# 0.97 inch
# E-paper Display Series

## GDEM0097F51

Dalian Good Display Co., Ltd.

# Product Specifications


| | |
|---|---|
| **Customer** | **Standard** |
| **Description** | **0.97” E-PAPER DISPLAY** |
| **Model Name** | **GDEM0097F51** |
| **Date** | **2024/05/13** |
| **Revision** | **1.0** |

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

GDEM0097F51 is an Active Matrix EPD all-in-one driver with timing controller for ESL. The sources have 2-bit outputs per pixel to support white/black/red/yellow. The 0.97 inch active are contains 88x184 pixel. The module is a TFT-array driving electrophoresis display, with integrated circuits including gate driver, source driver, MCU interface, timing controller, oscillator, DC-DC, SRAM, LUT, VCOM. Module can be used in portable electronic devices, such as Electronic Shelf Label(ESL) System.

## 2. Features

◆88×184 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
◆Built-in temperature sensor

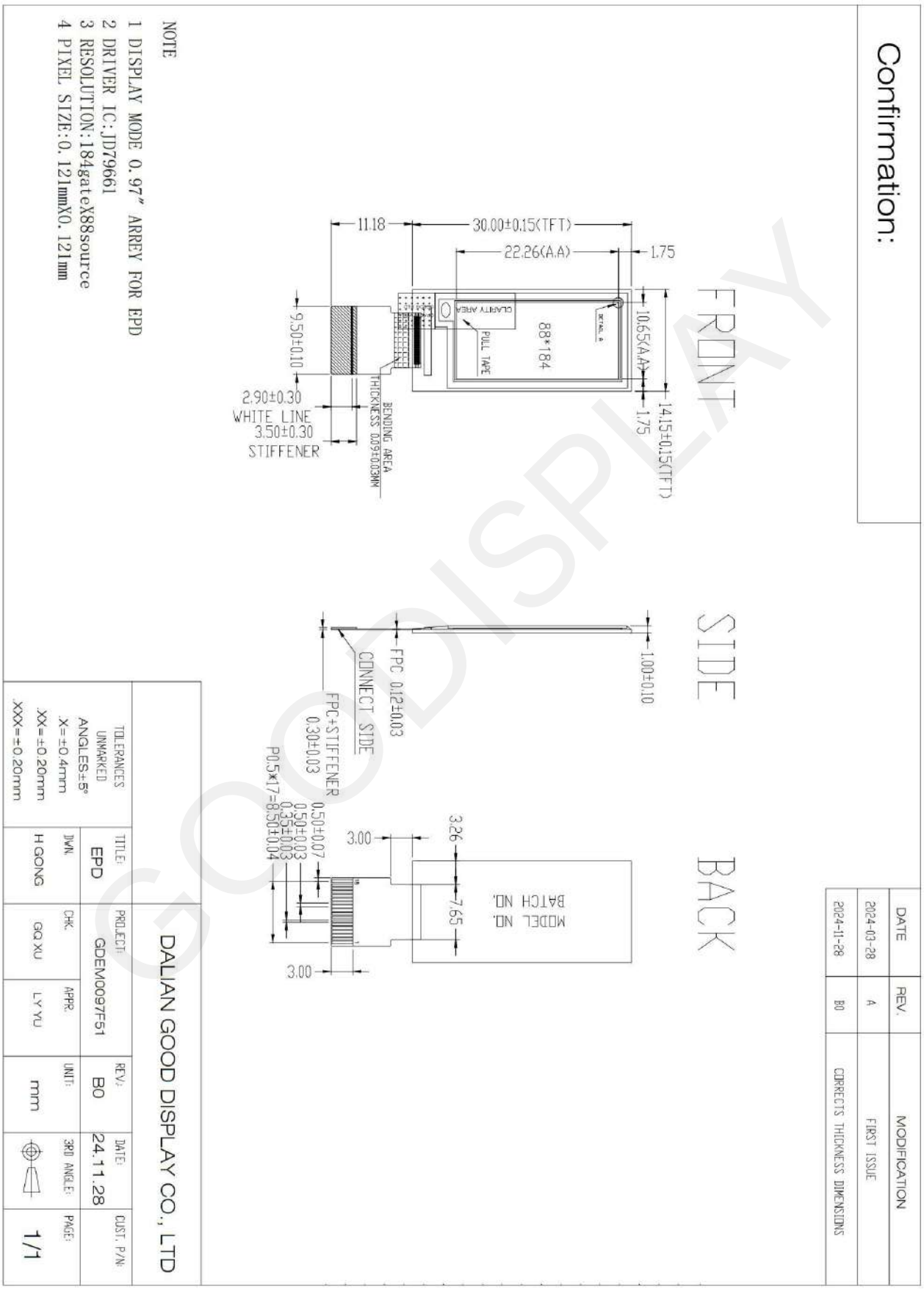
## 3. Mechanical and Optical Specification

| Parameter | Specifications | Unit | Remark |
|---|---|---|---|
| Screen Size | 0.97 | Inch | |
| Display Resolution | 88(H)×184(V) | Pixel | DPI:210 |
| Active Area | 10.65×22.26 | mm | |
| Pixel Pitch | 0.121×0.121 | mm | |
| Pixel Configuration | Square | | |
| Outline Dimension | 14.15(H)×30 (V) × 1.0(D) | mm | |
| Weight | 1.1±0.5 | g | |

| Temperature Range(℃) | | 0-9 | 10-19 | 20-29 | 30-40 | Units |
|---|---|---|---|---|---|---|
| White State | TYP L* | 64 | 63 | 63 | 63 | |
| | MIN L* | 62 | 62 | 62 | 62 | |
| | a* | ≤0 | ≤0 | ≤0 | ≤0 | |
| | b* | ≤2.5 | ≤2.5 | ≤2.5 | ≤2.5 | |
| Black State | TYP L* | 9 | 9 | 9 | 9 | |
| | MAX L* | 11 | 11 | 11 | 11 | |
| | a* | ≤9 | ≤9 | ≤8 | ≤10 | |
| Red State | MIN L* | 23 | 23 | 24 | 23 | |
| | TYP a* | 36 | 38 | 40 | 40 | |
| | MIN a* | 34 | 34 | 38 | 38 | |
| | MAX b* | 34 | 34 | 34 | 34 | |
| Yellow State | MIN L* | 50 | 50 | 54 | 54 | |
| | TYP b* | 55 | 63 | 66 | 66 | |
| | MIN b* | 53 | 56 | 60 | 60 | |
| | MAX a* | 18 | 18 | 18 | 18 | |
| Ghosting | | ≤2 | ≤2 | ≤2 | ≤2 | delta E |

**Notes: 3-1. Luminance meter: Eye-One Pro Spectrophotometer.**

## 4. Mechanical Drawing of EPD Module



## 5. Input/output Pin Assignment

| No. | Name | I/O | Description | Remark |
|---|---|---|---|---|
| 1 | GDR | O | N-Channel MOSFET Gate Drive Control | |
| 2 | RESE | I | Current Sense Input for the Control Loop | |
| 3 | VSH2 | C | Positive Source driving voltage2 | |
| 4 | BUSY | O | Busy state output pin | Note 5-4 |
| 5 | RES# | I | Reset signal input. Active Low. | Note 5-3 |
| 6 | D/C# | I | Data /Command control pin | Note 5-2 |
| 7 | CS# | I | Chip select input pin | Note 5-1 |
| 8 | SCL | I | Serial Clock pin (SPI) | |
| 9 | SDA | I/O | Serial Data pin (SPI) | |
| 10 | VCI | P | Power Supply for the chip | |
| 11 | VSS | P | Ground | |
| 12 | VDD | C | Core logic power pin VDD can be regulated internally from VCI. A capacitor should be connected between VDD and VSS | |
| 13 | VPP | P | FOR TEST | Keep Open |
| 14 | VSH1 | C | Positive Source driving voltage | |
| 15 | VGH | C | Power Supply pin for Positive Gate driving voltage and VSH1 | |
| 16 | VSL | C | Negative Source driving voltage | |
| 17 | VGL | C | Power Supply pin for Negative Gate driving voltage VCOM and VSL | |
| 18 | VCOM | C | VCOM driving voltage | |

**I = Input Pin, O =Output Pin, I/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 Low, the operation of chip should not be interrupted, command should not be sent. The chip would put Busy pin Low when -Outputting display waveform -Communicating with digital temperature sensor**

**Note 5-5: Bus interface selection pin**

**Note 5-6: This pin connect to the VSS if there is no external temperature sensor.**

| 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 | -0.3 to +6.0 | V |
| Logic Input voltage | VIN | -0.3 to VCI +0.3 | V |
| Operating Temp range | TOPR | 0 to +40 | ºC. |
| Storage Temp range | TSTG | -25 to+70 | ºC. |
| Optimal Storage Humidity | HST Go | 55±10 | %RH |

**Note:**

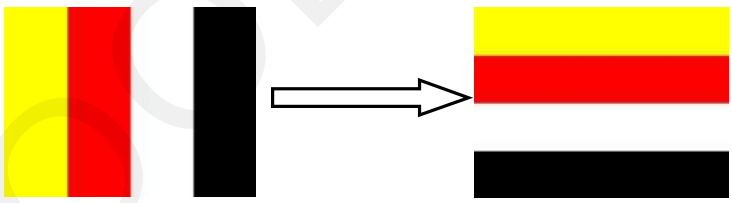
1. **Maximum ratings are those values beyond which damages to the device may occur.Functional operation should be restricted to the limits in the Panel DC Characteristics tables.**
2. **The storage time is within 10 days for -25℃ ~ 70℃.**
   **The display screen should be kept white and face up.**

## 6.2 Panel DC Characteristics

The following specifications apply for: VSS=0V, VCI=3.0V, TOPR =23ºC.

| Parameter | Symbol | Condition | Applicable pin | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Single ground | $V_{SS}$ | - | | - | 0 | - | V |
| Logic supply voltage | $V_{CI}$ | - | VCI | 2.3 | 3.0 | 3.6 | V |
| Core logic voltage | $V_{DD}$ | | VDD | 2.3 | 3.0 | 3.6 | V |
| High level input voltage | $V_{IH}$ | - | - | 0.7 VCI | - | VCI | V |
| Low level input voltage | $V_{IL}$ | - | - | 0 | - | 0.3 VCI | V |
| High level output voltage | $V_{OH}$ | IOH = 400Ma | - | VCI -0.4 | - | - | V |
| Low level output voltage | $V_{OL}$ | IOL = -400Ma | - | - | - | GND +0.4 | V |
| Typical power | $P_{TYP}$ | $V_{CI}$ =3.0V | - | - | 9 | - | mW |
| Deep sleep mode | $P_{STPY}$ | $V_{CI}$ =3.0V | - | - | 0.0012 | - | mW |
| Typical operating current | $Iopr_{VCI}$ | $V_{CI}$ =3.0V | - | - | 3 | - - | mA |
| Full/Fast image update | - | 23 ºC | - | - | 20/12 | - | sec |
| Deep sleep mode current | $Idslp_{VCI}$ | DC/DC off<br>No clock<br>No input load<br>Ram data not retain | - | - | 0.4 | 1 | uA |

**Notes: 1. The typical power is measured with following transition from horizontal 4 scale pattern to vertical 4 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**

**4. Electrical measurement：Tektronix oscilloscope - MDO3024，**

**Tektronix current probe–TCP0030A.**

## 6.3 Panel AC Characteristics

### 6.3.1 MCU Interface Selection

The pin assignment at different interface mode is summarized in Table 6-3-1. Different MCU mode can be set by hardware selection on BS1 pins. The display panel only supports 4-wire SPI or 3-wire SPI interface mode.

| Pin Name | Data/Command Interface | | Control Signal | | |
|---|---|---|---|---|---|
| Bus interface | SDA | SCL | CS# | D/C# | RES# |
| BS1=L 4-wire SPI | SDA | SCL | CS# | D/C# | RES# |
| BS1=H 3-wire SPI | SDA | SCL | CS# | L | RES# |

**Table 6-3-1: MCU interface assignment under different bus interface mode**

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

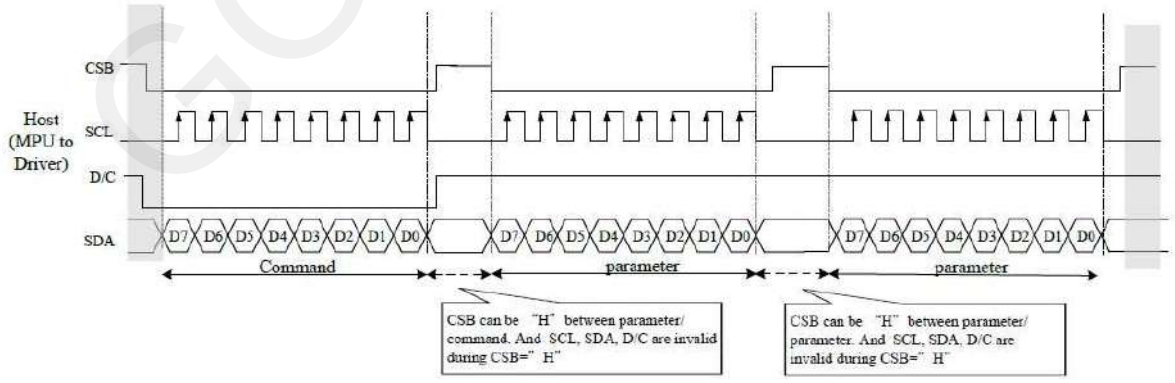
The serial interface consists of serial clock SCL, serial data SDA, D/C#, CS#. This interface supports Write mode and Read mode.

