

DG5140-5145

Low-Power – High-Speed CMOS Analog Switches



T-51-11

FEATURES

- ± 15 Volt Input Range
- ON Resistance $< 50 \Omega$
- Very Fast Switching Action
($t_{ON} < 100$ ns)
($t_{OFF} < 75$ ns)
- Ultra Low Power Requirements
($I_S < 1 \mu A$)
- TTL and CMOS Compatible

BENEFITS

- Improved Signal Headroom
- Low Signal Errors
- Break-Before-Make Switching Action
- Reduced Power Consumption
- Simple Interfacing

APPLICATIONS

- Audio Switching
- Precision Switching
- High-Speed Switching
- Battery-Operated Systems

DESCRIPTION

The DG5140 family of solid state analog switches is built on the Siliconix proprietary high voltage silicon gate process to achieve high voltage rating and superior switch time ON/OFF performance. Key performance features of the DG5140 series are break-before-make switching action to guarantee that an ON channel will be turned OFF before the OFF channel can turn ON, ultra-low power supply requirements, and TTL and CMOS compatibility. Each switch conducts equally well in both directions when ON and blocks up to 30 Volts peak-to-peak when OFF. With switch OFF leakage less than 100 pA and maximum power supply current of 1 μA

(A Suffix), these switches are ideal for battery powered industrial and military applications. An epitaxial layer prevents latchup.

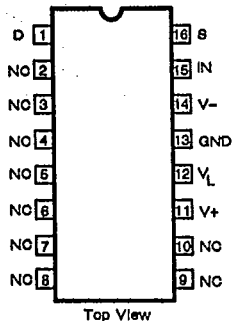
There are six devices in this series, which are differentiated by the type of switch action as shown in the functional block diagrams. In all cases the switches are bidirectional and maintain almost constant ON resistance throughout their operating range.

Package options include the 16-pin plastic and ceramic DIP. Temperature grades include commercial, C suffix (0 to 70°C), and military, A suffix (-55 to 125°C).

PIN CONFIGURATION

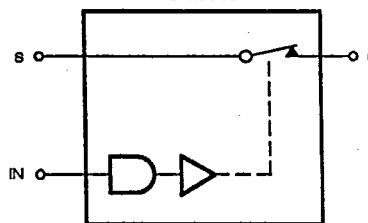
FUNCTIONAL BLOCK DIAGRAM

Dual-In-Line Package



Order Numbers:
CerDIP: DG5140AK, DG5140AK/883,
 DG5140CK
Plastic: DG5140CJ

DG5140



One SPST Switch per Package

Truth Table *

LOGIC	SWITCH
0	OFF
1	ON

Logic "0" ≤ 0.8 V
Logic "1" ≥ 2.4 V

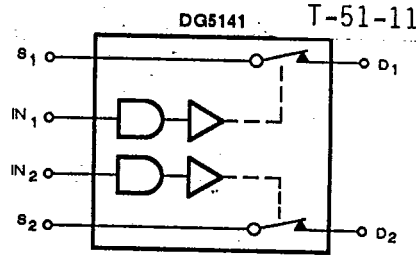
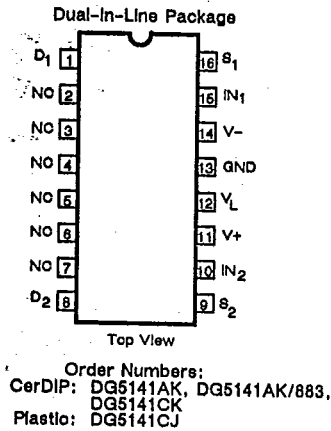
* Switches Shown for Logic "1" Input



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PIN CONFIGURATION (Cont'd)

FUNCTIONAL BLOCK DIAGRAM (Cont'd)

