

# Single 8-Ch/Differential 4-Ch CMOS Analog Multiplexers

(Obsolete for non-hermetic. Use DG408/409 as pin-for-pin replacements.)

## FEATURES

- Low On-Resistance: 240  $\Omega$
- TTL and CMOS Logic Compatible
- Low Power: 30 mW
- Break-Before-Make Switching
- 44-V Power Supply Rating
- Transition Time: 600 ns

## BENEFITS

- Easily Interfaced
- Low Power Consumption
- Low System Crosstalk
- Wide Analog Signal Range

## APPLICATIONS

- Communication Systems
- ATE
- Data Acquisition Systems
- Audio Signal Routing and Multiplexing
- Medical Instrumentation

## DESCRIPTION

The DG508A\_MIL, an 8-channel single-ended analog multiplexer, is designed to connect one of eight inputs to a common output as determined by a 3-bit binary address ( $A_0$ ,  $A_1$ ,  $A_2$ ).

The DG509A\_MIL, a dual 4-channel analog multiplexer, is designed to connect one of four differential inputs to a common output as determined by its 2-bit binary address ( $A_0$ ,  $A_1$ ) logic. Break-before-make switching action protects against momentary shorting of the input signals.

A channel in the on state conducts current equally well in both directions. In the off state each channel blocks voltages up to the power supply rails, normally 30 V peak-to-peak. An enable (EN) function allows for device selection when several multiplexers are used. All control inputs, address ( $A_x$ ) and

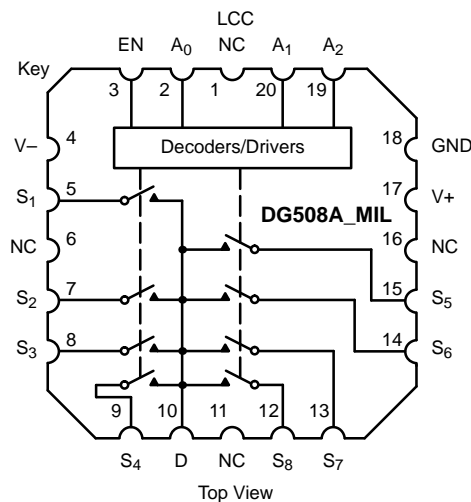
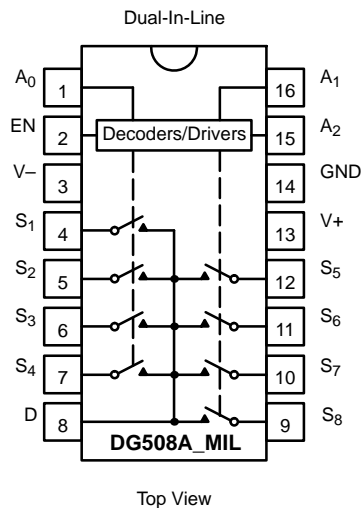
enable (EN) are TTL or CMOS compatible over the full specified operating temperature range.

Fabricated in the Vishay Siliconix Plus-40 process, the absolute maximum voltage rating is extended to 44 V, allowing increased operating headroom for standard  $\pm 15$ -V signal swings and operation with  $\pm 20$ -V supplies. An epitaxial layer prevents latch up.

The DG508A\_MIL/509A\_MIL are available in hermetic packages. For plastic packages, use the DG408/409 as pin-for-pin replacements.

For applications requiring address data latching, the DG528/529 is recommended. DG408/409 is recommended for higher precision applications. For wideband/video routing and multiplexing, the DG538A is recommended.

## FUNCTIONAL BLOCK DIAGRAMS AND PIN CONFIGURATIONS



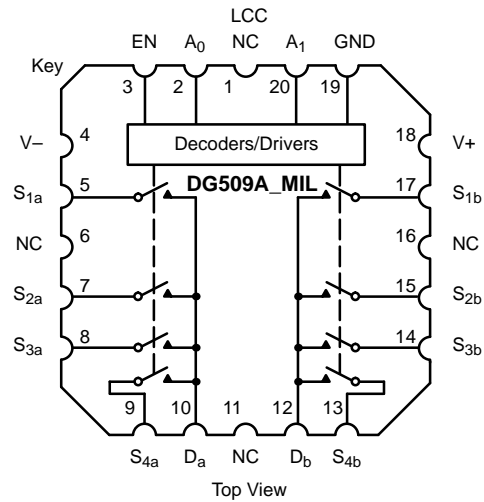
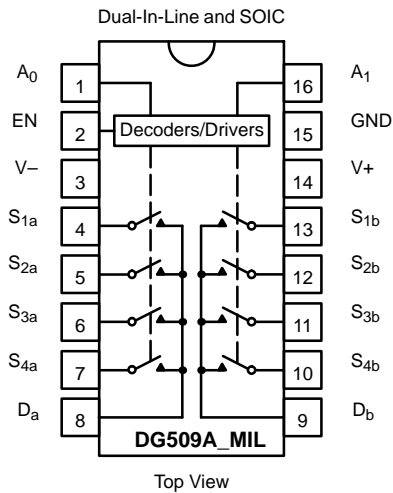


