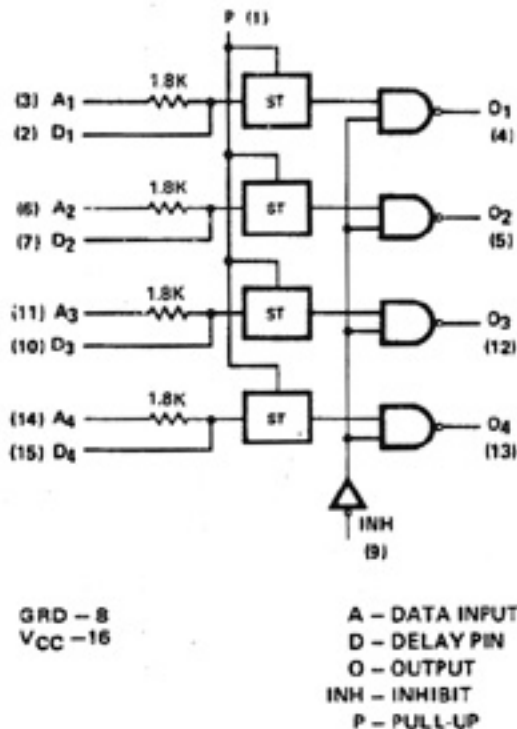


## Features

- 4.5V TYPICAL HYSTERESIS – 2.5V WORST CASE NOISE IMMUNITY, EVEN WHILE SWITCHING!
- 5.5V TYPICAL DC NOISE IMMUNITY – 4.5V WORST CASE
- OPTIONAL HOOKUP DOES NOT RECOGNIZE OPEN CIRCUITS – ELIMINATES FALSE COUNTS DUE TO CONTACT BOUNCE FROM SWITCHES AND RELAYS
- DELAY PINS ALLOW THE USE OF EXTERNAL SLOW-DOWN CAPACITORS – PROPAGATION DELAY INCREASES 2.5 ms/ $\mu$ F
- IDEAL FOR USE AS A LINE RECEIVER
- INHIBIT INPUT PERMITS INFORMATION TO BE ACCEPTED ONLY DURING PERIODS OF LOW NOISE IN THE SYSTEM CYCLE
- OVERVOLTAGE INPUT PROTECTION – WITHSTANDS  $\pm 100$ V, 1 $\mu$ SEC NOISE SPIKE OR -5V TO  $V_{CC}$  +5V STEADY-STATE

## Logic Diagram



367 – DIRECTLY INTERFACES WITH HiNIL AND CMOS

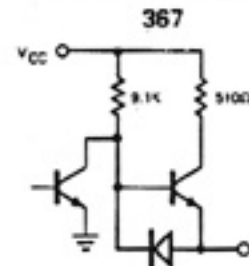
368 – DIRECTLY INTERFACES WITH TTL

## General Description

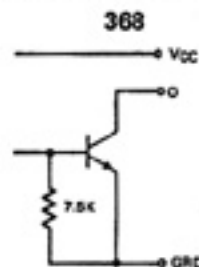
The Teledyne Semiconductor 367/368 Quad Schmitt Trigger has been designed as a universal input port for HiNIL logic blocks. Its unique truth table completely eliminates false counts due to contact bounce on switches, relays, etc. At the same time, its 6.5V DC noise immunity and the 4.5V dead zone provided by the Schmitt Trigger action totally eliminates noise problems occurring on long lines. Delay pins can be used with slowdown capacitors to slow the circuit down as far as needed, and still maintain 2.5V guaranteed noise immunity. An inhibit input can be used to accept input information only at certain times in the system cycle.

