MODEL NO. :   TM035HBHT1-00

ISSUED DATE: 2009-11-3

VERSION   :   Ver 0.0

■ **Provisinal Specification**
□ **Final Product Specification**

Customer :

Approved by	Notes

SHANGHAI TIANMA Confirmed :

prepared by	Checked by	Approved by

This technical specification is subjected to change without notice

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Record of Revision

Rev	Issued Date	Description
0.0	2009-11-3	Provisional spec release

1   General specifications

Feature		Spec
Display Spec.	Size	3.5 inch
	Resolution	240(RGB) X 320
	Interface	RGB 18 bits+4 SPI
	Color Depth	262K
	Technology type	a-si TFT
	Pixel pitch (mm)	0.2235x0.2235
	Pixel Configuration	R.G.B. Vertical Stripe
	Display Mode	ECB Transflective
	Surface Treatment(Up Polarizer)	Clear type (3H)
	Surface Treatment(TSP)	Clear type (3H)
	Viewing Direction	12 o'clock
	Gray Scale Inversion Direction	6 o'clock
Mechanical Characteristics	DIM. LCM (W x H x D) (mm)	64x85x4.13
	Active Area(mm)	53.64x 71.52
	With /Without TSP	With TSP
	Weight (gram)	TBD
	LED Numbers	6LEDs (serial)

Note 1：Viewing direction for best image quality is different from TFT definition, there is a 180 degree shift.

Note 2 : Requirements on Environmental Protection: RoHS

2 Input/Output terminals

2.1 J2 Pin Assignment

Recommendation Connector type：FH12A-50S-0.5SH

Pin	Symbol	I/O	Description	Remark
1	VL1	P	Power supply for LED(High voltage)	
2	GND	P	Ground	
3	VL2	P	Power supply for LED(Low voltage)	
4	GND	P	Ground	
5	VSHD	P	Power supply for digital	
6	GND	P	Ground	
7	GND	P	Ground	
8	GND	P	Ground	
9	VSYNC	I	Vertical sync. in RGB mode	
10	GND	P	Ground	
11	RESET	I	Reset(Low active)	
12	GND	P	Ground	
13	GND	P	Ground	
14	GND	P	Ground	
15	CS	I	Chip select input(Low enable)	
16	GND	P	Ground	
17	SDO	O	Serial output signal	
18	SDI	I	Serial input signal	
19	GND	P	Ground	
20	SCL	I	Serial interface clock	
21	GND	P	Ground	
22	B5	I	Blue data input(MSB)	
23	B4	I	Blue data input	
24	B3	I	Blue data input	
25	B2	I	Blue data input	
26	B1	I	Blue data input	
27	B0	I	Blue data input(LSB)	
28	ENAB	I	Data enable in RGB mode	
29	GND	P	Ground	
30	HSYNC	I	Horizontal sync. in RGB mode	
31	GND	P	Ground	
32	DCLK	I	Pixel clock signal in RGB mode	
33	GND	P	Ground	
34	G5	I	Green data input(MSB)	
35	G4	I	Green data input	
36	G3	I	Green data input	
37	G2	I	Green data input	
38	G1	I	Green data input	
39	G0	I	Green data input(LSB)	

40	GND	P	Ground	
41	R5	I	Red data input(MSB)	
42	R4	I	Red data input	
43	R3	I	Red data input	
44	R2	I	Red data input	
45	R1	I	Red data input	
46	R0	I	Red data input(LSB)	
47	GND	P	Ground	
48	GND	P	Ground	
49	GND	P	Ground	
50	GND	P	Ground	

Note1: P: Power/GND; I: input pin; O: output

2.2 J1 Pin Assignment

No	Symbol	I/O	No	Symbol	I/O	No	Symbol	I/O
1	DUMMY	-	37	VCI1	O	73	DB3	I
2	NULL	-	38	VCI	P	74	DB4	I
3	VCOM	P	39	VCI	P	75	DB5	I
4	VCOM	P	40	VCI	P	76	DB6	I
5	VCOM	P	41	VCI	P	77	DB7	I
6	FPCR_IN	-	42	VSS3	P	78	DB8	I
7	FPCR_OUT	-	43	VSS3	P	79	DB9	I
8	TG	-	44	VSS	P	80	DB10	I
9	VCOM	P	45	VSS	P	81	DB11	I
10	VCOM	P	46	VSS	P	82	DB12	I
11	VCOM	P	47	VSSC	P	83	DB13	I
12	C22P	-	48	VSSC	P	84	DB14	I
13	C22M	-	49	VSSC	P	85	DB15	I
14	C21P	-	50	VSSA	P	86	DB16	I
15	C21M	-	51	VSSA	P	87	DB17	I
16	VGH	P	52	VSSA	P	88	TE	-
17	VGH	P	53	VSSA	P	89	SDO	O
18	VGL	P	54	VGS	I	90	BC	-
19	VGL	P	55	EXTC	I	91	BC_CTRL	-
20	AVDD	P	56	IM3	I	92	VDD3_P	P
21	AVDD	P	57	IM2	I	93	DB18	-
22	AVDD	P	58	IM1	I	94	DB19	-
23	C12P	-	59	IM0	I	95	DB20	-
24	C12P	-	60	RESX	I	96	DB21	-

25	C12P	-	61	CSX	I	97	DB22	-
26	C12M	-	62	DCX	I	98	DB23	-
27	C12M	-	63	WRX	I	99	VDD3	P
28	C12M	-	64	RDX	I	100	VDD3	P
29	C11P	-	65	VSYNC	I	101	VDD3	P
30	C11P	-	66	HSYNC	I	102	VDD3	P
31	C11P	-	67	ENABLE	I	103	VDD	P
32	C11M	-	68	DOTCLK	I	104	VDD	P
33	C11M	-	69	SDA	I	105	VDD	P
34	C11M	-	70	DB0	I	106	VDD	P
35	VCI1	O	71	DB1	I	107	VDD	P
36	VCI1	O	72	DB2	I	108	VDD	P