**FUNCTIONAL BLOCK DIAGRAMS AND PIN CONFIGURATIONS**

ORDERING INFORMATION - DG508A_MIL		
Temp Range	Package	Part Number
0 to 70°C	16-Pin Plastic DIP	DG508ACJ
-25 to 85°C	16-Pin CerDIP	DG508ABK
-40 to 85°C	16-Pin Narrow SOIC	DG508ADY
-55 to 125°C	16-Pin CerDIP	DG508AAK
		DG508AAK/883
	LCC-20	DG508AAZ/883
	16-Pin Sidebrazed	7705201EA
		7705201EC
	16-Pin Flat Pack	7705201FA
16-Pin Sidebrazed	7705201FC	
	JM38510/19007BEA	
	JM38510/19007BEC	

TRUTH TABLE - DG508A_MIL				
A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>	EN	On Switch
X	X	X	0	None
0	0	0	1	1
0	0	1	1	2
0	1	0	1	3
0	1	1	1	4
1	0	0	1	5
1	0	1	1	6
1	1	0	1	7
1	1	1	1	8

Logic "0" = V<sub>AL</sub> ≤ 0.8 V  
 Logic "1" = V<sub>AH</sub> ≥ 2.4 V  
 X = Don't Care



ORDERING INFORMATION - DG509A_MIL		
Temp Range	Package	Part Number
-55 to 125°C	16-Pin CerDIP	DG509AAK
		DG509AAK/883
	LCC-20	DG509AAZ/883
	16-Pin Sidebrazed	JM38510/19008BEA
		JM38510/19008BEC

TRUTH TABLE - DG509A_MIL			
A <sub>1</sub>	A <sub>0</sub>	EN	On Switch
X	X	0	None
0	0	1	1
0	1	1	2
1	0	1	3
1	1	1	4

Logic "0" = V<sub>AL</sub> ≤ 0.8 V  
 Logic "1" = V<sub>AH</sub> ≥ 2.4 V  
 X = Don't Care



**ABSOLUTE MAXIMUM RATINGS**

Voltage Referenced to V-  
 V+ ..... 44 V  
 GND ..... 25 V  
 Digital Inputs<sup>a</sup>, V<sub>S</sub>, V<sub>D</sub> ..... (V-) -2 V to (V+) +2 V or 20 mA, whichever occurs first  
 Current (Any Terminal, Except S or D) ..... 30 mA  
 Continuous Current, S or D ..... 20 mA  
 Peak Current, S or D (Pulsed at 1 ms, 10% Duty Cycle Max) ..... 40 mA

Storage Temperature (K Suffix) ..... -65 to 150°C  
 (J and Y Suffix) ..... -65 to 125°C

Power Dissipation (Package)<sup>b</sup>  
 16-Pin CerDIP<sup>c</sup> ..... 900 mW  
 LCC-20° ..... 900 mW

Notes:

- a. Signals on S<sub>X</sub>, D<sub>X</sub> or I<sub>NX</sub> 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 12 mW/°C above 75°C.

SPECIFICATIONS <sup>a</sup>								
Parameter	Symbol	Test Conditions Unless Otherwise Specified V <sub>+</sub> = 15 V, V <sub>-</sub> = -15 V V <sub>IN</sub> = 2.4 V, 0.8 V <sup>f</sup>		Temp <sup>b</sup>	A Suffix -55 to 125°C			Unit
					Min <sup>d</sup>	Typ <sup>c</sup>	Max <sup>d</sup>	
<b>Analog Switch</b>								
Analog Signal Range <sup>e</sup>	V <sub>ANALOG</sub>			Full	-15		15	V
Drain-Source On-Resistance	r <sub>DS(on)</sub>	V <sub>D</sub> = ±10 V, I <sub>S</sub> = -200 μA		Room Full		240	400 500	Ω
r <sub>DS(on)</sub> Match	Δr <sub>DS(on)</sub>	-10 V < V <sub>S</sub> < 10 V		Room		6		%
Source Off Leakage Current	I <sub>S(off)</sub>	V <sub>EN</sub> = 0 V, V <sub>S</sub> = ±10 V V <sub>D</sub> = ∓10 V		Room Full	-1 -50		1 50	nA
Drain Off Leakage Current	I <sub>D(off)</sub>	V <sub>EN</sub> = 0 V V <sub>D</sub> = ±10 V V <sub>S</sub> = ∓10 V	DG508A_MIL	Room Full	-10 -200		10 200	
			DG509A_MIL	Room Full	-10 -100		10 100	
Drain On Leakage Current	I <sub>D(on)</sub>	V <sub>S</sub> = V <sub>D</sub> = ±10 V	DG508A_MIL	Room Full	-10 -200		10 200	
			DG509A_MIL	Room Full	-10 -100		10 100	
<b>Digital Control</b>								
Logic Input Current Input Voltage High	I <sub>AH</sub>	V <sub>A</sub> = 2.4 V		Room Full	-10 -30	-0.002		μA
		V <sub>A</sub> = 15 V		Room Full		0.006	10 30	
Logic Input Current Input Voltage Low	I <sub>AL</sub>	V <sub>EN</sub> = 0 V, 2.4 V, V <sub>A</sub> = 0 V		Room Full	-10 -30	-0.002		
<b>Dynamic Characteristics</b>								
Transition Time	t <sub>TRANS</sub>	See Figure 2		Room		0.6	1.0	μs
Break-Before-Make Time	t <sub>OPEN</sub>	See Figure 4		Room		0.2		
Enable Turn-On Time	t <sub>ON(EN)</sub>	See Figure 3		Room		1	1.5	
Enable Turn-Off Time	t <sub>OFF(EN)</sub>			Room		0.4	1.0	
Charge Injection	Q	See Figure 5		Room		6		pC
Off Isolation	OIRR	V <sub>EN</sub> = 0 V, R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 15 pF V <sub>S</sub> = 7 V <sub>RMS</sub> , f = 500 kHz		Room		68		dB
Logic Input Capacitance	C <sub>in</sub>	f = 1 MHz		Room		8		pF
Source Off Capacitance	C <sub>S(off)</sub>	V <sub>EN</sub> = 0 V, V <sub>S</sub> = 0 V, f = 140 kHz		Room		6		
Drain Off Capacitance	C <sub>D(off)</sub>	V <sub>EN</sub> = 0 V, V <sub>D</sub> = 0 V f = 140 kHz	DG508A_MIL	Room		25		
			DG509A_MIL	Room		12		

