Chunghwa Picture Tubes, Ltd.
Technical Specification

To ：

Date ：2012/03

CPT TFT-LCD

CLAA101FP01

ACCEPTED BY：

APPROVED BY	CHECKED BY	PREPARED BY
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Modification Record List

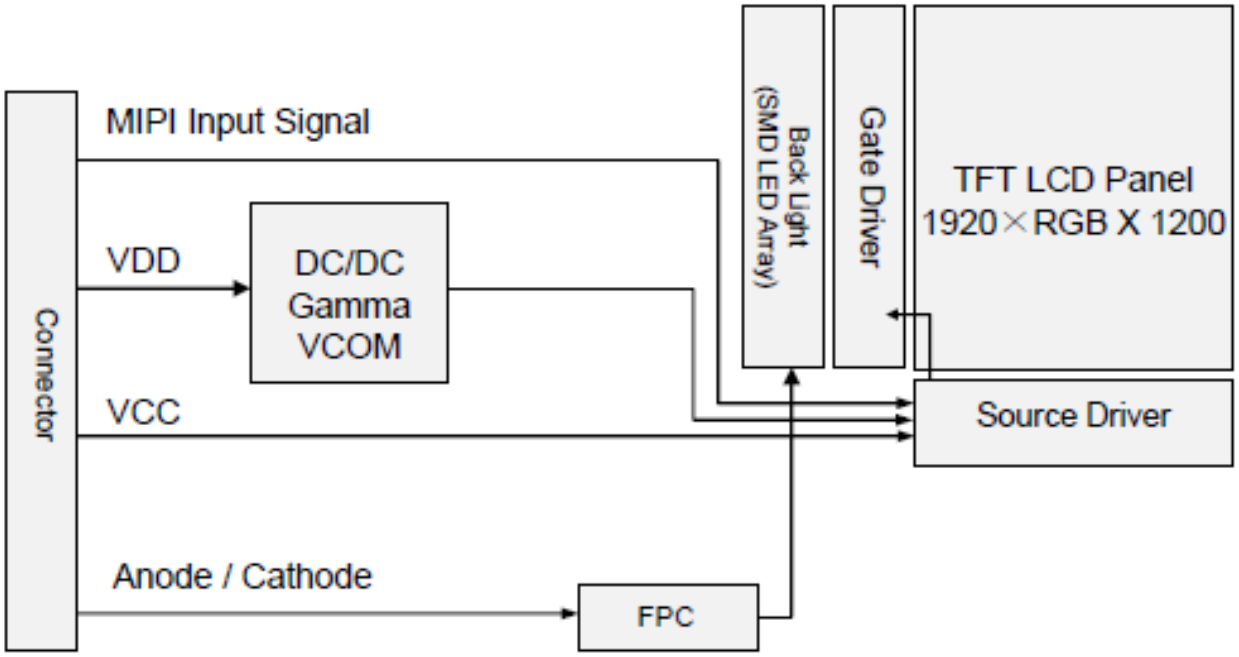
Vision Notice	Description	Rev. Date
1.0	First revision	2012/03/06

Contents

1.0 GENERAL DESCRIPTION

1.1 Introduction

CLAA101NP01 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 10.1 inch diagonally measured active area with WSVGA resolutions (1920 horizontal by 1200 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. The TFT-LCD panel used for this module is a low reflection and higher color type.



1.2 Features

_ Thin and Light Weight
_ 3.3 V Logic Power & 16 V Back-light power Supply
_ 1 Channel LVDS Interface
_ SMD LED (20EA) Array (Bottom Side/Horizontal Direction)
_ 16.7M Colors (6bits & HFRC)
_ Green Product (RoHS) & Halogen free

1.3 Application

_ E-book, etc

1.4 General Specifications

< Table 1. General Specifications >

Parameter	Specification	Unit	Remark
Active area	216.576(H) × 135.36(V)	mm	
Number of pixels	1920(H) × RGB X 1200(V)	pixels	
Pixel pitch	0.1128 × 0.1128	mm	
Pixel arrangement	RGB Vertical Stripe		
Display colors	16.7M (6bit + HFRC)	colors	
Display mode	Normally Black		
Outline dimension	229.±0.3(H)×153±0.3(V)×2.5±0.2(D)	mm	
Weight	150 (Typ.)	g	
Back-light	Top & Bottom alignment, 84-LEDs type		

2.0 ABSOLUTE MAXIMUM RATINGS

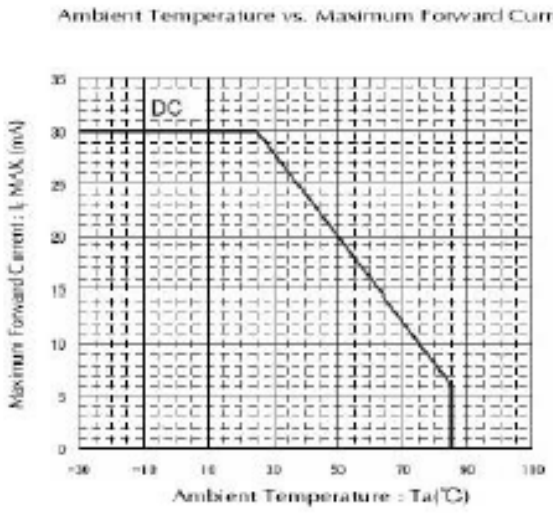
The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit.

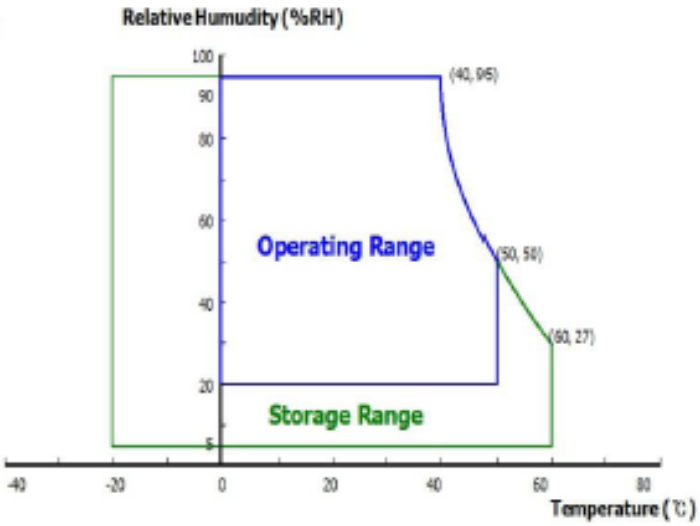
< Table 2. Absolute Maximum Ratings > Ta=25+/-2°C

Parameter	Symbol	Min.	Max.	Unit	Remarks
Logic Power Supply Voltage	V_{DD}	-0.3	4.0	V	
Logic Power Supply Voltage	V_{CC}	-0.3	2.0	V	
Back-light Power Supply Voltage	HV_{DD}	-0.3	40	V	
Back-light LED Current	I_{LED}	-	30	mA	Note 1
Back-light LED Reverse Voltage	V_R	-	5	V	
Operating Temperature	T_{OP}	-0	+50	℃	Note 1, Note 2
Storage Temperature	T_{SP}	-20	+60	℃	

Note 1. Ambient temperature vs allowable forward current are shown in the figure below.

