

**Display Elektronik GmbH**

# DATA SHEET

**TFT MODULE**

**DEM 800480J1 TMH-PW-N**

**7,0“ TFT**

**Product Specification**

**Ver.: 3**

**16.05.2015**



**CONTENTS**

**1. GENERAL INFORMATION .....4**

**2. ABSOLUTE MAXIMUM RATINGS .....4**

**3. ELECTRICAL CHARACTERISTICS .....5**

**4. BACKLIGHT CHARACTERISTICS.....5**

**5. EXTERNAL DIMENSIONS .....6**

**6. ELECTRO-OPTICAL CHARACTERISTICS .....6**

**7. INTERFACE DESCRIPTION .....10**

**8. AC CHARACTERISTICS.....10**

**9. POWER SEQUENCE .....13**

**10. RELIABILITY TEST CONDITIONS .....13**

**11. INSPECTION CRITERION.....14**

**12. HANDLING PRECAUTIONS .....17**

**13. PRECAUTION FOR USE .....18**

**1. GENERAL INFORMATION**

| No. | Item                           | Contents                           | Unit |
|-----|--------------------------------|------------------------------------|------|
| 1   | LCD Size                       | 7.0 Inch (Diagonal)                | -    |
| 2   | LCD Type                       | TN / Normally White / Transmissive | -    |
| 3   | Viewing Direction (Eye)        | 12 o'clock                         | -    |
| 4   | Gray Scale Inversion Direction | 6o'clock                           | -    |
| 5   | Resolution                     | 800xRGBx480                        | -    |
| 6   | Module Size                    | 164.90 x 100.00 x 3.50             | mm   |
| 7   | Active Area                    | 153.84 x 85.63                     | mm   |
| 8   | Pixel Pitch                    | 0.1923 x 0.1784                    | mm   |
| 9   | Interface Type                 | 24-BIT-RGB- Interface              | -    |
| 10  | Module Power Consumption       | 1.782                              | W    |
| 11  | Backlight Type                 | LED                                | -    |
| 12  | Driver IC                      | HX8264-D08 +HX8664-B or compatible | -    |
| 13  | Weight                         | 115.50                             | g    |

**2. ABSOLUTE MAXIMUM RATINGS**

| Item                             | Symbol | Min  | Max           | Unit |
|----------------------------------|--------|------|---------------|------|
| Power Supply Input Voltage (LCM) | VDD    | -0.3 | 3.6           | V    |
| Backlight Current (Normal Temp.) | ILED   | -    | 200           | mA   |
| Operation Temperature            | Top    | -20  | 70            | °C   |
| Storage Temperature              | Tst    | -30  | 80            | °C   |
| Humidity                         | RH     | -    | 90%(Max60 °C) | RH   |

**3. ELECTRICAL CHARACTERISTICS****DC CHARACTERISTICS (Ta=25°C)**

| Item                                   | Symbol | Min    | Typ  | Max    | Unit | Note |
|--|--------|--------|------|--------|------|------|
| Power Supply Input Voltage (LCM)       | VDD    | 3.0    | 3.3  | 3.6    | V    |      |
| I/O Logic Voltage                      | VDDIO  | N/A    | N/A  | N/A    | V    |      |
| Input Voltage 'H' Level                | VIH    | 0.7VDD | -    | VDD    | V    |      |
| Input Voltage 'L' Level                | VIL    | 0      | -    | 0.3VDD | V    |      |
| Power Supply Current                   | IVDD   | -      | 75   | -      | mA   |      |
| TFT Gate On Voltage                    | VGH    | -      | 18   | -      | V    |      |
| TFT Gate Off Voltage                   | VGL    | -      | -8   | -      | V    |      |
| Analog Power Supply Voltage            | AVDD   | -      | 10.3 | -      | V    |      |
| Differential Input Common Mode Voltage | Vcom   | -      | 3.4  | -      | V    |      |

