Thank You!

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No.120, DingCheng 3rd Street., XinDian Dist.,
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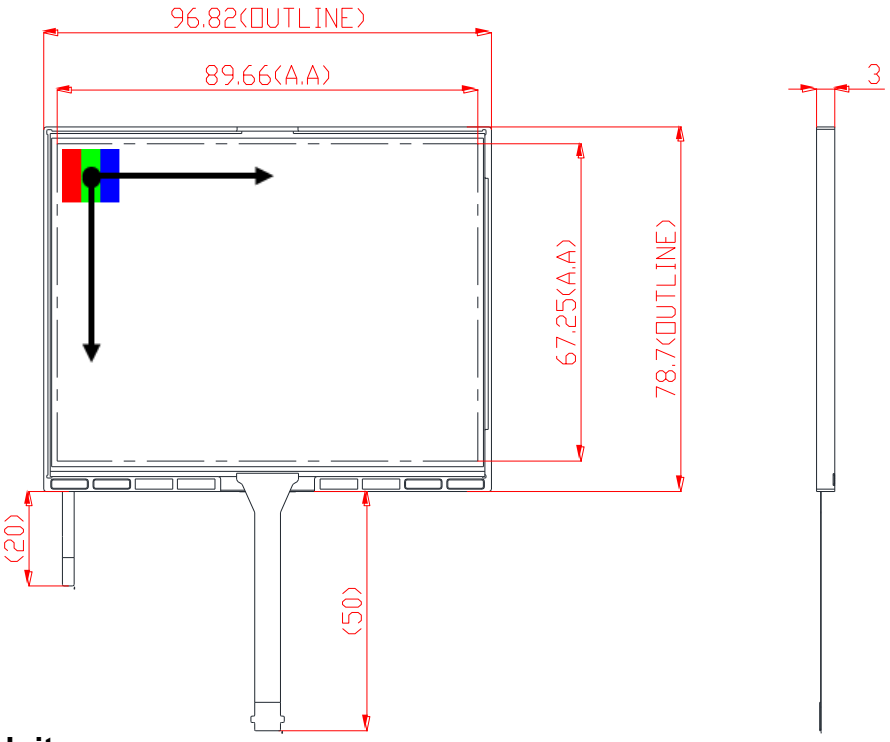
4.4” MIP Reflective Color LTPS TFT LCD with Back Light TX11D200VM1AAA

➢ Features:

- Ultra low power consumption
- 8 colors, SPI I/F
- Super high reflectance 18%
- Slim & compact design



Unit: mm

MP now

		Spec
General	LCD type	ECB, Full Reflective
	Diagonal size	4.4”
	Resolution	640RGBx480
	Active area	89.664mm(H) x 67.248mm(V)
	Pixel Pitch	46.7um(H)(Ave.) x 140.1um(V)
	PPI	181.3
Electrical	Interface (Note-1)	SPI **Max refresh frequency (2) Hz**
	Power Supply	VLCD=3V
	Power Consumption (except B/L) (Note-2)	Typ. 14μW @ MIP Static Image Typ. 123μW @MIP 1fps Image Typ. (250μW) @MIP 2fps Image Refresh
Optical @Reflective mode	Color gamut	Typ. 23% (NTSC ratio)
	Contrast ratio	Typ.40:1
	Number of colors	8 (1bit)
	Reflectance	18%
Mechanical	Glass size	92.664mm(H) x 72.748mm(V) x 1.0mm(T)
	Module structure	LCD panel + FPC + BL
	Module dimensions	96.82mm(H) x 78.7mm(V) x 3mm(D)
Feature	Feature	Memory In Pixel
Top/Tst		-20~70/-30~80

Note-1: Room Temperature, 3V drive
Note-2: Room Temperature, White Image

Reflective

Color reflective LCD

4.4-inch - TX11D200VM1AAA

This LCD modules are suitable for a wide variety of IoT products and application, including outdoor sports gears, medical & healthcare devices, remote controllers, and portable devices due to key features.

Ultra-Low Power Consumption

Long battery life with JDI's original technology.

User-friendly I/F

SPI/ 3V Drive

Good Outdoor Visibility

Good visibility realized by proprietary reflective color technology.

High Display Quality

Excellent image quality with high color reflectance

Features	1.28"	2.7"	4.4"
LCD type	ECB, Reflective	ECB, Reflective	ECB, Reflective
Resolution	176x176	400x240	640x480
Interface	SPI	←	←
Contrast	Typ. 30:1	Typ.(40:1)	←
No. of colors	8 colors	←	←
Color gamut (NTSC ratio)	23%	←	←
Reflectance	26%	19%	18%
Viewing angle (L/R/T/B, CR>2)	(60)/(65)/(65)/(60)	(70)/(70)/(70)/(70)	(70)/(70)/(70)/(70)
Backlight	Optional	Yes	Yes

Software Development Kit

Open source software is available at Mbed OS site (https://os.mbed.com/teams/JapanDisplayInc/)

KOE

JDI Group

Kaohsiung Opto-Electronics Inc.

FOR MESSRS : _____ DATE : Jun. 21st,2018

CUSTOMER'S ACCEPTANCE SPECIFICATIONS

TX11D200VM1AAA

Contents

ACCEPTED BY:_____ PROPOSED BY: Oblack Tsai

2. RECORD OF REVISION

DATE	SHEET No.	SUMMARY
Jun.21,'18	7B64PS-2703-TX11D200VM1AAA-2 Page 3-1/1	3.1 DISPLAY FEATURES Revised : Power Consumption : 0.153 W for LCD → 0.0054 W for LCD

3. GENERAL DATA

3.1 DISPLAY FEATURES

This module is a 4.4” VGA of 4:3 format of LTPS(Lower temperature Poly-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 , and LED backlight are applied on this display.

Part Name	TX11D200VM1AAA
Module Dimensions	96.82(W) mm x 78.7(H) mm x 3.0(D) mm
LCD Active Area	89.664(W) mm x 67.248(H) mm
Pixel Pitch	0.140(W) mm x 0.140(H) mm
Resolution	640 x 3(RGB)(W) x 480(H) Dots
Color Pixel Arrangement	R, G, B Vertical stripe
LCD Type	Reflective color TFT; Normal Black
Display Type	Active Matrix
Number of Colors	8 Colors
Backlight	Light Emitting Diode (LED)
Weight	30g
Interface	SPI ; 10 pins
Power Supply Voltage	3.3V for LCD; 3.3V for Backlight
Power Consumption	0.0054 W for LCD ;0.396W for backlight
Feature	MIP(Memory in pixel) Reflective type LCD
Polarizer	Hard Coat type (*Pencil Hardness : 2H)

4. ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit	Remarks
Supply Voltage for Analog	V_{DDA}	-0.3	3.6	V	-
Supply Voltage for Logic	V_{DD}	-0.3	3.6	V	-
Input Voltage of Logic	V_I	V_{SS}-0.3	3.6	V	-
Operating Temperature	T_{op}	-20	70	˚C	Note 1
Storage Temperature	T_{st}	-30	80	˚C	Note 1
Backlight Input Voltage	V_{BL+}	0	4	V	-
LED forward current	I_F	-	30	mA	Note 2
LED Pulse Forward current	I_{FP}	-	100	mA	Note 3

Note 1: 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:

- Optical performances and response time would be different in temperatures other than 25˚C.
- Operating under high temperature will shorten LED lifetime.

Note 2: Fig 4.1 shows the maximum rating of forward current based on different temperature.

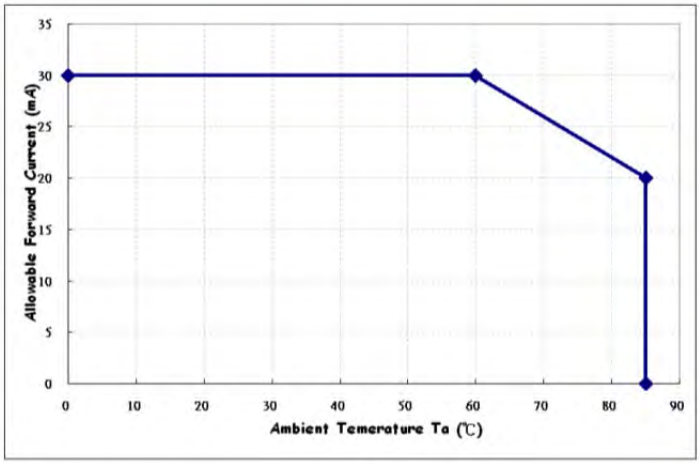


Fig 4.1

Note 3: Fig 4.2 shows the LED characteristics of the relationship I_{FP} v.s duty ratio.

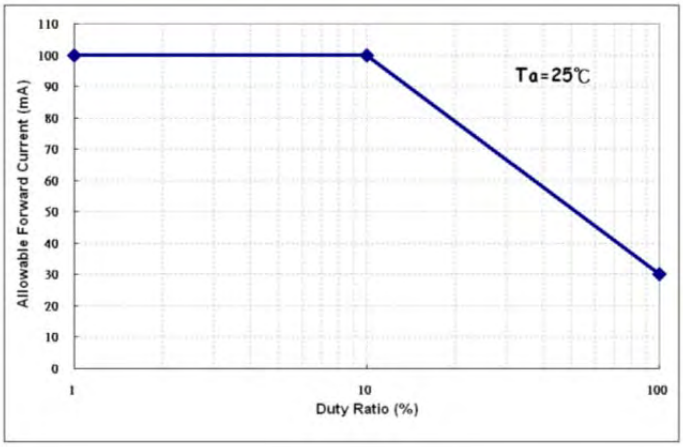


Fig 4.2

- I_{FP} condition : Pulse width ≦ 10ms, Duty≦1/10

5. ELECTRICAL CHARACTERISTICS

5.1 LCD CHARACTERISTICS

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

Item		Symbol	Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	Analog	V_{DDA}	2.7	3.0	3.6	V	-
		V_{SSA}	-	0	-		-
	Logic	V_{DD}	2.7	3.0	3.6		Note 1
		V_{SS}	-	0	-		Note 2
Input Signal Voltage	Hi	V_{IH}	V_{DD}-0.1	V_{DD}	V_{DD}		Note 3
	Low	V_{IL}	V_{SS}	V_{SS}	V_{SS}+0.1		
Power Supply Current	-	IDD	-	1.8	2.5	mA	Note 4

Note 1: Apply to EXTMODE = ”H”.

Note 2: Apply to EXTMODE = “L”.

Note 3: Apply to SCLK, SI, SCS, DISP, EXTCOMIN.

Note 4: Data update frequency=1Hz, fCOM frequency=60Hz, test pattern by “All White”.

5.2 BACKLIGHT CHARACTERISTICS

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

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
LED Input Voltage	V_{LED}	-	3.0	3.3	3.6	V	Note1
LED Forward Current	I_{LED}	-	-	120	-	mA	Note2
LED lifetime	-	I_{LED}=120 mA	-	50K	-	hrs	-

Note 1: As Fig. 5.1 shown the LED backlight circuit, V_{LED} and I_{LED} is many to one relationship, the above V_{LED} range is defined to obtain 120 mA.

Note 2: Estimated lifetime is specified as the time to reduce 50% brightness by applying 120 mA.

