



LV5202LP — Bi-CMOS IC LED driver for cellular phone

Overview

The LV5202LP is a LED driver for cellular phone.

Features

- LED driver × 13 (tricolor, main, sub, flash) and switching regulator control circuit incorporated
- Each LED current value adjustable by serial bus
- Compatible with flash LED strobo mode
- Ringing tone and tricolor LED synchronization function incorporated
- Gradation function incorporated
- Compact package

Functions

- PWM switching regulator control circuit
(Triangular wave oscillator, reference voltage, PWM comparator, driver, DTC, and short-circuit protective circuit incorporated)
(Timer-latch type output cut-off circuit in case of overload)
- LED drivers
 - Main LC backlight LED driver × 4
LED current 5-bit changeover 0.6mA to 19.2mA
 - Tricolor-based sub-LC backlight LED driver × 1
LED current 4-bit changeover 0.75mA to 12mA
 - Tricolor LED driver × 1
LED current 5-bit independent changeover 0.5 to 16mA
Ringing tone synchronization function (SCTL : Forced to operate at SCTL : H)

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Flash LED driver × 3

LED current 4-bit independent changeover 2mA to 32mA

During strobo mode 6mA to 93mA (FCTL : H)

- Gradation function

Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V _{CC} max		7	V
Allowable power dissipation	Pd max	Ta ≤ 75°C *Mounted on a board.	500	mW
Operating temperature	Topr		-30 to +75	°C
Storage temperature	Tstg		-40 to +125	°C

* Mounted on a 40mm×50mm×0.8mm, glass epoxy board.

Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage 1	VBAT		3.0 to 4.5	V
Supply voltage 2	V _{DD}		2.3 to 3	V

Electrical Characteristics [Analog block] Ta = 25°C, VBAT = 3.7V, V_{DD} = 2.6V, unless otherwise specified.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current drain						
Current drain 1	I _{CC1}	VBAT+V _{DD} current drain RESET : L (at reset)		0	5	μA
Current drain 2	I _{CC2}	VBAT+V _{DD} current drain RESET : H at serial default		0.5	5	μA
Current drain 3	I _{CC3}	VBAT+V _{DD} current drain at switching regulator ON		3.6	5	mA
Switching regulator control block :						
Error amplifier						
IN pin internal voltage	V _{O1}	I _O = 100mA	4.9	5.1	5.3	V
LED pin voltage	V _{O2}	MLED current setting MAX load MLED current	0.33	0.43	0.53	V
Down-time adjusting block						
Threshold voltage 1	VD1	Duty cycle = 100%	0.25	0.3	0.35	V
Threshold voltage 2	VD2	Duty cycle = MIN	0.7	0.75	0.8	V
Output block						
Output LOW voltage	VL	V _{IN} = 0V I _O = 10mA		0.1	0.3	V
Output H voltage	VH	V _{IN} = 0V I _O = 10mA	VBAT-0.3	VBAT-0.1		V
Triangular wave oscillation block						
Oscillation frequency	Fosc		900	1000	1100	kHz
LED driver block						
Min output current value 1	IMIN1	Tricolor LED driver Serial data = #00 V _O = 0.5V	0.2	0.5	1	mA
Min output current value 2	IMIN2	Tricolor Sub LED driver Serial data = #00 V _O = 0.5V	0.2	0.75	1.5	mA
Min output current value 3	IMIN3	Main LED driver Serial data = #00 V _O = 0.5V	0.2	0.8	1.4	mA
Min output current value 4	IMIN4	Flash LED driver Serial data = #00 V _O = 0.5V	0.5	2	3	mA
Min output current value 5	IMIN5	Flash LED driver Serial data = #00 V _O = 0.5V Flash mode	1	6	12	mA

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Max output current value 1	IMAX1	Tricolor LED driver Serial data = #FF $V_O = 0.5V$	15	16	17	mA
Max output current value 2	IMAX2	Tricolor Sub LED driver Serial data = #FF $V_O = 0.5V$	11	12	13	mA
Max output current value 3	IMAX3	Main LED driver Serial data = #FF $V_O = 0.5V$	18.2	19.4	20.6	mA
Max output current value 4	IMAX4	Flash LED driver Serial data = #FF $V_O = 0.55V$	30	32	34	mA
Max output current value 5	IMAX5	Flash LED driver Serial data = #FF $V_O = 0.65V$ Flash mode	87	93	99	mA
Non-linear error 1	LE1	Flash LED driver	-1		1	LSB
Differential linear error 1	DLE1	Flash LED driver	-1		1	LSB
Non-linear error 2	LE2	MAIN, tricolor SUB, tricolor LED driver	-2		2	LSB
Differential linear error 2	DLE2	MAIN, tricolor SUB, tricolor LED driver	-2		2	LSB
MAX output current 1	$\Delta IL1$	Tricolor LED driver MAX current setting $V_O = 4$ to $0.3V$	-10			%
MAX output current 2	$\Delta IL2$	Tricolor Sub LED driver MAX current setting $V_O = 2$ to $0.35V$	-10			%
MAX output current 3	$\Delta IL3$	Main LED driver MAX current setting $V_O = 2$ to $0.35V$	-10			%
MAX output current 4	$\Delta IL4$	Flash LED driver MAX current setting $V_O = 2$ to $0.55V$	-10			%
MAX output current 5	$\Delta IL5$	Flash LED driver MAX current setting $V_O = 2$ to $0.65V$ Flash mode	-10			%
Leak current 1	IL1	Tricolor LED driver LED driver : OFF $V_O = 5V$			1	μA
Leak current 2	IL2	Tricolor Sub LED driver LED driver : OFF $V_O = 5V$			1	μA
Leak current 3	IL3	Main LED driver LED driver : OFF $V_O = 5V$			1	μA
Leak current 4	IL4	Flash LED driver LED driver : OFF $V_O = 5V$			1	μA
Leak current 5	IL5	Flash LED driver LED driver : OFF $V_O = 5V$ Flash mode			1	μA

* Non-linear error : Error from the ideal current value.

