# LIQUID CRYSTAL DISPLAY MODULE

## Product Specification

| CUSTOMER | Standard |
|---|---|
| CUSTOMER PART NUMBER | |
| PRODUCT NUMBER | DET035HVNMNT0S-1A |

| Product Mgr | Design Eng |
|---|---|
| **Bruno Recaldini** | **Sunny** |
| Date: 18-Dec-13 | Date: 18-Dec-13 |

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**REVISION RECORD**

| Rev. | Date | Page | Chapt. | Comment | ECN no. |
|------|------|------|--------|---------|---------|
| 1.0 | 18-Dec-13 | | | Initial Release | |
| 2.0 | 13-Jan-15 | 8 | 3.3 | Recommended connector changed | |

# 1 MAIN FEATURES

| ITEM | CONTENTS |
|---|---|
| Screen Size | 3.5" Diagonal |
| Display Format | 320 x RGB x 480 Dots |
| N° of Colour | 262K |
| Active Area | 48.96 mm (H) x 73.44 mm (V) |
| LCD Type | TFT |
| Mode | IPS Transmissive / Normally Black |
| Viewing Direction | Full view |
| Interface | 8/9/16/18-bit DBI Type B (CPU) interface<br>6/16/18-bit RGB interface;<br>3/4-lines serial interface |
| Driver IC | ILI9486L or equivalent |
| 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 | 320 x RGB x 480 Dots | Dots |
| Overall Dimensions | 54.58 mm (H) x 83.57 mm (V) x 2.1 mm (D) | mm |
| Active Area | 48.96 mm (H) x 73.44 mm (V) | mm |
| pixel Pitch | 51 (H)  x 51 (V) | µm |
| Weight | 20 | g |

## 2.2 MECHANICAL DRAWING

# 3 ELECTRICAL SPECIFICATION

## 3.1 ABSOLUTE MAXIMUM RATINGS

| Item | Symbol | Condition | Min | Max | Unit | Note |
|------|--------|-----------|-----|-----|------|------|
| Power Supply Voltage | VCI | Ta=25°C | -0.3 | 5.0 | V | |
| Operating Temperature | TOP | | -20 | 70 | °C | 1 |
| Storage Temperature | TST | | -30 | 80 | °C | 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 DC ELECTRICAL CHARACTERISTICS

| Item | Symbol | Condition | Min | Typ | Max | Unit | Note |
|------|--------|-----------|-----|-----|-----|------|------|
| Supply Voltage | VCI | | 2.8 | 3.3 | 3.6 | V | |
| Input Voltage for Logic | VIH | | $0.8V_{CI}$ | - | - | V | |
| | VIL | | - | - | $0.2 V_{CI}$ | V | |
| Output Voltage for Logic | VOH | | $0.8 V_{CI}$ | - | - | V | |
| | VOL | | - | - | $0.2 V_{CI}$ | V | |
| Current Consumption | ICC | | - | 8 | | mA | 1 |

Note 1: The specified power consumption is under the conditions of VCI=3.3V, FV=60Hz.

## 3.3 INTERFACE PIN ASSIGNMENT

### 3.3.1 LCM PIN ASSIGNMENT

Recommended connector: MOLEX 51296-5093

| NO. | SYMBOL | Description |
|---|---|---|
| 1 | GND | Ground. |
| 2 | VCI | Power supply voltage (VCI=2.8V-3.3V). |
| 3 | VCI | |
| 4 | IM0 | Interface selecting mode signal. |
| 5 | IM1 | |
| 6 | IM2 | |
| 7 | RESET | Reset pin. Setting either pin low initializes the LSI. Must be reset after power is supplied. |
| 8 | VSYNC | Frame synchronizing signal for DPI I/F mode. If not used, please connect to GND. |
| 9 | HSYNC | Frame synchronizing signal for DPI I/F mode. If not used, please connect to GND. |
| 10 | PCLK | Pixel clock signal for DPI I/F mode. If not used, please connect to VCI. |
| 11 | DE | A DATA ENABLE signal for DPI I/F mode. If not used, please connect to GND. |
| 12-29 | DB17-DB0 | Data bus PINS. 18-bit bi-directional data bus. 8-bit bus: use DB7-DB0 9-bit bus: use DB8-DB0 16-bit bus: use DB15-DB0 18-bit bus: use DB17-DB0 When Operation in MIPI DPI interface mode, it is an 18-bit bus RGB data bus. 6-bit bus: use DB5-DB0 16-bit bus: use DB15-DB0 18-bit bus: use DB17-DB0 Pins not used must be connected to GND. |
| 30 | GND | Ground. |
| 31 | DOUT | Serial data output pin in serial bus system interface. If not used, please open this pin. |
| 32 | DINI_SDA | Serial data input pin or input/output pin in serial bus system inter face. The data is inputted on the rising edge of the SCL signal. If not used, please connect to GND. |
| 33 | RDX | DBI Type-B: Serves as a read signal and read data at the low level. If not used, please connect to VCI. |

| No | SYMBOL | Description |
|---|---|---|
| 34 | WRX_SCL | DBI Type-B: Serves as a write signal and write data at the low level. DBI Type-C: it servers as SCL (Serial Clock).If not use, please connect to GND. |
| 35 | DCX | Data / Command Selection pin. If not use, please connect to GND. |
| 36 | CSX | Chip select signal. Low: chip can be accessed; High: chip cannot be accessed. If not used, please connect to GND. |
| 37 | LEDA | Power supply for Backlight. |
| 38-45 | LEDK1-LEDK8 | Power supply for Backlight. |
| 46 | XR(NC) | NC. |
| 47 | YD(NC) | NC. |
| 48 | XL(NC) | NC. |
| 49 | YU(NC) | NC. |
| 50 | GND | Ground. |

