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National Semiconductor

April 1990

DS3686 Dual Positive Voltage Relay Driver

General Description

The DS3686 is a high voltage/current positive voltage relay driver having many features not available in present relay drivers.

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

Output leakage is specified over temperature at an output voltage of 54V. 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.

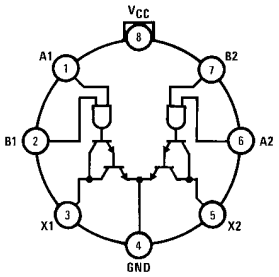
The circuit also features output transistor protection if the V_{CC} supply is lost by forcing the output into the high impedance ''OFF'' state with the same breakdown levels as when V_{CC} was applied.

Features

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

Connection Diagrams

Metal Can Package



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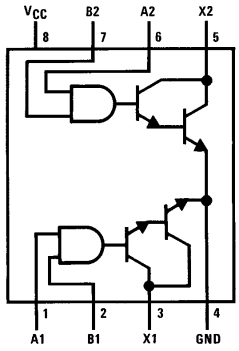
Top View

Pin 4 is in electrical contact with the case

Order Number DS3686H
See NS Package Number H08C

Dual-In-Line Package



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Top View

Order Number DS3686J-8 or DS3686N
See NS Package Number J08A or N08E

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''

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Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage	7V
Input Voltage	15V
Output Voltage	56V
Storage Temperature Range	−65°C to +150°C

Maximum Power Dissipation* at 25°C	
Cavity Package	1133 mW
Molded Package	1022 mW
TO-5 Package	787 mW
Lead Temperature (Soldering, 4 seconds)	260°C

*Derate cavity package 7.6 mW/°C above 25°C; derate molded package 8.2 mW/°C above 25°C; derate TO-5 package 5.2 mW/°C above 25°C.

Operating Conditions

	Min	Max	Units
Supply Voltage, V_{CC}	4.75	5.25	V
Temperature, T_A	0	±70	°C

Electrical Characteristics (Notes 2 and 3)

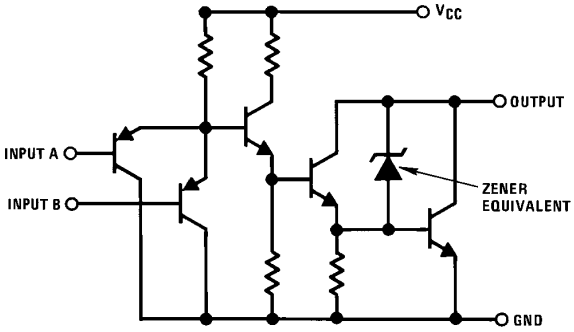
Symbol	Parameter	Conditions			Min	Typ	Max	Units
V_{IH}	Logical "1" Input Voltage	$R_L = 180\Omega$, $V_L = 54V$, $V_O \leq 2.5V$			2.0			V
I_{IH}	Logical "1" Input Current	V_{CC} = Max, $V_{IN} = 5.5V$				0.01	40	μA
V_{IL}	Logical "0" Input Voltage	$R_L = 180\Omega$, $V_L = 54V$, $V_O \leq 53.8V$					0.8	V
I_{IL}	Logical "0" Input Current	V_{CC} = Max, $V_{IN} = 0.4V$				−150	−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, $V_{IN} = 0.4V$, $V_{OUT} = 54V$				0.5	250	μA
V_{OL}	Output ON Voltage	V_{CC} = Min, $V_{IN} = 2.4V$	DS3686	$I_{OL} = 100$ mA		0.85	1.0	V
				$I_{OL} = 300$ mA		1.0	1.2	V
$I_{CC(1)}$	Supply Current (Both Drivers)	V_{CC} = Max, $V_{IN} = 0V$, Outputs Open				2	4	mA
$I_{CC(0)}$	Supply Current (Both Drivers)	V_{CC} = Max, $V_{IN} = 3V$, Outputs Open				18	28	mA
t_{PD0}	Propagation Delay to a Logical "0" (Output Turn ON)	$C_L = 15$ pF, $V_L = 10V$, $R_L = 50\Omega$, $T_A = 25°C$, $V_{CC} = 5V$				50		ns
t_{PD1}	Propagation Delay to a Logical "1" (Output Turn OFF)	$C_L = 15$ pF, $V_L = 10V$, $R_L = 50\Omega$, $T_A = 25°C$, $V_{CC} = 5V$				1		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 0°C to +70°C range for the DS3686. All typicals are given for $V_{CC} = 5V$ 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.

