



## Monolithic CMOS Analog Multiplexers

### General Description

Maxim's DG508A and DG509A are monolithic CMOS analog multiplexers (muxes): the DG508A is a single 8-channel (1-of-8) mux, and the DG509 is a differential 4-channel (2-of-8) mux.

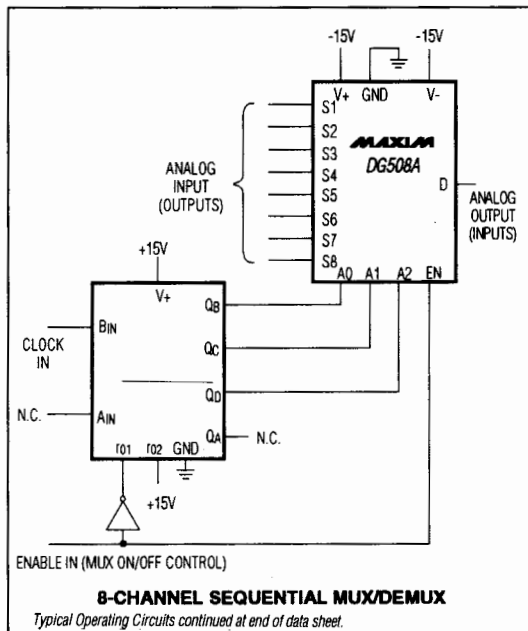
Both devices guarantee break-before-make switching. Maxim guarantees these muxes will not latch up if the power supplies are turned off with the input signals still present. Maxim also guarantees continuous operation when these devices are powered by supplies ranging from  $\pm 4.5V$  to  $\pm 18V$ .

The DG508A/DG509A are plug-in upgrades for the industry-standard DG508A/DG509A, respectively. Maxim's parts have lower on resistance, faster enable switching times, and significantly lower leakage currents. The DG508A/DG509A also consume significantly lower power, making them ideal for portable equipment.

### Applications

- Control Systems
- Data Logging Systems
- Aircraft Heads-Up Displays
- Data-Acquisition Systems
- Signal Routing

### Typical Operating Circuits



### Features

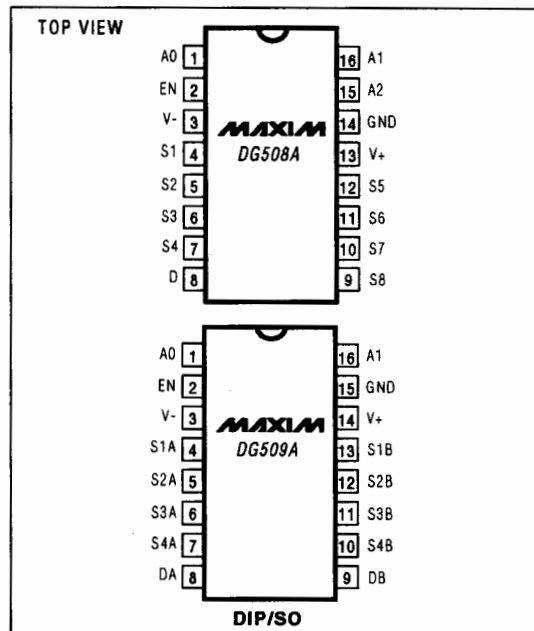
- ◆ Improved Second Source
- ◆ Operate from  $\pm 4.5V$  to  $\pm 18V$  Supplies
- ◆ Symmetrical, Bidirectional Operation
- ◆ Logic and Enable Inputs, TTL and CMOS Compatible
- ◆ Latchup-Proof Construction
- ◆ Monolithic, Low-Power CMOS Design

### Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
DG508ACJ	0°C to +70°C	16 Plastic DIP
DG508ACWE	0°C to +70°C	16 Wide SO
DG508AC/D	0°C to +70°C	Dice*
DG508ABK	-20°C to +85°C	16 CERDIP
DG508ADJ	-40°C to +85°C	16 Plastic DIP
DG508ADY	-40°C to +85°C	16 Narrow SO
DG508AEWE	-40°C to +85°C	16 Wide SO
DG508AAK	-55°C to +125°C	16 CERDIP

Ordering information continued at end of data sheet.  
\*Contact factory for dice specifications.

