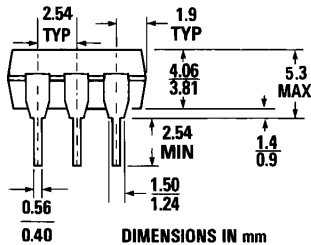
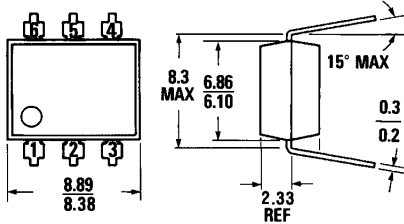


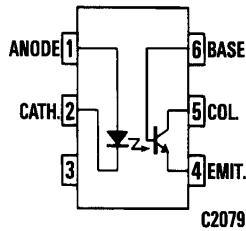
**4N25 4N27**  
**4N26 4N28**

## PACKAGE DIMENSIONS



DIMENSIONS IN mm  
PACKAGE CODE K

ST1603A



C2079

Equivalent Circuit

## DESCRIPTION

The 4N25, 4N26, 4N27, and 4N28 series of optocouplers have an NPN silicon planar phototransistor optically coupled to a gallium arsenide diode.

## FEATURES & APPLICATIONS

- AC line/digital logic isolator
- Digital logic/digital logic isolator
- Telephone/telegraph line receiver
- Twisted pair line receiver
- High frequency power supply feedback control
- Relay contact monitor
- Power supply monitor
- Small package size and low cost
- Excellent frequency response
- UL recognized—File E90700

## ABSOLUTE MAXIMUM RATINGS

### TOTAL PACKAGE

|  |                |
|--|----------------|
| *Storage temperature .....   | -55°C to 150°C |
| *Operating temperature at junction .....                                   | -55°C to 100°C |
| *Lead temperature (soldering, 10 sec) .....                                | 260°C          |
| *Total package power dissipation at 25°C ambient (LED plus detector) ..... | 250 mW         |
| *Derate linearly from 25°C .....   | 3.3 mW/°C      |

### INPUT DIODE

|   |           |
|---|-----------|
| *Forward DC current continuous .....                        | 80 mA     |
| *Reverse voltage .....                                      | 3.0 V     |
| *Peak forward current<br>(300 $\mu$ s, 2% duty cycle) ..... | 3.0 A     |
| *Power dissipation at 25°C ambient .....                    | 150 mW    |
| *Derate linearly from 25°C .....                            | 2.0 mW/°C |

### OUTPUT TRANSISTOR

|   |           |
|---|-----------|
| *Collector emitter voltage ( $BV_{CE0}$ ) ..... | 30 V      |
| *Collector base voltage ( $BV_{CBO}$ ) .....    | 70 V      |
| *Emitter collector voltage ( $BV_{ECO}$ ) ..... | 7 V       |
| *Power dissipation at 25°C ambient .....        | 150 mW    |
| *Derate linearly from 25°C .....                | 2.0 mW/°C |

\*Indicates JEDEC Registered Data.

## ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

### INDIVIDUAL COMPONENT CHARACTERISTICS

| CHARACTERISTICS  | SYMBOL     | MIN. | TYP. | GUAR. MAX. | UNITS         | TEST CONDITIONS                                  |
|--|------------|------|------|------------|---------------|--|
| <b>INPUT DIODE</b>                                       |            |      |      |            |               |  |
| *Forward voltage   | $V_f$      |      | 1.20 | 1.50       | V             | $I_f = 10 \text{ mA}$                            |
| Capacitance  | C          |      | 150  |            | pF            | $V_f = 0 \text{ V}, f = 1 \text{ MHz}$           |
| *Reverse leakage current                                 |            |      | .05  | 100        | $\mu\text{A}$ | $V_R = 3.0 \text{ V}, R_L = 1.0 \text{ M}\Omega$ |
| <b>DETECTOR</b>  |            |      |      |            |               |  |
| DC forward current gain                                  | $h_{FE}$   |      | 250  |            |               | $V_{CE} = 5 \text{ V}, I_C = 500 \mu\text{A}$    |
| *Collector to emitter breakdown voltage                  | $BV_{CEO}$ | 30   | 65   |            | V             | $I_C = 1.0 \text{ mA}, I_B = 0$                  |
| *Collector to base breakdown voltage                     | $BV_{CBO}$ | 70   | 165  |            | V             | $I_C = 100 \mu\text{A}, I_E = 0$                 |
| *Emitter to collector breakdown voltage                  | $BV_{ECO}$ | 7    | 14   |            | V             | $I_E = 100 \mu\text{A}, I_B = 0$                 |
| *Collector to emitter leakage current (4N25, 4N26, 4N27) | $I_{CEO}$  |      | 3.5  | 50         | nA            | $V_{CE} = 10 \text{ V}$ Base Open                |
| *Collector to emitter leakage current (4N28)             |            |      |      | 100        | nA            |  |
| *Collector to base leakage current                       | $I_{CBO}$  |      | 0.1  | 20         | nA            | $V_{CB} = 10 \text{ V}$ Emitter Open             |