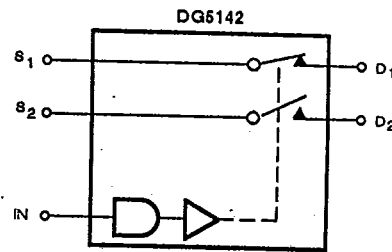
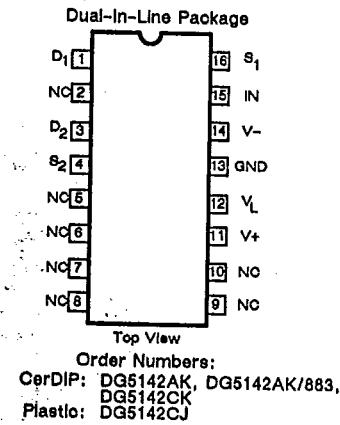


Two SPST Switches per Package

Truth Table *

LOGIC	SWITCH
0	OFF
1	ON

Logic "0" 0.8 V
Logic "1" 2.4 V

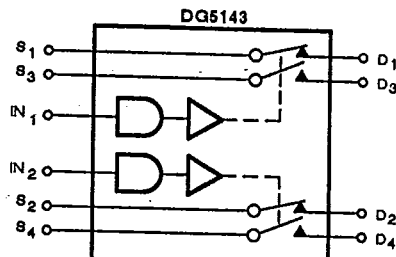
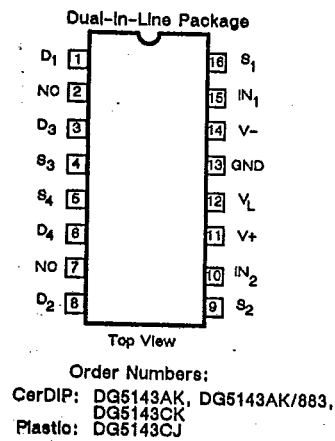


One SPDT Switch per Package

Truth Table *

LOGIC	SWITCH 1	SWITCH 2
0	OFF	ON
1	ON	OFF

Logic "0" 0.8 V
Logic "1" 2.4 V



Two SPDT Switches per Package

Truth Table *

LOGIC	SWITCH 1 SWITCH 2	SWITCH 3 SWITCH 4
0	OFF	ON
1	ON	OFF

Logic "0" 0.8 V
Logic "1" 2.4 V

* Switches Shown for Logic "1" Input

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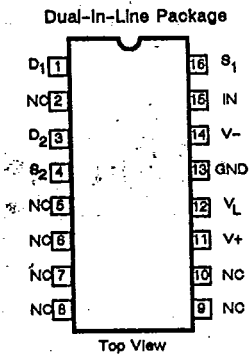
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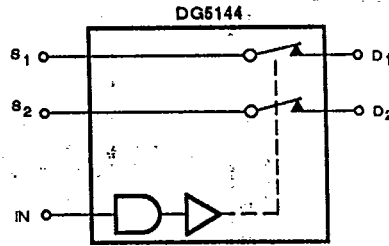
PIN CONFIGURATION (Cont'd)

FUNCTIONAL BLOCK DIAGRAM (Cont'd)

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Order Numbers:
 CerDIP: DG5144AK, DG5144AK/883,
 DG5144CK
 Plastic: DG5144CJ