## Equivalent Circuits

### TYPICAL OUTPUT



### TYPICAL OUTPUT



## Truth Tables

367/368  
PIN P OPEN

| INPUTS       |     | OUTPUT |
|--------------|-----|--------|
| A            | INH | O      |
| 0            | 0   | 1      |
| OPEN (was 0) | 0   | 1      |
| 1            | 0   | 0      |
| OPEN (was 1) | 0   | 0      |
| 0            | 1   | 1      |
| 1            | 1   | 1      |
| OPEN (was 0) | 1   | 1      |
| OPEN (was 1) | 1   | 1      |

367/368  
PIN P CONNECTED TO V<sub>CC</sub>

| INPUTS |     | OUTPUT |
|--------|-----|--------|
| A      | INH | O      |
| 0      | 0   | 1      |
| 1      | 0   | 0      |
| 0      | 1   | 1      |
| 1      | 1   | 1      |

## Specifications

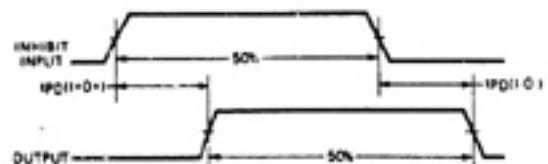
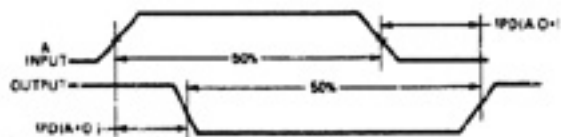
367

|                                  |       |       |       |       |
|----------------------------------|-------|-------|-------|-------|
| t <sub>PD</sub> (Pull-up Open)   | 340ns | 360ns | 250ns | 230ns |
| t <sub>PD</sub> (Pull-up Closed) | 300ns | 400ns | 250ns | 230ns |
| I/O function for t <sub>PD</sub> | A+O-  | A-O+  | I+O+  | I-O-  |

368 WITH 10K PULLUP ON OUTPUT

|                                  |       |       |       |       |
|----------------------------------|-------|-------|-------|-------|
| t <sub>PD</sub> (Pull-up Open)   | 340ns | 550ns | 450ns | 300ns |
| t <sub>PD</sub> (Pull-up Closed) | 300ns | 600ns | 450ns | 300ns |

