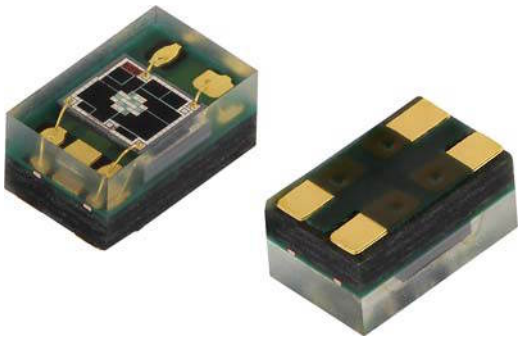
UVA and UVB Light Sensor with I²C Interface



FEATURES

- Package type: surface mount
- Dimensions (L x W x H in mm): 2.0 x 1.25 x 1.0
- Integrated modules: ultraviolet sensor (UV), and signal conditioning IC
- Converts solar UV light intensity to digital data
- Excellent UVA and UVB sensitivity
- Reliable performance of UV radiation measurement under long time solar UV exposure
- 16-bit resolution per channel
- UVA and UVB individual channel solution
- Low power consumption I²C protocol (SMBus compatible) interface
- Package: OPLGA
- Temperature compensation: -40 °C to +85 °C
- Output type: I²C bus
- Operation voltage: 1.7 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)

DESCRIPTION

The VEML6075 senses UVA and UVB light and incorporates photodiode, amplifiers, and analog / digital circuits into a single chip using a CMOS process. When the UV sensor is applied, it is able to detect UVA and UVB intensity to provide a measure of the signal strength as well as allowing for UVI measurement.

The VEML6075 provides excellent temperature compensation capability for keeping the output stable under changing temperature. VEML6075's functionality is easily operated via the simple command format of I²C (SMBus compatible) interface protocol. VEML6075's operating voltage ranges from 1.7 V to 3.6 V. VEML6075 is packaged in a lead (Pb)-free 4 pin OPLGA package which offers the best market-proven reliability.

APPLICATIONS

- Handheld device
- Notebook
- Consumer device
- Industrial and medical application

PRODUCT SUMMARY

PART NUMBER	OPERATING VOLTAGE RANGE (V)	I²C BUS VOLTAGE RANGE (V)	PEAK SENSITIVITY UVA, UVB (nm)	RANGE OF SPECTRAL BANDWIDTH UVB $\lambda_{0.5}$ (nm)	OUTPUT CODE
VEML6075	1.7 to 3.6	1.7 to 3.6	365, 330	± 10	16 bit, I²C

Note

(1) Adjustable through I²C interface

ORDERING INFORMATION

ORDERING CODE	PACKAGING	VOLUME (1)	REMARKS
VEML6075	Tape and reel	MOQ: 2500 pcs	2.0 mm x 1.25 mm x 1.0 mm

Note

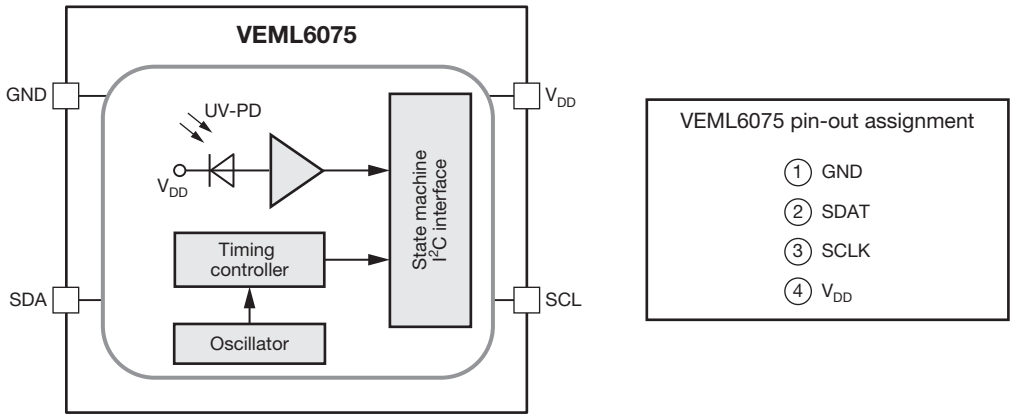
(1) MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS (T_{amb} = 25 °C, unless otherwise specified)					
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**MAX.**	**UNIT**
Supply voltage		V_{DD}	0	3.6	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}	1.7	3.6	V
Operation temperature range		T_{amb}	-40	+85	°C
I^2C bus operating frequency		$f_{(I2CCLK)}$	10	400	kHz

