



# **GlobalTech Display**

*A Professional LCD Displays Provider*

## **TFT LCD Display Specification**

**PN: GLT024240320TR2**

### Overview:

- 2.4" Diagonal
- TN 6 O' Clock
- Driver: ST7789V
- 262K Colors
- 350 Nits
- 240 x 320 Pixels
- Transmissive
- MCU 8/16
- No Touch Panel
- RoHS Compliant

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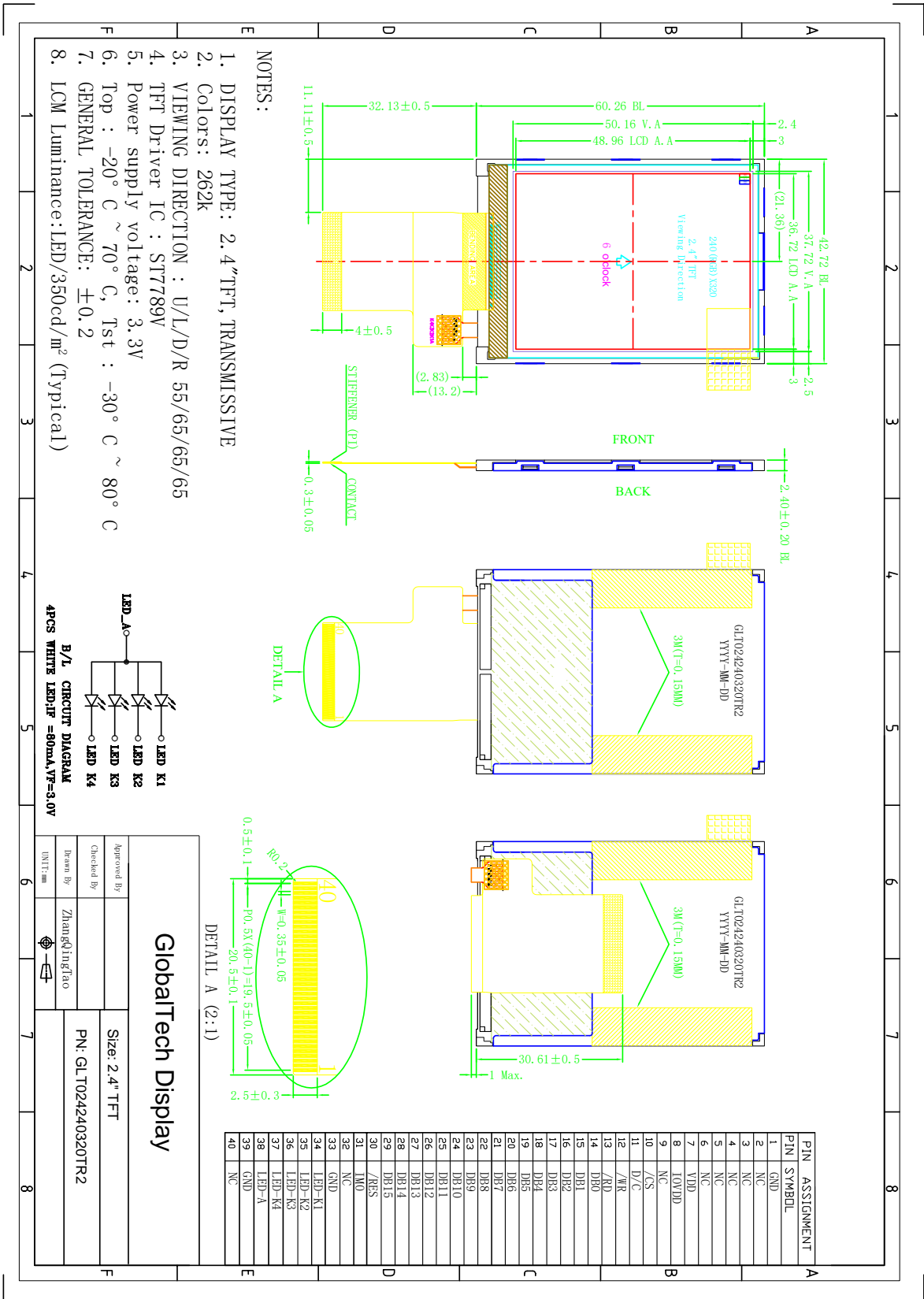


## 2. General Specifications

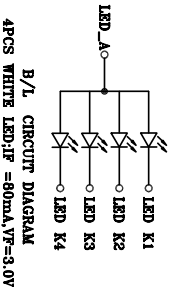
GLT024240320TR2 is a TFT-LCD module, which is composed of a TFT-LCD panel, driver IC, FPC, a back light. The 2.4" display area contains 240x320 pixels and can display up to 262K colors. This product accords with ROHS environmental criterion.

