**Version: 0.2**

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## Technical Specification

## MODEL NO:    5.65inch e-Paper (F)

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The content of this information is subject to be changed without notice.

Please contact Waveshare for further information

# Revision History

| Rev. | Issued Date | Revised Contents |
|------|-------------|------------------|
| 0.1 | 2019.10.16 | Tentative |
| 0.1 | 2019.10.30 | Preliminary |
| 0.2 | 2019.11.19 | Update Page 17: Remove R65H (DAM) SPI Flash control |
| | | |
| | | |
| | | |
| | | |

# *TECHNICAL SPECIFICATION*

# <u>*CONTENTS*</u>

# 1. General Description

This is a reflective electrophoretic E Ink® technology display module on an active matrixTFT substrate. The diagonal length of the active area is 5.65" and contains 600 x 448 pixels. The panelis capable of displaying 7-colors of black, white, red, yellow, blue, green, and orange images depending on the associated lookup table used. The circuitry on the panel includes an integrated gate and source driver, timing controller, oscillator, DC-DC boost circuit, and memory to store the frame buffer and lookup tables, and additional circuitry to control VCOM and BORDER settings.

# 2. Features

7-color ACeP display

High contrast TFT electrophoretic

600 x 448 display

High reflectance

Ultra wide viewing angle

Ultra low power consumption

Pure reflective mode

Bi-stable

Low current sleep mode

On chip display RAM

Serial Peripheral Interface

External SPI flash/eeprom for waveform

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

Operational temperature range (15 ~ 35℃)

# 3. Mechanical Specifications

| Parameter | Specifications | Unit | Remark |
|---|---|---|---|
| Screen Size | 5.65" | Inch | - |
| Display Resolution | 600 (H) × 448 (V) | Pixel | 132 dpi |
| Active Area | 114.9 (H) × 85.8 (V) | mm | - |
| Pixel Pitch | 191.5 (H) × 191.5 (V) | um | - |
| Pixel Configuration | Square | | - |
| Outline Dimension | 125.4 (H) × 99.5 (V) × 0.91 (D) | mm | Without protective film |
| Weight | TBD | g | - |
| Number of Colors | Black, White, Red, Yellow, Blue, Green and Orange | | |
| Display operating mode | Reflective mode | | |

# 4. Mechanical Drawing of EPD module



Note:
1. General tolerance is +/-0.2mm
2. Dimension in ( ) is for reference
3. Component height max. : 0.9mm
4. U1 flash IC : L=3±0.1mm  W=2±0.1mm  T=0.55±0.05mm
5. Unwelded component : C4 & C5

24.01 ±0.30
99.50 ±0.20(TFT)
( 93.80(FPS) )
( 90.29(FPL) )
85.79 ±0.10(AA)
5.25 ±0.30
4.60 ±0.30
55.47 ±0.30
125.40 ±0.20(TFT)
( 122.50(FPS) )
( 119.10(FPL) )
114.90 ±0.10(AA)

A

0.50 ±0.10
12.50 ±0.10
11.50 ±0.07
0.35 ±0.03
0.50 ±0.03
3.67 ±0.30

細部放大圖 A
比例 5:1

0.30 ±0.03
1.20 max.(UV glue)
1.08 max.
0.95 ±0.10(EPD+PF)
0.91 ±0.10(EPD)

Stiffener

PS
EC
non-scale
0.065 max.(thickness of EC over PS)

| MATERIAL | HEAT&SURFACE TREATMENT | | | | |
| APPROVE | Patrick Lin | | | SCALE 1:2 | UNIT mm |
| CHECK | Patrick Lin | | | | |
| DESIGN | Hero Wu | | | | |

| REV. | DESCRIPTION | DESIGN | DATE |
| 0.1 | Initial release | Hero Wu | 2019/11/14 |

# 5. Input/Output Terminals

## 5-1) Connector type: AYF532435

## Pin Assignment

| Pin # | Type | Single | Description | Remark |
|-------|------|--------|-------------|--------|
| 1 | I | MFCSB | MCU to flash/EEprom chip select | |
| 2 | O | GDR | N-Channel MOSFET Gate Drive Control | |
| 3 | O | RESE | Current Sense Input for the Control Loop | |
| 4 | P | VSL_LV | Negative source driver voltage (low voltage) | |
| 5 | P | VSH_LV | Positive source driver voltage (low voltage) | |
| 6 | O | TSCL | I2C Interface to digital temperature sensor Clock pin | |
| 7 | I/O | TSDA | I2C Interface to digital temperature sensor Data pin | |
| 8 | I | BS1 | Bus selection pin;　　　L: 4-wire IF.　H: 3-wire IF. (Default) | |
| 9 | O | BUSY | Busy state output pin | |
| 10 | I | RES# | Reset | |
| 11 | I | D/C # | Data /Command control pin | |
| 12 | I | CS # | Chip Select input pin | |
| 13 | O | SCL | Serial clock pin (SPI) | |
| 14 | I/O | SDA | Serial data pin (SPI) | |
| 15 | P | VDDIO | Power for interface logic pins | |
| 16 | P | VCI | Power Supply pin for the chip | |
| 17 | P | VSS | Ground | |
| 18 | P | VDD | Core logic power pin | |
| 19 | O | FMSDO | Flash/EEprom to MCU data output | Cannot share pin with SDA of SPI. |
| 20 | P | VSH | Positive Source driving voltage | |
| 21 | P | VGH | Power Supply pin for VGH , VSH and VSH_LV | |
| 22 | P | VSL | Negative Source driving voltage | |
| 23 | P | VGL | Power Supply pin for VCOM, VGL, VSL and VSL_LV | |
| 24 | P | VCOM | VCOM driving voltage | |

## 5-2) Panel Scan direction
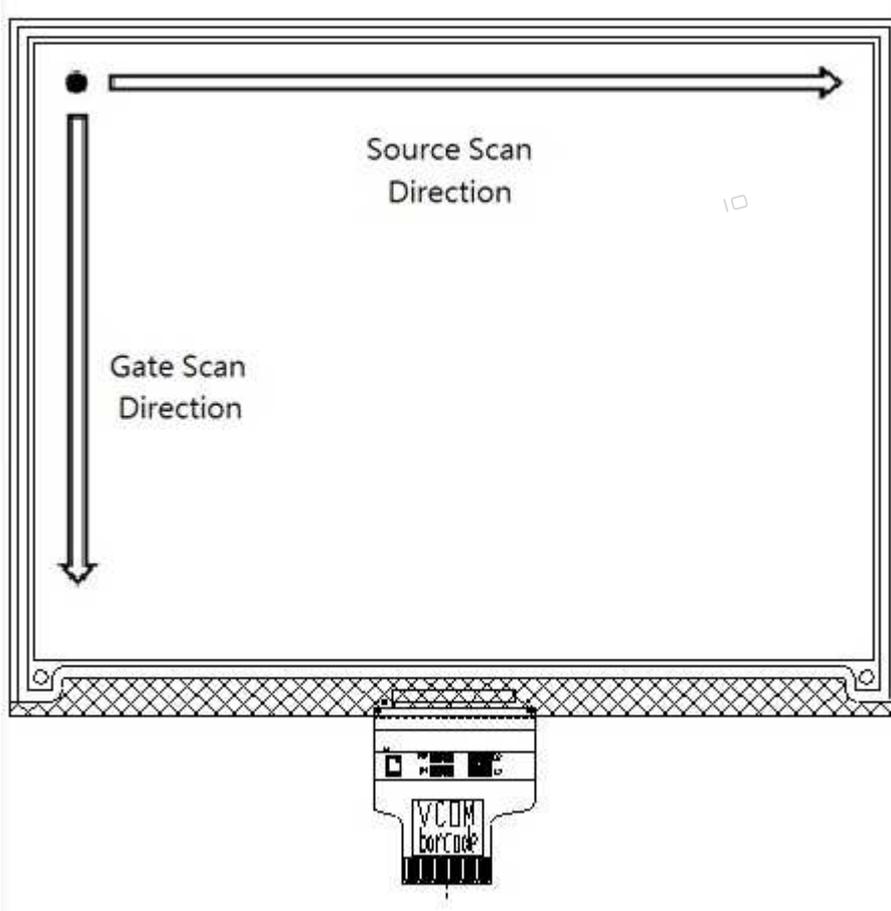
## 6. Command Table
### 6-1) Register Definition

### 6-1-1) R00H (PSR): Panel setting Register

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Setting the panel | 0 | 0 | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 0 | 1 | 1 | 1 | - | - | UD | SHL | SHD_N | RST_N |
| | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |

