19-4729; Rev. 0; 12/91

MAXIM

16-Channel/Dual 8-Channel High Performance CMOS Analog Multiplexers

General Description

The DG406/DG407 are monolithic CMOS analog multiplexers (muxes). The DG406 is a single-ended 1-of-16 device, and the DG407 is a differential 2-of-8 device. Both are pin and functionally compatible with the industry-standard DG506A/DG507A.

The DG406/DG407 are fabricated with Maxim's new improved silicon gate process. Both parts offer low on resistance (100Ω max), improved leakage over temperature, low power consumption (I_{SUPPLY} = 75µA max) and fast switching speeds (t_{TRANS} = 250ns max). The 44V maximum breakdown voltage allows switch-off blocking capability rail-to-rail.

These muxes can be used with a single positive supply (+12V to +30V) or split supplies (±4.5V to ±20V) while retaining CMOS logic input compatibility. CMOS inputs provide reduced input loading.

Applications

Sample-and-Hold Circuits

Test Equipment

Winchester Disk Drives

Heads-Up Displays

Guidance and Control Systems

Military Radios

Communications Systems

Battery-Operated Systems

PBX, PABX

Features

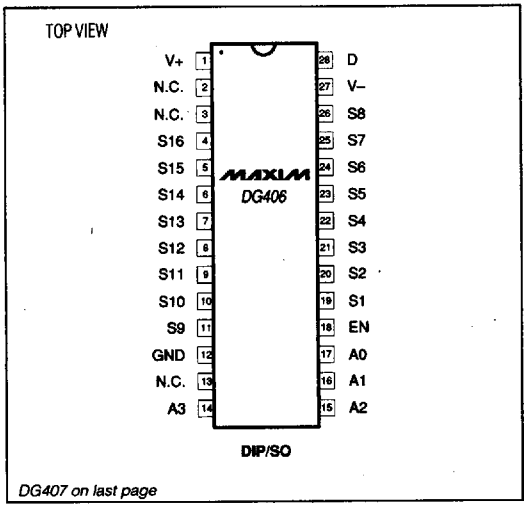
- ◆ $r_{DS(ON)}$: 100Ω Max, $\Delta r_{DS(ON)}$: 15Ω Max T-51-12
- ◆ t_{TRANS}: 250ns Max
- ◆ Leakage - $T_A = T_{MIN}$ to T_{MAX}
  $I_{S(OFF)}$: 50nA Max
  $I_{D(OFF)}$: 100nA Max (DG407), 200nA Max (DG406)
  $I_{(ON)}$: 100nA Max (DG407), 200nA Max (DG406)
- ◆ Q: 20pC Typ
- ◆ I_{SUPPLY}: 75µA Max
- ◆ Single- or Bipolar-Supply Operation
- ◆ TTL/CMOS Logic Compatible

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
DG406C/D	0°C to +70°C	Dice*
DG406DJ	-40°C to +85°C	28 Plastic DIP
DG406DN	-40°C to +85°C	28 PLCC
DG406DK	-40°C to +85°C	28 CERDIP
DG406AK	-55°C to +125°C	28 CERDIP**
DG407C/D	0°C to +70°C	Dice*
DG407DJ	-40°C to +85°C	28 Plastic DIP
DG407DN	-40°C to +85°C	28 PLCC
DG407DK	-40°C to +85°C	28 CERDIP
DG407AK	-55°C to +125°C	28 CERDIP**

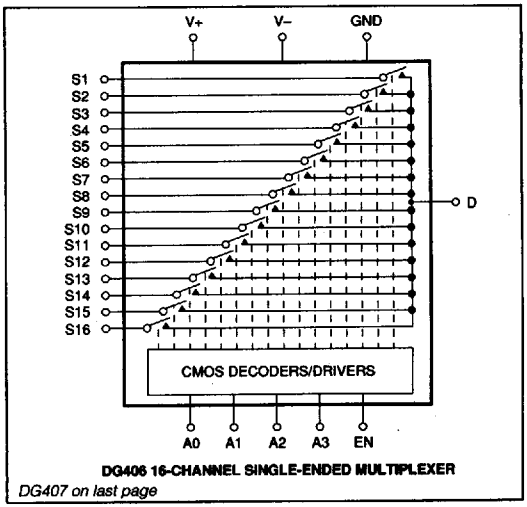
* *Contact factory for dice specifications.*
** *Contact factory for availability and processing to MIL-STD-883.*

