VEML7700 Ambient Light Sensor Module

5-pin I2C lux sensor breakout · 16-bit ambient light sensor IC · Onboard 3.3 V regulator and I2C level shifting · Fixed address 0x10

VIN 3 V TO 5 V | 0 TO ABOUT 140 000 LX | 0.0042 LX/COUNT | I2C 0x10 | 16-BIT | HEADER INCLUDED

1 DEVICE IDENTIFICATION

ITEM	VALUE
Order code	**MOD-VEML7700**
Contents	**1 x module, 1 x 5-pin straight 2.54 mm male header, not soldered**
Board markings	**VEML 7700 on the front; I2C Lux Sensor and Vin/logic: 3-5V on the back**
Sensor IC	**VEML7700 ambient light sensor: photodiode, amplifier and 16-bit ADC, clear 6.8 x 2.35 x 3.0 mm package**
Other fitted parts	**3.3 V regulator, MOSFET I2C level shifter, 10 kΩ pull-up array (marked 103)**
Interface	**I2C only, fixed 7-bit address 0x10. No interrupt pin**

2 PIN FUNCTIONS

PIN	NAME	FUNCTION
1	**VIN**	Supply, 3 V to 5 V. Use the same voltage as the host's I/O.
2	**3Vo**	3.3 V output from the onboard regulator. Light loads only; leave unconnected if unused.
3	**GND**	Ground, common with the host.
4	**SCL**	I2C clock. Level shifted, 10 kΩ pull-up fitted.
5	**SDA**	I2C data. Level shifted, 10 kΩ pull-up fitted.

Names as printed on the front. One row of 5 holes at 2.54 mm pitch, numbered left to right with the VEML 7700 text upright (Figure 3).

3 SPECIFICATIONS

3.1 RECOMMENDED OPERATING CONDITIONS (BOARD)

PARAMETER	CONDITIONS	MIN	MAX	UNIT
Supply, VIN	VIN to GND	**3.0**	**5.0**	V
Host I2C logic level	Same voltage as VIN	**3.0**	**5.0**	V
I2C clock	Standard or fast mode	**10**	**400**	kHz
Operating temperature	Sensor IC rating	**-25**	**+85**	°C

The regulator and level shifter let the board run from 5 V Arduino boards and 3.3 V boards such as the ESP32 and Raspberry Pi. The sensor IC itself runs at 3.3 V.

3.2 SENSOR IC ABSOLUTE MAXIMUM RATINGS

PARAMETER	CONDITIONS	MIN	MAX	UNIT
IC supply VDD (after the regulator)		**0**	**4**	V
Operating temperature		**-25**	**+85**	°C
Storage temperature		**-25**	**+85**	°C
Total power dissipation	25 °C		**50**	mW
Junction temperature			**100**	°C

Stress limits of the sensor IC only, not ratings for the VIN pin. Operation at these limits is not implied.

3.3 SENSOR IC ELECTRICAL CHARACTERISTICS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
IC supply VDD	Set by the regulator	**2.5**	**3.3**	**3.6**	V
Shutdown current	VDD 3.3 V, dark		**0.5**		µA
Operating current	Power saving off, 100 ms refresh		**45**		µA
Operating current	PSM mode 1, 600 ms refresh		**8**		µA
Operating current	PSM mode 4, 4100 ms refresh		**2**		µA
I2C input high, IC side	VDD 3.3 V	**1.3**		**3.6**	V
I2C input low, IC side	VDD 3.3 V	**-0.3**		**0.4**	V
SDA sink current	Output low	**3**			mA

Sensor IC current only, at 25 °C with a white LED source. The regulator, level shifter and pull-ups draw current in addition. The host sees the level-shifted bus, not the IC-side thresholds.