PIN DESCRIPTIONS			
PIN ASSIGNMENT	**SYMBOL**	**TYPE**	**FUNCTION**
1	GND	I	Ground
2	SDAT	I / O (open drain)	I^2C data bus data input / output
3	SCLK	I	I^2C digital bus clock input
4	V_{DD}	I	Power supply input

BLOCK DIAGRAM



BASIC CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)							
PARAMETER		**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Supply operation voltage			V_{DD}	1.7	-	3.6	V
Supply current		V_{DD} = 1.8 V	I_{DD}	-	480	-	µA
I^2C signal input	Logic high	V_{DD} = 3.3 V	V_{IH}	1.5	-	-	V
	Logic low		V_{IL}	-	-	0.8	
I^2C signal input	Logic high	V_{DD} = 2.6 V	V_{IH}	1.4	-	-	V
	Logic low		V_{IL}	-	-	0.6	
Operating temperature			T_{amb}	-40	-	+85	°C
Shutdown current		Light condition = dark; V_{DD} = 1.8 V, T_{amb} = 25 °C	I_{DD} (SD)	-	800	-	nA
UVA sensitivity		I_T = 50 ms (1)		-	0.93	-	counts/µW/cm²
UVB sensitivity		I_T = 50 ms (2)		-	2.1	-	counts/µW/cm²

Notes

(1) Nichia NCSU033X (365 nm)

(2) UVTOP310TO39HS (315 nm)

I²C TIMING CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)						
PARAMETER	SYMBOL	STANDARD MODE		FAST MODE		UNIT
		MIN.	MAX.	MIN.	MAX.	
Clock frequency	$f_{(SMBCLK)}$	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