*NOTE: "-" Don't care, can be set to VDD or GND level*

| | | | |
|---|---|---|---|
| **UD:** | **0: Scan down. (Default)** | First line to Last line: Gn-1 → Gn-2 → Gn-3 → … → G0 |
| | 1: Scan up. | First line to Last line: G0 → G1 → G2 → … … . → Gn-1 |
| **SHL:** | 0: Shift left. | First data to Last data: Sn-1 → Sn-2 → Sn-3 → … → S0 |
| | **1: Shift right. (Default)** | First data to Last data: S0 → S1 → S2 → … … . → Sn-1 |

**SHD_N:**     0: DC-DC converter will be turned OFF

               **1: DC-DC converter will be turned ON    (Default)**

When SHD_N become LOW, charge pump will be turned OFF, register and SRAM data will keep until VDD OFF, and SD output and VCOM will remain previous condition. SD output and Vcom may have two conditions: 0v or floating.

**RST_N:**     0: The controller is reset. Reset all registers to default value.

               **1: No effect    (Default)**

When RST_N become LOW, the driver will be reset, all registers will be reset to their default value. All driver functions will be disabled. SD output and VCOM will be 0V.

This command can be active only when BUSY_N = "1".

### 6-1-2) R01H (PWR): Power setting Register

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Selecting Internal/External Power | 0 | 0 | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** |
| | 0 | 1 | - | - | 0 | 0 | 0 | VSH/VSL | VSH_LV/VSL_LV | VDG_EN |
| | 0 | 1 | - | - | - | - | - | - | 0 | 0 |
| | 0 | 1 | - | - | - | - | - | - | - | - |
| | 0 | 1 | - | - | - | - | - | - | - | - |

*NOTE: "-" Don't care, can be set to VDD or GND level*

**VDS_EN:**  Source power selection (low powers)

0 : External source power from VSH_LV/ VSL_LV pins

1 : Internal DC/DC function for generating VDH/VDL

**VDG_EN:**  Gate power selection

0 : External gate power from VGH/VGL pins

1 : Internal DC/DC function for generating VGH/VGL

### 6-1-3) R02H (POF): Power OFF Command

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Turning OFF the power | 0 | 0 | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** |

After the Power Off command, driver will power off based on the Power Off Sequence, BUSY_N will become "0". This command will turn off DC - DC, source driver, gate driver, VCOM, and temperature sensor, but register data will be kept until VDD becomes OFF.

SD output will base on previous condition. It may have 2 conditions: 0V or floating.

This command can be active only when BUSY_N = "1".

## 6-1-4) R03H (PFS): Power off sequence setting Register

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Setting Power OFF sequence | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | 0 | 1 | - | - | T_VDS_OFF[1:0] | | - | | - | |

*NOTE: "-" Don't care, can be set to VDD or GND level*

**T_VDS_OFF[1:0]:**    Power OFF Sequence of VGH/VGL and VSH/VSL.

   **00b: 1 frame (Default)**        01b: 2 frames        10b: 3 frames        11b: 4 frame

This command can be active only when BUSY_N = "1".

## 6-1-5) R04H (PON): Power ON Command

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Turning ON the power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

After the Power ON command, the driver will be powered ON following the Power ON Sequence. After the Power ON command and all power sequence are ready, the BUSY_N signal will become "1". Refer to the Power ON Sequence section.

## 6-1-6) R06h (BTST): Booster Soft Start

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Starting data transmission | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |

*NOTE: "-" Don't care, can be set to VDD or GND level*

## 6-1-7) R07H (DSLP): Deep sleep

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Deep sleep | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |

*NOTE: "-" Don't care, can be set to VDD or GND level*

This command makes the chip enter the deep-sleep mode. The deep sleep mode could return to stand-by mode by hardware reset assertion.

The only one parameter is a check code, the command would be executed if check code is A5h.

### 6-1-8) R10H (DTM1): Data Start Transmission 1

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Starting data transmission | 0 | 0 | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** |
| | 0 | 1 | - | KPixel2[2:0] | | | - | KPixel2[2:0] | | |
| | 0 | 1 | ... | | | ... | ... | | | ... |
| | 0 | 1 | - | KPixel(2M-1)[2:0] | | | - | KPixel(2M)[2:0] | | |

*NOTE: "-" Don't care, can be set to VDD or GND level*

This command indicates that user starts to transmit data. Then write to SRAM. While complete data transmission, user must send a DataStop command (R11H). Then the chip will start to send data/VCOM for panel..

**KPixel[1~2M][2:0]:**

| | Source Driver Output | |
|---|---|---|
| | **DDX=1(Default)** | **DDX=0** |
| **KPixel[2:0]** | **LUT** | **LUT** |
| 000 | Black | Blue |
| 001 | White | Green |
| 010 | Green | White |
| 011 | Blue | Black |
| 100 | Red | Clean |
| 101 | Yellow | Orange |
| 110 | Orange | Yellow |
| 111 | Clean | Red |

### 6-1-9) R11H (DSP): Data Stop

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Stopping data transmission | 0 | 0 | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **1** |
| | 1 | 1 | data_flag | - | - | - | - | - | - | - |

*NOTE: "-" Don't care, can be set to VDD or GND level*

To stop data transmission, this command must be issued to check the data_flag.

Data_flag:     Data flag of receiving user data.

        0: Driver didn't receive all the data.

        1: Driver has already received all the one-frame data (DTM1).

This command can be active only when BUSY_N = "1".

After "Data Stop" (11h) commands, BUSY_N signal will become "0" until display update is finish.

## 6-1-10) R12H (DRF): Display Refresh

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Refreshing the display | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |

After this command is issued, driver will refresh display (data/VCOM) according to SRAM data and LUT.

After Display Refresh command, BUSY_N signal will become "0" until display update id finished.

## 6-1-11) R13H (IPC): Image Process Command

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Image Process Setting | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |
| | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## 6-1-12) R30H (PLL): PLL Control

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Controlling PLL | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| | 0 | 1 | 0 | 0 | M[2:0] | | | N[2:0] | | |

The command controls the PLL clock frequency. The PLL structure supports the following frame rates:

(FR: Frame Rate, Unit: Hz)

| D[5:0] | Frame Rate Selection |
|---|---|
| 00h | 12.5Hz |
| 01h | 25Hz |
| .... | ... |
| 0Eh | 187.5Hz |
| 0Fh | 200Hz |
| 39h | 200Hz |
| 3Ah | 100Hz |
| 3Ch | 50Hz |
| Other | 50Hz |

### 6-1-13) R40H (TSC) Temperature Sensor Command

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Sensing Temperature | 0 | 0 | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | A11 | A10 | A9 | A8 | A7 | A6 | A5 | A4 |
| | 1 | 1 | A3 | A2 | A1 | A0 | - | - | - | - |

This command reads the temperature sensed by the temperature sensor.