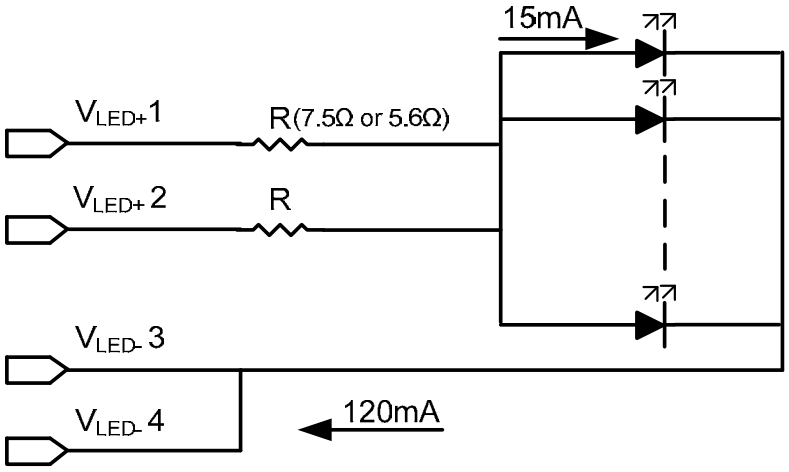


Fig 5.1

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 20 minutes.
- The ambient temperature is $25 \pm 5^{\circ}C$.
- In the dark room less than 100lx, the equipment has been set for the measurements as shown in Fig 6.1 and Fig 6.3.

For reflection mode

$T_a = 25^{\circ}C, V_{DD} = 3.0V$

Item	Symbol	Temp.(°C)	Rating			Unit	Remark
			Min.	Typ.	Max.		
Contrast	CR	25	20	40	-	-	Note 1
Response	tr	25	-	4	8	ms	Note 2
	tf		-	6	12		
Color Coordinates	Rx	25	-	0.51	-	-	Note 3
	Ry		-	0.32	-		
	Gx		-	0.30	-		
	Gy		-	0.45	-		
	Bx		-	0.16	-		
	By		-	0.18	-		
	Wx		-	0.30	-		
	Wy		-	0.33	-		
NTSC ratio	-	25	-	23	-	%	Note 4
Reflectance	-	25	10	18	-	%	-
Viewing Angle (CR>2)	θL	25	55	70	-	°	Note 5
	θR		55	70	-		
	θT		55	70	-		
	θB		55	70	-		

For transmission mode

$T_a = 25^{\circ}C, V_{DD} = 3.0V$

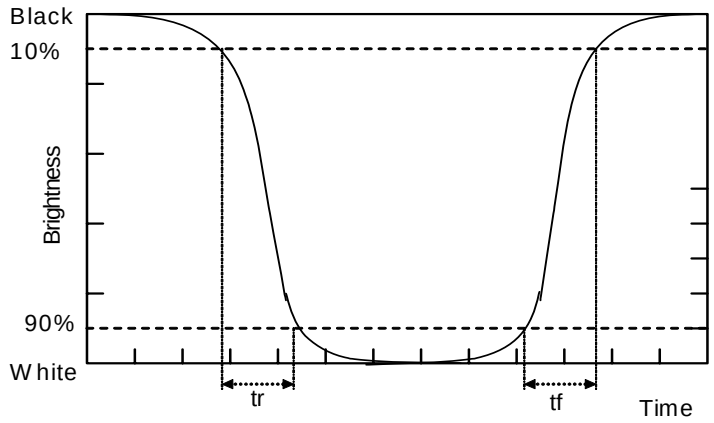
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Brightness of White	B	I_{BL}=120mA	8	10	-	cd/m^2	Note 7
Brightness Uniformity	-	-	70	-	-	%	Note 8

Note 1: This is a ratio between the screen surface reflectance of the white raster and the black raster

$$CR = \frac{\text{Reflection intensity on all pixels White}}{\text{Reflection intensity on all pixels Black}}$$

Note 2: The response time is defined as the following figure and shall be measured by matching the input signal for “Black” and “White”.

・Normally Black mode



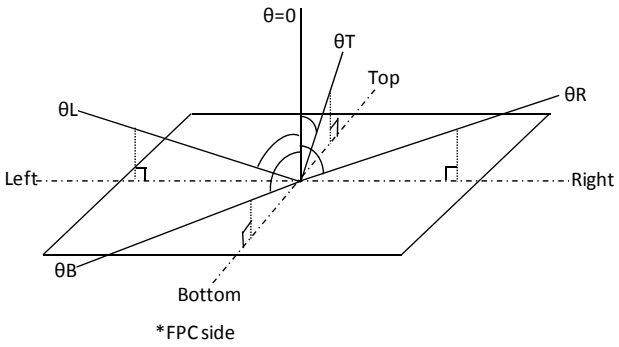
tr : Response time from Black to White

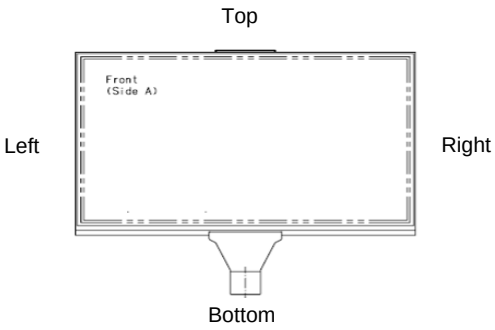
tf : Response time from White to Black

Note 3: This is the x-y coordinate of Red, Green, Blue and White colors specified on the CIE1931 chromaticity diagram. (* It is not a guaranteed value)

Note 4: This is an area of a triangle shaped by R, G and B coordinates on the CIE1931 chromaticity diagram.

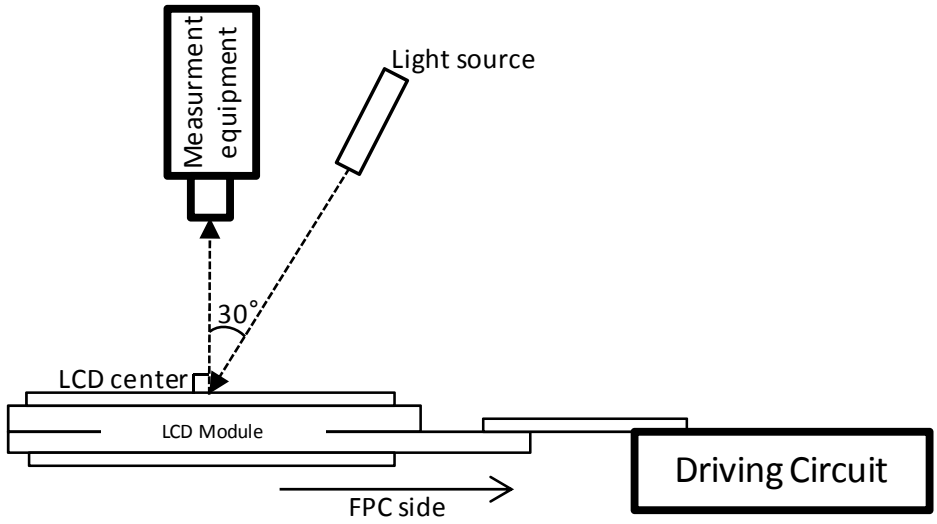
Note 5: This is a maximum angle θ from the normal direction that keeps having the contrast more than 2.





Note 6: Measurement system-for reflective mode

- Light source: Parallel light source
- D65 / 2 degree viewing angle
- Light source input direction : from opposite side of FPC side (30°)
- Light source receive direction : at LCD center (0°)



Note 7: The brightness and reflective ratio is measured from the panel center point, P5 in Fig. 6.2, for the typical value.

Note 8: The brightness uniformity is calculated by the equation as below:

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

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

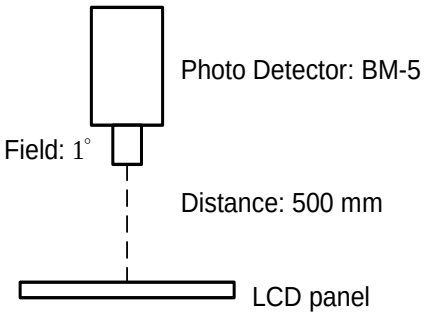


Fig 6.1

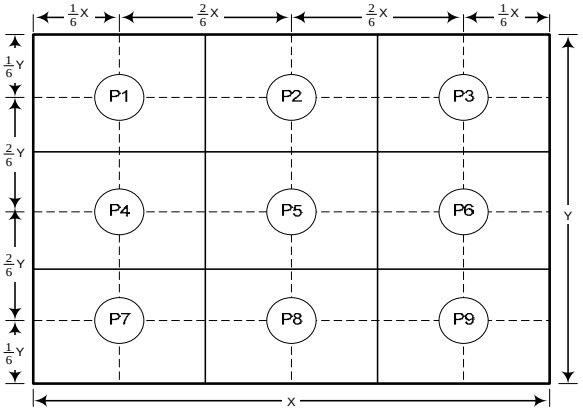
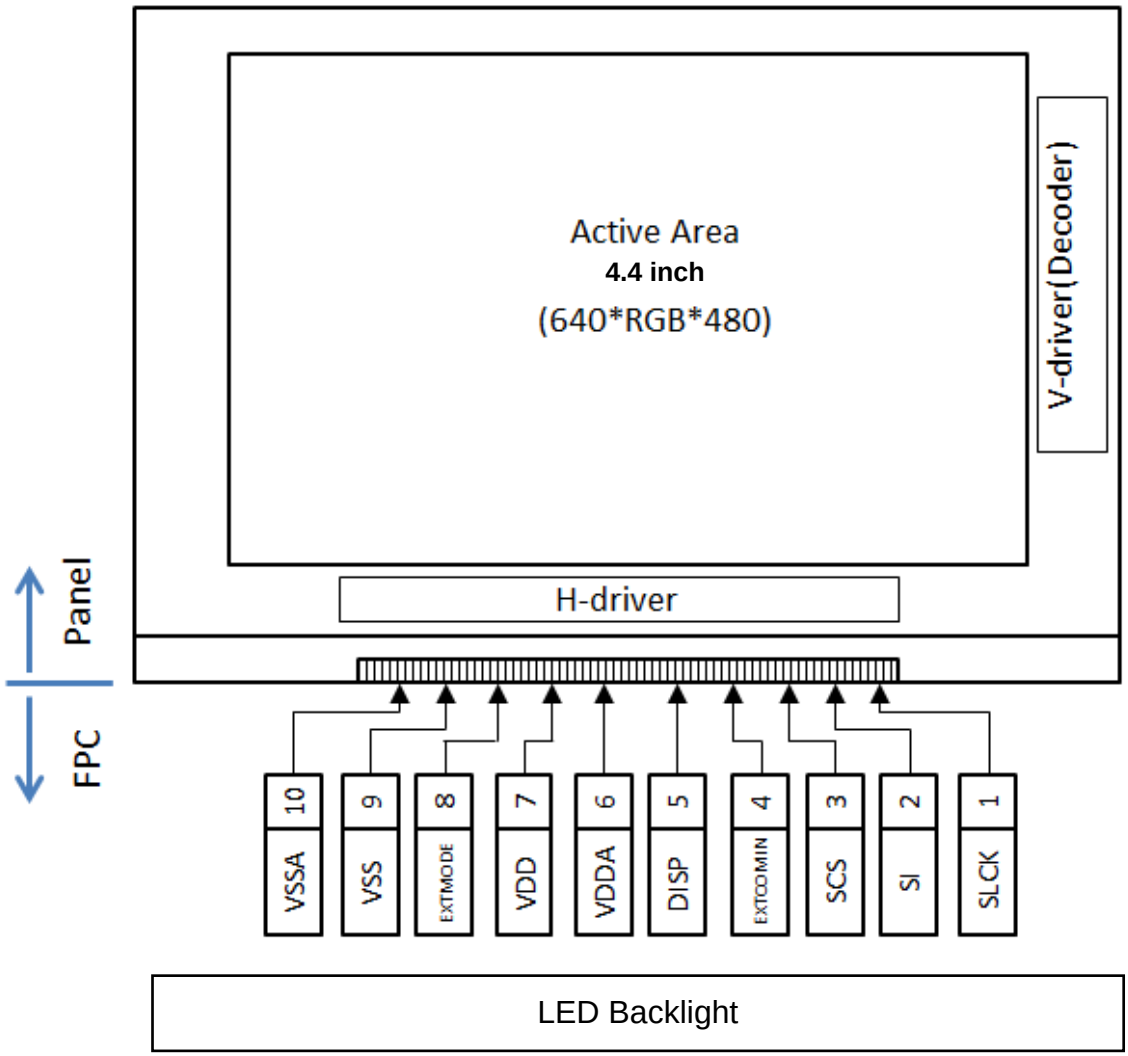


Fig 6.2

7. BLOCK DIAGRAM



Note 1: Signals are SCLK, SI, SCS, EXTCOMIN, DISP and EXTMODE.

