



# 16-Ch/Dual 8-Ch High-Performance CMOS Analog Multiplexers

## DESCRIPTION

The DG406B is a 16-channel single-ended analog multiplexer designed to connect one of sixteen inputs to a common output as determined by a 4-bit binary address. The DG407B selects one of eight differential inputs to a common differential output. Break-before-make switching action protects against momentary shorting of inputs.

An on channel conducts current equally well in both directions. In the off state each channel blocks voltages up to the power supply rails. An enable (EN) function allows the user to reset the multiplexer/demultiplexer to all switches off for stacking several devices. All control inputs, address (A<sub>x</sub>) and enable (EN) are TTL compatible over the full specified operating temperature range.

Applications for the DG406B, DG407B include high speed data acquisition, audio signal switching and routing, ATE systems, and avionics. High performance and low power dissipation make them ideal for battery operated and remote instrumentation applications.

Designed in the 44 V silicon-gate CMOS process, the absolute maximum voltage rating is extended to 44 V, allowing operation with ± 20 V supplies. Additionally single (12 V) supply operation is allowed. An epitaxial layer prevents latchup.

## FEATURES

- Low on-resistance - R<sub>DS(on)</sub>: 45 Ω
- Low charge injection - Q: 11 pC
- Fast transition time - t<sub>TRANS</sub>: 115 ns
- Low power: 0.2 mW
- Single supply capability
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



## Note

\* This datasheet provides information about parts that are RoHS-compliant and/or parts that are non-RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information/tables in this datasheet for details.

## BENEFITS

- Higher accuracy
- Reduced glitching
- Improved data throughput
- Reduced power consumption
- Increased ruggedness
- Wide supply ranges: ± 5 V to ± 20 V

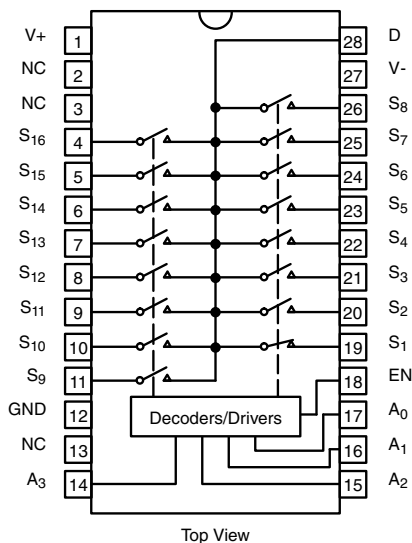
## APPLICATIONS

- Data acquisition systems
- Audio signal routing
- Medical instrumentation
- ATE systems
- Battery powered systems
- High-rel systems
- Single supply systems

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

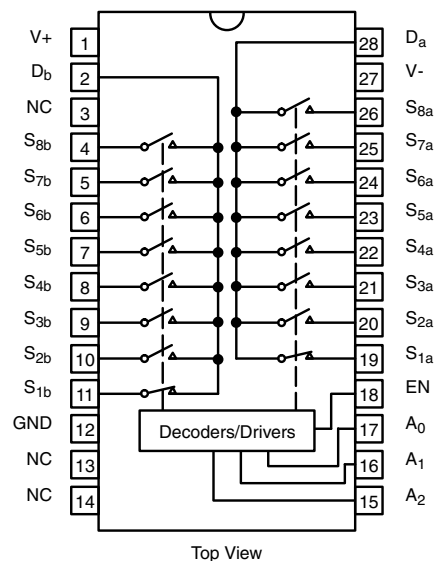
DG406B

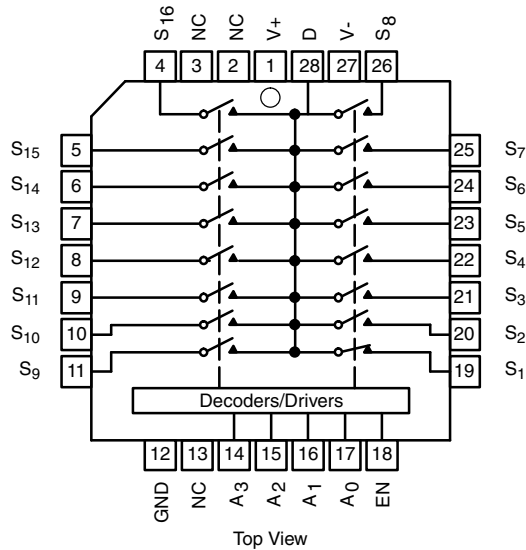
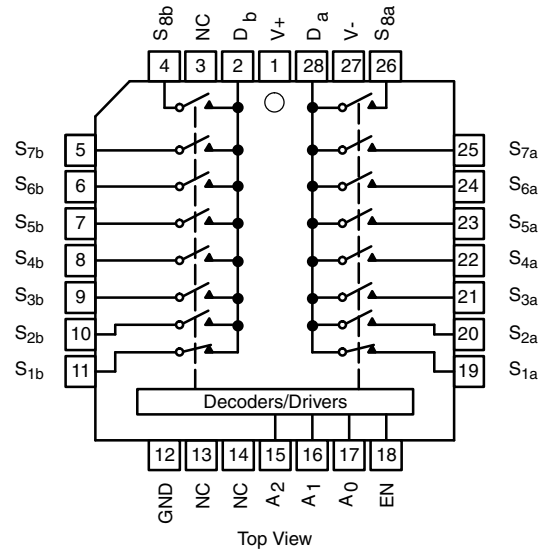
Dual-In-Line and SOIC Wide-Body



DG407B

Dual-In-Line and SOIC Wide-Body



**FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION**
**DG406B**
**PLCC and LCC**

**DG407B**
**PLCC and LCC**


TRUTH TABLE (DG406B)					
A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>	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

