

To : _____

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SPECIFICATIONS	
Product Name	LPM014M470B

Approval Signature

Accepted by : _____

Date : _____

Japan Display Inc.

Proposed by : *T. Idarayama*

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Sep.24. 2021 Rev.01	-	-	New Release	-	LPM014M470B (200140401)

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1. BASIC SPECIFICATIONS

LPM014M470B is a 1.389 inch reflective active matrix liquid crystal display (LCD) module, therefore, the specification is defined in reflective mode only unless otherwise specified in this specification sheet.

The Active area of the LCD module is round in shape and it has 280(H) x 280(V) pixels.

A pixel has 2-bit static random-access memory (SRAM) to store the image data for each sub-pixel and it is capable of displaying 64 colors.

This display is a reflective LCD therefore the specifications are defined in reflective mode only unless otherwise specified in this specification sheet.

1.1 STRUCTURES

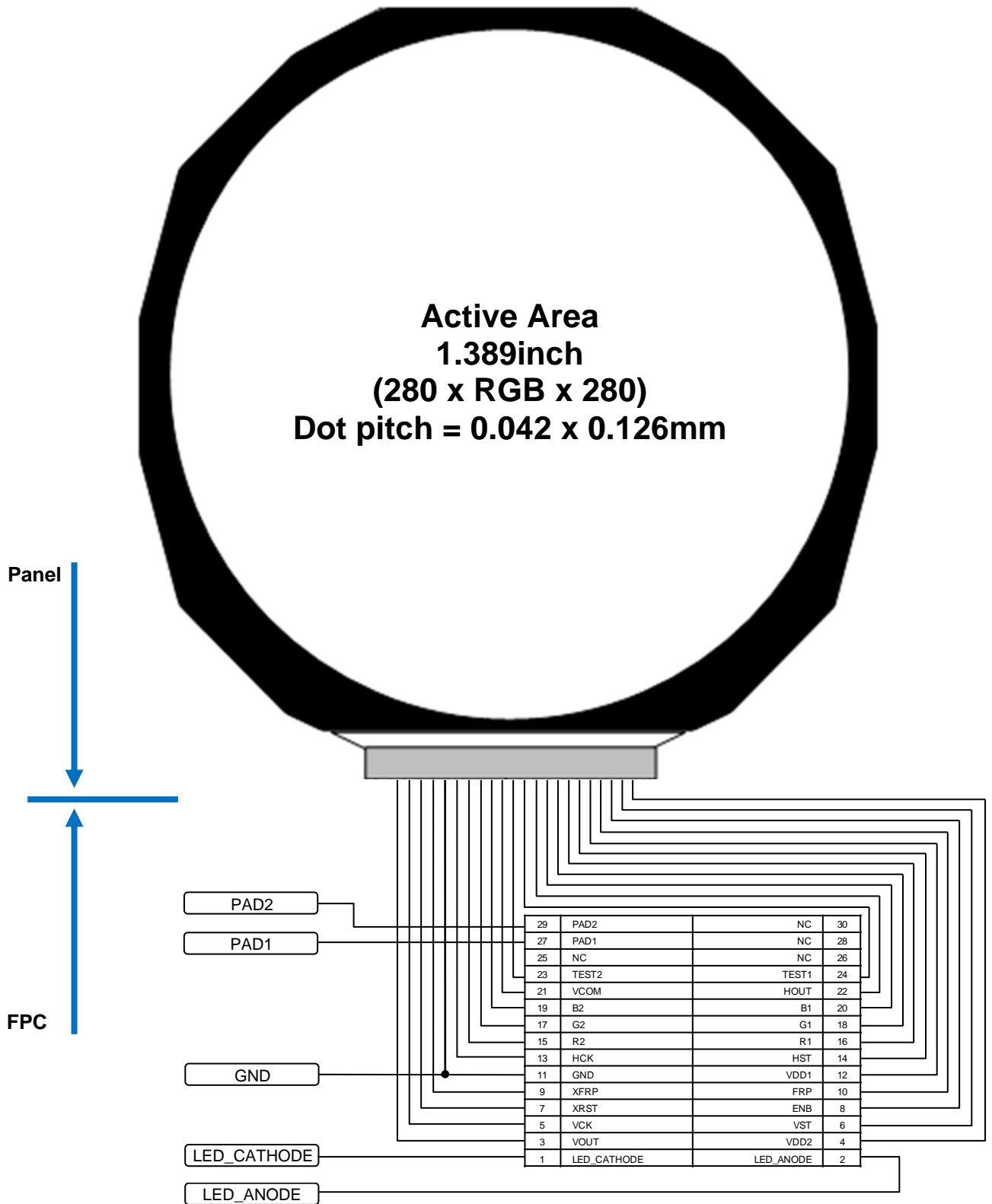
No.	FACTOR	SPECIFICATIONS	UNIT
1	LCD structure	LTPS (Memory in pixel type)	-
2	Outward (*1-1)	38.08(W) x 38.78(H) x 0.871(D) (*1-1)	mm
3	Weight	Approx. 2.2	g
4	Screen size	35.28 (1.389 inch) diameter	mm
5	Resolution	280(H) x 280(V)	dot
6	Interface	Direct I/F	-
7	Dot pitch (Horizontal x Vertical)	0.042(H) x 0.126(V)	mm
8	Dot layout	RGB stripe	-
9	Number of colors	64 colors	-
10	Liquid crystal mode	ECB normally black (Reflective type)	-
11	Front Polarizer	Hard Coat type (*Pencil Hardness : 2H)	-
12	Rear Polarizer	With APCF	-

Note)

(*1-1) Excluding FPC and part of protruding. See attached drawing for details.

1.2 PIN LAYOUT AND FPC CIRCUIT

Viewing in front of a LCD panel



1.3 INPUT / OUTPUT TERMINAL NAME AND FUNCTIONS

P: Power supply I: Input O: Output NC: Not connected

PIN	SYMBOL	TYPE	DESCRIPTION	REMARK
1	LED CATHODE	P	LED Cathode electrode	
2	LED ANODE	P	LED Anode electrode	
3	VOUT	O	Output from the end of the vertical shift register	(*1-2)
4	VDD2	P	Power supply for the vertical driver and pixel memory	
5	VCK	I	Shift clock for the vertical driver	
6	VST	I	Start signal for the vertical driver	
7	XRST	I	Reset signal for the horizontal and vertical driver	
8	ENB	I	Write enable signal for the pixel memory	
9	XFRP	I	Liquid crystal driving signal ("On" pixel)	
10	FRP	I	Liquid crystal driving signal ("Off" pixel)	
11	GND	P	Ground for the LCD	
12	VDD1	P	Power supply for the horizontal driver and pixel memory	
13	HCK	I	Shift clock for the horizontal driver	
14	HST	I	Start signal for the horizontal driver	
15	R2	I	Red image data (even pixels)	
16	R1	I	Red image data (odd pixels)	
17	G2	I	Green image data (even pixels)	
18	G1	I	Green image data (odd pixels)	
19	B2	I	Blue image data (even pixels)	
20	B1	I	Blue image data (odd pixels)	
21	VCOM	I	Common electrode driving signal	
22	HOUT	O	Output from the end of the horizontal shift register	(*1-2)
23	TEST2	NC	Mounting Resistance check	(*1-3)
24	TEST1	NC	Mounting Resistance check	(*1-3)
25	NC	NC	Not connected to the LCD	(*1-3)
26	NC	NC	Not connected to the LCD	(*1-3)
27	PAD1		Connected to PAD1	(*1-3)
28	NC	NC	Not connected to the LCD	(*1-3)
29	PAD2		Connected to PAD2	(*1-3)
30	NC	NC	Not connected to the LCD	(*1-3)

Note)

(*1-2) Do not connect any signal or power wire to these terminals.

(*1-3) It is recommended to connect to GND.

2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	RATINGS	UNIT	REMARKS
Power supply voltage	6.3	V	
VCOM, FRP and XFRP signal voltage	0 to 6.3	V	
Input control signal voltage	0 to 6.3	V	(*2-1)
Operating temperature range (LCD panel surface)	-20 to +70	°C	(*2-2)
Storage temperature range	-30 to +80	°C	(*2-2)

Note)

(*2-1) HST, HCK, XRST, VST, VCK, ENB, R1, G1, B1, R2, G2, B2

(*2-2) Maximum humidity is defined as follows:

$T_a \leq 40^\circ\text{C}$: 85%RH Max.

$T_a > 40^\circ\text{C}$: Absolute humidity needs to be equal or less than the numeric value at the condition of $T_a=40^\circ\text{C}$, 85%RH.

Don't condense dew.

3. ELECTRICAL CHARACTERISTICS

3.1 POWER SUPPLY VOLTAGE

PARAMETER	SYMBOL	Min.	Typ.	Max.	UNIT	REMARK
Power supply voltage1	VDD1	3.1	3.2	3.3	V	
Power supply voltage2	VDD2	4.4	4.5	5.2	V	
Ground for LCD	GND		0		V	

3.2 INPUT SIGNAL VOLTAGE

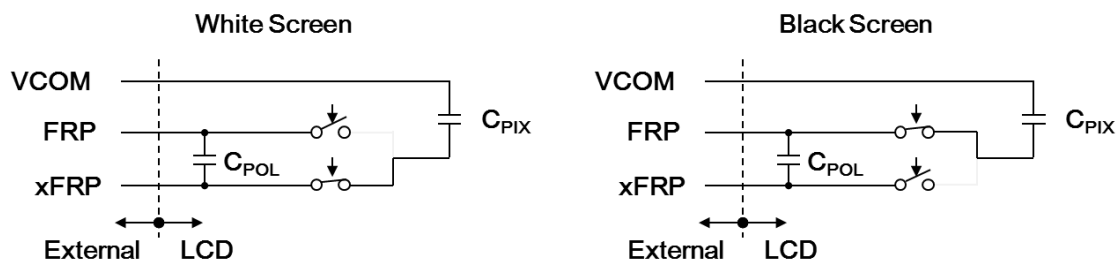
PARAMETER		Min.	Typ.	Max.	UNIT	REMARK
Input control signal	High	VDD1 - 0.1	VDD1	VDD1	V	(*3-1)
	Low	GND	GND	GND + 0.1	V	
VCOM, FRP, XFRP	High	VDD1 - 0.1	VDD1	VDD1	V	
	Low	GND	GND	GND + 0.1	V	

Note)

(*3-1) HST, HCK, XRST, VST, VCK, ENB, R1, G1, B1, R2, G2, B2

3.3 INPUT TERMINAL CAPACITANCE

PARAMETER	SYMBOL	Min.	Typ.	Max.	UNIT	REMARK
Input control signal	C _{IN}	-	10	14	pF	(*3-1)
VCOM	C _{PIX}	-	32	44	nF	
FRP	C _{PIX} + C _{POL}	-	32+10	44+14	nF	
XFRP	C _{PIX} + C _{POL}	-	32+10	44+14	nF	



3.4 POWER CONSUMPTION

STATIC IMAGE(VCOM frequency: 60Hz)

Driving Condition: VDD1=3.2V, VDD2=4.5V, Ta=25°C, White screen, Without Backlight

PARAMETER	SYMBOL	Min.	Typ.	Max.	UNIT
VDD1 current consumption	IVDD1	-	1	20	uA
VDD2 current consumption	IVDD2	-	1	25	uA
Total power consumption	PWR	-	0.008	0.177	mW

STATIC IMAGE (Refresh rate: 1Hz, VCOM frequency: 60Hz)

Driving Condition: VDD1=3.2V, VDD2=4.5V, Ta=25°C, White screen, Without Backlight

PARAMETER	SYMBOL	Min.	Typ.	Max.	UNIT
VDD1 current consumption	IVDD1	-	2	22	uA
VDD2 current consumption	IVDD2	-	2	27	uA
Total power consumption	PWR	-	0.015	0.192	mW

MOVING IMAGE (Refresh rate: 30Hz, VCOM frequency: 60Hz)

Driving Condition: VDD1=3.2V, VDD2=4.5V, Ta=25°C, White screen, Without Backlight

PARAMETER	SYMBOL	Min.	Typ.	Max.	UNIT
VDD1 current consumption	IVDD1	-	69	103	uA
VDD2 current consumption	IVDD2	-	4	30	uA
Total power consumption	PWR	-	0.239	0.465	mW