**A[11:4] ~TS[7:0]:**    When TSE (R41h) is set to 0, this command reads internal temperature sensor value.

**A[11:0]:**    When TSE (R41h) is set to 1, this command reads external LM75 temperature sensor value.

| TS[7:0] | Temperature(℃) |
|---|---|
| E7h | -25 |
| E8h | -24 |
| … | … |
| FFh | -1 |
| 00h | 0 |
| … | … |
| 18h | 24 |
| 19h | 25 |
| … | … |
| 3B | 59 |
| 3C | 60 |

### 6-1-14) R41H (TSE) Temperature Sensor Enable

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Calibrate Temperature Sensor | 0 | 0 | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **1** |
| | 0 | 1 | TSE | - | - | - | TO[3:0] | | | |

This command selects Internal or External temperature sensor.

**TSE:**      Internal temperature sensor switch

         **0: Enable (default)**        1: Disable; using external sensor.

**TO[3:0]:** Temperature Offset

| TO[3:0] | Temperature Offset | TO[3:0] | Temperature Offset |
|---|---|---|---|
| 0000 | +0(Default) | 1000 | -8 |
| 0001 | +1 | 1001 | -7 |
| 0010 | +2 | 1010 | -6 |
| 0011 | +3 | 1011 | -5 |
| 0100 | +4 | 1100 | -4 |
| 0101 | +5 | 1101 | -3 |
| 0110 | +6 | 1110 | -2 |
| 0111 | +7 | 1111 | -1 |

### 6-1-15) R42H (TSW) Temperature Sensor Write

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Temperature Sensor Write | 0 | 0 | **0** | **1** | **0** | **0** | **0** | **0** | **1** | **0** |
| | 0 | 1 | WATTR[7:0] | | | | | | | |
| | 0 | 1 | WMSB[7:0] | | | | | | | |
| | 0 | 1 | WLSB[7:0] | | | | | | | |

This command reads the temperature sensed by the temperature sensor.

**WATTR:**    **D[7:6]:**    $I^2C$ Write Byte Number

                 00 : 1 byte (head byte only)

                 01 : 2 bytes (head byte + pointer)

                 10 : 3 bytes (head byte + pointer + 1st parameter)

                 11 : 4 bytes (head byte + pointer + 1st parameter + 2nd parameter)

         **D[5:3]:**    User-defined address bits (A2, A1, A0)

         **D[2:0]:**    Pointer setting

WMSB[7:0]: MSByte of write-data to external temperature sensor

WLSB[7:0]: LSByte of write-data to external temperature sensor

**6-1-16) R43H (TSR) Temperature Sensor Read**

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | **0** | **1** | **0** | **0** | **0** | **0** | **1** | **1** |
| Temperature Sensor Read | 1 | 1 | RMSB[7:0] | | | | | | | |
| | 1 | 1 | RLSB[7:0] | | | | | | | |

This command reads the temperature sensed by the external temperature sensor.

**RMSB[7:0]:** MSByte read data from external temperature sensor

**RLSB[7:0]:** LSByte read data from external temperature sensor

**6-1-17) R50H (CDI) VCOM and Data interval setting**

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Set Interval between VCOM | 0 | 0 | **0** | **1** | **0** | **1** | **0** | **0** | **0** | **0** |
| and data | 1 | 1 | VBD[2:0] | | | DDX | CDI[3:0] | | | |

This command indicates the interval of Vcom and data output. When setting the vertical back porch, the total blanking will be kept
(20 Hsync).

**VBD[2:0]:** Border output selection

**DDX:** Data polarity.

| | Border Output | |
|---|---|---|
| | **DDX=1(Default)** | **DDX=0** |
| **VBD[2:0]** | **LUT** | **LUT** |
| 000 | Black | Blue |
| 001 | White | Green |
| 010 | Green | White |
| 011 | Blue | Black |
| 100 | Red | HIZ |
| 101 | Yellow | Orange |
| 110 | Orange | Yellow |
| 111 | HIZ | Red |

**CDI[3:0]:** Vcom and data interval

| CDI[3:0] | VCOM and Data interval | CDI[3:0] | VCOM and Data interval |
|---|---|---|---|
| 0000b | 17 hsync | 1000b | 9 |
| 0001 | 16 | 1001 | 8 |
| 0010 | 15 | 1010 | 7 |
| 0011 | 14 | 1011 | 6 |
| 0100 | 13 | 1100 | 5 |
| 0101 | 12 | 1101 | 4 |
| 0110 | 11 | 1110 | 3 |
| 0111 | 10(Default) | 1111 | 2 |
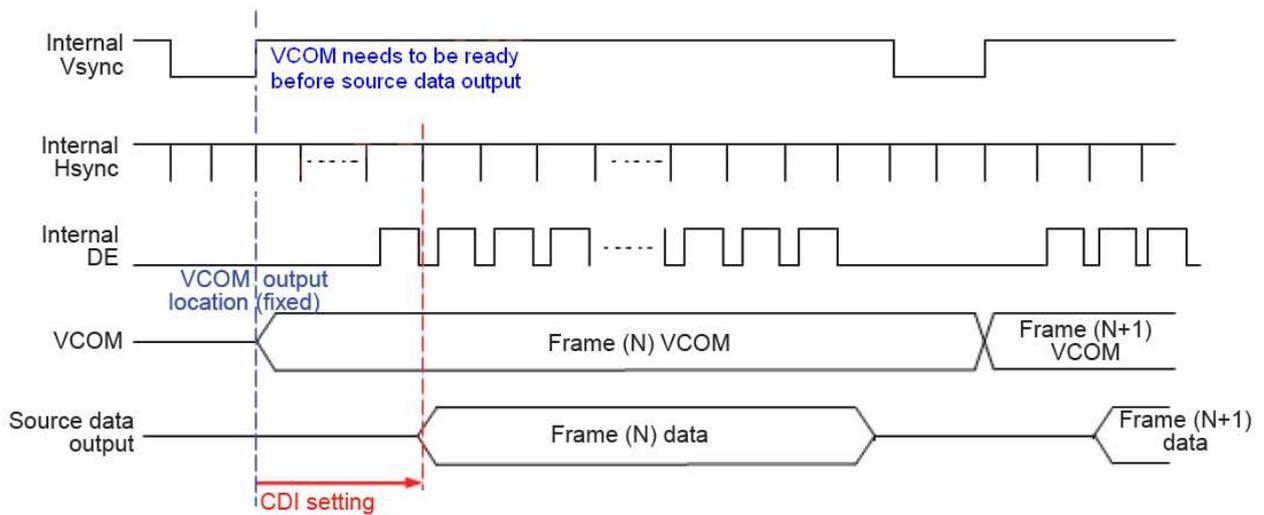


### 6-1-18) R51H (LPD) Low Power Detection

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Detect Low Power | 0 | 0 | **0** | **1** | **0** | **1** | **0** | **0** | **0** | **1** |
|  | 1 | 1 | - | - | - | - | - | - | - | LPD |

This command indicates the input power condition. Host can read this flag to learn the battery condition.

**LPD:** Internal temperature sensor switch

0: Low power input (VDD<2.5V)        **1: Normal status (default)**

## 6-1-19) R61H (TRES) Resolution Setting

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Set Display Resolution | 0 | 0 | **0** | **1** | **1** | **0** | **0** | **0** | **0** | **1** |
| | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |

## 6-1-20) R71H (FLG) Get Status

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Read Flags | 0 | 0 | **0** | **1** | **1** | **1** | **0** | **0** | **0** | **1** |
| | 1 | 1 | - | - | $I^2C\_ERR$ | $I^2C\_$ BUSYN | data_ flag | PON | POF | BUSY_ N |

This command reads the IC status.

**$I^2C\_ERR$:** $I^2C$ master error status

**$I^2C\_BUSYN$:** $I^2C$ master busy status (low active)

**data_flag:** Driver has already received all the one frame data

**PON:** Power ON status

**POF:** Power OFF status

**BUSY_N:** Driver busy status (low active)

## 6-1-21) R81H (VV) VCOM value

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Automatically measure Vcom | 0 | 0 | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **1** |
| | 1 | 1 | - | VV[6:0] | | | | | | |

This command gets the Vcom value.