* Differential linear error : Error from the ideal increment when increase by 1 bit is made.

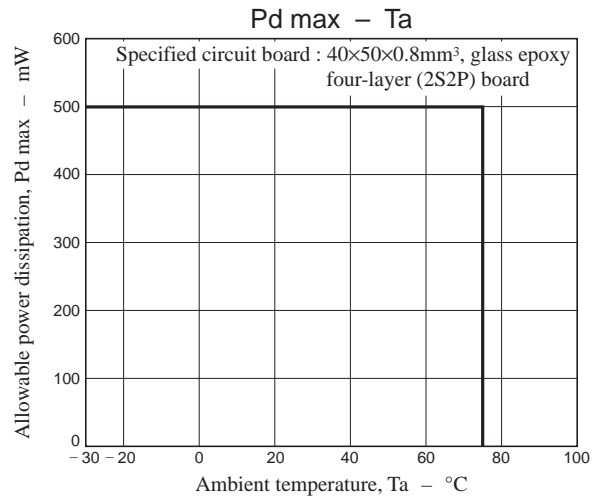
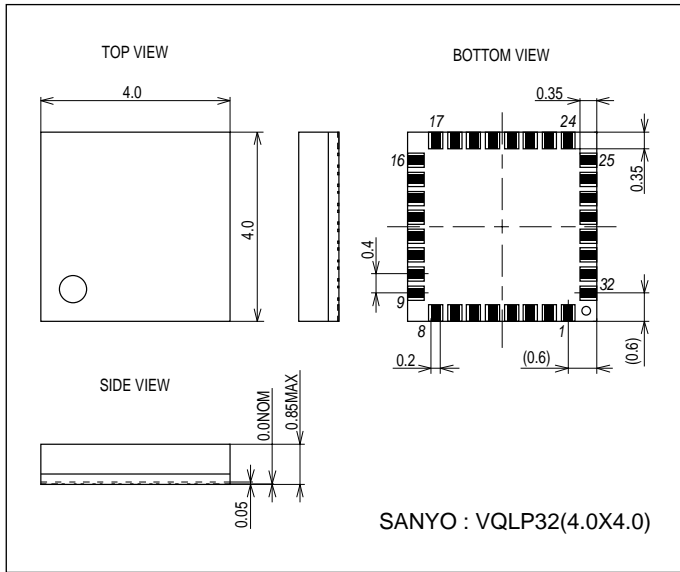
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Control circuit block						
H level 1	V_{INH1}	Input H level FCTL, SCTL	$V_{DD} \times 0.8$			V
L level 1	V_{INL1}	Input L level FCTL, SCTL	0		$V_{DD} \times 0.25$	V
H level 2	V_{INH2}	Input H level Serial signal input pin	$V_{DD} \times 0.8$			V
L level 2	V_{INL2}	Input L level Serial signal input pin	0		$V_{DD} \times 0.2$	V
H level 3	V_{INH3}	Input H level RESET	1.5			V
L level 3	V_{INL3}	Input L level RESET	0		0.3	V

