深圳市拓普微科技开发有限公司
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LMT056DIDFWD-NDN
LCD Module User Manual

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Date: 2014-08-04	Date:	Date:

Rev.	Descriptions	Release Date
0.1	Preliminary	2014-01-06
0.2	Add note details and typing correction in 3.1	2014-01-10
0.3	Revise General Specification	2014-07-24
0.4	Add note details in 3.1	2014-08-04

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1. General Specification

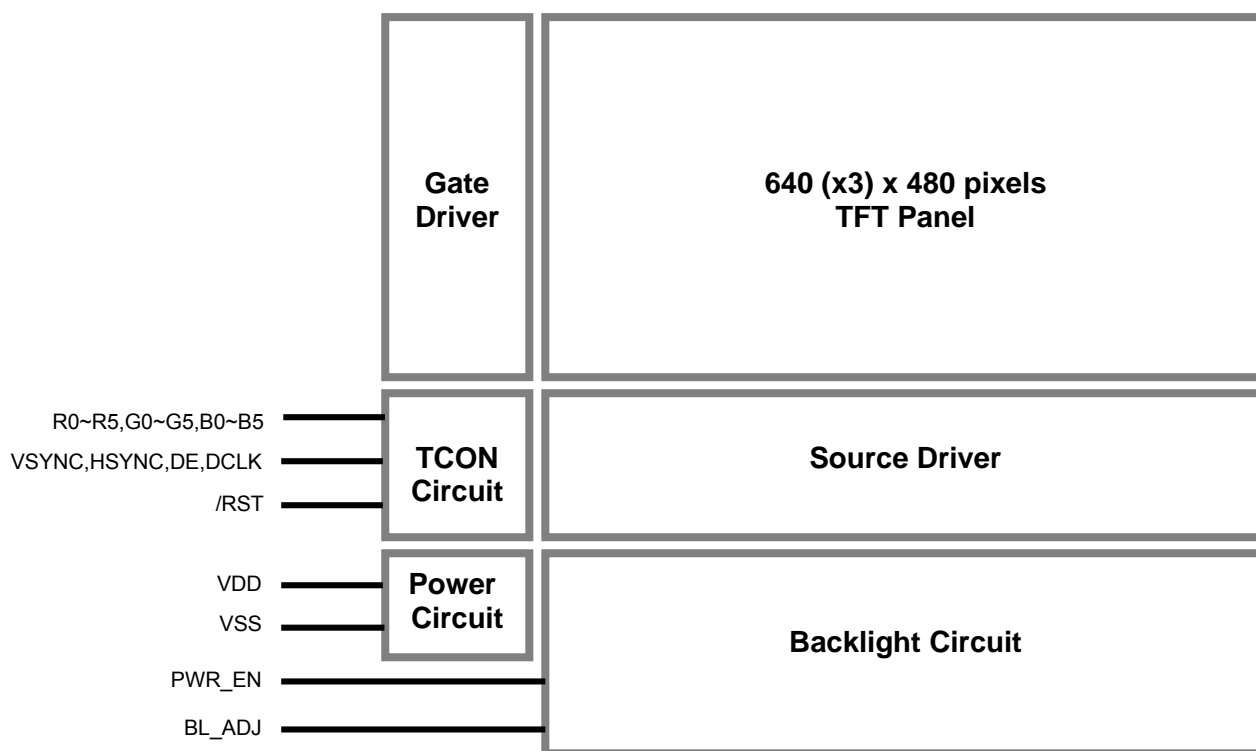|	
Screen Size(Diagonal) :	5.6 inch
Number of dots :	640x 480
Active Area :	112.896x84.672(mm)
Outline Dimension :	144.0x103.0x11.2 (mm) (See attached drawing details)
Display Mode :	Transmissive / Normal White
Pixel Arrangement :	RGB Vertical Stripe
Dot pitch :	0.1764x0.1764 (mm)
Color Depth:	262k color
Backlight Type	LEDs
Viewing Direction :	12H (*1) (gray scale inverse) 6H (*2)
Input Interface:	18bit Parallel(R:G:B=6:6:6)
Operating Temperature :	-20 ~ +70°C
Storage Temperature :	-30 ~ +80°C

Note:
*1. For saturated color display content (eg. pure-red, pure-green, pure-blue, or pure-colors-combinations).
*2. For "color scales" display content.
*3. Color tone may slightly change by Temperature and Driving Condition.