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

**Table 6-3-2: Control pins of 4-wire Serial Peripheral interface**

**Note: ↑ stands for rising edge of signal**

**Figure 6-3-1: 4-wire SPI mode**



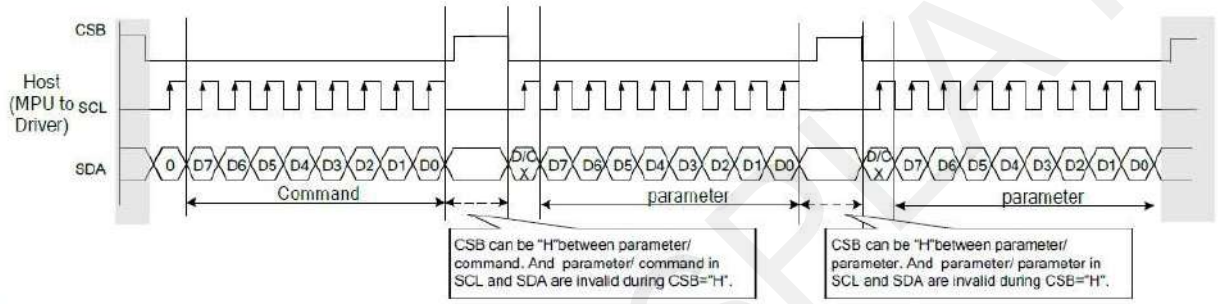
## 6.3.3 MCU Serial Interface (3-wire SPI)

| Function | CS# | D/C# | SCL |
|---|---|---|---|
| Write command | L | Tie | ↑ |
| Write data | L | Tie | ↑ |

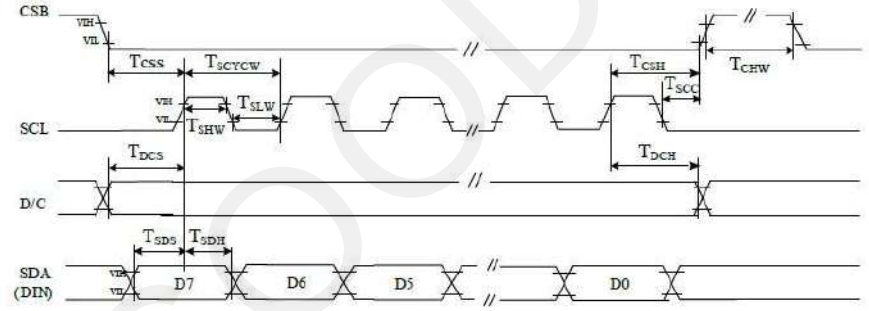
**Table 6-3-3: Control pins of 4-wire Serial Peripheral interface**

**Note：↑ stands for rising edge of signal**

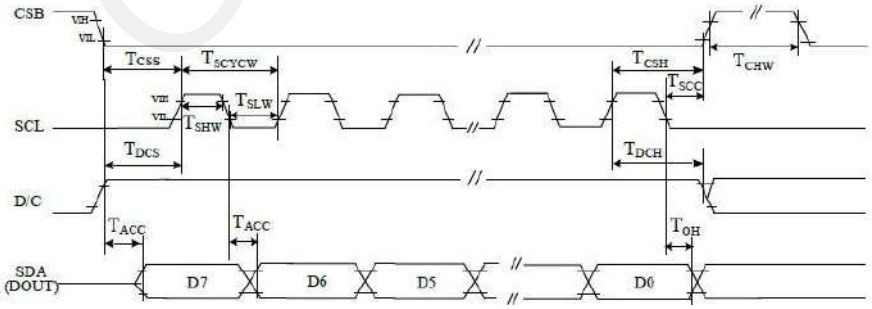
**Figure 6-3-2: 3-wire SPI mode**




## 6.3.4 Interface Timing




4 pin serial interface characteristics(write mode)



**Serial Interface Timing Characteristics**

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| SERIAL COMMUNICATION | | | | | | |
| CSB | $T_{CSS}$ | 60 | | | ns | Chip select setup time |
| | $T_{CSH}$ | 65 | | | ns | Chip select hold time |
| | $T_{SCC}$ | 20 | | | ns | Chip select CSB setup time |
| | $T_{CHW}$ | 40 | | | ns | Chip select setup time |
| SCL | $T_{SCYCW}$ | 100 | | | ns | Serial clock cycle (Write) |
| | $T_{SHW}$ | 35 | | | ns | SCL "H" pulse width (Write) |
| | $T_{SLW}$ | 35 | | | ns | SCL "L" pulse width (Write) |
| | $T_{SCYCR}$ | 150 | | | ns | Serial clock cycle (Read) |
| | $T_{SHR}$ | 60 | | | ns | SCL "H" pulse width (Read) |
| | $T_{SLR}$ | 60 | | | ns | SCL "L" pulse width (Read) |
| SDA (DIN) (DOUT) | $T_{SDS}$ | 30 | | | ns | Data setup time |
| | $T_{SDH}$ | 30 | | | ns | Data hold time |
| | $T_{ACC}$ | | | 10 | ns | Access time |
| | $T_{OH}$ | 15 | | | ns | Output disable time |
| D/C | $T_{DCS}$ | 20 | | | ns | DC setup time |
| | $T_{DCH}$ | 20 | | | ns | DC hold time |

# 7.Command Table

R/W: 0:Write Cycle 1:Read Cycle D/CX:0:Command/1:Data D7~D0:-:Don't Care

**1)R00H (PSR): Panel setting Register**

| R00H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| PSR | W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00H |
| 1st Parameter | W | 1 | RES[1] | RES[0] | PST_MODE | - | UD | SHL | SHD_N | RST_N | 0Fh |
| 2nd Parameter | W | 1 | LUT_EN | - | FOPT | VCMZ | TS_AUTO | TIEG | NORG | VC_LUTZ | 09h |

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

Description

-The command defines as :

1st parameter

| Bit | Name | Description |
|---|---|---|
| 0 | RST_N | RST_N function<br>1: no effect. (default)<br>0: Booster OFF, Register data are set to their default values, and Source/Boder/Vcom: floating |
| 1 | SHD_N | SHD_N function<br>0 : Booster OFF, register data are kept, and Source/Boder/Vcom are kept 0V or floating.<br>1 : Booster on. (default) |
| 2 | SHL | SHL function<br>0: Shift left; First data=Sn→Sn-1 →...→S2→Last data=S1.<br>1: Shift right: First data=S1→S2 →...→Sn-1→Last data=Sn. (default) |
| 3 | UD | UD function<br>0:Scan down; First line=Gn→Gn-1 →...→G2→Last line=G1.<br>1:Scan up; First line=G1→G2 →...→Gn-1→Last line=Gn. (default) |
| 5 | PST_MODE | Power switch operation mode<br>0:Power switching time in the period of frame scanning.(default)<br>1:Power switching time in the external period before frame scanning. |
| 7-6 | RES[1,0] | Resolution setting<br>00: Display resolution is 176x296 (default)<br>01: Display resolution is 128x296<br>10: Display resolution is 128x250<br>11: Display resolution is 112x204 |

2nd parameter

| Bit | Name | Description |
|---|---|---|
| 0 | VC_LUTZ | VCOM status function<br>0 : No effect<br>1 : After refreshing display,the output of VCOM is set to floating automatically (default) |
| 1 | NORG | VCOM status function<br>0 : No effect (default)<br>1 : After refreshing display, VCOM is tied to GND before power off |
| 2 | TIEG | VGN power off status function<br>0 : No effect (default)<br>1 : Power off, VGN will be tied to GND |
| 3 | TS_AUTO | Temperature sensing will be activated automatically one time<br>0 : Before enabling booster,Temperature Sensor will be activated automatically one time.<br>1 : When RST_N low to high,Temperature Sensor will be activated automatically one time. (default) |
| 4 | VCMZ | VCOM status function<br>0 : No effect (default)<br>1 : VCOM is always floating |
| 5 | FOPT | FOPT function<br>0: Scan 1 frame after waveform finished(default)<br>1: No scan after waveform finished and switch the source channel output to Hiz. |
| 7 | LUT_EN | LUT selection setting<br>0 : Using LUT from MTP(default)<br>1 : Using LUT from register |

Priority of VCOM setting: VCMZ > NORG > FOPT > VC_LUTZ

FOPT setting is part of refreshing display.
FOPT: Power off floating.

Notes:

1. Non-select gate line keep at VGN for DSP/DRF and AMV
2. Dummy source line follow LUTC for DSP/DRF
3. When SHD_N become low, DCDC will turn off. Register and SRAM data will keep until VDD turn off. SD output and VCOM will base on previous condition. It may have two condition:0V or floating.
4. When RST_N become low, driver will reset. All register will reset to default value. All of the driver's functions will disable. Source/Gate/Border/VCOM will be released to floating

| | |
|---|---|
| Restriction | |

**2) R01H (PWR): Power setting Register**

| R01H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| PWR | W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 01h |
| 1st Parameter | W | 1 | - | - | - | - | V_MODE | VSC_EN | VDS_EN | VDG_EN | 07h |
| 2nd Parameter | W | 1 | - | - | - | - | - | - | VGPN [1] | VGPN [0] | 00h |
| 3rd Parameter | W | 1 | - | VSPL_0 [6:0] | | | | | | | 00h |
| 4th Parameter | W | 1 | - | VSP_1 [6:0] | | | | | | | 00h |
| 5th Parameter | W | 1 | - | VSN_1 [6:0] | | | | | | | 00h |
| 6th Parameter | W | 1 | - | VSPL_1 [6:0] | | | | | | | 00h |

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

Description

-The command defines as :

1st Parameter:

| Bit | Name | Description |
|---|---|---|
| 0 | VDG_EN | Gate power selection.<br>0 : External gate power from VGP/VGN pins.<br>1 : Internal DCDC function for generate VGP/VGN. (default) |
| 1 | VDS_EN | Source power selection.<br>0 : External source power from VSP/VSN pins.<br>1 : Internal regulator function for generate VSP/VSN (default) |
| 2 | VSC_EN | Source LV power selection.<br>0 : External source power from VSPL pins.<br>1 : Internal regulator function for generate VSPL (default) |
| 3 | V_MODE | Source Power switching mode.<br>0: Mode0(default)<br>1: Mode1 |

2nd Parameter:

| Bit | Name | Description |
|---|---|---|
| 1-0 | VGPN | VGPN Voltage Level.<br>00: VGP=20 v, VGN=-20v (default)<br>01: VGP=17 v, VGN=-17v<br>10: VGP=15 v, VGN=-15v<br>11: VGP=10 v, VGN=-10v |

3rd & 4th & 6th Parameter: Internal VSP_1/VSPL_0/ VSPL_1 power selection

| Bit | Name | Description |
|---|---|---|
| 6-0 | VSP_1 & VSPL_0 & VSPL_1 | Internal VSP & VSPL power selection |

| bit[6:0] | | Voltage(V) | bit [6:0] | | Voltage(V) | bit [6:0] | | Voltage(V) |
|---|---|---|---|---|---|---|---|---|
| 0000000 | 00h | 3 | 0101001 | 29h | 7.1 | 1010010 | 52h | 11.2 |
| 0000001 | 01h | 3.1 | 0101010 | 2Ah | 7.2 | 1010011 | 53h | 11.3 |
| 0000010 | 02h | 3.2 | 0101011 | 2Bh | 7.3 | 1010100 | 54h | 11.4 |
| 0000011 | 03h | 3.3 | 0101100 | 2Ch | 7.4 | 1010101 | 55h | 11.5 |
| 0000100 | 04h | 3.4 | 0101101 | 2Dh | 7.5 | 1010110 | 56h | 11.6 |
| 0000101 | 05h | 3.5 | 0101110 | 2Eh | 7.6 | 1010111 | 57h | 11.7 |
| 0000110 | 06h | 3.6 | 0101111 | 2Fh | 7.7 | 1011000 | 58h | 11.8 |
| 0000111 | 07h | 3.7 | 0110000 | 30h | 7.8 | 1011001 | 59h | 11.9 |
| 0001000 | 08h | 3.8 | 0110001 | 31h | 7.9 | 1011010 | 5Ah | 12 |
| 0001001 | 09h | 3.9 | 0110010 | 32h | 8 | 1011011 | 5Bh | 12.1 |
| 0001010 | 0Ah | 4 | 0110011 | 33h | 8.1 | 1011100 | 5Ch | 12.2 |
| 0001011 | 0Bh | 4.1 | 0110100 | 34h | 8.2 | 1011101 | 5Dh | 12.3 |
| 0001100 | 0Ch | 4.2 | 0110101 | 35h | 8.3 | 1011110 | 5Eh | 12.4 |
| 0001101 | 0Dh | 4.3 | 0110110 | 36h | 8.4 | 1011111 | 5Fh | 12.5 |
| 0001110 | 0Eh | 4.4 | 0110111 | 37h | 8.5 | 1100000 | 60h | 12.6 |
| 0001111 | 0Fh | 4.5 | 0111000 | 38h | 8.6 | 1100001 | 61h | 12.7 |
| 0010000 | 10h | 4.6 | 0111001 | 39h | 8.7 | 1100010 | 62h | 12.8 |
| 0010001 | 11h | 4.7 | 0111010 | 3Ah | 8.8 | 1100011 | 63h | 12.9 |
| 0010010 | 12h | 4.8 | 0111011 | 3Bh | 8.9 | 1100100 | 64h | 13 |
| 0010011 | 13h | 4.9 | 0111100 | 3Ch | 9 | 1100101 | 65h | 13.1 |
| 0010100 | 14h | 5 | 0111101 | 3Dh | 9.1 | 1100110 | 66h | 13.2 |
| 0010101 | 15h | 5.1 | 0111110 | 3Eh | 9.2 | 1100111 | 67h | 13.3 |
| 0010110 | 16h | 5.2 | 0111111 | 3Fh | 9.3 | 1101000 | 68h | 13.4 |
| 0010111 | 17h | 5.3 | 1000000 | 40h | 9.4 | 1101001 | 69h | 13.5 |
| 0011000 | 18h | 5.4 | 1000001 | 41h | 9.5 | 1101010 | 6Ah | 13.6 |
| 0011001 | 19h | 5.5 | 1000010 | 42h | 9.6 | 1101011 | 6Bh | 13.7 |
| 0011010 | 1Ah | 5.6 | 1000011 | 43h | 9.7 | 1101100 | 6Ch | 13.8 |
| 0011011 | 1Bh | 5.7 | 1000100 | 44h | 9.8 | 1101101 | 6Dh | 13.9 |
| 0011100 | 1Ch | 5.8 | 1000101 | 45h | 9.9 | 1101110 | 6Eh | 14 |
| 0011101 | 1Dh | 5.9 | 1000110 | 46h | 10 | 1101111 | 6Fh | 14.1 |
| 0011110 | 1Eh | 6 | 1000111 | 47h | 10.1 | 1110000 | 70h | 14.2 |
| 0011111 | 1Fh | 6.1 | 1001000 | 48h | 10.2 | 1110001 | 71h | 14.3 |
| 0100000 | 20h | 6.2 | 1001001 | 49h | 10.3 | 1110010 | 72h | 14.4 |
| 0100001 | 21h | 6.3 | 1001010 | 4Ah | 10.4 | 1110011 | 73h | 14.5 |
| 0100010 | 22h | 6.4 | 1001011 | 4Bh | 10.5 | 1110100 | 74h | 14.6 |
| 0100011 | 23h | 6.5 | 1001100 | 4Ch | 10.6 | 1110101 | 75h | 14.7 |
| 0100100 | 24h | 6.6 | 1001101 | 4Dh | 10.7 | 1110110 | 76h | 14.8 |
| 0100101 | 25h | 6.7 | 1001110 | 4Eh | 10.8 | 1110111 | 77h | 14.9 |
| 0100110 | 26h | 6.8 | 1001111 | 4Fh | 10.9 | 1111000 | 78h | 15 |
| 0100111 | 27h | 6.9 | 1010000 | 50h | 11 | other | | 15 |
| 0101000 | 28h | 7 | 1010001 | 51h | 11.1 | | | |

