PRODUCT SPECIFICATIONS

ISO 9001:2000 FM86067

BONA Display Specialist

BT8027SRTUA

Product

Standard LCD Module
320 x RGB x 240 Dots graphic type
3.5” TFT LCD
COG bonding type
Wide temperature
With white LED back light

Version	Prepared / dd-mm-yy	Approved / dd-mm-yy
A	HB.Wan 07-09-2007	Zhanghong 10-09-07

Table of Contents

1. Revision History

Version	Summary	Date dd-mm-yy
A	Original	07-09-2007

2. MODULE CLASSIFICATION INFORMATION

BT□□□□□ - □ □ - □ □ - □
(a) (b) (c) (d) (e) (f) (g) (h)

(a) BT**:** Company Name Abbreviation

(b) Product Type
T—TFT（NUL）
C—CSTN
S—STN
O—OTHER

(c) Product Serial Number

(d) Number of Columns
A-16 B-32 C-64 D-67 E-80 F-96 G-100 H-102
I-112 J-120 K-128 L-130 M-132 N-160 O-176
P-220 Q-234 R-240 S-320 T-480 U-640 V-960
W-272

(e) Number of Rows
A-16 B-32 C-64 D-67 E-80 F-96 G-100 H-102
I-112 J-120 K-128 L-130 M-132 N-160 O-176
P-220 Q-234 R-240 S-320 T-480 U-640 V-960
W-272

(f) Display Mode
T:Transmissive R:Reflective F:Transflective C:Oled Color
M:Oled Mono

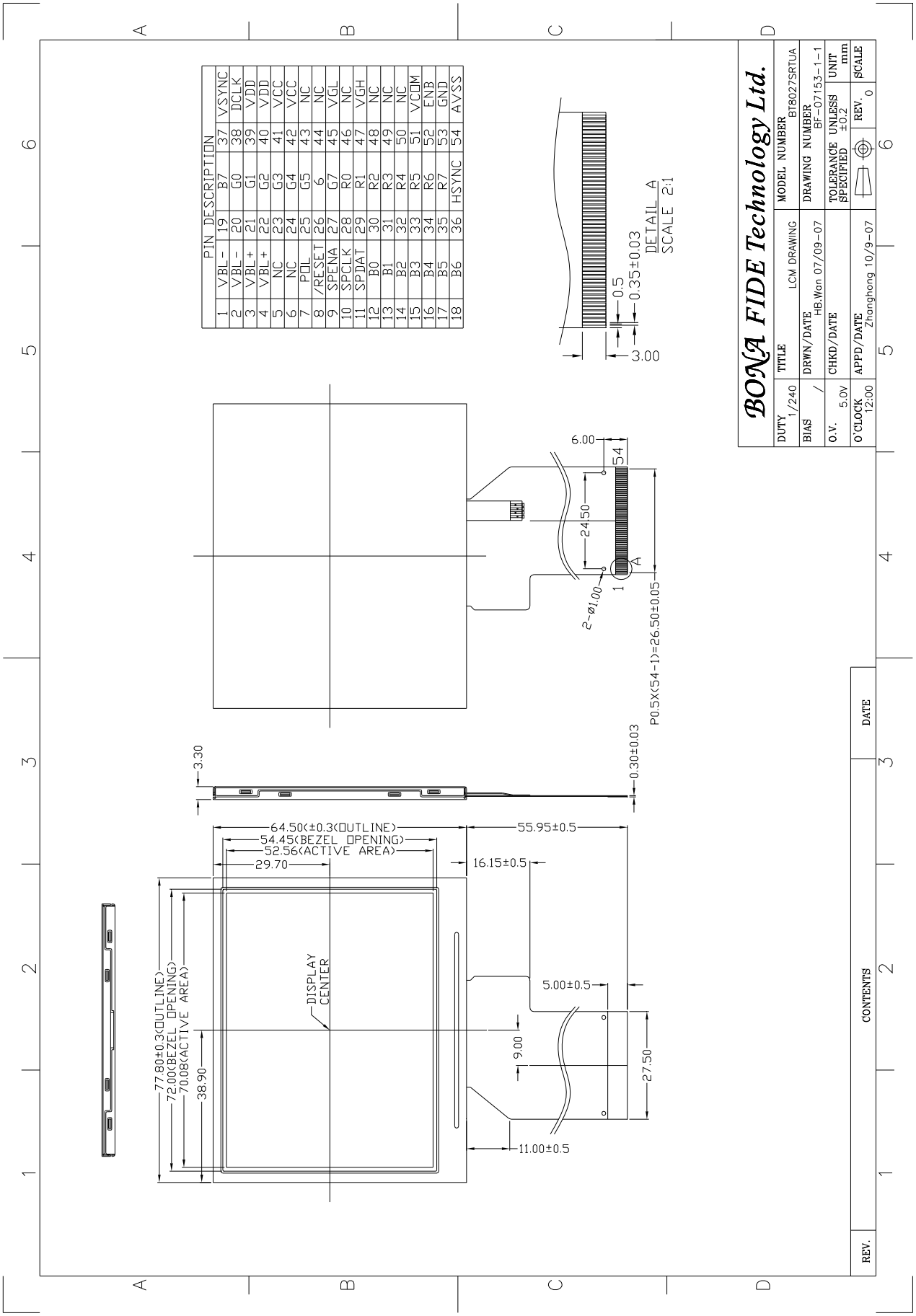
(g) Optimal View Direction
D---6 O'CLOCK
U—12 O'CLOCK
L—9 O'CLOCK
R—3 O'CLOCK
O—Other

