



|                |          |
|----------------|----------|
| Doc. version : | 1.1      |
| Total pages :  | 28       |
| Date :         | 2018/9/7 |

## Product Specification

### 3.5" COLOR TFT-LCD MODULE/PANEL

**MODEL NAME: A035QN02 VG**

< > Preliminary Specification  
< ◆ > Final Specification

**Note:**

The content of this specification is subject to change.

All changes to delivery specification shall be notified in advance.

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Record of Revision

| Version | Revise Date | Page  | Content                                        |
|---------|-------------|-------|------------------------------------------------|
| 0.0     | 2016/03/11  | All   | First Draft                                    |
| 0.1     | 2016/06/16  | 4     | Outline Dimension Changes to X0 version        |
|         |             | 14-19 | Update Command Register Map information        |
|         |             | 26    | Add application note                           |
| 0.2     | 2016/09/21  | 20    | Update Power On/Off Sequence                   |
| 1.0     | 2017/03/07  | 4     | Update Outline Dimension from X0 to X1 version |
| 1.1     | 2018/09/07  | 5-6   | Modify Pin35/36 Symbol                         |
|         |             | 12    | Modify SPI Timing Diagram                      |
|         |             |       |                                                |
|         |             |       |                                                |

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## Contents

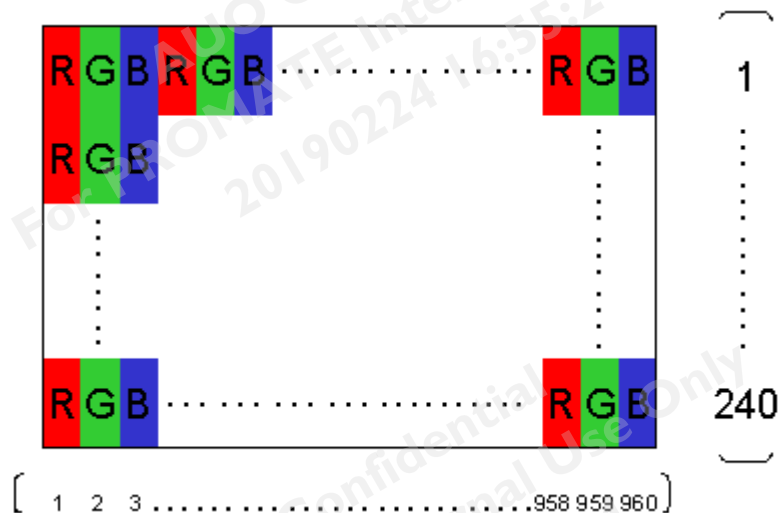
|                                       |           |
|---------------------------------------|-----------|
| <b>A. General Information</b>         | <b>3</b>  |
| <b>B. Outline Dimension</b>           | <b>4</b>  |
| <b>C. Electrical Specifications</b>   | <b>5</b>  |
| 1. TFT LCD Panel Pin Assignment       | 5         |
| 2. Absolute Maximum Ratings           | 7         |
| 3. Electrical DC Characteristics      | 8         |
| a. TFT- LCD Panel (GND=0V)            | 8         |
| b. Backlight Driving Conditions       | 8         |
| 4. Electrical AC Characteristics      | 9         |
| a. Signal AC Characteristics          | 9         |
| b. SPI Timing Diagram                 | 12        |
| c. SPI Timing Specification           | 13        |
| 5. Command Register Map               | 14        |
| a. Serial Setting Map                 | 14        |
| b. Description of serial control data | 15        |
| 6. Power On/Off Characteristics       | 20        |
| a. Recommended Power On Sequence      | 20        |
| b. Recommended Power Off Sequence     | 21        |
| <b>D. Optical Specification</b>       | <b>22</b> |
| <b>E. Reliability Test Items</b>      | <b>24</b> |
| <b>F. Packing and Marking</b>         | <b>25</b> |
| <b>G. Application note</b>            | <b>26</b> |
| <b>H. Precautions</b>                 | <b>27</b> |

