# 11.6 inch
# E-paper Display Series
# GDEY116T91

# Product Specifications

| Customer | Standard |
|---|---|
| Description | 11.6" E-PAPER DISPLAY |
| Model Name | GDEY116T91 |
| Date | 2023/11/07 |
| Revision | 1.0 |

| | Design Engineering | | |
|---|---|---|---|
| | Approval | Check | Design |
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## 1. Over View

GDEY116T91 is an 11.6-inch Active Matrix Electrophoretic Display(AM EPD) featuring a high-resolution 960×640 pixel display capability in 1-bit black and white. This display module is equipped with a TFT-array that efficiently drives electrophoresis, and it boasts a comprehensive set of integrated circuits. These include a gate driver, sourced river, MCU interface, timing controller, oscillator, DC-DC converter, SRAM, Look-Up Table(LUT), and VCOM.

This versatile module is ideal for use in various portable electronic devices, with particular applications in mind, such as Electronic Shelf Label(ESL) Systems.
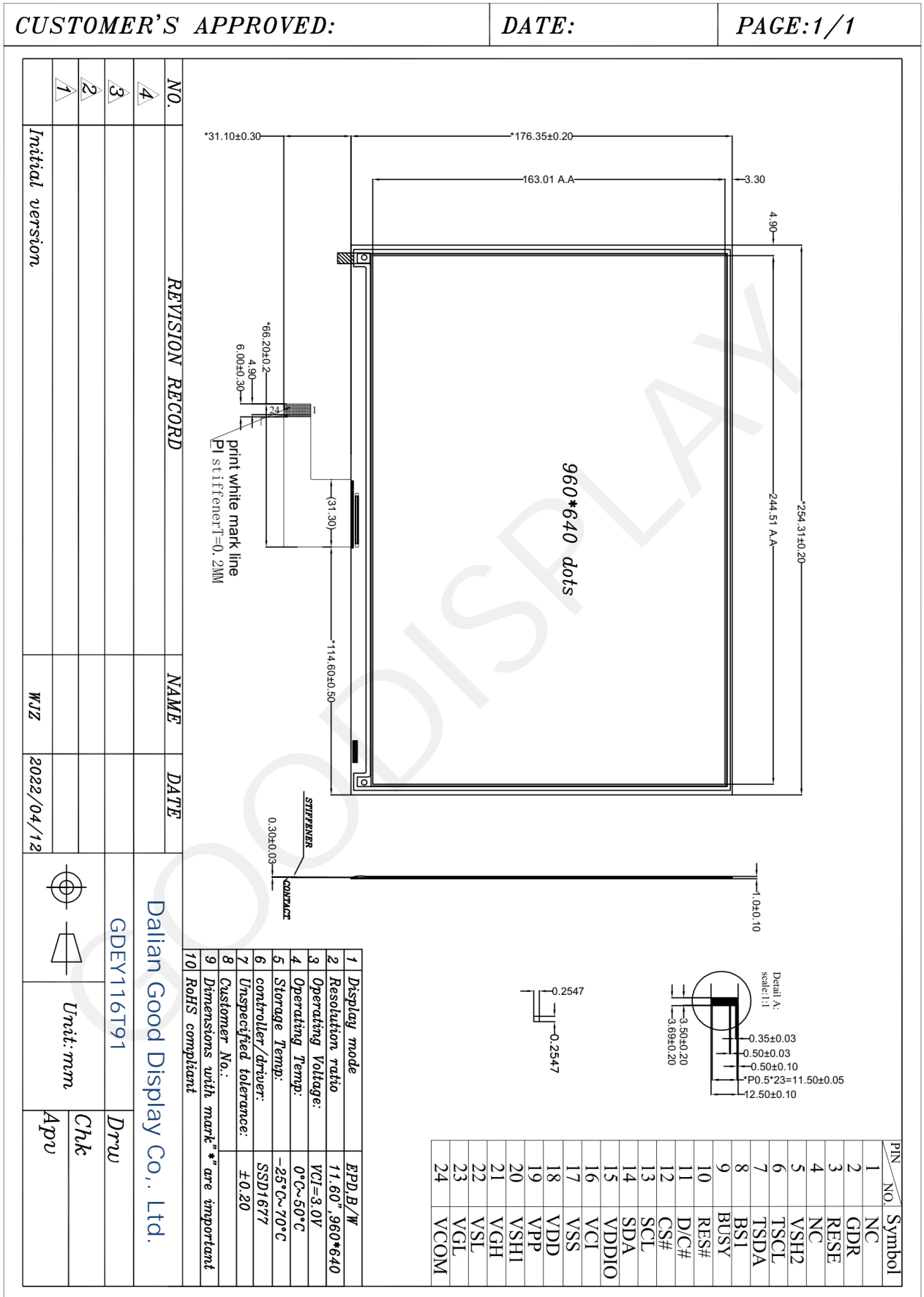
## 2. Features

- 960×640 pixels display
- High contrast High reflectance
- Ultra wide viewing angle Ultra low power consumption
- Pure reflective mode
- Bi-stable display
- Commercial temperature range
- Landscape portrait modes
- Hard-coat antiglare display surface
- Ultra Low current deep sleep mode
- On chip display RAM
- Waveform can stored in On-chip OTP or written by MCU
- Serial peripheral interface available
- On-chip oscillator
- On-chip booster and regulator control for generating VCOM, Gate and Source driving voltage
- $I^2C$ signal master interface to read external temperature sensor
- Support partial update mode
- Built-in temperature sensor

## 3. Mechanical Specifications

| Parameter | Specifications | Unit | Remark |
|---|---|---|---|
| Screen Size | 11.6 | Inch | |
| Display Resolution | 960(H)×640(V) | Pixel | Dpi:99 |
| Active Area | 244.51×163.01 | mm | |
| Pixel Pitch | 0.2547×0.2547 | mm | |
| Pixel Configuration | Rectangle | | |
| Outline Dimension | 254.31×176.35 ×1.0 | mm | |
| Weight | 139.5±0.5 | g | |

## 4. Mechanical Drawing of EPD module



| CUSTOMER'S APPROVED: | DATE: | PAGE:1/1 |

960*640 dots

*31.10±0.30
*176.35±0.20
163.01 A.A
3.30
4.90
*66.20±0.2
4.90
6.00±0.30
24
(31.30)
print white mark line
PI stiffener T=0.2MM
244.51 A.A
*254.31±0.20
*114.60±0.50
STIFFENER
CONTACT
0.30±0.03
1.0±0.10
0.2547
0.2547

Detail A:
scale:1:1
3.50±0.20
3.69±0.20
0.35±0.03
0.50±0.03
0.50±0.10
*P0.5*23=11.50±0.05
12.50±0.10

**REVISION RECORD**

| NO. | NAME | DATE | | |
|---|---|---|---|---|
| 1 | Initial version | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| | WJZ | 2022/04/12 | | |

| 1 | Display mode | EPD,B/W |
| 2 | Resolution ratio | 11.60",960*640 |
| 3 | Operating Voltage: | VCI=3.0V |
| 4 | Operating Temp: | 0°C~50°C |
| 5 | Storage Temp: | -25°C~70°C |
| 6 | controller/driver: | SSD1677 |
| 7 | Unspecified tolerance: | ±0.20 |
| 8 | Customer No.: | |
| 9 | Dimensions with mark"*" are important |
| 10 | RoHS compliant | |

Dalian Good Display Co., Ltd.

