HITACHI

KAOHSIUNG HITACHI ELECTRONICS CO., LTD.

FOR MESSRS:_____ DATE: Sep. 19th 2011

CUSTOMER'S ACCEPTANCE SPECIFICATION

TX18D38VM0EAA

Contents

ACCEPTED BY:_____ PROPOSED BY: Ken Chen

2. RECORD OF REVISION

DATE	SHEET No.	SUMMARY

3. GENERAL DATA

3.1 DISPLAY FEATURES

This module is a 7” WSVGA of 5:3 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	TX18D38VM0EAA
Module Dimensions	162.8(W) mm x 103.1(H) mm x 2.71(D) mm typ. (Excluding FPC and electronic components)
LCD Active Area	153.6(W) mm x 90(H) mm
Pixel Pitch	0.150(W) mm x 0.150(H) mm
Resolution	1024 x 3(RGB)(W) x 600(H) dots
Color Pixel Arrangement	R, G, B Vertical stripe
LCD Type	Transmissive Color TFT; Normally Black
Display Type	Active Matrix
Number of Colors	16.7M Colors (8bit)
Backlight	LED (7LEDs serial Ｘ3 parallel)
Weight	90g typ.
Interface	LVDS Interface + SPI (Clock synchronous serial interface)
Power Supply Voltage	3.3V for LCD; 22V for Backlight
Power Consumption	0.9W for LCD; 0.9W for backlight
Viewing Direction	Super wide version (In Plane Switching)

4. ABSOLUTE MAXIMUM RATINGS

4.1 ELECTRICAL ABSOLUTE MAXIMUM RATINGS OF LCD

T_a = 25 °C, GND = 0V

Item	Symbol	Min.	Max.	Unit	Remarks
Power Supply for LCD	VDD	-0.5	5.0	V	Note 1
Input Voltage	Vi	-0.5	5.0	V	Note 2
Static Electricity	-	-	± 2	kV	Note 3

Note 1: Keep all Voltages no lower than GND.

Note 2: Applies to the CLK pixel data pairs and SPI data.

Note 3: 100pF-1.5 kohm, 25°C-70%RH
Static electricity discharge is to be aimed at the center of the active area.

4.2 ENVERONMENTAL ABSOLUTE MAXMUM RATINGS

Item	Operating		Storage		Remarks
	Min.	Max.	Min.	Max.	
Ambient Temperature	-10°C	60°C	-30°C	70°C	Note 2,3
Humidity	Note 1		Note 1		No condensation
Corrosive Gas	Not Acceptable		Not Acceptable		

Note 1: Ta ≤ 40°C 85%RH max.
Ta >40°C Absolute humidity must be lower than the humidity of 85%RH at 40°C .

Note 2: Background color slightly changes depending on ambient temperature and viewing angle.
The speed of response is slower at 0°C .
The temperature for operating in the table above apply to operation only.
Visual qualities, such as contrast and speed of response, to be evaluated at Ta=25°C Operation.

Note 3: When mounting the LCD module in your set, be sure to prevent the LCD module from being influenced being influenced by mechanical impacts and/or a stress from temperature variation.

5. ELECTRICAL CHARACTERISTICS

LCD CHARACTERISTICS

T_a = 25 °C, GND = 0V

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage for Logic	VDD	-	3.2	3.3	3.4	V	
Input Voltage for Logic Circuits	Vi	"H" Level	0.7xVDD	-	VDD	V	
		"L" Level	0	-	0.3xVDD		
Output Voltage for Logic Circuits	Vo	"H" Level	VDD-0.4	-	-	V	
		"L" Level	-	-	VDD+0.4		
Power Supply Current	Idd	All White	-	275	315	mA	
Input/Output Leak Current	ILi	-	-1.0	-	1.0	μA	
Frame Frequency	fFLM	-	-	60	-	Hz	
LED Forward Voltage	VLED	-	-	22	-	V	
LED Forward Current	ILED	-	-	41.1	Note 1	mA	

Note 1: The operating current of LED should be determined within the maximum rating of the temperature environmental condition.

Note 2: Input : CLK pixel data pairs and SPI data.

Note 3: Please connect the resistor (R=200 ohm) for current control between LED (cathode) and GND in the customer's system.

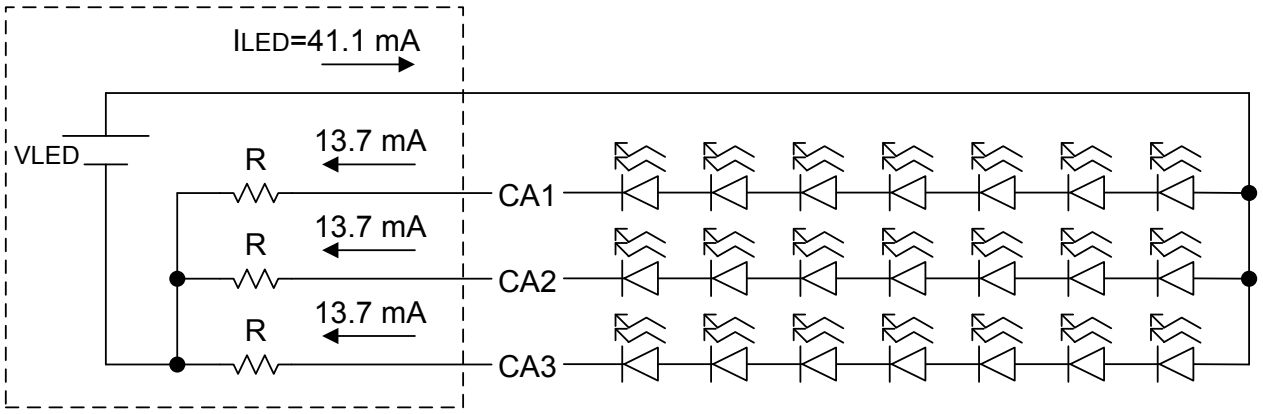


Fig 5.1

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.

