Siliconix incorporated

DG126/129/140 Dual DPST JFET Analog Switches

T-51-11

FEATURES

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

BENEFITS

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

APPLICATIONS

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

DESCRIPTION

The DG126, DG129 and DG140 are dual double-pole single-throw analog switches for use in instrumentation, process control, and audio communication systems. This series is ideally suited for applications requiring a constant ON resistance over the entire analog range.

ON resistance for the DG126 is < 80 Ω, the DG129 < 30 Ω and the DG140 < 10 Ω, and ON leakage for all three is < 2 nA. With all switches OFF, total power consumption is < 750 µW. These switches have Make-Before-Break action and due to the processing are relatively Radiation tolerant. An enable pin (V_R) simplifies interfacing with microprocessor, or other logic. Package options are the 14-pin side braze and flat pack.

Each device contains four junction-type field-effect transistors (JFETS) to achieve constant on resistance. Level-shifting drivers enable low-level inputs (0.8 to 2.5 V) to control the ON-OFF state of each switch. With logic "0" at the driver input the switches will be OFF. With a logic "1" at the input the switches will be ON. In the ON state each switch will conduct current 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 14-pin side braze and flatpack options. Performance grades include both military, A suffix (-55 to 125°C) and industrial, B suffix (-25 to 85°C) temperature ranges. The flatpack option is only available in the military grade.

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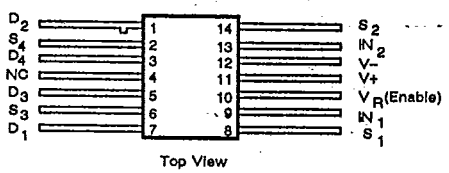
PIN CONFIGURATION

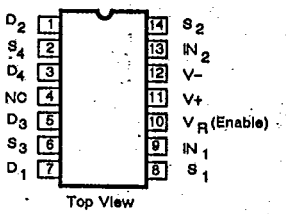
Flat Package



Top View

Order Numbers:
DG126AL/883, DG129AL/883,
DG140AL/883

Dual-In-Line Package



Top View

Order Numbers:
DG126AP, DG126BP
DG129AP, DG129BP
DG140AP, DG140BP

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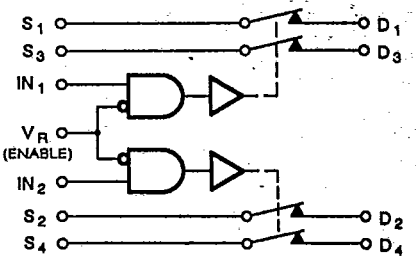
FUNCTIONAL BLOCK DIAGRAM



Two DPST Switches per Package*

Truth Table

LOGIC	SWITCH
0	OFF
1	ON

Logic "0" ≤ 0.8 V
Logic "1" ≥ 2.5 V

*Switches Shown for Logic "1" Input

ABSOLUTE MAXIMUM RATINGS

V+ to V- ..... 36 V
V+ to V_D ..... 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_R to V- ..... 25 V
V_{IN} to V- ..... 30 V
V+ to V_{IN} ..... 25 V
V_{IN} to V_R ..... ±6 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]

DG126

PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V+ = 12 V, V- = -18 V, V_R = 0 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	V_{ANALOG}			1,2,3		-10	10	-8	8	V
Drain-Source ON Resistance	$r_{DS(ON)}$	I_S = -10 mA, V_{IN} = 2.5 V	V_D = 10 V	1,3	30		80		150	Ω
				2			150			
			V_D = 8 V	1,3	25				100	
				2					150	
Source OFF Leakage Current	$I_{S(OFF)}$	V_{IN} = 0.8 V	V_S = 10 V, V_D = -10 V	1	0.01		1			nA
				2			100			
			V_S = 8 V, V_D = -8 V	1	0.05				5	
				2					100	
Drain OFF Leakage Current	$I_{D(OFF)}$		V_D = 10 V, V_S = -10 V	1	0.005		1			
				2			100			
			V_D = 8 V, V_S = -8 V	1	0.025				5	
				2					100	