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## A. General Information

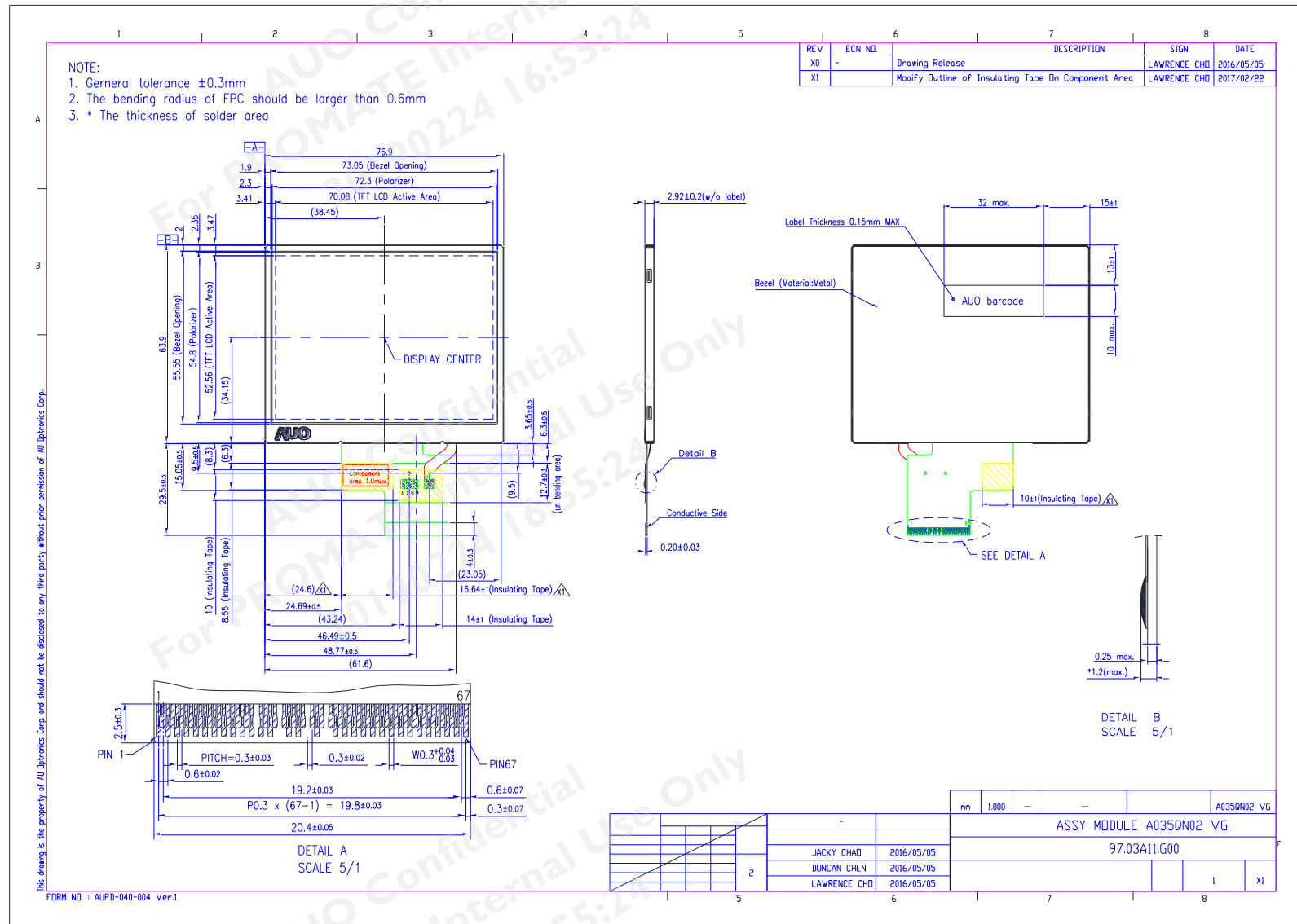
| NO. | Item                           | Unit | Specification               | Remark |
|-----|--------------------------------|------|-----------------------------|--------|
| 1   | Display Resolution             | dot  | 320 RGB (H)×240(V)          |        |
| 2   | Active Area                    | mm   | 70.08(H)×52.56(V)           |        |
| 3   | Screen Size                    | inch | 3.5(Diagonal)               |        |
| 4   | Dot Pitch                      | mm   | 0.219(H)×0.219(V)           |        |
| 5   | Color Configuration            | --   | R. G. B. Stripe             | Note 1 |
| 6   | Color Depth                    | --   | 262K Colors                 |        |
| 7   | Overall Dimension              | mm   | 76.9(H) × 63.9(V) × 2.92(T) | Note 2 |
| 8   | Weight                         | g    | 31                          |        |
| 9   | Display Mode                   | --   | Normally White              |        |
| 10  | Gray Level Inversion Direction |      | 6 O'clock                   |        |

Note 1: Below figure shows dot stripe arrangement.



Note 2: Not including FPC. Refer to the drawing next page for further information.

## B. Outline Dimension



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## C. Electrical Specifications

