19-0028; Rev 3; 9/01

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 DG509A 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 ±4.5V to ±18V.

The DG508A/DG509A are plug-in upgrades for the industry-standard DG08A/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

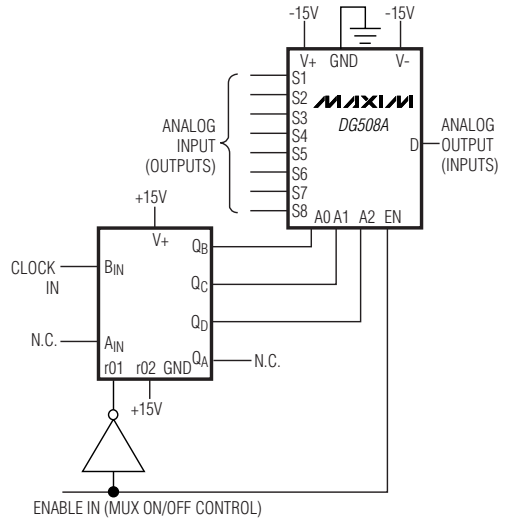
Data Logging Systems

Aircraft Heads-Up Displays

Data-Acquisition Systems

Signal Routing

Typical Operating Circuits



8-CHANNEL SEQUENTIAL MUX/DEMUX

Typical Operating Circuits continued at end of data sheet.

Features

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

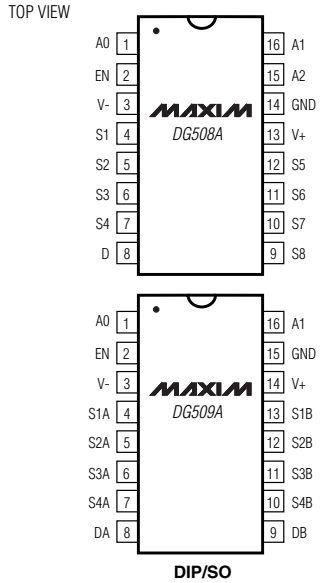
Ordering Information

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
DG508AEGE	-40°C to +85°C	16 QFN
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



DIP/SO

Pin Configurations continued at end of data sheet.

Monolithic CMOS Analog Multiplexers

ABSOLUTE MAXIMUM RATINGS

Voltage Referenced to V-
V+ .....+44V
GND ..... +25V
Digital Inputs, V_S and V_D (Note 1).....-2V to (V+ + 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_A = +70°C)
Plastic DIP (derate 10.53mW/°C above +70°C) 842mW
QFN (derate 19.2mW/°C above +70°C) 1538mW
Narrow SO (derate 8.70mWI°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/CGE .....0°C to +70°C
DG50_ABK .....-20°C to +85°C
DGS0_ADJ/DY/EWE/EGE .....-40°C to +85°C
DG50_AAK .....-55°C to +125°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

Note 1: Signals on S_, D_, or IN_ exceeding V+ or V- are 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 rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V+ = 15V, V- = -15V, GND = OV, **T_A = +25°C**, unless otherwise noted.)

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

ELECTRICAL CHARACTERISTICS (continued)