**4. BACKLIGHT CHARACTERISTICS**

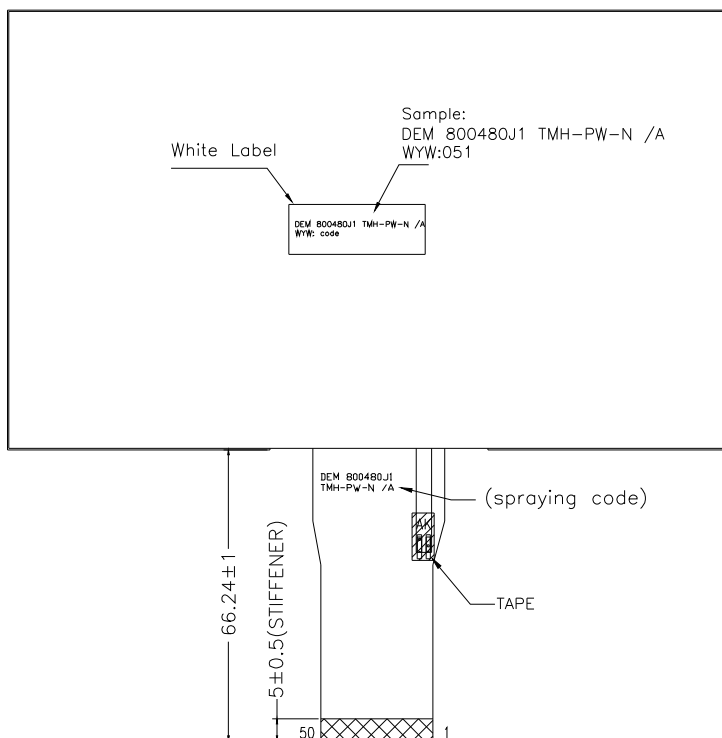
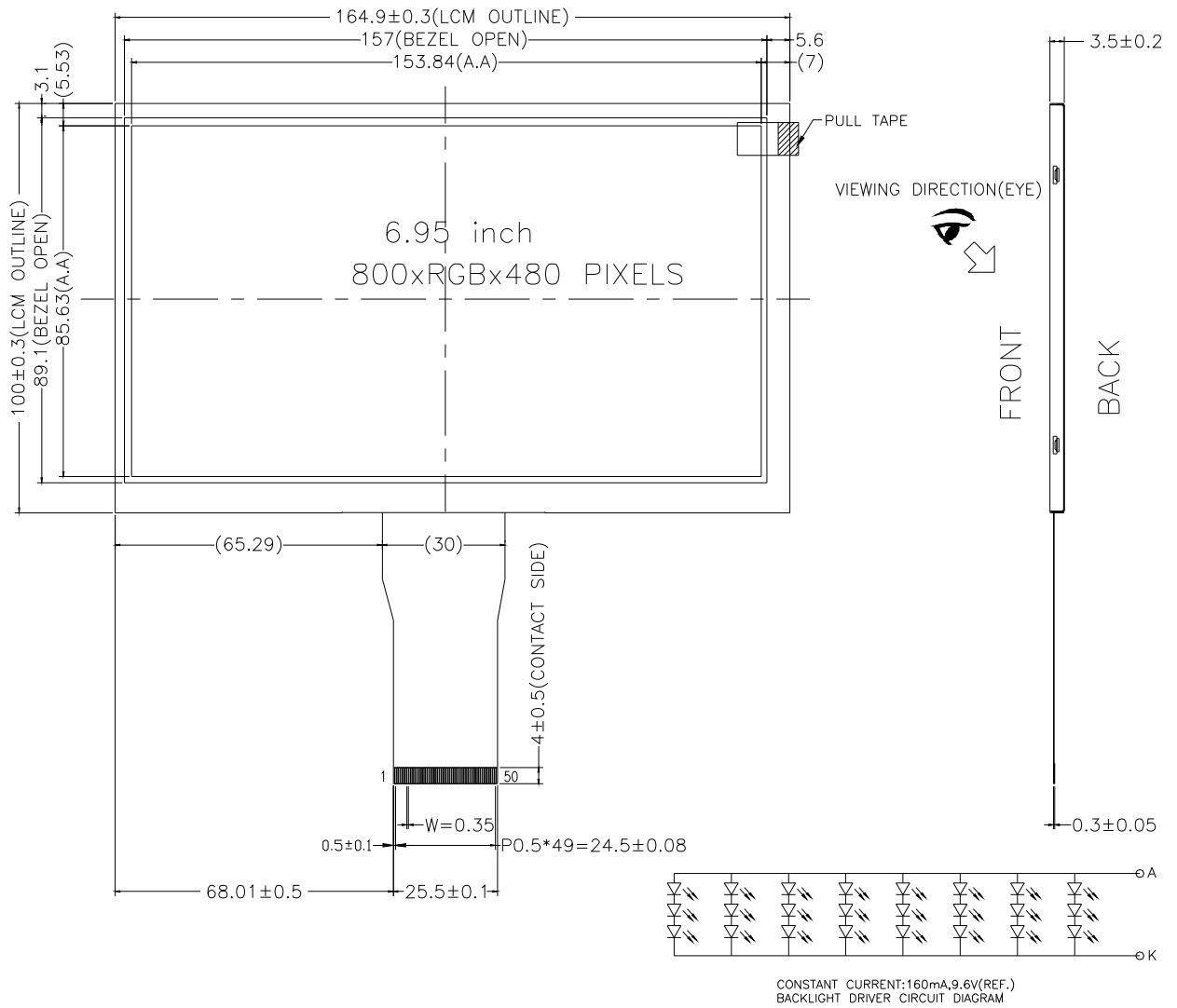
(Ta=25°C, RH=60%)

| Item                  | Symbol | Min.                       | Typ.  | Max. | Unit | Note     |
|-----------------------|--------|----------------------------|-------|------|------|----------|
| LED Forward Voltage   | VF     | -                          | 9.6   | -    | V    | IF=160mA |
| LED Forward Current   | IF     | -                          | 160   | -    | mA   |          |
| LED Power Consumption | PLED   | -                          | 1.536 | -    | W    | Note1    |
| Number of LED         | -      |                            | 24    |      | PCS  |          |
| Connection Mode       | -      | 3 in series *8 in parallel |       |      | /    |          |
| LED Lifetime          | -      | 50000                      | -     | -    | Hrs  | Note2    |

Note1. Calculator Value for reference:  $IF \cdot VF = PLED$ 

Note2. The LED Life-time define as the estimated time to 50% degradation of initial brightness at Ta=25°C and IF =160mA. The LED lifetime could be decreased if operating IF is larger than 160mA

5. EXTERNAL DIMENSIONS



LCM(PIN DEFINE)

| Pin No. | Symbol | Pin No. | Symbol |
|---------|--------|---------|--------|
| 1       | VLED+  | 26      | G1     |
| 2       | VLED+  | 27      | G0     |
| 3       | VLED-  | 28      | R7     |
| 4       | VLED-  | 29      | R6     |
| 5       | GND    | 30      | R5     |
| 6       | VCOM   | 31      | R4     |
| 7       | DVDD   | 32      | R3     |
| 8       | MODE   | 33      | R2     |
| 9       | DE     | 34      | R1     |
| 10      | VS     | 35      | R0     |
| 11      | HS     | 36      | GND    |
| 12      | B7     | 37      | DCLK   |
| 13      | B6     | 38      | GND    |
| 14      | B5     | 39      | L/R    |
| 15      | B4     | 40      | U/D    |
| 16      | B3     | 41      | VGH    |
| 17      | B2     | 42      | VGL    |
| 18      | B1     | 43      | AVDD   |
| 19      | B0     | 44      | RESET  |
| 20      | G7     | 45      | NC     |
| 21      | G6     | 46      | VCOM   |
| 22      | G5     | 47      | DITHB  |
| 23      | G4     | 48      | GND    |
| 24      | G3     | 49      | NC     |
| 25      | G2     | 50      | NC     |

