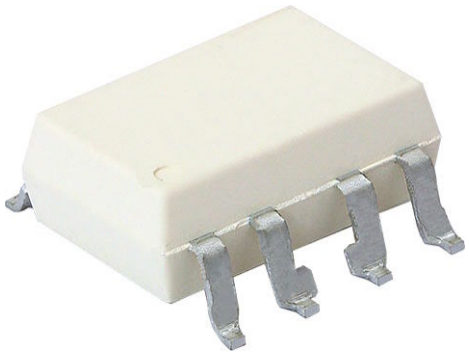
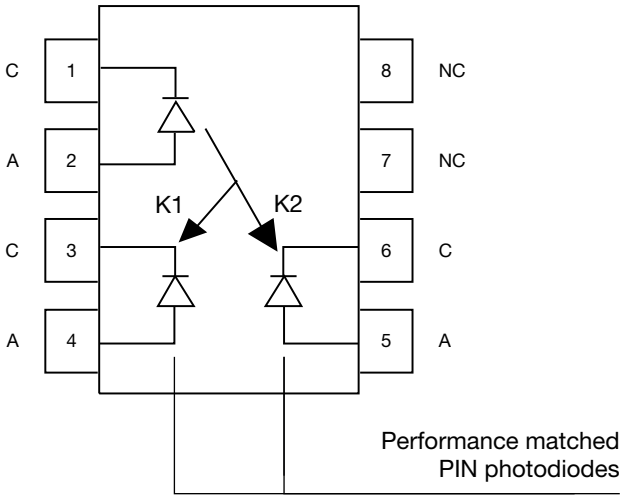
Automotive Fast Response Linear Optocoupler for Voltage and Current Sensing





K3 = K2 / K1

K1 = I_{P1}/I_F

K2 = I_{P2}/I_F

DESCRIPTION

The VOA300 linear optocoupler consists of an infrared emitter 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.

FEATURES

- AEC-Q102 qualified
- High gain linearity, ± 0.25 % typically
- Wide bandwidth, 1.4 MHz typically
- High gain stability, ± 0.005 %/°C typically
- High isolation voltage 5300 V_{RMS}
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

Pb-free

e3

RoHS COMPLIANT

HALOGEN FREE

GREEN (5-2008)

APPLICATIONS

- Galvanically isolated voltage and current sensing of automotive batteries
- On board charger (OBC) voltage monitoring
- DC/DC converter and AC/DC inverter stage voltage monitoring
- Isolated signal transfer for temperature sensors

AGENCY APPROVALS

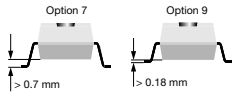
- UL
- cUL
- DIN EN 60747-5-5 (VDE 0884-5)
- BSI
- CQC

LINKS TO ADDITIONAL RESOURCES

Product Page | Application Notes | 3D Models | SPICE Models | Ultra Librarian EDA / CAD | Design Tools

ORDERING INFORMATION

V	O	A	3	0	0	-	D	E	F	G	-	X	0	#	#	T
PART NUMBER							K3 BIN					PACKAGE OPTION				TAPE AND REEL



AGENCY CERTIFIED / PACKAGE	K3 BIN			
VDE, UL, cUL, CQC	**0.765 to 1.181**	**0.851 to 1.061**	**0.945 to 1.181**	**0.945 to 1.061**
SMD-8, option 7	VOA300-DEFG-X017T	VOA300-EF-X017T	VOA300-FG-X017T	VOA300-F-X017T
SMD-8, option 9	VOA300-DEFG-X019T	VOA300-EF-X019T	VOA300-FG-X019T	VOA300-F-X019T

Note

- Additional options may be possible, please contact sales office

ABSOLUTE MAXIMUM RATINGS (T_{amb} = 25 °C, unless otherwise specified)

