ENTINC

SPECIFICATION OF LCD MODULE

MODEL NO. : ENT070TN94S

REVISION : 0

EDIT ON : 31-Mar-2014

CUSTOMER	
APPROVED BY	
DATE :	

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RECORDS OF REVISION

DATE	REVISED NO.	SUMMARY	CHECK
31-Mar-2014	0	First Issue	Y.J. MO

CONTENTS

1. GENERAL SPECIFICATION

No.	ITEM	CONTENTS
1	LCD Size	7.0 inch (Diagonal)
2	Driver Element	a-Si TFT Active matrix
3	Resolution	800 x 3(RGB) x 480
4	Display Mode	Normally White, Transmissive
5	Dot Pitch	0.0642 mm x 0.1790 mm
6	Active Area	154.08 mm x 85.92 mm
7	Module Size	164.9 (W) x 100.0 (H) x 5.7 (D) mm
8	Surface Treatement	Anti_Glare
9	Color Arrangement	RGB-Stripe
10	Interface	Digital
11	Backlight Power Consumption	1.674W Typ.
12	Penel Power Consumption	0.226W Typ.
13	Weight	148g Typ.

2. INTERNAL PIN ASSIGNMENT

FPC Connector is used for the module electronics interface.

The recommended model is FH12A-50S-0.5SH manufactured by Hirose.

Pin No.	Symbol	I/O	Description	Remark
1	V_{LED+}	P	Power for LED backlight (Anode)	
2	V_{LED+}	P	Power for LED backlight (Anode)	
3	V_{LED-}	P	Power for LED backlight (Cathode)	
4	V_{LED-}	P	Power for LED backlight (Cathode)	
5	GND	P	Power ground	
6	V_{COM}	I	Common voltage	
7	DV_{DD}	P	Power for digital circuit	
8	MODE	I	DE/SYNC mode select	Note 1
9	DE	I	Data input enable	
10	VS	I	Vertical sync input	
11	HS	I	Horizontal sync input	
12	B7	I	Blue data (MSB)	
13	B6	I	Blue data	
14	B5	I	Blue data	
15	B4	I	Blue data	
16	B3	I	Blue data	
17	B2	I	Blue data	
18	B1	I	Blue data	Note 2
19	B0	I	Blue data (LSB)	Note 2
20	G7	I	Green data (MSB)	
21	G6	I	Green data	
27	G5	I	Green data	
23	G4	I	Green data	
24	G3	I	Green data	
25	G2	I	Green data	

Pin No.	Symbol	I/O	Description	Remark
26	G1	I	Green data	Note 2
27	G0	I	Green data (LSB)	Note 2
28	R7	I	Red data (MSB)	
29	R6	I	Red data	
30	R5	I	Red data	
31	R4	I	Red data	
32	R3	I	Red data	
33	R2	I	Red data	
34	R1	I	Red data	Note 2
35	R0	I	Red data (LSB)	Note 2
36	GND	P	Power ground	
37	DCLK	I	Sample clock	Note 3
38	GND	P	Power ground	
39	L/R	I	Left / Right selection	Note 4,5
40	U/D	I	Up / Down selection	Note 4,5
41	V_{GH}	P	Gate On Voltage	
42	V_{GL}	P	Gate Off Voltage	
43	AV_{DD}	P	Power for analog circuit	
44	RESET	I	Global reset pin	Note 6
45	NC	-	No connection	
46	V_{COM}	I	Common voltage	
47	DITHB	I	Dithering fuction	Note 7
48	GND	P	Power ground	
49	NC	-	No connection	
50	NC	-	No connection	

I : Input , O : Output , P : Power

Note 1 : DE/SYNC mode select. Normally pull high.

When select DE mode, MODE = "1", VS and HS must pull high.

When select SYNC mode, MODE = "0" , DE must be grounded.

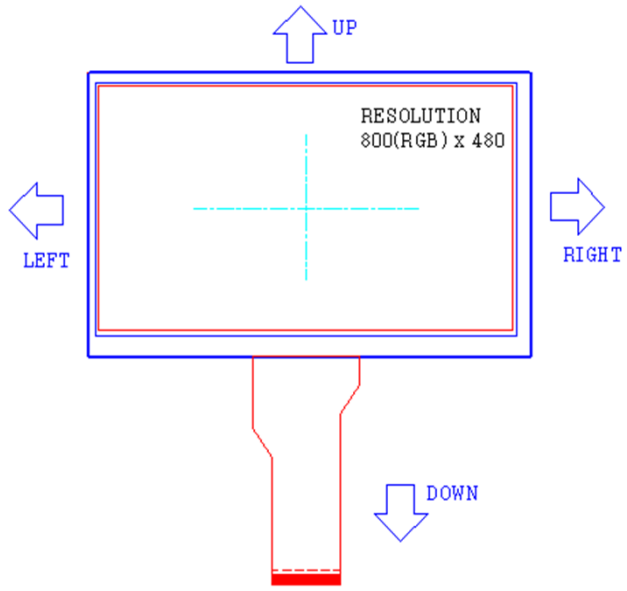
Note 2 : When input 18bit RGB data, the two low bits of RGB data must be grounded.

Note 3 : Data shell be latched at the falling edge of DCLK.

Note 4 : Selection of scanning mode.

Setting of scan control input		Scanning Direction
U/D	L/R	
GND	DV_{DD}	Up to down , Left to right
DV_{DD}	GND	Down to up , Right to left
GND	GND	Up to down , Right to left
DV_{DD}	DV_{DD}	Down to up , Left to right

Note 5 : Definition of scanning direction. Refer to the figure as below :



Note 6 : Global reset pin. Active low to enter reset state.

Suggest to connect with an RC reset circuit for stability. Normally pull high.

Note 7 : Dithering function enable control. Normally pull high.

DITHB = "1" , Disable internal dithering function.

For 18bit RGB interface, connect two LSB bits of all the RGB Data buses to GND.

DITHB = "0" , Enable internal dithering function, For TTL 24bit parallel RGB image data input.