## 6. ELECTRO-OPTICAL CHARACTERISTICS

| Item                    | Symbol   | Condition  | Min          | Typ   | Max          | Unit              | Remark           | Note   |
|-------------------------|----------|--|--------------|-------|--------------|-------------------|------------------|--------|
| Response Time           | Tr+ Tf   | -  | -            | 25    | 50           | ms                | FIG.1            | Note 4 |
| Contrast Ratio          | Cr       |  | 400          | 500   | -            | ---               | FIG.2            | Note 1 |
| Surface Luminance       | Lv       | $\theta=0^\circ$                                     | 400          | 450   | -            | cd/m <sup>2</sup> | FIG.2            | Note 2 |
| Luminance Uniformity    | -        | $\theta=0^\circ$                                     | 60           | 75    | -            | %                 | FIG.2            | Note 3 |
| NTSC                    | -        | $\theta=0^\circ$                                     | -            | 60    | -            | %                 | FIG.2            | Note 5 |
| Viewing Angle Range     | $\theta$ | $\varnothing = 90^\circ$                             | 60           | 70    | -            | deg               | FIG.3            | Note 6 |
|                         |          | $\varnothing = 270^\circ$                            | 55           | 65    | -            | deg               | FIG.3            |        |
|                         |          | $\varnothing = 0^\circ$                              | 60           | 70    | -            | deg               | FIG.3            |        |
|                         |          | $\varnothing = 180^\circ$                            | 60           | 70    | -            | deg               | FIG.3            |        |
| CIE (x, y) Chromaticity | Red x    | $\theta=0^\circ$<br>$\varnothing=0^\circ$<br>Ta=25°C | Typ<br>-0.04 | 0.601 | Typ<br>+0.04 | -                 | FIG.2<br>CIE1931 | Note 5 |
|                         | Red y    |  |              | 0.324 |              | -                 |                  |        |
|                         | Green x  |  |              | 0.301 |              | -                 |                  |        |
|                         | Green y  |  |              | 0.567 |              | -                 |                  |        |
|                         | Blue x   |  |              | 0.143 |              | -                 |                  |        |
|                         | Blue y   |  |              | 0.174 |              | -                 |                  |        |
|                         | White x  |  |              | 0.304 |              | -                 |                  |        |
|                         | White y  |  |              | 0.339 |              | -                 |                  |        |

**Note1. Definition of contrast ratio**

Contrast Ratio(CR) is defined mathematically by the following formula. For more information see FIG.2

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5,P6,P7,P8,P9)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P3, P4, P5,P6,P7,P8,P9)}}$$

**Note2. Definition of surface luminance**

Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see FIG.2

Lv = Average Surface Luminance with all white pixels(P1, P2, P3, P4, P5,P6,P7,P8,P9)

**Note3. Definition of luminance uniformity**

The luminance uniformity in surface luminance (  $\delta$  WHITE ) is determined by measuring luminance at each test position 1 through 9, and then dividing the maximum luminance of 9 points luminance by minimum luminance of 9 points luminance. For more information see FIG.2

$$Y_u = \frac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P3, P4, P5,P6,P7,P8,P9)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P3, P4, P5,P6,P7,P8,P9)}}$$

**Note4. Definition of Response time**

The response time is defined as the LCD optical switching time interval between "White" state and "Black" state. Rise time (T<sub>ON</sub>) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T<sub>OFF</sub>) is the time between photo detector output intensity changed from 10% to 90%. For additional information see FIG1.

**Note5. Definition of color chromaticity (CIE1931)**

CIE (x, y) chromaticity ,The x,y value is determined by screen active area center position P5,For more information see FIG.2

**Note6. Definition of Viewing angle**

Viewing angle is the angle at which the contrast ratio is greater than 10. angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG.3

For Viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope or DMS series Instruments or compatible. For contrast ratio, Surface Luminance, Luminance uniformity and CIE,the testing data is base on TOPCON's BM-5or BM-7 photo detector or compatible.

**Note:** For TFT module, Gray scale reverse occurs in the direction of panel viewing angle.

The definition of Response Time

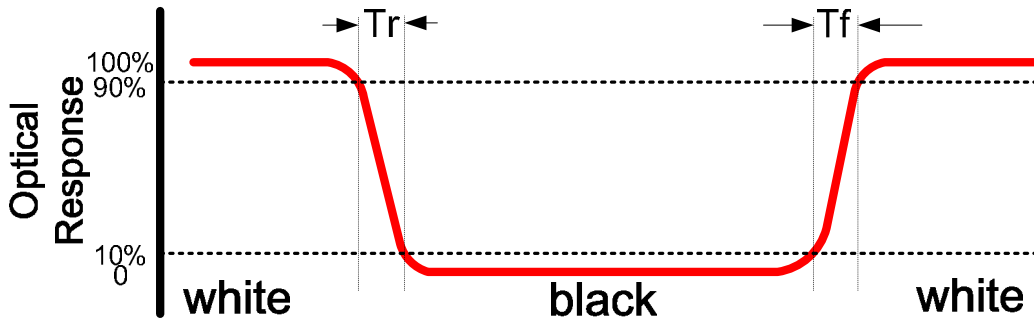


FIG.1. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

Size:  $S \leq 5"$  (see Figure a)

A : 5 mm B : 5 mm

H, V : Active Area

Light spot size  $\varnothing = 5\text{mm}$ (BM-5) or  $\varnothing = 7.7$

(BM-7)50cm distance or

compatible distance from the LCD surface to detector lens.

test spot position: see Figure a.

measurement instrument : TOPCON's luminance meter BM-5 or

BM-7 or compatible (see Figure c)

