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BYD LCM

PRODUCT SPECIFICATIONS

RoHS

MODULE NO.:　BM1024600-8688FTGG

For Customer:_____

Approved by: _____

Signature: _____

Date: _____

Please sign the cover page of the spec for your approval and return it to our local sales **within a month** after your receipt of the spec from Byd. In the case Byd does not receive the signed spec even after one month later, in general we will consider that the spec was already accepted by your company.

Prepared	Checked	Approved	Date
Zhang Yunduan	Yang Jianfeng	Wang Huazu	2010-6-4

History of Versions and Modifications

Version	Modifications	Date
A	Generation first version	**2010-1-26**
B	Update electro-optical characteristics	2010-2-2
C	Update LCM dimension	**2010-4-8**
D	Update inspection specification	**2010-5-12**
E	Update LCM drawing	**2010-5-13**
F	Add current consumption & backlight driving conditions	**2010-6-4**

PRODUCT SPECIFICATIONS

◆ MODULE CLASSIFICATION INFORMATION

BM1024600-8688FTGG

B: BYD Company Limited

M: M: LCD Module P: LCD Panel

1024600: Display Capacity

8688: Serial Number

F: LCM

T: TN	H: HTN	Y: STN Yellow green	B: STN Blue
G: STN Gray	D: DSTN	W: FSTN	C: Color STN
E: ECB LCD	M: MLCD	F: TFT LCD	O: OLED

T: Display Mode

T:Transmissive R:Reflective F:Transflective C:Oled Color M:Oled Mono

G: Connection Type or module Circuit Technique

P:Pin connection	H:Heat seal	C:FPC	Z:Zebra
B:COB	T:TAB	G:COG	F:COF
O:Others			

G: Product Version: From A to Z

◆ LCD MODULE PHYSICAL DATA

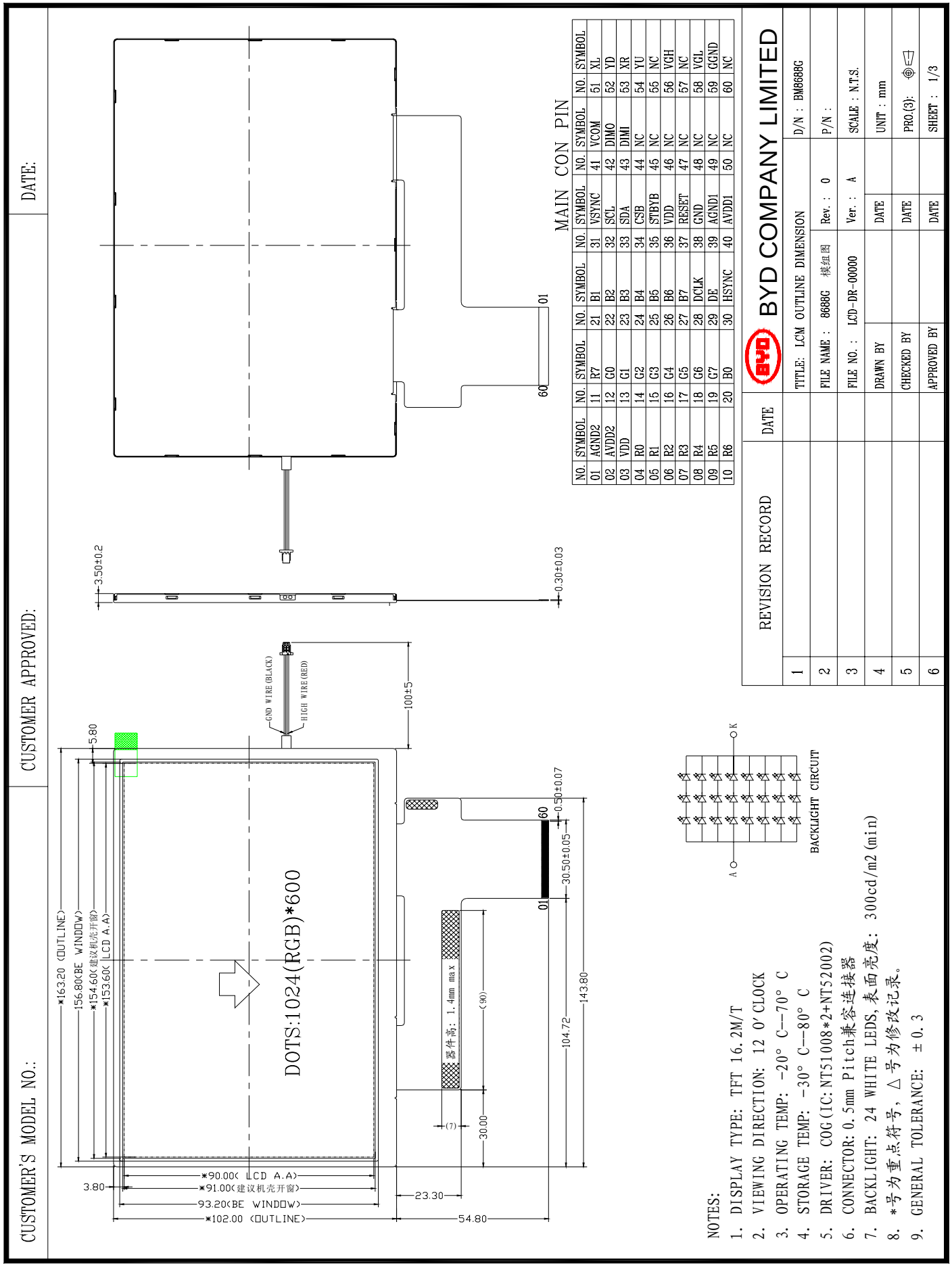
- **General Description**

Size	**7.0"**
Display Type	**16M TFT**
Display Mode	**TRANSMISSIVE**
Viewing Direction	**12 o'clock**
Connection Type	**COG**
Operation temperature	**-20℃ ~ 70℃**
Storage temperature	**-30℃ ~ 80℃**
Driving IC	**NT51008*2 & NT52002**

- **Mechanical Description**

Item	Standard Value	Unit
Number of dots	**1024RGB×600dots**	-
LCM dimension	**163.2(W)×102.0(H)×3. 5(T)**	**mm**
Active area	**153.60(W)×90.0(H)**	**mm**
Dot size	**0.14(W)×0.14(H)**	**mm**
Dot pitch	**0.15(W)×0.15(H)**	**mm**
Backlight	**24-chip white LEDS**	/
The KEY and accessory materials of our product according with BHS-001 standard		

◆ EXTERNAL DIMENSIONS



MAIN CON PIN

NO.	SYMBOL	NO.	SYMBOL	NO.	SYMBOL	NO.	SYMBOL
01	AGND2	11	R7	21	B1	31	VSYNC
02	AVDD2	12	G0	22	B2	32	SCL
03	VDD	13	G1	23	B3	33	SDA
04	R0	14	G2	24	B4	34	CSB
05	R1	15	G3	25	B5	35	STBYB
06	R2	16	G4	26	B6	36	VDD
07	R3	17	G5	27	B7	37	RESET
08	R4	18	G6	28	DCLK	38	GND
09	R5	19	G7	29	DE	39	AGND1
10	R6	20	B0	30	HSYNC	40	AVDD1

NO.	SYMBOL
41	VCOM
42	DIMO
43	DIMI
44	NC
45	NC
46	NC
47	NC
48	NC
49	NC
50	NC
51	XL
52	YD
53	XR
54	YU
55	NC
56	VGH
57	NC
58	VGL
59	GGND
60	NC

