

Specification

Module No. : GEA-156E01-DC9521-G020
Client Name : _____
Client Ref. : _____
Version No. : A1

Client Confirmation	Approved by	Prepared by
	Carl Chen	Dou Zhang

CONTENTS

1. Purpose	4
2. Feature	5
2.1 Overview	5
2.2 Absolute Maximum Ratings	5
2.3 Module Structure	6
2.4 Physical Specifications	7
3. Electrical Specifications	8
3.1 Display Electrical Specifications	8
3.1.1 TFT LCD Module	8
3.1.2 Back-Light Unit	9
3.1.3 Electrical Interface Connection	10
3.1.4 LVDS Interface	11
3.1.5 Signal Timing Specification	12
3.1.6 Input Signals, Basic Display & Gray Scale of Colors	13
3.1.7 Power Sequence	14
3.2 Touch Panel Electrical Specifications	15
3.2.1 Interface Connection	15
3.2.2 Connector Pins Definition	15
3.2.3 I ² C Interface	15
4. Optical Specifications	16
4.1 Display Optical Specifications	16
4.1.1 Overview	16
4.1.2 Optical Specifications	16
4.2 Appearance Specifications	20
4.2.1 Terms Definition	20
4.2.2 Inspection Conditions	21
4.2.3 Printing Area Appearance Inspection Criteria	22
4.2.4 View Area Appearance Inspection Criteria	23
4.2.5 Glass Breakage	25
5. Reliability Test	26
6. General Precaution	27
6.1 Mounting Method	27
6.2 Caution of LCD Handling and Cleaning	27
6.3 Caution Against Static Charge	28
6.4 Caution For Operation	28
6.5 Packaging	28
6.6 Storage	29
6.7 Safety	29
7. Packing	30
8. Mechanical Drawing	31

1. Purpose

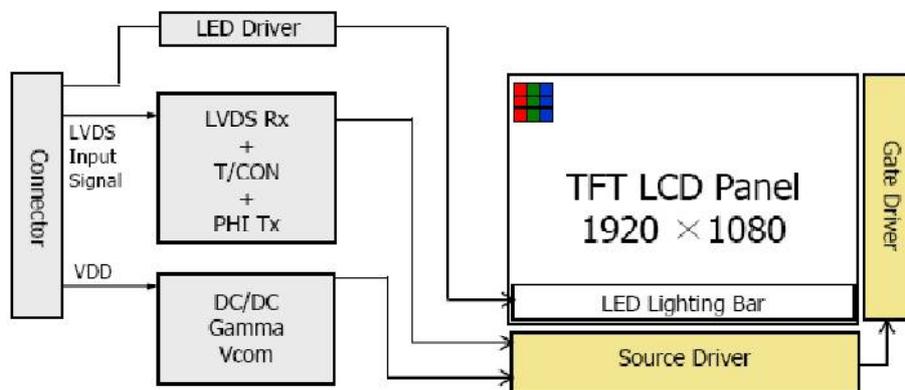
This specification document is issued for the 15.6" TFT Liquid Crystal Display bonded with Capacitive-Type Touch Panel delivered by General Electrical Touch Co., Limited. This document defined the general provisions (including structure, performance, characteristics and quality guarantee) for the specific 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 Overview

The touch part is a 15.6 inch DITO glass Capacitive-Type Touch Panel. It uses a SIS9521 touch controller and with USB & I²C communication.

The display part BOE EV156FHM-N11 which is a color active matrix TFT LCD module using amorphous silicon TFT's (Thin Film Transistors) as an active switching devices. This module has a 15.6 inch diagonally measured active area with FHD resolutions (1920 horizontal by 1080 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this module can display 16.7M colors.



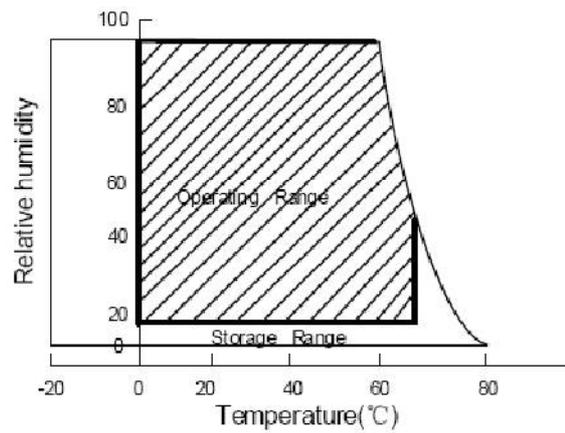
2.2 Absolute Maximum Ratings

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit.

Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	-0.3	4.0	V	Note 1
Logic Supply Voltage	V_{IN}	$V_{SS}-0.3$	$V_{DD}+0.3$	V	
Operating Temperature	T_{OP}	0	+70	°C	Note 2
Storage Temperature	T_{ST}	-20	+80	°C	

Notes:

1. Permanent damage to the device may occur if maximum values are exceeded functional operation should be restricted to the condition described under normal operating conditions.
2. Temperature and relative humidity range are shown in the figure below.
95 % RH Max. ($T_a \leq 40^\circ\text{C}$) Maximum wet-bulb temperature at 39°C or less.
($T_a > 40^\circ\text{C}$) No condensation.