Schematic Diagram



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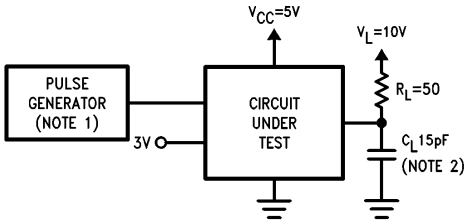
AC Test Circuit and Switching Time Waveforms



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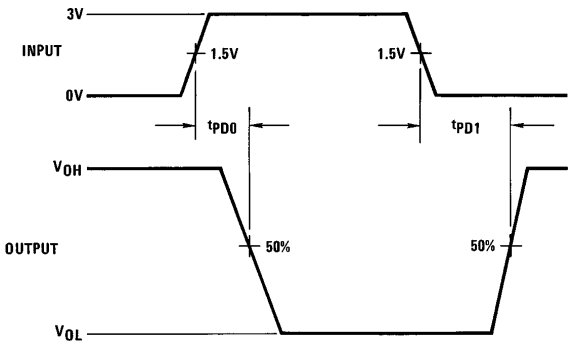
Note 1: The pulse generator has the following characteristics: PRR = 100 kHz, 50% duty cycle, Z_{OUT} = 50Ω, $t_r = t_f \leq 10$ ns.

Note 2: C_L includes probe and jig capacitance.



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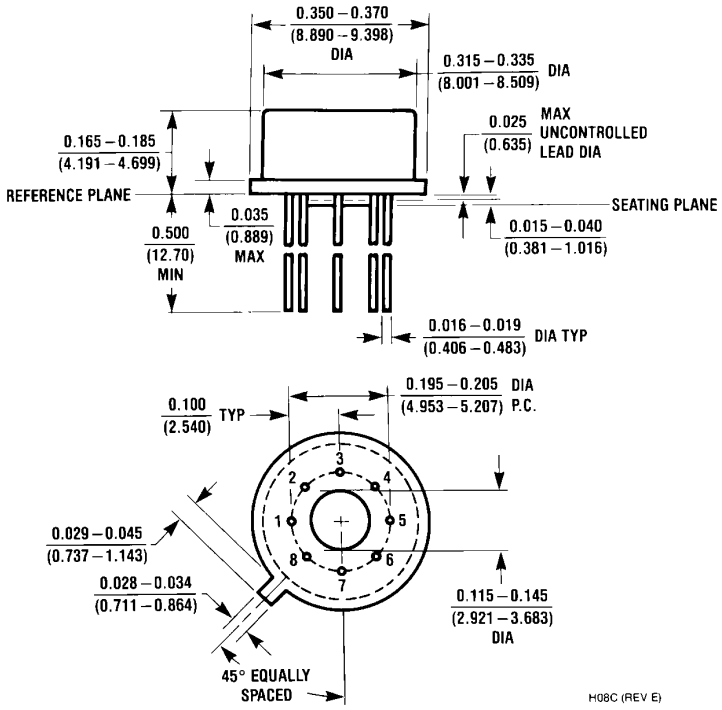
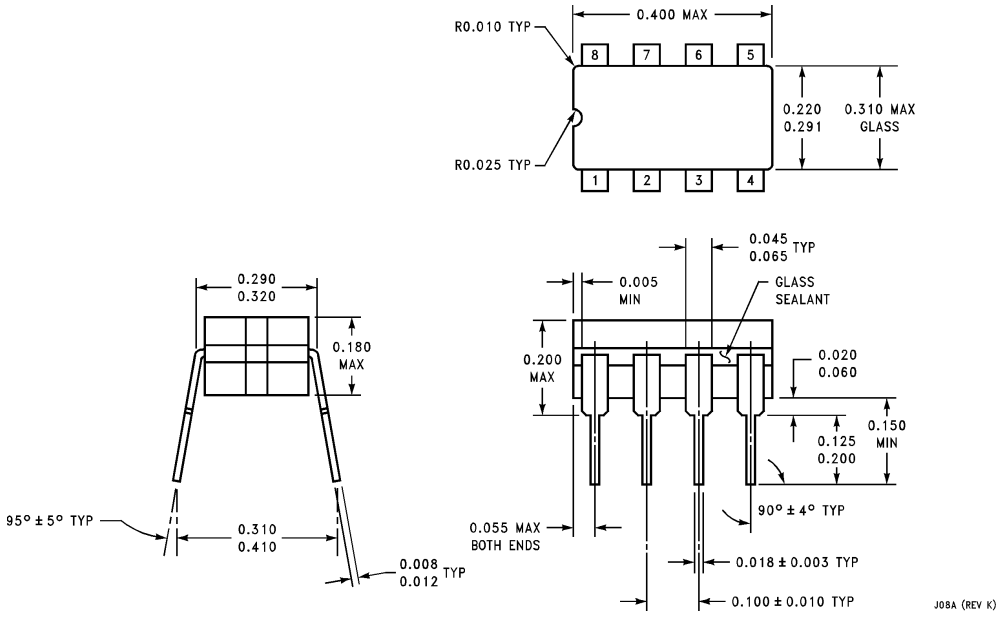
Physical Dimensions inches (millimeters)