GDEY116T91

Unit:mm

Drw
Chk
Apv

| PIN NO. | Symbol |
|---|---|
| 1 | NC |
| 2 | GDR |
| 3 | RESE |
| 4 | NC |
| 5 | VSH2 |
| 6 | TSCL |
| 7 | TSDA |
| 8 | BS1 |
| 9 | BUSY |
| 10 | RES# |
| 11 | D/C# |
| 12 | CS# |
| 13 | SCL |
| 14 | SDA |
| 15 | VDDIO |
| 16 | VCI |
| 17 | VSS |
| 18 | VDD |
| 19 | VPP |
| 20 | VSH1 |
| 21 | VGH |
| 22 | VSL |
| 23 | VGL |
| 24 | VCOM |

## 5. Input /Output Pin Assignment

| No. | Name | I/O | Description | Remark |
|-----|------|-----|-------------|--------|
| 1 | NC | | Do not connect with other NC pins | Keep Open |
| 2 | GDR | O | N-Channel MOSFET Gate Drive Control | |
| 3 | RESE | I | Current Sense Input for the Control Loop | |
| 4 | NC | NC | Do not connect with other NC pins | Keep Open |
| 5 | VSH2 | C | Positive Source driving voltage(Red) | |
| 6 | TSCL | O | I2C Interface to digital temperature sensor Clock pin | |
| 7 | TSDA | I/O | I2C Interface to digital temperature sensor Data pin | |
| 8 | BS1 | I | Bus Interface selection pin | Note 5-5 |
| 9 | BUSY | O | Busy state output pin | Note 5-4 |
| 10 | RES# | I | Reset signal input. Active Low. | Note 5-3 |
| 11 | D/C# | I | Data /Command control pin | Note 5-2 |
| 12 | CS# | I | Chip select input pin | Note 5-1 |
| 13 | SCL | I | Serial Clock pin (SPI) | |
| 14 | SDA | I | Serial Data pin (SPI) | |
| 15 | VDDIO | P | Power Supply for interface logic pins It should be connected with VCI | |
| 16 | VCI | P | Power Supply for the chip | |
| 17 | VSS | P | Ground | |
| 18 | VDD | C | Core logic power pin VDD can be regulated internally from VCI. A capacitor should be connected between VDD and VSS | |
| 19 | VPP | P | FOR  TEST | Keep Open |
| 20 | VSH1 | C | Positive Source driving voltage | |
| 21 | VGH | C | Power Supply pin for Positive Gate driving voltage and VSH1 | |
| 22 | VSL | C | Negative Source driving voltage | |
| 23 | VGL | C | Power Supply pin for Negative Gate driving voltage VCOM and VSL | |
| 24 | VCOM | C | VCOM driving voltage | |

I = Input Pin, O =Output Pin, /O = Bi-directional Pin (Input/output), P = Power Pin, C = Capacitor Pin

Note 5-1: This pin (CS#) is the chip select input connecting to the MCU. The chip is enabled for MCU communication only when CS# is pulled LOW.

Note 5-2: This pin is (D/C#) Data/Command control pin connecting to the MCU in 4-wire SPI mode. When the pin is pulled HIGH, the data at SDA will be interpreted as data. When the pin is pulled LOW, the data at SDA will be interpreted as command.

Note 5-3: This pin (RES#) is reset signal input. The Reset is active low.

Note 5-4: This pin is Busy state output pin. When Busy is High, the operation of chip should not be interrupted, command should not be sent. The chip would put Busy pin High when –Outputting display waveform -Communicating with digital temperature sensor

Note 5-5: Bus interface selection pin

| BS1 State | MCU Interface |
|-----------|---------------|
| L | 4-lines serial peripheral interface(SPI) - 8 bits SPI |
| H | 3- lines serial peripheral interface(SPI) - 9 bits SPI |

# 6. Electrical Characteristics

## 6.1 Absolute Maximum Rating

| Parameter | Symbol | Rating | Unit |
|-----------|--------|--------|------|
| Logic supply voltage | VCI | -0.5 to +4.0 | V |
| Logic Input voltage | VIN | -0.5 to $V_{DDIO}$ +0.5 | V |
| Logic Output voltage | VOUT | -0.5 to $V_{DDIO}$ +0.5 | V |
| Operating Temp range | TOPR | 0 to +50 | °C |
| Storage Temp range | TSTG | -25 to +70 | °C |
| Optimal Storage Temp | TSTGo | 23±2 | °C |
| Optimal Storage Humidity | HSTGo | 55±10 | %RH |

Note:Maximum ratings are those values beyond which damages to the device may occur. Functional operation should be restricted to the limits in the Electrical Characteristics tables or Pin Description section.

## 6.2 Panel DC Characteristics

The following specifications apply for: VSS=0V, VCI=3.0V, TOPR =25℃

| Parameter | Symbol | Conditions | Applicable pin | Min. | Typ. | Max | Units |
|---|---|---|---|---|---|---|---|
| Single ground | $V_{SS}$ | - | | - | 0 | - | V |
| Logic supply voltage | $V_{CI}$ | - | VCI | 2.2 | 3.0 | 3.3 | V |
| Core logic voltage | $V_{DD}$ | | VDD | 1.7 | 1.8 | 1.9 | V |
| High level input voltage | $V_{IH}$ | - | - | $0.8 V_{DDIO}$ | - | - | V |
| Low level input voltage | $V_{IL}$ | - | - | - | - | $0.2 V_{DDIO}$ | V |
| High level output voltage | $V_{OH}$ | IOH = -100uA | - | $0.9 V_{DDIO}$ | - | - | V |
| Low level output voltage | $V_{OL}$ | IOL = 100uA | - | - | - | $0.1V_{DDIO}$ | V |
| Typical power | $P_{TYP}$ | $V_{CI} =3.0V$ | - | - | 49.5 | - | mW |
| Deep sleep mode | $P_{STPY}$ | $V_{CI} =3.0V$ | - | - | 0.003 | - | mW |
| Typical operating current | $Iopr\_V_{CI}$ | $V_{CI} =3.0V$ | - | - | 15 | - | mA |
| Image update time | - | 25 ℃ | - | - | 5 | - | sec |
| Sleep mode current | $Islp\_V_{CI}$ | DC/DC off No clock No input load Ram data retain | - | - | 25 | | uA |
| Deep sleep mode current | $Idslp\_V_{CI}$ | DC/DC off No clock No input load Ram data not retain | - | - | 1 | 5 | uA |

Notes: 1. The typical power is measured with following transition from horizontal 2 scale pattern to vertical 2 scale pattern.
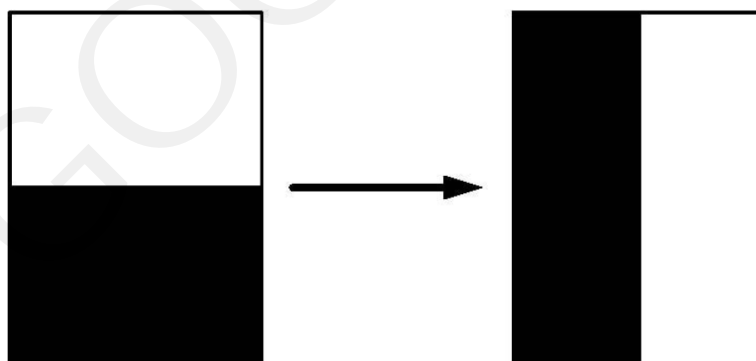


2. The deep sleep power is the consumed power when the panel controller is in deep sleep mode.

3. The listed electrical/optical characteristics are only guaranteed under the controller & waveform provided by Good Display.

## 6.3 Panel AC Characteristics

## 6.3.1 MCU Interface selection

It support 4-wire or 3-wire serial peripheral MCU interface, which is pin selectable by BS1 pin.The interface pin assignment for different MCU interfaces is shown in Table 6-1.

Table 6-1: Interface pin assignment for different MCU interfaces

| MCU Interface | Pin Name | | | | | | |
|---|---|---|---|---|---|---|---|
| | **BS1** | **RES#** | **CS#** | **D/C#** | **SCL** | **SDI** | **SDO** |
| 4-wire serial peripheral interface (SPI) | L | RES# | CS# | DC# | SCL | SDA | |
| 3-wire serial peripheral interface (SPI) – 9 bits SPI | H | RES# | CS# | L | SCL | SDA | |

**Note:**
(1) L is connected to $V_{SS}$ and H is connected to $V_{DDIO}$
(2) SDI and SDO are connected to be SDA pin for bi-directional data access

## 6.3.2 MCU Serial Interface (4-wire SPI)

The 4-wire SPI consists of serial clock SCL, serial data input SDI, D/C# and CS#. The control pins status in 4-wire SPI in writing command/data is shown in Table 6-2 and the write procedure in 4-wire SPI is shown in Figure 6-1.