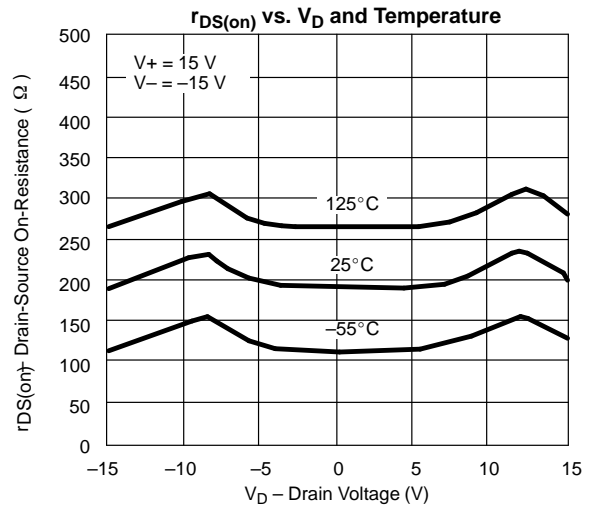
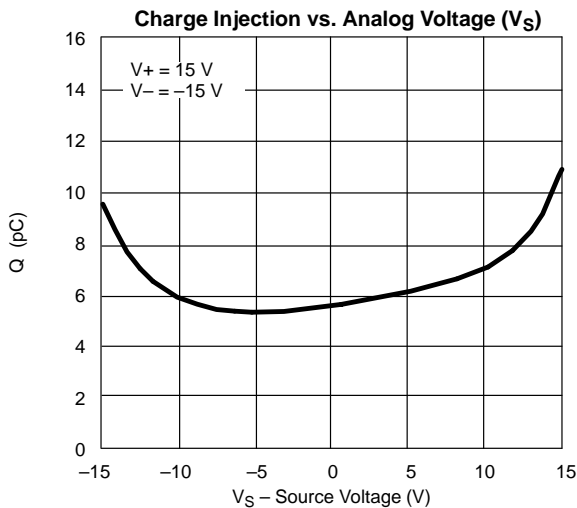
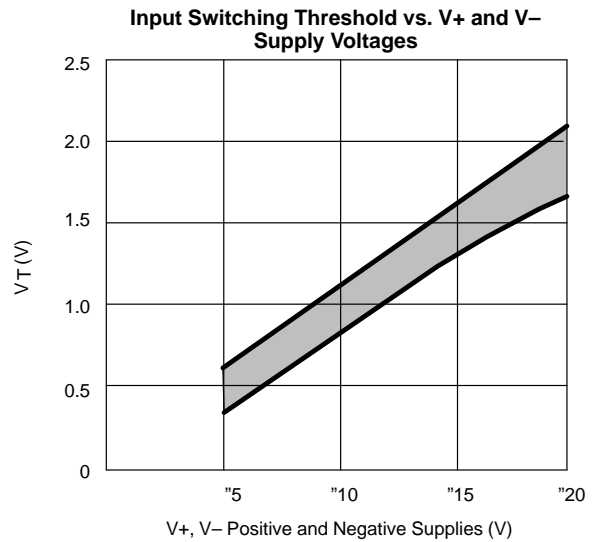
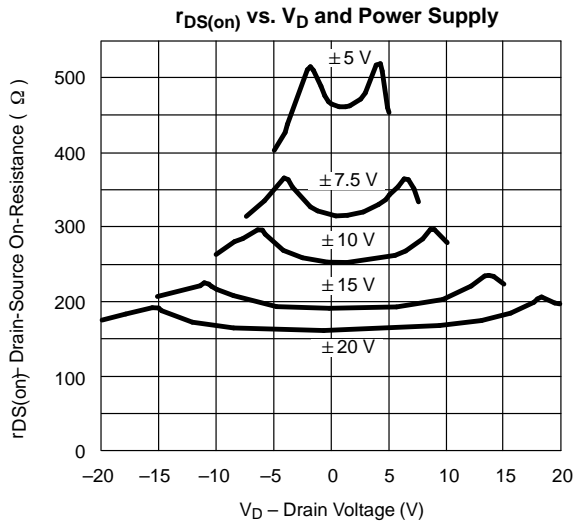


SPECIFICATIONS <sup>a</sup>							
Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_+ = 15\text{ V}, V_- = -15\text{ V}$ $V_{IN} = 2.4\text{ V}, 0.8\text{ V}^f$	Temp <sup>b</sup>	A Suffix -55 to 125°C			Unit
				Min <sup>d</sup>	Typ <sup>c</sup>	Max <sup>d</sup>	
<b>Power Supplies</b>							
Positive Supply Current	I+	$V_{EN} = 0\text{ V or } 2.4\text{ V}$	Room		1.3	2.4	mA
Negative Supply Current	I-		Room	-1.5	-0.7		

