

Ambient Light and Proximity Sensor with Integrated 850nm IR Emitter Version 1.2

SFH 7776



Features:

- Proximity sensor (PS)
 - Detection range up to 160 mm
 - 850 nm IR emitter integrated in package
 - Programmable pulse current up to 200 mA
 - No separator needed if placed <0.4mm behind glass window, window thickness<1.0 mm
- Ambient light sensor (ALS)
 - detection range 0.0022 - 73000 lx;
 - 50Hz/60Hz flicker noise suppression
- I²C interface (max. 400kHz)
- PS and ALS Interrupt function
- Current consumption
 - typ. 0.8µA in Standby mode
 - typ 90µA for ALS operation
 - typ 60µA for PS operation
- Miniature package 4mm x 2.1mm x 1.35mm

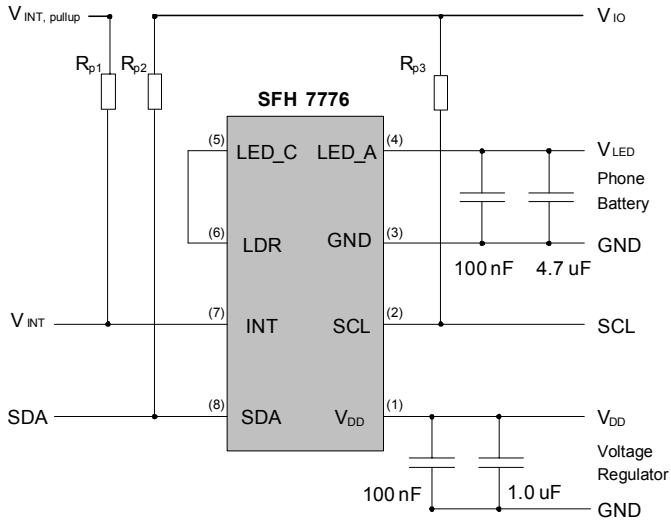
Applications

- Mobile phones
- PDAs- and notebooks
- Cameras
- Consumer products

Ordering Information

| Type: | Ordering Code |
|----------|---------------|
| SFH 7776 | Q65111A4188 |

Application diagram



- Bypass capacitors for VDD and VLED are required for proper operation of the device.
- Proposed size for the pull-up resistors Rp1, Rp2 and Rp3 are 10kOhm

Pin description

| Pin | Name | Function |
|-----|-----------------|-----------------------------------------------------------------------|
| 1 | V _{DD} | Power supply pin |
| 2 | SCL | I ² C bus serial clock pin |
| 3 | GND | Ground pin |
| 4 | LED_A | Anode of the LED |
| 5 | LED_C | Cathode of the LED |
| 6 | LDR | LED driver pin |
| 7 | INT | Interrupt pin; open drain output; configured via I ² C bus |
| 8 | SDA | I ² C bus serial data pin |

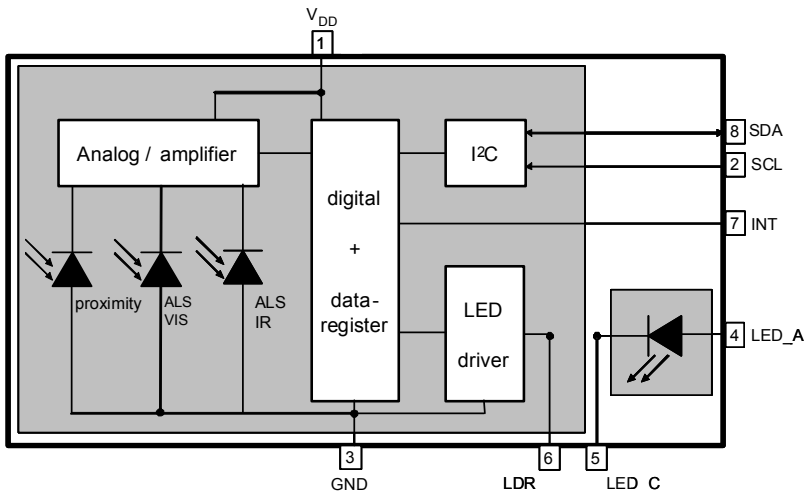
Short Evaluation program

| Address | Command | Action |
|------------|-----------|---------------------------------------------------------------|
| 0x42 | 0x3F | set LED pulse current to 200mA and ALS gain to x128 |
| 0x41 | 0x06 | activate ALS & PS with a measurement repetition time of 100ms |
| Wait 100ms | | |
| 0x44 | read data | read LSB of proximity measurement data |
| 0x45 | read data | read MSB of proximity measurement data |
| 0x46 | read data | read LSB of ambient light measurement of VIS diode |
| 0x47 | read data | read MSB of ambient light measurement of VIS diode |
| 0x48 | read data | read LSB of ambient light measurement of IR diode |
| 0x49 | read data | read MSB of ambient light measurement of IR diode |

I²C interface

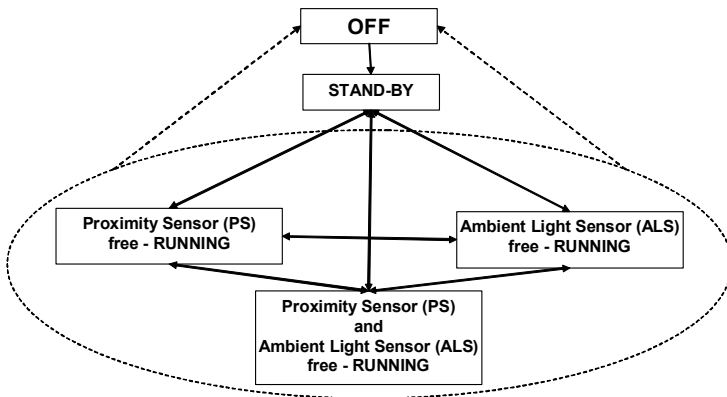
- I/O-pins are open drain type and logic high level is set with external pull-up resistor
- SFH 7776 operates in slave mode. Slave address is 0111001 (0x39h)
- Designed for the I²C Fast mode (400 kb/s)
- Interrupt pin (INT): open-drain output (like SDA and SCL)

Block diagram



Measurement modes

| Mode | Description |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OFF | The device is inactive. Other units may use the I ² C bus without any restrictions; I/O pins and INT are in high Z state. There is no sink current through the LED |
| STAND-BY | This is the initial mode after power-up. I_{DD} is typ. 0.8μA. No measurement is performed. Device can be activated by I ² C bus communication. Data registers can be read and written. |
| ALS / PS free - RUNNING | Measurements are triggered internally by the SFH 7776. Stand-by / active mode for ALS and PS, measurement times, interrupt options and LED current can be adjusted via I ² C register. Measurement results can be read from the data register, the status from the interrupt register. |



If V_{DD} exceeds the threshold voltage, the sensor will switch from OFF mode to STAND-BY mode. As shown in the transition-diagram above it is possible to switch between all modes without any restriction.

Maximum Ratings ($T_A = 25\text{ °C}$)

| Parameter | Symbol | Values | Unit |
|-----------------------------------------------------------------|---------------------|-------------|------|
| Storage temperature range | T_{stg} | -40 ... 100 | °C |
| Operating temperature range | T_{op} | -40 ... 85 | °C |
| Maximum supply voltage (between V_{DD} and GND) | V_{DD} | 4.5 | V |
| Maximum voltage of SDA, SCL to GND | V_{dig} | 4.5 | V |
| Maximum voltage of INT to GND | V_{int} | 7 | V |
| Maximum voltage of VLED to GND | V_{LED} | 7 | V |
| Maximum Current of INT and SDA | I_{INT} / I_{SDA} | 7 | mA |
| ESD withstand voltage (acc. to ANSI / ESDA JEDEC JS-001-HBM) | V_{ESD} | 2 | kV |

Operating conditions ($T_A = 25\text{ °C}$)

| Parameter | Symbol | Value | | | Unit |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-------|------|------|---------------|
| | | min. | typ. | max. | |
| Supply voltage | V_{DD} | 2.3 | 2.5 | 3.6 | V |
| Ripple on supply voltage (V_{DDmin} and V_{DDmax} must stay in the V_{DD} range, DC ... 100MHz) | $V_{DD,rip}$ | | | 200 | mV |
| VDD threshold voltage (voltage to initiate the start-up procedure) | $V_{DD; th}$ | | 1.7 | 2.3 | V |
| Voltage for INT | V_{INT} | | | 5.5 | V |
| Voltage for SCL and SDA | V_{SCL} V_{SDA} | 1.65 | | 3.6 | V |
| SDA and SCL input low level voltage | V_{SCL_low} V_{SDA_low} | | | 0.54 | V |
| SDA and SCL input high level voltage | V_{SCL_high} V_{SDA_high} | 1.26 | | | V |
| SDA and SCL input current | I_{SCL_low} I_{SDA_low} | -10 | | 10 | μA |
| INT output low level voltage ($I_{INT} = 3\text{ mA}$) (When INT is active: $V_{INT} = \text{low}$ when INT is inactive: $V_{INT} = \text{high}$) | V_{INT_low} | | | 0.4 | V |
| Supply voltage LED ¹⁾ | V_{LED} | 2.3 | 3.5 | 5.5 | V |
| Ripple VLED | $V_{LED,rip}$ | | | 200 | mV |

¹⁾2.3 V is only valid for an LED current setting up to 100mA; If the sensor is driven with LED currents >100mA the VLED voltage should be higher than 3.0V.

