MODEL NO. : G1549HD122GF-001

ISSUED DATE: 2016-05-27

VERSION : A0

■Preliminary Specification

□Final Product Specification

Customer :_____

| Approved by | Notes |
|---|---|
| | |

GVO Confirmed :

| Prepared by | Checked by | Approved by |
|---|---|---|
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This technical specification is subjected to change without notice.

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# Record of Revision

| Rev | Issue Date | Description | Editor |
|---|---|---|---|
| A0 | 2016.05.19 | Draft | Huang Saibo |
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# 1 General Specifications

| Feature | | Spec | Remark |
|---|---|---|---|
| Display Spec | Screen Size (inch) | 5.49 | |
| | Display Mode | AMOLED | |
| | Resolution(dot) | 720 (W) x RGB x 1280(H) | |
| | Active Area(mm) | 68.40(W)×121.60 (H) | |
| | Pixel Pitch (um) | 95.00(W) x 95.00 (H) | |
| | Pixel Configuration | V-Style3 | |
| | Technology Type | LTPS | |
| | Color Depth | 16.7M | |
| | Interface | MIPI 4LANE | |
| | Surface Treatment | Hard Coating | |
| Mechanical Characteristics | With TP/Without TP | With TP(on Cell) | |
| | Module Outline Dimension(W x H x D) (mm) | 70.80(W)x128.47(H)x 0.77 (D) | Excluding Cover lens |
| | Weight (g) | TBD | |
| Electronic | Driver IC(Type) | RM67120 | |
| | Touch IC(Type) | GT1151 | |

Note 1: Requirements on Environmental Protection: RoHS.

# 2 Input/output Terminals

## 2.1 Main FPC Pin Assignment

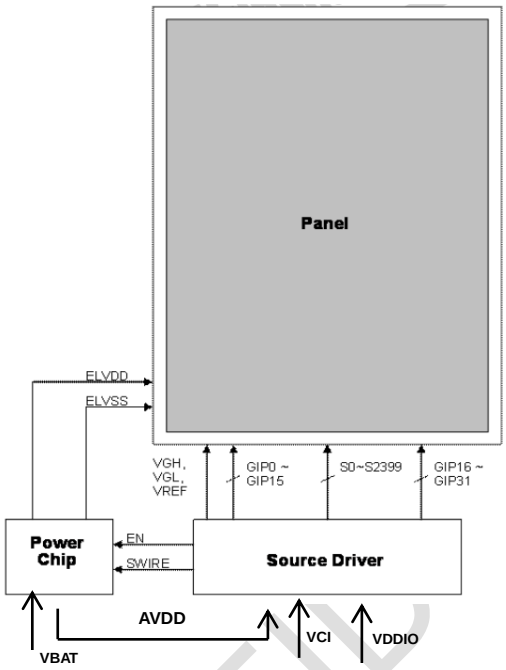
FPC connector: FP270H-039G1AM(JXT)/FP270H-039G10M(Shenzhen Pei Heng),ZIF Connector

| No | Symbol | I/O | Description |
|---|---|---|---|
| 1 | GND | GND | Ground |
| 2 | GND | GND | Ground |
| 3 | GND | GND | Ground |
| 4 | VBAT | POWER | Power Supply for Panel |
| 5 | VBAT | POWER | Power Supply for Panel |
| 6 | VBAT | POWER | Power Supply for Panel |
| 7 | VBAT | POWER | Power Supply for Panel |
| 8 | VBAT | POWER | Power Supply for Panel |
| 9 | GND | GND | Ground |
| 10 | OTPV | POWER | OTP function Pin. Must be left open if it is not used. |
| 11 | NC | NC | Not Connected |
| 12 | GND | GND | Ground |
| 13 | D3P | I | MIPI DSI data. |
| 14 | D3N | I | MIPI DSI data. |
| 15 | GND | GND | Ground |
| 16 | D0P | I/O | MIPI DSI data. |
| 17 | D0N | I/O | MIPI DSI data. |
| 18 | GND | GND | Ground |
| 19 | DKP | I | MIPI DSI data. |
| 20 | DKN | I | MIPI DSI data. |
| 21 | GND | GND | Ground |
| 22 | D1P | I | MIPI DSI data. |
| 23 | D1N | I | MIPI DSI data. |
| 24 | GND | GND | Ground |
| 25 | D2P | I | MIPI DSI data. |
| 26 | D2N | I | MIPI DSI data. |

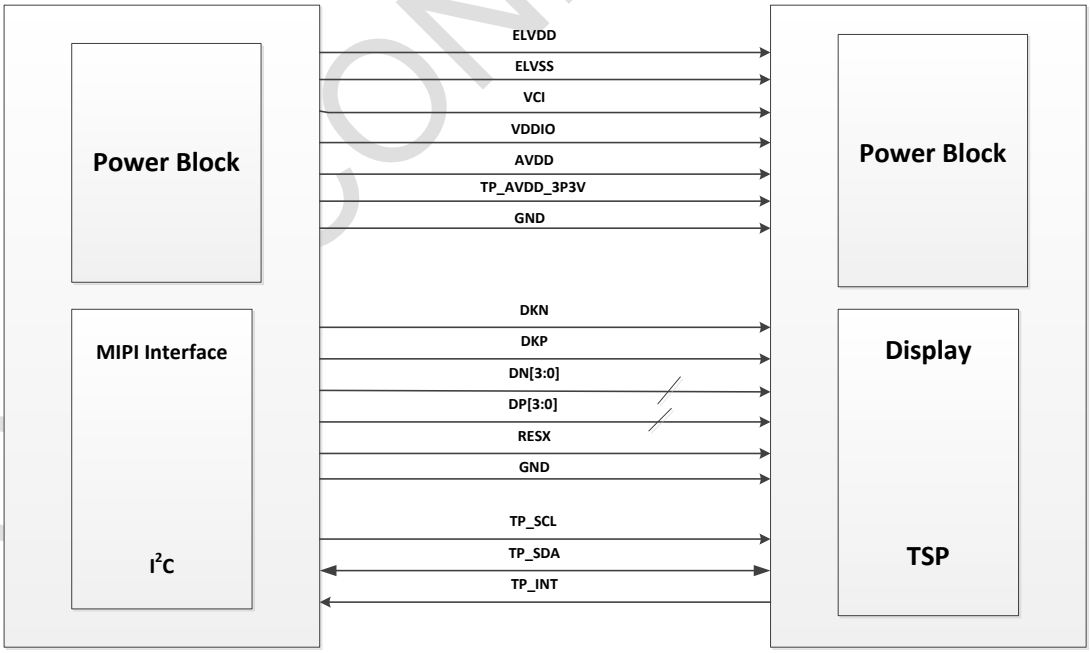
| | | | |
|---|---|---|---|
| 27 | GND | GND | Ground |
| 28 | RESX | I | This signal will reset the device and should be applied to properly initialize the chip. Signal is active low. |
| 29 | VDDIO | POWER | Power supply for driver IC logic circuit. |
| 30 | VCI | POWER | Power supply for driver IC analog circuit. |
| 31 | NC | NC | Not Connected |
| 32 | GND | GND | Ground |
| 33 | TP_AVDD_3P3V | POWER | TP power supply input. |
| 34 | TP_DVDD_1P8V | POWER | TP power supply for all GPIO pins.<br>Do not connect if it is not used. |
| 35 | TP_SDA | I/O | Touch panel I2C data. |
| 36 | TP_SCL | I/O | Touch panel I2C clock. |
| 37 | TP_RESET | I | Touch panel reset. |
| 38 | TP_INT | O | Touch panel interrupt output. |
| 39 | GND | GND | Ground |

Note: I=Input; O=Output; P=Power; I/O=Input / Output.

## 2.2 Circuit block diagram (Display)




## 2.3 MCU and Display Module Interface Conflagration



# 3 Absolute Maximum Ratings

## 3.1 Driving AMOLED Panel

Maximum Ratings (Voltage Referenced to VSS) Vss=0V, Ta=25℃

| Item | Symbol | MIN | MAX | Unit |
|---|---|---|---|---|
| Analog Power supply | VCI | -0.3 | +5.0 | V |
| Logic Power supply | VDDIO | -0.3 | +4.0 | V |
| Power IC Power Supply | VBAT | - | +4.5 | V |
| D0P, D0N<br>D1P, D1N<br>D2P, D2N<br>D3P, D3N<br>DKP,DKN | Differential Input | -0.3 | +2.5 | V |
| Touch analog power supply | TP_AVDD_3P3V | -0.3 | +4.0 | V |
| Touch IC input current at any pin | | — | ±100 | mA |

Note: Functional operation should satisfy the limits in the Electrical Characteristics tables or Pin Description section. If the module exceeds the absolute maximum ratings, permanent damage may occur. Besides, if the module is operated with the absolute maximum ratings for a long time, the reliability may also drop.

# 4 Electrical Characteristics

## 4.1 Driving AMOLED Panel

Ta=25℃

| Item | | Symbol | MIN | TYP | MAX | Unit |
|---|---|---|---|---|---|---|
| Logic Power supply | | VDDIO | 1.65 | 1.80 | 3.30 | V |
| Analog Power supply | | VCI | 2.65 | 2.80 | 3.60 | V |
| Power IC Power Supply | | VBAT | 2.90 | 3.70 | 4.50 | V |
| Touch analog power supply | | TP_AVDD_3P3V | 2.70 | 2.80 | 3.60 | V |
| Input Signal Voltage | High Level | VIH | 0.80*VDDIO | - | VDDIO | V |
| | Low Level | VIL | 0.00 | - | 0.20*VDDIO | V |
| Output Signal Voltage | High Level | VOH | 0.80*VDDIO | - | VDDIO | V |
| | Low Level | VOL | 0.00 | - | 0.20*VDDIO | V |

4.2 Current Consumption

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| Panel Power | | $P_{NL}$ | VCI=2.8V VDDIO=1.8V VBAT=3.7V | / | 1500 | / | mW | Note1 |
| IC | Normal | $I_{VCI}$ | | / | 54 | 56 | mA | Note2 |
| | | $I_{VDDIO}$ | | / | 0.02 | 0.04 | mA | |
| | Stand-by | $I_{VCI}$ | VCI=2.8V VDDIO=1.8V VBAT=3.7V | / | 20 | 70 | uA | |
| | | $I_{VDDIO}$ | | / | 5 | 10 | uA | |

Note1: Based on L255 (350) full white pattern.