TRUTH TABLE (DG407B)				
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

**Notes**

- Logic "0" =  $V_{AL} \leq 0.8\text{ V}$
- Logic "1" =  $V_{AH} \geq 2.4\text{ V}$
- X = Do not care

ORDERING INFORMATION (DG406B)		
TEMP. RANGE	PACKAGE	PART NUMBER
-40 °C to 85 °C	28-Pin Plastic DIP	DG406BDJ, DG406BDJ-E3
	28-Pin PLCC	DG406BDN, DG406BDN-T1-E3
	28-Pin Widebody SOIC	DG406BDW, DG406BDW-E3, DG406BDW-T1-E3

ORDERING INFORMATION (DG407B)		
TEMP. RANGE	PACKAGE	PART NUMBER
-40 °C to 85 °C	28-Pin Plastic DIP	DG407BDJ, DG407BDJ-E3
	28-Pin PLCC	DG407BDN, DG407BDN-T1-E3
	28-Pin Widebody SOIC	DG407BDW, DG407BDW-E3, DG407BDW-T1-E3

**Note**

- -T1 indicates Tape and Reel, -E3 indicates Lead-Free and RoHS Compliant, NO -E3 indicates standard Tin/Lead finish.



ABSOLUTE MAXIMUM RATINGS			
PARAMETER		LIMIT	UNIT
Voltages Referenced to V-	V+ to V- <sup>g</sup>	44	V
	GND to V-	-25	
Digital Inputs <sup>a</sup> , V <sub>S</sub> , V <sub>D</sub>		(V-) - 2 to (V+) + 2 or 20 mA, whichever occurs first	
Current (any terminal)		30	mA
Peak Current, S or D (pulsed at 1 ms, 10 % duty cycle max.)		100	
Storage Temperature		-65 to 150	°C
Power Dissipation (Package) <sup>b</sup>	28-Pin Plastic DIP <sup>c</sup>	625	mW
	28-Pin Plastic PLCC <sup>c</sup>	450	mW
	28-Pin Widebody SOIC <sup>f</sup>	450	mW

**Notes**

- a. Signals on S<sub>X</sub>, D<sub>X</sub> or IN<sub>X</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 8.3 mW/°C above 75 °C.
- d. Derate 16 mW/°C above 75 °C.
- e. Derate 18 mW/°C above 75 °C.
- f. Derate 6 mW/°C above 75 °C.
- g. Also applies when V- = GND.

SPECIFICATIONS							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED	TEMP. <sup>b</sup>	TYP. <sup>c</sup>	D SUFFIX -40 °C to 85 °C		UNIT
					MIN. <sup>d</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> = -10 mA sequence each switch on	Room	45	-	60	Ω
			Full	45	-	74	
R <sub>DS(on)</sub> Matching Between Channels <sup>g</sup>	ΔR <sub>DS(on)</sub>	V <sub>D</sub> = ± 10 V	Room	5	-	-	%
Source Off Leakage Current	I <sub>S(off)</sub>	V <sub>S</sub> = ± 10 V, V <sub>D</sub> = ± 10 V, V <sub>EN</sub> = 0 V	Room	-	-0.5	0.5	nA
			Full	-	-5	5	
Drain Off Leakage Current	DG406B	V <sub>D</sub> = ± 10 V, V <sub>S</sub> = ± 10 V, V <sub>EN</sub> = 0 V	Room	-	-1	1	
			Full	-	-40	40	
	DG407B		Room	-	-1	1	
			Full	-	-20	20	
Drain On Leakage Current	DG406B	V <sub>S</sub> = V <sub>D</sub> = ± 10 V sequence each switch on	Room	-	-1	1	
			Full	-	-40	40	
	DG407B		Room	-	-1	1	
			Full	-	-20	20	
<b>Digital Control</b>							
Logic High Input Voltage	V <sub>INH</sub>		Full	-	2.4	-	V
Logic Low Input Voltage	V <sub>INL</sub>		Full	-	-	0.8	
Logic High Input Current	I <sub>AH</sub>	V <sub>A</sub> = 2.4 V, 15 V	Full	-	-1	1	μA
Logic Low Input Current	I <sub>AL</sub>	V <sub>EN</sub> = 0 V, 2.4 V, V <sub>A</sub> = 0 V	Full	-	-1	1	
Logic Input Capacitance	C <sub>in</sub>	f = 1 MHz	Room	6	-	-	pF



SPECIFICATIONS								
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED	TEMP. <sup>b</sup>	TYP. <sup>c</sup>	D SUFFIX -40 °C to 85 °C		UNIT	
					MIN. <sup>d</sup>	MAX. <sup>d</sup>		
<b>Dynamic Characteristics</b>								
Transition Time	t <sub>TRANS</sub>	see figure 2	Room	115	-	148	ns	
			Full	-	-	161		
Break-Before-Make Interval	t <sub>OPEN</sub>	see figure 4	Room	39	10	-		
			Full	-	21	-		
Enable Turn-On Time	t <sub>ON(EN)</sub>	see figure 3	Room	75	-	107		
			Full	-	-	123		
Enable Turn-Off Time	t <sub>OFF(EN)</sub>		Room	50	-	88		
			Full	-	-	94		
Charge Injection	Q	C <sub>L</sub> = 1 nF, V <sub>S</sub> = 0 V R <sub>S</sub> = 0 Ω	Room	11	-	-	pC	
Off Isolation <sup>h</sup>	OIRR	V <sub>EN</sub> = 0 V, R <sub>L</sub> = 50 Ω, f = 1 MHz	Room	-86	-	-	dB	
Source Off Capacitance	C <sub>S(off)</sub>	V <sub>EN</sub> = 0 V, V <sub>S</sub> = 0 V, f = 1 MHz	Room	6	-	-	pF	
Drain Off Capacitance		V <sub>EN</sub> = 0 V, V <sub>D</sub> = 0 V, f = 1 MHz	Room	108	-	-		
	DG407B		C <sub>D(off)</sub>	Room	54	-		-
Drain On Capacitance	DG406B		C <sub>D(on)</sub>	Room	114	-		-
	DG407B		C <sub>D(on)</sub>	Room	57	-		-
<b>Power Supplies</b>								
Positive Supply Current	I <sub>+</sub>	V <sub>EN</sub> = V <sub>A</sub> = 0 V or 5 V	Room	23	-	30	μA	
			Full	-	-	75		
Negative Supply Current	I <sub>-</sub>		Room	-0.02	-1	-		
			Full	-	-10	-		
Positive Supply Current	I <sub>+</sub>	V <sub>EN</sub> = 2.4 V, V <sub>A</sub> = 0 V	Room	28	-	500		
			Full	-	-	700		
Negative Supply Current	I <sub>-</sub>		Room	-0.01	-20	-		
			Full	-	-20	-		

