

ROHM Electronic Components

Ambient Light Sensor IC Series Digital 16bit Serial Output Type

Ambient Light Sensor IC

BH1780GLI

No.09046EAT08

Descriptions

BH1780GLI is an digital Ambient Light Sensor IC for I^2C bus interface. This IC is the most suitable to obtain the ambient light data for adjusting LCD and Keypad backlight power of Mobile phone. It is possible to detect wide range at High resolution. (1 - 65535 lx).

Features

- 1) I²C bus Interface (F/S mode & Hs mode Support, Slave address : "0101001")
- 2) Spectral responsibility is approximately human eye response
- 3) Illuminance to Digital Converter
- 4) Wide range and High resolution. ($1-65535 \mbox{ lx}$)
- 5) Low Current by power down function
- 6) 50Hz / 60Hz Light noise reject-function
- 7) 1.8V Logic input interface
- 8) No need any external parts

9) Light source dependency is little. (ex. Incandescent Lamp. Fluorescent Lamp. Halogen Lamp. White LED. Sun Light)

10) Small measurement variation (+/- 20%)

11) The influence of infrared is very small.

Applications

Mobile phone, LCD TV, NOTE PC, Portable game machine, Digital camera, Digital video camera, Car navigation, PDA, LCD display

• Absolute Maximum Ratings

Parameter	Symbol	Limits	Units
Supply Voltage	Vmax	4.5	V
Operating Temperature	Topr	-40~85	°C
Storage Temperature	Tstg	-40~100	°C
SDA Sink Current	Imax	7	mA
Power Dissipation	Pd	120※	mW

% 70mm \times 70mm \times 1.6mm glass epoxy board. Derating in done at 1.6mW/°C for operating above Ta=25°C.

• Operating Conditions

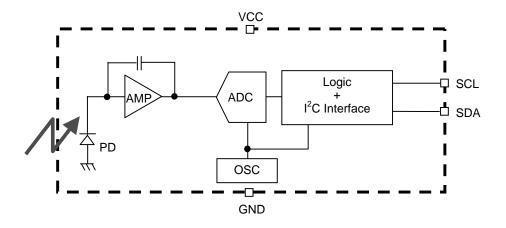
Parameter	Symbol	Min.	Тур.	Max.	Units
VCC Voltage	Vcc	2.3	2.5	3.0	V

• Electrical Characteristics (VCC = 2.5V, Ta = 25°C, unless otherwise noted)

Parameter	Symbol	Min.		Max.	Units	Conditions
Supply Current	Icc1		Тур. 120	200	uA	Ev=100 lx ※
Powerdown Current	lcc2	_	0.7	2.5	uA	No Input Light
Measurement Accuracy	S/A	0.8	1.0	1.2	Times	Sensor out / Actual Ix Ev=1000 Ix ※
Dark (0 lx) Sensor out	SO	0	0	2	count	
Measurement Time	tM	_	150	250	ms	
SCL SDA input 'H' Voltage	VIH	1.26	_	_	V	
SCL SDA input 'L' Voltage	VIL		_	0.54	V	
SCL SDA input 'H' / 'L' Current		-10		10	uA	
I ² C SDA Output 'L' Voltage	V _{OL1}	0	-	0.4	V	IOL=3 mA
I ² C Rejected Spike pulse witdh	t _{SP}	-	100	-	ns	F/S mode
I ² C Rejected Spike pulse witdh2	t _{SP}	-	20	-	ns	Hs mode
SDA SCL Capacitance	Ci	-	7	-	pF	
I ² C SCL Clock Frequency	f _{SCL}	-	_	400	kHz	F/S mode
I ² C SCL Clock Frequency2	f _{SCLH}	0	-	3.4	MHz	Hs mode Cb=100pF
I ² C Hold Time (Repeated) START Condition	t _{HD;STA}	0.6	_	_	us	F/S mode
I ² C Hold Time (Repeated) START Condition2	t _{HD;STA}	160	-	-	ns	Hs mode
I ² C 'L' Period of the SCL Clock	t _{LOW}	1.3	-	_	us	F/S mode
I ² C 'L' Period of the SCL Clock2	t _{LOW}	160	-	-	ns	Hs mode
I ² C 'H' Period of the SCL Clock	t _{HIGH}	0.6	_	_	us	F/S mode
I ² C 'H' Period of the SCL Clock2	t _{HIGH}	60	_	-	ns	Hs mode
I ² C Set up time for a Repeated START Condition	t _{SU;STA}	0.6	_	_	us	F/S mode
I ² C Set up time for a Repeated START Condition2	t _{SU;STA}	160	_	_	ns	Hs mode
I ² C Data Hold Time	t _{HD;DAT}	0	—	-	us	F/S mode
I ² C Data Hold Time2	t _{HD;DAT}	0	-	70	ns	Hs mode Cb=100pF
I ² C Data Setup Time	t _{SU;DAT}	100	-	_	ns	F/S mode
I ² C Data Setup Time2	t _{SU;DAT}	10	-	_	ns	Hs mode
I ² C Set up Time for STOP Condition	t _{su;sто}	0.6	-	-	us	F/S mode
I ² C Set up Time for STOP Condition2	t _{su;sto}	160	-	-	ns	Hs mode
I ² C Bus Free Time between a STOP and START Condition	t _{BUF}	1.3	-	-	us	
I ² C Data Valid Time	$t_{VD;DAT}$	-	-	0.9	us	F/S mode
I ² C Data Valid Acknowledge Time	t _{VD;ACK}	-	-	0.9	us	F/S mode
* White LED is used as optical s	Sourco		•	•	•	

