

SPECIFICATION

Product Type : EPD

Model Number : GDEH029A1

Description : Screen Size: 2.9"
Color: Black and White
Display Resolution: 296*128

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Issue Date : 2017.08.11



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| Version | Content | Date | Producer |
|----------------|---------------------------|-------------|-----------------|
| 1.0 | New release | 2015/01/10 | |
| 2.0 | Modify Reference Circuit | 2017/03/02 | |
| 3.0 | Updating | 2017/06/22 | |
| 3.1 | Modify Reference Circuit | 2017/08/04 | |
| 3.2 | Modify Mechanical Drawing | 2017/08/11 | |
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1 General Description

GDEH029A1 is an Active Matrix Electrophoretic Display(AMEPD) , with interface and a reference system design. The 2.9" active area contains 128×296 pixels, and has 1-bit B/W full display capabilities. An integrated circuit contains gate buffer, source buffer, interface, timing control logic, oscillator, DC-DC. SRAM. LUT ,VCOM,and border are supplied with each panel.

2 Features

- 128×296 pixels display
- White reflectance above 35%
- Contrast ratio 10:1
- 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 stored in On-chip OTP
- Serial peripheral interface available
- On-chip oscillator
- On-chip booster and regulator control for generating VCOM, Gate and Source driving voltage
- I2C signal master interface to read external temperature sensor

3 Application

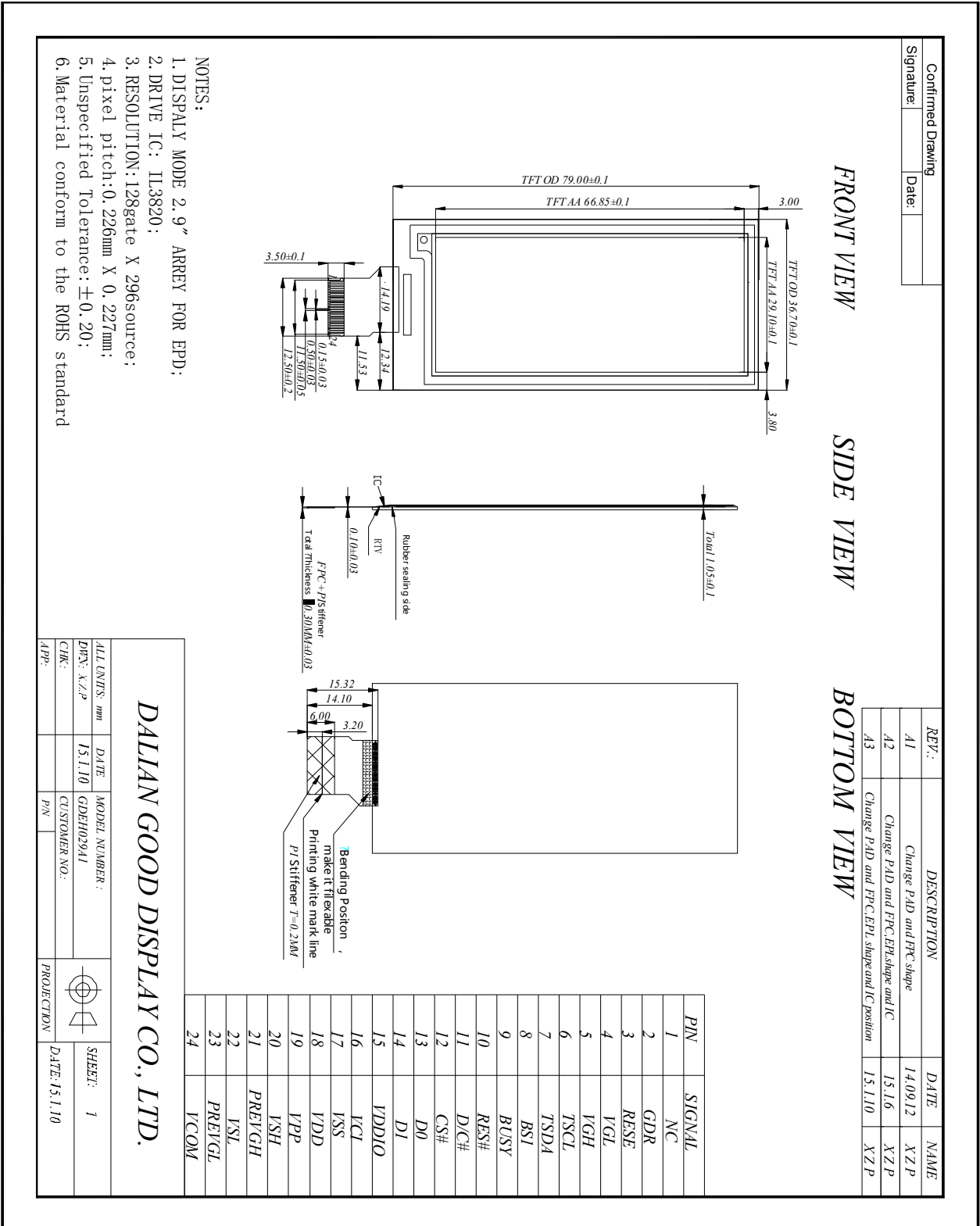
Electronic Shelf Label System

4 Mechanical Specifications

| Parameter | Specifications | Unit | Remark |
|---------------------|---------------------------|-------|---------|
| Screen Size | 2.9 | Inch | |
| Display Resolution | 128(H)×296(V) | Pixel | dpi:112 |
| Active Area | 29.1×66.85 | mm | |
| Pixel Pitch | 0.226×0.227 | mm | |
| Pixel Configuration | Rectangle | | |
| Outline Dimension | 36.7(H)×79.0 (V) ×1.05(D) | mm | |
| Weight | 6.5 ±0.2 | g | |



5 Mechanical Drawing of EPD module





6 Input/Output Terminals

6.1 Pin out List

| Pin # | Single | Description | Remark |
|-------|--------|---|-----------|
| 1 | NC | No connection and do not connect with other NC pins | Keep Open |
| 2 | GDR | N-Channel MOSFET Gate Drive Control | |
| 3 | RESE | Current Sense Input for the Control Loop | |
| 4 | VGL | Negative Gate driving voltage | |
| 5 | VGH | Positive Gate driving voltage | |
| 6 | TSCL | I2C Interface to digital temperature sensor Clock pin | |
| 7 | TSDA | I2C Interface to digital temperature sensor Date pin | |
| 8 | BS1 | Bus selection pin | Note 6-5 |
| 9 | BUSY | Busy state output pin | Note 6-4 |
| 10 | RES # | Reset | Note 6-3 |
| 11 | D/C # | Data /Command control pin | Note 6-2 |
| 12 | CS # | Chip Select input pin | Note 6-1 |
| 13 | D0 | serial clock pin (SPI) | |
| 14 | D1 | serial data pin (SPI) | |
| 15 | VDDIO | Power for interface logic pins | |
| 16 | VCI | Power Supply pin for the chip | |
| 17 | VSS | Ground | |
| 18 | VDD | Core logic power pin | |
| 19 | VPP | Power Supply for OTP Programming | |
| 20 | VSH | Positive Source driving voltage | |
| 21 | PREVGH | Power Supply pin for VGH and VSH | |
| 22 | VSL | Negative Source driving voltage | |
| 23 | PREVGL | Power Supply pin for VCOM, VGL and VSL | |
| 24 | VCOM | VCOM driving voltage | |



Note 6-1: 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 6-2: This pin (D/C#) is Data/Command control pin connecting to the MCU. When the pin is pulled HIGH,the data will be interpreted as data. When the pin is pulled LOW, the data will be interpreted as command.

Note 6-3: This pin (RES#) is reset signal input. The Reset is active low.

Note 6-4: This pin (BUSY) is Busy state output pin. When Busy is high the operation of chip should not be interrupted and any commands should not be issued to the module. The driver IC will put Busy pin high when the driver IC is working such as:

- Outputting display waveform; or
- Communicating with digital temperature sensor

Note 6-5: This pin (BS1) is for 3-line SPI or 4-line SPI selection. When it is “Low”, 4-line SPI is selected.

