KOE
JDI Group

TENTATIVE

Kaohsiung Opto-Electronics Inc.

FOR MESSRS : _____

DATE : Apr. 30th ,2020

TECHNICAL DATA

TX16D206VM0BQA

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ACCEPTED BY: _____

PROPOSED BY: *Oblack Tsai*

2. RECORD OF REVISION

DATE	SHEET No.	SUMMARY		
		SHEET NO.	7B64LTD-2644-1	PAGE	2-1/1

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	TX16D206M0BQA
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 Black
Polarizer Surface	Anti-glare
Display Type	Active Matrix
Number of Colors	262k Colors
Backlight	Light Emitting Diode (LED)
Weight	140g (typ.)
Interface	C-MOS; 18-bit RGB; 40 pins
Power Supply Voltage	3.3V for LCD; 12V for Backlight
Power Consumption	0.59 W for LCD; 1.68W W for Backlight
Viewing Direction	Super Wide Version (In-Plane Switching)
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_{DD}	-0.3	5	V	-
Input Voltage of Logic	V_I	-0.3	V_{DD}+0.3	V	Note 1
Operating Temperature	Top	-20	70	$^\circ$C	Note 2
Storage Temperature	Tst	-30	80	$^\circ$C	Note 2
Backlight Input Voltage	V_{LED}	-	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 $^\circ$C.

- Operating under high temperature will shorten LED lifetime.

5. ELECTRICAL CHARACTERISTICS

5.1 LCD CHARACTERISTICS

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

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} =3.3V	-	180	250	mA	Note 2
	I_{DD} for VGA		-	200	280		
Vsync Frequency	f_v	-	50	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 white check pattern is used when measuring I_{DD}. f_v is set to 60 Hz.

Note 3: 0.5A 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

$T_a = 25 \ ^\circ C$

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	-	140	-	mA	-
LED Lifetime	-	140 mA	-	50K	-	hrs	Note 2

Note 1: Fig. 5.1 shows the LED backlight circuit. V_{LED} and I_{LED} is many-to-one relationship, the above V_{LED} range is defined to obtain 140mA.

Note 2: The estimated lifetime is specified as the time to reduce 50% brightness by applying 140mA at $25 ^\circ C$.

Note 3: By applying different ILED, the estimated brightness curves are shown as Fig 5.2. for various environment use.
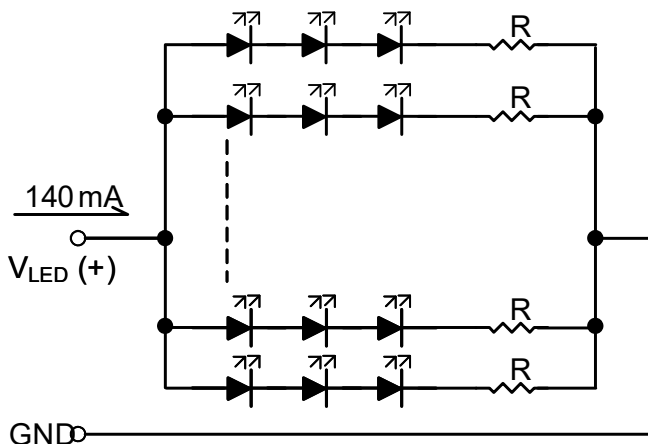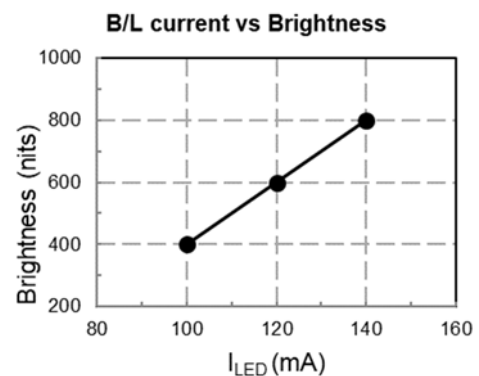

Fig. 5.1

Fig 5.2

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 less than 100 lx, the equipment has been set for the measurements as shown in Fig 6.1.

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

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Brightness of White		-	$\phi = 0°, \theta = 0°$, $I_{LED} = 140mA$	500	640	-	cd/m^2	Note 1
Brightness Uniformity		-		75	-	-	%	Note 2
Contrast Ratio		CR		600	1200	-	-	Note 3
Response Time		Rise + Fall	$\phi = 0°, \theta = 0°$	-	40	-	ms	Note 4
NTSC Ratio		-	$\phi = 0°, \theta = 0°$	-	60	-	%	-
Viewing Angle		θx	$\phi = 0°, CR \geq 10$	70	85	-	Degree	Note 5
		$\theta x'$	$\phi = 180°, CR \geq 10$	70	85	-		
		θy	$\phi = 90°, CR \geq 10$	70	85	-		
		$\theta y'$	$\phi = 270°, CR \geq 10$	70	85	-		
Color Chromaticity	Red	X	$\phi = 0°, \theta = 0°$	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.

