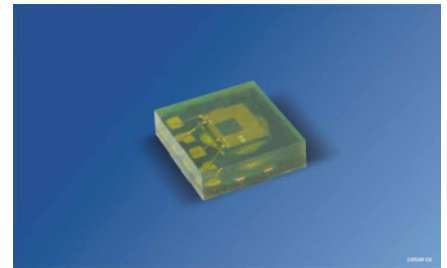


Hochgenauer Umgebungslichtsensor mit I²C Bus Schnittstelle
High Accuracy Ambient Light Sensor with I²C Bus Interface
Lead (Pb) Free Product - RoHS Compliant

SFH 5712



preliminary datasheet

Wesentliche Merkmale

- Gut an die Augenempfindlichkeit (V_λ) angepasst
- Hohe Genauigkeit von 3 - 65.000lx
- I²C Bus Schnittstelle
100kHz / 400kHz and 3.4 Mbit/s
- Niedriger Temperaturkoeffizient der Fotoempfindlichkeit

Anwendungen

- Für Consumer Produkte
- Steuerung von Displayhinterleuchtungen
- Mobile Geräte
- Sonnenlicht Sensor

Features

- Good match to Human Eye Sensitivity (V_λ)
- High accuracy from 3 - 65.000lx
- I²C bus Interface
100kHz / 400kHz and 3.4 Mbit/s
- Low temperature coefficient of spectral sensitivity

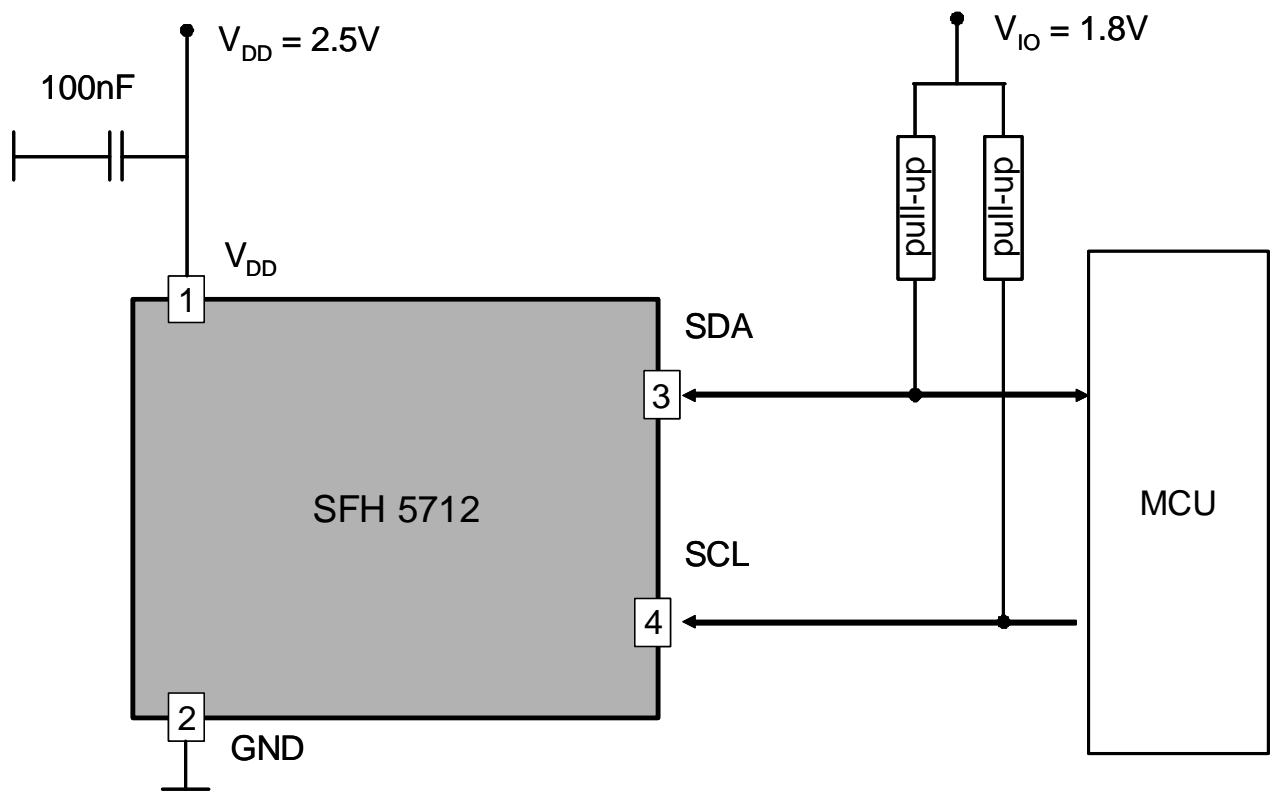
Applications

- For consumer products
- Control of display backlighting
- Mobile devices
- Sunlight sensor

Typ Type	Bestellnummer Ordering code	Digitaler Ausgang, $E_v= 1000lx$, (white LED) Digital out Out
SFH 5712-2/3 ¹⁾	Q65110A8485	500-1600

¹⁾ Nur eine Gruppe innerhalb einer Verpackungseinheit (Streuung kleiner als 2:1)
 Only one bin within one packing unit (variation lower 2:1)

