

## DS3680 Quad Negative Voltage Relay Driver

### General Description

The DS3680 is a quad high voltage negative relay driver designed to operate over wide ranges of supply voltage, common-mode voltage, and ambient temperature, with 50 mA sink capability. These drivers are intended for switching the ground end of loads which are directly connected to the negative supply, such as in telephone relay systems.

Since there may be considerable noise and IR drop between logic ground and negative supply ground in many applications, these drivers are designed to operate with a high common-mode range ( $\pm 20V$  referenced to negative supply ground). Each driver has a common-mode range separate from the other drivers in the package, which permits input signals from more than one element of the system.

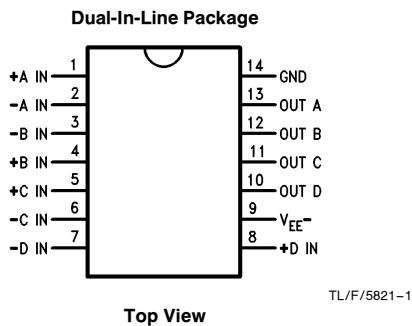
With low differential input current requirements (typically 100  $\mu A$ ), these drivers are compatible with TTL, LS and CMOS logic. Differential inputs permit either inverting or non-inverting operation.

The driver outputs incorporate transient suppression clamp networks, which eliminate the need for external networks when used in applications of switching inductive loads. A fail-safe feature is incorporated to insure that, if the +IN input or both inputs are open, the driver will be OFF.

### Features

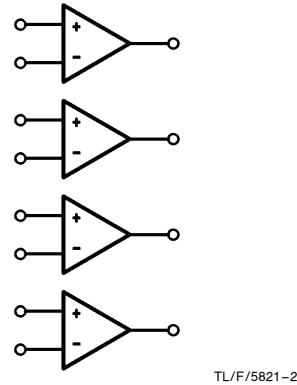
- -10V to -60V operation
- Quad 50 mA sink capability
- TTL/LS/COMS or voltage comparator input
- High input common-mode voltage range
- Very low input current
- Fail-safe disconnect feature
- Built-in output clamp diode

### Connection Diagram



Order Number DS3680J, DS3680M or DS3680N  
See NS Package Number J14A, M14A, N14A

### Logic Diagram



### Truth Table

| Differential Inputs | Outputs |
|---------------------|---------|
| $V_{ID} \geq 2V$    | On      |
| $V_{ID} \leq 0.8V$  | Off     |
| Open                | Off     |

## 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 (GND to $V_{EE-}$ , and Any Pin) | -70V             |
| Positive Input Voltage (Input to GND)           | 20V              |
| Negative Input Voltage (Input to $V_{EE-}$ )    | -5V              |
| Differential Voltage (+IN to -IN)               | $\pm 20V$        |
| Inductive Load                                  | $L_L \leq 5h$    |
|   | $I_L \leq 50 mA$ |
| Output Current                                  | -100 mA          |
| Storage Temperature                             | -65°C to +150°C  |
| Maximum Power Dissipation* at 25°C              |                  |
| Cavity Package                                  | 1433 mW          |
| Molded Dip Package                              | 1398 mW          |
| SO Package                                      | 1002 mW          |
| Lead Temperature (Soldering, 4 seconds)         | 260°C            |

\* Derate cavity package 9.6 mW/°C above 25°C; derate molded dip package 11.2 mW/°C above 25°C; derate SO package 8.02 mW/°C above 25°C.

## Recommended Operating Conditions

|                                    | Min | Max | Units |
|------------------------------------|-----|-----|-------|
| Supply Voltage (GND to $V_{EE-}$ ) | -10 | -60 | V     |
| Input Voltage (Input to GND)       | -20 | 20  | V     |
| Logic ON Voltage (+IN)             |     |     |       |
| Referenced to -IN                  | 2   | 20  | V     |
| Logic OFF Voltage (+IN)            |     |     |       |
| Referenced to -IN                  | -20 | 0.8 | V     |
| Temperature Range                  | -25 | +85 | °C    |

