

A Brighter Solution

AMP DISPLAY INC.

SPECIFICATIONS

4.3-in COLOR TFT MODULE

CUSTOMER:	
CUSTOMER PART NO.	
AMP DISPLAY PART NO.	AM480272H7TMQW-02H
APPROVED BY:	
DATE:	

APPROVED FOR SPECIFICATIONS

APPROVED FOR SPECIFICATION AND PROTOTYPES

AMP DISPLAY INC

9856 SIXTH STREET RANCHO CUCAMONGA CA 91730
TEL: 909-980-13410 FAX: 909-980-1419
WWW.AMPDISPLAY.COM

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RECORD OF REVISION

Revision Date	Page	Contents	Editor
2011/09/26	-	New Release	Kain
2011/11/15	8	Modify Block diagram	Kain
	9 - 10	Modify Interface	
2012/4/23	10	Correct VCC	Leo

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1. FEATURES

- (1) Construction : a-Si TFT-LCD with driving system, LED Driving circuit and White LED Backlight
- (2) LCD type : Transmissive , Normally White
- (3) Number of the Colors : 16.7M colors (R,G,B 8 bit digital each)
- (4) RGB Interface 54 pin.
- (5) LCD Power Supply Voltage : 3.3V for TFT circuit and 16.0V for LED backlight.

2. PHYSICAL SPECIFICATIONS

Item	Specifications	unit
Display size (diagonal)	4.3	inch
Resolution	480RGB (W) x 272(H)	dots
Display area	98.7 (W) x57.5 (H)	mm
Pixel pitch	0.198 (W) x 0.198 (H)	mm
Overall dimension	105.5(W)x67.2(H)x5.4(D)	mm
Color configuration	R.G.B Vertical stripe	
View Direction (Gray Inversion)	6 o'clock (Refer the mechanical drawing.)	

3. ABSOLUTE MAXIMUM RATINGS

item	Symbol	Values		Unit	Remark
		Min	Max		
Power Supply for logic	VCC	-0.3	5.0	V	GND=0
Signal input voltage	DCLK DE R0~R5 G0~G5 B0~b5	-0.3	VCC+0.3	V	GND=0
Operation Temperature (Ambient)	T _{OP}	-20	70	°C	
Storage Temperature (Ambient)	T _{ST}	-30	80	°C	Note 1
LED Forward current	I _f		20	mA	OneLED/Note2
LED Power Dissipation	P _d		66	mW	One LED

*TFT LCD Ratings

Note 1: Hsync, Vsync, DEN, DCLK, R0~R7, G0~G7, B0~B7

Note 2: Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

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4. OPTICAL CHARACTERISTICS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Response Time	Rise	T_r	$\Theta=0^\circ$	--	15	20	ms	Note 1,2,3,5
	Fall	T_f		--	35	50		
Contrast ratio		CR	At optimized viewing angle	150	250	--		Note 1,2,4,5
Viewing Angle	Top	θf	$CR \geq 10$	--	55	--	deg.	Note1,2, 5,6
	Bottom	θb		--	35	--		
	Left	θl		--	70	--		
	Right	θr		--	70	--		
Brightness LED BL Without TP		Y_L	($I_{LED}=60mA, 25^\circ C$)	--	800	--	cd/m ²	Note 7
Red chromaticity		XR	$\Theta=0^\circ$	(0.585)	(0.615)	(0.645)		Note 7 For reference only. These data should be update according the prototype.
		YR		(0.314)	(0.344)	(0.374)		
Green chromaticity		XG		(0.277)	(0.307)	(0.337)		
		YG		(0.532)	(0.562)	(0.592)		
Blue chromaticity		XB		(0.103)	(0.133)	(0.163)		
		YB		(0.120)	(0.150)	(0.180)		
White chromaticity		XW		(0.279)	(0.309)	(0.339)		
		YW		(0.320)	(0.350)	(0.380)		
LED Life time		-		20K			hour	Note 8

()For reference only. These data should be update according the prototype.

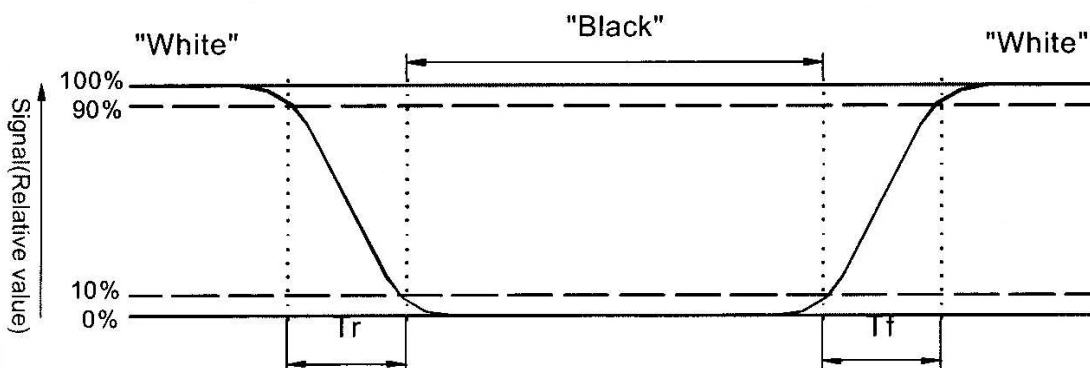
Note 1:

- LED BL : Ambient temperature= $25^\circ C$, and lamp current $I_{LED}=60mA$. To be measured in the dark room.
-

Note 2: To be measured on the center area of panel with a viewing cone of 1° by Topcon luminance meter BM-7, after 10 minutes operation.

