LED Drivers for LCD Backlight

Multifunction Backlight LED Driver for Small LCD Panels (Charge Pump Type)

BD6082GUL

No.11040EAT36

●Description

BD6082GUL is “Intelligent LED Driver” that is the most suitable for the cellular phone. It is possible to drive LED driver for LCD backlight (maximum 7 lights), RGB LED driver, and LED 6 lights for accessory. As it has charge pump circuit for LED power supply, it is no need to use coils, and it contributes to small space. VCSP50L3　3.60mm x 3.60mm It adopts the very thin CSP package that is the most suitable for the slim phone.

●Features

1) 7 LEDs driver for LCD Backlight
   - 7bit Current DAC (max25.6mA, 0.2mA step)
   - 3 LEDs for exclusive use of Main (BLLED1 – BLLED3)
   - Main group / sub group / non-lights　setting possible (BLLED4 – BLLED7)
   - Main group has slope function and external PWM light dimming function
2) RGB LED driver
   - 7bit Current DAC (max25.4mA, 0.2mA step)
   - Incorporates 16 kinds of automatic lighting patterns (including DC current setting)
   - Capable of setting pattern arbitrarily on each LED
   - Incorporates Illumination continuous mode and illumination one cycle mode
   - Incorporates Sleep mode that realizes low consumption at light blinking.
   - Synchronuos reception by external RGBCNT terminal
   - Capable of lighting synchronized with BD28xx series by basic clock output function.
3) LED 6 lights for accessory
   - 5bit Current DAC(max 32mA, 1mA step)
   - LED1-LED6 can be allocated to the below modes arbitrarily
     - ・Group 1 control
     - ・Group 2 control
     - ・Mobile light congrol
       Flash mode / torch mode switch after being synchronized with H/L of external FLCNT terminal.
       Flash mode / torch mode switch by resister setting
     - ・Independent control
4) Charge Pump boosting circuit
   - Automatically switch boosting mode by feedback of LED all terminals.
   - Iomax=270mA (VBAT≥3.2V, Vout=4.5V)
   - Soft start functions
   - Over voltage protection (Auto-return type)
   - Over current protection (Auto-return type)
5) Thermal shutdown (Auto-return type)
6) I^2C BUS FS mode(max 400kHz)Compatibility

●Absolute Maximum Ratings (Ta=25 ℃)

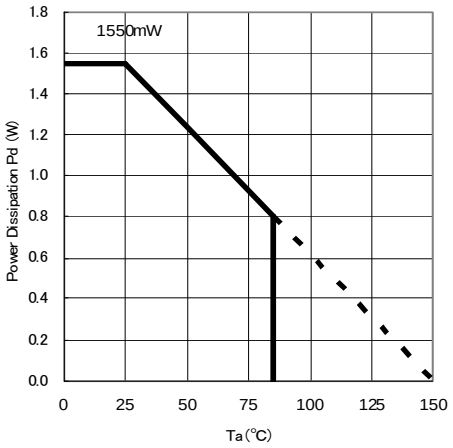
Parameter	Symbol	Ratings	Unit
Maximum voltage	VMAX	7	V
Power Dissipation	Pd	1550 *1	mW
OperatingTemperature Range	Topr	-30 ～ +85	℃
Storage Temperature Range	Tstg	-55 ～ +150	℃

*1 It’s deleting is on the board that is ROHM’s standard. Power dissipation deleting is 12.4mW/ ℃, when it’s used in over 25 ℃.

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



Information of the ROHM's standard board
Material : glass-epoxy
Size 50mm × 58mm × 1.75mm(8^{th} layer)

Fig.1 Power dissipation

●**Operating conditions**(VBAT≥VIO, Ta=-30～85 ℃)

Parameter	Symbol	Ratings	Unit
VBAT input voltage	VBAT	2.7 ～ 5.5	V
VIO pin voltage	VIO	1.65 ～ 3.3	V

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

Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
【Circuit Current】						
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	-	61	65	mA	DC/DC x1 mode, Io=60mA VBAT=4.0V
VBAT Circuit current 4	IBAT4	-	92	102	mA	DC/DC x1.5 mode, Io=60mA VBAT=3.6V
VBAT Circuit current 5	IBAT5	-	123	140	mA	DC/DC x2 mode, Io=60mA VBAT=2.7V
VBAT Circuit current 6	IBAT6	-	5	7.5	μA	RGB External clock sleep mode Fin=31.25kHz, ILED(RGB)=0mA
【B/L LED Driver】						
LED current Step (DC Setup)	IBLSTP1		128		Step	BLLED1~7
LED current Step (At slope)	IBLSTP2		256		Step	BLLED1~7
LED Maximum setup current	IMAXBLLED	-	25.6	-	mA	BLLED1~7
LED current accuracy	IBLLED	-7	-	+7	%	I_{LED}=15mA VLED=1.0V
LED current Matching	IBLMT	-	-	4	%	Between BLLED1~7at VLED=1.0V, ILED=15mA
LED OFF Leak current	ILKBL	-	-	1.0	μA	VLED=4.5V
【RGB LED Driver】						
LED current Step (DC Setup)	IRGBSTP		128		Step	R1LED, G1LED, B1LED
LED maximum current 1	IMAX RGBLED1	-	25.4	-	mA	R1LED, G1LED, B1LED RGBISET=120 kΩ
LED maximum current 2	IMAX RGBLED2	-	30.48	-	mA	R1LED, G1LED, B1LED RGBISET=100 kΩ
LED current accuracy	IRGBLED	-7	-	+7	%	I_{LED}=15mA VLED=1.0V, RGBISET=120kΩ
LED current matching	IRGBMT	-	-	4	%	Between R1,G1,B1 at VLED=1.0V, ILED=15mA
LED OFF leak current	ILKRGB	-	-	1.0	μA	VLED=4.5V
【Accessories LED Driver】						
LED current Step (DC Setup)	IACCSTP		32		Step	LED1~6
LEDmaximum current	IMAXACC LED	-	32	-	mA	LED1~6
LED current accuracy	IACCLED	-7	-	+7	%	I_{LED}=15mA VLED=1.0V
LED current matching	IACCMT	-	-	4	%	Between LED1~6 at VLED=1.0V, ILED=15mA
LED OFF leak current	ILKACC	-	-	1.0	μA	VLED=4.5V

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

Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
【DC/DC(Charge Pump)】						
Output voltage	VoCP	-	Vf+0.2	Vf+0.25	V	Vf is forward direction of LED
Drive ability1	IOUT1	-	-	270	mA	VBAT≥3.2V, VOUT=4.5V
Drive ability 2	IOUT2	-	-	330	mA	VBAT≥3.2V, VOUT=4.0V
Switching freguency	fosc	0.8	1.0	1.2	MHz	
Over voltage protection detect voltage	OVP	-	6.0	-	V	
Over current protection detect current	OCP	-	187	375	mA	VOUT=0V
【SDA, SCL】(I^2C Interface)						
L level input voltage	VILI	-0.3	-	0.25 × VIO	V	
H level input voltage	VIHI	0.75 × VIO	-	VBAT +0.3	V	
Hysteresis of Schmitt trigger input	VhysI	0.05 × VIO	-	-	V	
L level output voltage	VOLI	0	-	0.3	V	SDA Pin、IOL=3 mA
Input current	IinI	-	-	1	μA	Input Voltage= 0.1×VIO～0.9×VIO
【RESETB】(CMOS Input Pin)						
L level input voltage	VILR	-0.3	-	0.25 × VIO	V	
H level input voltage	VIHR	0.75 × VIO	-	VBAT +0.3	V	
Input Current	IinR	-	-	1	μA	Input Voltage= 0.1×VIO～0.9×VIO
【WPWMIN, FLCNT, RGBCNT】(NMOS Input Pin)						
L level input voltage	VILA	-0.3	-	0.3	V	
H level input voltage	VIHA	1.4	-	VBAT +0.3	V	
Input Current	IinA	-	3.6	10	μA	Input Voltage= 1.8V
PWM input minimum High pulse width 1	Pwmin1	120	-	-	μs	WPWMINPin *1
PWM input minimum High pulse width 2	Pwmin2	250	-	-	μs	WPWMINPin with charge pump auto mode change
【CLKIO(output)】(CMOS Output Pin)						
L level output voltage	VOLCLK	-	-	0.2	V	IOL=1mA
H level output voltage	VOHCLK	VIO -0.2	-	-	V	IOH=1mA
output frequency 1	fclk1	200	250	300	kHz	FSEL=0
output frequency 2	fclk2	25	31.25	37.5	kHz	FSEL=1
【CLKIO(input)】(CMOS Input Pin)						
L level input voltag	VILCLK	-0.3	-	0.25 × VIO	V	
H level input voltag	VIHCLK	0.75 × VIO	-	VIO +0.3	V	
Input Current	IinCLK	-	3.6	10	μA	Input Voltage= 1.8V

*1 When no need pump up using low Vf LED.

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●Block Diagram / Application Circuit example 1

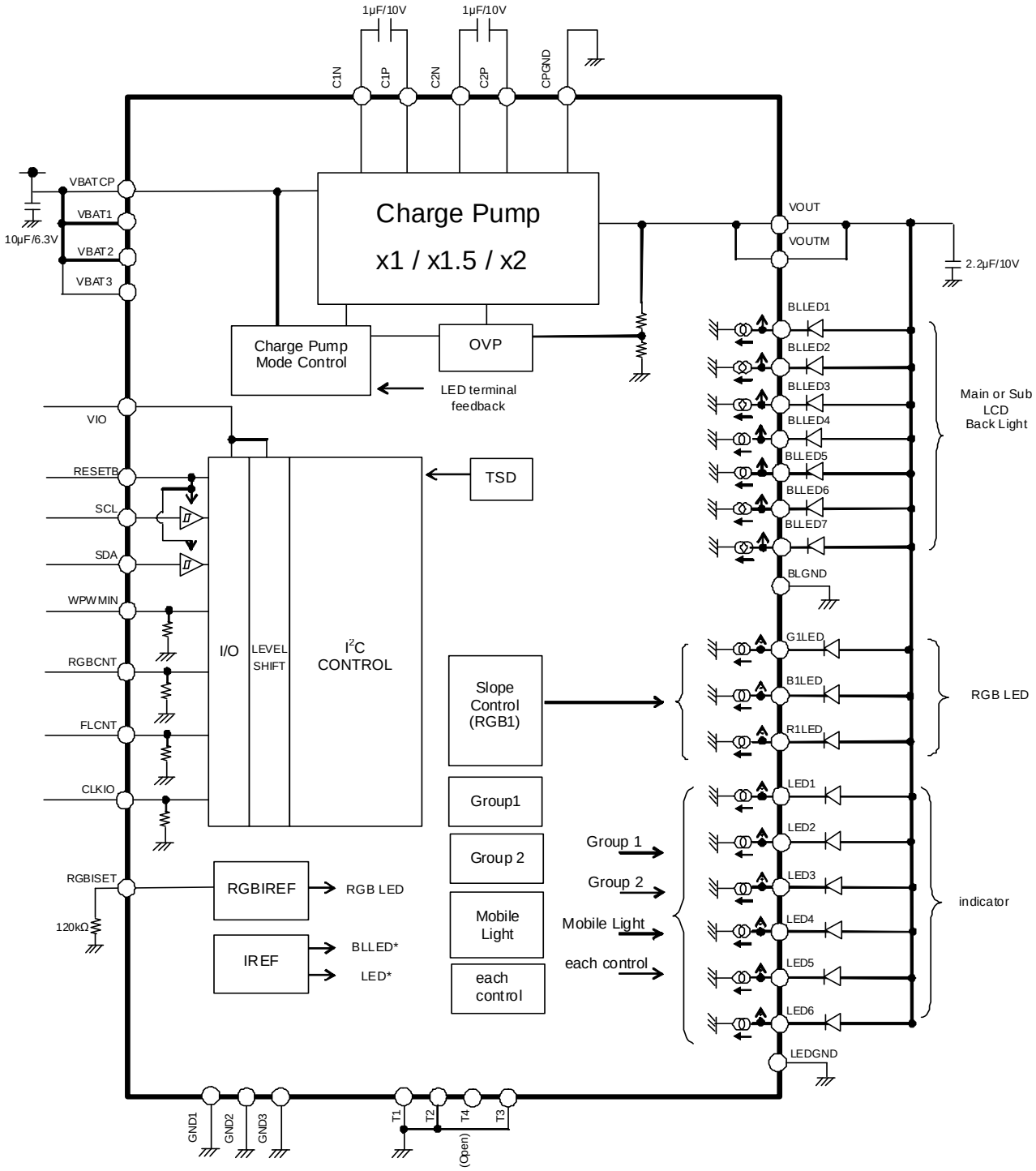


Fig.2 Block diagram and applied circuit example

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●Block Diagram / Application Circuit example 2

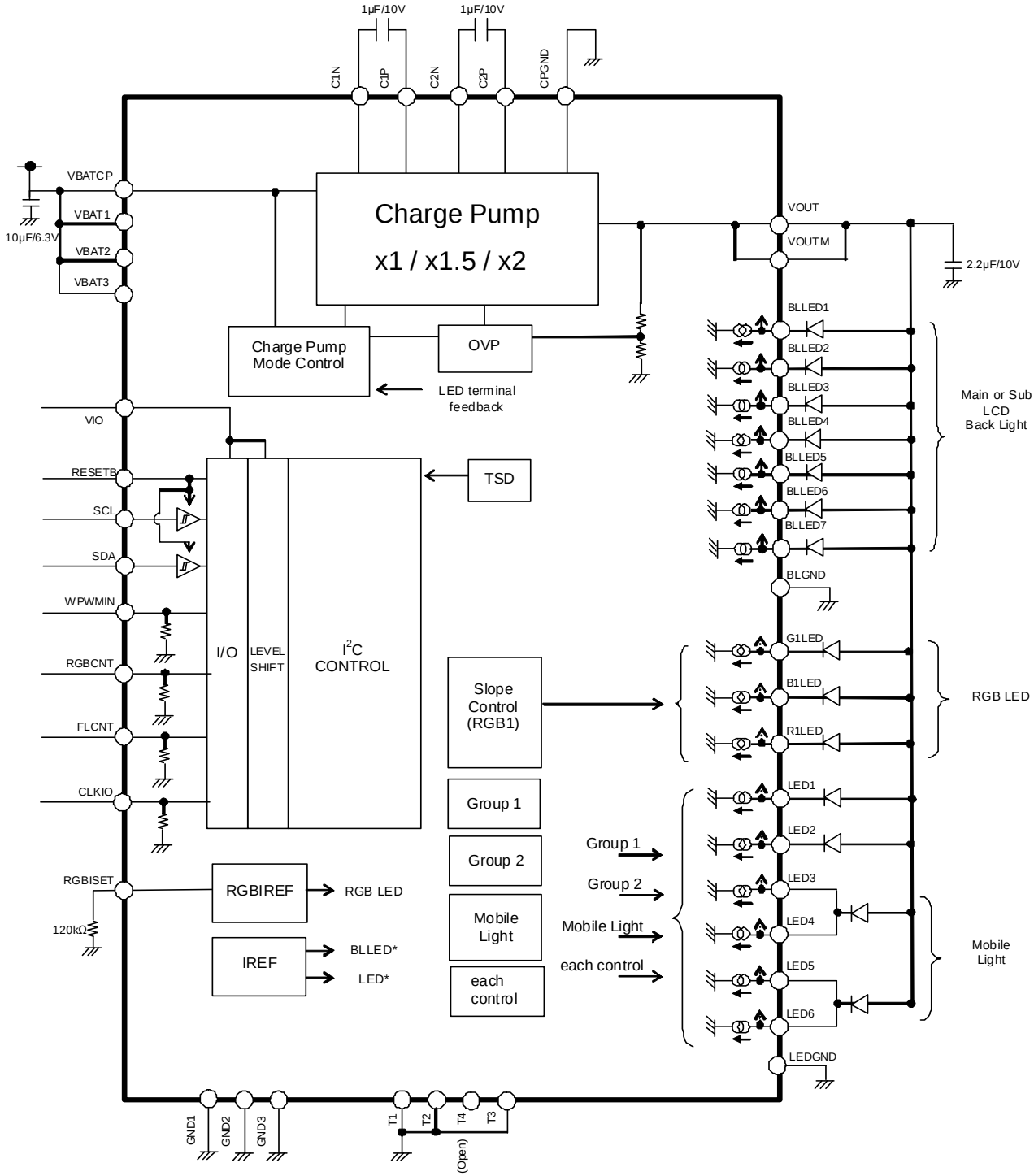


Fig.3 Block diagram and applied circuit example

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●**Pin Arrangement**［Bottom View］

	1	2	3	4	5	6	7
G	T4	GND3	VBAT3	GND1	G1LED	RGBISET	T3
F	BLLED1	BLLED2	RESETB	R1LED	B1LED	VIO	VBAT2
E	BLLED3	BLLED4	SCL	SDA	WPWMIN	RGBCNT	VOUT
D	BLGND	BLLDED5	NC	NC	CLKIO	VOUTM	C2P
C	BLLED6	BLLED7	INDEX	LED3	NC	FLCNT	C1P
B	VBAT1	LED1	LED4	LED5	GND2	C1N	VBATCP
A	T1	LED2	LEDGND	LED6	CPGND	C2N	T2

