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LCD Module
Product Specification

Product: INT028ATFT & INT028ATFT-TS
2.8'' Integrated TFT Display Module
(240RGBx320DOTS)

January 25, 2013.

1. REVISION RECORD

VERSION	CHANGES	DATE
1.0	Initial revision	16 May 2011
1.1	Changed the temperature range of TS version	3 November 2011
1.2	Add "ERRATA" section on page 1	January 25, 2013

2. ERRATA

(1) The reset line of devices with date codes earlier than 1306xxxxxxxx connects directly to the RA8872 controller and COG driver on the TFT module, but does not reset the on-board Atmel device. Therefore, driving the reset pin low will reset the RA8872 controller and COG driver, but the Atmel chip will not re-initialize these devices.

(2) In order to re-initialize the controller and driver, the user will need to send initialization commands to the controller and driver. For this reason, we recommend not driving the reset pin low at startup of the device. To fully reset and re-initialize the device, a power-cycle (power the device off and back on) is required.

(3) Alternatively, the customer may wish to re-route the reset line to the Atmel's reset pin by cutting the trace from pin 10 and adding a jumper wire from pin 10 to R2. Doing so will allow the user to reset the Atmel device, which will in turn reset and re-initialize the controller and driver.

(4) The auto-initialization of the controller and driver requires that the Atmel part assert control of the command and data lines of the on-board controller and driver. These lines will need to be set as inputs by the customer MCU during the auto-initialization time. Specifically, the CS, RS, RD, WR, RESET, and DATA lines need to be set as inputs during the initialization time. The customer can determine when auto-initialization has completed by monitoring the state of the CS line, or by simply waiting 1s at startup of the device.

Table of Content

3. Introduction

INT028ATFT & *INT028ATFT-TS* are integrated display module based upon a TFT display with 320 x 240RGB resolution. The TFT module is mounted on a PCB on which is mounted a RAIO RA8872 controller with integrated touch screen control and PWM driving circuit for the LED backlight. The TFT module is automatically initialised upon power up by an on-board controller circuit.

4. Features

- 8080/6800 MCU Interface (1)
- Text/Graphic mixed mode
- Low power sleep mode
- Embedded 10Kb Character ROM per ISO8859 - 1/2/3/4 with cursor
- Screen display rotation
- Font vertical rotation
- 256 User defined 8x16 characters
- 32 User defined graphic patterns
- Font enlargement x1, x2, x3, x4, horizontal or vertical
- Auto initialisation (2)
- Embedded 4-Wires Touch Panel Controller
- Embedded PWM control and LED driving circuit for backlight

Remarks:

(5) MCU Interface is selected by soldering option as below.
- Jumper **JP11** : 8080 interface is selected. (Default setting)
- Jumper **JP10** : 6800 interface is selected.

(6) "Auto Initialisation" takes around half second to complete, customer is suggested to add an one second delay at the beginning of their program.

5. General Specifications

Item	Specification	Unit
LCD mode	Transmissive	---
Resolution	240(RGB)	Line
	320	Line
Diagonal Size	2.8	Inch
Overall Size	60.00	mm
	71.20	mm
Active area	43.20	mm
	57.60	mm
Optimum Viewing Direction	6 o'clock	---
Controller IC	RA8872	---
Interface type	8080/6800 with 8 Data Bus Width (1)	---
Colours	65K	---
Operation temperature range	-20~70	°C
Storage temperature range	-30~80	°C

Remarks:

(1) MCU Interface is selected by soldering option as below.
- Jumper **JP11** : 8080 interface is selected. (Default setting)
- Jumper **JP10** : 6800 interface is selected.