8. RELIABILITY TESTS

Test Item	Condition	
High Temperature	1) Operating 2) 70℃	240 hrs
Low Temperature	1) Operating 2) -20℃	240hrs
High Temperature	1) Storage 2) 80℃	240 hrs
Low Temperature	1) Storage 2) -30℃	240 hrs
Thermal Shock	1) Non-Operating 2) -35℃ ↔ 85℃ 3) 0.5 hr ↔ 0.5 hr	240 hrs
High Temperature & Humidity	1) Operating 2) 40℃ & 85%RH 3) Without condensation	240 hrs (Note 3)
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: 150 pF, 330Ω 3) Contact discharge for glass: ± 1KV 4) R=1.5kΩ , C=100pF	1) Glass: 9 points (Note 4)

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

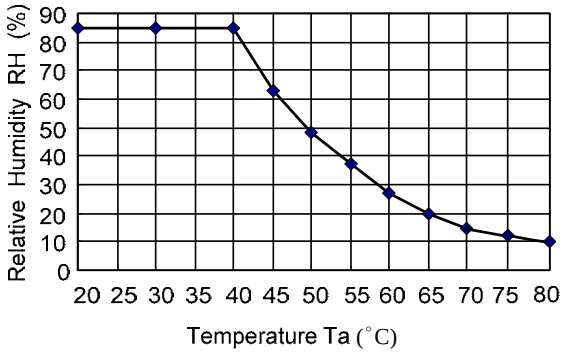


Fig. 8.1

Note 4: All pins of LCD interface (CN1) have been tested by ± 100V contact discharge of ESD under non-operating condition.

9. LCD INTERFACE

9.1 INTERFACE PIN CONNECTIONS

CN1 pin assignment of LCD interface is as below:

Pin No.	Symbol	Function	Remark
1	SCLK	Serial Clock Signal	
2	SI	Serial Data Input Signal	
3	SCS	Chip Select Signal	
4	EXTCOMIN	COM Inversion Signal Input	
5	DISP	Display ON/OFF Switching Signal	Note 1
6	V_{DDA}	Power Supply for Analog	
7	V_{DD}	Power Supply for Logic	
8	EXTMODE	COM Inversion Mode Select Terminal	Note 2
9	V_{SS}	Logic Ground	
10	V_{SSA}	Analog Ground	

Note 1: ON/OFF signal is only for display. Data memory is kept also at the time of on/off.

"H" : Data memory will be displayed.

"L" : Solid black color will be displayed and data memory will be saved.

Note 2: "H": Enable EXTCOMIN signal, connect to V_{DD}.

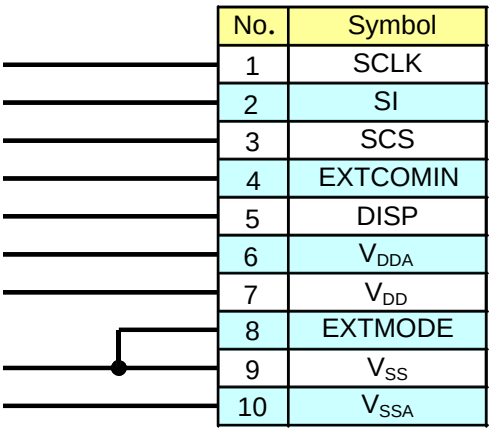
"L": Enable serial input flag, connect to V_{SS}.

CN2 pin assignment of Backlight is as below:

Pin No.	Signal	Level	Function
1	V_{LED}+	-	Power Supply for LED
2	V_{LED}+	-	Power Supply for LED
3	V_{LED}-	-	GND
4	V_{LED}-	-	GND

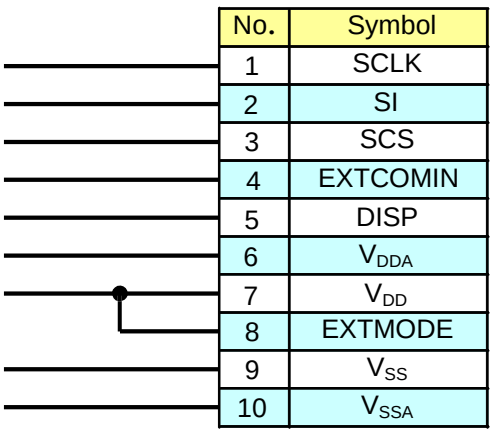
9.2 RECOMMENDED CIRCUIT

EXTMODE=L : COM Signal Serial Input



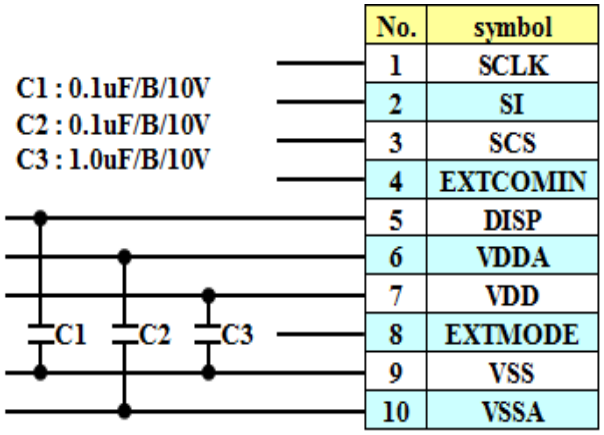
No.	Symbol
1	SCLK
2	SI
3	SCS
4	EXTCOMIN
5	DISP
6	V_{DDA}
7	V_{DD}
8	EXTMODE
9	V_{SS}
10	V_{SSA}

EXTMODE=H : COM Signal External Input



No.	Symbol
1	SCLK
2	SI
3	SCS
4	EXTCOMIN
5	DISP
6	V_{DDA}
7	V_{DD}
8	EXTMODE
9	V_{SS}
10	V_{SSA}

External circuit example



No.	symbol
1	SCLK
2	SI
3	SCS
4	EXTCOMIN
5	DISP
6	VDDA
7	VDD
8	EXTMODE
9	VSS
10	VSSA

9.3 INPUT SIGNAL CHARACTERISTICS

Ta=25ºC, Driving Condition : VDD=3.0V,VDDA=3.0V,VIH=3.0V,VIL=0V

PARAMETER	SYMBOL	Min.	Typ.	Max.	UNIT	REMARKS
Clock frequency	fSCLK	-	1.00	2.00	MHz	Note1
COM frequency	fCOM	50	60	-	Hz	Note2
SCS rising time	trSCS	-	-	50	ns	
SCS falling time	tfSCS	-	-	50	ns	
SCS Low width	twSCSL	6.0	-	-	us	
SCS settling time	tsSCS	6.0	-	-	us	
SCS holding time	thSCS	2.0	-	-	us	Note3
SI rising time	trSI	-	-	50	ns	
SI falling time	tfSI	-	-	50	ns	
SI settling time	tsSI	200	450	-	ns	
SI holding time	thSI	250	500	-	ns	
SCLK rising time	trSCLK	-	-	50	ns	
SCLK falling time	tfSCLK	-	-	50	ns	
SCLK High width	twSCLKH	250	500	-	ns	Note4
SCLK Low width	twSCLKL	250	500	-	ns	Note4
EXTCOMIN frequency	fXTCOMIN	1	-	140	Hz	
EXTCOMIN rising time	trEXTCOMIN	-	-	50	ns	
EXTCOMIN falling time	tfEXTCOMIN	-	-	50	ns	
EXTCOMIN High width	twEXTCOMIN	2.0	-	-	us	
DISP rising time	trDISP	-	-	50	ns	
DISP falling time	tfDISP	-	-	50	ns	

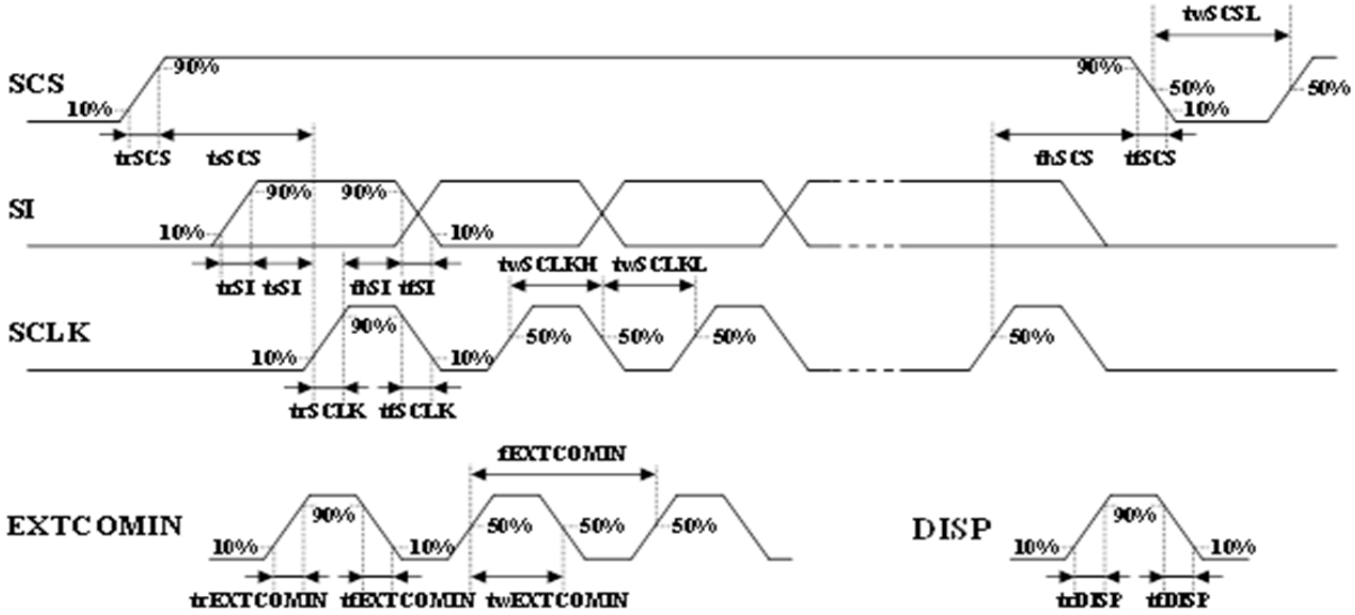
Note 1: Please note that Max. fSCLK may be lowered when VDD and VDDA fall than 3.0V at a low temperature.

Note 2: COM frequency should be around 60Hz for transmissive mode.

ex: For Data update mode M2 level must be reversed per 8 gate lines based on fSCLK =1MHz.

Note 3: In the case of data update mode in transmissive mode, thSCS should be 50us or less.