(h) Product Version: From A to Z

3. PHYSICAL DATA

Item	Contents	Unit
LCD type	3.5 inch TFT	---
Polarizer mode	Transmissive	---
Viewing direction	12:00	O'clock
Module size (W×H×T)	77.8 x 64.5 x 3.04	mm
Active area (W×H)	70.8 x64.5	mm
Number of dots	320 (W) x RGB x 240 (H)	Dots
Operation temperature	-20 ~70	℃
Storage temperature	-30 ~80	℃
Back light type/Color	LED back light/ White	---

4. OUTLINE DIMENSIONS



5. ABSOLUTE MAXIMUM RATINGS (Ta=25℃)

Parameter	Symbol	Min.	Max.	Unit	Note
Supply voltage range	VDD	-0.3	+5.5	V	
LCD Power supply voltage range	Vgh-Vgl	-	+40.0	V	
Input voltage range	Vin	-0.3	VDD+0.3	V	

Note : The module may be destroyed if they are used beyond the absolute maximum ratings.
All voltages value are reference to GND=0V

6. ELECTRICAL CHARACTERISTICS

(At Ta = 25 °C, VDD = 5V, GND=0V)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage (logic)	VCC-GND			5.0		V
TFT gate ON voltage	VGH (Note 2)	At Ta=25°C±5°C (Note 4)	-	15	-	V
TFT gate OFF voltage	VGL (Note 3)		-	-10	-	V
Input signal voltage	V_{IH}	"H" Level VCC=IOVCC	0.8IOVCC	-	IOVCC	V
	V_{IL}	"H" Level VCC=IOVCC	-0.3	-	0.2IOVCC	V
Supply current (Logic&LCD)	ICC	VCC=5V	-	-	5.0	mA
Color coordinate X	Forward current=20mA		0.27		0.32	nm
Color coordinate Y	Forward current=20mA		0.27		0.32	nm
Supply voltage of white LED backlight	VLED=V_{AK}	Forward current =20mA Number of LED dies=6		255	-	cd/m^2
Luminance (on the backlight surface)						

Note (1): There is tolerance in optimum LCD driving voltage during production and it will be within the specified range.
Note (2): VGH is TFT Gate operating voltage.
Note (3): VGL is TFT Gate operating voltage.
The low voltage level VGL signal must be fluctuates with same phase as Vcom in case of (Storage on Gate)structure.
Note (4): Vcom must be adjusted to optimize display quality.

7. TIMING CHART

7-1 Reset timing

At Ta =-20 °C To +70 °C, VDD = 5.0V, GND=0V.