## 3.4 TIMING CHARACTERISTICS

Please refer to Ilitech IC ILI9486L datasheet for more information

### 3.4.1 (CPU) DBI Type B (18/16/9/8 Bits) Timing Characteristics

| Item | Symbol | | MIN | MAX | Unit | Remark |
|---|---|---|---|---|---|---|
| Address setup time | RS(DCX) | tast | 0 | - | ns | |
| Address hold time (Write/Read) | | taht | 0 | - | ns | |
| CSX "H" pulse width | CS(CSX) | tchw | 0 | - | Ns | |
| Chip select setup time (write) | | tcs | 15 | - | ns | |
| Chip select setup time (Read ID) | | trcs | 45 | - | ns | |
| Chip select setup time (Read FM) | | trcsfm | 355 | - | ns | |
| Chip select Wait time (Write/Read) | | tcsf | 0 | - | ns | |
| Write cycle Time | WR(WRX) | twc | 50 | - | ns | |
| Write Control pulse H duration | | twrh | 15 | - | ns | |
| Write Control pulse L duration | | twrl | 15 | - | ns | |
| Read cycle (FM) | RD(RDX (FM)) | trcfm | 450 | - | ns | |
| Read Control H duration (FM) | | trdhfm | 90 | - | ns | |
| Read Control L duration (FM) | | trdlfm | 355 | - | ns | |
| Read cycle (ID) | RD(RDX (ID)) | trc | 160 | - | ns | |
| Read Control H duration | | trdh | 90 | - | ns | |
| Read Control L duration | | trdl | 45 | - | ns | |
| Write data setup time | BD[17:0], BD[8:0], BD[15:0], BD[7:0] | tdst | 10 | - | ns | For max CL=30pF<br>For min CL=8pF |
| Write data hold time | | tdht | 10 | - | ns | |
| Read access time | | trat | - | 40 | ns | |
| Read access time (FM) | | tratfm | - | 340 | ns | |
| Read output disable time | | trod | 20 | 80 | ns | |
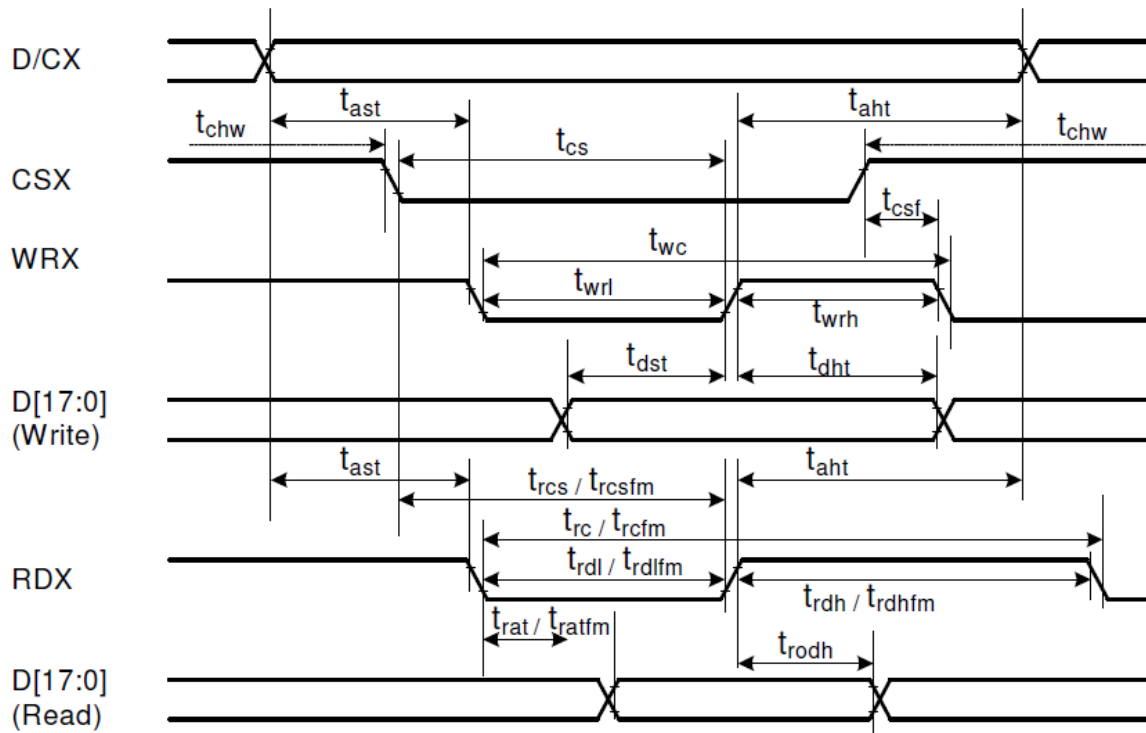
Note: (1) Ta=-20 to 70 °C, VCI= 3.3 V, DGND=0V
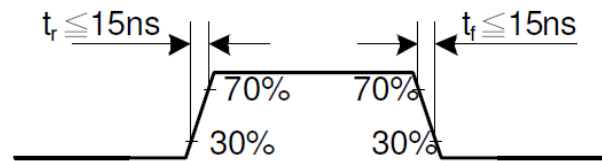


