PH5551A2NA1-E4

Data Sheet

R08DS0037EJ0100
Rev.1.00
Aug 03, 2011

Ambient Illuminance Sensor

DESCRIPTION

The PH5551A2NA1-E4 is a digital ambient illuminance sensor for I^2C bus interfaces and includes a 16-bit AD converter. This product has spectral characteristics close to human eye sensitivity and outputs digital signals corresponding to the ambient brightness.

The PH5551A2NA1-E4 can be used to improve the performance and reduce the power consumption of digital equipment such as FPD TV sets and mobile phones, by enabling automatic brightness control and automatic switching on and off of lighting systems.

FEATURES

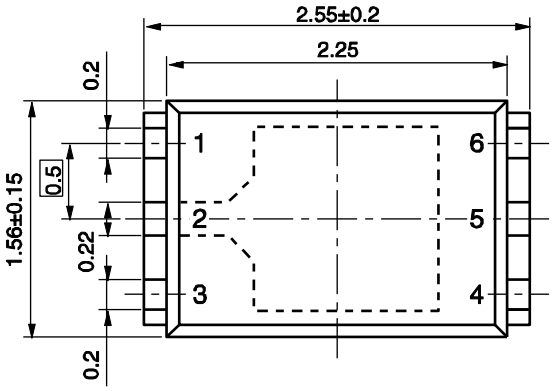
- Small and thin SON package 2.55 x 1.56 x 0.55 mm
- Built-in 16-bit AD converter
- I^2C bus interface
- Spectral characteristics close to human eye sensitivity
  Peak sensitivity wavelength 560 nm TYP.
- Wide illuminance range 1 to 65,535 lx
- I^2C slave address selectable 2 types
- Interrupt function
- Pb-free

APPLICATIONS

- FPD TV sets, displays
- Mobile phones, smartphones
- Notebook PCs, tablet PCs
- DSCs, DVCs
- FA equipments
- Lighting systems, etc.

PACKAGE DIMENSIONS (UNIT: mm)

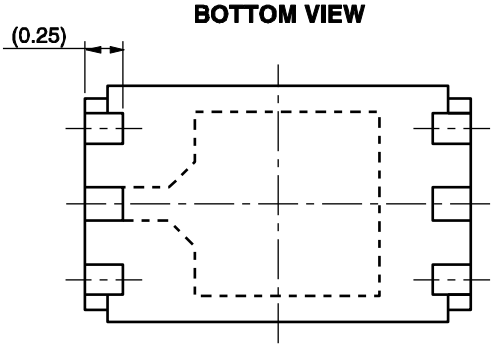
TOP VIEW



Remark Pin 1 is distinguishable by the shape of the lead frame.

SIDE VIEW

BOTTOM VIEW



Remark ( ) indicates nominal dimensions.

Pin No.	Terminal	I/O	Function
1	V_{DD}	–	Supply Voltage
2	GND	–	GND
3	ADDR_SEL	I	Slave Address (2 addresses selectable)
4	SCL	I	I^2C bus SCL
5	INT	O	Interrupt
6	SDA	IO	I^2C bus SDA

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C, unless otherwise specified)

Parameter	Symbol	Ratings	Unit
Supply Voltage	V_{DD}	4.5	V
Power Dissipation*1	P_D	135	mW
Operating Temperature	T_A	–30 to +85	°C
Storage Temperature	T_{stg}	–40 to +100	°C

Note: *1. Mounted on glass epoxy board (18 mm × 13 mm × t0.8 mm)

