# Microtips

## TECHNOLOGY

MU ÖÒŠÁP[ ĶÁT VÖ€FHJŒU ÕĔF

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# Record of Revision

| Date | Revision No. | Summary |
|------|--------------|---------|
| 2016-05-10 | 1.0 | Rev 1.0 was issued |

## 1. Scope

This data sheet is to introduce the specification of ÁΤ VÖ∈ΡΗJ0ΖUÕ∉ ,active matrix OLED module. It is composed of an OLED panel, driver IC and FPC. The 1.39″ display area contains 400 x 400 pixels.
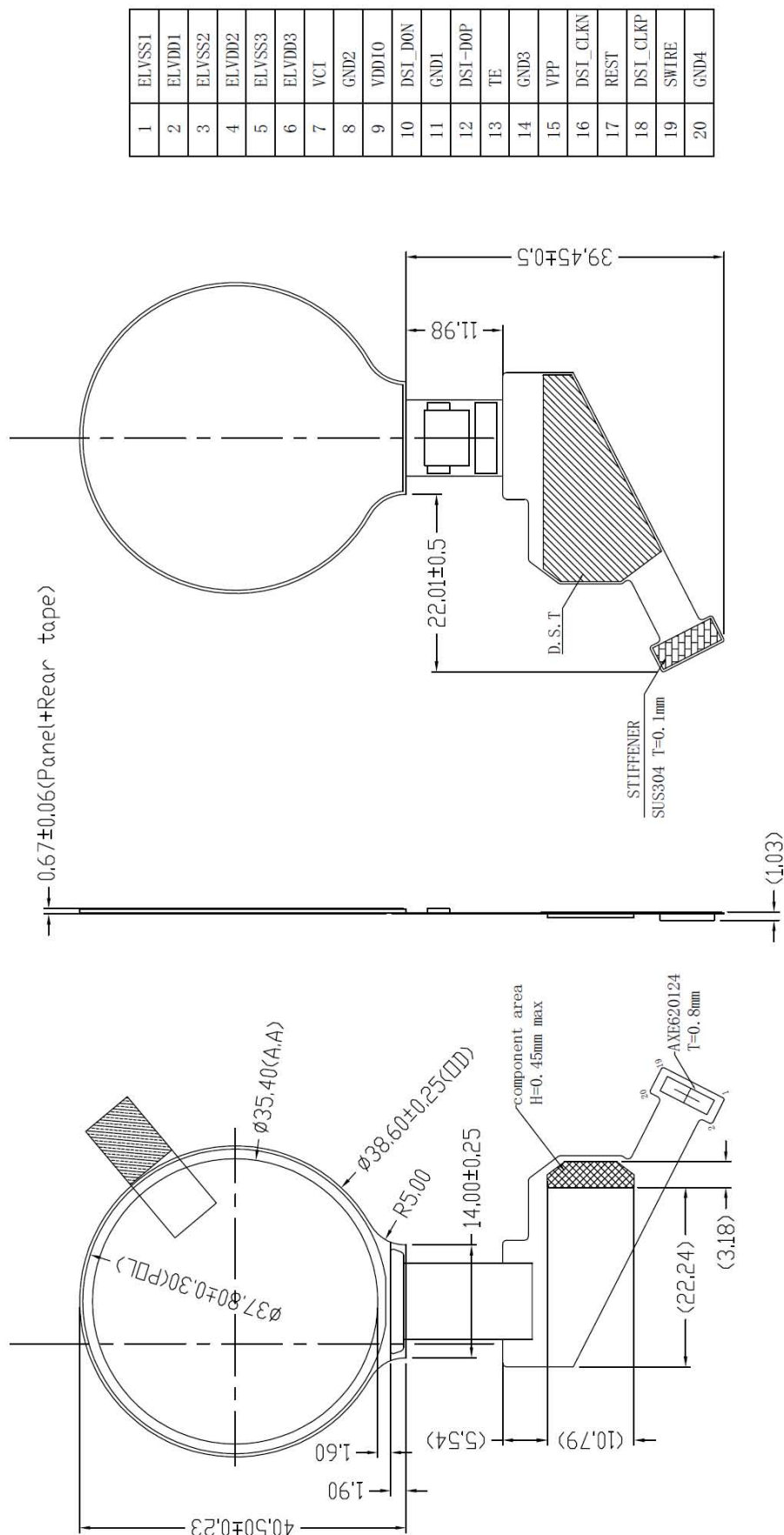
## 2. Application

Digital equipments which need display, instrumentation, remote control, electronic product.

## 3. General Information

| Item | Contents | Unit |
|---|---|---|
| Size | 1.39 | inch |
| Resolution | 400(RGB) x 400 | / |
| Display Color | Full Color | |
| Interface | MIPI DSI | |
| Outline Dimension | 38.6 x 40.5 x 0.67 | mm |
| Active Area | Φ 35.4 | mm |
| Weight | 2 | g |
| Operating Temperature | -20℃ ~ +60℃ | |
| Storage Temperature | -30℃ ~ +70℃ | |

## 4. Outline Drawing



| | |
|---|---|
| 1 | ELVSS1 |
| 2 | ELVDD1 |
| 3 | ELVSS2 |
| 4 | ELVDD2 |
| 5 | ELVSS3 |
| 6 | ELVDD3 |
| 7 | VCI |
| 8 | GND2 |
| 9 | VDDIO |
| 10 | DSI_D0N |
| 11 | GND1 |
| 12 | DSI_D0P |
| 13 | TE |
| 14 | GND3 |
| 15 | VPP |
| 16 | DSI_CLKN |
| 17 | REST |
| 18 | DSI_CLKP |
| 19 | SWIRE |
| 20 | GND4 |

TITLE: MTD0139AZ0G-1

DWG NO:

DWG NAME:

DRAWN BY:
CHECKED BY:
APPROVED BY:
CONFIRMED BY:

SCALE:
UNIT: mm
SHEET NO: OF

39.45±0.5

11.98

22.01±0.5

D.S.T

STIFFENER
SUS304 T=0.1mm

0.67±0.06(Panel+Rear tape)