Characteristics ($T_A = 25\text{ °C}$)

| Parameter | Symbol | Value | | | Unit |
|-----------|--------|-------|------|------|------|
| | | min. | typ. | max. | |

General

| | | | | | |
|-----------------------------------------------------------------------------------|------------------|--|-----|-----|---------|
| Conditions for OFF mode | $V_{DD,off}$ | | 0.5 | | V |
| Current consumption in OFF mode ($V_{DD} < 0.5V$) | $I_{DD,off}$ | | 0 | | μA |
| STAND-BY mode current consumption (Mode_control(41h) = 0x00; $V_{DD} = 2.5V$) | $I_{DD,standby}$ | | 0.8 | 1.5 | μA |

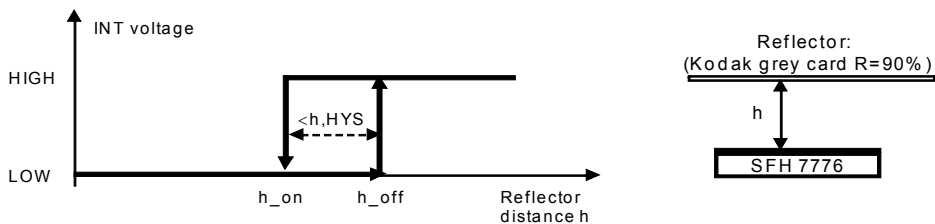
Proximity Sensor (PS)

| | | | | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------|------|------|---------|
| LED centroid wavelength ($I_{LED} = 100mA$) | $\lambda_{centroid}$ | | 850 | | nm |
| LED Spectral bandwidth ($I_{LED} = 100mA$) | $\Delta\lambda$ | | 30 | | nm |
| Temperature coefficient of optical power of LED | TC | | -0.5 | | %/K |
| ILED ON time for one measurement | $t_{LED\ ON}$ | 80 | 200 | 300 | μs |
| LED current, programmable $V_{LED} > 2.3V$ for $I_{LED} < 100mA$ $V_{LED} > 3.0V$ for $I_{LED} > 100mA$ | I_{LED} | 25 | | 200 | mA |
| Accuracy of LED current source (ALS_PS_CONTROL: LED Current = 00b) | I_{LED} | 22.5 | 25 | 27.5 | mA |
| Mean current consumption in PS mode (current consumption of the pulsed LED is not included; MODE_CONTROL(0x41h) = 0x03h; all other registers are default; $V_{DD} = 2.5V$) | I_{DD} | | 60 | 150 | μA |
| Mean current consumption in PS mode during the 200 μs LED pulse ($t_{LED\ ON}$) (current consumption of the pulsed LED is not included) | I_{DD} | | 6.5 | 8.5 | mA |
| Typical detection distance ¹⁾ KODAK grey card 100x130mm ² , R=90% ($I_{LED}=200mA$, $V_{DD}=2.5V$, $E_v = 0lx$; high threshold = 11 counts) | h_{on} | | 10 | | cm |

| | | | | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--|------|--|--------|
| Typical none detection distance ¹⁾ KODAK grey card 100x130mm ² , R=90% ($I_{LED}=200\text{mA}$, $V_{DD}=2.5\text{V}$, $E_v = 0\text{lx}$ low threshold = 8 counts) | h_{off} | | 12 | | cm |
| PS sensor output with human skin reflector ($I_{LED}=200\text{mA}$, $V_{DD}=2.5\text{V}$, $h=0\text{mm}$: skin directly on top of the sensor) | PS_{out} | | 850 | | counts |
| Temperature coefficient of the PS signal ($I_{LED}=200\text{mA}$, $V_{DD}=2.5\text{V}$, $R=90\%$, $A_{Reflector} = 10 \times 13 \text{cm}^2$, $h=4\text{cm}$) | TK_{PS} | | 0.15 | | %/K |

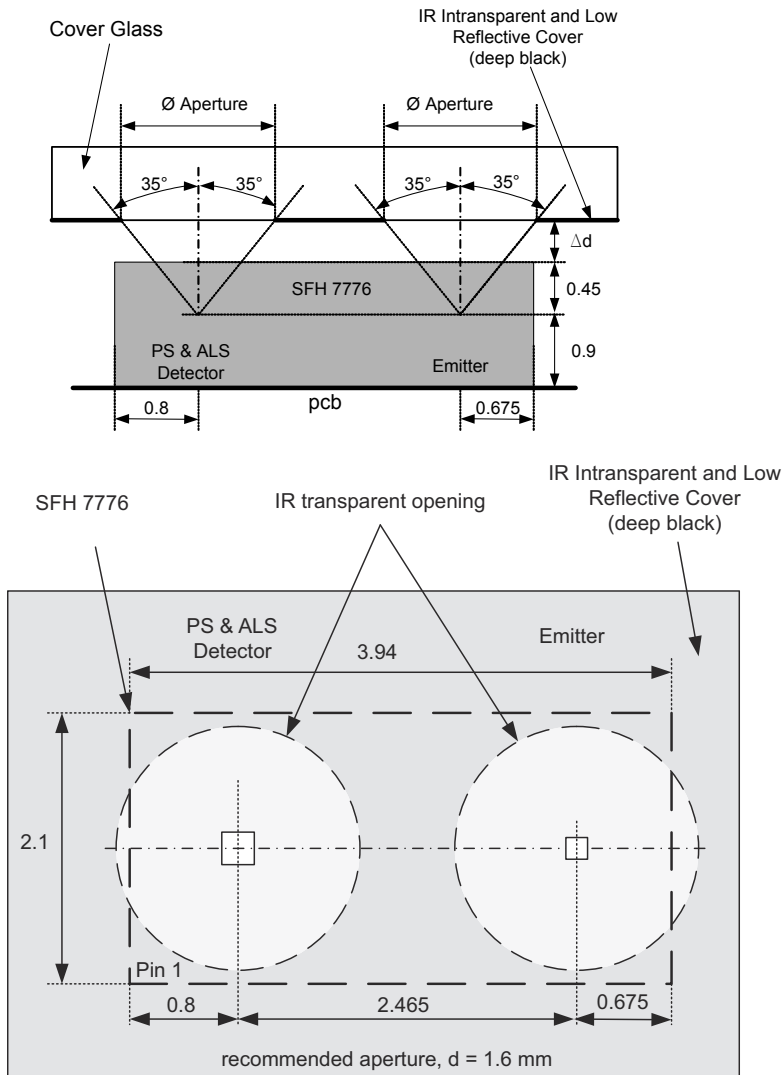
1) Example of PS Hysteresis

The switching distance h is specified from top sensor surface to the reflector.



