



FOR MESSRS : \_\_\_\_\_

DATE : Mar. 15<sup>th</sup> 2024

CUSTOMER'S ACCEPTANCE SPECIFICATIONS

TX16D20VM5BQA

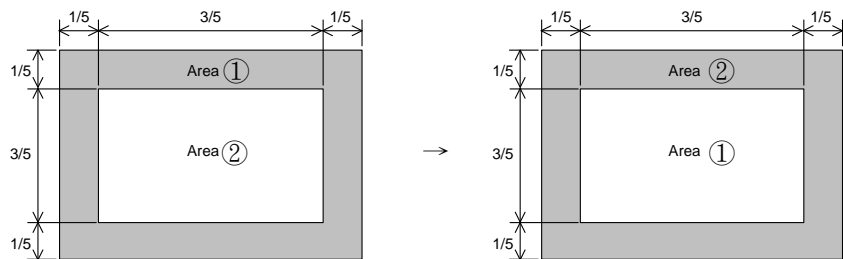
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ACCEPTED BY: \_\_\_\_\_

PROPOSED BY: Oblack Tsai

## 2. RECORD OF REVISION

DATE	SHEET No.	SUMMARY																						
May 13,'13	7B64PS 2705 – TX16D20VM5BQA-2 Page 5 – 1/1	5.1 LCD CHARACTERISTICS Revised : <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Item</th> <th>Symbol</th> <th>Typ.</th> <th>Max.</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Power Supply Current</td> <td>I<sub>DD</sub> for HVGA</td> <td>85</td> <td>105</td> </tr> <tr> <td>I<sub>DD</sub> for VGA</td> <td>105</td> <td>125</td> </tr> </tbody> </table> <p style="text-align: center;">↓</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Item</th> <th>Symbol</th> <th>Typ.</th> <th>Max.</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Power Supply Current</td> <td>I<sub>DD</sub> for HVGA</td> <td>180</td> <td>250</td> </tr> <tr> <td>I<sub>DD</sub> for VGA</td> <td>200</td> <td>280</td> </tr> </tbody> </table>	Item	Symbol	Typ.	Max.	Power Supply Current	I <sub>DD</sub> for HVGA	85	105	I <sub>DD</sub> for VGA	105	125	Item	Symbol	Typ.	Max.	Power Supply Current	I <sub>DD</sub> for HVGA	180	250	I <sub>DD</sub> for VGA	200	280
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7B64PS 2712 – TX16D20VM5BQA-2 Page 12 – 2/4	12.2 LCD APPEARANCE SPECIFICATION Revised : 																							
Jan. 10,'14	7B64PS 2712 – TX16D20VM5BQA-3 Page 12 – 3/4	12.2 LCD APPEARANCE SPECIFICATION Removed : LED BACKLIGHT APPEARANCE																						
Feb. 7,'14	7B64PS 2711 – TX16D20VM5BQA-4 Page 11 – 1/2	11.2 ELECTRICAL CHARACTERISTICS Changed : <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Item</th> <th>Specification</th> </tr> </thead> <tbody> <tr> <td>Resistance Between Terminal</td> <td>X1-X2 630~1610Ω</td> </tr> </tbody> </table> <p style="text-align: center;">↓</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Item</th> <th>Specification</th> </tr> </thead> <tbody> <tr> <td>Resistance Between Terminal</td> <td>X1-X2 590~1800Ω</td> </tr> </tbody> </table> Changed : Note 1: Test force : 100 g → 150g	Item	Specification	Resistance Between Terminal	X1-X2 630~1610Ω	Item	Specification	Resistance Between Terminal	X1-X2 590~1800Ω														
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Jun.8,'17	7B64PS 2711 – TX16D20VM5BQA-5 Page 10 – 1/2	10.1 FRONT VIEW Revised : All Page																						

## 2. RECORD OF REVISION

DATE	SHEET No.	SUMMARY																			
Jun. 8,'17	7B64PS 2711 – TX16D20VM5BQA-5 Page 11 – 1/2	11.2 ELECTRICAL CHARACTERISTICS Changed : <table border="1" data-bbox="580 313 1444 604" style="margin-left: 20px;"> <thead> <tr> <th data-bbox="580 313 1002 349">Item</th> <th colspan="2" data-bbox="1008 313 1444 349">Specification</th> </tr> </thead> <tbody> <tr> <td data-bbox="580 349 1002 385" rowspan="2">Resistance Between Terminal</td> <td data-bbox="1008 349 1145 385">X1-X2</td> <td data-bbox="1152 349 1444 385">590~1800Ω</td> </tr> <tr> <td data-bbox="1008 385 1145 439">Y1-Y2</td> <td data-bbox="1152 385 1444 439">110~340Ω</td> </tr> <tr> <td colspan="3" data-bbox="1002 439 1008 474" style="text-align: center;">↓</td> </tr> <tr> <th data-bbox="580 474 1002 510">Item</th> <th colspan="2" data-bbox="1008 474 1444 510">Specification</th> </tr> <tr> <td data-bbox="580 510 1002 546" rowspan="2">Resistance Between Terminal</td> <td data-bbox="1008 510 1145 546">X1-X2</td> <td data-bbox="1152 510 1444 546">300~1800Ω</td> </tr> <tr> <td data-bbox="1008 546 1145 604">Y1-Y2</td> <td data-bbox="1152 546 1444 604">100~800Ω</td> </tr> </tbody> </table>	Item	Specification		Resistance Between Terminal	X1-X2	590~1800Ω	Y1-Y2	110~340Ω	↓			Item	Specification		Resistance Between Terminal	X1-X2	300~1800Ω	Y1-Y2	100~800Ω
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Mar.15,'24	7B64PS 2714 – TX16D20VM5BQA-6 Page 14 – 1/1	14. DESIGNATION of LOT MARK Added Rev. <b>B</b> (LCD color filter Changed)																			

### 3. GENERAL DATA

#### 3.1 DISPLAY FEATURES

This module is a 6.2" HVGA of 8:3 format amorphous silicon TFT. The pixel format is vertical stripe and sub pixels are arranged as R (red), G (green), B (blue) sequentially. This display is RoHS compliant, COG (chip on glass) technology and LED backlight are applied on this display.

Part Name	TX16D20VM5BQA
Module Dimensions	173.0(W) mm x 70.0(H) mm x 8.6 (D) mm typ.
LCD Active Area	148.8(W) mm x 53.76(H) mm
Dot Pitch	0.0775(W) mm x 3 (R.G.B) (W) X0.224 (H) mm
Resolution	640 x 3(RGB)(W) x 240(H) dots
Color Pixel Arrangement	R, G, B Vertical stripe
LCD Type	Transmissive Color TFT; Normally White
Display Type	Active Matrix
Number of Colors	262k Colors
Backlight	21 LEDs (3 series x 7)
Weight	140g (typ.)
Interface	C-MOS; 18-bit RGB; 40 pins
Power Supply Voltage	3.3V for LCD; 12V for Backlight
Power Consumption	0.31 W for LCD; 1.008 W for Backlight
Viewing Direction	Super wide version
Touch Panel	Resistive type; Film on Glass; 4 wire type; Anti-glare surface

## 4. ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit	Remarks
Supply Voltage	V <sub>DD</sub>	-0.3	5	V	-
Input Voltage of Logic	V <sub>I</sub>	-0.3	V <sub>DD</sub> +0.3	V	Note 1
Operating Temperature	T <sub>op</sub>	-20	70	°C	Note 2
Storage Temperature	T <sub>st</sub>	-30	80	°C	Note 2
Backlight Input Voltage	V <sub>LED</sub>	-	15	V	-

Note 1: The rating is defined for the signal voltages of the interface such as DCLK, DE, and RGB data bus.

