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

LMK070DICFWD-NNA
LCD Module User Manual

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Date: 2017-10-31	Date:	Date:

Rev.	Descriptions	Release Date
0.1	Preliminary release	2017-02-22
0.2	Assemble Precaution	2017-10-31

Table of Content

1. General Specification

|	
Signal Interface :	Digital 24-bits RGB
Display Technology :	a-Si TFT active matrix
Display Mode :	TN Type Full Color / Transmissive / Normal White
Screen Size(Diagonal) :	7.0"
Outline Dimension :	204.0 x 150.0 x 32.0 (mm)
	(see attached drawing for details)
Active Area :	154.08 x 85.92 (mm)
Number of dots :	800 x 3 (RGB) x 480
Pixel Pitch :	0.1926 x 0.179 (mm)
Pixel Configuration :	RGB Stripe
Backlight :	LED
Viewing Direction :	6 o'clock(Gray scale Inversion) (*1)
	12 o'clock (*2)
Operating Temperature :	-20 ~ +70°C
Storage Temperature :	-30 ~ +80°C
Surface Treatment :	Anti-Glare Treatment

Note:
*1. For saturated color display content (eg. pure-red, pure-green, pure-blue or pure-colors-combinations).
*2. For "color scales" display content.
*3. Color tone may slightly change by temperature and driving condition.

