RGBCIR Color Sensor With I^{2}C Interface
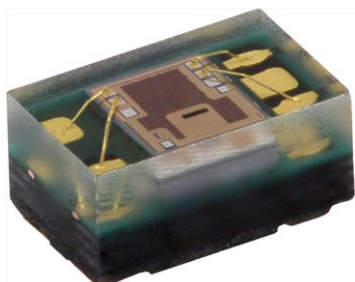
ADDITIONAL RESOURCES

Design Tools   Related Documents   3D Models   Application Notes

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 I^{2}C (SMBus compatible) interface
- Floor life: 168 h, MSL 3, according to J-STD-020
- Output type: I^{2}C bus
- Operation voltage: 2.6 V to 3.6 V
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

e4

RoHS COMPLIANT

HALOGEN **FREE**

GREEN (5-2008)

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	OPERATING VOLTAGE RANGE (V)	I^{2}C BUS VOLTAGE RANGE (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, I^{2}C

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

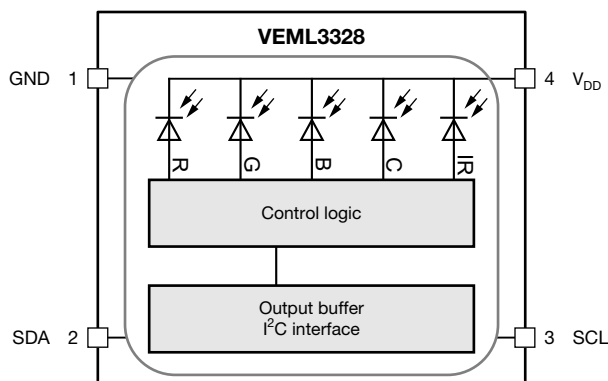## ABSOLUTE MAXIMUM RATINGS (T_{amb} = 25 °C, unless otherwise specified)

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	°C

RECOMMENDED OPERATING CONDITIONS (T_{amb} = 25 °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
I2C bus operating frequency		$f_{(I2CCLK)}$	10	400	kHz

PIN DESCRIPTIONS

PIN ASSIGNMENT	SYMBOL	TYPE	FUNCTION
1	GND	-	Power supply ground; all voltages are referenced to GND
2	SDA	I / O (open drain)	I2C digital bus data input / output
3	SCL	I	I2C digital bus clock input
4	V_{DD}	-	Supply voltage

BLOCK DIAGRAM

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	µA
I²C signal input [1]	Logic high		V_{IH}	1.2	-	-	V
	Logic low		V_{IL}	-	-	0.4	
Peak sensitivity wavelength			λ_{PC}	-	590	-	nm
			λ_{PR}	-	610	-	
			λ_{PG}	-	560	-	
			λ_{PB}	-	470	-	
			λ_{PIR}	-	825	-	
Irradiance responsivity		520 nm LED [1][2]	C	-	57	-	counts/(µW/cm²)
		850 nm LED [1][2]	IR	-	25	-	
		643 nm LED [1][2]	R	-	41	-	
		520 nm LED [1][2]	G	-	39	-	
		460 nm LED [1][2]	B	-	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 temperature 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 = (0 : 0) = x 4

I²C BUS TIMING CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)

