

Specification

Module No. : GEA-156B01-DC9521-G020

Version No. : A3

Client Confirmation	Approved by	Prepared by
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Issue History

Version	History	Date	Remarks
A1	First Issue	2021/03/23	
A2	Updated mechanical drawing	2022/01/04	
A3	Updated 3.Electrical Specifications Added 4.Optical Specifications Removed 5.General Precaution Updated 5.Reliability Test Added 6.1 Label&6.3 Firmware Version	2023/07/15	

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1. Overview

This specification document is issued for the 15.6" 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	2mm chemical strengthened glass	black printed boarder
Adhesive	SCA	0.25 mm
Touch Sensor	0.7mm DITO glass + COF FPC	SIS9521 Controller
Air Bonding Tape	3M 4905	0.50 mm
Display	TFT LCD	INNOLUX G156HCE-L01

2.2 General Specifications

Item	Specifications	Remark
Display Active Area	344.16(H) × 193.59(V) mm	
Display Resolution	1920(H) × R.G.B. × 1080(V)	
Pixel Pitch	0.17925 × 0.17925 mm	
Pixel Arrangement	R.G.B. Vertical Stripe	
Display Colors	16.2M colors	
Display Brightness	450 cd/m ²	Typ.
Display Mode	Normally Black	
Display Surface Treatment	AG type, 3H hard coating	
Electrical Interface	Display: 2ch- LVDS	
	Touch: USB and I ² C	
Touch Activation	Multi-finger touch	
Touch Resolution	36X, 63Y	
Touch Controller	SIS9521	
Bonding Method	CG to touch sensor: optical bonding TP module to display: tape bonding	
Outline Dimension	392.20(H) × 241.50(V) × 12.75(Max) mm	

3. Electrical Specifications

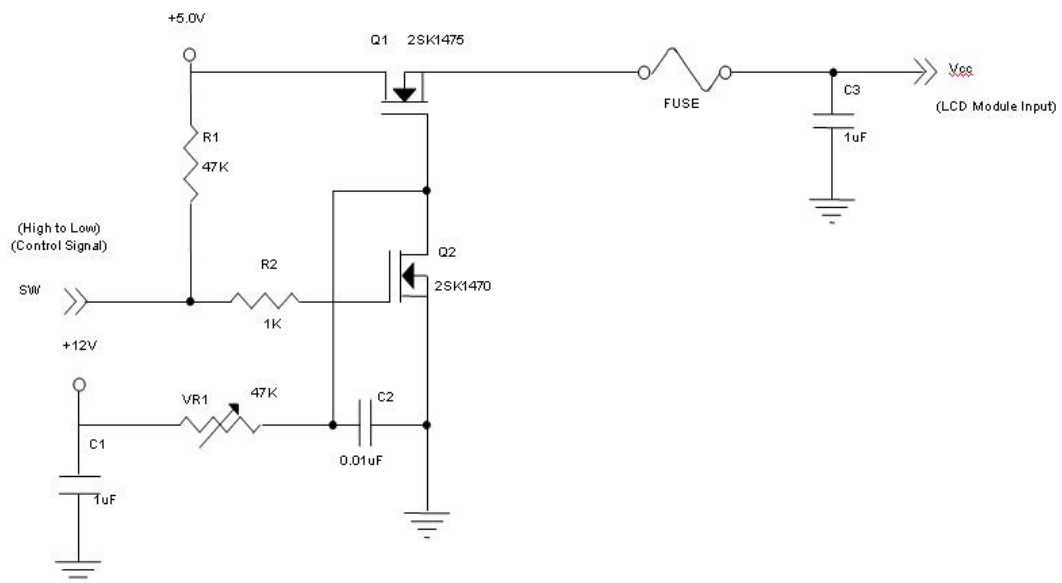
3.1 Display Electrical Specifications

3.1.1 LCD Electronics Specification

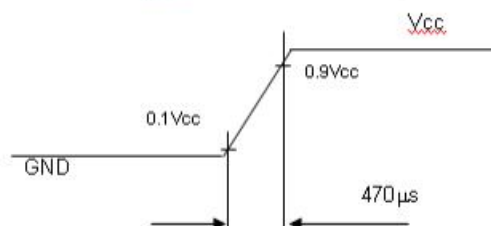
Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	V _{CC}	3	3.3	3.6	V	-
Ripple Voltage	V _{RP}	-	-	150	mV	-
Rush Current	I _{RUSH}	-	-	3	A	(2)
Power Supply Current	White	-	1.22	1.5	A	(3)a
	Black	-	0.51	0.7	A	(3)b
	Vertical Stripe	-	0.82	1	A	(3)c
Power Consumption	PLCD	-	4	5	Watt	(4)
LVDS differential input voltage	V _{id}	200		600	mV	(5)
LVDS common input voltage	V _{ic}	1.0	1.2	1.4	V	(5)
LVDS terminating resistor	R _T		100		ohm	

Note (1) The ambient temperature is Ta = 25±2°C.