(V+ = 15V, V- = -15V, GND = OV, **T_A = +25°C**, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		DG508AA DG509AA MIN	DG508AA DG509AA TYP	DG508AA DG509AA MAX	DG508AD/E/B/C DG509AD/E/B/C MIN	DG508AD/E/B/C DG509AD/E/B/C TYP	DG508AD/E/B/C DG509AD/E/B/C MAX	UNITS
LOGIC INPUT										
Logic Input Current, Input Voltage High	I_{AH}	V_A = 24V		-10	-0.002		10	-0.002		µA
		V_A = 15V			0.006	10		0.006	10	
Logic Input Current, Input Voltage Low	I_{AL}	All V_A = 0V	V_{EN} = 2.4V	-10	-0.002		10	-0.002		µA
			V_{EN} = 0V	-10	-0.002		-10	-0.002		
DYNAMIC										
Multiplexer Switching Time	$t_{transition}$	Figure 1			0.6	1. 0		0.6	1. 0	µs
Break-Before-Make Interval	t_{OPEN}	Figure 3			0.2			0.2		µs
Enable Turn-On Time	$t_{ON(EN)}$	Figure 2			0.4	1.0		0.4	1.5	µs
Enable Turn-Off Time	$t_{OFF(EN)}$	Figure 2			0.2	0.7		0.2	1.0	µs
Off-Isolation	OIRR	V_{EN} = 0V, R_L = 1kΩ, C_L = l5pF, V_S = 7V_{RMS} f = 500kHz (Note 3)			68			68		dB
Source Off-Capacitance	$C_{S(OFF)}$	V_S = 0V, V_{EN} = 0V, f = 140kHz			5			5		pF
Drain Off-Capacitance	IDG508A	$C_{D(OFF)}$	V_S = 0V, V_{EN} = 0V, f = 140kHz		25			25		pF
	DGS09A				12			12		
SUPPLY										
Positive Supply Current	I+	V_{EN} = 2.4V, all V_A = 0V or 2.4V			0.02	0.2		0.02	0.2	mA
Negative Supply Current	I-	V_{EN} = 2.4V, all V_A = 0V or 2.4V		-0.1	-0.01		-0.1	-0.01		mA
Positive Supply Current in Standby	I+	V_{EN} = 0V, all V_A = 0V or 2.4V			0.02	0.2		0.02	0.2	mA
Negative Supply Current in Standby	I-	V_{EN} = 0V, all V_A = 0V or 2.4V		-0.1	-0.01		-0.1	-0.01		mA
Power-Supply Range for Continuous Operation	V-, V+	(Notes 4, 5)		±4.5		±18.0	±4.5		±18.0	V

ELECTRICAL CHARACTERISTICS

(V+ = 15V, GND = 0V, **$T_A = T_{MIN}$ to T_{MAX}**, unless otherwise noted.)

PARAMETER		SYMBOL	CONDITIONS		DG508AA DG509AA MIN	DG508AA DG509AA TYP	DG508AA DG509AA MAX	DG508AD/E/B/C DG509AD/E/B/C MIN	DG508AD/E/B/C DG509AD/E/B/C TYP	DG508AD/E/B/C DG509AD/E/B/C MAX	UNITS
SWITCH											
Analog Signal Range		V_{ANALOG}			-15		+15	-15		+15	V
Drain-Source On-Resistance		$R_{DS(ON)}$	Sequence each switch on, V_{AL} = 0.8V, V_{AH} = 2.4V	V_D = 10V, I_S = -200µA		400			450		Ω
				V_D = 10V, I_S = -200µA		400			450		
Source Off-Leakage Current		$I_{S(OFF)}$	V_{EN} = 0V	V_S = 10V, V_D = -10V			+50			+50	nA
				V_S = -10V, V_D = -10V	-50			-50			
Drain Off-Leakage Current	DG508A	$I_{D(OFF)}$	V_{EN} = 0V	V_D = 10V, V_S = -10V			+200			+100	nA
				V_D = -10V, V_S = -10V	-200			-200			
	DG509A			V_D = 10V, V_S = -10V			+200			+100	
				V_D = -10V, V_S = -10V	-100			-100			
Drain On-Leakage Current	DG508A	$I_{D(ON)}$	Sequence each switch on, V_{AL} = 0.8V, V_{AH} = 2.4V (Note 2)	$V_{S(all)}$ = V_D = 10V			+200			+100	nA
				$V_{S(all)}$ = V_D = -10V	-200			-100			
	DG509A			$V_{S(all)}$ = V_D = 10V			+100			+100	
				$V_{S(all)}$ = V_D = -10V	-100			-100			
LOGIC INPUT											
Logic Input Current, Input Voltage High		I_{AH}	V_A = 2.4V		-30			-30			µA
			V_A = 15V				+30			+30	
Logic Input Current, Input Voltage Low		I_{AL}	All V_A = 0V	V_{EN} = 2.4V	-30			-30			µA
				V_{EN} = 0V	-30			-30			

Note 2: $I_{D(ON)}$ is leakage from driver into on switch.