Pin Configurations



DG407 on last page

Functional Diagrams



DG406 16-CHANNEL SINGLE-ENDED MULTIPLEXER

DG407 on last page

16-Channel/Dual 8-Channel High Performance CMOS Analog Multiplexers

ABSOLUTE MAXIMUM RATINGS

Voltage Referenced to V-
V+ 44V
GND 25V
Digital Inputs V_S, V_D (Note 1) ..... V- -2V to V+ +2V or 30mA (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) (Note 2)
28-Pin Plastic DIP (derate 9.09mW/°C above +70°C) ..727mW
28-Pin PLCC (derate 10.53mW/°C above +70°C) 842mW
28-Pin CERDIP (derate 16.67mW/°C above +70°C) ..1333mW
Operating Temperature Ranges:
DG406/407C/D ..... 0°C to +70°C
DG406/407D_ ..... -40°C to +85°C
DG406/407AK ..... -55°C to +125°C
Storage Temperature Range ..... -65°C to +150°C
Lead Temperature (soldering, 10 sec) ..... +300°C

Note 1: Signals on Sx, Dx, or INx exceeding V+ or V- are clamped by internal diodes. Limit forward current to maximum current ratings.
Note 2: All leads are soldered or welded to PC board.

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 (Dual Supplies)

(V+ = 15V, V- = -15V, GND = 0V, V_{AH} = +2.4V, V_{AL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS			MIN	TYP (Note 3)	MAX	UNITS
SWITCH								
Analog Signal Range	V_{ANALOG}	(Note 4)			-15		15	V
Drain-Source On Resistance	$r_{DS(ON)}$	I_S = -10mA, V_D = ±10V		T_A = +25°C		50	100	Ω
				T_A = T_{MIN} to T_{MAX}			125	
$r_{DS(ON)}$ Matching Between Channels	$\Delta r_{DS(ON)}$	V_D = ±10V (Note 5)		T_A = +25°C			15	Ω
Source-Off Leakage Current	$I_{S(OFF)}$	V_D = ±10V, V_S = ∓10V, V_{EN} = 0V		T_A = +25°C	-0.5		0.5	nA
				T_A = T_{MIN} to T_{MAX}	-50		50	
Drain-Off Leakage Current	$I_{D(OFF)}$	V_S = ±10V, V_D = ∓10V, V_{EN} = 0V	DG406	T_A = +25°C	-2		2	nA
				T_A = T_{MIN} to T_{MAX}	-200		200	
			DG407	T_A = +25°C	-2		2	nA
				T_A = T_{MIN} to T_{MAX}	-100		100	
Drain-On Leakage Current	$I_{D(ON)}$ + $I_{S(ON)}$	V_D = ±10V, V_S = ±10V, sequence each switch on	DG406	T_A = +25°C	-2		2	nA
				T_A = T_{MIN} to T_{MAX}	-200		200	
			DG407	T_A = +25°C	-2		2	nA
				T_A = T_{MIN} to T_{MAX}	-100		100	

16-Channel/Dual 8-Channel High Performance CMOS Analog Multiplexers

ELECTRICAL CHARACTERISTICS (continued)

