TIANMA

# SPECIFICATION

## FOR LCD MODULE

| | |
|---|---|
| CUSTOMER: | TM Standard LCM |
| CUSTOMER NO.: | ------ |
| PRODUCT NO.: | TM320240BCCWVSWA |
| PRODUCT TYPE: | Graphic Matrix STN |
| VERSION: | 1.0 |

■Preliminary specification

□Final specification

| | |
|---|---|
| CUSTOMER APPROVED | |

| PREPARED BY | CHECKED BY | VERIFIED BY QA DEPT. | APPROVED BY |
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# REVISION RECORD

| Version | Page | Revision Items | Name | Date |
|---|---|---|---|---|
| 0.0 | | First release | Jiayong Liu | 2008.2.1 |
| | | | | |



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# 1 Description

The TM320240BCCWVSWA, a Graphic LCM unit consists of 320(segment)×240(common) dots dot-matrix LCD panel, LCD driver, bias circuits on a single PCB.

- Wide viewing angle
- Wide operation temp.
- Requirements on environmental protection: RoHS.

# 2 Features

| Item | Contents |
|---|---|
| LCD type | FSTN |
| | Positive |
| LCD Duty | 1/240 |
| LCD Bias | 1/16 |
| Polarizer | Transflective |
| LCD background color | White |
| Segment color | Blue-black |
| Backlighting | LED |
| Backlighting type | Side |
| Backlighting color | White |
| View direction | 6:00 |
| Operating temperature | -20℃~70℃ |
| Storage temperature | -30℃~80℃ |
| Driver | SDN8080G |
| Frame | SUS430 |
| Technology | SMT |
| Data Transfer | 4 Bit Parallel |



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## 3 Absolute maximum ratings

(VSS=0V, Ta=25℃)

| Parameter | Symbol | Min | Max | Unit | Remark |
|---|---|---|---|---|---|
| Logic circuit supply voltage | $V_{CC}$ | -0.3 | +6.0 | V | --- |
| Input voltage of logic control or data pins | $V_I$ | -0.3 | $V_{DD}$+0.3 | V | --- |
| Voltage of $V_{ADJ}$ | $V_{ADJ}$ | -24 | 0.3 | V | --- |
| Voltage of $V_{EE}$ | $V_{EE}$ | -24 | 0.3 | V | --- |
| LCD driving voltage | $V_{LCD}$ | -0.3 | 28.0 | V | Note [3-2] |
| Operating temperature range | $T_{OP}$ | -20 | +70 | ℃ | Note [3-3] |
| Storage temperature range | $T_{ST}$ | -30 | +80 | ℃ | |

Note [3-1]: No parameter is allowed to exceed these maximum ratings.

Note [3-2]: LCD operating voltage is calculated as $V_{LCD}=V_{CC}-V_5$.

Note [3-3]: 95% RH MAX (40 °C ≥ Ta);

Maximum wet-bulb temperature is 39°C or less. (Ta >40 °C) No dew condensation.

Note [3-4]: Only operation is guarantied at operating temperature. Contrast, response time and another display quality are evaluated at +25°C.

## 4 Mechanical Characteristics

### 4.1 Mechanical features

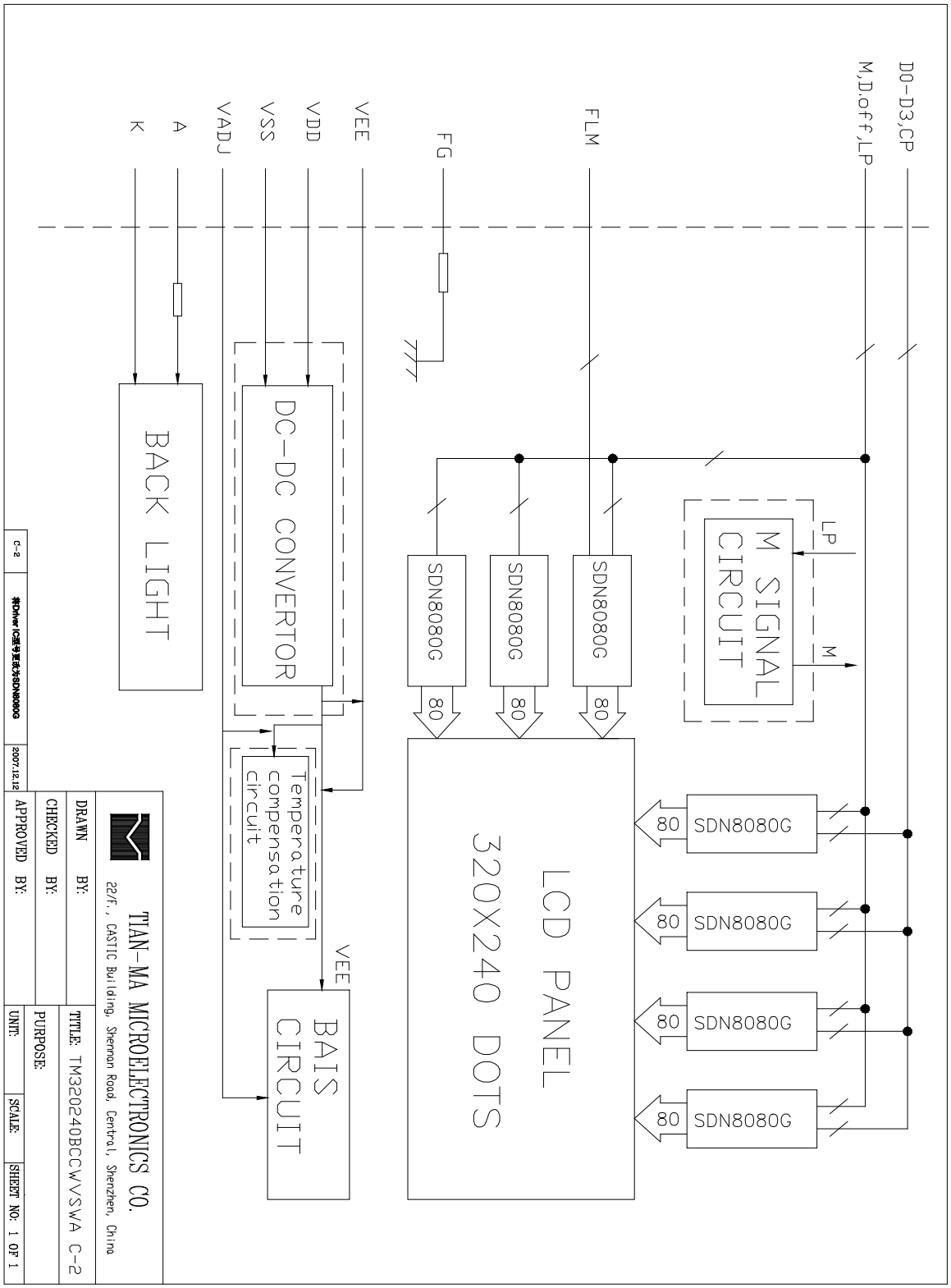
| Parameter | Standard Value | Unit |
|---|---|---|
| Display type | Graphics Matrix LCM | -- |
| Character size(W×H) | -- | mm |
| Number of dots | 320 x 240 | -- |
| View area (W×H) | 102.0 x 78.0 | mm |
| Active Area (W×H) | 95.97 x 71.97 | mm |
| Dot Size (W×H) | 0.27 x 0.27 | mm |
| Dot Pitch (W×H) | 0.30 x 0.30 | mm |
| Module size(W×H×D) | 139.0 x 100.0 x 13.5(MAX) | mm |
| Module total weight (approx) | 200 | g |