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

V_S = input to off switch,
V_D = output due to V_S.

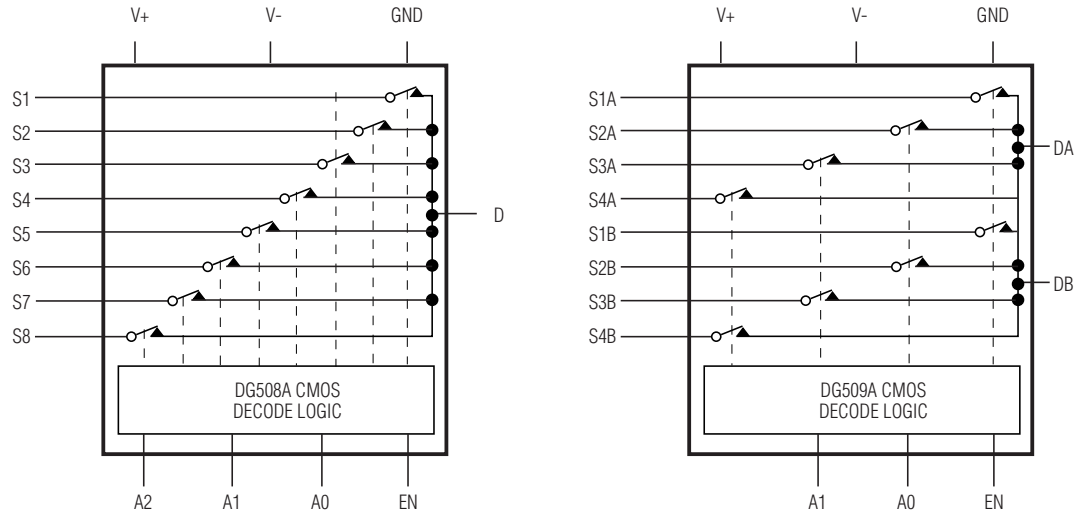
Note 4: Electrical characteristics (such as on-resistance) change when power supplies other than ±15V are used.

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.

Pin Description

PIN				NAME	FUNCTION
DG508A		DG509A			
DIP/SO	QFN	DIP/SO	QFN		
1, 15, 16	15, 14, 13	—	—	A0, A2, A1	Address Input
—	—	1, 16	15, 14	A0, A1	Address Input
2	16	2	16	EN	Enable
3	1	3	1	V-	Negative-Supply Voltage Input
4–7	2–5	—	—	S1–S4	Analog Inputs, Bidirectional
—	—	4–7	2–5	S1A–S4A	Analog Inputs, Bidirectional
8	6	—	—	D	Analog Outputs, Bidirectional
—	—	8, 9	6, 7	DA, DB	Analog Outputs, Bidirectional
9–12	7–10	—	—	S8–S5	Analog Inputs, Bidirectional
—	—	10–13	8–11	S4B–S1B	Analog Inputs, Bidirectional
13	11	14	12	V+	Positive-Supply Voltage Input
14	12	15	13	GND	Ground

