

# TFT LCD Preliminary Specification

**Model No.: PQ070WS01**

Customer: \_\_\_\_\_

Approved by: \_\_\_\_\_

Note:



## 1. GENERAL DESCRIPTION

### 1.1. OVERVIEW

PQ070WS01 is a 7.0" TFT Liquid Crystal Display module with a LED backlight unit and a 30-pin LVDS interface. This module supports 1024 x 600 Wide-SVGA (WSVGA) mode and can display 262,144 colors. This module also supports two low power modes: a transmissive mode with lower color and a reflective black and white (64 grayscales) mode. The LED converter for backlight module is also built in.

### 1.2. FEATURES

- WSVGA (1024 x 600 pixels) resolution
- 3.3V LVDS (Low Voltage Differential Signaling) interface with 1 pixel/clock
- Built in LED Converter
- Transmissive, transfective, and reflective display modes

### 1.3. APPLICATIONS

- Mobile notebook or netbook
- Multimedia tablet

### 1.4. GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Panel Diagonal	7.0	inch	
Pixels per inch color	170	ppi	
Active Area	153.60 (H) x 90.00 (V) (7.0" diagonal)	mm	
Bezel Opening Area	156.50 (H) x 92.90 (V)	mm	
Driver Element	a-Si TFT active matrix	-	-
Pixel Number	1024 x R.G.B. x 600	pixel	(1)
Pixel Pitch	0.150 (H) x 0.150 (V)	mm	-
Pixel Arrangement	RGB vertical stripe + 3 reflective subpixels	-	-
Display Colors	262,144	color	18 bit
Display Operating Modes	Transmissive, transfective, reflective. Normally black	-	-
Surface Treatment	Hard coating (3H), Anti-Glare	-	-

### 1.5. MECHANICAL SPECIFICATIONS

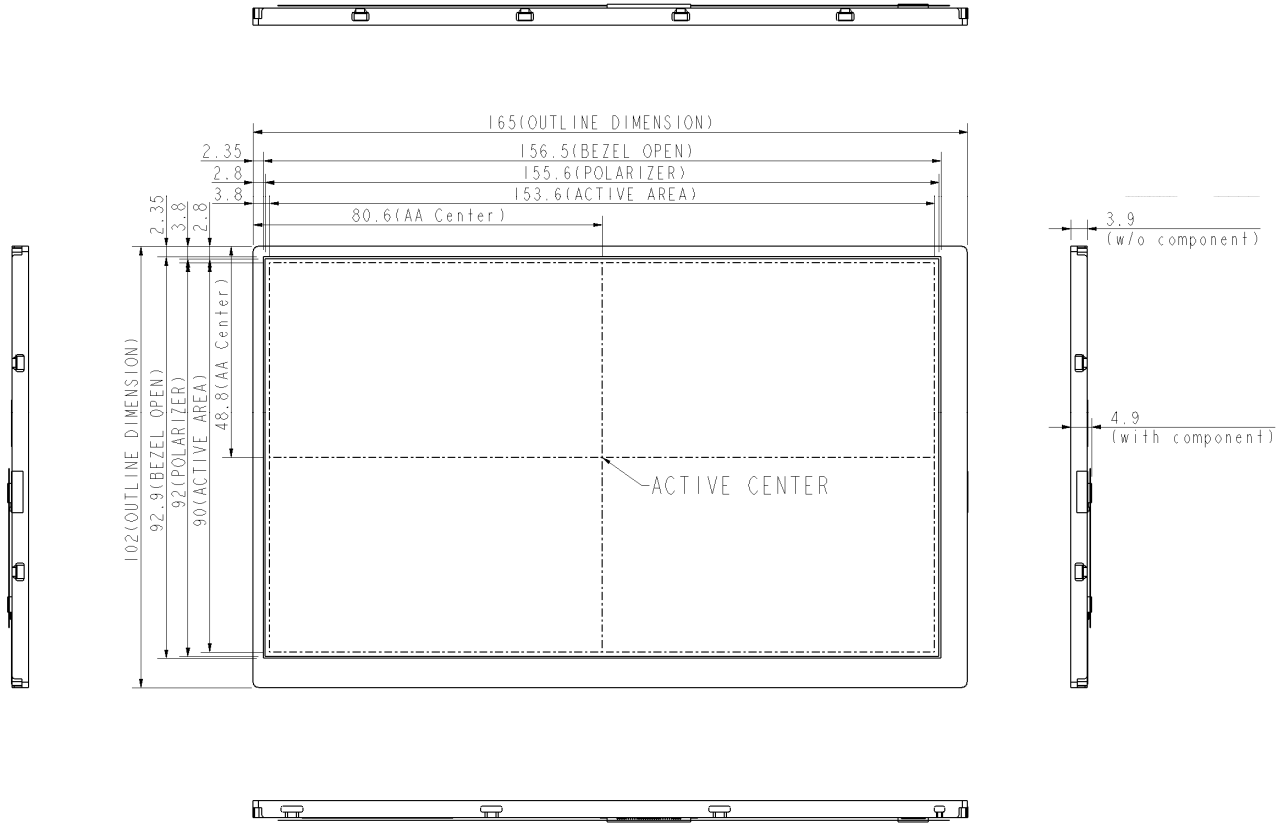
Item	Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)	165.0		mm	(2)
	Vertical(V)	102.0		mm	
	Thickness(T)	-	3.9	mm	
Weight	-	TBD		g	

Note (1) Each pixel is composed of 3 transmissive subpixels (RGB) and 3 reflective subpixels (grayscale).

Note (2) The thickness specification does not include PCB and components on the PCB.