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## 4.2 Mechanical drawing



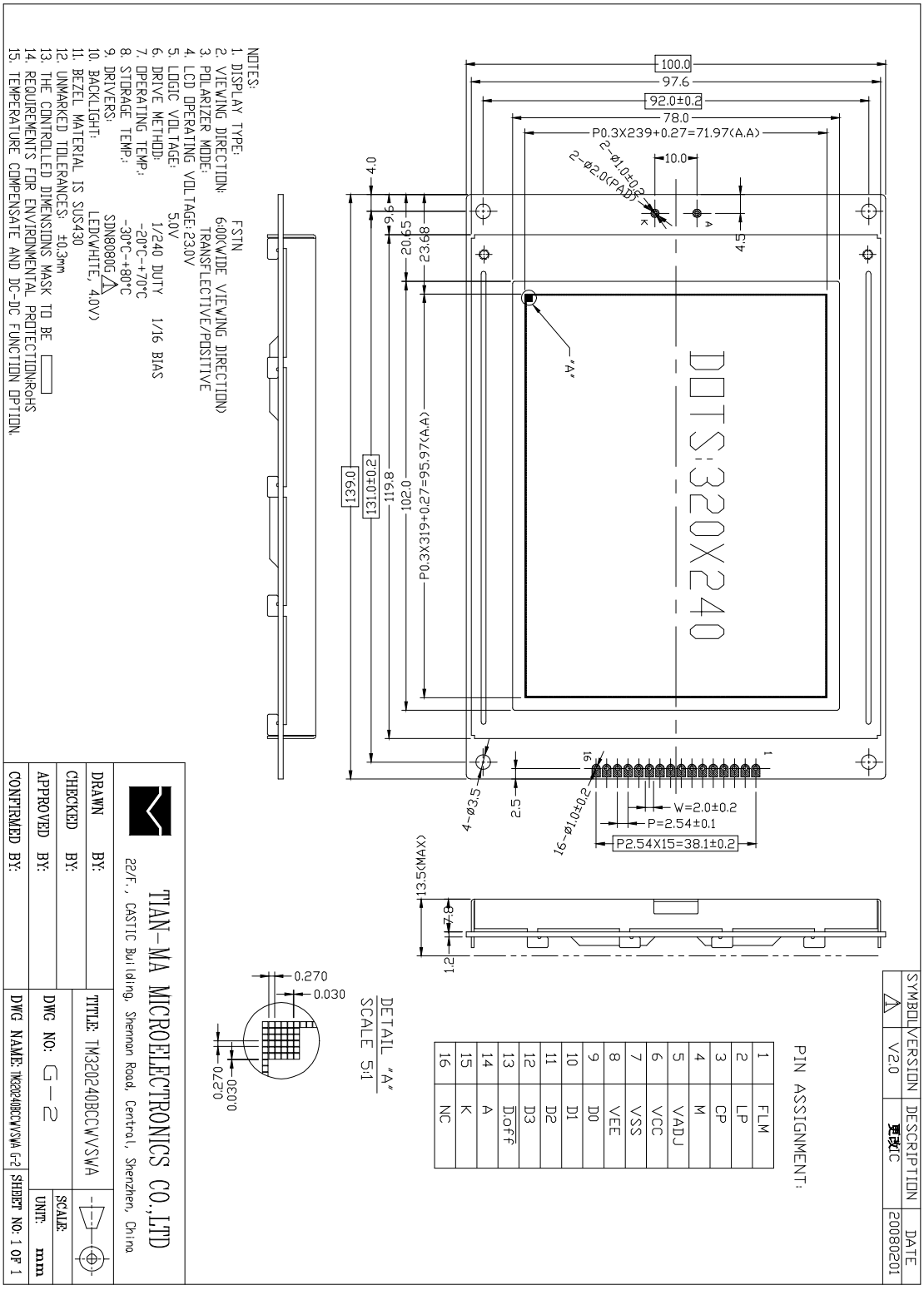



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# 5 Circuit

## 5.1 Block Diagram

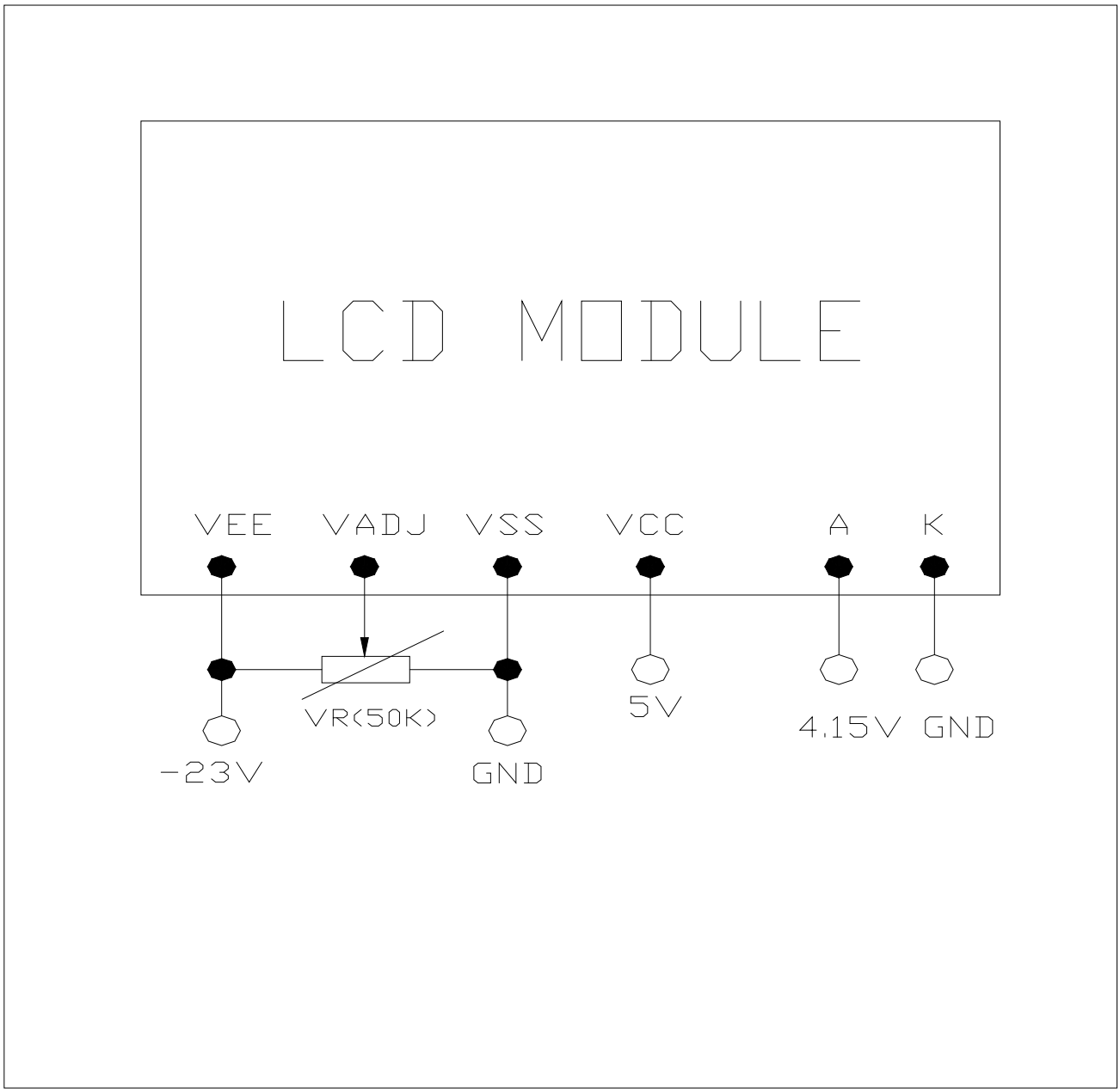





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**5.2 Recommend power supply circuit**




Note [5-1]: Input $V_{CC}$ and $V_{EE}$ , if you want to get perfect display effect, please add the VR.

Note [5-2]: You can get the right voltage Vadj by control the VR.



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## 6 Interface description

| Pin No. | Symbol | I/O | Description |
|---|---|---|---|
| 1 | FLM | I | Indicate the beginning of each frame |
| 2 | LP | I | Data latch clock |
| 3 | CP | I | Data shift clock |
| 4 | M | I | Alternating signal for generating alternating LCD-bias voltage. |
| 5 | $V_{ADJ}$ | -- | Adjustable operating voltage for LCD(-) |
| 6 | $V_{CC}$ | I | Power supply voltage for logic and LCD(+)(+5V) |
| 7 | $V_{SS}$ | I | Ground |
| 8 | $V_{EE}$ | I | Power supply voltage for LCD(-) |
| 9 | D0 | I | Data bit0 |
| 10 | D1 | I/O | Data bit1 |
| 11 | D2 | I | Data bit2 |
| 12 | D3 | I/O | Data bit3 |
| 13 | D.OFF | I | Display off (“H”=on, “L”=off) |
| 14 | A | I | Power supply voltage for LED(+),4.0V or 150mA. |
| 15 | K | I | Power supply voltage for LED(-) |
| 16 | NC | - | No connection. |



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# 7 Instruction Code & Timing characteristics

