Improved Quad SPST CMOS Analog Switches

DESCRIPTION

The DG444B, DG445B are monolithic quad analog switches designed to provide high speed, low error switching of analog and audio signals. The DG444B, DG445B are upgrades to the original DG444, DG445.

Combing low on-resistance (45 Ω, typ.) with high speed (t_{on} 120 ns, typ.), the DG444B, DG445B are ideally suited for data acquisition, communication systems, automatic test equipment, or medical instrumentation. Charge injection has been minimized on the drain for use in sample-and-hold circuits.

The DG444B, DG445B are built using Vishay Siliconix's high-voltage silicon-gate process. An epitaxial layer prevents latchup.

When on, each switch conducts equally well in both directions and blocks input voltages to the supply levels when off.

FEATURES

- Low on-resistance: 45 Ω
- Low power consumption: 1 mW
- Fast switching action - t_{on}: 120 ns
- Low charge injection
- TTL/CMOS-compatible logic
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

HALOGEN FREE

APPLICATIONS

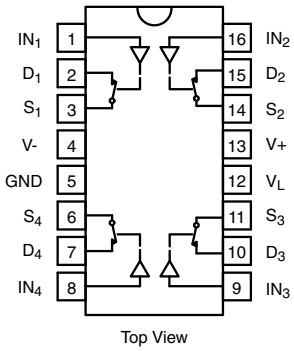
- Audio switching
- Data acquisition
- Sample-and-hold circuits
- Communication systems
- Automatic test equipment
- Medical instruments

BENEFITS

- Low signal errors and distortion
- Reduced power supply consumption
- Faster throughput
- Reduced pedestal errors
- Simple interfacing

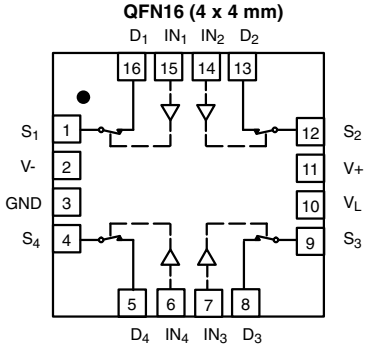
FUNCTIONAL BLOCK DIAGRAM AND PIN C#ONFIGURATION

DG444B
Dual-In-Line and SOIC



Top View

DG444B
QFN16 (4 x 4 mm)



Top View

TRUTH TABLE		
LOGIC	DG444B	DG445B
0	On	Off
1	Off	On

Note

- Logic "0" ≤ 0.8 V
  Logic "1" ≥ 2.4 V

ORDERING INFORMATION		
TEMP. RANGE	PACKAGE	PART NUMBER
-40 °C to +85 °C	16-pin narrow SOIC	DG444BDY-E3
		DG444BDY-T1-E3
		DG445BDY-E3
		DG445BDY-T1-E3
	16-pin QFN 4 x 4 mm (variation 1)	DG444BDN-T1-E4
		DG445BDN-T1-E4

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C, unless otherwise noted)				
PARAMETER		**SYMBOL**	**LIMIT**	**UNIT**
V+ to V-			44	V
GND to V-			25	
VL			(GND - 0.3 V) to (V+) + 0.3 V	
Digital inputs [a], V_S, V_D			(V-) - 2 to (V+) + 2 or 30 mA, whichever occurs first	
Continuous current (any terminal)			30	mA
Current, S or D (pulsed at 1 ms, 10 % duty cycle)			100	
Storage temperature			-65 to +125	°C
Power dissipation (package) [b]	16-pin narrow body SOIC [d]		640	mW
	QFN-16 [e]		850	

Notes

a. Signals on S_X, D_X, or IN_X exceeding V+ or V- will be clamped by internal diodes. Limit forward diode current to maximum current ratings
b. All leads welded or soldered to PC board
c. Derate 6 mW/°C above 75 °C
d. Derate 8 mW/°C above 75 °C
e. Derate 12 mW/°C above 75 °C