### Pin Configurations



DG508A/DG509A

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## ABSOLUTE MAXIMUM RATINGS

Voltage Referenced to V-

V+	.....	+44V
GND	.....	+25V
Digital Inputs, V <sub>S</sub> and V <sub>D</sub> (Note 1)	.....	-2V to (V <sub>+</sub> + 2V) or 20mA, whichever occurs first

Current (any terminal, except S or D)	.....	30mA
Continuous Current, S or D	.....	20mA
Peak Current, S or D (pulsed at 1ms, 10% duty cycle max)	..	40mA
Continuous Power Dissipation (T <sub>A</sub> = +70°C)		
Plastic DIP (derate 10.53mW/°C above +70°C)	.....	842mW
Narrow SO (derate 8.70mW/°C above +70°C)	.....	696mW
Wide SO (derate 9.52mW/°C above +70°C)	.....	762mW
CERDIP (derate 10.00mW/°C above +70°C)	.....	800mW

Operating Temperature Ranges:

DG50_ACJ/CWE	.....	0°C to +70°C
DG50_ABK	.....	-20°C to +85°C
DG50_ADJ/DY/EWE	.....	-40°C to +85°C
DG50_AAK	.....	-55°C to +125°C
Storage Temperature Range	.....	-65°C to +150°C
Lead Temperature (soldering, 10sec)	.....	+300°C

**Note 1:** Signals on S<sub>n</sub>, D<sub>n</sub>, or I<sub>N</sub> exceeding V<sub>+</sub> or V<sub>-</sub> will be clamped by internal diodes. Limit forward diode current to maximum current ratings.

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 ratings conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

(V<sub>+</sub> = 15V, V<sub>-</sub> = -15V, GND = 0V, T<sub>A</sub> = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	DG508AA DG509AA			DG508AD/E/B/C DG509AD/E/B/C			UNITS		
			MIN	TYP	MAX	MIN	TYP	MAX			
<b>SWITCH</b>											
Analog-Signal Range	V <sub>ANALOG</sub>		-15		15	-15		15	V		
Drain-Source On Resistance (Note 4)	r <sub>DS(ON)</sub>	Sequence each switch on, V <sub>AL</sub> = 0.8V, V <sub>AH</sub> = 2.4V	V <sub>D</sub> = 10V, I <sub>S</sub> = -200μA		170	300	170		350	Ω	
			V <sub>D</sub> = -10V, I <sub>S</sub> = -200μA		130	300	130		350		
Greatest Change in Drain-Source On Resistance Between Channels	Δr <sub>DS(ON)</sub>	Δr <sub>DS(ON)</sub> = $\frac{(r_{DS(ON) \text{ max}} - r_{DS(ON) \text{ min}})}{r_{DS(ON)}}$ -10V ≤ V <sub>S</sub> ≤ 10V	6			6			%		
Source-Off Leakage Current	I <sub>S(OFF)</sub>	V <sub>EN</sub> = 0V	V <sub>S</sub> = 10V, V <sub>D</sub> = -10V		0.002	0.5	0.002		1	nA	
			V <sub>S</sub> = -10V, V <sub>D</sub> = 10V		-0.5	-0.005	-1		-0.005		
Drain-Off Leakage Current	DG508A	V <sub>EN</sub> = 0V	V <sub>D</sub> = 10V, V <sub>S</sub> = -10V		0.01		2		0.01		5
			V <sub>D</sub> = -10V, V <sub>S</sub> = 10V		-2		-0.015		-5		
	DG509A		V <sub>D</sub> = 10V, V <sub>S</sub> = -10V		0.005		2		0.005		5
			V <sub>D</sub> = -10V, V <sub>S</sub> = 10V		-2		-0.008		-5		
Drain-On Leakage Current	DG508A	Sequence each switch on, V <sub>AL</sub> = 0.8V, V <sub>AH</sub> = 2.4V	V <sub>S(all)</sub> = V <sub>D</sub> = 10V		0.015		2		0.015		nA
			V <sub>S(all)</sub> = V <sub>D</sub> = -10V		2		-0.03		-5		
	V <sub>S(all)</sub> = V <sub>D</sub> = 10V		0.007		2		0.007		5		
	V <sub>S(all)</sub> = V <sub>D</sub> = -10V		-2		-0.015		-5				