3.5 AC CHARACTERISTICS

Driving Condition: VDD1=3.2V, VDD2=4.5V, Ta=25°C

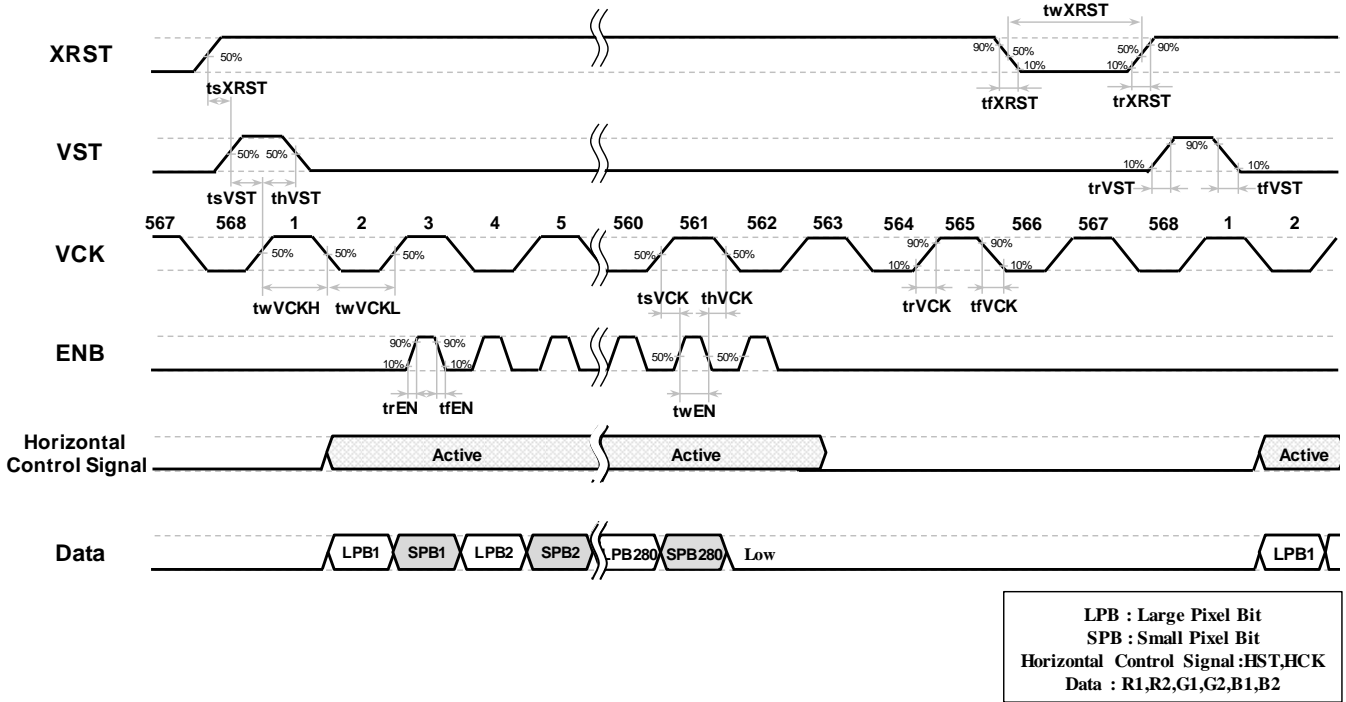
PARAMETER	SYMBOL	Min.	Typ.	Max.	UNIT	REMARK
Vertical Pixel Number	-	-	280	-	Pixels	
Vertical Frequency	Fv	-	-	31.00	Hz	
Vertical Period	Tv	32.26	-	-	msec	
Vertical Clock Number	Nv	-	568	-	Clocks	
Vertical Blanking Number	Nvbl	-	8	-	Clocks	
Horizontal Pixel Number	-	-	280	-	Pixels	
Horizontal Clock Number	Nh	-	142	-	Clocks	
Horizontal Blanking Number	Nhbl	-	2	-	Clocks	
HST rising time	trHST	-	-	50	nsec	
HST falling time	tfHST	-	-	50	nsec	
HST data set-up time	tsHST	200	-	-	nsec	
HST data hold time	thHST	200	-	-	nsec	
HST delay time	tdHST	400	-	-	nsec	
HCK rising time	trHCK	-	-	50	nsec	
HCK falling time	tfHCK	-	-	50	nsec	
HCK High width	twHCKH	400	-	-	nsec	
HCK Low width	twHCKL	400	-	-	nsec	
DATA rising time	trDT	-	-	50	nsec	
DATA falling time	tfDT	-	-	50	nsec	
DATA set-up time	tsDT	200	-	-	nsec	
DATA hold time	thDT	200	-	-	nsec	
VST rising time	trVST	-	-	50	nsec	
VST falling time	tfVST	-	-	50	nsec	
VST set-up time	tsVST	28.00	-	-	usec	
VST hold time	thVST	28.80	-	-	usec	
VCK rising time	trVCK	-	-	50	nsec	
VCK falling time	tfVCK	-	-	50	nsec	
VCK High width	twVCKH	56.80	-	100.00	usec	
		1.00	-	-	usec	(*3-1)
VCK Low width	twVCKL	56.80	-	100.00	usec	
		1.00	-	-	usec	(*3-1)
VCK set-up time	tsVCK	14.40	-	-	usec	
VCK hold time	thVCK	14.40	-	-	usec	
ENB rising time	trEN	-	-	50	nsec	
ENB falling time	tfEN	-	-	50	nsec	
ENB High width	twEN	28.80	-	-	usec	
XRST rising time	trXRST	-	-	50	nsec	
XRST falling time	tfXRST	-	-	50	nsec	
XRST Low width	twXRST	113.60	-	-	usec	
XRST set-up time	tsXRST	14.4	-	-	usec	
VCOM frequency	fVCOM	1	-	60	Hz	(*3-2)
VCOM rising time	trVCOM	-	-	100	usec	
VCOM falling time	tfVCOM	-	-	100	usec	

Note) (*3-1) Partial Update Mode (non-updated area)

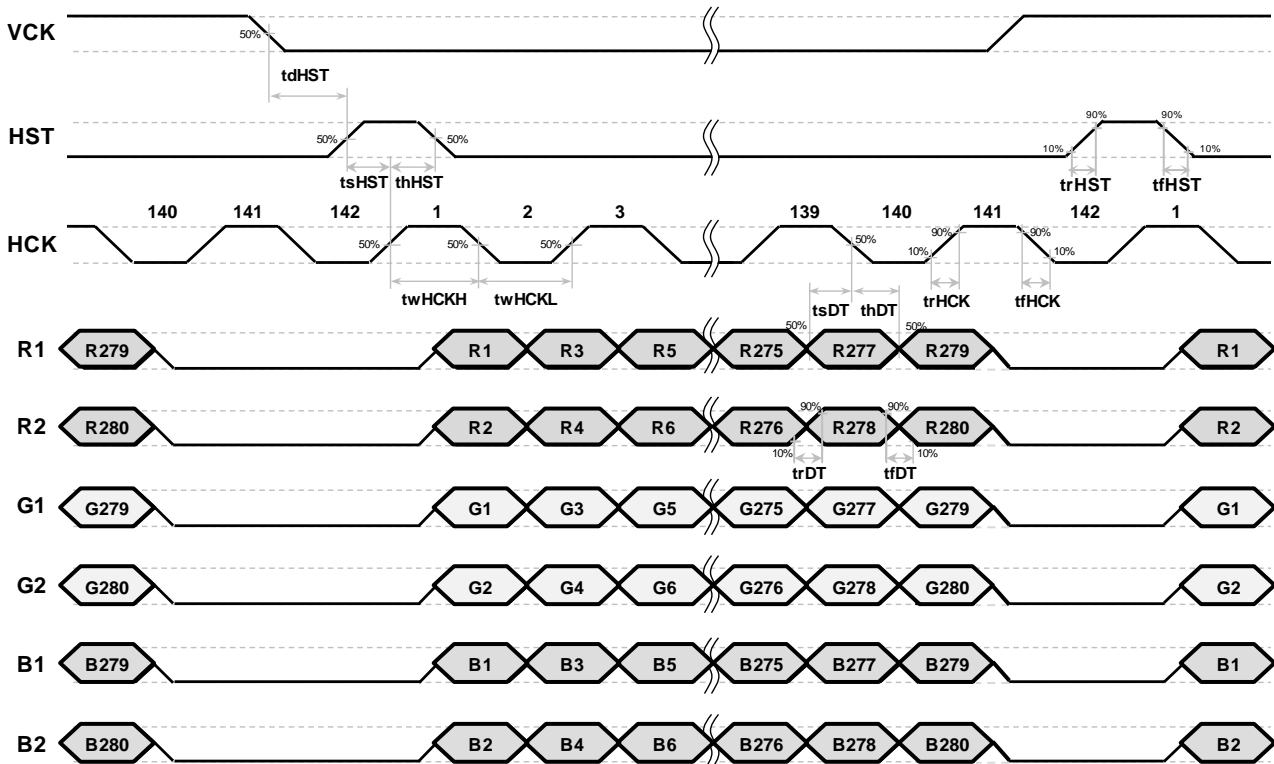
(*3-2) VCOM frequency should be around 60Hz for transmissive mode.

3.6 TIMING DIAGRAM (UPDATE MODE)

3.6.1 VERTICAL

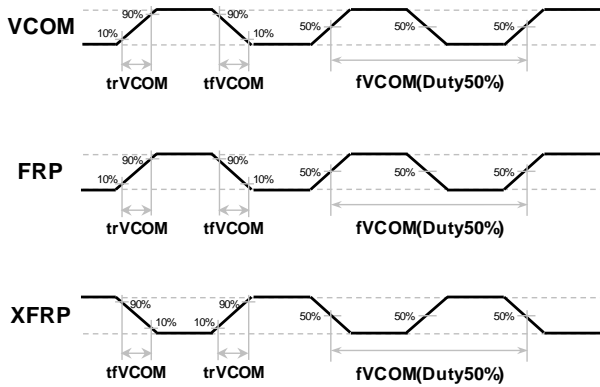


3.6.2 HORIZONTAL



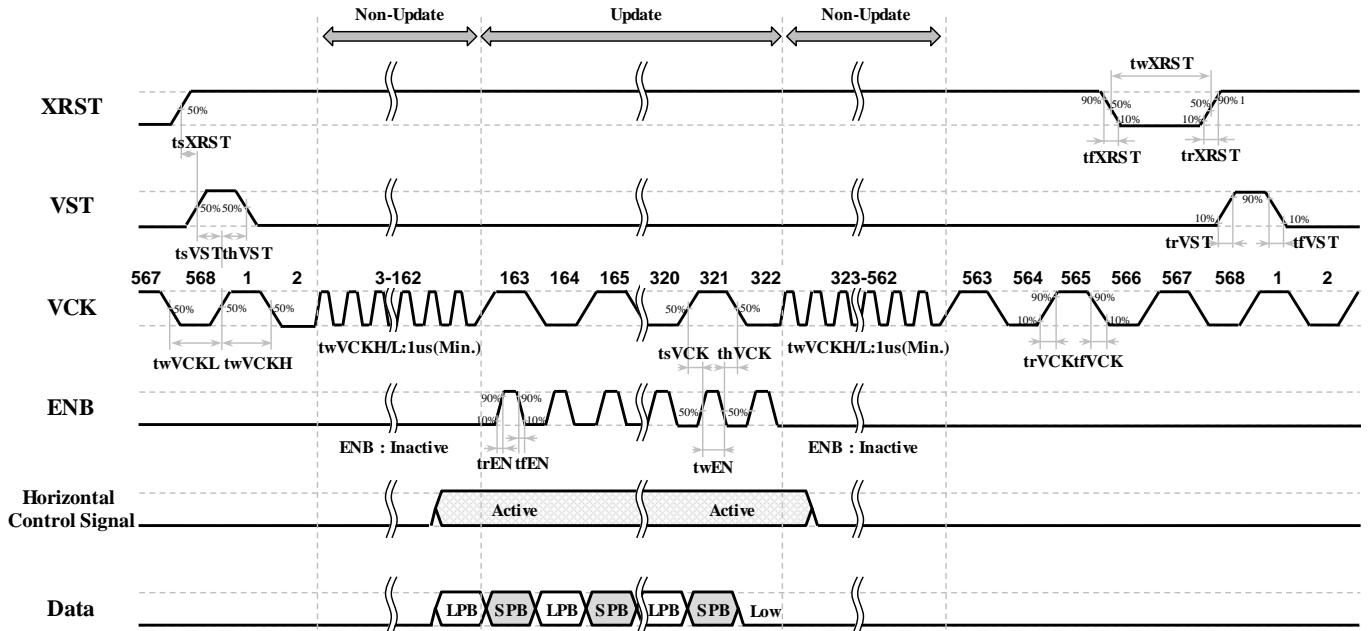
3.6.3 VCOM, FRP, XFRP

FRP is the same signal as VCOM, and XFRP is the inverse signal of VCOM and FRP.



3.7 TIMING DIAGRAM (PARTIAL-UPDATE MODE)

When 81-160 lines of the image is updated.