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V_{DD}	2.4	3.0	3.6	V

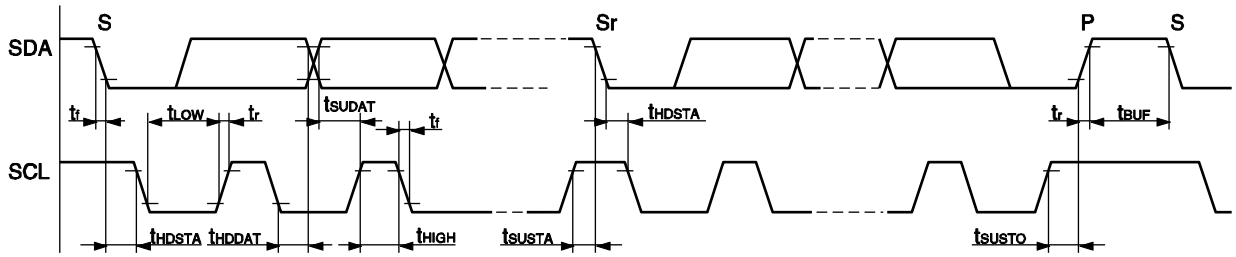
ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C, V_{DD} = 3.0 V, unless otherwise specified)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply Current 1	I_{DD1}	Ev = 100 lx *1		130	290	μA
Supply Current 2	I_{DD2}	Ev = 100 lx *1, power-down			1	μA
Dark Sensor Output	–	Ev = 0 lx			4	count
Peak Sensitivity Wavelength	λp			560		nm
H-Resolution Mode Resolution	HRM			1		lx
L-Resolution Mode Resolution	LRM			16		lx
Measurement Time in H-Resolution Mode	HRt			330	495	ms
Measurement Time in L-Resolution Mode	LRt			21	32	ms
I^2C SCL Clock Frequency	f_{SCL}				400	kHz
I^2C Bus Free Time	t_{BUF}		1.3			μs
I^2C Hold Time for START Condition	t_{HDSTA}		0.6			μs
I^2C Set-up Time for START Condition	t_{SUSTA}		0.6			μs
I^2C Set-up Time for STOP Condition	t_{SUSTO}		0.6			μs
I^2C Data Hold Time	t_{HDDAT}		0		0.9	μs
I^2C Data Set-up Time	t_{SUDAT}		100			ns
I^2C 'L' Period of the SCL Clock	t_{LOW}		1.3			μs
I^2C 'H' Period of the SCL Clock	t_{HIGH}		0.6			μs
I^2C 'L' Output Voltage at SDA	V_{OL}		0		0.4	V

Note: *1 Fluorescent light

I²C BUS INTERFACE SPECIFICATION

1. I²C Bus Interface Timing Chart



S :START Condition
Sr :Repeated START Condition
P :STOP Condition

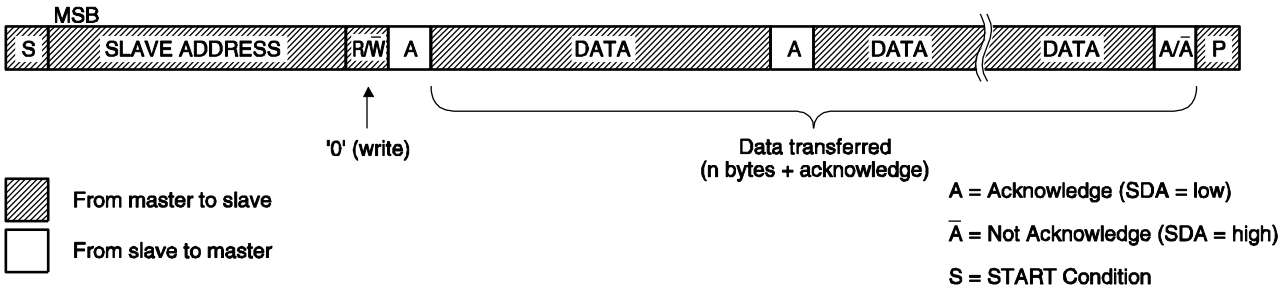
2. Slave Address

Two slave addresses are selectable. The slave address is determined by the ADDR_SEL pin.

