

LIQUID CRYSTAL DISPLAY MODULE

Product Specification

PRODUCT NUMBER	LMR5401EW2C40WF
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INTERNAL APPROVALS		
Product Manager	Engineering	Document Control

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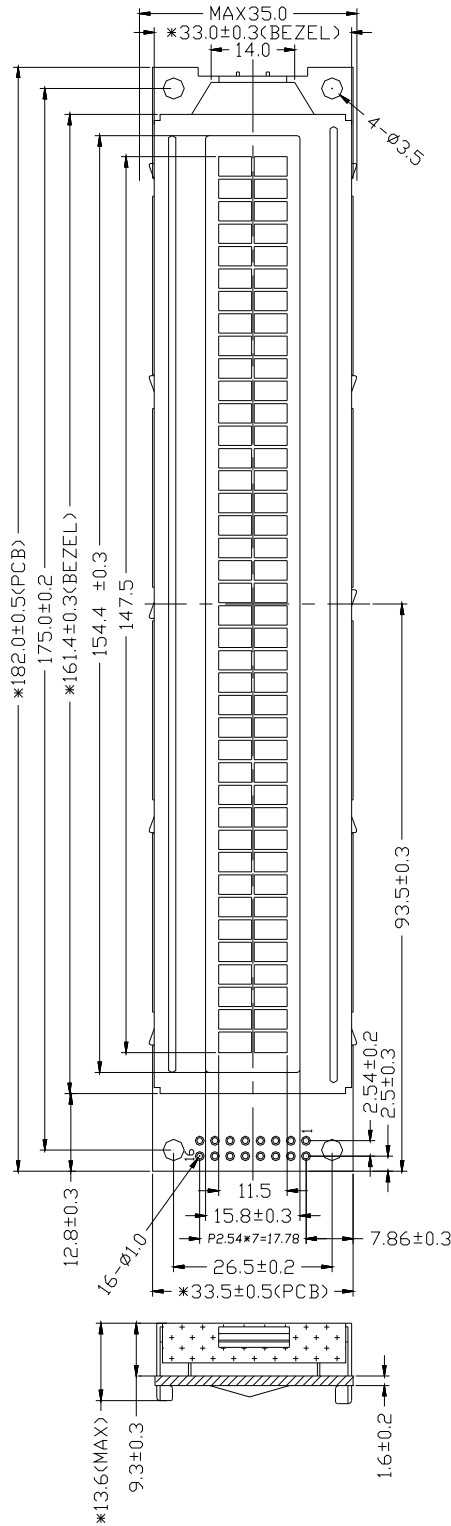
REVISION RECORD

Rev.	Date	Page	Par.	Comment	ECN no.
A	11/11/10	--	--	Initial DCA Release	E4380

1 MAIN FEATURES

ITEM	CONTENTS	UNIT
Outline Dimension	182.0 (W) x 33.5 (H) x 13.6 (D)	mm
Display Format	40 characters x 2 lines	Dots
Viewing Area	154.4 (W) x 15.8 (H)	mm
Character Size	3.2 x 5.55	mm
Dot Size	0.6 x 0.65	mm
LCD Type	FSTN / Negative / Transmissive	-
View Angle	6:00	O'clock
Duty Ratio	1/16	Duty
Bias	1/5	Bias
Module Operating Voltage	5.0	V
LCD Operating Voltage	4.7	V
Controller IC	SPLC780D1-001A-C	-
Operating Temperature	-20 ~ 70	°C
Storage Temperature	-30 ~ 85	°C
RoHS Compliant	Yes	-

2 MECHANICAL DRAWING



1	Operating Voltage:	5.0V
2	Drive method:	1/16Duty, 1/5Bias
3	Viewing Direction:	6:00
4	Operating Temp:	-20°C~70°C
5	Storage Temp:	-30°C~85°C
6	Display type:	PFSTN, Negative, T/T
7	Unspecified tolerance:	±0.2
8	LCD controller/driver:	SPIC780D1-001A-C
9	Backlight:	LED/WHITE
10	Customer No.:	
11	Dimensions with mark "*" are important	
12	RoHS compliant	

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3 ABSOLUTE MAXIMUM RATINGS

Characteristics	Symbol	Ratings	Unit	Note
Operating Voltage	VDD	-0.3 to +7.0	V	
Driver Supply Voltage	V _{LED}	VDD - 10 to VDD + 0.3	V	
Input Voltage Range	V _{IN}	-0.3 to VDD + 0.3	V	

Note: Stresses beyond those given in the Absolute Maximum Rating table may cause operational errors or damage to the device. For normal operational conditions see AC/DC Electrical Characteristics.