(1.03)

Ø35.40(A.A)

Ø38.60±0.25(OD)

R5.00

14.00±0.25

Ø37.80±0.30(POL)

component area
H=0.45mm max

AXE620124
T=0.8mm

(22.24)

(3.18)

1.60

1.90

(5.54)

(10.79)

40.50±0.23

NOTES:
1. DISPLAY: 1.39" ROUND AM-OLED
2. RESOLUTION: 400(RGB) *400
3. OPERATING TEMP: -20° C ~ 60° C
4. STORAGE TEMP: -30° C ~ 70° C
5. RoHS Compliance

## 5. Interface signals

FPCA recommended connector:AXE520124

| PIN NO. | PIN NAME | DESCRIPTION |
|---|---|---|
| 1 | ELVSS1 | Negative power supply |
| 2 | ELVDD1 | Positive power supply |
| 3 | ELVSS2 | Negative power supply |
| 4 | ELVDD2 | Positive power supply |
| 5 | ELVSS3 | Negative power supply |
| 6 | ELVDD3 | Positive power supply |
| 7 | VCI | Driver analog power supply |
| 8 | GND2 | Ground |
| 9 | VDDIO | Ditital I/O power supply |
| 10 | DSI_D0N | MIPI DSI data0- |
| 11 | GND1 | Ground |
| 12 | DSI_D0P | MIPI DSI data0+ |
| 13 | TE | Tearing effect output |
| 14 | GND3 | Ground |
| 15 | VPP | Power supply for OTP.<br>Leave the pin to open when not in use. |
| 16 | DSI_CLKN | MIPI DSI clock- |
| 17 | REST | This signal will reset the device and must be applied to properly initialize the chip.<br>Active low. |
| 18 | DSI_CLKP | MIPI DSI clock+ |
| 19 | SWIRE | Swire protocol setting pin for power IC |
| 20 | GND4 | Ground |

# 6.  Absolute maximum Ratings

## 6.1 Electrical Absolute max. ratings

| Parameter | Symbol | MIN | MAX | Unit | Remark |
|---|---|---|---|---|---|
| Digital Power Supply | VDDIO | -0.3 | 5.5 | V | |
| Analog Power Supply | VCI | -0.3 | 5.5 | V | |
| ELVDD power Supply | ELVDD | - | 5.0 | V | |
| ELVSS power Supply | ELVSS | -5.0 | - | V | |

## 6.2 Environment Conditions

| Item | Symbol | MIN | MAX | Unit | Remark |
|---|---|---|---|---|---|
| Operating Temperature | TOPR | -20 | 60 | ℃ | |
| Storage Temperature | TSTG | -30 | 70 | ℃ | |

# 7.  Electrical Specifications

## 7.1  Electrical characteristics

| Item | Symbol | MIN | TYP | MAX | Unit | Remark |
|---|---|---|---|---|---|---|
| Digital Power Supply | VDDIO | 1.65 | 1.8 | 1.95 | V | |
| Analog Power Supply | VCI | 2.7 | 2.8 | 2.9 | V | |
| ELVDD power Supply | ELVDD | 4.55 | 4.60 | 4.65 | V | |
| ELVSS power Supply | ELVSS | -2.45 | -2.40 | -2.35 | V | |
| High logic Input Voltage | VIH | 0.8*VDDIO | - | VDDIO | V | |
| Low logic Input Voltage | VIL | 0 | - | 0.2*VDDIO | V | |
| High logic Output Voltage | VOH | 0.8*VDDIO | - | VDDIO | V | |
| Low logic Output Voltage | VOL | 0 | - | 0.2*VDDIO | V | |

Note : The operation is guaranteed under the recommended operating conditions only. The operation is not guaranteed if a quick voltage change occurs during the operation. To prevent the noise, a bypass capacitor must be inserted into the line closed to the power pin.

**7.2** Current Consumption

7.2.1 Normal Mode

Power supply: IOVCC=1.8v    VCI=2.8v

Frame Frequency: $F_{frame}$ =60HZ @ 25degC,Brightness 300 nits, Command Mode

| Display Condition | Symbol | MIN | TYP | MAX | Unit |
|---|---|---|---|---|---|
| 100% Pixel On 300 nits | IELVDD/ELVSS | - | 21.0 | 25.4 | mA |
| | IVCI | - | 6.0 | 7.2 | mA |
| | IVDDIO | - | 2.0 | 2.4 | mA |
| 50% Pixel On 150 nits | IELVDD/ELVSS | - | 5.2 | 6.2 | mA |
| | IVCI | - | 6.6 | 8.0 | mA |
| | IVDDIO | - | 2.0 | 2.4 | mA |
| 10% Pixel On 50 nits | IELVDD/ELVSS | - | 0.4 | 0.5 | mA |
| | IVCI | - | 7.2 | 8.6 | mA |
| | IVDDIO | - | 2.0 | 2.4 | mA |

7.2.2 Idle Mode

Power supply: IOVCC=1.8v    VCI=2.8v

Frame Frequency: $F_{frame}$ =15HZ @ 25degC,Brightness 30 nits

| Display Condition | Symbol | MIN | TYP | MAX | Unit |
|---|---|---|---|---|---|
| 10% Pixel On 30 nits | IELVDD/ELVSS | - | - | - | mA |
| | IVCI | - | 3.0 | 3.6 | mA |
| | IVDDIO | - | 1.0 | 1.2 | mA |