Total (48) Balls

Fig.4 Pin Arrangement

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●Pin Functions

No	Ball No.	Pin Name	I/O	ESD Diode		Functions	Equivalent Circuit
				For Power	For Ground		
1	B7	VBATCP	-	-	GND	Battery is connected	A
2	B1	VBAT1	-	-	GND	Battery is connected	A
3	F7	VBAT2	-	-	GND	Battery is connected	A
4	G3	VBAT3	-	-	GND	Battery is connected	A
5	A1	T1	I	VBAT	GND	Test Input Pin (short to Ground)	S
6	A7	T2	I	VBAT	GND	Test Input Pin (short to Ground)	S
7	G7	T3	I	VBAT	GND	Test Input Pin (short to Ground)	S
9	G1	T4	O	VBAT	GND	Test Output Pin(Open)	M
8	F6	VIO	-	VBAT	GND	I/O Power supply is connected	C
10	E4	SDA	I/O	VBAT	GND	I^2C data input / output	I
11	E3	SCL	I	VBAT	GND	I^2C clock input	H
12	F3	RESETB	I	VBAT	GND	Reset Input (L:Reset, H:Reset Cancel)	H
13	A5	CPGND	-	VBAT	-	Ground	B
14	A3	LEDGND	-	VBAT	-	Ground	B
15	D1	BLGND	-	VBAT	-	Ground	B
16	G4	GND1	-	VBAT	-	Ground	B
17	B5	GND2	-	VBAT	-	Ground	B
18	G2	GND3	-	VBAT	-	Ground	B
19	B6	C1N	I/O	VBAT	GND	Charge Pump capacitor is connected	F
20	C7	C1P	I/O	-	GND	Charge Pump capacitor is connected	G
21	A6	C2N	I/O	VBAT	GND	Charge Pump capacitor is connected	F
22	D7	C2P	I/O	-	GND	Charge Pump capacitor is connected	G
23	E7	VOUT	O	-	GND	Charge Pump output pin	A
24	D6	VOUTM	O	-	GND	Charge Pump output pin	A
25	F1	BLLED1	I	-	GND	LED is connected 1 for LCD Back Light	E
26	F2	BLLED2	I	-	GND	LED is connected 2 for LCD Back Light	E
27	E1	BLLED3	I	-	GND	LED is connected 3 for LCD Back Light	E
28	E2	BLLED4	I	-	GND	LED is connected 4 for LCD Back Light	E
29	D2	BLLED5	I	-	GND	LED is connected 5 for LCD Back Light	E
30	C1	BLLED6	I	-	GND	LED is connected 6 for LCD Back Light	E
31	C2	BLLED7	I	-	GND	LED is connected 7 for LCD Back Light	E
32	F4	R1LED	I	-	GND	R LED terminal	E
33	G5	G1LED	I	-	GND	G LED terminal	E
34	F5	B1LED	I	-	GND	B LED terminal	E
35	B2	LED1	I	-	GND	Accessories LED terminal1	E
36	A2	LED2	I	-	GND	Accessories LED terminal2	E
37	C4	LED3	I	-	GND	Accessories LED terminal3	E
38	B3	LED4	I	-	GND	Accessories LED terminal4	E
39	B4	LED5	I	-	GND	Accessories LED terminal5	E
40	A4	LED6	I	-	GND	Accessories LED terminal6	E
41	E5	WPWMIN	I	VBAT	GND	External PWM input for Back Light *1	L
42	E6	RGBCNT	I	VBAT	GND	RGB syncronuos terminal *1	L
43	C6	FLCNT	I	VBAT	GND	Flash syncronuos terminal	L
44	D5	CLKIO	I/O	VBAT	GND	RGB base clock terminal	V
45	G6	RGBISET	O	VBAT	GND	RGB refarence resister terminal	O
46	C5	NC	-	-	-	Non Connect Pin	-
47	D3	NC	-	-	-	Non Connect Pin	-
48	D4	NC	-	-	-	Non Connect Pin	-

*1 A setup of a register is separately necessary to make it effective.

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●Equivalent Circuit

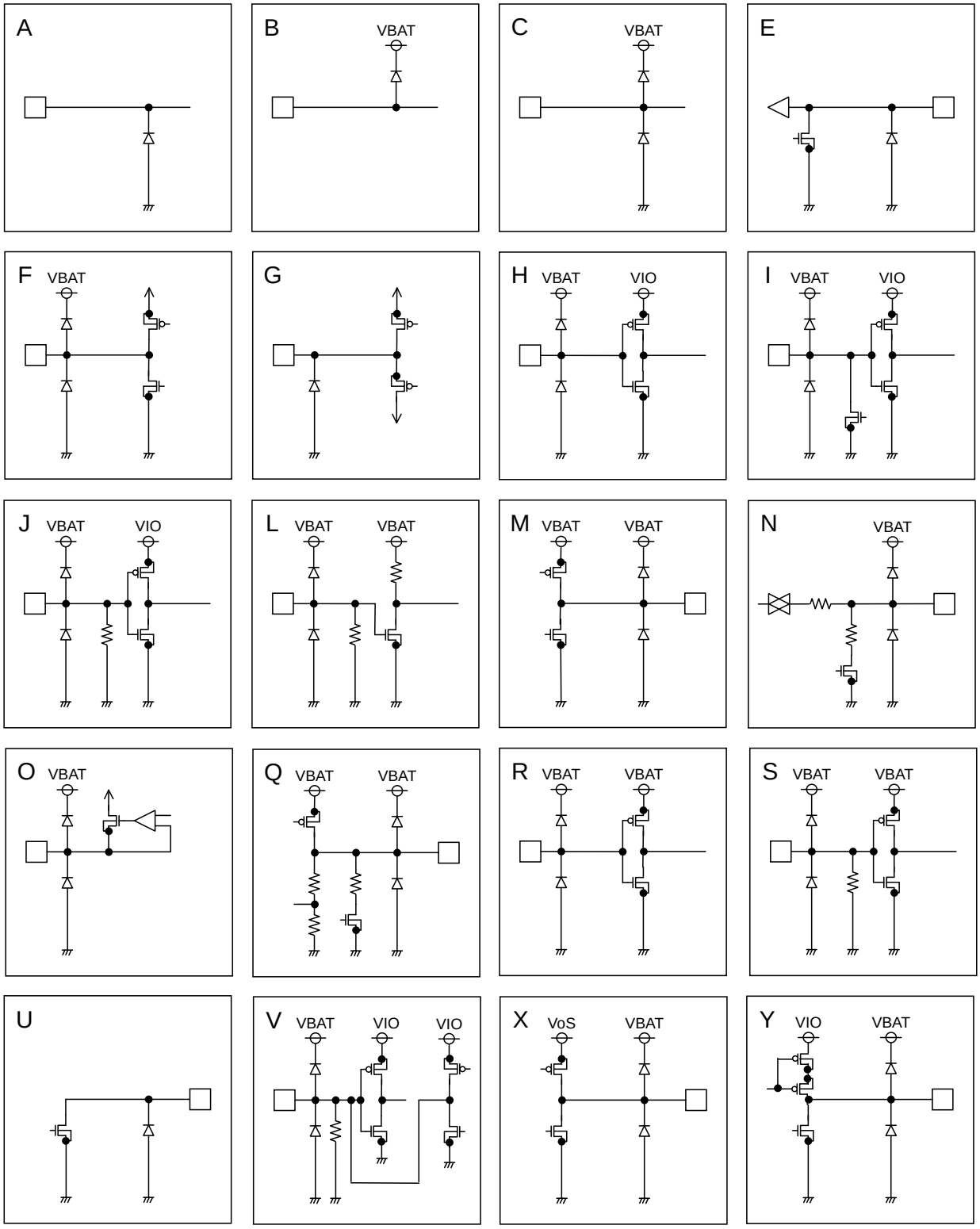


Fig.5 Equivalent Circuit

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●I²C BUS format

The writing/reading operation is based on the I²C slave standard.

・ Slave address

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

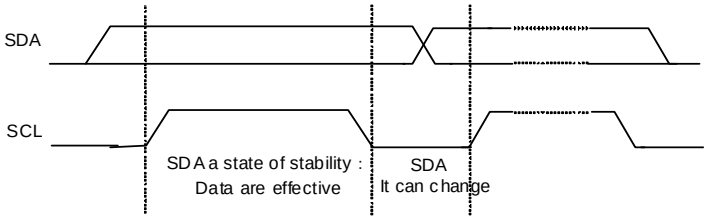


Fig.6 Bit Transfer

・START and STOP condition

When SDA and SCL are H, data is not transferred on the I²C- 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.

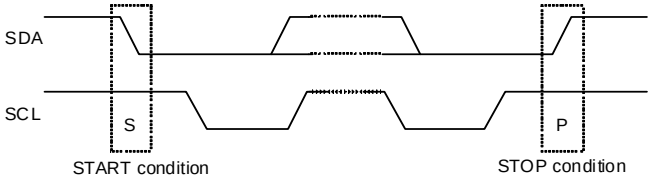


Fig.7 START and STOP condition

・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.

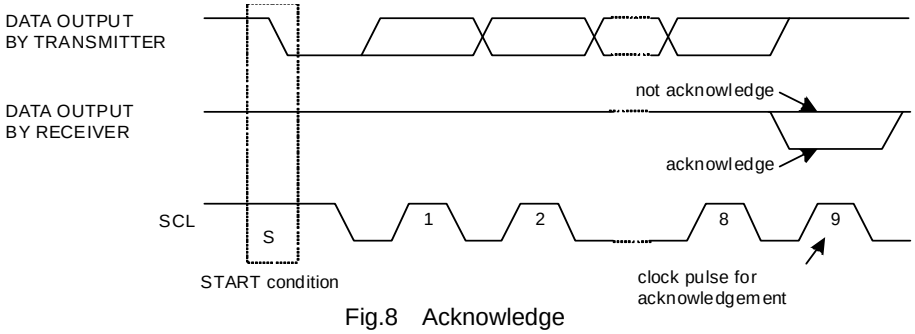


Fig.8 Acknowledge

・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.

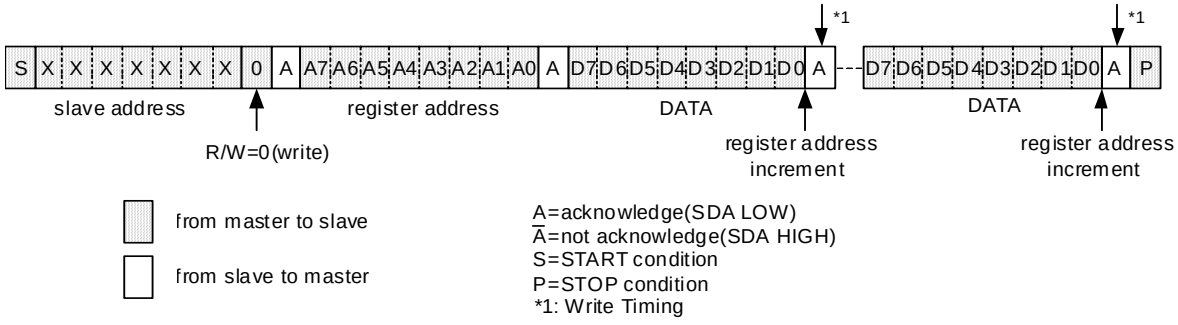


Fig.9 Writing protocol

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●Timing diagram

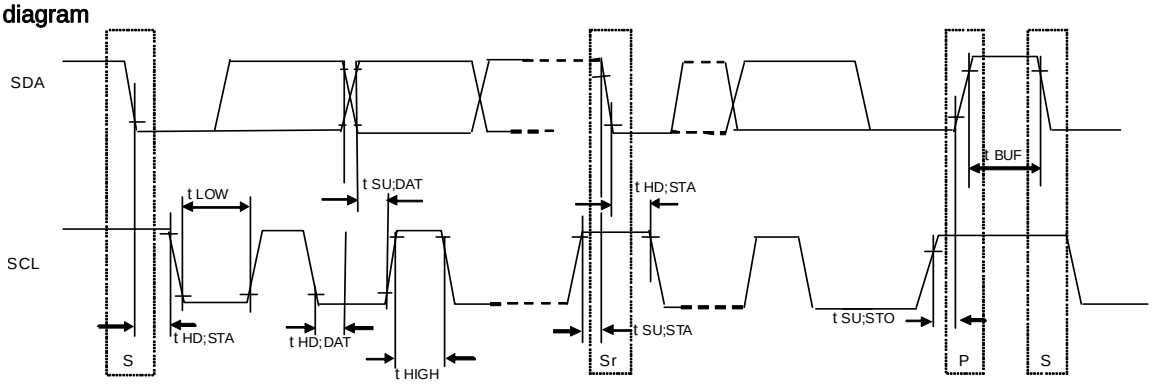


Fig.10 Timing diagram

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

Parameter	Symbol	Standard-mode			Fast-mode			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
【I^2C BUS format】								
SCL clock frequency	f_{SCL}	0	-	100	0	-	400	kHz
LOW period of the SCL clock	t_{LOW}	4.7	-	-	1.3	-	-	μs
HIGH period of the SCL clock	t_{HIGH}	4.0	-	-	0.6	-	-	μs
Hold time (repeated) START condition After this period, the first clock is generated	$t_{HD;STA}$	4.0	-	-	0.6	-	-	μs
Set-up time for a repeated START condition	$t_{SU;STA}$	4.7	-	-	0.6	-	-	μs
Data hold time	$t_{HD;DAT}$	0	-	3.45	0	-	0.9	μs
Data set-up time	$t_{SU;DAT}$	250	-	-	100	-	-	ns
Set-up time for STOP condition	$t_{SU;STO}$	4.0	-	-	0.6	-	-	μs
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	-	1.3	-	-	μs

●Register List

Input "0" for "-".
A free address has the possibility to assign it to the register for the test.
Access to the register for the test and the undefined register is prohibited.

Address	Register data								Function
	D7	D6	D5	D4	D3	D2	D1	D0	
00h	-	-	-	-	-	-	-	SFTRST	Software Reset
01h	W7MD(1)	W7MD(0)	W6MD(1)	W6MD(0)	W5MD(1)	W5MD(0)	W4MD(1)	W4MD(0)	Back light LED Assignment
02h	WPWMEN	-	-	SLEDEN	-	-	-	MLEDEN	Back light Control
03h	-	IMLED(6)	IMLED(5)	IMLED(4)	IMLED(3)	IMLED(2)	IMLED(1)	IMLED(0)	Main back light LED current
04h	-	ISLED(6)	ISLED(5)	ISLED(4)	ISLED(3)	ISLED(2)	ISLED(1)	ISLED(0)	Sub back light LED current
05h	-	THL (2)	THL (1)	THL (0)	-	TLH (2)	TLH (1)	TLH (0)	Main current time setup
06h	-	-	-	-	SLPMD	FSEL	CLKMD	CLKEN	RGB LED clock setup
07h	-	-	-	-	-	RGB1MEL	RGB1OS	RGB1EN	RGB LED Control
08h	SFRGB1(1)	SFRGB1(0)	SRRGB1(1)	SRRGB1(0)	-	TRGB1(2)	TRGB1(1)	TRGB1(0)	RGB LED time setup
09h	-	IR11(6)	IR11(5)	IR11(4)	IR11(3)	IR11(2)	IR11(1)	IR11(0)	R1 current 1 setup
0Ah	-	IR12(6)	IR12(5)	IR12(4)	IR12(3)	IR12(2)	IR12(1)	IR12(0)	R1 current 2 setup
0Bh	-	-	-	-	PR1(3)	PR1(2)	PR1(1)	PR1(0)	R1 Waveform pattern setup
0Ch	-	IG11(6)	IG11(5)	IG11(4)	IG11(3)	IG11(2)	IG11(1)	IG11(0)	G1 current 1 setup
0Dh	-	IG12(6)	IG12(5)	IG12(4)	IG12(3)	IG12(2)	IG12(1)	IG12(0)	G1 current 2 setup
0Eh	-	-	-	-	PG1(3)	PG1(2)	PG1(1)	PG1(0)	G1 Waveform pattern setup
0Fh	-	IB11(6)	IB11(5)	IB11(4)	IB11(3)	IB11(2)	IB11(1)	IB11(0)	B1 current 1 setup
10h	-	IB12(6)	IB12(5)	IB12(4)	IB12(3)	IB12(2)	IB12(1)	IB12(0)	B1 current 2 setup
11h	-	-	-	-	PB1(3)	PB1(2)	PB1(1)	PB1(0)	B1 Waveform pattern setup
12h	-	-	LED3MD(1)	LED3MD(0)	LED2MD(1)	LED2MD(0)	LED1MD(1)	LED1MD(0)	LED1 – LED3 Group setting
13h	-	-	LED6MD(1)	LED6MD(0)	LED5MD(1)	LED5MD(0)	LED4MD(1)	LED4MD(0)	LED4 – LED6 Group setting
14h	FLMD	-	-	-	-	FLLEDEN	GRP2EN	GRP1EN	Group control (1)
15h	-	-	LED6EN	LED5EN	LED4EN	LED3EN	LED2EN	LED1EN	Group control (2)
16h	-	-	-	IGRP1(4)	IGRP1(3)	IGRP1(2)	IGRP1(1)	IGRP1(0)	Group 1 current setup
17h	-	-	-	IGRP2(4)	IGRP2(3)	IGRP2(2)	IGRP2(1)	IGRP2(0)	Group 2 current setup
18h	-	-	-	ILED1(4)	ILED1(3)	ILED1(2)	ILED1(1)	ILED1(0)	LED1Independent current
19h	-	-	-	ILED2(4)	ILED2(3)	ILED2(2)	ILED2(1)	ILED2(0)	LED2 Independent current
1Ah	-	-	-	ILED3(4)	ILED3(3)	ILED3(2)	ILED3(1)	ILED3(0)	LED3 Independent current
1Bh	-	-	-	ILED4(4)	ILED4(3)	ILED4(2)	ILED4(1)	ILED4(0)	LED4 Independent current
1Ch	-	-	-	ILED5(4)	ILED5(3)	ILED5(2)	ILED5(1)	ILED5(0)	LED5 Independent current
1Dh	-	-	-	ILED6(4)	ILED6(3)	ILED6(2)	ILED6(1)	ILED6(0)	LED6 Independent current
1Eh	-	-	-	IFLLEDL(4)	IFLLEDL(3)	IFLLEDL(2)	IFLLEDL(1)	IFLLEDL(0)	Mobile light current setup (L)
1Fh	-	-	-	IFLLEDH(4)	IFLLEDH(3)	IFLLEDH(2)	IFLLEDH(1)	IFLLEDH(0)	Mobile light current setup (H)

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●Register Map

Address 00h < Software Reset >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
00h	W	-	-	-	-	-	-	-	SFTRST
Initial Value	00h	-	-	-	-	-	-	-	0

Bit[7:1] : (unused)
Bit0 : **SFTRST** Software Reset
"0" : Reset cancel
"1" : Reset(All register initializing)
Refer to "Reset" for detail.