$P_{NL}$= (ELVDD+|ELVSS|)*$I_{ELVDD}$+$P_{VCI}$+$P_{VDDIO}$

Note2: Video Mode 60Hz.

# 5 AC Characteristics

## 5.1 Input Timing

Table 5-1 Input Timing

| Resolution | | 720RGB X 1280 | | | Unit | Note |
|---|---|---|---|---|---|---|
| Input Timing | Symbol | Min. | Typ. | Max. | | |
| PCLK Frequency | - | 57.7 | 63.2 | 132.1 | MHz | - |
| Horizontal Active Area | THA | - | 720 | - | PCLK | - |
| Horizontal Back Porch | THB | 10 | 16 | 255 | PCLK | - |
| Horizontal Front Porch | THF | 10 | 16 | 255 | PCLK | - |
| Horizontal Total | THT | 740 | 784 | 1230 | PCLK | - |
| Vertical Active Area | TVA | - | 1280 | - | THT | - |
| Vertical Back Porch | TVB | 10 | 16 | 255 | THT | - |
| Vertical Front Porch | TVF | 10 | 16 | 255 | THT | - |
| Vertical Total | TVT | 1300 | 1344 | 1790 | THT | - |
| Vertical Frequency | - | - | 60 | - | Hz | - |

## 5.2 MIPI Interface Characteristics

### 5.2.1 General Description

The communication can be separated 2 different levels between the MCU and the display module:

- Interface Level: Low level communication
- Packet Level: High level communication

### 5.2.2 Interface Level Communication

The display module uses data and clock lane differential pairs for DSI. Both clock lane and data lane0 can be driven in Low Power (LP) or High Speed (HS) mode. Data lane1~3 can be driven in

High Speed mode only.

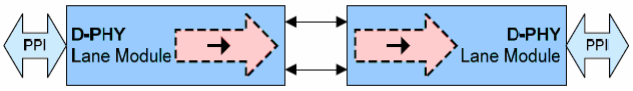
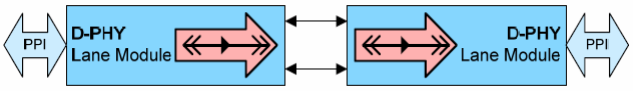
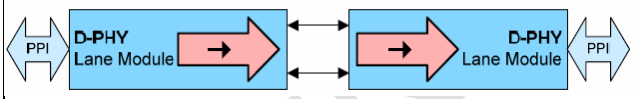
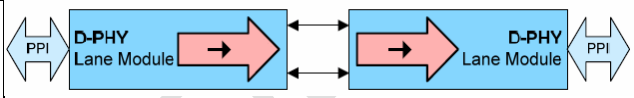
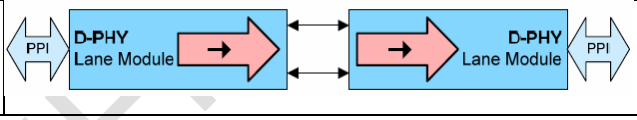
| | Lane support mode | MPU(Host) (Slave) |
|---|---|---|
| Clock Lane | Unidirectional lane<br>★High-Speed Clock only<br>★Simplified Escape Mode (ULPS Only) |  |
| Data lane0 | Bi-directional lane<br>★Forward high-speed only<br>★Bi-directional Escape Mode<br>★Bi-direction LPDT |  |
| Data lane1 | Unidirectional lane<br>★ Forward high-speed only<br>★Simplified Escape Mode (ULPS Only) |  |
| Data lane2 | Unidirectional lane<br>★Forward high-speed only |  |
| Data lane3 | Unidirectional lane<br>★Forward high-speed only |  |



Figure 5-1 Lane types and support mode

The State Codes of the High Speed (HS) and Low Power (LP) lane pair are defined below.

| Lane Pair State Code | Line DC Voltage Levels | | High Speed (HS) | Low-Power (LP) | |
|---|---|---|---|---|---|
| | Dn+ Line | Dn- Line | Burst Mode | Control Mode | Escape Mode |
| HS-0 | Low (HS) | High (HS) | Differential-0 | Note 1 | Note 1 |
| HS-1 | High (HS) | Low (HS) | Differential-1 | Note 1 | Note 1 |
| LP-00 | Low (LP) | Low (LP) | Not Defined | Bridge | Space |
| LP-01 | Low (LP) | High (LP) | Not Defined | HS-Request | Mark-0 |
| LP-10 | High (LP) | Low (LP) | Not Defined | LP-Request | Mark-1 |
| LP-11 | High (LP) | High (LP) | Not Defined | Stop | Note 2 |

Figure 5-2 High Speed and Low-Power Lane Pair State Descriptions

### 5.2.3 DSI-CLK Lanes

DSI-CLK+/- lanes can be driven into three different power modes: Low Power Mode (LPM LP-11), Ultra Low Power Mode (ULPM) or High Speed Clock Mode (HSCM).

Clock lanes are in a single end mode (LP=Low Power) when there is entering or leaving Low Power Mode (LPM) or Ultra Low Power Mode (ULPM).

Clock lanes are in the single end mode (LP=Low Power) when there is entering in or leaving out High Speed Clock Mode (HSCM). These entering and leaving protocols are using clock lanes in the single end mode to generate an entering or leaving sequences. The principal flow chart of the different clock lanes power modes is illustrated below.

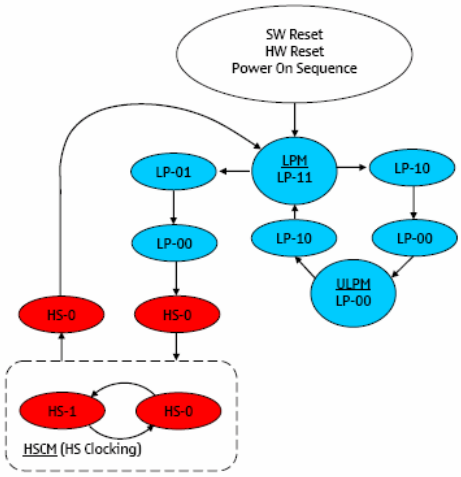



Figure 5-3 Clock Lanes Power Modes

Notes:

1. Low-Power Receivers (LP-Rx) of the lane pair are checking the LP-00 state code, when the Lane Pair is in the High Speed (HS) mode.
2. If Low-Power Receivers (LP-Rx) of the lane pair recognizes LP-11 state code, the lane pair returns to LP-11 of the Control Mode.

### 5.2.4 DSI Data Lanes

DSI-Dn+/- Data Lanes can be driven in different modes which are:

- Escape Mode (only support DSI_D0 data lane pair)
- High-Speed Data Transmission (support all data lane pairs)
- Bus Turnaround Request (only support DSI_D0 data lane pair)

These modes and their entering codes are defined on the following table.

Table 5-2 Entering and leaving sequences

| | Entering Mode Sequence | Leaving Mode Sequence |
|---|---|---|
| Escape Mode | LP-11 =>LP-10 =>LP-00 =>LP-01 =>LP-00 | LP-00 =>LP-10 =>LP-11 (Mark-1) |
| High-Speed Data Transmission | LP-11 =>LP-01 =>LP-00 =>HS-0 | (HS-0 or HS-1) =>LP-11 |
| Bus Turnaround Request | LP-11 =>LP-10 =>LP-00 =>LP-10 =>LP-00 | High-Z, Note |

### 5.2.5 Packet Level Communication

#### 5.2.5.1 Short Packet (SPa) and Long Packet (LPa) Structures

Short Packet (SPa) and Long Packet (LPa) are always used when data transmission is done in Low Power Data Transmission (LPDT) or High-Speed Data Transmission (HSDT) modes.

The type (SPa or LPa) of the packet can be recognized from their package headers (PH).