### 1. TFT LCD Panel Pin Assignment

Recommended connector : FH26G 67pin 0.3mm pitch connector

| Pin no | Symbol | I/O | Description                         | Remark |
|--------|--------|-----|-------------------------------------|--------|
| 1      | LED_C  | I   | Cathode for LED back-light          | --     |
| 2      | LED_A  | I   | Anode for LED back-light            | --     |
| 3      | GND1   | G   | Power Grounding                     | --     |
| 4      | NC     | N   | Reserved for touch panel            | --     |
| 5      | NC     | N   | Reserved for touch panel            | --     |
| 6      | NC     | N   | Reserved for touch panel            | --     |
| 7      | NC     | N   | Reserved for touch panel            | --     |
| 8      | GND2   | G   | Power Grounding                     | --     |
| 9      | VGH    | C   | Stabilizing capacitor               | Note   |
| 10     | C2P    | C   | Booster capacitor                   | Note   |
| 11     | C2N    | C   | Booster capacitor                   | Note   |
| 12     | C1P    | C   | Booster capacitor                   | Note   |
| 13     | C1N    | C   | Booster capacitor                   | Note   |
| 14     | VGL    | C   | Stabilizing capacitor               | Note   |
| 15     | C3N    | C   | Booster capacitor                   | Note   |
| 16     | C3P    | C   | Booster capacitor                   | Note   |
| 17     | GND3   | G   | Power Grounding                     | --     |
| 18     | VCIX2  | C   | Stabilizing capacitor               | Note   |
| 19     | CYP    | C   | Booster capacitor                   | Note   |
| 20     | CYN    | C   | Booster capacitor                   | Note   |
| 21     | VCI    | P   | Booster input voltage pin           | --     |
| 22     | NC     | N   | Not Connected                       | --     |
| 23     | GND4   | G   | Power Grounding                     | --     |
| 24     | VCIM   | C   | Stabilizing capacitor               | Note   |
| 25     | CXP    | C   | Booster capacitor                   | Note   |
| 26     | CXN    | C   | Booster capacitor                   | Note   |
| 27     | NC     | N   | Not Connected                       | --     |
| 28     | RESET  | I   | System reset pin                    | --     |
| 29     | GND5   | G   | Power Grounding                     | --     |
| 30     | VDDIO  | P   | Voltage input pin for logic I/O     | --     |
| 31     | VCORE  | C   | Stabilizing capacitor               | Note   |
| 32     | GND6   | G   | Power Grounding                     | --     |
| 33     | NC     | N   | Not Connected                       | --     |
| 34     | CSB    | I   | Chip select pin of serial interface | --     |
| 35     | SDA    | I   | Data input pin in serial mode       | --     |

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|    |        |   |                                    |      |
|----|--------|---|------------------------------------|------|
| 36 | SCL    | I | Clock input pin in serial mode     | --   |
| 37 | NC     | N | Not Connected                      | --   |
| 38 | DEN    | I | Display enable pin from controller | --   |
| 39 | BB5    | I | Blue Data Bit 5                    | --   |
| 40 | BB4    | I | Blue Data Bit 4                    | --   |
| 41 | BB3    | I | Blue Data Bit 3                    | --   |
| 42 | BB2    | I | Blue Data Bit 2                    | --   |
| 43 | BB1    | I | Blue Data Bit 1                    | --   |
| 44 | BB0    | I | Blue Data Bit 0                    | --   |
| 45 | GG5    | I | Green Data Bit 5                   | --   |
| 46 | GG4    | I | Green Data Bit 4                   | --   |
| 47 | GG3    | I | Green Data Bit 3                   | --   |
| 48 | GG2    | I | Green Data Bit 2                   | --   |
| 49 | GG1    | I | Green Data Bit 1                   | --   |
| 50 | GG0    | I | Green Data Bit 0                   | --   |
| 51 | RR5    | I | RED Data Bit 5                     | --   |
| 52 | RR4    | I | RED Data Bit 4                     | --   |
| 53 | RR3    | I | RED Data Bit 3                     | --   |
| 54 | RR2    | I | RED Data Bit 2                     | --   |
| 55 | RR1    | I | RED Data Bit 1                     | --   |
| 56 | RR0    | I | RED Data Bit 0                     | --   |
| 58 | VSYNC  | I | Frame synchronization signal       | --   |
| 58 | HSYNC  | I | Line synchronization signal        | --   |
| 59 | DOTCLK | I | Dot-clock and oscillator source    | --   |
| 60 | CDMUO  | C | Stabilizing capacitor              | Note |
| 61 | GND7   | G | Power Grounding                    | --   |
| 62 | VLCD63 | C | Stabilizing capacitor              | Note |
| 63 | VCOMH  | C | Stabilizing capacitor              | Note |
| 64 | VCOML  | C | Stabilizing capacitor              | Note |
| 65 | GND7   | G | Grounding for digital circuit      | --   |
| 66 | CSVCMP | C | Stabilizing capacitor              | Note |
| 67 | CSVCMN | C | Stabilizing capacitor              | Note |

I: Input pin; P: Power pin; G: Ground pin; C: Capacitor pin; N: Not connected

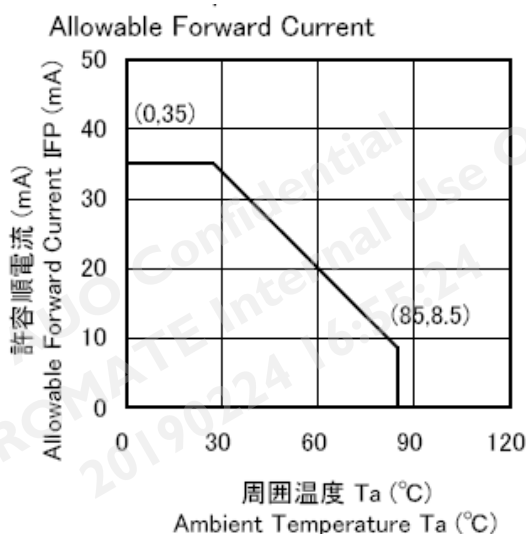
Note: IC pin connect to capacitor on FPCA. Open at FPC pin assignment.

