



倍顯(香港)有限公司
Facelcd(HongKong) Limited

SPECIFICATION FOR LCD MODULE

Customer : _____
Product Model: FB039XSG504-A
Sample code: _____

Designed by	Checked by	Approved by

Final Approval by Customer

☐ LCM Machinery OK Checked By _____ ☐ LCM Display OK Checked By _____	☐ LCM OK ☐ NG , Problem survey: Approved By _____
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※The specification of "TBD" should refer to the measured value of sample . If there is difference between the design specification and measured value, we naturally shall negotiate and agree to solution with customer.



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1. Record of Revision

Rev	Issued Date	Description	Editor
1.0	2014/8/14	First Release.	
2.0	2015/07/07	Update spece	
3.0	2015/07/17	Add Backlight life time	
4.0	2015/09/09	Update spece	
5.0	2015/09/14	Update HV mode	
6.0	2016/10/10	Update PN	
7.0	2016/11/08	Update Packing	
8.0	2016/11/24	Update Timing	
9.0	2016/12/29	Update Timing	



2. General Specifications

Feature		Spec
Characteristics	Size	3.9 inch
	Resolution	480(horizontal)*128(Vertical)
	Interface	RGB 24bit (HV mode)
	Connect type	Connector
	Color Depth	24bit
	Technology type	a-Si
	Display Spec. Pixel pitch (mm)	0.198 x 0.198
	Display colors	16.7M Dithering
	Pixel Configuration	R.G.B. Vertical Stripe
	Display Mode	Normally White
	Driver IC	ILI6480
	Surface Treatment	HC
	Viewing Direction	12 O'clock
	Gray Scale Inversion Direction	6 O'clock
Mechanical	LCM (W x H x D) (mm)	105.5*40.64*2.95
	Active Area(mm)	95.04 x 25.34
	With /Without TSP	WithOUT TSP
	Weight (g)	TBD
	LED Numbers	10 LEDs

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

Note 3: LCM weight tolerance: +/- 5%



3. Input/Output Terminals

No.	Symbol	Description
1	VBL-	Backlight LED Cathode
2	VBL+	Backlight LED Anode.
3	GND	System Ground
4	VCC	Power supply for logic operation
5~12	R0~R7	Data bus
13~20	G0~G7	Data bus
21~28	B0~B7	Data bus
29	GND	System Ground
30	CLK	Pixel clock signal
31	DISP	Display on/off control
32	HSYNC	Horizontal Sync signal
33	VSYSN	Vertical Sync signal
34	DEN	Data Enable Remark: internal pulled weak low
35	NC	No connection
36	GND	System Ground
37	XR(NC)	The right side signal of TP
38	YD(NC)	The down side signal of TP
39	XL(NC)	The left side signal of TP
40	YU(NC)	The up side signal of TP



4. Absolute Maximum Ratings

Recommended Operating Range

(GND=AGND=PGND=0V, TA= -20 to +85°C)

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Digital Supply Voltage	VDD	3.0	3.3	3.6	V	
Charge Pump Supply Voltage	PVDD	3.0	3.3	3.6	V	
Digital interface supply Voltage	VDDIO	1.8	-	VDD	V	
Digital Input Voltage	Din	0	-	VDDIO	V	
OTP Supply Voltage	VPP_OTP	-	6	-	V	
VCOM AC Voltage	VCOMH - VCOML	2.96	-	6.2	V	

Item	Symbol	MIN	MAX	Unit	Remark
Operating Temperature	T _{OPR}	-20	70	°C	
Storage Temperature	T _{STG}	-30	80	°C	



5. Electrical Characteristics

5.1 DC Electrical Characteristics

(VDDIO=VDD=3.0 to 3.6V, GND=AGND=PGND=0V, TA= -20 to 85 °C)

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Digital Block Circuit						
Low Level Input Voltage	Vil	GND	-	0.3xVDDIO	V	Digital input pins
High Level Input Voltage	Vih	0.7xVDDIO	-	VDDIO	V	Digital input pins
Input Leakage Current	Ii	-	-	±1	uA	Digital input pins
Pull-high/low Impedance	Rin	-	200K	-	ohm	Digital control input pins VDDIO=3.3V
High Level Output Voltage	Voh	VDDIO-0.4	-	-	V	Digital input pins Ioh=400uA
Low Level Output Voltage	Vol	GND	-	GND+0.4	V	Digital output pins Iol=-400uA
Digital Stand-by Current	Idst	-	TBD	TBD	uA	Output are High-Z, all pins are default
Digital Operating Current	Icc	-	TBD	-	mA	DCLK=9MHz, Fid=17.28KHz (@ 24bit RGB mode), no load
Analog Block Circuit						
Analog Supply Voltage	AVDD	-	5.2	5.6	V	
GAMMA reference voltage	VDDA	-	5	-	V	
Step-up Circuit 1 Output Voltage	VINT1	5.8	-	-	V	
VCOMH Output Level	VCOMH	2.46	-	5	V	By VCOMH[6:0] setting
VCOML Output Level	VCOML	-3	-	-0.46	V	By VCOML[6:0] setting; VCOML>VINT3
Feed back voltage for PWM VFB	0.25 0.6	0.8 V	-	-	-	DC-DC operating.
Base drive current for PWM	IDRV	-	20	-	mA	VDD=3.3V