(2) Color tune may be changed slightly by temperature and driving voltage.
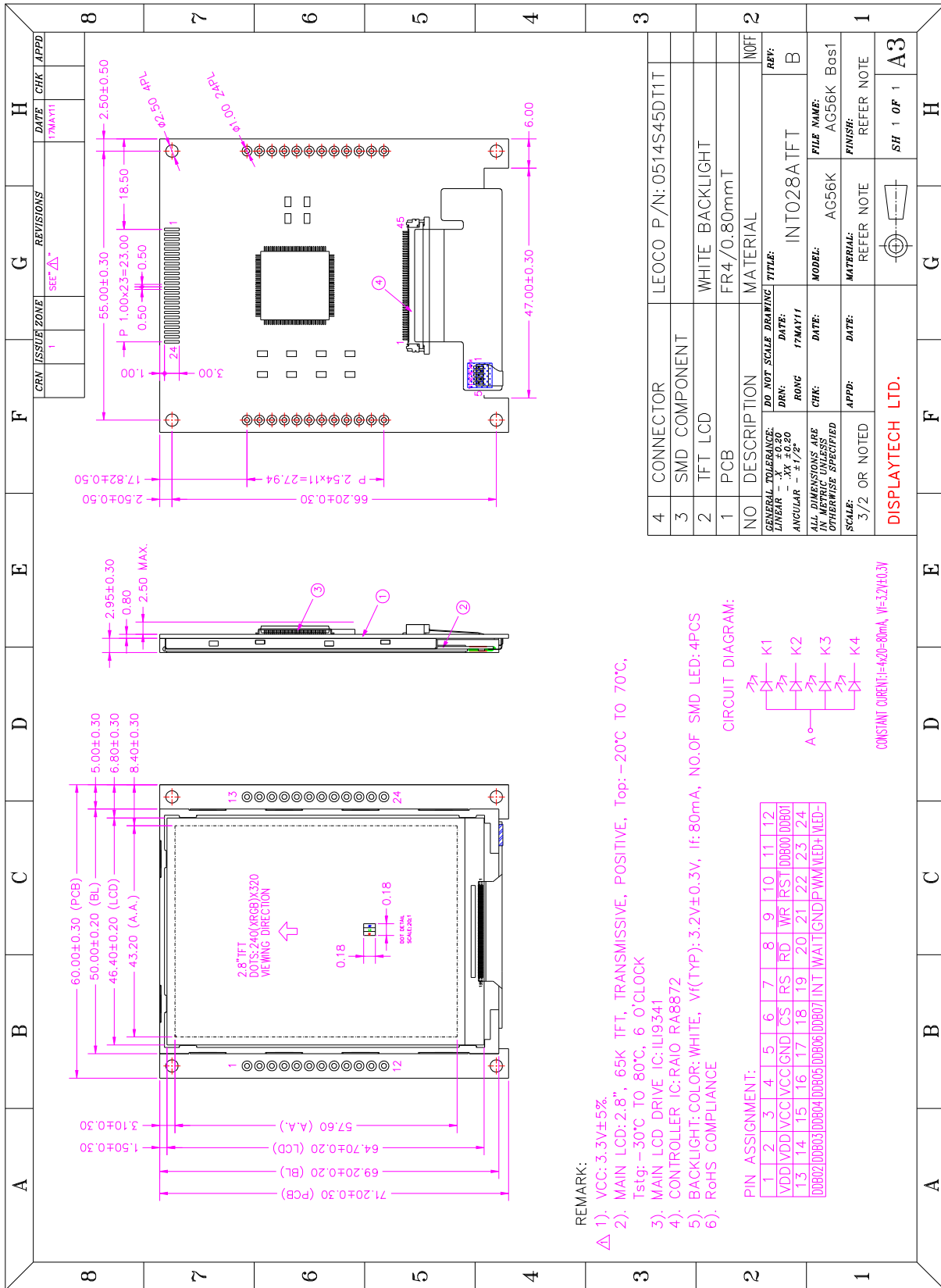
(3) RoHS compliant.

