深圳市拓普微科技开发有限公司
SHENZHEN TOPWAY TECHNOLOGY CO., LTD.

LMT097DNGFWD

LCD Module User Manual

Prepared by:	Checked by:	Approved by:
Chen Ji		
Date: 2016-09-12	Date:	Date:

Rev.	Descriptions	Release Date
0.1	Preliminary release	2012-09-05
0.2	Update 4.1 Input signal voltage	2016-09-12

Table of Content

1. General Specification

Signal Interface :	24-bits RGB
Display Technology :	a-Si TFT active matrix
Display Mode :	Transmissive / Normal White
Color Depth:	16.7M(24bit)
Screen Size(Diagonal) :	9.7”
Outline Dimension :	210.2 x 166.2 x 3.66 (mm) (exclude Fixing TAG&FPC) (see attached drawing for details)
Active Area :	196.61 x147.46 (mm)
Number of dots :	1024 x 3 (RGB) x 768
Pixel Pitch :	0.192 x 0.192 (mm)
Pixel Configuration :	RGB Stripe
Backlight :	LED
Surface Treatment :	Anti-Glare Treatment
Viewing Direction :	3 o’clock
Operating Temperature :	-20 ~ +70°C
Storage Temperature :	-30 ~ +80°C

2. Terminal Function

2.1 TFT Input Terminal

Pin No.	Pin Name	I/O	Descriptions	
			Sync Mode	DE Mode
1	NC	-	No connection	
2	CABC_EN1	-	-	
3	CABC_EN2	-	-	
4	DIMO	-	-	
5	GND	Power	Power GND (0V)	
6	VCOM	Input	Common voltage	
7	DVDD	Power	Power supply 3.3V	
8	MODE	Input	MODE=0	MODE=1
9	DE	Input	NC	Data input enable
10	VS	Input	Vertical Sync Input	NC
11	HS	Input	Horizontal Sync Input	NC
12	B7	Input	8bit Data for Blue	
:	:			
19	B0			
20	G7	Input	8bit Data for Green	
:	:			
27	G0			
28	R7	Input	8bit Data for Red	
:	:			
35	R0			
36	GND	Power	Power GND (0V)	
37	DCLK	Input	Clock for input data	
38	GND	Power	Power GND (0V)	
39	L/R	Input	Left / right selection (*1)	
40	U/D	Input	Up/down selection (*1)	
41	VGH	Power	Gate ON Supply	
42	VGL	Power	Gate OFF Supply	
43	AVDD	Power	Analog Power Supply	
44	RESET	Input	Global reset pin	
45	NC	-	No connection	
46	VCOM	Input	Common Voltage	
47	DITHB	Input	Dithering function (*2)	
48	GND	Power	Power GND (0V)	
49	NC	-	No connection	
50	NC			

Note:

*1: Selection of scanning mode

Setting of scan control input		Scanning direction
U/D	L/R	
GND	DVDD	Up to down, left to right
DVDD	GND	Down to up, right to left
GND	GND	Up to down, right to left
DVDD	DVDD	Down to up, left to right

*2: Dithering function enable control, normally pull high.
When DITHB=”1”,Disable internal dithering function,
When DITHB=”0”,Enable internal dithering function,

3. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Power voltage	DVDD	-0.3	5.0	V	
	AVDD	-0.5	13.5	V	
	VGH	-0.3	42.0	V	
	VGL	VGH-42	0.3	V	
Operating Temperature	T_{OP}	-20	70	°C	No Condensation
Storage Temperature	T_{ST}	-30	80	°C	No Condensation

Note:
*1. This rating applies to all parts of the module. And should not be exceeded.
*2. The operating temperature only guarantees operation of the circuit. The contrast, response speed, and the other specification related to electro-optical display quality is determined at the room temperature, T_{OP}=25.
*3. Ambient temperature when the backlight is lit (reference value)
*4. Any Stresses exceeding the Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

4. Electrical Characteristics

4.1 DC Characteristics

Items	Symbol	Min.	Typ.	Max.	Unit	Remark
Power voltage	DVDD	3.0	3.3	3.6	V	*2
	AVDD	12.3	12.5	12.7	V	
	VGH	20.8	22.0	23.3	V	
	VGL	-7.5	-7.0	-6.5	V	
Input signal voltage	VCOM	4.14	4.24	4.34	V	
Input logic high voltage	V_{IH}	0.7VDD	-	DV_{DD}	V	*3
Input logic low voltage	V_{IL}	0	-	$0.3DV_{DD}$	V	

