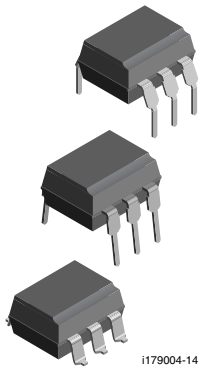
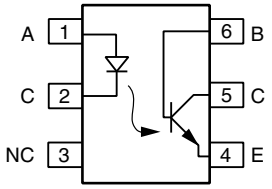
Optocoupler, Phototransistor Output, with Base Connection





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

AGENCY APPROVALS

- UL file no. E52744 (pending)
- cUL tested to CSA 22.2 bulletin 5A
- DIN EN 60747-5-2 (VDE 0884)/DIN EN 60747-5-5 (pending), available with option 1
- BSI: EN 60065, EN 60950-1
- FIMKO
- CQC

DESCRIPTION

This datasheet presents five families of Vishay industry standard single channel phototransistor couplers. These families include the 4N35, 4N36, 4N37, 4N38 couplers.

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

These couplers are Underwriters Laboratories (UL) listed to comply with a 5000 V_{RMS} isolation test voltage.

This isolation performance is accomplished through Vishay double molding isolation manufacturing process. Comliance to DIN EN 60747-5-5 partial discharge isolation specification is available for these families by ordering option 1.

These isolation processes and the Vishay ISO9001 quality program results in the highest isolation performance available for a commecial plastic phototransistor optocoupler.

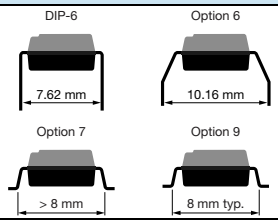
The devices are available in lead formed configuration suitable for surface mounting and are available either on tape and reel, or in standard tube shipping containers.

Note

- For additional design information see application note 45 normalized curves

ORDERING INFORMATION

4	N	3	x	-	X	0	#	#	T
PART NUMBER					PACKAGE OPTION				TAPE AND REEL



AGENCY CERTIFIED/PACKAGE	CTR (%)			
	10 mA			20 mA
UL, cUL, BSI, FIMKO	**≥ 100**			**≥ 20**
DIP-6	4N35-X000	4N36-X000	4N37-X000	4N38
DIP-6, 400 mil, option 6	4N35-X006	-	4N37-X006	-
SMD-6, option 7	4N35-X007T (1)	4N36-X007	4N37-X007	4N38-X007T (1)
SMD-6, option 9	4N35-X009T (1)	4N36-X009T (1)	4N37-X009	4N38-X009T
VDE, UL, cUL, BSI, FIMKO	**≥ 100**			**≥ 20**
DIP-6	4N35-X001	-	4N37-X001	-
DIP-6, 400 mil, option 6	4N35-X016	-	-	-
SMD-6, option 7	4N35-X017T (1)	-	-	-
SMD-6, option 9	4N35-X019T	-	-	-

Notes

- Additional options may be possible, please contact sales office.
(1) Also available in tubes; do not put T on end.

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ABSOLUTE MAXIMUM RATINGS (T_{amb} = 25 °C, unless otherwise specified)				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
INPUT				
Reverse voltage		V_R	6	V
Forward current		I_F	60	mA
Surge current	t ≤ 10 µs	I_{FSM}	2.5	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
Collector peak current	t_p/T = 0.5, t_p ≤ 10 ms	I_{CM}	100	mA
Output power dissipation		P_{diss}	150	mW
COUPLER				
Isolation test voltage	t = 1 s	V_{ISO}	5000	V_{RMS}
Creepage distance			≥ 7	mm
Clearance distance			≥ 7	mm
Isolation thickness between emitter and detector			≥ 0.4	mm
Comparative tracking index	DIN IEC 112/VDE 0303, part 1		≥ 175	
Isolation resistance	V_{IO} = 500 V, T_{amb} = 25 °C	R_{IO}	$\geq 10^{12}$	Ω
	V_{IO} = 500 V, T_{amb} = 100 °C	R_{IO}	$\geq 10^{11}$	Ω
Storage temperature		T_{stg}	- 55 to + 150	°C
Operating temperature		T_{amb}	- 55 to + 100	°C
Soldering temperature (1)	2 mm from case, ≤ 10 s	T_{sld}	260	°C

Notes

- 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.