5th Parameter: Internal VSN_1 power selection

| Bit | Name | Description |
|---|---|---|
| 6-0 | VSN_1 | Internal VSN power selection. |

| bit[6:0] | | Voltage(V) | bit [6:0] | | Voltage(V) | bit [6:0] | | Voltage(V) |
|---|---|---|---|---|---|---|---|---|
| 0000000 | 00h | -3 | 0101001 | 29h | -7.1 | 1010010 | 52h | -11.2 |
| 0000001 | 01h | -3.1 | 0101010 | 2Ah | -7.2 | 1010011 | 53h | -11.3 |
| 0000010 | 02h | -3.2 | 0101011 | 2Bh | -7.3 | 1010100 | 54h | -11.4 |
| 0000011 | 03h | -3.3 | 0101100 | 2Ch | -7.4 | 1010101 | 55h | -11.5 |
| 0000100 | 04h | -3.4 | 0101101 | 2Dh | -7.5 | 1010110 | 56h | -11.6 |
| 0000101 | 05h | -3.5 | 0101110 | 2Eh | -7.6 | 1010111 | 57h | -11.7 |
| 0000110 | 06h | -3.6 | 0101111 | 2Fh | -7.7 | 1011000 | 58h | -11.8 |
| 0000111 | 07h | -3.7 | 0110000 | 30h | -7.8 | 1011001 | 59h | -11.9 |
| 0001000 | 08h | -3.8 | 0110001 | 31h | -7.9 | 1011010 | 5Ah | -12 |
| 0001001 | 09h | -3.9 | 0110010 | 32h | -8 | 1011011 | 5Bh | -12.1 |
| 0001010 | 0Ah | -4 | 0110011 | 33h | -8.1 | 1011100 | 5Ch | -12.2 |
| 0001011 | 0Bh | -4.1 | 0110100 | 34h | -8.2 | 1011101 | 5Dh | -12.3 |
| 0001100 | 0Ch | -4.2 | 0110101 | 35h | -8.3 | 1011110 | 5Eh | -12.4 |
| 0001101 | 0Dh | -4.3 | 0110110 | 36h | -8.4 | 1011111 | 5Fh | -12.5 |
| 0001110 | 0Eh | -4.4 | 0110111 | 37h | -8.5 | 1100000 | 60h | -12.6 |
| 0001111 | 0Fh | -4.5 | 0111000 | 38h | -8.6 | 1100001 | 61h | -12.7 |
| 0010000 | 10h | -4.6 | 0111001 | 39h | -8.7 | 1100010 | 62h | -12.8 |
| 0010001 | 11h | -4.7 | 0111010 | 3Ah | -8.8 | 1100011 | 63h | -12.9 |
| 0010010 | 12h | -4.8 | 0111011 | 3Bh | -8.9 | 1100100 | 64h | -13 |
| 0010011 | 13h | -4.9 | 0111100 | 3Ch | -9 | 1100101 | 65h | -13.1 |
| 0010100 | 14h | -5 | 0111101 | 3Dh | -9.1 | 1100110 | 66h | -13.2 |
| 0010101 | 15h | -5.1 | 0111110 | 3Eh | -9.2 | 1100111 | 67h | -13.3 |
| 0010110 | 16h | -5.2 | 0111111 | 3Fh | -9.3 | 1101000 | 68h | -13.4 |
| 0010111 | 17h | -5.3 | 1000000 | 40h | -9.4 | 1101001 | 69h | -13.5 |
| 0011000 | 18h | -5.4 | 1000001 | 41h | -9.5 | 1101010 | 6Ah | -13.6 |
| 0011001 | 19h | -5.5 | 1000010 | 42h | -9.6 | 1101011 | 6Bh | -13.7 |
| 0011010 | 1Ah | -5.6 | 1000011 | 43h | -9.7 | 1101100 | 6Ch | -13.8 |
| 0011011 | 1Bh | -5.7 | 1000100 | 44h | -9.8 | 1101101 | 6Dh | -13.9 |
| 0011100 | 1Ch | -5.8 | 1000101 | 45h | -9.9 | 1101110 | 6Eh | -14 |
| 0011101 | 1Dh | -5.9 | 1000110 | 46h | -10 | 1101111 | 6Fh | -14.1 |
| 0011110 | 1Eh | -6 | 1000111 | 47h | -10.1 | 1110000 | 70h | -14.2 |
| 0011111 | 1Fh | -6.1 | 1001000 | 48h | -10.2 | 1110001 | 71h | -14.3 |
| 0100000 | 20h | -6.2 | 1001001 | 49h | -10.3 | 1110010 | 72h | -14.4 |
| 0100001 | 21h | -6.3 | 1001010 | 4Ah | -10.4 | 1110011 | 73h | -14.5 |
| 0100010 | 22h | -6.4 | 1001011 | 4Bh | -10.5 | 1110100 | 74h | -14.6 |
| 0100011 | 23h | -6.5 | 1001100 | 4Ch | -10.6 | 1110101 | 75h | -14.7 |
| 0100100 | 24h | -6.6 | 1001101 | 4Dh | -10.7 | 1110110 | 76h | -14.8 |
| 0100101 | 25h | -6.7 | 1001110 | 4Eh | -10.8 | 1110111 | 77h | -14.9 |
| 0100110 | 26h | -6.8 | 1001111 | 4Fh | -10.9 | 1111000 | 78h | -15 |
| 0100111 | 27h | -6.9 | 1010000 | 50h | -11 | other | | -15 |
| 0101000 | 28h | -7 | 1010001 | 51h | -7.1 | | | |

Notes:

1. VSP_0/VSN_0 voltage output is ±15 V fixed value.
2. When switching Mode0 or Mode1,the voltage output is:
   Mode0: VSP_0(+15) / VSN_0 (-15) / VSPL_0 (+3~+15)
   Mode1: VSP_1(+3 ~ +15) / VSN_1(-3 ~ -15) / VSPL_1(+3 ~ +15)

| | Mode0 | Mode1 |
|---|---|---|
| VSP | VSP_0(+15) | VSP_1(+3~+15) |
| VSN | VSN_0(-15) | VSN_1(-3~-15) |
| VSPL | VSPL_0(+3~+15) | VSPL_1(+3~+15) |

3. If gate voltage is set to +/-15v, +/-10v, IC will auto correct source voltage as follows
   I. VGP- VSP_0 / VSPL_0 / VSP_1 / VSPL_1 >= 2v
   II. VGN- VSN_0 / VSN_1 >= -2v
   For example:

| | symbol | Voltage setting | Real Voltage |
|---|---|---|---|
| Voltage | VGP | 10v | +10v |
| | VGN | 10v | -10v |
| | VSP_0 | +15v | +8v |
| | VSN_0 | -15v | -8v |
| | VSP_1 | +5v | +5v |
| | VSN_1 | -5v | -5v |
| | VSPL | +15v | +8v |
| | VCOMH | +15v+(-2v) | +8v +(-2v) |
| | VCOML | -15v+(-2v) | -8v +(-2v) |
| | VCOMDC | -2v | -2v |

4. Voltage setting limit: VSP_0 ≥ VSPL_0 , VSP_1 ≥ VSPL_1

| | |
|---|---|
| Restriction | |

**3)R02H (POF): Power OFF Command**

| R02H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| POF | W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 02H |
| 1st Parameter | W | 0 | - | - | - | - | - | - | - | EDSE | 00 |

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

| | |
|---|---|
| Description | -The command defines as :<br>● After power off command, driver will power off base on power off sequence.<br>● After power off command, BUSY_N signal will drop from high to low. When finish the power off sequence, BUSY_N singal will rise from low to high.<br>● Power off command will turn off charge pump, T-con, source driver, gate driver, VCOM, temperature sensor, but register and SRAM data will keep until VDD off.<br>● SD output and VCOM will base on previous condition. It may have two conditions: 0v or floating. |
| Restriction | This command only active when BUSY_N = "1". |

1st parameter

| Bit | Name | Description |
|---|---|---|
| 0 | EDSE | EPD Discharge Trigger<br>0 : Disable EPD discharge (default)<br>1 : Enable EPD discharge |

**4)R03H (PFS): Power off Sequence Setting Register**

| R03H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| PFS | W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 03H |
| 1st Parameter | W | 1 | - | | T_VDPG_OFF [1:0] | | - | | T_VDS_OFF [1:0] | | 00h |
| 2nd Parameter | W | 1 | VGP_LEN[3:0] | | | | VGP_EXT[3:0] | | | | 54h |
| 3rd Parameter | W | 1 | XON_DLY[3:0] | | | | XON_LEN[3:0] | | | | 44h |

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

Description

-The command defines as :

1st Parameter:

| Bit | Name | Description |
|---|---|---|
| 1-0 | T_VDS_OFF | Power off sequence of VSP /VSN<br>00: 20 ms (default)<br>01: 40 ms<br>10: 60 ms<br>11: 80 ms |
| 5-4 | T_VDPG_OFF | Power off sequence of VGP and VGN<br>00: 20 ms (default)<br>01: 40 ms<br>10: 60 ms<br>11: 80 ms |

2nd Parameter

| Bit | Name | Description |
|---|---|---|
| 1-0 | VGP_EXT | VGP extension time<br>0000: 0 ms<br>0001: 500 ms<br>0010: 1000 ms<br>0011: 1500 ms<br>0100: 2000 ms (default)<br>0101: 2500 ms<br>0110: 3000 ms<br>0111: 3500 ms<br>1000: 4000 ms<br>1001: 4500 ms<br>1010: 5000 ms<br>1011: 5500 ms<br>1100: 6000 ms<br>1101: 6500 ms |
| 7-4 | VGP_LEN | When power off, the length of time VGP stay 10V<br>0000: 0 ms<br>0001: 500 ms<br>0010: 1000 ms<br>0011: 1500 ms<br>0100: 2000 ms<br>0101: 2500 ms (default)<br>0110: 3000 ms<br>0111: 3500 ms<br>1000: 4000 ms<br>1001: 4500 ms<br>1010: 5000 ms<br>1011: 5500 ms |

| | | |
|---|---|---|
| | | 1100: 6000 ms<br>1101: 6500 ms |

3rd Parameter:

| Bit | Name | Description |
|---|---|---|
| 3-0 | XON_LEN | XON enable time<br>0000: 0 ms<br>0001: 500 ms<br>0010: 1000 ms<br>0011: 1500 ms<br>0100: 2000 ms (default)<br>0101: 2500 ms<br>0110: 3000 ms<br>0111: 3500 ms<br>1000: 4000 ms<br>1001: 4500 ms<br>1010: 5000 ms<br>1011: 5500 ms<br>1100: 6000 ms |
| 7-4 | XON_DLY | XON delay time<br>0000: 0 ms<br>0001: 500 ms<br>0010: 1000 ms<br>0011: 1500 ms<br>0100: 2000 ms (default)<br>0101: 2500 ms<br>0110: 3000 ms<br>0111: 3500 ms<br>1000: 4000 ms<br>1001: 4500 ms<br>1010: 5000 ms<br>1011: 5500 ms<br>1100: 6000 ms |

| | |
|---|---|
| Restriction | |

**5)(R04H) (PON):Power ON Command**

| R04H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| PON | W | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 04H |

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

| | |
|---|---|
| Description | -The command defines as :<br>● After power on command, driver will power on base on power on sequence.<br>● After power on command, BUSY_N signal will drop from high to low. When finishing the power on sequence(base on PWR command), BUSY_N signal will rise from low to high. |
| Restriction | This command only active when BUSY_N = "1". |

**6) R06H (BTST): Booster Soft Start Command**

| R06H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| BTST | W | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 06H |
| 1st Parameter | W | 1 | - | - | - | - | PHB_SFT [1:0] | | PHA_SFT [1:0] | | 00h |
| 2nd Parameter | W | 1 | - | - | PHA_ON [5:0] | | | | | | 02h |
| 3rd Parameter | W | 1 | - | - | PHA_OFF [5:0] | | | | | | 07h |
| 4th Parameter | W | 1 | - | - | PHB_ON [5:0] | | | | | | 02h |
| 5th Parameter | W | 1 | - | - | PHB_OFF [5:0] | | | | | | 07h |
| 6th Parameter | W | 1 | - | - | PHC_ON [5:0] | | | | | | 02h |
| 7th Parameter | W | 1 | - | - | PHC_OFF [5:0] | | | | | | 07h |

Description

-The command define as follows:

1st Parameter:

| Bit | Name | Description |
|---|---|---|
| 1-0 | PHA_SFT | Soft start period of phase A:<br>00: 10mS (default)<br>01: 20mS<br>10: 30mS<br>11: 40mS |
| 3-2 | PHB_SFT | Soft start period of phase B:<br>00: 10mS (default)<br>01: 20mS<br>10: 30mS<br>11: 40mS |

| | Bit[5:0] | Description | Bit[5:0] | Description | Bit[5:0] | Description |
|---|---|---|---|---|---|---|
| Driving strength of PHA_ON & PHB_ON & PHC_ON | 000000 | strength1 | 010110 | strength23 | 101100 | strength45 |
| | 000001 | strength2 | 010111 | strength24 | 101101 | strength46 |
| | 000010 | strength3 | 011000 | strength25 | 101110 | strength47 |
| | 000011 | strength4 | 011001 | strength26 | 101111 | strength48 |
| | 000100 | strength5 | 011010 | strength27 | 110000 | strength49 |
| | 000101 | strength6 | 011011 | strength28 | 110001 | strength50 |
| | 000110 | strength7 | 011100 | strength29 | 110010 | strength51 |
| | 000111 | strength8 | 011101 | strength30 | 110011 | strength52 |
| | 001000 | strength9 | 011110 | strength31 | 110100 | strength53 |
| | 001001 | strength10 | 011111 | strength32 | 110101 | strength54 |
| | 001010 | strength11 | 100000 | strength33 | 110110 | strength55 |
| | 001011 | strength12 | 100001 | strength34 | 110111 | strength56 |
| | 001100 | strength13 | 100010 | strength35 | 111000 | strength57 |
| | 001101 | strength14 | 100011 | strength36 | 111001 | strength58 |
| | 001110 | strength15 | 100100 | strength37 | 111010 | strength59 |
| | 001111 | strength16 | 100101 | strength38 | 111011 | strength60 |
| | 010000 | strength17 | 100110 | strength39 | 111100 | strength61 |
| | 010001 | strength18 | 100111 | strength40 | 111101 | strength62 |
| | 010010 | strength19 | 101000 | strength41 | 111110 | strength63 |
| | 010011 | strength20 | 101001 | strength42 | 111111 | strength64 |
| | 010100 | strength21 | 101010 | strength43 | | |
| | 010101 | strength22 | 101011 | strength44 | | |

| Description | | Bit[5:0] | Description | Bit[5:0] | Description | Bit[5:0] | Description |
|---|---|---|---|---|---|---|---|
| | Minimum OFF time setting of PHA_OFF & PHB_OFF & PHC_OFF | 000000 | Period1 | 010110 | Period23 | 101100 | Period45 |
| | | 000001 | Period2 | 010111 | Period24 | 101101 | Period46 |
| | | 000010 | Period3 | 011000 | Period25 | 101110 | Period47 |
| | | 000011 | Period4 | 011001 | Period26 | 101111 | Period48 |
| | | 000100 | Period5 | 011010 | Period27 | 110000 | Period49 |
| | | 000101 | Period6 | 011011 | Period28 | 110001 | Period50 |
| | | 000110 | Period7 | 011100 | Period29 | 110010 | Period51 |
| | | 000111 | Period8 | 011101 | Period30 | 110011 | Period52 |
| | | 001000 | Period9 | 011110 | Period31 | 110100 | Period53 |
| | | 001001 | Period10 | 011111 | Period32 | 110101 | Period54 |
| | | 001010 | Period11 | 100000 | Period33 | 110110 | Period55 |
| | | 001011 | Period12 | 100001 | Period34 | 110111 | Period56 |
| | | 001100 | Period13 | 100010 | Period35 | 111000 | Period57 |
| | | 001101 | Period14 | 100011 | Period36 | 111001 | Period58 |
| | | 001110 | Period15 | 100100 | Period37 | 111010 | Period59 |
| | | 001111 | Period16 | 100101 | Period38 | 111011 | Period60 |
| | | 010000 | Period17 | 100110 | Period39 | 111100 | Period61 |
| | | 010001 | Period18 | 100111 | Period40 | 111101 | Period62 |
| | | 010010 | Period19 | 101000 | Period41 | 111110 | Period63 |
| | | 010011 | Period20 | 101001 | Period42 | 111111 | Period64 |
| | | 010100 | Period21 | 101010 | Period43 | | |
| | | 010101 | Period22 | 101011 | Period44 | | |
| Restriction | | | | | | | |

**7) R07H (DSLP): Deep Sleep Command**

| R07H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| DSLP | W | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 07H |
| 1st Parameter | W | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | A5h |

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

| Description | The command define as follows:<br>After this command is transmitted, the chip would enter the deep-sleep mode to save power.<br>The deep sleep mode would return to standby by hardware reset.<br>The only one parameter is a check code, the command would be excited if check code = 0xA5. |
|---|---|
| Restriction | This command only active when BUSY_N = "1". |

**8）R10H (DTM): Data Start transmission Register**

| R10H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| DTM | W | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 10H |
| 2 bit mode | W | 1 | | | | | | | | | |
| 1st Parameter | W | 1 | Pixel1 | | Pixel2 | | Pixel3 | | Pixel4 | | 00h |
| : | W | 1 | : | | : | | : | | : | | 00h |
| Mth Parameter | W | 1 | Pixel(n-3) | | Pixel(n-2) | | Pixel(n-1) | | Pixel(n) | | 00h |

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

Description

The command define as follows:

The register is indicates that user start to transmit data, then write to SRAM. While data transmission complete, user must send command 12H. Then chip will start to send data/VCOM for panel.

