LIQUID CRYSTAL DISPLAY MODULE

Product Specification

CUSTOMER	
CUSTOMER PART NUMBER	
PRODUCT NUMBER	**DET043QQNTNT0-2A**

Product Mgr	Design Eng
Bruno Recaldini	**Sunny**
Date: 19-Sep-14	Date: 19-Sep-14

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REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECN no.
1.0	09-Apr-14			First Issue	
2.0	30-May-14			- Change the Brightness - Add min. backlight life time: 10,000hours	
3.0	19-Sep-14	3 5 10 14 21	1 2.2 3.5.1 4.1 7.1	Overall Dimension Mechanical Drawing AC Characteristics Optical Characteristics Reliability	

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1 MAIN FEATURES

ITEM	CONTENTS
Screen Size	4.3” Diagonal
Display Format	480 x RGB x 272 Dots
N° of Colour	16.7M
Overall Dimensions	105.4 mm (H) x 67.15 mm (V) x 2.86 mm (D)
Active Area	95.04 mm (H) x 53.856 mm (V)
LCD Type	TFT
Mode	Transmissive/ Normally White
Viewing Direction	6 O’clock
Electrical Interface	RGB Vertical stripe
Backlight Type	LED
Pixel pitch	0.198 mm (H) X 0.198 mm (V)
weight	43.5 (typ) g
Operating Temperature	-20°C ~ +70°C
Storage Temperature	-30°C ~ +80°C
RoHS compliant	Yes

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2 MECHANICAL SPECIFICATION

2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Display Format	480 x RGB x 272 Dots	Dots
Overall Dimensions	105.4 mm (H) x 67.15 mm (V) x 2.86 mm (D)	mm
Viewing Area	96.64 (H) x 55.46 (V)	mm
Active Area	95.04 mm (H) x 53.86 mm (V)	mm
Dot Pitch	0.198 (H) X 0.198 (V)	mm
Weight	43.5 (typ)	g

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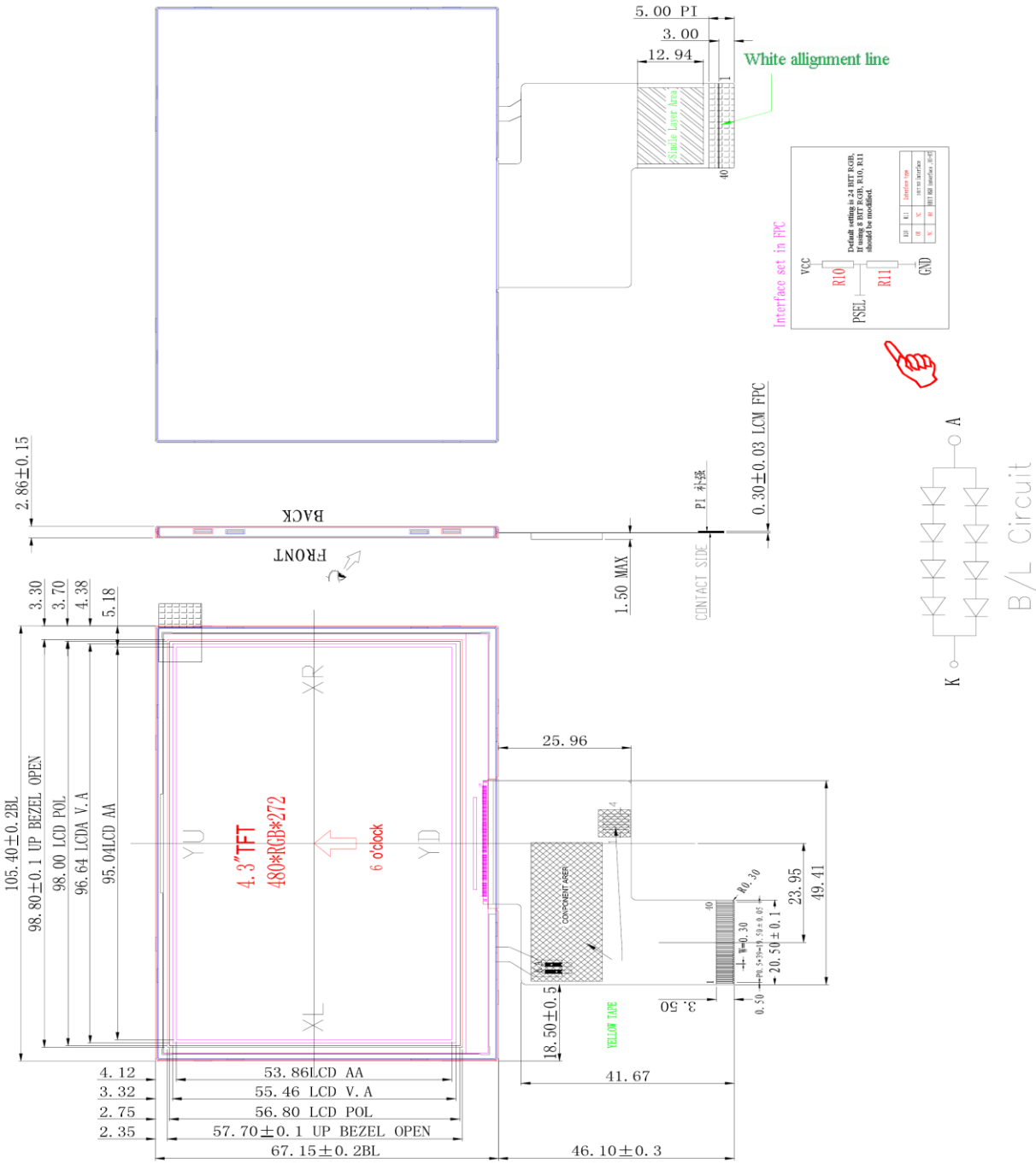
2.2 MECHANICAL DRAWING

