



# Applications for Low Input Current, High Gain Optocouplers

## Application Note 951-1

### Introduction

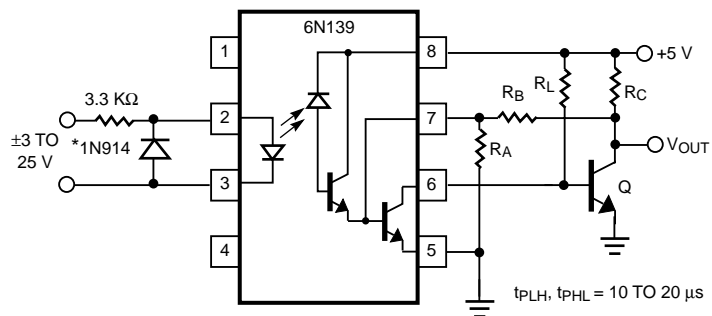
Optically coupled isolators are useful in applications where large common mode signals are encountered. Examples are: line receivers, logic isolation, power lines, medical equipment and telephone lines. This application note has at least one example in each of these areas for the 6N138/9 series high CTR couplers.

Agilent's 6N138/9 series couplers contain a high gain, high speed photodetector that provides a minimum current transfer ratio (CTR) of 300% at input currents of 1.6 mA for the 6N138 and 400% at 0.5 mA for the 6N139. The excellent low input current CTR enables these devices to be used in applications where low power consumption is required and

those applications that do not provide sufficient input current for other couplers. Separate pin connections for the photodiode and output transistor permit high speed operation and TTL compatible output. A base access terminal allows a gain bandwidth adjustment to be made.

### RS-232C Compatible Line Receiver

- 2500 V 60 Hz Common Mode Rejection
- Allows use of Low Cost Line
- Full 40 kBs Data Rate for Line Lengths up to 5000 ft.
- Hysteresis for Increased Noise Immunity



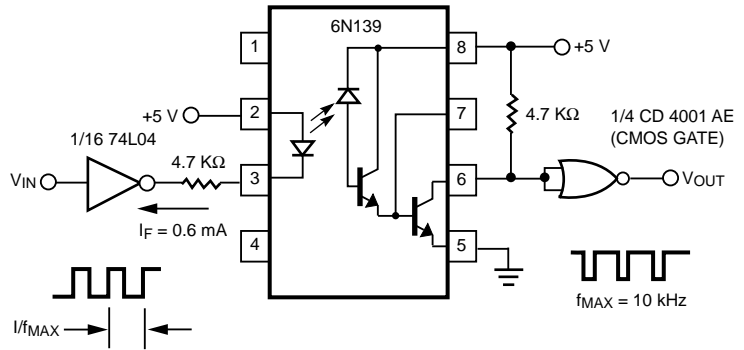
\*ANTIPARALLEL DIODE IS NEEDED ONLY IF REVERSE LINE VOLTAGE EXCEEDS 15V (TO PREVENT HIGH REVERSE VOLTAGE FROM CAUSING POWER DISSIPATION IN EXCESS OF INPUT DIODE MAXIMUM RATING).

R <sub>A</sub>	R <sub>B</sub>	R <sub>C</sub>	R <sub>L</sub>	Q
680K Ω	1.5M Ω	1.8K Ω	15K Ω	2N3904

REMOVE R<sub>A</sub> AND R<sub>B</sub> FOR NO HYSTERESIS

### Low Power Interface

- Operation at  $I_F \geq 0.5 \text{ mA}$
- $10 \text{ kHz } f_{MAX}$
- Low Power Consumption

