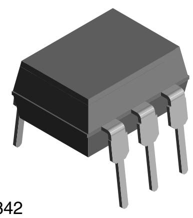
# Optocoupler, Phototransistor Output, with Base Connection



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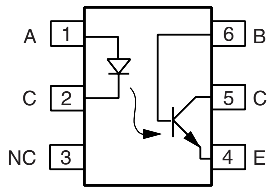



i179004-5

## FEATURES

- Isolation test voltage 5000 $V_{RMS}$
- Interfaces with common logic families
- Input-output coupling capacitance < 0.5 pF
- Industry standard dual-in-line 6 pin package
- Compliant to RoHS directive 2002/95/EC and in accordance to WEEE 2002/96/EC

Pb-free
e3
RoHS
COMPLIANT

## APPLICATIONS

- AC mains detection
- Reed relay driving
- Switch mode power supply feedback
- Telephone ring detection
- Logic ground isolation
- Logic coupling with high frequency noise rejection

## DESCRIPTION

Each optocoupler consists of gallium arsenide infrared LED and a silicon NPN phototransistor.

## AGENCY APPROVALS

- Underwriters laboratory file no. E52744
- BSI: EN 60065:2002, EN 60950:2000
- FIMKO; EN 60065, EN 60335, EN 60950 certificate no. 25156

| ORDER INFORMATION | |
|---|---|
| **PART** | **REMARKS** |
| 4N35 | CTR > 100 %, DIP-6 |
| 4N36 | CTR > 100 %, DIP-6 |
| 4N37 | CTR > 100 %, DIP-6 |

| ABSOLUTE MAXIMUM RATINGS (1) | | | | |
|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **VALUE** | **UNIT** |
| **INPUT** | | | | |
| Reverse voltage | | $V_R$ | 6 | V |
| Forward current | | $I_F$ | 50 | mA |
| Surge current | t ≤ 10 μs | $I_{FSM}$ | 1 | A |
| Power dissipation | | $P_{diss}$ | 70 | mW |
| **OUTPUT** | | | | |
| Collector emitter breakdown voltage | | $V_{CEO}$ | 70 | V |
| Emitter base breakdown voltage | | $V_{EBO}$ | 7 | V |
| Collector current | | $I_C$ | 50 | mA |
| | t ≤ 1 ms | $I_C$ | 100 | mA |
| Power dissipation | | $P_{diss}$ | 70 | mW |
| **COUPLER** | | | | |
| Isolation test voltage | | $V_{ISO}$ | 5000 | $V_{RMS}$ |
| Creepage | | | ≥ 7 | mm |
| Clearance | | | ≥ 7 | mm |
| Isolation thickness between emitter and detector | | | ≥ 0.4 | mm |

| ABSOLUTE MAXIMUM RATINGS (1) | | | | |
|---|---|---|---|---|
| PARAMETER | TEST CONDITION | SYMBOL | VALUE | UNIT |
| COUPLER | | | | |
| Comparative tracking index | DIN IEC 112/VDE 0303, part 1 | | 175 | |
| Isolation resistance | $V_{IO}$ = 500 V, $T_{amb}$ = 25 °C | $R_{IO}$ | $10^{12}$ | Ω |
| | $V_{IO}$ = 500 V, $T_{amb}$ = 100 °C | $R_{IO}$ | $10^{11}$ | Ω |
| Storage temperature | | $T_{stg}$ | - 55 to + 150 | °C |
| Operating temperature | | $T_{amb}$ | - 55 to + 100 | °C |
| Junction temperature | | $T_j$ | 100 | °C |
| Soldering temperature (2) | max.10 s dip soldering: distance to seating plane ≥ 1.5 mm | $T_{sld}$ | 260 | °C |

**Notes**

(1) $T_{amb}$ = 25 °C, unless otherwise specified.
Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to absolute maximum ratings for extended periods of the time can adversely affect reliability.