REVISION RECORD

	DATE
1	
2	
3	
4	
5	
6	

BYD COMPANY LIMITED

TITLE: LCM OUTLINE DIMENSION
FILE NAME: 8688G 模组图
FILE NO.: LCD-DR-00000
DRAWN BY
CHECKED BY
APPROVED BY

D/N : BM8688G
Rev. : 0
Ver. : A
DATE
DATE
DATE

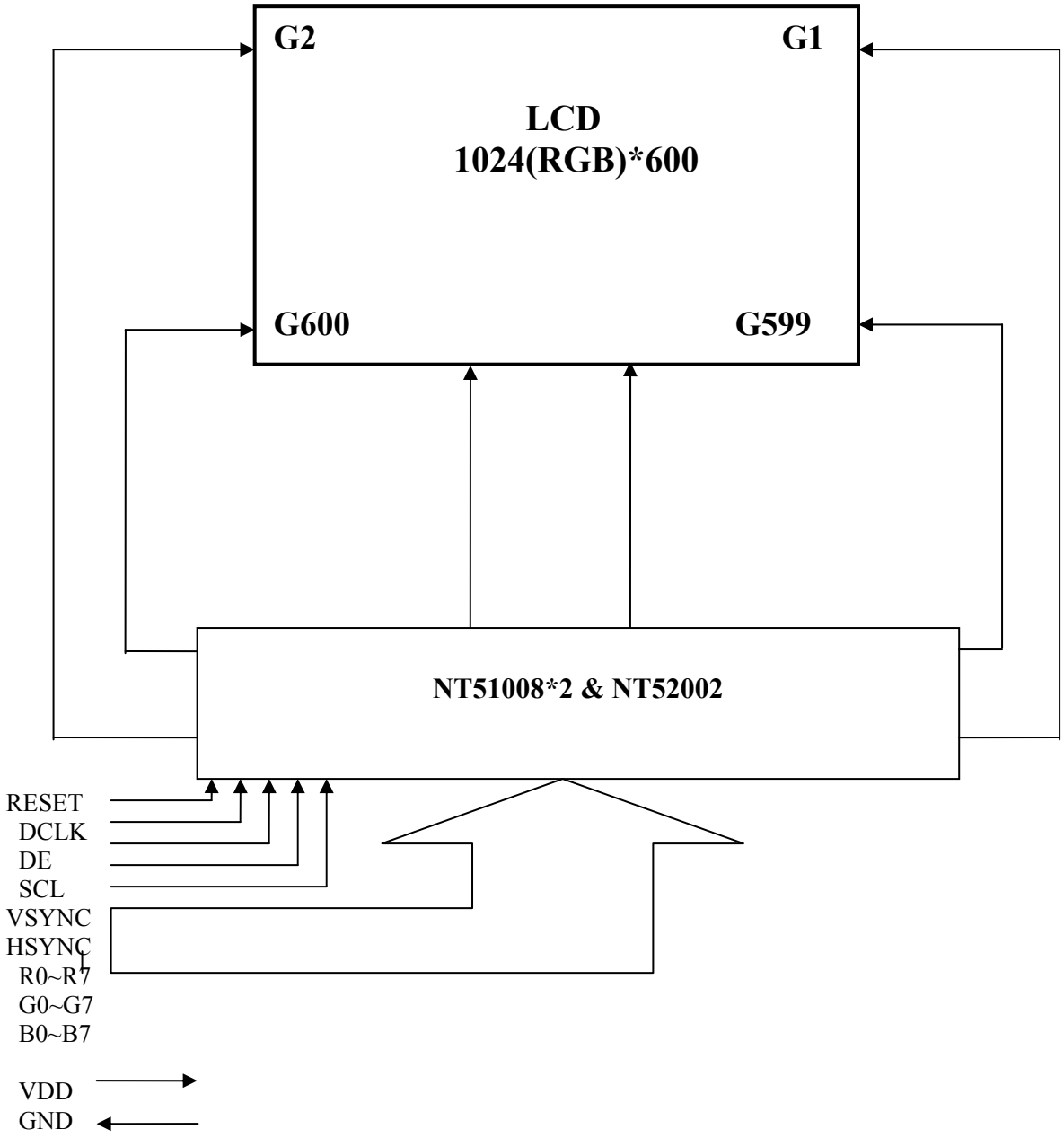
P/N :
SCALE : N.T.S.
UNIT : mm
PRO.(3):
SHEET : 1/3

NOTES:
1. DISPLAY TYPE: TFT 16.2M/T
2. VIEWING DIRECTION: 12 0'CLOCK
3. OPERATING TEMP: -20° C—70° C
4. STORAGE TEMP: -30° C—80° C
5. DRIVER: COG(IC:NT51008*2+NT52002)
6. CONNECTOR: 0.5mm Pitch兼容连接器
7. BACKLIGHT: 24 WHITE LEDS,表面亮度: 300cd/m2(min)
8. *号为重点符号, △号为修改记录。
9. GENERAL TOLERANCE: ±0.3

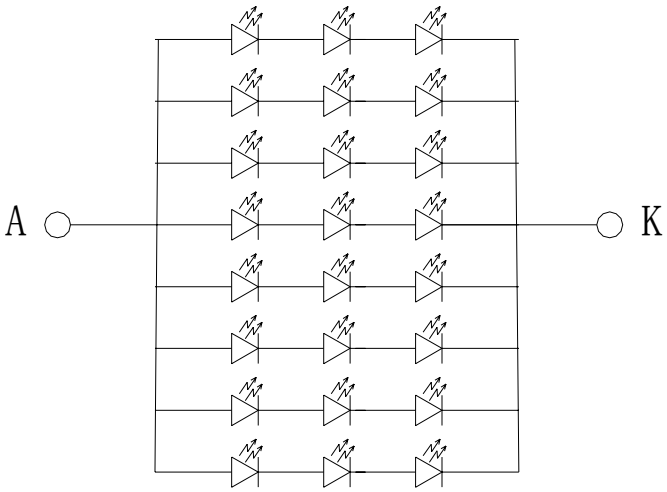
表格编码: FMLCD-MA-000010-02 A

◆ BLOCK DIAGRAM

- **TFT-LCD Module (Interface System Structure)**



- **Backlight Circuit**



◆ ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Rating	Unit
Operating temperature	Top	-20 to 70	℃
Storage temperature	Tst	-30 to 80	℃
Input voltage	Vin	-0.3 to VCC+0.3	V
Supply voltage for logic	VCC	-0.3 ~ + 3.3	V
Power supply voltage	IOVCC	-0.3 ~ +3.3	V
Supply voltage for LCD	VGH – VSSA	-0.3 to 16	V

NOTE:

1. **If the module is used above these absolute maximum ratings. It may become permanently damaged. Using the module within the following electrical characteristic conditions are also exceeded, the module will malfunction and cause poor reliability.**
2. **VDD>GND must be maintained.**

◆ ELECTRICAL CHARACTERISTICS

- **DC Characteristics**

Vss= 0V, Ta= 25℃

Item	Symbol	Condition	Min	Typ	Max	Unit
Input high voltage	VIH	-	0.7* IOVCC	-	IOVCC	V
Input low voltage	VIL	-	0	-	0.3* IOVCC	V
Output high voltage	VOH	-	0.7* IOVCC	-	-	V
Output low voltage	VOL	-	-	-	0.3* IOVCC	V
Operating voltage	AVDD	Ta=25℃	-	12	-	V
Current consumption for LCD normal operation	IDD	AVDD =12V	-	-	45	mA

- **Back-Light unit**

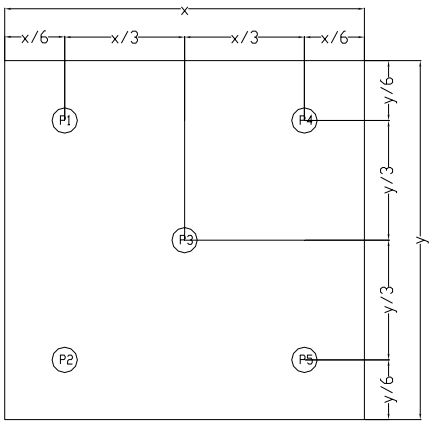
Item	Symbol	Min	Typ	Max	Unit	Remark
Current	I_{BL}	-	160	-	mA	24-chip white LEDS
CIE	X	0.25	-	0.29	-	-
	Y	0.24	-	0.28	-	
Brightness	-	-	4500	-	cd/m	-
Luminance Uniformity Ratio	-	80	-	-	%	-
Bezel(BE) must be connected to ground of the main board						

Note:

1. Average Luminous Uniformity of P1 ~ P5（Using a luminance meter BM-7）

2. Luminous Uniformity Ratio =(The Lvmin/Lvmax) * 100%

Measured Method (X*Y: Light Area).



