TFT LCD Specification

Model No.: PQ101WX01

Customer: _____

Approved by: _____

Note:

REVISION HISTORY

Version	Date	Part Rev.	Page (New)	Section	Description
0.1	Mar 7, 2011		All	All	Initial release
0.2	Mar 8, 2011				
0.3	Mar 14, 2011				
0.4	Mar 31, 2011				
0.5	Oct 12, 2011				
1.0	Oct 29, 2012			All	Updated electrical, mechanical, document cleanup

TABLE OF CONTENTS

1 GENERAL DESCRIPTION

1.1 OVERVIEW

PQ101WX01 is a 10.1" TFT Liquid Crystal Display module with a LED backlight unit and a 40-pin LVDS interface. This module supports 1280 x 800 Wide-XGA (WXGA) resolution and can display 262,144 colors. This module also supports two low power modes: a transflective mode and a reflective mode with lower color. The LED converter for the backlight module is also built in.

1.2 FEATURES

- WXGA (1280 x 800 pixels) resolution
- 3.3V LVDS (Low Voltage Differential Signaling) interface with 1 pixel/clock
- Built in LED driver
- Color transmissive, transflective, and reflective display modes

1.3 APPLICATIONS

- Mobile notebook or netbook
- Multimedia tablet

1.4 GENERAL SPECIFICATI0NS

Item	Specification	Unit	Note
Panel Diagonal	10.1	inch	
Pixels per inch color	150	ppi	
Active Area	216.96 (H) x 135.60 (V), 10.1" diagonal	mm	
Bezel Opening Area	220.36 (H) x 139.00 (V)	mm	
Driver Element	a-Si TFT active matrix	-	-
Pixel Number	1280 x R.G.B. x 800	pixel	(1)
Pixel Pitch	0.1695 (H) x 0.1695 (V)	mm	-
Pixel Arrangement	RGB vertical stripe + 3 reflective subpixels	-	-
Display Colors	262,144	color	18 bit
Display Operating Modes	Transmissive, transflective, reflective. Normally black	-	-
Surface Treatment	Hard coating (3H), Anti-Glare	-	-

1.5 MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)		229.46		mm	(2)
	Vertical(V)		149.20		mm	
	Thickness(T)	-	3.15		mm	
Weight		-	190		g	

Note (1) Each pixel is composed of 3 transmissive subpixels (RGB) and 3 reflective subpixels (RGB).

Note (2) The thickness specification does not include PCB and components on the PCB.

2 ABSOLUTE MAXIMUM RATINGS

Permanent damage to the device may occur if maximum values are exceeded. Operation should be restricted to the conditions described under Normal Operating Conditions.

2.1 ABSOLUTE MAXIMUMS, ENVIRONMENTAL

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T_{ST}	-20	+60	ºC	
Operating Ambient Temperature	T_{OP}	-10	+50	ºC	

2.2 ABSOLUTE MAXIMUMS, ELECTRICAL

2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V_{CC}	-0.3	+4.0	V	
Logic Input Voltage	V_{IN}	-0.3	V_{DD}+0.3	V	

2.2.2 BACKLIGHT CONVERTER INPUT

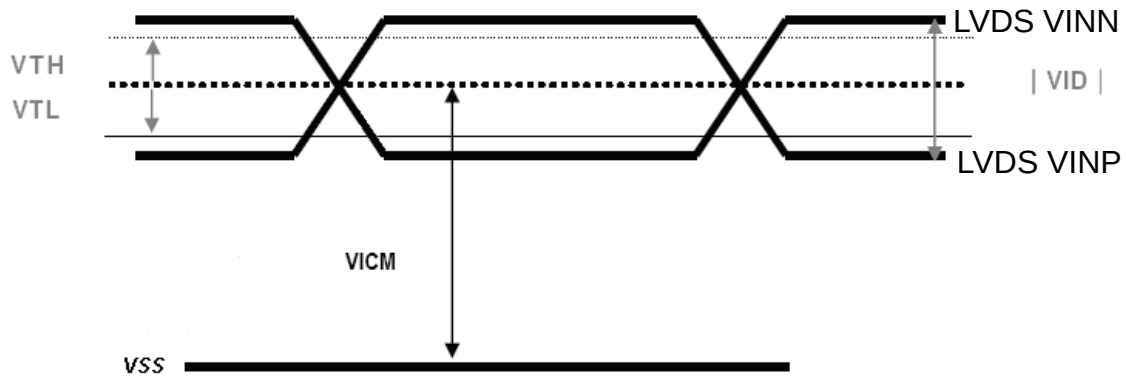
Item	Symbol	Value		Unit	Note
		Min.	Max.		
Converter Input Voltage	VLED	-0.3	24	V	
Converter Control Signal	V_{EN}, V_{PWM}	-0.3	5.5	V	

3 ELECTRICAL CHARACTERISTICS

3.1 TFT LCD

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Power Supply Voltage For LCD	VCC	3.0	3.3	3.6	V	
Power Supply Voltage For LED	VLED	4.5	12.0	21.0	V	
Logic Input Voltage (LVDS:IN+,IN-)	VCM	|VID|/2	1.25	2.4-(|VID|/2)	V	[Note1]
	| VID |	100	-	600	mV	[Note1]
	VTH	--	--	100	mV	[Note1]
	VTL	-100	--	--	mV	[Note1] When VCM=+1.25V
PWM Input Voltage	VIH	2.0		5.5	V	
	VIL	GND		0.15	V	

Note1: LVDS signal

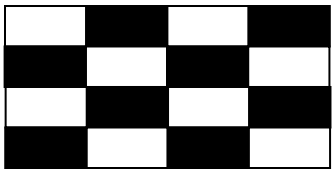


3.2 TFT CURRENT CONSUMPTION

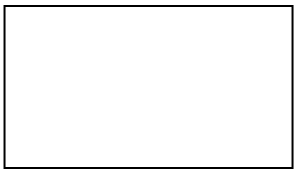
ITEM	SYMBOL	MIN.	TYPICAL	MAX.	UNIT	NOTE
LCD Power Current	ICC				mA	[Note1]
Black			137		mA	
Checkerboard			167		mA	
White			194		mA	
LED Power Current	IDD		168		mA	[Note2]

[Note1]