Application diagram and basic operation



Proposed size for the pull-up resistor is 560W

Basic operation

Address	Command	Action
switch V _{DD} on		
Wait >1ms		
0x80	Write 03	Ambient Light Sensor in ACTIVE mode
Wait >250 ms		
0x8C	Read data	read LSByte data from ambient light measurement
0x8D	Read data	read MSByte data from ambient light measurement
0x80	Write 00	Ambient Light Sensor in STAND-BY mode

Addressing for basic operation

Activation:

S	Address 0x29	W	A	Register 0x80	A	0x03	A	P
---	--------------	---	---	---------------	---	------	---	---

Read LSB:

S	Address 0x29	W	A	Register 0x8C	A	P
---	--------------	---	---	---------------	---	---

S	Address 0x29	R	A	LSByte DATA	A	P
---	--------------	---	---	-------------	---	---

Read MSB:

S	Address 0x29	W	A	Register 0x8D	A	P
---	--------------	---	---	---------------	---	---

S	Address 0x29	R	A	LSByte DATA	A	P
---	--------------	---	---	-------------	---	---

Deactivation:

S	Address 0x29	W	A	Register 0x80	A	0x00	A	P
---	--------------	---	---	---------------	---	------	---	---

Communication from master to SFH 5712

Communication from SFH 5712 to master

A = acknowledge (SDA LOW)

S = START condition

P = STOP condition

I²C interface

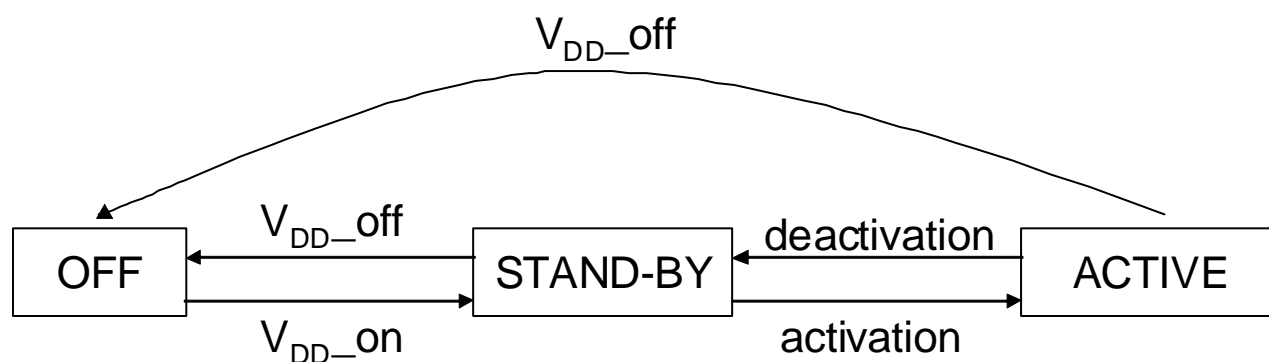
- 1.8V IO-logic level for SDA and SCL
- IO-pins are open drain type and logic high level is set with external pull-up resistor
- SFH 5712-1/2 operates always as slave, address is 0x29 (7bits). LSB bit can be used to change between Read (R/W bit =1) and Write mode (R/W bit =0)..

Address 0x29								
Bit	7	6	5	4	3	2	1	0
	Address							R/W bit
default	0	1	0	1	0	0	1	X

- Designed for the I²C-modes: Standard (100kHz), Fast (400kHz) and High Speed (3.4MHz)
- see I²C Bus specification UM10204 from NXP for detailed information
- Spikes up to 10 ns are suppressed on SDA & SCL

Modes

OFF	I_{DD} is below $2.5\mu\text{A}$ and the device is inactive. Other units may use the I ² C bus without any restrictions; I/O pins are in Z state.
STAND-BY	This is the initial mode after power-up. I_{DD} is below $2.5\mu\text{A}$. No measurement is performed. Device can be activated by I ² C bus communication. Data registers can be read and written.
ACTIVE	Measurements are triggered internally by SFH5712. The measurement repetition rate is 2/s. Measurement results can be read from the data register



Maximum Ratings

Parameter	Symbol	Value	Unit
Storage temperature	T_{stg}	- 40 ... + 85	°C
Supply voltage	V_{DD}	-0.3 ... +4.5	V
I ² C - Bus voltage	V_{IO}	-0.3 ... +2.5	V
Electrostatic discharge Human Body Model according to EOS/ESD-5.1-1993	ESD	2	kV
Electrostatic discharge charge device model according to JEDEC JESD22-C101D	ESD_{cdm}	500	V

Operating Conditions

Parameter	Symbol	Value			Unit
		min.	typ.	max.	
Operating temperature	T_{op}	-15		70	°C
Supply voltage	V_{DD}	2.3		3.0	V
Supply voltage ripple (frequency: 0...100Mhz, sinus wave)	dV_{DD}			100	mV
Illuminance	E_V	3		65k	lx
I ² C - Bus voltage	V_{IO}	1.6		2.0	V
Output current „Low“ ¹⁾	I_{IO}	3		12	mA

¹⁾ FAST MODE PLUS: requirement of I_{out_low} 20mA is not met.

