DG133/134/141
Dual SPST JFET Analog Swiches

Siliconix incorporated

FEATURES

- Low Standby Power (< 1 μW)
- Bipolar Drivers
- Constant $r_{DS(ON)}$ Over Signal Range
- High Off Isolation (> 60 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 DG133, DG134, and DG141 are dual precision single-pole, single-throw analog switches for use in process control, communication, and instrumentation applications. This series is ideally suited for applications requiring a constant ON resistance over the entire analog range.

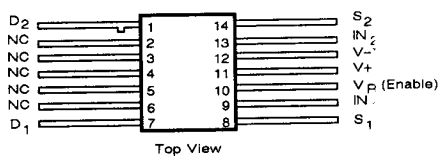
ON resistance of the DG134 is < 80 Ω, the DG133 is < 30 Ω, and the DG141 is < 10 Ω, and ON shunt leakage for all three is < 2 nA. With both drivers in the "switch OFF" state, total power consumption is 750 μW. Because JFET and bipolar processing is used, all three devices are relatively radiation tolerant.

The DG133, DG134, and DG141 each contain two junction-type field-effect transistors (JFETs) designed to function as two single-pole, single-throw electronic switches. Level-shifting drivers enable low-level inputs (0.8 to 2.5 V) to control the ON-OFF state of each switch. With a positive logic "0" at the driver input the switches will be OFF. With a positive 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 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

Flat Package

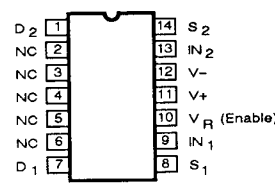


Top View

Order Numbers:
DG133AL/883, DG134AL/883
DG141AL/883

* Common to Substate and Base of Package

Dual-In-Line Package

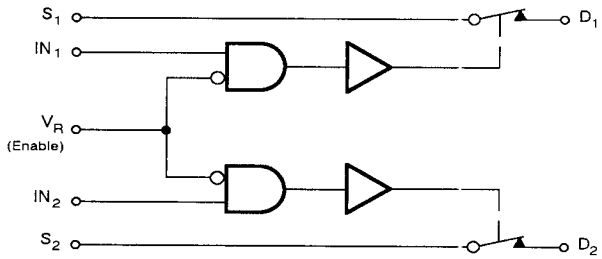


Top View

Order Numbers:
Side Braze: DG133AP, DG133BP
DG134AP, DG134BP
DG141AP, DG141BP

Not Recommended for New Designs

FUNCTIONAL BLOCK DIAGRAM



Two SPST 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 ..... ±3 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]

DG133

PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V+ = 12 V, V− = −18 V, V_R = 0		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_{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	

ELECTRICAL CHARACTERISTICS [a]

DG133

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)										
Drain OFF Leakage Current	$I_{D(OFF)}$	V_{IN} = 0.8 V	V_D = 10 V, V_S = −10 V	1 2	0.02		1 100			nA
			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			60 120		100 150	µA
Input Current with Input Voltage LOW	I_{INL}	V_{IN} = 0.8 V		1,3 2			0.1 2		4 4	
DYNAMIC										
Turn-ON Time	t_{ON}	See Switching Time Test Circuit [e]		1			0.6		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	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_{IN} = 2.5 V		1	2.1		3		3.3	mA
Negative Supply Current	I−			1	−1.2	−1.8		−2		
Reference Supply Current	I_R			1	−1	−1.4		−1.5		

Not Recommended for New Designs

ELECTRICAL CHARACTERISTICS [a]											DG133
		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 (Cont'd)											
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]											DG134
		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 [c]	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	30		80 150			Ω	
			V_D = 8 V	1,3 2	35				100 150		
Source OFF Leakage Current	$I_{S(OFF)}$	V_{IN} = 0.8 V	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_{IN} = 0.8 V	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_{IN} = 2.5 V	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]

DG134

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]	
INPUT										
Input Current with Input Voltage HIGH	I_{INH}	V_{IN} = 2.5 V		1,2 3			60 120		100 150	µA
Input Current with Input Voltage LOW	I_{INL}	V_{IN} = 0.8 V		1,3 2			0.1 2		4 4	µA
DYNAMIC										
Turn-ON Time	t_{ON}	See Switching Time Test Circuit [e]		1			0.6		1	µs
Turn-OFF Time	t_{OFF}			1			1.6		2	µs
Drain-OFF Capacitance	$C_{D(OFF)}$	f = 1 MHz	V_D = 0 V, I_S = 0	1	2.4					pF
Source-OFF Capacitance	$C_{S(OFF)}$		V_S = 0 V, I_D = 0	1	2.4					pF
Channel-ON Capacitance	$C_{D(ON)} + C_{S(ON)}$		$V_D = V_S$ = 0	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_{IN} = 2.5 V		1	2.1		3		3.3	mA
Negative Supply Current	I-			1	-1.2	-1.8		-2		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

Not Recommended for New Designs

ELECTRICAL CHARACTERISTICS [a]

DG141

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										
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_{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_{IN} = 0.8 V	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	-1.0			-5 -100		
INPUT										
Input Current with Input Voltage HIGH	I_{INH}	V_{IN} = 2.5 V		1,2 3			60 120		100 150	μA
Input Current with Input Voltage LOW	I_{INL}	V_{IN} = 0.8 V		1,3 2			0.1 2		4 4	
DYNAMIC										
Turn-ON Time	t_{ON}	See Switching Time Test Circuit [e]		1			1		1.5	μs
Turn-OFF Time	t_{OFF}			1	1.15		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					
OFF Isolation	OIRR	R_L = 75Ω, f = 1 MHz		1	>50					dB

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Not Recommended for New Designs

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ELECTRICAL CHARACTERISTICS [a]

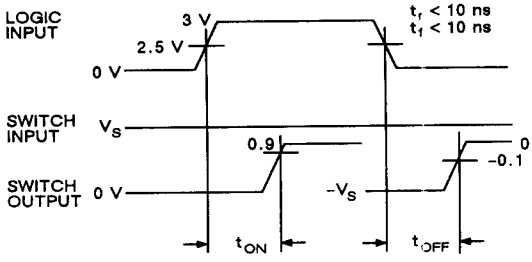
DG141

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]	
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		
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		

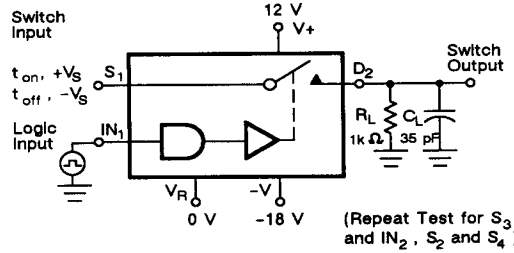
NOTES:
a. Refer to PROCESS OPTION FLOWCHART for additional information.
b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
c. Guaranteed by design, not subject to production test.
d. Typical values are for DESIGN AID ONLY,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



(Repeat Test for S_3 and IN_2, S_2 and S_4)

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

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

Not Recommended for New Designs

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	−5 to 13
10	−10	0	2.5/0.8	0 to 8