2.3 Module Structure

Main Component	Materials	Remarks
Cover Glass	2mm chemical strengthened glass	black printed board
Adhesive	SCA	Thickness: 0.25 mm
Touch Sensor	DITO glass	0.70mm, 60~90Ω/□
Air Bonding Tape	3M 4905	Thickness: 0.5 mm
Display	TFT LCD	BOE EV156FHM-N11

2.4 Physical Specifications

Item	Specifications	Remark
TFT Active Area	344.16(H)*193.59(V) mm	
Touch Visible Area	346.20(H)*195.50(V) mm	
Number Of Pixels	1920(H)×1080(V)	
Pixel Pitch	0.05975(H)×0.17925(V) mm	
Pixel Arrangement	Pixels RGB stripe arrangement	
Display Colors	16.7M(6bits+Hi FRC)	
Display Mode	Normally Black	
Surface Treatment	AG25	
Contrast Ratio	1200:1(Typ)	
Viewing Angle(CR>10)	89/89/89/89(Typ) deg.	
Response Time	25(Typ) ms	
Color Gamut	72%(Min)/78%(Typ)	NTSC
Brightness	425(Min)/500(Typ) cd/m ²	
Power Consumption	LCD: 2.8W(Typ) BLU: 8.7W(Max)	
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	392.2(H)*241.5(V)*13.1(Typ) mm	
Weight	1.4 KG	

3. Electrical Specifications

3.1 Display Electrical Specifications

3.1.1 TFT LCD Module

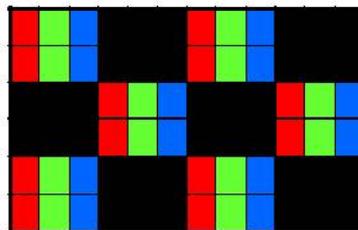
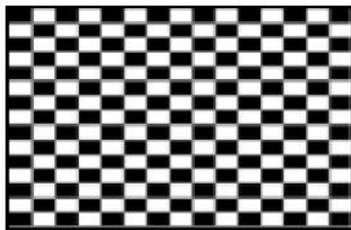
<LCD Module Electrical Specifications> [Ta=25± 2°C]

Parameter		Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	3.0	3.3	3.6	V	Note 1
Permissible Input Ripple Voltage	V_{RF}	-	-	100	mV	At $V_{DD} = 3.3V$
Power Supply Current	I_{DD}	-	900	-	mA	Note 1
Positive-going Input Threshold Voltage	V_{IT+}	-	-	100	mV	$V_{cm} = 1.2V$ typ.
Negative-going Input Threshold Voltage	V_{IT-}	-100	-	-	mV	
Differential Input Voltage	V_{ID}	200	-	600	mV	
Power Consumption	P_D	-	-	4.5	W	Note 1
	P_{BL}	-	-	8.8	W	Note 2
	P_{total}	-	-	13.3	W	

Notes : 1. The supply voltage is measured and specified at the interface connector of LCM.
The current draw and power consumption specified is for 3.3V at 25°C.

a) Typ: Mosaic Pattern

b) Max: R/G/B Pattern



2. Calculated value for reference (VLED × ILED).

3.1.2 Back-Light Unit

<LED Driver Electrical Specifications>

[Ta=25±2°C]

Parameter		Min.	Typ.	Max.	Unit	Remarks
LED Forward Voltage	V_F	-	3.0	3.3	V	-
LED Forward Current	I_F	-	60		mA	-
LED Power Consumption	P_{LED}		7.8	8.8	W	Note 1
LED Life-Time	N/A	50,000	-	-	Hour	$I_F = 60mA$
Power supply voltage for LED Driver	V_{LED}	10.8	12	13.2	V	
EN Control Level	Backlight on	2.5		5.0	V	
	Backlight off	0		0.8	V	
PWM Control Level	PWM High Level	2.5		5.0	V	
	PWM Low Level	0		0.8	V	
PWM Control Frequency	F_{PWM}	180	-	10,000	Hz	
Duty Ratio	-	10	-	100	%	

Notes: 1. $P_{LED} = V_{LED} \times I_{LED}$ (Without LED converter transfer efficiency).

2. The life time of LED, 50,000Hrs, is determined as the time at which luminance of the LED is 50% compared to that of initial value at the typical LED current on condition of continuous operating at 25±2°C.

3.1.3 Electrical Interface Connection

The electronics interface connector is I-PEX 20455-040E-66 or Compatible. The connector interface pin assignments are listed in below table.