When it is “High”, 3-line SPI (9 bits SPI) is selected. Please refer to below Table.

Table: Bus interface selection

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

6.2 MCU Interface

6.2.1 MCU Serial Peripheral Interface (4-wire SPI)

The 4-wire SPI consists of SCLK (serial clock), SDIN (serial data), D/C# and CS#. D0 acts as SCLK and D1 acts as SDIN.

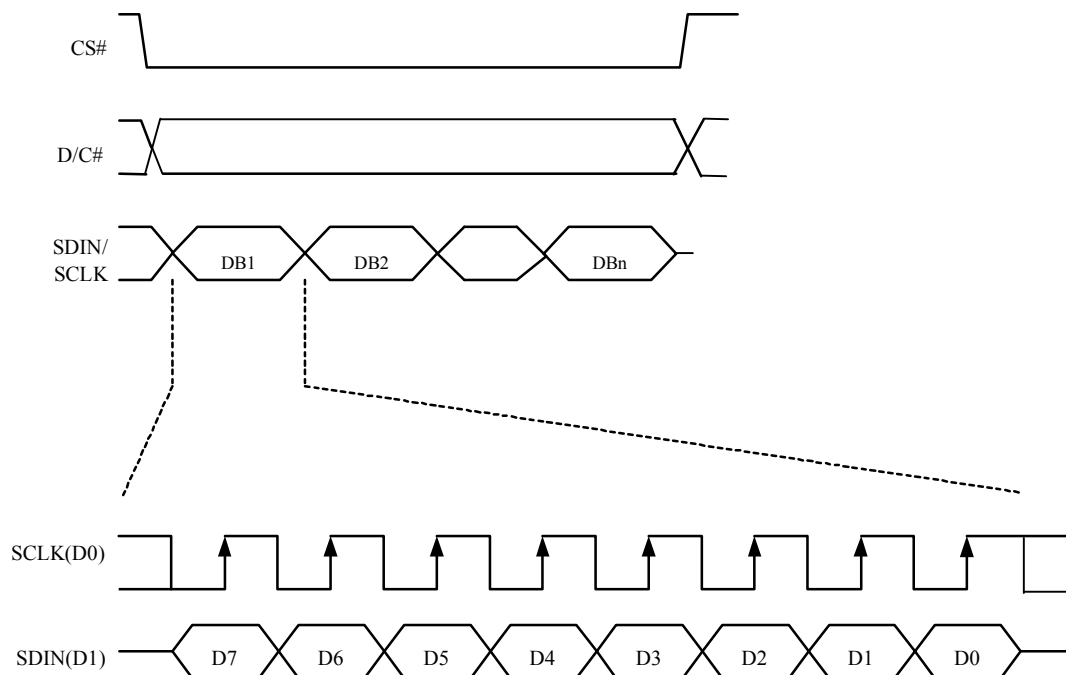
Table -1 : Control pins of 4-wire Serial Peripheral interface

| Function | CS# pin | D/C# pin | SCLK pin |
|---------------|---------|----------|----------|
| Write command | L | L | ↑ |
| Write data | L | H | ↑ |

Note: ↑ stands for rising edge of signal

SDIN is shifted into an 8-bit shift register in the order of D7, D6, ... D0. The data byte in the shift register is written to the Graphic Display Data RAM (RAM) or command register in the same clock. Under serial mode, only write operations are allowed.

Figure 6-1 : Write procedure in 4-wire Serial Peripheral Interface mode



6.2.2 MCU Serial Peripheral Interface (3-wire SPI)

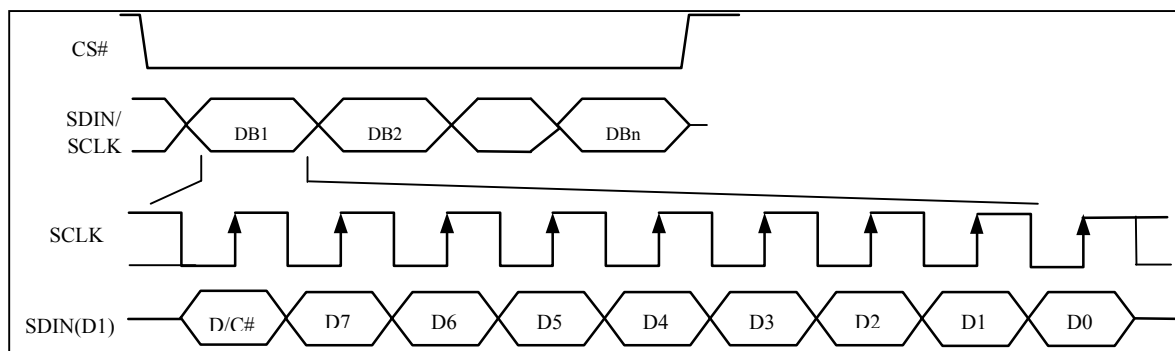
The 3-wire serial interface consists of SCLK (serial clock), SDIN (serial data) and CS#. In SPI mode, D0 acts as SCLK and D1 acts as SDIN. The operation is similar to 4-wire serial interface while D/C# pin is not used. There are altogether 9-bits will be shifted into the shift register in sequence: D/C# bit, D7 to D0 bit. The D/C# bit (first bit of the sequential data) will determine the following data byte in the shift register is written to the Display Data RAM (D/C# bit = 1) or the command register (D/C# bit = 0). Under serial mode, only write operations are allowed.

Table -2 : Control pins of 3-wire Serial Peripheral interface

| Function | CS# pin | D/C# pin | SCLK pin |
|---------------|---------|----------|----------|
| Write command | L | Tie LOW | ↑ |
| Write data | L | Tie LOW | ↑ |

Note: ↑ stands for rising edge of signal

Figure 6-1 : Write procedure in 3-wire Serial Peripheral Interface mode





6.3 External Temperature Sensor operation

There are two ways to let the module get the ambient temperature,

- 1) use the external temperature sensor interface, The module provides two I/O lines [TSDA and TSCL] for connecting digital temperature sensor for temperature reading sensing. TSDA will be treated as SDA line and TSCL will be treated as SCL line. They are required connecting with the external pull-up resistors when they are used to connect to the temperature sensor, then the module will check the temperature automatically.
- 2) use any kinds of external temperature sensor to get the temperature value then converted to hex format, then use the spi interface send command 0x1A and the temperature value into the module. The temperature value how to converted to hex as the follow:
 1. When the Temperature value MSByte bit D11 = 0, the temperature is positive and value (DegC) = + (Temperature value)/16
 2. When the Temperature value MSByte bit D11 = 1, the temperature is negative and value (DegC) = ~ (2's complement of Temperature value)/16

| 12-bit binary (2's complement) | Hexadecimal Value | Decimal Value | Value [DegC] |
|-----------------------------------|----------------------|------------------|-----------------|
| 0111 1111 0000 | 7F0 | 2032 | 127 |
| 0111 1110 1110 | 7EE | 2030 | 126.875 |
| 0111 1110 0010 | 7E2 | 2018 | 126.125 |
| 0111 1101 0000 | 7D0 | 2000 | 125 |
| 0001 1001 0000 | 190 | 400 | 25 |
| 0000 0000 0010 | 002 | 2 | 0.125 |
| 0000 0000 0000 | 000 | 0 | 0 |
| 1111 1111 1110 | FFE | -2 | -0.125 |
| 1110 0111 0000 | E70 | -400 | -25 |
| 1100 1001 0010 | C92 | -878 | -54.875 |
| 1100 1001 0000 | C90 | -880 | -55 |



