PRODUCT SPECIFICATIONS

For Customer: _____ ☐ : APPROVAL FOR SPECIFICATION

Customer Model No. _____ ☐ : APPROVAL FOR SAMPLE

Module No.: IE-A-0406C04P/S-00-1 *Date : 2022-06-8*

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For Customer's Acceptance:

Approved By	Comment

PREPARED	CHECKED	VERIFIED BY QA DEPT	VERIFIED BY R&D DEPT

2. Revision Record

Date	Rev.No.	Page	Revision Items	Prepared
2022.6.8	V0		The first release	

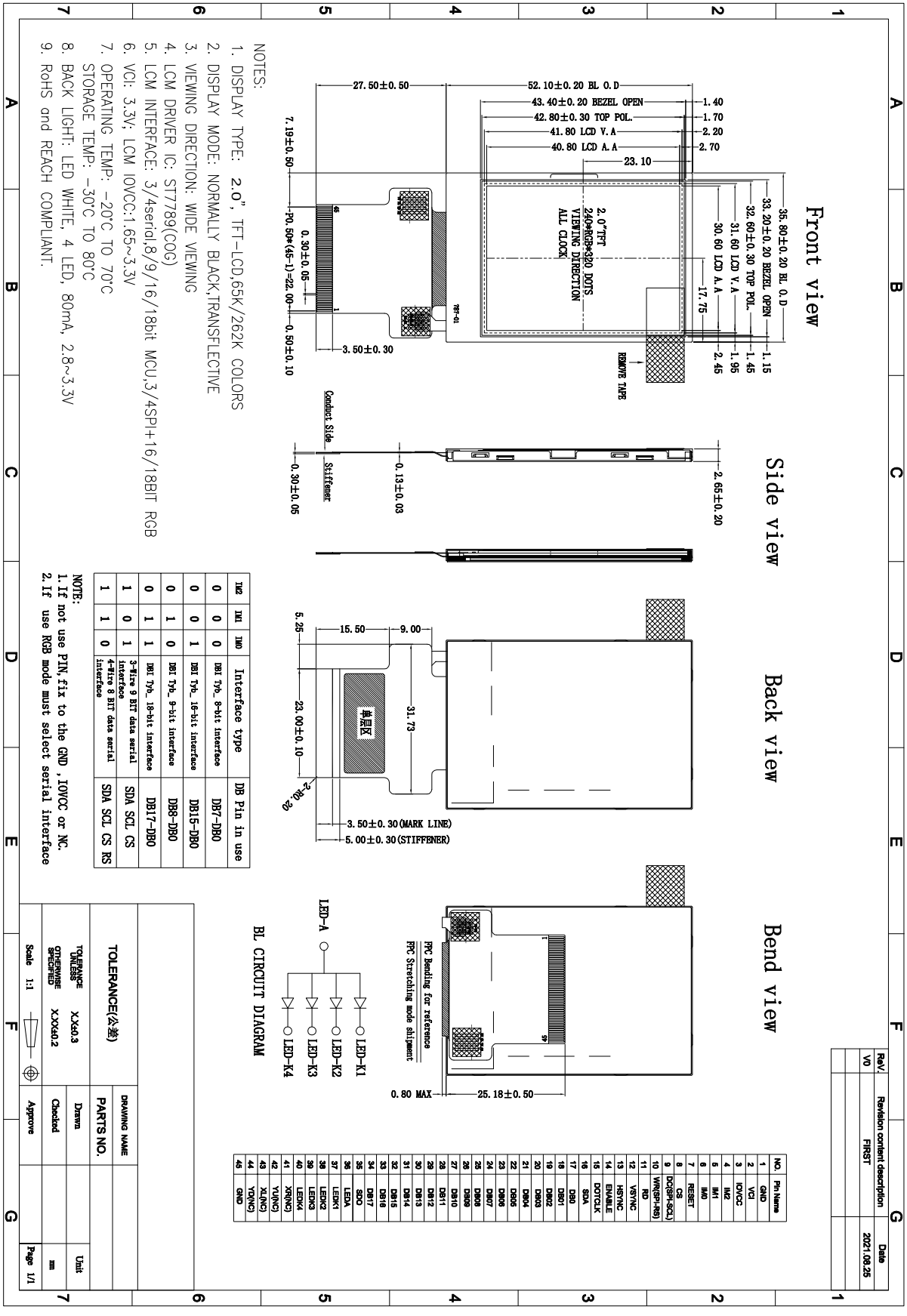
3. General Specifications

IE-A-0406C04P/S-00-1 *is a TFT-LCD module. It is composed of a TFT-LCD panel, driver IC, FPC, a back light unit. The 2.0″ display area contains 240*(RGB)*x320 pixels and can display up to 262K colors. This product accords with ROHS environmental criterion.*