Table 6

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Reset low pulse width	RSTB	T_{RW}		1000	-	ns
Reset time	-	t_R		-	1000	ns

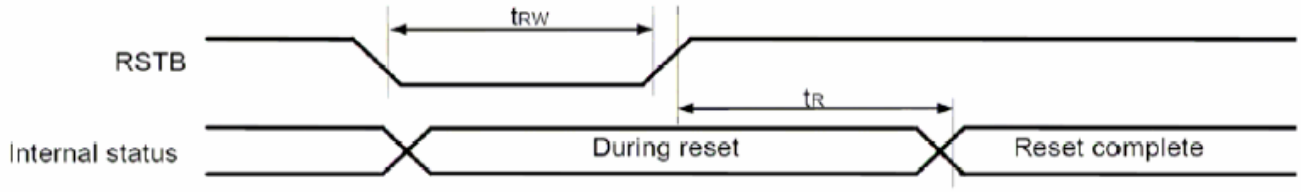
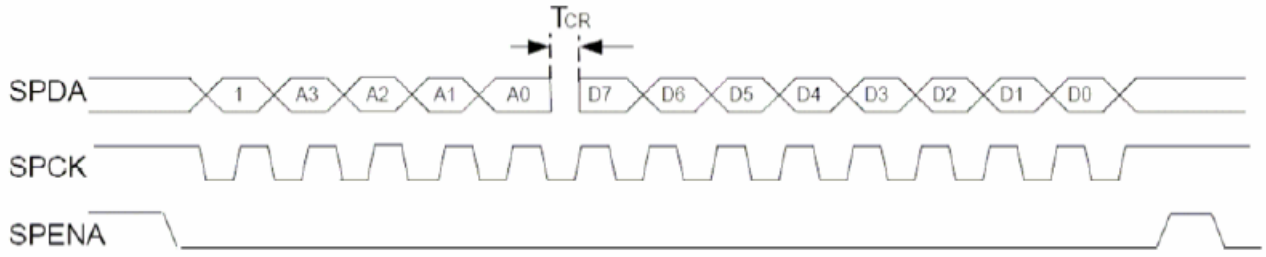


Figure 3:Reset Timing

7-2 SPI timing

7-2-1 SPI read timing

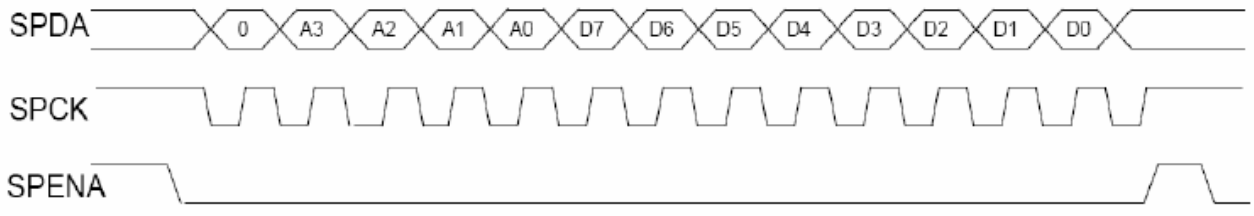


(1) Make a clock (2 MHZ) for SPCK.

(2) Set SPENA low to let the SPI valid.

(3) Send "1" in the MSB to show reading the SPI and the address 4-bits (A3 : MSB, A0 : LSB) in the rising edge of the SPCK then wait a half of the SPCK to read the data(D7 : MSB, D0 : LSB) in the falling edge of the SPCK.

7-2-2 SPI writer timing



(1) Make a clock (2 MHZ) for SPCK.

