

Specification

Module No. : GEA-215B02-DC9521-G030

Version No. : 01

Client Confirmation	Approved by	Prepared by
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Issue History

Version	History	Date	Remarks
01	First Issue	2024/05/27	

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1. Overview

This specification document is issued for the 21.5" TFT Liquid Crystal Display bonded with Capacitive-Type Touch Panel delivered by General Electrical Touch Co., Limited. This document defined the general provisions for the specific module listed at the front page of this document. In the event of conflict between this document and other documents, this document including the attachments and drawing, is highest-level specification for this products.

2. Feature

2.1 Module Structure

Main Component	Materials	Remarks
Cover Glass	3mm thermally strengthened glass with black printed boarder	AR&AF coating
Adhesive	0.25mm SCA	Anti-UV
Touch Sensor	0.7mm DITO glass + COF FPC	SIS9521 Controller
Air Bonding Tape	3M 4905	0.50 mm
Display	TFT LCD	INNOLUX G215HCJ-LH1

2.2 General Specifications

Item	Specifications	Remark
Display Active Area	476.6(H) × 268.1(V) mm	
Display Resolution	1920(H) × R.G.B. × 1080(V)	
Pixel Pitch	0.248 × 0.248 mm	
Pixel Arrangement	R.G.B. Vertical Stripe	
Display Colors	16.7M colors	
Display Center Luminance of White	1400 cd/m ²	Typ.
Display Mode	Normally Black	
Touch Display Surface Treatment	AR&AF coating, ≥7H hardness	
Electrical Interface	Display: 2ch- LVDS	
	Touch: USB and I ² C	
Touch Activation	Multi-finger touch	
Touch Resolution	41X, 72Y	
Touch Controller	SIS9521	
Bonding Method	CG to touch sensor: optical bonding TP module to display: tape bonding	
Outline Dimension	532.00(H) × 320.00(V) × 28.50(Max) mm	

3. Electrical Specifications

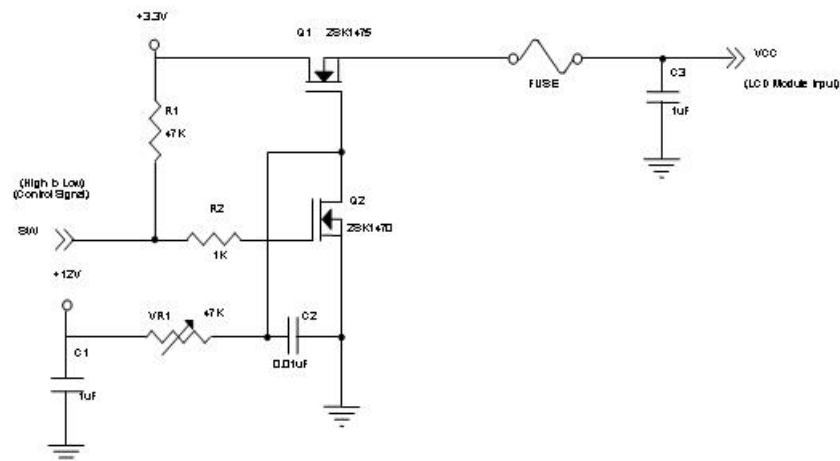
3.1 Display Electrical Specifications

3.1.1 LCD Electronics Specification

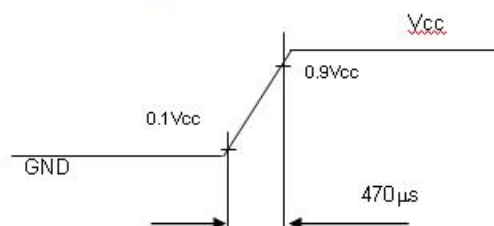
Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	V_{CC}	4.5	5.0	5.5	V	-
Ripple Voltage	V_{RP}	-	-	300	mVp-p	
Inrush Current	I_{INRUSH}	-	-	3.0	A	(2)
Power Supply Current	White	-	0.8	0.96	A	(3)a
	Black	-	0.4	0.48	A	(3)b
	Vertical Stripe	-	0.6	0.73	A	(3)c
LVDS differential input voltage	V_{id}	100	-	600	mV	
LVDS common input voltage	V_{ic}	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	R_T	-	100	-	Ohm	-

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

Note (2) Measurement Conditions:



Vcc rising time is 470μs



Note (3) The specified power supply current is under the conditions at $V_{CC} = 5.0\text{ V}$, $T_a = 25 \pm 2^\circ\text{C}$, $f_r = 60\text{ Hz}$, whereas a power dissipation check pattern below is displayed.