Voltage Deviation of Outputs	Vvd	-	±20	±35	mV	Vo=0.1V ~ 0.5V & AVDD-0.5 ~ AVDD-0.1
		-	±15	±20	mV	Vo=0.5V ~ AVDD-0.5V
Dynamic Range of Ouput	Vdr	0.1	-	AVDD-0.1	V	S1 to S720
Low-level Output Current of VCOM	IOLC	-	TBD	-	mA	VCOMH=4V, VCOML=-1V VCOM output=-1V V.S. -0.1V
High-level Output Current of VCOM	IOHC	-	TBD	-	mA	VCOMH=4V, VCOML=-1V VCOM output=4V V.S. 3.1V
Source Low-level Output Current	IOLS	TBD	-	-	uA	S1 to S720; VO=0.1 V.S. 1V
Source High-level Output Current	IOHS	TBD	-	-	uA	S1 to S720; VO=4.9 V.S 4.0
Gate Low-level Output Current	IOLG	TBD	-	-	uA	G1 to G544; VO=VGL V.S. VGL+0.5
Gate High-level Output Current	IOHG	TBD	-	-	uA	G1 to G544; VO=VGH V.S. VGH-0.5
Analog Stand-by Current	Iast	-	-	100	uA	STB="L", all function are shutdown
Analog Operating Current	IDD	-	TBD	-	mA	DCLK=9MHz, Fid=17.28KHz (@ 24bit RGB mode), No load



5.2 Driving Backlight

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I_F	36	40	50	mA	
Forward Voltage	V_F	15	16	17.5	V	
Backlight Power consumption	W_{BL}	-	TBD	-	W	
Backlight life time			25000		Hr	

Note 1: Each LED: $I_F = 20 \text{ mA}$, $V_F = 3.2 \text{ V}$.

Note 2: Optical performance should be evaluated at $T_a = 25^\circ \text{C}$ only.

Note 3: If LED is driven by high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.

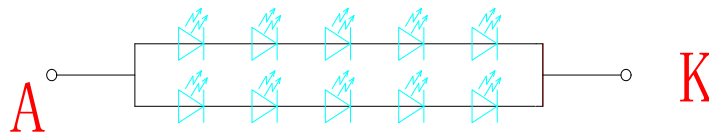
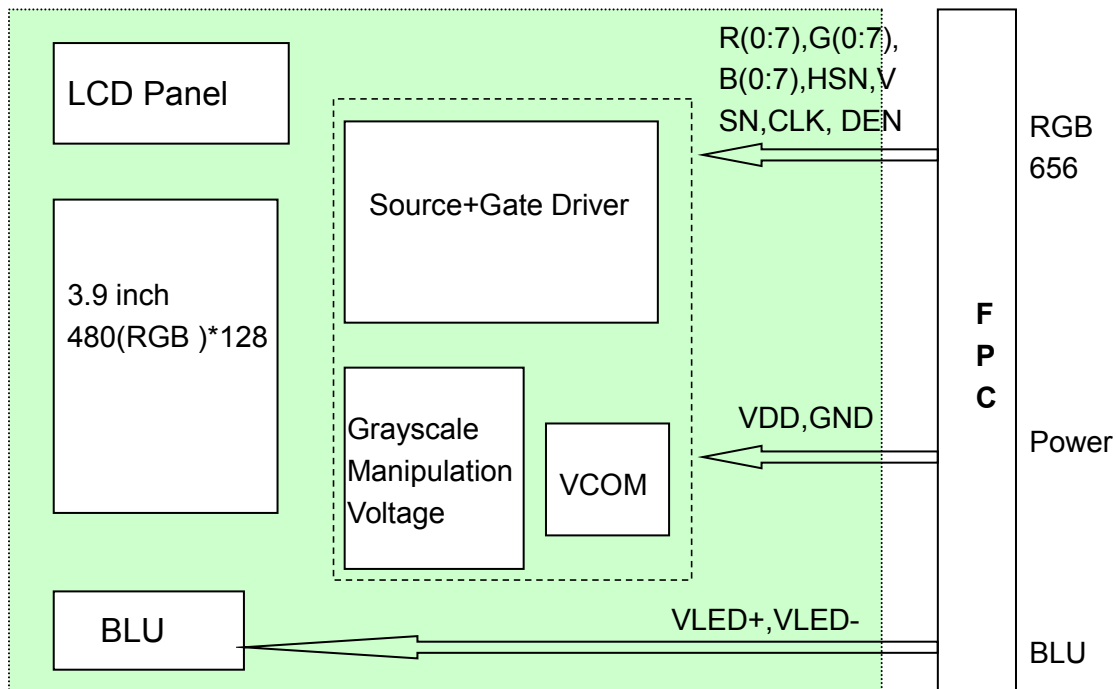
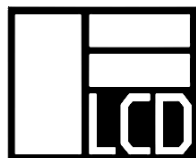