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
INPUT				
Power dissipation		P_{diss}	100	mW
Forward current		I_F	60	mA
Reverse voltage		V_R	5	V
Junction temperature		T_j	140	°C
OUTPUT				
Power dissipation		P_{diss}	50	mW
Reverse voltage		V_R	50	V
Junction temperature		T_j	140	°C
COUPLER				
Total package dissipation at 25 °C		P_{tot}	150	mW
Storage temperature		T_{stg}	-40 to +150	°C
Operating temperature		T_{amb}	-40 to +125	°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	-	1.4	1.5	V
Reverse current	V_R = 5 V	I_R	-	1	-	µA
Junction capacitance	V_F = 0 V, f = 1 MHz	C_j	-	26	-	pF
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}	-	90	-	µA
Junction capacitance	V_F = 0 V, f = 1 MHz	C_j	-	12	-	pF
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	0.005	0.009	0.015	
Servo photocurrent [1][2]	I_F = 10 mA, V_{det} = -15 V	I_{P1}	-	90	-	µA
K2, forward gain (I_{P2}/I_F)	I_F = 10 mA, V_{det} = -15 V	K2	0.005	0.009	0.015	
Forward current	I_F = 10 mA, V_{det} = -15 V	I_{P2}	-	90	-	µA
K3, transfer gain (K2/K1) [1][2]	I_F = 10 mA, V_{det} = -15 V	K3	0.765	1	1.181	K2/K1
Transfer gain stability	I_F = 10 mA, V_{det} = -15 V, T_{amb} = 0 °C to 75 °C	$\Delta K3/\Delta T_A$	-	± 0.005	± 0.15	%/°C
Transfer gain linearity	I_F = 2 mA to 10 mA	ΔK3	-	± 0.25	-	%
PHOTOCONDUCTIVE OPERATION						
Frequency response	I_F = 10 mA, MOD = ± 4 mA, R_L = 50 Ω	BW (-3 db)	-	1.4	-	MHz
Phase response at 200 kHz	V_{det} = -15 V		-	-45	-	°

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 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
K3 = K2/K1. K3 is tested at I_F = 10 mA, V_{det} = -15 V

(2) Bin categories: All VOA300s are sorted into a K3 bin, indicated by an alpha character that is marked on the part. The bins range from “D” through “G” as mentioned in [1] above.

(3) Category options: for customers requiring a narrower selection of bins, the bins can be grouped together as follows:
VOA300-DEFG: order this part number to receive categories D, E, F, G only
VOA300-EF: order this part number to receive categories E, F only
VOA300-E: order this part number to receive category E only

SWITCHING CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Rise time	I_F = 10 mA, MOD = +2 mA, R_L = 10 kΩ	t_r	-	0.8	-	µs
Fall time		t_f	-	0.8	-	µs

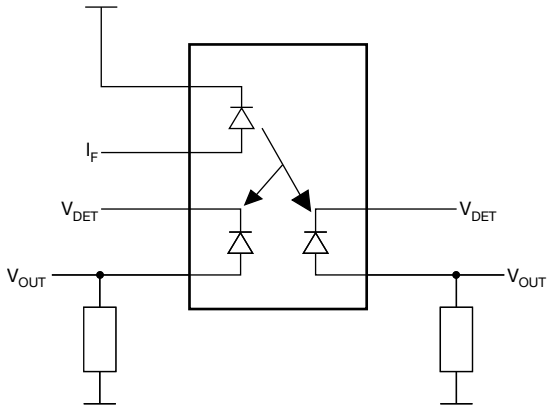


Fig. 1 - Test Circuit

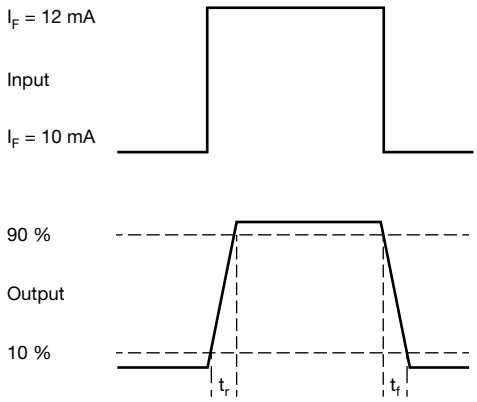


Fig. 2 - Switching Times

SAFETY AND INSULATION RATINGS				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
Climatic classification	According to IEC 68 part 1		40 / 125 / 21	
Comparative tracking index		CTI	400	
Maximum rated withstanding isolation voltage	t = 1 min	V_{ISO}	5300	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}	≥ 10^{12}	Ω
	V_{IO} = 500 V, T_{amb} = 100 °C	R_{IO}	≥ 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	SMD-8, option 7; SMD-8, option 9		≥ 8	mm
Clearance distance			≥ 8	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)