a. White Pattern



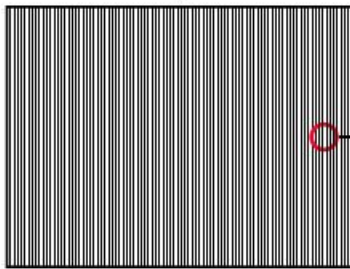
Active Area

b. Black Pattern

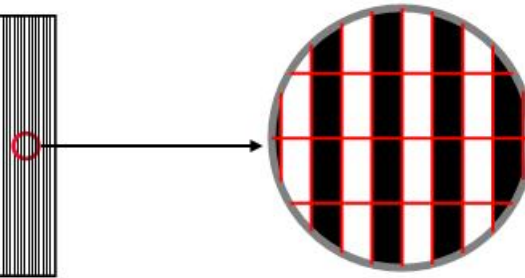


Active Area

c. Vertical Stripe Pattern



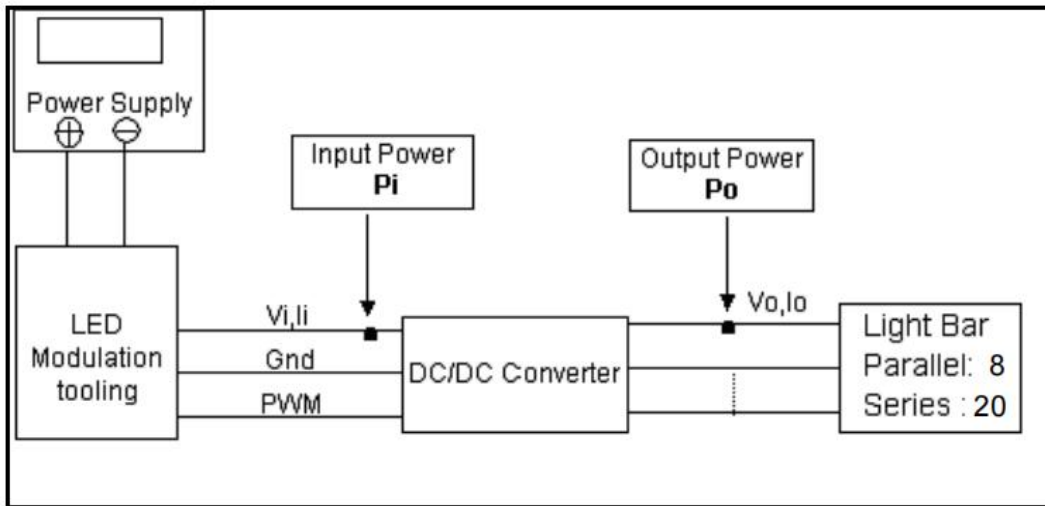
Active Area



3.1.2 Backlight Unit

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Converter Input Voltage		V _i	10.8	12.0	13.2	V _{DC}	(Duty 100%)
Converter Input Ripple Voltage		V _{IRP}	-	-	500	mV	
Converter Input Current		I _i	2.6	3.3	4.0	A _{DC}	@ V _i = 12V (Duty 100%)
Converter Inrush Current		I _{IRUSH}	-	-	10.0	A	@ V _i rising time=10ms (V _i =12V)
Input Power Consumption		P _i	-	40	48	W	(1)
EN Control Level	Backlight on	ENLED	2.0	3.3	5.0	V	
	Backlight off	(BLON)	0	-	0.3	V	
PWM Control Level	PWM High Level	Dimming	2.0	-	5.0	V	
	PWM Low Level	(E_PWM)	0	-	0.15	V	
PWN Noise Range		V _{Noise}	-	-	0.1	V	
PWM Control Frequency		f _{PWM}	190	200	20k	Hz	(3)
PWM Dimming Control Duty Ratio		-	5	-	100	%	(3), @ 190Hz<f _{PWM} <1kHz
			20	-	100	%	(2), @ 1kHz≤f _{PWM} <20kHz
LED Life Time		L _{LED}	50,000		-	Hrs	(2)

Note (1) LED current is measured by utilizing a high frequency current meter as shown below:



Note (2) The lifetime of LED is estimated data and defined as the time when it continues to operate under the conditions at $T_a = 25 \pm 2^\circ\text{C}$ and Duty 100% until the brightness becomes $\leq 50\%$ of its original value. Operating LED at high temperature condition will reduce life time and lead to color shift.

Note (3) At 190 ~1KHz PWM control frequency, duty ratio range is restricted from 5% to 100%. 1K ~20KHz PWM control frequency, duty ratio range is restricted from 20% to 100%. If PWM control frequency is applied in the range from 1KHz to 20KHz, The “non-linear” phenomenon on the Backlight Unit may be found.

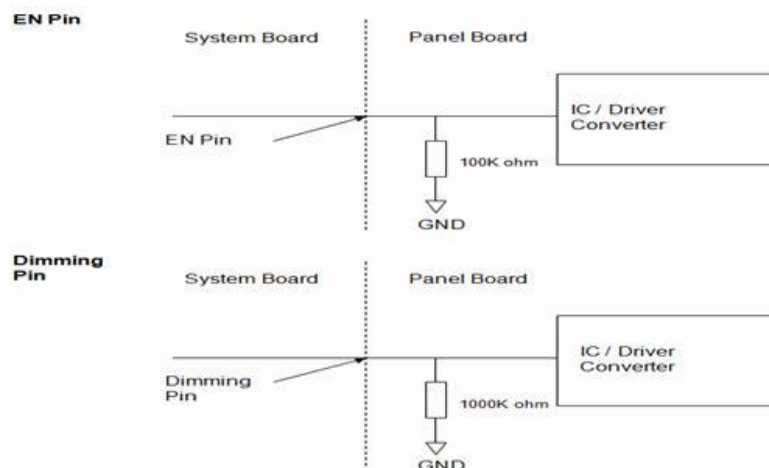
So It's a **suggestion** that PWM control frequency should be **less than 1KHz**.

Converter Connector PIN

Pin	Symbol	Description	Remark
1	V_i	Converter input voltage	12V
2	V_i	Converter input voltage	12V
3	V_i	Converter input voltage	12V
4	V_i	Converter input voltage	12V
5	V_{GND}	Converter ground	Ground
6	V_{GND}	Converter ground	Ground
7	V_{GND}	Converter ground	Ground
8	V_{GND}	Converter ground	Ground
9	EN	Enable pin	3.3V
10	Dimming	Backlight Adjust	PWM Dimming (Hi: 3.3V _{DC} , Lo: 0V _{DC})

Note (1) Connector Part No.: CI0110M1HR0-NH (Cvilux) or equivalent.

Note (2) User's connector Part No.: Cvilux CI01 or equivalent.



3.1.3 Electrical Interface Connection

PIN ASSIGNMENT

Pin	Name	Description
1	RXO0-	Negative LVDS differential data input. Channel O0 (odd)
2	RXO0+	Positive LVDS differential data input. Channel O0 (odd)
3	RXO1-	Negative LVDS differential data input. Channel O1 (odd)
4	RXO1+	Positive LVDS differential data input. Channel O1 (odd)
5	RXO2-	Negative LVDS differential data input. Channel O2 (odd)
6	RXO2+	Positive LVDS differential data input. Channel O2 (odd)
7	GND	Ground
8	RXOC-	Negative LVDS differential clock input. (odd)
9	RXOC+	Positive LVDS differential clock input. (odd)
10	RXO3-	Negative LVDS differential data input. Channel O3(odd)
11	RXO3+	Positive LVDS differential data input. Channel O3 (odd)
12	RXE0-	Negative LVDS differential data input. Channel E0 (even)
13	RXE0+	Positive LVDS differential data input. Channel E0 (even)
14	GND	Ground
15	RXE1-	Negative LVDS differential data input. Channel E1 (even)
16	RXE1+	Positive LVDS differential data input. Channel E1 (even)
17	GND	Ground
18	RXE2-	Negative LVDS differential data input. Channel E2 (even)
19	RXE2+	Positive LVDS differential data input. Channel E2 (even)
20	RXEC-	Negative LVDS differential clock input. (even)
21	RXEC+	Positive LVDS differential clock input. (even)
22	RXE3-	Negative LVDS differential data input. Channel E3 (even)
23	RXE3+	Positive LVDS differential data input. Channel E3 (even)
24	GND	Ground
25	NC	For LCD internal use only, Do not connect
26	NC	For LCD internal use only, Do not connect
27	NC	For LCD internal use only, Do not connect
28	Vcc	+5.0V power supply
29	Vcc	+5.0V power supply
30	Vcc	+5.0V power supply

Note (1) Connector Part No.:

P-TWO: 187098-30091 or FCN: WF13-428-3033 or equivalent.

