



# MOP-TFT480116-38G-BLH-TPC

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Hardware Manual

Revision 1.3

## Revision History

| Revision | Date              | Description                      | Author |
|----------|-------------------|----------------------------------|--------|
| 1.3      | March 25, 2019    | Corrected FFC header information | Divino |
| 1.2      | June 27, 2018     | Added FFC Information            | Divino |
| 1.1      | March 29, 2018    | Updated Naming Convention        | Divino |
| 1.0      | February 21, 2018 | Initial Release                  | Divino |



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## 1 General Information

| No. | Item                           | Contents                     | Unit   |
|-----|--------------------------------|------------------------------|--------|
| 1   | Display Size(Diagonal)         | 3.8"                         |        |
| 2   | LCD type                       | TN TFT                       |        |
| 3   | Display Mode                   | Transmissive/ Normally White |        |
| 4   | Resolution                     | 480 RGB x 116                | Pixels |
| 5   | View Direction                 | 12 O'clock                   |        |
| 6   | Gray Scale Inversion Direction | 6 O'clock                    |        |
| 7   | Module Outline                 | 105.5(H) x 37.8 (V) x 4.2(T) | mm     |
| 8   | Active Area                    | 95.04(H) x 22.97(V)          | mm     |
| 9   | Pixel Pitch                    | 198(H) x 198(V)              | μm     |
| 10  | Pixel Arrangement              | Stripe                       |        |
| 11  | Polarizer Surface Treatment    | Anti-glare                   |        |
| 12  | Display Colors                 | 16M                          |        |
| 13  | Interface                      | 24-bit RGB interface         |        |
| 14  | Driver IC                      | ST7282                       | -      |
| 15  | With or Without Touch Panel    | With                         |        |
| 16  | Operating Temperature          | -20~70                       | °C     |
| 17  | Storage Temperature            | -30~80                       | °C     |
| 18  | Weight                         | 35                           | g      |

## 2 Absolute Maximum Ratings

| Item                  | Symbol           | Min  | Max | Unit |
|-----------------------|------------------|------|-----|------|
| Supply Voltage        | VCC              | -0.3 | 4.6 | V    |
| Storage temperature   | T <sub>STG</sub> | -30  | +80 | °C   |
| Operating temperature | T <sub>OP</sub>  | -20  | +70 | °C   |

**\*Note:** If Ta below 50°C, the maximal humidity is 90%RH, if Ta over 50°C, absolute humidity should be less than 60%RH.

**\*\*Note:** The response time will be extremely slow when the operating temperature is around -10°C, and the back ground will become darker at high temperature operating.

## 3 Electrical Characteristics

### DC Characteristics (at Ta=25 °C)

| Item                             | Symbol          | Min                              | Typ | Max     | Unit |    |
|----------------------------------|-----------------|----------------------------------|-----|---------|------|----|
| Digital Interface Supply Voltage | VCC             | 3.0                              | 3.3 | 3.6     | V    |    |
| Logic Low input voltage          | V <sub>IL</sub> | GND                              | -   | 0.3*VCC | V    |    |
| Logic High input voltage         | V <sub>IH</sub> | 0.7*VCC                          | -   | VCC     | V    |    |
| Logic Low output voltage         | V <sub>OL</sub> | GND                              | -   | GND+0.4 | V    |    |
| Logic High output voltage        | V <sub>OH</sub> | VCC-0.4                          | -   | VCC     | V    |    |
| Current Consumption All Black    | Logic           | I <sub>cc</sub> +I <sub>in</sub> | -   | 15      | 30   | mA |
|                                  | Analog          |                                  |     |         |      |    |



## 4 Backlight Characteristics

(at Ta=25 °C, RH=60%)

| Item              | Symbol  | Condition                          | Min  | Typ. | Max. | Unit |
|-------------------|---|------------------------------------|------|------|------|------|
| Forward Voltage   | V <sub>F</sub>  | Ta=25 °C, I <sub>F</sub> =20mA/LED | 17.4 | 19.2 | 19.8 | V    |
| Forward Current   | I <sub>F</sub>  | Ta=25 °C, V <sub>F</sub> =3.2V/LED | -    | 40   | -    | mA   |
| Power dissipation | P <sub>D</sub>  |                                    | -    | 768  | -    | mW   |
| Uniformity        | Avg   |                                    | 80   | -    | -    | %    |
| Drive method      | Constant current  |                                    |      |      |      |      |
| LED Configuration | 12 White LEDs (6 LEDs in one string and 2 groups in parallel) |                                    |      |      |      |      |