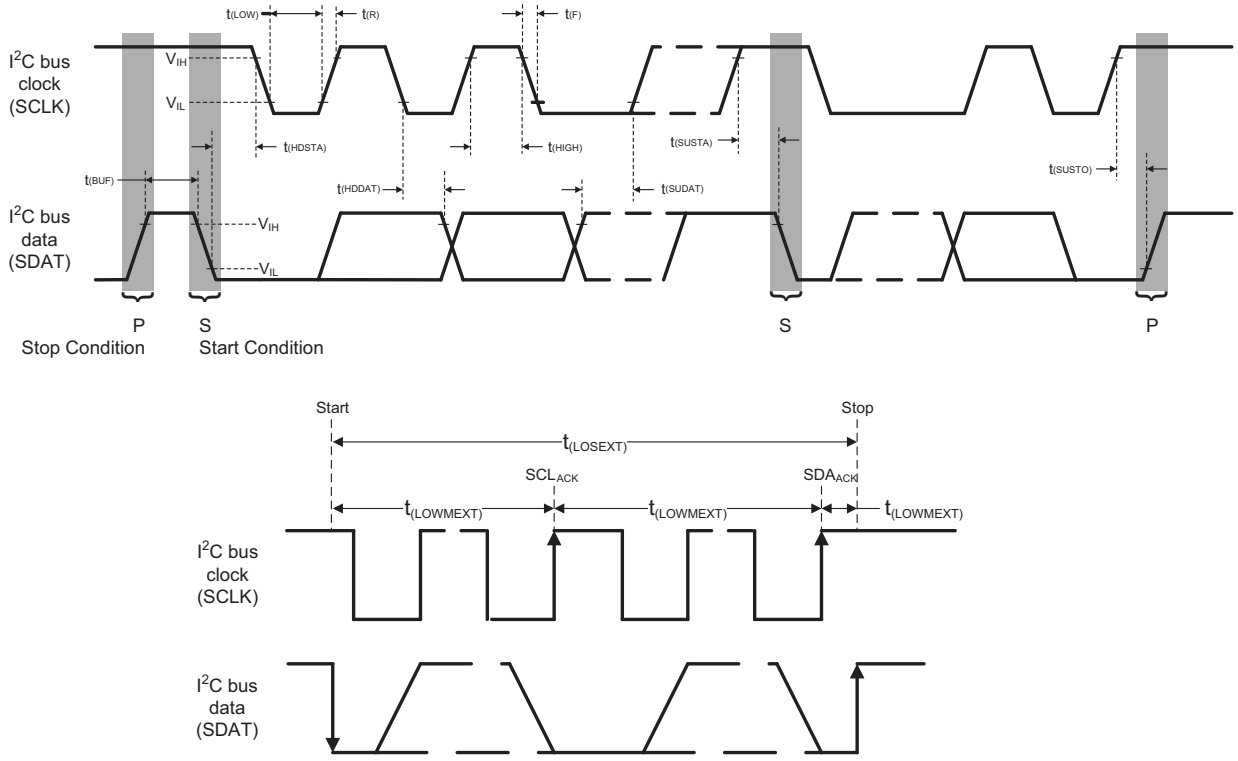


Fig. 1 - I²C Bus Timing Diagram

PARAMETER TIMING INFORMATION

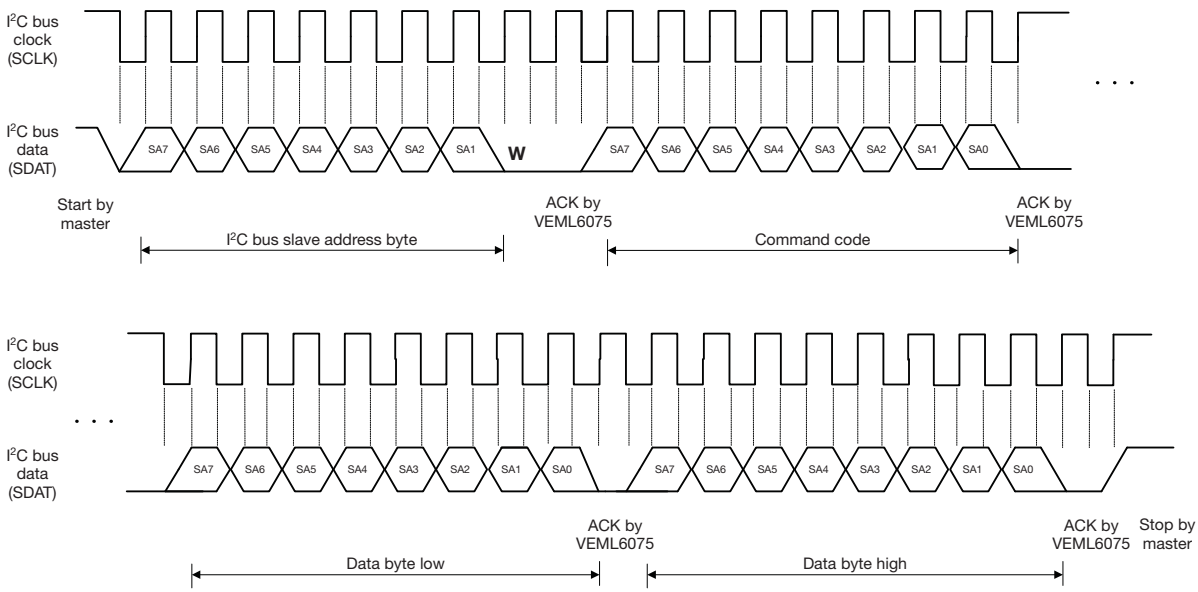


Fig. 2 - I²C Bus Timing for Sending Word Command Format

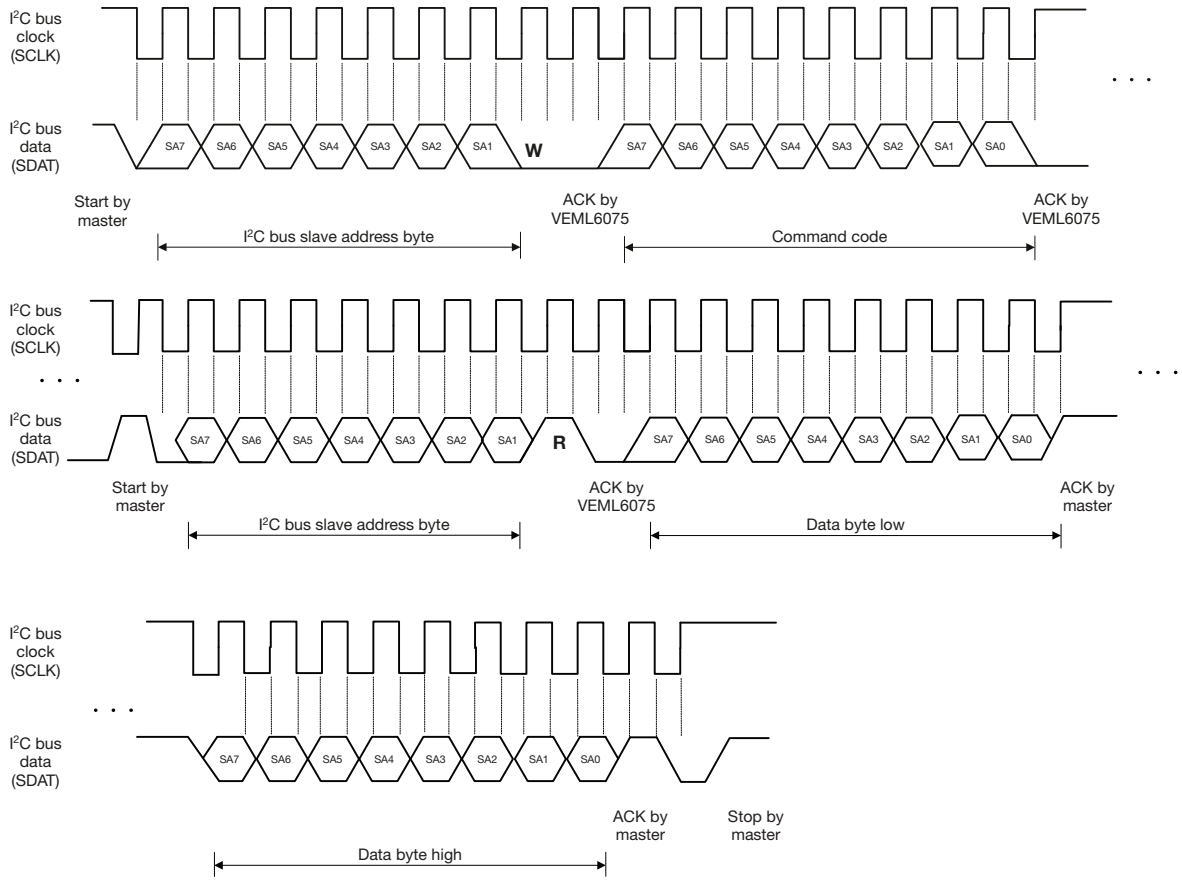


Fig. 3 - I²C Timing for Receive Word Command Format

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

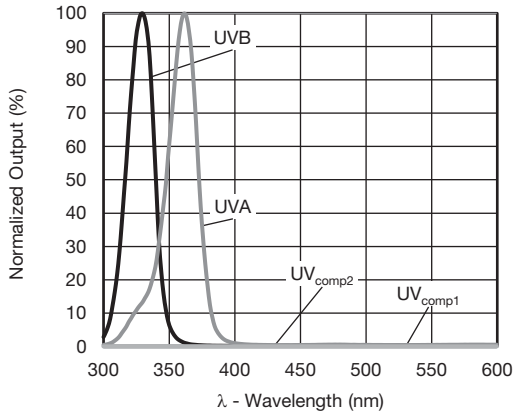


Fig. 4 - Normalized Spectral Response

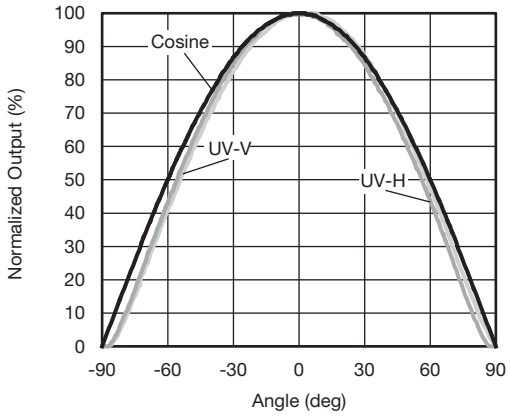


Fig. 5 - Normalized Output vs. View Angle

APPLICATION INFORMATION

Pin Connection with the Host

The configuration and data registers of the VEML6075 are accessed via the I^2C interface. The hardware schematic is shown below in fig. 6.

The 0.1 µF capacitor near the V_{DD} pin is used for power supply noise rejection. The 2.2 kΩ is suitable for the pull high resistor of I^2C.