## 2. Absolute Maximum Ratings

| Items               | Symbol | Values |      | Unit | Condition       |
|---------------------|--------|--------|------|------|-----------------|
|                     |        | Min.   | Max. |      |                 |
| Power Voltage       | VCI    | -0.3   | 3.6  | V    |                 |
| LED Reverse Voltage | Vr     |        | 5    | V    | One LED         |
| LED Forward Current | If     |        | 22   | mA   | One LED, Note 2 |

Note 1. If the operating condition exceeds the absolute maximum ratings, the TFT-LCD module may be damaged permanently. Also, if the module operated with the absolute maximum ratings for a long time, its reliability may drop.

Note 2. If LED current exceeds the limit curve, the lifetime will drop dramatically.





### 3. Electrical DC Characteristics

The following items are measured under stable condition and suggested application circuit.

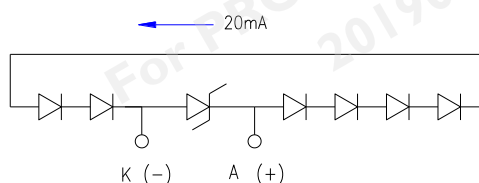
#### a. TFT- LCD Panel (GND=0V)

| Parameter               |     | Symbol | MIN      | TYP   | MAX      | Unit |  |
|-------------------------|-----|--------|----------|-------|----------|------|--|
| Power Supply            |     | VCI    | 3.0      | 3.3   | 3.6      | V    |  |
|                         |     | VDDIO  | 3.0      | 3.3   | 3.6      |      |  |
| Frame Frequency         |     | Hz     |          | 60    |          | Hz   |  |
| Dot Data Clock          |     | MH z   | —        | 6.134 | 7.5      | MH z |  |
| Input Signal<br>Voltage | VIH | V      | 0.8VDDIO | —     | VDDIO    | V    |  |
|                         | VIL | V      | 0        | —     | 0.2VDDIO | V    |  |
| Current Consumption     |     | mA     | —        | 15    | 18       | mA   |  |

#### b. Backlight Driving Conditions

| Parameter          | Symbol | Min.   | Typ.   | Max. | Unit | Remark        |
|--------------------|--------|--------|--------|------|------|---------------|
| LED Supply Current | $I_L$  |        | 20     | 22   | mA   | single serial |
| LED Supply Voltage | $V_L$  |        | (19.2) | 21   | V    | single serial |
| LED Life Time      | $L_L$  | 10,000 | ---    | ---  | Hr   | Note 2, 3     |

Note 1: LED backlight is six LEDs serial type.



Note 2: The "LED Supply Voltage" is defined by the number of LED at  $T_a=25^{\circ}\text{C}$ ,  $I_L=20\text{mA}$ . In the case of 6 pcs LED,  $V_L=3.2*6=19.2\text{V}$