Note 2. Temperature and relative humidity range are shown in the figure below.
90% RH Max. (40℃ ≥ Ta)
Maximum wet - bulb temperature at 39℃ or less. (> 40℃) No condensation.





3.0 ELECTRICAL SPECIFICATIONS

3.1 Electrical Specifications

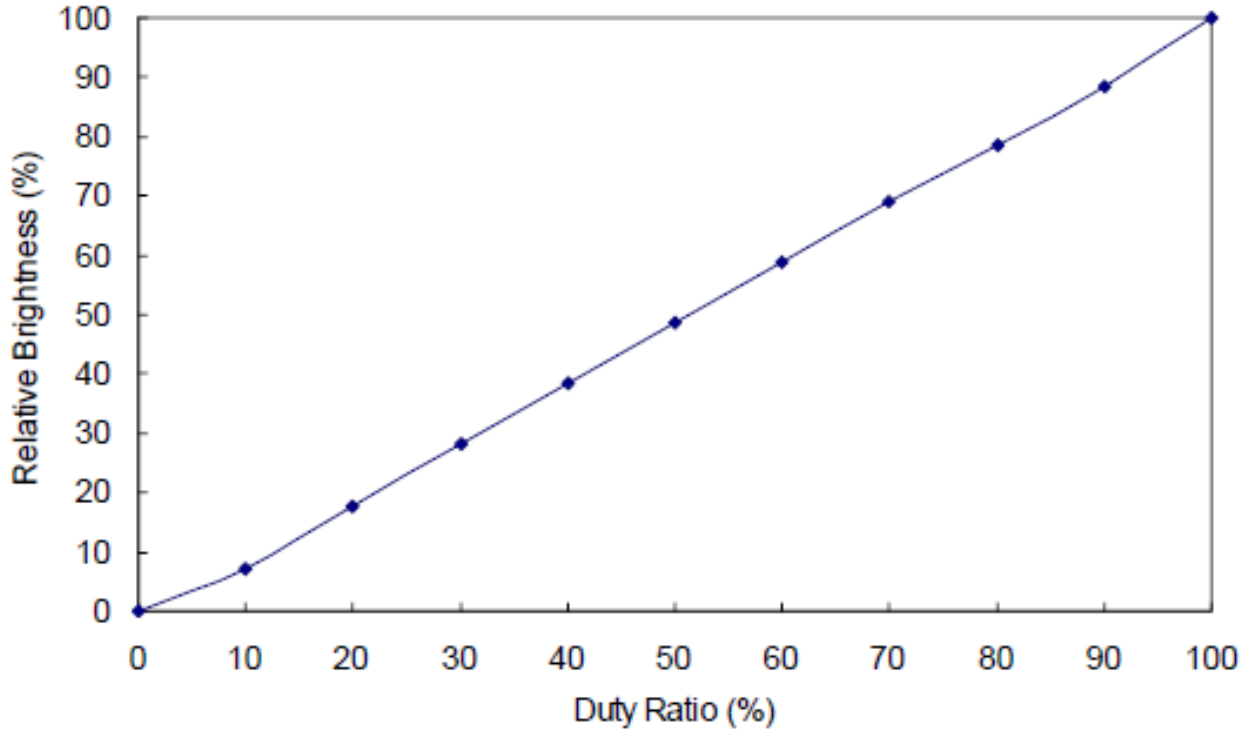
< Table 3. Electrical Specifications >

Parameter		Min.	Typ.	Max.	Unit	Remarks
Logic Power Supply Voltage	V_{DD}	-	3.3	-	V	
Logic Power Supply Current	I_{DD}	-	TBD	-	mA	Vdd=3.3V, 25℃ Note 1
Back-light LED Voltage / Back-light LED Total Voltage	V_{LED} /V_{BL}	-	3.0/42	-	V	Note 2
Back-light LED Current / Back-light LED Total Current	I_{LED} /I_{BL}	-	20/240	-	mA	Note 2
Power Consumption	P_{DD}	-	TBD	-	W	Vdd=3.3V, 25℃ Vcc=1.8V , 25℃ Note 1
	Pcc	-	TBD	-	W	
	P_{BL}	-	-	5.2	W	
	Ptotal	-	TBD	-	W	

Notes : 1. The supply voltage is measured and specified at the interface connector of LCM. (Max Pattern : White)

2. Calculated value for reference (VLED × ILED × # of LEDs (84EA)).

3.2 PWM Duty Ratio vs Brightness



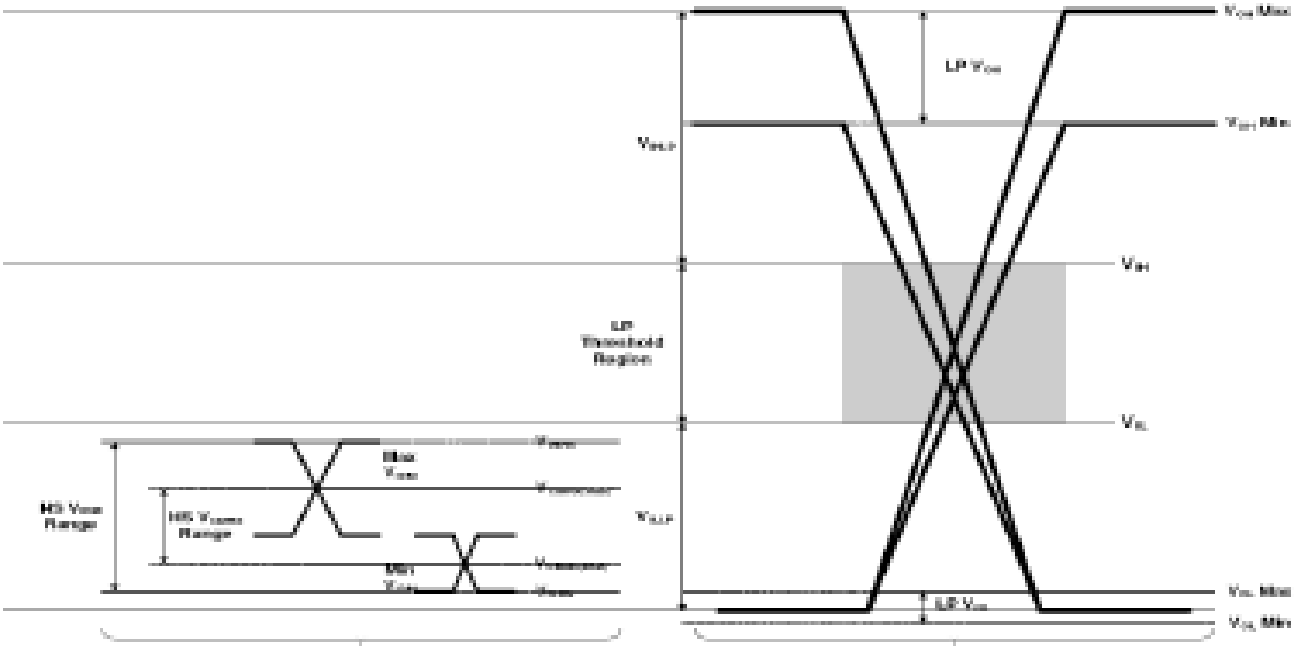
Notes :