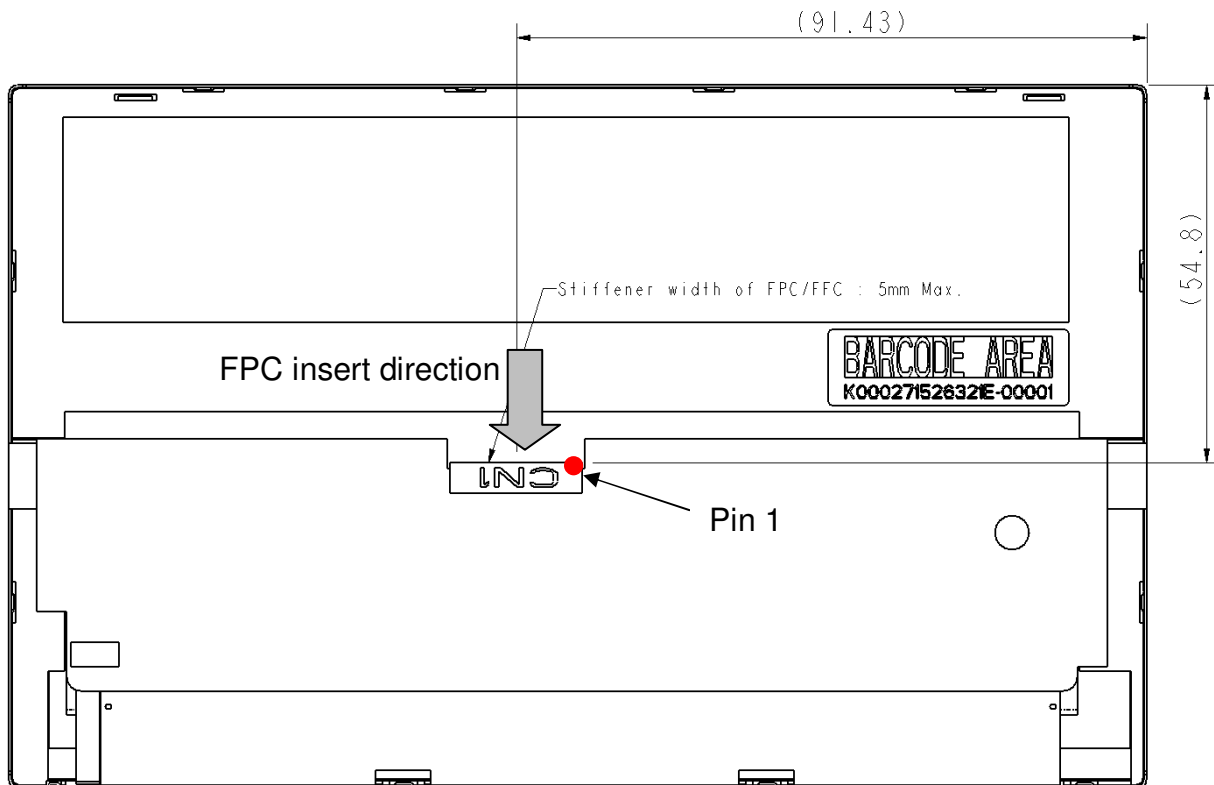
Figure 1.1 Module front outline



NOTE:

1. General tolerance :  $\pm 0.3\text{mm}$
2. Unit : mm

Figure 1.2 Module rear and side outline



NOTE :

1. General tolerance :  $\pm 0.3\text{mm}$
2. LCD connector CN1(30pin) : STARCONN · P/N : 089N30-000R00-G2

## 2. ABSOLUTE MAXIMUM RATINGS

### 2.1. ABSOLUTE MAXIMUMS, ENVIRONMENTAL

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T <sub>ST</sub>	-20	+60	°C	
Operating Ambient Temperature	T <sub>OP</sub>	-10	+50	°C	

### 2.2. ABSOLUTE MAXIMUMS, ELECTRICAL

Permanent damage to the device may occur if maximum values are exceeded. Operation should be restricted to the conditions described under Normal Operating Conditions.



2.2.1. TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V <sub>CC</sub>	-0.3	+4.0	V	
Logic Input Voltage	V <sub>IN</sub>	-0.3	V <sub>CC</sub> +0.3	V	

2.2.2. BACKLIGHT CONVERTER INPUT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Converter Input Voltage	VLED	-0.3	7.0	V	
Converter Control Signal	ADJ	-0.3	VLED	V	



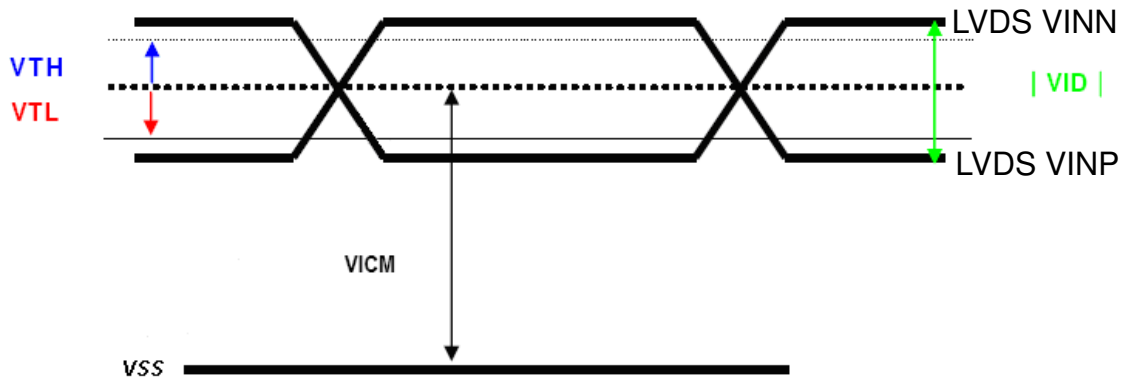
### 3. ELECTRICAL CHARACTERISTICS

#### 3.1. TFT LCD

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Power Supply Voltage For LCD	VCC	3.0	3.3	3.6	V	
Power Supply Voltage For LED	VLED	2.5	5.0	6.0		
Logic Input Voltage (LVDS:IN+,IN-)	VCM	1.08	1.2	1.32	V	[Note1]
	VID	250	350	450	mV	[Note1]
	VTH	--	--	100	mV	[Note1]
	VTL	-100	--	--	mV	[Note1] When VCM=+1.2V
ADJ Input Voltage	VIH	1.0		VLED	V	
	VIL	GND		0.4	V	

NOTE :

[Note1] LVDS signal



### 3.2. TFT Current Consumption

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
LCD Power Current	ICC	--	TBD	TBD	mA	[Note1]
LED Power Current	IDD		TBD	TBD	mA	[Note2]

