DMT150XGHLCMU-1A
PRODUCT SPECIFICATION

Version 0.3
May 25, 2021

TBD

Customer's Approval	
Signature	*Date*

Prepared by *Joyce Huang*
Approved by *Evan Huang*

Revision History

VERSION	DATE	DESCRIPTION	AUTHOR
0.1	Jan 12, 2021	Preliminary	Joyce Huang
0.2	May 10, 2021	Revise storage temperature, overall dimensions, and mechanical drawing.	Joyce Huang
0.3	May 25, 2021	Page.11 Modified Backlight Characteristics	Joyce Huang

Legal Notice

Table of Contents

1. General Description

1.1 Introduction

This is a 15.0” size colour active matrix TFT LCD module that uses amorphous silicon TFT as a switching device. The display is normally black mode and featuring high contrast and excellent colour saturation. The resolution of the TFT-LCD is 1024 x 768 and can display up to 16.7M/262K colours. The display module supports LVDS interface and Optical bonding touch panel.

1.2 Main Features

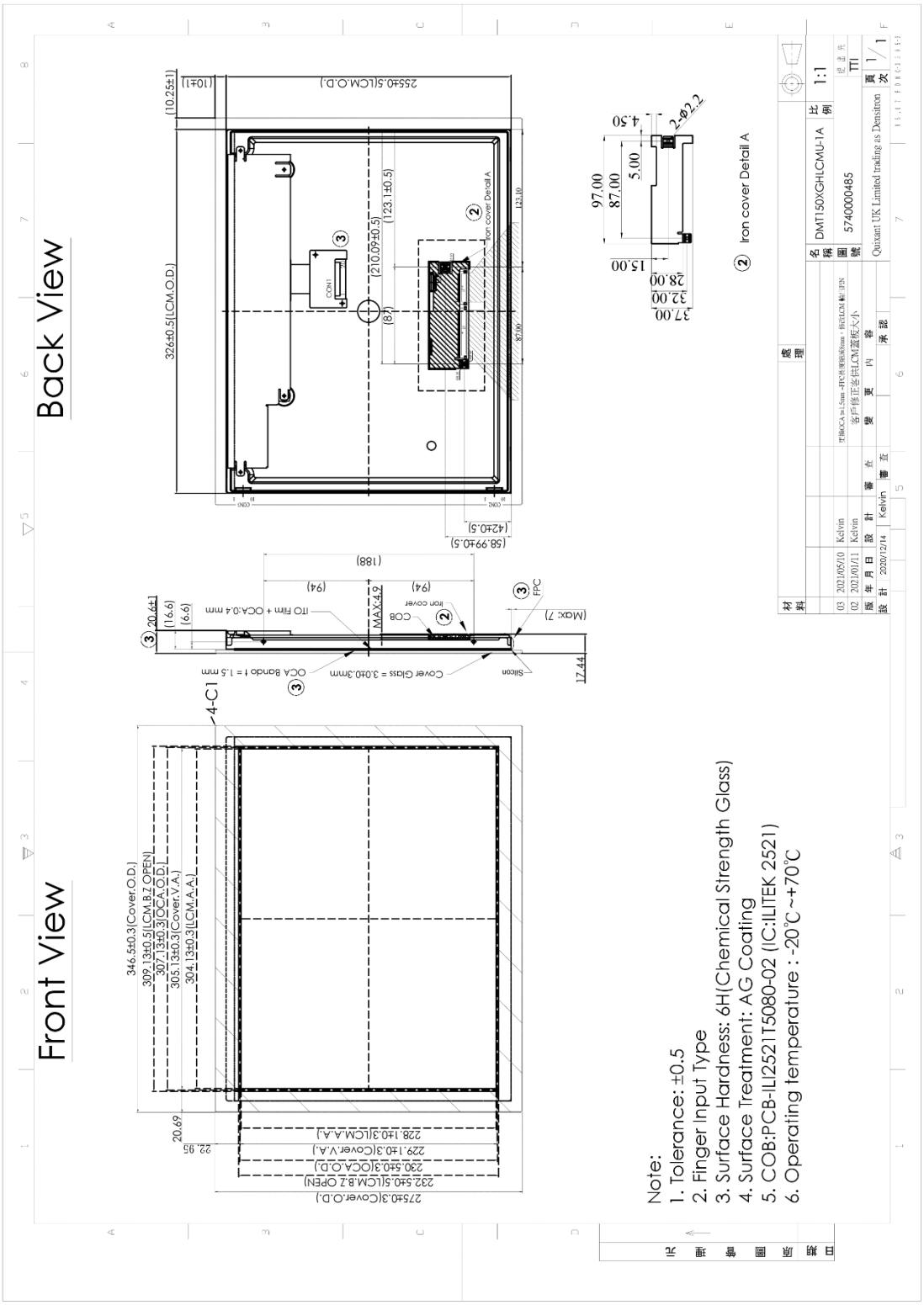
Item	Contents
Display Type	TFT LCD
Screen Size	15.0” Diagonal
Display Format	1024 x RGB x 768 Dots
No. of Colour	16.7M/262K
Overall Dimensions	346.5 (W) x 275.0 (H) x 20.3 (D) mm
Active Area	304.1 (W) x 228.1 (H) mm
Mode	Normally Black / VA
Surface Treatment	Hard Coating (6H), Anti-Glare
Viewing Direction	All round
Interface	LVDS (6 bit/8 bit)
Backlight Type	LED
Touch Panel	PCT
Touch Interface	USB
Touch Point	10 points
Bonding Type	Optical bonding
Operating Temperature	-20°C ~ +70°C
Storage Temperature	-20°C ~ +80°C
ROHS	Compliant to RoHS 2.0

2. Mechanical Specification

2.1 Mechanical Characteristics

Item	Characteristic	Unit
Display Format	1024 x RGB x 768	Dots
Overall Dimensions	346.5 (W) x 275 (H) x 20.3 (D)	mm
Active Area	304.1 (W) x 228.1 (H)	mm
Dot Pitch	0.297 (W) x 0.297 (H)	mm
Weight	TBD	g