Functional Diagrams



DG508A
8-CHANNEL SINGLE ENDED MULTIPLEXER

DG509A
DIFFERENTIAL 4-CHANNEL MULTIPLEXER

Monolithic CMOS Analog Multiplexers

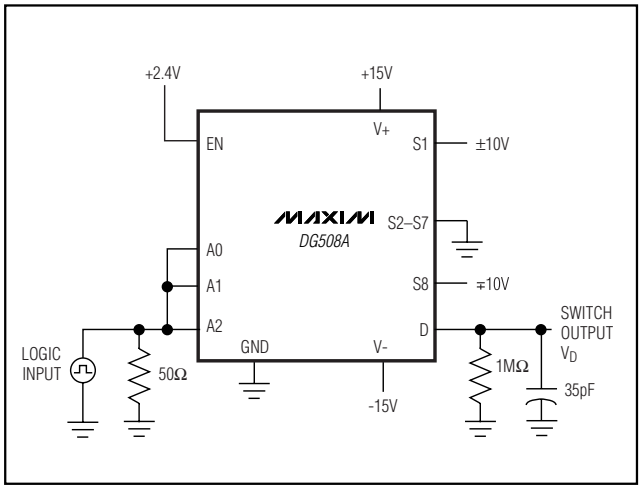


Figure 1a. Switching-Time Test Circuit

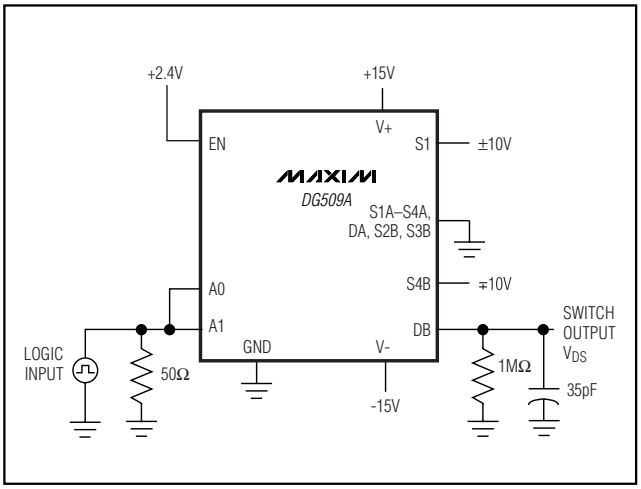


Figure 1b. Switching-Time Test Circuit

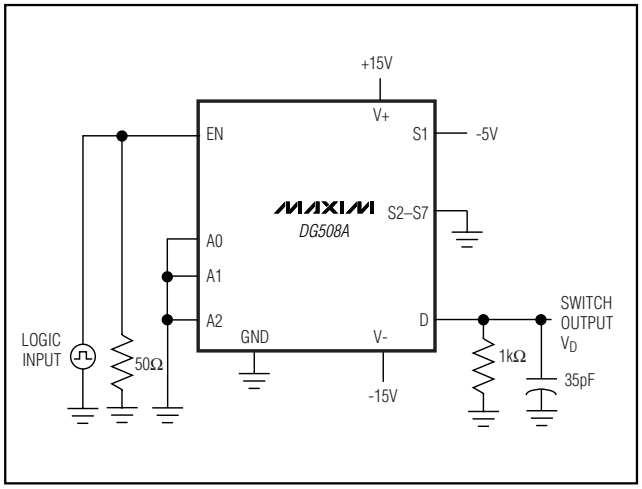


Figure 2a. DG509A Enable-Time Test Circuit

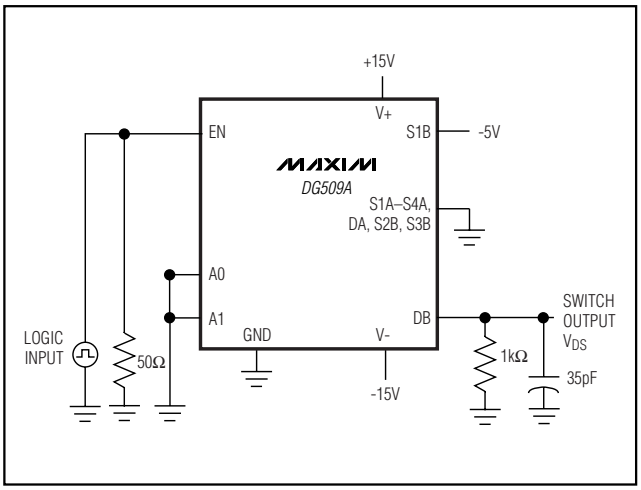


