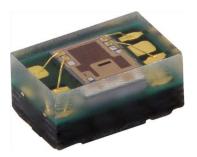
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RGBCIR Color Sensor With I²C Interface



ADDITIONAL RESOURCES



DESCRIPTION

VEML3328 sensor senses red, green, blue, clear, and IR light by incorporating photodiodes, amplifiers, and analog / digital circuits into a single CMOS chip. With this sensor, the brightness and color temperature of a display backlight can be adjusted based on the ambient light source, and it can differentiate indoor from outdoor lighting environments.

FEATURES

- Package type: surface-mount
- Dimensions (L x W x H in mm): 2.0 x 1.25 x 1.0
- Integrated modules: color sensor and signal conditioning IC
- Supports low transmittance (dark) lens design
- Provides 16-bit resolution for each channel (R, G, B, C, and IR)
- Package: OPLGA4
- Temperature compensation: -40 °C to +85 °C
- Low power consumption I²C (SMBus compatible) interface
- Floor life: 168 h, MSL 3, according to J-STD-020
- Output type: I²C bus
- Operation voltage: 2.6 V to 3.6 V
- Material categorization: for definitions of compliance please see <u>www.vishay.com/doc?99912</u>

APPLICATIONS

- Automatic white balancing and color cast correction in digital cameras
- Automatic LCD backlight adjustment
- Maintaining consistent true color and ideal brightness levels on handheld displays as users move between indoor and outdoor environments
- On / off light switching in industrial and consumer applications
- Active monitoring of LED color output for IoT and smart lighting

| PRODUCT SUMMARY | | | | | | |
|-----------------|--|------------|--|--------------------------|--|--|
| PART NUMBER | PART NUMBER OPERATING I ² C BUS VOLTAGE RANGE VOLTAGE RANGE (V) (V) | | PEAK SENSITIVITY (nm) | OUTPUT CODE | | |
| VEML3328 | 2.6 to 3.6 | 1.7 to 3.6 | 590, 610, 560, 470, 825 (C, R, G, B, IR) | 16 bit, l ² C | | |



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Pb-free (e4)

> RoHS COMPLIANT HALOGEN FREE GREEN (5-2008)



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ORDERING INFORMATION

| ORDERING CODE | PACKAGING | VOLUME ⁽¹⁾ | REMARKS | | | |
|---------------|---------------|-----------------------|-----------------------------|--|--|--|
| VEML3328 | Tape and reel | MOQ: 2500 pcs | 2.00 mm x 1.25 mm x 1.00 mm | | | |

Note

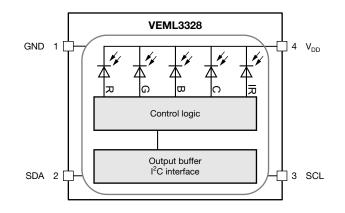
⁽¹⁾ MOQ: minimum order quantity

| ABSOLUTE MAXIMUM RATINGS (T _{amb} = 25 °C, unless otherwise specified) | | | | | | | |
|---|--|------------------|-----|-----|----|--|--|
| PARAMETER TEST CONDITION SYMBOL MIN. MAX. UNIT | | | | | | | |
| Supply voltage | | V _{DD} | 0 | 4 | V | | |
| Operation temperature range | | T _{amb} | -40 | +85 | °C | | |
| Storage temperature range | | T _{stg} | -40 | +85 | С° | | |

| RECOMMENDED OPERATING CONDITIONS ($T_{amb} = 25 \text{ °C}$, unless otherwise specified) | | | | | | | |
|---|--|-----------------------|-----|-----|-----|--|--|
| PARAMETER TEST CONDITION SYMBOL MIN. MAX. UNIT | | | | | | | |
| Supply voltage | | V _{DD} | 2.6 | 3.6 | V | | |
| Operation temperature range | | T _{amb} | -40 | +85 | °C | | |
| I ² C bus operating frequency | | f _(I2CCLK) | 10 | 400 | kHz | | |