7.2.3 Deep Standby Mode

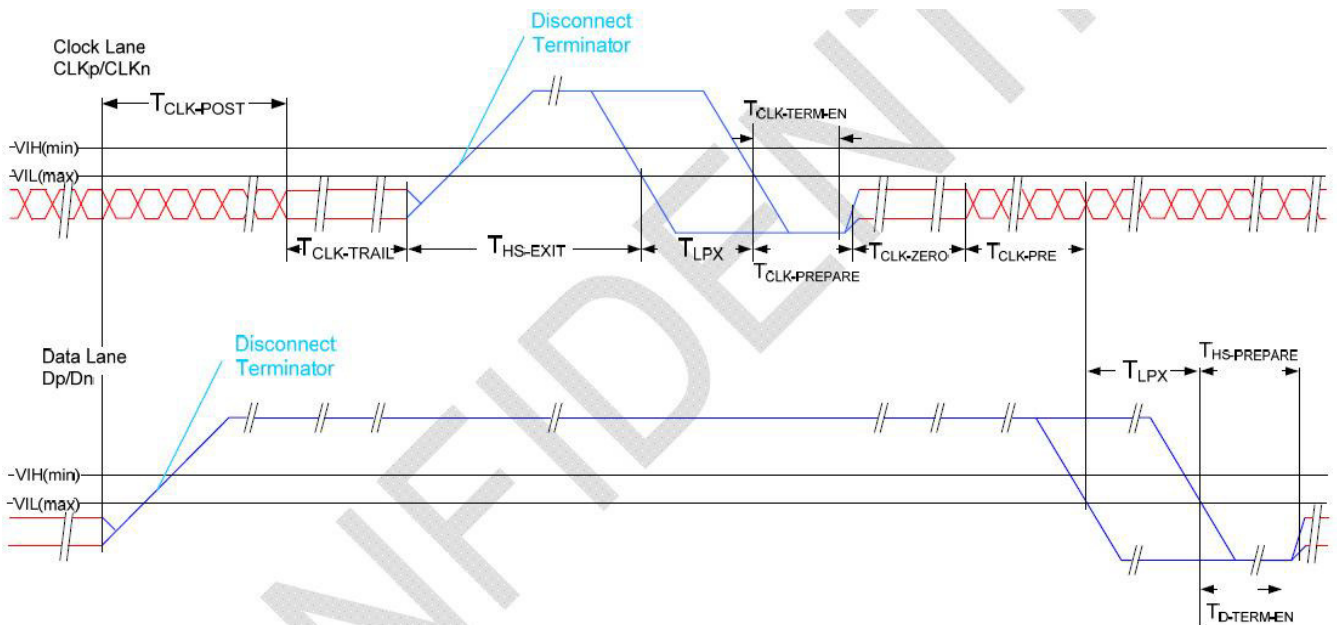| Display Condition | Symbol | MIN | TYP | MAX | Unit |
|---|---|---|---|---|---|
| Deep Standby | IVCI | - | - | 1 | uA |
| | IVDDIO | - | - | 0 | uA |