Note (2) Measurement Conditions:



Vcc rising time is 470μs



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

a. White Pattern



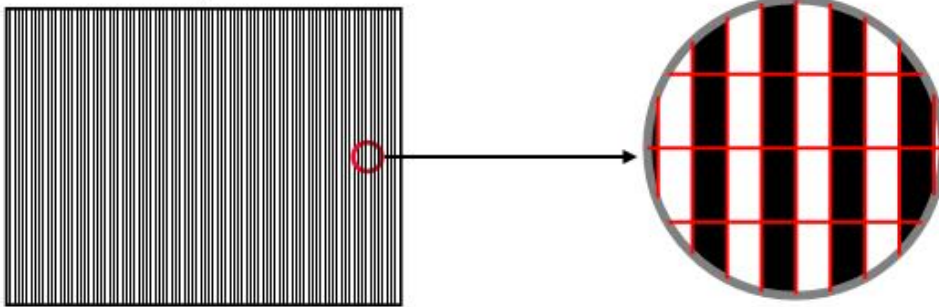
Active Area

b. Black Pattern



Active Area

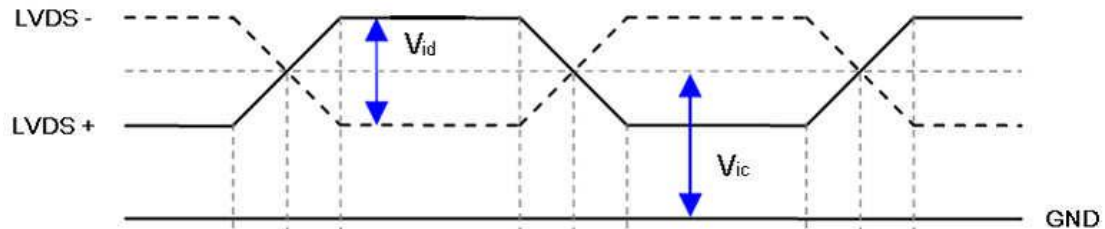
c. Vertical Stripe Pattern



Active Area

Note (4) The power consumption is specified at the pattern with the maximum current.

Note (5) VID waveform condition

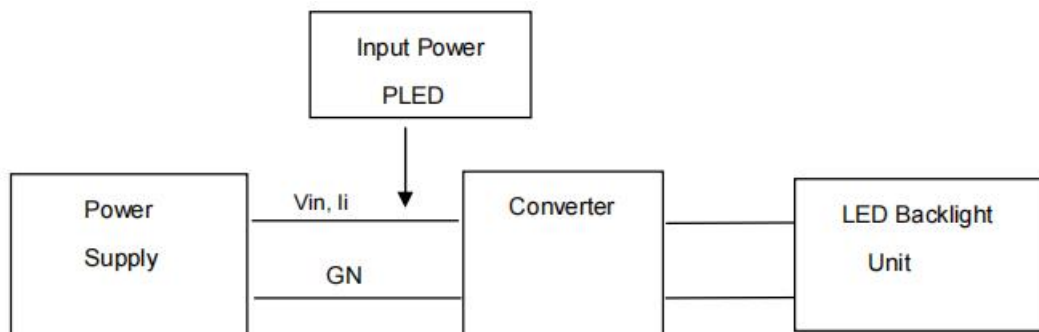


3.1.2 Backlight Unit

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Converter Power Supply Voltage		LED_Vin	10.8	12.0	13.2	V	
Converter Power Supply Current		Ii	0.8	1.0	1.2	A	@LED_Vin= 12V Duty=100%
Converter Input Rush Current		Iirsh			3	A	@LED_Vin rising = 1mS
Power Consumption		P _{LED}		12		W	@ LED_Vin = 12V Duty=100%
EN Control Level	Backlight on	LED_EN	2.0	5	5.5	V	
	Backlight off		0	0	0.8		
PWM Control Level	PWM High Level	LED_PWM	2.0	3.3	5.0	V	
	PWM Low Level		0	0	0.15		
PWM Control Duty Ratio			10	--	100	%	
PWM Control Frequency		f _{PWM}	190	200	20k	Hz	
LED Life Time		L _L	50,000			Hrs	(2)

Note (1) LED light bar input voltage and current are measured by utilizing a true RMS multi 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 Ta = 25±2°C and Duty 100% until the brightness becomes ≤ 50% of its original value. Operating LED under high temperature environment will reduce life time and lead to color shift.



BACKLIGHT PIN ASSIGNMENT

Pin	Symbol	Description	Remark
1	V _i	Converter input voltage	12V
2	V _{GND}	Converter ground	Ground
3	EN	Enable pin	3.3 / 5 V
4	ADJ	Backlight Adjust	PWM Dimming (Hi: 3.3 / 5V _{DC} , Lo: 0V _{DC})
5	NC	Not Connect	

Note (1) Connector Part No.: CI4205M2HRP-NH,CVILUX

3.1.3 Electrical Interface Connection

The LVDS connector interface pin assignments are listed in below table.