Characteristics

Parameter	Symbol	Value			Unit
		min.	typ.	max.	
Mean current consumption <i>ACTIVE mode</i> , $E_V = 0\text{lx}$, $V_{DD} = 2.5\text{ V}$	I_{DD}		145	200	μA
Mean current consumption <i>ACTIVE mode</i> , $E_V = 1000\text{lx}$, $V_{DD} = 2.5\text{ V}$	I_{DD}		170		μA
Mean current consumption <i>STAND-BY mode</i> , $V_{DD} = 2.5\text{ V}$	I_{DD}			2.5	μA
Spectral range of sensitivity	$\lambda_{20\%}$		400 ... 680		nm
Wavelength of max. photosensitivity	$\lambda_{s\text{ max}}$		500		nm
Dimensions of radiant sensitive area	$L \times W$		0.4 x 0.4		mm x mm
I ² C power up time after V _{DD} "ON" (see Appendix 1: flicker reduction and timing)	t_{on}		40		μs
Output update time for first measurement (see Appendix 1: flicker reduction and timing)	t_{upd}		1	1.5	ms
Resolution of the digital output signal (3lx ...65klx)	<i>Out</i>		1		count/lx
Digital output signal accuracy $V_{DD} = V_{DD, \text{min}}$ to $V_{DD, \text{max}}$; $E_V = 1000\text{lx}$			± 1		%
Deviation from linear output characteristics ¹⁾ X = 100-65klx X = 10-100lx X = 3-10lx	f_{lin}		± 5 ± 10 ± 20		%
Temperature coefficient of the output signal $T_{\text{op}} = 0...50^\circ\text{C}$ $T_{\text{op}} = -15...0^\circ\text{C}$ & $50...70^\circ\text{C}$ (1000lx; Norm light A)	TC_{EV}		<0.2 <0.25		%/K
Flicker reduction at the output (noise frequency: 50...60Hz) (see Appendix 1: flicker reduction and timing)			13		dB

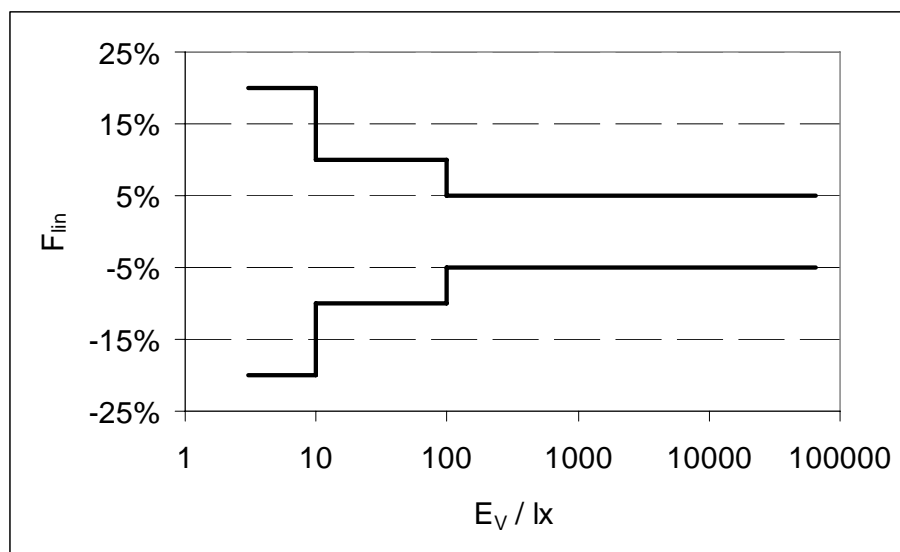
1) The deviation of the linear output characteristic is referenced to 1000lx and follows the formula:

$$f_{\text{lin}} = \left(\frac{Y_X}{Y_{1000\text{lx}}} \times \frac{1000\text{lx}}{X} - 1 \right) \times 100\%$$

X: sensor illumination level in lux

Y_X : sensor output / measurement value at illumination level X

$Y_{1000\text{lx}}$: sensor output / measurement value at illumination level 1000lx