Item	Contents	Unit	Note
LCD Type	TFT	-	
Display color	262K	Color	
Viewing Direction	6	O' Clock	
Operating temperature	-20 ~ +70	°C	
Storage temperature	-30 ~ +80	°C	
Module size	Refer to outline drawing	mm	
Active Area(W×H)	48.96 x 36.72	mm	
Number of Dots	240 x 320	dots	
Controller	ST7789V	-	
TFT Power Supply Voltage	3.3	V	
Backlight	1*4-LEDs (white)	pcs	
Weight	~10	g	
Interface	MCU interface	-	

# 3. Mechanical Drawing



- NOTES:**
1. DISPLAY TYPE: 2.4" TFT, TRANSMISSIVE
  2. Colors: 262K
  3. VIEWING DIRECTION : U/L/D/R 55/65/65/65
  4. TFT Driver IC : ST7789V
  5. Power supply voltage: 3.3V
  6. Top : -20° C ~ 70° C, Tst : -30° C ~ 80° C
  7. GENERAL TOLERANCE: ±0.2
  8. LCM Luminance: LED/350cd/m<sup>2</sup> (Typical)



<b>GlobalTech Display</b>	
Approved By	Size: 2.4" TFT
Checked By	
Drawn By	PN: GLT024240320TR2
UNIT:mm	

PIN	ASSIGNMENT
1	NC
2	GND
3	NC
4	NC
5	NC
6	NC
7	VDD
8	TOVDD
9	NC
10	/CS
11	D/C
12	/MR
13	/RD
14	DB0
15	DB1
16	DB2
17	DB3
18	DB4
19	DB5
20	DB6
21	DB7
22	DB8
23	DB9
24	DB10
25	DB11
26	DB12
27	DB13
28	DB14
29	DB15
30	/RBS
31	TM0
32	NC
33	GND
34	LED-K1
35	LED-K2
36	LED-K3
37	LED-K4
38	LED-A
39	GND
40	NC

## 4. Absolute Maximum Rating (Ta=25°C)

### 4.1 Electrical Absolute Maximum Rating (Vss=0V ,Ta=25°C)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VCC	-0.3	3.6	V	1, 2

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.

### 4.2 Environmental Absolute Maximum Rating

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

Notes:

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.  $T_a \leq 40^\circ\text{C}$ : 85%RH MAX.  
 $T_a \geq 40^\circ\text{C}$ : Absolute humidity must be lower than the humidity of 85%RH at 40°C.

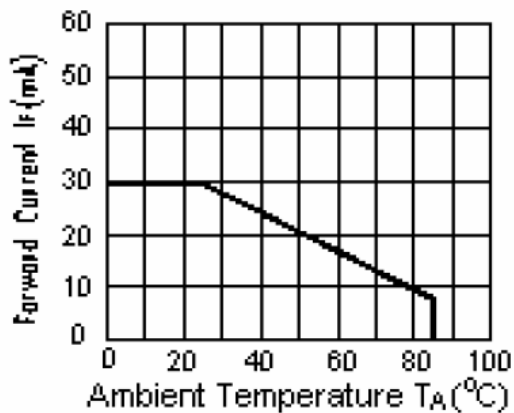
## 5. Electrical Specifications

### 5.1 Electrical characteristics (V<sub>SS</sub>=0V, T<sub>a</sub>=25°C)

Parameter	Symbol	Condition	Min	Typ	Max	Unit	
Power Supply Voltage	V <sub>CI</sub>	T <sub>a</sub> =25°C	2.4	2.8	3.3	V	
Input voltage	'H'	V <sub>IH</sub>	T <sub>a</sub> =25°C	0.7*IOVCC	-		IOVCC
	'L'	V <sub>IL</sub>	T <sub>a</sub> =25°C	0	-		0.3*IOVCC

### 5.2 LED backlight specification (V<sub>SS</sub>=0V, T<sub>a</sub>=25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply voltage	V <sub>f</sub>	I <sub>f</sub> =80mA	-	3	-	V	
Uniformity	ΔB <sub>p</sub>	I <sub>f</sub> =80mA	80	-	-	%	
Life Time	time	I <sub>f</sub> =80mA	20K	-	-	hours	1
Luminance for LCD	L <sub>v</sub>	I <sub>f</sub> =80mA	-	350	-	Cd/m <sup>2</sup>	



