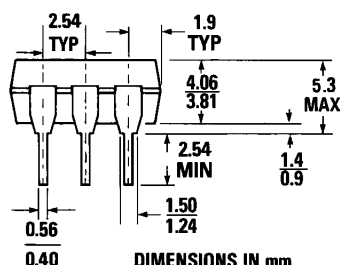
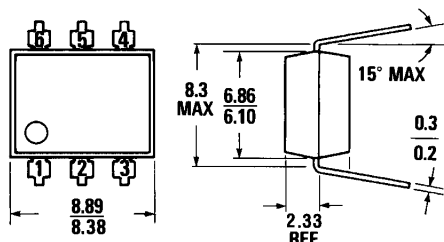
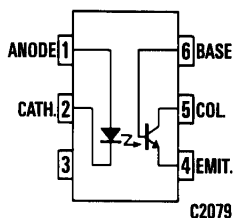


**PACKAGE DIMENSIONS**



DIMENSIONS IN mm  
PACKAGE CODE K

ST1603A



Equivalent Circuit

**DESCRIPTION**

The 4N35, 4N36, and 4N37 series of optocouplers have an NPN silicon planar phototransistor optically coupled to a gallium arsenide infrared emitting 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
- Industrial controls
- Covered under UL component recognition program, reference File E90700
- High DC current transfer ratio

**ABSOLUTE MAXIMUM RATINGS**

**TOTAL PACKAGE**

- \*Relative humidity . . . . . 85% @ 85°C
- \*Storage temperature . . . . . -55°C to 150°C
- \*Operating temperature . . . . . -55°C to 100°C
- \*Lead temperature (soldering, 10 sec) . . . . . 260°C

**INPUT DIODE**

- \*Forward DC current (continuous) . . . . . 60 mA
- Reverse voltage . . . . . 6 volts
- \*Peak forward current  
(1  $\mu$ s pulse, 300 pps) . . . . . 3.0 A
- \*Power dissipation at  $T_A=25^\circ\text{C}$  . . . . . 100 mW†
- \*Power dissipation at  $T_C=25^\circ\text{C}$  . . . . . 100 mW†  
( $T_C$  indicates collector lead temp  
1/32" from case)

**OUTPUT TRANSISTOR**

- \*Power dissipation at 25°C ambient . . . . . 300 mW
- Derate linearly above 25°C . . . . . 4 mW/°C
- \*Power dissipation at  $T_C=25^\circ\text{C}$  . . . . . 500 mW††  
( $T_C$  indicates collector lead temp  
1/32" from case)
- \* $V_{CEO}$  . . . . . 30 volts
- \* $V_{CBO}$  . . . . . 70 volts
- \* $V_{ECO}$  . . . . . 7 volts
- \*Collector current (continuous) . . . . . 100 mA

\*Indicates JEDEC registered values

†Derate 1.33 mW/°C above 25°C.

††Derate 6.7 mW/°C above 25°C.