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

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Brightness of White		-	$\phi = 0^{\circ}, \theta = 0^{\circ}$, ILED= 41.1 mA	340	400	-	cd/m^2	Note 1
Brightness Uniformity		-		80	85	-	%	Note 2
Contrast Ratio		CR		640	800	-	-	Note 3
Response Time (Rising + Falling)		$T_r + T_f$	$\phi = 0^{\circ}, \theta = 0^{\circ}$	-	35	60	ms	Note 4
NTSC Ratio		-	$\phi = 0^{\circ}, \theta = 0^{\circ}$	46	50	-	%	-
Viewing Angle		θ x	$\phi = 0^{\circ}$, CR ≥ 10	75	85	-	Degree	Note 5
		θ x′	$\phi = 180^{\circ}$, CR ≥ 10	75	85	-		
		θ y	$\phi = 90^{\circ}$, CR ≥ 10	75	85	-		
		θ y′	$\phi = 270^{\circ}$, CR ≥ 10	75	85	-		
Color Chromaticity	Red	X	$\phi = 0^{\circ}, \theta = 0^{\circ}$	0.585	0.615	0.645	-	Note 6
		Y		0.317	0.347	0.377		
	Green	X		0.285	0.315	0.345		
		Y		0.515	0.545	0.575		
	Blue	X		0.118	0.148	0.178		
		Y		0.077	0.107	0.137		
	White	X		0.280	0.310	0.340		
		Y		0.300	0.330	0.360		

Note 1: The brightness is measured from center point of the panel, P5 in Fig. 6.2, for the typical value.

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

$$\text{Brightness uniformity} = \frac{\text{Min. Brightness}}{\text{Max. Brightness}} \text{ X100\%}$$

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

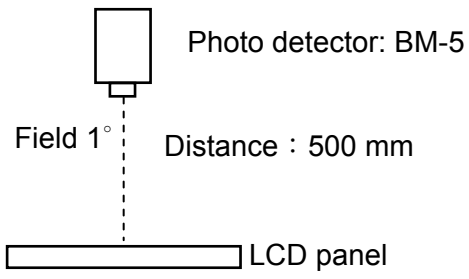


Fig. 6.1

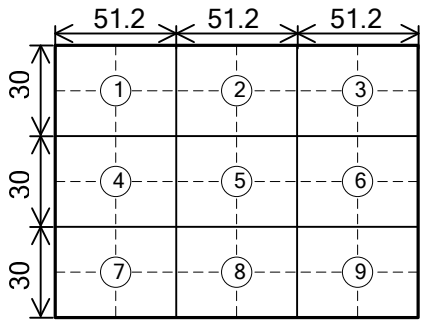


Fig. 6.2

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

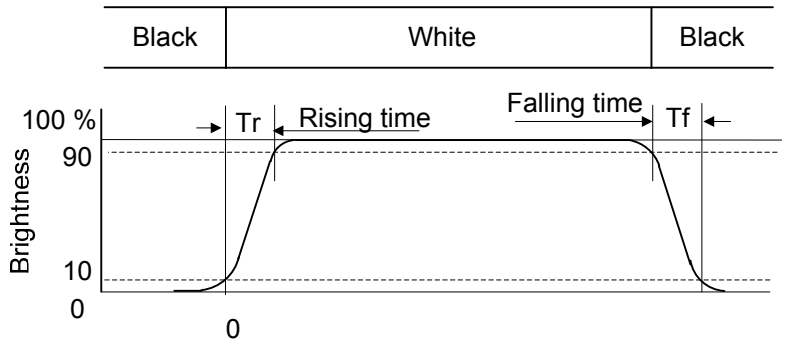


Fig . 6.3

Note 5: The definition of viewing angle is shown in Fig. 6.4. Angle ϕ is used to represent viewing directions, for instance, $\phi = 270^\circ$ means 6 o'clock, and $\phi = 0^\circ$ 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; 85° viewing angle can be obtained from each viewing direction.