[Note1] Typical: Under 64 gray pattern  
 Maximum: Under black pattern



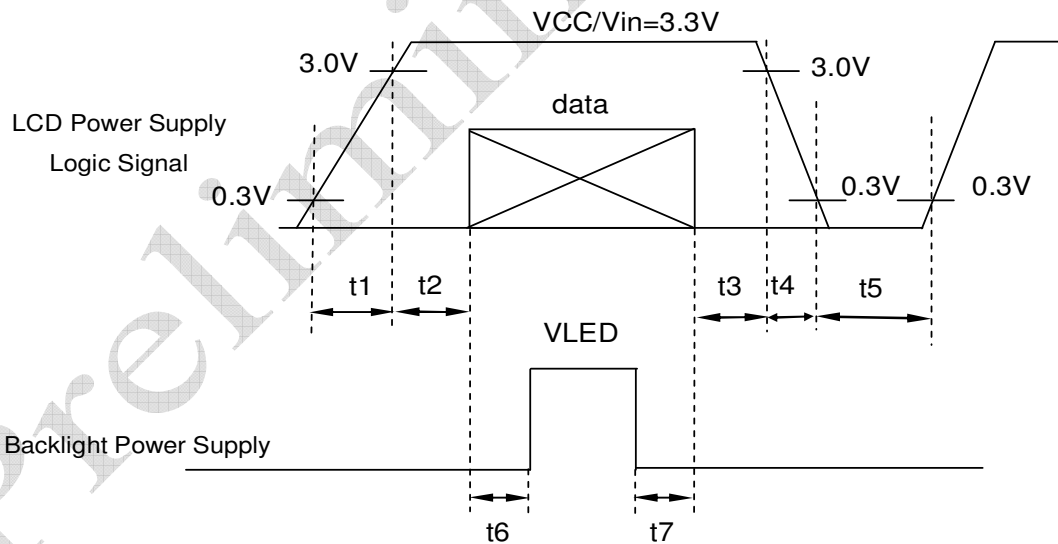
(a) 64 Gray Pattern



(b) Black Pattern

[Note2] Typical: When VDD is 5V  
 Maximum: When VDD is 4.5V

### 3.3. Power/signal sequence:



Data: RGB DATA, DCLK, DENA

- $0.5 < t1 \leq 10\text{ms}$        $200\text{ms} \leq t5$
- $0 < t2 \leq 50\text{ms}$        $200\text{ms} \leq t6$
- $0 < t3 \leq 50\text{ms}$        $200\text{ms} \leq t7$
- $0 < t4 \leq 10\text{ms}$



**3.4. Backlight**

Item	Symbol	Condition	Min	Typ	Max	Unit	Remarks
LED Lifetime	-	Ta=25°C Each serial=18mA	15,000			Hr	

Definition LED lifetime : Luminance decays less than 50%.

Preliminary Spec





**3.5. Interface connection**

CN1 : STARCONN P/N (089N30-00R00-G2)

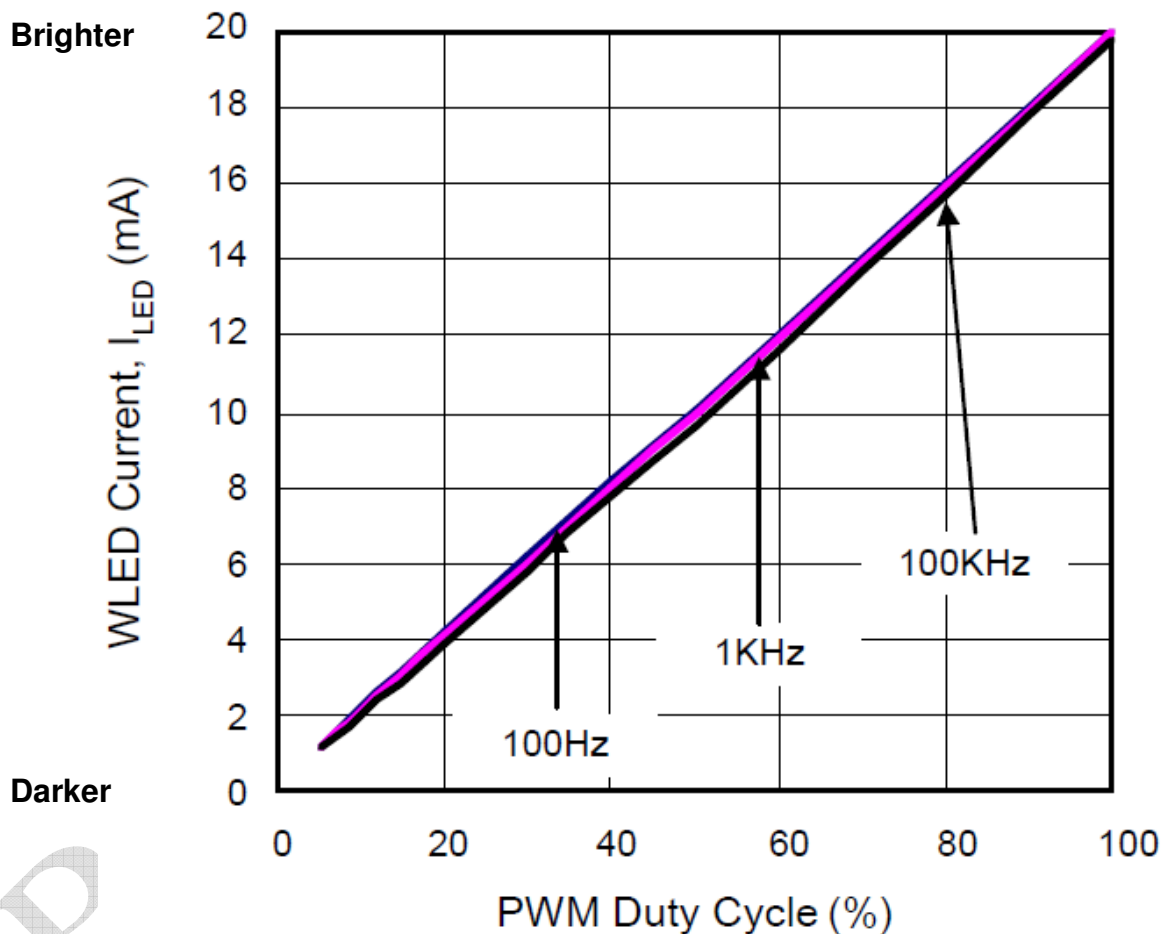
Pin NO.	SYMBOL	DESCRIPTION
1	AVSS	Power Ground
2	VCC	Power Supply for Digital circuit
3	VCC	Power Supply for Digital circuit
4	V_EDID	Power Supply for EDID circuit
5	ADJ	Adjust for LED brightness
6	CLK_EDID	EDID clock inputs
7	DATA_EDID	EDID data inputs
8	RXIN0-	Negative LVDS differential data inputs
9	RXIN0+	Positive LVDS differential data inputs
10	AVSS	Power Ground
11	RXIN1-	Negative LVDS differential data inputs
12	RXIN1+	Positive LVDS differential data inputs
13	AVSS	Power Ground
14	RXIN2-	Negative LVDS differential data inputs
15	RXIN2+	Positive LVDS differential data inputs
16	AVSS	Power Ground
17	RXCLK-	Negative LVDS differential clock inputs
18	RXCLK+	Positive LVDS differential clock inputs
19	AVSS	Power Ground
20	NC	NC
21	NC	NC
22	LR	Left / Right Display Control
23	UD	Up / Down Display Control
24	VLED	Power Supply for LED
25	VLED	Power Supply for LED
26	VLED	Power Supply for LED
27	NC	NC
28	NC	NC
29	NC	NC
30	NC	NC