2. Block Diagram

R0~R5,G0~G5,B0~B5
VSYNC,HSYNC,DE,DCLK
/RST

VDD
VSS
PWR_EN
BL_ADJ

Gate Driver

640 (x3) x 480 pixels TFT Panel

TCON Circuit

Source Driver

Power Circuit

Backlight Circuit

3. Terminal Functions

3.1 Interface

Pin No.	Pin Name	IO	Descriptions	Note
1~3	VDD	Power	Positive Power Supply	
4	VSS	Power	Power Ground (0V)	
5	/RST	Input	Reset signal	(*1)
6,7	NC	-	No connection	
8	B0	Input		
:	:	:	Blue data input	
13	B5	Input		
14,15	NC	-	No connection	
16	G0	Input	Green data input	
17	G1	Input	Green data input	
18	VSS	Power	Power Ground (0V)	
19	G2	Input		
:	:	:	Green data input	
22	G5	Input		
23,24	NC	-	No connection	
25	R0	Input		
:	:	:	Red data input	
30	R5	Input		
31	VSS	Power	Power Ground (0V)	
32	PWR_EN	Input	Backlight Driver Control	(*2)
33~35	NC	-	No connection	
36	DE	Input	Data enable	(*5)(*6)
37	VSYNC	Input	Vsync signal input	(*5)(*6)
38	HSYNC	Input	Hsync signal input	(*5)(*6)
39	DCLK	Input	Clock for input data.	(*3)
40	NC	-	No connection	
41	BL_ADJ	Input	Backlight dimming control (active high).	(*4)
42	VSS	Power	Power Ground (0V)	
43~45	NC	-	No connection	
46	VSS	Power	Power Ground (0V)	
47~49	NC	-	No connection	
50	VSS	Power	Power Ground (0V)	

Note:
*1. /RST = L, Initialization is executed;
/RST = H, Normal running;
With built-in RC reset circuit.
*2. PWR_EN = L, Backlight Driving Booster disable;
PWR_EN = H, Backlight Driving Booster enable;
If no use, Please pull high.
*3. Data latched at falling edge of this signal.
*4. PWM may be used to adjust the output brightness and recommended BL_ADJ PWM Freq. is 3kHz.

*5. Mode setting

JP5	JP6	MODE	Note
CLOSE	OPEN	DE	Default
OPEN	CLOSE	HV	

*6. DE MODE,HSYNC floating and VSYNC floating;
   HV MODE,DE floating.

4. Absolute Maximum Ratings

VDD=5.0V, VSS=0V, T_{OP}=25°C

Items	Symbol	Min.	Max.	Unit	Condition
Power Supply Voltage	VDD	-0.3	+6.0	V	
Operating Temperature	T_{OP}	-20	+70	°C	*(1)
Storage Temperature	T_{ST}	-30	+80	°C	*(1)

Note:
   *1.The absolute maximum rating values of the module should not be exceeded. Once exceeded absolute
      maximum rating values, the characteristics of the module may not be recovered. Even in an extreme
      condition, may result in module permanently destroyed.

5. Electrical Characteristics

5.1   Driving TFT LCD Panel

VDD =5.0V, Top=25℃, VSS=0V

Items	Symbol	MIN.	TYP.	MAX.	Unit	Note
Power Supply Voltage	VDD	4.8	5.0	5.5	V	
VDD Power Consumption	I_{VDD}	-	140	-	mA	(*1)
		-	310	755	mA	(*2)
Logic Voltage	-	3.0	3.3	3.6	V	

Note :
   *1. Backlight is all black with 70% PWM.
   *2. Backlight is all black with 100% PWM.

