

LIQUID CRYSTAL DISPLAY MODULE

Product Specification

CUSTOMER	Standard
CUSTOMER PART NUMBER	
PRODUCT NUMBER	DBC-24032035-1AR

Product Mgr	Design Eng
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Date: 10-Feb-12	Date: 10-Feb-12

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REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECN no.
1.0				First Issue	
1.1	10-Feb-12	8	2.3	Added Serial Label / Print	

1 MAIN FEATURES

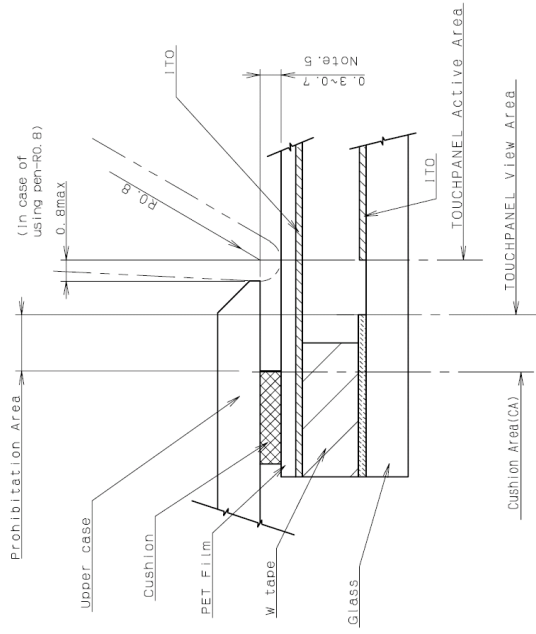
ITEM	CONTENTS
Screen Size	3.5" Diagonal
Display Format	240 x RGB x 320 Dots
N° of Colour	262k
Overall Dimensions	63.50 mm (H) x 85.00 mm (V) x 4.33 mm (D)
Active Area	53.64 mm (H) x 71.52 mm (V)
LCD Type	TFT
Mode	Sunlight Readable
Interface	6-bit RGB, parallel input
Backlight Type	LED
Operating Temperature	-20°C ~ +70°C
Storage Temperature	-30°C ~ +80°C
RoHS compliant	Yes

2 MECHANICAL SPECIFICATION

2.1 MECHANICAL CHARACTERISTICS

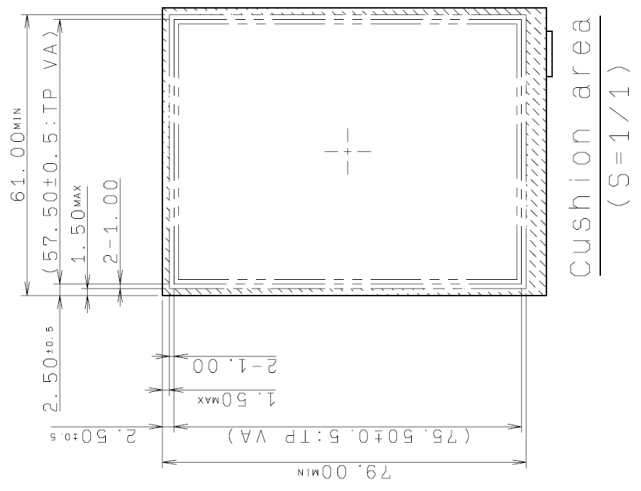
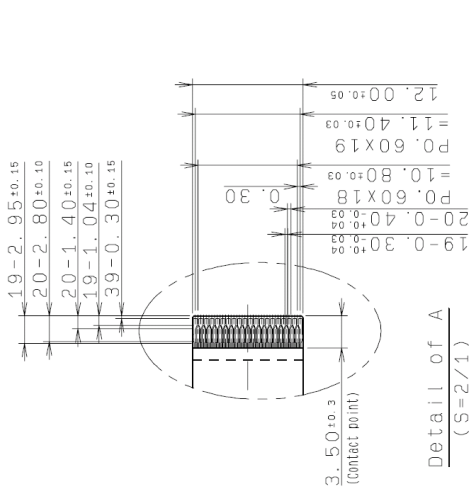
ITEM	CHARACTERISTIC	UNIT
Display Format	240 x RGB x 320	Dots
Overall Dimensions	63.50 (H) x 85.00 (V) x 4.33 (D)	mm
Bezel Opening Area	57.44 (H) x 75.32 (V)	mm
Active Area	53.64 (H) x 71.52 (V)	mm
Dot Pitch	74.5 (H) x RGB x 223.5 (V)	µm
Weight	43.5	g

Example of Housing Design



Design guidance for the upper case & the cushion

- Note 11: Upper case opening
- a. Please place the upper case opening to maintain the operation by a stylus pen inside the TP response area
 - b. The any pressures in the area between TP response area and TP viewing area is prohibited.
 - c. Please use the appropriate material (PMMA, PC, etc.) as the upper case.
- Note 12: Cushion design
- a. Please put the cushion on the upper case.
 - b. Do not use an adhesive tape to stick on the TP surface.
 - c. Please position the cushion over the cushion area to avoid a short.



2.3 SERIAL LABEL /PRINT

The label / print indicates the least significant digit of manufacture year (1digit), manufacture month with below alphabet (1letter), model code (4 or 5 characters), serial number (6 digits).

