CHI MEI OPTOELECTRONICS CORP.

Issued Date: Dec. 26, 2002
Model No.: M201U3 - L01
Tentative

TFT LCD Tentative Specification

MODEL NO.: M201U3 - L01

Liquid Crystal Display Division		
QRA Dept.	TD Division.	PDD I Dept.
Approval	Approval	Approval
陳 91.12.28 永一	李汪洋 91.12.26	林 91.12.27 添仁

- CONTENTS -

REVISION HISTORY

Version	Date	Page (New)	Section	Description
Ver 0.0	Dec.26,'02	All	All	Tentative Specification was first issued.

1. GENERAL DESCRIPTION

1.1 OVERVIEW

M201U3 - L01 is a 20.1" TFT Liquid Crystal Display module with a 6-CCFL backlight unit and a 2ch-LVDS interface. This module supports 1600 x 1200 UXGA mode and can display 16.7M colors. The inverter module for Backlight is not built in.

1.2 FEATURES

- Wide viewing angle
- High contrast ratio
- Fast response time
- High color saturation
- UXGA (1600 x 1200 pixels) resolution
- DE (Data Enable) only mode
- LVDS (Low Voltage Differential Signaling) interface

1.3 APPLICATION

- TFT LCD Monitor

1.4 GENERAL SPECIFICATI0NS

Item	Specification	Unit	Note
Active Area	408.0(H) x 306.0 (V) (20.1" diagonal)	mm	(1)
Bezel Opening Area	413.0 (H) x 311.0 (V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1600 x R.G.B. x 1200	pixel	-
Pixel Pitch	0.255 (H) x 0.255 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	16.7 M	color	-
Display Operation Mode	Transmissive mode / Normally black	-	-
Surface Treatment	Hard coating(2H), Anti-glare (Haze 25)	-	-

1.5 MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)	(431.5)	432.0	(432.5)	mm	(1), (2)
	Vertical(V)	(331.0)	331.5	(332.0)	mm	
	Depth(D)	TBD	25		mm	
Weight			(3700)	TBD	g	-

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

Note (2) Module Depth does not include connectors.

2. ABSOLUTE MAXIMUM RATINGS

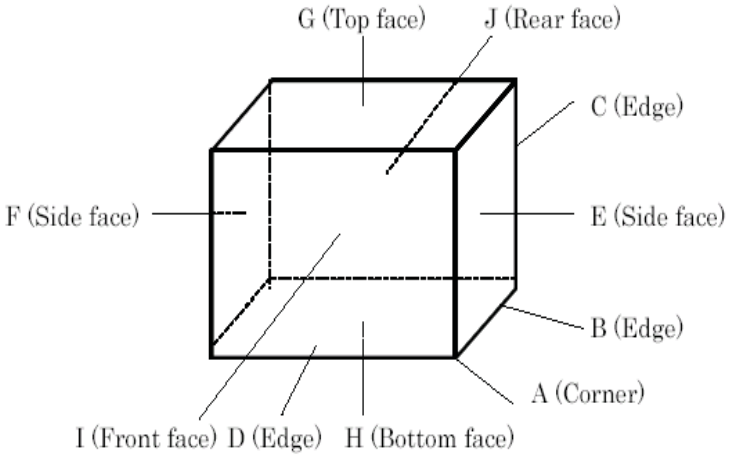
2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T_{ST}	-20	+60	ºC	Temperature on surface of LCD panel (display area.)
Operation Ambient Temperature	T_{OP}	0	+45	ºC	
Storage Humidity	H_{ST}	5	85	%RH	Maximum wet-bulb temperature should not exceed 29ºC. No condensation
Operation Humidity	H_{OP}	20	85	%RH	
Shock (Non-Operation) (1)	S_{NOP}	-	30	G	For single module without package.
Vibration (Non-Operation) (2)	V_{NOP}	-	2.0	G	

Note (1) 30G, 6ms, 1time each ± X, ± Y, ± Z direction.

Note (2) 10 ~ 500 Hz, loctave / 20 minutes, 2G, 1.5mm max, 1 hour each X, Y, Z direction.

Note (3) Figure below shows the shock directions when module is packed. The shock resistance standards are dropping location A ~J, dropping height 60 cm, and count 1 time for each direction.



2.2 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	Vcc	-0.3	+14.0	V	(1)
Logic Input Voltage	V_{IN}	-0.3	+ 3.6	V	

2.2.2 BACKLIGHT UNIT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Lamp Voltage	V_L	-	(2.5K)	V_{RMS}	(1), (2), I_L = 6.0 mA
Lamp Current	I_L	-	(6.5)	MA_{RMS}	(1), (2)
Lamp Frequency	F_L	-	(80)	KHz	

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for lamp (Refer to 3.2 for further information).