In case of duty ratio 0%, LED can't illuminate itself so this state is LED off.
In case of duty ratio 100%, the brightness of LED is maximum and the state is LED on.

3.3MIPI Interface DC Characteristic:

< Table 4. MIPI Interface DC Characteristic >

Parameter			Min.	Typ.	Max.	Unit	Remarks
Input data bit rate		BR_{MIPI}	200	-	1000	Mbps	
Differential Input Impedance		Z_{ID}	80	100	125	Ω	
High speed Rx	Common-mode voltage	V_{CMRX}	70	-	330	mV	
	Differential input high threshold	V_{IDTH}	-	-	70	mV	
	Differential input low threshold	V_{IDTL}	-70	-	-	mV	
	Differential input voltage range	$\|V_{ID}\|$	70	-	500	mV	
	Single-end input high voltage	V_{SHS}	-	-	460	mV	
	Single-end input low voltage	V_{LHS}	-40	-	-	mV	
Low Power Rx	Logic 1 input voltage	V_{ILP}	880	-	-	mV	
	Logic 0 input voltage	V_{ILLP}	-	-	550	mV	
Low power Tx	Output high level	V_{OH}	1.08	1.2	1.32	V	
	Output low level	V_{OL}	-50	-	50	mV	



High Speed Differential Signal

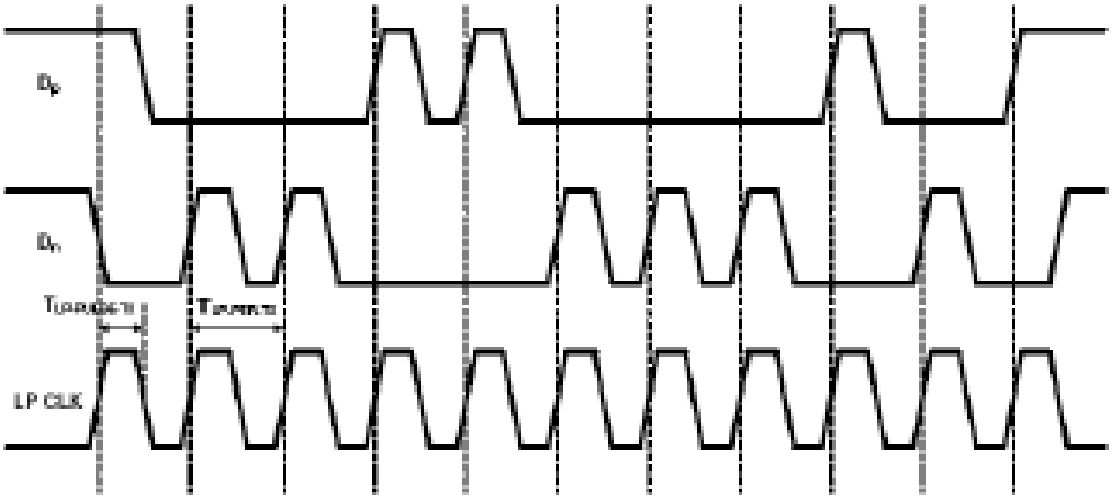
Low Power Single Ended Signal

3.4 MIPI Interface AC Characteristic:

< Table 5. LP Transmitter AC Specifications>

Parameter		Min.	Typ.	Max.	Unit	Remarks
Minimum pulse width response (LP Rx mode)	T_{MIN-RX}	50	-	-	ns	
Pulse width of the LP exclusive-OR clock	$T_{LP-PULSE-TX}$	50	55	58	ns	Note 1
15%~85% rise time and fall time (LP Tx mode)	T_{RLP} / T_{FLP}	-	-	25	ns	
30%~85% rise time and fall time of EOT (LP Tx mode)	T_{REOT}	-	-	35	ns	
Period of the LP exclusive-OR clock	$T_{LP-PER-TX}$	90	-	-	ns	
Data to clock setup time	T_{SETUP}	0.15	-	-	UI	
Data to clock setup time	T_{HOLD}	0.15	-	-	UI	

Note 1 : 1st clock pulse after STOP state or last clock pulse before STOP state/all other pulse



4.0 OPTICAL SPECIFICATIONS

4.1 Overview

The test of optical specifications shall be measured in a dark room (ambient luminance ≤ 1 lux and temperature = 25±2℃) with the equipment of Luminance meter system (Goniometer system and TOPCON BM-5A) 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 $\theta_{\Phi=0}$ (=θ3) as the 3 o'clock direction (the "right"), $\theta_{\Phi=90}$ (= θ12) as the 12 o'clock direction ("upward"), $\theta_{\Phi=180}$ (= θ9) as the 9 o'clock direction ("left") and $\theta_{\Phi=270}$(= θ6) as the 6 o'clock direction ("bottom"). While scanning θ and/or Ø, the center of the measuring spot on the Display surface shall stay fixed. The backlight should be operating for 30 minutes prior to measurement. V_{DD} shall be 3.3+/- 0.3V at 25°C.

