



Customer Approval Specification

Product: Multi-Touch Display Module

Model Name: VL156-192108YL-C02

Approved	Prepared
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Customer: _____

Project Name: _____

Part Number: _____

Approved By: _____

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1. Introduction

VL156-192108YL-C02 is a Touch Display Module, composed of a TFT-LCD panel, Timing Controller, Backlight Driving Unit and Projective Capacitive Touch Panel. This Touch Display Module can support high resolution (1920 x (R.G.B) X 1080) and can display up to 16.7M colors (RGB 8-bits).

VL156-192108YL-C02 is a Touch Display unit designed for industrial applications, such as Panel PC, Medical care device, Human Machine Interface, Gaming machine, KIOSK and ATM.

2. General Characteristics

No.	Item	Specification	Unit	Remark
1	Screen Size	15.6	Inch	Diagonal
2	Driver Element	a-Si TFT active matrix		
3	Pixels H x V	1920 × 3(RGB) × 1080		
4	Pixel Pitch	0.17925 x 0.17925	mm	
5	Pixel Arrangement	RGB Vertical Stripe		
6	Display Mode	Normally White, Transmissive		
7	Active Area	344.16(H) x 193.59(V)	mm	Note1
8	Module Size (LCD+TP)	385.23(W)×234.54(H)×13.05(D) mm		
9	Surface Treatment	CS, >=7H		Note2
10	LCD Interface	2 channel LVDS		
11	Support Color	16.7M colors		
12	Touch Type	PCAP Multi Touch		
13	Touch Interface	USB 1.1		
14	Operating Temperature	-20 ~ +70	°C	
15	Storage Temperature	-30 ~ +80	°C	

Note1: Please refer to mechanical drawing.

Note2: CS(Compressive Stress)≥300mpa, DoI≥8um.

According to Orihara FSM-6000.

3. Input Pin Assignment

3.1 LCD Panel

Pin No.	Symbol	Description	Remark
1	LED_VCC	Power supply +12V for backlight	
2	LED_VCC	Power supply +12V for backlight	
3	LED_VCC	Power supply +12V for backlight	
4	LED_VCC	Power supply +12V for backlight	
5	LED_GND	Power ground	
6	LED_GND	Power ground	
7	LED_GND	Power ground	
8	LED_GND	Power ground	
9	LED_EN	Backlight enable control	
10	LED_PWM	Backlight dimming control	
11	LCD_VCC	Power supply +3.3V for LCD	
12	LCD_VCC	Power supply +3.3V for LCD	
13	LCD_VCC	Power supply +3.3V for LCD	
14	NC	No connection	
15	NC	No connection	
16	NC	No connection	
17	LCD_GND	Power ground	
18	RX00-	- LVDS differential data input (Odd CH0)	
19	RX00+	+ LVDS differential data input (Odd CH0)	
20	RX01-	- LVDS differential data input (Odd CH1)	
21	RX01+	+ LVDS differential data input (Odd CH1)	
22	RX02-	- LVDS differential data input (Odd CH2)	
23	RX02+	+ LVDS differential data input (Odd CH2)	
24	LCD_GND	Power ground	
25	RXOC-	- LVDS differential clock input (Odd)	
26	RXOC+	+ LVDS differential clock input (Odd)	
27	LCD_GND	Power ground	
28	RX03-	- LVDS differential data input (Odd CH3)	
29	RX03+	+ LVDS differential data input (Odd CH3)	
30	RXE0-	- LVDS differential data input (Even CH0)	
31	RXE0+	+ LVDS differential data input (Even CH0)	
32	RXE1-	- LVDS differential data input (Even CH1)	
33	RXE1+	+ LVDS differential data input (Even CH1)	
34	LCD_GND	Power ground	
35	RXE2-	- LVDS differential data input (Even CH2)	
36	RXE2+	+ LVDS differential data input (Even CH2)	
37	RXEC-	- LVDS differential clock input (Even)	
38	RXEC+	+ LVDS differential clock input (Even)	
39	RXE3-	- LVDS differential data input (Even CH3)	
40	RXE3+	+ LVDS differential data input (Even CH3)	

Note1: LVDS Connector: I-PEX 20455-040E-76

Note2: User Connector (Mating connector): I-PEX 20454-#40T

3.2 Touch Panel

Pin No.	Symbol	Description	Interface
1	GND_E	Shielding pin	USB CN2
2	NC	No connection	
3	D+	Differential “1”	
4	D-	Differential “0”	
5	V _{TP}	Power supply 5V	
6	GND	Power ground	
1	GND	Power ground	I2C CN3
2	INT	Interruption	
3	RESET	Reset(No connection)	
4	VDD	Power supply 3.3 ~ 5V	
5	SCL	Serial clock	
6	SDA	Serial data	

Note1: Please connect GND_E to system ground or earth ground to obtain better noise resistance ability.

Note2: Touch connector: Molex 53780-0670 or equivalent.

Note3: User connector (Mating connector): Molex 51146-0600 or equivalent.

4. Operation Specifications

4.1 Absolute Maximum Ratings

Item	Symbol	Values(Note)		Unit	Remark
		Min.	Max.		
Power Voltage	V _{CC}	-0.3	4.0	V	
	V _{LED}	-0.3	18	V	
	V _{TP}	-0.5	6	V	
	B/L_EN	-	5.5	V	
	B/L_PWM	-	5.5	V	
Operation Temp.	T _{OP}	-20	70	°C	
Storage Temp.	T _{ST}	-30	80	°C	

Note: The absolute maximum rating values of this product are not allowed to be exceeded at any times. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed.

4.1.1 Typical Operation Conditions

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Power Voltage	V _{CC}	3.0	3.3	3.6	V	
	V _{TP}	4.5	5	5.5	V	
Current for LCD	I _{CC}	-	1.22	1.5	A	White pattern Ta = 25 °C
Current for Touch	I _{TP}	-	-	100	mA	