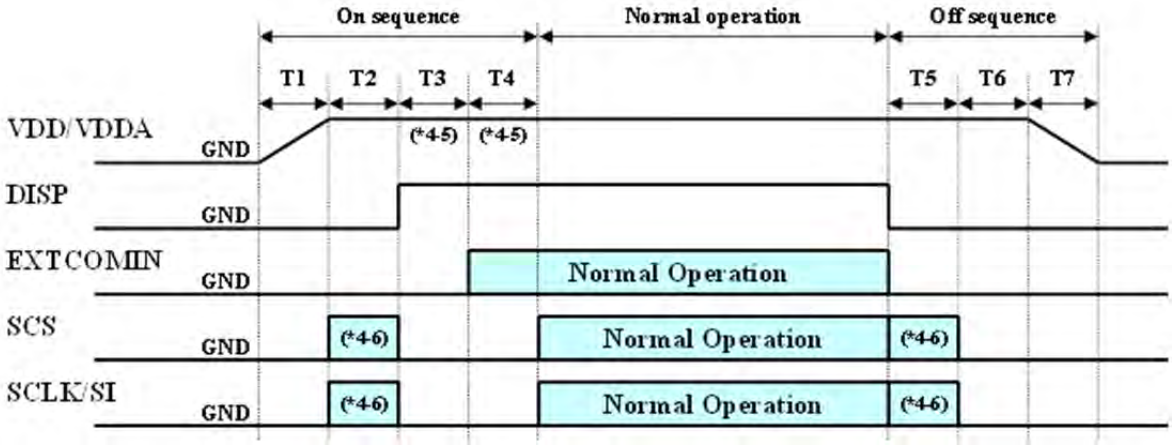
Note 4: twSCLKH and twSCLKL should be approximately the same length, if possible.


SCS
SI
SCLK
twSCSL
90%
10%
50%
trSCS
tsSCS
thSCS
tfSCS
trSI
tsSI
thSI
tfSI
twSCLKH
twSCLKL
trSCLK
tfSCLK

EXTCOMIN
fEXTCOMIN
90%
10%
50%
trEXTCOMIN
tfEXTCOMIN
twEXTCOMIN

DISP
90%
10%
trDISP
tfDISP

9.4 POWER ON/OFF SEQUENCE



[On sequence]
T1 : Power supply rising time. (Depends on external power supply)
T2 : Pixel memory initialization 1ms or more initialize with M2 (all clear flag)
T3 : Release time for internal latch circuits. 30us or more
T4 : COM polarity initialization time. 30us or more

[Normal operation]
Duration of normal operation

[Off sequence]
T5 : Pixel memory initialization. Same as T2.
T6 : COM and latch circuits initialization. 30us or more
T7 : Power supply falling time. (Depends on external power supply)

*Refer to the timing chart and electrical characteristics for details.

Note 5: It is allowed to replace T3 and T4 mutually.
In the case of starting EXTCOMIN before rising DISP, EXTCOMIN is ignored during DISP="L".
Also, it is allowed to start simultaneously DISP and EXTCOMIN.
In that case, it is necessary to insert 100us or more (200us or less) before normal operation.
Note 6: Pixel memory initialization.
Use M2 (all clear flag : refer to 6.8),
or write black data to all pixel memories (refer to the data update mode).

[Remark]
VDD and VDDA should rise simultaneously or VDD should rise first.
VDD and VDDA should fall simultaneously or VDDA should fall first.

9.5 Mode

9.5.1 MODE TABLE

Mode select Unassigned bit and AG9-8 : No care, it can be H or L (L is Recommended)

M0	M1	M2	M3	M4	M5	AG9	AG8	AG7	AG6	AG5	AG4	AG3	AG2	AG1	AG0	Mode
L	L/H	L	L	-	-	-	-	-	-	-	-	-	-	-	-	No-Update
L	L/H	L	H	L/H	L/H	-	-	-	-	-	-	-	-	-	-	Blinking
L	L/H	H	L/H	L/H	L/H	-	-	-	-	-	-	-	-	-	-	All Clear
H	L/H	L	L/H	L/H	-	AG9	AG8	AG7	AG6	AG5	AG4	AG3	AG2	AG1	AG0	Data-Update
H	L/H	H	L/H	L/H	L/H	-	-	-	-	-	-	-	-	-	-	No-Update
						Mode (6bit)										Gate Address (10bit)

Function table

M0=L or M0=H/M2=H

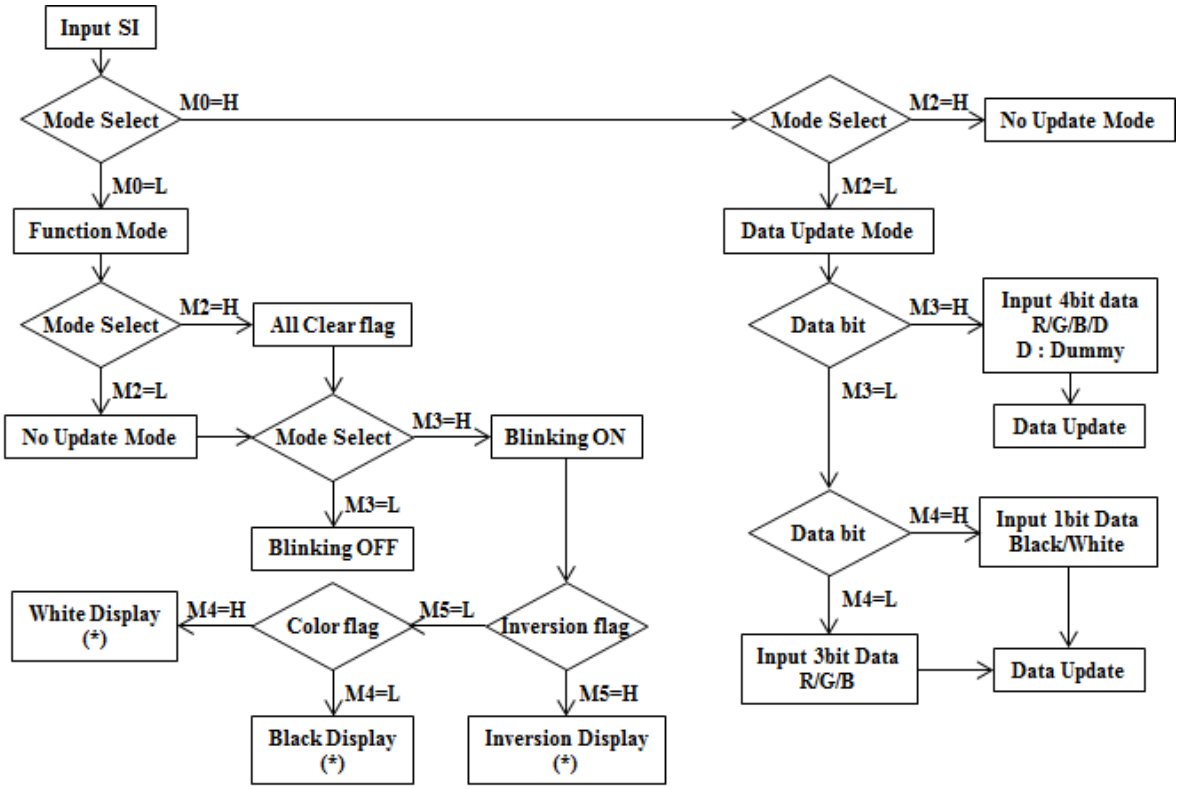
Mode	M3	M4	M5
Blinking OFF	L	-	-
Blink Black	H	L	L
Blink White	H	H	L
Blink Inversion	H	-	H

M0=H/M2=L

Mode	M3	M4	M5
3bit data input	L	L	-
1bit data input	L	H	-
4bit data input	H	-	-

Unassigned bit : No care, it can be H or L (L is Recommended)

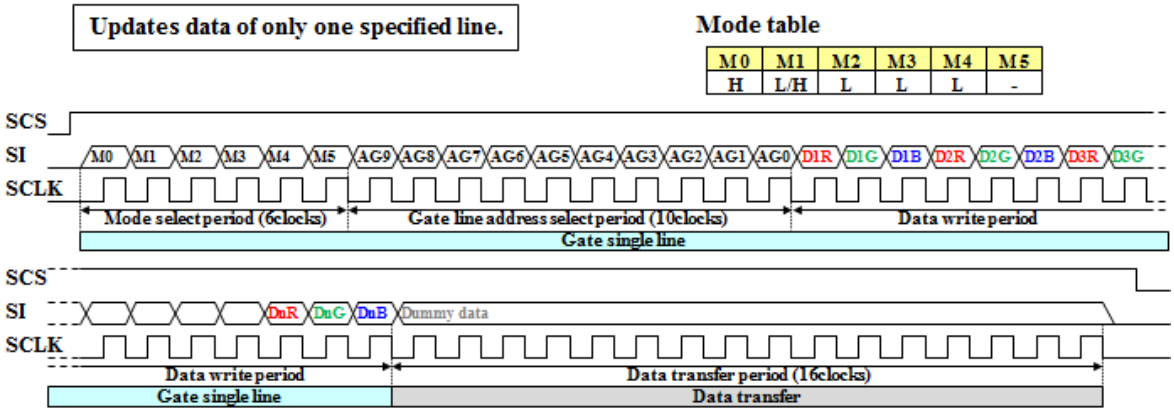
9.5.2 MODE CHART



(*) Pixel memories are kept.

9.6 Timing chart and details of mode

9.6.1 SINGLE LINE UPDATE MODE (3bit-data mode)



M0 : Mode flag. Set “H”, data update mode.
M1 : COM inversion flag. In the case of EXTMODE=“L”, it is valid.
In the case of “H”, outputs COM=“H”.
In the case of “L”, outputs COM=“L”.
In the case of EXTMODE=“H”, it is invalid, it can be “H” or “L”.
M2 : All clear flag. Set “L”, data update mode.
M3-M4 : Data-bit control flag. In the case of M3=“L” and M4=“L”, 3bit-data mode.
M5 : Invalid data, it can be “H” or “L”.

AG9-AG0 : Gate line address (10bit), refer to the Gate line address table.

Data : Pixel memory data. In the case of “L”, pixel is black.
In the case of 3bit-data mode,
input serially the pixel data in the order of Red-Green-Blue (3bit).
n : Number of horizontal line, refer to the Display address map and Pixel layout.

Dummy data : It can be “H” or “L”.

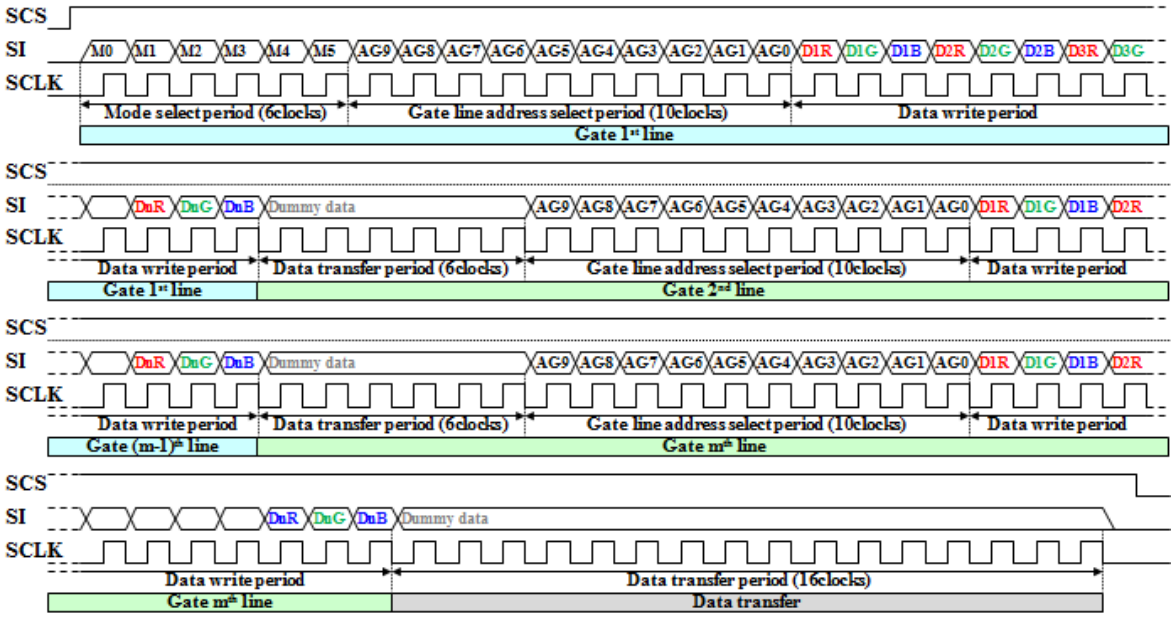
Insert transfer period which is 16clocks after the last data.
M0, M2 flags are cleared by SCS=“L”, and M3-M4 flags are cleared by DISP=“L”.

