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Vishay Semiconductors

# Optical Sensor With Photodiode Output for Optical Communication



#### **DESCRIPTION**

The VCND2045X02, VCND2045SLX02 are an optical sensor in a miniature SMD package used for optical data communication and reflective encoding. It has a compact construction where the emitting light source and the detector are arranged in the same plane. The operating infrared wavelength is 860 nm. The detector consists of a silicon photodiode. The sensor analog output signal (photo current) is triggered by light from other device for optical data transmission.

#### **FEATURES**

- Package type: SMD
- Package form: top view, side view
- Detector type: photodiode
- Dimensions (L x W x H in mm): 4.4 x 2.25 x 1.9
- Emitter wavelength: 860 nm
- Moisture sensitivity level (MSL): 3
- AEC-Q102 qualified
- Material categorization: for definitions of compliance please see www.vishav.com/doc?99912

#### AUTOMOTIVE GRADE





COMPLIANT
HALOGEN
FREE
GREEN
(5:2008)

#### **APPLICATIONS**

- Wireless optical communication
- · Position sensor
- · Optical switch
- Optical encoder

PRODUCT SUMMARY - EMITTER					
PART NUMBER	I <sub>e</sub> (mW/sr) at I <sub>F</sub> = 24 mA	φ (°)	λ <sub>p</sub> (nm)	t <sub>r</sub> (ns) <sup>(1)</sup>	
VCND2045X02	65	± 10	860	9	
VCND2045SLX02	65	± 10	860	9	

#### Note

(1) Conditions as in "Basic Characteristics"

PRODUCT SUMMARY - PHOTODIODE					
PART NUMBER	$I_{ra}$ (μA) at $E_e$ = 1 mW/cm <sup>2</sup> , $\lambda$ = 850 nm, $V_R$ = 2 V	φ (°)	λ <sub>p</sub> (nm)	DAYLIGHT BLOCKING FILTER INTEGRATED	
VCND2045X02	7.8	± 29	820	No	
VCND2045SLX02	7.8	± 29	820	No	

ORDERING INFORMATION					
ORDERING CODE	PACKAGING	VOLUME (1)	REMARKS		
VCND2045X02	Tape and reel	MOQ: 1000 pcs	Top looker variant		
VCND2045SLX02	Tape and reel	MOQ: 1500 pcs	Side looker variant		

#### Note

(1) MOQ: minimum order quantity



<b>ABSOLUTE MAXIMUM RATINGS</b> (T <sub>amb</sub> = 25 °C, unless otherwise specified)						
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT		
INPUT (EMITTER)						
Reverse voltage		$V_R$	5	V		
Forward current		I <sub>F</sub>	45	mA		
Junction temperature		TJ	125	°C		
Thermal resistance junction to ambient	Top looker, JESD 51	R <sub>thJA</sub>	200	K/W		
	Side looker, JESD 51	R <sub>thJA</sub>	250	K/W		
OUTPUT (DETECTOR)						
Reverse voltage		$V_R$	5	V		
SENSOR						
Total power dissipation	T <sub>amb</sub> ≤ 25 °C	P <sub>tot</sub>	120	mW		
Ambient temperature range		T <sub>amb</sub>	-40 to +110	°C		
Storage temperature range		T <sub>stg</sub>	-40 to +110	°C		
Soldering temperature	In accordance with Fig. 15	T <sub>sd</sub>	260	°C		