2.2 Mechanical Drawing



3. Electrical Specification

3.1 Absolute Maximum Ratings

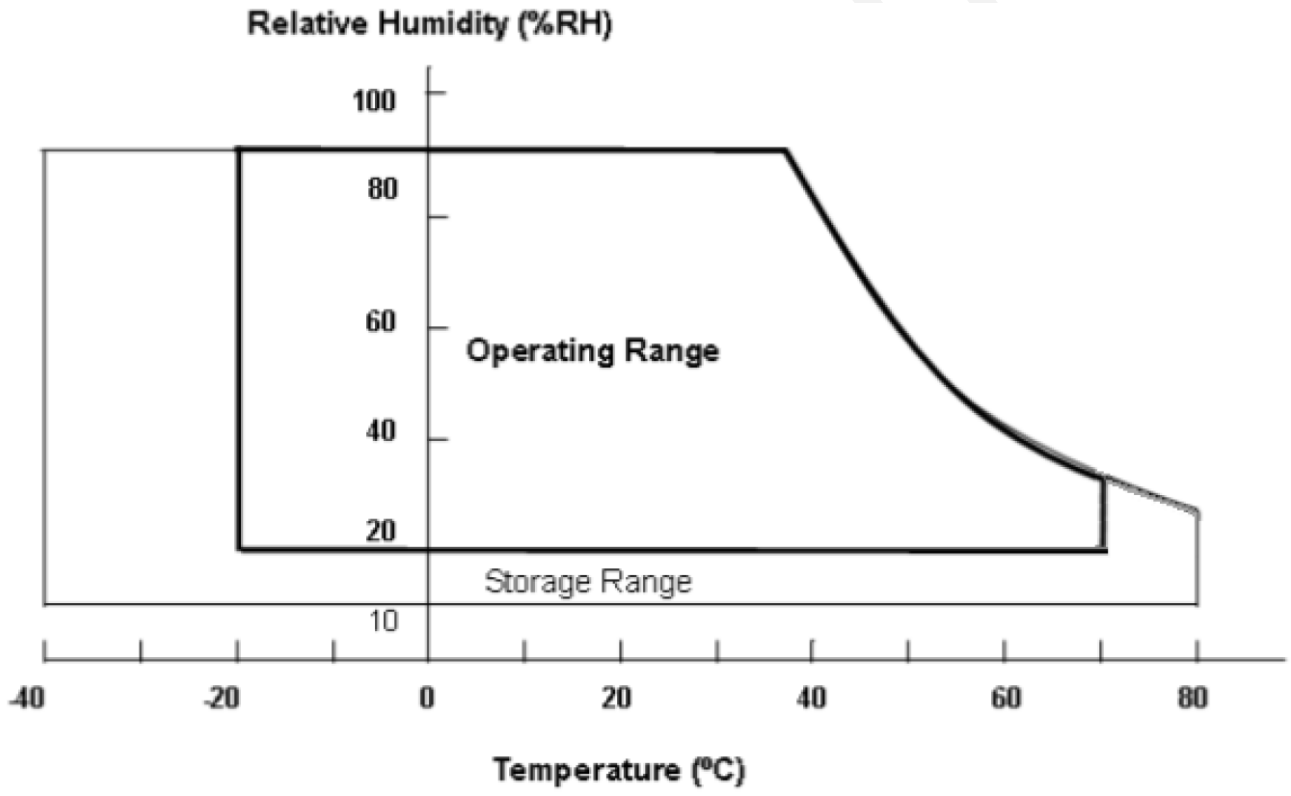
3.1.1 Absolute Ratings of Environment

Item	Symbol	Min	Max	Unit	Note
Operating Ambient Temperature	T_{OP}	-20	+70	°C	1, 2, 3
Storage Temperature	T_{ST}	-20	+80	°C	1, 2, 3

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

Note 2: 90 %RH Max. (Ta < 40℃).

Note 3: Wet-bulb temperature should be 39℃ Max.



3.1.2 Electrical Absolute Ratings

3.1.2.1 TFT LCD Module

Item	Symbol	Min	Max	Unit	Note
Power Supply Voltage	VCC	-0.3	4	V	1
Logic Input Voltage	VI	-0.3	VCC+0.3	V	

3.1.2.2 Backlight Unit

Item	Symbol	Min	Max	Unit	Note
Backlight (LED) Current	IF	0	180	mA	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 6.1 for further information).

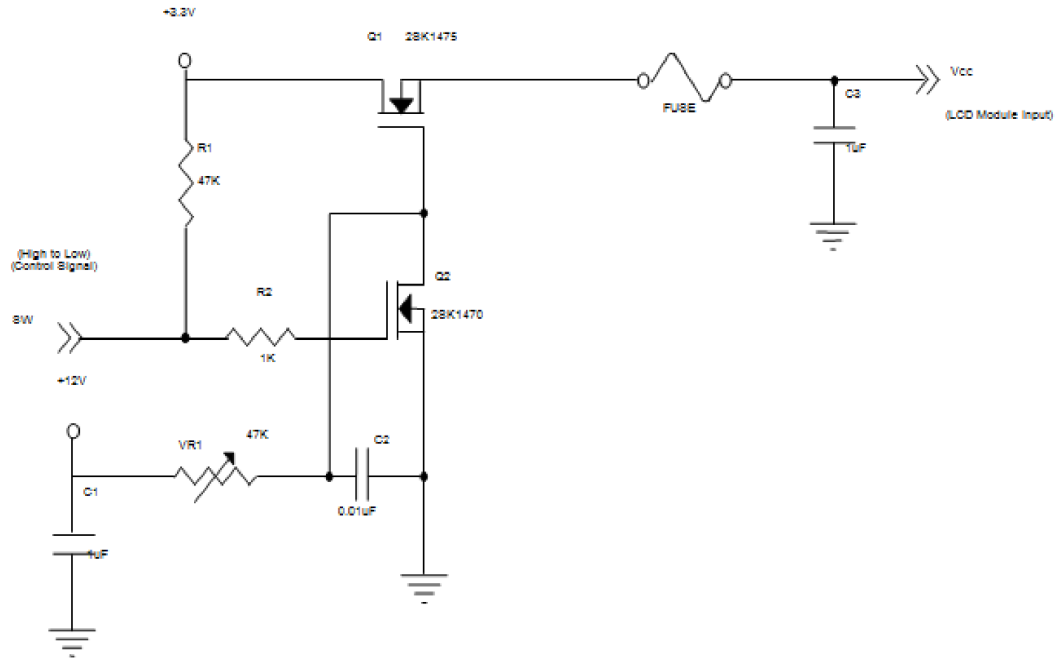
3.2 Electrical Characteristics

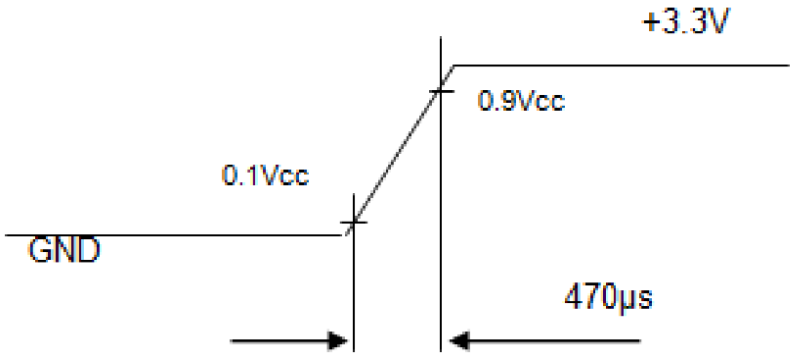
3.2.1 TFT LCD Module

Item		Symbol	Condition	Min	Typ.	Max	Unit	Note
Power Supply Voltage		V_{CC}	-	3.0	3.3	3.6	V	-
Ripple Voltage		V_{RP}	-		-	100	mVP-p	-
Rush Current		I_{RUSH}	-	-	-	2.0	A	2
Power Supply Current	White	I_{CC}	-	-	800	960	mA	3a
	Black			-	670	800	mA	3b
LVDS Differential Input Voltage		Vid	-	200	-	600	mV	-
LVDS Common Input Voltage		Vic	-	1.0	1.2	1.4	V	-
Differential Input Voltage for LVDS Receiver Threshold	"H" Level	V_{IH}	-	-	-	100	mV	-
	"L" Level	V_{IL}	-	-100	-	-	mV	-
Terminating Resistor		RT	-	-	100	-	Ohm	-

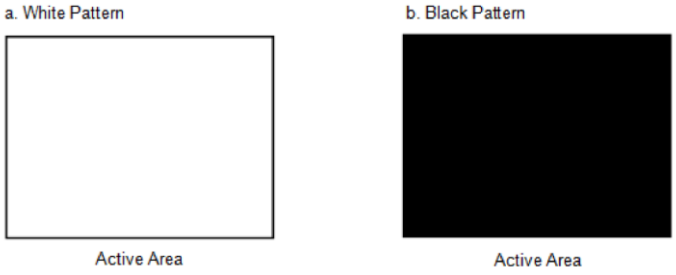
Note 1: The assembly should be always operated within above ranges.

Note 2: Measurement Conditions:





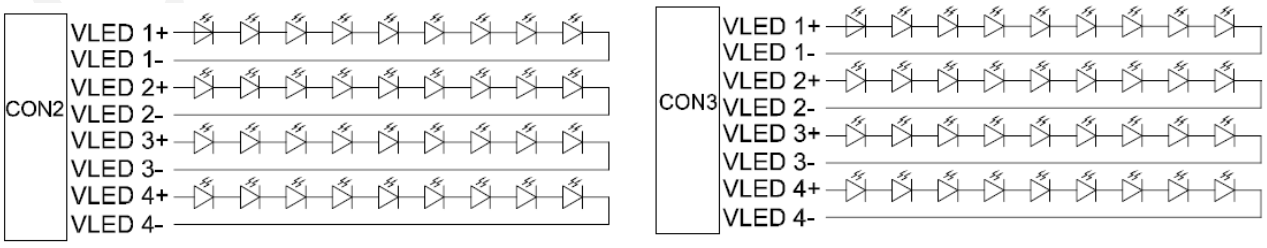
Note 3: The specified power supply is under the conditions at VDD=3.3V, Ta=25 ± 2 ºC, DC Current and fv = 60Hz, whereas a power dissipation check pattern below is displayed.