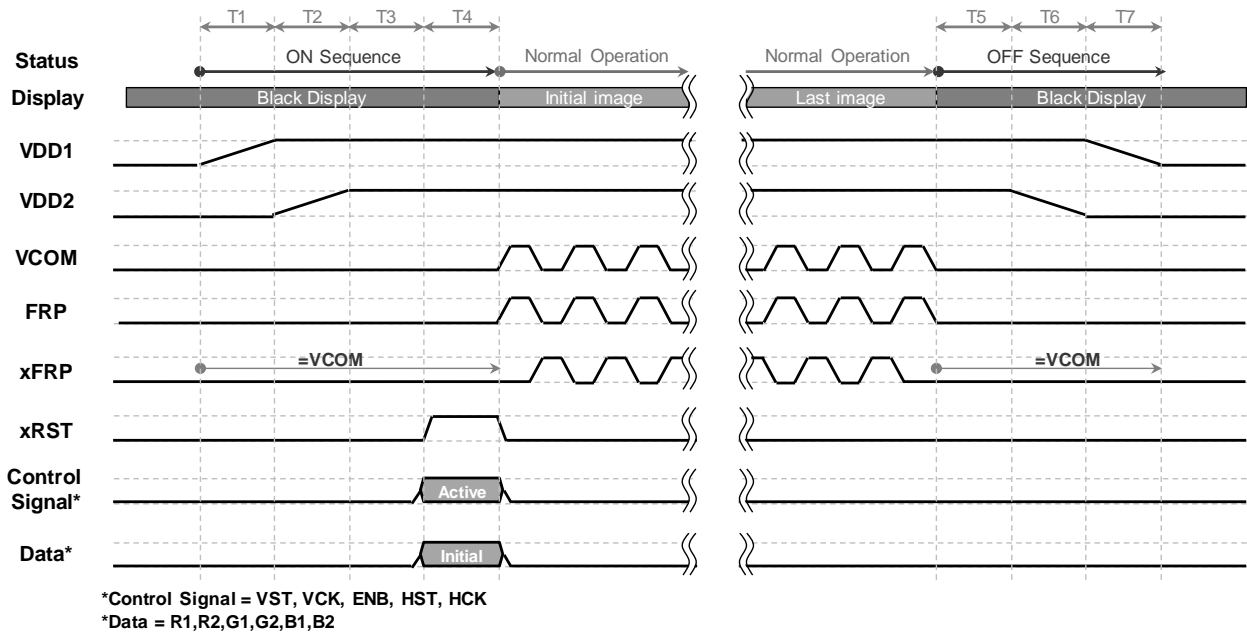


LPB : Large Pixel Bit
 SPB : Small Pixel Bit
 Horizontal Control Signal : HST, HCK
 Data : R1, R2, G1, G2, B1, B2

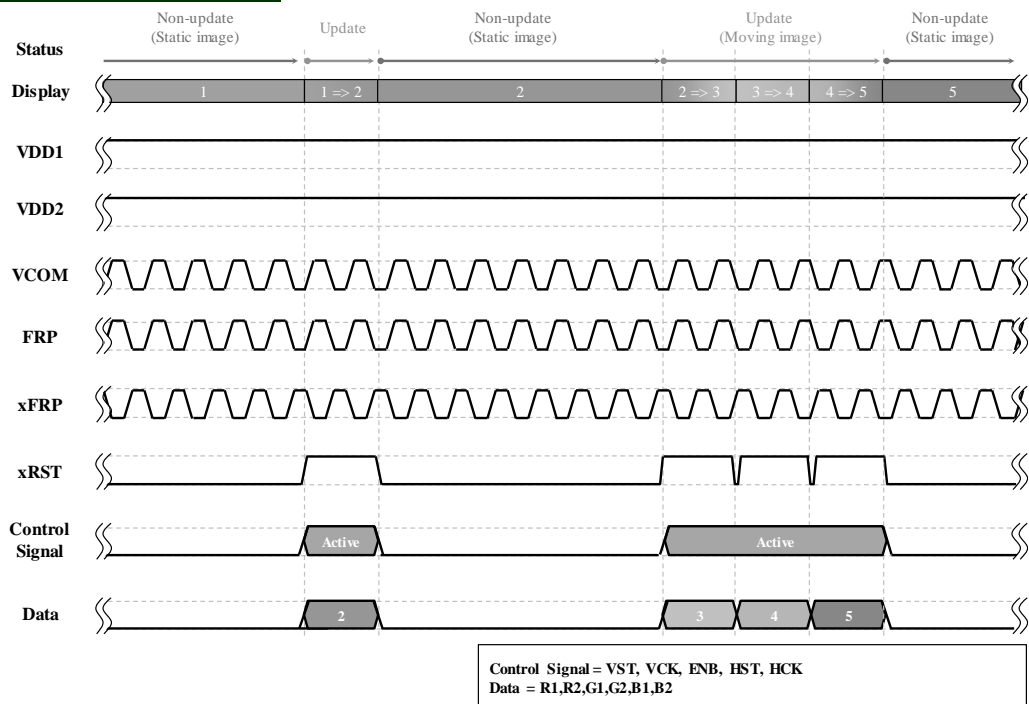
3.8 RECOMMENDED SEQUENCE

3.8.1 ON/OFF SEQUENCE

<p>[On Sequence]</p> <ol style="list-style-type: none"> 1) VDD1 Rise Time T1; Depends on IC 2) VDD2 Rise Time T2; Depends on IC 3) Internal Circuit Rest Time T3; twXRST or more 4) Pixel Memory Initialize Time T4; 1Frame 	<p>[OFF Sequence]</p> <ol style="list-style-type: none"> 1) Pixel electrode discharge time T5; twXRST or more 2) VDD2 fall time T6; Depends on IC 3) VDD1 fall time T7; Depends on IC
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3.8.2 MODE CHANGE SEQUENCE



4. PIXEL LAYOUT

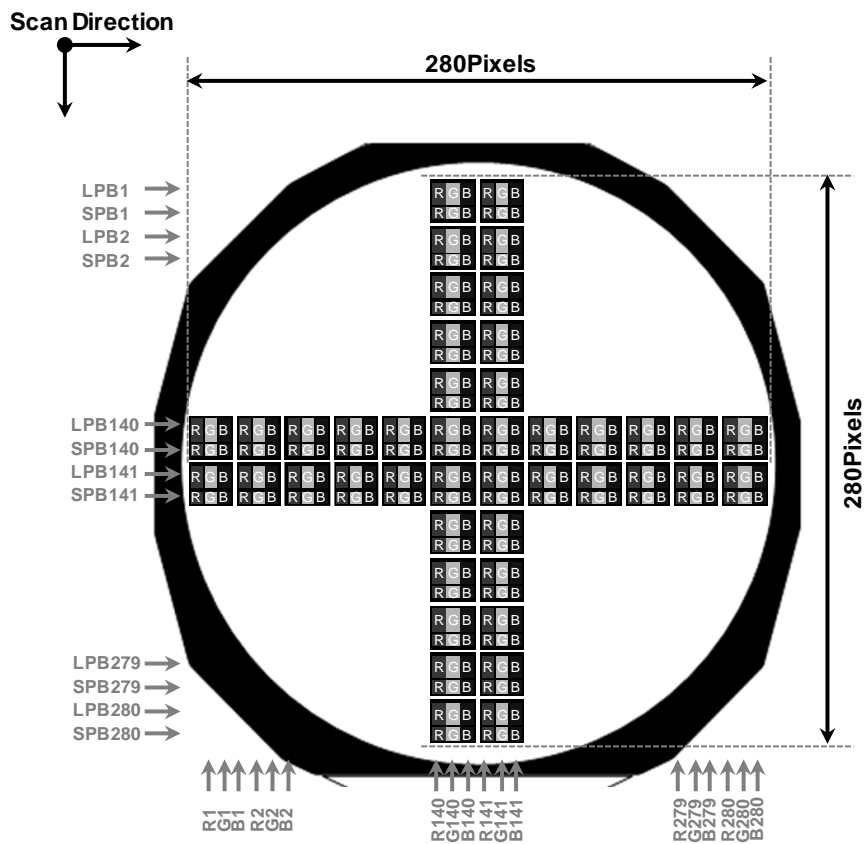
The LCD has 6-bit-per-pixel memory, and it is capable of displaying 64 colors.

Every RGB sub pixel has 2-bit Memory; Large pixel bit (LPB) of 2/3 area and Small pixel bit (SPB) of 1/3 area

There are 4 conditions of the pixel memory, which are as follows.

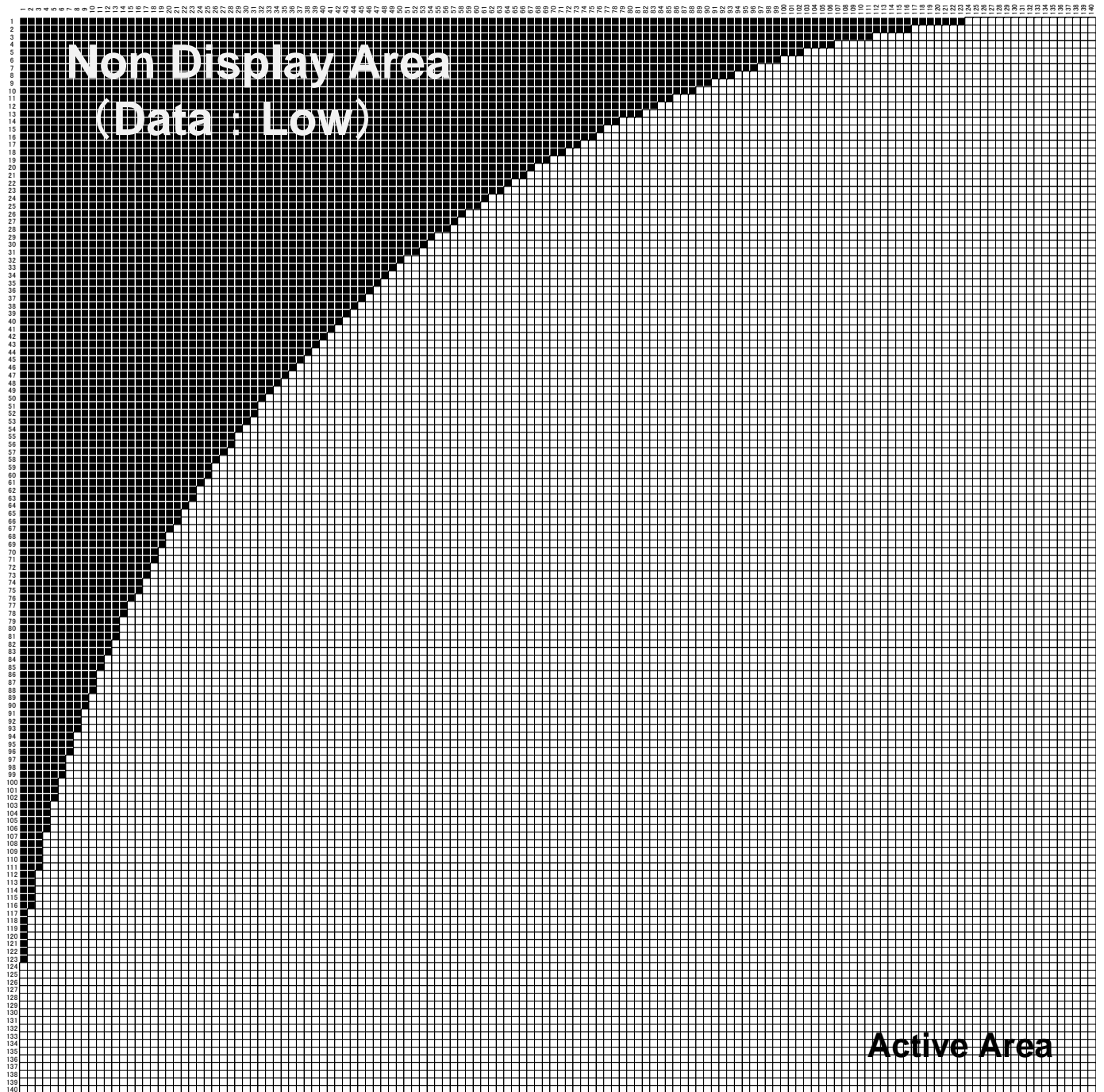
- 1) LPB and SPB are both high; 100% brightness
- 2) LPB is high, SPB is low; 67% brightness
- 3) LPB is low, SPB is high; 33% brightness
- 4) LPB and SPB are both Low; 0% brightness