9.6.2 MULTIPLE LINES UPDATE MODE (3bit-data mode)

Updates arbitrary multiple lines data.

Mode table

M0	M1	M2	M3	M4	M5
H	L/H	L	L	L	-



M0 : Mode flag. Set “H”, data update mode.
M1 : COM inversion flag. In the case of EXTMODE=“L”, it is valid.
In the case of “H”, outputs COM=“H”.
In the case of “L”, outputs COM=“L”.
In the case of EXTMODE=“H”, it is invalid, it can be “H” or “L”.
M2 : All clear flag. Set “L”, data update mode.
M3-M4 : Data-bit control flag. In the case of M3=“L” and M4=“L”, 3bit-data mode.
M5 : Invalid data, it can be “H” or “L”.

AG9-AG0 : Gate line address (10bit), refer to the Gate line address table.

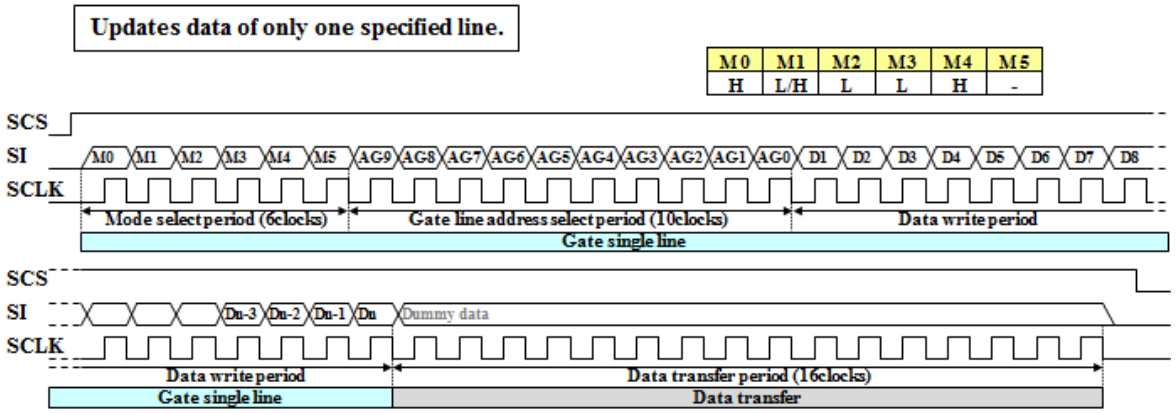
Data : Pixel memory data. In the case of “L”, pixel is black.
In the case of 3bit-data mode,
input serially the pixel data in the order of Red-Green-Blue (3bit).
n : Number of horizontal line, refer to the Display address map and Pixel layout.

Dummy data : It can be “H” or “L”.

Input data continuously.
m : Number of vertical line, refer to the Display address map and Pixel layout.

Insert transfer period which is 6clocks between the gate line and the next gate line.
Insert transfer period which is 16clocks after the last data.
M0, M2 flags are cleared by SCS=“L”, and M3-M4 flags are cleared by DISP=“L”.

9.6.3 SINGLE LINE UPDATE MODE (1bit-data mode)



M0 : Mode flag. Set “H”, data update mode.
M1 : COM inversion flag. In the case of EXTMODE=“L”, it is valid.
In the case of “H”, outputs COM=“H”.
In the case of “L”, outputs COM=“L”.
In the case of EXTMODE=“H”, it is invalid, it can be “H” or “L”.
M2 : All clear flag. Set “L”, data update mode.
M3-M4 : Data-bit control flag. In the case of M3=“L” and M4=“H”, 1bit-data mode.
M5 : Invalid data, it can be “H” or “L”.

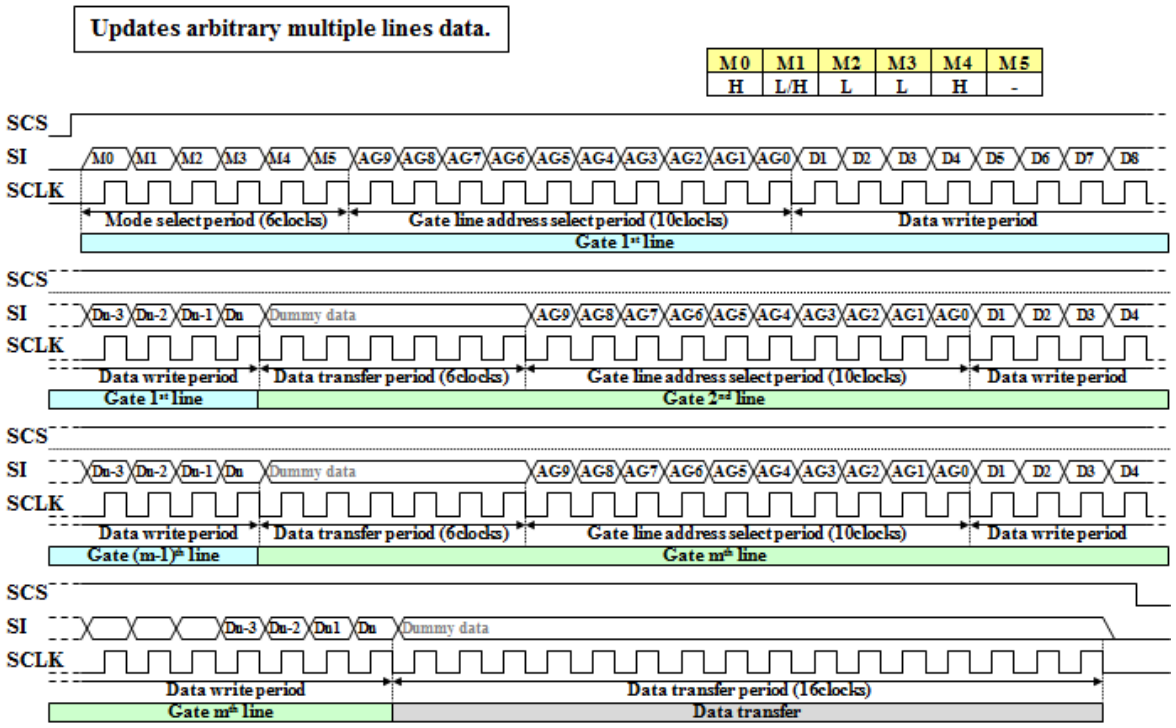
AG9-AG0 : Gate line address (10bit), refer to the Gate line address table.

Data : Pixel memory data. In the case of “L”, pixel is black.
In the case of 1bit-data mode, input the pixel data “H” or “L” (1bit).
Pixel memories of red, green and blue are written the same data.
n : Number of horizontal line, refer to the Display address map and Pixel layout.

Dummy data : It can be “H” or “L”.

Insert transfer period which is 16clocks after the last data.
M0, M2 flags are cleared by SCS=“L”, and M3-M4 flags are cleared by DISP=“L”.

9.6.4 MULTIPLE LINES UPDATE MODE (1bit-data mode)



M0 : Mode flag. Set “H”, data update mode.
M1 : COM inversion flag. In the case of EXTMODE=“L”, it is valid.
In the case of “H”, outputs COM=“H”.
In the case of “L”, outputs COM=“L”.
In the case of EXTMODE=“H”, it is invalid, it can be “H” or “L”.
M2 : All clear flag. Set “L”, data update mode.
M3-M4 : Data-bit control flag. In the case of M3=“L” and M4=“H”, 1bit-data mode.
M5 : Invalid data, it can be “H” or “L”.

AG9-AG0 : Gate line address (10bit), refer to the Gate line address table.

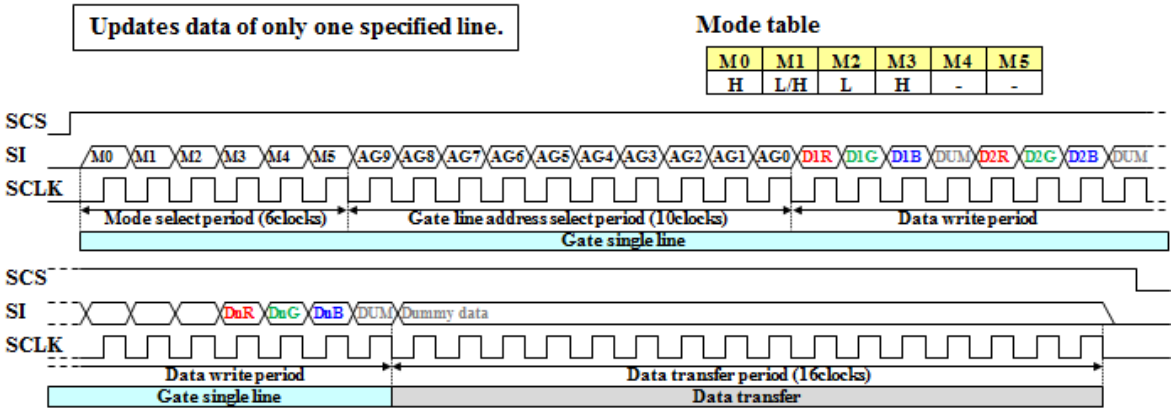
Data : Pixel memory data. In the case of “L”, pixel is black.
In the case of 1bit-data mode, input the pixel data “H” or “L” (1bit).
Pixel memories of red, green and blue are written the same data.
n : Number of horizontal line, refer to the Display address map and Pixel layout.

Dummy data : It can be “H” or “L”.

Input data continuously.
m : Number of vertical line, refer to the Display address map and Pixel layout.

Insert transfer period which is 6clocks between the gate line and the next gate line.
Insert transfer period which is 16clocks after the last data.
M0, M2 flags are cleared by SCS=“L”, and M3-M4 flags are cleared by DISP=“L”.

9.6.5 SINGLE LINE UPDATE MODE (4bit-data mode)



M0 : Mode flag. Set “H”, data update mode.
M1 : COM inversion flag. In the case of EXTMODE=“L”, it is valid.
In the case of “H”, outputs COM=“H”.
In the case of “L”, outputs COM=“L”.
In the case of EXTMODE=“H”, it is invalid, it can be “H” or “L”.
M2 : All clear flag. Set “L”, data update mode.
M3 : Data-bit control flag. In the case of M3=“H”, 4bit-data mode.
M4-M5 : Invalid data, it can be “H” or “L”.

AG9-AG0 : Gate line address (10bit), refer to the Gate line address table.

Data : Pixel memory data. In the case of “L”, pixel is black.
In the case of 4bit-data mode,
input serially the pixel data in the order of Red-Green-Blue-Dummy (4bit).

Dummy data (DUM) can be “H” or “L”.
n : Number of horizontal line, refer to the Display address map and Pixel layout.

Dummy data : It can be “H” or “L”.