Pin No.	Symbol	Description
1	BL_POWER	+12V Vi power supply
2	BL_POWER	+12V Vi power supply
3	BL_POWER	+12V Vi power supply
4	BL_POWER	+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 Power 3.3V
12	LCD_VCC	LCD Power 3.3V
13	LCD_VCC	LCD 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 Ground
18	RXO_0-	Negative LVDS differential data input Channel O0(Odd)
19	RXO_0+	Positive LVDS differential data input Channel O0(Odd)
20	RXO_1-	Negative LVDS differential data input Channel O1(Odd)
21	RXO_1+	Positive LVDS differential data input Channel O1(Odd)
22	RXO_2-	Negative LVDS differential data input Channel O2(Odd)
23	RXO_2+	Positive LVDS differential data input Channel O2(Odd)
24	LCD_GND	LCD Ground
25	RXO_C-	Negative LVDS differential clock input(Odd)
26	RXO_C+	Positive LVDS differential clock input (Odd)
27	LCD_GND	LCD Ground
28	RXO_3-	Negative LVDS differential data input Channel O3(Odd)
29	RXO_3+	Positive LVDS differential data input Channel O3(Odd)
30	RXE_0-	Negative LVDS differential data input Channel E0(Even)
31	RXE_0+	Positive LVDS differential data input Channel E0(Even)
32	RXE_1-	Negative LVDS differential data input Channel E1(Even)
33	RXE_1+	Positive LVDS differential data input Channel E1(Even)
34	LCD_GND	LCD Ground
35	RXE_2-	Negative LVDS differential data input Channel E2(Even)
36	RXE_2+	Positive LVDS differential data input Channel E2(Even)
37	RXE_C-	Negative LVDS differential clock input(Even)
38	RXE_C+	Positive LVDS differential clock input (Even)
39	RXE_3-	Negative LVDS differential data input Channel E3(Even)
40	RXE_3+	Positive LVDS differential data input Channel E3(Even)

3.1.4 LVDS Interface

	Input Signal	Transmitter		Interface		HR230WU-400 (CN11)	Remark
		Pin No.	Pin No.	System (Tx)	TFT-LCD (Rx)	Pin No.	
L V D S	OR0	51	48 47	OUT0- OUT0+	RXO0- RXO0+	1 2	
	OR1	52					
	OR2	54					
	OR3	55					
	OR4	56					
	OR5	3					
	OG0	4	46 45	OUT1- OUT1+	RXO1- RXO1+	3 4	
	OG1	6					
	OG2	7					
	OG3	11					
	OG4	12					
	OG5	14					
	OB0	15	42 41	OUT2- OUT2+	RXO2- RXO2+	5 6	
	OB1	19					
	OB2	20					
	OB3	22					
	OB4	23					
	OB5	24					
	Hsync	27	40 39	CLK OUT- CLK OUT+	RXO CLK- RXO CLK+	8 9	
	Vsync	28					
	DE	30	38 37	OUT3- OUT3+	RXO3- RXO3+	10 11	
	MCLK	31					
	OR6	50					
	OR7	2					
	OG6	8					
OG7	10						
OB6	16						
OB7	18						
RSVD	25						

3.1.5 Signal Timing Specification

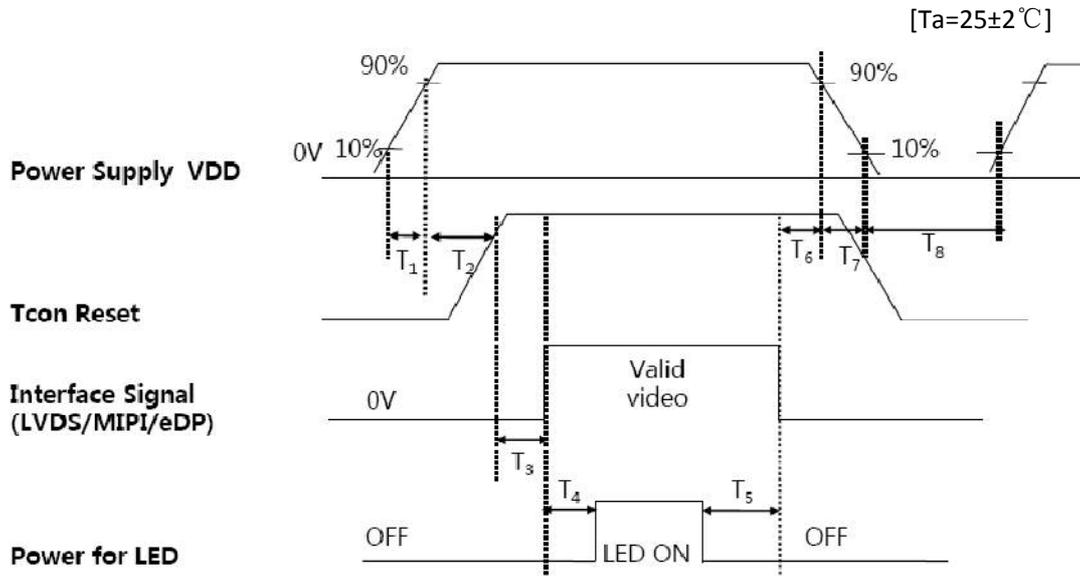
The EV156FHM-N11 is operated by the DE only.