Dimensions of proposed optical aperture

(optical aperture: IR transmitting opening in cover glass)



Dimensions in mm

Characteristics (Ta = 25°C)

| Parameter | Symbol | Value | | | Unit |
|-----------|--------|-------|------|------|------|
| | | min. | typ. | max. | |

Ambient Light Sensors: ALS VIS and ALS IR diode

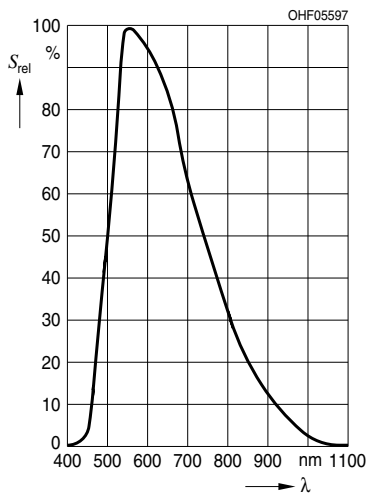
| | | | | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------|-----|-------|--------|
| Wavelength of max. sensitivity for ALS VIS | λS_{max} | | 560 | | nm |
| Spectral range of sensitivity (10% of S_{max}) of ALS VIS | $\lambda S_{10\%}$ | 450 | | 950 | nm |
| Wavelength of max. sensitivity of ALS IR | λS_{max} | | 880 | | nm |
| Spectral range of sensitivity (10% of S_{max}) of ALS IR | $\lambda S_{10\%}$ | 830 | | 1050 | nm |
| Illuminance measurement range is programmable (the maximum ALS sensitivity can be reached with the ALS high sensitivity mode --> 400ms ALS integration time) (MODE_CONTROL (0x41h) = 0Ah or 0Bh) | | 0.0022 | | 73000 | lx |
| ALS VIS sensor output (1000lx; white LED; V _{DD} = 2.5V) ((MODE_CONTROL (0x41h) = 08h) (ALS_PS_CONTROL (0x42h): Gain = X1) | ALS _{VIS_out} | 750 | 900 | 1080 | counts |
| ALS IR sensor output (324μW/cm ² ; IRED 850 nm; V _{DD} = 2.5V) ((MODE_CONTROL (0x41h) = 08h) (ALS_PS_CONTROL (0x42h): Gain = X1) | ALS _{IR_out} | 460 | 550 | 660 | counts |
| ALS VIS sensor output at darkness ((MODE_CONTROL (0x41h) = 08h) (ALS_PS_CONTROL (0x42h): Gain = X1) | ALS _{VIS_out} | 0 | 0 | 2 | counts |
| ALS IR sensor output at darkness ((MODE_CONTROL (0x41h) = 08h) (ALS_PS_CONTROL (0x42h): Gain = X1) | ALS _{IR_out} | 0 | 0 | 2 | counts |

| Parameter | Symbol | Value | | | Unit |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------|--------------------------------------------|------|---------------|
| | | min. | typ. | max. | |
| Resolution of the digital output signal based on gain settings for ALS VIS: MODE_CONTROL (0x41h) = 08h $t_{\text{int ALS}} = 100\text{ms}$ Gain X1 Gain X2 Gain X 64 Gain X 128 <i>High sensitive mode:</i> MODE_CONTROL (0x41h) = 0Ah $t_{\text{int ALS}} = 400\text{ms}$ Gain X 128 ($V_{\text{DD}} = 2.5\text{V}$; white LED) - Gain settings at ALS_PS_CONTROL (0x42h) | ALS _{VIS_out} | | 1.1 0.55 0.018 0.009 0.002 | | lx/count |
| Typical temperature coefficient for ALS measurement (1000lx; white LED; $V_{\text{DD}} = 2.5\text{V}$) | TC_{Ev} | | 0.2 | | %/K |
| Mean current consumption ((MODE_CONTROL (0x41h) = 08h) (other registers are in default) | I_{DD} | | 90 | 150 | μA |
| Typical error by Flicker noise (caused by bulbs (f=50 or 60Hz) or fluorescent lamps) | | | | 3 | % |

Diagrams for ALS sensor

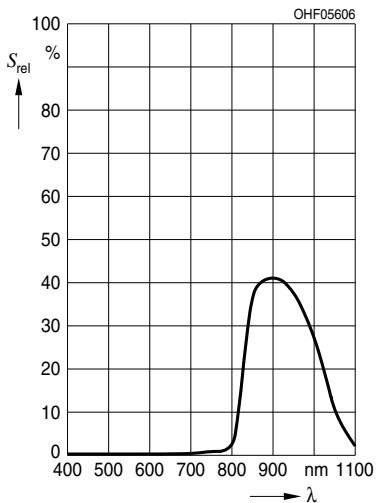
Relative Spectral Sensitivity of ALS VIS

$S_{rel_VIS} = f(\lambda)$



Relative Spectral Sensitivity of ALS IR

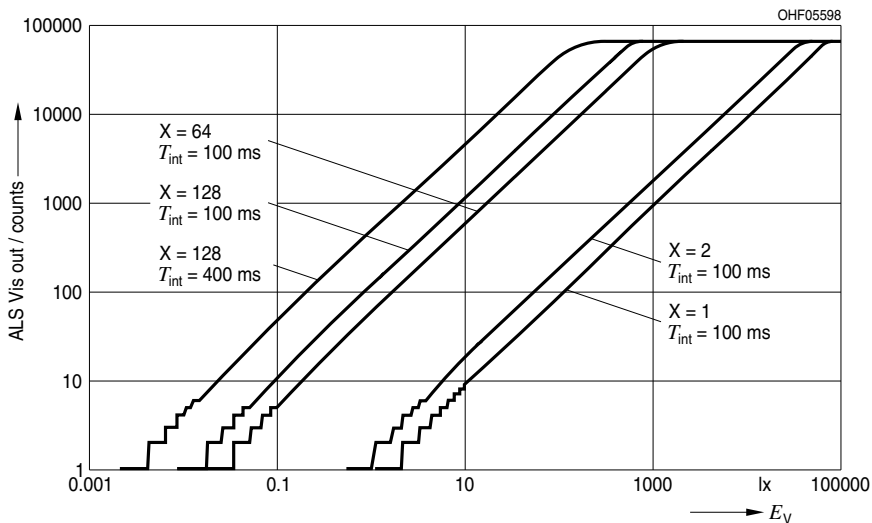
$S_{rel_IR} = f(\lambda)$; 100% = maximum sensitivity of ALS VIS diode



ALS VIS sensitivity ranges

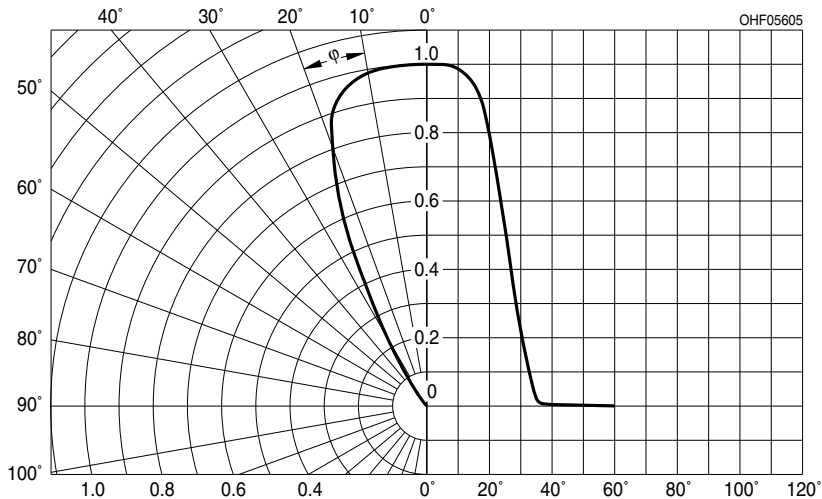
ALS VIS output $f(E_V)$; white LED; f (sensitivity settings);

T_{int} : integration time (register 0x41h); X: gain settings (register 0x42h)