4 PIN CONNECTIONS

Pin No.	Symbol	Function
1	Vss	Ground(0v)
2	Vdd	Logic Supply Voltage(+5.0v)
3	Vee	LCD Driver Voltage Input
4	RS	Data/Instruction Register Select
5	R/W	Read/Write Select
6	E	Enable Signal
7-14	DB0-DB7	Data Bus Line
15-16	LED+,LED-	LED Backlight

5 THE LED BACKLIGHT

5.1 ELECTRICAL CHARACTERISTICS

(Ta = 25°C)

Color:white

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
Forward Voltage	Vf	2.9	3.2	3.5	V	If=15×2 mA
Reverse Current	Ir			15×2	μ A	Vr=3V
Dominant wave length	λP				nm	If=15×2 mA
Spectral Line Half width	λ				nm	If=15×2 mA
Luminance	LV	78	105		cd/m ²	If=15×2 mA

WARNING:

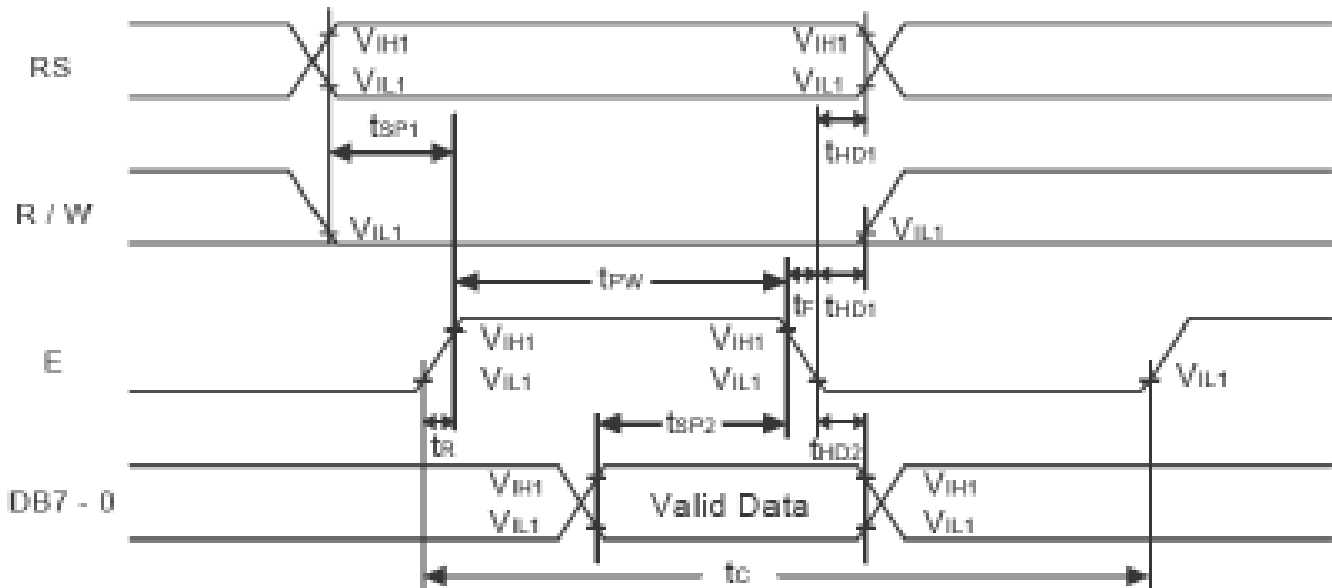
A BACKLIGHT IS A KIND OF CURRENT DEVICE,IT MUST CONNECT A RESISTANCE FOR LIMITING CURRENT ,OR IT WILL BE DAMAGED.