Black Pattern



ANSI checkerboard pattern

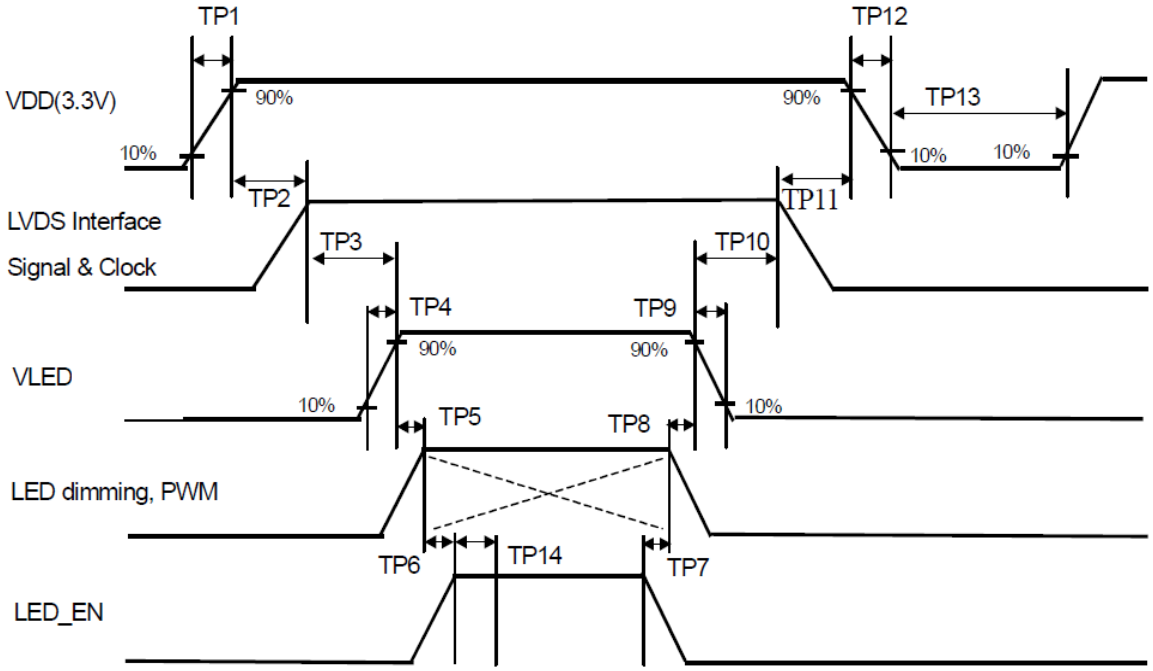


White pattern

Typical power consumption is further specified on page 13, section 4.3. Frame rate control and backlight duty ratio adjustment at different ambient light condition can further reduce the display power consumption.

[Note2] Typical: When VLED is 12V
Maximum: When VLED is 11.5V

3.3 POWER SEQUENCE



Item	Min.	Typ.	Max.	Unit	Remark
TP1	0.5	--	10	msec	
TP2	0	--	50	msec	
TP3	200	--	--	msec	
TP4	0.5	--	10	msec	
TP5	10	--	--	msec	
TP6	10	--	--	msec	
TP7	0	--	--	msec	
TP8	10	--	--	msec	
TP9	0	--	10	msec	
TP10	200	--	--	msec	
TP11	0	--	50	msec	
TP12	1	--	10	msec	
TP13	1000	--	--	msec	
TP14	50	--	--	msec	

3.4 BACKLIGHT

Item	Symbol	Condition	Min	Typ	Max	Unit	Remarks
LED Lifetime	-	Ta=25℃	30,000			Hr	

Definition LED lifetime：Luminance decays less than 50%.

3.5 INTERFACE CONNECTION

CN1：IPEX 20455-040E-12 (or equivalent)

Pin NO.	SYMBOL	DESCRIPTION
1	NC	No Connection
2	VCC	Power Supply for Digital Circuit
3	VCC	Power Supply for Digital Circuit
4	V_EDID	Power Supply for EDID Circuit
5	TP_VDD	Reserve for TP(No Connection if W/O TP)
6	CLK_EDID	EDID Clock Inputs
7	DATA_EDID	EDID Data Inputs
8	RXIN0-	Negative LVDS differential data inputs
9	RXIN0+	Positive LVDS differential data inputs
10	GND	Power Ground
11	RXIN1-	Negative LVDS differential data inputs
12	RXIN1+	Positive LVDS differential data inputs
13	GND	Power Ground
14	RXIN2-	Negative LVDS differential data inputs
15	RXIN2+	Positive LVDS differential data inputs
16	GND	Power Ground
17	RXCLK-	Negative LVDS differential clock inputs
18	RXCLK+	Positive LVDS differential clock inputs
19	GND	Power Ground
20	NC	No Connection
21	NC	No Connection
22	GND	Power Ground
23	TX	Reserve for TP (no connection if without TP)
24	RX	Reserve for TP (no connection if without TP)
25	GND	Power Ground
26	TP_FUNC	Reserve for TP (no connection if without TP)
27	TP_INT	Reserve for TP(No Connection if W/O TP)
28	GND	Power Ground
29	TP_D-	Reserve for TP(No Connection if W/O TP)
30	TP_D+	Reserve for TP(No Connection if W/O TP)
31	VLED_GND	Power Ground of LED
32	VLED_GND	Power Ground of LED
33	VLED_GND	Power Ground of LED
34	TP_RST	Reserve for TP(No Connection if W/O TP)

35	ADJ	LED Dimming Input Level
36	LED_EN	LED Enable Input Level
37	CABC	CABC Enable Pin (default low: disable)
38	VLED	Power Supply for LED
39	VLED	Power Supply for LED
40	VLED	Power Supply for LED

NOTE：

1) NC Pin must be retained; this pin can't contact GND or other signal.

2) GND Pin must connect to ground contact, cannot be floating.

3) PWM signal adjusts the brightness of the LED. Minimum PWM "on" time: 4 us. Higher Pulse duty ratio allows higher current flow at LED and generates brighter luminance. However at lower duty ratio, the converter efficiency may drop.