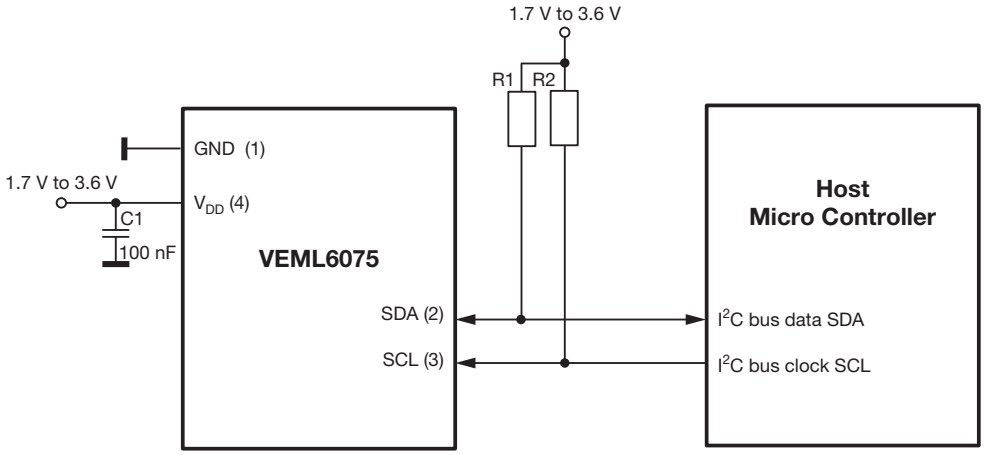


Fig. 6 - Hardware Pin Connection Diagram

Digital Interface

The VEML6075 contains a CONF register (00h) used for operation control and parameter setup. Measurement results are stored in four separate registers, one each for UVA, UVD, UVB, UV_{comp1}, and UV_{comp2} (07h to 0Bh respectively). All registers are accessible via I^2C communication. Fig. 7 shows the basic I^2C communication with the VEML6075. Each of the registers in the VEML6075 are 16 bit wide, so 16 bit should be written when a write command is sent, and 16 bit should be read when a read command is sent.

The built in I^2C interface is compatible with I^2C modes “standard” and “fast”: 100 kHz to 400 kHz

Fig. 7 - Command Protocol Format

Note

- Please note the repeat start condition when data is read from the sensor. A stop condition should not be sent here.

Slave Address and Function Description

VEML6075 uses 0x10 slave address for 7-bit I^2C addressing protocol. VEML6075 has 16-bit resolution for each channel (UVA, UVB, UV_{comp1}, UV_{comp2}, and UVD).

TABLE 1 - VEML6070 SLAVE ADDRESS AND FUNCTION DESCRIPTION

COMMAND CODE	DATE BYTE LOW / HIGH	REGISTER NAME	R / W	DEFAULT VALUE	FUNCTION DESCRIPTION
00h	L	UV_CONF	R / W	0x00	UV integration time, function enable and disable
	H	Reserved	R / W	0x00	Reserved
01h	L	Reserved	R / W	0x00	Reserved
	H	Reserved	R / W	0x00	Reserved
02h	L	Reserved	R / W	0x00	Reserved
	H	Reserved	R / W	0x00	Reserved
03h	L	Reserved	R / W	0x00	Reserved
	H	Reserved	R / W	0x00	Reserved
04h	L	Reserved	R / W	0x00	Reserved
	H	Reserved	R / W	0x00	Reserved
05h	L	Reserved	R / W	0x00	Reserved
	H	Reserved	R / W	0x00	Reserved
06h	L	Reserved	R / W	0x00	Reserved
	H	Reserved	R / W	0x00	Reserved
07h	L	UVA_Data	R	0x00	UVA LSB output data
	H	UVA_Data	R	0x00	UVA MSB output data
08h	L	Dummy	R	0x00	UVD
	H	Dummy	R	0x00	UVD
09h	L	UVB_Data	R	0x00	UVB LSB output data
	H	UVB_Data	R	0x00	UVB MSB output data
0Ah	L	UVCOMP1_Data	R	0x00	UV_{comp1} LSB output data
	H	UVCOMP1_Data	R	0x00	UV_{comp1} MSB output data
0Bh	L	UVCOMP2_Data	R	0x00	UV_{comp2} LSB output data
	H	UVCOMP2_Data	R	0x00	UV_{comp2} MSB output data
0Ch	L	ID	R	0x26	Device ID LSB
	H	ID	R	0x00	Device ID MSB

Command Register Format

The VEML6075 has 16-bit registers used to set up the measurements as well as pick up the measurement results. The description of each command format is shown in the following tables.

TABLE 2 - REGISTER UV_CONF DESCRIPTION

REGISTER NAME		COMMAND CODE: 0x00_L (0x00 DATA BYTE LOW) OR 0x00_H (0x00 DATA BYTE HIGH)							
COMMAND	BIT	7	6	5	4	3	2	1	0
REGISTER: UV_CONF		**COMMAND CODE: 0x00_L (0x00 DATA BYTE LOW)**							
COMMAND	BIT	Description							
Reserved	7	0							
UV_IT	6 : 4	(0 : 0 : 0) = 50 ms, (0 : 0 : 1) = 100 ms, (0 : 1 : 0) = 200 ms, (0 : 1 : 1) = 400 ms, (1 : 0 : 0) = 800 ms, (1 : 0 : 1) = reserved, (1 : 1 : 0) = reserved, (1 : 1 : 1) = reserved.							
HD	3	0 = normal dynamic setting, 1 = high dynamic setting							
UV_TRIG	1	0 = no active force mode trigger, 1 = trigger one measurement With UV_AF = 1 the VEML6075 conducts one measurement every time the host writes UV_Trig = 1. This bit returns to “0” automatically.							
UV_AF	0	0 = active force mode disable (normal mode), 1 = active force mode enable							
SD	0	0 = power on, 1 = shut down							