No	Symbol	I/O	No	Symbol	I/O	No	Symbol	I/O
109	GVDD	P	118	C31P	-	127	TG	-
110	GVDD	P	119	C31M	-	128	FPC_OUT	-
111	GVDD	P	120	C31M	-	129	FPC_IN	-
112	VCL	O	121	C31M	-	130	VCOM	P
113	VCL	O	122	DUMMYRI	-	131	VCOM	P
114	VCL	O	123	DUMMYR2	-	132	VCOM	P
115	VCL	O	124	VCOM	P	133	NULL	-
116	C31P	-	125	VCOM	P	134	DUMMY	-
117	C31P	-	126	VCOM	P			

P: Power/GND; I: input pin; I/O: input or output pin;

3 Absolute maximum ratings

3.1 Absolute Maximum Ratings

(GND=0, Ta = 25℃)

Parameter	Symbol	MIN	MAX	Unit	Remark
Digital supply Voltage	VSHD	2.4	3.3	V	
Supply voltage for logic block	VDD-GND	-0.3	+3.3	V	
Supply voltage for I/O block	VDD3-GND	-0.3	5.0	V	
Supply voltage for step-up circuit	VCI-GND	-0.3	5.0	V	
LCD Supply Voltage range	AVDD-GND	-0.3	6.5	V	
	VGH-GND	-0.3	22.0	V	
	GND-VGL	-0.3	22.0	V	
	GND-VCL	-0.3	5.0	V	
	|VGH-VGL|	0.3	33.0	V	
Operating Temperature	Top	-20.0	70.0	℃	
Storage Temperature	Tst	-30.0	80.0	℃	

Note 1: The parameter is for S6D04H0X02-B0C1 only.

4 LCD DC Characteristics

(GND=0,Ta=25℃)

4.1 Driving TFT LCD Panel

Parameter		Symbol	MIN	TYP	MAX	Unit	Remark
Digital supply Voltage		VSHD	2.52	2.8	3.08	V	
Gate on voltage		VGH	13.5	15.0	16.5	V	
Gate off voltage		VGL	-11.0	-10.0	-9.0	V	
Input Signal Voltage	Low Level	V_{IL}	0	-	0.3*VSHD	V	
	High Level	V_{IH}	0.7*VSHD	-	VSHD	V	
Output Signal Voltage	Low Level	VOL	0.0	-	0.2 VSHD	V	
	High Level	VOH	0.8VSHD	-	VSHD	V	
Current of VSHD Power supply		I_{CC}	-	TBD	-	mA	Note 1

Note1:To test the current dissipation,use"all Black Pattern".

4.2 Backlight Unit Driving Condition

(GND=0,Ta=25℃)

Parameter	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I_F	-	20	-	mA	Note 1
Forward Voltage	V_F	-	19.2	-	V	Note 2
Backlight Power	W_{BL}	-	384	-	mW	

Note 1 : The LED driving condition is defined for each LED module。
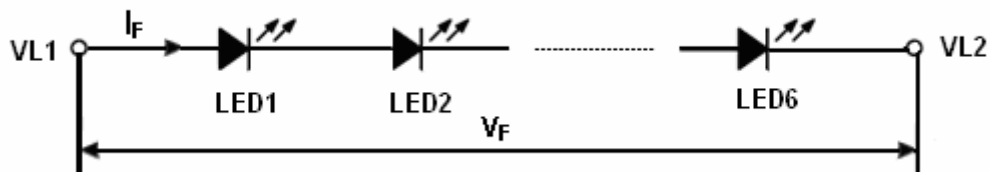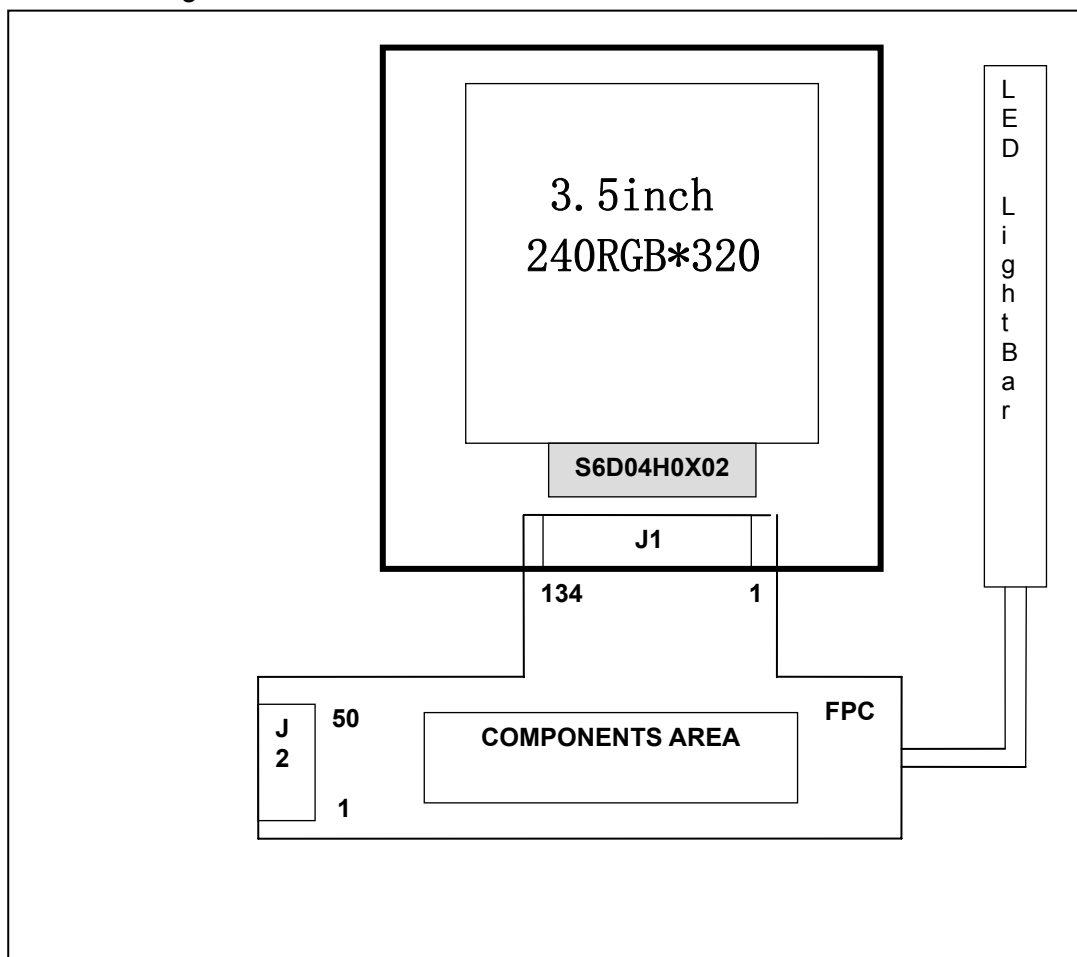Note 2: Backlight unit driving must depend on Forward Current setting.