## 5 Touch Panel Characteristics

(at Ta=25 °C)

| Item                             | Description       |
|----------------------------------|-------------------|
| IC solution on TP Model          | GT911*            |
| Touch Count Max                  | 5 point           |
| Display Resolution               | 480*116           |
| Interface Type                   | I2C               |
| Maximum Clock Speed              | 400Kbps           |
| Interrupt Signal                 | Active Low        |
| Default Origin                   | Upper Left Corner |
| Default I2C Address (Write/Read) | 0xBA/0xBB         |
| Hardness                         | 6H                |

| Parameter                  | Min.    | Typ. | Max.    | Unit |
|----------------------------|---------|------|---------|------|
| Power Voltage (VDD)        | 2.8     | ---  | 3.3     | V    |
| Signal Voltage             | 1.8     | 3.3  | 3.6     | V    |
| Signal HIGH                | 0.7*VDD | ---  | VDD     | V    |
| Signal LOW                 | 0       | ---  | 0.3*VDD | V    |
| Supply Current (Operation) | ---     | 6.0  | ---     | mA   |

\*Note: For more information, see the GT911 datasheet



# 6 External Dimensions

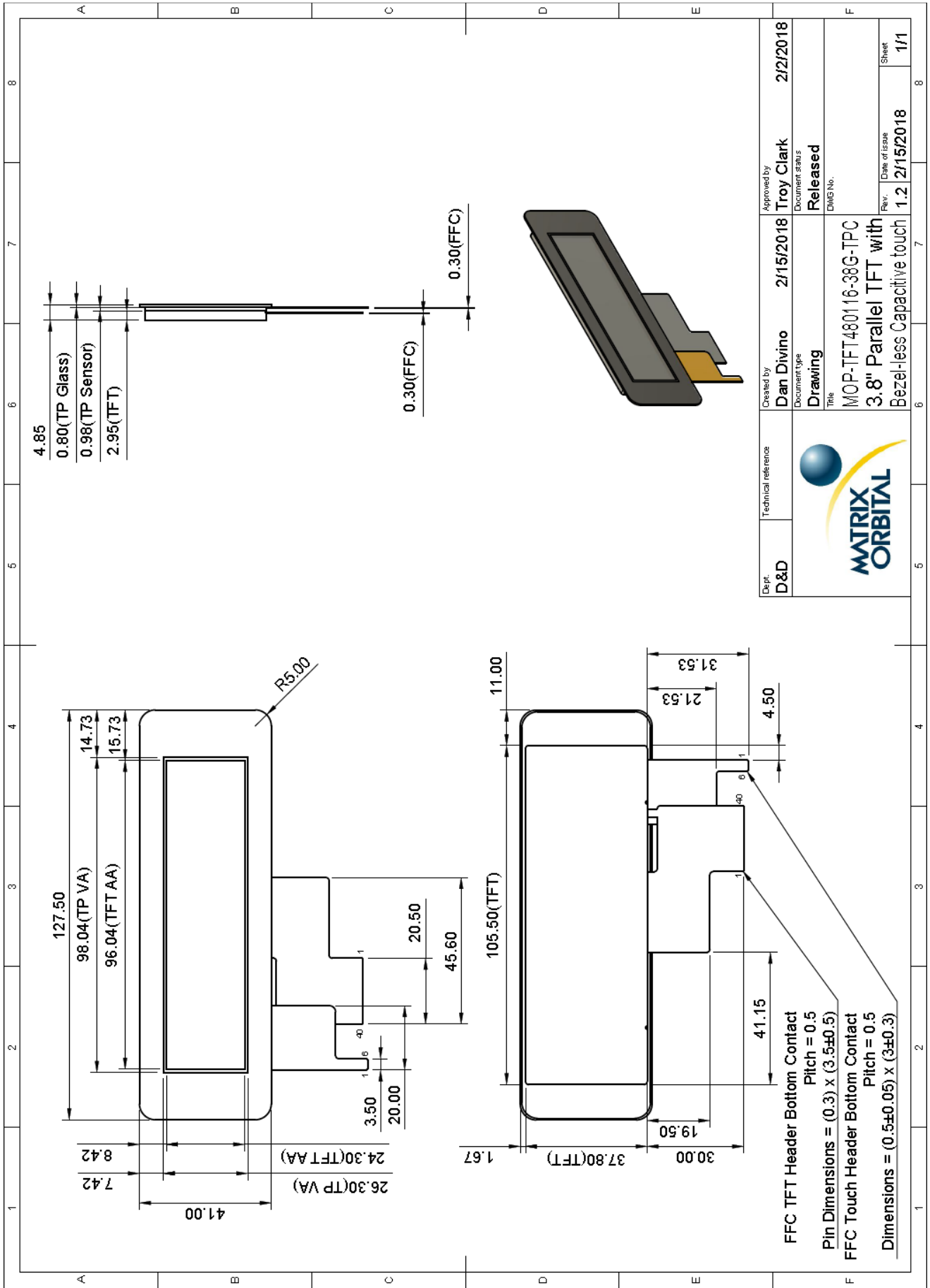


Figure 1: MOP-TFT480116-38G-BLH-TPC Drawing



## 7 Electro-Optical Characteristics

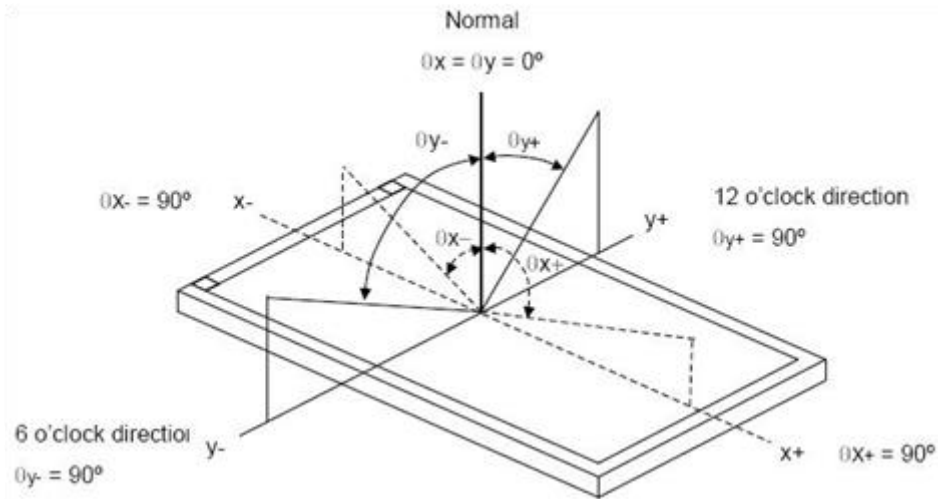


Figure 2: The definition of viewing angle

| Item  | Symbol         | Condition  | Specification |       |       | Unit            |
|---|----------------|--|---------------|-------|-------|-----------------|
|   |                |  | Min           | Typ   | Max   |                 |