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DG508A/DG509A

## ELECTRICAL CHARACTERISTICS (continued)

(V+ = 15V, V- = -15V, GND = 0V, TA = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	DG508AA DG509AA			DG508AD/E/B/C DG509AD/E/B/C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
<b>LOGIC INPUT</b>									
Logic Input Current, Input Voltage High	IAH	VA = 2.4V	-10	-0.002		-10	-0.002		μA
		VA = 15V		0.006	10		0.006	10	
Logic Input Current, Input Voltage Low	IAL	All VA = 0V	VEN = 2.4V	-10	-0.002		-10	-0.002	μA
			VEN = 0V	-10	-0.002		-10	-0.002	
<b>DYNAMIC</b>									
Multiplexer Switching Time	ttransition	Figure 1		0.6	1.0		0.6	1.0	μs
Break-Before-Make Interval	topen	Figure 3		0.2			0.2		μs
Enable Turn-On Time	ton(EN)	Figure 2		0.4	1.0		0.4	1.5	μs
Enable Turn-Off Time	toff(EN)	Figure 2		0.2	0.7		0.2	1.0	μs
Off Isolation (Note 3)	OIRR	VEN = 0V, RL = 1kΩ, CL = 15pF, Vs = 7VRMS, f = 500kHz		68			68		dB
Source-Off Capacitance	CS(off)	Vs = 0V, VEN = 0V, f = 140kHz		5			5		pF
Drain-Off Capacitance	DG508A	CD(off) Vs = 0V, VEN = 0V, f = 140kHz		25			25		pF
	DG509A			12			12		
<b>SUPPLY</b>									
Positive Supply Current	I+	VEN = 2.4V, all VA = 0V or 2.4V		0.02	0.2		0.02	0.2	mA
Negative Supply Current	I-	VEN = 2.4V, all VA = 0V or 2.4V	-0.1	-0.01		-0.1	-0.01		mA
Positive Supply Current in Standby	I+	VEN = 0V, all VA = 0V or 2.4V		0.02	0.2		0.02	0.2	mA
Negative Supply Current in Standby	I-	VEN = 0V, all VA = 0V or 2.4V	-0.1	-0.01		-0.1	-0.01		mA
Power-Supply Range for Continuous Operation (Notes 4, 5)	V-, V+		±4.5		±18.0	±4.5		±18.0	V

# Monolithic CMOS Analog Multiplexers

## ELECTRICAL CHARACTERISTICS (continued)

(V+ = 15V, GND = 0V, TA = TMIN to TMAX, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	DG508AA DG509AA			DG508AD/E/B/C DG509AD/E/B/C			UNITS	
			MIN	TYP	MAX	MIN	TYP	MAX		
<b>SWITCH</b>										
Analog-Signal Range	VANALOG		-15	15	-15	15			V	
Drain-Source On Resistance	rDS(ON)	Sequence each switch on, VAL = 0.8V, VAH = 2.4V	V <sub>D</sub> = 10V, I <sub>S</sub> = -200μA		400		450		Ω	
			V <sub>D</sub> = -10V, I <sub>S</sub> = -200μA		400		450		Ω	
Source-Off Leakage Current	I <sub>S(OFF)</sub>	V <sub>EN</sub> = 0V	V <sub>S</sub> = 10V, V <sub>D</sub> = -10V		50		50		nA	
			V <sub>S</sub> = -10V, V <sub>D</sub> = 10V	-50		-50			nA	
Drain-Off Leakage Current	I <sub>D(OFF)</sub>	V <sub>EN</sub> = 0V	V <sub>D</sub> = 10V, V <sub>S</sub> = -10V		200		100		nA	
			V <sub>D</sub> = -10V, V <sub>S</sub> = 10V	-200		-100				
			V <sub>D</sub> = 10V, V <sub>S</sub> = -10V		100		100			
			V <sub>D</sub> = -10V, V <sub>S</sub> = 10V	-100		-100				
Drain-On Leakage Current	I <sub>D(ON)</sub> (Note 2)	Sequence each switch on, VAL = 0.8V, VAH = 2.4V	V <sub>S(all)</sub> = V <sub>D</sub> = 10V		200		100		nA	
			V <sub>S(all)</sub> = V <sub>D</sub> = -10V	-200		-100				
			V <sub>S(all)</sub> = V <sub>D</sub> = 10V		100		100			
			V <sub>S(all)</sub> = V <sub>D</sub> = -10V	-100		-100				
<b>LOGIC INPUT</b>										
Logic Input Current, Input Voltage High	I <sub>AH</sub>	V <sub>A</sub> = 2.4V		-30		-30			μA	
		V <sub>A</sub> = 15V		30		30				
Logic Input Current, Input Voltage Low	I <sub>AL</sub>	All V <sub>A</sub> = 0V	V <sub>EN</sub> = 2.4V		-30		-30		μA	
			V <sub>EN</sub> = 0V		-30		-30			