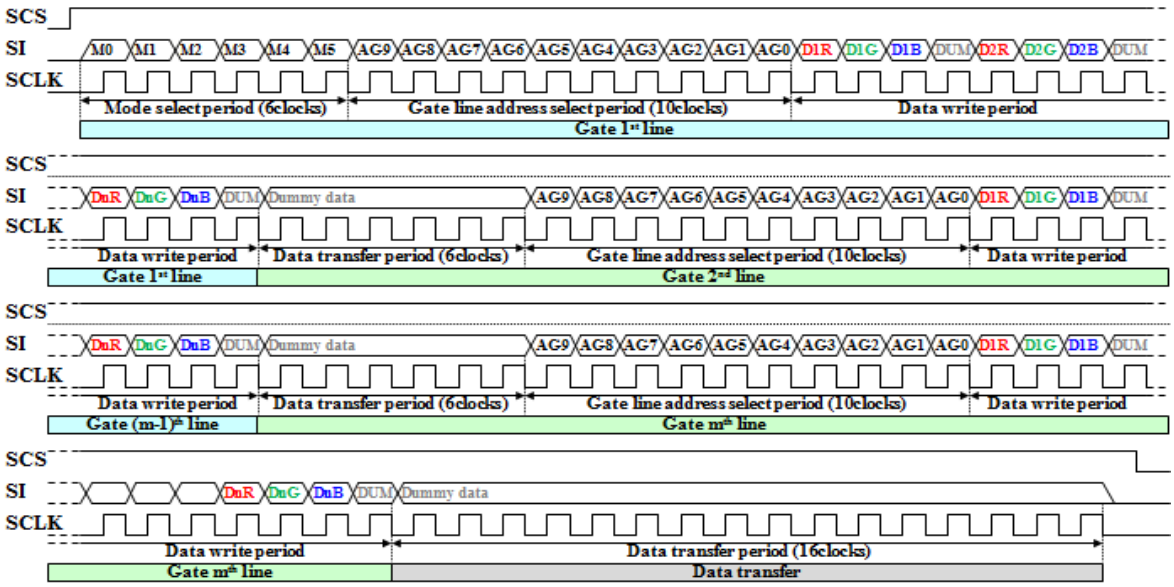
Insert transfer period which is 16clocks after the last data.
M0, M2 flags are cleared by SCS=“L”, and M3 flag is cleared by DISP=“L”.

9.7 MULTIPLE LINES UPDATE MODE (4bit-data mode)

Updates arbitrary multiple lines data.

Mode table

M0	M1	M2	M3	M4	M5
H	L/H	L	H	-	-



M0 : Mode flag. Set “H”, data update mode.
M1 : COM inversion flag. In the case of EXTMODE=“L”, it is valid.
In the case of “H”, outputs COM=“H”.
In the case of “L”, outputs COM=“L”.
In the case of EXTMODE=“H”, it is invalid, it can be “H” or “L”.
M2 : All clear flag. Set “L”, data update mode.
M3 : Data-bit control flag. In the case of M3=“H”, 4bit-data mode.
M4-M5 : Invalid data, it can be “H” or “L”.

AG9-AG0 : Gate line address (10bit), refer to the Gate line address table.

Data : Pixel memory data. In the case of “L”, pixel is black.
In the case of 4bit-data mode,
input serially the pixel data in the order of Red-Green-Blue-Dummy (4bit).
Dummy data (DUM) can be “H” or “L”.
n : Number of horizontal line, refer to the Display address map and Pixel layout.

Dummy data : It can be “H” or “L”.

Input data continuously.
m : Number of vertical line, refer to the Display address map and Pixel layout.

Insert transfer period which is 6clocks between the gate line and the next gate line.
Insert transfer period which is 16clocks after the last data.
M0, M2 flags are cleared by SCS=“L”, and M3 flag is cleared by DISP=“L”.

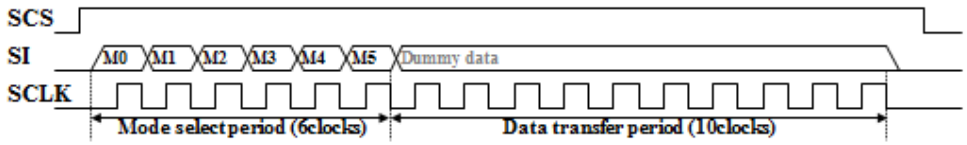
9.8 No-UPDATE MODE

Keeps memory internal data (current display).

Mode table

M0	M1	M2	M3	M4	M5
L	L/H	L	L	-	-

M0	M1	M2	M3	M4	M5
H	L/H	H	L	-	-



M0 : Mode flag.
M1 : COM inversion flag. In the case of EXTMODE="L", it is valid.
In the case of "H", outputs COM="H".
In the case of "L", outputs COM="L".
In the case of EXTMODE="H", it is invalid, it can be "H" or "L".
M2 : All clear flag.
Set "L" or "H" to both M0 and M2, no-update mode.
M3 : Blinking flag. In the case of "L", no-update mode and display blinking mode is terminated.
In the case of "H", display blinking mode. Refer to the 6.9 for details.
M4-M5 : Invalid data, it can be "H" or "L".

Dummy data : It can be "H" or "L".

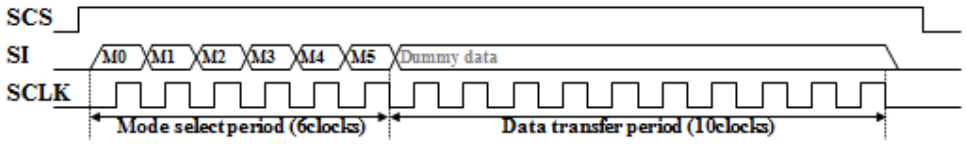
M0, M2 flags are cleared by SCS="L", and M3 flag is cleared by DISP="L".

9.9 ALL CLEAR MODE

Clears memory internal data and writes initial data.
Initial data is black.

Mode table

M0	M1	M2	M3	M4	M5
L	L/H	H	L/H	L/H	L/H



M0 : Mode flag. Set “L”, no-update mode.
M1 : COM inversion flag. In the case of EXTMODE=“L”, it is valid.
In the case of “H”, outputs COM=“H”.
In the case of “L”, outputs COM=“L”.
In the case of EXTMODE=“H”, it is invalid, it can be “H” or “L”.
M2 : All clear flag. Set “H”, all clear mode.
M3 : Blinking flag. In the case of “L”, display blinking mode is terminated.
In the case of “H”, display blinking mode. Refer to the 6.9 for details.
M4-M5 : Blinking mode flag. In the case of M3=“H”, it is valid.
In the case of M3=“L”, it is invalid, it can be “H” or “L”.

Dummy data : It can be “H” or “L”.

M0, M2 flags are cleared by SCS=“L”, and M3-M4 flags are cleared by DISP=“L”.

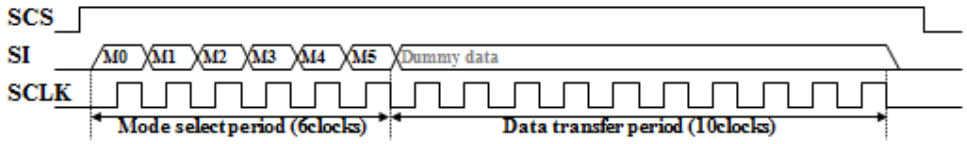
Display gives priority to blinking flag (M3).

9.10 DISPLAY BLINKING COLOR MODE

Forcibly display blinking color.
Keeps memory internal data, but ignored.

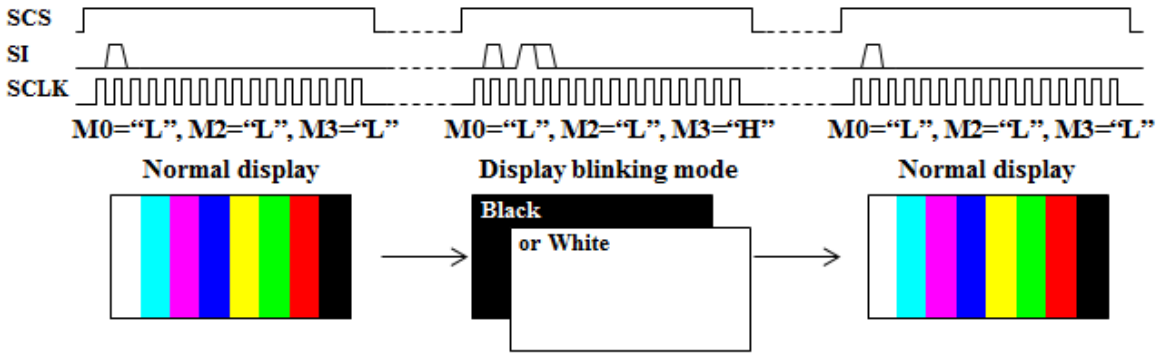
Mode table

M0	M1	M2	M3	M4	M5
L	L/H	L	H	L/H	L



M0 : Mode flag. Set “L”, no-update mode.
M1 : COM inversion flag. In the case of EXTMODE=“L”, it is valid.
In the case of “H”, outputs COM=“H”.
In the case of “L”, outputs COM=“L”.
In the case of EXTMODE=“H”, it is invalid, it can be “H” or “L”.
M2 : All clear flag. Set “L”, no-update mode.
In the case of “H”, all clear mode. Refer to the 6.8 for details.
M3 : Blinking flag. In the case of “H”, display blinking mode.
In the case of “L”, display blinking mode is terminated.
M4 : Blinking color flag. Apply to display blinking color.
In the case of “H”, solid white color is forcibly displayed.
In the case of “L”, solid black color is forcibly displayed.
M5 : Blinking inversion flag. Set “L”, blinking color mode.

Dummy data : It can be “H” or “L”.
M0, M2 flags are cleared by SCS=“L”, and M3-M5 flags are cleared by DISP=“L”.



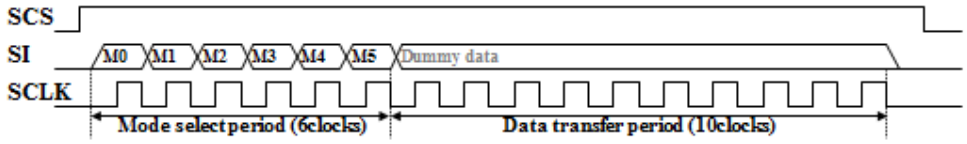
Blink display to alternate between normal display and display blinking mode.

9.11 DISPLAY COLOR INVERSION MODE

Forcibly display color inversion.
Keeps memory internal data, but ignored.

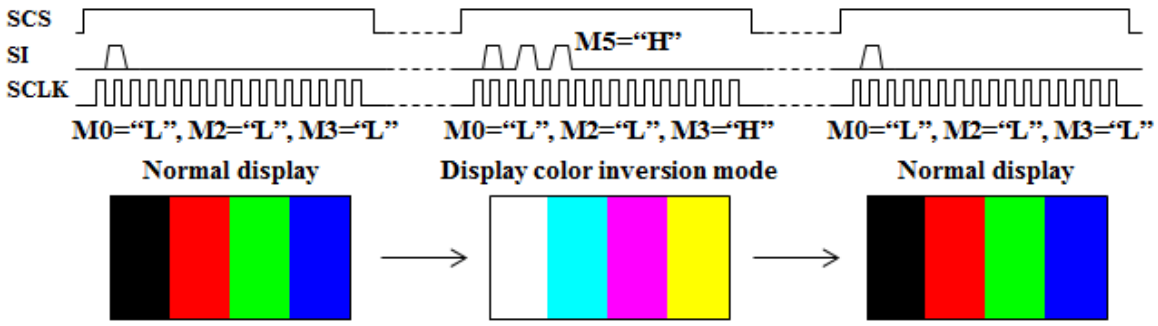
Mode table

M0	M1	M2	M3	M4	M5
L	L/H	L	H	-	H



M0 : Mode flag. Set “L”, no-update mode.
M1 : COM inversion flag. In the case of EXTMODE=“L”, it is valid.
In the case of “H”, outputs COM=“H”.
In the case of “L”, outputs COM=“L”.
In the case of EXTMODE=“H”, it is invalid, it can be “H” or “L”.
M2 : All clear flag. Set “L”, no-update mode.
In the case of “H”, all clear mode. Refer to the 6.8 for details.
M3 : Blinking flag. In the case of “H”, display blinking mode and forcibly display color inversion.
In the case of “L”, display blinking mode is terminated.
M4 : Blinking color flag. In the case of M5=“H”, it is invalid, it can be “H” or “L”.
In the case of M5=“L”, refer to the 6.9 for details.
M5 : Color inversion flag. Set “H”, display color is inverted.
For example, “Red” is changed to “Cyan”.
“Cyan” is complementary color of “Red”.