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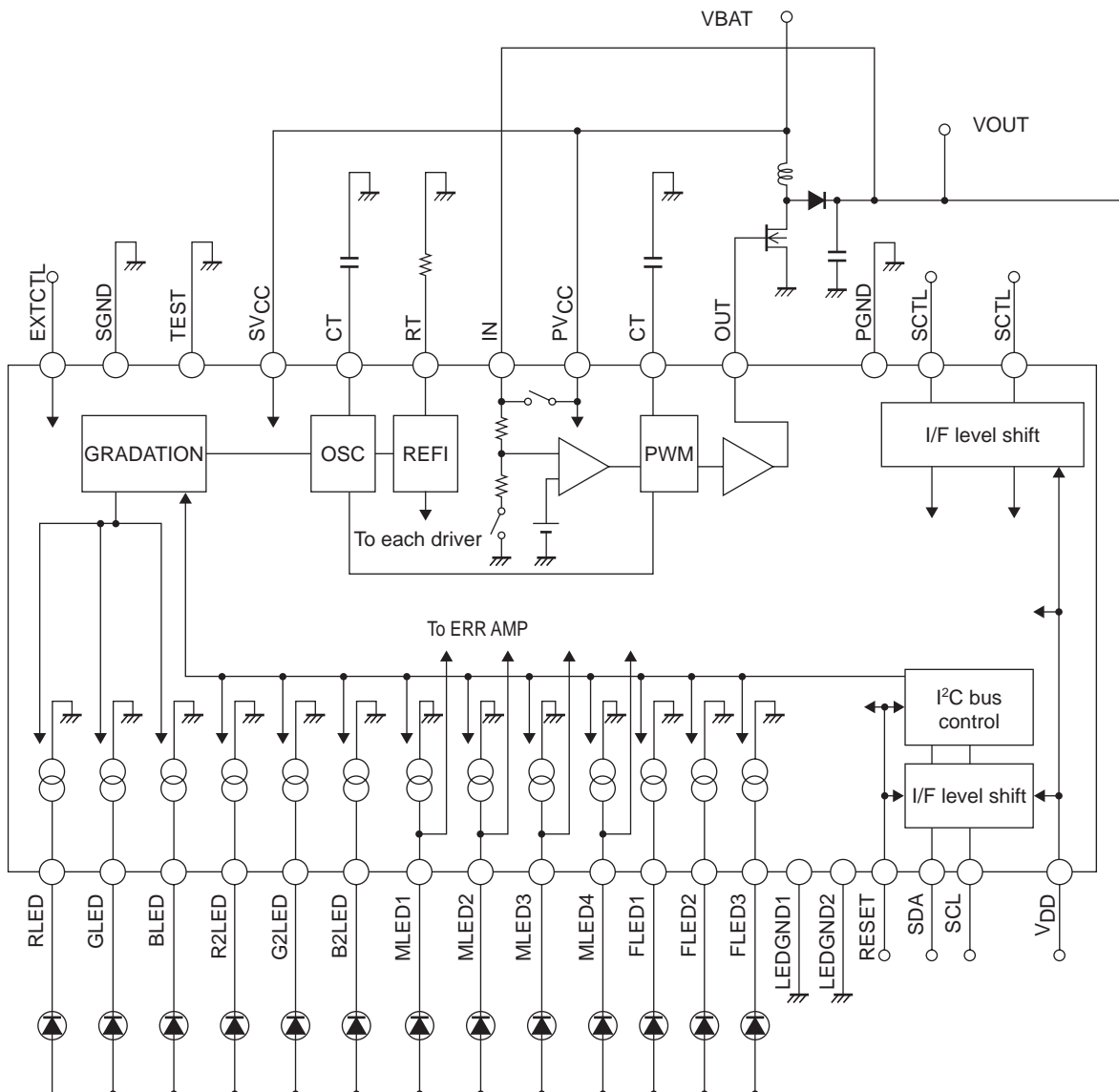
Package Dimensions

unit : mm (typ)

3331



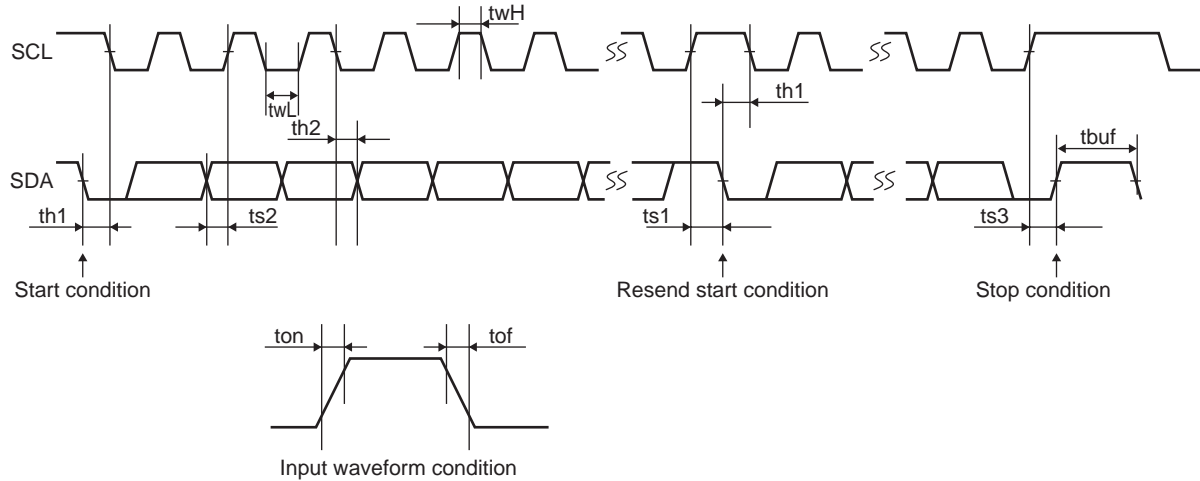
Block Diagram



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Serial Bus Communication Specifications

(1) I²C serial transfer timing conditions



Standard mode

Parameter	symbol	Conditions	min	typ	max	unit
SCL clock frequency	fscl	SCL clock frequency	0	-	100	kHz
Data setup time	ts1	SCL setup time relative to fall of SDA	4.7	-	-	μs
	ts2	SDA setup time relative to rise of SCL	250	-	-	ns
	ts3	SCL setup time relative to rise of SDA	4.0	-	-	μs
Data hold time	th1	SCL hold time relative to rise of SDA	4.0	-	-	μs
	th2	SDA hold time relative to fall of SCL	0	-	-	μs
Pulse width	twL	SCL pulse width for the L period	4.7	-	-	μs
	twH	SCL pulse width for the H period	4.0	-	-	μs
Input waveform conditions	ton	SCL, SDA (input) rise time	-	-	1000	ns
	tof	SCL, SDA (input) fall time	-	-	300	ns
Bus free time	tbuf	Time between STOP and START conditions	4.7	-	-	μs