PARAMETER	SYMBOL	STANDARD MODE		FAST MODE		UNIT
		MIN.	MAX.	MIN.	MAX.	
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
I²C clock (SCK) low period	$t_{(LOW)}$	4.7	-	1.3	-	µs
I²C 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
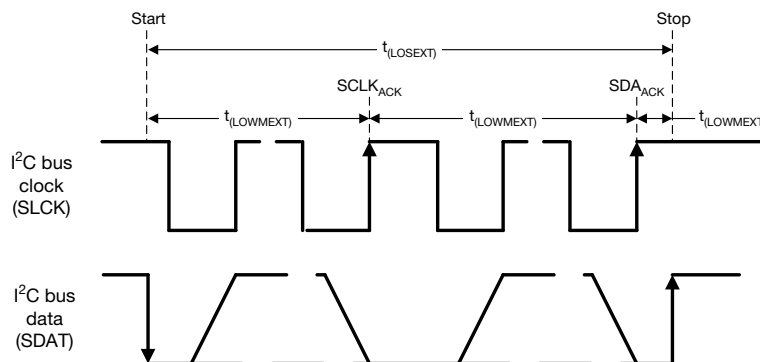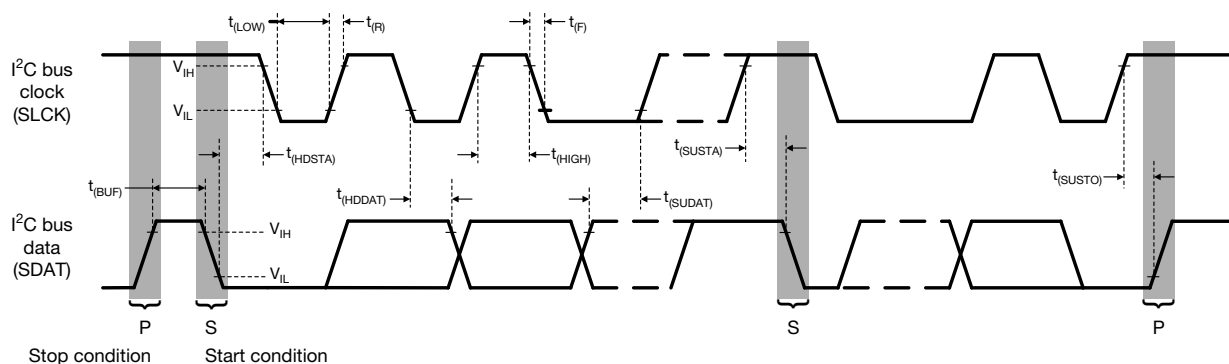
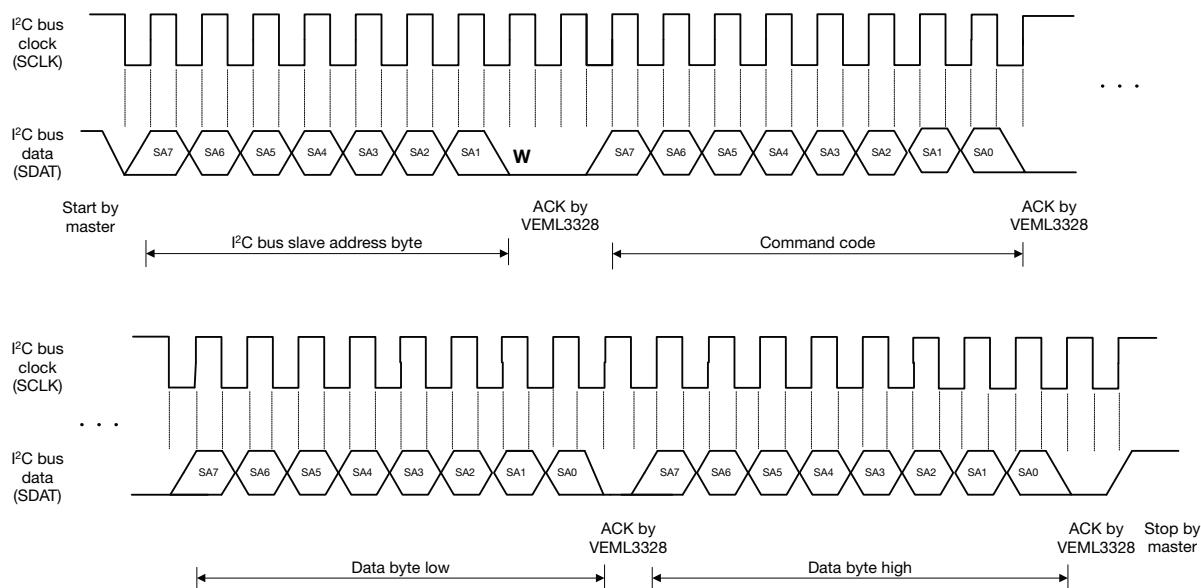Fig. 1 - I²C Bus Timing Diagram

