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Panasonic

AN32058A

http://www.semicon.panasonic.co.jp/en/

7 x 7 Dots Matrix LED Driver LSI

FEATURES

- 7 x 7 LED Matrix Driver
  (Total LED that can be driven = 49)
- Built-in memory (ROM and RAM)
- LDO : 2-ch
- SPI Interface : 1-ch
- Driver for RGB color unit : 1-ch
- 44 pin Plastic Quad Flat Non-leaded package (QFN Type)

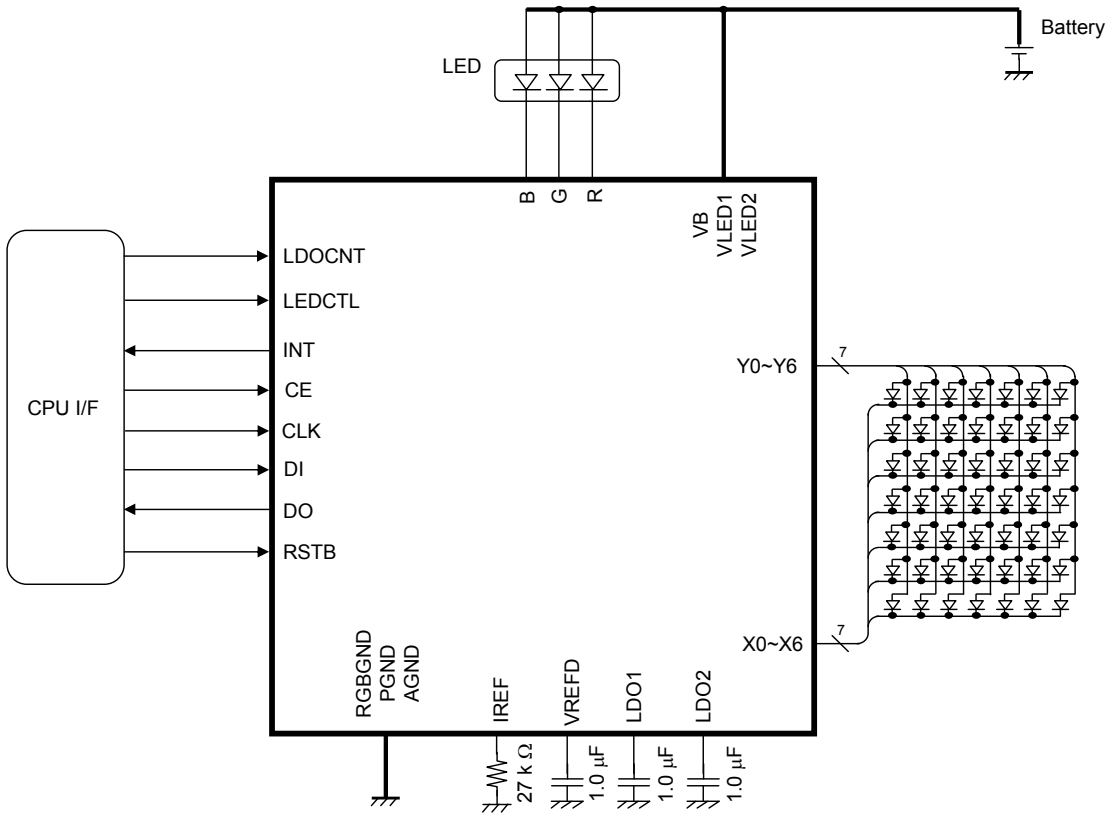
DESCRIPTION

AN32058A is 49 Dots Matrix LED Driver. It can drive up to 16 RGB LEDs.

APPLICATIONS

- Mobile Phone
- Smart Phone
- PCs
- Game Consoles
- Home Appliances etc.

TYPICAL APPLICATION



Note)
The application circuit is an example. The operation of the mass production set is not guaranteed. Sufficient evaluation and verification is required in the design of the mass production set. The Customer is fully responsible for the incorporation of the above illustrated application circuit in the design of the equipment.

Established : 2007-05-24
Revised : 2013-04-15

CONTENTS

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ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit	Note
Supply voltage	VB_{MAX}	6.0	V	*1
	$VLED_{MAX}$	6.5	V	*1
Operating ambience temperature	T_{opr}	– 30 to + 85	°C	*2
Operating junction temperature	T_j	– 30 to + 125	°C	*2
Storage temperature	T_{stg}	– 55 to + 125	°C	*2
Input Voltage Range	LEDCTL, RSTB, CE, CLK, DI	– 0.3 to 3.4	V	—
	LDOCNT	– 0.3 to 6.0	V	—
Output Voltage Range	INT, DO	– 0.3 to 3.4	V	—
	R, G, B, LDO1, LDO2, X0, X1, X2, X3, X4, X5, X6, Y0, Y1, Y2, Y3, Y4, Y5, Y6	– 0.3 to 6.5	V	—
ESD	HBM (Human Body Model)	2.0	kV	—

Note) This product may sustain permanent damage if subjected to conditions higher than the above stated absolute maximum rating. This rating is the maximum rating and device operating at this range is not guaranteeable as it is higher than our stated recommended operating range.
When subjected under the absolute maximum rating for a long time, the reliability of the product may be affected.
*1 VB_{MAX} = VB, $VLED_{MAX}$ = VLED1 = VLED2.
The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.
*2 Except for the power dissipation, operating ambient temperature, and storage temperature, all ratings are for Ta = 25°C.

POWER DISSIPATION RATING

PACKAGE	θ_{JA}	P_D (Ta=25 °C)	P_D (Ta=85 °C)
44 pin Plastic Quad Flat Non-leaded package (QFN Type)	71.8 °C /W	1.392 W	0.557 W

Note) For the actual usage, please refer to the P_D-Ta characteristics diagram in the package specification, follow the power supply voltage, load and ambient temperature conditions to ensure that there is enough margin and the thermal design does not exceed the allowable value.

CAUTION

Although this IC has built-in ESD protection circuit, it may still sustain permanent damage if not handled properly. Therefore, proper ESD precautions are recommended to avoid electrostatic damage to the MOS gates

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RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Supply voltage range	VB	3.1	3.7	4.6	V	*1
	VLED	3.1	5.0	5.6	V	*1
Input Voltage Range	LEDCTL, RSTB, CE, CLK, DI	– 0.3	—	3.0	V	—
	LDOCNT	– 0.3	—	VB + 0.3	V	*2
Output Voltage Range	INT, DO	– 0.3	—	3.0	V	—
	R, G, B, LDO1, LDO2, X0, X1, X2, X3, X4, X5, X6, Y0, Y1, Y2, Y3, Y4, Y5, Y6	– 0.3	—	VLED + 0.3	V	*2

Note) *1: The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.
Do not apply external currents and voltages to any pin not specifically mentioned.
Voltage values, unless otherwise specified, are with respect to GND. GND is voltage for AGND, RGBGND and PGND.
VB is voltage for VB. VLED is voltage for VLED1 and VLED2.
*2: (VB + 0.3) V must not exceed 6 V. (VLED + 0.3) V must not exceed 6.5 V.

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ELECTRICAL CHARACTERISTICS

VB = 3.6 V, VLED1 = VLED2 = 4.9 V

Note) T_a = 25 °C ± 2 °C unless otherwise specified.

Parameter	Symbol	Condition	Limits			Unit	Note
			Min	Typ	Max		
Current consumption							
Current consumption (1)	ICC1	At OFF mode LDOCNT = Low	—	0	1	μA	—
Current consumption (2)	ICC2	At Standby mode LDOCNT = Low LDO2 is active.	—	8	12	μA	—
Current consumption (3)	ICC3	LDOCNT = High LDO1 and LDO2 are active.	—	18	24	μA	—
Reference voltage							
Output voltage	VREF	I_{VREF} = 0 μA	1.21	1.24	1.27	V	—
Reference current							
Output voltage	VIREF	I_{IREF} = 0 μA	0.44	0.54	0.64	V	—
Voltage regulator (LDO1)							
Output voltage	VL1	I_{LDO1} = – 30 mA	1.79	1.85	1.91	V	—
Short circuit protection current	IPT1	LDOCNT = High REG18 = High V_{LDO1} = 0 V, IPT1 = I_{LDO1}	50	100	200	mA	—
Ripple rejection (1)	PSL11	VB = 3.6 V + 0.2 V[p-p] f = 1 kHz I_{LDO1} = – 15 mA PSL11 = 20log (acV_{LDO1} / 0.2)	—	– 45	– 40	dB	—
Ripple rejection (2)	PSL12	VB = 3.6 V + 0.2 V[p-p] f = 10 kHz I_{LDO1} = – 15 mA PSL12 = 20log (acV_{LDO1} / 0.2)	—	– 35	– 25	dB	—

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ELECTRICAL CHARACTERISTICS (continued)

VB = 3.6 V, VLED1 = VLED2 = 4.9 V

Note) T_a = 25 °C ± 2 °C unless otherwise specified.