(2) Refer to wave profile for soldering condditions for through hole devices (DIP).

| ELECTRICAL CHARACTERISTICS (1) | | | | | | | |
|---|---|---|---|---|---|---|---|
| PARAMETER | TEST CONDITION | PART | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| INPUT | | | | | | | |
| Junction capacitance | $V_R$ = 0 V, f = 1 MHz | | $C_j$ | | 50 | | pF |
| Forward voltage (2) | $I_F$ = 10 mA | | $V_F$ | | 1.3 | 1.5 | V |
| | $I_F$ = 10 mA, $T_{amb}$ = - 55 °C | | $V_F$ | 0.9 | 1.3 | 1.7 | V |
| Reverse current (2) | $V_R$ = 6 V | | $I_R$ | | 0.1 | 10 | µA |
| Capacitance | $V_R$ = 0 V, f = 1 MHz | | $C_O$ | | 25 | | pF |
| OUTPUT | | | | | | | |
| Collector emitter breakdown voltage(2) | $I_C$ = 1 mA | 4N35 | $BV_{CEO}$ | 30 | | | V |
| | | 4N36 | $BV_{CEO}$ | 30 | | | V |
| | | 4N37 | $BV_{CEO}$ | 30 | | | V |
| Emitter collector breakdown voltage(2) | $I_E$ = 100 µA | | $BV_{ECO}$ | 7 | | | V |
| OUTPUT | | | | | | | |
| Collector base breakdown voltage (2) | $I_C$ = 100 µA, $I_B$ = 1 µA | 4N35 | $BV_{CBO}$ | 70 | | | V |
| | | 4N36 | $BV_{CBO}$ | 70 | | | V |
| | | 4N37 | $BV_{CBO}$ | 70 | | | V |
| Collector emitter leakage current (2) | $V_{CE}$ = 10 V, $I_F$ = 0 | 4N35 | $I_{CEO}$ | | 5 | 50 | nA |
| | | 4N36 | $I_{CEO}$ | | 5 | 50 | nA |
| | $V_{CE}$ = 10 V, $I_F$ = 0 | 4N37 | $I_{CEO}$ | | 5 | 50 | nA |
| | $V_{CE}$ = 30 V, $I_F$ = 0, $T_{amb}$ = 100 °C | 4N35 | $I_{CEO}$ | | | 500 | µA |
| | | 4N36 | $I_{CEO}$ | | | 500 | µA |
| | | 4N37 | $I_{CEO}$ | | | 500 | µA |
| Collector emitter capacitance | $V_{CE}$ = 0 | | $C_{CE}$ | | 6 | | pF |
| COUPLER | | | | | | | |
| Resistance, input output (2) | $V_{IO}$ = 500 V | | $R_{IO}$ | $10^{11}$ | | | Ω |
| Capacitance, input output | f = 1 MHz | | $C_{IO}$ | | 0.6 | | pF |

**Notes**

(1) $T_{amb}$ = 25 °C, unless otherwise specified.
Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluation. Typical values are for information only and are not part of the testing requirements.

(2) Indicates JEDEC registered value.

| CURRENT TRANSFER RATIO | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **PART** | **SYMBOL** | **MIN** | **TYP.** | **MAX** | **UNIT** |
| DC current transfer ratio (1) | $V_{CE}$ = 10 V, $I_F$ = 10 mA | 4N35 | $CTR_{DC}$ | 100 | | | % |
| | | 4N36 | $CTR_{DC}$ | 100 | | | % |
| | | 4N37 | $CTR_{DC}$ | 100 | | | % |
| | $V_{CE}$ = 10 V, $I_F$ = 10 mA, $T_A$ = - 55 °C to + 100 °C | 4N35 | $CTR_{DC}$ | 40 | 50 | | % |
| | | 4N36 | $CTR_{DC}$ | 40 | 50 | | % |
| | | 4N37 | $CTR_{DC}$ | 40 | 50 | | % |

**Note**
(1) Indicates JEDEC registered values.

| SWITCHING CHARACTERISTICS | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| Switching time (1) | $V_{CC}$ = 10 V, $I_C$ = 2 mA, $R_L$ = 100 Ω | $t_{on}$, $t_{off}$ | | 10 | | μs |