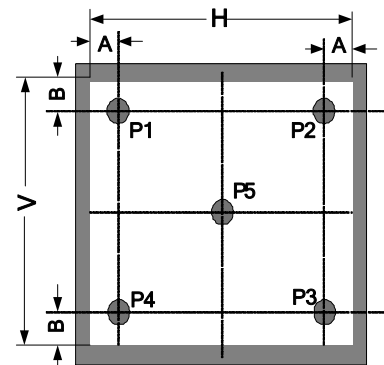


Figure a

Size:  $5" < S \leq 12.3"$  (see Figure b)

H, V : Active Area

Light spot size  $\varnothing = 5\text{mm}$ (BM-5) or  $\varnothing = 7.7\text{mm}$  (BM-7)50cm distance or

compatible distance from the LCD surface to detector lens

test spot position: see Figure b

measurement instrument : TOPCON's luminance meter BM-5 or

BM-7 or compatible (see Figure c)

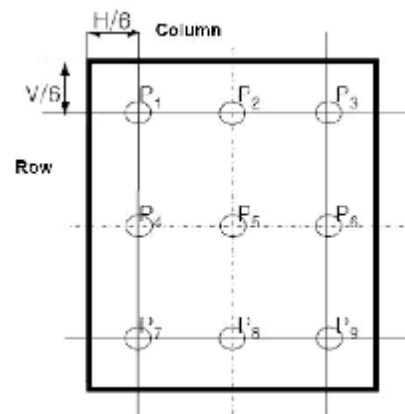


Figure b

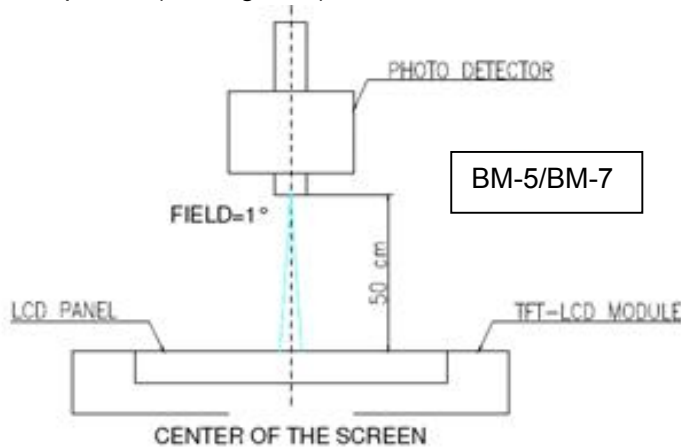
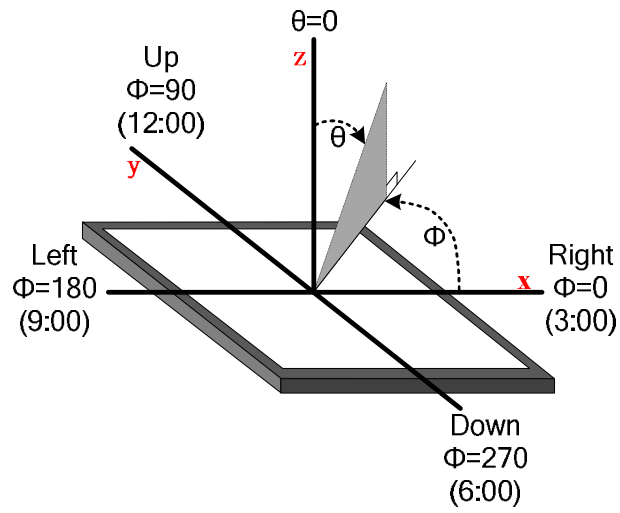


Figure c



FIG.2. The definition of viewing angle



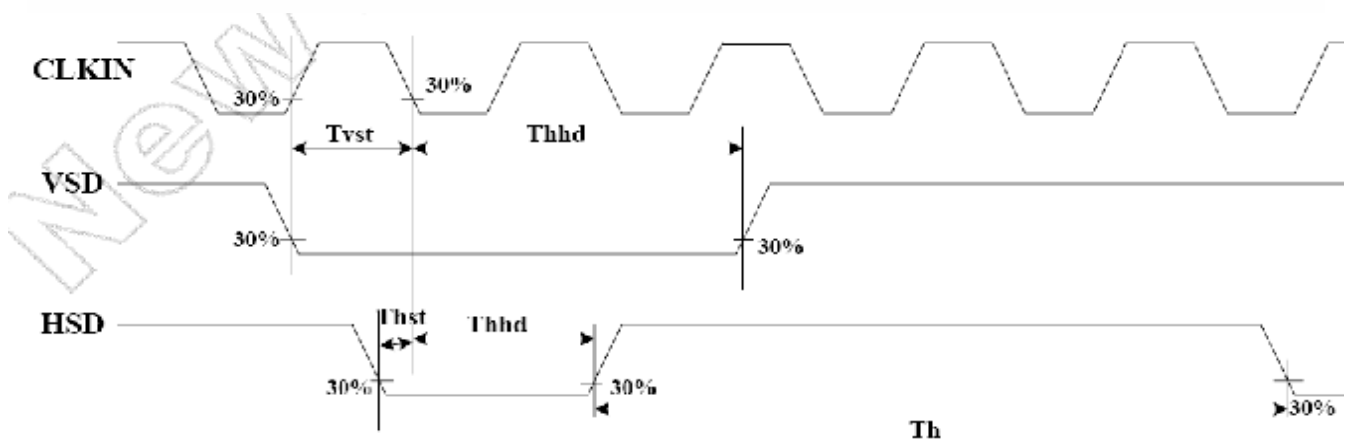
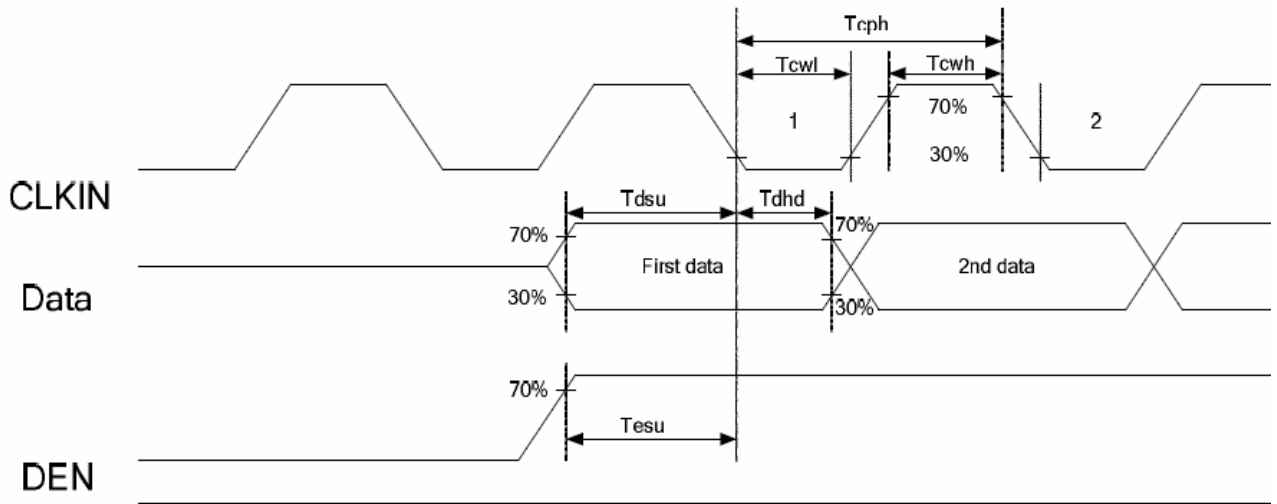
**7. INTERFACE DESCRIPTION**