- **AC Characteristics**

Refer to the SPEC of NT51008*2& NT52002

◆ INTERFACE PIN CONNECTIONS

NO.	Symbol	Function
1	AGND2	GND
2	AVDD2	+12V
3	VDD	Power supply（TYP：+3.3V）
4	R0	RED Data bus
5	R1	
6	R2	
7	R3	
8	R4	
9	R5	
10	R6	
11	R7	
12	G0	GREEN Data bus
13	G1	
14	G2	
15	G3	
16	G4	
17	G5	
18	G6	
19	G7	
20	B0	BLUE Data bus
21	B1	
22	B2	
23	B3	
24	B4	
25	B5	
26	B6	
27	B7	
28	DCLK	Dot clock signal
29	DE	Data eneable signal in RGB I/F mode
30	HSYNC	Horizon sync signal
31	VSYNC	Vertical sync signal
32	SCL	Serial clock input pin
33	SDA	Serial data input pin
34	CSB	Lcd chip select
35	STBYB	Standby mode, Normally pulled high. STBYB = “1”, normal operation STBYB = “0”, timing controller, source driver will turn off, all output are High-Z
36	VDD	Power supply（TYP：+3.3V）
37	RESET	Reset signal
38	GND	Ground
39	AGND1	GND
40	AVDD1	+12V
41	VCOM	+3.9V
42	DIMO	Brightness control signal. Normally pull high

43	**DIMI**	Backlight dimmer signal for external controller. DIMO = “0”, Turn off external backlight controller DIMO = “1”, Logical control signal to turn on external backlight controller NOTE : If CABC OFF , DIMO = DIMI . Else DIMO is controlled by CABC
44	**NC**	**No connection**
45	**NC**	
46	**NC**	
47	**NC**	
48	**NC**	
49	**NC**	
50	**NC**	
51	**XL**	**TP interface**
52	**YD**	
53	**XR**	
54	**YU**	
55	**NC**	**No connection**
56	**VGH**	**+16V**
57	**NC**	**No connection**
58	**VGL**	**-7V**
59	**GGND**	**GND**
60	**NC**	**No connection**

◆ RECOMMEND INITIAL CODE

```
void BM8688AInit(void)
{
   RESET=1;
    Delay(100);
   RESET=0;
   Delay(100);
   RESET=1;
   Delay(100);
   NT51008WriteCommand(0x0c);
   NT51008Writedata(0x04);
   Delay(60);

   NT51008WriteCommand(0x04);
   NT51008Writedata(0x90);
   Delay(60);

   NT51008WriteCommand(0x00);
   NT51008Writedata(0x2d);
   Delay(100);
}
```

Current Consumption

（PCLK=50MHZ）

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Current for Driver	I_{GH}		0.2	0.5	mA	V_{GH} =16V
	I_{GL}		0.2	1.0	mA	V_{GL} = -7.5V
	I_{CC}		80	120	mA	V_{CC} =3.3V
	IAV_{DD}		39	50	mA	AV_{DD} =12V

Backlight Driving Conditions

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
LED forward voltage	V_L	9.3	9.9	10.5	V	Note 1
LED forward current	I_L	144	160	176	mA	

Note 1: The LED Supply Voltage is defined by the number of LED at Ta=25℃ and I_L =160mA.

3-Wire Command Format

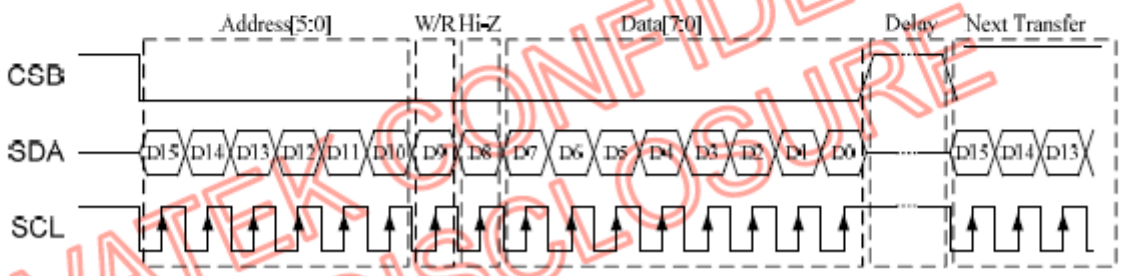
NT51008 use the 3-wire serial port as communication interface for all the function and parameter setting.

3-Wire communication can be bi-directional controlled by the "R/W" bit in address field. NT51008 3-Wire engine act as a "slave mode" for all the time, and will not issue any command to the 3-Wire bus itself.

Under read mode, 3-Wire engine will return the data during "Data phase". The returned data should be latched at the rising edge of SCL by external controller. Data in the "Hi-Z phase" will be ignored by 3-Wire engine during write operation, and should be ignored during read operation also. During read operation, external controller should float SDA pin under "Hi-Z phase" and "Data phase".

Each Read/Write operation should be exactly 16 bit. To prevent from incorrect setting of the internal register, any write operation with more or less than 16 bit data during a CSB Low period will be ignored by 3-Wire engine.

For prevent from incorrect setting of the internal register. Please refer to the section of "3-Wire Timing Diagram" for the detail timing.



3-Wire Command Format:

Bit	Description
D15-D10	Register Address [5:0].
D9	W/R control bit. "0" for Write; "1" for Read
D8	Hi-Z bit during read mode. Any data within this bits will be ignored during write mode
D7-D0	Data for the W/R operation to the address indicated by Address phase

3-Wire Writer Format:

MSB															LSB
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Register Address [5:0]						0	X	DATA (Issue by external controller)							

3-Wire Read Format:

MSB															LSB
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Register Address [5:0]						1	Hi-Z	DATA (Issue by 3-Wire engine)							

2. 3-Wire Control Registers

Following table list all the 3-Wire control registers and bit name definition for NT51008. Refer to the next section for detail register function description, please.

Setting of all the 3-Wire registers will take effect at the coming falling edge of VSD except GRB and STB bit.

R0: System Control Register

Designation	Address	Description
MODE	R0[0]	DE / SYNC mode select. MODE="0", HSD/VSD mode. MODE="1", DE mode. (Default)
DCLKPOL	R0[1]	DCLK polarity control bit. DCLKPOL="0": Data sampling at DCLK falling edge. (Default) DCLKPOL="1": Data sampling at DCLK rising edge.
GRB	R0[2]	Global reset bit. GRB="0", The controller is in reset state. GRB="1", Normal operation. (Default)
STBYB	R0[3]	Standby mode selection bit. STBYB="0", Timing control, driver and DC-DC converter, are off, and all outputs are High-Z. STBYB="1", Normal operation. (Default)
UPDN	R0[4]	G Gate Up or Down scan control. UPDN = "0", STV2 output vertical start pulse and UD pin output logical "0" to Gate driver. (Default) UPDN = "1", STV1 output vertical start pulse and UD pin output logical "1" to Gate driver.
SHLR	R0[5]	Right/Left sequence control of source driver. SHLR="0", Shift left: Last data=S1<-S2<-S3 … <-S960=First data. SHLR="1", Shift right: First data=S1->S2->S3 … ->S960=Last data. (Default)
	R0[6]	Reserved
PWR_EN	R0[7]	POWER enable. PWR_EN = H , enable PWM , Charge pump and VCOM buffer PWR_EN = L , disable PWM , Charge pump and VCOM buffer (Default)

