DMT068WVHTNT0-1A PRODUCT SPECIFICATION

Version 0.1 Nov 07, 2023

TBD

| Customer's Approval | | | | |
|---------------------|-------------|--|--|--|
| <u>Signature</u> | <u>Date</u> | | | |

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Revision History

| VERSION | DATE | DESCRIPTION | AUTHOR |
|---------|--------------|-------------|--------------|
| 0.1 | Nov 07, 2023 | Preliminary | Yvette Hsieh |
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1. General Description

1.1 Introduction

This is a 6.8" size colour active matrix TFT LCD module that uses amorphous silicon TFT as a switching device. The display is normally black mode, transmissive, and featuring high contrast and excellent colour saturation. The resolution of the TFT-LCD is 800 x 480 and can display up to 16.7M colours. The display module supports 24-bit RGB interface.

1.2 Main Features

| Item | Contents |
|-----------------------|---------------------------------------|
| Display Type | TFT LCD |
| Screen Size | 6.8" Diagonal |
| Display Format | 800 x RGB x 480 Dots |
| No. of Colour | 16.7M |
| Overall Dimensions | 156.10 (W) x 100.91 (H) x 5.50 (D) mm |
| Active Area | 148.1040 (W) x 88.8624 (H) mm |
| Mode | Normally Black / Transmissive |
| Surface Treatment | Anti-Glare (3H) |
| Viewing Direction | All round |
| Interface | 24-bit RGB |
| Driver IC | TBD |
| Backlight | LDE, White, 24 chips |
| Operating Temperature | -30°C ~ 85°C |
| Storage Temperature | -35°C ~ 85°C |
| ROHS | Compliant to RoHS 2.0 |

2. Mechanical Specification

2.1 Mechanical Characteristics

| Item | Characteristic | Unit | |
|--------------------|------------------------------------|------|--|
| Display Format | 800 x RGB x 480 | Dots | |
| Overall Dimensions | 156.10 (W) x 100.91 (H) x 5.50 (D) | mm | |
| Active Area | 148.1040 (W) x 88.8624 (H) | mm | |
| Dot Pitch | 0.18513 (W) x 0.18513 (H) | mm | |
| Weight | 133 | g | |
| Driver IC | TBD | | |

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2.2 Mechanical Drawing



3. Electrical Specification

3.1 Absolute Maximum Ratings

3.1.1 Absolute Ratings of Environment

| Item | Symbol | Min | Max | Unit |
|------------------------|-----------------|------|-----|------|
| Digital Supply Voltage | V _{DD} | -0.3 | 4.0 | V |
| Operating Temperature | Тор | -30 | +85 | °C |
| Storage Temperature | T _{ST} | -35 | +85 | °C |

Note 1: The absolute maximum rating values of this product are not allowed to be exceeded at any times. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed.

Note 2: Please refer to RELIABILITY.

3.2 DC Electrical Characteristics

3.2.1 Recommended Operating Condition

| ltem | Symbol | Min | Тур. | Max | Unit |
|------------------------|------------------|----------------------|---------|------------------------------|------|
| Digital Supply Voltage | DV _{DD} | 3.1 | 3.1 3.3 | | V |
| Normal Mode Current | I _{DD} | - | 40 | 80 | mA |
| | Vін | 0.7 DV _{DD} | - | DV _{DD} | V |
| Level input voltage | VIL | GND | - | $0.3 \text{ DV}_{\text{DD}}$ | V |
| | V _{OH} | $DV_{DD} - 0.4$ | - | VDD | V |
| Level Output Voltage | Vol | GND | - | GND + 0.4 | V |

