



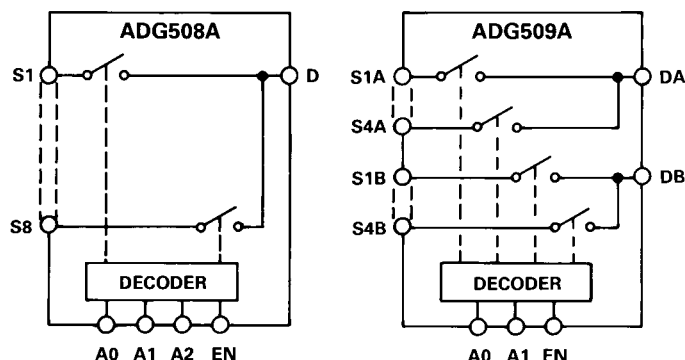
CMOS 4/8 Channel Analog Multiplexers

ADG508A/ADG509A

FEATURES

44V Supply Maximum Rating
 V_{SS} to V_{DD} Analog Signal Range
Single/Dual Supply Specifications
Wide Supply Ranges (10.8V to 16.5V)
Extended Plastic Temperature Range
(-40°C to $+85^{\circ}\text{C}$)
Low Power Dissipation (28mW max)
Low Leakage (20pA typ)
Available in 16-Lead DIP/SOIC and
20-Lead PLCC/LCCC Packages
Superior Alternative to:
DG508A, HI-508
DG509A, HI-509

FUNCTIONAL BLOCK DIAGRAMS



GENERAL DESCRIPTION

The ADG508A and ADG509A are CMOS monolithic analog multiplexers with 8 channels and dual 4 channels respectively. The ADG508A switches one of 8 inputs to a common output depending on the state of three binary addresses and an enable input. The ADG509A switches one of 4 differential inputs to a common differential output depending on the state of two binary addresses and an enable input. Both devices have TTL and 5V CMOS logic compatible digital inputs.

The ADG508A and ADG509A are designed on an enhanced LC^2MOS process which gives an increased signal capability of V_{SS} to V_{DD} and enables operation over a wide range of supply voltages. The devices can comfortably operate anywhere in the 10.8V to 16.5V single or dual supply range. These multiplexers also feature high switching speeds and low R_{ON} .

PRODUCT HIGHLIGHTS

1. Single/Dual Supply Specifications with a Wide Tolerance:
The devices are specified in the 10.8V to 16.5V range for both single and dual supplies.
2. Extended Signal Range:
The enhanced LC^2MOS processing results in a high breakdown and an increased analog signal range of V_{SS} to V_{DD} .
3. Break-Before-Make Switching:
Switches are guaranteed break-before-make so that input signals are protected against momentary shorting.
4. Low Leakage:
Leakage currents in the range of 20pA make these multiplexers suitable for high precision circuits.

ORDERING GUIDE

Model ¹	Temperature Range	Package Option ²
ADG508AKN	-40°C to $+85^{\circ}\text{C}$	N-16
ADG508AKR	-40°C to $+85^{\circ}\text{C}$	R-16A
ADG508AKP	-40°C to $+85^{\circ}\text{C}$	P-20A
ADG508ABQ	-40°C to $+85^{\circ}\text{C}$	Q-16
ADG508ATQ	-55°C to $+125^{\circ}\text{C}$	Q-16
ADG508ATE	-55°C to $+125^{\circ}\text{C}$	E-20A
ADG509AKN	-40°C to $+85^{\circ}\text{C}$	N-16
ADG509AKR	-40°C to $+85^{\circ}\text{C}$	R-16A
ADG509AKP	-40°C to $+85^{\circ}\text{C}$	P-20A
ADG509ABQ	-40°C to $+85^{\circ}\text{C}$	Q-16
ADG509ATQ	-55°C to $+125^{\circ}\text{C}$	Q-16
ADG509ATE	-55°C to $+125^{\circ}\text{C}$	E-20A

NOTES

¹To order MIL-STD-883, Class B processed parts, add /883B to part number. See Analog Devices Military Products Databook (1990) for military data sheet.

²E = Leadless Ceramic Chip Carrier (LCCC); N = Plastic DIP; P = Plastic Leaded Chip Carrier (PLCC); Q = Cerdip; R = 0.15" Small Outline IC (SOIC).