## Electrical Characteristics (Notes 2 and 3)

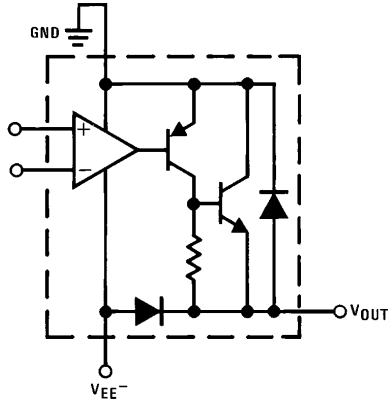
| Symbol        | Parameter                       | Conditions                                      | Min | Typ         | Max         | Units              |
|---------------|---------------------------------|---|-----|-------------|-------------|--------------------|
| $V_{IH}$      | Logic "1" Input Voltage         |   | 2.0 | 1.3         |             | V                  |
| $V_{IL}$      | Logic "0" Input Voltage         |   |     | 1.3         | 0.8         | V                  |
| $I_{INH}$     | Logic "1" Input Current         | $V_{IN} = 2V$<br>$V_{IN} = 7V$                  |     | 40<br>375   | 100<br>1000 | $\mu A$<br>$\mu A$ |
| $I_{INL}$     | Logic "0" Input Current         | $V_{IN} = 0.4V$<br>$V_{IN} = -7V$               |     | -0.01<br>-1 | -5<br>-100  | $\mu A$<br>$\mu A$ |
| $V_{OL}$      | Output ON Voltage               | $I_{OL} = 50 mA$                                |     | -1.6        | -2.1        | V                  |
| $I_{OFF}$     | Output Leakage                  | $V_{OUT} = V_{EE-}$                             |     | -2          | -100        | $\mu A$            |
| $I_{FS}$      | Fail-Safe Output Leakage        | $V_{OUT} = V_{EE-}$<br>(Inputs Open)            |     | -2          | -100        | $\mu A$            |
| $I_{LC}$      | Output Clamp Leakage Current    | $V_{OUT} = GND$                                 |     | 2           | 100         | $\mu A$            |
| $V_C$         | Output Clamp Voltage            | $I_{CLAMP} = -50 mA$<br>Referenced to $V_{EE-}$ |     | -2          | -1.2        | V                  |
| $V_P$         | Positive Output Clamp Voltage   | $I_{CLAMP} = 50 mA$<br>Referenced to GND        |     | 0.9         | 1.2         | V                  |
| $I_{EE(ON)}$  | ON Supply Current               | All Drivers ON                                  |     | -2          | -4.4        | mA                 |
| $I_{EE(OFF)}$ | OFF Supply Current              | All Drivers OFF                                 |     | -1          | -100        | $\mu A$            |
| $t_{PD(ON)}$  | Propagation Delay to Driver ON  | $L = 1h, R_L = 1k,$<br>$V_{IN} = 3V$ Pulse      |     | 1           | 10          | $\mu s$            |
| $t_{PD(OFF)}$ | Propagation Delay to Driver OFF | $L = 1h, R_L = 1k,$<br>$V_{IN} = 3V$ Pulse      |     | 1           | 10          | $\mu s$            |

**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 device should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

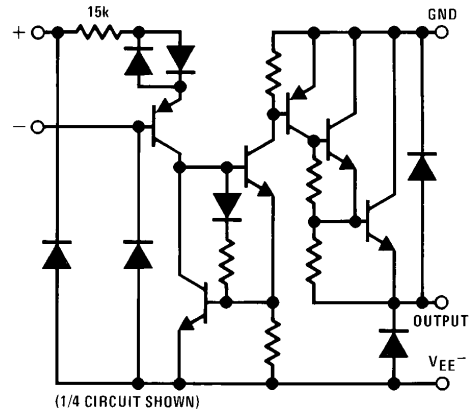
**Note 2:** Unless otherwise specified, the min/max limits of the table of "Electrical Characteristics" apply within the range of the table of "Operating Conditions". All typical values are given for  $V_{EE-} = 52V$ , and  $T_A = 25^\circ C$ .

**Note 3:** All current into device pins shown as positive, out of the device as negative. All voltages are referenced to ground unless otherwise noted.