2. Block Diagram
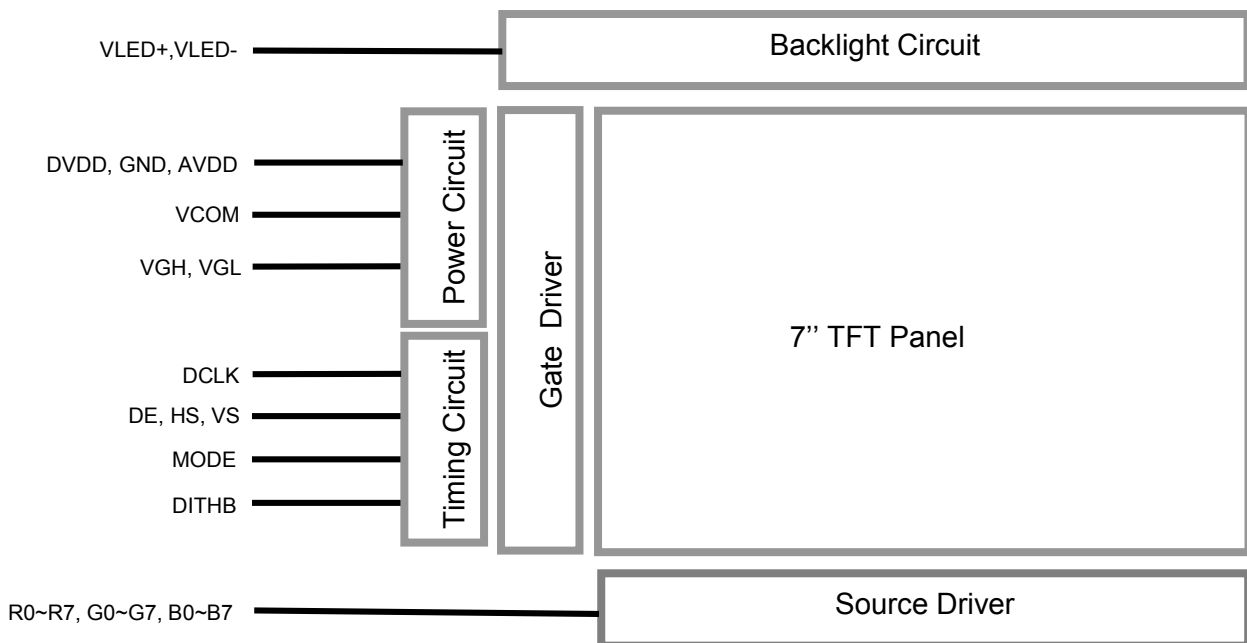
3. Terminal Function

3.1 K1 TFT Input Terminal

Pin No.	Pin Name	I/O	Descriptions
1	V_{LED+}	Power	Positive Backlight Power Supply
2	V_{LED+}		
3	V_{LED-}	Power	Negative Backlight Power Supply
4	V_{LED-}		
5	GND	Power	Power GND (0V)
6	V_{COM}	Input	Common voltage
7	DV_{DD}	Power	Power for Digital Circuit
8	MODE	Input	DE/SYNC mode select (*1)
9	DE	Input	Data input enable
10	VS	Input	Vertical Sync Input
11	HS	Input	Horizontal Sync Input
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	Sample clock(*2)
38	GND	Power	Power GND (0V)
39	L/R	Input	Left / right selection (*3)
40	U/D	Input	Up/down selection (*3)
41	V_{GH}	Power	Gate ON Voltage
42	V_{GL}	Power	Gate OFF Voltage
43	AV_{DD}	Power	Power for Analog Circuit
44	RESET	Input	Global reset pin (*4)
45	NC	-	No connection
46	V_{COM}	Input	Common Voltage
47	DITHB	Input	Dithering function (*5)
48	GND	Power	Power GND (0V)
49	NC	-	No connection
50	NC		

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.
* 2: Data shall be latched at the falling edge of DCLK.
* 3: 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

*4: Global reset pin. Active low to enter reset state. Suggest to connect with an RC reset circuit for stability. Normally pull high.
*5: Dithering function enable control, normally pull high.
   When DITHB="1",Disable internal dithering function.
   When DITHB="0",Enable internal dithering function.

4. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
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	
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.
*5. Before cosmetic and function test, the product must have enough recovery time, at least 24 hours at room temperature，with no condensation

5. Electrical Characteristics

5.1 DC Characteristics

Items	Symbol	Min.	Typ.	Max.	Unit	Remark
Power voltage	DV_{DD}	3.0	3.3	3.6	V	*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	
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.

5.2 Current Consumption

Items	Symbol	Min.	Typ.	Max.	Unit	Remark
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	mA	DV_{DD}=3.3V
	IAV_{DD}	-	20	50	mA	AV_{DD}=10.4V

5.3 LED Backlight Circuit Characteristics

Top=25℃

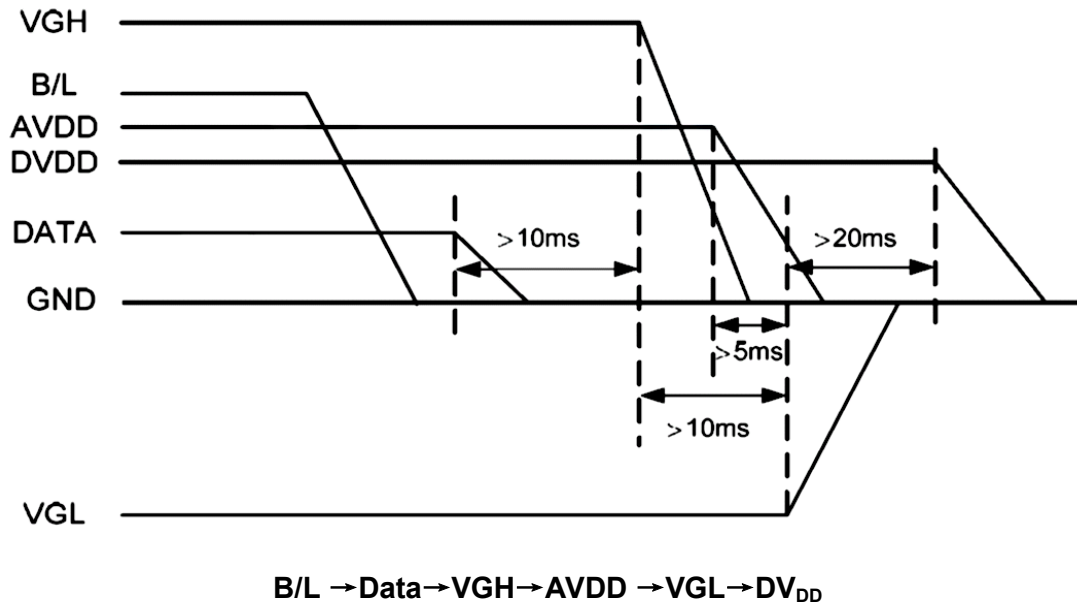| Items	Symbol	MIN.	TYP.	MAX.	Unit	Note
Forward Voltage	Vf	9.0	9.6	10.5	V	If=200mA
Forward Current	If	-	200.0	-	mA	