Parameter	Symbol	Condition	Limits			Unit	Note
			Min	Typ	Max		
Voltage regulator (LDO2)							
Output voltage	VL2	I_{LDO2} = – 30 mA	2.76	2.85	2.94	V	—
Short circuit protection current	IPT2	LDOCNT = High V_{LDO2} = 0V IPT2 = I_{LDO2}	50	100	300	mA	—
Ripple rejection (1)	PSL21	VB = 3.6 V + 0.2 V[p-p] f = 1 kHz I_{LDO2} = – 15 mA PSL21 = 20log (acV_{LDO2} / 0.2)	—	– 35	– 30	dB	—
Ripple rejection (2)	PSL22	VB = 3.6 V + 0.2 V[p-p] f = 10 kHz I_{LDO2} = – 15 mA PSL22 = 20log (acV_{LDO2} / 0.2)	—	– 25	– 15	dB	—
Oscillator							
Oscillation frequency	FDC	—	0.96	1.20	1.44	MHz	—
SCAN Switch							
Resistance at the Switch ON	RSCAN	$I_{Y0, Y1, Y2, Y3, Y4, Y5, Y6}$ = 5 mA RSCAN = $V_{Y0, Y1, Y2, Y3, Y4, Y5, Y6}$ / 5 mA	—	2	4.8	Ω	—

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ELECTRICAL CHARACTERISTICS (continued)

VB = 3.6 V, VLED1 = VLED2 = 4.9 V

Note) T_a = 25 °C ± 2 °C unless otherwise specified.

Parameter	Symbol	Condition	Limits			Unit	Note
			Min	Typ	Max		
Current generator (For 7 × 7 dots matrix LED)							
Output current (1)	IMX1	At 1mA setup $V_{X0, X1, X2, X3, X4, X5, X6}$ = 1 V IMX1 = $I_{X0, X1, X2, X3, X4, X5, X6}$	0.950	1.033	1.116	mA	*1
Output current (2)	IMX2	At 2 mA setup $V_{X0, X1, X2, X3, X4, X5, X6}$ = 1 V IMX2 = $I_{X0, X1, X2, X3, X4, X5, X6}$	1.907	2.073	2.239	mA	*1
Output current (3)	IMX4	At 4 mA setup $V_{X0, X1, X2, X3, X4, X5, X6}$ = 1 V IMX4 = $I_{X0, X1, X2, X3, X4, X5, X6}$	3.824	4.157	4.490	mA	*1
Output current (4)	IMX8	At 8 mA setup $V_{X0, X1, X2, X3, X4, X5, X6}$ = 1 V IMX8 = $I_{X0, X1, X2, X3, X4, X5, X6}$	7.660	8.326	8.992	mA	*1
Output current (5)	IMX15	At 15 mA setup $V_{X0, X1, X2, X3, X4, X5, X6}$ = 1 V IMX15 = $I_{X0, X1, X2, X3, X4, X5, X6}$	14.408	15.661	16.914	mA	*1
Leakage Current when matrix LED turns off	IMXOFF	Current OFF setup $V_{X0, X1, X2, X3, X4, X5, X6}$ = 4.75 V IMXOFF = $I_{X0, X1, X2, X3, X4, X5, X6}$	—	—	1	μA	—
The error between channels	IMXCH	The average value of all channels, and the current error of each channel	– 5	—	5	%	—

*1 : Values when recommended parts (ERJ2RHD273X) are used for IREF terminal.
The other current settings are combination of above items.

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ELECTRICAL CHARACTERISTICS (continued)

VB = 3.6 V, VLED1 = VLED2 = 4.9 V

Note) T_a = 25 °C ± 2 °C unless otherwise specified.

Parameter	Symbol	Condition	Limits			Unit	Note
			Min	Typ	Max		
Current generator (For RGB color unit)							
Output current (1)	IRGB1	At 1mA setup $V_{R, G, B}$ = 1 V	0.949	1.031	1.113	mA	*1
Output current (2)	IRGB2	At 2 mA setup $V_{R, G, B}$ = 1 V	1.892	2.056	2.220	mA	*1
Output current (3)	IRGB4	At 4 mA setup $V_{R, G, B}$ = 1 V	3.764	4.091	4.418	mA	*1
Output current (4)	IRGB8	At 8 mA setup $V_{R, G, B}$ = 1 V	7.510	8.163	8.816	mA	*1
Leakage Current when RGB turn off	IRGBOFF	Current OFF setup $V_{R, G, B}$ = 4.75 V IRGBOFF = $I_{R, G, B}$	—	—	1	μA	—
The error between channels	IRGBCH	The average value of all channels, and the current error of each channel	– 5	—	5	%	—

*1 : Values when recommended parts (ERJ2RHD273X) are used for IREF terminal.
The other current settings are combination of above items.

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ELECTRICAL CHARACTERISTICS (continued)

VB = 3.6 V, VLED1 = VLED2 = 4.9 V

Note) T_a = 25 °C ± 2 °C unless otherwise specified.

Parameter	Symbol	Condition	Limits			Unit	Note
			Min	Typ	Max		
SPI I/F, LEDCTL, RSTB							
Input voltage range of High-level	VIH	High-level recognition voltage	LDO1 × 0.8	—	LDO2 + 0.3	V	—
Input voltage range of Low-level	VIL	Low-level recognition voltage	– 0.3	—	0.4	V	—
Input current of High-level	IIH	$V_{LEDCTL, RSTB, CE, CLK, DI}$ = 1.85 V IIH = $I_{LEDCTL, RSTB, CE, CLK, DI}$	—	0	1	µA	—
Input current of Low-level	IIL	$V_{LEDCTL, RSTB, CSB, CLK, DI}$ = 0 V IIL = $I_{LEDCTL, RSTB, CE, CLK, DI}$	—	0	1	µA	—
INT							
Output voltage of High-level (1)	VOH1	I_{INT} = – 2 mA VDDSEL = LDO2	LDO2 × 0.8	—	—	V	—
Output voltage of Low-level (1)	VOL1	I_{INT} = 2 mA VDDSEL = LDO2 (I_{INT} = 0.5 mA)	—	—	LDO2 ×0.2 (0.15)	V	—
Output voltage of High-level (2)	VOH2	I_{INT} = – 2 mA VDDSEL = LDO1	LDO1 × 0.8	—	—	V	—
Output voltage of Low-level (2)	VOL2	I_{INT} = 2 mA VDDSEL = LDO1 (I_{INT} = 0.5 mA)	—	—	LDO1 ×0.3 (0.15)	V	—

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ELECTRICAL CHARACTERISTICS (continued)

VB = 3.6 V, VLED1 = VLED2 = 4.9 V

Note) T_a = 25 °C ± 2 °C unless otherwise specified.

Parameter	Symbol	Condition	Limits			Unit	Note
			Min	Typ	Max		
LDOCNT							
Input voltage range of High-level	VIH	High-level recognition voltage	VB × 0.7	—	VB + 0.3	V	—
Input voltage range of Low-level	VIL	Low-level recognition voltage	– 0.3	—	0.4	V	—
Input current of High-level	IIH	V_{LDOCNT} = 3.6 V IIH = I_{LDOCNT}	—	0	1	µA	—
Input current of Low-level	IIL	V_{LDOCNT} = 0 V IIL = I_{LDOCNT}	—	0	1	µA	—
DO							
Output voltage of High-level	VOH	I_{DO} = – 2 mA	LDO1 × 0.8	—	—	V	—
Output voltage of Low-level	VOL	I_{DO} = 2 mA	—	—	LDO1 × 0.2	V	—

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ELECTRICAL CHARACTERISTICS (continued)

VB = 3.6 V, VLED1 = VLED2 = 4.9 V

Note) T_a = 25 °C ± 2 °C unless otherwise specified.