(2) Logic high and low levels are specified as 30% and 70% of VCI for input signals.
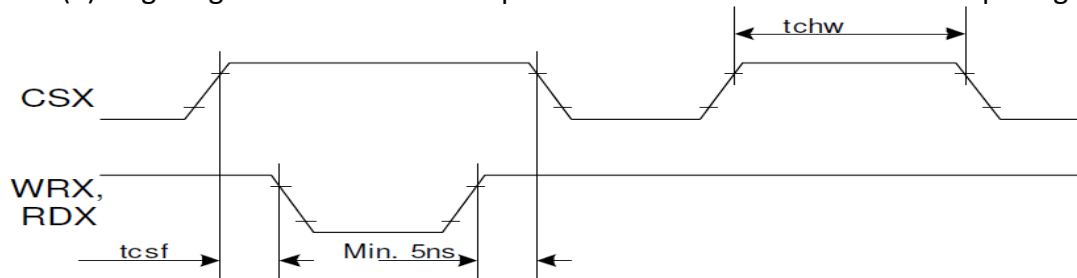


(3) Logic high and low levels are specified as 30% and 70% of VCI for input signals.



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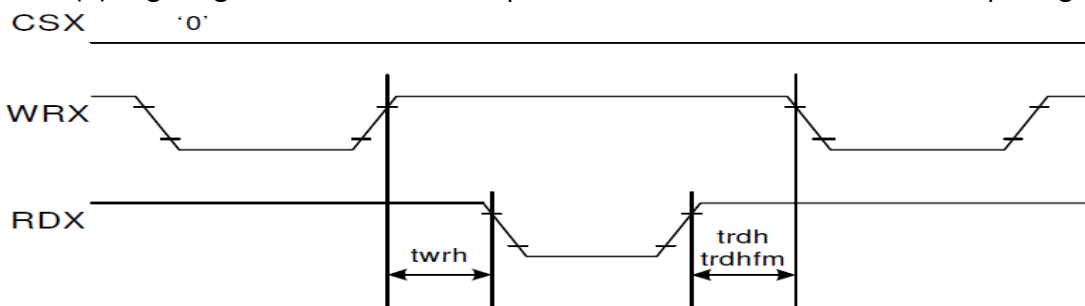
### 3.4.2 Parallel 18/16-bit RGB Interface Timing Characteristics
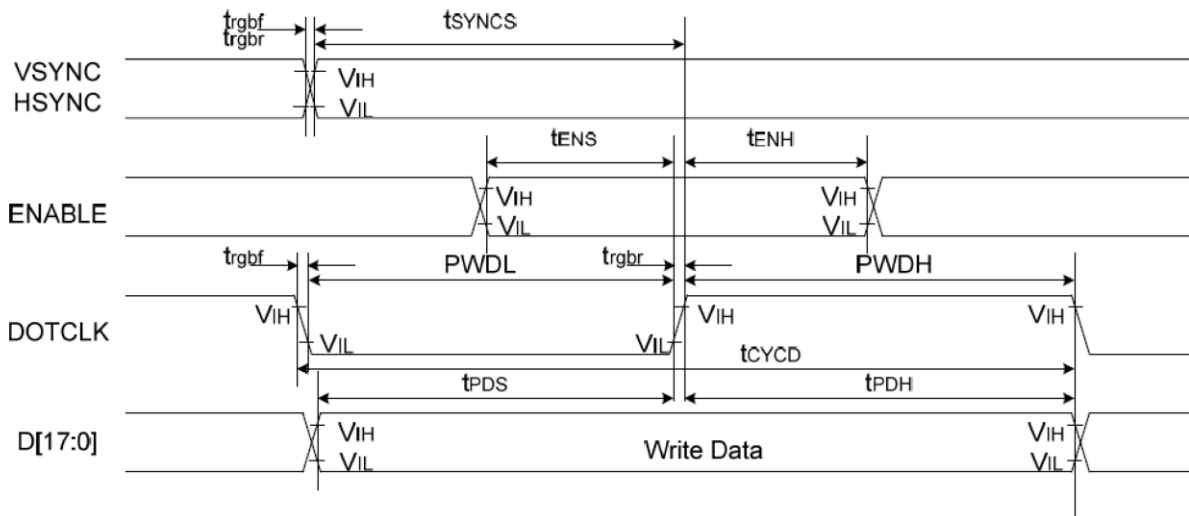