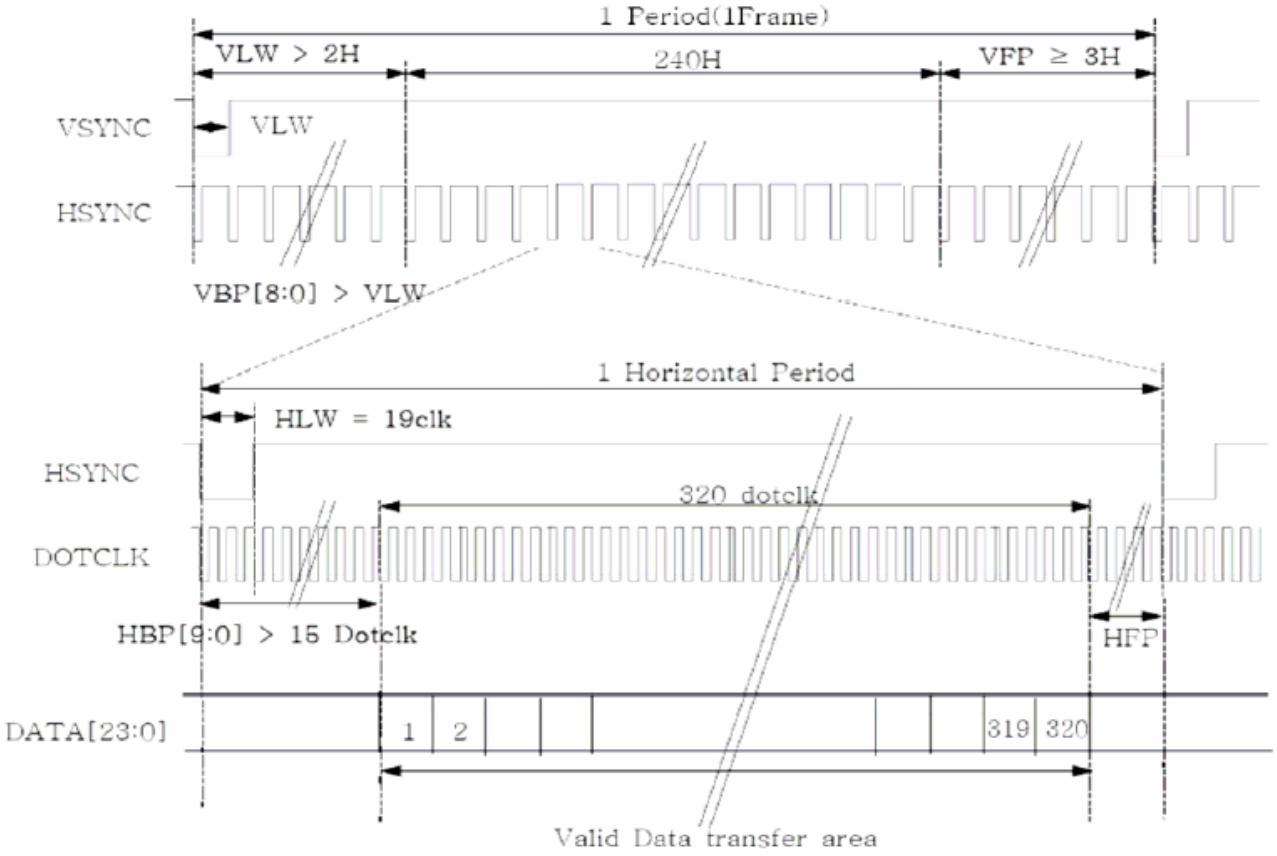
(2) Set SPENA low to let the SPI valid.

(3) Send "0" in the MSB to show writing the SPI and the address 4-bits (A3 : MSB, A0 : LSB) in the rising edge of the SPCK then read the data(D7 : MSB, D0 : LSB) in the rising edge of the SPCK.