Item	Contents	Unit	Note
LCD Type	TFT	-	
Display color	262K		1
Viewing Direction	ALL	O'Clock	
Operating temperature	-20~+70	℃	
Storage temperature	-30~+80	℃	
Module size	Refer to drawing	mm	2
Active Area(W×H)	30.6X40.8	mm	
Number of Dots	240×320	dots	
Controller	ST7789V	-	
Power Supply Voltage	3.3	V	
Backlight	4P-LEDs (white)	pcs	
Weight	---	g	
Interface	MCU/RGB	-	

Note 1: Color tune is slightly changed by temperature and driving voltage.

4.Outline.Drawing



IM2	IM1	IM0	Interface type	DB Pin in use
0	0	0	DBI Typ. 8-bit interface	DB7-DB0
0	0	1	DBI Typ. 16-bit interface	DB15-DB0
0	1	0	DBI Typ. 9-bit interface	DB8-DB0
0	1	1	DBI Typ. 18-bit interface	DB17-DB0
1	0	1	3-Wire 9 BIT data serial interface	SDA SCL CS
1	1	0	4-Wire 8 BIT data serial interface	SDA SCL CS RS

NO.	Pin Name
1	GND
2	VCI
3	IOVCC
4	IM2
5	IM1
6	IM0
7	RESET
8	CS
9	DC(SPI-SCL)
10	WR(SPI-SDA)
11	RD
12	VSYNC
13	HSYNC
14	ENABLE
15	DOTCLK
16	SDA
17	DB0
18	DB01
19	DB02
20	DB03
21	DB04
22	DB05
23	DB06
24	DB07
25	DB08
26	DB09
27	DB10
28	DB11
29	DB12
30	DB13
31	DB14
32	DB15
33	DB16
34	DB17
35	SDO
36	LEDA
37	LEDK1
38	LEDK2
39	LEDK3
40	LEDK4
41	XR(NC)
42	YU(NC)
43	XL(NC)
44	YD(NC)
45	GND

5. Absolute Maximum Ratings(Ta=25℃)

5.1 Electrical Absolute Maximum Ratings.(Vss=0V ,Ta=25℃)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VCI	-0.3	4.6	V	1，2
	IOVCC	-0.3	4.6		

Notes:1. If the module is 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. $V_{CI} > V_{SS}$ must be maintained.

3. Please be sure users are grounded when handing LCD Module.

5.2 Environmental Absolute Maximum Ratings.

Item	Storage		Operating		Note
	MIN.	MAX.	MIN.	MAX.	
Ambient Temperature	-30℃	80℃	-20℃	70℃	1,2
Humidity	-	-	-	-	3

1. The response time will become lower when operated at low temperature.

2. Background color changes slightly depending on ambient temperature.

The phenomenon is reversible.

3. Ta<=40 ℃:85%RH MAX.

Ta>=40 ℃:Absolute humidity must be lower than the humidity of 85%RH at 40 ℃.

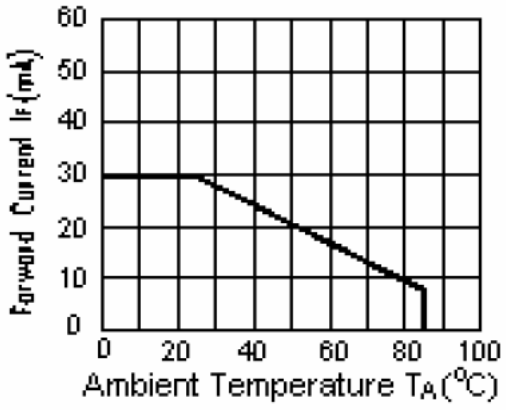
6. Electrical Specifications

6.1 Electrical characteristics(Vss=0V ,Ta=25℃)

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Note
Power supply		VCI	Ta=25℃	2.4	2.8	3.3	V	
		IOVCC	Ta=25℃	1.65	1.8	3.3	V	
		IDD	Ta=25℃	-	7	-	mA	
Input voltage	‘H’	V_{IH}	VCI=3.3V	0.7* VCI	-	VCI	V	
	‘L’	V_{IL}	VCI=3.3V	0	-	0.3* VCI	V	

