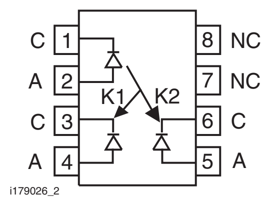
Linear Optocoupler, High Gain Stability, Wide Bandwidth



FEATURES

- Couples AC and DC signals
- 0.01 % servo linearity
- Wide bandwidth, > 200 kHz
- High gain stability, ± 0.005 %/°C typically
- Low input-output capacitance
- Low power consumption, < 15 mW
- Isolation rated voltage 4420 V_{RMS}
- Internal insulation distance, > 0.4 mm
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
e3
RoHS COMPLIANT

APPLICATIONS

- Power supply feedback voltage / current
- Medical sensor isolation
- Audio signal interfacing
- Isolated process control transducers
- Digital telephone isolation

AGENCY APPROVALS

- UL
- cUL
- DIN EN 60747-5-5 (VDE 0884-5) available with option 1
- BSI
- FIMKO
- CQC

DESCRIPTION

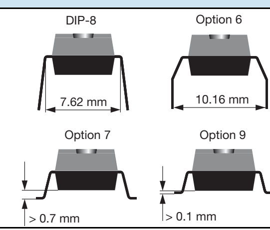
The IL300 linear optocoupler consists of an AlGaAs IRLED irradiating an isolated feedback and an output PIN photodiode in a bifurcated arrangement. The feedback photodiode captures a percentage of the LEDs flux and generates a control signal (I_{P1}) that can be used to servo the LED drive current. This technique compensates for the LED's non-linear, time, and temperature characteristics. The output PIN photodiode produces an output signal (I_{P2}) that is linearly related to the servo optical flux created by the LED.

The time and temperature stability of the input-output coupler gain (K3) is insured by using matched PIN photodiodes that accurately track the output flux of the LED.

ORDERING INFORMATION

I	L	3	0	0	-	D	E	F	G	-	X	0	#	#	T

PART NUMBER (IL300) — K3 BIN (DEFG) — PACKAGE OPTION (X0##) — TAPE AND REEL (T)



AGENCY CERTIFIED / PACKAGE	K3 BIN							
UL, cUL, BSI, FIMKO	**0.557 to 1.618**	**0.765 to 1.181**	**0.851 to 1.181**	**0.765 to 0.955**	**0.851 to 1.061**	**0.945 to 1.181**	**0.851 to 0.955**	**0.945 to 1.061**
DIP-8	IL300	IL300-DEFG	-	-	IL300-EF	-	IL300-E	IL300-F
DIP-8, 400 mil, option 6	IL300-X006	IL300-DEFG-X006	-	-	IL300-EF-X006	IL300-FG-X006	IL300-E-X006	IL300-F-X006
SMD-8, option 7	IL300-X007T (1)	IL300-DEFG-X007T (1)	IL300-EFG-X007	IL300-DE-X007T	IL300-EF-X007T (1)	IL300-FG-X007T	IL300-E-X007T	IL300-F-X007T (1)
SMD-8, option 9	IL300-X009T (1)	IL300-DEFG-X009T (1)	-	-	IL300-EF-X009T (1)	-	-	IL300-F-X009T (1)
VDE, UL, BSI, FIMKO	**0.557 to 1.618**	**0.765 to 1.181**	**0.851 to 1.181**	**0.765 to 0.955**	**0.851 to 1.061**	**0.945 to 1.181**	**0.851 to 0.955**	**0.945 to 1.061**
DIP-8	IL300-X001	IL300-DEFG-X001	-	-	IL300-EF-X001	-	IL300-E-X001	IL300-F-X001
DIP-8, 400 mil, option 6	IL300-X016	IL300-DEFG-X016	IL300-EFG-X016	-	IL300-EF-X016	-	-	IL300-F-X016
SMD-8, option 7	IL300-X017	IL300-DEFG-X017T (1)	-	-	IL300-EF-X017T (1)	-	IL300-E-X017T	IL300-F-X017T (1)
SMD-8, option 9	-	-	-	-	-	-	IL300-E-X009T	IL300-F-X019T (1)