| Luminance on TFT<br>( $I_f = 20\text{mA/LED}$ ) | Lv             | Normal viewing angle<br>$\theta_x = \varphi_y = 0^\circ$ | 640           | 800   | -     | $\text{cd/m}^2$ |
| Contrast Ratio                                  | CR             |  | 300           | 500   | -     |                 |
| Response time                                   | $T_R + T_F$    |  | -             | 30    | 50    |                 |
| Transmissive                                    | Red            | $X_R$  | 0.576         | 0.616 | 0.676 |                 |
|   |                | $Y_R$  | 0.309         | 0.359 | 0.409 |                 |
|   | Green          | $X_G$  | 0.274         | 0.324 | 0.374 |                 |
|   |                | $Y_G$  | 0.558         | 0.608 | 0.658 |                 |
|   | Blue           | $X_B$  | 0.099         | 0.149 | 0.199 |                 |
|   |                | $Y_B$  | 0.070         | 0.120 | 0.170 |                 |
|   | White          | $X_W$  | 0.237         | 0.287 | 0.337 |                 |
|   |                | $Y_W$  | 0.292         | 0.342 | 0.392 |                 |
| Horizontal                                      | $\theta_{X+}$  | Center CR $\geq 10$                                      | -             | 60    | -     | Deg.            |
|   |                |  | -             | 60    | -     |                 |
|   | $\varphi_{Y+}$ |  | -             | 50    | -     |                 |
|   |                |  | -             | 65    | -     |                 |
| Vertical  | $\varphi_{Y-}$ | -  | 50            | -     | %     |                 |
| NTSC Ratio(Gamut)                               |                |  | -             | 50    | -     | %               |