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	100	147.8	160	MHz
	High Time	Tch	-	4/7Tc	-	Tc
	Low Time	Tcl	-	4/7Tc	-	Tc
Frame Period	Tv		1112	1125	1238	lines
			40	60	66	Hz
			25	16.67	15.15	ms
Vertical Display Period	Tvd	-	1080	-	lines	
One line Scanning Period	Th	2080	2200	2400	clocks	
Horizontal Display Period	Thd	-	1920	-	clocks	

3.1.6 Input Signals, Basic Display & Gray Scale of Colors

	Colors & Gray scale	Data signal														
		R0 R1 R2 R3 R4 R5	G0 G1 G2 G3 G4 G5	B0 B1 B2 B3 B4 B5												
Basic colors	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0												
	Blue	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1												
	Green	0 0 0 0 0 0	1 1 1 1 1 1	0 0 0 0 0 0												
	Light Blue	0 0 0 0 0 0	1 1 1 1 1 1	1 1 1 1 1 1												
	Red	1 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0												
	Purple	1 1 1 1 1 1	0 0 0 0 0 0	1 1 1 1 1 1												
	Yellow	1 1 1 1 1 1	1 1 1 1 1 1	0 0 0 0 0 0												
Gray scale of Red	White	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1												
	Black	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												
	Darker	0 1 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0												
	△	↑	↑	↑												
	▽	↓	↓	↓												
	Brighter	1 0 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0												
Gray scale of Green	▽	0 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0												
	Red	1 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0												
	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	1 0 0 0 0 0	0 0 0 0 0 0												
	Darker	0 0 0 0 0 0	0 1 0 0 0 0	0 0 0 0 0 0												
	△	↑	↑	↑												
	▽	↓	↓	↓												
Gray scale of Blue	Brighter	0 0 0 0 0 0	1 0 1 1 1 1	0 0 0 0 0 0												
	▽	0 0 0 0 0 0	0 1 1 1 1 1	0 0 0 0 0 0												
	Green	0 0 0 0 0 0	1 1 1 1 1 1	0 0 0 0 0 0												
	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	0 0 0 0 0 0	1 0 0 0 0 0												
	Darker	0 0 0 0 0 0	0 0 0 0 0 0	0 1 0 0 0 0												
	△	↑	↑	↑												
Gray scale Of White & Black	▽	↓	↓	↓												
	Brighter	0 0 0 0 0 0	0 0 0 0 0 0	1 0 1 1 1 1												
	▽	0 0 0 0 0 0	0 0 0 0 0 0	0 1 1 1 1 1												
	Blue	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1												
	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0												
	△	1 0 0 0 0 0	1 0 0 0 0 0	1 0 0 0 0 0												
	Darker	0 1 0 0 0 0	0 1 0 0 0 0	0 1 0 0 0 0												
Gray scale Of White & Black	△	↑	↑	↑												
	▽	↓	↓	↓												
	Brighter	1 0 1 1 1 1	1 0 1 1 1 1	1 0 1 1 1 1												
	▽	0 1 1 1 1 1	0 1 1 1 1 1	0 1 1 1 1 1												
Gray scale Of White & Black	White	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1												

3.1.7 Power Sequence



<Sequence Table>

Parameter	Value			Units
	Min.	Typ.	Max.	
T1	0.1	-	5	(ms)
T2	10	-	30	(ms)
T3	5	-	100	(ms)
T4	200	-	-	(ms)
T5	200	-	-	(ms)
T6	0	-	50	(ms)
T7	0	-	10	(ms)
T8	500	-	-	(ms)

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	3CDFF6F7-4267-4555-AD05-B30A3D8938DE
HID Descriptor address	0x0000

4. Optical Specifications

4.1 Display Optical Specifications

4.1.1 Overview

The test of Optical specifications shall be measured in a dark room (ambient luminance ≤ 1 lux and temperature $= 25 \pm 2^\circ\text{C}$) with the equipment of Luminance meter system (Goniometer system and TOPCONE BM-5) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of θ and ϕ equal to 0° . We refer to $\theta\phi=0$ ($=\theta_3$) as the 3 o'clock direction (the "right"), $\theta\phi=90$ ($=\theta_{12}$) as the 12 o'clock direction ("upward"), $\theta\phi=180$ ($=\theta_9$) as the 9 o'clock direction ("left") and $\theta\phi=270$ ($=\theta_6$) as the 6 o'clock direction ("bottom"). While scanning θ and/or ϕ , the center of the measuring spot on the Display surface shall stay fixed. The measurement shall be executed after 30 minutes warm-up period. VDD shall be $3.3 \pm 0.3\text{V}$ at 25°C . Optimum viewing angle direction is 6 o'clock.