| PIN DESCRIPTIONS | PIN DESCRIPTIONS | | | | | | |
|------------------|------------------|--------------------|---|--|--|--|--|
| PIN ASSIGNMENT | SYMBOL | TYPE | FUNCTION | | | | |
| 1 | GND | - | Power supply ground; all voltages are referenced to GND | | | | |
| 2 | SDA | I / O (open drain) | I ² C digital bus data input / output | | | | |
| 3 | SCL | I | I ² C digital bus clock input | | | | |
| 4 | V _{DD} | - | Supply voltage | | | | |

BLOCK DIAGRAM





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| BASIC CHARACTERISTICS (T _{amb} = 25 °C, unless otherwise specified) | | | | | | | | |
|---|------------|------------------------------|------------------|------|-------|------|-----------------|--|
| PARAMETER | | TEST CONDITION | SYMBOL | MIN. | TYP. | MAX. | UNIT | |
| Supply voltage | | | V _{DD} | 2.6 | 3.0 | 3.6 | V | |
| Supply current (1) | | | I _{DD} | 500 | 580 | 1000 | μΑ | |
| I ² C signal input ⁽¹⁾ | Logic high | | V _{IH} | 1.2 | - | - | v | |
| 1-C signal input ··· | Logic low | | V _{IL} | - | - | 0.4 | v | |
| | | | λ _{PC} | - | 590 | - | | |
| | | | λ _{PR} | - | 610 | - | nm | |
| Peak sensitivity way | velength | | λ _{PG} | - | 560 | - | | |
| | | | λ _{PB} | - | 470 | - | 1 | |
| | | | λ _{PIR} | - | 825 | - | 1 | |
| | | 520 nm LED (1)(2) | С | - | 57 | - | | |
| | | 850 nm LED ⁽¹⁾⁽²⁾ | IR | - | 25 | - | counts/(µW/cm²) | |
| Irradiance responsiv | /ity | 643 nm LED (1)(2) | R | - | 41 | - | | |
| | | 520 nm LED (1)(2) | G | - | 39 | - | | |
| F | | 460 nm LED (1)(2) | В | - | 34 | - | | |
| Sensitivity | | 5000 K WLED (1)(3) | G | - | 0.003 | - | lx/count | |
| Dark offset (1)(3) | | | R, G, B, C, IR | 0 | - | 3 | counts | |
| Operating temperat | ure range | | T _{amb} | -40 | - | +85 | °C | |
| Shutdown current (1 |) | Light condition = dark | I _{DD} | 0 | 800 | 1000 | nA | |

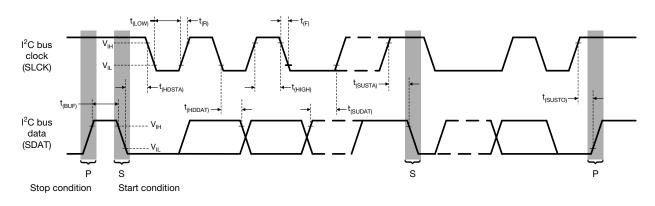
Notes

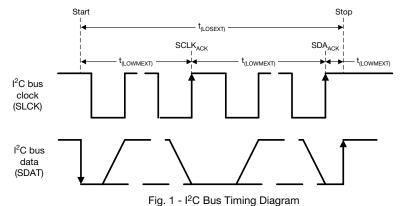
(1) Test condition: $V_{DD} = 3 V$, temperature: 25 °C (2) IT: 100 ms, SENS = (0) = x 1, DG = (0 : 0) = x 1, GAIN = (0 : 0) = x 1 (3) IT: 400 ms, SENS = (0) = x 1, DG = (1 : 0) = x 4, GAIN = (1 : 0) = x 4