4.1.2 Backlight Driving Conditions

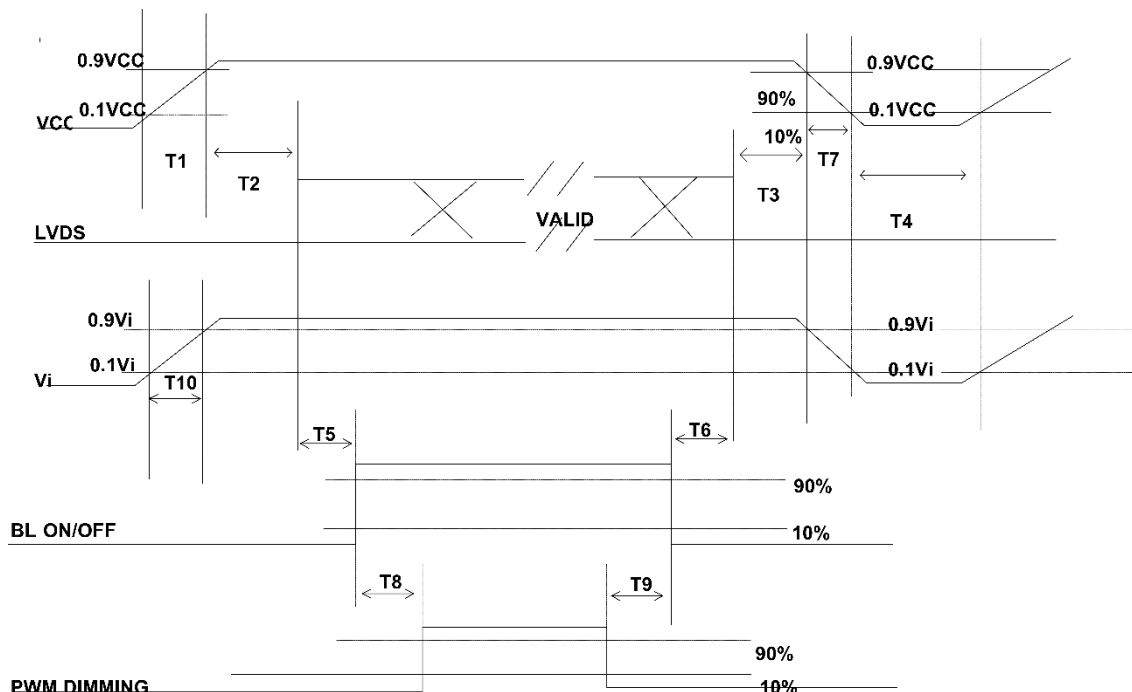
Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Voltage for LED Backlight	V _{LED}	10.8	12	13.2	V	
Current for LED Backlight	I _{LED}	0.8	1.0	1.2	A	
Enable Control	On	2.5	5.0	5.5	V	
	Off	0	0	0.15	V	
PWM Dimming Control	High	2.0	3.3	5.0	V	
	Low	0	0	0.15	V	
PWM Duty Ratio	-	10		100	%	
PWM Frequency	F _{PWM}	190	200	20K	Hz	
LED life time	-	50,000	-	-	Hrs	Note

Note: The lifetime of LED is estimated data and defined as the time when it continues to operate under the conditions at Ta = 25±2°C and Duty 100% until the brightness becomes ≤ 50% of its original value.

4.2 Power Sequence

4.2.1 LCD Panel

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

Parameter	Value			Unit
	Min.	Typ.	Max.	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-	-	ms
T5	450	-	-	ms
T6	200	-	-	ms
T7	10	-	100	ms
T8	10	-	-	ms
T9	10	-	-	ms
T10	20	-	50	ms

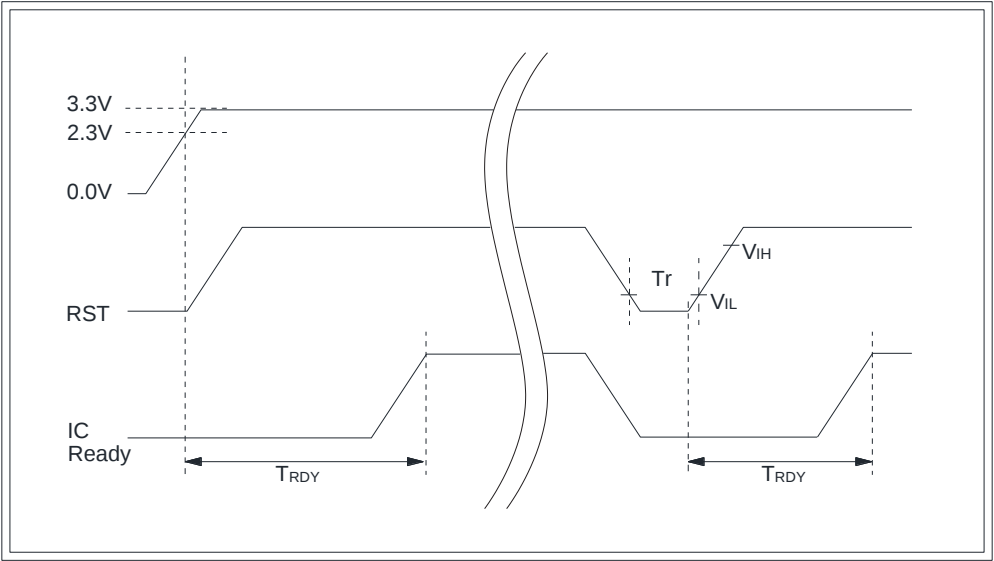
Note (1) Please avoid floating state of interface signal at invalid period.

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

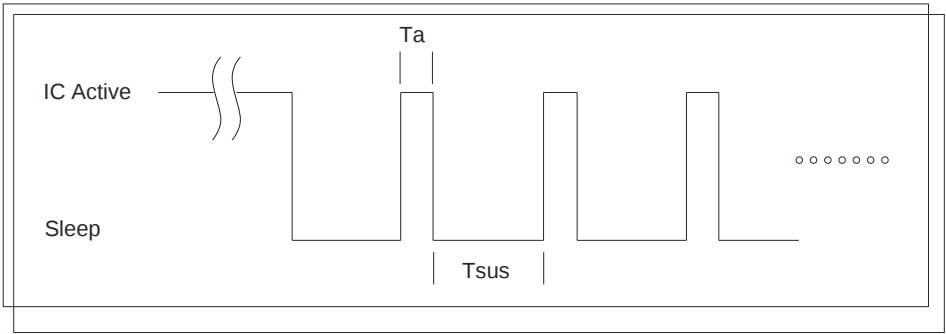
Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

4.2.2 Touch Panel

Power On Sequence Diagram



Idle Sequence Diagram



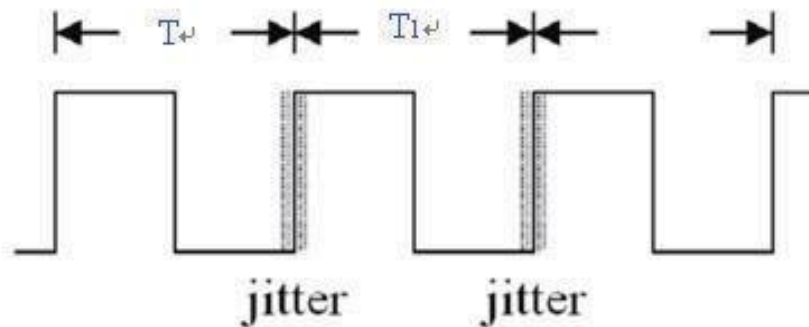
4.3 LCD Timing Characteristics

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	F _c	60	70.93	75	MHz	-
	Period	T _c		14.1		ns	
	Input cycle to cycle jitter	T _{rcl}	-0.02*T _c		0.02*T _c	ns	(3)
	Input clock to data skew	TLVCCS	-0.02*T _c		0.02*T _c	ns	(4)
	Spread spectrum modulation range	F _{clkin_mod}	FC*98%		FC*102%	MHz	(5)
	Spread spectrum modulation frequency	F _{SSM}			200	KHz	
Vertical Display Term	Frame Rate	Fr	50	60	60	Hz	Tv=Tvd+Tvb
	Total	Tv	1090	1110	1130	Th	-
	Active Display	Tvd	1080	1080	1080	Th	
	Blank	Tvb	Tv-Tvd	30	Tv-Tvd	Th	-
Horizontal Display Term	Total	Th	1050	1065	1075	Tc	Th=Thd+Thb
	Active Display	Thd	960	960	960	Tc	
	Blank	Thb	Th-Thd	105	Th-Thd	Tc	-