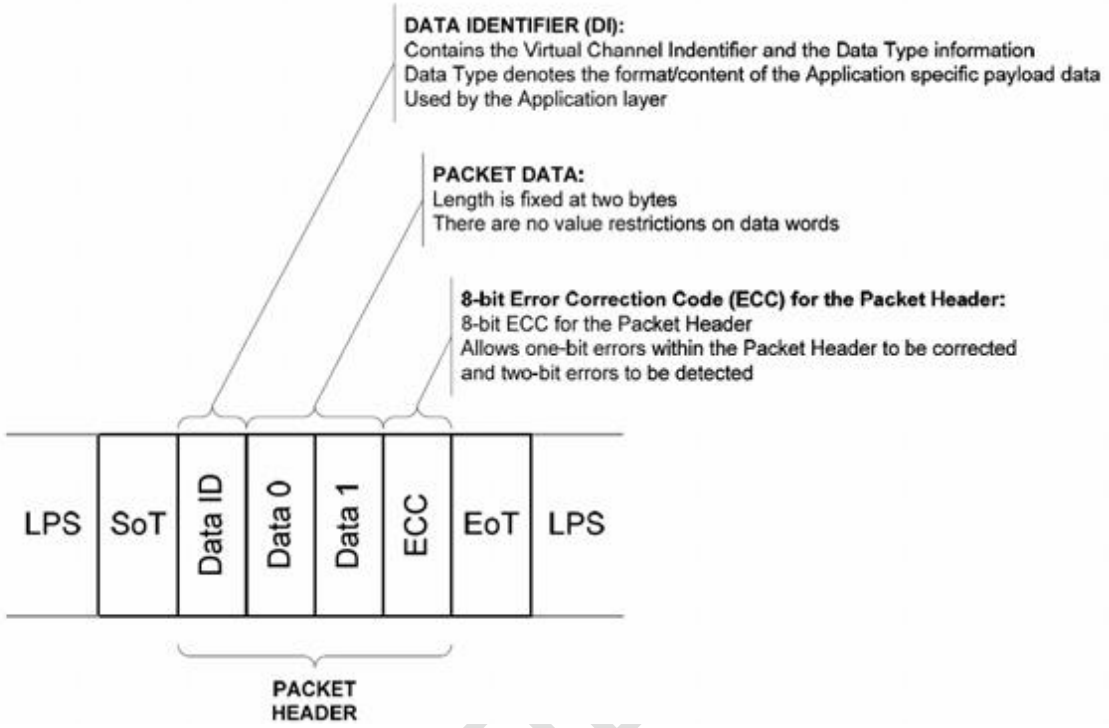



Figure 5-4 Short packet structure

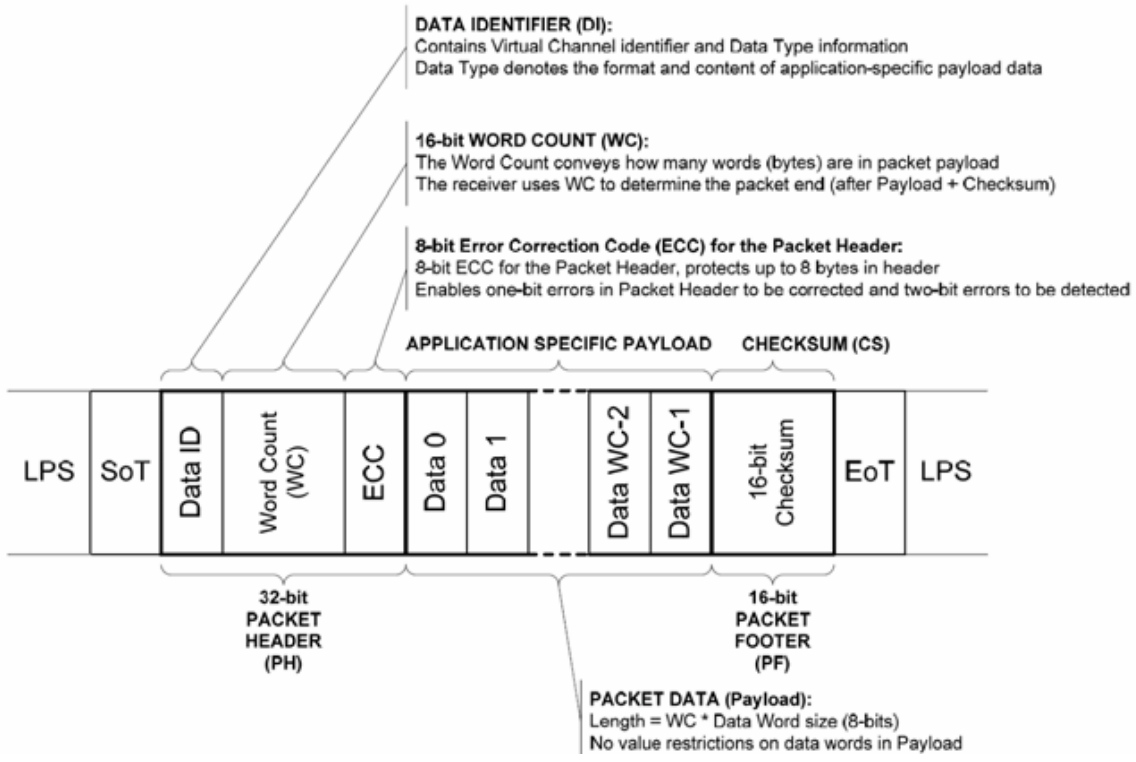



Figure 5-5 Long packet structure

5.2.5.2 Packet Transmissions

**Packet from the MCU to the display module**

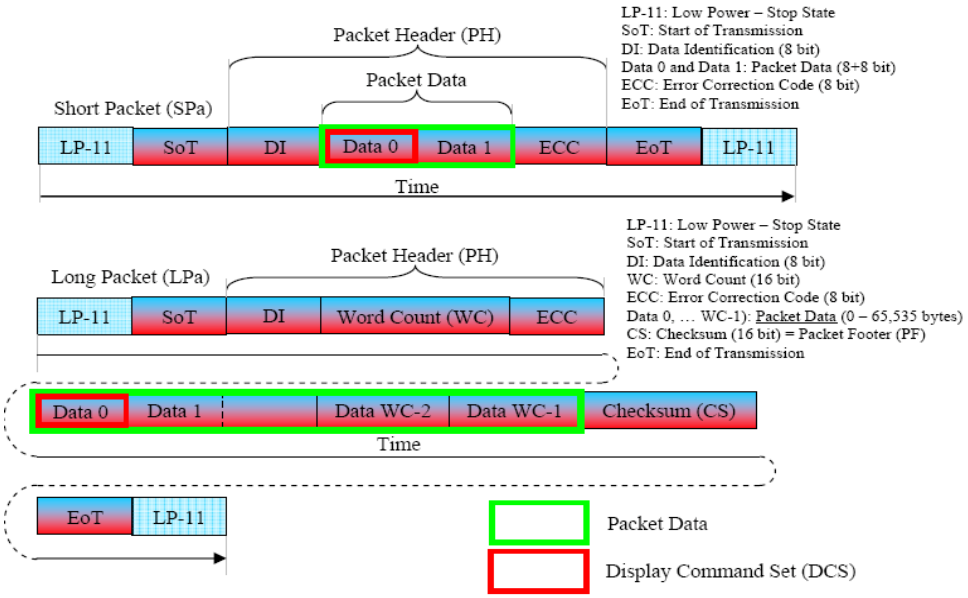



Figure 5-6 DCS on the short packet and long packet

**Packet from the display module to the MCU**

**Used packet types**

The display module is always using Short Packet (SPa) or Long Packet (LPa), when it is returning information to the MCU after the MCU has requested information from the Display Module. This information can be a response of the Display Command Set (DCS).

The used packet type is defined on Data Type (DT).

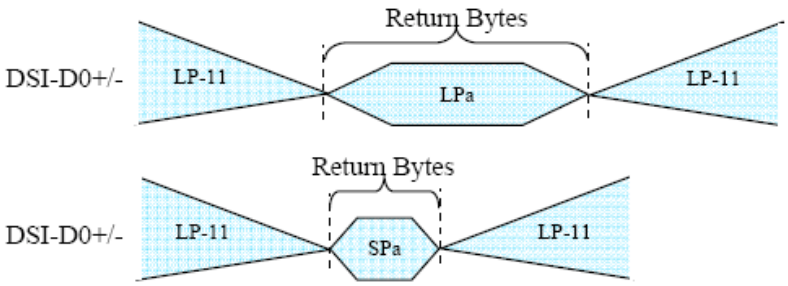



Figure 5-7 Return bytes on single packet

5.2.6 Customer-defined Generic Read Data Type Format

The short packet of Data Type 24h (Generic READ, 2 parameters) specifies the register content for read and the nth parameter that will begin reading. After Data Type 24h is received, BTA

is executed. Then, the Nth parameter becomes the first data, and the number of data of WC (word count) value is output.

Packet Structure (processor → peripheral)

| | | P0 | P1 | | |
|---|---|---|---|---|---|
| | Data Type 24h | Manufacturer Command | Start Parameter N | ECC | |

Low Power Data Transfer (peripheral → processor)

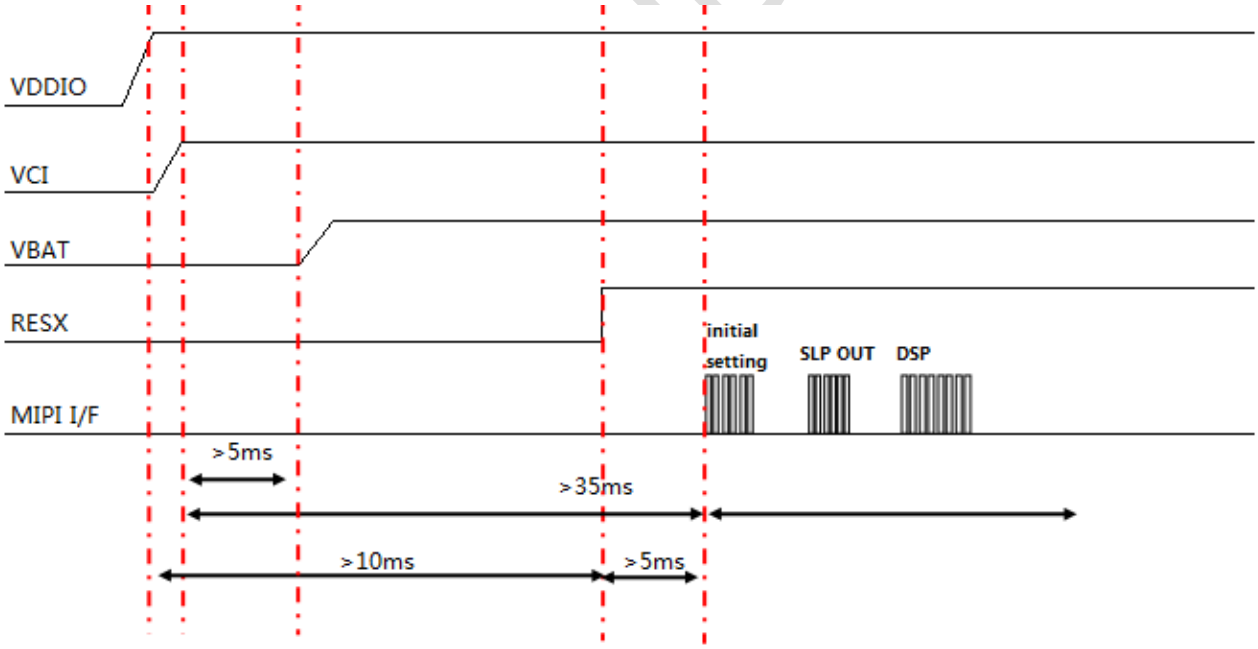
| | | | | | Data 0 | Data 1 | | Data 6 (WC-1) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Data Type 1Ah | 00h (WC0) | 06h (WC1) | ECC | Nth Parameter | (N+1)th Parameter | ..... | (N+6-1)th Parameter | CRC0 | CRC1 | |