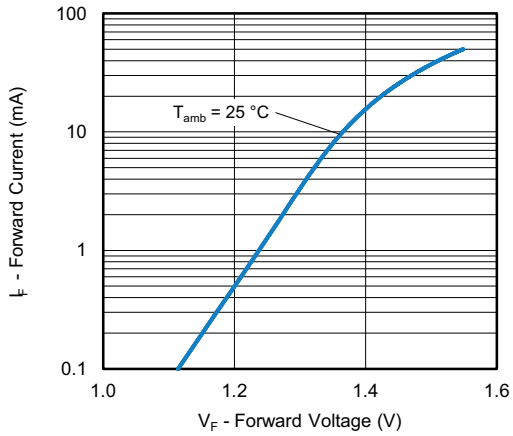


Fig. 3 - Forward Voltage vs. Forward Current

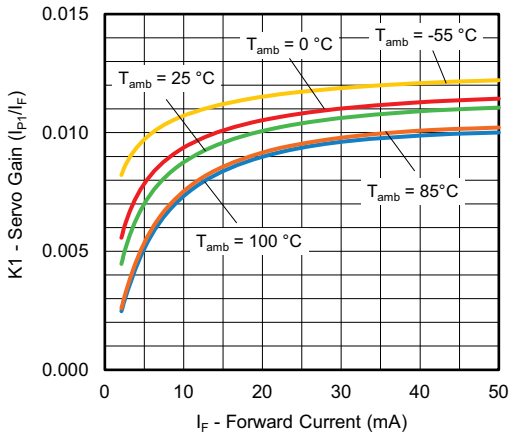


Fig. 6 - Servo Gain vs. Forward Current

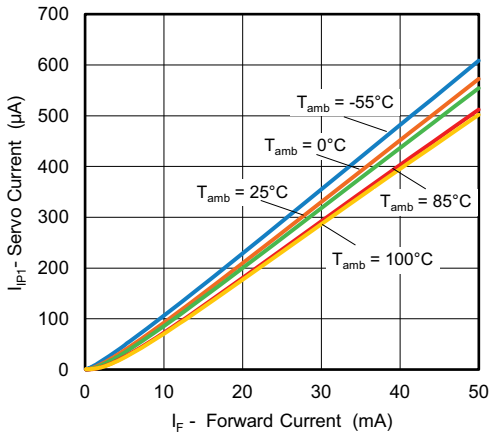


Fig. 4 - Servo Photocurrent vs. Forward Current

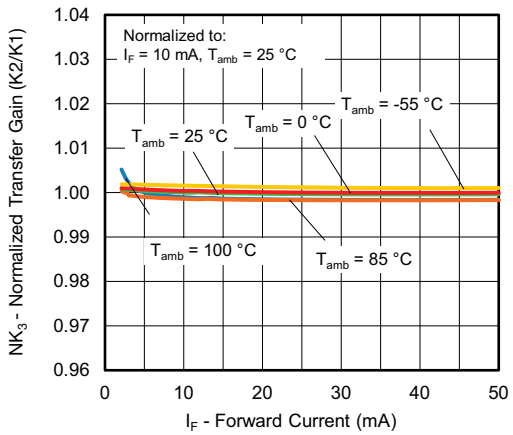


Fig. 7 - Normalized Transfer Gain vs. Forward Current

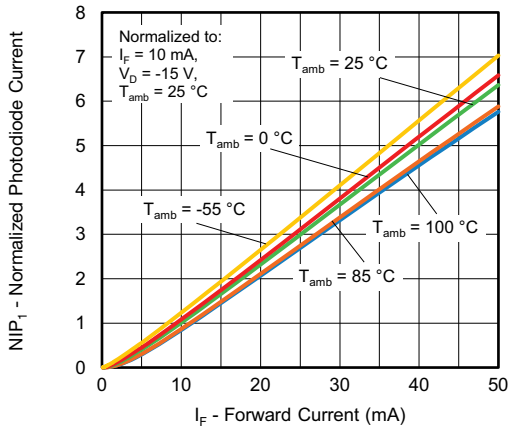
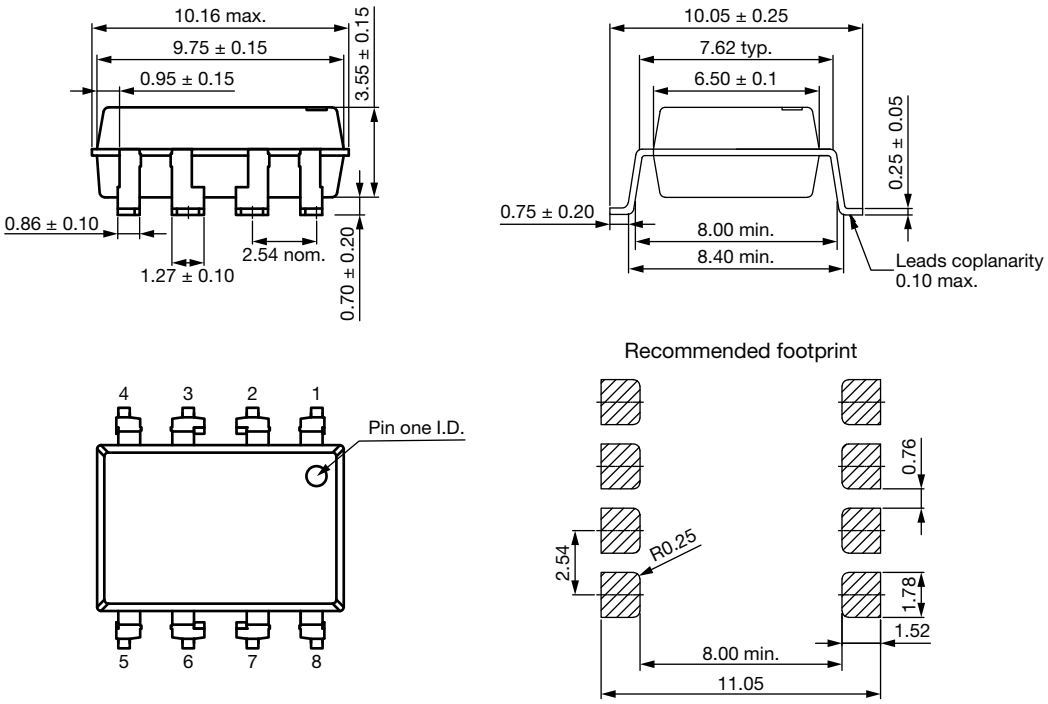