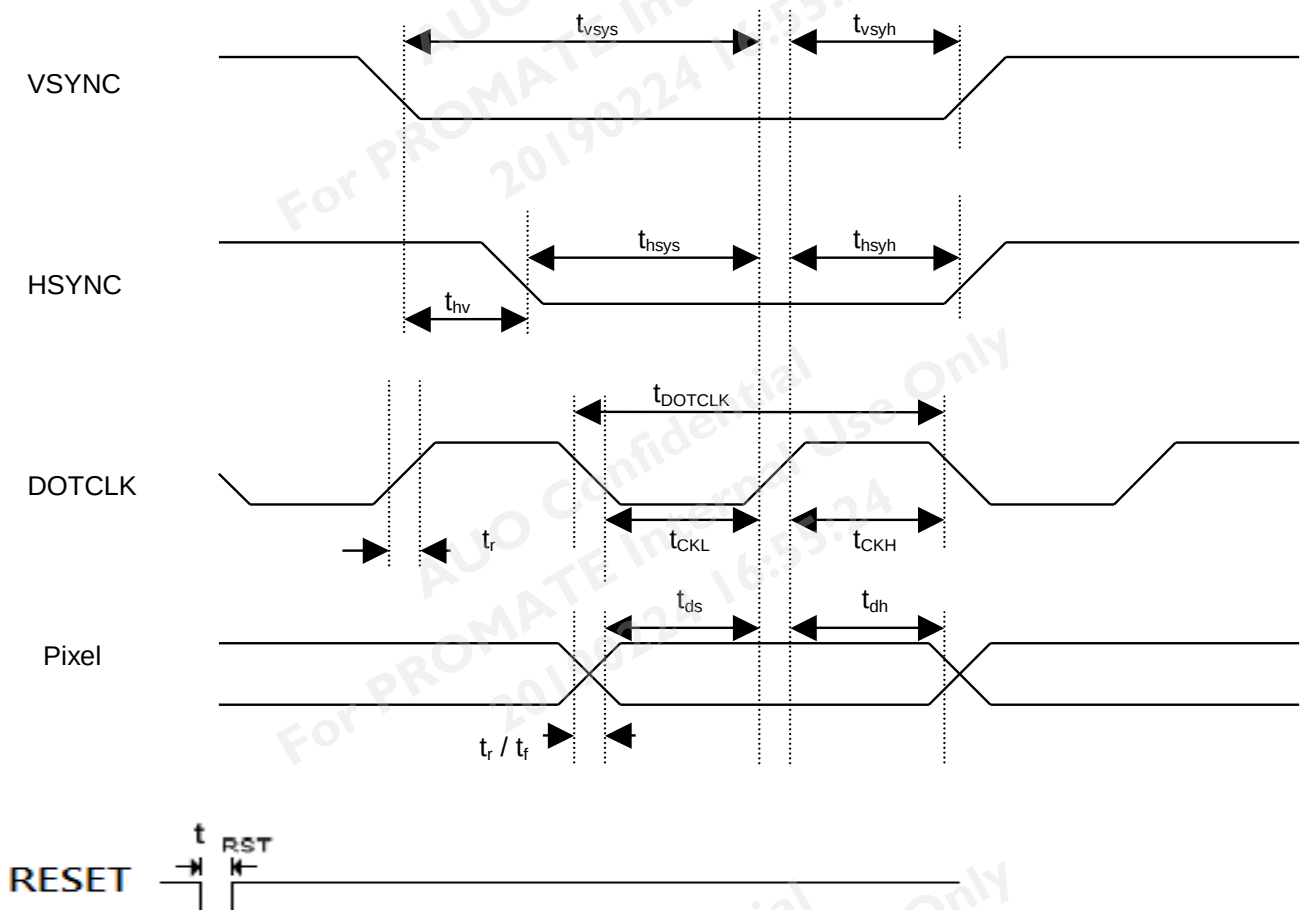
Note 3: The "LED life time" is defined as the time for the module brightness to decrease to 50% of the initial value at  $T_a=25^{\circ}\text{C}$ ,  $I_L=20\text{mA}$

Note 4: The LED lifetime could be decreased if operating  $I_L$  is larger than 25mA

## 4. Electrical AC Characteristics

### a. Signal AC Characteristics

|                         | Symbol  | MIN   | TYP   | MAX | Unit | Note |
|-------------------------|---------|-------|-------|-----|------|------|
| DOTCLK Frequency        | fDOTCLK | —     | 6.134 | 7.5 | MHz  |      |
| DOTCLK Period           | tDOTCLK | 133.5 | 163   | —   | nSec |      |
| Vsync Setup Time        | tvsys   | 20    | —     | —   | nSec |      |
| Vsync Hold Time         | tvsyh   | 20    | —     | —   | nSec |      |
| Hsync Setup Time        | thsys   | 20    | —     | —   | nSec |      |
| Hsync Hold Time         | thsyh   | 20    | —     | —   | nSec |      |
| DOTCLK Low Period Duty  | tCKL    | 40    | 50    | 60  | %    |      |
| DOTCLK High Period Duty | tCKH    | 40    | 50    | 60  | %    |      |
| Data Setup Time         | tds     | 30    | —     | —   | nSec |      |
| Data Hold Time          | tdh     | 30    | —     | —   | nSec |      |
| Reset Pulse Width       | tRES    | 50    | —     | —   | uSec |      |