4.2 Optical Specifications

<Table 6. Optical Specifications>

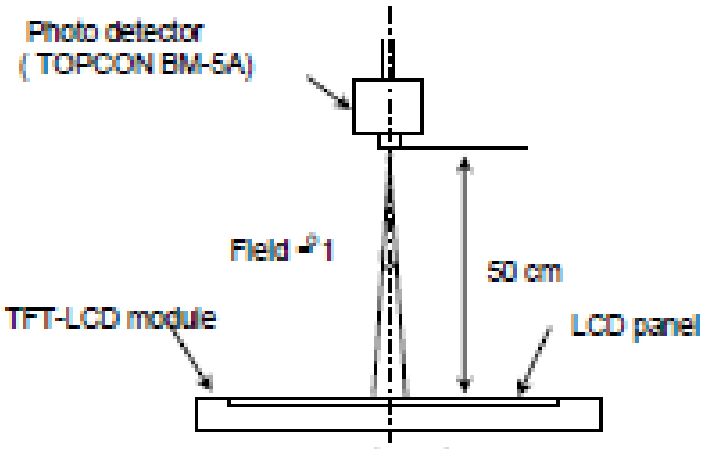
Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Viewing Angle range	Horizontal	Θ_3	CR > 10	80	89	-	Deg.	Note 1
		Θ_9		80	89	-	Deg.	
	Vertical	Θ_{12}		80	89	-	Deg.	
		Θ_6		80	89	-	Deg.	
Luminance Contrast ratio		CR	Θ = 0°	600	800	-		Note 2
Luminance of White	1 Points	Y_w	Θ = 0°	650	700	-	cd/m²	Note 4 Note 5
White Luminance uniformity	9 Points	ΔY9		75	-	-	%	
White Chromaticity		W_x	Θ = 0°	0.283	0.313	0.343	-	Note 3
		W_y		0.299	0.329	0.359	-	
Reproduction of color	Red	R_x	Θ = 0°	-	0.570	-	-	
		R_y		-	0.324	-	-	
	Green	G_x		-	0.331	-	-	
		G_y		-	0.578	-	-	
	Blue	B_x		-	0.159	-	-	
		B_y		-	0.105	-	-	
Response Time		Total ($T_r + T_d$)	Ta= 25° C Θ = 0°	-	30	40	ms	Note 6
Cross Talk		CT	Θ = 0°	-	-	2.0	%	Note 7

Notes :

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles 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 (see Figure1).
2. Contrast measurements shall be made at viewing angle of Θ= 0 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 Figure1). Luminance Contrast Ratio (CR) is defined mathematically as CR = Luminance when displaying a white raster / Luminance when displaying a black raster.
3. Reference only / Standard Front Surface Treatment Measured with green cover glass. The color chromaticity coordinates specified in Table 4 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.

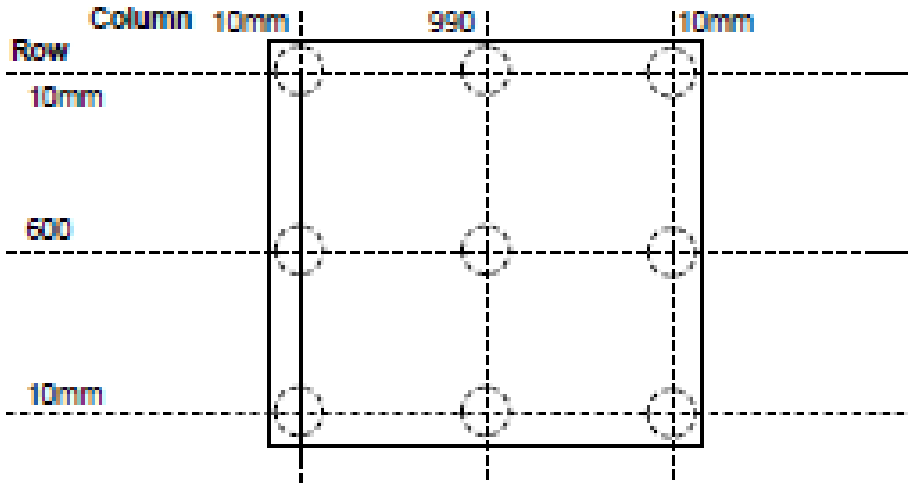
4.3 Optical Measurements

Figure 1. Measurement Set Up



Optical characteristics measurement setup

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



Note 4.

The White luminance uniformity on LCD surface is then expressed as :

ΔY = (Minimum Luminance of 9 points / Maximum Luminance of 9 points) * 100

Refer Figure 2 about measurement points

* LED Condition = (Duty Ratio 100%, LED current 20mA)

Figure 3. Response Time Testing

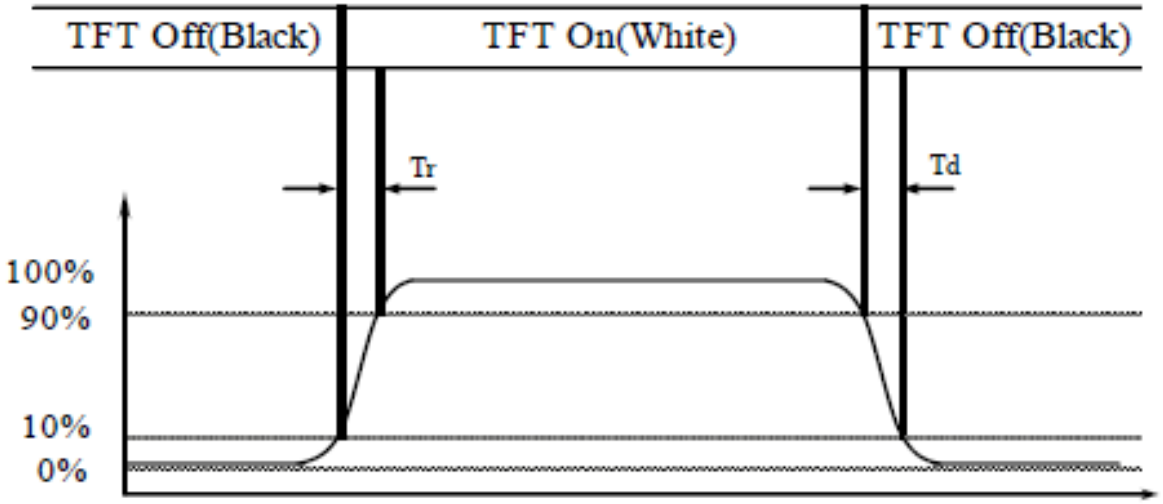
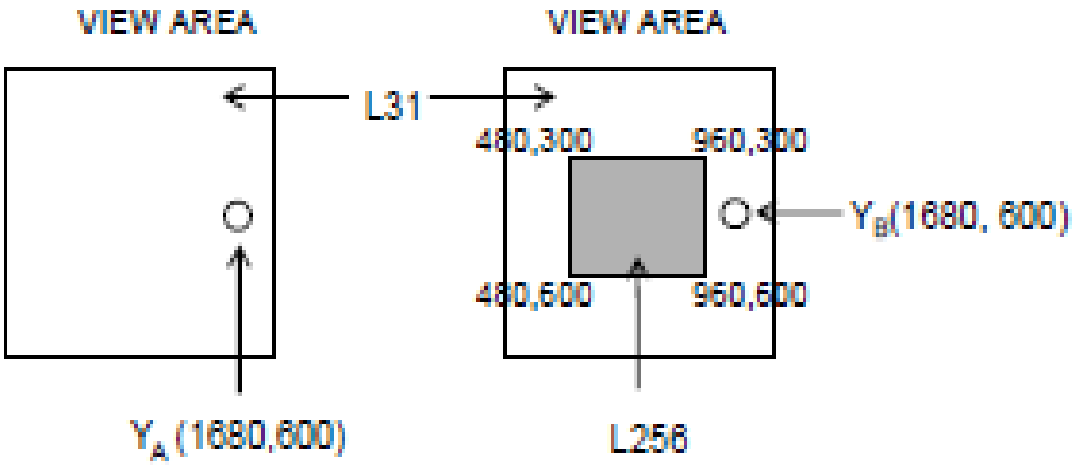


