Multifunction LCD Segment Driver

BU97941FV MAX 104 segments (SEG26×COM4)

●Features

- Integrated RAM for display data (DDRAM): 26 x 4 bit (Max 104 Segments)
- LCD drive output: 4 Common output, 26 Segment output
- Integrated 4ch LED driver circuit
- Support standby mode
- Integrated Power-on-Reset circuit (POR)
- Integrated Oscillator circuit
- No external component
- Low power consumption design
- Independent power supply for LCD driving

●Applications

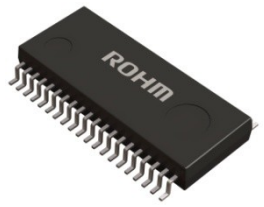
- Telephone
- FAX
- Portable equipment (POS, ECR, PDA etc.)
- DSC
- DVC
- Car audio
- Home electrical appliance
- Meter equipment

etc.

●Key Specifications

- Supply Voltage Range: +1.8V to +3.6V
- LCD drive power supply Range: +2.7V to +5.5V
- Operating Temperature Range: -40°C to +85°C
- Max Segments: 104 Segments
- Display Duty: Static, 1/3, 1/4 selectable
- Bias: Static, 1/3
- Interface: 3wire serial interface

●Package W (Typ.) x D (Typ.) x H (Max.)



SSOP-B40
13.60mm x 7.80mm x 2.00mm

●Typical Application Circuit

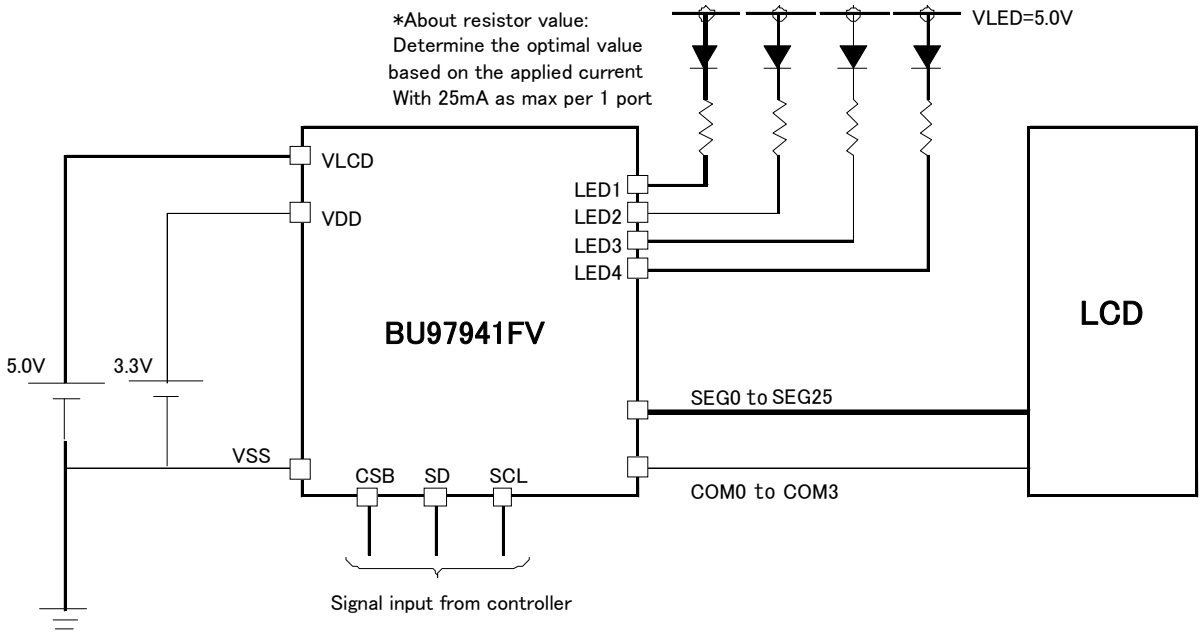


Figure 1. Typical application circuit

○Product structure : Silicon monolithic integrated circuit ○This product is not designed for protection against radioactive rays.

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●Block Diagram / Pin Configuration / Pin Description

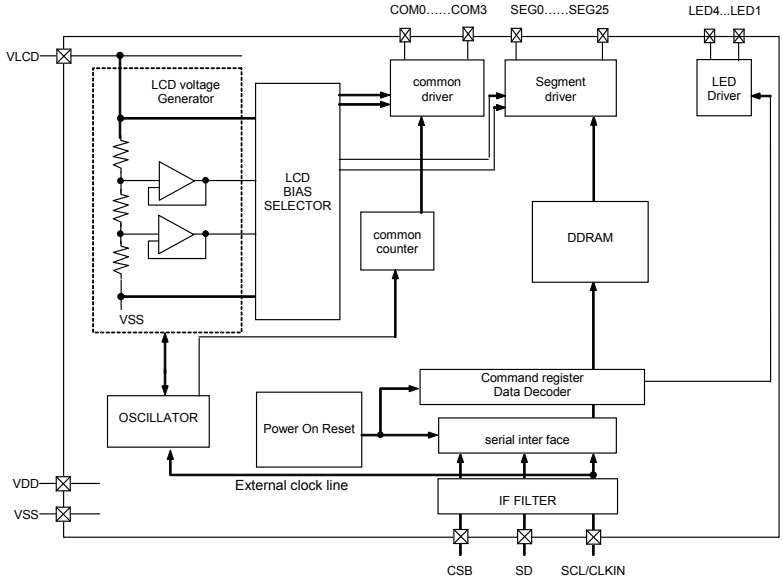


Figure 2. Block Diagram

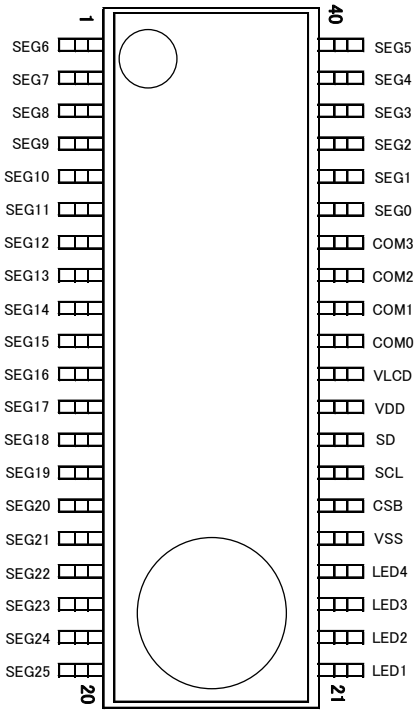


Figure 3. Pin Configuration (TOP VIEW)

Table 1 Pin Description

Pin Name	Pin No.	I/O	Setting when not in use	Function
CSB	26	I	VDD	Chip select: "L" active
SCL	27	I	VSS	Serial data transfer clock
SD	28	I	VSS	Input serial data
VDD	29	-	-	Power supply for LOGIC
VSS	25	-	-	External clock input terminal (for display/PWM using selectable) Support Hi-Z input mode at internal clock mode
VLCD	30	-	-	GND
COM0 to 3	31 to 34	O	OPEN	Power supply for LCD
SEG0 to 25	1 to 20 35 to 40	O	OPEN	COMMON output for LCD
LED1 to 4	21 to 24	O	OPEN	LED driver output

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●Absolute Maximum Ratings (VSS=0V)

Item	Symbol	Ratings	Unit	Remarks
Power supply Voltage1	VDD	-0.3 to +4.5	V	Power supply
Power supply Voltage2	VLCD	-0.5 to +7.0	V	Voltage for Liquid crystal Display
Power supply Voltage2	VLED	-0.5 to +7.0	V	Voltage for LED driving port terminal
Power Dissipation	Pd	0.8*1	W	
Input Voltage Range	VIN	-0.5 to VDD+0.5	V	
Operating Temperature Range	Topr	-40 to +85	℃	
Storage Temperature Range	Tstg	-55 to +125	℃	
Output Current	Iout1	5	mA	SEG Output
	Iout2	5	mA	COM Output
	Iout3	50	mA	LED Output (per 1 port)

*Decreases 8mW per 1℃ when using at 1 Ta=25℃ or higher. (During ROHM standard board mounting)
(Board size：74.2mm×74.2mm×1.6mm Material：FR4 Glass-epoxy board Copper foil： Land pattern only)

●Recommended Operating Ratings(Ta=-40°C to +85°C,VSS=0V)