6.2 LED backlight specification(VSS=0V ,Ta=25℃)

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply voltage	V_f	If=80mA	-	3.2	-	V	
Uniformity	∆Bp	If=80mA	80	-	-	%	
Life Time	time	If=80mA	50K	-		hours	1



Note 1: Brightness to be decreased to 50% of the initial value at ambient temperature TA=25 ℃

6.3 Interface signals

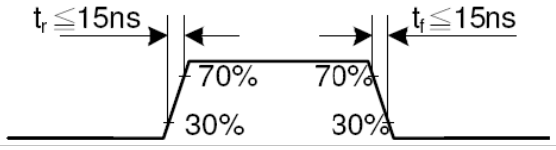
Pin No.	Symbol	Function
1	GND	Ground.
2	VCI	Supply voltage (3.3V)
3	IOVCC	Supply voltage (1.65-3.3V).
4	IM2	MPU Parallel interface bus and serial interface select If use RGB Interf ace must select serial interface. Fix this pin at VCI and GND.
5	IM1	
6	IM0	
7	RESET	This signal will reset the device and must be applied to properly initialize the chip.
8	CS	Frame sync signal
9	DC(SPI-SCL)	-Display data/command selection pin in parallel interface. -This pin is used to be serial interface clock. DC=’1’: display data or parameter. DC=’0’: command data. -If not used, please fix this pin at VDDI or DGND.
10	WR(SPI-RS)	-Write enable in MCU parallel interface. - Display data/command selection pin in 4-line serial interface. - Second Data lane in 2 data lane serial interface. -If not used, please fix this pin at VDDI or DGND.
11	RD	Serves as a read signal and MCU read data at the rising edge. fix this pin at VCI or GND when not in use.
12	VSYNC	Frame synchronizing signal for RGB interface operation. fix this pin at VCI or GND when not in use.
13	HSYNC	Line synchronizing signal for RGB interface operation. fix this pin at VCI or GND when not in use.
14	ENABLE	Data enable signal for RGB interface operation. fix this pin at VCI or GND when not in use.
15	DOTCLK	Dot clock signal for RGB interface operation. Fix this pin at VCI or GND when not in use.
16	SDA	Serial input signal. The data is latched on the rising edge of the SCL signal. fix this pin at VCI or GND when not in use.

17-34	DB0-DB17	18-bit parallel bi-directional data bus for MCU system and RGB i nterface mode . Fix to GND level when not in use
35	SDO	SPI interface output pin. -The data is output on the falling edge of the SCL signal. -If not used, let this pin open.
36	LEDA	Anode pin of backlight
37-40	LEDK1~4	Cathode pin OF backlight
41	XR(NC)	Touch panel Right Glass Terminal
42	YU(NC)	Touch panel Top Film Terminal
43	XL(NC)	Touch panel LIFT Glass Terminal
44	YD(NC)	Touch panel Bottom Film Terminal
45	GND	Ground

6.4 AC Characteristics

Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	10	-	ns	
CSX	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	twc	Write cycle	66	-	ns	
	twrh	Write Control pulse H duration	15	-	ns	
	twrl	Write Control pulse L duration	15	-	ns	
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
D[17:0], D[15:0], D[8:0], D[7:0]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