4) PWM signal operation frequency：200 Hz – 30K Hz PWM

3.6 TOTAL POWER CONSUMPTION

Mode	Preliminary Value			Unit	Note
	Min.	Typ.	Max.		
Reflective (low color)		0.40		W	30 fps, BLU off
		0.55		W	60 fps, BLU off
Transflective (Color)		0.66		W	30 fps with ANSI checkerboard pattern, BLU duty10%
		0.82		W	60 fps with ANSI checkerboard pattern, BLU duty 10%
		1.43		W	60 fps with ANSI checkerboard pattern, BLU duty 40%
Transmissive (Full Color Saturation)		2.41		W	30 fps with ANSI checkerboard pattern, BLU duty 100%
		2.57		W	60 fps with ANSI checkerboard pattern, BLU duty 100%

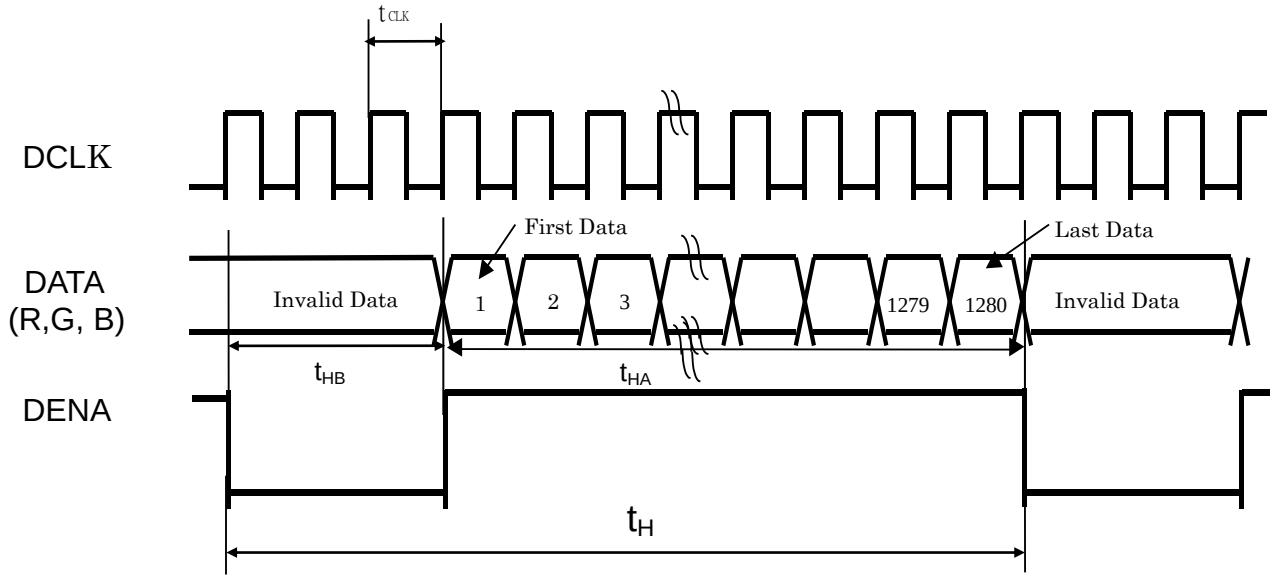
4 INPUT SIGNAL (DE only mode)

4.1 TIMING SPECIFICATION

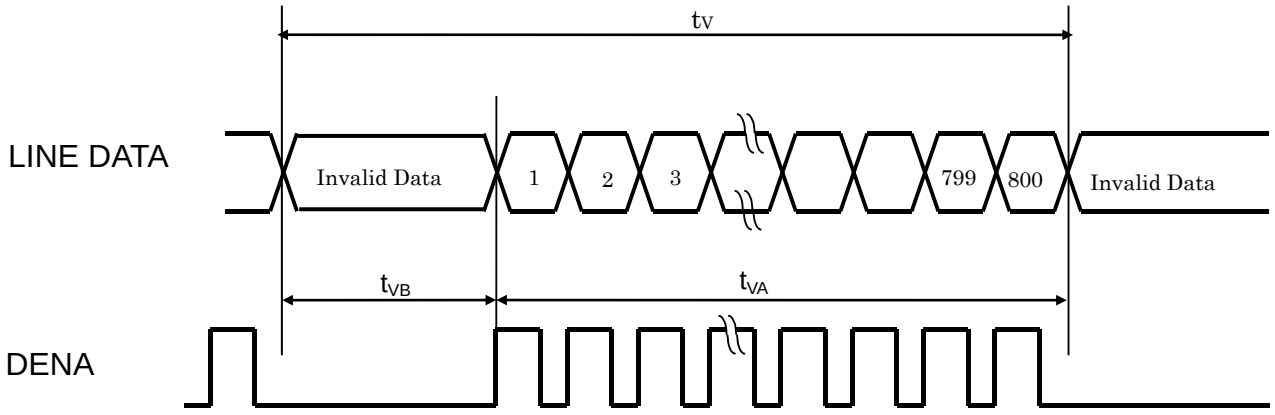
ITEM				SYMBOL	MIN.	TYP.	MAX.	UNIT
LVDS input signal sequence	CLK Frequency			f_{CLKin}	64.3	71.1	82	MHz
LCD input signal sequence （Input LVDS Transmitter）	DENA	Horizontal	Horizontal total Time	t_H	1334	1440	1961	t_{CLK}
			Horizontal effective Time	t_{HA}	1280			t_{CLK}
			Horizontal Blank Time	t_{HB}	54	160	681	t_{CLK}
		Vertical	Frame	f_V	55	60	65	Hz
			Vertical total Time	t_V	803	823	1023	t_H
			Vertical effective Time	t_{VA}	800			t_H
			Vertical Blank Time	t_{VB}	3	23	223	t_H