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3.3 Interface Pin Assignment

| No. | Symbol | Function | I/O |
|-------|--------|-----------------------------------|-----|
| 1-2 | VLED+ | Power for LED backlight (Anode) | Р |
| 3-4 | VLED- | Power for LED backlight (Cathode) | Р |
| 5 | GND | Power ground | Р |
| 6 | NC | No connection | - |
| 7 | DVDD | Power for digital circuit | Р |
| 8 | MODE | DE/SYNC mode select | I |
| 9 | DE | Data input enable | I |
| 10 | VS | Vertical sync input | 1 |
| 11 | HS | Horizontal sync input | I |
| 12-19 | В7-ВО | Blue data | I/O |
| 20-27 | G7-G0 | Green data | I/O |
| 28-35 | R7-R0 | Red data | I/O |
| 36 | GND | Power ground | Р |
| 37 | DCLK | Sample clock | I |
| 38 | GND | Power ground | Р |
| 39 | L/R | Left/right selection | I |
| 40 | U/D | Up/down selection | I |
| 41-43 | NC | No connection | - |
| 44 | RESET | Global reset pin | I |
| 45-47 | NC | No connection | - |
| 48 | GND | Power ground | Р |
| 49-50 | NC | No connection | - |

I: Input, O: Output, P: Power

Note 1: DE/SYNC mode select. Normal pull high.

When select DE mode, Mode = "1", VS and HS must pull high.

When select SYNC mode, Mode = "0", DE must be grounded.

Note 2: When input 18 bits RGB data, the two low bits of R, G and B data must be grouned.

Note 3: Data shall be latched at the falling edge of DCLK.

Note 4: Selection of scanning mode.

| Setting of scar | n control input | Scanning direction | | |
|------------------|------------------|---------------------------|--|--|
| U/D | L/R | | | |
| GND | DV _{DD} | Up to down, left to right | | |
| DV _{DD} | GND | Down to up, right to left | | |

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| Setting of scan control input | | Scapping direction | |
|-------------------------------|------------------|---------------------------|--|
| U/D | L/R | scanning direction | |
| GND | GND | Up to down, right to left | |
| DV _{DD} | DV _{DD} | Down to up, eft to right | |

Note 5: Definition of scanning direction refer to the figure as below.



Note 6: Global reset pin. Active low to enter reset state. Suggest connecting with an RC reset circuit for stability. Normally pull high.

3.4 Timing Characteristics

3.4.1 AC Characteristics

| Parameter | Symbol | Min | Тур | Max | Unit | Note |
|------------------------------|--------|-----|-----|-----|------|------------------------------|
| VDD Power Source Slew Time | TPOR | - | - | 20 | ms | From 0V to 9% VDD |
| GRB Pulse Width | tRSTW | 10 | 50 | - | us | R = 10Kohm, C = 1uF |
| SD Qutput Stable Time | Tst | - | - | 12 | us | Output settled within +20mV. |
| SD Output Stable Time | | | | | | Loading = 6.8K + 28.2pF |
| CD Output Biss and Fall Time | Tgst | - | - | 6 | 6 us | Output settled (5% ~ 95%) |
| GD Output Rise and Fail Time | | | | | | Loading = 6.8K + 28.2pF |

DC Electrical Characteristics (PVDD=VDD=VDDI=3.3V, AGND=0V, Ta=25°C, bare chip)

3.4.2 System Bus Timing for RGB Interface

DC Electrical Characteristics (PVDD=VDD=VDDI=3.3V, AGND=0V, Ta=25°C, bare chip)

| Parameter | Symbol | Min | Тур | Max | Unit |
|------------------|--------|-----|-----|-----|------|
| CLK Pulse Duty | Tcw | 40 | 50 | 60 | % |
| VSYNC Setup Time | Tvst | 40 | - | - | ns |
| VSYNC Hold Time | Tvhd | 10 | - | - | ns |
| HSYNC Setup Time | Thst | 10 | - | - | ns |
| HSYNC Hold Time | Thhd | 10 | - | - | ns |
| Data Setup Time | Tdsu | 10 | - | - | ns |
| Data Hold Time | Tdhd | 10 | | | ns |
| DE Setup Time | Tdest | 10 | - | - | ns |
| DE Hold Time | Tdehd | 10 | - | - | ns |