| Signal | Symbol | Parameter | min | max | Unit | Description |
|--------|--------|-----------|-----|-----|------|-------------|
| VSYNC / HSYNC | $t_{SYNCS}$ | VSYNC/HSYNC setup time | 15 | - | ns | |
| | $t_{SYNCH}$ | VSYNC/HSYNC hold time | 15 | - | ns | |
| ENABLE | $t_{ENS}$ | ENABLE setup time | 15 | - | ns | |
| | $t_{ENH}$ | ENABLE hold time | 15 | - | ns | |
| DB[17:0] | $t_{POS}$ | Data setup time | 15 | - | ns | 18/16-bit bus RGB interface mode |
| | $t_{PDH}$ | Data hold time | 15 | - | ns | |
| DOTCLK | PWDH | DOTCLK high-level period | 15 | - | ns | |
| | PWDL | DOTCLK low-level period | 15 | - | ns | |
| | $t_{CYCD}$ | DOTCLK cycle time | 66 | - | ns | |
| | $t_{rgbr}$, $t_{rgbf}$ | DOTCLK,HSYNC,VSYNC rise/fall time | - | 15 | ns | |
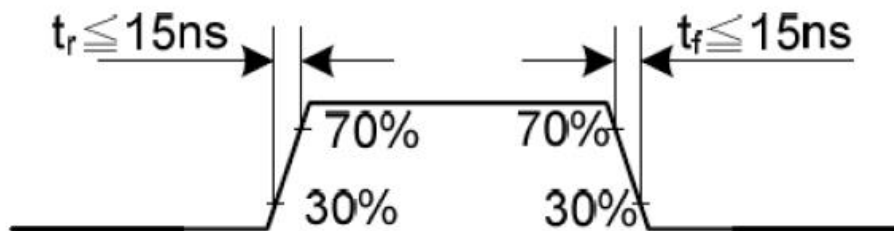
### 3.4.3 Display Serial Interface Timing Characteristics (3-line SPI system)
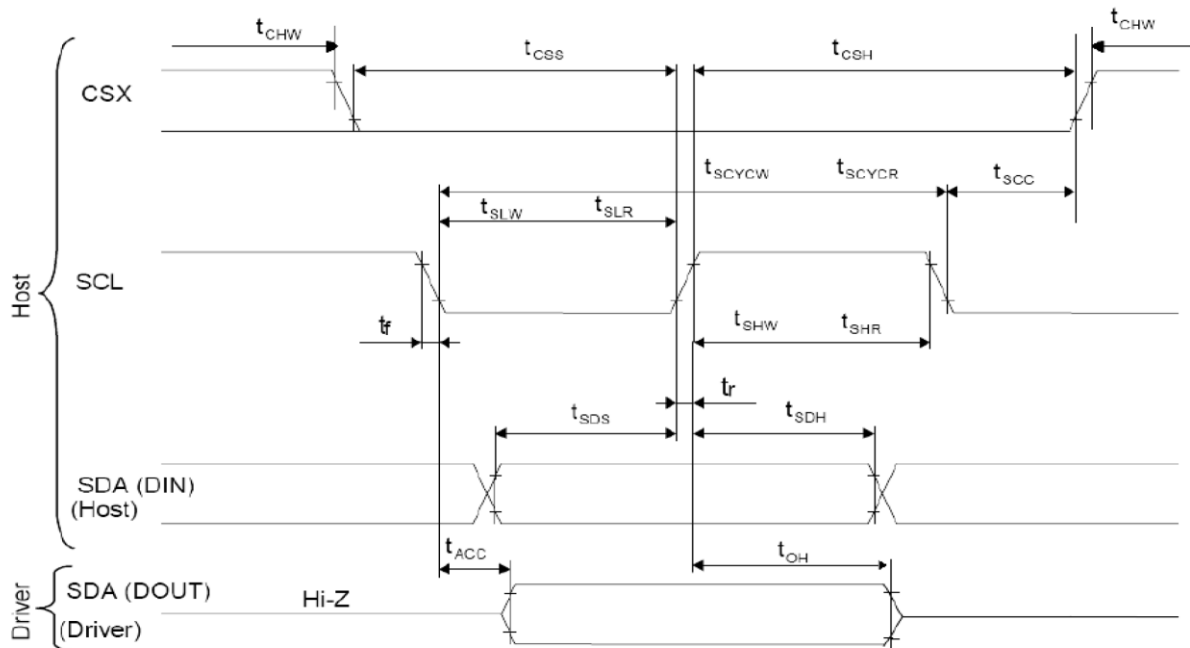


