



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_n) 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 - $R_{DS(on)}$: 45 Ω
- Low charge injection - Q: 11 pC
- Fast transition time - t_{TRANS} : 115 ns
- Low power: 0.2 mW
- Single supply capability
- Material categorization: For definitions of compliance please see 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.



RoHS*
Available

BENEFITS

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

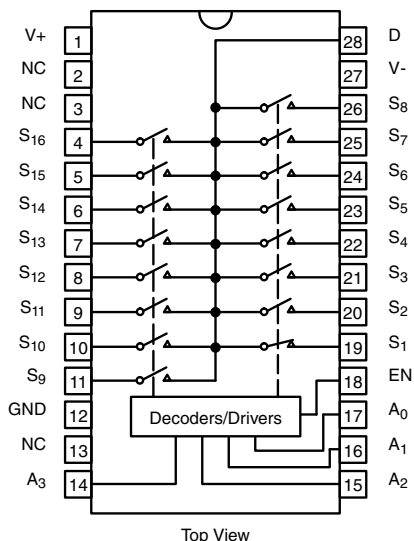
APPLICATIONS

- 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

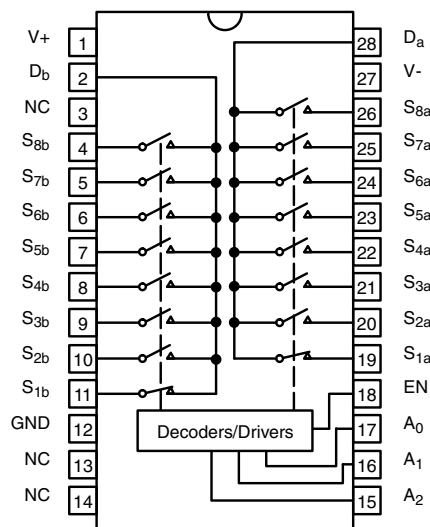
Dual-In-Line and SOIC Wide-Body



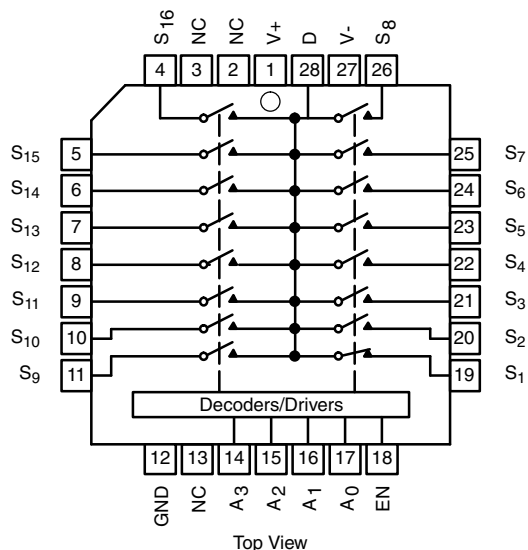
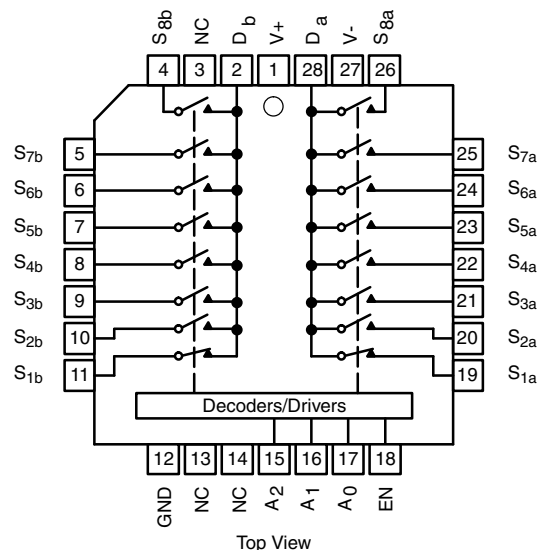
Top View

DG407B

Dual-In-Line and SOIC Wide-Body



Top View

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION
DG406B
PLCC and LCC

DG407B
PLCC and LCC

TRUTH TABLE (DG406B)

A ₃	A ₂	A ₁	A ₀	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

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

Note

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

TRUTH TABLE (DG407B)

A ₂	A ₁	A ₀	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} ≤ 0.8 V
- Logic "1" = V_{AH} ≥ 2.4 V
- X = Do not care

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

**ABSOLUTE MAXIMUM RATINGS**

PARAMETER		LIMIT	UNIT
Voltages Referenced to V-	V+ to V- ^g	44	V
	GND to V-	-25	
Digital Inputs ^a , V _S , V _D		(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) ^b	28-Pin Plastic DIP ^c	625	mW
	28-Pin Plastic PLCC ^c	450	mW
	28-Pin Widebody SOIC ^f	450	mW