TABLE 3 - REGISTER 00_H DESCRIPTION

REGISTER: reserved		COMMAND CODE: 0x00_H (0x00 DATA BYTE HIGH)
COMMAND	BIT	Description
Reserved	7 : 0	Default = (0 : 0 : 0 : 0 : 0 : 0 : 0 : 0)

TABLE 4 - REGISTER 01_L TO 06_L AND 01_H TO 06_L DESCRIPTION

REGISTER: reserved		COMMAND CODE: 0x01_L TO 0x06_L (0x01 TO 0x06 DATA BYTE LOW) COMMAND CODE: 0x01_H TO 0x06_H (0x01 TO 0x06 DATA BYTE HIGH)
REGISTER	BIT	Description
Reserved	7 : 0	Default = (0 : 0 : 0 : 0 : 0 : 0 : 0 : 0)
Reserved	7 : 0	Default = (0 : 0 : 0 : 0 : 0 : 0 : 0 : 0)

TABLE 5 - READ OUT COMMAND CODES DESCRIPTION

REGISTER	COMMAND CODE	BIT	DESCRIPTION
UVA_DATA	0x07_L (0x07 data byte low)	07:00	0x00 to 0xFF, UVA LSB output data
	0x07_H (0x07 data byte high)	07:00	0x00 to 0xFF, UVA MSB output data
DUMMY	0x08_L (0x08 data byte low)	07:00	0x00 to 0xFF, UVD
	0x08_H (0x08 data byte high)	07:00	0x00 to 0xFF, UVD
UVB_DATA	0x09_L (0x09 data byte low)	07:00	0x00 to 0xFF, UVB LSB output data
	0x09_H (0x09 data byte high)	07:00	0x00 to 0xFF, UVB MSB output data
UVCOMP1_DATA	0x0A_L (0x0A data byte low)	07:00	0x00 to 0xFF, UV_{comp1} LSB output data
	0x0A_H (0x0A data byte high)	07:00	0x00 to 0xFF, UV_{comp1} MSB output data
UVCOMP2_DATA	0x0B_L (0x0B data byte low)	07:00	0x00 to 0xFF, UV_{comp2} LSB output data
	0x0B_H (0x0B data byte high)	07:00	0x00 to 0xFF, UV_{comp2} MSB output data
ID	0x0C_L (0x0C data byte low)	07:00	Default = 0x26, device ID LSB byte
	0x0C_H (0x0C data byte high)	07:06 05:04 03:00	Company code = 00, (0 : 0) Slave address = 0x20 Version code (0 : 0 : 0 : 0) = VEML6075 CS Device ID MSB byte

Data Access

VEML6075 has 16-bit high resolution sensitivity for each UV channel. 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 6 - 16-BIT DATA FORMAT

	VEML6075 16-BIT DATA FORMAT															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Data byte low									◄							►
Data byte high	◄							►								

Note

Receive byte Read data from VEML6075

S	Slave address	Wr	A	Command code	A	S	Slave address	Rd	A	Data byte (LSB)	A	Data byte (MSB)	N	P

S = start condition
P = stop condition
A = acknowledge
N = no acknowledge

Host action
VEML6075 response

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

Data Auto-Memorization

VEML6075 keeps the last results read. These values will remain in the registers, and can be read from these registers, until the device wakes up and a new measurement is made.

UV-Index Calculation

In order to use the result data to calculate the UV-Index, please refer to the “Designing the VEML6075 into an Application” application note (www.vishay.com/doc?84339).