SPECIFICATIONS (for dual supplies)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 15 V, V- = -15 V V_L = 5 V, V_{IN} = 2.4 V, 0.8 V [e]**	**TEMP. [a]**	**D SUFFIX -40 °C TO +85 °C**			**UNIT**
				MIN. [b]	**TYP. [c]**	**MAX. [b]**	
Analog Switch							
Analog signal range [d]	V_{ANALOG}		Full	-15	-	15	V
Drain-source on-resistance	$R_{DS(on)}$	I_S = 1 mA, V_D = ± 10 V	Room	-	45	80	Ω
			Full	-	-	95	
Switch off leakage current	$I_{S(off)}$	V_D = ± 14 V, V_S = ± 14 V	Room	- 0.5	± 0.01	0.5	nA
			Full	- 5	-	5	
	$I_{D(off)}$		Room	- 0.5	± 0.01	0.5	
			Full	- 5	-	5	
Channel on leakage current	$I_{D(on)}$	V_S = V_D = ± 14 V	Room	-0.5	± 0.02	0.5	
			Full	-10	-	10	
Digital Control							
Input, low voltage	V_{INH}		Full	-	-	0.8	V
Input, high voltage	V_{INL}		Full	2.4	-	-	
Input current V_{IN} low	I_{INL}	V_{IN} under test = 0.8 V, all other = 2.4 V	Full	-1	- 0.01	1	µA
Input current V_{IN} high	I_{INH}	V_{IN} under test = 2.4 V, all other = 0.8 V	Full	-1	0.01	1	
Dynamic Characteristics							
Turn-on time	t_{on}	R_L = 1 kΩ, C_L = 35 pF, V_S = ± 10 V, See figure 2	Room	-	-	300	ns
Turn-off time	t_{off}		Room	-	-	200	
Charge Injection [e]	Q	C_L = 1 nF, V_S = 0 V, V_{gen} = 0 V, R_{gen} = 0 Ω	Room	-	1	-	pC
Off isolation [e]	OIRR	R_L = 50 Ω, CL = 15 pF, v = 1 V_{RMS}, f = 100 kHz	Room	-	-90	-	dB
Crosstalk (channel-to-channel) [d]	X_{TALK}		Room	-	-95	-	
Source off capacitance	$C_{S(off)}$	V_S = 0 V, f = 100 kHz	Room	-	5	-	pF
Drain off capacitance	$C_{D(off)}$		Room	-	5	-	
Channel on capacitance	$C_{D(on)}$	V_S = V_D = 0 V, f = 1 MHz	Room	-	16	-	
Power Supplies							
Positive supply current	I+	V_{IN} = 0 V or 5 V	Room	-	-	1	µA
			Full	-	-	5	
Negative supply current	I-		Room	-1	-	-	
			Full	-5	-	-	
Logic supply current	I_{IN}		Room	-	-	1	
			Full	-	-	5	

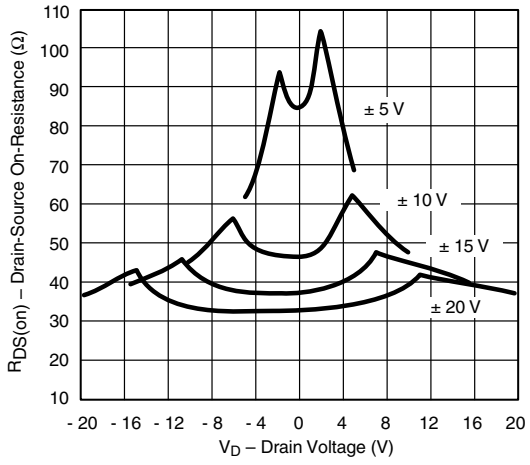
SPECIFICATIONS (for unipolar supplies)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 12 V, V- = 0 V V_L = 5 V, V_{IN} = 2.4 V, 0.8 V [e]**	**TEMP. [a]**	**D SUFFIX -40 °C TO +85 °C**			**UNIT**
				MIN. [b]	**TYP. [c]**	**MAX. [b]**	
Analog Switch							
Analog signal range [d]	V_{ANALOG}		Full	0	-	12	V
Drain-source on-resistance [d]	$R_{DS(on)}$	I_S = 1 mA, V_D = 3 V, 8 V	Room	-	90	160	Ω
			Full	-	-	200	
Dynamic Characteristics							
Turn-on time	t_{on}	R_L = 1 kΩ, C_L = 35 pF, V_S = 8 V, See Fig. 2	Room	-	120	300	ns
Turn-off time	t_{off}		Room	-	60	200	
Charge Injection	Q	C_L = 1 nF, V_{gen} = 6 V, R_{gen} = 0 Ω	Room	-	4	-	pC
Power Supplies							
Positive supply current	I+	V_{IN} = 0 V or 5 V	Room	-	-	1	µA
			Full	-	-	5	
Negative supply current	I-		Room	- 1	-	-	
			Full	- 5	-	-	
Logic supply current	I_{IN}	V_L = 5.25 V, V_{IN} = 0 V or 5 V	Room	-	-	1	
			Full	-	-	5	

Notes

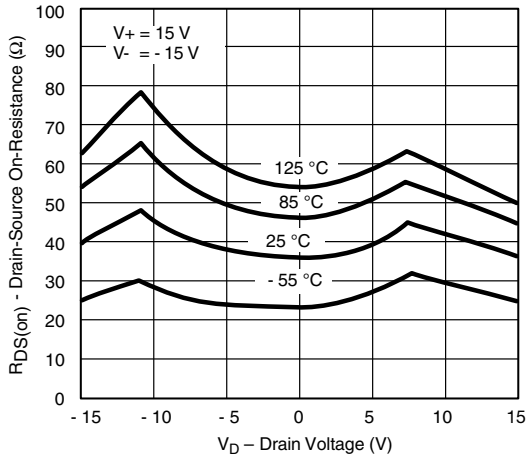
a. Room = 25 °C, full = as determined by the operating temperature suffix
b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing
d. Guaranteed by design, not subject to production test
e. V_{IN} = input voltage to perform proper function

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 °C, unless otherwise noted)