Note 2: The maximum rating is defined as above based on the chamber temperature, which might be different from ambient temperature after assembling the panel into the application. Moreover, some temperature-related phenomenon as below needed to be noticed:

- Background color, contrast and response time would be different in temperatures other than 25°C.
- Operating under high temperature will shorten LED lifetime.

## 5. ELECTRICAL CHARACTERISTICS

### 5.1 LCD CHARACTERISTICS

$T_a = 25\text{ }^\circ\text{C}$ ,  $V_{SS} = 0\text{V}$

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	$V_{DD}$	-	3.0	3.3	3.6	V	-
Input Voltage of Logic	$V_I$	"H" level	2.0	-	$V_{DD}$	V	Note 1
		"L" level	$V_{SS}$	-	0.8		
Power Supply Current	$I_{DD}$ for HVGA	$V_{DD}-V_{SS}$ $=3.3\text{V}$	-	180	250	mA	Note 2
	$I_{DD}$ for VGA		-	200	280		
Vsync Frequency	$f_v$	-	52	60	68	Hz	-
Hsync Frequency	$f_H$ for HVGA	-	15	15.6	16.2	KHz	-
	$f_H$ for VGA	-	29.4	30	30.6		
DCLK Frequency	$f_{CLK}$ for HVGA	-	9.6	12.5	15.2	MHz	-
	$f_{CLK}$ for VGA	-	18.4	24	28.8		

Note 1: The rating is defined for the signal voltages of the interface such as DE, DCLK and RGB data bus.

Note 2: An all black check pattern is used when measuring  $I_{DD}$ .  $f_v$  is set to 60 Hz.

Note 3: 0.4A fuse is applied in the module for  $I_{DD}$ . For display activation and protection purpose, power supply is recommended larger than 1.0A to start the display and break fuse once any short circuit occurred.

### 5.2 BACKLIGHT CHARACTERISTICS

$T_a = 25\text{ }^\circ\text{C}$

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
LED Input Voltage	$V_{LED}$	Backlight Unit	11.5	12.0	12.5	V	Note1
LED Forward Current	$I_{LED}$	Backlight Unit	-	84	95	mA	-
LED Lifetime	-	84 mA	-	40K	-	hrs	Note 2

Note 1: Fig. 5.1 shows the LED backlight circuit. The circuit has 21 LEDs in total and R is  $280\ \Omega$ .

Note 2: The estimated lifetime is specified as the time to reduce 50% brightness by applying 84 mA at  $25\text{ }^\circ\text{C}$ .

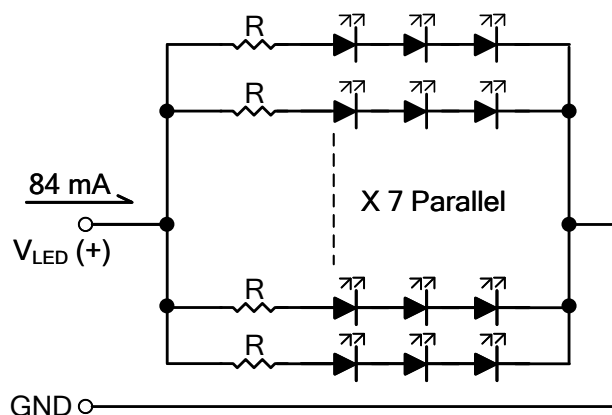


Fig. 5.1

## 6. OPTICAL CHARACTERISTICS

The optical characteristics are measured based on the conditions as below:

- Supplying the signals and voltages defined in the section of electrical characteristics.
- The backlight unit needs to be turned on for 30 minutes.
- The ambient temperature is 25 °C .
- In the dark room around 500~1000 lx, the equipment has been set for the measurements as shown in Fig 6.1.

$$T_a = 25 \text{ }^\circ\text{C}, f_v = 60\text{Hz}, V_{DD} = 3.3\text{V}$$

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks	
Brightness of White	-	$\phi = 0^\circ, \theta = 0^\circ,$ $I_{LED} = 84 \text{ mA}$	260	320	-	cd/m <sup>2</sup>	Note 1	
Brightness Uniformity	-		75	-	-	%	Note 2	
Contrast Ratio	CR		200	400	-	-	Note 3	
Response Time	Rise + Fall	$\phi = 0^\circ, \theta = 0^\circ$	-	45	-	ms	Note 4	
NTSC Ratio	-	$\phi = 0^\circ, \theta = 0^\circ$	-	60	-	%	-	
Viewing Angle	$\theta_x$	$\phi = 0^\circ, CR \geq 5$	-	80	-	Degree	Note 5	
	$\theta_{x'}$	$\phi = 180^\circ, CR \geq 5$	-	80	-			
	$\theta_y$	$\phi = 90^\circ, CR \geq 5$	-	80	-			
	$\theta_{y'}$	$\phi = 270^\circ, CR \geq 5$	-	80	-			
Color Chromaticity	Red	X	$\phi = 0^\circ, \theta = 0^\circ$	0.57	0.62	0.67	-	Note 6
		Y		0.29	0.34	0.39		
	Green	X		0.30	0.35	0.40		
		Y		0.55	0.60	0.65		
	Blue	X		0.09	0.14	0.19		
		Y		0.04	0.09	0.14		
	White	X		0.24	0.29	0.34		
		Y		0.26	0.31	0.36		

Note 1: The brightness is measured from 9 point average value of the panel, P1~P9 in Fig. 6.2, for the typical value.

Note 2: The brightness uniformity is calculated by the equation as below:

$$\text{Brightness uniformity} = \frac{\text{Min. Brightness}}{\text{Max. Brightness}} \times 100\%$$

, which is based on the brightness values of the 9 points measured by BM-5 as shown in Fig. 6.2.

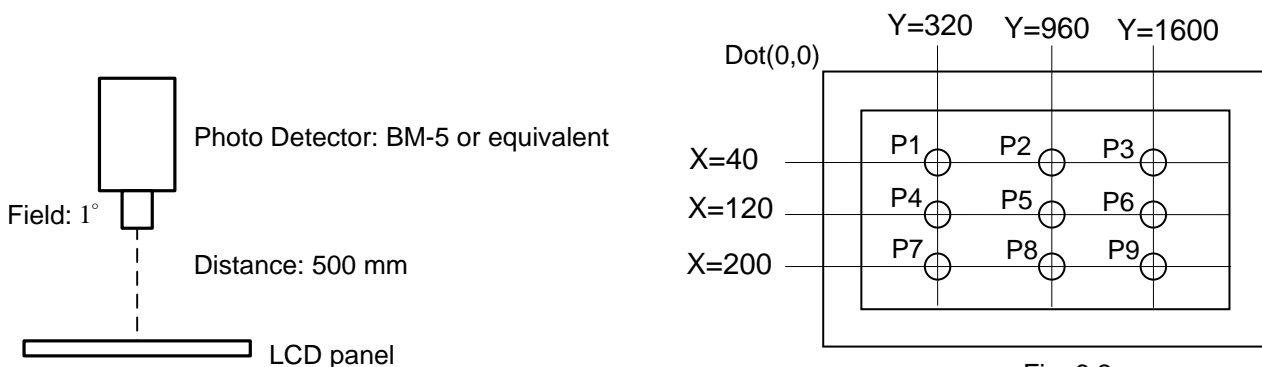


Fig. 6.2

Fig. 6.1

Note 3: The Contrast ratio is measured from the center point of the panel, P5, and defined as the following equation:

$$CR = \frac{\text{Brightness of White}}{\text{Brightness of Black}}$$

Note 4: The definition of response time is shown in Fig. 6.3. The rising time is the period from 90% brightness to 10% brightness when the data is from white to black. Oppositely, Falling time is the period from 10% brightness rising to 90% brightness.

