DG139/142/145
Dual DPDT JFET Analog Swiches

Siliconix incorporated

FEATURES

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

BENEFITS

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

APPLICATIONS

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

DESCRIPTION

The DG139, DG142, and DG145 are precision dual double-pole double-throw analog switches designed for use in low distortion, high frequency circuits.

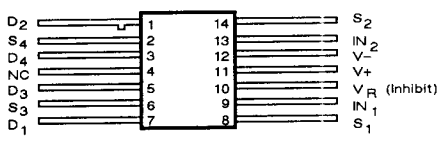
ON resistance of the DG139 is < 30 Ω, the DG142 < 80 Ω and the DG145 is < 10 Ω and ON shunt leakage for all three is < 2 nA. With both drivers in the "switch OFF" state, total power consumption is < 750 μW. By using the JFET process, all three analog switches are relatively radiation tolerant.

The DG139, DG142 and DG145 each contain four junction-type field-effect transistors (JFETs) designed to function as two double-pole double-throw electronic switches. Level-shifting drivers enable low-level inputs (2 V to 3 V) to control the ON-OFF state of the switches. The driver inputs are connected differentially, therefore with input IN2 connected to a 2.5 voltage reference, a positive logic "0" at the input IN1 will turn switches 1 and 3 OFF and switches 2 and 4 ON. A positive logic "1" at IN1 will turn switches 1 and 3 ON and switches 2 and 4 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 includes the 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

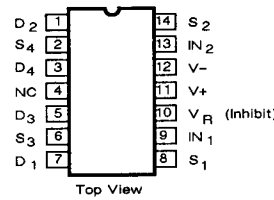
Flat Package



Top View

Order Numbers:
DG139AL/883, DG142AL/883
DG145AL/883

Dual-In-Line Package

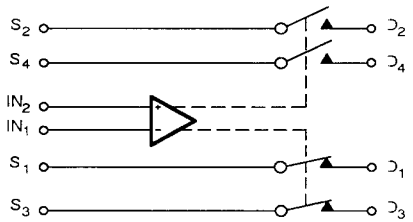


Top View

Order Numbers:
DG139AP, DG139BP
DG142AP, DG142BP

Not Recommended for New Designs

FUNCTIONAL BLOCK DIAGRAM



Two DPDT Switches per Package*

Truth Table

Logic	SW1 SW3	SW2 SW4
0	OFF	ON
1	ON	OFF

*Switches Shown for Logic "1" Input at IN_1 and a 2.5 V reference at IN_2

ABSOLUTE MAXIMUM RATINGS

$V+$ to $V-$, V_D or V_S ..... 36 V
V_D or V_S to $V-$ ..... 36 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} ..... ±6 V
V_{IN1} or V_{IN2} to V_R ..... ±6 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.

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ELECTRICAL CHARACTERISTICS [a]

DG139

PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: $V+$ = 12 V, $V-$ = -18 V, V_R = 0, V_{IN2} = 2.5 V		LIMITS 1=25°C 2=125,85°C 3=-55,-25°C TEMP	TYP [d]	A SUFFIX -55 to 125°C MIN [b]	A SUFFIX -55 to 125°C MAX [b]	B SUFFIX -25 to 85°C MIN [b]	B SUFFIX -25 to 85°C MAX [b]	UNIT
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, 3 ON), V_{IN1} = 2 V (SW2, 4 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, 3 OFF), V_{IN1} = 3 V (SW2, 4 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	

Not Recommended for New Designs

ELECTRICAL CHARACTERISTICS [a]

DG139

PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V+ = 12 V, V− = −18 V, V_R = 0, V_{IN2} = 2.5 V		LIMITS 1=25°C 2=125,85°C 3=−55,−25°C TEMP	TYP [d]	A SUFFIX −55 to 125°C MIN [b]	A SUFFIX −55 to 125°C MAX [b]	B SUFFIX −25 to 85°C MIN [b]	B SUFFIX −25 to 85°C MAX [b]	UNIT
SWITCH (Cont'd)										
Drain OFF Leakage Current	$I_{D(OFF)}$	V_{IN1} = 2 V (SW1, 3 OFF), V_{IN1} = 3 V (SW2, 4 OFF)	V_D = 10 V, V_S = −10 V	1 2	0.03		1 100			nA
			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, 3 ON), V_{IN1} = 2 V (SW2, 4 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			0.8		1	µs
Turn-OFF Time	t_{OFF}			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	OIRR	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		