3. OPERATION SPECIFICATION

3-1. ABSOLUTE MAXIMUM RATINGS

Note 1

ITEM	SYMBOL	VALUES		UNIT	REMARK
		MIN.	MAX.		
Power Voltage	DV_{DD}	-0.3	5.0	V	
	AV_{DD}	6.5	13.5	V	
	V_{GH}	-0.3	40.0	V	
	V_{GL}	-20.0	0.3	V	
	V_{GH} - V_{GL}	-	40.0	V	
Operation Temperature	T_{OP}	-20	70	℃	
Storage Temperature	T_{ST}	-30	80	℃	
LED Reverse Voltage	V_R	-	1.2	V	Each LED , Note 2
LED Forward Current	I_F	-	25	mA	Each LED

Note 1 : The absolute maximum rating values of this product are not allowed to be exceeded at any times.
Should a module be used with any of the absolute maximum ratings exceeded,
the characteristics of the module may not be recovered, or in an extreme case,
the module may be permanently destroyed.

Note 2. : V_R Conditions : Zener Diode 20mA

3-2. TYPICAL OPERATION CONDITIONS

Note 1

ITEM	SYMBOL	VALUES			UNIT	REMARK
		MIN.	TYP.	MAX.		
Power Voltage	DV_{DD}	3	3.3	3.6	V	Note 2
	AV_{DD}	10.2	10.4	10.6	V	
	V_{GH}	15.3	16.0	16.7	V	
	V_{GL}	-7.7	-7.0	-6.3	V	
Input Signal Voltage	V_{COM}	2.6	3.6	4.6	V	Note 4
Input Logic High Voltage	V_{IH}	0.7 DV_{DD}	-	DV_{DD}	V	Note 3
Input Logic Low Voltage	V_{IL}	0	-	0.3 DV_{DD}	V	

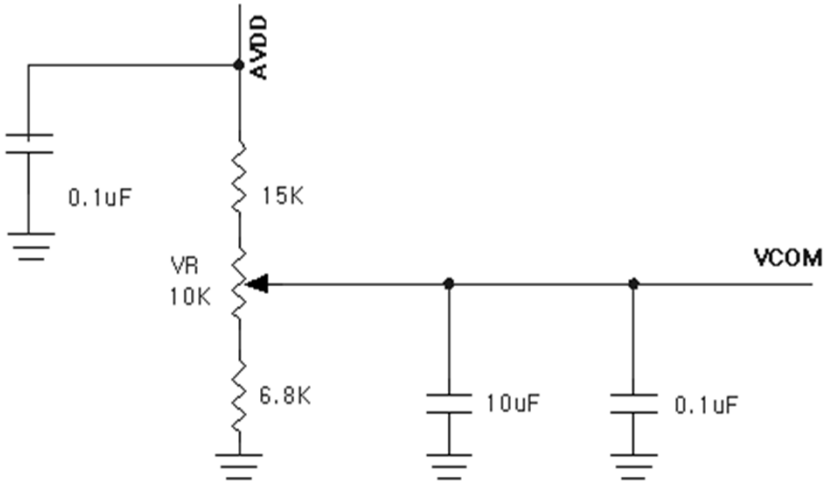
Note 1: Be sure to apply DV_{DD} and V_{GL} to the LCD first, and then apply V_{GH}.

Note 2: DV_{DD} setting should match the signals output voltage (Note 3) of customer's system board.

Note 3: DCLK,HS,VS,RESET,U/D, L/R,DE,R0~R7,G0~G7,B0~B7,MODE,DITHB.

Note 4: Typical V_{COM} is only a reference value. It must be optimized according to each LCM.

Please use VR and base on below application circuit.



3-3. CURRENT CONSUMPTION

ITEM	SYMBOL	VALUES			UNIT	REMARK
		MIN.	TYP.	MAX.		
Current for Driver	I_{GH}	-	0.2	1.0	mA	V_{GH} = 16.0V
	I_{GL}	-	0.2	1.0	mA	V_{GL} = -7.0V
	IDV_{DD}	-	4.0	10.0	mA	DV_{DD} = 3.3V
	IAV_{DD}	-	20.0	50.0	mA	AV_{DD} = 10.4V

3-4. BACKLIGHT DRIVING CONDITION

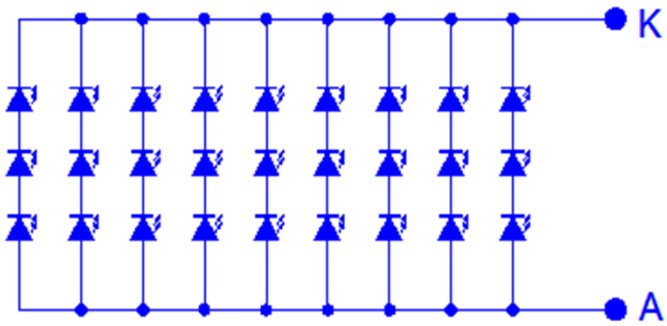
ITEM	SYMBOL	VALUES			UNIT	REMARK
		MIN.	TYP.	MAX.		
Voltage for LED backlight	V_L	8.4	9.3	10.2	V	Note 1
Current for LED backlight	I_L	170	180	200	mA	
LED life time	-	20,000	-	-	Hr	Note 2

Note 1: The LED Supply Voltage is defined by the number of LED at Ta=25℃ and I_L =180mA.

Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and I_L =180mA.