PARAMETER TIMING INFORMATION

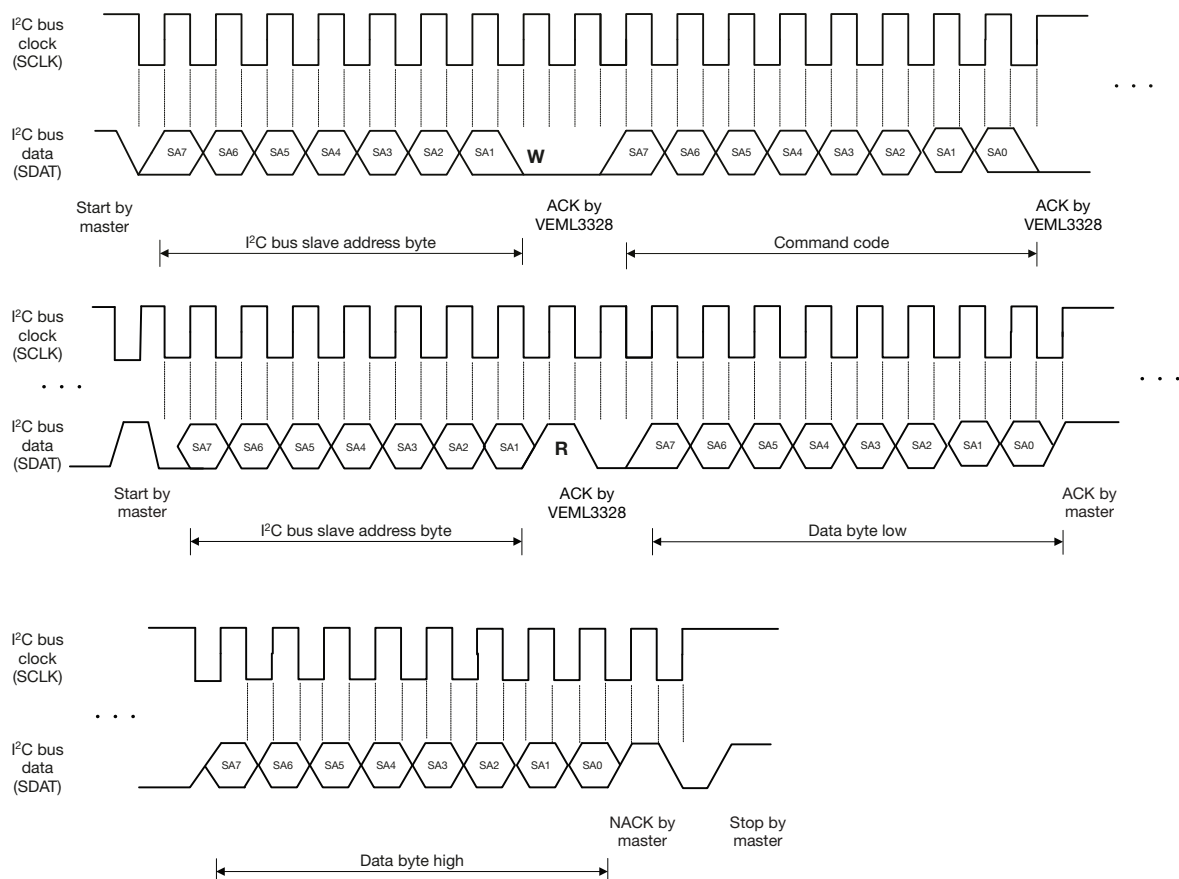Fig. 2 - I²C Bus Timing for Sending Word Command Format

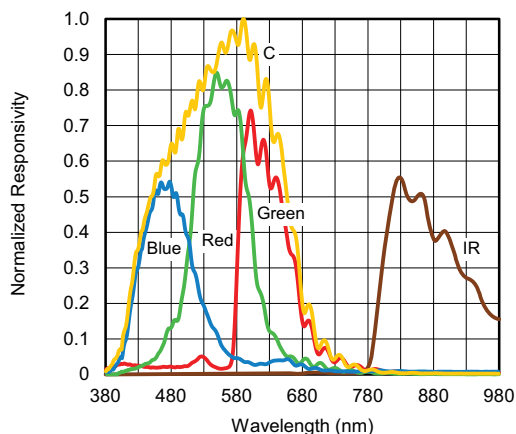

Fig. 3 - I²C Bus Timing for Receiving Word Command Format

TYPICAL PERFORMANCE CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)