4.2 TIMING SEQUENCE

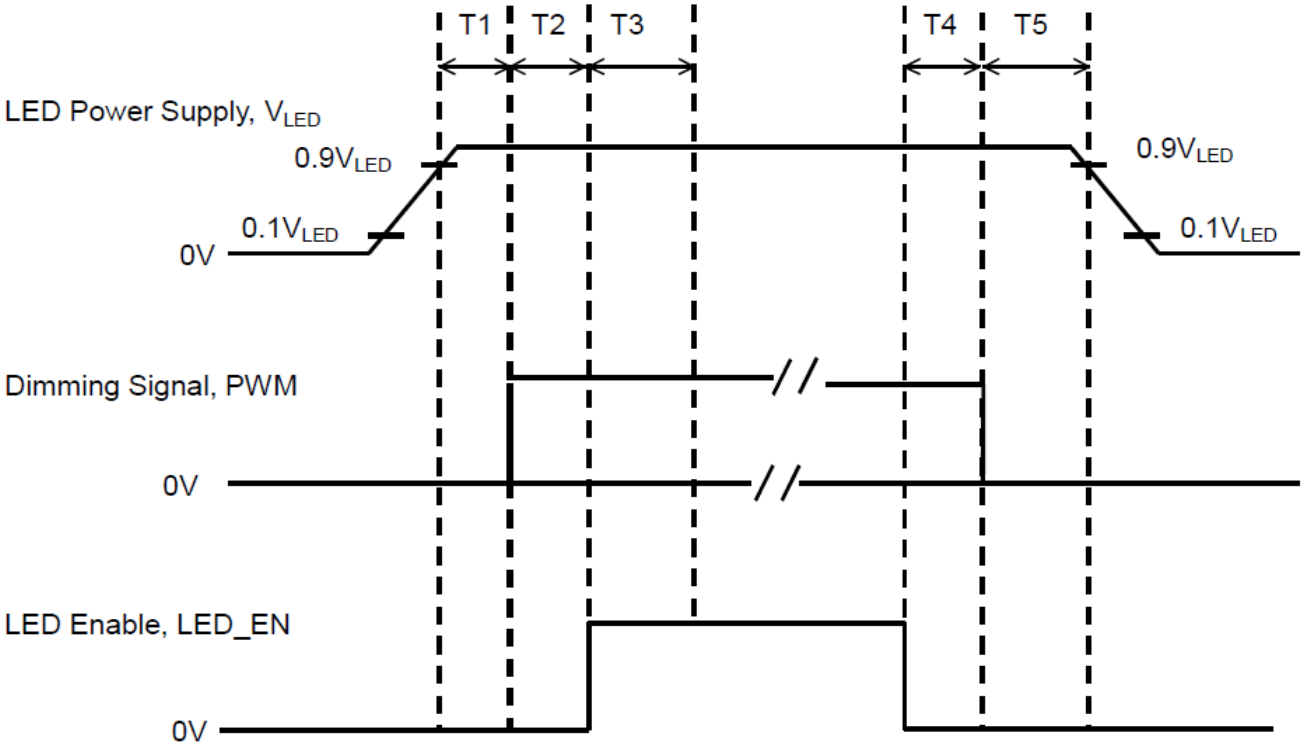
Horizontal Timing Sequence



Vertical Timing Sequence

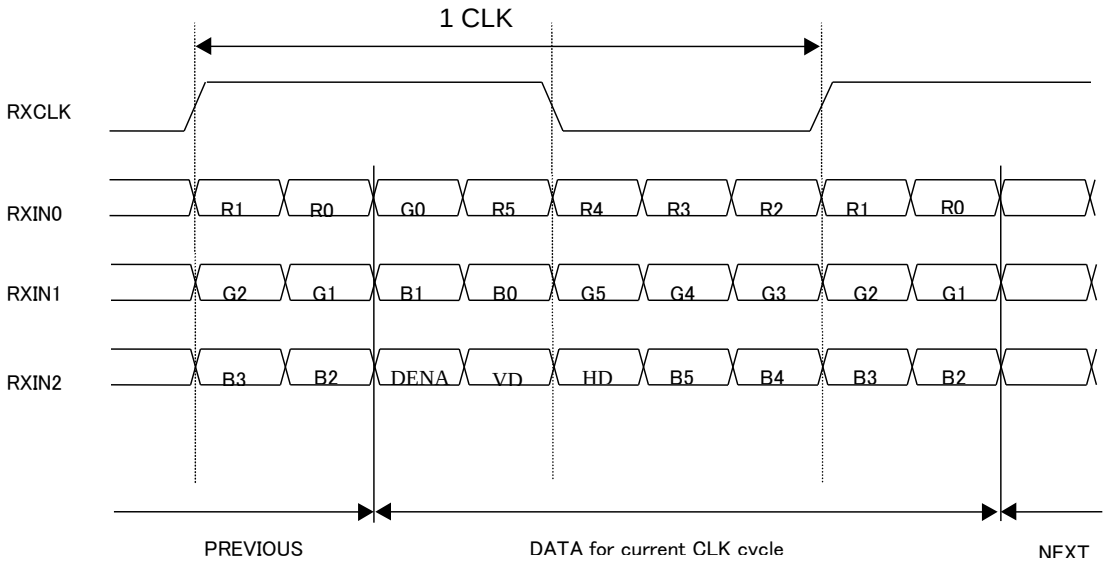


LED Power On/Off Sequence

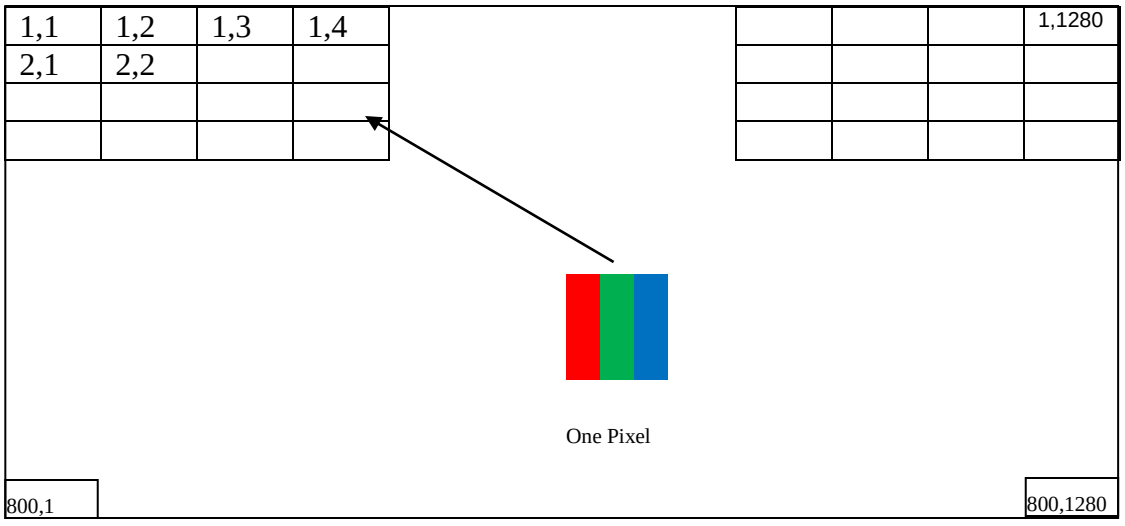


Symbol	Value			Unit
	Min	Typ	Max	
T1	10	--	--	ms
T2	10	--	--	
T3	50	--	--	
T4	0	--	--	
T5	10	--	--	

4.3 LVDS INPUT DATA MAPPING



4.4 PIXEL FORMAT



4.5 COLOR DATA ASSIGNMENT

COLOR	INPUT DATA	R DATA						G DATA						B DATA					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
		MSB					LSB	MSB					LSB	MSB					LSB
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	BLUE(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	CYAN	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	MAGENTA	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
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	RED(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(1)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	GREEN(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	GREEN(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
BLUE	BLUE(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	BLUE(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	BLUE(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	BLUE(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