Pin	Name
1	VLED-
2	VLED+
3	GND
4	VDD
5	R0
6	R1
7	R2
8	R3
9	R4
10	R5
11	R6
12	R7
13	G0
14	G1
15	G2
16	G3
17	G4
18	G5
19	G6
20	G7
21	B0
22	B1
23	B2
24	B3
25	B4
26	B5
27	B6
28	B7
29	GND
30	PCLK
31	DISP
32	HSYNC
33	VSYNC
34	DE
35	NC
36	GND
37	XR(NC)
38	YD(NC)
39	XL(NC)
40	YU(NC)



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3 ELECTRICAL SPECIFICATION

3.1 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit	Note
Power Supply Voltage	VDD	Ta=25˚C	-0.5	5.0	V	
Operating Temperature	TOP		-20	70	℃	1
Storage Temperature	TST		-30	80	℃	1,2,3

Note 1. 90 % RH Max for Ta<50 °C, and 60% RH for Ta≥50°C.
Note 2. In case of below 0°C, the response time of liquid crystal (LC) becomes slower and the colour of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's characteristic.
Note 3. Only operation is guaranteed at operating temperature. Contrast, response time, another display quality are evaluated at +25°C.

3.2 ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply Voltage	VDD		3.0	3.3	3.6	V	
Input Voltage for Logic	VIH		0.7xVDD	-	VDD	V	Note1
	VIL		GND	-	0.3xVDD	V	
Current Consumption	IDD		-	25	-	mA	Vdd=3.3V

Note 1: HSYNC,VSYNC,DE,R/G/B Data

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3.3 INTERFACE PIN ASSIGNMENT

3.3.1 LCM PIN ASSIGNMENT

Recommended connect: HIROSE FH19SC-40S-0.5SH(05)

Pin No.	Symbol	Function
1	VLED-	Power for LED backlight cathode
2	VLED+	Power for LED backlight anode
3	GND	Ground
4	VDD	Power Supply Voltage
5	R0	Red data (LSB)
6	R1	Red data
7	R2	Red data
8	R3	Red data
9	R4	Red data
10	R5	Red data
11	R6	Red data
12	R7	Red data (MSB)
13	G0	Green Data (LSB)
14	G1	Green Data
15	G2	Green Data
16	G3	Green Data
17	G4	Green Data
18	G5	Green Data
19	G6	Green Data
20	G7	Green Data(MSB)
21	B0	Blue Data (LSB)
22	B1	Blue Data
23	B2	Blue Data
24	B3	Blue Data
25	B4	Blue Data
26	B5	Blue Data
27	B6	Blue Data
28	B7	Blue Data (MSB)
29	GND	Ground
30	DCLK	Pixel clock
31	DISP (STB)	Display on/ off
32	HSYNC (HSD)	Horizontal sync signal
33	VSYNC (VSD)	Vertical sync signal
34	DE (DEN)	Data enable
35	NC	No connection
36	GND	Ground
37	NC	No connection
38	NC	No connection
39	NC	No connection
40	NC	No connection