Address 01h < Backlight LED allocation>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
01h	W	W7MD(1)	W7MD(0)	W6MD(1)	W6MD(0)	W5MD(1)	W5MD(0)	W4MD(1)	W4MD(0)
Initial Value	00h	0	0	0	0	0	0	0	0

Bit[7:6] : **W7MD(1:0)** BLLED7 main / sub group allocation
"00" : BLLED7 reflect main group control(Initial Value)
"01" : BLLED7 reflect sub group control
"10" : BLLED7 OFF
"11" : BLLED7 OFF
Bit[5:4] : **W6MD(1:0)** BLLED6 main / sub group allocation
"00" : BLLED6 reflect main group control(Initial Value)
"01" : BLLED6 reflect sub group control
"10" : BLLED6 OFF
"11" : BLLED6 OFF
Bit[3:2] : **W5MD(1:0)** BLLED5 main / sub group allocation
"00" : BLLED5 reflect main group control (Initial Value)
"01" : BLLED5 reflect sub group control
"10" : BLLED5 OFF
"11" : BLLED5 OFF
Bit[1:0] : **W4MD(1:0)** BLLED4 Main / sub group allocation
"00" : BLLED4 reflect main group control (Initial Value)
"01" : BLLED4 reflect sub group control
"10" : BLLED4 OFF
"11" : BLLED4 OFF

Address 02h < Back light light control>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
02h	W	WPWMEN	-	-	SLEDEN	-	-	-	MLEDEN
Initial Value	00h	0	-	-	0	-	-	-	0

Bit7 : **WPWMEN** Effective / ineffective of external PWM input of main group
"0" : Exterminal PWM input ineffective(Initial Value)
"1" : External PWM input effective
Bit[6:5] : (unused)
Bit4 : **SLEDEN** Sub group LED light control
"0" : Sub group OFF (Initial Value)
"1" : Sub group ON
Bit[3:1] : (unused)
Bit0 : **MLEDEN** Main group LED light control
"0" : Main group OFF (Initial Value)
"1" : Main group ON

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Address 03h < Main backlight LED current setting >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
03h	W	-	IMLED(6)	IMLED(5)	IMLED(4)	IMLED(3)	IMLED(2)	IMLED(1)	IMLED(0)
Initial Value	00h	-	0	0	0	0	0	0	0

Bit7 : (unused)

Bit[6:0] : **IMLED (6:0)** Main backlight LED current setting

“0000000” :	0.2 mA (Initial Value)	“1000000” :	13.0 mA
“0000001” :	0.4 mA	“1000001” :	13.2 mA
“0000010” :	0.6 mA	“1000010” :	13.4 mA
“0000011” :	0.8 mA	“1000011” :	13.6 mA
“0000100” :	1.0 mA	“1000100” :	13.8 mA
“0000101” :	1.2 mA	“1000101” :	14.0 mA
“0000110” :	1.4 mA	“1000110” :	14.2 mA
“0000111” :	1.6 mA	“1000111” :	14.4 mA
“0001000” :	1.8 mA	“1001000” :	14.6 mA
“0001001” :	2.0 mA	“1001001” :	14.8 mA
“0001010” :	2.2 mA	“1001010” :	15.0 mA
“0001011” :	2.4 mA	“1001011” :	15.2 mA
“0001100” :	2.6 mA	“1001100” :	15.4 mA
“0001101” :	2.8 mA	“1001101” :	15.6 mA
“0001110” :	3.0 mA	“1001110” :	15.8 mA
“0001111” :	3.2 mA	“1001111” :	16.0 mA
“0010000” :	3.4 mA	“1010000” :	16.2 mA
“0010001” :	3.6 mA	“1010001” :	16.4 mA
“0010010” :	3.8 mA	“1010010” :	16.6 mA
“0010011” :	4.0 mA	“1010011” :	16.8 mA
“0010100” :	4.2 mA	“1010100” :	17.0 mA
“0010101” :	4.4 mA	“1010101” :	17.2 mA
“0010110” :	4.6 mA	“1010110” :	17.4 mA
“0010111” :	4.8 mA	“1010111” :	17.6 mA
“0011000” :	5.0 mA	“1011000” :	17.8 mA
“0011001” :	5.2 mA	“1011001” :	18.0 mA
“0011010” :	5.4 mA	“1011010” :	18.2 mA
“0011011” :	5.6 mA	“1011011” :	18.4 mA
“0011100” :	5.8 mA	“1011100” :	18.6 mA
“0011101” :	6.0 mA	“1011101” :	18.8 mA
“0011110” :	6.2 mA	“1011110” :	19.0 mA
“0011111” :	6.4 mA	“1011111” :	19.2 mA
“0100000” :	6.6 mA	“1100000” :	19.4 mA
“0100001” :	6.8 mA	“1100001” :	19.6 mA
“0100010” :	7.0 mA	“1100010” :	19.8 mA
“0100011” :	7.2 mA	“1100011” :	20.0 mA
“0100100” :	7.4 mA	“1100100” :	20.2 mA
“0100101” :	7.6 mA	“1100101” :	20.4 mA
“0100110” :	7.8 mA	“1100110” :	20.6 mA
“0100111” :	8.0 mA	“1100111” :	20.8 mA
“0101000” :	8.2 mA	“1101000” :	21.0 mA
“0101001” :	8.4 mA	“1101001” :	21.2 mA
“0101010” :	8.6 mA	“1101010” :	21.4 mA
“0101011” :	8.8 mA	“1101011” :	21.6 mA
“0101100” :	9.0 mA	“1101100” :	21.8 mA
“0101101” :	9.2 mA	“1101101” :	22.0 mA
“0101110” :	9.4 mA	“1101110” :	22.2 mA
“0101111” :	9.6 mA	“1101111” :	22.4 mA
“0110000” :	9.8 mA	“1110000” :	22.6 mA
“0110001” :	10.0 mA	“1110001” :	22.8 mA
“0110010” :	10.2 mA	“1110010” :	23.0 mA
“0110011” :	10.4 mA	“1110011” :	23.2 mA
“0110100” :	10.6 mA	“1110100” :	23.4 mA
“0110101” :	10.8 mA	“1110101” :	23.6 mA
“0110110” :	11.0 mA	“1110110” :	23.8 mA
“0110111” :	11.2 mA	“1110111” :	24.0 mA
“0111000” :	11.4 mA	“1111000” :	24.2 mA
“0111001” :	11.6 mA	“1111001” :	24.4 mA
“0111010” :	11.8 mA	“1111010” :	24.6 mA
“0111011” :	12.0 mA	“1111011” :	24.8 mA
“0111100” :	12.2 mA	“1111100” :	25.0 mA
“0111101” :	12.4 mA	“1111101” :	25.2 mA
“0111110” :	12.6 mA	“1111110” :	25.4 mA
“0111111” :	12.8 mA	“1111111” :	25.6 mA

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Address 04h < Sub backlight LED current setting >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
04h	W	-	ISLED(6)	ISLED(5)	ISLED(4)	ISLED(3)	ISLED(2)	ISLED(1)	ISLED(0)
Initial Value	00h	-	0	0	0	0	0	0	0

Bit7 : (unused)

Bit[6:0] : **ISLED (6:0)** Sub backlight LED current setting

“0000000” :	0.2 mA (Initial Value)	“1000000” :	13.0 mA
“0000001” :	0.4 mA	“1000001” :	13.2 mA
“0000010” :	0.6 mA	“1000010” :	13.4 mA
“0000011” :	0.8 mA	“1000011” :	13.6 mA
“0000100” :	1.0 mA	“1000100” :	13.8 mA
“0000101” :	1.2 mA	“1000101” :	14.0 mA
“0000110” :	1.4 mA	“1000110” :	14.2 mA
“0000111” :	1.6 mA	“1000111” :	14.4 mA
“0001000” :	1.8 mA	“1001000” :	14.6 mA
“0001001” :	2.0 mA	“1001001” :	14.8 mA
“0001010” :	2.2 mA	“1001010” :	15.0 mA
“0001011” :	2.4 mA	“1001011” :	15.2 mA
“0001100” :	2.6 mA	“1001100” :	15.4 mA
“0001101” :	2.8 mA	“1001101” :	15.6 mA
“0001110” :	3.0 mA	“1001110” :	15.8 mA
“0001111” :	3.2 mA	“1001111” :	16.0 mA
“0010000” :	3.4 mA	“1010000” :	16.2 mA
“0010001” :	3.6 mA	“1010001” :	16.4 mA
“0010010” :	3.8 mA	“1010010” :	16.6 mA
“0010011” :	4.0 mA	“1010011” :	16.8 mA
“0010100” :	4.2 mA	“1010100” :	17.0 mA
“0010101” :	4.4 mA	“1010101” :	17.2 mA
“0010110” :	4.6 mA	“1010110” :	17.4 mA
“0010111” :	4.8 mA	“1010111” :	17.6 mA
“0011000” :	5.0 mA	“1011000” :	17.8 mA
“0011001” :	5.2 mA	“1011001” :	18.0 mA
“0011010” :	5.4 mA	“1011010” :	18.2 mA
“0011011” :	5.6 mA	“1011011” :	18.4 mA
“0011100” :	5.8 mA	“1011100” :	18.6 mA
“0011101” :	6.0 mA	“1011101” :	18.8 mA
“0011110” :	6.2 mA	“1011110” :	19.0 mA
“0011111” :	6.4 mA	“1011111” :	19.2 mA
“0100000” :	6.6 mA	“1100000” :	19.4 mA
“0100001” :	6.8 mA	“1100001” :	19.6 mA
“0100010” :	7.0 mA	“1100010” :	19.8 mA
“0100011” :	7.2 mA	“1100011” :	20.0 mA
“0100100” :	7.4 mA	“1100100” :	20.2 mA
“0100101” :	7.6 mA	“1100101” :	20.4 mA
“0100110” :	7.8 mA	“1100110” :	20.6 mA
“0100111” :	8.0 mA	“1100111” :	20.8 mA
“0101000” :	8.2 mA	“1101000” :	21.0 mA
“0101001” :	8.4 mA	“1101001” :	21.2 mA
“0101010” :	8.6 mA	“1101010” :	21.4 mA
“0101011” :	8.8 mA	“1101011” :	21.6 mA
“0101100” :	9.0 mA	“1101100” :	21.8 mA
“0101101” :	9.2 mA	“1101101” :	22.0 mA
“0101110” :	9.4 mA	“1101110” :	22.2 mA
“0101111” :	9.6 mA	“1101111” :	22.4 mA
“0110000” :	9.8 mA	“1110000” :	22.6 mA
“0110001” :	10.0 mA	“1110001” :	22.8 mA
“0110010” :	10.2 mA	“1110010” :	23.0 mA
“0110011” :	10.4 mA	“1110011” :	23.2 mA
“0110100” :	10.6 mA	“1110100” :	23.4 mA
“0110101” :	10.8 mA	“1110101” :	23.6 mA
“0110110” :	11.0 mA	“1110110” :	23.8 mA
“0110111” :	11.2 mA	“1110111” :	24.0 mA
“0111000” :	11.4 mA	“1111000” :	24.2 mA
“0111001” :	11.6 mA	“1111001” :	24.4 mA
“0111010” :	11.8 mA	“1111010” :	24.6 mA
“0111011” :	12.0 mA	“1111011” :	24.8 mA
“0111100” :	12.2 mA	“1111100” :	25.0 mA
“0111101” :	12.4 mA	“1111101” :	25.2 mA
“0111110” :	12.6 mA	“1111110” :	25.4 mA
“0111111” :	12.8 mA	“1111111” :	25.6 mA

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Address 05h < Main backlight current change time setting >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
05h	W	-	THL(2)	THL(1)	THL(0)	-	TLH(2)	TLH(1)	TLH(0)
Initial Value	55h	-	1	0	1	-	1	0	1

Bit7 : (unused)

Bit[6:4] : **THL (2:0)** Fall slope time of main LED current per 1 step (0.2mA)
"000" : 0.256 ms
"001" : 0.512 ms
"010" : 1.024 ms
"011" : 2.048 ms
"100" : 4.096 ms
"101" : 8.192 ms (Initial Value)
"110" : 16.38 ms
"111" : 32.77 ms
Setting time is based on switching frequency of charge pump.
The above is a value of Typ (1MHz) time.

Bit3 : (unused)

Bit[2:0] : **TLH (2:0)** Rise slope time of main LED current per 1 step (0.2mA)
"000" : 0.256 ms
"001" : 0.512 ms
"010" : 1.024 ms
"011" : 2.048 ms
"100" : 4.096 ms
"101" : 8.192 ms (Initial Value)
"110" : 16.38 ms
"111" : 32.77 ms
Setting time is based on switching frequency of charge pump.
The above is a value of Typ (1MHz) time.

Address 06h < RGB LED basic clock setting>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
06h	W	-	-	-	-	SLPMD	FSEL	CLKMD	CLKEN
Initial Value	00h	-	-	-	-	0	0	0	0

Bit[7:4] : (unused)

Bit3 : **SLPMD** Select normal mode / sleep mode at illumination
"0" : Normal mode(Initial Value)
"1" : Sleep mode

Bit2 : **FSEL** Basic clock output frequency setting
"0" : f=250KHz (typ) (Initial Value)
"1" : f=31.25KHz(typ)

Bit1 : **CLKMD** Basic clock input / Output setting
"0" : Basic clock input mode (Initial Value)
"1" : Basic clock output mode

Bit0 : **CLKEN** Basic clock input and output mode effective / ineffective setting
"0" : Basic clock input and output mode ineffective (Initial Value)
"1" : Basic clock input and output mode effective

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Address 07h < RGB LED Light control>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
07h	W	-	-	-	-	-	RGB1MEL	RGB1OS	RGB1EN
Initial Value	00h	-	-	-	-	-	0	0	0

Bit[7:3] : (unused)

Bit2 : **RGB1MEL** Effective / ineffective external control by RGB1CNT
"0" : External control ineffective (Initial Value)
"1" : Exteral control effective

Bit1 : **RGB1OS** RGB1 illumination one cycle operation setting
"0" : RGB1 stop (Initial Value)
"1" : RGB1 one cycle operation
RGB1OS is set as 0 automatically after one cycle operation.
RGB1EN has more priority on RGBOS.
(RGB1EN=0 is needed when using with one cycle operation.)