### TRANSFER CHARACTERISTICS

| DC CHARACTERISTICS  | SYMBOL        | MIN.       | TYP.       | GUAR. MAX. | UNITS | TEST CONDITIONS                                       |
|---|---------------|------------|------------|------------|-------|---|
| *Collector output current (a)<br>(4N25, 4N26)<br>(4N27, 4N28) | $I_C$         | 2.0<br>1.0 | 5.0<br>3.0 | —<br>—     | mA    | $V_{CE} = 10 \text{ V}, I_f = 10 \text{ mA}, I_B = 0$ |
| *Collector-emitter saturation                                 | $V_{CE(SAT)}$ |            | 0.2        | 0.5        | V     | $I_C = 2.0 \text{ mA}, I_f = 50 \text{ mA}$           |

### TRANSFER CHARACTERISTICS

| AC CHARACTERISTICS                       | SYMBOL | TYP. | UNITS         | TEST CONDITIONS  |
|--|--------|------|---------------|--|
| Non-saturated<br>Collector<br>Delay time | $t_d$  | 0.5  | $\mu\text{S}$ | $R_L = 100 \Omega, I_C = 2 \text{ mA}, V_{CC} = 10 \text{ V}$<br>(Fig. 10 and 11)      |
| Rise time                                | $t_r$  | 2.5  | $\mu\text{S}$ |  |
| Fall time                                | $t_f$  | 2.6  | $\mu\text{S}$ |  |
| Non-saturated<br>Collector<br>Delay time | $t_d$  | 2.0  | $\mu\text{S}$ | $R_L = 1\text{k}\Omega, I_C = 2 \text{ mA}, V_{CC} = 10 \text{ V}$<br>(Fig. 10 and 11) |
| Rise time                                | $t_r$  | 15   | $\mu\text{S}$ |  |
| Fall time                                | $t_f$  | 15   | $\mu\text{S}$ |  |

\*Indicates JEDEC Registered Data.

- (a) Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$   
 (b) For this test LED pins 1 and 2 are common and Phototransistor pins 4, 5 and 6 are common.  
 (c) If adjusted to yield  $I_C = 2 \text{ mA}$  and  $t_c = 0.7 \text{ mA RMS}$ ; Bandwidth referenced to 10 kHz.

## ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

### TRANSFER CHARACTERISTICS (Cont'd)

| AC CHARACTERISTICS  | SYMBOL          | MIN.                | TYP.        | GUAR. MAX.  | UNITS       | TEST CONDITIONS  |
|---|-----------------|---------------------|-------------|-------------|-------------|--|
| Saturated<br>$t_{on}$ (from 5 V to 0.8 V)                                     | $t_{on}$ (SAT)  |                     | 5           |             | $\mu s$     | $R_L=2k\Omega, I_F=15\text{ mA}, V_{CC}=5\text{ V}$                |
| $t_{off}$ (from SAT to 2.0 V)   | $t_{off}$ (SAT) |                     | 25          |             | $\mu s$     | $R_B=Open$ (Fig. 10)   |
| Saturated<br>$t_{on}$ (from 5 V to 0.8 V)                                     | $t_{on}$ (SAT)  |                     | 5           |             | $\mu s$     | $R_L=2k\Omega, I_F=20\text{ mA}, V_{CC}=5\text{ V}$                |
| $t_{off}$ (from SAT to 2.0 V)   | $t_{off}$ (SAT) |                     | 18          |             | $\mu s$     | $R_B=100k\Omega$ (Fig. 10)   |
| Non-saturated<br>Base—Collector photo diode<br>Rise time                      | $t_r$           |                     | 175         |             | ns          | $R_L=1k\Omega, V_{CB}=10\text{ V}$                                 |
| Fall time   | $t_f$           |                     | 175         |             | ns          |  |
| Isolation voltage (b)<br>(4N25, 4N26, 4N27, 4N28)<br>*(4N26, 4N27)<br>*(4N28) | $V_{iso}$       | 5300<br>1500<br>500 | —<br>—<br>— | —<br>—<br>— | V<br>V<br>V | $I_{i0} \leq 1\ \mu A$<br>RMS, $t=1\text{ minute}$<br>Peak<br>Peak |
| Isolation resistance (b)  |                 |                     | $10^{11}$   |             | $\Omega$    | $V=500\text{ VDC}$   |
| Isolation capacitance (b)   |                 |                     | 1.3         |             | pF          | $V=0, f=1.0\text{ MHz}$  |
| Bandwidth (c)<br>(also see note 2)  | $B_w$           |                     | 300         |             | kHz         | $I_C=2.0\text{ mA}, R_L=100\ \Omega$<br>(Fig. 12)                  |