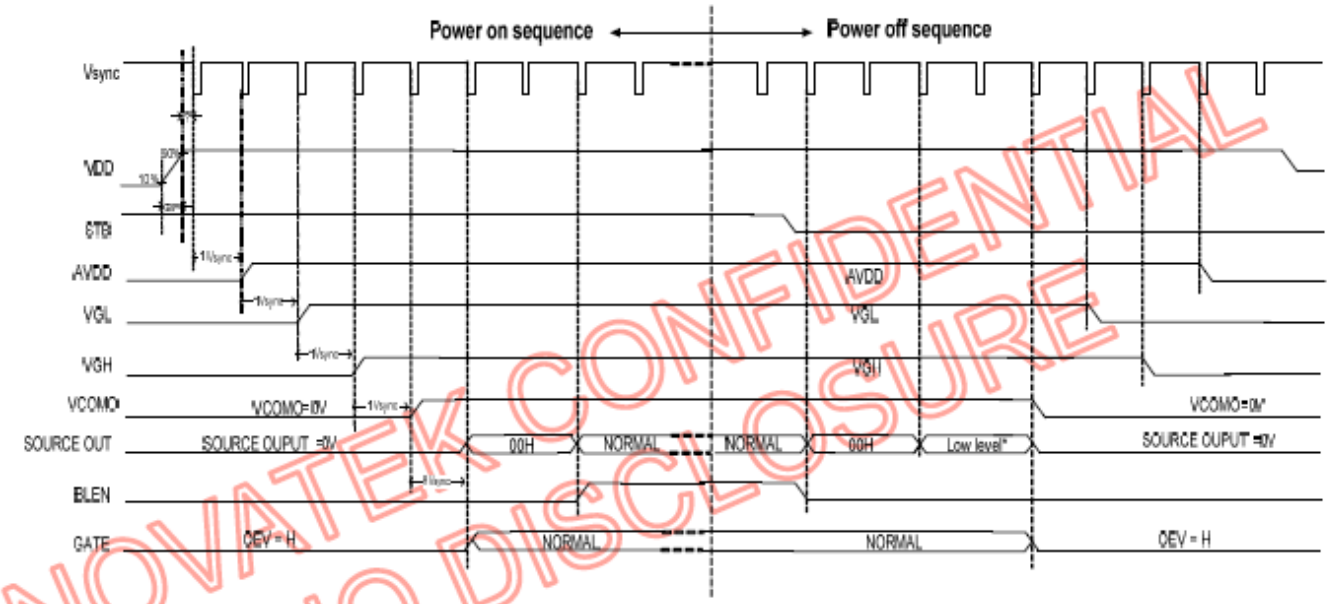
R1: System Control Register

Designation	Address	Description
		Reserved
RES[1:0]	R1[2:1]	Display resolution selection. RES[1:0] = "01", for 1024(RGB)*768 display resolution(dual or cascade) RES[1:0] = "00", for 1024(RGB)*600 display resolution(dual or cascade) (Default) RES[1:0] = "10", for 800(RGB)*600 display resolution(dual or cascade) (601~936 channel disable) RES[1:0] = "11", for 800(RGB)*480 display resolution(dual or cascade) (601~936 channel disable)
BIST	R1[3]	Normal Operation/BIST pattern select. BIST = H : BIST(DCLK input is not needed) BIST = L : Normal Operation (Default)
DITHER	R1[4]	Dithering function enable control. DITHER = "1", Enable internal dithering function DITHER = "0", Disable internal dithering function (Default)
HFRC	R1[5]	H-FRC selection. HFRC = H : H-FRC enable HFRC = L : FRC enable (Default) If DITHER = "0" , disable dithering function(H-FRC and FRC disable)
CABC_EN[1:0]	R1[7:6]	CABC H/W enable pin. Normally pull low. When CABC_EN="00", CABC OFF. (Default mode) When CABC_EN="01", User interface Image. When CABC_EN="10", Still Picture. When CABC_EN="11", Moving Image.

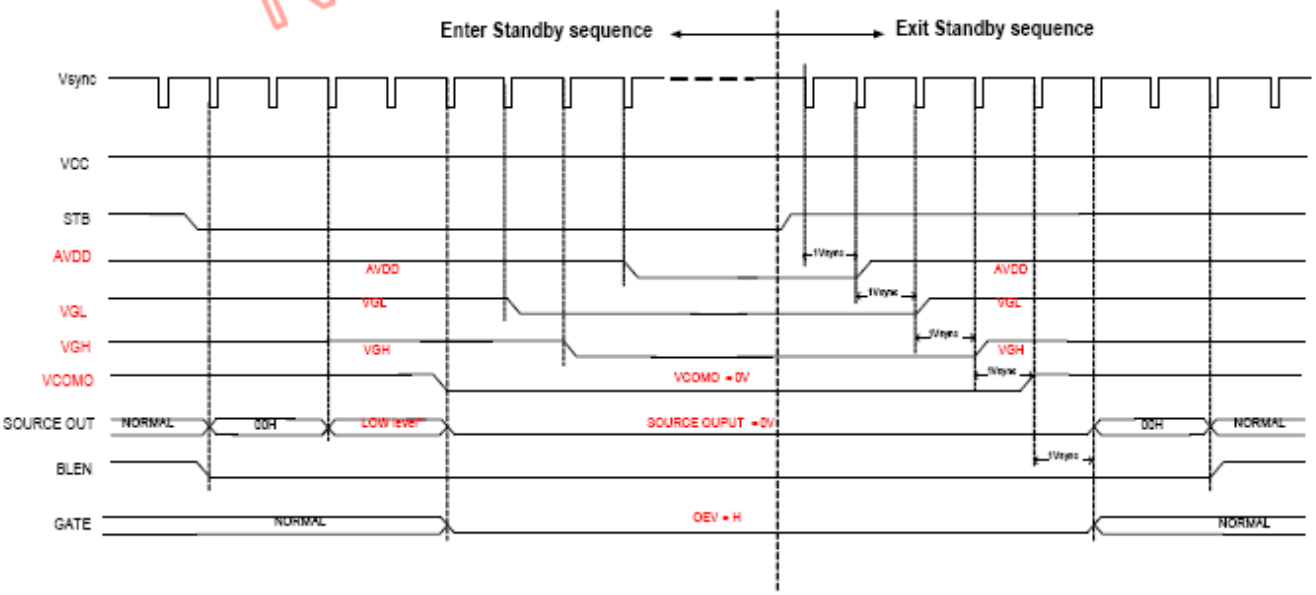
Power On/Off Sequence

In order to prevent IC from power on reset fail, the rising time (T_{POR}) of the digital power supply VDD should be maintained within the given specifications. Refer to "AC Characteristics" for more detail on timing.

Power-On/Off Timing Sequence:



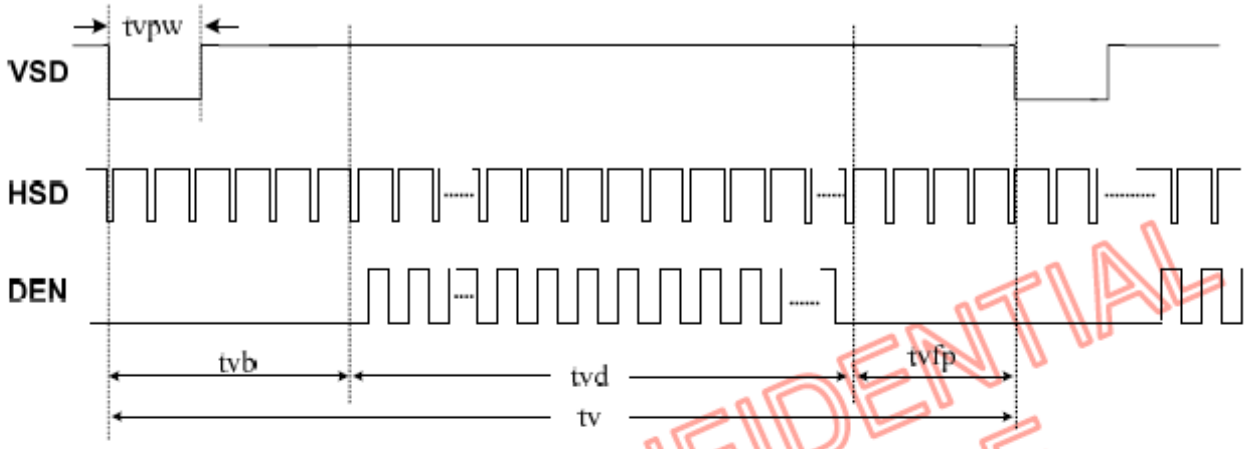
Enter and Exit Standby Mode Sequence:



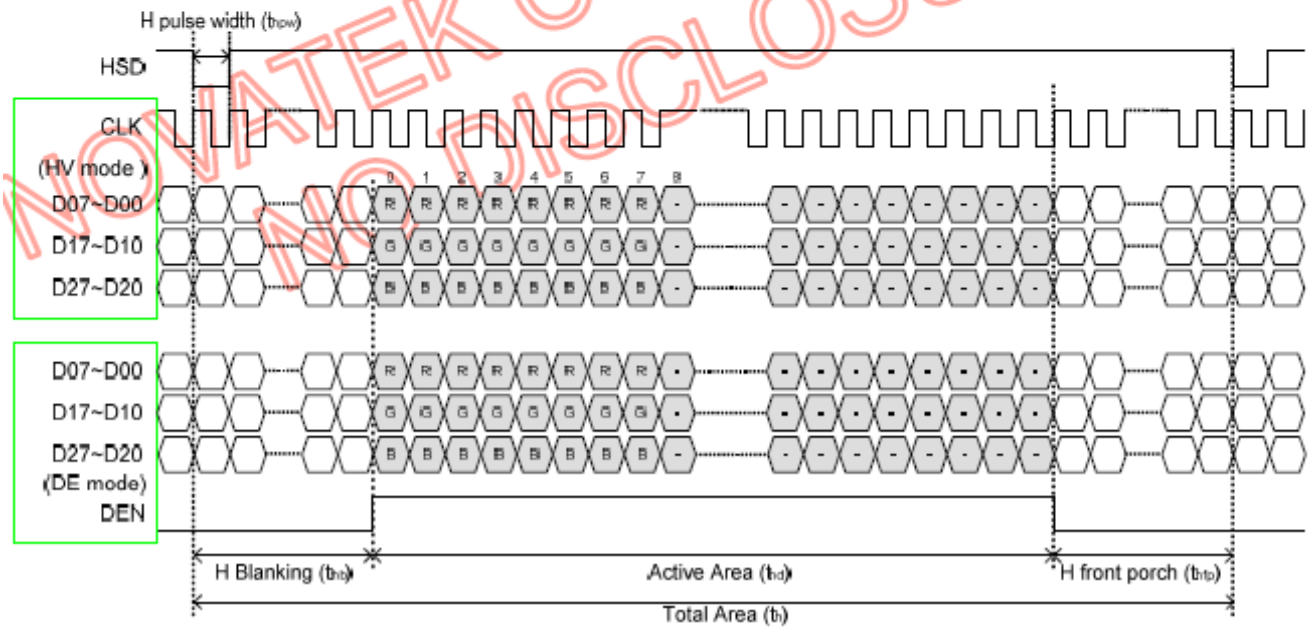
*Note : Low level = 3FH , when NBW = L (Normally white)
Low level = 00H , when NBW = H (Normally black)