* Label / Print Contents

* * ****(*) *****
a b c d

where:

- a The least significant digit of manufacturing year
- b Manufacturing Month:
Jan-A, Feb-B, Mar-C, Apr-D, May-E, Jun-F, Jul-G, Aug-H, Sep-I, Oct-J, Nov-K, Dec-L
- c Model code
35FCC →Made in Japan
35FDC →Made in Malaysia
35FEC →Made in China
- d Serial number, like "000125"

Examples:

Made in Japan
OK35FCC000125
means "manufactured in November 2010, model 35FCC, serial number 000125"

Made in Malaysia
OK35FDC000125
means "manufactured in November 2010, model 35FDC, serial number 000125"

Made in China
OK35FEC000125
means "manufactured in November 2010, model 35FEC, serial number 000125"

3 ELECTRICAL SPECIFICATION

3.1 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit	Applicable terminal
Supply Voltage	VDD	Ta=25°C	-0.3	4.6	V	VDD
Input Voltage for Logic	VI		-0.3	VDD+0.3	V	CLK, VSYNC, HSYNC, DE, D[05;00], D[15;10], D[25;20], STBYB, RESETB, TEST1, TEST2
Touch Panel Input Voltage	VIT		-	7.0	V	XL, YD, XR, YU

3.2 ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit	Applicable terminal
Supply Voltage	VDD		2.7	3.0	3.6	V	VDD
Input Voltage for Logic	VI		0	-	VDD	V	CLK, VSYNC, HSYNC, DE, D[05;00], D[15;10], D[25;20], STBYB, RESETB, TEST1, TEST2
Input Voltage for Logic	VIH		0.7xVDD	-	VDD	V	CLK, VSYNC, HSYNC, DE, STBYB, RESETB, D[05;00]; D[15;10], D[25;20] TEST1, TEST2
	VIL		0	-	0.3xVDD	V	
Current Consumption	IDD	fCLK=6.25MHz Colour bar display	-	6.8	13.6	mA	VDD

3.3 INTERFACE PIN ASSIGNMENT

3.3.1 LCM PIN ASSIGNMENT

Pin No.	Symbol	Function
1	VSS	Ground
2	VSS	Ground
3	VDD	Power supply
4	VDD	Power supply
5	VSS	Ground
6	RESETB	Reset signal. When RESETB is Lo, an internal reset is performed
7	HSYNC	Horizontal sync signal input. (Low active)
8	VSYNC	Vertical sync signal input. (Low active)
9	CLK	Clock signal for data latching and internal counter of the timing controller
10	VSS	Ground
11	D00	Display data (B) 00h: Black D00:LSB D05:MSB Driver has internal gamma conversion.
12	D01	
13	D02	
14	D03	
15	D04	
16	D05	Display data (G) 00h: Black D10:LSB D15:MSB Driver has internal gamma conversion.
17	D10	
18	D11	
19	D12	
20	D13	
21	D14	Display data (R) 00h: Black D20:LSB D25:MSB Driver has internal gamma conversion.
22	D15	
23	D20	
24	D21	
25	D22	
26	D23	Ground
27	D24	
28	D25	Input data effective signal (it is effective for the period of "H")
29	VSS	
30	DE	Standby signal (Hi: Normal operation, Lo: Standby operation)
31	STBYB	
32	TEST1	Connect to Ground
33	XL	X-axis left terminal
34	YD	Y-axis downside terminal
35	XR	X-axis right terminal
36	YU	Y-axis upside terminal
37	TEST2	Connect to Ground.
38	BLH	LED drive power source (Anode side)
39	BLL	LED drive power source (Cathode side)

Recommended connector: Hirose Electric FH23 series [FH23-39S-0.3SHW(05)]

As FCB cable has gold plated terminals, gilt finish contact shoe connector is recommended.