Notes

- a. Signals on S_X, D_X or I_{NX} 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. ^b	TYP. ^c	D SUFFIX -40 °C to 85 °C		UNIT
			V+ = 15 V, V- = -15 V			MIN. ^d	MAX. ^d	
			V _{AL} = 0.8 V, V _{AH} = 2.4 V ^f					
Analog Switch								
Analog Signal Range ^e		V _{ANALOG}		Full	-	-15	15	V
Drain-Source On-Resistance		R _{DS(on)}	V _D = ± 10 V, I _S = -10 mA sequence each switch on	Room	45	-	60	Ω
				Full	45	-	74	
R _{DS(on)} Matching Between Channels ^g		ΔR _{DS(on)}	V _D = ± 10 V	Room	5	-	-	%
Source Off Leakage Current		I _{S(off)}	V _S = ± 10 V, V _D = ± 10 V, V _{EN} = 0 V	Room	-	-0.5	0.5	nA
				Full	-	-5	5	
Drain Off Leakage Current	DG406B	I _{D(off)}	V _D = ± 10 V, V _S = ± 10 V, V _{EN} = 0 V	Room	-	-1	1	
	Full			-	-40	40		
	Room			-	-1	1		
	Full			-	-20	20		
Drain On Leakage Current	DG406B	I _{D(on)}	V _S = V _D = ± 10 V sequence each switch on	Room	-	-1	1	
	Full			-	-40	40		
	Room			-	-1	1		
	Full			-	-20	20		
Digital Control								
Logic High Input Voltage		V _{INH}		Full	-	2.4	-	V
Logic Low Input Voltage		V _{INL}		Full	-	-	0.8	
Logic High Input Current		I _{AH}	V _A = 2.4 V, 15 V	Full	-	-1	1	μA
Logic Low Input Current		I _{AL}	V _{EN} = 0 V, 2.4 V, V _A = 0 V	Full	-	-1	1	
Logic Input Capacitance		C _{in}	f = 1 MHz	Room	6	-	-	pF



SPECIFICATIONS								
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED	TEMP. ^b	TYP. ^c	D SUFFIX -40 °C to 85 °C		UNIT	
		V+ = 15 V, V- = -15 V			MIN. ^d	MAX. ^d		
		V _{AL} = 0.8 V, V _{AH} = 2.4 V ^f						
Dynamic Characteristics								
Transition Time	t _{TRANS}	see figure 2	Room	115	-	148	ns	
			Full	-	-	161		
Break-Before-Make Interval	t _{OPEN}	see figure 4	Room	39	10	-		
			Full	-	21	-		
Enable Turn-On Time	t _{ON(EN)}	see figure 3	Room	75	-	107		
			Full	-	-	123		
Enable Turn-Off Time	t _{OFF(EN)}		Room	50	-	88		
			Full	-	-	94		
Charge Injection	Q	C _L = 1 nF, V _S = 0 V R _S = 0 Ω	Room	11	-	-	pC	
Off Isolation ^h	OIRR	V _{EN} = 0 V, R _L = 50 Ω, f = 1 MHz	Room	-86	-	-	dB	
Source Off Capacitance		C _{S(off)}	Room	6	-	-	pF	
Drain Off Capacitance								
	DG407B	C _{D(off)}	V _{EN} = 0 V, V _D = 0 V, f = 1 MHz	Room	108	-		-
	Room			54	-	-		
Drain On Capacitance	DG406B	C _{D(on)}		Room	114	-		-
	DG407B			Room	57	-		-
Power Supplies								
Positive Supply Current	I+	V _{EN} = V _A = 0 V or 5 V	Room	23	-	30	μA	
			Full	-	-	75		
Negative Supply Current	I-		Room	-0.02	-1	-		
			Full	-	-10	-		
Positive Supply Current	I+	V _{EN} = 2.4 V, V _A = 0 V	Room	28	-	500		
			Full	-	-	700		
Negative Supply Current	I-		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_{IN} = input voltage to perform proper function.
g. ΔR_{DS(on)} = R_{DS(on)} max. - R_{DS(on)} 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. ^b	TYP. ^c	D SUFFIX -40 °C to 85 °C		UNIT	
		V ₊ = 15 V, V ₋ = -15 V			MIN. ^d	MAX. ^d		
		V _{AL} = 0.8 V, V _{AH} = 2.4 V ^f						
Analog Switch								
Analog Signal Range ^e		V _{ANALOG}		Full	-	0	12	V
Drain-Source On-Resistance		R _{DS(on)}	V _D = 3 V, I _S = -1 mA sequence each switch on	Room	78	-	100	Ω
R _{DS(on)} Matching Between Channels ^g		ΔR _{DS(on)}		Room	5	-	-	%
Source Off Leakage Current ^a		I _{S(off)}	V _D = 10 V or 0.5 V, V _S = 0.5 V or 10 V, V _{EN} = 0 V	Room	-	-0.5	0.5	nA
Drain Off Leakage Current	DG406B	I _{D(off)}		Room	-	-1	1	
	DG407B		Room	-	-1	1		
Drain On Leakage Current	DG406B	I _{D(on)}	V _S = V _D = ± 10 V sequence each switch on	Room	-	-1	1	
	DG407B			Room	-	-1	1	
Dynamic Characteristics								
Transition Time		t _{TRANS}	V _{S1} = 8 V, V _{S8} = 0 V, V _{IN} = 2.4 V	Room	130	-	163	ns
Enable Turn-On Time		t _{ON(EN)}	V _{INH} = 2.4 V, V _{INL} = 0 V, V _{IN} = 5 V	Room	93	-	125	
Enable Turn-Off Time		t _{OFF(EN)}		Room	63	-	94	
Charge Injection		Q	C _L = 1 nF, V _S = 6 V R _S = 0 Ω	Room	9	-	-	pC
Power Supplies								
Positive Supply Current		I ₊	V _{EN} = 0 V or 5 V V _A = 0 V or 5 V	Room	13	-	30	μA
				Full	-	-	75	
Positive Supply Current		I ₊		Room	-0.01	-20	-	
				Full	-	-20	-	