 $\,\, \ensuremath{\mathbb{X}}$ White LED is used as optical source.

Block Diagram



• PD

Photo diode with approximately human eye response.

• AMP

Integration-OPAMP for converting from PD current to voltage.

ADC

AD converter for obtainment digital 16bit data.

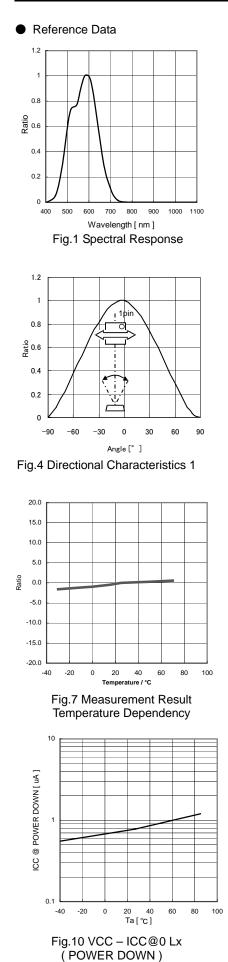
• Logic + I²C Interface

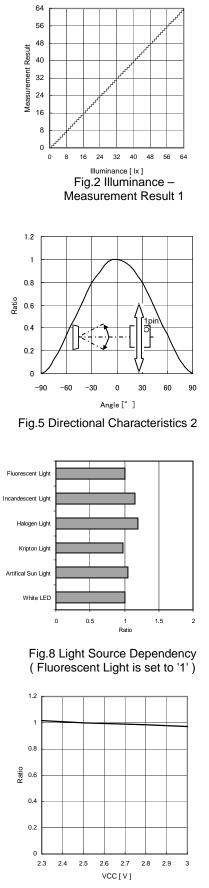
Ambient Light Calculation and I²C bus Interface. It is including below register.

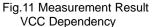
Data Register \rightarrow This is for registration of Ambient Light Data. Initial Value is "0000_0000_0000_0000".

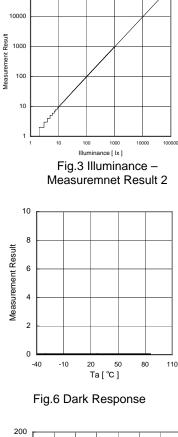
• OSC

Internal Oscillator (typ. 320kHz). It is CLK for internal logic.