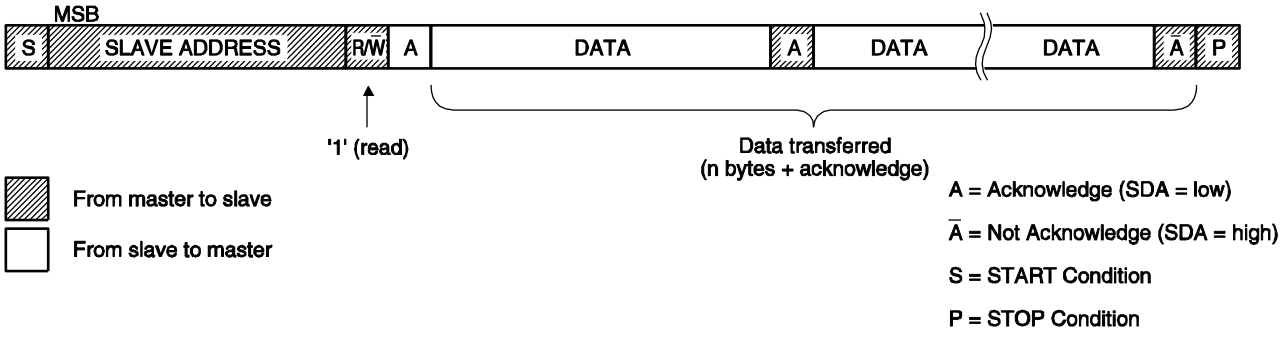
When ADDR_SEL = “H”, the address is “1100100”.
When ADDR_SEL = “L”, the address is “0111001”.

3. I²C Protocols

(1) Write Format



(2) Read Format



INSTRUCTION CODE AND REGISTER MAP

1. Instruction Code
   The instruction code is specified after the slave address.

0	1	0	1	0	0	0	0	Default
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
REG_SEL		AP_CNT		ADR_PTR			PWR *1	

Note: *1 There are two PWR bits, one in the instruction code and one in the control register. When one bit changes, the other bit also changes at the same time.

(1) REG_SEL: Register selection for Write or Read operation

Code	Register Address Selection	Write Operation	Read Operation
00	Control Register	Control Register	Control Register
01	Measurement Register	Control Register	Measurement Register
10	Measurement Register	–	Measurement Register

(2) AP_CNT: Address Pointer Control

Code	Description
00	The address is fixed to the register address specified by ADR_PTR.
01	The register address is incremented when one item of data is written or read.
10	If these bits are read after being written, the current register address is output.

(3) ADR_PTR: Register Address
Specify the address of the register to be written or read by using these 3 bits.

(4) PWR: Power On/Power Down
Power on/Power down (1: Power on)

2. Register Map

The register map is specified after the instruction code.

(1) Control Register

(a) Register Address: 000

0	0	0	0	0	0	0	0	Default
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Reserved	SWRST	INTCLR	INT_COND		RSLTN	INT_EN *2	PWR *1	

Notes: *1 There are two PWR bits, one in the instruction code and one in the control register. When one bit changes, the other bit also changes at the same time.

*2 There are two INT_EN bits in the control register. When one bit changes, the other bit also changes at the same time.

SWRST : Register reset (Initial values are restored by setting this bit to 1.)
INTCLR : Interrupt source clear (1: Clear interrupt source)
INT_COND : Interrupt result
(00: No comparison with threshold value; 01: Measured lux is lower than lower-limit threshold value;
11: Measured lux is higher than upper-limit threshold value.)
RSLTN : Resolution selection (1 lx/16 lx) (0: 1 lx resolution; 1: 16 lx resolution)
INT_EN : Interrupt enable/disable (1: Enable interrupts)
PWR : Power on/Power down (1: Power on)

(b) Register Address: 001

0	0	0	0	0	0	0	0	Default
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Lower interrupt generation threshold when interrupts are enabled - Lower 8 bits								