**Notes**

- a. Guaranteed by ± 15 V leakage test, not production tested.
- 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 datasheet.
- e. Guaranteed by design, not subject to production test.
- f. V<sub>IN</sub> = input voltage to perform proper function.
- g. ΔR<sub>DS(on)</sub> = R<sub>DS(on)</sub> max. - R<sub>DS(on)</sub> min.
- h. Worst case isolation occurs on channel 4 due to proximity to the drain pin.



SPECIFICATIONS FOR SINGLE SUPPLY									
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED		TEMP. <sup>b</sup>	TYP. <sup>c</sup>	D SUFFIX -40 °C to 85 °C		UNIT	
		V <sub>+</sub> = 15 V, V <sub>-</sub> = -15 V				MIN. <sup>d</sup>	MAX. <sup>d</sup>		
		V <sub>AL</sub> = 0.8 V, V <sub>AH</sub> = 2.4 V <sup>f</sup>							
<b>Analog Switch</b>									
Analog Signal Range <sup>e</sup>	V <sub>ANALOG</sub>			Full	-	0	12	V	
Drain-Source On-Resistance	R <sub>DS(on)</sub>	V <sub>D</sub> = 3 V, I <sub>S</sub> = -1 mA sequence each switch on		Room	78	-	100	Ω	
R <sub>DS(on)</sub> Matching Between Channels <sup>g</sup>	ΔR <sub>DS(on)</sub>			Room	5	-	-	%	
Source Off Leakage Current <sup>a</sup>	I <sub>S(off)</sub>	V <sub>D</sub> = 10 V or 0.5 V, V <sub>S</sub> = 0.5 V or 10 V, V <sub>EN</sub> = 0 V		Room	-	-0.5	0.5	nA	
Drain Off Leakage Current	DG406B		I <sub>D(off)</sub>		Room	-	-1		1
	DG407B				Room	-	-1		1
Drain On Leakage Current	DG406B		I <sub>D(on)</sub>		Room	-	-1		1
	DG407B			Room	-	-1	1		
<b>Dynamic Characteristics</b>									
Transition Time	t <sub>TRANS</sub>	V <sub>S1</sub> = 8 V, V <sub>S8</sub> = 0 V, V <sub>IN</sub> = 2.4 V		Room	130	-	163	ns	
Enable Turn-On Time	t <sub>ON(EN)</sub>	V <sub>INH</sub> = 2.4 V, V <sub>INL</sub> = 0 V, V <sub>IN</sub> = 5 V		Room	93	-	125		
Enable Turn-Off Time	t <sub>OFF(EN)</sub>			Room	63	-	94		
Charge Injection	Q	C <sub>L</sub> = 1 nF, V <sub>S</sub> = 6 V R <sub>S</sub> = 0 Ω		Room	9	-	-	pC	
<b>Power Supplies</b>									
Positive Supply Current	I <sub>+</sub>	V <sub>EN</sub> = 0 V or 5 V V <sub>A</sub> = 0 V or 5 V		Room	13	-	30	μA	
				Full	-	-	75		
Positive Supply Current	I <sub>+</sub>			Room	-0.01	-20	-		
				Full	-	-20	-		

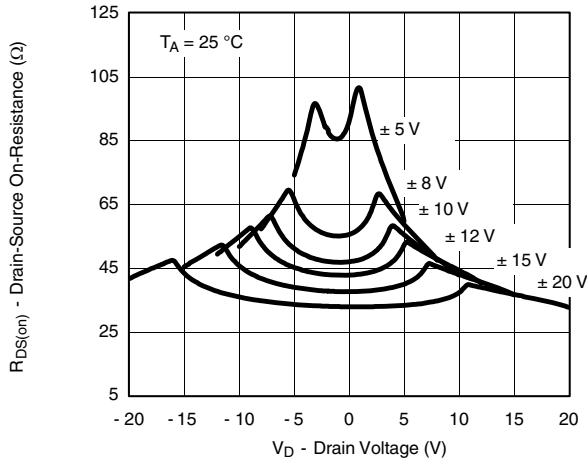
**Notes**

- a. Guaranteed by ± 15 V leakage test, not production tested.
- 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.
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- e. Guaranteed by design, not subject to production test.
- f. V<sub>IN</sub> = input voltage to perform proper function.
- g. ΔR<sub>DS(on)</sub> = R<sub>DS(on)</sub> max. - R<sub>DS(on)</sub> min.
- h. Worst case isolation occurs on channel 4 due to proximity to the drain pin.