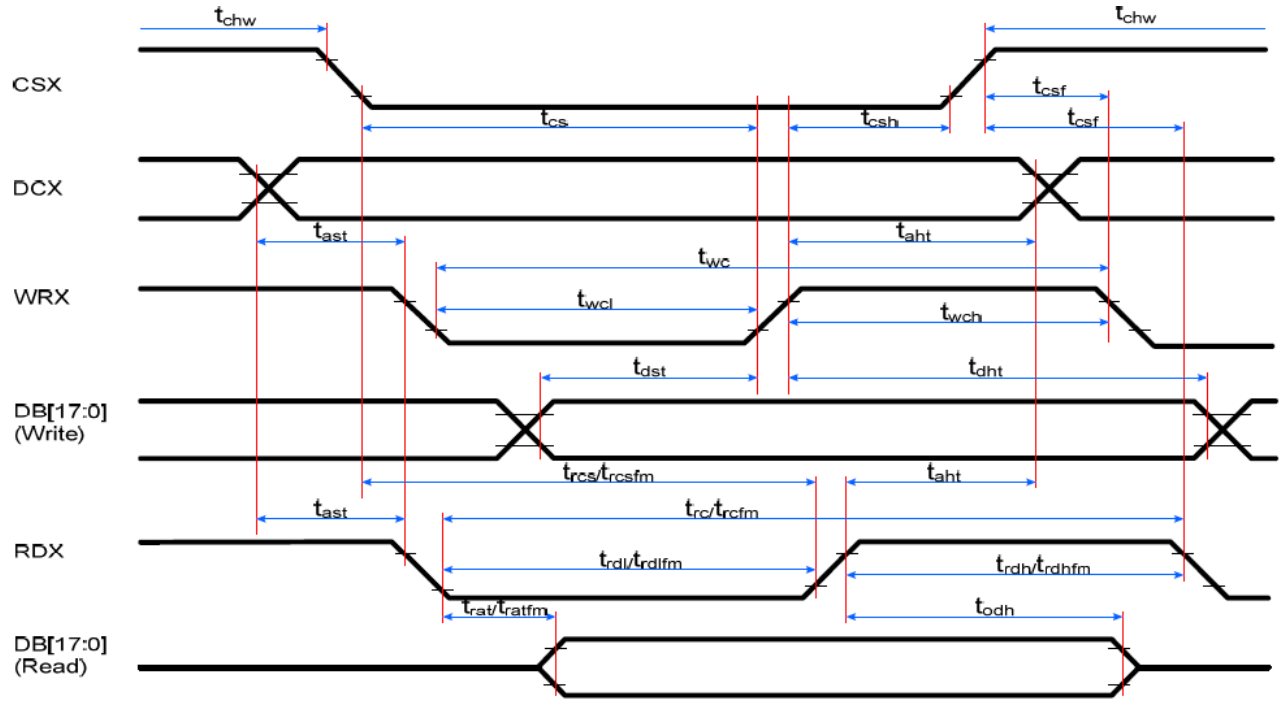
Note: Ta = -30 to 70 ℃, IOVCC=1.65V to 2.8V, VCI=2.6V to 3.3V, GND=0V