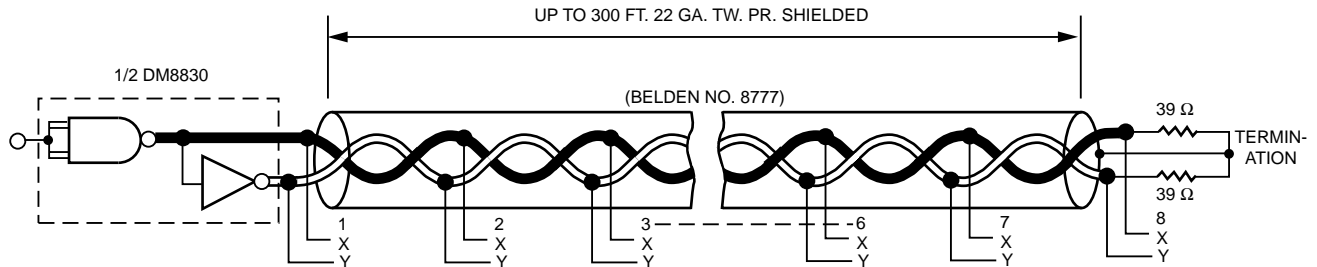


$f_{MAX}$  IS THE FREQUENCY AT WHICH A 50% DUTY FACTOR AT THE INPUT IS DEGENERATED TO 10% OR 90% DUTY FACTOR AT THE OUTPUT.

### Line Receiver for Party Line

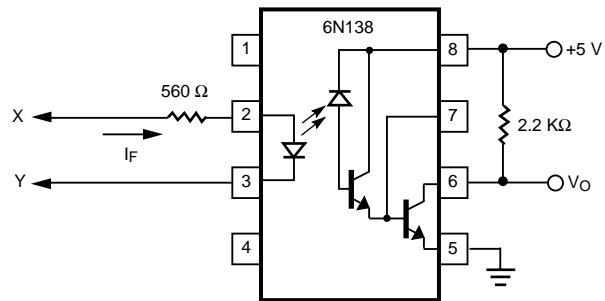
- 1 - 8 Receivers can be used with circuit shown
- Uses conventional IC Line Driver
- Total Line Length 1 - 300 ft.

- Typical Data Rate: 180 kBs ( $t_{PHL}, t_{PLH} = 3 \mu\text{sec}$ )
- Allows use of Low Cost Line



ISOLATOR LOADS MAY BE DISTRIBUTED RANDOMLY ALONG THE LENGTH OF THE LINE, OR ALL MAY BE LUMPED AT THE END.  $I_F$  FOR 1 AND 8 ISOLATOR LOADS WOULD BE 2.7 AND 1.8 mA RESPECTIVELY.

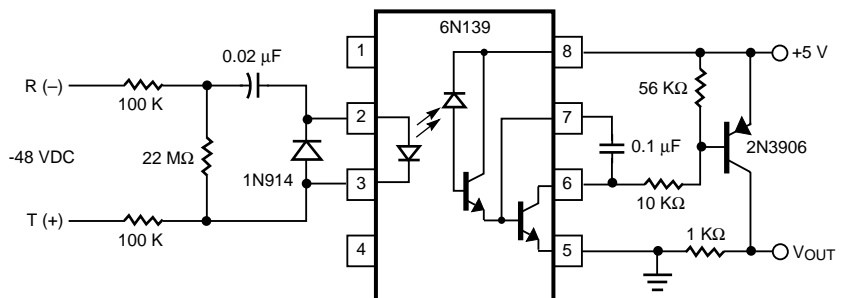
PROPAGATION DELAY:  $t_{PHL}, t_{PLH} = 0.5 \text{ TO } 5 \mu\text{s}$



OUTPUT GROUNDS MAY ALL BE ELECTRICALLY SEPARATED

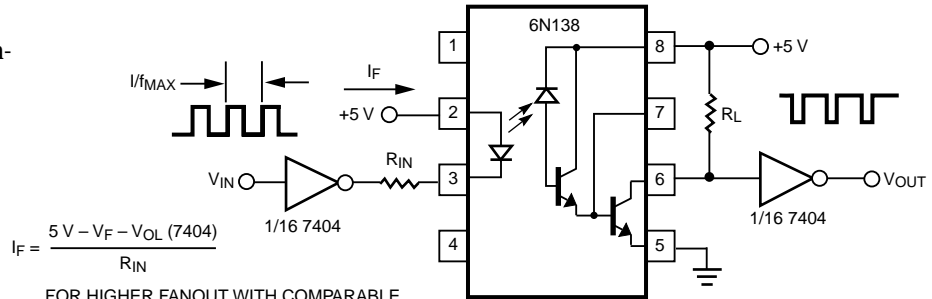
### Telephone Ring Detector

- Discriminates between Ring and Dial Signals
- Minimal Line Loading
- 2500 V Insulation from Telephone Line
- Small Size
- Integrator Included