Data Input Format for TTL

Vertical input timing



Horizontal input timing



Parallel RGB input timing table

For 1024x600 panel

DE mode

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
DCLK frequency @ Frame rate = 60Hz	fclk	40.8	51.2	67.2	MHz
Horizontal display area	thd		1024		DCLK
HSYNC period time	th	1114	1344	1400	DCLK
HSYNC blanking	thb+thfp	90	320	376	DCLK
Vertical display area	tvd		600		H
VSYNC period time	tv	610	635	800	H
VSYNC blanking	tvb+tvfp	10	35	200	H

HV mode

Horizontal input timing

Parameter		Symbol	Value			Unit
Horizontal display area		thd		1024		DCLK
DCLK frequency @ Frame rate = 60Hz		fclk	Min.	Typ.	Max.	
			44.9	51.2	63	MHz
1 Horizontal Line		th	1200	1344	1400	DCLK
HSYNC pulse width	Min.	thpw		1		
	Typ.			-		
	Max.			140		
HSYNC blanking		thb	160	160	160	
HSYNC front porch		thfp	16	160	216	

Vertical input timing

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Vertical display area	tvd		600		H
VSYNC period time	tv	624	635	750	H
VSYNC pulse width	tvpw	1	-	20	H
VSYNC Blanking (tvb)	tvb	23	23	23	H
VSYNC Front porch (tvfp)	tvfp	1	12	127	H

DC Electrical Characteristics

(VDD= 2.3 to 3.6V, AVDD= 6.5 to 13.5V, GND=AGND= 0V, TA= -20 to +85°C)
TTL mode

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Low level input voltage	Vil	0	-	0.3xVDD	V	For the digital circuit
High level input voltage	Vih	0.7xVDD	-	VDD	V	For the digital circuit
Input leakage current	Ii	-	-	±1	μA	For the digital circuit
High level output voltage	Voh	VDD-0.4	-	-	V	Ioh= -400μA
Low level output voltage	Vol	-	-	GND+0.4	V	Iol= +400μA
Pull low/high resistor	Ri	200K	250K	300K	ohm	For the digital input pin @ VDD=3.3V
Digital Operating Current	Idd	-	8 (TBD)	10 (TBD)	mA	Fclk=65 MHz, FLD=50KHz, VDD=3.3V
Digital Stand-by Current	Ist1	-	10 (TBD)	50 (TBD)	μA	Clock & all functions are stopped
Analog Operating Current	Idda	-	10 (TBD)	12 (TBD)	mA	No load, Fclk=65MHz, FLD=50KHz @ AVDD=10V,V1=8V, V14=0.4V
Analog Stand-by Current	Ist2	-	10 (TBD)	50 (TBD)	μA	No load, Clock & all functions are stopped
Input level of V1 ~ V7	Vref1	0.4* AVDD	-	AVDD-0.1	V	Gamma correction voltage input
Input level of V8 ~ V14	Vref2	0.1	-	0.6* AVDD	V	Gamma correction voltage input
Output Voltage deviation	Vod1	-	±20	±35	mV	Vo = AGND+0.1V ~ AGND+0.5V & Vo = AVDD-0.5V ~ AVDD-0.1V
Output Voltage deviation	Vod2	-	±15	±20	mV	Vo = AGND+0.5V ~ AVDD-0.5V
Output Voltage Offset between Chips	Voc	-	-	±20	mV	Vo = AGND+0.5V ~ AVDD-0.5V
Dynamic Range of Output	Vdr	0.1	-	AVDD-0.1	V	SO1 ~ SO1536
Sinking Current of Outputs	IOLy	80	-	-	uA	SO1 ~ SO1536; Vo=0.1V v.s 1.0V , AVDD=13.5V
Driving Current of Outputs	IOHy	80	-	-	uA	SO1 ~ SO1536; Vo=13.4V v.s 12.5V , AVDD=13.5V
Resistance of Gamma Table	Rg	0.7*Rn	1.0*Rn	1.3*Rn	ohm	Rn: Internal gamma resistor

AC Electrical Characteristics

(VDD= 2.3 to 3.6V, AVDD= 6.5 to 13.5V, GND=AGND= 0V, TA= -20 to +85°C)
TTL mode

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
VDD Power On Slew rate	T_{POR}	-	-	20	ms	From 0V to 90% VDD
RSTB pulse width	T_{Rst}	50	-	-	us	DCLK = 65MHz
DCLK cycle time	Tcph	14			ns	
DCLK pulse duty	Tcwh	40	50	60	%	
VSD setup time	Tvst	5	-	-	ns	
VSD hold time	Tvhd	5	-	-	ns	
HSD setup time	Thst	5	-	-	ns	
HSD hold time	Thhd	5	-	-	ns	
Data set-up time	Tdsu	5	-	-	ns	D0[7:0], D1[7:0], D2[7:0] to DCLK
Data hold time	Tdhd	5	-	-	ns	D0[7:0], D1[7:0], D2[7:0] to DCLK
DE setup time	Tesu	5	-	-	ns	
DE hold time	Tehd	5	-	-	ns	
Output stable time	Tsst	-	-	6	us	10% to 90% target voltage. CL=90pF, R=10K ohm (Cascade)
				3		Dual gate

◆ ELECTRO-OPTICAL CHARACTERISTICS

Driving condition:VDD= 2.8V, I_{BL}= 20mA/LED, Temperature =23℃±5℃ Humidity=60%±20%RH

Item			Light angle (°)	Temp (°C)	Symbol	Specifications			Unit	Conditions	Note
						Min.	Typ.	Max.			
Transmittance			0	25	-	-	5.1	-	%	(Equipment :BM-7/CS200)	(1)
Contrast ratio			0	25	Cr	-	650	-	-		(2)
Brightness			0	25	-	300	-	-	-		-
Luminance uniformity (surface within panel)			0	25	Lu	70	80	-	%		(3)
Cross talk			0	25	CTV	-	-	20	%		(4)
Chromaticity	R x		0	25	Rx	0.5783	0.6283	0.6783	-		-
	R y				Ry	0.2750	0.3250	0.3750			
	G x				Gx	0.2842	0.3342	0.3842			
	G y				Gy	0.5539	0.6039	0.6539			
	B x				Bx	0.0934	0.1434	0.1934			
	B y				By	0.0285	0.0785	0.1285			
	W x				Wx	0.2357	0.2857	0.3357			
	W y				Wy	0.2646	0.3146	0.3646			
Color Reproduction Area(NTSC)			0	25	-	-	65	-	%	CIE1931(x,y)	(5)
Response time	Tr		0	25	-	-	5	-	ms	Viewing normal angle $\theta_X = \theta_Y = 0^0$	-
	Tf					-	15	-			
Viewing angle	Hor.	θ_{X+}	0	25	-	50	60	-	deg	Center CR≥10	-
		θ_{X-}			-	50	60	-			
	Ver.	θ_{Y+}			-	50	60	-			
		θ_{Y-}			-	40	50	-			

Note:

(1) .Transmittance

Introduction

Transmittance (diffuse transmission factor) is a measure for the LCD panel transparency. The Light Source for this measurement is the accompanying LCD-module backlight system (LEDs, Lightguide…)

Measurement conditions:

Measuring Equipment	BM-7/CS-200
Measurement Point Diameter	3mm
Measurement Point Location	Active Area Center Point
Light source	LCD module backlight
Reflectance Plate	Reflectance Standard(cal. plate)
Test pattern	All pixels white
Contrast setting	Maximum

Measuring procedure:

Transmittance:

The light source is located at the backside of the panel.

1、 Measure the light source

2、 Place the LCD panel in front of the light source. Measure the luminance on the LCD panel surface

Definitions

$$\tau = \frac{Lv_{LCD-panel}}{Lv_{lightsource}} * 100\%$$

(2) Definition of Contrast Ratio (C/R): Ratio of gray max (Gmax) & gray min (Gmin) at the center point.

$$CR = \frac{G(Max)}{G(Min)}$$

Where

Gmax: Luminance with all pixels white

Gmin: Luminance with all pixels black

(3). Surface luminance uniformity within panel

Measurement conditions:

Measuring Equipment	**CS-200 // BM-7**
Measurement Point Diameter	**3mm // 1mm**
Measurement Point Location	**Active Area**
Light Source	**Transmissive Mode: Internal (Backlight)**
Test pattern	**White**

Measuring procedure:

Measure the luminance Li with the points in figure 1.