Pixel [1~n][1:0]: 2-bit/pixel

| Image Data | DDX=1 (default) | | DDX=0 | |
|---|---|---|---|---|
| Pixel[1:0] | Gray level select | IP output LUT select | Gray level select | IP output LUT select |
| 00b | Gray0 | ogray00 | Gray3 | ogray03 |
| 01b | Gray1 | ogray01 | Gray2 | ogray02 |
| 10b | Gray2 | ogray02 | Gray1 | ogray01 |
| 11b | Gray3 | ogray03 | Gray0 | ogray00 |

Data mapping example:

When DDX=1,Pixel[1:0]=01 ->Gray level select=Gray1,follow LUT data output from IP output port"ogray01".

When DDX=0,Pixel[1:0]=11 ->Gray level select=Gray0,follow LUT data output from IP output port"ogray00"

Restriction

**9)R11H (DSP): Data Stop Command**

| R11H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| DSP | W | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 11H |
| 1st Parameter | R | 1 | Data_flag | - | - | - | - | - | - | - | - |

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

| | |
|---|---|
| Description | -The command defines as :<br>■While finished the data transmitting, user must send this command to driver and read Data_flag information.<br><br>1st Parameter:<br>Bit 7 — Name: Data_flag — Description: 0: Driver didn't receive all the data. 1: Driver has already received all of the one frame data.<br><br>After "Data Start" (10h) or "Data Stop" (11h) commands and when data_flag=1, BUSY_N signal will become "0" and the refreshing of panel starts. |
| Restriction | This command only actives when BUSY_N = "1". |

**10)R12H (DRF): Display Refresh Command**

| R12H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| DRF | W | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 12H |
| 1st Parameter | W | 1 | - | - | - | - | - | - | - | AC/DC VCOM | 00h |

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

| | |
|---|---|
| Description | -The command defines as :<br>While users send this command, driver will refresh display (data/VCOM) base on SRAM data and LUT.<br>**AC/DC VCOM:**<br>**0: AC VCOM, VCOM will follow LUTC when updating image. (default)**<br>1: DC VCOM, VCOM will always be VCOMDC when updating image<br><br>After display refresh command, BUSY_N signal will become "0" |
| Restriction | This command only actives when BUSY_N = "1" |

**11) R17H (AUTO): Auto Sequence**

| R17H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| Auto Sequence | W | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 17H |
| 1st Parameter | W | 1 | Code[7] | Code[6] | Code[5] | Code[4] | Code[3] | Code[2] | Code[1] | Code[0] | A5h |

| | |
|---|---|
| Description | The command can enable the internal sequence to execute several commands continuously. The successive execution can minimize idle time to avoid unnecessary power consumption and reduce the complexity of host's control procedure. The sequence contains several operations, including PON, DRF, POF, DSLP.<br><br>AUTO (0x17) + Code(0xA5) = (PON→DRF→POF)<br>AUTO (0x17) + Code(0xA7) = (PON→DRF→POF→DSLP) |
| Restriction | This command only actives when BUSY_N = "1". |

**12) R30H (PLL): PLL Control Register**

| R30H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| PLL | W | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 30H |
| 1st Parameter | W | 1 | - | - | - | - | Dyna | FR[2] | FR[1] | FR[0] | 02h |

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

Description

-The command defines as:

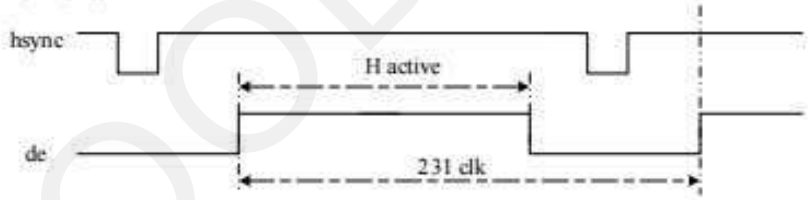
The command controls the PLL clock frequency. The PLL structure must support the following frame rates:

| bit3 | Dynamic frame rate |
|---|---|
| 0 | Disable (default) |
| 1 | Enable |

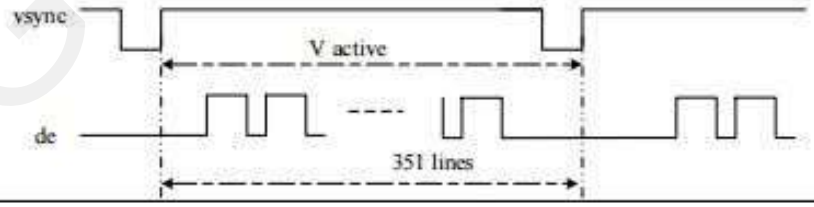
| FR[2:0] | Frame rate |
|---|---|
| 000 | 12.5 Hz |
| 001 | 25 Hz |
| 010 | 50 Hz (default) |
| 011 | 65 Hz |
| 100 | 75 Hz |
| 101 | 85 Hz |
| 110 | 100 Hz |
| 111 | 120 Hz |

remark

-Horizental




-Vertical




Restriction

**13)R40H (TSC): Temperature Sensor Command**

| R40H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| TSC | W | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 40H |
| 1st Parameter | R | 1 | D10/TS[7] | D9/TS[6] | D8/TS[5] | D7/TS[4] | D6/TS[3] | D5/TS[2] | D4/TS[1] | D3/TS[0] | - |
| 2nd Parameter | R | 1 | D2/ TS[9] | D1/ TS[8] | D0 | - | - | - | - | - | - |

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

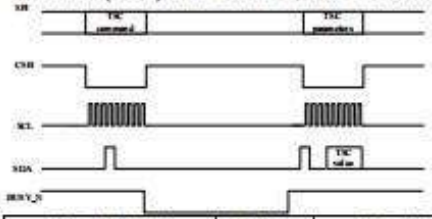
Description

-The command define as follows:

This command indicates the temperature value.

If R41H(TSE) bit7 set to 0, this command reads internal temperature sensor value.

If R41H(TSE) bit7 set to 1, this command reads external (LM75) temperature sensor value



| TS[7:0]/D[10:3] | T (°C) | TS[7:0]/D[10:3] | T (°C) | TS[7:0]/D[10:3] | T (°C) |
|---|---|---|---|---|---|
| 11100111 | -25 | 00000000 | 0 | 00011001 | 25 |
| 11101000 | -24 | 00000001 | 1 | 00011010 | 26 |
| 11101001 | -23 | 00000010 | 2 | 00011011 | 27 |
| 11101010 | -22 | 00000011 | 3 | 00011100 | 28 |
| 11101011 | -21 | 00000100 | 4 | 00011101 | 29 |
| 11101100 | -20 | 00000101 | 5 | 00011110 | 30 |
| 11101101 | -19 | 00000110 | 6 | 00011111 | 31 |
| 11101110 | -18 | 00000111 | 7 | 00100000 | 32 |
| 11101111 | -17 | 00001000 | 8 | 00100001 | 33 |
| 11110000 | -16 | 00001001 | 9 | 00100010 | 34 |
| 11110001 | -15 | 00001010 | 10 | 00100011 | 35 |
| 11110010 | -14 | 00001011 | 11 | 00100100 | 36 |
| 11110011 | -13 | 00001100 | 12 | 00100101 | 37 |
| 11110100 | -12 | 00001101 | 13 | 00100110 | 38 |
| 11110101 | -11 | 00001110 | 14 | 00100111 | 39 |
| 11110110 | -10 | 00001111 | 15 | 00101000 | 40 |
| 11110111 | -9 | 00010000 | 16 | 00101001 | 41 |
| 11111000 | -8 | 00010001 | 17 | 00101010 | 42 |
| 11111001 | -7 | 00010010 | 18 | 00101011 | 43 |
| 11111010 | -6 | 00010011 | 19 | 00101100 | 44 |
| 11111011 | -5 | 00010100 | 20 | 00101101 | 45 |
| 11111100 | -4 | 00010101 | 21 | 00101110 | 46 |
| 11111101 | -3 | 00010110 | 22 | 00101111 | 47 |
| 11111110 | -2 | 00010111 | 23 | 00110000 | 48 |
| 11111111 | -1 | 00011000 | 24 | 00110001 | 49 |

| TS[9:8] | T (°C) |
|---|---|
| 00 | +0 |
| 01 | +0.25 |
| 10 | +0.5 |
| 11 | +0.75 |

| Restriction | This command only actives when BUSY_N = "1". |
|---|---|

**14)R41H (TSE): Temperature Sensor Calibration Register**

| R41H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| TSE | W | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 41H |
| 1st Parameter | W | 1 | TSE | - | - | TO[4] | TO[3] | TO[2] | TO[1] | TO[0] | 00h |

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

Description

-The command defines as:
This command indicates the driver IC temperature sensor enable and calibration function.

Reserve one temperature offset TO[3:0] for calibration
1. TO[3]: mean '+' or '-', while 0 is '+'; 1 is '-'
2. TO[2:0]: mean temperature offset value

| Bit | Name | Description |
|---|---|---|
| 3-0 | TO[3:0] | Temperature level:<br>0000: +0°C (default)<br>0001: +0.5°C<br>0010: +1°C<br>0011: +1.5°C<br>0100: +2°C<br>0101: +2.5°C<br>0110: +3°C<br>0111: +3.5°C<br>1000: -4°C<br>1001: -3.5°C<br>1010: -3°C<br>1011: -2.5°C<br>1100: -2°C<br>1101: -1.5°C<br>1110: -1°C<br>1111: -0.5°C |
| 4 | TO[4] | 0: +0.0°C (default)<br>1: +0.25°C |
| 7 | TSE | Internal temperature sensor enable<br>0: Internal temperature sensor enable.(default)<br>1: Internal temperature sensor disable, using external temperature sensor. |

Restriction: This command only actives after R04H(PON)

**15)R42H (TSW): Temperature Sensor Write Register**

| R42H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| TSW | W | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 42H |
| 1st Parameter | W | 1 | WATTR[7] | WATTR[6] | WATTR[5] | WATTR[4] | WATTR[3] | WATTR[2] | WATTR[1] | WATTR[0] | 00h |
| 2nd Parameter | W | 1 | WMSB[7] | WMSB[6] | WMSB[5] | WMSB[4] | WMSB[3] | WMSB[2] | WMSB[1] | WMSB[0] | 00h |
| 3rd Parameter | W | 1 | WLSB[7] | WLSB[6] | WLSB[5] | WLSB[4] | WLSB[3] | WLSB[2] | WLSB[1] | WLSB[0] | 00h |

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

Description

-The command defines as:

This command writes the temperature.

1st Parameter:

| Bit | Name | Description |
|---|---|---|
| 2-0 | WATTR[2:0] | Pointer setting |
| 5-3 | WATTR[5:3] | User-defined address bits (A2, A1, A0) |
| 7-6 | WATTR[7:6] | I2C Write Byte Number<br>00: 1 byte (head byte only)<br>01: 2 bytes (head byte + pointer)<br>10: 3 bytes (head byte + pointer + 1st parameter)<br>11: 4 bytes (head byte + pointer + 1st parameter + 2nd parameter) |

2nd Parameter:

| Bit | Name | Description |
|---|---|---|
| 7-0 | WMSB[7:0] | MSByte of write-data to external temperature sensor |

3rd Parameter:

| Bit | Name | Description |
|---|---|---|
| 7-0 | WLSB[7:0] | LSByte of write-data to external temperature sensor |

Restriction: This command only actives after R04H(PON)

**16)R43H (TSR): Temperature Sensor Read Register**

| R43H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| TSR | W | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 43H |
| 1st Parameter | R | 1 | RMSB[7] | RMSB[6] | RMSB[5] | RMSB[4] | RMSB[3] | RMSB[2] | RMSB[1] | RMSB[0] | - |
| 2nd Parameter | R | 1 | RLSB[7] | RLSB[6] | RLSB[5] | RLSB[4] | RLSB[3] | RLSB[2] | RLSB[1] | RLSB[0] | - |

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

Description

-The command defines as:

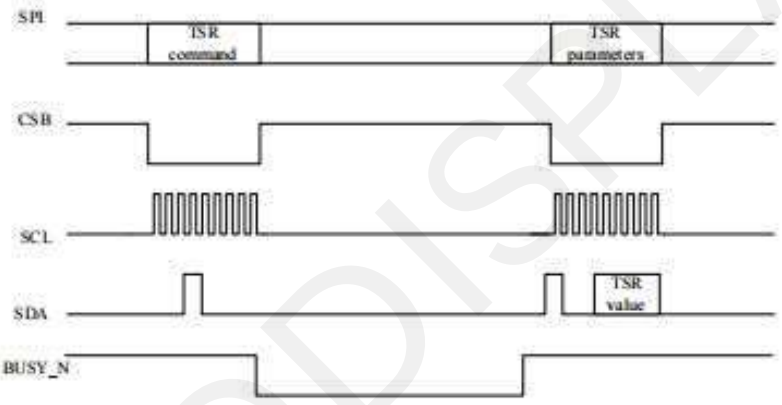
This command reads the temperature sensed by the temperature sensor.