6 AC CHARACTERISTICS

Write Operation (Writing Data from MPU to SPLC780D1)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_c	400	-	-	ns	Pin E
E Pulse Width	t_{pw}	150	-	-	ns	Pin E
E Rise/Fall Time	t_r, t_f	-	-	25	ns	Pin E
Address Setup Time	t_{sp1}	30	-	-	ns	Pins: RS, R/W, E
Address Hold Time	t_{hd1}	10	-	-	ns	Pins: RS, R/W, E
Data Setup Time	t_{sp2}	40	-	-	ns	Pins: DB0 - DB7
Data Hold Time	t_{hd2}	10	-	-	ns	Pins: DB0 - DB7

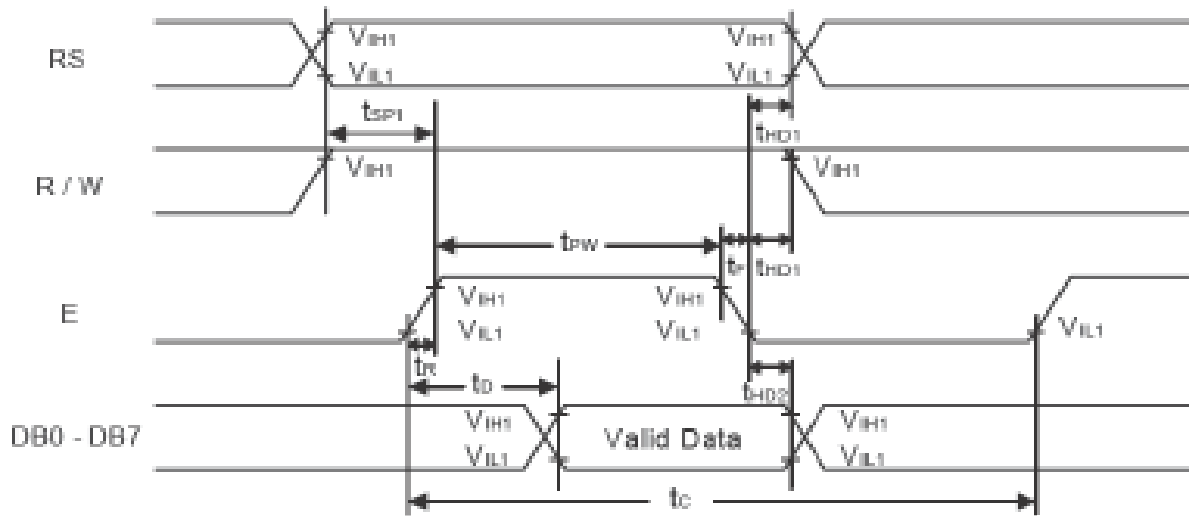
Write mode timing diagram (Writing Data from MPU to SPLC780D1)



Read Operation (Reading Data from SPLC780D1 to MPU)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_c	400	-	-	ns	Pin E
E Pulse Width	t_w	150	-	-	ns	Pin E
E Rise/Fall Time	t_r, t_f	-	-	25	ns	Pin E
Address Setup Time	t_{sp1}	30	-	-	ns	Pins: RS, R/W, E
Address Hold Time	t_{hd1}	10	-	-	ns	Pins: RS, R/W, E
Data Output Delay Time	t_o	-	-	100	ns	Pins: DB0 - DB7
Data hold time	t_{hd2}	5.0	-	-	ns	Pin DB0 - DB7

Read mode timing diagram (Reading Data from SPLC780D1 to MPU)