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

**INDIVIDUAL COMPONENT CHARACTERISTICS**

| CHARACTERISTIC                               | SYMBOL     | MIN. | TYP. | MAX. | UNITS         | TEST CONDITIONS                                                    |
|----------------------------------------------|------------|------|------|------|---------------|--------------------------------------------------------------------|
| <b>INPUT DIODE</b>                           |            |      |      |      |               |                                                                    |
| *Forward voltage                             | $V_F$      | .8   |      | 1.50 | V             | $I_F = 10 \text{ mA}$                                              |
| *Forward voltage temp. coefficient           | $V_F$      | .9   |      | 1.7  | V             | $I_F = 10 \text{ mA}$ , $T_A = -55^\circ\text{C}$                  |
| *Forward voltage                             | $V_F$      | .7   |      | 1.4  | V             | $I_F = 10 \text{ mA}$ ,<br>$T_A = +100^\circ\text{C}$              |
| *Junction capacitance                        | $C_J$      |      |      | 100  | pF            | $V_F = 0 \text{ V}$ , $f = 1 \text{ MHz}$                          |
| *Reverse leakage current                     |            |      | .01  | 10   | $\mu\text{A}$ | $V_R = 6.0 \text{ V}$                                              |
| <b>DETECTOR</b>                              |            |      |      |      |               |                                                                    |
| DC forward current gain                      | $h_{FE}$   |      | 250  |      |               | $V_{CE} = 5 \text{ V}$ , $I_C = 100 \mu\text{A}$                   |
| *Collector to emitter breakdown voltage      | $BV_{CEO}$ | 30   | 65   |      | V             | $I_C = 10 \text{ mA}$ , $I_F = 0$                                  |
| *Collector to base breakdown voltage         | $BV_{CBO}$ | 70   | 165  |      | V             | $I_C = 100 \mu\text{A}$ , $I_F = 0$                                |
| *Emitter to collector breakdown voltage      | $BV_{ECO}$ | 7    | 14   |      | V             | $I_E = 100 \mu\text{A}$ , $I_F = 0$                                |
| Collector to emitter, leakage current        | $I_{CEO}$  |      | 5    | 50   | nA            | $V_{CE} = 10 \text{ V}$ , $I_F = 0$                                |
| *Collector to emitter leakage current (dark) | $I_{CEO}$  |      |      | 500  | $\mu\text{A}$ | $V_{CE} = 30 \text{ V}$ , $I_F = 0$ ,<br>$T_A = 100^\circ\text{C}$ |
| Capacitance collector to emitter             | $C_{CEW}$  |      | 8    |      | pF            | $V_{CE} = 0$                                                       |
| Capacitance collector to base                | $C_{CBO}$  |      | 20   |      | pF            | $V_{CB} = 10 \text{ V}$                                            |
| Capacitance base to emitter                  | $C_{BEO}$  |      | 10   |      | pF            | $V_{BE} = 0$                                                       |

**TRANSFER CHARACTERISTICS**

| CHARACTERISTICS                          | SYMBOL        | MIN. | TYP. | MAX. | UNITS | TEST CONDITIONS                                                                 |
|------------------------------------------|---------------|------|------|------|-------|---------------------------------------------------------------------------------|
| <b>COUPLED</b>                           |               |      |      |      |       |                                                                                 |
| †*DC current transfer ratio              | CTR           | 100  |      |      | %     | $I_F = 10 \text{ mA}$ , $V_{CE} = 10 \text{ V}$                                 |
| †*DC current transfer ratio              | CTR           | 40   |      |      | %     | $I_F = 10 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ ,<br>$T_A = -55^\circ\text{C}$  |
| †*DC current transfer ratio              | CTR           | 40   |      |      | %     | $I_F = 10 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ ,<br>$T_A = +100^\circ\text{C}$ |
| *Saturation voltage—collector to emitter | $V_{CE(SAT)}$ |      |      | .3   | volts | $I_F = 10 \text{ mA}$ , $I_C = 0.5 \text{ mA}$                                  |

**TRANSFER CHARACTERISTICS**

| AC CHARACTERISTICS | SYMBOL    | MIN. | TYP. | MAX. | UNITS           | TEST CONDITIONS                                                                                  |
|--------------------|-----------|------|------|------|-----------------|--------------------------------------------------------------------------------------------------|
| *Turn on time      | $t_{ON}$  |      | 5    | 10   | $\mu\text{sec}$ | $V_{CC} = 10 \text{ V}$ , $I_C = 2 \text{ mA}$ ,<br>$R_L = 100\Omega$ ,<br>(Fig. 10 and Fig. 11) |
| *Turn off time     | $t_{OFF}$ |      | 5    | 10   | $\mu\text{sec}$ | $V_{CC} = 10 \text{ V}$ , $I_C = 2 \text{ mA}$ ,<br>$R_L = 100\Omega$ ,<br>(Fig. 10 and Fig. 11) |