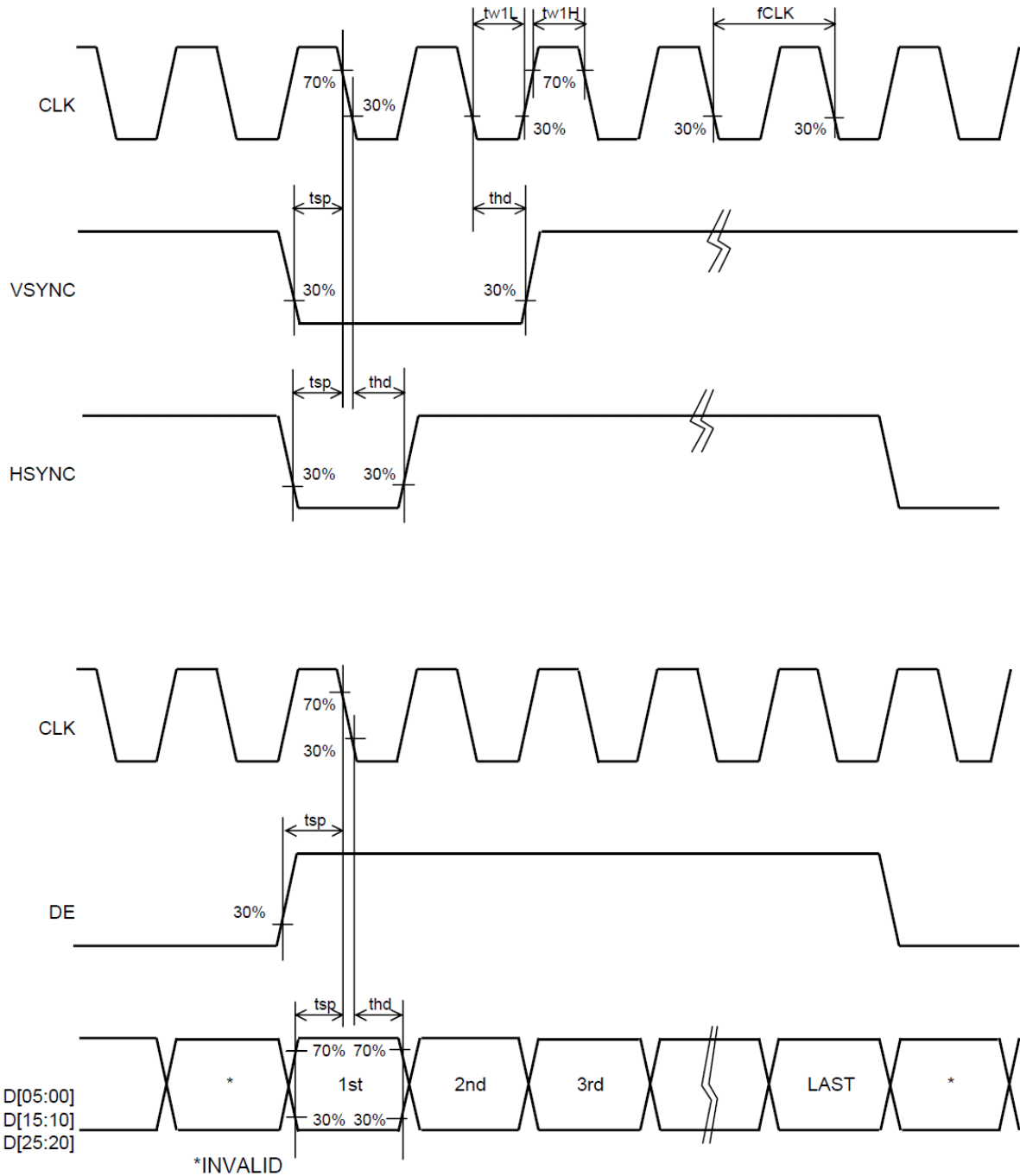
3.4 TIMING CHARACTERISTICS

3.4.1 AC Timing Characteristics

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
CLK frequency	fCLK		4.4	5.6	7.0	MHz	CLK
CLK Low period	tw1L	0.3xVDD or less	15	-	-	ns	
CLK High period	tw1H	0.7xVDD or more	15	-	-	ns	
Input Setup time	tsp		15	-	-	ns	CLK, VSYNC, HSYNC, DE, STBYBD[05:00], D[15:10], D[25:20]
Input Hold time	thd		15	-	-	ns	

3.4.2 AC Timing Diagrams

Switching Characteristics Wave Form



3.4.3 Input Timing Characteristics

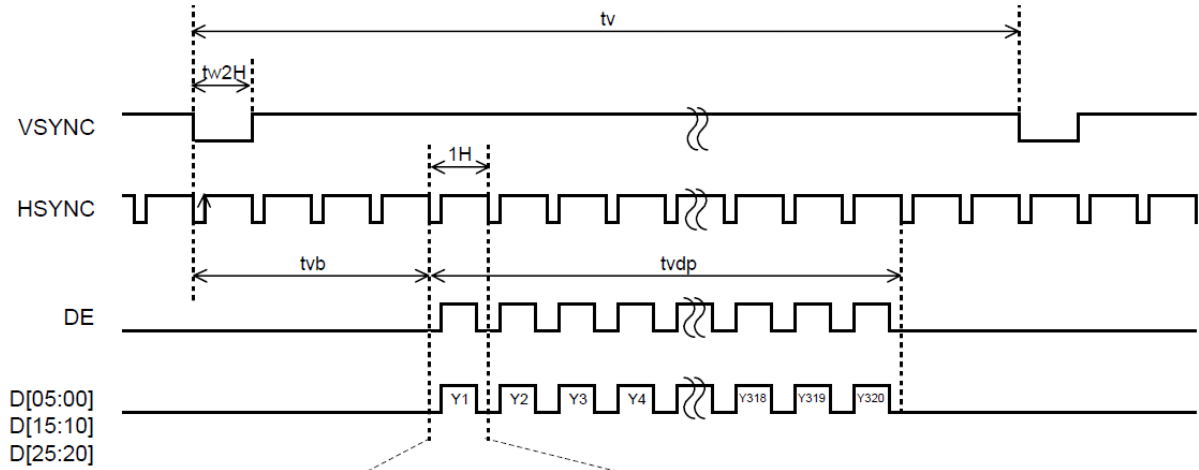
Unless otherwise noted, Ta=25°C, VDD=3.3V, VSS=0V

Item	Symbol	Rating			Unit	Applicable terminal
		MIN	TYP	MAX		
CLK frequency	fCLK	4.4	5.6	7.0	MHz	CLK
VSYNC frequency Note1	fVSYNC	54	60	66	Hz	VSYNC
VSYNC signal cycle time	tv	324	325	348	H	VSYNC, HSYNC
VSYNC pulse width	tw2H	1	-	-	H	
Vertical back porch	tvb	2	-	14	H	VSYNC, HSYNC, DE, D[05:00]; D[15:10], D[25:20]
Vertical display period	tvdP	-	320	-	H	VSYNC, HSYNC, DE, D[05:00], D[15:10], D[25:20]
HSYNC frequency	fHSYNC	-	19.5	-	KHz	HSYNC
HSYNC signal cycle time	th	-	287	402	CLK	HSYNC, CLK
HSYNC pulse width	tw3H	1	-	-	CLK	
Horizontal back porch	thb	2	-	14	CLK	HSYNC, DE, CLK, D[05:00], D[15:10], D[25:20]
DE pulse width	tw4H	-	240	-	CLK	DE, CLK
Horizontal display period	thdp	-	240	-	CLK	DE, D[05:00], D[15:10], D[25:20], CLK

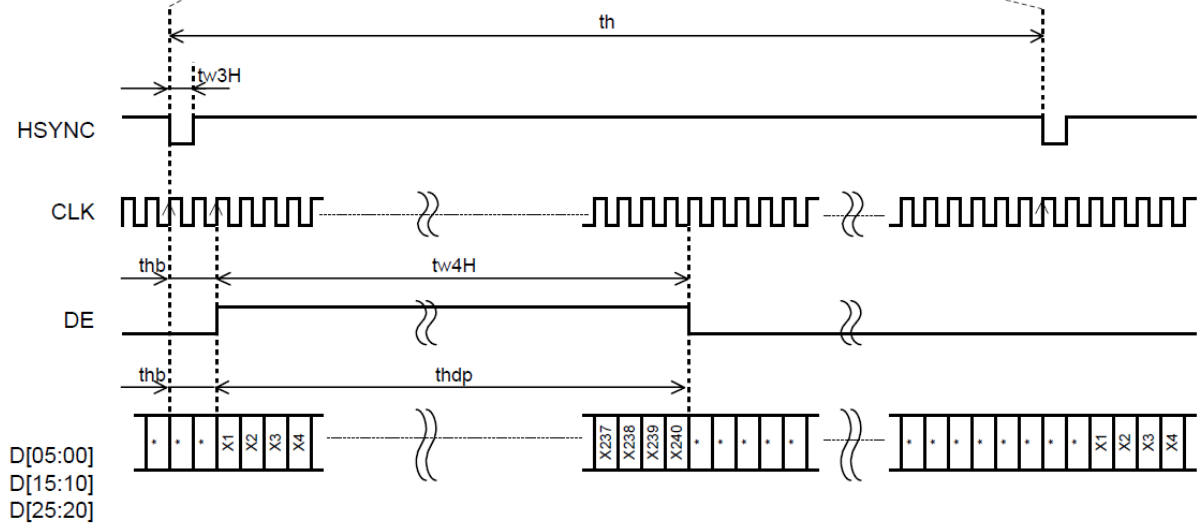
Note 1: The characteristic of this item is recommended as standard.

