

DG143/144/146

SPDT JFET

Analog Switches

FEATURES

- Low Standby Power ($< 1 \mu\text{W}$)
- Bipolar Drivers
- Constant $r_{DS(ON)}$ Over Signal Range
- High Off Isolation ($> 60 \text{ dB}$ @ 1 MHz)

BENEFITS

- Minimizes Standby Power Requirement
- Better Radiation Tolerance
- Less Signal Distortion
- Higher Frequency Switching

APPLICATIONS

- Portable and Battery Powered Systems
- Switching in Satellite Applications
- Low Distortion Circuits
- High Frequency Switching Circuits

DESCRIPTION

The DG143, DG144, and DG146 are precision single-pole double-throw analog switches designed for use in low distortion, high frequency circuits.

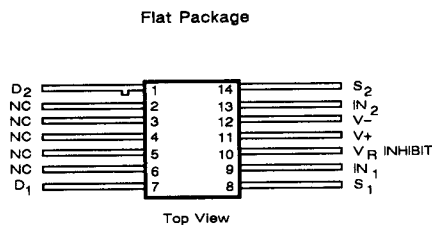
ON resistance of the DG143 is $< 80 \Omega$, the DG144 $< 30 \Omega$ and the DG146 is $< 10 \Omega$ and ON shunt leakage for all three is $< 2 \text{ nA}$. With the driver in the "switch OFF" state, total power consumption is $< 750 \mu\text{W}$. By using the JFET process, all three analog switches are relatively radiation tolerant.

The DG143, DG144 and DG146 each contain two junction-type field-effect transistors (JFETs) designed to function as single-pole double-throw electronic switches. Level-shifting drivers enable low-level inputs (2 to 3 V) to control the ON-OFF state of the switches. The driver inputs are connected differentially, therefore with input IN_2

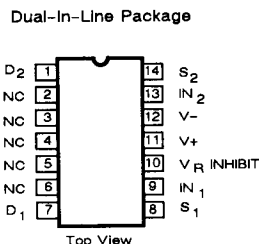
connected to a 2.5 voltage reference, a positive logic "0" at the input IN_1 will turn switch 1 OFF and switch 2 ON. A positive logic "1" at IN_1 will turn switch 1 ON and switch 2 OFF. The normally grounded V_R terminal may be used as an "inhibit" terminal, in which case all switches may be held OFF with a positive voltage applied to V_R . In the ON state each switch conducts equally well in either direction, and in the OFF state each switch will block voltages up to 20 V peak-to-peak.

Packaging for this series include a 14-pin side braze and flatpack options. Performance grades include both a military, A suffix (-55 to 125°C) and industrial, B suffix (-25 to 85°C) temperature range. The flatpack option is only available in the military grade.

PIN CONFIGURATION

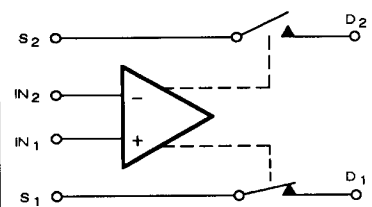


Order Numbers:
DG143AL/883, DG144AL/883
or DG146AL/883



Order Numbers:
DG143AP, DG143BP
DG144AP, DG144BP
DG146AP, DG146BP

FUNCTIONAL BLOCK DIAGRAM



One SPDT Switch per Package*

Truth Table

LOGIC	SW1	SW2
0	OFF	ON
1	ON	OFF

*Switches Shown for Logic "1" Input at IN_1 , and 2.5 V Reference at IN_2

ABSOLUTE MAXIMUM RATINGS

V_+ to V_- , V_D or V_S	33 V
V_D or V_S to V_-	33 V
V_D to V_S	± 22 V
V_+ to V_R	25 V
V_+ to V_{IN1} or V_{IN2}	25 V
V_R to V_-	25 V
V_{IN1} to V_{IN2}	± 3 V
V_{IN1} or V_{IN2} to V_R	± 3 V
V_{IN1} or V_{IN2} to V_-	30 V

Current, (Any Terminal) 30 mA

Storage Temperature -65 to 150°C

Operating Temperature (A Suffix) -55 to 125°C
(B Suffix) -25 to 85°C

Power Dissipation*

Flat Package** 750 mW

14-Pin DIP*** 825 mW

* All leads welded or soldered to PC board.