| Signal | Symbol | Parameter | min | max | Unit | Description |
|---|---|---|---|---|---|---|
| SCL | tscycw | Serial Clock Cycle (Write) | 66 | - | ns | |
| | tshw | SCL 'H' Pulse Width (Write) | 15 | - | ns | |
| | tslw | SCL "L" Pulse Width (Write) | 15 | - | ns | |
| | tscycr | Serial Clock Cycle (Read) | 150 | - | ns | |
| | tshr | SCL 'H' Pulse Width (Read) | 60 | - | ns | |
| | tslr | SCL "L" Pulse Width (Read) | 60 | - | ns | |
| SDA / SDI (Input) | tsds | Data setup time (Write) | 10 | - | ns | |
| | tsdh | Data hold time (Write) | 10 | - | ns | |
| SDA / SDO (Output) | tacc | Access time (Read) | 10 | 50 | ns | |
| | toh | Output disable time (Read) | 15 | 50 | ns | |
| CSX | tscc | SCL-CSX | 15 | - | ns | |
| | tchw | CSX "H" Pulse Width | 40 | - | ns | |
| | tcss | CSX-SCL Time | 60 | - | ns | |
| | tcsh | | 65 | - | ns | |
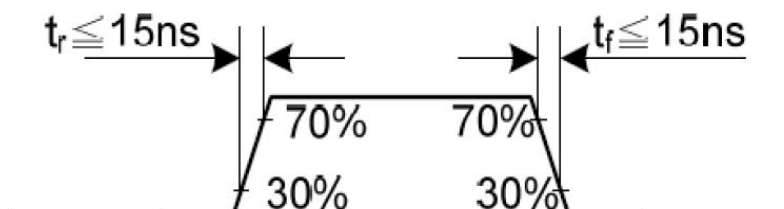
### 3.4.4  Display Serial Interface Timing Characteristics (4-line SPI system)
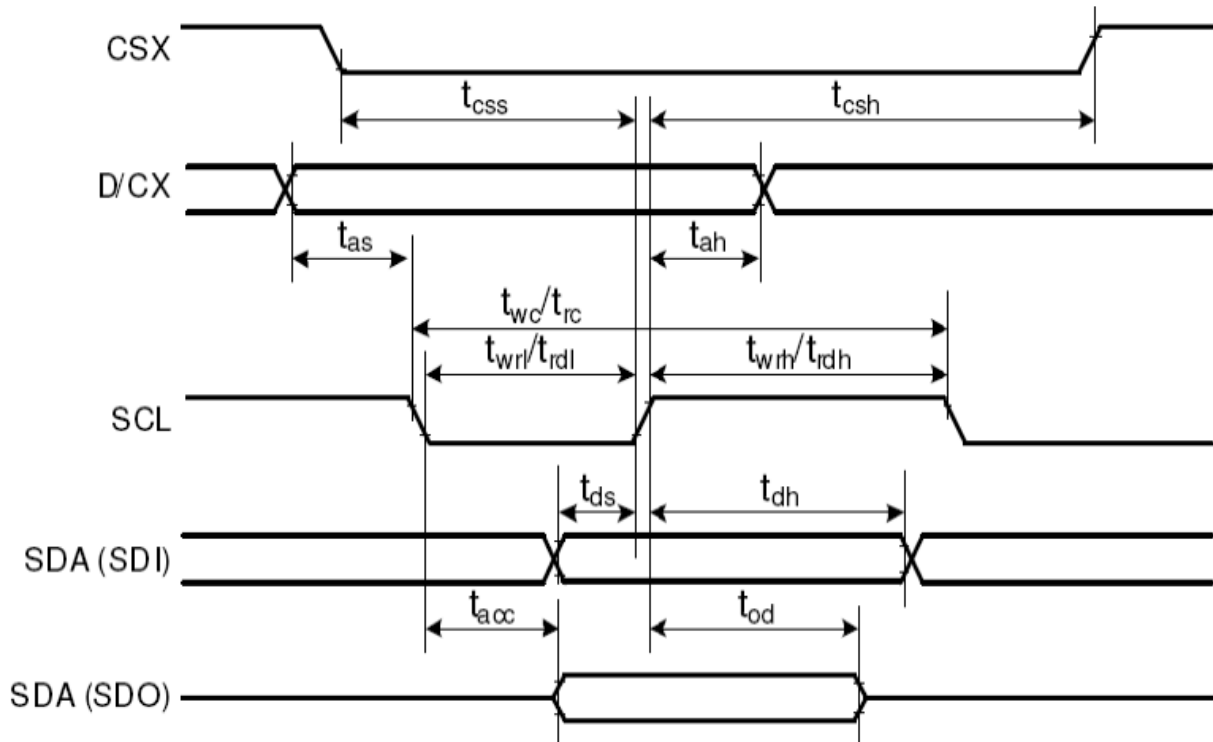


| Signal | Symbol | Parameter | min | max | Unit | Description |
|--------|--------|-----------|-----|-----|------|-------------|
| CSX | tcss | Chip select time (Write) | 15 | - | ns | |
| | tcsh | Chip select hold time (Read) | 60 | - | ns | |
| SCL | twc | Serial clock cycle (Write) | 66 | - | ns | |
| | twrh | SCL "H" pulse width (Write) | 15 | - | ns | |
| | twrl | SCL "L" pulse width (Write) | 15 | - | ns | |
| | trc | Serial clock cycle (Read) | 150 | - | ns | |
| | trdh | SCL "H" pulse width (Read) | 60 | - | ns | |
| | trdl | SCL "L" pulse width (Read) | 60 | - | ns | |
| D/CX | tas | D/CX setup time | 10 | - | ns | |
| | tah | D/CX hold time (Write / Read) | 10 | - | ns | |
| SDA / SDI (Input) | tds | Data setup time (Write) | 10 | - | ns | |
| | tdh | Data hold time (Write) | 10 | - | ns | |
| SDA / SDO (Output) | tacc | Access time (Read) | 10 | 50 | ns | For maximum CL=30pF |
| | tod | Output disable time (Read) | 15 | 50 | ns | For minimum CL=8pF |

### 3.4.5 Reset Timing Characteristics
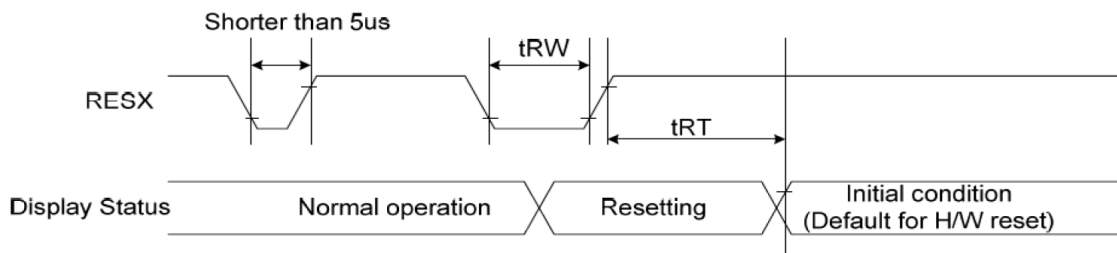


| Signal | Symbol | Parameter | Min | Max | Unit |
|--------|--------|-----------|-----|-----|------|
| RESX | tRW | Reset pulse duration | 10 | | uS |
| | tRT | Reset cancel | | 5 (note 1,5) | mS |
| | | | | 120 (note 1,6,7) | mS |

Note 1: The reset cancel includes also required time for loading ID bytes. VCOM setting and other settings from EEPROM to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after rising edge of RESX.