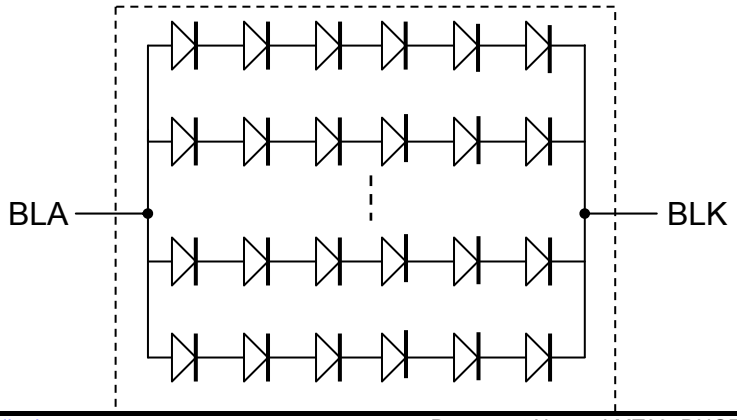
Note:
*1.Be sure to apply DVDD and VGL to the LCD first, and then apply VGH.
*2: DVDD setting should match the signals output voltage (refer to Note 3) of customer's system board.
*3: DCLK,HS,VS,RESET,U/D, L/R,DE,R0~R7,G0~G7,B0~B7,MODE,DITHB.
*4: Typical Vcom is only a reference value.It must be optimized according to each LCM.Please use VR for VCOM circuit.

4.2 LED Backlight Circuit Characteristics

Top=25℃

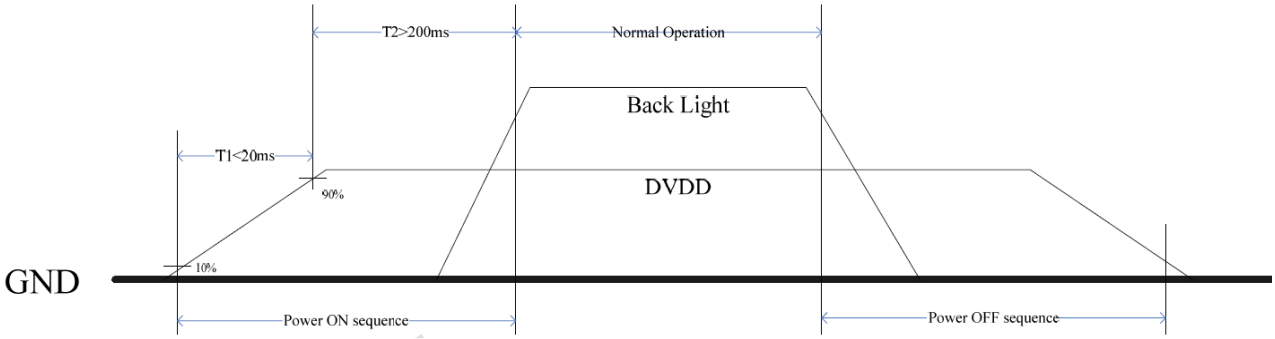
Items	Symbol	MIN.	TYP.	MAX.	Unit	Note
Forward Voltage	Vf_{BLA}	-	19.2	-	V	If=100mA
Forward Current	If_{BLA}	-	120.0	-	mA	

Cautions:
Exceeding the recommended driving current could cause substantial damage to the backlight and shorten its lifetime.

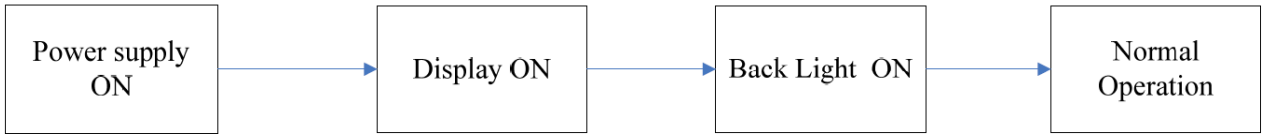


No. of LED = 6x6=36 pcs

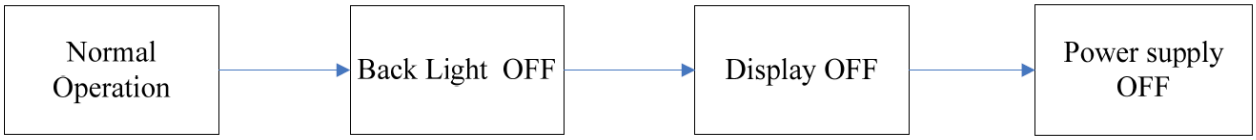
4.3 Power Sequence



Power on:



Power off:



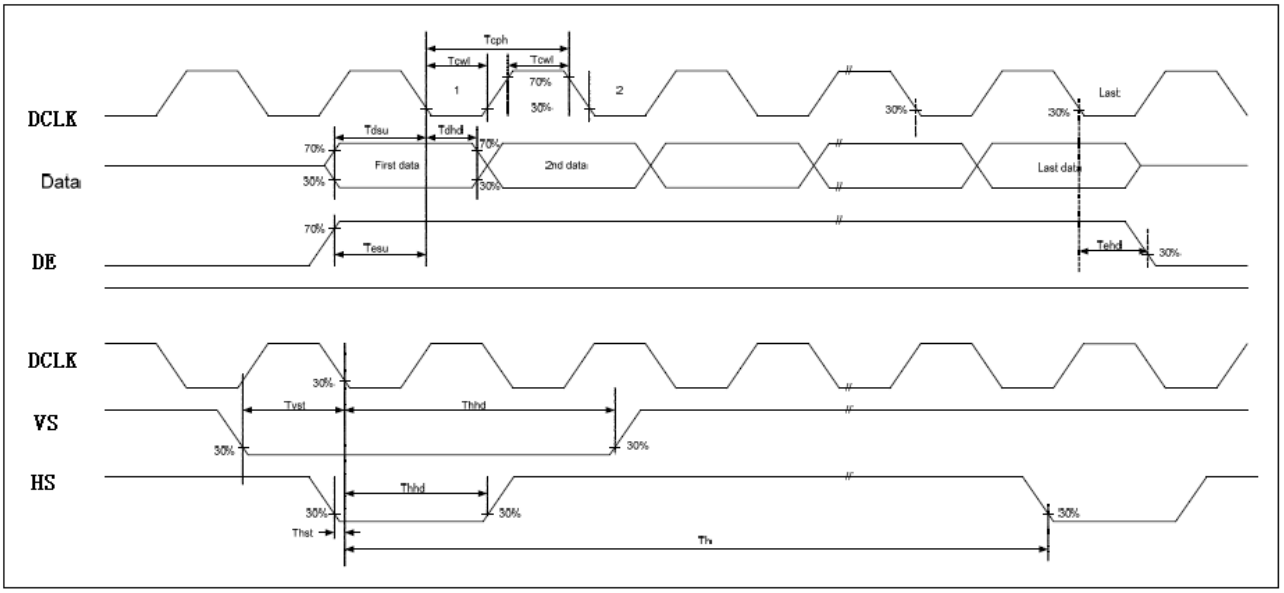
5. AC Characteristics

5.1 Timing Characteristics

Item	Symbol	MIN.	TYP.	MAX.	Unit	Remark
DCLK cycle time	Tcph	14	-	-	ns	
DCLK pulse width	Tcwh	40	50	60	%	
VS setup time	Tvst	5	-	-	ns	
VS hold time	Tvhd	5	-	-	ns	
HS setup time	Thst	5	-	-	ns	
HS hold time	Thhd	5	-	-	ns	
Data setup time	Tdsu	5	-	-	ns	
Data hole time	Tdhd	5	-	-	ns	
DE setup time	Tesu	5	-	-	ns	
DE hold time	Tehd	5	-	-	ns	

Note: For the details of the timing, please see the Driver IC data sheet.

