

## System LED Drivers for Mobile Phones

# ALC\* PWM controller



(\*ALC : Auto Luminous Control)

### BD6092GU

No.09041EAY08

#### ●Description

BD6092GU is the Auto Luminous Control IC, which adjusts PWM duty by surrounding ambient light. Analog ambient light sensor is connected, and Auto Luminous Control does the automatic adjustment of the PWM output duty by surrounding ambient light. By connecting to the LED driver's control port, it can decrease the power consumption of the back light system. It is possible to input the external PWM signal, and it can be mixed to PWM output. This IC achieves compact size with the CSP package. (VCSP85H2).

#### ●Features

- 1) Ambient Light Sensor interface  
Main backlight can be controlled by ambient brightness.  
Photo Diode, Photo Transistor, Photo IC(Linear/Logarithm) can be connected.  
Bias source for ambient light sensor, ADC with an average filter, LOG conversion function, gain and offset
- 2) adjustment are built in.  
PWM duty as ambient level can be customized.  
Automatic gain control function can reduce sensor current at high brightness, and sensitivity up at dark brightness.  
It can be input the external PWM. Output is mixed internal PWM and external PWM.
- 3) UVLO Function
- 4) I<sup>2</sup>C BUS Fast-mode protocol compatible(max 400kHz)
- 5) Package : VCSP85H2 (2.8mm<sup>2</sup>, 0.5mm pitch) CSP package

\*This chip is not designed to protect itself against radioactive rays.

\*This material may be changed on its way to designing.

\*This material is not the official specification.

#### ●Absolute Maximum Ratings (Ta=25 °C)

Parameter	Symbol	Limits	Unit
Maximum voltage	VMAX	7	V
Power Dissipation	Pd	1250 (note)	mW
Operating Temperature Range	Topr	-40 ~ +85	°C
Storage Temperature Range	Tstg	-55 ~ +150	°C

note)Power dissipation deleting is 10mW/°C, when it's used in over 25 °C.(It's deleting is on the board that is ROHM's standard)

#### ●Operating conditions (VBAT ≥ VIO, Ta=-40~85°C)

Parameter	Symbol	Limits	Unit
VBAT input voltage	VBAT1,2	2.7 ~ 5.5	V
VIO pin voltage	VIO	1.65 ~ 3.3	V

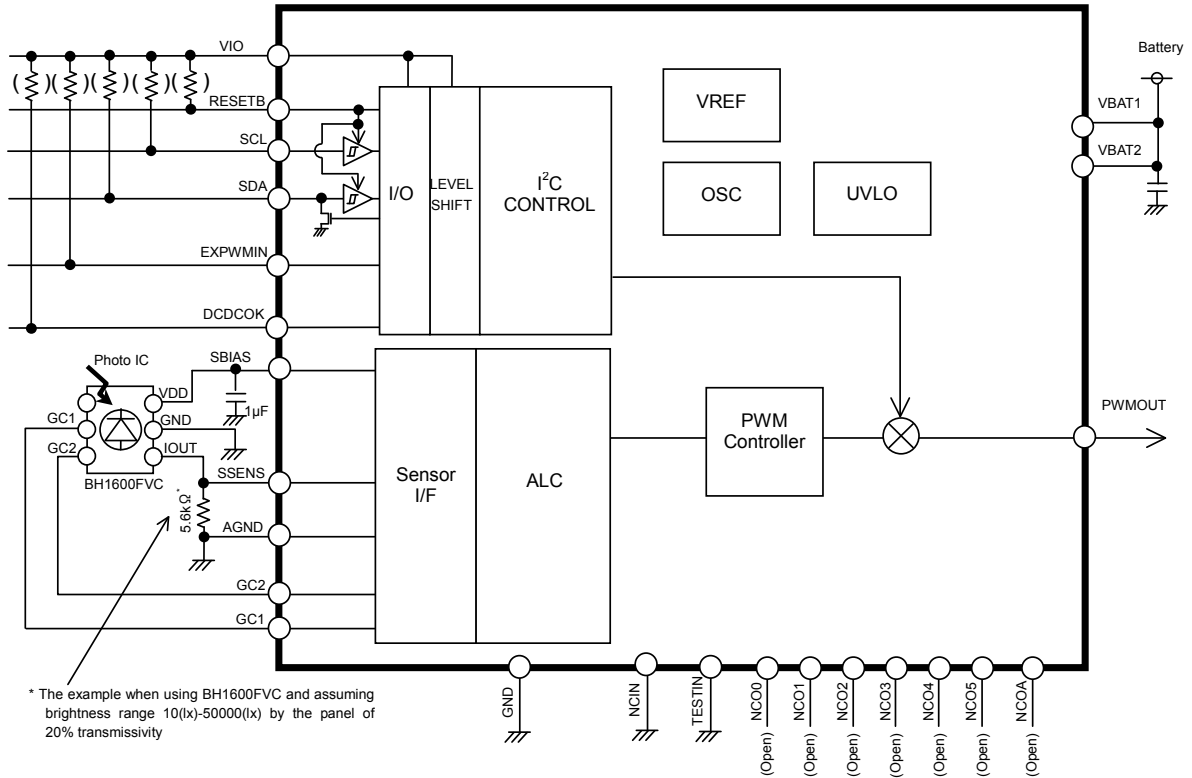
Note1) Using at VBAT ≥ VIO condition

Note2) Using at same voltage VBAT1 and VBAT2

**●Electrical Characteristics (Unless otherwise specified, Ta=25°C, VBAT=3.6V, VIO=1.8V)**

Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
<b>【Circuit Current】</b>						
VBAT Circuit Current 1	IBAT1	-	0.1	3.0	μA	RESETB=0V, VIO=0V
VBAT Circuit Current 2	IBAT2	-	0.5	3.0	μA	RESETB=0V, VIO=1.8V
VBAT Circuit Current 3	IBAT3	-	0.17	1.0	mA	ALC block ON, ADCYC=0.5s setting. Except sensor current
<b>【Sensor Interface】</b>						
SBIAS Output voltage	VoS	2.85	3.0	3.15	V	Io=200μA
		2.47	2.6	2.73	V	Io=200μA
SBIAS Output current	IomaxS	30	-	-	mA	Vo=2.6V setting
SBIAS Discharge resistor at OFF	ROFFS	-	1.0	1.5	kΩ	
SSENS Input range	VISS	0	-	VoS× 255/256	V	
ADC resolution	ADRES	8			bit	
ADC Integral non-linearity error	ADINL	-3	-	+3	LSB	
ADC differential non-linearity error	ADDNL	-1	-	+1	LSB	
<b>【OSC】</b>						
Oscillation frequency	FOSC	0.8	1.0	1.2	MHz	
<b>【UVLO】</b>						
UVLO detect voltage	VUVLO1	1.5	1.95	-	V	VBAT fall down
UVLO un-detect voltage	VUVLO2	-	2.15	2.65	V	VBAT rise up
UVLO detect voltage hysteresis	UVLOHYS	50	200	-	mV	
<b>【SDA, SCL】 (I<sup>2</sup>C interface)</b>						
Input L level voltage	VILI	-0.3	-	0.25 × VIO	V	
Input H level voltage	VIHI	0.75 × VIO	-	VBAT +0.3	V	
Hysteresis of Schmitt trigger input	Vhysl	0.05 × VIO	-	-	V	
Output L level voltage	VOLI	0	-	0.3	V	SDA, IOL=3 mA
Input current	Iinl	-10	-	10	μA	Input voltage= 0.1×VIO~0.9×VIO
<b>【RESETB, EXPWMIN】 (CMOS input)</b>						
Input L level voltage	VIL	-0.3	-	0.25 × VIO	V	
Input H level voltage	VIH	0.75 × VIO	-	VBAT +0.3	V	
Input current	Iin	-10	-	10	μA	Input volage= 0.1×VIO~0.9×VIO
PWM input frequency range	fpwm	-	-	1000	kHz	PWMIN, Duty=50% input
<b>【DCDCOK】 (CMOS input)</b>						
Input L level voltage	VIL	-0.3	-	0.25 × VIO	V	
Input H level voltage	VIH	0.75 × VIO	-	VBAT +0.3	V	
Input current	Iin	-10	-	10	μA	Input voltage= 0.1×VIO~0.9×VIO
<b>【PWMOUT】 (CMOS output)</b>						
Output L level voltage	VOLPW	-	-	0.2	V	IOL=1mA
Output H level voltage	VOHPW	VIO -0.2	-	-	V	IOH=1mA
Output Duty resolution	DTYRES	8			bit	
<b>【GC1, GC2】 (Sensor gain control, CMOS output)</b>						
Output L level voltage	VOLGC	-	-	0.2	V	IOL=1mA
Output H level voltage	VOHGC	VoS -0.2	-	-	V	IOH=1mA

●Block Diagram / Application Circuit example



Pin number : 24 pins

●Pin Arrangement [Bottom View]

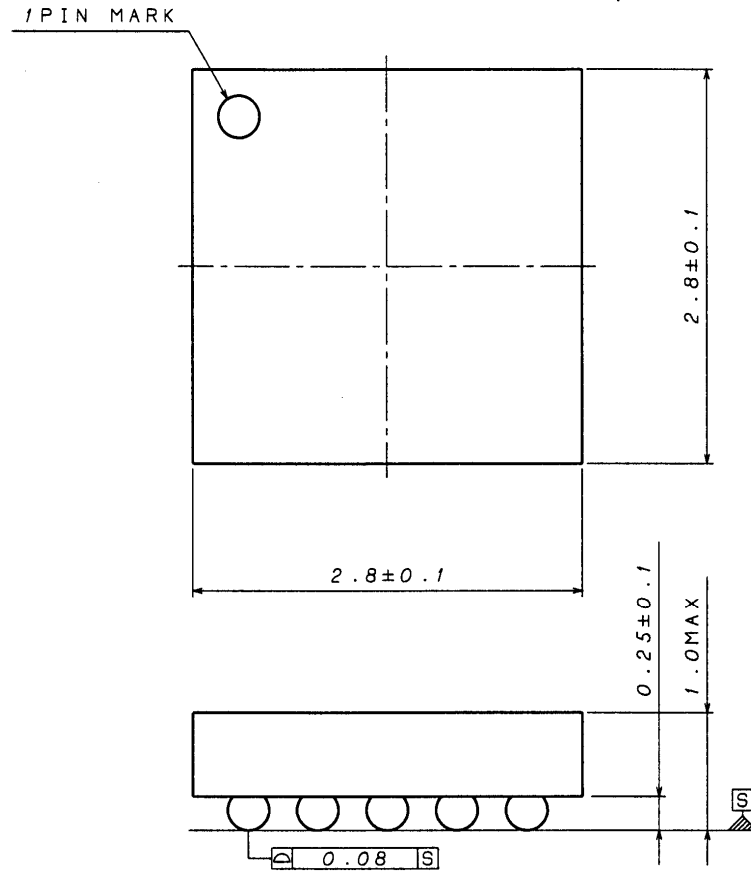
E	NCIN	SSENS	DCDCOK	PWMOUT	NCO1
D	SBIAS	AGND	NCO0	SCL	SDA
C	GC1	GC2	NCO2	EXPWMIN	VIO
B	VBAT1	index	VBAT2	NCO5	NCO4
A	NCOA	TESTIN	GND	RESETB	NCO3
	1	2	3	4	5