## Switching Time Waveforms



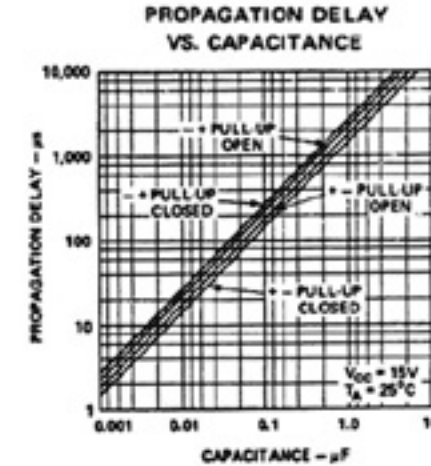
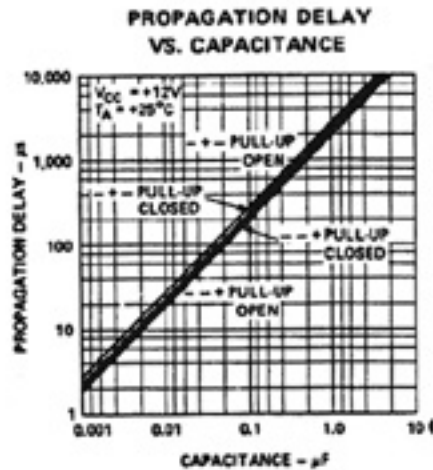
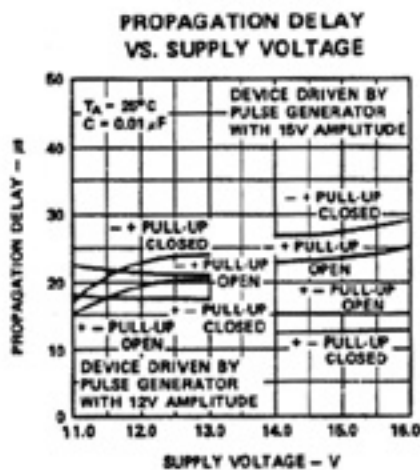
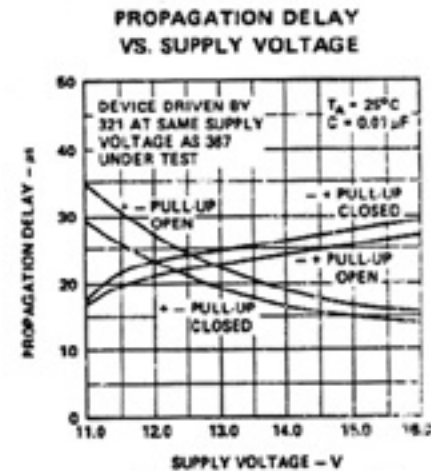
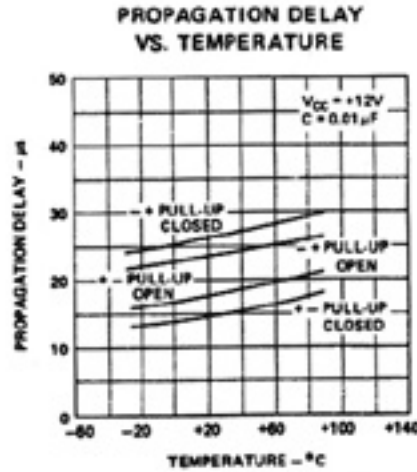
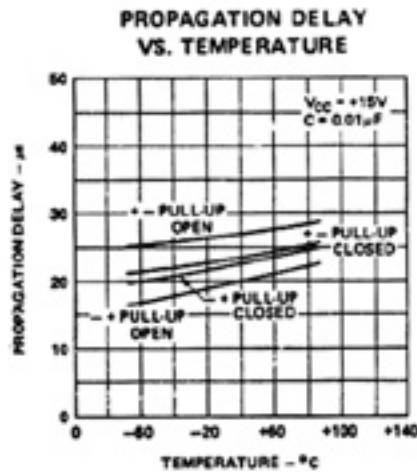