\*Indicates JEDEC Registered Data.

(a) Pulse Test: Pulse Width=300  $\mu s$ , Duty Cycle  $\leq 2.0\%$

(b) For this test LED pins 1 and 2 are common and Phototransistor pins 4, 5 and 6 are common.

(c) If adjusted to yield  $I_C=2\text{ mA}$  and  $i_C=0.7\text{ mA RMS}$ ; Bandwidth referenced to 10 kHz.

## TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (25°C Free Air Temperature Unless Otherwise Specified)

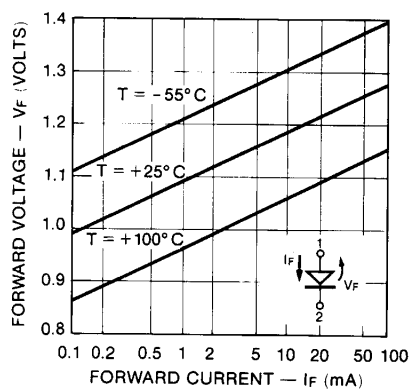


Fig. 1. Forward Voltage vs. Current

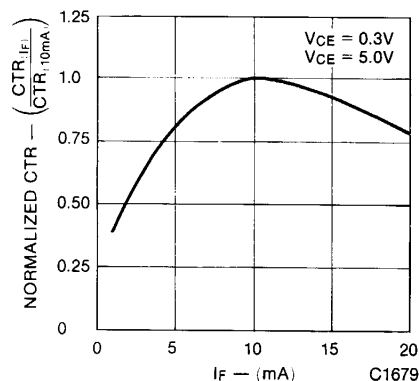


Fig. 2. Normalized CTR vs. Forward Current

**TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES**  
(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

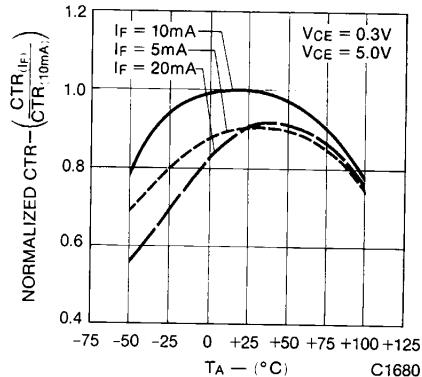


Fig. 3. Normalized CTR vs. Temperature

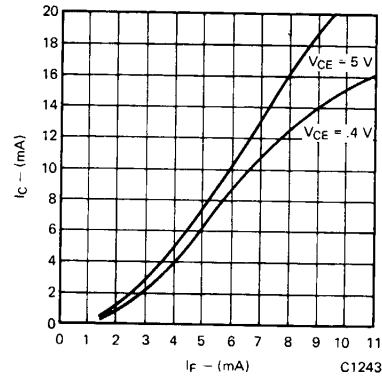


Fig. 4. Collector Current vs. Forward Current

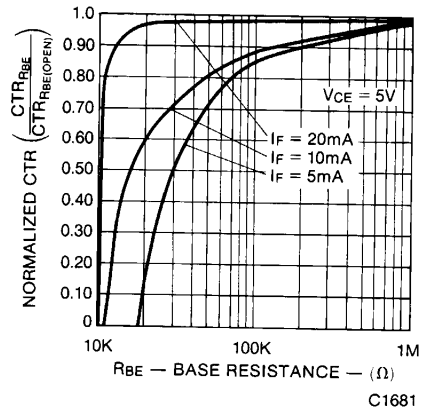


Fig. 5. CTR vs. R<sub>BE</sub> (Unsaturated)