# 8. Command/AC Timing
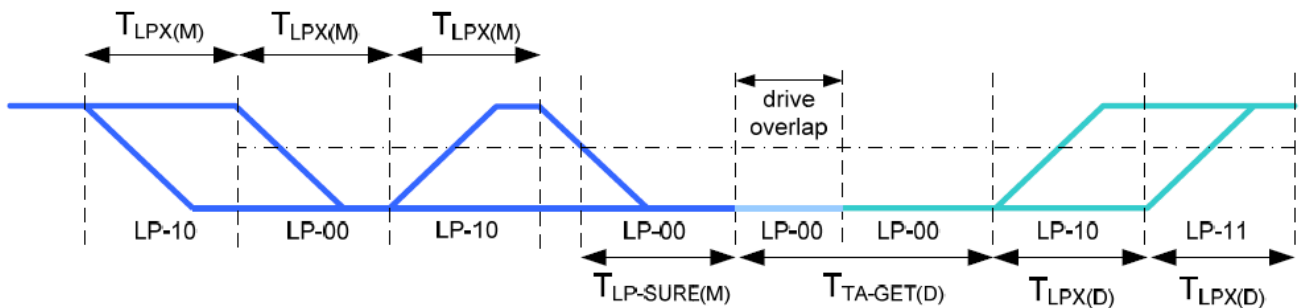
## 8.1 MIPI Interface Characteristics

### 1) HS Data Transmission Burst
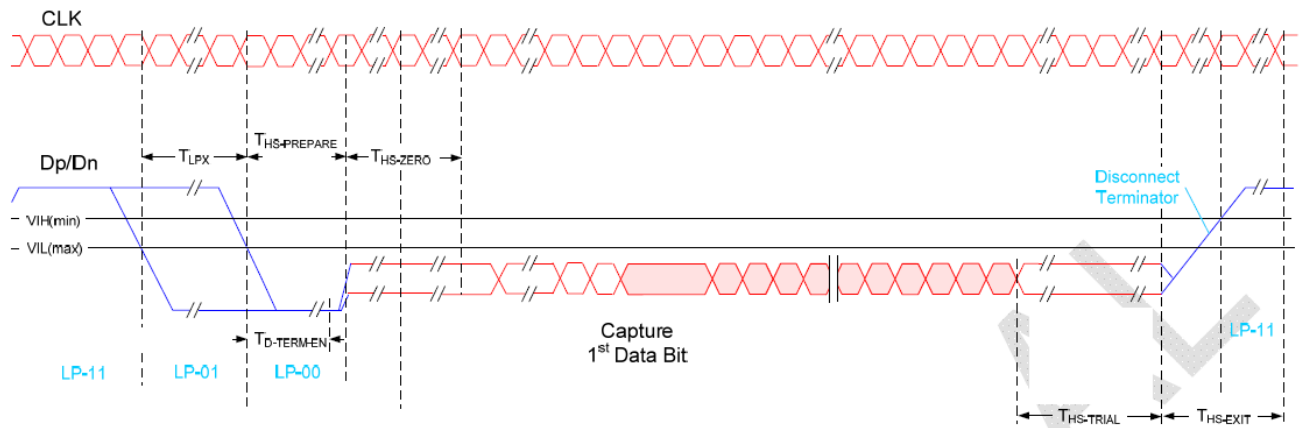


### 2) HS clock transmission



### 3) Turnaround Procedure

## 4) Timing Parameters

| Symbol | Description | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| TREOT | 30%-85% rise time and fall time | - | - | 35 | ns |
| TCLK-MISS | Timeout for receiver to detect absence of Clock transitions and disable the Clock Lane HS-RX. | - | - | 60 | ns |
| TCLK-POST*1 | Time that the transmitter continues to send HS clock after the last associated Data Lane has transitioned to LP Mode. Interval is defined as the period from the end of THS-TRAIL to the beginning of TCLK-TRAIL. | 60ns + 52*UI (For DCS) | - | - | ns |
| TCLK-PRE | Time that the HS clock shall be driven by the transmitter prior to any associated Data Lane beginning the transition from LP to HS mode. | 8 | - | - | ns |
| TCLK-SETTLE | Time interval during which the HS receiver shall ignore any Clock Lane HS transitions, starting from the beginning of TCLK-PRE. | 95 | - | 300 | ns |
| TCLK-TERM-EN | Time for the Clock Lane receiver to enable the HS line termination,starting from the time point when Dn crosses VIL,MAX. | Time for Dn to reach VTERM-EN | | 38 | ns |
| THS-SETTLE | Time interval during which the HS receiver shall ignore any Data Lane HS transitions, starting from | 85 ns + 6*UI | | 145 ns + 10*UI | ns |

| | | | | | |
|---|---|---|---|---|---|
| | the beginning of THSPREPARE. | | | | |
| TEOT | Time from start of THS-TRAIL or TCLK-TRAIL period to start of LP-11 state | - | - | 105ns+48*UI | ns |
| THS-EXIT(1) | time to drive LP-11 after HS burst | 100 | - | - | ns |
| THS-PREPARE | Time to drive LP-00 to prepare for HS transmission | 40ns + 4*UI | - | 85ns+6*UI | ns |
| THS-PREPARE + THS-ZERO | THS-PREPARE + Time to drive HS-0 before the Sync sequence | 145ns + 10*UI | - | - | ns |
| THS-SKIP | Time-out at RX to ignore transition period of EoT | 40 | - | 55ns+4*UI | ns |
| THS-TRAIL | Time to drive flipped differential state after last payload data bit of a HS transmission burst | 60 + 4*UI | - | - | ns |
| TLPX | Length of any Low-Power state period | 50 | - | - | ns |
| Ratio TLPX | Ratio of TLPX(MASTER)/TLPS(SLAVE) between Master and Slave side | 2/3 | - | 3/2 | ns |
| TTA-GET | Time to drive LP-00 by new TX | 5*TLPX | 5*TLPX | 5*TLPX | ns |
| TTA-GO | Time to drive LP-00 after Turnaround Request | 4*TLPX | 4*TLPX | 4*TLPX | ns |
| TTA-SURE | Time-out before new TX side starts driving | TLPX | - | 2*TLPX | ns |

## 8.2 Display RESET Timing Characteristics
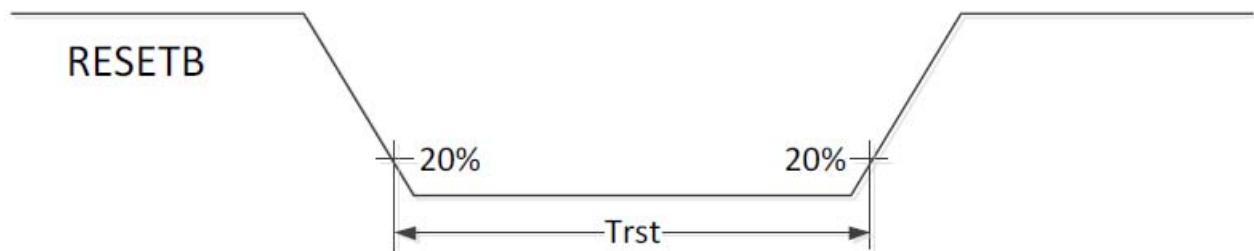
### 8.2.1 Reset input timing



**Figure: Reset timing**

### 8.2.2 Timing Parameters

When RESETB of the reset pin equals to Low, it will be in the condition of reset.

When it is in the condition of reset, it will make the device recover the initial set.

However, in order to avoid the reset noise cause reset, there is a mechanism to judge about whether the reset is needed or not.
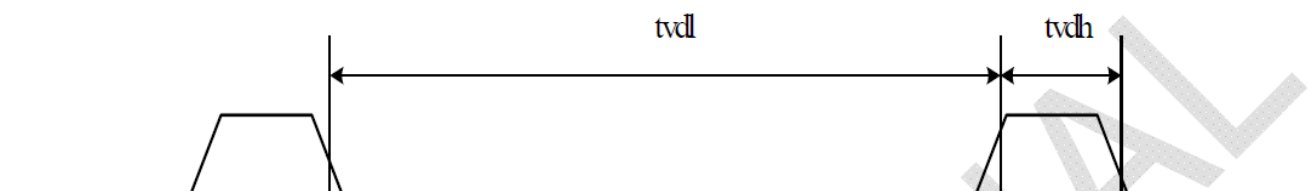
The closed interval of Low can be shown as the following.

**(Test condition: VDDIO=1.65V~3.6V, VSS=0V, TA=-20℃~+70℃)**

| Parameter | Symbol | Conditions | Spec | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Reset low pulse width | Trst | - | 20 | - | - | µs |

### 8.2.3 TE Timing Characteristics

Mode 1, the tearing effect output signal consist of V-sync information only:
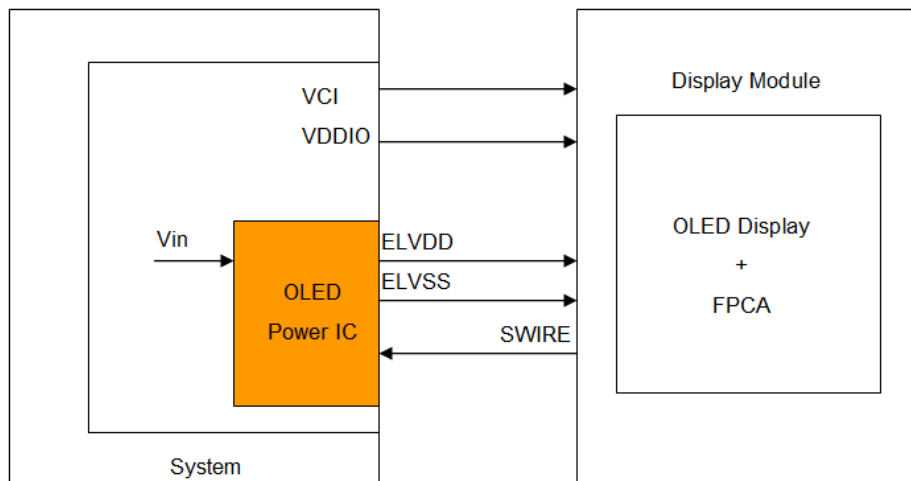