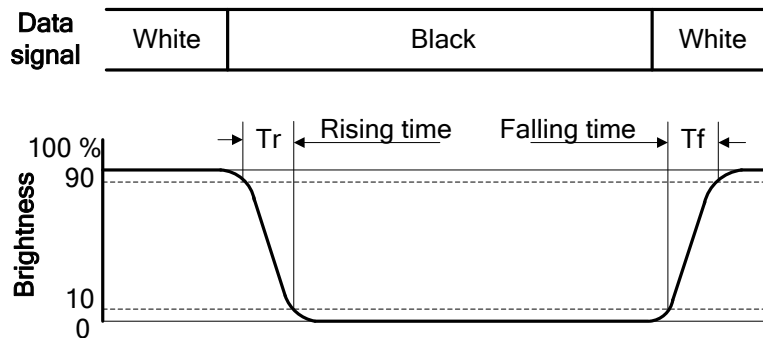


Fig. 6.3

Note 5: The definition of viewing angle is shown in Fig. 6.4. Angle  $\phi$  is used to represent viewing directions, for instance,  $\phi = 270^\circ$  means 6 o'clock, and  $\phi = 0^\circ$  means 3 o'clock. Moreover, angle  $\theta$  is used to represent viewing angles from axis Z toward plane XY.

The viewing direction of this display is 12 o'clock, which means that a photograph with gray scale would not be reversed in color and the brightness change would be less from this direction. However, the best contrast peak would be located at 6 o'clock.

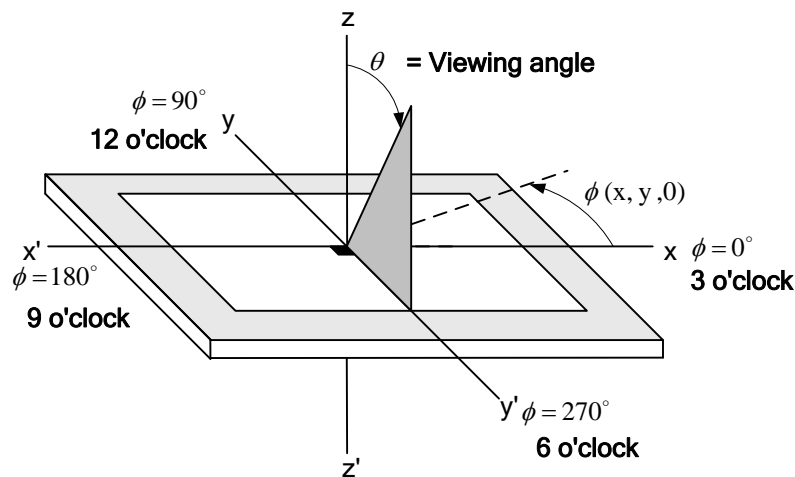
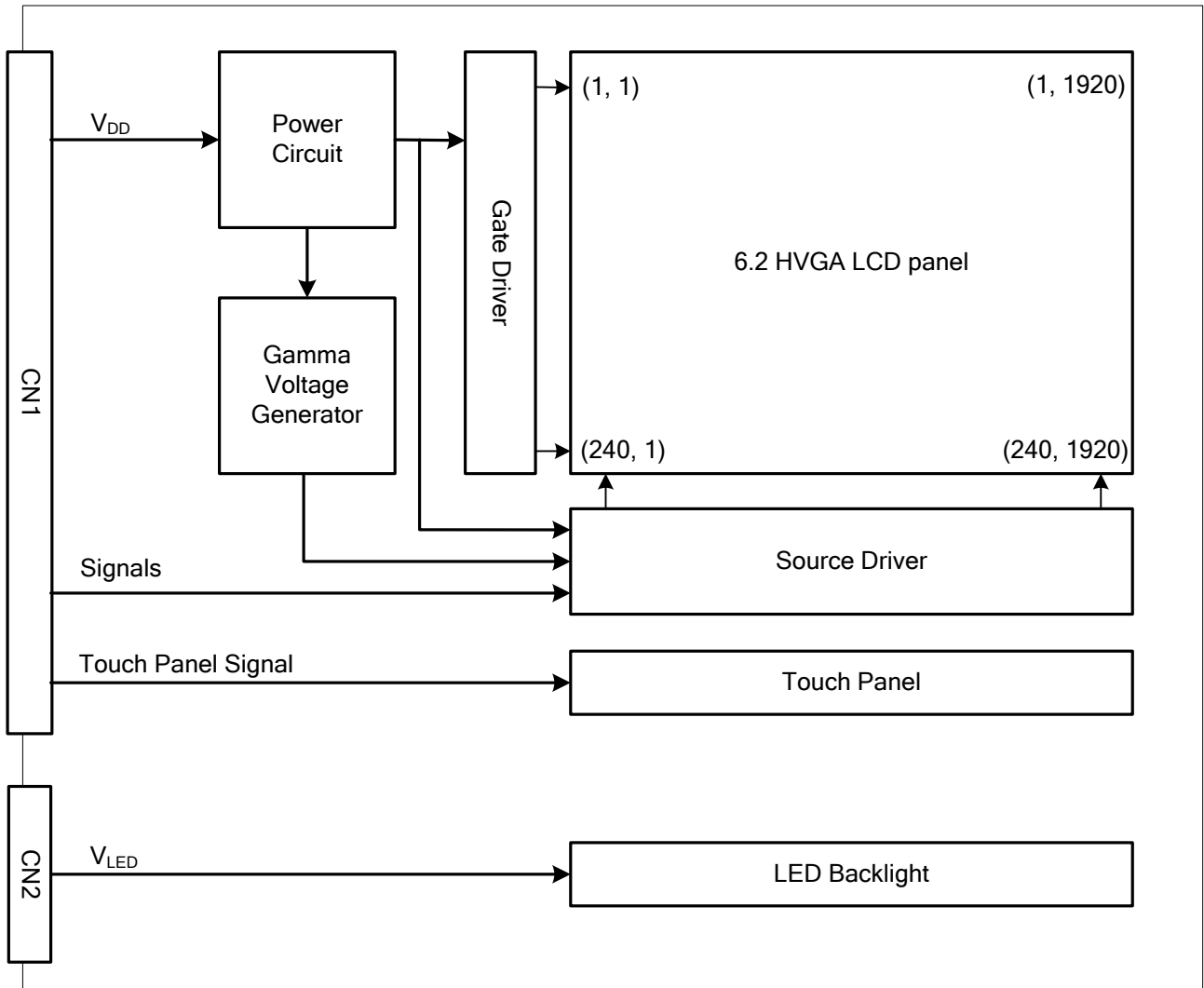


Fig. 6.4

Note 6: The color chromaticity is measured from the center point of the panel, P5, as shown in Fig. 6.2



# 7. BLOCK DIAGRAM



Note 1: Signals are DCLK, DE, and RGB data bus.

## 8. RELIABILITY TESTS

Test Item	Condition	
High Temperature	1) Operating 2) 70 °C	240 hrs
Low Temperature	1) Operating 2) -20 °C	240 hrs
High Temperature	1) Storage 2) 80 °C	240 hrs
Low Temperature	1) Storage 2) -30 °C	240 hrs
Heat Cycle	1) Operating 2) -20 °C ~70 °C 3) 3hrs~1hr~3hrs	240 hrs
Thermal Shock	1) Non-Operating 2) -35 °C ↔ 85 °C 3) 0.5 hr ↔ 0.5 hr	240 hrs
High Temperature & Humidity	1) Operating 2) 40 °C & 85%RH 3) Without condensation (Note4)	240 hrs
Vibration	1) Non-Operating 2) 20~200 Hz 3) 2G 4) X, Y, and Z directions	1 hr for each direction
Mechanical Shock	1) Non-Operating 2) 10 ms 3) 50G 4) ±X, ±Y and ±Z directions	Once for each direction
ESD	1) Operating 2) Tip: 200 pF, 250 Ω 3) Air discharge for glass: ± 8KV 4) Contact discharge for metal frame: ± 8KV	1) Glass: 9 points 2) Metal frame: 8 points (Note3)

Note 1: Display functionalities are inspected under the conditions defined in the specification after the reliability tests.