High-speed mode

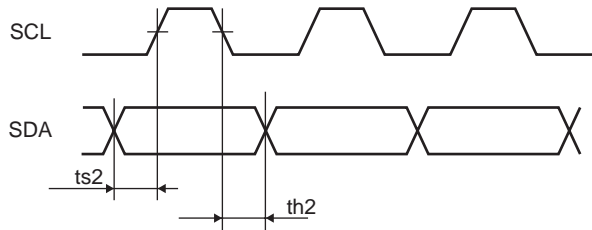
Parameter	Symbol	Conditions	min	typ	max	unit
SCL clock frequency	fscl	SCL clock frequency	0	-	400	kHz
Data setup time	ts1	SCL setup time relative to fall of SDA	0.6	-	-	μs
	ts2	SDA setup time relative to rise of SCL	100	-	-	ns
	ts3	SCL setup time relative to rise of SDA	0.6	-	-	μs
Data hold time	th1	SCL hold time relative to rise of SDA	0.6	-	-	μs
	th2	SDA hold time relative to fall of SCL	0	-	0.9	μs
Pulse width	twL	SCL pulse width for the L period	1.3	-	-	μs
	twH	SCL pulse width for the H period	0.6	-	-	μs
Input waveform conditions	ton	SCL, SDA (input) rise time	-	-	300	ns
	tof	SCL, SDA (input) fall time	-	-	300	ns
Bus free time	tbuf	Time between STOP and START conditions	1.3	-	-	μs

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(2) I²C bus transmission method

Start and stop conditions

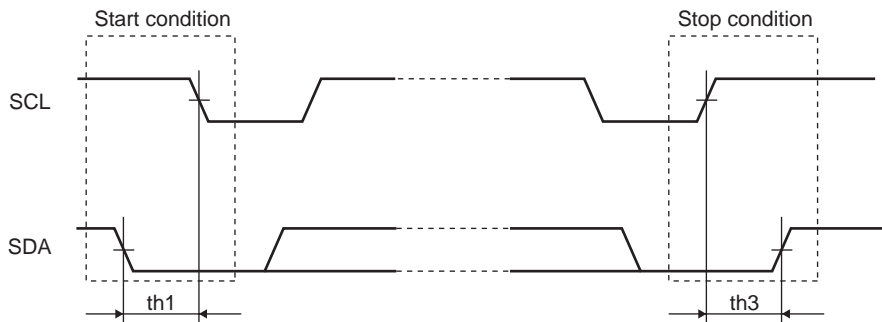
In the I²C bus, SDA must basically be kept in the constant state while SCL is "H" as shown below during data transfer.



When data transfer is not made, both SCL and SDA are in the "H" state.

When SCL = SDA = "H", change of SDA from "H" to "L" enables the start conditions to start access.

When SCL is "H", change of SDA from "L" to "H" enables the stop conditions to stop access.



Data transfer and acknowledgement response

After establishment of start conditions, data transfer is made by one byte (8 bits).

Data transfer enables continuous transfer of any number of bytes.

Each time the 8-bit data is transferred, the ACK signal is sent from the receive side to the send side.

The ACK signal is issued when SDA on the send side is released and SDA on the receive side is set to "L" immediately after fall of the clock pulse at the SCL eighth bit of data transfer to "L".

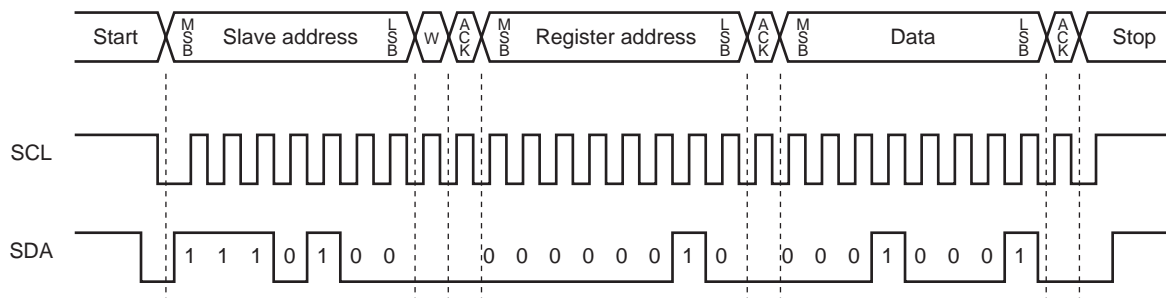
When the next 1-byte transfer is left in the receive state after transmission of the ACK signal from the receive side, the receive side releases SDA at fall of the SCL ninth clock.

In the I²C bus, there is no CE signal. Instead, the 7-bit slave address is assigned to each device and the first byte of transfer is assigned to the command (R/W) representing the 7-bit slave address and subsequent transfer direction.

Note that only WRITE is valid in this IC.

The 7-bit address is transferred sequentially from MSB and the eighth bit is "L" representing WRITE.

In LV5202LP, the slave address is specified as (1110100).