Table 6-2 : Control pins status of 4-wire SPI

| Function | SCL pin | SDI pin | D/C# pin | CS# pin |
|---|---|---|---|---|
| Write command | ↑ | Command bit | L | L |
| Write data | ↑ | Data bit | H | L |

**Note:**
(1) L is connected to $V_{SS}$ and H is connected to $V_{DDIO}$
(2) ↑ stands for rising edge of signal

SDI is shifted into an 8-bit shift register on every rising edge of SCL in the order of D7, D6, ... D0. The level of D/C# should be kept over the whole byte. The data byte in the shift register is written to the Graphic Display Data RAM (RAM)/Data Byte register or command Byte register according to D/C# pin.
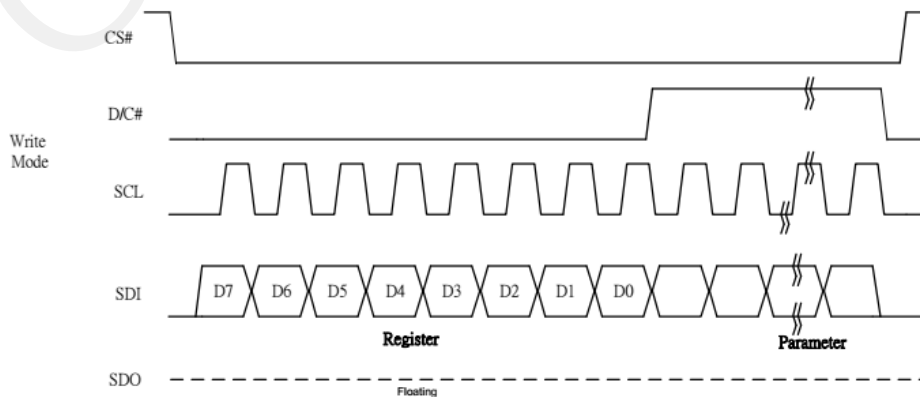


Figure 6-1 : Write procedure in 4-wire SPI mode

In the read operation, after CS# is pulled low, the first byte sent is command byte, D/C# is pulled low. After command byte sent, the following byte(s) read are data byte(s), so D/C# bit is then pulled high. An 8-bit data will be shifted out on every clock falling edge. The serial data output SDO bit shifting sequence is D7, D6, to D0 bit. Figure 6-2 shows the read procedure in 4-wire SPI.
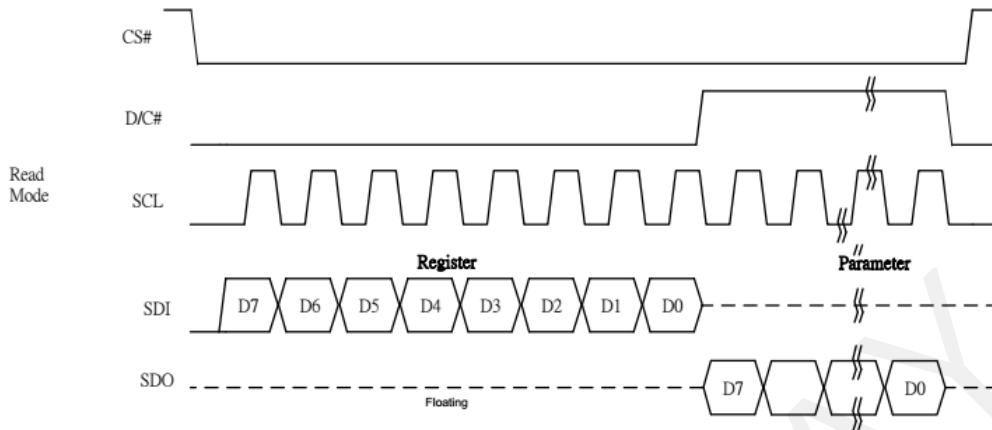


Figure 6-2 : Read procedure in 4-wire SPI mode

## 6.3.3 MCU Serial Interface(3-wire SPI)

The 3-wire SPI consists of serial clock SCL, serial data input SDI, and CS#. The operation is similar to 4-wire SPI while D/C# pin is not used and it must be tied to LOW. The control pins status in 3-wire SPI is shown in Table 6-3.In the write operation, a 9-bit data will be shifted into the shift register on every clock rising edge. The bit shifting sequence is D/C# bit, D7 bit, D6 bit to D0 bit. The first bit is D/C# bit which determines the following byte is command or data. When D/C# bit is 0, the following byte is command. When D/C# bit is 1,the following byte is data. Table 6-3 shows the write procedure in 3-wire SPI

Table 6-3 : Control pins status of 3-wire SPI

| Function | SCL pin | SDI pin | D/C# pin | CS# pin |
|---|---|---|---|---|
| Write command | ↑ | Command bit | Tie LOW | L |
| Write data | ↑ | Data bit | Tie LOW | L |

Note:
(1) L is connected to $V_{SS}$ and H is connected to $V_{DDIO}$
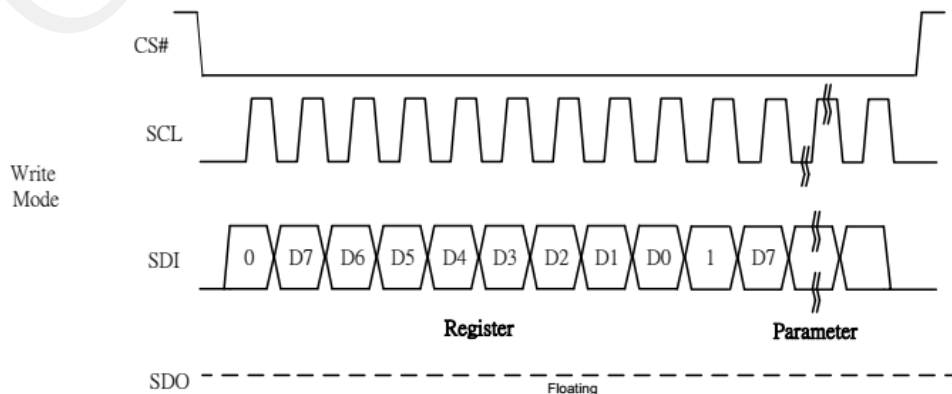(2) ↑ stands for rising edge of signal



Figure 6-3 : Write procedure in 3-wire SPI

In the read operation, serial data are transferred in the unit of 9 bits. After CS# pull low, the first byte is command byte, the D/C# bit is as 0 and following with the register byte. After command byte send, the following byte(s) are data byte(s), with D/C# bit is 1. After D/C# bit sending from MCU, an 8-bit data will be shifted out on every clock falling edge. The serial data output SDO bit shifting sequence is D7, D6, to D0 bit. Figure 6-4 shows the read procedure in 3-wire SPI.
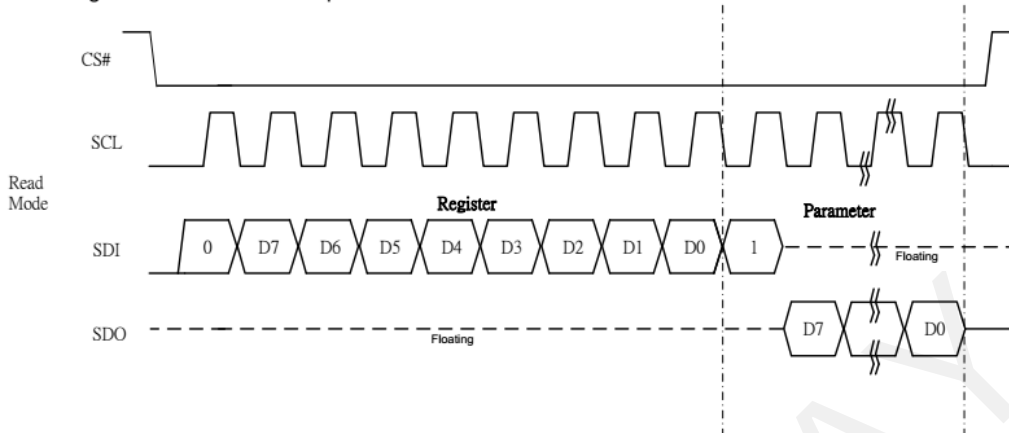


Figure 6-4 : Read procedure in 3-wire SPI mode

## 6.3.4 Interface Timing

The following specifications apply for: VDDIO - VSS = 2.2V to 3.7V, CL=30pF

Table 12-1 : Serial Peripheral Interface Timing Characteristics

**Write mode**

| Symbol | Parameter | Min | Typ | Max | Unit |
|--------|-----------|-----|-----|-----|------|
| $f_{SCL}$ | SCL frequency (Write Mode) | | | 20 | MHz |
| $t_{CSSU}$ | Time CS# has to be low before the first rising edge of SCLK | 20 | | | ns |
| $t_{CSHLD}$ | Time CS# has to remain low after the last falling edge of SCLK | 20 | | | ns |
| $t_{CSHIGH}$ | Time CS# has to remain high between two transfers | 100 | | | ns |
| $t_{SCLCYC}$ | SCL cycle time | 50 | | | ns |
| $t_{SCLHIGH}$ | Part of the clock period where SCL has to remain high | 25 | | | ns |
| $t_{SCLLOW}$ | Part of the clock period where SCL has to remain low | 25 | | | ns |
| $t_{SISU}$ | Time SI (SDA Write Mode) has to be stable before the next rising edge of SCL | 10 | | | ns |
| $t_{SIHLD}$ | Time SI (SDA Write Mode) has to remain stable after the rising edge of SCL | 40 | | | ns |