(1) Refer to reflow profile for soldering conditions for surface mounted devices (SMD). Refer to wave profile for soldering condditions for through hole devices (DIP).

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)							
PARAMETER	**TEST CONDITION**	**PART**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
INPUT							
Forward voltage (1)	I_F = 10 mA		V_F		1.2	1.5	V
	I_F = 10 mA, T_{amb} = - 55 °C		V_F	0.9	1.3	1.7	V
Reverse current (1)	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 (1)	I_C = 1 mA	4N35	BV_{CEO}	30			V
		4N36	BV_{CEO}	30			V
		4N37	BV_{CEO}	30			V
		4N38	BV_{CEO}	80			V
Emitter collector breakdown voltage (1)	I_E = 100 µA		BV_{ECO}	7			V
Collector base breakdown voltage (1)	I_C = 100 µA, I_B = 1 µA	4N35	BV_{CBO}	70			V
		4N36	BV_{CBO}	70			V
		4N37	BV_{CBO}	70			V
		4N38	BV_{CBO}	80			V

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ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)							
PARAMETER	**TEST CONDITION**	**PART**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
OUTPUT							
Collector emitter leakage current (1)	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} = 60 V, I_F = 0	4N38	I_{CEO}			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
	V_{CE} = 60 V, I_F = 0, T_{amb} = 100 °C	4N38	I_{CEO}		6		µA
Collector emitter capacitance	V_{CE} = 0		C_{CE}		6		pF
coupler							
Resistance, input output (1)	V_{IO} = 500 V		R_{IO}	10^{11}			Ω
Capacitance, input output	f = 1 MHz		C_{IO}		0.5		pF

Notes

- 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.

(1) Indicates JEDEC registered value.

CURRENT TRANSFER RATIO (T_{amb} = 25 °C, unless otherwise specified)							
PARAMETER	**TEST CONDITION**	**PART**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
I_C/I_F (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 = 20 mA	4N38	CTR_{DC}	20			%
	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		%
		4N38	CTR_{DC}		30		%

Note

(1) Indicates JEDEC registered values.

SWITCHING CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Turn-on time (1)	V_{CC} = 5 V, I_C = 2 mA, R_L = 100 Ω	t_{on}		10		µs
Turn-off time (1)	V_{CC} = 5 V, I_C = 2 mA, R_L = 100 Ω	t_{off}		10		µs

Note

(1) Indicates JEDEC registered values.

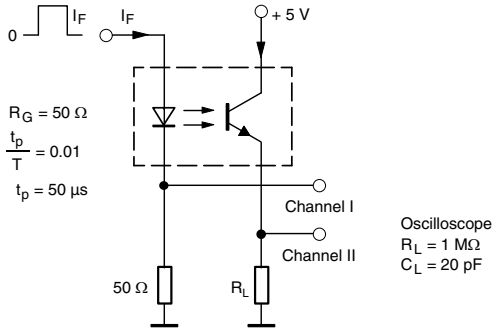

Fig. 1 - Test Circuit, Non-Saturated Operation

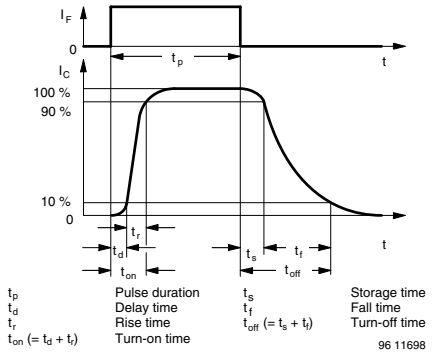

Fig. 2 - Switching Times

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TYPICAL CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)