(c) Register Address: 010

0	0	0	0	0	0	0	0	Default
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Lower interrupt generation threshold when interrupts are enabled - Higher 8 bits								

(d) Register Address: 011

0	0	0	0	0	0	0	0	Default
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Upper interrupt generation threshold when interrupts are enabled - Lower 8 bits								

(e) Register Address: 100

0	0	0	0	0	0	0	0	Default
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Upper interrupt generation threshold when interrupts are enabled - Higher 8 bits								

(f) Register Address: 101

0	0	0	0	0	0	0	0	Default
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Reserved	Reserved	Reserved	STOP	INT_COUNT		INT_AT_RT	INT_EN*1	

Note: *1 There are two INT_EN bits in the control register. When one bit changes, the other bit also changes at the same time.

STOP : Stops lux measurement after the current ADC cycle. The lux data measured last is retained. The ADC enters standby mode.(1: Stop)

INT_COUNT : How many times the upper or lower threshold value is exceeded in succession before an interrupt signal is generated.
(00: Once; 01: 4 times; 10: 8 times; 11: 16 times)

INT_AT_RT : Automatic restoration from interrupt enable/disable
(0: Processing automatically restored; 1: Processing not automatically restored (restored after the interrupt is cancelled by the system))

INT_EN : Interrupt enable/disable (0: Disable interrupts; 1: Enable interrupts)

3. Measurement Register

(a) Register Address: 000

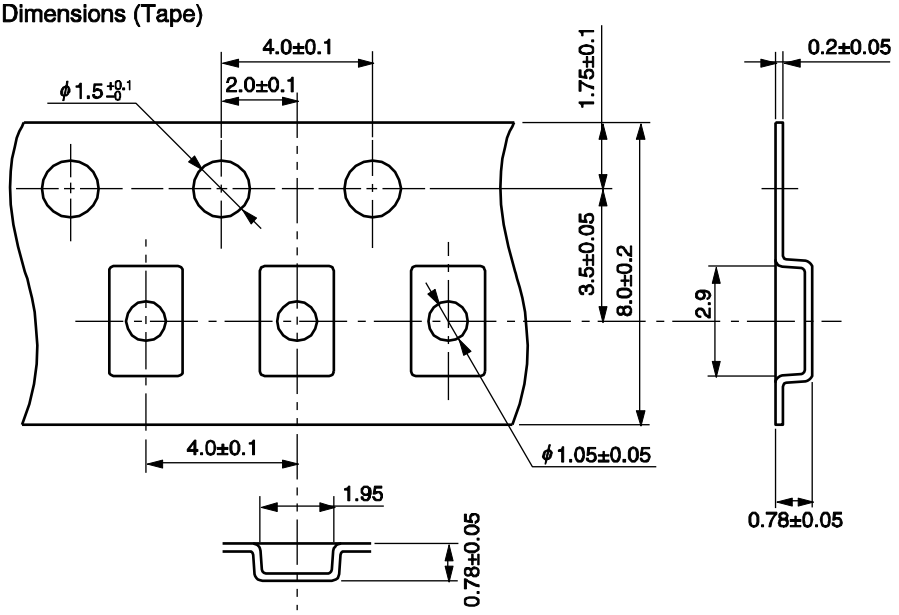
0	0	0	0	0	0	0	0	Default
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Measurement of lux - lower 8 bits (read only)								