I/O: I:input O:output

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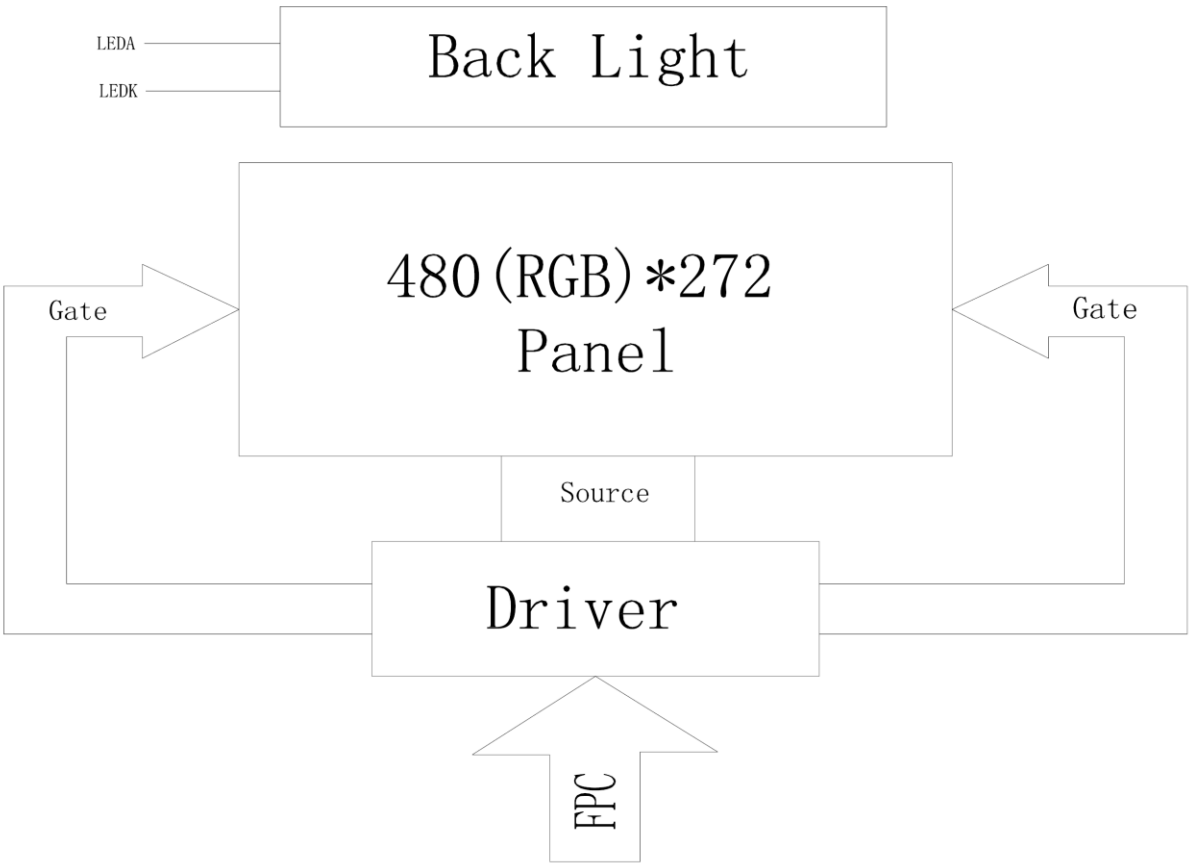
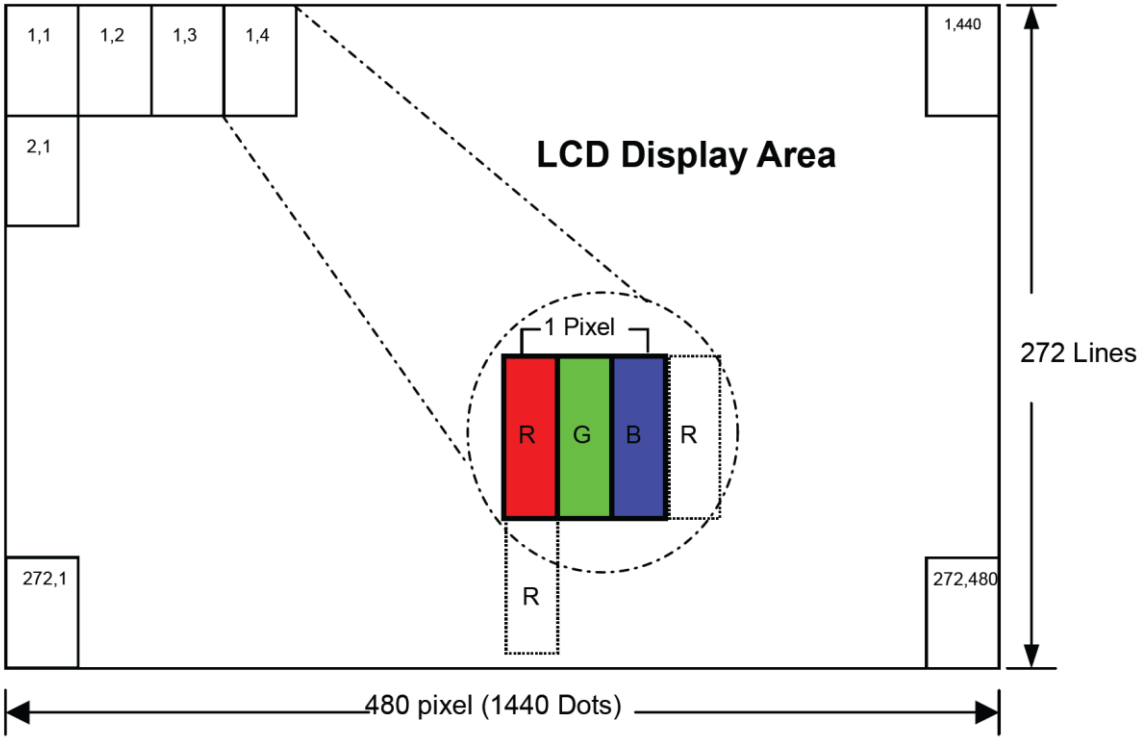
3.4 BLOCK DIAGRAM





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3.5 TIMING CHARACTERISTICS

3.5.1 AC Characteristics

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
System operation timing						
VDD power source slew time	TPOR	-	-	20	ms	From 0V to 99% VDD
GRB pulse width	tRSTW	10	50	-	us	R=10Kohm, C=1uF
Input Output timing						
DCLK clock time	Tclk	33.3	-	-	ns	DCLK=30MHz
DCLK clock low period	Tcwl	40	-	60	%	
DCLK clock high period	Tcwh	40	-	60	%	
Clock rising time	Trck	9	-	-	ns	
Clock falling time	Tfck	9	-	-	ns	
HSD width	Thwh	1	-	-	DCLK	
HSD period time	Th	55	60	65	us	
HSD setup time	Thsu	12	-	-	ns	
HSD hold time	Thhd	12	-	-	ns	
VSD width	Tvwh	1	-	-	Th	
VSD setup time	Tvsu	12	-	-	ns	
VSD hold time	Tvhd	12	-	-	ns	
Data setup time	Tdasu	12	-	-	ns	
Data hold time	Tdahd	12	-	-	ns	
DE setup time	Tdesu	12	-	-	ns	
DE hold time	Tdehd	12	-	-	ns	
Source output setting time	Tsst	-	-	TBD	us	10% to 90% CL=60pF, RL=2Kohm
Gate output setting time	Tgst	-	-	TBD	ns	10% to 90%, CL=60pF
VCOM output setting time	Tcst	-	-	TBD	us	10% to 90%, CL=40nF, RL=50ohm
Time from VSD to 1st line data input	Tvs	3	8	31	Th	HV mode By HDL[4:0] setting