REV. B

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ADG508A/ADG509A—SPECIFICATIONS

DUAL SUPPLY ($V_{DD} = +10.8V$ to $+16.5V$, $V_{SS} = -10.8V$ to $-16.5V$ unless otherwise specified)

	ADG508A ADG509A K Version		ADG508A ADG509A B Version		ADG508A ADG509A T Version			
Parameter	+ 25°C	− 40°C to + 85°C	25°C	− 40°C to + 85°C	+ 25°C	− 55°C to + 125°C	Units	Comments
ANALOG SWITCH								
Analog Signal Range	V _{SS} V _{DD}	V _{SS} V _{DD}	V _{SS} V _{DD}	V _{SS} V _{DD}	V _{SS} V _{DD}	V _{SS} V _{DD}	V _{min} V _{max}	
R _{ON}	280 450 300	 600 400	280 450 300	 600 400	280 450 300	 600 400	Ω typ Ω max Ω max	− 10V ≤ V _S ≤ + 10V, I _{DS} = 1mA; Test Circuit 1
R _{ON} Drift	0.6		0.6		0.6		%/°C typ	V _{DD} = 15V(± 10%), V _{SS} = − 15V(± 10%)
R _{ON} Match	5		5		5		% typ	V _{DD} = 15V(± 5%), V _{SS} = − 15V(± 5%)
I _S (OFF), Off Input Leakage	0.02 1	 50	0.02 1	 50	0.02 1	 50	nA typ nA max	V _S = 0, I _{DS} = 1mA − 10V ≤ V _S ≤ + 10V, I _{DS} = 1mA
I _D (OFF), Off Output Leakage	0.04 1	 100	0.04 1	 100	0.04 1	 100	nA typ nA max	V ₁ = ± 10V, V ₂ = ∓ 10V; Test Circuit 2
ADG508A	1	50	1	50	1	50	nA max	V ₁ = + 10V, V ₂ = ∓ 10V; Test Circuit 3
ADG509A	1	50	1	50	1	50	nA max	
I _D (ON), On Channel Leakage	0.04 1	 100	0.04 1	 100	0.04 1	 100	nA typ nA max	V ₁ = V ₂ = ± 10V; Test Circuit 4
ADG508A	1	100	1	100	1	100	nA max	
ADG509A	1	50	1	50	1	50	nA max	
I _{DIFF} , Differential Off Output Leakage (ADG509A only)		25		25		25	nA max	V ₁ = ± 10V, V ₂ = ∓ 10V; Test Circuit 5
DIGITAL CONTROL								
V _{INH} , Input High Voltage		2.4		2.4		2.4	V _{min}	
V _{INL} , Input Low Voltage		0.8		0.8		0.8	V _{max}	
I _{INL} or I _{INH}		1		1		1	μA max	V _{IN} = 0 to V _{DD}
C _{IN} Digital Input Capacitance	8		8		8		pF max	
DYNAMIC CHARACTERISTICS ¹								
t _{TRANSITION} ¹	200 300	 400	200 300	 400	200 300	 400	ns typ ns max	V ₁ = ± 10V, V ₂ = ∓ 10V; Test Circuit 6
t _{OPEN} ¹	50 25	 10	50 25	 10	50 25	 10	ns typ ns min	Test Circuit 7
t _{ON} (EN) ¹	200 300	 400	200 300	 400	200 300	 400	ns typ ns max	Test Circuit 8
t _{OFF} (EN) ¹	200 300	 400	200 300	 400	200 300	 400	ns typ ns max	Test Circuit 8
OFF Isolation	68 50		68 50		68 50		dB typ dB min	V _{EN} = 0.8V, R _L = 1kΩ, C _L = 15pF, V _S = 7V _{rms} , f = 100kHz
C _S (OFF)	5		5		5		pF typ	V _{EN} = 0.8V
C _D (OFF)								
ADG508A	22		22		22		pF typ	V _{EN} = 0.8V
ADG509A	11		11		11		pF typ	
Q _{INJ} , Charge Injection	4		4		4		pC typ	R _S = 0Ω, V _S = 0; Test Circuit 9
POWER SUPPLY								
I _{DD}	0.6	 1.5	0.6	 1.5	0.6	 1.5	mA typ mA max	V _{IN} = V _{INL} or V _{INH}
I _{SS}	20	 0.2	20	 0.2	20	 0.2	μA typ mA max	V _{IN} = V _{INL} or V _{INH}
Power Dissipation	10	 28	10	 28	10	 28	mW typ mW max	

NOTE

¹Sample tested at 25°C to ensure compliance.

Specifications subject to change without notice.

SINGLE SUPPLY ($V_{DD} = +10.8V$ to $+16.5V$, $V_{SS} = GND = 0V$ unless otherwise noted.)