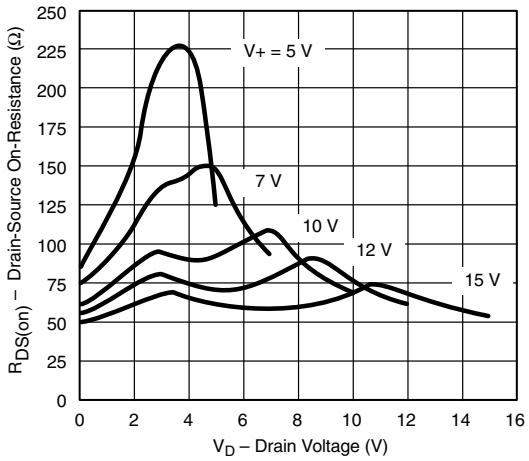


$R_{DS(on)}$ vs. V_D and Power Supply Voltages

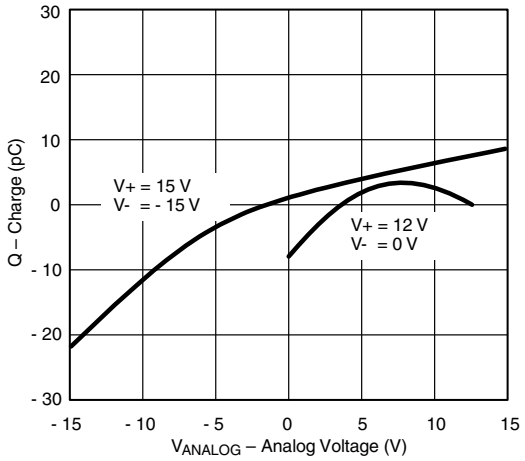


$R_{DS(on)}$ vs. V_D and Temperature

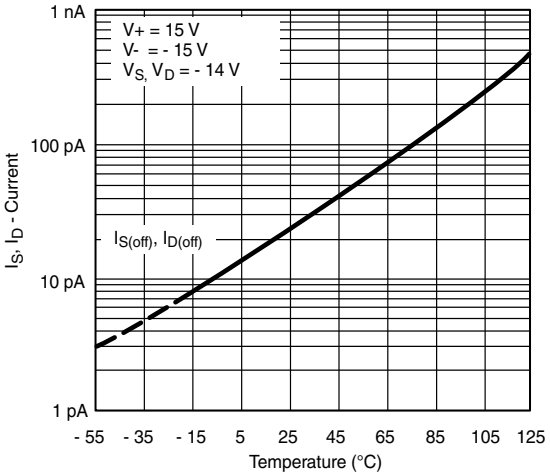
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



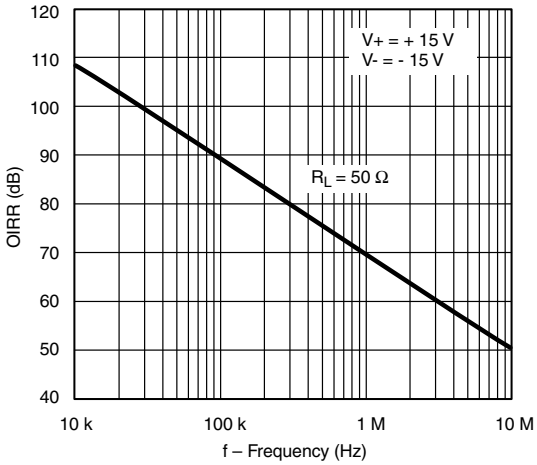
$R_{DS(on)}$ vs. V_D and Single Power Supply Voltages



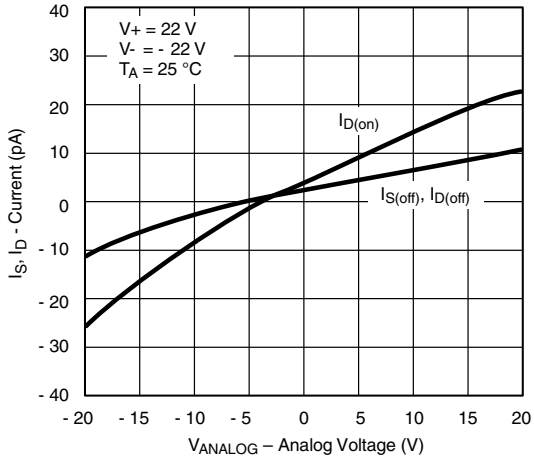
Q_S, Q_D - Charge Injection vs. Analog Voltage



Leakage Current vs. Temperature



Off Isolation vs. Frequency



Leakage Currents vs. Analog Voltage

SCHEMATIC DIAGRAM (typical channel)