Figure: LED connection of backlight

5.3 Block Diagram



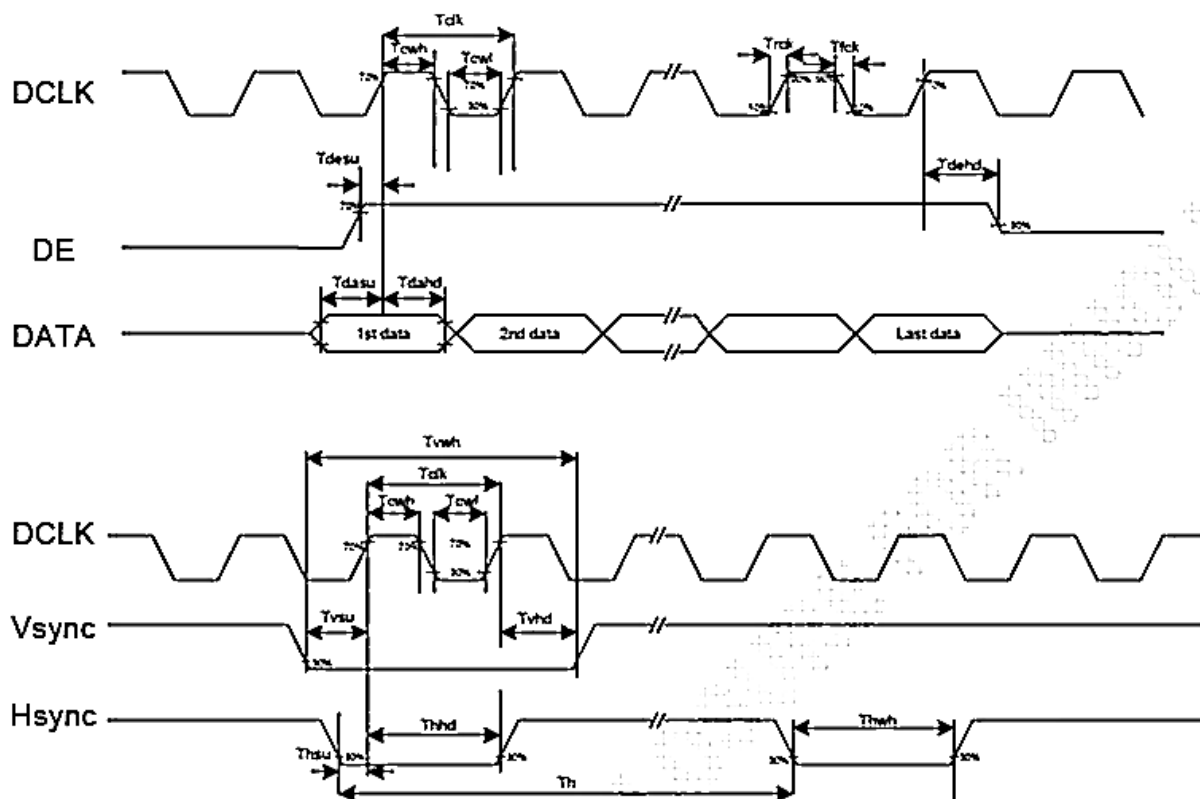


6. Interface Timing

6.1 AC Characteristic

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
System operation timing						
VDD power source slew time	TPOR	-	-	20	ms	From 0V to 99% VDD
GRB pulse width	tIRSTW	10	50	-	us	R=10Kohm, C=1uF
Input Output timing						
DCLK clock time	Tclk	33.3	-	-	ns	DCLK=30MHz
DCLK clock low period	Tcwl	40	-	60	%	
DCLK clock high period	Tcwh	40	-	60	%	
Clock rising time	Trck	9	-	-	ns	
Clock falling time	Tfck	9	-	-	ns	
HSD width	Thwh	1	-	-	DCLK	
HSD period time	Th	55	60	65	us	
HSD setup time	Thsu	12	-	-	ns	
HSD hold time	Thhd	12	-	-	ns	
VSD width	Tvwh	1	-	-	Th	
VSD setup time	Tvsu	12	-	-	ns	
VSD hold time	Tvhd	12	-	-	ns	
Data setup time	Tdasu	12	-	-	ns	
Data hold time	Tdahd	12	-	-	ns	
DE setup time	Tdesu	12	-	-	ns	
DE hold time	Tdehd	12	-	-	ns	
Source output setting time	Tsst	-	-	TBD	us	10% to 90% CL=60pF, RL=2Kohm
Gate output setting time	Tgst	-	-	TBD	ns	10% to 90%, CL=60pF
VCOM output setting time	Tcst	-	-	TBD	us	10% to 90%, CL=40nF, RL=50ohm
Time from VSD to 1st line data input	Tvs	3	8	31	Th	HV mode By HDL[4:0] setting
3-wire serial communication AC timing						
Serial clock	Tsck	200	-	-	ns	For SCL pin
SCL pulse low period	Tckl	40	-	60	%	
SCL pulse high period	Tckh	40	-	60	%	
Serial data setup time	Tisu	50	-	-	ns	
Serial data hold time	Tihd	50	-	-	ns	
Serial clock high/low	Tssw	50	-	-	ns	
CSB to VSD	Tcv	1			us	
CSB distinguish time	Tcd	400	-	-	ns	
CSB input setup time	Tcsu	50	-	-	ns	
CSB input hold time	Tchd	50	-	-	ns	