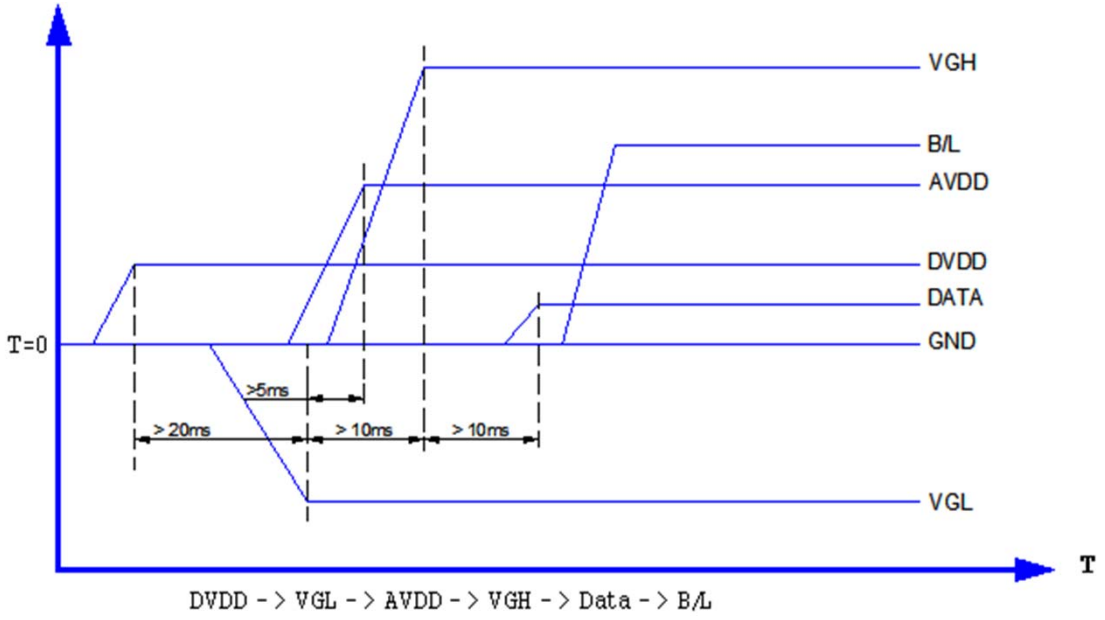
The LED lifetime could be decreased if operating I_L is lager than 180mA.

3-5. LED CIRCUIT DIAGRAM

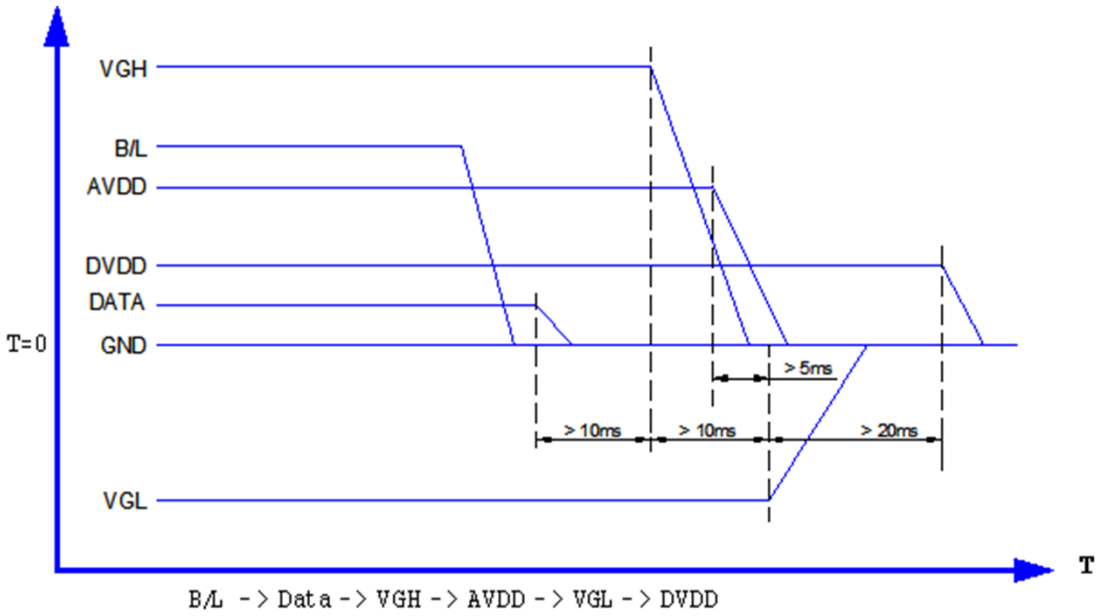


3-6. POWER SEQUENCE

3-6-1. Power On :



3-6-2. Power Off :



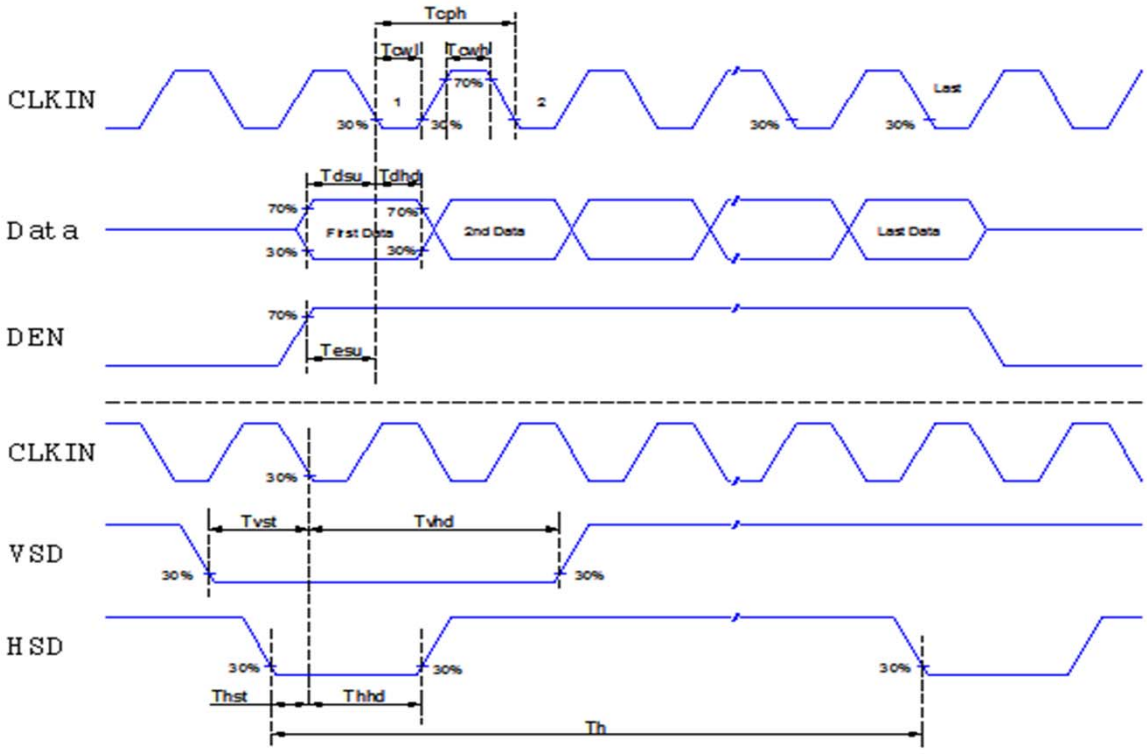
Note: Data include R0~R7, B0~B7, GO~G7, U/D, L/R, DCLK, HS,VS,DE.