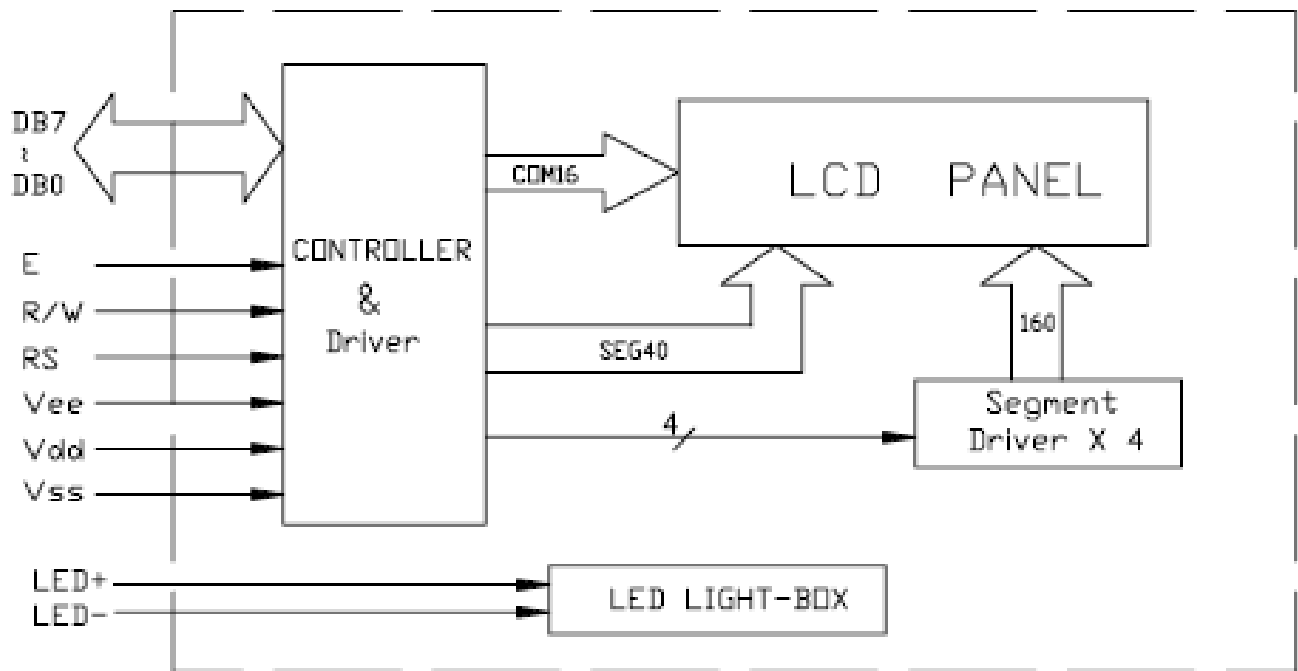


7 ELECTRO-OPTICAL CHARACTERISTICS

(Temp. = 23 ± 3 °C)


NO	Item	Symbol	Min.	Typ.	Max.	Unit	Condition
1	Supply Voltage(Logic)	Vdd-Vss		5.0		V	
3	LCD Operating Voltage	Vdd-V ₀		5.1		V	-20°C
			4.5	4.7	4.9	V	25°C
				4.3		V	70°C
4	Response Time	T _{on}		184		ms	
		T _{off}		84		ms	
5	Contrast	CR					
6	Viewing Angel	12H	θ 1	42		Deg.	(CR ≥ 2.0)
		6H	θ 2	52			
		3H	θ 3	45			
		9H	θ 4	45			

8 BLOCK DIAGRAM



PIN NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SYMBOL	Vss	Vdd	Vee	RS	R/W	E	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7	LED+	LED-