Connector model number: 20455-040E-76

Manufacturer: I-PEX

Pin	Name	Description
1	LED_Vcc	+12V Vi power supply
2	LED_Vcc	+12V Vi power supply
3	LED_Vcc	+12V Vi power supply
4	LED_Vcc	+12V Vi power supply
5	GND	Ground
6	GND	Ground
7	GND	Ground
8	GND	Ground
9	LED_EN	Enable pin
10	LED_PWM	Backlight Adjust
11	LCD_VCC	LCD logic and driver power 3.3V
12	LCD_VCC	LCD logic and driver power 3.3V
13	LCD_VCC	LCD logic and driver power 3.3V
14	NC	Not connection, this pin should be open
15	NC	Not connection, this pin should be open
16	NC	Not connection, this pin should be open
17	LCD GND	LCD logic and driver ground
18	RX00-	Negative LVDS differential data input. Channel O0 (odd)
19	RX00+	Positive LVDS differential data input. Channel O0 (odd)
20	RX01-	Negative LVDS differential data input. Channel O1 (odd)
21	RX01+	Positive LVDS differential data input. Channel O1 (odd)
22	RX02-	Negative LVDS differential data input. Channel O2 (odd)
23	RX02+	Positive LVDS differential data input. Channel O2 (odd)
24	LCD GND	LCD logic and driver ground
25	RXOC-	Negative LVDS differential clock input. (odd)
26	RXOC+	Positive LVDS differential clock input. (odd)
27	LCD GND	LCD logic and driver ground
28	RX03-	Negative LVDS differential data input. Channel O3(odd)
29	RX03+	Positive LVDS differential data input. Channel O3 (odd)
30	RXE0-	Negative LVDS differential data input. Channel E0 (even)
31	RXE0+	Positive LVDS differential data input. Channel E0 (even)
32	RXE1-	Negative LVDS differential data input. Channel E1 (even)
33	RXE1+	Positive LVDS differential data input. Channel E1 (even)
34	LCD GND	LCD logic and driver ground
35	RXE2-	Negative LVDS differential data input. Channel E2 (even)
36	RXE2+	Positive LVDS differential data input. Channel E2 (even)
37	RXEC-	Negative LVDS differential clock input. (even)
38	RXEC+	Positive LVDS differential clock input. (even)
39	RXE3-	Negative LVDS differential data input. Channel E3 (even)
40	RXE3+	Positive LVDS differential data input. Channel E3 (even)

3.1.4 Interface Timing

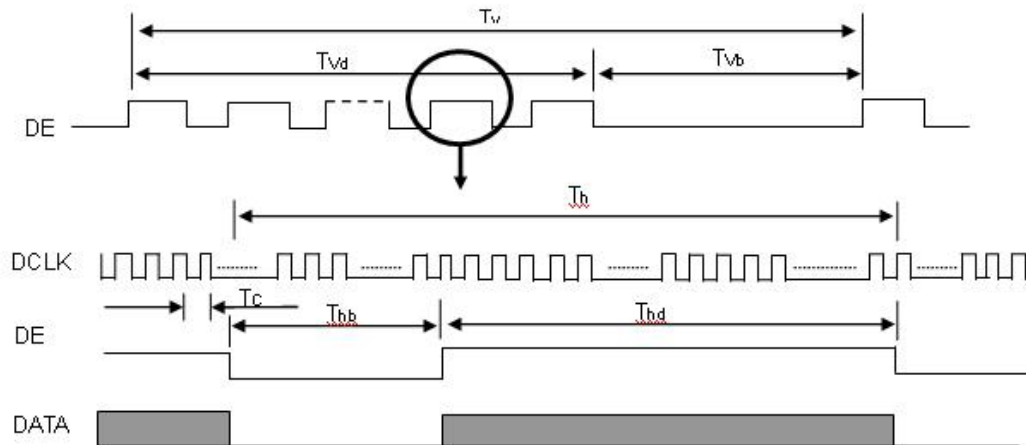
The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	Fc	60	70.93	75	MHz	-
	Period	Tc		14.1		ns	
	Input cycle to cycle jitter	T _{rd}	-0.02*Tc		0.02*Tc	ns	(3)
	Input clock to data skew	TLVCCS	-0.02*Tc		0.02*Tc	ns	(4)
	Spread spectrum modulation range	Fclk _{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	-

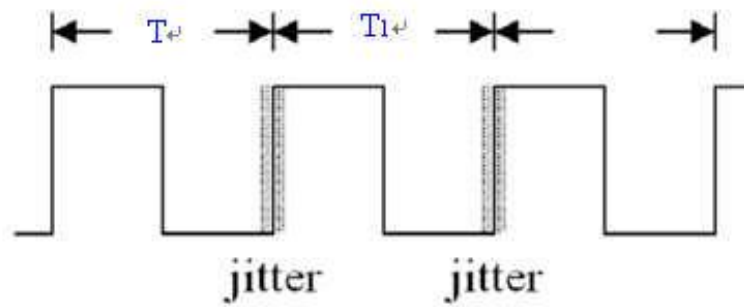
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals are ignored.