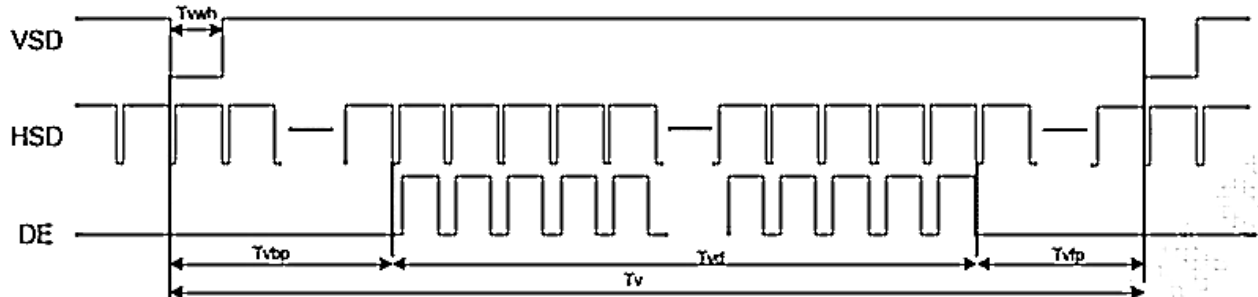
6.2 Clock and Data input Waveforms



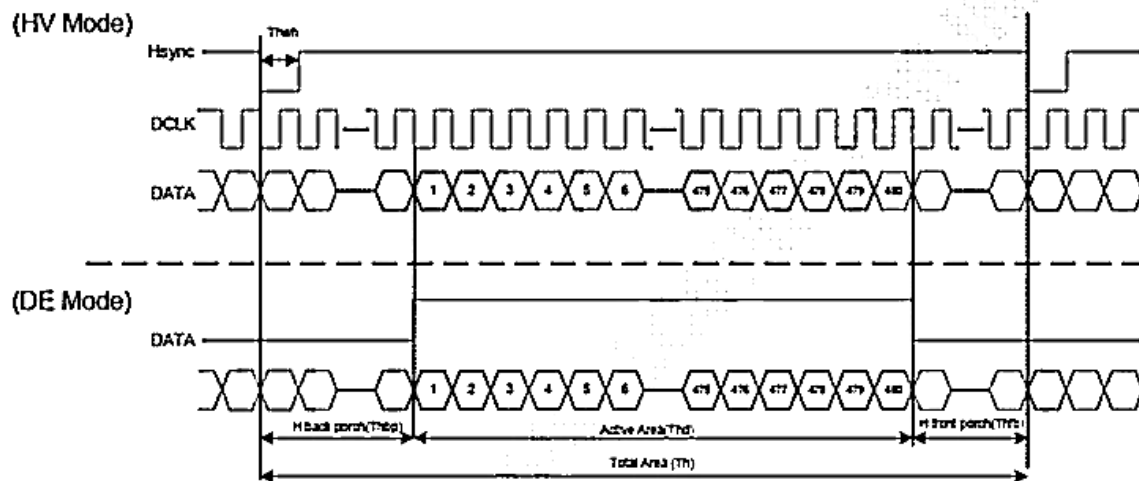


6.3 Data input Format

Vertical input timing



Serial 8-bit RGB Mode Data format

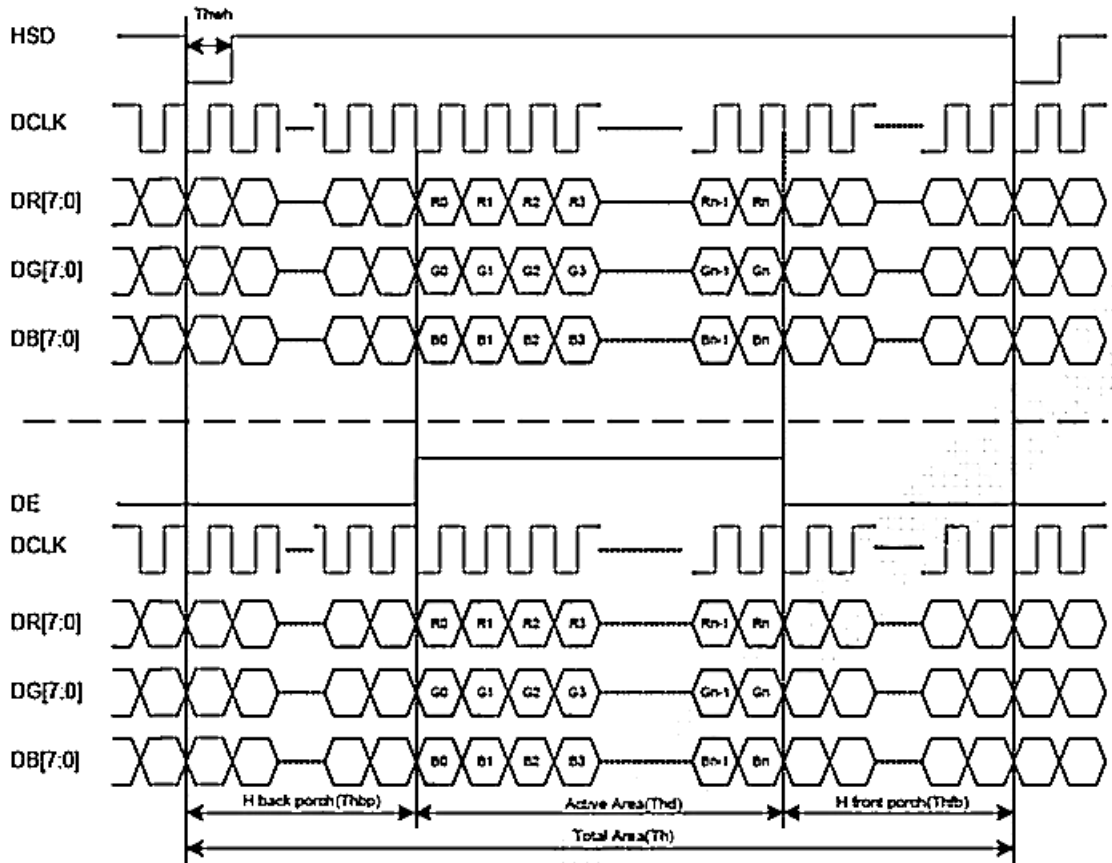


Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
DCLK frequency	Fclk	24	27	30	MHz	
DCLK cycle time	Tclk	83	110	200	ns	
DCLK pulse duty	Tcwh	40	50	60	%	
Time from HSD to source output	Thso	-	13	-	DCLK	
Time from HSD to gate output	Thgo	-	27	-	DCLK	
Time from HSD to gate output off	Thgz	-	3	-	DCLK	
Time from HSD to VCOM	Thvc	-	12	-	DCLK	