Note 2: Spike due to an electrostatic discharge on RESX line dose not because irregular system reset according to the table below:

| RESX Pulse | Action |
|------------|--------|
| Shorter than 5us | Reset Rejected |
| Longer than 9us | Reset |
| Between 5us and 9us | Reset starts |

Note 3: During the resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120ms, when reset starts in Sleep Out-mode. The display remains the blank state in Sleep In-mode.) and then return to default condition for Hardware Reset.

Note 4: Spike rejection also applies during a valid reset pulse as shown below:
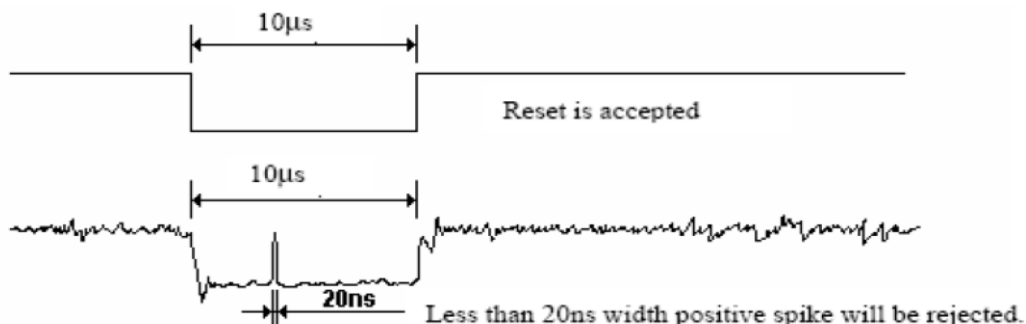


Note 5: When reset applied during Sleep in Mode.

Note 6: When reset applied during Sleep out Mode.

Note 7: It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

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|-------------|-------------------|----------|--|------|---------|
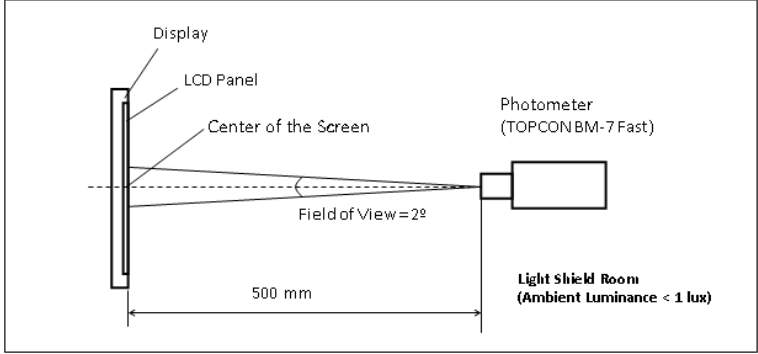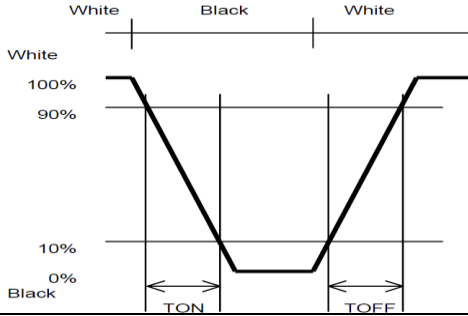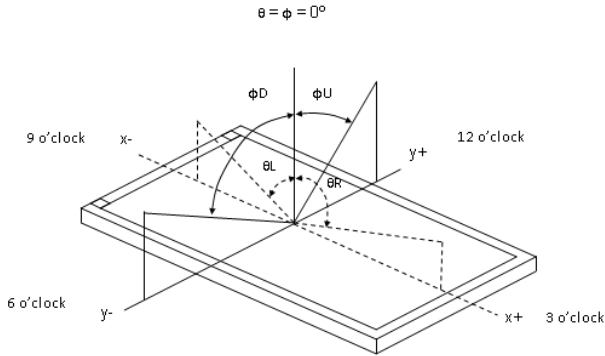
# 4 OPTICAL SPECIFICATION

## 4.1 OPTICAL CHARACTERISTICS

Measuring instruments:     LCD-5100, Eldim, Topcon BM-7
Driving condition:         VCI = 3.3V, VSS = 0V
Backlight:                 IF=160mA
Measured temperature:      Ta = 25° C