Figure 2b. DG509A Enable-Time Test Circuit

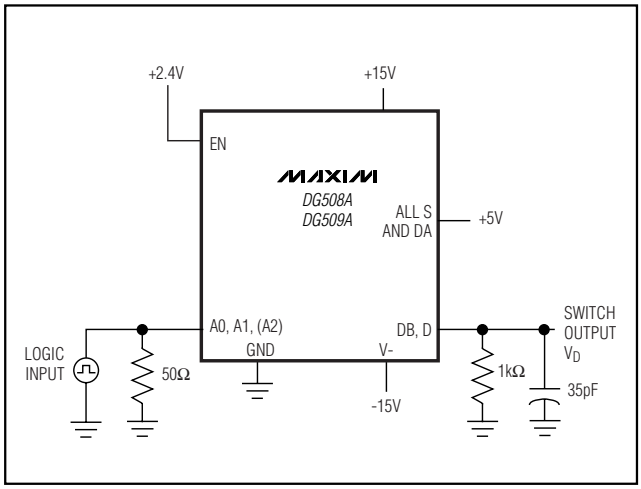


Figure 3. Break-Before-Make Test Circuit

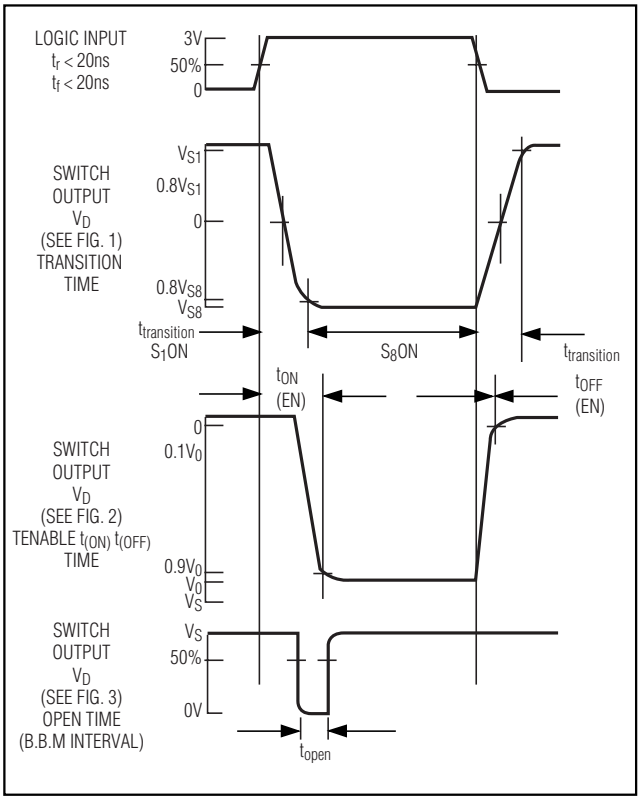


Figure 4. Timing Diagram for Figures 1, 2, and 3

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.

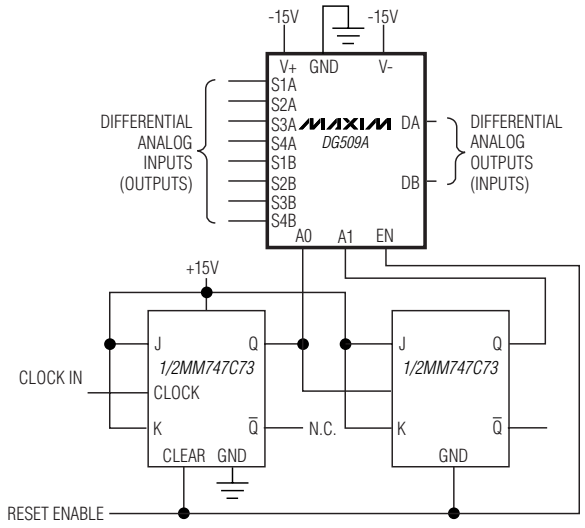
Table 1 b. DG509A Truth Table

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)