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| I ² C BUS TIMING CHARACTERISTICS (T _{amb} = 25 °C, unless otherwise specified) | | | | | | |
|--|-----------------------|---------------|------|------|------|------|
| PABAMETER | SYMBOL | STANDARD MODE | | FAST | MODE | |
| PARAMETER | STIVIDOL | MIN. | MAX. | MIN. | MAX. | UNIT |
| Clock frequency | f _(I2CCLK) | 10 | 100 | 10 | 400 | kHz |
| Bus free time between start and stop condition | t _(BUF) | 4.7 | - | 1.3 | - | μs |
| Hold time after (repeated) start condition; after this period, the first clock is generated | t _(HDSTA) | 4.0 | - | 0.6 | - | μs |
| Repeated start condition setup time | t _(SUSTA) | 4.7 | - | 0.6 | - | μs |
| Stop condition setup time | t _(SUSTO) | 4.0 | - | 0.6 | - | μs |
| Data hold time | t _(HDDAT) | - | 3450 | - | 900 | ns |
| Data setup time | t _(SUDAT) | 250 | - | 100 | - | ns |
| I ² C clock (SCK) low period | t _(LOW) | 4.7 | - | 1.3 | - | μs |
| I ² C clock (SCK) high period | t _(HIGH) | 4.0 | - | 0.6 | - | μs |
| Clock / data fall time | t _f | - | 300 | - | 300 | ns |
| Clock / data rise time | t _r | - | 1000 | - | 300 | ns |





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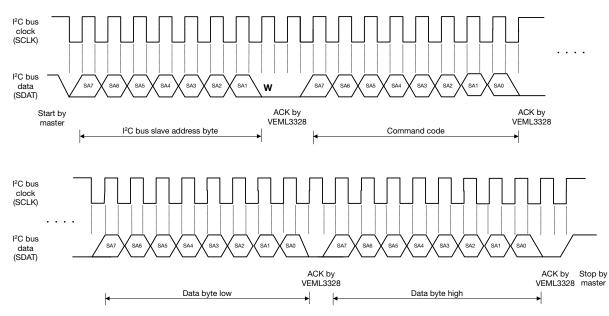
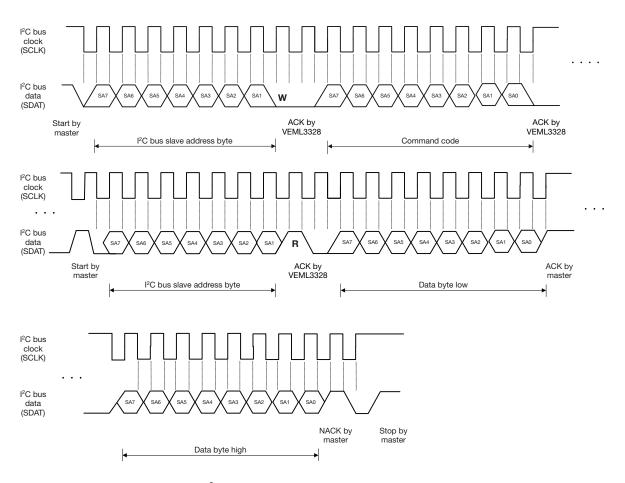


Fig. 2 - I²C Bus Timing for Sending Word Command Format

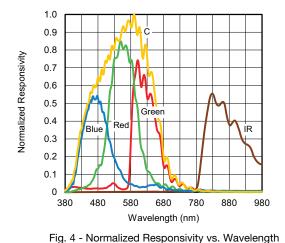






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TYPICAL PERFORMANCE CHARACTERISTICS (Tamb = 25 °C, unless otherwise specified)



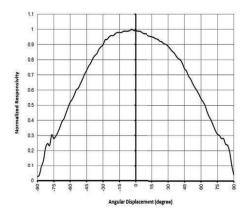


Fig. 5 - Normalized Responsivity vs. Angular Displacement

APPLICATION INFORMATION

Pin Connection With the Host

The VEML3328 is a cost effective solution color and IR sensor with an I²C interface. All possible settings and result data can be accessed via the standard I²C interface.