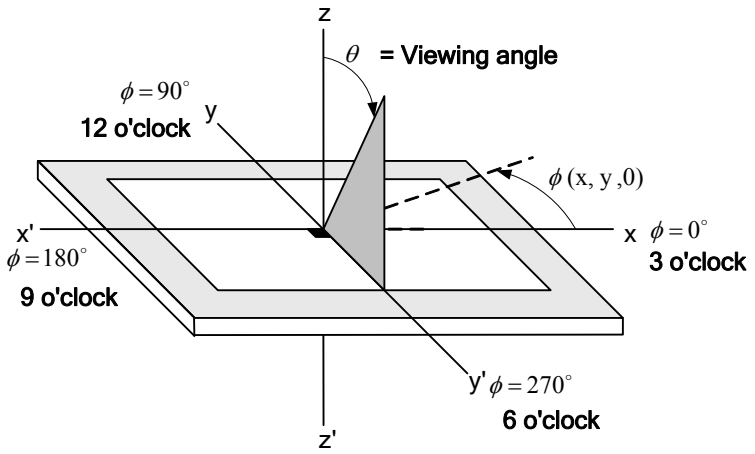
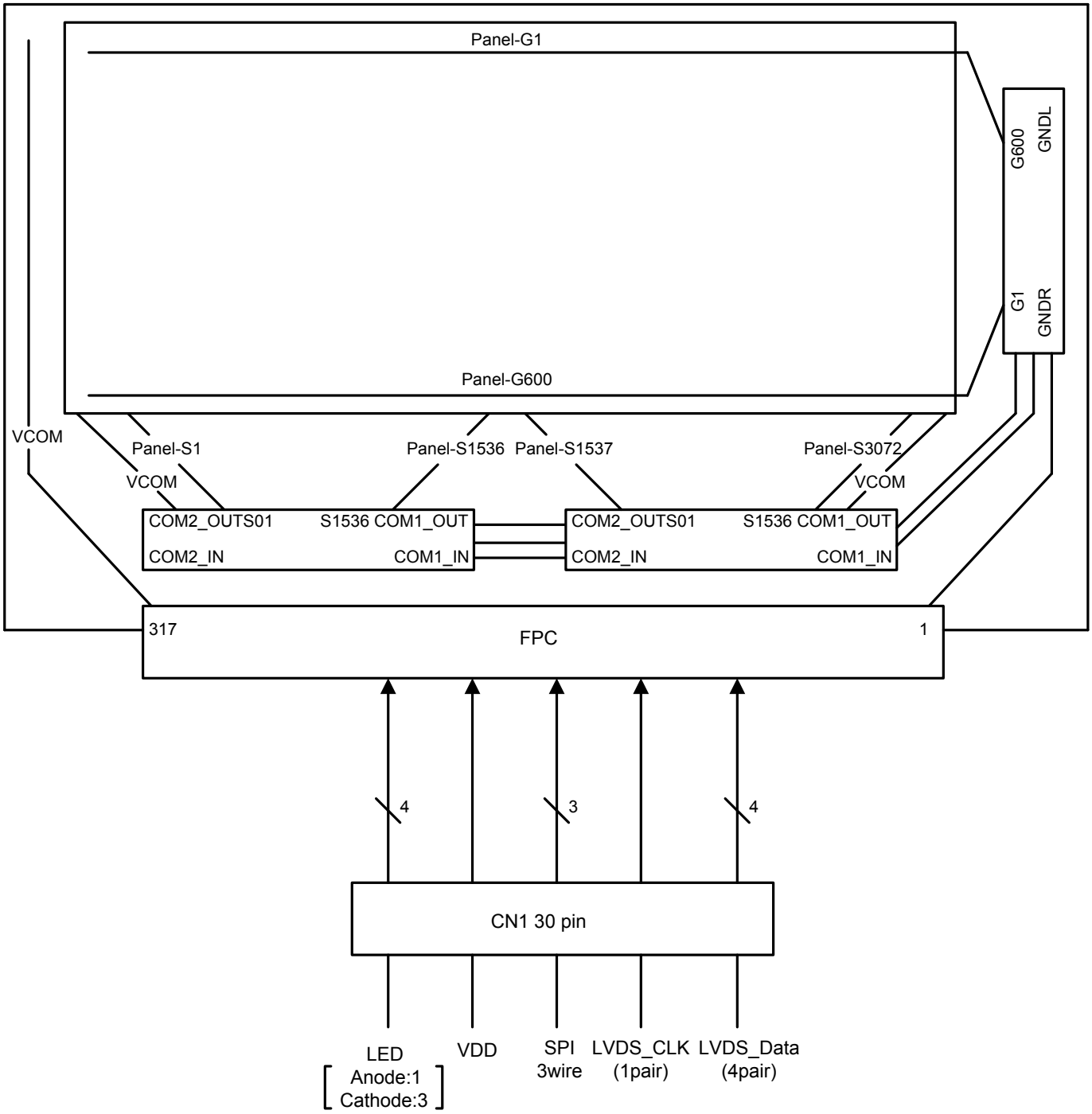


Fig. 6.4

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

7. BLOCK DIAGRAM



8. RELIABILITY TESTS

No.	Test Item	Condition	Remarks
1	High Temperature, operating	55°C, 96h	Note 1, 2
2	Low temperature, operating	-10°C, 96h	
3	High temperature & high humidity, operating	50°C, 90%RH, 96h	
4	High temperature, storage	70°C, 96h	Note 2
5	Low temperature, storage	-30°C, 96h	
6	High temperature & high humidity, storage	60°C, 90%RH, 96h	
7	Thermal shock, storage	-30°C (0.5h) ± 70°C (0.5h), 10cycles	
8	Vibration	Non-operation sin wave 20-150Hz, 50m/sec^2 acceleration 90min in each axis, 270min (3axis) in total.	
9	Packaging drop test	Drop height: 30 cm, 1 angle, 3edges	

Note 1: Operation conditions : VDD=3.3V.

Note 2: To be no defective functions related to electrical and/or optical characteristics when the tested module operates.

9. LCD INTERFACE

9.1 INTERFACE PIN CONNECTIONS

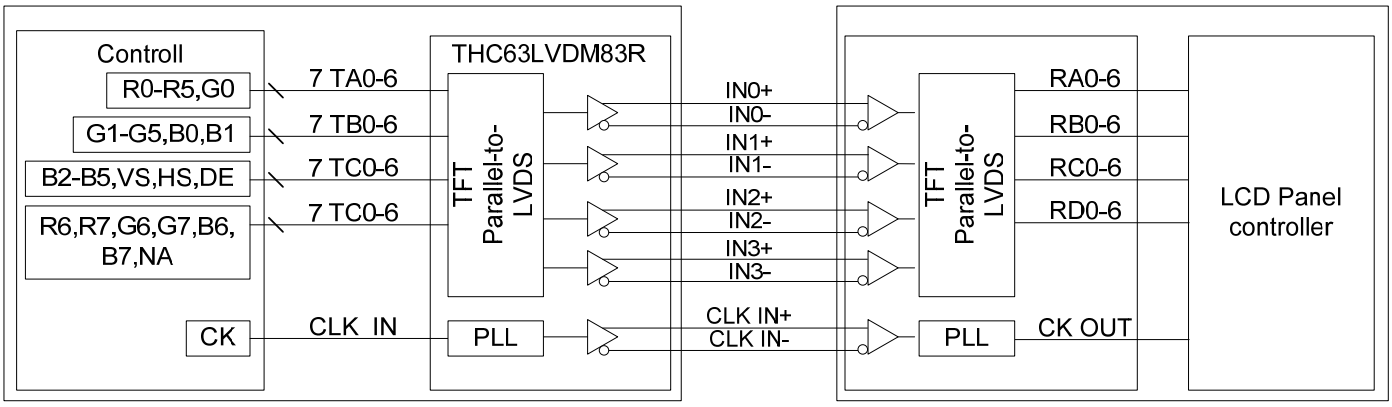
The display interface is FPC and pin assignment is as below:

Pin No.	Symbol	I/O	Description
1	VID0	-	Connect to VDD
2	VID1	-	Connect to GND
3	VDD	-	3.3V Power Supply
4	GND	-	-
5	GND	-	-
6	GND	-	-
7	CLK IN-	I	LVDS Differential clock-
8	CLK IN+	I	LVDS Differential clock+
9	GND	-	-
10	IN0-	I	LVDS Differential data 0-
11	IN0+	I	LVDS Differential data 0+
12	GND	-	-
13	IN1-	I	LVDS Differential data 1-
14	IN1+	I	LVDS Differential data 1+
15	GND	-	-
16	IN2-	I	LVDS Differential data 2-
17	IN2+	I	LVDS Differential data 2+
18	GND	-	-
19	IN3-	I	LVDS Differential data 3-
20	IN3+	I	LVDS Differential data 3+
21	GND	-	-
22	SPI_CLK	I	SPI clock input (SCL)
23	SPI_DI	I	SPI data input (SDA)
24	SPI_CS#	I	SPI Chip select (CSB)
25	N.C.	-	-
26	N.C.	-	-
27	VLED_A	-	LED Power (Anode)
28	VLED_C1	-	LED Power (Cathode)
29	VLED_C2	-	LED Power (Cathode)
30	VLED_C3	-	LED Power (Cathode)

9.2 LVDS INTERFACE

Machine Side TFT-LCD Side

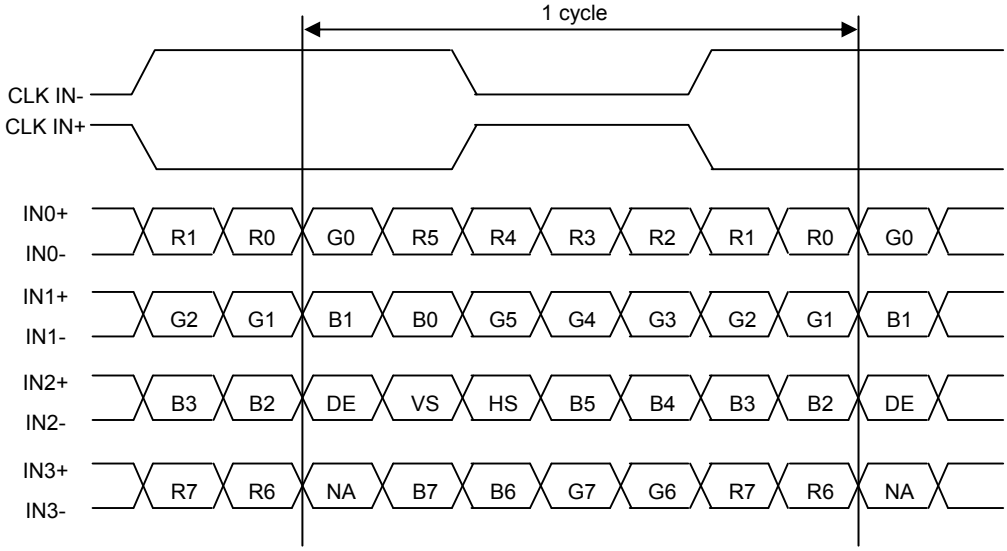
8Bit Mode



Note 1: LVDS cable impedance should be 100 ohms per signal line when each 2-lines (+, -) is used in differential mode.

Note 2: The recommended transmitter, THC63LVDM83R, is made by Thine or equivalent, which is not contained in the module.