Item	Symbol	MIN	TYP	MAX	Unit	Remarks
Power supply Voltage1	VDD	1.8	-	3.6	V	Power supply
Power supply Voltage2	VLCD	2.7	-	5.5	V	Voltage for Liquid crystal Display
Output Current	Iout1	-	-	25	mA	LED Output (per LED1 port)
	Iout2	-	-	100	mA	LED Output (LED port current total sum)

●Electrical Characteristics

DC Characteristics (Ta=-40°C to +85°C、VDD=1.8V to 3.6V、VLCD=2.7V to 5.5V、VSS=0V)

Item	Symbol	Limit Value			Unit	Condition
		MIN	TYP	MAX		
“H” level input voltage	VIH	0.8VDD	-	VDD	V	SD, SCL, CSB
“L” level input voltage	VIL	VSS	-	0.2VDD	V	SD, SCL, CSB
Hysteresis width	VH	-	0.2	-	V	SCL, VDD=3.3V、Ta=25°C
“H” level input current	IIH1	-	-	5	uA	SD,SCL, CSB, VI=3.6V
LED off leak	OFF LEAK	5	0	5	uA	LED VI=5.5V
“H” level output voltage (*2)	VOH1	VLCD -0.4	-	-	V	Iload=-50uA, VLCD=5.0V SEG0 to SEG25
	VOH2	VLCD -0.4	-	-	V	Iload=-50uA, VLCD=5.0V、COM0 to COM3
“L” level output voltage (*2)	VOL1	-	-	0.4	V	Iload= 50uA, VLCD=5.0V、SEG0 to SEG25
	VOL2	-	-	0.4	V	Iload= 50uA, VLCD=5.0V、COM0 to COM3
	VOL4	-	0.11	0.5	V	Iload=20mA、VLCD=5.0V、LED1 to 4
output voltage (*2)	VOUT1	2.73	3.33	3.93	V	Iload=+/-50uA, VLCD=5.0V, SEG0 to 25, COM0 to 3
	VOUT2	1.07	1.67	2.27	V	Iload=+/-50uA, VLCD=5.0V, SEG0 to 25, COM0 to 3
Supply current (*1)	IstVDD	-	3	10	uA	Input pin ALL ’L’, Display off, Oscillation off
	IstVLCD	-	0.5	5	uA	Input pin ALL ’L’, Display off, Oscillation off
	IVDD1	-	8	15	uA	VDD=3.3V、Ta=25°C、1/3bias、fFR=64Hz、Output open
	IVLCD1	-	10	15	uA	VLCD=5.0V、Ta=25°C、1/3bias、fFR=64Hz、Output open

＊1 During Power save mode 1、Frame inversion.

＊2 Iload：When setting the load of 1 pin only.

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●**Electrical Characteristics – continued**

Oscillation Frequency Characteristics (Ta=-40°C to +85°C、VDD=1.8V to 3.6V、VLCD=2.7V to 5.5V、VSS=0V)

Item	Symbol	Limit Value			Unit	Condition
		MIN	TYP	MAX		
Frame Frequency 1	fFR1	76.5	85	93.5	Hz	VDD=3.3V、Ta=25°C、fFR=85Hz setting
Frame Frequency 2	fFR2	68	85	97.0	Hz	VDD=2.5V to 3.6V fFR=85Hz setting
Frame Frequency 3	fFR3	59.7	-	68	Hz	VDD=1.8V to 2.5V fFR=85Hz setting

MPU Interface Characteristics (Ta=-40°C to +85°C、VDD=1.8V to 3.6V、VLCD=2.7V to 5.5V、VSS=0V)

Item	Symbol	Limit Value			Unit	Condition
		MIN	TYP	MAX		
Input Rise Time	tr	-	-	50	ns	
Input Fall Time	tf	-	-	50	ns	
SCL Cycle	tSCYC	250	-	-	ns	
“H” SCL pulse width	tSHW	50	-	-	ns	
“L” SCL pulse width	tSLW	50	-	-	ns	
SD Setup Time	tSDS	50	-	-	ns	
SD Hold Time	tSDH	50	-	-	ns	
CSB Setup Time	tCSS	50	-	-	ns	
CSB Hold Time	tCSH	50	-	-	ns	
“H” CSB pulse width	tCHW	50	-	-	ns	