Photo Detector: BM-5 or equivalent
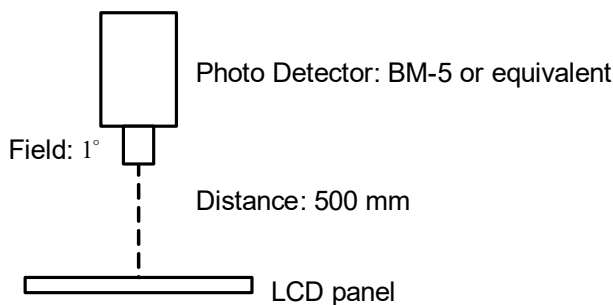
Field: $1°$

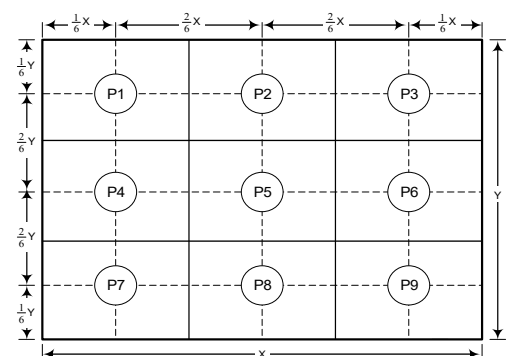Distance: 500 mm

LCD panel

Fig. 6.1

Fig. 6.2

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 10% brightness to 90% brightness when the data is from black to white. Oppositely, Falling time is the period from 90% brightness falling to 10% brightness.
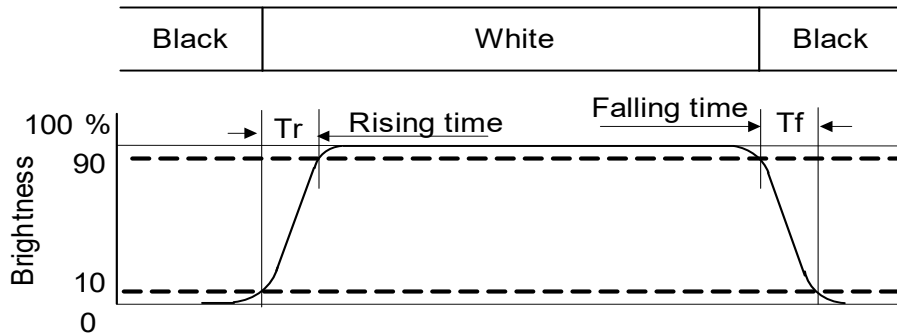