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Serial modes setting

0	0	0	0	0	0	0	0	0	0	D7	D6	D5	D4	D3	D2	D1	D0
---	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----

D0	STBY	STANDBY mode setting
0	OFF	*Default
1	ON	
D1	RGSW	SW regulator setting
0	OFF	*Default
1	ON	
D2	FXSW	Output voltage mode setting
0	OFF	*Default
1	Fixed	(Fixed : Fixed at the voltage set with serial VD)
D3	MSW	Main LED output setting
0	OFF	*Default
1	ON	
D5	MLED4	MLED4 output setting
0	OFF	*Default
1	ON	(OFF when main LED3 is ON and ON when LED4 is to be used)
D6	RLSW	Load resistance SW
0	OFF	*Default
1	ON	
D7	EXTEN	EXTCT signal L enable
0	EXTCTL ineffective	*Default According to SBY setting
1	EXTCTL effective	According to EXTCTL signal (forced OFF preferred)

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1	0	0	0	0	0	0	0	0	1	D7	D6	D5	D4	D3	D2	D1	D0
---	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----

D0	RSW	LEDR output setting
0	OFF	*Default
1	ON	

D1	GSW	LEDG output setting
0	OFF	*Default
1	ON	

D2	BSW	LEDB output setting
0	OFF	*Default
1	ON	

D3	F1SW	Flash LED 1 output setting
0	OFF	*Default
1	ON	

D4	F2SW	Flash LED 2 output setting
0	OFF	*Default
1	ON	

D5	F3SW	Flash LED 3 output setting
0	OFF	*Default
1	ON	

D7	SCTEN	SCTL signal enable
0	SCTL effective	*Default
1	SCTL ineffective	

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2 0 0 0 0 0 0 1 0 **D7** **D6** **D5** **D4** **D3** **D2** **D1** **D0**

D4	D3	D2	D1	D0	Current value (mA)
0	0	0	0	0	0.8
0	0	0	0	1	1.4
0	0	0	1	0	2.0
0	0	0	1	1	2.6
0	0	1	0	0	3.2
0	0	1	0	1	3.8
0	0	1	1	0	4.4
0	0	1	1	1	5.0
0	1	0	0	0	5.6
0	1	0	0	1	6.2
0	1	0	1	0	6.8
0	1	0	1	1	7.4
0	1	1	0	0	8.0
0	1	1	0	1	8.6
0	1	1	1	0	9.2
0	1	1	1	1	9.8
1	0	0	0	0	10.4
1	0	0	0	1	11.0
1	0	0	1	0	11.6
1	0	0	1	1	12.2
1	0	1	0	0	12.8
1	0	1	0	1	13.4
1	0	1	1	0	14.0
1	0	1	1	1	14.6
1	1	0	0	0	15.2
1	1	0	0	1	15.8
1	1	0	1	0	16.4
1	1	0	1	1	17.0
1	1	1	0	0	17.6
1	1	1	0	1	18.2
1	1	1	1	0	18.8
1	1	1	1	1	19.4

Main LED current value setting

*Default

D7	D6	D5	Output voltage (V)
0	0	0	4.3
0	0	1	4.5
0	1	0	4.7
0	1	1	4.9
1	0	0	5.1
1	0	1	5.3
1	1	0	5.5
1	1	1	5.7

Output DC setting

*Default

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3 0 0 0 0 0 0 0 1 1 **D7** **D6** **D5** **D4** **D3** **D2** **D1** **D0**

D4	D3	D2	D1	Current value (mA)
0	0	0	0	0.75
0	0	0	1	1.50
0	0	1	0	2.25
0	0	1	1	3.00
0	1	0	0	3.75
0	1	0	1	4.50
0	1	1	0	5.25
0	1	1	1	6.00
1	0	0	0	6.75
1	0	0	1	7.50
1	0	1	0	8.25
1	0	1	1	9.00
1	1	0	0	9.75
1	1	0	1	10.50
1	1	1	0	11.25
1	1	1	1	12.00

R2LED current value setting

*Default

D7	D6	D5	D4	Current value (mA)
0	0	0	0	0.75
0	0	0	1	1.50
0	0	1	0	2.25
0	0	1	1	3.00
0	1	0	0	3.75
0	1	0	1	4.50
0	1	1	0	5.25
0	1	1	1	6.00
1	0	0	0	6.75
1	0	0	1	7.50
1	0	1	0	8.25
1	0	1	1	9.00
1	1	0	0	9.75
1	1	0	1	10.50
1	1	1	0	11.25
1	1	1	1	12.00

G2LED current value setting

*Default

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4 0 0 0 0 0 1 0 0 0 **D6** **D5** **D4** **D3** **D2** **D1** **D0**

D4	D3	D2	D1	Current value (mA)
0	0	0	0	0.75
0	0	0	1	1.50
0	0	1	0	2.25
0	0	1	1	3.00
0	1	0	0	3.75
0	1	0	1	4.50
0	1	1	0	5.25
0	1	1	1	6.00
1	0	0	0	6.75
1	0	0	1	7.50
1	0	1	0	8.25
1	0	1	1	9.00
1	1	0	0	9.75
1	1	0	1	10.50
1	1	1	0	11.25
1	1	1	1	12.00

B2LED current value setting

*Default

D4	R2SW
0	OFF
1	ON

R2LED output setting

*Default

D5	G2SW
0	OFF
1	ON

G2LED output setting

*Default

D6	B2SW
0	OFF
1	ON

B2LED output setting

*Default

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5 0 0 0 0 0 1 0 1 **D7** **D6** **D5** **D4** **D3** **D2** **D1** **D0**

D3	D2	D1	D0	Current value (mA)
0	0	0	0	2.0
0	0	0	1	4.0
0	0	1	0	6.0
0	0	1	1	8.0
0	1	0	0	10.0
0	1	0	1	12.0
0	1	1	0	14.0
0	1	1	1	16.0
1	0	0	0	18.0
1	0	0	1	20.0
1	0	1	0	22.0
1	0	1	1	24.0
1	1	0	0	26.0
1	1	0	1	28.0
1	1	1	0	30.0
1	1	1	1	32.0