(V+ = 15V, V- = -15V, GND = 0V, V_{AH} = +2.4V, V_{AL} = +0.8V, $T_A = T_{MIN}$ to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS			MIN	TYP	MAX (Note 3)	UNITS
INPUT								
Input Current with Input Voltage High	I_{AH}	V_A = 2.4V, 15V				–10	10	µA
Input Current with Input Voltage Low	I_{AL}	V_{EN} = 0V, 2.4V, V_A = 0V				–10	10	µA
SUPPLY								
Power-Supply Range					±4.5		±20	V
Positive Supply Current	I+	$V_{EN} = V_A$ = 0V					75	µA
Negative Supply Current	I–	$V_{EN} = V_A$ = 0V				–75		µA
Positive Supply Current	I+	V_{EN} = 2.4V, V_A = 0V		T_A = +25°C			0.5	mA
				$T_A = T_{MIN}$ to T_{MAX}			2	
Negative Supply Current	I–	V_{EN} = 2.4V, V_A = 0V				–500		µA
DYNAMIC								
Transition Time	t_{TRANS}	Figure 1		T_A = +25°C			250	ns
Break-Before-Make Interval	t_{OPEN}	Figure 2		T_A = +25°C	10			ns
Enable Turn-On Time	$t_{ON(EN)}$	Figure 3		T_A = +25°C			200	ns
Enable Turn-Off Time	$t_{OFF(EN)}$	Figure 3		T_A = +25°C			150	ns
Charge Injection	Q	C_L = 1nF, V_S = 0V, R_S = 0Ω		T_A = +25°C		20		pC
Off Isolation (Note 6)		V_{EN} = 0V, R_L = 1kΩ, f = 100kHz		T_A = +25°C		–65		dB
Logic Input Capacitance	C_{IN}	f = 1MHz		T_A = +25°C		8		pF
Source-Off Capacitance	$C_{S(OFF)}$	f = 1MHz, $V_{EN} = V_S$ = 0V		T_A = +25°C		11		pF
Drain-Off Capacitance	$C_{D(OFF)}$	f = 1MHz, $V_{EN} = V_D$ = 0V	DG406	T_A = +25°C		70		pF
			DG407			35		
Channel-On Capacitance	$C_{D(ON)}$ + $C_{S(ON)}$	f = 1MHz, $V_{EN} = V_D$ = 0V	DG406	T_A = +25°C		100		pF
			DG407			50		

16-Channel/Dual 8-Channel High Performance CMOS Analog Multiplexers

ELECTRICAL CHARACTERISTICS (Single Supply)

(V+ = 12V, V- = 0V, GND = 0V, V_{AH} = +2.4V, V_{AL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS			MIN	TYP	MAX (Note 3)	UNITS
SWITCH								
Analog Signal Range	V_{ANALOG}	(Note 4)		T_A = +25°C	0		12	V
Drain-Source On Resistance	$r_{DS(ON)}$	I_S = -1mA, V_D = 3V, 10V		T_A = +25°C		90		Ω
DYNAMIC								
Transition Time	t_{TRANS}	Figure 1, V_{S1} = 8V, V_{S8} = 0V, V_{IN} = 2.4V		T_A = +25°C		300		ns
Enable Turn-On Time	$t_{ON(EN)}$	Figure 3, V_{INH} = 2.4V, V_{INL} = 0V, V_{S1} = 5V		T_A = +25°C		250		ns
Enable Turn-Off Time	$t_{OFF(EN)}$	Figure 3, V_{INH} = 2.4V, V_{INL} = 0V, V_{S1} = 5V		T_A = +25°C		150		ns
Charge Injection	Q	C_L = 1nF, V_S = 6V, R_S = 0Ω		T_A = +25°C		5		pC

Note 3: The algebraic convention, where the most negative value is a minimum and the most positive value a maximum, is used in this data sheet.

Note 4: Guaranteed by design.

Note 5: $\Delta r_{DS(ON)} = \Delta r_{DS(ON)}MAX - \Delta r_{DS(ON)}MIN$

Note 6: Worst-case isolation is on channel 4 because of its proximity to the drain pin. Off isolation = $20\log_{10} V_D/V_S$, V_D = output, V_S = input to off switch.