Note (2) User's connector Part No:

Mating Wire Cable Connector Part No.: FI-X30H(JAE) or FI-X30HL (JAE)

Mating FFC Cable Connector Part No.: 217007-013001 (P-TWO) or JF05X030-1 (JAE).

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

Note (4) Pin25, Pin26, Pin27 input signals should be set to no connection, this module would operate normally.

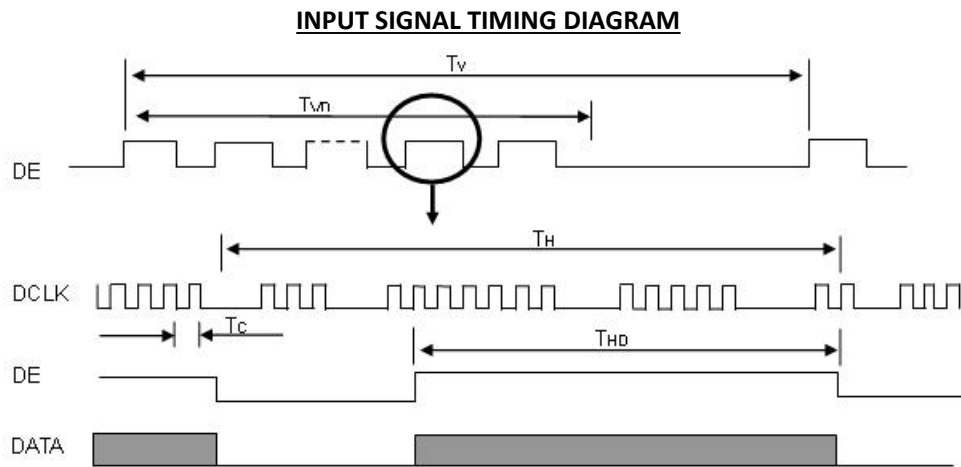
3.1.4 Interface Timing

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

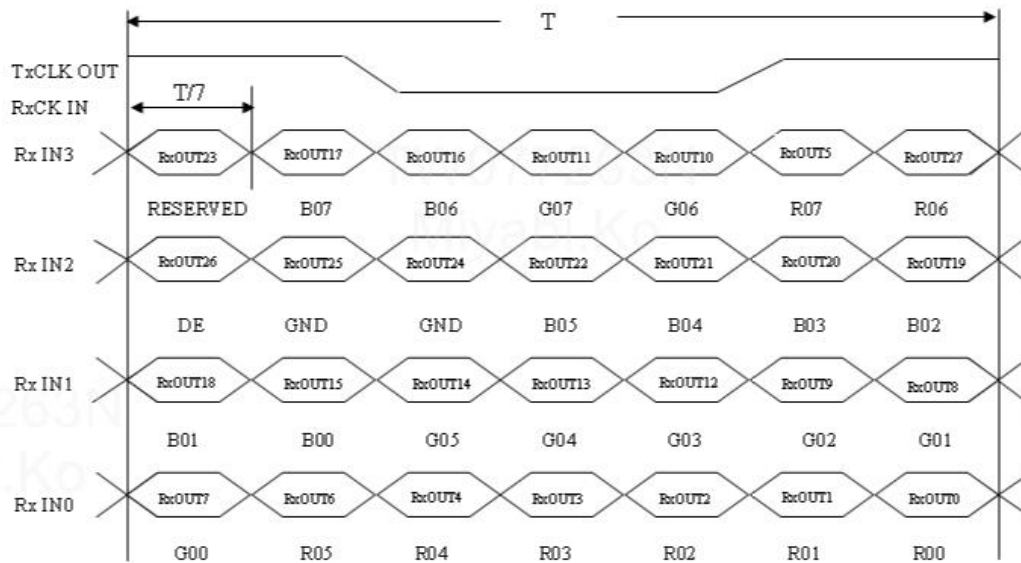
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	F _c	58.54	74.25	97.98	MHz	-
	Period	T _c	-	13.47	-	ns	-
	Input cycle to cycle jitter	T _{rd}	---	---	200	ns	(a)
	Input Clock to data skew	TLVCCS	-0.02*T _c	-	0.02*T _c	ps	(b)
	Spread spectrum modulation range	F _{clk_in_mod}	0.987*F _c	---	1.013*F _c	MHz	(c)
	Spread spectrum modulation frequency	F _{SSM}	---	---	200	KHz	
Vertical Display Term	Frame Rate	Fr	50	60	75	Hz	T _v =T _{vd} +T _{vb}
	Total	T _v	1110	1125	1220	Th	-
	Active Display	T _{vd}	1080	1080	1080	Th	-
	Blank	T _{vb}	T _v -T _{vd}	45	T _v -T _{vd}	Th	-
Horizontal Display Term	Total	T _h	1050	1100	1150	Tc	T _h =T _{hd} +T _{hb}
	Active Display	T _{hd}	960	960	960	Tc	-
	Blank	T _{hb}	T _h -T _{hd}	140	T _h -T _{hd}	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.

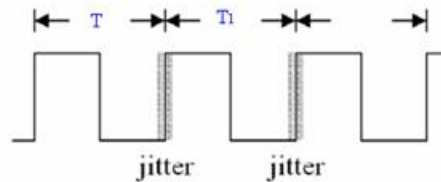
Note (2) The T_v(T_{vd}+T_{vb}) must be integer, otherwise, the module would operate abnormally.