7-2-3 24bit RGB interface timing

At Ta=-20℃ T0 +70℃ VDD=5V GND=0V

a. SYNC mode

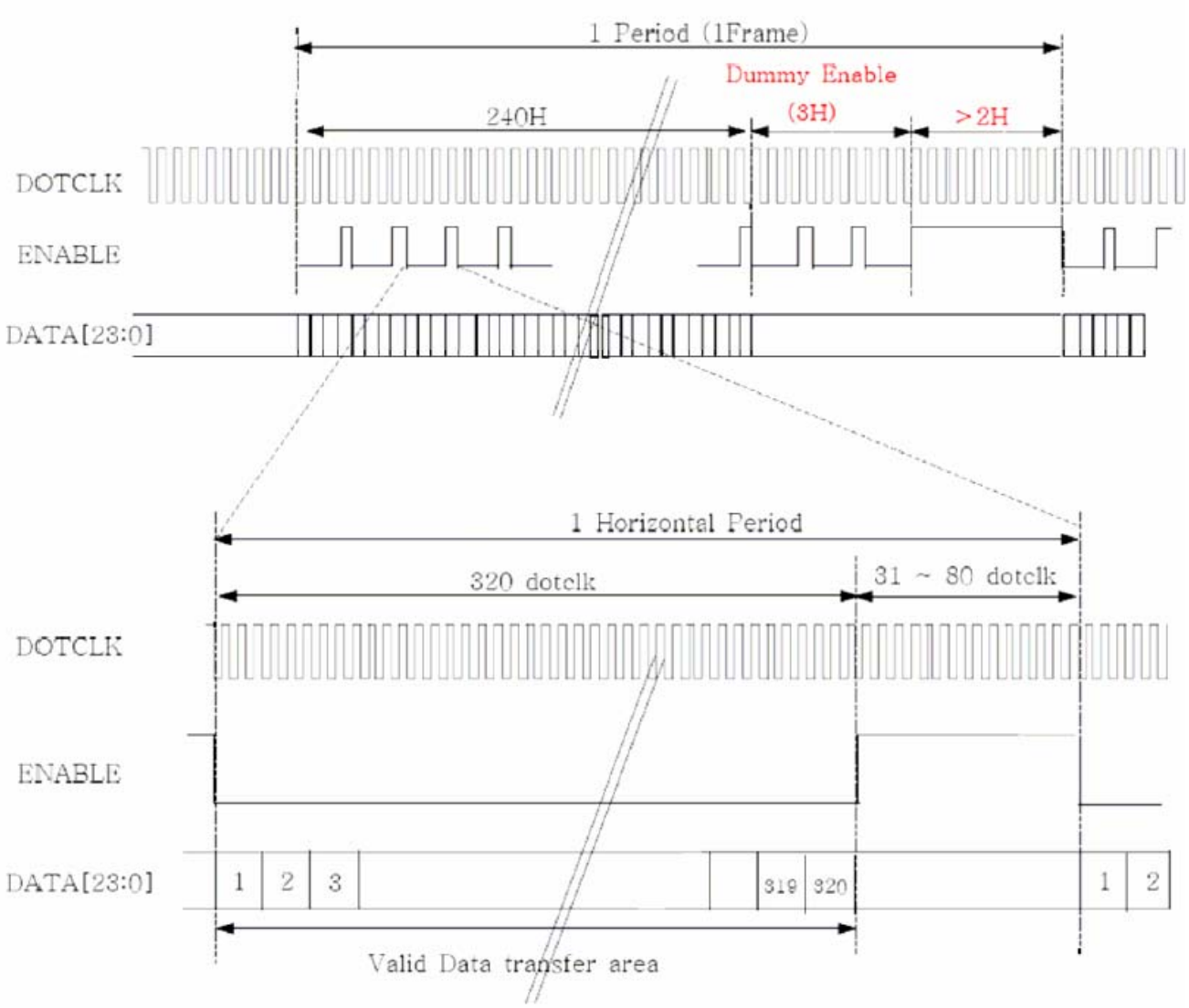


* DOTCLK = f_{frame} × (240 + VBP + VFP) × (320 + HBP + HFP)
  = 75Hz × (240 + VBP + VFP) × (320 + HBP + HFP)
* 3H ≤ VFP
* HBP > HLW
* VBP > VLW
* 15clk < HLW < 20clk
* VLW > HLW