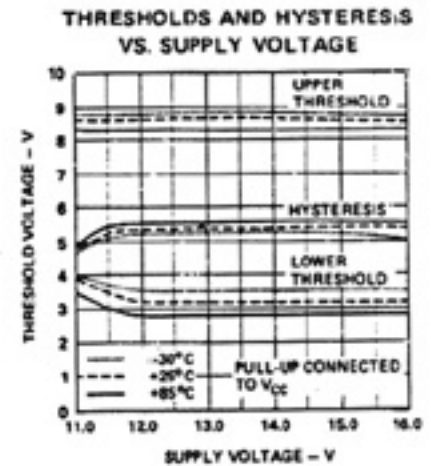
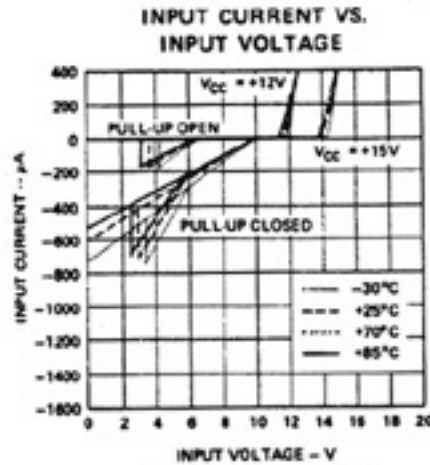
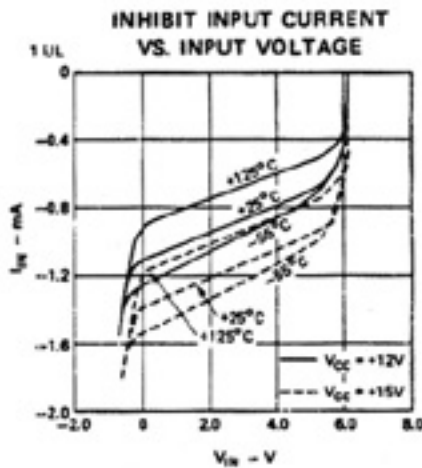
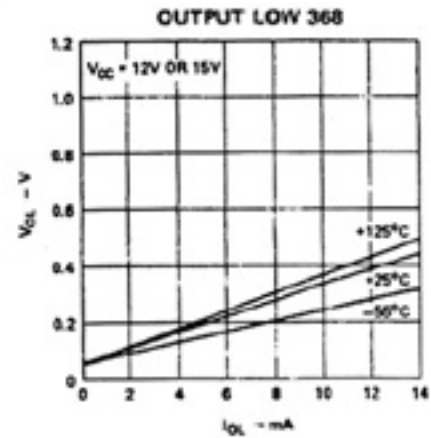
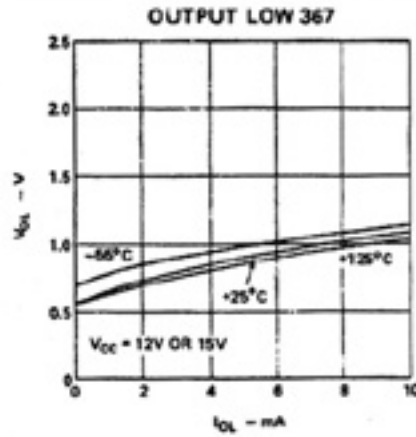
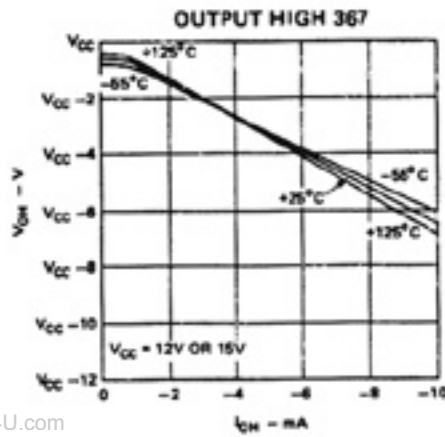
## Loading Table