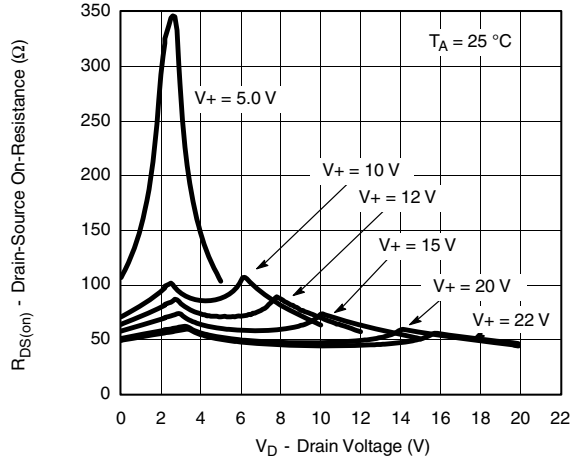
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.



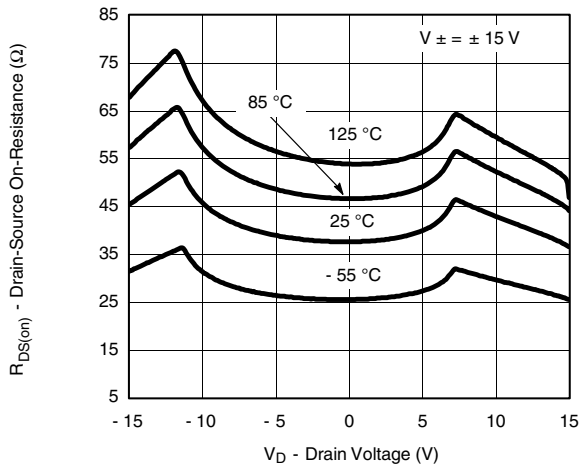
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



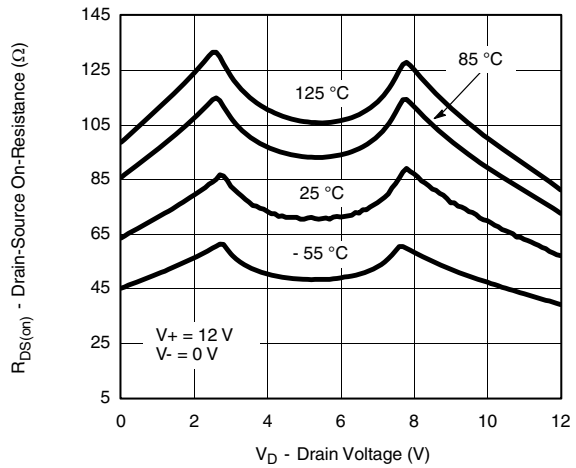
On-Resistance vs.  $V_D$  and Dual Supply Voltage



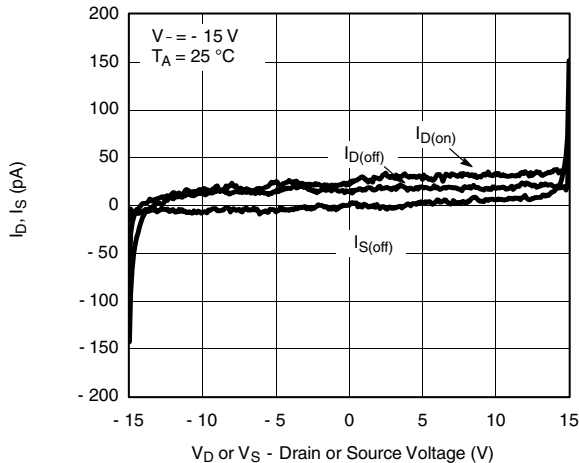
On-Resistance vs.  $V_D$  and Unipolar Supply Voltage



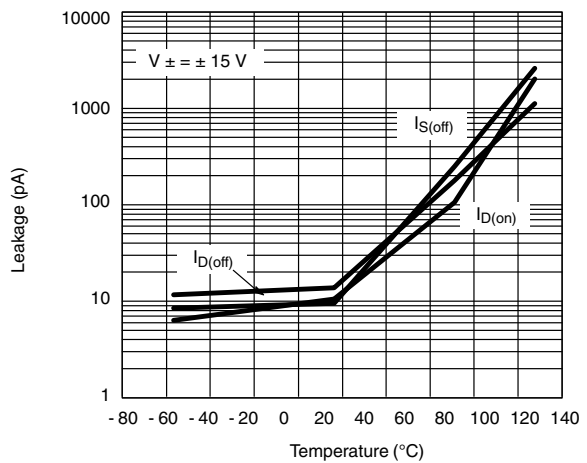
On-Resistance vs.  $V_D$  and Temperature