3-7. TIMING CHARACTERISTIC

3-7-1. AC Electrical Characteristic

ITEM	SYMBOL	VALUES			UNIT	REMARK
		MIN.	TYP.	MAX.		
HS Setup Time	T_{hst}	8	-	-	ns	
HS Hold Time	T_{hhd}	8	-	-	ns	
VS Setup Time	T_{vst}	8	-	-	ns	
VS Hold Time	T_{vhd}	8	-	-	ns	
Data Setup Time	T_{dsu}	8	-	-	ns	
Data Hold Time	T_{dhd}	8	-	-	ns	
DE Setup Time	T_{esu}	8	-	-	ns	
DE Hold Time	T_{ehd}	8	-	-	ns	
DV_{DD} Power On slew rate	T_{POR}	-	-	20	ms	From 0 to 90% DV_{DD}
RESET Pulse Width	T_{Rst}	1	-	-	ms	
DCLK Cycle Time	T_{cph}	20	-	-	ns	
DLCK Pulse Duty	T_{cwh}	40	50	60	%	

3-7-2 Input Clock and Data Timing Diagram



3-7-3. Timing

ITEM	SYMBOL	VALUES			UNIT	REMARK
		MIN.	TYP.	MAX.		
Horizontal Display Area	thd	-	800	-	DCLK	
DCLK Frequency	fclk	26.4	33.3	46.8	MHz	
One Horizontal Line	thd	862	1056	1200	DCLK	
HS Pulse Width	thpw	1	-	40	DCLK	
HS Blanking	thb	46	46	46	DCLK	
HS Front Porch	thfp	16	210	354	DCLK	

ITEM	SYMBOL	VALUES			UNIT	REMARK
		MIN.	TYP.	MAX.		
Vertical Display Area	tvd	-	480	-	TH	
VS Period Time	tvd	510	525	650	TH	
VS Pulse Width	tvpw	1	-	20	TH	
VS Blanking	tvb	23	23	23	TH	
VS Front Porch	tvfp	7	22	147	TH	