Setting of the flash LED normal mode current value
*Default

D7	D6	D5	D4	Current value (mA)
0	0	0	0	6.0
0	0	0	1	11.8
0	0	1	0	17.6
0	0	1	1	23.4
0	1	0	0	29.2
0	1	0	1	35.0
0	1	1	0	40.8
0	1	1	1	46.6
1	0	0	0	52.4
1	0	0	1	58.2
1	0	1	0	64.0
1	0	1	1	69.8
1	1	0	0	75.6
1	1	0	1	81.4
1	1	1	0	87.2
1	1	1	1	93.0

Setting of the flash LED strobo mode current value
(effective with FCTL = H)
*Default

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6 0 0 0 0 0 1 1 0 0 0 0 D4 D3 D2 D1 D0

D4	D3	D2	D1	D0	Current value (mA)
0	0	0	0	0	0.5
0	0	0	0	1	1.0
0	0	0	1	0	1.5
0	0	0	1	1	2.0
0	0	1	0	0	2.5
0	0	1	0	1	3.0
0	0	1	1	0	3.5
0	0	1	1	1	4.0
0	1	0	0	0	4.5
0	1	0	0	1	5.0
0	1	0	1	0	5.5
0	1	0	1	1	6.0
0	1	1	0	0	6.5
0	1	1	0	1	7.0
0	1	1	1	0	7.5
0	1	1	1	1	8.0
1	0	0	0	0	8.5
1	0	0	0	1	9.0
1	0	0	1	0	9.5
1	0	0	1	1	10.0
1	0	1	0	0	10.5
1	0	1	0	1	11.0
1	0	1	1	0	11.5
1	0	1	1	1	12.0
1	1	0	0	0	12.5
1	1	0	0	1	13.0
1	1	0	1	0	13.5
1	1	0	1	1	14.0
1	1	1	0	0	14.5
1	1	1	0	1	15.0
1	1	1	1	0	15.5
1	1	1	1	1	16.0

LEDR current value setting

*Default

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7 0 0 0 0 0 1 1 1 0 0 0 D4 D3 D2 D1 D0

D4	D3	D2	D1	D0	Current value (mA)
0	0	0	0	0	0.5
0	0	0	0	1	1.0
0	0	0	1	0	1.5
0	0	0	1	1	2.0
0	0	1	0	0	2.5
0	0	1	0	1	3.0
0	0	1	1	0	3.5
0	0	1	1	1	4.0
0	1	0	0	0	4.5
0	1	0	0	1	5.0
0	1	0	1	0	5.5
0	1	0	1	1	6.0
0	1	1	0	0	6.5
0	1	1	0	1	7.0
0	1	1	1	0	7.5
0	1	1	1	1	8.0
1	0	0	0	0	8.5
1	0	0	0	1	9.0
1	0	0	1	0	9.5
1	0	0	1	1	10.0
1	0	1	0	0	10.5
1	0	1	0	1	11.0
1	0	1	1	0	11.5
1	0	1	1	1	12.0
1	1	0	0	0	12.5
1	1	0	0	1	13.0
1	1	0	1	0	13.5
1	1	0	1	1	14.0
1	1	1	0	0	14.5
1	1	1	0	1	15.0
1	1	1	1	0	15.5
1	1	1	1	1	16.0

LEDG current value setting

*Default

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9 0 0 0 0 1 0 0 1 0 0 **D5** **D4** **D3** **D2** **D1** **D0**

D2	D1	D0	Fin
0	0	0	No slope
0	0	1	Slope 1/32
0	1	0	1/16
0	1	1	1/8
1	0	0	1/4
1	0	1	1/2
1	1	0	2/3
1	1	1	Slope MAX

Fin slope setting
*Default

D5	D4	D3	Fout
0	0	0	No slope
0	0	1	Slope 1/32
0	1	0	1/16
0	1	1	1/8
1	0	0	1/4
1	0	1	1/2
1	1	0	2/3
1	1	1	Slope MAX

Fout slope setting
*Default

10 0 0 0 0 1 0 1 0 **D7** 0 0 **D4** **D3** **D2** **D1** **D0**

D2	D1	D0	AT
0	0	0	0.25s
0	0	1	0.5s
0	1	0	1s
0	1	1	2s
1	0	0	4s
1	0	1	8s
1	1	×	-

Auto ON/OFF cycle setting
*Default

D3	GRON
0	OFF
1	ON

Auto ON/OFF function setting
*Default

D4	GRIM
0	OFF
1	ON

One-time execution of gradation function
*Default

D7	CKSEL
0	1MHz
1	0.5MHz

Oscillation frequency switching
*Default

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11	0	0	0	0	1	0	1	1	0	0	D5	D4	D3	D2	D1	D0
	D5-0 R auto OFF position setting (Default ALL0)															
12	0	0	0	0	1	1	0	0	0	0	D5	D4	D3	D2	D1	D0
	D5-0 R auto ON position setting (Default ALL0)															
	LED OFF over the entire cycle with Raon = Raoff															
13	0	0	0	0	1	1	0	1	0	0	D5	D4	D3	D2	D1	D0
	D5-0 G auto OFF position setting (Default ALL0)															
14	0	0	0	0	1	1	1	0	0	0	D5	D4	D3	D2	D1	D0
	D5-0 G auto ON position setting (Default ALL0)															
	LED OFF over the entire cycle with Gaon = Gaoff															
15	0	0	0	0	1	1	1	1	0	0	D5	D4	D3	D2	D1	D0
	D5-0 B auto OFF position setting (Default ALL0)															
16	0	0	0	1	0	0	0	0	0	0	D5	D4	D3	D2	D1	D0
	D5-0 B auto ON position setting (Default ALL0)															
	LED OFF over the entire cycle with Baon = Baoff															