On-Resistance vs.  $V_D$  and Temperature



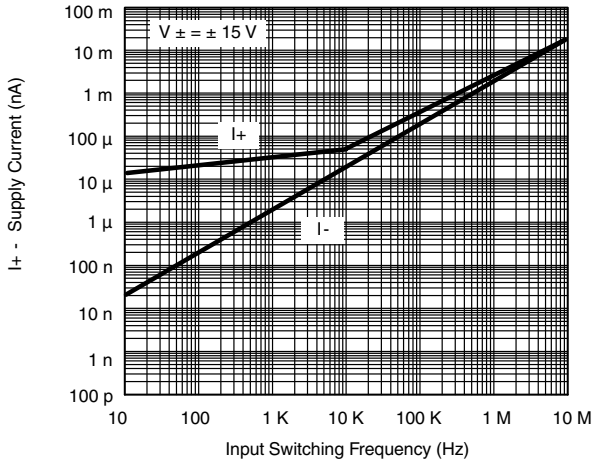
Leakage vs. Analog Voltage



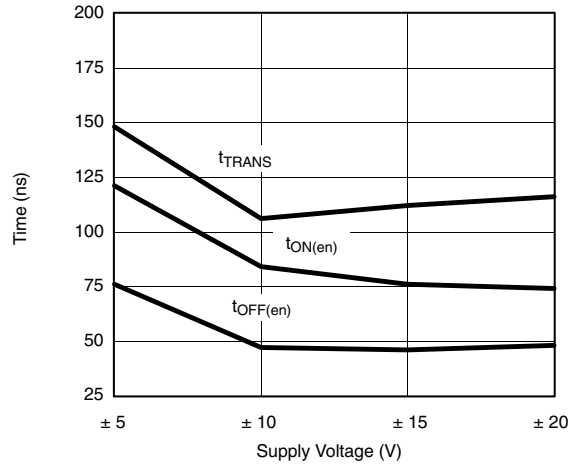
Leakage vs. Current



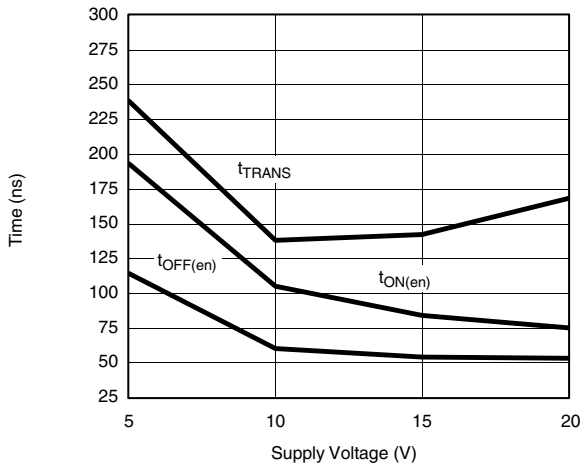
TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, unless otherwise noted)



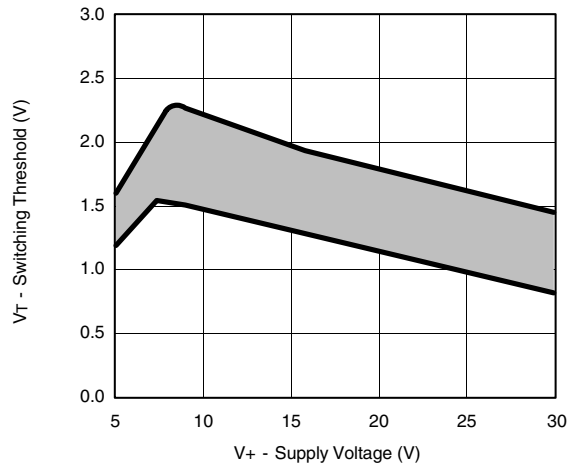
Supply Current vs. Input Switching Frequency