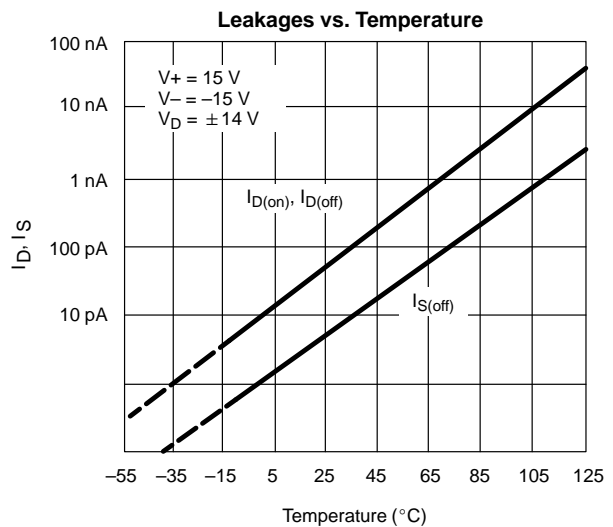
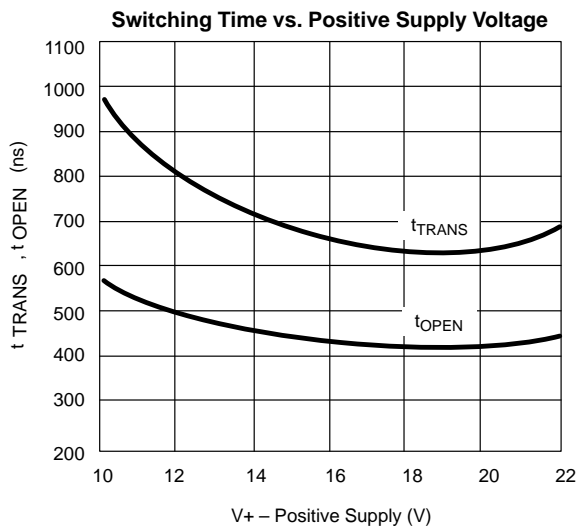
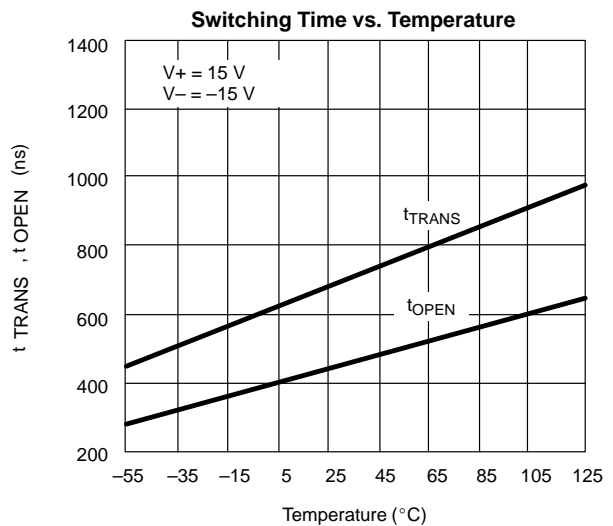
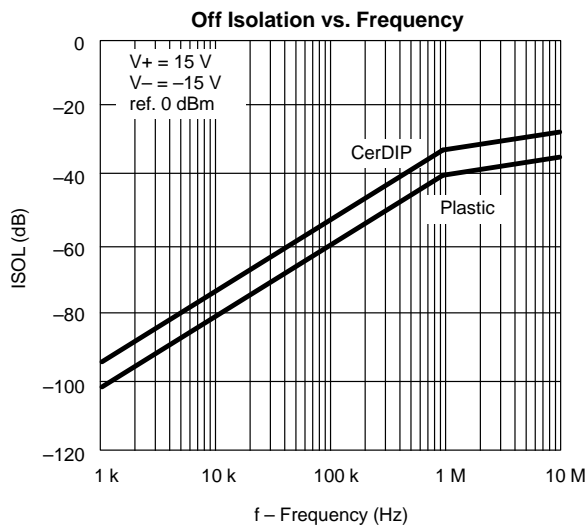
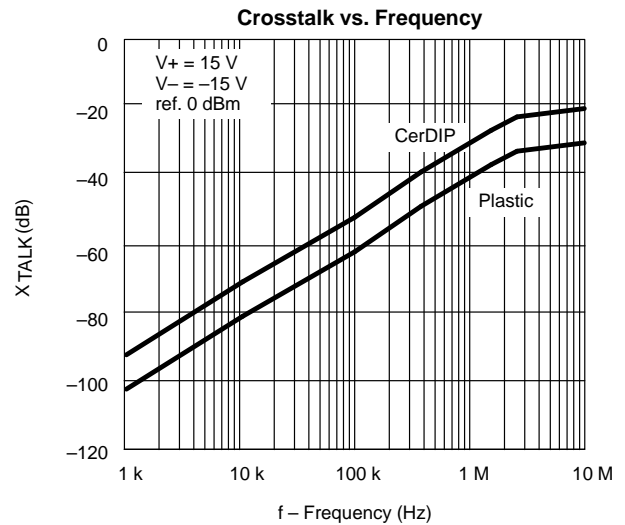
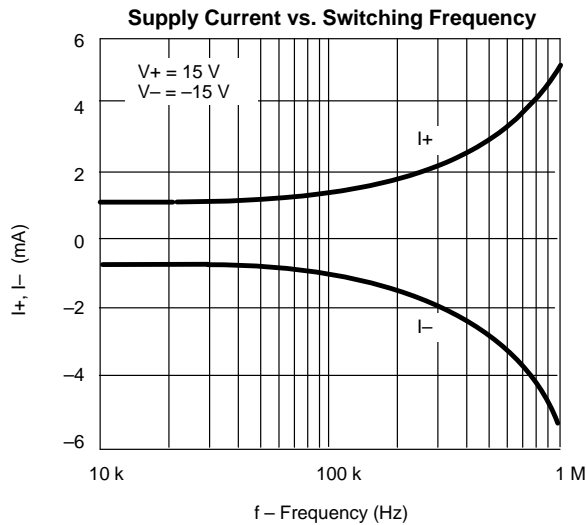
Notes:

- 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.