A typical application circuit is shown in Fig. 6 below. The additional 0.1 µF capacitor near the V_{DD} pin in the circuit is used for power supply noise rejection. Pull-up resistors for the l^2C bus design are recommended to be 2.2 k Ω .

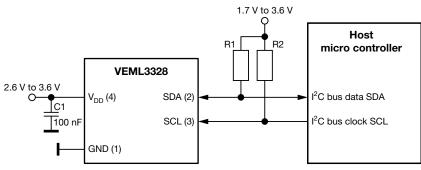


Fig. 6 - Hardware Pin Connection Diagram (Slave Address 0x10)

Digital Interface

The VEML3328 contains a command register accessible via the I²C bus. All settings can be controlled via this register. The VEML3328's I²C command format description for read and write operations between VEML3328 and the host is shown in Fig. 7. The white areas indicate the host activity and the gray areas indicate VEML3328's acknowledgement of the host access activity. Note that this protocol must be followed exactly to avoid false communication on the bus. Special care should be taken for the "Read Word" format, as here a repeated start condition is a must, as indicated.

Send word \rightarrow write command to VEML3328 8 S Slave address Wr А Command code А Data byte low А Data byte high А Р Receive word → read data from VEML3328 S Slave address Wr А Command code А S Rd А Data byte high Ν Р Slave address Data byte low S = start condition Host action P = stop condition A = acknowledge VEML3328 acknowledge N = not acknowledge Fig. 7 - Command Protocol Format

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Document Number: 84968

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6

VEML3328 Vishay Semiconductors



Command Register Format

VEML3328 uses 0x10 slave address for 7-bit I²C addressing protocol. VEML3328 has 16-bit resolution for each channel (R, G, B, C, and IR).

| TABLE 1 - CO | TABLE 1 - COMMAND CODE DESCRIPTION | | | | | | |
|--------------|------------------------------------|---------|---|-----|--|--|--|
| COMMAND CODE | REGISTER NAME | BIT | FUNCTION DESCRIPTION | R/W | | | |
| | SD1 | 15 | Shutdown setting ⁽¹⁾ SD1 = 0 power on; SD1 = 1 shutdown (default) | | | | |
| | SD_ALS only | 14 | 0 = power on all channels (default) 1 = power on G, C, and IR (R, B shutdown) | | | | |
| | DG | 13 : 12 | (0:0) = x 1 (default) (0:1) = x 2 (1:0) = x 4 (1:1) = reserved | | | | |
| | GAIN | 11 : 10 | (1:1) = x 1/2 (0:0) = x 1 (default) (0:1) = x 2 (1:0) = x 4 | | | | |
| | Reserved | 9:8 | Set (0 : 0) Set 0 | | | | |
| 0x00 | Reserved | 7 | | | | | |
| 0x00 | SENS | 6 | 0 = high sensitivity (default); 1 = low sensitivity (1/3) | R/W | | | |
| | п | 5:4 | Integration time setting (0:0) = 50 ms (default) (0:1) = 100 ms (1:0) = 200 ms (1:1) = 400 ms | | | | |
| | AF | 3 | Auto / active force mode 0 = auto mode (default); 1 = active force mode | | | | |
| | TRIG | 2 | Trigger a single measurement when in active force mode. This bit resets to "0" automatically when the measurement cycle is complete. 0 = no trigger (default); 1 = trigger one measurement cycle | | | | |
| | Reserved | 1 | Set 0 | | | | |
| | SD0 | 0 | Shutdown setting ⁽¹⁾ SD0 = 0 power on; SD0 = 1 shutdown (default) | | | | |