3.4.4 Driving Timing Chart

I. Vertical Timing

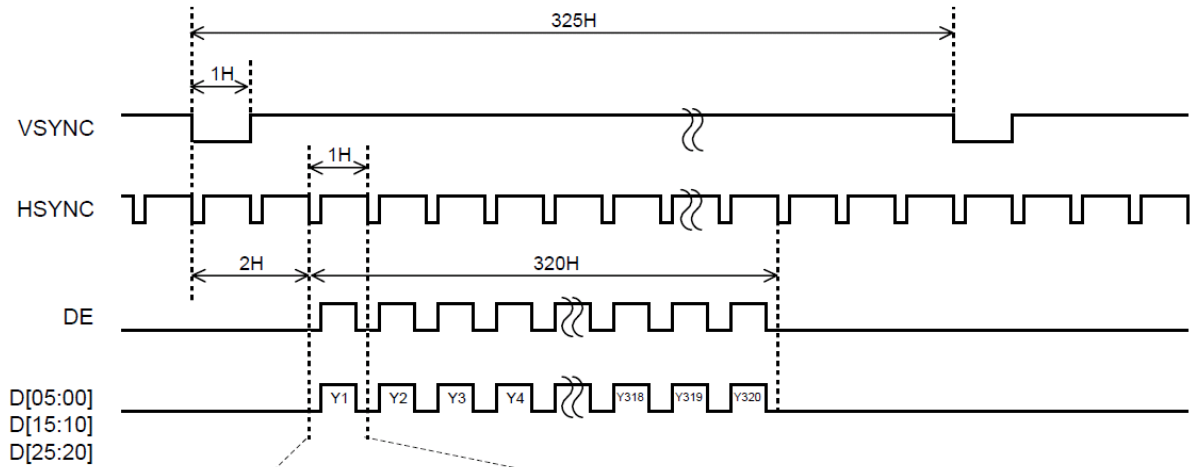


II. Horizontal Timing

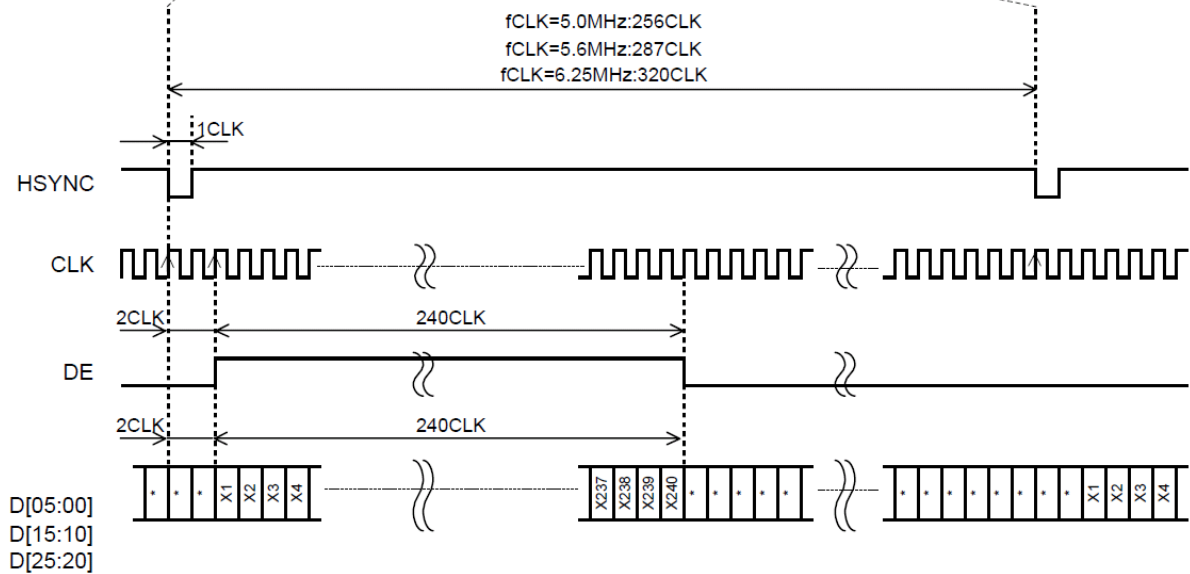


3.4.5 Example of Input Timing Chart (fCLK= 5.0MHz, 5.6MHz, 6.25MHz)

I. Vertical Timing

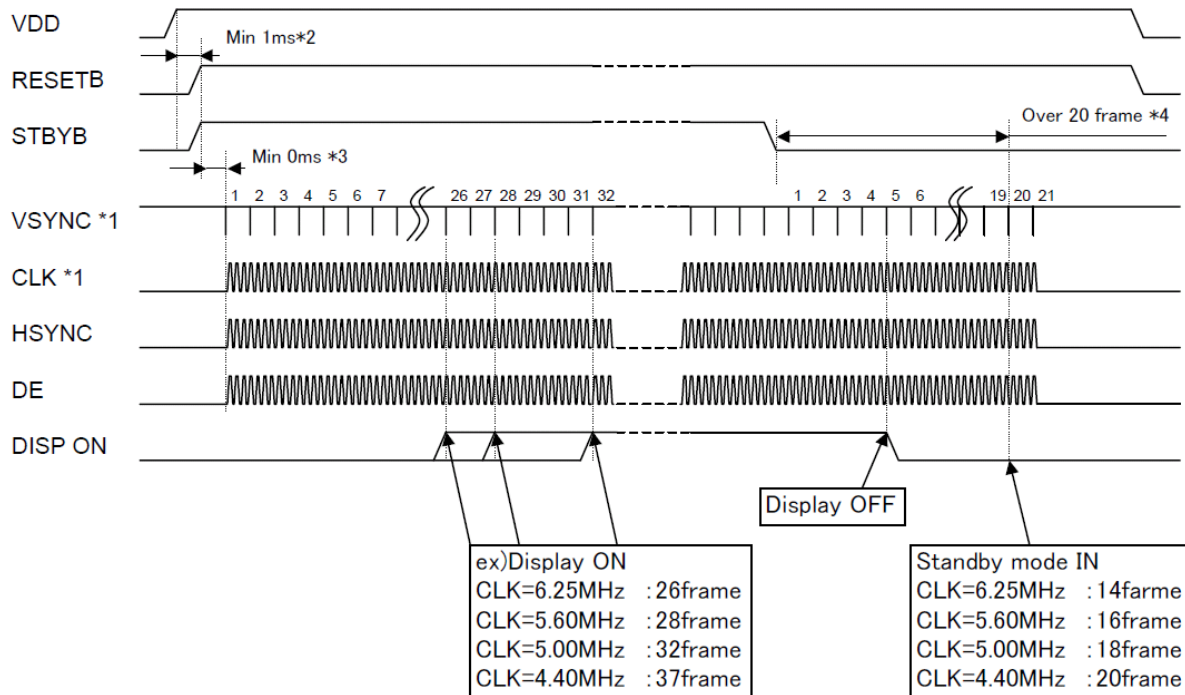


II. Horizontal Timing



3.5 POWER SEQUENCE

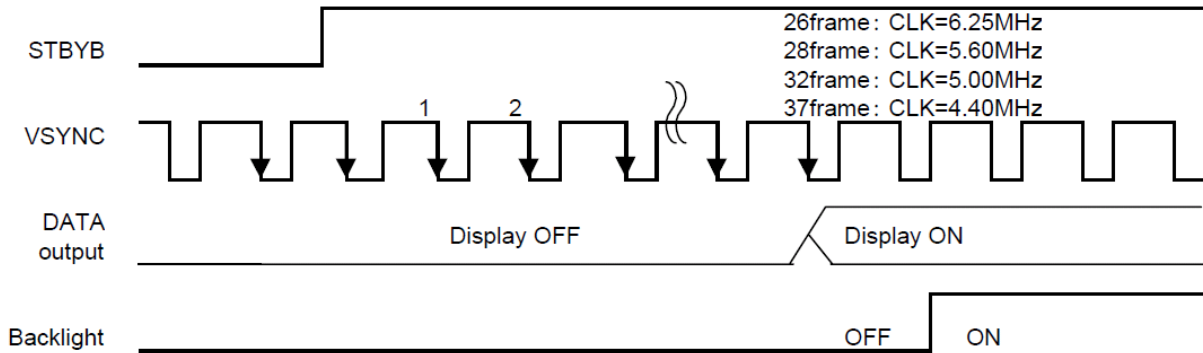
3.5.1 Power ON/OFF Sequence



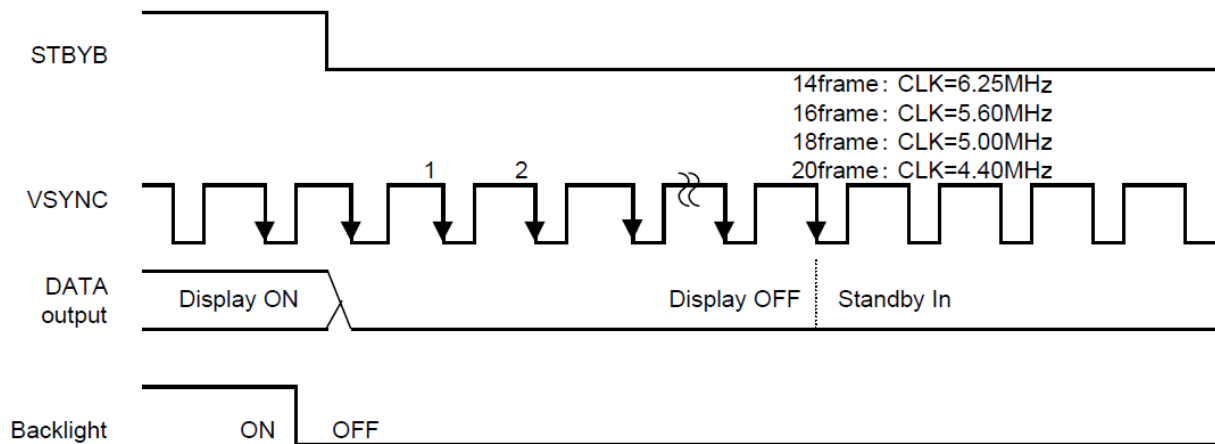
- *1 DOTCLK is used for Gate array CLK on FPC
VSYNC is used for Gate array's inside counter.
It becomes the operation after CLK(DOTCLK),VSYNC input.
- *2 After the power supply. Please execute RESETB (refer to reset sequence)
- *3 There is no regulation at time until each signal is supplied from RESETB"H"
But meanwhile, It is necessary to fix each signal to "H"or"L".