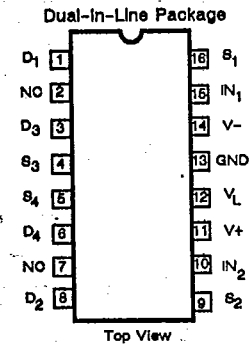


One DPST Switch per Package

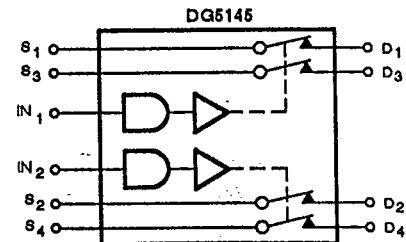
Truth Table *

LOGIC	SWITCH
0	OFF
1	ON

Logic "0" \approx 0.8 V
 Logic "1" \approx 2.4 V



Order Numbers:
 CerDIP: DG5145AK, DG5145AK/883,
 DG5145CK
 Plastic: DG5145CJ



Two DPST Switches per Package

Truth Table *

LOGIC	SWITCH
0	OFF
1	ON

Logic "0" \approx 0.8 V
 Logic "1" \approx 2.4 V

* Switches Shown for Logic "1" Input

ABSOLUTE MAXIMUM RATINGS

(V+) - (V-)	< 36 V
(V+) - (V _D)	< 30 V
(V _D) - (V-)	< 30 V
(V _D) - (V _S)	< ±22 V
(V _L) - (V-)	< 33 V
(V _L) - (V _{IN})	< 30 V
V _L	< 20 V
V _{IN}	< 20 V
Continuous Current, Any Terminal	30 mA

Peak Current, S or D (Pulsed at 1 ms, 10% duty cycle max)	100 mA
Storage Temperature (A Suffix)	-85 to 150°C
(C Suffix)	-85 to 125°C
Operating Temperature (A Suffix)	-55 to 125°C
(C Suffix)	0 to 70°C
Power Dissipation (Package)*	
16-Pin Plastic DIP**	450 mW
16-Pin CerDIP***	900 mW

* All leads welded or soldered to PC board.

** Derate 8 mW/°C above 75°C.

*** Derate 12 mW/°C above 75°C.



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ELECTRICAL CHARACTERISTICS ^a

PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V ₊ = 15 V V ₋ = -15 V V _L = 5 V GND = 0 V V _{IN} = 2.4 V, 0.8 V ^o	LIMITS						UNIT
			1=25°C		A SUFFIX -55 to 125°C		C SUFFIX 0 to 70°C		
			TEMP	TYP ^d	MIN ^b	MAX ^b	MIN ^b	MAX ^b	
SWITCH									
Analog Signal Range ^o	V _{ANALOG}		1,2,3		-14	14	-14	14	V
Drain-Source ON Resistance	r _{DS(ON)}	V ₊ = 15 V, V ₋ = -15 V I _S = -10 mA, V _D = ±10 V	1 2, 3			50 75		75 100	Ω
Switch OFF Leakage Current	I _{S(OFF)}	V _D = -10 V, V _S = 10 V V _D = 10 V, V _S = -10 V	1 2			0.5 20		5 20	nA
	I _{D(OFF)}		1 2			0.5 20		5 20	
Channel ON Leakage Current	I _{D(ON)} + I _{S(ON)}	V _S = V _D = -10 to 10 V	1 2			1 40		2 40	
INPUT									
Input Current with V _{IN} LOW	I _{IL}	V _{IN} under test = 0.8 V All Other = 2.4 V	1,2			1		1	μA
Input Current with V _{IN} HIGH	I _{IH}	V _{IN} under test = 2.4 V All Other = 0.8 V	1,2			1		1	
DYNAMIC									
Turn-ON Time	t _{ON}	R _L = 300Ω, C _L = 35 pF See Figure 1 DG5140-DG5145	1			150		175	ns
Turn-OFF Time	t _{OFF}		1			125		150	
Switch ON Time ^o	t _{ON}	DG5140 DG5141	Figure 2	1		100		150	
			Figure 3	1		150		175	
		DG5142 DG5143	Figure 2 and 4	1		175		250	
			Figure 5	1		200		300	
Switch OFF Time ^o	t _{OFF}	DG5140 DG5141	Figure 2	1		75		125	
			Figure 3	1		125		150	
		DG5142 DG5143 DG5144 DG5145	Figures 2,3,4 and 5	1		125		150	
				1		125		150	