Parameter	Symbol	Condition	Limits			Unit	Note
			Min	Typ	Max		
Voltage regulator (LDO1) Output capacitor 1 µF, Output capacitor's ESR less than 0.1 Ω							
Rise time	Tsu1	Time until output voltage reaches to 0 V to 90%	—	0.25	—	ms	*2 *3
Fall time	Tsd1	Time until output voltage reaches to 10%	—	5	—	ms	*2 *3
Maximum load current	IOMAX1	—	—	15	—	mA	*3
Load transient response (1)	Vtr11	I_{LDO1} = – 50 µA → – 15 mA (1 µs)	—	70	—	mV	*3
Load transient response (2)	Vtr12	I_{LDO1} = – 15 mA → – 50 µA (1 µs)	—	70	—	mV	*3
Voltage regulator (LDO2) Output capacitor 1 µF, Output capacitor's ESR less than 0.1 Ω							
Rise time	Tsu2	Time until output voltage reaches to 0 V to 90%	—	0.25	—	ms	*2 *3
Fall time	Tsd2	Time until output voltage reaches to 10%	—	5	—	ms	*2 *3
Maximum load current	IOMAX2	—	—	15	—	mA	*3
Load transient response (1)	Vtr21	I_{LDO2} = – 50 µA → – 15 mA (1 µs)	—	70	—	mV	*3
Load transient response (2)	Vtr22	I_{LDO2} = – 15 mA → – 50 µA (1 µs)	—	70	—	mV	*3
TSD (Thermal shutdown circuit)							
Detection temperature	Tdet	Temperature which LDO1, LDO2, Constant current circuit, Matrix SW and RGB turns off.	—	160	—	°C	*3 *4
Return temperature	Tsd11	Returning temperature	—	110	—	°C	*3 *5

Note) *2 : Rise time and Fall time are defined as below.

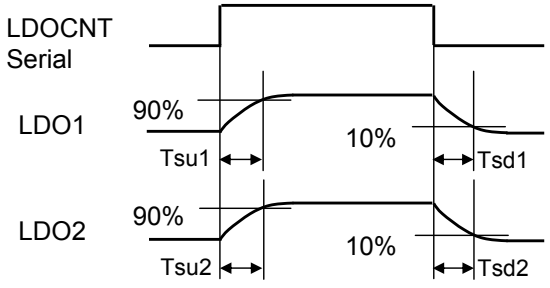
Actual evaluation result of rise time : LDO1 : 290 to 400 µs, LDO2 : 220 to 310 µs

Actual evaluation result of fall time : LDO1 : 6.2 to 8.5 ms, LDO2 : 5.8 to 7.9 ms

*3 : Typical Design Value

*4 : LDO1, LDO2, Constant current circuit, and Matrix SW and RGB are turned off when TSD is High. When TSD is High, the register is set as 14hD1 = 1. However, data can be read only when the register is read immediately after INT occurs since internal regulator is turned off.

*5 : Only LDO1 and LDO2 return after ON state of TSD. A logic part will be in Reset state.



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ELECTRICAL CHARACTERISTICS (continued)

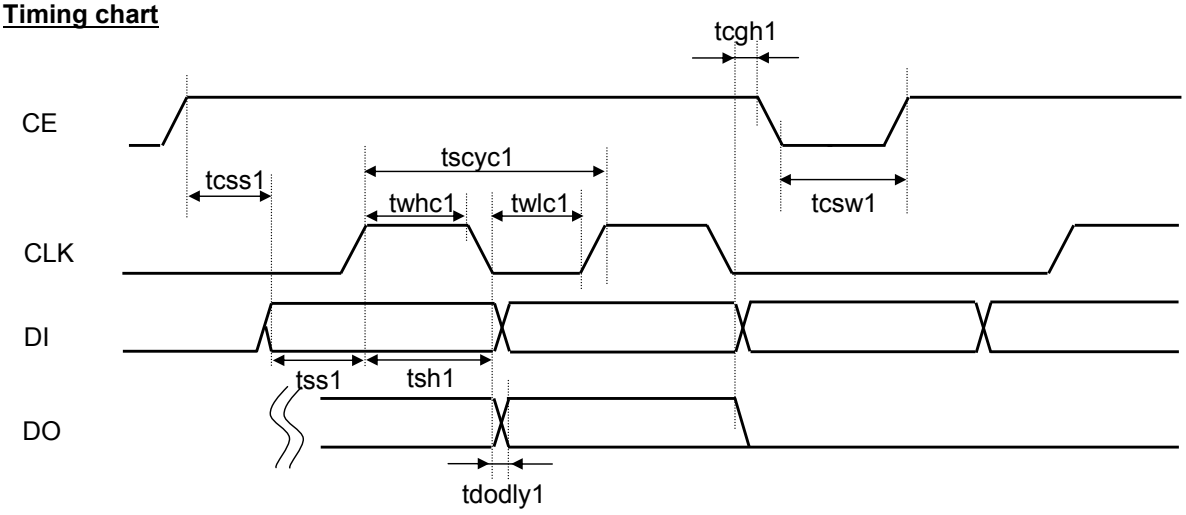
VB = 3.6 V, VLED1 = VLED2 = 4.9 V

Note) T_a = 25 °C ± 2 °C unless otherwise specified.

Parameter	Symbol	Condition	Limits			Unit	Note
			Min	Typ	Max		
Microcomputer interface characteristic (Vdd = 1.85 V ± 3 %) Write access Timing							
CLK cycle time	tscyc1	—	—	125	—	ns	*3
CLK cycle time High period	twhc1	—	—	60	—	ns	*3
CLK cycle time Low period	twlc1	—	—	60	—	ns	*3
Serial-data setup time	tss1	—	—	62	—	ns	*3
Serial-data hold time	tsh1	—	—	62	—	ns	*3
Transceiver interval	tcsw1	—	—	62	—	ns	*3
Chip enable setup time	tcss1	—	—	5	—	ns	*3
Chip enable hold time	tcgh1	—	—	5	—	ns	*3
Microcomputer interface characteristic (Vdd = 1.85 V ± 3 %) Read access Timing							
CLK cycle time	tscyc1	—	—	125	—	ns	*3
CLK cycle time High period	twhc1	—	—	60	—	ns	*3
CLK cycle time Low period	twlc1	—	—	60	—	ns	*3
Serial-data setup time	tss1	—	—	62	—	ns	*3
Serial-data hold time	tsh1	—	—	62	—	ns	*3
Transceiver interval	tcsw1	—	—	62	—	ns	*3
Chip enable setup time	tcss1	—	—	5	—	ns	*3
Chip enable hold time	tcgh1	—	—	5	—	ns	*3
DC delay time	tdodly1	Only read mode	—	25	—	ns	*3

Note) *3 : Typical Design Value

Timing chart



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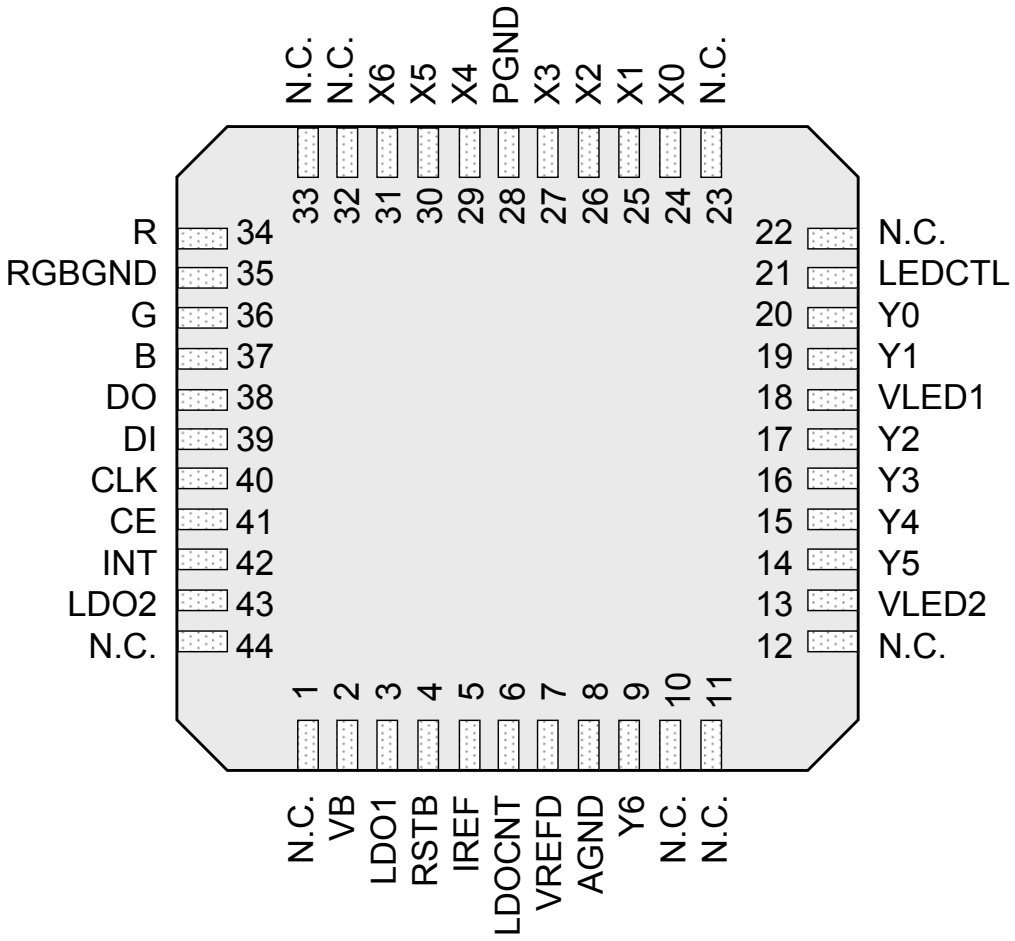
PIN CONFIGURATION