3.4 SENSOR IC OPTICAL CHARACTERISTICS (25 °C)

PARAMETER	CONDITIONS	TYP	UNIT
Measurement range	All settings combined	**0 to about 140 000**	lx
Finest resolution	Gain x2, 800 ms	**0.0042**	lx/count
Maximum illuminance	Gain x1/8, 25 ms	**140 926**	lx
Lowest detectable level	Gain x2, 800 ms, 2 counts	**0.008**	lx
Dark offset	Gain x2, 800 ms	**3**	counts
ADC output	ALS and WHITE channels	**16**	bit
Gain settings	ALS_GAIN	**x1/8, x1/4, x1, x2**	
Integration time	ALS_IT	**25, 50, 100, 200, 400, 800**	ms
Integration time tolerance	Allow for in read timing	**±30**	%
Linear range, no correction	Gain x1/4 or x1/8	**up to about 1000**	lx
Deviation between light sources	ALS channel vs. reference meter	**within ±10**	%
Angle of half sensitivity	From the sensor axis	**about ±55**	°
Flicker rejection	Mains lighting	**100 and 120**	Hz
Wake-up time	After clearing shutdown	**2.5**	ms

The ALS channel follows the human eye response curve, so readings agree closely under LED, fluorescent, halogen light and daylight. The WHITE channel responds over a wider spectrum and reads up to about twice the ALS value.

Gain x1 and x2 become non-linear above about 100 lx. Above 1000 lx apply the correction in 6.2.

4 I2C INTERFACE

4.1 INTERFACE SUMMARY

PARAMETER	VALUE
Address	**0x10, fixed (7-bit). Write byte 0x20, read byte 0x21**
Devices per bus	**One. Use an I2C multiplexer for more**
Bus speed	**10 kHz to 400 kHz, standard and fast mode**
Pull-ups	**10 kΩ fitted on SCL and SDA**
Register width	**16 bits, sent and read LSB first, then MSB**
Write	**START, 0x20, command code, data LSB, data MSB, STOP**
Read	**START, 0x20, command code, repeated START, 0x21, LSB, MSB, NACK, STOP**
ID register 0x07	**Reads 0xC481 (low byte 0x81 is the device ID)**
Power-up state	**Shut down. Clear ALS_SD (bit 0 of 0x00) to start measuring**
Low timeout	**Clock or data held low is detected after 25 ms to 35 ms**

4.2 I2C TIMING (SENSOR IC)

PARAMETER	SYMBOL	STD MIN	STD MAX	FAST MIN	FAST MAX	UNIT
Clock frequency	f_{SCL}	**10**	**100**	**10**	**400**	kHz
Bus free, STOP to START	t_{BUF}	**4.7**		**1.3**		µs
Hold time, (repeated) START	$t_{HD;STA}$	**4.0**		**0.6**		µs
Set-up, repeated START	$t_{SU;STA}$	**4.7**		**0.6**		µs
Set-up, STOP	$t_{SU;STO}$	**4.0**		**0.6**		µs
Data hold time	$t_{HD;DAT}$	**0**	**3450**	**0**	**900**	ns
Data set-up time	$t_{SU;DAT}$	**250**		**100**		ns
SCL low period	t_{LOW}	**4.7**		**1.3**		µs
SCL high period	t_{HIGH}	**4.0**		**0.6**		µs
Low timeout	$t_{TIMEOUT}$	**25**	**35**			ms
Fall time, SCL and SDA	t_F		**300**		**300**	ns
Rise time, SCL and SDA	t_R		**1000**		**300**	ns

Standard I2C protocol figures for the sensor IC. Keep host wiring short at 400 kHz; the 10 kΩ pull-ups suit short runs.

5 REGISTER SUMMARY

5.1 REGISTER MAP

CODE	NAME	CONTENT	ACCESS
0x00	**ALS_CONF_0**	Gain, integration time, persistence, interrupt enable, shutdown	R/W
0x01	**ALS_WH**	High threshold, 16 bits	R/W
0x02	**ALS_WL**	Low threshold, 16 bits	R/W
0x03	**PSM**	[2:1] power saving mode, [0] PSM_EN. Bits 15:3 set to 0	R/W
0x04	**ALS**	ALS result, 16 bits	R
0x05	**WHITE**	WHITE channel result, 16 bits	R
0x06	**ALS_INT**	[15] low threshold crossed, [14] high threshold crossed	R
0x07	**ID**	0xC481	R

This board has no interrupt pin. Threshold crossings can still be read from 0x06 when ALS_INT_EN is set. The last result stays readable while the IC is shut down.