367/368

| PINS                                                              | FUNCTION | LOADING |
|-------------------------------------------------------------------|----------|---------|
| Inhibit                                                           | Inhibit  | 1 UL    |
| O <sub>1</sub> , O <sub>2</sub> , O <sub>3</sub> , O <sub>4</sub> | Outputs  | 5 UL    |

## Typical Performance Characteristics

## OUTPUT CURRENT VS. OUTPUT VOLTAGE



## Electrical Characteristics

| Parameter                               | Definition                                | $-30^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$<br>Type C<br>( $V_{CC} = +12\text{V} \pm 1\text{V}$ ) | $-30^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$<br>Type A<br>( $V_{CC} = +15\text{V} \pm 1\text{V}$ ) | Test Conditions                                                                                                           |
|-----------------------------------------|-------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| $V_{INL}$ (Inhibit)                     | Input threshold voltage, low              | 5.0V min.                                                                                                     | 5.0V min.                                                                                                     | Guaranteed input low threshold for Inhibit                                                                                |
| $V_{INH}$ (Inhibit)                     | Input threshold voltage, high             | 6.5V max.                                                                                                     | 6.5V max.                                                                                                     | Guaranteed input high threshold for Inhibit                                                                               |
| $I_{INL}$ (Inhibit)                     | Input current, low                        | -2.1mA                                                                                                        | -2.6mA                                                                                                        | At $V_{CC}$ max. with $V_{IN} = V_{OL1}$                                                                                  |
| $I_{INH}$ (Inhibit)                     | Input leakage current                     | 10 $\mu$ A                                                                                                    | 10 $\mu$ A                                                                                                    | At $V_{CC}$ max. with $V_{IN} = V_{CC}$ max.                                                                              |
| $V_T +$ (Data input-A) (pull-up open)   | Positive going threshold voltage          | 8.0V min.<br>10.0V max.                                                                                       | 7.5V min.<br>10.0V max.                                                                                       | Guaranteed positive going threshold for Data input (pull-up open)                                                         |
| $V_T -$ (Data input-A) (pull-up open)   | Negative going threshold voltage          | 2.0V min.<br>5.5V max.                                                                                        | 2.0V min.<br>5.0V max.                                                                                        | Guaranteed negative going threshold for Data input (pull-up open)                                                         |
| $V_T +$ (Data input-A) (pull-up closed) | Positive going threshold voltage          | 7.5V min.<br>9.5V max.                                                                                        | 7.5V min.<br>9.5V max.                                                                                        | Guaranteed positive going threshold for Data input (pull-up closed)                                                       |
| $V_T -$ (Data input-A) (pull-up closed) | Negative going threshold voltage          | 1.5V min.<br>5.0V max.                                                                                        | 1.0V min.<br>4.5V max.                                                                                        | Guaranteed negative going threshold for Data input (pull-up closed)                                                       |
| $I_T +$ (Data input-A) (pull-up open)   | Input current at positive going threshold | 40 $\mu$ A max.                                                                                               | 40 $\mu$ A max.                                                                                               | Guaranteed input leakage current<br>$V_{IN} = 10\text{V}$ (pull-up open)                                                  |
| $I_T -$ (Data input-A) (pull-up open)   | Input current at negative going threshold | -1.0mA max.                                                                                                   | -1.2mA max.                                                                                                   | Guaranteed input low current. $V_{IN} = 1.5\text{V}$ for C device and 1.8V for A device (pull-up open)                    |
| $I_T +$ (Data input-A) (pull-up closed) | Input current at positive going threshold | 40 $\mu$ A max.                                                                                               | 40 $\mu$ A max.                                                                                               | Guaranteed input leakage current<br>$V_{IN} = 10\text{V}$ (pull-up closed)                                                |
| $I_T -$ (Data input-A) (pull-up closed) | Input current at negative going threshold | -2.1mA                                                                                                        | -2.6mA                                                                                                        | Guaranteed input low current $V_{IN} = 1.5\text{V}$ for C device and 1.8V for A device (pull-up closed)                   |
| $I_T$ (max)                             | Maximum input current                     | 1.0mA                                                                                                         | 1.5mA                                                                                                         | $V_{IN} = 13\text{V}$ , $V_{CC} = 13\text{V}$ for C device,<br>$V_{IN} = 15\text{V}$ , $V_{CC} = 16\text{V}$ for A device |
| $V_{OL}$                                | Output low voltage                        | 1.5V max.                                                                                                     | 1.8V max.                                                                                                     | $I_{OL} = 5\text{ UL}$ (1 UL = 2.1mA for C grade and 2.6mA for A grade)                                                   |
| $V_{OL3}$ (368 only)                    | Output low voltage                        | 0.4V max.                                                                                                     | 0.4V max.                                                                                                     | At $V_{CC} = V_{CC\text{ min}}$ , $I_{OL} = 6.4\text{mA}$ (4 TTL UL)                                                      |
| $V_{OH}$ (367 only)                     | Output high voltage                       | 10.0V min.                                                                                                    | 13.0V min.                                                                                                    | $I_{OH} = 5\text{ UL}$ (1 UL = 10 $\mu$ A)                                                                                |
| $V_{OHL}$ (367 only)                    | Output high voltage loaded                | 7.0V min.                                                                                                     | 9.5V min.                                                                                                     | At $V_{CC}$ nominal $I_{OH} = -5\text{mA}$                                                                                |
| $I_{CC}$                                | Power supply current (367) (368)          | 36mA max.<br>33mA max.                                                                                        | 54mA max.<br>50mA max.                                                                                        | At $V_{CC}$ maximum. Unit tested under worst case conditions                                                              |
| $I_{CEX}$                               | Output high leakage current (368)         | 25 $\mu$ A max.                                                                                               | 25 $\mu$ A max.                                                                                               | At $V_{CC}$ maximum, $V_{INL} = 5.0\text{V}$ ,<br>$V_{CEX} = V_{CC\text{ max}}$                                           |
| $V_{MAX}$ (368 only)                    | Output high breakdown voltage             | 13.0V min.                                                                                                    | 16.5V min.                                                                                                    | At $I_{max} = 1.0\text{mA}$ , $V_{INL} = 5.0\text{V}$ with $I_{max}$ forced into output                                   |