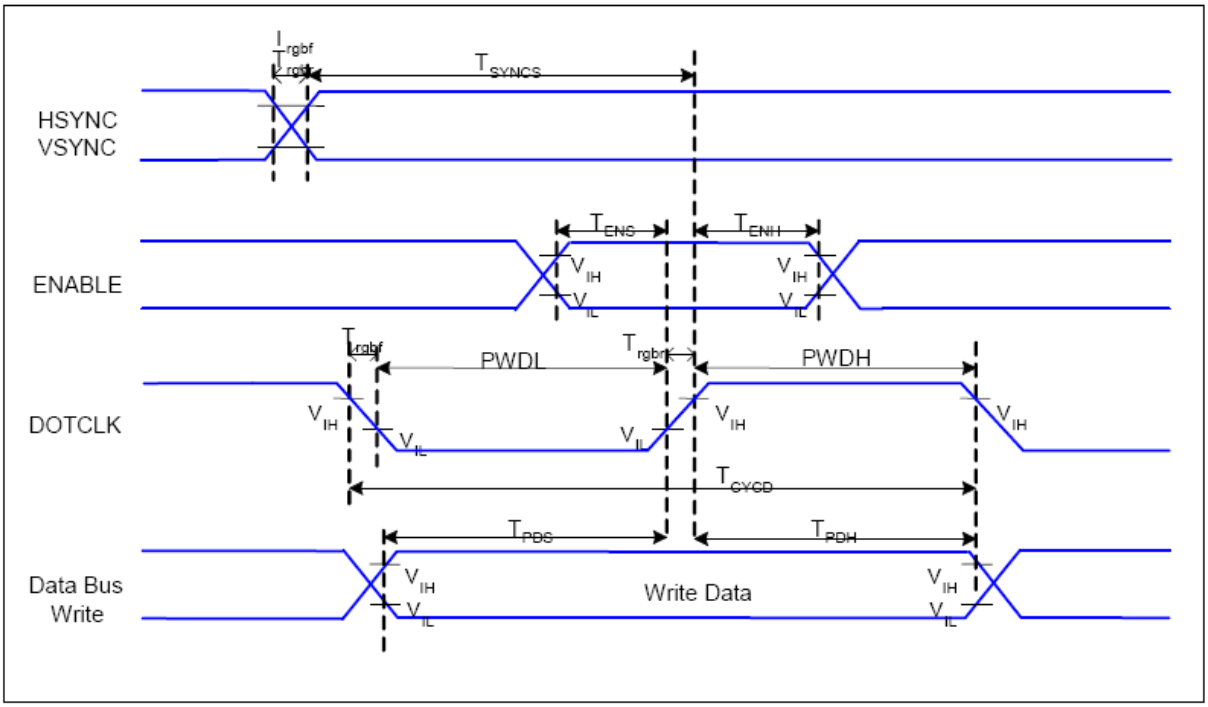


VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 ~ 70 ℃

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
HSYNC, VSYNC	T_{SYNCS}	VSYNC, HSYNC Setup Time	30	-	ns	
ENABLE	T_{ENS}	Enable Setup Time	25	-	ns	
	T_{ENH}	Enable Hold Time	25	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	60	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	60	-	ns	
	T_{CYCD}	DOTCLK Cycle Time	120	-	ns	
	Trghr, Trghf	DOTCLK Rise/Fall time	-	20	ns	
DB	T_{PDS}	PD Data Setup Time	50	-	ns	
	T_{PDH}	PD Data Hold Time	50	-	ns	

6.5 Timing diagram





7. *Optical Characteristics*

Item	Symbol		**Condition**	Min.	Typ.	Max.	Unit	Note
Brightness	Bp		θ=0° Φ=0°	330	345	-	Cd/m^2	1
Uniformity	⊿Bp			80	-	-	%	1,2
Viewing Angle	3:00		Cr≥10	-	80	-	Deg	3
	6:00			-	80	-		
	9:00			-	80	-		
	12:00			-	80	-		
Contrast Ratio	Cr		θ=0° Φ=0°	600	800	-	-	4
Response Time	$T_{r+}T_f$			-	35	45	ms	
Color of CIE Coordinate（±0.03）	W	x	θ=0° Φ=0°	-	0.333	-	-	1,6
		y			0.385		-	
	R	x			0.522		-	
		y			0.338		-	
	G	x			0.345		-	
		y			0.539		-	
	B	x			0.169		-	
		y			0.182		-	
NTSC Ratio	S			-	TBD	-	%	

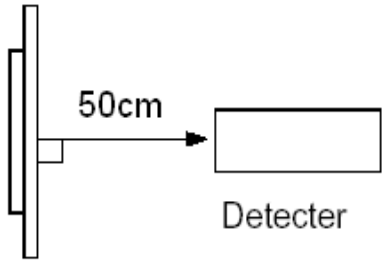
Note：The parameter is slightly changed by temperature, driving voltage and materiel

*Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipm*ent BM-7 (Φ5mm)

Measuring condition:

- *Measuring surroundings: Dark room.*
- *Measuring temperature: Ta=25℃.*
- *Adjust operating voltage to get optimum contrast at the center of the display.*

Measured value at the center point of LCD panel after more than 5 minutes while backlight turning on.

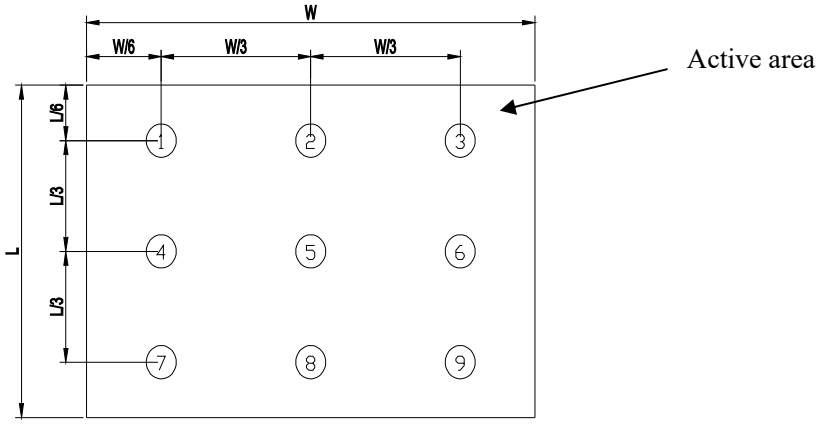


Note 2: The luminance uniformity is calculated by using following formula.