Note 1. Polarity register setting : VPL = 0, HPL = 0, DPL=0

2. The rising edge of DOTCLK is used to fetch display data

b. DE mode



Note 1. Polarity register setting : EPL = 0, DPL=0

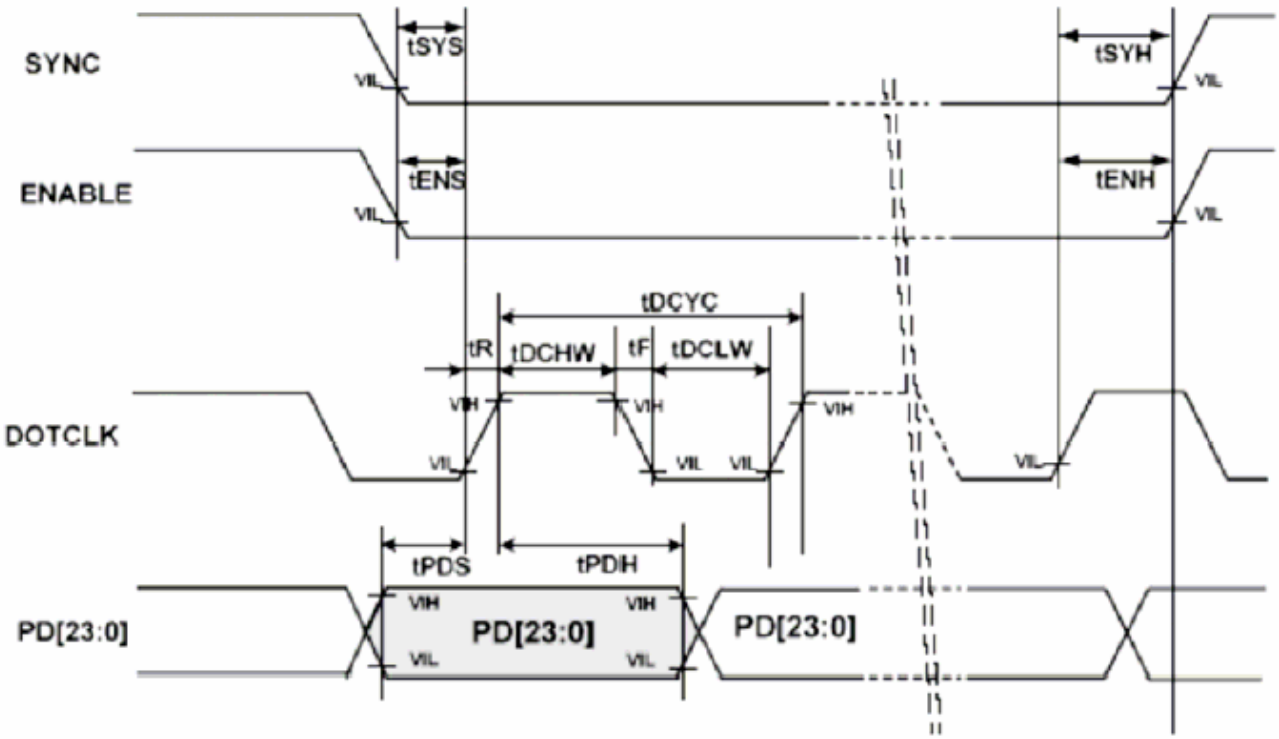
2. The rising edge of DOTCLK is used to fetch display data

7-3 Electrical specifications

a. RGB Data Interface Characteristics

(T_A = -40 to +85°C)

Characteristic	Symbol	24bit RGB Interface		Unit
		Min	Max	
DOTCLK cycle time	tDCYC	100	-	ns
DOTCLK rise/fall time	tR,tF	-	2	
DOTCLK Pulse width high	tDCHW	50	-	
DOTCLK Pulse width low	tDCLW	50	-	
SYNC setup time	tSYS	30	-	
SYNC hold time	tSYH	30	-	
ENABLE setup time	tENS	30	-	
ENABLE hold time	tENH	30	-	
PD data setup time	tPDS	30	-	
PD data hold time	tPDH	30	-	



AC Characteristics

b. Clock Synchronized Serial Mode Characteristics

(T_A = -40 to +85℃)

Characteristic	Symbol	Min	Max	Unit
Serial clock cycle time	tscyc	100	-	ns
Serial clock rise/fall time	tR,tF	-	2	
Pulse width high for write	tSCHW	30	-	
Pulse width high for read	tSCHR	50	-	
Pulse width low for write	tSCLW	30	-	
Pulse width low for read	tSCLR	50	-	
Chip Select setup time	tCSS	20	-	
Chip Select hold time	tCSH	50	-	
Serial input data setup time	tSIDS	30	-	
Serial input data hold time	tSIDH	30	-	
Serial output data delay time	tSODD	-	100	
Serial output data hold time	tSODH	5	-	

c. Reset Timing Characteristics

(T_A = -40 to +85°C)

Characteristic	Symbol	Min	Max	Unit
Reset low pulse width	tRES	3*	-	us

*NOTE. Reset low pulse width shorter than 1us do not make reset. It means undesired short pulse such as glitch, bouncing noise or electorstatic discharge do not cause irregular system reset. Please refer to the table below.

tRES Pulse	Action
Shorter than 1 us	No reset
Longer than 3 us	Reset
Between 1 us and 3 us	Not determined

