

TFT LCD **Tentative** Specification

MODEL NO.: **N141X3 - 02**

Liquid Crystal Display Division		
QRA Dept.	RD Dept.	PD Dept.
Approval	Approval	Approval

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REVISION HISTORY

Version	Date	Page (New)	Section	Description
Ver 0.1	Oct.27,'00	All	All	Tentative Specification was first issued.

1. GENERAL DESCRIPTION

1.1 OVERVIEW

N141X3 - 02 is a 14.1" TFT Liquid Crystal Display module with single CCFL Backlight unit and 20 pins LVDS interface. This module supports 1024 x 768 XGA mode and can display 262,144 colors. The optimum viewing angle is at 6 o'clock direction. The inverter module for Backlight is not built in.

1.2 FEATURES

- 1 CCFLs (Cold Cathode Fluorescent Lamp)
- XGA (1024 x 768 pixels) resolution
- DE (Data Enable) only mode
- 3.3V LVDS (Low Voltage Differential Signaling) interface with 1 pixel/clock

1.3 APPLICATION

- TFT LCD Notebook

1.4 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Active Area	285.7 (H) x 214.3 (V) (14.1" diagonal)	mm	(1)
Bezel Opening Area	288.8 (H) x 217.4 (V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1024 x R.G.B. x 768	pixel	-
Pixel Pitch	0.279 (H) x 0.279 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	262,144	color	-
Transmissive Mode	Normally white	-	-
Surface Treatment	Hard coating (3H), Anti-glare (Haze 12)	-	-

1.5 MECHANICAL SPECIFICATIONS

Item	Min.	Typ.	Max.	Unit	Note	
Module Size	Horizontal(H)	(298.0)	298.5	(299.0)	mm	(1)
	Vertical(V)	(227.0)	227.5	(228.0)	mm	
	Depth(D)	-	(5.7)	6.0	mm	
Weight	-	(510)	530	g	-	

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

2. ABSOLUTE MAXIMUM RATINGS

2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T _{ST}	-20	+60	°C	(1)
Operating Ambient Temperature	T _{OP}	0	+50	°C	(1), (2)
Shock (Non-Operating)	S _{NOP}	-	30	G	(3), (5)
Vibration (Non-Operating)	V _{NOP}	-	1.5	G	(4), (5)

Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max. ($T_a \leq 40$ °C).

(b) Wet-bulb temperature should be 39 °C Max. ($T_a > 40$ °C).

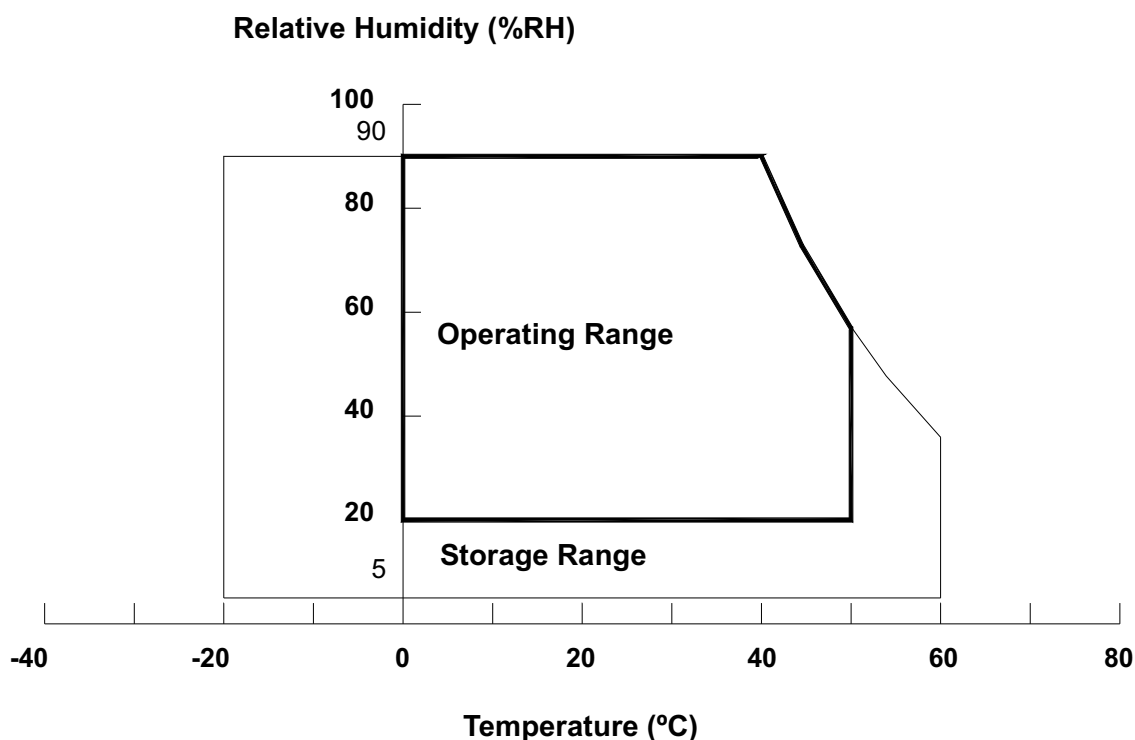
(c) No condensation.

Note (2) The temperature of panel surface should be 0 °C Min. and 60 °C Max.

Note (3) 6ms, sine wave, 1 time for $\pm X, \pm Y, \pm Z$.