3-7-4. Data Input Format

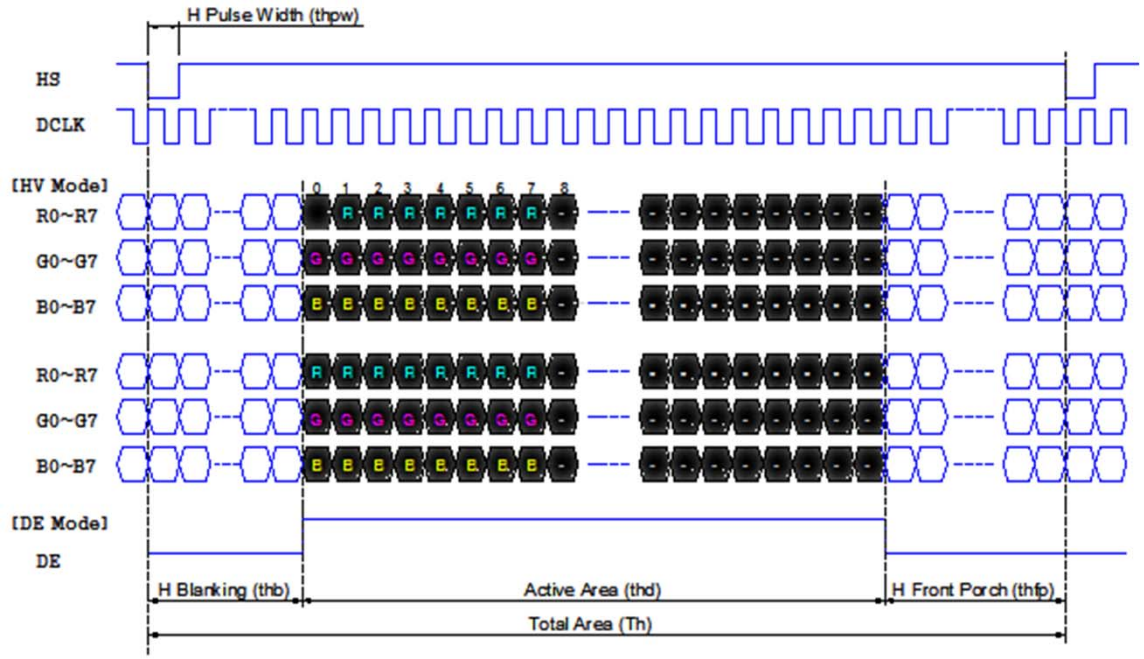


Figure 3.1 Horizontal input timing diagram

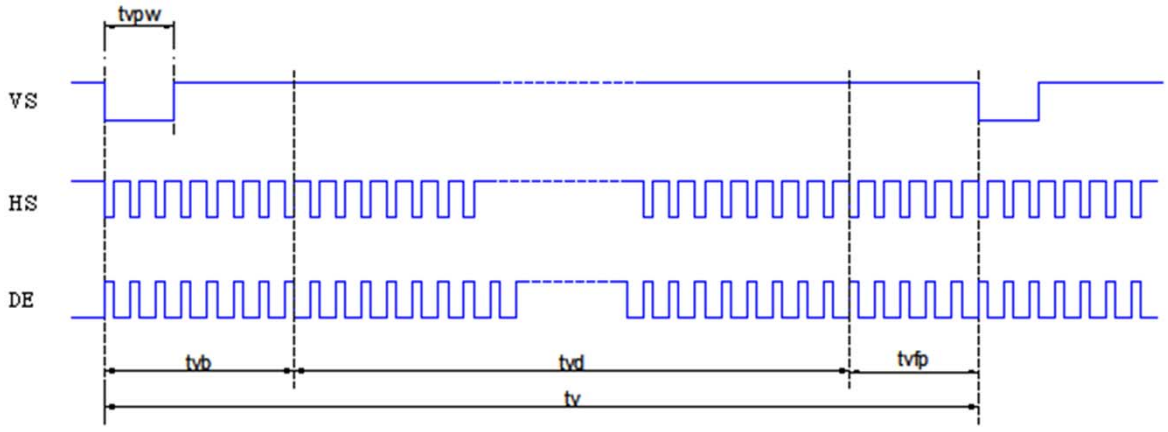


Figure 3.2 Vertical input timing diagram

4. OPTICAL SPECIFICATION

ITEM	SYMBOL	CONDITION	VALUES			UNIT	REMARK
			MIN.	TYP.	MAX.		
Viewing Angle (CR ≥ 10)	Θ_L	Φ=180°(9 o'clock)	60	70	-	Degree	Note 1
	Θ_R	Φ=0°(3 o'clock)	60	70	-		
	Θ_T	Φ=90°(12 o'clock)	40	50	-		
	Θ_B	Φ=270°(6 o'clock)	60	70	-		
Response Time	T_{ON}	Normal $\Theta = \Phi = 0°$	-	10	20	ms	Note 3
	T_{OFF}		-	15	30	ms	Note 3
Contrast Ratio	CR		500	-	-	-	Note 4
Color Chromaticity	Wx		0.27	0.31	0.35	-	Note 2 Note 5 Note 6
	Wy		0.29	0.33	0.37	-	
Luminance	L		320	400	-	cd/㎡	Note 6
Luminance Uniformity	Yu		70	75	-	%	Note 7

Test Conditions:

1. DV_{DD}=3.3V, I_L=180mA (Backlight current), the ambient temperature is 25℃.

2. The test systems refer to Note 2.

Note 1 : Definition of viewing angle range

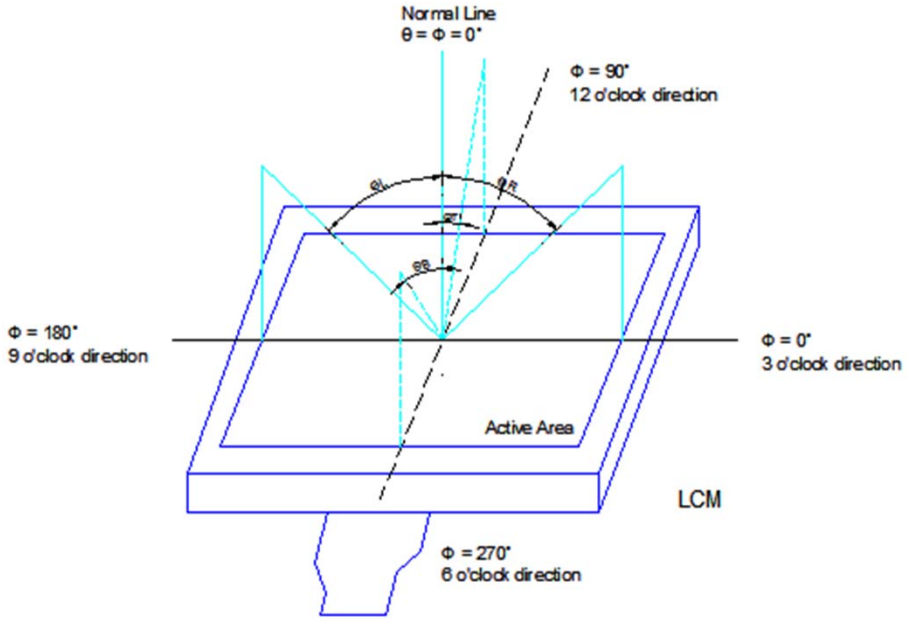


Fig. 4-1 Definition of viewing angle

Note 2 : Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 30 minutes operation, the optical properties are measured at the center point of the LCD screen.
(Response time is measured by Photo detector TOPCON BM-7,
other items are measured by BM-5A/Field of view: 1° /Height: 500mm.)

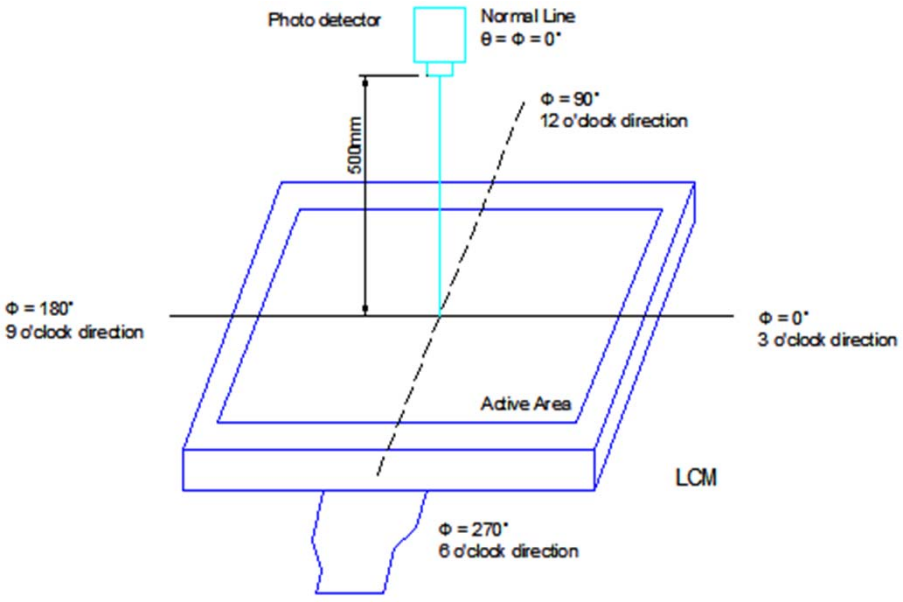


Fig. 4-2 Optical measurement system setup

Note 3 : Definition of Response time

The response time is defined as the LCD optical switching time interval between "White" state and "Black" state. Rise time (T_{ON}) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T_{OFF}) is the time between photo detector output intensity changed from 10% to 90%.