**VV[6:0]:** Vcom Value Output

| VV[6:0] | VCOM Value |
|---|---|
| 000 0000b | (Reserved) |
| 000 0001b | (Reserved) |
| 000 0010b | -0.10V |

| 000 0011b | -0.15V |
| 000 0100b | -0.20V |
| : | : |
| 101 0000b | -4.0V |
| (others) | -4.0V |

## 6-1-22) R82H (VDCS) VCM_DC Setting

| Action | W/R | C/D | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Set VCM_DC | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | 0 | 1 | - | VDCS[6:0] | | | | | | |

This command sets VCOM_DC value

**VDCS[6:0]:** Vcom_DC setting

| VDCS[6:0] | VCOM_DC value |
|---|---|
| 000 0000b | (Reserved) |
| 000 0001b | (Reserved) |
| 000 0010b | -0.10 V |
| 000 0010b | -0.15V |
| 000 1100b | -0.20V |
| … | … |
| 101 0000b | -4.0V |
| (others) | -4.0V |

# 7. Electrical Characteristics
## 7-1) Absolute Maximum Ratings (TBD)

| Item | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Logic Supply Voltage | VCI | -0.3 | +4.0 | V |
| Tst | Storage Temperature | (-25) | (60) | ℃ |
| Tot | Operating Temperature | (15) | (35) | ℃ |

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 chapter.

## 7-2) Panel DC characteristics

| DIGITAL DC CHARACTERISTICS | | | | | | | |
|---|---|---|---|---|---|---|---|
| Symbol | Parameter | Conditions | MIN. | TYP. | MAX. | Unit |
| VCI | Logic supply voltage | | 2.5 | 3.3 | 3.6 | V |
| $V_{IL}$ | Low level input voltage | Digital input pins | 0 | -- | 0.2xVCI | V |
| $V_{IH}$ | High level input voltage | Digital input pins | 0.8xVCI | -- | VCI | V |
| $V_{OH}$ | High level output voltage | Digital input pins, $I_{OH}$= 400 uA | 0.8xVCI | -- | -- | V |
| $V_{OL}$ | Low level output voltage | Digital input pins, $I_{OL}$= -400 uA | 0 | -- | 0.2VCI | V |
| $R_{IN}$ | Pull-up/down impedance | | | 200 | | KΩ |
| $I_{MSTB}$ | Module stand-by current | Stand-by mode | -- | 0.2 | | mA |
| $I_{MDS}$ | Module deep sleep & Flash power down current | Deep sleep mode & Flash power down mode | | 1.0 | | uA |
| Inc | Inrush Current | | | 0.1 | | A |
| $I_{MOPR}$ | Module operating current | | | TDB | TDB | mA |
| P | Operation Power Dissipation | VCI=3.3V with DC-DC | | TDB | TDB | mW |
| $P_{STBY}$ | Standby Power Dissipation | VCI=3.3V | | 0.66 | | mW |

Note: The Module operating current data is measured by using Oscilloscope, and extract the Mean value.

- The Typical power consumption is measured using associated 25C waveform with following pattern transition: from full white pattern to black, white, red, yellow, blue, green and orange stripe pattern. (Note 7-1)
- The Max power consumption is measured using associated 25C waveform with following pattern transition: from full white pattern to pattern of repeated 1 consecutive black scan lines followed by 1 consecutive white scan line. (Note 7-2)
- The standby power is the consumed power when panel controller is in standby mode.
- The listed electrical/optical characteristics are only guaranteed under the controller & waveform provided by Waveshare.

## Note 7-1

The Typical power consumption
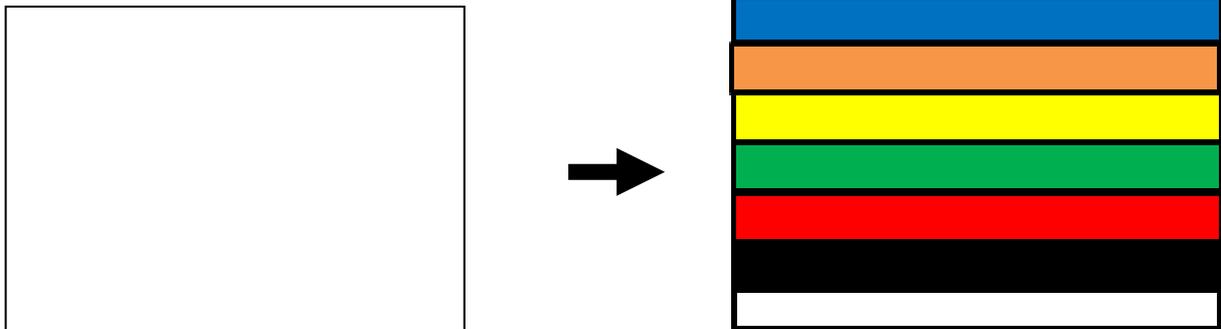


## Note 7-2

The Maximum power consumption
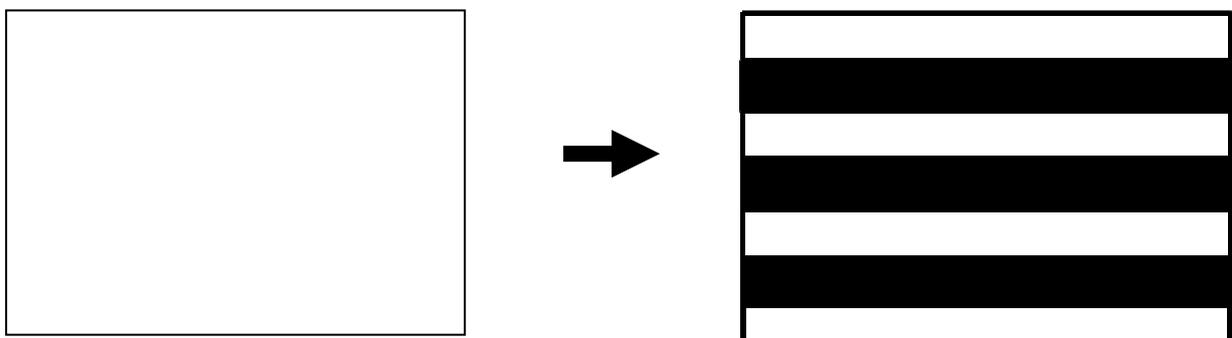
## 7-3) Panel AC characteristics

VDD=2.5V to 3.6V, unless otherwise specified.