6. AC Characteristics

6.1 Timing Conditions

Input/Output Timing   VDD=5.0V, VSS=0V, T_{OP}=25°C

Items	Symbol	Min.	Typ.	Max.	Unit	Note
PXLCLK clock time	Tclk	33.3	39.7	-	ns	
PXLCLK pulse duty	Tcwh	40	50	60	%	Tclk
DATA set-up time	Tdsu	12	-	-	ns	DATA to PXLCLK
DATA hold time	Tdhd	12	-	-	ns	DATA to PXLCLK
DE setup time	Tesu	12	-	-	ns	DE to PXLCLK
VSYNC setup time	Tvst	12	-	-	ns	
VSYNC hold time	Tvhd	12	-	-	ns	
HSYNC setup time	Thst	12	-	-	ns	
HSYNC hold time	Thhd	12	-	-	ns	
HSYNC period time	Th	22.91	31.76	-	us	
HSYNC width	Thwh	1	-	-	Tclk	
VSYNC width	Tvwh	1	-	-	Th	
HSYNC to CLKIN	Thc	-	-	1	Tclk	

DE Mode input Timing

Items	Min.	Typ.	Max.	Unit	Note
THC	48	160	765	tclk	
THD	640	640	640	tclk	
TH	688	800	1405	tclk	1TH=1line
TVC	6	45	255	line	
TVD	480	480	480	line	
TV	486	525	735	line	1TV=1field

HV Mode input Timing

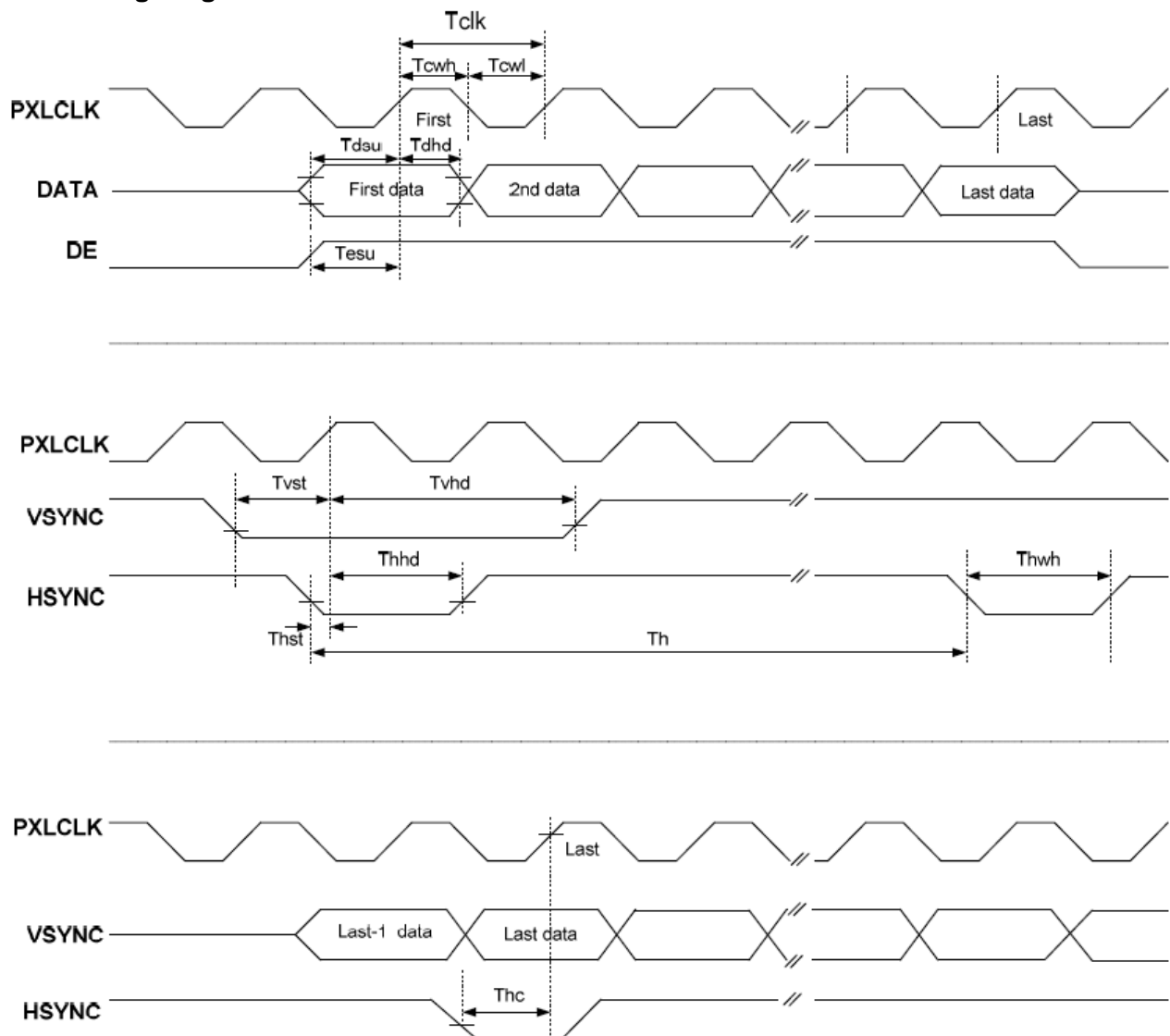| Items	Min.	Typ.	Max.	Unit	Note
Thwh	-	10	-	tclk	
Thbp	-	134	-	tclk	
Thfp	-	16	-	tclk	
THD	-	640	-	tclk	
TH	-	800	-	tclk	1TH=1 line
Tvwh	-	2	-	line	
Tvbp	-	11	-	line	
Tvfp	-	32	-	line	
TVD	-	480	-	line	
TV	-	525	-	line	1TV=1 field