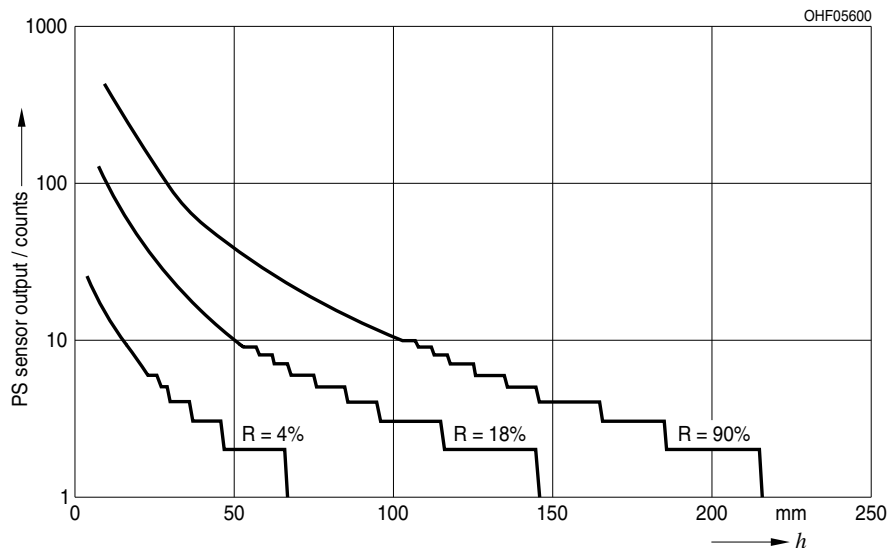


Direction Characteristic of ALS Vis diode

$S_{rel} f(\varphi)$

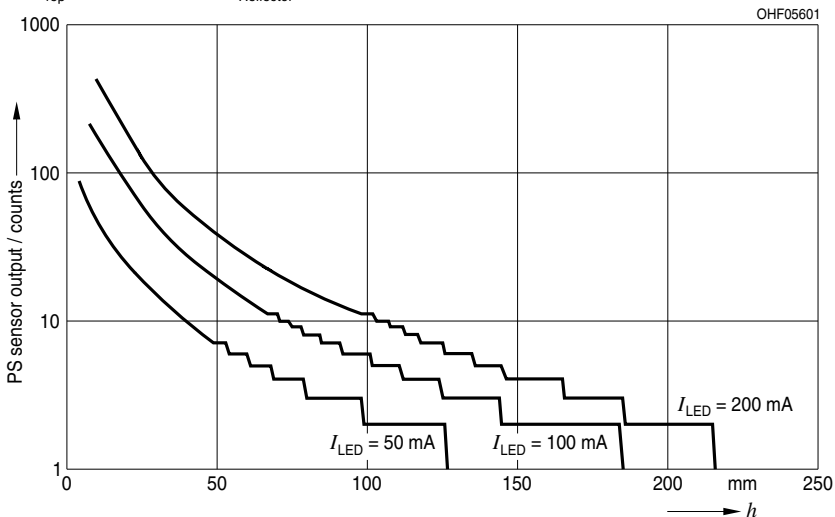


Diagrams for PS sensor

PS sensitivity $f(R = \text{reflectivity})$ $V_{DD} = 2.5V$; $I_{LED} = 200mA$; $T_{rep} = 100ms$; $A_{Reflector} = 10 \times 13 \text{ cm}^2$ 

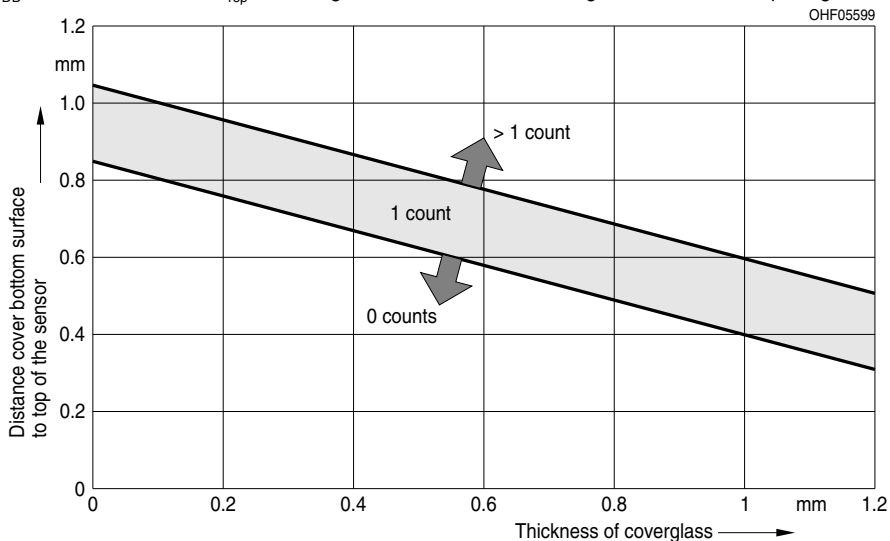
PS sensitivity $f(I_{LED})$

$V_{DD}=2.5V$; $T_{rep}=100ms$; $R=90\%$; $A_{Reflector} = 10 \times 13 \text{ cm}^2$



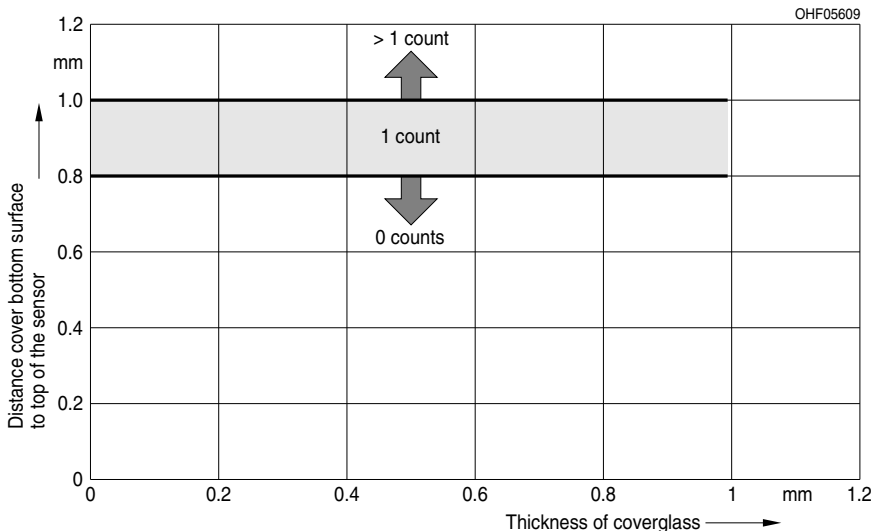
Typical crosstalk free range

$V_{DD}=2.5V$; $I_{LED}=200mA$; $T_{rep}=100ms$; glass without ink and one single IR transmissive opening ;



Typical crosstalk free range

$V_{DD}=2.5V$; $I_{LED}=200mA$; $T_{rep}=100ms$; glass without ink and a two separate IR transmissive openings for emitter and detector

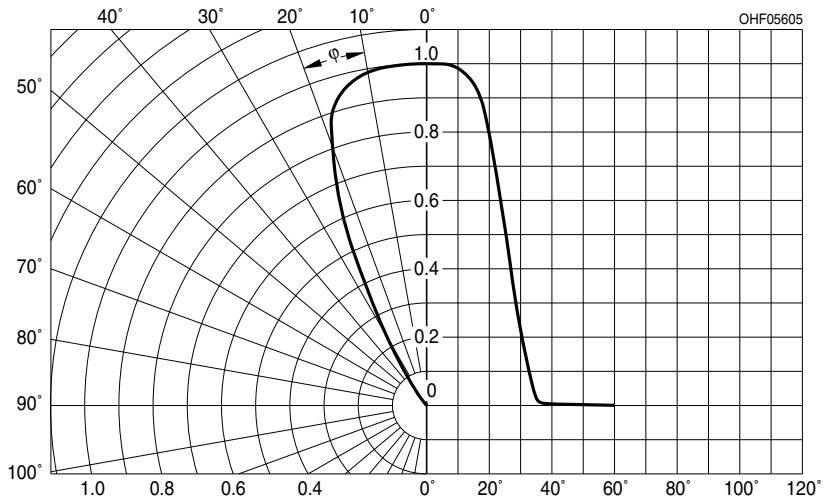


Note for crosstalk free range: The displayed crosstalk free ranges for a single or two hole IR transmissive opening are measured with a clear cover. Depending on the used ink the crosstalk level can differ and needs to be measured. OSRAM OS provides customer related application support and measurements - please contact your OSRAM OS marketing or sales partner, if support is required.

As the measurement results show the typical performance of the sensor OSRAM OS recommends to design inn a additional safety guard in the distance of the cover bottom surface to the top of the sensor of 200µm. e.g.: for a 0.5mm thick cover window with two holes and an acceptable crosstalk level of 0 counts the distance of the cover window bottom surface to the top of the sensor should not exceed 0.6mm (typ. it would be 0.8mm)!