Fig.4-1 LED connection of backlight

4.3 Block Diagram

5. AC ELECTRICAL CHARACTERISTICS

5.1 RGB INTERFACE CHARACTERISTICS

5.1.1 RGB Interface Timing
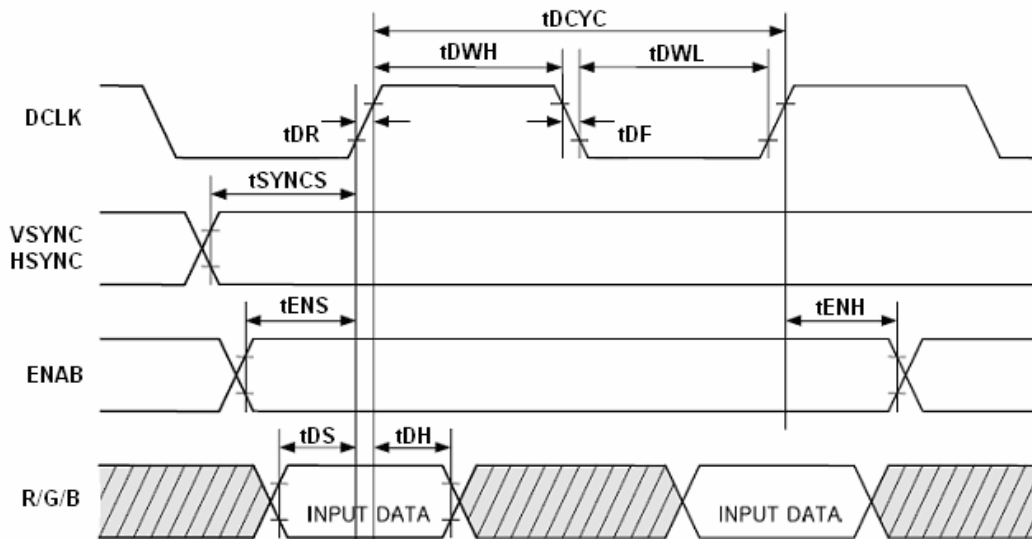
Fig.5-1 RGB Interface Timing
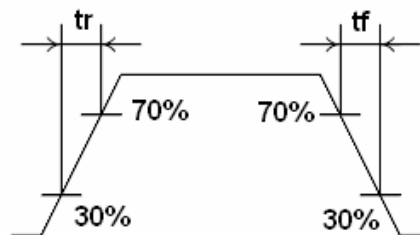
Fig.5-2 Input signal's rise and fall times

Tab.5-1 RGB Interface AC Characteristics

(VSHD=2.4~3.3V,Ta=-40~+85℃)

Parameter	Description	Min	Max	Unit	Remark
tDCYC	DCLK period	100	-	ns	
tDWL	DCLK pluse width low	50	-	ns	
tDWH	DCLK pluse width high	50	-	ns	
tDR/tDF	DCLK rising/falling time	-	20	ns	
tSYNCS	VSYNC,HSYNC setup	30	-	ns	Note1
tENS	ENAB setup	50	-	ns	
tENH	ENAB hold	50	-	ns	
tDS	Input Data setup	50	-	ns	
tDH	Input Data hold	50	-	ns	
tf	signal's rise time	-	15	ns	Note2
tr	signal's fall time	-	15	ns	Note2

Note1： VSYNC Low Pulse Width≥1H;HSYNC Low Pluse Width≥1DCLK

Note 2： For all signals.

5.1.2 Recommend RGB Interface Timing
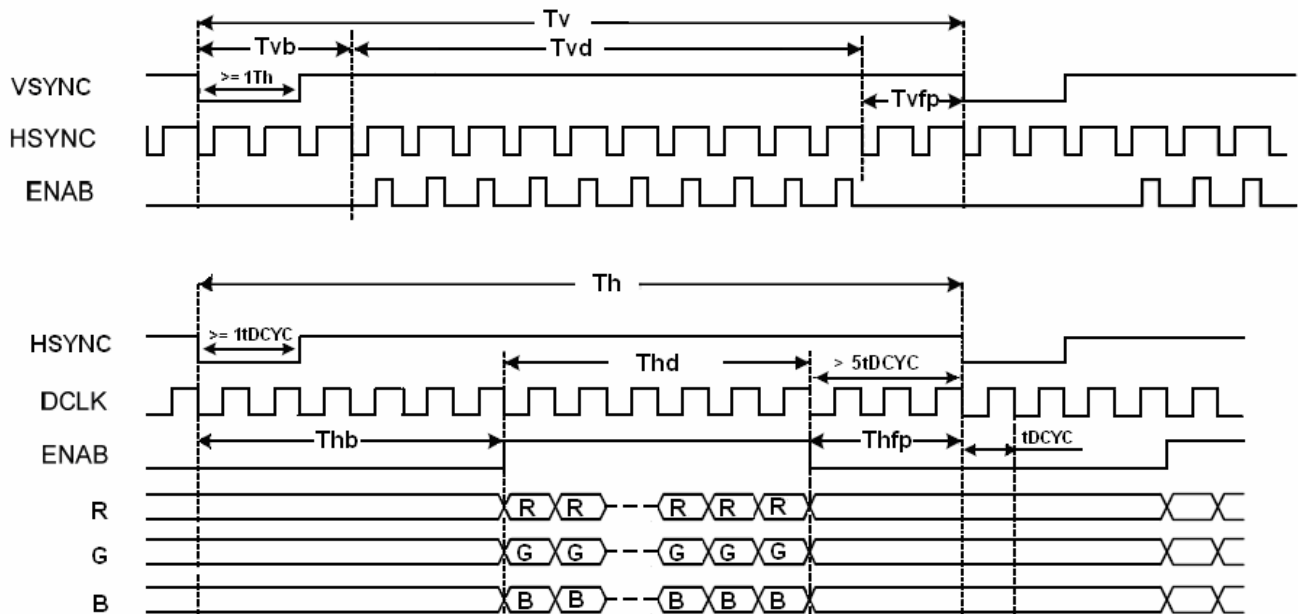
Fig.5-3 Recommend RGB Interface Timing

Tab.5-2 Recommend Input Timing (DCLK, HSYNC, VSYNC, ENAB)