Bit0 : **RGB1EN** RGB1 illumination serial operation setting
"0" : RGB1 stop (Initial Value)
"1" : RGB1 continuous operation

Address 08h < RGB LED time setting>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
08h	W	SFRGB1(1)	SFRGB1(0)	SRRGB1(1)	SRRGB1(0)	-	TRGB1(2)	TRGB1(1)	TRGB1(0)
Initial Value	00h	0	0	0	0	-	0	0	0

Bit[7:6] : **SFRGB1(1:0)** RGB1 slope fall time (time between start and finish of slope)
"00" : Slope time 0 (Initial Value)
"01" : Slope time (waveform cycle/16)
"10" : Slope time (waveform cycle/8)
"11" : Slope time (waveform cycle/4)

Bit[5:4] : **SRRGB1(1:0)** RGB1 slope rise time (time between start and finish of slope)
"00" : Slope time 0 (Initial Value)
"01" : Slope time (waveform cycle/16)
"10" : Slope time (waveform cycle/8)
"11" : Slope time (waveform cycle/4)

Bit3 : (unused)

Bit[2:0] : **TRGB1(2:0)** RGB1 waveform cycle setting
"000" : 0.131s (Initial Value)
"001" : 0.52s
"010" : 1.05s
"011" : 2.10s
"100" : 4.19s
"101" : 8.39s
"110" : 12.6s
"111" : 16.8s

Setting time can be set based on the following.
Inside clock mode：1MHz(typ)
Outside clock input mode：31.25KHz(typ)

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Address 09h < R1LED Current 1 setup >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
09h	W	-	IR11(6)	IR11(5)	IR11(4)	IR11(3)	IR11(2)	IR11(1)	IR11(0)
Initial Value	00h	-	0	0	0	0	0	0	0

Bit7 : (unused)

Bit[6:0] : **IR11 (6:0)** R1LED Current 1 setup (RGBISET=120kΩ)

“0000000” :	0.0 mA (Initial Value)	“1000000” :	12.8 mA
“0000001” :	0.2 mA	“1000001” :	13.0 mA
“0000010” :	0.4 mA	“1000010” :	13.2 mA
“0000011” :	0.6 mA	“1000011” :	13.4 mA
“0000100” :	0.8 mA	“1000100” :	13.6 mA
“0000101” :	1.0 mA	“1000101” :	13.8 mA
“0000110” :	1.2 mA	“1000110” :	14.0 mA
“0000111” :	1.4 mA	“1000111” :	14.2 mA
“0001000” :	1.6 mA	“1001000” :	14.4 mA
“0001001” :	1.8 mA	“1001001” :	14.6 mA
“0001010” :	2.0 mA	“1001010” :	14.8 mA
“0001011” :	2.2 mA	“1001011” :	15.0 mA
“0001100” :	2.4 mA	“1001100” :	15.2 mA
“0001101” :	2.6 mA	“1001101” :	15.4 mA
“0001110” :	2.8 mA	“1001110” :	15.6 mA
“0001111” :	3.0 mA	“1001111” :	15.8 mA
“0010000” :	3.2 mA	“1010000” :	16.0 mA
“0010001” :	3.4 mA	“1010001” :	16.2 mA
“0010010” :	3.6 mA	“1010010” :	16.4 mA
“0010011” :	3.8 mA	“1010011” :	16.6 mA
“0010100” :	4.0 mA	“1010100” :	16.8 mA
“0010101” :	4.2 mA	“1010101” :	17.0 mA
“0010110” :	4.4 mA	“1010110” :	17.2 mA
“0010111” :	4.6 mA	“1010111” :	17.4 mA
“0011000” :	4.8 mA	“1011000” :	17.6 mA
“0011001” :	5.0 mA	“1011001” :	17.8 mA
“0011010” :	5.2 mA	“1011010” :	18.0 mA
“0011011” :	5.4 mA	“1011011” :	18.2 mA
“0011100” :	5.6 mA	“1011100” :	18.4 mA
“0011101” :	5.8 mA	“1011101” :	18.6 mA
“0011110” :	6.0 mA	“1011110” :	18.8 mA
“0011111” :	6.2 mA	“1011111” :	19.0 mA
“0100000” :	6.4 mA	“1100000” :	19.2 mA
“0100001” :	6.6 mA	“1100001” :	19.4 mA
“0100010” :	6.8 mA	“1100010” :	19.6 mA
“0100011” :	7.0 mA	“1100011” :	19.8 mA
“0100100” :	7.2 mA	“1100100” :	20.0 mA
“0100101” :	7.4 mA	“1100101” :	20.2 mA
“0100110” :	7.6 mA	“1100110” :	20.4 mA
“0100111” :	7.8 mA	“1100111” :	20.6 mA
“0101000” :	8.0 mA	“1101000” :	20.8 mA
“0101001” :	8.2 mA	“1101001” :	21.0 mA
“0101010” :	8.4 mA	“1101010” :	21.2 mA
“0101011” :	8.6 mA	“1101011” :	21.4 mA
“0101100” :	8.8 mA	“1101100” :	21.6 mA
“0101101” :	9.0 mA	“1101101” :	21.8 mA
“0101110” :	9.2 mA	“1101110” :	22.0 mA
“0101111” :	9.4 mA	“1101111” :	22.2 mA
“0110000” :	9.6 mA	“1110000” :	22.4 mA
“0110001” :	9.8 mA	“1110001” :	22.6 mA
“0110010” :	10.0 mA	“1110010” :	22.8 mA
“0110011” :	10.2 mA	“1110011” :	23.0 mA
“0110100” :	10.4 mA	“1110100” :	23.2 mA
“0110101” :	10.6 mA	“1110101” :	23.4 mA
“0110110” :	10.8 mA	“1110110” :	23.6 mA
“0110111” :	11.0 mA	“1110111” :	23.8 mA
“0111000” :	11.2 mA	“1111000” :	24.0 mA
“0111001” :	11.4 mA	“1111001” :	24.2 mA
“0111010” :	11.6 mA	“1111010” :	24.4 mA
“0111011” :	11.8 mA	“1111011” :	24.6 mA
“0111100” :	12.0 mA	“1111100” :	24.8 mA
“0111101” :	12.2 mA	“1111101” :	25.0 mA
“0111110” :	12.4 mA	“1111110” :	25.2 mA
“0111111” :	12.6 mA	“1111111” :	25.4 mA

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Address 0Ah < R1LED Current 2 setup >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0Ah	W	-	IR12(6)	IR12(5)	IR12(4)	IR12(3)	IR12(2)	IR12(1)	IR12(0)
Initial Value	00h	-	0	0	0	0	0	0	0

Bit7 : (unused)

Bit[6:0] : **IR12 (6:0)** R1LED Current 2 setup (RGBISET=120kΩ)

“0000000” :	0.0 mA (Initial Value)	“1000000” :	12.8 mA
“0000001” :	0.2 mA	“1000001” :	13.0 mA
“0000010” :	0.4 mA	“1000010” :	13.2 mA
“0000011” :	0.6 mA	“1000011” :	13.4 mA
“0000100” :	0.8 mA	“1000100” :	13.6 mA
“0000101” :	1.0 mA	“1000101” :	13.8 mA
“0000110” :	1.2 mA	“1000110” :	14.0 mA
“0000111” :	1.4 mA	“1000111” :	14.2 mA
“0001000” :	1.6 mA	“1001000” :	14.4 mA
“0001001” :	1.8 mA	“1001001” :	14.6 mA
“0001010” :	2.0 mA	“1001010” :	14.8 mA
“0001011” :	2.2 mA	“1001011” :	15.0 mA
“0001100” :	2.4 mA	“1001100” :	15.2 mA
“0001101” :	2.6 mA	“1001101” :	15.4 mA
“0001110” :	2.8 mA	“1001110” :	15.6 mA
“0001111” :	3.0 mA	“1001111” :	15.8 mA
“0010000” :	3.2 mA	“1010000” :	16.0 mA
“0010001” :	3.4 mA	“1010001” :	16.2 mA
“0010010” :	3.6 mA	“1010010” :	16.4 mA
“0010011” :	3.8 mA	“1010011” :	16.6 mA
“0010100” :	4.0 mA	“1010100” :	16.8 mA
“0010101” :	4.2 mA	“1010101” :	17.0 mA
“0010110” :	4.4 mA	“1010110” :	17.2 mA
“0010111” :	4.6 mA	“1010111” :	17.4 mA
“0011000” :	4.8 mA	“1011000” :	17.6 mA
“0011001” :	5.0 mA	“1011001” :	17.8 mA
“0011010” :	5.2 mA	“1011010” :	18.0 mA
“0011011” :	5.4 mA	“1011011” :	18.2 mA
“0011100” :	5.6 mA	“1011100” :	18.4 mA
“0011101” :	5.8 mA	“1011101” :	18.6 mA
“0011110” :	6.0 mA	“1011110” :	18.8 mA
“0011111” :	6.2 mA	“1011111” :	19.0 mA
“0100000” :	6.4 mA	“1100000” :	19.2 mA
“0100001” :	6.6 mA	“1100001” :	19.4 mA
“0100010” :	6.8 mA	“1100010” :	19.6 mA
“0100011” :	7.0 mA	“1100011” :	19.8 mA
“0100100” :	7.2 mA	“1100100” :	20.0 mA
“0100101” :	7.4 mA	“1100101” :	20.2 mA
“0100110” :	7.6 mA	“1100110” :	20.4 mA
“0100111” :	7.8 mA	“1100111” :	20.6 mA
“0101000” :	8.0 mA	“1101000” :	20.8 mA
“0101001” :	8.2 mA	“1101001” :	21.0 mA
“0101010” :	8.4 mA	“1101010” :	21.2 mA
“0101011” :	8.6 mA	“1101011” :	21.4 mA
“0101100” :	8.8 mA	“1101100” :	21.6 mA
“0101101” :	9.0 mA	“1101101” :	21.8 mA
“0101110” :	9.2 mA	“1101110” :	22.0 mA
“0101111” :	9.4 mA	“1101111” :	22.2 mA
“0110000” :	9.6 mA	“1110000” :	22.4 mA
“0110001” :	9.8 mA	“1110001” :	22.6 mA
“0110010” :	10.0 mA	“1110010” :	22.8 mA
“0110011” :	10.2 mA	“1110011” :	23.0 mA
“0110100” :	10.4 mA	“1110100” :	23.2 mA
“0110101” :	10.6 mA	“1110101” :	23.4 mA
“0110110” :	10.8 mA	“1110110” :	23.6 mA
“0110111” :	11.0 mA	“1110111” :	23.8 mA
“0111000” :	11.2 mA	“1111000” :	24.0 mA
“0111001” :	11.4 mA	“1111001” :	24.2 mA
“0111010” :	11.6 mA	“1111010” :	24.4 mA
“0111011” :	11.8 mA	“1111011” :	24.6 mA
“0111100” :	12.0 mA	“1111100” :	24.8 mA
“0111101” :	12.2 mA	“1111101” :	25.0 mA
“0111110” :	12.4 mA	“1111110” :	25.2 mA
“0111111” :	12.6 mA	“1111111” :	25.4 mA

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Address 0Bh < R1LED Waveform pattern setup >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0Bh	W	-	-	-	-	PR1(3)	PR1(2)	PR1(1)	PR1(0)
Initial Value	07h	-	-	-	-	0	1	1	1

Bit[7:4] : (unused)

Bit[3:0] : **PR1 (3:0)** R1LED Waveform pattern

"0000" : Pattern1
"0001" : Pattern2
"0010" : Pattern3
"0011" : Pattern4
"0100" : Pattern5
"0101" : Pattern6
"0110" : Pattern7
"0111" : Pattern8 (initial value)
"1000" : Pattern9
"1001" : Pattern10
"1010" : Pattern11
"1011" : Pattern12
"1100" : Pattern13
"1101" : Pattern14
"1110" : Pattern15
"1111" : Pattern16

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Address 0Ch < G1LED Current 1 setup >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0Ch	W	-	IG11(6)	IG11(5)	IG11(4)	IG11(3)	IG11(2)	IG11(1)	IG11(0)
Initial Value	00h	-	0	0	0	0	0	0	0

Bit7 : (unused)

Bit[6:0] : **IG11 (6:0)** G1LED Current 1 setup (RGBISET=120kΩ)

“0000000” :	0.0 mA (Initial Value)	“1000000” :	12.8 mA
“0000001” :	0.2 mA	“1000001” :	13.0 mA
“0000010” :	0.4 mA	“1000010” :	13.2 mA
“0000011” :	0.6 mA	“1000011” :	13.4 mA
“0000100” :	0.8 mA	“1000100” :	13.6 mA
“0000101” :	1.0 mA	“1000101” :	13.8 mA
“0000110” :	1.2 mA	“1000110” :	14.0 mA
“0000111” :	1.4 mA	“1000111” :	14.2 mA
“0001000” :	1.6 mA	“1001000” :	14.4 mA
“0001001” :	1.8 mA	“1001001” :	14.6 mA
“0001010” :	2.0 mA	“1001010” :	14.8 mA
“0001011” :	2.2 mA	“1001011” :	15.0 mA
“0001100” :	2.4 mA	“1001100” :	15.2 mA
“0001101” :	2.6 mA	“1001101” :	15.4 mA
“0001110” :	2.8 mA	“1001110” :	15.6 mA
“0001111” :	3.0 mA	“1001111” :	15.8 mA
“0010000” :	3.2 mA	“1010000” :	16.0 mA
“0010001” :	3.4 mA	“1010001” :	16.2 mA
“0010010” :	3.6 mA	“1010010” :	16.4 mA
“0010011” :	3.8 mA	“1010011” :	16.6 mA
“0010100” :	4.0 mA	“1010100” :	16.8 mA
“0010101” :	4.2 mA	“1010101” :	17.0 mA
“0010110” :	4.4 mA	“1010110” :	17.2 mA
“0010111” :	4.6 mA	“1010111” :	17.4 mA
“0011000” :	4.8 mA	“1011000” :	17.6 mA
“0011001” :	5.0 mA	“1011001” :	17.8 mA
“0011010” :	5.2 mA	“1011010” :	18.0 mA
“0011011” :	5.4 mA	“1011011” :	18.2 mA
“0011100” :	5.6 mA	“1011100” :	18.4 mA
“0011101” :	5.8 mA	“1011101” :	18.6 mA
“0011110” :	6.0 mA	“1011110” :	18.8 mA
“0011111” :	6.2 mA	“1011111” :	19.0 mA
“0100000” :	6.4 mA	“1100000” :	19.2 mA
“0100001” :	6.6 mA	“1100001” :	19.4 mA
“0100010” :	6.8 mA	“1100010” :	19.6 mA
“0100011” :	7.0 mA	“1100011” :	19.8 mA
“0100100” :	7.2 mA	“1100100” :	20.0 mA
“0100101” :	7.4 mA	“1100101” :	20.2 mA
“0100110” :	7.6 mA	“1100110” :	20.4 mA
“0100111” :	7.8 mA	“1100111” :	20.6 mA
“0101000” :	8.0 mA	“1101000” :	20.8 mA
“0101001” :	8.2 mA	“1101001” :	21.0 mA
“0101010” :	8.4 mA	“1101010” :	21.2 mA
“0101011” :	8.6 mA	“1101011” :	21.4 mA
“0101100” :	8.8 mA	“1101100” :	21.6 mA
“0101101” :	9.0 mA	“1101101” :	21.8 mA
“0101110” :	9.2 mA	“1101110” :	22.0 mA
“0101111” :	9.4 mA	“1101111” :	22.2 mA
“0110000” :	9.6 mA	“1110000” :	22.4 mA
“0110001” :	9.8 mA	“1110001” :	22.6 mA
“0110010” :	10.0 mA	“1110010” :	22.8 mA
“0110011” :	10.2 mA	“1110011” :	23.0 mA
“0110100” :	10.4 mA	“1110100” :	23.2 mA
“0110101” :	10.6 mA	“1110101” :	23.4 mA
“0110110” :	10.8 mA	“1110110” :	23.6 mA
“0110111” :	11.0 mA	“1110111” :	23.8 mA
“0111000” :	11.2 mA	“1111000” :	24.0 mA
“0111001” :	11.4 mA	“1111001” :	24.2 mA
“0111010” :	11.6 mA	“1111010” :	24.4 mA
“0111011” :	11.8 mA	“1111011” :	24.6 mA
“0111100” :	12.0 mA	“1111100” :	24.8 mA
“0111101” :	12.2 mA	“1111101” :	25.0 mA
“0111110” :	12.4 mA	“1111110” :	25.2 mA
“0111111” :	12.6 mA	“1111111” :	25.4 mA

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Address 0Dh < G1LED Current 2 setup >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0Dh	W	-	IG12(6)	IG12(5)	IG12(4)	IG12(3)	IG12(2)	IG12(1)	IG12(0)
Initial Value	00h	-	0	0	0	0	0	0	0

Bit7 : (unused)

Bit[6:0] : **IG12 (6:0)** G1LED Current 2 setup (RGBISET=120kΩ)