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

5.4 Power Sequence

5.4.1 Power on:

$$DV_{DD} \rightarrow VGL \rightarrow AVDD \rightarrow VGH \rightarrow Data \rightarrow B/L$$

5.4.2 Power off:

$$B/L \rightarrow Data \rightarrow VGH \rightarrow AVDD \rightarrow VGL \rightarrow DV_{DD}$$
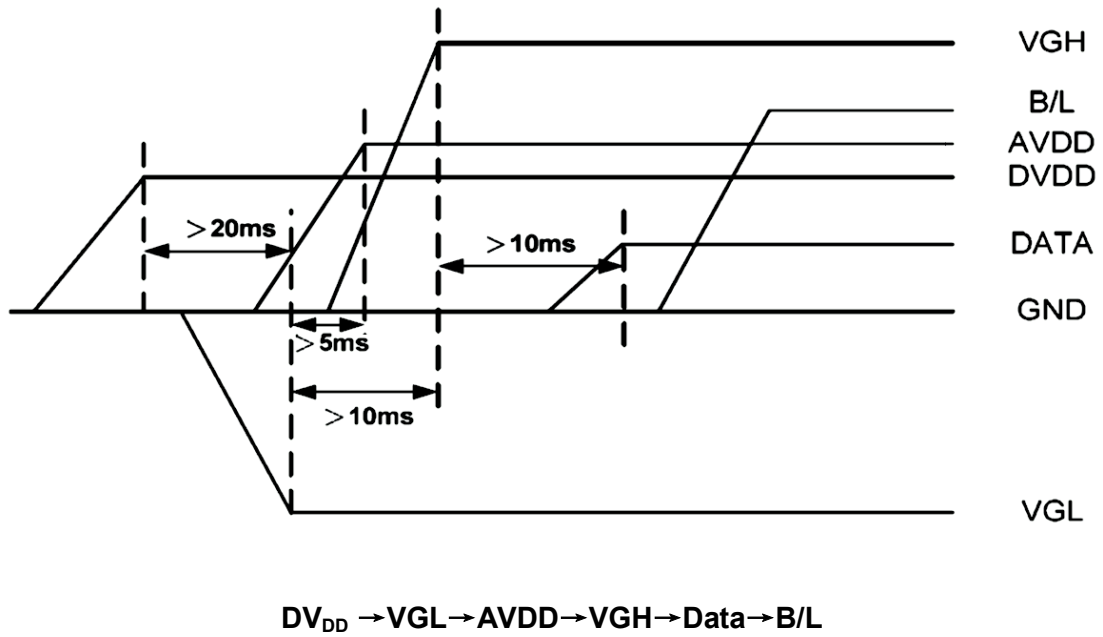
Note :Data include R0~R7,B0~B7,G0~G7,U/D,L/R,DCLK,HS,VS,DE.

