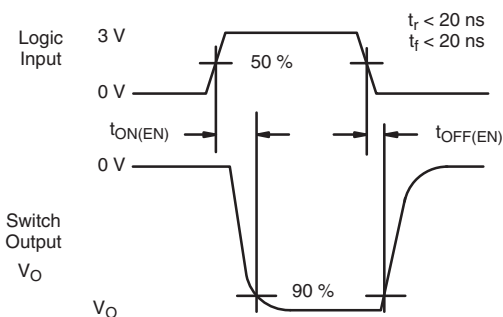
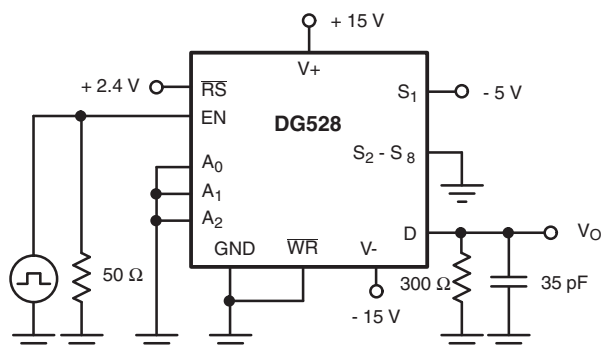
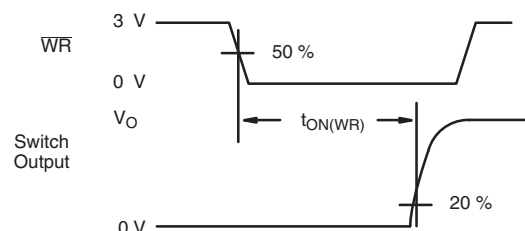
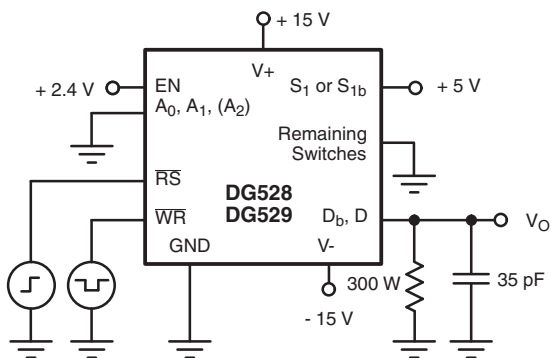