3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

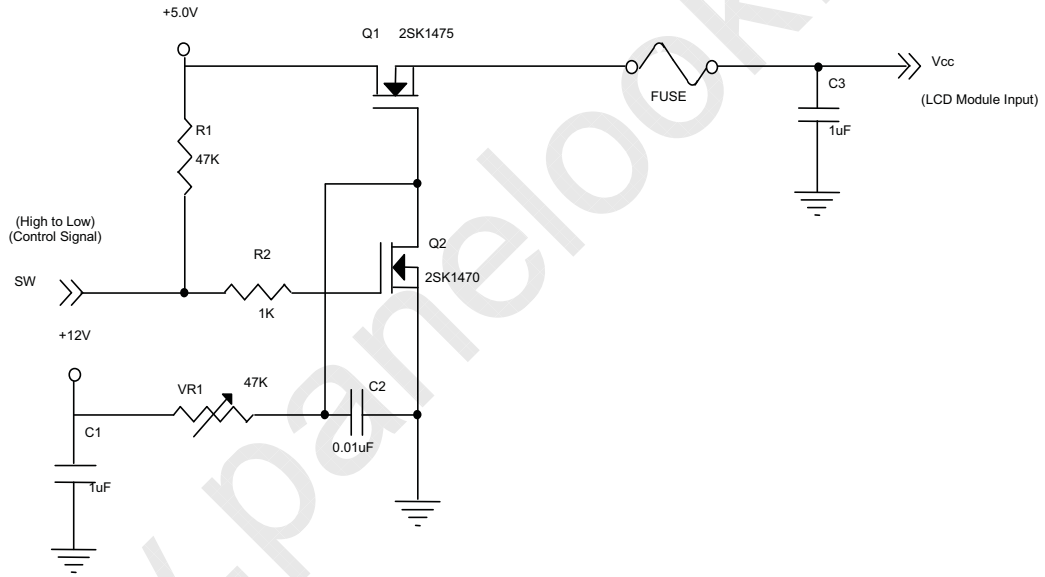
Ta = 25 ± 2 ºC

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	Vcc	(11.5)	12.0	(12.5)	V	-
Ripple Voltage	V_{RP}			(0.1)	mV	-
Power Supply Current	Icc	-	(600)	(1,200)	mA	(1)
Rush Current	I_{RUSH}			(5.8)	A	(2)
LVDS differential input voltage (High)	Vih	-	-	100	mV	
LVDS differential input voltage (Low)	Vil	-100	-	-	mV	
LVDS common input voltage	Vic	TBD	TBD	TBD	V	
Logic “L” input voltage	Vil	Vss	-	TBD	V	

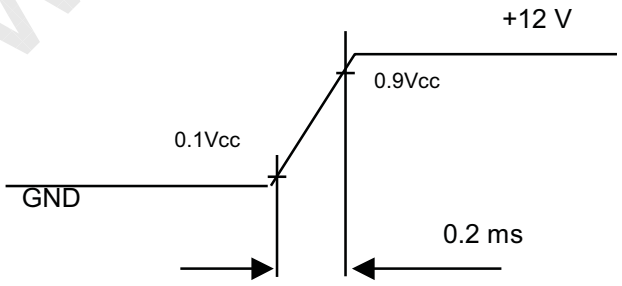
Note (1) Typical current situation: Color bar pattern, Vcc=12.0V, without rush current.

Maximum current situation: White Screen, Vcc=11.5V, without rush current.

Note (2) Measurement Conditions:



Vcc rising time is 0.2 ms

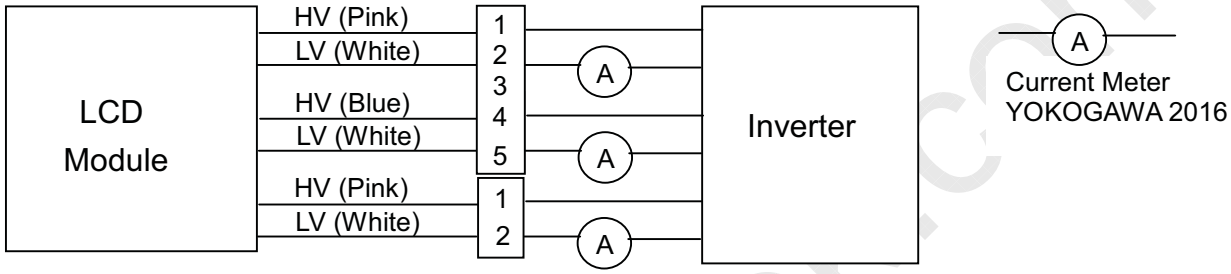


3.2 BACKLIGHT UNIT

Ta = 25 ± 2 ºC

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Lamp Input Voltage	V_L	TBD	(800)	TBD	V_{RMS}	I_L = (6.0) mA
Lamp Current	I_L	(3.0)	TBD	(7.0)	mA_{RMS}	(1)
Lamp Turn On Voltage	V_S			900 (25 °C)	V_{RMS}	(2)
				1,300 (0 °C)	V_{RMS}	(2)
Operating Frequency	F_L	(40)	(50)	(60)	KHz	(3)
Lamp Life Time	L_{BL}	50,000	-	-	Hrs	(5)
Power Consumption	P_L	-	(28.8)	-	W	(4), I_L = (6.0) mA

Note (1) Lamp current is measured by utilizing high frequency current meters as shown below:



Note (2) The voltage shown above should be applied to the lamp for more than 1 second after startup. Otherwise the lamp may not be turned on.

Note (3) The lamp frequency may produce interference with horizontal synchronous frequency from the display, and this may cause line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible.

Note (4) $P_L = I_L \times V_L$

Note (5) The lifetime of lamp can be defined as the time in which it continues to operate under the condition Ta = 25 ±2 °C and I_L = (3.0) ~ (7.0) mArms until one of the following events occurs:

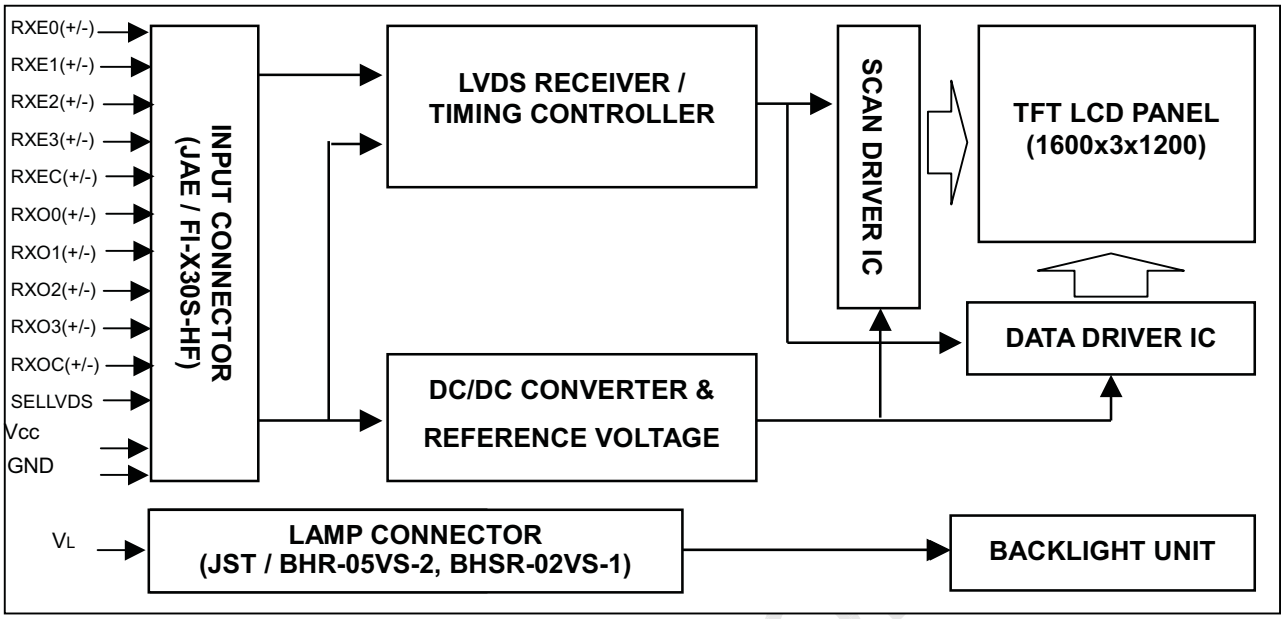
(a) When the brightness becomes or lower than 50% of its original value.

(b) When the effective ignition length becomes or lower than 80% of its original value. (Effective ignition length is defined as an area that has less than 70% brightness compared to the brightness in the center point.)

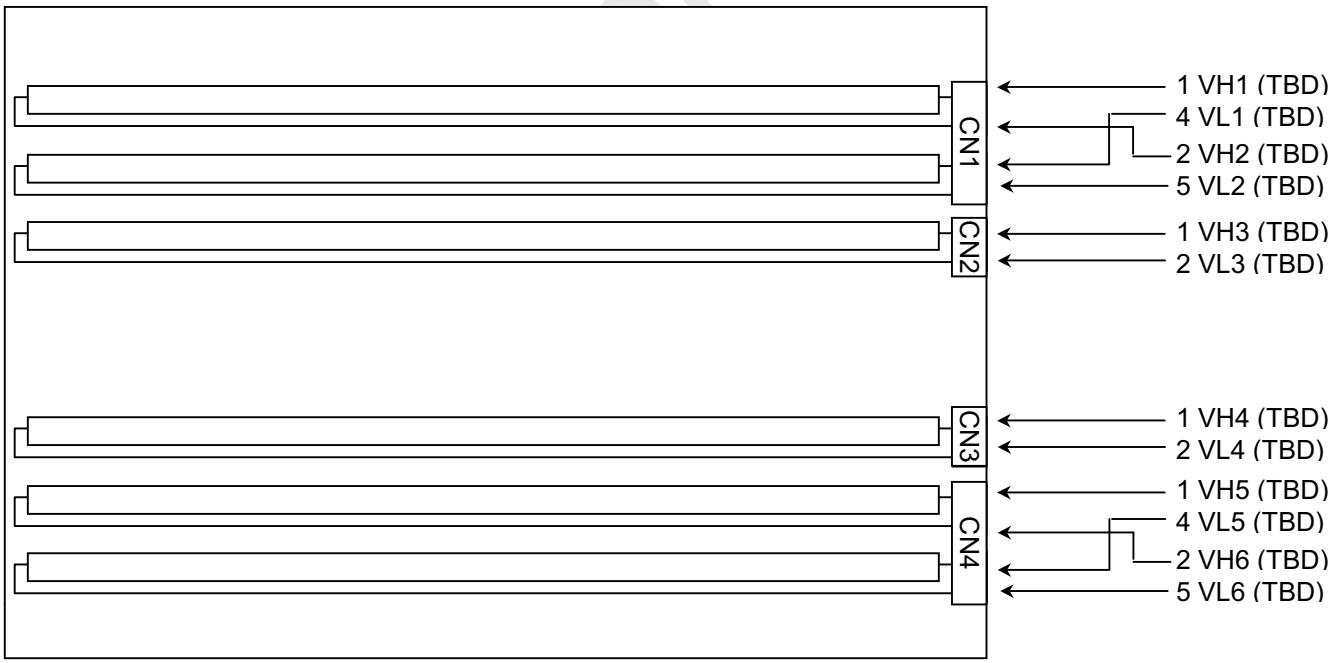
Note (6) The waveform of the voltage output of inverter must be area-symmetric and the design of the inverter must have specifications for the modularized lamp. The performance of the Backlight, such as lifetime or brightness, is greatly influenced by the characteristics of the DC-AC inverter for the lamp. All the parameters of an inverter should be carefully designed to avoid producing too much current leakage from high voltage output of the inverter. When designing or ordering the inverter please make sure that a poor lighting caused by the mismatch of the Backlight and the inverter (miss-lighting, flicker, etc.) never occurs. If the above situation is confirmed, the module should be operated in the same manners when it is installed in your instrument.