4.1.2 Optical Specifications

[VDD = 3.3V, Frame rate = 60Hz, Clock = 74.25MHz, IBL = 240mA, Ta = $25 \pm 2^\circ\text{C}$]

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle range	Horizontal	θ_3	CR > 10	80	89	-	Deg.	Note 1
		θ_9		80	89	-	Deg.	
	Vertical	θ_{12}		80	89	-	Deg.	
		θ_6		80	89	-	Deg.	
Luminance Contrast ratio		CR		1000	1200			Note 2
Luminance of White		Y_w		425	500		cd/m ²	Note 3
White luminance uniformity		ΔY		75	80		%	Note 4
Reproduction of color	White	W_x	$\theta = 0^\circ$ (Center) Normal Viewing Angle	0.283	0.313	0.343	-	Note 5
		W_y		0.299	0.329	0.359	-	
	Red	R_x		0.622	0.652	0.682	-	
		R_y		0.299	0.329	0.359	-	
	Green	G_x		0.265	0.295	0.325	-	
		G_y		0.605	0.635	0.665	-	
	Blue	B_x		0.118	0.148	0.178	-	
		B_y		0.035	0.065	0.095	-	
Response Time	GTG	T_g		25	30	ms	Note 6	
Cross Talk		CT		-	-	2.0	%	Note 7

Note:

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface.

2. Contrast measurements shall be made at viewing angle of $\theta = 0^\circ$ and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. (See FIGURE 1 shown in Appendix) Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. Center Luminance of white is defined as the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in FIGURE 2 for a total of the measurements per display.

4. The White luminance uniformity on LCD surface is then expressed as : $\Delta Y = (\text{Minimum Luminance of 9points} / \text{Maximum Luminance of 9points}) * 100$ (See FIGURE 2 shown in Appendix).

5. The color chromaticity coordinates specified in the table above. shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

6. Response time T_g is the average time required for display transition by switching the input signal as below table and is based on Frame rate $f_V = 60\text{Hz}$ to optimize. Each time in below table is defined as Figure 3 and shall be measured by switching the input signal for "any level of gray(bright)" and "any level of gray(dark)". (See FIGURE 3 shown in Appendix).

7. Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance (YA) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance (YB) of that same area when any adjacent area is driven dark. (See FIGURE 4 shown in Appendix).

Figure 1. Measurement Set Up

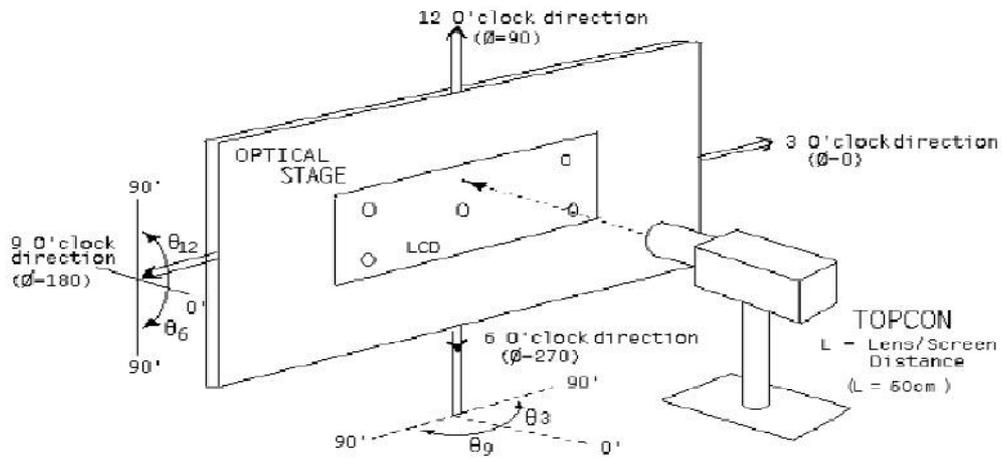


Figure 2. White Luminance and Uniformity Measurement Locations (9 points)