Figure 5. Transition Time

TEST CIRCUITS

Figure 6. Enable t_{ON}/t_{OFF} Time

Figure 7. Write Turn-On Time $t_{ON(WR)}$

TEST CIRCUITS

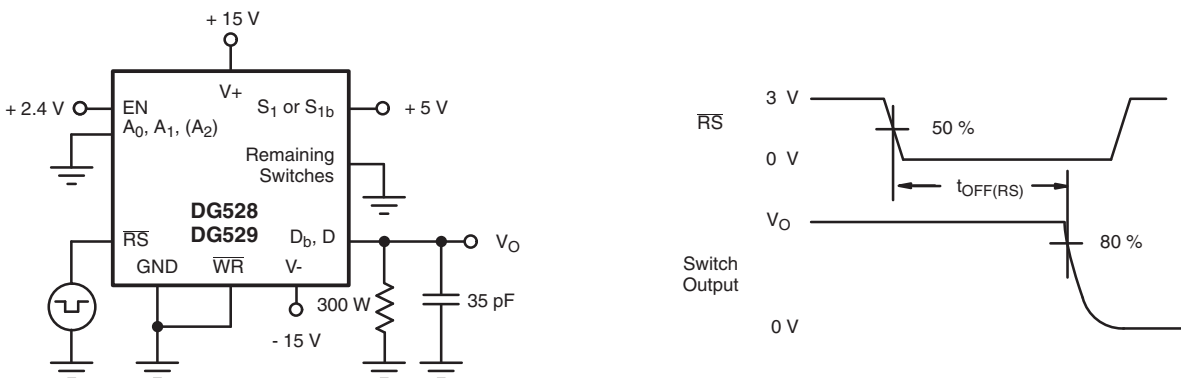


Figure 8. Reset Turn-Off Time $t_{OFF(RS)}$

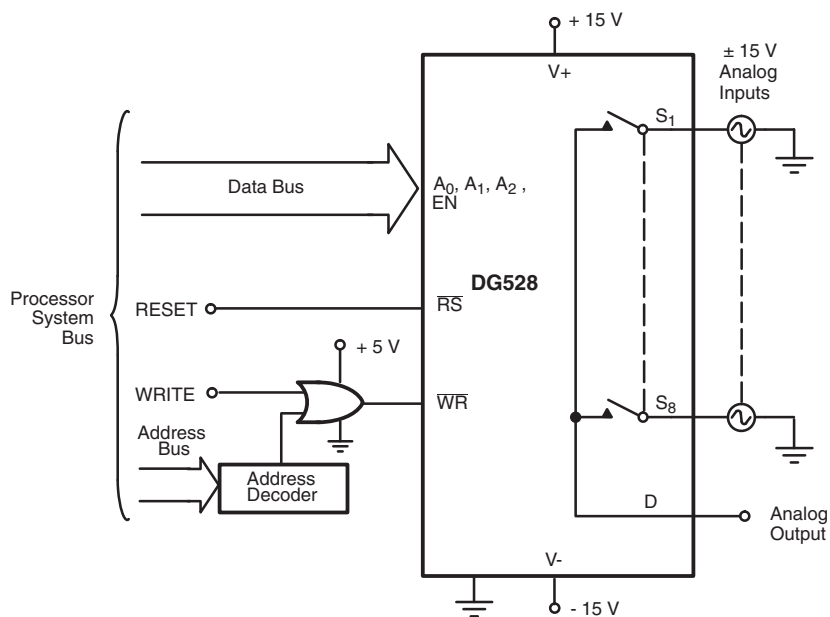


Figure 9. Bus Interface

**APPLICATION HINTS^a**

| V₊ Positive Supply Voltage (V) | V₋ Negative Supply Voltage (V) | V_{IN} Logic Input Voltage V_{INH(min)}/V_{INL(max)} (V) | V_S or V_D Analog Voltage Range (V) |
|--|--|---|--|
| 20 | - 20 | 2.4/0.8 | ± 20 |
| 15 ^b | - 15 | 2.4/0.8 | ± 15 |
| 8 ^c | - 8 (min) | 2.4/0.8 | ± 8 |

Notes:

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

b. Electrical Parameter Chart based on V₊ = 15 V, V₋ = - 15 V, V_R = GND.

c. Operation below ± 8 V is not recommended.

The DG528/DG529 minimize the amount of interface hardware between a microprocessor system bus and the analog system being controlled or measured. The internal TTL compatible latches give these multiplexers write-only memory, that is, they can be programmed to stay in a particular switch state (e.g., switch 1 on) until the microprocessor determines it is necessary to turn different switches on or turn all switches off (see Figure 9).

The input latches become transparent when \overline{WR} is held low; therefore, these multiplexers operate by direct command of the coded switch state on A₂, A₁, A₀. In this mode the DG528 is identical to the popular DG508A. The same is true of the DG529 versus the popular DG509A.

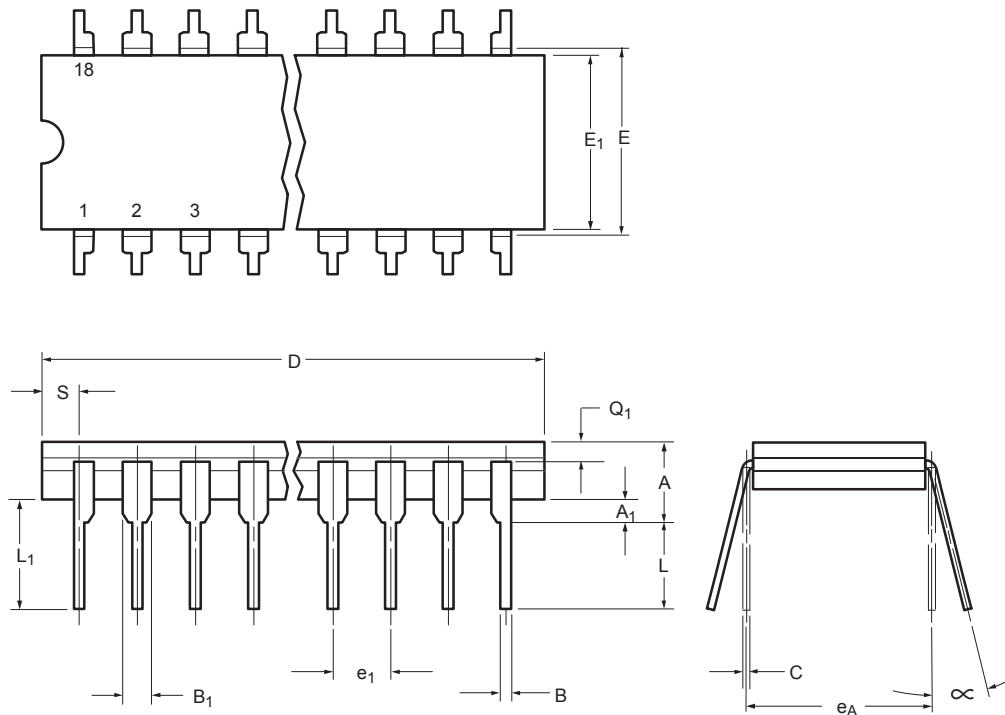
During system power-up, \overline{RS} would be low, maintaining all eight switches in the off state. After \overline{RS} returned high the DG528 maintains all switches in the off state. When the system program performs a write operation to the address assigned to the DG528, the address decoder provides a \overline{CS} active low signal which is gated with the WRITE (\overline{WR}) control signal. At this time the data on the DATA BUS (that will determine which switch to close) is stabilizing. When the \overline{WR} signal returns to the high state, (positive edge) the input latches of the DG528 save the data from the DATA BUS. The coded information in the A₀, A₁, A₂ and EN latches is decoded and the appropriate switch is turned on.