Note 3. Definition of response time:

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.



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Note 4. Definition of contrast ratio:

Contrast ratio is calculated with the following formula.

$$\text{Contrast ratio(CR)} = \frac{\text{Photo detector output when LCD is at "White" state}}{\text{Photo detector Output when LCD is at "Black" state}}$$

Note 5: White $V_i = V_{i50} + 1.5V$

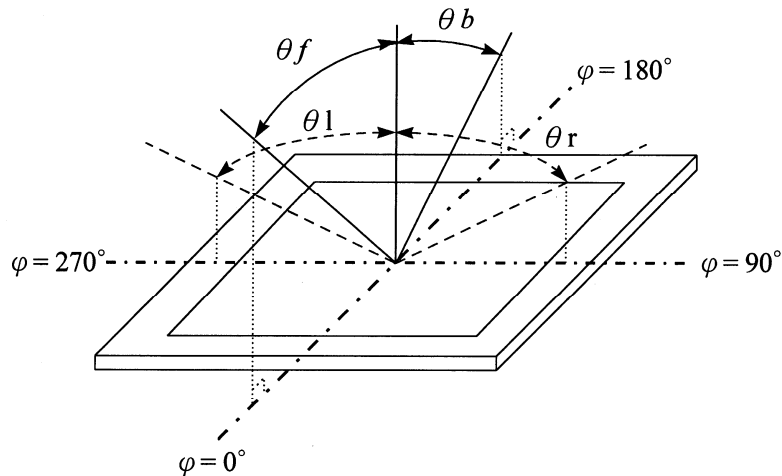
Black $V_i = V_{i50} + 2.0V$

"±" means that the analog input signal swings in phase with V_{COM} signal.

"∓" means that the analog input signal swings out of phase with V_{COM} signal.

V_{i50} : The analog input voltage when transmission is 50%. The 100% Transmission is defined as the transmission of LCD panel when all the Input terminals of module are electrically opened.

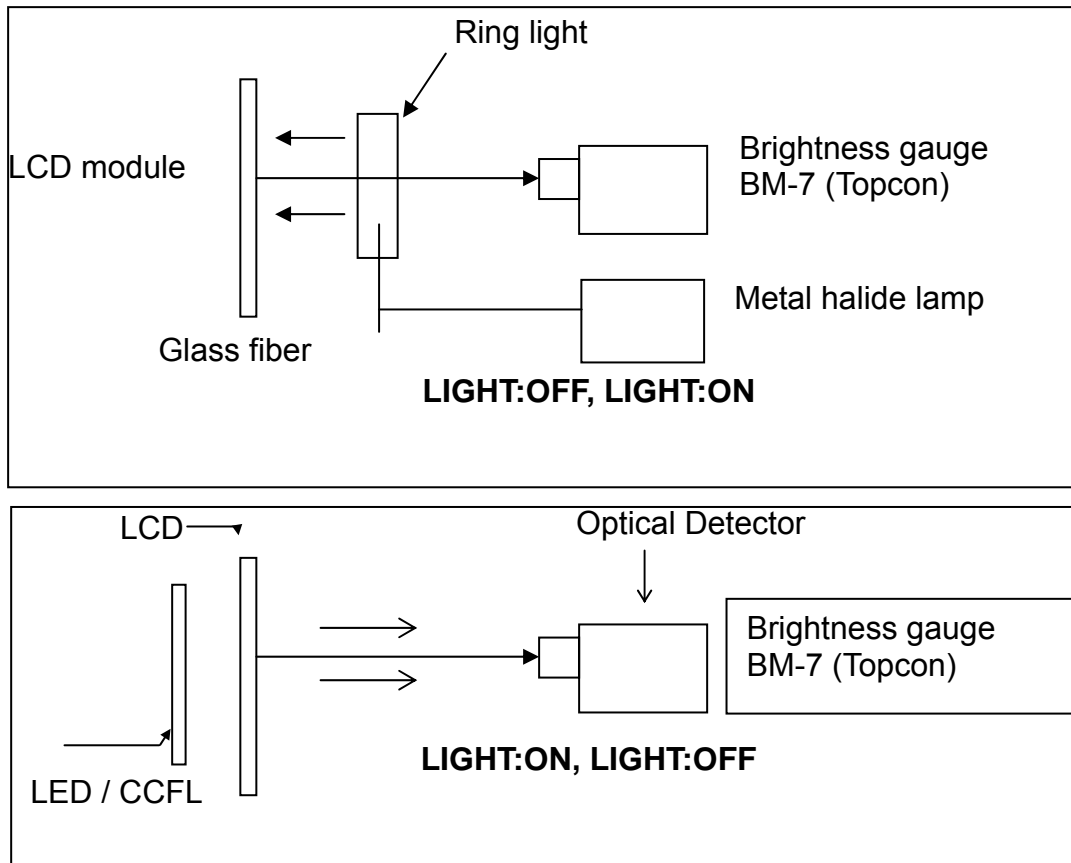
Note 6. Definition of viewing angle, Refer to figure as below.