5.2 Input Clock and Data Timing Diagram



5.3 Recommended Timing Setting Of TCON

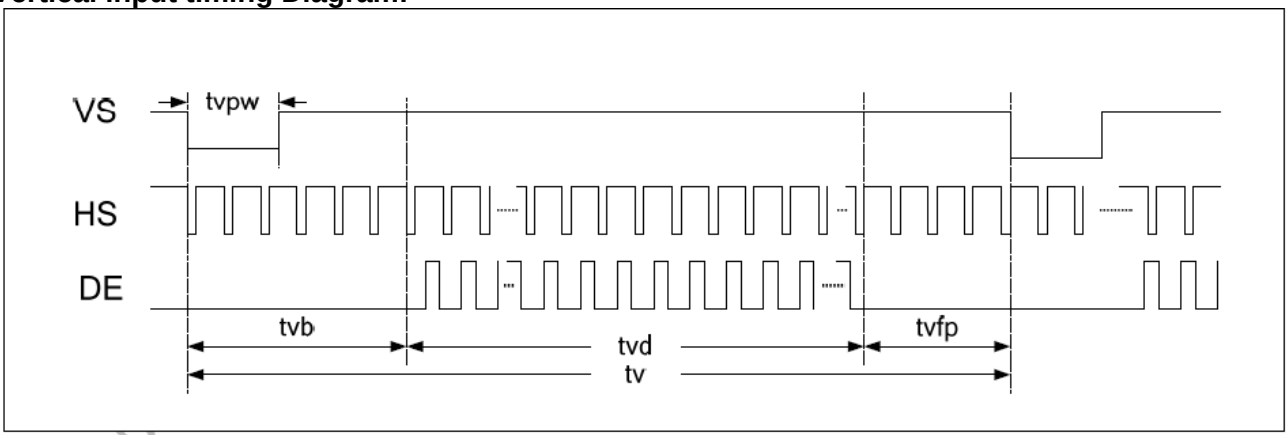
TCON (Embedded In Source IC) Input Timing (DCLK, HSD, VSD, DE)

DVDD=3.3V, AVDD=12.5V, AGND=GND=0V, Ta=25℃

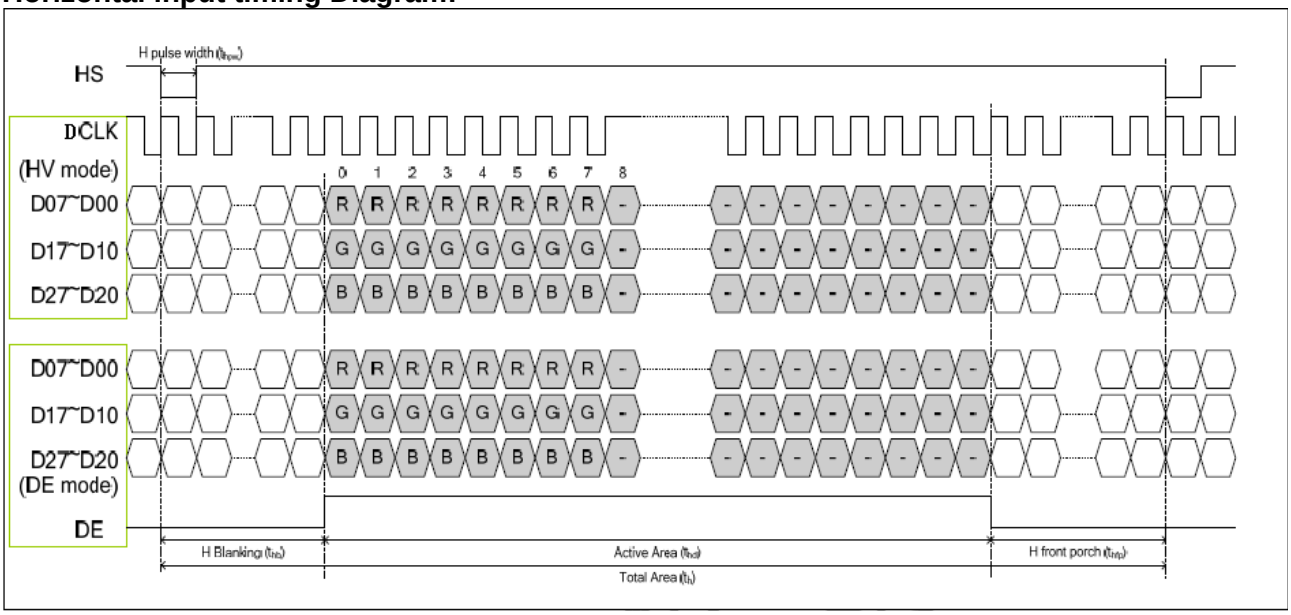
Parameter	Symbol	Min	Typ	Max	Unit	Remark
DCLK	Fclk	57	65	70.5	MHZ	
HSD	th	1200	1344	1400	tclk	
	thd		1024		tclk	
	thpw	1	-	140	tclk	
	thb		160		tclk	
	thfp	16	160	216	tclk	
VSD	tv	792	806	840	th	
	tvd		768		th	
	tvpw	1	-	20	th	
	tvb		23		th	
	tvfp	1	15	49	th	

Note: DE timing refer to HSD, VSD input timing.