Note

(1) Also available in tubes, do not put "T" on the end

ABSOLUTE MAXIMUM RATINGS (T_{amb} = 25 °C, unless otherwise specified)				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
INPUT				
Power dissipation		P_{diss}	160	mW
Derate linearly from 25 °C			2.13	mW/°C
Forward current		I_F	60	mA
Surge current (pulse width < 10 μs)		I_{PK}	250	mA
Reverse voltage		V_R	5	V
Thermal resistance		R_{th}	470	K/W
Junction temperature		T_j	100	°C
OUTPUT				
Power dissipation		P_{diss}	50	mW
Derate linearly from 25 °C			0.65	mW/°C
Reverse voltage		V_R	50	V
Thermal resistance		R_{th}	1500	K/W
Junction temperature		T_j	100	°C
COUPLER				
Total package dissipation at 25 °C		P_{tot}	210	mW
Derate linearly from 25 °C			2.8	mW/°C
Storage temperature		T_{stg}	-55 to +150	°C
Operating temperature		T_{amb}	-55 to +100	°C

Note

- 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

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
INPUT (LED EMITTER)						
Forward voltage	I_F = 10 mA	V_F	-	1.25	1.50	V
V_F temperature coefficient		$\Delta V_F/\Delta°C$	-	-2.2	-	mV/°C
Reverse current	V_R = 5 V	I_R	-	1	-	μA
Junction capacitance	V_F = 0 V, f = 1 MHz	C_j	-	15	-	pF
Dynamic resistance	I_F = 10 mA	$\Delta V_F/\Delta I_F$	-	6	-	Ω
OUTPUT						
Dark current	V_{det} = -15 V, I_F = 0 A	I_D	-	1	25	nA
Open circuit voltage	I_F = 10 mA	V_D	-	500	-	mV
Short circuit current	I_F = 10 mA	I_{SC}	-	120	-	μA
Junction capacitance	V_F = 0 V, f = 1 MHz	C_j	-	12	-	pF
Noise equivalent power	V_{det} = 15 V	NEP	-	4×10^{-14}	-	W/√Hz
COUPLER						
Input-output capacitance	V_F = 0 V, f = 1 MHz		-	1	-	pF
K1, servo gain (I_{P1}/I_F)	I_F = 10 mA, V_{det} = -15 V	K1	0.006	0.012	0.017	
Servo photocurrent (1)(2)	I_F = 10 mA, V_{det} = -15 V	I_{P1}	-	120	-	μA
K2, forward gain (I_{P2}/I_F)	I_F = 10 mA, V_{det} = -15 V	K2	0.006	0.012	0.017	
Forward current	I_F = 10 mA, V_{det} = -15 V	I_{P2}	-	120	-	μA
K3, transfer gain (K2/K1) (1)(2)	I_F = 10 mA, V_{det} = -15 V	K3	0.56	1	1.65	K2/K1
Transfer gain stability	I_F = 10 mA, V_{det} = -15 V	$\Delta K3/\Delta T_A$	-	± 0.005	± 0.15	%/°C
Transfer gain linearity	I_F = 1 mA to 10 mA	$\Delta K3$	-	± 0.25	-	%
	I_F = 1 mA to 10 mA, T_{amb} = 0 °C to 75 °C		-	± 0.5	-	%

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
PHOTOCONDUCTIVE OPERATION						
Frequency response	I_{Fq} = 10 mA, MOD = ± 4 mA, R_L = 50 Ω	BW (-3 db)	-	200	-	kHz
Phase response at 200 kHz	V_{det} = -15 V		-	-45	-	Deg.

Notes

- Minimum and maximum values were tested 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) Bin sorting: K3 (transfer gain) is sorted into bins that are ± 6 %, as follows:
Bin A = 0.557 to 0.626
Bin B = 0.620 to 0.696
Bin C = 0.690 to 0.773
Bin D = 0.765 to 0.859
Bin E = 0.851 to 0.955
Bin F = 0.945 to 1.061
Bin G = 1.051 to 1.181
Bin H = 1.169 to 1.311
Bin I = 1.297 to 1.456
Bin J = 1.442 to 1.618
K3 = K2/K1. K3 is tested at I_F = 10 mA, V_{det} = -15 V

(2) Bin categories: All IL300s are sorted into a K3 bin, indicated by an alpha character that is marked on the part. The bins range from “A” through “J”.
The IL300 is shipped in tubes of 50 each. Each tube contains only one category of K3. The category of the parts in the tube is marked on the tube label as well as on each individual part

(3) Category options: standard IL300 orders will be shipped from the categories that are available at the time of the order. Any of the ten categories may be shipped. For customers requiring a narrower selection of bins, the bins can be grouped together as follows:
IL300-DEFG: order this part number to receive categories D, E, F, G only
IL300-EF: order this part number to receive categories E, F only
IL300-E: order this part number to receive category E only

SWITCHING CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Switching time	ΔI_F = 2 mA, I_{Fq} = 10 mA	t_r	-	1	-	μs
		t_f	-	1	-	μs
Rise time		t_r	-	1.75	-	μs
Fall time		t_f	-	1.75	-	μs