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

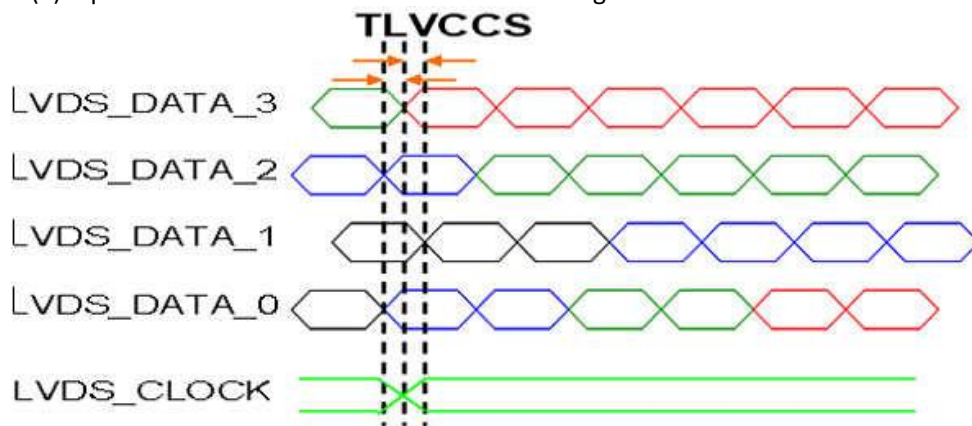
INPUT SIGNAL TIMING DIAGRAM



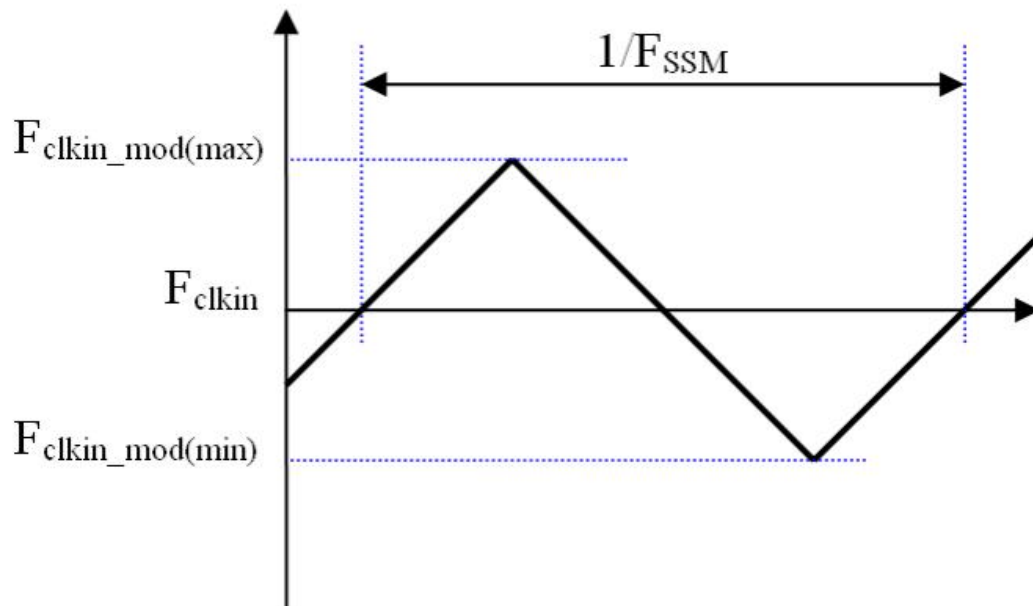
Note (3) The input clock cycle-to-cycle jitter is defined as below figures. $Trcl = |T1 - Tl|$



Note (4) Input Clock to data skew is defined as below figures.