Truth Tables

A3	A2	A1	A0	EN	ON Switch
X	X	X	X	0	None
0	0	0	0	1	1
0	0	0	1	1	2
0	0	1	0	1	3
0	0	1	1	1	4
0	1	0	0	1	5
0	1	0	1	1	6
0	1	1	0	1	7
0	1	1	1	1	8
1	0	0	0	1	9
1	0	0	1	1	10
1	0	1	0	1	11
1	0	1	1	1	12
1	1	0	0	1	13
1	1	0	1	1	14
1	1	1	0	1	15
1	1	1	1	1	16

DG406

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

DG407

LOGIC "0" $V_{AL} \leq 0.8$ V, LOGIC "1" = $V_{AH} \geq 2.4$ V

16-Channel/Dual 8-Channel High Performance CMOS Analog Multiplexers

Test Circuits/Timing Diagrams

T-51-12

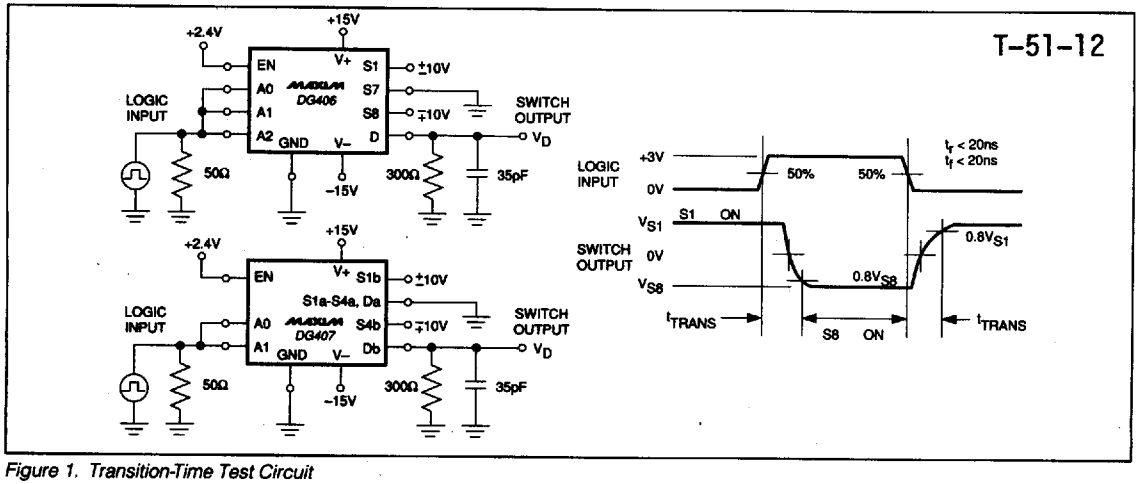


Figure 1. Transition-Time Test Circuit

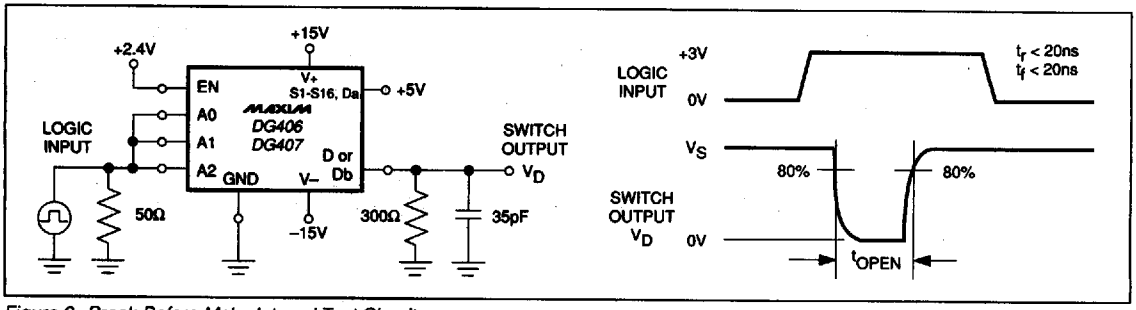


Figure 2. Break-Before-Make Interval Test Circuit

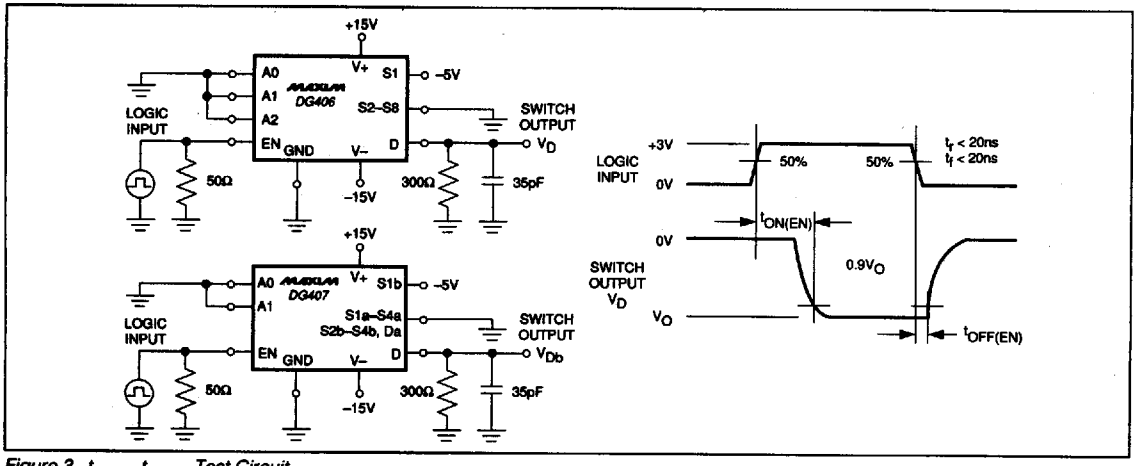
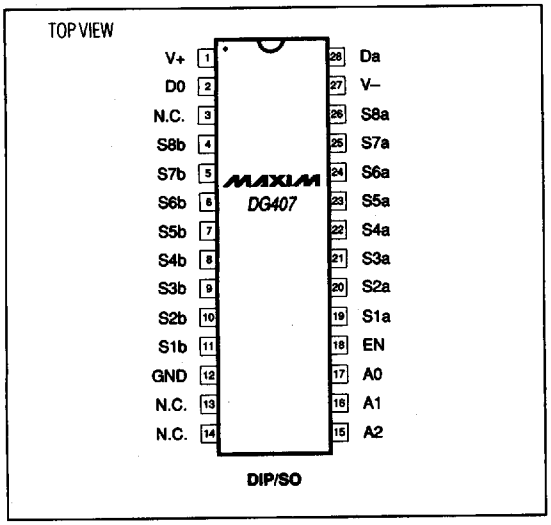


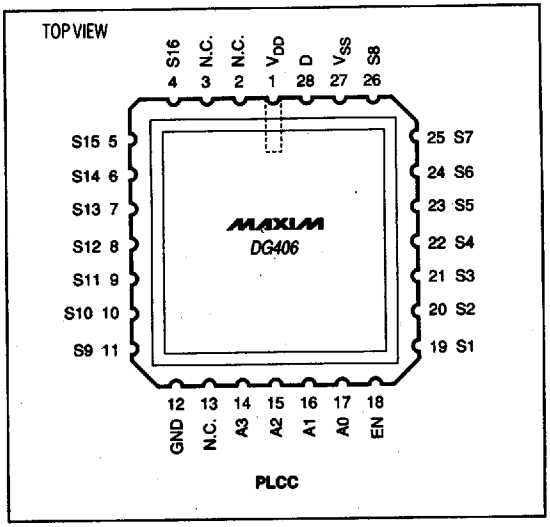
Figure 3. $t_{ON(EN)}$, $t_{OFF(EN)}$ Test Circuit

16-Channel/Dual 8-Channel High Performance CMOS Analog Multiplexers

T-51-12

Pin Configurations (continued)





Functional Diagrams (continued)