●Package

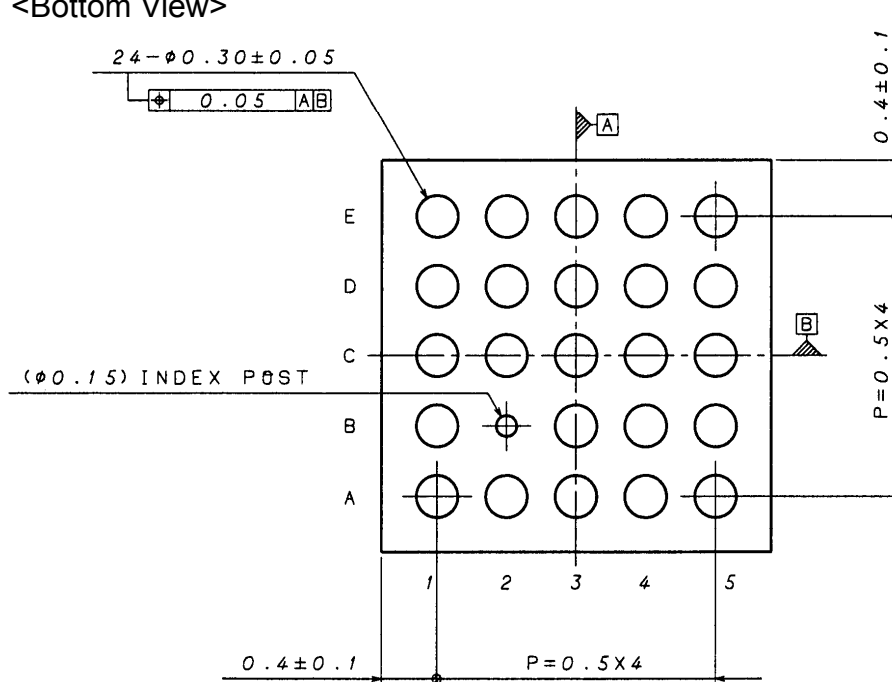
VCSP85H2

Size : 2.80mm<sup>2</sup>

Ball pitch : 0.5mm



<Bottom View>



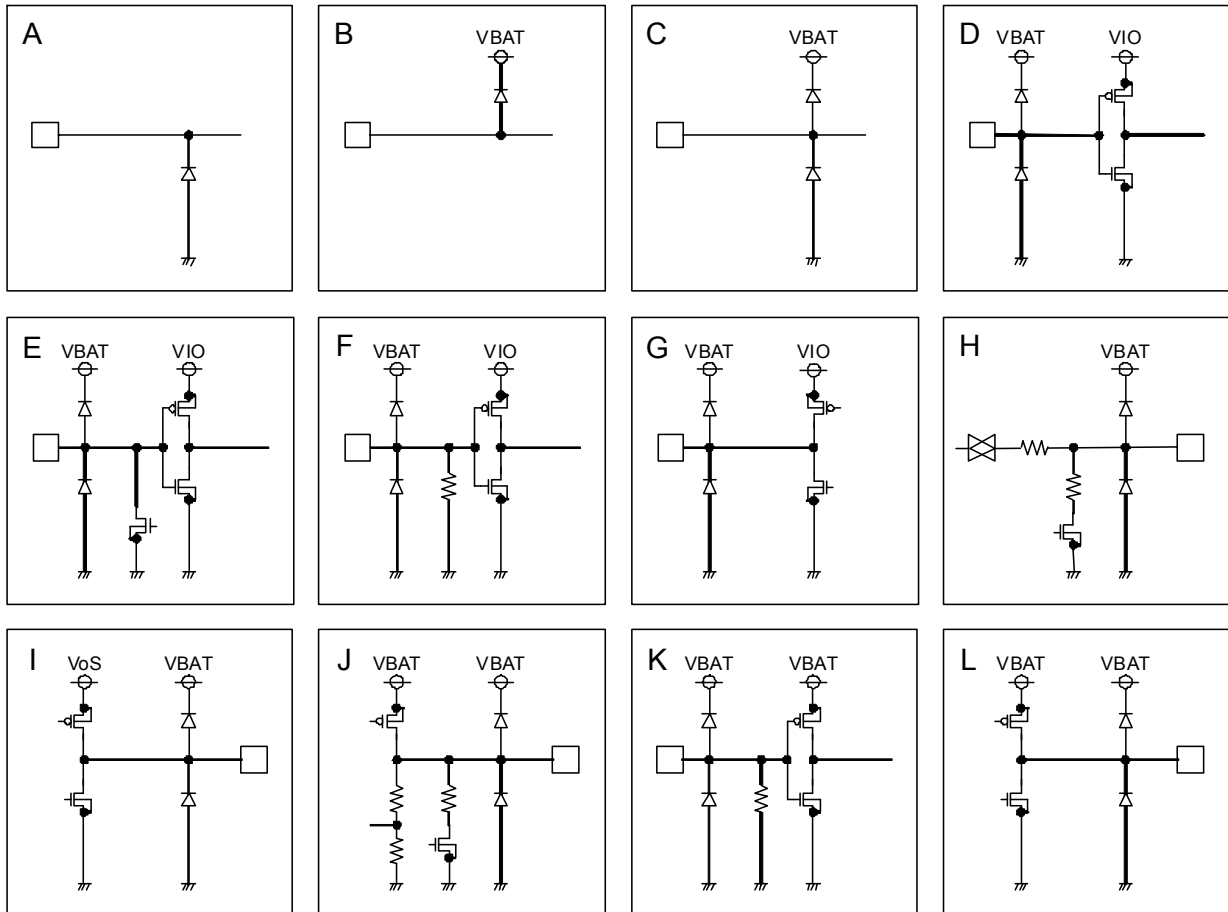
(UNIT : mm)

● Pin Functions

No	Pin No.	Pin name	I/O	ESD Diode		Function	Equivalent Circuit
				For VBAT	For GND		
1	B1	VBAT1	-	-	AGND	Power supply	A
2	B3	VBAT2	-	-	GND	Power supply	A
3	A3	GND	-	VBAT2	-	Ground	B
4	D2	AGND	-	VBAT1	-	Ground	B
5	C5	VIO	-	VBAT2	GND	Power supply for I/O	C
6	A4	RESETB	I	VBAT2	GND	Reset input (L: reset, H: reset cancel)	D
7	D5	SDA	I/O	VBAT2	GND	I <sup>2</sup> C data input / output	E
8	D4	SCL	I	VBAT2	GND	I <sup>2</sup> C clock input	D
9	D1	SBIAS	O	VBAT1	AGND	Bias output for the Ambient Light Sensor	J
10	E2	SSENS	I	VBAT1	AGND	Ambient Light Sensor input	H
11	C1	GC1	O	VBAT1	AGND	Ambient Light Sensor gain control output 1	I
12	C2	GC2	O	VBAT1	AGND	Ambient Light Sensor gain control output 2	I
13	C4	EXPWMIN	I	VBAT2	GND	External PWM input	D
14	E4	PWMOUT	O	VBAT2	GND	PWM output	G
15	E3	DCDCOK	I	VBAT2	GND	DC/DC rise up flag input	D
16	A2	TESTIN	I	VBAT2	GND	Test input (Ground short)	K
17	E1	NCIN	I	VBAT1	AGND	Test input (Ground short)	K
18	D3	NCO0	O	VBAT2	GND	Test output(Open)	L
19	E5	NCO1	O	VBAT2	GND	Test output(Open)	L
20	C3	NCO2	O	VBAT2	GND	Test output(Open)	L
21	A5	NCO3	O	VBAT2	GND	Test output(Open)	L
22	B5	NCO4	O	VBAT2	GND	Test output(Open)	L
23	B4	NCO5	O	VBAT2	GND	Test output(Open)	L
24	A1	NCOA	O	VBAT2	GND	Test output(Open)	H

Using at same voltage VBAT1 and VBAT2. Using at same voltage GND and AGND.  
Voltage level is based on the voltage of GND and AGND.

● Equivalent Circuit



● I<sup>2</sup>C BUS format

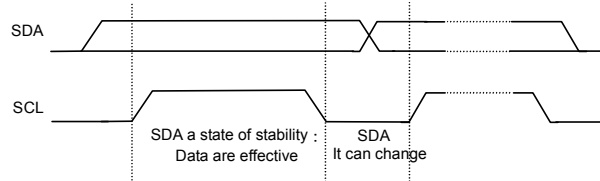
The writing/reading operation is based on the I<sup>2</sup>C slave standard.

• Slave address

A7	A6	A5	A4	A3	A2	A1	R/W
1	1	1	0	1	1	1	1/0

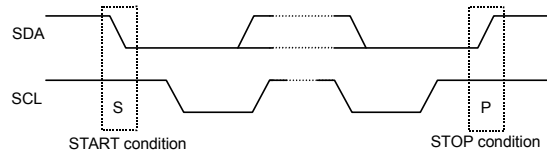
• Bit Transfer

SCL transfers 1-bit data during H. SCL cannot change signal of SDA during H at the time of bit transfer. If SDA changes while SCL is H, START conditions or STOP conditions will occur and it will be interpreted as a control signal.



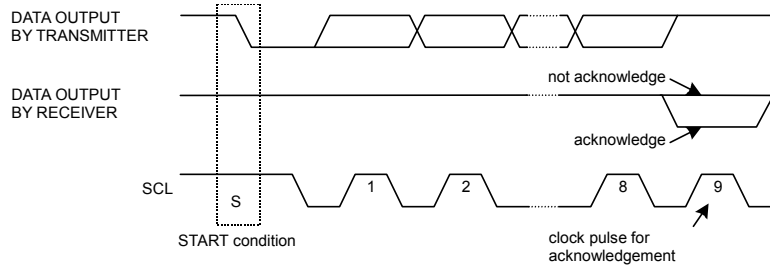
• START and STOP condition

When SDA and SCL are H, data is not transferred on the I<sup>2</sup>C- bus. This condition indicates, if SDA changes from H to L while SCL has been H, it will become START (S) conditions, and an access start, if SDA changes from L to H while SCL has been H, it will become STOP (P) conditions and an access end.