Note 2: The display is not guaranteed for use in corrosive gas environments.

Note 3: All pins of LCD interface (CN1) have been tested by ±100V contact discharge of ESD under non-operating condition.

Note 4: Under the condition of high temperature & humidity, if the temperature is higher than 40°C, the humidity needs to be reduced as Fig. 8.1 shown.

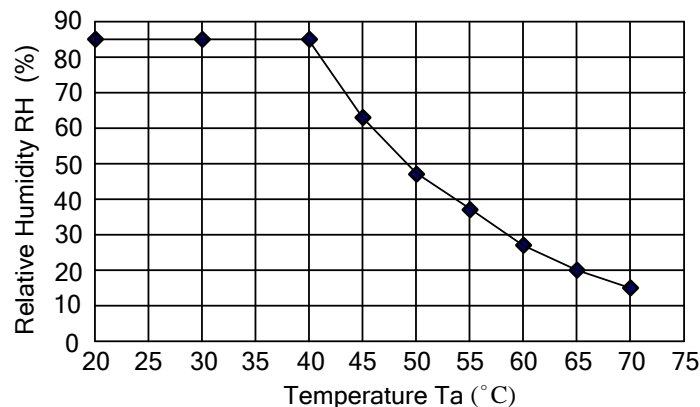


Fig. 8.1

## 9. LCD INTERFACE

### 9.1 INTERFACE PIN CONNECTIONS

The display interface connector is FA5B040HP1R3000 made by JAE (Thickness:  $0.3 \pm 0.05\text{mm}$ ; Pitch:  $0.5 \pm 0.05\text{mm}$ ) and more details of the connector are shown in the section of outline dimension.

Pin assignment of LCD interface is as below:

Pin No.	Signal	Function	Pin No.	Signal	Function
1	V <sub>DD</sub>	Power Supply for Logic	21	G4	Green Data
2	V <sub>DD</sub>		22	G3	
3	V <sub>DD</sub>		23	V <sub>SS</sub>	GND
4	V <sub>DD</sub>		24	G2	Green Data
5	NC	No Connection	25	G1	
6	DE	Data Enable	26	G0	GND
7	V <sub>SS</sub>	GND	27	V <sub>SS</sub>	
8	DCLK	Dot Clock	28	R5	Red Data
9	V <sub>SS</sub>	GND	29	R4	
10	NC	No Connection	30	R3	
11	V <sub>SS</sub>	GND	31	V <sub>SS</sub>	GND
12	B5	Blue Data	32	R2	Red Data
13	B4		33	R1	
14	B3		34	R0	
15	V <sub>SS</sub>	GND	35	V <sub>com</sub>	Common Voltage (Generated by LCM)
16	B2	Blue Data	36	V <sub>SS</sub>	GND
17	B1		37	X1	Analog Signal Touch Panel
18	B0		38	Y1	Analog Signal Touch Panel
19	V <sub>SS</sub>	GND	39	X2	Analog Signal Touch Panel
20	G5	Green Data	40	Y2	Analog Signal Touch Panel

The backlight interface connector is BHR-03VS-1 made by JST, and pin assignment of backlight is as below:

Pin No.	Signal	Level	Function
1	V <sub>LED+</sub>	-	Power Supply for LED
2	NC	-	No connection
3	V <sub>LED-</sub>	-	GND