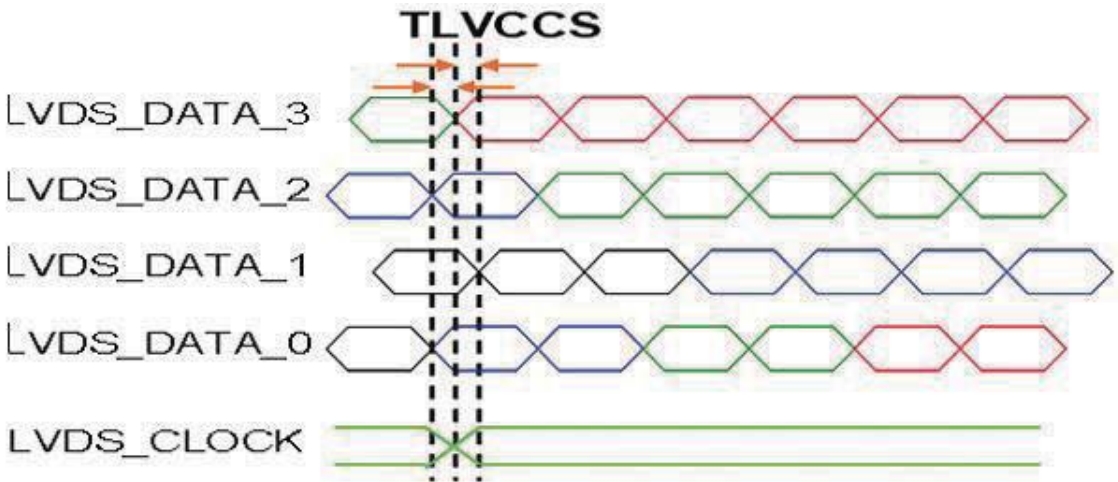
Note1: DE mode only, Hsync and Vsync signals are ignored.

Note2: The Tv must be integer, otherwise, this module would operate abnormally.

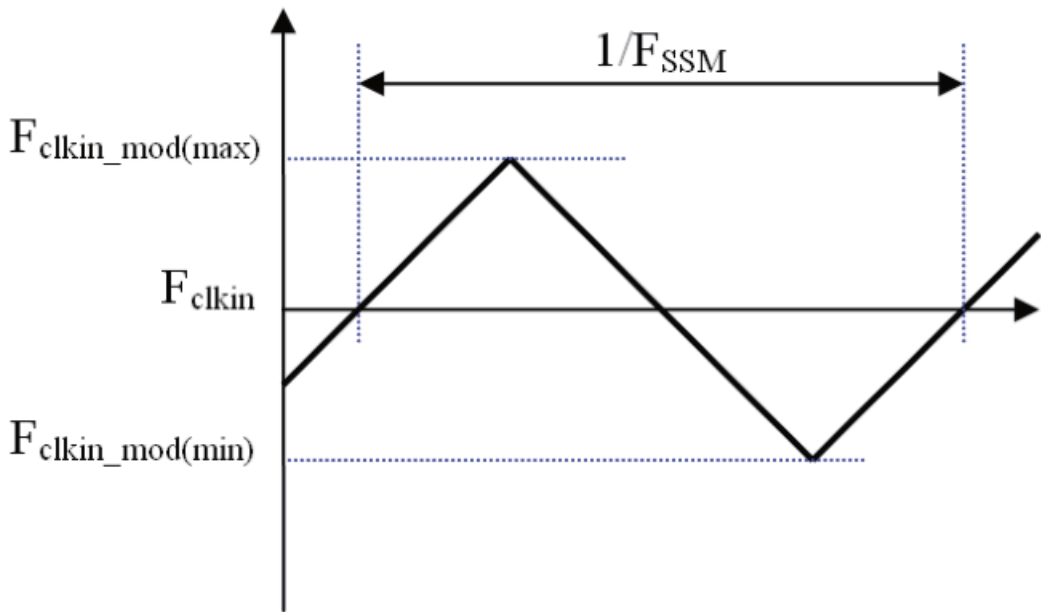
Note3: The input clock cycle-to-cycle jitter is defined as below figures. $T_{rcl} = |T_1 - T|$



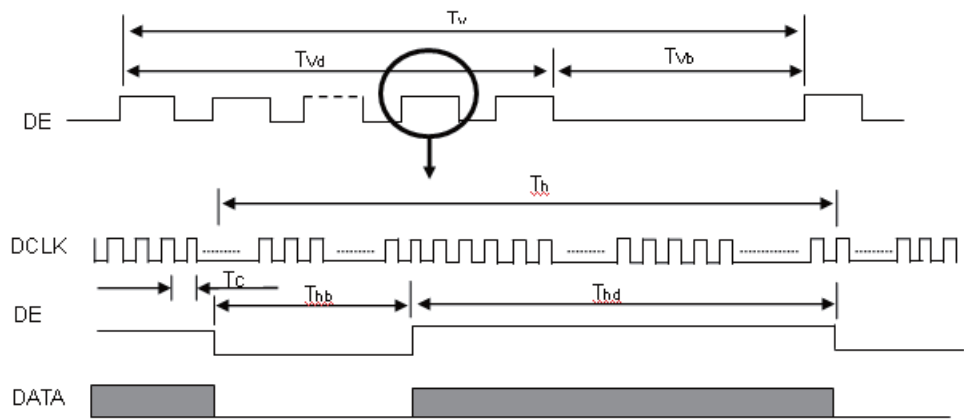
Note4: Input clock to data skew is defined as below figures.



Note5: The Spread spectrum clock generator is defined as below figures.