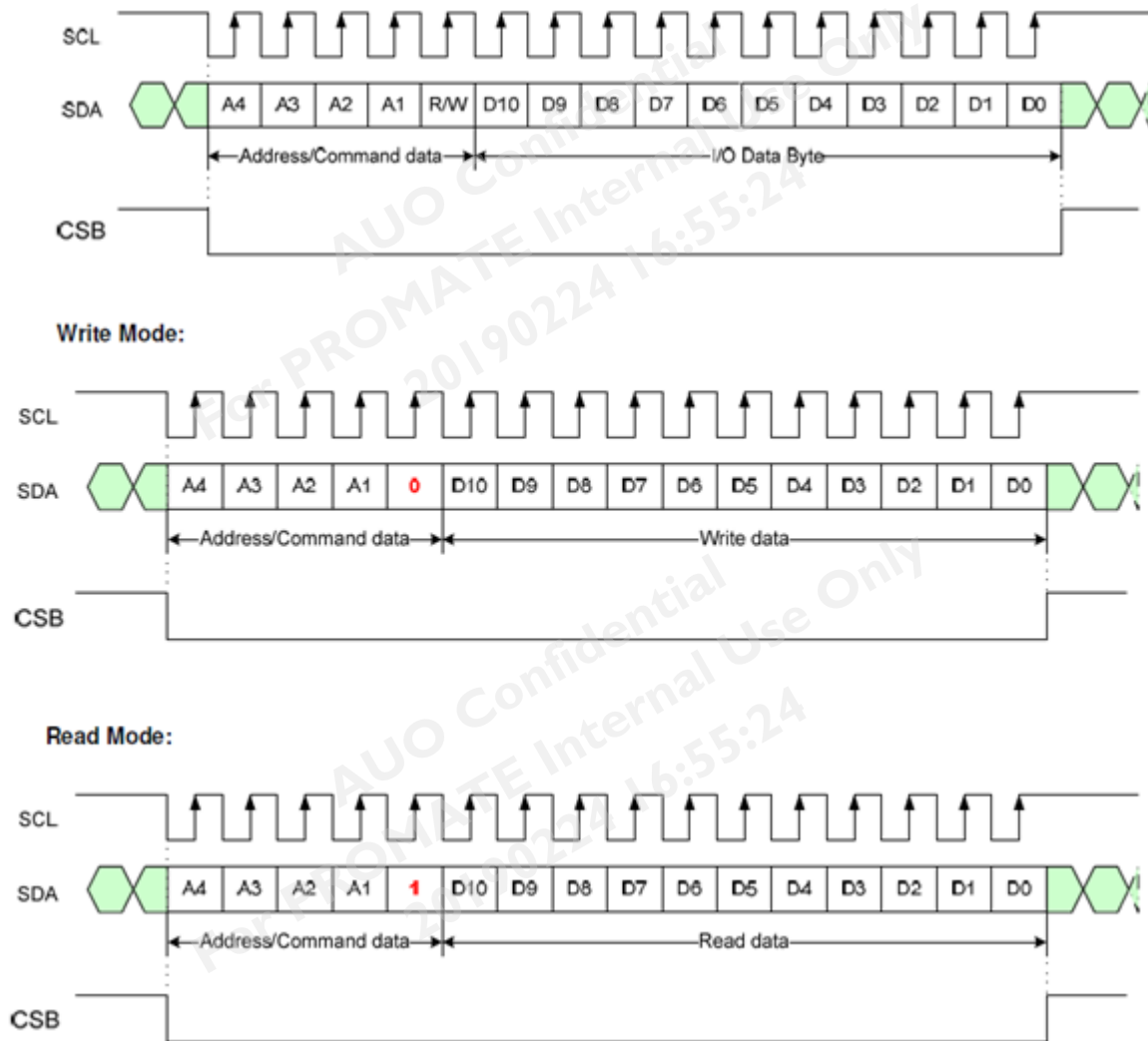
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| Parameter      |                |      | Symbol              | Min.                | Typ.                | Max.            | Unit.             | Remark |
|----------------|----------------|------|---------------------|---------------------|---------------------|-----------------|-------------------|--------|
| DCLK frequency |                |      | 1/t <sub>DCLK</sub> | 5.3                 | 6.134               | 7.5             | MHz               |        |
| HSYNC          | Period         |      | t <sub>H</sub>      | 377                 | 390                 | 476             | t <sub>DCLK</sub> |        |
|                | Display period |      | t <sub>hd</sub>     | 320                 |                     |                 | t <sub>DCLK</sub> |        |
|                | Back porch     |      | t <sub>hbp</sub>    | 50                  | 61                  | 63              | t <sub>DCLK</sub> |        |
|                | Front porch    |      | t <sub>hfp</sub>    | 7                   | 9                   | 93              | t <sub>DCLK</sub> |        |
|                | Pulse width    |      | t <sub>hsw</sub>    | 1                   | 1                   | 50              | t <sub>DCLK</sub> |        |
| VSYNC          | Period         | Odd  | t <sub>v</sub>      | 247.5               | 262.5               | 276.5           | t <sub>H</sub>    |        |
|                |                | Even |                     |                     |                     |                 |                   |        |
|                | Display Period | Odd  | t <sub>vd</sub>     | 240                 |                     |                 | t <sub>H</sub>    |        |
|                |                | Even |                     |                     |                     |                 |                   |        |
|                | Back porch     | Odd  | t <sub>vbp</sub>    | 6                   | 21                  | 31              | t <sub>H</sub>    |        |
|                |                | Even |                     | 6.5                 | 21.5                | 31.5            |                   |        |
|                | Front porch    | Odd  | t <sub>vfp</sub>    | 1.5                 | 1.5                 | -               | t <sub>H</sub>    |        |
|                |                | Even |                     | 1                   | 1                   | -               |                   |        |
|                | Pulse width    |      | t <sub>vsw</sub>    | 1 t <sub>DCLK</sub> | 1 t <sub>DCLK</sub> | 6t <sub>H</sub> |                   |        |