Not Recommended for New Designs

ELECTRICAL CHARACTERISTICS [a]											DG139
		Test Conditions Unless Otherwise Specified: $V+ = 12$ V, $V- = -18$ V, $V_R = 0$, $V_{IN2} = 2.5$ V		LIMITS							
				1=25°C 2=125,85°C 3=-55,-25°C		A SUFFIX -55 to 125°C		B SUFFIX -25 to 85°C			
PARAMETER	SYMBOL			TEMP	TYP [d]	MIN [b]	MAX [b]	MIN [b]	MAX [b]	UNIT	
SUPPLY (Cont'd)											
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	-0.2	-25		-25			

ELECTRICAL CHARACTERISTICS [a]											DG142
		Test Conditions Unless Otherwise Specified: $V+ = 12$ V, $V- = -18$ V, $V_R = 0$, $V_{IN2} = 2.5$ V		LIMITS							
				1=25°C 2=125,85°C 3=-55,-25°C		A SUFFIX -55 to 125°C		B SUFFIX -25 to 85°C			
PARAMETER	SYMBOL			TEMP	TYP [d]	MIN [b]	MAX [b]	MIN [b]	MAX [b]	UNIT	
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, 3 ON) $V_{IN1} = 2$ V (SW2, 4 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, 3 OFF) $V_{IN1} = 3$ V (SW2, 4 OFF)	$V_S = 10$ V, $V_D = -10$ V	1 2	0.01		1 100			nA	
			$V_S = 8$ V, $V_D = -8$ V	1 2	0.05				5 100		
Drain OFF Leakage Current	$I_{D(OFF)}$	$V_{IN1} = 2$ V (SW1, 3 OFF) $V_{IN1} = 3$ V (SW2, 4 OFF)	$V_D = 10$ V, $V_S = -10$ V	1 2	0.005		1 100				
			$V_D = 8$ V, $V_S = -8$ V	1 2	0.025				5 100		
Channel ON Leakage Current	$I_{D(ON)} + I_{S(ON)}$	$V_{IN1} = 3$ V (SW1, 3 ON) $V_{IN1} = 2$ V (SW2, 4 ON)	$V_D = V_S = -10$ V	1 2	-0.02	-2 100					
			$V_D = V_S = -8$ V	1 2	-0.05			-5 -100			

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ELECTRICAL CHARACTERISTICS [a]

DG142

PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V+ = 12 V, V− = −18 V, V_R = 0, V_{IN2} = 2.5 V		LIMITS 1=25°C 2=125,85°C 3=−55,−25°C TEMP	TYP [d]	A SUFFIX −55 to 125°C MIN [b]	A SUFFIX −55 to 125°C MAX [b]	B SUFFIX −25 to 85°C MIN [b]	B SUFFIX −25 to 85°C MAX [b]	UNIT
INPUT										
Input 1 Current Input 1 Voltage LOW	I_{IN1L}	V_{IN1} = 2 V		1,3 2	0.0005		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	µA
Input 1 Current Input 1 Voltage HIGH	I_{IN1H}	V_{IN1} = 3 V		1,2 3	25		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		60 120		100 150	µA
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		2.0	µs
Drain-OFF Capacitance	$C_{D(OFF)}$	f = 1 MHz	V_D = 0 V, I_S = 0	1	2.4					pF
Source-OFF Capacitance	$C_{S(OFF)}$	f = 1 MHz	V_S = 0 V, I_D = 0	1	2.4					pF
Channel-ON Capacitance	$C_{D(ON)}$ + $C_{S(ON)}$	f = 1 MHz	V_D = V_S = 0 V	1	2.8					pF
OFF Isolation	OIRR	R_L = 75 Ω, f = 1 MHz		1	>60					dB
SUPPLY										
Positive Supply Current	I+	One Channel ON V_{IN1} = 2 V, V_{IN1} = 3 V		1	2.6		4.2		4.5	mA
Negative Supply Current	I−	One Channel ON V_{IN1} = 2 V, V_{IN1} = 3 V		1	−1.3	−2		−2.2		mA
Reference Supply Current	I_R	One Channel ON V_{IN1} = 2 V, V_{IN1} = 3 V		1	−1.4	−2.2		−2.4		mA
Positive Supply Current	I+	All Channels OFF V_{IN1} = V_{IN2} = 0.8 V		1	0.75		25		25	µA
Negative Supply Current	I−	All Channels OFF V_{IN1} = V_{IN2} = 0.8 V		1	−1	−25		−25		µA
Reference Supply Current	I_R	All Channels OFF V_{IN1} = V_{IN2} = 0.8 V		1	−0.2	−25		−25		µA