Not Recommended for New Designs

ELECTRICAL CHARACTERISTICS [a] — DG126

PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V+ = 12 V, V− = −18 V, V_R = 0 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 (Cont'd)										
Channel ON Leakage Current	$I_{D(ON)} + I_{S(ON)}$	V_{IN} = 2.5 V	$V_D = V_S$ = −10 V	1 2	−0.02	−2 −100				nA
			$V_D = V_S$ = −8 V	1 2	−0.05			−5 −100		
INPUT										
Input Current with Input Voltage HIGH	I_{INH}	V_{IN} = 2.5 V		1,2 3	20		60 120		100 150	µA
Input Current with Input Voltage LOW	I_{INL}	V_{IN} = 0.8 V		1,3 2	0.004		0.1 2		4 4	
DYNAMIC										
Turn-ON Time [e]	t_{ON}	See Switching Time Test Circuit		1	0.4		0.6		1	µs
Turn-OFF Time [e]	t_{OFF}			1	1.3		1.6		2	
Source-OFF Capacitance	$C_{S(OFF)}$	f = 1 MHz	V_S = 0, I_D = 0	1	2.4					pF
Drain-OFF Capacitance	$C_{D(OFF)}$		V_D = 0, I_S = 0	1	2.4					
Channel ON Capacitance	$C_{D+S(ON)}$		$V_D = V_S$ = 0	1	2.8					
Off Isolation		R_L = 75Ω, f = 1 MHz		1	>60					dB
SUPPLY										
Positive Supply Current	I+	One Channel ON V_{IN} = 2.5 V		1	2.1		3		3.3	mA
Negative Supply Current	I−			1	−1.2	−1.8		−2.0		
Reference Supply Current	I_R			1	−1	−1.4		−1.5		
Positive Supply Current	I+	All Channels OFF Both V_{IN} = 0 V		1	0.1		25		25	µA
Negative Supply Current	I−			1	−0.5	−25		−25		
Reference Supply Current	I_R			1	−0.5	−25		−25		

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ELECTRICAL CHARACTERISTICS [a] — DG129

PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V+ = 12 V, V− = −18 V, V_R = 0 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	V_{ANALOG}			1,2,3		−10	10	−8	8	V
Drain-Source ON Resistance	$r_{DS(ON)}$	I_S = −10 mA, V_{IN} = 2.5 V	V_D = 10 V	1,3 2	20		30 60			Ω
			V_D = 8 V	1,3 2	30				50 75	
Source OFF Leakage Current	$I_{S(OFF)}$	V_{IN} = 0.8 V	V_S = 10 V, V_D = −10 V	1 2	0.03		1 100			nA
			V_S = 8 V, V_D = −8 V	1 2					5 100	
Drain OFF Leakage Current	$I_{D(OFF)}$		V_D = 10 V, V_S = −10 V	1 2	0.02		1 100			
			V_D = 8 V, V_S = −8 V	1 2	0.1				5 100	
Channel ON Leakage Current	$I_{D(ON)}$ + $I_{S(ON)}$	V_{IN} = 2.5 V	V_D = V_S = −10 V	1 2	−0.03	−2 −100				
			V_D = V_S = −8 V	1 2	−0.08			−5 −100		
INPUT										
Input Current with Input Voltage HIGH	I_{INH}	V_{IN} = 2.5 V		1,2 3	15		60 120		100 150	µA
Input Current with Input Voltage LOW	I_{INL}	V_{IN} = 0.8 V		1,3 2	0.005		0.1 2		4 4	
DYNAMIC										
Turn-ON Time [e]	t_{ON}	See Switching Time Test Circuit		1	0.5		0.6		1	µs
Turn-OFF Time [e]	t_{OFF}			1	1.1		1.6		2	
Source-OFF Capacitance	$C_{S(OFF)}$	f = 1 MHz	V_S = 0, I_D = 0	1	2.4					pF
Drain-OFF Capacitance	$C_{D(OFF)}$		V_D = 0, I_S = 0	1	2.4					
Channel ON Capacitance	$C_{D+S(ON)}$		V_D = V_S = 0	1	2.8					
Off Isolation		R_L = 75Ω, f = 1 MHz		1	>60					dB

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ELECTRICAL CHARACTERISTICS [a]			DG129						
		Test Conditions Unless Otherwise Specified: V+ = 12 V, V− = −18 V, V_R = 0 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									
Positive Supply Current	I_+	One Channel ON V_{IN} = 2.5 V	1	2.5		3		3.3	mA
Negative Supply Current	I_-		1	−1.6	−1.8		−2.0		
Reference Supply Current	I_R		1	−1.1	−1.4		−1.5		
Positive Supply Current	I_+	All Channels OFF Both V_{IN} = 0 V	1	0.1		25		25	µA
Negative Supply Current	I_-		1	−0.5	−25		−25		
Reference Supply Current	I_R		1	−0.5	−25		−25		