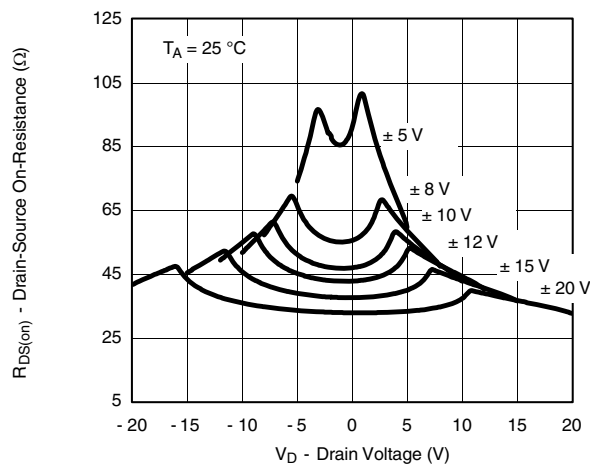
Notes

- 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_{IN} = input voltage to perform proper function.
g. ΔR_{DS(on)} = R_{DS(on)} max. - R_{DS(on)} min.
h. Worst case isolation occurs on channel 4 due to proximity to the drain pin.

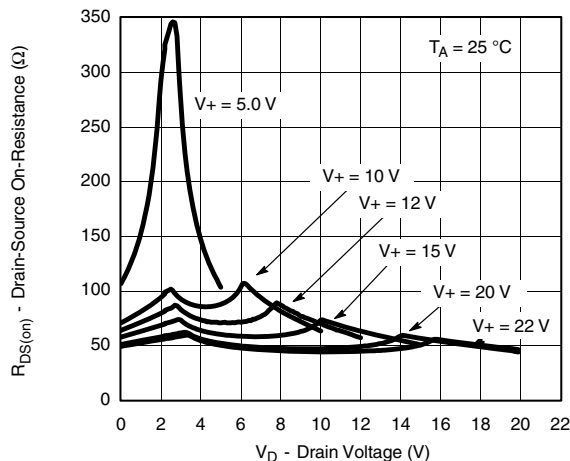
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



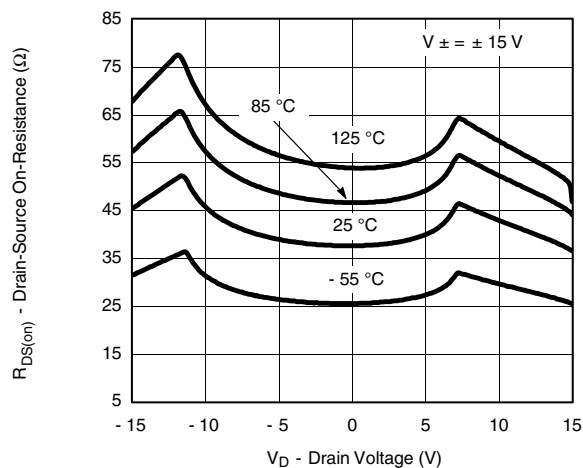
TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, unless otherwise noted)