(VSHD=2.4~3.3V,Ta=-40~+85℃)

Parameter	Symbol	Symbol	Min.	Typ.	Max.	Unit	Remark
DCLK	DCLK frequency	fDCYC	-	5.64	10	MHz	
	DCLK period	tDCYC	100	177.15	-	ns	
HSYNC	Horizontal	Thd		240		Tclk	
	1horizontalline	Th	259	280	-		
	Horizontal blank	Thb	3	20	-		
	Horizontal front porch	Thfp	15	20	-		
VSYNC	Vertical display area	Tvd		320		Th	
	Vsync period time	Tv	325	336	-		
	Vsync blank	Tvb	2	8	-		
	Vsync Front porch	Tvfp	2	8	-		

5.2 3-WIRE 9-BIT SERIAL INTERFACE

5.2.1 3-Wire 9-Bit data serial interface write mode
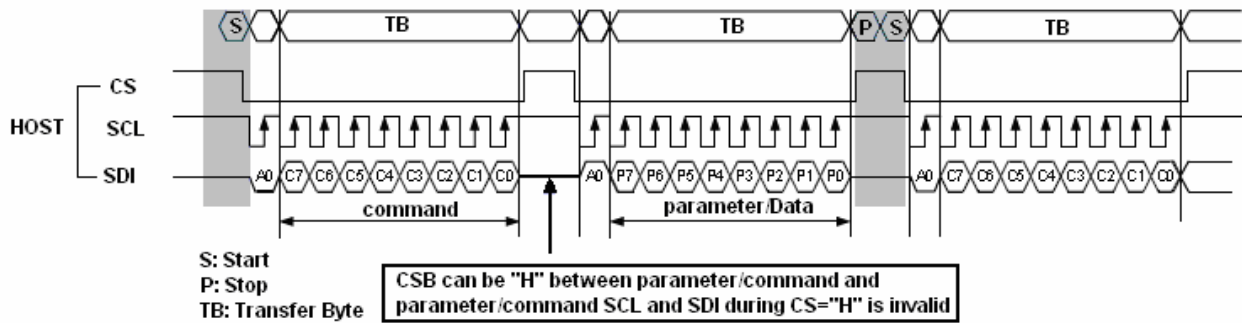
Figure. 5-4 3-Wire 9-Bit Serial Interface I Bus Protocol, Write to Register or Display RAM
Note: A0=0, Transfer Command; A0=1, Transfer Data.
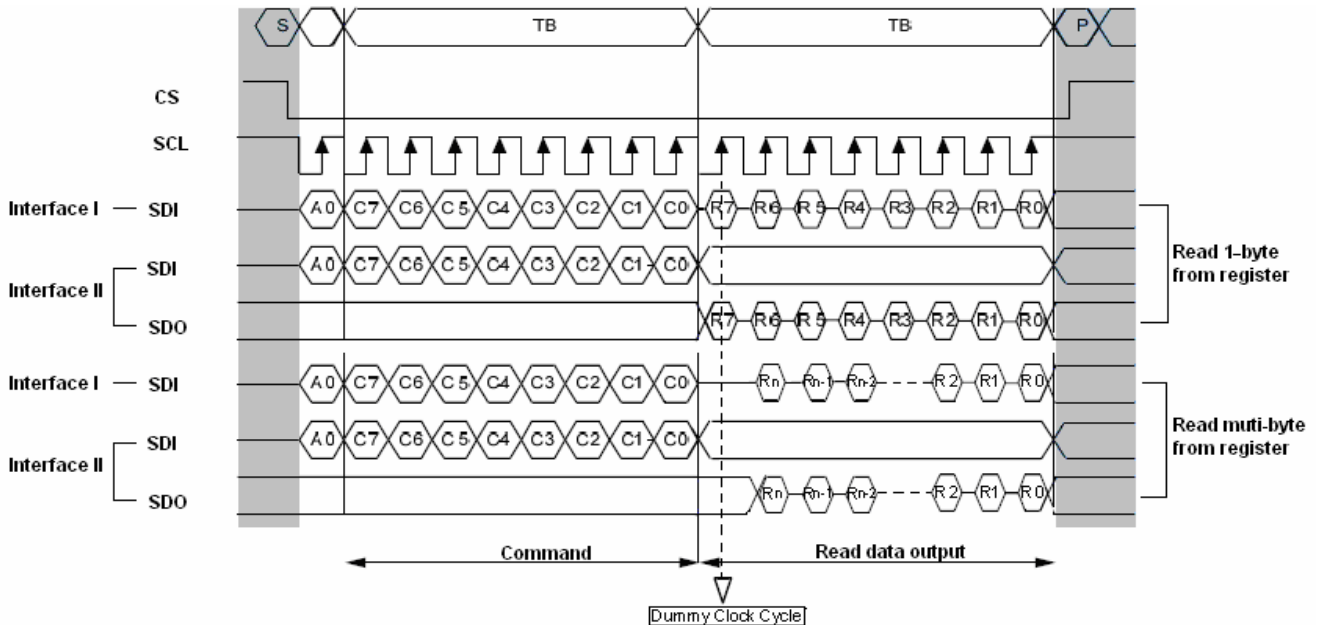
5.2.2 3-Wire 9-Bit data serial interface read mode