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3.4.3 Input Timing Table

Parallel 24-bit RGB Input Timing (PVDD=VDD=VDDI=3.3V, AGND=0V, Ta=25°C)

| Parameter | | Symbol | Min | Тур | Max | Unit |
|-----------|----------------|--------|-----|-----|-----|-------|
| D | CLK Frequency | FCLK | 23 | 25 | 27 | MHz |
| | Period Time | Th | 808 | 816 | 848 | DCLK |
| | Display Period | Thdisp | | 800 | | DCLK |
| HSYNC | Back Porch | Thbp | 4 | 8 | 24 | DCLK |
| | Front Porch | Thfp | 4 | 8 | 24 | DLCK |
| | Pulse Width | Thw | 2 | 4 | 8 | DLCK |
| | Period Time | Τv | 496 | 512 | 528 | HSYNC |
| | Display Period | Tvdisp | | 480 | | HSYNC |
| VSYNC | Back Porch | Tvbp | 8 | 16 | 24 | HSYNC |
| | Front Porch | Tvfp | 8 | 16 | 24 | HYSNC |
| | Pulse Width | tvw | 2 | 4 | 8 | HSYNC |

Note 1: The minimum blanking time depends on the GIP timing of the panel specification.

Note 2: To ensure the compatibility of different panels, it is recommended to use the typically setting.

Notre 3: It is necessary to keep Tvbp = 8 and Thbp = 8 in sync mode. DE mode is unnecessary to keep it.

Note 4: The maximum DCLK Frequency is 27MHz.

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3.4.4 Power On/Off Sequence



| Symbol | Description | Time | Unit |
|--------|---|-------|------|
| то | System power stability to RGB RESET signal | ≥1 | ms |
| T1 | RGB RESET = "High" to DISP = "High" | ≥ 10 | ms |
| T2 | DISP = "High" to Source/GIP scan blank | 85 | ms |
| Т3 | Display signal input to Backlight power on (base on Display Signal Frame Rate 60Hz) | ≥ 100 | ms |

Note 1: When DISP pull "H" or "L", IC will execute the internal power on or power off procedures. Please be careful about the timing of DISO and do not interrupt it during power on or power off procedures, otherwise, unexpected errors will occur.

Note 2: RGB interface Display signal: DCLK, VSYNC, HSYNC, DE, DR [7:0], DG [7:0], DB [7:0]

Note 3: LVDS interface Display signal: DLCK P/N, RX [3:0] P/N

4. Optical Specification

4.1 Optical Characteristics

| Chara | cteristics | Symbol | Conditions | Min | Тур. | Max | Unit | Note |
|----------|------------|------------------|----------------------|-------|-------|-------|-------------------|--------------|
| Contr | ast Ratio | CR | θ=0 | - | 1000 | - | - | 1, 2 |
| Respo | onse time | TR + TF | Normal Viewing Angle | - | 30 | - | ms | 1, 3 |
| <u>e</u> | Left | θ _x - | | - | 85 | - | | |
| ξAnε | Right | θx+ | CR ≥ 10 | - | 85 | - | | |
| wing | Up | θ _Y + | | - | 85 | - | | 1, 4 |
| Vie | Down | θγ- | | - | 85 | - | | |
| | | Rx | | 0.576 | 0.616 | 0.656 | | |
| | Red | Ry | | 0.329 | 0.369 | 0.409 | - | |
| ticity | _ | Gx | | 0.288 | 0.328 | 0.368 | | |
| oma | Green | Gy | | 0.523 | 0.563 | 0.603 | | |
| r Chr | | Bx | | 0.108 | 0.148 | 0.188 | | 1, 4, CA-310 |
| olou | Blue | Ву | | 0.018 | 0.058 | 0.098 | | |
| U | | Wx | | 0.257 | 0.297 | 0.337 | | |
| | White | Wy | | 0.266 | 0.306 | 0.346 | | |
| Uni | formity | Avg | | 80 | - | - | % | 5 |
| Lum | ninance | LV | - | 750 | 800 | - | cd/m ² | - |
| Colo | r Gamut | S (%) | | 52 | 57 | - | % | - |

Measuring Condition: in dark room, at ambient temperature 25±2°C, for 15 min warm-up time.

