

# Optocoupler, Phototransistor Output, with Base Connection



21842



I179004-5

## 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

## FEATURES

- Isolation test voltage 5000 V<sub>RMS</sub>
- 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


**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

## 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
<b>INPUT</b>				
Reverse voltage		V <sub>R</sub>	6	V
Forward current		I <sub>F</sub>	50	mA
Surge current	t ≤ 10 μs	I <sub>FSM</sub>	1	A
Power dissipation		P <sub>diss</sub>	70	mW
<b>OUTPUT</b>				
Collector emitter breakdown voltage		V <sub>CEO</sub>	70	V
Emitter base breakdown voltage		V <sub>EBO</sub>	7	V
Collector current		I <sub>C</sub>	50	mA
	t ≤ 1 ms	I <sub>C</sub>	100	mA
Power dissipation		P <sub>diss</sub>	70	mW
<b>COUPLER</b>				
Isolation test voltage		V <sub>ISO</sub>	5000	V <sub>RMS</sub>
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
<b>COUPLER</b>				
Comparative tracking index	DIN IEC 112/VDE 0303, part 1		175	
Isolation resistance	$V_{IO} = 500 \text{ V}, T_{amb} = 25 \text{ }^\circ\text{C}$	$R_{IO}$	$10^{12}$	$\Omega$
	$V_{IO} = 500 \text{ V}, T_{amb} = 100 \text{ }^\circ\text{C}$	$R_{IO}$	$10^{11}$	$\Omega$
Storage temperature		$T_{stg}$	- 55 to + 150	$^\circ\text{C}$
Operating temperature		$T_{amb}$	- 55 to + 100	$^\circ\text{C}$
Junction temperature		$T_j$	100	$^\circ\text{C}$
Soldering temperature (2)	max. 10 s dip soldering: distance to seating plane $\geq 1.5 \text{ mm}$	$T_{sld}$	260	$^\circ\text{C}$

### Notes

(1)  $T_{amb} = 25 \text{ }^\circ\text{C}$ , 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 conditions for through hole devices (DIP).

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

### Notes

(1)  $T_{amb} = 25 \text{ }^\circ\text{C}$ , 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 <sup>(1)</sup>	$V_{CE} = 10 \text{ V}, I_F = 10 \text{ mA}$	4N35	$CTR_{DC}$	100			%
		4N36	$CTR_{DC}$	100			%
		4N37	$CTR_{DC}$	100			%
	$V_{CE} = 10 \text{ V}, I_F = 10 \text{ mA}, T_A = -55 \text{ }^\circ\text{C to } +100 \text{ }^\circ\text{C}$	4N35	$CTR_{DC}$	40	50		%
		4N36	$CTR_{DC}$	40	50		%
		4N37	$CTR_{DC}$	40	50		%

**Note**
<sup>(1)</sup> Indicates JEDEC registered values.

SWITCHING CHARACTERISTICS							
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT	
Switching time <sup>(1)</sup>	$V_{CC} = 10 \text{ V}, I_C = 2 \text{ mA}, R_L = 100 \text{ } \Omega$	$t_{on}, t_{off}$		10		$\mu\text{s}$	