| SYMBOL | SIGNAL | | | MIN. | TYP. | MAX. | UNIT |
|--------|--------|---|---|------|------|------|------|
| | | SERIAL COMMUNICATION | | | | | |
| tCSS | CSB | Chip select setup time | | 60 | | | ns |
| tCSH | | Chip select hold time | | 65 | | | ns |
| tSCC | | Chip select setup time | | 20 | | | ns |
| tCHW | | Chip select setup time | | 40 | | | ns |
| tSCYCW | SCL | Serial clock cycle (Write) | | 100 | | | ns |
| tSHW | | SCL "H" pulse width (Write) | | 35 | | | ns |
| tSLW | | SCL "L" pulse width (Write) | | 35 | | | ns |
| tSCYCR | | Serial clock cycle (Read) | | 150 | | | ns |
| tSHR | | SCL "H" pulse width (Read) | | 60 | | | ns |
| tSLR | | SCL "L" pulse width (Read) | | 60 | | | ns |
| tSDS | SDA (DIN) (DOUT) | Data setup time | | 30 | | | ns |
| tSDH | | Data hold time | | 30 | | | ns |
| tACC | | Access time | | | | 10 | ns |
| tOH | | Output disable time | | 15 | | | ns |
| | | DRIVER | | | | | |
| trS | | Source driver rise time | 99% final value | | 5 | | us |
| tFS | | Source driver fall time | | | 5 | | us |
| trG | | Gate driver rise time | 99% final value | | 5 | | us |
| tFG | | Gate driver fall time | | | 5 | | us |
| trCOM | | VCOM rise time | 99% final value | | 1 | | ms |
| tFCOM | | VCOM fall time | | | 1 | | ms |
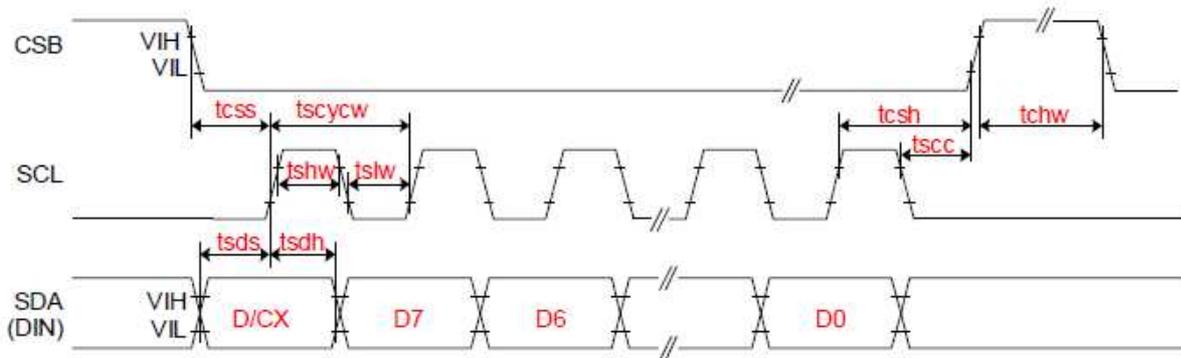


3-wire Serial Interface – Write
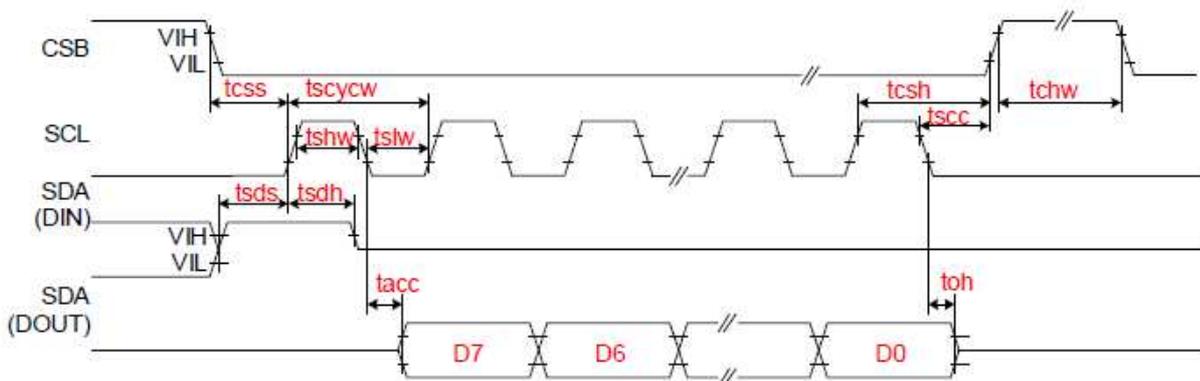
## 7-3-1) MCU Serial Interface

### 3-WIRE SPI
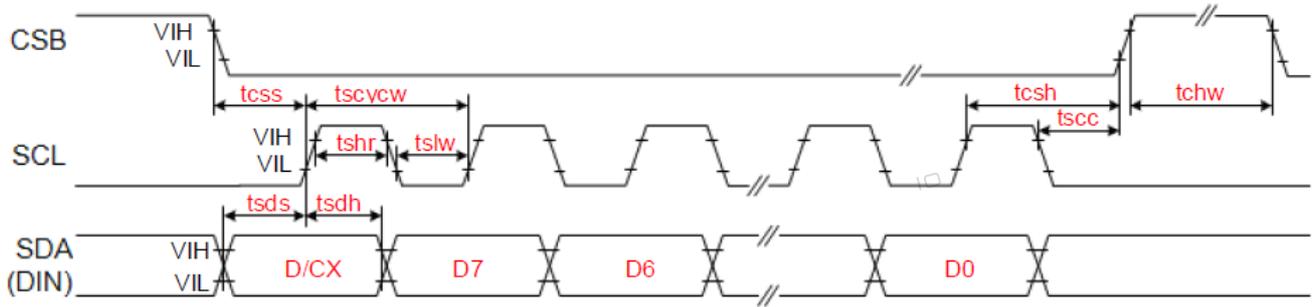


Figure : 3-wire Serial Interface – Write
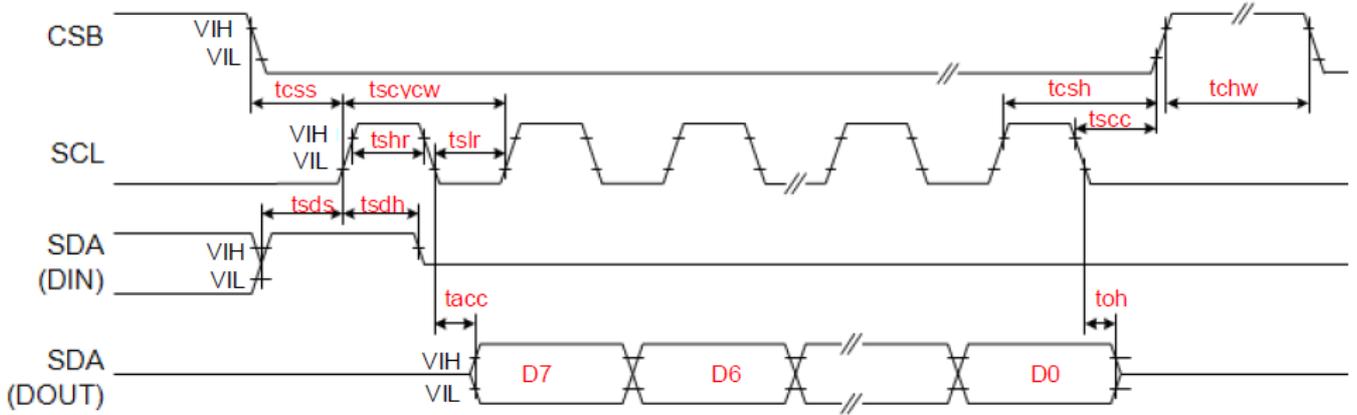