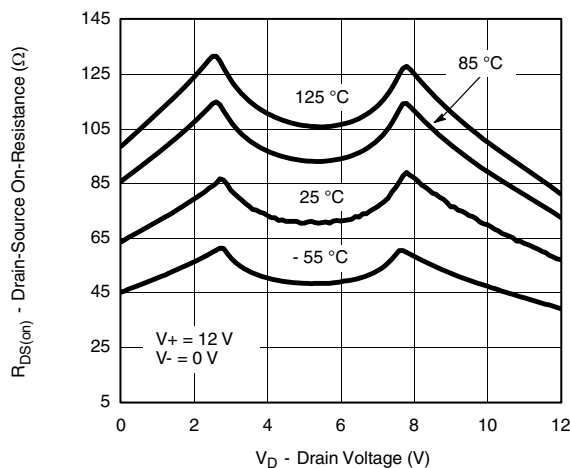
On-Resistance vs. V_D and Dual Supply Voltage



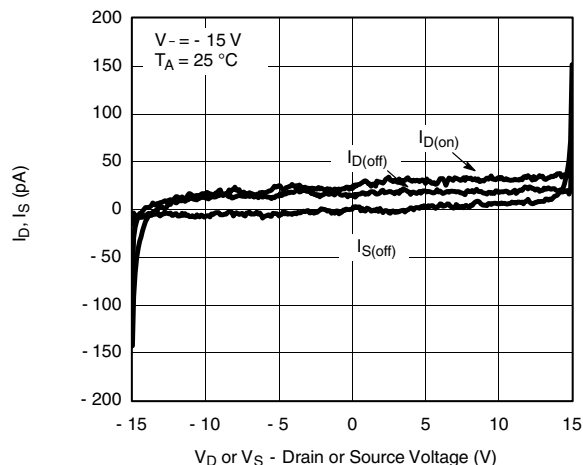
On-Resistance vs. V_D and Unipolar Supply Voltage



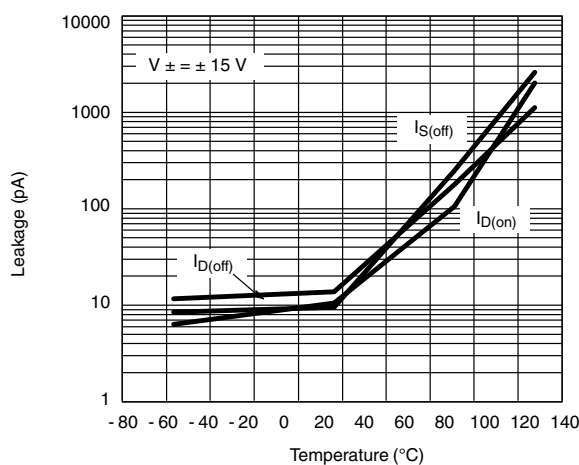
On-Resistance vs. V_D and Temperature



On-Resistance vs. V_D and Temperature



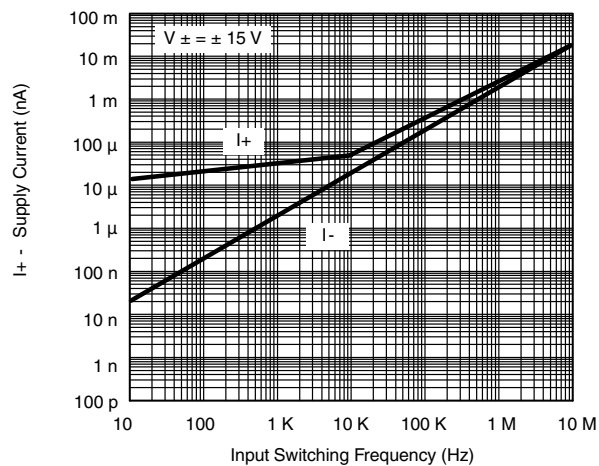
Leakage vs. Analog Voltage



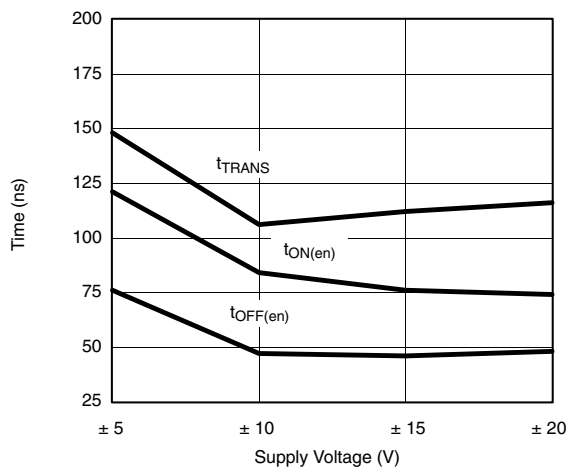
Leakage vs. Current



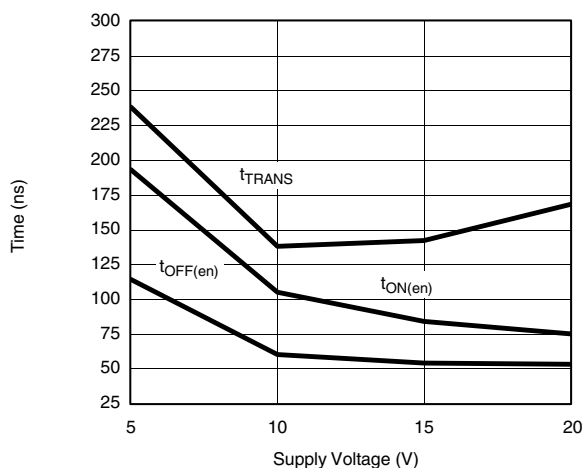
TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, unless otherwise noted)