## LCM Interface description

| Interface No. | Name  | I/O or connect to | Description  |
|---------------|-------|-------------------|--|
| 1-2           | VLED+ | P                 | Power for LED backlight(Anode)   |
| 3-4           | VLED- | P                 | Power for LED backlight(Cathode)   |
| 5             | GND   | P                 | Power Ground   |
| 6             | VCOM  | I                 | For external VCOM DC input(Optional)   |
| 7             | DVDD  | P                 | Digital Power,   |
| 8             | MODE  | I                 | DE/SYNC mode select .normally pull high<br>MODE="1"----DEmode<br>MODE="0"----SYNC mode                                       |
| 9             | DE    | I                 | Data Enable signal ;normally pull low  |
| 10            | VS    | I                 | Vertical sync input.Negative polarity  |
| 11            | HS    | I                 | Horizontal sync input.Negative polarity  |
| 12-19         | B7-B0 | I                 | Blue data  |
| 20-27         | G7-G0 | I                 | Green data   |
| 28-35         | R7-R0 | I                 | Red data(MSB)  |
| 36            | GND   | P                 | Power Ground   |
| 37            | DCLK  | I                 | Clock input ;default falling edge  |
| 38            | GND   | P                 | Power Ground   |
| 39            | L/R   | I                 | Source right or left sequence control.L/R="H"---left to right;<br>L/R="L"---right to left                                    |
| 40            | U/D   | I                 | gate up or down scan control. U/D="L"---up to down;<br>U/D="H"---down to up  |
| 41            | VGH   | P                 | Gate ON voltage  |
| 42            | VGL   | P                 | Gate OFF voltage   |
| 43            | AVDD  | P                 | Analog Power   |
| 44            | RESET | I                 | Reset signal; suggest connect with RC circuit;low active   |
| 45            | NC    | -                 | Not connect  |
| 46            | VCOM  | I                 | For external VCOM DC input(Optional)   |
| 47            | DITHB | I                 | Dithering setting: DITH="H" 6bit resolution (last 2 bits of input data truncated) (default setting) DITH="L" 8bit resolution |
| 48            | GND   | P                 | Power Ground   |
| 49-50         | NC    | -                 | Not connect  |

8. AC CHARACTERISTICS

| Item                    | Symbol | Min | Typ | Max | Unit | Remark        |
|-------------------------|--------|-----|-----|-----|------|---------------|
| HS setup time           | Thst   | 8   | -   | -   | ns   |               |
| HS hold time            | Thhd   | 8   | -   | -   | ns   |               |
| VS setup time           | Tvst   | 8   | -   | -   | ns   |               |
| VS hold time            | Tvhd   | 8   | -   | -   | ns   |               |
| Data setup time         | Tdsu   | 8   | -   | -   | ns   |               |
| Data hold time          | Tdhd   | 8   | -   | -   | ns   |               |
| DE setup time           | Tesu   | 8   | -   | -   | ns   |               |
| DE hold time            | Tehd   | 8   | -   | -   | ns   |               |
| Dvdd power on slew rate | Tpor   | -   | -   | 20  | ms   | 0 to 90% DVDD |
| RESET pulse width       | Trst   | 10  | -   | -   | us   |               |
| DCLK cycle time         | Tcoh   | 20  | -   | -   | ns   |               |
| DCLK pulse duty         | Tcwh   | 40  | 50  | 60  | %    |               |