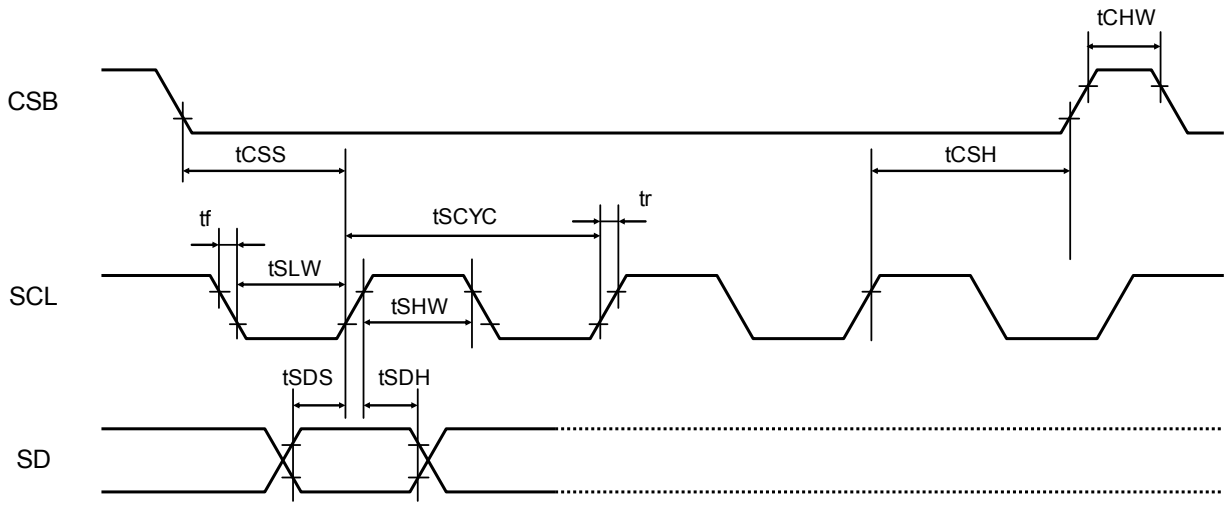


Figure 4. Serial Interface Timing

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●I/O equivalent circuit

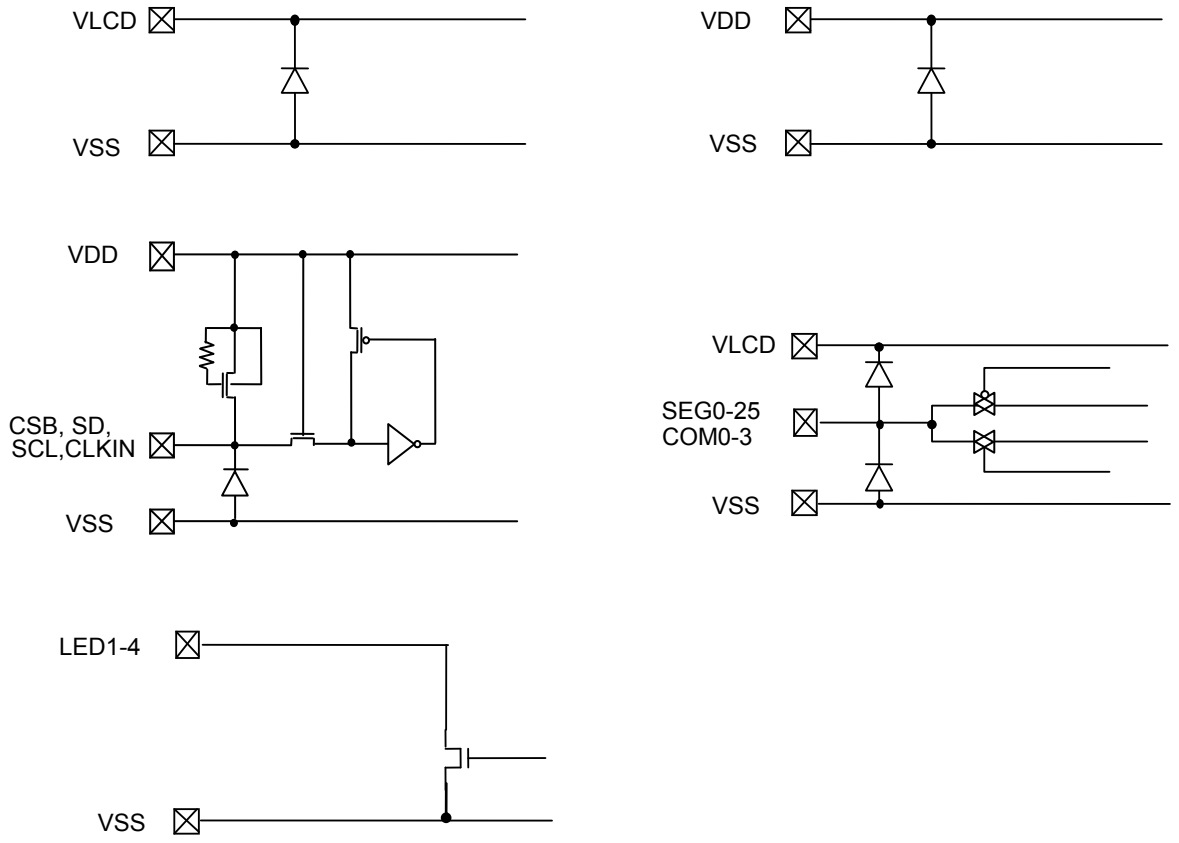


Figure 5. I/O equivalent circuit

●Example of recommended circuit

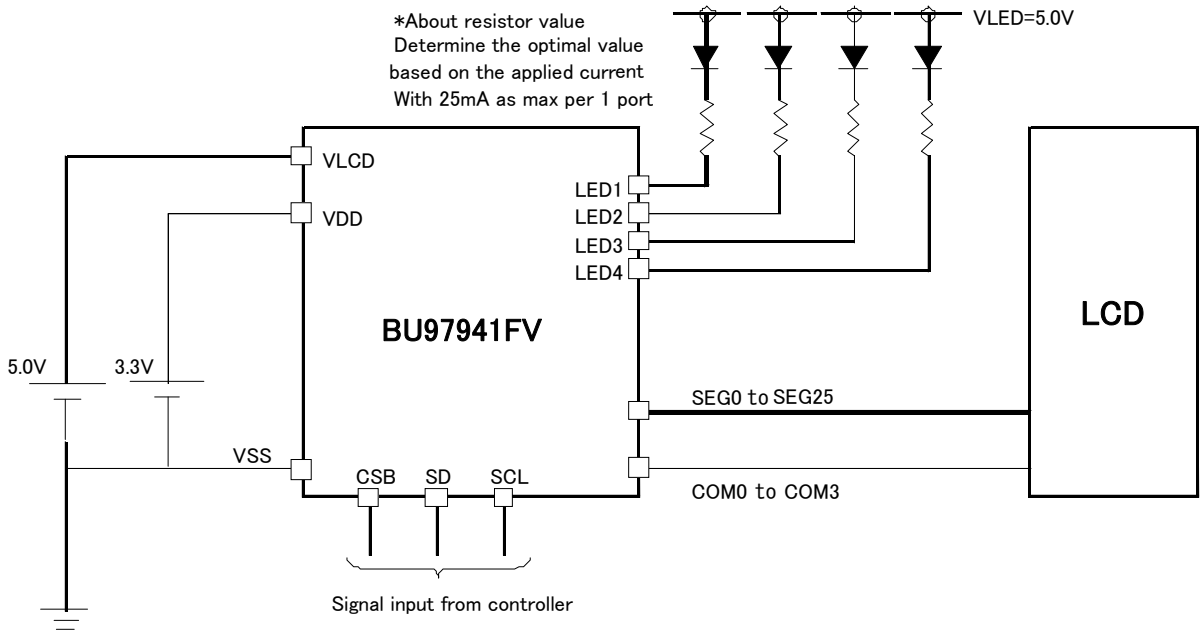


Figure 6. Recommended circuit example

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●Function Description

○Command・Data Transfer Method

○3-SPI（3-wire Serial Interface）

This device is controlled by a 3-wire signal: CSB, SCL, SD.
First, Interface Counter is initialized with CSB=”H”.
Setting CSB = “L” enables SD and SCL inputs.
Each command starts with Command or data judgment bit (D/C) as MSB data,
followed by D6 to D0 (this is while CSB=”L).
Internal data is latched at the rising edge of SCL, then the data is converted to an 8-bit parallel data at the falling edge of the 8th CLK.

When CSB changes from “L” to “H” and the data being transferred is less than 8 bits, command and data being transferred will be cancelled.
To start sending command again, please set CSB to “L”. Then, be sure to input a 1-byte command .

Also, when DDRAM data becomes input state through RAMWR command, the device cannot accept command inputs.
In order to input again, please start up CSB.
If CSB is set to ”H”, the data input state is cancelled and if ”CSB” is set to ”L” again, command will be received.

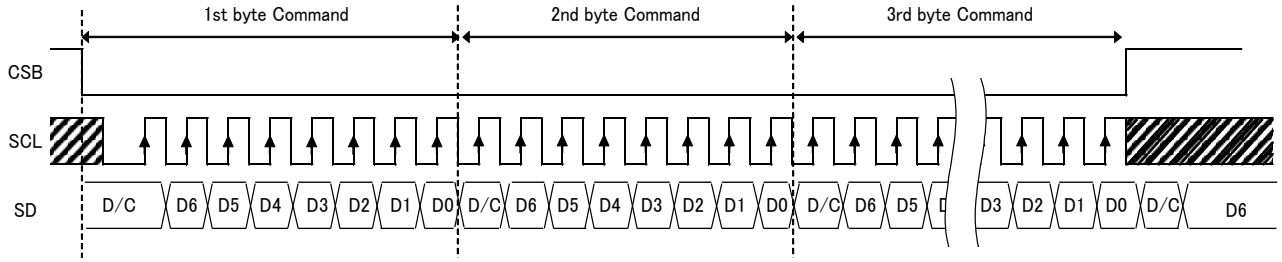
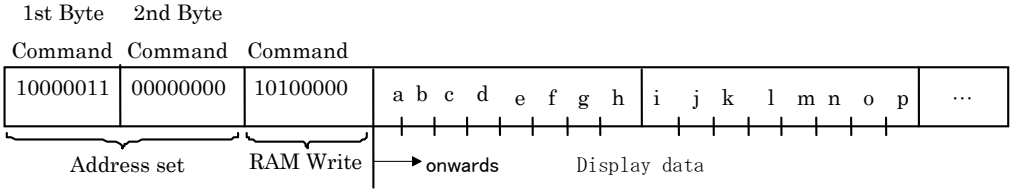


Figure 7. 3-SPI Data Transfer Format

○ Write and Transfer Method of Display Data

This device has display data ram of 26×4＝104bit.
The handling of display data with write and the handling of DDRAM data and Address and display are as follows:



Binary 8-bit data is written to DDRAM. The starting address is set with the Address set command, and is automatically incremented per 4bit data received.
Next, by transferring data, data can be written continuously to DDRAM.
(When continuously writing data to DDRAM, after writing to the final address 19h（SEG25）, address will return to 00h (SEG0) through auto increment.)

DDRAM address

BIT	00	01	02	03	04	05	06	07	・・・	17h	18h	19h	
0	a	e	i	m									COM0
1	b	f	j	n									COM1
2	c	g	k	o									COM2
3	d	h	l	p									COM3
	SEG 0	SEG 1	SEG 2	SEG 3	SEG 4	SEG 5	SEG 6	SEG 7		SEG 23	SEG 24	SEG 25	

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Writing to RAM is done per 4bit. When CSB is set to 'H' and the data is less than 4 bits, the writing of RAM will be cancelled. （Transfer of command is done per 8bit.）