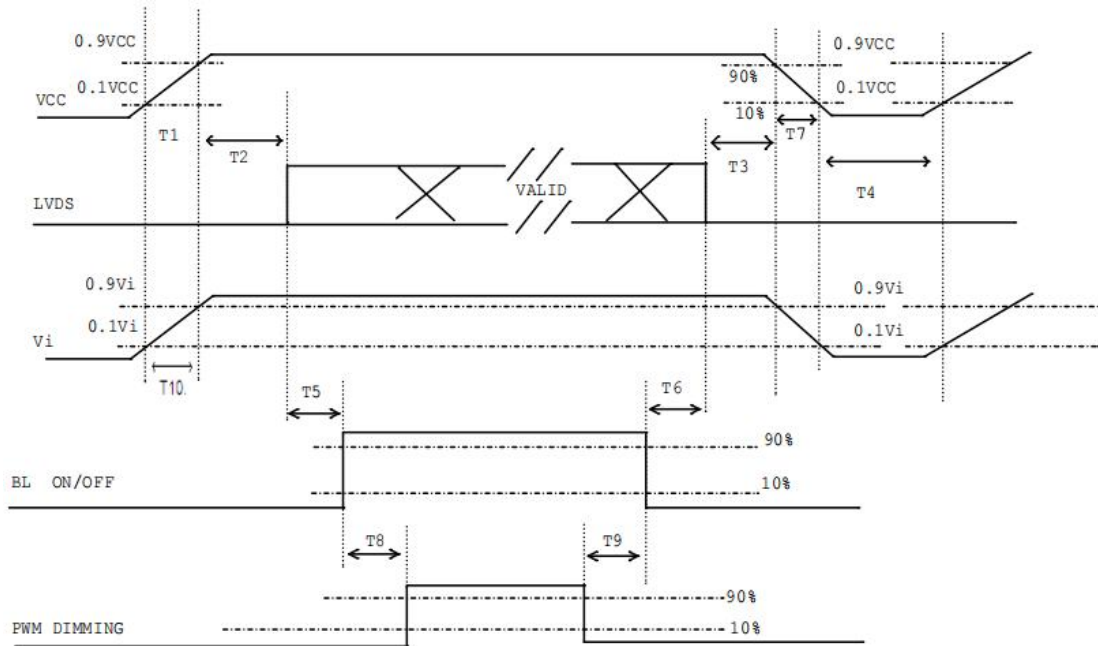


Note (5) The SSCG (Spread spectrum clock generator) is defined as below figures.



3.1.5 Power ON/OFF Sequence

The power sequence specifications are shown as the following table and diagram.



Timing Specifications:

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	20	-	-	ms
T7	10	-	300	ms
T8	10	-	-	ms
T9	10	-	-	ms
T10	20	-	-	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.

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

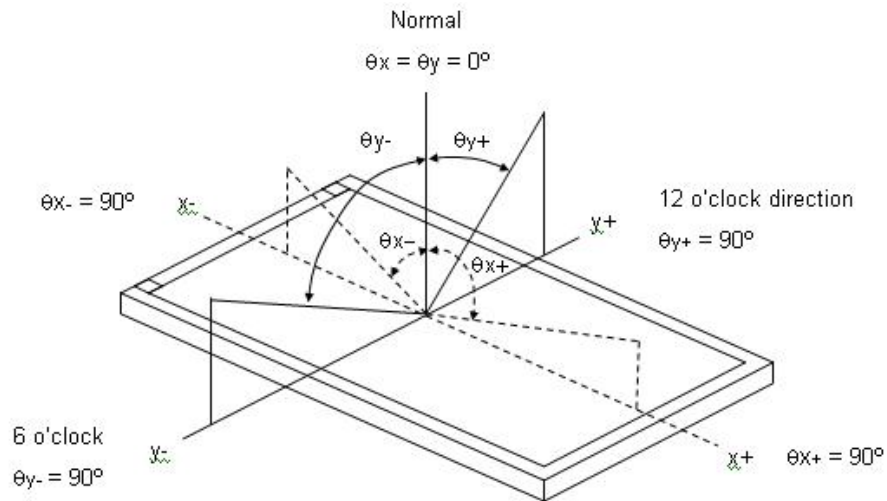
4.1.1 Test Conditions

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	According to typical value in "ELECTRICAL CHARACTERISTICS"		
Input Signal			
LED Light Bar Input Current Per Input Pin			

4.1.2 Optical Specifications

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Chromaticity (CIE 1931)	Red	R _x	$\theta_x=0^\circ, \theta_y=0^\circ$ CS-2000 R=G=B=255 Gray scale	Typ – 0.05	0.652	Typ + 0.05	-	(1), (5)
		R _y			0.338			
	Green	G _x			0.333			
		G _y			0.613			
	Blue	B _x			0.150			
		B _y			0.050			
	White	W _x			0.313			
		W _y			0.329			
Center Luminance of White		L _C	360	450	-	cd/m ²	(4), (5)	
Contrast Ratio		CR	600	800	-	-	(2), (5)	
Response Time		T _R	$\theta_x=0^\circ, \theta_y=0^\circ$	-	13	18	ms	(3)
		T _F		-	12	17		
White Variation		W	$\theta_x=0^\circ, \theta_y=0^\circ$	70	-	-	%	(5), (6)
Viewing Angle	Horizontal	θ_{x+}	CR ≥ 10	80	85	---	Deg.	(1), (5)
		θ_{x-}		80	85			
	Vertical	θ_{y+}		80	85			
		θ_{y-}		80	85	---		

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.