Figure 5-8 Generic read data type format

# 6 Recommended Operating Sequence

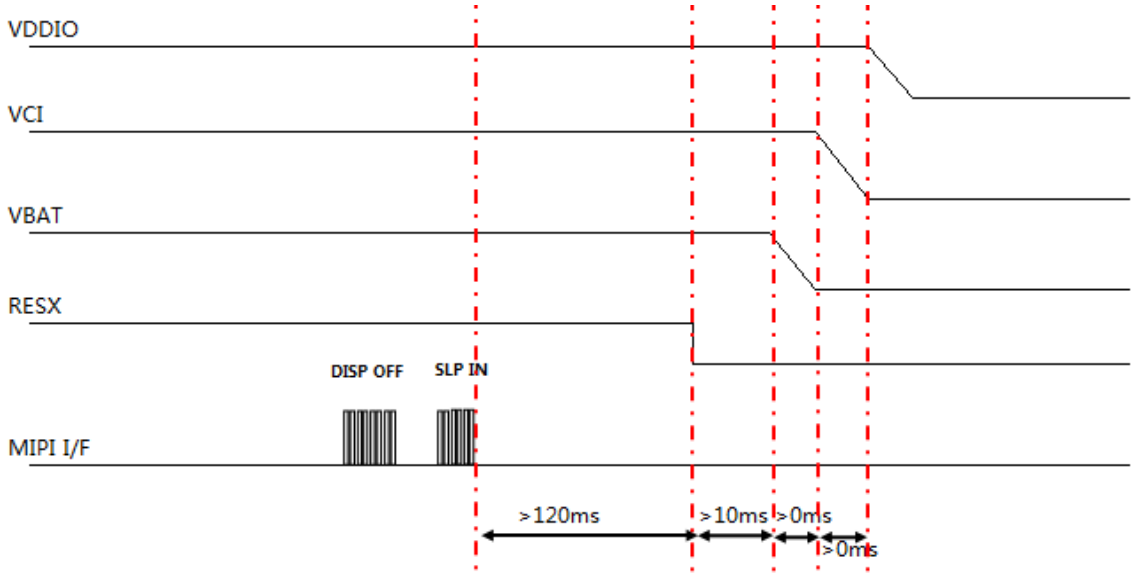
## 6.1 Display Power on / off Sequence

### 6.1.1 Power On Sequence




Note : VBAT is the power of power IC(for ELVDD & ELVSS & AVDD).

### 6.1.2 Power Off Sequence




## 6.2 Display Initial code

| step | Instruction/ Parameter | Delay times | R/W | mipi data type | address | | data |
|---|---|---|---|---|---|---|---|
| | | | | | mipi | others | |
| 1 | code1 | | w | 0x39 | F0 | F000 | 55 |
| | | | | | | F001 | AA |
| | | | | | | F002 | 52 |
| | | | | | | F003 | 08 |
| | | | | | | F004 | 00 |
| 2 | code2 | | w | 0x39 | C0 | C000 | C7 |
| | | | | | | C001 | 00 |
| | | | | | | C002 | 0 |
| | | | | | | C003 | 0 |
| | | | | | | C004 | 1E |
| | | | | | | C005 | 10 |
| | | | | | | C006 | 60 |
| | | | | | | C007 | E5 |
| 3 | code3 | | w | 0x39 | C1 | C100 | C0 |
| | | | | | | C101 | 1 |
| | | | | | | C102 | 0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | C103 | 0 |
| | | | | | | C104 | 1D |
| | | | | | | C105 | 0 |
| | | | | | | C106 | F0 |
| | | | | | | C107 | C8 |
| 3 | code4 | | w | 0x39 | C2 | C200 | C0 |
| | | | | | | C201 | 2 |
| | | | | | | C202 | 0 |
| | | | | | | C203 | 0 |
| | | | | | | C204 | 1D |
| | | | | | | C205 | 2A |
| | | | | | | C206 | A0 |
| | | | | | | C207 | 9F |
| 3 | code5 | | w | 0x39 | C3 | C300 | C0 |
| | | | | | | C301 | 2 |
| | | | | | | C302 | 0 |
| | | | | | | C303 | 0 |
| | | | | | | C304 | 1E |
| | | | | | | C305 | 2A |
| | | | | | | C306 | A0 |
| | | | | | | C307 | 9F |
| 3 | code6 | | w | 0x39 | C4 | C400 | C0 |
| | | | | | | C401 | 2 |
| | | | | | | C402 | 0 |
| | | | | | | C403 | 0 |
| | | | | | | C404 | 1D |
| | | | | | | C405 | 10 |
| | | | | | | C406 | 80 |
| | | | | | | C407 | B8 |
| 3 | code7 | | w | 0x39 | C5 | C500 | C0 |
| | | | | | | C501 | 2 |
| | | | | | | C502 | 0 |
| | | | | | | C503 | 0 |
| | | | | | | C504 | 1E |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | C505 | 10 |
| | | | | | | C506 | A0 |
| | | | | | | C507 | B8 |
| 3 | code8 | | w | 0x39 | C6 | C600 | C7 |
| | | | | | | C601 | 0 |
| | | | | | | C602 | 2 |
| | | | | | | C603 | 0 |
| | | | | | | C604 | 1E |
| | | | | | | C605 | 10 |
| | | | | | | C606 | A0 |
| | | | | | | C607 | EC |
| 3 | code9 | | w | 0x39 | C7 | C700 | C7 |
| | | | | | | C701 | 0 |
| | | | | | | C702 | 0 |
| | | | | | | C703 | 0 |
| | | | | | | C704 | 1F |
| | | | | | | C705 | 10 |
| | | | | | | C706 | 60 |
| | | | | | | C707 | E5 |
| 4 | code10 | | w | 0x39 | C8 | C800 | FF |
| 5 | code11 | | w | 0x39 | B0 | B000 | 00 |
| | | | | | | B001 | 08 |
| | | | | | | B002 | 0C |
| | | | | | | B003 | 14 |
| | | | | | | B004 | 14 |
| | code12 | | W | 0x39 | BA | BA00 | 20 |
| 6 | code13 | | w | 0x39 | BB | BB00 | 55 |
| | | | | | | BB01 | 55 |
| | | | | | | BB02 | 55 |
| | | | | | | BB03 | 55 |
| | | | | | | BB04 | 55 |
| | | | | | | BB05 | 55 |
| | | | | | | BB06 | 55 |
| 1 | code14 | | w | 0x39 | F0 | F000 | 55 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | F001 | AA |
| | | | | | | F002 | 52 |
| | | | | | | F003 | 08 |
| | | | | | | F004 | 02 |
| | code14a | | w | 0x39 | E1 | E100 | 00 |
| | code15 | | w | 0x39 | CA | CA00 | 04 |
| | code16 | | w | 0x39 | E2 | E200 | 0A |
| | code17 | | w | 0x39 | E3 | E300 | 00 |
| | code18 | | w | 0x39 | E7 | E700 | 00 |
| 7 | code19 | | w | 0x39 | ED | ED00 | 48 |
| | | | | | | ED01 | 0 |
| | | | | | | ED02 | E0 |
| | | | | | | ED03 | 13 |
| | | | | | | ED04 | 8 |
| | | | | | | ED05 | 0 |
| | | | | | | ED06 | 92 |
| | | | | | | ED07 | 8 |
| | code20 | | W | 0x39 | FD | FD00 | 0 |
| | | | | | | FD01 | 8 |
| | | | | | | FD02 | 1C |
| | | | | | | FD03 | 0 |
| | | | | | | FD04 | 0 |
| | | | | | | FD05 | 1 |
| 8 | code21 | | w | 0x39 | C3 | C300 | 11 |
| | | | | | | C301 | 24 |
| | | | | | | C302 | 4 |
| | | | | | | C303 | 0A |
| | | | | | | C304 | 1 |
| | | | | | | C305 | 4 |
| | | | | | | C306 | 0 |
| | | | | | | C307 | 1C |
| | | | | | | C308 | 10 |
| | | | | | | C309 | F0 |
| | | | | | | C30A | 0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | code22 | | w | 0x39 | EA | EA00 | 7F |
| | | | | | | EA01 | 20 |
| | | | | | | EA02 | 0 |
| | | | | | | EA03 | 0 |
| | | | | | | EA04 | 0 |
| 1 | code23 | | w | 0x39 | F0 | F000 | 55 |
| | | | | | | F001 | AA |
| | | | | | | F002 | 52 |
| | | | | | | F003 | 08 |
| | | | | | | F004 | 01 |
| | code24 | | w | 0x39 | B0 | B000 | 1 |
| | | | | | | B001 | 1 |
| | | | | | | B002 | 1 |
| | code25 | | w | 0x39 | B1 | B100 | 5 |
| | | | | | | B101 | 5 |
| | | | | | | B102 | 5 |
| | code26 | | w | 0x39 | B2 | B200 | D0 |
| | | | | | | B201 | D0 |
| | | | | | | B202 | D0 |
| | code27 | | w | 0x39 | B4 | B400 | 37 |
| | | | | | | B401 | 37 |
| | | | | | | B402 | 37 |
| | code28 | | w | 0x39 | B5 | B500 | 5 |
| | | | | | | B501 | 5 |
| | | | | | | B502 | 5 |
| | code29 | | w | 0x39 | B6 | B600 | 54 |
| | | | | | | B601 | 54 |
| | | | | | | B602 | 54 |
| | code30 | | w | 0x39 | B7 | B700 | 24 |
| | | | | | | B701 | 24 |
| | | | | | | B702 | 24 |
| | code31 | | w | 0x39 | B8 | B800 | 24 |
| | | | | | | B801 | 24 |
| | | | | | | B802 | 24 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | code32 | | w | 0x39 | B9 | B900 | 14 |
| | | | | | | B901 | 14 |
| | | | | | | B902 | 14 |
| | code33 | | w | 0x39 | BA | BA00 | 14 |
| | | | | | | BA01 | 14 |
| | | | | | | BA02 | 14 |
| | code34 | | w | 0x39 | BC | BC00 | 0 |
| | | | | | | BC01 | F8 |
| | | | | | | BC02 | B2 |
| | code35 | | w | 0x39 | BE | BE00 | 23 |
| | | | | | | BE01 | 0 |
| | | | | | | BE02 | 90 |
| | code36 | | w | 0x39 | CA | CA00 | 80 |
| 8 | code37 | | w | 0x39 | CB | CB00 | 0 |
| | | | | | | CB01 | 0 |
| | | | | | | CB02 | 0 |
| | | | | | | CB03 | 0 |
| | | | | | | CB04 | 0 |
| | | | | | | CB05 | 0 |
| | | | | | | CB06 | 0 |
| | | | | | | CB07 | 0 |
| | | | | | | CB08 | 0 |
| | | | | | | CB09 | 0 |
| | | | | | | CB0A | 0 |
| | | | | | | CB0B | 0 |
| 9 | code38 | | w | 0x39 | CC | CC00 | 19 |
| | | | | | | CC01 | 19 |
| | | | | | | CC02 | 19 |
| | | | | | | CC03 | 19 |
| | | | | | | CC04 | 19 |
| | | | | | | CC05 | 19 |
| | | | | | | CC06 | 19 |
| | | | | | | CC07 | 19 |
| | | | | | | CC08 | 19 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | CC09 | 19 |
| | | | | | | CC0A | 19 |
| | | | | | | CC0B | 19 |
| 1 | code39 | | w | 0x39 | F0 | F000 | 55 |
| | | | | | | F001 | AA |
| | | | | | | F002 | 52 |
| | | | | | | F003 | 08 |
| | | | | | | F004 | 03 |
| 1 | code40 | | w | 0x39 | F1 | F100 | 10 |
| | | | | | | F101 | 0 |
| | | | | | | F102 | 0 |
| | | | | | | F103 | 00 |
| | | | | | | F104 | 01 |
| | | | | | | F105 | 30 |
| | code41 | | W | 0x39 | F6 | F600 | 0A |
| 1 | code42 | | w | 0x39 | F0 | F000 | 55 |
| | | | | | | F001 | AA |
| | | | | | | F002 | 52 |
| | | | | | | F003 | 08 |
| | | | | | | F004 | 05 |
| 1 | code43 | | w | 0x39 | C0 | C000 | 6 |
| | | | | | | C001 | 2 |
| | | | | | | C002 | 2 |
| | | | | | | C003 | 22 |
| | | | | | | C004 | 00 |
| | | | | | | C005 | 00 |
| | | | | | | C006 | 01 |
| 13 | code44 | | w | 0x39 | 35 | 3500 | 0 |
| 14 | | | w | 0x39 | 11 | | |
| 15 | delay(ms) | 100 | | | | | |
| 16 | display on | | w | 0x39 | 29 | | |