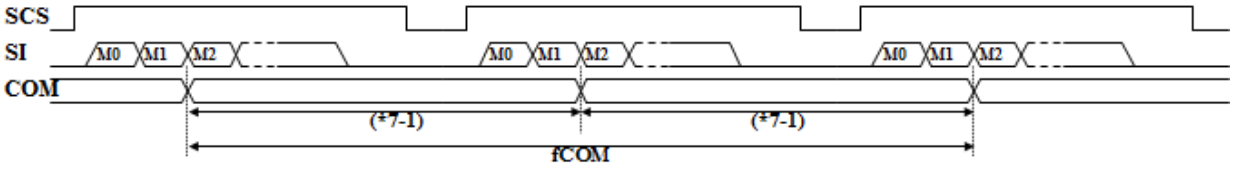
Dummy data : It can be “H” or “L”.
M0, M2 flags are cleared by SCS=“L”, and M3, M5 flags are cleared by DISP=“L”.



Blink display to alternate between normal display and display blinking mode.

9.12 COM Inversion

9.12.1 COM POLARITY SERIAL INPUT / EXTMODE = “L”

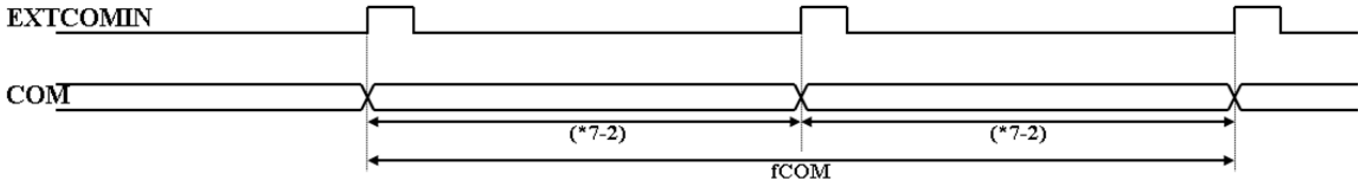


M1 : COM inversion flag. In thae case of “H”, outputs COM=“H”. In the case of “L”, outputs COM=“L”.

COM polarity inversion has been changed by M1 flag state.

Note 1: The periods of positive and negative polarity should be same length as much as possible.

9.12.2 EXTCOMIN SIGNAL / EXTMODE=“H”



COM polarity inversion has been changed by the rising timing of EXTCOMIN.

COM polarity (positive or negative) is controlled by internal circuit.

Note 2: The periods of positive and negative polarity should be same length as much as possible.

9.13 Gate address table

LPM044M141 : V1- V255

V	AG9	AG8	AG7	AG6	AG5	AG4	AG3	AG2	AG1	AG0
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	0	1	0
3	0	0	0	0	0	0	0	0	1	1
4	0	0	0	0	0	0	0	1	0	0
5	0	0	0	0	0	0	0	1	0	1
6	0	0	0	0	0	0	0	1	1	0
7	0	0	0	0	0	0	0	1	1	1
8	0	0	0	0	0	0	1	0	0	0
9	0	0	0	0	0	0	1	0	0	1
10	0	0	0	0	0	0	1	0	1	0
11	0	0	0	0	0	0	1	0	1	1
12	0	0	0	0	0	0	1	1	0	0
13	0	0	0	0	0	0	1	1	0	1
14	0	0	0	0	0	0	1	1	1	0
15	0	0	0	0	0	0	1	1	1	1
16	0	0	0	0	0	1	0	0	0	0
17	0	0	0	0	0	1	0	0	0	1
18	0	0	0	0	0	1	0	0	1	0
19	0	0	0	0	0	1	0	0	1	1
20	0	0	0	0	0	1	0	1	0	0
21	0	0	0	0	0	1	0	1	0	1
22	0	0	0	0	0	1	0	1	1	0
23	0	0	0	0	0	1	0	1	1	1
24	0	0	0	0	0	1	1	0	0	0
25	0	0	0	0	0	1	1	0	0	1
26	0	0	0	0	0	1	1	0	1	0
27	0	0	0	0	0	1	1	0	1	1
28	0	0	0	0	0	1	1	1	0	0
29	0	0	0	0	0	1	1	1	0	1
30	0	0	0	0	0	1	1	1	1	0
31	0	0	0	0	0	1	1	1	1	1
32	0	0	0	0	1	0	0	0	0	0
33	0	0	0	0	1	0	0	0	0	1
34	0	0	0	0	1	0	0	0	1	0
35	0	0	0	0	1	0	0	0	1	1
36	0	0	0	0	1	0	0	1	0	0
37	0	0	0	0	1	0	0	1	0	1
38	0	0	0	0	1	0	0	1	1	0
39	0	0	0	0	1	0	0	1	1	1
40	0	0	0	0	1	0	1	0	0	0
41	0	0	0	0	1	0	1	0	0	1
42	0	0	0	0	1	0	1	0	1	0
43	0	0	0	0	1	0	1	0	1	1
44	0	0	0	0	1	0	1	1	0	0
45	0	0	0	0	1	0	1	1	0	1
46	0	0	0	0	1	0	1	1	1	0
47	0	0	0	0	1	0	1	1	1	1
48	0	0	0	0	1	1	0	0	0	0
49	0	0	0	0	1	1	0	0	0	1
50	0	0	0	0	1	1	0	0	1	0
51	0	0	0	0	1	1	0	0	1	1
52	0	0	0	0	1	1	0	1	0	0
53	0	0	0	0	1	1	0	1	0	1
54	0	0	0	0	1	1	0	1	1	0
55	0	0	0	0	1	1	0	1	1	1
56	0	0	0	0	1	1	1	0	0	0
57	0	0	0	0	1	1	1	0	0	1
58	0	0	0	0	1	1	1	0	1	0
59	0	0	0	0	1	1	1	0	1	1
60	0	0	0	0	1	1	1	1	0	0
61	0	0	0	0	1	1	1	1	0	1
62	0	0	0	0	1	1	1	1	1	0
63	0	0	0	0	1	1	1	1	1	1
64	0	0	0	1	0	0	0	0	0	0
65	0	0	0	1	0	0	0	0	0	1
66	0	0	0	1	0	0	0	0	1	0
67	0	0	0	1	0	0	0	0	1	1
68	0	0	0	1	0	0	0	1	0	0
69	0	0	0	1	0	0	0	1	0	1
70	0	0	0	1	0	0	0	1	1	0
71	0	0	0	1	0	0	0	1	1	1
72	0	0	0	1	0	0	1	0	0	0
73	0	0	0	1	0	0	1	0	0	1
74	0	0	0	1	0	0	1	0	1	0
75	0	0	0	1	0	0	1	0	1	1
76	0	0	0	1	0	0	1	1	0	0
77	0	0	0	1	0	0	1	1	0	1
78	0	0	0	1	0	0	1	1	1	0
79	0	0	0	1	0	0	1	1	1	1
80	0	0	0	1	0	1	0	0	0	0
81	0	0	0	1	0	1	0	0	0	1
82	0	0	0	1	0	1	0	0	1	0
83	0	0	0	1	0	1	0	0	1	1
84	0	0	0	1	0	1	0	1	0	0
85	0	0	0	1	0	1	0	1	0	1
86	0	0	0	1	0	1	0	1	1	0
87	0	0	0	1	0	1	0	1	1	1
88	0	0	0	1	0	1	1	0	0	0
89	0	0	0	1	0	1	1	0	0	1
90	0	0	0	1	0	1	1	0	1	0
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LPM044M141 : V256- V480