## 9.2 TIMING CHART

### 9.2.1 HVGA MODE

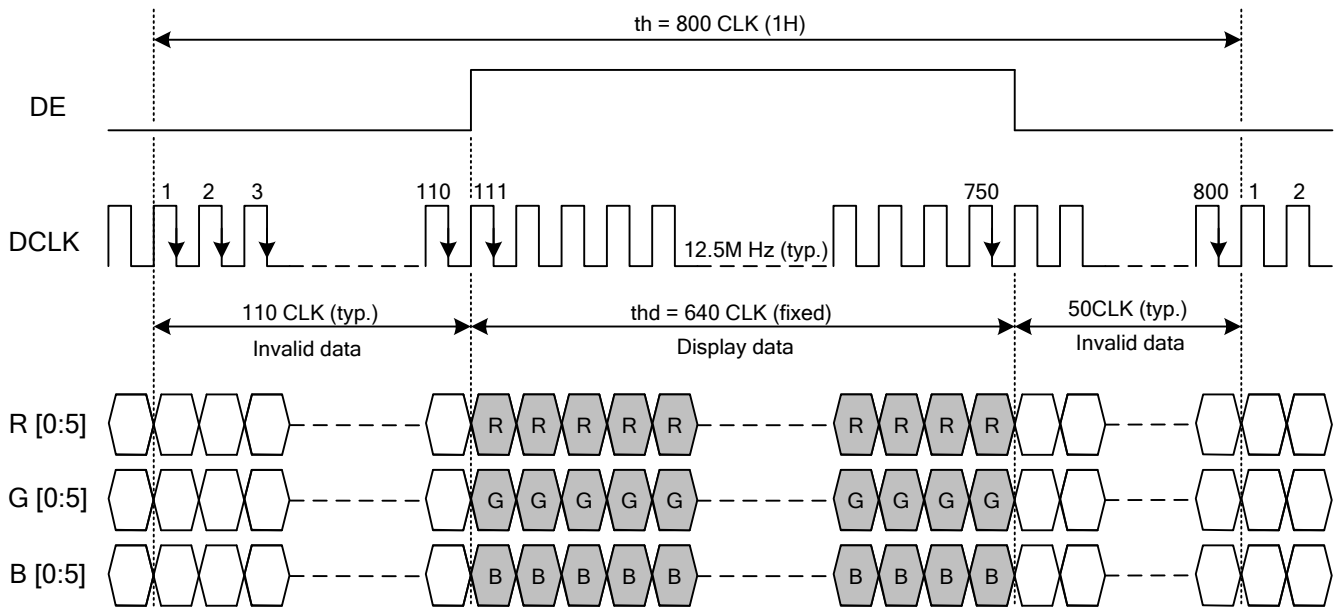


Fig. 9.1 Horizontal Timing of HVGA Mode

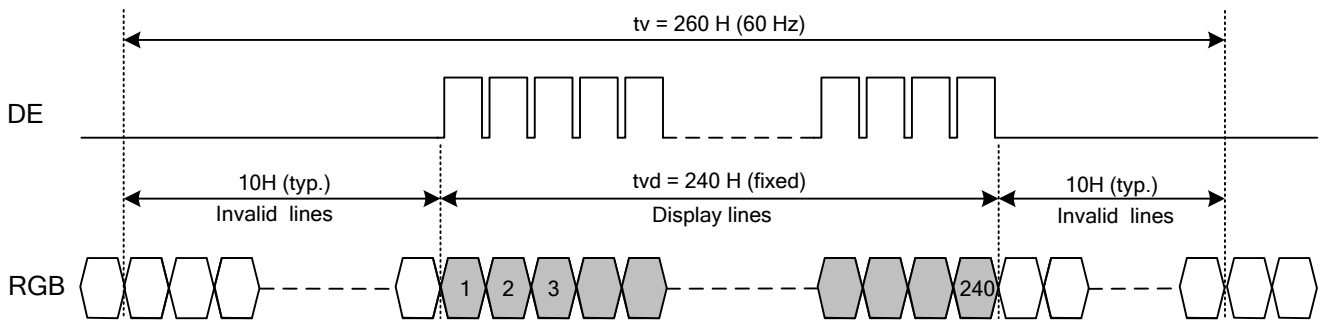


Fig. 9.2 Vertical Timing of HVGA Mode

### 9.2.2 VGA MODE

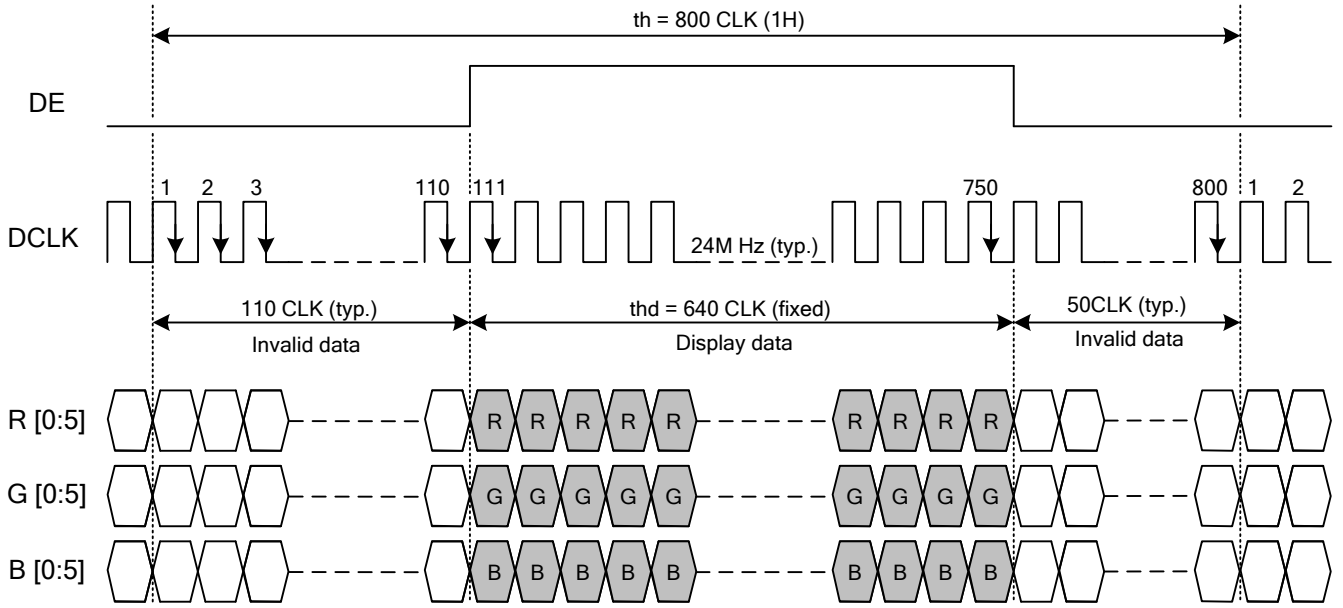


Fig. 9.3 Horizontal Timing of VGA Mode

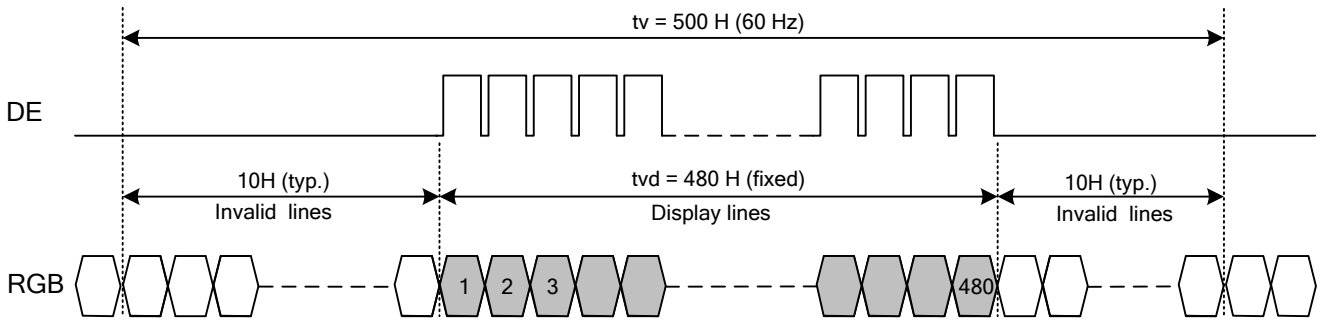


Fig. 9.4 Vertical Timing of VGA Mode

### 9.2.3 CLOCK AND DATA INPUT TIMING

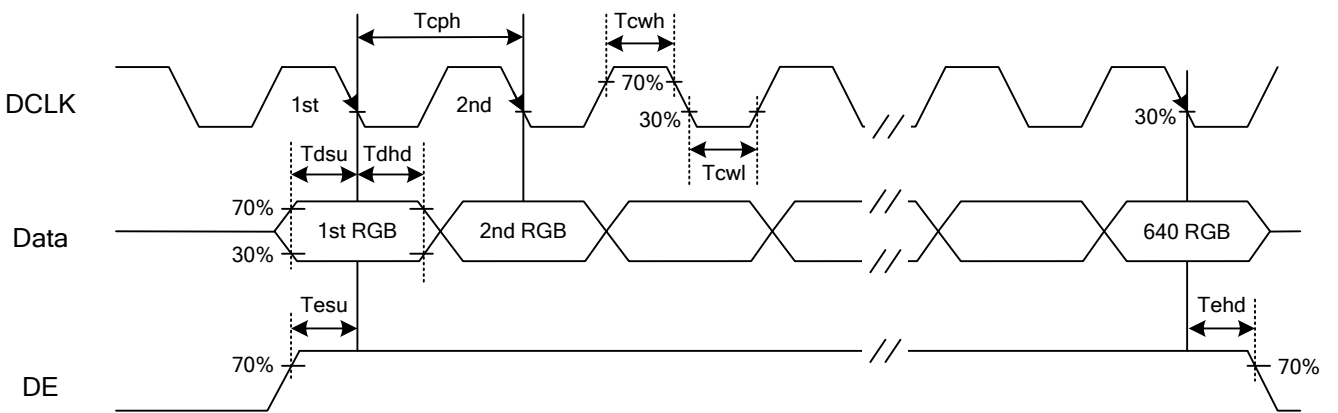


Fig. 9.5 Setup & Hold Time of Data and DE signal.

### 9.3 TIME TABLE

#### A. HVGA MODE

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Vsync Frequency	$f_V$	-	50	60	68	Hz
DCLK Frequency	$f_{CLK}$	-	9.6	12.5	15.2	MHz
DE	Horizontal Cycle	$t_H$	766	800	830	CLK
	Horizontal Valid Data Width	$t_{HD}$	640			
	Horizontal Porch Width	$t_{HB}$	126	160	190	
	Vertical Cycle	$t_V$	250	260	270	H
	Vertical Valid Data Width	$t_{VD}$	240			
	Vertical Porch Width	$t_{VB}$	10	20	30	

#### B. VGA MODE

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Vsync Frequency	$f_V$	-	50	60	68	Hz
DCLK Frequency	$f_{CLK}$	-	18.4	24	28.8	MHz
DE	Horizontal Cycle	$t_H$	750	800	830	CLK
	Horizontal Valid Data Width	$t_{HD}$	640			
	Horizontal Porch Width	$t_{HB}$	110	160	190	
	Vertical Cycle	$t_V$	490	500	510	H
	Vertical Valid Data Width	$t_{VD}$	480			
	Vertical Porch Width	$t_{VB}$	10	20	30	

#### C. CLOCK AND DATA INPUT TIMING

Item		Symbol	Min.	Typ.	Max.	Unit
Data	Setup Time	Tdsu	8	-	-	ns
	Hold Time	Tdhd	8	-	-	
DE	Setup Time	Tesu	8	-	-	
	Hold Time	Tehd	8	-	-	