Note 1: Brightness to be decreased to 50% of the initial value at ambient temperature  $T_A=25^\circ\text{C}$

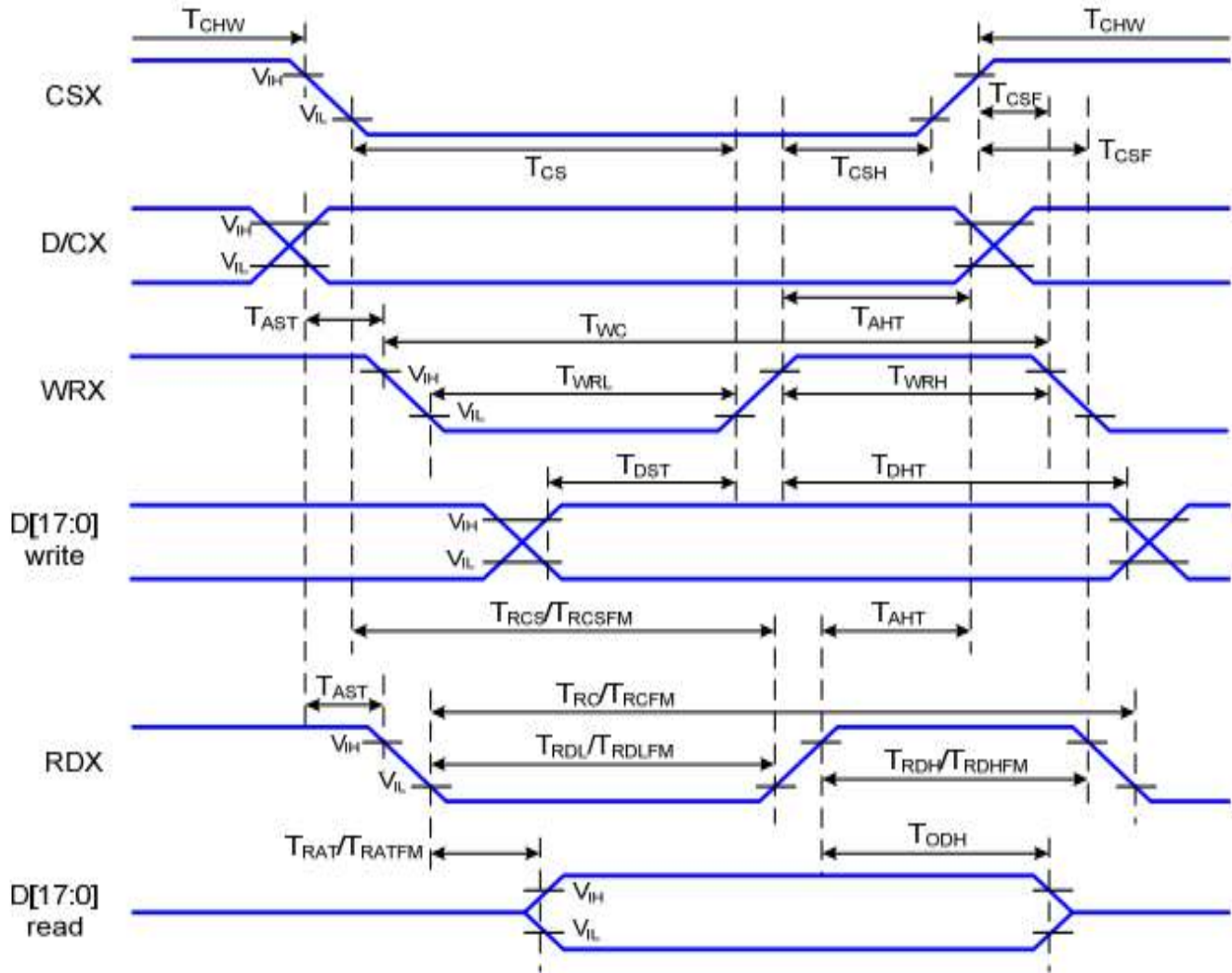
### 5.3 Interface signals

Pin No.	Symbol	I/O	Function
1	GND	P	Ground
2-6	NC	-	No connection
7	VDD	P	Power supply
8	IOVDD	P	Power Supply for I/O
9	NC	-	No connection
10	/CS	I	Chip select signal
11	D/C	I	Display data/command selection pin in parallel interface
12	/WR	I	Write enable in MCU parallel interface
13	/RD	I	Read enable in MCU parallel interface
14-29	DB0-DB15	I	Data bus
30	/RES	I	Reset the display
31	IM0	I	The MCU interface mode select
32	NC	-	No connection
33	GND	P	Ground
34	LED-K1	P	LED back light(Cathode)
35	LED-K2	P	
36	LED-K3	P	
37	LED-K4	P	
38	LED-A	P	LED back light(Anode)
39	GND	P	Ground
40	NC	-	No connection