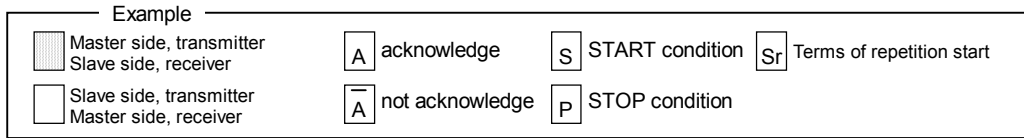


• Acknowledge

It transfers data 8 bits each after the occurrence of START condition. A transmitter opens SDA after transfer 8bits data, and a receiver returns the acknowledge signal by setting SDA to L.

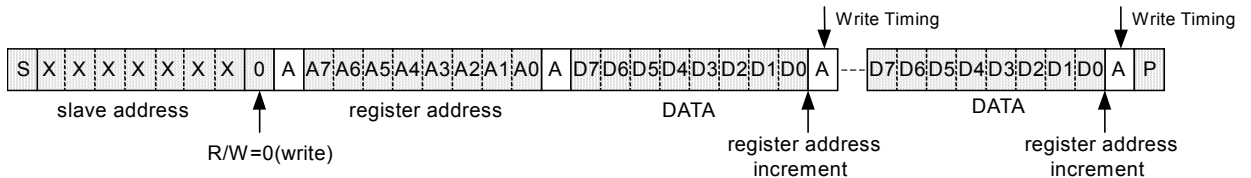


• Protocol



1. Writing protocol

A register address is transferred by the next 1 byte that transferred the slave address and the write-in command. The 3rd byte writes data in the internal register written in by the 2nd byte, and after 4th byte or, the increment of register address is carried out automatically. However, when a register address turns into the last address, it is set to 00h by the next transmission. After the transmission end, the increment of the address is carried out.



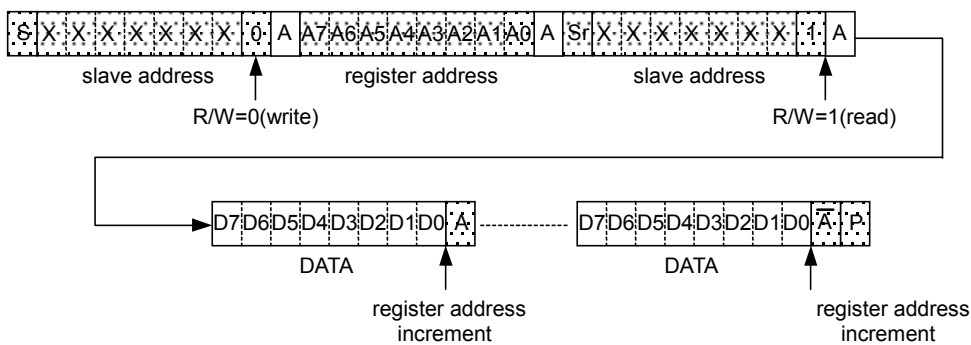
2. Reading protocol

It reads from the next byte after writing a slave address and R/W bit. The register to read considers as the following address accessed at the end, and the data of the address that carried out the increment is read after it. If an address turns into the last address, the next byte will read out 00h. After the transmission end, the increment of the address is carried out.



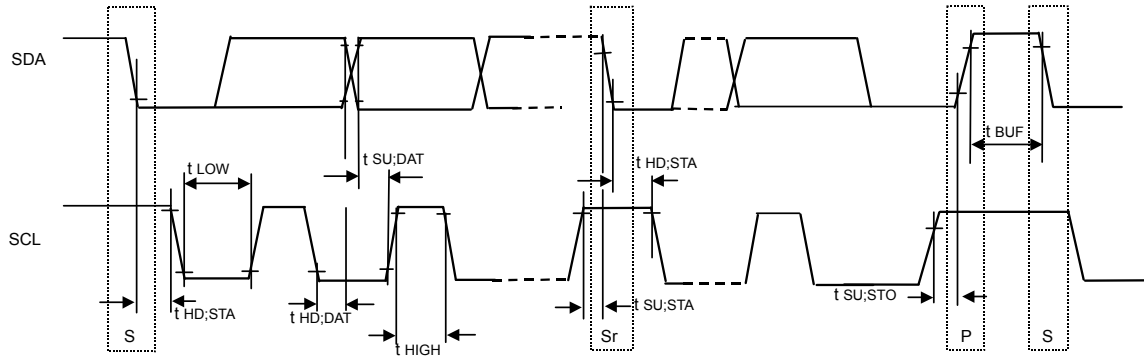
3. Multiple reading protocols

After specifying an internal address, it reads by repeated START condition and changing the data transfer direction. The data of the address that carried out the increment is read after it. If an address turns into the last address, the next byte will read out 00h. After the transmission end, the increment of the address is carried out.



\*As for reading protocol and multiple reading protocols, please do  $\bar{A}$  (not acknowledge) after doing the final reading operation. It stops with read when ending by A (acknowledge), and SDA stops in the state of Low when the reading data of that time is 0. However, this state returns usually when SCL is moved, data is read, and A (not acknowledge) is done.

●Timing diagram



●Electrical Characteristics(Unless otherwise specified, Ta=25 °C, VBAT=3.6V, VIO=1.8V)

Parameter	Symbol	Standard-mode			Fast-mode			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
<b>[I<sup>2</sup>C BUS format]</b>								
SCL clock frequency	fSCL	0	-	100	0	-	400	kHz
LOW period of the SCL clock	tLOW	4.7	-	-	1.3	-	-	μs
HIGH period of the SCL clock	tHIGH	4.0	-	-	0.6	-	-	μs
Hold time (repeated) START condition After this period, the first clock is generated	tHD;STA	4.0	-	-	0.6	-	-	μs
Set-up time for a repeated START condition	tSU;STA	4.7	-	-	0.6	-	-	μs
Data hold time	tHD;DAT	0	-	3.45	0	-	0.9	μs
Data set-up time	tSU;DAT	250	-	-	100	-	-	ns
Set-up time for STOP condition	tSU;STO	4.0	-	-	0.6	-	-	μs
Bus free time between a STOP and START condition	tBUF	4.7	-	-	1.3	-	-	μs

## ●Register List

Address	W/R	Register data								Function
		D7	D6	D5	D4	D3	D2	D1	D0	
00h	W	-	-	-	-	-	-	-	SFTRST	Software reset
01h	W	-	-	ADCYC (1)	ADCYC (0)	GAIN (1)	GAIN(0)	STYPE	VSB	Measurement mode setting
02h	W	-	FOUT (2)	FOUT (1)	FOUT (0)	EXPWMEN	OUTMD(2)	OUTMD(1)	OUTMD(0)	Output mode setting Output frequency setting
03h	W	FIXDUT (7)	FIXDUT (6)	FIXDUT (5)	FIXDUT (4)	FIXDUT (3)	FIXDUT (2)	FIXDUT (1)	FIXDUT (0)	Fixed PWM duty setting
04h	W	THL (3)	THL (2)	THL (1)	THL (0)	TLH (3)	TLH (2)	TLH (1)	TLH (0)	PWM duty transition time
05h	W	SOFS (3)	SOFS (2)	SOFS (1)	SOFS (0)	SGAIN (3)	SGAIN (2)	SGAIN (1)	SGAIN (0)	Measurement data correction
06h	W/R	SB_ON	ADSTW(2)	ADSTW(1)	ADSTW(0)	AMB (3)	AMB (2)	AMB (1)	AMB (0)	Ambient level output AD start time setting
07h	W	DUT0 (7)	DUT0 (6)	DUT0 (5)	DUT0 (4)	DUT0 (3)	DUT0 (2)	DUT0 (1)	DUT0 (0)	PWM duty at ambient level 0
08h	W	DUT1 (7)	DUT1 (6)	DUT1 (5)	DUT1 (4)	DUT1 (3)	DUT1 (2)	DUT1 (1)	DUT1 (0)	PWM duty at ambient level 1
09h	W	DUT2 (7)	DUT2 (6)	DUT2 (5)	DUT2 (4)	DUT2 (3)	DUT2 (2)	DUT2 (1)	DUT2 (0)	PWM duty at ambient level 2
0Ah	W	DUT3 (7)	DUT3 (6)	DUT3 (5)	DUT3 (4)	DUT3 (3)	DUT3 (2)	DUT3 (1)	DUT3 (0)	PWM duty at ambient level 3
0Bh	W	DUT4 (7)	DUT4 (6)	DUT4 (5)	DUT4 (4)	DUT4 (3)	DUT4 (2)	DUT4 (1)	DUT4 (0)	PWM duty at ambient level 4
0Ch	W	DUT5 (7)	DUT5 (6)	DUT5 (5)	DUT5 (4)	DUT5 (3)	DUT5 (2)	DUT5 (1)	DUT5 (0)	PWM duty at ambient level 5
0Dh	W	DUT6 (7)	DUT6 (6)	DUT6 (5)	DUT6 (4)	DUT6 (3)	DUT6 (2)	DUT6 (1)	DUT6 (0)	PWM duty at ambient level 6
0Eh	W	DUT7 (7)	DUT7 (6)	DUT7 (5)	DUT7 (4)	DUT7 (3)	DUT7 (2)	DUT7 (1)	DUT7 (0)	PWM duty at ambient level 7
0Fh	W	DUT8 (7)	DUT8 (6)	DUT8 (5)	DUT8 (4)	DUT8 (3)	DUT8 (2)	DUT8 (1)	DUT8 (0)	PWM duty at ambient level 8
10h	W	DUT9 (7)	DUT9 (6)	DUT9 (5)	DUT9 (4)	DUT9 (3)	DUT9 (2)	DUT9 (1)	DUT9 (0)	PWM duty at ambient level 9
11h	W	DUTA (7)	DUTA (6)	DUTA (5)	DUTA (4)	DUTA (3)	DUTA (2)	DUTA (1)	DUTA (0)	PWM duty at ambient level A
12h	W	DUTB (7)	DUTB (6)	DUTB (5)	DUTB (4)	DUTB (3)	DUTB (2)	DUTB (1)	DUTB (0)	PWM duty at ambient level B
13h	W	DUTC (7)	DUTC (6)	DUTC (5)	DUTC (4)	DUTC (3)	DUTC (2)	DUTC (1)	DUTC (0)	PWM duty at ambient level C
14h	W	DUTD (7)	DUTD (6)	DUTD (5)	DUTD (4)	DUTD (3)	DUTD (2)	DUTD (1)	DUTD (0)	PWM duty at ambient level D
15h	W	DUTE (7)	DUTE (6)	DUTE (5)	DUTE (4)	DUTE (3)	DUTE (2)	DUTE (1)	DUTE (0)	PWM duty at ambient level E
16h	W	DUTF (7)	DUTF (6)	DUTF (5)	DUTF (4)	DUTF (3)	DUTF (2)	DUTF (1)	DUTF (0)	PWM duty at ambient level F

Input "0" for "-".