6.2   Timing Diagram

Fig.3-1 Clock and Data Input Timing Diagram

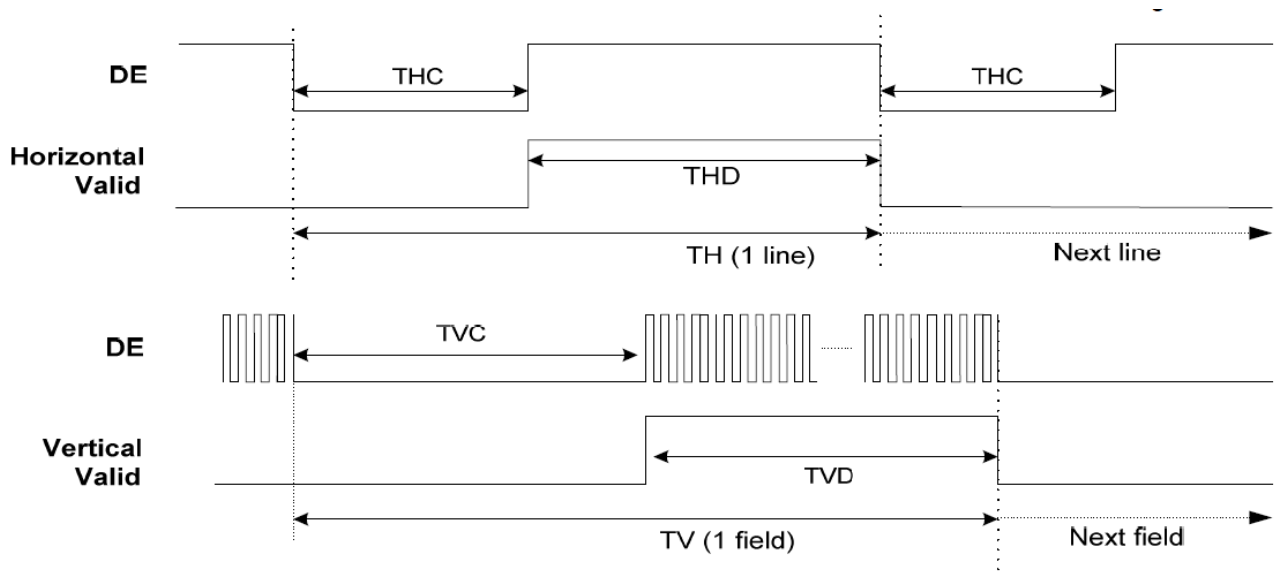