## Typical Applications

The HiNIL 367/368 Quad Schmitt Trigger has been designed to be a universal input port into HiNIL logic blocks. Its active outputs (367) are fully compatible with the rest of the HiNIL logic family and 12 or 15V CMOS. Although its inputs are not standard HiNIL, they can be used either with other HiNIL logic elements or with switch and relay contacts. The device is unique in that the user is presented with a choice of two truth tables, determined by whether an internal pullup resistor (pin P) is left open or is connected to  $V_{CC}$ . If Pin P is left open, the device will not recognize open circuits. By this we mean that the input will continue to see the logic state that was at the input before the connection was broken. It is this character-

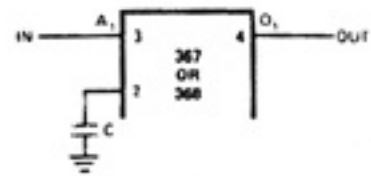
istic that eliminates errors due to contact bounce on relay or switch contacts. If Pin P is tied to  $V_{CC}$ , the device acts like a standard HiNIL circuit and considers an open input connection to be a logic one.

Occasionally a system is expected to be operable in extremely noisy environments where short noise pulses are expected in excess of 4.5V noise immunity. This problem can be eliminated by adding slow-down capacitors to special delay pins provided for this purpose. For each  $\mu\text{F}$  of capacitance added between the delay pin and ground the propagation delay will be increased by 2.5 ms.

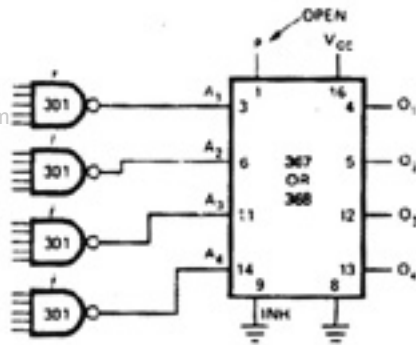
## Typical Applications (contd.)

An inhibit pin is provided that forces all outputs high whenever it is high. This can be used to restrict the 367/368 so that it accepts input information only at certain points in the machine cycle. When used with pullup resistors, the open collector 368 allows direct interface to TTL, RTL, and low voltage CMOS, NMOS, or PMOS.