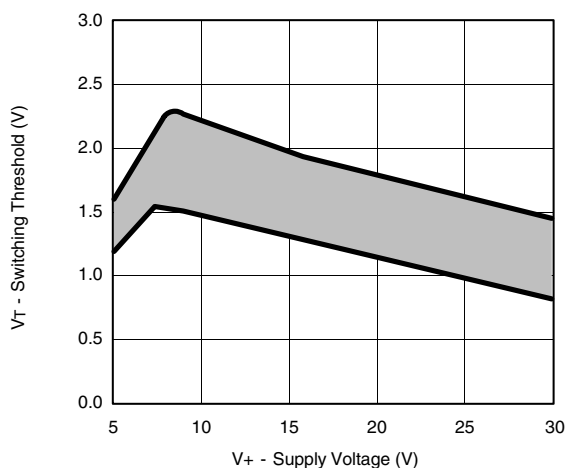
Supply Current vs. Input Switching Frequency



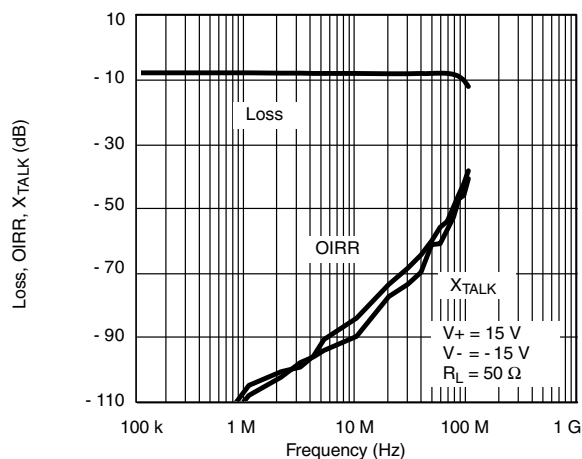
Switching Time vs. Bipolar Supplies



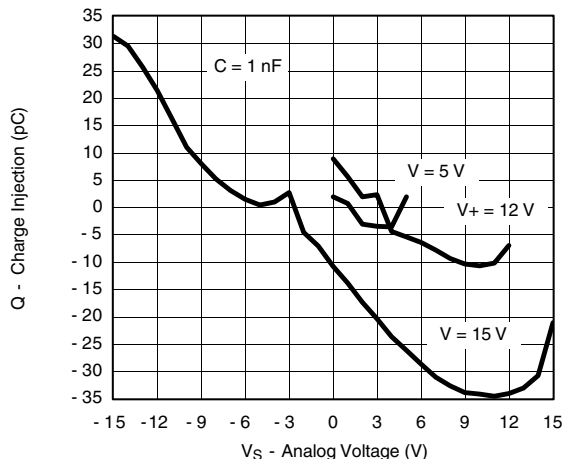
Switching Time vs. Single Supplies



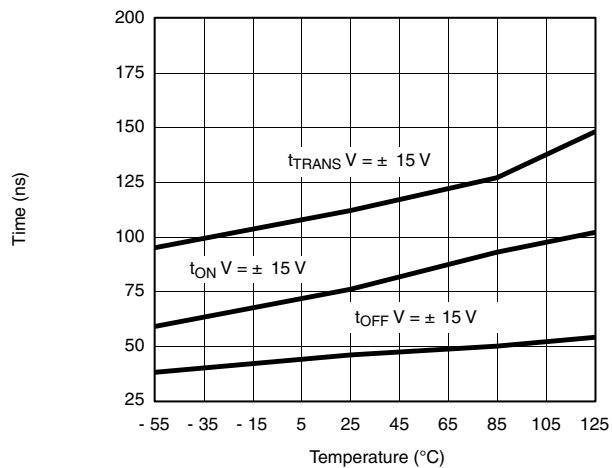
Switching Threshold vs. Supply Voltage