**Read mode**

| Symbol | Parameter | Min | Typ | Max | Unit |
|--------|-----------|-----|-----|-----|------|
| $f_{SCL}$ | SCL frequency (Read Mode) | | | 2.5 | MHz |
| $t_{CSSU}$ | Time CS# has to be low before the first rising edge of SCLK | 100 | | | ns |
| $t_{CSHLD}$ | Time CS# has to remain low after the last falling edge of SCLK | 50 | | | ns |
| $t_{CSHIGH}$ | Time CS# has to remain high between two transfers | 250 | | | ns |
| $t_{SCLHIGH}$ | Part of the clock period where SCL has to remain high | 180 | | | ns |
| $t_{SCLLOW}$ | Part of the clock period where SCL has to remain low | 180 | | | ns |
| $t_{SOSU}$ | Time SO(SDA Read Mode) will be stable before the next rising edge of SCL | | 50 | | ns |
| $t_{SOHLD}$ | Time SO (SDA Read Mode) will remain stable after the falling edge of SCL | | 0 | | ns |

Note: All timings are based on 20% to 80% of VDDIO-VSS

**Figure 12-1: SPI timing diagram**
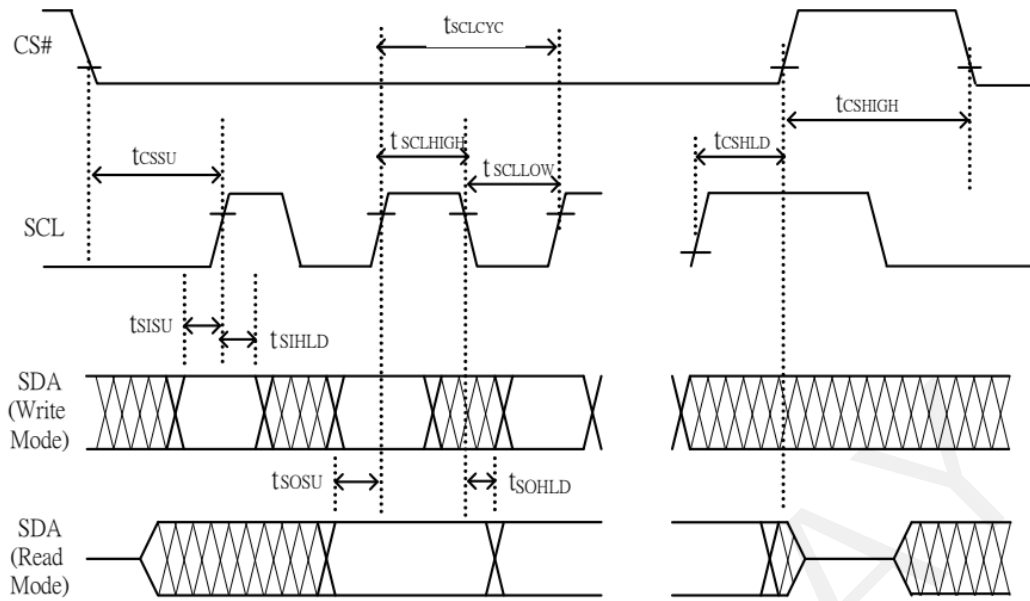
## 7. Command Table

| R/W# | D/C# | Hex | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Command | Description |
|------|------|-----|----|----|----|----|----|----|----|----|---------|-------------|
| 0 | 0 | 01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Driver Output control | Gate setting<br>Set A[9:0]=2A7h[POR] ,680MUX<br>Set B[2:0]=000[POR] |
| 0 | 1 | | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | |
| 0 | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | A9 | A8 | | |
| 0 | 1 | | 0 | 0 | 0 | 0 | 0 | B2 | B1 | B0 | | |
| 0 | 0 | 03 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | Gate Driving voltage control | SetGate Driving voltage<br>A[4:0]=17h[POR],VGH at 20V[POR]<br>VGH setting from 12V to 20V |
| 0 | 1 | | 0 | 0 | 0 | A4 | A3 | A2 | A1 | A0 | | |
| 0 | 0 | 04 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | Source Driving voltage control | SetSource Driving voltage<br>A[7:0]= 41h[POR],VSH1 at 15V<br>B[7:0]=A8h[POR],VSH2 at 5.0V<br>C[7:0]= 32h[POR], VSL at -15V |
| 0 | 1 | | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | |
| 0 | 1 | | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| 0 | 1 | | C7 | C6 | C5 | C4 | C3 | C2 | C1 | C0 | | |
| 0 | 0 | 10 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | Deep Sleep mode | Deep Sleep mode Control<br><br>| A[1:0] : | Description |<br>| 00 | Normal Mode [POR] |<br>| 11 | Enter Deep Sleep Mode |<br><br>After this command initiated, the chip will enter Deep Sleep Mode, BUSY pad will keep output high. |
| 0 | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | $A_1$ | $A_0$ | | |
| 0 | 0 | 11 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | Data Entry mode setting | Define data entry sequence<br>A [1:0] = ID[1:0]Address automatic increment / decrement setting<br>The setting of incrementing or decrementing of the address counter can be made independently in each upper and lower bit of the address.<br>00 –Y decrement, X decrement,<br>01 –Y decrement, X increment,<br>10 –Y increment, X decrement,<br>11 –Y increment, X increment [POR]<br>A[2] = AM<br>Set the direction in which the address counter is updated automatically after data are written to the RAM.<br>AM= 0, the address counter is updated in the X direction. [POR]<br>AM = 1, the address counter is updated in the Y direction. |
| 0 | 1 | | 0 | 0 | 0 | 0 | 0 | $A_2$ | $A_1$ | $A_0$ | | |
| 0 | 0 | 12 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | SWRESET | It resets the commands and parameters to their S/W Reset default values except R10h-Deep Sleep Mode<br>During operation ,BUSY pad will output high.<br>Note: RAM are unaffected by this command. |

| | | | | | | | | | | | Command | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 18 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | Temperature Sensor Control | Temperature Sensor Selection A[7:0] = 48h [POR], external temperature sensor A[7:0] = 80h Internal temperature sensor |
| 0 | 1 | | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | |
| 0 | 0 | 1A | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | Temperature Sensor Control (Write to temperature register) | Write to temperature register. A[11:0]=7FFh[POR] |
| 0 | 1 | | A11 | A10 | A9 | A8 | A7 | A6 | A5 | A4 | | |
| 0 | 1 | | A3 | A2 | A1 | A0 | 0 | 0 | 0 | 0 | | |
| 0 | 0 | 20 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | Master Activation | Activate Display Update Sequence The Display Update Sequence Option is located at R22h User should not interrupt this operation to avoid corruption of panel images. |
| 0 | 0 | 21 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Display Update Control 1 | RAM content option for Display Update A[7:0]=00h[POR] A[7:4] Red RAM option |
| 0 | 1 | | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | |

A[7:4] Red RAM option

| | |
|---|---|
| 0000 | Normal |
| 0100 | Bypass RAM content as 0 |
| 1000 | Inverse RAM content |

A[3:0] BW RAM option

| | |
|---|---|
| 0000 | Normal |
| 0100 | Bypass RAM content as 0 |
| 1000 | Inverse RAM content |

| | | | | | | | | | | | Command | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 22 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | Display Update Control 2 | Display Update Sequence Option: Enable the stage for Master Activation |
| | 1 | | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | |

**Setting for LUT from MCU**

| | |
|---|---|
| Enable Clock Signal, Then Enable Analog Then PATTERN DISPLAY Then Disable Analog Then Disable OSC | C7 |

**Setting for LUT from OTP according to external Temperature Sensor operation**

| | |
|---|---|
| Then Enable Analog Then Load LUT | 90 |
| Enable Analog Then PATTERN DISPLAY Then Disable Analog Then Disable OSC | 47 |

| | | | | | | | | | | | Command | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 24 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | Write RAM (BW) | After this command, data entries will be written into the 1RAM until another command is written. Address pointers will advance accordingly. For Write pixel: Content of write RAM(BW)=1 For Black pixel: Content of write RAM(BW)=0 |