	ADG508A ADG509A K Version		ADG508A ADG509A B Version		ADG508A ADG509A T Version			
Parameter	+25°C	−40°C to +85°C	+25°C	−40°C to +85°C	+25°C	−55°C to +125°C	Units	Comments
ANALOG SWITCH								
Analog Signal Range	GND	GND	GND	GND	GND	GND	V min	GND≤V _S ≤+10V, I _{DS} =0.5mA Test; Circuit 1
	V _{DD}	V _{DD}	V _{DD}	V _{DD}	V _{DD}	V _{DD}	V max	
R _{ON}	500		500		500		Ω typ	
	700	1000	700	1000	700	1000	Ω max	
R _{ON} Drift	0.6		0.6		0.6		%/°C typ	
R _{ON} Match	5		5		5		% typ	V _S =0, I _{DS} =0.5mA
I _S (OFF), Off Input Leakage	0.02		0.02		0.02		nA typ	GND≤V _S ≤+10V, I _{DS} =0.5mA
	1	50	1	50	1	50	nA max	V1 = +10V/GND, V2 = GND/+10V, Test Circuit 2
I _D (OFF), Off Output Leakage	0.04		0.04		0.04		nA typ	V1 = +10V/GND, V2 = GND/+10V;
ADG508A	1	100	1	100	1	100	nA max	Test Circuit 3
ADG509A	1	50	1	50	1	50	nA max	
I _D (ON), On Channel Leakage	0.04		0.04		0.04		nA typ	V1 = V2 = +10V/GND;
ADG508A	1	100	1	100	1	100	nA max	Test Circuit 4
ADG509A	1	50	1	50	1	50	nA max	
I _{DIFF} , Differential Off Output Leakage (ADG509A only)		25		25		25	nA max	V1 = +10V/GND, V2 = GND/+10V; Test Circuit 5
DIGITAL CONTROL								
V _{INH} , Input High Voltage		2.4		2.4		2.4	V min	V _{IN} =0 to V _{DD}
V _{INL} , Input Low Voltage		0.8		0.8		0.8	V max	
I _{INL} or I _{INH}		1		1		1	μA max	
C _{IN} Digital Input Capacitance	8		8		8		pF max	
DYNAMIC CHARACTERISTICS								
t _{TRANSITION} ¹	300		300		300		ns typ	V1 = +10V/GND, V2 = GND/+10V; Test Cicuit 6
	450	600	450	600	450	600	ns max	
t _{OPEN} ¹	50		50		50		ns typ	Test Circuit 7
	25	10	25	10	25	10	ns min	
t _{ON} (EN) ¹	250		250		250		ns typ	Test Circuit 8
	450	600	450	600	450	600	ns max	
t _{OFF} (EN) ¹	250		250		250		ns typ	Test Circuit 8
	450	600	450	600	450	600	ns max	
OFF Isolation	68		68		68		dB typ	V _{EN} =0.8V, R _L =1kΩ, C _L =15pF, V _S =3.5V rms, f=100kHz
	50		50		50		dB min	
C _S (OFF)	5		5		5		pF typ	V _{EN} =0.8V
C _D (OFF)								
ADG508A	22		22		22		pF typ	V _{EN} =0.8V
ADG509A	11		11		11		pF typ	
Q _{INJ} , Charge Injection	4		4		4		pC typ	R _S =0Ω, V _S =0V; Test Circuit 9
POWER SUPPLY								
I _{DD}	0.6		0.6		0.6		mA typ	V _{IN} =V _{INL} or V _{INH}
		1.5		1.5		1.5	mA max	
Power Dissipation	10		10		10		mW typ	
		25		25		25	mW max	

NOTE

¹Sample tested at 25°C to ensure compliance.

Specifications subject to change without notice.

TERMINOLOGY

R_{ON}	Ohmic resistance between terminals D and S
R_{ON} Match	Difference between the R_{ON} of any two channels
R_{ON} Drift	Change in R_{ON} versus temperature
I_S (OFF)	Source terminal leakage current when the switch is off
I_D (OFF)	Drain terminal leakage current when the switch is off
I_D (ON)	Leakage current that flows from the closed switch into the body
V_S (V_D)	Analog voltage on terminal S or D
C_S (OFF)	Channel input capacitance for "OFF" condition
C_D (OFF)	Channel output capacitance for "OFF" condition

 C_{IN} $t_{OFF} (EN)$ $t_{TRANSITION}$ t_{OPEN} V_{INL} V_{INH} I_{INL} (I_{INH}) V_{DD} V_{SS} I_{DD} I_{SS}

Digital input capacitance

Delay time between the 50% and 10% points of the digital input and switch "OFF" condition

Delay time between the 50% and 90% points of the digital inputs and switch "ON" condition when switching from one address state to another

"OFF" time measured between 50% points of both switches when switching from one address state to another

Maximum input voltage for Logic "0"

Minimum input voltage for Logic "1"

Input current of the digital input

Most positive voltage supply

Most negative voltage supply

Positive supply current

Negative supply current

ADG508A/ADG509A

ABSOLUTE MAXIMUM RATINGS*

(T_A = 25°C unless otherwise noted)