NOTE：

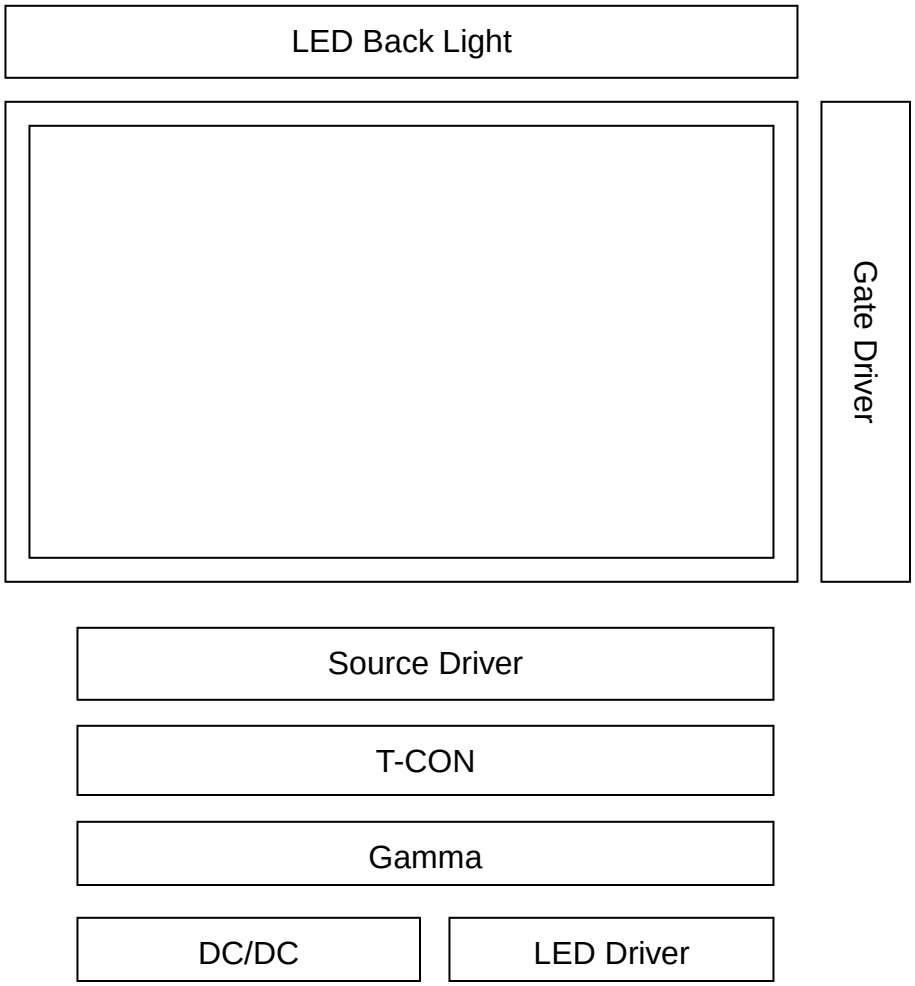
(1) Definition of Gray Scale

color(n)：n is level of Gray Scale

The higher n is, the higher the Gray Scale.

(2) Data:1-High,0-Low

5 BLOCK DIAGRAM



6 OPTICAL CHARACTERISTICS

6.1 REFLECTIVE MODE (Backlight Off)*

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	REMARK
Hemispheric Reflectance**	HR	$\theta = \phi = 0^\circ$		20		%	Note 1
Reflective Contrast Ratio	CR	$\theta = 0^\circ$		5		--	Note 2
Reflective Viewing Angle	Vertical	θ *2, CR≧2		140	140	Degree	Note 3
	Horizontal	ϕ *2, CR≧2		140	140	Degree	Note 3

* Ambient condition：25°C±2°C, 60±10%RH.

Note 1: Use the Reflectance Measurement Tool (RMT) developed by Pixel Qi. RMT includes a Falcon Hemispheric Illumination Device FLDM and X-rite i1 Basic Pro Spectrophotometer. The panel under measurement is placed 0 mm from the RMT.

The definition of Hemispheric Reflectance is:

$$\frac{\text{Measured reflective optical output of panel displaying “white”}}{\text{Measured reflective optical output of “white standard”}}$$

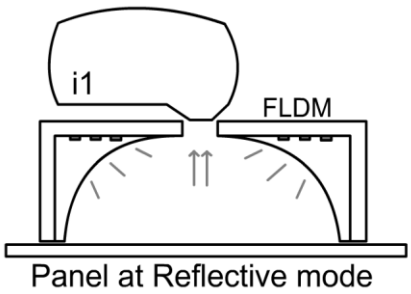


Figure 6.1 Reflectance Measurement Tool

Note 2: Use the X-rite i1 Basic Pro Spectrophotometer in reflective measurement mode.

The definition of Reflective Contrast Ratio is:

$$\frac{\text{Measured reflective optical output of panel displaying “white” } \theta=0^\circ}{\text{Measured reflective optical output of panel displaying “Black” } \theta=0^\circ}$$

Note 3: Using the diffuse illumination measurement system of DMS 803 with a D65 illumination source, the

definition of Reflective Viewing Angle:

Vertical reflective viewing angle = θ*2, at which measured CR≧2

Horizontal reflective viewing angle = ϕ*2, at which measured CR≧2

Measurement angles are defined in Figure 6.2.

6.2 TRANSMISSIVE MODE (Backlight On)*

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Contrast Ratio**		CR	Point-5	--	110	--	--	Note 4
Luminance		Lw	Point-5	--	200	--	cd/m^2	Note 5
Luminance Uniformity		ΔL			85	--	%	Note 6
Response Time (White - Black)		Tr+ Tf	Point-5	--	30	---	ms	Note 7
Viewing Angle		η*2	CR≧10 Point-5		100	--	Degree	Note 8
Color Coordinate	White	Wx Wy			0.296 0.316			
	Red	Rx Ry			0.564 0.336			
	Green	Gx Gy			0.341 0.564			
	Blue	Bx By			0.151 0.122			
	NTSC			--	45		%	Note 9

* Ambient condition：25℃±2℃，60±10%RH,; under 10 Lux in the darkroom

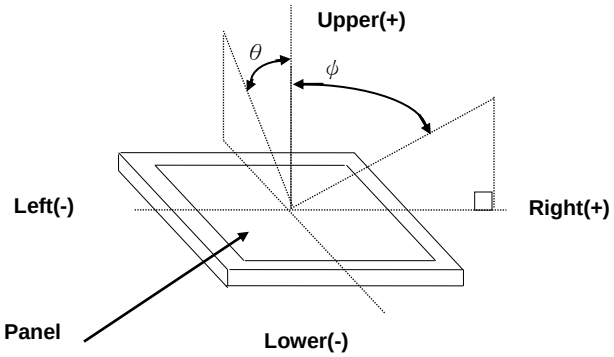


Figure 6.2 Measurement angles definition

Note 4: Use Minolta CA-210 for transmissive mode contrast ratio measurement.