**Note**
<sup>(1)</sup> Indicates JEDEC registered values.

**TYPICAL CHARACTERISTICS**
 $T_{amb} = 25 \text{ }^\circ\text{C}$ , unless otherwise specified


Fig. 1 - Forward Voltage vs. Forward Current

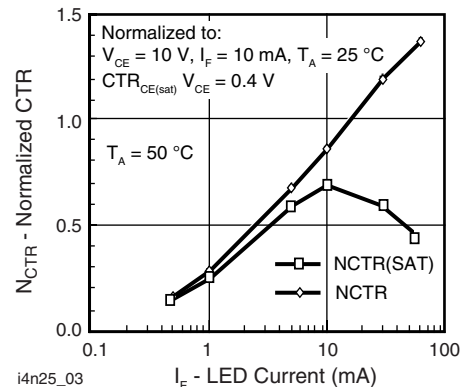


Fig. 3 - Normalized Non-Saturated and Saturated CTR vs. LED Current



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



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

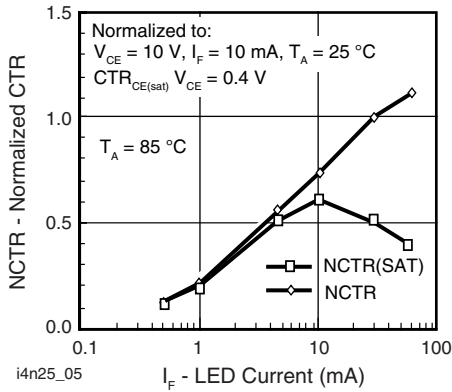


Fig. 5 - Normalized Non-Saturated and Saturated CTR vs. LED Current

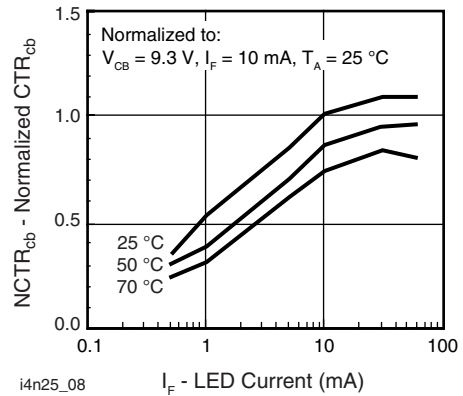


Fig. 8 - Normalized  $CTR_{cb}$  vs. LED Current and Temperature

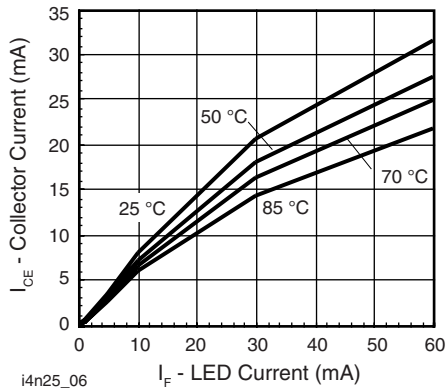


Fig. 6 - Collector Emitter Current vs. Temperature and LED Current

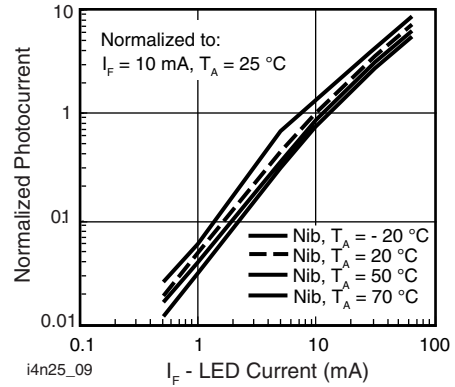