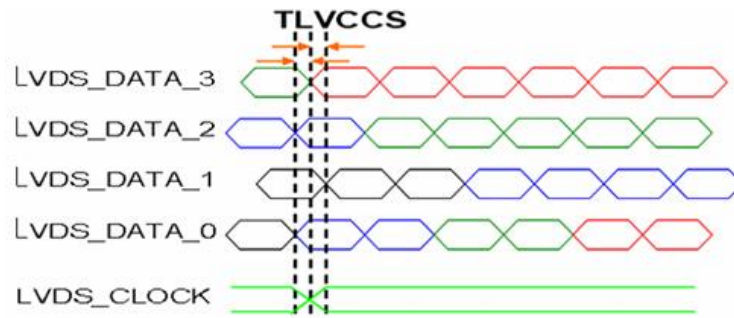
TIMING DIAGRAM of LVDS



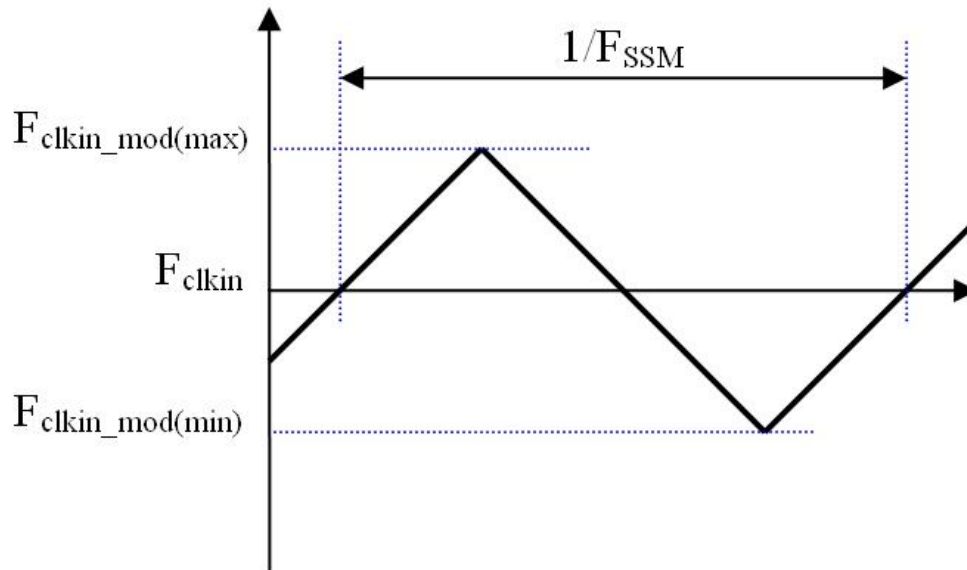
Note (a) The input clock cycle-to-cycle jitter is defined as below figures. $T_{rd} = |T_1 - T|$



Note (b) Input Clock to data skew is defined as below figures.

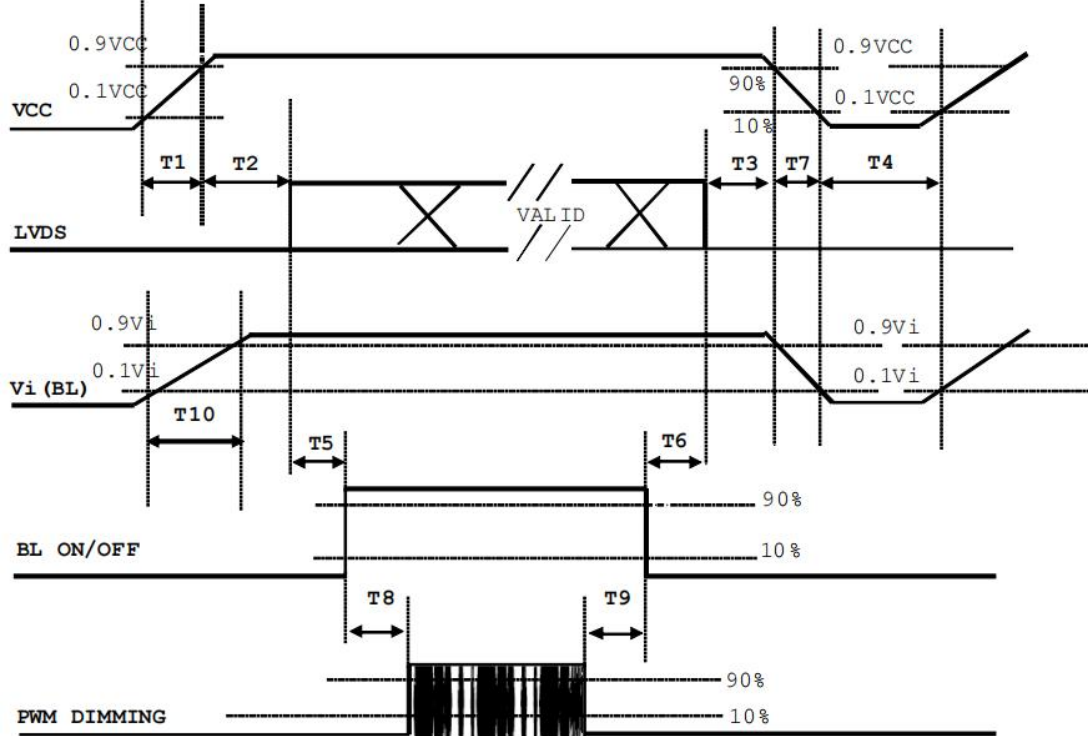


Note (c) The SSCG (Spread spectrum clock generator) is defined as below figures.



3.1.5 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.



Parameter	Value			Units
	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) The supply voltage of the external system for the module input should be the same as the definition of Vcc.

Note (2) When the backlight turns on before the LCD operation of the LCD turns off, the display may momentarily become abnormal screen.

Note (3) In case of VCC = off level, please keep the level of input signals on the low or keep a high impedance.

Note (4) T4 should be measured after the module has been fully discharged between power

off and on period.

Note (5) Interface signal shall not be kept at high impedance when the power is on.

Note (6) GET won't take any responsibility for the products which are damaged by the customers not following the Power Sequence.

Note (7) There might be slight electronic noise when LCD is turned off (even backlight unit is also off). To avoid this symptom, we suggest "Vcc falling timing" to follow "T7 spec".

3.2 Touch Panel Electrical Specifications

3.2.1 Interface Connection

Item	Specification	Remarks
FPC type	COF	
Connector	USB-MINI-B	
	Molex 53261-1071	or compatible
Communication	USB and I ² C	

3.2.2 Connector Pins Definition

<Molex 53261-1071 Pins Definition>

Pin	Definition	Description
1	Vcc	5V
2	USB Data+	
3	USB Data-	
4	SDA	I ² C serial data
5	SCL	I ² C serial clock
6	INT	Interrupt pin sending request to HOST
7	Reset	Low active power on reset signal
8	GPIO0	
9	GND	
10	GND-Shielding	

3.2.3 I²C Interface

Slaver address	0x5c(7-bits addressing, programmable)
Clock rate	@400 kHz(fast mode)
Interrupt mode	Default active low, level trigger
_CID	PNP0C50
_DSM	3CDF6F7-4267-4555-AD05-B30A3D8938DE
HID Descriptor address	0x0000

4. Optical Specifications

4.1 Display Optical Specifications

4.1.1 Test Conditions

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	oC
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	According to typical value and tolerance in "ELECTRICAL CHARACTERISTICS"		
Input Signal			
PWM Duty Ratio	D	100	%

4.1.2 Optical Specifications

The relative measurement methods of optical characteristics are shown here and all items are measured at the center point of screen unless otherwise noted. The following items should be measured under the test conditions described above and stable conditions shown in Note (5).