Fig. 4 - Normalized Responsivity vs. Wavelength

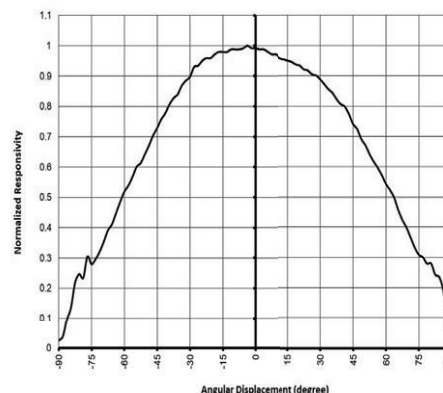Fig. 5 - Normalized Responsivity vs. Angular Displacement

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 I2C bus design are recommended to be 2.2 kΩ.
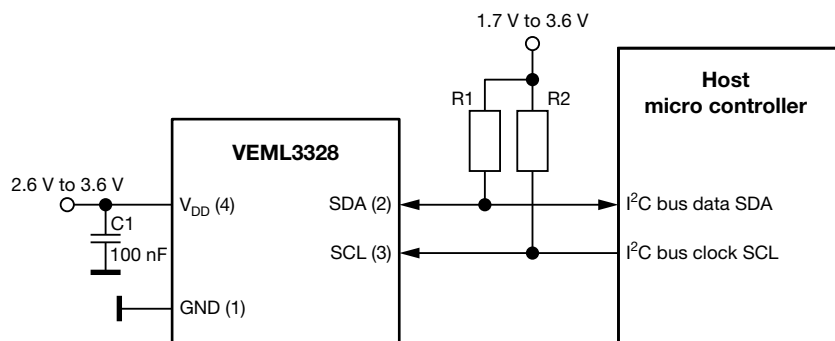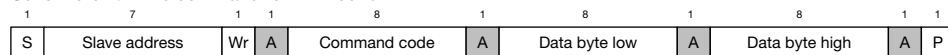

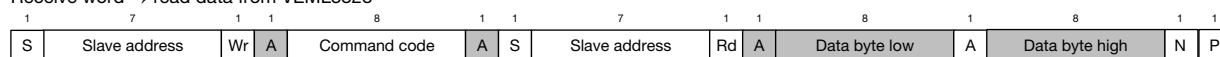Fig. 6 - Hardware Pin Connection Diagram (Slave Address 0x10)

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 → write command to VEML3328

1	7	1	1	8	1	8	1	8	1	1
S	Slave address	Wr	A	Command code	A	Data byte low	A	Data byte high	A	P

Receive word → read data from VEML3328

1	7	1	1	8	1	1	7	1	1	8	1	8	1	1
S	Slave address	Wr	A	Command code	A	S	Slave address	Rd	A	Data byte low	A	Data byte high	N	P

S = start condition
P = stop condition
A = acknowledge
N = not acknowledge

☐ Host action

▩ VEML3328 acknowledge

Fig. 7 - Command Protocol Format

For technical questions, contact: sensorstechsupport@vishay.com

Command Register Format

VEML3328 uses 0x10 slave address for 7-bit I^{2}C addressing protocol. VEML3328 has 16-bit resolution for each channel (R, G, B, C, and IR).

TABLE 1 - COMMAND CODE DESCRIPTION					
COMMAND CODE	**REGISTER NAME**	**DATE BYTE LOW / HIGH**	**BIT**	**FUNCTION DESCRIPTION**	**R / W**
0x00	Reserved	Low	7	Set 0	R /W
	SENS		6	0 = high sensitivity, 1 = low sensitivity (1/3)	
	IT		5 : 4	Integration time setting (0 : 0) = 50 ms (0 : 1) = 100 ms (1 : 0) = 200 ms (1 : 1) = 400 ms	
	AF		3	Auto / manual force mode 0 = auto mode 1 = 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 1 = trigger one measurement cycle	
	Reserved		1		
	SD		0	Shutdown setting 00 = power on 11 = shut down	
		High	7		
	SD_ALS only		6	0 = power on all channels 1 = power on G, C, and IR (R, B shut down)	
	DG		5 : 4	(0 : 0) = x1 (0 : 1) = x2 (1 : 0) = x4 (1 : 1) = reserved	
	GAIN		3 : 2	(1 : 1) = x1/2 (0 : 0) = x1 (0 : 1) = x2 (1 : 0) = x4	
	Reserved		1 : 0	Set (0 : 0)	