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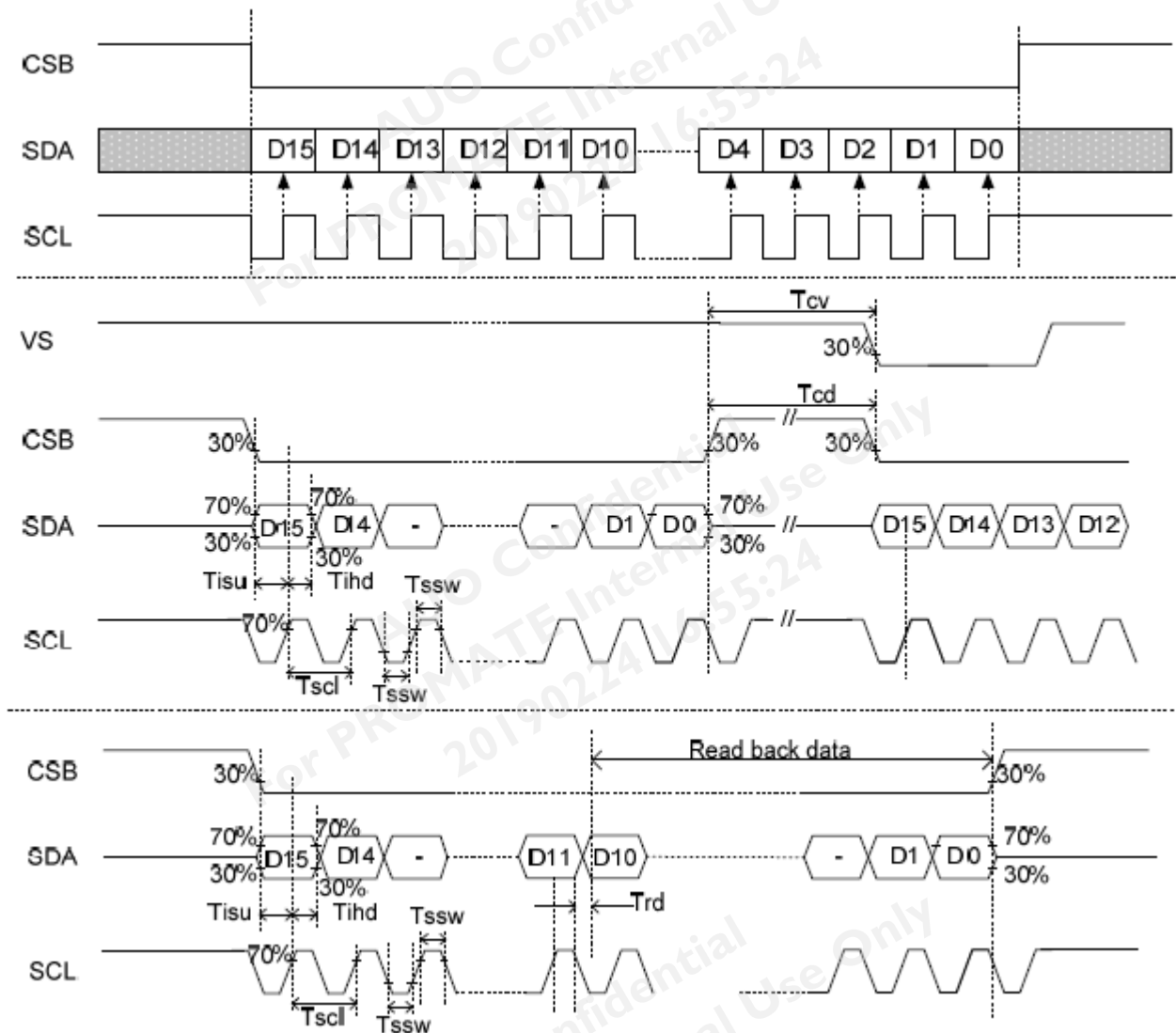
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## b. SPI Timing Diagram



### c.SPI Timing Specification

| 3-wire serial communication AC timing            |        |      |      |      |      |            |
|--------------------------------------------------|--------|------|------|------|------|------------|
| Parameter                                        | Symbol | Min. | Typ. | Max. | Unit | Conditions |
| Serial clock Frequency                           | 1/Tscl | 0.2  |      | 3    | MHz  |            |
| SCL pulse duty                                   | Tscw   | 40   | 50   | 60   | %    |            |
| SCL high/low pulse width                         | Tssw   | 50   |      |      | ns   |            |
| SDA setup time                                   | Tisu   | 50   |      |      | ns   |            |
| SDA hold time                                    | Tihd   | 50   |      |      | ns   |            |
| CSB setup time                                   | Tcsu   | 50   |      |      | ns   |            |
| CSB hold time                                    | Tchd   | 50   |      |      | ns   |            |
| Chip select distinguish(CSB pulse width)         | Tcd    | 1    |      |      | us   |            |
| Time that the SDA to VS                          | Tcv    | 1    |      |      | us   |            |
| Time that from read to 1 <sup>st</sup> data back | Trd    | 30   |      |      | ns   |            |