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Note 7. Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.



Note 8 Condition: $T_a=25^{\circ}\text{C}$, continuous lighting
Life time is estimated data.

Definitions of failure:

1. LCM brightness becomes half of the minimum value.
2. LED doesn't light normally.

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5. ELECTRICAL CHARACTERISTICS

LCD driving

Item	Symbol	Min.	Typ.	Max.	Unit	Note	
Power supply voltage	VDD	3.0	3.3	3.6	V		
	VLED	5		12	V		
Input voltage for logic	H Level	V_{IH}	0.8 VDD	--	VDD	V	(1)
	L Level	V_{IL}	0	--	0.2 VDD	V	
Power Supply current	IDD	--	45	--	mA	(2)	
	ILED		300		mA	VLED=5V	

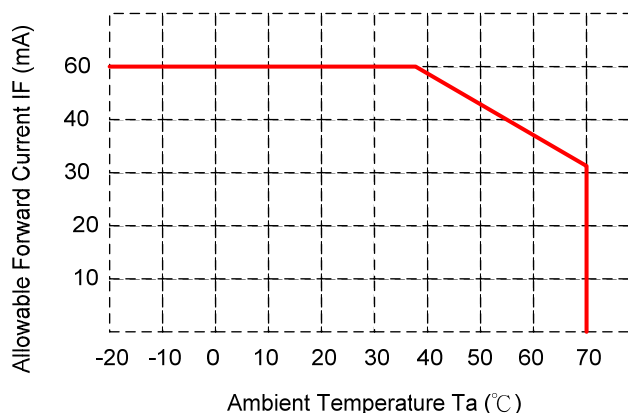
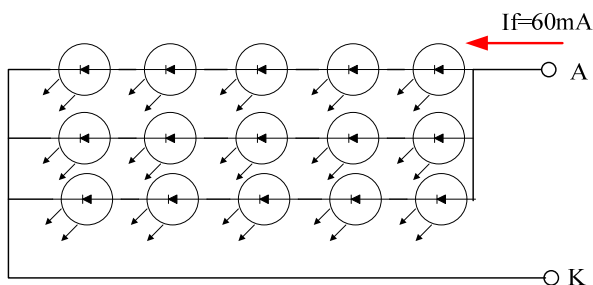
Note 1: Hsync, Vsync, DEN, DCLK, R0~R5, G0~G5, B0~B5

Note 2: fV =60Hz , Ta=25°C , Display pattern : All Black

LED back light specification

Item	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage	V_f	$I_f = 60\text{mA}$	-	16.0	-	V
Forward current	I_f	5-chip serial*3	-	60	-	mA
Uniformity (with L/G)	-	$I_f = 60\text{mA}$	75%*1	-	-	
Luminous color	White					
Chip connection	5 chip serial connection*3					

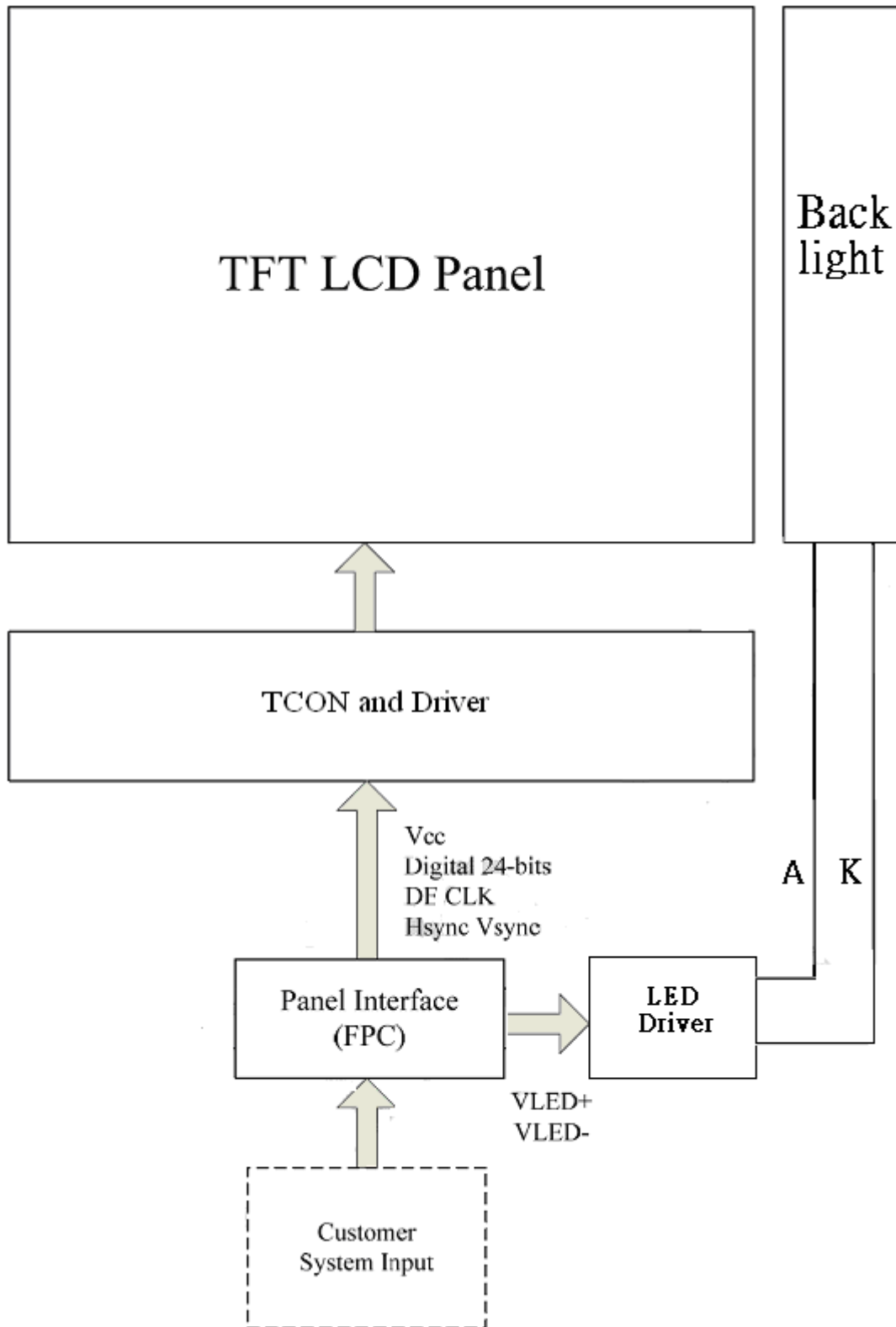
- The constant current source is needed for white LED back-light driving. When LCM is operated over 40 deg.C ambient temperature, the I_f of the LED back-light should be adjusted to 30mA max*