Component Life Cycle

1) Storage Life: min. 1 Year
2) Operation Life (*1): min. 43 x 10³ h (24hr/day x 7days/week x 52weeks/year x 5years)
   (Not include backlight)
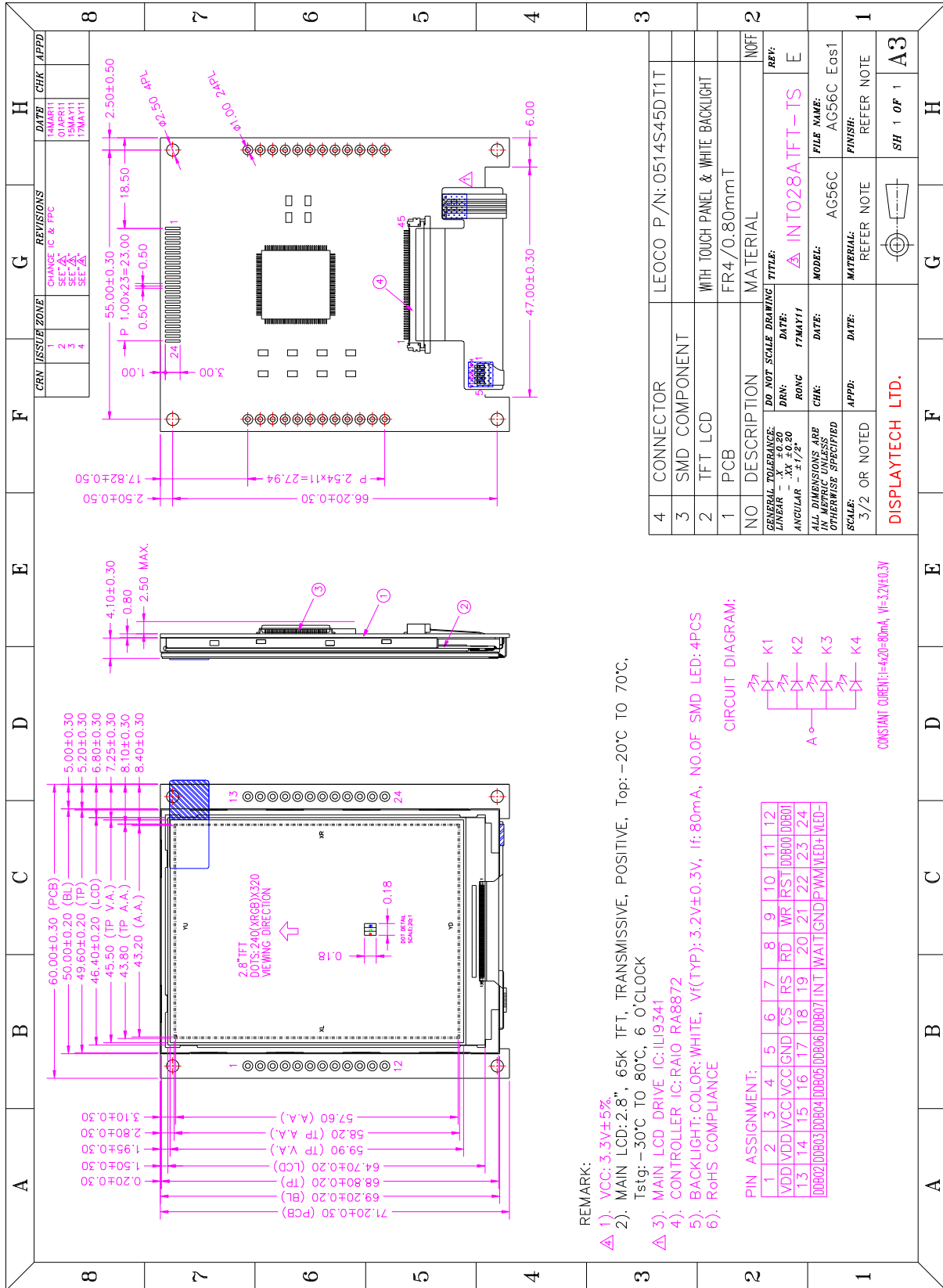3) Storage and Operation Life Times are defined for a temperature of +25°C