(b) Register Address: 001

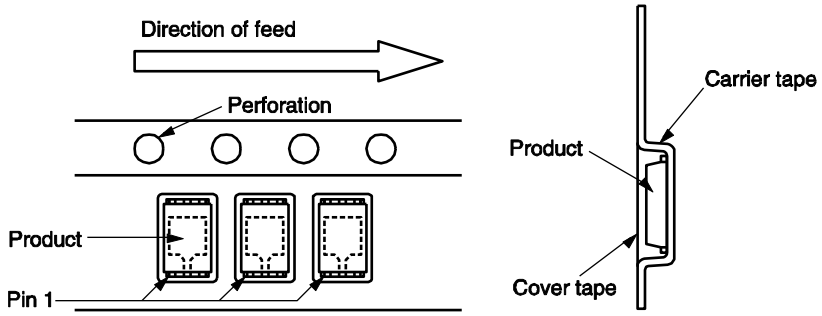
0	0	0	0	0	0	0	0	Default
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Measurement of lux - higher 8 bits (read only)								

TAPING SPECIFICATIONS (UNIT: mm)

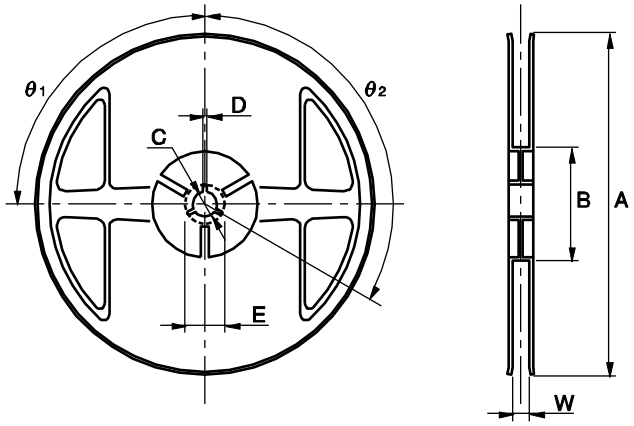
Outline and Dimensions (Tape)



Tape Direction



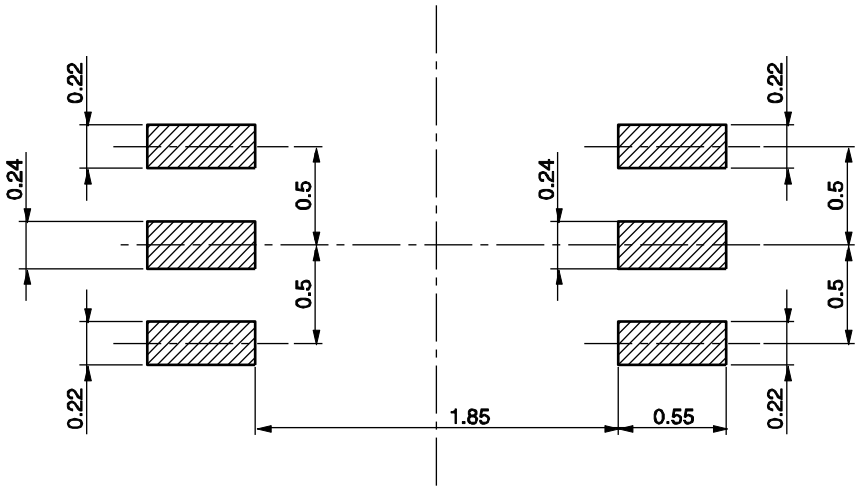
Outline and Dimensions (Reel)



Symbol	Dimensions (mm)
A	φ180 +0 −1.5
B	φ60 +1 −0
W	9.0 +1 −0

Symbol	Dimensions (mm)
C	φ13±0.2
D	2.0±0.5
E	21.0±0.8
θ1	90°
θ2	120°

RECOMMENDED MOUNT PAD DIMENSIONS (Unit: mm)



Remark All dimensions in this figure must be evaluated before use.