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6. BLOCK DIAGRAM



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7. TFT LCD Panel FPC Descriptions

Pin no	Symbol	Function
1	GND	LED Driver: Ground.
2	GND	
3	VLED	LED Driver: Power supply of LED driver IC (5V)
4	VLED	
5	GND	Ground
6	DISP	Display ON/OFF
7	GND	Ground
8	NC	No Connection
9	NC	No Connection
10	NC	No Connection
11	NC	No Connection
12	B0	Blue Data Bit 0
13	B1	Blue Data Bit 1
14	B2	Blue Data Bit 2
15	B3	Blue Data Bit 3
16	B4	Blue Data Bit 4
17	B5	Blue Data Bit 5
18	B6	Blue Data Bit 6
19	B7	Blue Data Bit 7
20	G0	Green Data Bit 0
21	G1	Green Data Bit 1
22	G2	Green Data Bit 2
23	G3	Green Data Bit 3
24	G4	Green Data Bit 4
25	G5	Green Data Bit 5
26	G6	Green Data Bit 6
27	G7	Green Data Bit 7
28	R0	Red Data Bit 0
29	R1	Red Data Bit 1
30	R2	Red Data Bit 2
31	R3	Red Data Bit 3
32	R4	Red Data Bit 4
33	R5	Red Data Bit 5
34	R6	Red Data Bit 6
35	R7	Red Data Bit 7
36	HSYNC	Horizontal Sync Input
37	VSYNC	Vertical Sync Input

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38	DCLK	Dot Data Clock
39	NC	NC
40	NC	NC
41	VCC	Power Supply(3.3V)
42	VCC	Power Supply(3.3V)
43	GND	Ground
44	R/L	Shift direction control pin for Horizontal R/L=H, STV OUT1 OUT2 ...OUT480 R/L=L, STV OUT480 OUT479 ...OUT1 (Note1.)
45	NC	NC
46	U/D	Shift direction control pin for Vertical U/D=H, STV OUT1 OUT2 ...OUT272 U/D=L, STV OUT272 OUT271 ...OUT1 (Note1.)
47	PWM	LED Driver: PWM dimming pin. PWM frequency 5Khz~100KHz.
48	GND	Ground
49	GND	Ground
50	GND	Ground
51	NC	NC
52	ENB	Data Enable
53	GND	Ground
54	GND	Ground

Note1:

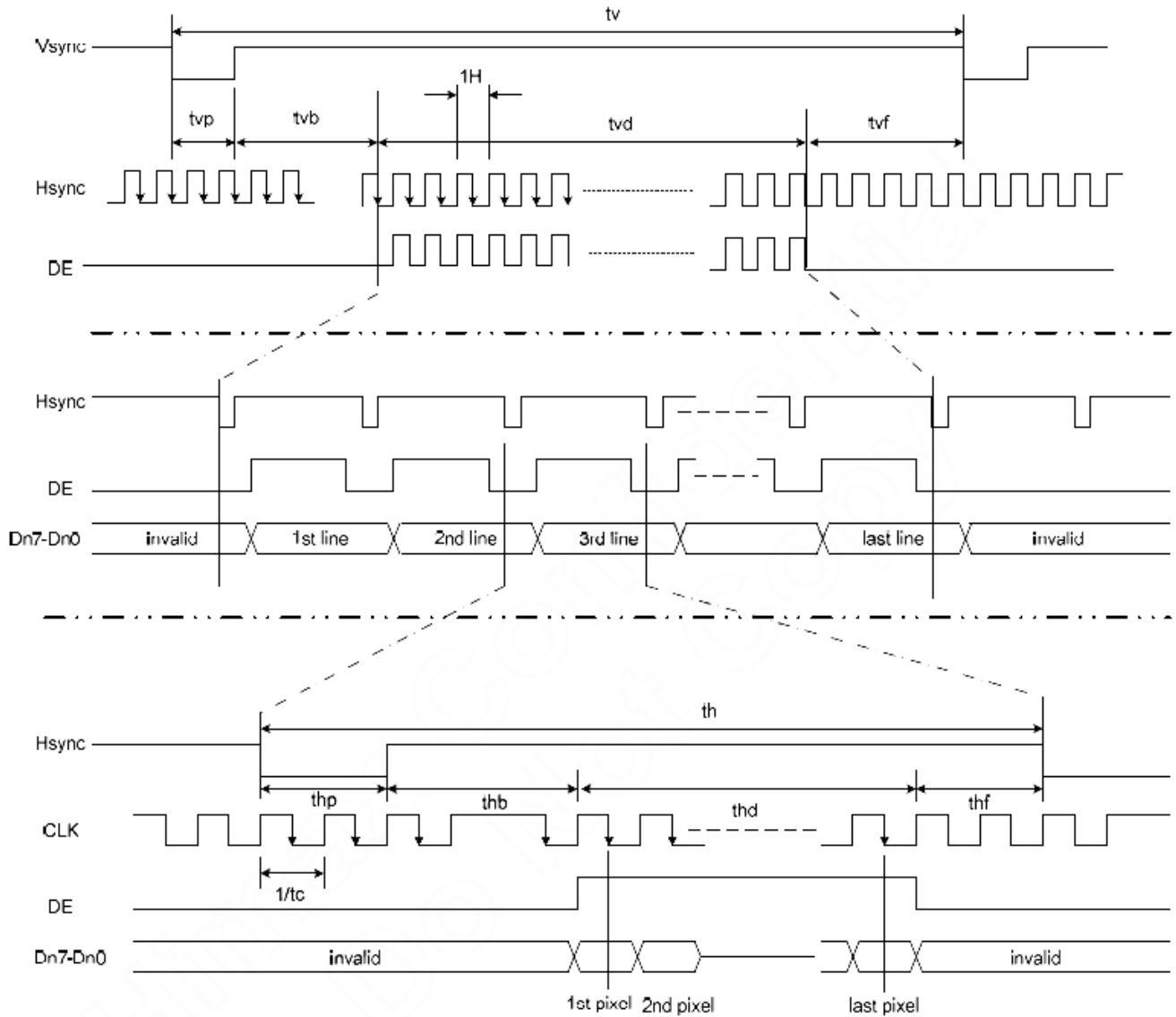
		Default setting
	L/R=1 U/D=1	L/R=0 U/D=0
scan direction		
View angle (Gray Inversion)	6H	12H

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8. INPUT SIGNAL

8.1 Parallel RGB input timing Chart



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8.2 Timing Specification

Parallel RGB input timing requirement

PARAMETER	Symbol	Min.	Typ.	Max.	Unit
Clock cycle	$1/t_c^{*1}$		9	15	MHz
Hsync cycle	$1/f_H$		17.14	-	KHz
Vsync cycle	$1/f_V$		59.94	-	Hz
Horizontal Signal					
Horizontal cycle	th^2	575	575	605	CLK
Horizontal display period	thd	480	480	480	CLK
Horizontal front porch	thf	2	2	82	CLK
Horizontal pulse width	thp	2	41	41	CLK
Horizontal back porch	thb	2	2	41	CLK
Vertical Signal					
Vertical cycle	tv	285-	286	511	H
Vertical display period	tvd	272	272	272	H
Vertical front porch	tvf	1	2	227	H
Vertical pulse width	tvp	1	10	11	H
Vertical back porch	tvb	1	2	11	H

Note:

1. Unit: CLK=1/ fCLK , H=th
2. Parallel interface. Clock frequency and horizontal signal parameters are tripled in serial interface. The Maximum clock frequency of serial interface is 33MHz
3. thd=480CLK, thf=2CLK, thp=41CLK, thb=2CLK, thf + fhp + ftb > 44

8.3 Timing Chart 2

Input setup timing requirement

PARAMETER	Symbol	Min.	Typ.	Max.	Unit
DISP setup time	t_{diss}	10	-	-	ns
DISP hold time	t_{dish}	10	-	-	ns
Clock period	PW_{CLK}^{*1}	66.7	-	-	ns
Clock pulse high period	PWH^{*1}	26.7	-	-	ns
Clock pulse low period	PWL^{*1}	26.7	-	-	ns
Hsync setup time	t_{hs}	10	-	-	ns
Hsync hold time	t_{hh}	10	-	-	ns
Data setup time	t_{ds}	10	-	-	ns
Data hold time	t_{dh}	10	-	-	ns
DE setup time	t_{des}	10	-	-	ns
DE hold time	t_{deh}	10	-	-	ns
Vsync setup time	t_{vhs}	10	-	-	ns
Vsync hold time	t_{vhh}	10	-	-	ns