“0000000” :	0.0 mA (Initial Value)	“1000000” :	12.8 mA
“0000001” :	0.2 mA	“1000001” :	13.0 mA
“0000010” :	0.4 mA	“1000010” :	13.2 mA
“0000011” :	0.6 mA	“1000011” :	13.4 mA
“0000100” :	0.8 mA	“1000100” :	13.6 mA
“0000101” :	1.0 mA	“1000101” :	13.8 mA
“0000110” :	1.2 mA	“1000110” :	14.0 mA
“0000111” :	1.4 mA	“1000111” :	14.2 mA
“0001000” :	1.6 mA	“1001000” :	14.4 mA
“0001001” :	1.8 mA	“1001001” :	14.6 mA
“0001010” :	2.0 mA	“1001010” :	14.8 mA
“0001011” :	2.2 mA	“1001011” :	15.0 mA
“0001100” :	2.4 mA	“1001100” :	15.2 mA
“0001101” :	2.6 mA	“1001101” :	15.4 mA
“0001110” :	2.8 mA	“1001110” :	15.6 mA
“0001111” :	3.0 mA	“1001111” :	15.8 mA
“0010000” :	3.2 mA	“1010000” :	16.0 mA
“0010001” :	3.4 mA	“1010001” :	16.2 mA
“0010010” :	3.6 mA	“1010010” :	16.4 mA
“0010011” :	3.8 mA	“1010011” :	16.6 mA
“0010100” :	4.0 mA	“1010100” :	16.8 mA
“0010101” :	4.2 mA	“1010101” :	17.0 mA
“0010110” :	4.4 mA	“1010110” :	17.2 mA
“0010111” :	4.6 mA	“1010111” :	17.4 mA
“0011000” :	4.8 mA	“1011000” :	17.6 mA
“0011001” :	5.0 mA	“1011001” :	17.8 mA
“0011010” :	5.2 mA	“1011010” :	18.0 mA
“0011011” :	5.4 mA	“1011011” :	18.2 mA
“0011100” :	5.6 mA	“1011100” :	18.4 mA
“0011101” :	5.8 mA	“1011101” :	18.6 mA
“0011110” :	6.0 mA	“1011110” :	18.8 mA
“0011111” :	6.2 mA	“1011111” :	19.0 mA
“0100000” :	6.4 mA	“1100000” :	19.2 mA
“0100001” :	6.6 mA	“1100001” :	19.4 mA
“0100010” :	6.8 mA	“1100010” :	19.6 mA
“0100011” :	7.0 mA	“1100011” :	19.8 mA
“0100100” :	7.2 mA	“1100100” :	20.0 mA
“0100101” :	7.4 mA	“1100101” :	20.2 mA
“0100110” :	7.6 mA	“1100110” :	20.4 mA
“0100111” :	7.8 mA	“1100111” :	20.6 mA
“0101000” :	8.0 mA	“1101000” :	20.8 mA
“0101001” :	8.2 mA	“1101001” :	21.0 mA
“0101010” :	8.4 mA	“1101010” :	21.2 mA
“0101011” :	8.6 mA	“1101011” :	21.4 mA
“0101100” :	8.8 mA	“1101100” :	21.6 mA
“0101101” :	9.0 mA	“1101101” :	21.8 mA
“0101110” :	9.2 mA	“1101110” :	22.0 mA
“0101111” :	9.4 mA	“1101111” :	22.2 mA
“0110000” :	9.6 mA	“1110000” :	22.4 mA
“0110001” :	9.8 mA	“1110001” :	22.6 mA
“0110010” :	10.0 mA	“1110010” :	22.8 mA
“0110011” :	10.2 mA	“1110011” :	23.0 mA
“0110100” :	10.4 mA	“1110100” :	23.2 mA
“0110101” :	10.6 mA	“1110101” :	23.4 mA
“0110110” :	10.8 mA	“1110110” :	23.6 mA
“0110111” :	11.0 mA	“1110111” :	23.8 mA
“0111000” :	11.2 mA	“1111000” :	24.0 mA
“0111001” :	11.4 mA	“1111001” :	24.2 mA
“0111010” :	11.6 mA	“1111010” :	24.4 mA
“0111011” :	11.8 mA	“1111011” :	24.6 mA
“0111100” :	12.0 mA	“1111100” :	24.8 mA
“0111101” :	12.2 mA	“1111101” :	25.0 mA
“0111110” :	12.4 mA	“1111110” :	25.2 mA
“0111111” :	12.6 mA	“1111111” :	25.4 mA

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Address 0Eh < G1LED Waveform pattern setup >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0Eh	W	-	-	-	-	PG1(3)	PG1(2)	PG1(1)	PG1(0)
Initial Value	07h	-	-	-	-	0	1	1	1

Bit[7:4] : (unused)

Bit[3:0] : **PG1 (3:0)** G1LED Waveform pattern

"0000" : Pattern1
"0001" : Pattern2
"0010" : Pattern3
"0011" : Pattern4
"0100" : Pattern5
"0101" : Pattern6
"0110" : Pattern7
"0111" : Pattern8 (initial value)
"1000" : Pattern9
"1001" : Pattern10
"1010" : Pattern11
"1011" : Pattern12
"1100" : Pattern13
"1101" : Pattern14
"1110" : Pattern15
"1111" : Pattern16

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Address 0Fh < B1LED Current 1 setup >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0Fh	W	-	IB11(6)	IB11(5)	IB11(4)	IB11(3)	IB11(2)	IB11(1)	IB11(0)
Initial Value	00h	-	0	0	0	0	0	0	0

Bit7 : (unused)

Bit[6:0] : **IB11 (6:0)** B1LED Current 1 setup (RGBISET=120kΩ)

“0000000” :	0.0 mA (Initial Value)	“1000000” :	12.8 mA
“0000001” :	0.2 mA	“1000001” :	13.0 mA
“0000010” :	0.4 mA	“1000010” :	13.2 mA
“0000011” :	0.6 mA	“1000011” :	13.4 mA
“0000100” :	0.8 mA	“1000100” :	13.6 mA
“0000101” :	1.0 mA	“1000101” :	13.8 mA
“0000110” :	1.2 mA	“1000110” :	14.0 mA
“0000111” :	1.4 mA	“1000111” :	14.2 mA
“0001000” :	1.6 mA	“1001000” :	14.4 mA
“0001001” :	1.8 mA	“1001001” :	14.6 mA
“0001010” :	2.0 mA	“1001010” :	14.8 mA
“0001011” :	2.2 mA	“1001011” :	15.0 mA
“0001100” :	2.4 mA	“1001100” :	15.2 mA
“0001101” :	2.6 mA	“1001101” :	15.4 mA
“0001110” :	2.8 mA	“1001110” :	15.6 mA
“0001111” :	3.0 mA	“1001111” :	15.8 mA
“0010000” :	3.2 mA	“1010000” :	16.0 mA
“0010001” :	3.4 mA	“1010001” :	16.2 mA
“0010010” :	3.6 mA	“1010010” :	16.4 mA
“0010011” :	3.8 mA	“1010011” :	16.6 mA
“0010100” :	4.0 mA	“1010100” :	16.8 mA
“0010101” :	4.2 mA	“1010101” :	17.0 mA
“0010110” :	4.4 mA	“1010110” :	17.2 mA
“0010111” :	4.6 mA	“1010111” :	17.4 mA
“0011000” :	4.8 mA	“1011000” :	17.6 mA
“0011001” :	5.0 mA	“1011001” :	17.8 mA
“0011010” :	5.2 mA	“1011010” :	18.0 mA
“0011011” :	5.4 mA	“1011011” :	18.2 mA
“0011100” :	5.6 mA	“1011100” :	18.4 mA
“0011101” :	5.8 mA	“1011101” :	18.6 mA
“0011110” :	6.0 mA	“1011110” :	18.8 mA
“0011111” :	6.2 mA	“1011111” :	19.0 mA
“0100000” :	6.4 mA	“1100000” :	19.2 mA
“0100001” :	6.6 mA	“1100001” :	19.4 mA
“0100010” :	6.8 mA	“1100010” :	19.6 mA
“0100011” :	7.0 mA	“1100011” :	19.8 mA
“0100100” :	7.2 mA	“1100100” :	20.0 mA
“0100101” :	7.4 mA	“1100101” :	20.2 mA
“0100110” :	7.6 mA	“1100110” :	20.4 mA
“0100111” :	7.8 mA	“1100111” :	20.6 mA
“0101000” :	8.0 mA	“1101000” :	20.8 mA
“0101001” :	8.2 mA	“1101001” :	21.0 mA
“0101010” :	8.4 mA	“1101010” :	21.2 mA
“0101011” :	8.6 mA	“1101011” :	21.4 mA
“0101100” :	8.8 mA	“1101100” :	21.6 mA
“0101101” :	9.0 mA	“1101101” :	21.8 mA
“0101110” :	9.2 mA	“1101110” :	22.0 mA
“0101111” :	9.4 mA	“1101111” :	22.2 mA
“0110000” :	9.6 mA	“1110000” :	22.4 mA
“0110001” :	9.8 mA	“1110001” :	22.6 mA
“0110010” :	10.0 mA	“1110010” :	22.8 mA
“0110011” :	10.2 mA	“1110011” :	23.0 mA
“0110100” :	10.4 mA	“1110100” :	23.2 mA
“0110101” :	10.6 mA	“1110101” :	23.4 mA
“0110110” :	10.8 mA	“1110110” :	23.6 mA
“0110111” :	11.0 mA	“1110111” :	23.8 mA
“0111000” :	11.2 mA	“1111000” :	24.0 mA
“0111001” :	11.4 mA	“1111001” :	24.2 mA
“0111010” :	11.6 mA	“1111010” :	24.4 mA
“0111011” :	11.8 mA	“1111011” :	24.6 mA
“0111100” :	12.0 mA	“1111100” :	24.8 mA
“0111101” :	12.2 mA	“1111101” :	25.0 mA
“0111110” :	12.4 mA	“1111110” :	25.2 mA
“0111111” :	12.6 mA	“1111111” :	25.4 mA

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Address 10h < B1LED Current 2 setup >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
10h	W	-	IB12(6)	IB12(5)	IB12(4)	IB12(3)	IB12(2)	IB12(1)	IB12(0)
Initial Value	00h	-	0	0	0	0	0	0	0

Bit7 : (unused)

Bit[6:0] : **IB12 (6:0)** B1LED Current 2 setup (RGBISET=120kΩ)

“0000000” :	0.0 mA (Initial Value)	“1000000” :	12.8 mA
“0000001” :	0.2 mA	“1000001” :	13.0 mA
“0000010” :	0.4 mA	“1000010” :	13.2 mA
“0000011” :	0.6 mA	“1000011” :	13.4 mA
“0000100” :	0.8 mA	“1000100” :	13.6 mA
“0000101” :	1.0 mA	“1000101” :	13.8 mA
“0000110” :	1.2 mA	“1000110” :	14.0 mA
“0000111” :	1.4 mA	“1000111” :	14.2 mA
“0001000” :	1.6 mA	“1001000” :	14.4 mA
“0001001” :	1.8 mA	“1001001” :	14.6 mA
“0001010” :	2.0 mA	“1001010” :	14.8 mA
“0001011” :	2.2 mA	“1001011” :	15.0 mA
“0001100” :	2.4 mA	“1001100” :	15.2 mA
“0001101” :	2.6 mA	“1001101” :	15.4 mA
“0001110” :	2.8 mA	“1001110” :	15.6 mA
“0001111” :	3.0 mA	“1001111” :	15.8 mA
“0010000” :	3.2 mA	“1010000” :	16.0 mA
“0010001” :	3.4 mA	“1010001” :	16.2 mA
“0010010” :	3.6 mA	“1010010” :	16.4 mA
“0010011” :	3.8 mA	“1010011” :	16.6 mA
“0010100” :	4.0 mA	“1010100” :	16.8 mA
“0010101” :	4.2 mA	“1010101” :	17.0 mA
“0010110” :	4.4 mA	“1010110” :	17.2 mA
“0010111” :	4.6 mA	“1010111” :	17.4 mA
“0011000” :	4.8 mA	“1011000” :	17.6 mA
“0011001” :	5.0 mA	“1011001” :	17.8 mA
“0011010” :	5.2 mA	“1011010” :	18.0 mA
“0011011” :	5.4 mA	“1011011” :	18.2 mA
“0011100” :	5.6 mA	“1011100” :	18.4 mA
“0011101” :	5.8 mA	“1011101” :	18.6 mA
“0011110” :	6.0 mA	“1011110” :	18.8 mA
“0011111” :	6.2 mA	“1011111” :	19.0 mA
“0100000” :	6.4 mA	“1100000” :	19.2 mA
“0100001” :	6.6 mA	“1100001” :	19.4 mA
“0100010” :	6.8 mA	“1100010” :	19.6 mA
“0100011” :	7.0 mA	“1100011” :	19.8 mA
“0100100” :	7.2 mA	“1100100” :	20.0 mA
“0100101” :	7.4 mA	“1100101” :	20.2 mA
“0100110” :	7.6 mA	“1100110” :	20.4 mA
“0100111” :	7.8 mA	“1100111” :	20.6 mA
“0101000” :	8.0 mA	“1101000” :	20.8 mA
“0101001” :	8.2 mA	“1101001” :	21.0 mA
“0101010” :	8.4 mA	“1101010” :	21.2 mA
“0101011” :	8.6 mA	“1101011” :	21.4 mA
“0101100” :	8.8 mA	“1101100” :	21.6 mA
“0101101” :	9.0 mA	“1101101” :	21.8 mA
“0101110” :	9.2 mA	“1101110” :	22.0 mA
“0101111” :	9.4 mA	“1101111” :	22.2 mA
“0110000” :	9.6 mA	“1110000” :	22.4 mA
“0110001” :	9.8 mA	“1110001” :	22.6 mA
“0110010” :	10.0 mA	“1110010” :	22.8 mA
“0110011” :	10.2 mA	“1110011” :	23.0 mA
“0110100” :	10.4 mA	“1110100” :	23.2 mA
“0110101” :	10.6 mA	“1110101” :	23.4 mA
“0110110” :	10.8 mA	“1110110” :	23.6 mA
“0110111” :	11.0 mA	“1110111” :	23.8 mA
“0111000” :	11.2 mA	“1111000” :	24.0 mA
“0111001” :	11.4 mA	“1111001” :	24.2 mA
“0111010” :	11.6 mA	“1111010” :	24.4 mA
“0111011” :	11.8 mA	“1111011” :	24.6 mA
“0111100” :	12.0 mA	“1111100” :	24.8 mA
“0111101” :	12.2 mA	“1111101” :	25.0 mA
“0111110” :	12.4 mA	“1111110” :	25.2 mA
“0111111” :	12.6 mA	“1111111” :	25.4 mA

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Address 11h < B1LED Waveform pattern setup >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
11h	W	-	-	-	-	PB1(3)	PB1(2)	PB1(1)	PB1(0)
Initial Value	07h	-	-	-	-	0	1	1	1

Bit[7:4] : (unused)

Bit[3:0] : **PB1 (3:0)** B1LED Waveform pattern

"0000" : Pattern1
"0001" : Pattern2
"0010" : Pattern3
"0011" : Pattern4
"0100" : Pattern5
"0101" : Pattern6
"0110" : Pattern7
"0111" : Pattern8 (initial value)
"1000" : Pattern9
"1001" : Pattern10
"1010" : Pattern11
"1011" : Pattern12
"1100" : Pattern13
"1101" : Pattern14
"1110" : Pattern15
"1111" : Pattern16

Address 12h < LED1- LED3 Group setting >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
12h	W	-	-	LED3MD(1)	LED3MD(0)	LED2MD(1)	LED2MD(0)	LED1MD(1)	LED1MD(0)
Initial Value	00h	-	-	0	0	0	0	0	0

Bit[7:6] : (unused)

Bit[5:4] : **LED3MD(1:0)** LED3 Group setting
"00" : Individual control (Initial Value)
"01" : Group 1 control
"10" : Group 2 control
"11" : Mobile light control

Bit[3:2] : **LED2MD(1:0)** LED2 Group setting
"00" : Individual control (Initial Value)
"01" : Group 1 control
"10" : Group 2 control
"11" : Mobile light control

Bit[1:0] : **LED1MD(1:0)** LED1 Group setting
"00" : Individual control (Initial Value)
"01" : Group 1 control
"10" : Group 2 control
"11" : Mobile light control

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Address 13h < LED4- LED6 Group setting >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
13h	W	-	-	LED6MD(1)	LED6MD(0)	LED5MD(1)	LED5MD(0)	LED4MD(1)	LED4MD(0)
Initial Value	00h	-	-	0	0	0	0	0	0

Bit[7:6] : (unused)

Bit[5:4] : **LED6MD(1:0)** LED6 Group setting
"00" : Individual control (Initial Value)
"01" : Group 1 control
"10" : Group 2 control
"11" : Mobile light control

Bit[3:2] : **LED5MD(1:0)** LED5 Group setting
"00" : Individual control (Initial Value)
"01" : Group 1 control
"10" : Group 2 control
"11" : Mobile light control

Bit[1:0] : **LED4MD(1:0)** LED4 Group setting
"00" : Individual control (Initial Value)
"01" : Group 1 control
"10" : Group 2 control
"11" : Mobile light control

Address 14h < Group control (1) >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
14h	W	FLMD	-	-	-	-	FLLEDEN	GRP2EN	GRP1EN
Initial Value	00h	0	-	-	-	-	0	0	0

Bit7 : **FLMD** Mobile light Flash mode／Torch mode
"0" : Torch mode (Current setup「Mobile light Current setup(L)」) (Initial Value)
"1" : Flash mode (Current setup「Mobile light Current setup(H)」)

Bit[6:3] : (unused)

Bit2 : **FLLEDEN** Mobile light Current setup
"0" : OFF (Initial Value)
"1" : ON

Bit1 : **GRP2EN** Group 2 Current setup
"0" : OFF (Initial Value)
"1" : ON

Bit0 : **GRP1EN** Group 1 Current setup
"0" : OFF (Initial Value)
"1" : ON

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Address 15h < Group control (2) >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
15h	W	-	-	LED6EN	LED5EN	LED4EN	LED3EN	LED2EN	LED1EN
Initial Value	00h	-	-	0	0	0	0	0	0

Bit[7:6] : (unused)

Bit5 : **LED6EN** LED6 lights control (independent control setting)
"0" : OFF (Initial Value)
"1" : ON

Bit4 : **LED5EN** LED5 lights control (independent control setting)
"0" : OFF (Initial Value)
"1" : ON

Bit3 : **LED4EN** LED4 lights control (independent control setting)
"0" : OFF (Initial Value)
"1" : ON

Bit2 : **LED3EN** LED3 lights control (independent control setting))
"0" : OFF (Initial Value)
"1" : ON

Bit1 : **LED2EN** LED2 lights control (independent control setting)
"0" : OFF (Initial Value)
"1" : ON

Bit0 : **LED1EN** LED1 lights control (independent control setting)
"0" : OFF (Initial Value)
"1" : ON

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Address 16h < Group 1 Current setup>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
16h	W	-	-	-	IGRP1(4)	IGRP1(3)	IGRP1(2)	IGRP1(1)	IGRP1(0)
Initial Value	00h	-	-	-	0	0	0	0	0

Bit[7:5] : (unused)