Parallel RGB Mode Data format

(HV Mode)

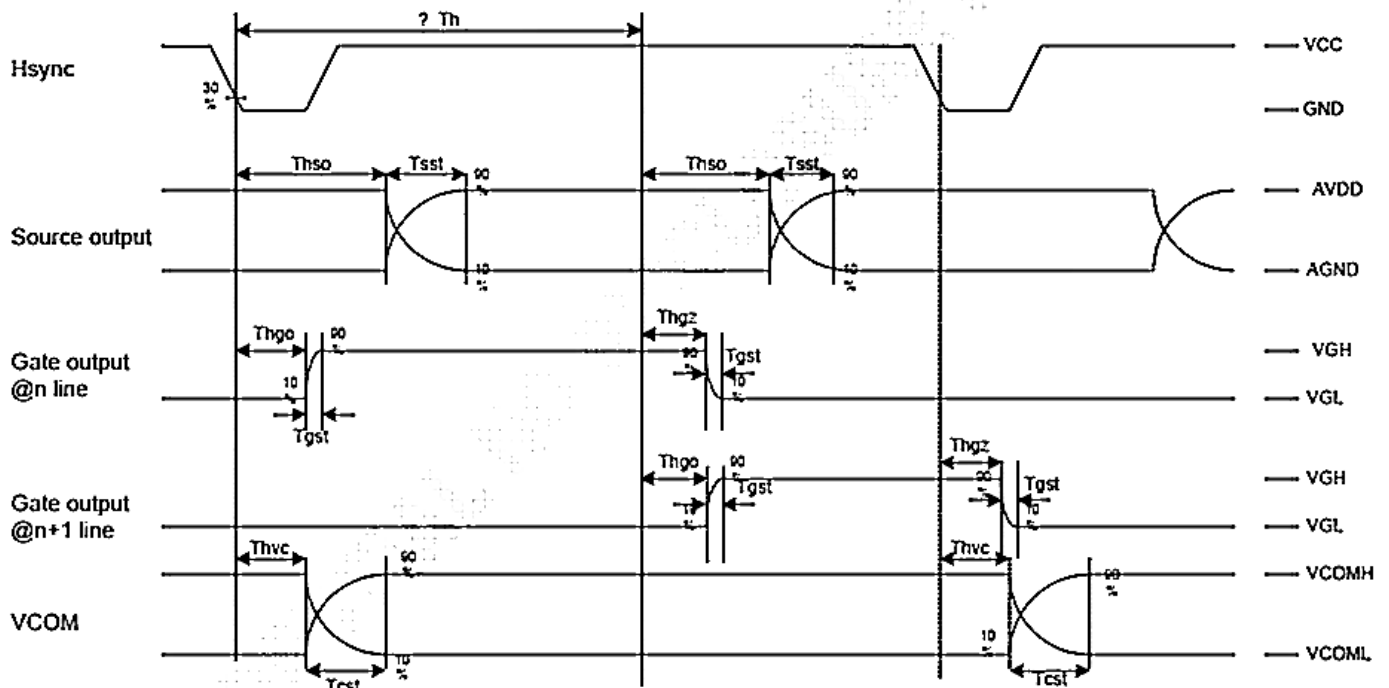


Parameter	Symbol	Value			Unit
		Min	Typ	Max	
DCLK frequency	FCLK	5	9	12	MHZ
VSD period time	T_v	133	144	256	H
VSD display area	T_{VD}	128	128	128	H
VSD back porch	T_{VB}	3	8	31	H
VSD front porch	T_{VFP}	2	8	97	H
HSD period time	T_H	520	525	800	DCLK



HSD display area	T_{HD}	480	480	480	DCLK
HSD back porch	T_{HBP}	36	40	255	DCLK
HSD front porch	T_{HFP}	4	5	65	DCLK