## 9.4 POWER SEQUENCE

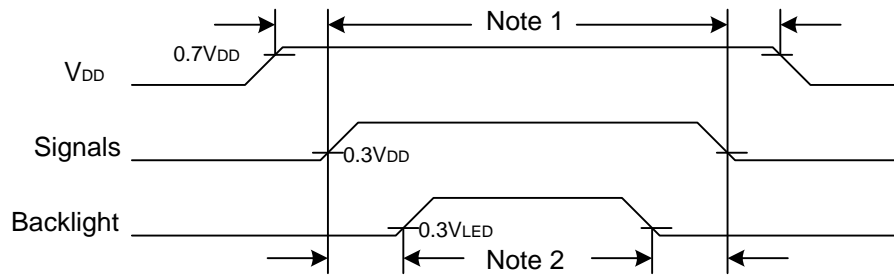


Fig. 9.6 Power Sequence Timing

Note 1: In order to avoid any damages, V<sub>DD</sub> has to be applied before all other signals. The opposite is true for power Off where V<sub>DD</sub> has to be remained on until all other signals have been switch off. The recommended time period is 1 second. Hot plugging might cause display damage due to incorrect power sequence, please pay attention on interface connecting before power on.

Note 2: In order to avoid showing uncompleted patterns in transient state. It is recommended that switching the backlight on is delayed for 1 second after the signals have been applied. The opposite is true for power Off where the backlight has to be switched off 1 second before the signals are removed.

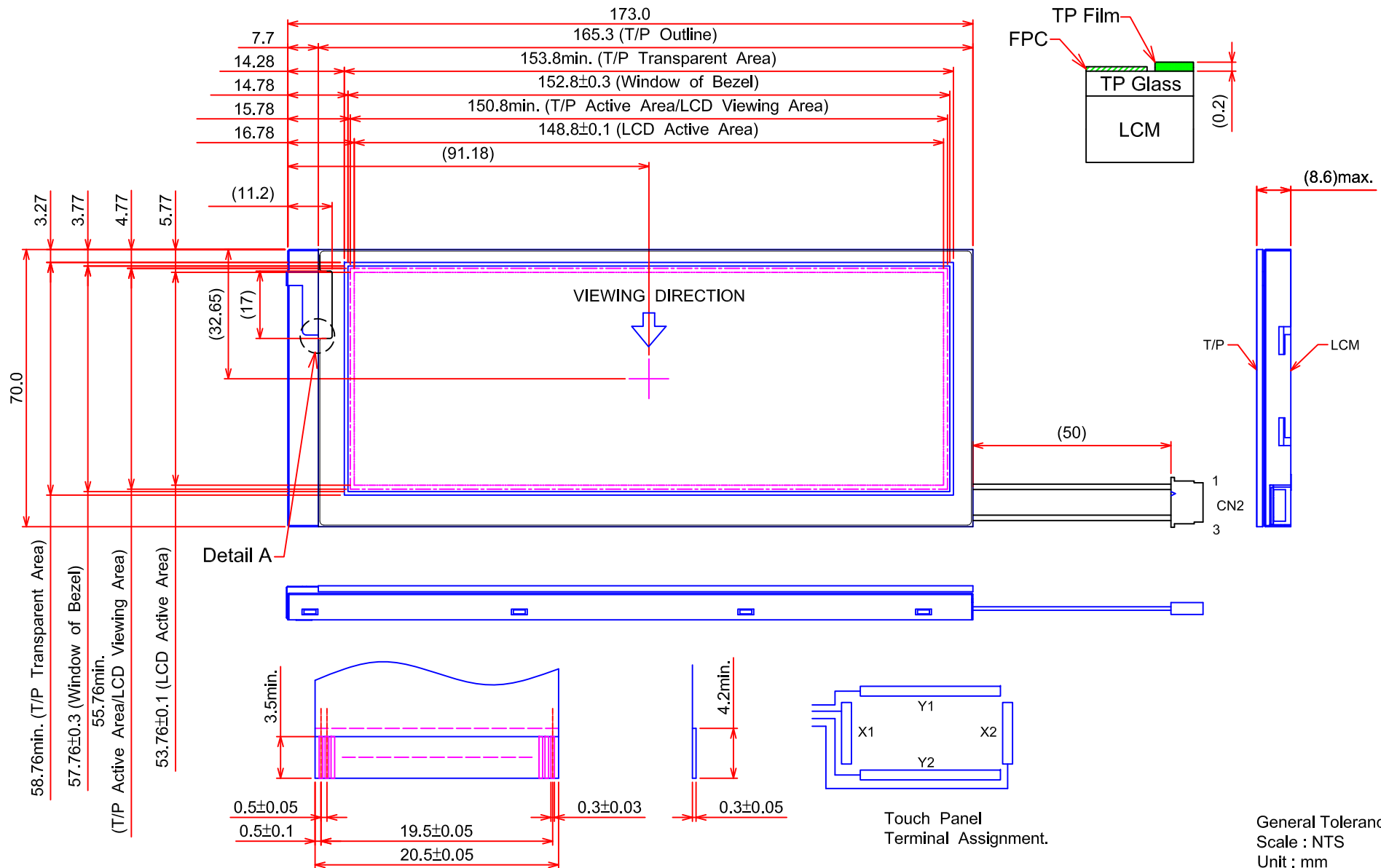
### 9.5 DATA INPUT for DISPLAY COLOR

	COLOR & Gray Scale	Data Signal																	
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
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	Black	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	Black	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	Black	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	

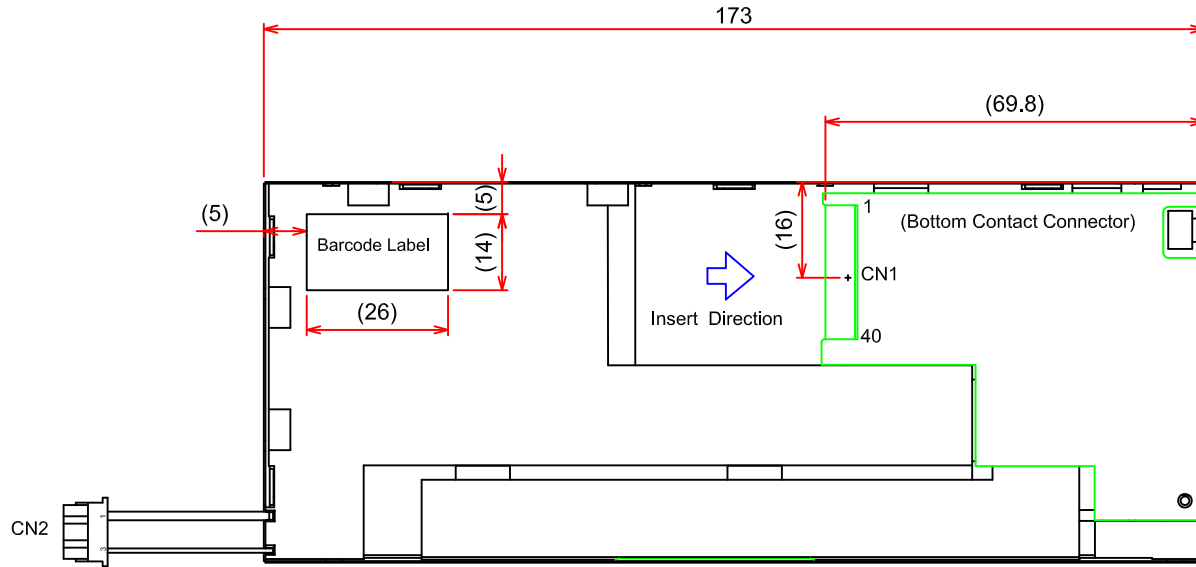


# 10. OUTLINE DIMENSIONS

## 10.1 FRONT VIEW



# 10.2 REAR VIEW



Scale : NTS  
Unit : mm

# 11. TOUCH PANEL

The type of touch panel used on this display is resistive, analog, 4-wire and film on glass, and more characteristics are shown as below:

## 11.1 OPERATING CONDITIONS

Item	Specification	Remarks
Operating Voltage	5VDC	-

## 11.2 ELECTRICAL CHARACTERISTICS

Item	Specification	Remarks
Resistance Between Terminal	X1-X2	300~1800Ω
	Y1-Y2	100~800Ω
Insulation Resistance	X-Y	20MΩ min. At 25V DC
Linearity	X	±1.5% max.
	Y	±1.5% max.
Chattering	10ms max.	-

Note 1: The test conditions and equipments of linearity are as below:

- Material of pen: poly-acetal resin
- End shape: R 0.8 mm
- Test force: 150 g
- Pitch: 10 mm
- Test area is shown in Fig. 11.1

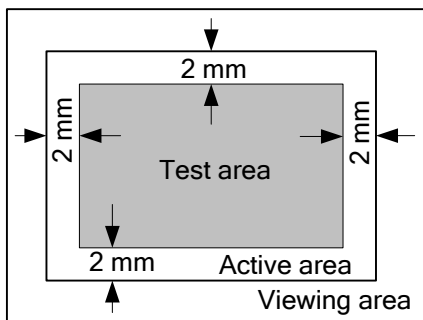


Fig. 11.1

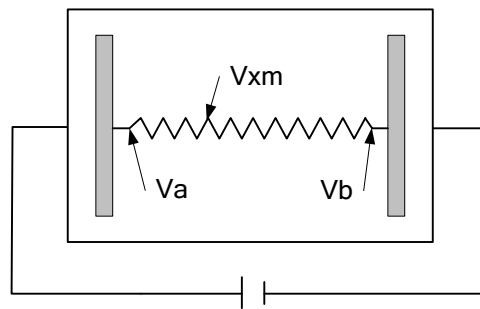


Fig. 11.2

As shown in Fig. 11.2, applying voltage meter to measure Va, Vb and Vxm, where Va is the maximum voltage in the active area; Vb is the minimum voltage in the active area; Vxm is the measured voltage of point x selected by random. Afterwards, the linearity can be calculated by following equation:

$$Linearity = \frac{|V_{xi} - V_{xm}|}{V_a - V_b} \times 100\%$$

where Vxi is the idea voltage of point x.

The method to measure the linearity of Y-axis is the same as above.

### 11.3 MECHANICAL CHARACTERISTICS

Item	Specification	Remarks
Pen Input Pressure	1.2N max.	R0.8, Polyacetal Pen
Finger	1.2N max.	R8.0, Silicon Rubber
Surface Hardness	3H min.	JIS K 5400

### 11.4 OPTICAL CHARACTERISTICS

Item	Specification	Remarks
Transmittance	77% min.	-

### 11.5 SAFETY AND ATTENTIONS

- 1) Do not put heavy shock or stress on the touch panel.
- 2) Please use soft cloth or absorbent cotton with ethanol to clean the touch panel by gently wiping. Moreover, please wipe it by horizontal or vertical direction instead of circling to prevent leaving scars on the touch panel's surface.
- 3) Do not use any harmful chemicals such as acetone, toluene, and isopropyl alcohol to clean the display's surface.
- 4) UV protection is recommended to avoid the possibility of performance degrading when touch panel is likely applied under UV environment for a long period of time.

## 12. APPEARANCE STANDARD

The appearance inspection is performed in a dark room around 500~1000 lx based on the conditions as below:

- The distance between inspector's eyes and display is 30 cm.
- The viewing zone is defined with angle  $\theta$  shown in Fig. 12.1 The inspection should be performed within  $45^\circ$  when display is shut down. The inspection should be performed within  $5^\circ$  when display is power on.

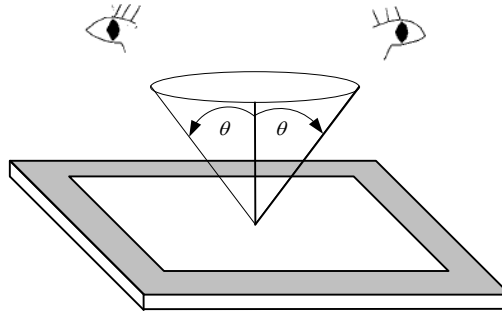


Fig. 12.1

### 12.1 THE DEFINITION OF LCD ZONE

LCD panel is divided into 2 areas as shown in Fig.12.2 for appearance specification in next section. A zone is the LCD active area (dot area); B zone is the area between A zone and metal frame.

In terms of housing design, B zone is the recommended window area customers' housing should be located in.

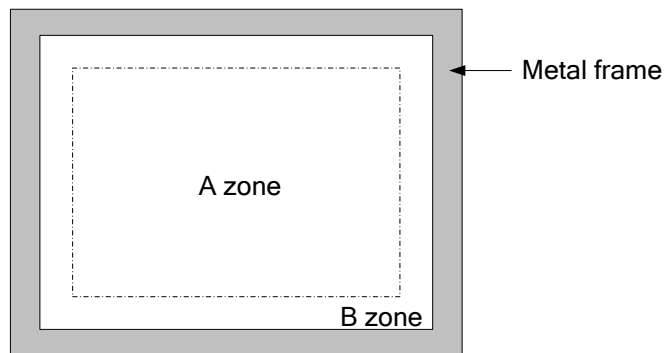


Fig. 12.2

## 12.2 LCD APPEARANCE SPECIFICATION

The specification as below is defined as the amount of unexpected phenomenon or material in different zones of LCD panel. The definitions of length, width and average diameter using in the table are shown in Fig. 12.4 and Fig. 12.5.

Item	Criteria				Applied zone
	Length (mm)	Width (mm)	Maximum number	Minimum space	
Scratches	$L \leq 15$	$W \leq 0.02$	Ignored	-	A
	$L \leq 15$	$0.02 < W \leq 0.1$	5	-	
	$L > 15$	$0.1 < W$	0	-	
Dent	Serious one is not allowed				A
Wrinkles in polarizer	Serious one is not allowed				A
Bubbles on polarizer	Average diameter (mm)		Maximum number		A
	$D \leq 0.3$		Ignored		
	$0.3 \leq D \leq 0.6$		4		
	$0.6 < D$		0		
1) Stains 2) Foreign Materials 3) Dark Spot	Filamentous (Line shape)				A
	Length (mm)	Width (mm)	Maximum number		
	$L \leq 2.0$	$W \leq 1.5$	5		
	$L > 2.0$	$1.5 < W$	0		
	Round (Dot shape)				A
	Average diameter (mm)	Maximum number	Minimum Space		
	$D \leq 0.2$	Ignored	-		
	$0.2 \leq D < 0.6$	4	-		
		$0.6 \leq D$	0	-	
	Those wiped out easily are acceptable				
Dot-Defect		Area①	Area②	Maximum number	A (Note 1)
	Bright dot-defect	1 dot	2 dot	3 dot	
	Dark dot-defect	2 dot	3 dot	4 dot	
	Bright + Dark point	3 dot	4 dot	5 dot	

Note 1: The Dot-Defect inspection within A zone (active area) would be divided into area ①, ② as Fig. 12.3 shown.