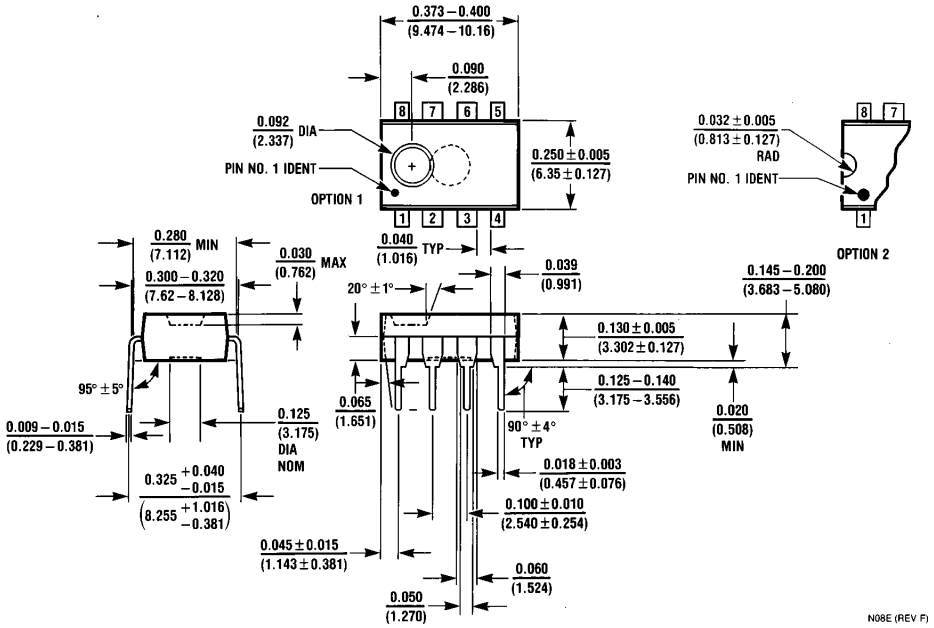
Metal Can Package (H)
Order Number DS3686H
NS Package Number H08C

Physical Dimensions inches (millimeters) (Continued)



Ceramic Dual-In-Line Package (J)
Order Number DS3686J-8
NS Package Number J08A

Physical Dimensions inches (millimeters) (Continued)



Molded Dual-In-Line Package (N)
Order Number DS3686N
NS Package Number N08E

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