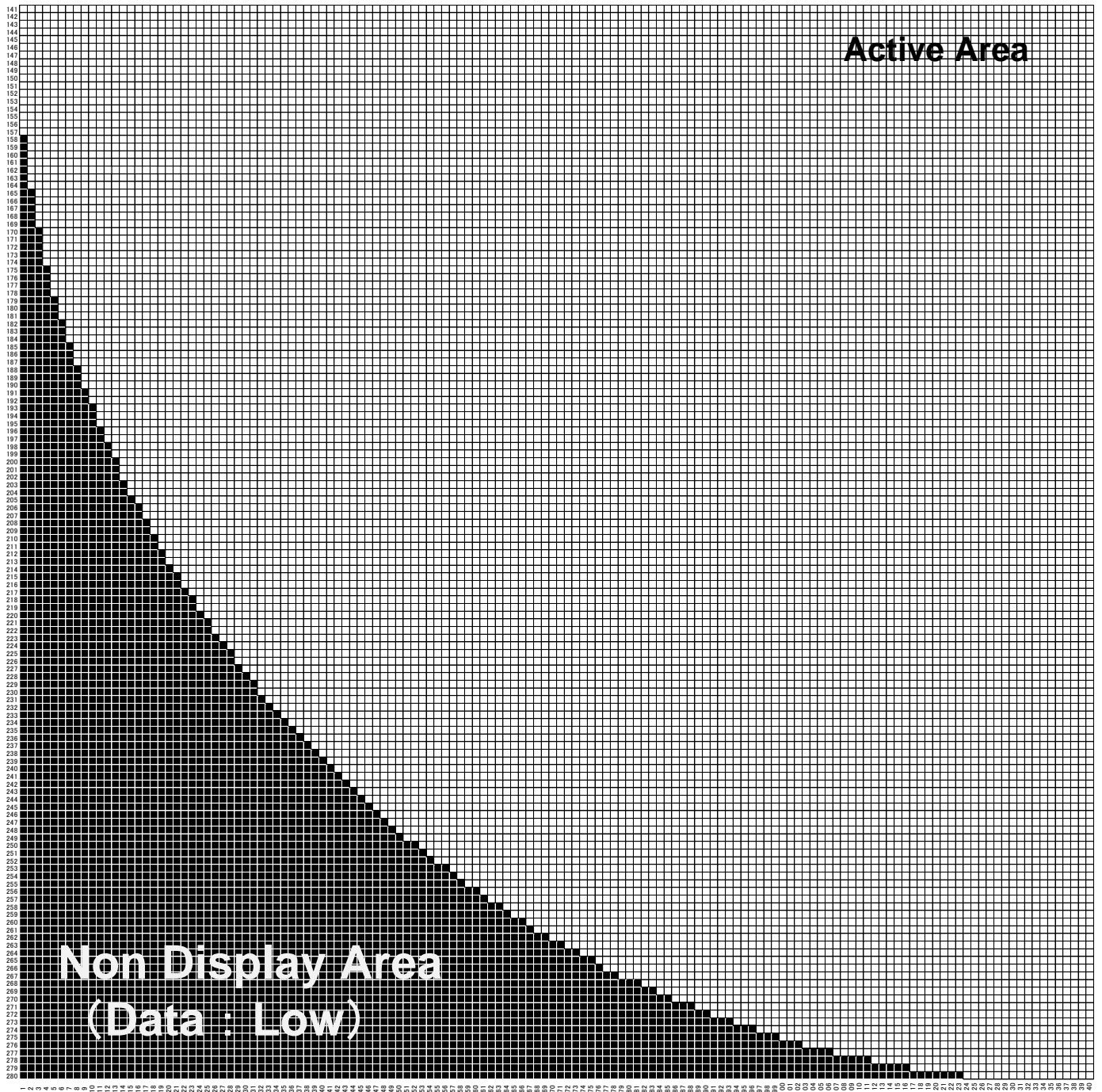
4.1 PIXEL CONFIGURATION

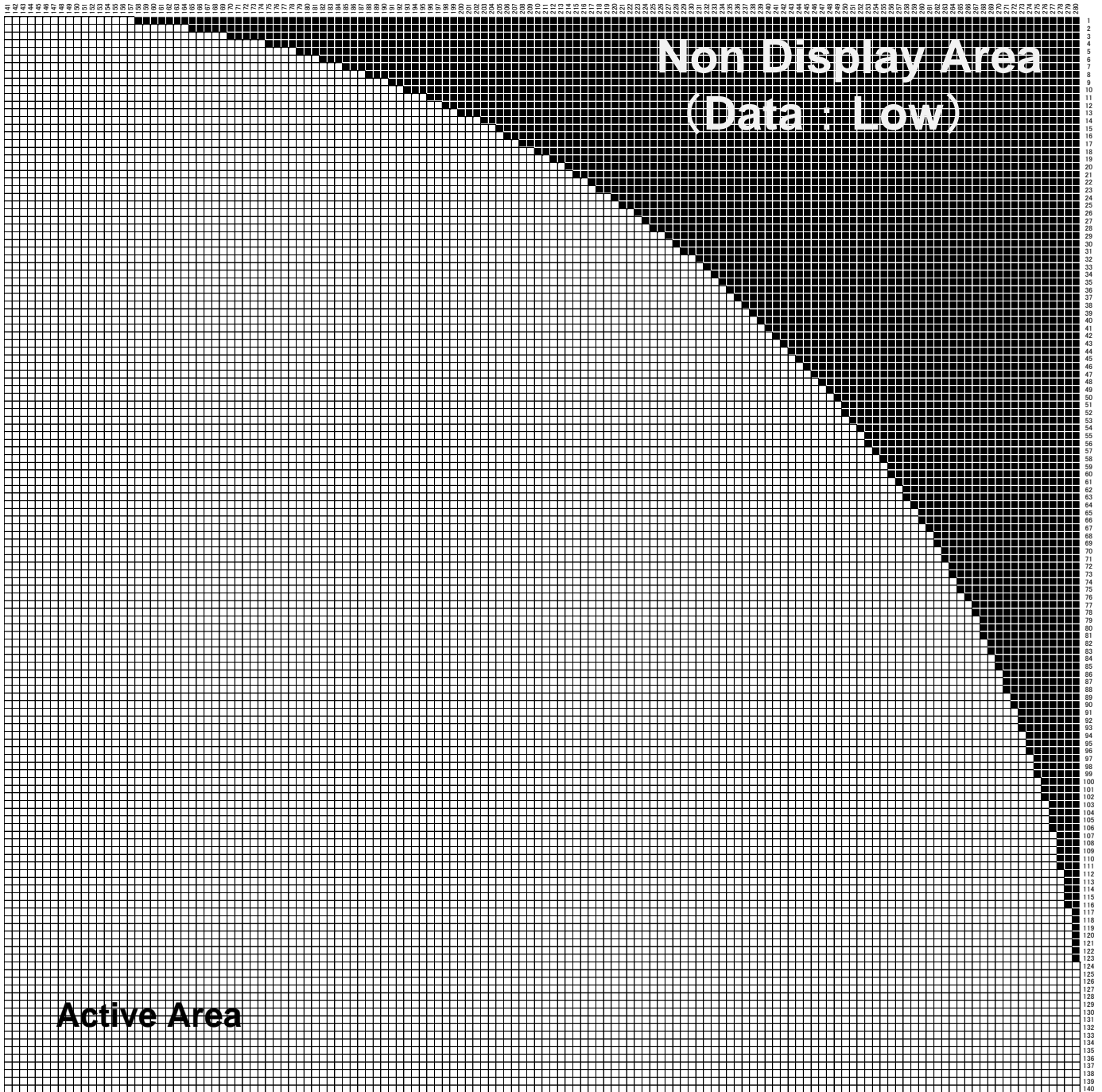


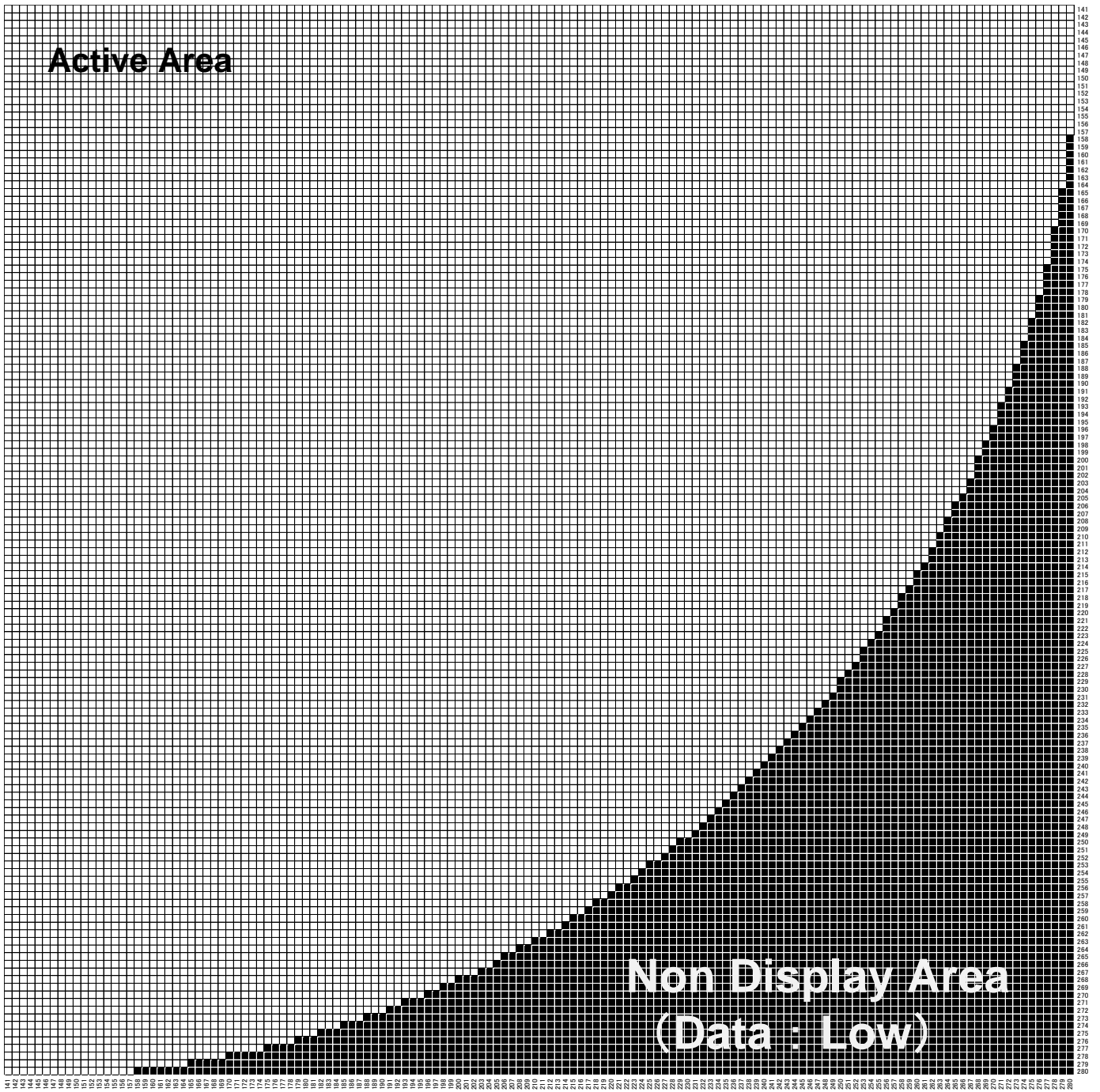
4.2 PIXEL ADDRESS MAP

The Active area of this LCD is round in shape.
Thus input square image (280x280 pixels) is cropped to fit active area.
Keep RGB signal Low out of the active area to reduce power consumption.