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

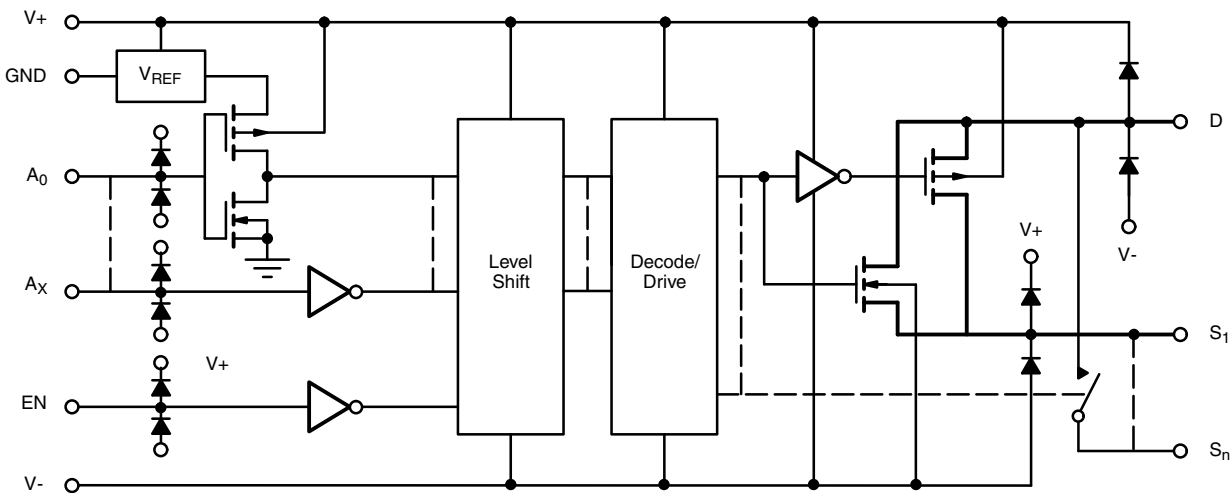
SCHEMATIC DIAGRAM (Typical Channel)


Fig. 1

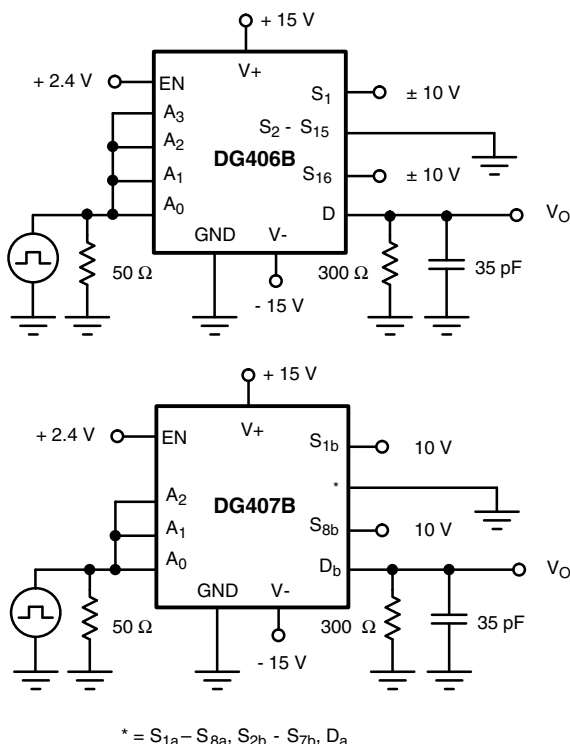
TEST CIRCUITS


Fig. 2 - Transition Time

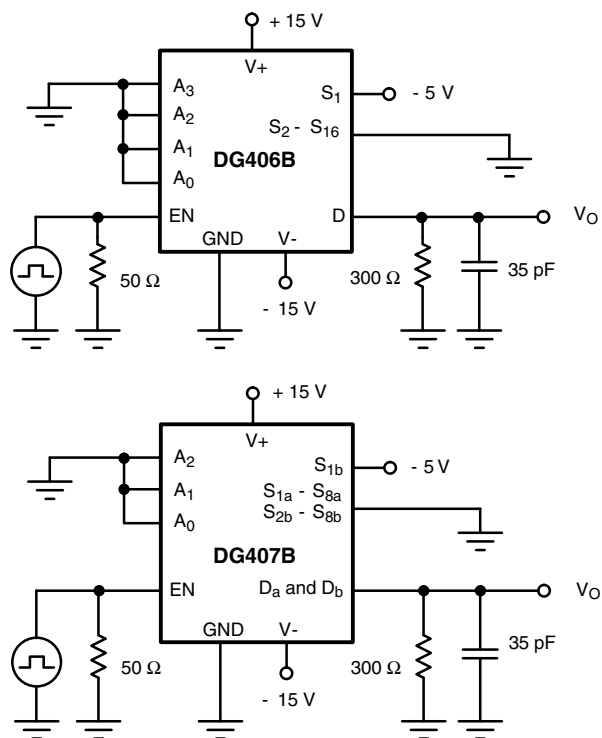
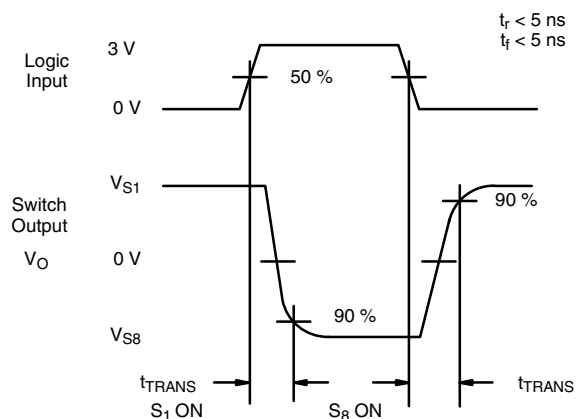
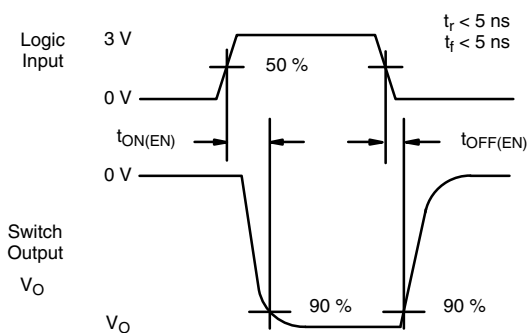