COMMON MODE TRANSIENT IMMUNITY						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Common mode capacitance	V_F = 0 V, f = 1 MHz	C_{CM}	-	0.5	-	pF
Common mode rejection ratio	f = 60 Hz, R_L = 2.2 kΩ	CMRR	-	130	-	dB

SAFETY AND INSULATION RATINGS				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
Climatic classification	According to IEC 68 part 1		55 / 100 / 21	
Comparative tracking index		CTI	175	
Maximum rated withstanding isolation voltage	t = 1 min	V_{ISO}	4420	V_{RMS}
Maximum transient isolation voltage		V_{IOTM}	10 000	V_{peak}
Maximum repetitive peak isolation voltage		V_{IORM}	890	V_{peak}
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
Output safety power		P_{SO}	400	mW
Input safety current		I_{SI}	275	mA
Safety temperature		T_S	175	°C
Creepage distance			≥ 7	mm
Clearance distance			≥ 7	mm
Insulation thickness		DTI	≥ 0.4	mm

Note

- As per IEC 60747-5-5, § 7.4.3.8.2, this optocoupler is suitable for “safe electrical insulation” only within the safety ratings. Compliance with the safety ratings shall be ensured by means of protective circuits

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

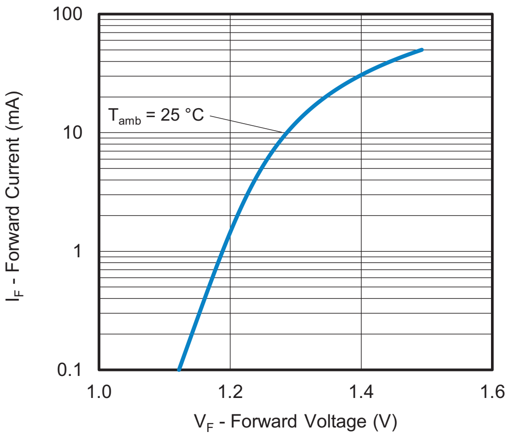


Fig. 1 - Forward Current vs. Forward Voltage

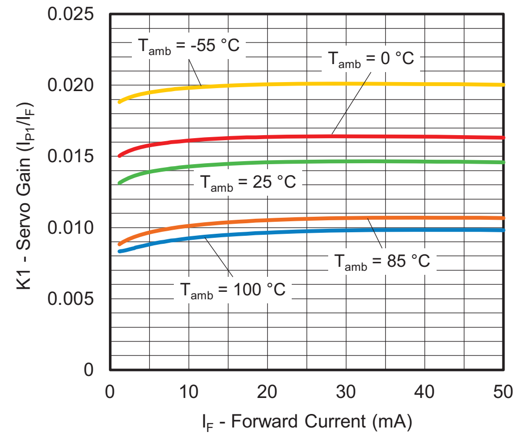


Fig. 4 - Servo Gain vs. Forward Current

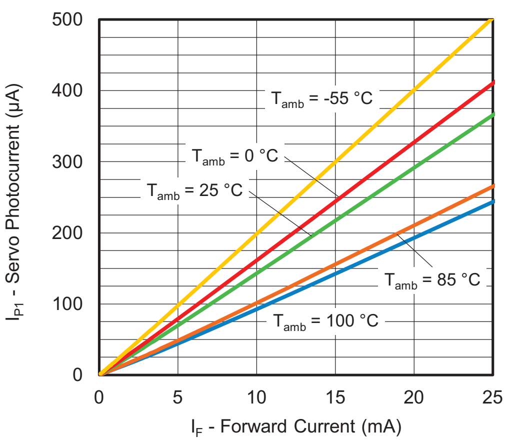


Fig. 2 - Servo Photocurrent vs. Forward Current

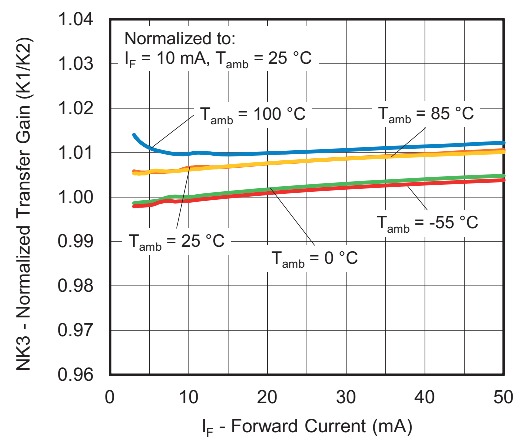


Fig. 5 - Normalized Transfer Gain vs. Forward Current

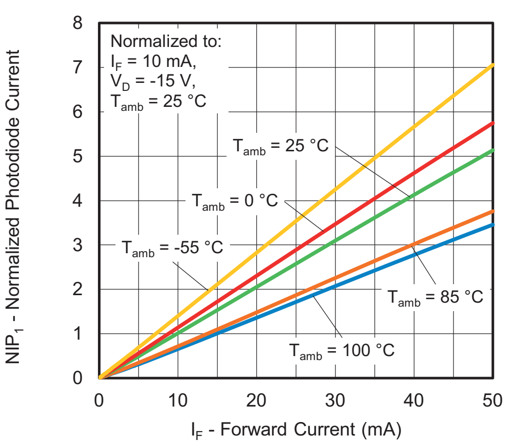


Fig. 3 - Normalized Photodiode Current vs. Forward Current

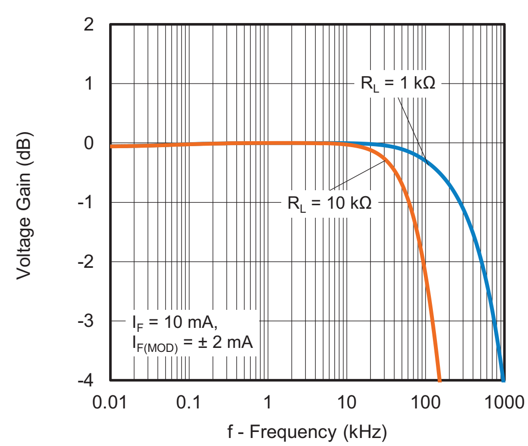


Fig. 6 - Voltage Gain vs. Frequency
(2 mA)