Definition of Contrast Ratio：CR = White Luminance (ON) / Black Luminance (OFF)

Note 5: Use Minolta CA-210 for transmissive mode luminance measurement.

Definition of luminance：Measure white luminance on the point 5 as figure 6.

Note 6: Use Minolta CA-210 for transmissive mode luminance uniformity measurement.

Definition of Luminance Uniformity:

Measure white luminance on the point1～9 as figure 6.3

$\Delta L = [L(MIN)/L(MAX)] \times 100$

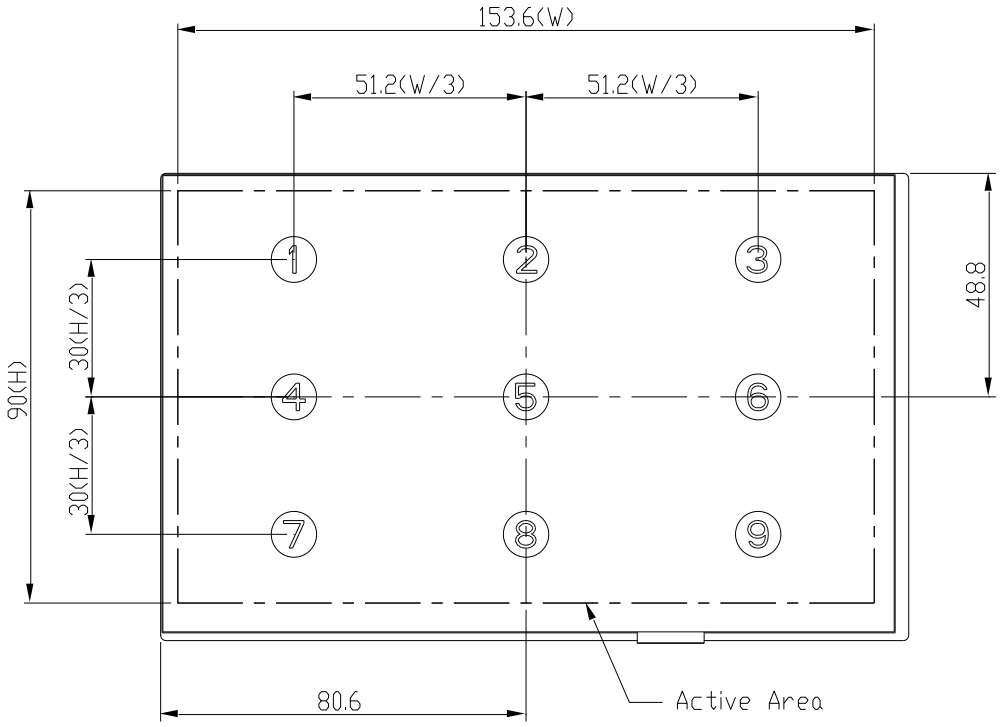
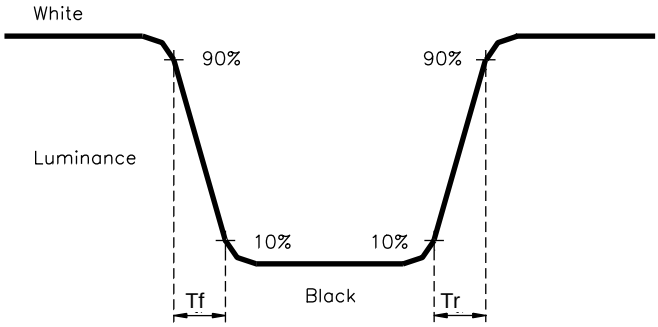


Figure 6.3 Measuring points

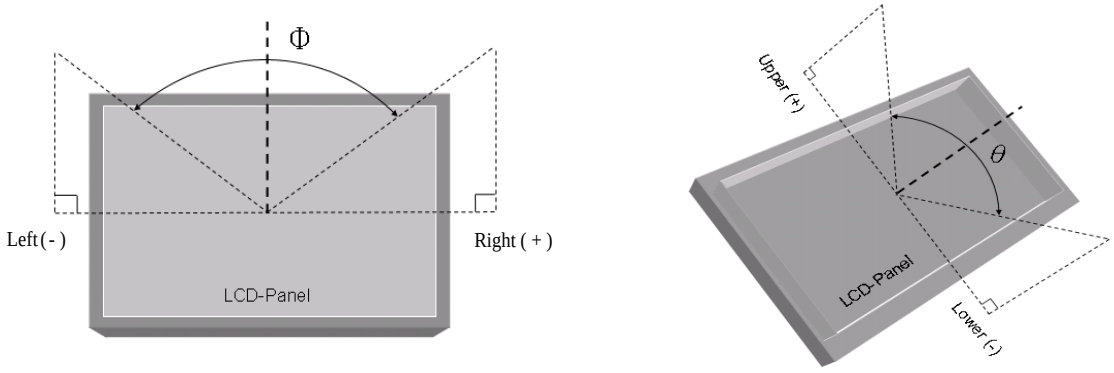
Note 7: Definition of response time：The response time is defined as the time interval between the 10% and 90% amplitudes.



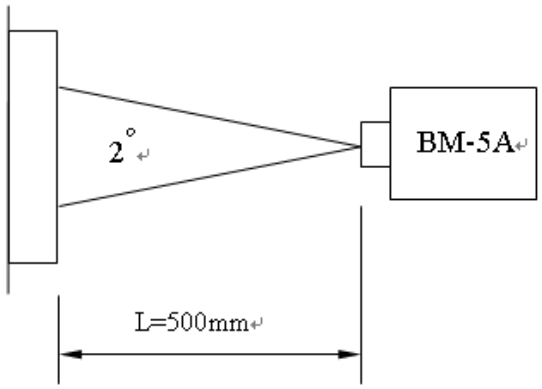
Note 8: Definition of transmissive viewing angle; symmetric around the normal

Transmissive viewing angle = η *2, at which measured CR≧10

Definition of viewing angle(θ，ψ)：



Measurement condition: 25°C±2°C，60±10%RH, under 10 Lux in the dark room. BM-5A (TOPCON), viewing angle 2°, VCC=3.3V，VLED=5V.