| 0 | 0 | 26 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | Write RAM (RED) | After this command, data entries will be written into the 2 RAM until another command is written. Address pointers will advance accordingly.<br>For RED pixel:<br>Content of write RAM(RED)=1<br>For White/Black pixel:<br>Content of write RAM(RED)=0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 2C | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | Write VCOM register | Set A[7:0]=50h |
| 0 | 1 | | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | |
| 0 | 0 | 2D | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | OTP Register Read | Read Register stored in OTP:<br>1. A[7:0]~ B[7:0]: VCOM Information<br>2. C[7:0]~G[7:0]:Display mode<br>3. H[7:0]~K[7:0]: Waveform Version [4bytes] |
| 1 | 1 | | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | |
| 1 | 1 | | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| 1 | 1 | | C7 | C6 | C5 | C4 | C3 | C2 | C1 | C0 | | |
| 1 | 1 | | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | |
| 1 | 1 | | E7 | E6 | E5 | E4 | E3 | E2 | E1 | E0 | | |
| 1 | 1 | | F7 | F6 | F5 | F4 | F3 | F2 | F1 | F0 | | |
| 1 | 1 | | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | | |
| 1 | 1 | | H7 | H6 | H5 | H4 | H3 | H2 | H1 | H0 | | |
| 1 | 1 | | I7 | I6 | I5 | I4 | I3 | I2 | I1 | I0 | | |
| 1 | 1 | | J7 | J6 | J5 | J4 | J3 | J2 | J1 | J0 | | |
| 1 | 1 | | K7 | K6 | K5 | K4 | K3 | K2 | K1 | K0 | | |
| 0 | 0 | 2F | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | Status Bit Read | Read IC status Bit [POR 0x21]<br>A[5]: HV Ready Detection flag [POR=1]<br>0: Ready<br>1: Not Ready<br>A[4]: VCI Detection flag [POR=0]<br>0: Normal<br>1: VCI lower than the Detect level<br>A[3]: [POR=0]<br>A[2]: Busy flag [POR=0]<br>0: Normal<br>1: BUSY<br>A[1:0]: Chip ID [POR=01]<br>Remark:<br>A[5] and A[4] status are not valid after RESET, they need to be initiated by command 0x14 and command 0x15 respectively. |
| 1 | 1 | | 0 | 0 | A5 | A4 | 0 | 0 | A1 | A0 | | |
| 0 | 0 | 32 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | Write LUT register | Write LUT register from MCU interface [105 bytes]. |
| 0 | 1 | | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | |
| 0 | 1 | | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| 0 | 1 | | : | : | : | : | : | : | : | : | | |
| 0 | 1 | | : | : | : | : | : | : | : | : | | |
| 0 | 1 | | : | : | : | : | : | : | : | : | | |

| | | | | | | | | | | | Name | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 3A | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | Reserved | Reserved |
| 0 | 0 | 3B | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | Reserved | Reserved |
| 0 | 0 | 3C | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | Border Waveform Control | Select border waveform for VBD A [7:0]=C0h[POR],set VBD as HIZ A [7:6] Select VBD option |
| 0 | 1 | | $A_7$ | $A_6$ | $A_5$ | $A_4$ | 0 | 0 | $A_1$ | $A_0$ | | |

A[7:6] Select VBD option

| A[7:6] | Select VBD as |
|---|---|
| 00 | GS Transition Define A[1:0] |
| 01 | Fix Level Define A [5:4] |
| 10 | VCOM |
| 11[POR] | HIZ |

A [5:4] Fix Level Setting for VBD

| A[5:4] | VBD level |
|---|---|
| 00[POR] | VSS |
| 01 | VSH1 |
| 10 | VSL |
| 11 | VSH2 |

A[1:0]) BW Transition setting for VBD

| A[1:0] | VBD Transition |
|---|---|
| 00 [POR] | LUT0 |
| 01 | LUT1 |
| 10 | LUT2 |
| 11 | LUT3 |

| | | | | | | | | | | | Name | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 44 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | Set RAM X - address Start / End position | Specify the start/end positions of the window address in the X direction by an address unit A[9:0]: XSA[9:0], X Start, POR = 000h B[9:0]: XEA[9:0], X End, POR = 3BFh |
| 0 | 1 | | $A_7$ | $A_6$ | $A_5$ | $A_4$ | $A_3$ | $A_2$ | $A_1$ | $A_0$ | | |
| 0 | 1 | | - | - | - | - | - | - | $A_9$ | $A_8$ | | |
| 0 | 1 | | $B_7$ | $B_6$ | $B_5$ | $B_4$ | $B_3$ | $B_2$ | $B_1$ | $B_0$ | | |
| 0 | 1 | | - | - | - | - | - | - | $B_9$ | $B_8$ | | |
| 0 | 0 | 45 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | Set Ram Y- address Start / End position | Specify the start/end positions of the window address in the Y direction by an address unit A[9:0], YSA[9:0], Y Start, POR = 000h B[9:0]: YEA[9:0], Y End, POR = 2A7h |
| 0 | 1 | | $A_7$ | $A_6$ | $A_5$ | $A_4$ | $A_3$ | $A_2$ | $A_1$ | $A_0$ | | |
| 0 | 1 | | - | - | - | - | - | - | $A_9$ | $A_8$ | | |
| 0 | 1 | | $B_7$ | $B_6$ | $B_5$ | $B_4$ | $B_3$ | $B_2$ | $B_1$ | $B_0$ | | |
| 0 | 1 | | - | - | - | - | - | - | $B_9$ | $B_8$ | | |
| 0 | 0 | 4E | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | Set RAM X address counter | Make initial settings for the RAM X address in the address counter (AC) A[9:0]: 000h[POR] |
| 0 | 1 | | $A_7$ | $A_6$ | $A_5$ | $A_4$ | $A_3$ | $A_2$ | $A_1$ | $A_0$ | | |
| 0 | 1 | | - | - | - | - | - | - | $A_9$ | $A_8$ | | |
| 0 | 0 | 4F | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | Set RAM Y address counter | Make initial settings for the RAM Y address in the address counter (AC) A[9:0]: 000h[POR] |
| 0 | 1 | | $A_7$ | $A_6$ | $A_5$ | $A_4$ | $A_3$ | $A_2$ | $A_1$ | $A_0$ | | |
| 0 | 1 | | - | - | - | - | - | - | $A_9$ | $A_8$ | | |
| 0 | 1 | | $A_7$ | $A_6$ | $A_5$ | $A_4$ | $A_3$ | $A_2$ | $A_1$ | $A_0$ | | |

## 8. Optical Specifications

Measurements are made with that the illumination is under an angle of 45 degree, the detection is perpendicular unless otherwise specified

| Symbol | Parameter | Conditions | Min | Typ. | Max | Units | Notes |
|--------|-----------|------------|-----|------|-----|-------|-------|
| R | White Reflectivity | White | 30 | 35 | - | % | 8-1 |
| CR | Contrast Ratio | Indoor | 8:1 | | - | | 8-2 |
| GN | 2Grey Level | - | DS+(WS-DS)*n(m-1) | | | | 8-3 |
| T update | Image update time | at 25 ℃ | 5 | | - | sec | |
| Life | | Topr | 1000000times or 5years | | | | |

Notes: 8-1. Luminance meter: Eye-One Pro Spectrophotometer.

8-2. CR=Surface Reflectance with all white pixel/Surface Reflectance with all black pixels. 8-3. WS: White state, DS: Dark state