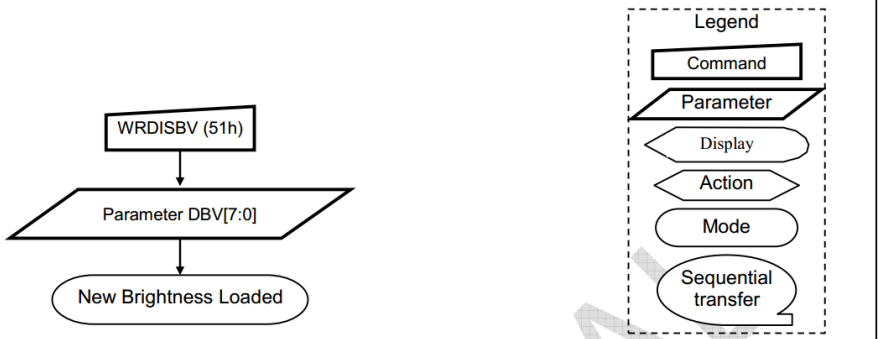
### 6.3 Brightness control

**Use “command 5100h, data xxh” to adjust the Manual Brightness value of the display:**

In principle relationship is that 00h value means the lowest brightness and FFh value means the highest brightness.

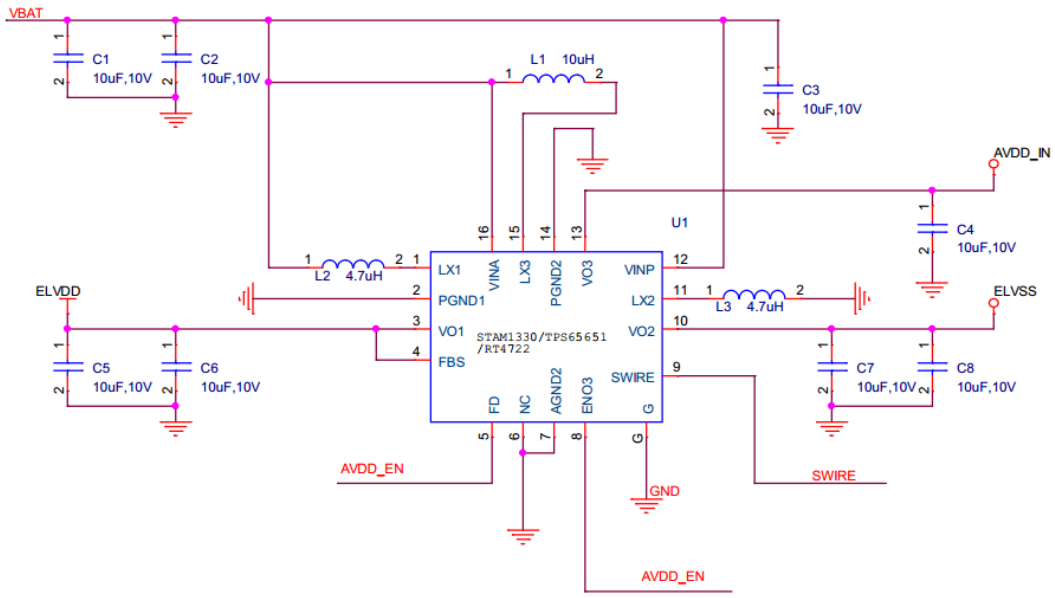
| | WRDISBV | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | Address | | D15-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |
| | | MIPI | Other | | | | | | | | | | |
| WRDISBV | W | 51h | 5100h | x | DBV7 | DBV6 | DBV5 | DBV4 | DBV3 | DBV2 | DBV1 | DBV0 | FF |

Flow chart




## 7 Application Circuit

Concerning ELVDD&ELVSS & AVDD power supply schematic, the Triple DC/DC converter STAM1330/TPS65651/RT4722 is recommended. The application schematics and external components are as below.



| Description | Part Reference | Manufacturer | Manufacturer PN |
|---|---|---|---|
| 10uF, 10V, ±20%, X5R, 0402 | C1 C2 C3 C4 C5 C6 C7 C8 | Murata | GRM155R61A106ME44D |
| | | Samsung | CL05A106MP5NUNC |
| Power Inductor, 10uH, 20%, LS2520 | L1 | 成育科技 | ACDNR252010UP-100MT |
| | | 科明电子 | KMPHS252010-100M |
| Power Inductor, 4.7uH, 20%, LS2520 | L2 L3 | 成育科技 | ACDMR252010T-4R7MT |
| | | 科明电子 | KMPHS252010-4R7M |
| QFN16 ( 3.0x3.0 ) | U1 | TI | TPS65651 |
| | | ST | STAM1330 |
| | | RICHTEK | RT4722 |

# 8 Optical Characteristics Optical Specification

| Item | | Symbol | Condition | Min | Typ | Max | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| View Angle | | θT | CR≥10 | 80 | 88 | | Degree | Note 2<br>Test Equipment：CS2000A |
| | | θB | | 80 | 88 | | | |
| | | θL | | 80 | 88 | | | |
| | | θR | | 80 | 88 | | | |
| Contrast Ratio | | CR | θ=0° | 10000 | | | | Note1<br>Note3<br>Test Equipment：CS2000A |
| Response Time | | $T_{ON}$ | 25℃ | | | 1 | ms | Note1<br>Note4<br>Test Equipment：Admesy MSE |
| | | $T_{OFF}$ | | | | | | |
| Chromaticity | White | x | | (0.270) | (0.300) | (0.330) | | Test Equipment：CS2000A<br>Note: Chromaticity can be modified according to customer demand |
| | | y | | (0.285) | (0.315) | (0.345) | | |
| | Red | x | | (0.630) | (0.670) | (0.710) | | |
| | | y | | (0.290) | (0.330) | (0.370) | | |
| | Green | x | | (0.200) | (0.250) | (0.300) | | |
| | | y | | (0.660) | (0.710) | (0.760) | | |
| | Blue | x | | (0.110) | (0.140) | (0.170) | | |
| | | y | | (0.030) | (0.060) | (0.090) | | |
| Uniformity | | U | | 75 | 80 | | % | Note1<br>Note6<br>luminance of center point is 350±50nits<br>Test Equipment：CS2000A |
| NTSC | | | | 85 | 100 | | % | Note5 |
| Luminance | | L | | 300 | 350 | 400 | $Cd/m^2$ | Note1<br>Note7<br>Test Equipment：CS2000A |
| Cross-talk | | | | | | 3 | % | Note8<br>L≤350nits<br>Test Equipment： |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | CS2000A |
| Gamma | | | 1.9 | 2.2 | 2.5 | | Gamma=2.2±0.3（L≤350nits）；<br>Gamma Self-adjustment (L＞350nits)<br>Test Equipment：CS2000A |

Test Conditions:

1. the ambient temperature is 25℃.
2. The test systems refer to Note1 and Note2.

Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. The optical properties are measured at the center point of the AMOLED screen. All input terminals AMOLED panel must be ground when measuring the center area of the panel.

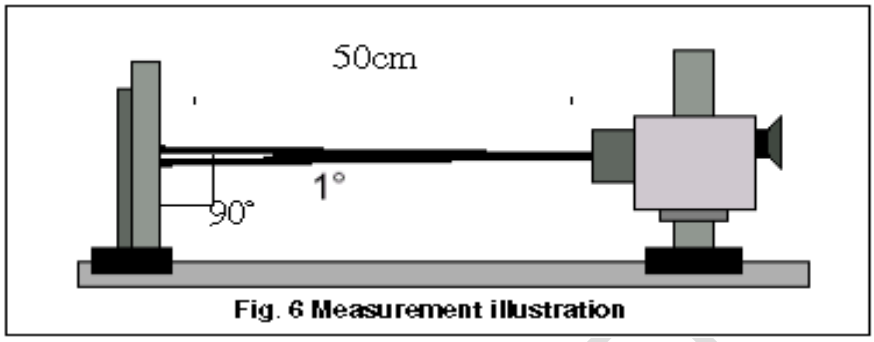



Fig. 6 Measurement illustration

Note 2: Definition of viewing angle range and measurement system.

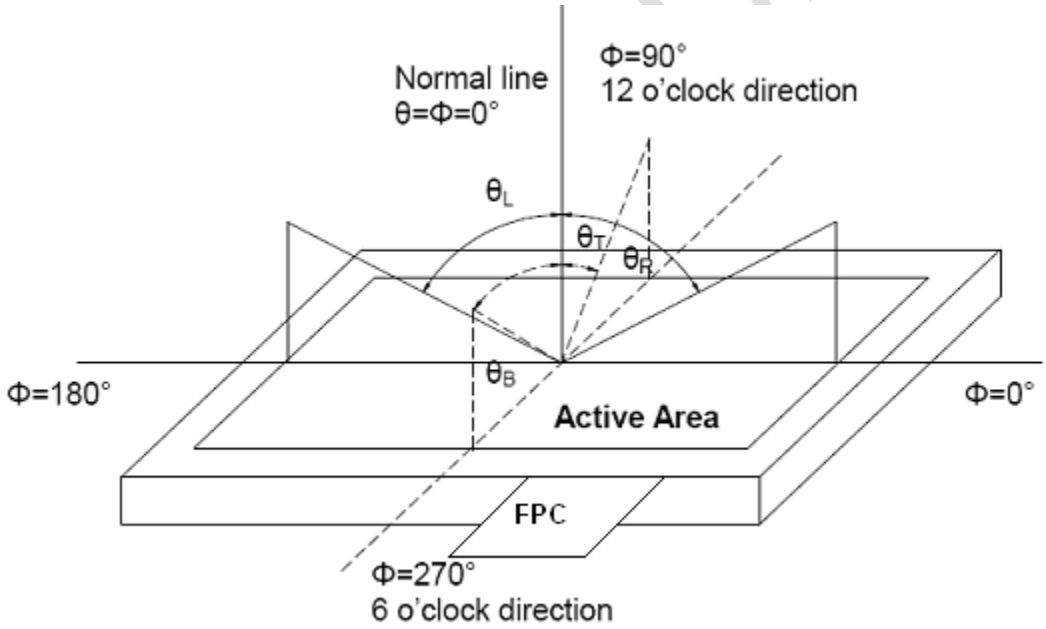



Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

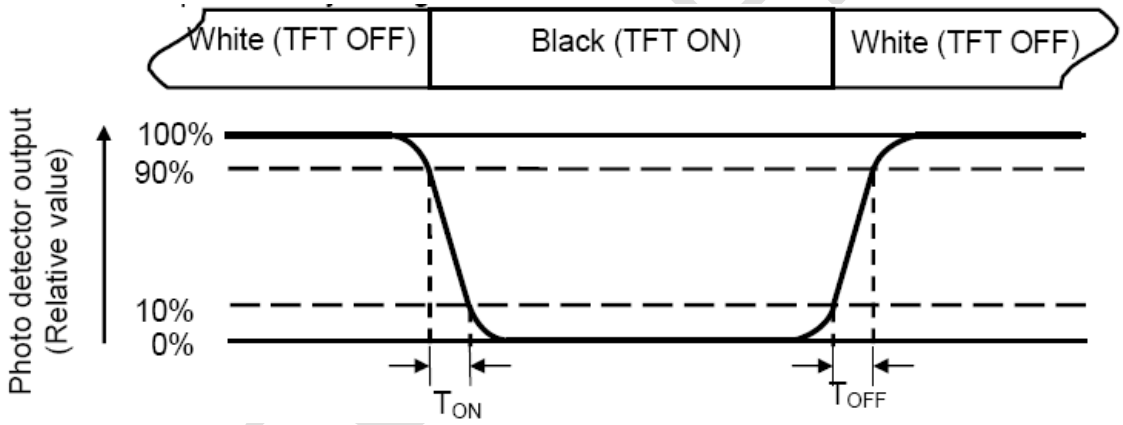
$$\text{Contrast ratio(CR)} = \frac{\text{Luminance measured when LCD is on the "white" state}}{\text{Luminance measured when LCD is on the "Black" state}}$$

“White state “: A state where the AMOLED should be driven by Vwhite.

“Black state”: A state where the AMOLED should be driven by Vblack.

Note 4: Definition of response time

The response time is defined as the AMOLED optical switching time interval between “White” state and “Black” state. Rise time ($T_{ON}$) is the time between photo detector output intensity changing from 90% to 10%. And fall time ($T_{OFF}$) is the time between photo detector output intensity changing from 10% to 90%.




Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of AMOLED.

Note 6: Definition of luminance uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity(U) = Lmin/ Lmax

L-------Active area length W----- Active area width

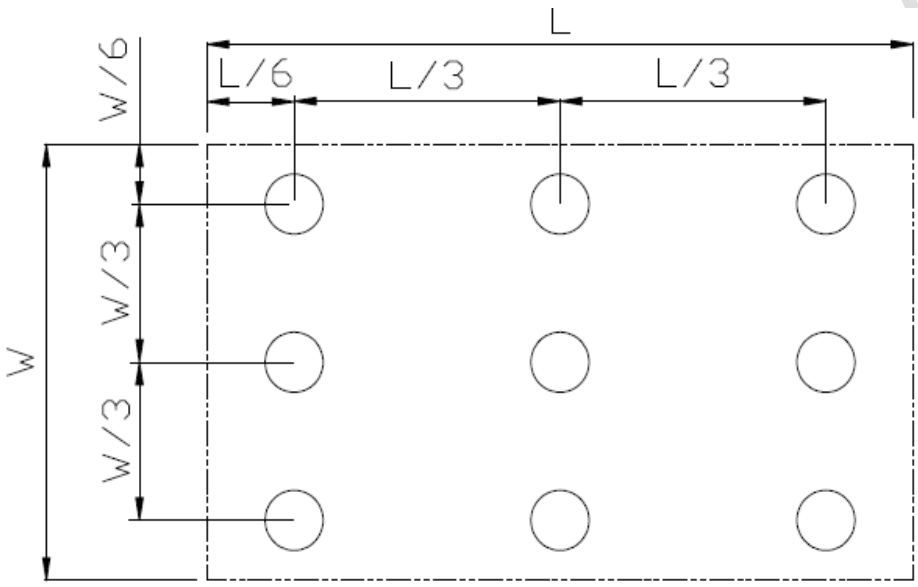



Fig. 2 Definition of uniformity

Lmax: The measured maximum luminance of all measurement position.

Lmin: The measured minimum luminance of all measurement position.

Note 7: Definition of luminance

Measure the luminance of white state at center point.

