VISHAY INTERTECHNOLOGY, INC.

INFRARED EMITTERS, PHOTO DETECTORS, AND OPTICAL SENSORS

OPTOELECTRONICS

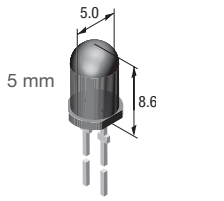
SELECTOR GUIDE

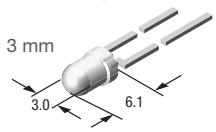
www.vishay.com

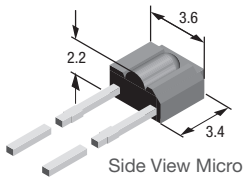
Infrared Emitters

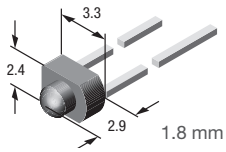
Vishay offers emitters in more wavelengths than any other supplier: 830 nm, 850 nm, 870 nm, 890 nm, 940 nm, and 950 nm. Providing fast rise and fall response times, Vishay also has the broadest selection of double hetero infrared emitters. They are the highest-power infrared emitters with the lowest forward voltages on the market and ideal for high-current applications. The latest surface emitter technology based devices, which provide highest radiant intensities, round up our extensive IR emitter portfolio.

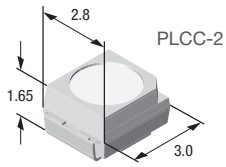
Package	Part Number	Peak Wave-length (nm)	Angle of Half Intensity (+/-°)	Radiant Intensity, I_e (mW/sr)	Rise and Fall Time, t_r/t_f (ns)	Remark
Through-Hole Packages						
5 mm	TSAL5100	940	10	130	800	Stand-off
	TSAL5300	940	22	45	800	Stand-off
	TSAL6100	940	10	130	800	No stand-off
	TSAL6200	940	17	60	800	No stand-off
	TSAL6400	940	25	40	800	No stand-off
	TSAL7200	940	17	60	800	No stand-off
	TSAL7300	940	22	45	800	No stand-off
	TSAL7400	940	25	40	800	No stand-off
	TSAL7600	940	30	25	800	No stand-off
	TSFF5210	870	10	180	15	Stand-off
	TSFF5410	870	22	70	15	Stand-off
	TSFF5510	870	38	32	15	Stand-off
	TSFF6210	870	10	180	15	No stand-off
	TSFF6410	870	22	70	15	No stand-off
	TSHA5203	875	12	65	600	Stand-off
	TSHA5500	875	24	30	600	Stand-off
	TSHA6203	875	12	65	600	No stand-off
	TSHA6500	875	24	30	600	No stand-off
	TSHF5210	890	10	180	30	Stand-off
	TSHF5410	890	22	70	30	Stand-off
	TSHF6210	890	10	180	30	No stand-off
	TSHF6410	890	22	70	30	No stand-off
	TSHG5210	850	10	230	20	Stand-off
	TSHG5410	850	18	90	20	Stand-off
	TSHG5510	830	38	32	15	Stand-off
	TSHG6200	850	10	180	20	No stand-off
	TSHG6210	850	10	230	20	No stand-off
	TSHG6400	850	22	70	20	No stand-off
	TSHG6410	850	18	90	20	No stand-off
	TSHG8200	830	10	180	20	No stand-off
	TSHG8400	830	22	70	20	No stand-off
	TSUS5202	950	15	30	800	Stand-off
	TSUS5402	950	22	20	800	Stand-off
	VSLY5850[2]	850	3	600	10	Stand-off
3 mm	TSAL4400	940	25	30	800	No stand-off
	TSHA4400	875	20	20	600	No stand-off
	TSUS3400	950	18	15	800	Stand-off
	TSHF4410	890	22	40	30	No stand-off
	TSUS4300	950	16	18	800	No stand-off
	TSUS4400	950	18	15	800	No stand-off
	VSLB3940	940	22	65	15	No stand-off

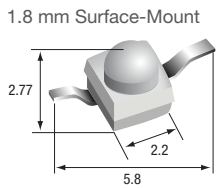


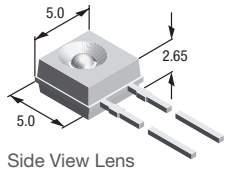


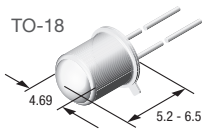










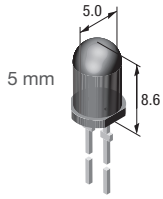


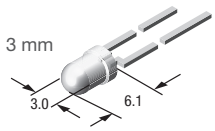
(2) Target specification, product release pending