## 9. Typical Application Circuit
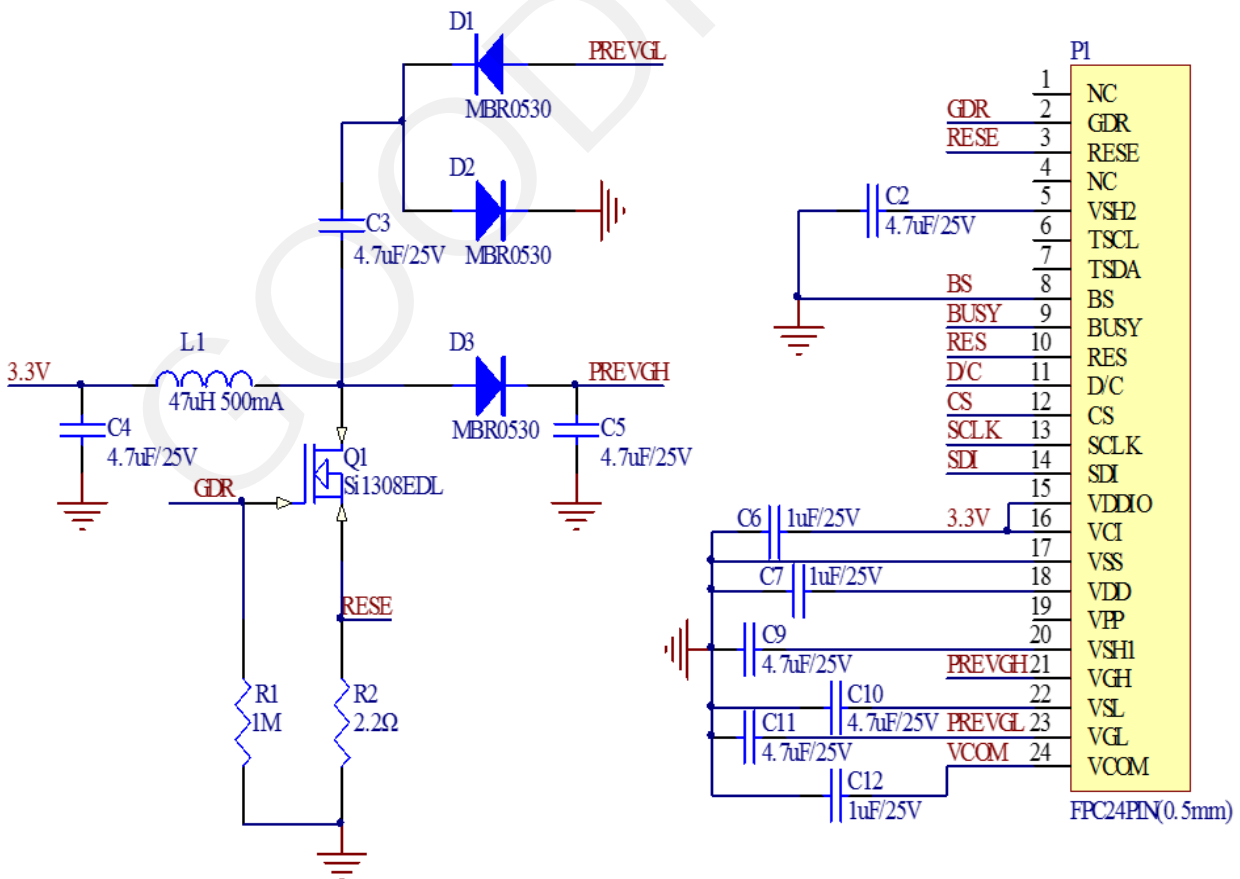
## 10.  Matched Development Kit

Our Development Kit designed for SPI E-paper Display aims to help users to learn how to use E-paper Display more easily. It can refresh black-white E-paper Display, three-color (black, white and red/Yellow) E-paper Display and four-color(black, white, red and yellow) Good Display 's E-pa per Display. And it is also added the functions of USB serial port, FLASH c hip, font chip, current detection ect.
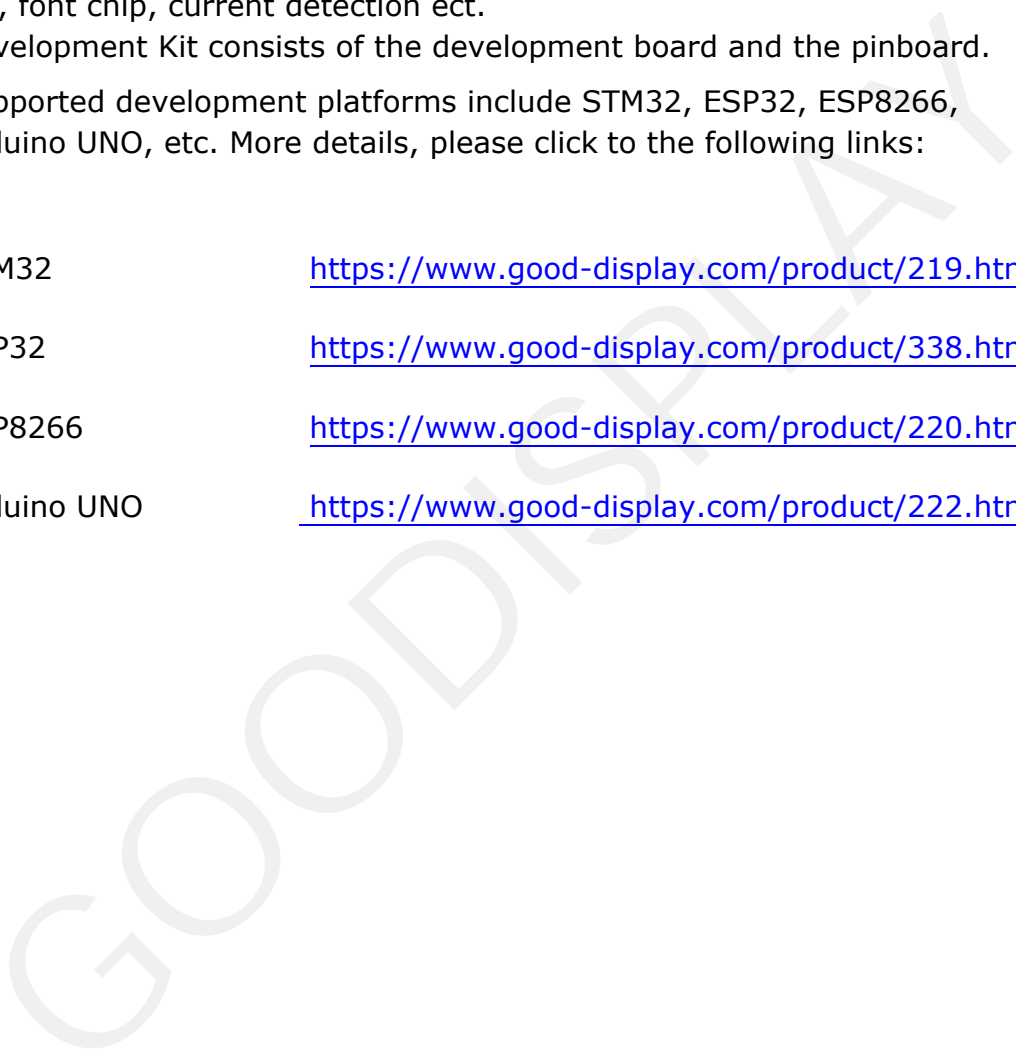Development Kit consists of the development board and the pinboard.

Supported development platforms include STM32, ESP32, ESP8266, Arduino UNO, etc. More details, please click to the following links:
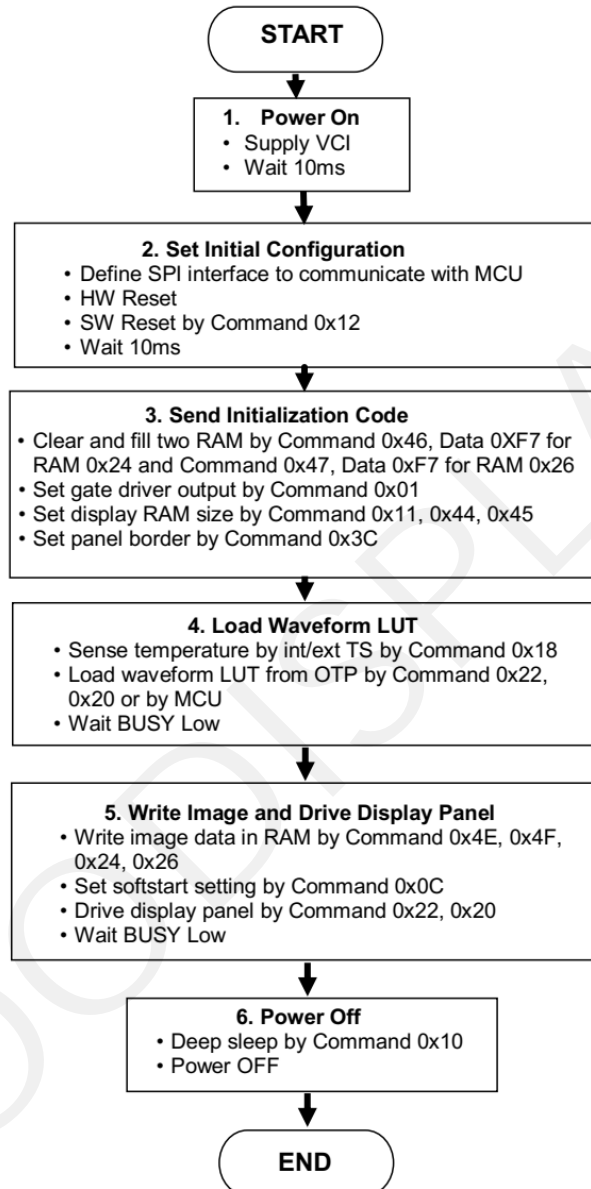

STM32                    https://www.good-display.com/product/219.html

ESP32                    https://www.good-display.com/product/338.html

ESP8266                 https://www.good-display.com/product/220.html

Arduino UNO            https://www.good-display.com/product/222.html

## 11. Reliability test

| NO | Test items | Test condition |
|---|---|---|
| 1 | Low-Temperature Storage | T = -25 ℃, 240 h<br>Test in white pattern |
| 2 | High-Temperature Storage | T=70º C，RH=40%，240h<br>Test in white pattern |
| 3 | High-Temperature Operation | T=50º C，RH=35%，240h |
| 4 | Low-Temperature Operation | 0º C，240h |
| 5 | High-Temperature, High-Humidity Operation | T=40º C，RH=80%，240h |
| 6 | High Temperature, High Humidity Storage | T=50º C，RH=80%，240h<br>Test in white pattern |
| 7 | Temperature Cycle | 1 cycle:[-25°C 30min]→[+70 ° C 30 min] : 50 cycles<br>Test in white pattern |
| 8 | UV exposure Resistance | 765W/m ²for 168hrs,40 ℃<br>Test in white pattern |
| 9 | ESD Gun | Air+/-15KV;Contact+/-8KV<br>(Test finished product shell, not display only)<br>Air+/-8KV;Contact+/-6KV<br>(Naked EPD display, no including IC and FPC area)<br>Air+/-4KV;Contact+/-2KV<br>(Naked EPD display, including IC and FPC area) |

Note: Put in normal temperature for 1hour after test finished, display performance is ok.