The EN latch allows all switches to be turned off under program control. This becomes useful when two or more DG528s are cascaded to build 16-line and larger multiplexers.

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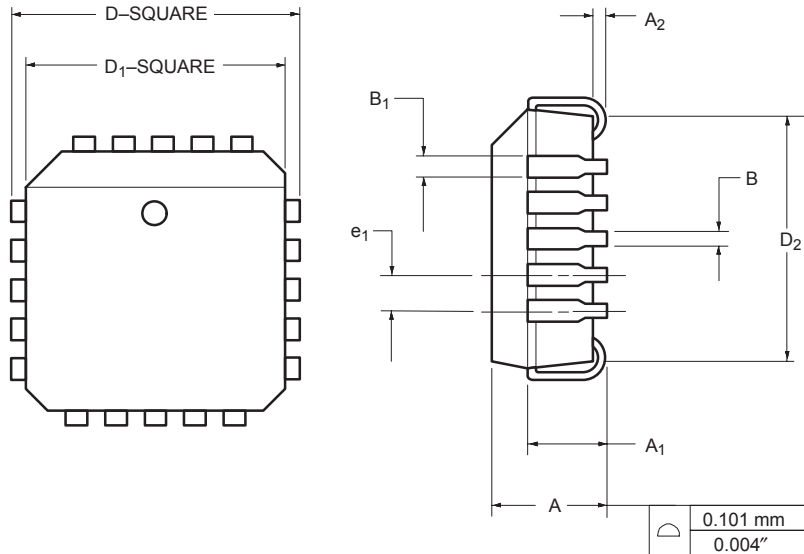
CERDIP: 18-LEAD



| Dim | MILLIMETERS | | INCHES | |
|---|-------------|-------|-----------|-------|
| | Min | Max | Min | Max |
| A | 4.06 | 5.08 | 0.160 | 0.200 |
| A ₁ | 0.51 | 1.14 | 0.020 | 0.045 |
| B | 0.38 | 0.51 | 0.015 | 0.020 |
| B ₁ | 1.14 | 1.65 | 0.045 | 0.065 |
| C | 0.20 | 0.30 | 0.008 | 0.012 |
| D | 22.35 | 22.86 | 0.880 | 0.900 |
| E | 7.62 | 8.26 | 0.300 | 0.325 |
| E ₁ | 6.60 | 7.62 | 0.260 | 0.300 |
| e ₁ | 2.54 BSC | | 0.100 BSC | |
| e _A | 7.62 BSC | | 0.300 BSC | |
| L | 3.18 | 3.81 | 0.125 | 0.150 |
| L ₁ | 3.81 | 5.08 | 0.150 | 0.200 |
| Q ₁ | 1.27 | 2.16 | 0.050 | 0.085 |
| S | 0.76 | 1.52 | 0.030 | 0.060 |
| ∞ | 0° | 15° | 0° | 15° |
| ECN: S-03946—Rev. D, 09-Jul-01 DWG: 5313 | | | | |



PLCC: 20-LEAD



| Dim | MILLIMETERS | | INCHES | |
|---|-------------|-------|-----------|-------|
| | Min | Max | Min | Max |
| A | 4.20 | 4.57 | 0.165 | 0.180 |
| A ₁ | 2.29 | 3.04 | 0.090 | 0.120 |
| A ₂ | 0.51 | — | 0.020 | — |
| B | 0.331 | 0.553 | 0.013 | 0.021 |
| B ₁ | 0.661 | 0.812 | 0.026 | 0.032 |
| D | 9.78 | 10.03 | 0.385 | 0.395 |
| D ₁ | 8.890 | 9.042 | 0.350 | 0.356 |
| D ₂ | 7.37 | 8.38 | 0.290 | 0.330 |
| e ₁ | 1.27 BSC | | 0.050 BSC | |
| ECN: S-03946—Rev. C, 09-Jul-01 DWG: 5306 | | | | |



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