Note (4) 10 ~ 500 Hz, Sweep rate 20min, 60min for X,Y,Z.

Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.



2.2 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V _{CC}	3.0	3.6	V	(1)
Logic Input Voltage	V _{IN}	-0.3	V _{CC} +0.3	V	

2.2.2 BACKLIGHT UNIT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Lamp Voltage	V _L	-	-	V _{RMS}	(1), (2), I _L = (6.0) mA
Lamp Current	I _L	4.0	7.0	mA _{RMS}	
Lamp Frequency	F _L	40	70	KHZ	(1), (2)

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

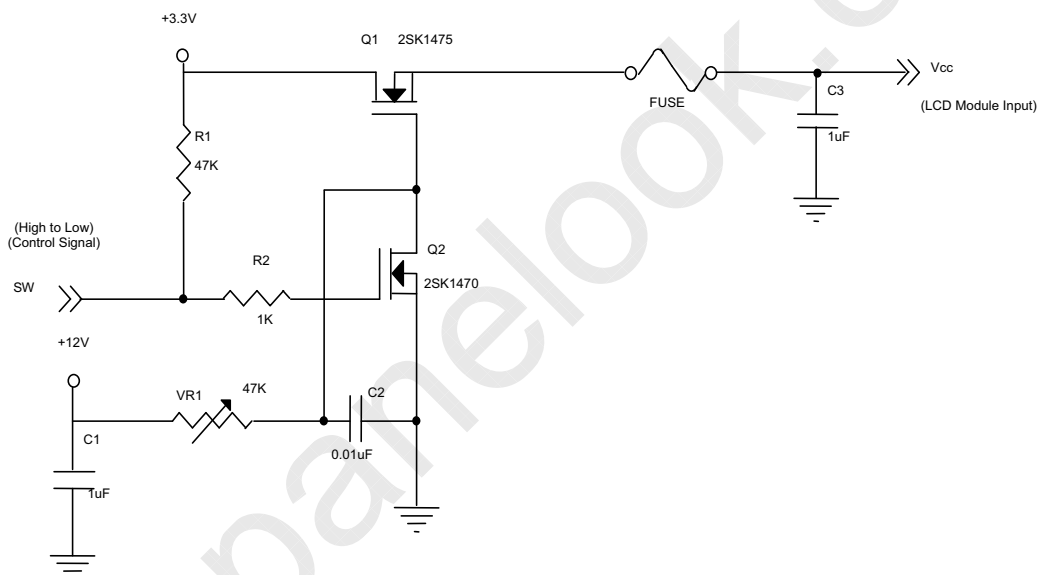
3.1 TFT LCD MODULE

Ta = 25 ± 2 °C

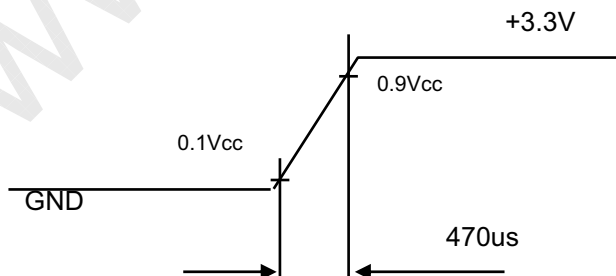
Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	V _{CC}	3.0	3.3	3.6	V	-
Ripple Voltage	V _{RP}	-	(50)		mV	-
Rush Current	I _{RUSH}	-	(1.6)	(1.8)	A	(2)
Power Supply Current	I _{CC}	White	-	TBD	mA	(3)a
		Black	-	TBD	mA	(3)b
		TBD	-	TBD	mA	(3)c
Logical Input Voltage	"H" Level	V _{IL}	-	+100	mV	-
	"L" Level	V _{IH}	-100	-	mV	-
Terminating Resistor	R _T	-	100	-	Ohm	-

Note (1) The module should be always operated within above ranges.