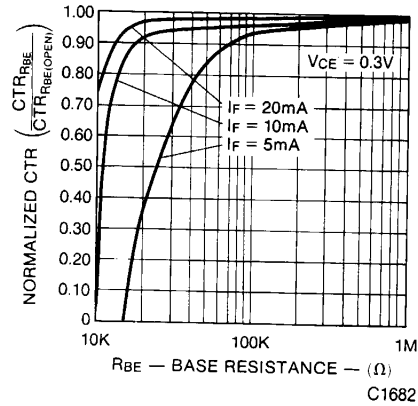


Fig. 6. CTR vs. R<sub>BE</sub> (Saturated)

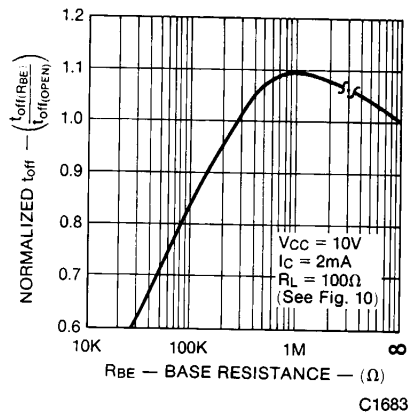


Fig. 7. Normalized T<sub>off</sub> vs. R<sub>BE</sub>

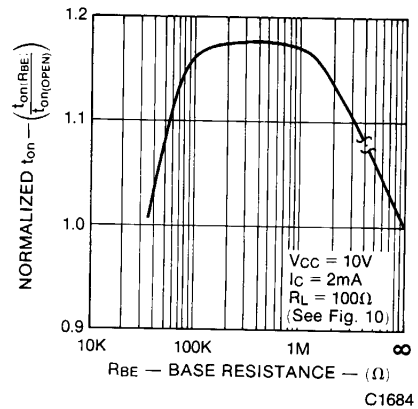


Fig. 8. Normalized T<sub>on</sub> vs. R<sub>BE</sub>

**TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES**

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

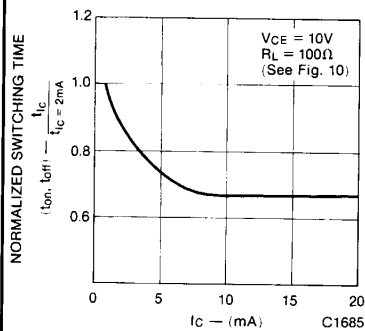


Fig. 9. Switching Time vs. IC

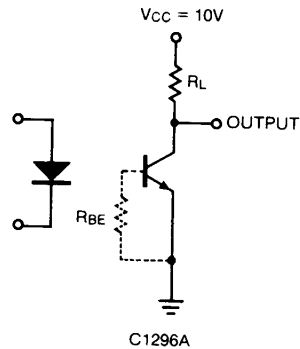


Fig. 10. Switching Time Test Circuit

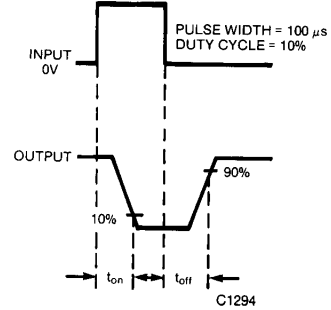


Fig. 11. Switching Time Waveforms

**OPERATING SCHEMATICS**

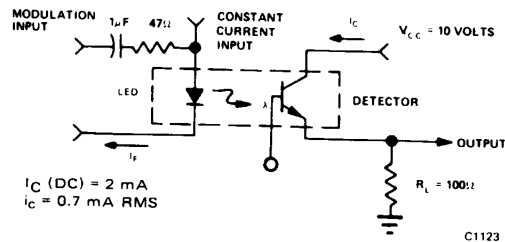


Fig. 12. Modulation Circuit Used to Obtain Output vs. Frequency Plot

**NOTES**

1. The current transfer ratio ( $I_C/I_F$ ) is the ratio of the detector collector current to the LED input current with  $V_{CE}$  at 10 volts.
2. The frequency at which  $i_c$  is 3dB down from the 10 kHz value.
3. Rise time ( $t_r$ ) is the time required for the collector current to increase from 10% of its final value to 90%.  
Fall time ( $t_f$ ) is the time required for the collector current to decrease from 90% of its initial value to 10%.