\*Indicates JEDEC registered values

†Pulse test: pulse width =  $300 \mu\text{s}$ ,  
duty cycle  $\leq 2.0\%$

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

**ISOLATION CHARACTERISTICS**

| CHARACTERISTICS                                                            | SYMBOL    | MIN. | TYP. | MAX. | UNITS      | TEST CONDITIONS                                                       |
|----------------------------------------------------------------------------|-----------|------|------|------|------------|-----------------------------------------------------------------------|
| Isolation voltage all devices                                              | $V_{iso}$ | 5300 |      |      | $V_{RMS}$  | $I_{i-o} \leq 1 \mu A$<br>$t = 1 \text{ minute}$                      |
| *Input to output isolation current<br>(pulse width=8 msec)<br>(see Note 1) | $I_{i-o}$ |      |      |      |            |                                                                       |
| 4N35                                                                       |           |      |      | 100  | $\mu A$    | $V_{so} = 3550 \text{ VAC (peak)}$                                    |
| 4N36                                                                       |           |      |      | 100  | $\mu A$    | $V_{so} = 2500 \text{ VAC (peak)}$                                    |
| 4N37                                                                       |           |      |      | 100  | $\mu A$    | $V_{so} = 1500 \text{ VAC (peak)}$                                    |
| *Input to output resistance                                                | $R_{i-o}$ | 100  |      |      | gigaohms   | Input to output voltage =<br>500 V (see Note 1)                       |
| *Input to output capacitance                                               | $C_{i-o}$ |      |      | 2.5  | picofarads | Input to output voltage =<br>0 V, $f = 1 \text{ MHz}$<br>(see Note 1) |

\*Indicates JEDEC registered values

†Pulse test: pulse width=300 $\mu$ S,  
duty cycle $\leq$ 2.0%

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

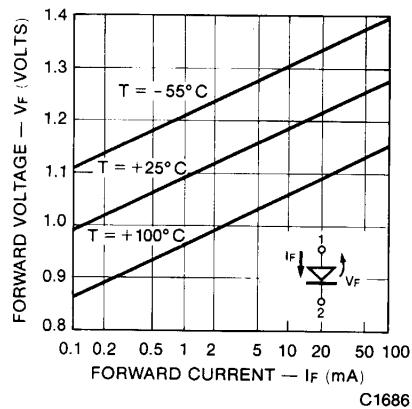


Fig. 1. Forward Voltage vs.  
Current

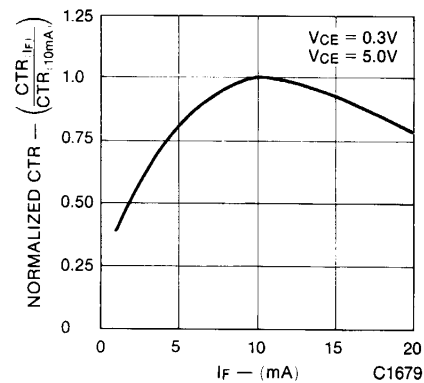


Fig. 2. Normalized CTR vs.  
Forward Current

**TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES**

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

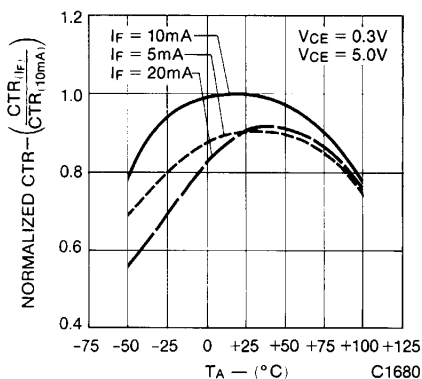


Fig. 3. Normalized CTR vs. Temperature

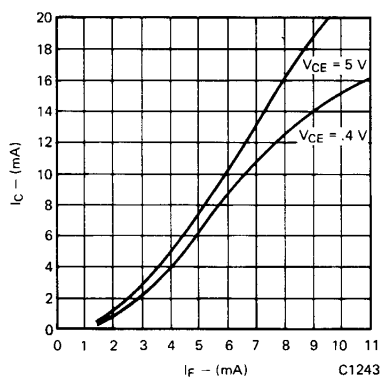


Fig. 4. Collector Current vs. Forward Current

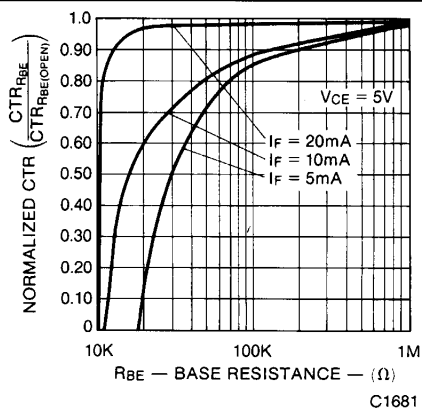


Fig. 5. CTR vs. RBE (Unsaturated)