** Derate 10 mW/°C above 75°C.

*** Derate 11 mW/°C above 75°C.

ELECTRICAL CHARACTERISTICS ^a											DG143	
PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V ₊ = 12 V V ₋ = -18 V V _R = 0 V V _{IF12} = 2.5 V				LIMITS						UNIT
						1=25°C 2=125,85°C 3=-55,-25°C		A SUFFIX -55 to 125°C		B SUFFIX -25 to 85°C		
						TEMP	TYP ^d	MIN ^b	MAX ^b	MIN ^b	MAX ^b	
SWITCH												
Analog Signal Range ^c	V _{ANALOG}					1,2,3		-10	10	-8	8	V
Drain-Source ON Resistance	r _{DS(ON)}	I _S = -10 mA V _{IN1} = 3 V (SW1 ON) V _{IN1} = 2 V (SW2 ON)	V _D = 10 V	1,3 2	30		80 150				Ω	
			V _D = 8 V	1,3 2	35				100 150			
Source OFF Leakage Current	I _{S(OFF)}	V _{IN1} = 2 V (SW1 OFF) V _{IN1} = 3 V (SW2 OFF)	V _S = 10 V V _D = -10 V	1 2	0.15		1 100				nA	
			V _S = 8 V V _D = -8 V	1 2	0.75				5 100			
Drain OFF Leakage Current	I _{D(OFF)}		V _D = 10 V V _S = -10 V	1 2	0.03		1 100					
			V _D = 8 V V _S = -8 V	1 2	0.15				5 100			
Channel ON Leakage Current	I _{D(ON)} + I _{S(ON)}	V _{IN1} = 3 V (SW1 ON) V _{IN1} = 2 V (SW2 ON)	V _D = V _S = -10 V	1 2	-0.05	-2 -100						
			V _D = V _S = -8 V	1 2	-0.12				-5 -100			
INPUT												
Input 1 Current Input 1 Voltage LOW	I _{IN1L}	V _{N1} = 2 V				1,3 2	0.001		0.1 2		4 4	μA
Input 2 Current Input 2 Voltage LOW	I _{IN2L}	V _{IN2} = 2 V, V _{IN1} = 2.5 V				1,3 2	0.001		0.1 2		4 4	

Not Recommended for New Designs

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ELECTRICAL CHARACTERISTICS ^a											DG143	
PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V ₊ = 12 V V ₋ = -18 V V _R = 0 V V _{IN2} = 2.5 V			LIMITS						UNIT	
					1=25°C 2=125,85°C 3=-55,-25°C		A SUFFIX -55 to 125°C		B SUFFIX -25 to 85°C			
					TEMP	TYP ^d	MIN ^b	MAX ^b	MIN ^b	MAX ^b		
INPUT (Cont'd)												
Input 1 Current Input 1 Voltage HIGH	I _{IN1H}	V _{IN1} = 3 V			1,2 3	25 35		60 120		100 150	μA	
Input 2 Current Input 2 Voltage HIGH	I _{IN2H}	V _{IN2} = 3 V, V _{IN1} = 2.5 V			1,2 3	25 35		60 120		100 150		
DYNAMIC												
Turn-ON Time	t _{ON}	See Switching Time Test Circuit ^e				1	0.5		0.8		1	μs
Turn-OFF Time	t _{OFF}					1	1.1		1.6		2	
Drain-OFF Capacitance	C _{D(OFF)}	f = 1 MHz	V _D = 0 V I _S = 0	1	2.4						pF	
Source-OFF Capacitance	C _{S(OFF)}		V _S = 0 V I _D = 0	1	2.4							
Channel-ON Capacitance	C _{D(ON)} + C _{S(ON)}		V _D = V _S = 0 V	1	2.8							
OFF Isolation		R _L = 75 Ω , f = 1 MHz				1	> 60					dB
SUPPLY												
Positive Supply Current	I ₊	One Channel ON V _{IN1} = 2 V or V _{IN1} = 3 V				1	2.6		4.2		4.5	mA
Negative Supply Current	I ₋					1	-1.3	-2		-2.2		
Reference Supply Current	I _R					1	-1.4	-2.2		-2.4		
Positive Supply Current	I ₊	All Channels OFF V _{IN1} = V _{IN2} = 0.8 V				1	0.75		25		25	μA
Negative Supply Current	I ₋					1	-1	-25		-25		
Reference Supply Current	I _R					1	0.5	-25		-25		