Radiation Characteristics of the IR Emitter

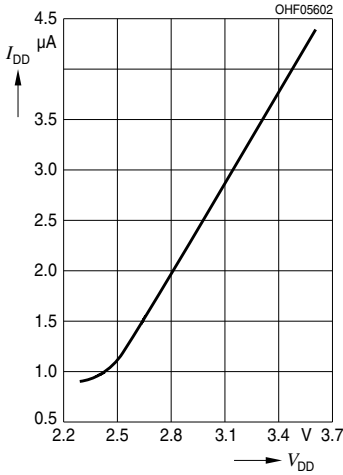
$I_{rel} f(\varphi)$



Diagrams for I_{DD} current consumption

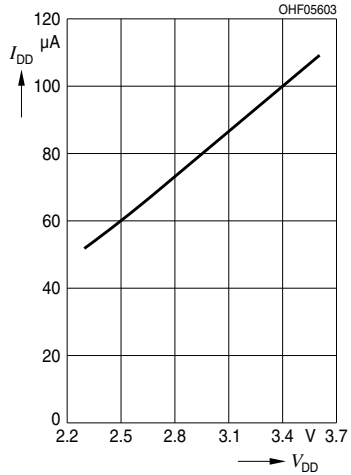
Current consumption I_{DD} in standby mode

$I_{DD} = f(V_{DD});$ Register 0x41= 0x00



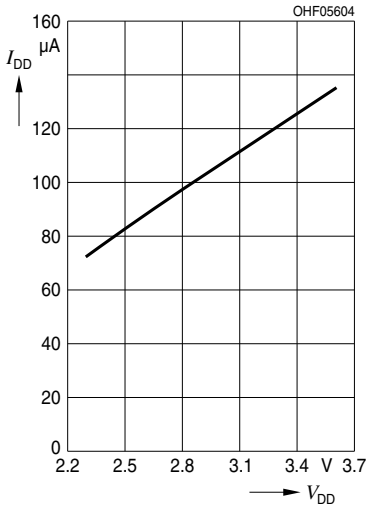
Current consumption I_{DD} in PS mode

$I_{DD} = f(V_{DD});$ Register 0x41= 0x03



Current consumption I_{DD} in ALS mode

$I_{DD} = f(V_{DD});$ Register 0x41= 0x08



Register

SYSTEM_CONTROL register (0x40h)

The SYSTEM_CONTROL register is used to control the software (SW) reset and the interrupt function (INT). Manufacturer ID and Part ID can be read.

| R/W-Register 0x40 | | | | | | | | | | | |
|-------------------|---------------------------------------|--|---------------------------------------------|--|--|-----------------------------|---|---|---------------------|---|---|
| Bit | 7 | | 6 | | | 5 | 4 | 3 | 2 | 1 | 0 |
| | SW reset | | INT reset | | | Manufacturer ID (Read only) | | | Part ID (Read only) | | |
| default | 0 Initial reset is not started | | 0 INT pin status is not initialized | | | 001 | | | 001 | | |
| | 0 Initial reset is not started | | 0 INT pin status is not initialized | | | | | | | | |
| | 1 Initial reset started | | 1 INT pin become inactive (high impedance) | | | | | | | | |

MODE_CONTROL register (0x41h)

CONTROL of PS and ALS operating modes and time settings.

Repetition time is the time between two separate measurements. Integration time is the duration for one measurement. ALS high sensitivity modes are 1010 and 1011 with an increased integration time of 400ms. In PS operating mode: „normal mode“ only one PS measurement is performed during one PS repetition time. In PS operating mode „twice mode“ two independent PS measurement are performed within one PS repetition time. Both measurements are independent and can trigger the interrupt. This feature can be used to decrease the interrupt update time if the persistence function (register 0x43h) is used.

| R/W-Register 0x41 | | | | | | | | | | | |
|-------------------|----------------|---|---|-------------------|--|------|---|----------------------|---------|-------------------------------|-----------------|
| Bit | 7 | 6 | 5 | 4 | | 3 | 2 | 1 | 0 | Repetition / Integration time | Repetition time |
| | Reserved | | | PS operating mode | | | | ALS | | PS | |
| default | | | | 0 normal mode | | 0000 | | standby | standby | standby | |
| | | | | 0 normal mode | | 0000 | | standby | standby | standby | |
| | | | | 1 twice mode | | 0001 | | standby | standby | 10ms | |
| | | | | | | 0010 | | standby | standby | 40ms | |
| | | | | | | 0011 | | standby | standby | 100ms | |
| | | | | | | 0100 | | standby | standby | 400ms | |
| | | | | | | 0101 | | 100ms / 100ms | standby | standby | |
| | | | | | | 0110 | | 100ms / 100ms | 100ms | 100ms | |
| | | | | | | 0111 | | 100ms / 100ms | 400ms | 400ms | |
| | | | | | | 1000 | | 400ms / 100ms | standby | standby | |
| | | | | | | 1001 | | 400ms / 100ms | 100ms | 100ms | |
| | | | | | | 1010 | | 400ms / 400ms | standby | standby | |
| | | | | | | 1011 | | 400ms / 400ms | 400ms | 400ms | |
| | | | | | | 1100 | | 50ms / 50ms | 50ms | 50ms | |
| | Rest forbidden | | | | | | | | | | |

ALS_PS_CONTROL register (0x42h)

ALS and PS Control of set the PS output mode, the ALS gain and the LED current. In the „Infrared DC level output“ PS mode (bit <6> = 1) the sensor measures the infrared DC ambient level. The proximity value of the reflected signal is not available in this mode.

| R/W-Register 0x42 | | | | | | | | | | | |
|-------------------|----------------------|--------------------|---------------------------------|---|----|----|---------|--|--------|-------------|--|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | | 0 | | |
| | Reserved (read only) | PS output | ALS Gain for ALS VIS and ALS IR | | | | ALS VIS | | ALS PS | LED current | |
| default | write 0 | 0 proximity output | 0000 | | X1 | X1 | 11 | | 200mA | | |

| R/W-Register 0x42 | | | | | | | | | |
|-------------------|----------------------|----------------------------|--|---------------------------------|------|------|-------------|---|---|
| Bit | 7 | 6 | | 5 | 4 | 3 | 2 | 1 | 0 |
| | Reserved (read only) | PS output | | ALS Gain for ALS VIS and ALS IR | | | LED current | | |
| | | 0 proximity output | | 0000 | X1 | X1 | 00 25 mA | | |
| | | 1 Infrared DC level output | | 0100 | X2 | X1 | 01 50 mA | | |
| | | | | 0101 | X2 | X2 | 10 100 mA | | |
| | | | | 1010 | X64 | X64 | 11 200 mA | | |
| | | | | 1110 | X128 | X64 | | | |
| | | | | 1111 | X128 | X128 | | | |
| | | | | rest forbidden | | | | | |

Persistence Register (0x43h)

Settings for the interrupt activation and of the persistence interrupt function. Persistence function is only valid for the PS measurements.

| R/W-Register 0x43 | | | | | | | | | |
|-------------------|----------------------|---|---|---|---------------------------------------------------------|---|---|---|--|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
| | Reserved (read only) | | | | Persistence | | | | |
| default | 0000 | | | | 0001 Interrupt status is updated after each measurement | | | | |

| R/W-Register 0x43 | | | | | | | | |
|-------------------|----------------------|---|---|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | Reserved (read only) | | | | Persistence | | | |
| | | | | | 0000 Interrupt becomes active after each measurement (The mode indicates that a PS or ALS measurement has been finished and can be read via the register. It is independent of the ALS & PS measurement value and threshold settings) | | | |
| | | | | | 0001 Interrupt status is updated after each measurement (The interrupt status is updated independently after each measurement. <i>Active</i> or <i>Inactive</i> status of the interrupt is depending on the values of the last measurement in combination with the interrupt settings :“interrupt mode“ (register 0x4Ah) and „thresholds“ register 0c4Ch and following.) | | | |
| | | | | | 0010 Interrupt status is updated if two consecutive threshold judgement are the same (The interrupt status only changes if the interrupt judgement of 2 consecutive measurement results are the same and different to the current interrupt status.) | | | |
| | | | | | 0011 ... 1111 Interrupt status is updated if threshold judgement are the same over consecutive set times (3 .. 15) (This is the same procedure like in the 0010 persistence mode, but instead of 2 consecutive threshold judgments more are needed (3 to 15 depending on the setting) to change the interrupt status.) e.g.: 1010: 10 measurement results in a row need to fulfill the interrupt judgement to update the interrupt status | | | |

PS_DATA_LSBs register (0x44h)

LSB of the PS output.