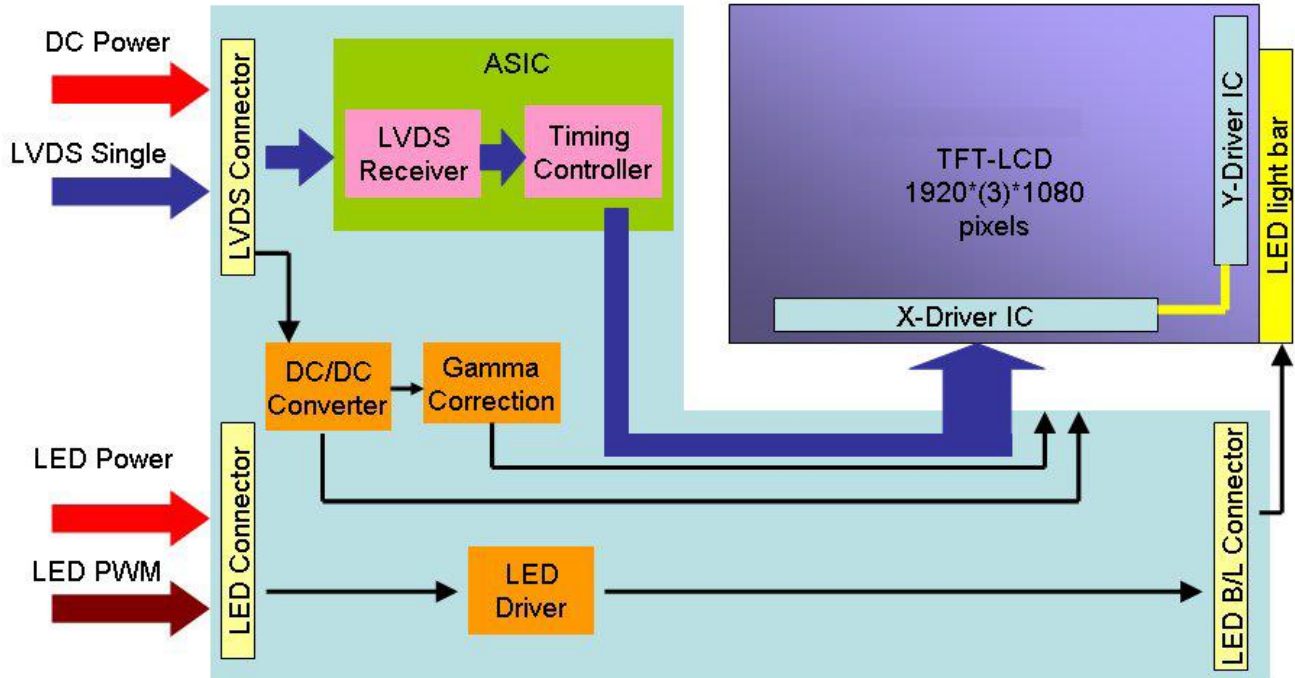


4.3.1 Input Signal Timing Diagram

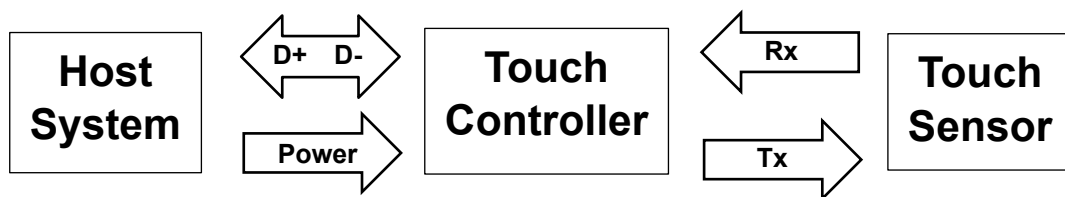


5. Block Diagrams

5.1 LCD Panel



5.2 Touch Panel



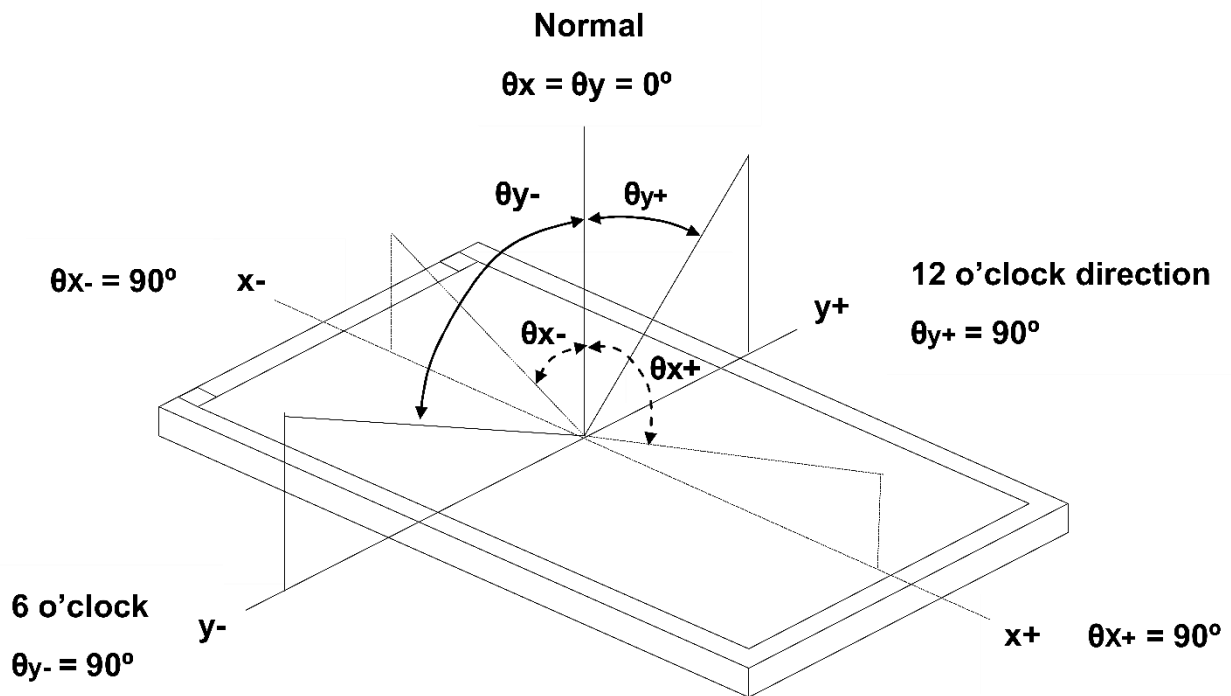
6. Optical Specifications

Item	Symbol	Condition	Values			Unit	Remark
			Min.	Typ.	Max		
LCD Viewing angle (CR $\geq$ 10)	θ_L	$\Phi=180^\circ$ (9 o'clock)	80	85	-	degree	Note1
	θ_R	$\Phi=0^\circ$ (3 o'clock)	80	85	-		
	θ_T	$\Phi=90^\circ$ (12 o'clock)	80	85	-		
	θ_B	$\Phi=270^\circ$ (6 o'clock)	80	85	-		
LCD Response time	$T_R + T_F$	Normal $\theta=\Phi=0^\circ$	-	25	35	msec	Note3
LCD Contrast ratio	CR		600	800	-	-	Note4
LCD Color chromatically	W_X		0.263	0.313	0.363	-	Note2
	W_Y		0.279	0.329	0.379	-	Note5
	R_X		0.602	0.652	0.702		Note6
	R_Y		0.288	0.338	0.388		
	G_X		0.283	0.333	0.383		
	G_Y		0.563	0.613	0.663		
	B_X		0.100	0.150	0.200		
	B_Y		0.000	0.050	0.100		
LCD Luminance	L		350	450	-	cd/m ²	Note6
Luminance uniformity	Y_u		70	-	-	%	Note7
Touch Panel Light Transmittance		Visible Spectrum 400nm ~ 700nm	88	90	92	%	

Test Conditions:

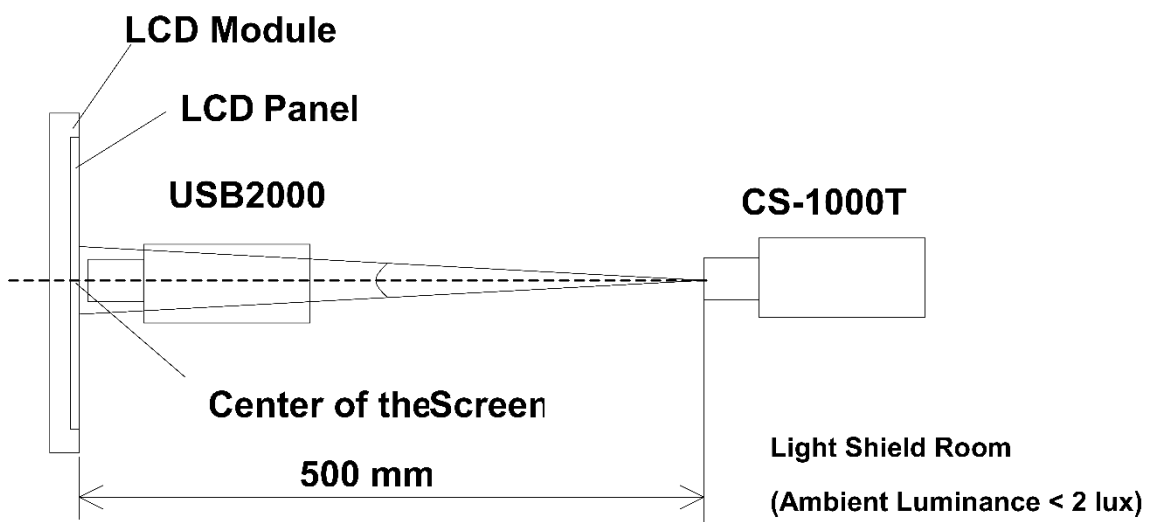
1. $T_a = 25 \pm 2^\circ\text{C}$ and Duty 100%.
2. The test systems refer to Note 2.