ELECTRICAL CHARACTERISTICS ^a										DG144
PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V ₊ = 12 V V ₋ = -18 V V _R = 0 V V _{IN2} = 2.5 V		LIMITS						UNIT
				1=25°C 2=125,85°C 3=-55,-25°C		A SUFFIX -55 to 125°C		B SUFFIX -25 to 85°C		
				TEMP	TYP ^d	MIN ^b	MAX ^b	MIN ^b	MAX ^b	
SWITCH										
Analog Signal Range ^c	V _{ANALOG}			1,2,3		-10	10	-8	8	V
Drain-Source ON Resistance	r _{DS(ON)}	I _S = -10 mA V _{IN1} = 3 V (SW1 ON) V _{IN1} = 2 V (SW2 ON)	V _D = 10 V	1,3 2	20		30 60			Ω
			V _D = 8 V	1,3 2	35				50 75	
Source OFF Leakage Current	I _{S(OFF)}	V _{IN1} = 2 V (SW1 OFF); V _{IN1} = 3 V (SW2 OFF);	V _S = 10 V V _D = -10 V	1 2	0.15		1 100			nA
			V _S = 8 V V _D = -8 V	1 2	0.75				5 100	
Drain OFF Leakage Current	I _{D(OFF)}		V _D = 10 V V _S = -10 V	1 2	0.03		1 100			
			V _D = 8 V V _S = -8 V	1 2	0.15				5 100	
Channel ON Leakage Current	I _{D(ON)} + I _{S(ON)}	V _{IN1} = 3 V (SW1 ON) V _{IN1} = 2 V (SW2 ON)	V _D = V _S = -10 V	1 2	-0.05	-2 -100				
			V _D = V _S = -8 V	1 2	-0.12			-5 -100		
INPUT										
Input 1 Current Input 1 Voltage LOW	I _{IN1L}	V _{IN1} = 2 V		1,3 2	0.001		0.1 2		4 4	μA
Input 2 Current Input 2 Voltage LOW	I _{IN2L}	V _{IN2} = 2 V, V _{IN1} = 2.5 V		1,3 2	0.001		0.1 2		4 4	
Input 1 Current Input 1 Voltage HIGH	I _{IN1H}	V _{IN1} = 3 V		1,2 3	20		60 120		100 150	
Input 2 Current Input 2 Voltage HIGH	I _{IN2H}	V _{IN2} = 3 V, V _{IN1} = 2.5 V		1,2 3	20		60 120		100 150	
DYNAMIC										
Turn-ON Time	t _{ON}	See Switching Time Test Circuit ^e		1	0.5		0.8		1	μs
Turn-OFF Time	t _{OFF}			1	1.0		1.6		2	