4. BLOCK DIAGRAM

4.1 TFT LCD MODULE



4.2 BACKLIGHT UNIT



5. INPUT TERMINAL PIN ASSIGNMENT

5.1 TFT LCD MODULE

Pin	Name	Description
1	VCC	+12V power supply
2	VCC	+12V power supply
3	VCC	+12V power supply
4	TST	Test Pin *3
5	PD	LVDS Core Power Down
6	SELLVDS	Select LVDS data order *4
7	GND	Ground
8	RXE3+	Positive LVDS differential data input. Channel E3 (even)
9	RXE3-	Negative LVDS differential data input. Channel E3 (even)
10	RXEC+	Positive LVDS differential clock input. (even)
11	RXEC-	Negative LVDS differential clock input. (even)
12	RXE2+	Positive LVDS differential data input. Channel E2 (even)
13	RXE2-	Negative LVDS differential data input. Channel E2 (even)
14	GND	Ground
15	RXE1+	Positive LVDS differential data input. Channel E1 (even)
16	RXE1-	Negative LVDS differential data input. Channel E1 (even)
17	GND	Ground
18	RXE0+	Positive LVDS differential data input. Channel E0 (even)
19	RXE0-	Negative LVDS differential data input. Channel E0 (even)
20	RXO3+	Positive LVDS differential data input. Channel O3 (odd)
21	RXO3-	Negative LVDS differential data input. Channel O3(odd)
22	RXOC+	Positive LVDS differential clock input. (odd)
23	RXOC-	Negative LVDS differential clock input. (odd)
24	GND	Ground
25	RXO2+	Positive LVDS differential data input. Channel O2 (odd)
26	RXO2-	Negative LVDS differential data input. Channel O2 (odd)
27	RXO1+	Positive LVDS differential data input. Channel O1 (odd)
28	RXO1-	Negative LVDS differential data input. Channel O1 (odd)
29	RXO0+	Positive LVDS differential data input. Channel O0 (odd)
30	RXO0-	Negative LVDS differential data input. Channel O0 (odd)

Note (1) Connector Part No.: FI-X30S-HF (JAE)

Note (2) Mating Connector Part No.: FI-X30M or FI-X30H or FI-X30C (JAE)

Note (3) Keep open. (Internal test use only)

Note (4) 3.3V CMOS signal input. (High or Low)

5.2 LVDS DATA ASSIGNMENT

Input signal *1			Transmitter DS90CF383,C385		Interface connector			Receiver DS90CF386		LCD input (Sel LVDS)	
SEL LVDS	Low	High	pin	INPUT	System side	LCD module pin		pin	OUTPUT	Low	High
LVDS Odd	RO2	RO0	51	TxIN0	Tx OUT0+	2	RxO0+	27	RxOUT0	RO2	RO0
	RO3	RO1	52	TxIN1				29	RxOUT1	RO3	RO1
	RO4	RO2	54	TxIN2				30	RxOUT2	RO4	RO2
	RO5	RO3	55	TxIN3				32	RxOUT3	RO5	RO3
	RO6	RO4	56	TxIN4	Tx OUT0-	1	RxO0-	33	RxOUT4	RO6	RO4
	RO7	RO5	3	TxIN6				35	RxOUT6	RO7	RO5
	GO2	GO0	4	TxIN7				37	RxOUT7	GO2	GO0
	GO3	GO1	6	TxIN8	Tx OUT1+	4	RxO1+	38	RxOUT8	GO3	GO1
	GO4	GO2	7	TxIN9				39	RxOUT9	GO4	GO2
	GO5	GO3	11	TxIN12				43	RxOUT12	GO5	GO3
	GO6	GO4	12	TxIN13				45	RxOUT13	GO6	GO4
	GO7	GO5	14	TxIN14	Tx OUT1-	3	RxO1-	46	RxOUT14	GO7	GO5
	BO2	BO0	15	TxIN15				47	RxOUT15	BO2	BO0
	BO3	BO1	19	TxIN18				51	RxOUT18	BO3	BO1
	BO4	BO2	20	TxIN19	Tx OUT2+	6	RxO2+	53	RxOUT19	BO4	BO2
	BO5	BO3	22	TxIN20				54	RxOUT20	BO5	BO3
	BO6	BO4	23	TxIN21				55	RxOUT21	BO6	BO4
	BO7	BO5	24	TxIN22				1	RxOUT22	BO7	BO5
	RSVD	RSVD	27	TxIN24	Tx OUT2-	5	RxO2-	3	RxOUT24	Not use	Not use
	RSVD	RSVD	28	TxIN25				5	RxOUT25	Not use	Not use
	ENAB	ENAB	30	TxIN26				6	RxOUT26	ENAB	ENAB
	RO0	RO6	50	TxIN27	Tx OUT3+	11	RxO3+	7	RxOUT27	RO0	RO6
	RO1	RO7	2	TxIN5				34	RxOUT5	RO1	RO7
	GO0	GO6	8	TxIN10				41	RxOUT1	GO0	GO6
	GO1	GO7	10	TxIN11				42	RxOUT11	GO1	GO7
	BO0	BO6	16	TxIN16	Tx OUT3-	10	RxO3-	49	RxOUT16	BO0	BO6
	BO1	BO7	18	TxIN17				50	RxOUT17	BO1	BO7
	RSVD	RSVD	25	TxIN23				2	RxOUT23	Not use	Not use
	DCLK		31	TxCLK IN	TxCLK OUT+ TxCLK OUT-	9 8	RxCLK IN+ RxCLK IN-	26	RxCLK OUT	DCLK	
LVDS Even	RE2	RE0	51	TxIN0	Tx OUT0+	13	RxE0+	27	RxOUT0	RE2	RE0
	RE3	RE1	52	TxIN1				29	RxOUT1	RE3	RE1
	RE4	RE2	54	TxIN2				30	RxOUT2	RE4	RE2
	RE5	RE3	55	TxIN3				32	RxOUT3	RE5	RE3
	RE6	RE4	56	TxIN4	Tx OUT0-	12	RxE0-	33	RxOUT4	RE6	RE4
	RE7	RE5	3	TxIN6				35	RxOUT6	RE7	RE5
	GE2	GE0	4	TxIN7				37	RxOUT7	GE2	GE0
	GE3	GE1	6	TxIN8	Tx OUT1+	16	RxE1+	38	RxOUT8	GE3	GE1
	GE4	GE2	7	TxIN9				39	RxOUT9	GE4	GE2
	GE5	GE3	11	TxIN12				43	RxOUT12	GE5	GE3
	GE6	GE4	12	TxIN13				45	RxOUT13	GE6	GE4
	GE7	GE5	14	TxIN14	Tx OUT1-	15	RxE1-	46	RxOUT14	GE7	GE5
	BE2	BE0	15	TxIN15				47	RxOUT15	BE2	BE0
	BE3	BE1	19	TxIN18				51	RxOUT18	BE3	BE1
	BE4	BE2	20	TxIN19	Tx OUT2+	19	RxE2+	53	RxOUT19	BE4	BE2
	BE5	BE3	22	TxIN20				54	RxOUT20	BE5	BE3
	BE6	BE4	23	TxIN21				55	RxOUT21	BE6	BE4
	BE7	BE5	24	TxIN22				1	RxOUT22	BE7	BE5
	RSVD	RSVD	27	TxIN24	Tx OUT2-	18	RxE2-	3	RxOUT24	Not use	Not use
	RSVD	RSVD	28	TxIN25				5	RxOUT25	Not use	Not use
	RSVD	RSVD	30	TxIN26				6	RxOUT26	Not use	Not use
	RE0	RE6	50	TxIN27	Tx OUT3+	23	RxE3+	7	RxOUT27	RE0	RE6
	RE1	RE7	2	TxIN5				34	RxOUT5	RE1	RE7
	GE0	GE6	8	TxIN10				41	RxOUT10	GE0	GE6
	GE1	GE7	10	TxIN11				42	RxOUT11	GE1	GE7
	BE0	BE6	16	TxIN16	Tx OUT3-	22	RxE3-	49	RxOUT16	BE0	BE6
	BE1	BE7	18	TxIN17				50	RxOUT17	BE1	BE7
	RSVD		25	TxIN23				2	RxOUT23	Not use	Not use
	DCLK		31	TxCLK IN	TxCLK OUT+ TxCLK OUT-	21 20	RxCLK IN+ RxCLK IN-	26	RxCLK OUT	Not use	