## PULSE DELAY

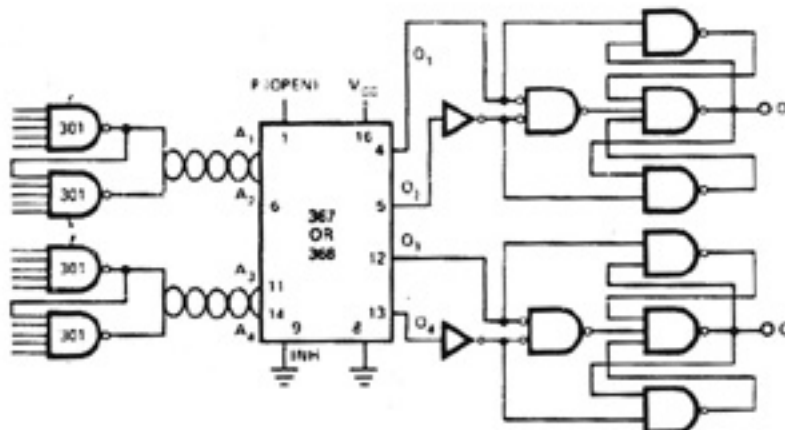


## LINE RECEIVERS



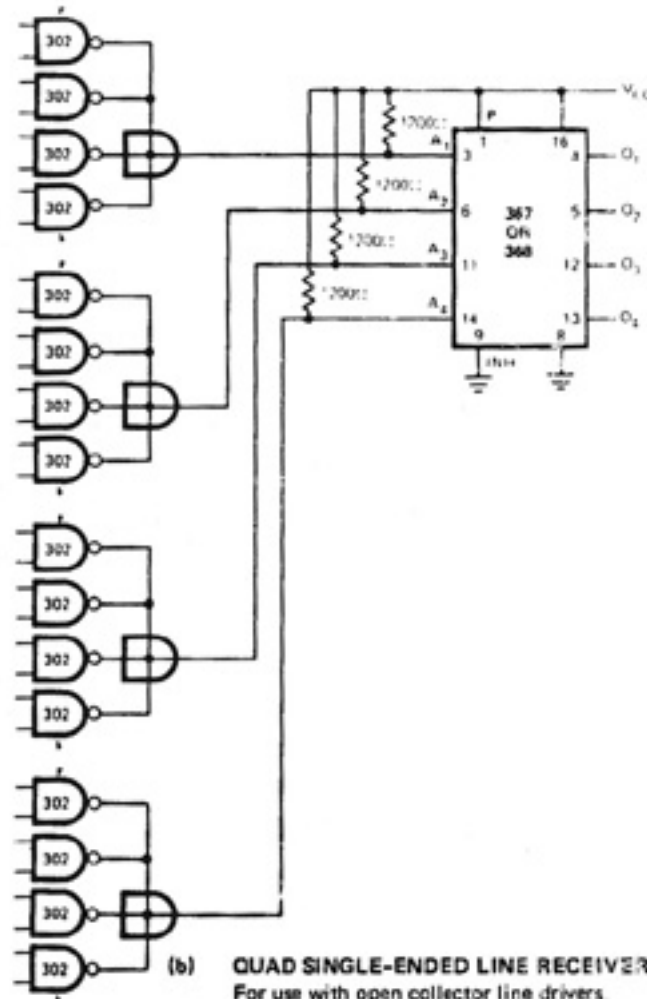
(a) QUAD SINGLE-ENDED LINE RECEIVER

Slow down capacitors may be added to the delay inputs to improve noise-immunity.



(c) DUAL DIFFERENTIAL LINE-RECEIVER

Slow down capacitors may be added to the delay inputs to improve noise immunity.

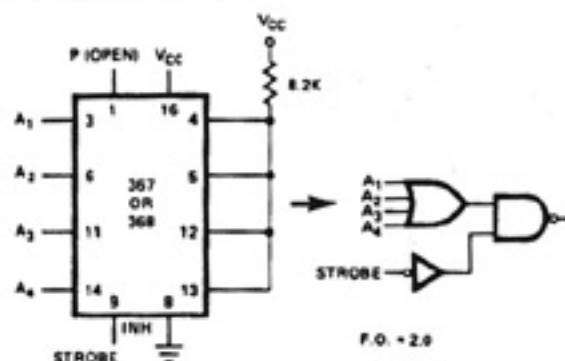


(b) QUAD SINGLE-ENDED LINE RECEIVER

For use with open collector line drivers. Slow down capacitors may be added to the delay inputs to improve noise immunity.

## 4 INPUT STROBED NOR GATE

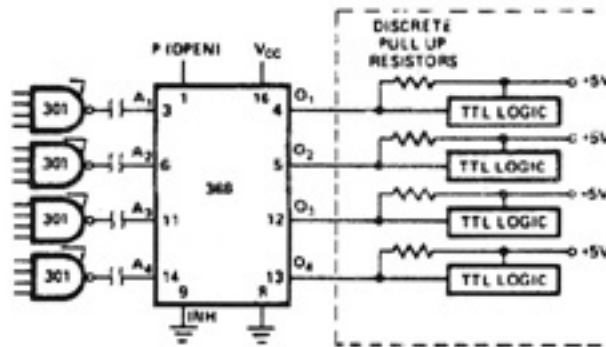
The 368 can be used as a strobed 4 input NOR gate by tying all output pins (collector-ORing) to a common pull-up resistor, and connecting the strobe input to the INHIBIT line.