6. AC Characteristics

6.1 Timing Characteristics

Item	Symbol	MIN.	TYP.	MAX.	Unit	Remark
HS setup time	Thst	8	-	-	ns	
HS hold time	Thhd	8	-	-	ns	
VS setup time	Tvst	8	-	-	ns	
VS hold time	Tvhd	8	-	-	ns	
Data setup time	Tdsu	8	-	-	ns	
Data hole time	Tdhd	8	-	-	ns	
DE setup time	Tesu	8	-	-	ns	
DV_{DD} Power On Slew rate	TPOR	-	-	20	ms	From 0 to 90% DV_{DD}
DCLK cycle time	Tcph	20	-	-	ns	
DCLK pulse duty	Tcwh	40	50	60	%	

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

6.2 Input Clock and Data Timing Diagram
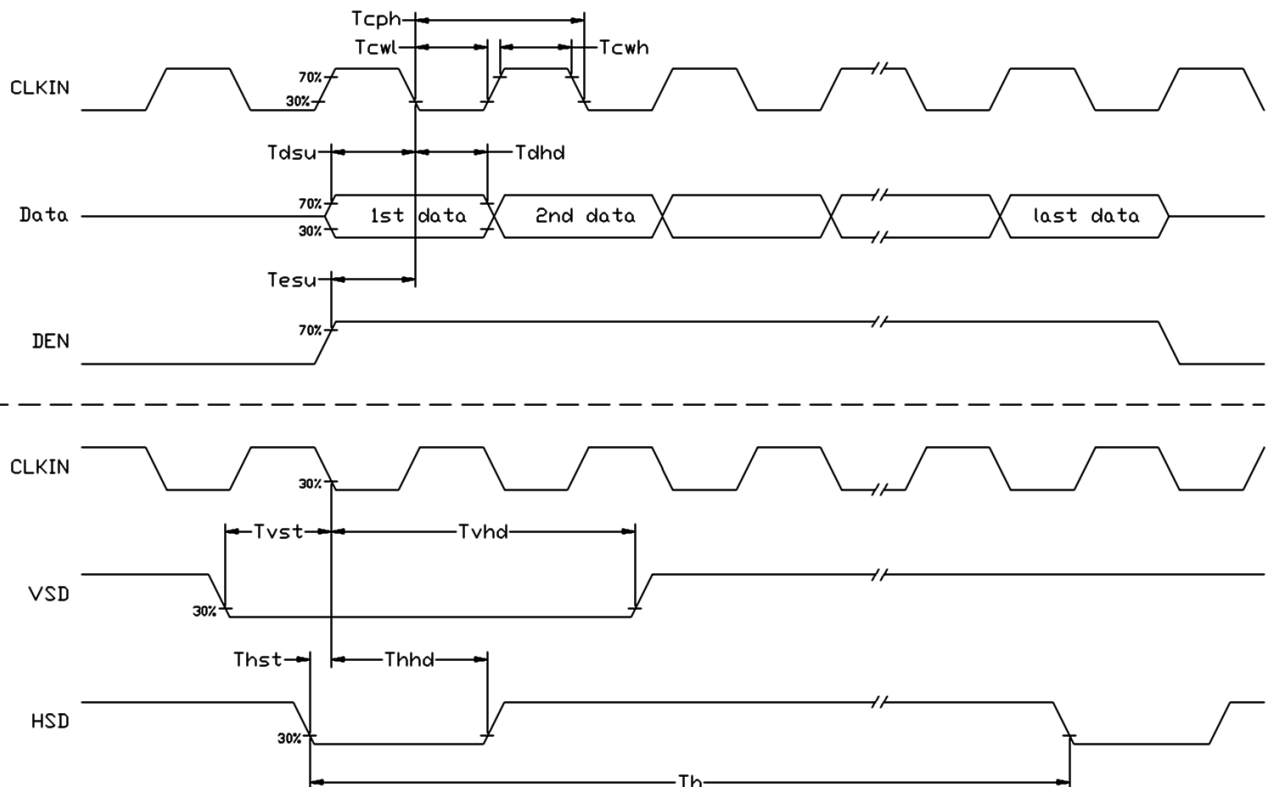
6.3 Timing

Item	Symbol	MIN.	TYP.	MAX.	Unit	Remark
Horizontal Display Area	thd	-	800	-	DCLK	
DCLK Frequency	fclk	26.4	33.3	46.8	MHz	
One Horizontal Line	th	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	
Vertical Display Area	tvd	-	480	-	TH	
VS period time	tv	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	