Note, RSVD(reserved) pin on a transmitter should be connected with Ground,

Input odd or even data depending on the display position of the LCD module.

5.3 BACKLIGHT UNIT

NO.	Pin No.	Symbol	Description	Color
CN1 / CN4	1	VH1 / VH5	High Voltage	TBD
	2	VH2 / VH6	High Voltage	TBD
	3	-	NC	
	4	VL1 / VL5	Low Voltage	TBD
	5	VL2 / VL6	Low Voltage	TBD
CN2 / CN3	1	VH3 / VH4	High Voltage	TBD
	2	VL3 / VL4	Low Voltage	TBD

Note (1) Connector Part No.: CN1, 4 / BHR-05VS-2, CN2,3 / BHSR-02VS-1 (JST)

Note (2) Mating connector Part No.: CN1,4 / SM05(9.0)B-BHS-1-TB, CN2, 3 / SM02B-BHSS-1-TB (JST)

5.4 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																							
		Red								Green								Blue							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale Of Red	Red(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(253)	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Green	Green(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale Of Blue	Blue(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

Note (1) 0: Low Level Voltage, 1: High Level Voltage

6. INTERFACE TIMING

6.1 INPUT SIGNAL TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK signal (Clock)	Period	Tc	11.765	12.345	20.000	ns	
	Frequency	1/Tc	60	81	85	MHZ	
	Duty	Tch/Tc	45	50	55	%	
	High time	TclkH	3.5	-	-	ns	
	Low time	TclkL	3.5	-	-	ns	
DCLK-Data Timing	Setup time	Tset	3	-	-	ns	
	Hold time	Thold	2	-	-	ns	
ENAB signal	Horizontal period	Th	865	1080	1130	DCLK	*1
	Hor. Period	Th	13.0	13.3	14.65	us	
	Hor. Display period	Thd	800	800	800	DLCK	*2
	Vertical period	Tv	1207	1250	1280	Hz	
	Ver. Frequency	1/Tv	(50)	60	(62)	Hz	
	Ver. Display period	Tvd	1200	1200	1200	Hz	
	Data-ENAB timing	Tdn	-	0	-	DCLK	*3

Note (1) Horizontal display position is specified by the rise of ENAB. The data latched at falling edge of DCLK after rise of ENAB is displayed at the left edge of the display area.