Note 8: Cross Talk

A. Measure luminance at the position, P0.

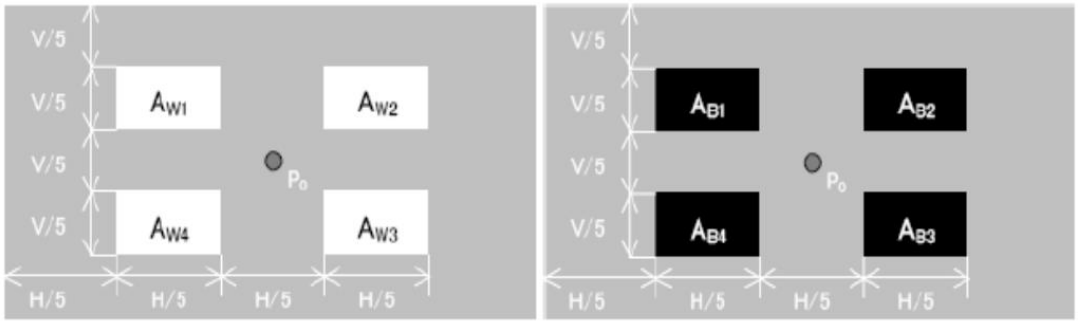
B. Calculate cross talk as below equation.

$$L_{W\_OFF} = \frac{L_{W1} + L_{W2} + L_{W3} + L_{W4}}{4}$$

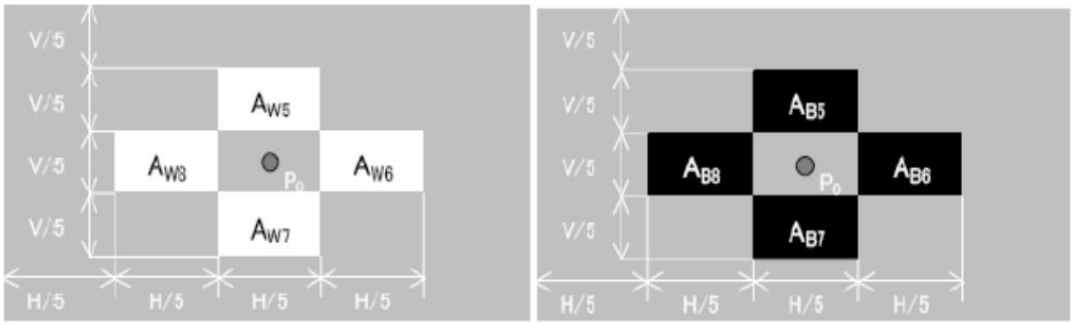
$$L_{B\_OFF} = \frac{L_{B1} + L_{B2} + L_{B3} + L_{B4}}{4}$$

$$crosstalk = \frac{|L_{Wi\_ON} - L_{W\_OFF}|}{L_{W\_OFF}} \times 100\% \qquad (i = 5 \text{ to } 8)$$

$$crosstalk = \frac{|L_{Bi\_ON} - L_{B\_OFF}|}{L_{B\_OFF}} \times 100\% \qquad (i = 5 \text{ to } 8)$$

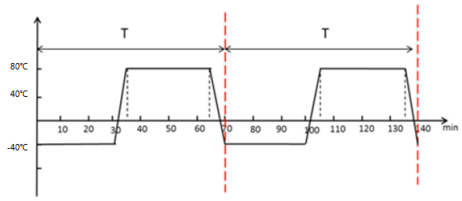
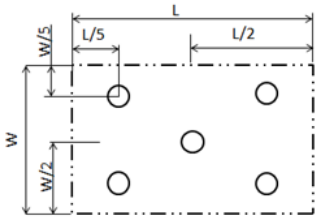



(a) $L_{W\_OFF}$, $L_{B\_OFF}$ measuring pattern




(b) $L_{W\_ON}$, $L_{B\_ON}$ measuring pattern

# 9 Environmental / Reliability Test

| No | Test Item | Condition | Remark |
|---|---|---|---|
| 1 | High Temperature Operation | +70℃, 120hrs | IEC60068-2-2,GB2423.2 |
| 2 | Low Temperature Operation | -20℃, 120hrs | IEC60068-2-1<br>GB2423.1 |
| 3 | High Temperature Storage | +80℃, 120hrs | IEC60068-2-2<br>GB2423.2 |
| 4 | Low Temperature Storage | -30℃, 120hrs | IEC60068-2-1<br>GB2423.1 |
| 5 | High Temperature & High Humidity Operation | 60℃, 90% RH,120hrs | IEC60068-2-78<br>GB/T2423.3 |
| 6 | Thermal Shock (Non-operation) | -40℃(30 min)~+80℃(30 min),<br>Change time:5min, 30 Cycles<br>  | Start with cold temperature,<br>End with high temperature,<br>IEC60068-2-14,GB2423.22 |
| 7 | Electro Static Discharge (Operation) | C=150pF, R=330Ω，5points/panel<br>Air:±8KV, 5times;<br>Contact:±4KV, 5 times;<br>(Environment: 15℃~35℃,<br>30%~60%, 86Kpa~106Kpa).<br>  | IEC61000-4-2<br>GB/T17626.2 |
| 8 | Package Drop Test | 1 corner, 3 edges, 6 surfaces<br>Drop height:760mm | IEC60068-2-32<br>GB/T2423.8 |
| 9 | Package Vibration Test | Random Vibration:<br>1.146Grms, 1~200Hz, Random,<br>30mins/(X，Y，Z)axis | IEC60068-2-34<br>GB/T2423.11 |

# 10 Quality Level

## 10.1 AMOLED Module of Characteristic Inspection

The environmental condition and visual inspection shall be conducted as below:

(1) Ambient temperature: 22± 3℃

(2) Humidity: 55 ± 10%RH

(3) Ambient light intensity of visual inspection: 800 ~ 1200 lux

(4) Ambient light intensity of function inspection: ≤200lux

(5) Viewing Distance: 35 ± 5cm

(6) Viewing angle (tolerance): the front side 90° (Z) ±30°

(7) Inspection time: 10 ±2 sec

## 10.2 Sampling Procedures for each item acceptance table

| Defect type | Sampling Procedures | AQL |
|---|---|---|
| Major defect | GB/T2828.1-2003 Inspection level Ⅱ<br>normal inspection<br>single sample inspection | 0.65 |
| Minor defect | GB/T2828.1-2003 Inspection level Ⅱ<br>normal inspection<br>single sample inspection | 1.0 |

Major defect:

Any defect may result in functional failure, or reduce the usability of product for its purpose, such as electrical failure, deformation and etc.

Minor defect

A defect does not reduce the usability of product for its intended purpose and un-uniformity, such as dot defect.

The criteria on major and/or minor judgment will be according with the classification of defects.