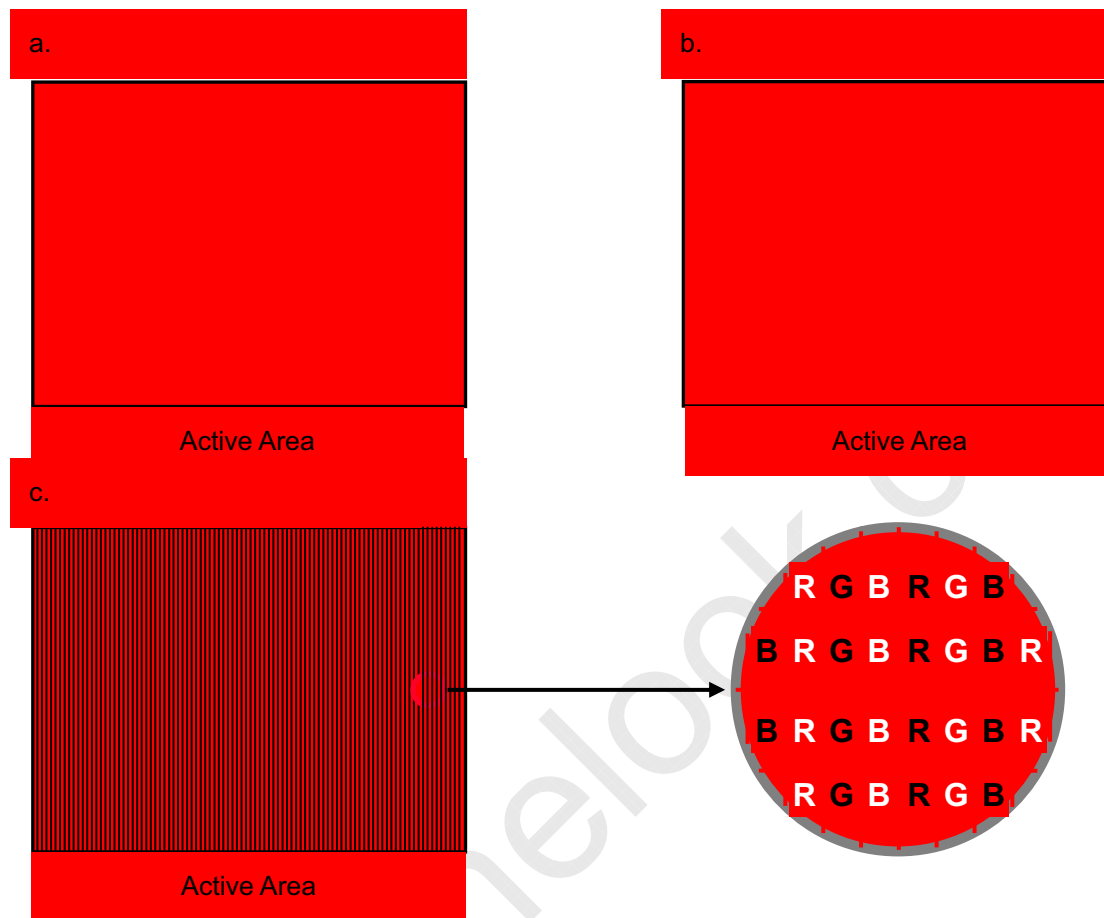
Note (2) Measurement Conditions:



Vcc rising time is 470us



Note (3) The specified power supply current is under the conditions at $V_{CC} = 3.3 \text{ V}$, $T_a = 25 \pm 2 \text{ }^\circ\text{C}$, $f_v = 60 \text{ Hz}$, whereas a power dissipation check pattern below is displayed.

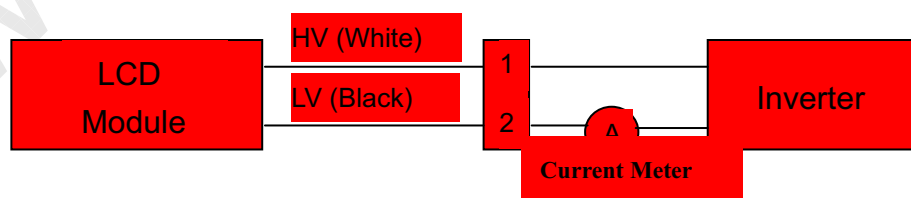


3.2 BACKLIGHT UNIT

$T_a = 25 \pm 2 \text{ }^\circ\text{C}$

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Lamp Input Voltage	V_L		630		V_{RMS}	$I_L = (6.0) \text{ mA}$
Lamp Current	I_L	4.0	6.0	7.0	mA_{RMS}	(1)
Lamp Turn On Voltage	V_s	-		975 (25 $^\circ\text{C}$)	V_{RMS}	(2)
		-		1170 (0 $^\circ\text{C}$)	V_{RMS}	(2)
Operating Frequency	F_L	40	55	70	KHz	(3)
Lamp Life Time	L_{BL}	12000	20000	-	Hrs	(5)
Power Consumption	P_L	-	4.2	-	W	(4), $I_L = (6.0) \text{ mA}$

Note (1) Lamp current is measured by utilizing a high frequency current meter 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 $T_a = 25 \pm 2 \text{ }^\circ\text{C}$ and $I_L = 6.0 \text{ mA}$ until one of the following events occurs:

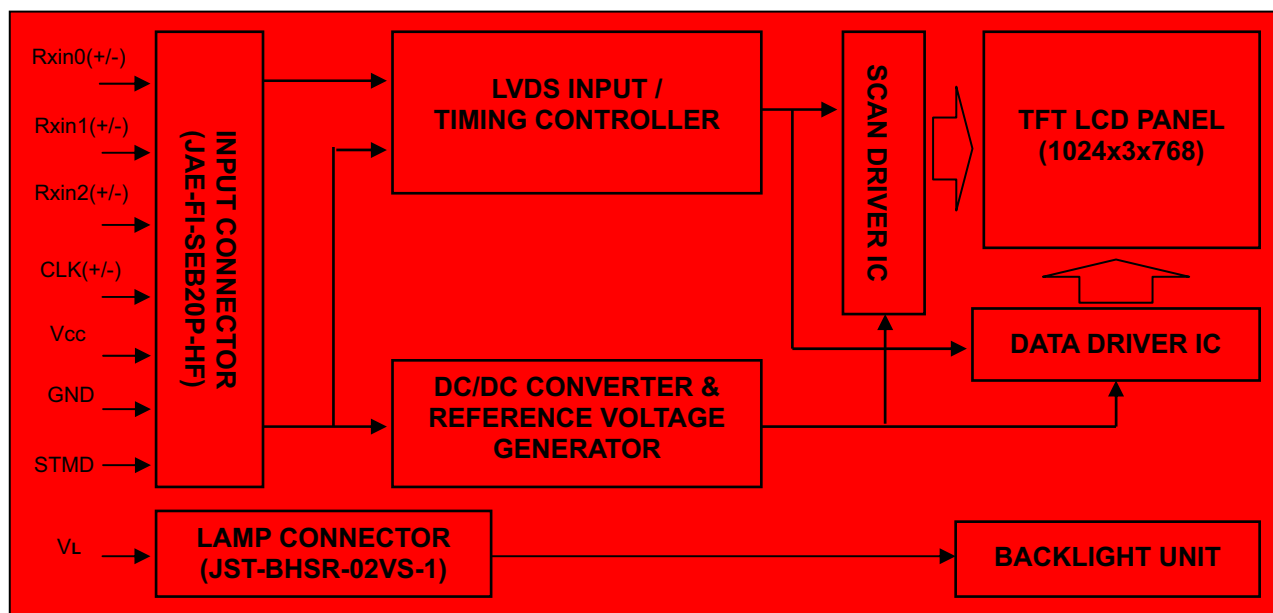
(a) When the brightness becomes or lower than 50% of its original value.