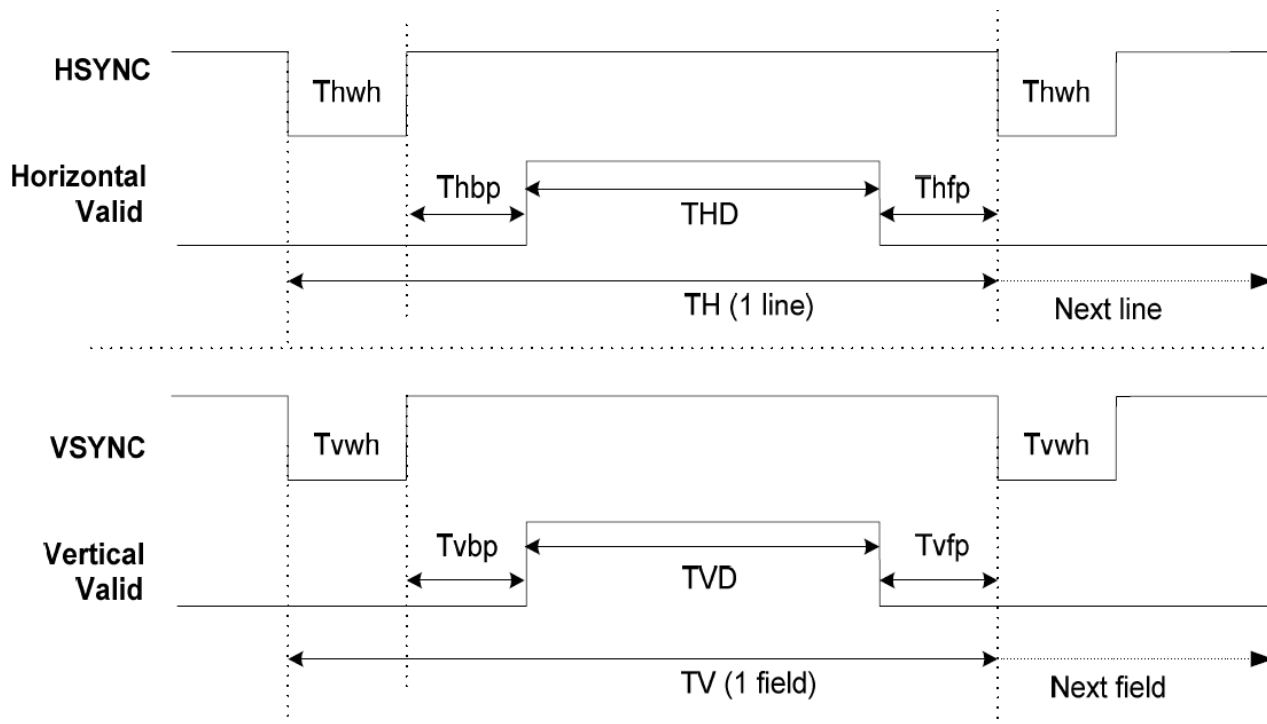**Fig.3-2 DE Mode Input Timing**
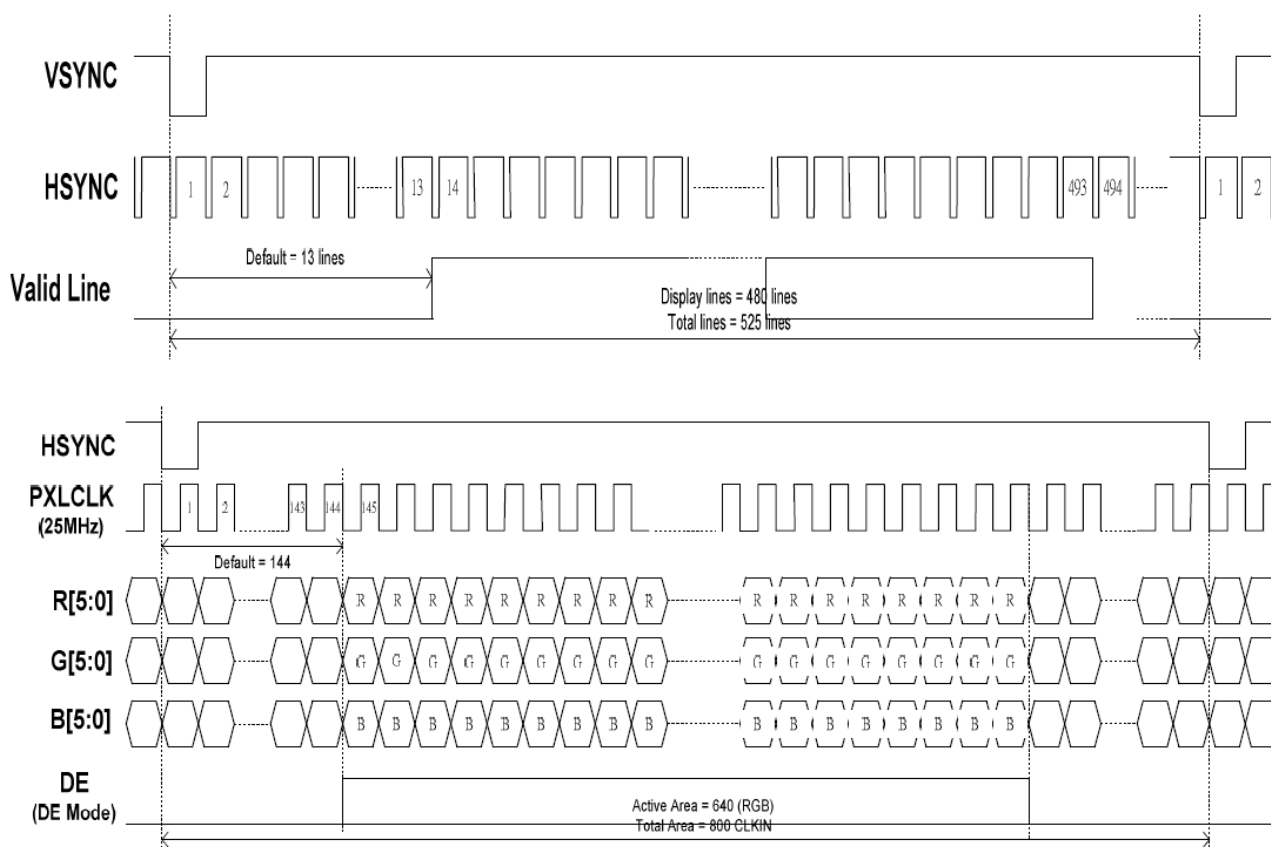
Fig.3-3 HV Mode Input Timing