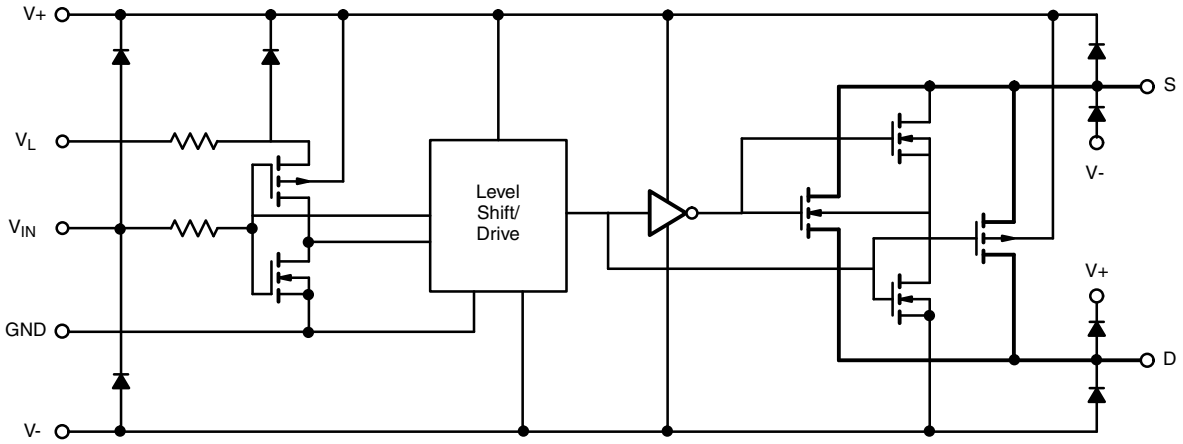
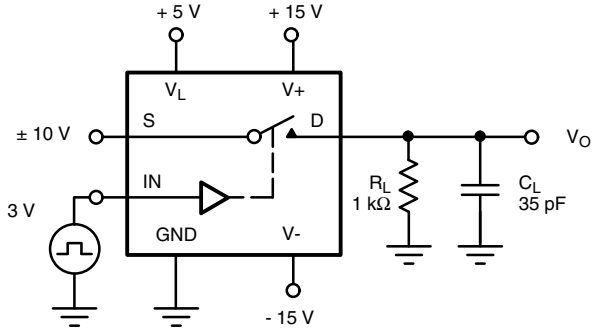
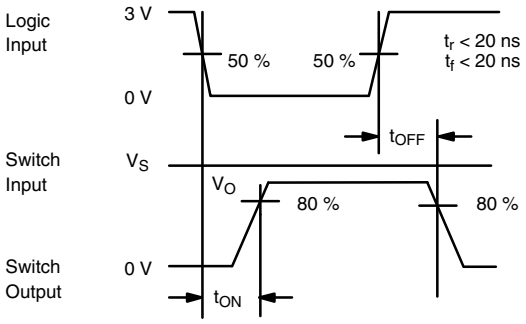


Fig. 1

TEST CIRCUITS

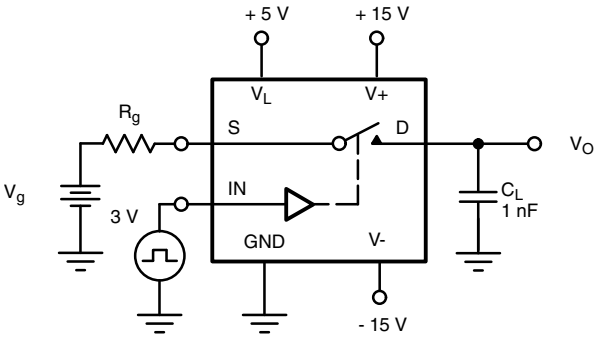


C_L (includes fixture and stray capacitance)



Note: Logic input waveform is inverted for DG445.