Figure 4. Cross Modulation Test Description



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

Where:

Y_A = Initial luminance of measured area (cd/m^2)

Y_B = Subsequent luminance of measured area (cd/m^2)

The location measured will be exactly the same in both patterns

Note 6.

The electro-optical response time measurements shall be made as Figure 4 by switching the "data" input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is Tr, and 90% to 10% is Td.

Note 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 (Refer to Figure 4).

5.0 INTERFACE CONNECTIONS

5.1 Electrical Interface Connection

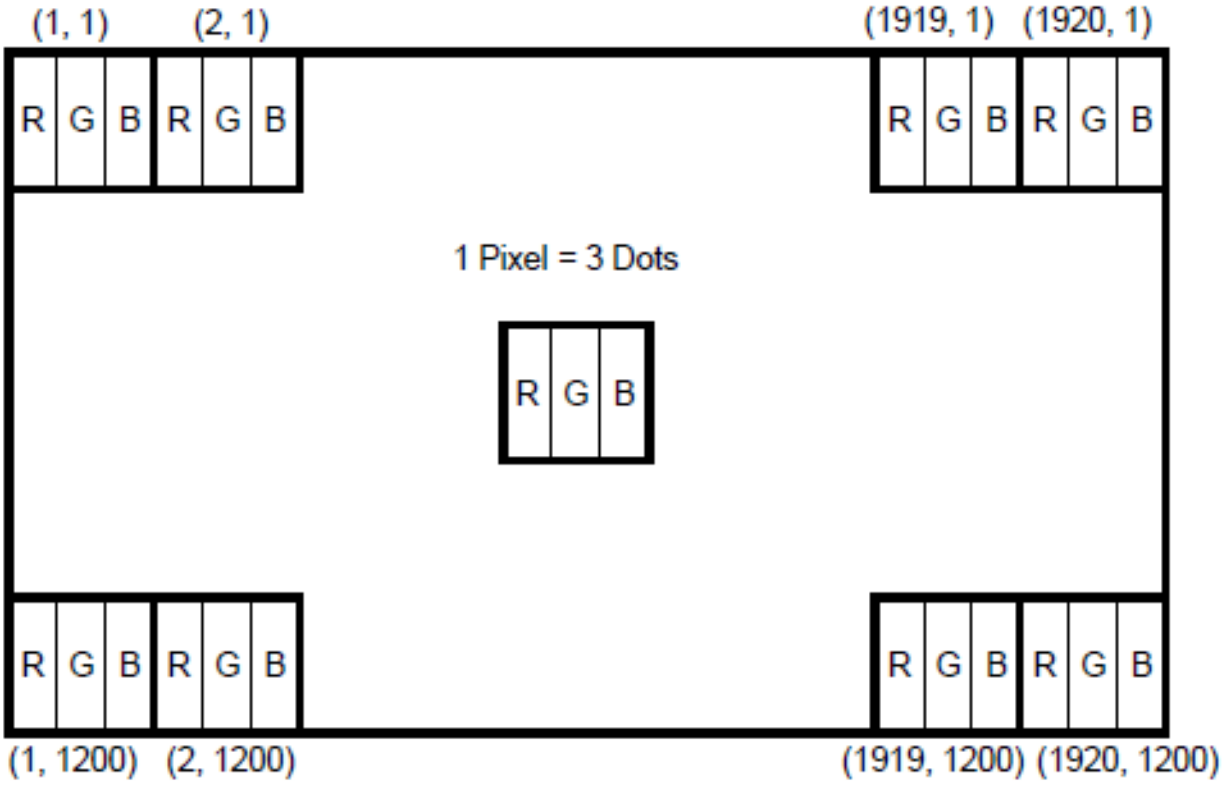
CN1 Interface Connector (AYF334535, Manufactured by JAE)

< Table 7, Electrical Interface Connection >

Pin No.	SYMBOL	FUNCTION
1	VDD	Power Supply, 3.3V(Typical)
2	VDD	Power Supply, 3.3V(Typical)
3	VDD	Power Supply, 3.3V(Typical)
4	VDD	Power Supply, 3.3V(Typical)
5	NC(BIST)	BIST testing (Only for Hydis)
6	NC/ALV_3P	NC/LVDS Input Data Pair
7	GND	Ground
8	NC/ALV_3N	NC/LVDS Input Data Pair
9	GND	Ground
10	GND	Ground
11	MIPI_D3N/BLV_3P	MIPI Input Data Pair /LVDS Input Data Pair
12	NC/ALV_CLKP	NC/LVDS Input Data Pair
13	MIPI_D3P/BLV_3N	MIPI Input Data Pair /LVDS Input Data Pair
14	NC/ALV_CLKN	NC/LVDS Input Data Pair
15	GND	Ground
16	GND	Ground
17	MIPI_D0N/BLV_CLKP	MIPI Input Data Pair /LVDS Input Data Pair
18	NC/ALV_2P	NC/LVDS Input Data Pair
19	MIPI_D0P/BLV_CLKN	MIPI Input Data Pair /LVDS Input Data Pair
20	NC/ALV_2N	NC/LVDS Input Data Pair
21	GND	Ground
22	GND	Ground
23	MIPI_CKN/BLV_2P	MIPI Input Data Pair /LVDS Input Data Pair
24	NC/ALV_1P	NC/LVDS Input Data Pair