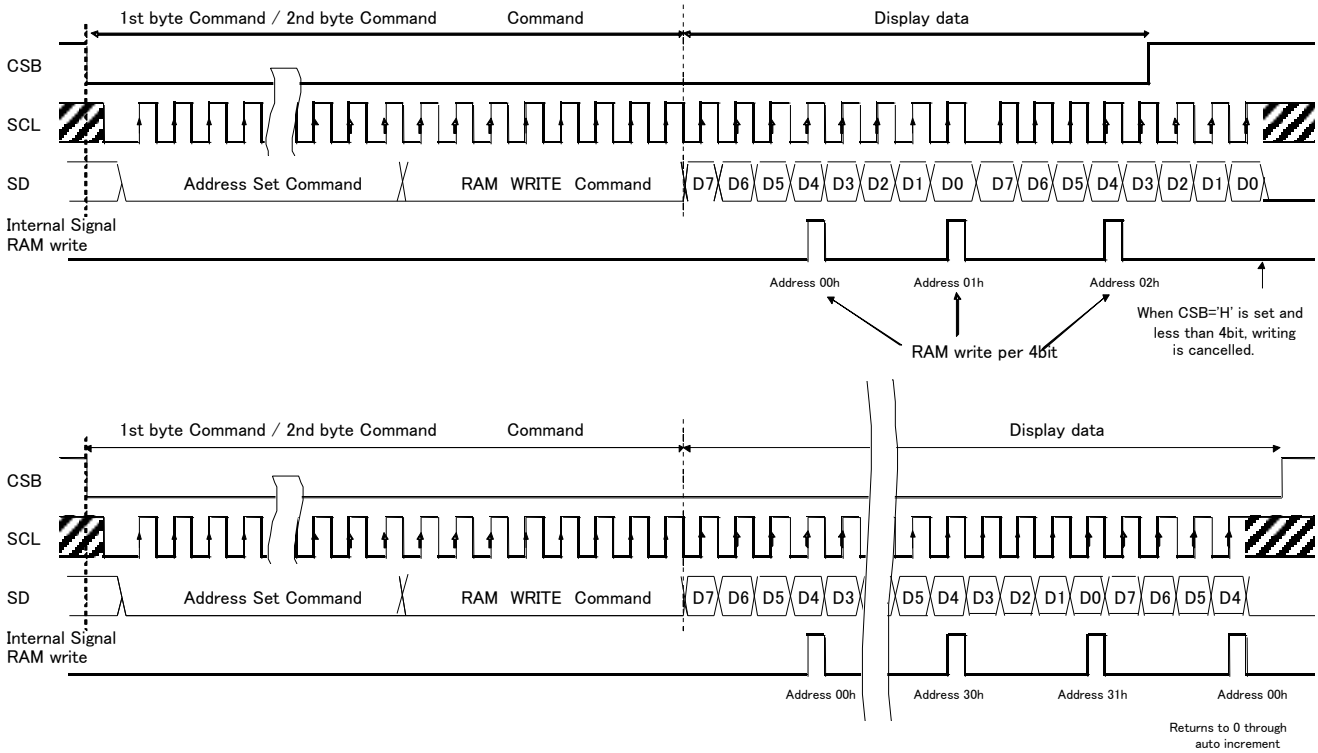


Figure 8. Display Data Transfer Method

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○LCD Driver Bias / Duty Circuit

Voltage is generated for LCD driver.
Buffer amplifier is integrated with low power consumption possible.
＊Line and frame inversion can be set by MODESET command.
＊1/4duty, 1/3duty, and static duty can be set by DISCTL command.
For each liquid crystal display waveform, see ”Liquid crystal Display Waveform”.

○Reset Initial State

The default condition after executing Software Reset is as follows:
・ Display is turned OFF.
・ Each command register enters Reset state.
・ DDRAM address is initialized.
(DDRAM data is not initialized. Therefore, it is recommended to write initial values to all DDRAM before Display on.）

●Command / Function Table

Function Description Table

NO	Command	Function
1	Mode Set (MODESET)	Liquid crystal Display setting
2	Display control (DISCTL)	LCD setting1
3	Address set (ADSET)	LCD setting2
4	LED control (LEDCTL)	LED board ON/OFF setting
5	RAM WRITE (RAMWR)	RAM Write Start setting
6	All Pixel ON (APON)	All display ON
7	All Pixel OFF (APOFF)	All display OFF
8	All Pixel On/Off mode off (NORON)	Normal display APON/APOFF setting release）
9	Software Reset (SWRST)	Software reset

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●Command Description

D/C (MSB) is a bit for command or data judgment.
For details, see 3-wire Serial Interface Command, Data Transfer Method.

○Mode Set Command (MODESET)

	MSB							LSB		
	D/C	D6	D5	D4	D3	D2	D1	D0	Hex	Reset
1st byte Command	1	0	0	0	0	0	0	1	81h	-
2nd byte Command	0	0	0	0	P3	P2	P1	P0	-	00h

Display setting

Setting	P3	Reset state
Display OFF	0	○
Display ON	1	

Display OFF : Oscillation circuit operation OFF, Liquid crystal power supply circuit operation OFF with frame cycle. Display OFF state (Output : VSS level)
Display ON : Oscillation circuit operation ON, Liquid crystal power supply circuit ON. Read operation from DDRAM starts. Display ON state with frame cycle.

∗ LED board is not affected by the ON/OFF state of Display.
The output state of LED port is determined by the setting of the LEDCTL command.

Liquid crystal Drive Waveform Setting

Setting	P2	Reset state
Frame inversion	0	○
Line inversion	1	

Power save mode (Low current consumption mode) setting

Setting	P1	P0	Reset state
Power save mode1	0	0	○
Power save mode2	0	1	
Normal mode	1	0	
High power mode	1	1	

∗ Use high power mode at VLCD＞3V or higher.

(Reference Current Consumption Data)

Setting	Current Consumption
Power save mode 1	×1.0
Power save mode 2	×1.7
Normal mode	×2.7
High power mode	×5.0

∗ The current consumption data above is reference data and changes according to panel load.

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○Display control command (DISCTL)

	MSB							LSB		
	D/C	D6	D5	D4	D3	D2	D1	D0	Hex	Reset
1st byte Command	1	0	0	0	0	0	1	0	82h	-
2nd byte Command	0	0	0	0	P3	P2	P1	P0	-	02h

Duty setting

Setting	P3	P2	Reset state
1/4duty (1/3bias)	0	0	○
1/3duty (1/3bias)	0	1	
Static (1/1bias)	1	*	

(*: Don't care)

At 1/3duty, the display / blink data for COM3 are invalid.
(COM3: same waveform with COM1)
At 1/1duty (Static), the display / blink data for COM1 to 3 are invalid.
(COM1 to 3: same waveform with COM0)

Be careful in sending display data.
For sample output waveform of SEG/COM with duty setting, see "Liquid crystal Display Waveform".

Frame Frequency Setting

Setting (When 1/4,1/3,1/1duty)	P1	P0	Reset state
(128Hz, 130Hz, 128Hz)	0	0	
(85Hz, 86hz, 64Hz)	0	1	○
(64Hz, 65Hz, 48Hz)	1	0	
(51Hz, 52Hz, 32Hz)	1	1	

The relationship with frame frequency (FR), internal osc frequency and dividing number is below:

DISCTL (P1,P0)	Divide			FR [Hz]		
	1/4duty	1/3duty	1/1duty	1/4duty	1/3duty	1/1duty
(0,0)	160	156	160	128	131.3	128
(0,1)	240	237	320	85.3	86.4	64
(1,0)	320	315	428	64	65	47.9
(1,1)	400	393	640	51.2	52.1	32

When calculating the OSC frequency from the measurement value of frame frequency, use the following equation:

" OSC frequency = Frame Frequency (Measurement value) × Dividing number"

Dividing number : Using the values of Frame Frequency setting (P1,P0) and duty setting(P3,P2), determine the values from the table above.

Ex) (P1,P0) = (0,1) 、(P3,P2) = (0,1) ⇒ Dividing number= 237

＊1 : The value of FR in the table above is the Frame Frequency calcuated as OSC Frequency = 20.48KHz (typ).

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○Address set command (ADSET)

	MSB							LSB		
MSB	D/C	D6	D5	D4	D3	D2	D1	D0	Hex	Reset
1st byte Command	1	0	0	0	0	0	1	1	83h	-
2nd byte Command	0	0	0	P4	P3	P2	P1	P0	-	00h

Sets the starting RAM address for normal display.
Address can be set from 00h to 1Bh.
Setting is prohibited for addresses not written above.
Address during Reset is 00h.
When writing to RAM, a separate RAM WRITE setting is needed.

○LED control command (LEDCTL)

	MSB							LSB		
MSB	D/C	D6	D5	D4	D3	D2	D1	D0	Hex	Reset
1st byte Command	1	0	0	0	0	1	0	1	85h	-
2nd byte Command	0	0	0	0	P3	P2	P1	P0	-	00h

Sets the driver of the LED port. Setting during Reset is 00h.
The relationship between each parameter and the Drive board is as follows:

	LED1 P0	LED2 P1	LED3 P2	LED4 P3
LED ON	1	1	1	1
LED OFF	0	0	0	0

＊ Please input CSB="H" after LEDCTL command is issued.
To avoid noise and reset interface.