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ELECTRICAL CHARACTERISTICS ^a										DG144	
PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V ₊ = 12 V V ₋ = -18 V V _R = 0 V V _{IN2} = 2.5 V			LIMITS						UNIT
					1=25°C 2=125,85°C 3=-55,-25°C		A SUFFIX -55 to 125°C		B SUFFIX -25 to 85°C		
					TEMP	TYP ^d	MIN ^b	MAX ^b	MIN ^b	MAX ^b	
DYNAMIC (Cont'd)											
Drain-OFF Capacitance	C _{D(OFF)}	f = 1 MHz	V _D = 0 V I _S = 0	1	2.4					pF	
Source-OFF Capacitance	C _{S(OFF)}		V _S = 0 V I _D = 0	1	2.4						
Channel-ON Capacitance	C _{D(ON)} + C _{S(ON)}		V _D = V _S = 0 V	1	2.8						
OFF Isolation		R _L = 75 Ω, f = 1 MHz			1	>60				dB	
SUPPLY											
Positive Supply Current	I ₊	One Channel ON V _{IN1} = 2 V or V _{IN1} = 3 V		1	2.6		4.2		4.5	mA	
Negative Supply Current	I ₋			1	-1.3	-2		-2.2			
Reference Supply Current	I _R			1	-1.4	-2.2		-2.4			
Positive Supply Current	I ₊	All Channels OFF V _{IN1} = V _{IN2} = 0.8 V		1	0.75		25		25	μA	
Negative Supply Current	I ₋			1	-1	-25		-25			
Reference Supply Current	I _R			1	-0.5	-25		-25			

ELECTRICAL CHARACTERISTICS ^a										DG146	
PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V ₊ = 12 V V ₋ = -18 V V _R = 0 V V _{IN2} = 2.5 V		LIMITS						UNIT	
				1=25°C		A SUFFIX		B SUFFIX			
				2=125, 85°C		-55 to 125°C		-25 to 85°C			
				3=-55, -25°C							
				TEMP	TYP ^d	MIN ^b	MAX ^b	MIN ^b	MAX ^b		
SWITCH											
Analog Signal Range ^c	V _{ANALOG}				1, 2, 3		-10	10	-8	8	V
Drain-Source ON Resistance	r _{DS(ON)}	I _S = -10 mA V _{IN1} = 3 V (SW1 ON)	V _D = 10 V	1, 3 2	7		10 20			Ω	
			V _D = 8 V	1, 3 2					15 25		

ELECTRICAL CHARACTERISTICS ^a										DG146
PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V ₊ = 12 V V ₋ = -18 V V _R = 0 V V _{N2} = 2.5 V		LIMITS						UNIT
				1=25°C 2=125,85°C 3=-55,-25°C		A SUFFIX -55 to 125°C		B SUFFIX -25 to 85°C		
				TEMP	TYP ^d	MIN ^b	MAX ^b	MIN ^b	MAX ^b	
SWITCH (Cont'd)										
Source OFF Leakage Current	I _{S(OFF)}	V _{IN1} = 2 V (SW1 OFF) V _{IN1} = 3 V (SW2 OFF)	V _S = 10 V V _D = -10 V	1 2	0.1		10 1000			nA
			V _S = 8 V V _D = -8 V	1 2					15 300	
Drain OFF Leakage Current	I _{D(OFF)}		V _D = 10 V V _S = -10 V	1 2	0.1		10 1000			
			V _D = 8 V V _S = -8 V	1 2					15 300	
Channel ON Leakage Current	I _{D(ON)} + I _{S(ON)}	V _{IN1} = 3 V (SW1 ON) V _{IN1} = 2 V (SW2 ON)	V _D = V _S = -10 V	1 2	-0.04	-2 -100				
			V _D = V _S = -8 V	1 2				-5 -100		
INPUT										
Input 1 Current Input 1 Voltage LOW	I _{IN1L}	V _{N1} = 2 V		1,3 2	0.001		0.1 2		4 4	μA
Input 2 Current Input 2 Voltage LOW	I _{IN2L}	V _{IN2} = 2 V, V _{IN1} = 2.5 V		1,3 2	0.001		0.1 2		4 4	
Input 1 Current Input 1 Voltage HIGH	I _{IN1H}	V _{IN1} = 3 V		1,2 3	20		60 120		100 150	
Input 2 Current Input 2 Voltage HIGH	I _{IN2H}	V _{IN2} = 3 V, V _{IN1} = 2.5 V		1,2 3	20		60 120		100 150	
DYNAMIC										
Turn-ON Time	t _{ON}	See Switching Time Test Circuit ^e		1	0.5		1		1.5	μs
Turn-OFF Time	t _{OFF}			1	1.2		2.5		2.5	
Drain-OFF Capacitance	C _{D(OFF)}	f = 1 MHz	V _D = 0 V I _S = 0	1	3					pF
Source-OFF Capacitance	C _{S(OFF)}		V _S = 0 V I _D = 0	1	3					
Channel-ON Capacitance	C _{D(ON)} + C _{S(ON)}		V _D = V _S = 0 V	1	2.8					
OFF Isolation		R _L = 75 Ω, f = 1 MHz		1	>50					dB