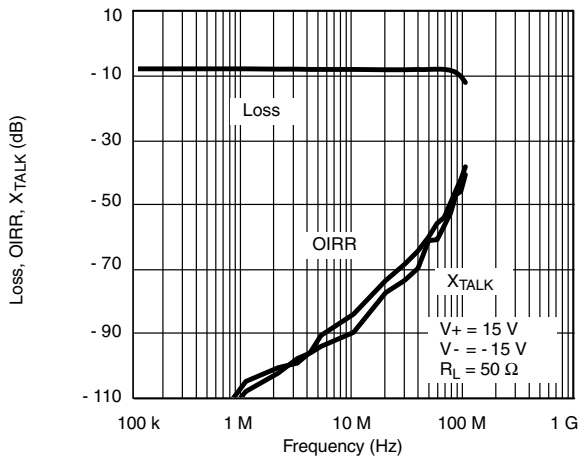
Switching Time vs. Bipolar Supplies



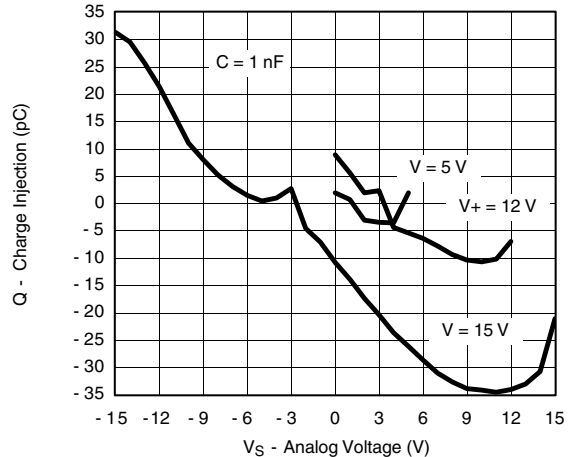
Switching Time vs. Single Supplies



Switching Threshold vs. Supply Voltage

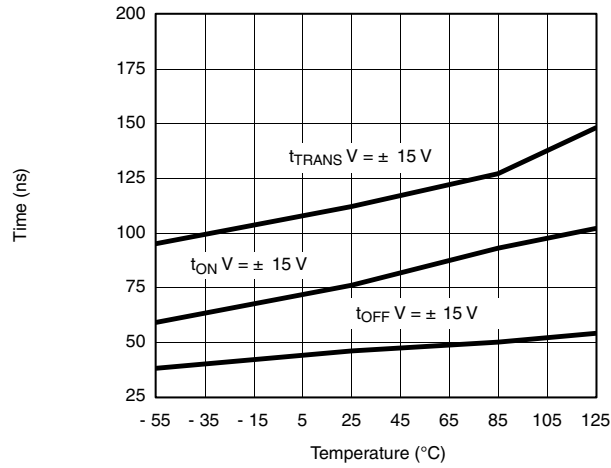


Insertion Loss, Off -Isolation Crosstalk vs. Frequency



Charge Injection vs. Analog Voltage

**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



Switching Time vs. Temperature

**SCHEMATIC DIAGRAM** (Typical Channel)

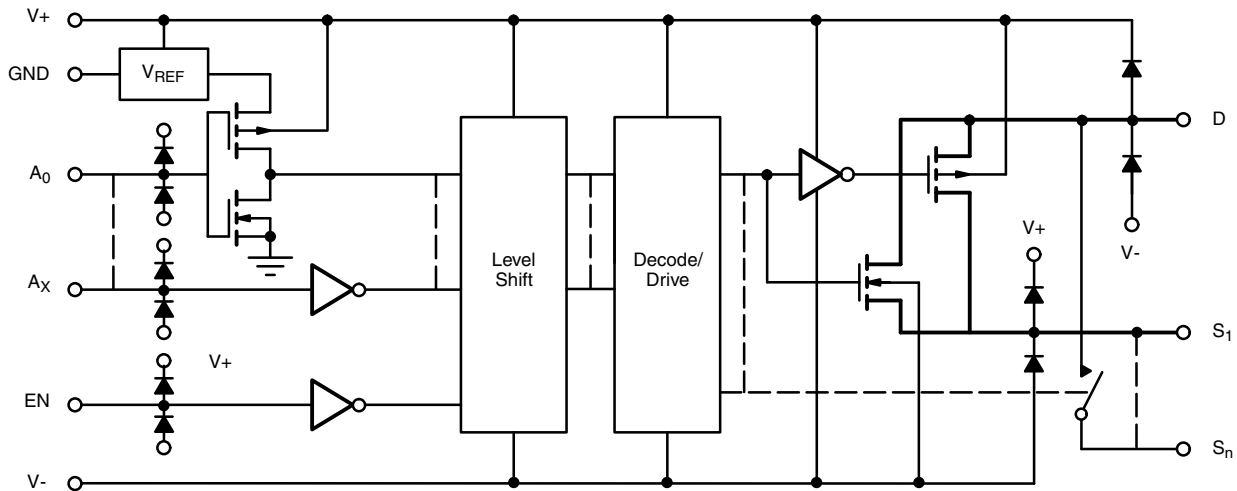
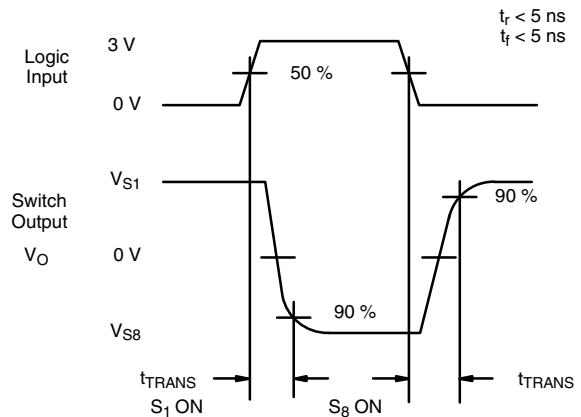
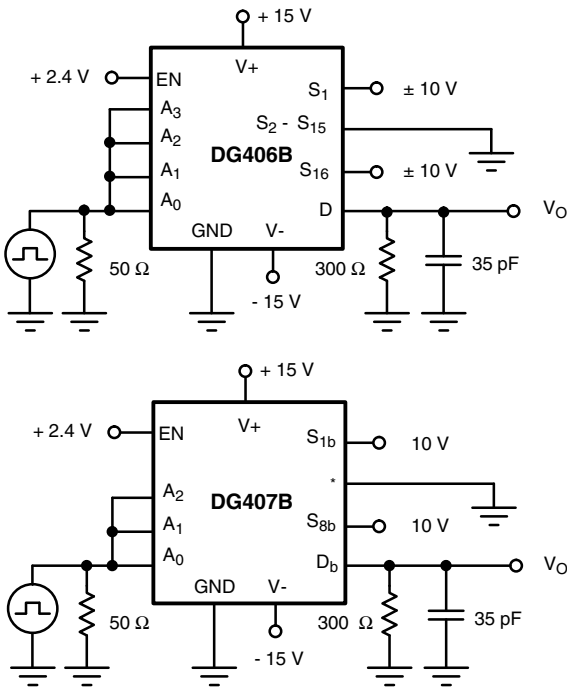


Fig. 1



TEST CIRCUITS



\* = S<sub>1a</sub> - S<sub>8a</sub>, S<sub>2b</sub> - S<sub>7b</sub>, D<sub>a</sub>

Fig. 2 - Transition Time

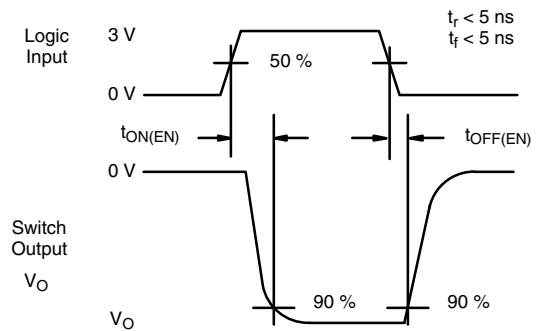
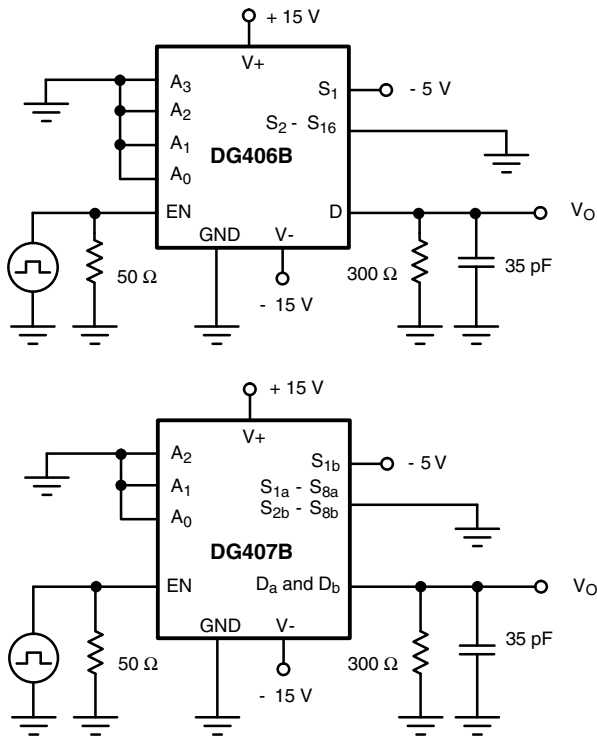