Pin No.	SYMBOL	FUNCTION
25	MIPI_CKP/BLV_2N	MIPI Input Data Pair /LVDS Input Data Pair
26	NC/ALV_1N	NC/LVDS Input Data Pair
27	GND	Ground
28	GND	Ground
29	MIPI_D1N/BLV_1P	MIPI Input Data Pair /LVDS Input Data Pair
30	NC/ALV_0P	NC/LVDS Input Data Pair
31	MIPI_D1P/BLV_1N	MIPI Input Data Pair /LVDS Input Data Pair
32	NC/ALV_0N	NC/LVDS Input Data Pair
33	GND	Ground
34	GND	Ground
35	MIPI_D2N/BLV_0P	MIPI Input Data Pair /LVDS Input Data Pair
36	NC	NC
37	MIPI_D2P/BLV_0N	MIPI Input Data Pair /LVDS Input Data Pair
38	LED_EN	LED Enable Pin
39	NC	NC
40	CABC_EN	CABC Function Enable Pin
41	LED_PWM	PWM Signal for LED Dimming Control
42	VLED	LED Power Supply
43	VLED	LED Power Supply
44	VLED	LED Power Supply
45	VLED	LED Power Supply

5.2 Data Input Format



6.0. SIGNAL TIMING SPECIFICATIONS

6.1 The LCM is operated by the only DE (Data enable) mode

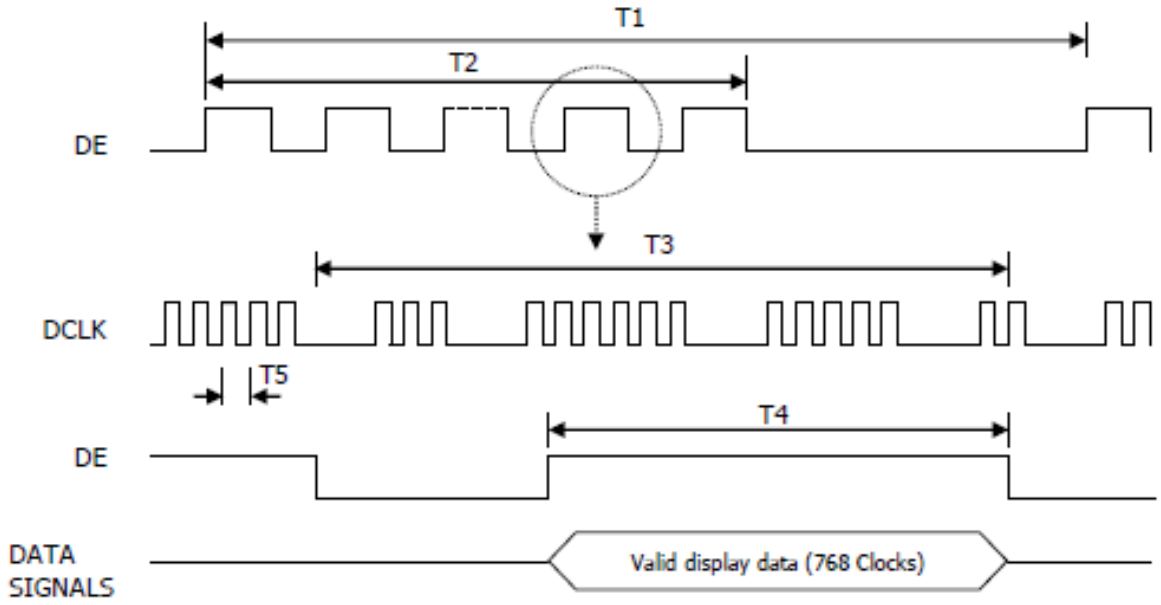
< Table 8, Signal Timing >

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Frame Period	T1		T.B.D		Lines	
Vertical Display Period	T2	-	1920	-	Lines	
One line Scanning Period	T3		T.B.D		Clocks	
Horizontal Display Period	T4	-	1200	-	Clocks	
Clock Frequency	1/T5		T.B.D		MHz	Note 1

Note 1. This value only guarantee for the circuit-operation

7.0 SIGNAL TIMING WAVEFORMS

7.1 Timing Waveforms of Interface Signal



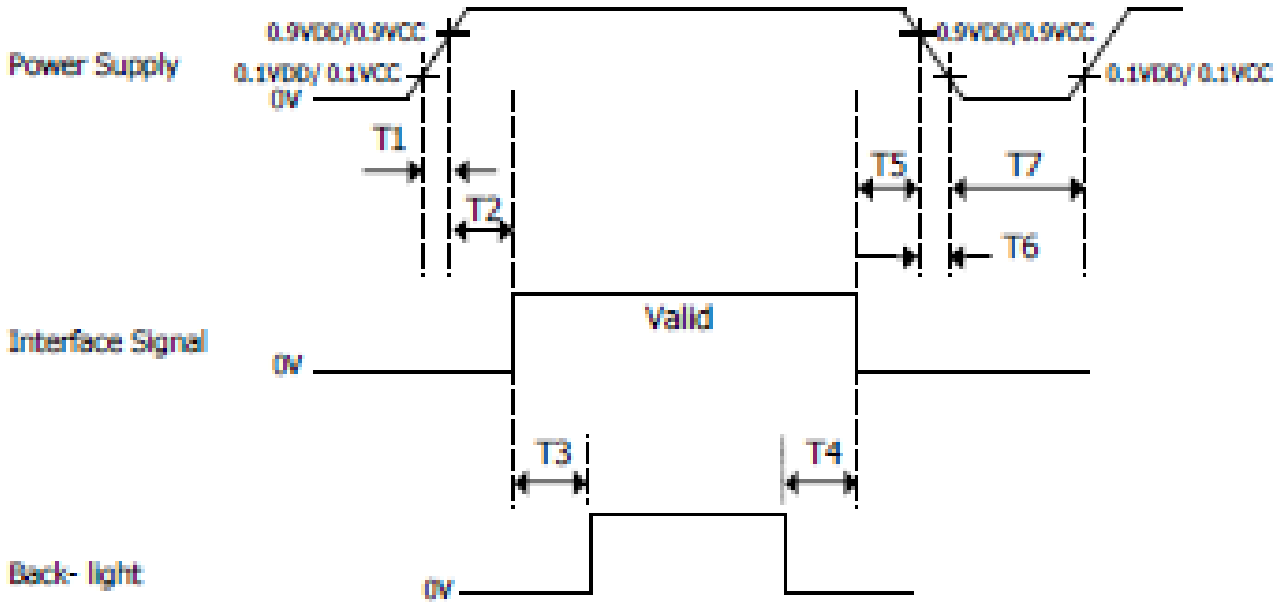
8.0 INPUT SIGNALS, BASIC DISPLAY COLORS & GRAY SCALE OF COLORS

A total of 16.7M colors are displayed with dither & HFRC using 64 gray from 8bit input.