6.4   Data Input Format
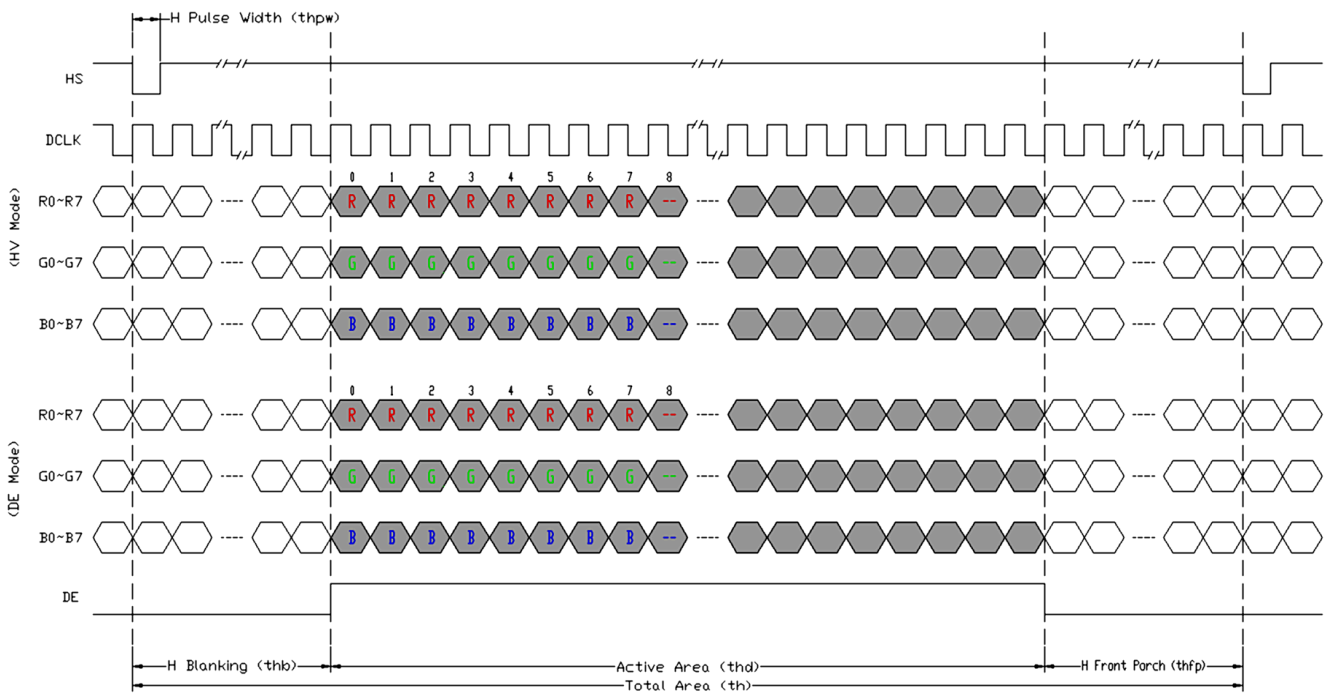
Figure 6-4-1 Horizontal input timing diagram.
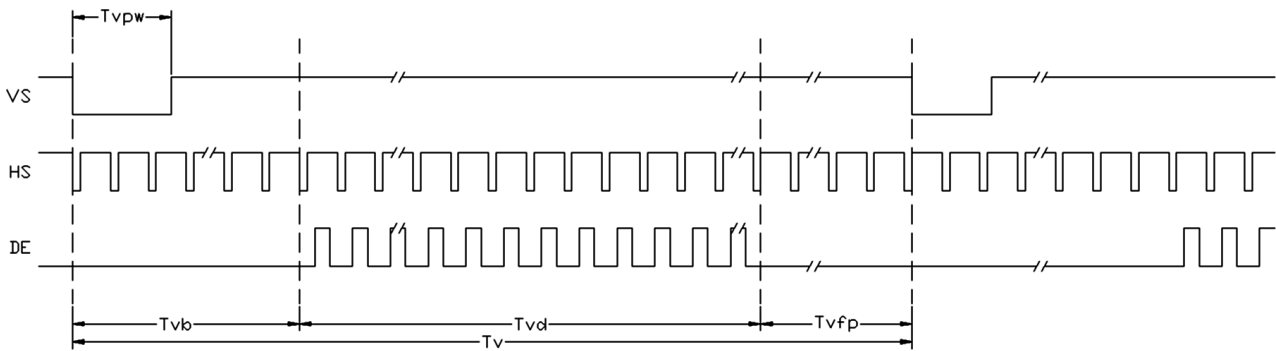
Figure 6-4-2 Vertical input timing diagram.