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Chromaticity	Red	Rx	0.602	0.652	0.702	-	(1), (5)
		Ry	0.288	0.338	0.388		
	Green	Gx	0.280	0.330	0.380		
		Gy	0.559	0.609	0.659		
	Blue	Bx	0.101	0.151	0.201		
		By	0.004	0.054	0.104		
	White	Wx	0.263	0.313	0.363		
		Wy	0.279	0.329	0.379		
	Center Luminance of White	LC	1120	1400		cd/m2	(4), (5)
	Contrast Ratio	CR	800	1000			(2), (5)
Response Time	TR	$\theta X=0^\circ, \theta Y=0^\circ$	-	13	18	-	(3)
	TF		-	12	17	-	
White Variation	δW	$\theta X=0^\circ, \theta Y=0^\circ$	75	80	-	%	(5), (6)
Viewing Angle	Horizontal	$\theta X+$	80	89	-	Deg.	(1), (5)
		$\theta X-$	80	89	-		
	Vertical	$\theta Y+$	80	89	-		
		$\theta Y-$	80	89	-		

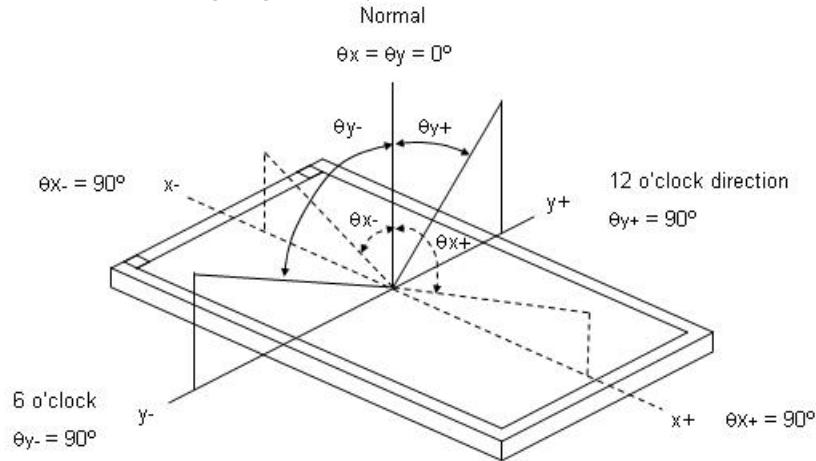
Definition:

Grayscale Maximum: Grayscale 255 (10 bits: grayscale 1023; 8 bits : grayscale 255; 6 bits: grayscale 63)

White: Luminance of Grayscale Maximum (All R,G,B)

Black: Luminance of grayscale 0 (All R,G,B)

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

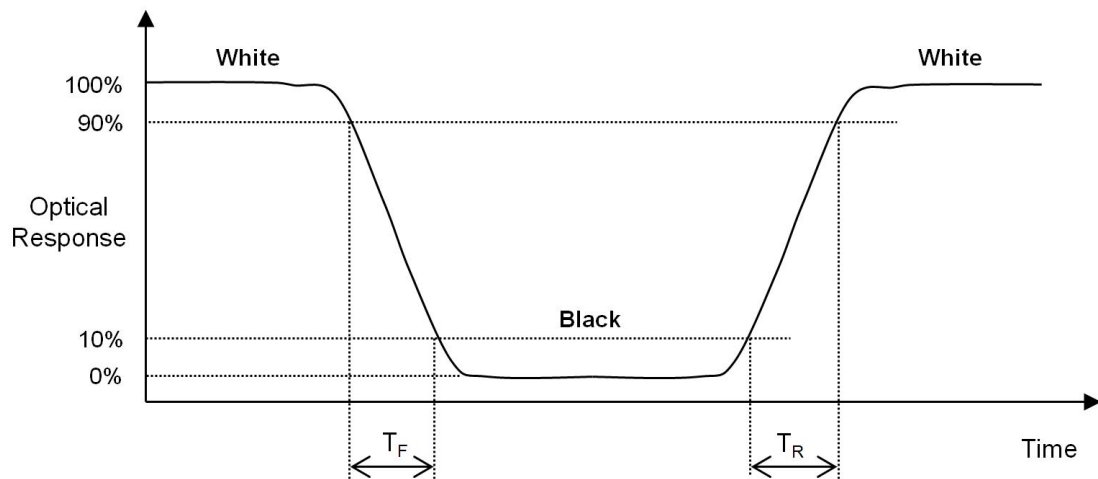


Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression at center point.

Contrast Ratio (CR) = White / Black.

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

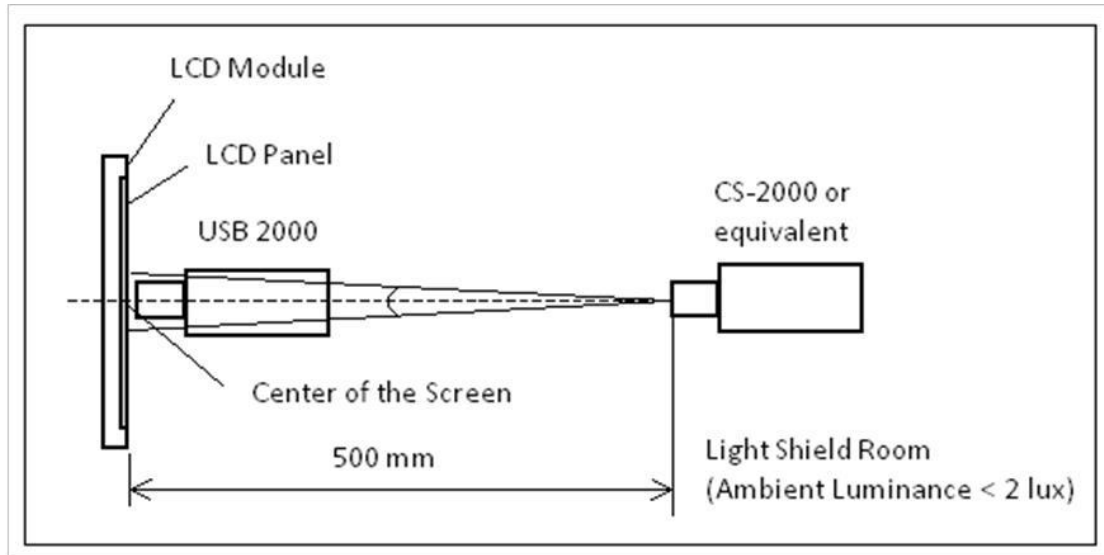


Note (4) Definition of Luminance of White (L_c):

Measure the luminance of White at center point.