Figure. 5-5 3-Wire 9-Bit Serial Interface I/II Bus Protocol, Read From Register
Note: A0=0, Transfer Command; A0=1, Transfer Data.
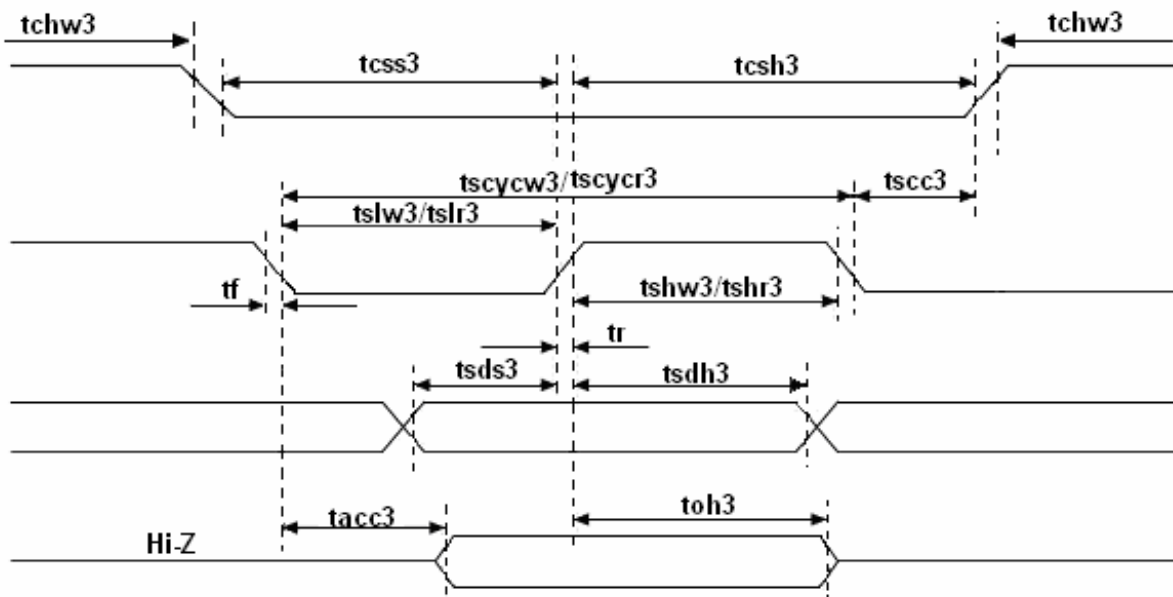

5.2.3 3-Wire 9-Bit serial interface Timing

Fig.5-6 AC Characteristics of 3-Wire 9-Bit Serial Interface timing

Tab.5-3 AC Characteristics of 3-Wire 9-Bit Serial Interface

(VSHD=2.4~3.3V,Ta=-40~+85℃)

Parameter	Symbol	Conditions	Min	Max	Unit	Remark
Serial Clock Cycle(Write)	tscycw3	SCL	100	-	ns	
SCL "H" pluse width(Write)	tshw3	SCL	35	-	ns	
SCL "L" pluse width(Write)	tslw3	SCL	35	-	ns	
Data setup time(Write)	tsds3	SDA	30	-	ns	
Data hold time(Write)	tsdh3	SDA	30	-	ns	
Serial Clock Cycle(Read)	tscycr3	SCL	150	-	ns	
SCL "H" pluse width(Read)	tshr3	SCL	60	-	ns	
SCL "L" pluse width(Read)	tslr3	SCL	60	-	ns	
Access time	tacc3	SDO(Note2)	10	50	ns	
Output disable time	toh3	SDO(Note2)	15	50	ns	
CS "H" pluse width	tchw3	CS	40	-	ns	
CS-SCL time	tcssw3	CS (Write)	60	-	ns	
	tcshw3	CS (Write)	65	-	ns	

Note: For maximum CL=30pF, for minimum CL=8pF

5.3 Reset Timing
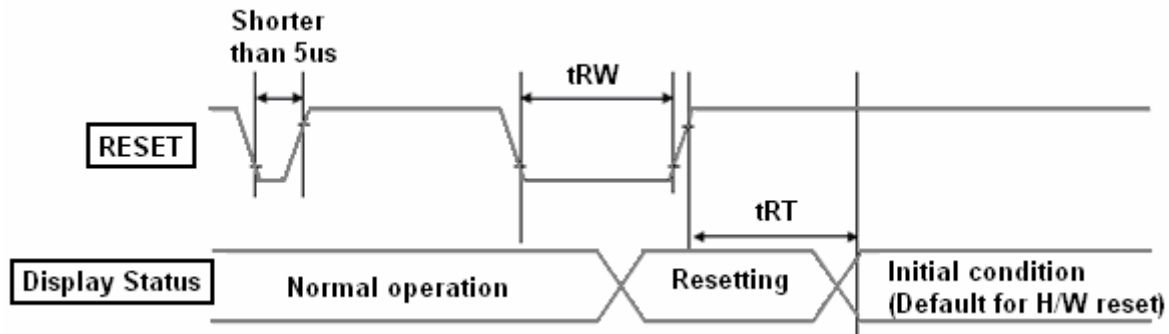
Fig.5-7 Reset timing

Tab.5-4 Reset input timing

Parameter	Symbol	MIN	TYP	MAX	Unit	Remark
RESET	tRW	10	-	-	us	-
	tRT	-	-	5	ms	note 1
		-	-	120	ms	note 2