9.3 LVDS DATA FORMAT



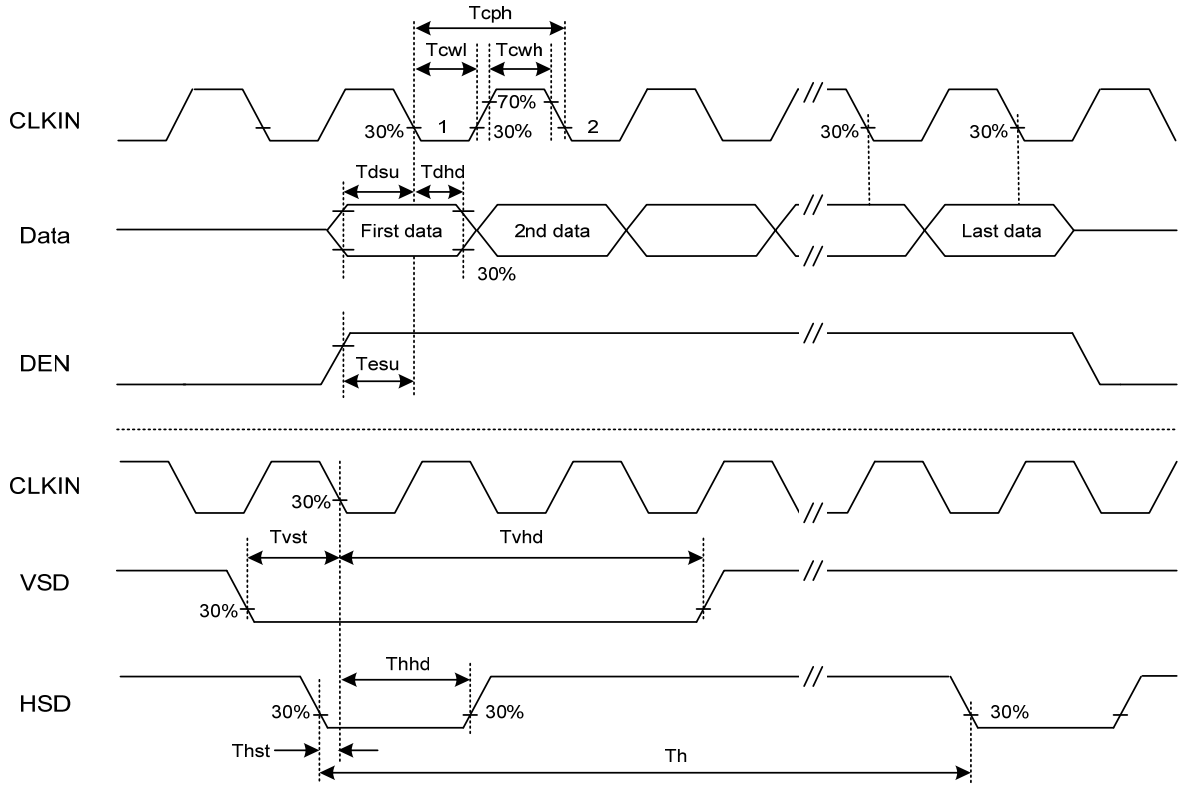
DE: Display Enable

NA: Not Available

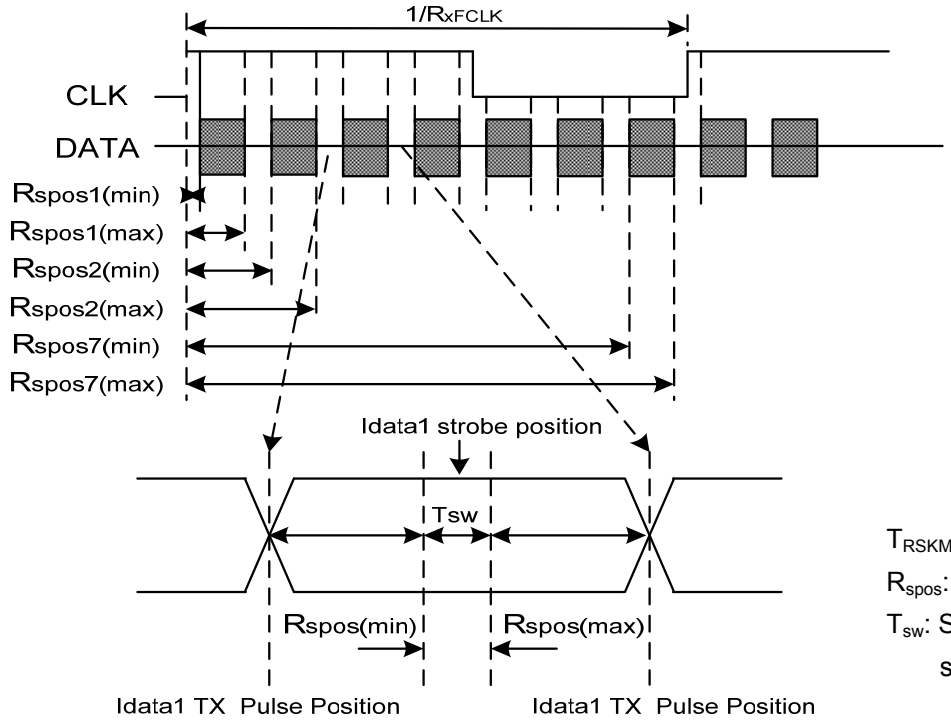
9.4 INTERFACE TIMING SPECIFICATIONS

The column of timing sets including minimum, typical, and maximum as below are based on the best optical performance, frame frequency (Vsync) = 60 Hz to define. If 60 Hz is not the aim to set, less than 70 Hz for Vsync is recommended to apply for better performance by other parameter combination as the definitions in section 5.1.

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
DCLK frequency @ Frame rate=60HZ	fclk	40.8	51.2	67.2	MHz
Horizontal display area	thd		1024		DCLK
HSD period time	th	-	1344	-	DCLK
HSD blanking	thb+thfp	-	320	-	DCLK
Vertical display area	tvd		600		H
VSD period time	tv	-	635	-	H
VSD blanking	tvb+tvfp	-	35	-	H



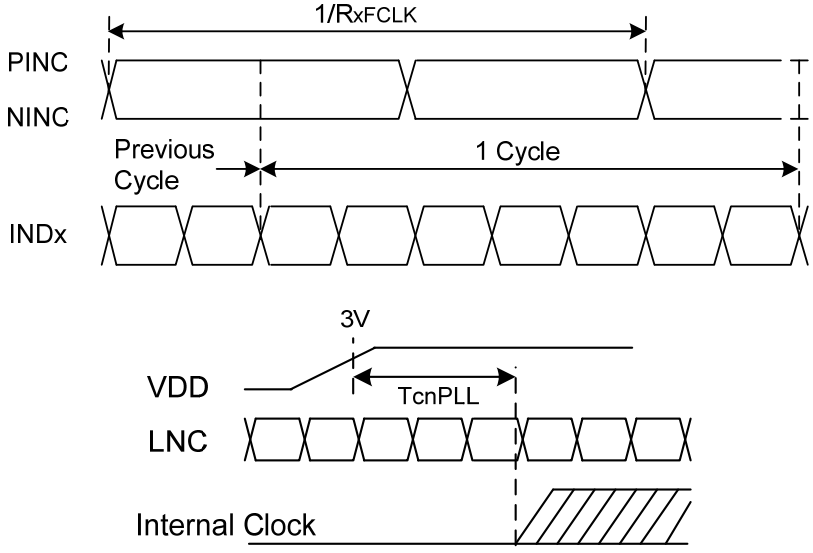
9.5 LVDS RECEIVER TIMIG



T_{RSKM}: Receiver strobe margin
R_{spos}: Receiver strobe position
T_{sw}: Strobe width (Internal data sampling window)