| Black | White | Black |

Fig. 6.3

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

The display is super wide viewing angle version, so that the best optical performance can be obtained from every viewing direction.
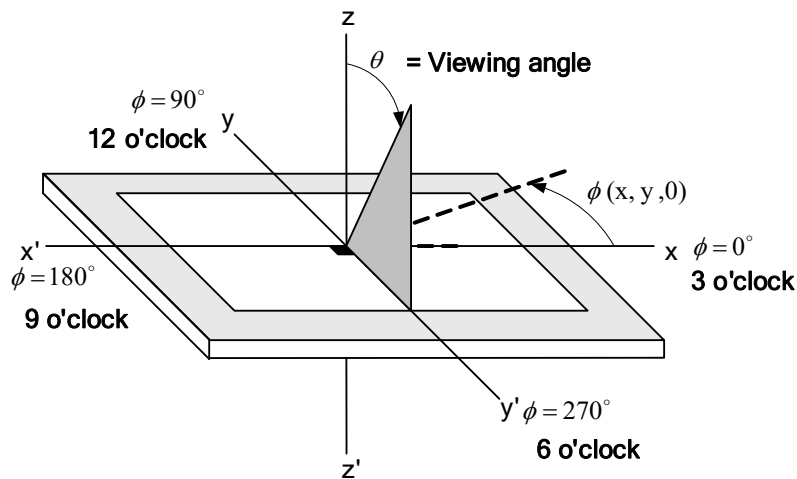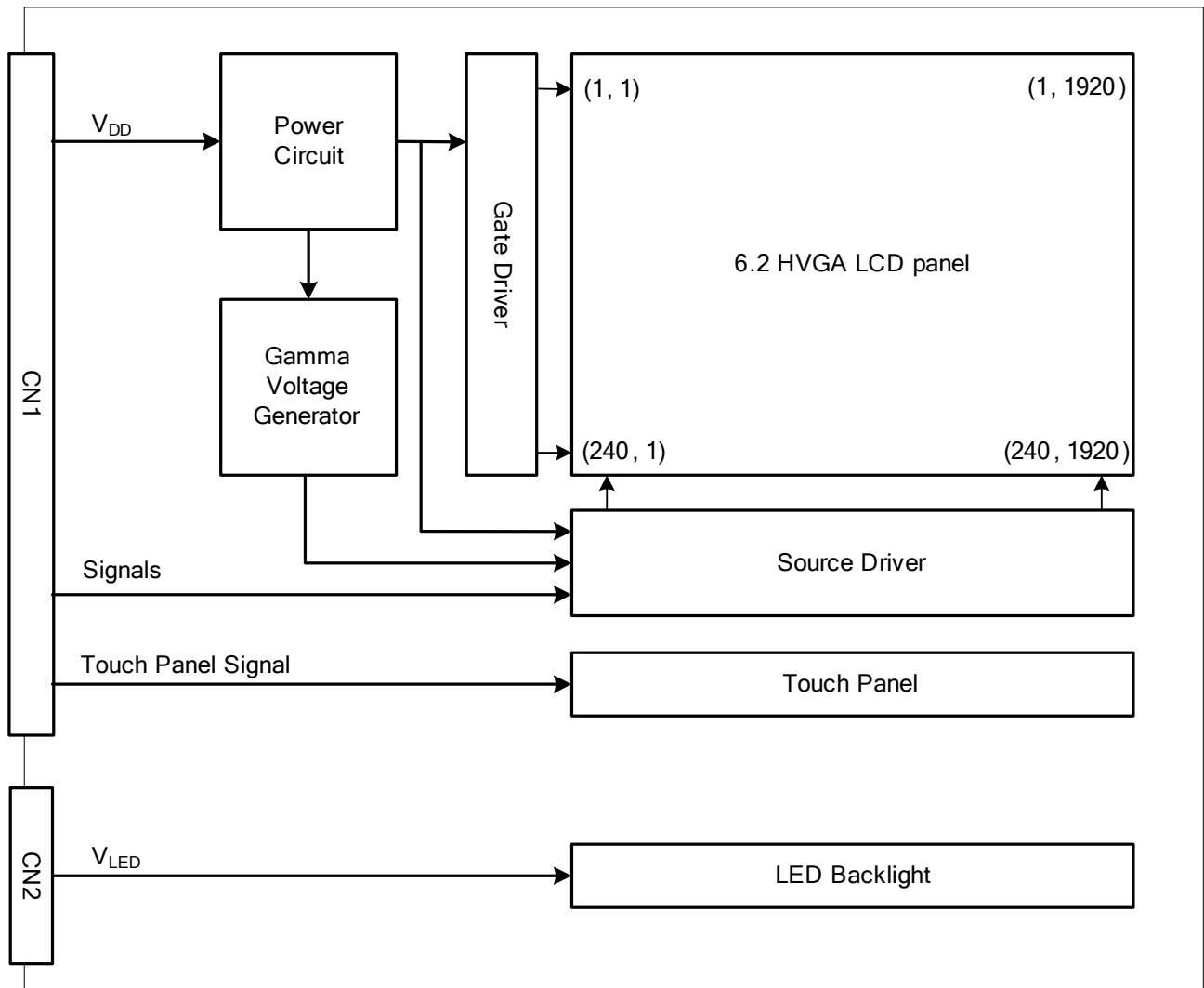

Fig. 6.4

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. LCD INTERFACE

8.1 INTERFACE PIN CONNECTIONS

The display interface connector is FA5B040HP1R3000 made by JAE (Thickness: 0.3 ± 0.05mm; Pitch: 0.5 ± 0.05mm) 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_{DD}	Power Supply for Logic	21	G4	Green Data
2	V_{DD}		22	G3	
3	V_{DD}		23	V_{SS}	GND
4	V_{DD}		24	G2	Green Data
5	NC	No Connection	25	G1	
6	DE	Data Enable	26	G0	
7	V_{SS}	GND	27	V_{SS}	GND
8	DCLK	Dot Clock	28	R5	Red Data
9	V_{SS}	GND	29	R4	
10	NC	No Connection	30	R3	
11	V_{SS}	GND	31	V_{SS}	GND
12	B5	Blue Data	32	R2	Red Data
13	B4		33	R1	
14	B3		34	R0	
15	V_{SS}	GND	35	Vcom	Common Voltage (Generated by LCM)
16	B2	Blue Data	36	V_{SS}	GND
17	B1		37	NC	No Connection
18	B0		38	NC	No Connection
19	V_{SS}	GND	39	NC	No Connection
20	G5	Green Data	40	NC	No Connection