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 Set A[8:0] = 0C7h Set B[2:0] = 0h | | |
| 0 | 1 | | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | | | |
| 0 | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | A8 | | | | |
| 0 | 1 | | 0 | 0 | 0 | 0 | 0 | B2 | B1 | B0 | | | | |
| 0 | 0 | 0C | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | Booster Soft start Control | Set A[7:0] = CFh Set B[7:0] = CEh Set C[7:0] = 8Dh | | |
| 0 | 1 | | 1 | A ₆ | A ₅ | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | | | |
| 0 | 1 | | 1 | B ₆ | B ₅ | B ₄ | B ₃ | B ₂ | B ₁ | B ₀ | | | | |
| 0 | 1 | | 1 | C ₆ | C ₅ | C ₄ | C ₃ | C ₂ | C ₁ | C ₀ | | | | |
| 0 | 0 | 10 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | Deep Sleep mode | Deep Sleep mode Control | | |
| 0 | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | A ₀ | | | | |
| | | | | | | | | | | | | | A[0] : | Description |
| | | | | | | | | | | | | | 0 | Normal Mode [POR] |
| | | | | | | | | | | | 1 | Enter Deep Sleep Mode | | |
| 0 | 0 | 11 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | Data Entry mode setting | Define data entry sequence A [1:0] = ID[1:0] Address automatic increment / decrement setting The setting of incrementing or decrementing of the address counter can be made independently in each upper and lower bit of the address. 00 –Y decrement, X decrement, 01 –Y decrement, X increment, 10 –Y increment, X decrement, 11 –Y increment, X increment [POR] A[2] = AM Set the direction in which the address counter is updated automatically after data are written to the RAM. AM= 0, the address counter is updated in the X direction. [POR] 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 Note: RAM are unaffected by this command. | | |



| R/W# | D/C# | Hex | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Command | Description |
|------|------|-----|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--|--|
| 0 | 0 | 1A | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | Temperature Sensor Control (Write to temperature register) | Write to temperature register. A[7:0] – MSByte 01111111[POR] B[7:0] – LSByte 11110000[POR] |
| 0 | 1 | | A ₇ | A ₆ | A ₅ | A ₄ | A ₃ | A ₂ | A ₁ | A 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 | Option for Display Update Bypass Option used for Pattern Display, which is used for display the RAM content into the Display OLD RAM Bypass option A [7] A[7] = 1: Enable bypass A[7] = 0: Disable bypass [POR] A[4] value will be used as for bypass. A[4] = 0 [POR] A[1:0] Initial Update Option - Source Control |
| 0 | 1 | | A ₇ | 0 | 0 | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | |

| | | |
|----------|-----|-----|
| A[1:0] | GSC | GSD |
| 01 [POR] | GS0 | GS1 |



| R/W# | D/C# | Hex | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | 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 | | |
| 0 | 1 | | A ₇ | A ₆ | A ₅ | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | | Parameter (in Hex) | |
| | | | | | | | | | | | | | Enable Clock Signal, Then Enable CP Then Load Temperature value Then Load LUT Then INITIAL DISPLAY Then PATTERN DISPLAY Then Disable CP Then Disable OSC | FF [POR] |
| | | | | | | | | | | | | | To Enable Clock Signal (CLKEN=1) | 80 |
| | | | | | | | | | | | | | To Enable Clock Signal, then Enable CP (CLKEN=1, CPEN=1) | C0 |
| | | | | | | | | | | | | | To INITIAL DISPLAY + PATTEN DISPLAY | 0C |
| | | | | | | | | | | | | | To INITIAL DISPLAY | 08 |
| | | | | | | | | | | | | | To DISPLAY PATTEN | 04 |
| | | | | | | | | | | | | | To Disable CP, then Disable Clock Signal (CLKEN=1, CPEN=1) | 03 |
| | | | | | | | | | | | | | To Disable Clock Signal (CLKEN=1) | 01 |
| | | | | | | | | | | | | Remark: CLKEN=1: If CLS=VDDIO then Enable OSC If CLS=VSS then Enable External Clock CLKEN=0: If CLS=VDDIO then Disable OSC AND INTERNAL CLOCK Signal = VSS, | | |
| 0 | 0 | 24 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | Write RAM | After this command, data entries will be written into the RAM until another command is written. Address pointers will advance accordingly. | | |
| 0 | 0 | 2C | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | Write VCOM register | Write VCOM register from MCU interface | | |
| 0 | 1 | | A ₇ | A ₆ | A ₅ | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | | | |



| R/W# | D/C# | Hex | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Command | Description | | | | | | | | | | | | | | | | |
|----------|-----------|-----|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------------------|---|--|---|--------|-----------|----|-----|----|-----|----|-----|---------|-----|--------|-----|-----|----------|
| 0 | 0 | 32 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | Write LUT register | Write LUT register from MCU [240 bits], (excluding the VSH/VSL and Dummy bit) | | | | | | | | | | | | | | | | |
| 0 | 1 | | LUT [30 bytes] | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ... | ... | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 3A | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | Set dummy line period | Set A[7:0] = 1Bh | | | | | | | | | | | | | | | | |
| 0 | 1 | | 0 | A ₆ | A ₅ | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 3B | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | Set Gate line width | Set B[3:0] = Bh | | | | | | | | | | | | | | | | |
| 0 | 1 | | 0 | 0 | 0 | 0 | A ₃ | A ₂ | A ₁ | A ₀ | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 3C | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | Border Waveform Control | Select border waveform for VBD A [7] Follow Source at Initial Update Display A [7]=0: [POR] A [7]=1: Follow Source at Initial Update Display for VBD, A [6:0] setting are being overridden at Initial Display STAGE. A [6] Select GS Transition/ Fix Level for VBD A [6]=0: Select GS Transition A[3:0] for VBD A [6]=1: Select FIX level Setting A[5:4] for VBD [POR] A [5:4] Fix Level Setting for VBD | | | | | | | | | | | | | | | | |
| 0 | 1 | | A ₇ | A ₆ | A ₅ | A ₄ | 0 | 0 | A ₁ | A ₀ | | | | <table border="1" style="margin-left: 20px;"> <tr> <td>A[5:4]</td> <td>VBD level</td> </tr> <tr> <td>00</td> <td>VSS</td> </tr> <tr> <td>01</td> <td>VSH</td> </tr> <tr> <td>10</td> <td>VSL</td> </tr> <tr> <td>11[POR]</td> <td>HiZ</td> </tr> </table> A [1:0] GS transition setting for VBD (Select waveform like data A[3:2] to data A[1:0]) <table border="1" style="margin-left: 20px;"> <tr> <td>A[1:0]</td> <td>GSA</td> <td>GSB</td> </tr> <tr> <td>01 [POR]</td> <td>GS0</td> <td>GS1</td> </tr> </table> | A[5:4] | VBD level | 00 | VSS | 01 | VSH | 10 | VSL | 11[POR] | HiZ | A[1:0] | GSA | GSB | 01 [POR] |
| A[5:4] | VBD level | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 00 | VSS | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 01 | VSH | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | VSL | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11[POR] | HiZ | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A[1:0] | GSA | GSB | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 01 [POR] | GS0 | GS1 | | | | | | | | | | | | | | | | | | | | | | | | | | |



| R/W# | D/C# | Hex | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Command | 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[4:0]: XSA[4:0], XStart, POR = 00h B[4:0]: XEA[4:0], XEnd, POR = 1Dh |
| 0 | 1 | | 0 | 0 | 0 | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | |
| 0 | 1 | | 0 | 0 | 0 | B ₄ | B ₃ | B ₂ | B ₁ | B ₀ | | |
| 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[8:0]: YSA[8:0], YStart, POR = 000h B[8:0]: YEA[8:0], YEnd, POR = 13Fh |
| 0 | 1 | | A ₇ | A ₆ | A ₅ | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | |
| 0 | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | A ₈ | | |
| 0 | 1 | | B ₇ | B ₆ | B ₅ | B ₄ | B ₃ | B ₂ | B ₁ | B ₀ | | |
| 0 | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 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[4:0]: XAD[4:0], POR is 00h |
| 0 | 1 | | 0 | 0 | 0 | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | |
| 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[8:0]: YAD8:0], POR is 000h |
| 0 | 1 | | A ₇ | A ₆ | A ₅ | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | |
| 0 | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | A ₈ | | |
| 0 | 1 | FF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | NOP | This command is an empty command; it does not have any effect on the display module. However it can be used to terminate Frame Memory Write or Read Commands. |