○RAM WRITE command (RAMWR)

	MSB							LSB		
	D/C	D6	D5	D4	D3	D2	D1	D0	Hex	Reset
1st byte Command	1	0	1	0	0	0	0	0	A0h	-
2nd byte Command	Display data									Random
	・・・・									
n byte Command	Display data									Random

The input data after command setting is the data input for display.
Be sure to send this command after setting the ADSET command.
The display data is transferred per 4bit. (For details, see “Write and Transfer Method of Display Data.”)

○All Pixel ON command (APON)

	MSB							LSB		
	D/C	D6	D5	D4	D3	D2	D1	D0	Hex	Reset
1st byte Command	1	0	0	1	0	0	0	1	91h	-

Regardless of the contents of DDRAM, the SEG output will enter all light up mode. (Pin that selects SEG output)

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○All Pixel OFF command (APOFF)

	MSB							LSB		
	D/C	D6	D5	D4	D3	D2	D1	D0	Hex	Reset
1st byte Command	1	0	0	1	0	0	0	0	90h	-

Regardless of the contents of DDRAM, the SEG output will enter all light up mode. (Pin that selects SEG output)

○All Pixel ON/OFF mode off (NORON)

	MSB							LSB		
	D/C	D6	D5	D4	D3	D2	D1	D0	Hex	Reset
1st byte Command	1	0	0	1	0	0	1	1	93h	-

APON / OFF mode is cancelled and switches to normal display mode. (Pin that selects SEG output)
After reset, NORON is set and becomes normal display state.

○Software Reset command (SWRST)

	MSB							LSB		
	D/C	D6	D5	D4	D3	D2	D1	D0	Hex	Reset
1st byte Command	1	0	0	1	0	0	1	0	92h	-

Resets software. This IC is in reset state.

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●Liquid crystal Drive Waveform

1/4Duty

Line inversion

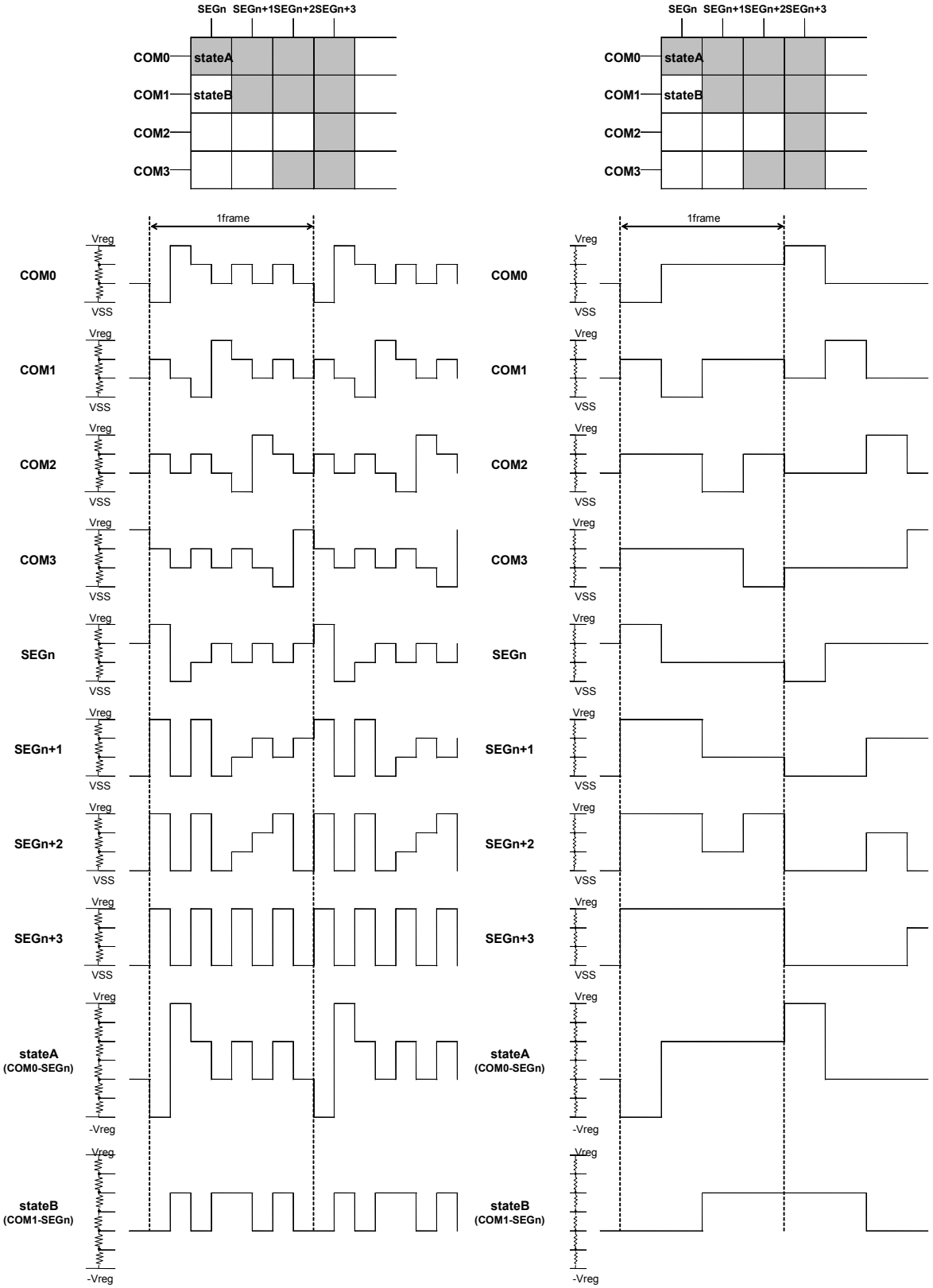


Figure 9. LCD Drive Waveform during Line inversion

Frame inversion

Figure 10.LCD Drive Waveform during Frame inversion

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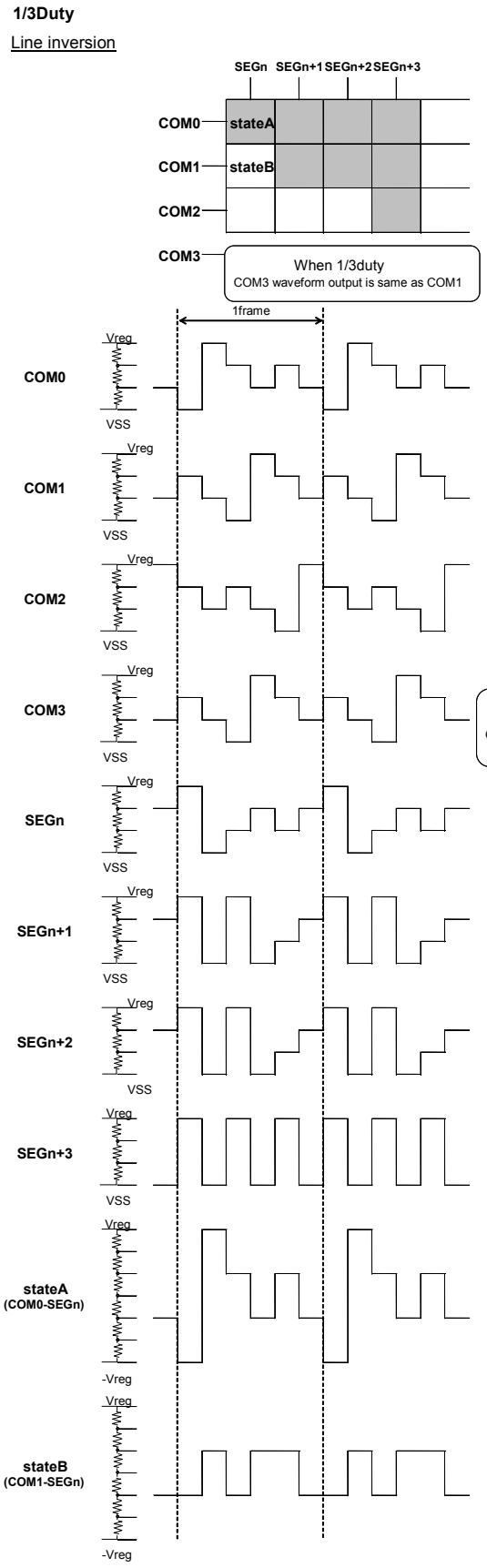