## 8 Interface Description

### 8.1 LCM Interface Description

The MOP-TFT480116-38G-BLH-TPC uses a FFC cable for 24bit RGB parallel communication. The FFC cable is compatible with any 40 position FFC connector with a 0.5mm pitch and Top/Bottom contacts such as the Omron Electronics Inc XF2M-4015-1A.

| Interface No. | Name       | Description  |
|---------------|------------|--|
| 1             | LEDK       | Backlight Cathode  |
| 2             | LEDA       | Backlight Anode  |
| 3             | GND        | Ground   |
| 4             | VCC        | Power source   |
| 5-12          | Red(0-7)   | Red data signal  |
| 13-20         | Green(0-7) | Green data signal  |
| 21-28         | Blue(0-7)  | Blue data signal   |
| 29            | GND        | Ground   |
| 30            | CLK        | Clock signal to sample each data                                 |
| 31            | DISP       | Display on/off signal. DISP="H" Display on; DISP="L" Display off |
| 32            | HSYNC      | Horizontal synchronizing signal                                  |
| 33            | VSYNC      | Vertical synchronizing signal                                    |
| 34            | DEN        | Input data enable control  |
| 35            | NC         | No connection  |
| 36            | GND        | Ground   |
| 37            | XR(NC)     | No Connect   |
| 38            | YD(NC)     | No Connect   |
| 39            | XL(NC)     | No Connect   |
| 40            | YU(NC)     | No Connect   |

### 8.2 Capacitive Touch Panel Interface Description

The capacitive touch panel uses a 6 pin FFC cable to relay touch information to the host. The FFC cable is compatible with any 6 position connector with a 0.5mm pitch and Top/Bottom contacts such as the Molex, LLC 5034800600.

| Interface No. | Name  | I/O Pin Connections | Description                         |
|---------------|-------|---------------------|-------------------------------------|
| 1             | RST*  | I                   | Reset (Active Low)                  |
| 2             | INT*  | O                   | State change interrupt (Active Low) |
| 3             | GND   | P                   | Ground                              |
| 4             | SDA** | I/O                 | Serial interface data               |
| 5             | SCL** | I                   | Serial interface clock              |
| 6             | VDD   | P                   | Power supply of CTP                 |

\*Note: Pull up resistors of 10K ohms to VDD are recommended for RST and INT.

\*\*Note: Pull up resistors of 1K-10K ohms to VDD are required for SCL and SDA.