3.2.2 Backlight

Item	Symbol	Condition	Min	Typ.	Max	Unit	Note
LED Voltage	V_F	IF=100mA,Ta=25℃	-	27	31	V	-
LED Current	I_F	Ta=25℃	-	800	880	mA	1
LED Life Time	LT	Brightness to be decreased to 50%. IF=100mA,Ta=25℃	80,000	100,000	-	h	-

Note 1: There are groups LED.



CIRCUIT DIAGRAM (9 X 4 X 2 = 72 DIE)
(100mA x 4 =400mA , 27V)

3.3 Interface Pin Assignment

3.3.1 TFT LCD Module (CN1)

No.	Symbol	I/O	Function	Polarity	Note
1	VCC	P	Power Supply: +3.3V (typical)	-	-
2	VCC	P	Power Supply: +3.3V (typical)	-	-
3	GND	P	Ground	-	-
4	GND	P	Ground	-	-
5	RX0-	I	LVDS Differential Data Input	Negative	-
6	RX0+	I	LVDS Differential Data Input	Positive	-
7	GND	P	Ground	-	-
8	RX1-	I	LVDS Differential Data Input	Negative	-
9	RX1+	I	LVDS Differential Data Input	Positive	-
10	GND	P	Ground	-	-
11	RX2-	I	LVDS Differential Data Input	Negative	-
12	RX2+	I	LVDS Differential Data Input	Positive	-
13	GND	P	Ground	-	-
14	RXCLK-	I	LVDS Differential Data Input	Negative	-
15	RXCLK+	I	LVDS Differential Data Input	Positive	-
16	GND	P	Ground	-	-
17	RX3-	I	LVDS Differential Data Input	Negative	-
18	RX3+	I	LVDS Differential Data Input	Positive	-
19	Mode	I	LVDS 6/8 bit select function control, Low → 6bit Input Mode High → 8bit Input Mode	-	3
20	SC	I	Reverse Scan Control Low →Normal Mode. High →Horizontal/Vertical Reverse Scan	-	3

Note 1: Connector Part No.: Hirose DF14-20P-1.25H or equivalent.

Note 2: User's connector Part No.: Hirose DF14-20S-1.25C or equivalent.

Note 3: "Low" stands for 0V. "High" stands for 3.3V. "NC" stands for "No Connection".

Note 4: Pin10 input signals should be set to no connection or ground, this module would operate normally.

3.3.2 BACKLIGHT UNIT (CN2, CN3)

No.	Symbol	I/O	Function	Remark
1	NC	-	This pin should be open.	-
2	NC	-	This pin should be open.	-
3	LED C1	P	LED cathode 1	-
4	LED A1	P	LED anode 1	-
5	LED A2	P	LED anode 2	-
6	LED C2	P	LED cathode 2	-
7	LED C3	P	LED cathode 3	-
8	LED A3	P	LED anode 3	-
9	LED A4	P	LED anode 4	-
10	LED C4	P	LED cathode 4	-

Note 1: Backlight-side connector: SM10B-SHLS-TF(LF)(SN)(JST) or equivalent.

Note 2: User's Corresponding connector: SHLP-10V-S-B(JST) or equivalent.

3.3.3 TOUCH UNIT(CN4)

No.	Symbol	I/O	Function	Remark
1	NC	-	This pin should be open.	-
2	NC	-	This pin should be open.	-
3	SC	I	Original coordinate reversed. L: Norma, H: Reversed	-
4	GND	P	GND	-
5	NC	-	This pin should be open.	-
6	NC	-	This pin should be open.	-
7	NC	-	This pin should be open.	-
8	NC	-	This pin should be open.	-
9	RESET	I	H: Normal, L: Reset	RESET
10	D-	I/O	USB Data negative analog input/output	USB2.0 Standard
11	D+	I/O	USB Data positive analog input/output	USB2.0 Standard
12	VBUS	P	Supply voltage	Power 5V

Note 1: Touch-side connector: SM12B-SHLS-TF(LF)(SN)(JST) or equivalent.

Note 2: User's Corresponding connector: SHLP-12V-S-B(JST) or equivalent.

3.4 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)/Dar k	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	0	0	0	0	0	0	0	0	0
	Green(2)	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Green(253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	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	1	0	0	0	0	0	0	0	0
	Green(255)																								

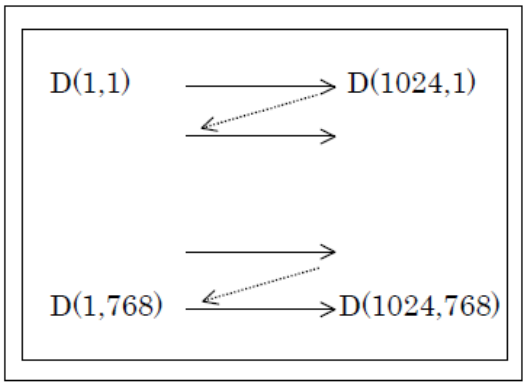
Color		Data Signal																							
		Red								Green								Blue							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Gray Scale of Blue	Blue(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(2)	0: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

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

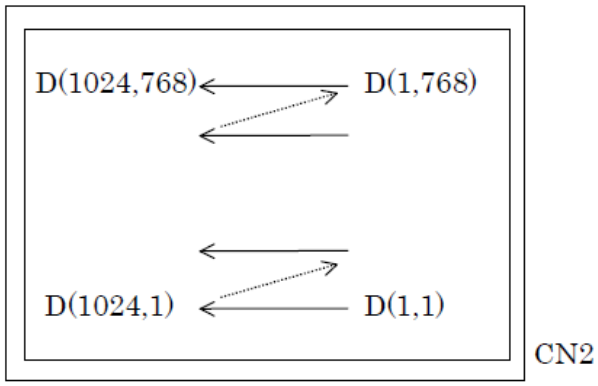
Note 2: Display Position and Scan Direction

D(X,Y) shows the data number of input signal.