## 7.1 Interface Timing characteristics

Note: Please refer to AVANT's SDN8080G data sheet for more details.

AC CHARACTERISTICS

(1) SEGMENT DRIVER APPLICATION

(Vss = 0 V, Ta = -20 ~ +70°C)

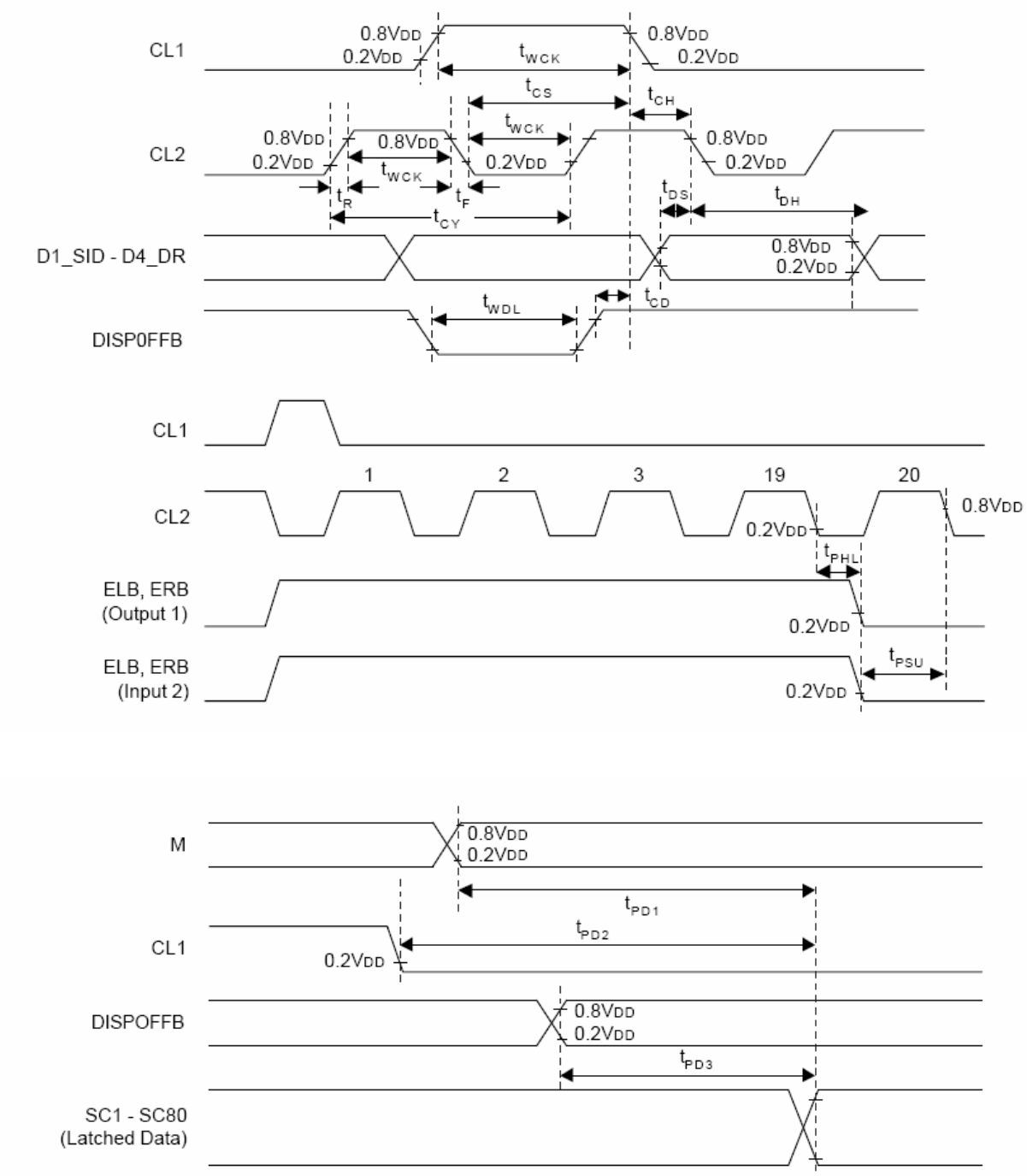
| Characteristic | Symbol | Test Condition | (1) VCC=5 V ±10% | | | (2) VCC=3 V ±10% | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Clock cycle time | tCY | Duty=50% | 125 | - | - | 250 | - | - | ns |
| Clock pulse width | tWCK | - | 45 | - | - | 95 | - | - | |
| Clock rise/fall time | tR/tF | - | - | - | 30 | - | - | 30 | |
| Data set-up time | tDS | - | 30 | - | - | 65 | - | - | |
| Data hold time | tDH | - | 30 | - | - | 65 | - | - | |
| Clock set-up time | tCS | - | 80 | - | - | 120 | - | - | |
| Clock hold time | tCH | - | 80 | - | - | 120 | - | - | |
| Propagation delay time | tPHL | ELB Output | - | - | 60 | - | - | 125 | |
| | | ERB Output | | | 60 | | | 125 | |
| ELB,ERB set-up time | tPSU | ELB Input | 30 | - | - | 65 | - | - | |
| | | ERB Input | 30 | - | - | 65 | - | - | |
| DISPOFFB low pulse width | tWDL | - | 1.2 | - | - | 1.2 | - | - | s |
| DISPOFFB clear time | tCD | - | 100 | - | - | 100 | - | | ns |
| M - OUT propagation delay time | tPD1 | CL=15 pF | - | - | 1.0 | - | - | 1.2 | s |
| CL1 - OUT propagation delay time | tPD2 | | - | - | 1.0 | - | - | 1.2 | |
| DISPOFFB – OUT propagation delay time | tPD3 | | - | - | 1.0 | - | - | 1.2 | |