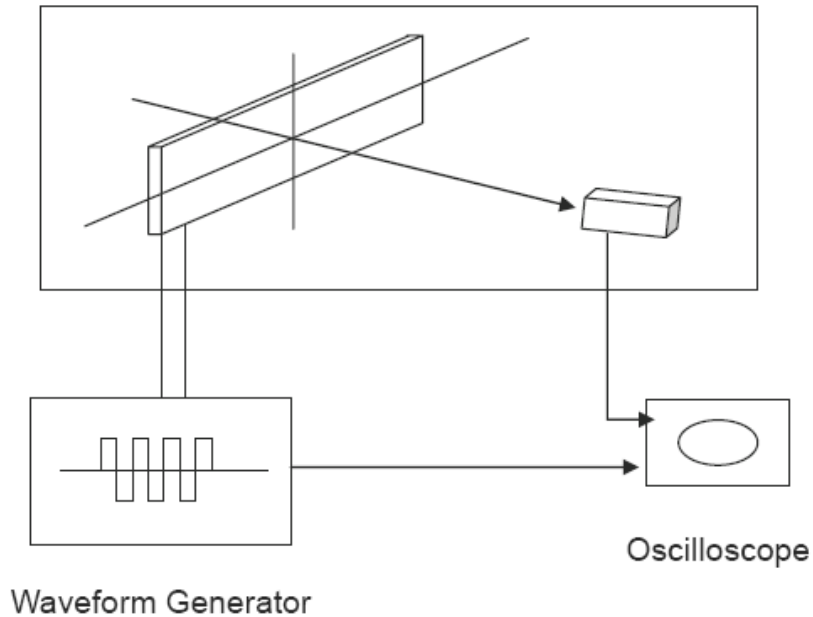
9 RELIABILITY TEST

No.	Items	Test Condition	Equipment	Test Result
1	High Temp. Storage	Temp.: $80 \pm 2^{\circ}\text{C}$ Time: 96h Restore: 24h	Tenny	Passed
2	Low Temp. Storage	Temp.: $-30 \pm 3^{\circ}\text{C}$ Time: 96h Restore: 24h	Tenny	Passed
3	High Temp. Operating	Temp.: $70 \pm 2^{\circ}\text{C}$ Time: 24h Restore: 24h	Tenny	Passed
4	Low Temp. Operating	Temp.: $-20 \pm 2^{\circ}\text{C}$ Time: 24h Restore: 24h	Tenny	Passed
5	High Temp. / High Humidity Storage	Temp.: $40 \pm 2^{\circ}\text{C}$ Hum: 95 % RH Time: 96h Restore: 24h	Tenny	Passed
6	Thermal Shock	Temp.: ($^{\circ}\text{C}$)  5 Cycles, Restore: 24h	Tenny	Passed

10 THE LCD MEASURING METHOD AND EQUIPMENT

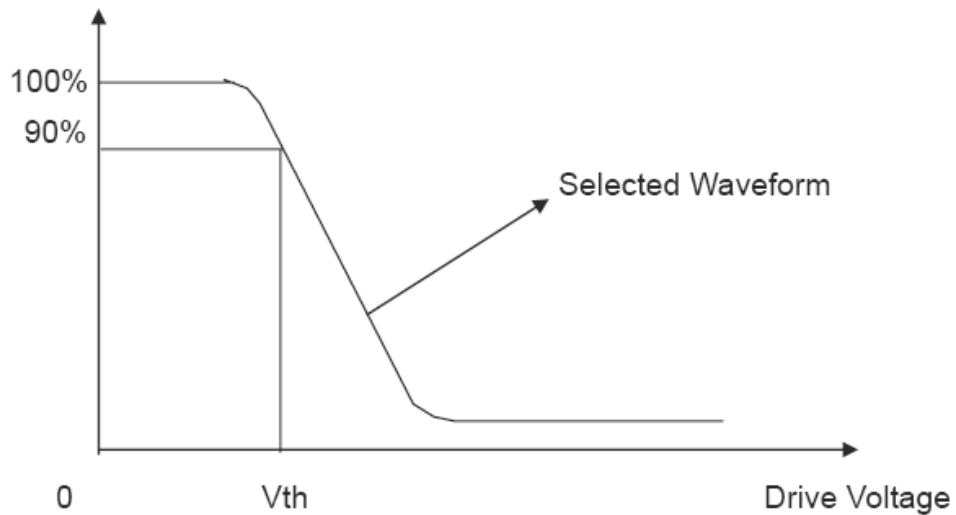
1. Threshold Voltage and Response Time Measuring