Note1: When Reset applied during Sleep In Mode.
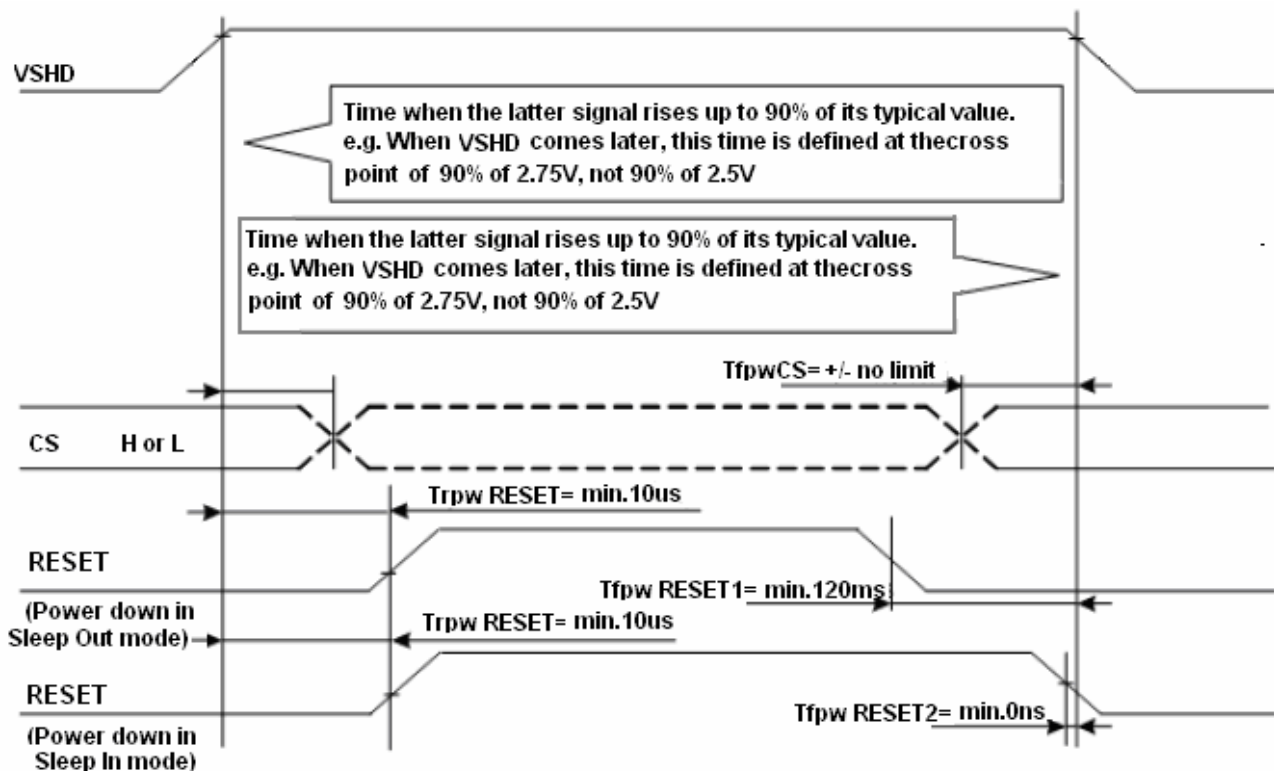Note2: When Reset applied during Sleep Out Mode.

5.4 POWER ON/OFF SEQUENCE

Fig.6-1 Power On/Off Sequence

Note 1. Tfpw RESET1 is applied to RESET falling in the sleep out mode.
Note 2. Tfpw RESET2 is applied to RESET falling in the sleep in mode.

## 6   Optical characteristics

6.1 Optical Specification

Ta=25℃

Item		Symbol	Condition	Min	Typ.	Max.	Unit	Remark
View Angles		$\ominus$T	CR≧10	40	45	-	Degree	Note 2
		$\ominus$B		40	45	-		
		$\ominus$L		40	45	-		
		θR		40	45	-		
Contrast Ratio		CR	θ=0°	200	350	-		Note1 Note3
Response Time		Ton	25℃	-	35		ms	Note1 Note4
		Toff						
Chromaticity	White	x	Brightness is on	0.290	0.300	0.310		Note5, Note1
		y		0.300	0.310	0.320		
	RED	x			TBD			
		y			TBD			
	GREEN	x			TBD			
		y			TBD			
	BLUE	x			TBD			
		y			TBD			
Uniformity		U			80	-	%	Note1 Note6
NTSC				-	30	-	%	Note 5
Luminance		L		100	125	-	cd/m^2	Note1 Note7
Reflectance					6		%	Note8

Test Conditions:

1.   VDD=2.8V, I_L=20mA(LED current), the ambient temperature is 25℃.

2.   The test systems refer to Note 1 , Note 2 and Note 8.

Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.
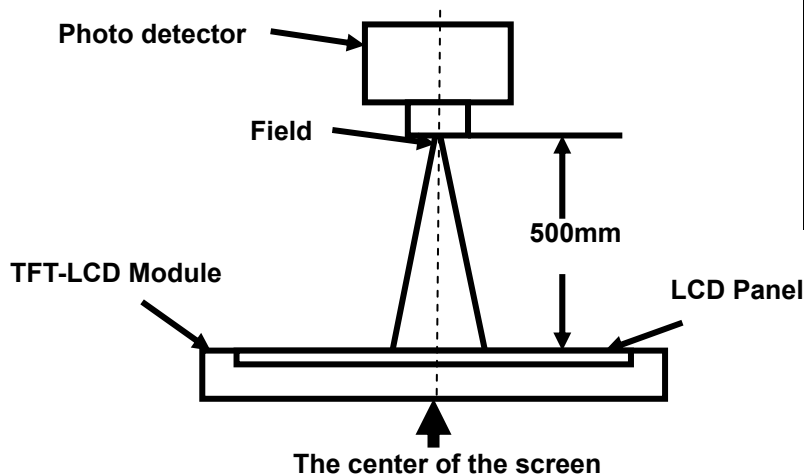
Item	Photo detector	Field
Contrast Ratio	SR-3A	1°
Luminance		
Chromaticity		
Lum Uniformity		
Response Time	BM-7A	2°

Photo detector

Field

500mm

TFT-LCD Module

LCD Panel

The center of the screen

Note 2: Definition of viewing angle range and measurement system.

viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80)。

Φ=90°
12 o'clock direction

Normal line
θ=Φ=0°

$θ_L$

$θ_T$ $θ_R$

Φ=180°

Φ=0°

$θ_B$

Active Area

Φ=270°
6 o'clock direction
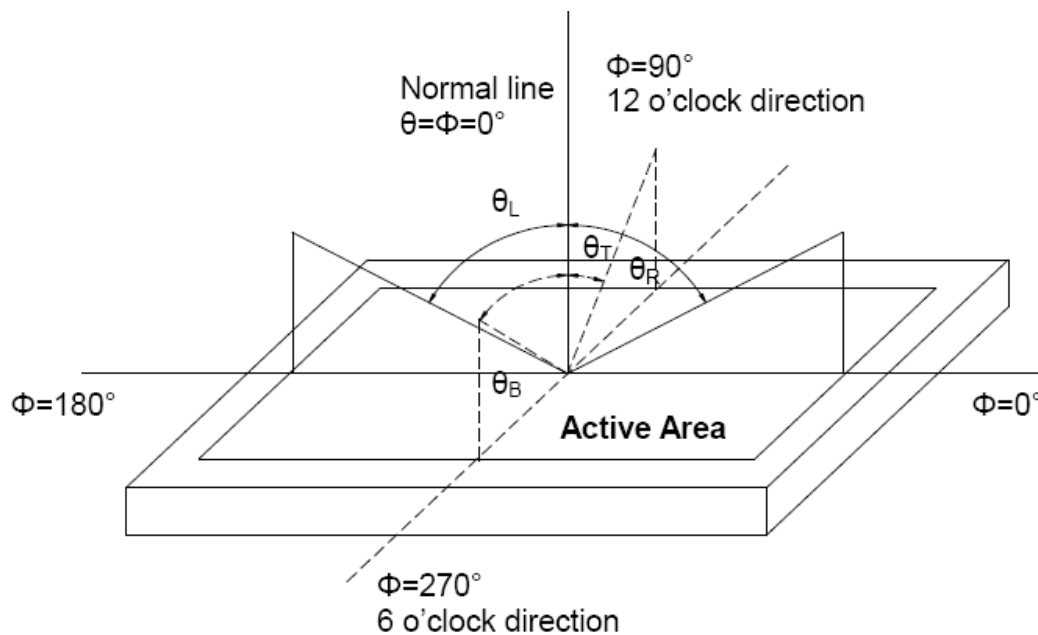
Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

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

"White state ":The state is that the LCD should driven by Vwhite.

"Black state": The state is that the LCD should driven by Vblack.

Vwhite: To be determined   Vblack: To be determined.

Note 4: Definition of Response time

The response time is defined as the LCD optical switching time interval between "White" state and "Black" state. Rise time (TON) is the time between photo detector output intensity changed from 90% to 10%. And fall time (TOFF) is the time between photo detector output intensity changed from 10% to 90%.
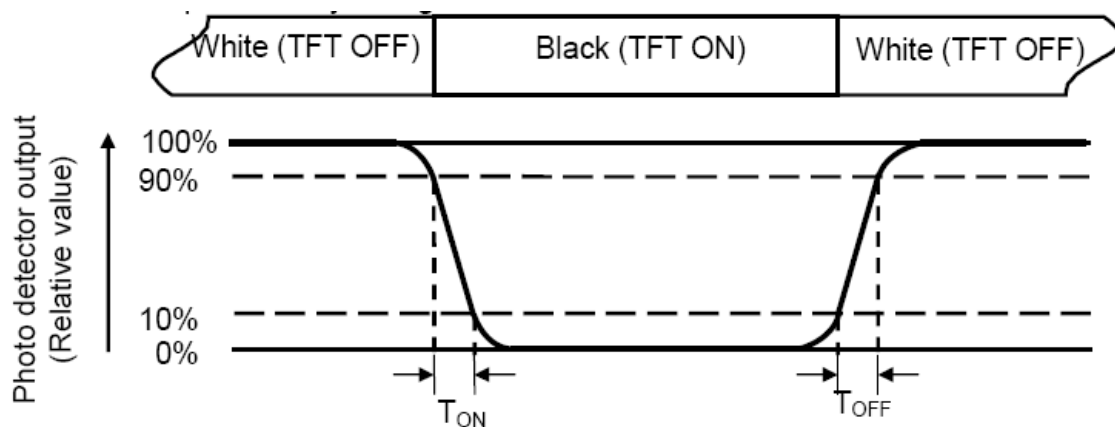
Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note 6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity(U) = Lmin/ Lmax
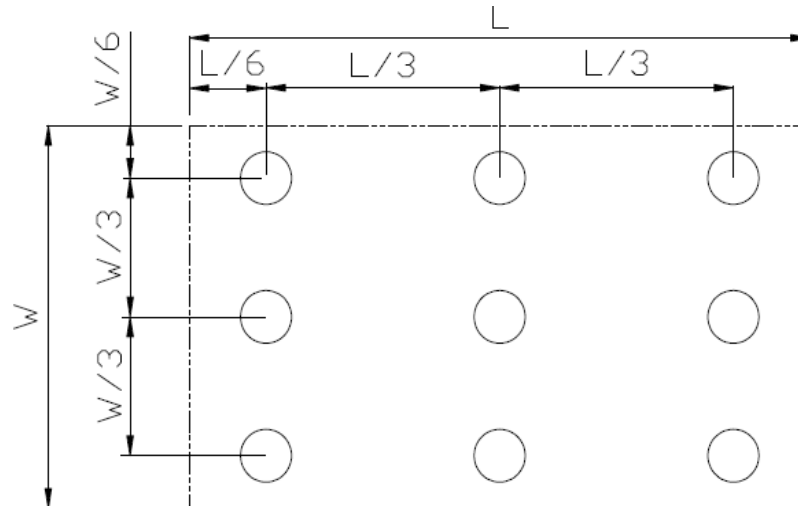
L-------Active area length W----- Active area width

Fig. 2 Definition of uniformity

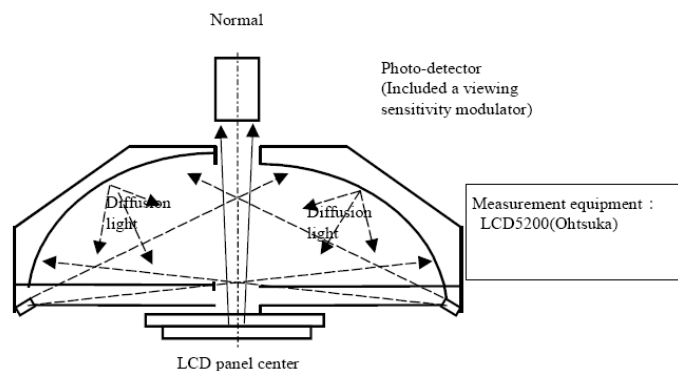Lmax: The measured maximum luminance of all measurement position.

Lmin: The measured minimum luminance of all measurement position.

Note 7: Definition of Luminance :

Measure the luminance of white state at center point.