tvdh = The LCD display is not updated from the frame memory.
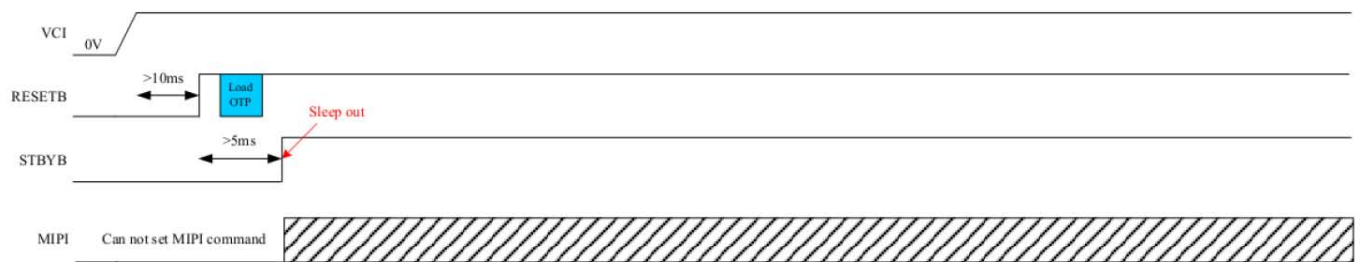tvdl = The LCD display is updated from the frame memory.
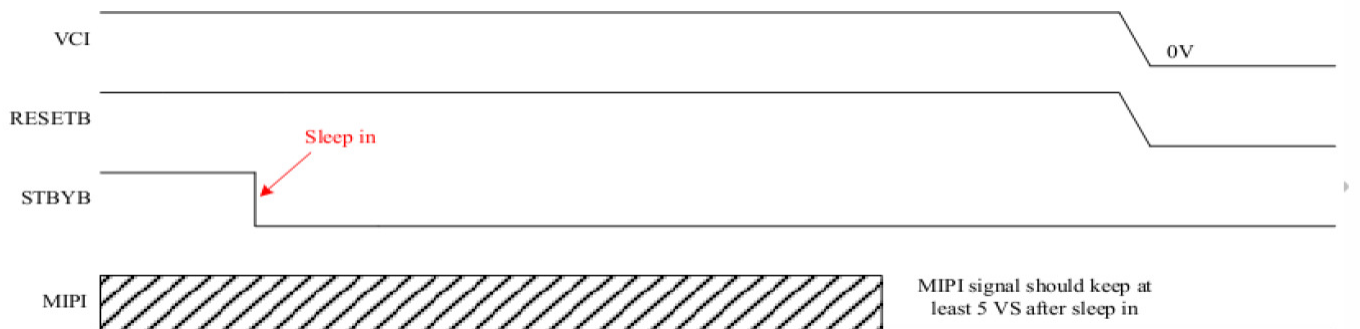
### 8.2.4 MIPI Initial CMD Flow
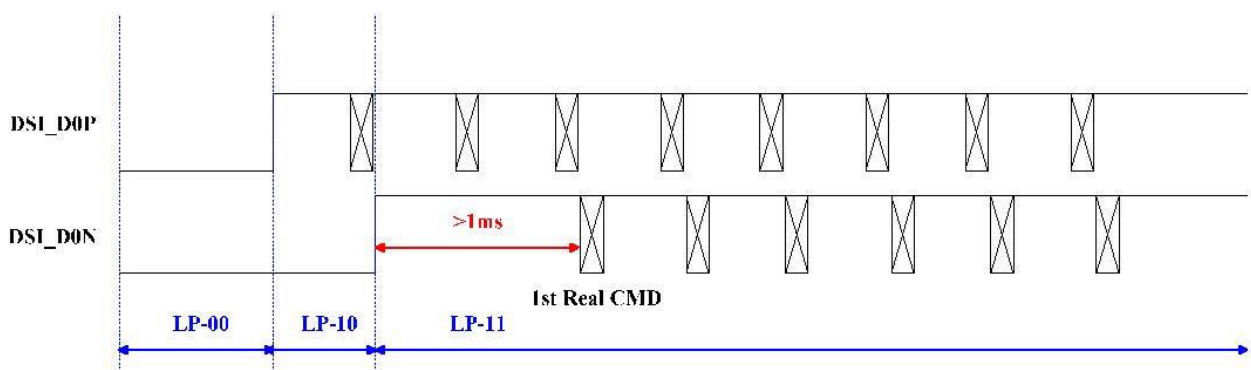
### 8.2.5 Operating Sequence
Power Structure