ELECTRICAL CHARACTERISTICS [a]				DG140						
			Test Conditions Unless Otherwise Specified: V+ = 12 V, V− = −18 V, V_R = 0 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	V_{ANALOG}			1,2,3		−10	10	−8	8	V
Drain-Source ON Resistance	$r_{DS(ON)}$	I_S = −10 mA, V_{IN} = 2.5 V	V_D = 10 V	1,3 2	6.3		10 20			Ω
			V_D = 8 V	1,3 2	9.5				15 25	
Source OFF Leakage Current	$I_{S(OFF)}$	V_{IN} = 0.8 V	V_S = 10 V, V_D = −10 V	1 2	0.04		10 1000			nA
			V_S = 8 V, V_D = −8 V	1 2	0.06				15 300	
Drain OFF Leakage Current	$I_{D(OFF)}$		V_D = 10 V, V_S = −10 V	1 2			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_{IN} = 2.5 V	V_D = V_S = −10 V	1 2	−0.4	−2 −100				
			V_D = V_S = −8 V	1 2	−1			−5 −100		

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ELECTRICAL CHARACTERISTICS [a]											DG140
		Test Conditions Unless Otherwise Specified: V+ = 12 V, V− = −18 V, V_R = 0 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	
INPUT											
Input Current with Input Voltage HIGH	I_{INH}	V_{IN} = 2.5 V		1,2 3	13		60 120		100 150	µA	
Input Current with Input Voltage LOW	I_{INL}	V_{IN} = 0.8 V		1,3 2	0.004		0,1 2		4 4	µA	
DYNAMIC											
Turn-ON Time [e]	t_{ON}	See Switching Time Test Circuit		1	0.6		1		1.5	µs	
Turn-OFF Time [e]	t_{OFF}			1	1.15		2.5		2.5	µs	
Source-OFF Capacitance	$C_{S(OFF)}$	f = 1 MHz	V_S = 0, I_D = 0	1	3					pF	
Drain-OFF Capacitance	$C_{D(OFF)}$		V_D = 0, I_S = 0	1	3					pF	
Channel ON Capacitance	$C_{D+S(ON)}$		V_D = V_S = 0	1	2.8					pF	
Off Isolation		R_L = 75Ω, f = 1 MHz		1	>50					dB	
SUPPLY											
Positive Supply Current	I_+	One Channel ON V_{IN} = 2.5 V		1	2.4		3		3.3	mA	
Negative Supply Current	I_-			1	−1.5	−1.8		−2.0		mA	
Reference Supply Current	I_R			1	−1	−1.4		−1.5		mA	
Positive Supply Current	I_+	All Channels OFF Both V_{IN} = 0 V		1	0.1		25		25	µA	
Negative Supply Current	I_-			1	−0.5	−25		−25		µA	
Reference Supply Current	I_R			1	−0.5	−25		−25		µA	

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.

Not Recommended for New Designs

SWITCHING TIME TEST CIRCUIT

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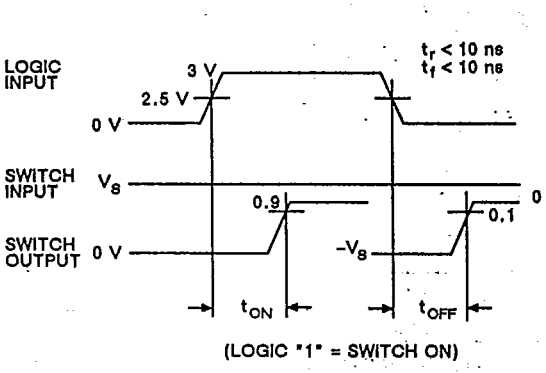
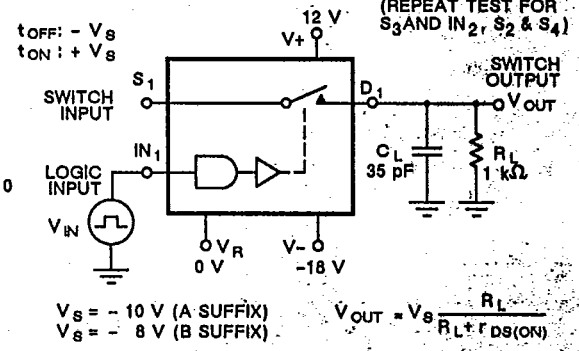
Switch output waveform shown for V_S = constant with logic input waveform as shown. Note that V_S may be + or − as per switching time test circuit. V_O is the steady state output with switch on. Feedthrough via gate capacitance may result in spikes at leading and trailing edge of output waveform.





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APPLICATION HINTS

V+ Positive Supply Voltage (V)	V− Negative Supply Voltage (V)	V_R Reference Voltage (V)	V_{IN} Logic Input Voltage V_{INH} Min/ V_{INL} Max (V)	V_S or V_D Analog Voltage Range (V)
12	−18	0	2.5/0.8	−10 to 10
15	−15	0	2.5/0.8	−7 to 13
7	−12	0	2.5/0.8	−5 to 5
5	−15	0	2.5/0.8	−7 to 3
5	−10	0	2.5/0.8	−2 to 3