Notes:

*1. Operation life ends when one of the listed faults occurs:
- The on/off response-times reach 1.5 times of the max. value specified for a new display
- The contrast is reduced to 0.5 of the original contrast value
- Loss of function
- The number of cosmetic defects exceeds the maximum defined

6. Mechanical Drawing
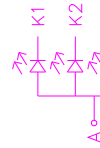
- **INT028ATFT**

- **INT028ATFT-TS (Touch Screen version)**

7. Interface Description

Pin no	Symbol	I/O	Description
1~2	VDD	---	Power supply 3.3V
3~4	VCC	---	Power supply 3.3V
5	GND	---	Power ground 0V
6	/CS	I	**Chip Select Input** Low active chip select pin.
7	RS	I	**Command / Data Select Input** The pin is used to select command/data cycle. RS = 0, data Read/Write cycle is selected. RS = 1, status read/command write cycle is selected. In 8080 interface, usually it connects to "A0" address pin. <table><tr><th>RS</th><th>WR#</th><th>Access Cycle</th></tr><tr><td>0</td><td>0</td><td>Data Write</td></tr><tr><td>0</td><td>1</td><td>Data Read</td></tr><tr><td>1</td><td>0</td><td>CMD Write</td></tr><tr><td>1</td><td>1</td><td>Status Read</td></tr></table>
8	/RD	I	**Enable/Read Enable** When MCU interface (I/F) is 8080 series, this pin is used as data read (RD#), active low. When MCU I/F is 6800 series, this pin is used as Enable (EN), active high.
9	/WR	I	**Write/Read-Write** When MCU I/F is 8080 series, this pin is used as data write (WR#), active low. When MCU I/F is 6800 series, this pin is used as data read/write control (RW#). Active high for read and active low for write.
10	/RST	I	**Reset Signal Input** This active-low input performs a hardware reset on the RA8872. It is a Schmitt-trigger input for enhanced noise immunity; however, care should be taken to ensure that it is not triggered if the supply voltage is lowered.
11 ~ 18	DDB00 ~ DDB07	I/O	**Data Bus** These are data bus for data transfer.
19	INT	O	**Interrupt Signal Output** The interrupt output for MCU to indicate the status of RA8872.
20	WAIT	O	**Wait Signal Output** This is a WAIT output to indicate the RA8872 is in busy state. The RA8872 can't access MCU cycle when WAIT# pin is active. It is active low and could be used for MCU to poll busy status by connecting it to I/O port.
21	GND	---	Power ground 0V
22	NC (PWM)	---	No connection
23	NC (VLED+)	---	No connection
24	NC (VLED-)	---	No connection

8. Absolute Maximum Ratings

(Ta=25°C)

Item	Symbol	Min.	Max.	Unit
Power supply voltage	VCC	3.0	3.6	V
Logic signal input/output voltage	Vin	-0.3	VCC +0.3	V
Operating Temperature	TOP	-20	+70	°C
Storage Temperature	TST	-30	+80	°C

Note:

- When temperature is below 0°C, the response time of liquid crystal (LC) will be slower and the color of panel will be darker.
- If module driving condition exceeds the absolute maximum ratings, permanent damaged may be resulted. If module is driven within the absolute maximum ratings but exceeded the DC characteristics, mal-function may be resulted.
- VDD/VCC > VSS

9. Electrical Characteristics

DC Characteristics

(Vss=0V, Ta=25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power supply	VCC / VDD		3.135	3.3	3.465	V
Input voltage "H"	VIH	---	0.8 VCC	---	VCC	V
Input voltage "L"	VIL	---	VSS	---	0.2 VCC	V
Output voltage "H"	VOH	---	VCC –0.4	---	VCC	V
Output voltage "L"	VOL	---	VSS	---	VSS +0.4	V