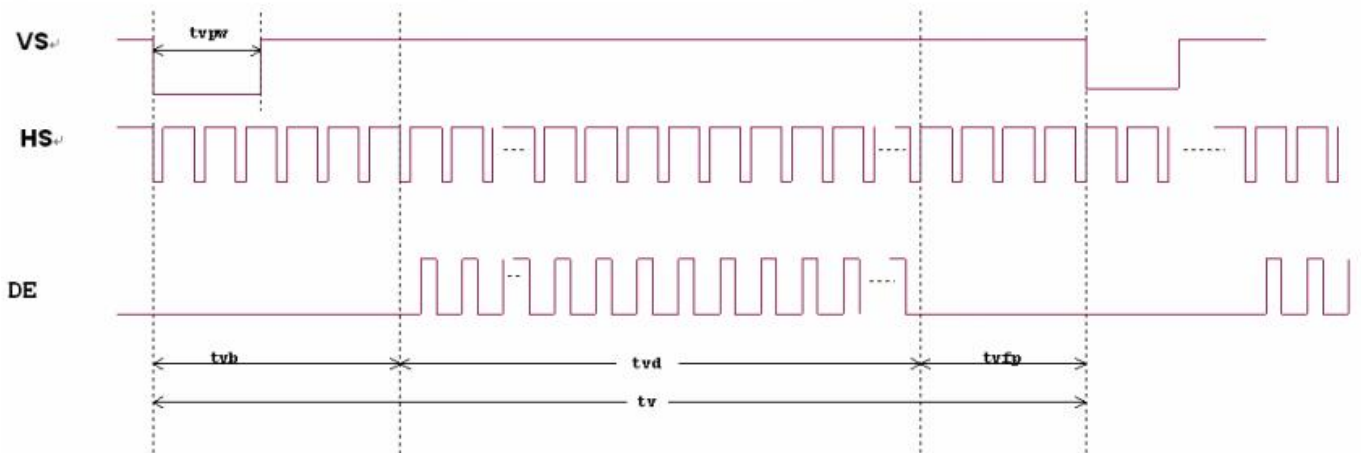


| Item                    | Symbol | Min | Typ | Max  | Unit | Remark |
|-------------------------|--------|-----|-----|------|------|--------|
| Horizontal Display Area | thd    |     | 800 |      | DCLK |        |
| Dclk frequency          | felk   | -   | 30  | 50   | MHZ  |        |
| One horizontal line     | th     | 889 | 928 | 1143 | DCLK |        |
| HS pulse width          | thpw   | 1   | 48  | 255  | DCLK |        |
| HS blanking             | thb    |     | 88  |      | DCLK |        |
| HS front porch          | thfp   | 1   | 40  | 255  | DCLK |        |
| Vertical Display Area   | tvd    |     | 480 |      | TH   |        |
| VS period time          | tv     | 513 | 525 | 767  | TH   |        |
| VS pulse width          | typw   | 3   | 3   | 255  | TH   |        |
| VS blanking             | tvb    |     | 32  |      | TH   |        |
| VS front porch          | tvfp   | 1   | 13  | 255  | TH   |        |

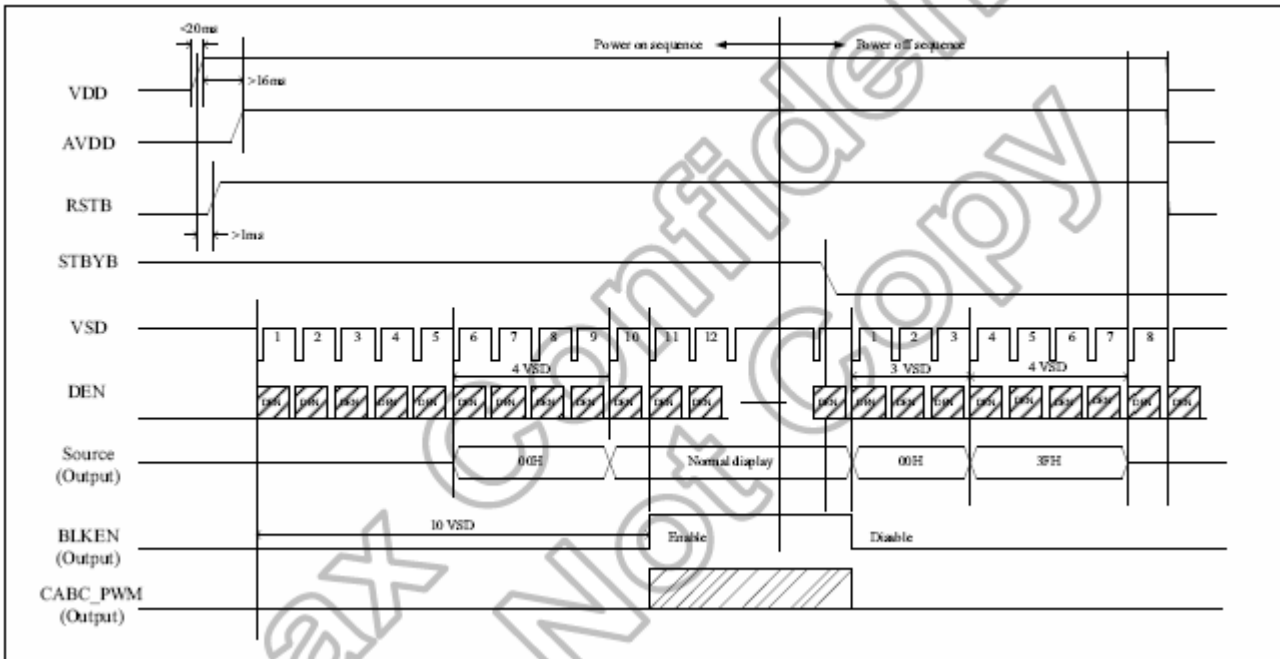
Horizontal input timing diagram.



Vertical input timing diagram.