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(2) SEGMENT DRIVER APPLICATION TIMING






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(3) COMMON DRIVER APPLICATION

(Vss = 0 V, Ta = -20 ~ +70°C)

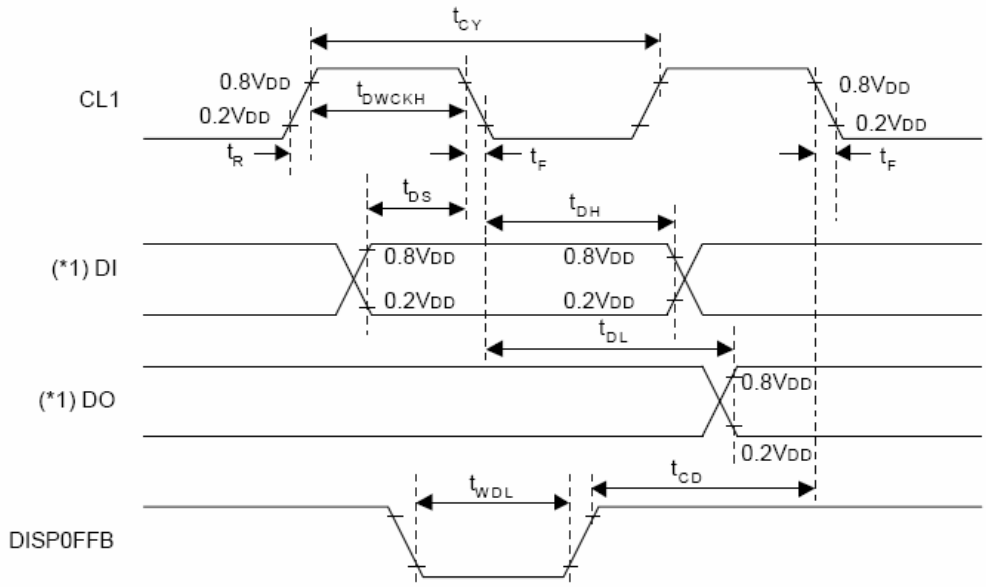
| Characteristic | Symbol | Test Condition | (1) VCC=5 V±10% | | | (2) VCC=3V±10% | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP. | MAX. | MIN | TYP. | MAX | |
| Clock cycle time | tCY | Duty=50% | 250 | - | - | 500 | - | - | ns |
| Clock pulse width | tWCK | - | 45 | - | - | 95 | - | - | |
| Clock rise/fall time | tR/tF | - | - | - | 50 | - | - | 50 | |
| Data set-up time | tDS | - | 30 | - | - | 65 | - | - | |
| Data hold time | tDH | - | 30 | - | - | 65 | - | - | |
| DISPOFFB low pulse width | tWDL | - | 1.2 | - | - | 1.2 | - | - | □s |
| DISPOFFB clear time | tCD | - | 100 | - | - | 100 | - | - | ns |
| Output delay time | tDL | CL=15 pF | - | - | 200 | - | - | 250 | |
| M - OUT propagation delay time | tPD1 | | - | - | 1.0 | - | - | 1.2 | □s |
| CL1 - OUT propagation delay time | tPD2 | | - | - | 1.0 | - | - | 1.2 | |
| DISPOFFB - OUT propagation delay time | tPD3 | | - | - | 1.0 | - | - | 1.2 | |



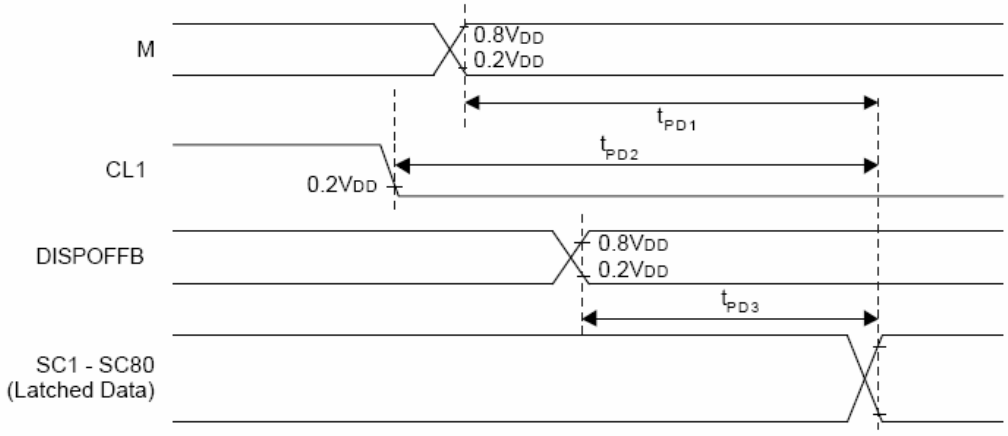
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(4) COMMON DRIVER APPLICATION TIMING




(*1) When in Single-type Interface Mode
DI => D2_DL (SHL = L), D4_DR (SHL = H)
DO => D4_DR (SHL = L ), D2_DL (SHL = H)
When in Dual-type Interface Mode
DI => D2_DL and D3_DM (SHL = L), D4_DR and D3_DM (SHL = H)
DO => D4_DR (SHL = L), D2_DL (SHL = H)






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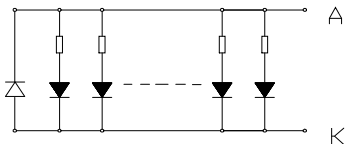
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## 8 Electrical characteristics

| Parameter | | Symbol | Condition | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| Logic circuit supply voltage | | $V_{CC}$ | -- | 4.8 | 5.0 | 5.2 | V |
| Power supply LCD(-) | | $V_{EE}$ | -- | -- | -23 | -- | |
| Input voltage for logic circuit | "H" level | $V_{IH}$ | $V_{CC}$=5.0V | 0.8 $V_{DD}$ | $V_{DD}$ | $V_{DD}$ +0.3 | |
| | "L" level | $V_{IL}$ | | VSS-0.3 | $V_{SS}$ | 0.2VDD | |
| Output voltage for logic circuit | "H" level | $V_{OH}$ | | -- | $V_{DD}$ | -- | |
| | "L" level | $V_{OL}$ | | -- | $V_{SS}$ | -- | |
| Logic power supply current (Without backlighting) | | $I_{CC}$ | | -- | TBD | -- | mA |
| Used driver IC | | SDN8080G(COM/SEG Driver) | | | | | |