5. OPTICAL SPECIFICATION

5.1 OPTICAL CHARACTERISTICS

5.1.1 REFLECTIVE MODE

Driving Condition: VDD1=3.2V, VDD2=4.5V, VCOM frequency = 60Hz±10%

Item	Symbol	Temp. (°C)	Rating			Unit	Definition (Measurement setup)	Remark
			Min.	Typ.	Max.			
Contrast	CR	25	10	20	-	-	1	
Response	T_r	25	-	3	6	ms	2	Black → White
	T_d		-	6	10			White → Black
Color coordinates	R_x	25	-	0.505	-	-	3	
	R_y		-	0.315	-			
	G_x		-	0.300	-			
	G_y		-	0.445	-			
	B_x		-	0.170	-			
	B_y		-	0.175	-			
	W_x		-	0.315	-			
	W_y		-	0.338	-			
NTSC ratio	-	25	(16)	23	-	%	4	*Reference value
Reflectance	-	25	(18)	23	-	%	Basic measurement condition & Measurement system	*Reference value
Viewing Angle (CR>2)	θ_L	25	45	60	-	deg	5	Horizontal
	θ_R		50	65	-			Vertical
	θ_T		50	65	-			
	θ_B		45	60	-			

*() : Reference value

5.1.2 TRANSMISSIVE MODE

Driving Condition: VDD1=3.2V, VDD2=4.5V, VCOM frequency = 60Hz±10%

Item	Symbol	Temp. (°C)	Rating			Unit	Definition (Measurement setup)	Remark
			Min.	Typ.	Max.			
Transmittance	T	25	-	(0.60)	-	%	6	*Reference value

*() : Reference value

5.2 DEFINITION AND CONDITION OF OPTICAL CHARACTERISTICS

5.2.1 DEFINITIONS OF OPTICAL CHARACTERISTICS

Definition 1

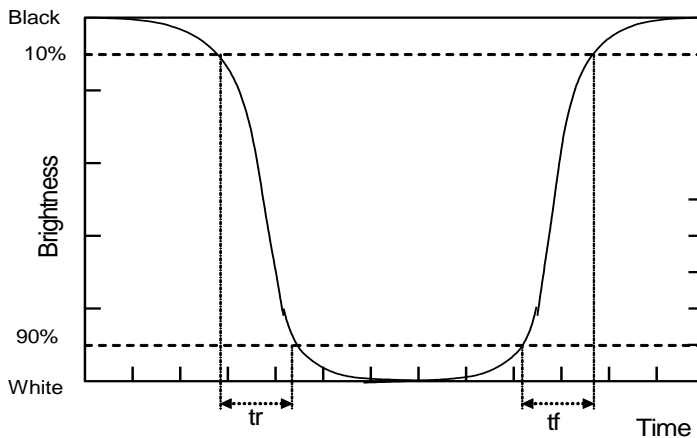
This is a ratio between the screen surface reflectance(transmittance) of the white raster and the black raster.

$$\text{Contrast ratio (CR)} = \frac{\text{Reflection(Transmission) intensity on all pixels White}}{\text{Reflection(Transmission) intensity on all pixels Black}}$$

Definition 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

Definition 3

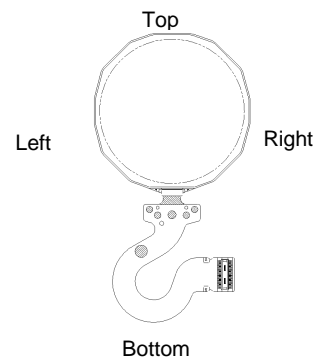
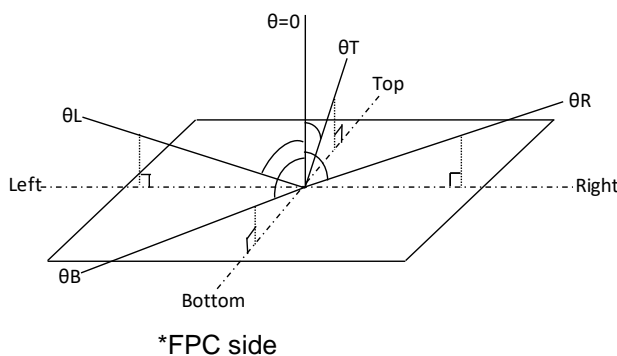
This is the x-y coordinate of Red, Green, Blue and White colors specified on the CIE1931 chromaticity diagram. (* It is not a guaranteed value)

Definition 4

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

Definition 5

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



Definition 6

Transmittance and contrast are defined by the result of measuring backlight provided by Japan Display Inc.

- Measurement method of optical characteristics -

< Basic measurement conditions >

a) Driving voltage

VDD1 = 3.2V, VDD2 = 4.5V

b) Measurement temperature

25°C unless otherwise specified

c) Measurement point

Center of the Active area (one point) unless otherwise specified

d) Measurement equipment

Reflective mode: LCD-5200 (Otsuka Electronics) or similar instrument

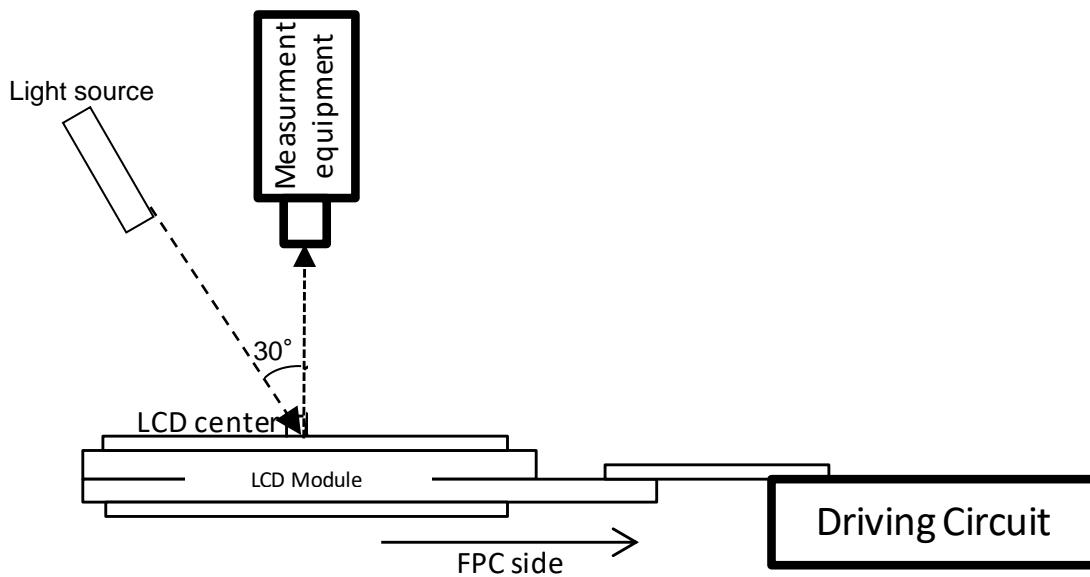
Transmissive mode: CS-2000A or similar instrument

f) Light source

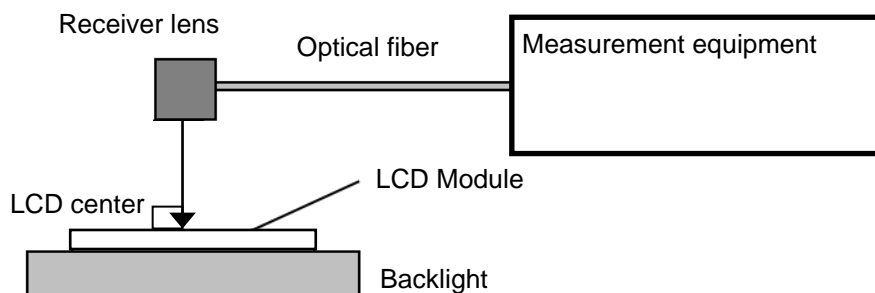
Parallel light source

- Light source input direction: form TOP side (30°)
- Light source receive direction: at LCD center (0°)

< Measurement system- I for reflective mode >



< Measurement system- II for transmissive mode >



6. INSPECTION

6.1 QUALITY STANDARD

6.1.1 INSPECTION CONDITION

(1) Ambient Conditions

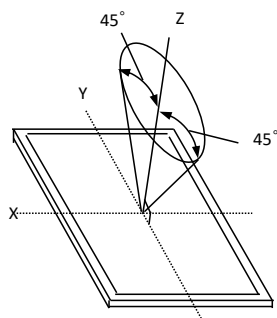
Temperature : 25 °C ($\pm 5^{\circ}\text{C}$)
Humidity : 60% ($\pm 20\%$)
Ambient Luminance : 1000 – 2000 lux
Supply Voltage : VDD1=3.2(V) / VDD2=4.5(V)

(2) Viewing Distance

The distance between the LCD and the inspector's eyes should be 30cm ($\pm 5\text{cm}$).

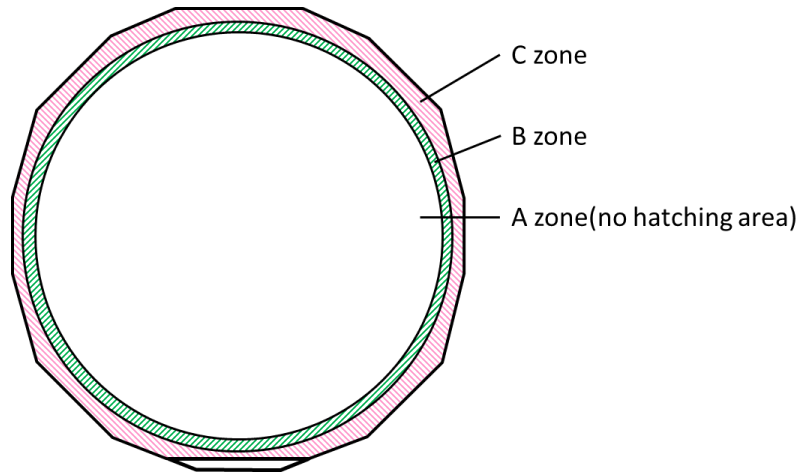
(3) Viewing Angle

Viewing angle shall be ± 45 degrees from the vertical direction as shown below.



6.1.2 ZONE DEFINITION

- A zone : Active area
B zone : Viewing area
C zone : Except A and B zone



*For detail dimensions refer to outline drawing.

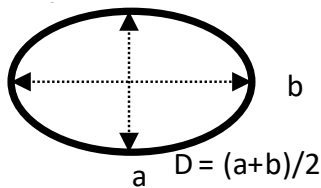
6.1.3 TREATMENT OF PROBLEMS

If there are any troubles which are concerned with our products assembled at your company's manufacturing processes, both companies shall jointly investigate and resolve the causes.

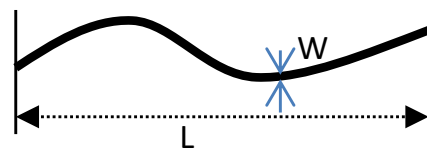
6.2 DISPLAY APPEARANCE STANDARDS

Item		Zone	Criteria		Remark
Name	Cause		Size(mm)	N.	
Dot type defect	B/W spot (Dent in glass or Upper polarizer, Particle, Swell) Bright/Dark dot defect	A	$D \leq 0.15$	Ignore	Keep two defect distance more than 5mm
			$0.15 < D \leq 0.25$	2	
			$0.25 < D$	0	
		B	$D \leq 0.25$	Ignore	
			$0.25 < D \leq 0.3$	3	
			$0.3 < D$	0	
C	Ignore				
Line type defect	Scratch on polarizer or Foreign material between Upper polarizer and glass	A	$W \leq 0.03$	Ignore	Keep two defect distance more than 5mm
			$0.03 < W \leq 0.08, L \leq 2$	2	
			$0.08 < W$ or $2 < L$	0	
		B	$W \leq 0.10, L \leq 3$	3	
			$0.10 < W$ or $3 < L$	0	
		C	Ignore		
Air bubble	Air bubble	A	$D1 \leq 0.25$	2	
			$D2 \leq 0.20$	2	
			$0.5 < D1 + D2$	0	
		B	Ignore		
		C	Ignore		

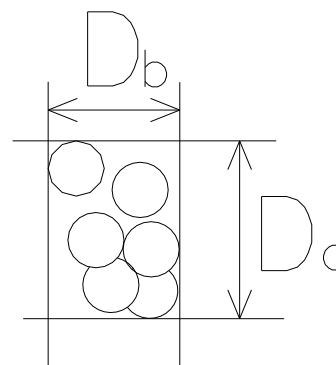
Dot type defect



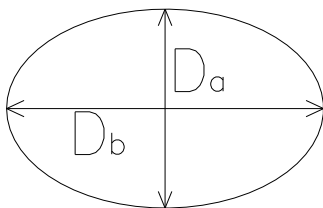
Line type defect



Aggregate of small air bubbles



Big air bubble



*When there is an agreement limit samples, Item is judged according to the limit sample.

*Total defect quantity: A zone ($N \leq 3$) * each inspection (lighting / appearance) , B zone ($N \leq 5$)

*Other items are to be decided by agreement between both parties.

*Big air bubble: The longer one is defined as D1 among D_a and D_b .

*Aggregate of small air bubbles: The longer one is defined as D2 among D_a and D_b .

6.3 EXTERNAL APPEARANCE STANDARDS

Item	Criteria		Remarks
	Size(mm)	Number	
Chipping	(A) $W \leq 3, L \leq 0.2, T = 1/2t$	Ignore	Fig.1
	(B) $W \leq 3, L \leq 0.6, T < 1/2t$	Ignore	Fig.2
	Except (A) & (B)	0	
Chipping on the corner	Showing on below figure		Fig.3 & Fig.7
Projection	$W \leq 0.3, L \leq 5.0$	Ignore	Fig.4
	$0.3 < W$ or $5.0 < L$	0	
Corner burr	$W \leq 0.2, L \leq 0.5$	Ignore	Fig.5
	$0.2 < W$ or $0.5 < L$	0	
Crack (*6-1)	$W \leq 3, L \leq 0.5$	Ignore	V-shaped chipping included, Fig.6
	$3 < W$ or $0.5 < L$	0	

Note) (*6-1)"Crack" means the one which would progress further.