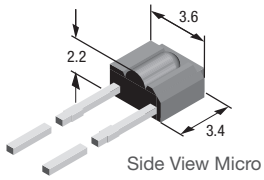
Infrared Emitters (continued)

Package	Part Number	Peak Wave-length (nm)	Angle of Half Intensity (+/-°)	Radiant Intensity, I_e (mW/sr)	Rise and Fall Time, t_r/t_f (ns)	Remark
Through-Hole Packages						
1.8 mm	CQY36N	950	55	1.50	800	No stand-off
	CQY37N	950	12	5	800	No stand-off
Side View Micro	TSSS2600	950	25H, 65V	2.6	800	No stand-off
Side View Lens	TSKS5400S	950	30	4.5	800	No stand-off
TO-18	TSTA7100	875	5	50	600	No stand-off
	TSTA7300	875	12	20	600	No stand-off
	TSTA7500	875	30	6	600	No stand-off
	TSTS7100	950	5	18	800	No stand-off
	TSTS7300	950	12	6	800	No stand-off
	TSTS7500	950	30	1.6	800	No stand-off
Surface-Mount Packages						
PLCC-2	VSMB3940X01(1)	940	60	13	15	
	VSMF3710	890	60	10	30	
	VSMF4710	870	60	10	15	
	VSMF4720	870	60	16	15	
	VSMG2700	830	60	10	20	
	VSMG2720	830	60	14	20	
	VSMG3700	850	60	10	20	
	VSML3710	940	60	6	800	
	VSMS3700	950	60	4.5	800	
	VSMY3850X01(1) (2)	850	60	17	10	
1.8 mm	VSMB2000X01(1)	940	12	40	15	Reverse gullwing
	VSMB2020X01(1)	940	12	40	15	Gullwing
	VSMY2850RGX01(1) (2)	850	10	100	10	Reverse gullwing
	VSMY2850GX01 (1) (2)	850	10	100	10	Gullwing
0805	VSMB1940X01(1)	940	60	6	15	
	VSMY1850X01(1) (2)	850	60	12	10	

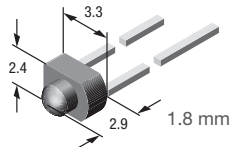
(1) Products ending in "X01" are AEC-Q101 qualified (2) Target specification, product release pending

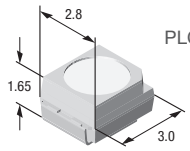




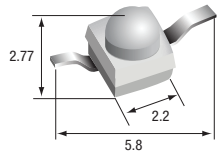


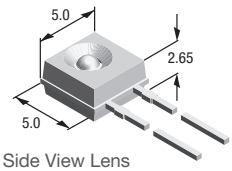
Side View Micro



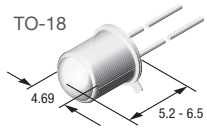


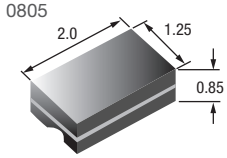
1.8 mm Surface-Mount

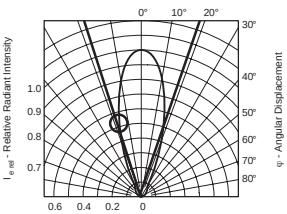




Side View Lens







Stand-Off

To control the height of the emitter when inserted into the PCB for soldering, some leaded emitters and photo detectors are also available with a standoff option (shown at left). The stand off is the tab on the leads. It is sometimes called a stopper.

Angle of Half Intensity, $\varphi_{0.5}$ or θ

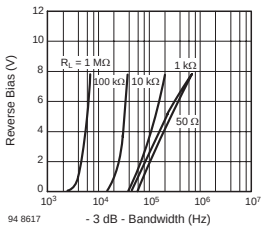
In a radiation diagram, the angle within which the radiant intensity is greater than or equal to half of the maximum intensity. In Vishay datasheets, the symbol $\varphi_{0.5}$ is most commonly used for the angle of half intensity. For visible LEDs this is sometime called the viewing angle. There is still light, be it infrared or visible, outside of this angle.

PIN Photo Diodes

Vishay has the broadest portfolio of PIN photodiodes on the market. With lower capacitance, they provide high-speed response, low noise and low dark current along with excellent sensitivity. They are ideal for high-speed data transfer, light barriers, alarm systems, and linear light measurement.