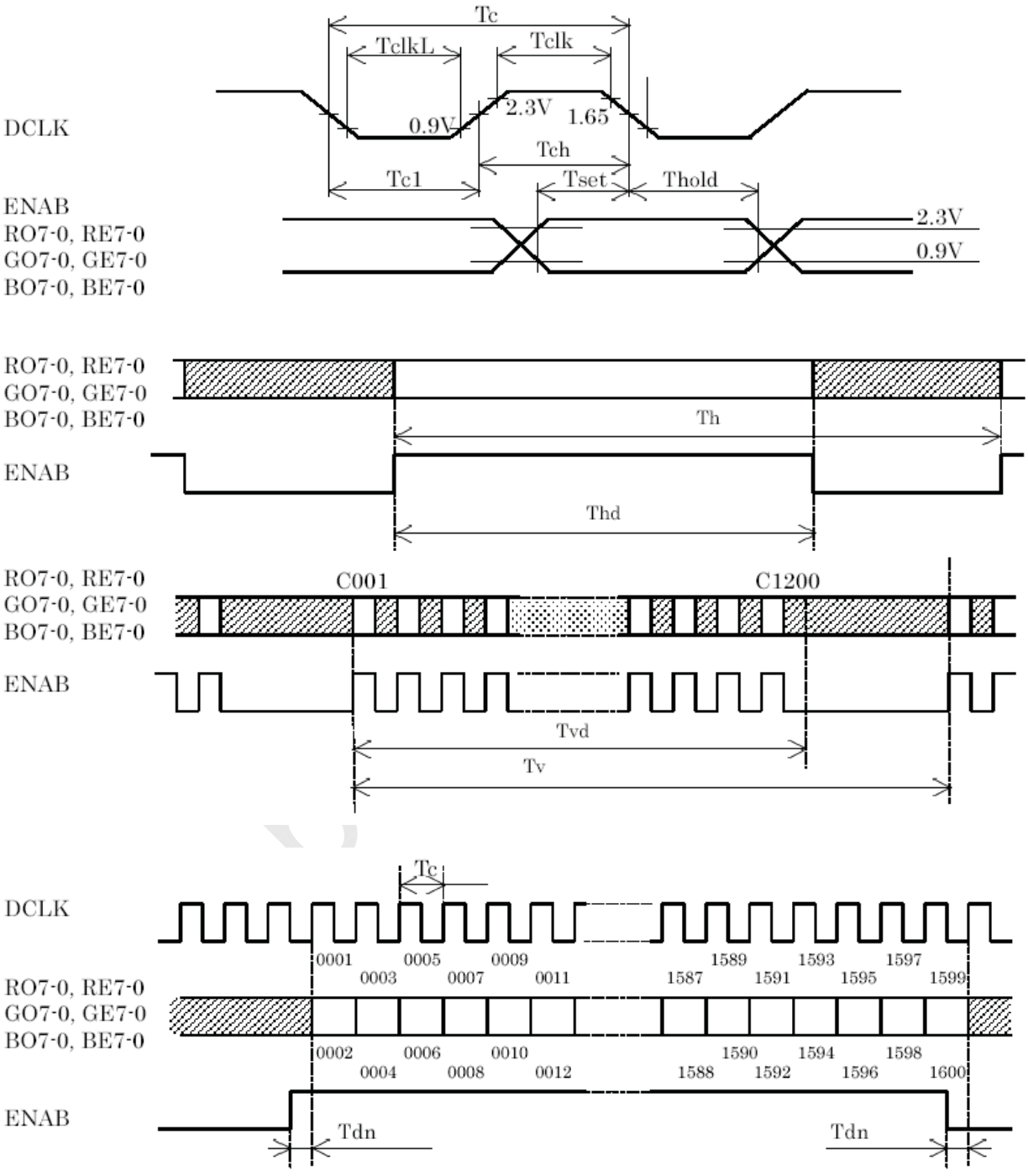
Vertical display position is specified by the rise of ENAB after low level continuation over 5500 DCLK. The data latched at the rise of ENAB is displayed at the top line of the display area.

Note (2) If the “High” level of ENAB is less than 800 DCLK, black color is displayed at the rest of display area.

Note (3) If ENAB does not synchronize with the effective display data, the display position does not fit to the display area.

Note (4) Because of this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

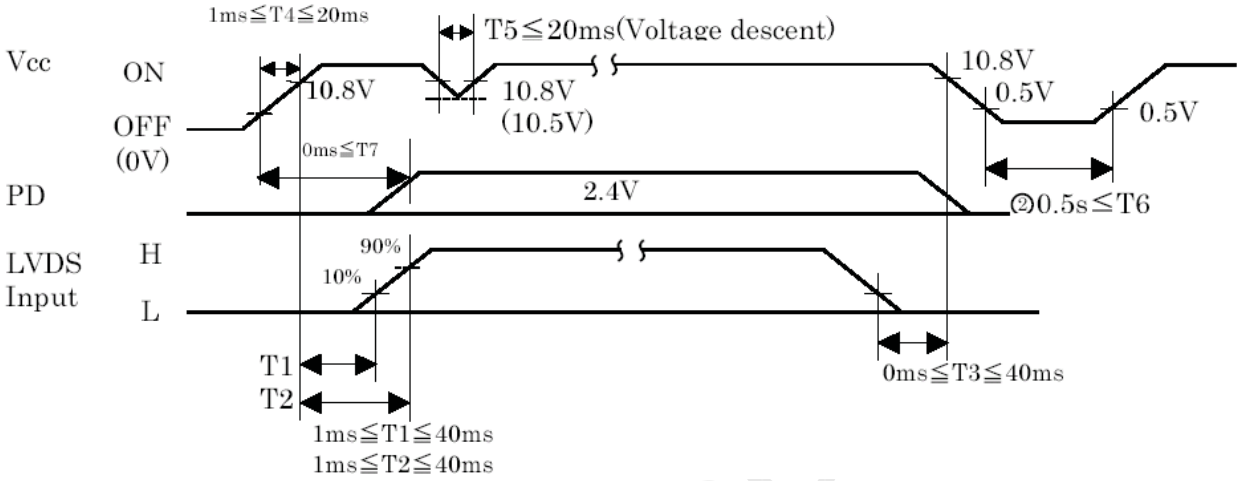
INPUT SIGNAL TIMING DIAGRAM



6.2 POWER ON/OFF SEQUENCE

The sequence of input signals and On/Off of the power supply of the LCD module should be in the specification shown as below to prevent latch-up of the driver ICs and DC driving of LCD panel.