100000

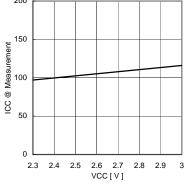


Fig.9 VCC – ICC (During measurement)

Command Set

Address	Register name	Register function
	COMMAND	Specifies register address
0h	CONTROL	Control of basic functions
Ah	PART ID	Part ID
Bh	MANUFACTURE ID	Manufacture ID
Ch	DATALOW	Low byte of ADC
Dh	DATAHIGH	High byte of ADC

O Command Register

7	6	5	4	3	2	1	0
CMD	XXX				ADDF	RESS	

default value 00h

Field	Bit	Description
CMD	7	Write 1
xxx	6 : 4	Write "000" Don't care if ADDRESS(Command Register< 3 : 0 >) is "0h" or "Ah" or "Bh" or "Ch" or "Dh".
ADDRESS	3:0	Register address

O Control Register (0h)

7	6	5	4	3	2	1	0
RES	RES	RES	RES	RES	RES	POV	VER

default value 00h

Field	Bit	Description
RES	7:2	Write "000000"
POWER	1:0	"00" : Power down "01" : Resv "10" : Resv "11" : Power up

O PART ID Register (Ah)

The PART ID register provides device identification. It is a read only register.

7	6	5	4	3	2	1	0
	PART NO				RI	ΞV	

Field	Bit	Description
PARTNO	7:4	"1000"
REV	3:0	"0001"

O MANUFATCURE ID Register (Bh)

The MANUFACTURE ID register provides device identification. It is a read only register.

7	6	5	4	3	2	1	0
MANUFACTURE ID							

Field	Bit	Description
MANUFACTURE ID	7:0	"00000001"

O ADC channel data registers (Ch, Dh)

Illuminance data register.

ĺ	7	6	5	4	3	2	1	0
ĺ				CHANN	NEL DATA			

Register	Address	Bit	Description
DATALOW	Ch	7:0	Lower byte
DATAHIGH	Dh	7:0	Upper byte

Lux calculation

Measurement result is registered to ADC channel data registers(Ch, Dh) in below format.

DATALOW (Ch)

7	6	5	4	3	2	1	0
2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰

DATAHIGH (Dh)

7	6	5	4	3	2	1	0
2 ¹⁵	2 ¹⁴	2 ¹³	2 ¹²	2 ¹¹	2 ¹⁰	2 ⁹	2 ⁸

This is an example for DATA to Lux convertion when DATA Register values are seeing in below condition.

ex)

DATA Low Byte = "1001_0000" DATA High Byte = "1000_0011"

 $(2^{15} + 2^9 + 2^8 + 2^7 + 2^4) \doteq 33680 [lx]$

Measurement sequence example from "Write instruction" to "Read measurement result"



① Send Power up instruction.

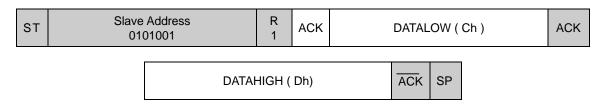
ST	Slave Address 0101001	W 0	ACK	Command Register 10000000	ACK
	0.0.001				

2 Change ADDRESS Field of Control Register to Ch(DATALOW).

ST	Slave Address 0101001	W 0	ACK	Command Register 10001100	ACK	SP
----	--------------------------	--------	-----	------------------------------	-----	----

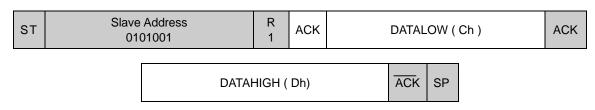
Wait 150ms until Measurement result is output.

③ Read measurement result.



④ Wait 150ms until measurement result is updated.

5 Read measurement result.



6 Send Power down instruction

ST	Slave Address 0101001	W 0	ACK	С	ommar 100	nd Reg 00000	-	АСК
							_	
		Control Register(0h) 00000000				SP		

I²C Bus Communication

1) Slave Address "0101001"

2) Main write Format

1. Write to Command Register

ST	Slave Address 0101001	W 0	АСК	Data to Command Register 1000XXXX	АСК	SP
----	--------------------------	--------	-----	--------------------------------------	-----	----

2. Write to Control Register

ST	Slave Address 0101001	W 0	ACK	Data to Control Register 000000XX	ACK	SP
----	--------------------------	--------	-----	--------------------------------------	-----	----

% Data<7:2> must be "000000"

* Data<7:4> must be "1000"

% It is necessary that ADDRESS Field of Command Register must set "0000".