Fig. 3 - Enable Switching Time





TEST CIRCUITS

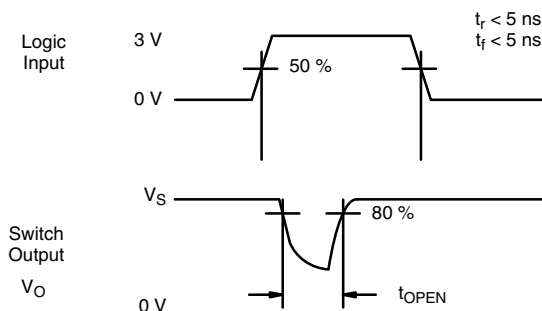
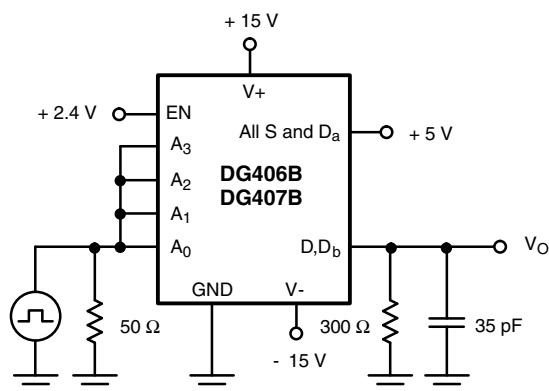


Fig. 4 - Break-Before-Make Interval

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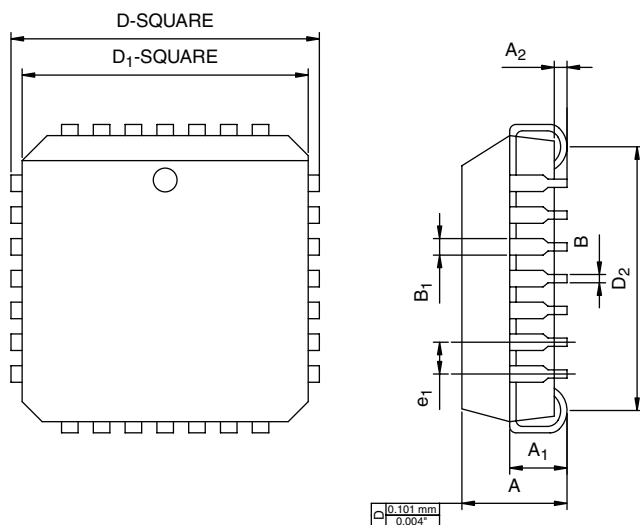
PDIP: 28-LEAD



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	2.29	5.08	0.090	0.200
A₁	0.39	1.77	0.015	0.070
B	0.38	0.56	0.015	0.022
B₁	0.89	1.65	0.035	0.065
C	0.204	0.30	0.008	0.012
D	35.10	39.70	1.380	1.565
E	15.24	15.88	0.600	0.625
E₁	13.21	14.73	0.520	0.580
e₁	2.29	2.79	0.090	0.110
e_A	14.99	15.49	0.590	0.610
L	2.60	5.08	0.100	0.200
Q₁	0.95	2.345	0.0375	0.0925
S	0.995	2.665	0.0375	0.105