Note

⁽¹⁾ For power on, both SD0 and SD1 have to be set to 0. For shutdown, both SD0 and SD1 have to be set to 1

| TABLE 2 - | TABLE 2 - DATA REGISTERS | | | | | | |
|-----------------|--------------------------|-------------------------|-----|---------------------------|-------|--|--|
| COMMAND CODE | REGISTER NAME | DATE BYTE LOW / HIGH | BIT | FUNCTION DESCRIPTION | R / W | | |
| 0x04 | C_LSB | Low | 7:0 | Clear channel LSB data | | | |
| 0x04 | C_MSB | High | 7:0 | Clear channel MSB data | | | |
| 0x05 | R_LSB | Low | 7:0 | Red channel LSB data | | | |
| 0X05 | R_MSB | High | 7:0 | Red channel MSB data | | | |
| 0x06 | G_LSB | Low | 7:0 | Green channel LSB data | | | |
| 0000 | G_MSB | High | 7:0 | Green channel MSB data | В | | |
| 0x07 | B_LSB | Low | 7:0 | Blue channel LSB data | n | | |
| 0.07 | B_MSB | High | 7:0 | Blue channel MSB data | | | |
| 0x08 | IR_LSB | Low | 7:0 | Infrared channel LSB data | | | |
| 0000 | IR_MSB | High | 7:0 | Infrared channel MSB data | | | |
| 0x0C | ID_L | Low | 7:0 | Device ID 0x28 | | | |
| UXUC | Reserved | High | 7:0 | | | | |

Note

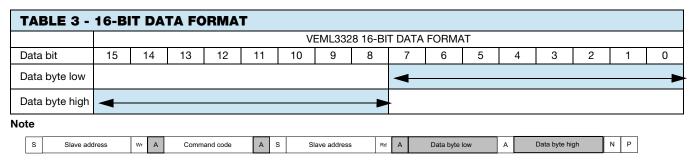
• Command codes 0x01 to 0x03 and 0x09 to 0x0B are reserved



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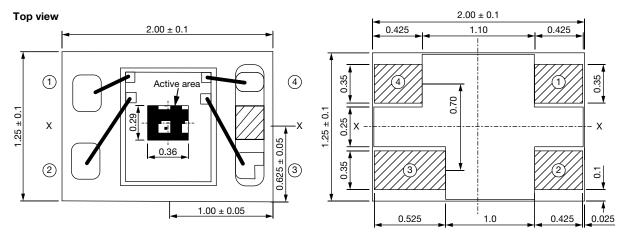
Data Access

Each of the C, R, G, B, and IR result registers has a 16-bit resolution (2 bytes). One byte is the LSB and the other byte is the MSB. The host needs to follow the read word protocol as shown in Fig. 7. The data format shows as below.



• Data byte low represents LSB and data byte high represents MSB

PACKAGE INFORMATION in millimeters



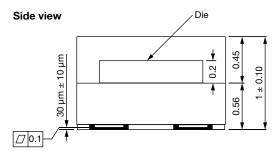
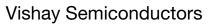


Fig. 8 - VEML3328A3OG Package Dimensions







Recommended footprint

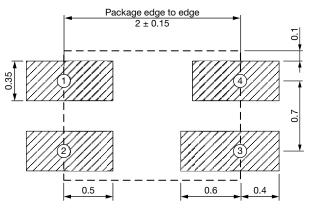


Fig. 9 - VEML3328A3OG PCB Layout Footprint

| RECOMMENDED STORAGE AND REBAKING CONDITIONS | | | | | | | |
|---|--|------|------|--------|--|--|--|
| PARAMETER | CONDITIONS | MIN. | MAX. | UNIT | | | |
| Storage temperature | | 5 | 50 | °C | | | |
| Relative humidity | | - | 60 | % | | | |
| Open time | | - | 168 | h | | | |
| Total time | From the date code on the aluminized envelope (unopened) | - | 12 | months | | | |
| Dehalving | Tape and reel: 60 °C | - | 22 | h | | | |
| Rebaking | Tube: 60 °C | - | 22 | 11 | | | |