Contrast Ratio (CR) = L255 / L0

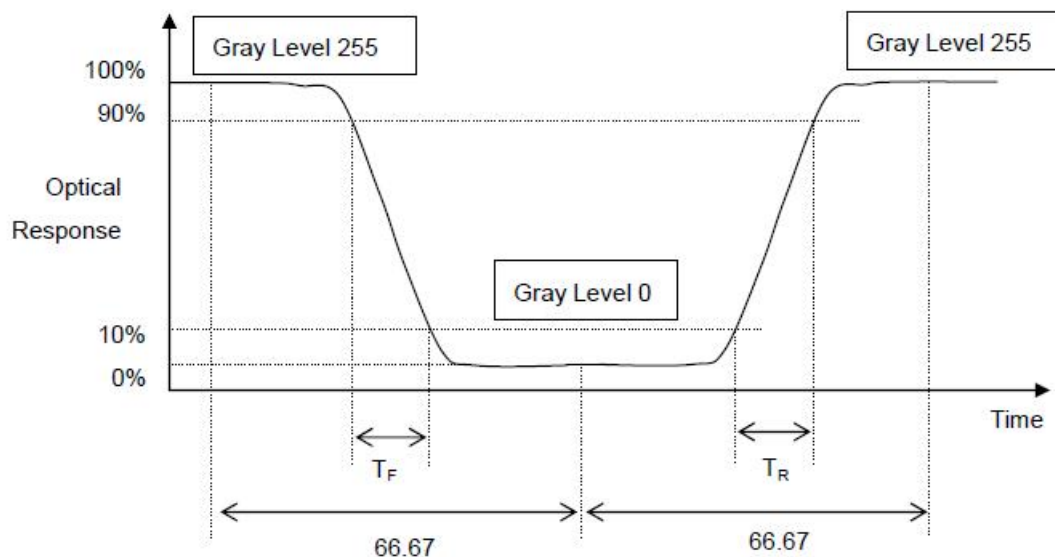
L255: Luminance of gray level 255

L0: 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).

Note (3) Definition of Response Time (TR, TF):



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

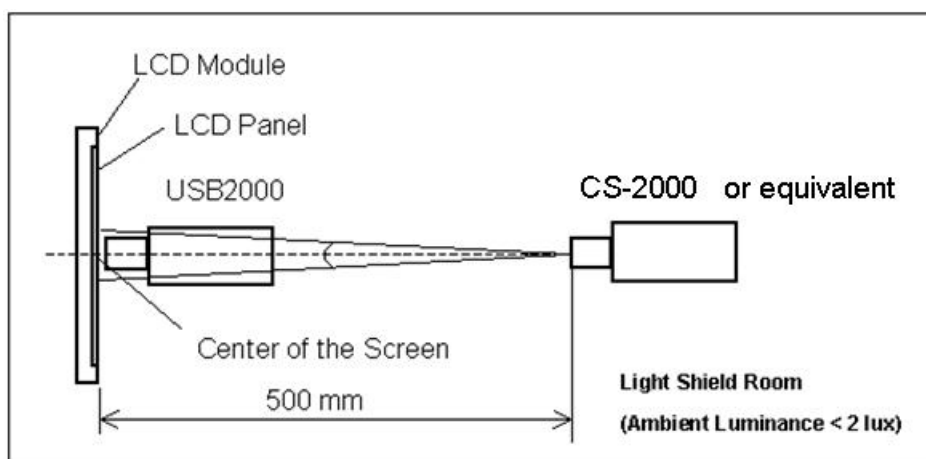
Measure the luminance of gray level 255 at center point

LC = L (5)

L (x) is corresponding to the luminance of the point X at Figure in Note (6).

Note (5) Measurement Setup:

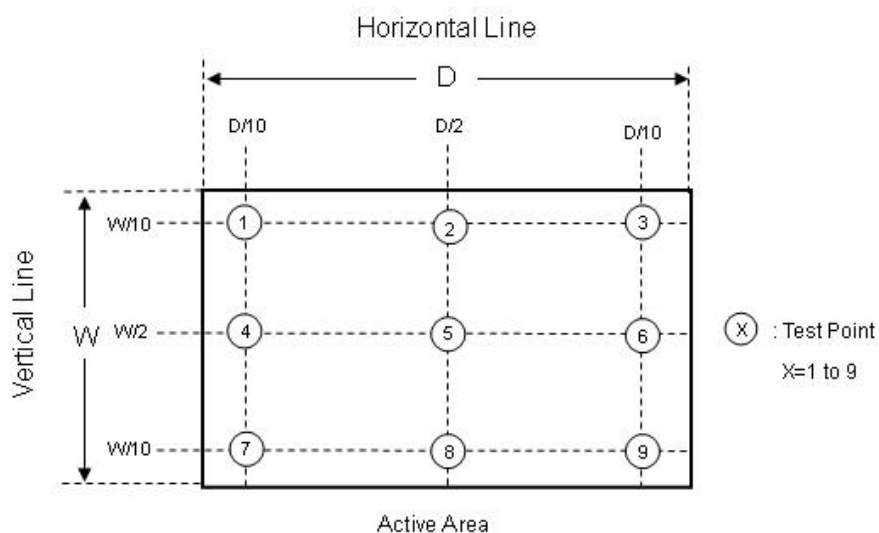
The LCD module should be stabilized at given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 30 minutes in a windless room.