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

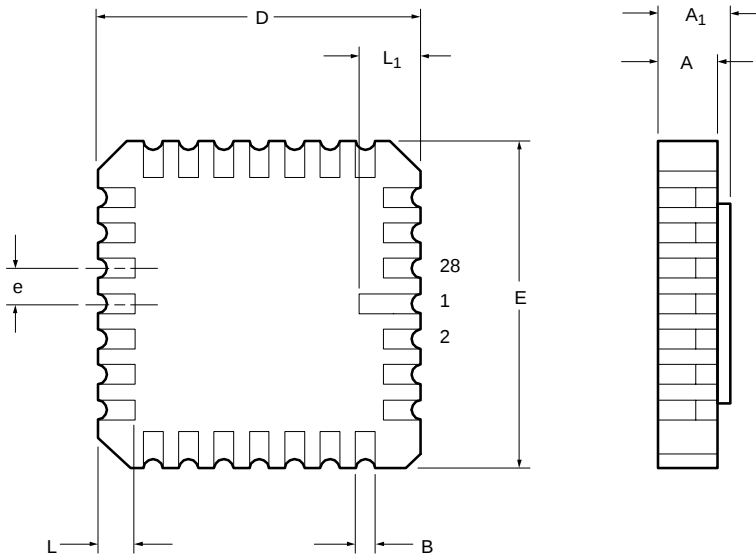
PLCC: 28-LEAD



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



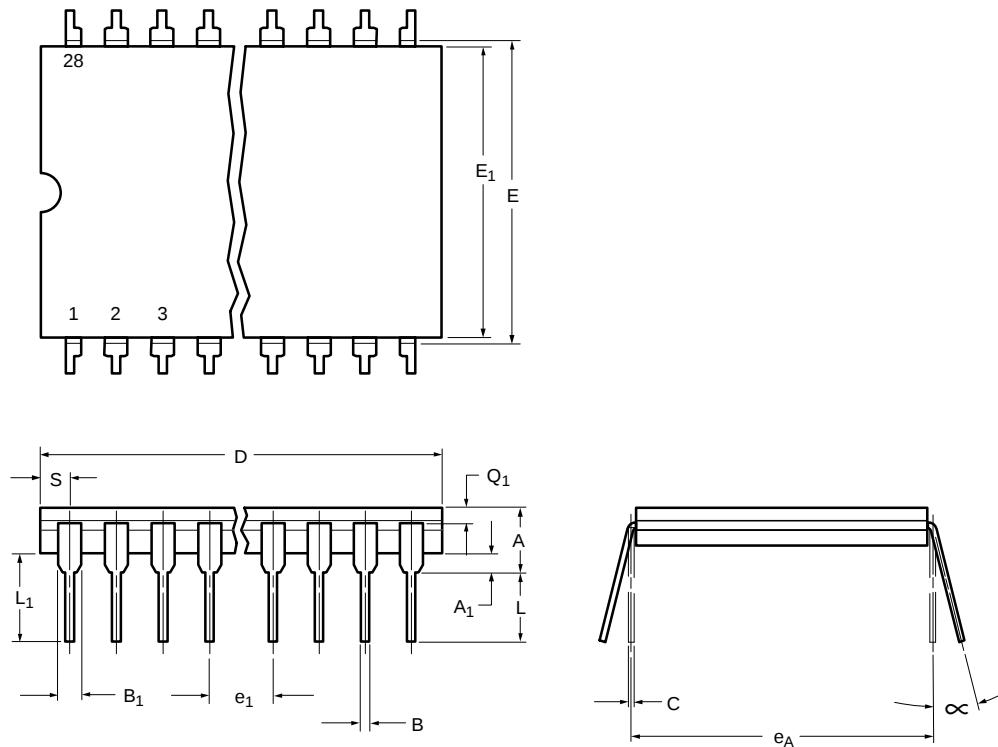
28-LEAD LCC



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	1.37	2.24	0.054	0.088
A₁	1.63	2.54	0.064	0.100
B	0.56	0.71	0.022	0.028
D	11.23	11.63	0.442	0.458
E	11.23	11.63	0.442	0.458
e	1.27 BSC		0.050 BSC	
L	1.14	1.40	0.045	0.055
L₁	1.96	2.36	0.077	0.093
ECN: S-03946—Rev. B, 09-Jul-01 DWG: 5319				



CERDIP: 28-LEAD



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	4.06	5.92	0.160	0.232
A ₁	0.38	1.52	0.015	0.060
B	0.38	0.51	0.015	0.020
B ₁	1.14	1.65	0.045	0.065
C	0.20	0.30	0.008	0.012
D	36.58	37.08	1.440	1.460
E	15.24	15.88	0.600	0.625
E ₁	12.95	13.46	0.510	0.530
e ₁	2.54 BSC		0.100 BSC	
e _A	15.24 BSC		0.600 BSC	
L	3.18	3.81	0.125	0.150
L ₁	3.81	5.08	0.150	0.200
Q ₁	1.27	2.16	0.050	0.085
S	1.52	2.29	0.060	0.090
∞	0°	15°	0°	15°
ECN: S-03946—Rev. E, 09-Jul-01 DWG: 5434				



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