Figure : 3-wire Serial Interface – Read

## 4-WIRE SPI
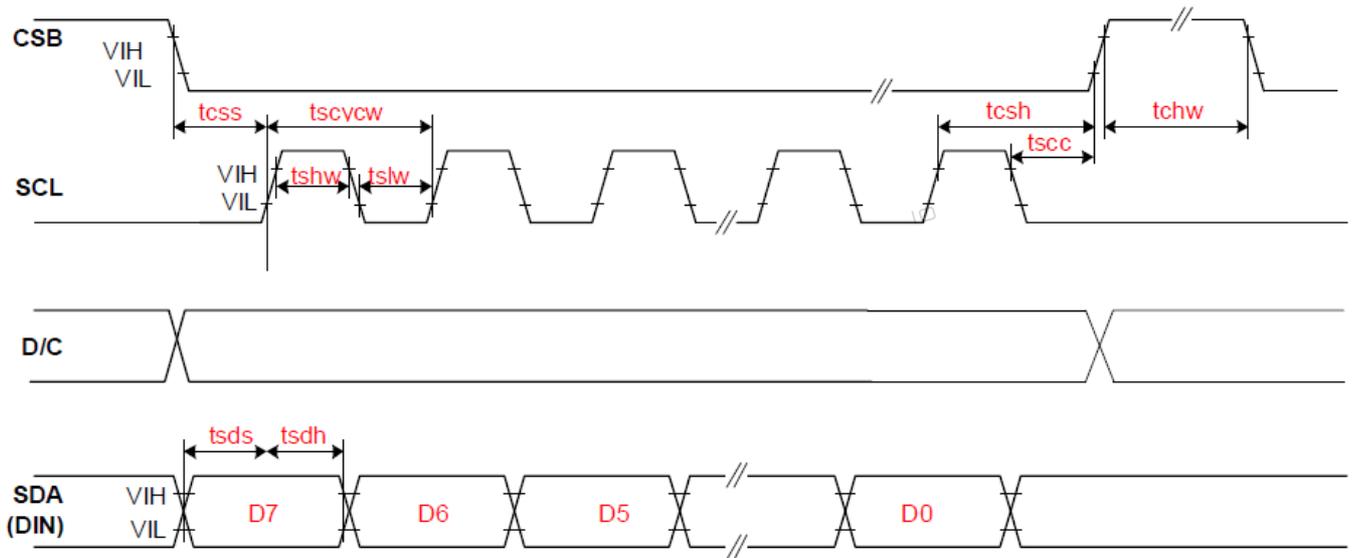


**Figure :** 4-wire Serial Interface – Read

## 7-3-2) Power On/Off Characteristics

## Power ON Sequence
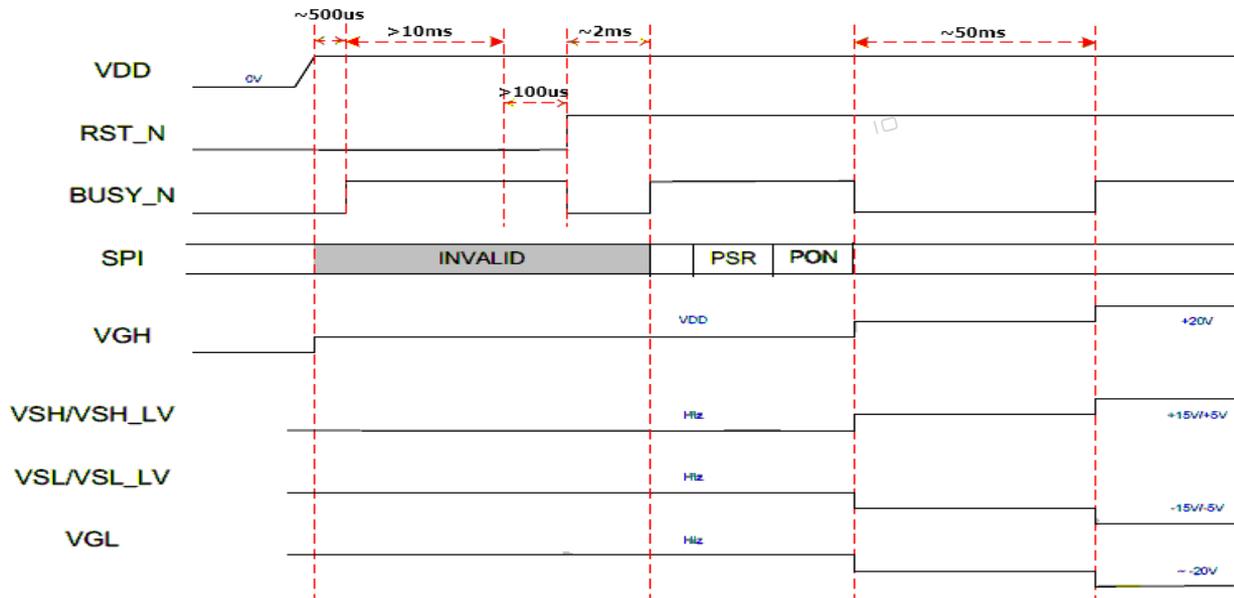


## Power OFF Sequence
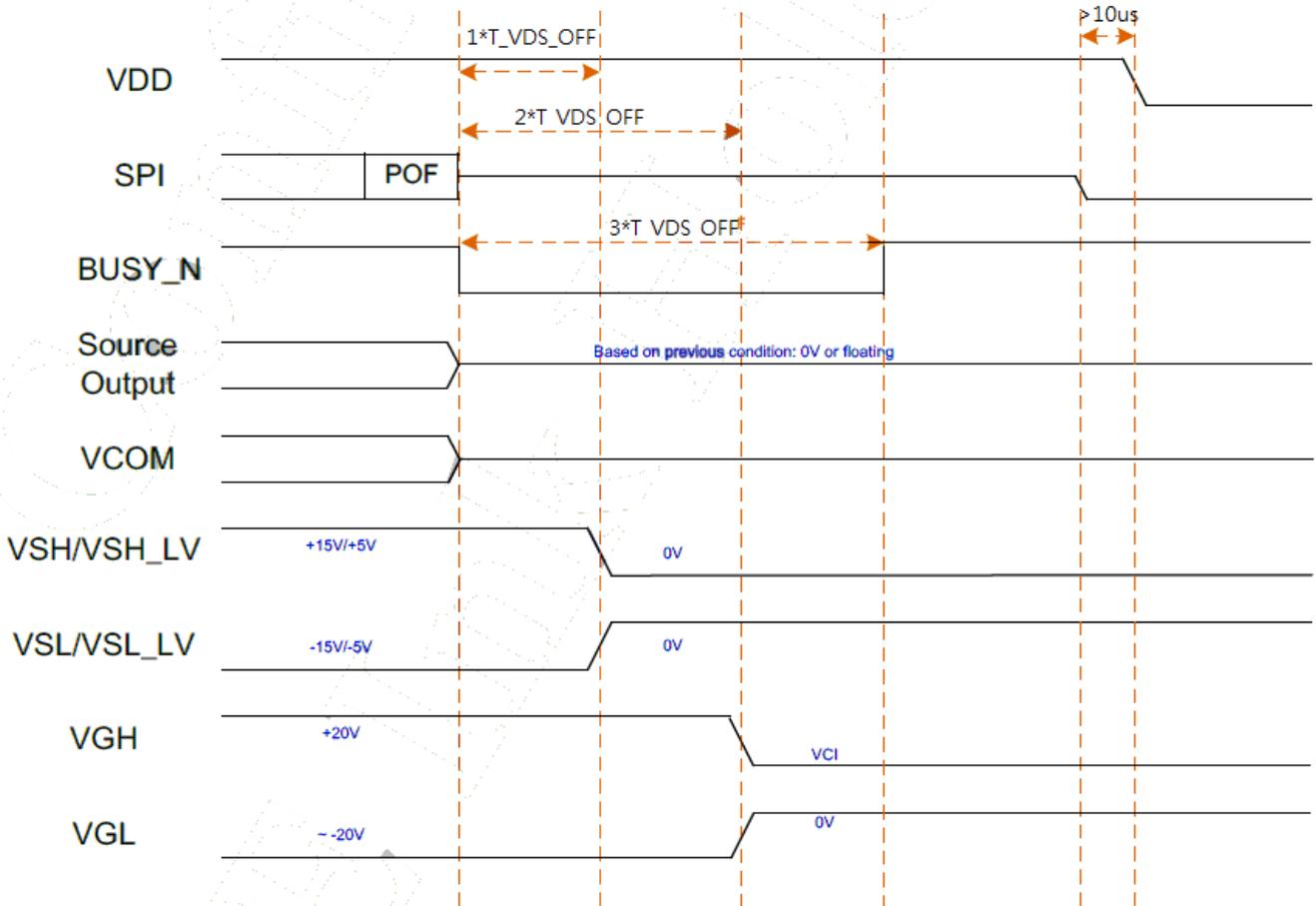
## 7-4) Reference Circuit
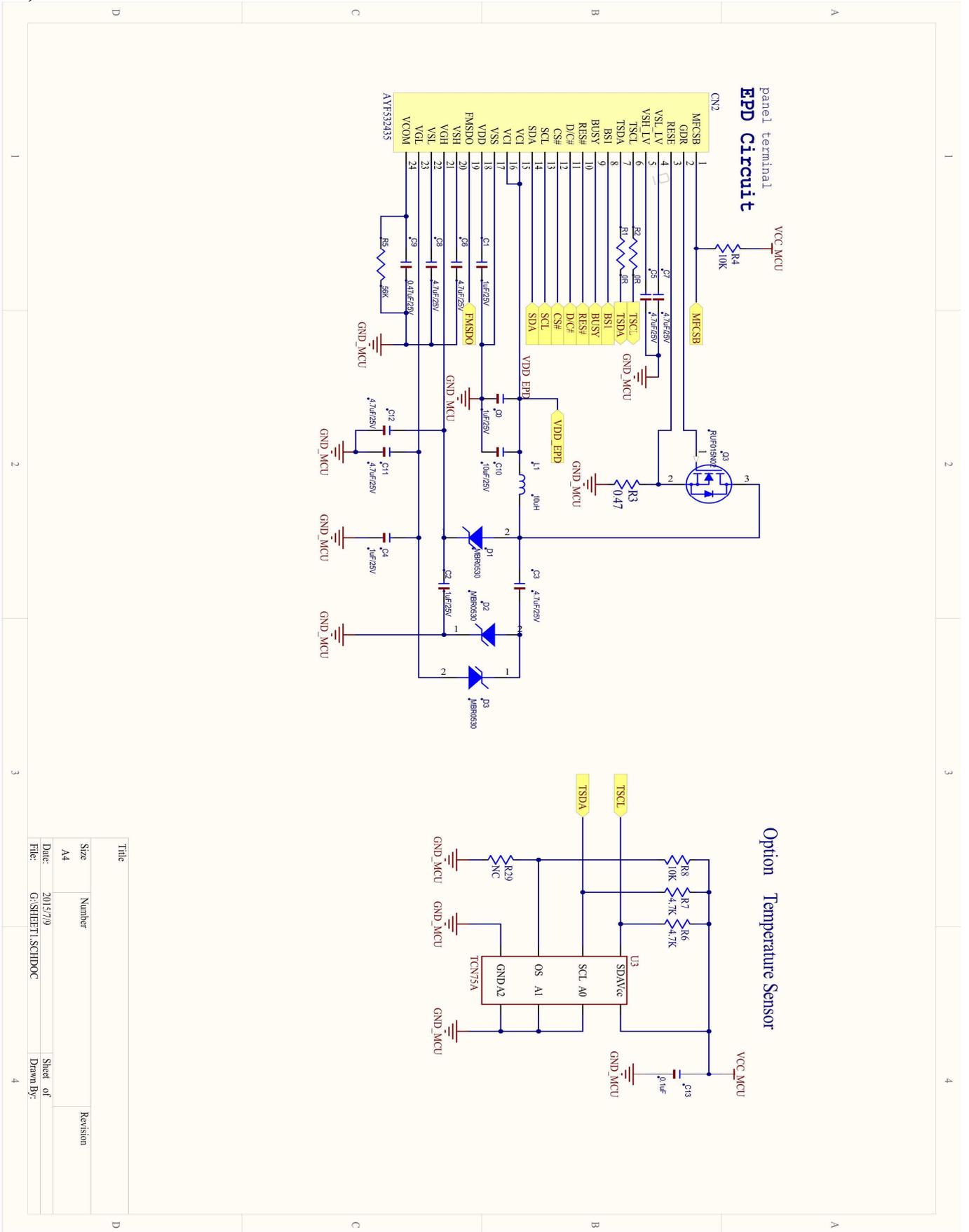