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

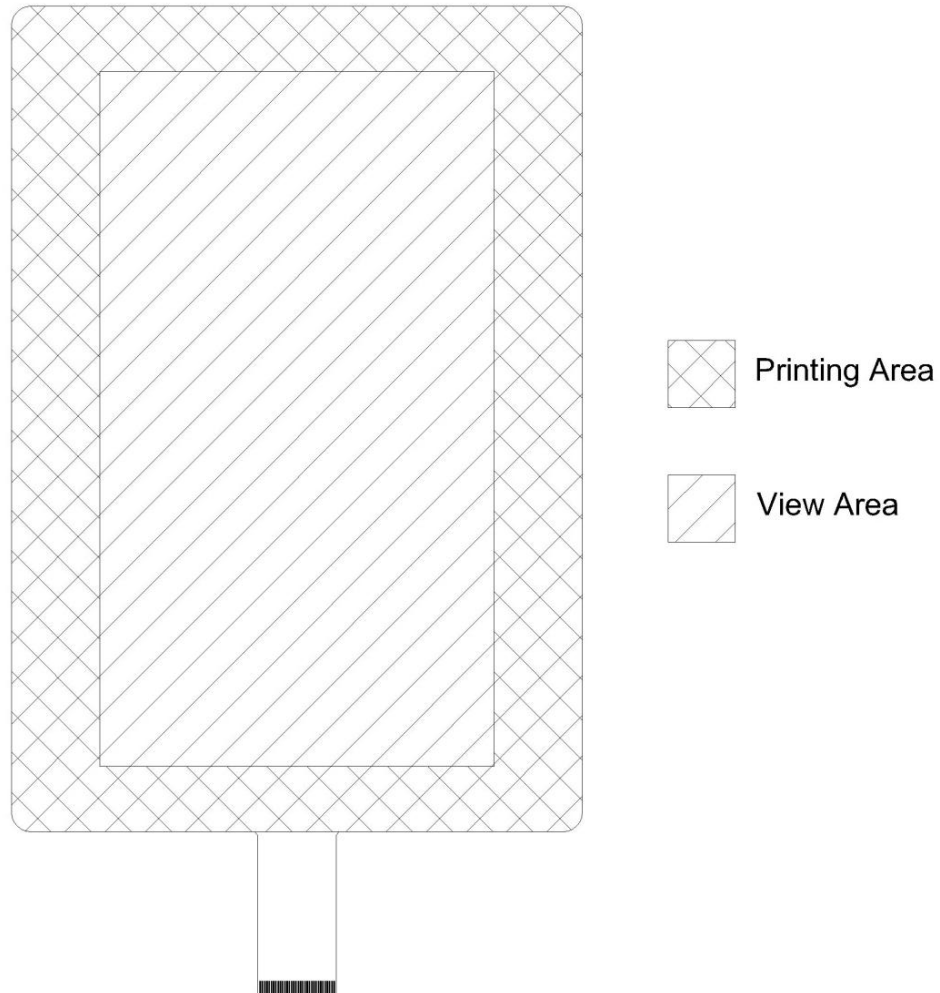
Measure the luminance of gray level 255 at 9 points

$$\delta W = (\text{Minimum} [L(1) \sim L(9)] / \text{Maximum} [L(1) \sim L(9)]) * 100\%$$

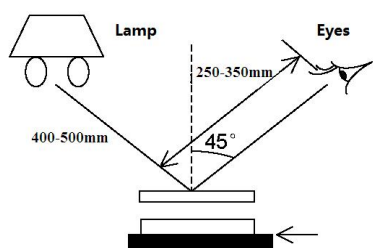
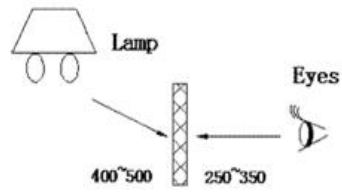


4.2 Appearance Specifications

4.2.1 Terms Definition



4.2.2 Inspection Conditions

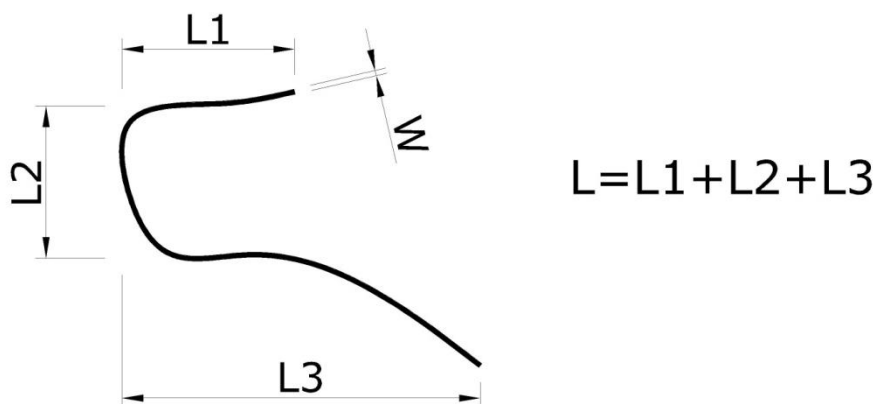
Items	Conditions	Remarks
Inspection Lamp	Florescent Cool White Lamp, 1000~1200Lux	
Inspection with Reflect Light (RL)	*Normal eyes level 1.0 (with Glasses accepted); *Distance between Lamp and product:40-50cm; *Distance between Eyes and Product:25-35cm; *Angle of view: 45°; *Black background; *Inspection 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	$W \leq 0.03$	Not limited	*Accept QTY: not limited.
	$0.03 < W \leq 0.06$	$L \leq 10$	*Accept QTY: not more than 6; *Not allowed if the distance between 2 objects is less than 20 mm.
	$0.06 < W \leq 0.10$	$L \leq 10$	*Accept QTY: not more than 4; *Not allowed if the distance between 2 objects is less than 20 mm.
	$W > 0.10$	$L > 10$	*Not allowed.
	Liner-like Defects including: Liner Foreign Object/Scratch.		