NOTE :

- 1) NC Pin must be retained; this pin can't contact GND or other signal.
- 2) GND Pin must connect to ground contact, cannot be floating.
- 3) ADJ adjusts the brightness of the control Pin. Higher Pulse duty ratio allows higher current flow at LED and generates brighter luminance. However at lower duty ratio, the converting efficiency may drop.
- 4) ADJ signal operation frequency : 100Hz - 100KHz PWM

## WLED Current vs. PWM Duty Cycle





5) U/D and L/R are display orientation control function

L/R	U/D	FUNCTION
1	0	Normal display
0	0	Left and Right reversed
1	1	Up and Down reversed
0	1	Left and Right reversed · Up and Down reversed

### 3.6. TOTAL POWER CONSUMPTION (TO BE CONFIRMED)

Mode	Preliminary Value			Unit	Note
	Min.	Typ.	Max.		
Reflective (Black and white with 64 gray shades)	-	-		W	30 fps, BLU off
				W	60 fps, BLU off
Transflective (Low Color)	-	-	TBD	W	30 fps with ANSI checkerboard pattern, BLU duty 10%
				W	60 fps with ANSI checkerboard pattern, BLU duty 10%
				W	60 fps with ANSI checkerboard pattern, BLU duty 40%
Transmissive (Full Color Saturation)	-	-	TBD	W	30 fps with ANSI checkerboard pattern, BLU duty 100%
				W	60 fps with ANSI checkerboard pattern, BLU duty 100%



4. INPUT SIGNAL (DE only mode)

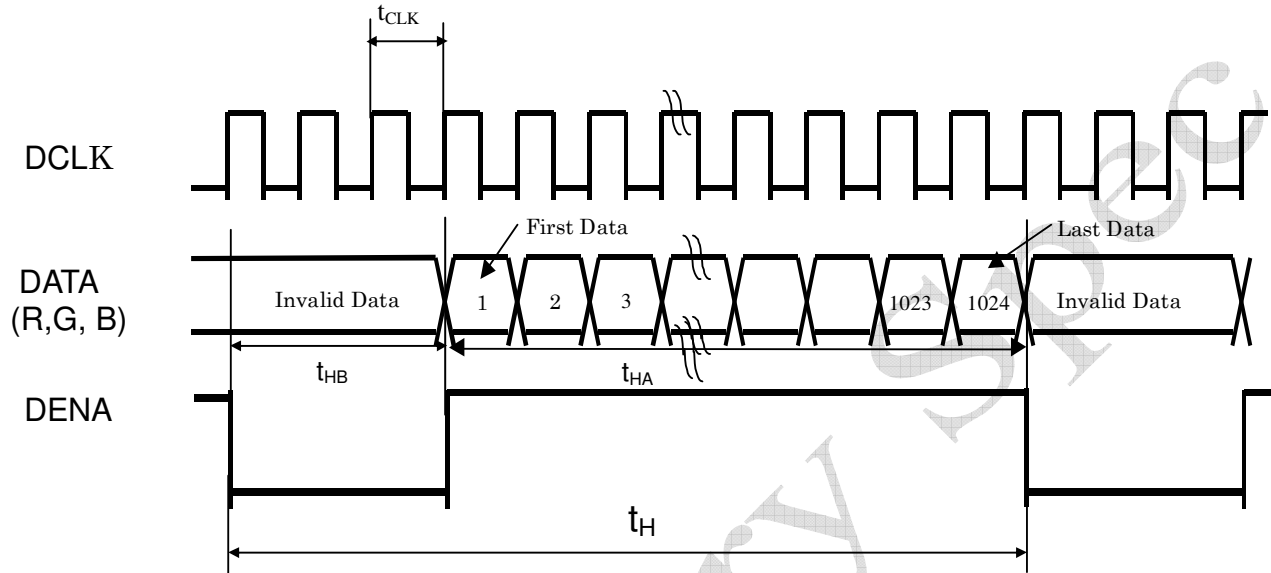
4.1. Timing Specification

ITEM			SYMBOL	MIN.	TYP.	MAX.	UNIT
LVDS input signal sequence	CLK Frequency		$f_{CLKin}$	39	45	52	MHz
LCD input signal sequence (Input LVDS Transmitter)	Horizontal	Horizontal total Time	$t_H$	1150	1200	1250	$t_{CLK}$
		Horizontal effective Time	$t_{HA}$	1024			$t_{CLK}$
		Horizontal Blank Time	$t_{HB}$	126	176	226	$t_{CLK}$
	Vertical	Frame	$f_V$	55	60	65	Hz
		Vertical total Time	$t_V$	610	625	640	$t_H$
		Vertical effective Time	$t_{VA}$	600			$t_H$
		Vertical Blank Time	$t_{VB}$	10	25	40	$t_H$