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5. LED Backlight Specification

5.1 LED Driver Electrical Characteristics

The back-light system is edge-lighting type with 24 chips LED.

| Item | Symbol | Min | Тур. | Max | Unit |
|-----------------|--------|------|-------|------|------|
| Forward Current | lF | - | 150 | - | mA |
| Forward Voltage | VF | 22.4 | 24 | 26.4 | V |
| LED Lifetime | Hr | - | 20000 | - | Hrs |

Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition: $Ta = 25\pm3^{\circ}C$, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The "LED lifetime" is defined as the module brightness decrease to 50% original brightness at Ta = 25°C and IL = 150 mA. The LED lifetime could be decreased if operating IL is larger than 150mA. The constant current driving method is suggested.

5.2 Internal Circuit Diagram



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6. Packaging

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7. Quality Assurance Specification

7.1 Conformity

The performance, function and reliability of the shipped products conform to the Product Specification.

7.2 Environment Required

Customer's test & measurement are required to be conducted under the following conditions:

| Temperature: | 25 ± 5 ∘ C |
|---|---|
| Humidity: | 65% ± 10% RH |
| Viewing Angle: | Normal viewing Angle |
| Illumination: | 300 ~ 700 Lux (single fluorescent lamp) |
| Viewing distance: | 30 ~ 50cm |
| Finger glove (or finger cover) must be worn by the inspector. | |
| Inspection table or jig must be anti-electrostatic. | |
| | |



7.3 Delivery Assurance

7.3.1 Delivery Inspection Standards

Class II, Normal Inspection, MIL-STD-105E

7.3.2 Zone Definition



Zone A: Effective Viewing Area (Character or Digit can be seen)

Zone B: Viewing Area except Zone A

Zone C: Outside (Zone A+Zone B) which cannot be seen after assembly by customer.

Zone D: IC Bonding Area

Note: As a general rule, visual defects in Zone C can be ignored when it doesn't affect product function or appearance after assembly by customer

7.3.3 Criteria & Acceptable Quality Level

| Item | Criteria | Classification | Partition | |
|----------------------|--|----------------|-----------|--|
| | 1) No display, Open or miss line | | | |
| Functional defects | 2) Display abnormally, Short | | | |
| | 3) Backlight no lighting, abnormal lighting etc. | Major | 0.65 | |
| Missing | Missing components and etc. | IVIAJOI | 0.05 | |
| Outline dimension | Overall outline dimension beyond the drawing is | | | |
| | not allowed, deformation and etc. | | | |
| Color tone | Color unevenness, refer to limited sample | | | |
| Spat/Lina defect | Light dot, dim spot, polarizer air bubble, polarizer | | | |
| Spot/Line defect | accidented spot and etc. | Minor | 1.5 | |
| Soldering appearance | Good soldering, peeling off is not allowed and etc. | | | |
| LCD/Polarizer | Black/White spot/line, scratch, crack, etc. | | | |

Note:

a) Light dot : Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

b) Dim dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.