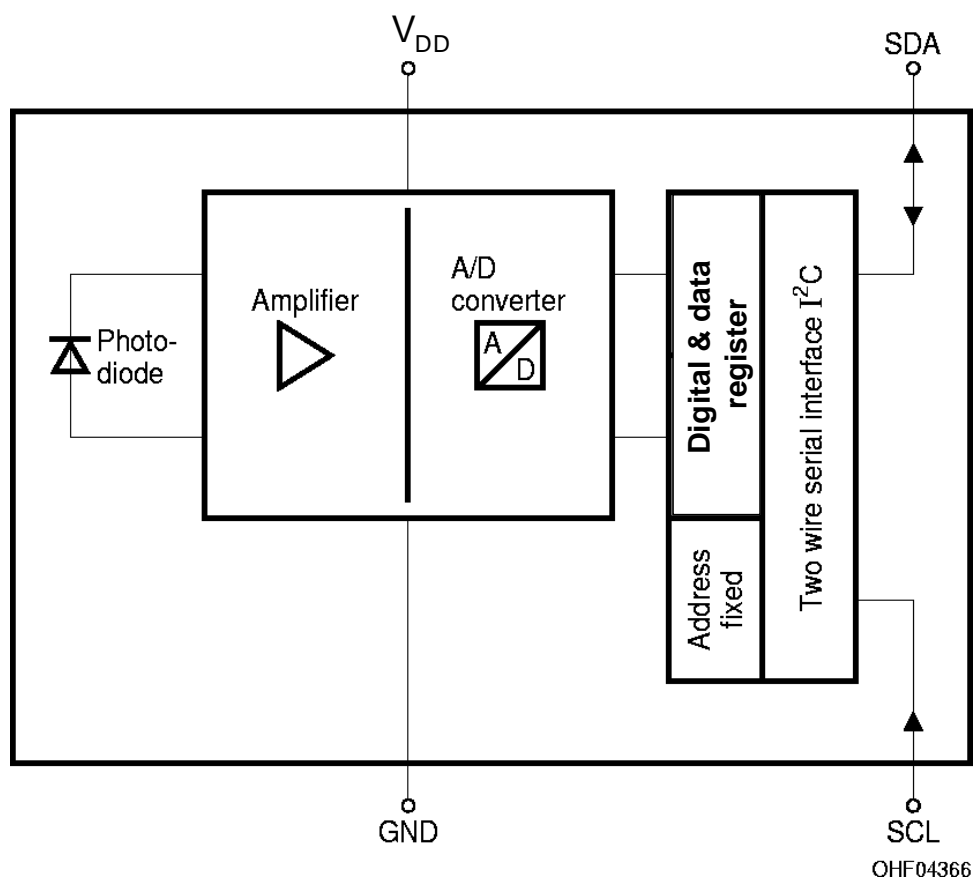


Figure 1 Circuitry

Pin functions

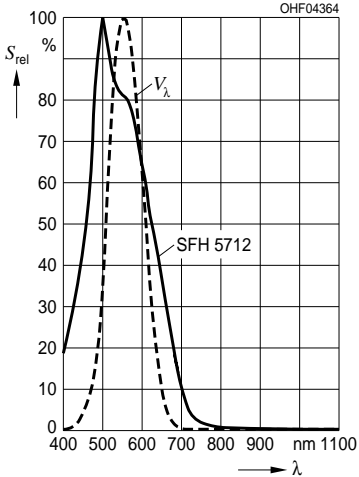
Pin	Description
V _{DD}	supply voltage
GND	ground
SCL	I ² C bus clock serial I/O terminal (SCL)
SDA	I ² C bus serial data I/O terminal (SDA)

Binning ($T_A = 25\text{ °C}$)

Parameter	Symbol	Value		Unit
		-2	-3	
Output signal $E_V = 1000\text{ lx}$ (white LED LW 541C)	<i>Out</i>	500...1000	800...1600	count

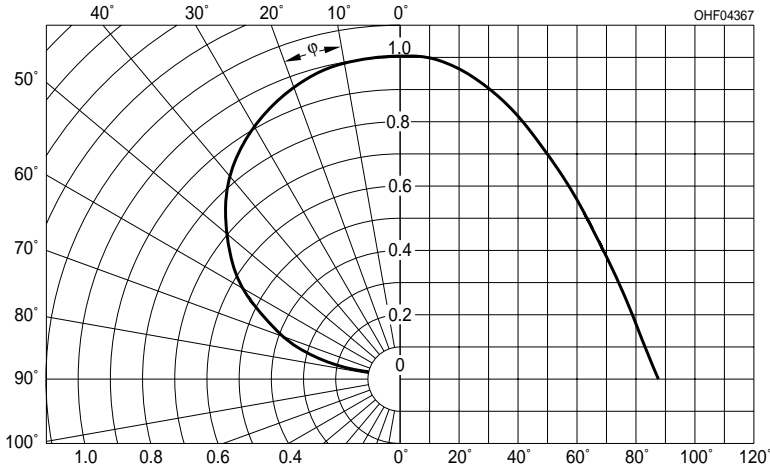
Relative Spectral Sensitivity

$S_{rel} = f(\lambda); T_A = 25\text{ }^\circ\text{C}$



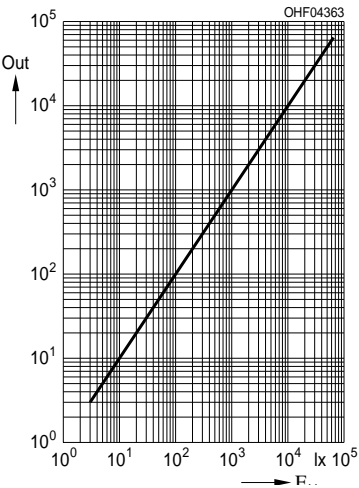
Directional Characteristics

$S_{rel} = f(\phi); T_A = 25\text{ }^\circ\text{C}$



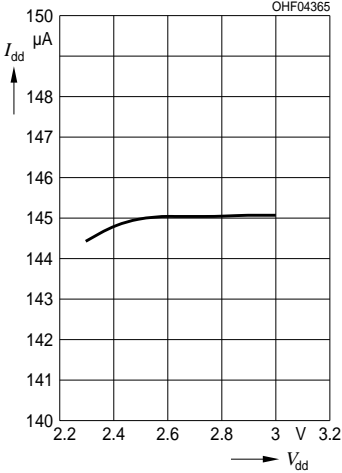
Output

$Out = f(E_V); T_A = 25\text{ }^\circ\text{C}$



Current Consumption

$I_{DD} = f(V_{DD}); T_A = 25\text{ }^\circ\text{C}; V_{DD} = 2.5\text{V};$
ACTIVE mode



Appendix 1: Flicker reduction and timing

Sensor is smoothing the output signal by averaging 32 single measurements. Flicker caused by artificial light sources e.g. from fluorescent lamps usually occurred at 100Hz or 120Hz. Oscillation of the optical input signal will be reduced by 13dB at the output for sinus signals (Definition is shown in figure 2). E.g. the sensor output variation will only be 5% of the optical input peak to peak variation from fluorescent light.