# 12. Typical Operating Sequence

## 12.1 Normal Operation Flow

```
                              ┌─────────────┐
                              │    START    │
                              └─────────────┘
                                     │
                                     ▼
                    ┌──────────────────────────────────┐
                    │  1.   Power On                    │
                    │  • Supply VCI                     │
                    │  • Wait 10ms                      │
                    └──────────────────────────────────┘
                                     │
                                     ▼
          ┌──────────────────────────────────────────────────┐
          │  2. Set Initial Configuration                     │
          │  • Define SPI interface to communicate with MCU   │
          │  • HW Reset                                       │
          │  • SW Reset by Command 0x12                       │
          │  • Wait 10ms                                      │
          └──────────────────────────────────────────────────┘
                                     │
                                     ▼
          ┌──────────────────────────────────────────────────┐
          │  3. Send Initialization Code                      │
          │  • Clear and fill two RAM by Command 0x46, Data 0XF7 for │
          │    RAM 0x24 and Command 0x47, Data 0xF7 for RAM 0x26 │
          │  • Set gate driver output by Command 0x01         │
          │  • Set display RAM size by Command 0x11, 0x44, 0x45 │
          │  • Set panel border by Command 0x3C               │
          └──────────────────────────────────────────────────┘
                                     │
                                     ▼
          ┌──────────────────────────────────────────────────┐
          │  4. Load Waveform LUT                             │
          │  • Sense temperature by int/ext TS by Command 0x18 │
          │  • Load waveform LUT from OTP by Command 0x22,    │
          │    0x20 or by MCU                                 │
          │  • Wait BUSY Low                                  │
          └──────────────────────────────────────────────────┘
                                     │
                                     ▼
          ┌──────────────────────────────────────────────────┐
          │  5. Write Image and Drive Display Panel           │
          │  • Write image data in RAM by Command 0x4E, 0x4F, │
          │    0x24, 0x26                                     │
          │  • Set softstart setting by Command 0x0C          │
          │  • Drive display panel by Command 0x22, 0x20      │
          │  • Wait BUSY Low                                  │
          └──────────────────────────────────────────────────┘
                                     │
                                     ▼
                    ┌──────────────────────────────────┐
                    │  6. Power Off                     │
                    │  • Deep sleep by Command 0x10     │
                    │  • Power OFF                      │
                    └──────────────────────────────────┘
                                     │
                                     ▼
                              ┌─────────────┐
                              │     END     │
                              └─────────────┘
```

# 13. Inspection method and condition

## 13.1 Inspection condition

| Item | Condition |
|---|---|
| Illuminance | ≥1000 lux |
| Temperature | 22℃ ±3℃ |
| Humidity | 45-65 % RoHS |
| Distance | ≥30cm |
| Angle | ±45 ° |
| Inspection method | By eyes |
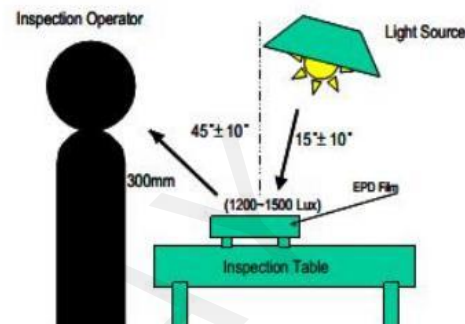


## 13.2 Display area

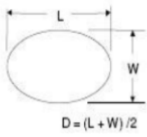## 13.2.1 Zone definition:

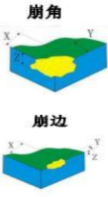A Zone： Active area

B Zone： Border zone

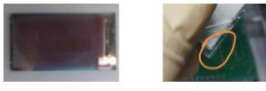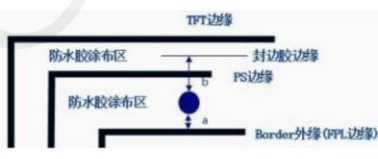C Zone： From B zone edge to panel edge
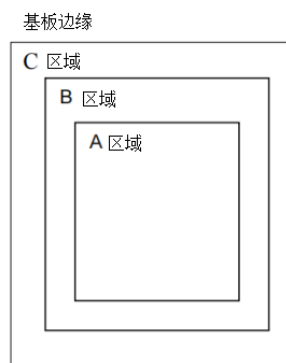
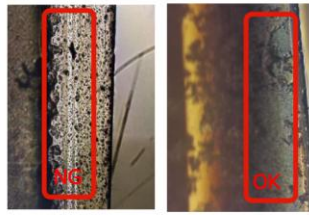## 13.3 General inspection standards for products

## 13.3.1 Appearance inspection standard

| Inspection item | | Figure | | A zone inspection standard | B/C zone | Inspection method | MAJ/MIN |
|---|---|---|---|---|---|---|---|
| Spot defects | Spot defects such as dot, foreign matter, air bubble, and dent etc. | Diameter D=(L+W)/2 (L-length、W-width ) Measuring method shown in the figure below $D = (L + W) /2$ | A spec module<br><br>The distance between the two spots should not be less than 10mm | 7.5"-13.3"Module（Not include 7.5"）：<br>D＞1mm N=0    0.5＜D≤0.8 N≤4          D≤0.5<br>Ignore    0.8＜D≤1      N≤2<br><br>4.2"-7.5"Module（Not include 4.2"）：<br>D＞0.5 N=0      0.4＜D≤0.5 N≤2          D≤0.25<br>Ignore    0.25＜D≤0.4  N≤4<br><br>Module below 4.2"：<br>D＞0.5    N=0    0.4＜D≤0.5 N≤1<br>D≤0.25   Ignore    0.25＜D≤0.4 N≤4<br>0.1mm＜D≤0.25      N≤3/cm² | Foreign matter<br><br>D≤1mm Pass | Check by eyes<br><br>Film gauge | MIN |
| | | Major axis D2<br><br>Major axis D1 | B spec module<br><br>The distance between the two spots should not be less than 5mm（Outside the AA area, ignore if not serious when checking by eyes） | No affect on display | | | |

| Inspection item | | Figure | | A zone inspection standard | B/C zone | Inspection method | MAJ/MIN |
|---|---|---|---|---|---|---|---|
| Line defects | Line defects such as scratch, hair etc. | L-Length，W-Width，(W/L)＜1/4 Judged by line，(W/L)≥1/4 Judged by dot | A spec module<br><br>The distance between the two lines should not be less than 5mm | 7.5"-13.3"Module（Not include 7.5"）：<br>L＞10mm,N=0   W＞0.8mm，N=0<br>5mm≤L≤10mm, 0.5mm≤W≤0.8mm<br>   N≤2   L≤5mm, W≤0.5mm   Ignore<br><br>4.2"-7.5"Module（Not include 4.2"）：<br>  L＞8mm,N=0   W＞0.2mm, N=0<br>2mm≤L≤8mm, 0.1mm≤W≤0.2mm   N≤4<br>  L≤2mm, W≤0.1mm   Ignore<br><br>Module below 4.2"：<br>L＞5mm,N=0   W＞0.2mm, N=0<br>2mm≤L≤5mm, 0.1mm≤W≤0.2mm   N≤4<br>L≤2mm，W≤0.1mm   Ignore | Ignore | Check by eyes<br><br>Film gauge | MIN |
| | | W<br>L | B spec module<br><br>The distance between the two lines should not be less than 5mm（Outside the AA area, ignore if not serious when checking by eyes） | No affect on display | | | |

| Inspection item | | Figure | Inspection standard | Inspection method | MAJ/MIN |
|---|---|---|---|---|---|
| Panel chipping and crack defects | TFT panel chipping | X the length, Y the width, Z the chipping height, T the thickness of the panel 崩角  崩边  | Chipping at the edge: Module over 7.5" (Include 7.5"): X≤6mm,Y≤1mm  Z≤T  N=3  Allowed<br><br>Module below 7.5"(Not include 7.5"): X≤3mm,Y≤1mm  Z≤T  N=3  Allowed<br><br>Chipping on the corner: IC sideX≤2mm Y≤2mm, Non-IC sideX≤1mm Y≤1mm .  Allowed<br><br>Note: 1、Chipping should not damage the edge wiring. If it does not affect the display, allowed 2、The size of the chipping is larger than the above conditions but the display is normal, it can be taken as the B spec. | Check by eyes、Film gauge | MIN |
| | Crack | 玻璃裂纹 | Crack at any zone of glass ,    Not allowed | Check by eyes、Film gauge | MIN |
| | Burr edge | | No exceed the positive and negative deviation of the outline dimensions    X+Y≤0.2mm    Allowed | Calliper | MIN |
| | Curl of panel | H Curl height | Curl height H≤Total panel length 1%    Allowed | Check by eyes | MIN |