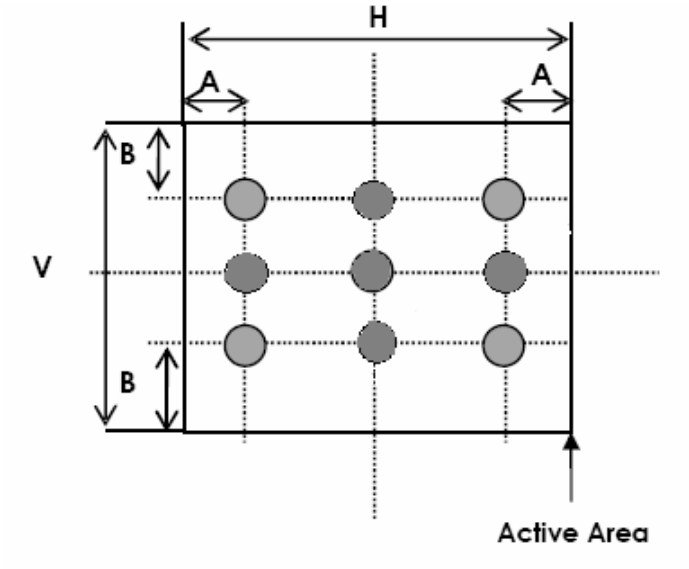


Figure 1

A: 5 mm B: 5 mm
H, V: Active Area

Uniformity value (Lu):

$$Lu = \frac{\min(Li)}{\max(Li)} * 100\%$$

(4).CROSS-TALK

Introduction：

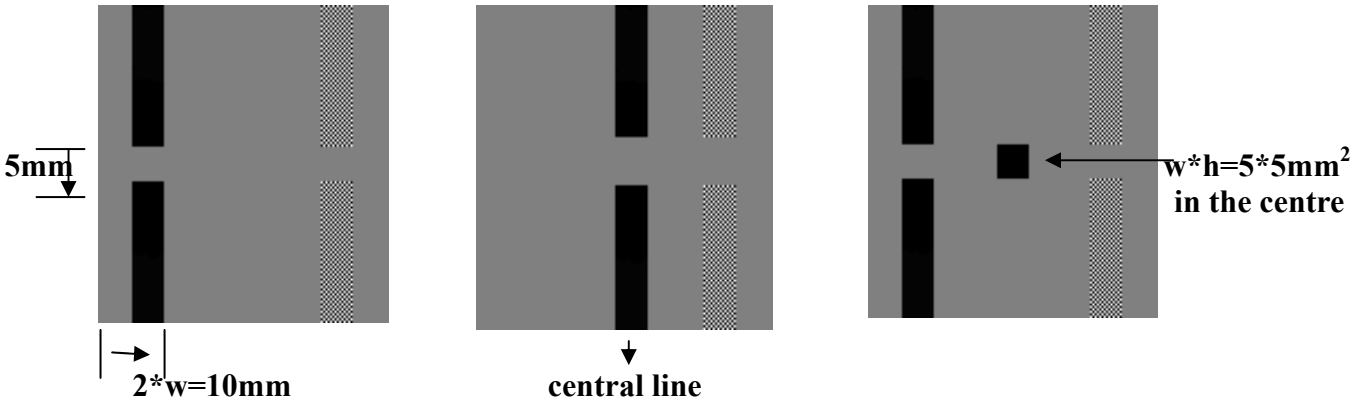
Crosstalk is an effect where the contrast of a display pixel is influenced by the state of the related pixels. A measure for this effect is the Cross Talk Value (CTV)

Measurement conditions:

Measuring Equipment	**CS-200 // BM-7**
Measurement Point Diameter	**3mm // 1mm**
Measurement Point Location	
Light Source	**Transmissive Mode: Internal (Backlight)**
Contrast setting	**Maximum**

●Test Pattern (valid for all greyscales):

W: The width of the rectangle in the following pictures;



Pattern A **Pattern B** **Pattern C**

● Definitions：

Cross Talk Value：

CTV = |LvA - LvB| / LvA * 100%

Where：

LvA: Luminance measured with the centre test point of pattern A

LvB: Luminance measured with the centre test point of pattern B.

● Measuring procedure：

Adaptation of the display to the highest contrast ratio (CR = LvA/LvC) as defined by the test patterns and a test area of 14 x 14 dots.

Measurement of Luminance with test point A, B.

Determination of Crosstalk value (CTV)

(5). NTSC

Measurement conditions:

Measuring Equipment	LCD-5200
Measuring Point Diameter	3mm//1mm
Measuring point location	Active Area center point
Light source	Transmissive Mode: internal(Backlight)
Test pattern	All Pixels White Red.Green.Blue.White: Maximum colour saturation (maximum gradation level)
Contrast setting	Maximum

Definitions

Panel colour coordinates according the CIE colour system (CIE 1931). In general, It is always requested to measure the X, Y and Z values.

Here u´, v´ and L* are according CIE 1931:

$$x' = \frac{4 \cdot X}{X + 15 \cdot Y + 3 \cdot Z}$$

$$y' = \frac{9 \cdot Y}{X + 15 \cdot Y + 3 \cdot Z}$$

$$L^* = 116 \cdot \left(\frac{Y}{Y_n} \right)^{1/3} - 16$$

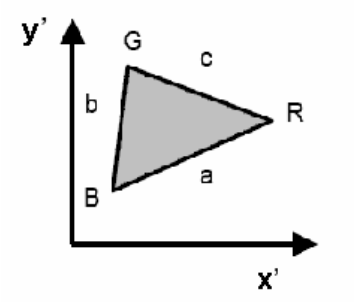
Colour distance definition (maximum allowed colour distance to specified typical colour coordinate):

$$\Delta x'y' = \sqrt{\Delta x'^2 + \Delta y'^2}$$

Where:

$$\Delta x' = Max\left\{ \left| x'_{typ} - x'_{\max} \right|, \left| x'_{typ} - x'_{\min} \right| \right\}$$

$$\Delta y' = Max\left\{ \left| y'_{typ} - y'_{\max} \right|, \left| y'_{typ} - y'_{\min} \right| \right\}$$



Color Gamut definition:

$$F = \sqrt{s(s-a)(s-b)(s-c)} * 1000$$

Where

$$s = \frac{(a+b+c)}{2}$$

$$a = \sqrt{\left(x'_{blue} - x'_{red}\right)^2 + \left(y'_{blue} - y'_{red}\right)^2}$$

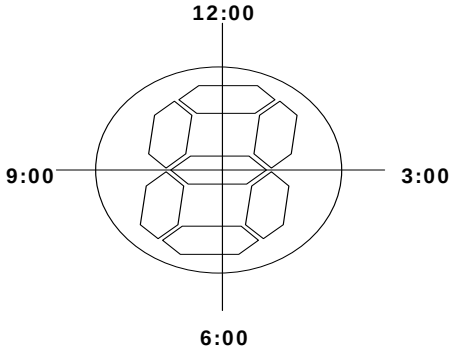
$$b = \sqrt{\left(x'_{blue} - x'_{green}\right)^2 + \left(y'_{blue} - y'_{green}\right)^2}$$

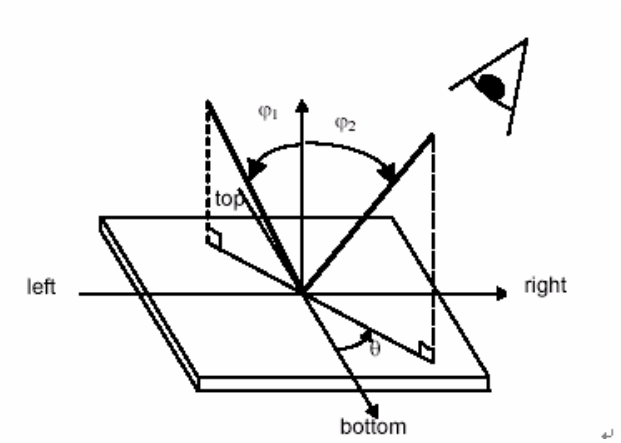
$$c = \sqrt{\left(x'_{red} - x'_{green}\right)^2 + \left(y'_{red} - y'_{green}\right)^2}$$

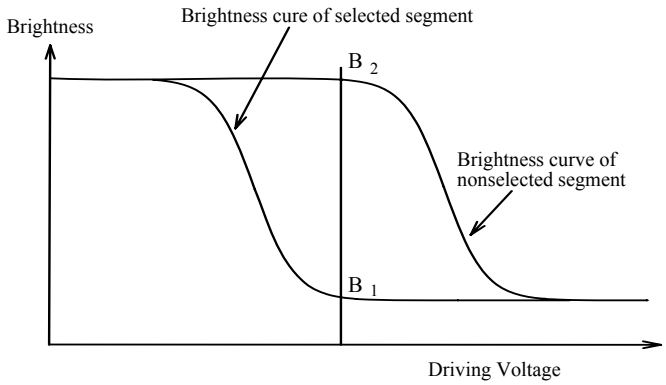
Color Gamut Ratio (NTSC) related to NTSC':
NTSC: =F (display)/F (NTSC')
NTSC' primaries:

	x'	y'
Red	**0.67**	**0.33**
Green	**0.21**	**0.71**
Blue	**0.14**	**0.08**

F (NTSC') =74.42







Perpendicular line (θ=90°)

◆ SPECIFICATION OF QUALITY ASSURANCE

● Summary

The customer should check and accept the products of BYD within one month after reception. This standard for quality assurance should affirm the quality of LCD products to supply to purchaser by BYD COMPANY LIMITED. Entire process is controlled according to ISO9001.