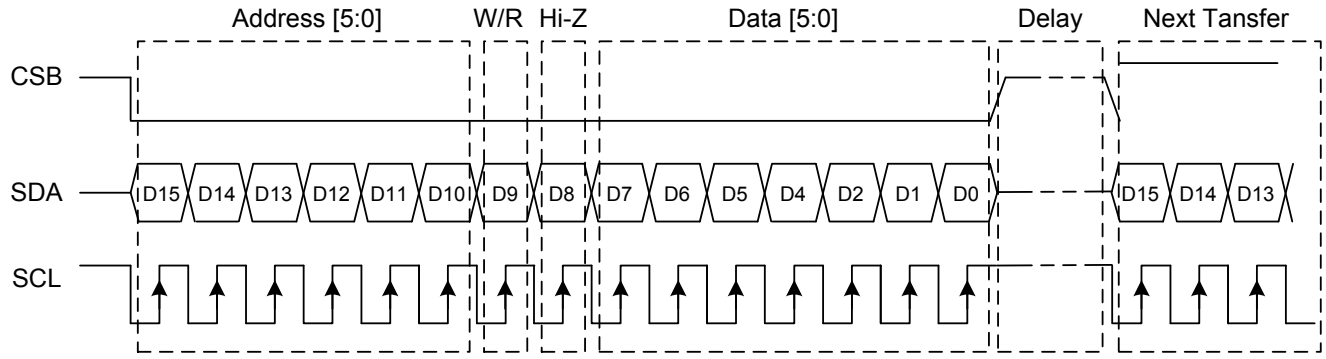
VDD = 3.3V , GND = 0V

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Clock frequency	R_{XFCLK}	40.8	51.2	67.2	MHZ	
Input data skew margin	T_{RSKM}	500			pS	$\lvert V_{ID} \rvert$=400mV R_{xVCM}=1.2V R_{XFCLK}=71MHz
Clock high time	T_{LVCH}		4/(7*RxFCLK)		ns	
Clock low time	$T_{LVC}L$		3/(7*RxFCLK)		ns	
PLL wake-up time	T_{enPLL}			150	us	



9.6 INTERFACE MODE SETTING

9.6.1 Serial Commomd Format



3-Wire Command Format:

Bit	Description
D15-D10	Register Address [5:0]
D9	W/R control bit. “0” for Write; “1” for Read
D8	Hi-Z bit during read mode. Any data within this bits will be ignored during write mode
D7-D0	Data for the W/R operation to the address indicated by Address phase

3-Wire Writer Format:

MSB															LSB
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Register Address [5:0]						0	X	DATA (Issue by external controller)							

3-Wire Reed Format:

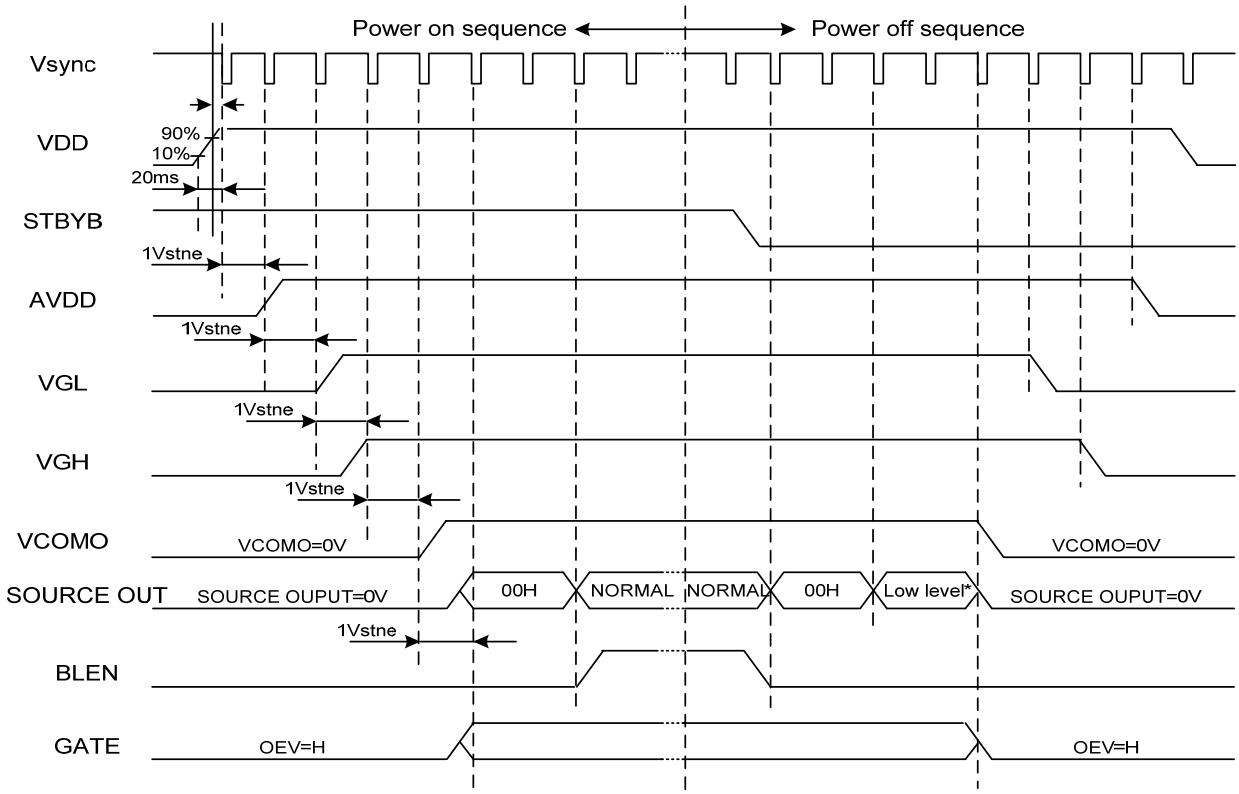
MSB															LSB
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Register Address [5:0]						1	Hi-Z	DATA (Issue by 3-Wire engine)							