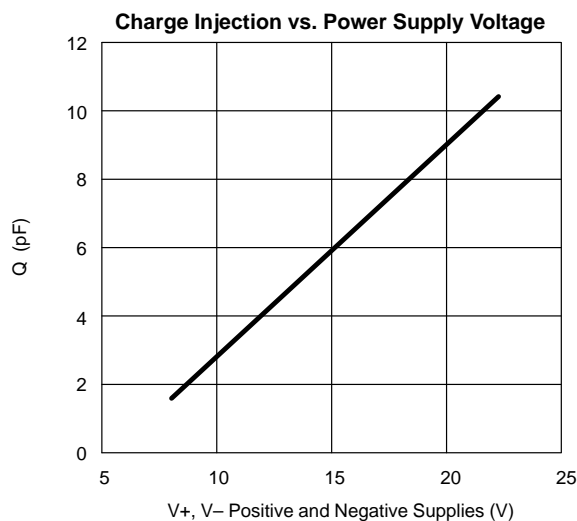
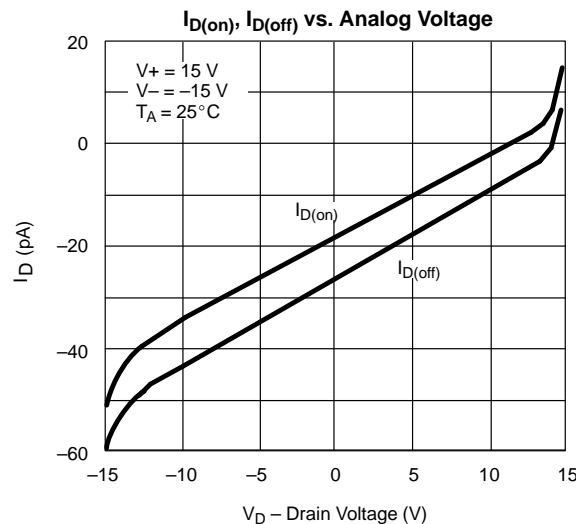
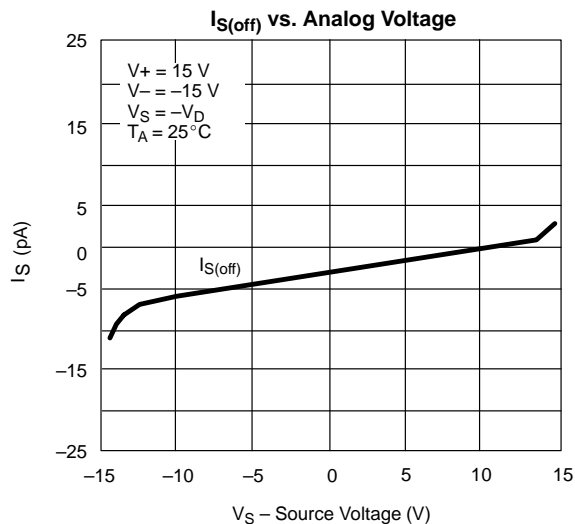
**TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)**



**TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)**



**TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)**



**SCHEMATIC DIAGRAM (TYPICAL CHANNEL)**

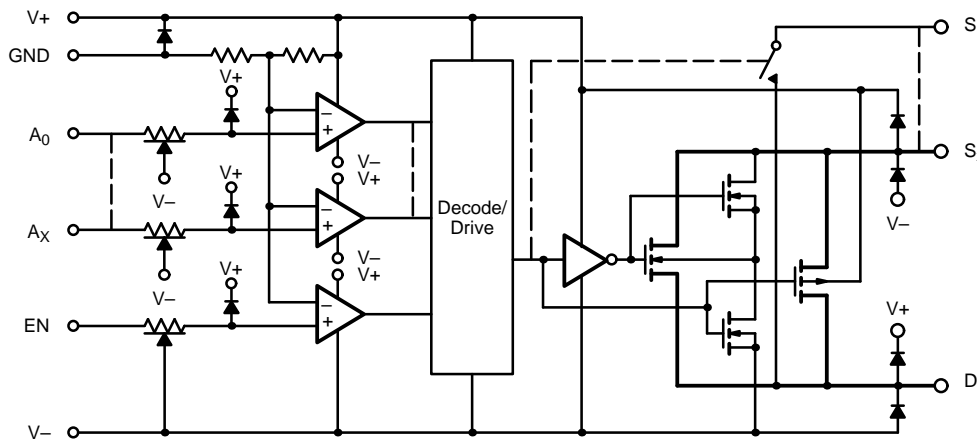


FIGURE 1.