6.4 Output Timing Diagram





7. Optical Characteristics

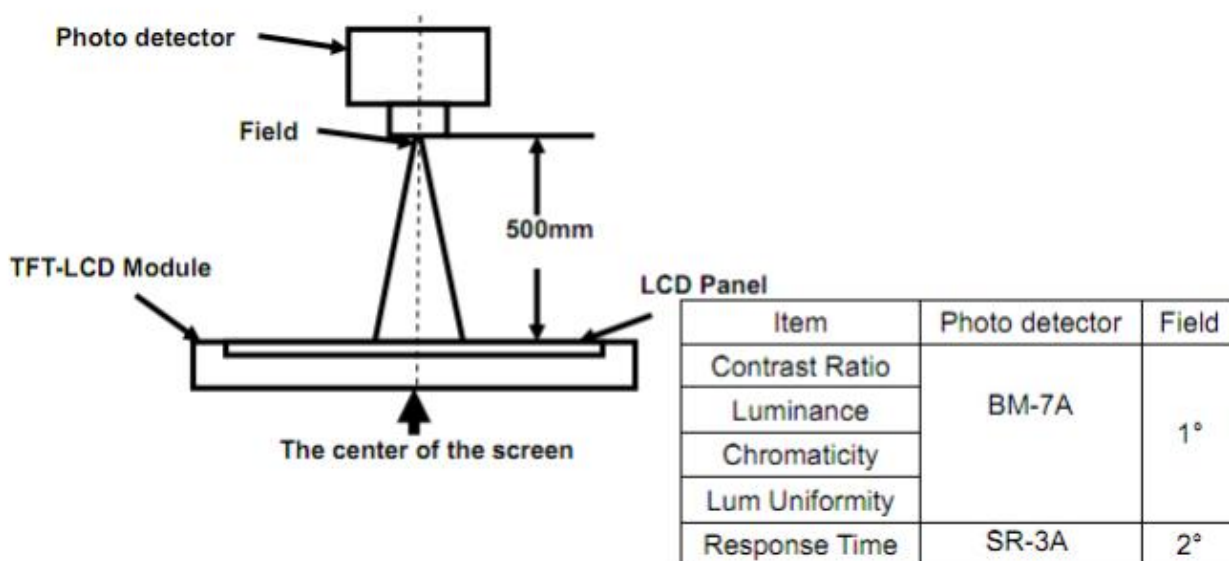
Items		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angles		θ_T	Center CR≥10	40	50	-	Degree.	Note2
		θ_B		60	70	-		
		θ_L		60	70	-		
		θ_R		60	70	-		
Contrast Ratio		CR	$\Theta =0$	400	500	-	-	Note1, Note3
Response Time		T _{ON}	25°C	-	10	20	ms	Note1, Note4
		T _{OFF}		-	15	30		
Chromaticity	White	X _W	Backlight is on	0.26	0.31	0.36	-	Note1, Note5
		Y _W		0.28	0.33	0.38	-	
Uniformity		U		75	80	-	%	Note1, Note6
NTSC					50		%	Note5
Luminance		L		400	500	-	Nits	Note1, Note7

Test Conditions:

1. IF= 20mA (one channel), the ambient temperature is 25°C.
2. The test systems refer to Note 1 and Note 2.

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.



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).

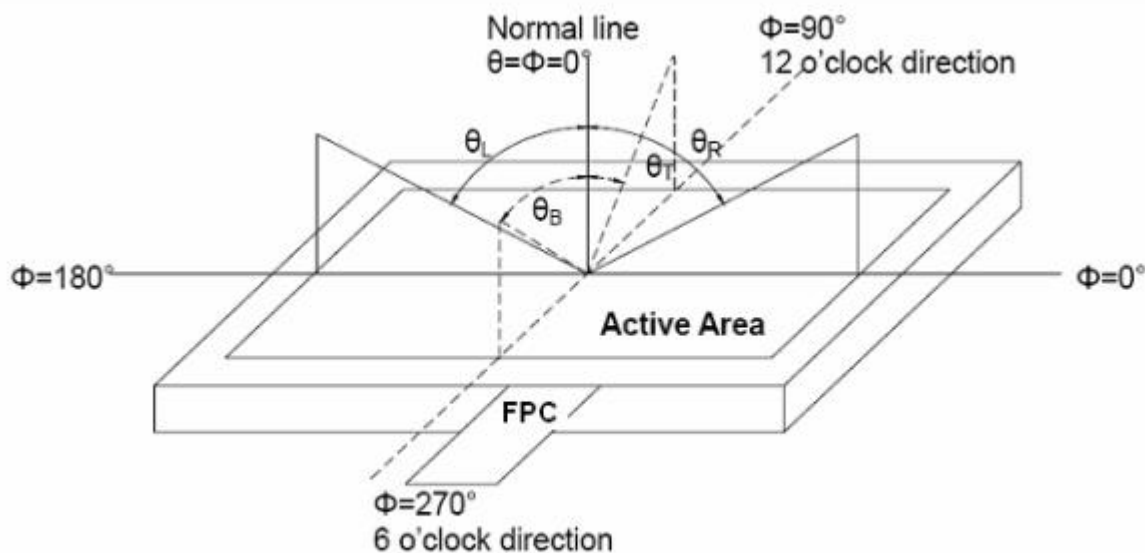


Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

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

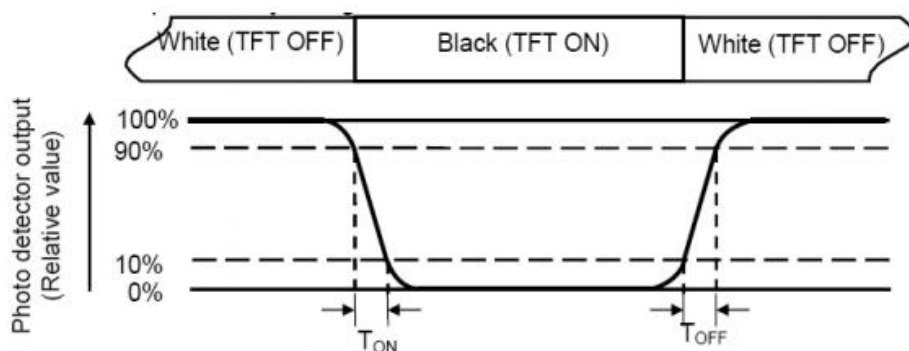
The state is that the LCD should driven by V_{white}.

“Black state”: The state is that the LCD should driven by V_{black}.

V_{white}: To be determined V_{black}: 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 (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%.