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ELECTRICAL CHARACTERISTICS ^a		T-51-11							
PARAMETER ^f	SYMBOL	Test Conditions Unless Otherwise Specified: V ₊ = 15 V V ₋ = -15 V V _L = 5 V GND = 0 V V _{IN} = 2.4 V, 0.8 V ^e	LIMITS						
			1=25°C		A SUFFIX -55 to 125°C		C SUFFIX 0 to 70°C		
			TEMP	TYP ^d	MIN ^b	MAX ^b	MIN ^b	MAX ^b	UNIT
Break-Before-Make Time	t _{ON} - t _{OFF}	See Figure 2	1		10		5		ns
Charge Injection ^o	Q	C _L = 10,000 pF V _{gen} = 0 V, R _{gen} = 0 Ω	1			100		150	pC
Off Isolation ^o		R _L = 100 Ω, C _L ≤ 5 pF f = 1 MHz	1		-54		-50		dB
Crosstalk ^o (Channel-to-Channel)		Any Other Channel Switches R _L = 100 Ω, C _L ≤ 5 pF f = 1 MHz	1			-54		-50	
SUPPLY									
Positive Supply Current	I ₊	V _{IN} = 0 V or 5 V Switch Duty Cycle < 10%	1			1		10	μA
Negative Supply Current	I ₋		1		-1		-10		
Logic Supply Current	I _L		1			1		10	
Ground Current	I _{GND}		1		-1		-10		

NOTES:

- a. Refer to PROCESS OPTION FLOWCHART for additional information.
- b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- c. Guaranteed by design, not subject to production test.
- d. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- e. V_{IN} = Input voltage to perform proper function.
- f. Signals on S_X, D_X or IN_X exceeding V₊ or V₋ will be clamped by internal diodes. Limit forward diode current to 30 mA.

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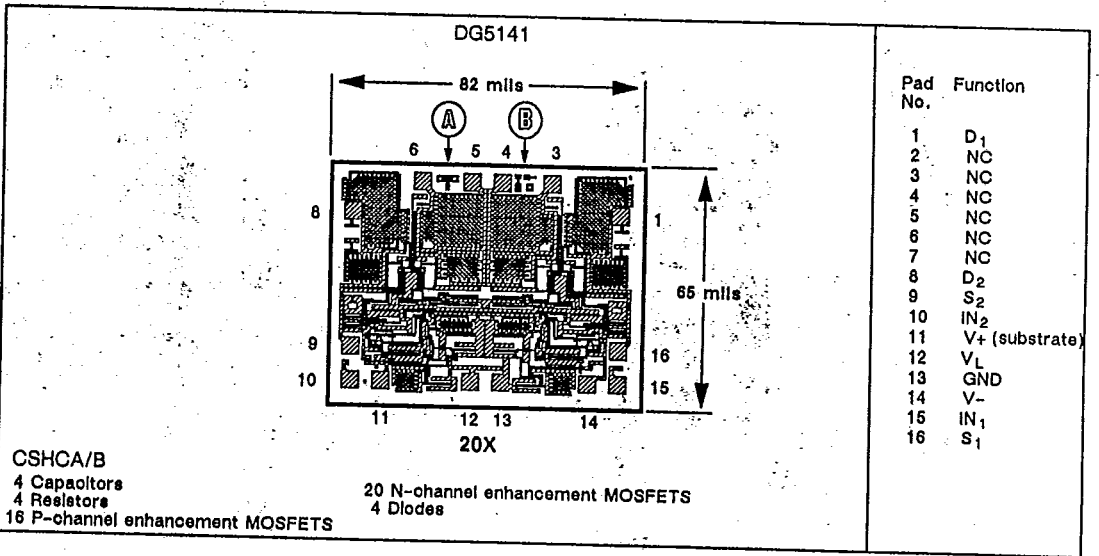
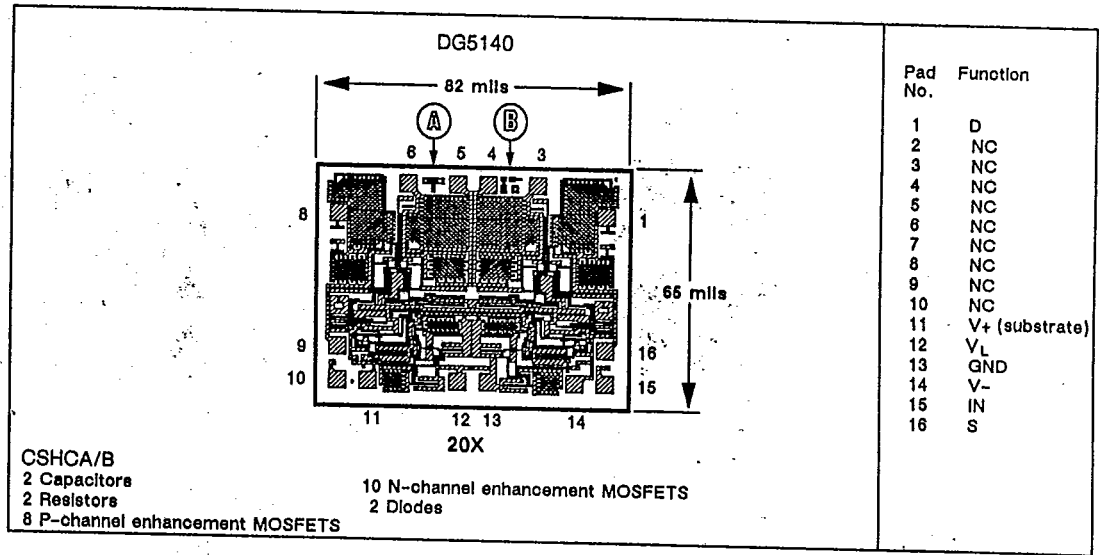
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DIE TOPOGRAPHY