Top View



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PIN FUNCTIONS

Pin No.	Pin name	Type	Description
1 10 11 12 22 23 32 33 44	N.C.	—	No Connection
2	VB	Power supply	The power supply's connect terminal for BGR circuit and LDO circuit.
3	LDO1	Output	LDO1 (1.85 V) output terminal.
4	RSTB	Input	Reset input terminal ("L" active)
5	IREF	Output	The resistance connect terminal for constant current value setup.
6	LDOCNT	Input	ON/OFF control terminal of LDO1 and LDO2.
7	VREFD	Output	BGR circuit output terminal.
8	AGND	Ground	The GND terminal for Analog circuitry.
9	Y6	Output	The output terminal of matrix switching control. It connects with the G Column of matrix LED.
13 18	VLED2 VLED1	Power supply	The power supply's connect terminal for matrix LED. Connect with the output of battery or step-up DC/DC converter
14	Y5	Output	The output terminal of matrix switching control. It connects with the F Column of matrix LED.
15	Y4	Output	The output terminal of matrix switching control. It connects with the E Column of matrix LED.
16	Y3	Output	The output terminal of matrix switching control. It connects with the D Column of matrix LED.
17	Y2	Output	The output terminal of matrix switching control. It connects with the C Column of matrix LED.
19	Y1	Output	The output terminal of matrix switching control. It connects with the B Column of matrix LED.
20	Y0	Output	The output terminal of matrix switching control. It connects with the A Column of matrix LED.
21	LEDCTL	Input	LED's lighting ON/OFF control terminal. (It is based on register 0Ah.)

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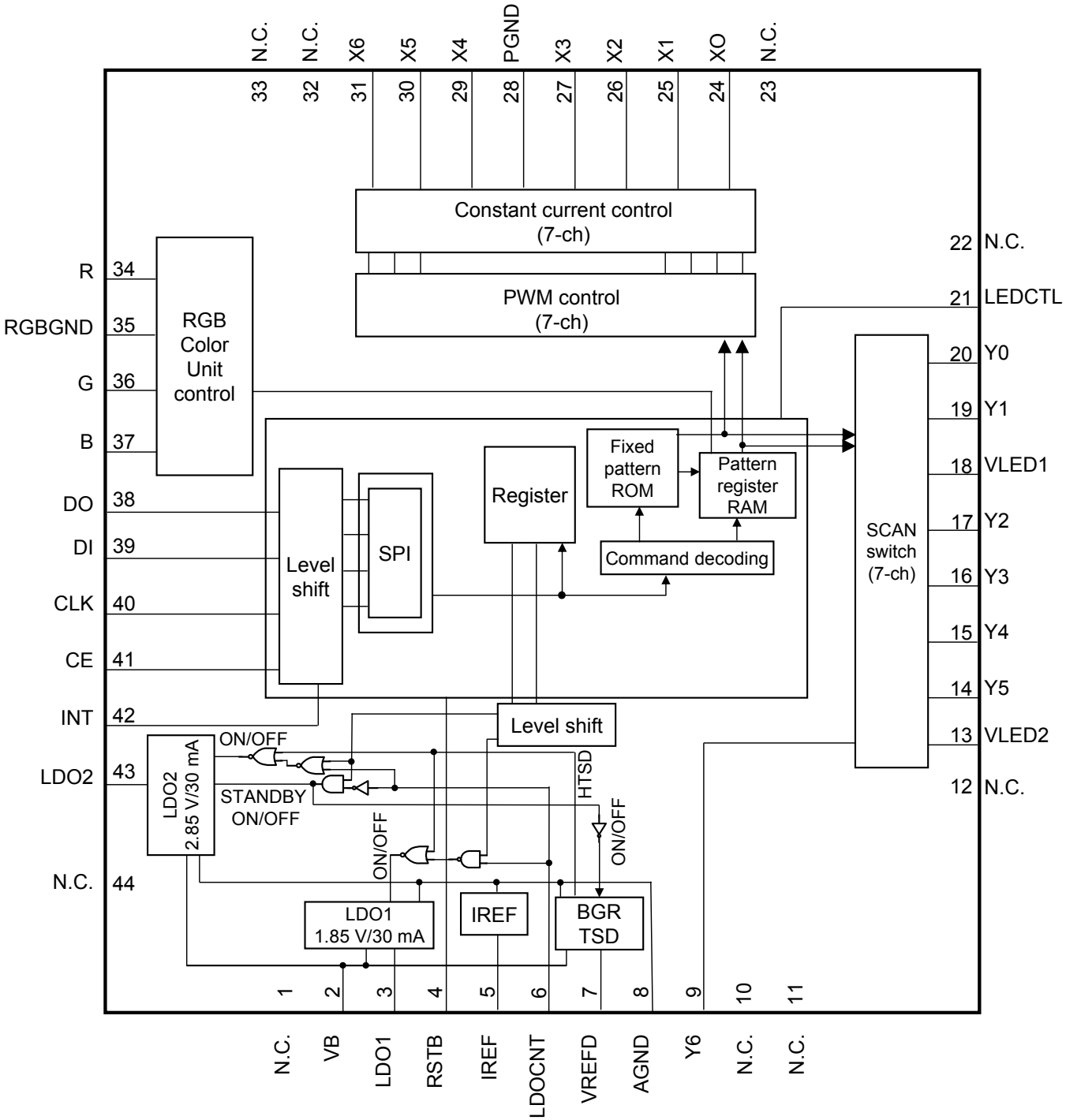
PIN FUNCTIONS (continued)

Pin No.	Pin name	Type	Description
24	X0	Output	Constant current circuit. The output terminal of PWM control. It connects with the 1st Row of matrix LED.
25	X1	Output	Constant current circuit. The output terminal of PWM control. It connects with the 2nd Row of matrix LED.
26	X2	Output	Constant current circuit. The output terminal of PWM control. It connects with the 3rd Row of matrix LED.
27	X3	Output	Constant current circuit. The output terminal of PWM control. It connects with the 4th Row of matrix LED.
28	PGND	Ground	The GND terminal for matrix LED
29	X4	Output	Constant current circuit. The output terminal of PWM control. It connects with the 5th Row of matrix LED.
30	X5	Output	Constant current circuit. The output terminal of PWM control. It connects with the 6th Row of matrix LED.
31	X6	Output	Constant current circuit. The output terminal of PWM control. It connects with the 7th Row of matrix LED.
34	R	Output	LED contact terminal.
35	RGBGND	Ground	The GND terminal for RGB terminal.
36	G	Output	LED contact terminal.
37	B	Output	LED contact terminal.
38	DO	Output	Data output terminal for SPI interface.
39	DI	Input	Data input terminal for SPI interface.
40	CLK	Input	Clock input terminal for SPI interface.
41	CE	Input	Chip-enable terminal for SPI1 interface. ("H" active)
42	INT	Output	Interrupt output terminal.
43	LDO2	Output	LDO2 (2.85 V) output terminal.

FUNCTIONAL BLOCK DIAGRAM



Notes: This block diagram is for explaining functions. Part of the block diagram may be omitted, or it may be simplified.