8 Reference Circuit

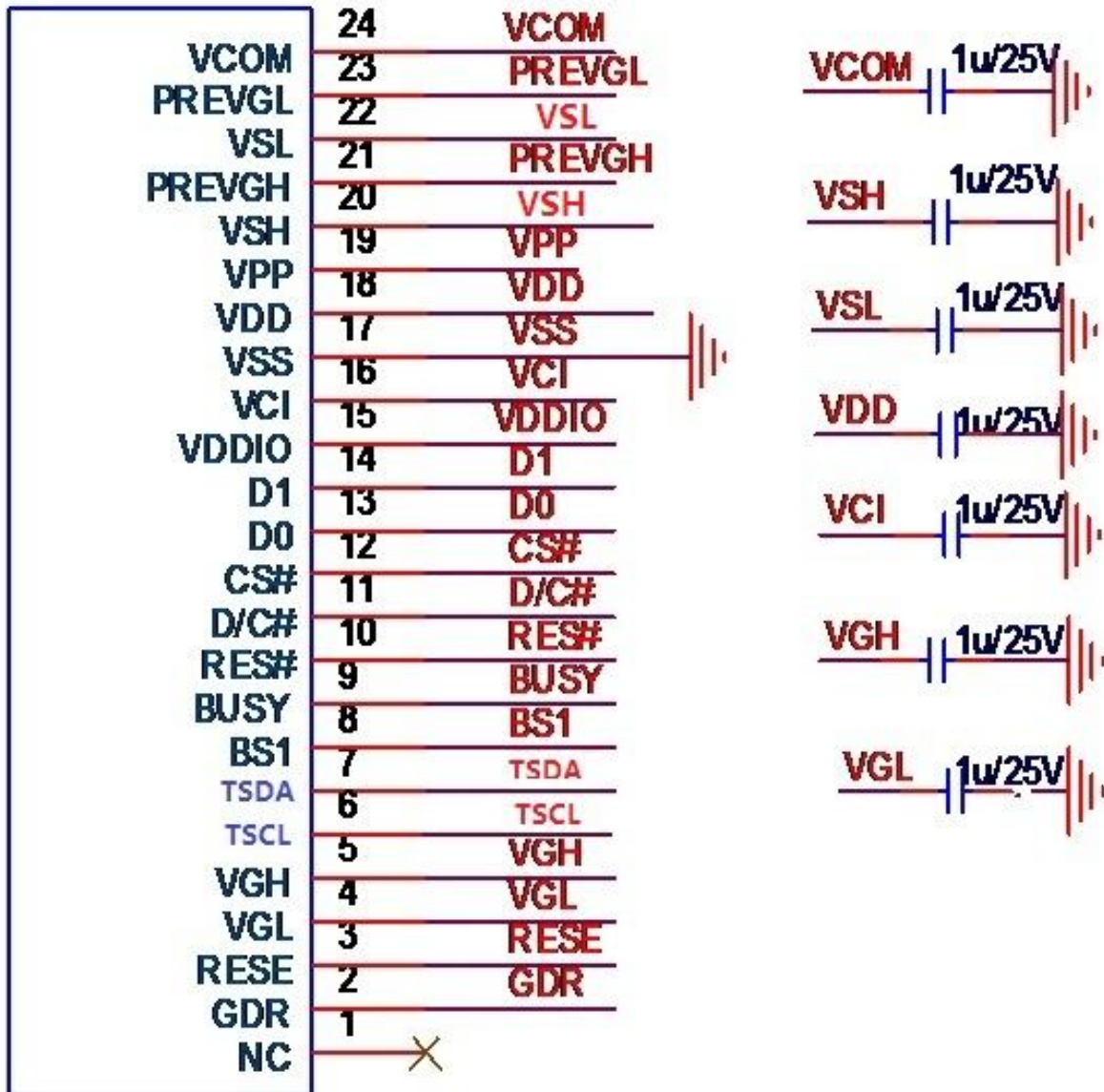


Figure . 8-1

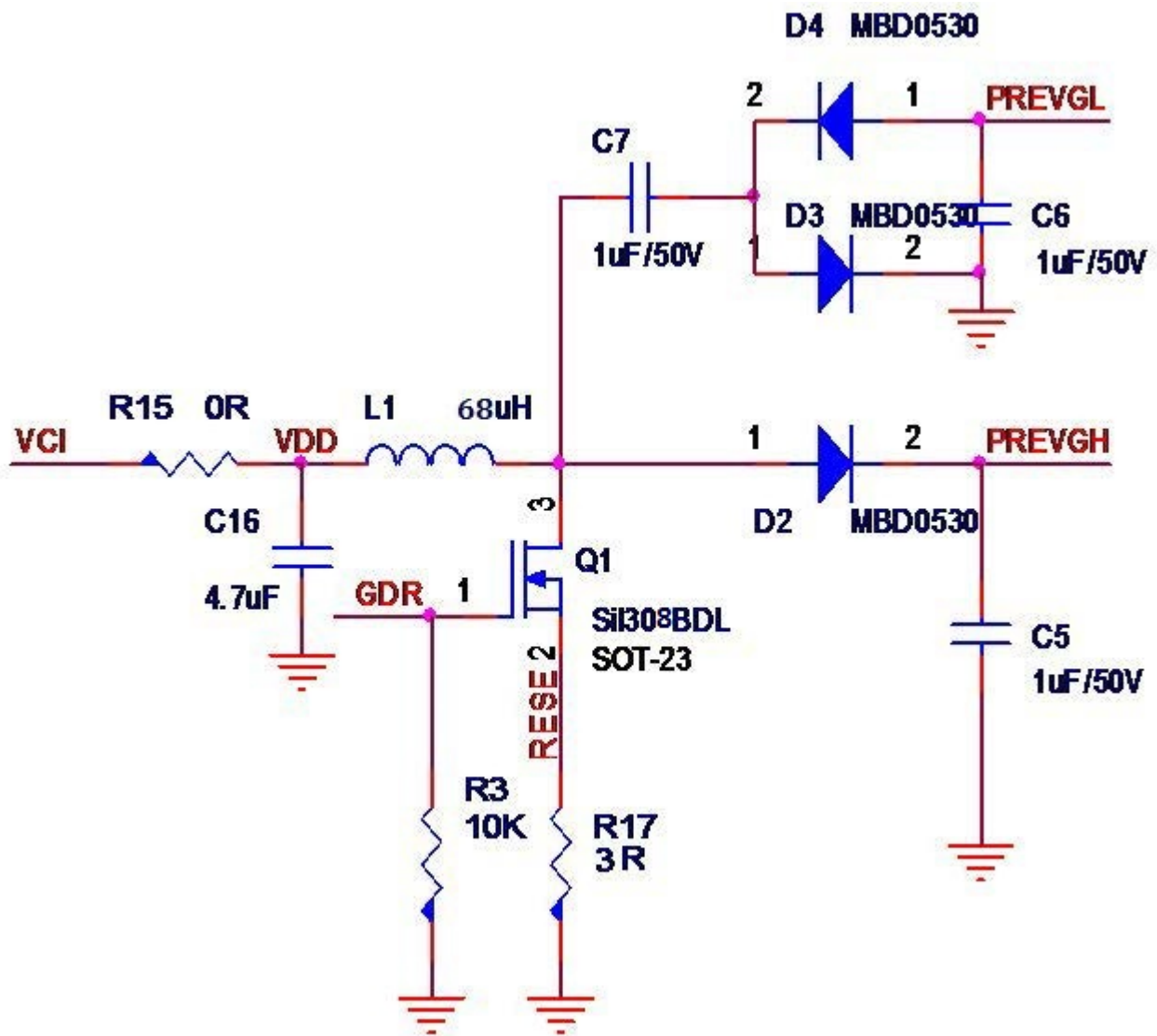


Figure . 8-2

9 MAXIMUM RATINGS

Table 9-1: Maximum Ratings

| Symbol | Parameter | Rating | Unit |
|------------------|-----------------------------|--------------|------|
| V _{CI} | Logic supply voltage | -0.5 to +4.0 | V |
| T _{OPR} | Operation temperature range | 0~50 | °C |
| T _{STG} | Storage temperature range | -25~60 | °C |

10 DC CHARACTERISTICS

The following specifications apply for: VSS=0V, VCI=3.3V, TOPR=25°C.