Colors & Gray Scale		Red data								Green data								Blue data							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	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	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale Of Red	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	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▽	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Green	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	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	▽	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale Of Blue	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	▽	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Gray Scale Of White & Black	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	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1
	▽	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

9.0 POWER SEQUENCE

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence shall be as shown in below



- T1 ≤ 50 ms
- 100 ≤ T2 ≤ 150 ms
- 200 ms ≤ T3
- 200 ms ≤ T4
- 0 ≤ T5 ≤ 50 ms
- 0 ≤ T6 ≤ 10ms
- 150ms ≤ T7

Notes : 1. When the power supply VDD/ VCC is 0V, Keep the level of input signals on the low or keep high impedance.
2. Do not keep the interface signal high impedance when power is on.
3. Back Light must be turn on after power for logic and interface signal are valid.

10.0 MECHANICAL CHARACTERISTICS

10.1 Dimensional Requirements

Figure 5 & 6 shows mechanical outlines for the model

< Table 9, Mechanical Characters >

Parameter	Specification	Unit
Active Area	216.576(H) × 135.35(V)	mm
Number of pixels	1920(H) X 1200(V) (1 pixel = R + G + B dots)	
Pixel pitch	0.1128(H) X 0.1128(V)	mm
Pixel arrangement	RGB Vertical stripe	
Display colors	16.7M (6bit + HFRC)	
Display mode	Normally Black	
Outline dimension	229(H)×153(V)×2.5(D) (Typ.)	mm
Weight	150(Typ.)	g
Back-light	Top & Bottom alignment 84-LEDs type (2 X 42 Array)	

10.2 Polarizer Hardness.

The surface of the LCD has a low reflection coating and a coating to reduce scratching.

10.3 Light Leakage

There shall not be visible light from the back-lighting system around the edges of the screen as seen from a distance 50cm from the screen with an overhead light level of 150lux. The manufacture shall furnish limit samples of the panel showing the light leakage acceptable.

11.0 MECHANICAL DRAWING

Figure 5. TFT-LCD Module Outline Dimension (Front View)

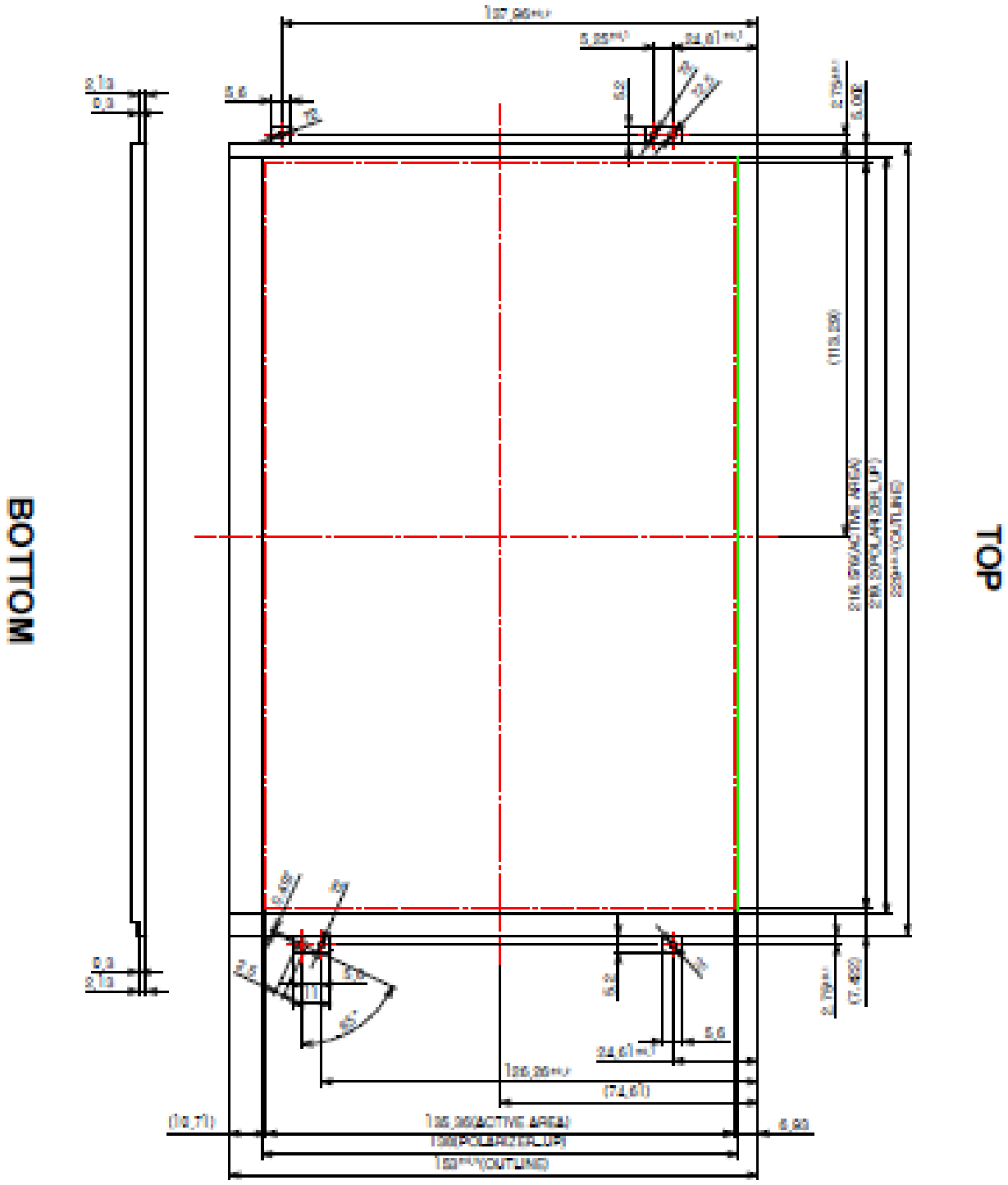
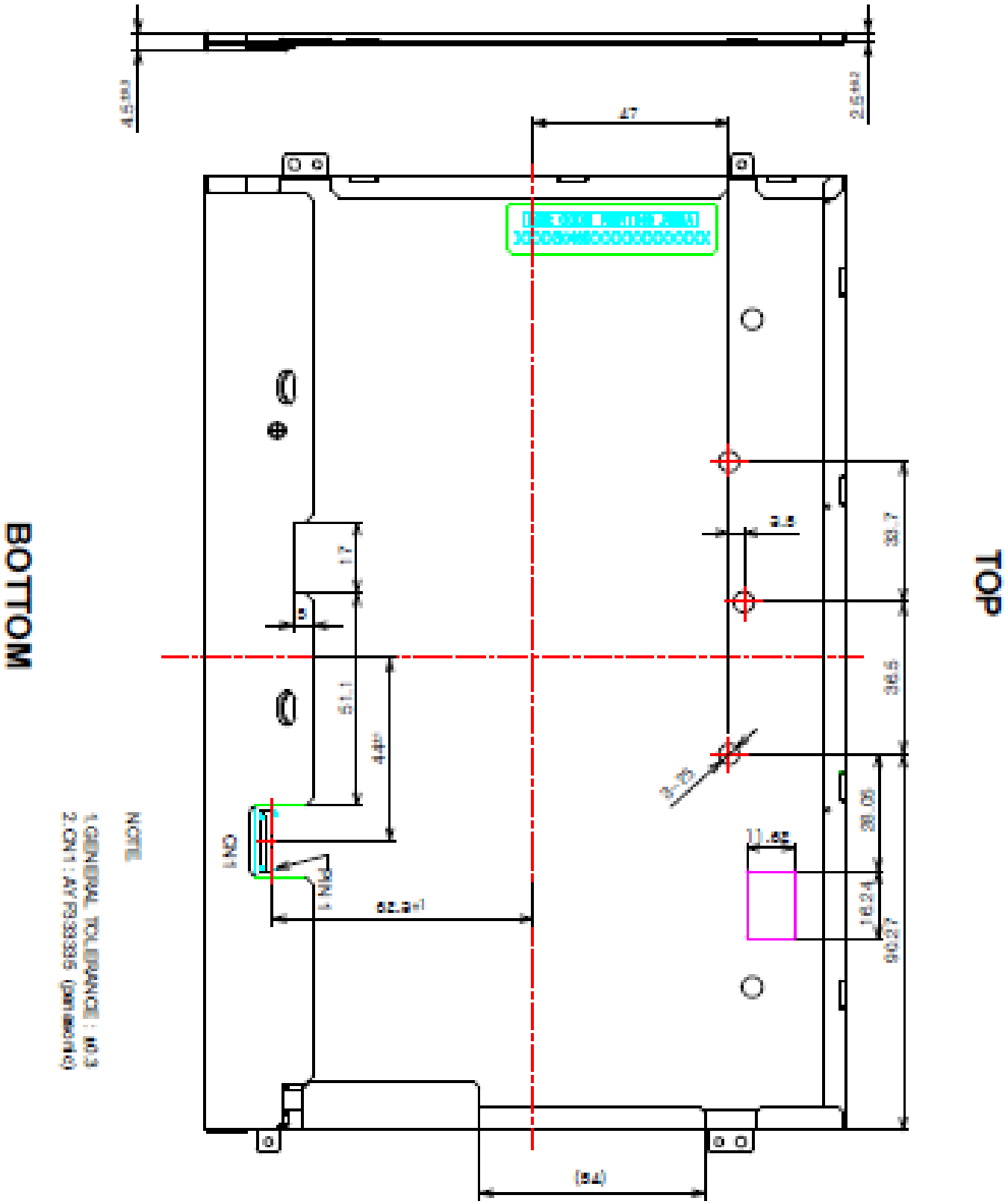