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OPERATION

1. Explanation in each mode (Power supply starting sequence)

Mode	LDOCNT	REG18	REG28	Note
OFF	Low	0	0	• It is necessary to make it LDOCNT = High for the return from OFF-mode.
OFF → Normal mode	"L" → "H"	0/1	0/1	• The signal from serial interface is not received in LDOCNT = Low and the state of REG28 = Low or REG18 = Low. • It shifts to standby mode with LDOCNT = Low and REG28 = High. • The signal from serial interface is not received at Standby-mode. (Power supply for Logic is LDO1 and LDO2.) Therefore, standby release by the signal from serial interface cannot be performed. • In Standby-mode, if LDOCNT is switched to High from Low, it will return to the normal mode. • It cannot shift to OFF-mode from Standby-mode. Once returning to the normal mode, please shift to OFF-mode.
	"H"	0/1	0/1	
Normal mode → OFF	"H" → "L"	0	0	• Regardless of the value of REG18, LDO1 turns on at LDOCNT = High. • Regardless of the value of REG28, LDO2 turns on at LDOCNT = High. • Serial interface signal is not received at RSTB = Low • 5 ms after being set to LDOCNT = High, the receptionist of serial interface signal is attained. • RSTB terminal prohibits the input signal of those other than a rectangle wave. • All register setting become default setting if RSTB = Low • (The default setting of REG18 and REG28 are [1] • If RSTB = Low before LDOCNT = Low, LDO1 and LDO2 can't turn off.) • All register setting become default setting when LDO2 turn off. • The setting order to change off mode is as following. • REG18, 28 = [0] → LDOCNT = "L" → RSTB = "L"
Normal mode → Standby mode		0	1	

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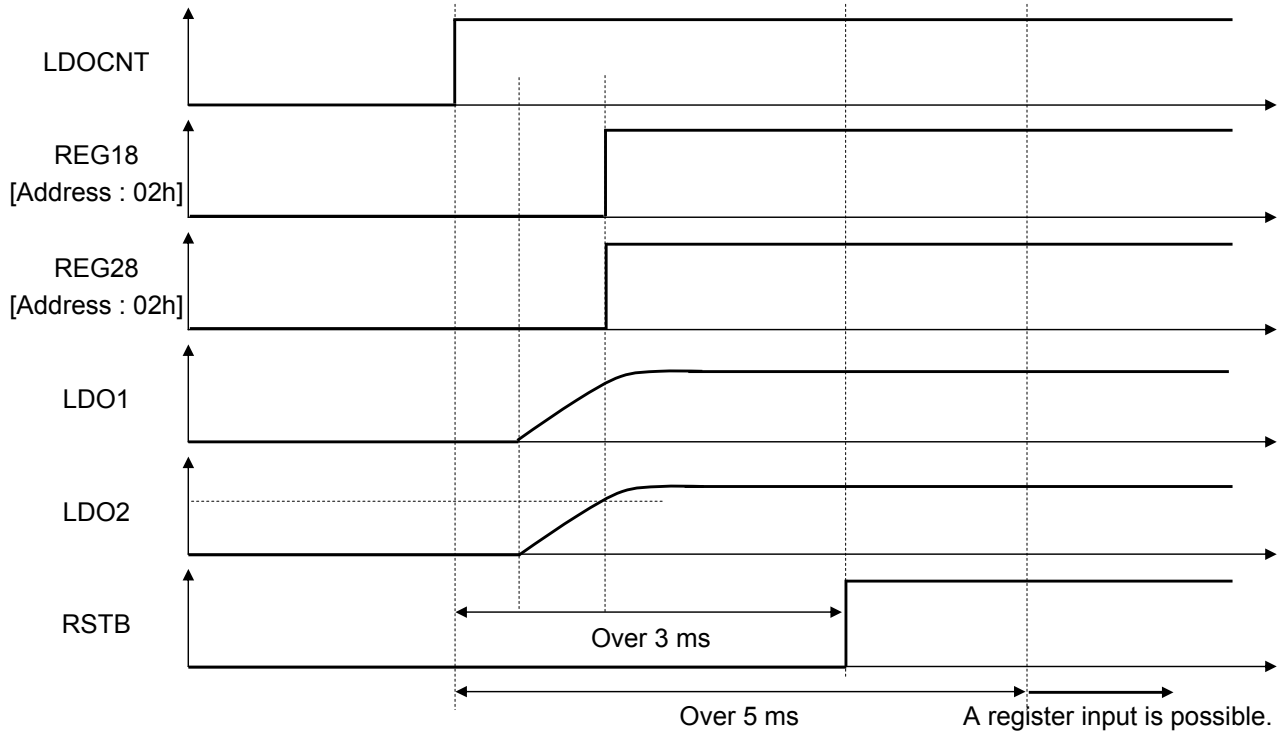
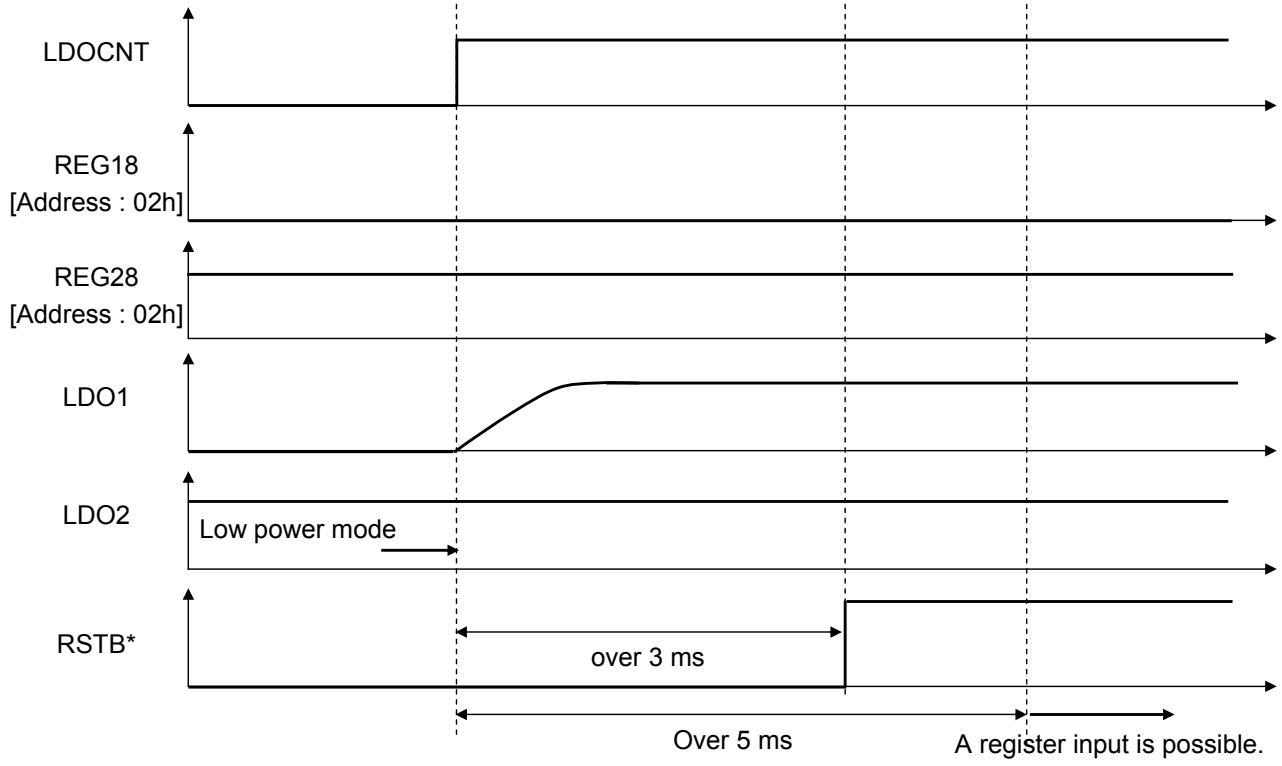
OPERATION (continued)

1. Explanation in each mode (Power supply starting sequence) (continued)

- Shift to the Normal mode from OFF-mode



- Shift to the Normal mode from Standby mode



* It is a waveform in the case of applying reset to register setup at Standby mode.
* Maintain the state of RSTB = High to hold the register setup.