Fig. 2 - Switching Time



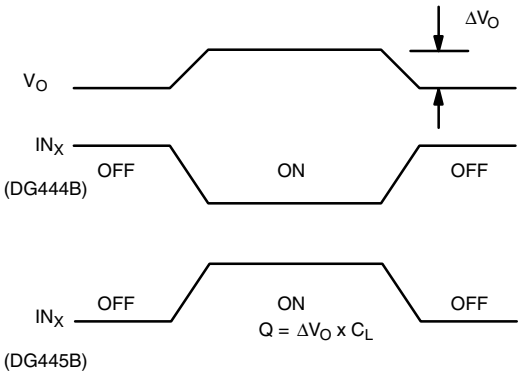


Fig. 3 - Charge Injection

TEST CIRCUITS

C = 1 mF tantalum in parallel with 0.01 mF ceramic

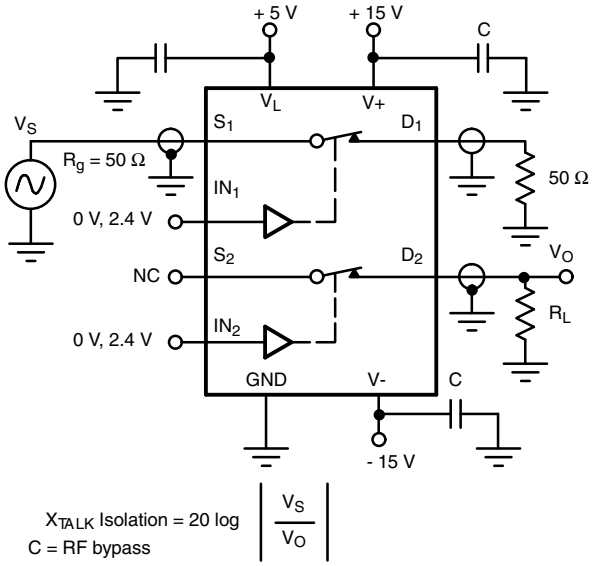


Fig. 4 - Crosstalk

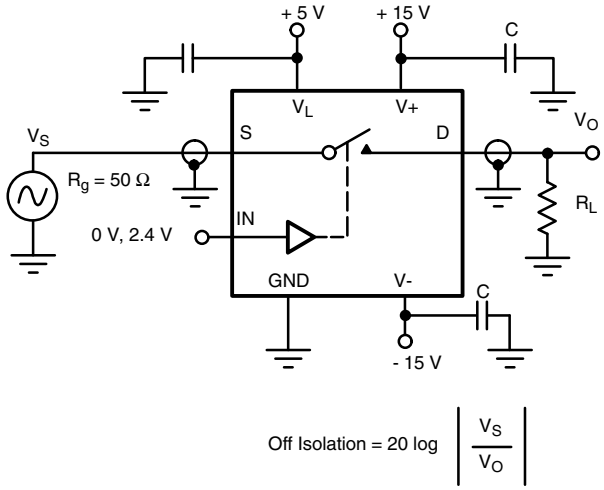


Fig. 5 - Off Isolation

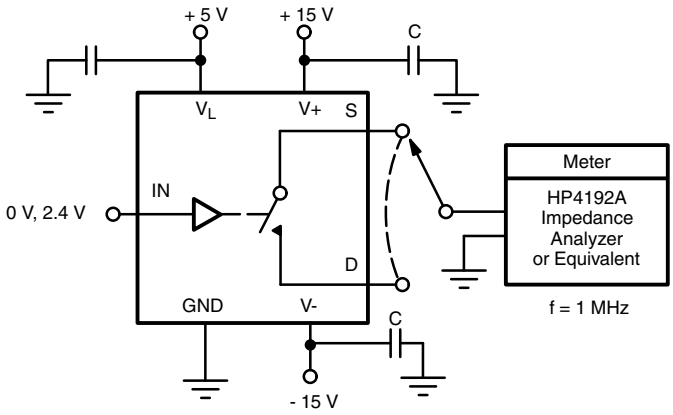


Fig. 6 - Source/Drain Capacitances

APPLICATIONS

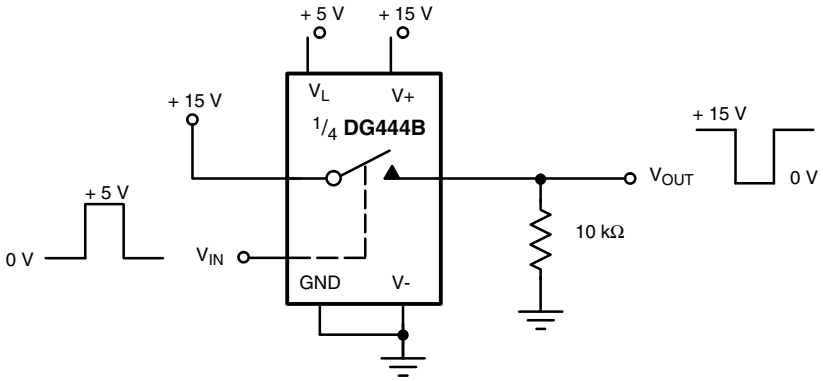


Fig. 7 - Level Shifter

APPLICATIONS

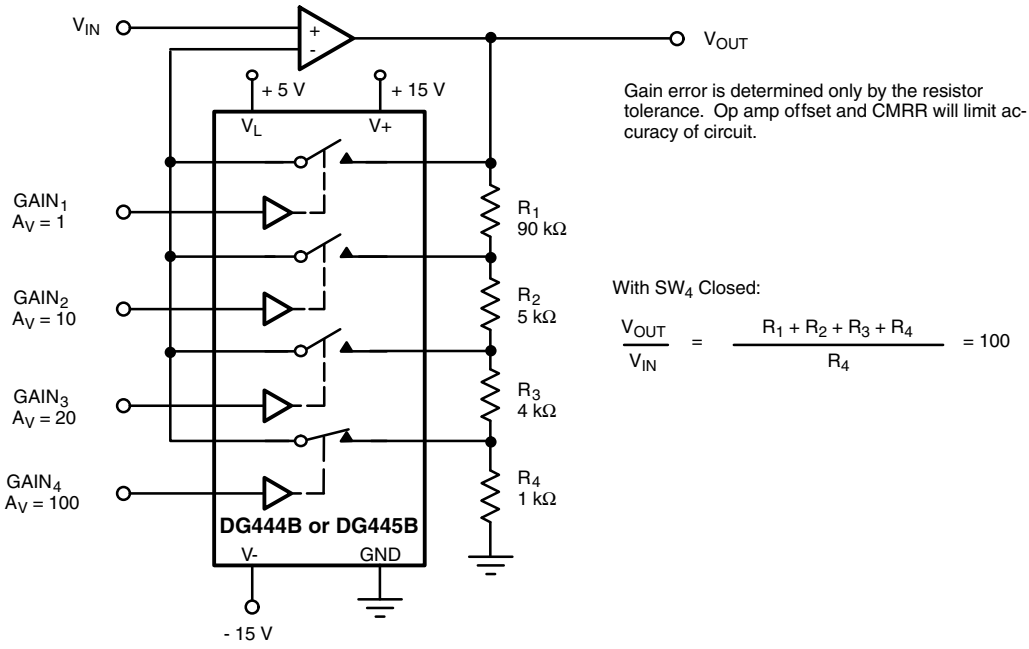


Fig. 8 - Precision-Weighted Resistor Programmable-Gain Amplifier

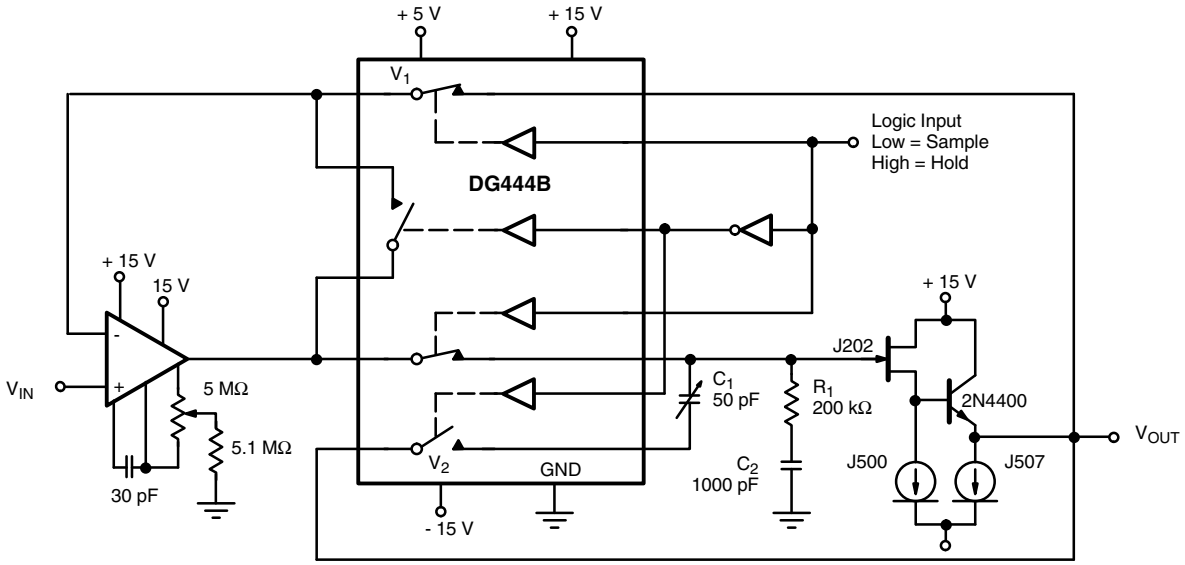


Fig. 9 - Precision Sample-and-Hold

PRODUCT SUMMARY				
Part number	DG444B	DG444B	DG445B	DG445B
Status code	2	2	2	2
Configuration	SPST x 4, NC	SPST x 4, NC	SPST x 4, NO	SPST x 4, NO
Single supply min. (V)	5	5	5	5
Single supply max. (V)	36	36	36	36
Dual supply min. (V)	5	5	5	5