Note1: Definition of viewing angle.



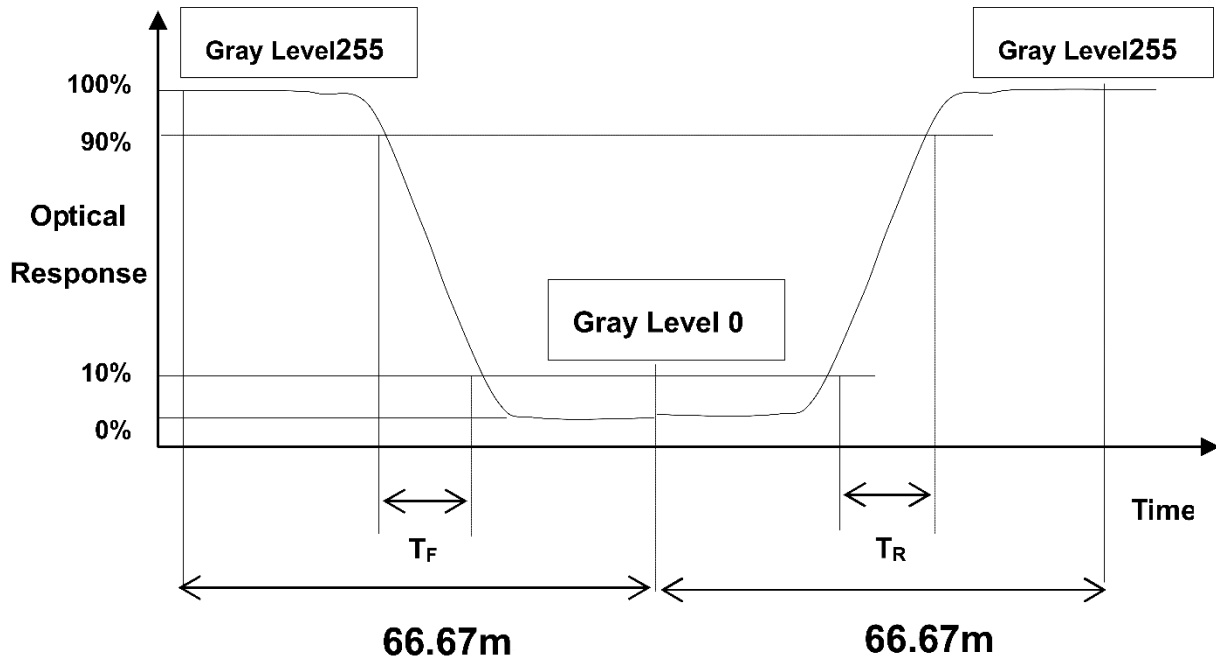
Note2: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 30 minutes operation, the optical properties are measured at the center point of the LCD screen. (Response time is measured by Photo detector TOPCON BM-7, other items are measured by BM-5A/Field of view: 1° /Distance: 500mm.)



Note3: Definition of Response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time (T_R) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T_F) is the time between photo detector output intensity changed from 10% to 90%.



Note4: Definition of contrast ratio

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{255} / L_0$$

L_{255} : 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 (6).

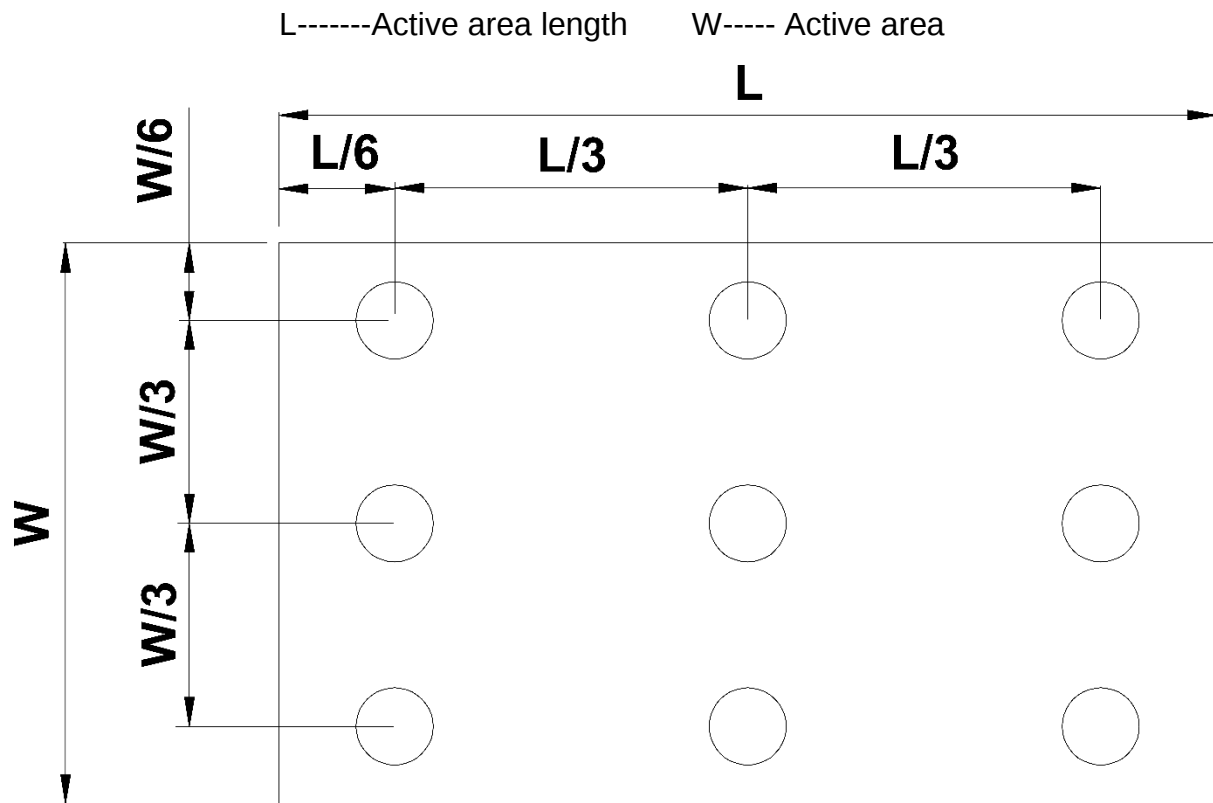
Note5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note6: All input terminals LCD panel must be ground while measuring the center area of the panel. The brightness is measured when Touch Panel on LCD Panel, therefore the brightness should be lower than original due to the 90% transmission rate of Touch Panel.