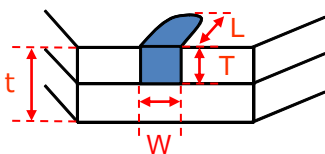


Fig.1

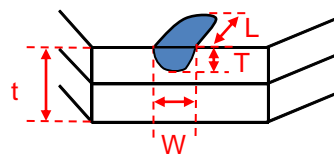


Fig.2

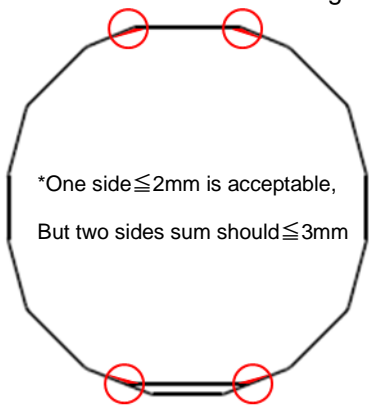


Fig.3

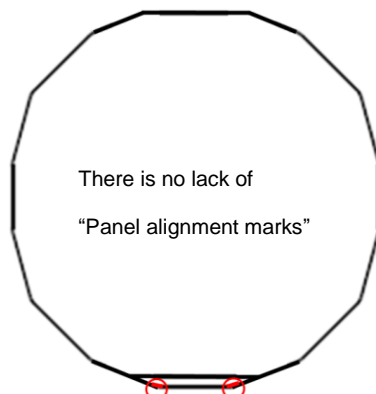


Fig.7

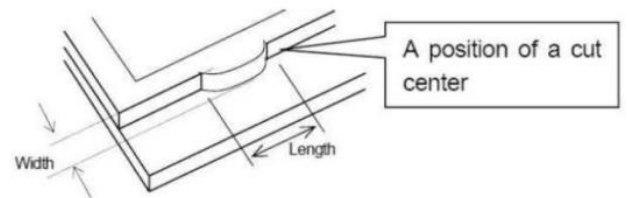


Fig.4

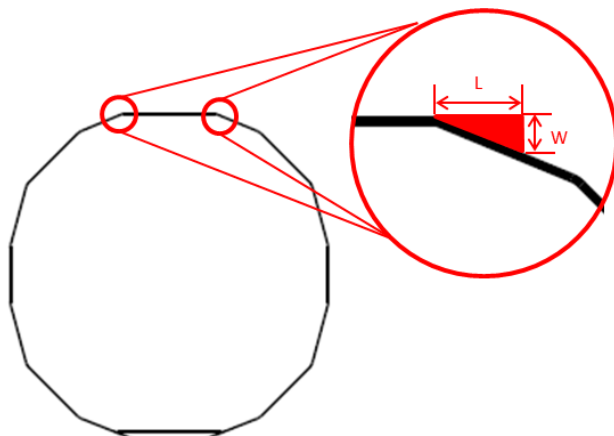


Fig.5

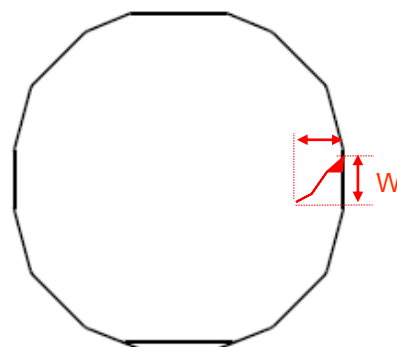


Fig.6

7. RELIABILITY SPECIFICATION

7.1 CONDITIONS OF RELIABILITY AND MECHANICAL TEST

No.	TEST ITEM	CONDITION		REMARK
1	High Temperature Storage	Ta=80° C	240h	
2	Low Temperature Storage	Ta=-30° C	240h	
3	High Temperature & High Humidity Storage	Ta=60° C / 90%RH (No condensation)	240h	
4	High Temperature & High Humidity Operation	Ta=40° C / 90%RH (No condensation)	240h	
5	High Temperature Operation	Ta=70° C	240h	
6	Low Temperature Operation	Ta=-20° C	240h	
7	Thermal shock (non-operating)	Ta=-20° C to 70° C (30min each)	50cycles	
8	ESD	HBM IEC 61340-3-1, ESD STM5.1 V = ±1.0kV (Contact) R = 1.5kΩ, C = 100pF	1 time each terminal	
9	Packing Vibration	Random Vibration 5~500Hz	101min Direction Z	(*7-1)
10	Packing Drop	Height 60cm, 1 corner 3 edges, 6 surfaces	1 time Each direction	(*7-1)

Note)

(*7-1) Tests are done using conducted package.

Above test evaluate for development. It is not guaranteed value for lot acceptance.

If a nonconformance is found, both parties will have a discussion to solve it.

7.2 CRITERIA FOR JUDGEMENT

After the above tests, return samples to the normal temperature and moisture environment in the thermostat chamber room over 30 minutes not to condense. Inspect samples kept for more than 1 hour after pulling them out of the thermostat chamber room.

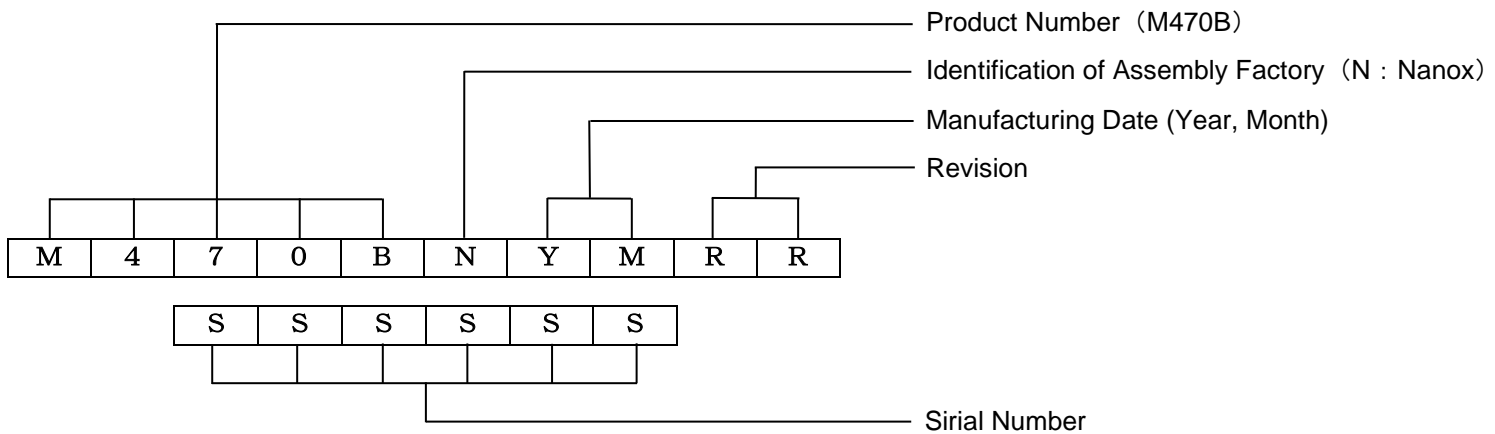
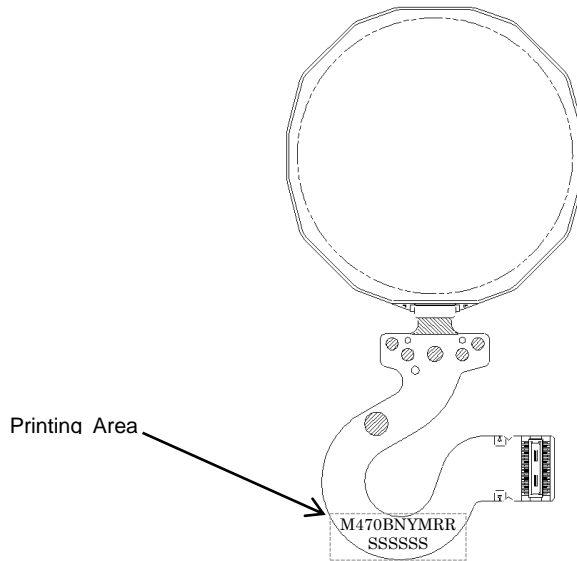
(1) There shall be no abnormality in the functions (Ex. No display, abnormal display, line defects).

(2) There shall be no serious degradation.(Ex. Brightness uniformity, reversible changes, optical changes due to polarizer are ignored.)

8. DESIGNATION OF LOT MARK

8.1 LOT MARK

Lot mark is printed on the FPC of the LCD module.



Year	Figure in lot mark
2021	1
2022	2
2023	3
2024	4
2025	5

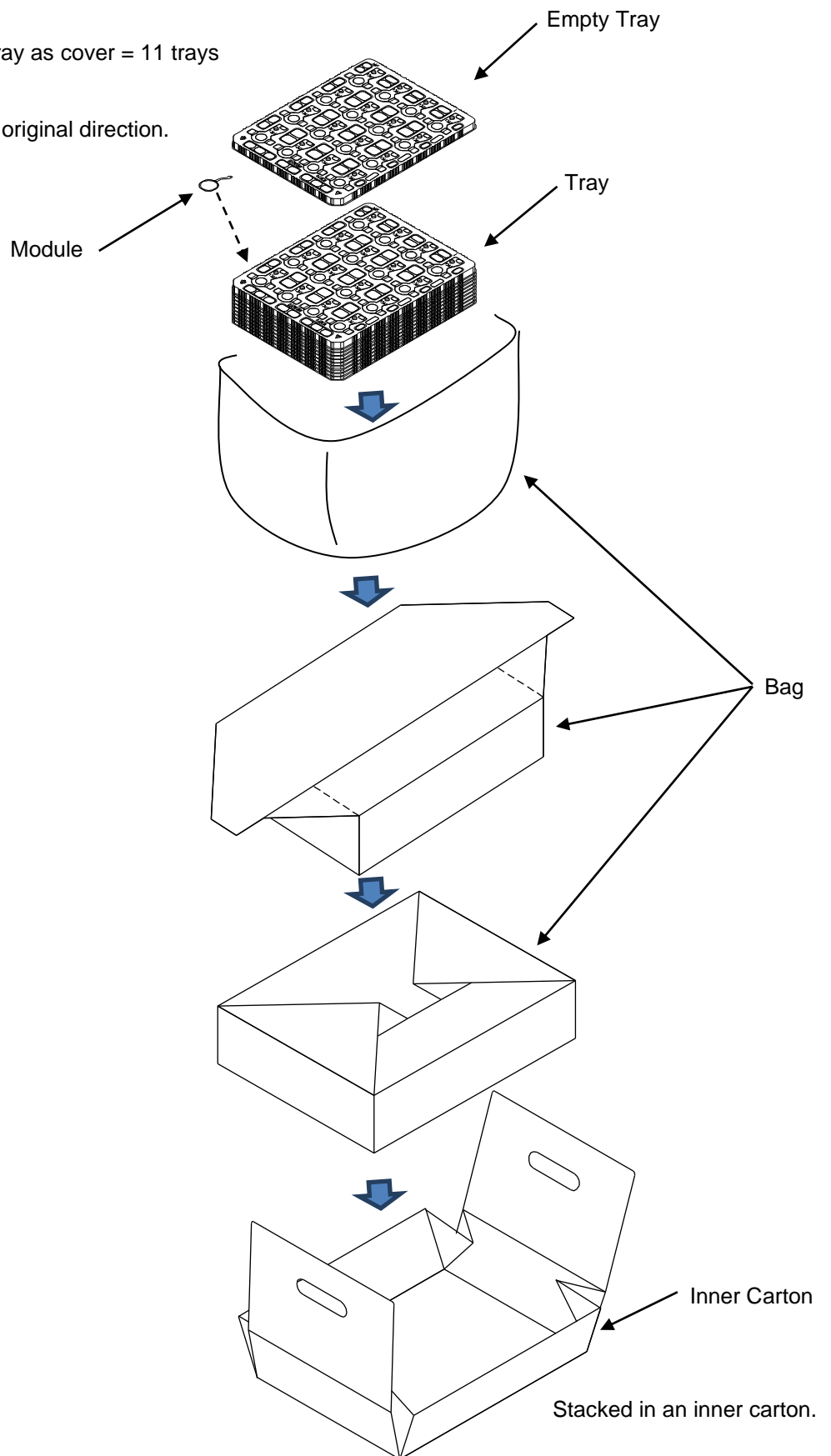
Month	Figure in lot mark	Month	Figure in lot mark
Jan.	A	Jul.	G
Feb.	B	Aug.	H
Mar.	C	Sep.	I
Apr.	D	Oct.	J
May	E	Nov.	K
Jun.	F	Dec.	L