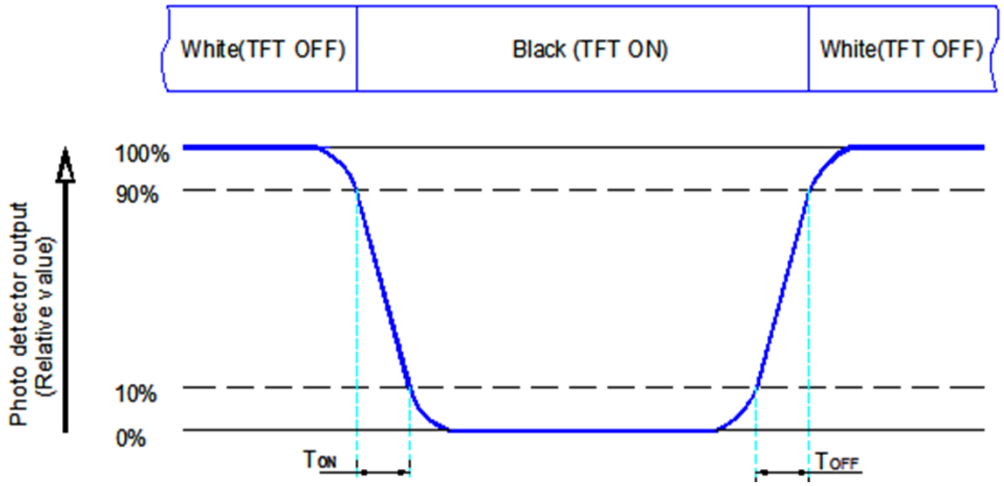


Fig. 4-3 Definition of response time

Note 4 : Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "Black" state}}{\text{Luminance measured when LCD on the " White" state}}$$

Note 5 : Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note 6 : All input terminals LCD panel must be ground while measuring the center area of the panel. The LED driving condition is I_L=180mA .

Note 7 : Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer to Fig. 4-4).

Every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity (Yu)} = \frac{\text{B min}}{\text{B max}}$$

Bmax: The measured maximum luminance of all measurement position.

Bmin: The measured minimum luminance of all measurement position.

L-------Active area length W----- Active area width

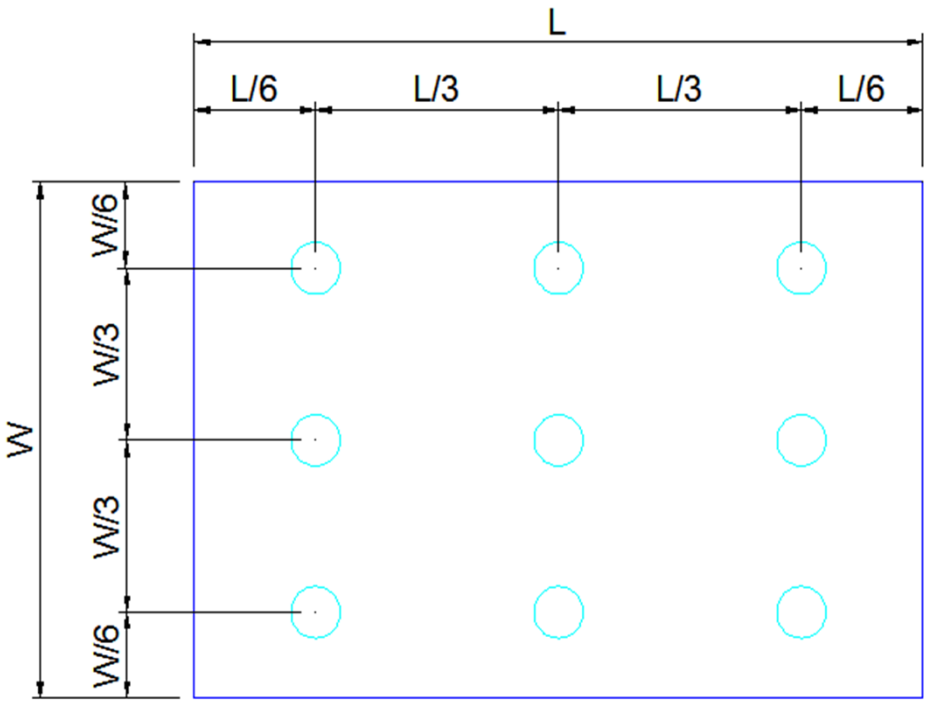


Fig. 4-4 Definition of measuring points

5. RELIABILITY TEST ITEMS

(Note 3)

ITEM	TEST CONDITION	REMARK
High Temperature Storage	Ta = 80℃ 240hrs	Note 1 , Note 4
Low Temperature Storage	Ta = -30℃ 240hrs	Note 1 , Note 4
High Temperature Operation	Ts = 70℃ 240hrs	Note 2 , Note 4
Low Temperature Operation	Ta = -20℃ 240hrs	Note 1 , Note 4
Operation at High Temperature and Humidity	60℃ , 90%RH max. 240hrs	Note 4
Thermal Shock	-30℃/30 min ~ +80℃/30 min for a total 100cycles, Start with cold temperature and end with high temperature.	Note 4
Vibration Test	Frequency range :10~55Hz Stroke :1.5mm Sweep :10Hz~55Hz~10Hz 2 hours for each direction of X. Y. Z. (6 hours for total)	-
Mechanical Shock	100G 6ms,±X, ±Y, ±Z 3 times for each direction	-
Package Vibration Test	Random Vibration : 0.015G*G/Hz from 5-200Hz, -6dB/Octave from 200-500Hz 2 hours for each direction of X. Y. Z. (6 hours for total)	-
Package Drop Test	Height : 60 cm 1 corner , 3 edges , 6 surfaces	-
Electro Static Discharge	± 2KV, Human Body Mode, 100pF/1500Ω	-

Note 1 : Ta is the ambient temperature of samples.

Note 2 : Ts is the temperature of panel's surface.

Note 3 : In the standard condition,

there shall be no practical problem that may affect the display function.

After the reliability test, the product only guarantees operation,

but don't guarantee all of the cosmetic specification.

Note 4 : Before cosmetic and function test, the product must have enough recovery time,

at least 2 hours at room temperature.

6. GENERAL PRECAUTIONS

6.1. SAFETY

Liquid crystal is poisonous. Do not put it in your mouth.