● Warranty period

Warranty period of this product is 12 months from manufacture code.

● Standard for quality test

1、 Inspection

Before delivering, the supplier should take the following test, and confirm the quality of product.

2、 Electro-Optical Characteristics

According to the individual specification to test the product.

3、 Test of Appearance Characteristics:

According to the individual specification to test the product.

4、 Test of Reliability Characteristics

According to the definition of reliability on specification for test product.

5、Delivery Test

Before delivering, the supplier should take the delivery test

6、Sampling Method: GB/T2828.1-2003, Level II

7、The defects classify of AQL as following

Major defect : AQL=0.65

Minor defect:: AQL= 1.5

● Nonconforming Analysis & Deal With Manners

✧ Nonconforming Analysis

1、 Purchaser should supply the detail data of nonconforming sample and the non-suitable state.

2、 After accepting the detail data from purchaser ,the analysis of nonconforming should be finished in two weeks.

3、 If supplier can not finish analysis on time ,must announce purchaser before two weeks.

✧ Disposition of nonconforming

1、 If find any supplier defect during assembly line, supplier must change the good product for every defect after recognition.

2、Both supplier and customer should analysis the reason and discuss the disposition of nonconforming when the reason of nonconforming is not sure.

● Agreement items.

Both sides should discuss together when the following problems happen:

1、 There is any problem of standard of quality assurance, and both sides think that must be modifier.

2、There is any argument item which does not record in the quality assurance.

3、Any other special problem.

● Standard of the Product Appearance Test

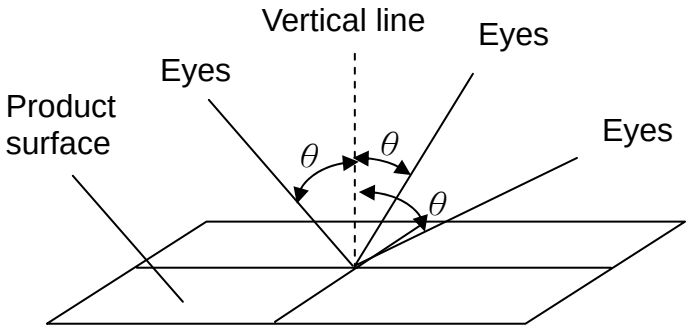
■ Manner of appearance test

1、 The test must be under 20W*2 or 40W fluorescent light ,and the distance of view must be at 30±5

cm;

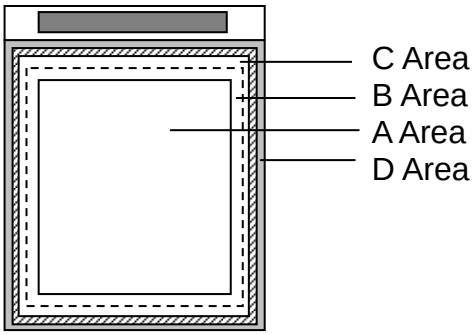
2、 When test the model of Transmissive product must add the reflective plate.

3、 The test direction is base on about around 30 degree(within θ range)of vertical line, and the test time is below 5s.



4、Definition of Area:

A Area: Active area
B Area: Viewing area
C Area: Out of viewing area
D Area: Seal area



Note:
A: Active Area is drawn in the drawing
B: Viewing Area border is 2mm from Active Area border

■ Basic principle:

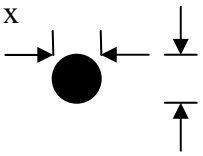
1、 It will accord to the AQL when the standard can not be described.

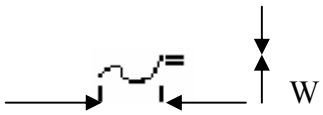
2、 The sample of the lowest acceptable quality level must be discussed by both supplier and customer when any dispute happened.

3、 Must add new item on time when it is necessary.

■ **Inspection specification**

NO	Item	Criterion	AQL
01	Electrical Testing	1.1 Missing vertical, horizontal segment, segment contrast defect. 1.2 Missing character, dot or icon. 1.3 Display malfunction.	

<table>
<tr><td></td><td></td><td>1.4 No function or no display.
1.5 Current consumption exceeds product specifications.
1.6 LCD viewing angle defect.
1.7 Contrast defect</td><td>0.65</td></tr>
<tr><td>02</td><td>LCM black spots, white spots, bright spots , contamination (display/non-display)</td><td>Φ=(x+y)/2
x
 
y
<table>
<tr><th></th><th>Size</th><th>Acceptable QTY</th><th>Remark</th></tr>
<tr><td rowspan="4">Common dots defect</td><td>Φ≦0.15</td><td>Ignore</td><td>/</td></tr>
<tr><td>0.15<Φ≦0.25</td><td>3</td><td>The distance between two defective dots should be larger than 10 mm; for the neglectable dot, there should be no more than 5 dots within 1cm^2</td></tr>
<tr><td>0.25<Φ≤0.30</td><td>2</td><td>/</td></tr>
<tr><td>0.30<Φ</td><td>0</td><td>/</td></tr>
</table></td><td>1.5</td></tr>
</table>

<table>
<tr>
<td>03</td>
<td>Scratches/line type contamination (display/non-display)</td>
<td>As following drawing
 

L
<table>
<tr><th>Length</th><th>Width</th><th>Acceptable QTY</th><th>Remark</th></tr>
<tr><td>---</td><td>W≦0.03</td><td>Ignore</td><td>/</td></tr>
<tr><td>L≦3.5</td><td>0.03< W≦0.05</td><td>3</td><td rowspan="2">More than 10mm between two defects</td></tr>
<tr><td>L≦2.5</td><td>0.05< W≦0.08</td><td>3</td></tr>
<tr><td>---</td><td>0.08< W</td><td>0</td><td>/</td></tr>
</table>
The LCD with extensive crack is not acceptable.</td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>Polarizer bubbles</td>
<td>If bubbles are visible, judge using black spot specifications, not easy to find, must check in specify direction.
<table>
<tr><th>Size</th><th>Acceptable QTY</th><th>Remark</th></tr>
<tr><td>Φ≦0.2 0</td><td>ignore</td><td>/</td></tr>
<tr><td>0.20<Φ≤0.50</td><td>2</td><td>More than 10mm between two defects</td></tr>
<tr><td>0.50<Φ</td><td>0</td><td>/</td></tr>
</table></td>
<td>1.5</td>
</tr>
<tr>
<td>05</td>
<td>Backlight elements</td>
<td>5.1 Illumination source flickers when lit.
5.2 Spots or scratches that appear when lit must be judged using LCD spot, lines and contamination standards.
5.3 Backlight doesn’t light or color is wrong</td>
<td>0.65
1.5

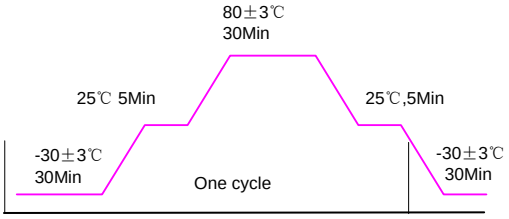
0.65</td>
</tr>
<tr>
<td>06</td>
<td>Soldering</td>
<td>6.1 No unmelted solder paste may be present on the PCB.
6.2 No cold solder joints, missing solder connections, oxidation or icicle.
6.3 No residue or solder balls on PCB.
6.4 No short circuits in components on PCB.</td>
<td>0.65
0.65