3. Write to Command Register and Control Register

ST	Slave Address 0101001	W 0	ACK	Command Register 1000XXXX	ACK
----	--------------------------	--------	-----	------------------------------	-----

3) Main read Format

ST	Slave Address 0101001	R 1	ACK	Data specified at ADDRESS Field of Command Register	ACK	
----	--------------------------	--------	-----	--	-----	--

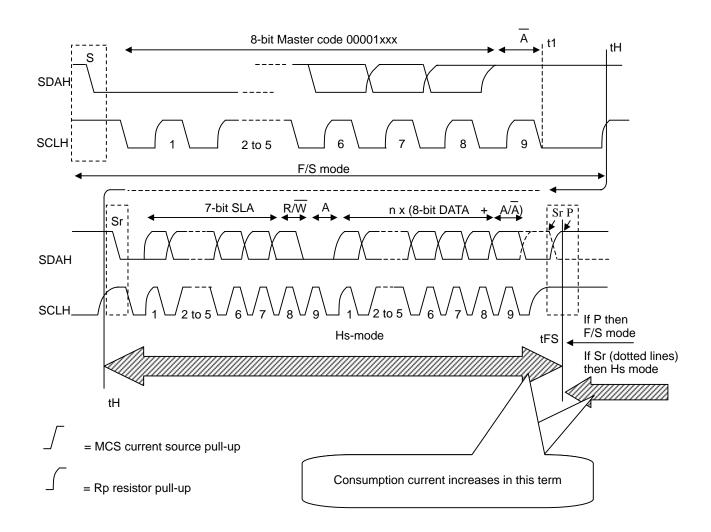
Data specified at ADDRESS Field of Command Register+1	АСК		ACK	Data specified at ADDRESS Field of Command Register +N	IACK	SP
--	-----	--	-----	---	------	----

0h - Ah - BH1780GLI outputs Data from specified ADDRESS Field of Command Register until Master issues stop condition.Read cycle is Bh - Ch - Dh - 0h - Ah - Bh - Ch - Dh

ex) If ADDRESS Field of Command Register is Ch, then BH1780GLI outputs data like seeing in below. Ch - Dh - Ah - Bh - Ch - Dh - Ah It is continued until Master issues stop condition. 4) High speed mode

BH1780GLI supports I²C bus High speed mode (Hs-mode). Approximately 80uA is consumped when I²C bus is set at Hs-mode. Typical consumption current is seeing in below table.

State	F/S mode	Hs-mode	unit
Power down	0.7	80	uA
Power up	120	200	uA



Caution of power on reset function

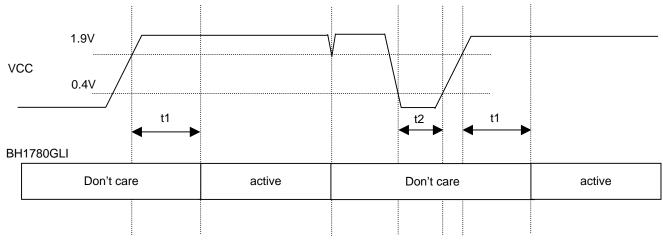
BH1780GLI has power on reset (POR) function. POR is to reset all register and flip flop when VCC Power supplies. There is some cautions about power on and down sequence seeing in below.

① Power on time : t1

More than 2ms is need to active BH1780GLI after VCC supplies more than 1.9V from VCC is less than 0.4V.

2 Power off time : t2

More than 1ms (VCC < 0.4V) is need to active BH1780GLI.

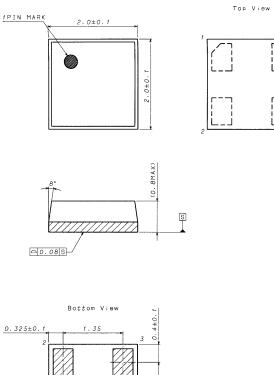


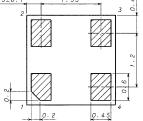
*"active state" is that BH1780GLI works and accept $\mathsf{I}^2\mathsf{C}$ bus access correctly.