Fig. 3-4 18 bit RGB mode for 640 x (RGB) x 480

7. Optical Characteristics

Item		Symbol	Condition	MIN.	TYP.	MAX.	UNIT	Note.
Viewing angle		θ_T	(CR≥10)	40	50	-	degree	Note 2
		θ_B		60	70	-		
		θ_L		60	70	-		
		θ_R		60	70	-		
Contrast ratio		CR	θ=0°	500	600	-	-	Note 1,3
Response Time		T_{on}	25℃	-	20	30	msec	Note 1,4
		T_{off}		-	20	30	msec	
Chromaticlty	White	X	Backlight is on	0.260	0.310	0.360		Note 1,5
		Y		0.280	0.330	0.380		
	Red	X		0.540	0.590	0.640		
		Y		0.300	0.350	0.400		
	Green	X		0.298	0.348	0.398		
		Y		0.520	0.570	0.620		
	Blue	X		0.095	0.145	0.195		
		Y		0.060	0.110	0.160		
Luminance		L		-	200	-	cd/m^2	Note 1,6
NTSC				-	50		%	Note 5
Luminance uniformity		U		75	80	-	%	Note 1,7

Test Conditions:
1.VDD=5.0V, backlight with 100% PWM, and the ambient temperature is 25. ℃
2. The test systems refer to Note 1 and Note 2.

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 SR-3A (1°)
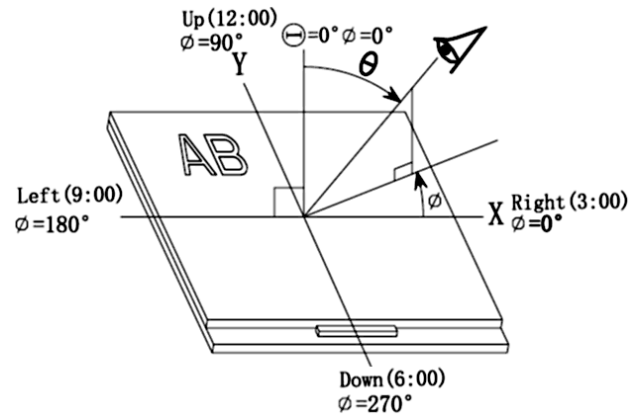Measuring condition:
- Measuring surroundings: Dark room
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.