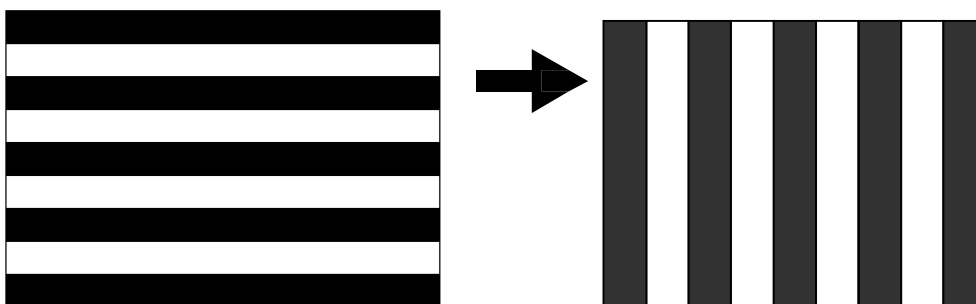
Table 10-1: DC Characteristics

| Symbol | Parameter | Test Condition | Applicable pin | Min. | Typ. | Max. | Unit |
|---------------------|---------------------------|----------------|-----------------------|----------|------|----------|------|
| V _{CI} | VCI operation voltage | - | VCI | 2.4 | 3.3 | 3.7 | V |
| V _{IH} | High level input voltage | - | D1 (SDIN), D0 (SCLK), | 0.8VDDIO | - | - | V |
| V _{IL} | Low level input voltage | - | CS#, D/C#, RES#, BS1, | - | - | 0.2VDDIO | V |
| V _{OH} | High level output voltage | IOH = -100uA | BUSY, TSDA, TSCL | 0.9VDDIO | - | - | V |
| V _{OL} | Low level output voltage | IOL = 100uA | | - | - | 0.1VDDIO | V |
| I _{update} | Module operating current | - | - | - | 6.5 | - | mA |
| I _{sleep} | Deep sleep mode | VCI=3.3V | - | - | 0.6 | 1 | uA |

- The Typical power consumption is measured using associated 25°C waveform with following pattern transition: from horizontal scan pattern to vertical scan pattern. (Note 10-1)
- The listed electrical/optical characteristics are only guaranteed under the controller & waveform provided by Good Display.
- Vcom value will be OTP before in factory or present on the label sticker.

Note 10-1

The Typical power consumption

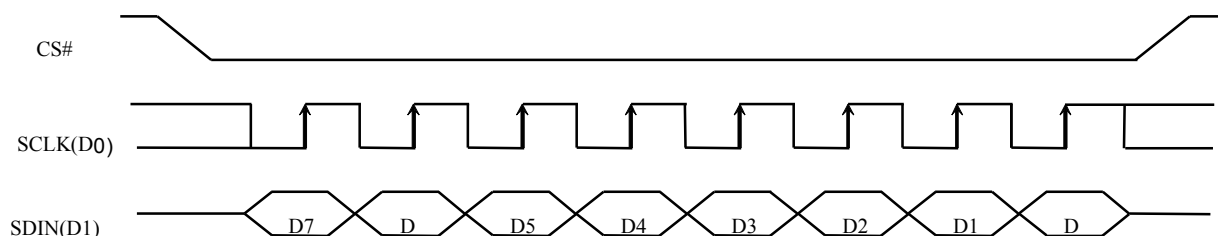
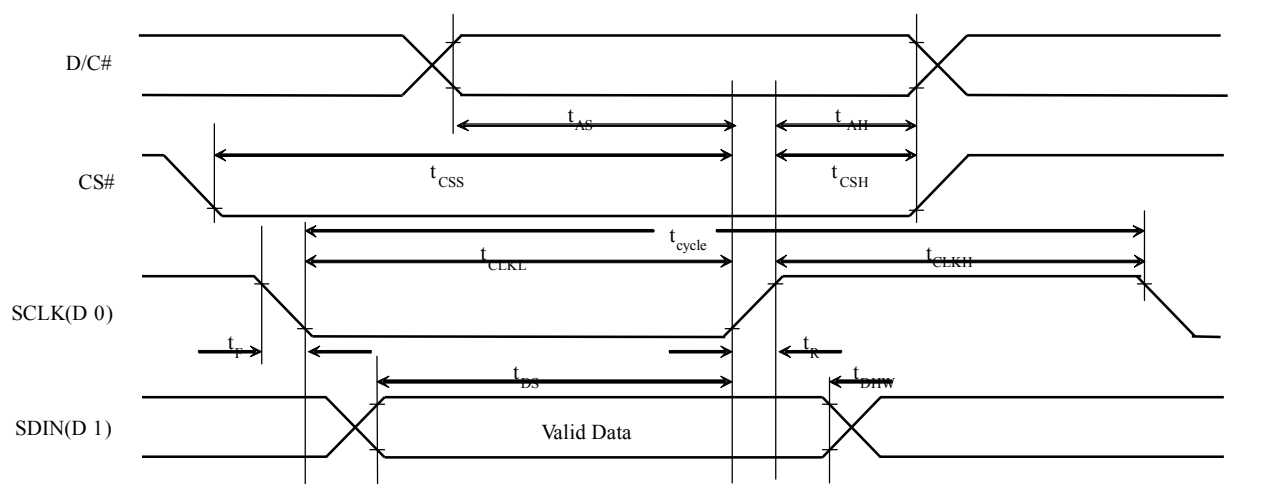




11 Serial Peripheral Interface Timing

The following specifications apply for: VSS=0V, VCI=2.4V to 3.7V, T_{OPR}=25°C

| Symbol | Parameter | Min | Typ | Max | Unit |
|--------------------|------------------------|-----|-----|-----|------|
| t _{cycle} | Clock Cycle Time | 250 | - | - | ns |
| t _{AS} | Address Setup Time | 150 | - | - | ns |
| t _{AH} | Address Hold Time | 150 | - | - | ns |
| t _{CSS} | Chip Select Setup Time | 120 | - | - | ns |
| t _{CSH} | Chip Select Hold Time | 60 | - | - | ns |
| t _{DSW} | Write Data Setup Time | 50 | - | - | ns |
| t _{DHW} | Write Data Hold Time | 15 | - | - | ns |
| t _{CLKL} | Clock Low Time | 100 | - | - | ns |
| t _{CLKH} | Clock High Time | 100 | - | - | ns |
| t _R | Rise Time [20% ~ 80%] | - | - | 15 | ns |
| t _F | Fall Time [20% ~ 80%] | - | - | 15 | ns |