| R-Register 0x44 | | | | | | | | |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 2^7 | 2^6 | 2^5 | 2^4 | 2^3 | 2^2 | 2^1 | 2^0 |
| default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

PS_DATA_MSBs register (0x45h)

MSB of the PS output.

| R-Register 0x45 | | | | | | | | |
|-----------------|----------|----------|----------|----------|----------|----------|-------|-------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | not used | not used | not used | not used | 2^{11} | 2^{10} | 2^9 | 2^8 |
| default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

ALS_VIS_DATA_LSBs register (0x46h)

LSB of the ALS VIS output.

| R-Register 0x46 | | | | | | | | |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 2^7 | 2^6 | 2^5 | 2^4 | 2^3 | 2^2 | 2^1 | 2^0 |
| default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

ALS_VIS_DATA_MSBs register (0x47h)

MSB of the ALS VIS output.

| R-Register 0x47 | | | | | | | | |
|-----------------|----------|----------|----------|----------|----------|----------|-------|-------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 2^{15} | 2^{14} | 2^{13} | 2^{12} | 2^{11} | 2^{10} | 2^9 | 2^8 |
| default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

ALS_IR_DATA_LSBs register (0x48h)

LSB of the ALS IR output.

| R-Register 0x48 | | | | | | | | |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 2^7 | 2^6 | 2^5 | 2^4 | 2^3 | 2^2 | 2^1 | 2^0 |
| default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

ALS_IR_DATA_MSBs register (0x49h)

MSB of the ALS IR output.

| R-Register 0x49 | | | | | | | | |
|-----------------|----------|----------|----------|----------|----------|----------|-------|-------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 2^{15} | 2^{14} | 2^{13} | 2^{12} | 2^{11} | 2^{10} | 2^9 | 2^8 |
| default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Interrupt function setting register (0x4Ah)

Setting of the interrupt functions.

| R/W-Register 0x4A | | | | | | | | |
|-------------------|----------------------------------|-----------------------------------|----------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------------|-----------------------------------------------------------|-------------------------|---------------------------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | PS INT status (read only) | ALS INT status (read only) | PS INT mode | | INT assert | INT latch | INT trigger | |
| default | 0 inactive | 0 inactive | 00 PS_TH is only active | | 0 INT „L“ is stable | 0 INT is latched | 00 inactive | |
| | 0 inactive | 0 inactive | 00 PS_TH (PS high threshold 0x4Bh & 0x4Ch) is only active | | 0 INT „L“ is stable if newer measurement results is also interrupt active | 0 INT is latched until INT register is read or initialize | 00 INT pin is inactive | |
| | 1 active | 1active | 01 PS_TH & PS_TL (PS high & low threshold) are active as hysteresis | | 1 INT „L“ is de-assert and re-assert if newer measurement results is also interrupt active | 1INT is updated after each measurement | 01 triggered by PS only | |
| | | | 10 PS_TH & PS_TL (PS high & low threshold) are active as outside detection | | | | | 10 triggered by ALS only |
| | | | 11 forbidden | | | | | 11 triggered by PS or ALS |

PS INT and **ALS INT** status (bit <7;6>): Directly after reading the register the interrupt status for PS and ALS and the INT Pin of the sensor is automatically set back to inactive status independent on the measurement results.

PS INT mode (bit <5;4>): The INT modes are only valid for the PS interrupt function. For description please see extra chapter „**PS INT Modes**“ (at the end of the register chapter).

INT assert (bit <3>): Is used to adjust the sensor behaviour to the used micro controller trigger settings. In case a repeated trigger in low state is needed the **INT assert** can be set to 1.

INT trigger (bit <2>): defines the source / sources for the interrupt.

INT latched (bit <1>): In latched mode the interrupt status stays active after the first activation. It is only released by reading the status are performing an interrupt reset.

PS_TH_LSBs register (0x4Bh)

LSB for the PS threshold „HIGH“.

| R/W-Register 0x4B | | | | | | | | |
|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 2 ⁷ | 2 ⁶ | 2 ⁵ | 2 ⁴ | 2 ³ | 2 ² | 2 ¹ | 2 ⁰ |
| default | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

PS_TH_MSBs register (0x4Ch)

MSB for the PS threshold „HIGH“.

| R/W-Register 0x4C | | | | | | | | |
|-------------------|---|---|---|---|----------|----------|-------|-------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | | | | | 2^{11} | 2^{10} | 2^9 | 2^8 |
| default | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |

PS_TL_LSBs register (0x4Dh)

LSB for the PS threshold „LOW“.

| R/W-Register 0x4D | | | | | | | | |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 2^7 | 2^6 | 2^5 | 2^4 | 2^3 | 2^2 | 2^1 | 2^0 |
| default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

PS_TL_MSBs register (0x4Eh)

MSB for the PS threshold „LOW“.

| R/W-Register 0x4E | | | | | | | | |
|-------------------|---|---|---|---|----------|----------|-------|-------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | | | | | 2^{11} | 2^{10} | 2^9 | 2^8 |
| default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

ALS_VIS_TH_LSBs register (0x4Fh)

LSB for the ALS VIS threshold „HIGH“.

| R/W-Register 0x4F | | | | | | | | |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 2^7 | 2^6 | 2^5 | 2^4 | 2^3 | 2^2 | 2^1 | 2^0 |
| default | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

ALS_VIS_TH_MSBs register (0x50h)

MSB for the ALS VIS threshold „HIGH“.

| R/W-Register 0x50 | | | | | | | | |
|-------------------|----------|----------|----------|----------|----------|----------|-------|-------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 2^{15} | 2^{14} | 2^{13} | 2^{12} | 2^{11} | 2^{10} | 2^9 | 2^8 |
| default | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

ALS_VIS_TL_LSBs register (0x51h)

LSB for the ALS VIS threshold „LOW“.

| R/W-Register 0x51 | | | | | | | | |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 2^7 | 2^6 | 2^5 | 2^4 | 2^3 | 2^2 | 2^1 | 2^0 |
| default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

ALS_VIS_TL_MSBs register (0x52h)

MSB for the ALS VIS threshold „LOW“.

| R/W-Register 0x52 | | | | | | | | |
|-------------------|----------|----------|----------|----------|----------|----------|-------|-------|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 2^{15} | 2^{14} | 2^{13} | 2^{12} | 2^{11} | 2^{10} | 2^9 | 2^8 |
| default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

INT modes

The Interrupt function compares ALS and PS measurement values with the current interrupt threshold level. PS and ALS VIS Interrupt status is readable via register 0x4Ah or at the INT pin of the sensor.

The Interrupt persistence function is only valid for PS measurements and is defined at register (0x43h). The INT pin of the SFH 7776 is an open drain output and should be pulled-up to V_{IO} by an external resistor. When VDD is supplied to the sensor the INT pin is per default in high ohmic (inactive) state. The INT status becomes inactive by writing an INT reset command, reading the INT status register or performing a software reset.

The INT status stays in its last state when the sensor is set to the standby mode. In the INT active state „low“ the sensor consumes ~25µA extra current. Therefore OSRAM recommends to set the INT state to high impedance before setting the sensor in standby mode.

Below the ALS and PS INT modes are described for the unlatched mode. In latched mode the switching back to the „inactive“ INT state is depending on an interrupt reset or on reading out the INT status register.

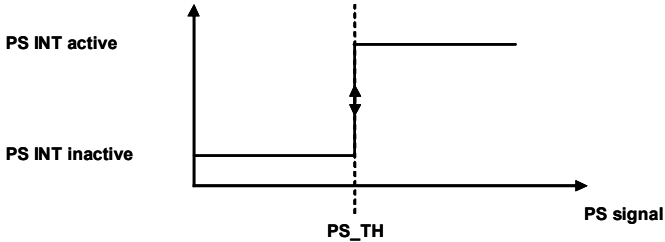
ALS INT mode:

The ALS VIS threshold levels high (register 0x4Fh & 0x50h) and low (register 0x4Fh & 0x50h) are only valid for the ALS VIS measurement values. The ALS VIS INT mode is fixed and can not be adapted via register. The thresholds define a window with the following functionality:
 ALS INT is active, if the ALS VIS measurement values are outside the window
 ALS INT is inactive, if the ALS VIS measurement results are inside the window.