Note 2:
The definition of viewing angle:
Refer to the graph below marked by θ and Φ

Note 3:
The definition of contrast ratio (Test LCM using SR-3A (1°)):

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

(Contrast Ratio is measured in optimum common electrode voltage)

Note 4:
Definition of Response time. (Test LCD using BM-7A(2°)):
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.
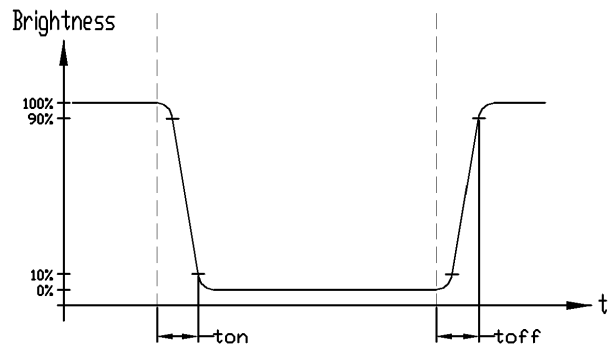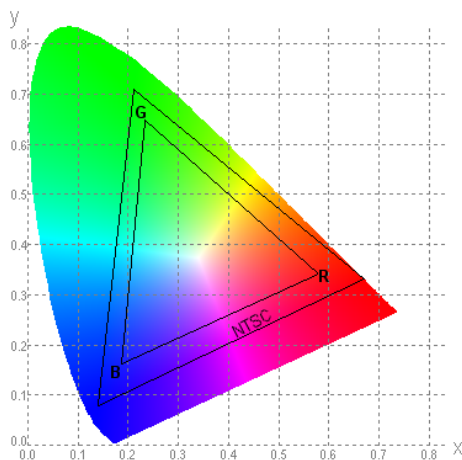

Note 5:
Definition of Color of CIE1931 Coordinate and NTSC Ratio.

Color gamut:

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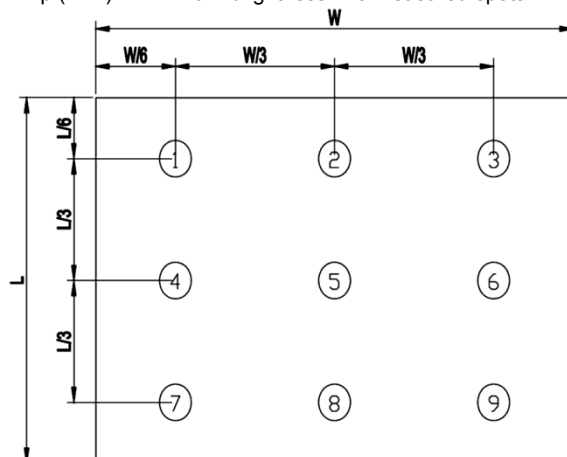

Note 6:
The luminance uniformity is calculated by using following formula.
$\triangle Bp = Bp \text{ (Min.)} / Bp \text{ (Max.)} \times 100 \text{ (%)}$
Bp (Max.) = Maximum brightness in 9 measured spots
Bp (Min.) = Minimum brightness in 9 measured spots.

Note 7:
Measured the luminance of white state at center point

8. Precautions of using LCD Modules

Mounting
- Mounting must use holes arranged in four corners or four sides.
- The mounting structure so provide even force on to LCD module. Uneven force (ex. Twisted stress) should not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- It is suggested to attach a transparent protective plate to the surface in order to protect the polarizer. It should have sufficient strength in order to the resist external force.
- The housing should adopt radiation structure to satisfy the temperature specification.
- Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. Never rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics deteriorate the polarizer.)
- When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer

Operating
- The spike noise causes the mis-operation of circuits. It should be within the $\pm200mV$ level (Over and under shoot voltage)
- Response time depends on the temperature.(In lower temperature, it becomes longer.)
- Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
- Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- When fixed patterns are displayed for a long time, remnant image is likely to occur.
- Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference

Electrostatic Discharge Control
Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

Strong Light Exposure
Strong light exposure causes degradation of polarizer and color filter.

Storage
When storing modules as spares for a long time, the following precautions are necessary.
- Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

Protection Film
- When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt tore main on the polarizer. Please carefully peel off the protection film without rubbing it against the polarizer.
- When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.
- You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

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