Dual supply max. (V)	22	22	22	22
On-resistance (Ω)	45	45	45	45
Charge injection (pC)	1	1	1	1
Source on capacitance (pF)	16	16	16	16
Source off capacitance (pF)	5	5	5	5
Leakage switch on typ. (nA)	0.02	0.02	0.02	0.02
Leakage switch off max. (nA)	0.5	0.5	0.5	0.5
-3 dB bandwidth (MHz)	-	-	-	-
Package	SO-16 (narrow) AS	QFN-16 4 x 4	SO-16 (narrow) AS	QFN-16 4 x 4
Functional circuit / applications	Multi purpose, instrumentation, medical and healthcare	Multi purpose, instrumentation, medical and healthcare	Multi purpose, instrumentation, medical and healthcare	Multi purpose, instrumentation, medical and healthcare
Interface	Parallel	Parallel	Parallel	Parallel
Single supply operation	Yes	Yes	Yes	Yes
Dual supply operation	Yes	Yes	Yes	Yes
Turn on time max. (ns)	300	300	300	300
Crosstalk and off isolation	-90	-90	-90	-90

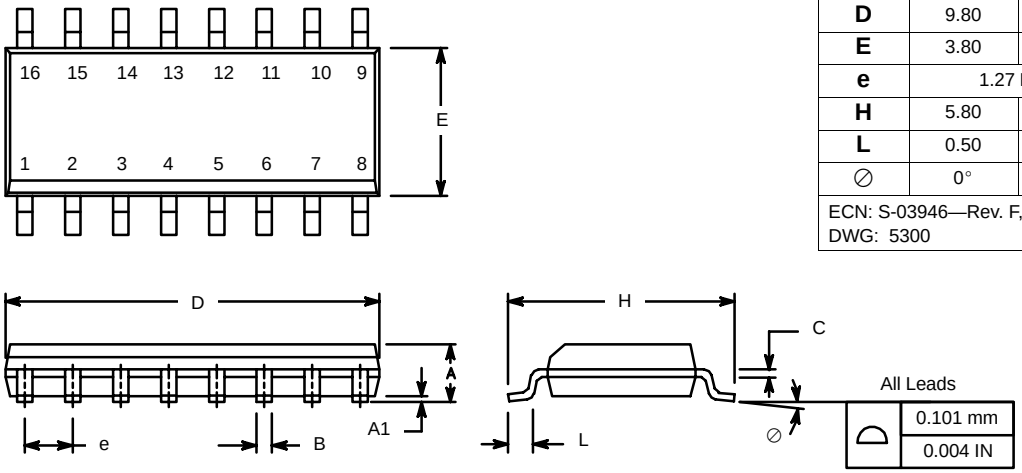
Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?72626.