Vertical input timing Diagram:



Horizontal input timing Diagram:



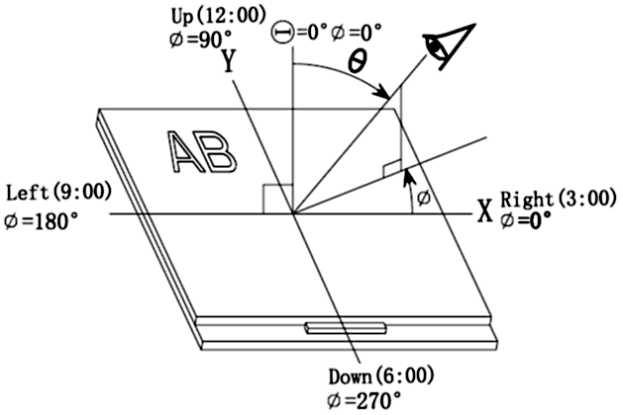
6. Optical Characteristics

Item		Symbol	Condition	MIN.	TYP.	MAX.	UNIT	Note.
Viewing angle		θ_T	(CR≥10)	-	70	-	degree	Note 2
		θ_B		-	70	-		
		θ_L		-	70	-		
		θ_R		-	60	-		
Contrast ratio		CR	θ=0°	-	500	-	-	Note 1,3
Response Time		T_{on}	25℃	-	20	-	msec	Note 1,4
		T_{off}					msec	
Chromaticlty	White	X	Backlight is on	-	0.313	-		Note 1,5
		Y		-	0.329	-		
	Red	X		-	TBD	-		
		Y		-	TBD	-		
	Green	X		-	TBD	-		
		Y		-	TBD	-		
	Blue	X		-	TBD	-		
		Y		-	TBD	-		
Luminance		L		-	220	-	cd/m^2	Note 1,6
NTSC				-	50		%	Note 5
Luminance uniformity		U		-	75	-	%	Note 1,7

Test Conditions:
1. IF= 120 mA, VF=19.2V, and the ambient temperature is 25. ℃
2. The test systems refer to Note 1 and Note 2.

Note 1:
The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment SR-3A (1°)
Measuring condition:
- Measuring surroundings: Dark room
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.

Note 2:
The definition of viewing angle:
Refer to the graph below marked by θ and Φ

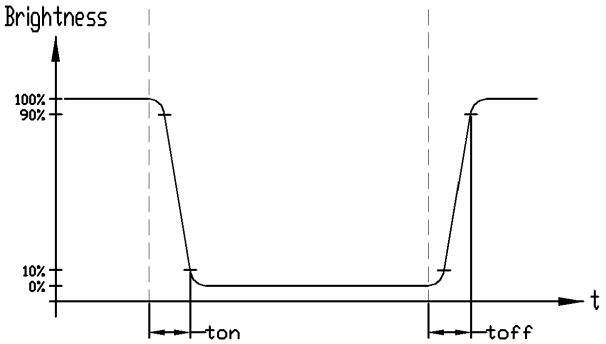


Note 3:
The definition of contrast ratio (Test LCM using SR-3A (1°)):

$$\text{Contrast Ratio(CR)} = \frac{\text{Luminance When LCD is at "White" state}}{\text{Luminance When LCD is at "Black" state}}$$

(Contrast Ratio is measured in optimum common electrode voltage)

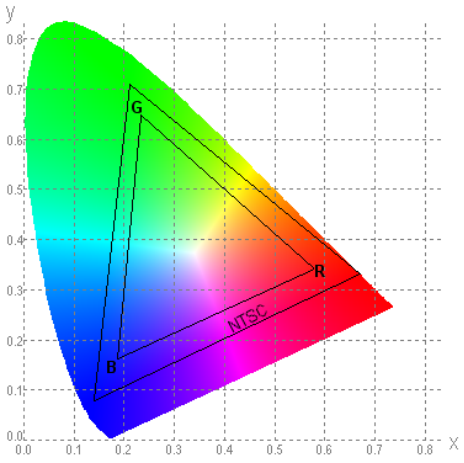
Note 4:
Definition of Response time. (Test LCD using BM-7A(2°)):
The output signals of photo detector are measured when the input signals are changed from "black" to "white"(falling time) and from "white" to "black"(rising time), respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes.Refer to figure as below.