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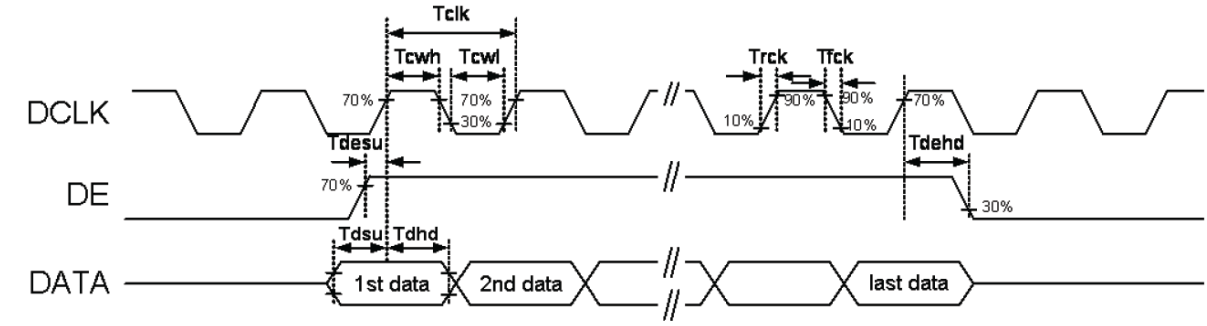
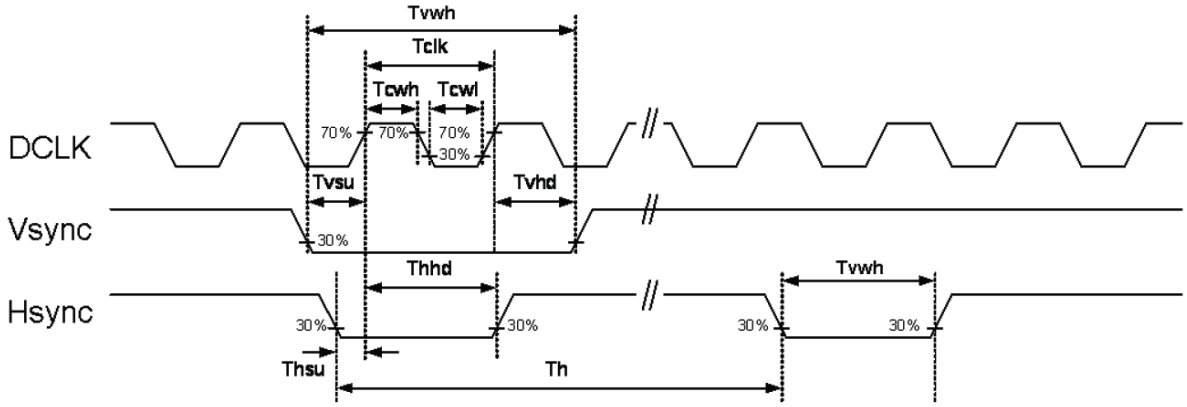
Clock and Data Input Timing Diagram





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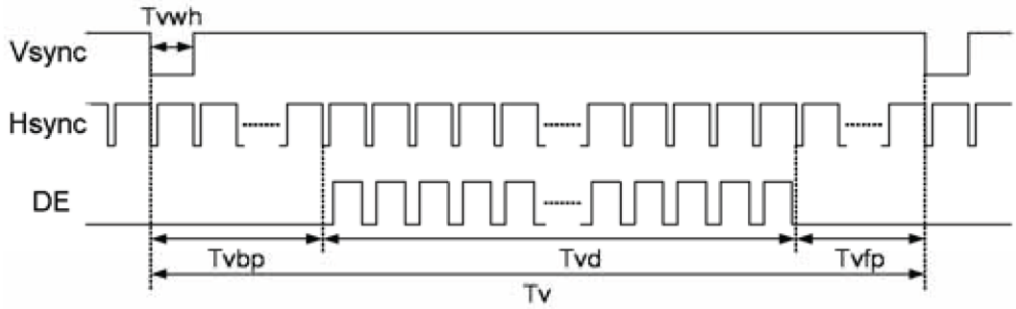
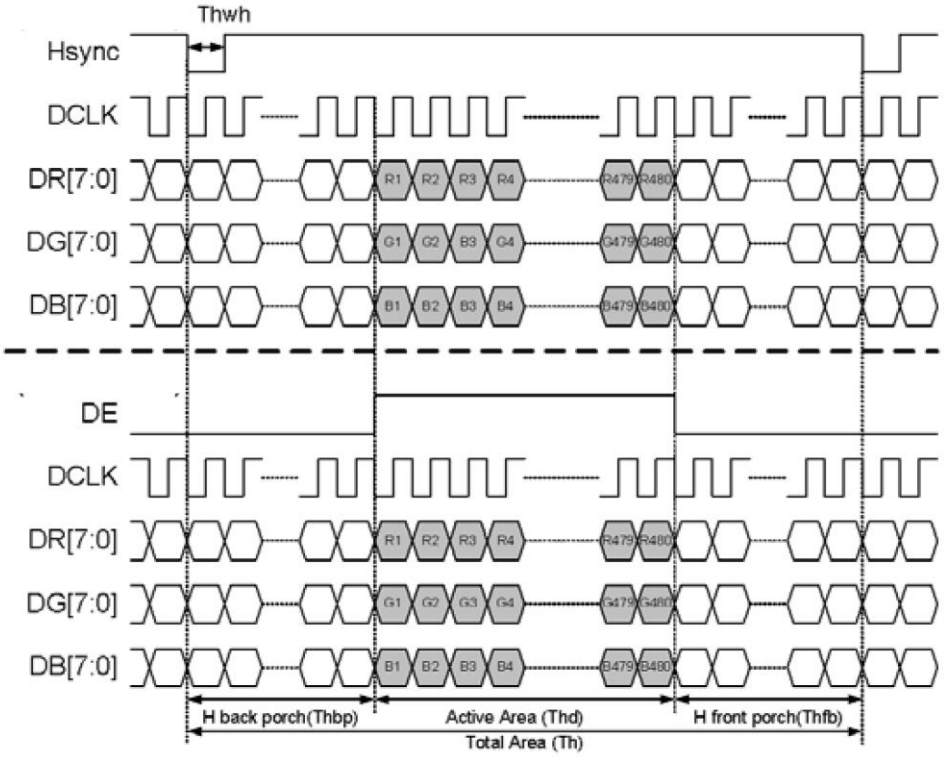
3.5.2 Parallel 24-bit RGB Interface Timing Characteristics