## 5.4 TFT AC Characteristics

### 5.4.1 MCU Interface Characteristics



Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	$T_{AST}$	Address setup time	0		ns	-
	$T_{AHT}$	Address hold time (Write/Read)	10		ns	
CSX	$T_{CHW}$	Chip select "H" pulse width	0		ns	-
	$T_{CS}$	Chip select setup time (Write)	15		ns	
	$T_{RCS}$	Chip select setup time (Read ID)	45		ns	
	$T_{RCSFM}$	Chip select setup time (Read FM)	355		ns	
	$T_{CSF}$	Chip select wait time (Write/Read)	10		ns	
	$T_{CSH}$	Chip select hold time	10		ns	
WRX	$T_{WC}$	Write cycle	66		ns	
	$T_{WRH}$	Control pulse "H" duration	15		ns	
	$T_{WRL}$	Control pulse "L" duration	15		ns	
RDX (ID)	$T_{RC}$	Read cycle (ID)	160		ns	When read ID data
	$T_{RDH}$	Control pulse "H" duration (ID)	90		ns	
	$T_{RDL}$	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	$T_{RCFM}$	Read cycle (FM)	450		ns	When read from frame memory
	$T_{RDHFM}$	Control pulse "H" duration (FM)	90		ns	
	$T_{RDLFM}$	Control pulse "L" duration (FM)	355		ns	
D[17:0]	$T_{DST}$	Data setup time	10		ns	For CL=30pF
	$T_{DHT}$	Data hold time	10		ns	
	$T_{RAT}$	Read access time (ID)		40	ns	
	$T_{RATFM}$	Read access time (FM)		340	ns	
	$T_{ODH}$	Output disable time	20	80	ns	

## 6. Optical Characteristics

Item	Symbol		Condition	Min.	Typ.	Max.	Unit	Note
Brightness	Bp		$\theta=0^\circ$ $\Phi=0^\circ$	-	350	-	Cd/m <sup>2</sup>	1
Uniformity	$\Delta$ Bp			80	-	-	%	1,2
Viewing Angle	3:00		Cr $\geq$ 10	-	65	-	<b>Deg</b>	<b>3</b>
	6:00			-	65	-		
	9:00			-	65	-		
	12:00			-	55	-		
Contrast Ratio	Cr		$\theta=0^\circ$ $\Phi=0^\circ$	150	200	-	-	4
Response Time	T <sub>r</sub> +T <sub>f</sub>			-	30	-	ms	5
Color of CIE Coordinate	W	x	$\theta=0^\circ$ $\Phi=0^\circ$	Typ. -0.05	0.308	Typ. +0.05	-	1,6
		y			0.325		-	
	R	x			0.612		-	
		y			0.329		-	
	G	x			0.299		-	
		y			0.567		-	
	B	x			0.144		-	
		y			0.110		-	
NTSC	S			55	60	-	%	

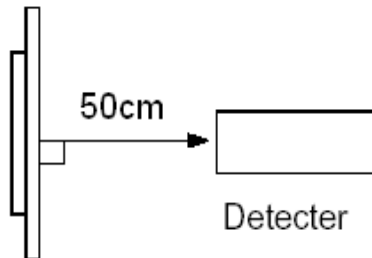
Note: The parameter is slightly changed by temperature, driving voltage and material

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 equipment BM-7 (Φ5mm)

Measuring condition:

- Measuring surroundings: Dark room.
- Measuring temperature:  $T_a=25^{\circ}\text{C}$ .
- 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.