**Note 2:** I<sub>D(ON)</sub> is leakage from driver into "on" switch.

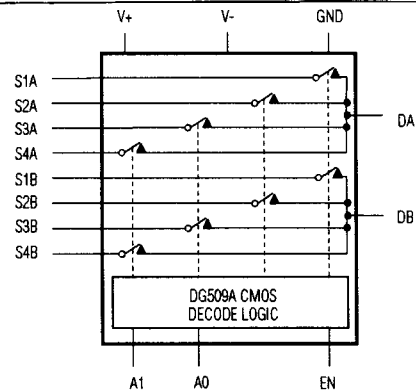
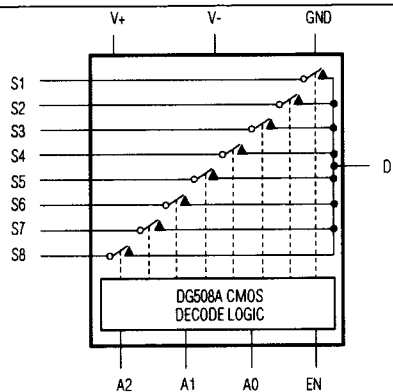
**Note 3:** Off isolation =  $20 \log \frac{|V_S|}{|V_D|}$ ,

V<sub>S</sub> = input to "off" switch,  
V<sub>D</sub> = output due to V<sub>S</sub>.

**Note 4:** Electrical characteristics (such as on resistance) will change when power supplies other than ±15V are used.

**Note 5:** For designs requiring single 5V or dual ±5V operation, refer to Maxim's improved MAX338 and MAX339. Minimum operating voltage for DG508ADY and DG509ADY is ±9V.