1）Display Power on/off Sequence
Power on sequence



Power off sequence

2）Display Initial Setting

| | | | | | Recommended Power on Initial Sequence | | | |
|---|---|---|---|---|---|---|---|---|
| Step | Instruction/Parameters | Delay time | R/W | MIPI Data Type | Address | | Data hex. | Description |
| | | | | | MIPI | Others | | |
| 1 | Turn on V_CI | | | | | | | VCI=2.8V |
| 2 | Turn on V_DDIO | | | | | | | VDDIO=1.8V |
| 3 | Delay | no limit | | | | | | |
| 4 | REST pin low | 20us | | | | | | |
| 5 | REST pin high | | | | | | | |
| 6 | Delay | 5 ms | | | | | | |
| 7 | | | W | 0x15 | FE | FE00 | 05 | |
| 8 | | | W | 0x15 | 05 | 0580 | 00 | |
| 9 | | | W | 0x15 | FE | FE00 | 07 | |
| 10 | | | W | 0x15 | 07 | 07A0 | 4F | |
| 11 | | | W | 0x15 | FE | FE00 | 0A | |
| 12 | | | W | 0x15 | 1C | 1CD0 | 1B | |
| 13 | | | W | 0x15 | FE | FE00 | 00 | |
| 14 | | | W | 0x15 | 35 | 3500 | 00 | |
| 15 | Sleep out | | W | 0x05 | 11 | 1100 | 00 | |
| 16 | Turn on peripheral packet | | | 0x32 | | | | Video Turn On |
| 17 | Delay | 300 ms | | | | | | |
| | Display on | | W | 0x05 | 29 | 2900 | 00 | |

| | | | | | Recommended Power off Mode Sequence | | | |
|---|---|---|---|---|---|---|---|---|
| Step | Instruction/Parameters | Delay time | R/W | MIPI Data Type | Address | | Data hex. | Description |
| | | | | | MIPI | Others | | |
| 1 | Display Off | | W | 0x05 | 28 | 2800 | 00 | |
| 2 | Sleep in | | W | 0x05 | 10 | 1000 | 00 | |
| 3 | delay | 120ms | | | | | | |
| 4 | Power off | | | | | | | |

## 8.2.6    Idle mode Flow

(1) Normal to Idle

| | | | | | Recommended Idle Initial Sequence | | | |
|---|---|---|---|---|---|---|---|---|
| Step | Instruction/Parameters | Delay time | R/W | MIPI Data Type | Address | | Data hex. | Description |
| | | | | | MIPI | Others | | |
| 1 | Enter Idle mode | | W | 0x05 | 39 | 3900 | 00 | Idle mode 15HZ |

(2) Idle to Normal

| | | | | | Recommended Power on Initial Sequence | | | |
|---|---|---|---|---|---|---|---|---|
| Step | Instruction/Parameters | Delay time | R/W | MIPI Data Type | Address | | Data hex. | Description |
| | | | | | MIPI | Others | | |
| 1 | Idle mode Off | | W | 0x05 | 38 | 3800 | 00 | Normal mode 60HZ |

Brightness Control

| | | | | Recommended Brightness Control | | | |
|---|---|---|---|---|---|---|---|
| Instruction/Parameters | Delay time | R/W | MIPI Data Type | Address | | Data hex. | Description |
| | | | | MIPI | Others | | |
| Brightness control | | W | 0x05 | 51 | 5100 | Value | Value form 0~255(FF) |

## 9. Optical Specification

| Item | | Symbol | Condition | Min | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| Contrast Ratio | | CR | θ=0° | 5000 | 10000 | - | | Note1 Note2 |
| View Angles | | Θ | -- | 160 | 170 | - | Degree | Note 4 |
| Optical Switching Time | | (Tr+Tf)/2 | 25℃ | - | 2 | 4 | ms | Note1 Note3 |
| Chromaticity | White | x | Brightness is on | 0.27 | 0.30 | 0.33 | | Note5, Note1 |
| | | y | | 0.28 | 0.31 | 0.34 | | |
| | Red | x | | - | 0.66 | - | | |
| | | y | | - | 0.34 | - | | |
| | Green | x | | - | 0.21 | - | | |
| | | y | | - | 0.74 | - | | |
| | Blue | x | | - | 0.13 | - | | |
| | | y | | - | 0.06 | - | | |
| Luminance | | L | | 250 | 300 | - | cd/m2 | Note1 Note6 |
| Brightness Uniformity | | | | 85 | - | - | % | Note7 |
| NTSC | | | | 85 | 100 | - | % | |
| Gamma | | | | 1.9 | 2.2 | 2.5 | | Note8 |
| Flicker | | | | - | -30 | - | db | Note9 |
| Crosstalk | | | | - | - | 110 | % | Note10 |

Note 1: Definition of optical measurement system.

Temperature = 25℃(±3℃)

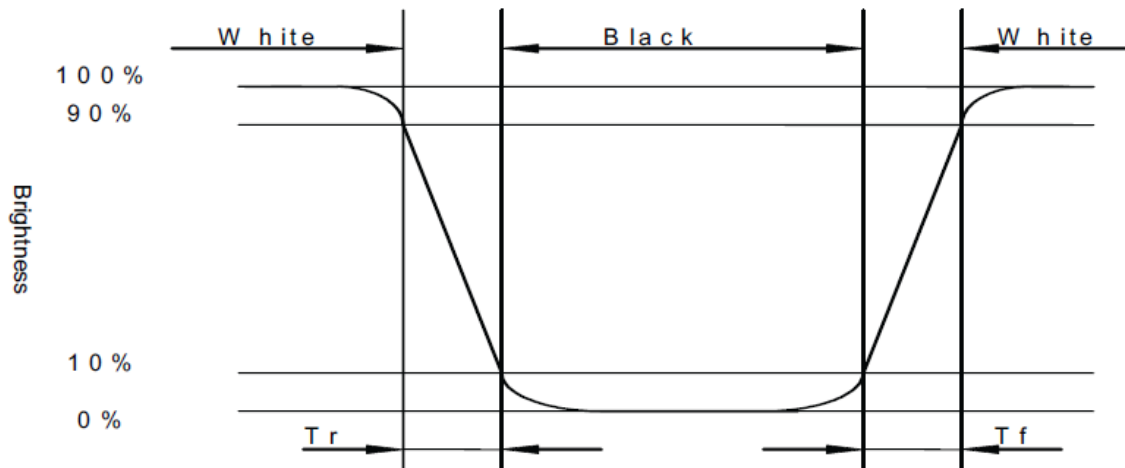LED back-light: ON, Environment brightness < 150 lx
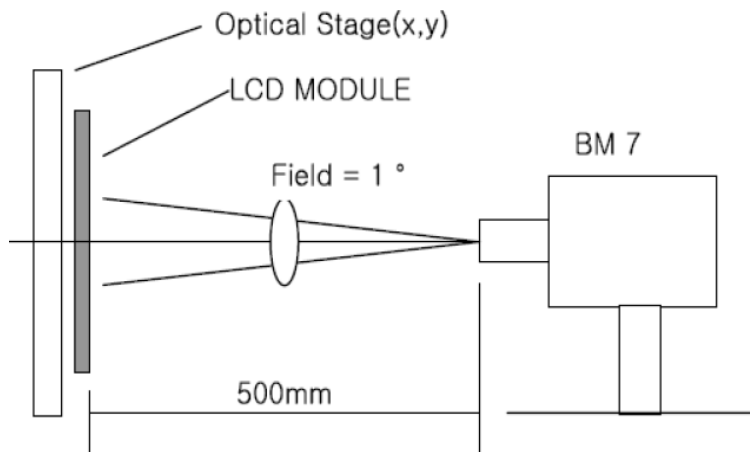
Note 2: Contrast ratio is defined as follow:

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$
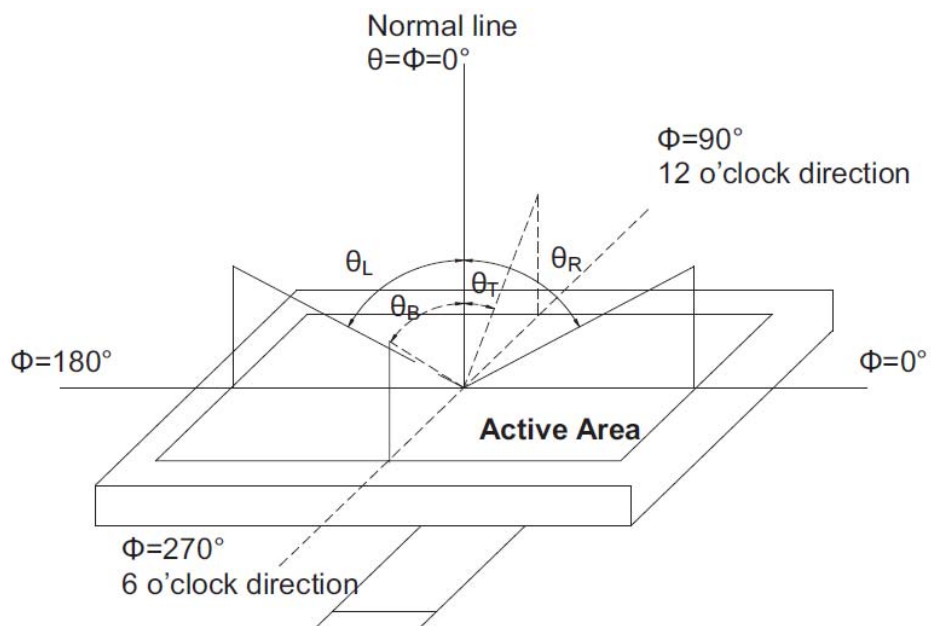
Note 3: Response time is defined as follow:

Response time is the time required for the display to transition from black to white (Rise Time, Tr) and from white to black(Decay Time, Tf).
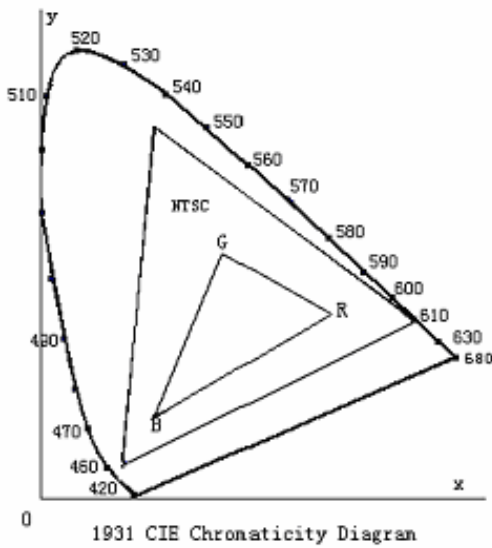


Note 4: Viewing angle range is defined as follow:

Viewing angle is measured at the center point of the LCD.

Note 5: Color chromaticity is defined as follow: (CIE1931)

Color coordinates measured at center point of LCD.



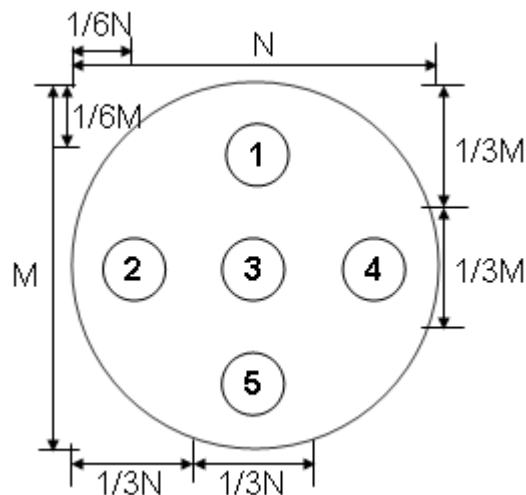1931 CIE Chromaticity Diagram

$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$

Note 6: Luminance is defined as follow:

Luminance is defined as the brightness of all pixels "White" at the center of display area on optimum contrast.

Note 7: Uniformity. Refer to figure as below



- Bp = Bp (Min.) / Bp (Max.)×100 (%)
- Bp (Max.) = Maximum brightness in 5 measured spots
- Bp (Min.) = Minimum brightness in 5 measured spots.

Note 8:

Gamma spec. is based on Gray level 255, 250, 244, 240, 232, 224, 206, 192, 160, 128, 95, 63, 47 & 31.

## Note 9: Flicker

The flicker level is defined using Fast Fourier Transformation (FTT) as follows:

$$Flic\ker = 20\log_{10}\left(2\frac{f_{FFTC}(n)}{f_{FFTC}(0)}\right) + FS(Hz) \quad \text{(dB)}$$

where

fFFTC(n) is the nth FFT coefficient, and fFFTC(0) is the 0th FFT coefficient which is DC component. FS(Hz) is the flicker sensitivity as a function of frequency.