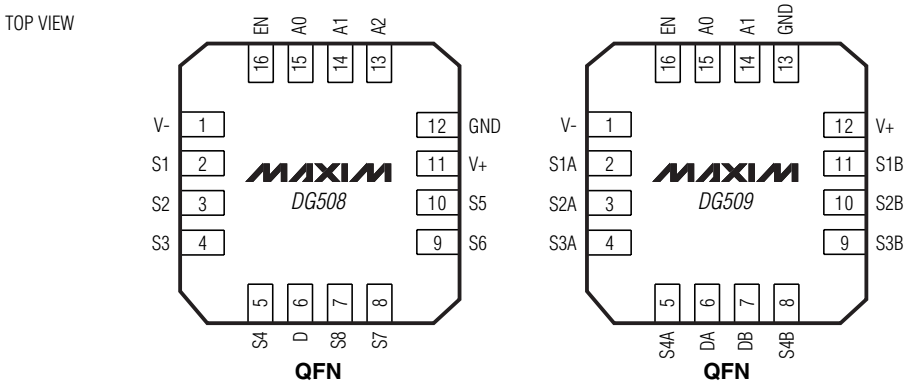
DIFFERENTIAL 4-CHANNEL SEQUENTIAL MUX/DEMUX

Ordering Information (continued)

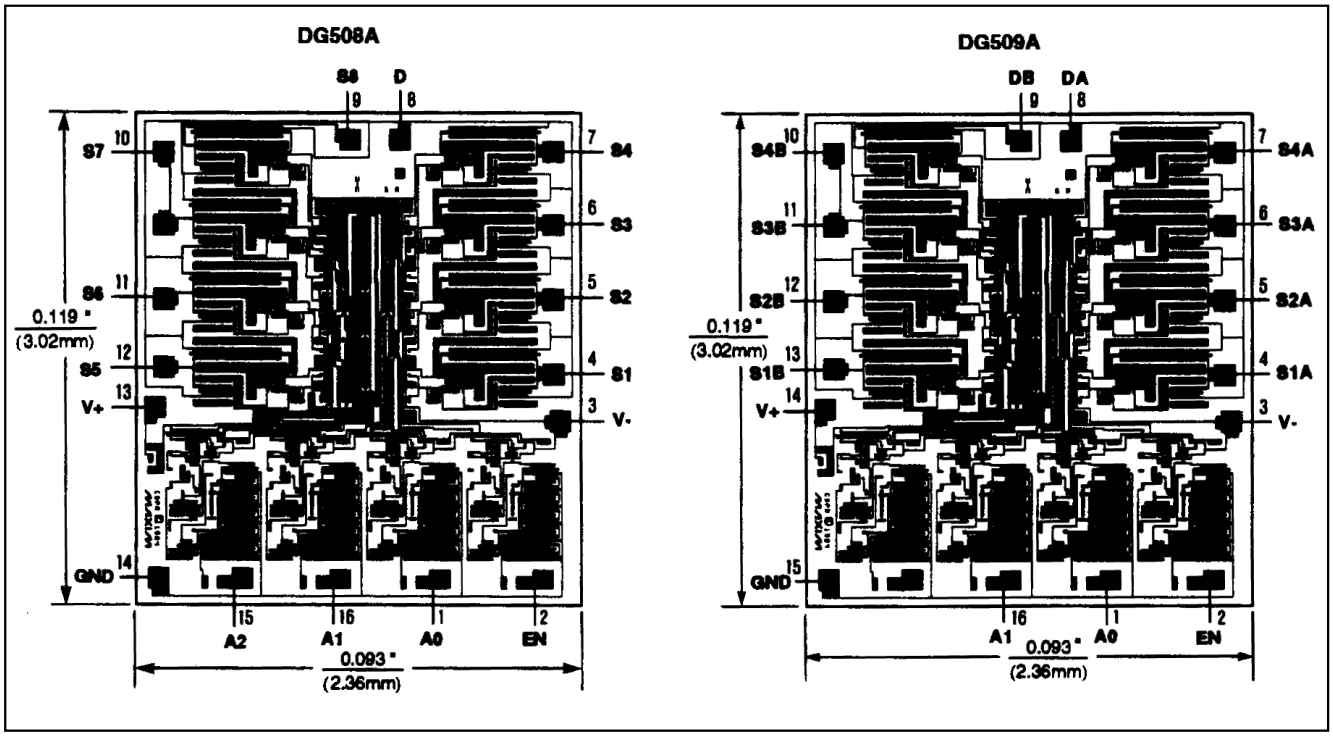
PART	TEMP RANGE	PIN-PACKAGE
DG509ACJ	0°C to +70°C	16 Plastic DIP
DG509ACWE	0°C to +70°C	16 Wide SO
DG509AC/D	0°C to +70°C	Dice*
DG509ABK	-20°C to +85°C	16 CERDIP
DG509ADJ	-40°C to +85°C	16 Plastic DIP
DG509ADY	-40°C to +85°C	16 Narrow SO
DG509AEGE	-40°C to +85°C	16 QFN
DG509AEWE	-40°C to +85°C	16 Wide SO
DG509AAK	-55°C to +125°C	16 CERDIP