1st Parameter:

| Bit | Name | Description |
|---|---|---|
| 7-0 | RMSB[7:0] | MSByte of read-data from external temperature sensor |

2nd Parameter:

| Bit | Name | Description |
|---|---|---|
| 7-0 | RLSB[7:0] | LSByte of write-data from external temperature sensor |




Restriction: This command only actives after R04H(PON)

**17)R50H (CDI): VCOM and DATA interval setting Register**

| R50H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| CDI | W | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 50H |
| 1st Parameter | W | 1 | VBD[2] | VBD[1] | VBD [0] | DDX | CDI[3] | CDI[2] | CDI[1] | CDI[0] | 97h |

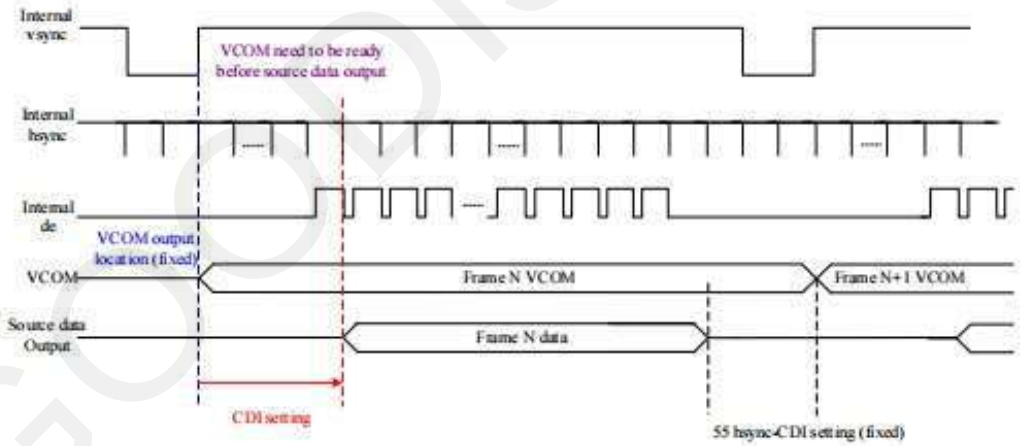
*NOTE: "-" Don't care, can be set to VDD or GND level*

Description

-The command defines as:
This command can set 2 kinds of parameters, 1.VCOM to data output interval(CDI)
:

**CDI[3:0]:** This command indicates the interval of VCOM and data output. When setting the vertical back porch, the total blanking will be keep (55hsync).

| Bit | Name | Description |
|---|---|---|
| 3-0 | CDI[3:0] | Vcom and data interval<br>0000: 17 hsync<br>0001:16 hsync<br>0010:15 hsync<br>0011:14 hsync<br>0100:13 hsync<br>0101:12 hsync<br>0110:11 hsync<br>0111:10 hsync(default)<br>1000:9 hsync<br>1001:8 hsync<br>1010:7 hsync<br>1011:6 hsync<br>1100:5 hsync<br>1101:4 hsync<br>1110:3 hsync<br>1111:2 hsync |



**VBD[2:0]:** Border data selection. (from LUT output by IP port border_w[1:0])

This register will make boarder pin output being mapped to a certain gray scale.

| Bit 4 | Bit7-5 | Description | IP setting for Border LUT select |
|---|---|---|---|
| DDX | VBD[2:0] | Gray level | |
| 0 | 000 | Floating | N/A |
| | 001 | Gray3 | border_buf=011 |
| | 010 | Gray2 | border_buf=010 |
| | 011 | Gray1 | border_buf=001 |
| | 100 | Gray0 | border_buf=000 |
| 1 (default) | 000 | Gray0 | border_buf=000 |
| | 001 | Gray1 | border_buf=001 |
| | 010 | Gray2 | border_buf=010 |
| | 011 | Gray3 | border_buf=011 |
| | 100 | Floating | N/A |

Border output voltage level: The level selection is based on mapping LUT data.

Ex: Gray 1 waveform is mapping to 15V,without VCOM offset, the real output on Boarder pin shall be 15V.

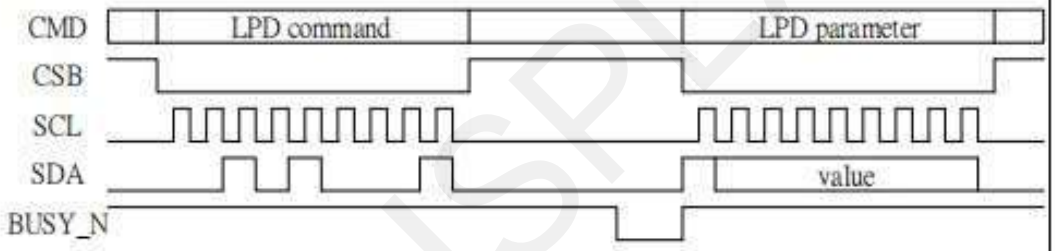
Boarder output will follow FOPT definition being defined in R00h.

| Restriction | |
|---|---|

**18) R51H (LPD): Lower Power Detection Register**

| R51H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| LPD | W | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 51H |
| 1st Parameter | R | 1 | - | - | - | - | - | - | - | LPD | -- |

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

| | |
|---|---|
| Description | -The command defines as:<br>This command indicates the input power condition. Host can read this data to understand the battery's condition.<br>When LPD="1", system input power is normal.<br>When LPD="0", system input power is lower (VDD<2.5v, which could be select in RE4H (LVSEL)).<br><br>1st Parameter:<br>Bit 0 = LPD: 0 = Low power input. 1 = Normal status.<br><br>  |
| Restriction | This command only actives when BUSY_N = "1". |

**19)R61H (TRES): Resolution setting**

| R61H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| TRES | W | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 61H |
| 1st Parameter | W | 1 | - | - | - | - | - | - | HRES(9) | HRES(8) | 00h |
| 2nd Parameter | W | 1 | HRES(7) | HRES(6) | HRES(5) | HRES(4) | HRES(3) | HRES(2) | 0 | 0 | 00h |
| 3rd Parameter | W | 1 | - | - | - | - | - | - | VRES(9) | VRES(8) | 00h |
| 4th Parameter | W | 1 | VRES(7) | VRES(6) | VRES(5) | VRES(4) | VRES(3) | VRES(2) | VRES(1) | VRES(0) | 00h |

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

| | |
|---|---|
| Description | -The command define as follows:<br>When using register:<br>Horizontal display resolution(source) = HRES<br>Vertical display resolution(gate) = VRES<br><br>Note:<br>No matter HRES[9:8],HRES[1:0],VRST[9] value being filled, it's always be 00b.<br><br>Channel disable calculation:<br>GD : First G active = G0; LAST active GD= first active +VRES[9:0]-1<br>SD : First active channel: =S0 ; LAST active SD= first active +HRES[9:2]*4-1<br><br>EX :176X296<br>GD: First G active = G0<br>LAST active GD= 0+296-1= 295; (G295)<br>SD : First active channel: =S0<br>LAST active SD=0+44*4-1=175; (S175)<br><br>Note : Only supports source 176.ch for source 160ch. above |
| Restriction | Horizontal resolution should be 4-multiple. |

**20) R65H(GSST): Gate/Source Start Setting Register**

| R65H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| GSST | W | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 65H |
| 1st Parameter | W | 1 | - | - | - | - | - | - | S_start[9] | S_start[8] | 00h |
| 2nd Parameter | W | 1 | S_start[7] | S_start[6] | S_start[5] | S_start[4] | S_start[3] | S_start[2] | 0 | 0 | 00h |
| 3rd Parameter | W | 1 | - | - | - | - | - | - | G_start[9] | G_start[8] | 00h |
| 4th Parameter | W | 1 | G_start[7] | G_start[6] | G_start[6] | G_start[4] | G_start[3] | G_start[2] | G_start[1] | G_start[0] | 00h |

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

| | |
|---|---|
| Description | -The command define as follows:<br><br>Note:<br>No matter S_start[9:8], S_start [1:0],VRST[9] value being filled, it's always be 00b.<br><br>1.S_Start [7:0] describe which source output line is the first date line<br>2.G_Start[8:0] describe which gate line is the first scan line |
| Restriction | S_Start should be the multiple of 4 |

**21)R70H (REV): REVISION register**

| R70H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| REV | W | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 70H |
| 1st Parameter | R | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 03h |
| 2nd Parameter | R | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 02h |
| 3rd Parameter | R | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 01h |

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

| | |
|---|---|
| Description | -The command defines as:<br><br>1st & 2nd & 3rd Parameter: |

| Bit | Description |
|---|---|
| 7-0 | CHIP_REV |

| | |
|---|---|
| Restriction | |

**22)R80H (AMV): Auto Measure VCOM register**

| R80H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| AMV | W | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80H |
| 1st Parameter | W | 1 | P[1] | P[0] | AMVT[1] | AMVT[0] | XON | AMVS | AMV | AMVE | 00h |

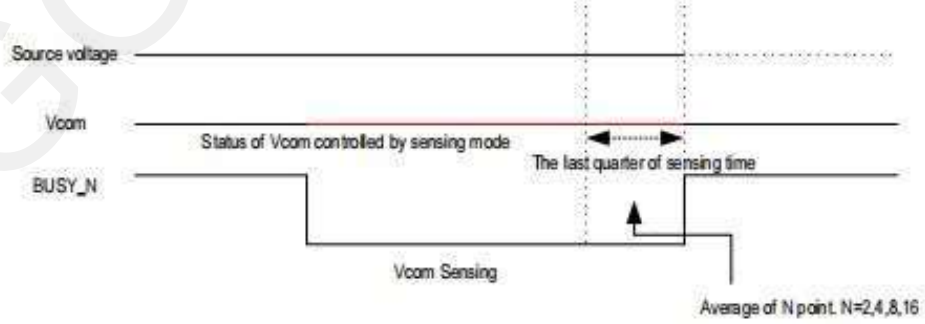
*NOTE: "-" Don't care, can be set to VDD or GND level*

Description

-The command defines as:
This command indicates the IC status. Host can read this data to understand the IC status.

1st Parameter:

| Bit | Name | Description |
|---|---|---|
| 0 | AMVE | AMVE: Auto Measure Vcom Setting<br>0: Auto measure VCOM disable (default)<br>1: Auto measure VCOM enable |
| 1 | AMV | AMV: Analog signal<br>0:Get Vcom value from R81h(default)<br>1:Get Vcom value in analog signal |
| 2 | AMVS | AMVS: setting for Source output of AMV<br>0: Source output 0V during Auto Measure VCOM period. (default)<br>1: Source output VSPL_0 during Auto Measure VCOM period. |
| 3 | XON | XON: setting for all Gate ON of AMV<br>0: Gate normally scan during Auto Measure VCOM period. (default)<br>1: All Gate ON during Auto Measure VCOM period. |
| 5-4 | AMVT[1:0] | The sensing time of VCOM detection<br>00: 5s (default)<br>01: 10s<br>10: 15s<br>11: 20s |
| 7-6 | P[1:0] | The sensing points of sampling time<br>00: 2 (default)<br>01: 4<br>10: 8<br>11: 16<br>Sampling time = the last quarter of sensing time (T) VCOM = average of N points. N=2,4,8,16 |




Restriction: This command only actives when BUSY_N = "1".

**23)R81H (VV): VCOM Value register**

| R81H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| VV | W | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 81H |
| 1st Parameter | R | 1 | - | VV[6] | VV[5] | VV[4] | VV[3] | VV[2] | VV[1] | VV[0] | -- |

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

Description

-The command defines as:
This command could get the VCOM value

1st Parameter:

| Bit | Name | Description |
|---|---|---|
| 6-0 | VV[6:0] | VCOM value |

| VCOM[6:0] | | Voltage(V) | VCOM[6:0] | | Voltage(V) | VCOM[6:0] | | Voltage(V) |
|---|---|---|---|---|---|---|---|---|
| 0000000 | 00h | 0 | 0011100 | 1Ch | -1.4 | 0111000 | 38h | -2.8 |
| 0000001 | 01h | -0.05 | 0011101 | 1Dh | -1.45 | 0111001 | 39h | -2.85 |
| 0000010 | 02h | -0.1 | 0011110 | 1Eh | -1.5 | 0111010 | 3Ah | -2.9 |
| 0000011 | 03h | -0.15 | 0011111 | 1Fh | -1.55 | 0111011 | 3Bh | -2.95 |
| 0000100 | 04h | -0.2 | 0100000 | 20h | -1.6 | 0111100 | 3Ch | -3 |
| 0000101 | 05h | -0.25 | 0100001 | 21h | -1.65 | 0111101 | 3Dh | -3.05 |
| 0000110 | 06h | -0.3 | 0100010 | 22h | -1.7 | 0111110 | 3Eh | -3.1 |
| 0000111 | 07h | -0.35 | 0100011 | 23h | -1.75 | 0111111 | 3Fh | -3.15 |
| 0001000 | 08h | -0.4 | 0100100 | 24h | -1.8 | 1000000 | 40h | -3.2 |
| 0001001 | 09h | -0.45 | 0100101 | 25h | -1.85 | 1000001 | 41h | -3.25 |
| 0001010 | 0Ah | -0.5 | 0100110 | 26h | -1.9 | 1000010 | 42h | -3.3 |
| 0001011 | 0Bh | -0.55 | 0100111 | 27h | -1.95 | 1000011 | 43h | -3.35 |
| 0001100 | 0Ch | -0.6 | 0101000 | 28h | -2 | 1000100 | 44h | -3.4 |
| 0001101 | 0Dh | -0.65 | 0101001 | 29h | -2.05 | 1000101 | 45h | -3.45 |
| 0001110 | 0Eh | -0.7 | 0101010 | 2Ah | -2.1 | 1000110 | 46h | -3.5 |
| 0001111 | 0Fh | -0.75 | 0101011 | 2Bh | -2.15 | 1000111 | 47h | -3.55 |
| 0010000 | 10h | -0.8 | 0101100 | 2Ch | -2.2 | 1001000 | 48h | -3.6 |
| 0010001 | 11h | -0.85 | 0101101 | 2Dh | -2.25 | 1001001 | 49h | -3.65 |
| 0010010 | 12h | -0.9 | 0101110 | 2Eh | -2.3 | 1001010 | 4Ah | -3.7 |
| 0010011 | 13h | -0.95 | 0101111 | 2Fh | -2.35 | 1001011 | 4Bh | -3.75 |
| 0010100 | 14h | -1 | 0110000 | 30h | -2.4 | 1001100 | 4Ch | -3.8 |
| 0010101 | 15h | -1.05 | 0110001 | 31h | -2.45 | 1001101 | 4Dh | -3.85 |
| 0010110 | 16h | -1.1 | 0110010 | 32h | -2.5 | 1001110 | 4Eh | -3.9 |
| 0010111 | 17h | -1.15 | 0110011 | 33h | -2.55 | 1001111 | 4Fh | -3.95 |
| 0011000 | 18h | -1.2 | 0110100 | 34h | -2.6 | 1010000 | 50h | -4 |
| 0011001 | 19h | -1.25 | 0110101 | 35h | -2.65 | other | | -4 |
| 0011010 | 1Ah | -1.3 | 0110110 | 36h | -2.7 | | | |
| 0011011 | 1Bh | -1.35 | 0110111 | 37h | -2.75 | | | |

Restriction

**24)R82H (VDCS): VCOM_DC Setting Register**

| R82H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| VDCS | W | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 82H |
| 1st Parameter | W | 1 | MTP_VCM | VDCS[6] | VDCS[5] | VDCS [4] | VDCS [3] | VDCS [2] | VDCS [1] | VDCS [0] | 00h |

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

Description

-The command defines as:
This command set the VCOM DC value. Driver will base on this value for VCM_DC.