Fig. 3 - Enable Switching Time

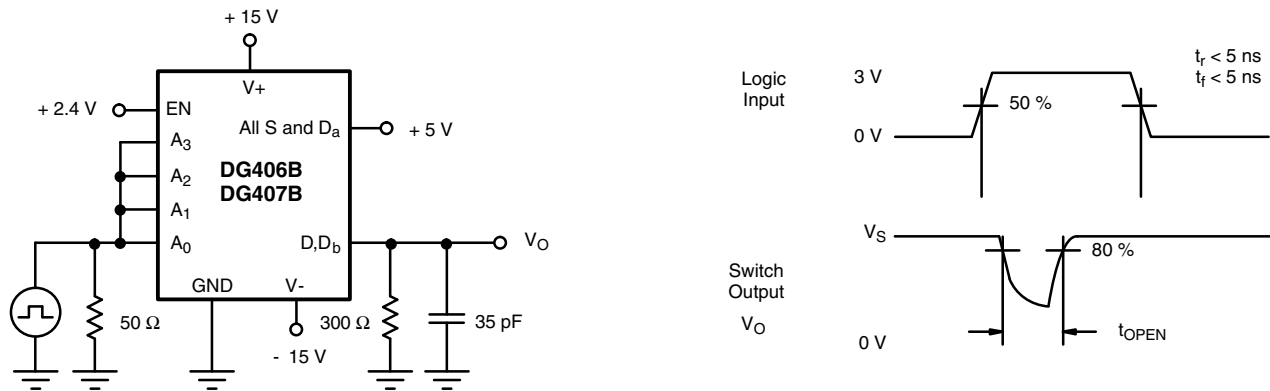
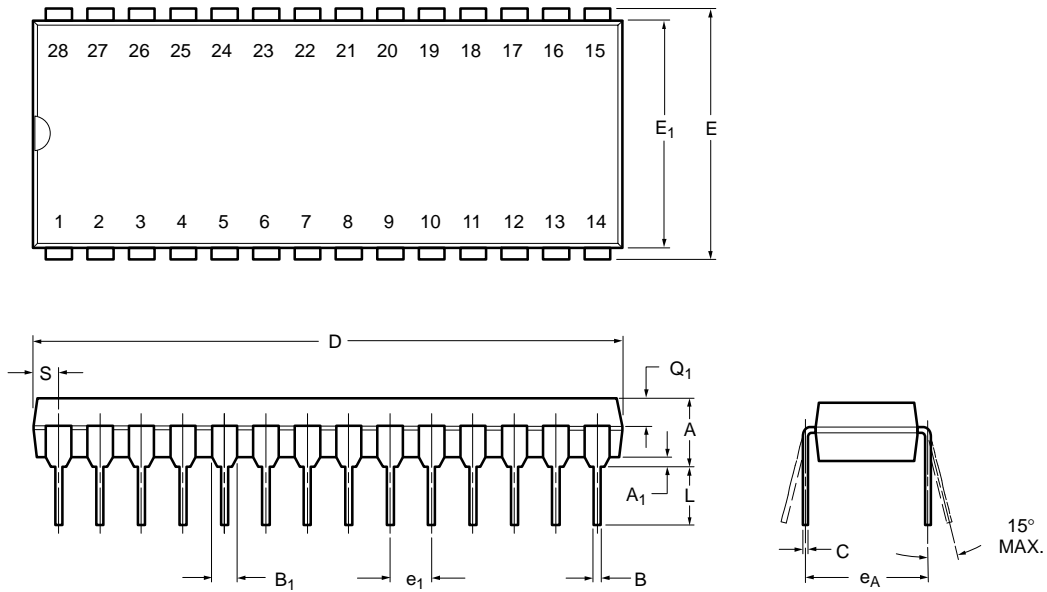
**TEST CIRCUITS**


Fig. 4 - Break-Before-Make Interval

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see [www.vishay.com/ppg?72552](http://www.vishay.com/ppg?72552).



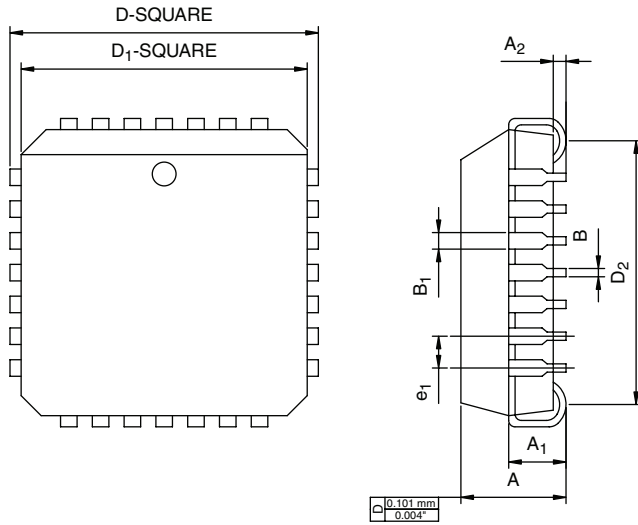
**PDIP: 28-LEAD**



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
<b>A</b>	2.29	5.08	0.090	0.200
<b>A<sub>1</sub></b>	0.39	1.77	0.015	0.070
<b>B</b>	0.38	0.56	0.015	0.022
<b>B<sub>1</sub></b>	0.89	1.65	0.035	0.065
<b>C</b>	0.204	0.30	0.008	0.012
<b>D</b>	35.10	39.70	1.380	1.565
<b>E</b>	15.24	15.88	0.600	0.625
<b>E<sub>1</sub></b>	13.21	14.73	0.520	0.580
<b>e<sub>1</sub></b>	2.29	2.79	0.090	0.110
<b>e<sub>A</sub></b>	14.99	15.49	0.590	0.610
<b>L</b>	2.60	5.08	0.100	0.200
<b>Q<sub>1</sub></b>	0.95	2.345	0.0375	0.0925
<b>S</b>	0.995	2.665	0.0375	0.105