## TEST CIRCUITS

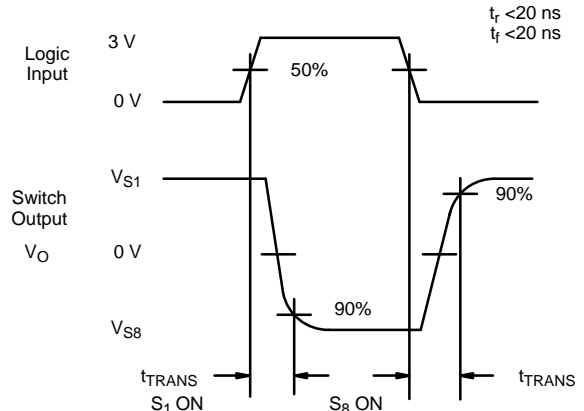
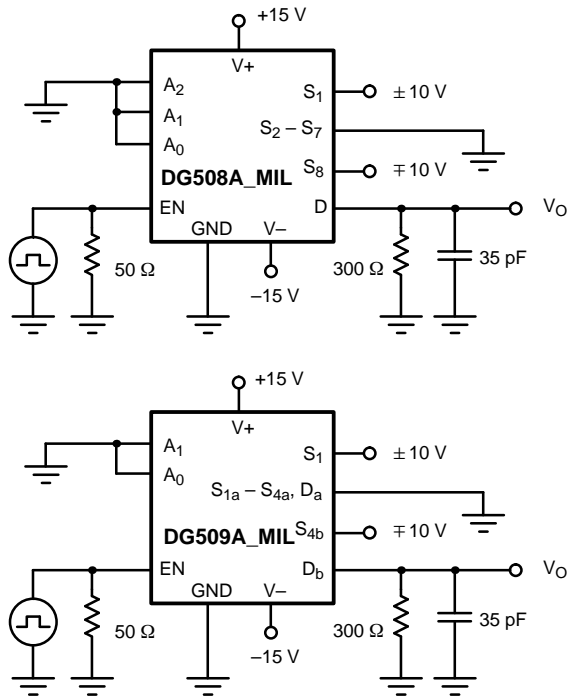


FIGURE 2. Transition Time

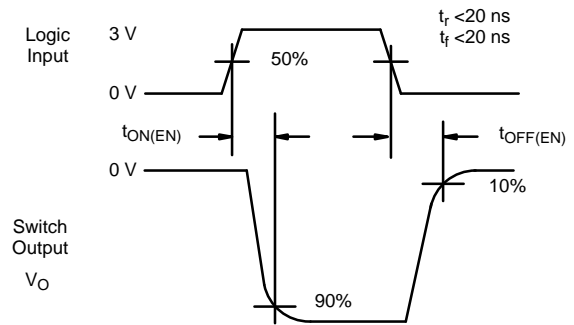
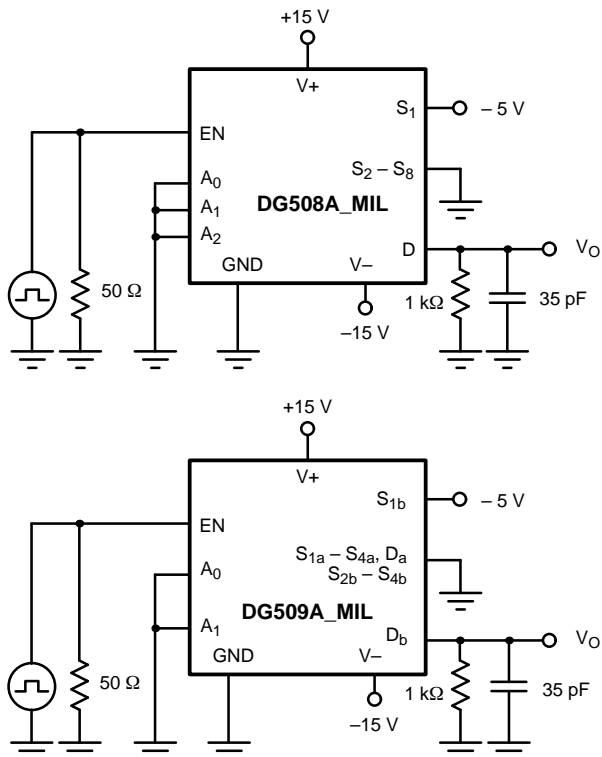
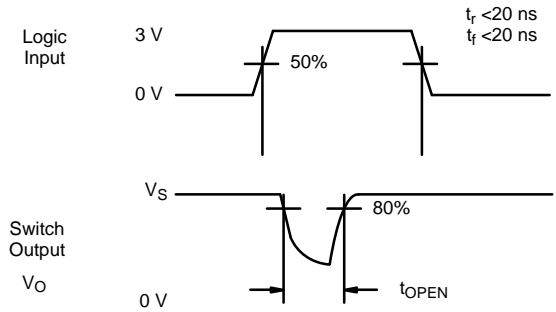
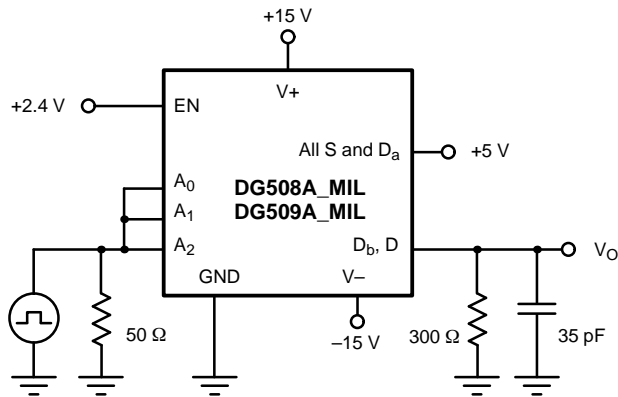
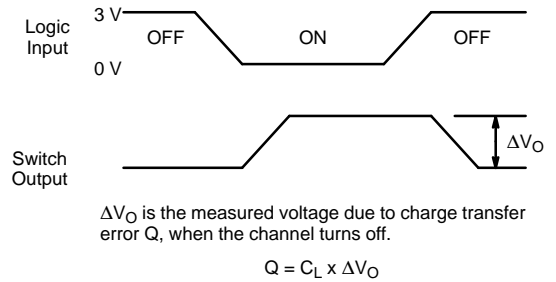
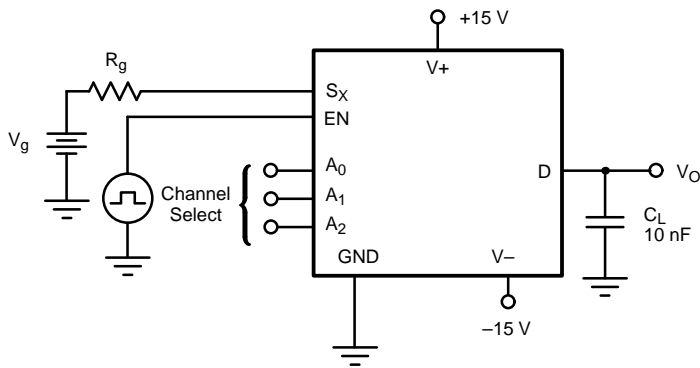