10. Display Controller /Power Supply Timing

"Auto Initialisation" takes around half second to complete, so customer is suggested to add a one second delay at the beginning of their program.
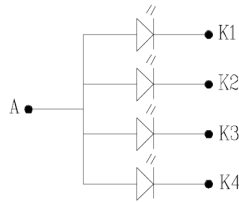
See Display Controller Specification: **RAIO RA8872**

11.Backlight specification

(Vcc=3.3V, Vss=0V, Ta=25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply voltage	Vf	If=80mA	2.9	3.2	3.5	V	1
Forward current	If		---	---	80	mA	2
Uniformity	ΔBp		80	---	---	%	
Color coordination	X	If=80mA	0.270	---	0.315	---	
	Y		0.270	---	0.315	---	

LED circuit diagram:

CIRCUIT DIAGRAM

Constant current If=4x20mA=80mA; Vf=3.2V(typ)

Note:
1) As there has built-in PWM control for the backlight, so the backlight driving specification is only applicable for direct driving.
2) The LED's driver mode needs to be constant current mode.
3) Permanent damage to the device may occur if maximum values are exceeded. Functional operation should be restricted to the conditions described under normal operating conditions.

12.Optical Characteristics

(Vcc=3.3V, Vss=0V, Ta=25°C)

Item		Symbol	Condition	Min	Typ	Max	Unit	Note
Brightness		Bp	θ=0°	180	220	---	cd/m²	1
Uniformity		ΔBp	Φ=0°	80	---	---	%	1, 2
Viewing Angle		θ1 (Φ=90° or 270°)	Cr≥10		-70 ~ 50		deg	3
		θ2 (Φ=0° or 180°)			-70 ~ 70			
Contrast ratio		Cr	θ=0° Φ=0°	400	500	---	---	4
Response Time		Tr	θ=0° Φ=0°	---	25	30	ms	5
		Tf						
CIE (x,y) Chromaticity	White	x	θ=0° Φ=0°	0.230	0.280	0.330	---	1, 6
		y		0.248	0.298	0.348		
	Red	x		0.580	0.630	0.680		
		y		0.279	0.329	0.379		
	Green	x		0.288	0.338	0.388		
		y		0.557	0.607	0.657		
	Blue	x		0.093	0.143	0.193		
		y		0.025	0.075	0.125		
NTSC Ratio		S		---	65	---	---	

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 PR-705 (Φ8mm)

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

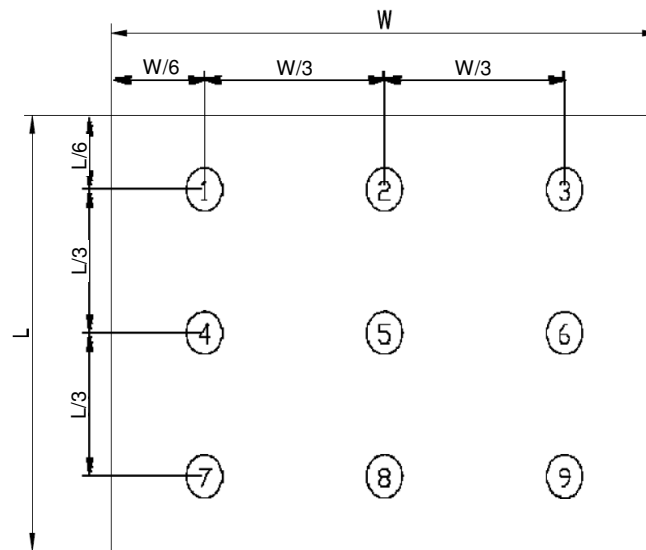Measured value at the center point of LCD panel after more than 5 minutes while backlight turning on.
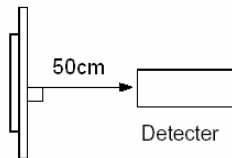
Note 2:   The luminance uniformity is calculated by using following formula.
$\Delta Bp = Bp \ (Min.) \ / \ Bp \ (Max.) \times 100 \ (\%)$
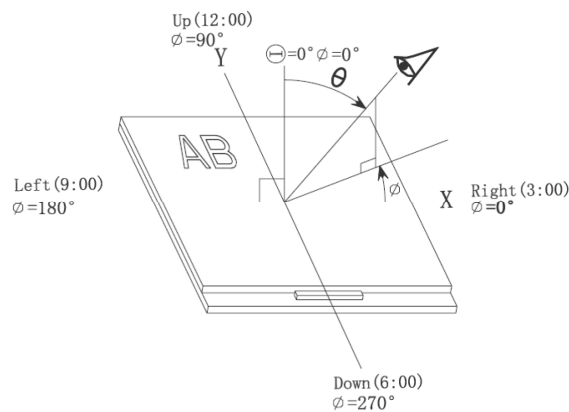Bp (Max.) = Maximum brightness in 9 measured spots
Bp (Min.) = Minimum brightness in 9 measured spots.