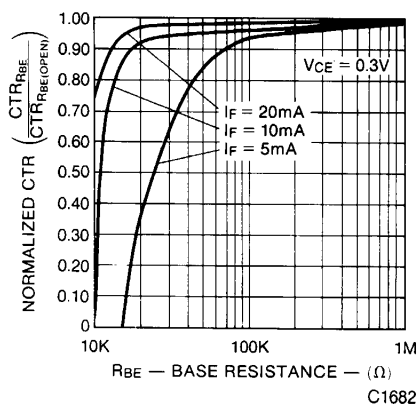


Fig. 6. CTR vs. RBE (Saturated)

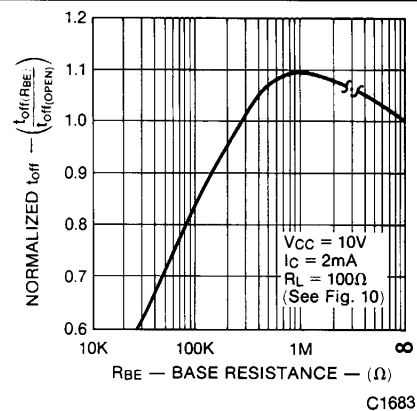


Fig. 7. Normalized  $T_{OFF}$  vs. RBE

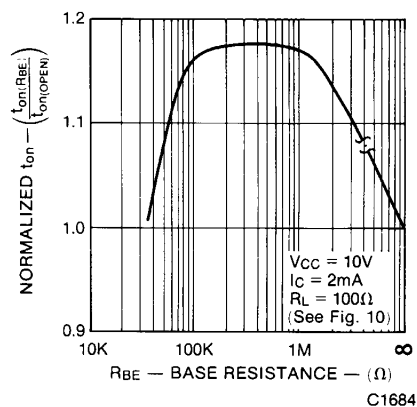
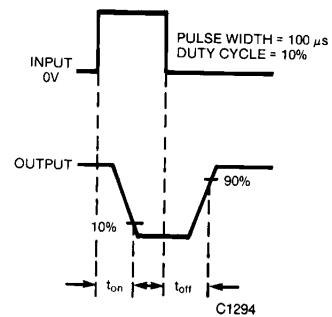
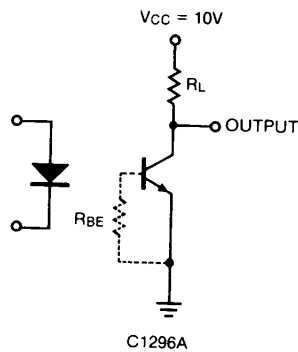
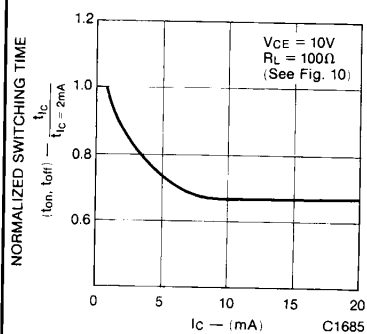


Fig. 8. Normalized  $T_{ON}$  vs. RBE

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



**NOTES**

1. Tests of input to output isolation current resistance and capacitance are performed with the input terminals (diode) shorted together and the output terminals (transistor) shorted together.
2. The current transfer ratio ( $I_c/I_e$ ) is the ratio of the detector collector current to the LED input current with  $V_{CE}$  at 10 volts.
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%.



## PHOTOTRANSISTOR OPTOCOUPLERS

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2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.