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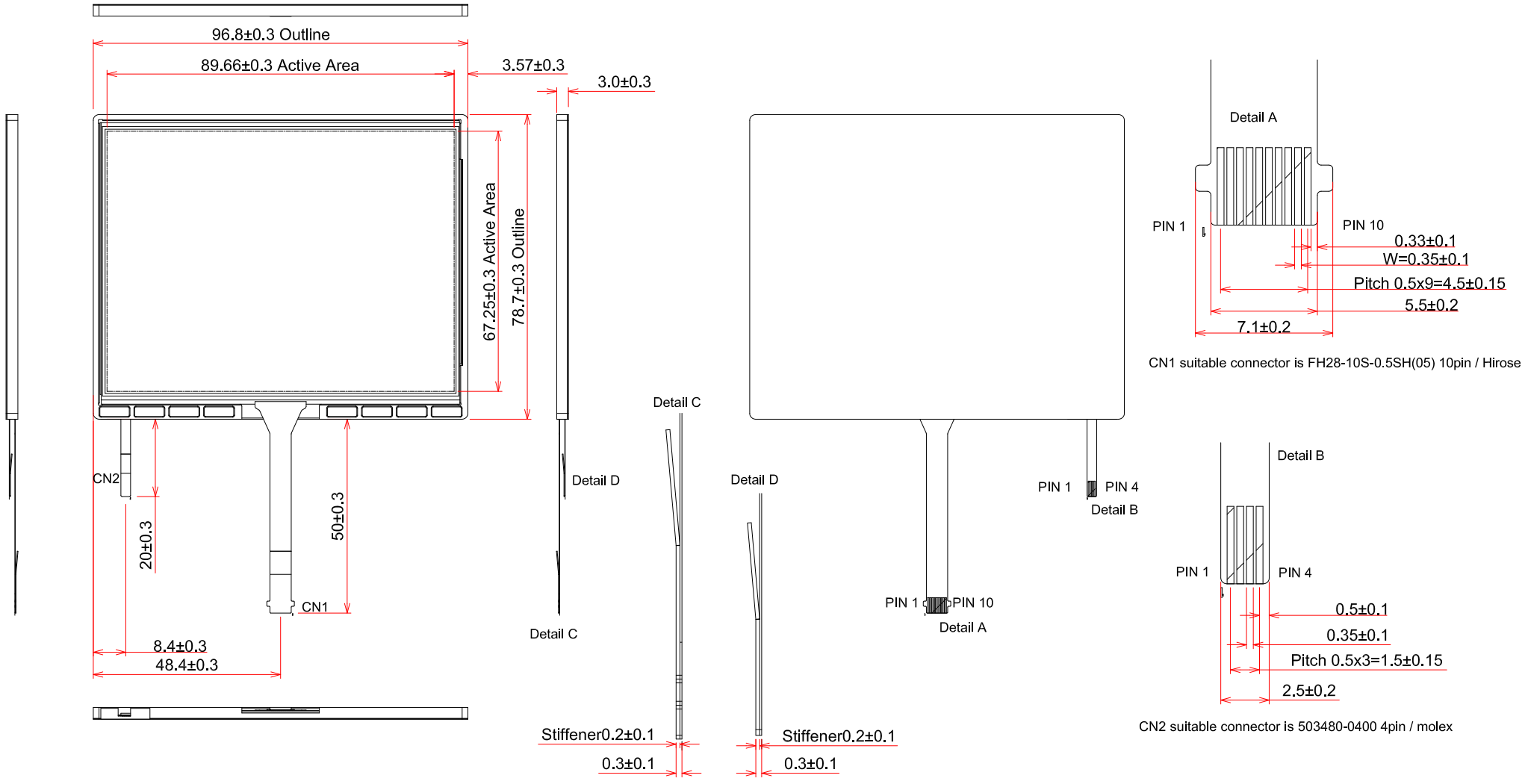
441	0	1	1	0	1	1	1	0	0	1
442	0	1	1	0	1	1	1	0	1	0
443	0	1	1	0	1	1	1	0	1	1
444	0	1	1	0	1	1	1	1	0	0
445	0	1	1	0	1	1	1	1	0	1
446	0	1	1	0	1	1	1	1	1	0
447	0	1	1	0	1	1	1	1	1	1
448	0	1	1	1	0	0	0	0	0	0
449	0	1	1	1	0	0	0	0	0	1
450	0	1	1	1	0	0	0	0	1	0
451	0	1	1	1	0	0	0	0	1	1
452	0	1	1	1	0	0	0	1	0	0
453	0	1	1	1	0	0	0	1	0	1
454	0	1	1	1	0	0	0	1	1	0
455	0	1	1	1	0	0	0	1	1	1
456	0	1	1	1	0	0	1	0	0	0
457	0	1	1	1	0	0	1	0	0	1
458	0	1	1	1	0	0	1	0	1	0
459	0	1	1	1	0	0	1	0	1	1
460	0	1	1	1	0	0	1	1	0	0
461	0	1	1	1	0	0	1	1	0	1
462	0	1	1	1	0	0	1	1	1	0
463	0	1	1	1	0	0	1	1	1	1
464	0	1	1	1	0	1	0	0	0	0
465	0	1	1	1	0	1	0	0	0	1
466	0	1	1	1	0	1	0	0	1	0
467	0	1	1	1	0	1	0	0	1	1
468	0	1	1	1	0	1	0	1	0	0
469	0	1	1	1	0	1	0	1	0	1
470	0	1	1	1	0	1	0	1	1	0
471	0	1	1	1	0	1	0	1	1	1
472	0	1	1	1	0	1	1	0	0	0
473	0	1	1	1	0	1	1	0	0	1
474	0	1	1	1	0	1	1	0	1	0
475	0	1	1	1	0	1	1	0	1	1
476	0	1	1	1	0	1	1	1	0	0
477	0	1	1	1	0	1	1	1	0	1
478	0	1	1	1	0	1	1	1	1	0
479	0	1	1	1	0	1	1	1	1	1
480	0	1	1	1	1	0	0	0	0	0
481	0	1	1	1	1	0	0	0	0	1
482	0	1	1	1	1	0	0	0	1	0
483	0	1	1	1	1	0	0	0	1	1
484	0	1	1	1	1	0	0	1	0	0
485	0	1	1	1	1	0	0	1	0	1
486	0	1	1	1	1	0	0	1	1	0
487	0	1	1	1	1	0	0	1	1	1
488	0	1	1	1	1	0	1	0	0	0
489	0	1	1	1	1	0	1	0	0	1
490	0	1	1	1	1	0	1	0	1	0
491	0	1	1	1	1	0	1	0	1	1
492	0	1	1	1	1	0	1	1	0	0
493	0	1	1	1	1	0	1	1	0	1
494	0	1	1	1	1	0	1	1	1	0
495	0	1	1	1	1	0	1	1	1	1
496	0	1	1	1	1	1	0	0	0	0
497	0	1	1	1	1	1	0	0	0	1
498	0	1	1	1	1	1	0	0	1	0
499	0	1	1	1	1	1	0	0	1	1
500	0	1	1	1	1	1	0	1	0	0
501	0	1	1	1	1	1	0	1	0	1
502	0	1	1	1	1	1	0	1	1	0
503	0	1	1	1	1	1	0	1	1	1
504	0	1	1	1	1	1	1	0	0	0
505	0	1	1	1	1	1	1	0	0	1
506	0	1	1	1	1	1	1	0	1	0
507	0	1	1	1	1	1	1	0	1	1
508	0	1	1	1	1	1	1	1	0	0
509	0	1	1	1	1	1	1	1	0	1
510	0	1	1	1	1	1	1	1	1	0
511	0	1	1	1	1	1	1	1	1	1

10. OUTLINE DIMENSIONS



CN1 suitable connector is FH28-10S-0.5SH(05) 10pin / Hirose

CN2 suitable connector is 503480-0400 4pin / molex

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

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11. APPEARANCE STANDARD

The appearance inspection is performed in a 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.11.1 The inspection should be performed within 45° when display is shut down. The inspection should be performed within 5° when display is power on.

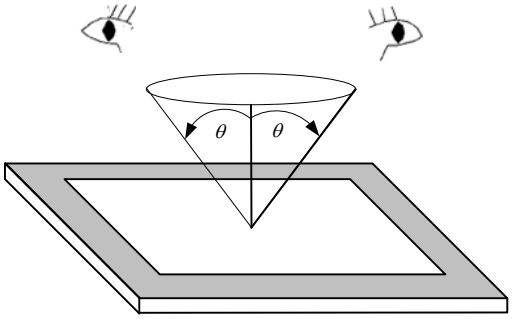


Fig. 11.1

11.1 THE DEFINITION OF LCD ZONE

LCD panel is divided into 2 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 between A zone and LCD edge.

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

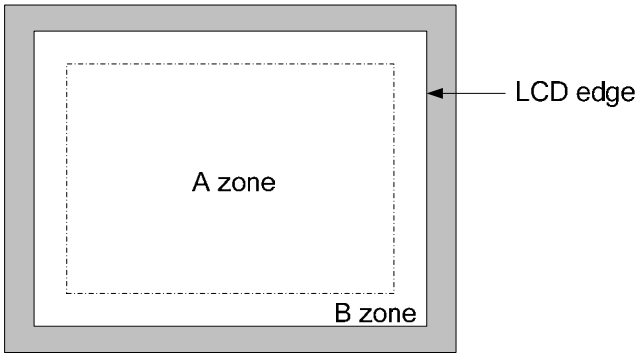


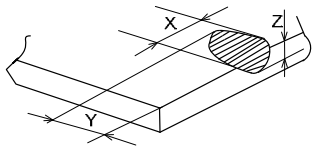
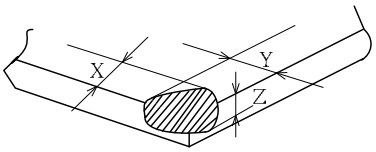
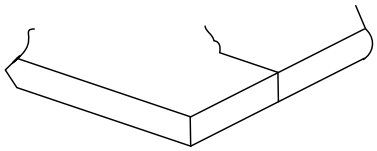
Fig. 11.2

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			Zone
Dot type	B/W spot (Dent in glass or Upper polarizer, Particle, Swell) Bright/Dark dot defect	Average Diameter (mm)	Maximum Number	Minimum Space	
		D≦0.15	Ignore	-	A
		0.15<D≦0.25	2	-	
		0.25<D	0	-	
		D≦0.25	Ignore	-	B
		0.25<D≦0.3	3	-	
		0.3<D	0	-	
		Ignore			C
		Keep two defect distance more than 5mm			
Line type	Scratch on Upper polarizer or Foreign material between Upper polarizer and Glass	Length (mm)	Width (mm)	Maximum Number	
		-	W≦0.03	Ignore	A
		L≦2	0.03<W≦0.08	2	
		2<L	0.08<W	0	
		L≦3	W≦0.10	3	B
		3<L	0.10<W	0	
		Ignore			C
		Keep two defect distance more than 5mm			
Air bubble	Air bubble	Average Diameter (mm)	Maximum Number	Minimum Space	
		D≦0.15	Ignore	-	A
		0.15<D≦0.25	2	-	
		0.25<D	0	-	
		Ignore			B
		Ignore			C

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

Item	Specifications	
Edge flaw		X ≤ 3.0 mm Y ≤ 3.0 mm Z ≤ Thickness
Corner flaw		X ≤ 2.0 mm Y ≤ 2.0 mm Z ≤ Thickness
Progressive flaw		Not allowed

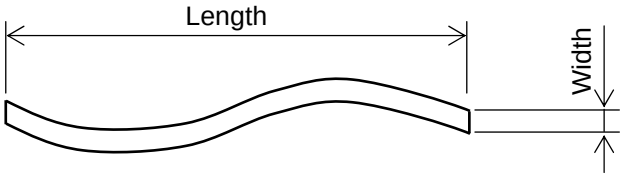
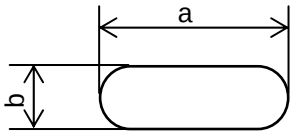


Fig.11.3



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

Fig.11.4

Note 1: C zone defects other than the above are ignored when function / display is not affected.

Note 2: When there is an agreement limit samples, Item is judged according to limit sample.

Note 3: Total defect quantity : A zone (N≦3) each inspection (lighting / appearance), B zone (N≦5).

Note 4: Other items are to be decided by agreement between both parties.

Note 5: Ignore any dirt which can be removed.

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 using sharp tools harder than 3H, especially touch panel, metal frame and polarizer.

2) Please do not stack the displays as this may damage the surface. In order to avoid any injuries, please avoid touching the edge of the glass or metal frame and wore gloves during handling.

3) Touching the polarizer or terminal pins with bare hand should be avoided to prevent staining and poor electrical contact.

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 permanent damages.

7) Maximum pressure to the surface of the display must be less than $1{,}96 \times 10^4$ Pa. If the area of applied pressure is less than 1 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°. 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 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.

13. DESIGNATION of LOT MARK

1) The lot mark is showing in Fig.13.1. First 4 digits are used to represent production lot, T represented made in Taiwan, and the last 6 digits are the serial number.

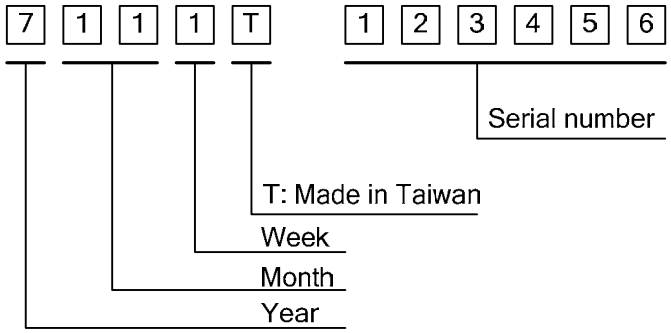


Fig. 13.1

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

Year	Lot Mark
2017	7
2018	8
2019	9
2020	0
2021	1

Month	Lot Mark	Month	Lot Mark
Jan.	01	Jul.	07
Feb.	02	Aug.	08
Mar.	03	Sep.	09
Apr.	04	Oct.	10
May	05	Nov.	11
Jun.	06	Dec.	12

Week	Lot Mark
1~7 days	1
8~14 days	2
15~21 days	3
22~28 days	4
29~31 days	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. 13.2.

Label example:

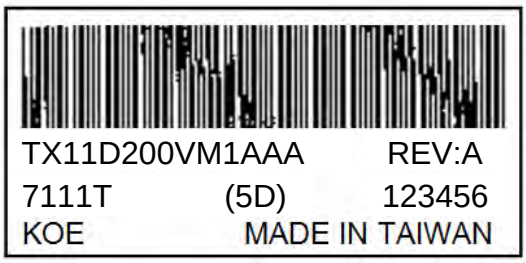


Fig. 13.2