Bit[4:0] : **IGRP1(4:0)** Group 1 Current setup

"00000" : 1mA (Initial Value)
"00001" : 2mA
"00010" : 3mA
"00011" : 4mA
"00100" : 5mA
"00101" : 6mA
"00110" : 7mA
"00111" : 8mA
"01000" : 9mA
"01001" : 10mA
"01010" : 11mA
"01011" : 12mA
"01100" : 13mA
"01101" : 14mA
"01110" : 15mA
"01111" : 16mA
"10000" : 17mA
"10001" : 18mA
"10010" : 19mA
"10011" : 20mA
"10100" : 21mA
"10101" : 22mA
"10110" : 23mA
"10111" : 24mA
"11000" : 25mA
"11001" : 26mA
"11010" : 27mA
"11011" : 28mA
"11100" : 29mA
"11101" : 30mA
"11110" : 31mA
"11111" : 32mA

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Address 17h < Group 2 Current setup>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
17h	W	-	-	-	IGRP2(4)	IGRP2(3)	IGRP2(2)	IGRP2(1)	IGRP2(0)
Initial Value	00h	-	-	-	0	0	0	0	0

Bit[7:5] : (unused)

Bit[4:0] : **IGRP2(4:0)** Group 2 Current setup

"00000" : 1mA (Initial Value)
"00001" : 2mA
"00010" : 3mA
"00011" : 4mA
"00100" : 5mA
"00101" : 6mA
"00110" : 7mA
"00111" : 8mA
"01000" : 9mA
"01001" : 10mA
"01010" : 11mA
"01011" : 12mA
"01100" : 13mA
"01101" : 14mA
"01110" : 15mA
"01111" : 16mA
"10000" : 17mA
"10001" : 18mA
"10010" : 19mA
"10011" : 20mA
"10100" : 21mA
"10101" : 22mA
"10110" : 23mA
"10111" : 24mA
"11000" : 25mA
"11001" : 26mA
"11010" : 27mA
"11011" : 28mA
"11100" : 29mA
"11101" : 30mA
"11110" : 31mA
"11111" : 32mA

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Address 18h < LED1 Independent control current setup>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
18h	W	-	-	-	ILED1(4)	ILED1(3)	ILED1(2)	ILED1(1)	ILED1(0)
Initial Value	00h	-	-	-	0	0	0	0	0

Bit[7:5] : (unused)

Bit[4:0] : **ILED1(4:0)** LED1 Independent control current setup

"00000" : 1mA (Initial Value)
"00001" : 2mA
"00010" : 3mA
"00011" : 4mA
"00100" : 5mA
"00101" : 6mA
"00110" : 7mA
"00111" : 8mA
"01000" : 9mA
"01001" : 10mA
"01010" : 11mA
"01011" : 12mA
"01100" : 13mA
"01101" : 14mA
"01110" : 15mA
"01111" : 16mA
"10000" : 17mA
"10001" : 18mA
"10010" : 19mA
"10011" : 20mA
"10100" : 21mA
"10101" : 22mA
"10110" : 23mA
"10111" : 24mA
"11000" : 25mA
"11001" : 26mA
"11010" : 27mA
"11011" : 28mA
"11100" : 29mA
"11101" : 30mA
"11110" : 31mA
"11111" : 32mA

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Address 19h < LED2 Independent control current setup>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
19h	W	-	-	-	ILED2(4)	ILED2(3)	ILED2(2)	ILED2(1)	ILED2(0)
Initial Value	00h	-	-	-	0	0	0	0	0

Bit[7:5] : (unused)

Bit[4:0] : **ILED2(4:0)** LED2 Independent control current setup

"00000" : 1mA (Initial Value)
"00001" : 2mA
"00010" : 3mA
"00011" : 4mA
"00100" : 5mA
"00101" : 6mA
"00110" : 7mA
"00111" : 8mA
"01000" : 9mA
"01001" : 10mA
"01010" : 11mA
"01011" : 12mA
"01100" : 13mA
"01101" : 14mA
"01110" : 15mA
"01111" : 16mA
"10000" : 17mA
"10001" : 18mA
"10010" : 19mA
"10011" : 20mA
"10100" : 21mA
"10101" : 22mA
"10110" : 23mA
"10111" : 24mA
"11000" : 25mA
"11001" : 26mA
"11010" : 27mA
"11011" : 28mA
"11100" : 29mA
"11101" : 30mA
"11110" : 31mA
"11111" : 32mA

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Address 1Ah < LED3 Independent control current setup>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1Ah	W	-	-	-	ILED3(4)	ILED3(3)	ILED3(2)	ILED3(1)	ILED3(0)
Initial Value	00h	-	-	-	0	0	0	0	0

Bit[7:5] : (unused)

Bit[4:0] : **ILED3(4:0)** LED3 Independent control current setup

“00000” :	1mA	(Initial Value)
“00001” :	2mA	
“00010” :	3mA	
“00011” :	4mA	
“00100” :	5mA	
“00101” :	6mA	
“00110” :	7mA	
“00111” :	8mA	
“01000” :	9mA	
“01001” :	10mA	
“01010” :	11mA	
“01011” :	12mA	
“01100” :	13mA	
“01101” :	14mA	
“01110” :	15mA	
“01111” :	16mA	
“10000” :	17mA	
“10001” :	18mA	
“10010” :	19mA	
“10011” :	20mA	
“10100” :	21mA	
“10101” :	22mA	
“10110” :	23mA	
“10111” :	24mA	
“11000” :	25mA	
“11001” :	26mA	
“11010” :	27mA	
“11011” :	28mA	
“11100” :	29mA	
“11101” :	30mA	
“11110” :	31mA	
“11111” :	32mA	

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Address 1Bh < LED4 Independent control current setup>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1Bh	W	-	-	-	ILED4(4)	ILED4(3)	ILED4(2)	ILED4(1)	ILED4(0)
Initial Value	00h	-	-	-	0	0	0	0	0

Bit[7:5] : (unused)

Bit[4:0] : **ILED4(4:0)** LED4 Independent control current setup

"00000" : 1mA (Initial Value)
"00001" : 2mA
"00010" : 3mA
"00011" : 4mA
"00100" : 5mA
"00101" : 6mA
"00110" : 7mA
"00111" : 8mA
"01000" : 9mA
"01001" : 10mA
"01010" : 11mA
"01011" : 12mA
"01100" : 13mA
"01101" : 14mA
"01110" : 15mA
"01111" : 16mA
"10000" : 17mA
"10001" : 18mA
"10010" : 19mA
"10011" : 20mA
"10100" : 21mA
"10101" : 22mA
"10110" : 23mA
"10111" : 24mA
"11000" : 25mA
"11001" : 26mA
"11010" : 27mA
"11011" : 28mA
"11100" : 29mA
"11101" : 30mA
"11110" : 31mA
"11111" : 32mA

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Address 1Ch < LED5 Independet control current setting>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1Ch	W	-	-	-	ILED5(4)	ILED5(3)	ILED5(2)	ILED5(1)	ILED5(0)
Initial Value	00h	-	-	-	0	0	0	0	0

Bit[7:5] : (unused)

Bit[4:0] : **ILED5(4:0)** LED5 Independent control current setting

“00000” :	1mA	(Initial Value)
“00001” :	2mA	
“00010” :	3mA	
“00011” :	4mA	
“00100” :	5mA	
“00101” :	6mA	
“00110” :	7mA	
“00111” :	8mA	
“01000” :	9mA	
“01001” :	10mA	
“01010” :	11mA	
“01011” :	12mA	
“01100” :	13mA	
“01101” :	14mA	
“01110” :	15mA	
“01111” :	16mA	
“10000” :	17mA	
“10001” :	18mA	
“10010” :	19mA	
“10011” :	20mA	
“10100” :	21mA	
“10101” :	22mA	
“10110” :	23mA	
“10111” :	24mA	
“11000” :	25mA	
“11001” :	26mA	
“11010” :	27mA	
“11011” :	28mA	
“11100” :	29mA	
“11101” :	30mA	
“11110” :	31mA	
“11111” :	32mA	

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Address 1Dh < LED6 Independent control current setting>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1Dh	W	-	-	-	ILED6(4)	ILED6(3)	ILED6(2)	ILED6(1)	ILED6(0)
Initial Value	00h	-	-	-	0	0	0	0	0

Bit[7:5] : (unused)

Bit[4:0] : **ILED6(4:0)** LED6 Independent control current setting

"00000" : 1mA (Initial Value)
"00001" : 2mA
"00010" : 3mA
"00011" : 4mA
"00100" : 5mA
"00101" : 6mA
"00110" : 7mA
"00111" : 8mA
"01000" : 9mA
"01001" : 10mA
"01010" : 11mA
"01011" : 12mA
"01100" : 13mA
"01101" : 14mA
"01110" : 15mA
"01111" : 16mA
"10000" : 17mA
"10001" : 18mA
"10010" : 19mA
"10011" : 20mA
"10100" : 21mA
"10101" : 22mA
"10110" : 23mA
"10111" : 24mA
"11000" : 25mA
"11001" : 26mA
"11010" : 27mA
"11011" : 28mA
"11100" : 29mA
"11101" : 30mA
"11110" : 31mA
"11111" : 32mA

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Address 1Eh < Mobile light current setting (L)>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1Eh	W	-	-	-	IFLLEDL(4)	IFLLEDL(3)	IFLLEDL(2)	IFLLEDL(1)	IFLLEDL(0)
Initial Value	00h	-	-	-	0	0	0	0	0

Bit[7:5] : (Unused)

Bit[4:0] : **IFLLEDL(4:0)** Mobile light current setting(L)

“00000” :	1mA	(Initial Value)
“00001” :	2mA	
“00010” :	3mA	
“00011” :	4mA	
“00100” :	5mA	
“00101” :	6mA	
“00110” :	7mA	
“00111” :	8mA	
“01000” :	9mA	
“01001” :	10mA	
“01010” :	11mA	
“01011” :	12mA	
“01100” :	13mA	
“01101” :	14mA	
“01110” :	15mA	
“01111” :	16mA	
“10000” :	17mA	
“10001” :	18mA	
“10010” :	19mA	
“10011” :	20mA	
“10100” :	21mA	
“10101” :	22mA	
“10110” :	23mA	
“10111” :	24mA	
“11000” :	25mA	
“11001” :	26mA	
“11010” :	27mA	
“11011” :	28mA	
“11100” :	29mA	
“11101” :	30mA	
“11110” :	31mA	
“11111” :	32mA	

Current setting of FLMD=0 and FLCNT=L at mobile light setting.

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Address 1Fh < Mobile light current setting(H)>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1Fh	W	-	-	-	IFLLEDH(4)	IFLLEDH(3)	IFLLEDH(2)	IFLLEDH(1)	IFLLEDH(0)
Initial Value	00h	-	-	-	0	0	0	0	0

Bit[7:5] : (Unused)

Bit[4:0] : **IFLLEDH(4:0)** Mobile light current setting (H)

“00000” :	1mA	(Initial Value)
“00001” :	2mA	
“00010” :	3mA	
“00011” :	4mA	
“00100” :	5mA	
“00101” :	6mA	
“00110” :	7mA	
“00111” :	8mA	
“01000” :	9mA	
“01001” :	10mA	
“01010” :	11mA	
“01011” :	12mA	
“01100” :	13mA	
“01101” :	14mA	
“01110” :	15mA	
“01111” :	16mA	
“10000” :	17mA	
“10001” :	18mA	
“10010” :	19mA	
“10011” :	20mA	
“10100” :	21mA	
“10101” :	22mA	
“10110” :	23mA	
“10111” :	24mA	
“11000” :	25mA	
“11001” :	26mA	
“11010” :	27mA	
“11011” :	28mA	
“11100” :	29mA	
“11101” :	30mA	
“11110” :	31mA	
“11111” :	32mA	

Current setting of FLMD=1 or FLCNT=H at mobile light setting.

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●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 an automatically returned to "0". (Auto Return 0).

(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.

(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”)

●Explain about operation of I/O part

1. RESETB terminal

Arbitrary input signal never goes to logic part of IC, because SDA or SCL is stopped at RESETB terminal=L.

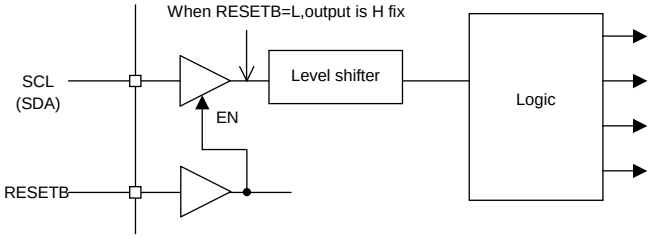


Fig.11 RESET terminal

Please be careful that current channel might occur through terminal protection Diode depending on the rising order of I/O power supply and input level.

2. Power supply ON/OFF sequence

Please apply voltage at activation as the following shows. When inputting reset OFF signal connecting delay element to VIO power supply, please pay enough attention to rise time of VIO power supply and also delay RESETB signal for sure.

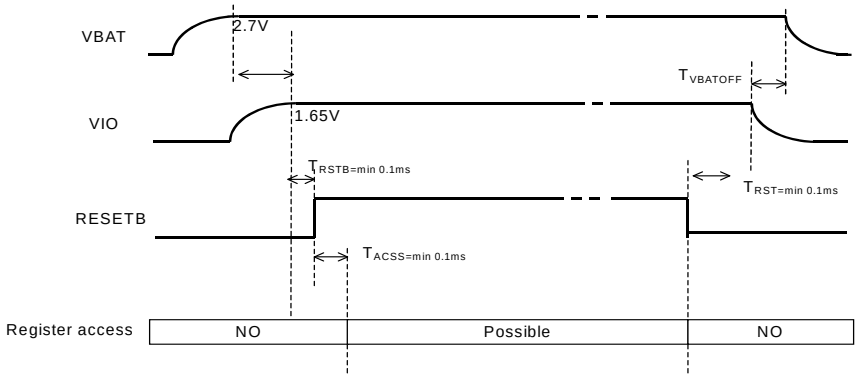


Fig.12 Power supply ON/OFF sequence

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3. VIODET(VIO voltage detect circuit)

The decline of the VIO voltage is detected, and faulty operation inside the LSI is prevented by giving resetting to Levelsift block. When the VIO voltage becomes more than typ1.0V(Vth of NMOS in the IC), VIODET is removed. On the contrary, when VIO is as follows 1.0V, it takes reset.(The VBAT voltage being a prescribed movement range)

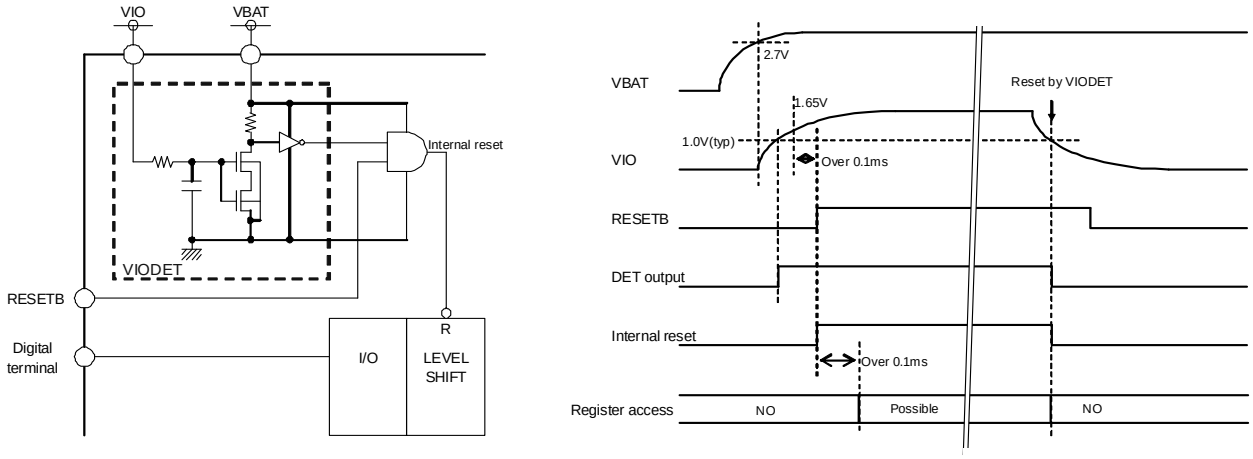


Fig.13 VIO voltage detect circuit

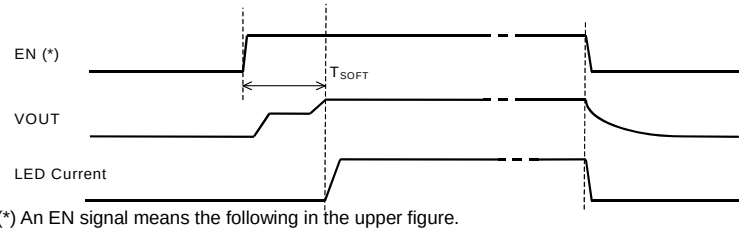
●Thermal shutdown

Thermal shutdown is effective for charge pomp part and LED part.
The thermal shutdown function is detection temperature that it works is about 195℃.
Detection temperature has a hysteresis, and detection release temperature is about 175 ℃.(Design reference value)

●DC/DC

Start

DC/DC circuit operates when any LED turns ON. (DCDCFON=0)
When the start of theDC/DC circuit is done, it has the soft start function to prevent a rush current.
Force of VBAT and VIO is to go as follows.