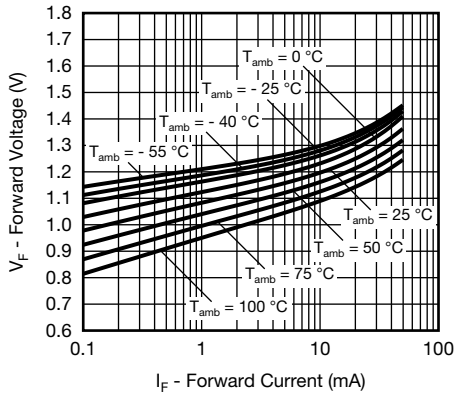

Fig. 3 - Forward Voltage vs. Forward Current

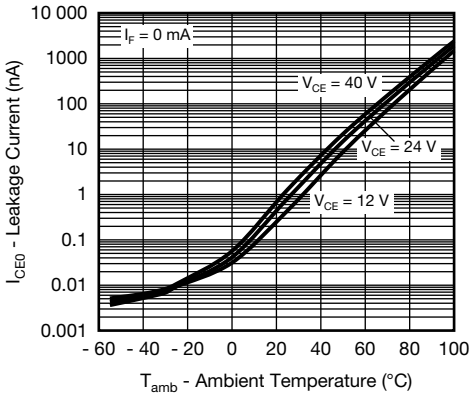

Fig. 6 - Leakage Current vs. Ambient Temperature

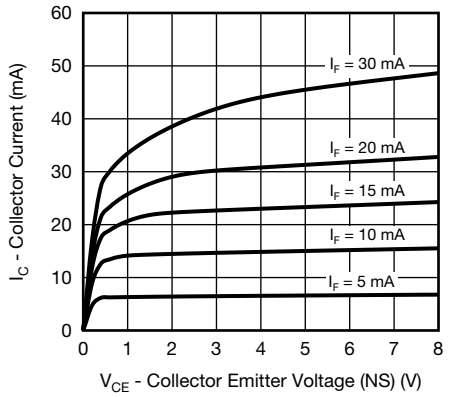

Fig. 4 - Collector Current vs. Collector Emitter Voltage (NS)

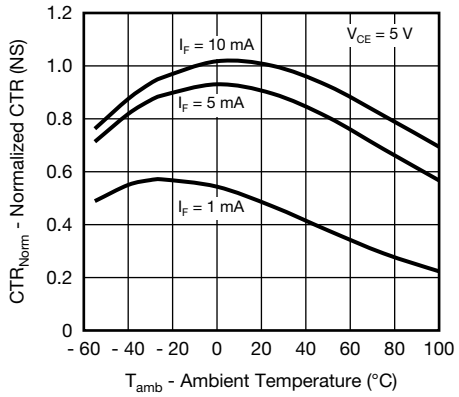

Fig. 7 - Normalized CTR (NS) vs. Ambient Temperature

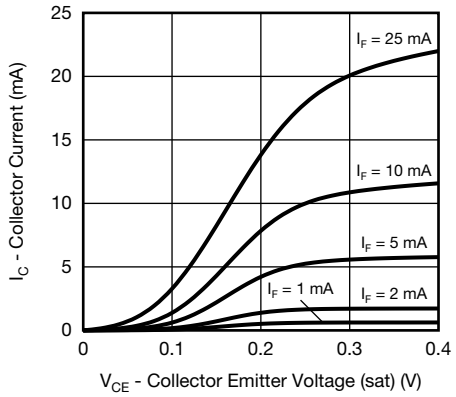

Fig. 5 - Collector Current vs. Collector Emitter Voltage (sat)