Note7: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer to below graphic).
Every measuring point is placed at the center of each measuring area.



$B_{\max}$: The measured maximum luminance of all measurement position.

$B_{\min}$: The measured minimum luminance of all measurement position.

7. Reliability Test Items

7.1 LCD Panel Reliability

Item	Test Conditions(Note3)	Remark
High Temperature Storage	Ta = 80°C, 240hrs	Note1, Note4
Low Temperature Storage	Ta = -30°C, 240hrs	Note1, Note4
High Temperature Operation	Ts = 70°C, 240hrs	Note2, Note4
Low Temperature Operation	Ta = -20°C, 240hrs	Note1, Note4
Operate at High Temperature and Humidity	+60°C, 90%RH, 240hrs	Note4
Thermal Shock	-30°C/30 min ~ +80°C/30 min for a total 100 cycles, Start with cold temperature and end with high temperature.	Note4
Vibration Test	Frequency range:10~55Hz Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X. Y. Z. (6 hours for total)	
Mechanical Shock	100G 6ms,±X, ±Y, ±Z 3 times for each direction	
Package Vibration Test	Random Vibration : 0.015G*G/Hz from 5-200HZ, -6dB/Octave from 200-500HZ 2 hours for each direction of X. Y. Z. (6 hours for total)	
Package Drop Test	Height:60 cm 1 corner, 3 edges, 6 surfaces	
Electro Static Discharge	± 2KV, Human Body Mode, 100pF/1500Ω	

Note1: Ta is the ambient temperature of samples.

Note2: Ts is the temperature of panel's surface.

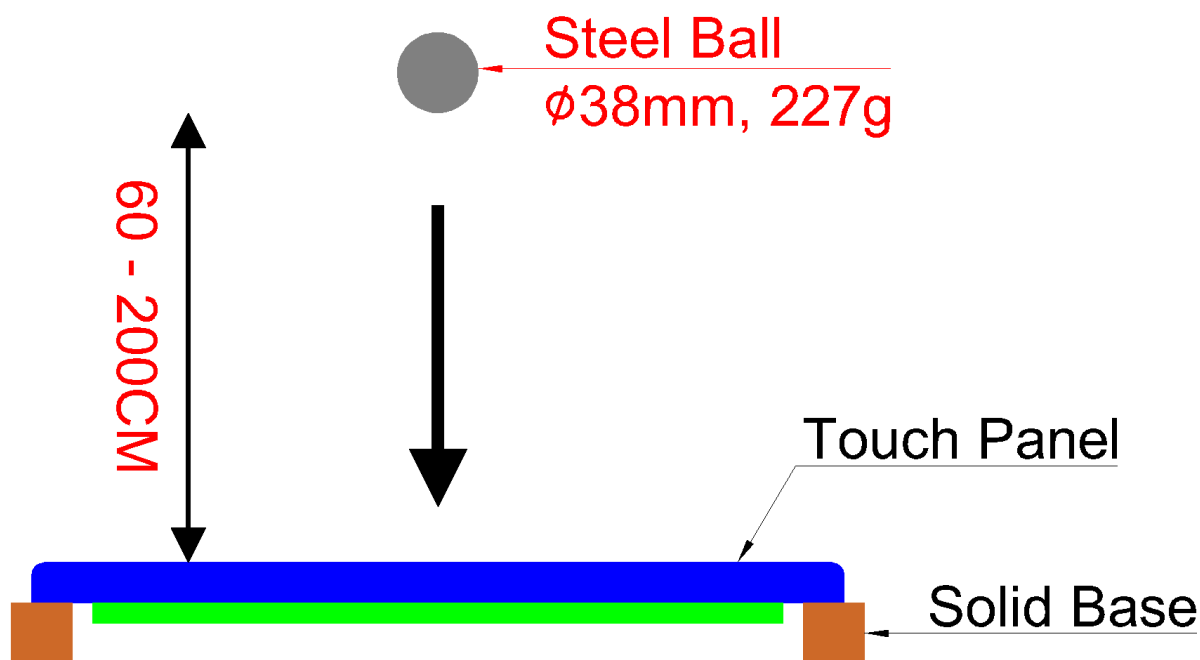
Note3: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but don't guarantee all of the cosmetic specification.

Note4: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

7.2 Touch Panel Reliability

7.2.1 Impact Test

Cover Glass Thickness	Test Condition	Testing Height	Remark
2mm	Steel ball 227g, Diameter 38mm, One-time Impact at Center	150cm	No Damage



7.2.2 Environmental Test

No	Item	Specification	Remark
1	High temperature storage	70°C, 240 hr (Confirm after 4hr room temp.)	No condensation.
2	Low temperature storage	-20°C, 240 hr (Confirm after 4hr room temp.)	
3	High temperature high humidity storage	50°C, 80%RH, 240 hr (Confirm after 24hr room temp.)	
4	Thermal Cycling	-30°C ~+80°C (30min each), 10cycles (Confirm after 24hr room temp.)	

8. Visual Inspection

8.1 Sampling Plan

Unless there is other agreement, the sampling plan for incoming inspection shall follow MIL-STD-105E.

8.1.1 Lot size: Quantity per shipment as one lot (different model as different lot).

8.1.2 Sampling type: Normal inspection, single sampling.

8.1.3 Sampling level: Level II.

8.1.4 AQL: Major defect: AQL=0.65

Minor defect: AQL=1.0

8.2 LCD Panel Inspection Condition

8.2.1 Environment: Room Temperature: 25±5°C.

Humidity: 65±5% RH.

Illumination: 300 ~ 700 Lux.

8.2.2 Inspection Distance: 35±5 cm

8.2.3 Inspection Angle:

The vision of inspector should be perpendicular to the surface of the Module.

8.2.4 Inspection time: Perceptibility Test Time: 20 seconds max.

8.3 LCD Panel Quality

8.3.1 Function Related:

The function defects of line defect, abnormal display, and no display are considered Major defects.

8.3.2 Bright/Dark Dots:

Defect Type	Specification	Major	Minor
Bright Dots	$N \leq 2$		V
Dark Dots	$N \leq 3$		V
Total	$N \leq 4$		V

Note: The definition of dot: The size of a defective dot over 1/2 of whole dot is regarded as one defective dot.

Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

The bright dot defect must be visible through 2% ND filter

Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue pattern.

8.3.3 Pixel Definition

R	G	B	R	G	B	R	G	B			Dot Defect
R	G	B	R	G	B	R	G	B			Adjacent Dot Defect
R	G	B	R	G	B	R	G	B			Cluster

Note1: If pixel or partial sub-pixel defects exceed 50% of the affected pixel or sub-pixel area, it shall be considered as 1 defect.

Note 2: There should be no distinct non-uniformity visible through 2% ND Filter within 2 sec inspection times.

8.3.4 Visual Inspection Specifications

Defect Type	Specification	Count	Major	Minor
Dot Shape (Particle, Scratch, Bubble in Active area)	$D \leq 0.3 \text{ mm}$	Ignored		V
	$0.3 < D \leq 0.5 \text{ mm}$	$N \leq 5$		
	$D > 0.6 \text{ mm}$	$N = 0$		
Line Shape (Particles、Scratch、Lint, Bubbles in Active area)	$W \leq 0.05 \text{ mm}$	Ignored		V
	$0.1 < W \leq 0.2 \text{ mm}, L \leq 15 \text{ mm}$	$N \leq 3$		
	$0.05 < W \leq 0.1 \text{ mm}, L \leq 10 \text{ mm}$	$N \leq 5$		
	$W > 0.2 \text{ mm}$ or $L > 15 \text{ mm}$	$N = 0$		

Note: Extraneous substance and scratch not affecting the display of image, for instance, extraneous substance under polarizer film but outside the display area, or scratch on metal bezel and backlight module or polarizer film outside the display area, shall not be considered as defective or non-conforming.