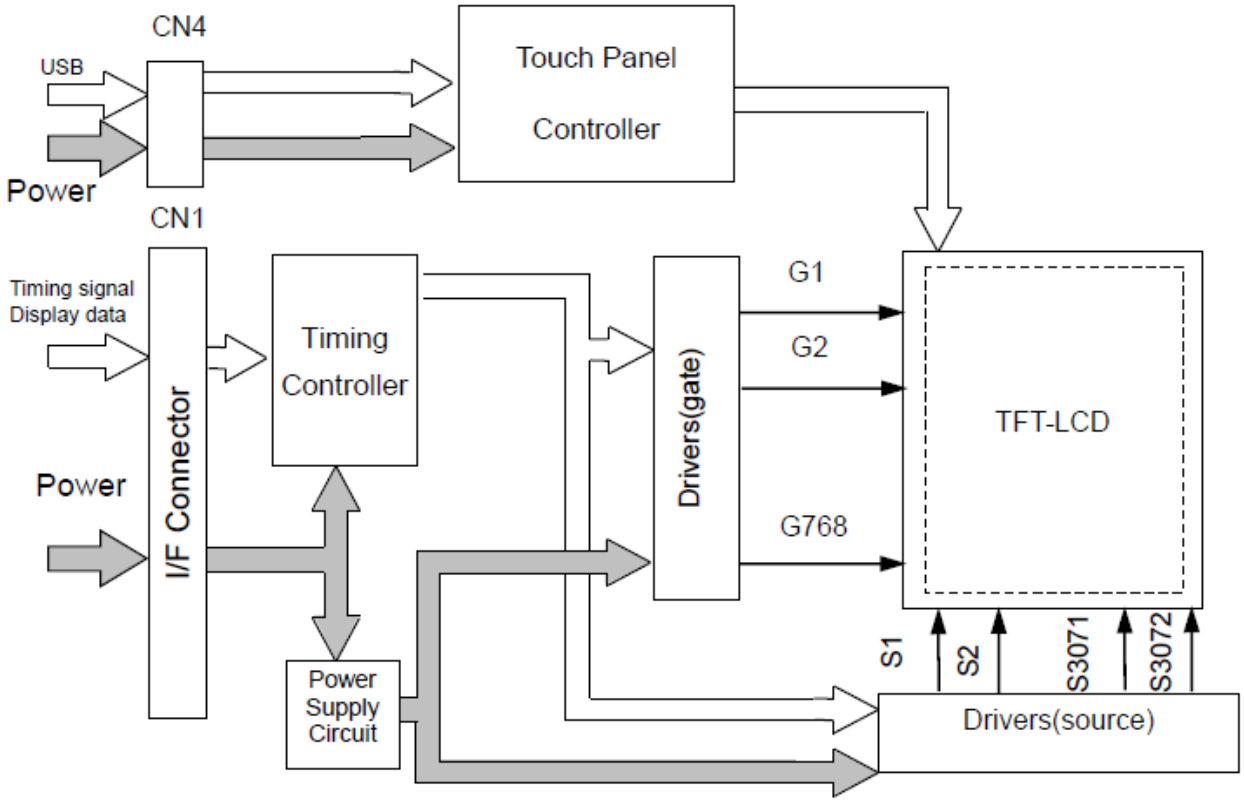
SC: Low

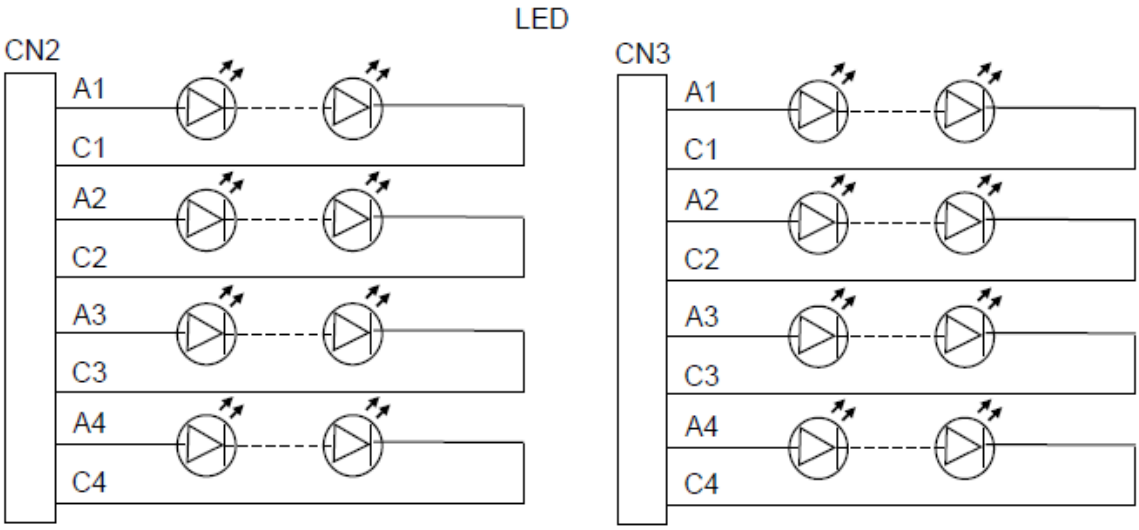


SC: High



3.5 Block Diagram





3.6 Timing Characteristics

3.6.1 Input Signal Timing Specifications

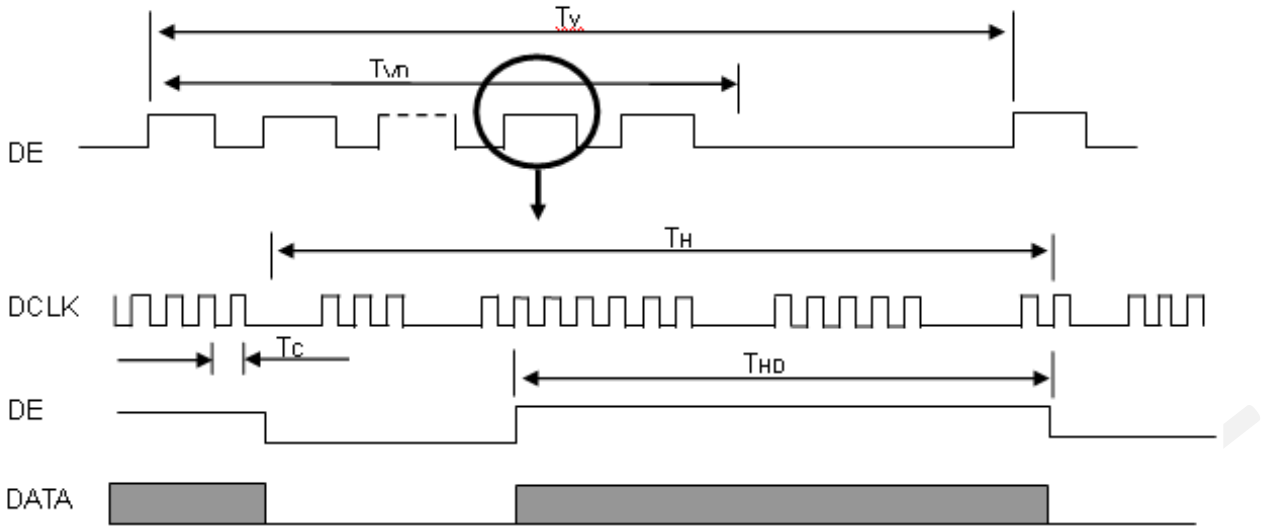
The input signal timing specifications are shown as the following table and timing diagram.

Item	Item	Symbol	Min	Typ.	Max	Unit	Note
LVDS Clock	Frequency	Fc	53.35	65	80	MHz	-
	Period	Tc	12.5	15.38	18.75	ns	-
	Input Cycle to Cycle Jitter	T_{rcl}	-	-	200	ns	1
	Input Clock to Data Skew	TLVCCS	-0.02*Tc	-	0.02*Tc	Ps	2
	Spread Spectrum Modulation Range	F_{clkin_mod}	-	-	1.02*Fc	MHz	3
	Spread Spectrum Modulation Frequency	F_{SSM}	-	-	200	KHz	
Vertical Display Term	Frame Rate	Fr	55	60	70	Hz	Tv=Tvd+Tvb
	Total	Tv	780	806	840	Th	-
	Active Display	Tvd	768	768	768	Th	-
	Blank	Tvb	Tv-Tvd	38	Tv-Tvd	Th	-
Horizontal Display Term	Total	Th	1240	1344	1360	Tc	Th=Thd+Thb
	Active Display	Thd	1024	1024	1024	Tc	-
	Blank	Thb	Th-Thd	320	Th-Thd	Tc	-