## Schematic Diagrams



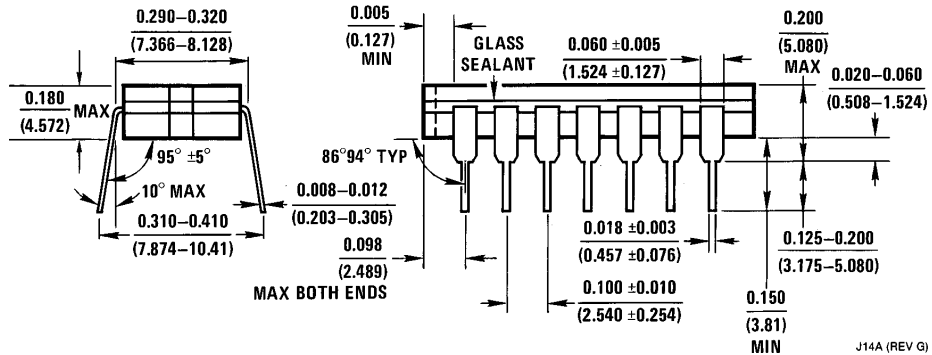
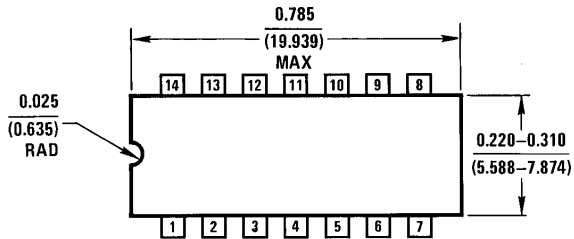
TL/F/5821-3



(1/4 CIRCUIT SHOWN)

TL/F/5821-4

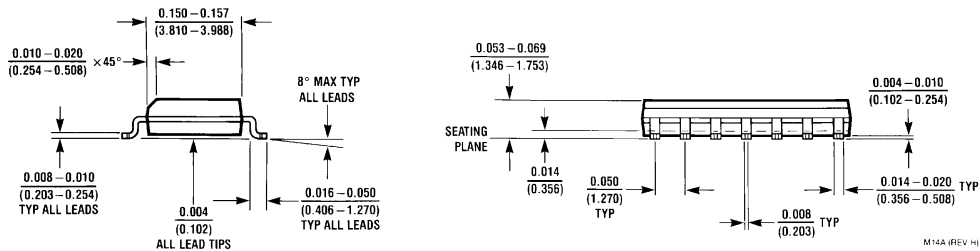
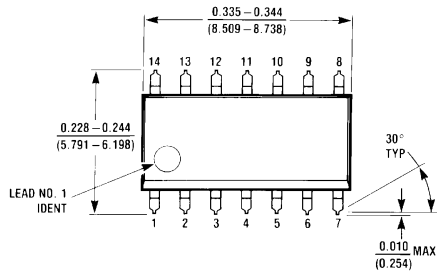
## Physical Dimensions inches (millimeter)



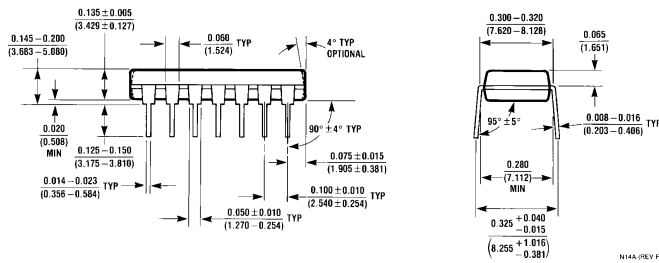
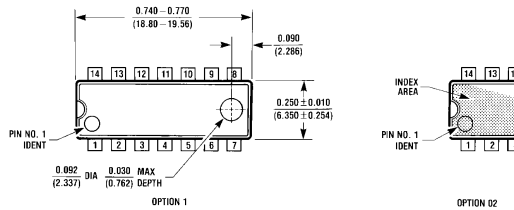
Ceramic Dual-In-Line Package (J)  
Order Number DS3680J  
NS Package Number J14A

J14A (REV G)

**Physical Dimensions** inches (millimeters) (Continued)



**SO Package (M)**  
**Order Number DS3680M**  
**NS Package Number M14A**



**Molded Dual-In-Line Package (N)**  
**Order Number DS3680N**  
**NS Package Number N14A**



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