PACKAGE INFORMATION in millimeters

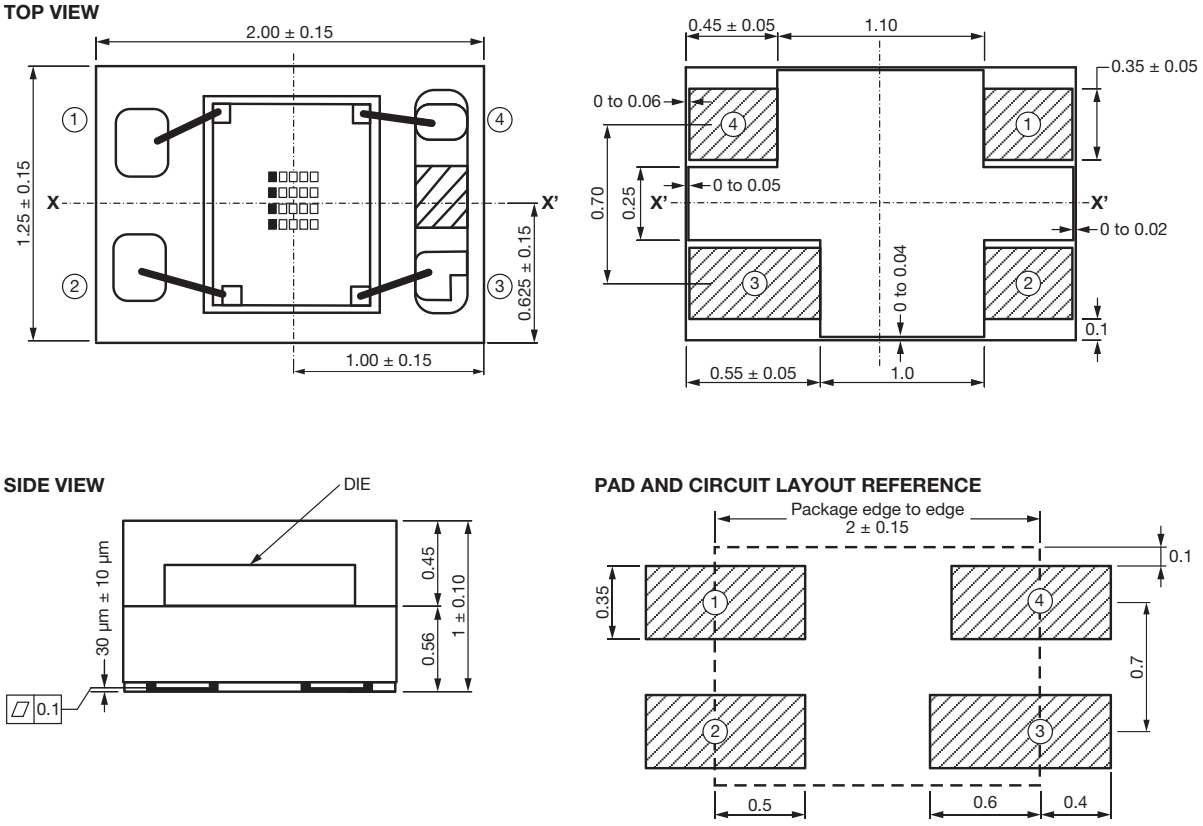


Fig. 8 - VEML6075 A3OP Package Dimensions

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	h

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

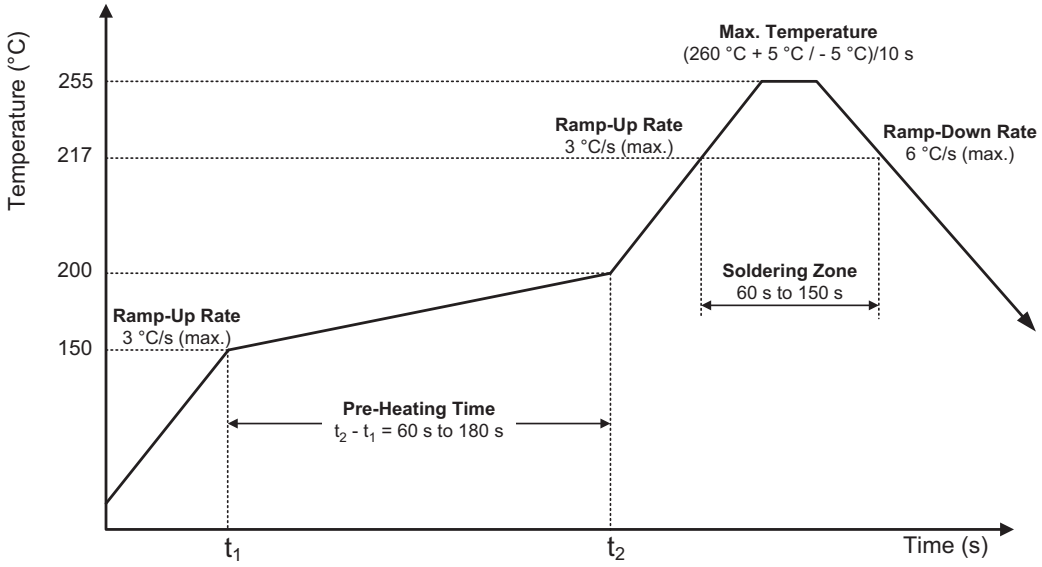


Fig. 9 - VEML6075 OPLGA Solder Reflow Profile Chart