# 9 AC Characteristics

## 9.1 Pixel Timing

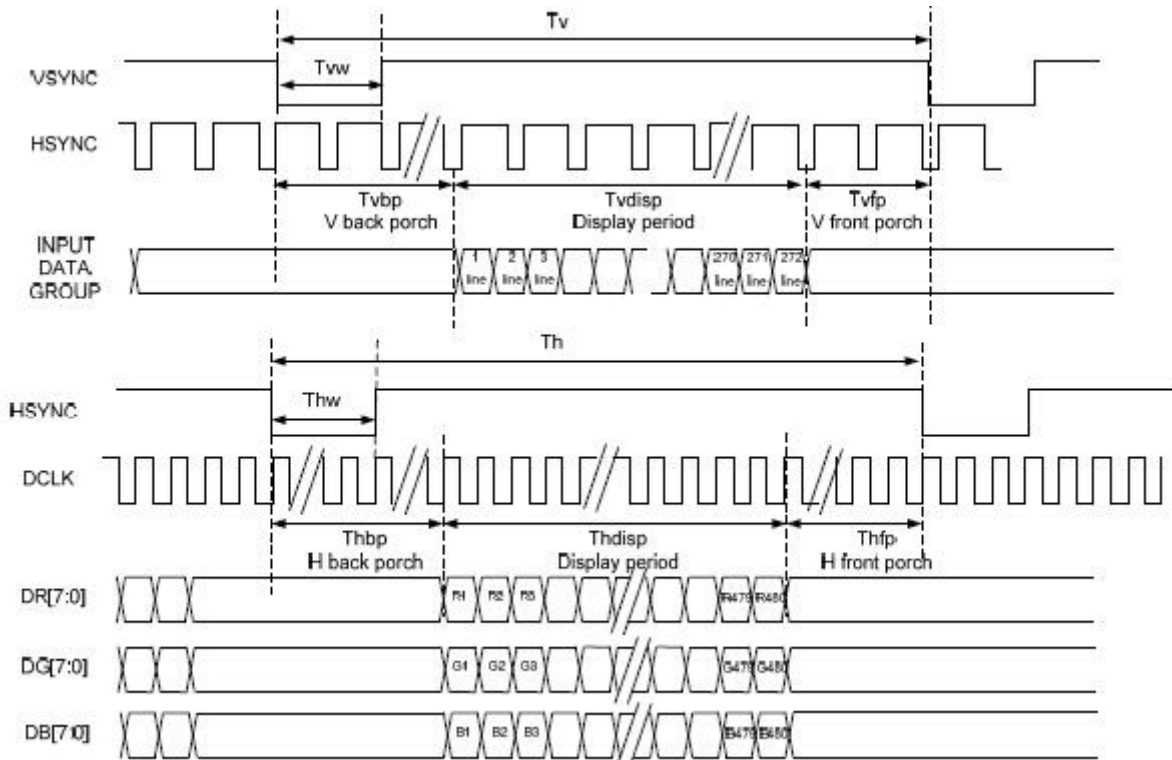


Figure 3: SYNC-DE Mode Timing Diagram

| Characteristics  |                | Symbol | Min. | Typ. | Max. | Unit |
|------------------|----------------|--------|------|------|------|------|
| DOTCLK Frequency |                | Fclk   | -    | 12   | -    | MHz  |
| Hsync            | Period Time    | Th     | -    | 524  | -    | DCLK |
|                  | Display Period | Thdisp | -    | 480  | -    | DCLK |
|                  | Back Porch     | Thbp   | -    | 43   | -    | DCLK |
|                  | Front Porch    | Thfp   | -    | 1    | -    | DCLK |
|                  | Pulse Width    | Thw    | -    | 2    | -    | DCLK |
| Vsync            | Period Time    | Tv     | -    | 288  | -    | H    |
|                  | Display Period | Tvdisp | -    | 272  | -    | H    |
|                  | Back Porch     | Tvbp   | -    | 12   | -    | H    |
|                  | Front Porch    | Tvfp   | -    | 4    | -    | H    |
|                  | Pulse Width    | Tvw    | -    | 2    | -    | H    |

\*Note: The 1-156 gate lines must be sent back data

## 9.2 Touch Panel Timing

Table 1: Write Operation

|       |                 |     |               |     |               |     |          |     |     |          |     |     |
|-------|-----------------|-----|---------------|-----|---------------|-----|----------|-----|-----|----------|-----|-----|
| Start | Address (Write) | ACK | Register (H)* | ACK | Register (L)* | ACK | Data (1) | ACK | ... | Data (n) | ACK | End |
|-------|-----------------|-----|---------------|-----|---------------|-----|----------|-----|-----|----------|-----|-----|

Table 2: Read Operation

|       |           |     |       |     |       |     |     |       |          |     |       |     |     |       |     |     |
|-------|-----------|-----|-------|-----|-------|-----|-----|-------|----------|-----|-------|-----|-----|-------|-----|-----|
| Start | A (Write) | ACK | R (H) | ACK | R (L) | ACK | End | Start | A (Read) | ACK | D (1) | ACK | ... | D (n) | ACK | End |
|-------|-----------|-----|-------|-----|-------|-----|-----|-------|----------|-----|-------|-----|-----|-------|-----|-----|

\*Note: For a complete list of registers and additional information, see the GT911 datasheet.