SOIC (NARROW): 16-LEAD

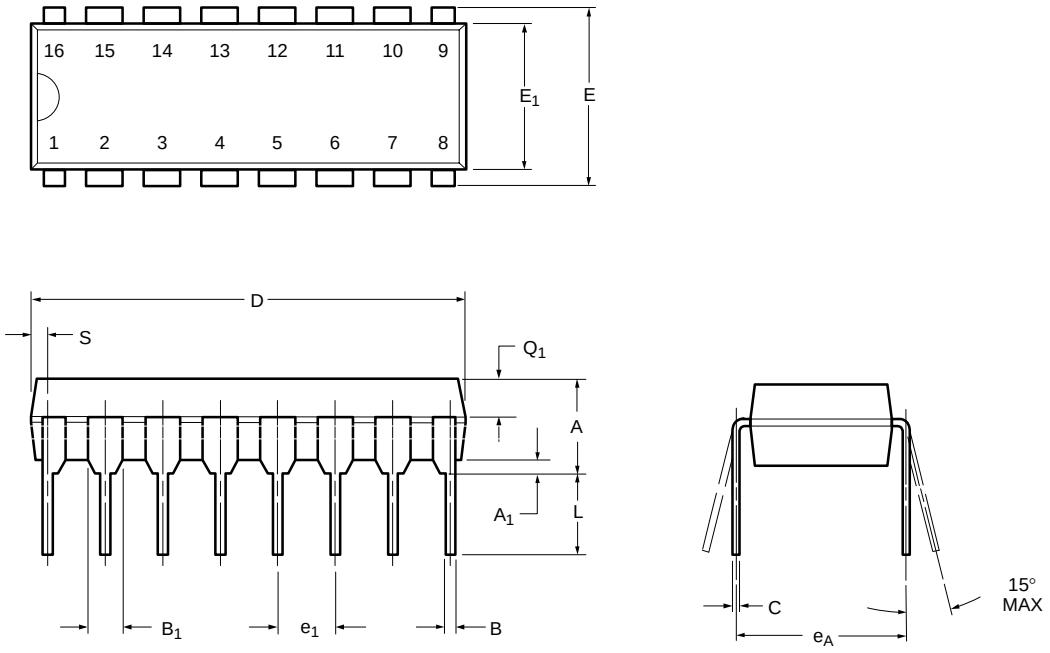
JEDEC Part Number: MS-012

Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	1.35	1.75	0.053	0.069
A_1	0.10	0.20	0.004	0.008
B	0.38	0.51	0.015	0.020
C	0.18	0.23	0.007	0.009
D	9.80	10.00	0.385	0.393
E	3.80	4.00	0.149	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
L	0.50	0.93	0.020	0.037
⊘	0°	8°	0°	8°

ECN: S-03946—Rev. F, 09-Jul-01
DWG: 5300

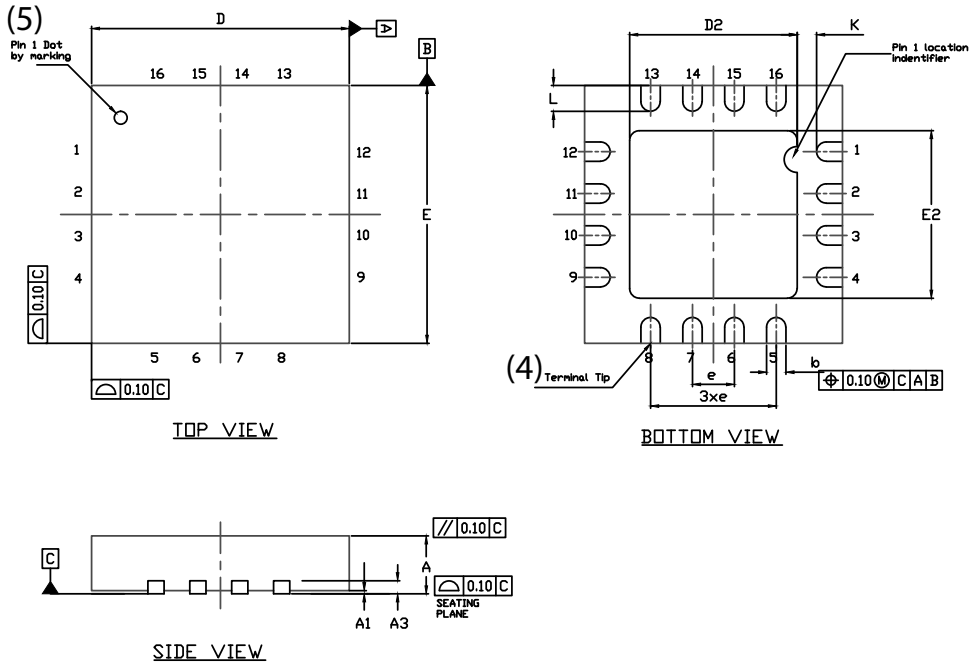


PDIP: 16-LEAD



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	3.81	5.08	0.150	0.200
A_1	0.38	1.27	0.015	0.050
B	0.38	0.51	0.015	0.020
B_1	0.89	1.65	0.035	0.065
C	0.20	0.30	0.008	0.012
D	18.93	21.33	0.745	0.840
E	7.62	8.26	0.300	0.325
E_1	5.59	7.11	0.220	0.280
e_1	2.29	2.79	0.090	0.110
e_A	7.37	7.87	0.290	0.310
L	2.79	3.81	0.110	0.150
Q_1	1.27	2.03	0.050	0.080
S	0.38	1.52	.015	0.060
ECN: S-03946—Rev. D, 09-Jul-01 DWG: 5482				