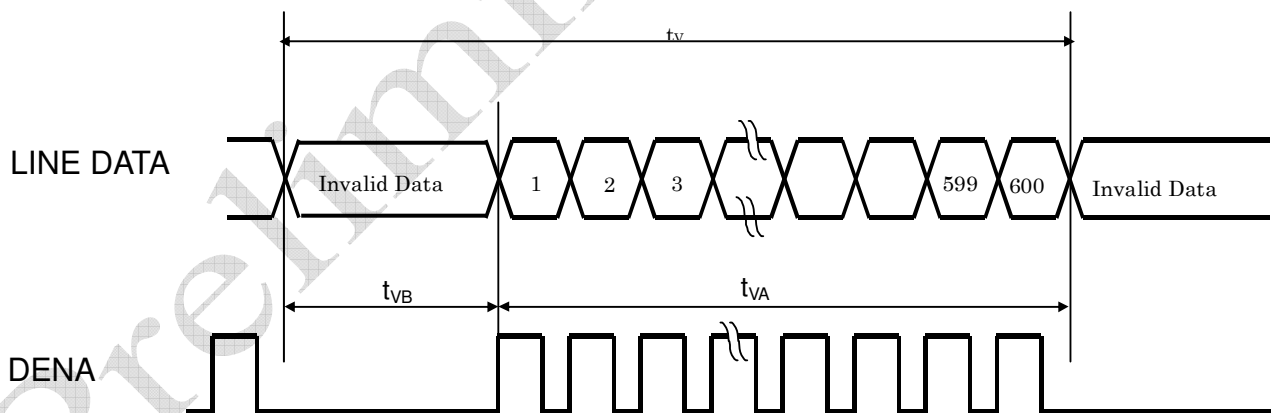


## 4.2. Timing sequence

### Horizontal Timing Sequence

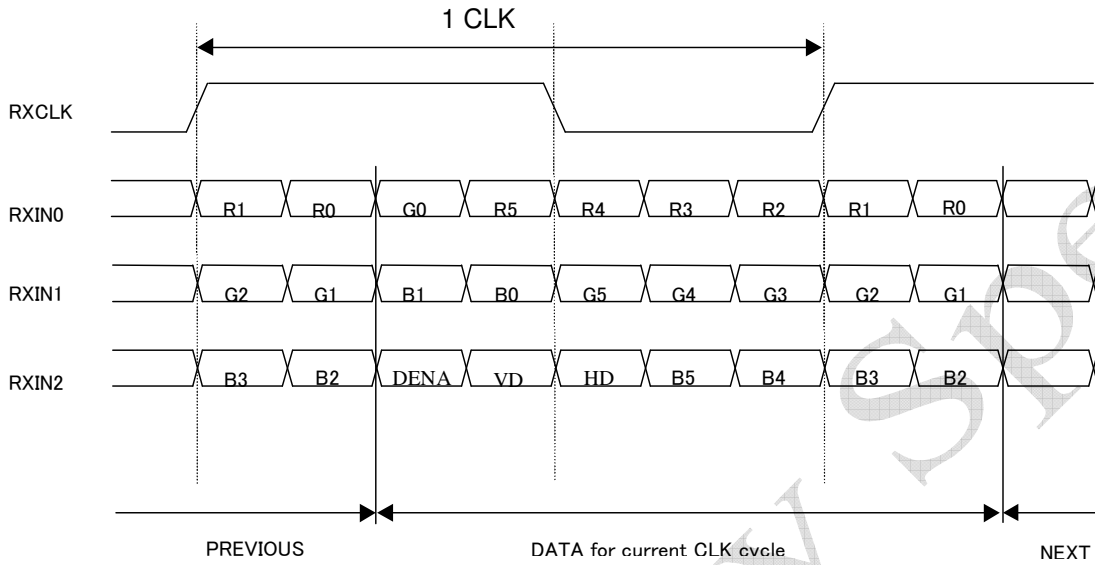


### Vertical Timing Sequence

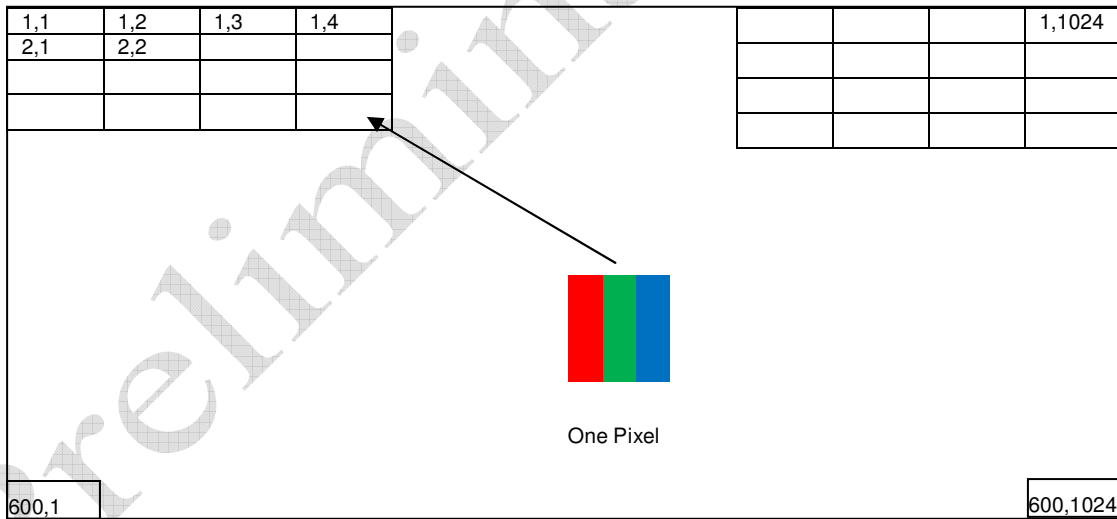




### 4.3. LVDS Input Data mapping



### 4.4. Pixel Format





4.5. Color Data Assignment

COLOR	INPUT DATA	R DATA						G DATA						B DATA					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	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
	RED(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	BLUE(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	CYAN	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	MAGENTA	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	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
RED	RED(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	1	0	0	0	0	0	0	0	0	0	0	0	0
	RED(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(63)	1	1	1	1	1	1	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
	GREEN(1)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	GREEN(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	GREEN(63)	0	0	0	0	0	0	1	1	1	1	1	1	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
	BLUE(1)	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	1	0
	BLUE(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	BLUE(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1



NOTE :