Note

- Slave address is 7-bit addressing protocol

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	R
	C_MSB	High	7 : 0	Clear channel MSB data	
0x05	R_LSB	Low	7 : 0	Red channel LSB data	
	R_MSB	High	7 : 0	Red channel MSB data	
0x06	G_LSB	Low	7 : 0	Green channel LSB data	
	G_MSB	High	7 : 0	Green channel MSB data	
0x07	B_LSB	Low	7 : 0	Blue channel LSB data	
	B_MSB	High	7 : 0	Blue channel MSB data	
0x08	IR_LSB	Low	7 : 0	Infrared channel LSB data	
	IR_MSB	High	7 : 0	Infrared channel MSB data	
0x0C	ID_L	Low	7 : 0	Device ID 0x28	
	Reserved	High	7 : 0		

Note

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

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.

TABLE 3 - 16-BIT DATA FORMAT																
	VEML3328 16-BIT DATA FORMAT															
Data bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Data byte low									←——————————————————————→							
Data byte high	←——————————————————————→															

Note

S	Slave address	Wr	A	Command code	A	S	Slave address	Rd	A	Data byte low	A	Data byte high	N	P

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

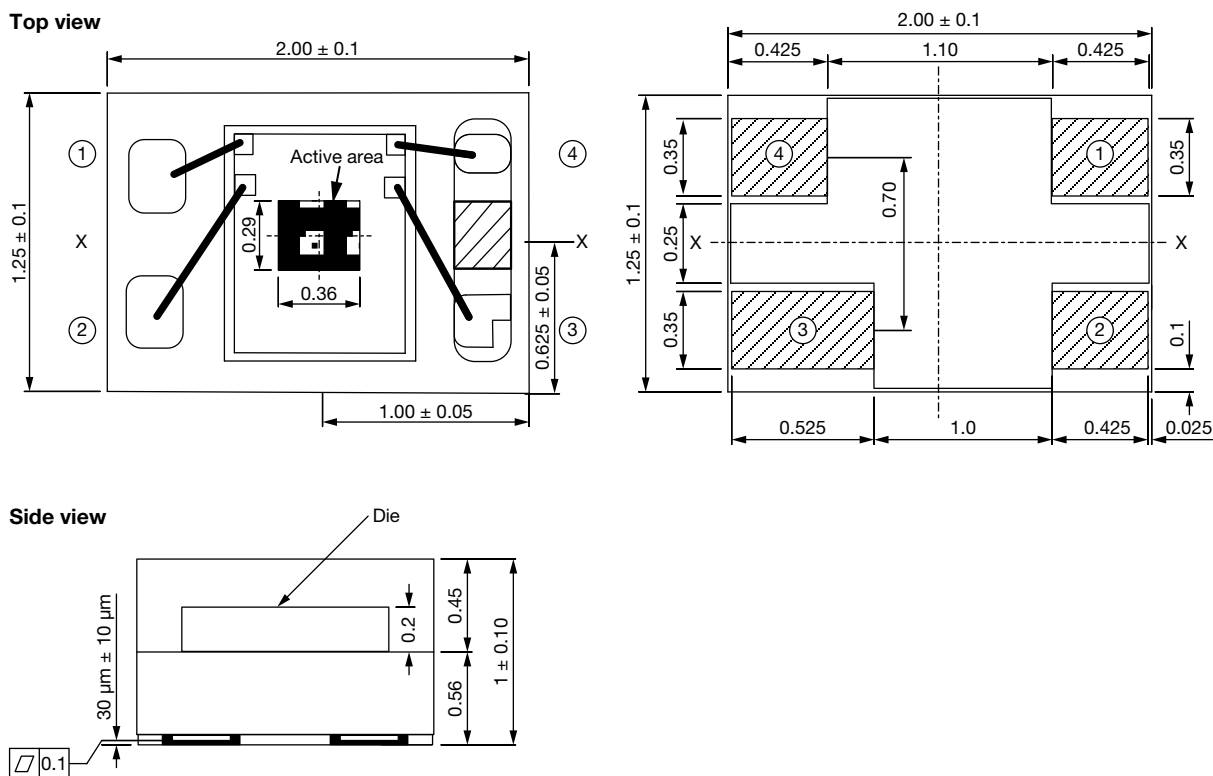## PACKAGE INFORMATION in millimeters

Top view

Side view

Fig. 8 - VEML3328A3OG Package Dimensions

Recommended footprint
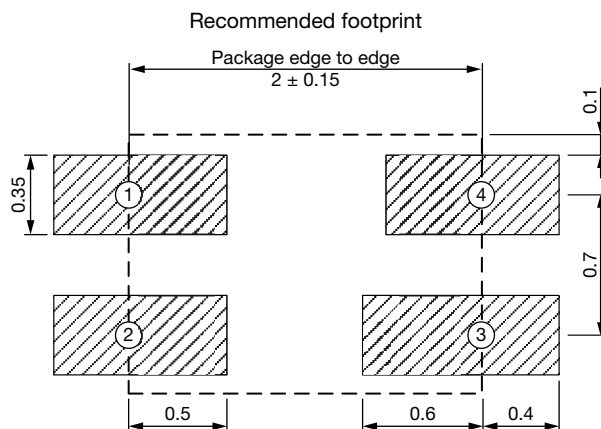
Fig. 9 - VEML3328A3OG PCB Layout Footprint

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
Rebaking	Tape and reel: 60 °C	-	22	h
	Tube: 60 °C	-	22	

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.)	-

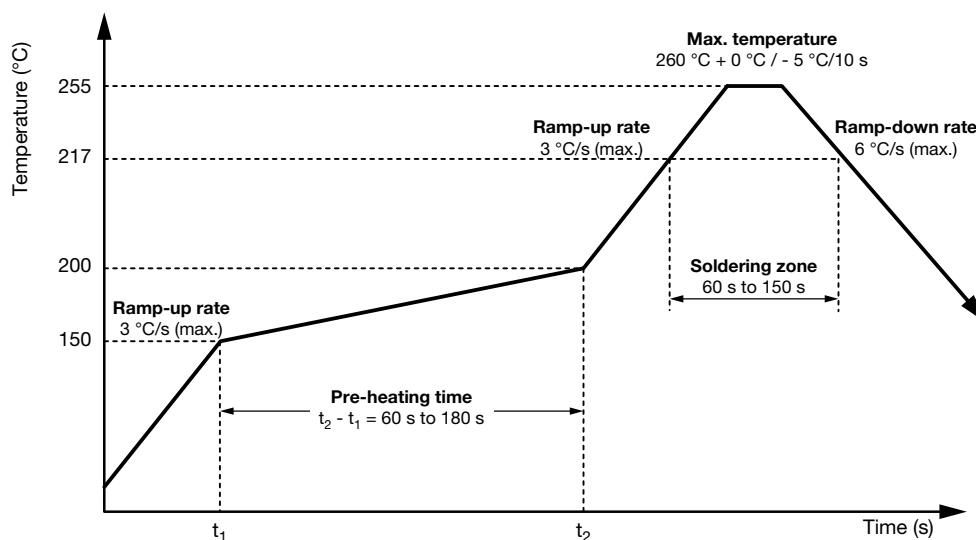Recommend Normal Solder Reflow is 235 °C to 255 °C