Vacancy address may be use for test.

Prohibit to accessing the address that isn't mentioned and the register for test.

When reading data, I<sup>2</sup>C control timing and IC internal timing are non-synchronous relations. Please design that the problem does not occur in application. For example, Three times agreement sequence is introduced.

The time indicated in register explanation is the TYP time made by dividing of the built-in OSC.

The registers except the following must be changed when only BD6092GU is not operate (OUTMD (2:0) = "000").

- FIXDUT (7:0) (Address03h: bit [7:0])
- THL (3:0) (Address04h: bit [7:4])
- TLH (3:0) (Address04h: bit [3:0])
- SB\_ON (Address06h: bit [7])

(Value setting of SB\_ON has some restriction. See "●About setting of the output mode" to get more information.)

●Register Map

Address 00h < Software reset >

BIT	Name	Init	Function	
			0	1
D7	-	-	-	-
D6	-	-	-	-
D5	-	-	-	-
D4	-	-	-	-
D3	-	-	-	-
D2	-	-	-	-
D1	-	-	-	-
D0	SFTRST	0	Reset Release	Reset (Auto Return 0)

Address 01h < Measurement mode setting>

BIT	Name	Init	Function																							
			0		1																					
D7	-	-	-	-	-	-																				
D6	-	-	-	-	-	-																				
D5	ADCYC(1)	0	<table border="1"> <thead> <tr> <th>ADCYC(1)</th> <th>ADCYC(0)</th> <th colspan="2">Ambient brightness measurement period</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td colspan="2">0.52 s</td> </tr> <tr> <td>0</td> <td>1</td> <td colspan="2">1.05 s</td> </tr> <tr> <td>1</td> <td>0</td> <td colspan="2">1.57 s</td> </tr> <tr> <td>1</td> <td>1</td> <td colspan="2">2.10 s</td> </tr> </tbody> </table>				ADCYC(1)	ADCYC(0)	Ambient brightness measurement period		0	0	0.52 s		0	1	1.05 s		1	0	1.57 s		1	1	2.10 s	
			ADCYC(1)	ADCYC(0)	Ambient brightness measurement period																					
0	0	0.52 s																								
0	1	1.05 s																								
1	0	1.57 s																								
1	1	2.10 s																								
D4	ADCYC(0)	0																								
D3	GAIN(1)	1	<table border="1"> <thead> <tr> <th>GAIN(1)</th> <th>GAIN(0)</th> <th>GC1 output</th> <th>GC2 output</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td colspan="2">Automatic</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> </tbody> </table>				GAIN(1)	GAIN(0)	GC1 output	GC2 output	0	0	Automatic		0	1	1	0	1	0	0	1	1	1	0	0
			GAIN(1)	GAIN(0)	GC1 output	GC2 output																				
0	0	Automatic																								
0	1	1	0																							
1	0	0	1																							
1	1	0	0																							
D2	GAIN(0)	1																								
D1	STYPE	1	linear sensor connection (Internal LOG conversion)		LOG sensor connection (Internal through)																					
D0	VSB	1	SBIAS output voltage 3.0V		SBIAS output voltage 2.6V																					

Address 02h < Output mode, Output frequency setting >

BIT	Name	Init	Function																																														
			0	1																																													
D7	-	-	-	-																																													
D6	FOUT(2)	0	<table border="1"> <thead> <tr> <th>FOUT(2)</th> <th>FOUT(1)</th> <th>FOUT(0)</th> <th>Output frequency</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>FOSC x 1/8192 (122.1Hz)</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>FOSC x 1/4096 (244.1Hz)</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>FOSC x 1/2048 (488.3Hz)</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>FOSC x 1/1024 (976.6Hz)</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>FOSC x 1/512 (1953.1Hz)</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>FOSC x 1/256 (3906.2Hz)</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>Prohibit</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>Prohibit</td> </tr> </tbody> </table> <p>Frequency is a calculation value as an internal OSC frequency 1MHz (typ)</p>		FOUT(2)	FOUT(1)	FOUT(0)	Output frequency	0	0	0	FOSC x 1/8192 (122.1Hz)	0	0	1	FOSC x 1/4096 (244.1Hz)	0	1	0	FOSC x 1/2048 (488.3Hz)	0	1	1	FOSC x 1/1024 (976.6Hz)	1	0	0	FOSC x 1/512 (1953.1Hz)	1	0	1	FOSC x 1/256 (3906.2Hz)	1	1	0	Prohibit	1	1	1	Prohibit									
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D4	FOUT(0)	0																																															
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Mode	OUTMD(2)	OUTMD(1)	OUTMD(0)	Output setting																																													
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Mode6	1	1	0	(Prohibition)																																													
Mode7	1	1	1	ALC PWM output																																													
D1	OUTMD(1)	0																																															
D0	OUTMD(0)	0																																															

Address 03h < Fixed PWM duty setting >

BIT	Name	Init	Function																																																																						
			0				1																																																																		
D7	FIXDUT(7)	0																																																																							
D6	FIXDUT(6)	0																																																																							
D5	FIXDUT(5)	0	<table border="1"> <thead> <tr> <th>FIXDUT(7)</th> <th>FIXDUT(6)</th> <th>FIXDUT(5)</th> <th>FIXDUT(4)</th> <th>FIXDUT(3)</th> <th>FIXDUT(2)</th> <th>FIXDUT(1)</th> <th>FIXDUT(0)</th> <th>PWM Duty</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>1/256</td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>2/256</td> </tr> <tr> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>1/256</td> </tr> <tr> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>step</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>255/256</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>256/256</td> </tr> </tbody> </table>								FIXDUT(7)	FIXDUT(6)	FIXDUT(5)	FIXDUT(4)	FIXDUT(3)	FIXDUT(2)	FIXDUT(1)	FIXDUT(0)	PWM Duty	0	0	0	0	0	0	0	0	1/256	0	0	0	0	0	0	0	1	2/256	.	.	.	.	.	.	.	.	1/256	.	.	.	.	.	.	.	.	step	1	1	1	1	1	1	1	0	255/256	1	1	1	1	1	1	1	1	256/256
FIXDUT(7)	FIXDUT(6)	FIXDUT(5)	FIXDUT(4)	FIXDUT(3)	FIXDUT(2)	FIXDUT(1)	FIXDUT(0)	PWM Duty																																																																	
0	0	0	0	0	0	0	0	1/256																																																																	
0	0	0	0	0	0	0	1	2/256																																																																	
.	.	.	.	.	.	.	.	1/256																																																																	
.	.	.	.	.	.	.	.	step																																																																	
1	1	1	1	1	1	1	0	255/256																																																																	
1	1	1	1	1	1	1	1	256/256																																																																	
D4	FIXDUT(4)	0																																																																							
D3	FIXDUT(3)	0																																																																							
D2	FIXDUT(2)	0																																																																							
D1	FIXDUT(1)	0																																																																							
D0	FIXDUT(0)	0																																																																							

Address 04h <PWM duty transition time>

BIT	Name	Init	Function				
			0		1		
D7	THL (3)	1	THL (3) TLH (3)	THL (2) TLH (2)	THL (1) TLH (1)	THL (0) TLH (0)	LED Current slope control 1 step time
D6	THL (2)	1	0	0	0	0	0.128 ms
			0	0	0	1	0.256 ms
			0	0	1	0	0.512 ms
D5	THL (1)	0	0	0	1	1	1.024 ms
			0	1	0	0	2.048 ms
			0	1	0	1	4.096 ms
D4	THL (0)	0	0	1	1	0	8.192 ms
			0	1	1	1	16.384 ms (TLH Initial)
			1	0	0	0	32.768 ms
D3	TLH (3)	0	1	0	0	1	65.536 ms
			1	0	1	0	98.304 ms
			1	0	1	1	131.072 ms
D2	TLH (2)	1	1	1	0	0	163.840 ms (THL Initial)
			1	1	0	1	196.608 ms
			1	1	1	0	229.376 ms
D1	TLH (1)	1	1	1	1	0	262.144 ms
			1	1	1	1	
D0	TLH (0)	1					

The duty step and the amount of Duty change per slope time vary according to the chosen output PWM frequency. Moreover, final step is maybe rounded in the particular case of duty setting.

Address 05h < Measurement data correction >

BIT	Name	Init	Function				
			0			1	
D7	SOFS(3)	0	SOFS(3)	SOFS(2)	SOFS(1)	SOFS(0)	AD data Offset adjust
			1	0	0	0	-8 LSB
			1	0	0	1	-7 LSB
D6	SOFS(2)	0	⋮	⋮	⋮	⋮	⋮
			1	1	1	1	-1 LSB
			0	0	0	0	non-adjust
D5	SOFS(1)	0	0	0	0	1	+1 LSB
			⋮	⋮	⋮	⋮	⋮
			0	1	1	0	+6 LSB
D4	SOFS(0)	0	0	1	1	1	+7 LSB
			Offset adjust is performed to ADC data.				
D3	SGAIN(3)	0	SGAIN(3)	SGAIN(2)	SGAIN(1)	SGAIN(0)	AD data Gain adjust
			1	0	0	0	(reserved)
			1	0	0	1	(reserved)
D2	SGAIN(2)	0	1	0	1	0	-37.5%
			1	0	1	1	-31.25%
			1	1	0	0	-25%
D1	SGAIN(1)	0	1	1	0	1	-18.75%
			1	1	1	0	-12.5%
			1	1	1	1	-6.25%
D0	SGAIN(0)	0	0	0	0	0	non-adjust
			0	0	0	1	+6.25%
			0	0	1	0	+12.5%
D0	SGAIN(0)	0	0	0	1	1	+18.75%
			0	1	0	0	+25%
			0	1	0	1	+31.25%
D0	SGAIN(0)	0	0	1	1	0	+37.5%
			0	1	1	1	(reserved)
Gain adjust is performed to ADC data The data after adjustment are round off by 8-bit data.							