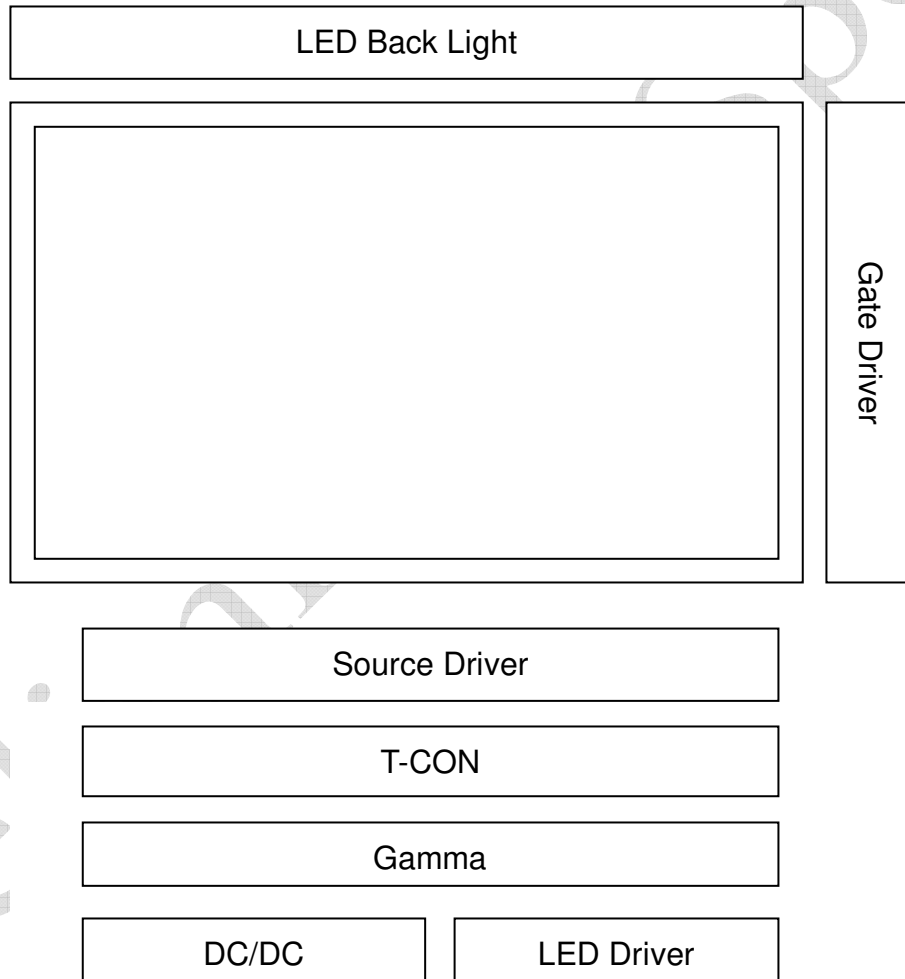
(1) Definition of Gray Scale

color(n) : n is level of Gray Scale

The higher n is, the higher the Gray Scale.

(2) Data:1-High,0-Low

5. BLOCK DIAGRAM







### 6. OPTICAL CHARACTERISTICS (Target)

#### 6.1. Reflective mode (BLU Off)\*

ITEM	SYMBOL	CONDITIO N	MIN.	TYP.	MAX.	UNIT	REMARK
Hemispheric Reflectance**	HR	$\theta = \phi = 0^\circ$		20		%	Note 1
Diffuse Reflectance	DR			40		%	Note 1.1
Reflective Contrast Ratio	CR	$\theta = 0^\circ$		10		--	Note 2
Reflective Viewing Angle	Vertical	$\theta * 2$	$CR \geq 2$	140	140	Degree	Note 3
	Horizontal	$\phi * 2$	$CR \geq 2$	140	140	Degree	Note 3

	<i>Illumination contributions and angles of specular and hemispheric illuminates for common usage</i>				
<b>Perceived Usage Conditions (Common)</b>	Ambient Hemisphere Illumination <i>(% of total illumination)</i>	Ambient Specular Illumination <i>(% of total illumination)</i>	Ambient Specular Illumination: <i>Est. Source Angle (in degrees)</i>	Est. Viewer Angle <i>In degrees</i>	<b>Approximate Total Perceived Reflectance % reflectance</b>
<b>Indoor Illumination</b>	50%	50%	20	-8	<b>30%</b>
<b>Outdoor Overcast</b>	100%	0%	35	-20	<b>20%</b>
<b>Outdoor Sunny Day</b>	20%	80%	35	-20	<b>36%</b>

\* Ambient condition : 25°C ± 2°C, 60 ± 10%RH, under 10 Lux in the darkroom.

\*\* Measuring device : DMS 803 The Measuring method of the optical characteristics is shown by the following figure. (The distance between hemisphere source and panel top surface is 17 mm.)

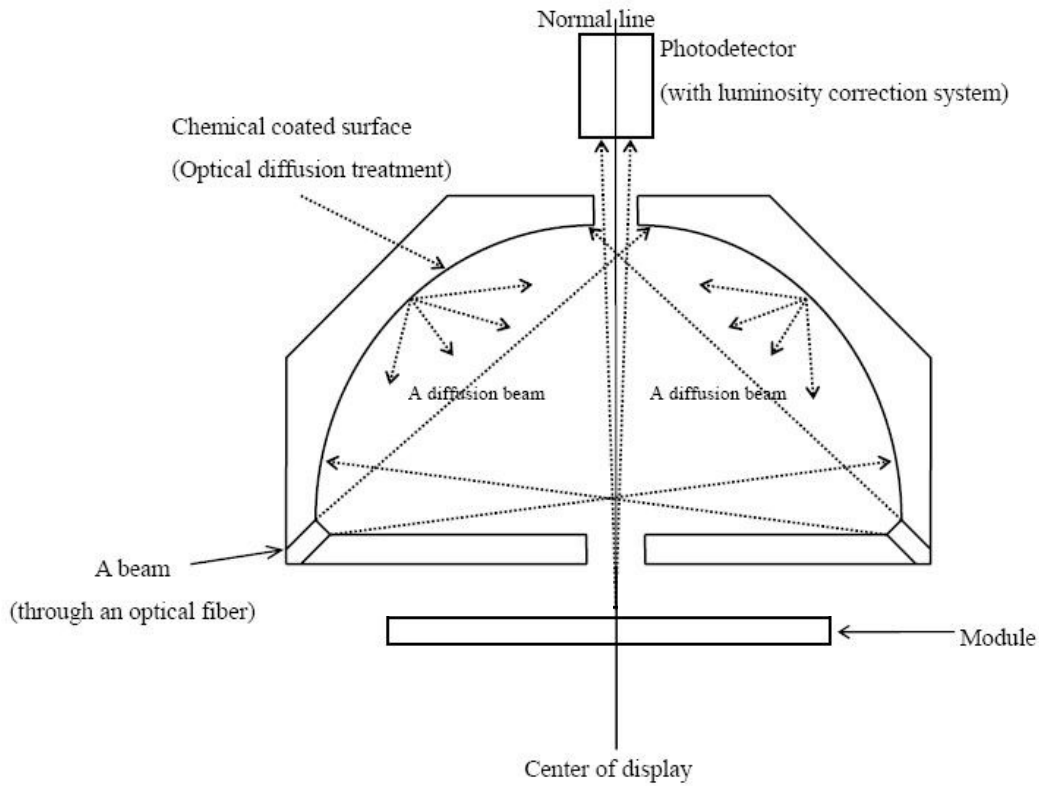


Figure 6.1 Configuration of diffusive hemisphere source of DMS 803 system.