Power Supply Sequence (Logic)



7. OPTICAL CHARACTERISTICS

7.1 TEST CONDITIONS

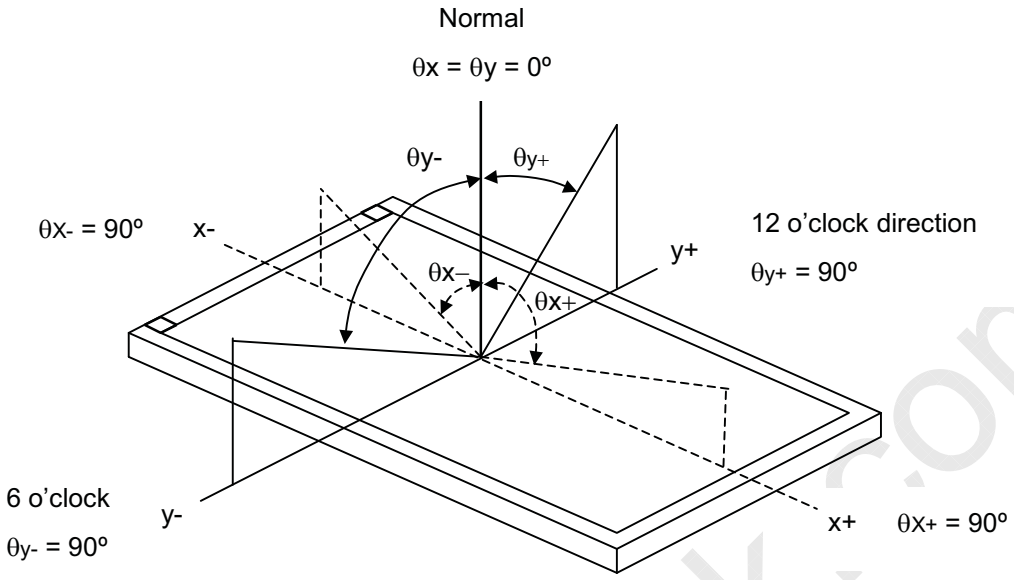
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V_{CC}	5.0	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Inverter Current	I_L	6.0	mA
Inverter Driving Frequency	F_L	50	KHz
Inverter	--		

7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 7.2. The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (6).

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	θ_x=0°, θ_Y =0° Viewing Normal Angle	(400)	(600)	-	-	(2), (6)
Response Time		T_R		-	(15)	(30)	ms	(3)
		T_F		-	(10)	(25)	ms	
Center Luminance of White		L_C		(200)	(250)	-	cd/m^2	(4), (6)
Average Luminance of White		L_{AVE}		TBD	(220)	-	cd/m^2	(4), (6)
White Variation		δW		-	TBD	(1.40)	-	(6), (7)
Cross Talk		CT		-	-	TBD	%	(5), (6)
Color Chromaticity	Red	Rx			TBD		-	(1), (6)
		Ry			TBD		-	
	Green	Gx			TBD		-	
		Gy			TBD		-	
	Blue	Bx			TBD		-	
		By			TBD		-	
	White	Wx		(0.283)	(0.313)	(0.343)	-	
		Wy		(0.299)	(0.329)	(0.359)	-	
Viewing Angle	Horizontal	θ_x+	CR≥10	(85)	-	-	Deg.	
		θ_x-		(85)	-	-		
	Vertical	θ_Y+		(85)	-	-		
		θ_Y-		(85)	-	-		

Note (1) Definition of Viewing Angle (θx, θy):



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = L255 / L0

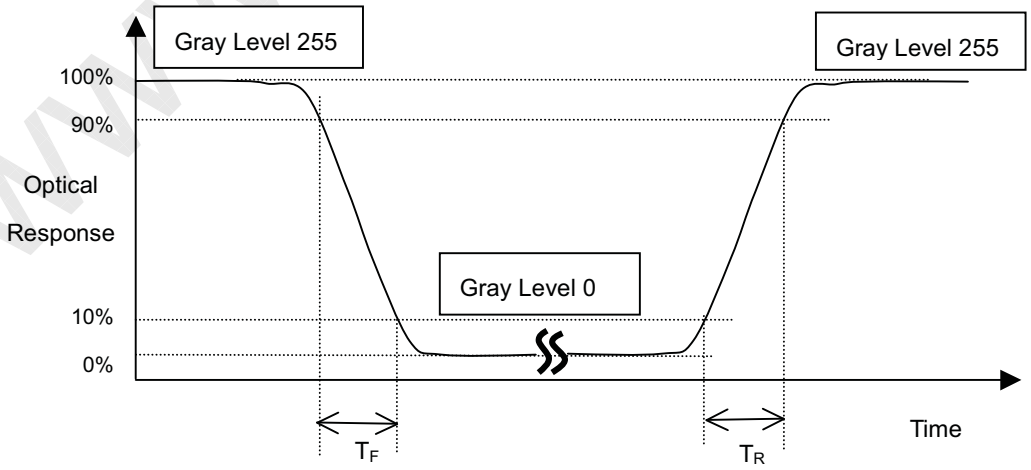
L255: Luminance of gray level 255

L 0: Luminance of gray level 0

CR = CR (5)

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (7).

Note (3) Definition of Response Time (T_R, T_F):



Note (4) Definition of Luminance of White (L_C, L_{AVE}):

Measure the luminance of gray level 255 at center point and 5 points

$L_C = L(5)$

$L_{AVE} = [L(1)+ L(2)+ L(3)+ L(4)+ L(5)] / 5$

L (x) is corresponding to the luminance of the point X at Figure in Note (7).

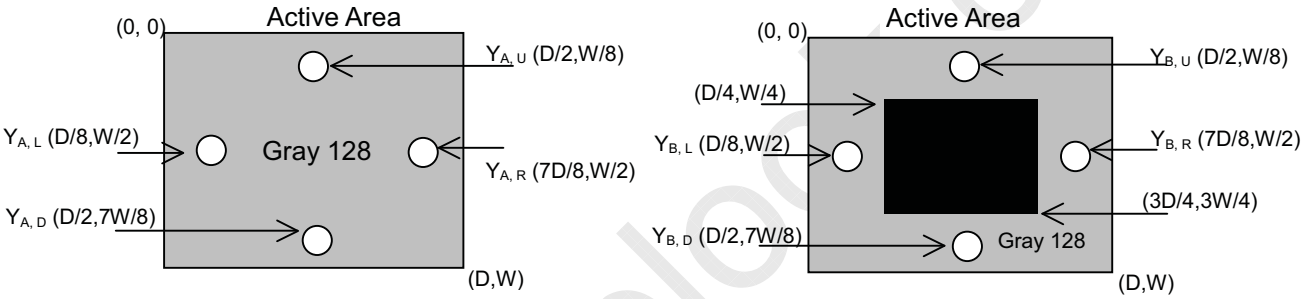
Note (5) Definition of Cross Talk (CT):