Note (5) Measurement Setup:

The LCD module should be stabilized at given temperature to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 40 minutes in a windless room. The measurement placement of module should be in accordance with module drawing.

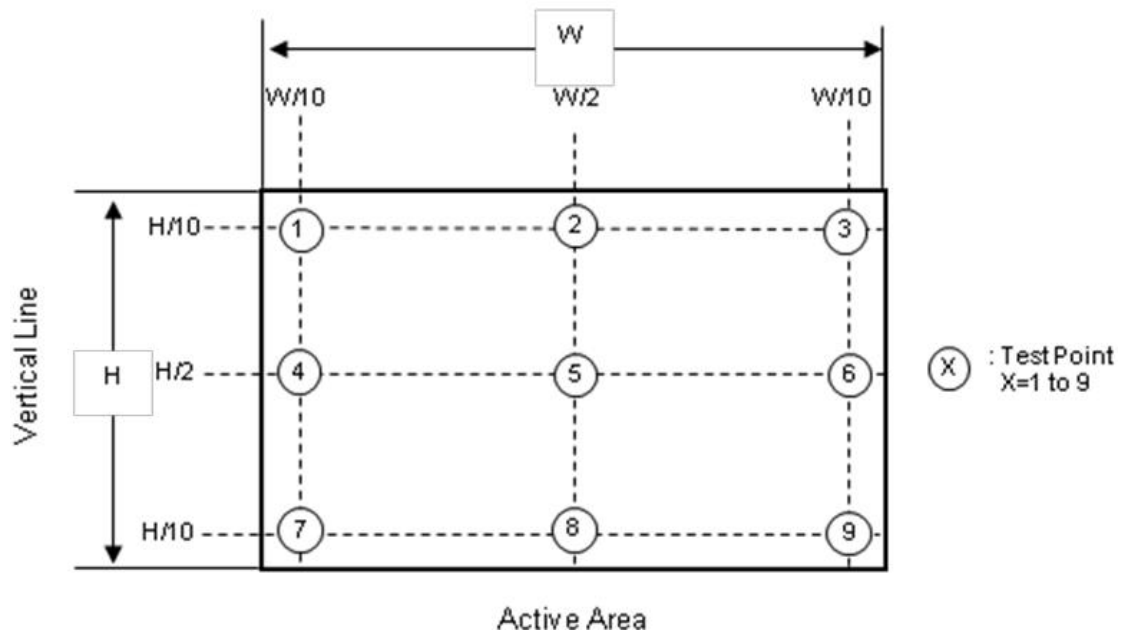


Note (6) Definition of White Variation (δW):

Measure the luminance of White at 9 points.

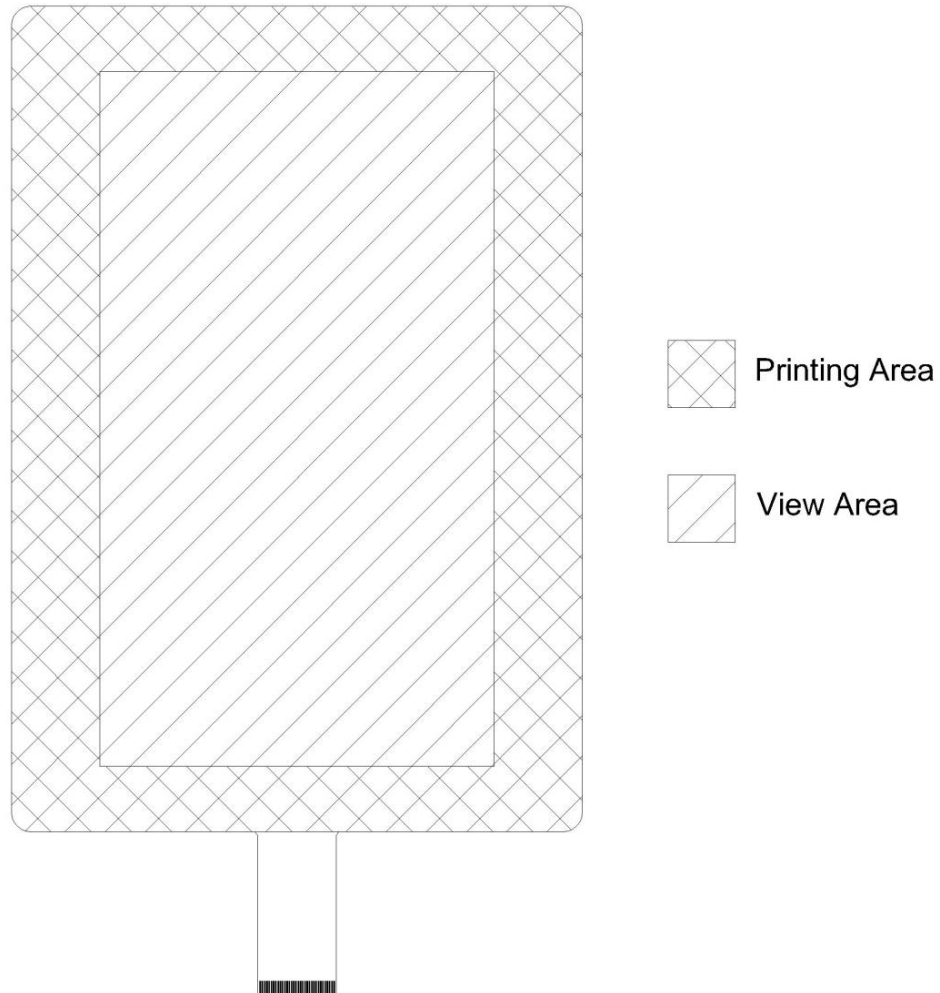
Luminance of White : $L(X)$, where X is from 1 to 9.