#### **ABSOLUTE MAXIMUM RATINGS**

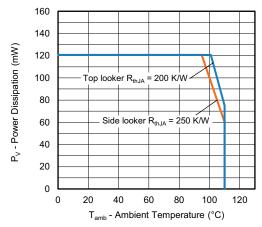


Fig. 1 - Power Dissipation vs. Ambient Temperature

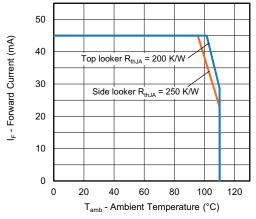


Fig. 2 - Forward Current vs. Ambient Temperature

<b>BASIC CHARACTERISTICS</b> (T <sub>amb</sub> = 25 °C, unless otherwise specified)						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
INPUT (EMITTER)						
Forward voltage	I <sub>F</sub> = 24 mA	V <sub>F</sub>	-	2.5	3.3	V
Temperature coefficient of V <sub>F</sub>	I <sub>F</sub> = 24 mA	TKV <sub>F</sub>	-	-1.8	-	mV/K
Reverse current		I <sub>R</sub>	Not de	signed for operation	reverse	μΑ
Junction capacitance	V <sub>R</sub> = 0 V, f = 1 MHz, E = 0	C <sub>j</sub>	-	19.5	-	pF
Radiant intensity	$I_F = 24 \text{ mA}, t_p = 20 \text{ ms}$	l <sub>e</sub>	35	65	100	mW/sr
Radiant power	$I_F = 24 \text{ mA}, t_p = 20 \text{ ms}$	фe	-	12	-	mW
Angle of half intensity		φ	-	± 10	-	0
Peak wavelength	I <sub>F</sub> = 24 mA	$\lambda_{P}$	-	860	-	nm
Spectral bandwidth	I <sub>F</sub> = 24 mA	Δλ <sub>P, 0.5</sub>	-	37	-	nm



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<b>BASIC CHARACTERISTICS</b> (T <sub>amb</sub> = 25 °C, unless otherwise specified)						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
OUTPUT (DETECTOR)						
Forward voltage	I <sub>F</sub> = 50 mA	$V_{F}$	-	0.9	1.1	٧
Reverse dark current	$V_R = 10 \text{ V}, E = 0$	I <sub>ro</sub>	-	0.01	10	nA
Diode capacitance	$V_R = 0 V, f = 1 MHz, E = 0$	C <sub>D</sub>	-	5.8	-	pF
Open circuit voltage	$E_e = 1 \text{ mW/cm}^2, \lambda = 850 \text{ nm}$	V <sub>O</sub>	-	429	-	mV
Temperature coefficient of V <sub>O</sub>	$E_e = 1 \text{ mW/cm}^2, \lambda = 850 \text{ nm}$	TKV <sub>O</sub>	-	-2.6	-	mV/K
Short circuit current	$E_e = 1 \text{ mW/cm}^2, \lambda = 850 \text{ nm}$	l <sub>k</sub>	-	7.8	-	μΑ
Temperature coefficient of $I_K$	$E_e = 1 \text{ mW/cm}^2, \lambda = 850 \text{ nm}$	TKI <sub>K</sub>	-	0.1	-	%/K
Reverse light current	$E_e = 1 \text{ mW/cm}^2$ , $\lambda = 850 \text{ nm}$ , $V_R = 2 \text{ V}$	I <sub>ra</sub>	4	7.8	10	μΑ
Wavelength of peak sensitivity		$\lambda_{p}$	-	820	-	nm
Angle of half sensitivity		φ	-	± 29	-	0
SENSOR						
	V <sub>R</sub> = 2 V, I <sub>F</sub> = 24 mA, d = 4 mm, mirror, reflective setup <sup>(1)</sup>		-	166	-	
Reverse light current	$V_R = 2 \text{ V}, I_F = 24 \text{ mA}, d = 4 \text{ mm},$ KODAK Gray Card, gray side, reflective setup (1)		-	8	-	μА
neverse light current	$V_R = 2 \text{ V}, I_F = 24 \text{ mA}, d = 4 \text{ mm},$ KODAK Gray Card, white side, reflective setup $^{(1)}$	I <sub>ra</sub>	-	42	-	
	$V_R = 2 \text{ V}, I_F = 24 \text{ mA}, d = 10 \text{ mm},$ communication setup $^{(2)}$		-	274	-	
Output rise time (20 % to 80 %)	Push-pull driver with $I_F = 24$ mA,	t <sub>r</sub>	-	9	-	ns
Output fall time (80 % to 20 %)	$I_{ra} = 5 \mu A$ , $V_R = 2 V$ , communication setup (2)	t <sub>f</sub>	-	9	-	ns

#### **Notes**

- (1) Reflective test setup as described in Fig. 4
- (2) Communication test setup as described in Fig. 5