**Note**
(1) Indicates JEDEC registered values.

## TYPICAL CHARACTERISTICS

$T_{amb}$ = 25 °C, unless otherwise specied

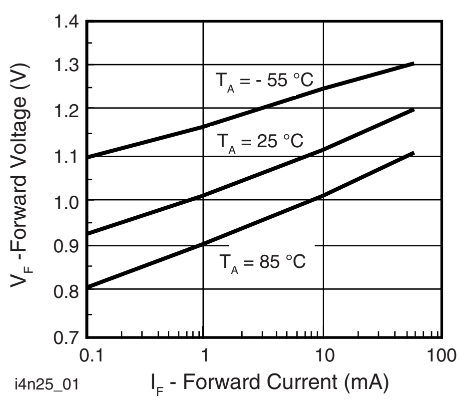



Fig. 1 - Forward Voltage vs. Forward Current

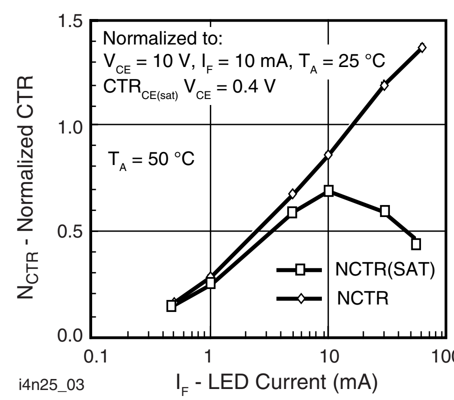



Fig. 3 - Normalized Non-Saturated and Saturated CTR vs. LED Current

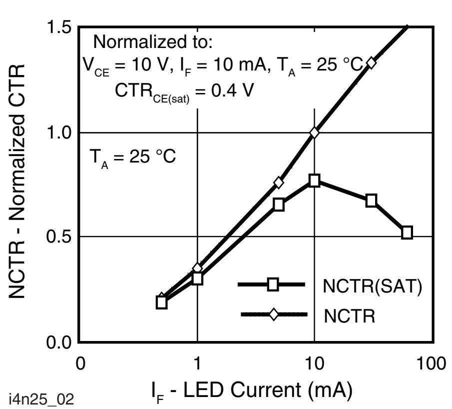



Fig. 2 - Normalized Non-Saturated and Saturated CTR vs. LED Current

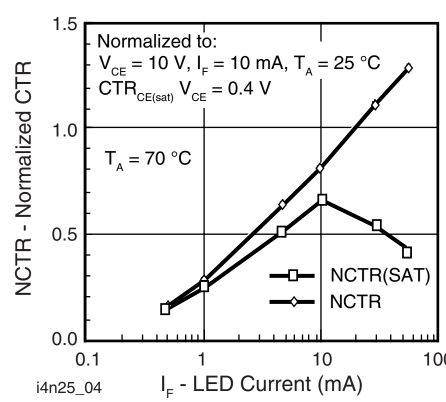



Fig. 4 - Normalized Non-Saturated and Saturated CTR vs. LED Current

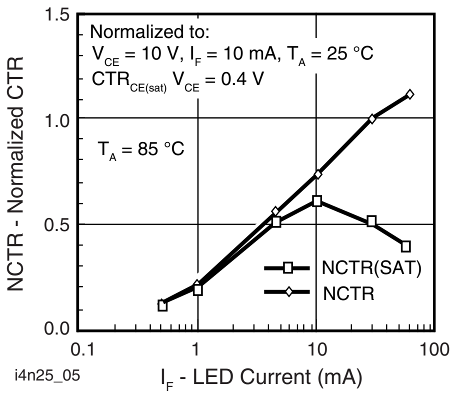