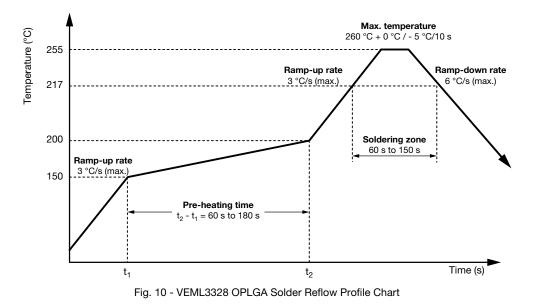


RECOMMENDED INFRARED REFLOW

Soldering conditions which are based on J-STD-020 C

| IR REFLOW PROFILE CONDITION | | | | | | | |
|--|------------|---------------------------------------|---------------|--|--|--|--|
| PARAMETER | CONDITIONS | TEMPERATURE | TIME | | | | |
| Peak temperature | | 255 °C + 0 °C / - 5 °C (max.: 260 °C) | 10 s | | | | |
| Preheat temperature range and timing | | 150 °C to 200 °C | 60 s to 180 s | | | | |
| Timing within 5 °C to peak temperature | | - | 10 s to 30 s | | | | |
| Timing maintained above temperature / time | | 217 °C | 60 s to 150 s | | | | |
| Timing from 25 °C to peak temperature | | - | 8 min (max.) | | | | |
| Ramp-up rate | | 3 °C/s (max.) | - | | | | |
| Ramp-down rate | | 6 °C/s (max.) | - | | | | |

Recommend Normal Solder Reflow is 235 °C to 255 °C



RECOMMENDED IRON TIP SOLDERING CONDITION AND WARNING HANDLING

- 1. Solder the device with the following conditions:
- 1.1. Soldering temperature: 400 °C (max.)
- 1.2. Soldering time: 3 s (max.)
- 2. If the temperature of the method portion rises in addition to the residual stress between the leads, the possibility that an open or short circuit occurs due to the deformation or destruction of the resin increases
- 3. The following methods: VPS and wave soldering, have not been suggested for the component assembly
- 4. Cleaning method conditions:
 - 4.1. Solvent: methyl alcohol, ethyl alcohol, isopropyl alcohol
 - 4.2. Solvent temperature < 45 °C (max.)
 - 4.3. Time: 3 min (min.)



TAPE PACKAGING INFORMATION in millimeters

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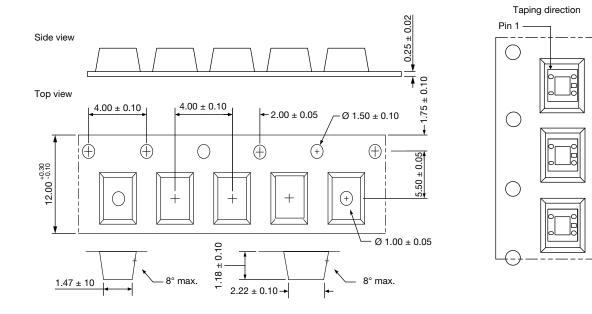


Fig. 11 - VEML3328 A3OG Package Carrier Tape

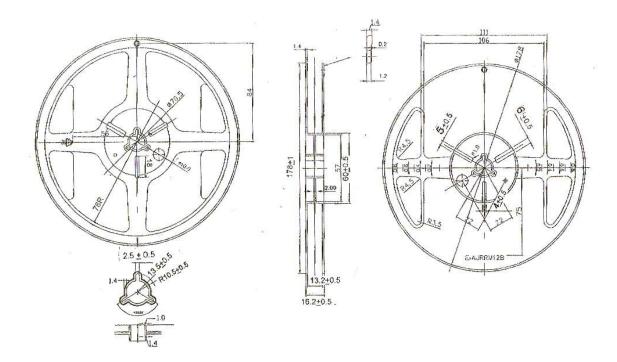


Fig. 12 - Reel Dimensions



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