Address 06h < Ambient level output, AD start time setting>

Wright / Read register

BIT	Name	Init	Function				
			0		1		
D7	SB_ON	0	Intermittent ON		Usually ON		
D6	ADSTW(2)	0	ADSTW (2)	ADSTW (1)	ADSTW (0)	AD start wait time	
			0	0	0	0.512ms(16cycle)	
			0	0	1	8.704ms(272 cycle)	
D5	ADSTW(1)	0	0	1	0	16.90ms(528 cycle)	
			0	1	1	33.28ms(1040 cycle)	
			1	0	0	66.05ms(2064 cycle)	
D4	ADSTW(0)	0	1	0	1	131.6ms(4112 cycle)	
			1	1	0	262.7ms(8208 cycle)	
			1	1	1	Prohibit	
"1cycle=FOSC/32 (Hz)" FO SC means internal clock frequency. Internal frequency is 1MHz (typ.)							
D3	AMB (3)	-	AMB (3)	AMB (2)	AMB (1)	AMB (0)	Brightness data
D2	AMB (2)	-	0	0	0	0	Brightness 0
D1	AMB (1)	-	0	0	0	1	Brightness 1
			.	.	.	.	.
D0	AMB (0)	-	1	1	1	0	Brightness E
			1	1	1	1	Brightness F

Read-out is possible only with AMB (3:0) of D3-0 through I<sup>2</sup>C. "0000" does read-out with D7-4

Address 07 h ~ 16h < PWM duty at ambient level \* >

BIT	Name	Init	Function								
			0				1				
D7	DUT* (7)	(*1)									
D6	DUT* (6)	(*1)									
D5	DUT* (5)	(*1)	DUT* (7)	DUT* (6)	DUT* (5)	DUT* (4)	DUT* (3)	DUT* (2)	DUT* (1)	DUT* (0)	PWM Duty
D4	DUT* (4)	(*1)	0	0	0	0	0	0	0	0	1/256
D3	DUT* (3)	(*1)	0	0	0	0	0	0	0	1	2/256
			.	.	.	.	.	.	.	.	.
D2	DUT* (2)	(*1)	.	.	.	.	.	.	.	.	
D1	DUT* (1)	(*1)	1	1	1	1	1	1	1	0	255/256
D0	DUT* (0)	(*1)	1	1	1	1	1	1	1	1	256/256

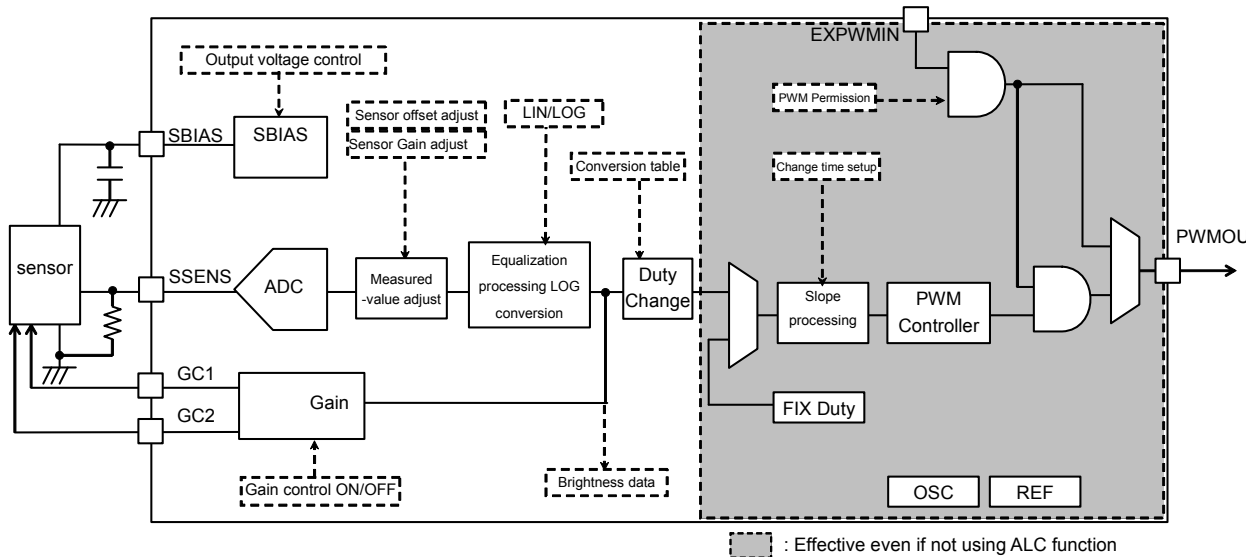
\* in the table shows 0~F.

(\*1) Refer to 8.PWM output duty change (table setup (initial value)).

●The explanation of the Auto Luminous Control

PWM duty to the brightness level is output by detecting the ambient information from the external ambient light sensor. The auto luminous control system to the ambient brightness can be built by controlling DC/DC for the back light.

- Since BD6092GU has the bias adjustment function for sensors, ADC with an average filter, a gain offset adjustment function, and LOG conversion function, an ambient light can be broadly chosen from Photo Diode, Photo Transistor, Photo IC (a linear output / LOG output), etc.
- Ambient light is changed into brightness data by digital processing. The external output of data is possible by I<sup>2</sup>C.
- PWM Duty to brightness can be customized by the built-in pre-set table or the setting the registers.
- A slope function at PWM duty changing is built in. PWM duty changes without the incongruity.
- "Brightness data" is changing by IC internal clock. Be careful that the internal clock and the I<sup>2</sup>C clock are asynchronous when reading the brightness by I<sup>2</sup>C.

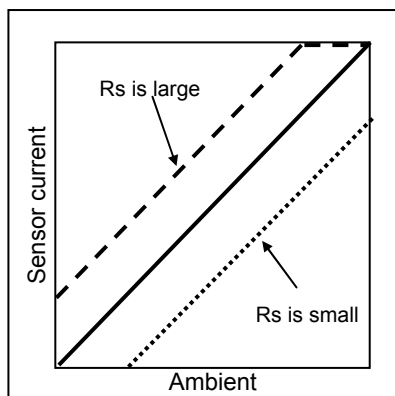


(1) Auto Luminous Control ON/OFF

- ALC block is ON/OFF automatically in accordance with the setup of OUTMD (2:0). When only reading brightness information, an auto luminous control system can be built by reading register by I<sup>2</sup>C.

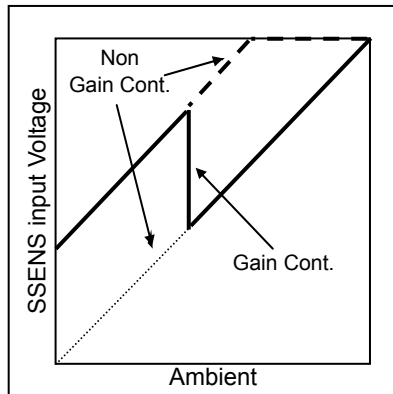
(2) Sensor I/F

- The bias voltage is supplied to the ambient sensor by using SBIAS circuit.
- The bias voltage (VoS) is selectable by register setup.  
Register: VSB
- The external resistance for the I-V conversion (Rs) is adjusted with adaptation of sensor characteristic.



(3) I/V conversion

- Sensor gain switching function is built in to extend the dynamic range.
- It is controlled by register setup.
- When automatic gain control is off, the output logic of GC1 and GC2 can be set up in the manual.  
Register: GAIN (1:0)

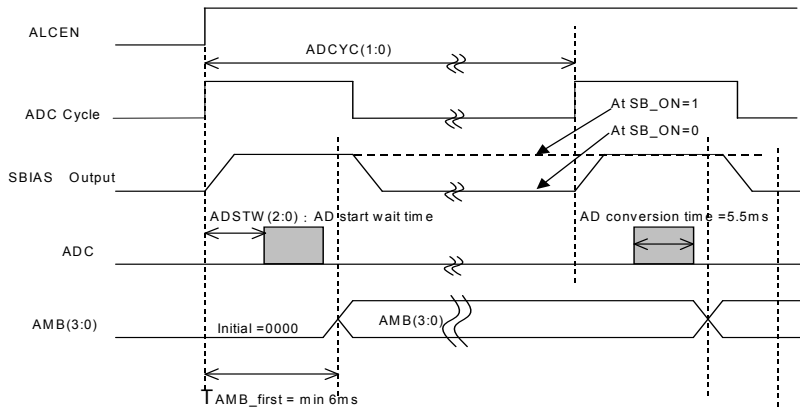


	ex1 (BH1600FVC and connection)				ex2			ex3	
Application circuit					<p>Resistance is a relative value.</p>				
Operation mode	Automatic		Manual		Automatic		Manual		Fixation
GAIN(1:0)	00		01	10	00		01	10	11
GC1 output	H	L	H	L	H	L	H	L	L
GC2 output	L	H	L	H	L	H	L	H	L
Sensor Application Gain state	Automatic		High	Low	Automatic		High	Low	Low

Auto luminous control operates as Low gain when GAIN (1:0) is "01", as High gain when "10" or "11".

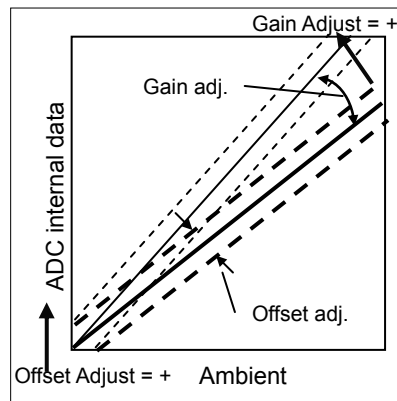
(4). AD conversion

- Detection of ambient light information is periodically performed for low-power realization.  
Bit: ADCYC(1:0)
- The current consumption of the sensor is reduced by turning off SBIAS and ADC except when measuring the brightness.
- Pull-down of SBIAS terminal and the SSENS terminal is on except when measuring the brightness.
- AD start wait time can be changed.  
Bit : ADSTW(2:0)
- Since The calculation time of AMB (3:0) value is varied according to ADTSW (2:0), which means AD start wait time, TAMB\_first = 6-350mS. Take this time into consideration when reading AMB (3:0).
- SBAIS output can be set up in Intermittent or usually on.  
Bit : SB\_ON  
SB\_ON must be changed when REF block is ON only. Refer to "About setting of the output mode".



(5) ADC data gain / offset adjustment

- Gain and offset adjustment to ADC output data is possible.
- They are controlled by register setup. Register: SGAIN(3:0) Register: SOFS(3:0)

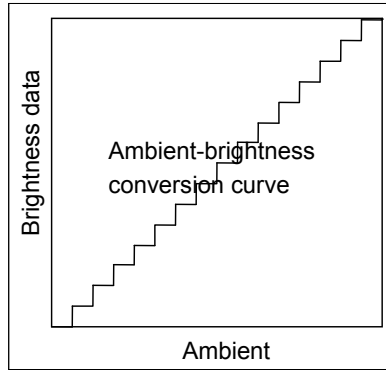


(6) Average filter

- Average filter is built in to rid noise or flicker.
- 16 times average

(7) Brightness data conversion

- Brightness data is judged to the 16 level by the ambient light.
- The table with LOG conversion or without LOG conversion can be chosen by the type of ambient light sensor.  
Using linear type sensor: Logarithmic conversion  
Using logarithmic type sensor: Data through Resister : STYPE
- The brightness data is output through I<sup>2</sup>C. (I<sup>2</sup>C and internal data are asynchronous.)