1.5
0.65</td>
</tr>
</table>

07	General appearance	7.1 No oxidation, contamination, curves or, bends on interface pin (OLB) of FPC	1.5
		7.2 No cracks on interface pin(OLB) of FPC	0.65
		7.3 NO contamination, solder residue or solder balls on product.	1.5
		7.4 The IC on the FPC may not be damaged, circuits.	0.65
		7.5 The residual rosin or tin oil of soldering (component or chip component) is not burned into brown or black color.	1.5
		7.6 Sealant on top of the ITO circuit has not hardened	1.5
		7.7 Pin type must match type in specification sheet.	1.5
		7.8 LCD pin loose or missing pins.	0.65
		7.9 Product packaging must the same as specified on packaging specification sheet.	1.5
		7.10 Product dimension and structure must conform to product specification sheet.	1.5

◆ RELIABILITY

1. Environmental Test

No	Test Item	Test Condition& Criteria	Sample Size	Determinant Stand.
1-1	High Temperature Operation	Temperature:70±3℃; Humidity: Except; Test method: Operation Duration: 96Hrs	Sample Do:≥2PCS On Going:≥3PCS/ LOT	TS-01 TS-02
1-2	Low temperature Operation	Temperature:-20±3℃; Humidity: Except; Test method: Operation Duration: 96Hrs	Sample Do:≥2PCS On Going:≥3PCS/ LOT	TS-01 TS-02
1-3	High Temperature / High Humidity Operation	Temperature:60±3℃; Humidity: 95%±3%RH; Test method: Operation Duration: 96Hrs	Sample Do:≥2PCS On Going:≥3PCS/ LOT	TS-01 TS-02
1-4	Temperature Shock	Shock Temperature & Time: 	Sample Do:≥2PCS On Going:≥3PCS/ LOT	TS-01 TS-02

		Duration: 20cycle		
1-5	Temperature Cycle	normal temperature 2H→-30±3℃,10H(3H) →60±3℃,90±3%,RH10H(3H) →80±3℃,10H(2H) →(25℃) 5 cycles	Sample Do:≥2PCS On Going:≥3PCS/ LOT	TS-01 TS-02

Item	FAULT JUDGMENT CRITERIA
TS-01	1. Contrast ratio must be at least 50% of initial value. 2. R, G and B color area must be at least 0.5 times initial value. 3. Current consumption must not exceed 2 times initial value.
TS-02	1. No clearly visible defects or deterioration of display quality allowed. 2. No function – related abnormalities.

NOTE：

1. When temperature moves, LCD's valve voltage will be influenced by it, which leads to LCD's contrast and chroma change.
2. In high temperature operation and storage tests in MQE test will make LCD's power consumption increase. The reason is that a few crystal molecules are apart because of high temperature when there is a long time storage and operation in high temperature, which leads to decrease of gross resistance ratio of crystal molecules. Hence, LCD's power consumption goes up than that of before test.

2. Mechanical Reliability Test

No.	Test Item	Test Condition& Criteria	Sample Size	Determinant Spec.
2-1	ESD test	Discharge modality: Contact voltage: ±1KV、±2KV; Air voltage: ±2KV、±4KV、±6KV; (Discharge R=330Ω;C=150PF)	2PCS	No software error
2-2	LCM monomer drop test	Drop high:60cm~80cm； Drop to ground: marble Drop direction /times:3 times each obverse and inverse	2PCS	The inspection of appearance、the whole structure no error

3. Soldering

(1) Soldering temperature: 340+/-10℃.
(2) Available times for repeated soldering: 5 times
(3) Attentions paid when soldering：

A. FPC's golden finger and soldering pad are butt-jointed before soldered. Tolerance is within the 1/3 width of golden finger and 0.5~1mm of FPC's length is allowed to be exposed in the jointed soldering pad.

B. Coat proper tin in the iron-head when soldering, with dragging speed of 2.5cm/sec.
C. The soldering part is warmed up first with iron-head when there is a rework. Then heat it up from one side until tin is melted, last, take off FPC.

4. FPC cable flexing and bending test

Number of Bending / Flexing Cycles:	<10 times
Radius of the Bend Mandrels:	>0.4 mm
Degree of Bend:	<180°

◆ SUGGESTIONS FOR USING LCD MODULES

- **Handling of LCM**

(1) The LCD screen is made of glass. Don't give excessive external shock, or drop from a high place.

(2) If the LCD screen is damaged and the liquid crystal leaks out, do not lick and swallow. When the liquid is attach to your hand, skin, cloth etc, wash it off by using soap and water thoroughly and immediately.

(3) Don't apply excessive force on the surface of the LCM.

(4) If the surface is contaminated ,clean it with soft cloth. If the LCM is severely contaminated , use Isopropyl alcohol/Ethyl alcohol to clean. Other solvents may damage the polarizer . The following solvents is especially prohibited: water , ketone Aromatic solvents etc.

(5) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

(6) Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.

(7) Don’t disassemble the LCM.

(8) To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Be sure to ground the body when handling the LCD modules.
- Tools required for assembling, such as soldering irons, must be properly grounded.
- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

(9) Do not alter, modify or change the the shape of the tab on the metal frame.

(10) Do not make extra holes on the printed circuit board, modify its shape or change the positions of

components to be attached.

(11) Do not damage or modify the pattern writing on the printed circuit board.

(12) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector

(13) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.

(14) Do not drop, bend or twist LCM

.

- **Storage**

(1) Store in an ambient temperature of 5 to 45 °C, and in a relative humidity of 40% to 60%. Don't expose to sunlight or fluorescent light.

(2) Storage in a clean environment, free from dust, active gas, and solvent.

(3) Store in antistatic container.

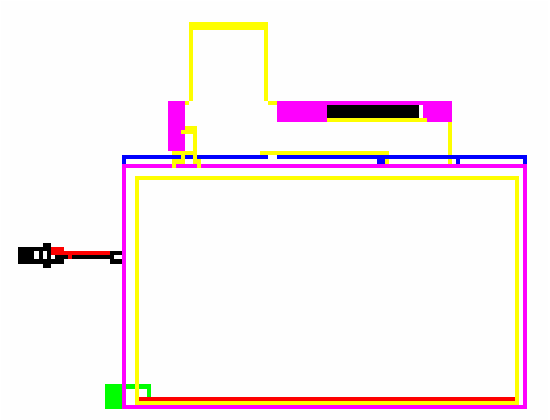
◆ PACKING

- **Packing Materials**

NO.	ITEM	Dimension(LXWXH) (mm)	Quantity
1	Middle box	386X335X118mm	40
2	Big box	409X360X265mm	80

- **Packing Method**

(1) (2)

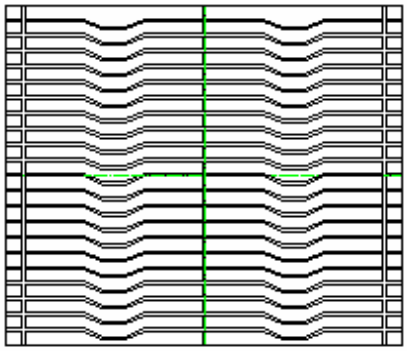


LCM sketch-map

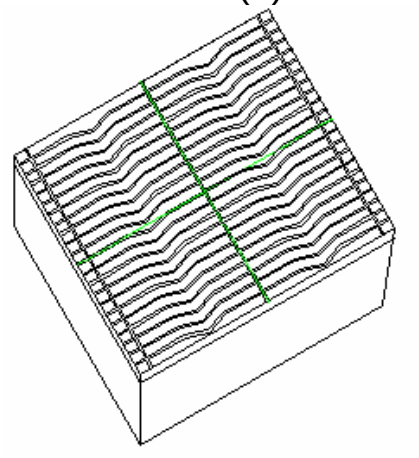
Put the LCM into gas bubbles bag

(3)

(4)



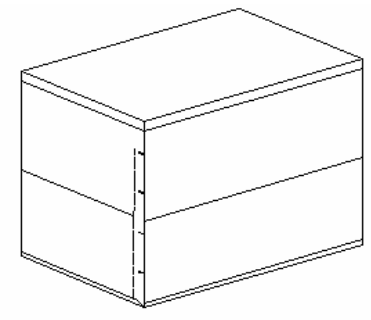
(Groove aggregate sketch-map)

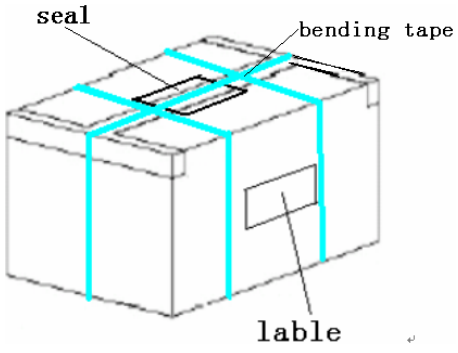


(Put the bag with LCM into the groove)

(5)

(6)





One box with two layers Groove aggregate

End

◆ ENVIRONMENT-RELATED SUBSTANCES

- Meet with BYD Environment-Related Substances Controlled Standard BHS-001