- *4 It is necessary to supply VSYNC and CLK(DOTCLK) for 20 frames or less from STBYB "L" to turning off the power supply without leaving the afterimage.

3.5.2 Display ON/OFF sequence

It explains the display sequence when display ON/OFF by the STBYB signal. The following time will be needed according to the CLK cycle by the time the displays begun from the standby release.

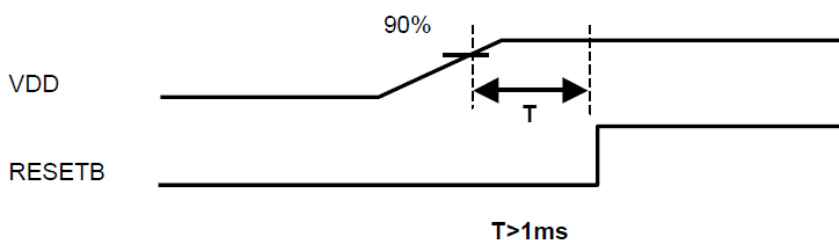


The following time will be needed according to the CLK cycle by the time the standby sequence is ended from the standby setting. Meanwhile, DOTCLK and the VSYNC signal should keep being supplied. When DOTCLK and the VSYNC signal are stopped or the power supply is turned off to a regulated frame or less, the afterimage might remain.