# 10 Power Sequence

## 10.1 Power Up Sequence

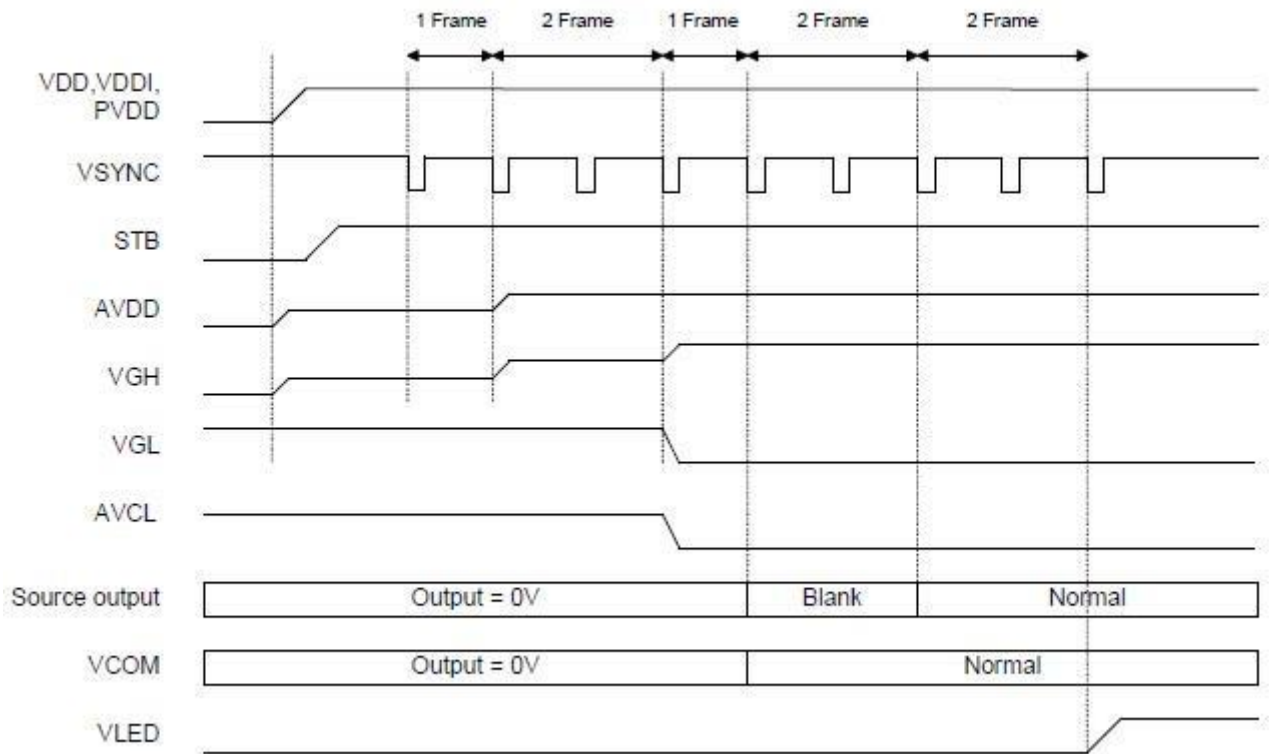


Figure 4: Power Up Sequence

## 10.2 Power Down Sequence

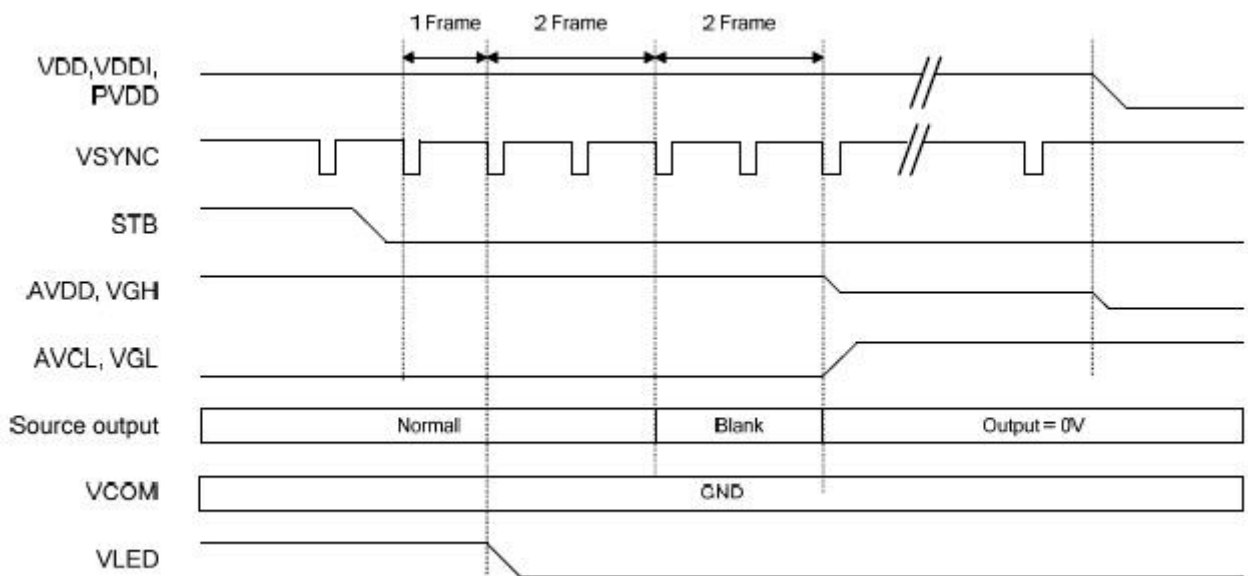


Figure 5: Power Down Sequence



# 11 Inspection Criterion

## 11.1 Description

This specification is made to be used as the standard acceptance/rejection criteria for the MOP-TFT480116-38G-BLH-TPC.