(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.)

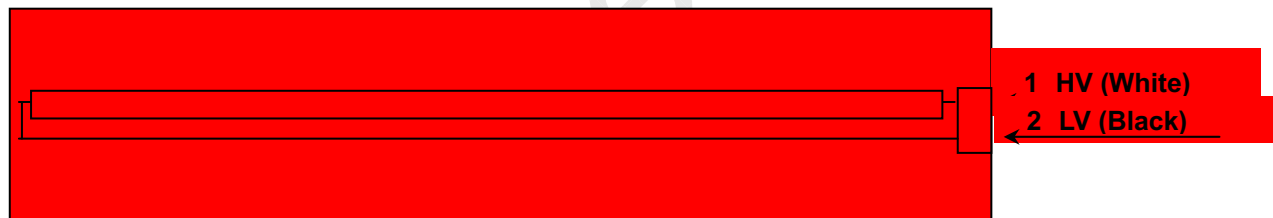
Note (6) The waveform of the voltage output of inverter must be area-symmetric and the design of the inverter must have specifications for the modularized lamp. The performance of the Backlight, such as lifetime or brightness, is greatly influenced by the characteristics of the DC-AC inverter for the 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	Symbol	Description	Polarity	Remark
1	Vcc	Power Supply +3.3 V		-
2	Vcc	Power Supply +3.3 V		-
3	Vss	Ground		-
4	Vss	Ground		-
5	Rxin0-	LVDS Differential Data Input	Negative	R0~R5,G0
6	Rxin0+	LVDS Differential Data Input	Positive	
7	Vss	Ground		-
8	Rxin1-	LVDS Differential Data Input	Negative	G1~G5,B0,B1
9	Rxin1+	LVDS Differential Data Input	Positive	
10	Vss	Ground		-
11	Rxin2-	LVDS Differential Data Input	Negative	B2~B5,DE,Hsync,Vsync
12	Rxin2+	LVDS Differential Data Input	Positive	
13	Vss	Ground		-
14	CLK-	LVDS Clock Data Input	Negative	LVDS Level
15	CLK+	LVDS Clock Data Input	Positive	
16	Vss	Ground		-
17	NC	Non-Connection		-
18	STMD	Standard mode selection		See Section 6.1
19	Vss	Ground		-
20	Vss	Ground		-

Note (1) Connector Part No.: **JAE-FI-SEB20P-HF13R** or equivalent

Note (2) User's connector Part No: **JAE-FI-S20S** or **FI-SE20M(JAE)**

Note (3) The first pixel is **even**.

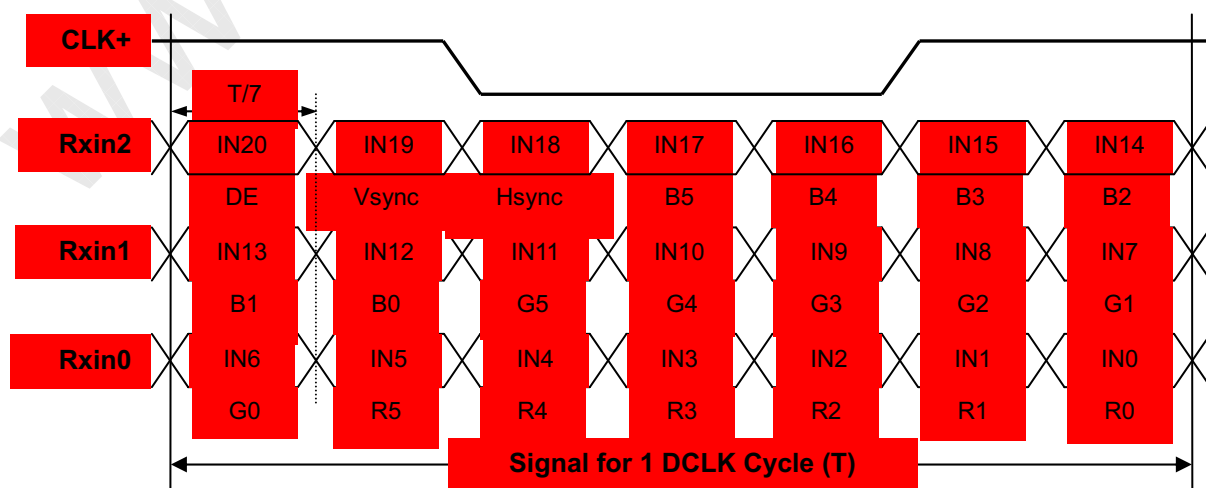
5.2 BACKLIGHT UNIT

Pin	Symbol	Description	Color
1	HV	High Voltage	White
2	LV	Ground	Black

Note (1) Connector Part No.: **JST-BHTR-02VS-1** or equivalent

Note (2) User's connector Part No.: **JST-SM02B-BHTS-B-TB** or equivalent

5.3 TIMING DIAGRAM OF LVDS INPUT SIGNAL



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The information described in this technical specification is **tentative** and it is possible to be changed without prior notice. Please contact CMO's representative while your product design is based on this specification. **Version 0.1**