## Functional Diagrams



# Monolithic CMOS Analog Multiplexers

## Test Circuits/Timing Diagrams

**DG508A/DG509A**

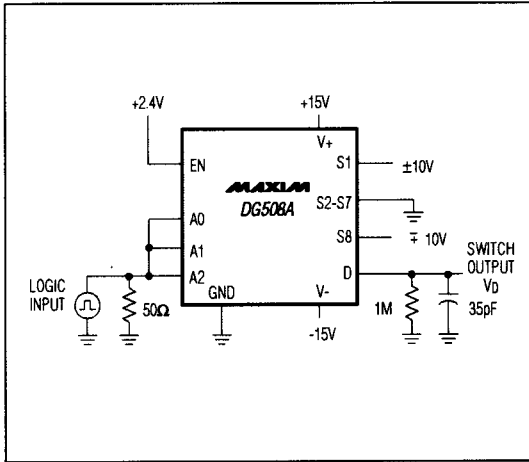


Figure 1a. Switching-Time Test Circuit

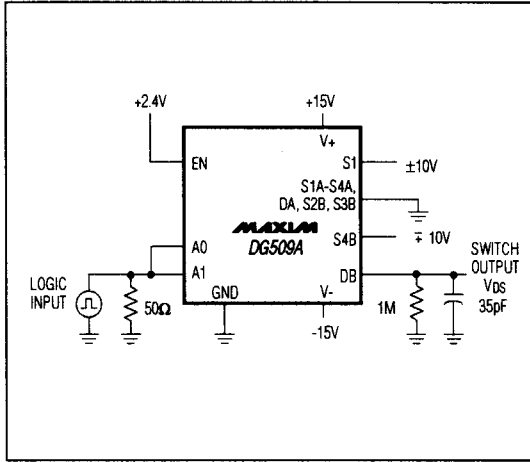


Figure 1b. Switching-Time Test Circuit

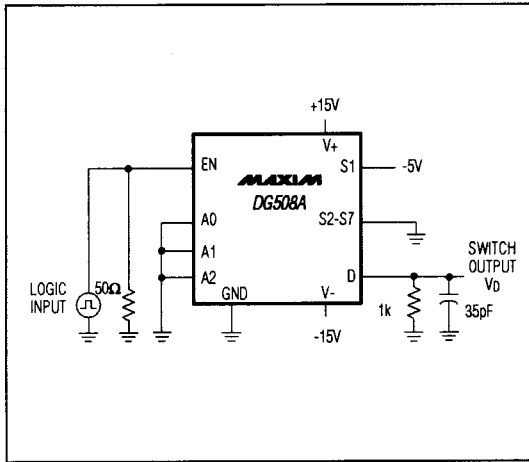


Figure 2a. DG509A Enable-Time Test Circuit

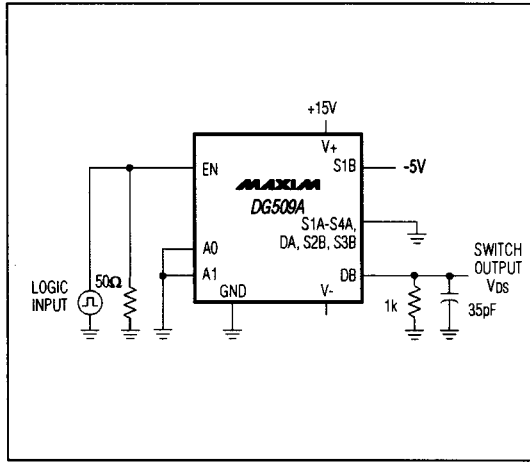


Figure 2b. DG509A Enable-Time Test Circuit

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## Test Circuits/Timing Diagrams (continued)