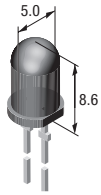
Package	Part Number	Peak Wave-length (nm)	Bandwidth $\lambda_{0.5}$ (nm)	Sensi-tivity I_{ra} (µA)(1)	Angle of Half Sensitivity (+/-°)	Photo Area (nm)(2)	Rise/Fall Time, t_r/t_f (ns)(2)	Remark
Through-Hole Packages								
5 mm	BVP10	920	380 to 1140(7)	70	20	0.78	2,5(3)	Stand-off
	BPV10NF	940	790 to 1050	60	20	0.78	2,5(3)	Stand-off
Side View	BPW41N	950	870 to 1050	45	65	7.5	100	5 x 4 x 6,8
	BPW46 (L)	900	430 to 1100(7)	50	65	7.5	100	5 x 3 x 6,4
	BPW82	950	790 to 1050	45	65	7.5	100	5 x 4 x 6,8
	BPW83	950	790 to 1050	45	65	7.5	100	5 x 3 x 6,4
Side View High Perfor-mance	BPV22F	950	870 to 1050	80	60	7.5	100	
	BPV22NF	940	790 to 1050	85	60	7.5	100	
	BPV23F	950	870 to 1050	63	60	4.4	70	
	BPV23NF	940	790 to 1050	65	60	4.4	70	
TO-5	BPW20RF	920	400 to 1100(7)	42	50	7.5	3600(6)	
TO-18	BPW24R	900	430 to 1100(7)	60	12	0.78	7(4)(5)	
Top View Leaded	BP104	950	870 to 1050	45	65	7.5	100	
	BPW34	900	430 to 1100(7)	55	65	7.5	100	
Surface-Mount Packages								
Top View	TEMD5080X01(8)	940	350 to 1100(7)	60	65	7.5	40(4)	AEC-Q101
	TEMD5020X01(8)	940	430 to 1100(7)	35	65	4.4	100	AEC-Q101
	TEMD5120X01(8)	940	790 to 1050	35	65	4.4	100	AEC-Q101
	TEMD5010X01(8)	940	430 to 1100(7)	55	65	7.5	100	AEC-Q101
	TEMD5110X01(8)	940	790 to 1050	55	65	7.5	100	AEC-Q101
	VBP104S	940	430 to 1100(7)	35	65	4.4	100	Gullwing
	VBP104SR	940	430 to 1100(7)	35	65	4.4	100	Reverse gullwing
	VBP104FAS	950	780 to 1050	35	65	4.4	100	Gullwing
	VBP104FASR	950	780 to 1050	35	65	4.4	100	Reverse gullwing
	VBPW34S	940	430 to 1100(7)	55	65	7.5	100	Gullwing
	VBPW34SR	940	430 to 1100(7)	55	65	7.5	100	Reverse gullwing
	VBPW34FAS	950	780 to 1050	55	65	7.5	100	Gullwing
	VBPW34FASR	950	780 to 1050	55	65	7.5	100	Reverse gullwing
1.8 mm	VEMD2000X01	940	750 to 1050	12	15	0.23	100	Reverse gullwing
	VEMD2020X01(8)	940	750 to 1050	12	15	0.23	100	Gullwing
	VEMD2500X01(8)	900	350 to 1120(7)	12	15	0.23	100	Reverse gullwing
	VEMD2520X01(8)	900	350 to 1120(7)	12	15	0.23	100	Gullwing
0805	TEMD7000X01(8)	900	350 to 1120(7)	3	60	0.23	100	
	TEMD7100X01(8)	950	750 to 1050	3	60	0.23	100	

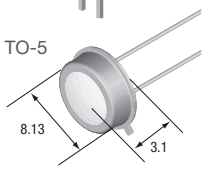
Notes: (1) Sensitivity: VR = 5 V, E_e = 1 mW/cm², λ = 950 nm; (2) Speed: R_L = 1 kΩ, λ = 820 nm, VR = 10 V
(3) VR = 50 V, R_L = 50 Ω, λ = 820 nm; (4) R_L = 50 Ω; (5) VR = 20 V; (6) VR = 0V (7) Bandwidth λ0.1 (nm)
(8) Products ending in "X01" are AEC-Q101 qualified

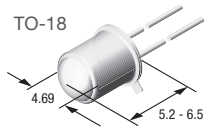


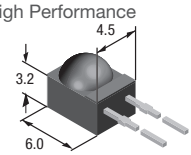
Rise and Fall Times

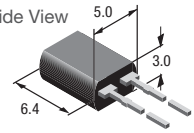
Switching times of photo detectors are strongly dependent on the measurement conditions. Shown in the diagrams are two major conditions: the reverse bias and the value of the load resistor used in the circuit. The switching time of a photo diode varies by two orders of magnitude when the load resistor value changes from 50 Ω to 10 kΩ. The lower the value of the load resistor, the faster the diode becomes. Also, the lower the reverse bias, the faster the switching times.