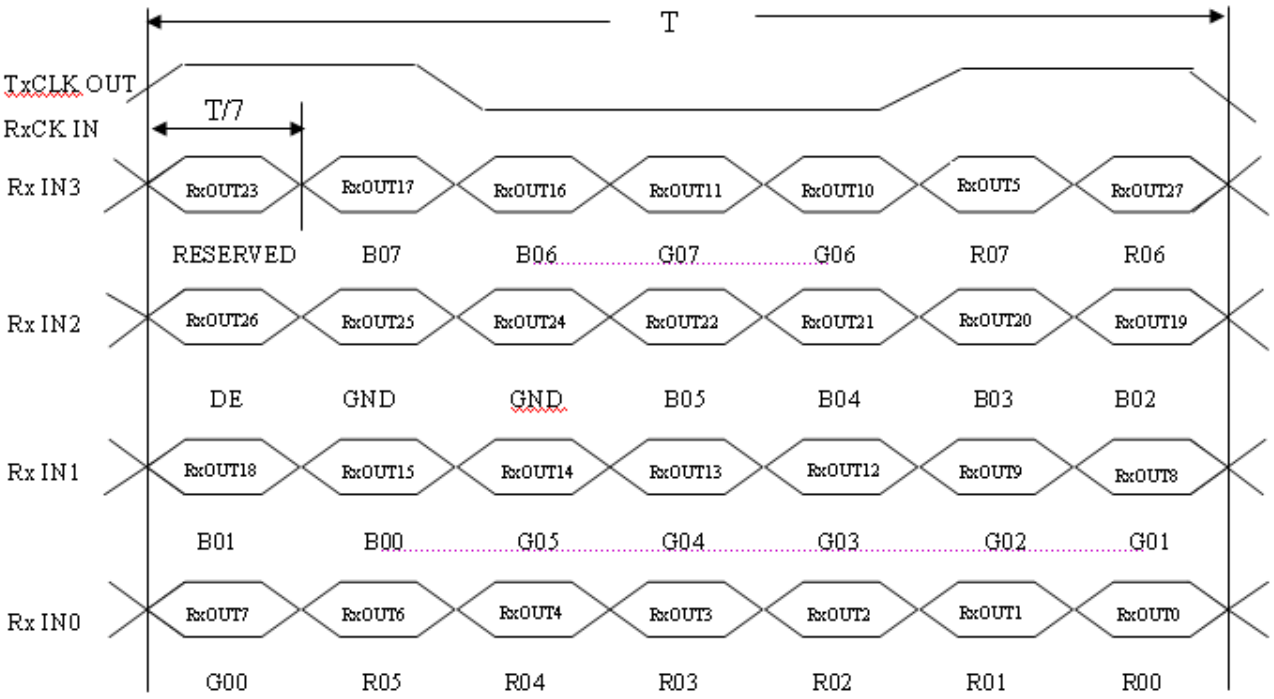
Note 1: Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

Note 2: The Tv(Tvd+Tvb) must be integer, otherwise, the module would operate abnormally.

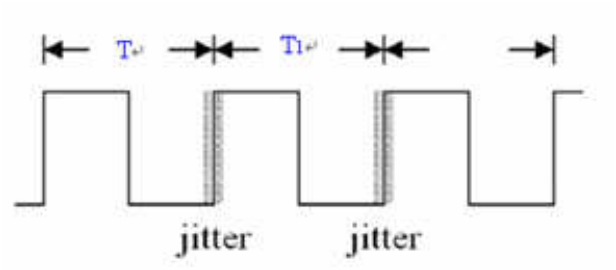
Input Signal Timing Diagram



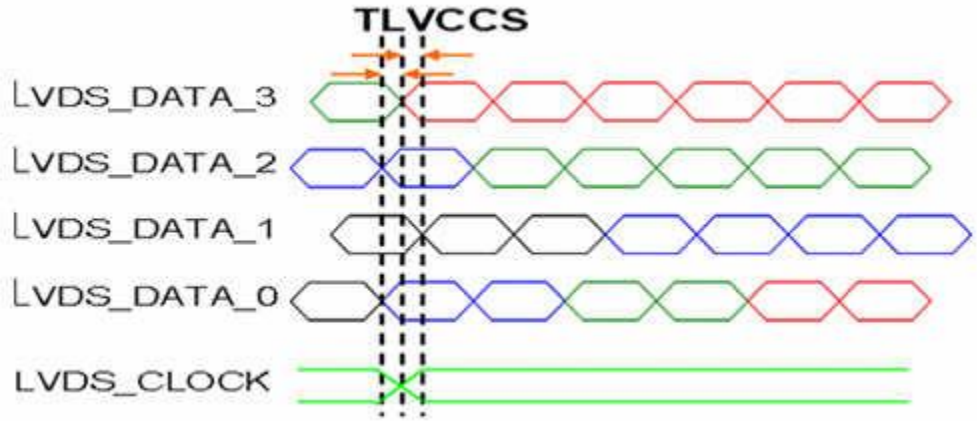
Timing Diagram of LVDS



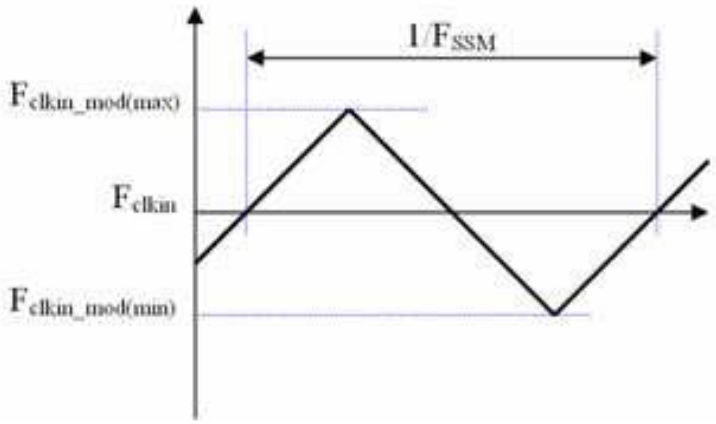
Note 1: The input clock cycle-to-cycle jitter is defined as below figures. Trcl = I T1 – TI



Note 2: Input Clock to data skew is defined as below figures.



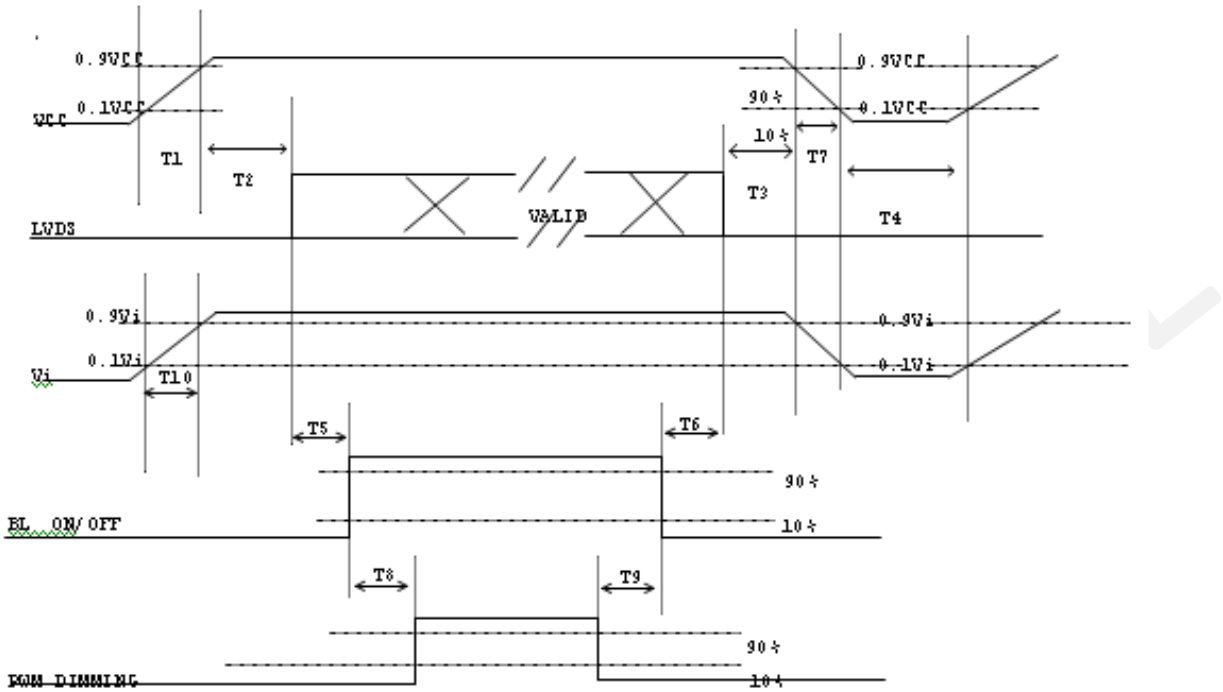
Note 3: The SSCG (Spread spectrum clock generator) is defined as below figures.