9.6.2 REGISTER SETTING

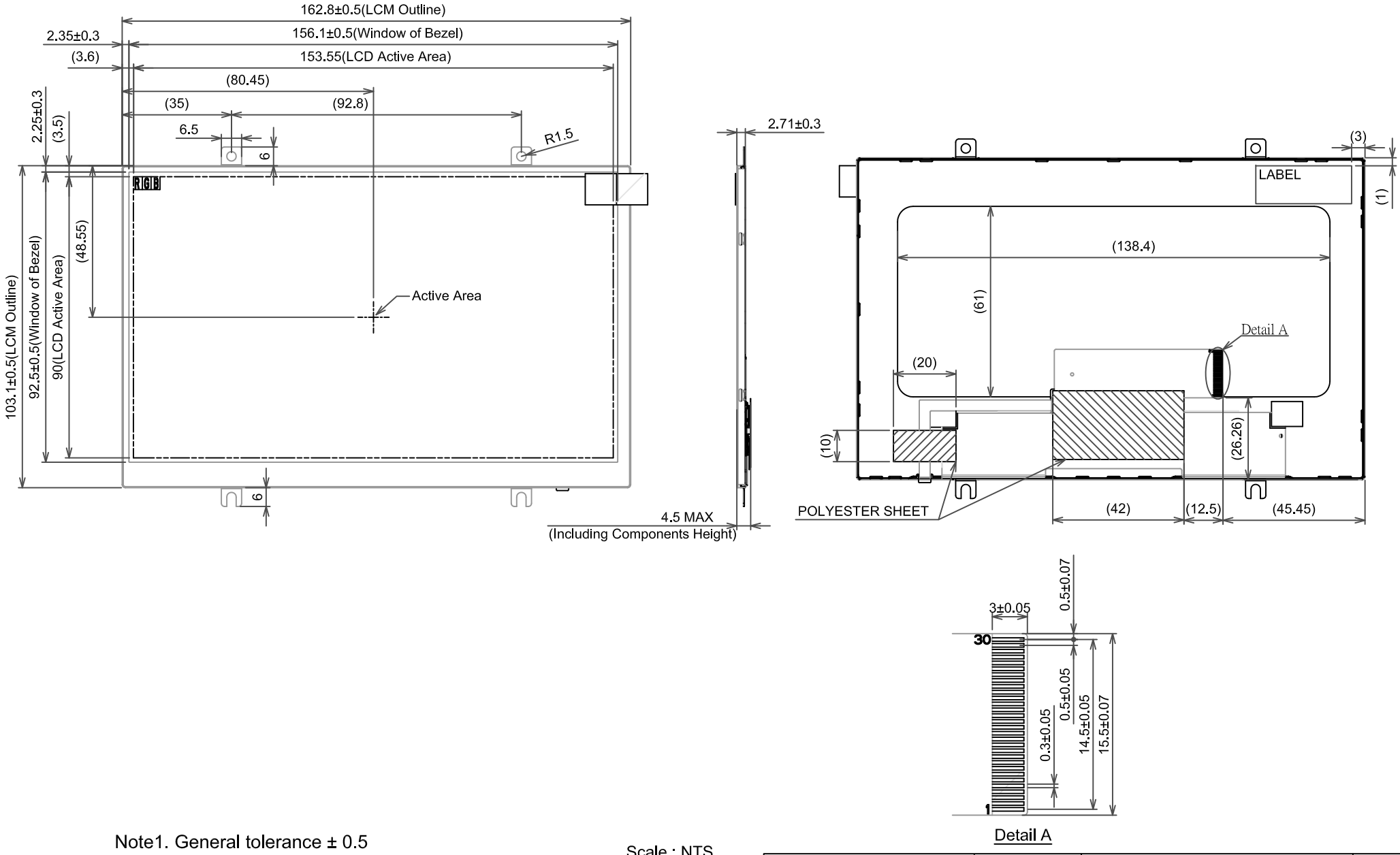
(1) Control Registers Setting

	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	
1-->A00=29’h	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	RESET
2-->A00=25’h	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	STANBY
3-->A02=40’h	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	Enable Normally Black
4-->A01=30’h	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	Enable FRC/Dither
5-->A0e=5f’h	0	0	1	1	1	0	0	0	0	1	0	1	1	1	1	1	Enter Test mode(1)
6-->A0f=a4’h	0	0	1	1	1	1	0	0	1	0	1	0	0	1	0	0	Enter Test mode(2)
7-->A0d=09’h	0	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	Enable SDRRS, enlarge OE width
8-->A10=41’h	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	Adopt 2Line /1 Dot
																	Wait 100ms
9-->A00=ad’h	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	1	DISPLAY ON

9.7 POWER SEQUENCE



10. OUTLINE DIMENSIONS



Note1. General tolerance ± 0.5

Scale : NTS
Unit : mm

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11. 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 θ shown in Fig. 11. The inspection should be performed within 45° when display is shut down. The inspection should be performed within 5° when display is power on.

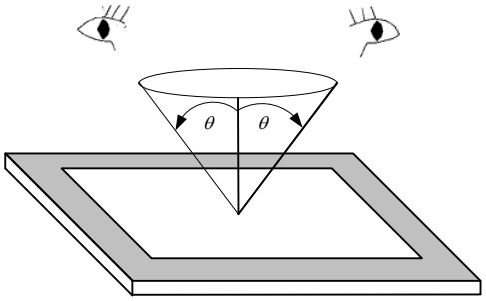


Fig. 11.1

11.1 THE DEFINITION OF LCD ZONE

LCD panel is divided into 3 areas as shown in Fig.11.2 for appearance specification in next section. A zone is the LCD active area (dot area); B zone is the area, which extended 1 mm out from LCD active area; C zone is the area between B zone and metal frame.

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

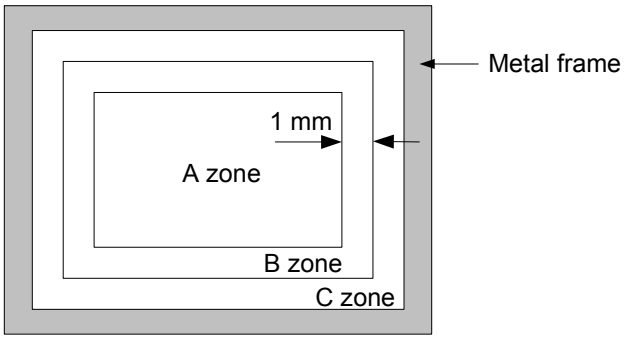


Fig. 11.2

11.2 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. 11.3 and Fig. 11.4.