Note 8: Definition of Reflectance measurement system

Note 5) Reflectance is defined as follows:

7 Environmental / Reliability tests

No	Test Item	Condition	Remarks
1	High Temperature Operation	Ts=+60℃, 240hrs	Note1 IEC60068-2-2,GB2423.2—89
2	Low Temperature Operation	Ta=-20℃, 240hrs	IEC60068-2-1 GB2423.1—89
3	High Temperature Storage	Ta=+70℃, 240hrs	IEC60068-2-2, GB2423.2—89
4	Low Temperature Storage	Ta=-30℃, 240hrs	IEC60068-2-1 GB2423.1—89
5	High Temperature & High Humidity Storage	+40℃, 90% RH max,240 hours	Note2 IEC60068-2-3, GB/T2423.3—2006
6	Thermal Shock (Non-operation)	-30℃ 30 min~+70℃ 30 min, Change time:5min, 20 Cycle	Start with cold temperature, End with high temperature, IEC60068-2-14,GB2423.22—87
7	Electro Static Discharge (Operation)	C=150pF, R=330Ω，5points/panel Air:± 8KV, 5times; Contact:± 4KV, 5 times; （Environment: 15℃～35℃, 30%～60%, 86Kpa～106Kpa）	IEC61000-4-2 GB/T17626.2—1998
8	Vibration (Non-operation)	Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 1 hours for each direction of X.Y.Z.(3 hours for total)	IEC60068-2-6 GB/T2423.10—1995
9	Shock (Non-operation)	60G 6ms, ± X,± Y,± Z 3times for each direction	IEC60068-2-27 GB/T2423.5—1995
10	Package Drop Test	Height:80 cm，1 corner, 3 edges, 6 surfaces	IEC60068-2-32 GB/T2423.8—1995

Note1: Ts is the temperature of panel's surface.

Note2: Ta is the ambient temperature of sample.

8　Mechanical drawing
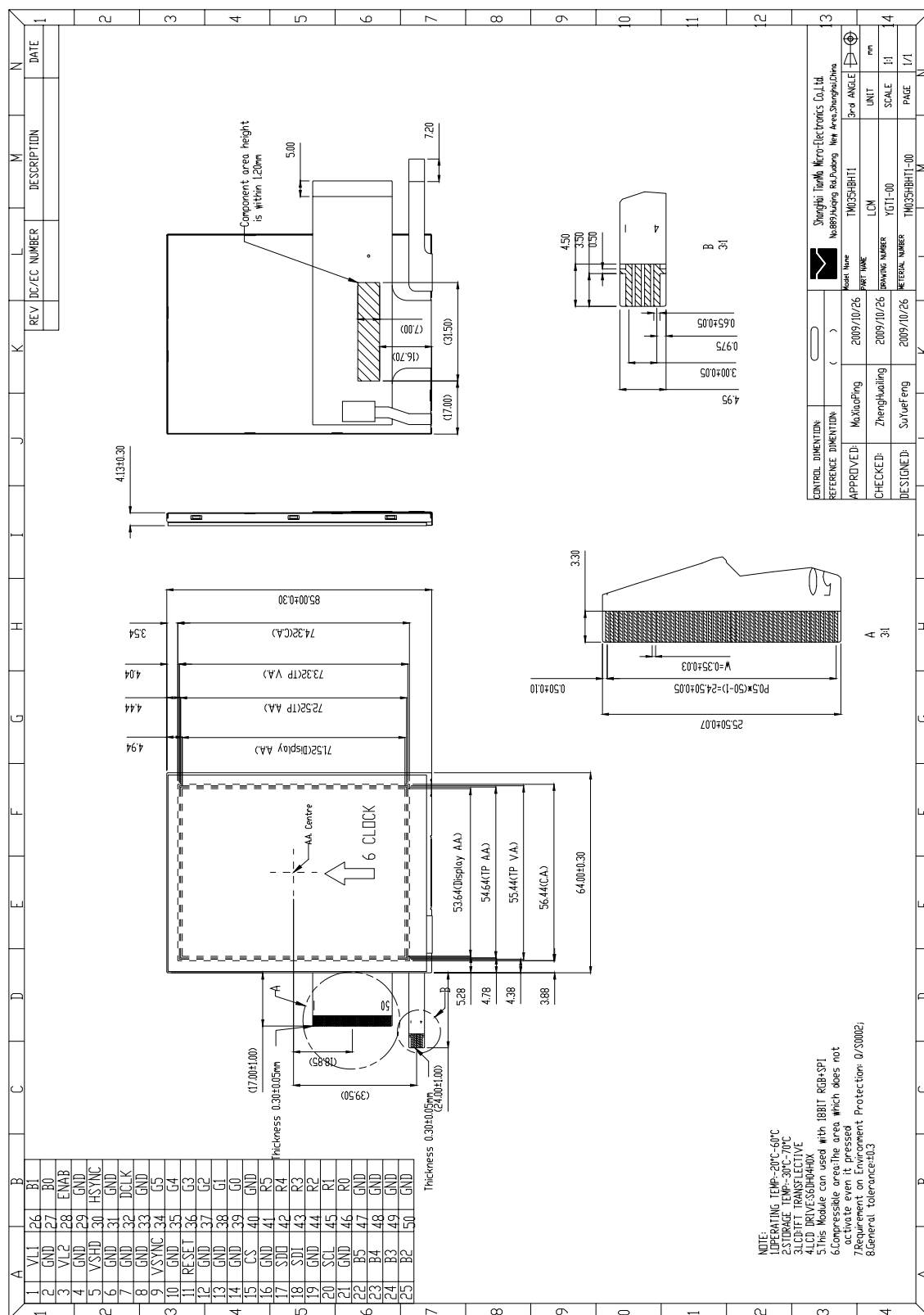
9 Packing drawing

10 Precautions for use of LCD modules

10.1 Handling Precautions

10.1.1　The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

10.1.2　If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

10.1.3　Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

10.1.4　The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

10.1.5　If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

－ Isopropyl alcohol、

－ Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

－ Water

－ Ketone

－ Aromatic solvents

10.1.6　Do not attempt to disassemble the LCD Module.

10.1.7　If the logic circuit power is off, do not apply the input signals.

10.1.8　To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

10.1.8.1 Be sure to ground the body when handling the LCD Modules.

10.1.8.2　Tools required for assembly, such as soldering irons, must be properly ground.

10.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

10.1.8.4 The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

10.2 Storage precautions

10.2.1　When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

10.2.2　The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0℃ ～ 40℃   Relatively humidity: ≤80%

10.2.3　The LCD modules should be stored in the room without acid, alkali and harmful gas.

10.3 Transportation Precautions:

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.