V _{DD} to V _{SS}	44V
V _{DD} to GND	25V
V _{SS} to GND	-25V

Analog Inputs¹

Voltage at S, D	V _{SS} - 2V to V _{DD} + 2V or 20mA, Whichever Occurs First
-----------------	--

Continuous Current, S or D 20mA

Pulsed Current S or D

1ms Duration, 10% Duty Cycle 40mA

Digital Inputs¹

Voltage at A, EN	V _{SS} - 4V to V _{DD} + 4V or 20mA, Whichever Occurs First
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Power Dissipation (Any Package)

Up to +75°C 470mW

Derates above +75°C by 6mW/°C

Operating Temperature

Commercial (K Version) -40°C to +85°C

Industrial (B Version) -40°C to +85°C

Extended (T Version) -55°C to +125°C

Storage Temperature Range -65°C to +150°C

NOTE

¹Overvoltage at A, EN, S or D will be clamped by diodes. Current should be limited to the Maximum Rating above.

TRUTH TABLES

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

ADG508A

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

X = Don't Care

ADG509A

*COMMENT: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

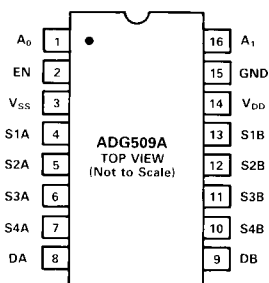
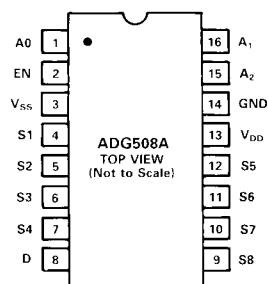
CAUTION

ESD (electrostatic discharge) sensitive device. The digital control inputs are Zener protected; however, permanent damage may occur on unconnected devices subject to high energy electrostatic fields. Unused devices must be stored in conductive foam or shunts. The protective foam should be discharged to the destination socket before devices are removed.

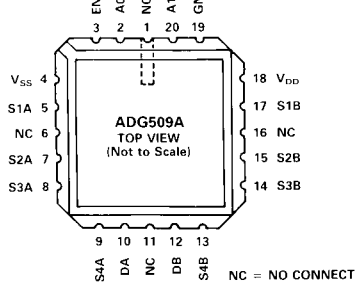
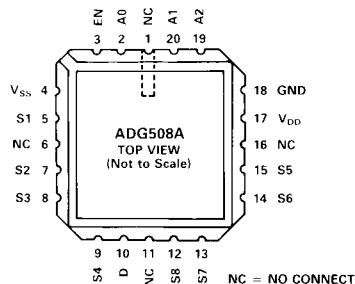


PIN CONFIGURATIONS

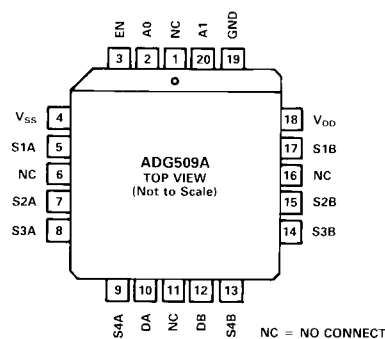
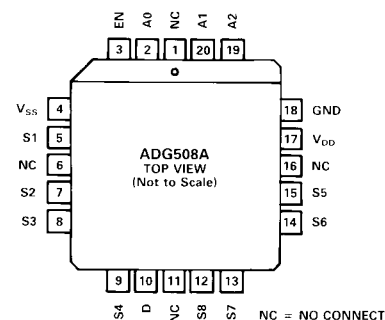
DIP, SOIC