5.2 ALS_CONF_0 FIELDS (0X00)

BITS	SETTING
[15:13]	Reserved, set 000
[12:11] ALS_GAIN	00 x1, 01 x2, 10 x1/8, 11 x1/4
[10]	Reserved, set 0
[9:6] ALS_IT	1100 25 ms, 1000 50 ms, 0000 100 ms, 0001 200 ms, 0010 400 ms, 0011 800 ms
[5:4] ALS_PERS	00 1, 01 2, 10 4, 11 8 readings
[3:2]	Reserved, set 00
[1] ALS_INT_EN	0 off, 1 on
[0] ALS_SD	0 on, 1 shut down (default)

Example: `0x1000` gives gain x1/8, 100 ms, sensor on.

6 RESOLUTION AND LUX CALCULATION

6.1 RESOLUTION AND MAXIMUM ILLUMINANCE

IT (MS)	X2	X1	X1/4	X1/8	MAX LX, X1/4	MAX LX, X1/8
800	**0.0042**	**0.0084**	**0.0336**	**0.0672**	**2202**	**4404**
400	**0.0084**	**0.0168**	**0.0672**	**0.1344**	**4404**	**8808**
200	**0.0168**	**0.0336**	**0.1344**	**0.2688**	**8808**	**17 616**
100	**0.0336**	**0.0672**	**0.2688**	**0.5376**	**17 616**	**35 232**
50	**0.0672**	**0.1344**	**0.5376**	**1.0752**	**35 232**	**70 463**
25	**0.1344**	**0.2688**	**1.0752**	**2.1504**	**70 463**	**140 926**

Gain columns give resolution in lx per count. Maximum illuminance is the full 16-bit count (65 535) times the resolution; at gain x2 and x1 it is 275 lx to 17 616 lx, but use those gains below about 100 lx only.

6.2 LUX CALCULATION

1. Read the 16-bit ALS result from 0x04.
2. lux = ALS counts x resolution for the gain and IT in use (6.1).
3. Above 1000 lx at gain x1/4 or x1/8, correct the result with the polynomial below.

$$L_c = a \cdot L^4 + b \cdot L^3 + c \cdot L^2 + d \cdot L$$

`a = 6.0135e-13  b = -9.3924e-9`
`c = 8.1488e-5  d = 1.0023`

L is the uncorrected lux value and L_c the corrected value. Example: 5581 counts at gain x1/4, 100 ms gives 5581 x 0.2688 = 1500 lx, corrected to 1658 lx. The correction gives good linear results up to about 100 000 lx.

7 RECOMMENDED SETTINGS

7.1 SETTINGS BY LIGHT LEVEL

SITUATION	GAIN	IT	WHY
Unknown or changing light	x1/8	100 ms	Start here. If the result is 100 counts or fewer, step up to x1/4, x1, x2, then longer IT.
Rooms, about 100 to 1000 lx	x1/4	100 ms	0.2688 lx per count, linear without correction.
Dim light, below 100 lx	x1 or x2	100 to 800 ms	Finest resolution. Do not use above about 100 lx.
Outdoors and direct sun	x1/8	25 ms	Reads up to 140 926 lx. Apply the correction in 6.2.
Behind a dark tinted cover	x2	100 ms or longer	Only a small share of the light reaches the sensor.

Wait at least the integration time between reads when power saving is off.

Outdoors: mount the board behind a clear, weatherproof cover. Full sun can saturate the higher gains, so use x1/8 and 25 ms.