Note: The pin of FMSDO can't connect with the I/O pin of other ICs(Ex. Flash) for preventing to affect the signal of other ICs.

# 8. Optical characteristics

## 8-1) Specification

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

TBD

## 8-2) Definition of contrast ratio

The contrast ratio (CR) is the ratio between the reflectance in a full white area (Rl) and the reflectance in x

$$CR = Rl/Rd$$



Eye-One Spectrophotometer

Detector

Light Sources in a ring

45°   45°

EPD Sample
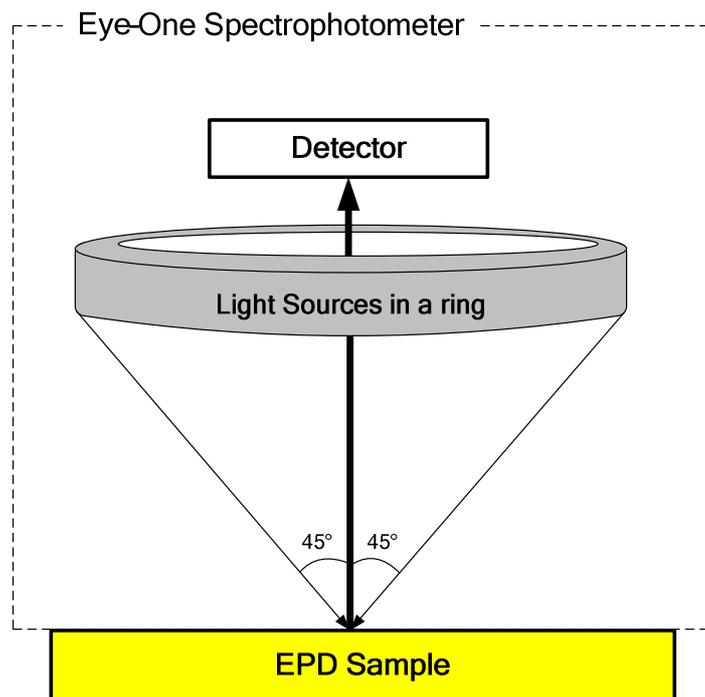
## 8-3) Reflection Ratio

The reflection ratio is expressed as：

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

$L_{\text{center}}$ is the luminance measured at center in a white area (R=G=B=1). $L_{\text{white board}}$ 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.

## 9. HANDLING, SAFETY AND ENVIROMENTAL REQUIREMENTS AND REMARK

| 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. |

| 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. |

**Data sheet status**

| Product specification | This data sheet contains preliminary 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 at 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.

**Long Term Storage**

When storing modules as spares for a long time, the following precautions are necessary.

(1)  Store them in dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5℃  and 35℃  at normal humidity.

| 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. |

# 10. Reliability test
**TBD**

# 11. Block Diagram

## 12. Packing

| REV | DESCRIPTION | DESIGN | DATE |
|---|---|---|---|
| 1.0 | Preliminary drawing | Hero.Wu | 2019.10.29 |
|  |  |  |  |