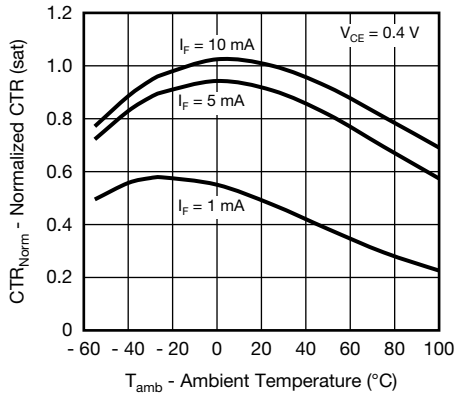

Fig. 8 - Normalized CTR (sat) vs. Ambient Temperature

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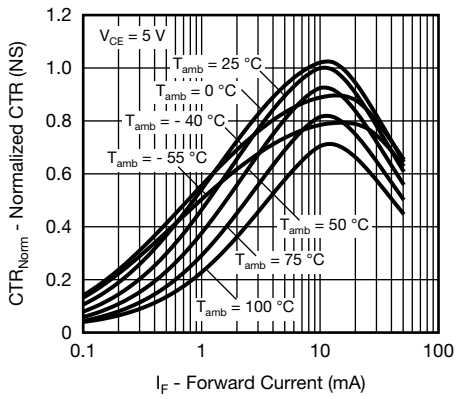