8. ENVIRONMENTAL REQUIREMENTS

Item	Operating temperature (Topr)		Storage temperature (Tstg) (Note 1)		Remark
	Min.	Max.	Min.	Max.	
Ambient temperature (Ta)	-20°C	+70°C	-30°C	+80°C	Dry
Humidity (Note 1)	90% max. RH for Ta ≤ 40°C < 50% RH for 40°C < Ta ≤ Maximum operating temperature				No condensation
Vibration (IEC 68-2-6) cells must be mounted on a suitable connector	Frequency: 10 ~ 55 Hz Amplitude: 0.75 mm Duration: 20 cycles in each direction.				3 directions
Shock (IEC 68-2-27) Half-sine pulse shape	Pulse duration: 11 ms Peak acceleration: 981 m/s^2 = 100g Number of shocks: 3 shocks in 3 mutually perpendicular axes.				3 directions

Note: Product cannot sustain at extreme storage conditions for long time.

9. INTERFACE PIN CONNECTIONS

Pin No.	Symbol	I/O	Description	Remark
1	VBL-	I	Backlight LED Ground	
2	VBL-	I	Backlight LED Ground	
3	VBL+	I	Backlight LED Power	
4	VBL+	I	Backlight LED Power	
5	NC	-	No Connection	
6	NC	-	No Connection	
7	POL	O	Polarity Signal Connect to Vcom Driving Circuit	
8	/RESET	I	Hardware Reset	
9	SPENA	I	SPI Interface Data Enable Signal	
10	SPCLK	I	SPI Interface Data Clock	
11	SPDAT	I	SPI Interface Data	
12	B0	I	Blue Data Bit 0	
13	B1	I	Blue Data Bit 1	
14	B2	I	Blue Data Bit 2	
15	B3	I	Blue Data Bit 3	
16	B4	I	Blue Data Bit 4	
17	B5	I	Blue Data Bit 5	
18	B6	I	Blue Data Bit 6	
19	B7	I	Blue Data Bit 7	
20	G0	I	Green Data Bit 0	
21	G1	I	Green Data Bit 1	
22	G2	I	Green Data Bit 2	
23	G3	I	Green Data Bit 3	
24	G4	I	Green Data Bit 4	
25	G5	I	Green Data Bit 5	
26	G6	I	Green Data Bit 6	

27	G7	I	Green Data Bit 7	
28	R0	I	Red Data Bit 0	
29	R1	I	Red Data Bit 1	
30	R2	I	Red Data Bit 2	
31	R3	I	Red Data Bit 3	
32	R4	I	Red Data Bit 4	
33	R5	I	Red Data Bit 5	
34	R6	I	Red Data Bit 6	
35	R7	I	Red Data Bit 7	
36	HSYNC	I	Horizontal Sync Input	
37	VSYNC	I	Vertical Sync Input	
38	DCLK	I	Dot Data Clock	
39	VDD	I	Analog Power	
40	VDD	I	Analog Power	
41	VCC	I	Digital Power	
42	VCC	I	Digital Power	
43	NC	-	No Connection	
44	NC	-	No Connection	
45	VGL	I	Gate off Power	
46	NC	-	No Connection	
47	VGH	I	Gate on Power	
48	NC	-	No Connection	
49	NC	-	No Connection	
50	NC	-	No Connection	
51	VCOM	I	Driving Input	
52	ENB	I	Data Enable Input	
53	GND	I	Ground	
54	AVSS	I	Ground	

10. USING LCD MODULES

10-1. Liquid Crystal Display Modules

LCD is composed of glass and polarizer. Pay attention to the following items when handling.

1. Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.
2. Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc).
3. N-hexane is recommended for cleaning the adhesive used to attach front/rear polarizers and reflectors made of organic substances which will be damaged by chemicals such as acetone, toluene, ethanol and isopropylalcohol.
4. When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzin. Do not scrub hard to avoid damaging the display surface.
5. Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.
6. Avoid contacting oil and fats.
7. Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.
8. Do not put or attach anything on the display area to avoid leaving marks on.
9. Do not touch the display with bare hands .This will stain the display area and degradate insulation between terminals (some cosmetics are determinated to the polarizers).
10. As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring.

10-2. Precaution for Handling LCD Modules

Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

1. Do not alter, modify or change the shape of the tab on the metal frame.
2. Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
3. Do not damage or modify the pattern writing on the printed circuit board.
4. Absolutely do no modify the zebra rubber strip (conductive rubber) or heat seal connector.
5. Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
6. Do not drop, bend or twist LCM.