3.6.2 Power On/Off Sequence

To prevent a latch-up or DC operation of LCD assembly, the power on/off sequence should be as the diagram below.

Power On/Off Sequence



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.

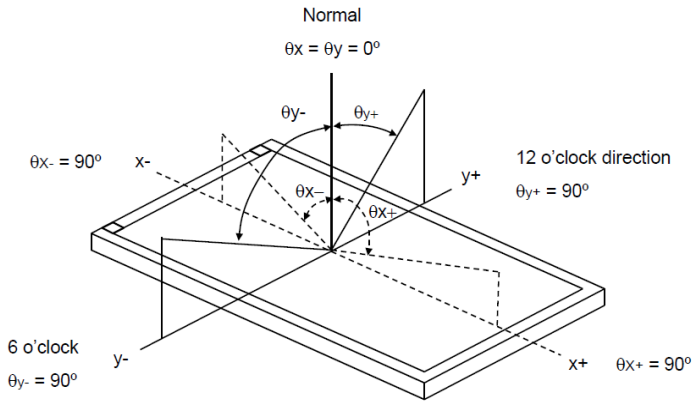
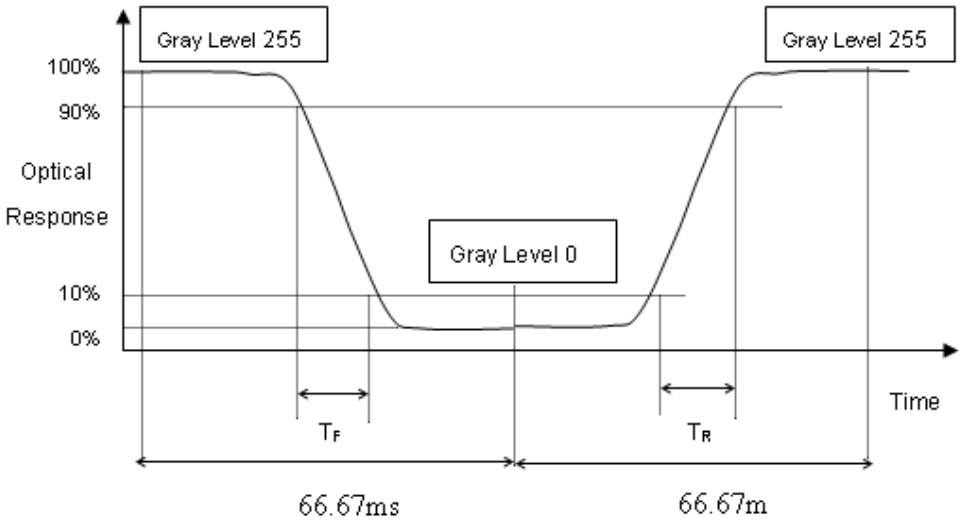
Note 3: The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

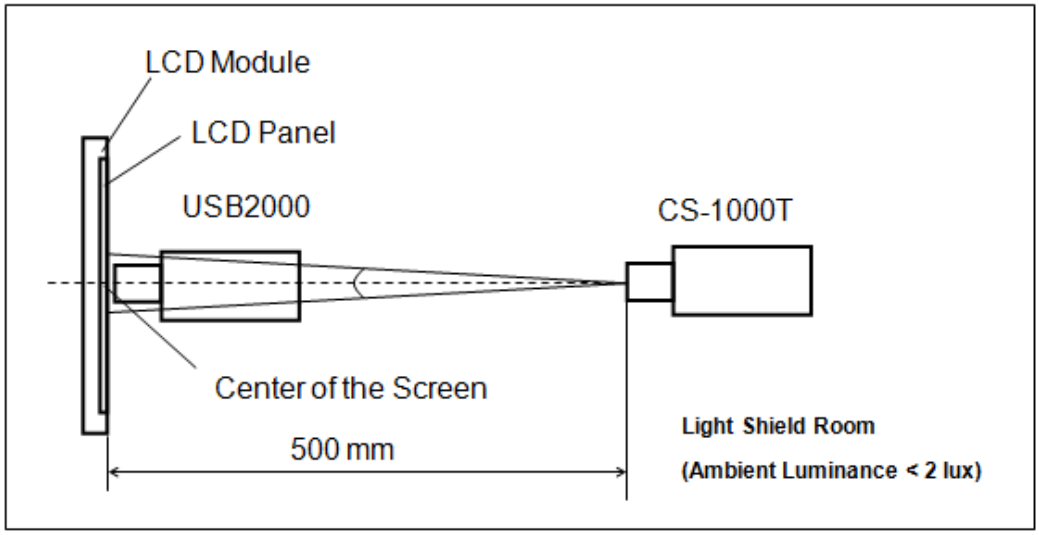
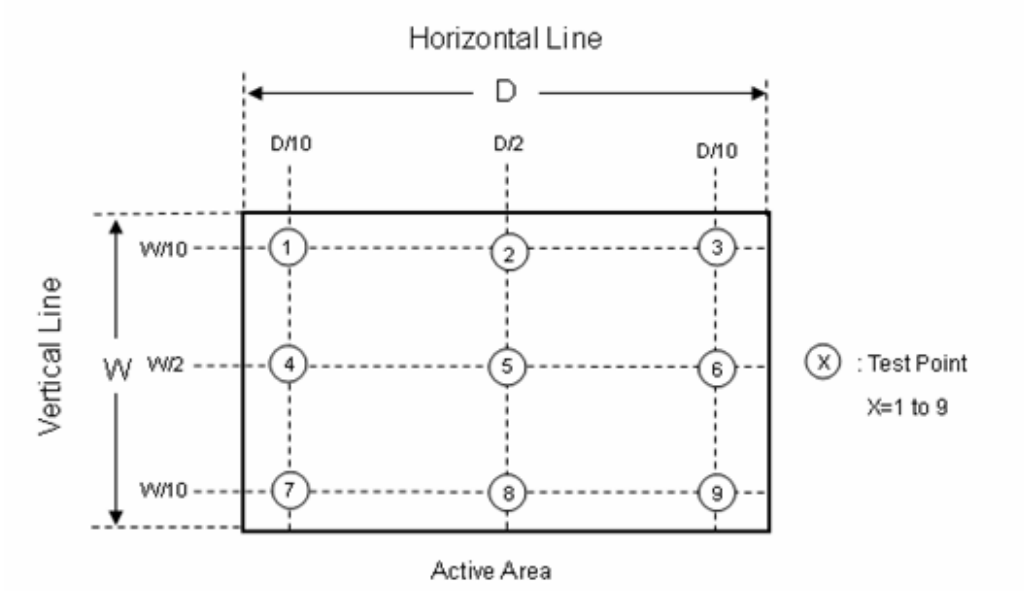
Item	Min	Typ.	Max	Unit	Note
T1	0.5	-	10	ms	-
T2	0	-	50	ms	-
T3	0	-	50	ms	-
T4	500	-	-	ms	-
T5	200	-	-	ms	-
T6	200	-	-	ms	-
T7	5	-	300	ms	-
T8	10	-	-	ms	-
T9	10	-	-	ms	-
T10	20	-	50	ms	-

4. Optical Specification

4.1 Optical Characteristics

Characteristics		Symbol	Conditions	Min	Typ.	Max	Unit	Note
Contrast Ratio		CR	θ = 0° CS-1000T	1800	2500	-	-	2, 5
Response time		TR		-	16	21	ms	3
		TF		-	7	14		
Center Luminance of White		Lc		(900)	(1200)	-	cd/m^2	4, 5
White Variation		δW	θ = 0° USB2000	-	1.25	1.33	-	5, 6
Viewing Angle	Left	θ_x-	CR≧10 USB2000	80	88	-	Deg.	1, 5
	Right	θ_x+		80	88	-		
	Up	θ_Y+		80	88	-		
	Down	θ_Y-		80	88	-		
Colour Chromaticity	Red	Rx	θ = 0° CS-1000T	Typ. -0.05	0.647	Typ. +0.05	-	1, 5
		Ry			0.338			
	Green	Gx			0.321			
		Gy			0.606			
	Blue	Bx			0.157			
		By			0.039			
	White	Wx			0.313			
		Wy			0.329			

Note	Item	Test method
1	Definition of Viewing Angle (θx, θy)	
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 the figure in Note (6). Contrast ratio (CR) = Luminance measured when LCD is at "white state" / Luminance measured when LCD is at "black state"
3	Definition of Response Time (T_R, T_F)	
4	Definition of Luminance of White (LC)	Measure the luminance of gray level 255 at center point LC = L (5) L (x) is corresponding to the luminance of the point X at Figure in Note (6).