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

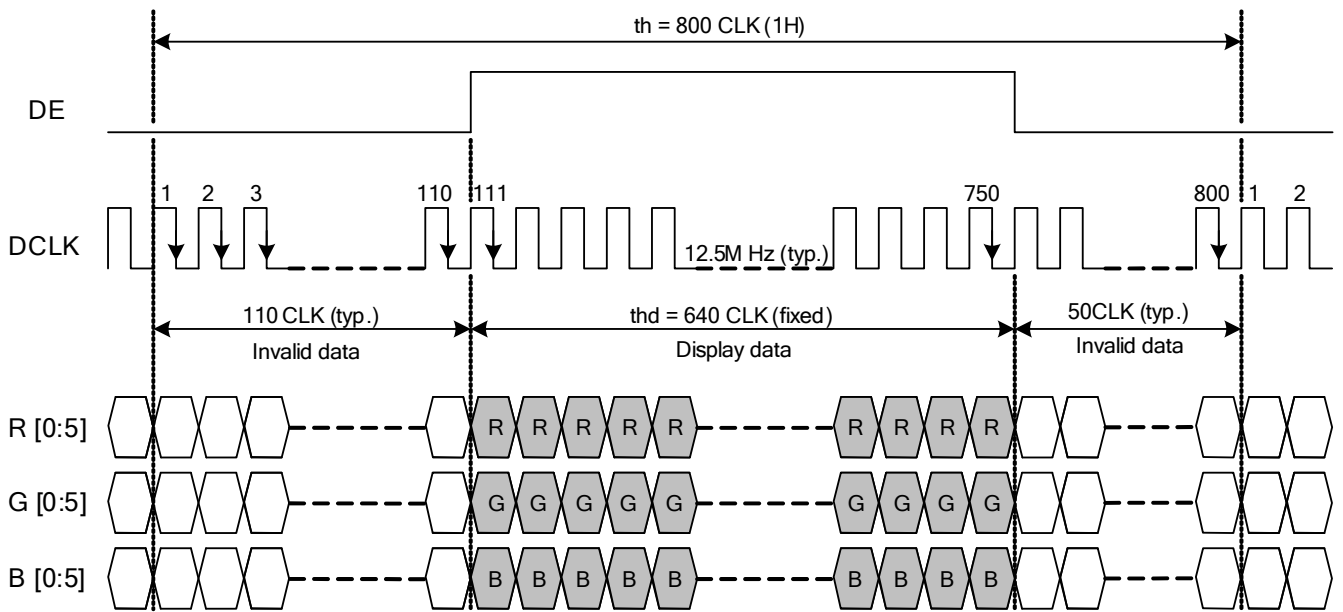| Pin No.	Signal	Level	Function
1	$V_{LED}+$	-	Power Supply for LED
2	NC	-	No connection
3	$V_{LED}-$	-	GND

8.2 TIMING CHART

8.2.1 HVGA MODE

Fig. 9.1 Horizontal Timing of HVGA Mode
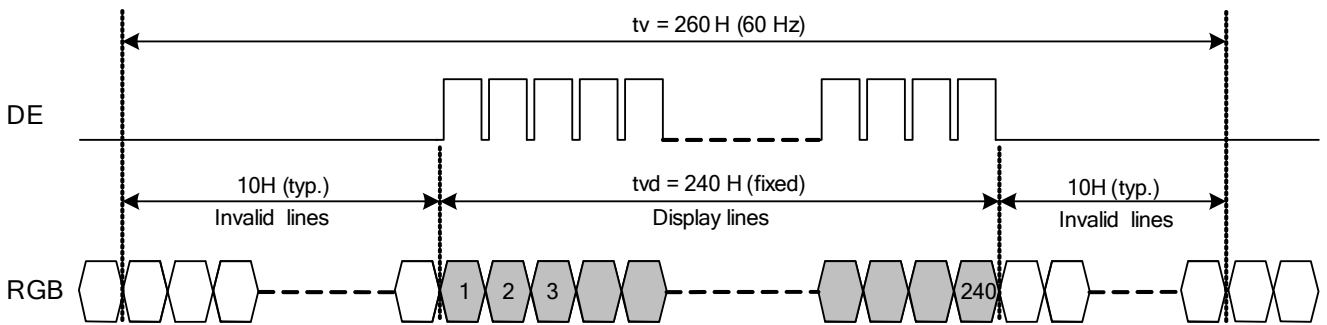
Fig. 9.2 Vertical Timing of HVGA Mode