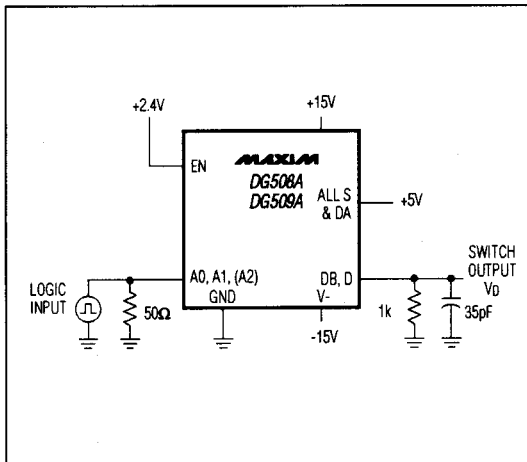


Figure 3. Break-Before-Make Test Circuit

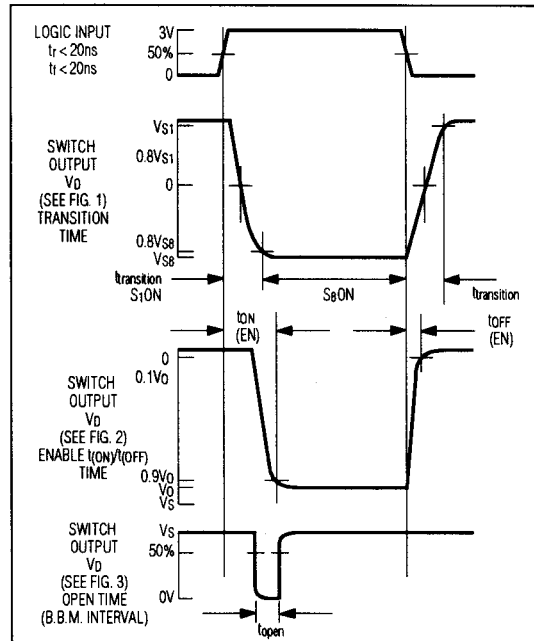


Figure 4. Timing Diagram for Figures 1, 2, and 3

Table 1a. DG508A Truth Table

A2	A1	A0	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

X = Don't Care

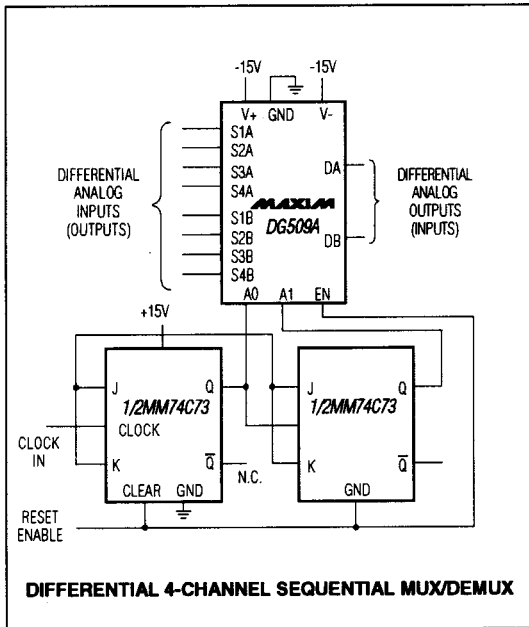
Table 1b. DG509A Truth Table

A1	A0	EN	ON SWITCH
X	X	0	NONE
0	0	1	1
0	1	1	2
1	0	1	3
1	1	1	4

X = Don't Care

# Monolithic CMOS Analog Multiplexers

## Typical Operating Circuits (continued)



## Ordering Information (continued)

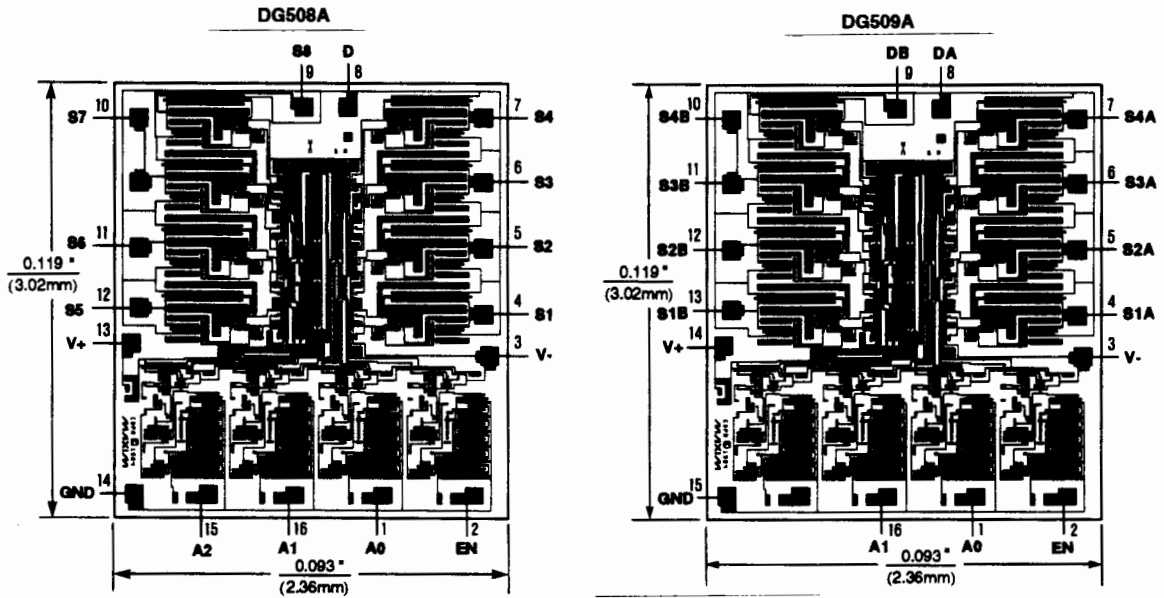
PART	TEMP. RANGE	PIN-PACKAGE
DG509ACJ	0°C to +70°C	16 Plastic DIP
DG509ACWE	0°C to +70°C	16 Wide SO
DG509AC/D	0°C to +70°C	Dice*
DG509ABK	-20°C to +85°C	16 CERDIP
DG509ADJ	-40°C to +85°C	16 Plastic DIP
DG509ADY	-40°C to +85°C	16 Narrow SO
DG509AEWE	-40°C to +85°C	16 Wide SO
DG509AAK	-55°C to +125°C	16 CERDIP

\*Contact factory for dice specifications.

**DG508A/DG509A**

# Monolithic CMOS Analog Multiplexers

## Chip Topographies



Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

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