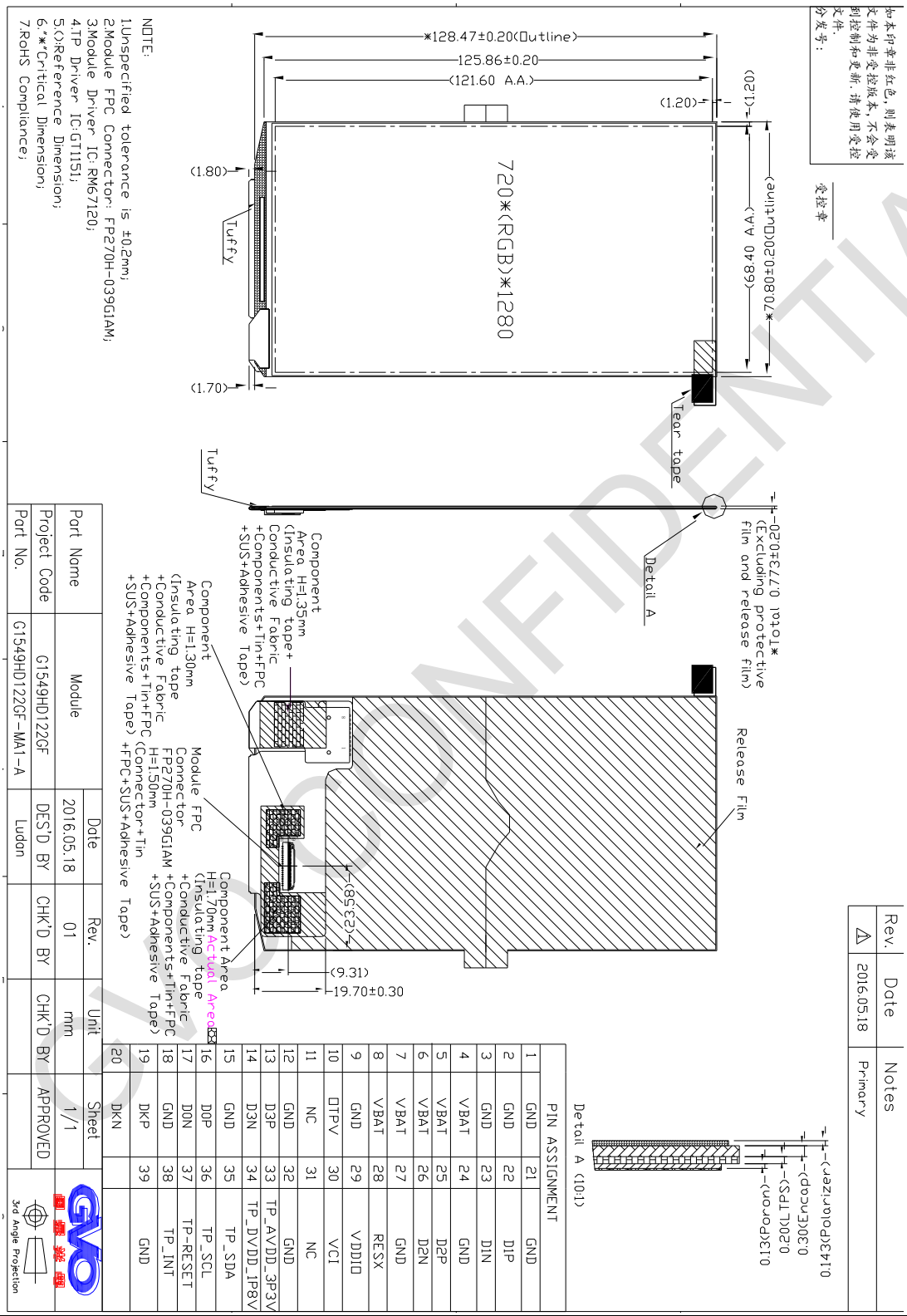
**10.3** Inspection Item

| No. | Item | Area | Criterion of Defect | | | | Defect type |
|---|---|---|---|---|---|---|---|
| 1 | Dot defect | AA | Type | DS | | Acceptable number | |
| | | | Bright Dot | ≥10mm | | 0 | Minor |
| | | | Dark Dot | ≥10mm | | 4 | |
| 2 | No display | AA | / | | | Not allowed | Major |
| 3 | Abnormal display | AA | / | | | Not allowed | Major |
| 4 | Normally white | AA | / | | | Not allowed | Major |
| 5 | Line Defect | AA | single line | Bright line | | Not allowed | Major |
| | | | | Dark line | | Not allowed | |
| | | | Multiple lines | Bright line | | Not allowed | |
| | | | | Dark line | | Not allowed | |
| | | | Half-Line | Bright line | | Not allowed | |
| | | | | Dark line | | Not allowed | |
| 6 | Edge/Side breakage | OA | The following Criterion is applicable to any side（unit：mm） | | | | Minor |
| | | | Z | X | Y | Acceptable number | |
| | | | ≤ T | ≤2.0 | not extended to circuit Area or Frit | ＜5 | |
| 7 | Glass crack | Whole area | / | | | Not allowed | Major |
| 8 | Panel scratch | AA | W（mm） | L（mm） | DS（mm） | Acceptable number | Minor |
| | | | W≤0.03 | L＜5.0 | ≥10 | Ignore | |
| | | | 0.03＜W≤0.05 | L≤2.0 | ≥10 | Ignore | |
| | | | | 2.0＜ L≤5.0 | ≥10 | 2 | |
| | | | 0.05＜W | - | 0 | 0 | |
| | | | | L>5.0 | 0 | 0 | |
| 9 | Frit encapsulation | FA | Frit width can’t be less than the design width of 9/10.It should not have bubble or breakage. | | | | Minor |
| 10 | Raised point | AA、OA | / | | | Not | Major |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | allowed | |
| 11 | Concave dot、Black and white dot、Polarizer Dent/Bubble | AA | Front(Encap surface) | D（mm） | DS（mm） | Acceptable number | Minor |
| | | | | D≤0.20 | ≥10 | Ignore | |
| | | | | 0.20＜D≤0.50 | ≥10 | 3 | |
| | | | | 0.50＜D | ≥10 | 0 | |
| | | | Rear（LTPS surface） | / | / | Ignore | |
| 12 | Polarizer scratch/ Fiber(Linear) | AA | W（mm） | L（mm） | DS | Acceptable number | Minor |
| | | | W≤0.03 | Ignore | ≥10 | Ignore | |
| | | | 0.03＜W≤0.05 | L≤2.0 | ≥10 | Ignore | |
| | | | | 2.0＜L≤5.0 | ≥10 | 3 | |
| | | | 0.05＜W | - | ≥10 | 0 | |
| | | | | L>5.0 | ≥10 | 0 | |
| 13 | Panel dirt | AA | / | / | / | Not allowed | Minor |
| 14 | UV | Not IC side | Over coating | | | Not allowed | Minor |
| | | IC side | The coating of IC side is not higher than POL. | | | | |
| 15 | Tuffy glue | IC and FPC bonding area | The coating should not have breakage or Bubble. | | | | Major |
| | | | The coating is not higher than POL. | | | | Minor |
| | | Other area | Tuffy glue is not allowed to interrupt and the diameter of Bubble is not more than 0.5mm. | | | | |
| | | | The coating is not higher than POL. | | | | |
| | | IC | Not allowed | | | | |
| | | FPC | Ribbon glue: the width is not more than 1mm.<br>Dot glue: the diameter is not more than 2mm. | | | | |
| 16 | FPCA | FPC | The component can not reverse polarity. | | | | Major |
| | | | No wrong insertion | | | | Major |
| | | | FPC should not have serious crease which destroy the line, prick and spots damage. Scratch is not allowed if Cu layer is exposed. | | | | Minor |
| | | | The gold fingers should not be oxidized, scraped, folded, impressed, broken, spotted or dissymmetry. | | | | Major |
| | | | Make sure FPC is not scalded, with its location holes not having deficiency or obviously shift. | | | | Major |
| | | | The component of FPC should be the same as BOM list. | | | | Major |
| | | | No remaining soldering Sn | | | | Major |
| | | | No visual particle on the pad line | | | | Minor |

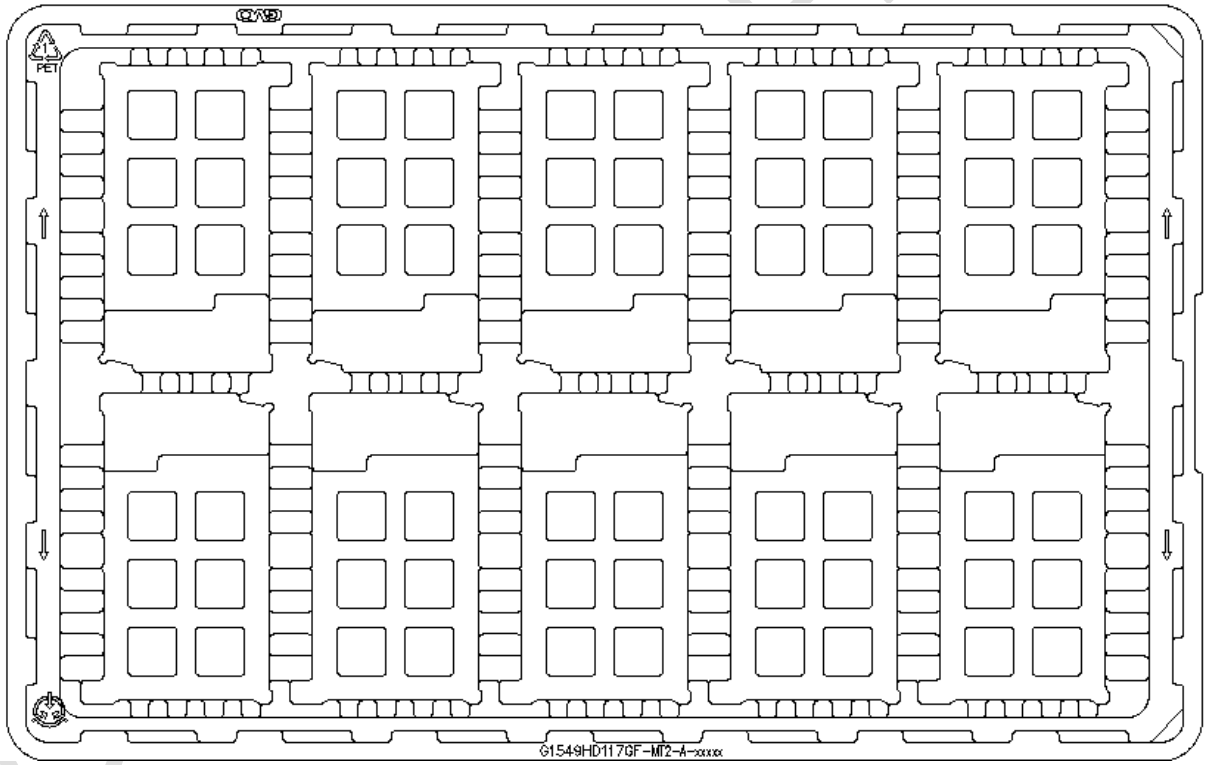
| | | | | |
|---|---|---|---|---|
| 17 | FPCA End Overhang | Bonding area | The size above 1/2 of soldering electrode of the parts overhang to the LAND is prohibited.<br>(Contacting near other components is prohibited) | Major |
| 18 | FPCA Tilt Defect | Bonding area | Not allowed | Major |
| 19 | Package | other | Products should put into the anti-static trays with non-overlapping and the trays should be staggered placed. | Minor |
| | | | Different products cannot be mixed into the same inner package. | |
| | | | The package should not have obvious deformation or breakage .The printing labels type and quantity are correct. | |
| | | | The package should have QC signature. ROHS label is needed if the product is under ROHS control. | |

# 11 Mechanical Drawing



# Packing Drawing

| Packing Condition | Contents |
|---|---|
| Packing Type | TRAY + Carton packing type |
| TRAY material model | tray ($10^5$~$10^9\Omega$) |
| Tray packing type | See the picture 1 |
| Number of panels per tray | 10 pieces |
| Number of Tray per carton | 18units (( 17 units + 1 empty)PET tray ) |
| Number of panels per carton | 170 pieces |




Picture 1

# 12 Precautions for Use of AMOLED Modules

## 12.1 Handling Precautions:

12.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from height.

12.1.2 Do not press down the screen or the adjoining areas too hard because the color tone may be shifted.

12.1.3 The polarizer covering the display surface of the AMOLED module is soft and easily scratched. Handle this polarizer carefully.

12.1.4 If the display surface is contaminated, blow on the surface and gently wipe it with a soft dry cloth. If it is still not completely clear, moisten the cloth with ethyl alcohol.

12.1.5 Solvents may damage the polarizer. Do not use water, ketone or aromatic solvents except ethyl alcohol.
Do not attempt to disassemble the AMOLED Module.

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

12.1.7 To prevent destruction from static electricity, be careful to maintain an optimum working environment.

12.1.8 Be sure to make yourself in contact with the ground when handling with the AMOLED Modules.

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

12.1.10 To reduce the generation of static electricity, do not conduct assembly or other work under dry conditions.

12.1.11 To protect the display surface, the AMOLED Module is coated with a film. Be careful when peeling off this protective film, because static electricity may generate.

## 12.2 Storage Precautions:

12.2.1 When storing the AMOLED modules, be sure that they are not directly exposed to the sunlight or the light of fluorescent lamps.

12.2.2 The AMOLED modules should be stored under the storage temperature range. If the AMOLED modules will be stored for a long time, the recommended condition is:
Temperature: 0℃~40℃ Relatively humidity: ≤80%

12.2.3 The AMOLED modules should be stored in the room without acid, alkali or harmful gas.

## 12.3 Transportation Precautions:

12.3.1 The AMOLED modules should not be suffered from falling and violent shocking during transportation. Besides, excessive press, water, damp and sunshine, should be avoided.