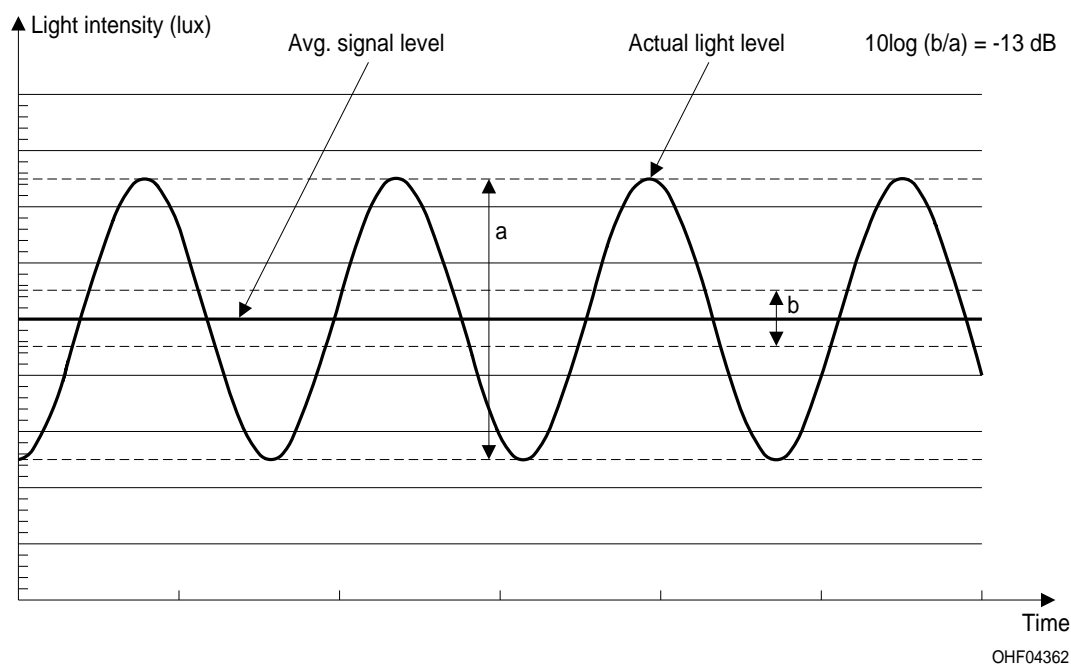


Figure 2 flicker reduction (average of 32 measurements)

To achieve the maximum flicker reduction performance only the 32fold averaged output value should be used, because flicker rejection and signal accuracy correlates with the number of averaged measurements.

Typically 186ms (max. 250ms) after sensor activation the first full averaged signal can be read at the sensor output. The output is refreshed already 3 times before with a reduced amount of averaged values. The first measurement (no averaging) result can be read at the output 1ms (max 1.5ms) after sensor activation followed by the average of 8 and 16 measurements (figure 3).

After the first full averaged measurement value the output will be refresh automatically every 565ms.

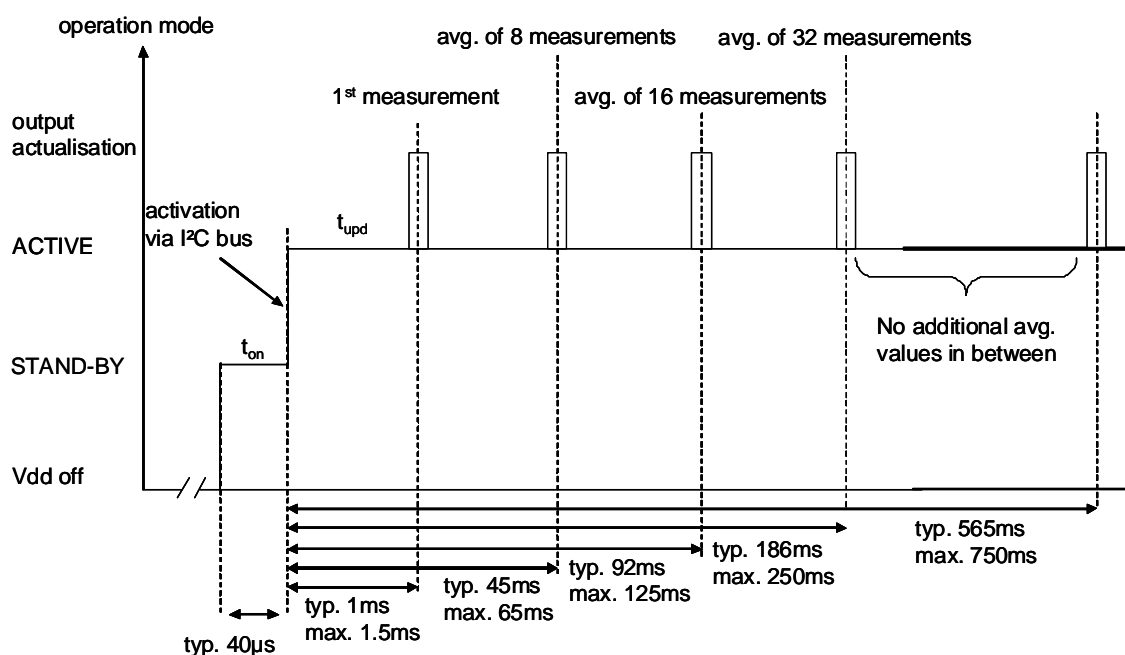


Figure 3: SFH 5712 averaging and timing

Appendix 2: Digital Interface characteristics

Interface and control is accomplished through a two-wire I²C bus serial interface. The sensor works in multi-master/multi-slave environment, multiple devices may be connected to the same bus. The device conforms to I²C interface specification version 3.0 Rev. 03 dated 19 June 2007.