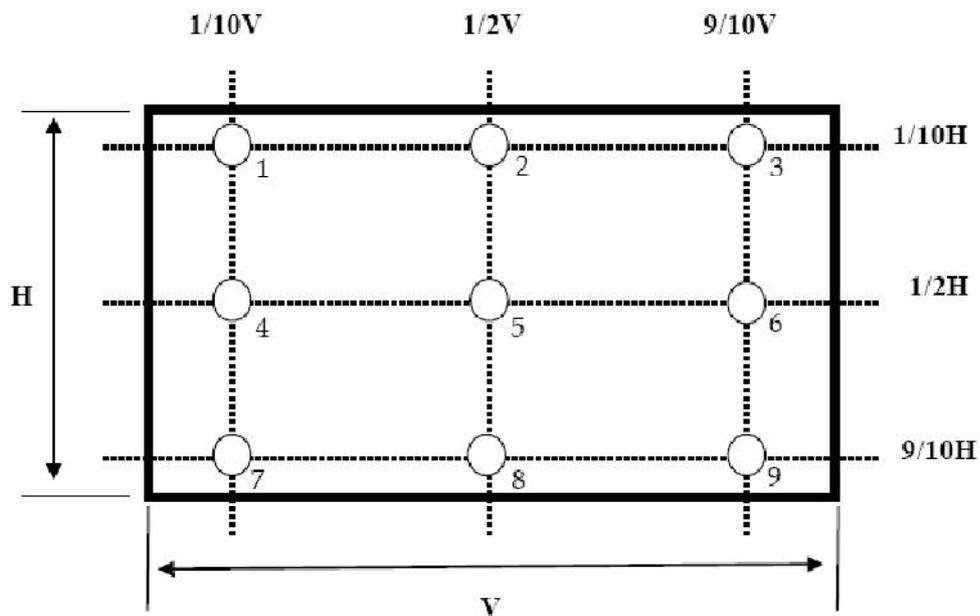
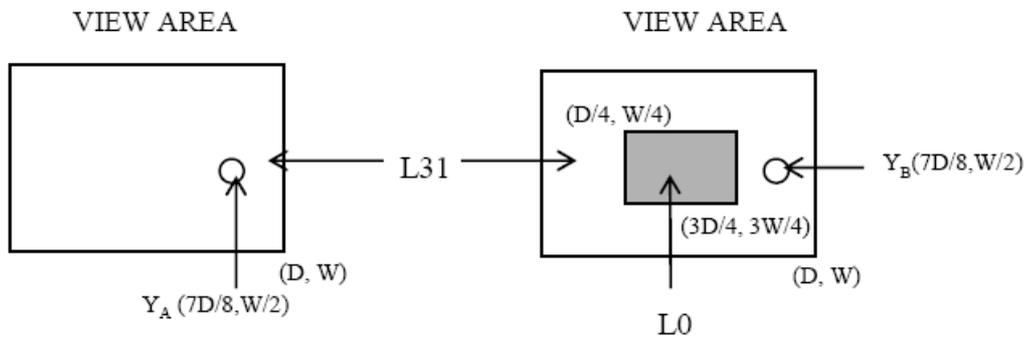


Figure 3. Response Time Testing



Figure 4. Cross Modulation Test Description



$$\text{Cross-Talk (\%)} = \left| \frac{Y_B - Y_A}{Y_A} \right| \times 100$$

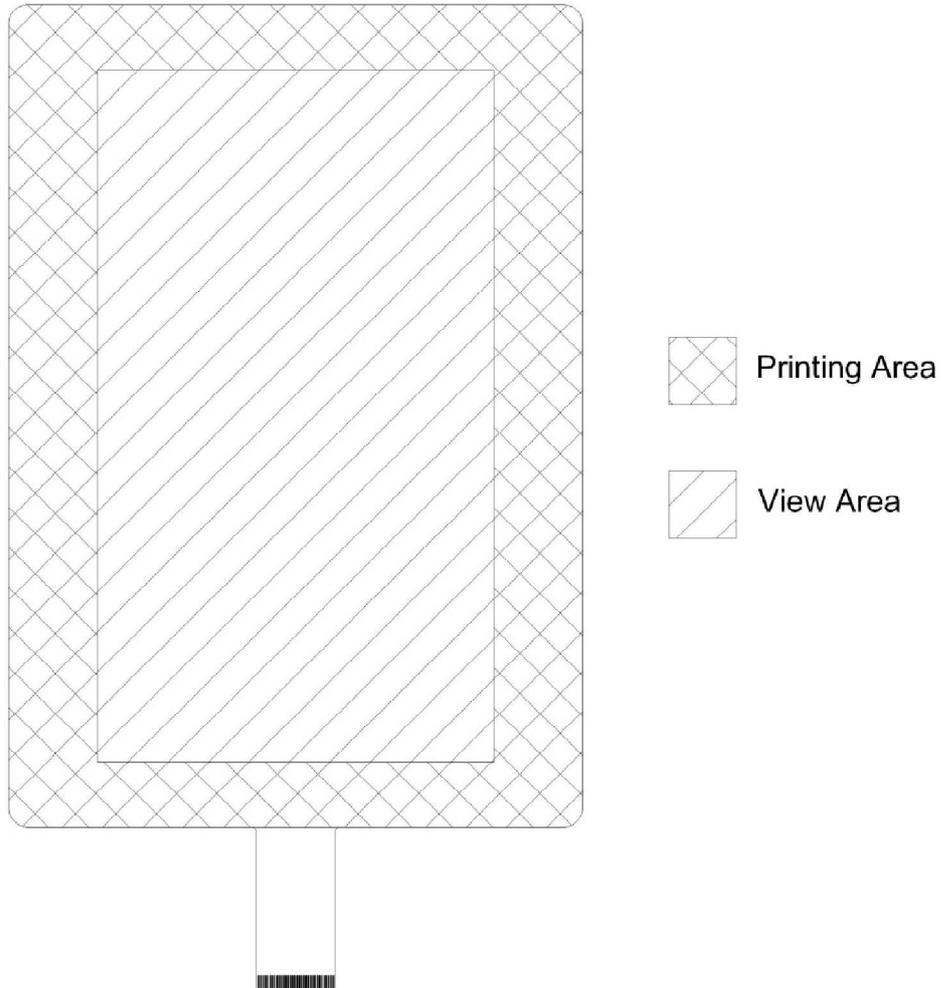
Where: YA = Initial luminance of measured area (cd/m²)