Brightness data	SSENS voltage			
	With LOG conversion			Without LOG conversion
	Without GAIN control (GAIN=11, STYPE=0)	With GAIN control (GAIN ≠ 11)		Without GAIN control (GAIN=11, STYPE=1)
		Low mode	High mode	
0	VoS×0/256	-	VoS×0/256	VoS×0/256 VoS×17/256
1	VoS×1/256	-	VoS×1/256	VoS×18/256 VoS×26/256
2	VoS×2/256	-	VoS×2/256	VoS×27/256 VoS×36/256
3	VoS×3/256	-	VoS×3/256 VoS×4/256	VoS×37/256 VoS×47/256
4	VoS×4/256 VoS×5/256	-	VoS×5/256 VoS×7/256	VoS×48/256 VoS×59/256
5	VoS×6/256 VoS×7/256	VoS×0/256	VoS×8/256 VoS×12/256	VoS×60/256 VoS×71/256
6	VoS×8/256 VoS×10/256	VoS×1/256	VoS×13/256 VoS×21/256	VoS×72/256 VoS×83/256
7	VoS×11/256 VoS×15/256	VoS×2/256 VoS×3/256	VoS×22/256 VoS×37/256	VoS×84/256 VoS×95/256
8	VoS×16/256 VoS×22/256	VoS×4/256 VoS×6/256	VoS×38/256 VoS×65/256	VoS×96/256 VoS×107/256
9	VoS×23/256 VoS×32/256	VoS×7/256 VoS×10/256	VoS×66/256 VoS×103/256	VoS×108/256 VoS×119/256
A	VoS×33/256 VoS×47/256	VoS×11/256 VoS×18/256	VoS×104/256 VoS×179/256	VoS×120/256 VoS×131/256
B	VoS×48/256 VoS×68/256	VoS×19/256 VoS×32/256	VoS×180/256 VoS×255/256	VoS×132/256 VoS×143/256
C	VoS×69/256 VoS×95/256	VoS×33/256 VoS×59/256	-	VoS×144/256 VoS×155/256
D	VoS×96/256 VoS×135/256	VoS×60/256 VoS×99/256	-	VoS×156/256 VoS×168/256
E	VoS×136/256 VoS×186/256	VoS×100/256 VoS×186/256	-	VoS×169/256 VoS×181/256
F	VoS×187/256 VoS×255/256	VoS×187/256 VoS×255/256	-	VoS×182/256 VoS×255/256

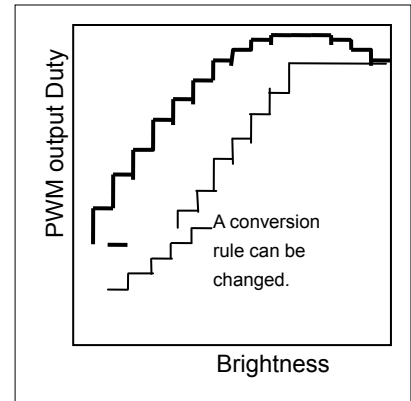
In the Gain control mode, sensor gain changes in gray-colored ambient level.

(8) PWM output Duty setting

- The current of the LED driver to each Brightness is set up.
- Although a table setup (initial value) is prepared beforehand, it can change into a user setup by overwriting.
- Bit : DUT\*(7:0)

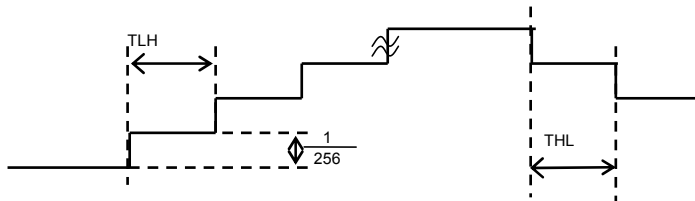
Table setup (Initial value)

Brightness	setup	Duty	Brightness	setup	Duty
0	2Dh	46/256	8	B9h	186/256
1	31h	50/256	9	DEh	223/256
2	36h	55/256	A	F5h	246/256
3	3Fh	64/256	B	FFh	256/256
4	4Eh	79/256	C	FFh	256/256
5	60h	97/256	D	FFh	256/256
6	7Ch	125/256	E	FFh	256/256
7	99h	154/256	F	FFh	256/256



(9) Slope process

- Slope process is given to LED current to dim naturally.
- LED current changes in the 256Step gradation in sloping.
- UP(dark→bright), Down(bright→dark) LED current transition speed are set individually.
- Bit : THL(3:0), TLH(3:0)
- PWM Duty as follows at the time of a slope.
- TLH (THL) is a time setup of the current steps 2/256.



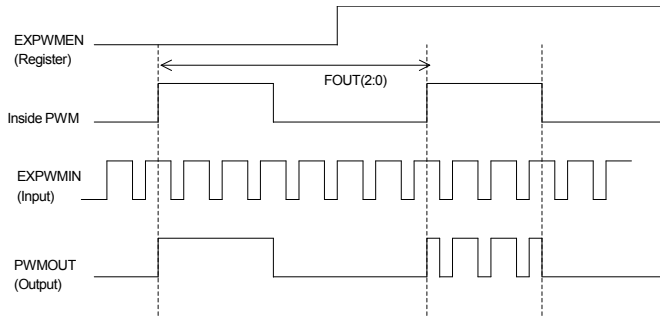
(10) External PWM input

- The external PWM signal is output in accordance with the setup of OUTMD (2:0).
- It becomes PWM operation added to the PWM signal formed inside, and the most suitable for brightness compensation, which reflected a factor except for ambient light.  
The external PWM signal and an internal PWM signal are composed of the simple gate circuit with an output step, and it can't keep synchronous relations. Therefore, a short pulse at the time of the mixing input may be output. Confirm that you don't have an influence with a device to connect fully.
- The frequency of the external PWM signal and the internal PWM signal is to give the difference in ten times and more as a recommendation. The frequency of the internal PWM signal can be set up with FOUT [2:0].

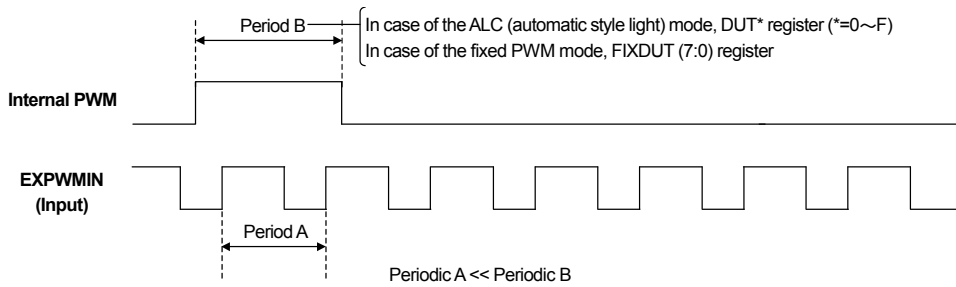
(Example)

The external PWM input frequency = 5kHz

Internal PWM output frequency = 488.3Hz (FOUT [2:0] = "010" setup)



- Set up Duty of internal longer PWM than the period of the external PWM when a mixing has the external PWM signal and an internal PWM signal. (Recommendation)



●About setting of the output mode

The output mode is set up by the register OUTMD (2:0) as follows.  
The state of internal circuit operation to each setup as follows.

Mode (OUTMD(2:0))	Internal block				PWMOUT output	Ambient lbrightness measurement and external PWM function	
	REF	OSC	A/D SBIAS	Internal PWM Slope setting		Ambient light measurement	External PWM
Mode 0 ("000")	OFF	OFF	OFF	Invalid	Forced L output (ALC= off)	Acceptable	It can't be output.
Mode 1 ("001")	ON	ON	ON	Invalid	Forced L output (ALC=ON)	Possible	It can't be output.
Mode 2 ("010")	OFF	OFF	OFF	Invalid	Internal PWM forced H (ALC=OFF)	Acceptable	By EXPWMEN (EXPWMIN through is possible.)
Mode 3 ("011")	ON	ON	ON	Invalid	Internal PWM forced H (ALC=ON)	Possible	By EXPWMEN (EXPWMIN through is possible.)
Mode 4 ("100")	ON	ON	OFF	Effective	Fixed PWM output (ALC=OFF)	Acceptable	By EXPWMEN (An EXPWMIN mixing is possible.)
Mode 5 ("101")	ON	ON	ON	Effective	Fixed PWM output (ALC=ON)	Possible	By EXPWMEN (An EXPWMIN mixing is possible.)
Mode 6 ("110")	(Prohibition against a setup)				(Prohibition against a setup)	(Prohibition against a setup)	
Mode 7 ("111")	ON	ON	ON	Effective	ALC PWM output	Possible	By EXPWMEN (An EXPWMIN mixing is possible.)

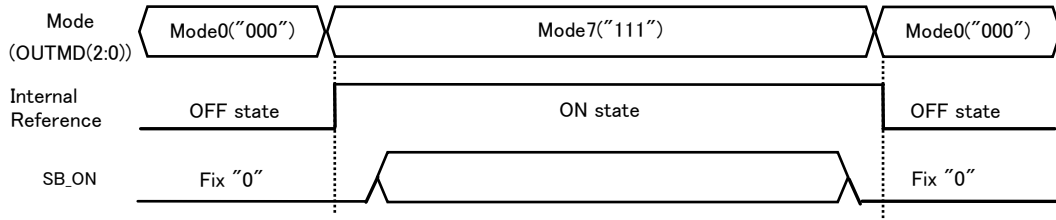
A/D circuit operates regardless of SB\_ON synchronizing with a measurement cycle.

SBIAS circuit operates synchronizing with a measurement cycle at SB\_ON=0, and always operates at SB\_ON=1.

(Note)It is necessary for setting SB\_ON=1, to turn on REF block (Mode1,3,4,5,7).

When REF block turn off (Mode0,2), SB\_ON must be set to "0".

Example of SB\_ON value setting



Measured brightness is reflected in AMB (3:0) register when A/D, SBIAS circuit are operating.

The enable/disable of external PWM signal input, is controlled by register EXPWMEN.

PWMOUT output forced L at Mode0, Mode.