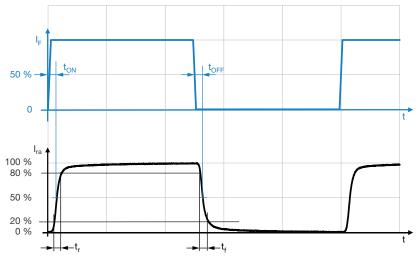


Fig. 3 - Switching Times

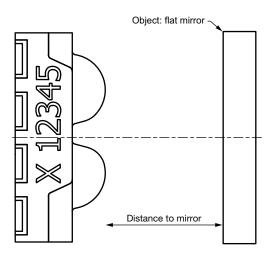


Fig. 4 - Test Setup - Reflective

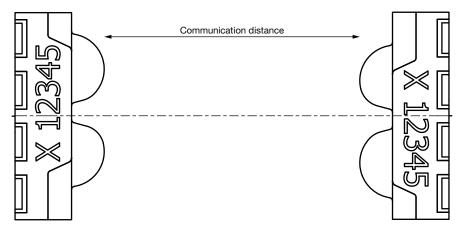


Fig. 5 - Test Setup - Communication

#### BASIC CHARACTERISTICS (T<sub>amb</sub> = 25 °C, unless otherwise specified)

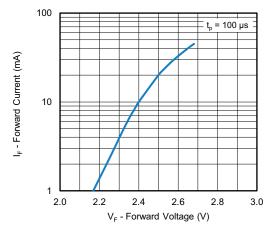


Fig. 6 - Forward Current vs. Forward Voltage

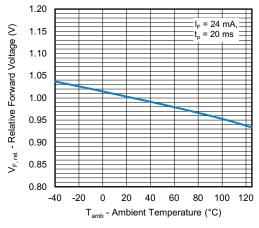


Fig. 7 - Relative Forward Voltage vs. Ambient Temperature

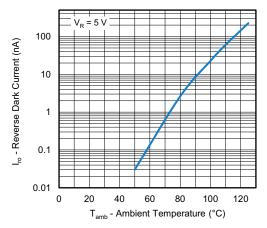


Fig. 8 - Reverse Dark Current vs. Ambient Temperature

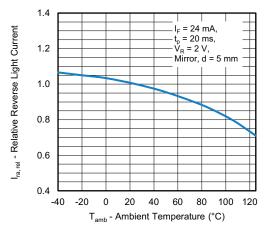


Fig. 9 - Relative Reverse Light Current vs. Ambient Temperature

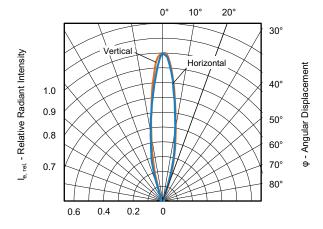


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

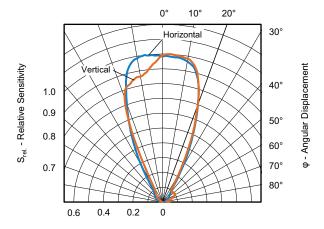


Fig. 11 - Relative Sensitivity vs. Angular Displacement



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#### **FLOOR LIFE**

Time between soldering and removing from MBB must not exceed the time indicated in J-STD-020:

Moisture sensitivity: level 3

Floor life: 168 h

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

#### **DRYING**

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or recommended conditions:

192 h at 40 °C (+ 5 °C), RH < 5 %

or

96 h at 60 °C (+ 5 °C), RH < 5 %

#### **REFLOW SOLDER PROFILE**

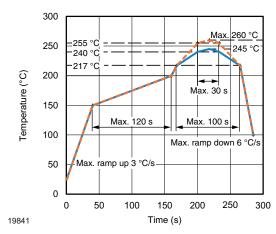


Fig. 15 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020

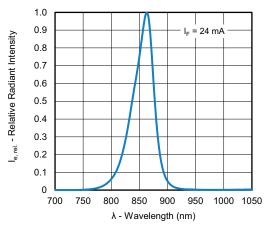


Fig. 12 - Relative Radiant Intensity vs. Wavelength

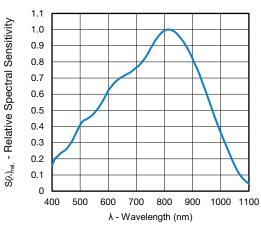


Fig. 13 - Relative Spectral Sensitivity vs. Wavelength

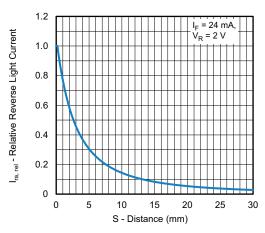
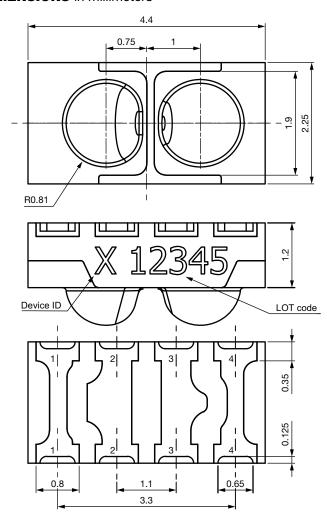