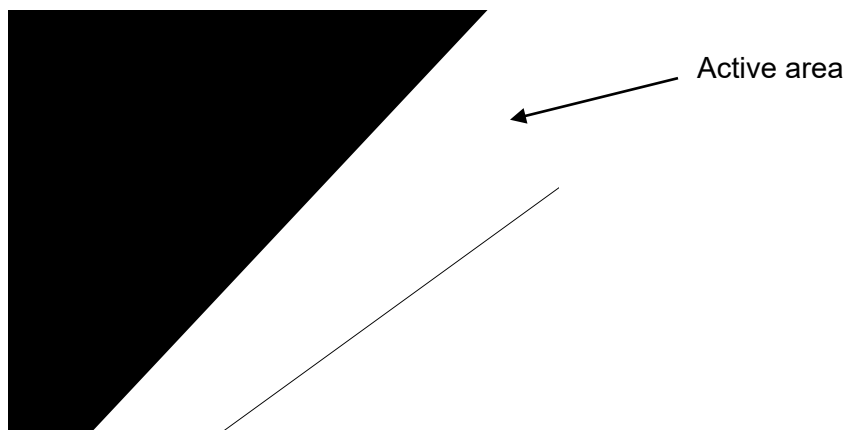


Note 2: The luminance uniformity is calculated by using following formula.

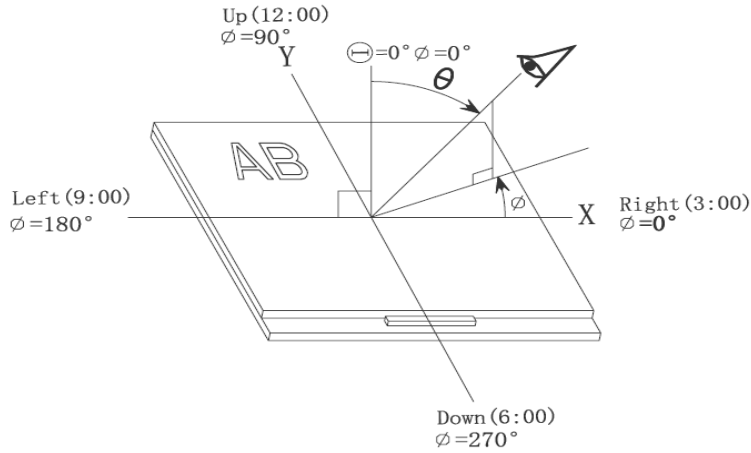
$$\Delta B_p = B_p (\text{Min.}) / B_p (\text{Max.}) \times 100 (\%)$$

$B_p (\text{Max.})$  = Maximum brightness in 9 measured spots

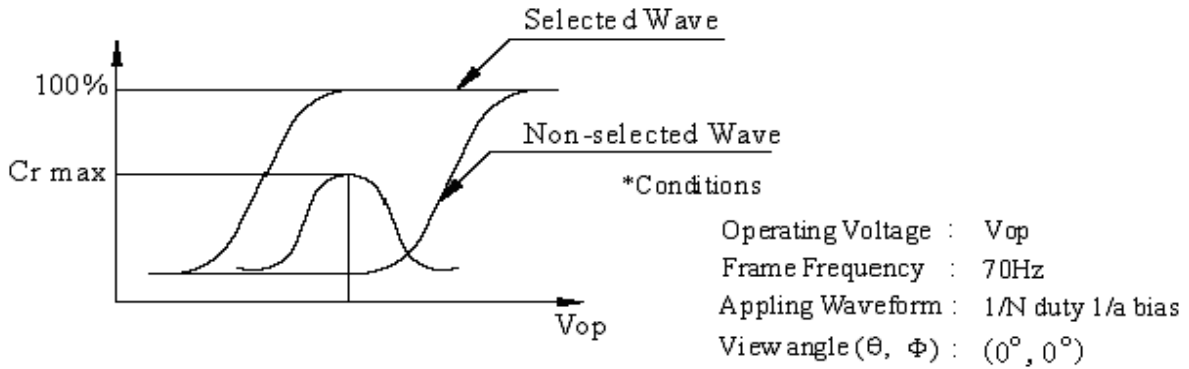
$B_p (\text{Min.})$  = Minimum brightness in 9 measured spots.