In order to spread external PWM signal in the IO or internal circuit, it consumes toggle current.

Supposing you care about consumption current, please stop an external PWM signal.

●Output PWM frequency and slope time

Output PWM frequency to choose, and slope time become the following relations.

When slope time is shortened in the slow PWM frequency, PWM Duty value to change in 1 step hit disappears in every 1 step. (The yellow part of the bottom table) Because of that, a slope becomes rough. Though it becomes the following step by the internal calculation, it is rounded, and an error goes through the final step

FOUT (2:0)	The time per 1 step (ms)	The number of PWM clocks per 1 step	The change value of PWM duty
(000)	0.128	1	64
	0.256	1	32
	0.512	1	16
	1.024	1	8
	2.048	1	4
	4.096	1	2
	8.192	1	1
	16.384	2	1
	32.768	4	1
	65.536	8	1
	98.304	12	1
	131.072	16	1
	163.840	20	1
	196.608	24	1
229.376	28	1	
262.144	32	1	

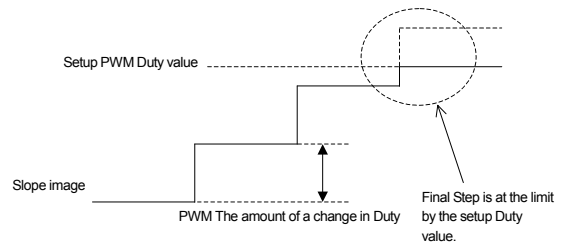
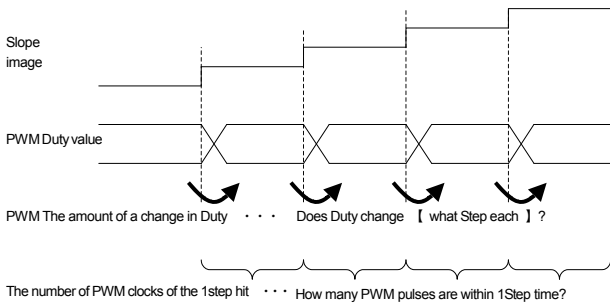
FOUT (2:0)	The time per 1 step (ms)	The number of PWM clocks per 1 step	The change value of PWM duty
(001)	0.128	1	32
	0.256	1	16
	0.512	1	8
	1.024	1	4
	2.048	1	2
	4.096	1	1
	8.192	2	1
	16.384	4	1
	32.768	8	1
	65.536	16	1
	98.304	24	1
	131.072	32	1
	163.840	40	1
	196.608	48	1
229.376	56	1	
262.144	64	1	

FOUT (2:0)	The time per 1 step (ms)	The number of PWM clocks per 1 step	The change value of PWM duty
(010)	0.128	1	16
	0.256	1	8
	0.512	1	4
	1.024	1	2
	2.048	1	1
	4.096	2	1
	8.192	4	1
	16.384	8	1
	32.768	16	1
	65.536	32	1
	98.304	48	1
	131.072	64	1
	163.840	80	1
	196.608	96	1
229.376	112	1	
262.144	128	1	

FOUT (2:0)	The time per 1 step (ms)	The number of PWM clocks per 1 step	The change value of PWM duty
(011)	0.128	1	8
	0.256	1	4
	0.512	1	2
	1.024	1	1
	2.048	2	1
	4.096	4	1
	8.192	8	1
	16.384	16	1
	32.768	32	1
	65.536	64	1
	98.304	96	1
	131.072	128	1
	163.840	160	1
	196.608	192	1
229.376	224	1	
262.144	256	1	

FOUT (2:0)	The time per 1 step (ms)	The number of PWM clocks per 1 step	The change value of PWM duty
(100)	0.128	1	4
	0.256	1	2
	0.512	1	1
	1.024	2	1
	2.048	4	1
	4.096	8	1
	8.192	16	1
	16.384	32	1
	32.768	64	1
	65.536	128	1
	98.304	192	1
	131.072	256	1
	163.840	320	1
	196.608	384	1
229.376	448	1	
262.144	512	1	

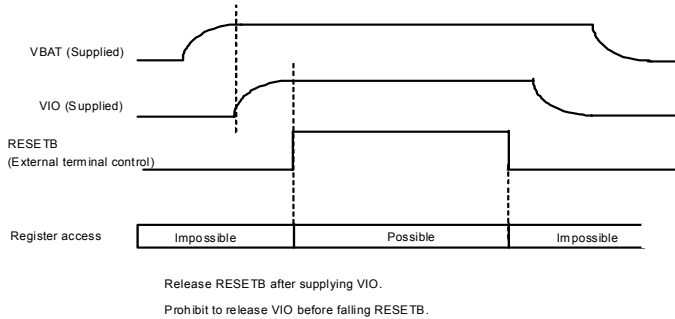
FOUT (2:0)	The time per 1 step (ms)	The number of PWM clocks per 1 step	The change value of PWM duty
(101)	0.128	1	2
	0.256	1	1
	0.512	2	1
	1.024	4	1
	2.048	8	1
	4.096	16	1
	8.192	32	1
	16.384	64	1
	32.768	128	1
	65.536	256	1
	98.304	384	1
	131.072	512	1
	163.840	640	1
	196.608	768	1
229.376	896	1	
262.144	1024	1	



●Start sequence

1. Powers supply applied, register access

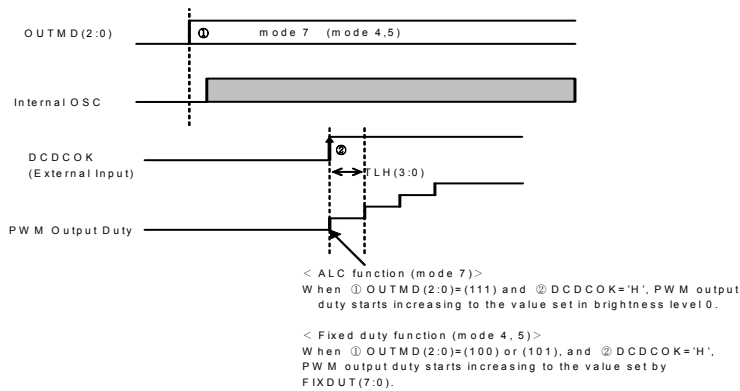
Do applied of the VIO voltage, a release of resetting and access to the register with the following process. When the voltage condition of the VIO voltage >VBAT voltage occurred in short off of VBAT and so on, the ESD protection diode of the VIO-VBAT space has the possibility that has electric current pass occurs. But, there is no faulty operation if it is within the movement voltage range in a VIO voltage and a VBAT voltage.



2.PWM output start

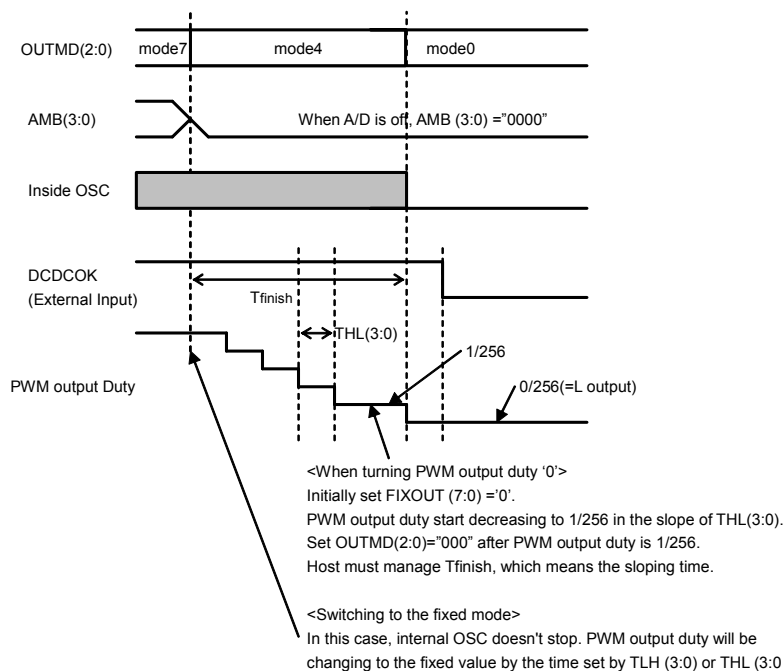
A PWM signal starts as follows.

The start sequence which kept in touch with the LED driver is possible by using the DCDCOK input.



3.PWM output end

Do the following sequence when you make it finish LED electric current of the LED driver which connects PWM output smoothly. PWM output becomes L momentarily when DCDCOK=L or OUTMD (2:0) = "000" is taken.



## ●Explanation for operate

### 1. Reset

There are two kinds of reset, software reset and hardware reset.

#### (1) Software reset

- All the registers are initialized by SFTRST="1".
- SFTRST is automatically returned to "0". (Auto Return 0).
- Reset state needs over 1μs wait times from SFTRST="1".

#### (2) Hardware reset

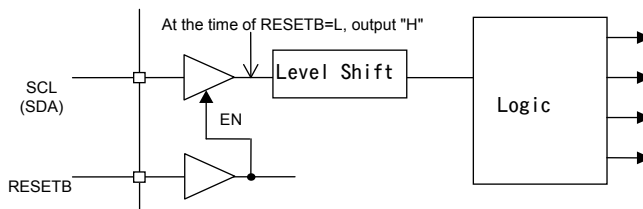
- It shifts to hardware reset by changing RESETB pin "H" → "L".
- The condition of all the registers under hardware reset pin is returned to the initial value, and it stops accepting all address.
- It's possible to release from a state of hardware reset by changing RESETB pin "L" → "H".
- RESETB pin has delay circuit. It doesn't recognize as hardware reset in "L" period under 5μs.
- Even if RESETB=L, at FLASHCNT=H, Flash mode becomes ON by minimum setting.

#### (3) Reset Sequence

- When hardware reset was done during software reset, software reset is canceled when hardware reset is canceled. (Because the initial value of software reset is "0")

## ●I/O

An optional input signal never spreads in the part Logic of the IC to stop the movement of the input buffer of SDA and SCL at the time of the RESETB terminal =L.



It goes through the protection Diode of the terminal by rise up of the I/O power supply and the input level, and an electric current route may occur.

## ●UVLO

The decrease voltage detection circuit of the VBAT terminal is built in.

It is effective when an internal standard voltage (REF) is turned on.