## 11.2 Sample plan

Sampling plan:

1999 and ANSI/ASQC Z1.4-1993

Single sampling, normal inspection

Visual inspection: AQL 1.5%

Electrical functional: AQL 0.65%

## 11.3 Inspection condition

- Viewing distance for cosmetic inspection is about  $30 \pm 2$  cm with bare eyes, and under a 1000~1500lux environment for visual inspection. All directions for inspecting the sample should be within  $45^\circ$  against perpendicular line. (Normal temperature  $18 \sim 28^\circ\text{C}$  and normal humidity  $60 \pm 15\% \text{RH}$ ).
- During testing, the LCD is driven using the voltage level (Within  $\pm 0.5\text{V}$  of the typical value at  $25^\circ\text{C}$ .) that provides the most optical contrast

## 11.4 Definition of inspection zone in LCD

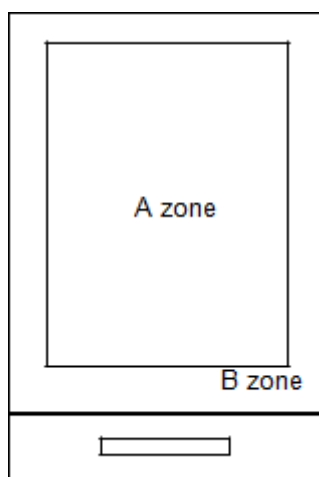


Figure 6: Inspection Zones in an LCD

Zone A: Active Area

Zone B: Viewing Area

## 11.5 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.   |                           |

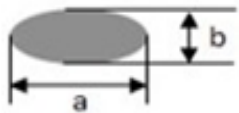
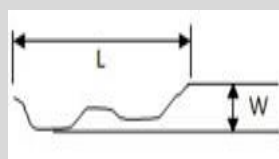
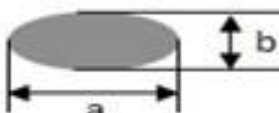


### 11.6 LCD pixel defect (bad dot) (defect type: MI)

| Checking item | Judgment criterion                | Total      |
|---------------|-----------------------------------|------------|
| Bright dot    | 0                                 | 0          |
| Dark dot      | $N \leq 2$                        | $N \leq 2$ |
| Total dot     | $N \leq 2$                        | $N \leq 2$ |
| Mura          | Not visible through 5% ND filters |            |

**\*Note:** Bright dot caused by scratch and foreign object accords to item 1.

### 11.7 Dot and line defect (defect type: MI)

| Checking item  | Judgment criterion  |                      |                    | Figure   |
|--|---|----------------------|--------------------|--|
|  | Diameter(mm)\LCD Size                                     |                      | S ≤5.0 Inch        |  |
| Dot defect   | $D \leq 0.10$   |                      | Allowed            | <br>$D = (a+b)/2$   |
|  | $0.10 < D \leq 0.15$                                      |                      | 2                  |  |
|  | $0.15 < D \leq 0.25$                                      |                      | 1                  |  |
|  | $0.25 < D$  |                      | 0                  |  |
|  | Total   |                      | 2                  |  |
|  | Distance between 2 defects should be more than 3mm apart. |                      |                    |  |
| Line defect  | Length(mm)  | Width(mm)            | Judgment criterion |                    |
|  | ---   | $W \leq 0.03$        | allowed            |  |
|  | $L \leq 2.5$  | $0.03 < W \leq 0.05$ | 3                  |  |
|  | $L \leq 2.5$  | $0.05 < W \leq 0.10$ | 2                  |  |
|  | ---   | $0.1 < W$            | 0                  |  |
|  | Total   |                      | 3                  |  |
| Distance between 2 defects should more than 3mm apart. Scratches not viewable through the back of the display are acceptable |   |                      |                    |  |
| Concave point and air bubble for polarizer   | Size(mm)  |                      | Judgment criterion | <br>$D = (a+b)/2$ |
|  | $D \leq 0.20$   |                      | allowed            |  |
|  | $0.20 < D \leq 0.30$                                      |                      | 4                  |  |
|  | $0.30 < D \leq 0.50$                                      |                      | 1                  |  |
|  | $D > 0.50$  |                      | None               |  |



## 12 Handling Precautions

### 12.1 Mounting method

Do not make extra holes in the display or modify its shape. When mounting the display, ensure that the display does not flex, bend or twist. Extreme care should be used when handling the LCD modules.