6.2. Transmissive mode (Driving the Back Light condition)\*

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Contrast Ratio**		CR	Point-5	--	100	--	--	Note 4
Luminance		Lw	Point-5	--	200	--	cd/m <sup>2</sup>	Note 5
Luminance Uniformity		ΔL		--	80	--	%	Note 6
Response Time (White - Black)		Tr+ Tf	Point-5	--	30	---	ms	Note 7
Viewing Angle		η*2	CR ≥ 10 Point-5		100	--	Degree	Note 8
Color Coordinate	White	Wx Wy			TBD			
	Red	Rx Ry			TBD			
	Green	Gx Gy			TBD			
	Blue	Bx By			TBD			
	NTSC			--	45		%	Note 9

\* Ambient condition : 25°C ± 2°C , 60 ± 10%RH,; under 10 Lux in the darkroom

\*\* Measuring device : BM5A for viewing angle; DMS 803 for the others

Note 1: Using the diffuse illumination measurement system of DMS 803 with a D65 illumination source, the definition of Reflection Ratio is:

$$\Rightarrow \frac{(\text{measured optical output of panel displaying "white"}) \times (\text{reflectance factor of reflectance standard})}{(\text{measured optical output of reflectance standard})}$$

Note 1.1:

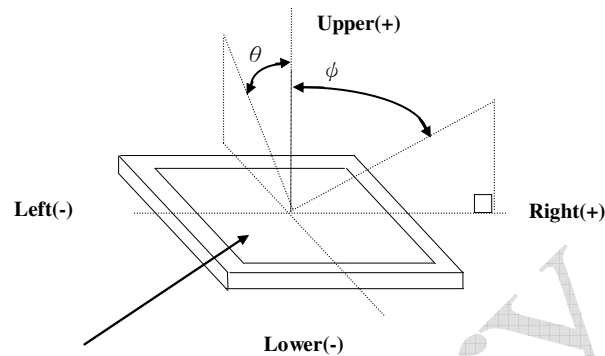
*Diffuse Reflectance Measurement (from section 4.8.16.2.3.1 of Mil-L-85762A)*

The illuminance source shall be positioned on the display's axis perpendicular to the display face. The diffuse reflective luminance shall be measured by a photometer which is oriented at an angle of 30 degrees +/- 2 degrees. The photometer shall be focused to produce a clear measurement spot at the display surface. With a white diffuse reflecting standard surface (barium sulfate or equivalent) substituted for the display surface, the illuminance source shall be adjusted to produce 10,000 fL. The white reflectance standard

surface shall then be removed and replaced by the display surface to be measured.

Note 2: Using the diffuse illumination measurement system of DMS 803 with a D65 illumination source, the definition of Reflective Contrast Ratio is:

$$\Rightarrow \frac{(\text{measured optical output of panel displaying "white"})_{\theta=0^\circ}}{(\text{measured optical output of panel displaying "black"})_{\theta=0^\circ}}$$



Note 3: Using the diffuse illumination measurement system of DMS 803 with a D65 illumination source, the definition of Reflective Viewing Angle:

Vertical reflective viewing angle =  $\theta * 2$ , at which measured  $CR \geq 2$

Horizontal reflective viewing angle =  $\phi * 2$ , at which measured  $CR \geq 2$

Note 4: Definition of Contrast Ratio :

$$CR = \text{White Luminance (ON)} / \text{Black Luminance (OFF)}$$

Note 5: Definition of luminance : Measure white luminance on the point 5 as figure 6.2

Note 6: Definition of Luminance Uniformity:

Measure white luminance on the point1~9 as figure 6.2

$$\Delta L = [L(\text{MIN})/L(\text{MAX})] \times 100$$

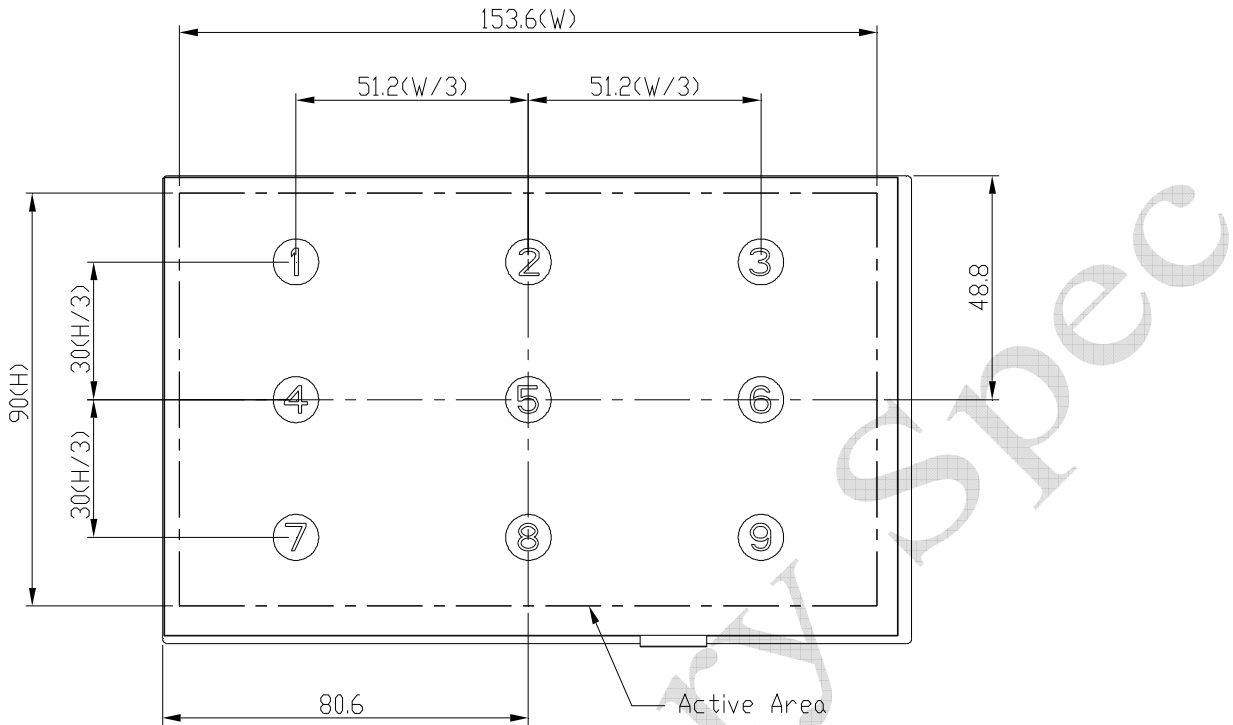
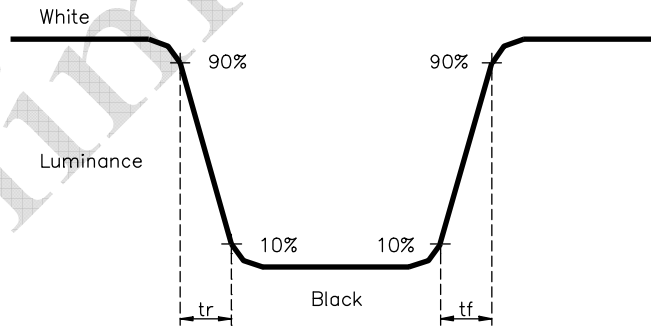


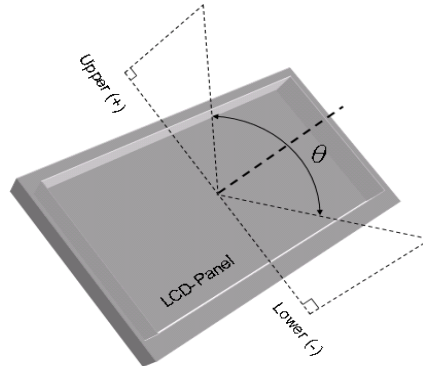
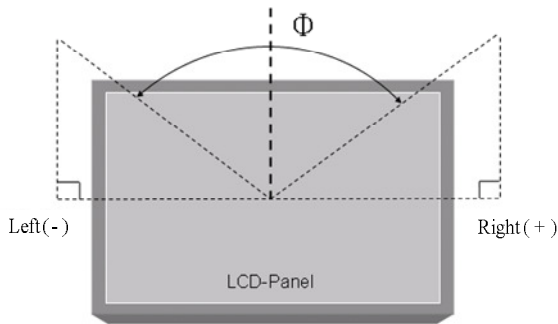
Figure 6.2 Measuring points

Note 7: Definition of response time : The response time is defined as the time interval between the 10% and 90% amplitudes.

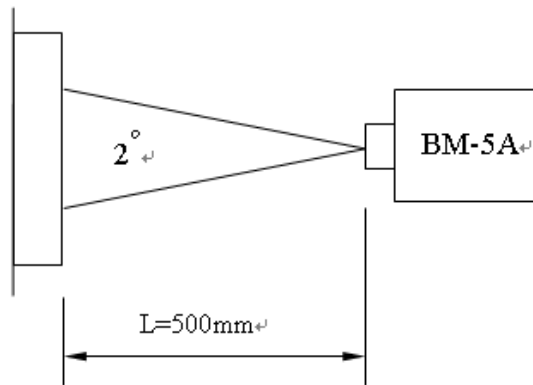


Note 8: Definition of transmissive viewing angle; symmetric around the normal  
 Transmissive viewing angle =  $\eta * 2$ , at which measured  $CR \geq 10$

Definition of viewing angle( $\theta$  ,  $\psi$ ) :



Measure condition :  $25^{\circ}C \pm 2^{\circ}C$  ,  $60 \pm 10\%RH$ , under 10Lux in the dark room. BM-5A (TOPCON), viewing angle  $2^{\circ}$  ,  $VCC=3.3V$  ,  $VLED=TBD$ .



Note 9: NTSC% measurement is based on CIE 1931.



## 7. RELIABILITY TEST

### 7.1. Temperature and humidity

TEST ITEMS	CONDITIONS	NOTE
High Temperature Operation	50°C , 240Hrs	
High Temperature Storage	60°C , 240Hrs	
High Temperature High Humidity Operation	40°C , 90%RH , 240Hrs	No condensation
Low Temperature Operation	-10°C , 240Hrs	
Low Temperature Storage	-20°C , 240Hrs	
Thermal Shock	-20°C (0.5Hr) ~ 60°C(0.5Hr) 100 cycles	

### 7.2. Shock and Vibration

TEST ITEMS	CONDITIONS
Shock (Non-operation)	<ul style="list-style-type: none"> <li>● Shock level: 980m/s<sup>2</sup>(equal to 100G)</li> <li>● Waveform: half sinusoidal wave, 6ms.</li> <li>● Number of shocks: one shock input in each direction of three mutually perpendicular axes for a total of three shock inputs.</li> </ul>
Vibration (Non-operation)	<ul style="list-style-type: none"> <li>● Frequency range: 8~33.3Hz</li> <li>● Stroke: 1.3mm</li> <li>● Vibration: sinusoidal wave, perpendicular axis (both x, z axis:2Hrs, y axis:4Hrs).</li> <li>● Sweep: 2.9G,33.3Hz-400Hz</li> <li>● Cycle:15min</li> </ul>

### 7.3. ESD

ITEM	CONDITION	NOTE
ESD	150pF , 330Ω , ±8KV&±15KV air test	[Note1]
	200pF , 0Ω , ±200V contact test	[Note2]

[Note1] LCD glass and metal bezel

[Note2] Connector pins



#### 7.4. Judgment standard

The Judgment of the above test should be made as the follow:

Pass: Normal display image with no obvious non-uniformity and no line defect. Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defect.

Preliminary Spec