Figure 6. TFT-LCD Module Outline Dimensions (Rear view)



12.0 RELIABLITY TEST

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

< Table10, Reliability Test >

No	Test Item	Conditions
1	High temperature storage	80C/240h
2	Low temperature storage	-30C/240h
3	High temperature /High humidity Storage	60C/90%RH/240h
4	High temperature operating	60C/240H
5	Low temperature operating	-20C/240h
6	High temperature /High humidity operating	40C/90%RH/240h
7	Thermal Shock Storage	-30℃ (30 min)~ +80 ℃(30 min) ,27 cycles
8	Shock test	980m/s2,Action time: 6ms, Time: 3 times for each direction, Direction:+/-X, +/-Y, +/-Z
9	Package Vibration test	Frequency range: 10-55Hz, stroke:1.5mm, sweep time: 1 minute, test period: 2 hours for each direction of X, Y, Z
10	Package Drop test	Height: 60cm, 1 corner, 3 edges, 6 surfaces : 1 time for each direction
11	FPC Bending test	Bending degree is 180, bending 30 times and the bending radius is 1.0mm
12	FPC Insert/Remove test	30 time FPC insert/remove
13	Low Air Pressure Test	533mbar(100mbar/min ramp), "-40C~55C"(1C/min ramp) and 2hrs per each temperature
14	ESD test	Air +/-15KV ,contact +/-8KV , no damage

13.0 HANDLING & CAUTIONS

13.1 Cautions when taking out the module

- Pick the pouch only, when taking out module from a shipping package.

13.2 Cautions for handling the module

- As the electrostatic discharges may break the LCD module, handle the LCD module with care. Peel a protection sheet off from the LCD panel surface as slowly as possible.
- As the LCD panel and back - light element are made from fragile glass (epoxy) material, impulse and pressure to the LCD module should be avoided.
- As the surface of the polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.
- Do not pull the interface connector in or out while the LCD module is operating.
- Put the module display side down on a flat horizontal plane.
- Handle connectors and cables with care.

13.3 Cautions for the operation

- When the module is operating, do not lose MCLK, DE signals. If any one of these signals were lost, the LCD panel would be damaged.
- Obey the supply voltage sequence. If wrong sequence is applied, the module would be damaged.

13.4 Cautions for the atmosphere

- Dew drop atmosphere should be avoided.
- Do not store and/or operate the LCD module in a high temperature and/or humidity atmosphere. Storage in an electro-conductive polymer packing pouch and under relatively low temperature atmosphere is recommended.

13.5 Cautions for the module characteristics

- Do not apply fixed pattern data signal to the LCD module at product aging.
- Applying fixed pattern for a long time may cause image sticking.

13.6 Cautions for the digitizer assembly

- When assembling FPC connector, do not flip connector past 90° due to possible damage to connector.
- When positioning digitizer underneath driver IC, do not lift driver IC past 90° due to possible damage to drive IC pattern.
- Please be warned that during assembly of digitizer, the opening or closing of FPC will result in possible electrostatic discharge damage to the LED

13.7 Other cautions

- Do not re-adjust variable resistor or switch etc.
- When returning the module for repair or etc., Please pack the module not to be broken. We recommend to use the original shipping packages.