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
DCLK frequency	fclk	5	9	12	MHz	
VSYNC period time	Tv	277	288	400	Th	
VSYNC display area	Tvd		272		Th	
VSYNC back porch	Tvbp	3	8	31	Th	
VSYNC front porch	Tvfp	2	8	93	Th	
HSYNC period time	Th	520	525	800	DCLK	
HSYNC display area	Thd		480		DCLK	
HSYNC back porch	Thbp	36	40	255	DCLK	
HSYNC front porch	Thfp	4	5	65	DCLK	

Vertical Input Timing



Parallel 24-bit RGB Mode Data Format (HV Mode/ DE Mode)



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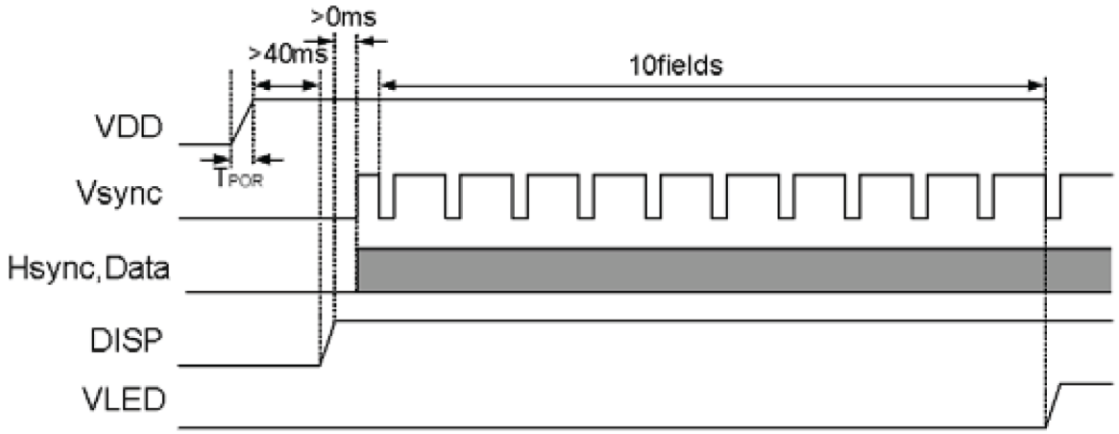
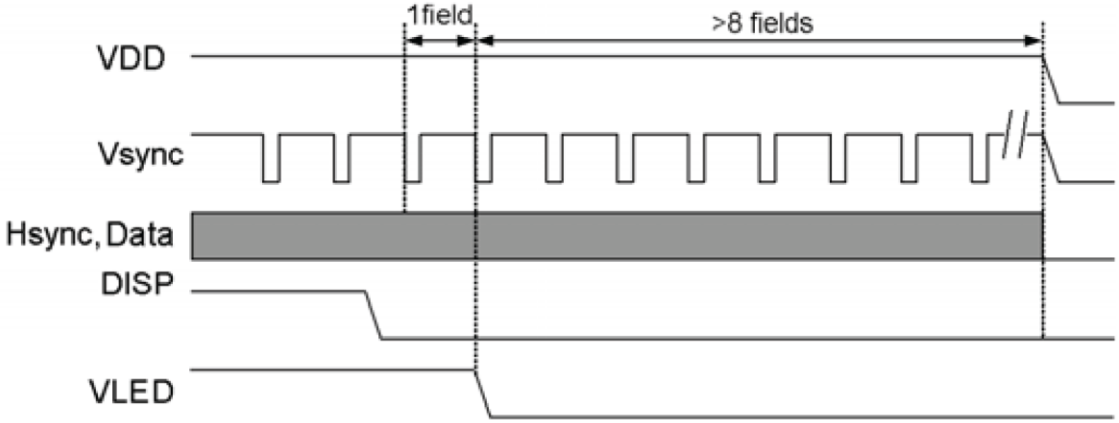
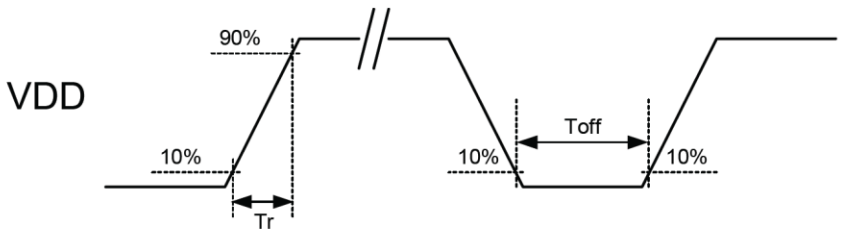
3.6 POWER ON/OFF SEQUENCE