9. PACKING SPECIFICATIONS

9.1 INNER CARTON

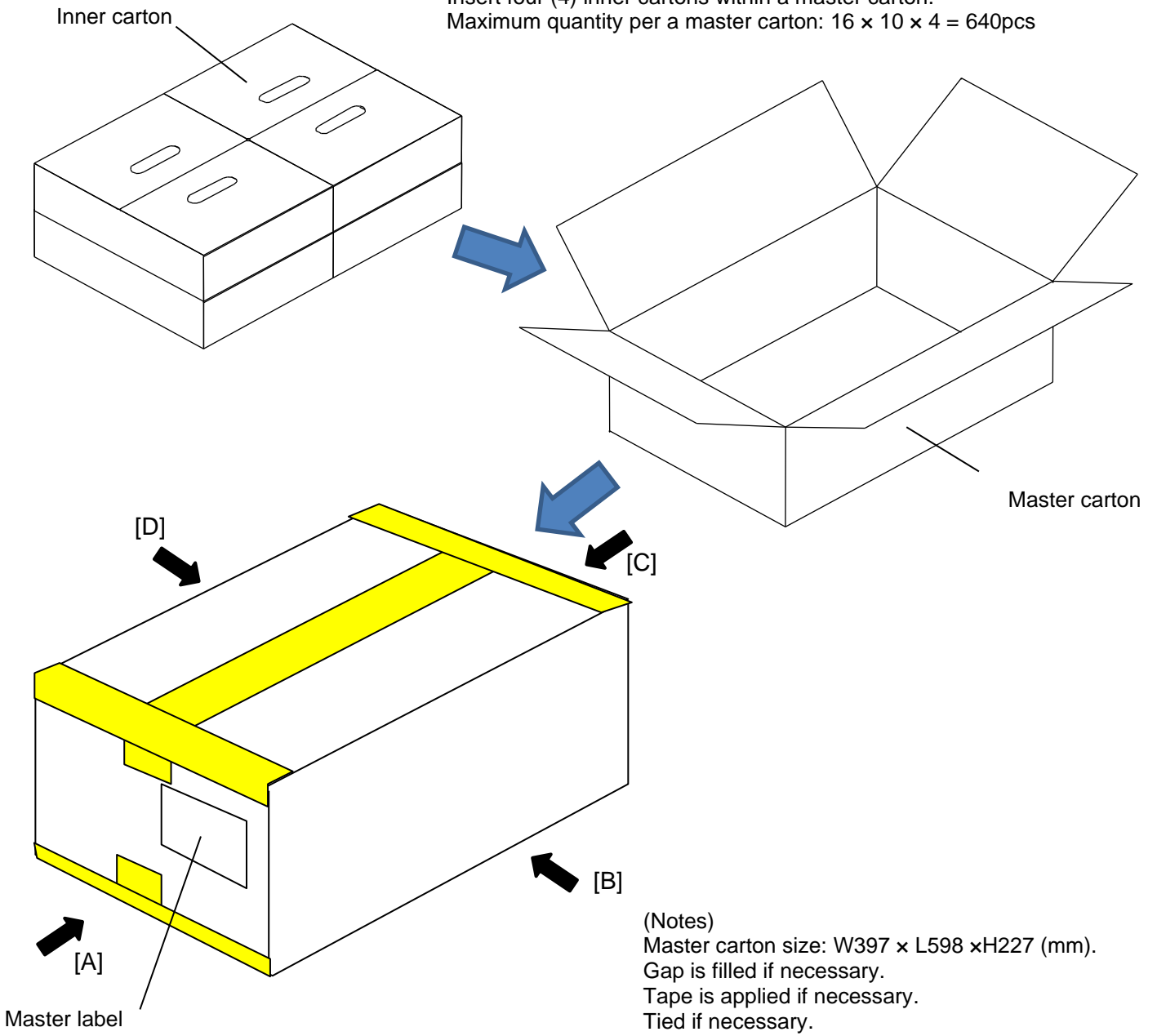
16pcs LCD modules per tray
10 trays with products + empty tray as cover = 11 trays

Note)
Tray orientation must be kept its original direction.




9.2 MASTER CARTON

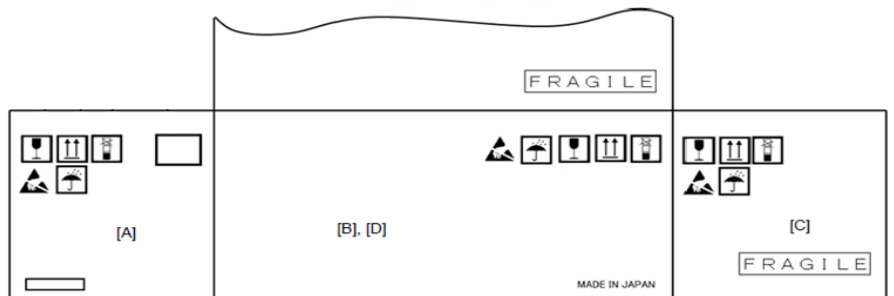
Insert four (4) inner cartons within a master carton.
 Maximum quantity per a master carton: $16 \times 10 \times 4 = 640$ pcs



Contents of master label

Japan Display Inc.	
200140401	
LPM014M470B	640 pcs
21-12-15-0000	
<RMK>	MADE IN PHILIPPINES
440-00284-01	
LPM014M470A-03	
	
1MF0001N 200140401 640	

Indication onto [A] [B] [C] [D] on master carton are shown as below



10. LCD MODULE USAGE AND PRECAUTIONS

10.1 HANDLING

- (1) The display panel is made of glass. Do not subject it to mechanical shock such as dropping it from a high position, etc.
- (2) If the display panel is damaged and internal liquid crystal substance leaks out, be sure not to inhale or consume it. If the internal liquid crystal substance comes into contact with skin or clothing, promptly wash it off using soap and running water.
- (3) Do not apply excessive force on the surface, perimeter or adjoining areas of LCD module since this may cause display panel color tone to vary.
- (4) The polarizer covering the display panel surface of the LCD module is soft and can be easily scratched or dented. Handle this polarizer carefully.
- (5) If the surface polarizer becomes contaminated, use the following recommended or equivalent adhesive tape for contaminants removal.
 - Scotch-brand mending tape (No. 810)
- (6) Do not breathe on the display surface or use Ethyl Alcohol solvent for contaminant removal as polarizer discoloration may occur. Furthermore, solvent other than mentioned above may also damage the polarizer. Especially, do not use the followings.
 - Water
 - Ketones
 - Aromatic solvents
- (7) When mounting the LCD Module, be sure that it is free from twisting, warping, or distortion. Any stress can have great influence to the display quality. Also, in cases where outer case or frame is included, be sure to secure sufficient stiffness on the outer case or frame for a robust design.
- (8) Do not apply pressure at or around the FPC bonding area and the surrounding area.
- (9) Do not attempt to disassemble or rework the LCD module.
- (10) To prevent destruction of the elements by static electricity, be careful to maintain an optimum working environment.
 - Be sure to ground your body before handling the LCD module.
 - Make sure that solder guns and all other tools required for assembly have been grounded.
 - To reduce occurrence of static electricity, avoid using this product in dry environments.
 - A protective film has been attached to the surface of the LCD panel. When peeling off the protective film, be careful to prevent electrostatic discharges.
- (11) To minimize performance degradation of the LCD module caused by destructive forces such as static electricity, etc., avoid direct contact to the following sections when handling the LCD module.
 - terminal electrodes of connector
 - wiring pattern on FPC
- (12) LCD Panel surface is protected by a protective film layer. This protective film must be removed before final product installation. After removal of protective film layer, some adhesive residues maybe left on the LCD panel, especially after long storage period, please refer to section 5) listed above for proper contaminant removal procedure.
- (13) Take precaution to minimize corrosion of electrodes. Corrosion of electrodes is accelerated by moisture, condensation or a current flow in a high-humidity environment.
- (14) Do not apply excessive pressure to the FPC part. Force type such as twist, warp, etc., may damage FCP patterning traces.
- (15) Do not use sharp, pointy or rigid tools when handing LCD panels. These objects can scratch or nick the glass panel which can cause it to crack.

- (16) Do not touch or handle the LCD module directly with bare hands. Residue of dirt, oil or water may have the possibility to cause corrosion. Be sure to wear finger sacks or gloves when handling LCD modules. When holding an LCD panel module, carefully hold the panel by the edges of the glass plate.
- (17) Avoid using LCD module under condensation or high humidity environment because polarizer etc. maybe damaged in these conditions.
- (18) Trays are used to package LCD modules for shipment. If LCD modules scratch the tray during shipment, material of the scratched tray may be left on LCD modules. In such case, clean up LCD modules after removal from trays.
- (19) When installing LCD module, don't apply excess stress of bending or stretching to the input cable
- (20) Keep NC terminal open electrically.
- (21) After storage under high humidity or condensation environment, keep LCD module under room temperature more than 30 minutes before operation.
- (22) Take precautions to handling LCD module because the glass plate has very keen edges.

10.2 DESIGN OF APPLICATION

- (1) The absolute maximum ratings represent the rated values which LCD module cannot exceed. When LCD modules are used beyond this rated value, the operating characteristics may be adversely affected.
- (2) To prevent the occurrence of erroneous operation caused by noise, special attention on satisfying VIL, VIH specified values is required. This includes taking the precautionary measures of using short cables for signal transferring.
- (3) An inherent characteristic of liquid crystal display is its temperature dependency. Be sure to use the LCD modules within the specified operating temperature range, as recognition of the display becomes difficult when the LCD module is used outside its range. Also, keep in mind that the voltage levels necessary for clear display images will vary according to temperature.
- (4) It is recommended that power supply lines to include current surge protection. (Fuse etc. recommend value: 0.5A)
- (5) Note the peripheral devices can cause mutual noise interference with LCD modules. Especially, input devices such as Touch Panel, etc., may output operational level by radiation noise even when these devices are not in operation. Actual performance confirmation and verification under actual usage environment by actual final product is highly recommended.
- (6) To avoid EMI, preventive measures should be implemented in the final product.
- (7) Display abnormality may occur with sudden removal of power supply such as device battery. Sudden removal of power supply shall be avoided at all time. LCD module quality cannot be guaranteed under such condition.
- (8) Ensure sufficient light shading measures during design phase and when assemble the LCD module.
- (9) Ensure sufficient light shading measures in the inspection process.
- (10) Similar to general electronic components, ESD may cause LCD IC to malfunction. ESD preventive measures should be considered around the LCD module.
- (11) While display data may be kept, data can be easily changed by external noise. Noise shall be minimized at device or system level.
- (12) As unexpected noise may occur, periodic refresh operation such as resend the command and display data is highly recommended as part of the software routine.
- (13) When logic circuit power is off, do not apply any signals to the input terminals.
- (14) Do not use other components such as FPC or other features to fix the LCD module position, as pressure/tension may produce undesired result such as FPC trace crack.

10.3 DISPLAY CHARACTERISTICS

- (1) Because the optimum LCD driving voltage depends on the ambient temperature, display may slightly flicker at the environment of high temperature.
- (2) One of the special characteristics of liquid crystal is that it freezes when stored at the temperature below the storage temperature range. Such freezing may cause orientation defects or bubbles (black or white) to appear in the LCD panel. Bubbles may also occur if the panel receives an impact in a low-temperature environment.
- (3) If the LCD module is left operating for a long time with the same display showing, the displayed pattern may leave traces on the screen or the contrast may become inconsistent.

10.4 KEEPING THE PRODUCTS

(1) When keeping LCD modules, avoid the following condition or environment.

- Exposure to direct sunlight or fluorescent lamps lightings.
- High-temperature/high-humidity or very low-temperature (below 0°C) environments.
- Exposure to water droplets, condensation, etc.

Furthermore, keep LCD modules in anti-static bags to prevent static electricity charge ups. Whenever possible, LCD modules should be stored in the same conditions in which they were shipped from Japan Display Inc.

(2) Take precaution to minimize corrosion of electrodes. Corrosion of electrodes is accelerated by moisture, condensation or a current flow in a high-humidity environment.

(3) Recommended keeping conditions.

- Keeping environment : +15°C to 35°C, less than 65%RH
- Duration: up to 2 months after shipping date

(4) The shipping carton must not be stacked up over 1.5m in height.