3.5.3 Reset sequence

There is a limitation between the power supply turning on and the RESETB input. Please defend the following conditions.



4 OPTICAL SPECIFICATION

4.1 OPTICAL CHARACTERISTICS

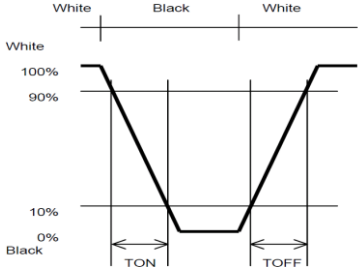
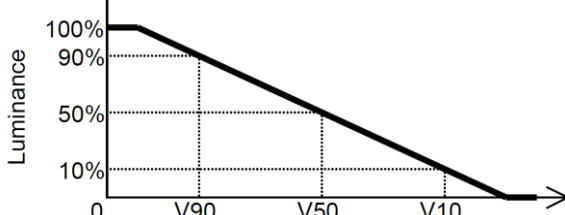
Measuring instruments:	CS1000 (KONICA MINOLTA), LCD7000 (OTSUKA ELECTRONICS) EZcontrast160D (ELDIM)
Driving condition:	VDD = 3.0V, VSS = 0V Optimized Vcom/c VLCD= Vsigpp±Vcompp /2
Backlight:	IL=10mA
Measured temperature:	Ta = 25° C

Ta = 25 °C

Item		Symbol	Condition	MIN	TYP	MAX	Unit	Note No.	Note
Response Time	Rise Time	TON	VLCD=0.6V→4.9V	-	-	40	ms	1	*
	Fall Time	TOFF	VLCD=4.9V→0.6V	-	-	60	ms		
Contrast Ratio	Backlight ON	CR	VLCD= 0.6V/4.9V	240	400	-		2	
	Backlight OFF			-	1.9	-			
Viewing Angle	Left	θL	VLCD= 0.6V/4.8V CR ≥ 10	80	-	-	deg	3	*
	Right	θR		80	-	-	deg		
	Up	φU		80	-	-	deg		
	Down	φD		80	-	-	deg		
V-T Threshold Voltage		V90		1.2	1.5	1.8	V	4	*
		V50		1.7	2.0	2.3	V		
		V10		2.4	2.7	3.0	V		
White V-T Curve				Refer to Fig. 3 : White V-T Curve					Reference
White Chromaticity		x	VLCD= 0.6V	Fig. 4: White Chromaticity Range				5	
		y							
Burn-in				No noticeable burn-in image should be observed after 2hours of window pattern display.				6	
Centre Brightness			VLCD= 0.6V	130	190	-	cd/m ²	7	
Brightness Distribution			VLCD= 0.6V	70	-	-	%	8	

* Measured in the form of LCD module

4.1.1 Test Method

Note	Item	Test method	Measuring instrument	Remark
1	Response time	<p>Measure output signal waveform by the luminance meter when raster of window pattern is changed from white to black and from black to white.</p> 	LCD7000	<p>Black display VLCD=4.9V White display VLCD=0.6V TON Rise Time</p> <p>TOFF Fall Time</p>
2	Contrast ratio	<p>Measure maximum luminance Y1 (VLCD=0.6V) and minimum luminance Y2 (VLCD=4.9V) at the centre of the screen by displaying raster or window pattern. Then calculate the ratio between these two values. Contrast ratio = Y1/Y2 Diameter of measuring point: 8mm Ø</p>	CS1000 LCD7000	Backlight ON Backlight OFF
3	Viewing angle Horizontal θ Vertical Ø	Move the luminance meter from right to left and up and down and determinate the angles where contrast ratio is 10	EZcontrast160D	
4	V-T Threshold Value	<p>Change VLCD by 0.1V step and plot the points where the luminance is 90% as V90, 50% as V50 and 10% as V10 of maximum luminance.</p> 	LCD7000	
5	White chromaticity	Measure chromaticity coordinates x and y of CIE1931 colorimetric system at VLCD=0.6V Colour matching faction: 2° view	CS1000	
6	Burn-in	Visually check burn-in image on the screen after 2 hours of "window display" (VLCD=0.6V/4.9V).		At optimized Vcom/C
7	Centre brightness	Measure the brightness at the centre of the screen	CS1000	
8	Brightness distribution	(Brightness distribution)= 100 x B/A % A: max. brightness of the 9 points B: min. brightness of the 9 points	CS1000	

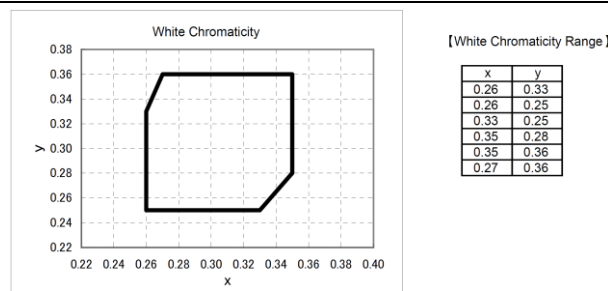


Fig. 4: White Chromaticity Range

5 BACKLIGHT SPECIFICATION

5.1 LED DRIVING CONDITIONS

Item	Symbol	Condition	Rating			Unit	Applicable Terminal
			Min	Typ	Max		
Forward Current	IL25	Ta=25 °C	-	10	35	mA	BLH-BLL
	IL70	Ta= 70°C	-		15	mA	
Forward Voltage	VL	Ta= 25°C, IL= 10mA	-	18.0	19.7	V	
Estimated Life of LED	LL	Ta= 25°C, IL= 10mA Note	-	(50,000)	-	hr	

Note:

- The lifetime of the LED is defined as a period till the brightness of the LED decreases to the half of its initial value.
- This figure is given as a reference purpose only, and not a guarantee.
- This figure is estimated for an LED operating alone.
The performance of an LED may differ when assembled as a monitor together with a TFT panel due to different environmental temperature.
- Estimated lifetime could vary on a different temperature and usually higher temperature could reduce the life significantly.