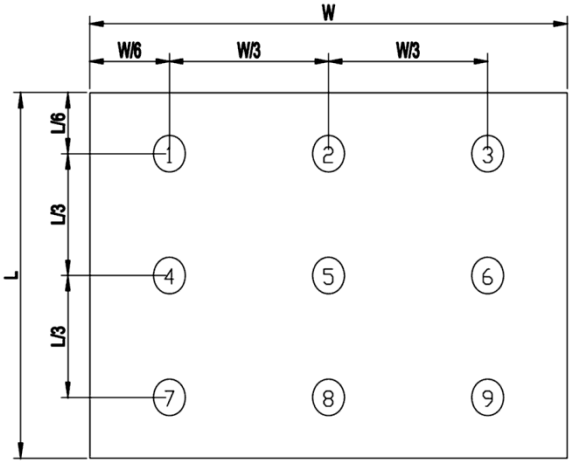
Note 5:
Definition of Color of CIE1931 Coordinate and NTSC Ratio.

Color gamut:

$$S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$



Note 6:
The luminance uniformity is calculated by using following formula.
△Bp = Bp (Min.) / Bp (Max.)×100 (%)
Bp (Max.) = Maximum brightness in 9 measured spots
Bp (Min.) = Minimum brightness in 9 measured spots.



Note 7:
Measured the luminance of white state at center point

7. Precautions of using LCD Modules

Mounting

- Mounting must use holes arranged in four corners or four sides.
- The mounting structure so provide even force on to LCD module. Uneven force (ex. Twisted stress) should not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- It is suggested to attach a transparent protective plate to the surface in order to protect the polarizer. It should have sufficient strength in order to the resist external force.
- The housing should adopt radiation structure to satisfy the temperature specification.
- Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. Never rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics deteriorate the polarizer.)
- When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer

Operating

- The spike noise causes the mis-operation of circuits. It should be within the ±200mV level (Over and under shoot voltage)
- Response time depends on the temperature.(In lower temperature, it becomes longer.)
- Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
- Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- When fixed patterns are displayed for a long time, remnant image is likely to occur.
- Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference

Electrostatic Discharge Control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

Storage

When storing modules as spares for a long time, the following precautions are necessary.

- Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

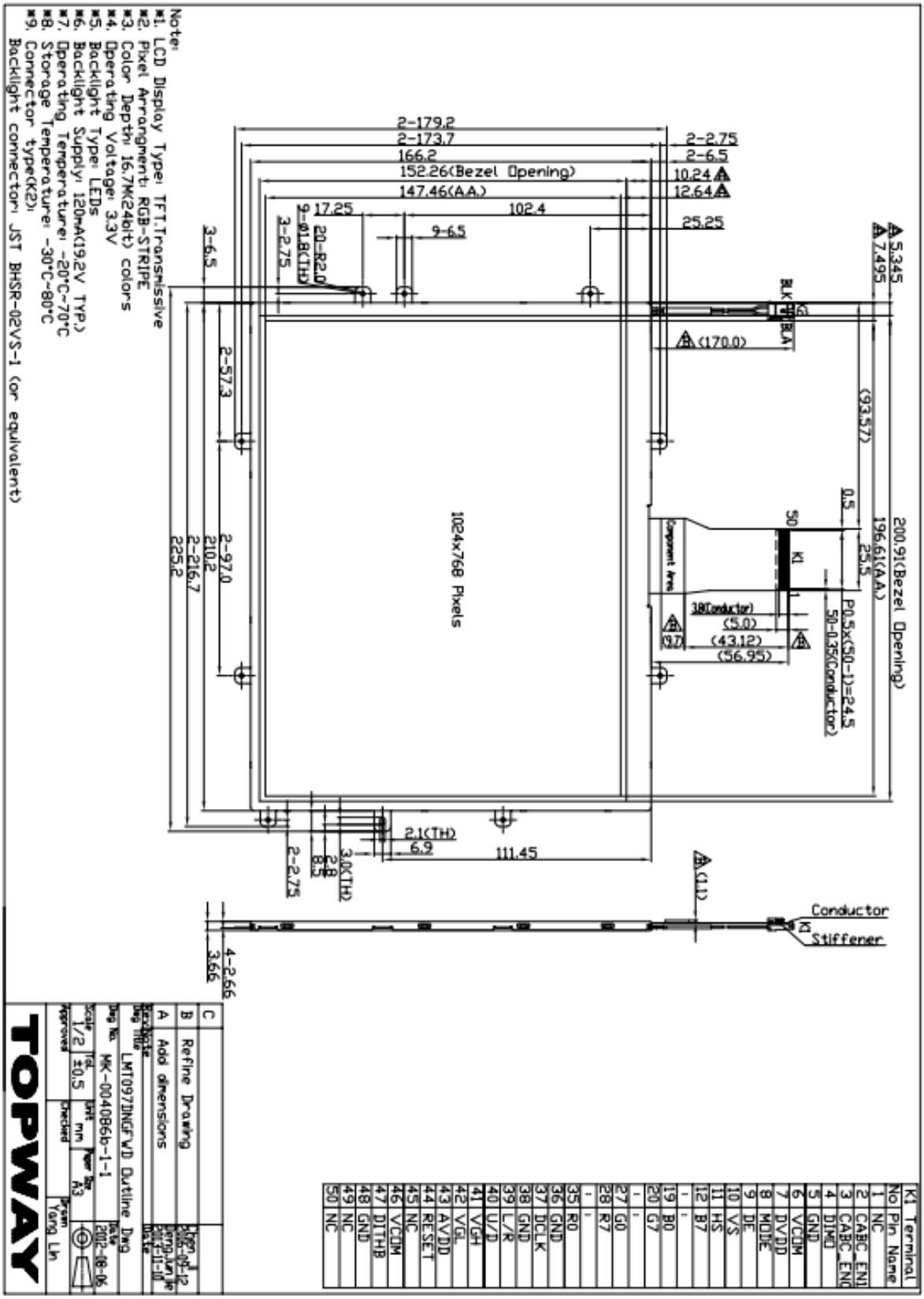
Protection Film

- When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt tore main on the polarizer. Please carefully peel off the protection film without rubbing it against the polarizer.
- When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.
- You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

Transportation

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

8. Outline


Note:
1. LCD Display Type: TFT,Transmissive
2. Pixel Arrangement: RGB-STRIPE
3. Color Depth: 16.7M(24bit) colors
4. Operating Voltage: 3.3V
5. Backlight Type: LEDs
6. Backlight Supply: 120mA(19.2V TYP.)
7. Operating Temperature: -20°C~70°C
8. Storage Temperature: -30°C~80°C
9. Connector type(K2):
Backlight connector: JST BHSR-02VS-1 (or equivalent)
2-179.2
2-173.7
166.2
152.26(Bezel Opening)
147.46(A.A.)
2-2.75
2-6.5
10.24
12.64
102.4
25.25
17.25
9-6.5
3-6.5
9-Ø1.8(TH)
3-2.75
20-R2.0
5.345
7.495
(170.0)
(93.57)
2-57.3
2-97.0
210.2
2-216.7
225.2
1024x768 Pixels
0.5
50
K1
196.61(A.A.)
25.5
200.91(Bezel Opening)
Component Area
18Conductor
(5.0)
(43.12)
(56.95)
P0.5x(50-1)=24.5
50-0.35(Conductor)
2.1(TH)
6.9
111.45
2-2.75
2.8
8.5
3.0(TH)
(1.1)
Conductor
K1
Stiffener
4-2.66
3.66
K1 Terminal
No Pin Name
1 NC
2 CABC_EN1
3 CABC_EN0
4 DIMO
5 GND
6 VCOM
7 DVDD
8 MODE
9 DE
10 VS
11 HS
12 B7
- -
19 B0
20 G7
- -
27 G0
28 R7
- -
35 R0
36 GND
37 DCLK
38 GND
39 L/R
40 U/D
41 VGH
42 VGL
43 AVDD
44 RESET
45 NC
46 VCOM
47 DITHB
48 GND
49 NC
50 NC
C
B Refine Drawing
A Add dimensions
LMT097DNGFWD Outline Dwg
MK-004086b-1-1
2012-08-06
TOPWAY
1/2
±0.5
A3
Yang Lin