QFN 4x4-16L Case Outline



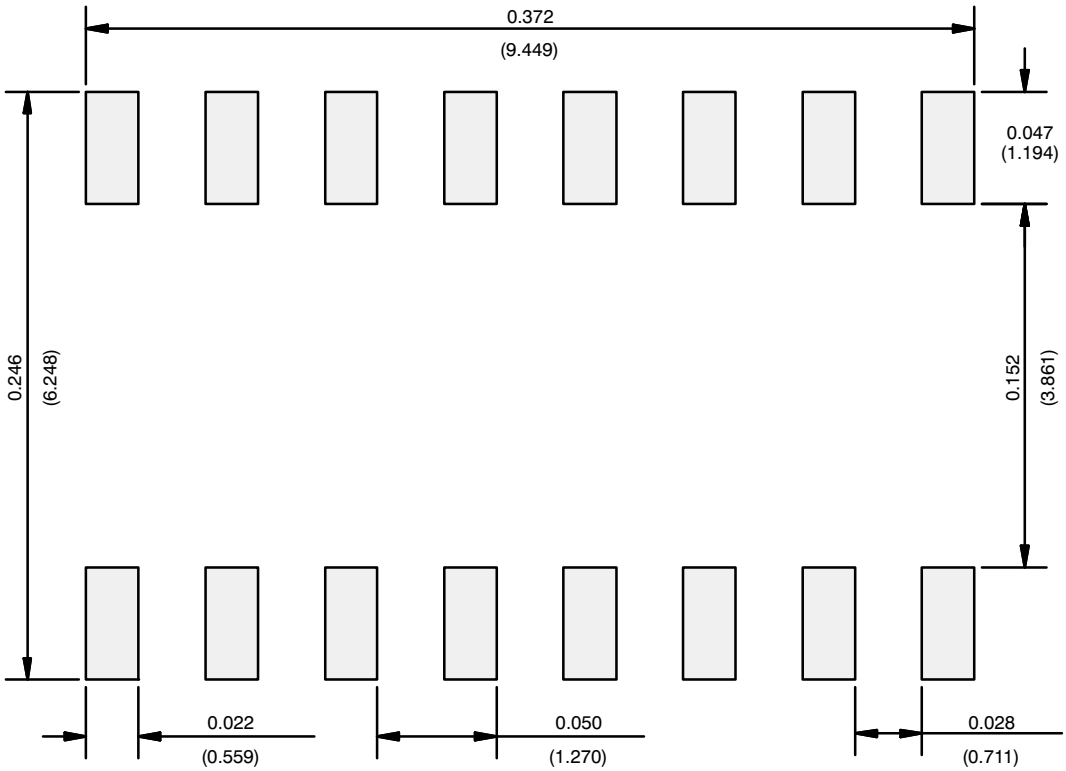
DIM	VARIATION 1						VARIATION 2					
	MILLIMETERS[1]			INCHES			MILLIMETERS[1]			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.75	0.85	0.95	0.029	0.033	0.037	0.75	0.85	0.95	0.029	0.033	0.037
A1	0	-	0.05	0	-	0.002	0	-	0.05	0	-	0.002
A3	0.20 ref.			0.008 ref.			0.20 ref.			0.008 ref.		
b	0.25	0.30	0.35	0.010	0.012	0.014	0.25	0.30	0.35	0.010	0.012	0.014
D	4.00 BSC			0.157 BSC			4.00 BSC			0.157 BSC		
D2	2.0	2.1	2.2	0.079	0.083	0.087	2.5	2.6	2.7	0.098	0.102	0.106
e	0.65 BSC			0.026 BSC			0.65 BSC			0.026 BSC		
E	4.00 BSC			0.157 BSC			4.00 BSC			0.157 BSC		
E2	2.0	2.1	2.2	0.079	0.083	0.087	2.5	2.6	2.7	0.098	0.102	0.106
K	0.20 min.			0.008 min.			0.20 min.			0.008 min.		
L	0.5	0.6	0.7	0.020	0.024	0.028	0.3	0.4	0.5	0.012	0.016	0.020
N[3]	16			16			16			16		
Nd[3]	4			4			4			4		
Ne[3]	4			4			4			4		

Notes

(1) Use millimeters as the primary measurement.
(2) Dimensioning and tolerances conform to ASME Y14.5M. - 1994.
(3) N is the number of terminals. Nd and Ne is the number of terminals in each D and E site respectively.
(4) Dimensions b applies to plated terminal and is measured between 0.15 mm and 0.30 mm from terminal tip.
(5) The pin 1 identifier must be existed on the top surface of the package by using identification mark or other feature of package body.
(6) Package warpage max. 0.05 mm.

ECN: S13-0893-Rev. B, 22-Apr-13
DWG: 5890

RECOMMENDED MINIMUM PADS FOR SO-16



Recommended Minimum Pads
Dimensions in Inches/(mm)

Return to Index

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