9. POWER SEQUENCE



10. RELIABILITY TEST CONDITIONS

| No. | Test Item                  | Test Condition   | Inspection after test   |
|-----|----------------------------|--|---|
| 1   | High Temperature Storage   | 80±2°C/240 hours   | Inspection after 2~4hours storage at room temperature, the sample shall be free from defects:<br>1. Current changing value before test and after test is 50% larger ;<br>2. function defect:Non-display ,abnormal-display,missing lines,Short lines , ITO corosion ;<br>3.visual defect:Air bubble in the LCD,Sealleak,Glass crack. |
| 2   | Low Temperature Storage    | -30±2°C/240 hours  |   |
| 3   | High Temperature Operating | 70±2°C/120 hours   |   |
| 4   | Low Temperature Operating  | -20±2°C/120 hours  |   |
| 5   | Temperature Cycle          | -20±2°C~25~70±2°C*10cycles (30min.) (5min.) (30min.)   |   |
| 6   | Damp Proof Test            | 50°C*90% RH/120 hours  |   |
| 7   | Vibration Test             | Frequency : 10Hz~55Hz~10Hz<br>Amplitude :1.5mm, X ,Y ,Z direction for total 3hours (Packing condition) |   |
| 8   | Dropping test              | Drop to the ground from 1m height, one time, every side of carton. (Packing condition)                 |   |
| 9   | ESD test                   | Voltage:±8KV R: 330Ω C: 150pF<br>Air discharge, 10time   |   |

Remark:

- 1.The test samples should be applied to only one test item.
- 2.Sample size for each test item is 3~5pcs.
- 3.For Damp Proof Test, Pure water(Resistance > 10MΩ) should be used.
- 4.In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.
- 5.EL evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
- 6.Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

**11. INSPECTION CRITERION**

**11.1 Description**

This specification is made to be used as the standard acceptance/rejection criteria for TFT LCM Product.

**1. Sample plan**

Sampling plan according to GB/T2828.1-2003/ISO 2859-1 : 1999 and ANSI/ASQC Z1.4-1993, normal level 2 and based on:

Major defect: AQL 0.65

Minor defect: AQL 1.5

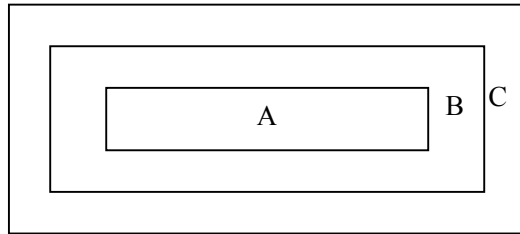
**2. Inspection condition**

● Viewing distance for cosmetic inspection is about 30±5cm with bare eyes, and under an environment 600~1000lux for visual inspection and 0~200lux for function test., all directions for inspecting the sample should be within 45° against perpendicular line. (Normal temperature 18~28°C and normal humidity 60±15%RH).

● Driving voltage

The Vop value from which the most optical contrast can be obtained near the specified Vop in the specification (Within ±0.5V of the typical value at 25°C.).

**3. Definition of inspection zone in LCD**



Zone A: character/Digit area

Zone B: viewing area except Zone A (Zone A+Zone B=minimum Viewing area)

Zone C: Outside viewing area (invisible area after assembly in customer's product)

Fig.1 Inspection zones in an LCD.

Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

**11.2 Inspection criterion**

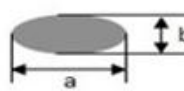

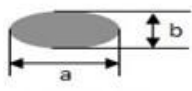

**11.2.1 Function defect**

| Items to be inspected  | Inspection criterion  | Classification of defects |
|------------------------|---|---------------------------|
| All functional defects | 1) No display<br>2) Display abnormally<br>3) Missing vertical , horizontal segment<br>4) Short circuit<br>5) Back-light no lighting, flickering and abnormal lighting.<br>6) obvious striation<br>7) Current beyond specification value | MA                        |
| Missing                | Missing component   |                           |
| Outline dimension      | Overall outline dimension exceed the drawing is not allowed.  |                           |

11.2.2 LCD pixel defect ( bad dot) (defect type:MI)

| Checking item                       | Judgment criterion            |             |                  |
|-------------------------------------|-------------------------------|-------------|------------------|
|                                     | Item/LCD size                 | S ≤5.0 Inch | 5.0 < S≤7.0 Inch |
| Color bad dot-bright dot(R、 G、 B)   | 1                             | 2           | 3                |
| two adjacent bright point           | 0                             | 1           | 2                |
| three or more adjacent point        | 0                             | 0           | 0                |
| total points for bad dot-bright dot | 1                             | 2           | 5                |
| Bad dot-dark dot                    | 2                             | 4           | 5                |
| two adjacent dark point             | 1                             | 2           | 3                |
| three or more adjacent point        | 0                             | 1           | 1                |
| total points for bad dot -dark dot  | 3                             | 6           | 7                |
| patch bright dot                    | Invisible with ND5%,it is OK. |             |                  |

11.2.3 dot and line defect (defect type:MI)