Figure 11. LCD Drive Waveform during Line inversion

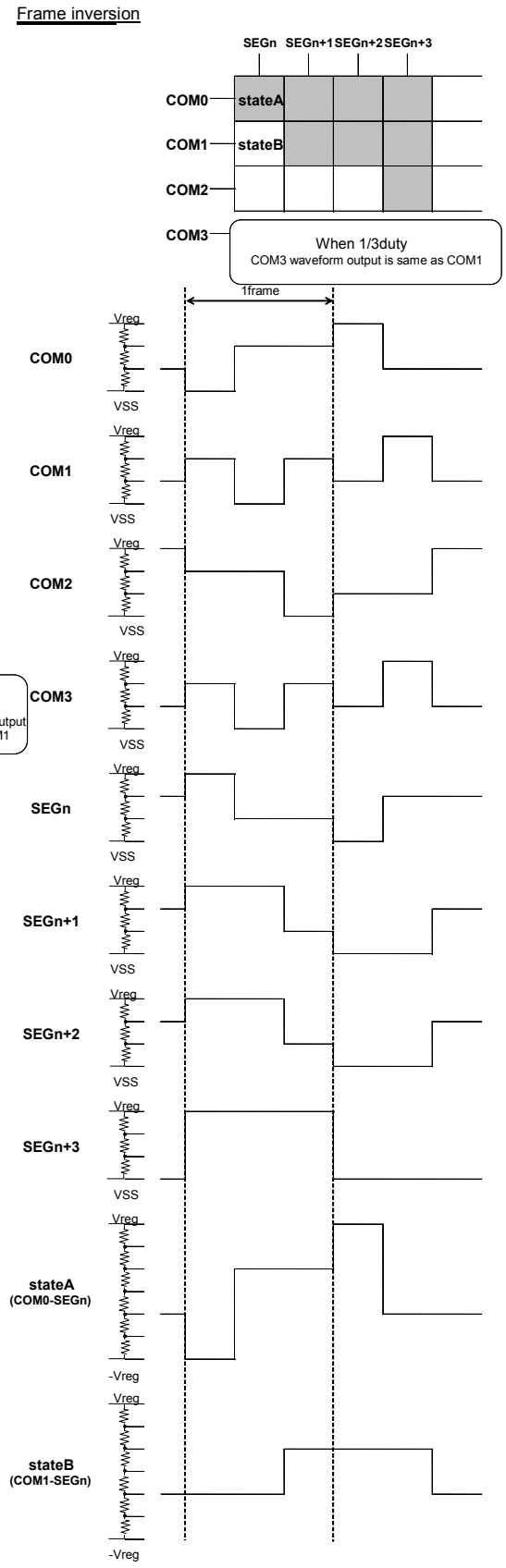


Figure 12. LCD Drive Waveform during Frame inversion

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1/1Duty (Static)

Line inversion

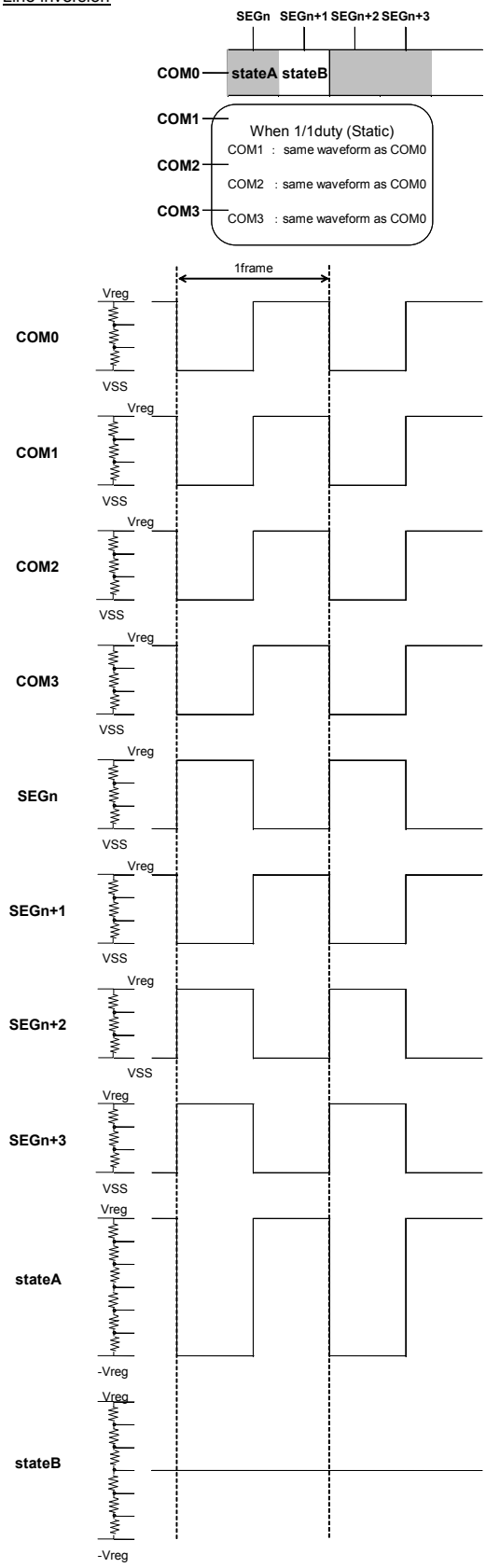


Figure 13.LCD Drive Waveform during Line inversion

Frame inversion

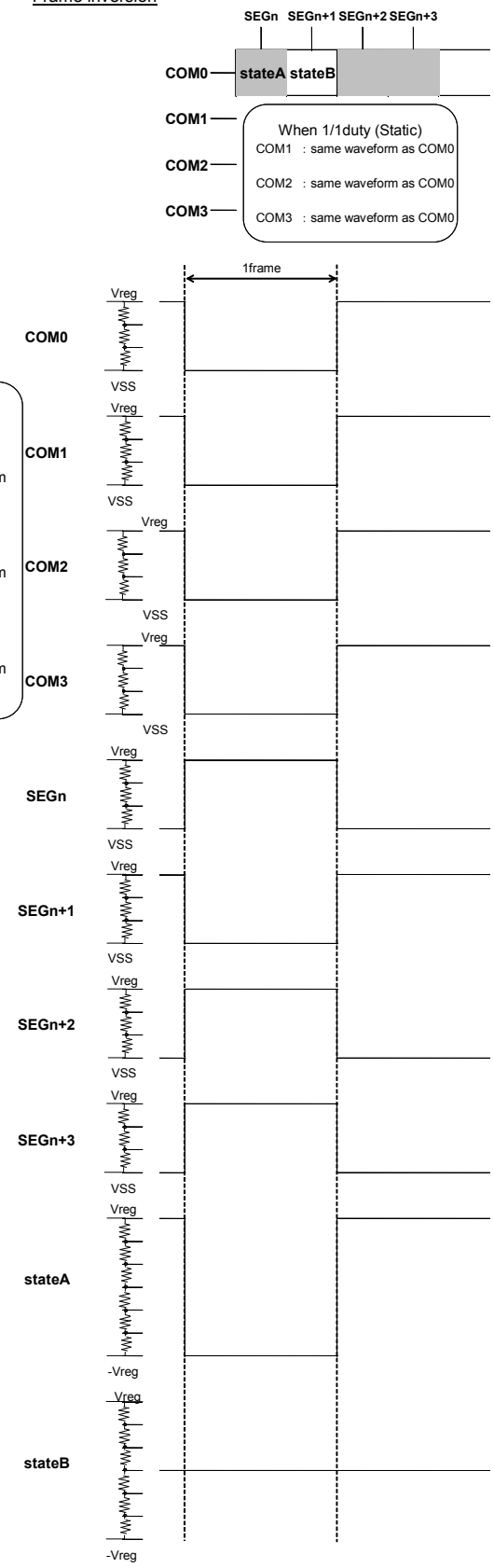


Figure 14. LCD Drive Waveform during Frame inversion

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●Initialization Sequence

Execute the following sequence after power supply and start display after the IC has initialized.

Power supply
↓
CSB ‘H’ …Initialize I/F
↓
CSB ‘L’ …Start I/F Data Transfer
↓
Execute Software Reset from SWRST command
↓
MODESET (Display off)
↓
Various command setting
↓
RAM WRITE
↓
MODESET (Display on)
↓
Start display

∗ After inserting power supply, each register value, DDRAM address and DDRAM data are random prior to initialization.