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.

$$\text{Luminance Uniformity (U)} = \text{Lmin/Lmax} \times 100\%$$

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

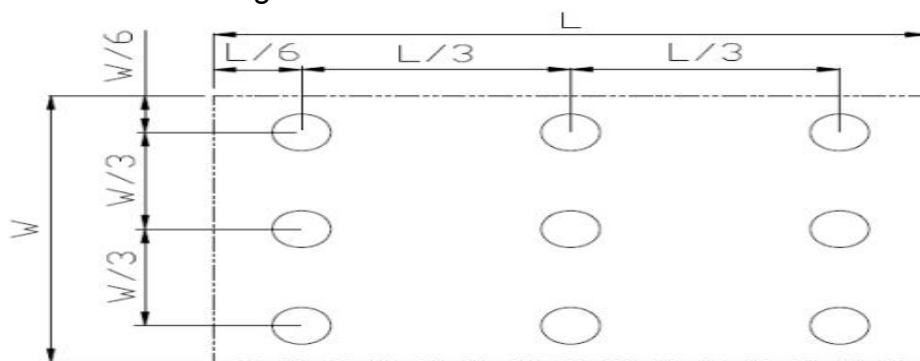


Fig. 2 Definition of uniformity

L_{max}: The measured maximum luminance of all measurement position.

L_{min}: The measured minimum luminance of all measurement position.

Note 7: Definition of Luminance:

Measure the luminance of white state at center point.



8. Environmental / Reliability Tests

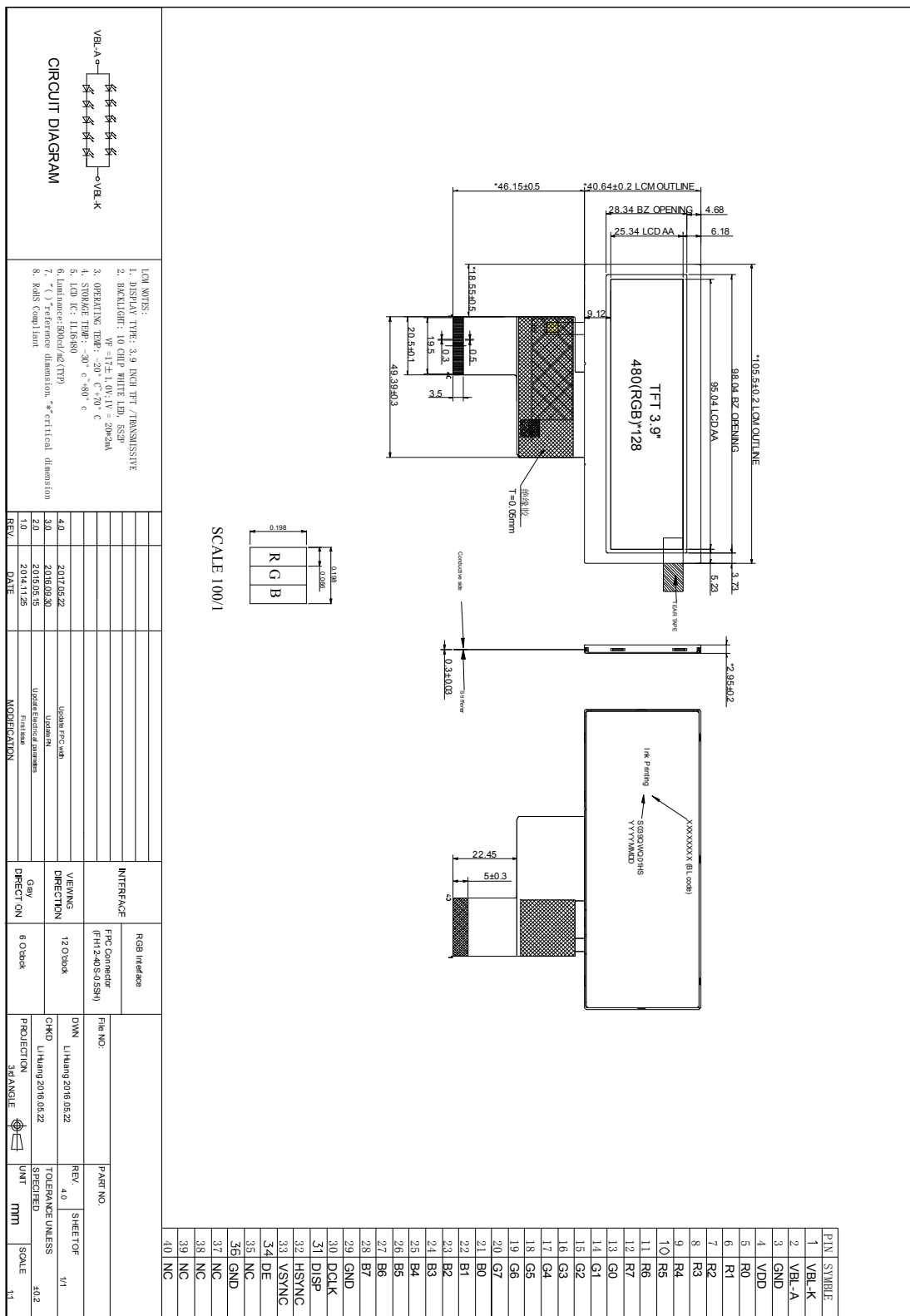
No	Test Item	Condition	Remarks
1	High Temperature Opeartion	Ts= +70℃, 240hrs	Note 1 IEC60068-2-2, GB2423. 2-89
2	Low Temperature Opeartion	Ta= -20℃, 240hrs	Note 2 IEC60068-2-1 GB2423.1-89
3	High Temperature Storage	Ta= +80℃, 240hrs	IEC60068-2-2 GB2423. 2-89
4	Low Temperature Storage	Ta= -30℃, 240hrs	IEC60068-2-1 GB/T2423.1-89
5	High Temperature & Humidity Storage	Ta= +60℃, 90% RH max, 160 hours	IEC60068-2-3 GB/T2423.3-2006
6	Thermal Shock (Non-operation)	-30℃ 30 min ~ +80℃ 30 min Change time: 5min, 30 Cycle	Start with cold temperature, end with high temperature IEC60068-2-14, GB2423.22-87
7	Electro Discharge (Operation) Static	C=150pF, R=330 Ω, 5 points/panel Air:±8KV, 5 times; 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.mm Sweep: 10Hz~55Hz~10Hz 2 hours for each direction of X .Y. Z. (package condition)	IEC60068-2-6 GB/T2423.5-1995
9	Shock (Non-operation)	60G 6ms, ± X, ±Y , ± Z 3 times 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