5.4 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-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					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	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
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	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
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
	Red(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Red(63)	1	1	1	1	1	1	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
	Green(1)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	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
	Blue(1)	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	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	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 specifications of input signal timing are as the following table and timing diagram.

Signal	Parameter	Symbol	Min	Typ	Max	Unit	Remarks
DCLK	Pixel clock period	Tck	-	15	-	ns	

a.)DE Only Mode

If 'Pin 18' is left open or pulled high, DE mode is selected. When N141X3 is working under DE mode, the signals, VSYNC and HSYNC, are ignored. All timing of timing controller is **derived** from DE signal.

VSYNC	Vertical period	Tvp	777	806	834	Thp	
	Vertical display blank period	Tvdb	9	38	66	Thp	$T_{vdb} = T_{pw} + T_{bp} + T_{fp}$
	Vertical display active period	Tvda	768	768	768	Thp	
	Vertical sync. back porch	Vbp	0	29	65	Thp	
	Vertical sync. front porch	Vfp	0	3	65	Thp	
	Vertical sync. pulse width	Vpw	1	6	66	Thp	
HSYNC	Horizontal period	Thp	1342	1344	1356	Tck	Need to be even
	Horizontal display blank period	Thdb	318	320	332	Tck	$T_{hdb} = H_{pw} + H_{bp} + H_{fp}$
	Horizontal display active period	Thda	1024	1024	1024	Tck	
	Horizontal sync. back porch	Hbp	24	105	331	Tck	
	Horizontal sync. front porch	Hfb	0	70	307	Tck	
	Horizontal sync. pulse width	Hpw	1	145	308	Tck	

Note (1) Because 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.

Note (2) The duration of DE signal must be longer than 1 clock period at every horizontal sync. period.

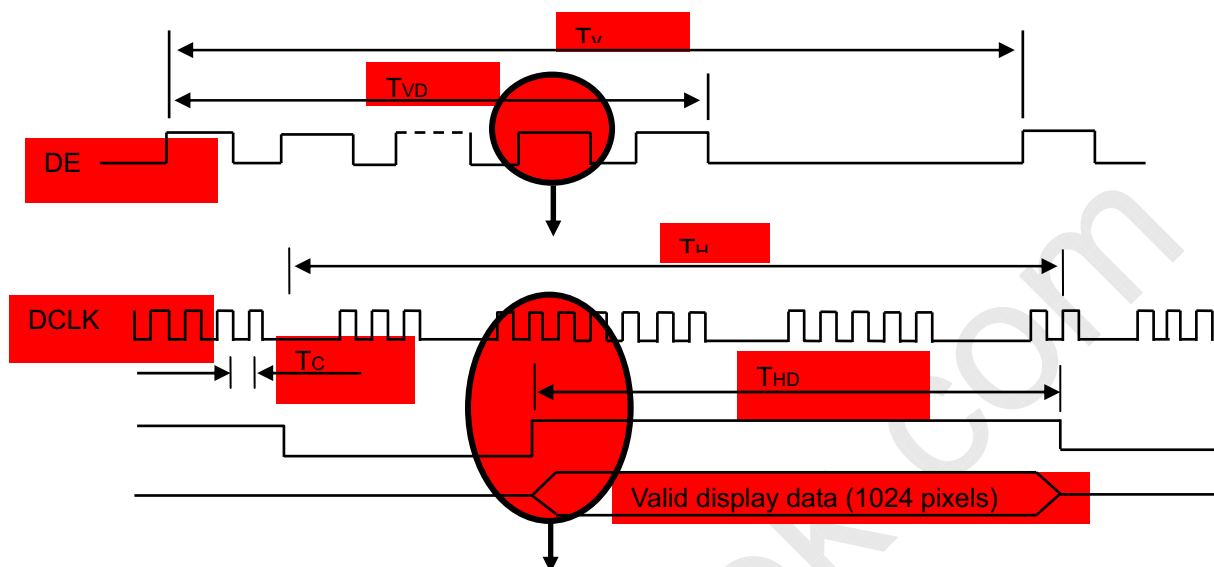
b.) Standard Mode

If 'Pin 18' is pulled down, Standard mode is selected. When Standard mode is used, VSYNC, HSYNC and DE should be provided.