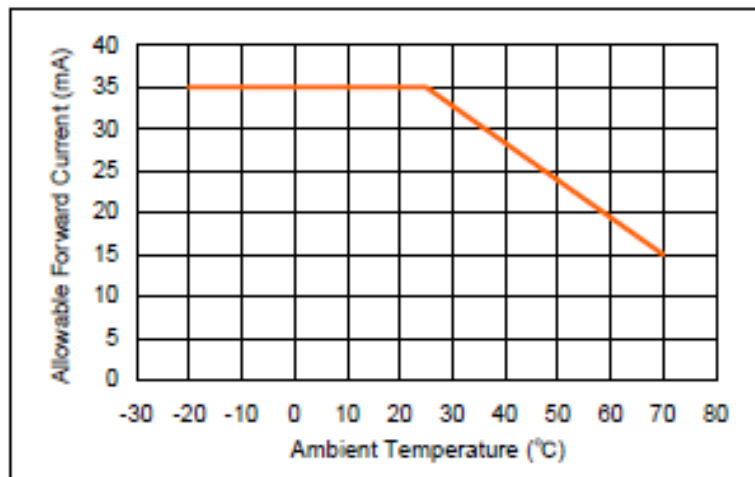
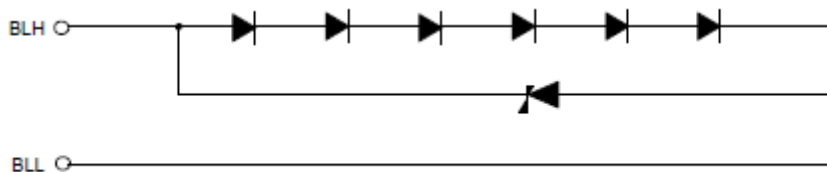


Fig. 2: Allowable Forward Current

5.2 LED CIRCUIT



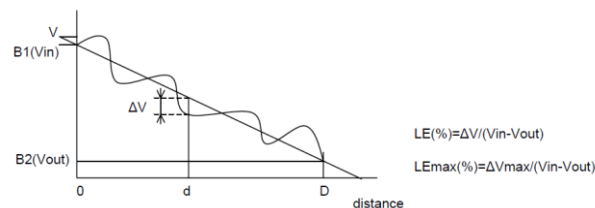
6 TOUCH PANEL SPECIFICATION

6.1 TOUCH PANEL CHARACTERISTICS

Item	Symbol	Condition	Rating			Unit	Applicable Terminal
			Min	Typ	Max		
Linearity	LE	3 mm in surrounding notes is excluded	-1.5	-	+1.5	%	
Insulation Resistance	RI	DC 25V	20	-	-	MΩ	XL,XR – YD,YU
Terminal Resistance		X	200	-	900	Ω	XL,XR
		Y	200	-	900	Ω	YD,YU
Rated Voltage	VIT	DC	-	5	7	V	XL, YD, XR, YU
ON/OFF Chattering		R 0.8 mm Polyacetal pen	-	-	10	Ms	XL, YD, XR, YU

Note: Load 2.45N.

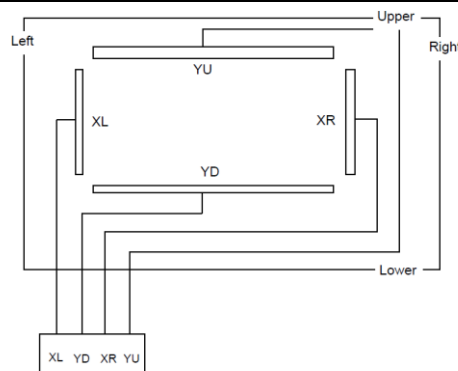
Linearity measurement:



6.2 MECHANICAL RELIABILITY

Item	Rating			Unit	Remark
	Min	Typ	Max		
Detectable Activation Force	0.05	-	0.80	N	R 0.8mm Polyacetal pen or finger Resistance between X and Y axis must be equal or lower than 2KΩ
Keystroke Durability	1,000,000	-	-	Times	Key the same part by silicon rubber on touch panel active are only Rubber tip part: R8 mm Load: 2.45N Speed: 2 times/second

6.3 TOUCH PANEL CIRCUIT



7 QUALITY ASSURANCE SPECIFICATION

7.1 DEFECTIVE DISPLAY AND SCREEN QUALITY

Observed TFT-LCD monitor from front during operation with the following conditions

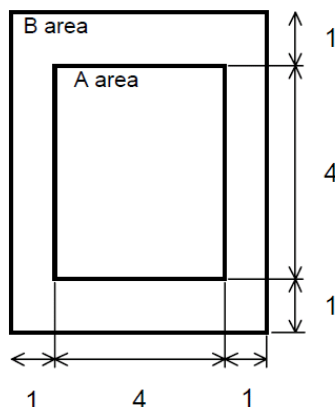
Driving signal	Raster Pattern (RGB in monochrome, white black)
Signal condition	VLCD: 0.6V, 2.2 V, 4.9V (3 Steps)
Observation Distance	30cm
Illuminance	200 to 350 lx
Backlight	IL= 10mA

Defect item		Defect content		Criteria
Display Quality	Line defect	Black, white or color line, 3 or more neighboring defective dots		Not exists
	Dot defect	Uneven brightness on dot-by-dot base due to defective TFT or CF, or dust is counted as dot defect (brighter dot, darker dot) High bright dot: Visible through 2% ND filter at VLCD=4.9V Low bright dot: Visible through 5% ND filter at VLCD=4.9V Dark dot: Appear dark through white display at VLCD=2.1V		Refer to table 1
Screen Quality	Dirt	Point-like uneven brightness (white stain, black stain etc)		Invisible through 1% ND filter
	Foreign particle	Point-like	$0.25\text{mm} < \phi$	N=0
			$0.20 < \phi \leq 0.25\text{mm}$	$N \leq 2$
			$\phi \leq 0.20\text{mm}$	Ignored
	Flaw	Liner	$3.0\text{mm} < \text{length and } 0.08\text{mm} < \text{width}$	N=0
			$\text{length} \leq 3.0\text{mm}$ or $\text{width} \leq 0.08\text{mm}$	Ignored
			$0.05\text{mm} < W$	Conform to the criteria of point-like foreign particles.
Flaw	Flaw on the surface of the Touch panel	$0.03 < W \leq 0.05\text{mm}$	$2 < L \leq 5\text{mm}$	$N \leq 5$
		$W \leq 0.03\text{mm}$	$L \leq 2\text{mm}$	Ignored
				Ignored
Others			Use boundary sample for judgment when necessary	