Note: 1. T_s is the temperature of panel's surface.

2. Ta is the ambient temperature of sample.



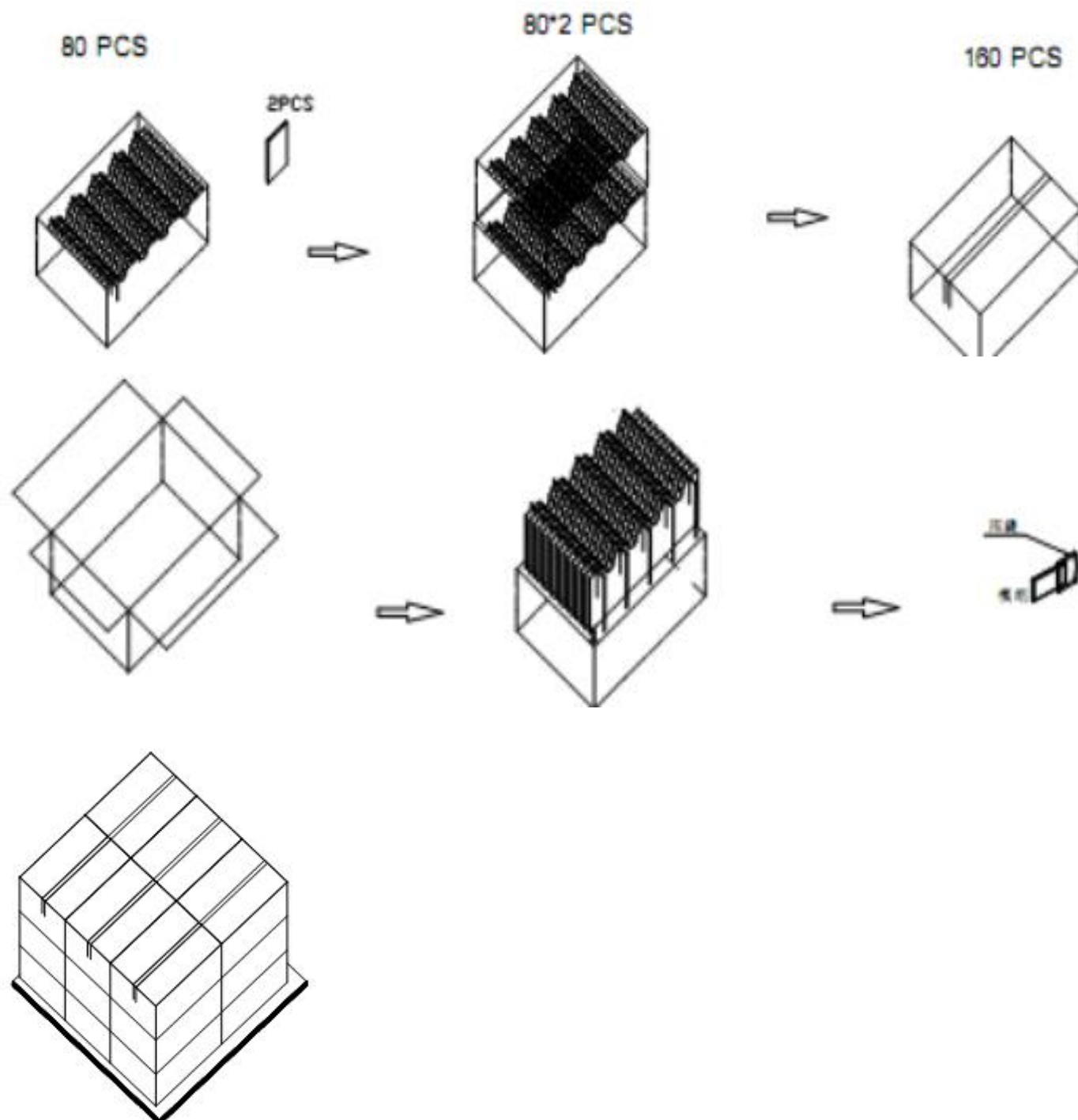
9 Mechanical Drawing





10. Packing

Packing Method





11. Precautions For Use of LCD modules

11.1 Handling Precautions

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

11.1.2. 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.

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

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

11.1.5. 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

11.1.6. Do not attempt to disassemble the LCD Module.

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

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

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

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

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

11.1.8.4. 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.

11.2 Storage Precautions

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

11.2.2. 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%

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

11.3 Transportation Precautions

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