### TTL to TTL Interface

- Direct Input and Output Compatibility
- Adjustable Data Rate
- High Fan-Out



$$I_F = \frac{5V - V_F - V_{OL}(7404)}{R_{IN}}$$

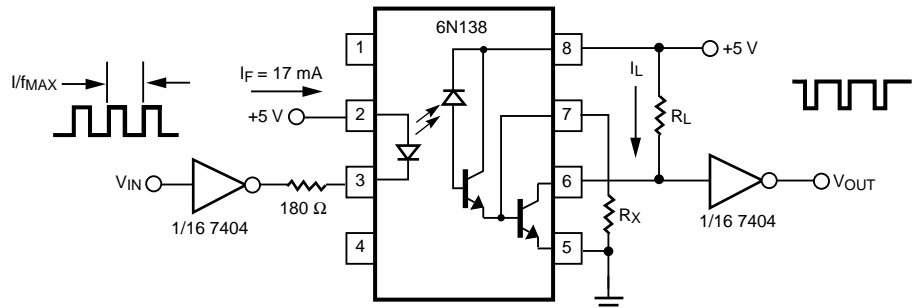
FOR HIGHER FANOUT WITH COMPARABLE DATA RATES USE SMALLER VALUES OF  $R_{IN}$

$R_L$ ( $\Omega$ )	$R_{IN}$ ( $\Omega$ )	$I_F$ (mA)	$f_{MAX}$ (kHz)
2200	1800	1.7	40
270	390	8	125
100	180	17	250

$f_{MAX}$  IS THE FREQUENCY AT WHICH A 50% DUTY FACTOR AT THE INPUT IS DEGENERATED TO 10% OR 90% DUTY FACTOR AT THE OUTPUT.

### Gain/Speed Trade Off

- Obtain Maximum Speed at Required Gain
- Single Resistor Required
- Use same device for Multiple Applications



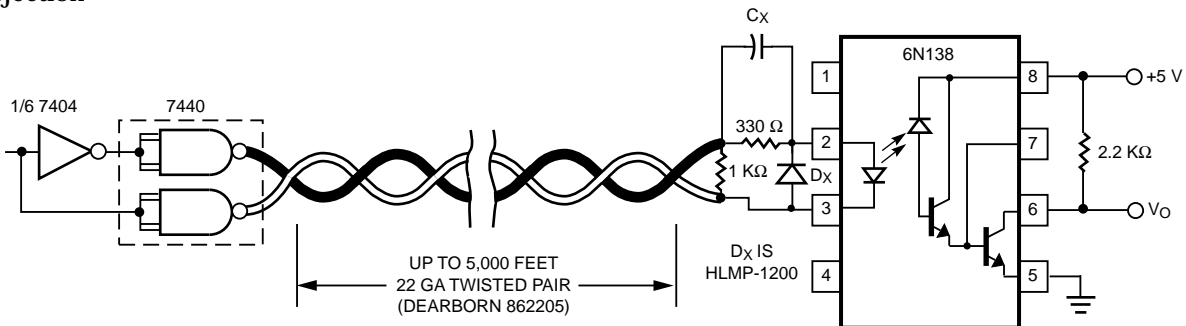
$R_X$ ( $\Omega$ )	$R_L$ ( $\Omega$ )	$I_L$ (mA)	$f_{MAX}$ (kHz)
NONE	100	46	250
820	1000	4.6	650

$f_{MAX}$  IS THE FREQUENCY AT WHICH A 50% DUTY FACTOR AT THE INPUT IS DEGENERATED TO 10% OR 90% DUTY FACTOR AT THE OUTPUT.