(1) Equipment

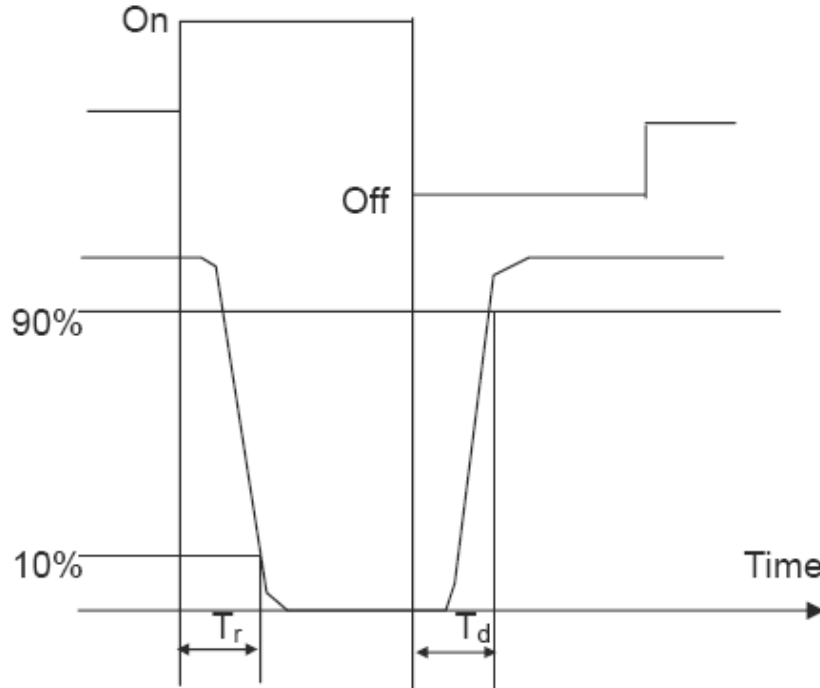


(2) Definition

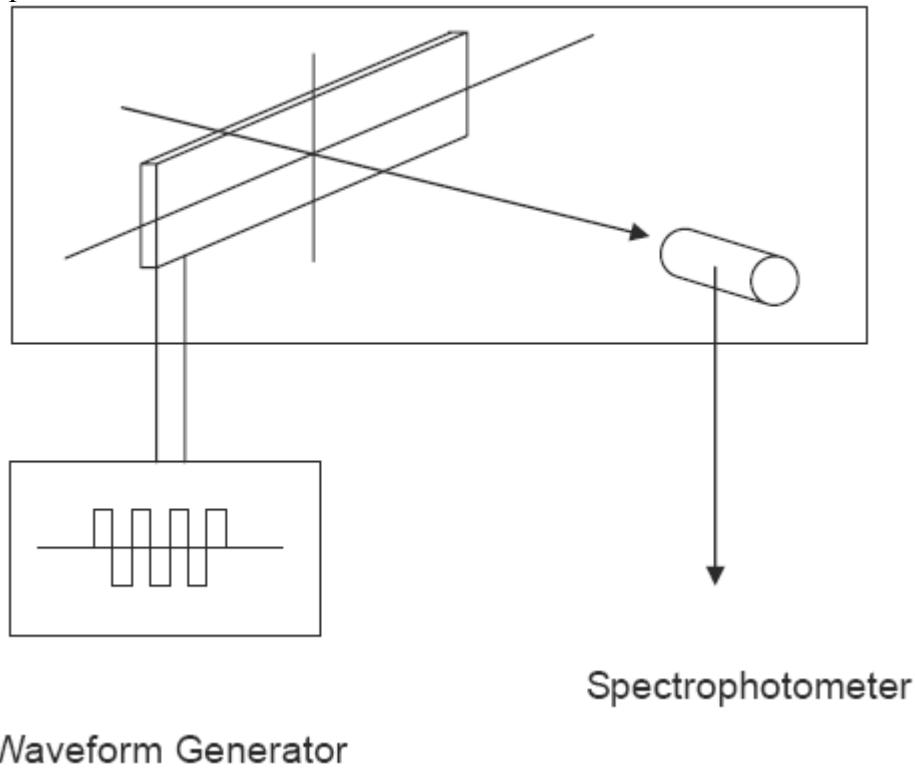
- A. Threshold Voltage (V_{th})
Brightness