ECN: S-03946—Rev. F, 09-Jul-01  
DWG: 5488

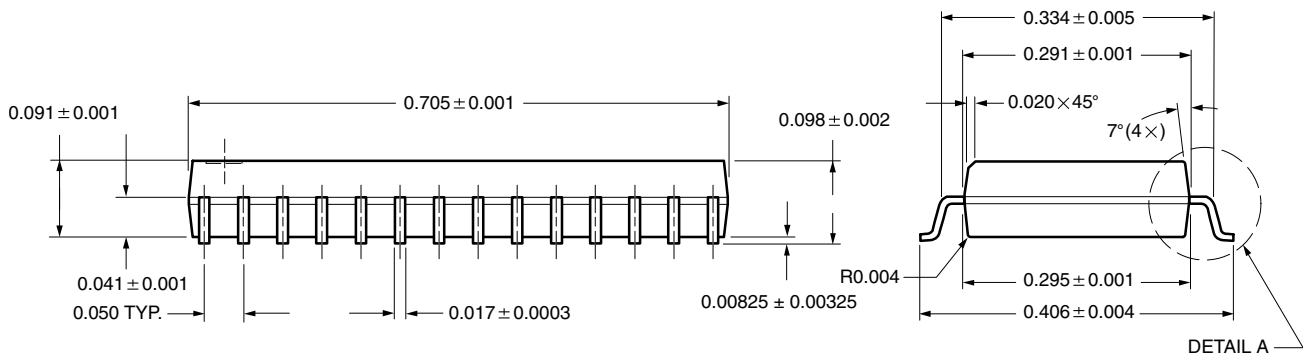
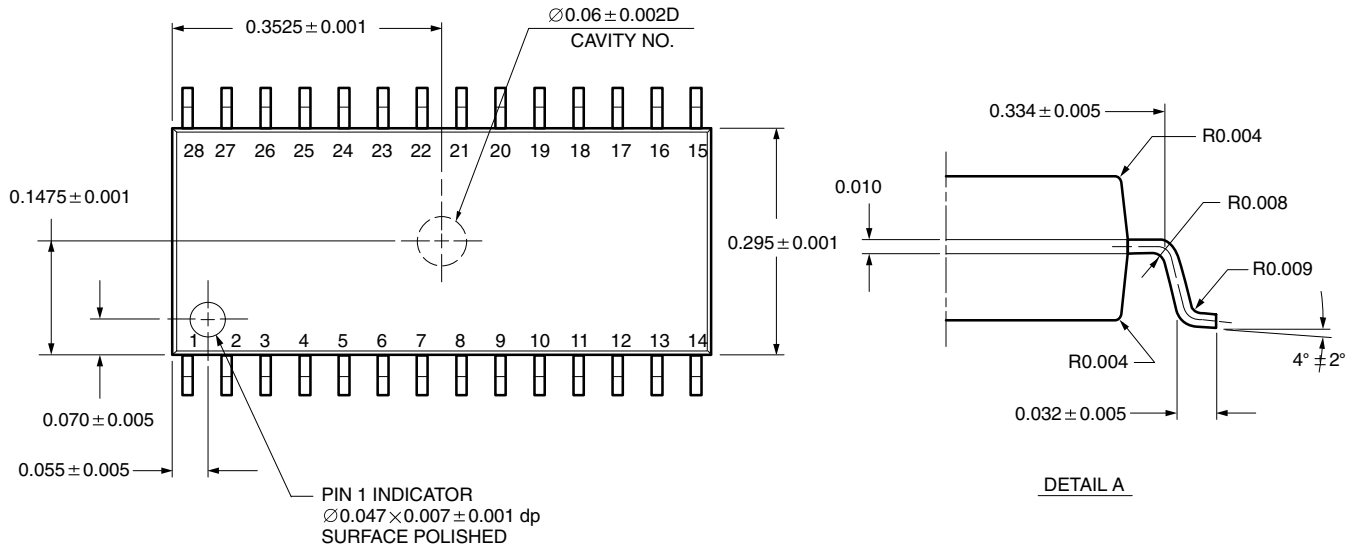
## PLCC: 28-LEAD



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.20	4.57	0.165	0.180
A <sub>1</sub>	2.29	3.04	0.090	0.120
A <sub>2</sub>	0.51	-	0.020	-
B	0.331	0.553	0.013	0.021
B <sub>1</sub>	0.661	0.812	0.026	0.032
D	12.32	12.57	0.485	0.495
D <sub>1</sub>	11.430	11.582	0.450	0.456
D <sub>2</sub>	9.91	10.92	0.390	0.430
e <sub>1</sub>	1.27 BSC		0.050 BSC	
ECN: T09-0766-Rev. D, 28-Sep-09 DWG: 5491				



### SOIC (WIDE-BODY): 28-LEADS



All Dimensions In Inches

ECN: E11-2209-Rev. D, 01-Aug-11  
DWG: 5850



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