Fig. 10 - VEML3328 OPLGA Solder Reflow Profile Chart

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

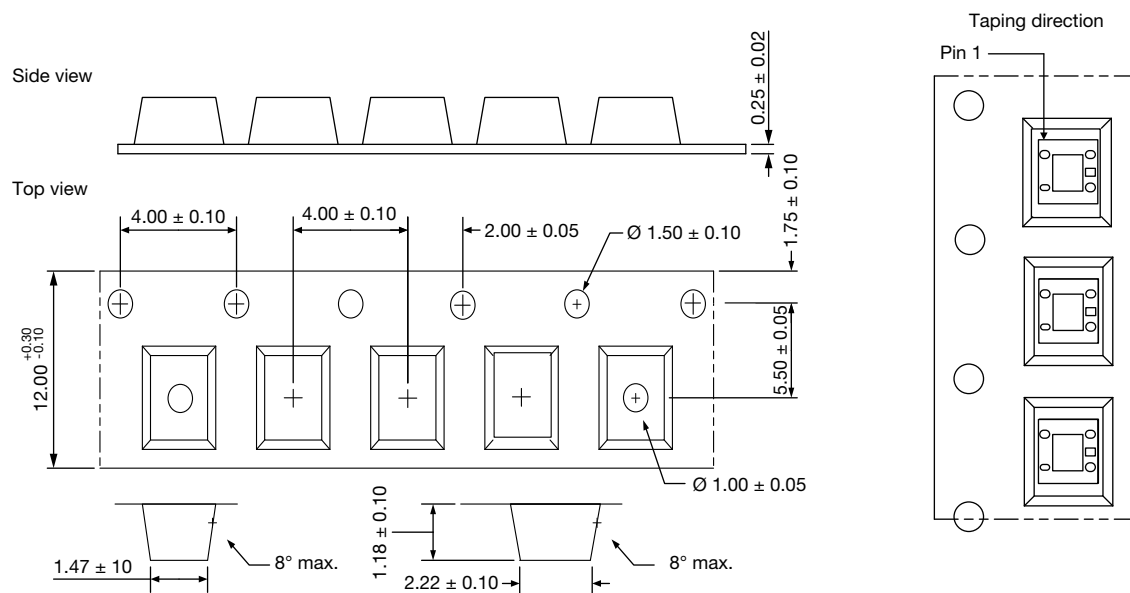   4.2. Solvent temperature < 45 °C (max.)

   4.3. Time: 3 min (min.)

TAPE PACKAGING INFORMATION in millimeters

Fig. 11 - VEML3328 A3OG Package Carrier Tape

Fig. 12 - Reel Dimensions

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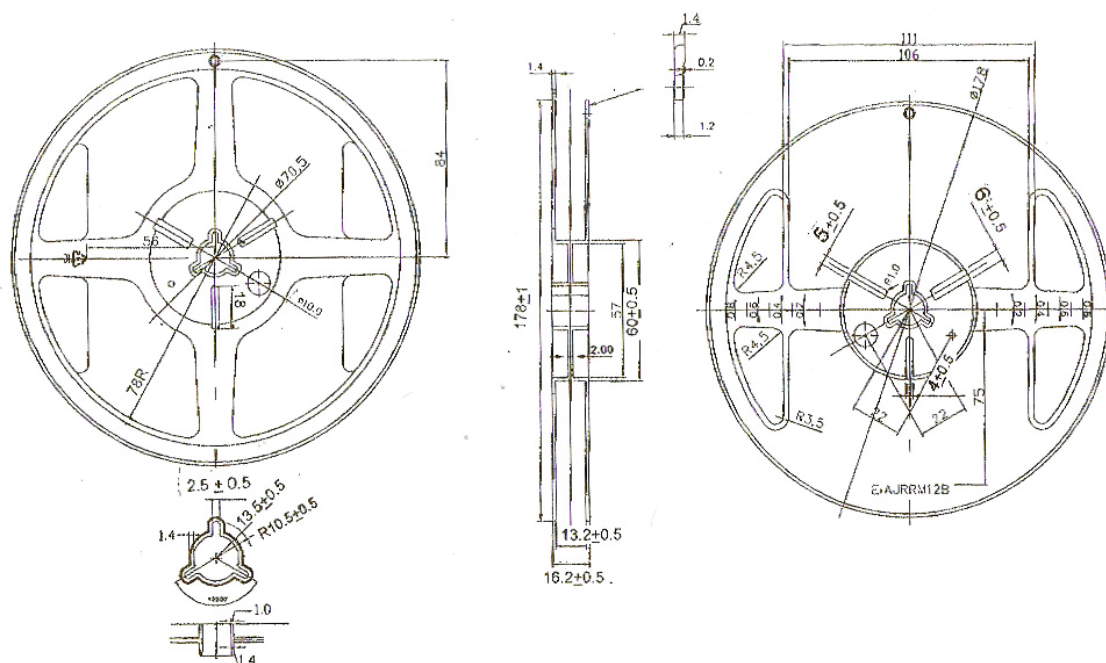
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