7.2 POWER SAVING MODES (GAIN X2)

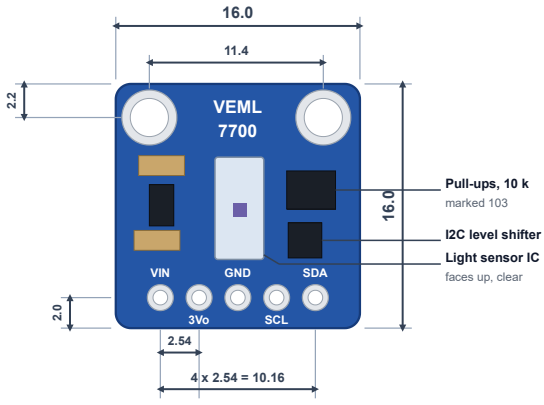
IT	MODE 1	MODE 2	MODE 3	MODE 4
100 ms	**600 / 8**	**1100 / 5**	**2100 / 3**	**4100 / 2**
200 ms	**700 / 13**	**1200 / 8**	**2200 / 5**	**4200 / 3**
400 ms	**900 / 20**	**1400 / 13**	**2400 / 8**	**4400 / 5**
800 ms	**1300 / 28**	**1800 / 20**	**2800 / 13**	**4800 / 8**

Each cell is refresh time in ms / typical sensor IC current in µA at VDD 3.3 V. Enable with PSM_EN = 1 in 0x03; bits [2:1] select the mode.

8 MECHANICAL DATA



Figure 1. Front, VEML 7700 text upright. **Figure 2.** Back. The pin order is reversed when viewed from the back: SDA is on the left.



Front view, VEML 7700 text upright. 3.3 V regulator at left.

Figure 3. Front view, simplified, not to scale. Dimensions in mm, approximate (±0.5 mm), measured from stock using the 2.54 mm pin pitch.

Board size	**about 16.0 x 16.0 mm**	Pins	**5 holes, one row along the bottom edge**
Pin pitch	**2.54 mm, 10.16 mm across all 5**	Header	**5-pin straight male, 2.54 mm, supplied loose**
Mounting holes	**2, about 2.5 mm, suit M2 screws**	Hole spacing	**about 11.4 mm between centres**
Sensor position	**near the board centre, facing up**	Sensor IC package	**6.8 x 2.35 x 3.0 mm, clear**

9 APPLICATION AND IMPLEMENTATION

9.1 HOST CONNECTIONS

MODULE	UNO / NANO	MEGA 2560	ESP32	RASPBERRY PI
VIN	5V	5V	3V3	3V3 (pin 1)
3Vo	Leave unconnected			
GND	GND	GND	GND	GND (pin 6)
SCL	A5	21 (SCL)	GPIO22	GPIO3 (pin 5)
SDA	A4	20 (SDA)	GPIO21	GPIO2 (pin 3)

ESP32 pins are the ESP32 Dev Module defaults for `Wire.begin()`. On a Raspberry Pi, enable I2C; `i2cdetect -y 1` should show 10.

Use 3Vo only for a small 3.3 V load such as another sensor, never to power a microcontroller board.

9.2 REGISTER-LEVEL START-UP

1. Write `0x1001` to 0x00 (gain x1/8, 100 ms, still shut down), sent as LSB `0x01` then MSB `0x10`.
2. Write `0x0000` to 0x03 to leave power saving off.
3. Write `0x1000` to 0x00 to start measuring, then wait 2.5 ms.
4. Wait at least 100 ms, read 0x04 and multiply by 0.5376 for lux.
5. Step the gain or IT as in 7.1 and apply the correction in 6.2 above 1000 lx.

9.3 SOFTWARE SUPPORT

PLATFORM	PACKAGE AND USE
Arduino IDE	Adafruit VEML7700 Library (2.1.6, October 2026). Choose Install all for its dependencies. `begin()` sets gain x1/8 and 100 ms. `readLux(VEML_LUX_AUTO)` adjusts gain and IT and applies the correction.
Python, CircuitPython	`pip install adafruit-circuitpython-veml7700` (2.2.2)
ESPHome	`platform: veml7700`. Auto gain and the lux correction are on by default; set `glass_attenuation_factor` when the sensor sits behind a cover.

9.4 PLACEMENT AND COVERS

- Point the sensor at the area to be measured. Keep it clear of status LEDs and displays on the same build.
- A cover must pass visible light (400 nm to 700 nm). Centre its window over the sensor and keep the sensor close to it; the field of view is about ±55°.
- Under a tinted cover, divide by the cover's light transmission, or calibrate against a light meter.
- Outdoors, use a clear weatherproof enclosure and keep water and condensation off the window.

10 REVISION HISTORY

REV	DATE	CHANGE
1	2026-10-14	Initial release.