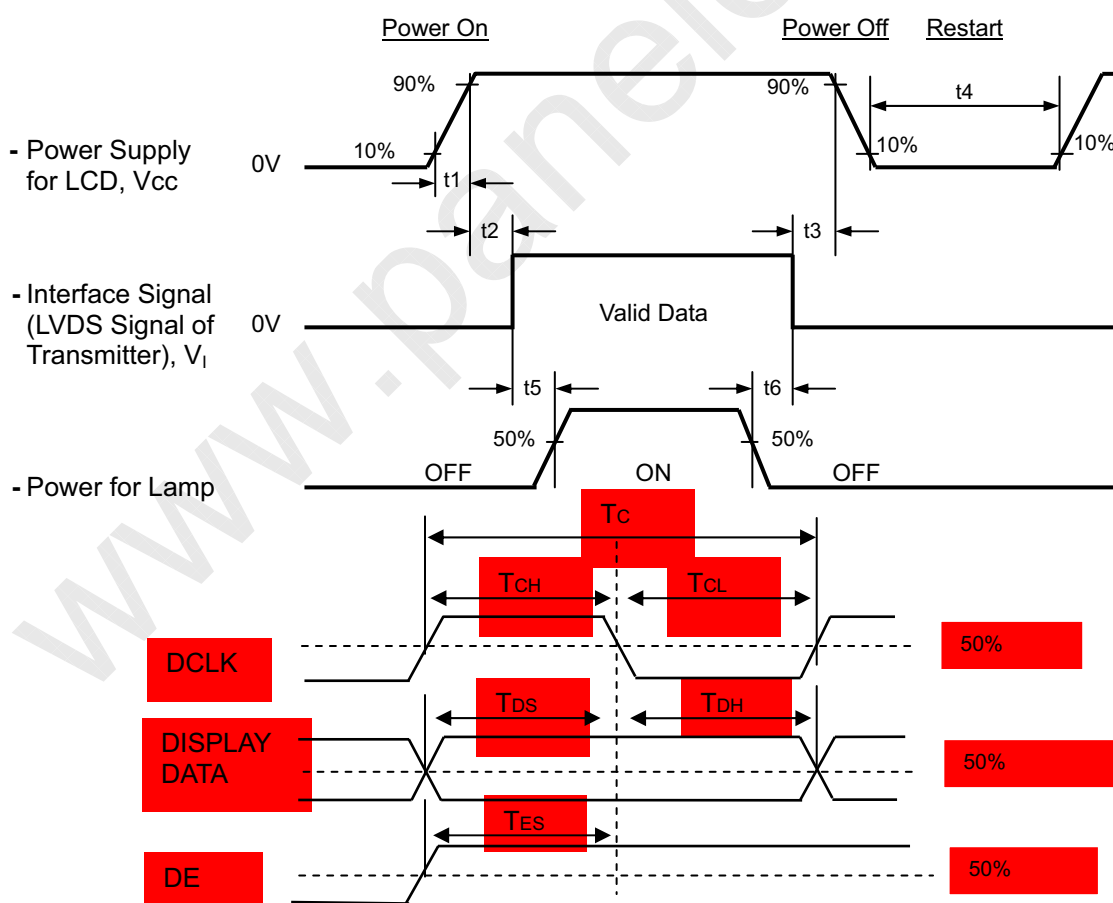
VSYNC	Vertical period	Tvp	769	806	1000	Thp	
	Vertical display blank period	Tvdb	1	38	232	Thp	$T_{vdb} = T_{pw} + T_{bp} + T_{fp}$
	Vertical display active period	Tvda	768	768	768	Thp	
	Vertical sync. back porch	Vbp	0	29	231	Thp	
	Vertical sync. front porch	Vfp	0	3	231	Thp	
	Vertical sync. pulse width	Vpw	1	6	232	Thp	
HSYNC	Horizontal period	Thp	1100	1344	1612	Tck	Need to be even
	Horizontal display blank period	Thdb	76	320	588	Tck	$T_{hdb} = H_{pw} + H_{bp} + H_{fp}$
	Horizontal display active period	Thda	1024	1024	1024	Tck	
	Horizontal sync. back porch	Hbp	10	105	564	Tck	
	Horizontal sync. front porch	Hfb	0	70	554	Tck	

Horizontal sync. pulse width	Hpw	24	145	578	Tck
------------------------------	-----	----	-----	-----	-----

INPUT SIGNAL TIMING DIAGRAM



6.2 POWER ON/OFF SEQUENCE



Timing Specifications:

$$0 < t1 \leq (10) \text{ msec}$$

$$0 < t2 \leq (50) \text{ msec}$$

$$0 < t3 \leq (50) \text{ msec}$$

$$t4 \geq 0.7 \text{ sec}$$

$$t5 \geq 170\text{msec}$$

$$t6 \geq 200\text{msec}(\text{min.})$$

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD Vcc to 0 V.

Note (3) The Backlight inverter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight inverter power must be turned off before the power supply for the logic and the interface signal is invalid.