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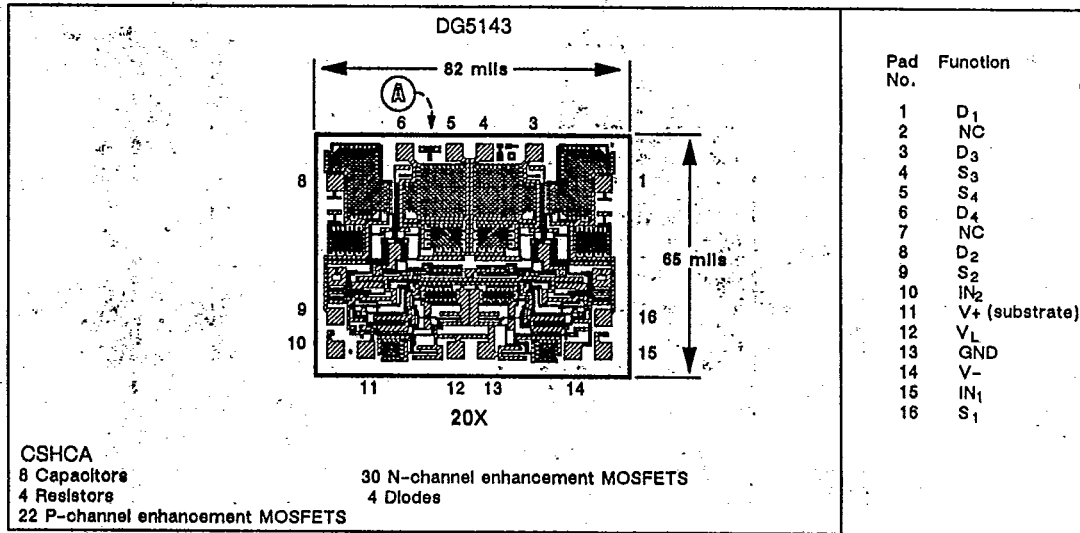
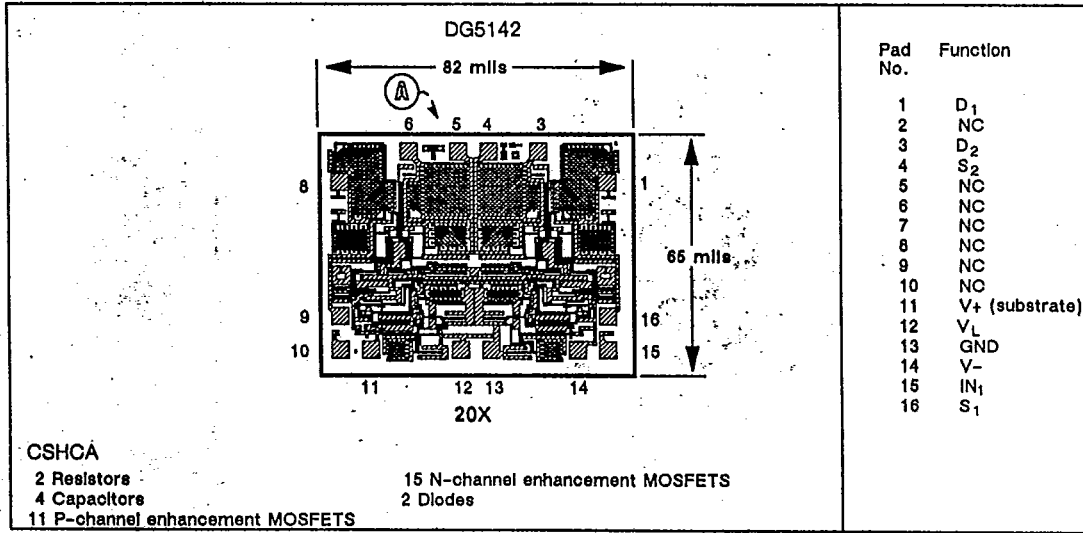
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DIE TOPOGRAPHY (Cont'd)