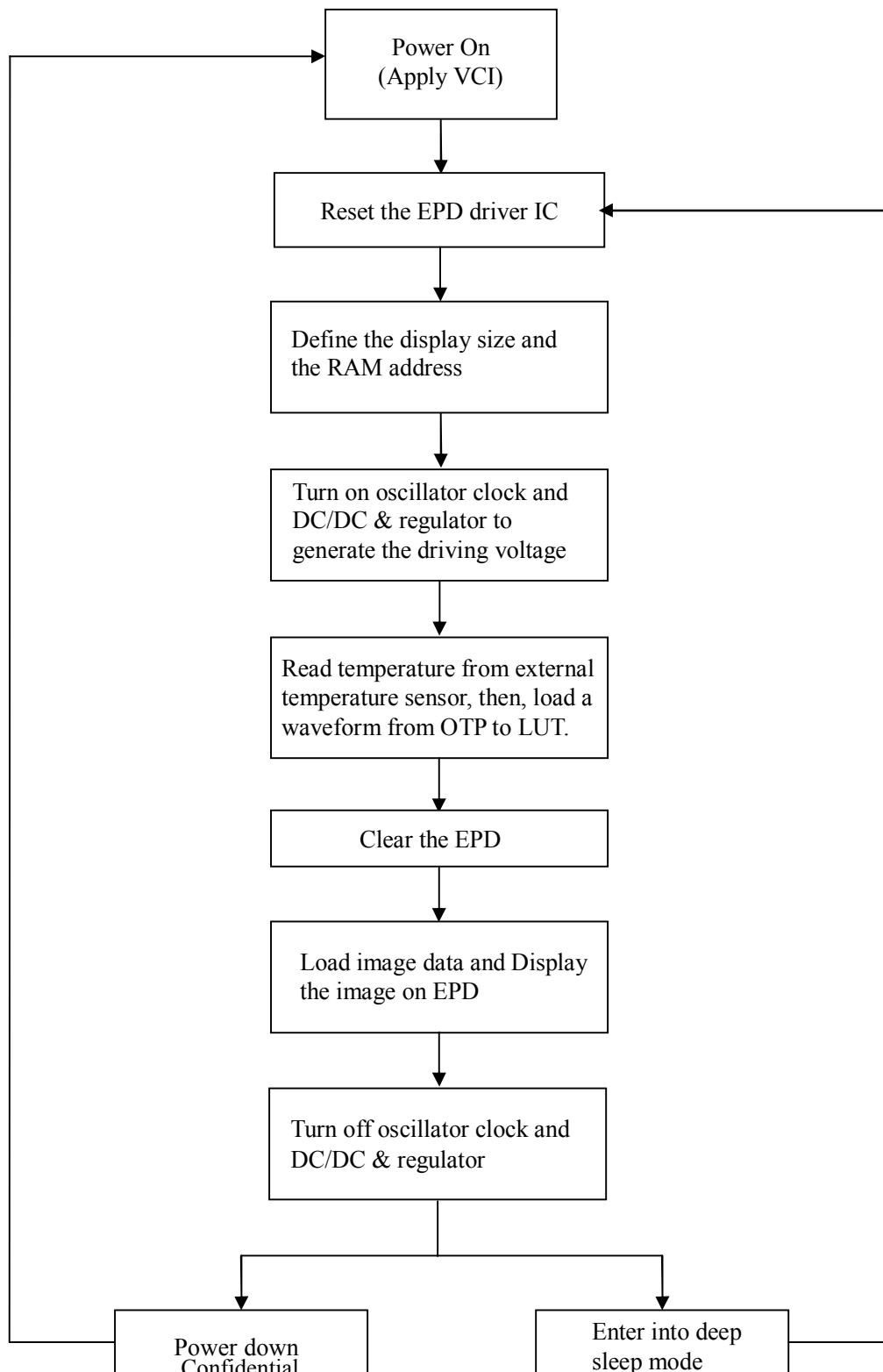
12 Power Consumption

| Parameter | Symbol | Conditions | TYP | Max | Unit | Remark |
|---------------------------------------|--------|------------|-----|-----|------|--------|
| Panel power consumption during update | - | 25°C | 13 | - | mAs | - |
| Deep sleep mode | - | 25°C | 0.6 | - | uA | - |

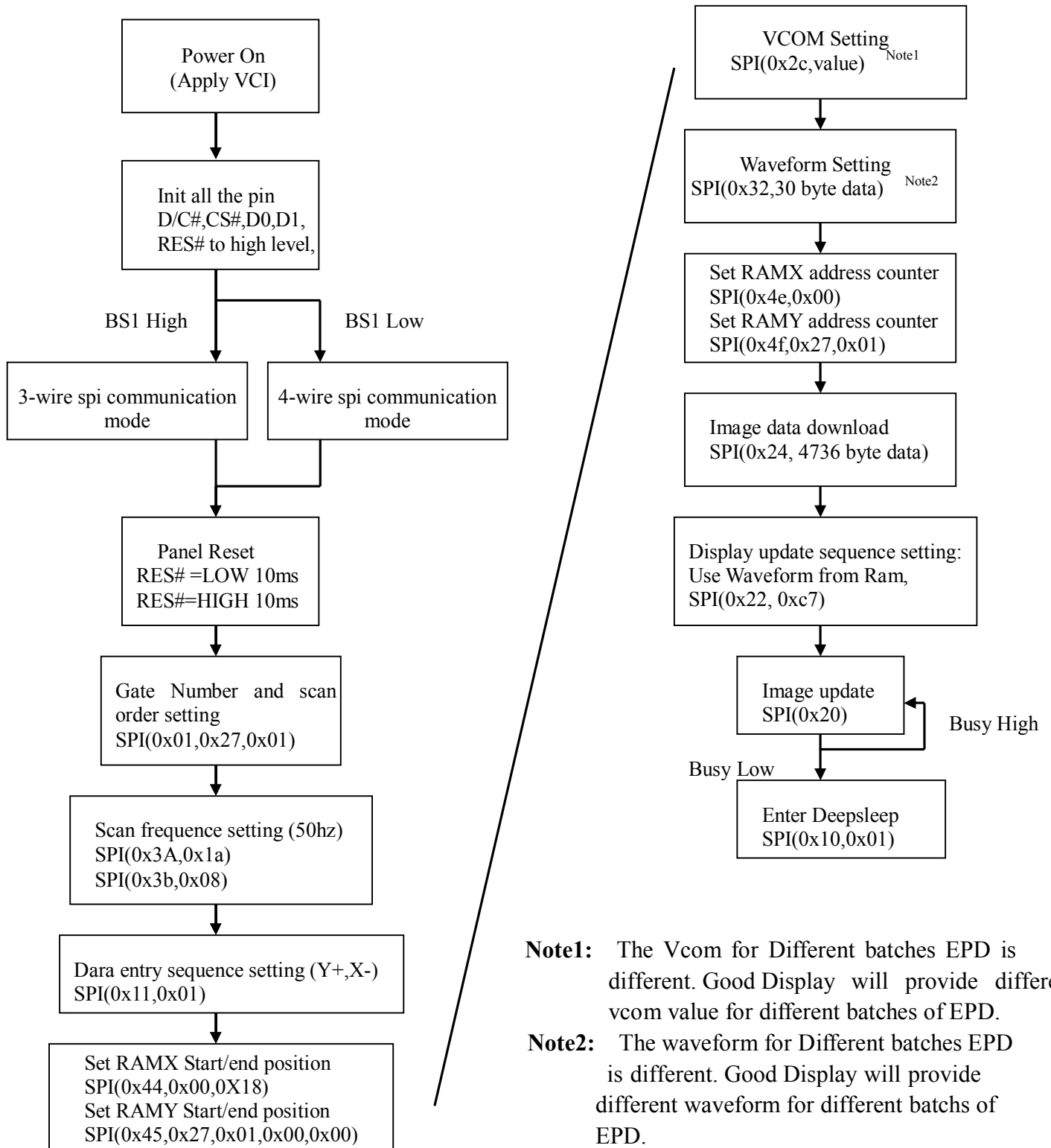


13 Typical Operating Sequence

13.1 Normal Operation Flow



13.2 Reference Program Code



Note1: The Vcom for Different batches EPD is different. Good Display will provide different vcom value for different batches of EPD.

Note2: The waveform for Different batches EPD is different. Good Display will provide different waveform for different batches of EPD.



14 Optical characteristics

14.1 Specifications

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

T=25°C

| SYMBOL | PARAMETER | CONDITIO NS | MIN | TYPE | MAX | UNIT | Note |
|--------------|----------------|----------------|-----|---------------------------|-----|------|-----------|
| R | Reflectance | White | 30 | 35 | - | % | Note 14-1 |
| Gn | 2Grey Level | - | - | $DS+(WS-DS)\times n(m-1)$ | - | L* | - |
| CR | Contrast Ratio | indoor | - | 10 | - | - | - |
| Panel's life | - | 0°C~50°C | | 5years or 1000000 times | - | - | Note 14-2 |

WS: White state, DS : Dark state

m: 2

Note 14-1: Luminance meter : Eye - One Pro Spectrophotometer

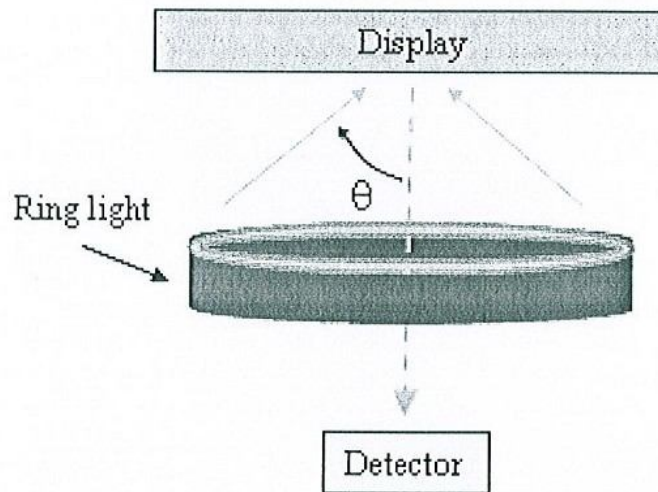
Note 14-2: We guarantee display quality from 10°C~30°C generally,If operation ambient temperature from 0°C~50°C, will add external temperature sensor .