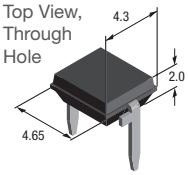
5 mm


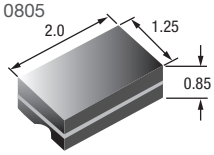
TO-5


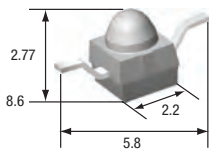
TO-18


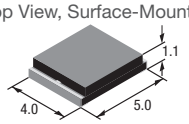
Side View, High Performance


Side View


Top View, Through Hole


0805


1.8 mm Surface-Mount


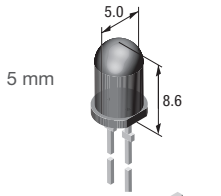
Top View, Surface-Mount


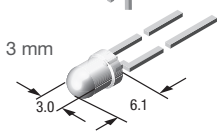
Phototransistors

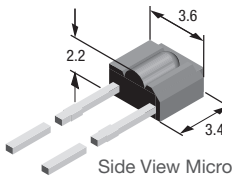
Vishay provides the industry's widest selection of phototransistors. Offered in over 10 different packages, Vishay's phototransistors are exceptionally sensitive and simplify circuit design by eliminating the need for a separate amplifier.

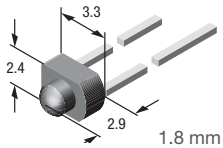
Package	Part Number	Peak Wave-length (nm)	Band-width $\lambda_{0.5}$ (nm)	Collector Light Current, I_{ca} (mA)(1)	Angle of Half Sensitvity (+/-°)	Rise and Fall Time, t_r/t_f (ns)(2)	Remark
Through-Hole Packages							
5 mm	BPV11	850	450 to 1080(3)	10	15	6	With base pin
	BPV11F	930	900 to 980	9	15	6	With base pin
	BPW96C	850	450 to 1080(3)	8	20	2	Stand-off
3 mm	BPW85C	850	450 to 1080(3)	5	25	2	Stand-off
	TEFT4300	925	875 to 1000	3.2	30	2	No stand-off
1.8 mm	BPW16N	825	450 to 1040(3)	0.14	40	4.8	
	BPW17N	825	450 to 1040(3)	1	12	4.8	
Side View Micro	TEST2600	920	850 to 980	2.5	30H, 60V	6	
Side View Lens	TEKT5400S	920	850 to 980	4	37	6	
TO-18	BPW76B	850	450 to 1080(3)	1.2	40	6	
	BPW77NB	850	450 to 1080(3)	20	10	6	
Surface-Mount Packages							
PLCC-2	VEMT3700	850	450 to 1080(3)	0.5	60	2	
	VEMT3700F	940	850 to 1050	0.5	60	2	
	VEMT4700	850	450 to 1080(3)	0.5	60	2	With base pin
1.8 mm	VEMT2000X01(4)	860	790 to 970	6	15	2	Reverse gullwing
	VEMT2020X01(4)	860	790 to 970	6	15	2	Gullwing
	VEMT2500X01(4)	850	470 to 1090(3)	6	15	2	Reverse gullwing
	VEMT2520X01(4)	850	470 to 1090(3)	6	15	2	Gullwing
0805	TEMT7000X01(4)	850	470 to 1090(3)	0.45	60	2	
	TEMT7100X01(4)	870	750 to 1010	0.45	60	2	

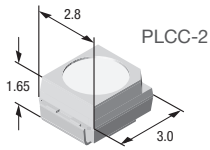
Notes: (1) Collector light current: V_{CE} = 5 V, E_e = 1 mW/cm², λ = 950 nm, typical
(2) Speed: V_S = 5 V, I_C = 5 mA, R_L = 100 Ω
(3) Bandwidth $\lambda_{0.1}$ (nm)
(4) Products ending in "X01" are AEC-Q101 qualified