## 9 LED backlight characteristics

CIRCUIT DIAGRAM(1X10 LED'S)




| Item | Symbol | Condition | MIN. | TYP. | MAX. | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| Forward voltage | $V_f$ | $I_f$=150mA | -- | 4.0 | 4.2 | V | -- |
| Forward current | $I_f$ | $V_f$= 4.0V | -- | 150 | 200 | mA | **--** |
| Lifetime | t | -- | -- | TBD | -- | hours | Note [9-1,2] |

Note [9-1]**:** If the backlight is used above its' driving voltage or current for a long time, its lifetime will reduce or it will cause poor reliability.

Note [9-2]**:** The backlight lifetime lasts until the luminance reduces to 50% of its initial value.



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## 10 Optical Characteristics

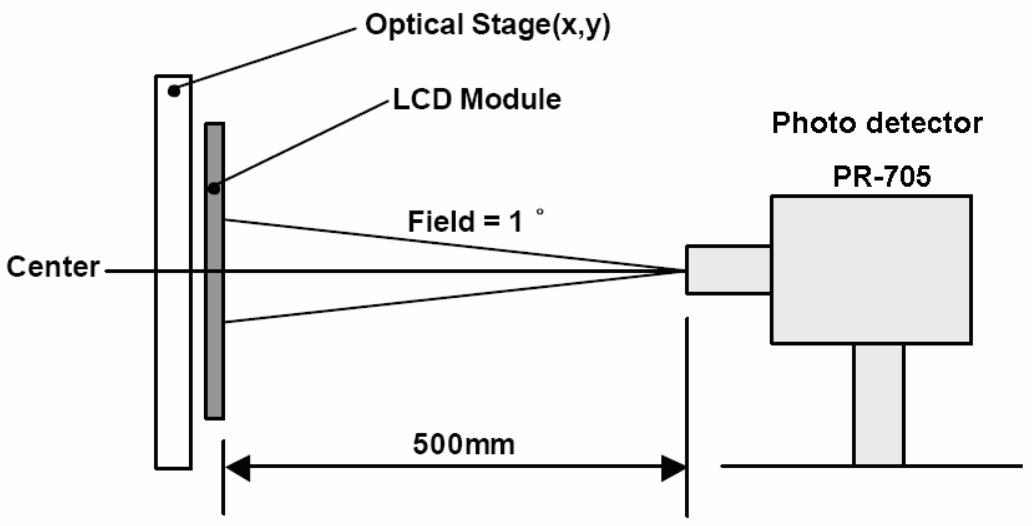
1/240Duty, 1/16Bias, Vo=25V(Note [10-2]), f=70Hz

| Parameter | | Symbol | Ratings | | | Unit | Measuring Temp. | Remark |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Type | Max. | | | |
| Contrast ratio | | Cr ($\theta$=0°,$\Phi$=0°) | 2.5 | --- | --- | --- | 25□ | Note[10-1,3] |
| Response time | Turn on | $t_{on}$ | --- | 200 | --- | ms | 25□ | Note[10-1,4] |
| | | | --- | TBD | --- | | 0□ | |
| | Turn off | $t_{off}$ | --- | 320 | --- | ms | 25□ | |
| | | | --- | TBD | --- | | 0□ | |
| Viewing angle (Cr≥2) | Up-down | $\theta$1 ($\Phi$=0°) | --- | 15 | --- | deg | 25□ | Note[10-1,5] |
| | | | --- | 20 | --- | | | |
| | Left-right | $\theta$2 ($\theta$=0°) | --- | 20 | --- | deg | 25□ | |
| | | | --- | 20 | --- | | | |
| Luminance | | $Y_L$ ($\theta$=0°,$\Phi$=0°) | --- | TBD | --- | $Cd/m^2$ | 25□ | Note[10-1] ($I_f$=150mA) |
| Luminance Uniformity | | $L_U$ ($\theta$=0°,$\Phi$=0°) | 70 | --- | --- | % | 25□ | Note[10-1,6] |

Note [10-1]: Measuring equipments: DMS-501, PR-705.

Measuring condition:

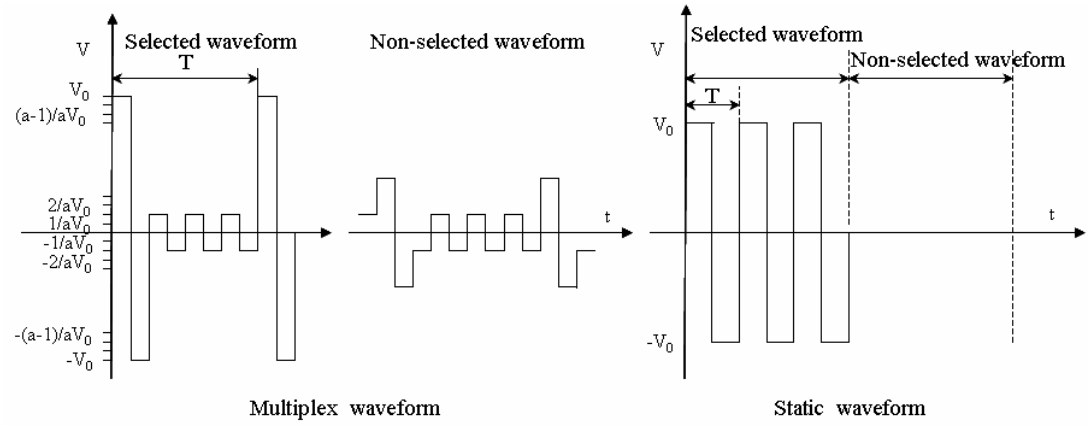
- After stabilizing and leaving the panel alone at a given temperature for 30 min, the measurement should be executed,
- Measuring surroundings: a stable, windless and dark room,
- Measuring temperature: Ta=25°C,
- 30 min after lighting the back-light.