10.5 DISPOSAL

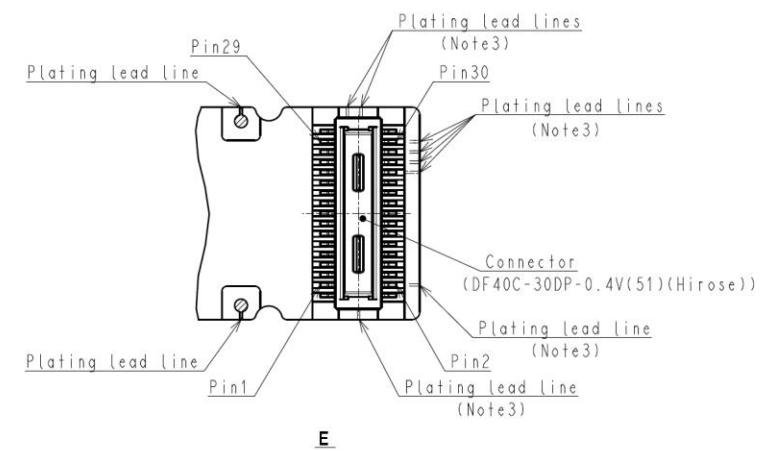
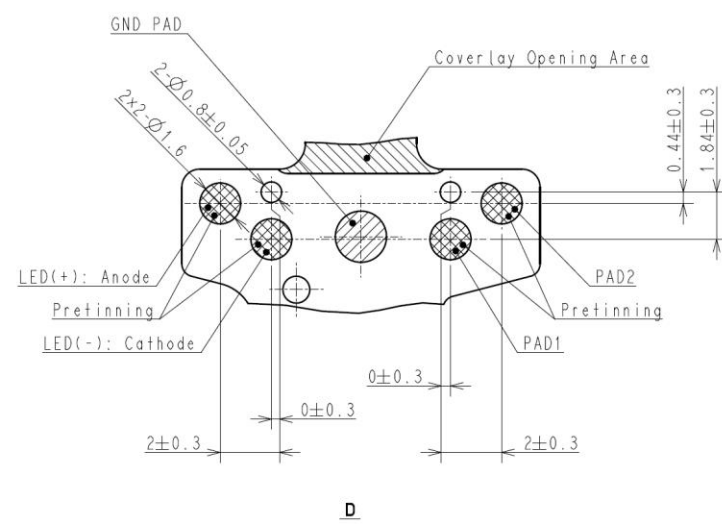
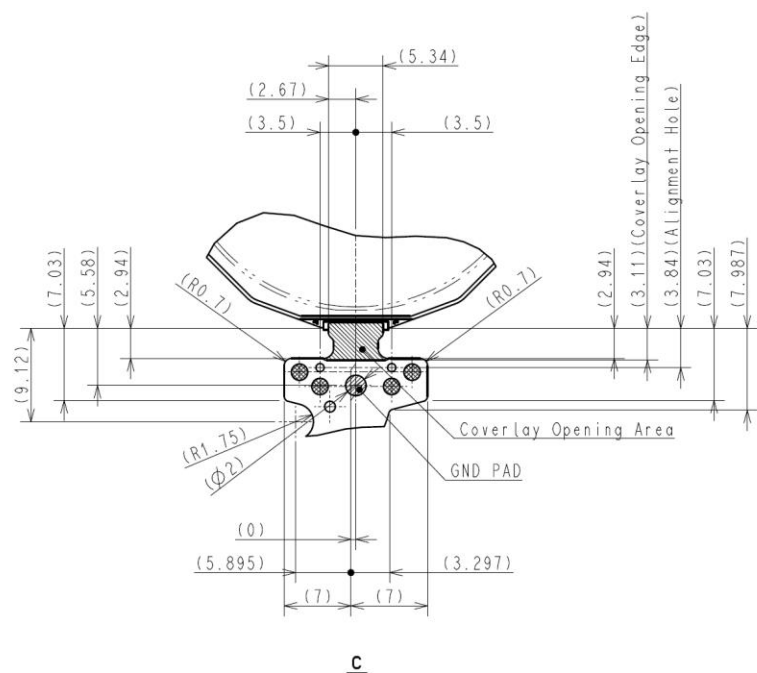
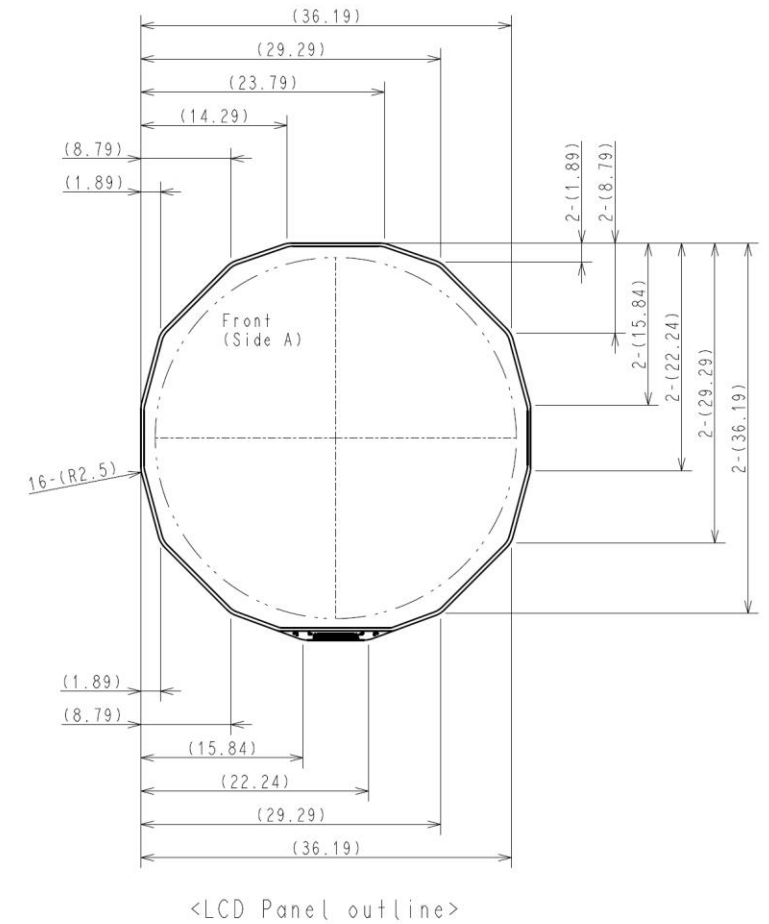
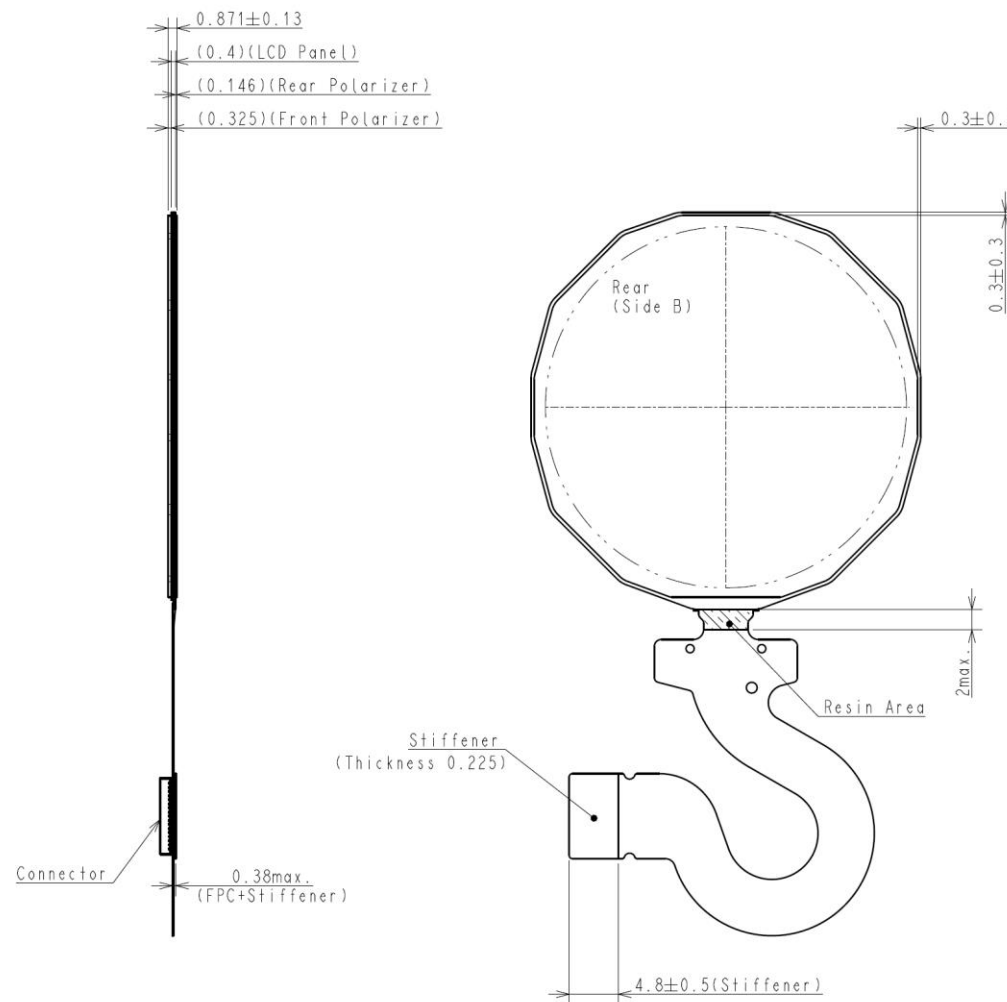
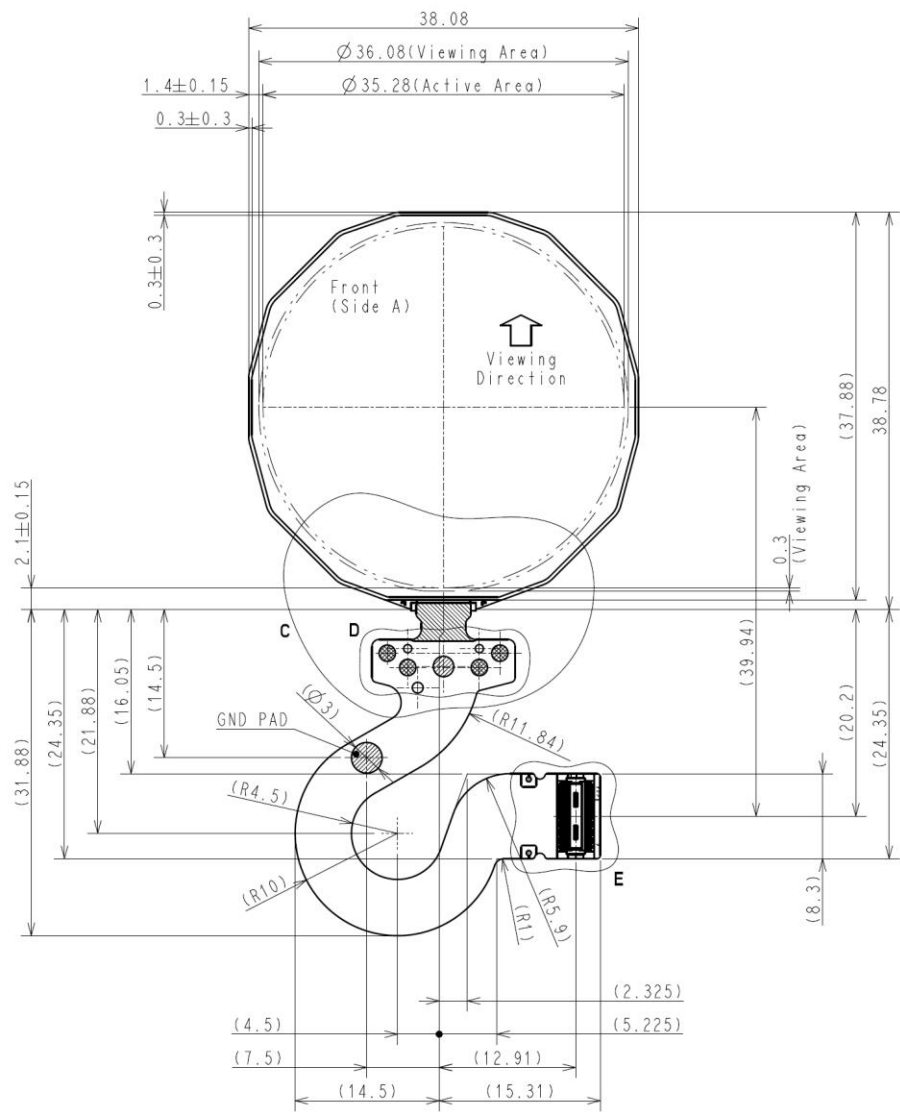
(1) When disposing LCD modules, consult company specialized in industrial waste treatment which is permitted by the government or local authority. When incineration is the method of LCD module disposal, law of environmental hygienic must be obeyed.

10.6 OTHERS

(1) This product is designed to be used in ordinary electronic devices. Do not use this product in other applications, especially in devices that may cause direct bodily damage to end users (such as aerospace equipment, traffic control equipment, medical equipment, life-support system equipment, or safety equipment).

(2) Japan Display Inc. shall not be responsible for defects that occur in this product or in equipment connected to this product if the product is used in an environment that exceeds the ranges specified in this document, or in an environment not described in this document.

·OUTLINE DRAWING



Note 1) Cosmetic imperfection will be allowed outside the Viewing Area.
 2) Viewing Direction is the angle to get best reflective performance.
 3) Please avoid contact of plating lead lines with any conductive object.
 4) All dimensions are in millimeters(mm).
 5) Unless otherwise specified, tolerance shall be ±0.2.

Scale: NTS