Power On Sequence



Power Off Sequence





VDD power input timing

Notes:

Data include R0~R7, G0~G7, B0~B7, HSD, VSD, DCLK, DE
Power on sequence: VDD → DISP → Data → V_{LED}
Power off sequence: DISP → V_{LED} → Data → VDD
VDD power input timing: 0.5ms < Tr < 10ms; Toff > 500ms

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4 OPTICAL SPECIFICATION

4.1 OPTICAL CHARACTERISTICS

Measuring instruments: LCD-5100, Eldim, Topcon BM-7
Driving condition: VDD = 3.3V, GND = 0V
Backlight: IF=40mA
Measured temperature: Ta ＝ 25° C

Item		Symbol	Condition	MIN	TYP	MAX	Unit	Note
Response Time		TR+TF	θ=Φ=0° Normal Viewing Angle	-	25	50	ms	2
Contrast Ratio		CR		400	500	-		3
Viewing Angle	Left	θL	CR>10	60	70	-	deg	4
	Right	θR		60	70	-	deg	
	Up	ϕU		40	50	-	deg	
	Down	ϕD		60	70	-	deg	
Colour Chromaticity	White	Wx	θ=Φ=0° Normal Viewing Angle	0.260	0.310	0.360	-	5
		Wy		0.280	0.330	0.380	-	
Central Brightness				350	400	-	Cd/m2	6
Brightness distribution				80	-	-	%	7

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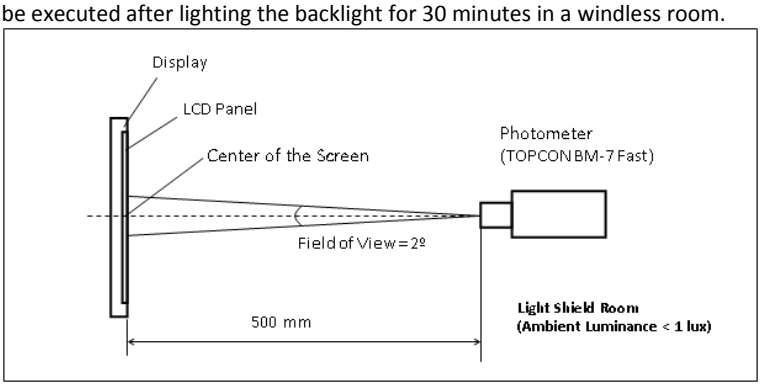
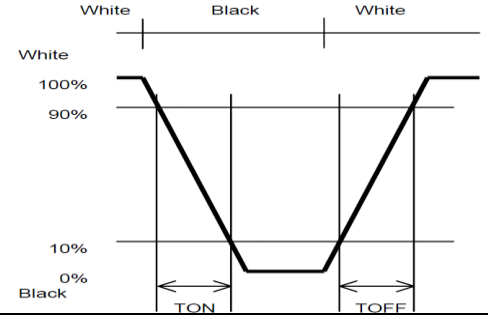
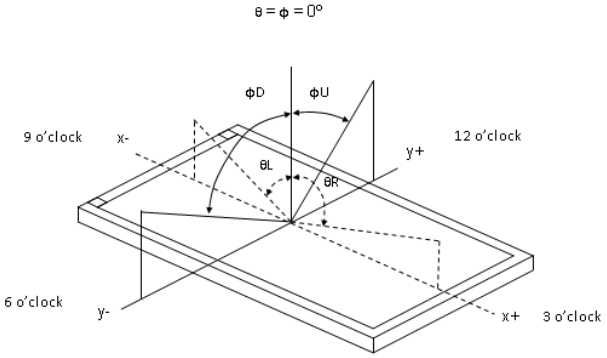
4.1.1 Test Method

Note	Item	Test method
1	Setup	The display should be stabilised at a given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilise the luminance, measurements should be executed after lighting the backlight for 30 minutes in a windless room. 
2	Response time	Measure output signal waveform by the luminance meter when raster of window pattern is changed from white to black and from black to white. 
3	Contrast ratio	Measure maximum brightness and minimum brightness at the centre of the screen by displaying raster or window pattern. Then calculate the ratio between these two values. Contrast Ratio (CR) = Brightness of unselected position (white) / Brightness of selected position (black)
4	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 
5	Colour chromaticity	Measure chromaticity coordinates x and y of CIE1931 colorimetric system
6	Centre brightness	Measure the brightness at the centre of the screen
7	Brightness distribution	(Brightness distribution)= 100 x B/A % A: max. brightness of the 9 points B: min. brightness of the 9 points