Note 9: NTSC% measurement is based on CIE 1976.

7 RELIABILITY TEST

7.1 TEMPERATURE AND HUMIDITY

TEST ITEMS	CONDITIONS	NOTE
High Temperature Operation	50℃，240Hrs	
High Temperature Storage	60℃，240Hrs	
High Temperature High Humidity Operation	40℃，90%RH，240Hrs	No condensation
Low Temperature Operation	-10℃，240Hrs	
Low Temperature Storage	-20℃，240Hrs	
Thermal Shock	-20℃（0.5Hr）~ 60℃(0.5Hr) 100 cycles	

7.2 SHOCK AND VIBRATION

TEST ITEMS	CONDITIONS
Shock (Non-operation)	• Shock level: 980m/s^2(equal to 100G) • Waveform: half sinusoidal wave, 6ms. • Number of shocks: one shock input in each direction of three mutually perpendicular axes for a total of three shock inputs.
Vibration (Non-operation)	• Frequency range: 8~33.3Hz • Stroke: 1.3mm • Vibration: sinusoidal wave, perpendicular axis (both x, z axis:2Hrs, y axis:4Hrs). • Sweep: 2.9G,33.3Hz-400Hz • Cycle:15min

7.3 ESD

ITEM	CONDITION	NOTE
ESD	150pF，330Ω，±8KV&±15KV air test	[Note1]
	200pF，0Ω，±200V contact test	[Note2]

[Note1] LCD glass and metal bezel

[Note2] Connector pins

7.4 **Judgment standard**

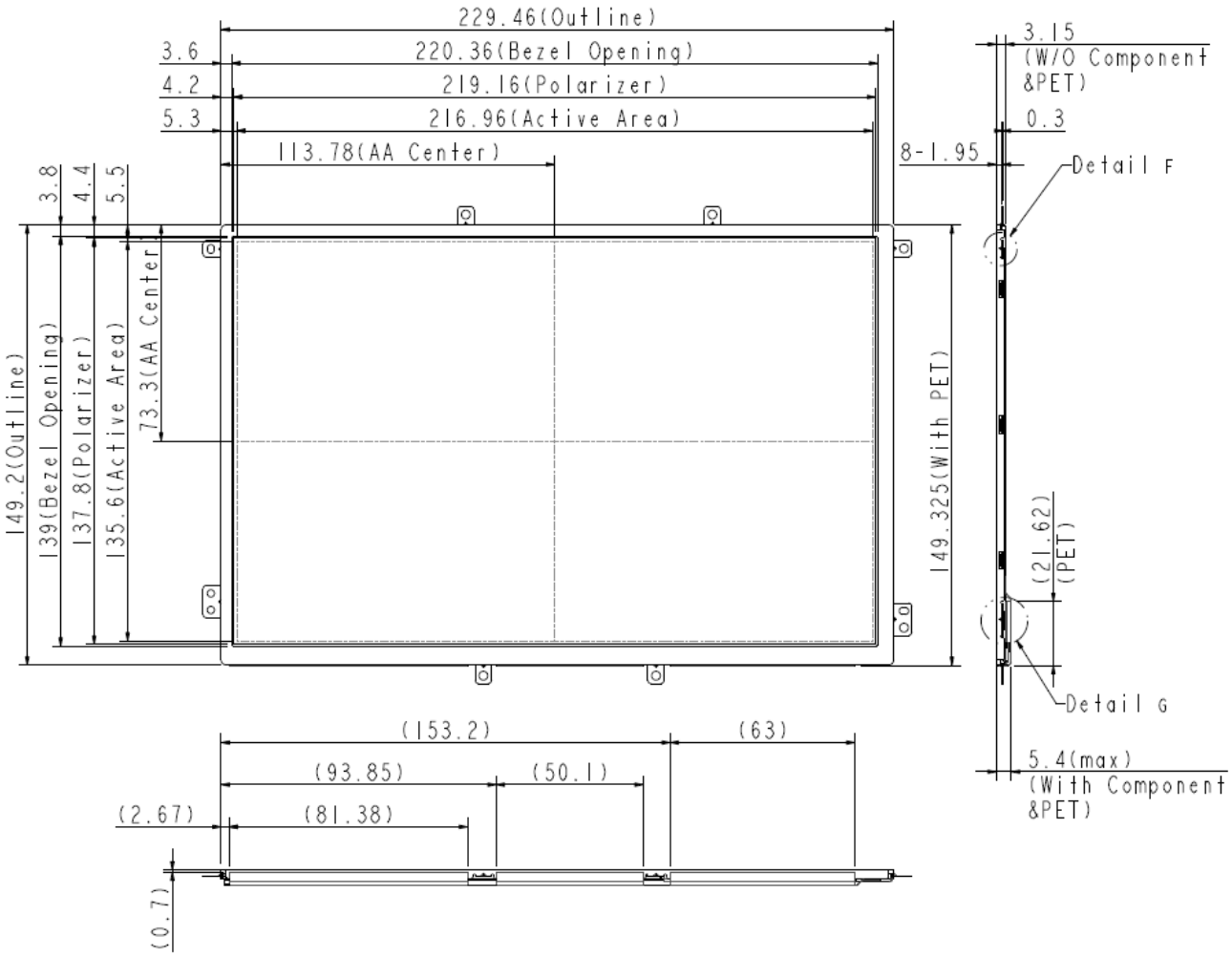
The judgment of the above tests should be made as follows:

Pass: Normal display image with no obvious non-uniformity and no line defect. Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defect.