8.2.2 VGA MODE
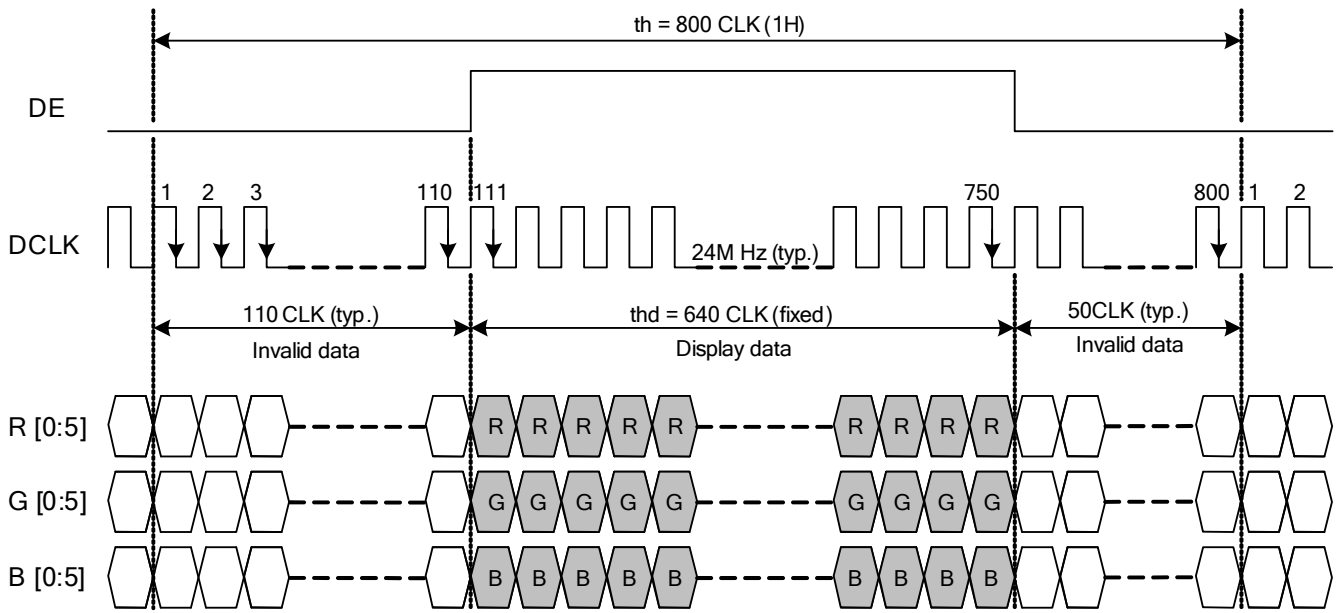
Fig. 9.3 Horizontal Timing of VGA Mode

th = 800 CLK (1H)

110 CLK (typ.) Invalid data

thd = 640 CLK (fixed) Display data

50CLK (typ.) Invalid data

24M Hz (typ.)
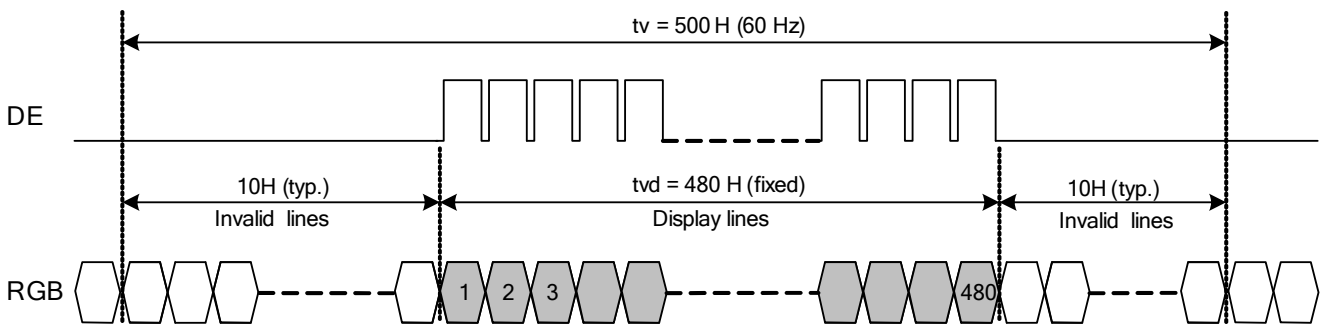
Fig. 9.4 Vertical Timing of VGA Mode

tv = 500 H (60 Hz)