10-3. Electro-Static Discharge Control

Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

1. Make certain that you are grounded when handing LCM.
2. Before remove LCM from its packing case or incorporating it into a set , be sure the module and your body have the same electric potential.
3. When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.

4. When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.
5. As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.
6. To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%~60% is recommended.

10-4. Precaution for soldering to the LCM

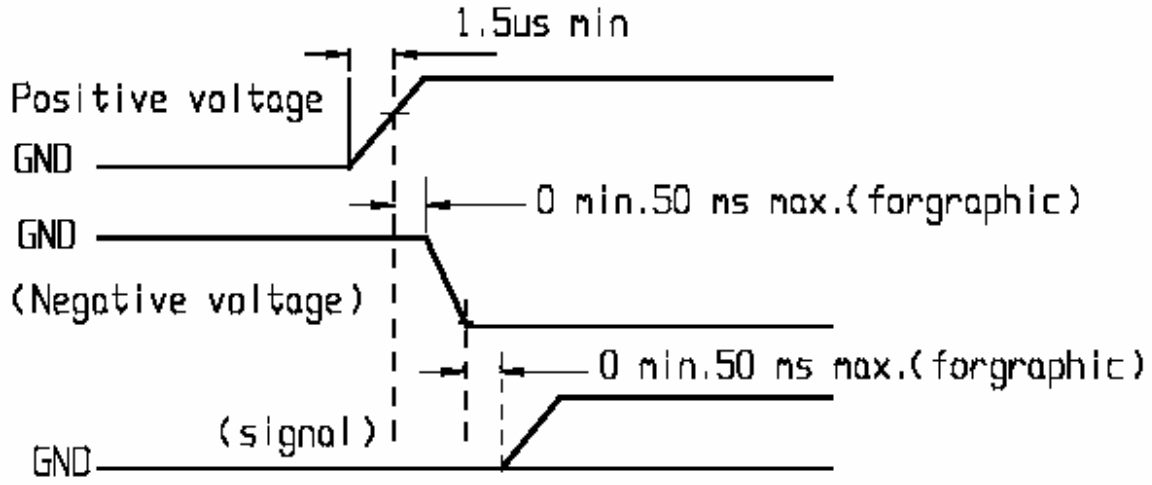
1. Observe the following when soldering lead wire, connector cable and etc. to the LCM.
   - Soldering iron temperature:280℃±10℃
   - Soldering time: 3-4 sec.
   - Solder: eutectic solder.

If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non- halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage dug to flux spatters.

2. When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature of the soldering iron.
3. When remove the electroluminescent panel form the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged

10-5. Precaution for Operation

1. Viewing angle varies with the change of liquid crystal driving voltage (Vo). Adjust Vo to show the best contrast.
2. Driving the LCD in the voltage above the limit shortens its life.
3. Response time is greatly at temperature below the operating temperature range. However, this does not mean the LCM will be out of the order. It will recover when it returns to the specified temperature range.
4. If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.
5. Condensation of terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used under the relative condition of 40℃,50%RH .
6. When turning the power on, input each signal after the positive/negative voltage becomes stable.



10-6. Storage

When storing LCDs as spares for some years, the following precaution are necessary.

1. Store them in a sealed polyethylene bag. If properly sealed, there is no need for dessicant.
2. Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0℃ and 35℃.
3. The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped.)
4. Environmental conditions:
   - Do not leave them for more than 168hrs. at 60℃.
   - Should not be left for more than 48hrs. at -20℃.

10-7. Safety

1. It is recommended to crush damaged or unnecessary LCDs into pieces and wash off with solvents such as acetone and ethanol, which should later be burned.
2. If any liquid leak out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

13-8. Limited Warranty

Unless agreed between BONA AND customer, BONA will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with BONA LCD acceptance standards(copies available upon request) for a period of one year from date of shipments. Cosmetic/ visual defects must be returned to BONA within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of BONA limited to repair and/or replacement on the terms set forth above. BONA will not be responsible for any subsequent or consequential events.

10-9. Return LCM under warranty

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are:

- Broken LCD glass.
- PCB eyelet's damaged.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- Soldering to or modifying the bezel in any manner.

Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet's conductors and terminals.