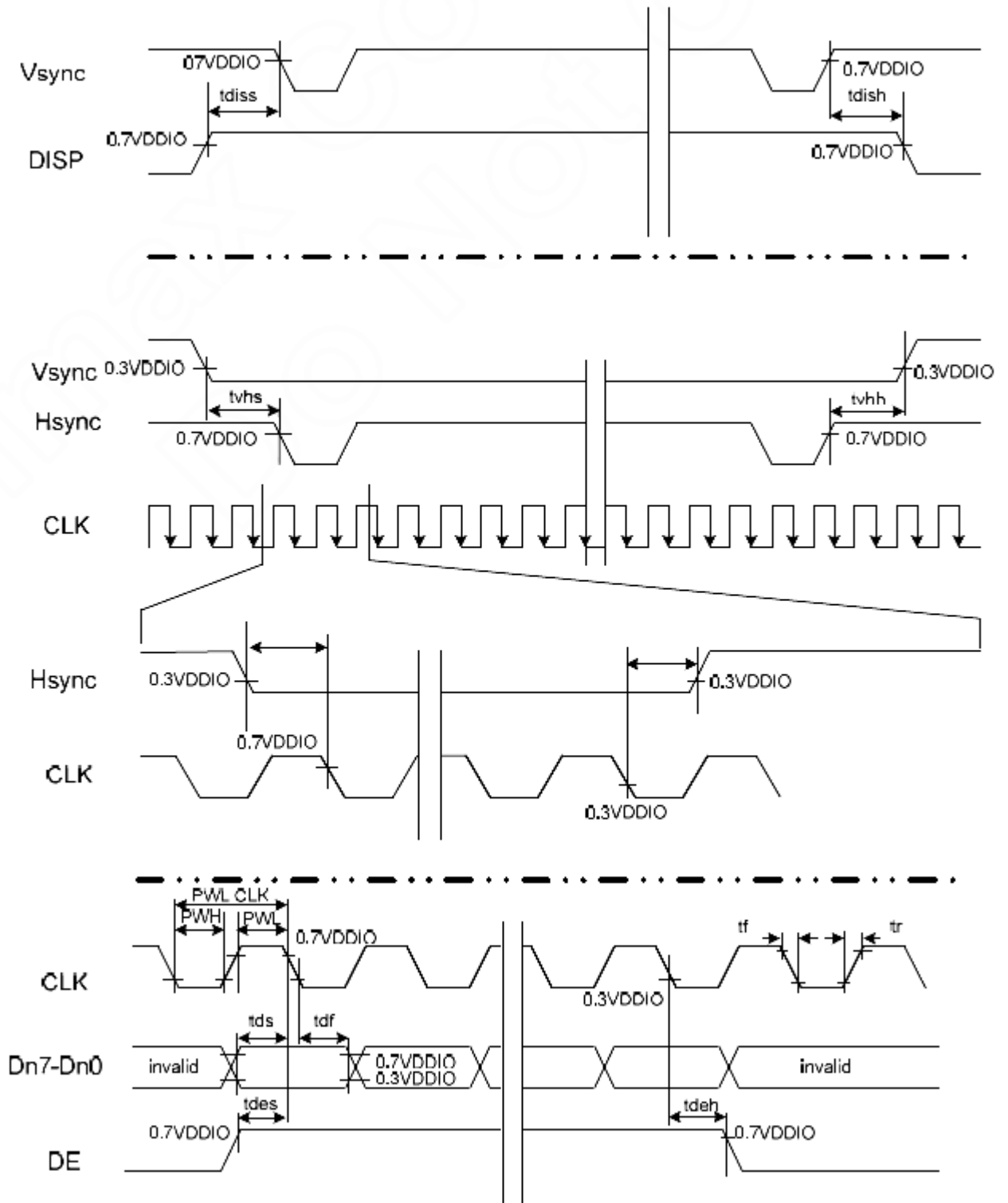
Note

1. For parallel interface, maximum clock frequency is 15MHz.
2. tr, tf is defined 10% to 90% of signal amplitude.

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8.4 Input setup timing Chart



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9. Color Data Assignment

COLOR	INPUT DATA	R DATA								G DATA								B DATA							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
		MSB							LSB	MSB							LSB	MSB							LSB
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	GREEN(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	GREEN(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
BLUE	BLUE(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	BLUE(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	BLUE(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

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10. QUALITY AND RELIABILITY

1. Scope

Specifications contain

1.1 Display Quality Evaluation

1.2 Mechanics Specification

2. Sampling Plan

Unless there is other agreement, the sampling plan for incoming inspection shall follow MIL-STD-105E LEVEL II.

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

2.2 Sampling type: Normal inspection, single sampling.

2.3 Sampling level: Level II.

2.4 AQL: Acceptable Quality Level

Major defect: AQL=0.65

Minor defect: AQL=1.0

3. Panel Inspection Condition

3.1 Environment:

Room Temperature: $25\pm 5^{\circ}\text{C}$.