(*) An EN signal means the following in the upper figure.
EN = “MLEDEN” or “W ∗ EN”
(= LED The LED lighting control of a setup of connection VOUT)
But, as for Ta > T_{TSD} (typ : 195° C), a protection function functions, and an EN signal doesn't become effective.
T_{SOFT} changes by the capacitor connected to VOUT and inside OSC.
T_{SOFT} is Typ 200μs (when the output capacitor of VOUT =2.2μF).

Fig.14 Start of DC/DC

Over Voltage protection / Over Current protection

DC/DC circuit output (VOUT) is equipped with the over-voltage protection and the over current protection function.
A VOUT over-voltage detection voltage is about 6V(typ). (VOUT at the time of rise in a voltage)
A detection voltage has a hysteresis, and a detection release voltage is about 5.8V(typ).(Design value)
And, when VOUT output short to ground, input current of the battery terminal is limited by an over current protection function.

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Mode transition

The transition of boosts multiple transits automatically by VBAT Voltage and the VOUT Pin Voltage.

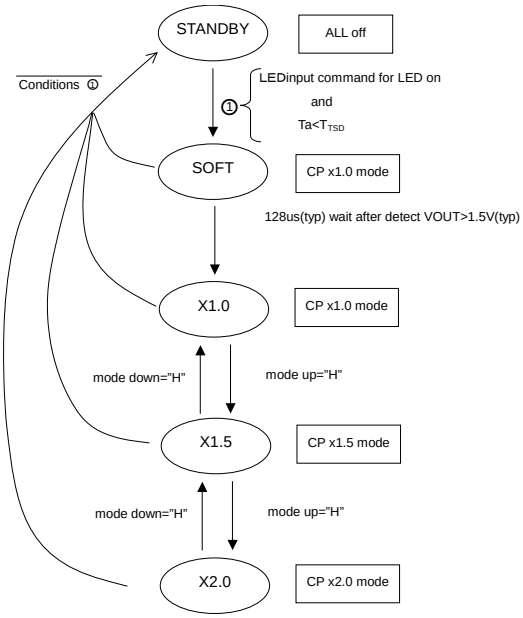


Fig.15 Mode transition

The mode transition of the charge pump works as follows.

＜x1.0→x1.5→x2.0 Mode transition＞

The transition of the mode is done when VOUT was compared with VBAT and the next condition was satisfied.

x1.0→x1.5 Mode transition
VBAT ≤ VOUT + (Ron10×Iout)
(LED Pin feedback：VOUT = Vf+0.2(Typ))
x1.5→x2.0 Mode transition
VBAT×1.5 ≤ VOUT +(Ron15×Iout)
(LED Pin feedback：VOUT = Vf+0.2(Typ))

Ron10: x1 Charge pump on resistance 0.57Ω(Typ)
Ron15: x1.5 Charge pump on resistance 3.23Ω(Typ)

＜x2.0→x1.5→x1.0 Mode transition＞

The transition of the mode is done when the ratio of VOUT and VBAT is detected and it exceeds a fixed voltage ratio.

x1.5→x1.0 Mode transition
VBAT / VOUT =1.18(Design value)
x2.0→x1.5 Mode transition
VBAT / VOUT =1.08(Design value)

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●LED Driver for back light

The LED driver of 7ch is constructed as the below diagram shows.
BLLED1~3 are mostly for main group, and BLLED4~7 can be allocated to main group / sub group / non-lighting. Slope control is possible in main group that can set rise/fall time independently. Please make time setting minimum in order for light to turn on instantly. Slope control is not effective for light control for sub group.

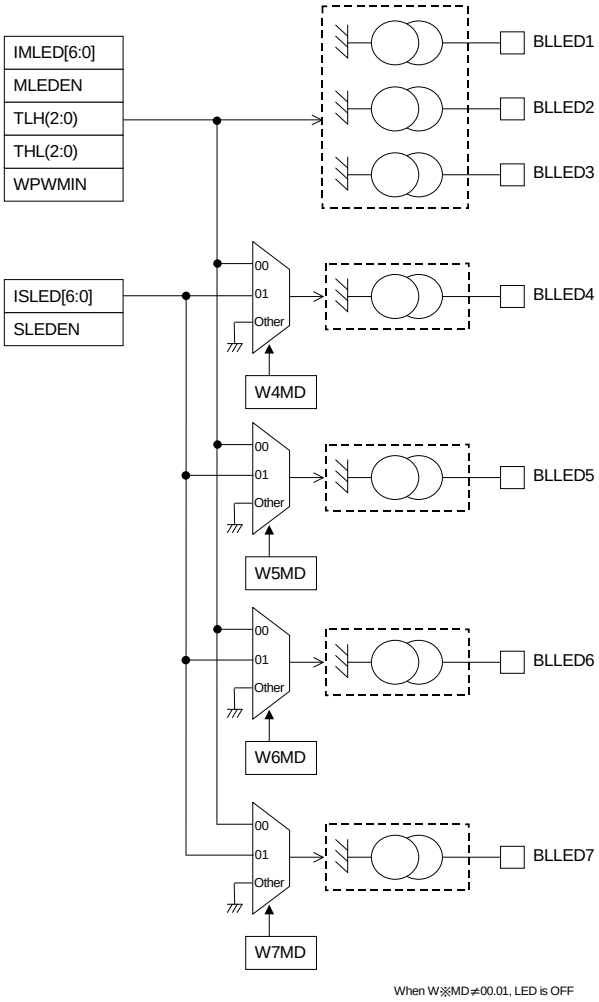


Fig.16 LED Driver for back light

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●Explain bout operation of LED driver part for accessory

LED driver for accessory 6ch is consisted as the below diagram shows.
It is possible to allocate all LED1~6 to group1 / group2/ mobile light control/ independent control.
Current setting and light control precede selected group.
Current setting resistor can be selected under mobile light control because of setting of FLMD(resistor) or FLCNT(outside terminal).

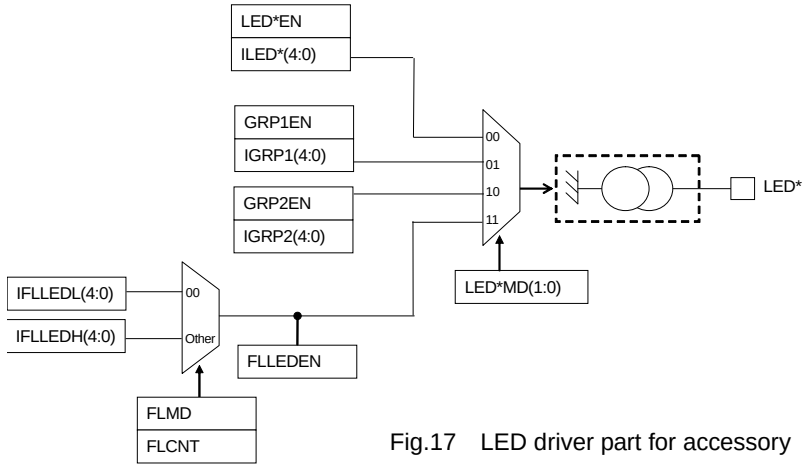


Fig.17 LED driver part for accessory

When mobile right mode, control following by register and external terminal.

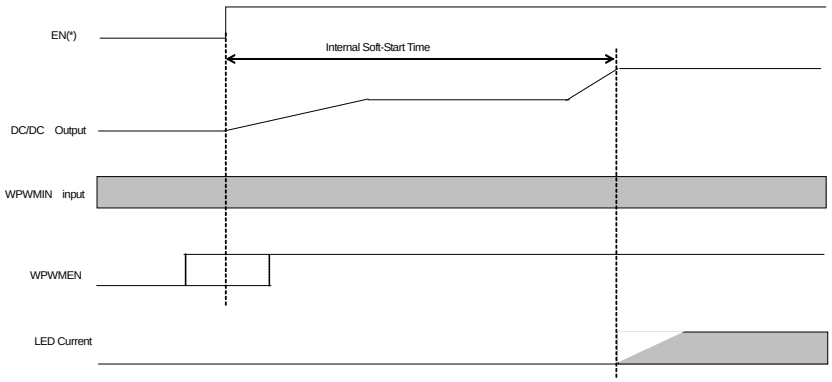
FLEDEN (Register)	FLMD (Register)	FLCNT (External Pin)	Current setting
0	*	*	OFF
1	0	L	IFLLEDL(4:0)
		H	IFLLEDH(4:0)
	1	L	
		H	

●External PWM light dimming of main back light

PWM light dimming by external e terminal (WPWMIN) is possible if permitted with resister setting.
It is suitable for the intensity correction by external control, because PWM based on Main LED current Of register setup.

WPWMEN (Register)	WPWMIN(External Pin)	Main group LED current
0	L	Normal operation
	H	Normal operation
1	L	Forced OFF
	H	Normal operation

"Normal operation" depends on the setup of each register



EN(*) : "MLEDEN=1"

It is possible to input WPWMIN and changing WPWMEN=1 before EN(*).
PWM drive can be effective from the time of LED current rising.

DC/DC output rise time delays according to the proportion of PWM Duty when it rises with PWM operation.
When inputting extremely slow frequency and low Duty, it influences on the appearance.

Please make sure to keep more than 250μs during H section at applying PWM pulse.

Fig.18 External PWM light dimming of main back light

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●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.
  Register : THL(3:0)
  Register : TLH(3:0)
- Main LED current changes as follows at the time as the slope.
  TLH (THL) is setup of time of the current step 2/256.

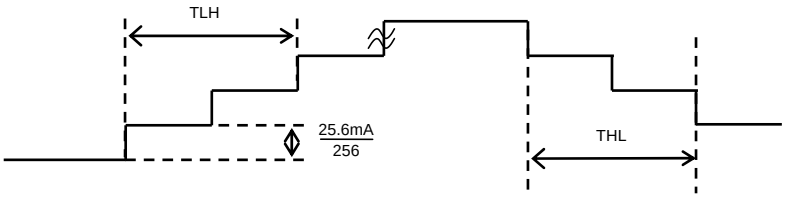
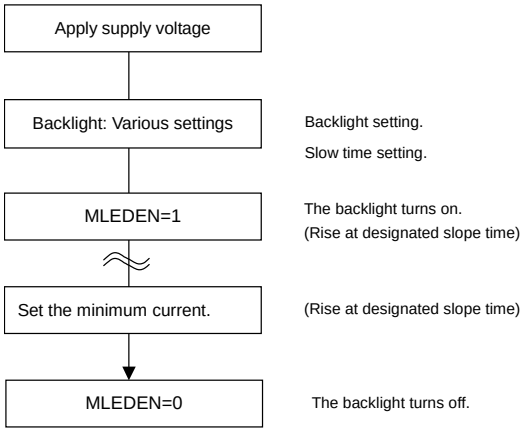


Fig.19 Slope process

Please follow the below instruction to fade in / fade out main backlight.



●Explain about operation of RGB LED driver part

- Possible to select among 16 kinds of waveform pattern (R,G,B independet)
- Possible to set rise／Fall slope time independently (R,G,B in common)
- Please refer to “RGB Waveform Setting“.
- LED current can be set with resistor value RISET connected to RGBISET terminal. Maximum current value can be caluculated by the below formula.
  I_{LEDmax} [A] = 3.048 / R_{ISET} [kΩ] (Typ)
  However, please set maximum current value less than 30.48mA. Moreover, excessive LED current can be prevented when low impedance occurs against ground, because RGBISET terminal has over current protection function.

Parameter setting in RGB LED driver part

Parameter	Setting
Waveform cycle	RGB in common
Selecting waveform pattern	RGB independent
LED current H side	RGB independent
LED current L side	RGB independent
Slope rise time	RGB in common
Slope fall time	RGB in common
Outside terminal synchronism function	RGB in common

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●RGB Waveform Setting

Various kinds of RGB control can be implemented by designating waveform cycles, waveform patterns, current settings 1, 2 and rising/falling slope times.
To activate a RGB waveform, a continuous operation via RGB1EN or a single-shot operation via RGB1OS can be selected.
In addition, when control via the external terminal RGB1CNT is enabled via RGB1MEL, the corresponding LED can be lit in synchronization with the external signal.

1. Waveform cycle
   - A single cycle time is set for a waveform pattern.
2. Waveform pattern
   - A pattern in a waveform cycle is set.
   - Sixteen types of waveform patterns can be set in units of waveform patterns.
   - For concrete waveform patterns, refer to the timing diagram shown on the next page.
3. Current settings 1 and 2 (I1, I2)
   - Two currents (I1, I2) in a waveform pattern are set.
   - When the maximum current value is 25.4mA, it is possible to set the current ranging from 0 to 25.4mA with an increment of 0.2mA (128 steps).
   - The polarity of a waveform is determined by the greater-than/ less-than relationship in the current setting.
   - This setting can be made in units of terminals.
4. Rising/falling slope time
   - A current change time during switching between current settings 1 and 2 is set.
   - A time per step (0.2mA) is calculated based on a difference between the currents selected in current settings 1, 2 and a setting slope time.
     For this reason, a time per step (0.2mA) is short when a difference between setting currents I1 and I2 is large. In contrast, it is long when a difference between setting currents I1 and I2 is small.
   - Regardless of current settings 1 and 2, a rising slope time applies at current increase and a falling slope time applies at current decrease. For concrete waveform images, refer to the timing diagram shown on the next page.
5. External terminal synchronization control
   When control via the external terminal RGB1CNT is enabled via RGB1MEL, lighting is enabled if the input external signal goes “H.” In contrast, it is disabled if the external input signal goes “L.” In this way, synchronization with the external signal is enabled so that LED can be blinked in conjunction with a ringing tone (a melody signaling a ringtone).

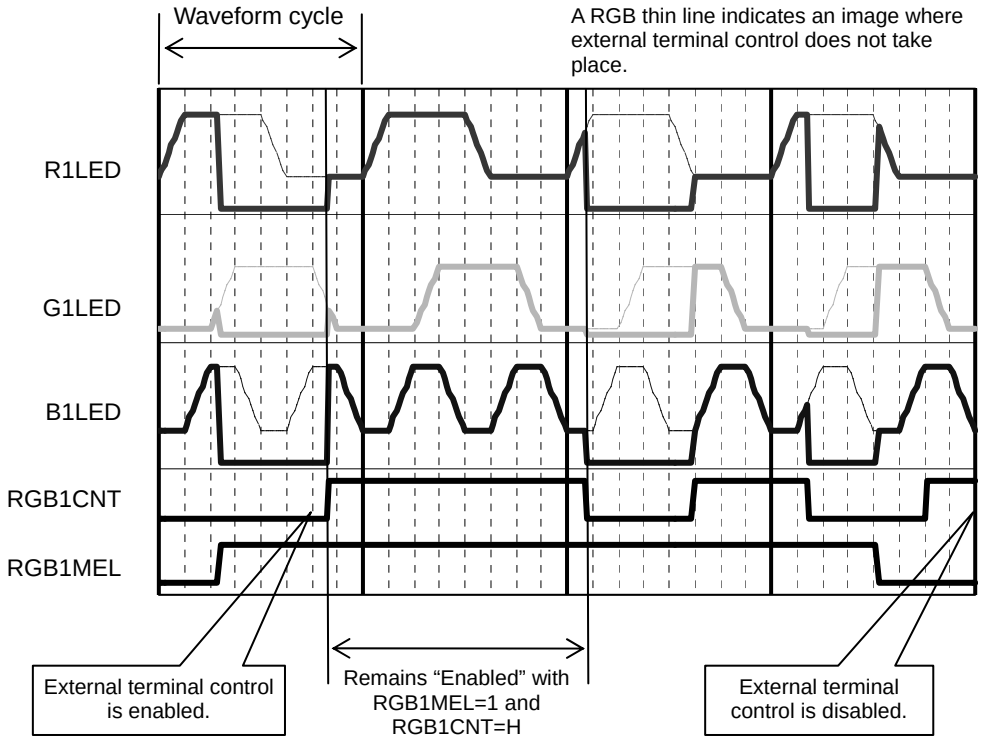


Fig.20 External terminal synchronization control

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●Built-in RGB waveform pattern