10H (typ.) Invalid lines

tvd = 480 H (fixed) Display lines

10H (typ.) Invalid lines

8.2.3 CLOCK AND DATA INPUT TIMING
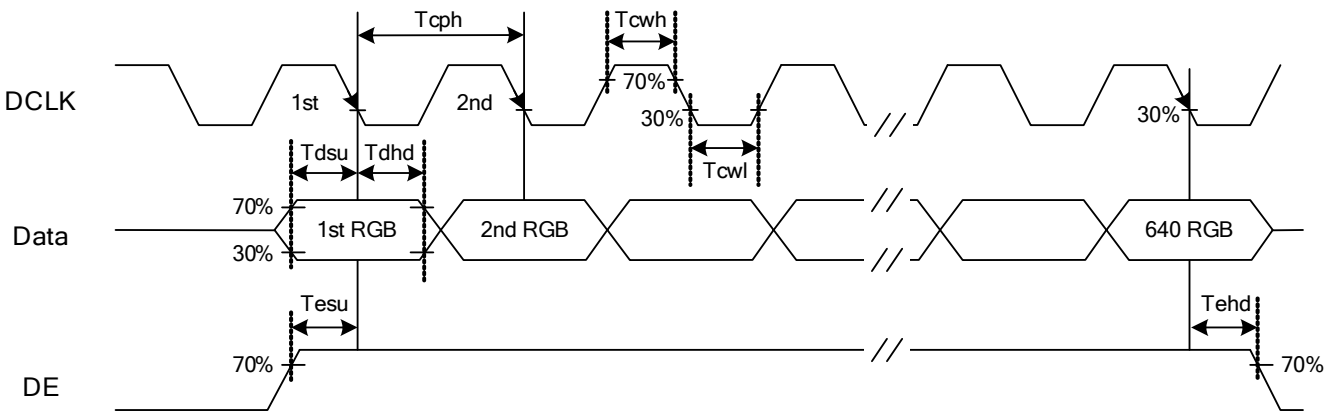
Fig. 9.5 Setup & Hold Time of Data and DE signal.

8.3 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	-	-	

8.4 POWER SEQUENCE
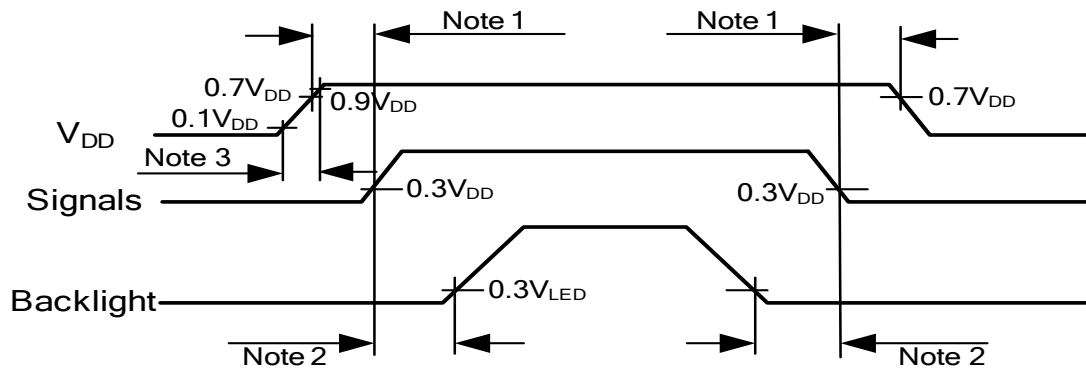
Note 1: In order to avoid any damages, V_{DD} has to be applied before all other signals. The opposite is true for power off where V_{DD} has to be remained on until all other signals have been switch off. The recommended time period is 1 second.