LCCC

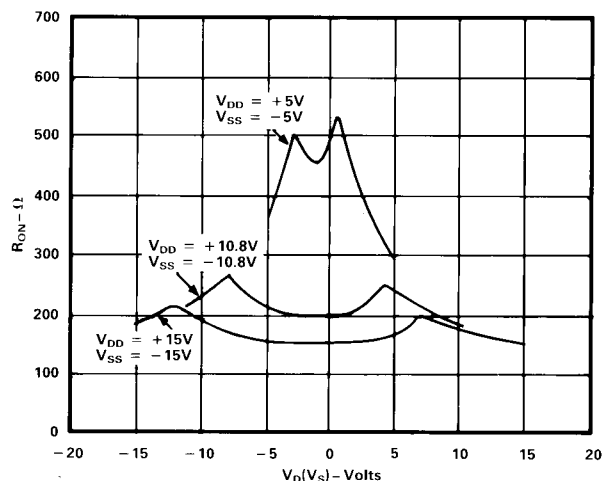


PLCC

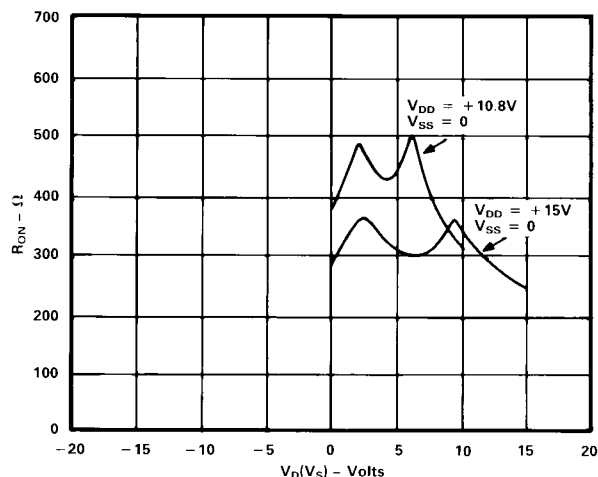


Typical Performance Characteristics—ADG508A/ADG509A

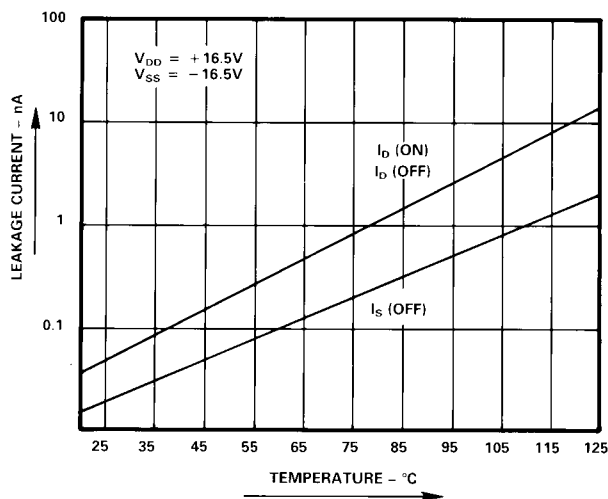
The multiplexers are guaranteed functional with reduced single or dual supplies down to 4.5V.



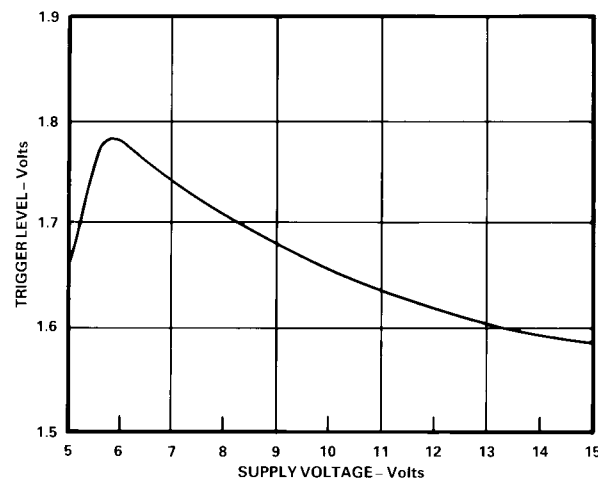
R_{ON} as a Function of $V_D(V_S)$: Dual Supply Voltage, $T_A = +25^\circ\text{C}$



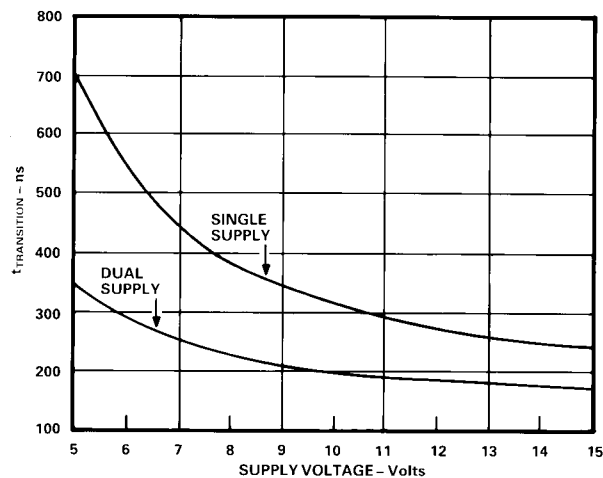
R_{ON} as a Function of $V_D(V_S)$: Single Supply Voltage, $T_A = +25^\circ\text{C}$