Humidity: $65\pm 5\%$ RH.

Illumination: 300 ~ 700 Lux.

3.2 Inspection Distance:

35-40 cm

3.3 Inspection Angle:

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

3.4 Inspection time :

Perceptibility Test Time: 20 seconds max.

4. Display Quality

4.1 Function Related:

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

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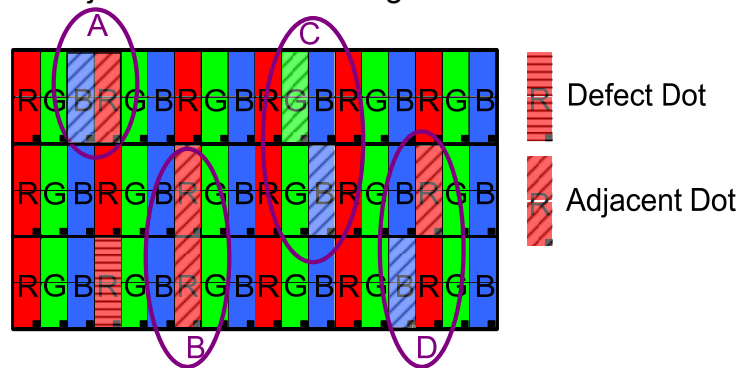
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4.2 Bright/Dark Dots:

Defect Type / Specification	G0 Grade	A Grade
Bright Dots	0	$N \leq 2$
Dark Dots	0	$N \leq 3$
Total Bright and Dark Dots	0	$N \leq 4$

[Note 1]

Judge defect dot and adjacent dot as following.



- (1) One pixel consists of 3 sub-pixels, including R,G, and B dot.(Sub-pixel = Dot)
- (2) The definition of dot: The size of a defective dot over 1/2 of whole dot is regarded as one defective dot.
- (3) Allow above (as A, B, C and D status) adjacent defect dots, including bright and dark adjacent dot. And they will be counted 2 defect dots in total quantity.
- (4) Defects on the Black Matrix, out of Display area, are not considered as a defect or counted.
- (5) There should be no distinct non-uniformity visible through 6% ND Filter within 2 sec inspection times.

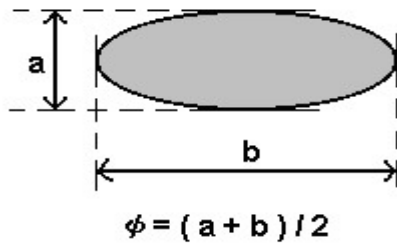
4.3 Visual Inspection specifications:

Defect Type	Specification	Count(N)
Dot Shape (Particle、Scratch and Bubbles in display area)	$D \leq 0.2\text{mm}$	Ignored
	$0.2\text{mm} < D \leq 0.4\text{mm}$	$N \leq 3$
	$D > 0.4\text{mm}$	$N=0$
Line Shape (Particles、Scratch、Lint and Bubbles in display area)	$W \leq 0.05\text{mm}$	Ignored
	$0.05\text{mm} < W \leq 0.1\text{mm}$, $L \leq 4\text{mm}$	$N \leq 3$
	$W > 0.1\text{mm}$, $L > 4\text{mm}$	$N=0$

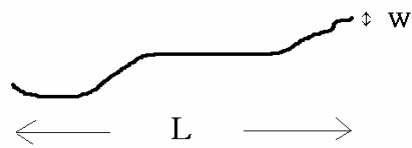
[Note 2] W : Width[mm], L : Length[mm], N : Number, ϕ : Average Diameter

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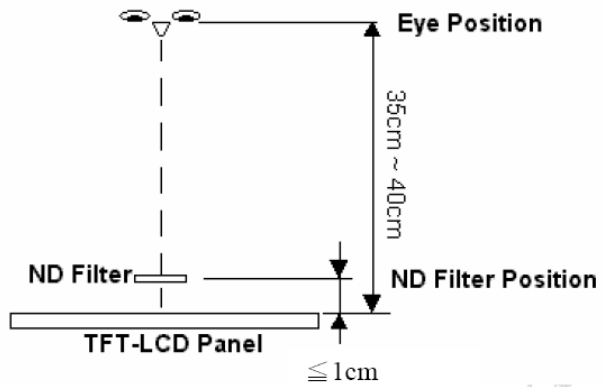
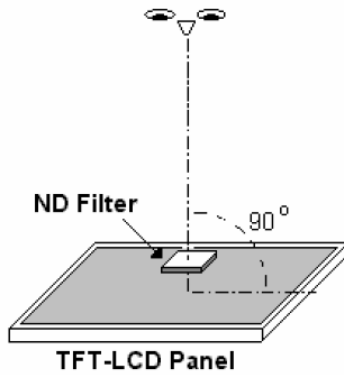


- 1. (White, black) Spot
- 2. Polarizer Bubble



1. fiber

[Note 3] Bright dot is defined through 6% transmission ND Filter as following.