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.
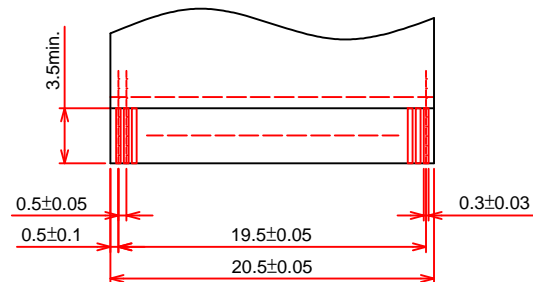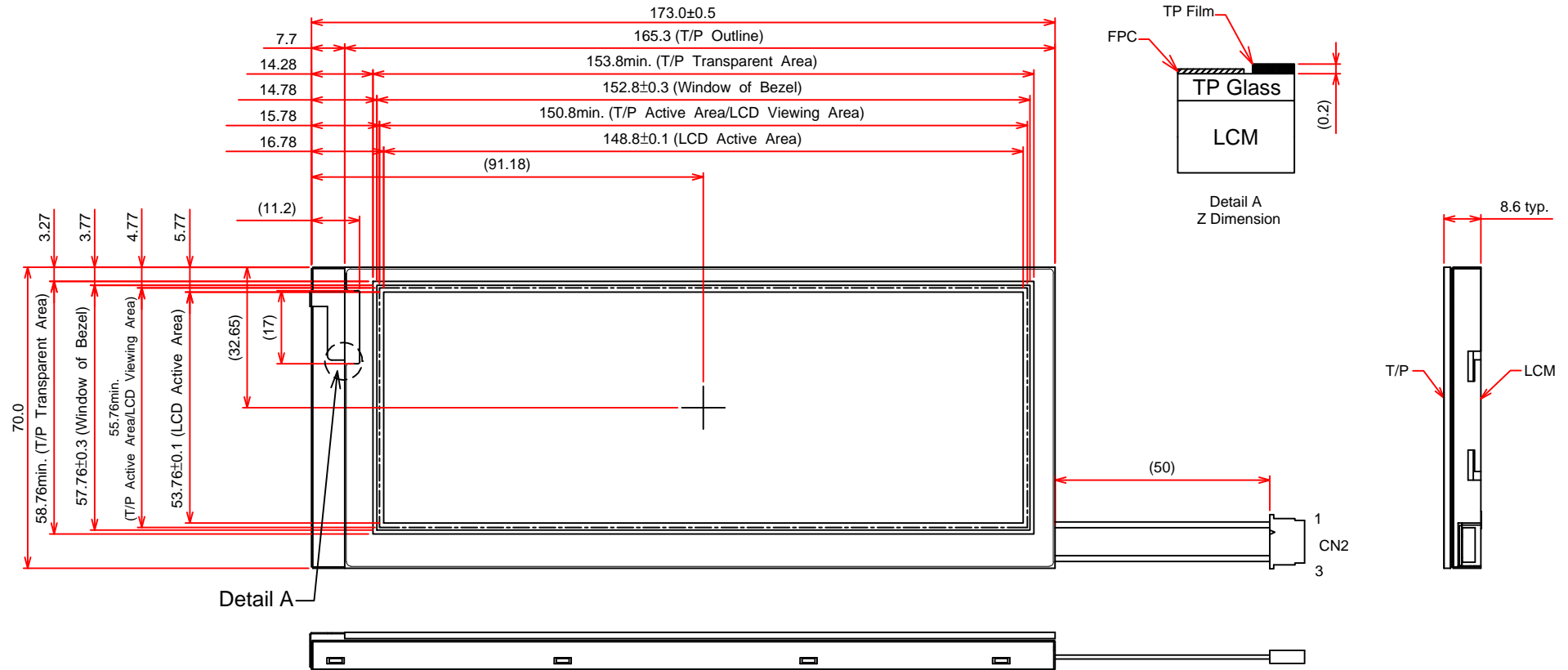
Note 3: In order to avoid high Inrush current, VDD rising time need to set more than 0.5ms.
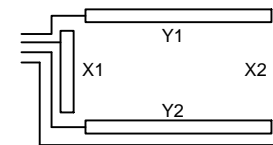
8.5 DATA INPUT for DISPLAY COLOR

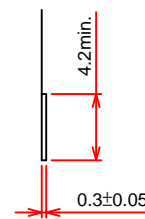|	COLOR & Gray Scale	Data Signal																	
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green (63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue (63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	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

9. OUTLINE DIMENSIONS
9.1 FRONT VIEW

173.0±0.5
165.3 (T/P Outline)
7.7
14.28 153.8min. (T/P Transparent Area)
14.78 152.8±0.3 (Window of Bezel)
15.78 150.8min. (T/P Active Area/LCD Viewing Area)
16.78 148.8±0.1 (LCD Active Area)

(91.18)

(11.2)

TP Film
FPC
TP Glass
(0.2)
LCM

Detail A
Z Dimension

8.6 typ.

3.27
3.77
4.77
5.77

58.76min. (T/P Transparent Area)
57.76±0.3 (Window of Bezel)
55.76min. (T/P Active Area/LCD Viewing Area)
53.76±0.1 (LCD Active Area)
70.0

(32.65)
(17)

T/P
LCM

(50)

1
CN2
3

Detail A

3.5min.

4.2min.

Y1
X1   X2
Y2

Touch Panel
Terminal Assignment.

0.5±0.05
0.5±0.1
0.3±0.03
19.5±0.05
20.5±0.05

0.3±0.05

Recommended design rule for I/F FPC

General Tolerance:±0.5mm
Scale : NTS
Unit : mm

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9.2 RAER VIEW

173±0.5

(69.8)

(5)

(14)

(5)

Barcode Label

(26)

(16)

1

(Bottom Contact Connector)

+ CN1

Insert Direction

40

CN2

General Tolerance:±0.5mm
Scale : NTS
Unit : mm

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SHEET No.