Fig. 9 - Normalized Photocurrent vs.  $I_F$  and Temperature

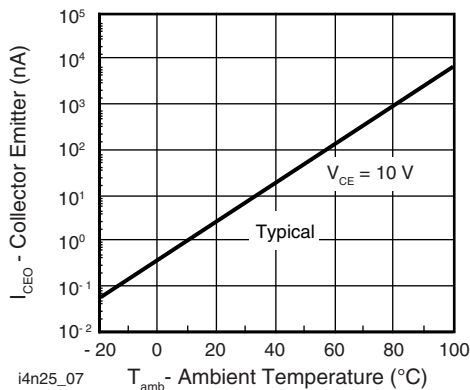


Fig. 7 - Collector Emitter Leakage Current vs. Temperature

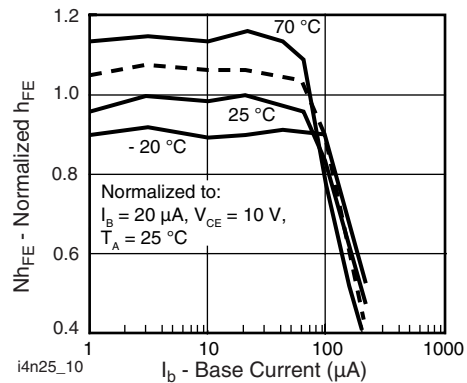


Fig. 10 - Normalized Non-Saturated  $h_{FE}$  vs. Base Current and Temperature



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

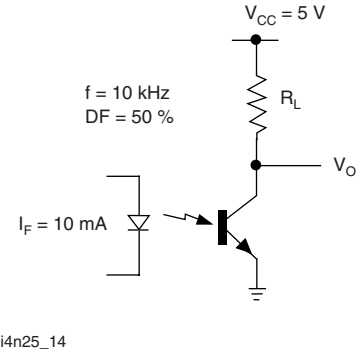


Fig. 14 - Switching Schematic

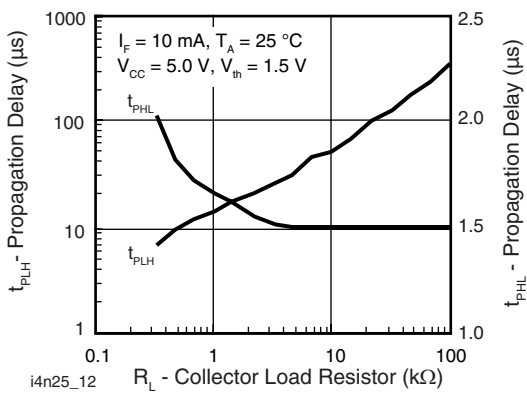


Fig. 12 - Propagation Delay vs. Collector Load Resistor

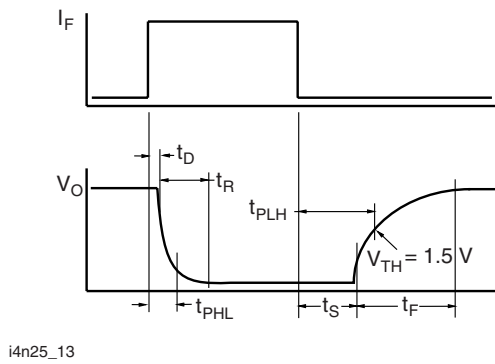


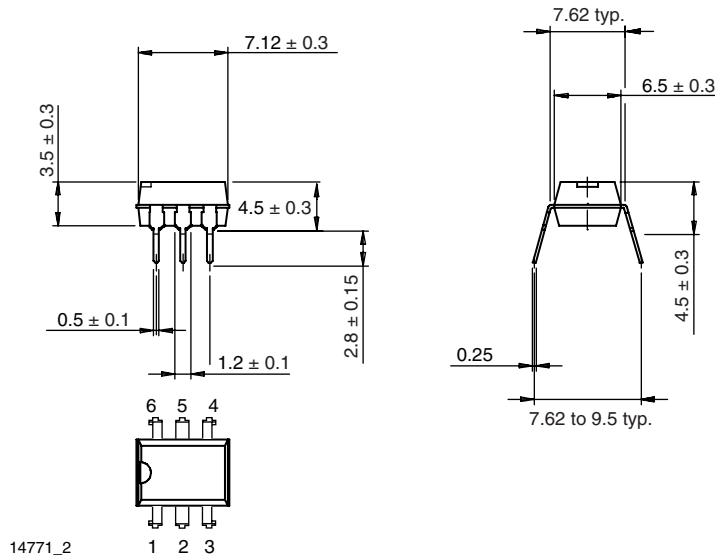
Fig. 13 - Switching Timing

# 4N35, 4N36, 4N37



Vishay Semiconductors Optocoupler, Phototransistor Output,  
with Base Connection

## PACKAGE DIMENSIONS in millimeters



## PACKAGE MARKING





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