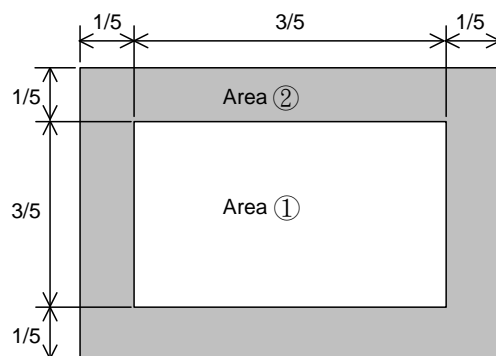


Fig. 12.3

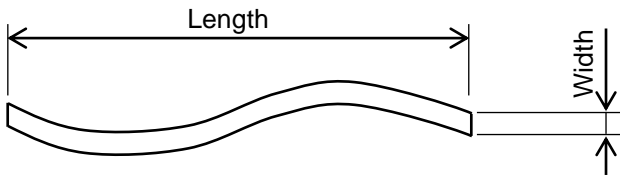


Fig 12.4

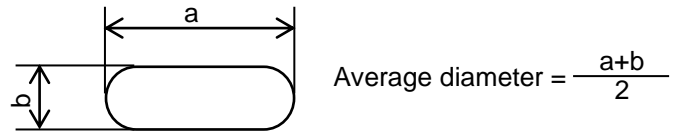


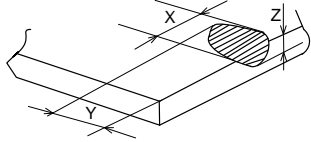
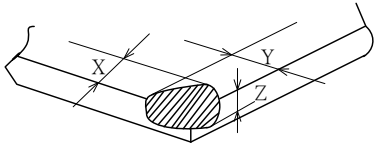
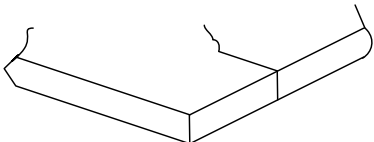
Fig 12.5

### 12.3 TOUCH PANEL APPEARANCE SPECIFICATION

The specification as below is defined by the amount of unexpected material in different zones of touch panel.

Item	Criteria			Applied zone
Scratches	Width (mm)	Length (mm)	Maximum number	A
	$W > 0.1$	-	Not allowed	
	$0.10 \geq W > 0.05$	$10 < L$	4 pcs max.	
	$0.05 \geq W$	-	Ignored	
Foreign Materials	Filamentous (Line shape)			A
	Width (mm)	Length (mm)	Maximum number	
	$W > 0.10$	-		
	$0.10 \geq W > 0.05$	$3 < L$	Not allowed	
	$0.05 \geq W$	-	Ignored	
	Round (Dot shape)			A
	Average diameter (mm)	Maximum number		
	$D > 0.3$	Not allowed		
$0.3 \geq D > 0.25$	3 pcs max.			
	$0.25 > D$	Ignored		

The limitation of glass flaw occurred on touch panel is defined in the table as below.

Item	Specifications	
Edge flaw		$X \leq 5.0 \text{ mm}$ $Y \leq 1.0 \text{ mm}$ $Z \leq \text{Thickness}$
Corner flaw		$X \leq 3.0 \text{ mm}$ $Y \leq 3.0 \text{ mm}$ $Z \leq \text{Thickness}$
Progressive flaw		Not allowed



## 13. PRECAUTIONS

### 13.1 PRECAUTIONS of ESD

- 1) Before handling the display, please ensure your body has been connected to ground to avoid any damages by ESD. Also, do not touch display's interface directly when assembling.
- 2) Please remove the protection film very slowly before turning on the display to avoid generating ESD.

### 12.2 PRECAUTIONS of HANDLING

- 1) In order to keep the appearance of display in good condition; please do not rub any surfaces of the displays by sharp tools harder than 3H, especially touch panel, metal frame and polarizer.
- 2) Please do not pile the displays in order to avoid any scars leaving on the display. In order to avoid any injuries, please pay more attention for the edges of glasses and metal frame, and wear finger cots to protect yourself and the display before working on it.
- 3) Touching the display area or the terminal pins with bare hand is prohibited. This is because it will stain the display area and cause poor insulation between terminal pins, and might affect display's electrical characteristics furthermore.
- 4) Do not use any harmful chemicals such as acetone, toluene, and isopropyl alcohol to clean display's surfaces.
- 5) Please use soft cloth or absorbent cotton with ethanol to clean the display by gently wiping. Moreover, when wiping the display, please wipe it by horizontal or vertical direction instead of circling to prevent leaving scars on the display's surface, especially polarizer.
- 6) Please wipe any unknown liquids immediately such as saliva, water or dew on the display to avoid color fading or any permanently damages.
- 7) Maximum pressure to the surface of the display must be less than  $1.96 \times 10^4$  Pa. If the area of adding pressure is less than  $1 \text{ cm}^2$ , the maximum pressure must be less than 1.96N.

### 13.3 PRECAUTIONS OF OPERATING

- 1) Please input signals and voltages to the displays according to the values defined in the section of electrical characteristics to obtain the best performance. Any voltages over than absolute maximum rating will cause permanent damages to this display. Also, any timing of the signals out of this specification would cause unexpected performance.
- 2) When the display is operating at significant low temperature, the response time will be slower than it at  $25 \text{ C}^\circ$ . In high temperature, the color will be slightly dark and blue compared to original pattern. However, these are temperature-related phenomenon of LCD and it will not cause permanent damages to the display when used within the operating temperature.
- 3) The use of screen saver or sleep mode is recommended when static images are likely for long periods of time. This is to avoid the possibility of image sticking.
- 4) Spike noise can cause malfunction of the circuit. The recommended limitation of spike noise is no bigger than  $\pm 100 \text{ mV}$ .

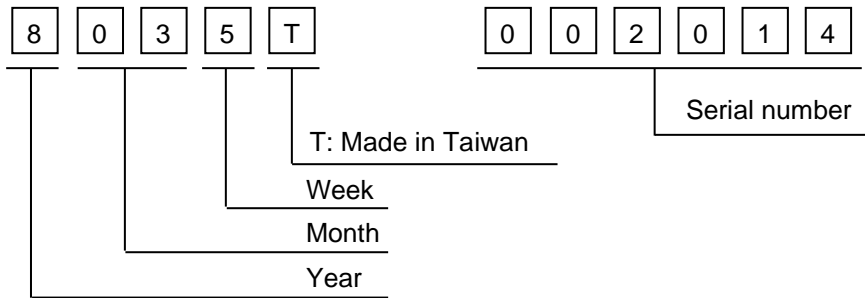
### 13.4 PRECAUTIONS of STORAGE

If the displays are going to be stored for years, please be aware the following notices.

- 1) Please store the displays in a dark room to avoid any damages from sunlight and other sources of UV light.
- 2) The recommended long-term storage temperature is between 10 C° ~35 C° and 55%~75% humidity to avoid causing bubbles between polarizer and LCD glasses, and polarizer peeling from LCD glasses.
- 3) It would be better to keep the displays in the container, which is shipped from KOE, and do not unpack it.
- 4) Please do not stick any labels on the display surface for a long time, especially on the polarizer.

# 14. DESIGNATION of LOT MARK

1) The lot mark is showing in Fig.14.1. First 4 digits are used to represent production lot, T represented made in Taiwan, and the last 6 digits are the serial number.



2) The tables as below are showing what the first 4 digits of lot mark are shorted for.

Year	Mark
2013	3
2014	4
2015	5
2016	6
2017	7

Month	Mark	Month	Mark
1	01	7	07
2	02	8	08
3	03	9	09
4	04	10	10
5	05	11	11
6	06	12	12

Week (Days)	Mark
1~7	1
8~14	2
15~21	3
22~28	4
29~31	5

3) Except letters I and O, revision number will be shown on lot mark and following letters A to Z.

REV.No	ITEM	REMARKS
A	-	-
B	LCD color filter Changed	-

4) The location of the lot mark is on the back of the display shown in Fig. 14.1.



Fig 14.1