Fig. 9 - Normalized CTR (NS) vs. Forward Current

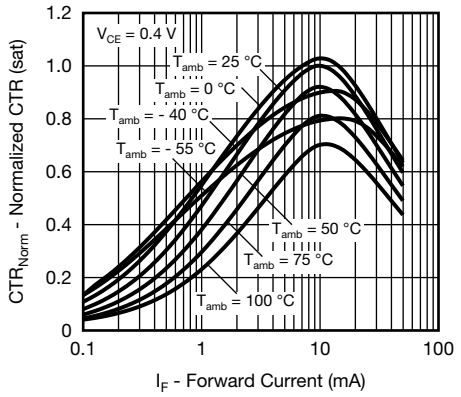

Fig. 10 - Normalized CTR (sat) vs. Forward Current

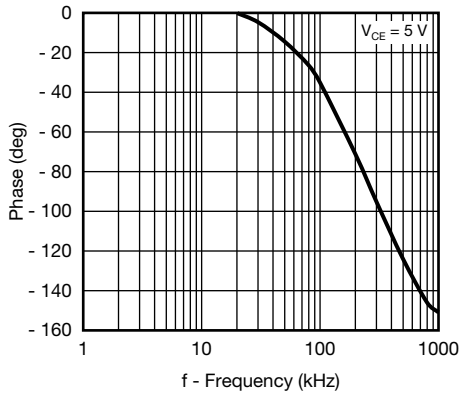

Fig. 11 - CTR Frequency vs. Phase Angle

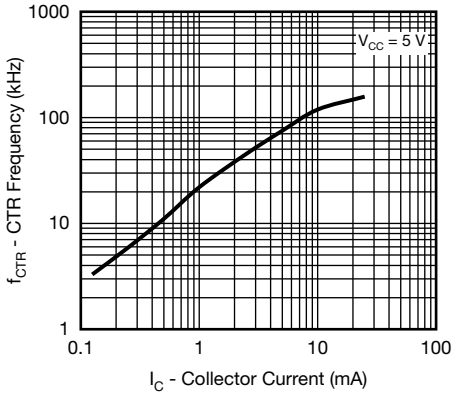

Fig. 12 - CTR Frequency vs. Collector Current

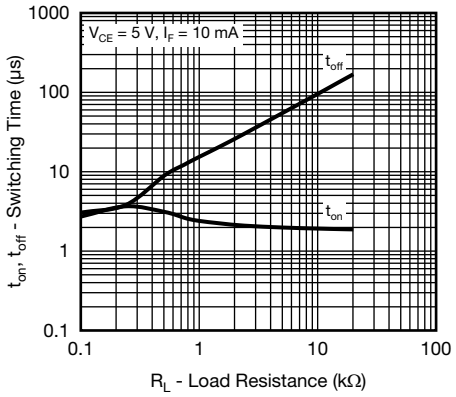

Fig. 13 - Switching Time vs. Load Resistance

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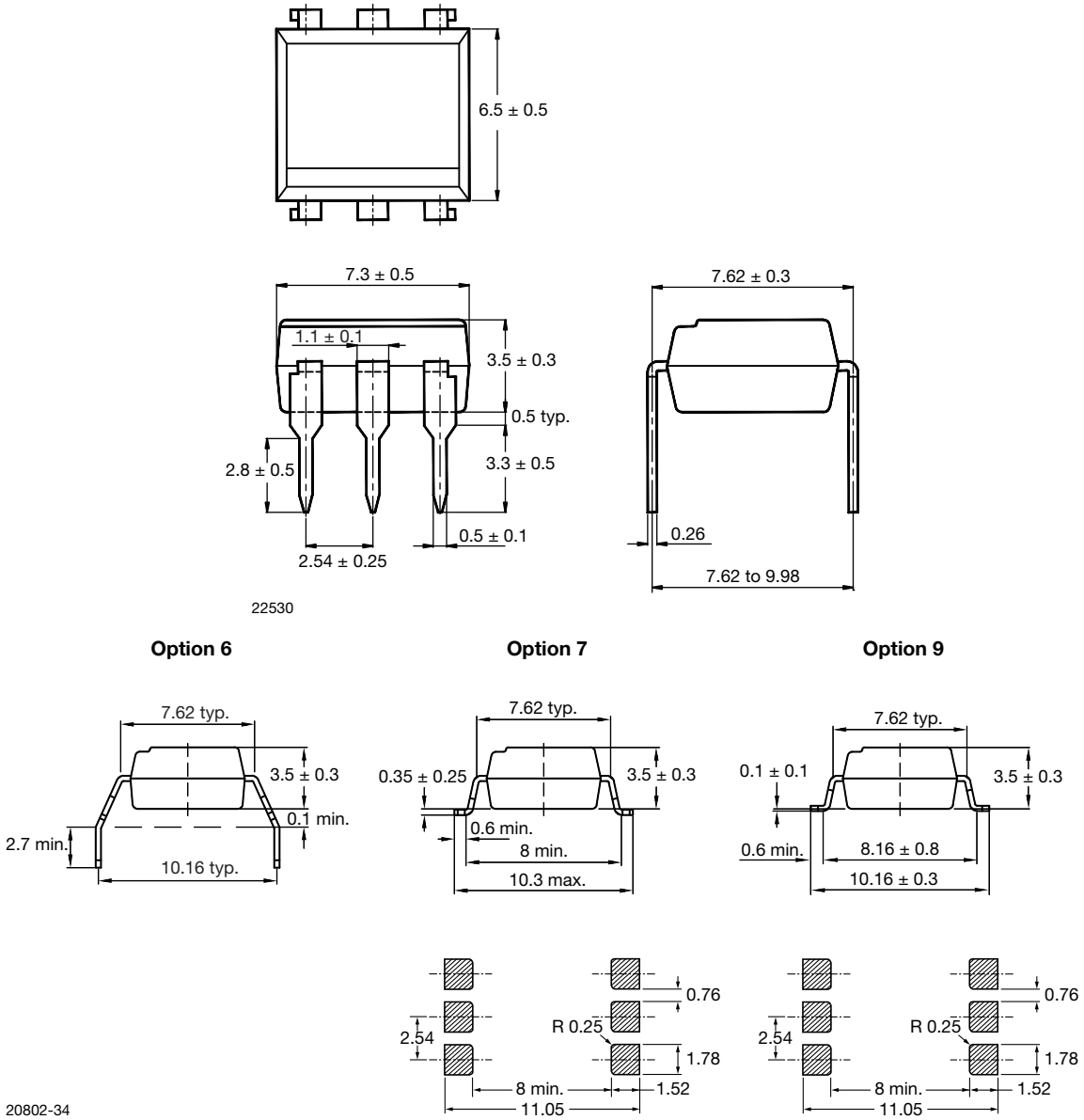
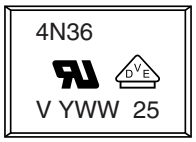
PACKAGE DIMENSIONS in millimeters



PACKAGE MARKING



Notes

- VDE logo is only marked on option 1 parts. Option information is not marked on the part.
- Tape and reel suffix (T) is not part of the package marking.

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