$$\delta W = \frac{\text{Minimum}[L(1) \text{ to } L(9)]}{\text{Maximum}[L(1) \text{ to } L(9)]} \times 100\%$$

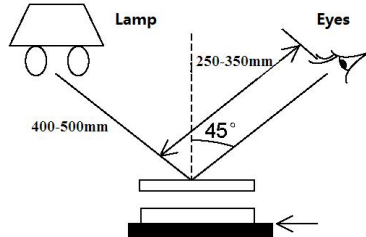
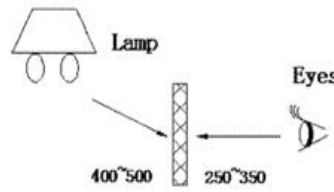


4.2 Appearance Specifications

4.2.1 Terms Definition



4.2.2 Inspection Conditions

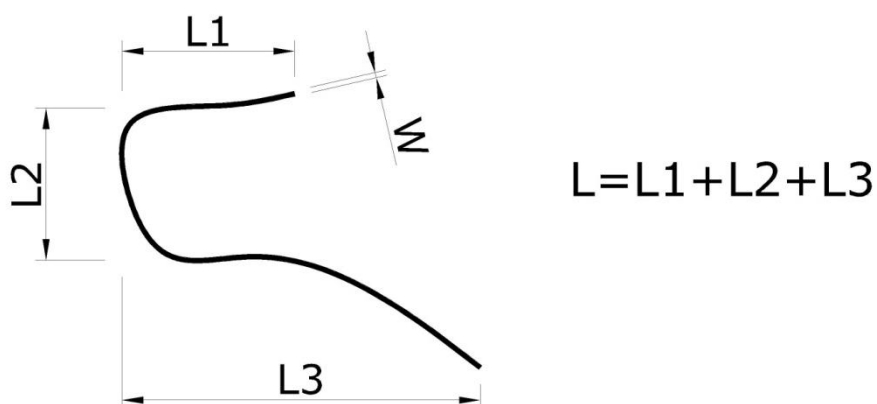
Items	Conditions	Remarks
Inspection Lamp	Florescent Cool White Lamp, 1000~1200Lux	
Inspection with Reflect Light (RL)	*Normal eyes level 1.0 (with Glasses accepted); *Distance between Lamp and product:40-50cm; *Distance between Eyes and Product:25-35cm; *Angle of view: 45°; *Black background; *Inspection time no more than 10s.	
Inspection with Through Light (TL)	*Normal eyes level 1.0 (with Glasses accepted); *Distance between Lamp and Product: 40-50cm; *Distance between Eyes and Product: 25-35cm; *Angle of view: 45°; *Black background; *Inspection time no more than 10s.	

4.2.3 Printing Area Appearance Inspection Criteria

Items	Conditions	Inspection Criteria	Method
Light Transparent Hole/Light Leakage	TL	Not Allowed (Repaired with black marker pen at the back side can be accepted.)	Eye view
Ink Off	TL	Not Allowed	Eye view
Stain and Dirty Mark	RL	*Stain and dirty mark refer to visible sheet contamination; the non-cleanable stain should be inspected as "Dot-like Defects". *Contamination cannot be cleaned by soft cloth and alcohol, Not Allowed; *Contamination can be cleaned by soft cloth and alcohol, Accept; but if the ratio of such contamination defected products is more than 10% of all the inspected products, Not Allowed;	Eye view
Liner-like Defects	RL	Refer to 4.2.4 Liner-like Defects.	Eye view, dot/wire gauge
Dot-like Defects	RL	Refer to 4.2.4 Dot-like Defects.	Eye view, dot/wire gauge
Logo/ Letter	RL	*Logo Break; Not Allowed *within a shaping printing < 120 mm: ± 0.10 ≥ 120 mm < 400 mm: ± 0.15 ≥ 400 mm: ± 0.25 *between shaping printing(offset to 2nd, 3rd, etc. color) < 400 mm: ± 0.30 ≥ 400 mm: ± 0.50	Eye view, dot/wire gauge

4.2.4 View Area Appearance Inspection Criteria

(W=Width, L=Length)



<Liner-like Defects>

Condition	Width(mm)	Length(mm)	Criteria
RL	$W \leq 0.05$	Not limited	*Accept QTY: not limited.
	$0.05 < W \leq 0.08$	$L \leq 10$	*Accept QTY: not more than 6; *Not allowed if the distance between 2 objects is less than 30 mm.
	$0.08 < W \leq 0.15$	$L \leq 10$	*Accept QTY: not more than 4; *Not allowed if the distance between 2 objects is less than 30 mm.
	$W > 0.15$	$L > 10$	*Not allowed.
	Liner-like Defects including: Liner Foreign Object/Scratch.		

< Dot-like Defects>

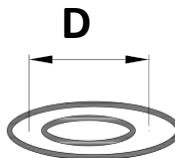
(D=Diameter)

Condition	Average Diameter(mm)	Criteria
RL	$D \leq 0.25$	*Not limited.
	$0.25 < D \leq 0.35$	*Accept Qty: not more than 10; *Not allowed if the distance between 2 defects is less than 30mm.
	$0.35 < D \leq 0.50$	*Accept Qty: not more than 5; *Not allowed if the distance between 2 defects is less than 30mm.
	$D > 0.50$	*Not allowed.
	Dot-like Defects including: Foreign Objects/Stab.	

< Stain and Dirty Mark>

Condition	Criteria
RL	* Stain and Dirty Mark refer to the visible contamination in mass, Dot-like contamination should be inspect as “Dot-like Defects”; *Contamination cannot be clean by soft cloth and alcohol, Not Allowed; *Contamination can be clean by soft cloth and alcohol, Accept; but if the ratio of such defected products are more than 10% of all the inspected products, Not Allowed.

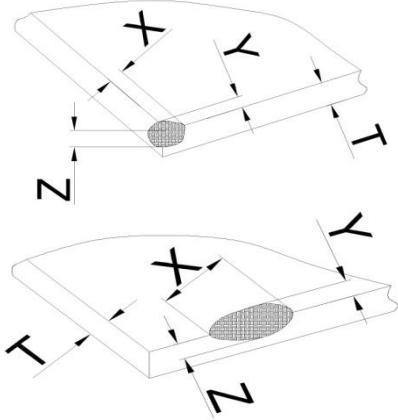
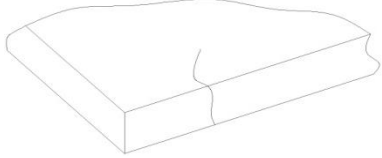
< Surface Fisheye>

Condition	Average Diameter(mm)	Criteria	Remarks
RL	$D \leq 0.15$	*Accept QTY: not more than 3; * Not allowed if the distance between 2 objects is less than 50 mm.	
	$0.15 < D \leq 0.30$	*Accept Qty: not more than 2; * Not allowed if the distance between 2 objects is less than 50 mm.	
	$0.30 < D \leq 0.50$	*Accept Qty: not more than 1.	
	$D > 0.50$	*Not allowed.	