7. OPTICAL CHARACTERISTICS

7.1 TEST CONDITIONS

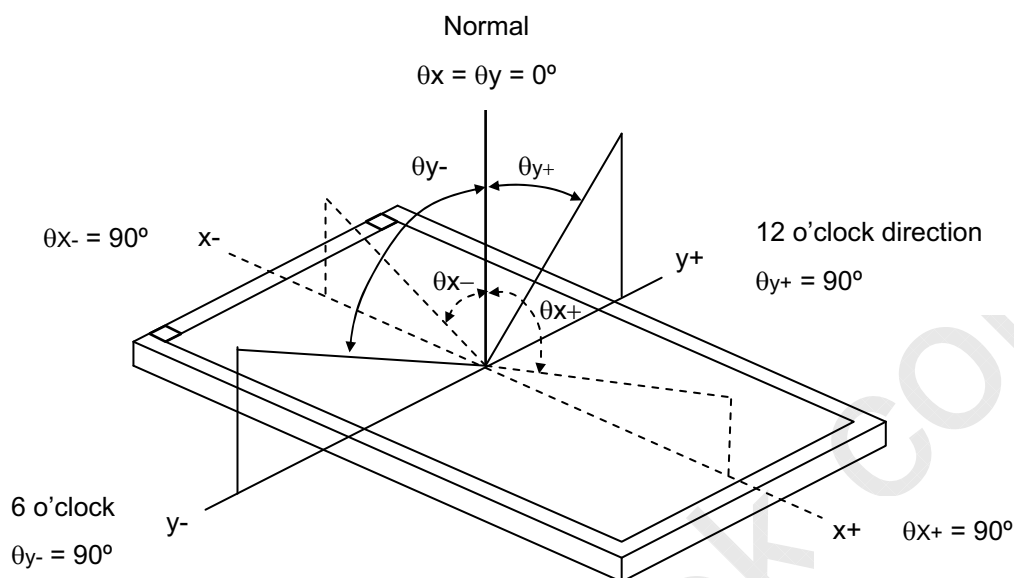
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V _{CC}	3.3	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Inverter Current	I _L	(6.0)	mA
Inverter Driving Frequency	F _L	(55)	KHz
Inverter		TBD	

The relative measurement methods of optical characteristics are shown in 6.2. The following items should be measured under the test conditions described in 6.1 and stable environment shown in Note (6).

7.2 OPTICAL SPECIFICATIONS

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Contrast Ratio	CR	$\theta_x=0^\circ, \theta_y=0^\circ$ Viewing Normal Angle	(150)		-	-	(2), (6)	
Response Time	T _R		-	(15)	(30)	ms	(3)	
	T _F		-	(35)	(50)	ms		
Center Luminance of White	L		(120)	(150)	-	cd/m ²	(6)	
Average Luminance of White	L _{Ave}		(110)	(140)	-	cd/m ²	(4), (6)	
White Variation	δW		-	(1.4)	(1.6)	-	(6), (7)	
Cross Talk	CT		-	-	TBD	%	(5), (6)	
Color Chromaticity	Red		R _x		(0.58)		-	(1), (6)
			R _y		(0.35)		-	
	Green		G _x		(0.32)		-	
		G _y		(0.54)		-		
	Blue	B _x		(0.15)		-		
		B _y		(0.14)		-		
White	W _x		(0.31)		-			
	W _y		(0.33)		-			
Viewing Angle	Horizontal	θ_{x+}	40	45		Deg.		
		θ_{x-}	40	45				
	Vertical	θ_{y+}	10	15				
		θ_{y-}	30	35				

Note (1) Definition of Viewing Angle (θ_x , θ_y):



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

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{63} / L_0$$

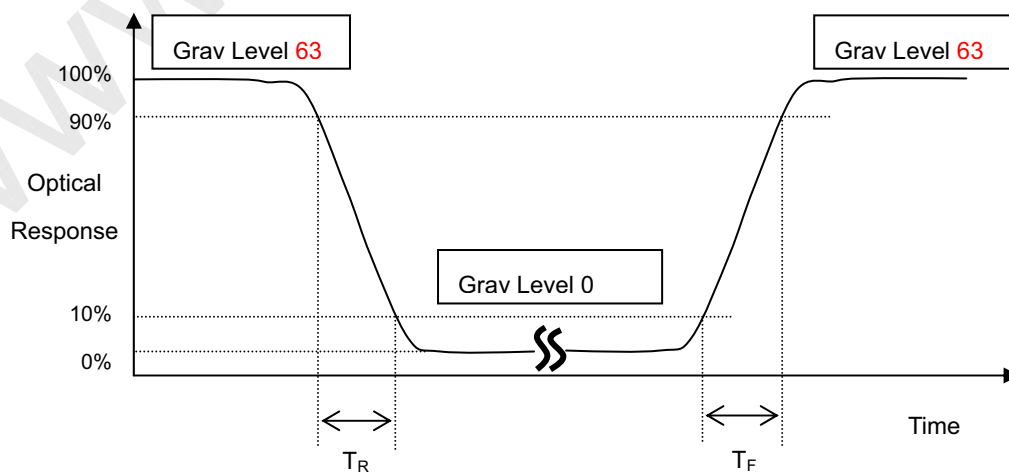
L_{63} : Luminance of gray level 63

L_0 : Luminance of gray level 0

$$\text{CR} = \text{CR} (5)$$

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 Average Luminance of White (L_{AVE}):

Measure the luminance of gray level 63 at 5 points

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

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

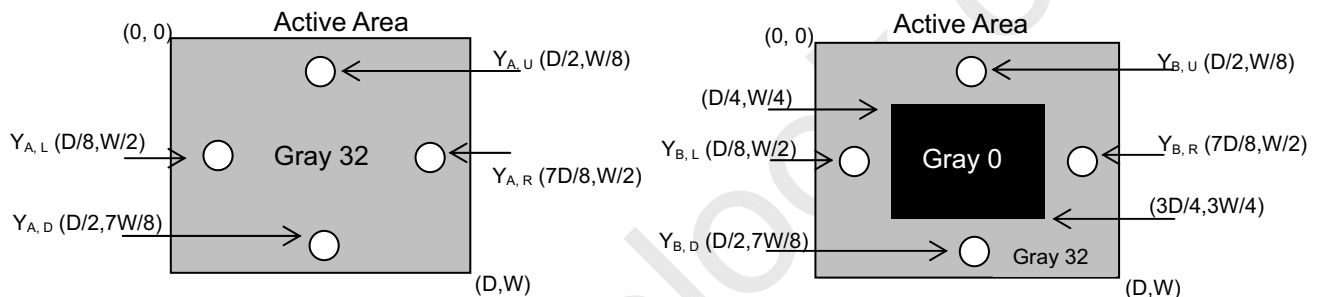
Note (5) Definition of Cross Talk (CT):