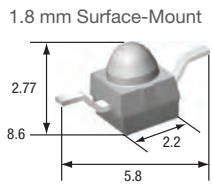


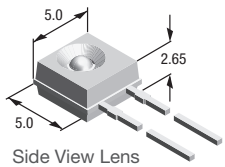


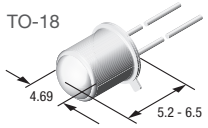


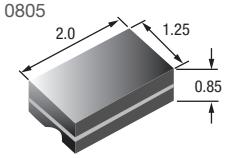


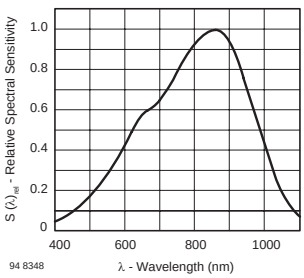












Bandwidth: $\lambda_{0.5}$ and $\lambda_{0.1}$

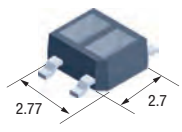
The diagram to the left shows the relative spectral sensitivity of the BPV11 phototransistor. The peak sensitivity is found at 850 nm. The bandwidth of the detector can be defined by using a relative sensitivity value of 0.5 or 0.1. Vishay datasheets will show one of these values. In the case of the BPV11, the bandwidth in the datasheet is 450 nm to 1080 nm, $\lambda_{0.1}$.

Reflective Sensors

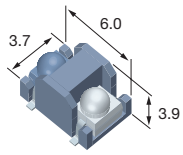
Reflective sensors incorporate an infrared emitter and photo detector adjacent to each other. When an object is in the sensing area, the emitted light is reflected back towards the photo detector, and the amount of light energy reaching the detector increases. This change in light energy or photo current is used as an input signal in the application.

Part Number(1)	Operating Range(2) (mm)	Peak Operating Distance (mm)
TCND5000(3)	2 to 25	7
TCNT2000*	1 to 5	1
TCRT1000/1010	1 to 2	1
TCRT5000(L)	1 to 14	2.5
CNY70	1 to 3	0

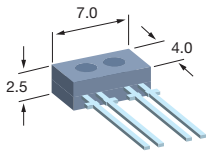
Notes: (1) All optical sensors have phototransistor output except where noted.
(2) Relative collector current > 20 %
(3) TCND5000 has a PIN photodiode output
(*) Target specification, product release pending



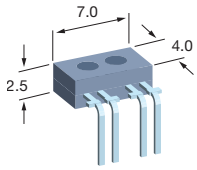
TCNT2000



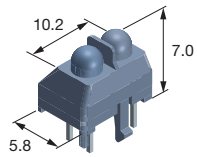
TCND5000



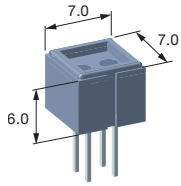
TCRT1000



TCRT1010



TCRT5000(L)



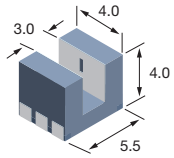
CNY70

Transmissive Sensors

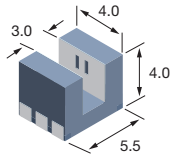
Transmissive sensors, also called interrupter sensors, incorporate an infrared emitter and photo detector that face each other. When an object is located between the emitter and detector in the sensing path, it interrupts or breaks the optical beam of the emitter. A change in light energy reaching the detector results in a change in photo current which is used as an input to the application.

Part Number(1)	Gap (mm)	Aperture (mm)	Typical Output Current (mA)	On / Off Time t_{on} / t_{off} (µs)
TCPT1300X01(3)	3.0	0.3	0.6	20 / 30
TCUT1300X01(2) (3)	3.0	0.3	0.6	20 / 30
TCST1030	3.0	none	2.4	15 / 10
TCST1103	3.1	1	4	10 / 8
TCST1202	3.1	0.5	2	10 / 8
TCST1230	3	0.5	2.0	15 / 10
TCST1300	3.1	0.3	0.5	10 / 8
TCST2103	3.1	1.0	4.0	10 / 8
TCST2202	3.1	0.5	2.0	10 / 8
TCST2300	3.1	0.3	0.5	10 / 8
TCST5250	2.7	0.5	1.5	15 / 10

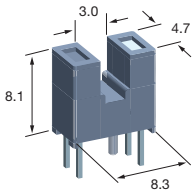
Notes: (1) All optical sensors have phototransistor output
(2) Dual channel
(3) Products ending in “X01” are AEC-Q101 qualified.