Remarks: The total number of defects in a single piece of A-spec glass is not allowed to exceed 4.

| Inspection item | | Figure | Inspection standard | Inspection method | MAJ/MIN |
|---|---|---|---|---|---|
| PS defect | Water proof film | | 1 .Waterproof film damage,   wrinkled, open edge,   not allowed 2. Exceeding the edge of module(according to the lamination drawing) Not allowed 3. Edge warped exceeds height of technical file,   not allowed | Check by eyes | MIN |
| RTV defect | Adhesive effect | | Adhesive height exceeds the display surface, not allowed | Check by eyes | MIN |
| | | | 1 .Overflow, exceeds the panel side edge, affecting the size, not allowed 2 .No adhesive at panel edge≤1mm, mo exposure of wiring, allowed 3. No adhesive at edge and corner1*1mm, no exposure of wiring, allowed | | |
| | | | Protection adhesive, coverage width within W≤1.5mm, no break of adhesive, allowed | | |
| | Adhesive re-fill | | Dispensing is uniform, without obvious concave and breaking, bubbling and swell, not higher than the upper surface of the PS, and the diameter of the adhesive re-filling is not more than 8mm, allowed | Check by eyes | MIN |
| EC defect | Adhesive bubble | TFT边缘 防水胶涂布区  封边胶边缘 PS边缘 防水胶涂布区 Border外缘(FPL边缘) | 1、 Effective edge sealing area of hot melt products ≥1/2 edge sealing area; 2、Bubble a+b/2≥1/2 effective width, N≤3,   spacing≥5mm , allowed    No exposure of wiring, allowed | Check by eyes | MIN |

| Inspection item | | Figure | Inspection standard | Inspection method | MAJ/ MIN |
|---|---|---|---|---|---|
| EC defect | Adhesive effect |  | 1 .Overflow, exceeds the panel side edge, affecting the size, not allowed<br>2.No adhesive at panel edge≤1mm, mo exposure of wiring, allowed<br>3.No adhesive at edge and corner 1*1mm, no exposure of wiring, allowed<br>4. Adhesive height exceeds the display surface, not allowed | Visual, caliper | MIN |
| Silver dot adhesive defect | Silver dot adhesive | | 1、Single silver dot dispensing amount ≥1mm, allowed<br>2、One of the double silver dot dispensing amount is ≥1mm and the other has adhesive (no reference to 1mm) Allowed | Visual | MIN |
| | | | Silver dot dispensing residue on the panel ≤0.2mm, allowed | Film gauge | MIN |
| FPC defect | FPC wiring |  | FPC, TCP damage / gold finger peroxidation, adhesive residue, not allowed | Visual | MIJ |
| | FPC golden finger | | The height of burr edge of TCP punching surface ≧ 0.4mm, not allowed | Caliper | MIN |
| | FPC damage/cr ease |  | Damage and breaking, not allowed<br>Crease does not affect the electrical performance display, allowed | Check by eyes | MIN |

| Inspection item | | Figure | Inspection standard | Inspection method | MAJ/ MIN |
|---|---|---|---|---|---|
| Protective film defect | Protective film | | Scratch and crease on the surface but no affect to protection function, allowed | Check by eyes | MIN |
| | | | Adhesive at edge L≤5mm，W≤0.5mm，N=2, no entering into viewing area | Check by eyes | MIN |
| Stain defect | Stain | | If stain can be normally wiped clean by > 99% alcohol, allowed | Visual | MIN |
| Pull tab defect | Pull tab | | The position and direction meet the document requirements, and ensure that the protective film can be pulled off. | Check by eyes/ Manual pulling | MIN |
| Shading tape defect | Shading tape | | Tilt≤10°, flat without warping, completely covering the IC. | Check by eyes/ Film gauge | MIN |
| Stiffener | Stiffener | | Flat without warping, Exceeding the left and right edges of the FPC is not allowed. Left and right can be less than 0.5mm from FPC edge | Check by eyes | MIN |
| Label | Label/ Spraying code | | The content meets the requirements of the work sheet. The attaching position meets the requirements of the technical documents. | Check by eyes | MIN |

**Remarks: The definition of other appearance B spec products,　no affect to the display, and no entering into the viewing area.**

# 14. Handling, Safety and Environmental Requirements

| WARNING |
|---|
| The display glass may break when it is dropped or bumped on a hard surface. Handle with care. Should the display break, do not touch the electrophoretic material. In case of contact with electrophoretic material, wash with water and soap. |

| CAUTION |
|---|
| The display module should not be exposed to harmful gases, such as acid and alkali gases, which corrode electronic components. |
| Disassembling the display module can cause permanent damage and invalidate the warranty agreements. |

Observe general precautions that are common to handling delicate electronic components. The glass can break and front surfaces can easily be damaged. Moreover the display is sensitive to static electricity and other rough environmental conditions.

| Data sheet status | |
|---|---|
| Product specification | The data sheet contains final product specifications. |
| **Limiting values** | |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. | |
| **Application information** | |
| Where application information is given, it is advisory and dose not form part of the specification. | |

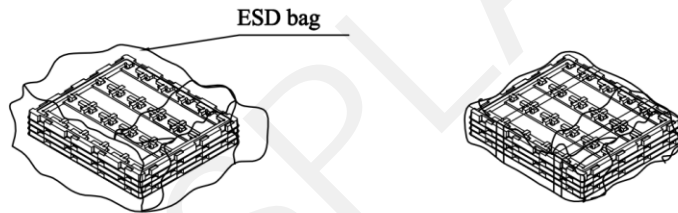| Product Environmental certification |
|---|
| RoHS |

# 15. Packaging

PACKLING ORDER:

1) Putting 2 pcs Modules on each PET tray.And cover a dedicated EPE film.
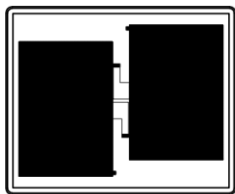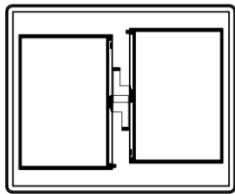
2) Putting 18 pcs PET trays together with 1 empty tray on the top of PET tray. Insert in the ESD bag, add desiccant in the ESD bag.
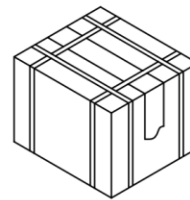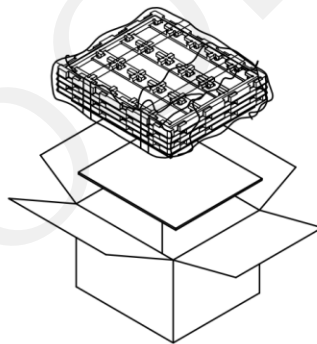
3) the tray together with adhesive tape

ESD bag

4) Putting into one outcarton

5) Packing finished

Note:2 pcs in a tray, 18 trays in a out carton, so 2x (19-1)=36pcs/Outcarton

Dimension (Out carton ): 454*374*190mm

# 16. Precautions

(1) Do not apply pressure to the EPD panel in order to prevent damaging it.

(2) Do not connect or disconnect the interface connector while the EPD panel is in operation.

(3) Do not touch IC bonding area. It may scratch TFT lead or damage IC function.

(4) Please be mindful of moisture to avoid its penetration into the EPD panel, which may cause damage during operation.

(5) If the EPD Panel / Module is not refreshed every 24 hours, a phenomena known as "Ghosting" or "Image Sticking" may occur. It is recommended to refreshed the ESL / EPD Tag every 24 hours in use case. It is recommended that customer ships or stores the ESL / EPD Tag with a completely white image to avoid this issue

(6) High temperature, high humidity, sunlight or fluorescent light may degrade the EPD panel's performance. Please do not expose the unprotected EPD panel to high temperature, high humidity, sunlight, or fluorescent for long periods of time.

https://www.good-display.com/news/80.html