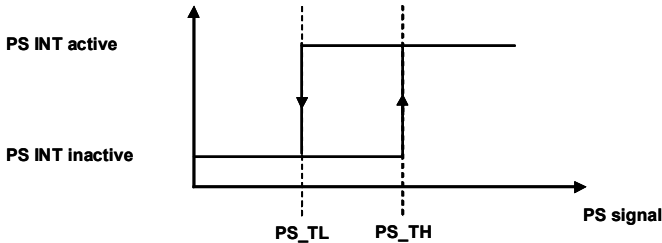
PS INT Modes: Bit <5;4> of interrupt function setting register (0x4Ah)
00 PS_TH is active only:

The INT state is active, if the PS measurement result is equal or higher than the set PS_TH high threshold.

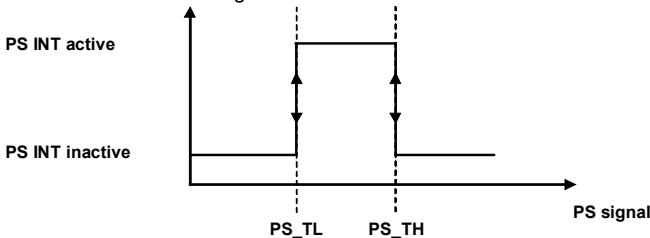
The INT state is inactive, if the PS measurement result is lower than the set PS_TH high threshold.


01 PS_TH & PS_TL (PS high & low threshold) are active as hysteresis:

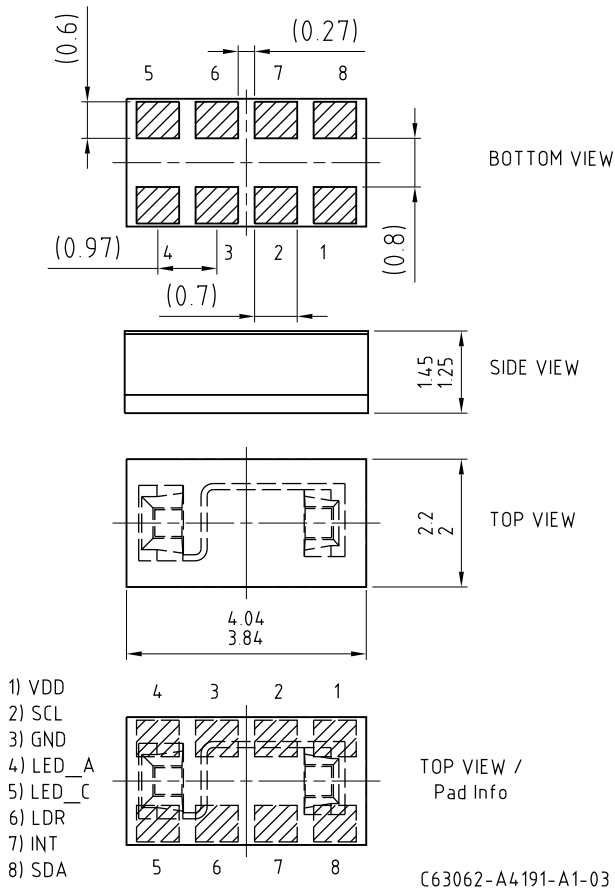
PS_TH and PS_TL are working as a hysteresis. If the PS measurement signal is higher than the PS high threshold (PS_TH) the INT state is switched to active. If the PS measurement signal is lower than the PS low threshold (PS_TL) the INT state is inactive. If once the interrupt signal becomes active, the INT status is kept active until the measurement result becomes less than the PS_TL register value.


10 PS_TH & PS_TL (PS high & low threshold) are active as outside detection:

In case of "PS outside detection" mode interrupt signal inactive means that the measurement result is within the registered threshold level and the interrupt signal active means that the measurement result is out of registered threshold level.



Package Outline



Dimensions in mm.

The emitter is located in the cavity between pad 4 and 5. The orientation of the sensor can be detected by the asymmetrical channel on the sensor top side.

For optical aperture design please see page 8.

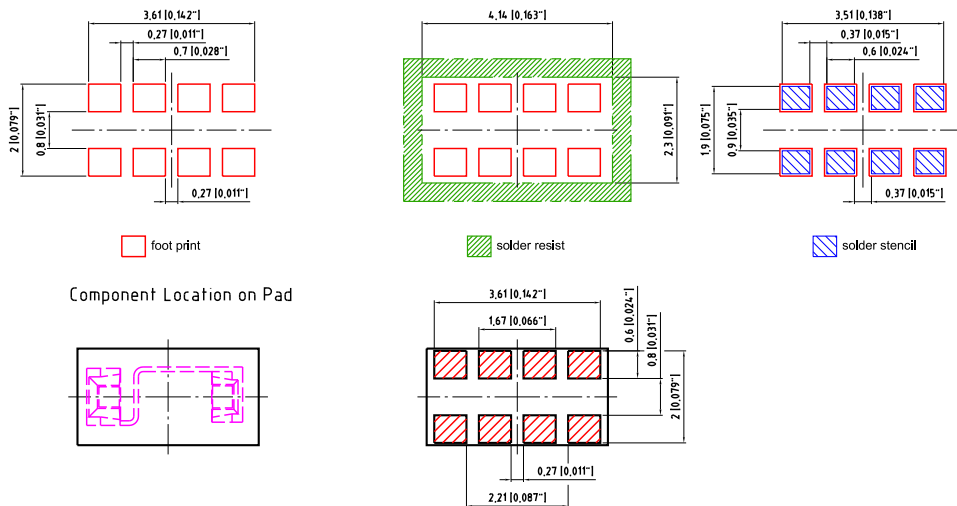
Package:

Chip on Board

Approximate Weight:

15 mg

Recommended solder pad design



E062 3010.14.7-01

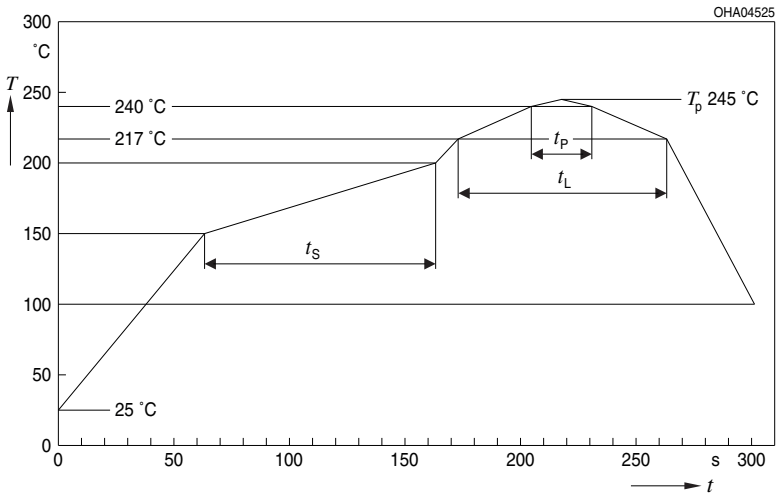
Dimensions in mm (inch).

Cleaning / Washing

In general, OSRAM Opto Semiconductors does not recommend a wet cleaning process for the components **SFH7776** as the package is not hermetically sealed. Due to the open design, all kind of cleaning liquids can infiltrate the package and cause a degradation or a complete failure of the LED or ASIC. It is also recommended to prevent penetration of organic substances from the environment which could interact with the hot surfaces of the operating chips. Ultrasonic cleaning is generally not recommended for all types of LEDs (see also the application note "Cleaning of LEDs"). As is standard for the electronic industry, OSRAM Opto Semiconductors recommends using low-residue or no-clean solder paste, so that PCB cleaning after soldering is no longer required. In any case, all materials and methods should be tested beforehand in order to determine whether the component will be damaged in the process.