$CT = | Y_B – Y_A | / Y_A \times 100\ (\%)$

Where:

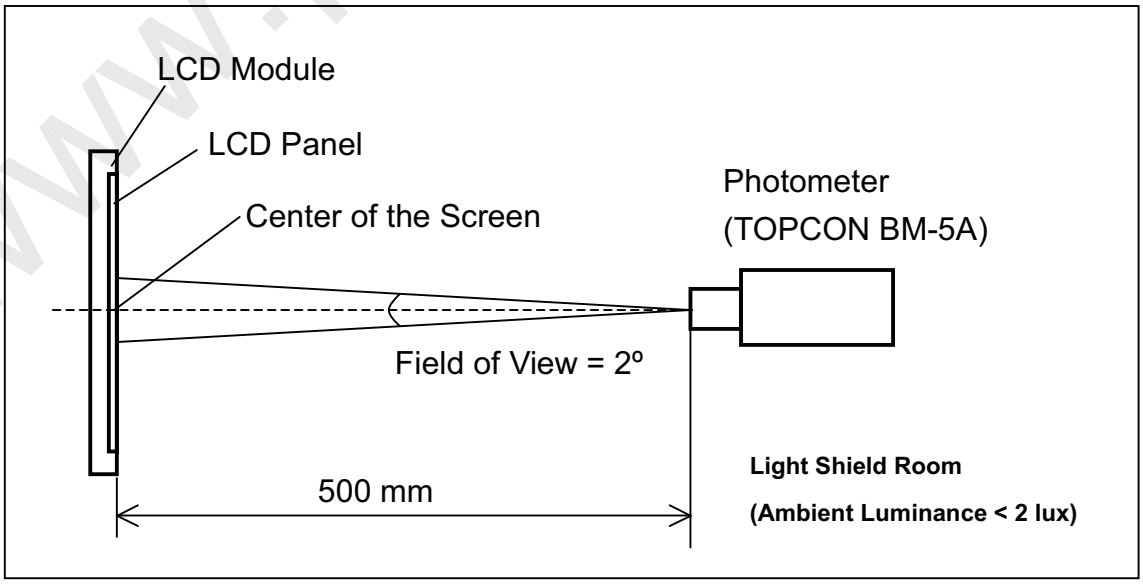
Y_A = Luminance of measured location without gray level 0 pattern (cd/m^2)

Y_B = Luminance of measured location with gray level 0 pattern (cd/m^2)



Note (6) Measurement Setup:

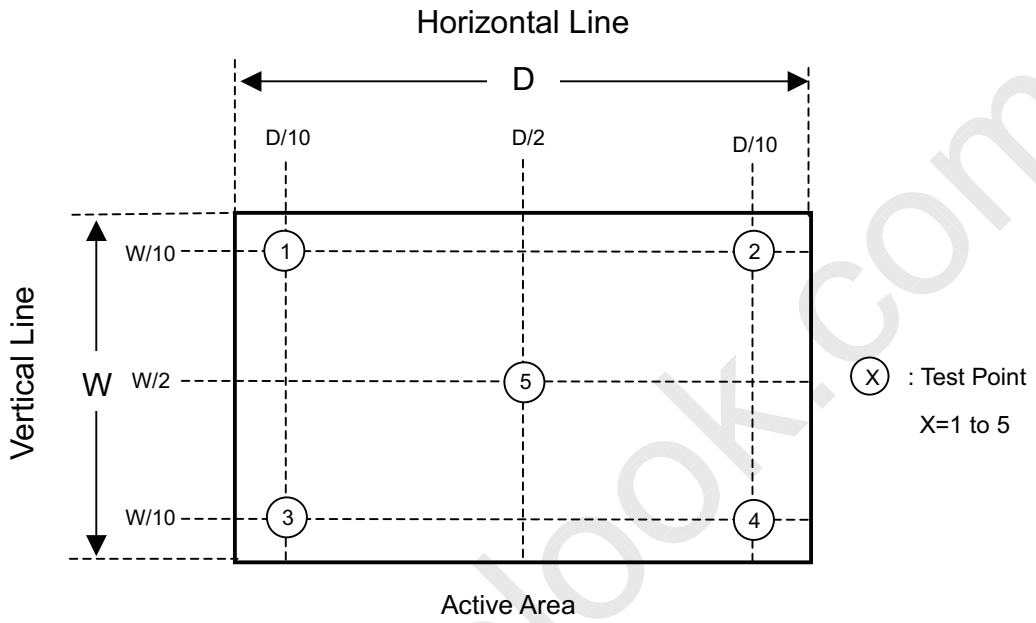
The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



Note (7) Definition of White Variation (δW):

Measure the luminance of gray level 255 at 5 points

δW = Maximum [L (1), L (2), L (3), L (4), L (5)] / Minimum [L (1), L (2), L (3), L (4), L (5)]



8. PRECAUTIONS

8.1 ASSEMBLY AND HANDLING PRECAUTIONS

(1) Do not apply rough force such as bending or twisting to the module during assembly.

(2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.

(3) It's not permitted to have pressure or impulse on the module because the LCD panel and Backlight will be damaged.

(4) Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.

(5) Do not pull the I/F connector in or out while the module is operating.

(6) Do not disassemble the module.

(7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.

(8) It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.

(9) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.

(10) When ambient temperature is lower than 10ºC may reduce the display quality. For example, the response time will become slowly, and the starting voltage of CCFL will be higher than room temperature.

8.2 SAFETY PRECAUTIONS

(1) The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while assembling with inverter. Do not disassemble the module or insert anything into the Backlight unit.

(2) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.

(3) After the module's end of life, it is not harmful in case of normal operation and storage.