8 MECHANICAL DRAWINGS

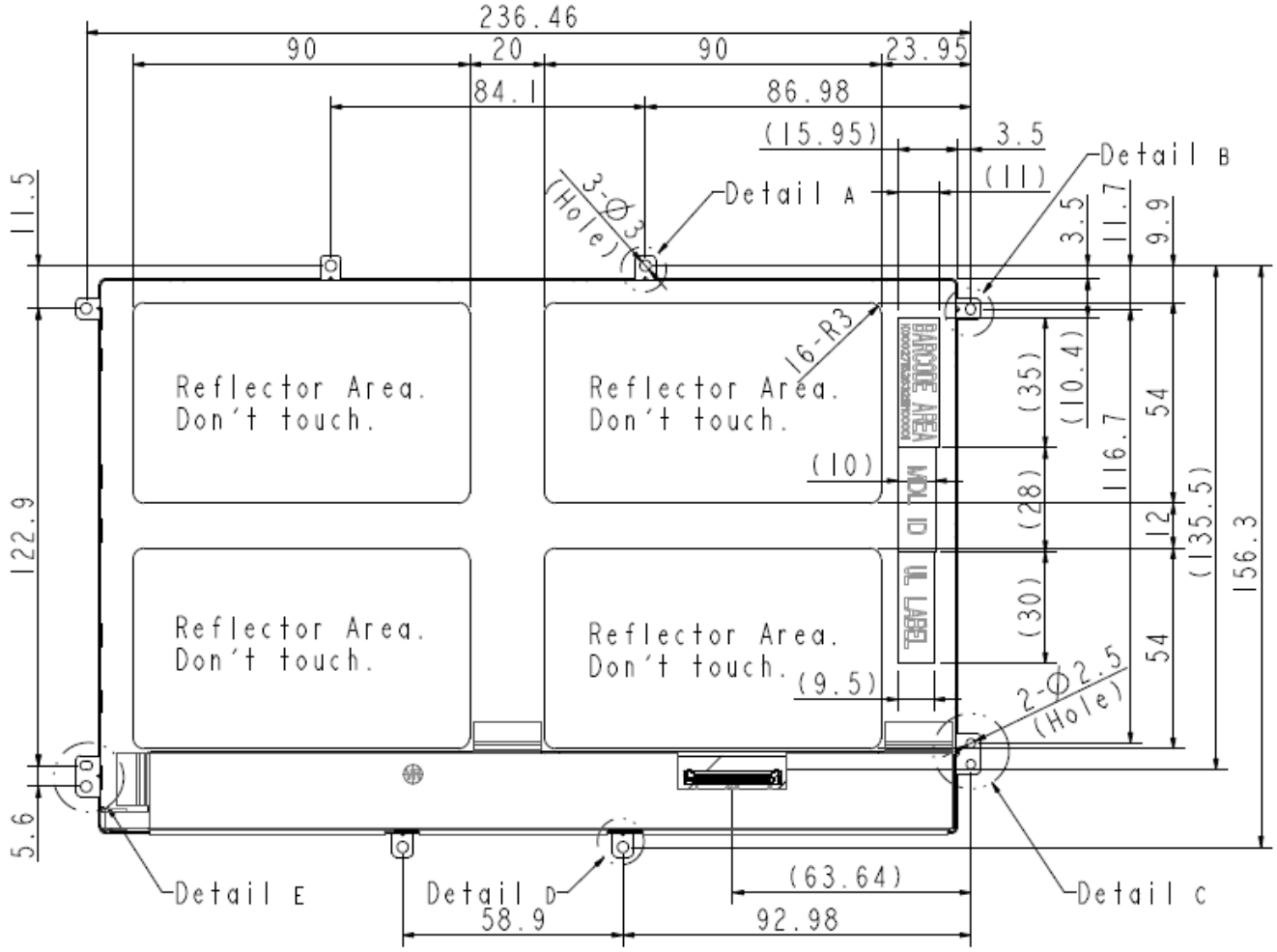
Figure 8.1 Module front and side outline



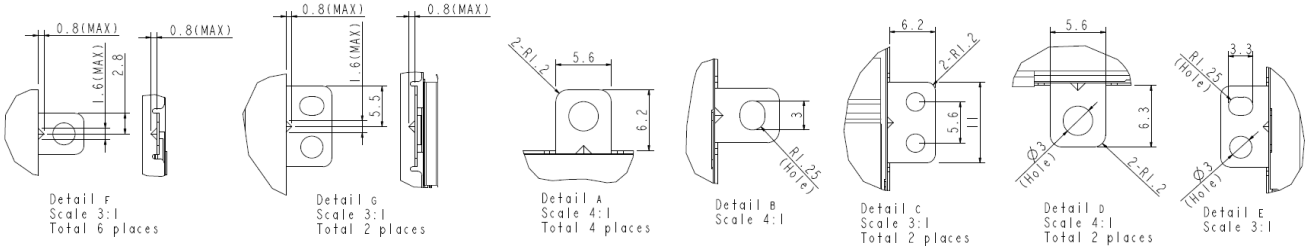
NOTE:

1. General tolerance：±0.3mm
2. Unit：mm

Figure 8.2 Module rear outline and mounting tabs



NOTE：General tolerance：±0.3mm



9 PRECAUTIONS – System integration, handling and storage, operation

1. Please keep radio antennas away from the PCB to avoid wireless interference
2. The module should be assembly firmly into the system. Shock cushioning material may be required for robustness in certain applications. Please make sure the module is not bent or twisted during assembly or operation.
3. Module assembly must be done in a clean environment. Dust or oil may cause electrical damage or impact optical performance.
4. Use finger or hand coverings to keep display clean during inspection and assembly.
5. Do not press or scratch the display surface with anything harder than an HB pencil.
6. The display surface may be cleaned with absorbent cotton or other soft cloth. Please do not use Ketone type materials (e.g. Acetone), Ethyl alcohol, Toluene, Ethyl acid, or Methyl chloride to avoid permanent damage to the top polarizer. Small quantities of Isopropyl alcohol are preferred for cleaning.
7. Wipe off any droplets of fluid (water, oil, etc) immediately. Staining or discoloration may appear if fluids are allowed to remain on the panel.
8. If the liquid crystal material leaks from the panel it should be kept away from the eyes or mouth. In case of contact with skin or clothing, it should be washed thoroughly with soap.
9. The module is a static sensitive device. Please protect from ESD events to avoid damage.
10. Do not disassemble the module or insert anything into the backlight unit.
11. Do not pull or fold any of the flex cables.
12. Do not directly touch the pins of the cable connector.
13. Optical performance may be reduced at high or low ambient temperatures or high humidity. For example, switching speed will be reduced at low ambient temperatures. Please operate and store the module within the specified environmental conditions.
14. When fixed patterns are displayed for a long time, residual images may occur.
15. Please do not expose the module to moisture.
16. Please do not connect the panel when the cable is powered, and do not disconnect the panel when it is operating.
17. Always follow the correct power on and power off sequences specified.

10 EDID DATA: TBD