National Semiconductor

DS1687/DS3687 Negative Voltage Relay Driver

General Description

The DS1687/DS3687 is a high voltage/current negative voltage relay driver having many features not available in present relay drivers.

PNP inputs provide both TTL/DTL compatibility and high input impedance for low input loading.

Output leakage is specified over temperature at an output voltage of −54 V. Minimum output breakdown (AC/latch breakdown) is specified over temperature at −5 mA. This clearly defines the actual breakdown of the device, since the circuit has incorporated in it an internal reference which does not allow output breakdown latching found in existing relay drivers. Additionally, this internal reference circuit feature will eliminate the need in most cases of an external clamping (inductive transient voltage protection) diode. When the output is turned "OFF", by input logic conditions, the resulting inductive voltage transient seen at the output is detected by an internal zener reference. The reference then momentarily activates the output transistor long enough so that the relay energy is discharged. This feature eliminates the need of external circuit protection components and insures output transistor protection.

The outputs are Darlington connected transistors, which allow high current operation at low internal V_{CC} current levels — base drive for the output transistor is obtained from the load in proportion to the required loading conditions. Typical V_{CC} power with both outputs "ON" is 90 mW.

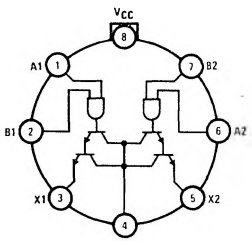
The circuit also features output transistor protection if the V_{CC} supply is lost by forcing the output into the high impedance "OFF" state with the same breakdown levels as when V_{CC} was applied.

Features

- TTL/DTL/CMOS compatible inputs
- High impedance inputs (PNP's)
- High output voltage breakdown (−65 V typ.)
- High output current capability (300 mA max.)
- Internal protection circuit eliminates need for output protection diode in most applications
- Output breakdown protection if V_{CC} supply is lost
- Low power dissipation [90 mW (typ.) both outputs "ON"]
- Voltage and current levels compatible for use in telephone relay applications

Connection Diagrams

Metal Can Package

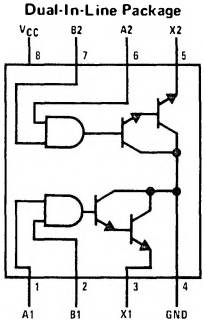


TOP VIEW

Pin 4 is in electrical contact with the case

Order Number DS1687H
or DS3687H

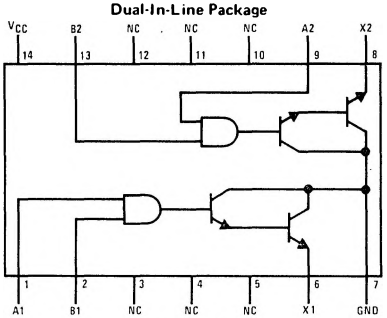
Dual-In-Line Package



TOP VIEW

Order Number DS3687N

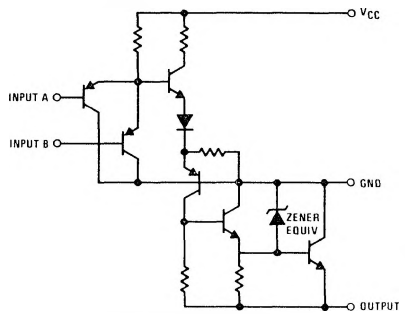
Dual-In-Line Package



TOP VIEW

Order Number DS1687J
or DS3687J

Schematic Diagram



Truth Table

Positive logic. $\overline{AB} = X$

A	B	OUTPUT X
0	0	1
1	0	1
0	1	1
1	1	0

Logic "0" output "ON"
Logic "1" output "OFF"

Absolute Maximum Ratings (Note 1)

Supply Voltage	7V
Input Voltage	15V
Output Voltage	-56V
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C

Operating Conditions

	MIN	MAX	UNITS
Supply Voltage, V_{CC}			
DS1687	4.5	5.5	V
DS3687	4.75	5.25	V
Temperature, T_A			
DS1687	−55	+125	°C
DS3687	0	+70	°C

Electrical Characteristics (Notes 2 and 3)

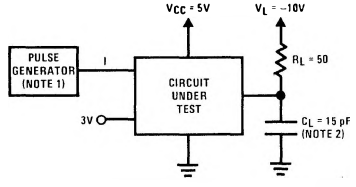
PARAMETER		CONDITIONS			MIN	TYP	MAX	UNITS
V_{IH}	Logical "1" Input Voltage				2.0			V
I_{IH}	Logical "1" Input Current	V_{CC} = Max, V_{IN} = 5.5V				0.01	40	μA
V_{IL}	Logical "0" Input Voltage						0.8	V
I_{IL}	Logical "0" Input Current	V_{CC} = Max, V_{IN} = 0.4V				−60	−250	μA
V_{CD}	Input Clamp Voltage	V_{CC} = 5V, I_{CLAMP} = −12 mA, T_A = 25°C				−1.0	−1.5	V
V_{OH}	Output Breakdown	V_{CC} = Max, V_{IN} = 0V, I_{OUT} = −5 mA			−56	−65		V
I_{OH}	Output Leakage	V_{CC} = Max, V_{IN} = 0V, V_{OUT} = −54V				−0.5	−250	μA
V_{OL}	Output "ON" Voltage	V_{CC} = Min, V_{IN} = 2V	I_{OUT} = 100 mA	DS1687		−0.85	−1.1	V
				DS3687		−0.85	−1.0	V
			I_{OUT} = 300 mA	DS1687		−0.95	−1.3	V
				DS3687		−0.95	−1.2	V
$I_{CC(1)}$	Supply Current (Both Drivers)	V_{CC} = Max, V_{IN} = 0V, Outputs Open				2.0	4.0	mA
$I_{CC(0)}$	Supply Current (Both Drivers)	V_{CC} = Max, V_{IN} = 3V, Outputs Open				18.0	28	mA
$t_{pd(ON)}$	Propagation Delay to a Logical "0" (Output Turn "ON")	C_L = 15 pF, V_L = −10V, R_L = 50Ω, T_A = 25°C, V_{CC} = 5.0V				50		ns
$t_{pd(OFF)}$	Propagation Delay to a Logical "1" (Output Turn "OFF")	C_L = 15 pF, V_L = −10V, R_L = 50Ω, T_A = 25°C, V_{CC} = 5.0V				1.0		μs

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

Note 2: Unless otherwise specified min/max limits apply across the −55°C to +125°C temperature range for the DS1687 and across the 0°C to +70°C range for the DS3687. All typicals are given for V_{CC} = 5.0V and T_A = 25°C.

Note 3: All currents into device pins shown as positive, out of device pins as negative, all voltages referenced to ground unless otherwise noted. All values shown as max or min on absolute value basis.

AC Test Circuit and Switching Time Waveforms



Note 1: The pulse generator has the following characteristics: PRR = 1 MHz, 50% duty cycle, $Z_{OUT} \geq 50\Omega$, $t_r = t_f \leq 10$ ns.
Note 2: C_L includes probe and jig capacitance.