1st Parameter:

| Bit | Name | Description |
|---|---|---|
| 6-0 | VDCS[6:0] | VCOM value |

| VCOM[6:0] | | Voltage(V) | VCOM[6:0] | | Voltage(V) | VCOM[6:0] | | Voltage(V) |
|---|---|---|---|---|---|---|---|---|
| 0000000 | 00h | 0(default) | 0011100 | 1Ch | -1.4 | 0111000 | 38h | -2.8 |
| 0000001 | 01h | -0.05 | 0011101 | 1Dh | -1.45 | 0111001 | 39h | -2.85 |
| 0000010 | 02h | -0.1 | 0011110 | 1Eh | -1.5 | 0111010 | 3Ah | -2.9 |
| 0000011 | 03h | -0.15 | 0011111 | 1Fh | -1.55 | 0111011 | 3Bh | -2.95 |
| 0000100 | 04h | -0.2 | 0100000 | 20h | -1.6 | 0111100 | 3Ch | -3 |
| 0000101 | 05h | -0.25 | 0100001 | 21h | -1.65 | 0111101 | 3Dh | -3.05 |
| 0000110 | 06h | -0.3 | 0100010 | 22h | -1.7 | 0111110 | 3Eh | -3.1 |
| 0000111 | 07h | -0.35 | 0100011 | 23h | -1.75 | 0111111 | 3Fh | -3.15 |
| 0001000 | 08h | -0.4 | 0100100 | 24h | -1.8 | 1000000 | 40h | -3.2 |
| 0001001 | 09h | -0.45 | 0100101 | 25h | -1.85 | 1000001 | 41h | -3.25 |
| 0001010 | 0Ah | -0.5 | 0100110 | 26h | -1.9 | 1000010 | 42h | -3.3 |
| 0001011 | 0Bh | -0.55 | 0100111 | 27h | -1.95 | 1000011 | 43h | -3.35 |
| 0001100 | 0Ch | -0.6 | 0101000 | 28h | -2 | 1000100 | 44h | -3.4 |
| 0001101 | 0Dh | -0.65 | 0101001 | 29h | -2.05 | 1000101 | 45h | -3.45 |
| 0001110 | 0Eh | -0.7 | 0101010 | 2Ah | -2.1 | 1000110 | 46h | -3.5 |
| 0001111 | 0Fh | -0.75 | 0101011 | 2Bh | -2.15 | 1000111 | 47h | -3.55 |
| 0010000 | 10h | -0.8 | 0101100 | 2Ch | -2.2 | 1001000 | 48h | -3.6 |
| 0010001 | 11h | -0.85 | 0101101 | 2Dh | -2.25 | 1001001 | 49h | -3.65 |
| 0010010 | 12h | -0.9 | 0101110 | 2Eh | -2.3 | 1001010 | 4Ah | -3.7 |
| 0010011 | 13h | -0.95 | 0101111 | 2Fh | -2.35 | 1001011 | 4Bh | -3.75 |
| 0010100 | 14h | -1 | 0110000 | 30h | -2.4 | 1001100 | 4Ch | -3.8 |
| 0010101 | 15h | -1.05 | 0110001 | 31h | -2.45 | 1001101 | 4Dh | -3.85 |
| 0010110 | 16h | -1.1 | 0110010 | 32h | -2.5 | 1001110 | 4Eh | -3.9 |
| 0010111 | 17h | -1.15 | 0110011 | 33h | -2.55 | 1001111 | 4Fh | -3.95 |
| 0011000 | 18h | -1.2 | 0110100 | 34h | -2.6 | 1010000 | 50h | -4 |
| 0011001 | 19h | -1.25 | 0110101 | 35h | -2.65 | other | | -4 |
| 0011010 | 1Ah | -1.3 | 0110110 | 36h | -2.7 | | | |
| 0011011 | 1Bh | -1.35 | 0110111 | 37h | -2.75 | | | |

| | | | |
|---|---|---|---|
| | 7 | MTP_VCM | Follow MTP VCOM value in MTP mode<br>0: From the setting of MTP (default)<br>1:From the setting of register |
| Restriction | | | |

**25) R83H (PTL): Partial Window Register**

| R83H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| PTL | W | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 83H |
| 1st Parameter | W | 1 | - | - | - | - | - | - | HRST[9] | HRST[8] | 00h |
| 2nd Parameter | W | 1 | HRST[7] | HRST[6] | HRST[5] | HRST[4] | HRST[3] | HRST[2] | - | - | 00h |
| 3rd Parameter | W | 1 | - | - | - | - | - | - | HRED[9] | HRED[8] | 00h |
| 4th Parameter | W | 1 | HRED[7] | HRED[6] | HRED[5] | HRED[4] | HRED[3] | HRED[2] | - | - | 00h |
| 5th Parameter | W | 1 | - | - | - | - | - | - | VRST[9] | VRST[8] | 00h |
| 6th Parameter | W | 1 | VRST[7] | VRST[6] | VRST[5] | VRST[4] | VRST[3] | VRST[2] | VRST[1] | VRST[0] | 00h |
| 7th Parameter | W | 1 | - | - | - | - | - | - | VRED[9] | VRED[8] | 00h |
| 8th Parameter | W | 1 | VRED[7] | VRED[6] | VRED[5] | VRED[4] | VRED[3] | VRED[2] | VRED[1] | VRED[0] | 00h |
| 9th Parameter | W | 1 | - | - | - | - | - | - | - | PMODE | 00h |

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

Description

-This command sets partial window.

| Name | Description |
|---|---|
| HRST[9:2] | Horizontal start address |
| HRED[9:2] | Horizontal end address. HRED must be greater than HRST. |
| VRST[9:0] | Vertical start address. |
| VRED[9:0] | Vertical end address. VRED must be greater than VRST. |
| PMODE | 0: disable partial mode(default)<br>1: enable partial mode |

Note:
No matter HRST[1:0] ,HRST[9:8],HRED[9:8],VRST[9],VRED[9] value being filled, it's always be 00b.
No matter HRED[1:0] value being filled, it's always be 11b.

**Gates scan both inside and outside of the partial window.**

Restriction

**26) R90H (PGM): Program Mode**

| R90H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| PGM | W | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 90H |

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

| | |
|---|---|
| Description | -The command define as follows:<br>After this command is issued, the chip would enter the program mode.<br>The mode would return to standby by hardware reset. |
| Restriction | |

**27)R91H (APG): Active Program**

| R91H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| APG | W | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 91H |

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

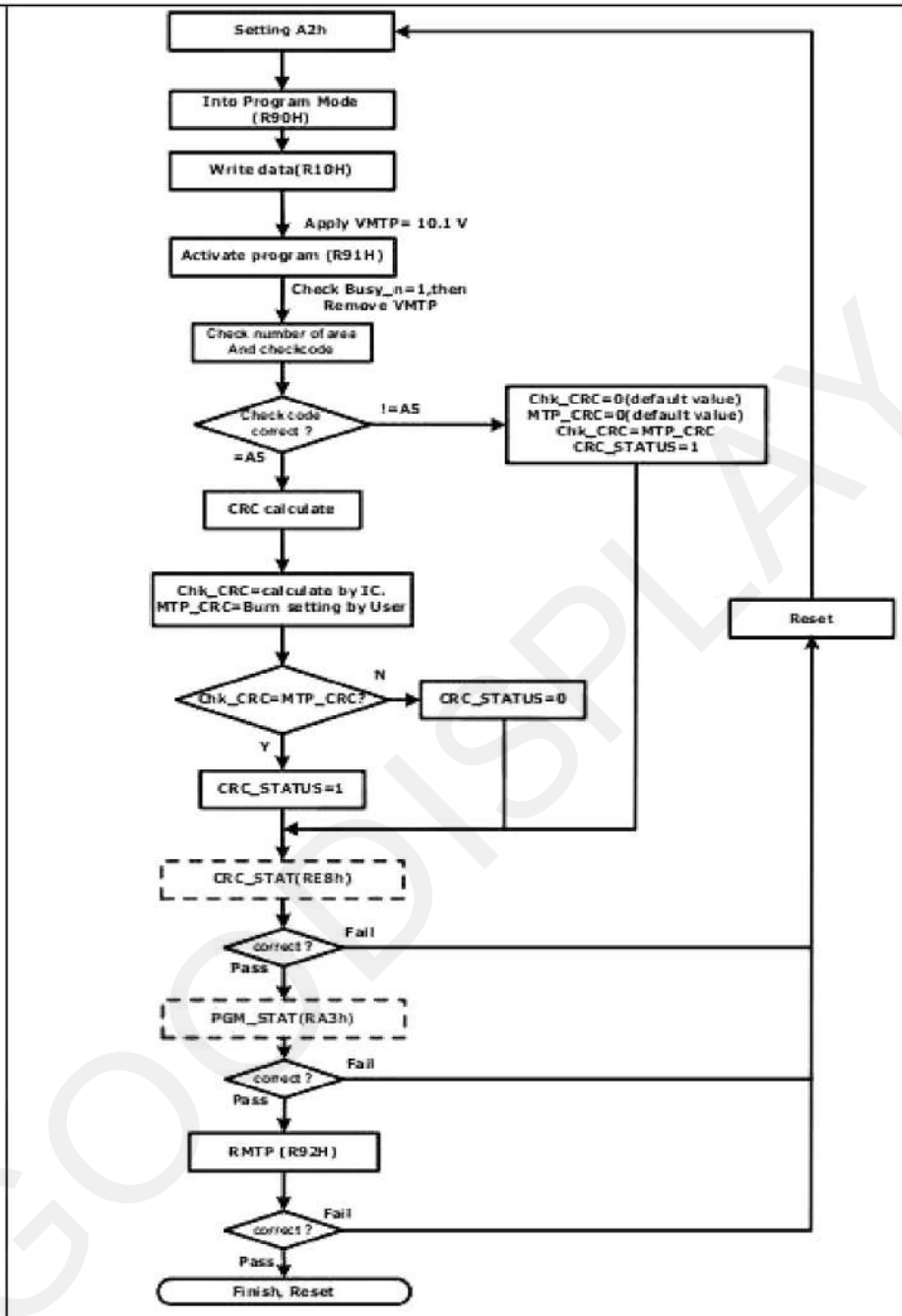
| | |
|---|---|
| Description | -The command define as follows:<br>After this command is transmitted, the programming state machine would be activated. |
| Restriction | The BUSY flag would change state from 0 to 1 while the programming is completed. |

**28)R92H (RMTP): Read MTP Data**

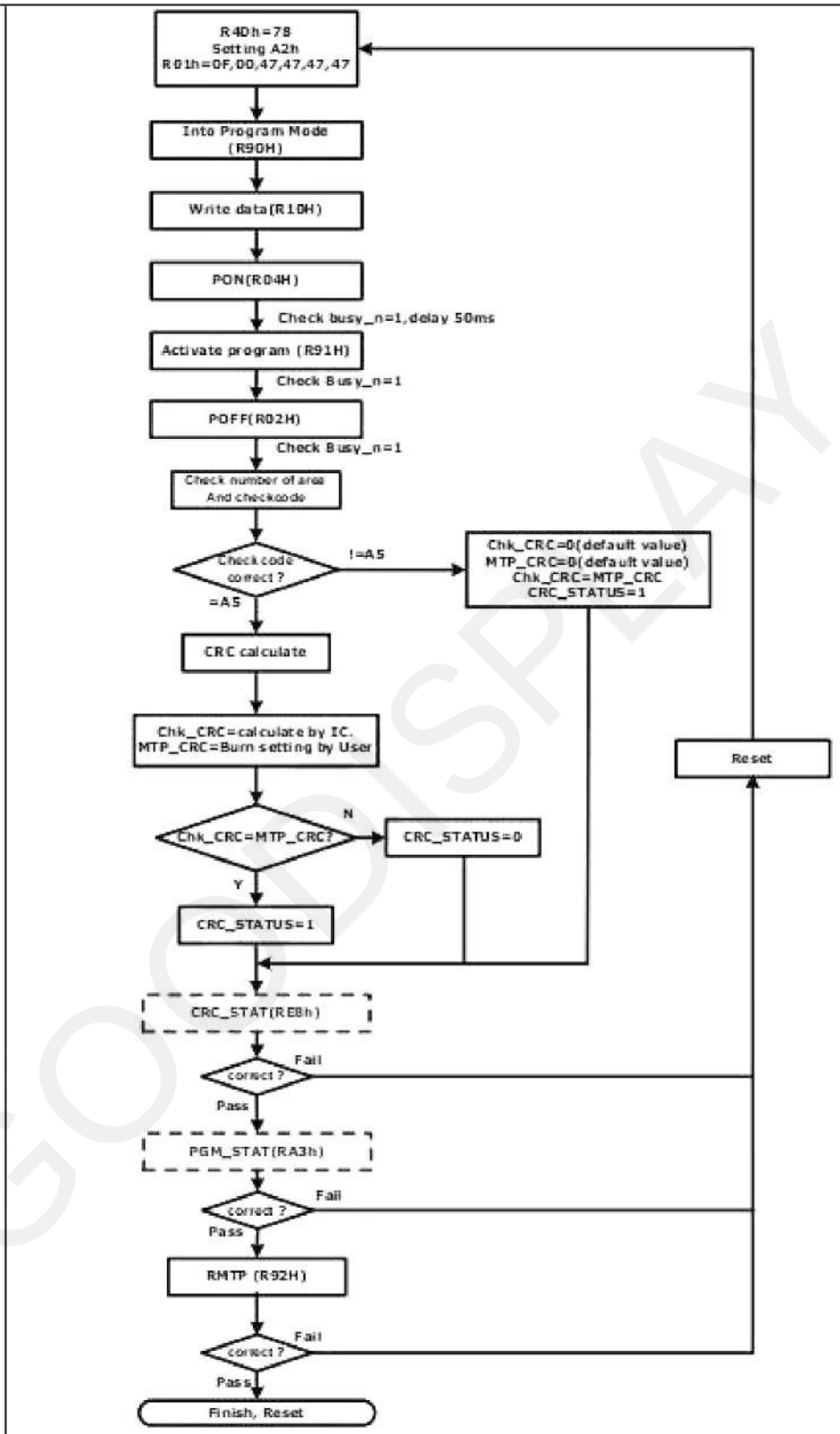
| R92H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| RMTP | W | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 92H |
| 1st Parameter | R | 1 | Dummy | | | | | | | | - |
| 2nd Parameter | R | 1 | The data of address 0x000 in the MTP | | | | | | | | - |
| 3rd Parameter | R | 1 | The data of address 0x001 in the MTP | | | | | | | | - |
| 4th Parameter | R | 1 | : | | | | | | | | - |
| 5th Parameter | R | 1 | The data of address (n-1) in the MTP | | | | | | | | - |
| 6th~(m-1)th Parameter | R | 1 | ..... | | | | | | | | - |
| mth Parameter | R | 1 | The data of address (n) in the MTP | | | | | | | | - |

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

| | |
|---|---|
| Description | -The command define as follows:<br>The command is used for reading the content of MTP for checking the data of programming.<br>The value of (n) is depending on the amount of programmed data, the max address = 0x17FF |




The sequence of programming MTP(External power)




The sequence of programming MTP(Internal power)

| | |
|---|---|
| Restriction | This command only actives when BUSY_N = "1". |

**29)R9EH(REV2): REVISION2 register**

| R9EH | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| REV2 | W | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 9EH |
| 1st Parameter | R | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 01h |

| | |
|---|---|
| Description | -The command defines as:<br><br>1st Parameter:<br>Bit: 7-0 — Description: CHIP_REV |
| Restriction | |