7.3.4 Criteria & Classification

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| $ \begin{array}{c c c c c c c c c c c c c c c c c c c $ |
|---|
| 2. Dim spot (light leakage, dent, dark spot etc)SizeAcceptable numberY $\Phi \le 0.15$ Ignore0.15 < $\Phi \le 0.25$ 3 (distance ≥ 10 mm)0.25 < $\Phi \le 0.4$ 2 (distance ≥ 10 mm) $\Phi > 0.4$ 0 |
| SizeAcceptable numberYYABC $\Phi \le 0.15$ Ignore $0.15 < \Phi \le 0.25$ 3 (distance ≥ 10 mm) $0.25 < \Phi \le 0.4$ 2 (distance ≥ 10 mm) $\Phi > 0.4$ 03. Polarizer accidented spot |
| X $Size$ A B C $\Phi \le 0.15$ $Ignore$ $0.15 < \Phi \le 0.25$ $3 (distance \ge 10mm)$ $0.25 < \Phi \le 0.4$ $2 (distance \ge 10mm)$ $0.25 < \Phi \le 0.4$ 0 $3. Polarizer accidented spot$ $Accentable number$ |
| Y $\Phi \le 0.15$ IgnoreX $0.15 < \Phi \le 0.25$ 3 (distance ≥ 10 mm)0.25 < $\Phi \le 0.4$ 2 (distance ≥ 10 mm) $\Phi > 0.4$ 03. Polarizer accidented spot |
| X $0.15 < \Phi \le 0.25$ $3 \text{ (distance } \ge 10 \text{ mm)}$ $0.25 < \Phi \le 0.4$ $2 \text{ (distance } \ge 10 \text{ mm)}$ $\Phi > 0.4$ 0 3. Polarizer accidented spot |
| X $0.25 < \Phi \le 0.4$ 2 (distance ≥ 10 mm) $\Phi > 0.4$ 0 3. Polarizer accidented spot |
| Φ > 0.4 0 3. Polarizer accidented spot |
| 3. Polarizer accidented spot |
| Accentable number |
| Size Acceptable Humber |
| A B C |
| $\Phi \le 0.2$ Ignore |
| $0.2 < \Phi \le 0.5$ 2 (distance ≥ 10 mm) Ignore |
| Φ > 0.5 0 |
| 4. Polarizer Bubble |
| Size Acceptable number |
| A B C |
| $\Phi \le 0.2$ Ignore |
| $0.2 < \Phi \le 0.4$ 2 (distance ≥ 10 mm) Ignore |
| 0.4 < Φ ≤ 0.5 1 |
| Φ > 0.5 0 |
| Pixel bad points |
| Item Zone A Acceptable number |
| Random N ≤ 2 |
| Bright dot 2 dots adjacent N ≤ 0 |
| $\frac{3 \text{ dots adjacent}}{N \leq 0}$ |
| Random N ≤ 3 |
| LCD Pixel defect Dark dot 2 dots adjacent N ≤ 0 |
| $\frac{3 \text{ dots adjacent}}{N \le 0}$ |
| 1. Minimum distance between |
| Dright dots. |
| Distance Distance Distance Detween dark 5mm |
| date |
| dots 3. Minimum distance between dark |

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| Item | | Criteria (mm) | | | | |
|--------------------------------------|--|-------------------------|----------|------------|--------|--|
| | Total brigh | it and dark dot | | N ≤ | 4 | |
| | Note: | | | | | |
| | A) Bright dot: Dots appear bright and unchanged in size in which LCD panel | | | | | |
| | is displaying under black pattern. | | | | | |
| | B) Dark dot: Dots appear dark and unchanged in size in which LCD panel is | | | | | |
| | displaying under pure r | ed, green, blue picture | | | | |
| | C) 2 dot adjacent = 1 pa | air = 2 dots | | | | |
| | Picture: | | | | | |
| | | | | | | |
| | | | | | | |
| | 2 dot adjace | nt 2 | dot adja | cent | | |
| | | | | | | |
| | | | | | | |
| | 2 dot adjacent (vertical) 2 dot a | | | cent (slar | nt) | |
| | N : Count | | | | | |
| Line defect (LCD/Polarizer backlight | | | Acce | eptable nu | ımber | |
| black/white line, scratch, stain) | Width (mm) | Length (mm) | А | В | С | |
| | W ≤ 0.05 | Ignore | Ign | ore | | |
| ↓ w | 0.05 < W ≤ 0.06 | L ≤ 5.0 | N s | ≤ 3 | Ignore | |
| W: width, L : length | 0.06 < W ≤ 0.08 | L ≤ 4.0 | N s | ≤ 2 | | |
| | W > 0.08 Define as spot defect | | | | | |
| Electronic Components SMT | Not allow missing parts, solderless connection, cold solder joint, mismatch. | | | | | |
| | The positive and negative polarity opposite | | | | | |
| | 1. Color: Measuring the color coordinates. The measurement standard | | | | | |
| Display color & Brightness. | according to the datashe | eet or samples. | | | | |
| | 2. Brightness: Measuring the brightness of White screen. The measurement | | | | | |
| | standard according to th | e datasheet or Sample | S. | | | |
| LCD Mura/Waving/Hot spot | Not visible through 5% ND filter in 50% gray or judge by limit sample if | | | | | |
| | necessary. | | | | | |

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Criteria (functional items)

| Number | ltem | Criteria |
|--------|-----------------------|-------------|
| 1 | No display | |
| 2 | Missing segment | Netallowed |
| 3 | Short | NOT dilowed |
| 4 | Backlight no lighting | |

7.4 Dealing with Customer Complaints

7.4.1 Non-conforming Analysis

Purchaser should supply Densitron with detailed data of non-conforming sample.