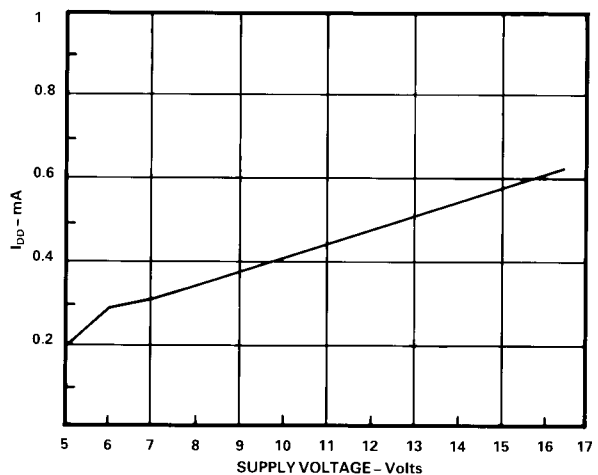
Leakage Current as a Function of Temperature
(Note: Leakage Currents Reduce as the Supply Voltages Reduce)



Trigger Levels vs. Power Supply Voltage, Dual or Single Supply, $T_A = +25^\circ\text{C}$



$t_{TRANSITION}$ vs. Supply Voltage: Dual and Single Supplies, $T_A = +25^\circ\text{C}$
(Note: For V_{DD} and $|V_{SS}| < 10\text{V}$; $V1 = V_{DD}/V_{SS}$, $V2 = V_{SS}/V_{DD}$. See Test Circuit 6)

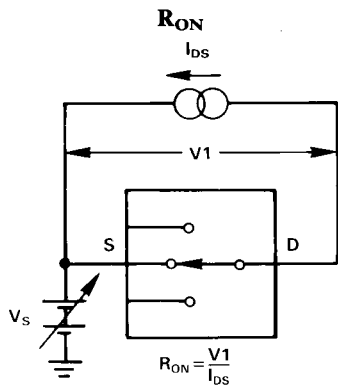


I_{DD} vs. Supply Voltage: Dual or Single Supply, $T_A = +25^\circ\text{C}$

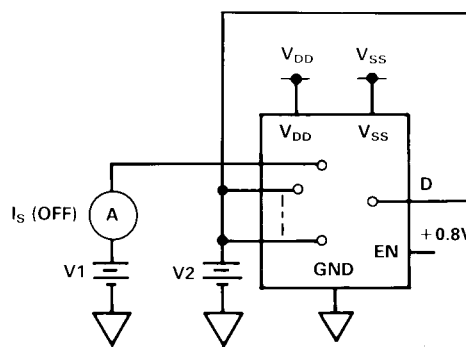
ADG508A/ADG509A—Test Circuits

Note: All Digital Input Signal Rise and Fall Times Measured from 10% to 90% of 3V. $t_R = t_F = 20\text{ns}$.

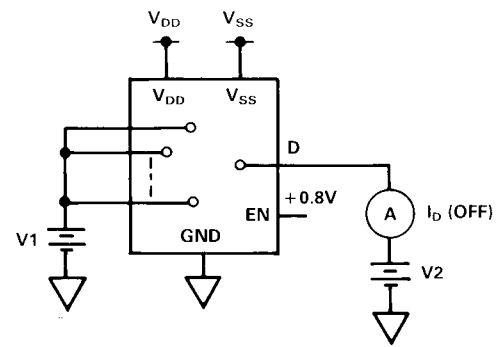
TEST CIRCUIT 1



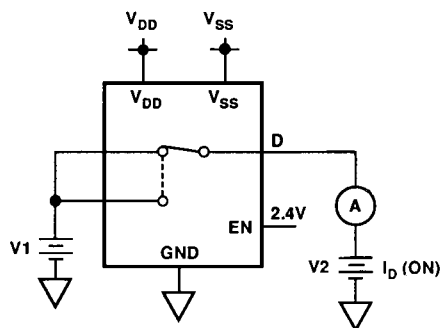
TEST CIRCUIT 2
 I_S (OFF)



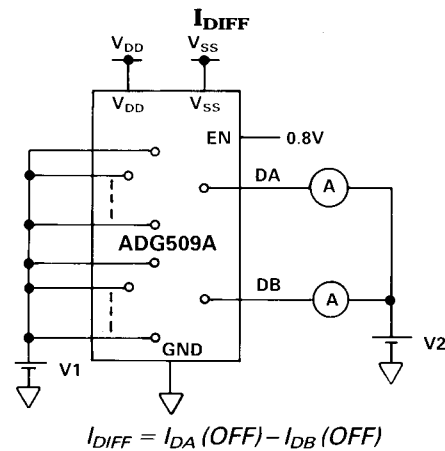
TEST CIRCUIT 3
 I_D (OFF)