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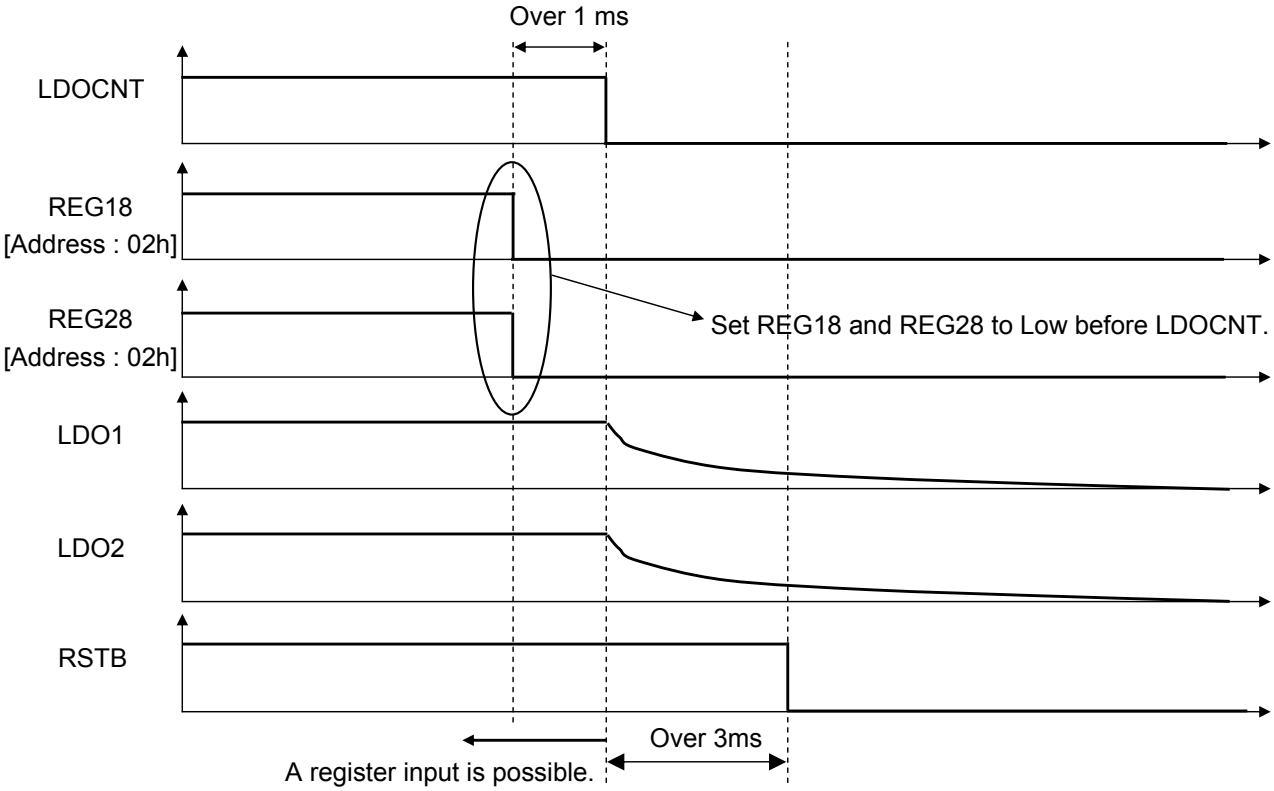
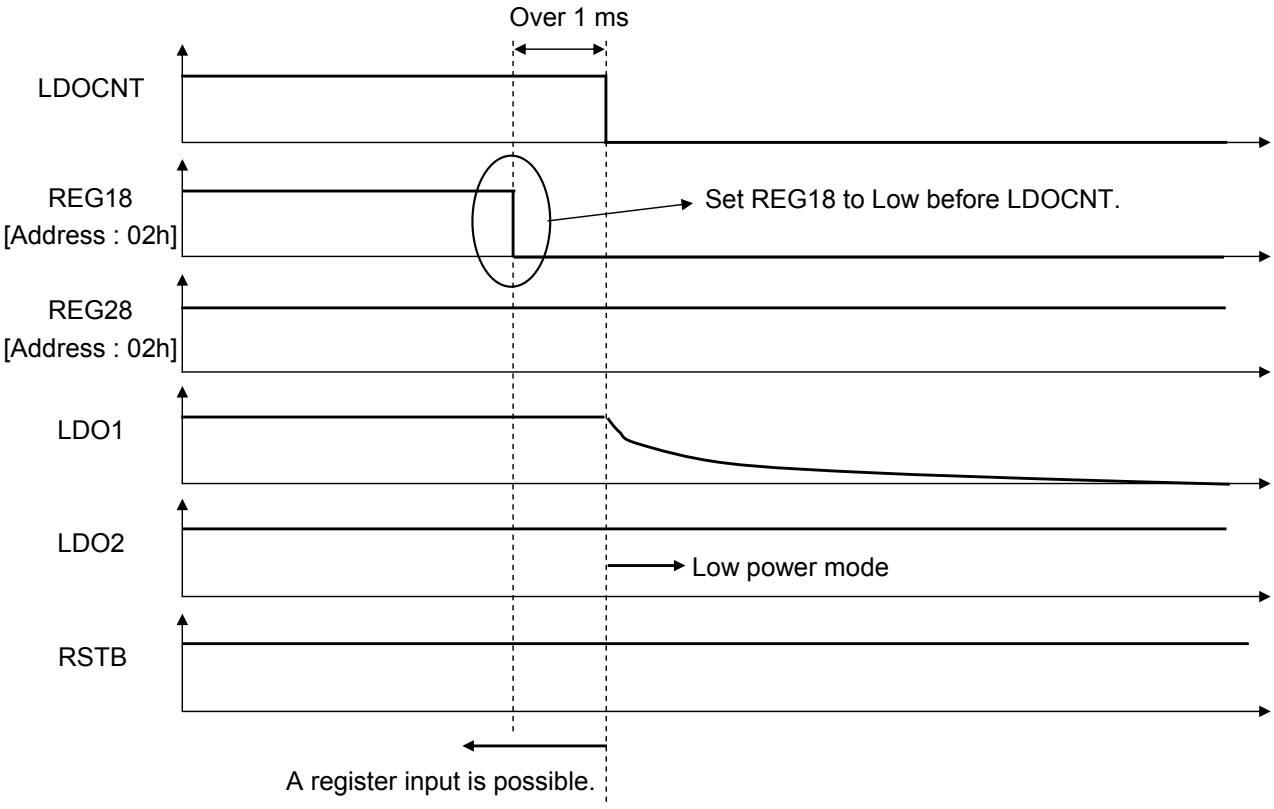
OPERATION (continued)

1. Explanation in each mode (Power supply starting sequence) (continued)

- Shift to the OFF-mode from Normal mode



- Shift to the Standby mode from Normal mode



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OPERATION (continued)

1. Explanation in each mode (Power supply starting sequence) (continued)

• Shift to the OFF-mode from Normal mode

VBAT	LDOCNT	MODE
"L"	"L"	OFF
"L"	"H"	Prohibition
"H"	"L"	OFF
"H"	"H"	ON

Note) "L" in column of VBAT and LDOCNT means 0 V, "H" means 3.1 to 4.6 V (operating supply voltage range).

• Logic pin condition

The following setting is common for OFF, Standby and Normal mode.
The pin setting when RSTB = Low, under Normal mode is as follows.

Pin name	Pin state	Logic*
INT	Output	"L"
CE	Input	"L"
CLK	Input	"L"
DI	Input	"L"
DO	Output	"L"
LEDCTL	Input	"L"
LDOCNT	Input	Depends on each mode

Note)*: Logic state for pins indicated as “Output” under Pin state shows the output level.
Logic state for pins indicated as “Input” under Pin state shows the input level to be set to the pins.