**Contact factory for dice specifications.*

Pin Configurations (continued)



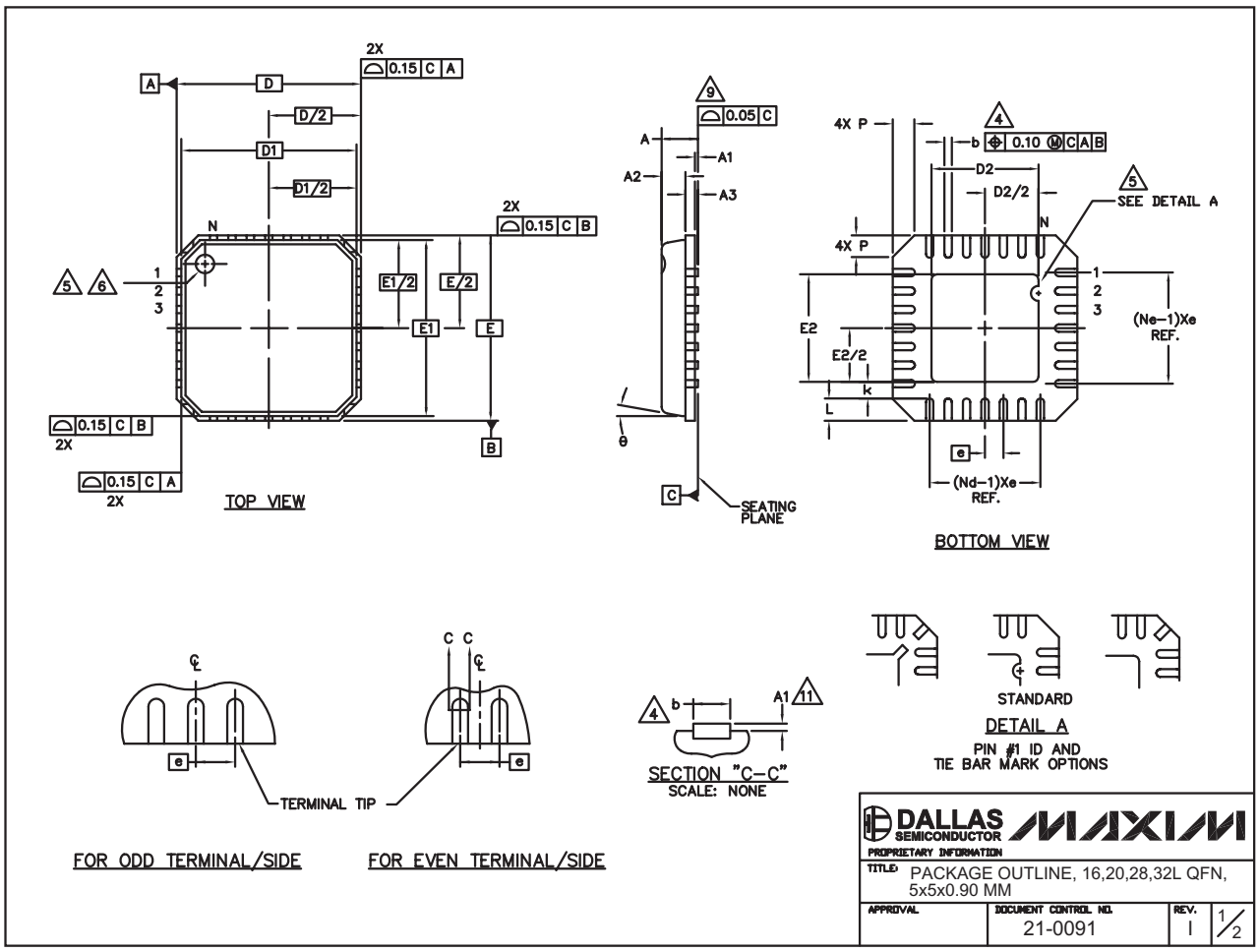
Chip Topographies



Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to **www.maxim-ic.com/packages**.)

32L QFN.EPS



Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to **www.maxim-ic.com/packages**.)

COMMON DIMENSIONS												
PKG	16L 5x5			20L 5x5			28L 5x5			32L 5x5		
SYMBOL	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.80	0.90	1.00	0.80	0.90	1.00	0.80	0.90	1.00	0.80	0.90	1.00
A1	0.00	0.01	0.05	0.00	0.01	0.05	0.00	0.01	0.05	0.00	0.01	0.05
A2	0.00	0.65	1.00	0.00	0.65	1.00	0.00	0.65	1.00	0.00	0.65	1.00
A3	0.20 REF			0.20 REF			0.20 REF			0.20 REF		
b	0.28	0.33	0.40	0.23	0.28	0.35	0.18	0.23	0.30	0.18	0.23	0.30
D	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10
D1	4.75 BSC			4.75 BSC			4.75 BSC			4.75 BSC		
E	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10
E1	4.75 BSC			4.75 BSC			4.75 BSC			4.75 BSC		
e	0.80 BSC			0.65 BSC			0.50 BSC			0.50 BSC		
k	0.25	–	–	0.25	–	–	0.25	–	–	0.25	–	–
L	0.35	0.55	0.75	0.35	0.55	0.75	0.35	0.55	0.75	0.30	0.40	0.50
N	16			20			28			32		
ND	4			5			7			8		
NE	4			5			7			8		
P	0.00	0.42	0.60	0.00	0.42	0.60	0.00	0.42	0.60	0.00	0.42	0.60
θ	0°		12°	0°		12°	0°		12°	0°		12°

EXPOSED PAD VARIATIONS						