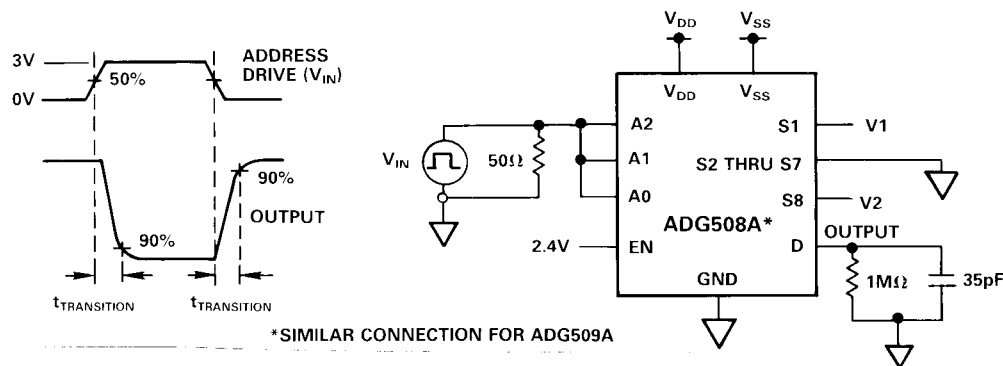
TEST CIRCUIT 4
 I_D (ON)



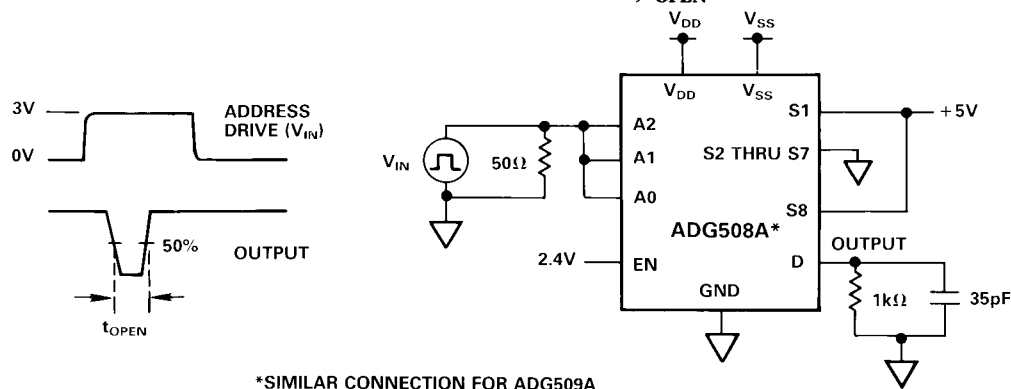
TEST CIRCUIT 5
 I_{DIFF}



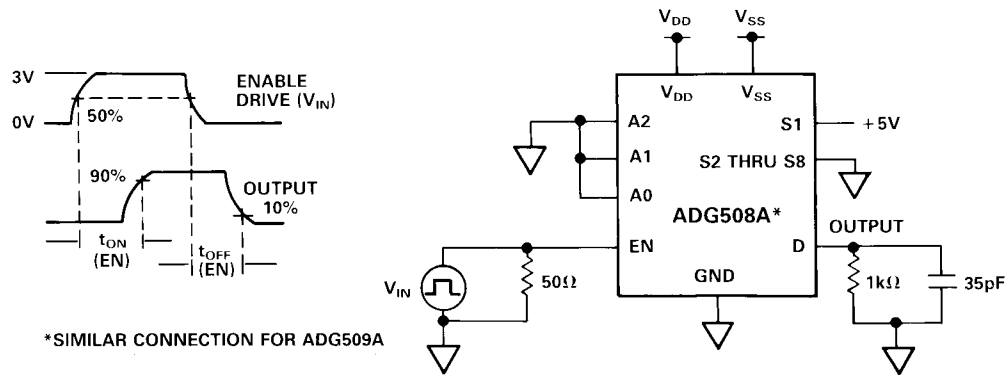
TEST CIRCUIT 6
SWITCHING TIME OF MULTIPLEXER, $t_{TRANSITION}$



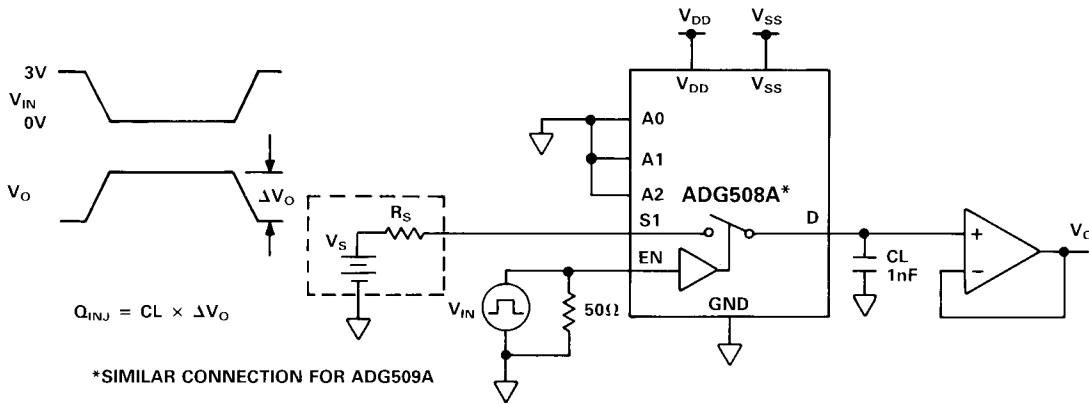
TEST CIRCUIT 7
BREAK-BEFORE-MAKE DELAY, t_{OPEN}