| Item | | Symbol | Condition | MIN | TYP | MAX | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Response Time | | TR+TF | θ=Φ=0° Normal Viewing Angle | - | 35 | 50 | ms | 2 |
| Contrast Ratio | | CR | | 400 | 500 | - | | 3 |
| Viewing Angle | Left | θL | | - | 80 | - | deg | 4 |
| | Right | θR | CR ≥ 10 | - | 80 | - | deg | |
| | Up | φU | | - | 80 | - | deg | |
| | Down | φD | | - | 80 | - | deg | |
| Colour Chromaticity | Red | Rx | | 0.640 | 0.660 | 0.680 | - | 5 |
| | | Ry | | 0.297 | 0.317 | 0.337 | - | |
| | Green | Gx | | 0.240 | 0.260 | 0.280 | - | |
| | | Gy | CR ≥ 10 | 0.555 | 0.575 | 0.595 | - | |
| | Blue | Bx | | 0.121 | 0.141 | 0.161 | - | |
| | | By | | 0.055 | 0.075 | 0.095 | - | |
| | White | Wx | | 0.275 | 0.295 | 0.315 | - | |
| | | Wy | | 0.297 | 0.317 | 0.337 | - | |
| Centre Brightness | | | | - | 600 | - | 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.<br> |
| 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.<br> |
| 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.<br><br>$$\text{Contrast Ratio (CR)} = \frac{\text{Brightness of unselected position (white)}}{\text{Brightness of selected position (black)}}$$ |
| 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<br> |
| 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 %<br>A: max. brightness of the 9 points<br>B: min. brightness of the 9 points |

# 5 BACKLIGHT SPECIFICATION

## 5.1 LED DRIVING CONDITIONS

| Item | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Forward Current | IF | Ta=25 °C, VF=3.2V/LED | 120 | 160 | - | mA |
| Forward Voltage | VF | Ta= 25°C, IF= 20mA/LED | | 3.2 | | V |

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

LED Circuit Drawing



LED(B/L) CIRCUIT
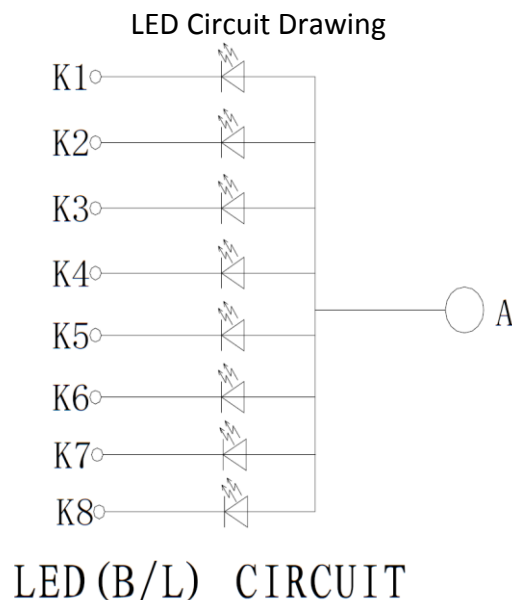
# 6 QUALITY ASSURANCE SPECIFICATION

## 6.1 DELIVERY INSPECTION STANDARDS

### 6.1.1 Inspection Conditions

Inspection distance: 30 cm ± 2 cm
Viewing angle: ±45°
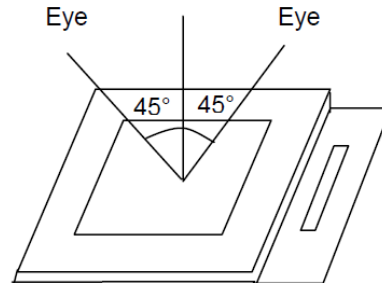
### 6.1.2 Environmental Conditions

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
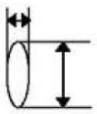
A zone: active area
B zone: viewing area
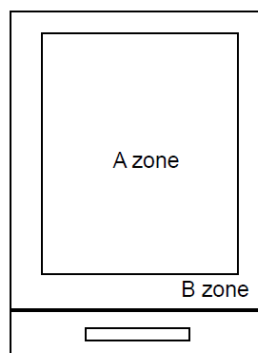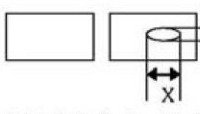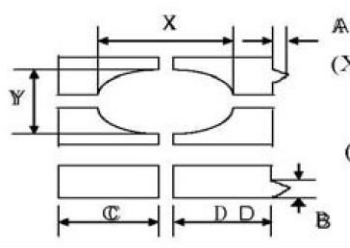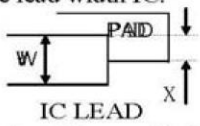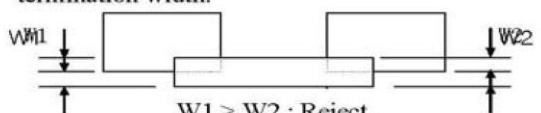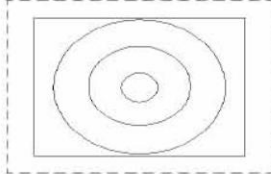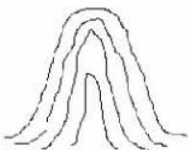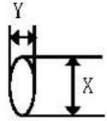
### 6.1.5 Basic Principle

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

| No | Item | Criteria | Rank | Remark |
|---|---|---|---|---|
| 1 | Segment Short Segment Missing | Not allowed | MA | X |
| 2 | Solder Bridging | Any bridging between components, except common circuit, is not allowed. | MA | |
| 3 | Outside Dimension | Drawing & specification must be within permitable tolerance.  A Area  B Area | MA | |
| 4 | Cold Solder | Cold solder is not allowed. | MA | |
| 5 | Black(White) Spots, Foreign Substances | 1) Round Type (see table below)  2) Liner Type (see table below)  At (1) & (2) total defect q'ty is must not exceed 5 pieces. | MI | ** : Mean Diameter $(X + Y)/2$ |
| 6 | OC Spot | (see table below) | MI | |
| 7 | Air Bubles Between Glass & Polarizer (Polarizer Defects) | (see table below) | MI | |