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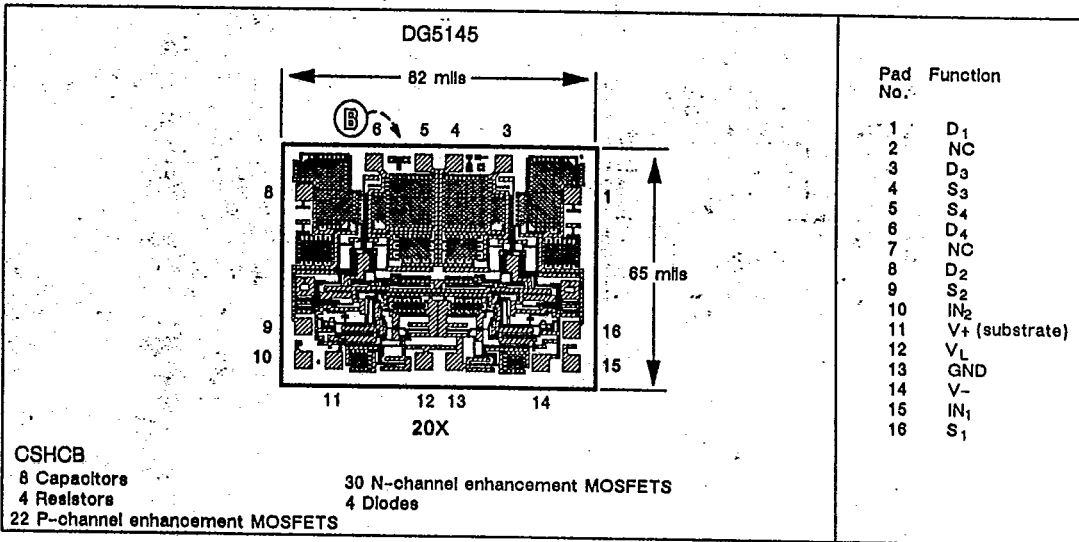
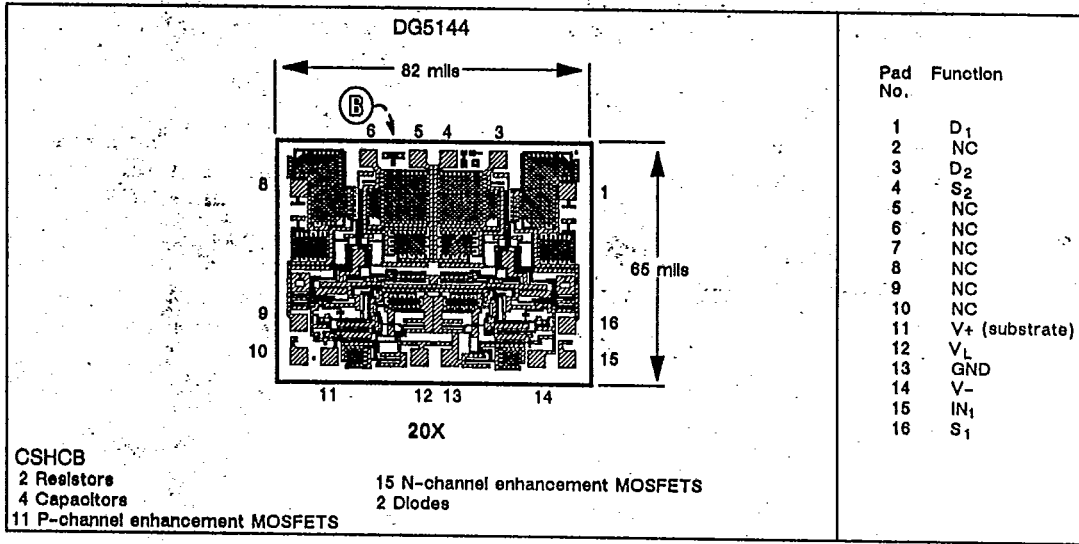