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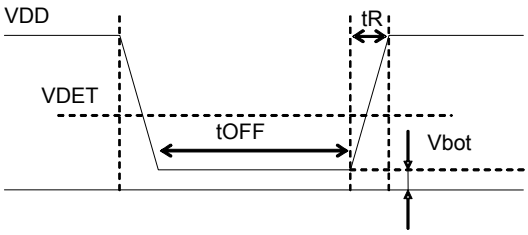
●Caution during Power supply ON/OFF

○POR circuit

During power supply rise, because the IC internal circuit and reset pass through an area of unstable low voltage and VDD starts up, there is a risk that the inside of the IC is not completely reset and wrong operation might occur. In order to prevent this, P.O.R circuit and Software Reset functions are incorporated. In order to ensure that operation, do as follows during power supply rise:

1. Set power up conditions to meet the recommended tR, tOFF and Vbot specs below in order to ensure POR operation.
（POR circuit uses VDET type）

(＊The voltage detection of POR differs depending on the used environment etc.
In order to to assure the operation of POR, it is recommended to make Vbot = 0.5V or lower.)



Recommended conditions of tR, tOFF, Vbot

tR	tOFF	Vbot	VDET
10ms or lower	1ms or higher	0.5V or lower	TYP 1.2V

* VDET is integrated POR detection level

Figure 15. Rise Waveform

2. When the conditions are not met, do the following countermeasures after power supply ON:

(1) Set CSB to 'H'.
(2) Turn ON the CSB and execute SWRST command.

In order for the SWRST command to take effect for sure, it is recommended to start up CSB after 1ms after the VDD level has reached 90%.

※Since the state is irregular until SWRST command input after power supply ON, countermeasure through Software Reset is not the perfect substitute for P.O.R function so it is important to be careful.

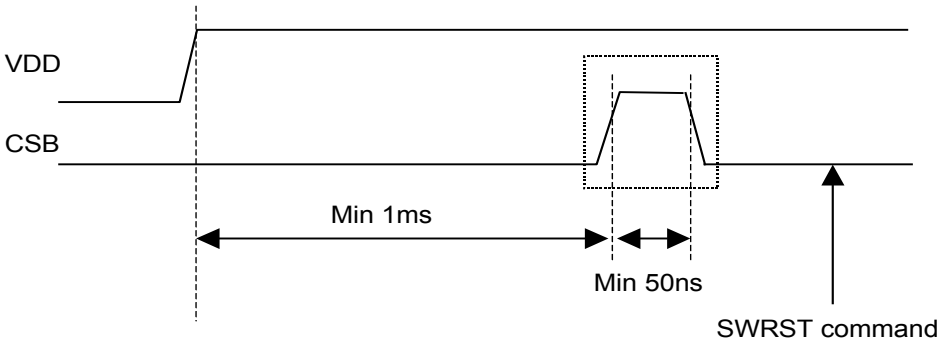


Figure 16. SWRST command sequence

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●Power ON / OFF Sequence

To prevent incorrect display, malfunction and abnormal current,
VDD must be turned on before VLCD In power up sequence.
VDD must be turned off after VLCD In power down sequence.
Please satisfies VLCD≥VDD, t1>0ns, t2>0ns

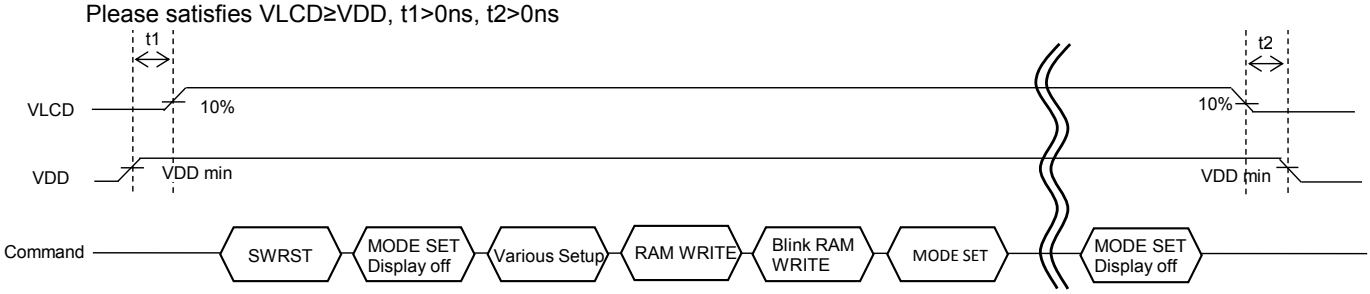


Figure 17. Power On/Off Sequence

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●**Attention about using LEDCTL(85h) command**

Please input CSB="H" after LEDCTL command is issued. To avoid noise and reset interface.

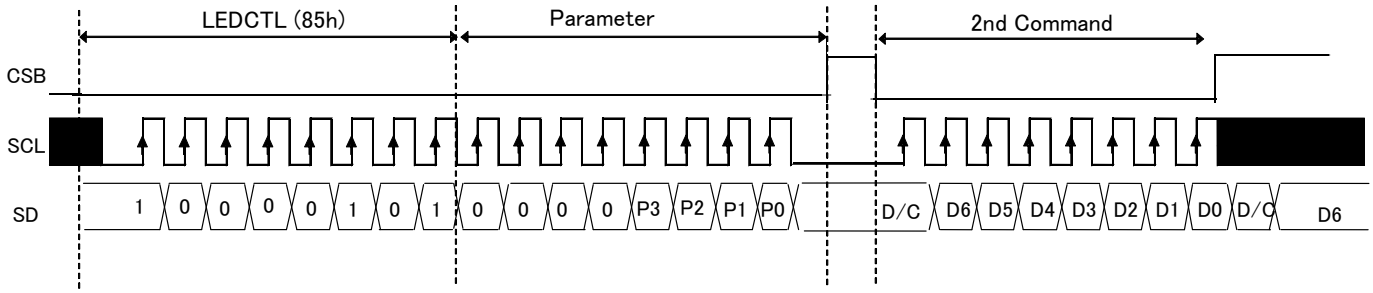


Figure 18. Recommended sequence when using LEDCTL (85h) command

●**Attention about input port pull down**

Satisfy the following sequence if input terminals are pulled down by external resistors (In case MPU output Hi-Z).

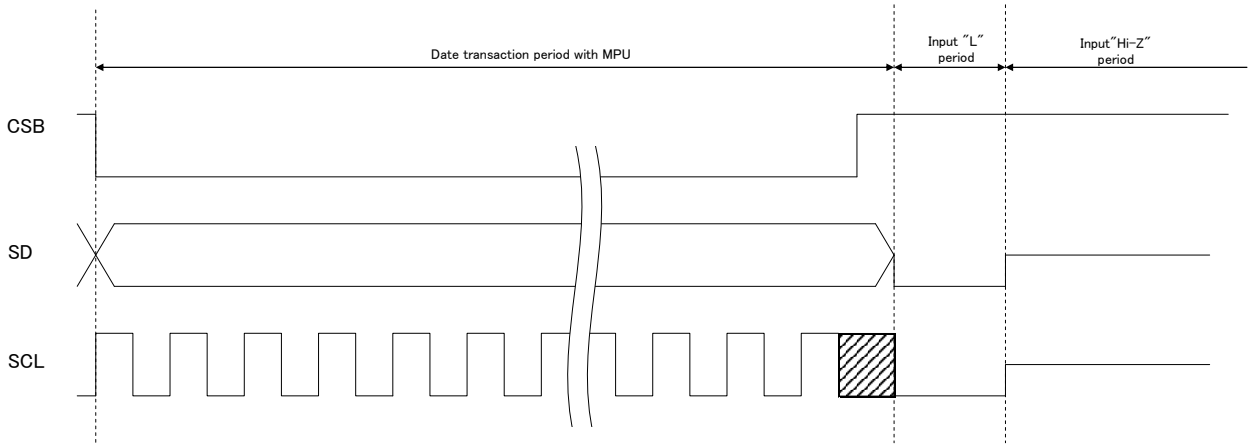


Figure 19. Recommended sequence when input ports are pulled down

BU97941FV adopts a 5V tolerant I/O for the digital input. This circuit includes a bus-hold function to keep the level of HIGH.
A pull down resistor of below 10KΩshall be connected to the input terminals to transit from HIGH to LOW because the bus-hold transistor turns on during the input's HIGH level. (Refer to the Figure 5. I/O Equivalent Circuit)
A higher resistor than 10KΩ (approximate) causes input terminals being steady by intermediate potential between HIGH and LOW level so unexpected current is consumed by the system.
The potential depends on the pull down resistance and bus-hold transistor's resistance.
As the bus-hold transistor turns off upon the input level cleared to LOW a higher resistor can be used as a pull down resistor if an MPU sets SD and SCL lines to LOW before it releases the lines.