14.2 Definition of contrast ratio

The contrast ratio (CR) is the ratio between the reflectance in a full white area (R1) and the reflectance in a dark area (Rd) :

R1: white reflectance Rd: dark reflectance

$$CR = R1/Rd$$

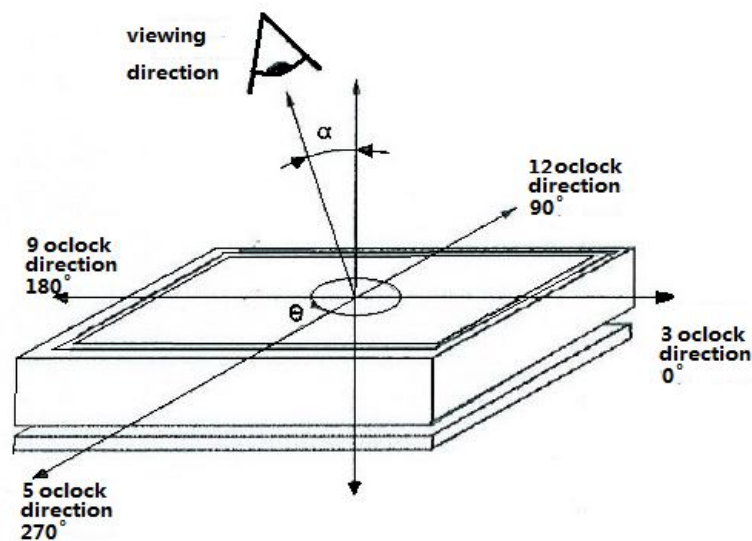


14.3 Reflection Ratio

The reflection ratio is expressed as :

$$R = \text{Reflectance Factor white board} \times (L_{\text{center}} / L_{\text{white board}})$$

L center is the luminance measured at center in a white area (R=G=B=1) . L white board is the luminance of a standard white board . Both are measured with equivalent illumination source . The viewing angle shall be no more than 2 degrees .





15 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.

IPA solvent can only be applied on active area and the back of a glass. For the rest part, it is not allowed.

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.

Mounting Precautions

(1) It's recommended that you consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module.

(2) It's recommended that you attach a transparent protective plate to the surface in order to protect the EPD. Transparent protective plate should have sufficient strength in order to resist external force.

(3) You should adopt radiation structure to satisfy the temperature specification.

(4) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the PS at high temperature and the latter causes circuit break by electro-chemical reaction.

(5) Do not touch, push or rub the exposed PS with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of PS for bare hand or greasy cloth. (Some cosmetics deteriorate the PS)

(6) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach the PS. Do not use acetone, toluene and alcohol because they cause chemical damage to the PS.

(7) Wipe off saliva or water drops as soon as possible. Their long time contact with PS causes deformations and color fading.

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 does not form part of the specification. |
|---|

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

| |
|------|
| ROHS |
|------|

| REMARK |
|---------------|
|---------------|

| |
|---|
| All The specifications listed in this document are guaranteed for module only. Post-assembled operation or component(s) may impact module performance or cause unexpected effect or damage and therefore listed specifications is not warranted after any Post-assembled operation. |
|---|



16. Reliability test

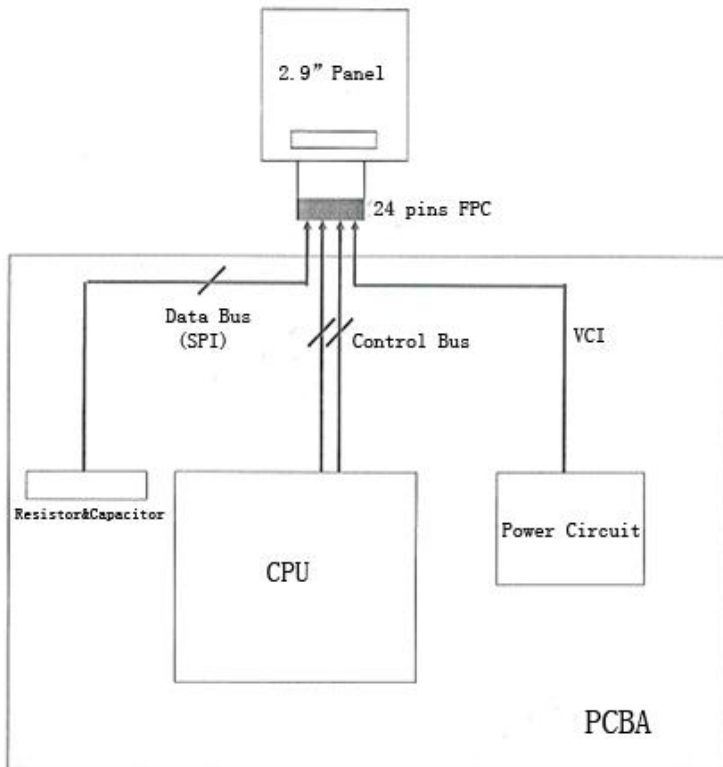
| | TEST | CONDITION | METHOD | REMARK |
|----|---|---|--------------------------|--------|
| 1 | High-Temperature Operation | T=50°C, RH=30%RH, For 240Hr | IEC 60 068-2-2Bb | |
| 2 | Low-Temperature Operation | T = 0°C for 240 hrs | IEC 60 068-2-2Ab | |
| 3 | High-Temperature Storage | T=70°C RH=40%RH For 240Hr Test in white pattern | IEC 60 068-2-2Bb | |
| 4 | Low-Temperature Storage | T = -25°C for 240 hrs Test in white pattern | IEC 60 068-2-2Ab | |
| 5 | High Temperature, High-Humidity Operation | T=40°C, RH=90%RH, For 168Hr | IEC 60 068-2-3CA | |
| 6 | High Temperature, High-Humidity Storage | T=60°C, RH=80%RH, For 480Hr Test in white pattern | IEC 60 068-2-3CA | |
| 7 | Temperature Cycle | -25°C(30min)~70°C(30min), 50 Cycle Test in white pattern | IEC 60 068-2-14NB | |
| 8 | Package Vibration | 1.04G,Frequency : 10~500Hz Direction : X,Y,Z Duration:1hours in each direction | Full packed for shipment | |
| 9 | Package Drop Impact | Drop from height of 122 cm on Concrete surface Drop sequence:1 corner, 3edges, 6face One drop for each. | Full packed for shipment | |
| 10 | UV exposure Resistance | 765 W/m ² for 168hrs,40°C | IEC 60068-2-5 Sa | |
| 11 | Electrostatic discharge | Machine model: +/-250V,0Ω,200pF | IEC61000-4-2 | |

Actual EMC level to be measured on customer application.

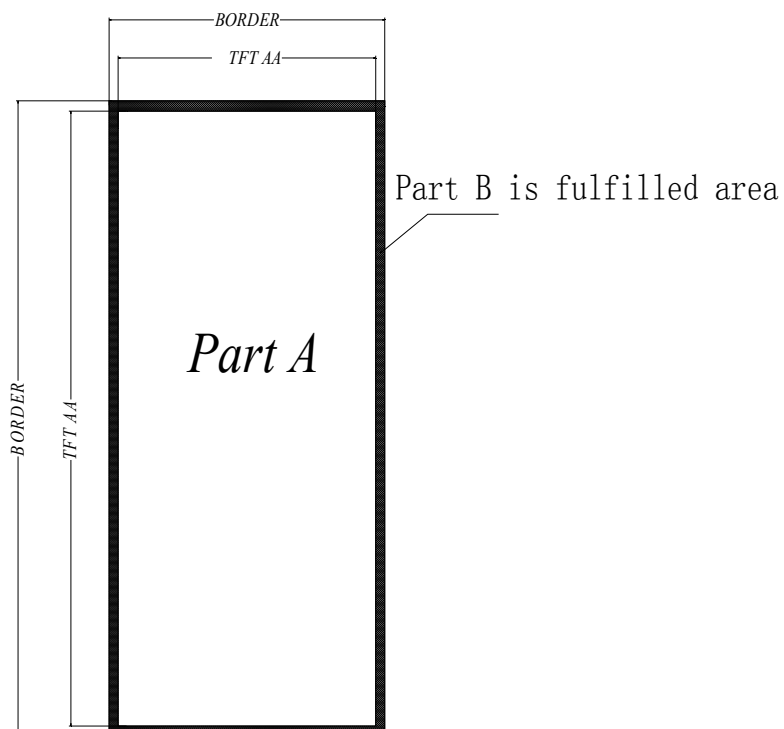
Note1: The protective film must be removed before temperature test.