Cautions for serial transmission and use

- * Set FXSW ON when all LEDs are set to OFF in the switching regulator ON setting.
 - * Set FXSW to ON when the switching regulator is set to ON and only the main LED is set to OFF.
 - * Start the switching regulator always with the LED driver OFF.
 - * Be sure to keep the gradation state OFF when setting gradation.
 - * Be sure to set MSW to ON when turning ON the MLED4 setting.
 - * Set RLSW to the ON state only when the switching regulator is ON.
 - * When using the through mode, adjust the DTC pin external capacitance to prevent LED from flashing at a time of changeover.
- When LED pin is not to be used
Connect the LED driver pin to VBAT when LED is not to be connected to the LED pin.

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Serial map

		Register address								Data								
		A7	A6	A5	A4	A3	A2	A1	A0	D7	D6	D5	D4	D3	D2	D1	D0	
0		0	0	0	0	0	0	0	0	EXTEN	RLSW	MLED4	x	MSW	FXSW	RGSW	STBY	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1		0	0	0	0	0	0	0	1	SCTEN	x	F3SW	F2SW	F1SW	BSW	GSW	RSW	
		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
2		0	0	0	0	0	0	1	0	VD [2 : 0]			MAIN [4 : 0]					
		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
3		0	0	0	0	0	0	1	1	G2 [3 : 0]			R2 [3 : 0]					
		0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	
4		0	0	0	0	0	1	0	0	x	B2SW	G2SW	R2SW	B2 [3 : 0]				
		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
5		0	0	0	0	0	1	0	1	FHC [3 : 0]			FLC [3 : 0]					
		0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
6		0	0	0	0	0	1	1	0	x	x	x	RC [4 : 0]					
		0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	
7		0	0	0	0	0	1	1	1	x	x	x	GC [4 : 0]					
		0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	
8		0	0	0	0	1	0	0	0	x	x	x	BC [4 : 0]					
		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
9		0	0	0	0	1	0	0	1	x	x	FOUT [2 : 0]			FIN [2 : 0]			
		0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	
10		0	0	0	0	1	0	1	0	CKSEL	x	x	GR1M	GRON	AT [2 : 0]			
		0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
11		0	0	0	0	1	0	1	1	x	x	RAoff [5 : 0]						
		0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	
12		0	0	0	0	1	1	0	0	x	x	RAon [5 : 0]						
		0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	
13		0	0	0	0	1	1	0	1	x	x	GAoff [5 : 0]						
		0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	
14		0	0	0	0	1	1	1	0	x	x	GAon [5 : 0]						
		0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
15		0	0	0	0	1	1	1	1	x	x	BAoff [5 : 0]						
		0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	
16		0	0	0	1	0	0	0	0	x	x	BAon [5 : 0]						
		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	

Table upper stage : Register name Table lower stage : Default value

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Pin Functions

Pin No.	Pin name	Pin Description	Equivalent Circuit
1	LEDGND1	GND pin dedicated to LED driver.	
2 3 4	FLED1 FLED2 FLED3	Flash LED driver pin. Feedback is applied so that the current flow through the output transistor becomes equal to the set current value. Each driver output current value can be adjusted independently with the 2mA step from about 2mA to 32mA through serial setting. With the FCTL pin at "H", adjustment from 6mA to 96mA in the 6mA step is possible by serial setting. FLED1, 2, and 3 have the same set current value. ON/OFF setting can be made independently.	<p>2,3,4</p>
5 6 7	R2LE G2LED B2LED	Sub LC backlight LED driver. Feedback is applied so that the current flow through the output transistor of sub-LC backlight LED driver pin becomes equal to the set current value. The driver current value can be adjusted with about 0.75mA step from about 0.75mA to 12mA through serial setting.	<p>5,6,7</p>
8	LEDGND2	GND pin dedicated to LED driver	
9 10 11 12	MLED1 MLED2 MLED3 MLED4	Main LC backlight LED driver pin. Feedback is applied so that the current flow through the output transistor becomes equal to the set current value. The driver current value can be adjusted with the 0.6mA step from about 0.6mA to 19.2mA through serial setting. These pins function as the pin to detect changeover from the through to switching regulator mode and the pin to detect feedback of the output voltage to the LED pin. MLED4 for tricolor enables independent ON/OFF serial setting. Note that MLED4 : ON is active only with MSW : ON. Connect MLED4 pin to VBAT when it is not to be used.	<p>9,10,11,12</p>
13	SCL	Serial clock signal input pin.	<p>13</p>
14	SDA	Serial data signal input pin.	<p>14</p>
15	EXTCTL	EXTCTL pin. H : Sleep L : Normal To activate this pin setting, set EXTEN to EXCTL ON by serial setting.	<p>15</p>
16	VDD	Power pin for SCLK, SDATA, EXTCTL, SCTL, and FCTL pin input circuits.	
17	PGND	GND pin for pin 18 output driver.	