1st Layer

2nd Layer

Total 12 Layers
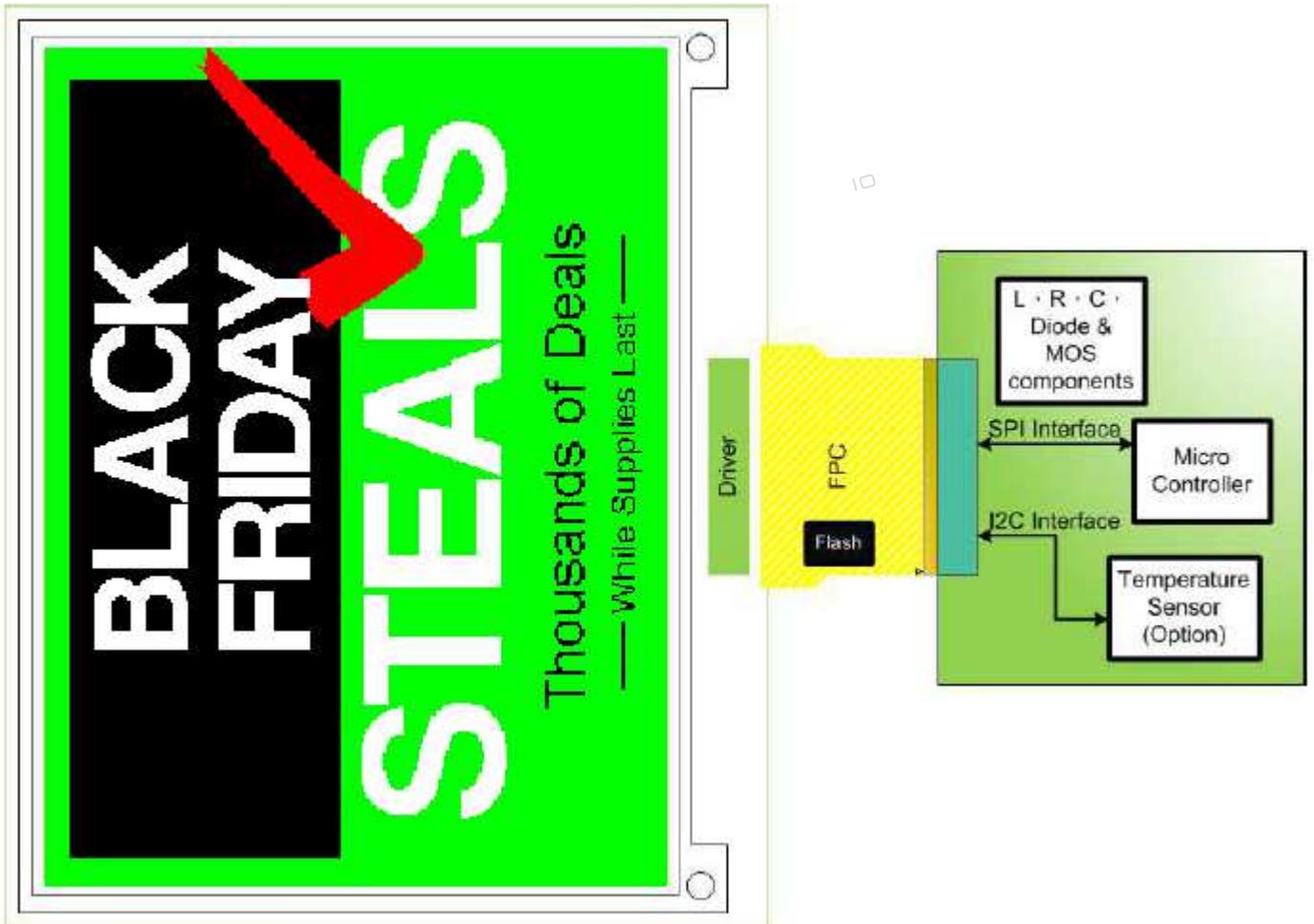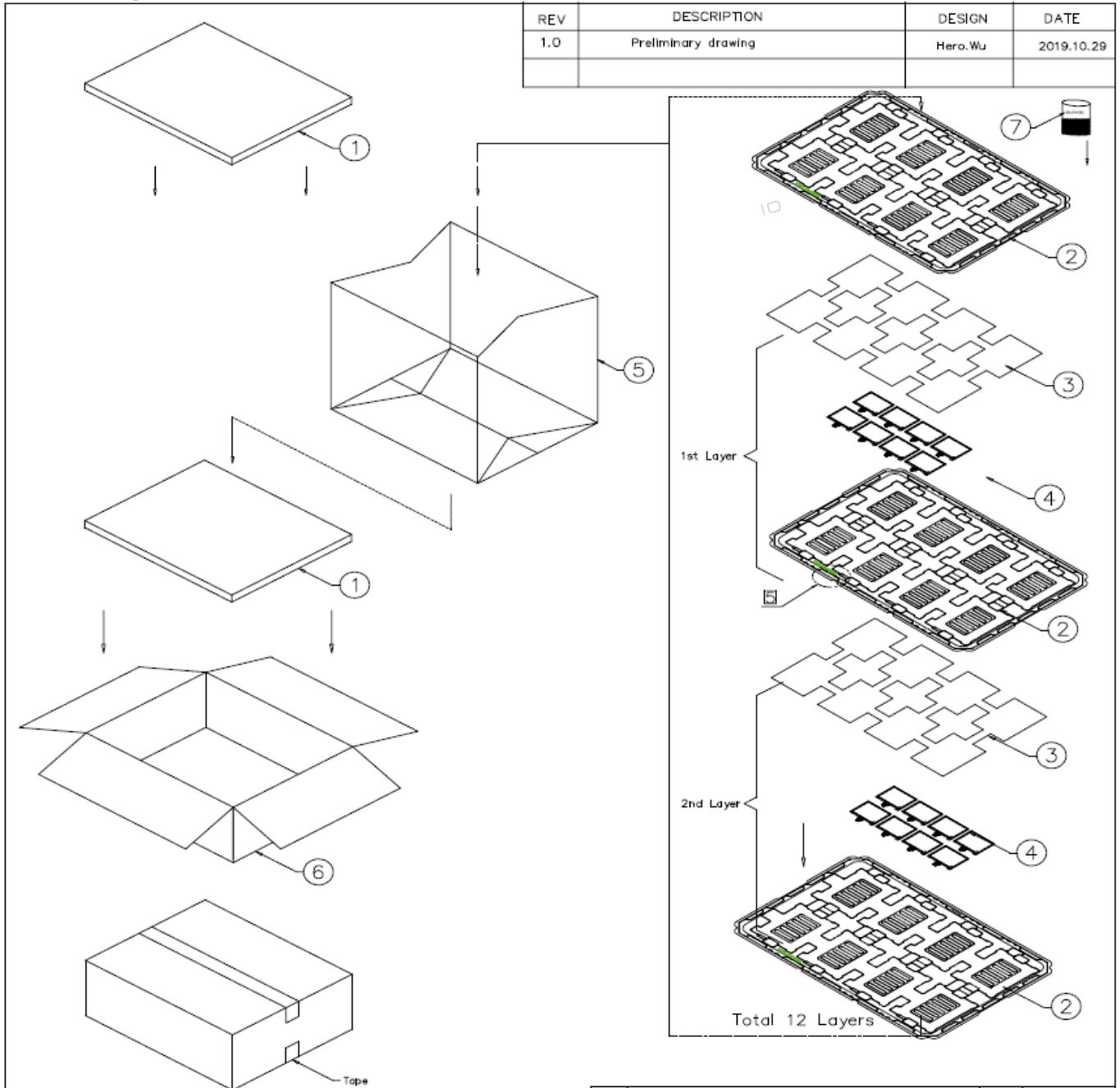
NOTE:
1. One layer include: 8 pcs panel,
   1 pc epe cusion sheet & 1 pc tray
2. Q'TY: 96 pcs panel/carton.
3. Dimension: 558*370*170mm
4. Weight: 5.9kg
5. Make sure tray stacked with 0° rotation,
   we can check this by tray's half circles from lateral side view

| ITEM | DESCRIPTION | QTY | REMARK |
|---|---|---|---|
| 7 | 30g 防潮剂 | 2 |  |
| 6 | CARTON INTERNAL | 1 |  |
| 5 | 捆口袋 | 1 | 抗靜電 |
| 4 | EPD | 96 |  |
| 3 | EPE CUSION SHEET | 12 |  |
| 2 | TRAY | 13 | 抗靜電 |
| 1 | EPE FOAM | 2 |  |

| MTL.SPEC. |  | UNSPECIFIED TOL'S | | REMARK | | | | |
|---|---|---|---|---|---|---|---|---|
|  |  | ANGLE | | | | | | |
|  |  | ROUGHNESS | | | | | | |
| APPROVE | Patrick.Lin | 2019.10.29 | UNIT | SHEET | DWG.TITLE | | | |
| CHECK | Hero.Wu | 2019.10.29 | mm | 1 OF 1 | | | | A4 SIZE |
| DESIGN | Hero.Wu | 2019.10.29 | | | | | | |