Fig. 14 - Relative Reverse Light Current vs. Distance (communication setup)



#### **PACKAGE DIMENSIONS** in millimeters



1.895

Not indicated tolerances  $\pm$  0.1

Device ID: 1 = VCND2040 2 = VCND2045

PIN	SIGNAL	
1	PD anode	
2	PD cathode	
3	LED anode	
4	LED cathode	



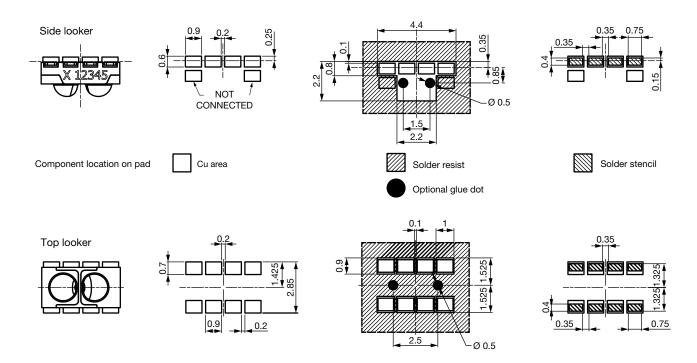
Technical drawings according to DIN specification

Drawing-No.: 6.550-5376.01-4 Issue: 1\_A; 27.08.2025



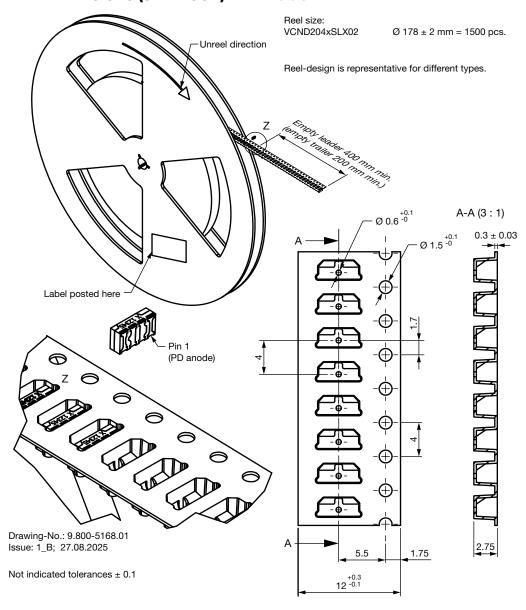


#### **RECOMMENDED SOLDER PAD** in millimeters



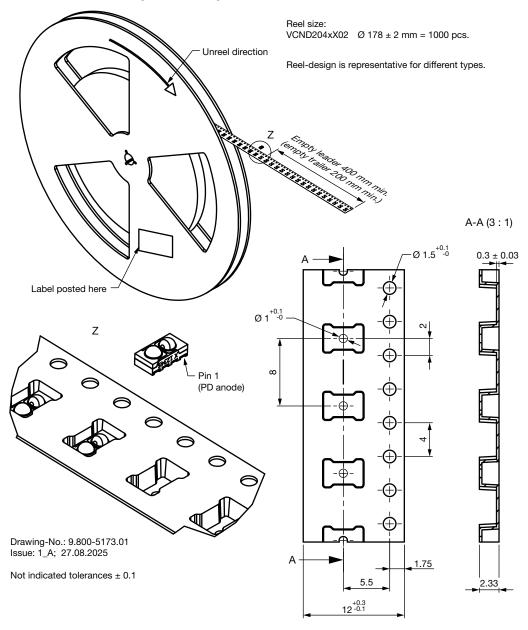


#### TAPE AND REEL DIMENSIONS (SIDE LOOK) in millimeters





#### TAPE AND REEL DIMENSIONS (TOP LOOK) in millimeters





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