**30) R9FH(RMRB) Read MTP Reserved Bytes**

| R9FH | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| RMRB | W | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 9FH |
| 1st Parameter | R | 1 | Dummy | | | | | | | | 00h |
| 2nd Parameter | R | 1 | The data of address 0x16F7 in the MTP | | | | | | | | 00h |
| 3rd Parameter | R | 1 | : | | | | | | | | 00h |
| : | R | 1 | : | | | | | | | | 00h |
| 97th Parameter | R | 1 | : | | | | | | | | 00h |
| 98th Parameter | R | 1 | : | | | | | | | | 00h |
| 101th Parameter | R | 1 | The data of address 0x175A in the MTP | | | | | | | | 00h |

| | |
|---|---|
| Description | -The command define as follows:<br>The command is used for reading the content of MTP Reserved Byte for checking the data of programming.<br><br>This command could read these information from MTP directly. |
| Restriction | |

**31) RE3H (PWS): Power Saving Register**

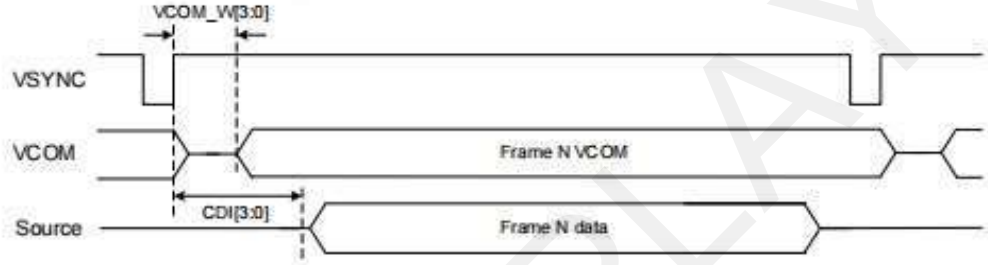
| RE3H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| PWS | W | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | E3H |
| 1st Parameter | W | 1 | VCOM_W[3:0] | | | | SD_W[3:0] | | | | 00h |

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

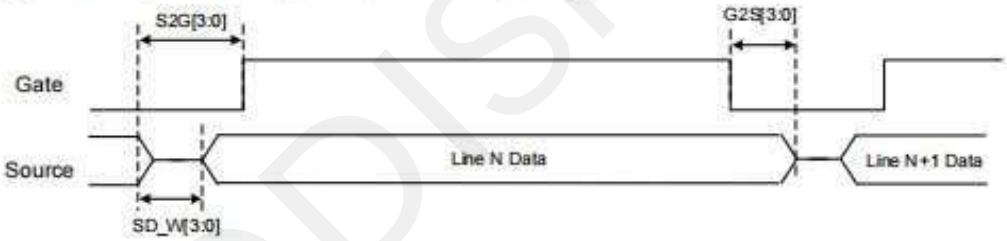
Description

- This command is set for saving power during refreshing period. If the output voltage of VCOM / Source is from negative to positive or from positive to negative, the power saving mechanism will be activated. The active period width is defined by the following two parameters.

VCOM_W: VCOM power saving width (unit = line period)




SD_W: Source power saving width (unit = 500nS), SD_W<=S2G




Restriction

**32) RE4H (LVSEL): LVD Voltage Select Register**

| RE4H | Bit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inst/Para | R/W | D/CX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Code |
| LVSEL | W | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | E4H |
| 1st Parameter | W | 1 | - | - | - | - | - | - | LVD_SEL[1:0] | | 03h |

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

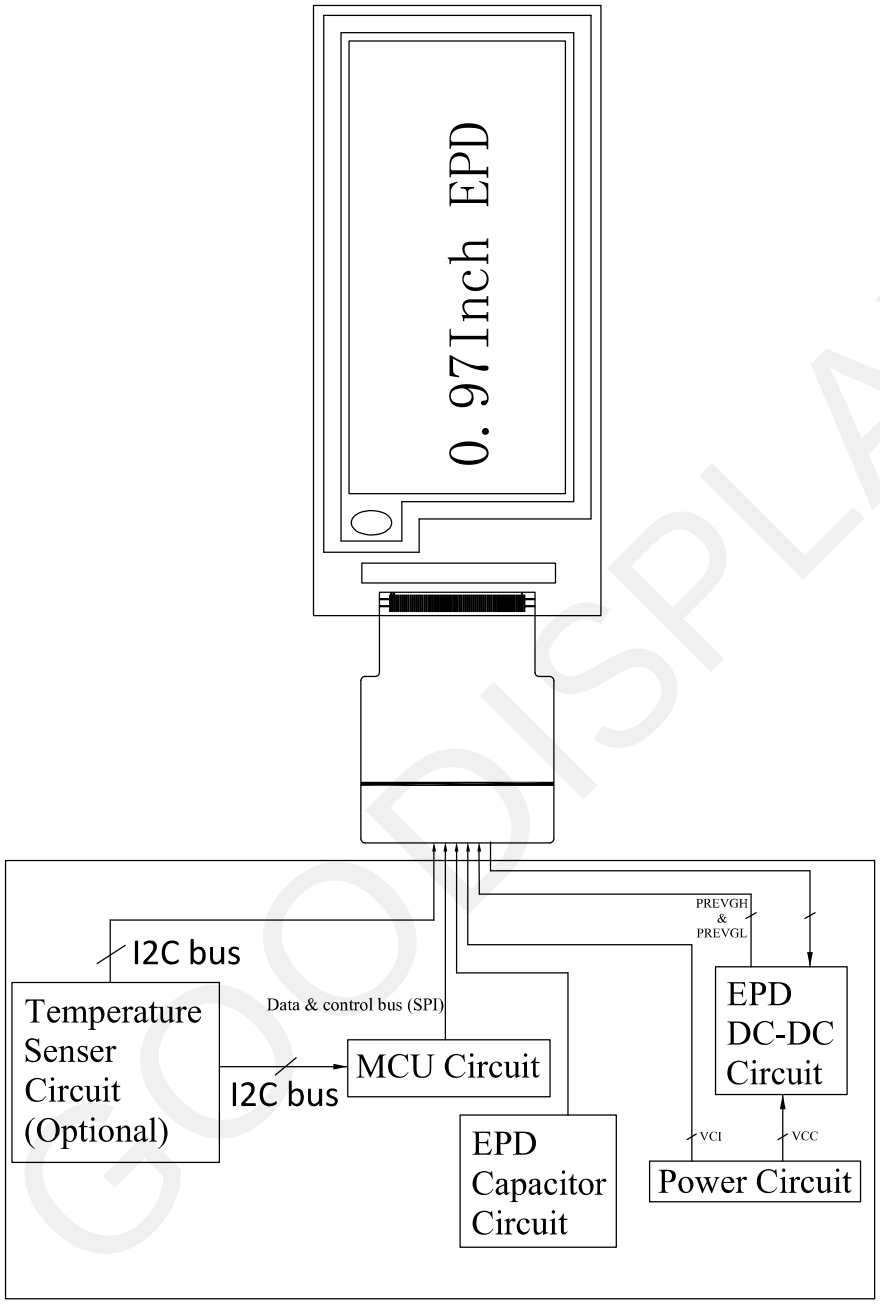
Description

LVD_SEL[1:0]: Low Power Voltage Selection

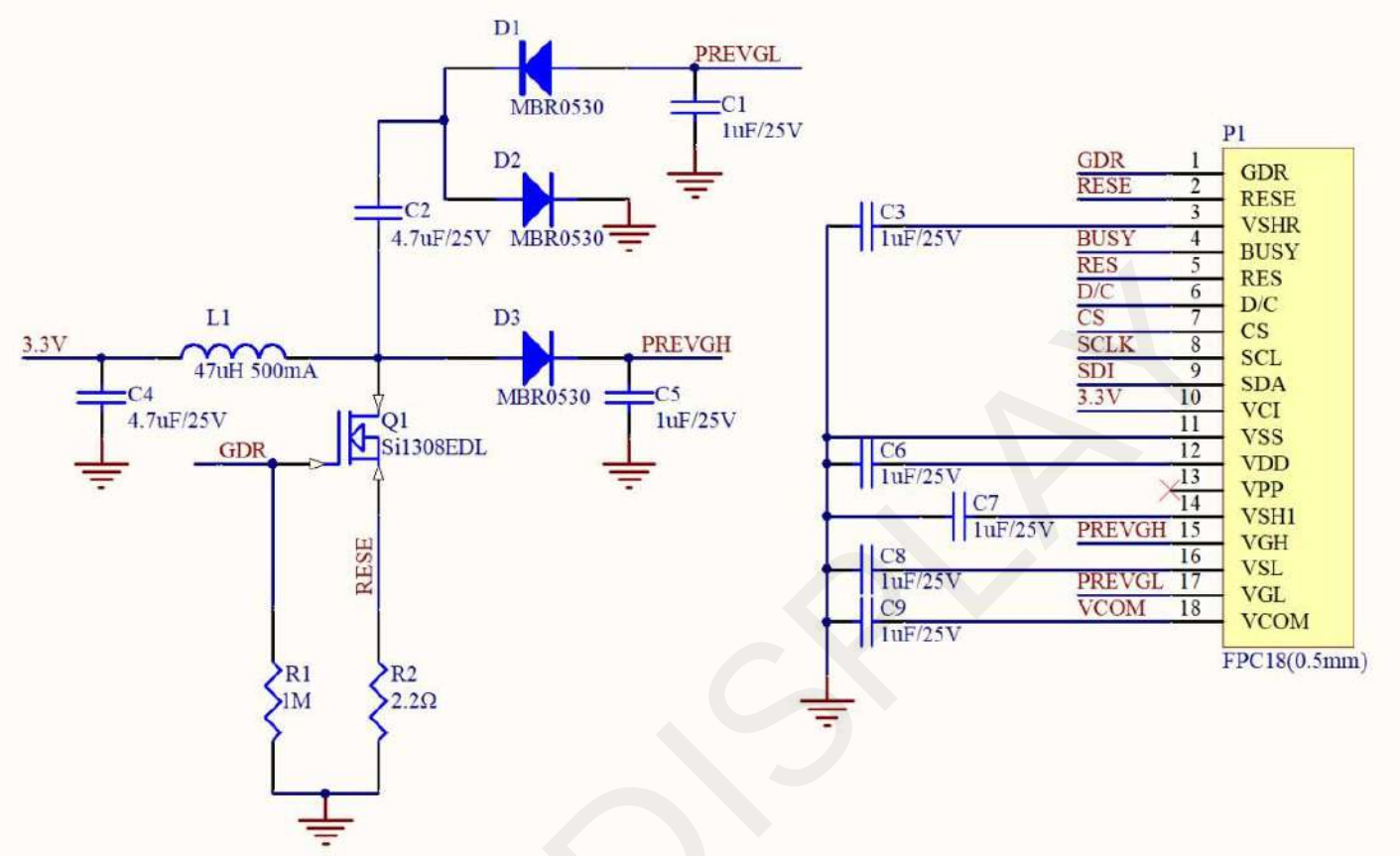
| LVD_SEL[1:0] | LVD value |
|---|---|
| 00 | < 2.2 V |
| 01 | < 2.3 V |
| 10 | < 2.4 V |
| 11 | < 2.5 V (default) |

Restriction

## 8.Block Diagram



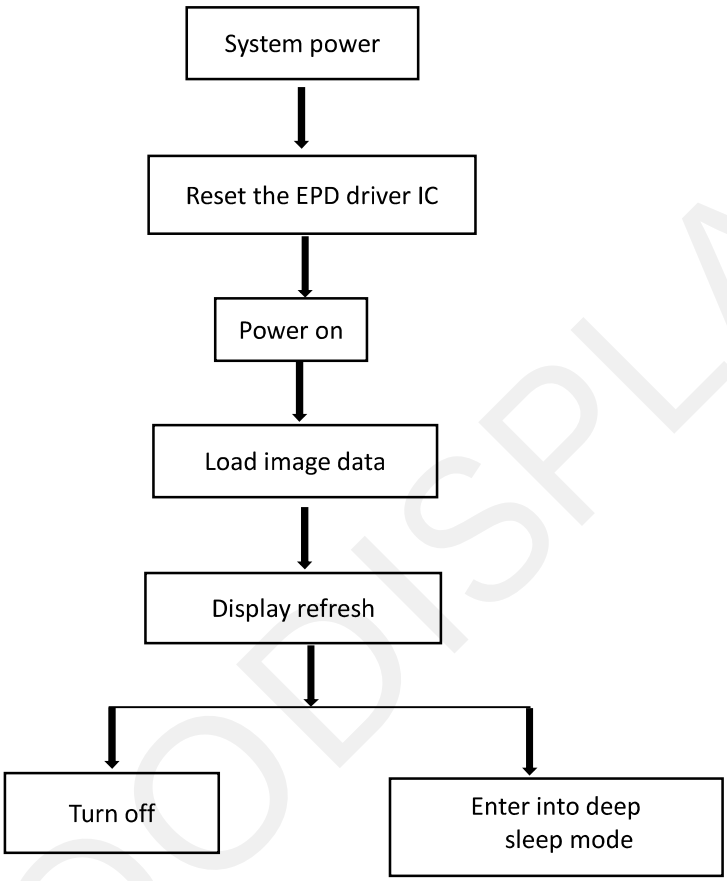
## 9. Typical Application Circuit with SPI Interface



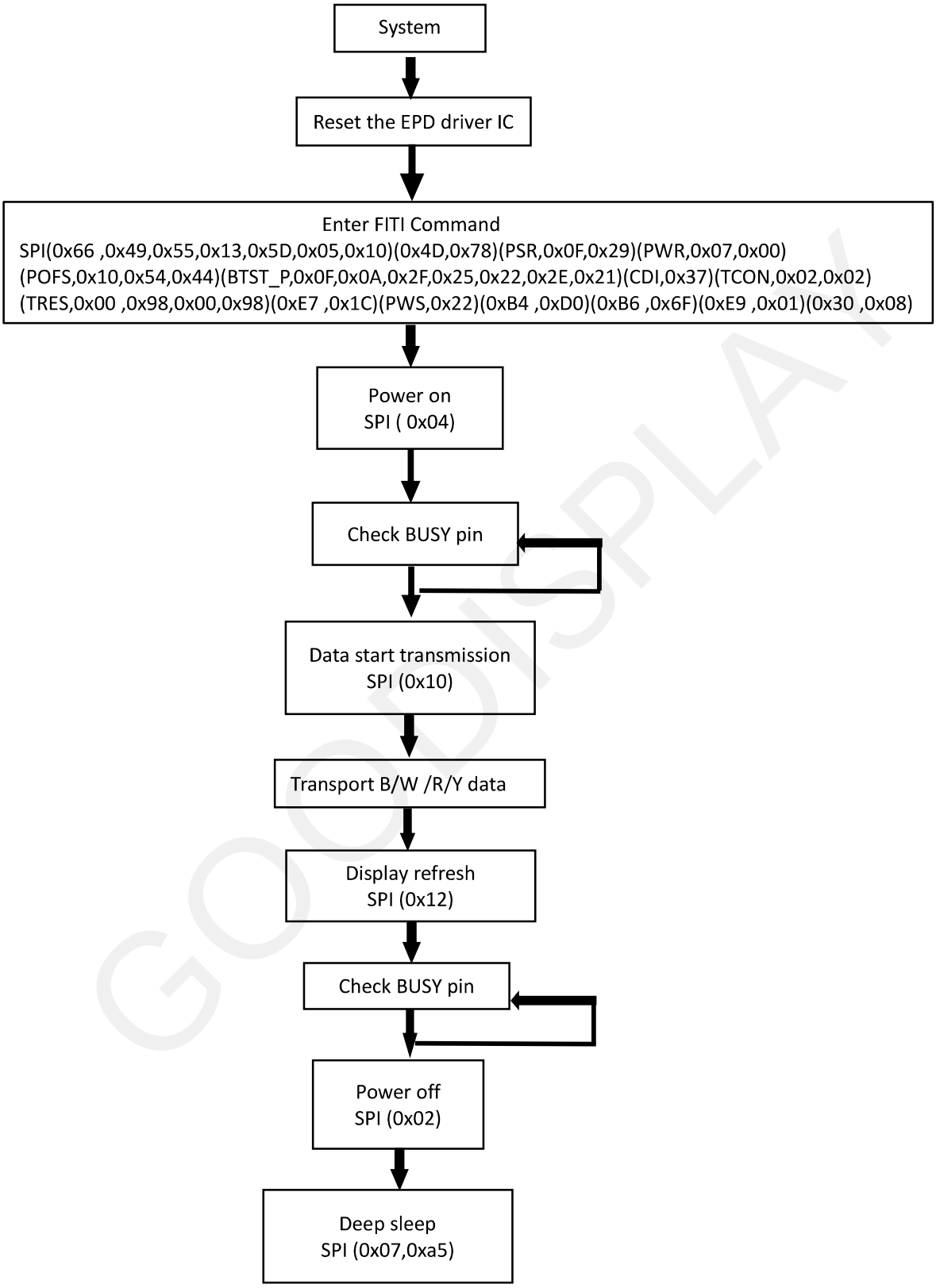

| Part Name | Requirements for spare part |
|---|---|
| C1—C9 | 0603/0805; X5R/X7R;Voltage Rating:≥25V |
| R1、R2 | 0603/0805;1% variation,≥0.05W |
| D1—D3 | MBR0530: 1)Reverse DC Voltage≥30V 2)Io≥500mA 3)Forward voltage ≤430mV |
| Q1 | Si1308EDL:1)Drain-Source breakdown voltage≥30V 2)Vgs(th) ≤1.5V 3)Rds(on)≤400mΩ |
| L1 | NR3015: Io=500mA(max) |
| P1 | 18pins,0.5mm pitch |