PKG. CODES	D2			E2		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
G1655-3	2.95	3.10	3.25	2.95	3.10	3.25
G2055-1	2.55	2.70	2.85	2.55	2.70	2.85
G2055-2	2.95	3.10	3.25	2.95	3.10	3.25
G2855-1	2.55	2.70	2.85	2.55	2.70	2.85
G2855-2	2.95	3.10	3.25	2.95	3.10	3.25
G3255-1	2.95	3.10	3.25	2.95	3.10	3.25

NOTES:

1. DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM)
2. DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. – 1994.
3. N IS THE NUMBER OF TERMINALS.
   Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION & Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
5. THE PIN #1 IDENTIFIER MUST BE EXISTED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR INK/LASER MARKED. DETAILS OF PIN #1 IDENTIFIER IS OPTIONAL, BUT MUST BE LOCATED WITHIN ZONE INDICATED.
6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
7. ALL DIMENSIONS ARE IN MILLIMETERS.
8. PACKAGE WARPAGE MAX 0.05mm.
9. APPLIED FOR EXPOSED PAD AND TERMINALS. EXCLUDE EMBEDDED PART OF EXPOSED PAD FROM MEASURING.
10. MEETS JEDEC MO220; EXCEPT DIMENSION "b".
11. APPLIED FOR EXPOSED PAD AND TERMINALS. EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
12. THIS PACKAGE OUTLINE APPLIES TO ANVIL SINGULATION (STEPPED SIDES).

DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE, 16,20,28,32L QFN, 5x5x0.90 MM			
APPROVAL	DOCUMENT CONTROL NO. 21-0091	REV. I	2/2