Not Recommended for New Designs

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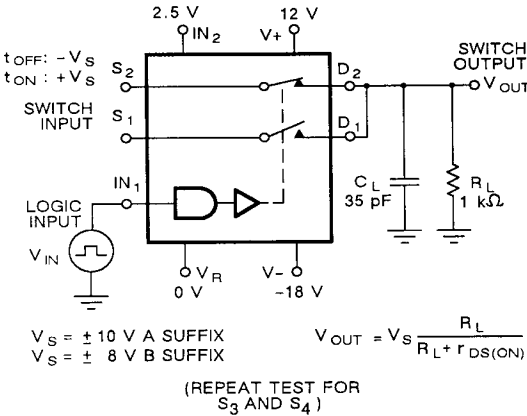
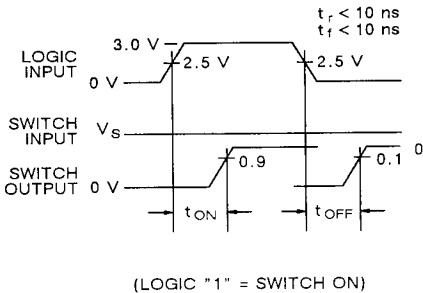
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ELECTRICAL CHARACTERISTICS ^a										DG146
PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V ₊ = 12 V V ₋ = -18 V V _R = 0 V V _{IN2} = 2.5 V	LIMITS						UNIT	
			1=25°C 2=125,85°C 3=-55,-25°C		A SUFFIX -55 to 125°C		B SUFFIX -25 to 85°C			
			TEMP	TYP ^d	MIN ^b	MAX ^b	MIN ^b	MAX ^b		
SUPPLY										
Positive Supply Current	I ₊	One Channel ON V _{IN1} = 2 V or V _{IN1} = 3V	1	2.6		4.2		4.5	mA	
Negative Supply Current	I ₋		1	-1.2	-2		-2.2			
Reference Supply Current	I _R		1	-1.4	-2.2		-2.4			
Positive Supply Current	I ₊	All Channels OFF V _{IN1} = V _{IN2} = 0.8 V	1	0.75		25		25	μA	
Negative Supply Current	I ₋		1	-1	-25		-25			
Reference Supply Current	I _R		1	-0.5	-25		-25			

- 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} must be a step function with a minimum rise and fall time of 1 V/μs.

SWITCHING TIME TEST CIRCUIT

Switch output waveform shown for V_S = 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.



APPLICATION HINTS

V ₊ Positive Supply Voltage (V)	V ₋ Negative Supply Voltage (V)	V _R Reference Voltage (V)	V _{IN1} Input 1 Voltage V _{INH} /V _{INL} (V)	V _{IN2} Input 2 Voltage (V)	V _S or V _D Analog Voltage Range (V)
12	-18	0	3/2	2.5	-10 to 10
15	-15	0	3/2	2.5	-7 to 13
10	-15	0	3/2	2.5	-7 to 8

Not Recommended for New Designs

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