Fig. 5 - Normalized Non-Saturated and Saturated CTR vs. LED Current

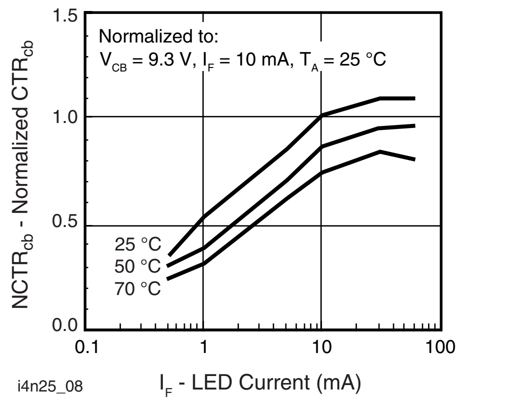



Fig. 8 - Normalized $CTR_{cb}$ vs. LED Current and Temperature

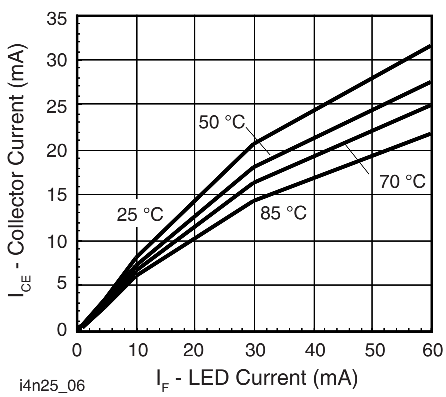



Fig. 6 - Collector Emitter Current vs. Temperature and LED Current

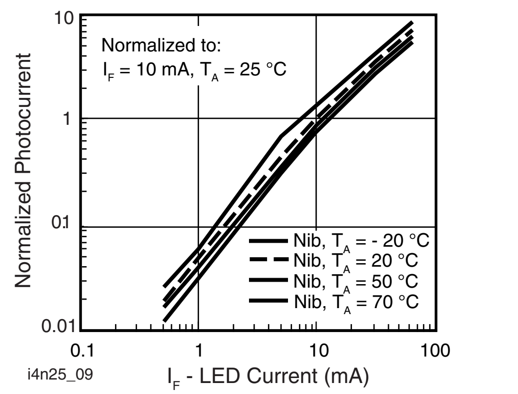



Fig. 9 - Normalized Photocurrent vs. $I_F$ and Temperature

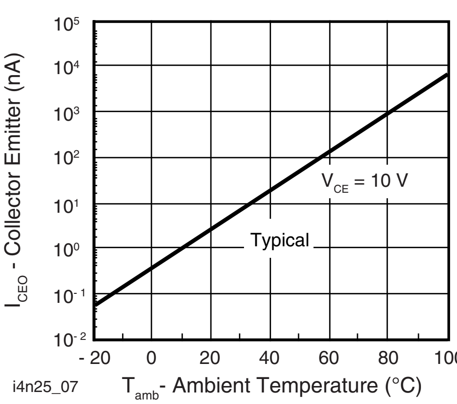



Fig. 7 - Collector Emitter Leakage Current vs. Temperature

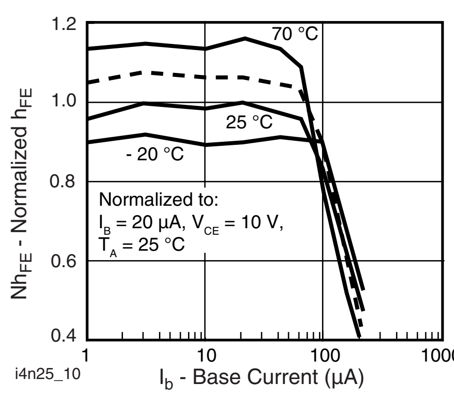



Fig. 10 - Normalized Non-Saturated $h_{FE}$ vs. Base Current and Temperature