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10.1 Reliability Test

Test Item	Test Conditions	Note
High Temperature Operation	70±3°C , t=240 hrs	
Low Temperature Operation	-20±3°C , t=240 hrs	
High Temperature Storage	80±3°C , t=240 hrs	1,2
Low Temperature Storage	-30±3°C , t=240 hrs	1,2
Thermal Shock Test	-20°C ~ 25 °C ~ 70 °C 30 m in. 5 min. 30 min. (1 cycle) Total 5 cycle	1,2
Humidity Test	60 °C, Humidity 90%, 96 hrs	1,2
Vibration Test (Packing)	Sweep frequency : 10 ~ 55 ~ 10 Hz/1min Amplitude : 0.75mm Test direction : X.Y.Z/3 axis Duration : 30min/each axis	2

Note 1 : Condensation of water is not permitted on the module.

Note 2 : The module should be inspected after 1 hour storage in normal conditions (15-35°C , 45-65%RH).

Definitions of life end point :

- Current drain should be smaller than the specific value.
- Function of the module should be maintained.
- Appearance and display quality should not have degraded noticeably.
- Contrast ratio should be greater than 50% of the initial value.

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11. USE PRECAUTIONS

11.1 Handling precautions

- 1) The polarizing plate may break easily so be careful when handling it. Do not touch, press or rub it with a hard-material tool like tweezers.
- 2) Do not touch the polarizing plate surface with bare hands so as not to make it dirty. If the surface or other related part of the polarizing plate is dirty, soak a soft cotton cloth or chamois leather in benzene and wipe off with it. Do not use chemical liquids such as acetone, toluene and isopropyl alcohol. Failure to do so may bring chemical reaction phenomena and deteriorations.
- 3) Remove any spit or water immediately. If it is left for hours, the suffered part may deform or decolorize.
- 4) If the LCD element breaks and any LC stuff leaks, do not suck or lick it. Also if LC stuff is stuck on your skin or clothing, wash thoroughly with soap and water immediately.

11.2 Installing precautions

- 1) The PCB has many ICs that may be damaged easily by static electricity. To prevent breaking by static electricity from the human body and clothing, earth the human body properly using the high resistance and discharge static electricity during the operation. In this case, however, the resistance value should be approx. 1M Ω and the resistance should be placed near the human body rather than the ground surface. When the indoor space is dry, static electricity may occur easily so be careful. We recommend the indoor space should be kept with humidity of 60% or more. When a soldering iron or other similar tool is used for assembly, be sure to earth it.
- 2) When installing the module and ICs, do not bend or twist them. Failure to do so may crack LC element and cause circuit failure.
- 3) To protect LC element, especially polarizing plate, use a transparent protective plate (e.g., acrylic plate, glass etc) for the product case.
- 4) Do not use an adhesive like a both-side adhesive tape to make LCD surface (polarizing plate) and product case stick together. Failure to do so may cause the polarizing plate to peel off.

11.3 Storage precautions

- 1) Avoid a high temperature and humidity area. Keep the temperature between 0°C and 35°C and also the humidity under 60%.
- 2) Choose the dark spaces where the product is not exposed to direct sunlight or fluorescent light.
- 3) Store the products as they are put in the boxes provided from us or in the same conditions as we recommend.

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11.4 Operating precautions

- 1) Do not boost the applied drive voltage abnormally. Failure to do so may break ICs. When applying power voltage, check the electrical features beforehand and be careful. Always turn off the power to the LC module controller before removing or inserting the LC module input connector. If the input connector is removed or inserted while the power is turned on, the LC module internal circuit may break.
- 2) The display response may be late if the operating temperature is under the normal standard, and the display may be out of order if it is above the normal standard. But this is not a failure; this will be restored if it is within the normal standard.
- 3) The LCD contrast varies depending on the visual angle, ambient temperature, power voltage etc. Obtain the optimum contrast by adjusting the LC drive voltage.
- 4) When carrying out the test, do not take the module out of the low-temperature space suddenly. Failure to do so will cause the module condensing, leading to malfunctions.
- 5) Make certain that each signal noise level is within the standard (L level: 0.2V_{dd} or less and H level: 0.8V_{dd} or more) even if the module has functioned properly. If it is beyond the standard, the module may often malfunction. In addition, always connect the module when making noise level measurements.
- 6) The CMOS ICs are incorporated in the module and the pull-up and pull-down function is not adopted for the input so avoid putting the input signal open while the power is ON.
- 7) The characteristic of the semiconductor element changes when it is exposed to light emissions, therefore ICs on the LCD may malfunction if they receive light emissions. To prevent these malfunctions, design and assemble ICs so that they are shielded from light emissions.
- 8) Crosstalk occurs because of characteristics of the LCD. In general, crosstalk occurs when the regularized display is maintained. Also, crosstalk is affected by the LC drive voltage. Design the contents of the display, considering crosstalk.

11.5 Other

- 1) Do not disassemble or take the LC module into pieces. The LC modules once disassembled or taken into pieces are not the guarantee articles.
- 2) The residual image may exist if the same display pattern is shown for hours. This residual image, however, disappears when another display pattern is shown or the drive is interrupted and left for a while. But this is not a problem on reliability.
- 3) AMIPRE will provide one year warranty for all products and three months warranty for all repairing products.

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12 OUTLINE DIMENSION