8.4 Touch Panel Inspection

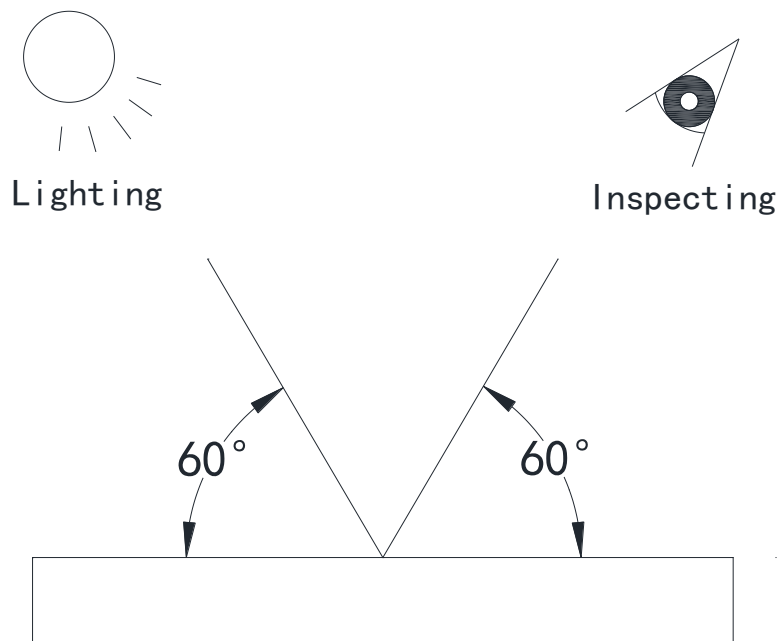
8.4.1 Inspection Method

(A)The lightness of place: 500~800 LUX

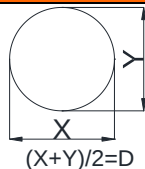
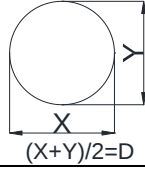
(B)The distance of eyeshot: 30 CM

(C)The angle of eyeshot: $>60^\circ$

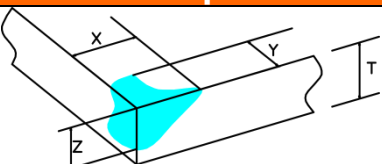
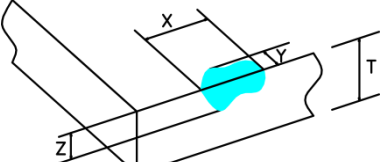
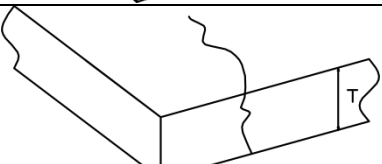
(D)Inspection time: 10 sec



8.4.2 Inspection Standard

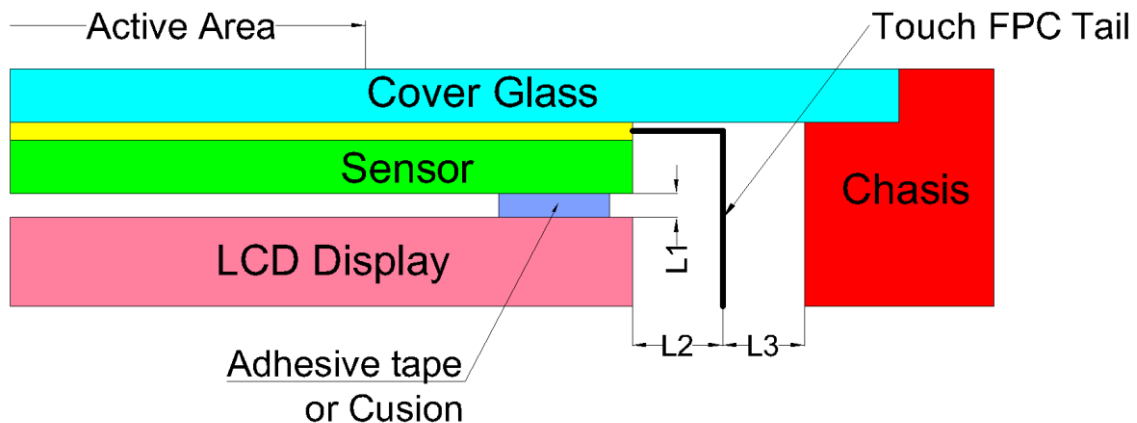
No	Item	Specification	Allowance	Remark
1	Granular foreign object	$D > 0.6\text{mm}$	0	
		$0.3 < D \leq 0.6\text{mm}$	5	
		$D < 0.3\text{mm}$	Ignore	
2	Linear foreign matter	$W > 0.2\text{mm}, L > 15\text{mm}$	0	$W = \text{Width}$ $L = \text{Length}$
		$0.1 < W \leq 0.2\text{mm}, L \leq 15\text{mm}$	5	
		$W < 0.1\text{mm}$	Ignore	
3	Scratch	$W > 0.2\text{mm}, L > 15\text{mm}$	0	
		$0.1 < W \leq 0.2\text{mm}, L \leq 15\text{mm}$	5	
		$W < 0.1\text{mm}$	Ignore	
4	Bubble	$D > 0.6\text{mm}$	0	
		$0.3 < D \leq 0.6\text{mm}$	5	
		$D < 0.3\text{mm}$	Ignore	

8.4.3 Glass Chip

No	Item	Description	Allowance	Remark
1	Corner Judgement		$X \leq 3.0\text{mm}$ $Y \leq 3.0\text{mm}$ $Z \leq T$	
2	Edge Judgement		$X \leq 3.0\text{mm}$ $Y \leq 3.0\text{mm}$ $Z \leq T$	
3	Progressive Judgement		Not Allowed	