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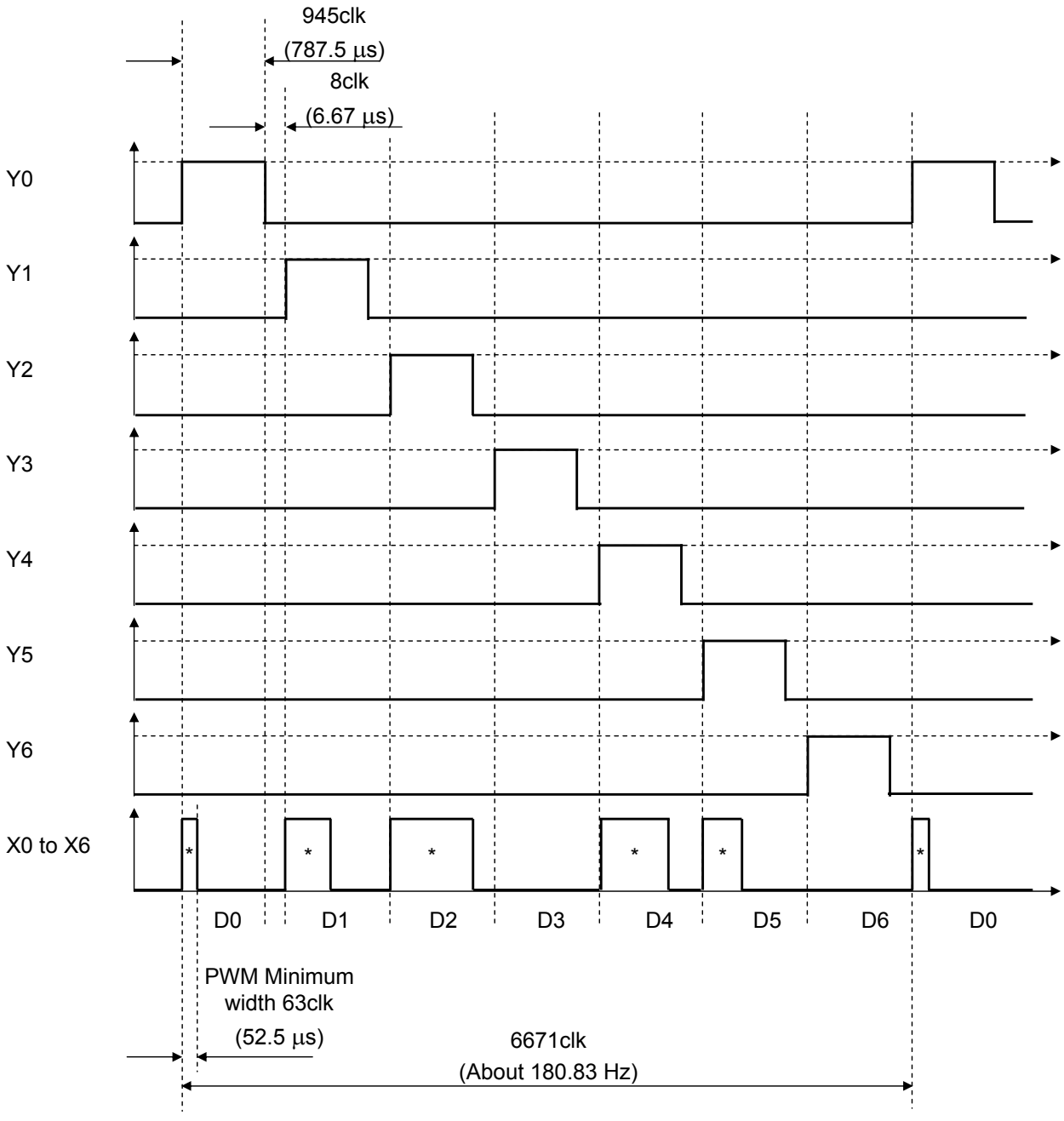
OPERATION (continued)

2. Explanation of operation

- Matrix part operation waveform

- The following waveform is an internal signal. In following Yx = Xx = Low, the waveform of actual Yx terminal is set to Hi-Z.
- It is controlled by internal 1.2 MHz clock in default condition.
- Y side switches from Y0 to Y6 in that order. The turning on term of each pin is constant 945clock (787.5 µs) and each turning on term includes 8clock (6.67 µs) interval.
- "*" mark shows the turning on term and D3, D6 is the turning off term in the following figure.
- 7×7 matrix display is controlled by X0 to X6 with Yx switching timing.



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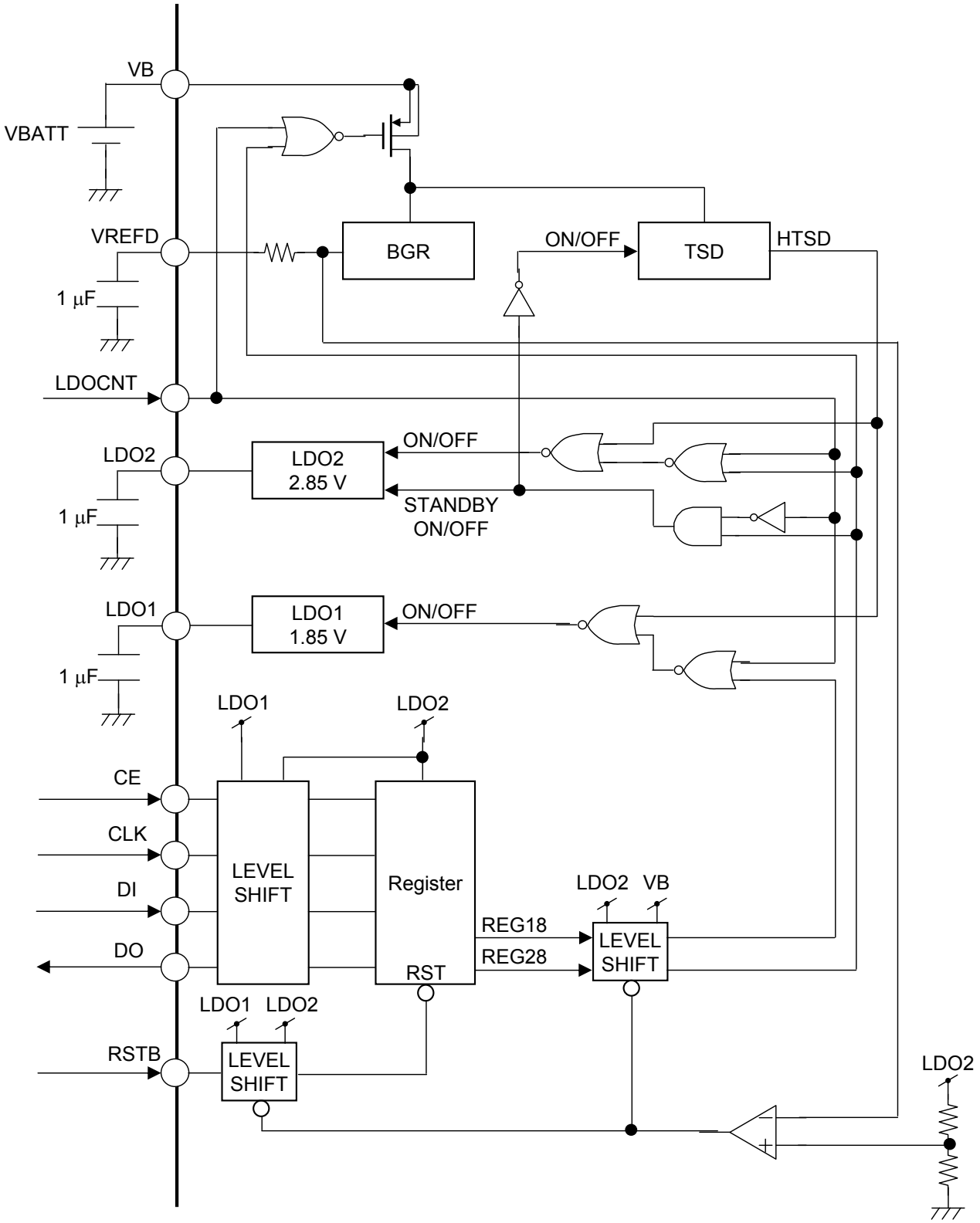
OPERATION (continued)

3. Block configuration

- RESET part block configuration



All the logic portions to which the power supply is not connected are connected to VB as power supplies.