### 12.2 LCD Handling and Cleaning Precaution

To clean the display surface, it is recommended to wipe lightly using a soft cloth with either Isopropyl alcohol or Ethyl alcohol.

Do not wipe the display surface with dry or hard materials as it may damage the polarizer surface.

Do not use Water or Aromatics to clean the display.

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

Do not use Soldering flux, Chlorine(Cl), and Sulfur(S) on the pad or prevent it from being contaminated.

If the display is sent without applying a silicon coat on the pad, the ITO patterns could be damaged due to corrosion as time goes on.

If ITO corrosion occurs due to customer miss-handling, or if the customer applies materials such as Chlorine (Cl), Sulfur (S) to the display, the responsibility is placed the customer.

### 12.3 Static Charge Precaution

The LCD module uses CMOS 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
- Ground your body, work/assembly areas, and assembly equipment to protect against static electricity.

### 12.4 Packing

The module employs 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 Precautions during Operation

- It is an indispensable condition to drive the LCD module within the specified voltage limits. Applying voltage higher than the limit will reduce the life span of the LCD.
- Using direct drive current should be avoided, as it will induce an electrochemical reaction causing undesirable deterioration.
- The LCD's response time will be delayed when operating at a temperature lower than the suggested operating range. When operating at a temperature higher than the suggested range, the LCD will be noticeably darker. The display will return to normal when it is brought back to the specified operation temperature.
- If the display area is pushed hard during operation, some font may be abnormally drawn but the LCD will return to normal after it is reset.
- Slight dew depositing on terminals can cause an electro-chemical reaction, damaging traces and resulting in an open circuit.

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



## 12.6 Storage Recommendations

When storing the LCD for a prolonged period of time, the following recommendations will help prevent damage or deterioration

- Store the display in an ambient temperature range between 10°C to 30°C, and in a relative humidity of 45% to 75%.
- Do not leave the display exposed to sunlight or fluorescent light.
- Place the display in a polyethylene bag with the opening sealed.
- Ensure that nothing is making contact with the polarizer surface.
- It is recommended to store them in the same packaging that was provided upon purchase

## 12.7 Safety Precautions

In the case that the LCD glass has shattered, it is recommended to remove any glass pieces, wash off the liquid crystal using either acetone or ethanol, and proceed to burn any remaining display pieces.

If any liquid leaked out of a damaged glass cell, and comes in contact with your hands, please wash it off well with soap and water



## 13 Ordering

### 13.1 Part Numbering Scheme

Table 3: Parallel TFT Part Numbering Scheme

| MOP | TFT | 480 | 116 | 38 | G | BLH | CTB |
|-----|-----|-----|-----|----|---|-----|-----|
| 1   | 2   | 3   | 4   | 5  | 6 | 7   | 8   |

### 13.2 Options

Table 4: Parallel Part Options

| # | Designator          | Options  |
|---|---------------------|--|
| 1 | Product Line        | MOP: Matrix Orbital Parallel Display   |
| 2 | Screen Type         | TFT: Graphic TFT   |
| 3 | Display Columns     | 480: Four Hundred Eight Pixel Columns  |
| 4 | Display Rows        | 116: One Hundred Sixteen Pixel Rows  |
| 5 | Display Size        | 38: 3.8"   |
| 6 | Display Form Factor | G: G Form Factor   |
| 7 | Brightness Level    | -BLS: Brightness < 300 Nit<br>-BLM: 300 Nit < Brightness < 600 Nit<br>-BLH: 600 Nit < Brightness < 1000 Nit<br>-BLD: Brightness > 1000 Nit |
| 8 | Touch Panel Type    | TPN: None<br>TPR: Resistive<br>CTB: Bezel-less Capacitive  |

## 14 Contact

### Sales

Phone: 403.229.2737

Email: [sales@matrixorbital.ca](mailto:sales@matrixorbital.ca)

### Support

Phone: 403.204.3750

Email: [support@matrixorbital.ca](mailto:support@matrixorbital.ca)

### Online

Purchasing: [www.matrixorbital.com](http://www.matrixorbital.com)

Support: [www.matrixorbital.ca](http://www.matrixorbital.ca)