TEST CIRCUIT 8 ENABLE DELAY, $t_{ON}(EN)$, $t_{OFF}(EN)$



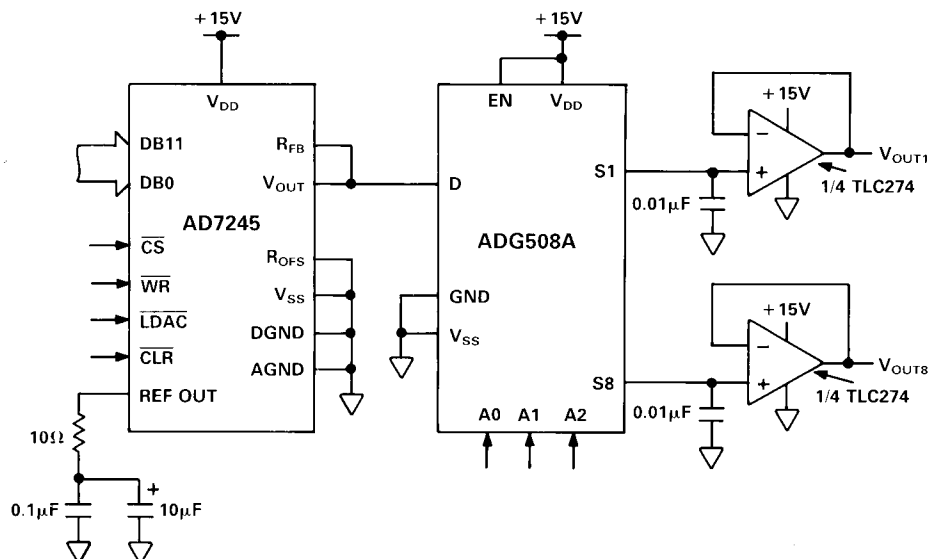
TEST CIRCUIT 9 CHARGE INJECTION



SINGLE SUPPLY OCTAL DAC APPLICATION

The following circuit shows the ADG508A connected as a demultiplexer to provide eight separate digitally programmable voltages (0 to +10V) from the AD7245. The AD7245 is a complete 12-bit, voltage output DAC with output amplifier and Zener

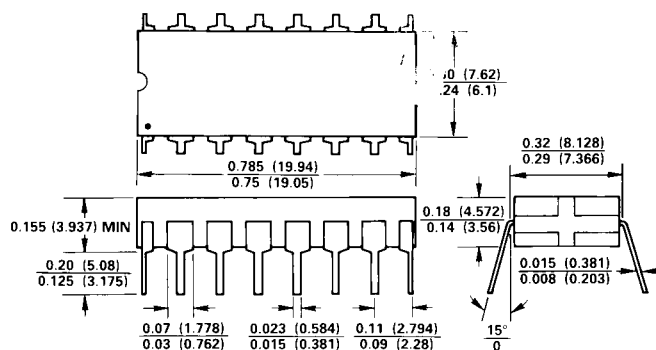
voltage reference on a monolithic CMOS chip. The entire system operates from a single +15V power supply. The ADG508A is ideally suited for the application because it has both low charge injection and I_S (OFF) leakage current.



ADG508A in a Single-Supply Octal DAC Circuit

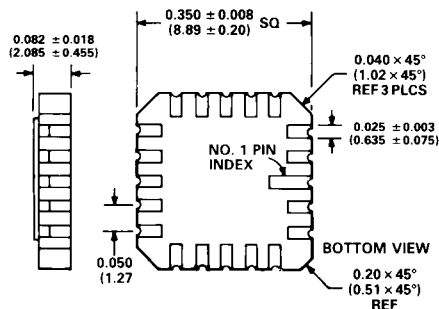
Dimensions shown in inches and (mm).

16-Pin Cerdip (Q-16)



NOTES:
LEAD NO. 1 IDENTIFIED BY DOT OR NOTCH.
LEADS ARE SOLDER OF TIN-PLATED KOVAR OR ALLOY 42

20-Terminal Leadless Ceramic Chip Carrier (E-20A)



(P-20A)