NOTES ON HANDLING

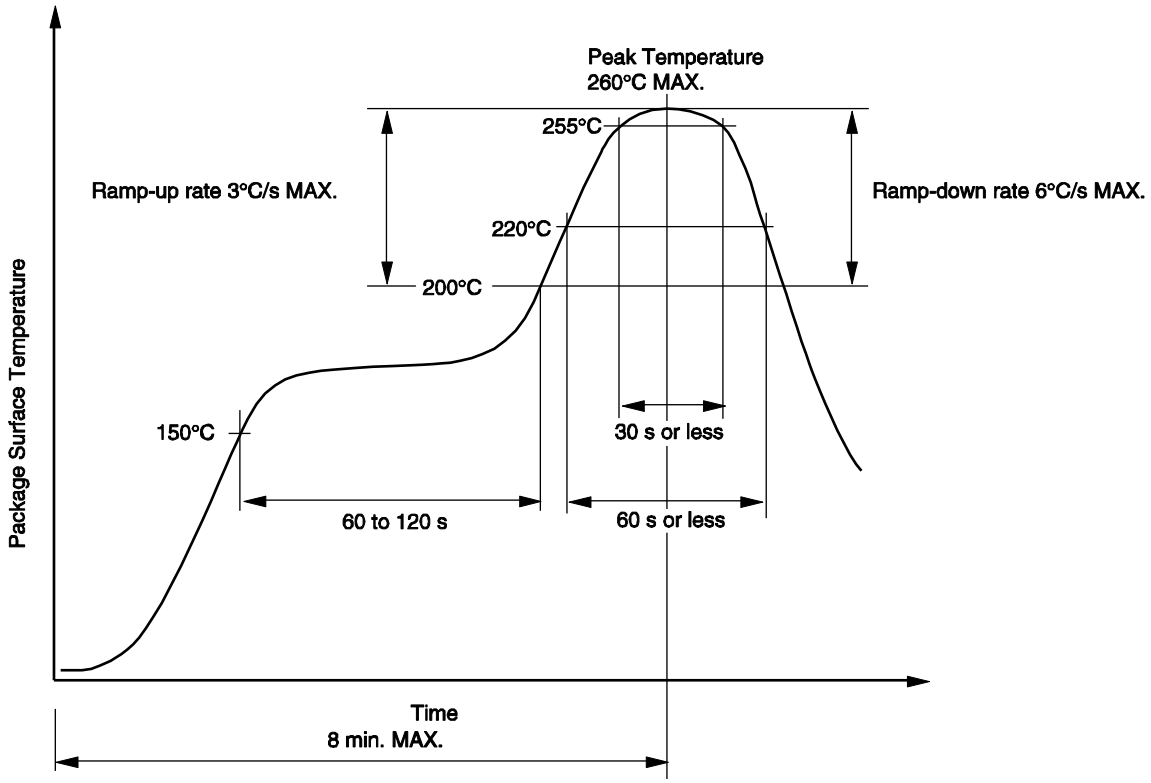
1. Recommended reflow soldering conditions
   (including infrared reflow, convection reflow, and infrared + convection reflow)

   (1) This product is dry-packed with desiccant in order to avoid moisture absorption.
   (2) After breaking the seal, reflow soldering must be done within 168 hours under the recommended temperature profile shown below.
   (3) If more than 168 hours have passed after breaking the seal, the baking process must be done by using a tape and reel.
   Baking conditions: Once, with tape and reel, 60±5°C, 10 to 24 hours
   After the baking process, this product must be stored under conditions of 30°C or below, 70% RH or below, and reflow soldering must be done within 168 hours.

   <Storage conditions after breaking seal>
   - Storage conditions : 30°C or below, 70% RH or below
   - Maximum storage period after breaking seal : 168 hours (Second reflow soldering must be completed within 168 hours.)

   <Reflow soldering conditions>
   - Peak reflow temperature : 260°C or below (Package surface temperature)
   - Maximum number of reflows : 2
   - No repair by hand soldering
   - Maximum chlorine content of rosin flux (percentage mass) : 0.2% or less

Recommended Temperature Profile of Reflow



Revision History	PH5551A2NA1-E4 Data Sheet

Rev.	Date	Description	
		Page	Summary
1.00	Aug 03, 2011	–	First edition issued