F.O. = 2.0

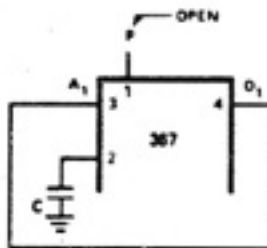
## Typical Applications (contd.)

## QUAD LINE RECEIVER/TTL INTERFACE



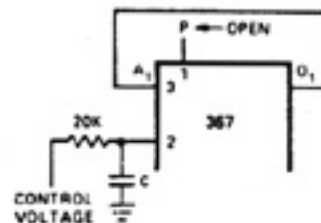
The 368 with open collector output allows direct drive interface to TTL logic.

## FREE-RUNNING OSCILLATOR



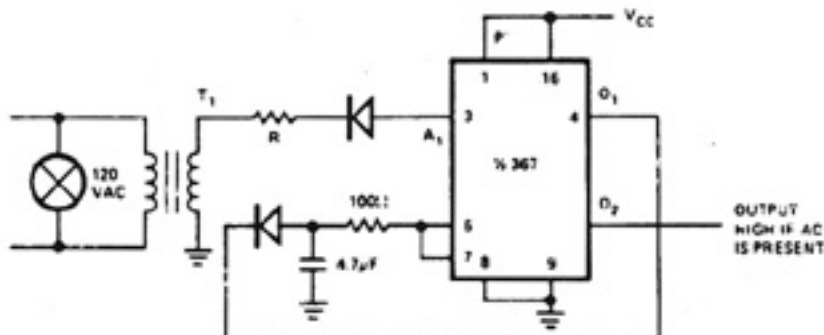
The 367 can be used to make four independent free-running oscillators. The frequency is set by the value of C tied to each delay input. The oscillators can all be started and stopped by using the inhibit input.

## VOLTAGE CONTROLLED OSCILLATOR



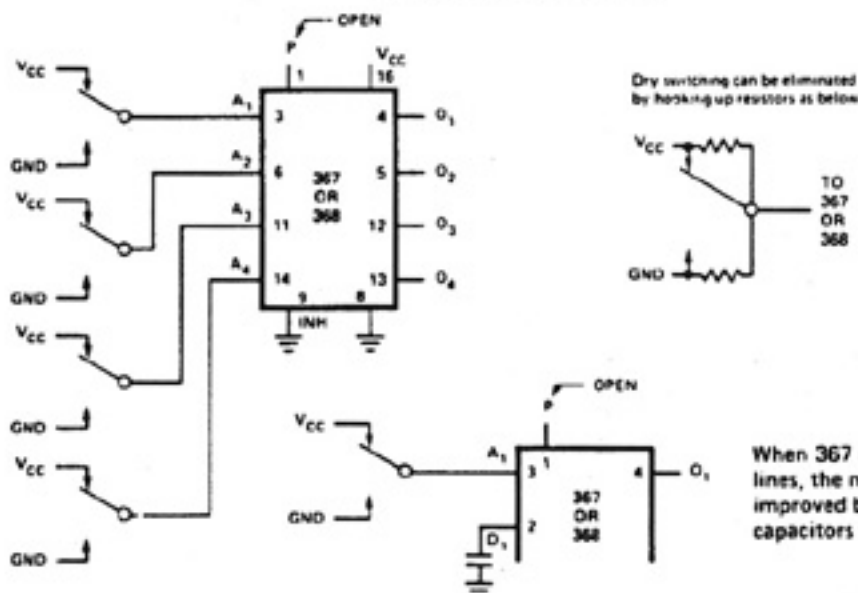
The 367 can be used to make four, independent voltage controlled oscillators.

## AC LINE VOLTAGE DETECTOR



This circuit delivers logic one's whenever 120 VAC is present on the solenoid valve. Since only 1/2 of the 367 is used, two such circuits can be built with each device.

## BOUNCE-FREE SWITCH



When 367 is being used with long lines, the noise immunity may be improved by adding slow-down capacitors to the delay input.