Measurement equipment PR-705 (Φ8mm)

Note 3:   The definition of viewing angle:
Refer to the graph below marked by θ and Φ

Note 4:   The definition of contrast ratio (Test LCM using PR-705):

$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance When LCD is at "White" state}}{\text{Luminance When LCD is at "Black" state}}$$

(Contrast Ratio is measured in optimum common electrode voltage)

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.
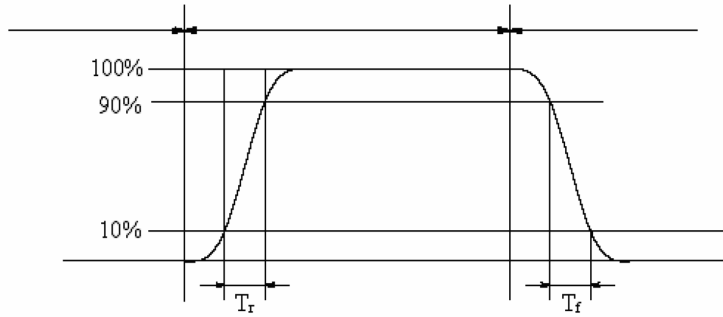
The definition of response time

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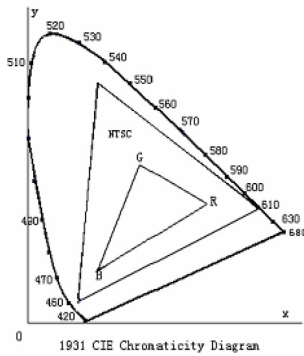
Color gamut:

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

13. Safety Precaution

Handling precautions:

- This device is susceptible to Electro-Static Discharge (ESD) damage. Observe Anti-Static   precautions.

Power supply precautions:

- Identify and, at all times, observe absolute maximum ratings for both logic and LC   drivers. Note that there is some variance between models.

- Prevent the application of reverse polarity to VCC and GND, however briefly.

- Use a clean power source free from transients. Power up conditions are occasionally "jolting" and may exceed the maximum ratings of the modules.

- The VCC power of the module should also supply the power to all devices that may access the display. Don't allow the data bus to be driven when the logic supply to the module is turned off.

Operating precautions:

- DO NOT plug or unplug the module when the system is powered up.

- Minimize the cable length between the module and host MPU.

- Operate the module within the limits of the modules temperature specifications.

Mechanical/Environmental precautions:

- Improper soldering is the major cause of module difficulty. Use of flux cleaner is not recommended.

- Mount the module so that it is free from torque and mechanical stress.

- Surface of the LCD panel should not be touched or scratched. The display front surface is an easily scratched, plastic polarizer. Avoid contact and clean only when necessary with soft, absorbent cotton dampened with petroleum benzene.

- Always employ anti-static procedure while handling the module.

- Prevent moisture build-up upon the module and observe the environmental constraints for storage temperature and humidity.

- Do not store in direct sunlight

- If leakage of the liquid crystal material should occur, avoid contact with this material, particularly ingestion. If the body or clothing becomes contaminated by the liquid crystal material, wash thoroughly with water and soap