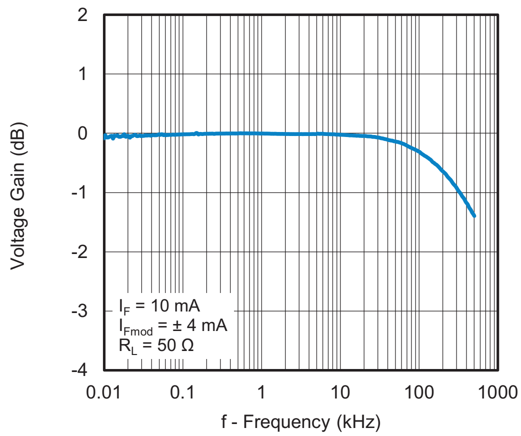


Fig. 7 - Voltage Gain vs. Frequency

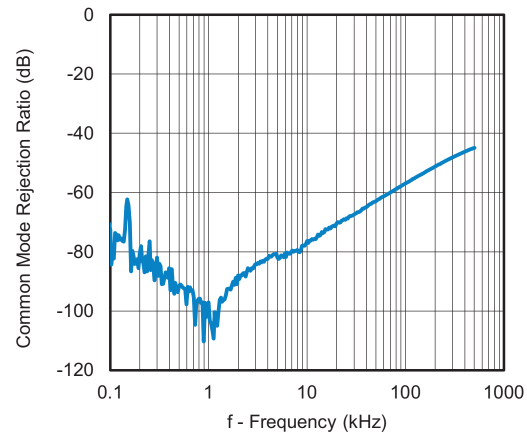


Fig. 9 - Common-Mode Rejection Ratio vs. Frequency

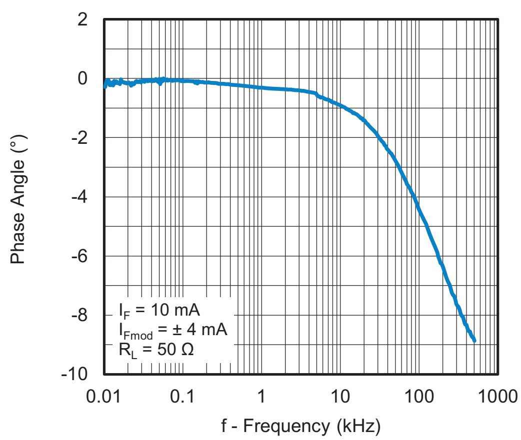


Fig. 8 - Phase Angle vs. Frequency

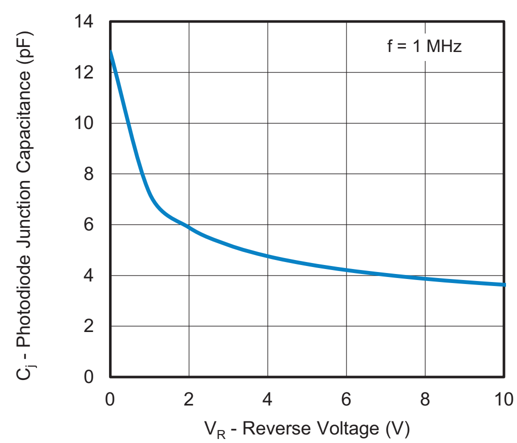