B. Response Time

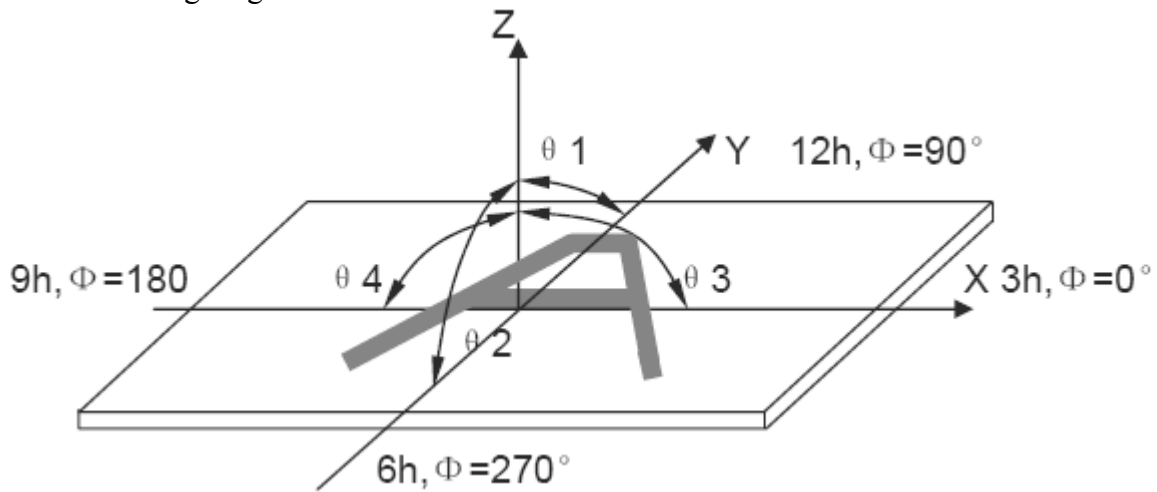


2. Contrast Measuring
(1) Equipment



(2) Definition:

A. Viewing Angle:



B. Contrast Ratio (Positive)

$$CR = \frac{\text{Brightness of non-selected wave-form}}{\text{Brightness of selected wave-form}}$$

11 STANDARD SPECIFICATIONS FOR PRODUCT QUALITY

1. Manner of Test:

1.1. The test must be under 40w fluorescent light, and the distance of view must be at 30 cm.

1.2. The test direction is based on around 15°- 45° of vertical line.

2. Definition of Defects

2.1 Major Defects

A: Non-Display

B: Segment Missing

C: Over Current

D: Segment Short

E: Sealant Disharden

F: Wrong Polarizer Direction

2.2 Minor Defects: The Others.

3. Major defects should be in AQL 0.25, and the minor in AQL 1.00.

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4. Inspection Item and Standards

Item	The standard of quality inspection	Checking Manner	Quality Ratio
1. Frame	Smooth and even surface, no crack, no scratch, no rust, and not be wrenched out of shape. The range between convex and concave is: $d \leq 0.35$ mm and the frame must be connected to the ground.	Check With Eyes And Using Vernier Caliper, Multimeter	100%
2. LCD	1. The major defects would be rejected. 2. No scratch and no dusty on the LCD glass surface. 3. $D \leq 0.15$ mm $n \leq 2$ diameter of bubble: $d \leq 0.5$ $n \leq 2$ damaged size of polarizer: $d \leq 0.15$ mm, $n \leq 2$. 4. No scratch and dusty between the LCD and led.	Check It When Displaying	100%
3. The Relative Position of LCD and Frame	1. The LCD should not be twisted. 2. The LCD graphic should be in the middle position of the frame.	Check With Eyes	100%
4. The Relative Position of PCB Panel and Frame	1. The frame installing direction must be correct. 2. The twisted angle of the pin is from 45° to 60° . 3. The pin is vertical to PCB panel and it should be in the middle position of the installing holes.	Check With Eyes	100%
5. LED	1. The led would be amber. 2. The led would be uniform.	Check With Eyes	100%
6. Function Test	1. The major defects must be reject. 2. Test flow chart (see attached chart) 3. Background changes evenly and no disorderly displaying phenomenon. 4. Display no shortage.	Check It When Displaying	100%

Note: D ~ Diameter N ~ Quantity Unit: mm

12 HANDLING PRECAUTIONS

Safety

If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or in your eyes. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Mounting and Design

Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface. When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean. Design the system so that no input signal is given unless the power supply voltage is applied.

Caution during LCD cleaning

Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotrifluoroethane. Do not wipe the display surface with dry or hard materials that will damage the polariser surface. Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

Caution against static charge

As the display uses C-MOS LSI drivers, connect any unused input terminal to VDD or VSS. Do not input any signals before power is turned on. Also, ground your body, work/assembly table and assembly equipment to protect against static electricity.

Packaging

Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height. To prevent displays from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

Caution during operation

It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life. Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation. Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged. If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once. Even a small amount of condensation on the contact pads (terminals) can cause an electro-chemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

Storage

Store the display in a dark place where the temperature is $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ and the humidity below 50%RH. Store the display in a clean environment, free from dust, organic solvents and corrosive gases. Do not crash, shake or jolt the display (including accessories).

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