If liquid crystal touches your skin or clothes, wash it off immediately by using soap and water.

6.2. HANDLING

1. The LCD panel is plate glass.

   Do not subject the panel to mechanical shock or to excessive force on its surface.

2. The polarizer attached to the display is easily damaged.

   Please handle it carefully to avoid scratch or other damages.

3. To avoid contamination on the display surface,

   do not touch the module surface with bare hands.

4. Keep a space so that the LCD panels do not touch other components.

5. Put cover board such as acrylic board on the surface of LCD panel to protect panel from damages.

6. Transparent electrodes may be disconnected if you use the LCD panel under

   environmental conditions where the condensation of dew occurs.

7. Do not leave module in direct sunlight to avoid malfunction of the ICs.

6.3. STATIC ELECTRICITY

1. Be sure to ground module before turning on power or operating module.

2. Do not apply voltage which exceeds the absolute maximum rating value.

6.4. STORAGE

1. Store the module in a dark room where must keep at 25±10℃ and 65%RH or less.

2. Do not store the module in surroundings containing organic solvent or corrosive gas.

3. Store the module in an anti-electrostatic container or bag.

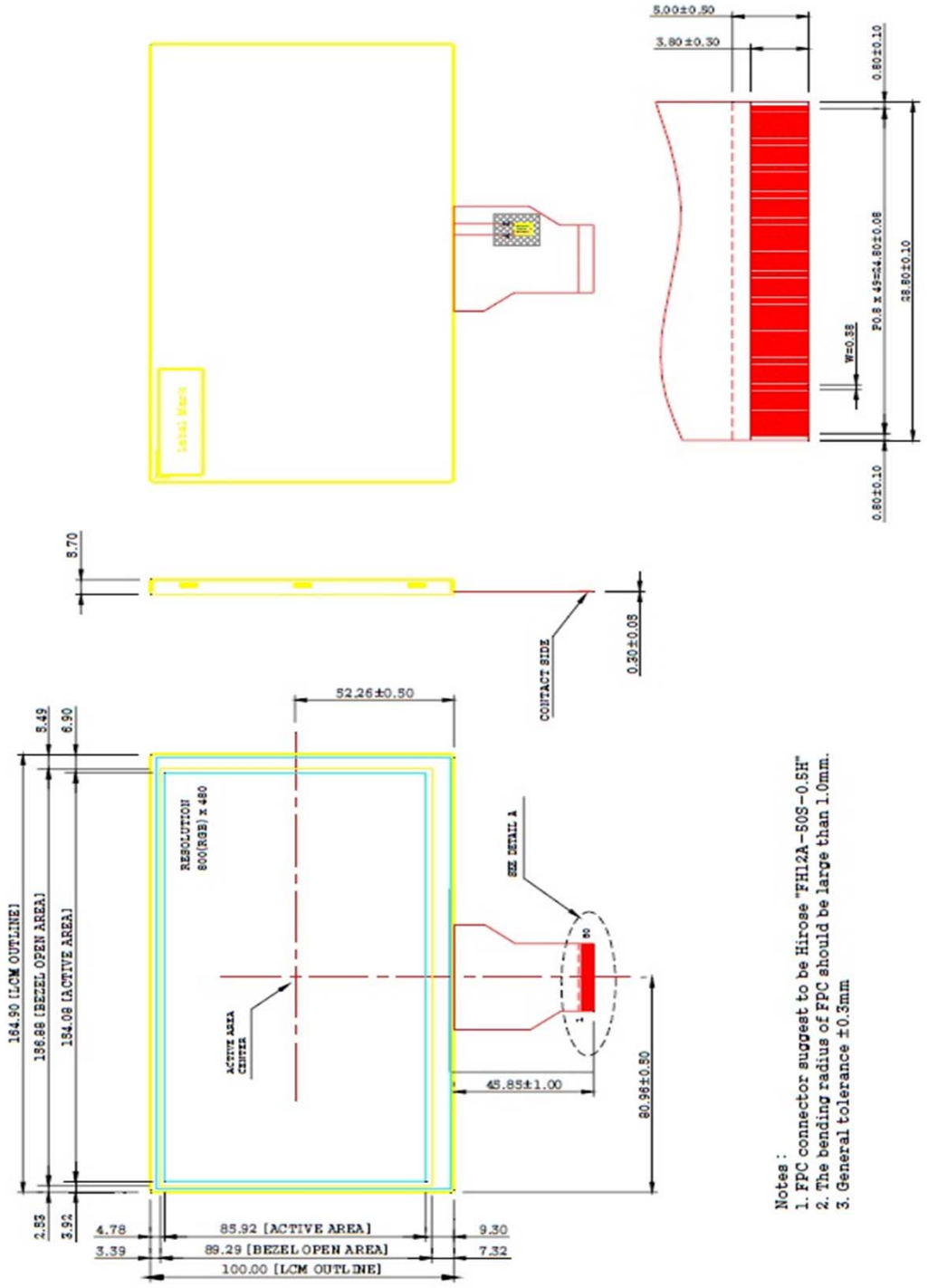
6.5. CLEANING

1. Do not wipe the polarizer with dry cloth. It might cause scratch.

2. Only use a soft sloth with IPA to wipe the polarizer,

   other chemicals might permanent damage to the polarizer.

7. MECHANICAL DRAWING



8. INCOMING INSPECTION SPECIFICATION

8-1. INCOMING INSPECTION

Both parties agree that the inspection specifications of TFT-LCD Modules (hereinafter known as "Modules") stipulated hereunder is the only and final standard applicable in the process of inspection. ENTINC shall be under no liability or obligation (including incidental loss, products liability or other consequential loss) whatsoever for any defect in quality or performance or shortage in quantity of the Modules that have passed such inspection.

8-2. LIABILITY

8-2-1. Inspection Deadline

The Customer should inspect the Modules either at the Delivery Point or within twenty (20) calendar days after arrival at the Delivery Destination.

8-2-2 . Notification of Rejection

The Customer may reject one or more defective or non-conforming Modules if the Modules fail to meet the AQL (Acceptable Quality Level) and pass the inspection. In that case, the customer should notify ENTINC of the rejection by either documents or mail within in three (3) business days from the date of reception of the Modules. Otherwise, the Modules shall be deemed to have met the AQL and passed the inspection.