Note	Item	Test method
5	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. 
6	Definition of White Variation (δW)	Measure the luminance of gray level 63 (255) at 9 points $\delta W = \frac{\text{Maximum [L (1), L (2), L (3), L (4), L (5) , L (6), L (7), L (8), L (9)]}}{\text{Minimum [L (1), L (2), L (3), L (4), L (5) , L (6), L (7), L (8), L (9)]}}$ 

5. Packaging

TBD

6. Quality Assurance Specification

6.1 Conformity

The performance, function and reliability of the shipped products conform to the Product Specification.

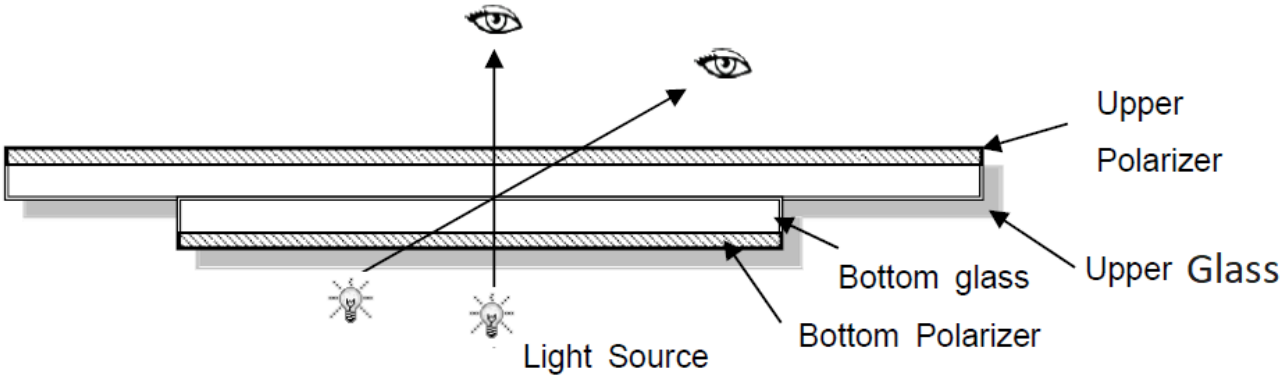
6.2 Environment Required

Customer's test & measurement are required to be conducted under the following conditions:

Temperature:	25°C
Humidity:	25~75 %RH
Viewing Angle:	a) 15 degree to the front surface of display panel in vertical direction.
	b) 45 degree to the front surface of display panel in horizontal direction
Illumination:	300 ~ 500 Lux for external appearance inspection
	100 ~ 200 Lux for light on inspection
Viewing distance:	35cm or more between the LCD module and eyes of inspector.

Finger glove (or finger cover) must be worn by the inspector.

Inspection table or jig must be anti-electrostatic.

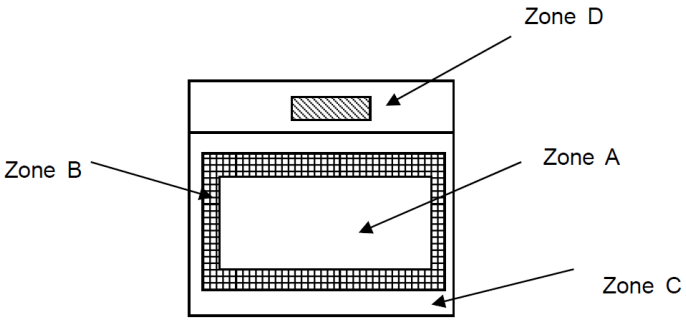


6.3 Delivery Assurance

6.4 Delivery Inspection Standards

Class II, Normal Inspection, MIL-STD-105E

6.5 Zone Definition



Zone A: Effective Viewing Area (Character or Digit can be seen)

Zone B: Viewing Area except Zone A

Zone C: Outside (Zone A + Zone B) Area which cannot be seen after assembly by customer.

Zone D: IC Bonding Area

Note: Generally, visual defects in Zone C can be ignored when it doesn't affect product function or appearance after assembly by customer

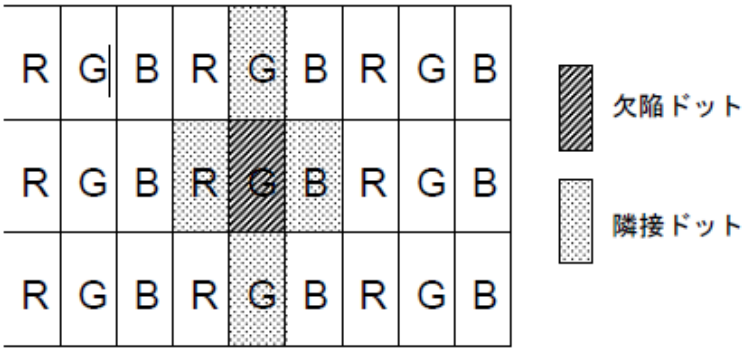
6.5.1 Inspection Criteria

Items		Acceptable Count	
LCD Module Standard Appearance	Straight Scratches	0.01 mm < W ≤ 0.05 mm L ≤ 10 mm	N≤4
		0.01 mm ≤ W 10 mm < L	N=0
		0.05 mm < W	N=0
	Circular Scratches	0.2 mm< ϕ ≤0.4 mm	N≤4
		0.4 mm < ϕ	N=0
	Circular Foreign Black Bubble	0.2 mm< ϕ ≤0.4 mm	N≤ 5
		0.4 mm < ϕ	N=0
	Foreign Fiber	L ≤3 mm W ≤0.1 mm	N≤4
		3 mm < L W ≤0.1 mm	N=0
		0.1 mm < W	Circular Foreign Black Matter By standard
CTP Standard Appearance	Straight Scratches	0.1mm < W ≤ 0.2 mm L ≤ 20 mm	N ≤ 5
		20 mm < L	N = 0
		0.2 mm < W	N = 0
	Circular Scratches	0.4mm < ϕ ≤ 0.5 mm	N ≤ 5
		0.5 mm < ϕ	N = 0
	Foreign Fiber	0.1mm < W ≤ 0.2 mm L ≤ 20 mm	N ≤ 5
		20 mm < L	N = 0
		0.2 mm < W	N = 0
	Circular Foreign Bubble Air Bubbles	0.4mm < ϕ ≤ 0.5 mm	N ≤ 5
		0.5 mm < ϕ	N = 0
	Crack/Broken Glass	Progressive	N = 0
Bad Points	Bright Dot Defect	N ≤ 3	
	Black Dot Defect	N ≤ 3	
	Total Number of Defects	N ≤ 5	
	2 Defect Dots Adjacent	-	

Items		Acceptable Count
	Bright Dot Defect	≤ 1 Pair
	Black Dot Defect	≤ 1 Pair
	3 defect Dots Adjacent	Not Acceptable
	Line Defect	Not Acceptable

Note 1: W: Width, L: Length, ϕ: Diameter, N; Number

Note 2: Definition of defect dots adjacent: When the adjacent dots are defects with respect to the defect dots, as shown in the below figure.