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Pin No.	Pin name	Pin Description	Equivalent Circuit
18	OUT	Switching regulator external TR drive output pin. The output transistor ON resistance is about 10Ω for both PCH and NCH.	
19	PVCC	Power for pin 18 output driver.	
20	IN	Switching regulator output voltage input pin. In the output voltage fixed mode, feedback is applied so that the input voltage becomes equal to the set voltage. When the input voltage rises to a level about 0.8V above the fixed mode set voltage, the over-voltage limiter is activated. When the input voltage drops, the switching regulator is stopped in about 100ms. In this case, either reset it or set the serial RSW to OFF.	
21	SVCC	Power pin for circuits other than the power system.	
22	FCTL	Flash LED driver strobo mode control pin. When serial F1SW, F2SW, and F3SW are ON, setting the application voltage to "H" causes the strobo mode and the serial setting FHC current value is obtained. When the voltage is set to "L", the FLC set current is obtained.	
23	SCTL	External LED control pin. When serial RSW,GSW,and BSW are set to ON, setting the application voltage to H causes tricolor LED to go ON. With the application voltage set to L, tricolor LED goes OFF. Note that, if the serial setting STLEN is set to ignore SCTL, tricolor LED goes ON regardless of the state of SCTL.	
24	RT	Reference current setting resistor connection pin. By connecting the external resistor to GND, the reference current is generated. The pin voltage is about 1V. Change of this current value enables change of the oscillation frequency and LED driver current value.	
25	CT	Oscillation frequency setting capacitor connection pin. By connecting the external capacitor to GND, the triangular wave is generated. Change of the external capacitance enables change of the switching regulator clock frequency and gradation time.	

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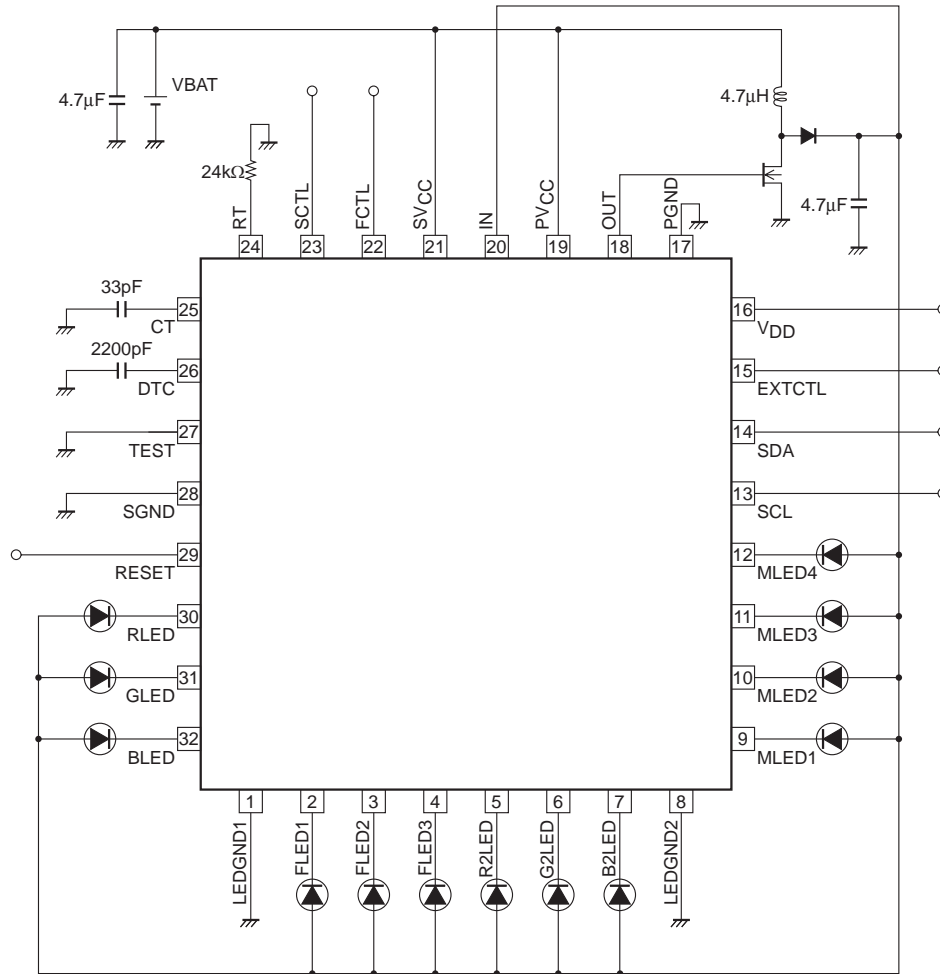
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Pin No.	Pin name	Pin Description	Equivalent Circuit
26	DTC	Switching regulator MAX duty setting pin. The MAX duty can be changed by connecting the resistor externally. By connecting the capacitor to GND for setting of switching regulator soft start, the soft start time can be adjusted.	
27	TEST	Test signal input pin. Be sure to connect the pin to GND.	
28	SGND	GND pin for circuits other than the power circuit.	
29	RESET	Reset signal input pin. The pin is in the reset state when it is set to L.	
30 31 32	RLED GLED BLED	Tricolor LED driver pin. Feedback is applied so that the current flow through the output transistor becomes equal to the set current value. Each driver output current value can be adjusted independently with the 0.5mA step from about 0.5mA to 16mA through serial setting. These pins are turned ON only when the SCTL pin is H or the serial SCTEN is set to ignore SCTL.	

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Standard sample application circuit



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