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

Where:

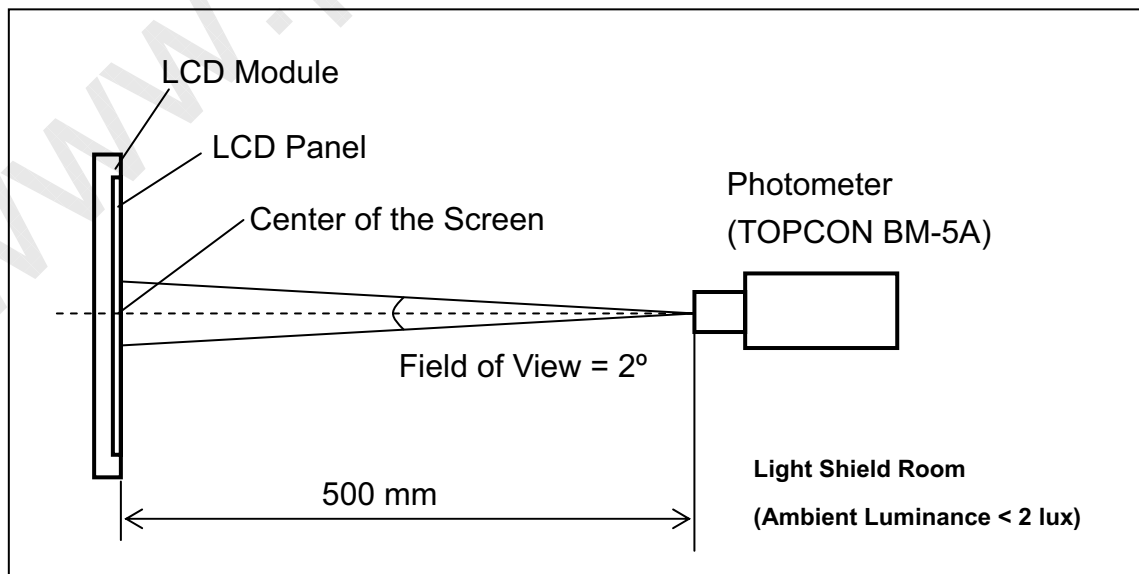
Y_A = Luminance of measured location without gray level 0 pattern (cd/m^2)

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



Note (6) Measurement Setup:

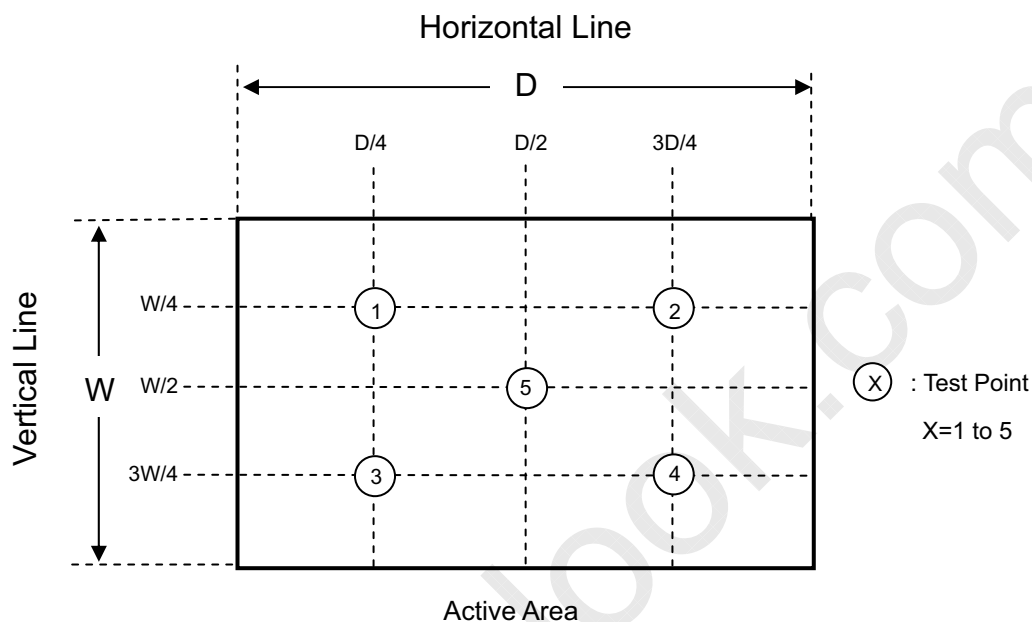
The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



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

Measure the luminance of gray level 63 at 5 points

$$\delta W = \text{Maximum} [L(1), L(2), L(3), L(4), L(5)] / \text{Minimum} [L(1), L(2), L(3), L(4), L(5)]$$



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 10°C 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.