9. Mounting Condition

Suggested Mounting Condition - Bezel Free

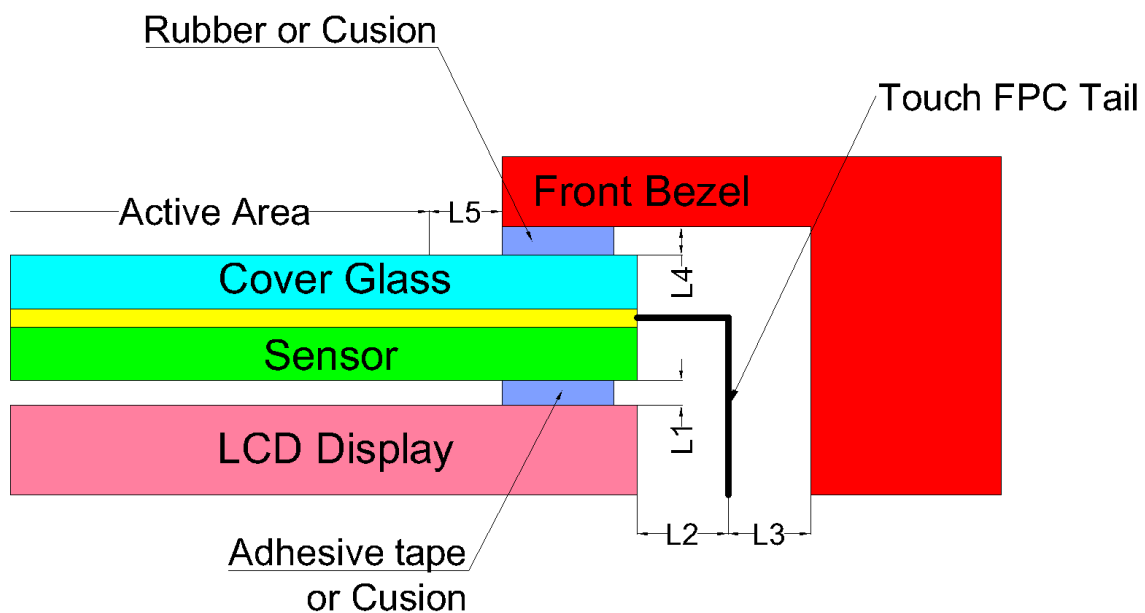


$L1 \geq 1.5\text{mm}$, Gap between Touch panel and LCD panel.

$L2 \geq 2\text{mm}$, Gap between Touch FPC and LCD panel.

$L3 \geq 2\text{mm}$, Gap between Touch FPC and Chasis.

Suggested Mounting Condition - Front Bezel



$L1 \geq 1.5\text{mm}$, Gap between Touch panel and LCD panel.

$L2 \geq 2.0\text{mm}$, Gap between Touch FPC and LCD panel.

$L3 \geq 2.0\text{mm}$, Gap between Touch FPC and Chasis.

$L4 \geq 1.5\text{mm}$, Gap between Touch panel and Front Bezel.

$L5 \geq 2.0\text{mm}$, Gap between Touch AA and Front Bezel.

10. General Precautions

10.1 Safety

Liquid crystal is poisonous. Do not put it in your mouth. If liquid crystal touches your skin or clothes, wash it off immediately by using soap and water.

10.2 Handling

1. The LCD panel is plate glass. Do not subject the panel to mechanical shock or to excessive force on its surface.
2. The polarizer attached to the display is easily damaged. Please handle it carefully to avoid scratch or other damages.
3. To avoid contamination on the display surface, do not touch the module surface with bare hands.
4. Keep a space so that the LCD panels do not touch other components.
5. Put cover board such as acrylic board on the surface of LCD panel to protect panel from damages.
6. Transparent electrodes may be disconnected if you use the LCD panel under environmental conditions where the condensation of dew occurs.
7. Do not leave module in direct sunlight to avoid malfunction of the ICs.

10.3 Static Electricity

1. Be sure to ground module before turning on power or operating module.
2. Do not apply voltage which exceeds the absolute maximum rating value.

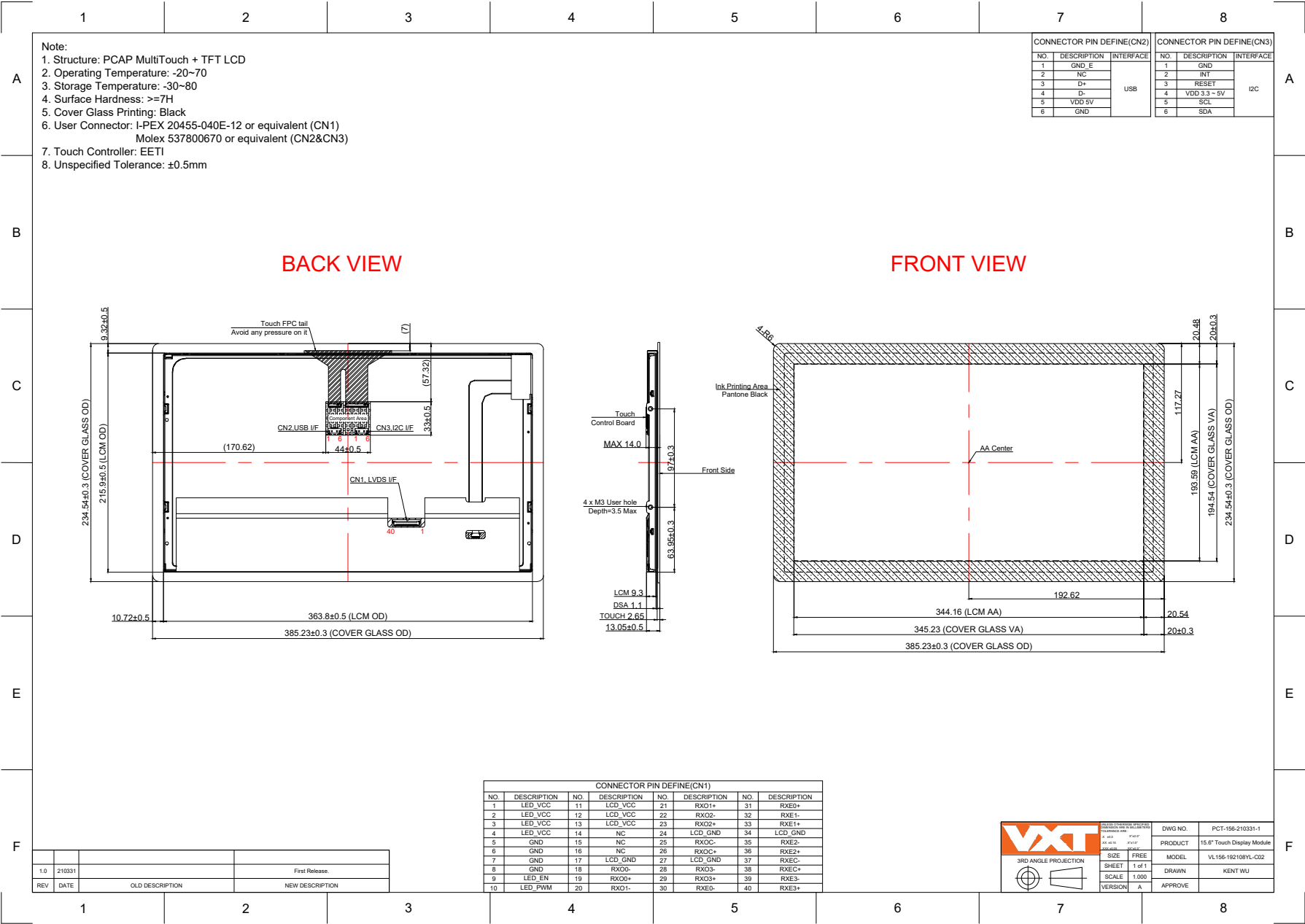
10.4 Storage

1. Store the module in a dark room where must keep at $25\pm 10^{\circ}\text{C}$ and 65%RH or less.
2. Do not store the module in surroundings containing organic solvent or corrosive gas.
3. Store the module in an anti-electrostatic container or bag.

10.5 Cleaning

1. Do not wipe the polarizer with dry cloth. It might cause scratch.
2. Only use a soft sloth with IPA to wipe the polarizer, other chemicals might permanent damage to the polarizer.

11. Mechanical Drawing



Revision History			
Date	Version	Description	Remark
2021/04/01	1.0	First release	

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