Terminal Description

PIN No.	Terminal Name	Equivalent Circuit	Function
1	VCC		Power Supply Terminal
2	GND		GND Terminal
3	SDA		I ² C bus Interface SDA Terminal
4	SCL		I ² C bus Interface SCL Terminal

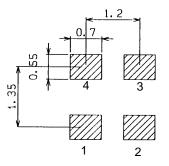
Package Outlines





(UNIT:mm)

• Recommended Land pattern (Top view)



Cautions on use

1) Absolute Maximum Ratings

An excess in the absolute maximum ratings, such as supply voltage (Vmax), temperature range of operating conditions (Topr), etc., can break down devices, thus making impossible to identify breaking mode such as a short circuit or an open circuit. If any special mode exceeding the absolute maximum ratings is assumed, consideration should be given to take physical safety measures including the use of fuses, etc.

2) GND voltage

Make setting of the potential of the GND terminal so that it will be maintained at the minimum in any operating state. Furthermore, check to be sure no terminals are at a potential lower than the GND voltage including an actual electric transient.

3) Short circuit between terminals and erroneous mounting

In order to mount ICs on a set PCB, pay thorough attention to the direction and offset of the ICs. Erroneous mounting can break down the ICs. Furthermore, if a short circuit occurs due to foreign matters entering between terminals or between the terminal and the power supply or the GND terminal, the ICs can break down.

4) Operation in strong electromagnetic field

Be noted that using ICs in the strong electromagnetic field can malfunction them.

5) Inspection with set PCB

On the inspection with the set PCB, if a capacitor is connected to a low-impedance IC terminal, the IC can suffer stress. Therefore, be sure to discharge from the set PCB by each process. Furthermore, in order to mount or dismount the set PCB to/from the jig for the inspection process, be sure to turn OFF the power supply and then mount the set PCB to the jig. After the completion of the inspection, be sure to turn OFF the power supply and then dismount it from the jig. In addition, for protection against static electricity, establish a ground for the assembly process and pay thorough attention to the transportation and the storage of the set PCB.

6) Input terminals

In terms of the construction of IC, parasitic elements are inevitably formed in relation to potential. The operation of the parasitic element can cause interference with circuit operation, thus resulting in a malfunction and then breakdown of the input terminal. Therefore, pay thorough attention not to handle the input terminals; such as to apply to the input terminals a voltage lower than the GND respectively, so that any parasitic element will operate.

7) Thermal design

Perform thermal design in which there are adequate margins by taking into account the power dissipation (Pd) in actual states of use.

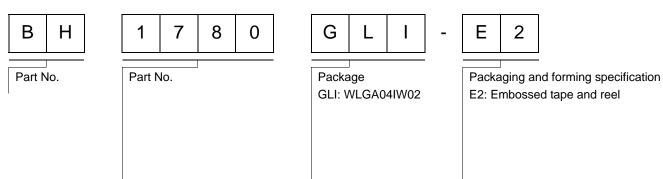
8) Treatment of package

Dusts or scratch on the photo detector may affect the optical characteristics. Please handle it with care.

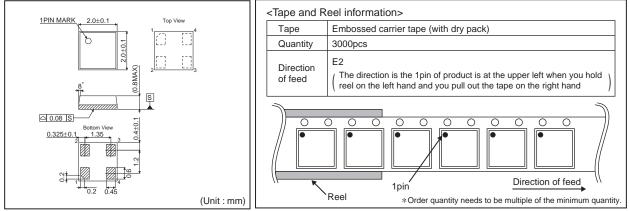
9) Rush current

When power is first supplied to the CMOS IC, it is possible that the internal logic may be unstable and rush current may flow instantaneously. Therefore, give special consideration to power coupling capacitance, power wiring, width of GND wiring, and routing of connections.

Ordering part number



WLGA04IW02



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