<http://www.standardics.nxp.com/support/documents/i2c/pdf/ics.bus.specification.pdf>

The device implements the I²C write protocol as well as the I²C read (combined mode) protocol. In block read mode (as slave) the device will transmit registers in a cyclic manner until master issues a stop condition. E.g. if host uses block read and starts from register Ch, slave will return the following sequence of register values:

Ch, Dh, 0h, Ah, Bh, Ch, Dh, 0h,....

until host issues a stop condition.

The address counter always increases the register address after output of register content. This is also valid, if the device is powered down (stand-by mode) between readings.

Control of ambient lightsensor

R/W-Register 0x80									
Bit	7	6	5	4	3	2	1	0	
	not used					mode of ambient lightsensor			
default	00000					00 STAND-BY			
						00 STAND-BY			
						11 ACTIVE			

Part number and revision Identification

R-Register 0x8A										
Bit	7	6	5	4	3	2	1	0		
	Part number ID					Revision ID				
	1000					XXXX (start with 0001)				

Manufacturer Identification

R-Register 0x8B									
Bit	7	6	5	4	3	2	1	0	
	Manufacturer Identification								
	0000				0011				

Ambientlight measurement data (LSB 8bit)

R-Register 0x8C								
Bit	7	6	5	4	3	2	1	0
	LSB data							
default	00000000							

Ambientlight measurement data (MSB 8bit)

R-Register 0x8D								
Bit	7	6	5	4	3	2	1	0
	MSB data							
default	00000000							

The result of the ambient lightsensor is a 16bit word with MSB and LSB and is stored in two registers. The binary data can be converted directly to decimal „lx“ values (max. 65535lx)

The upper byte data registers can only be read following a read to the corresponding lower byte register. When the lower byte register is read, the upper bits are stored in a temporary register, which is read by a subsequent read to the upper byte. The upper register will read the correct value even if additional integration cycles end between the reading of the lower and upper registers.

Example:

DATALOW and DATAHIGH bits are combined to illuminance reading (33680 lux) as follows:

DATALOW = 90 (1001 0000)

DATAHIGH = 83 (1000 0011)

-> in hex: illuminance = (DATAHIGH <<8) + DATALOW = (83 <<8) + 90 = 8300 + 90 =
8390 = 33680 lux

-> in binary: illuminance = 1000 0011 combined with 1001 0000 = 1000 0011 1001 0000 = 33680 lx