Note 3: The definition of viewing angle: Refer to the graph below marked by  $\theta$  and  $\Phi$



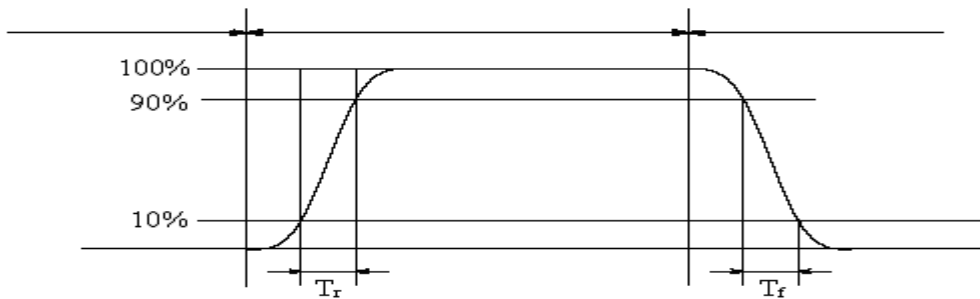
Note 4: Definition of contrast ratio. (Test LCD using DMS501)



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

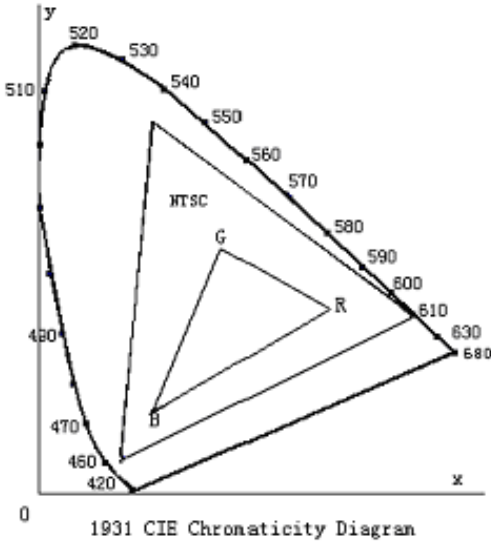
Note 5: Definition of Response time. (Test LCD using DMS501):

The output signals of photo detector are measured when the input signals are changed from “black” to “white” (falling time) and from “white” to “black” (rising 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.

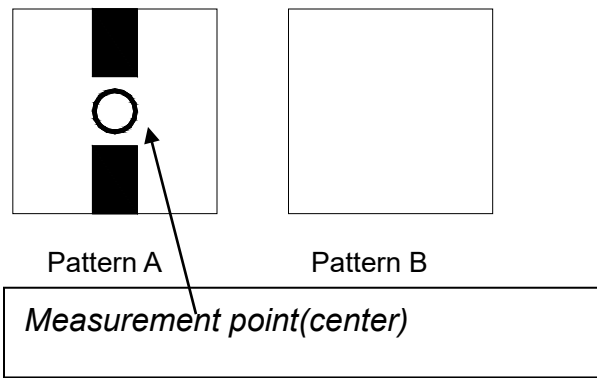


Color gamut:

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

Note 7: Definition of cross talk.

Cross talk ratio(%)=|pattern A Brightness-pattern B Brightness|/pattern A Brightness\*100



Electric volume value=3F+/-3Hex

## 7. Reliability Test Items and Criteria

Test Item	Test condition	Remark
High Temperature Storage	Ta = 80°C 96hrs	Note1,Note3,4
Low Temperature Storage	Ta = -30°C 96hrs	Note1,Note3,4
High Temperature Operation	Ta = 70°C 96hrs	Note2,Note3,4
Low Temperature Operation	Ta = -20°C 96hrs	Note1,Note3,4
Operation at High Temperature/Humidity	+60°C, 90%RH 96hrs	Note3,Note4
Thermal Shock	-30°C/30 min ~ +80°C/30 min for a total 10 cycles, Start with cold temperature and end with high temperature.	Note3,Note4
Vibration Test	Frequency range:10~55Hz Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X. Y. Z. (6 hours for total)	
Mechanical Shock	100G 6ms,±X, ±Y, ±Z 3 times for each direction	
Package Vibration Test	Random Vibration : 0.015G*G/Hz from 5-200HZ, -6dB/Octave from 200-500HZ 2 hours for each direction of X. Y. Z. (6 hours for total)	
Package Drop Test	Height:60cm 1 corner, 3 edges, 6 surfaces	
Electro Static Discharge	±2KV, Human Body Mode, 100pF/1500Ω	

Note 1: Ta is the ambient temperature of samples.

Note 2: Ts is the temperature of panel's surface.

Note 3: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but don't guarantee all of the cosmetic specification.

Note 4: Before cosmetic and function test, the product must have enough recovery time,at least 2 hours at room temperature

## 8. Precautions for Use of LCD Modules

### 8.1 Handling Precautions

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

8.1.2 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.

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

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

8.1.5 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

8.1.6 Do not attempt to disassemble the LCD Module.

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

8.1.8 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.



## **8.2 Storage precautions**

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

8.2.2 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°C ~ 40°C

Relatively humidity: ≤ 80%

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

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