FIGURE 3. Enable Switching Time

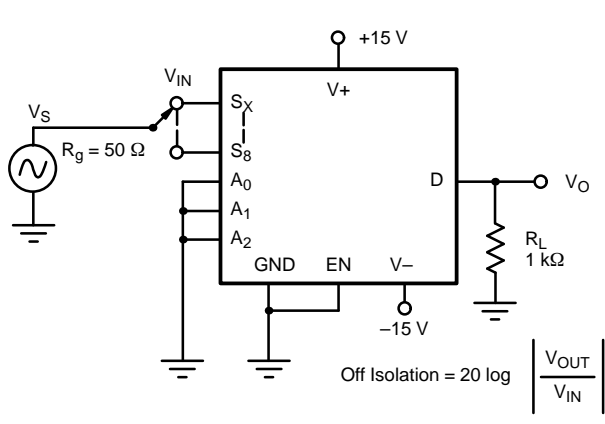
**TEST CIRCUITS**



**FIGURE 4.** Break-Before-Make Interval

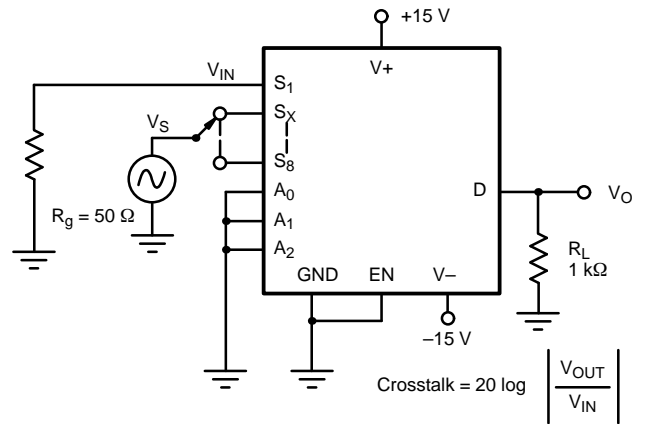


**FIGURE 5.** Charge Injection



$$\text{Off Isolation} = 20 \log \left| \frac{V_{OUT}}{V_{IN}} \right|$$

**FIGURE 6.** Off Isolation

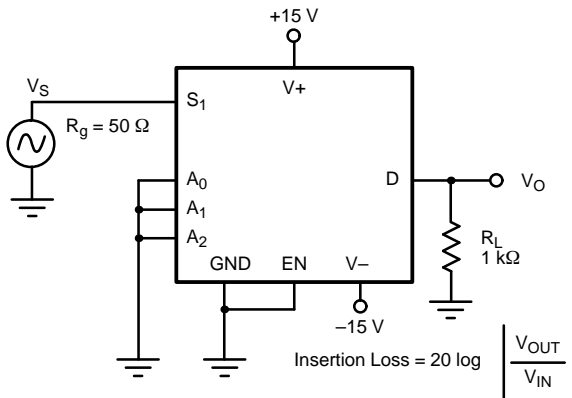


$$\text{Crosstalk} = 20 \log \left| \frac{V_{OUT}}{V_{IN}} \right|$$

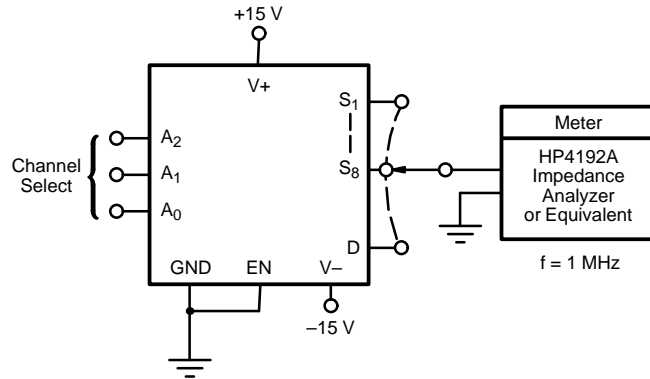
**FIGURE 7.** Crosstalk



**TEST CIRCUITS**



**FIGURE 8.** Insertion Loss



**FIGURE 9.** Source Drain Capacitance

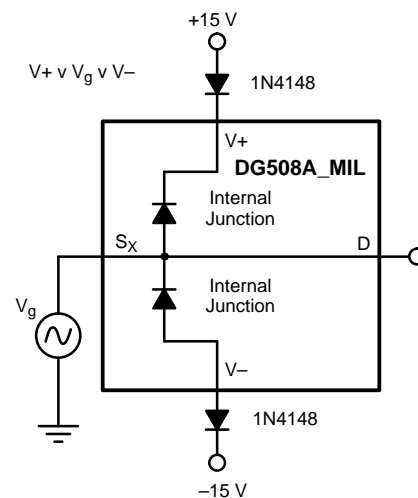
<b>APPLICATIONS<sup>a</sup></b>			
<b>V+</b> Positive Supply Voltage (V)	<b>V-</b> Negative Supply Voltage (V)	<b>V<sub>IN</sub></b> Logic Input Voltage V <sub>INH(min)</sub> /V <sub>INL(max)</sub> (V)	<b>V<sub>S</sub> or V<sub>D</sub></b> Analog Voltage Range (V)
15	-15	2.4/0.8	-15 to 15
10	-12	2.4/0.8	-12 to 12
12	-10	2.4/0.6	-10 to 10
8 <sup>b</sup>	-8	2.4/0.4	-8 to 8

Notes:

- a. Application Hints are for DESIGN AID ONLY, not guaranteed and not subject to production testing.