6.5 Optical Characteristics

| Item	Symbol	Condition	MIN.	TYP.	MAX.	UNIT	Note.
Viewing angle (CR≥10)	θ_L	9 o'clock	60	70	-	degree	*2
	θ_R	3 o'clock	60	70	-		
	θ_T	12 o'clock	40	50	-		
	θ_B	6 o'clock	60	70	-		
Response Time	T_f		-	10	20	msec	*3
	T_r		-	15	30	msec	
Contrast ratio	CR	Normal $\theta=0°$	400	500	-	-	*1
Color chromaticlty	W_X		0.26	0.31	0.26	-	
	W_Y		0.28	0.33	0.38	-	
Luminance	L		-	500	-	cd/m^2	*4
Luminance uniformity	Y_U		70	75	-	%	*4

Note:
*1. Definition of Contrast Ratio
The contrast ratio could be calculate by the following expression:
Contrast Ratio (CR) = Luminanc with all pixels white / Luminance with all pixels black

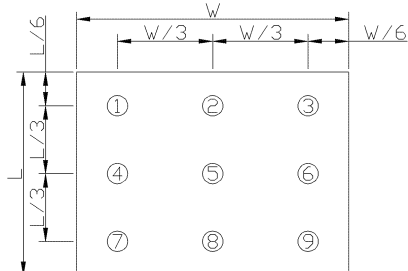*2 Definition of Viewing Angle
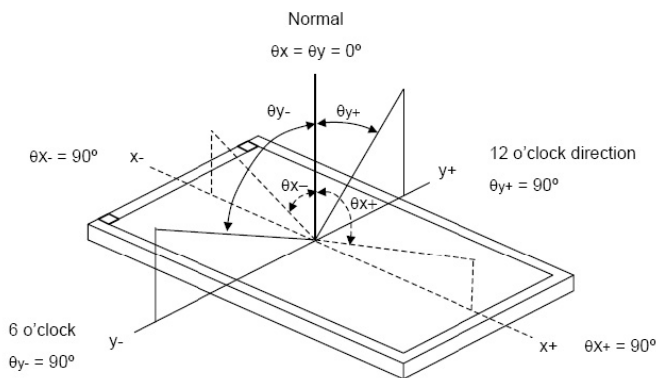
*3 Definition of response time
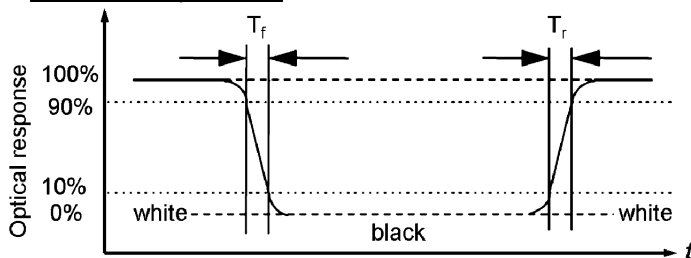
*4 Definition of Luminance Uniformity
Luminance uniformity (Lu)=
Min. Luminance form pt1~pt9 / Max Luminance form Pt1~pt9