8-3. INSPECTION SPECIFICATION

Both parties agree that the inspection shall contain and follow the inspection specifications stipulated in the attachment, including:

8-3-1. Scope

Specifications contain

(1) Display Quality Evaluation

(2) Mechanics Specification

8-3-2. Sampling Plan

Unless there is other agreement,

the sampling plan for incoming inspection shall follow MIL-STD-105E.

(1) Lot size: Quantity per shipment as one lot (different model as different lot).

(2) Sampling type: Normal inspection, single sampling.

(3) Sampling level: Level II.

(4) AQL: Acceptable Quality Level

Major defect: AQL=0.65

Minor defect: AQL=1.0

8-3-3. Panel Inspection Condition

(1) Environment:

Room Temperature : 25±5°C.

Humidity : 65±5% RH.

Illumination : 300 ~ 700 Lux.

(2) Inspection Distance : 35±5 cm

(3) Inspection Angle :

The vision of inspector should be perpendicular to the surface of the Module.

(4) Inspection time：

Perceptibility Test Time : 20 seconds max.

8-3-4. Display Quality

(1) Function Related :

The function defects of line defect, abnormal display, and no display are considered Major defects.

(2) Bright/Dark Dots:

Defect Type	Specification	Major	Minor
Bright Dots	N ≤ 4	-	●
Dark Dots	N ≤ 4	-	●
Total Bright and Dark Dots	N ≤ 5	-	●

Note: 1: The definition of dot :

The size of a defective dot over 1/2 of whole dot is regarded as one defective dot.

Bright dot : Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

The bright dot defect must be visible through 2% ND filter

Dark dot : Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue pattern.

(3) Pixel Definition

R	G	B	R	G	B	R	G	B	R	G	B	Dot Defect
R	G	B	R	G	B	R	G	B	R	G	B	Adjacent Defect
R	G	B	R	G	B	R	G	B	R	G	B	Cluster

Note 1 : If pixel or partial sub-pixel defects exceed 50% of the affected pixel or sub-pixel area, it shall be considered as1 defect.

Note 2 : There should be no distinct non-uniformity visible through 2% ND Filter within 2 sec inspection times.

(4) Visual Inspection specifications:

Defect Type		Specification Size	Count (N)	Major	Minor
Dot Shape (Particle, Scratch and Bubbles in display area) D = Diameter		D ≤ 0.25mm	Ignored	-	●
		0.25mm D ≤ 0.5mm	N ≤ 3		
		D > 0.5mm	N = 0		
Newton Ring (Only for Touch Panel)		D ≤ 70mm	N ≤ 4	-	●
		D > 70mm	N = 0		
TSP fish Eyes (Only for Touch Panel) (Bubble / Dent)		0.1mm< D ≤ 0.2mm	N ≤ 4	-	●
		0.2mm< D ≤ 0.3mm	N ≤ 3		
		0.3mm< D ≤ 0.4mm	N ≤ 2		
Line Shape (Particles , Scratch , Lint and Bubbles in display area) L = Length , W = Width		W ≤ 0.01mm	Ignored	-	●
		0.01mm< W ≤ 0.05mm and L ≤ 3mm	N ≤ 3		
		W >0.05mm or L >3mm	N = 0		
Bubble in cell (Active area)		It should be found by eyes		-	●
Bezel	Scratch	No harm		-	●
	Dirt				
	Wrap				
	Sunken				
Label	No label	No		-	●
	Inverted lable				
	Brocken				
	Dirt	Word can be read		-	●
	Not clear	No		-	●
	Word out of shape				
	Mistake				
	Position	Be attached on right position		-	●
Screw	Not enougt	No		-	●
	Limp				
Connector	Connection status	No bend on pins and damage		-	●
FPC/FFC	Brocken	No		-	●

Note : Extraneous substance and scratch not affecting the display of image,
for instance, extraneous substance under polarizer film but outside the display area, or scratch on metal bezel and backlight module or polarizer film outside the display area, shall not be considered as defective or non-conforming.

8-3-5. Mechanics Specifications

As for the outside dimensions and weight of the Modules,
please refer to product specifications for more details.

8-3-6. Notification for Storage Handling

(1) Storage

1) Enviroment condition must be within the product specifications,
otherwise the Module might be damaged.

2) Pile of stacking shall follow the instruction of ENTINC.

(2) Handling

1) Twisting or Bending of the Module is prohibited.

2) All chemicals are unfit for use unless otherwise instructed by ENTINC.

3) Plugging in & unplugging :
The power must be turned off before plugging in or unplugging the Module.

4) ESD protection : The Module must not be touched without proper grounding.

5) High Voltage : The rear side of Module must not be touched without protection.

6) Power sequence : Shall follow the instruction of ENTINC.

8-4. LIMITED WARRANTY

ENTINC represents and warrants that all Modules shall (i) conform to the specifications set hereunder , and (ii) be free from any defects in material and workmanship for twelve (12) months after the Customer's acceptance or deemed acceptance.

ENTINC will replace, rework or refund the Customer for the defective or non-conforming Modules at ENTINC's option, provided that the Customer

(i) promptly informs ENTINC of the defects or non-conformities within the warranty period,

(ii) complies with the specifications and conditions hereunder, and

(iii) complies with ENTINC's procedure for Modules replacement, reworking and/or return.

The warranty period for the Modules replaced or reworked shall be the remaining term for such Modules.

8-5. THE WARRANTIES AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, TERMS OR CONDITIONS, EXPRESS OR IMPLIED, EITHER IN FACT OR BY OPERATION OF LAW, STATUTORY OR OTHERWISE, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ALL OF WHICH ARE EXPRESSLY DISCLAIMED. CHIMEI-INNOLUX'S WARRANTIES HEREIN APPLY ONLY TO THE CUSTOMER AND ARE NOT TO BE EXTENDED TO ANY THIRD PARTY.

8-6. GOVERNING LOW

This Agreement shall be governed and construed in accordance with the laws of the Republic of China. Both parties agree to submit any dispute, which cannot be amicably resolved, to Hsinchu District Court for the first instance.