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

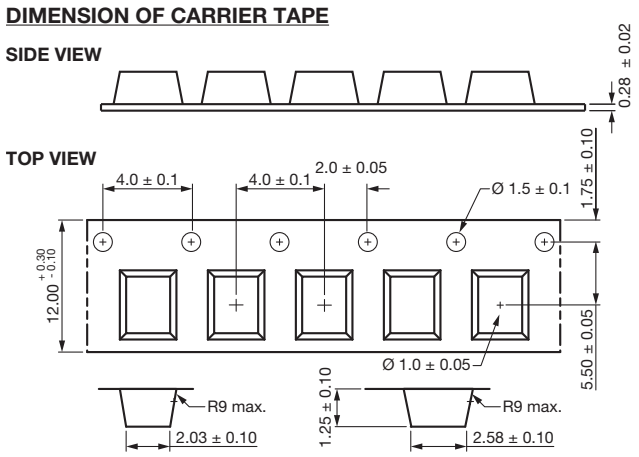


Fig. 10 - VEML6070 A3OP Package Carrier Tape

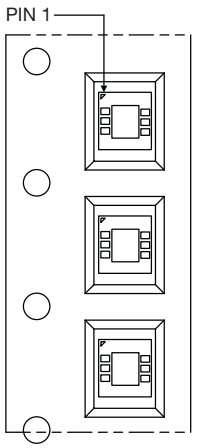


Fig. 11 - Taping Direction

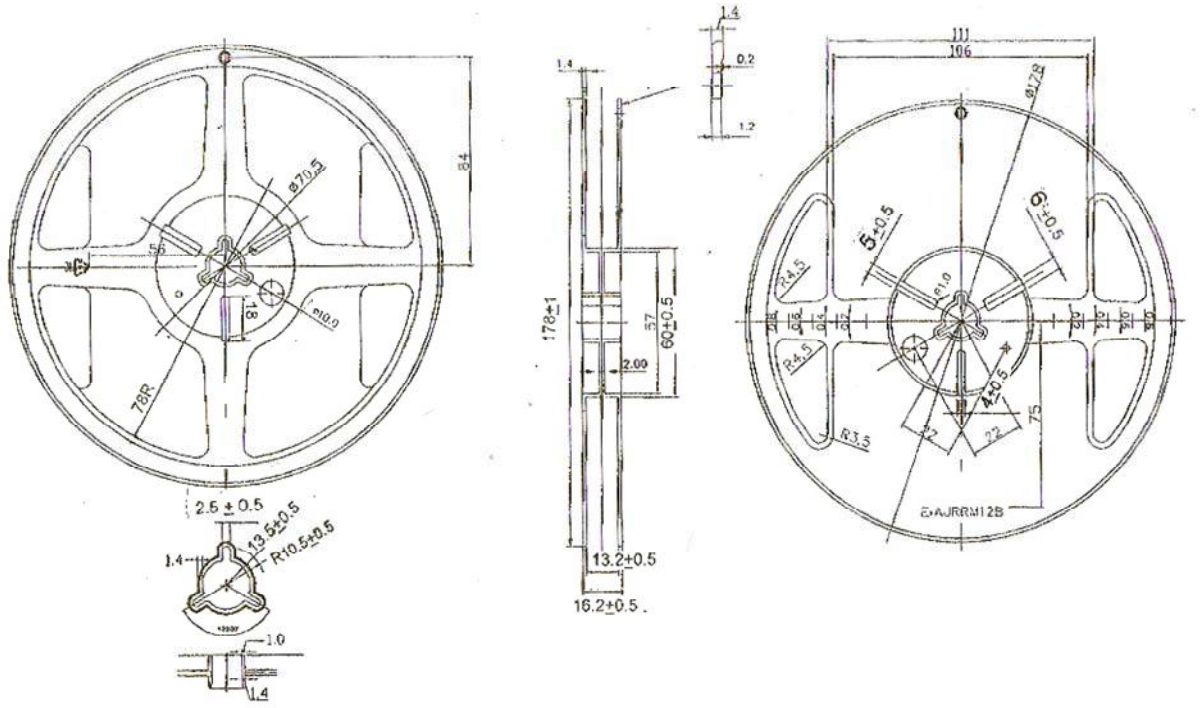


Fig. 12 - Reel Dimension

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