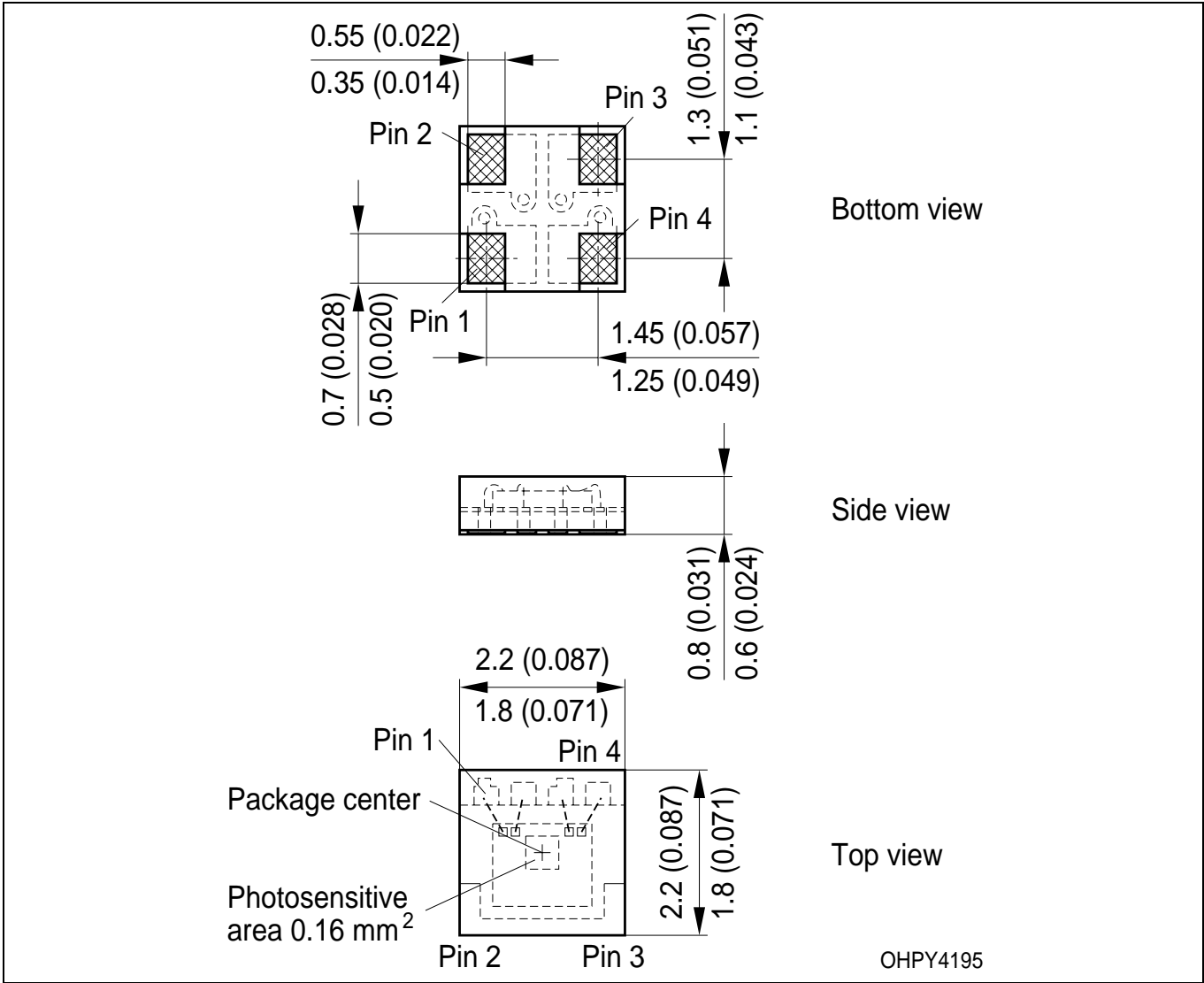
I2C bus address

7 bit sensor address

binary: 0101001 / hex: 29

If the I²C bus master sends a not specified register address (e.g. Eh see table 1), the device (slave) will not send ACK and go to an idle mode and wait for another command.

Package Outlines

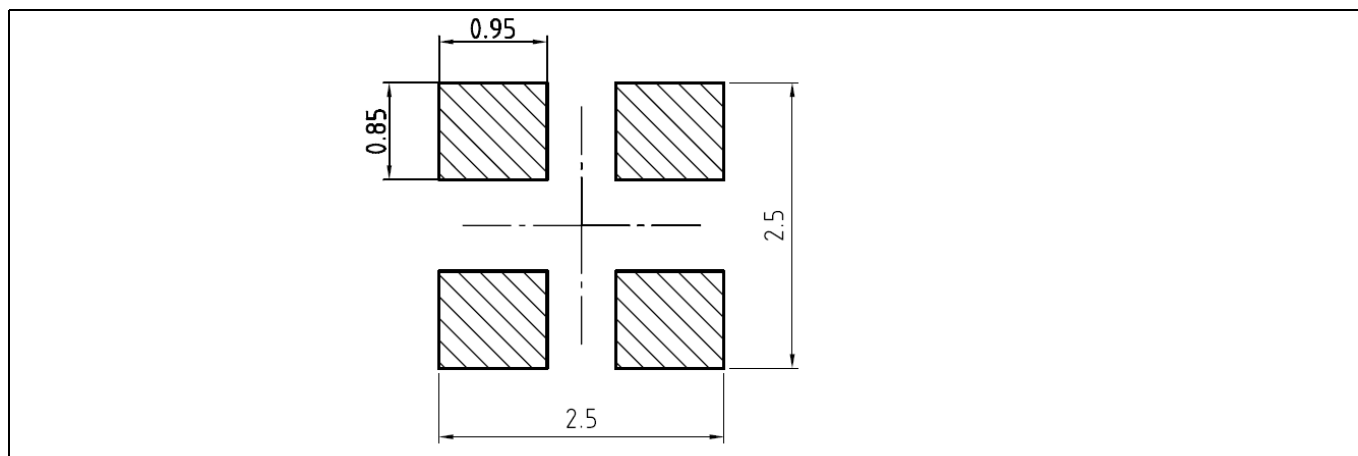


Dimensions in mm (inch)

Pin configuration

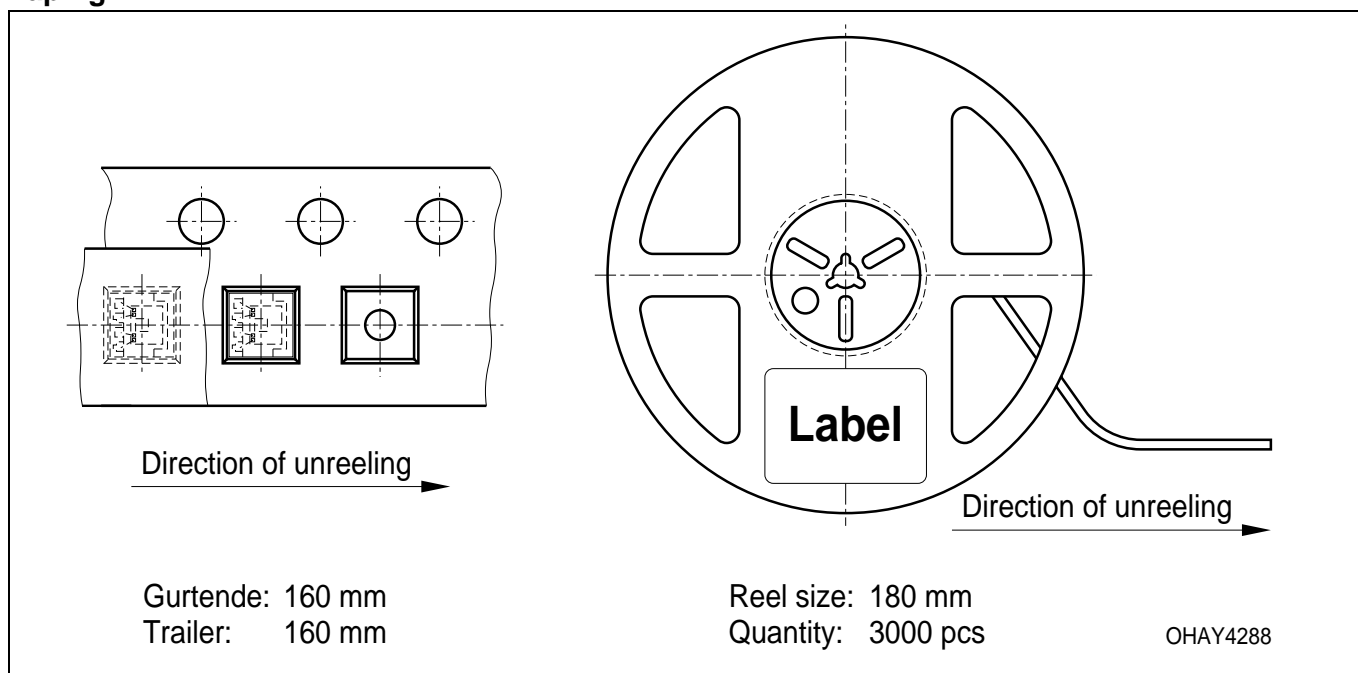
Pin #	Description
1	V _{DD}
2	GND
3	SDA
4	SCL