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DIE TOPOGRAPHY (Cont'd)

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SWITCHING TIME TEST CIRCUITS

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Switch output waveform shown for $V_S = \text{constant}$ with logic input waveform as shown. Note that V_S may be + or - as per switching time test circuit. V_O is the steady state output with switch ON. Feedthrough via gate capacitance may result in spikes at leading and trailing edge of output waveform.

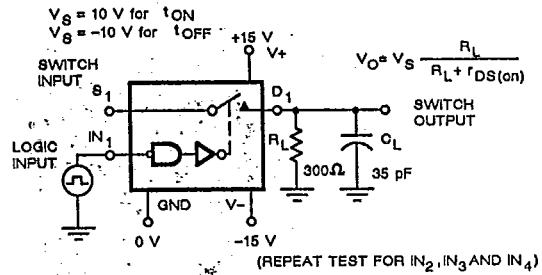
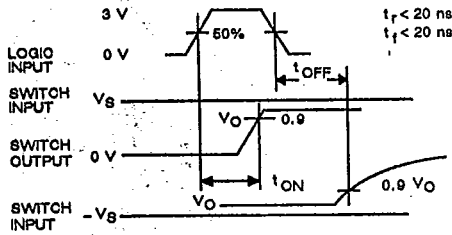


Figure 1.

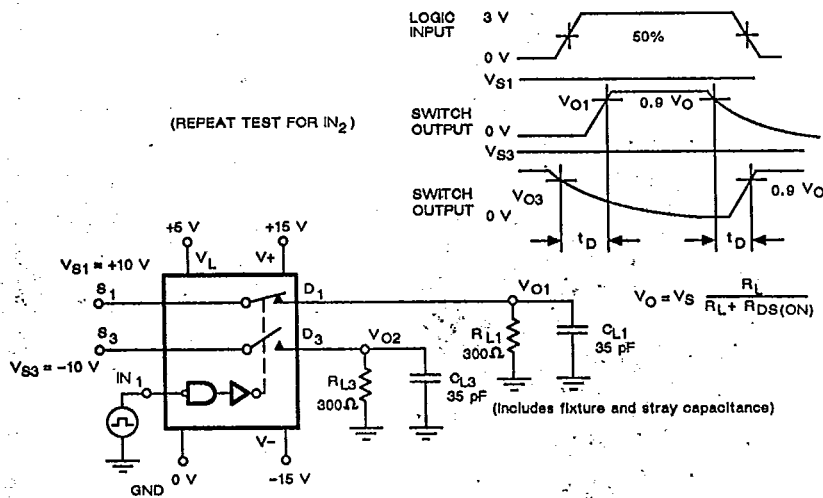


Figure 2.