Item	Criteria				Applied zone
Scratches	Length (mm)	Width (mm)	Maximum number	Minimum space	A, B
	Ignored	W≦0.02	Ignored	-	
	L≦40	0.02＜W≦0.04	10	-	
	L≦20	W≦0.04	10	-	
Dent	Distinguished one is acceptable (To be judged by HITACHI standard)				A
Wrinkles in polarizer	Same as above				A
Bubbles on polarizer	Average diameter (mm)		Maximum number		A
	D≦0.2		Ignored		
	0.2＜D≦0.3		12		
	0.3＜D≦0.5		3		
	0.5＜D		None		
1) Stains 2) Foreign Materials 3) Dark Spot	Filamentous (Line shape)				A, B
	Length (mm)	Width (mm)	Maximum number		
	L≦2.0	W≦0.03	Ignored		
	L≦3.0	0.03＜W≦0.05	6		
	L≦2.5	0.05＜W≦0.1	1		
	Round (Dot shape)				A, B
	Average diameter (mm)	Maximum number	Minimum Space		
	D≦0.2	Ignored	-		
	0.2≦D＜0.3	10	10 mm		
	0.3≦D＜0.4	5	30 mm		
	0.4≦D	None	-		
	In total	Filamentous + Round=10			
	Those wiped out easily are acceptable				
Color Tone	To be judged by HITACHI STANDARD				A
Color Uniformity	Sane as above				A
Dot-Defect (Note 1)		Type	Maximum number		A
	Bright dot-defect	1 dot	4		
		2 dot	1		
		In total	5		
	Dark dot-defect	1 dot	5		
		2 dot	2		
		In total	5		
	In total		10		

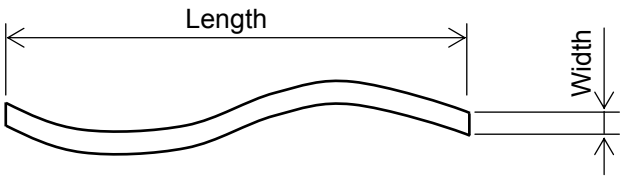
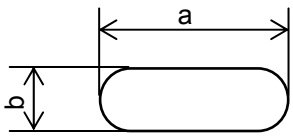


Fig 11.3



Average diameter = $\frac{a+b}{2}$

Fig 11.4

Note 1: The definitions of dot defect are as below:

- The defect area of the dot must be bigger than half of a dot.
- For bright dot-defect, showing black pattern, the dot's brightness must be over 30% brighter than others.
- For dark dot-defect, showing white pattern, the dot's brightness must be under 70% darker than others.
- The definition of 1-dot-defect is the defect-dot, which is isolated and no adjacent defect-dot.
- The definition of adjacent dot is shown as Fig. 11.5.
- The Density of dot defect is defined in the area within diameter ϕ =20mm.

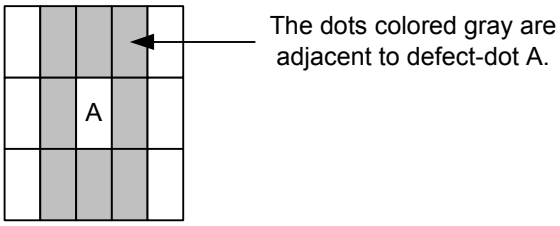


Fig. 11.5

12. PRECAUTIONS

12.1 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 $1\ \mathrm{cm}^2$, the maximum pressure must be less than 1.96N.

12.3 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 $25\,C^\circ$. 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 mV.

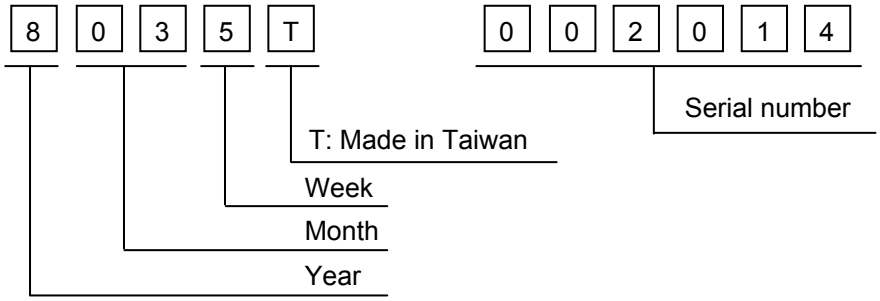
12.4 PRECAUTIONS of STORAGE

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℃~35℃ 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 Hitachi, and do not unpack it.
4) Please do not stick any labels on the display surface for a long time, especially on the polarizer.

13. DESIGNATION of LOT MARK

1) The lot mark is showing in Fig.13.3. 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
2011	1
2012	2
2013	3
2014	4
2015	5

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.

4) The location of the lot mark is on the back of the display shown in Fig. 13.3.

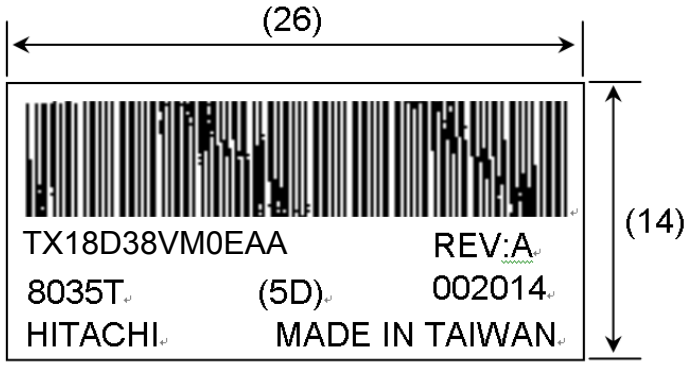


Fig 13.3