### 1 - 5000 ft. Line Receiver

- Drive with Standard TTL Buffer Gate
- 2500 V 60 Hz Common Mode Rejection

- Allows use of Low Cost Line
- 40 kBs Data Rate
- TTL Compatible Output

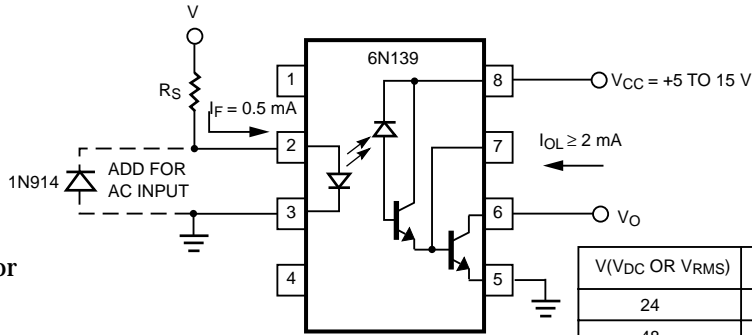


PROPAGATION DELAY: WITHOUT  $C_X$ ,  $D_X$ ,  $t_{PLH} = 2$  TO  $5 \mu s$ ;  $t_{PHL} = 25 \mu s$   
 WITH  $D_X$ ,  $C_X$ ,  $\geq 0.002 \mu F$ ,  $t_{PLH} = 2 \mu s$ ;  $t_{PHL} = 7 \mu s$



### High Voltage Status Indicator

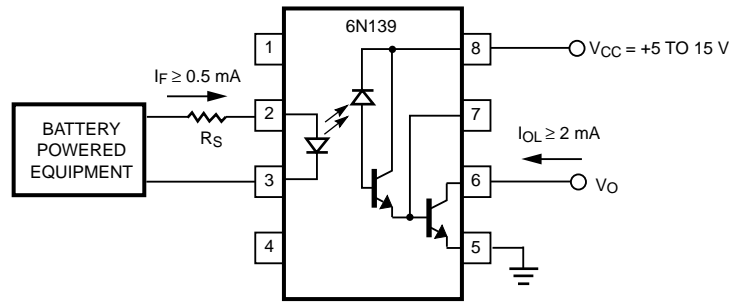
- Low Power Consumption
- TTL Compatible Output
- High Speed
- Use for Power Turn On Anticipation Circuit, 117 V Line Monitor or Other High Voltage Sensing



V(VDC OR VRMS)	Rs	V • If (mW)
24	47 KΩ	11
48	100 KΩ	22
117	220 KΩ	62
230	470 KΩ	113

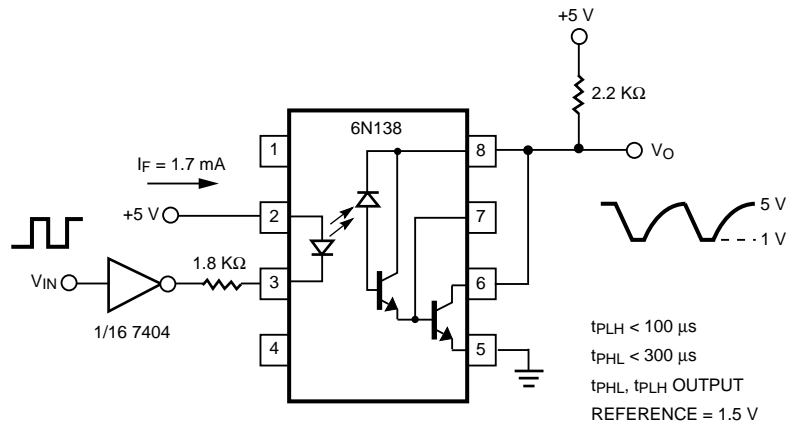
### Medical Equipment Isolation

- Low Power Consumption
- 2500 V 60 Hz Isolation
- Digital or Analog Operation



### Conventional Darlington

- No Bias Supply Required
- Base Lead available for Gain/Bandwidth Adjust
- Data Rates of 2 kBs



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