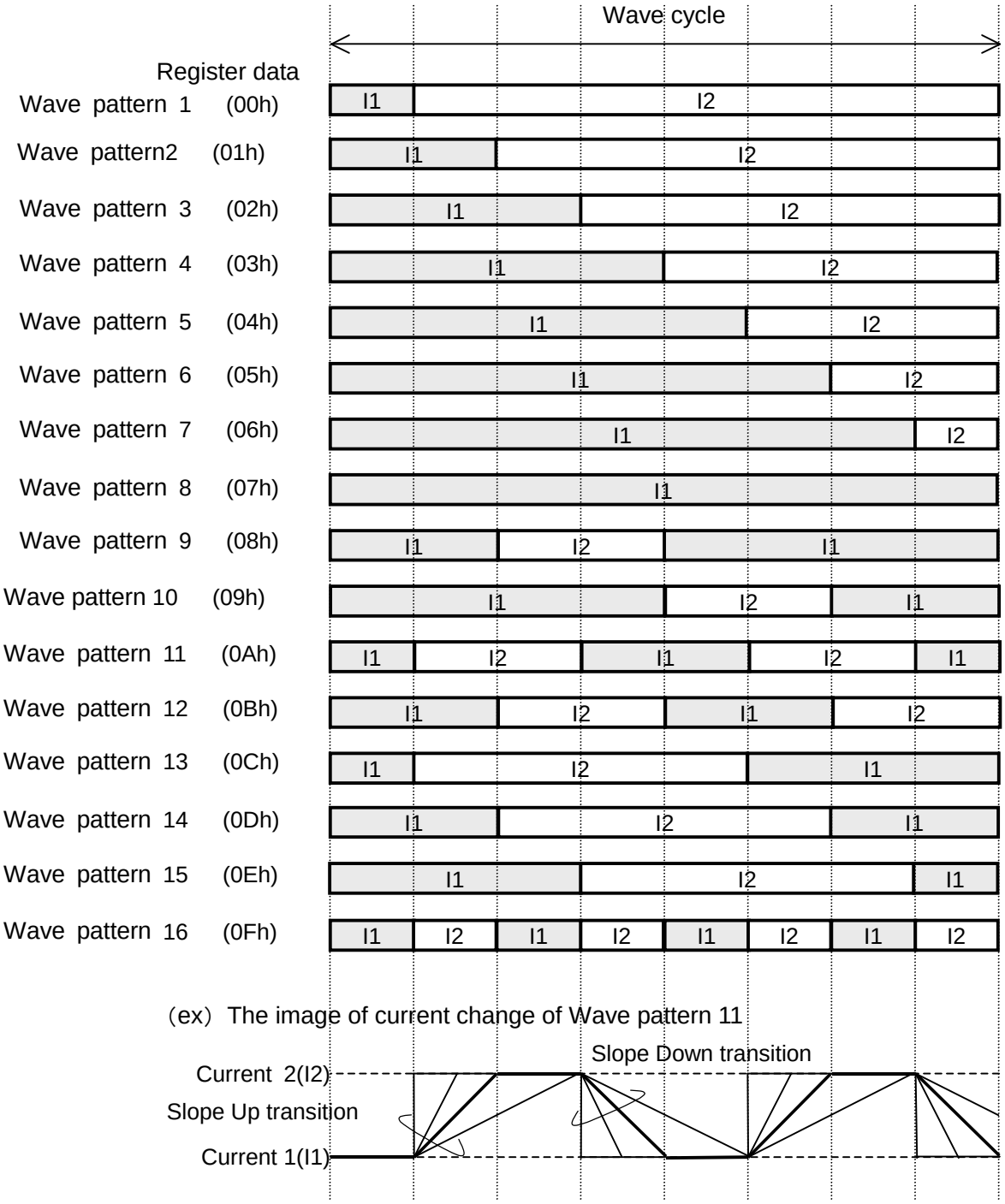


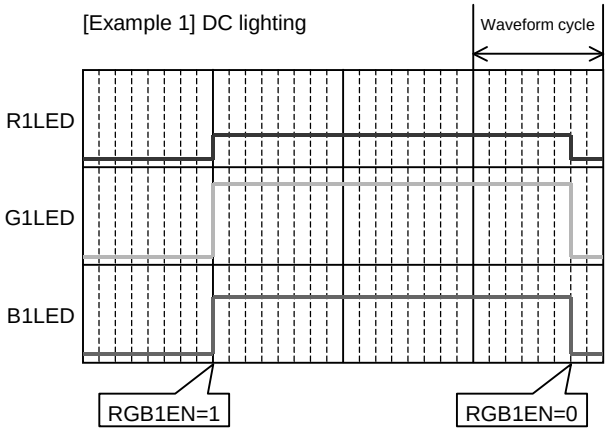
Fig.21 RGB wave setting timing diagram

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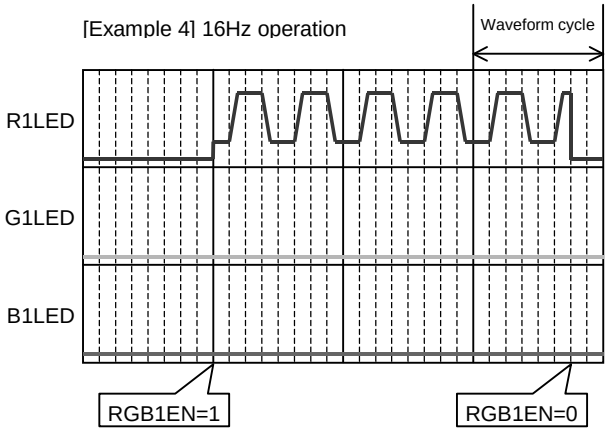
●RGB waveform setting examples

[Example 1] DC lighting



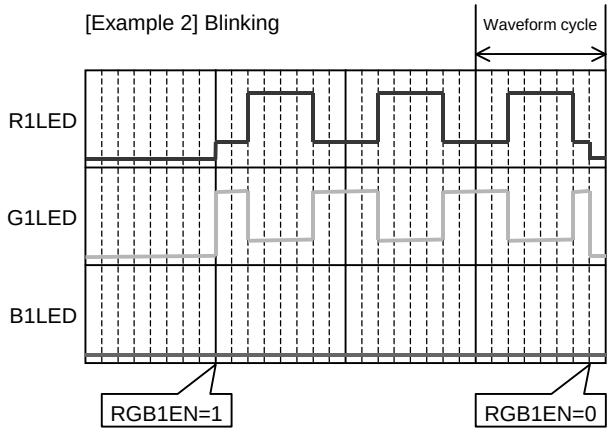
Selecting a waveform pattern 8 causes a continuous normal operation to take place through the setting current 1.

[Example 4] 16Hz operation



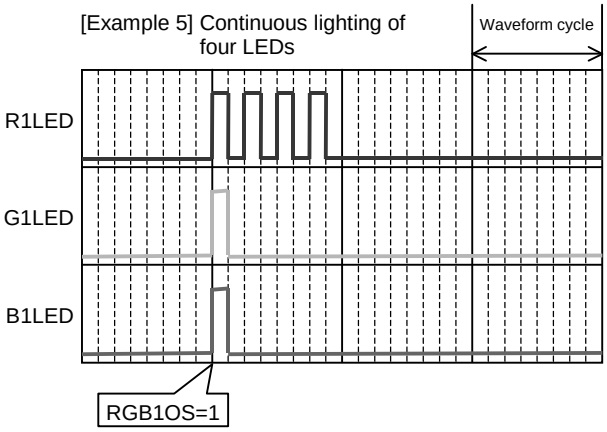
Combining the settings of a waveform pattern 11 and a waveform cycle 131ms causes blinking at a rate of 15.3Hz (approx. 16Hz).

[Example 2] Blinking



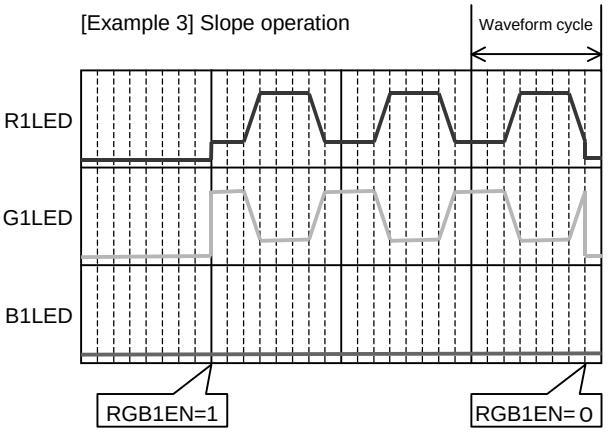
Setting a rising/falling slope time to “0” causes blinking to take place. Phase switching takes place via the setting currents of R and G.

[Example 5] Continuous lighting of four LEDs



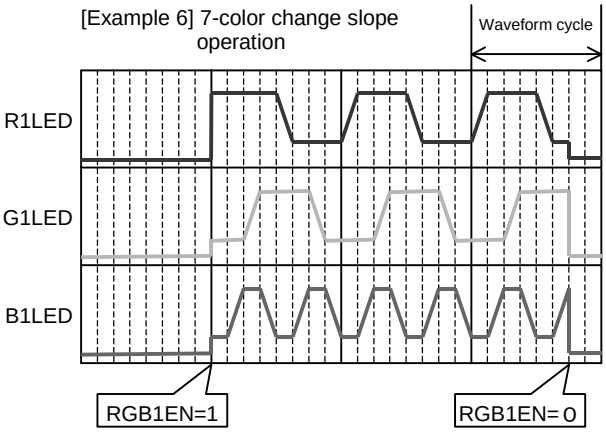
This example shows that lighting occurs continuously in the order of white, red, red and red. To achieve this, waveform patterns 16, 1 and RGB*OS single cycle operation need to be combined.

[Example 3] Slope operation



When a rising/falling slope time is longer than the setting made in example 2, a continuous color change is made by slope operation.

[Example 6] 7-color change slope operation



R, G and B waveform patterns are set in a way that any of R, G and B changes constantly.

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●RGB slope waveforms

- Example of waveform at activation (Waveform pattern=14)
  Current setting: I1 < I2

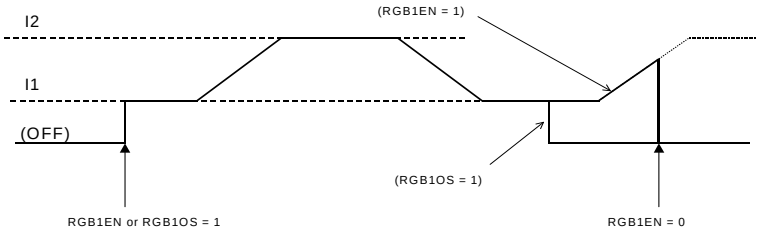


Fig.22 Example of waveform at activation Current setting: I1 < I2

Current setting: I1 > I2

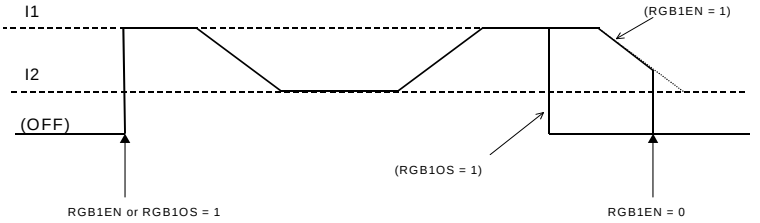


Fig.23 Example of waveform at activation Current setting: I1 > I2

- Current difference in each channel (example)

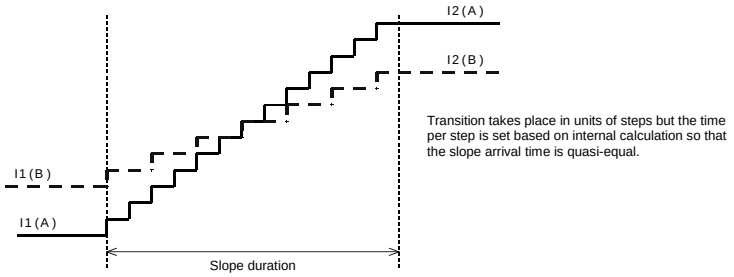


Fig.24 Current difference in each channel (example)

●Setting change in slope duration

A slope operation is performed by an internal sequencer.
When an attempt is made to change the setting (Address 02h~15h) in a slope duration, the active slope operation is reset and a newly set slope operation is restarted.
In this case, however, LED lighting stops for a maximum of 16.4ms (OSC frequency=typ) for synchronization with the internal clock until the operation is restarted.

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●RGB LED Sleep operation mode

It can be set as a sleep mode by SLPMD=1 setup. In a sleep mode, all the LED current under lighting operation serves as low consumption operation mode at 0mA. Therefore, an analog block unnecessary for operation can be turned off. In an internal clock sleep mode, a block required for clock generation remains turning on. Starting sequence of charge pump enters by LED lighting. Therefore, lighting timing changes compared with the normal mode.

CLKEN	CLKMD	FSEL	SLPMD	CLKIO Terminal condition	Illuminations Sleep mode
0	*	*	*	Clock I/O invalid	Normal mode
1	0	1	0	Input (fin=31.25kHz)	Normal mode
			1	Input (fin=31.25kHz)	External clock Sleep mode
	1	0	0	Output (fout=250kHz)	Normal mode
		1	0	Output (fout=31.25kHz)	Normal mode
			1	Output (fout=31.25kHz)	Internal clock Sleep mode

Setup other than the above is prohibition.

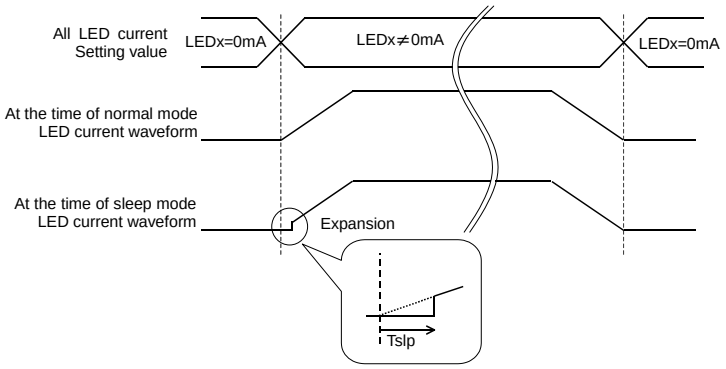


Fig.25 RGB LED Sleep operation mode

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●RGB LED basic clock input and output

It has input and output function of basic clock. When connecting BD28xx series as expansion of illumination, it is possible to synchronize waveform lighting pattern of several RGB.
Because a sequence is already programmed within an IC chip for RGB falling, “Enable” shall be set to “OFF” and clock supply shall be continued for at least three clocks so that operations can be performed using external clocks

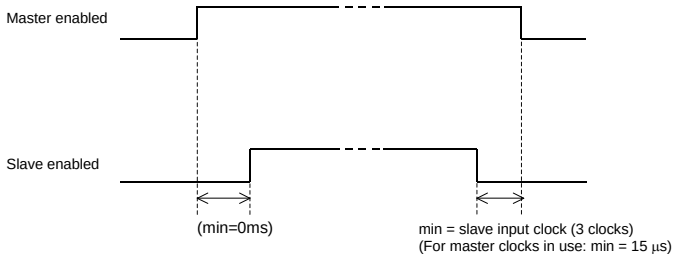


Fig.26 RGB LED basic clock input and output

Master: Chip using CLKIO as output
Slave: Chip using CLKIO as input

* Even in independent slave mode, its setting “Enable” shall be reset to “OFF” and then clock supply must be continued for 3 clocks or more.

Clock I/O switching shall be avoided during RGB operation.
Enable：CLKEN, RGB1EN, RGB1OS

- Setting example

Master side (clock output side) RGB waveform setting
↓
Slave side (clock input side) RGB waveform setting
↓
Master side Clock output setting
CLKEN=1, CLKMD=1 --- Performs clock output.
↓
Slave side Clock input setting
CLKEN=1, CLKMD=0 --- Allows clock reception.
↓
Master side RGB lighting
↓ This duration shall be short as much as possible.
Slave side RGB lighting

●About the pin management of the function that isn't used and test pins

Setting it as follows is recommended with the test pin and the pin that isn't used.
Set up pin referring to the “Equivalent circuit diagram” so that there may not be a problem under the actual use.

T1, T2, T3	Short to GND because pin for test input
T4	OPEN because pin for test output
Non-used LED Pin	Short to GND (Must) But, the setup of a register concerned with LED that isn’t used is prohibited.
RGBCNT	Short to ground (A Pull-Down resistance built-in terminal is contained, too.)
CLKIO	Short to ground (A Pull-Down resistance built-in terminal is contained, too.)
WPWMIN	Short to ground (A Pull-Down resistance built-in terminal is contained, too.)
FLCNT	Short to ground (A Pull-Down resistance built-in terminal is contained, too.)

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●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.

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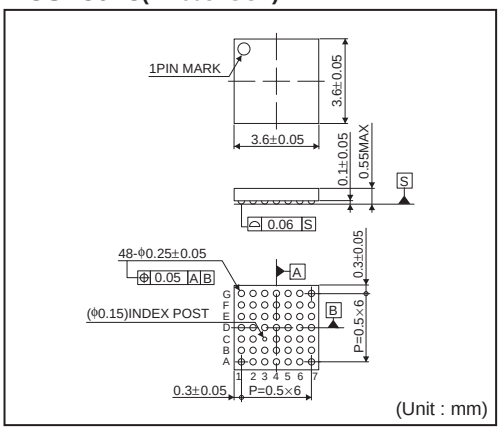
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●Ordering Part Number

B	D	6	0	8	2	G	U	L	-	E	2

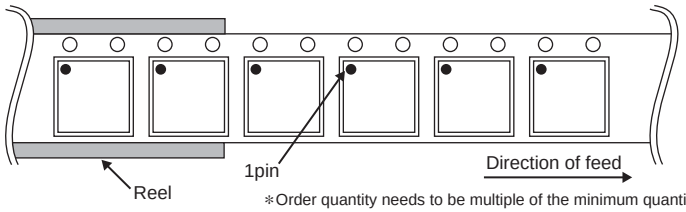
Part No.	Part No.	Package	Packaging and forming specification
BD	6082	GUL: VCSP50L3	E2: Embossed tape and reel

VCSP50L3(BD6082GUL)



<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)



∗Order quantity needs to be multiple of the minimum quantity.

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Notice

Precaution on using ROHM Products

1. Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are designed and manufactured for use under standard conditions and not under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

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Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   - [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   - [b] the temperature or humidity exceeds those recommended by ROHM
   - [c] the Products are exposed to direct sunshine or condensation
   - [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

QR code printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

Precaution Regarding Intellectual Property Rights

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