PWMOUT output becomes L forcibly at the time of the decrease voltage detection, and resetting gets the order circuit of the ALC block except for the control register of I<sup>2</sup>C and the PWM control block, and it is initialized

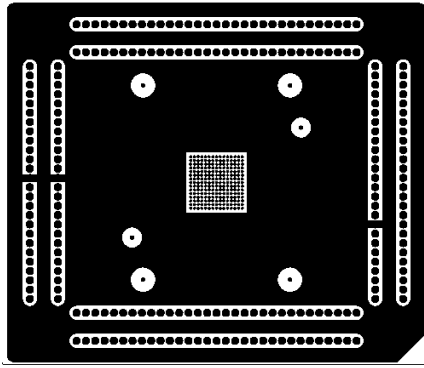
## ●About the terminal management of the function which isn't used

Set up a test terminal and the terminal which isn't used as follows.

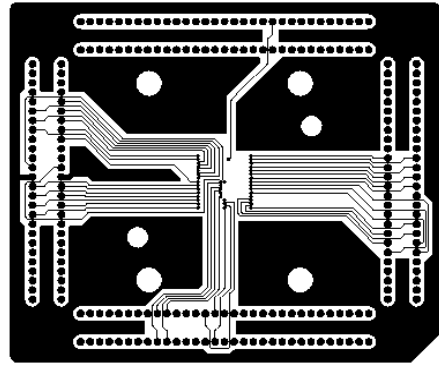
Do terminal management so that there may not be a problem referring to the equivalent circuit of the former extension under the state of actual use.

- EXPWMIN . . . . . It short-circuits to the ground. (Make a setup of a register EXPWMEN=0.)
- DCDCOK . . . . . It short-circuits to VIO. (It doesn't start when it short-circuits in the ground.)
- GC1, GC2 . . . . . For the output terminal, opening
- NCIN, TESTIN . . . . . It short-circuits to the ground.
- NCO0~5, NCOA . . . . . For the output terminal, opening

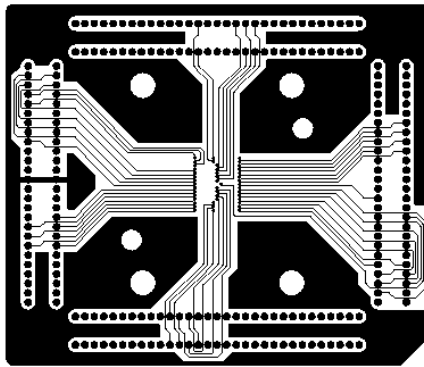
●PCB pattern of the Power dissipation measuring board



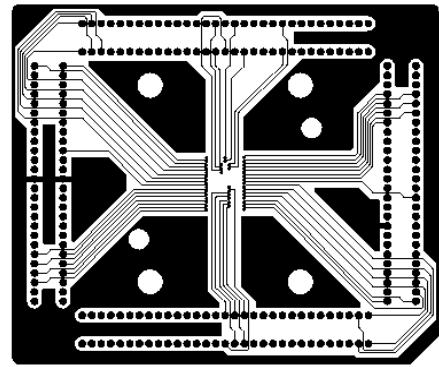
1<sup>st</sup> layer(component)



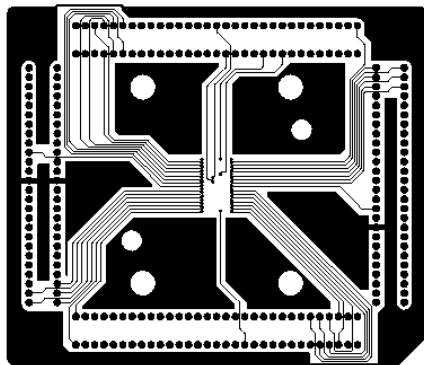
2<sup>nd</sup> layer



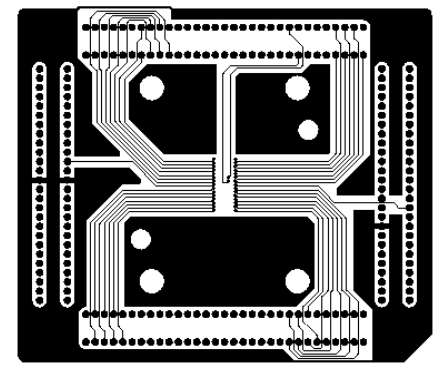
3<sup>rd</sup> layer



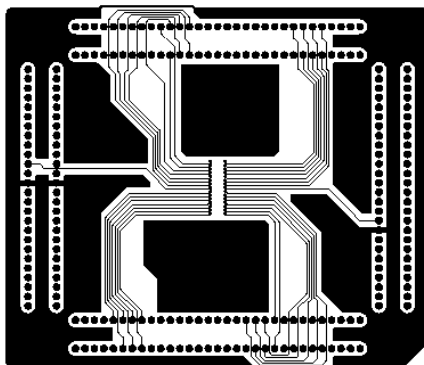
4<sup>th</sup> layer



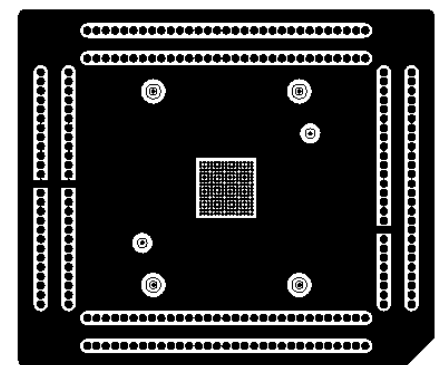
5<sup>th</sup> layer



6<sup>th</sup> layer



7<sup>th</sup> layer

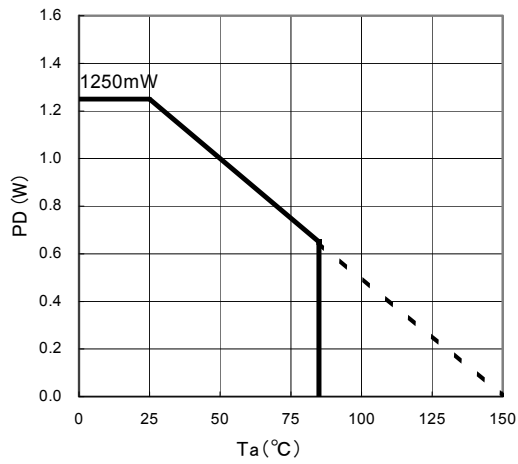


8<sup>th</sup> layer(solder)

**●Notes for use**

- (1) Absolute Maximum Ratings  
An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, 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) Power supply and ground line  
Design PCB pattern to provide low impedance for the wiring between the power supply and the ground lines. Pay attention to the interference by common impedance of layout pattern when there are plural power supplies and ground lines. Especially, when there are ground pattern for small signal and ground pattern for large current included the external circuits, please separate each ground pattern. Furthermore, for all power supply pins to ICs, mount a capacitor between the power supply and the ground pin. At the same time, in order to use a capacitor, thoroughly check to be sure the characteristics of the capacitor to be used present no problem including the occurrence of capacity dropout at a low temperature, thus determining the constant.
- (3) Ground voltage  
Make setting of the potential of the ground pin so that it will be maintained at the minimum in any operating state. Furthermore, check to be sure no pins are at a potential lower than the ground voltage including an actual electric transient.
- (4) Short circuit between pins 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 pins or between the pin and the power supply or the ground pin, the ICs can break down.
- (5) Operation in strong electromagnetic field  
Be noted that using ICs in the strong electromagnetic field can malfunction them.
- (6) Input pins  
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 pin. Therefore, pay thorough attention not to handle the input pins, such as to apply to the input pins a voltage lower than the ground respectively, so that any parasitic element will operate. Furthermore, do not apply a voltage to the input pins when no power supply voltage is applied to the IC. In addition, even if the power supply voltage is applied, apply to the input pins a voltage lower than the power supply voltage or within the guaranteed value of electrical characteristics.
- (7) External capacitor  
In order to use a ceramic capacitor as the external capacitor, determine the constant with consideration given to a degradation in the nominal capacitance due to DC bias and changes in the capacitance due to temperature, etc.
- (8) Thermal shutdown circuit (TSD)  
This LSI builds in a thermal shutdown (TSD) circuit. When junction temperatures become detection temperature or higher, the thermal shutdown circuit operates and turns a switch OFF. The thermal shutdown circuit, which is aimed at isolating the LSI from thermal runaway as much as possible, is not aimed at the protection or guarantee of the LSI. Therefore, do not continuously use the LSI with this circuit operating or use the LSI assuming its operation.
- (9) Thermal design  
Perform thermal design in which there are adequate margins by taking into account the permissible dissipation (Pd) in actual states of use.
- (10) LDO  
Use each output of LDO by the independence. Don't use under the condition that each output is short-circuited because it has the possibility that an operation becomes unstable.
- (11) About the pin for the test, the un-use pin  
Prevent a problem from being in the pin for the test and the un-use pin under the state of actual use. Please refer to a function manual and an application notebook. And, as for the pin that doesn't specially have an explanation, ask our company person in charge.
- (12) About the rush current  
For ICs with more than one power supply, it is possible that rush current may flow instantaneously due to the internal powering sequence and delays. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of wiring.
- (13) About the function description or application note or more.  
The function description and the application notebook are the design materials to design a set. So, the contents of the materials aren't always guaranteed. Please design application by having fully examination and evaluation include the external elements.

●Power dissipation (On the ROHM's standard board)



ROHM's standard board

Material : glass-epoxy

Size : 50mm×58mm×1.75mm (8 layers)

Pattern : Refer to after

● Ordering part number

B	D
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Part No.

6	0	9	2
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Part No.  
6092

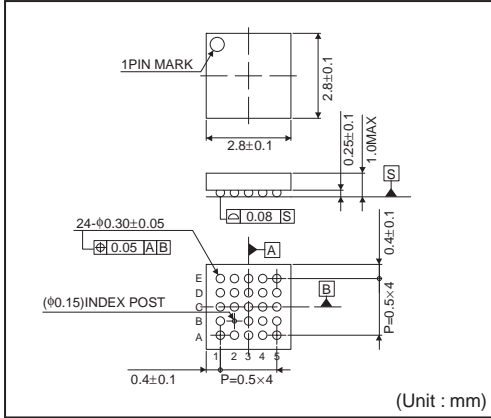
G	U
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Package  
GU : VCSP85H2

E	2
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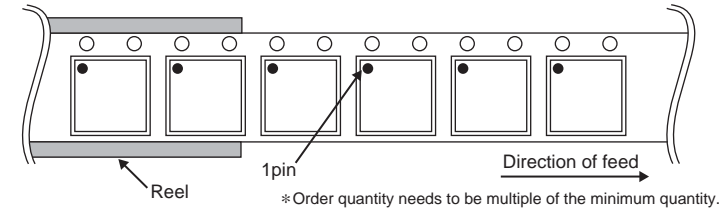
Packaging and forming specification  
E2: Embossed tape and reel

VCSP85H2 (BD6092GU)



<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand )



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