⊿Bp = Bp (Min.) / Bp (Max.)×100 (%)

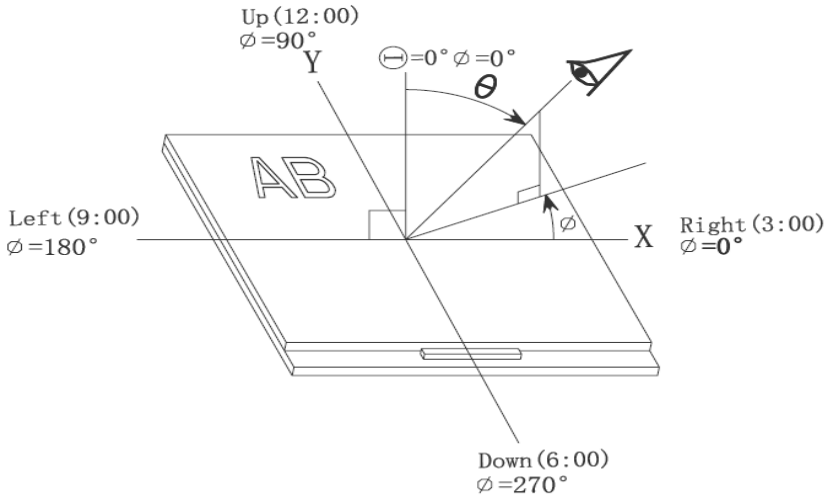
Bp (Max.) = Maximum brightness in 9 measured spots

Bp (Min.) = Minimum brightness in 9 measured spots.

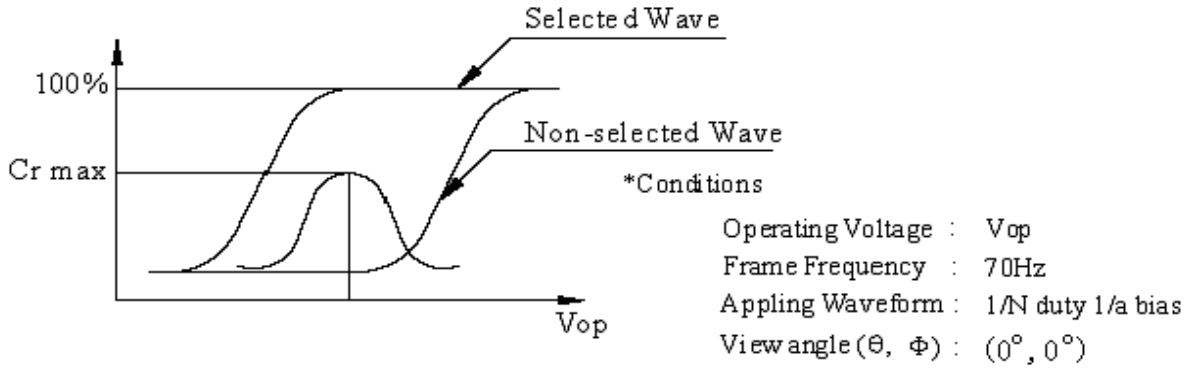


Note 3: The definition of viewing angle:

Refer to the graph below marked by ϑ and Φ



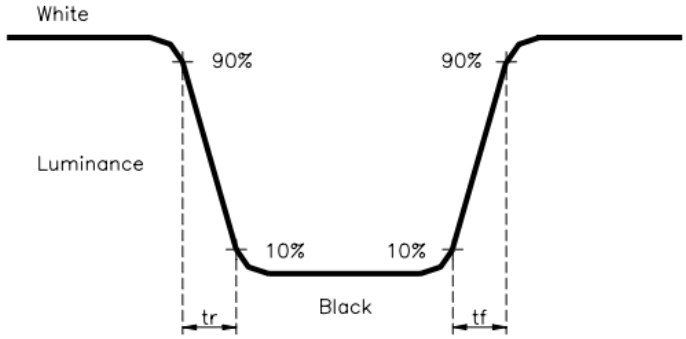
Note 4: Definition of contrast ratio.(Test LCD using DMS501)



$$Contrast\ ratio(Cr) = \frac{Brightness\ of\ selected\ dots}{Brightness\ of\ non-selected\ dots}$$