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Note [10-2]: The maximum and minimum ratings don't mean the LCD works well in the whole range of Vo. Vo must be adjusted to optimize the viewing angle and contrast. Refer to the following definition of drive voltage:




| | |
|---|---|
| Operating voltage： $V_o$ | Frame frequency: f=1/T |
| Duty: 1/N | Bias: 1/a |

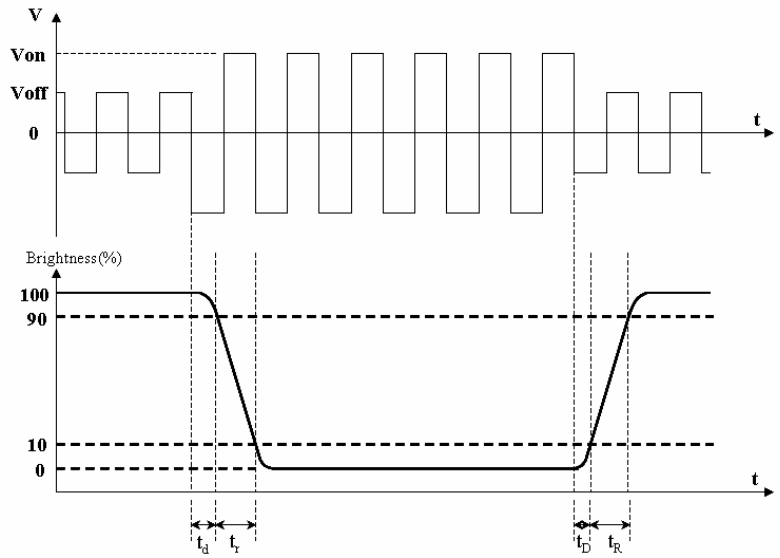
Note [10-3]: Contrast ratio(CR) is defined as follows:

$$CR = \frac{L_{ON}\ (\text{Luminance of the ON segments})}{L_{OFF}\ (\text{Luminance of the OFF segments})}$$

Note [10-4]: Definition of response time:

Turn on time (rise time): $t_{on} = t_d + t_r$ (The time that the luminance level reaches 90% of the saturation level from 0% when ON signal is applied)

Turn off time (fall time): $t_{off} = t_d + t_r$ (The time that the luminance level reaches 10% of the saturation level from 100% when OFF signal is applied)

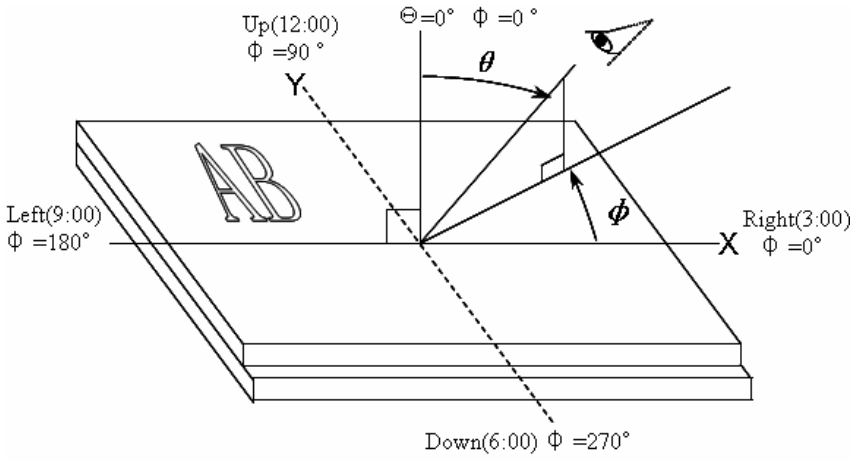




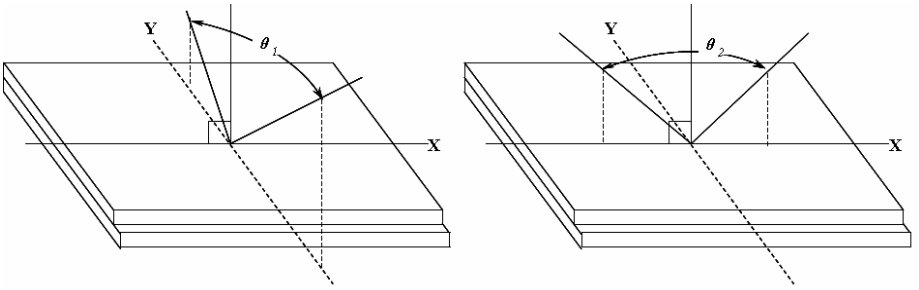

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Note [10-5]: Definition of viewing direction

Refer to the picture below marked by $\theta$ and $\Phi$




Definition of viewing angle



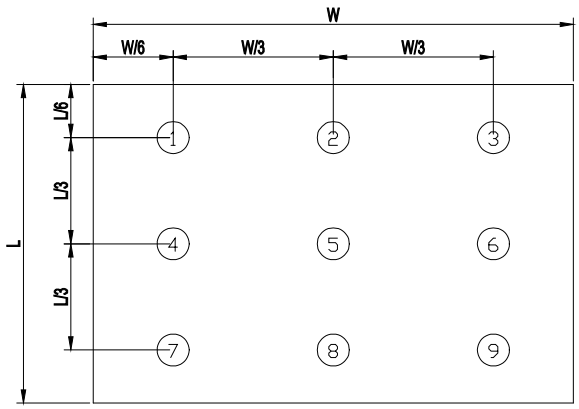

$\theta_1$ ——range of viewing angle from up to down; $\theta_2$ ——range of viewing angle from left to right.

Note [10-6]: The definition of luminance uniformity:

The luminance uniformity is calculated by using following formula.

$$\text{Luminance uniformity (Lu)} = \frac{\text{Minimum luminance from } \square \text{ to } \square}{\text{Maximum luminance from } \square \text{ to } \square}$$

The luminance is measured at near the 9 points shown below.






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# 11 Reliability

## 11.1 Content of Reliability Test

| No. | Test Item | Test condition | Remark | Criterion |
|---|---|---|---|---|
| 1 | High Temperature Storage | Ta=80□, 120H | | Remark1<br>Remark2<br>Remake3<br>Remake4 |
| 2 | Low Temperature Storage | Ta=-30□, 120H | Note[11-1] | |
| 3 | High Temperature Operation | Ta=70□, 120H | | |
| 4 | Low Temperature Operation | Ta=-20□, 120H | Note[11-1] | |
| 5 | High Temperature & High Humidity Operation | Ta=60□,90%RH,120H | Note[11-1] | |
| 6 | Temperature Cycle Test<br>(Non-Operating) | -30 °C↔+25 °C↔+80 °C,100 Cycles<br>30min 5min 30min | Note[11-1] | |
| 7 | Vibration Test | Frequency: 10 ~150 Hz,<br>Stroke: 1.5mm<br>Sweep time: 11 min<br>Test Period: 6 Cycles for each direction of X,Y,Z,120 min every direction | Note[11-2] | Remark1<br>Remark5<br>Remark6 |
| 8 | Shock Test | Waveform : Half Sinusoidal Wave<br>Shock Level:50 G,<br>Pulse Width:11 ms,<br>Direction: ±X, ±Y, ±Z,<br>Cycle:3 times | Note[11-2] | |

Note [11-1]: No dew condensation to be observed.

Note [11-2]: Vibration test will be conducted to the product itself without putting it in a container.

Note [11-3]: The test sample is inspected after 2 hours or more storing at room temperature and room humidity after each test item is finished.

Note[11-4]:T he criteria refer to 11.2.