Fig. 5 - Normalized Photodiode Current vs. Forward Current

PACKAGE DIMENSIONS (in millimeters)

Option 7



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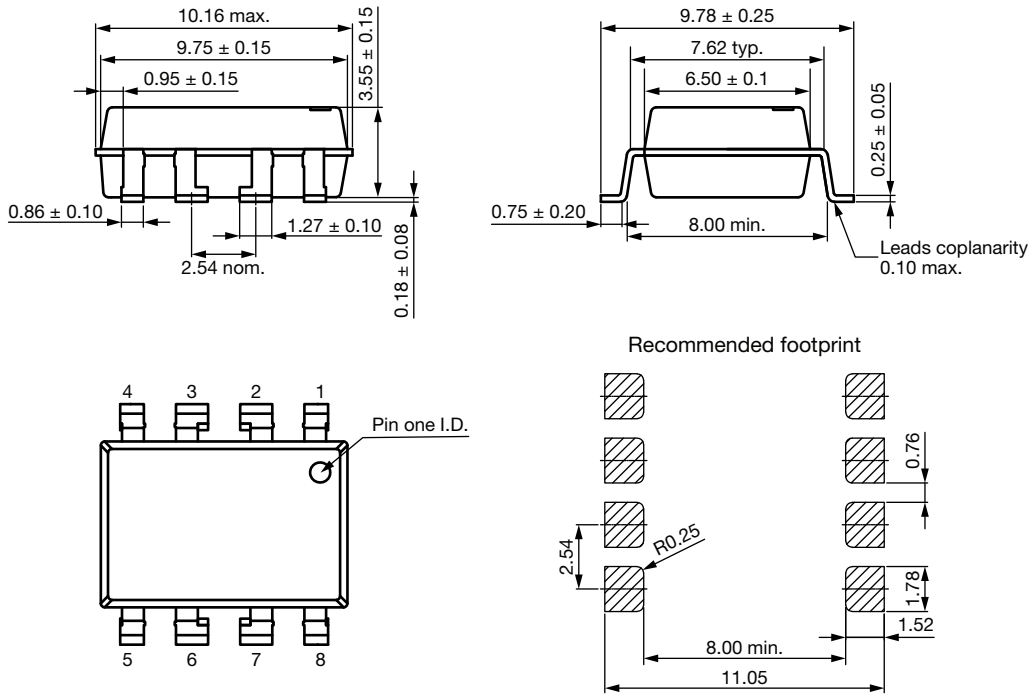
Issue: C; 02.06.2022

Option 9



Drawing No.: VMS 006-2330
Issue: C; 02.06.2022

PACKAGE MARKING

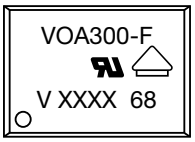


Fig. 8 - Example of VOA300-F-X001

Notes

- XXXX = LMC (lot marking code)
- VDE logo is only marked on “option 1” parts
- Tape and reel suffix (T) is not part of the package marking

SOLDER PROFILES

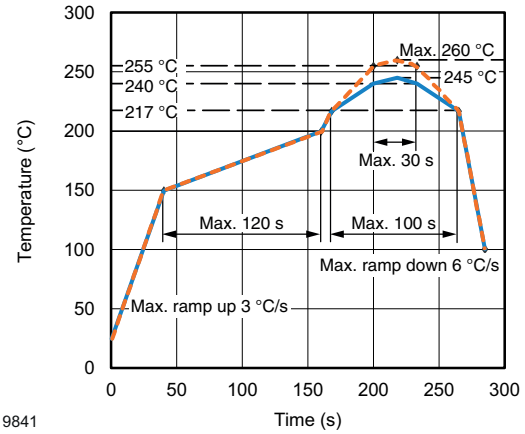


Fig. 9 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD Devices

HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 1C

Floor life: unlimited

Conditions: T_{amb} < 30 °C, RH < 60 %

Moisture sensitivity level 1, according to J-STD-020

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