

## Fully Integrated Proximity and Ambient Light Sensor with Infrared Emitter, I<sup>2</sup>C Interface, and Interrupt Function



### DESCRIPTION

VCNL4040 integrates a proximity sensor (PS), ambient light sensor (ALS), and a high power IRED into one small package. It incorporates photodiodes, amplifiers, and analog to digital converting circuits into a single chip by CMOS process. The 16-bit high resolution ALS offers excellent sensing capabilities with sufficient selections to fulfill most applications whether dark or high transparency lens design. High and low interrupt thresholds can be programmed for both ALS and PS, allowing the component to use a minimal amount of the microcontrollers resources.

The proximity sensor features an intelligent cancellation scheme, so that cross talk phenomenon is eliminated effectively. To accelerate the PS response time, smart persistence prevents the misjudgment of proximity sensing but also keeps a fast response time. In active force mode, a single measurement can be requested, allowing another good approach for more design flexibility to fulfill different kinds of applications with more power saving.

The patented Filtron™ technology achieves ambient light spectral sensitivity closest to real human eye response and offers the best background light cancellation capability (including sunlight) without utilizing the microcontrollers' resources. VCNL4040 provides an excellent temperature compensation capability for keeping output stable under various temperature configurations. ALS and PS functions are easily set via the simple command format of I<sup>2</sup>C (SMBus compatible) interface protocol. Operating voltage ranges from 2.5 V to 3.6 V. VCNL4040 is packaged in a lead-free 8-pin molding package, which offers the best market-proven reliability quality.

### FEATURES

- Package type: surface mount
- Dimensions (L x W x H in mm): 4.0 x 2.0 x 1.1
- Integrated modules: infrared emitter (IRED), ambient light sensor (ALS), proximity sensor (PS), and signal conditioning IC
- Operates ALS and PS in parallel structure
- Filtron™ technology adoption for robust background light cancellation
- Temperature compensation: -40 °C to +85 °C
- Low power consumption I<sup>2</sup>C (SMBus compatible) interface
- Floor life: 168 h, MSL 3, according to J-STD-020
- Output type: I<sup>2</sup>C bus (ALS / PS)
- Operation voltage: 2.5 V to 3.6 V
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### PROXIMITY FUNCTION

- Immunity to red glow (940 nm IRED)
- Programmable IRED sink current
- Intelligent cancellation to reduce cross talk phenomenon
- Smart persistence scheme to reduce PS response time
- Selectable for 12- / 16-bit PS output data

### AMBIENT LIGHT FUNCTION

- High accuracy of ALS ±10 %
- Fluorescent light flicker immunity
- Spectrum close to real human eye responses
- Selectable maximum detection range (819 / 1638 / 3277 / 6553) lux with highest sensitivity 0.0125 lux/step

### INTERRUPT

- Programmable interrupt function for ALS and PS with upper and lower thresholds
- Adjustable persistence to prevent false triggers for ALS and PS

### APPLICATIONS

- Handheld device
- Notebook, tablet PC
- Consumer device
- Industrial application

**PRODUCT SUMMARY**

| PART NUMBER | OPERATING RANGE (mm) | OPERATING VOLTAGE RANGE (V) | I <sup>2</sup> C BUS VOLTAGE RANGE (V) | IRED PULSE CURRENT <sup>(1)</sup> (mA) | AMBIENT LIGHT RANGE (lx) | AMBIENT LIGHT RESOLUTION (lx) | OUTPUT CODE              | ADC RESOLUTION PROXIMITY / AMBIENT LIGHT |
|-------------|----------------------|-----------------------------|----------------------------------------|----------------------------------------|--------------------------|-------------------------------|--------------------------|------------------------------------------|
| VCNL4040    | 0 to 200             | 2.5 to 3.6                  | 1.8 to 3.6                             | 200                                    | 0.0125 to 6553           | 0.0125                        | 16 bit, I <sup>2</sup> C | 16 bit / 16 bit                          |

**Note**

<sup>(1)</sup> Adjustable through I<sup>2</sup>C interface

**ORDERING INFORMATION**

| ORDERING CODE   | PACKAGING     | VOLUME <sup>(1)</sup> | REMARKS                     |
|-----------------|---------------|-----------------------|-----------------------------|
| VCNL4040M3OE    | Tape and reel | MOQ: 2500 pcs         | 4.0 mm x 2.0 mm x 1.1 mm    |
| VCNL4040M3OE-H3 |               | MOQ: 1500 pcs         | 4.34 mm x 2.35 mm x 3.25 mm |
| VCNL4040M3OE-H5 |               |                       | 4.34 mm x 2.35 mm x 3.65 mm |

**Note**

<sup>(1)</sup> MOQ: minimum order quantity

**ABSOLUTE MAXIMUM RATINGS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

| PARAMETER                   | TEST CONDITION | SYMBOL    | MIN. | MAX. | UNIT               |
|-----------------------------|----------------|-----------|------|------|--------------------|
| Supply voltage              |                | $V_{DD}$  | 2.5  | 3.6  | V                  |
| Operation temperature range |                | $T_{amb}$ | -40  | +85  | $^{\circ}\text{C}$ |
| Storage temperature range   |                | $T_{stg}$ | -40  | +100 | $^{\circ}\text{C}$ |

**RECOMMENDED OPERATING CONDITIONS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

| PARAMETER                                | TEST CONDITION | SYMBOL         | MIN. | MAX. | UNIT               |
|------------------------------------------|----------------|----------------|------|------|--------------------|
| Supply voltage                           |                | $V_{DD}$       | 2.5  | 3.6  | V                  |
| Operation temperature range              |                | $T_{amb}$      | -40  | +85  | $^{\circ}\text{C}$ |
| I <sup>2</sup> C bus operating frequency |                | $f_{(I2CCLK)}$ | 10   | 400  | kHz                |

**PIN DESCRIPTIONS**

| PIN ASSIGNMENT | SYMBOL   | TYPE               | FUNCTION                                      |
|----------------|----------|--------------------|-----------------------------------------------|
| 1              | GND      | I                  | Ground                                        |
| 2              | CATHODE  | I                  | Cathode (sensor) connection                   |
| 3              | $V_{DD}$ | I                  | Power supply input                            |
| 4              | ANODE    | I                  | Anode for IRED                                |
| 5              | CATHODE  | I                  | Cathode (LED) connection                      |
| 6              | INT      | O                  | Interrupt pin                                 |
| 7              | SDAT     | I / O (open drain) | I <sup>2</sup> C data bus data input / output |
| 8              | SCLK     | I                  | I <sup>2</sup> C digital bus clock input      |