The flicker level shall be measured with the test pattern in below.

The gray leves of test pattern is 128.
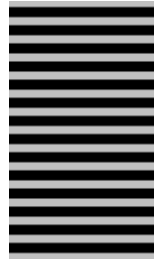


## Note 10: Cross-talk

• There should be no visible cross-talk in normal direction of the display when the two "Cross-talk Test Patterns " below are loaded.

• Measurement equipment: DMS-803 or similar equipments

• The point should be marked is, the background of Cross-talk Test Pattern-"gray " are defined as middle gray scale . For example, RGB 24bit "gray" defined as below:

| R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |

•Bpn = Bpn (gray) / Bpn (white)

Which n means the dot No. In the Cross-talk Test Pattern ;

Bpn (gray) means the brightness of the No.n spots in Cross-talk Test Pattern A and B;

Bpn (white) means the brightness of the No.n spots in Full white Test Pattern;

•Bp (Max.) = Maximum value in A1~A4 and B1~B4.

•Bp (Min.) = Minimum value in A1~A4 and pB1~B4.

•CT=Bp (Max.)/Bp(Min.).

•CT must be less than 1.10
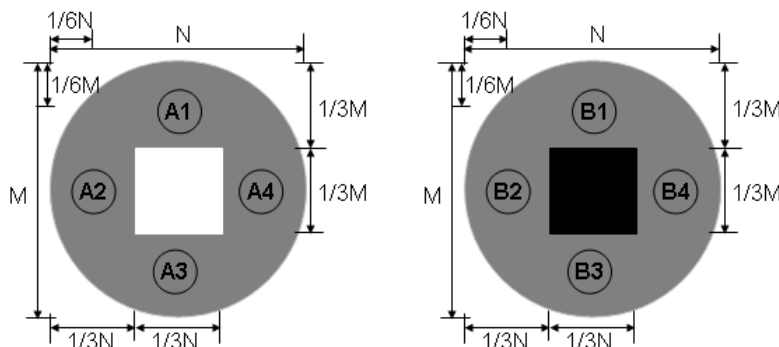
## 10. Environmental / Reliability Tests

| No | Test Item | Condition | Judgment criteria |
|---|---|---|---|
| 1 | High Temp Operation | Ts=+60℃, 120hrs | Per table in below |
| 2 | Low Temp Operation | Ta=-20℃, 120hrs | Per table in below |
| 3 | High Temp Storage | Ta=+70℃, 120hrs | Per table in below |
| 4 | Low Temp Storage | Ta=-30℃, 120hrs | Per table in below |
| 5 | High Temp & High Humidity Storage | Ta=+65℃, 90% RH 96 hours | Per table in below (polarizer discoloration is excluded) |
| 6 | Thermal Shock (Non-operation) | -20°C ~70°C，Dwell for 30 min. 100 cycles | Per table in below |
| 7 | ESD (Operation) | Air discharge model, ±8kV, 10 times | Per table in below |
| 8 | Vibration | Frequency : 5~50HZ, 0.5G  Scan rate : 1 oct/min Time : 2 hrs/axis Test axis : X, Y, Z | Per table in below |
| 9 | Package Drop Test | Height: 80cm Sequence : 1 angle,3 edges and 6 faces | Per table in below |

| INSPECTION | CRITERION(after test) |
|---|---|
| Appearance | No Crack on the FPC, on the OLED Panel |
| Alignment of OLED Panel | No Bubbles in the OLED Panel No other Defects of Alignment in Active area |
| Electrical current | Within device specifications Current consumption: within · 50% of initial value. |
| Function / Display | No Broken Circuit, No Short Circuit or No Black line No Other Defects of Display |

# 11. Precautions for Use of OLED Modules

## 11.1 Safety
The liquid crystal in the OLED is poisonous. Do not put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.

## 11.2 Handling
A. The OLED and touch panel is made of plate glass. Do not subject the panel to mechanical shock or to excessive force on its surface.

B. Do not handle the product by holding the flexible pattern portion in order to assure the reliability

C. Transparency is an important factor for the touch panel. Please wear clear finger sacks, gloves and mask to protect the touch panel from finger print or stain and also hold the portion outside the view area when handling the touch panel.

D. Provide a space so that the panel does not come into contact with other components.

E. To protect the product from external force, put a covering lens (acrylic board or similar board) and keep an appropriate gap between them.

F. Transparent electrodes may be disconnected if the panel is used under environmental conditions where dew condensation occurs.

G. Property of semiconductor devices may be affected when they are exposed to light, possibly resulting in IC malfunctions.

H. To prevent such IC malfunctions, your design and mounting layout shall be done in the way that the IC is not exposed to light in actual use.

## 11.3 Static Electricity
A. Ground soldering iron tips, tools and testers when they are in operation.

B. Ground your body when handling the products.

C. Power on the OLED module before applying the voltage to the input terminals.

D. Do not apply voltage which exceeds the absolute maximum rating.

E. Store the products in an anti-electrostatic bag or container.

## 11.4 Storage
A. Store the products in a dark place at $+25℃\pm10℃$ with low humidity (40% RH to 60% RH). Don't expose to sunlight or fluorescent light.

B. Storage in a clean environment, free from dust, active gas, and solvent.

## 11.5 Cleaning
A. Do not wipe the touch panel with dry cloth, as it may cause scratch.

B. Wipe off the stain on the product by using soft cloth moistened with ethanol. Do not allow ethanol to get in between the upper film and the bottom glass. It may cause peeling issue or defective operation. Do not use any organic solvent or detergent other than ethanol.

## 11.6 Cautions for installing and assembling
Bezel edge must be positioned in the area between the Active area and View area. The bezel may press the touch screen and cause activation if the edge touches the active area. A gap of approximately 0.5mm is needed between the bezel and the top electrode. It may cause unexpected activation if the gap is too narrow. There is a tolerance of 0.2 to 0.3mm for the outside dimensions of the touch panel and tail. A gap must be made to absorb the tolerance in the case and connector.