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5 BACKLIGHT SPECIFICATION

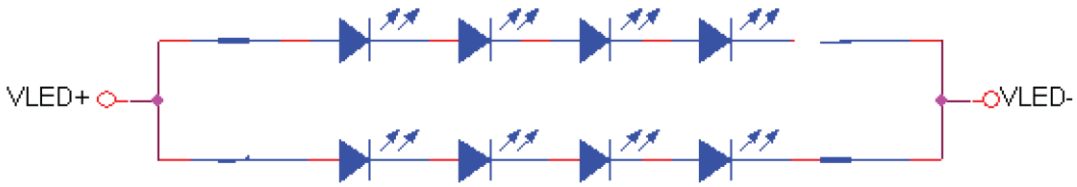
5.1 LED DRIVING CONDITIONS

Item	Symbol	Condition	Min	Typ	Max	Unit
LED Current	IL	Ta=25 °C, VL=12.8V	-	40	-	mA
LED Voltage	VL	Ta= 25°C, IL= 40mA/LED	-	12.8	-	V
Estimated Life of LED	LL	Ta= 25°C, IL= 40mA Note	(10,000)		-	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.

5.2 LED CIRCUIT



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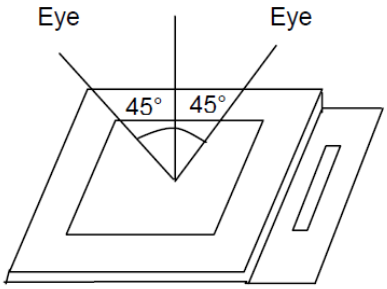
6 QUALITY ASSURANCE SPECIFICATION

6.1 DELIVERY INSPECTION STANDARDS

6.1.1 Inspection Conditions

Inspection distance: 30 cm ± 2 cm
Viewing angle: ±45°



6.1.2 Environmental Conditions

Ambient temperature: 23°C ±5°C
Ambient humidity: 55±10% RH
Ambient illumination: 1000~1500 lux

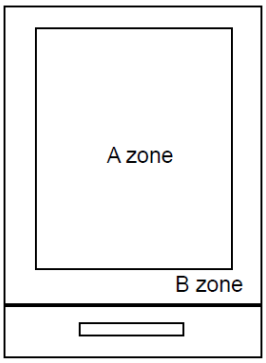
6.1.3 Sampling Conditions

1. Lot size: quantity of shipment lot per model
2. Sampling method:

Sampling Plan		ANSI / ASQC Z1.4-1993
		Normal inspection, Single Sampling
AQL	Major Defect	0.65%
	Minor Defect	1.5%

6.1.4 Definition of Area

A zone: active area
B zone: viewing area



6.1.5 Basic Principle

A set of sample to indicate the limit of acceptable quality level shall be discussed should a dispute occur.

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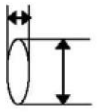
6.1.6 Inspection Criteria