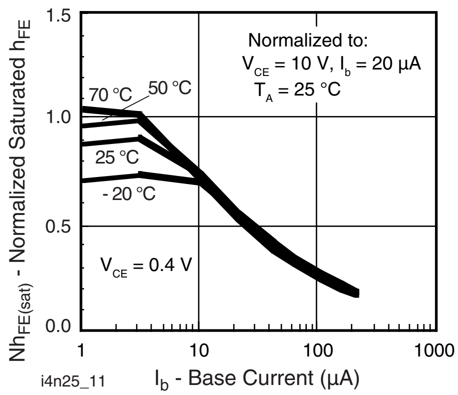



Fig. 11 - Normalized $h_{FE}$ vs. Base Current and Temperature

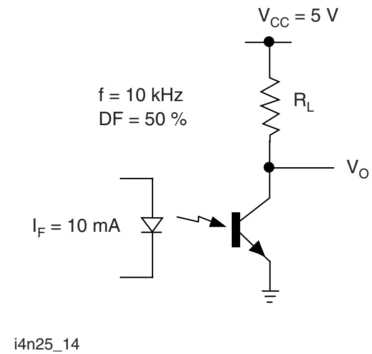



Fig. 14 - Switching Schematic

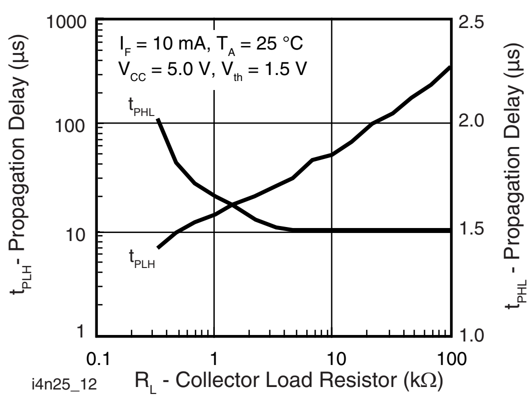



Fig. 12 - Propagation Delay vs. Collector Load Resistor

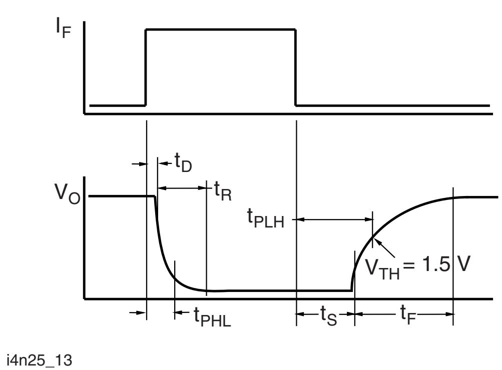
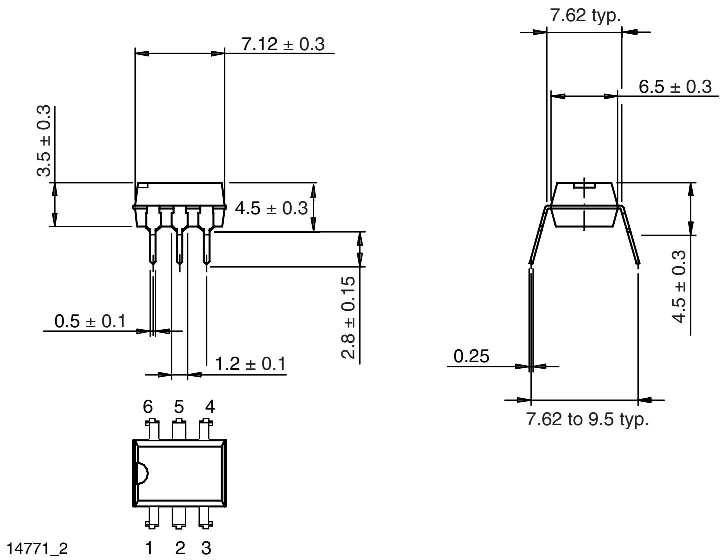
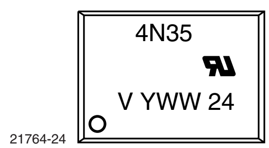



Fig. 13 - Switching Timing

## PACKAGE DIMENSIONS in millimeters




## PACKAGE MARKING






For technical questions, contact: optocoupleranswers@vishay.com

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