Note2: Stay white pattern for storage and non-operation test.

17 Block Diagram

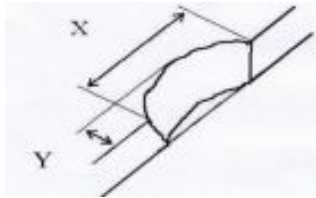


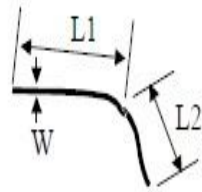
18 PartA/PartB specification





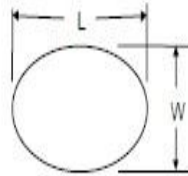
19 Point and line standard

| Shipment Inspection Standard | | | | | | |
|---|---|--|---------------|-------------|--------|-------------|
| Equipment: Electrical test fixture, Point gauge | | | | | | |
| Outline dimension | 36.7 (H) × 79(V) × 1.05(D) | Unit: mm | Part-A | Active area | Part-B | Border area |
| Environment | Temperature | Humidity | Illuminance | Distance | Time | Angle |
| | 19°C ~ 25°C | 55% ± 5%RH | 800 ~ 1300Lux | 300 mm | 35Sec | |
| Defet type | Inspection method | Standard | | Part-A | Part-B | |
| Spot | Electric Display | D ≤ 0.25 mm | | Ignore | Ignore | |
| | | 0.25 mm < D ≤ 0.4 mm | | N ≤ 4 | Ignore | |
| | | D > 0.4 mm | | Not Allow | Ignore | |
| Display unwork | Electric Display | Not Allow | | Not Allow | Ignore | |
| Display error | Electric Display | Not Allow | | Not Allow | Ignore | |
| Scratch or line defect(include dirt) | Visual/Film card | L ≤ 2 mm, W ≤ 0.2 mm | | Ignore | Ignore | |
| | | 2.0mm < L ≤ 5.0mm, 0.2 < W ≤ 0.3mm, | | N ≤ 2 | Ignore | |
| | | L > 5 mm, W > 0.3 mm | | Not Allow | Ignore | |
| PS Bubble | Visual/Film card | D ≤ 0.2mm | | Ignore | Ignore | |
| | | 0.2mm ≤ D ≤ 0.35mm & N ≤ 4 | | N ≤ 4 | Ignore | |
| | | D > 0.35 mm | | Not Allow | Ignore | |
| Side Fragment | Visual/Film card | X ≤ 5mm, Y ≤ 0.5mm, Do not affect the electrode circuit, Ignore | | | | |
| | |  | | | | |
| Remark | 1. Cannot be defect & failure cause by appearance defect; | | | | | |
| | 2. Cannot be larger size cause by appearance defect; | | | | | |
| | L=long W=wide D=point size N=Defects NO | | | | | |



$$L = L1 + L2$$

Line Defect



$$D = (L + W) / 2$$

Spot Defect

L=long W=wide D=point size

20.Packing

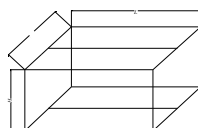
Packing Spec

Sheet No :

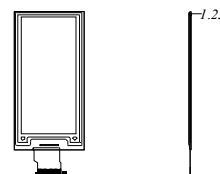
| | | | | | | | | |
|--|---------|-----------|------|--------------|-----|----|------|-----|
| | Part No | GDEH029A1 | DATE | 2017. 06. 22 | VER | A0 | Page | 2-1 |
|--|---------|-----------|------|--------------|-----|----|------|-----|

一, Package Type: Box

| | |
|-------------|-------------|
| Box No | GDEH029A1 |
| Box size | 515*322*170 |
| Containment | 240PCS |



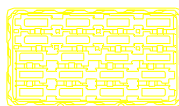
PRODUCT DRAWING



二, Inside package type: Plastic

Tray unit: mm

| | | |
|-----------------------|----------------|--------|
| Plastic Tray | 465*280*15 | 13 pcs |
| Anti-static foil bags | 700*530*0.1 | 1 pcs |
| EPE (inside) | 408.86*231.5*2 | 12 pcs |
| EPE (Up-Down) | 485*145*10 | 2 pcs |
| EPE (Left-Right) | 285*480*10 | 2 pcs |
| EPE (Front-back) | 310*145*10 | 2 pcs |
| Chip board | 500*306*5 | 2 pcs |
| Quantity/tray | 20 pcs | |
| Tray number/sheet | 12+1 Sheets | |
| Box | 1 | |



Step 1:

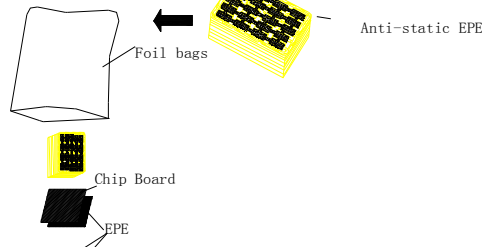
Material: Tray, EPE
Put the product in to the tray and keep the display side up. Then put anti-static EPE in to each holes.

Step 2:

1) Must keep the angle 180 degree placed between the neighboring Plastic trays.
2) There are 12 layers product, total 20*12=240 pcs.
3) An empty Plastic tray intersects put on the top of the plastic trays.

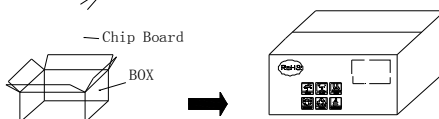
Step 3:

1) In each case, put 2 bags of desiccant, then seal the trays with adhesive tapes.
2) Put the trays into foil bags.
3) heat seal the foil bags.



Step 4:

1) First put a chip board on the bottom of the box, then placed the down EPE, the left - right and front -back EPE.
2) Placed the sealed products into the box.
3) The last placed the up EPE on the top of the trays, and place a chip board on it.



Step 5:

1) Seal the box with adhesive tapes .
2) Paste the lable onto the exterior box, and the lable can't cover the safety , transfer and RoSH sign.

| | | | | | |
|--------|--------------|---------|--------------|---------|--------------|
| Design | X. Z. P | Approve | J. P. F | Confirm | X.X.M |
| Date | 2017. 06. 22 | Date | 2017. 06. 22 | Date | 2017. 06. 22 |



Packing Spec

Sheet No

| | | | | | | | | |
|--|---------|-----------|------|------------|-----|----|------|-----|
| | Part No | GDEH029A1 | Date | 2017.06.22 | VER | A0 | Page | 2-2 |
|--|---------|-----------|------|------------|-----|----|------|-----|

The label outside the carton print as below

| | | | |
|------------------------------|-------------------------|--------------|----|
| | Packing Label 出货包装标签 | | |
| CUSTOMER: 客户名称: | | | |
| CUSTOMER P/N: 客户产品编码: | | | |
| CUSTOMER P/O: 客户订单号: | | | |
| GOOD DISPLAY P/N: 佳显产品编码: | | | |
| N/W: 净重: | KG | G/W: 毛重: | KG |
| C/N: 箱号: | of | | |
| QTY: 数量: | PCS | DATE: 日期: | |
| REMARK: 备注: | | | |
| SHIP FROM: 发货地址: | | | |
| SHIP TO: 收货地址: | | | |
| PACKAGE-ID: 外箱ID: | | | |

| | | | | | |
|--------|------------|---------|------------|---------|------------|
| Design | X. Z. P | Approve | J. P. F | Confirm | X.X.M |
| Date | 2017.06.22 | Date | 2017.06.22 | Date | 2017.06.22 |