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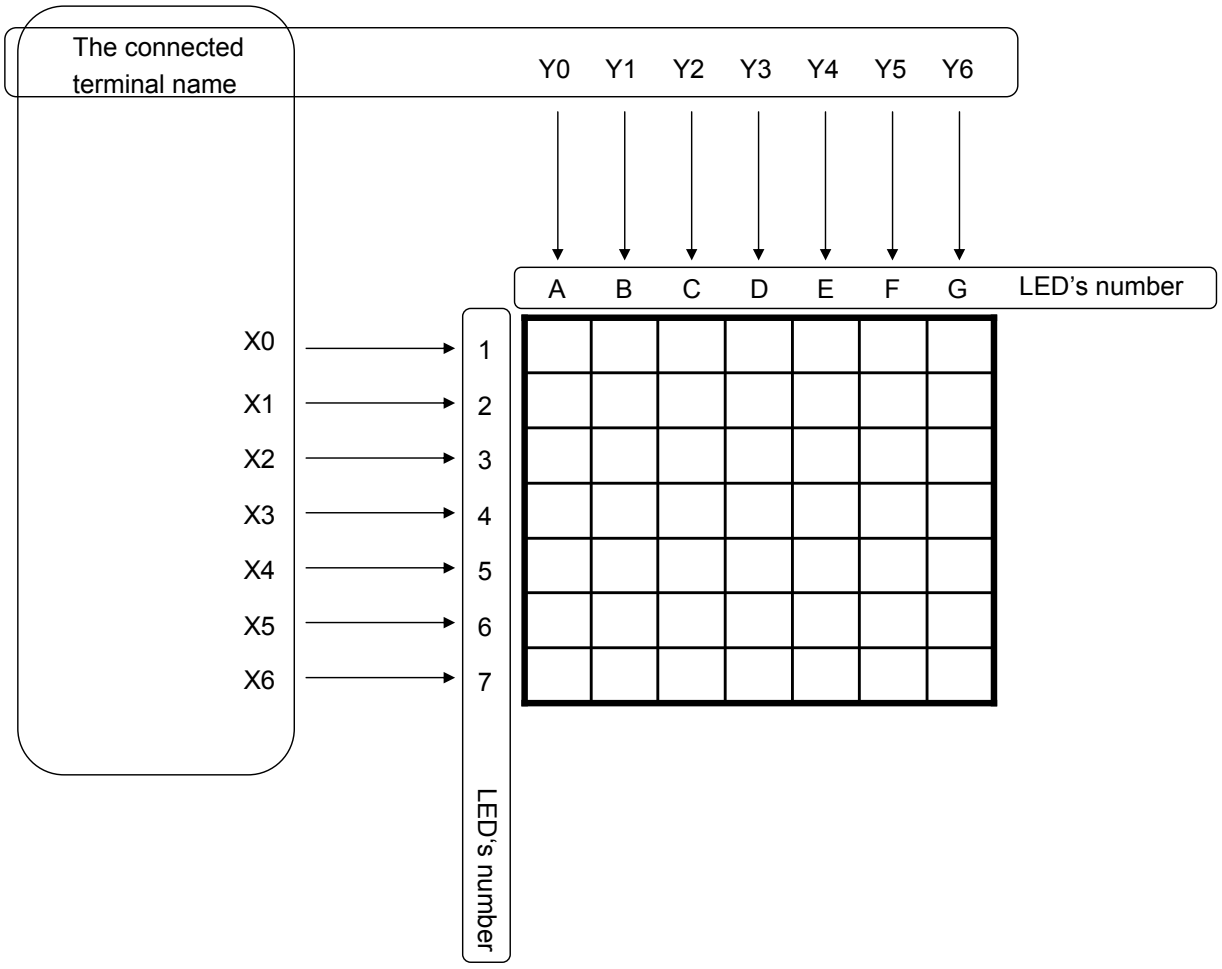
OPERATION (continued)

3. Block configuration (continued)

- Explanation of matrix LED part, matrix LED's number

- LED matrix driver circuit can display character and pattern by controlling the 7×7 matrix LED individually.
- In this specification, LED's number controlled by each terminal can be matched off against the following figure.
- It is controlled by internal 1.2 MHz clock in default condition.
- In the scroll mode, LED matrix can move the display of character from right to left as the following arrangement.



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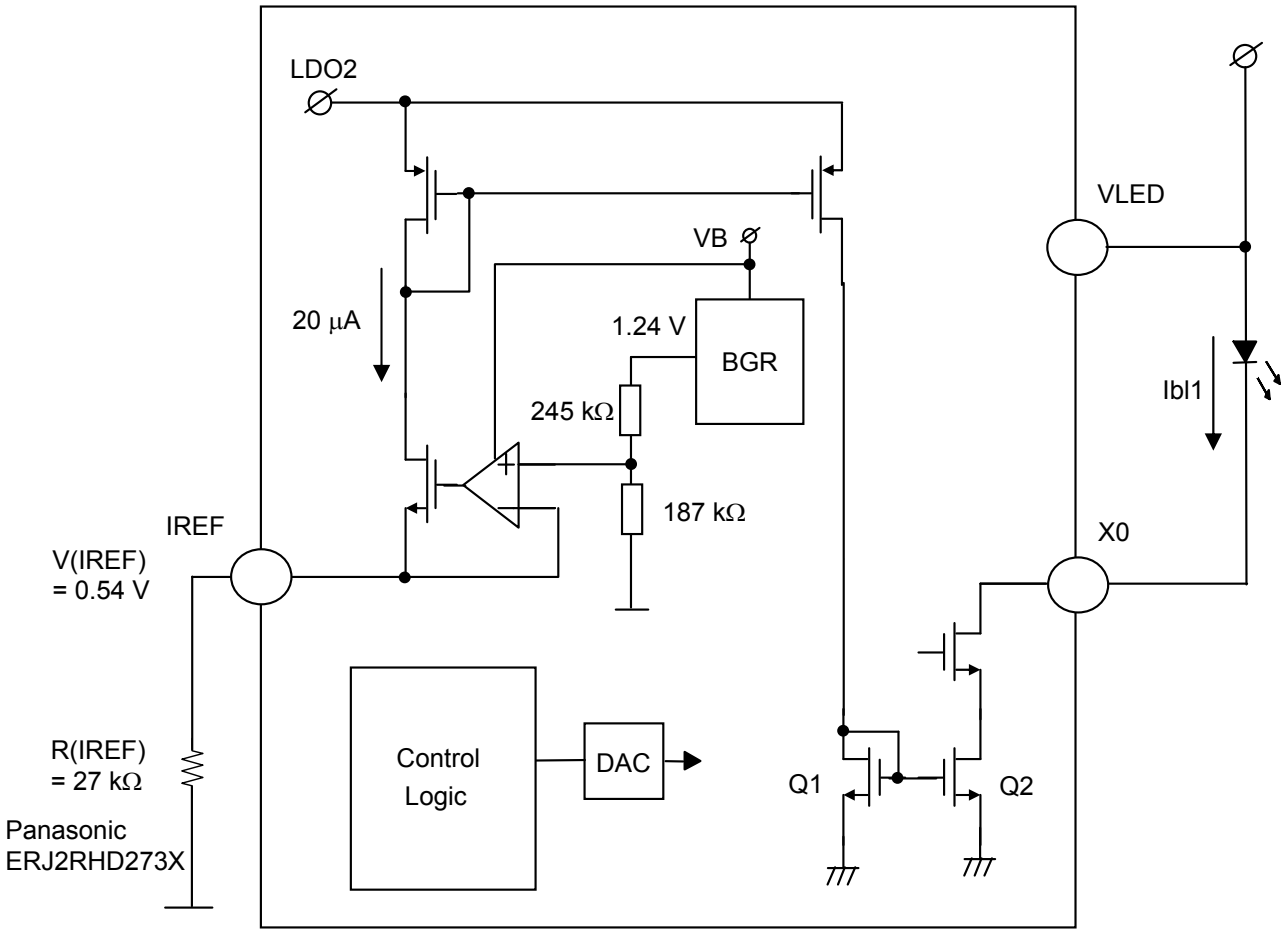
OPERATION (continued)

3. Block configuration (continued)

- Equivalent circuit of matrix LED driver

X0 terminal case



- The reference current for constant current driver is calculated by the following formula.
  V(IREF) / R(IREF) = 0.54 V / 27 kΩ = 20 μA
- The LED driver current can be set from 0 mA to 30 mA by register setting via serial interface.
- The constant current value can be changed by the external resistor value of IREF terminal, but the accuracy in case of that setting is not guaranteed.
- ERJ2RHD273X is recommended for the external resistor of IREF terminal to keep the constant current accuracy.

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OPERATION (continued)

4. Register and Address

- Register Map

Sub address	R/W	Data name	Data							
			D7	D6	D5	D4	D3	D2	D1	D0
01h	W	POWERCNT	—	—	—	—	—	OSCEN	—	—
02h	W	LDOCNT	—	—	—	—	—	—	REG18	REG28
03h	For test									
04h	For test									
05h	For test									
06h	For test									
07h	For test									
08h	For test									
09h	For test									
0Ah	W	LEDCTL	LEDACT	—	—	—	—	DISMTX	DISRGB	—
10h	For test									
11h	For test									
12h	For test									
13h	For test									
14h	R	IOFACTOR	FACGD1	—	—	—	RAM ACT	FRMINT	CPUWRER	TSD
15h	For test									
16h	For test									
17h	For test									
18h	For test									
19h	For test									
1Ah	W/R	VDDSEL	INTVSEL	—	—	—	—	—	—	—

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