Recommended Solderpad Design



Dimensions in mm

Taping

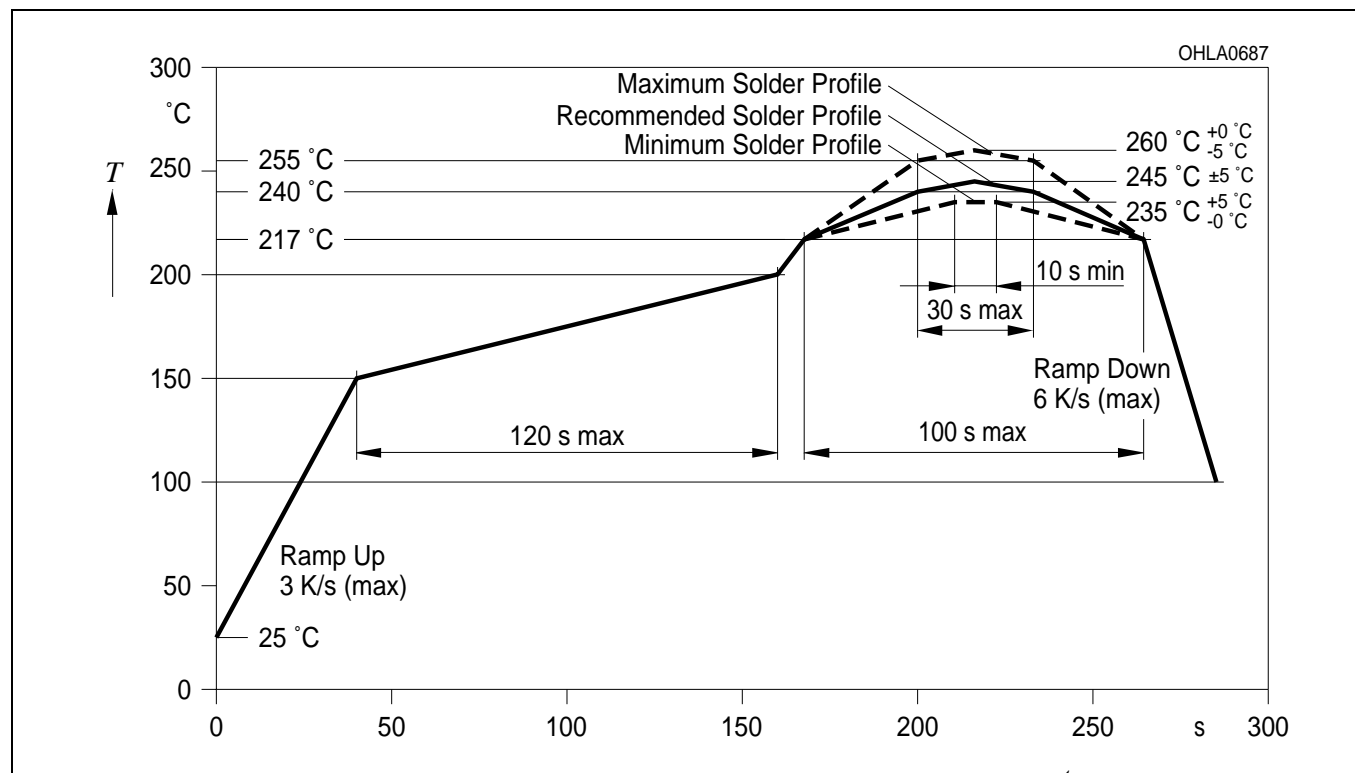


Soldering Conditions

Preconditioning acc. to JEDEC Level 3

Reflow Soldering Profile for lead free soldering

(acc. to J-STD-020C)



Published by
OSRAM Opto Semiconductors GmbH
 Leibnizstrasse 4, D-93055 Regensburg
www.osram-os.com

© All Rights Reserved.

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.

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 components¹, may only be used in life-support devices or systems² with the express written approval of OSRAM OS.

¹ 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 effectiveness of that device or system.

² 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 of the user may be endangered.

EU RoHS and China RoHS compliant product



此产品符合欧盟 RoHS 指令的要求；

按照中国的相关法规和标准，不含有毒有害物质或元素。