YB = Subsequent luminance of measured area (cd/m²)

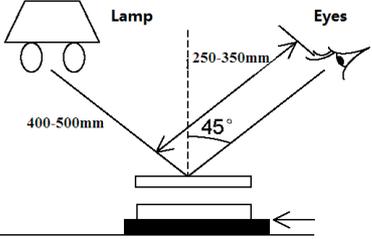
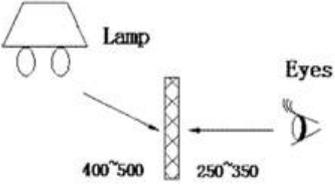
The location measured will be exactly the same in both patterns.

4.2 Appearance Specifications

4.2.1 Terms Definition



4.2.2 Inspection Conditions

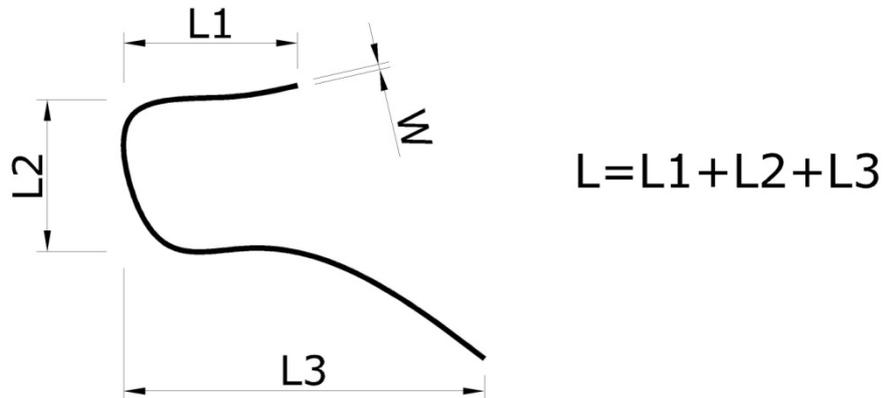
Items	Conditions	Remarks
Inspection Lamp	Florescent Cool White Lamp, 1000~1200Lux	
Inspection with Reflect Light (RL)	*Normal eyes level 1.0 (with Glasses accepted); *Distance between Lamp and product:40-50cm; *Distance between Eyes and Product:25-35cm; *Angle of view: 45°; *Black background; *Inspection 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>

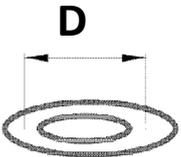
(D=Diameter)

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 PS, Not Allowed;

Mechanical damages on FPC(dent/kink), Not Allowed;

Glue residue, broken and oxidation on gold finger, Not Allowed.

4.2.5 Glass Breakage

Items	Criteria	Remarks
Corner/ Edge Breakage	<p>*$(X+Y)/2 < 0.3 \text{ mm}$, $Z < 1/3T \text{ mm}$; distance between 2 defects more than 5 mm; *Accept QTY: not more than 3.</p>	
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°C, 240 hrs
2	Low temperature storage test	Ta = -20°C, 240 hrs
3	High temperature & high humidity operation test	Ta = 50°C, 80%RH, 240hrs
4	High temperature operation test	Ta = 70°C, 240hrs
5	Low temperature operation test	Ta = 0°C, 240hrs
6	Thermal shock	Ta = -20°C ↔ 60°C (0.5hr), 100 cycle
7	Vibration test (non-operating)	Frequency 10 ~ 500 Hz, half sine Gravity / AMP 1.5 Grms Period X, Y, Z /Sweep rate:1hour
8	Shock test (non-operating)	Gravity 220G
		Pulse width Half sine wave 2m sec
		Direction ±X, ±Y, ±Z Once for each
9	Electro-static discharge test (non-operating)	Air: 150 pF, 330Ω, 15KV Contact: 150 pF, 330Ω, 8KV
10	Impact Resistance	Steel ball: 64 g Height: 30 cm

6. General Precaution

6.1 Mounting Method

- The panel of the LCD consists of two thin glasses with polarizer which easily get damaged. So extreme care should be taken when handling the LCD.
- Excessive stress or pressure on the glass of the LCD should be avoided. Care must be taken to insure that no torsional or compressive forces are applied to the LCD unit when it is mounted.
- If the customer's set presses the main parts of the LCD, the LCD may show the abnormal display. But this phenomenon does not mean the malfunction of the LCD and should be pressed by the way of mutual agreement.
- To determine the optimum mounting angle, refer to the viewing angle range in the specification for each model.
- Mount a LCD module with the specified mounting parts.