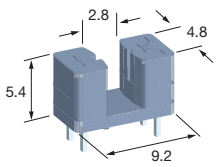
TCPT1300X01



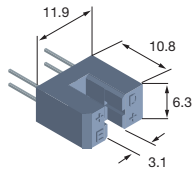
TCUT1300X01



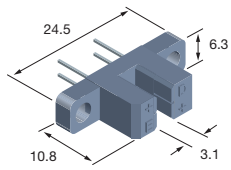
TCST1030, L



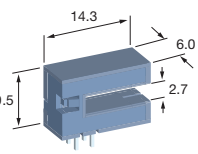
TCST1230



TCST1x0x



TCST2x0x



TCST5250

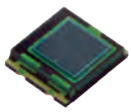
Ambient Light Sensors

Ambient light sensors are used to detect light or brightness in a manner similar to the human eye. They are most commonly found in industrial lighting, consumer electronics, and automotive systems, where they allow settings to be adjusted automatically in response to changing ambient light conditions. By turning on, turning off, or adjusting features, ambient light sensors can conserve battery power or provide extra safety while eliminating the need for manual adjustments.

Package	Part Number	Peak Wave-length (nm)	Band-width $\lambda_{0.5}$ (nm)	Angle of Half Sensitvity (+/-°)	Light Current(1) Incandescent (µA)	Light Current(2) Fluorescent (µA)	Remark
Photo Diodes							
0805, SMD	TEMD6200FX01(3)	540	430 to 610	60	0.04	0.03	Stand-off
1206, SMD	TEMD6010FX01(3)	540	430 to 610	60	0.04	0.03	
Top View SMD	TEMD5510FX01(3)	540	430 to 610	65	1	0.7	
TO-5, Leaded	BPW21R	565	420 to 675	50	0.9	0.75	
Phototransistors							
0805, SMD	TEMT6200FX01(3)	550	450 to 610	60	12	7	
1206, SMD	TEMT6000X01(3)	570	430 to 800	60	50	21	
5 mm, flat top	TEPT5700	570	430 to 800	50	75	31	Leaded
5 mm	TEPT5600	570	430 to 800	20	350	145	Leaded
3 mm	TEPT4400	570	430 to 800	30	200	83	Leaded

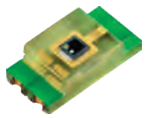
Notes: (1) Ev = 100 lux, V_{CE} = 5 V, CIE illuminant A, typical (2) Ev = 100 lux, V_{CE} = 5 V, e.g. Sylvania color abbrev. D830, typical
(3) Products ending in "X01" are AEC-Q101 qualified

F	Part numbers with an F contain an infrared filtering epoxy to further improve the ambient light sensing performance
X01	Part numbers with an X01 are qualified to the AEC Q101 standard and support operating temperatures from - 40 C° to + 100 °C



TEMD5510FX01

TEMT6200FX01
TEMD6200FX01

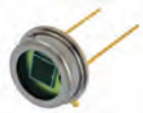


TEMD6010FX01
TEMT6000X01

TEPT5600

TEPT4400

TEPT5700



BPW21R

Proximity Sensor with Integrated Ambient Light Sensor								
Package	**Part Number**	**Operating Range (mm)**	**Operating Voltage Range (V)**	**I²C Bus Voltage Range (V)**	**Sample Rate(1) (Hz)**	**LED Pulse Current(1) (mA)**	**Ambient Light Range (lux)**	**Ambient Light Resolution (lux)**
LLP, SMD 3.95 mm x 3.95 mm x 0.75 mm	VCNL4000*	1 to 200	2.5V to 3.6V	1.7V to 5.0V	1 to 250	10 to 200	0.2 to 13000	0.2

Notes: (1) Adjustable through I²C interface (*) Target specification, product release pending

The VCNL4000 is a proximity sensor with integrated ambient light sensor. It is the industry's first optical sensor to combine an IR Emitter, Photo-PIN-Diode, Ambient Light Detector and signal processing IC into a single package, which greatly simplifies the use and design-in of these features in various consumer and industrial applications.

- Integrated emitter eliminates need for discrete part - simplifies Window design
- Low profile of 0.75 mm - ideal for smartphone and digital camera applications
- Proximity distance up to 20 cm
- I²C fast mode interface - data interface and set point adjustment
- 16-bit digital resolution for ambient light and proximity signal

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