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### 11.2 Inspection of criteria

| Remark NO. | Content |
|---|---|
| 1 | Function test is OK. Missing Segment, shorts, unclear segment, non-display, display abnormally, liquid crystal leak are unallowable. |
| 2 | After testing, cosmetic defects should not happen, no low temperature bubbles, seal loose and fall, frame rainbow, ACF bubble growing are unallowable in the appearance test. |
| 3 | Total current consumption should not be over 10% of initial value. |
| 4 | After tests, the contrast ratio must be larger than 70% of its value before. |
| 5 | No glass crack, chipped glass, end seal loose frame crack and so on. |
| 6 | No structure looseness. |

## 12 Package

**TBD**



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# 13 Quality level

| Examination or Test | At $T_a$=25□ (Unless otherwise stated) | Inspection | | | | |
|---|---|---|---|---|---|---|
| | | Min | Max | Unit | IL | AQL |
| External Visual Inspection | Under normal illumination and eyesight condition, the distance between eyes and LCD is 25cm. | Refer to appendix A | | | II | Major 1.0 Minor 2.5 |
| Display Defects | Under normal illumination and eyesight condition, display on inspection. | Refer to appendix B | | | II | Major 1.0 Minor 2.5 |
| Note: Major defects: Open segment or common, Short, Serious damages, Leakage<br>Miner defects: Others<br>Sampling standard conforms to GB2828 | | | | | | |

# 14 Precautions for Use of LCD Modules

## 14.1 Handling Precautions

14.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

14.1.2 Liquid in LCD is hazardous substance, if the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, thoroughly and promptly wash it off using soap and water.

14.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

14.1.4 Don't touch, push or rub the exposed polarizer covering the display surface of the LCD module with anything harder than an HB pencil lead, the polarizer is soft and easily scratched, handle it carefully.

14.1.5 Don't put or attach anything on the display area to avoid leaving any marks on.

14.1.6 If the display surface is contaminated or becomes dusty, breathe on the surface and gently wipe it with a soft dry cloth. do not scrub hard to avoid damage the surface. If still not completely clear, moisten cloth with one of the following solvents:

— Isopropyl alcohol
— Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

— Water
— Ketone
— Aromatic solvents

14.1.7 Do not attempt to disassemble the LCD Module.

14.1.8 If the logic circuit power is off, do not apply the input signals.

14.1.9 Avoid using the same display pattern long time ( continous ON segment).Software must be prepared so that the pattern will be changed



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14.1.10 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

a. Be sure to ground the body and electric appliances when handling the LCD Modules. It is preferable to use conductive mat on table and wear cotton clothes or conductive processed fibre. Synthetic fibre is not recommended.

b. Tools required for assembly, such as soldering irons, must be properly ground.

c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

d. The LCD Module is coated with a film to protect the display surface. Be careful and slow when peeling off this protective film since static electricity may be generated. It is recommended to use ionic fan or machine when operating. It is recommended to remove the protection foil slowly (> 3 sec.).

e. It is preferable to wear gloves etc, to avoid damaging the LCD. Please do not touch electrodes with bare hands or avoid any other contamination.

## 14.2 Storage precautions

14.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

14.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 5□ ～ 40□

Relatively humidity: ≤80%

14.2.3 The LCD modules should be stored in a clean environment or room, free from acid, alkali and harmful gas.

14.2.4 Store the module in anti-static electricity container and without any physical load.

## 14.3 Transportation precautions

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.

## 14.4 Soldering

14.4.1 Use the high quality solders, only solder the I/O terminals.

14.4.2 No higher than 280□ and time less than 3-4 second during soldering.

14.4.3 Rewiring: no more than 3 times.

14.4.4 when you remove connector or cable soldered to I/O terminals, please confirm that solder is fully melted. If you remove by force, electrodes at I/O terminals may be damaged (or stripped off). It is recommended to use solder suction machine.



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## 15. LCD Module Part Numbering System

| TM | 320240 | B | C | C | W | V | S | W | A |
|---|---|---|---|---|---|---|---|---|---|
| □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |

| NO. | Explanation | |
|---|---|---|
| ① | **TIANMA module indicating** | |
| ② | **Module type: 320 columns X 240 rows** | |
| ③ | **TIANMA module series** | |
| ④ | **LCD type** | |
| | C | Positive, FSTN |
| ⑤ | **Backlight type** | |
| | C | Transflective, LED |
| ⑥ | **Temperature range** | |
| | W | Wide temperature |
| ⑦ | **Viewing Angle** | |
| | V | Wide viewing direction |
| ⑧ | **Technology** | |
| | S | SMT (only SMT) |
| ⑨ | **The color of backlight** | |
| | W | White |
| ⑩ | **Function choice** | |
| | A | Basic function |

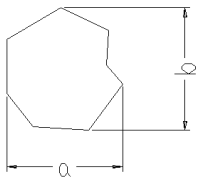
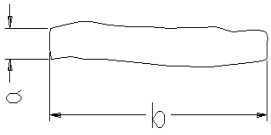
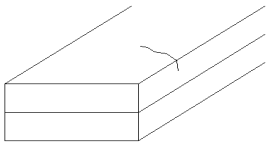


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## Appendix A

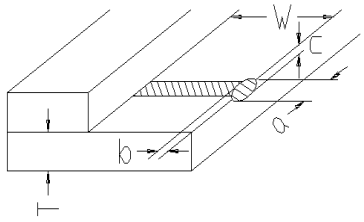
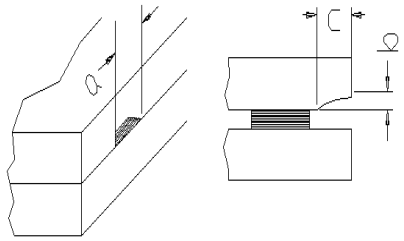
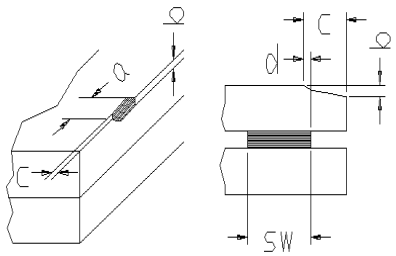
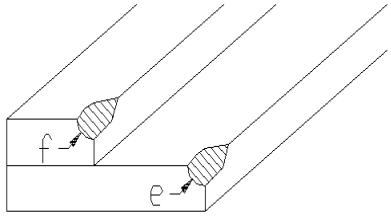
**Inspection items and criteria for appearance defects**

<table>
<tr><th>Items</th><th>Contents</th><th colspan="3">Criteria</th></tr>
<tr><td>Protective Glue</td><td></td><td colspan="3">No clear defects</td></tr>
<tr><td>Cover Tape</td><td></td><td colspan="3">Covering all of the chip and no clear crimple</td></tr>
<tr><td>Leakage</td><td></td><td colspan="3">Not permitted</td></tr>
<tr><td>Rainbow</td><td></td><td colspan="3">According to the limit specimen</td></tr>
<tr><td rowspan="4">Polarizer</td><td>Wrong polarizer attachment</td><td colspan="3">Not permitted</td></tr>
<tr><td rowspan="2">Bubble between polarizer and glass</td><td>Not counted</td><td colspan="2">Max. 3 defects allowed</td></tr>
<tr><td>ϕ<0.3mm</td><td colspan="2">0.3mm≤ϕ≤0.5mm</td></tr>
<tr><td>Scratches of polarizer</td><td colspan="3">According to the limit specimen</td></tr>
<tr><td rowspan="3">Black spot (in viewing area)</td><td rowspan="3"></td><td>Not counted</td><td>Max. 3 spots allowed</td><td rowspan="5">Max. 3 spots (lines) allowed</td></tr>
<tr><td>X<0.20mm</td><td>0.20mm≤X≤0.5mm</td></tr>
<tr><td colspan="2">X=(a+b)/2</td></tr>
<tr><td rowspan="2">Black line (in viewing area)</td><td rowspan="2"></td><td>Not counted</td><td>Max. 3 lines allowed</td></tr>
<tr><td>a<0.02mm</td><td>0.02mm≤a≤0.05mm<br>b≤2.0mm</td></tr>
<tr><td>Progressive cracks</td><td></td><td colspan="2">Not permitted</td><td></td></tr>
</table>