Reflow Soldering Profile

Product complies to MSL Level 3 acc. to JEDEC J-STD-020D.01



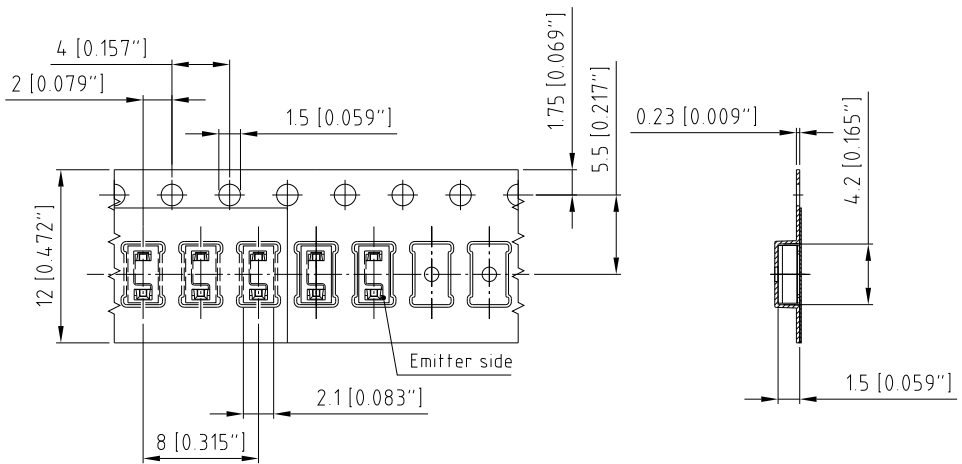
OHA04612

| Profile Feature Profil-Charakteristik | Symbol Symbol | Pb-Free (SnAgCu) Assembly | | | Unit Einheit |
|-------------------------------------------------------------------|------------------|---------------------------|----------------|---------|-----------------|
| | | Minimum | Recommendation | Maximum | |
| Ramp-up rate to preheat*) 25 °C to 150 °C | | | 2 | 3 | K/s |
| Time t_S T_{Smin} to T_{Smax} | t_S | 60 | 100 | 120 | s |
| Ramp-up rate to peak*) T_{Smax} to T_P | | | 2 | 3 | K/s |
| Liquidus temperature | T_L | 217 | | | °C |
| Time above liquidus temperature | t_L | | 80 | 100 | s |
| Peak temperature | T_P | | 245 | 260 | °C |
| Time within 5 °C of the specified peak temperature T_P - 5 K | t_P | 10 | 20 | 30 | s |
| Ramp-down rate* T_P to 100 °C | | | 3 | 6 | K/s |
| Time 25 °C to T_P | | | | 480 | s |

All temperatures refer to the center of the package, measured on the top of the component

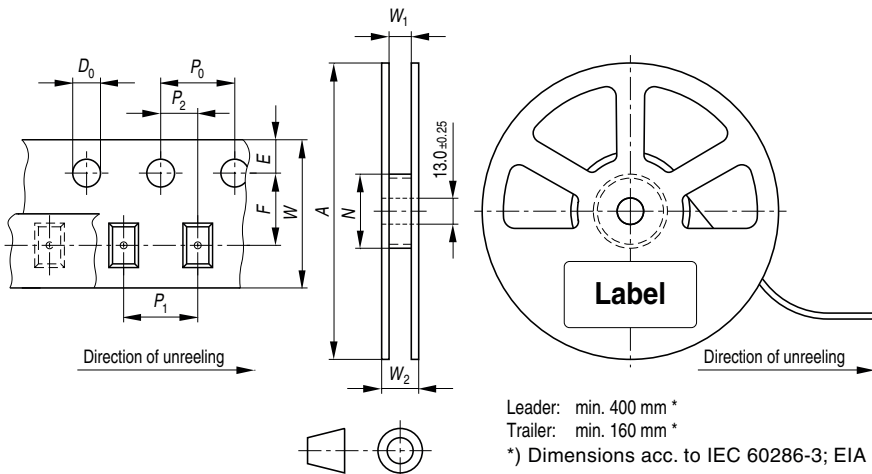
* slope calculation DT/Dt : Dt max. 5 s; fulfillment for the whole T-range

Method of Taping



C63062-A4 191-B6 -01

Dimensions in mm (inch).

Tape and Reel12 mm tape with 2000 pcs. on \varnothing 180 mm reel

Dimensions in mm

Tape Dimensions [mm]

| W | P ₀ | P ₁ | P ₂ | D ₀ | E | F |
|----------------|----------------|----------------|----------------|----------------|-----------|-----------|
| 12 +0.3 / -0.1 | 4 ±0.1 | 4 ±0.1 | 2 ±0.05 | 1.5 ±0.1 | 1.75 ±0.1 | 5.5 ±0.05 |

Reel Dimensions [mm]

| A | W | N _{min} | W ₁ | W _{2max} |
|-----|----|------------------|----------------|-------------------|
| 180 | 12 | 60 | 12.4 +2 | 18.4 |

Barcode-Product-Label (BPL)

OSRAM Opto Semiconductors LX XXXX BIN1: XX-XX-X-XXX-X

RoHS Compliant

(6P) BATCH NO: 1234567890

(1T) LOT NO: 1234567890 (9D) D/C: 1234

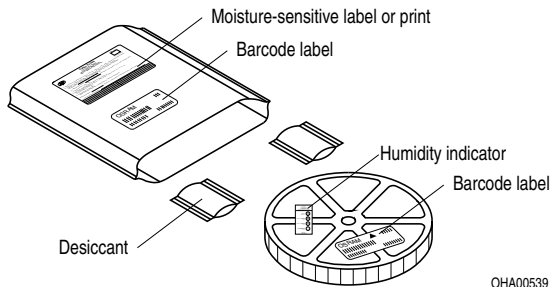
(X) PROD NO: 123456789 (Q) QTY: 9999 (G) GROUP: XX-XX-X-X

ML Temp ST
X XXX °C X

Pack: RXX
DEMY XXX
X_X123_1234.1234 X

OHA04563

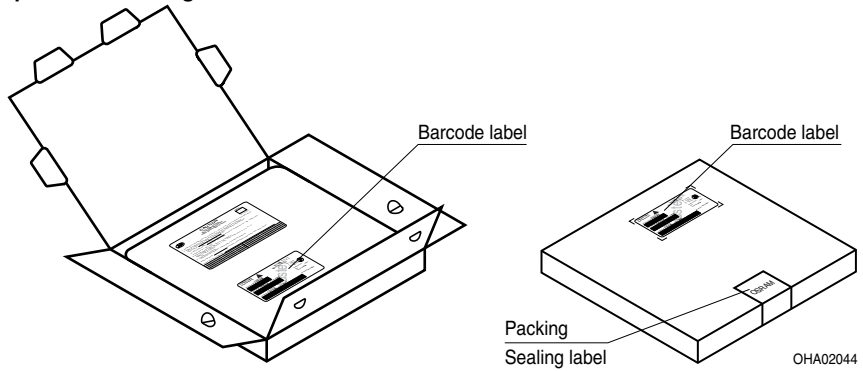
Dry Packing Process and Materials



Note:

Moisture-sensitive product is packed in a dry bag containing desiccant and a humidity card. Regarding dry pack you will find further information in the internet. Here you will also find the normative references like JEDEC.

Transportation Packing and Materials



Dimensions of transportation box in mm

| Width | Length | Height |
|---------|---------|--------|
| 195 ± 5 | 195 ± 5 | 42 ± 5 |

Disclaimer

Language english will prevail in case of any discrepancies or deviations between the two language wordings.

Attention please!

The information describes the type of component and shall not be considered as assured characteristics.

Terms of delivery and rights to change design reserved. Due to technical requirements components may contain dangerous substances.

For information on the types in question please contact our Sales Organization. ?If printed or downloaded, please find the latest version in the Internet.

Packing

Please use the recycling operators known to you. We can also help you – get in touch with your nearest sales office. ?By agreement we will take packing material back, if it is sorted. You must bear the costs of transport. For packing material that is returned to us unsorted or which we are not obliged to accept, we shall have to invoice you for any costs incurred.

Components used in life-support devices or systems must be expressly authorized for such purpose!

Critical components* may only be used in life-support devices** or systems with the express written approval of OSRAM OS.

*) A critical component is a component used in a life-support device or system whose failure can reasonably be expected to cause the failure of that life-support device or system, or to affect its safety or the effectiveness of that device or system.

**) Life support devices or systems are intended (a) to be implanted in the human body, or (b) to support and/or maintain and sustain human life. If they fail, it is reasonable to assume that the health and the life of the user may be endangered.

Glossary

- 1) **Typical Values:** Due to the special conditions of the manufacturing processes of LED and photodiodes, the typical data or calculated correlations of technical parameters can only reflect statistical figures. These do not necessarily correspond to the actual parameters of each single product, which could differ from the typical data and calculated correlations or the typical characteristic line. If requested, e.g. because of technical improvements, these typ. data will be changed without any further notice.

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EU RoHS and China RoHS compliant product



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