<Defects of back side, locates outside the View Area>

The Appearance defects, such as Scratch, Foreign Object, Stain and Dirty-mark, on the backside of Module not lead to the performance failure	Accept
FPC and sensor pin bonding migration not more than pin width 1/2	Accept
Scratches on bonding area on silver	Not Allowed
Mechanical damages on FPC(dent/kink)	Not Allowed
Glue residue, broken and oxidation on gold fingers	Not Allowed

4.2.5 Glass Breakage

Items	Criteria	Remarks
Corner/ Edge Breakage	$*(X+Y)/2 < 0.3 \text{ mm}$, $Z < 1/3T \text{ mm}$; distance between 2 defects more than 5 mm; *Accept QTY: not more than 3.	
Crack	Not Allowed.	

5. Reliability Test

The reliability test items and its conditions are shown in below.

No	Test Items	Conditions	Note
1	High temperature storage test	Ta =80℃, 240 hrs	(1),(2) (4),(5)
2	Low temperature storage test	Ta =-30℃, 240 hrs	
3	High temperature & high humidity operation test	Ta =60℃, 90%RH, 240hrs	
4	High temperature operation test	Ta =80℃, 240hrs	
5	Low temperature operation test	Ta =-30℃, 240hrs	
6	Thermal shock	Ta = -20℃↔60℃(0.5hr), 100 cycle	
7	Vibration test (Non-Operating)	1.5G, 10 ~ 300 Hz sine wave, 10 min/cycle, 3 cycles each X, Y, Z direction	(2),(3)
8	Shock Test (Non-operation)	Acceleration: 50 G Wave: Half-sine Active Time: 11 ms Direction : ± X, ± Y, ± Z.(one time for each Axis)	
9	ESD test	150pF, 330Ω, 1 sec/cycle Condition 1: panel contact, ±8 KV Condition 2: panel non-contact ±15 KV	(1),(4)
10	Impact Resistance	Steel ball: 227 g Height: 60 cm	

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

Note (2) Temperature of panel display surface area should be 80℃ 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.

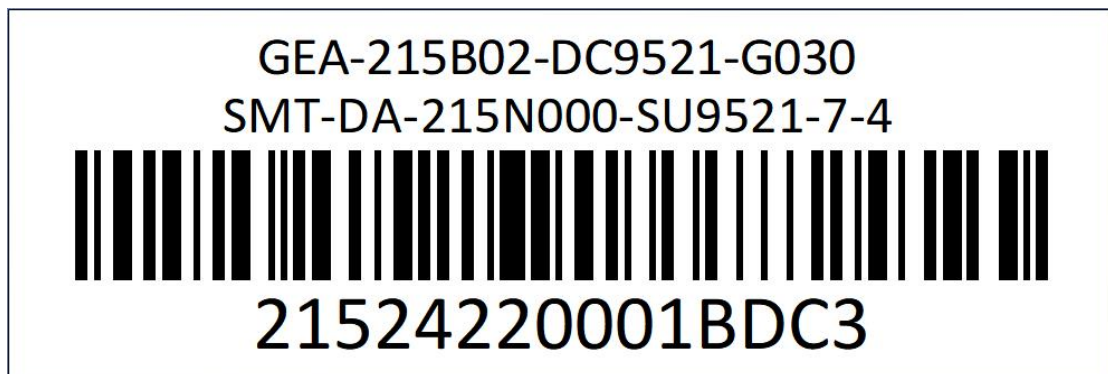
Note (4) In the standard conditions, there is no function failure issue occurred. All the cosmetic specification is judged before reliability test.

Note (5) Before cosmetic and function test, the product must have enough recovery time, at least 24 hours at room temperature.

6. Label, Package and Firmware Version

6.1 Label

6.1.1 Product Label Information



GEA-215B02-DC9521-G030

Product code.

SMT-DA-215N000-SU9521-7-4

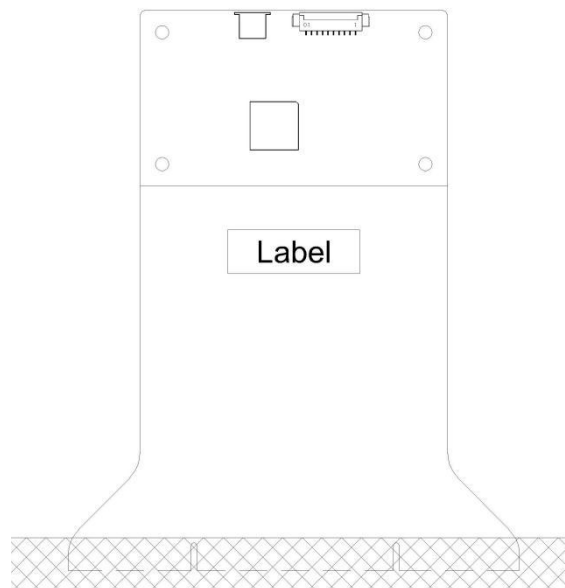
Touch sensor type for test.

21524220001BDC3

215: product active area size 2422: YYWW 0001: series number BDC3: internal code

6.1.2 Product Label Size and Position

Label size: 30mm*10mm. Label position: front side of touch sensor FPC.



6.2 Package

6.2.1 Packaging Steps

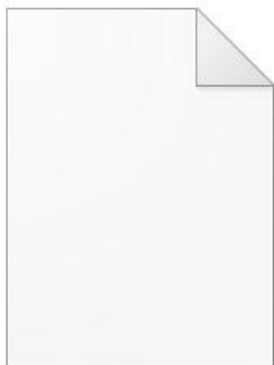
TBC

6.2.2 Carton Information

Size	xx*xx*xx (L*W*H)	cm
Product QTY of full box	TBC	PCS
Total weight	TBC	kg
Single product weight	3.10	kg

6.3 Firmware Version

fw_v0409_21_5_HATTELAND_new.BIN



fw_v0409_21_5_HATTELAND_new.B
IN

7. Mechanical Drawing