# 10.Typical Operating Sequence

## 10.1 LUT from OTP Operation Flow



## 10.2 OTP Operation Reference Program Code



# 11. Reliability Test

| NO | Test items | Test condition |
|---|---|---|
| 1 | Low-Temperature Storage | T = -25°C，500 h<br>Test in white pattern |
| 2 | High-Temperature Storage | T=60ºC，RH=35%，500h<br>Test in white pattern |
| 3 | High-Temperature Operation | T=40ºC，RH=30%， 500h |
| 4 | Low-Temperature Operation | 0ºC，500h |
| 5 | High-Temperature, High-Humidity Operation | T=40ºC，RH=90%，500h |
| 6 | High- Temperature, High -Humidity Storage | T=60ºC，RH=80%，500h<br>Test in white pattern |
| 7 | Temperature Cycle | 1 cycle:[-25°C 30min]→[+60 °C 30 min] : 100 cycles<br>Test in white pattern |

**Note：1. Stay white pattern for storage and non-operation test.**

**2. Operation is black→white→red→yellow pattern, the interval is 150s.**

**3. Put in 20℃--25℃ for 1hour after test finished, The function ,appearance and display performance is OK.**

## 12.Quality Assurance

### 12.1 Environment

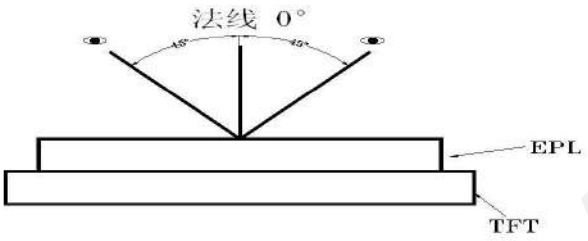
Temperature： 23±2℃

Humidity： 55±10%RH

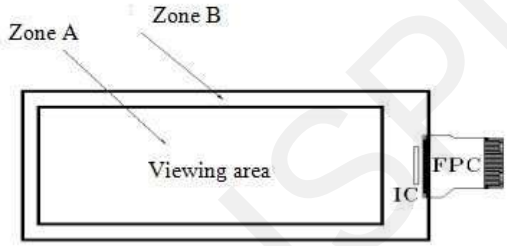
### 12.2 Illuminance

Brightness:1200～1500LUX;distance:20-30CM;Angle:Relate 45°surround.

### 12.3 Inspect method

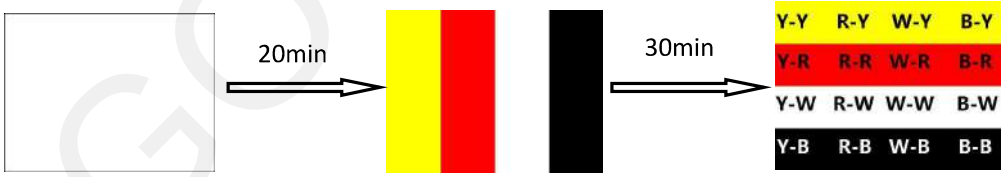



### 12.4 Display are




### 12.5 Ghosting test method

Three-color ghosting is measured with following transition from horizontal 4 scale pattern to vertical 4 scale pattern. The listed optical characteristics are only guaranteed under the controller & waveform provided by Good Display




1）Measurement Instruments：X-rite i1Pro

2）Ghosting formula:

**W ghosting：ΔE= Max (ΔEab(Y-W, R-W),ΔEab(Y-W, W-W),ΔEab(Y-W, B-W),ΔEab(R-W, W-W),ΔEab(R-W, B-W),ΔEab(W-W, B-W))**

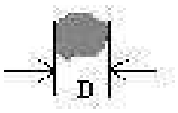
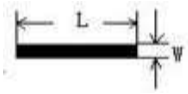
**K ghosting：ΔE= Max (ΔEab(Y-B, R-B),ΔEab(Y-B, W-B),ΔEab(Y-B, B-B),ΔEab(R-B, W-B),ΔEab(R-B, B-B),ΔEab(W-B, B-B))**

**R ghosting：ΔE= Max (ΔEab(Y-R, R-R),ΔEab(Y-R, W-R),ΔEab(Y-R, B-R),ΔEab(R-R, W-R),ΔEab(R-R, B-R),ΔEab(W-R, B-R))**

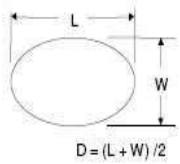
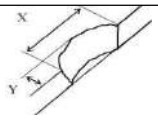
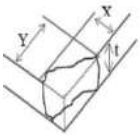
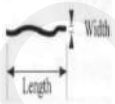
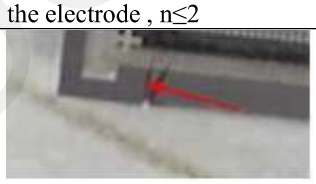
**Y ghosting：ΔE= Max (ΔEab(Y-Y, R-Y),ΔEab(Y-Y, W-Y),ΔEab(Y-Y, B-Y),ΔEab(R-Y, W-Y),ΔEab(R-Y, B-Y),ΔEab(W-Y, B-Y))**

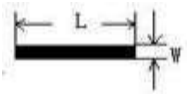
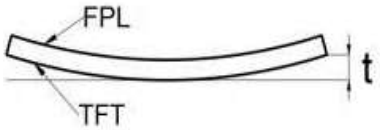
## 12.6 Inspection standard

### 12.6.1 Electric inspection standard

| NO. | Item | Standard | Defect level | Method | Scope |
|---|---|---|---|---|---|
| 1 | Display | Clear display Display complete<br>Display uniform | MA | Visual inspection | Zone A |
| 2 | Black/White spots |  <br>D≤0.25mm，Allowed<br>0.25mm＜D≤0.4mm。<br>N≤4 allowable<br>D＞0.4mm is not allowed | MI | | |
| 3 | Black/White lines (No switch) |  <br>L≤0.4mm,W≤0.1mm negligible<br>0.4mm＜L≤1.0mm<br>0.1mm＜W≤0.4mm<br>N≤4 allowable<br>L＞1.0mm ,W＞0.4mm is not allowed | | Visual/ Inspection card | |
| 4 | Ghost image | Allowed in switching process | MI | Visual inspection | |
| 5 | Flash dot / Multilateral | Flash points are allowed when switching screens<br>Multilateral colors outside the frame are allowed for fixed screen time | MI | Visual/ Inspection card | Zone A<br>Zone B |
| 6 | Segmented display | Selection segments are all displayed, and other segments are not displayed after the selection segment. | MA | Visual inspection | Zone A |
| 7 | Short circuit/ Circuit break/ Abnormal Display | Not Allow | | | |

### 12.6.2 Appearance inspection standard

| NO. | Item | Standard | Defect level | Method | Scope |
|---|---|---|---|---|---|
| 1 | B/W spots /Bubble/ Foreign bodies/ Dents |  <br>D≤0.25mm negligible<br>0.25mm＜D≤0.4mm N≤4 allowable<br>D＞0.4mm is not allowed | MI | Visual inspection | Zone A |
| 2 | Glass crack | Not Allow | MA | Visual / Microscope | Zone A<br>Zone B |
| 3 | \Dirty | Allowed if can be removed | MI | | Zone A<br>Zone B |
| 4 | Chips/Scratch/ Edge crown |  <br>X≤3mm,Y≤0.5mm And without affecting the electrode is permissible<br>  <br>2mm≤X or 2mm≤Y t= not counted.and without affecting the electrode , permissible<br>  <br>W≤0.1mm,L≤5mm, without affecting the electrode , n≤2 | MI | Visual / Microscope | Zone A<br>Zone B |
| 5 | TFT Cracks |  <br>Not Allow | MA | Visual / Microscope | Zone A<br>Zone B |
| 6 | Dirty/ foreign body | Allowed if can be removed/ allow | MI | Visual / Microscope | Zone A / Zone B |
| 7 | FPC broken/ FPC oxidation / scratch |   <br>Not Allow | MA | Visual / Microscope | Zone B |

| | | | | | |
|---|---|---|---|---|---|
| 8 | B/W Line |  <br>L≤0.4mm,W≤0.1mm negligible<br>0.4mm＜L≤1.0mm<br>0.1mm＜W≤0.4mm<br>N≤4 allowable<br>L＞1.0mm ,W＞0.4mm is not allowed | MI | Visual / Ruler | Zone B |
| 9 | TFT edge bulge /TFT chromatic aberration | TFT edge bulge：<br>X≤3mm，Y≤0.3mm Allowed<br>TFT chromatic aberration :Allowed | MI | Visual / Microscope | Zone A<br>Zone B |
| 10 | Electrostatic point | D≤0.2mm, allow<br>0.2mm＜D≤0.35mm ,n≤4 allow<br>D＞0.35mm is not allowed<br>(n≤5 items are allowed within 5 mm in diameter) | MI | Visual / Microscope | Zone A |
| 11 | PCB damaged/ Poor welding/ Curl | PCB（Circuit area）damaged Not Allow<br>PCB Poor welding Not Allow<br>PCB Curl≤1% | MI | Visual / Ruler | Zone B |
| 12 | Edge glue height/ Edge glue bubble | Edge Adhesives H≤PS surface (Including protect film) Edge adhesives seep in≤1/2 Margin width Length excluding<br>Edge adhesives bubble：bubble Width<br>≤1/2 Margin width；Length<br>≤5.0mm。n≤5 | MI | | |
| 13 | Protect film | Surface scratch but not effect protect function, Allow | MI | Visual Inspection | |
| 14 | Silicon glue | Thickness≤PS surface(With protect film):<br>Full cover the IC;<br>Shape:<br>The width on the FPC≤0.5mm (Front) The width on the FPC≤1.0mm (Back)<br>smooth surface, No obvious raised. | MI | Visual Inspection | |
| 15 | Warp degree (TFT substrate) |  <br>t≤1.0mm | MI | Ruler | |
| 16 | Color difference in COM area (Silver point area) | Allowed | | Visual Inspection | |

## 13. 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-paper Display. And it is also added the functions of USB serial port, FLASH chip, 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 |

## 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).<br>Stress above one or more of the limiting values may cause permanent damage to the device.<br>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

# PACKING INSTRUCTION

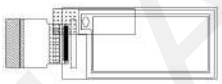
| P/N | Customer Code | Ref.P/N |
|---|---|---|
| | | |

| Type | PKG Method | Marking | Surface Marks | Pull Tape | |
|---|---|---|---|---|---|
| GLASS | Blister | BACK | None | YES | |

| Packing Materials List | | | | |
|---|---|---|---|---|
| List | Model | Materials | Q'ty | Unit |
| Carton | 7# 417*362*229 mm | corrugate | 1 | Piece |
| Inner Carton | 7#(INNER)400*343 *95 mm | corrugate | 2 | Piece |
| Blister | | PET | 22 | Piece |
| Thin foam | 268.49*313.17*T1.5-1.8mm | EPE | 20 | Piece |
| Antistatic vacuum bag | 450*590*0.075 | | 2 | Piece |
| Foam board | | EPE | 3 | Piece |
| PULL TAPE | 16*5*T0.05 | | 1560 | Piece |

78PCS/LAYER, 20LAYER/CTN, TOTAL 1560PCS/CTN.

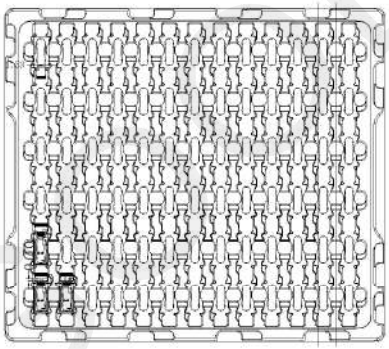
Pull tape:



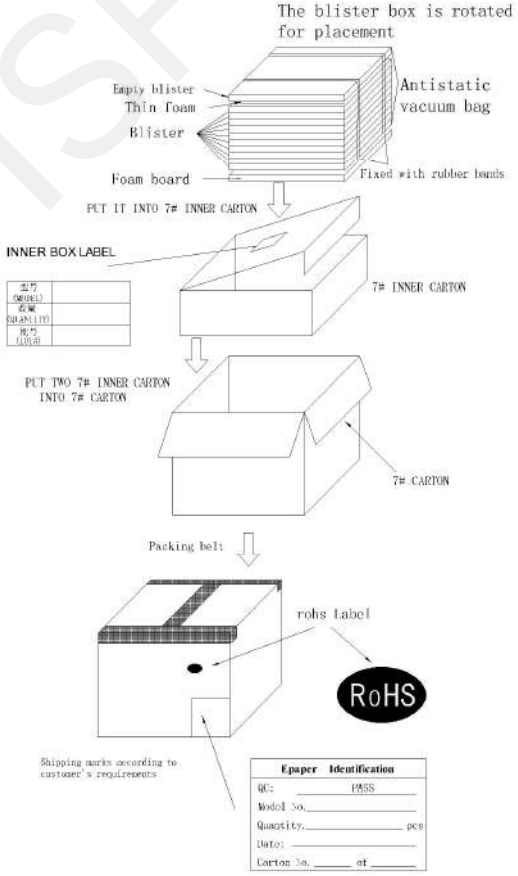
Detail:

Blister box:

Note: there are 20 layers of products, divided into 2 inner boxes, and an empty blister box is placed on the top of each inner box, so the number of blister boxes is 22



QUANTITY: 78PCS



## 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.

(7) For more precautions, please click on the link:
*https://www.good-display.com/news/80.html*