6.2 Caution of LCD Handling and Cleaning

- Since the LCD is made of glass, do not apply strong mechanical impact or static load onto it. Handling with care since shock, vibration, and careless handling may seriously affect the product. If it falls from a high place or receives a strong shock, the glass may be broken.
- The polarizer on the surface of panel are made from organic substances. Be very careful for chemicals not to touch the polarizer or it leads the polarizer to be deteriorated.
- If the use of a chemical is unavoidable, use soft cloth with solvent(recommended below) to clean the LCD's surface with wipe lightly.
-IPA(Isopropyl Alcohol), Ethyl Alcohol, Trichlorotrifluoroethane.
- Do not wipe the LCD's surface with dry or hard materials that will damage the polarizer and others. Do not use the following solvent.
-Water, Ketone, Aromatics.
- It is recommended that the LCD be handled with soft gloves during assembly, etc. The polarizer on the LCD's surface are vulnerable to scratch and thus to be damaged by sharp particles.
- Do not drop water or any chemicals onto the LCD's surface.
- A protective film is supplied on the LCD and should be left in place until the LCD is required for operation.
- The ITO pad area needs special careful caution because it could be easily corroded. Do not contact the ITO pad area with HCFC, Soldering flux, Chlorine, Sulfur, saliva or fingerprint. To prevent the ITO corrosion, customers are recommended that the ITO area would be covered by UV or silicon.

6.3 Caution Against Static Charge

- The LCD modules use C-MOS drivers, so customers are recommended that any unused input terminal would be connected to Vdd or Vss, do not input any signals before power is turn on, and ground you body, work/assembly area, assembly equipments to protect against static electricity.
- Remove the protective film slowly, keeping the removing direction approximate 30-degree not vertical from panel surface, If possible, under ESD control device like ion blower, and the humidity of working room should be kept over 50%RH to reduce the risk of static charge.
- Avoid the use work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
- In handling the LCD, wear non-charged material gloves. And the conducting wrist to the earth and the conducting shoes to the earth are necessary.

6.4 Caution For Operation

- It is indispensable to drive the LCD within the specified voltage limit since the higher Voltage than the limit causes the shorter LCD's life. An electro-chemical reaction due to DC causes undesirable deterioration of the LCD so that the use of DC drive should avoid.
- Do not connect or disconnect the LCD to or from the system when power is on.
- Never use the LCD under abnormal conditions of high temperature and high humidity.
- When expose to drastic fluctuation of temperature (hot to cold or cold to hot) ,the LCD may be affected; Specifically, drastic temperature fluctuation from cold to hot ,produces dew on the LCD's surface which may affect the operation of the polarizer and the LCD.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD may turn black at temperature above its operational range. However those phenomena do not mean malfunction or out of order with the LCD. The LCD will revert to normal operation once the temperature returns to the recommended temperature range for normal operation.
- Do not display the fixed pattern for a long time because it may develop image sticking due to the LCD structure. If the screen is displayed with fixed pattern, use a screen saver.

6.5 Packaging

- Modules use LCD element, and must be treated as such.
 - Avoid intense shock and falls from a height.
 - To prevent modules from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity for long periods.

6.6 Storage

- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Relative humidity of the environment should therefore be kept below 60%RH.
- Original protective film should be used on LCD's surface (polarizer). Adhesive type protective film should be avoided, because it may change color and/or properties of the polarizer.
- Do not store the LCD near organic solvents or corrosive gasses.
- Keep the LCD safe from vibration, shock and pressure.
- Black or white air-bubbles may be produced if the LCD is stored for long time in the lower temperature or mechanical shocks are applied onto the LCD.
- In the case of storing for a long period of time for the purpose or replacement use, the following ways are recommended.
 - Store in a polyethylene bag with sealed so as not to enter fresh air outside in it.
 - Store in a dark place where neither exposure to direct sunlight nor light is.
 - Keep temperature in the specified storage temperature range.
 - Store with no touch on polarizer surface by the anything else. If possible, store the LCD in the packaging situation LCD when it was delivered.

6.7 Safety

- For the crash damaged or unnecessary LCD, it is recommended to wash off liquid crystal by either of solvents such as acetone and ethanol and should be burned up later.
- In the case the LCD is broken, watch out whether liquid crystal leaks out or not. If your hands touch the liquid crystal, wash your hands cleanly with water and soap as soon as possible.
- If you should swallow the liquid crystal, first, wash your mouth thoroughly with water, then drink a lot of water and induce vomiting, and then, consult a physician.
- If the liquid crystal should get in your eyes, flush your eyes with running water for at least fifteen minutes.
- If the liquid crystal touches your skin or clothes, remove it and wash the affected part of your skin or clothes with soap and running water.

7. Packing

TBD