< Dot-like Defects>

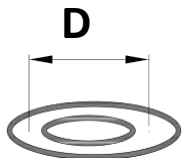
(D=Diameter)

Condition	Average Diameter(mm)	Criteria
RL	$D \leq 0.20$	*Not limited.
	$0.20 < D \leq 0.30$	*Accept Qty: not more than 10; *Not allowed if the distance between 2 defects is less than 20mm.
	$0.30 < D \leq 0.40$	*Accept Qty: not more than 5; *Not allowed if the distance between 2 defects is less than 20mm.
	$D > 0.40$	*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.

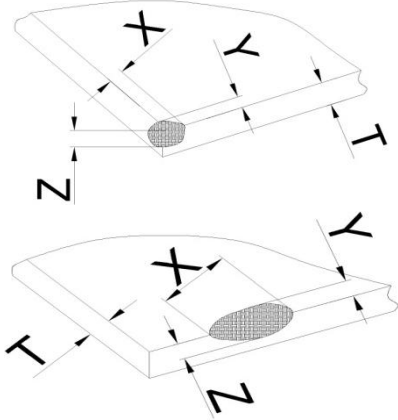
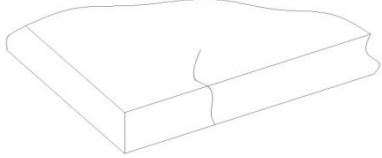
< Surface Fisheye>

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
1	High temperature storage test	Ta =80℃, 240 hrs
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 = -30℃↔80℃ (0.5hr), 100 cycle
7	Vibration test (Non-Operating)	1.5G, 10 ~ 300 Hz, 10min/cycle, 3 cycles each X, Y, Z
8	Shock test (Non-Operating)	50G, 11ms, half sine wave, 1 time for ± X, ± Y, ± Z.
9	Impact Resistance	Steel ball: 64 g Height: 30 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 98 °C 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.

6. Label, Package and Firmware Version

6.1 Label

6.1.1 Product Label Information



GEA-156B01-DC9521-G020

Product code.

SMT-DA-156N000-SU9521-7-4

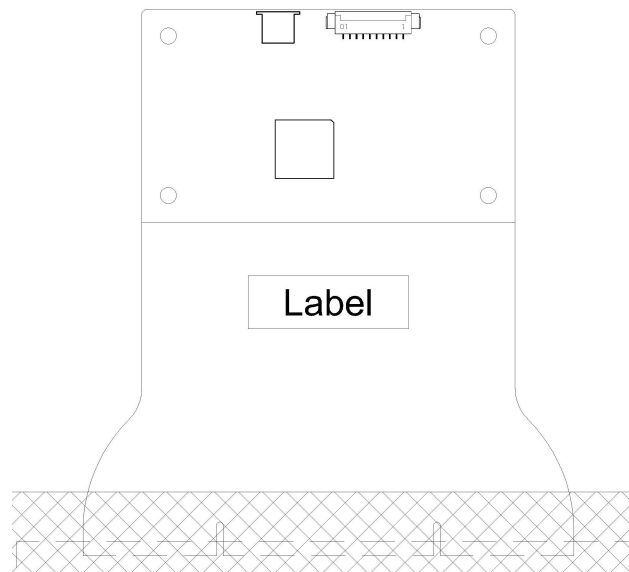
Touch sensor type for test.

15623280001BDC2

156: product active area size 2328: YYWW 0001: series number BDC2: 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

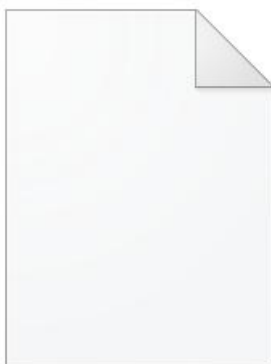
TBC

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	TBC	kg

6.3 Firmware Version

fw_15_6_USB_EB.bin



fw_15_6_USB_EB.bin

7. Mechanical Drawing