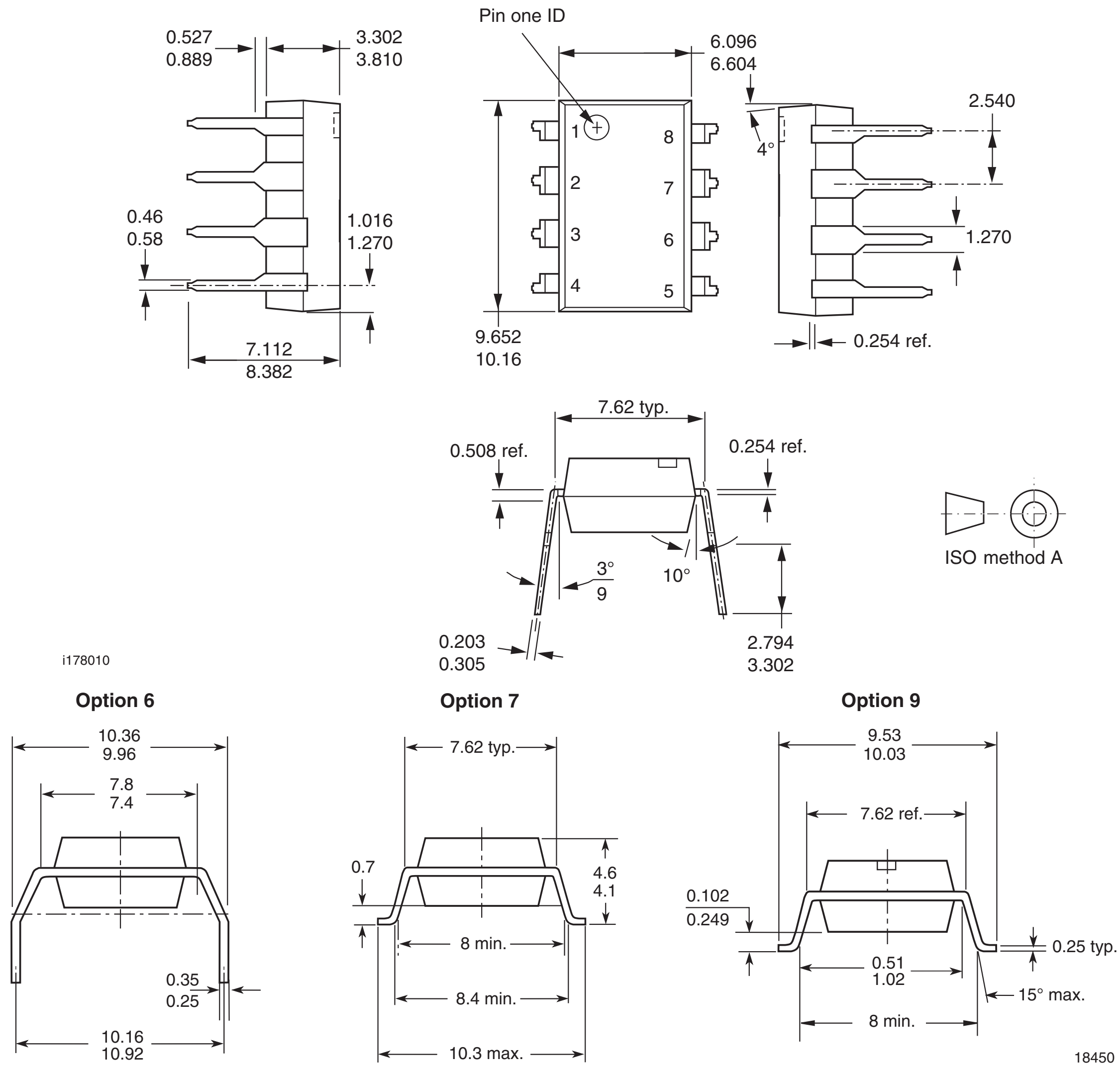
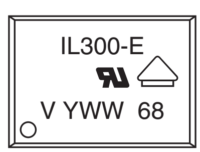


Fig. 10 - Photodiode Junction Capacitance vs. Reverse Voltage

PACKAGE DIMENSIONS (in millimeters)



PACKAGE MARKING (example of IL300-E-X001)



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