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 $\pm200mV$ 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. Assemble Precaution

安装注意事项

1. Customer front panel opening and thickness for TOPWAY display module should be fit for its assembling and sealing.
   - ☐ The suggested assemble gap(A) should be about 0.3~0.5mm on each side.
   - ☐ The suggested front panel thickness(B) should be about 1.5~4.0mm.
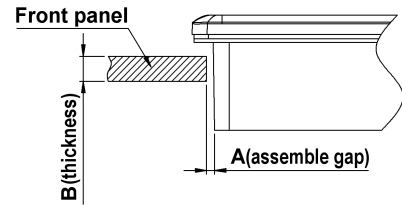
   客户面板开窗及厚度应适合 TOPWAY 显示模块的安装及密封.
   - · 建议每边安装间隙(A)约为 0.3 ~0.5mm.
   - · 建议面板厚度(B) 约为 1.5~4.0mm.

2. A silicon sealing ring ships with TOPWAY display module. It should be in place before assembling to the front panel.
   TOPWAY 显示模块上的硅胶密封圈在安装时确保嵌入到位.
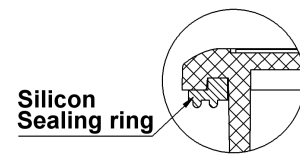
3. It should fix the TOPWAY display module into the front panel with two steps.
   - ☐ Pre-fixing: Slightly tighten the screws on beam clamp in sequence as picture on the right side.
   - ☐ Final-fixing: Tighten the fixing screws on beam clamp in sequence as well with twist torque about 8~10kg.cm (*1) . and put the beam clamp straight.
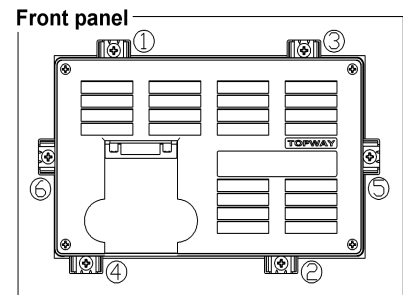
   Note:
   *1. Over tightening might damage the shell and cause bad sealing result.

   应分两步将 TOPWAY 显示模块固定在面板上.
   - · 预紧: 将卡扣螺钉按右图所示顺序稍加预紧.
   - · 紧定:再次按顺序用 **8~10kg.cm** 扭力拧紧卡扣螺钉(*1),并注意卡扣置正无歪斜.
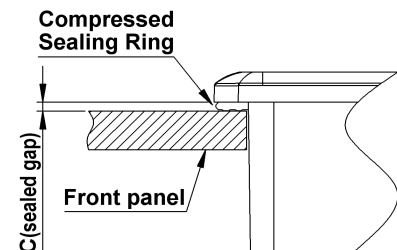
   注:
   *1. 过度拧紧可能会损坏外壳和影响密封效果.

4. It is strongly suggested to check the seal balancing of the four-side of the TOPWAY display module.
   - ☐ The suggested after assemble sealed gap(C) should be about 1.0~1.5mm.

   需注意检查 TOPWAY 显示模块四周在安装后保证平衡密封.
   - · 建议组装后的密封间隙(C)约为 1.0 ~1.5 mm.

5. Others:
   - ☐ Never hot plug the device! Power off the device before connect or disconnect the display module.
   - ☐ Don't forget to remove the cover protective film for normal operation.

   其它:
   - · 视频线禁止带电插拔！ 在连接或断开显示模块之前先关闭设备电源.
   - · 使用前请揭去保护膜.