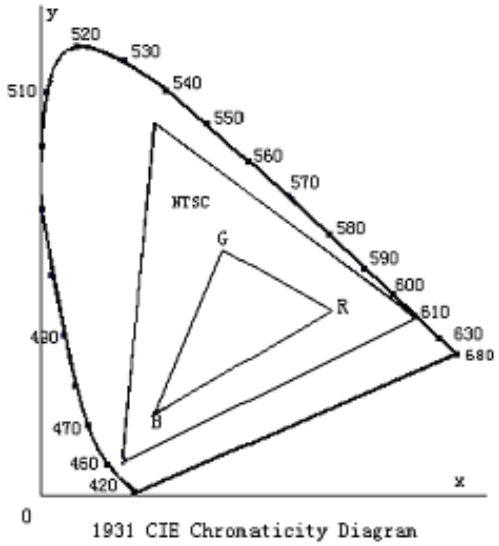
Note 5: Definition of Response time. (Test LCD using DMS501):

The output signals of photo detector are measured when the input signals are changed from"white"to"black"(rising time) and from "black" to "white"(falling time) , respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes.Refer to figure as below.



The definition of response time

Note 6: Definition of Color of CIE Coordinate and NTSC Ratio.

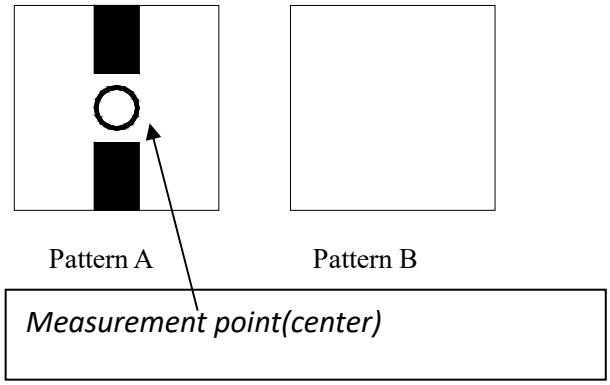


1931 CIE Chromaticity Diagram

Color gamut:

$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$

Note 7: Definition of cross talk.
*Cross talk ratio(%)=|pattern A Brightness-pattern B Brightness|/pattern A Brightness*100*



Electric volume value=3F+/-3Hex

8. Reliability Test Items and Criteria

No	Test Item	Test condition	Criterion
1	High Temperature Storage	80℃±2℃ 96H Restore 2H at 25℃ Power off	1. After testing, cosmetic and electrical defects should not happen. 2. Total current consumption should not be more than twice of initial value.
2	Low Temperature Storage	-30℃±2℃ 96H Restore 2H at 25℃ Power off	
3	High Temperature Operation	70℃±2℃ 96H Restore 2H at 25℃ Power on	
4	Low Temperature Operation	-20℃±2℃ 96H Restore 4H at 25℃ Power on	
5	High Temperature/Humidity Storage	60℃±2℃ 90%RH 96H Power on	
6	Temperature Cycle	-30℃←——→80℃ 30min 5min 30min after 5 cycle, Restore 2H at 25℃ Power off	

Note: Operation: Supply 3.3V for logic system.

The inspection terms after reliability test, as below

ITEM	Inspection
Contrast	CR>50%
IDD	IDD<200%
Brightness	Brightness>60%
Color Tone	Color Tone+/-0,05

9. *Precautions for Use of LCD Modules*

9.1 Handling Precautions

9.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

9.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

9.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

9.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

9.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

— Isopropyl alcohol — Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

— Water — Ketone — Aromatic solvents

9.1.6 Do not attempt to disassemble the LCD Module.

9.1.7 If the logic circuit power is off, do not apply the input signals.

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

a. Be sure to ground the body when handling the LCD Modules.

b. Tools required for assembly, such as soldering irons, must be properly ground.

c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

d. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

9.2 Storage precautions

9.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

9.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : *0℃ ～ 40℃*

Relatively humidity: *≤80%*

9.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

9.3 ***The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.***

END