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<table>
<tr><th>Item</th><th>Contents</th><th colspan="5">Criteria</th></tr>
<tr><td rowspan="4">Glass Cracks</td><td>Cracks on pads<br><br></td><td>a</td><td>b</td><td>c</td><td rowspan="3">Max. 2 Cracks allowed</td><td rowspan="4">Max. 5 cracks allowed</td></tr>
<tr><td></td><td>≤3mm</td><td>≤W/5</td><td>≤T/2</td></tr>
<tr><td></td><td>≤2mm</td><td>≤W/5</td><td>T/2<C<T</td></tr>
<tr><td>Cracks on contact side<br><br></td><td colspan="2">a</td><td>b</td><td rowspan="3">Max. 2 cracks allowed</td></tr>
<tr><td colspan="2">≤3mm</td><td>≤T/2</td></tr>
<tr><td colspan="2">≤2mm</td><td>T/2<b<T</td></tr>
<tr><td>Cracks on non-contact side<br><br></td><td colspan="3">C shall be not reach the seal area</td><td colspan="2">Max. 2 cracks allowed</td></tr>
<tr><td colspan="2">a</td><td>b</td><td colspan="2" rowspan="4">Max. 2 cracks allowed</td></tr>
<tr><td colspan="2">≤3mm</td><td>≤T/2</td></tr>
<tr><td colspan="2">≤2mm</td><td>T/2<b<T</td></tr>
<tr><td colspan="3">C≤0.5mm</td></tr>
<tr><td>Corner cracks<br><br></td><td colspan="3">d≤SW/3</td><td colspan="2">Max. 3 cracks allowed</td></tr>
<tr><td colspan="3">e<2.0mm$^2$<br>f<2.0mm$^2$</td><td colspan="2">Max. 3 cracks allowed</td></tr>
</table>

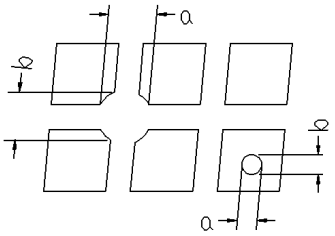
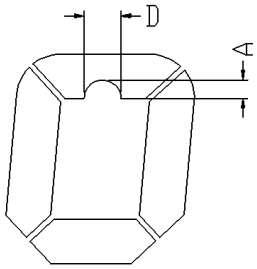
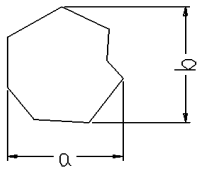
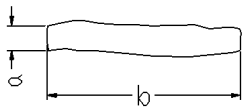


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## Appendix B

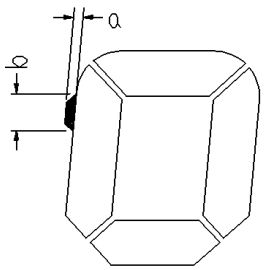
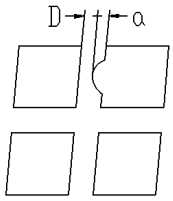
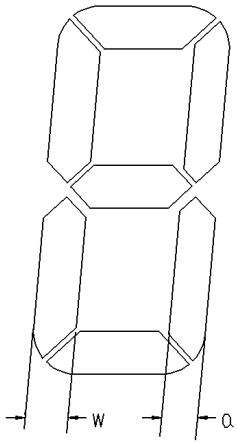
### Inspection items and criteria for display defects

<table>
<tr><th>Items</th><th>Contents</th><th colspan="3">Critera</th></tr>
<tr><td colspan="2">Open segment or open common</td><td colspan="3">Not permitted</td></tr>
<tr><td colspan="2">Short</td><td colspan="3">Not permitted</td></tr>
<tr><td colspan="2">Wrong viewing angle</td><td colspan="3">Not permitted</td></tr>
<tr><td colspan="2">Contrast radio uneven</td><td colspan="3">According to the limit specimen</td></tr>
<tr><td colspan="2">Crosstalk</td><td colspan="3">According to the limit specimen</td></tr>
<tr><td rowspan="4">Pin holes and cracks in segment (DOT)</td><td rowspan="3"></td><td>Not counted</td><td>Max.3 dots allowed</td><td rowspan="4">Max.3 dots allowed</td></tr>
<tr><td>X<0.1mm</td><td>0.1mm≤X≤0.2mm</td></tr>
<tr><td colspan="2">X=(a+b)/2</td></tr>
<tr><td></td><td>Not counted</td><td>Max.2 dots allowed</td></tr>
<tr><td colspan="2">A<0.1mm</td><td>0.1mm≤A≤0.2mm<br>D<0.25mm</td></tr>
<tr><td rowspan="3">Black spot (in viewing area)</td><td rowspan="3"></td><td>Not counted</td><td>Max.3 spots allowed</td><td rowspan="4">Max.3 spots (lines) allowed</td></tr>
<tr><td>X<0.1mm</td><td>0.1mm≤X≤0.2mm</td></tr>
<tr><td colspan="2">X=(a+b)/2</td></tr>
<tr><td rowspan="2">Black line (in viewing area)</td><td rowspan="2"></td><td>Not counted</td><td>Max.3 lines allowed</td></tr>
<tr><td>a<0.02mm</td><td>0.02mm≤a≤0.05mm<br>b≤0.5mm</td></tr>
</table>



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<table>
<tr><th>Items</th><th>Content</th><th colspan="3">Critera</th></tr>
<tr><td rowspan="4">Transfor-<br>mation<br>of segment</td><td rowspan="2">
</td><td>Not counted</td><td>Max. 2 defects allowed</td><td rowspan="3">Max.3<br>defects<br>allowe<br>d</td></tr>
<tr><td>x＜0.1mm</td><td>0.1mm≤x≤0.2mm</td></tr>
<tr><td colspan="2">x=(a+b)/2</td></tr>
<tr><td rowspan="2">
</td><td>Not counted</td><td>Max. 1 defects allowed</td></tr>
<tr><td>a＜0.1mm</td><td>0.1mm≤a≤0.2mm<br>D>0</td><td></td></tr>
<tr><td>
</td><td colspan="3">Max.2 defects allowed<br>0.8W≤a≤1.2W<br><br>a = measured value of width<br>W = nominal value of width</td></tr>
</table>



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