ϕ (mm): Average diameter = (major axis + minor axis)/2
Permissible number: N

Table 1

Area	High bright dot	Low bright dot	Dark dot	Total	Criteria
A	0	2	2	3	Permissible distance between same color bright dots (includes neighboring dots): 3 mm or more Permissible distance between same color high bright dots (includes neighboring dots): 5 mm or more
B	2	4	4	6	
Total	2	4	4	7	



Division of A and B areas
B area: Active area
Dimensional ratio between A and B areas: 1: 4: 1 (Refer to the left figure)

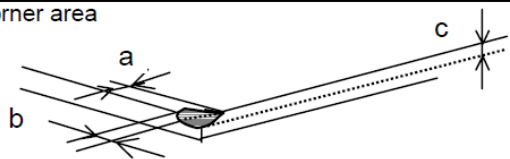
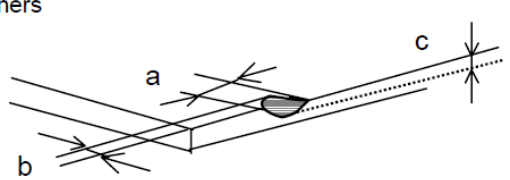
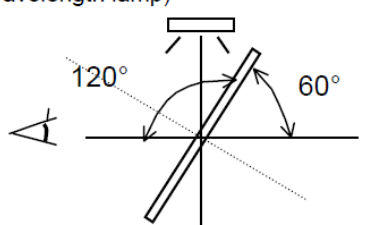
7.2 SCREEN AND OTHER APPEARANCE

Testing conditions

Illuminance 1200~2000 lx

Observation distance 30cm

Item	Criteria	Remark
Polarizer Flaw Stain Bubble Dust Dent	Ignore invisible defect when the backlight is on.	Applicable area: Active area only (
S-case	No functional defect occurs	
FPC cable	No functional defect occurs	

Item	Appearance	Criteria
Touch Panel	Corner area 	Unit:mm $a \leq 3$ $b \leq 3$ $c \leq t$ (t: glass thickness) $a, b \leq 0.5$ is ignored $n \leq 2$
	Others 	Unit:mm $a \leq 5$ $b \leq 1$ $c \leq t$ (t:glass thickness) $a, b \leq 0.5$ is ignored Maximum permissible number of chipping off on a side is 5.
	Progressive crack	Any of them is rejected
Interference fringe	Concentric interference fringe (Test method) Observe the Panel surface from 60 degrees angle to the surface under white fluorescent lamp (Triple wavelength lamp) 	Average diameter $d \leq 8\text{mm}$ is acceptable. Darkness: comply with the boundary sample

7.3 DEALING WITH CUSTOMER COMPLAINTS

7.3.1 Non-conforming analysis

Purchaser should supply Densitron with detailed data of non-conforming sample. After accepting it, Densitron should complete the analysis in two weeks from receiving the sample.

If the analysis cannot be completed on time, Densitron must inform the purchaser.

7.3.2 Handling of non-conforming displays

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.

Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.

Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

8 RELIABILITY SPECIFICATION

8.1 RELIABILITY TESTS

	Test Item	Test Condition	Number of failures/ number of examinations
Durability Test	High Temperature Storage	Ta= 80°C 240h	0/3
	Low Temperature Storage	Ta=-30°C 240h	0/3
	High Temperature & High Humidity Storage	Ta= 60°C, RH= 90% 240h Non condensing	0/3
	High Temperature Operation	Tp= 70°C 240h	0/3
	Low Temperature Operation	Tp= -20°C 240h	0/3
	High Temperature & Humidity Operation	Tp= 40°C RH= 90% 240h Non condensing	0/3
	Thermal Shock Storage	-30↔ 80°C (30 min/ 30min) 100cycles	0/3
Mechanical Environmental Test	Electrostatic Discharge Test (non operation)	Confirms to EIAJ ED-4701/300 C= 200 pF, R= 0 Ω, V= ±200V Each 3 times of discharge on and power supply and other terminals.	0/3
	Surface Discharge Test (non operation)	C= 250 pF, R= 100 Ω, V=± 12kV Each 5 times of discharge in both polarities on the centre of screen with the case and Touch Panel terminal grounded.	0/3
	Vibration test	Total amplitude 1.5 mm, f= 10~55 Hz, X,Y,Z directions for each 2 hours.	0/3
	Impact test	Use original jig and make an impact with peak acceleration of 1000 m/s ² for 6 ms with half sine-curve at 3 times to each X, Y, Z directions in conformance with JIS 60068-2-27-1995	0/3
Packing Test	Packing Vibration-Proof Test	Acceleration of 19.6 m/s ² with frequency of 10 → 55→ 10 Hz, X, Y, Z direction for each 30 minutes.	0/1 Packing
	Packing Drop Test	Drop from 75 cm high. 1 time to each 6 surfaces, 3 edges, 1 corner	0/1 Packing

Note: Ta=ambient temperature Tp= Panel temperature

9 HANDLING PRECAUTIONS

Safety

If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or in your eyes.

If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Mounting and Design

Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface.

When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean.

Design the system so that no input signal is given unless the power supply voltage is applied.

Caution during LCD cleaning

Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotrifluoroethane.

Do not wipe the display surface with dry or hard materials that will damage the polariser surface.

Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

Caution against static charge

As the display uses C-MOS LSI drivers, connect any unused input terminal to VDD or VSS.

Do not input any signals before power is turned on. Also, ground your body, work/assembly table and assembly equipment to protect against static electricity.

Packaging

Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height.

To prevent displays from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

Caution during operation

It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life. Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation. Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged. If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once. Even a small amount of condensation on the contact pads (terminals) can cause an electro-chemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

Storage

Store the display in a dark place where the temperature is 25°C ± 10°C and the humidity below 50%RH. Store the display in a clean environment, free from dust, organic solvents and corrosive gases.

Do not crash, shake or jolt the display (including accessories).

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