After accepting it, Densitron should complete the analysis in reasonable time and update the status to the purchaser.

7.4.2 Handling of Non-conforming Displays

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

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

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

8. Reliability Specification

8.1 Reliability Tests

| Test Item | Test Condition | Inspection after Test |
|--------------------------------|--|--|
| High Temperature Operation | 85°C, 96 hours | |
| Low Temperature Operation | -30°C, 96 hours | _ |
| High Temperature Storage | 85°C, 96 hours | |
| Low Temperature Storage | -30°C, 96 hours | Inspection after 2~4hours |
| Damp Proof Test | 60°C, 90%RH, 96 hours | storage at room |
| Temperature Cycle | -10°C ~ 60°C, 20cycles, 30 min Change time: 5min | temperature, the sample shall be free from defects: |
| ESD Test | C = 150pF, R = 330,5points/panel Air: ±8KV, 5times; Contact: ±6KV, 5 times. (Environment: 15°C ~ 35°C, 30% ~ 60%). | Air bubble in the LCD. Non-display. Missing segments. Glass crack |
| Vibration Test (non-operation) | Frequency : 10Hz ~ 55Hz Stroke: 1.5mm Sweep: 10Hz ~ 55Hz ~ 10Hz, 2 hours for each direction of X.Y.Z. (6 hours for total) (Package condition). | 5. Current Idd is twice higher than initial value. |
| Box Drop Test | 1 Corner 3 Edges 6 faces,80cm (MEDIUM BOX) | - |

Note 1: The test samples should be applied to only one test item.

Note 2: Sample size for each test item is 5~10pcs.

Note 3: For Damp Proof Test, Pure water(Resistance > $10M\Omega$) should be used.

Note 4: In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.

Note 5: Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

Note 6: The color fading mura of polarizing filter should not care.

8.1.1 Inspection Check Standard

After the completion of the described reliability test, the samples are to be left at room temperature for 4 hrs prior to conducting the inspection check at 25±5 °C, 65±5% RH.

9. Handling Precautions

9.1 Handling Precautions

- 1) Since the display panel is made of glass, do not apply mechanical impacts such us dropping from a high position.
- 2) If the display panel is broken by accident and the internal organic substance leaks out, be careful not to inhale nor lick the organic substance.
- 3) If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water
- 4) If pressure is applied to the display surface or its neighbourhood of the display module, the cell structure may be damaged and be careful not to apply pressure to these sections.
- 5) The polarizer covering the surface of the display module is soft and easily scratched. Please be careful when handling the display module.
- 6) When the surface of the polarizer of the display module has soil, clean the surface. It takes advantage of by using following adhesion tape.
 - a. Scotch Mending Tape No. 810 or an equivalent
 - b. Never try to breathe upon the soiled surface nor wipe the surface using cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.
 - c. Also, pay attention that the following liquid and solvent may spoil the polarizer:
 - Water
 - Ketone
 - Aromatic Solvents
- 7) Hold the display module very carefully when placing it into the system housing. Do not apply excessive stress or pressure to display module. And, do not over bend the film with electrode pattern layouts. These stresses will



influence the display performance. Also, secure sufficient rigidity for the outer cases.

- 8) Do not apply stress to the LSI chips and the surrounding molded sections.
- 9) Do not disassemble nor modify the display module.
- 10) Do not apply input signals while the logic power is off.
- 11) Pay sufficient attention to the working environments when handing display modules to prevent occurrence of element breakage accidents by static electricity.
 - a. Be sure to make human body grounding when handling display modules.