- b. Operation below ±8 V is not recommended.

**Overvoltage Protection**

A very convenient form of overvoltage protection consists of adding two small signal diodes (1N4148, 1N914 type) in series with the supply pins (see Figure 11). This arrangement effectively blocks the flow of reverse currents. It also floats the supply pin above or below the normal V+ or V- value. In this case the overvoltage signal actually becomes the power supply of the IC. From the point of view of the chip, nothing has changed, as long as the difference between V<sub>S</sub> and the V- rail doesn't exceed +44 V. The addition of these diodes will reduce the analog signal range to 1 V below V+ and 1 V above V-, but it preserves the low channel resistance and low leakage characteristics.



**FIGURE 10.** Overvoltage Protection Using Blocking Diodes

**APPLICATIONS**

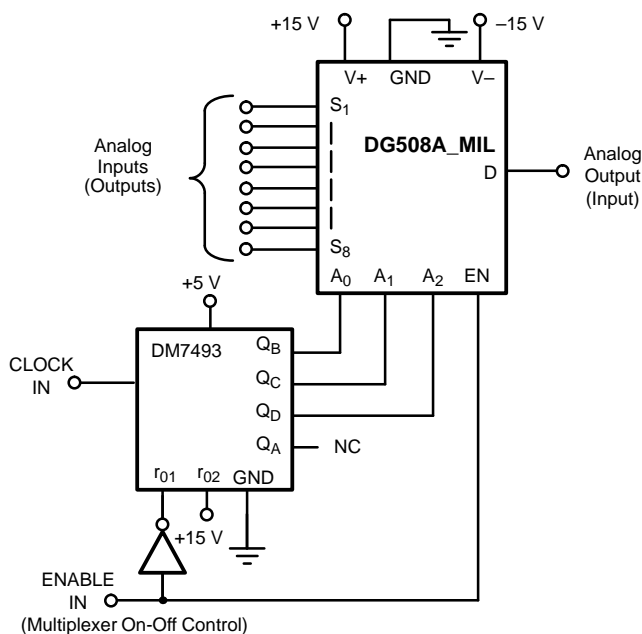


FIGURE 11. 8-Channel Sequential Multiplexer/ Demultiplexer

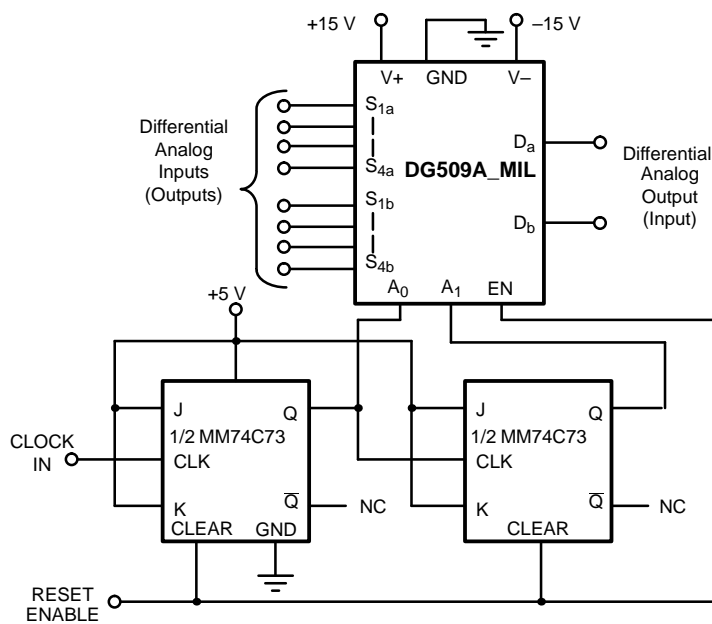


FIGURE 12. Differential 4-Channel Sequential Multiplexer/ Demultiplexer



## Notice

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