The LOW period preceding the MPU's bus release shall be at least 50ns as same as a minimum CLK width (tSLW).

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●Operational Notes

(1) Absolute maximum ratings
Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.

(2) Recommended operating conditions
These conditions represent a range within which the expected characteristics of the IC can be approximately obtained. The electrical characteristics are guaranteed under the conditions of each parameter.

(3) Reverse connection of power supply
Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply terminals.

(4) Power supply lines
Design the PCB layout pattern to provide low impedance ground and supply lines. Separate the ground and supply lines of the digital and analog blocks to prevent noise in the ground and supply lines of the digital block from affecting the analog block. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

(5) Ground Voltage
The voltage of the ground pin must be the lowest voltage of all pins of the IC at all operating conditions. Ensure that no pins are at a voltage below the ground pin at any time, even during transient condition.

(6) Short between pins and mounting errors
Be careful when mounting the IC on printed circuit boards. The IC may be damaged if it is mounted in a wrong orientation or if pins are shorted together. Short circuit may be caused by conductive particles caught between the pins.

(7) Operation under strong electromagnetic field
Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

(8) Testing on application boards
When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

(9) Regarding input pins of the IC
In the construction of this IC, P-N junctions are inevitably formed creating parasitic diodes or transistors. The operation of these parasitic elements can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions which cause these parasitic elements to operate, such as applying a voltage to an input pin lower than the GND voltage should be avoided. Furthermore, do not apply a voltage to the input terminals when no power supply voltage is applied to the IC. Even if the power supply voltage is applied, make sure that the input terminals have voltages within the values specified in the electrical characteristics of this IC.

(10) GND wiring pattern
When using both small-signal and large-current GND traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the GND traces of external components do not cause variations on the GND voltage. The power supply and ground lines must be as short and thick as possible to reduce line impedance.

(11) External Capacitor
When using a ceramic capacitor, determine the dielectric constant considering the change of capacitance with temperature and the decrease in nominal capacitance due to DC bias and others.

(12) Unused input terminals
Input terminals of an IC are often connected to the gate of a CMOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of IC. So unless otherwise specified, input terminals not being used should be connected to the power supply or ground line.

(13) Rush current
When power is first supplied to the IC, rush current may flow instantaneously. It is possible that the charge current to the parasitic capacitance of internal photo diode or the internal logic may be unstable. Therefore, give special consideration to power coupling capacitance, power wiring, width of GND wiring, and routing of connections.

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●Ordering Information

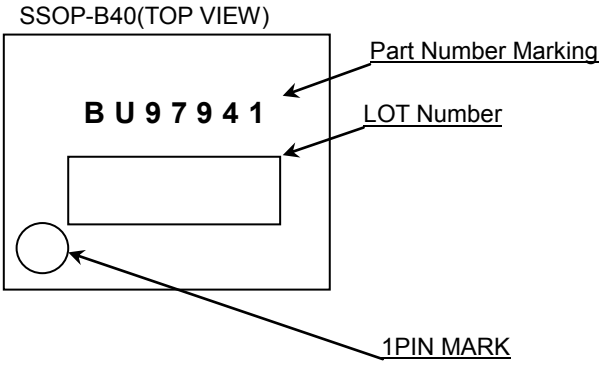
B U 9 7 9 4 1 F V - E 2

Part Number

Package
FV : SSOP-B40

Packaging and forming specification
E2: Embossed tape and reel
(SSOP-B40)

●Marking Diagram

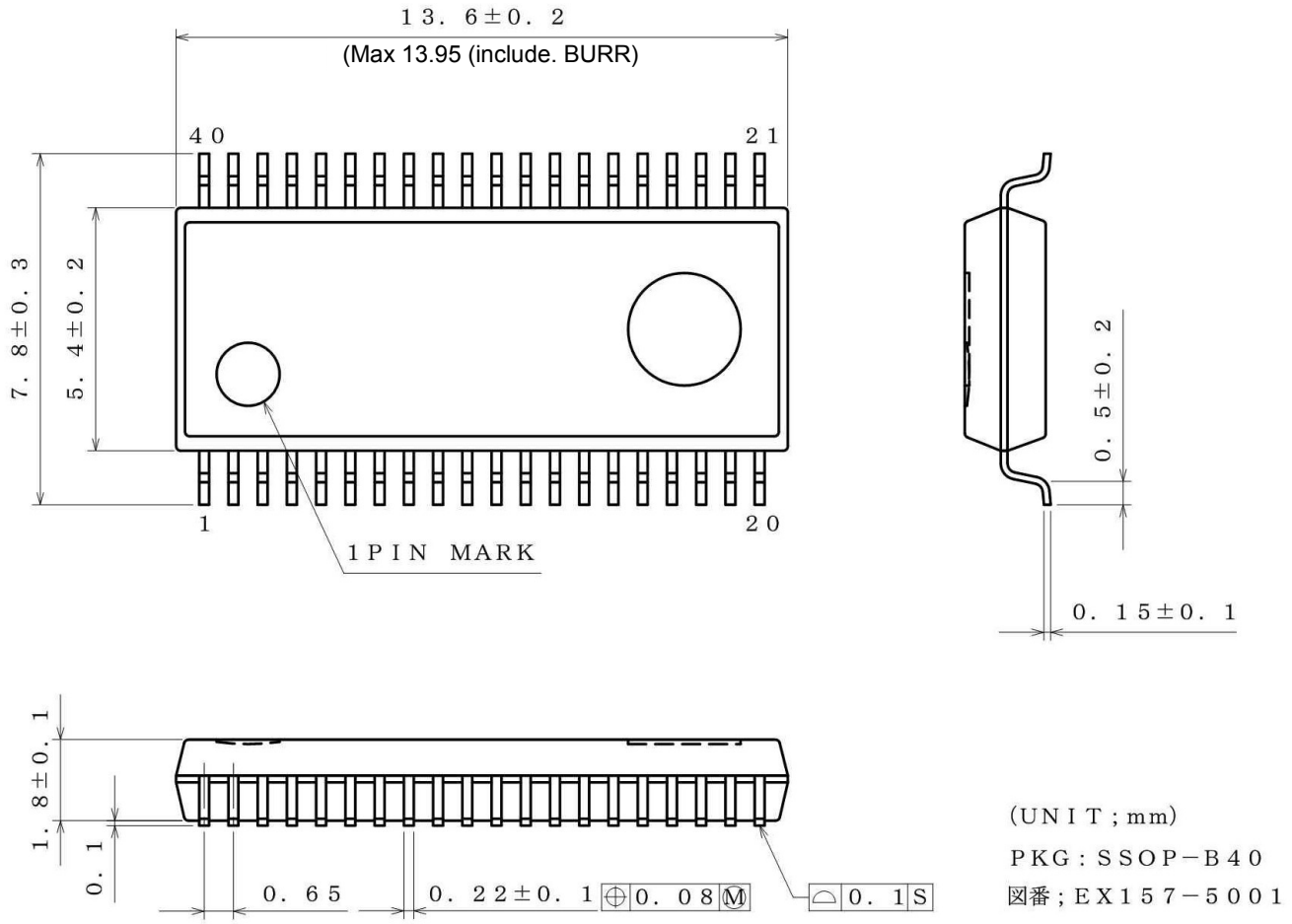


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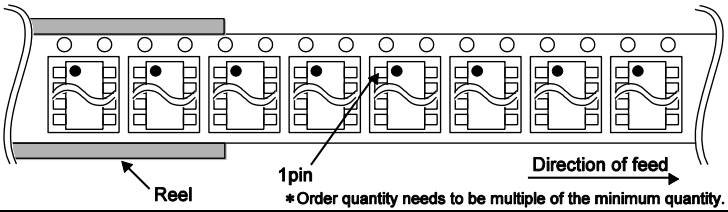
●**Physical Dimension, Tape and Reel Information**

Package Name	SSOP-B40



<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2000pcs
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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●**Revision History**

Date	Revision	Changes
14.Mar.2012	001	New Release
8.Jan.2013	002	Improved the statement in all pages. Deleted “Status of this document” in page 20. Changed format of Physical Dimension, Tape and Reel Information
26.Jan.2015	003	Add the condition when power supply in page 18.
10.Apr.2015	004	Modified figure of Power On/Off Sequence in page 18.

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(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

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   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

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   [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 on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

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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.

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

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