- b. Be sure to ground tools to use or assembly such as soldering irons.
- c. To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
- d. Protective film is being applied to the surface of the display panel of the display module. Be careful since static electricity may be generated when exfoliating the protective film.
- 12) A Protection film is being applied to the surface of the display panel and removes the protection film before assembling it. If the display module has been stored for a long period of time, residue adhesive material of the protection film may remain on the surface of the display panel after removed of the film. In such case, remove the residue material by the method introduced in the above Section 5).
- 13) If electric current is applied when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful to avoid the above.

9.2 Storage Precautions

- 1) When storing display modules, put them in static electricity preventive bags avoiding exposure to direct sun light nor to lights of fluorescent lamps, etc. and, also, avoiding high temperature and high humidity environments or low temperature (less than 0°C) environments. (We recommend you store these modules in the packaged state when they are shipped from Densitron) At that time, be careful not to let water drops adhere to the packages or bags nor let dewing occur with them.
- 2) If electric current is applied when water drops are adhering to the surface of the display module, when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful about the above.

9.3 Designing Precautions

- 1) The absolute maximum ratings are the ratings which cannot be exceeded for display module, and if these values are exceeded, panel damage may happen.
- 2) To prevent occurrence of malfunctioning by noise, pay attention to satisfy the VIL and VIH specifications and, at the same time, to make the signal line cable as short as possible.
- 3) We recommend you install excess current preventive unit (fuses, etc.) to the power circuit (VDD). (Recommend value: 0.5A)
- 4) Pay sufficient attention to avoid occurrence of mutual noise interference with the neighbouring devices.
- 5) As for EMI, take necessary measures on the equipment side basically.
- 6) When fastening the display module, fasten the external plastic housing section.
- 7) If power supply to the display module is forcibly shut down by such errors as taking out the main battery while the display panel is in operation, we cannot guarantee the quality of this display module.

9.4 Operation Precautions

TFT LCD Module

- 1) It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life.
- 2) 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.
- 3) 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.
- 4) To protect display modules from performance drops by static electricity rapture, etc., do not touch the following sections whenever possible while handling the display modules.
 - a. Pins and electrodes
 - b. Pattern layouts such as the FPC
- 5) When the driver is being exposed (COG), semiconductor elements change their characteristics when light is radiated according to the principle of the solar battery. Consequently, if the driver is exposed to light, malfunctioning may occur.
 - a. Design the product and installation method so that the driver may be shielded from light in actual usage.
 - b. Design the product and installation method so that the driver may be shielded from light during the inspection processes.
- 6) Although the display module stores the operation state data by the commands and the indication data, when excessive external noise, etc. enters into the module, the internal status may be changed. It therefore is necessary to take appropriate measures to suppress noise generation or to protect from the influences of noise on the system design.
- 7) We recommend you construct its software to make periodical refreshments of the operation statuses (re-setting of the commands and re-transference of the display data) to cope with catastrophic noise.

9.5 Cleaning Precautions

1) Keep TFT Scratch free: Avoid using abrasive materials like paper towels and newspaper in cleaning TFT LCD screens as they may scratch the surface. Instead, opt for a lint-free cloth. Don't spray the liquid directly on the monitor and remember to put gentle pressure when wiping the screen.

2) Avoid Vibration: During cleaning process, try to keep the TFT on shock proof platform to avoid strong shock and vibration. Do not apply pressure to the LCD screen of the LCD or bump or squeeze the LCD display back cover.

3) When the surface of the polarizer of the display module has soil, clean the surface. It takes advantage of using the following adhesion tape:

- a) Scotch Mending Tape No. 810 or an equivalent.
- b) Never try to breathe upon the soiled surface.
- c) List of Safe and Unsafe solvents to clean TFT display:

TFT LCD Module

| Safe Solvents | Unsafe Solvents |
|--|-----------------|
| Distilled Water | Ammonia |
| Isopropyl Alcohol | Acetone |
| Diluted White Vinegar = Water (Mix 1 part vinegar + 5 parts of Water) | Ethyl Alcohol |
| | Methyl Chloride |
| | Ethyl Acid |

9.6 Other Precautions

1) Request the qualified companies to handle industrial wastes when disposing of the display modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.