Note 3: Definition of bright dot defects: Not visible through 5% ND filter in 50% gray or judge by limit sample if necessary.

6.5.2 Non-conforming Analysis

Purchaser should supply Densitron with detailed data of non-conforming sample.

After accepting it, Densitron should complete the analysis in two weeks from receiving the sample.
If the analysis cannot be completed on time, Densitron must inform the purchaser.

6.5.3 Handling of Non-conforming Displays

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.
Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.
Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

7. Reliability Specification

7.1 Reliability Tests

Test Item	Test Condition	Note
High Temperature Storage Test	80℃, 240 hours	1, 2, 4, 5
Low Temperature Storage Test	-20℃, 240 hours	
Thermal Shock Storage Test	-20℃, 1 hour←→80℃, 1 hour; 100cycles, (2 hours/cycle)	
High Temperature Operation Test	70℃, 240 hours	
Low Temperature Operation Test	-20℃, 240 hours	
High Temperature & High Humidity Operation Test	40℃, RH 90%, 240 hours	1, 2, 4, 6
ESD Test (Operation)	150pF, 330Ω, 10 cycle, 1 sec/cycle Contact, ±8 KV	1, 4
ESD Test (Non-Operation)	200pF, 0Ω, 10 cycle, 1 sec/cycle Air ±15 KV	1,4
Shock (Non-Operating)	50G, 11ms, half sine wave, 1 time for ± X, ± Y, ± Z direction	2, 3
Vibration (Non-Operating)	1.5G, 10 ~ 300 Hz sine wave, 10 min/cycle, 3 cycles each X, Y, Z direction	2, 3

Note 1: There should be no condensation on the surface of panel during test.

Note 2: Temperature of panel display surface area should be 90ºC Max.

Note 3: 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.

Note 4: In the standard conditions, there is no function failure issue occurred. All the cosmetic specification is judged before reliability test.

Note 5: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

Note 6: Before cosmetic and function test, the product must have enough recovery time, at least 24 hours at room temperature.

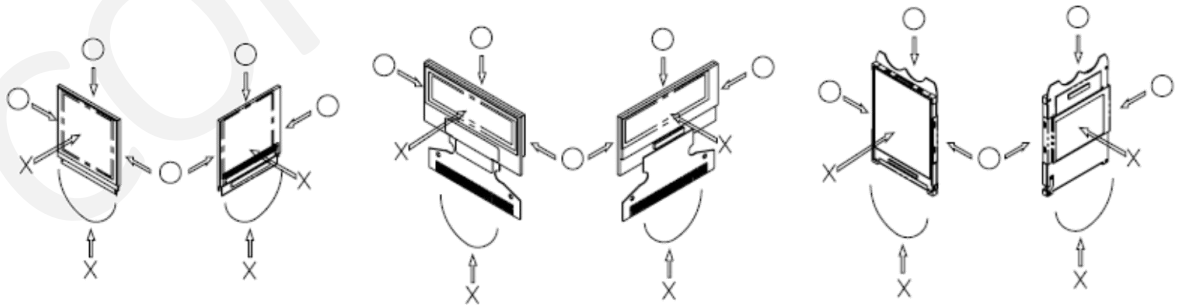
7.1.1 Inspection Check Standard

After the completion of the described reliability test, the samples are to be left at room temperature for 4 hrs prior to conducting the inspection check at 25±2 °C, 50±10% RH.

8. Handling Precautions

8.1 Handling Precautions

1) Since the display panel is being made of glass, do not apply mechanical impacts such us dropping from a high position.
2) If the display panel is broken by some accident and the internal organic substance leaks out, be careful not to inhale nor lick the organic substance.
3) If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water
4) If pressure is applied to the display surface or its neighborhood of the display module, the cell structure may be damaged and be careful not to apply pressure to these sections.
5) The polarizer covering the surface of the display module is soft and easily scratched. Please be careful when handling the display module.
6) When the surface of the polarizer of the display module has soil, clean the surface. It takes advantage of by using following adhesion tape.
   a. Scotch Mending Tape No. 810 or an equivalent
   b. Never try to breathe upon the soiled surface nor wipe the surface using cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.
   c. Also, pay attention that the following liquid and solvent may spoil the polarizer:
      - Water
      - Ketone
      - Aromatic Solvents
7) Hold the display module very carefully when placing it into the system housing. Do not apply excessive stress or pressure to display module. And, do not over bend the film with electrode pattern layouts. These stresses will



influence the display performance. Also, secure sufficient rigidity for the outer cases.
8) Do not apply stress to the LSI chips and the surrounding molded sections.
9) Do not disassemble nor modify the display module.
10) Do not apply input signals while the logic power is off.
11) Pay sufficient attention to the working environments when handing display modules to prevent occurrence of element breakage accidents by static electricity.

a. Be sure to make human body grounding when handling display modules.
b. Be sure to ground tools to use or assembly such as soldering irons.
c. To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
d. Protective film is being applied to the surface of the display panel of the display module. Be careful since static electricity may be generated when exfoliating the protective film.

12) Protection film is being applied to the surface of the display panel and removes the protection film before assembling it. If the display module has been stored for a long period of time, residue adhesive material of the protection film may remain on the surface of the display panel after removed of the film. In such case, remove the residue material by the method introduced in the above Section 5).
13) If electric current is applied when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful to avoid the above.

8.2 Storage Precautions

1) When storing display modules, put them in static electricity preventive bags avoiding exposure to direct sun light nor to lights of fluorescent lamps, etc. and, also, avoiding high temperature and high humidity environments or low temperature (less than 0°C) environments. (We recommend you to store these modules in the packaged state when they were shipped from Densitron) At that time, be careful not to let water drops adhere to the packages or bags nor let dewing occur with them.
2) If electric current is applied when water drops are adhering to the surface of the display module, when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful about the above.

8.3 Designing Precautions

1) The absolute maximum ratings are the ratings which cannot be exceeded for display module, and if these values are exceeded, panel damage may be happen.
2) To prevent occurrence of malfunctioning by noise, pay attention to satisfy the VIL and VIH specifications and, at the same time, to make the signal line cable as short as possible.
3) We recommend you to install excess current preventive unit (fuses, etc.) to the power circuit (VDD). (Recommend value: 0.5A)
4) Pay sufficient attention to avoid occurrence of mutual noise interference with the neighboring devices.
5) As for EMI, take necessary measures on the equipment side basically.
6) When fastening the display module, fasten the external plastic housing section.
7) If power supply to the display module is forcibly shut down by such errors as taking out the main battery while the display panel is in operation, we cannot guarantee the quality of this display module.

8.4 Operation Precautions

1) It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life.
2) Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation.
3) Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged.
4) To protect display modules from performance drops by static electricity rapture, etc., do not touch the following sections whenever possible while handling the display modules.
   a. Pins and electrodes
   b. Pattern layouts such as the FPC
5) When the driver is being exposed (COG), semiconductor elements change their characteristics when light is radiated according to the principle of the solar battery. Consequently, if the driver is exposed to light, malfunctioning may occur.
   a. Design the product and installation method so that the driver may be shielded from light in actual usage.
   b. Design the product and installation method so that the driver may be shielded from light during the inspection processes.
6) Although the display module stores the operation state data by the commands and the indication data, when excessive external noise, etc. enters into the module, the internal status may be changed. It therefore is necessary to take appropriate measures to suppress noise generation or to protect from influences of noise on the system design.
7) We recommend you to construct its software to make periodical refreshment of the operation statuses (re-setting of the commands and re-transference of the display data) to cope with catastrophic noise.

8.5 Other Precautions

1) Request the qualified companies to handle industrial wastes when disposing of the display modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.