| Checking item   | Judgment criterion                             |                    |                           |                 | Figure   |         |
|---|--|--------------------|---------------------------|-----------------|--|---------|
|   | Diameter(mm)LCD Size                           | S ≤5.0 Inch        | 5 < S≤7 Inch              | 7 < S≤12.3 Inch |  |         |
| Dot defect  | D≤0.1  | allowed            | allowed                   | allowed         | <br>D=(a+b)/2  |         |
|   | 0.1 < D≤0.2                                    | 4                  | allowed                   | allowed         |  |         |
|   | 0.2 < D≤0.3                                    | 0                  | 5                         | 6               |  |         |
|   | 0.3 < D≤0.5                                    | 0                  | 0                         |                 |  |         |
|   | D > 0.5  | 0                  | 0                         | 0               |  |         |
|   | the distance between the two defect dot:DS≥5mm |                    |                           |                 |  |         |
| line defect   | <b>Length(mm)</b>                              | <b>width(mm)</b>   | <b>Judgment criterion</b> |                 |               |         |
|   | disregard                                      | W≤0.05             | allowed                   | allowed         |  | allowed |
|   | L≤5  | 0.05 < W≤0.1       | 4                         | 5               |  | 7       |
|   | L > 5  | W > 0.1            | 0                         | 0               |  | 0       |
| Concave point and air bubble for polarizer  | <b>LCD Size(mm)</b>                            |                    | <b>Judgment criterion</b> |                 | <br>D=(a+b)/2 |         |
|   | D≤0.3  |                    | allowed                   | allowed         |  | allowed |
|   | 0.3 < D≤1.0                                    |                    | 3                         | 4               |  | 5       |
|   | 1.0 < D≤1.5                                    |                    | 1                         | 2               |  | 3       |
|   | D > 1.5  |                    | 0                         | 0               |  | 0       |
| Fold mark, linear scar for polarizer  | <b>Length ( mm)</b>                            | <b>width ( mm)</b> | <b>Judgment criterion</b> |                 |               |         |
|   | disregard                                      | W≤0.05             | allowed                   | allowed         |  | allowed |
|   | 1 < L≤5  | 0.05 < W≤0.2       | 3                         | 4               |  | 5       |
|   | L > 5  | W > 0.2            | 0                         | 0               |  | 0       |
| Notes:1.If the fold mark and linear scar for polarizer is visible with operating condition,the defect is judged with line judge ; 2.If the fold mark and linear scar for polarizer is visible with non-operating condition,the defect is judged with the above judgment standard. |  |                    |                           |                 |  |         |

## 11.2.4 Corner and others crack for LCD (defect type:MI)

| Checking item             | Judgment criterion   | Figure |
|---------------------------|--|--------|
| electric conduction crack | $X \leq 3.0\text{mm}, Y \leq 1/4w, Z \leq t, N \leq 2$   |        |
| corner crack              | $X \leq 3.0\text{mm}, Y \leq 3.0\text{mm}, Z \leq t, N \leq 3$<br>Corner crack extended to ITO PIN, none allowed |        |
| surface crack             | $X \leq 1.5\text{mm}, Y \leq 1.0\text{mm}, Z \leq t, N \leq 4$   |        |

## 11.2.5 Module Cosmetic Criteria (defect type:MI)

| Item                                  | Judgment Criterion  |
|---------------------------------------|---|
| Difference in Spec.                   | None allowed  |
| Pattern peeling                       | No substrate pattern peeling and floating   |
| Soldering defects                     | No soldering missing<br>No soldering bridge<br>No cold soldering<br>Notes:detail judgment referring to IPC-A-610 grade II |
| Resist flaw on Printed Circuit Boards | visible copper foil ( $\square 0.5\text{mm}$ or more) on substrate pattern, none allowed                                  |
| Accretion of metallic Foreign matter  | No accretion of metallic foreign matters (Not exceed $\square 0.2\text{mm}$ )   |
| Stain                                 | No stain to spoil cosmetic badly  |
| Plate discoloring                     | No plate fading, rusting and discoloring  |
| Newton ring                           | Referring to limited sample   |
| Mura                                  | Invisible with 5%ND, allowed  |
| Light leaks                           | Referring to limited sample   |



## **12. HANDLING PRECAUTIONS**

### **12.1 Mounting method**

The LCD module consists of two thin glass plates with polarizers which easily be damaged. And since the module is so constructed as to be fixed by utilizing fitting holes in the printed circuit board. Extreme care should be needed when handling the LCD modules.

### **12.2 Caution of LCD handling and cleaning**

When cleaning the display surface, Use soft cloth with solvent

[recommended below] and wipe lightly

- .Isopropyl alcohol
- .Ethyl alcohol

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

Do not use the following solvent:

- .Water
- .Aromatics

Do not wipe ITO pad area with the dry or hard materials that will damage the ITO patterns

Do not use the following solvent on the pad or prevent it from being contaminated:

- .Soldering flux
- .Chlorine (Cl) , Sulfur (S)

If goods were sent without being silicon coated on the pad, ITO patterns could be damaged due to the corrosion as time goes on.

If ITO corrosion happens by miss-handling or using some materials such as Chlorine (Cl), Sulfur (S) from customer, Responsibility is on customer.

### **12.3 Caution against static charge**

The LCD module uses C-MOS LSI drivers, so we recommend that you:

Connect any unused input terminal to Vdd or Vss, do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

### **12.4 Packing**

Modules employ LCD elements and must be treated as such.

- .Avoid intense shock and falls from a height.
- .To prevent modules from degradation, do not operate or store them exposed direct to sunshine or high temperature/humidity

### **12.5 Caution for operation**

- .It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage than the limit causes the shorter LCD life.
- .An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.
- .Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, which will come back in the specified operation temperature.
- .If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- .A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

Usage under the maximum operating temperature, 50%Rh or less is required.

**12.6 Storage**

In the case of storing for a long period of time for instance, for years for the purpose or replacement use, the following ways are recommended.

- .Storing in an ambient temperature 10°C to 30°C, and in a relative humidity of 45% to 75%. Don't expose to sunlight or fluorescent light.
- .Storing in a polyethylene bag with the opening sealed so as not to enter fresh air outside in it . And with no desiccant.
- .Placing in a dark place where neither exposure to direct sunlight nor light's keeping the storage temperature range.
- .Storing with no touch on polarizer surface by the anything else.

It is recommended to store them as they have been contained in the inner container at the time of delivery from us.

**12.7 Safety**

- .It is recommendable to crash damaged or unnecessary LCD's into pieces and wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.
- .When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water

**13. PRECAUTION FOR USE**

**13.1** A limit sample should be provided by the both parties on an occasion when the both parties agreed its necessity. Judgment by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.

**13.2** On the following occasions, the handing of problem should be decided through discussion and agreement between responsible of the both parties.

- .When a question is arisen in this specification
- .When a new problem is arisen which is not specified in this specifications
- .When an inspection specifications change or operating condition change in customer is reported to DISPLAY , and some problem is arisen in this specification due to the change
- .When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.