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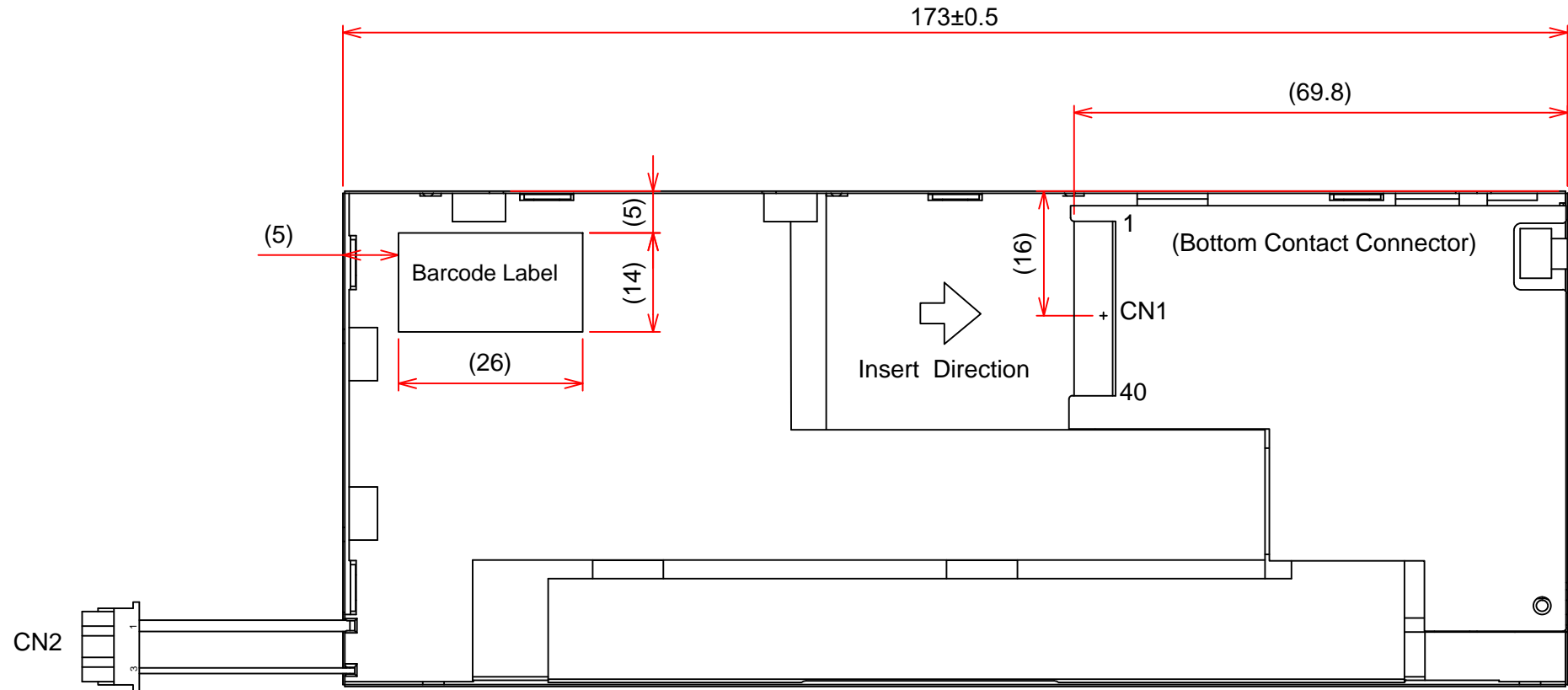
10. TOUCH PANEL

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:

10.1 OPERATING CONDITIONS

Item	Specification	Remarks
Operating Voltage	5VDC	-

10.2 ELECTRICAL CHARACTERISTICS

Item		Specification	Remarks
Resistance	X1-X2	300~1800Ω	-
Between Terminal	Y1-Y2	100~800Ω	
Insulation Resistance	X-Y	20MΩ min.	At 25V DC
Linearity	X	±1.5% max.	Note 1
	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
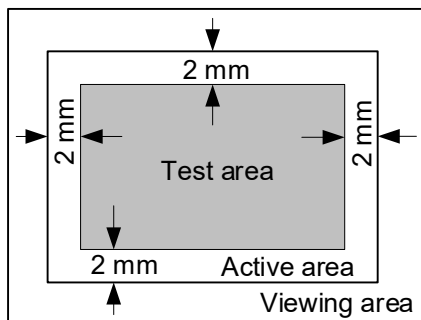
- Pitch: 10 mm

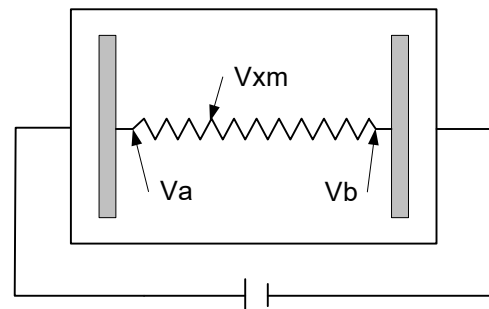- Test area is shown in Fig. 10.1

Fig. 10.1

Fig. 10.2

As shown in Fig. 10.2, 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:

$$Linearity = \frac{|Vxi - Vxm|}{Va - Vb} \times 100\%,$$

where Vxi is the idea voltage of point x.

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

10.3 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

10.4 OPTICAL CHARACTERISTICS

Item	Specification	Remarks
Transmittance	77% min.	-

10.5 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.