Not Recommended for New Designs

ELECTRICAL CHARACTERISTICS [a]

DG145

PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: $V_+ = 12$ V, $V_- = -18$ V, $V_R = 0$, $V_{IN2} = 2.5$ V		LIMITS 1=25°C, 2=125,85°C, 3=-55,-25°C		A SUFFIX -55 to 125°C		B SUFFIX -25 to 85°C		UNIT
				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, 3 ON), $V_{IN1} = 2$ V (SW2, 4 ON)	$V_D = 10$ V	1,3 2	7		10 20			Ω
			$V_D = 8$ V	1,3 2					15 25	
Source OFF Leakage Current	$I_{S(OFF)}$	$V_{IN1} = 2$ V (SW1, 3 OFF), $V_{IN1} = 3$ V (SW2, 4 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	$I_{D(OFF)}$	$V_{IN1} = 2$ V (SW1, 3 OFF), $V_{IN1} = 3$ V (SW2, 4 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, 3 ON), $V_{IN1} = 2$ V (SW2, 4 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}	$V_{IN1} = 2$ 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		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	$C_{D(ON)} + C_{S(ON)}$		$V_D = V_S = 0$	1	2.8					

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Not Recommended for New Designs

ELECTRICAL CHARACTERISTICS [a]

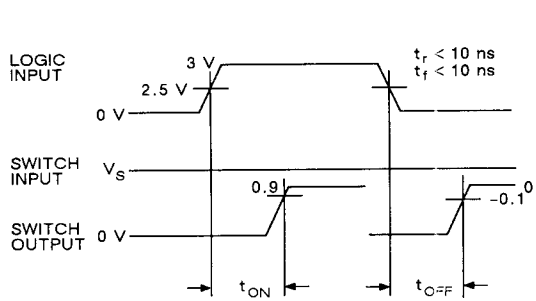
DG145

PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V+ = 12 V, V− = −18 V, V_R = 0, V_{IN2} = 2.5 V	LIMITS 1=25°C, 2=125,85°C, 3=−55,−25°C		A SUFFIX −55 to 125°C		B SUFFIX −25 to 85°C		UNIT
			TEMP	TYP [d]	MIN [b]	MAX [b]	MIN [b]	MAX [b]	
DYNAMIC (Cont'd)									
OFF Isolation	OIRR	R_L = 75 Ω, f = 1 MHz	1	>50					dB
SUPPLY									
Positive Supply Current	I+	One Channel ON V_{IN1} = 2 V, V_{IN1} = 3 V	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	−0.2	−25		−25		

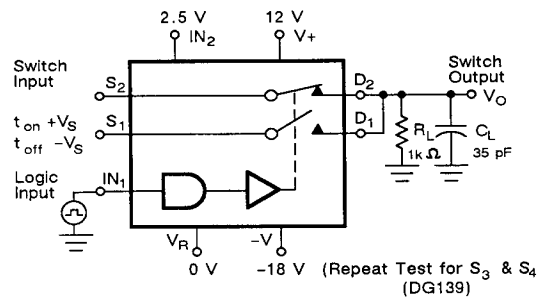
NOTES:
a. Refer to PROCESS OPTION FLOWCHART for additional information.
b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
c. Guaranteed by design, not subject to production test.
d. Typical values are for DESIGN AID ONLY, 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.



(LOGIC "1" = SWITCH ON)



V_S = ±10 V A Suffix
V_S = ± 8 V B Suffix

$$V_O = V_S \frac{R_L}{R_L + r_{DS(on)}}$$

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	-5 to 13
5	-15	0	3/2	2.5	-5 to 3