<table>
<tr><th>No</th><th>Item</th><th>Criteria</th><th>Rank</th><th>Remark</th></tr>
<tr><td>1</td><td>Segment Short
Segment Missing</td><td>Not allowed</td><td>MA</td><td>X</td></tr>
<tr><td>2</td><td>Solder Bridging</td><td>Any bridging between components,
except common circuit, is not allowed.</td><td>MA</td><td></td></tr>
<tr><td>3</td><td>Outside Dimension</td><td>Drawing & specification must be within
permitable tolerance.</td><td>MA</td><td></td></tr>
<tr><td>4</td><td>Cold Solder</td><td>Cold solder is not allowed.</td><td>MA</td><td></td></tr>
<tr><td>5</td><td>Black(White)
Spots, Foreign
Substances</td><td>1) Round Type
<table>
<tr><th rowspan="2">Area
Dimension**</th><th colspan="2">Acceptable Q'ty</th><th rowspan="2">Remark</th></tr>
<tr><th></th><th></th></tr>
<tr><td>≤ 0.1</td><td colspan="2">Ignore</td><td></td></tr>
<tr><td>≤ 0.2</td><td>2</td><td>Ignore</td><td></td></tr>
<tr><td>≤ 0.3</td><td>1</td><td>Ignore</td><td></td></tr>
<tr><td>0.3 <</td><td>0</td><td>Ignore</td><td></td></tr>
</table>
2) Liner Type
<table>
<tr><th colspan="2">Dimension</th><th colspan="2">Acceptable Q'ty</th><th rowspan="2">Remark</th></tr>
<tr><th>Length</th><th>Width</th><th>A Area</th><th>B Area</th></tr>
<tr><td>-</td><td>≤ 0.025</td><td colspan="2">Ignore</td><td></td></tr>
<tr><td>≤ 2.5</td><td>≤ 0.05</td><td>3</td><td>Ignore</td><td></td></tr>
<tr><td>≤ 1.5</td><td>≤0.075</td><td>2</td><td>Ignore</td><td></td></tr>
<tr><td></td><td>0.075 <</td><td colspan="2">Follow round type</td><td></td></tr>
</table>
At (1) & (2) total defect q'ty is must not exceed 5 pieces.</td><td>MI</td><td> 
** : Mean Diameter (X + Y)/2</td></tr>
<tr><td>6</td><td>OC Spot</td><td>
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<tr><td>≤ 0.8</td><td>3</td><td>Ignore</td><td></td></tr>
<tr><td>≤ 1.0</td><td>1</td><td>Ignore</td><td></td></tr>
</table>
</td><td>MI</td><td></td></tr>
<tr><td>7</td><td>Air Bubles
Between Glass &
Polarizer
(Polarizer Defects)</td><td>
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Dimension**</th><th colspan="2">Acceptable Q'ty</th><th rowspan="2">Remark</th></tr>
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<tr><td>≤ 0.3</td><td>3</td><td>Ignore</td><td></td></tr>
<tr><td>≤ 0.5</td><td>2</td><td>Ignore</td><td></td></tr>
<tr><td>≤ 0.7</td><td>1</td><td>Ignore</td><td></td></tr>
<tr><td>Total</td><td>5</td><td>Ignore</td><td></td></tr>
</table>
</td><td>MI</td><td></td></tr>
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<table>
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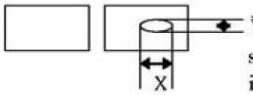
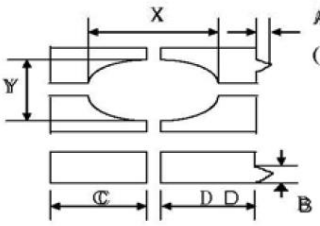
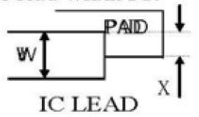
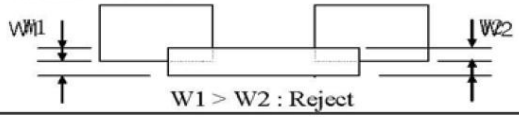
(On Segment)</td><td> 
(X+Y)/2 ≤ 0.2㎜
Within 1 per one segment (Less than 0.1㎜ is not counted)
Total defects q'ty is must not exceed 5 pieces.</td><td>MI</td><td></td></tr>
<tr><td>9</td><td>Segment
Deformation</td><td> 
(X+Y)/2 ≤ 0.2㎜
A ≤ 0.2㎜
B ≤ 0.2㎜
(C-D) ≤ 0.2㎜
<table><tr><th></th><th>Acceptable Q'ty</th></tr><tr><td>Dot, Segment</td><td>1</td></tr><tr><td>LCD</td><td>5</td></tr><tr><td>≤ 0.1</td><td>Ignore all defect</td></tr></table>Each visible dot must be more than half effective dot area</td><td>MI</td><td>(X + Y)/2
≤ 0.2㎜</td></tr>
<tr><td>10</td><td>Color Variation</td><td>Within the three colors, except LCD Standard color is acceptable.</td><td>MI</td><td></td></tr>
<tr><td>11</td><td>Glass & Polarizer Scratch</td><td>Follow NO.5(2) condition</td><td>MI</td><td></td></tr>
<tr><td>12</td><td>Solder Ball</td><td>1)Acceptable if the size of void is less than 0.18㎜
2)Acceptable if a solder ball is not movable
3)Rejectable if the solder ball exceed 5EA in 2.54 × 2.54㎜ area.</td><td>MI</td><td></td></tr>
<tr><td>13</td><td>Miss Alignment</td><td>1)Acceptable if it dose not exceed 50% of the lead width IC.
 
X ≤ W/2 : Accept
X > W/2 : Reject
IC LEAD
2)Rejectable, provided that it does exceed 50% of the component termination width.
 
W1 > W2 : Reject</td><td></td><td></td></tr>
</table>

Note : A limitation sample is given top priority

6.1.7 Classification of Defects

Visual defects (except no or wrong label) are treated as minor defects, while electrical defects are treated as major defects.
Two minor defects are equal to one major defect in lot sampling inspection.

6.1.8 Identification / marking criteria

Any unit with illegible / wrong / double or no marking / label shall be rejected.

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6.2 DEALING WITH CUSTOMER COMPLAINTS

6.2.1 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.

6.2.2 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.

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7 RELIABILITY SPECIFICATION

7.1 RELIABILITY TESTS

Test Item		Test Condition	
Durability Test	High Temperature Storage	Ta= 80˚C	96h
	Low Temperature Storage	Ta=-30˚C	96h
	Temperature Cycle Storage	-20°C for 30 min, then 70°C for 30 min, 5 cycles	
	High Temperature Operation	Tp= 70°C	96h
	Low Temperature Operation	Tp= -20°C	96h
	High Temperature & Humidity Operation	Tp= 60°C RH= 90% 96h Non condensing	
	Box Drop Test	1 corner, 3 edges, 6 faces, 66 cm height	
	Vibration	1.Random: 1.04Grms, 5~500Hz, X/Y/Z, 30min/each direction 2. Sine: Freq. Range: 8~33.3Hz Stoke: 1.3mm Sweep: 2.9G, 33.3~400Hz X/Z: 2hr, Y: 4hr, cyc: 15min	
	Shock	100G, 6ms, ±X, ±Y, ±Z 3 time for each direction	
	Vibration (with carton)	Random: 0.015G^2/Hz, 5~200Hz -6dB/Octave, 200~400Hz XYZ each direction: 2hr	

Note: Ta=ambient temperature Tp= Panel temperature

Notes:
1. No dew condensation to be observed.
2. The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
3. No cosmetic or functional defects should be allowed.
4. Total current consumption should be less than twice the initial value.

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8 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 Trichlorotriflorothane.
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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