**Item 5 — 1) Round Type**

| Area Dimension** | Acceptable Q'ty | | Remark |
|---|---|---|---|
| ≤ 0.1 | Ignore | | |
| ≤ 0.2 | 2 | Ignore | |
| ≤ 0.3 | 1 | Ignore | |
| 0.3 < | 0 | Ignore | |

**Item 5 — 2) Liner Type**

| Dimension | | Acceptable Q'ty | | Remark |
|---|---|---|---|---|
| Length | Width | A Area | B Area | |
| - | ≤ 0.025 | Ignore | | |
| ≤ 2.5 | ≤ 0.05 | 3 | Ignore | |
| ≤ 1.5 | ≤ 0.075 | 2 | Ignore | |
| | 0.075 < | Follow round type | | |

**Item 6 — OC Spot**

| Area Dimension** | Acceptable Q'ty | | Remark |
|---|---|---|---|
| ≤ 0.2 | Ignore | | |
| ≤ 0.8 | 3 | Ignore | |
| ≤ 1.0 | 1 | Ignore | |

**Item 7 — Air Bubles Between Glass & Polarizer**

| Area Dimension** | Acceptable Q'ty | | Remark |
|---|---|---|---|
| ≤ 0.15 | Ignore | | |
| ≤ 0.3 | 3 | Ignore | |
| ≤ 0.5 | 2 | Ignore | |
| ≤ 0.7 | 1 | Ignore | |
| Total | 5 | Ignore | |

| No | Item | Criteria | Rank | Remark |
|----|------|----------|------|--------|
| 8 | Pin hole (On Segment) | $(X+Y)/2 \leq 0.2mm$ Within 1 per one segment ( Less than 0.1mm is not counted) Total defects q'ty is must not exceed 5 pieces. | MI | |
| 9 | Segment Deformation | $(X+Y)/2 \leq 0.2mm$<br>$A \leq 0.2mm$<br>$B \leq 0.2mm$<br>$(C-D) \leq 0.2mm$<br><br>| | Acceptable Q'ty |<br>|---|---|<br>| Dot, Segment | 1 |<br>| LCD | 5 |<br>| $\leq 0.1$ | Ignore all defect |<br><br>Each visible dot must be more than half effective dot area | MI | $(X + Y)/2 \leq 0.2mm$ |
| 10 | Color Variation | Within the three colors, except LCD Standard color is acceptable. | MI | |
| 11 | Glass & Polarizer Scratch | Follow NO.5(2) condition | MI | |
| 12 | Solder Ball | 1)Acceptable if the size of void is less than 0.18mm<br>2)Acceptable if a solder ball is not movable<br><br>3)Rejectable if the solder ball exceed 5EA in $2.54 \times 2.54mm$ area. | MI | |
| 13 | Miss Alignment | 1)Acceptable if it dose not exceed 50% of the lead width IC.<br>$X \leq W/2$ : Accept<br>$X > W/2$ : Reject<br>IC LEAD<br>2)Rejectable, provided that it does exceed 50% of the component termination width.<br>$W1 > W2$ : Reject | | |

| No | Item | Criteria | Rank | Remark |
|----|------|----------|------|--------|
| 14 | Touch Panel | 1) Round Type、Foreign Substances | MI | |

1) Round Type、Foreign Substances

| Area Dimension** | Acceptable Q'ty | | Remark |
|---|---|---|---|
| | A Area | B Area | |
| ≤ 0.1 | Ignore | | |
| ≤ 0.2 | 2 | Ignore | |
| ≤ 0.3 | 1 | Ignore | |
| 0.3 < | 0 | Ignore | |

** : Mean Diameter (X + Y)/2

2) Liner Type & Scratch

| Dimension | | Acceptable Q'ty | | Remark |
|---|---|---|---|---|
| Length | Width | A Area | B Area | |
| - | W≤0.025 | Ignore | | |
| L≤3.0 | W≤0.05 | Ignore | | |
| 3.0<L≤5.0 | | 2 | | Ignore |
| ≤ 7 | W≤0.1 | 1 | | |
| - | W>0.1 | Follow round type | | |

4) Newton Ring
a)Regular

The area of the Newton ring is more than 1/3 area of the touch panel It's NG.
The area of the Newton ring is less than 1/3 area of the touch panel It's OK.

b)None-regularity

The area of the Newton ring is more than 1/2 area of the touch panel It's NG.
The area of the Newton ring is less than 1/2 area of the touch panel It's OK.

### 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.

# 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, 20 cycles | |
| | High Temperature Operation | Tp= 70°C | 96h |
| | Low Temperature Operation | Tp= -20°C | 96h |
| | High Temperature & Humidity Operation | Tp= 40°C    RH= 90%    96h<br>Non condensing | |
| | Thermal Shock Resistance | The sample should be allowed to stand the following 5 cycles of operation: TSTL for 30 minutes -> normal temperature for 5 minutes -> TSTH for 30 minutes -> normal temperature for 5 minutes, as one cycle, then taking it out and drying it at normal temperature, and allowing it stand for 24 hours | |
| | Box Drop Test | 1 Corner 3 Edge 6 faces, 66 cm (Medium Box) | |

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.

# 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).