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## 5. Command Register Map

### a. Serial Setting Map

➤ ( ) is suggested value

| No. | Register address |    |    |    |     | MSB          |              | Register data    |                    |                    |                   |                 |                   |            |                 | LSB         |  |  |  |
|-----|------------------|----|----|----|-----|--------------|--------------|------------------|--------------------|--------------------|-------------------|-----------------|-------------------|------------|-----------------|-------------|--|--|--|
|     | A4               | A3 | A2 | A1 | R/W | D10          | D9           | D8               | D7                 | D6                 | D5                | D4              | D3                | D2         | D1              | D0          |  |  |  |
| R0  | 0                | 0  | 0  | 0  | R/W | MODE<br>(00) |              | 0                | 0                  | 0                  | UD<br>(1)         | SHL<br>(1)      | GRB<br>(1)        | STB<br>(0) | SHDB<br>(0)     | SHCB<br>(1) |  |  |  |
| R1  | 0                | 0  | 0  | 1  | R/W | 0            | 0            | 0                | 0                  | 0                  | 1                 | 1               | 1                 | 0          | 1               | 1           |  |  |  |
| R2  | 0                | 0  | 1  | 0  | R/W | 0            | 0            | 0                | HBLK<br>(00111101) |                    |                   |                 |                   |            |                 |             |  |  |  |
| R3  | 0                | 0  | 1  | 1  | R/W | 0            | 0            | 0                | 0                  | 0                  | 0                 | VBLK<br>(10101) |                   |            |                 |             |  |  |  |
| R4  | 0                | 1  | 0  | 0  | R/W | 0            | 1            | 1                | 1                  | 1                  | 0                 | 0               | 1                 | 0          | 0               | 1           |  |  |  |
| R5  | 0                | 1  | 0  | 1  | R/W | 0            | 0            | 0                | 0                  | 0                  | 0                 | 0               | 1                 | 0          | 0               | 0           |  |  |  |
| R6  | 0                | 1  | 1  | 0  | R/W | 0            | 0            | 0                | 0                  | 1                  | 0                 | 0               | 0                 | 0          | 0               | 0           |  |  |  |
| R7  | 0                | 1  | 1  | 1  | R/W | 0            | 0            | 0                | 0                  | 0                  | 0                 | 0               | VGL_SEL<br>(11)   |            | VGH_SEL<br>(11) |             |  |  |  |
| R8  | 1                | 0  | 0  | 0  | R/W | 0            | 0            | 0                | 1                  | VCOMH<br>(0111011) |                   |                 |                   |            |                 |             |  |  |  |
| R9  | 1                | 0  | 0  | 1  | R/W | 0            | 0            | 0                | 0                  | VCOML<br>(0111100) |                   |                 |                   |            |                 |             |  |  |  |
| R10 | 1                | 0  | 1  | 0  | R/W | 0            | 0            | 0                | PWM_400K<br>(0)    | DC_F<br>(1)        | CLK_ChP_M<br>(10) |                 | 0                 | 1          | 1               | 0           |  |  |  |
| R11 | 1                | 0  | 1  | 1  | R/W | 0            | GMA_M<br>(0) | GMA_V4<br>(010)  |                    |                    | GMA_V1<br>(010)   |                 | GMA_V0<br>(011)   |            |                 |             |  |  |  |
| R12 | 1                | 1  | 0  | 0  | R/W | 0            | 0            | GMA_V48<br>(011) |                    |                    | GMA_V36<br>(011)  |                 | GMA_V16<br>(011)  |            |                 |             |  |  |  |
| R13 | 1                | 1  | 0  | 1  | R/W | 0            | 0            | 0                | 0                  | 0                  | GMA_V59<br>(011)  |                 | GMA_V55<br>(011)  |            |                 |             |  |  |  |
| R14 | 1                | 1  | 1  | 0  | R/W | 0            | 0            | 0                | 0                  | 0                  | GMA_V63<br>(010)  |                 | GMA_V62<br>(000)  |            |                 |             |  |  |  |
| R15 | 1                | 1  | 1  | 1  | R/W | 0            | 0            | 0                | 0                  | 0                  | VENDOR<br>(00)    |                 | VERSION<br>(0000) |            |                 |             |  |  |  |

#### NOTE:

1. "0\*" and "1\*" is for engineering reserved register setting, and please follow the suggested value.
2. Please refer to our recommended register settings section for better performance.

## b. Description of serial control data

### R0 Register

| No. | A4 | A3 | A2 | A1 | R/W | D10          | D9 | D8 | D7 | D6 | D5        | D4         | D3         | D2         | D1          | D0          |
|-----|----|----|----|----|-----|--------------|----|----|----|----|-----------|------------|------------|------------|-------------|-------------|
| R0  | 0  | 0  | 0  | 0  | R/W | MODE<br>(00) |    | 0  | 0  | 0  | UD<br>(1) | SHL<br>(1) | GRB<br>(1) | STB<br>(0) | SHDB<br>(0) | SHCB<br>(1) |

MODE Vertical shift direction selection

| UD     | Function                 |
|--------|--------------------------|
| D10~D9 |                          |
| x0     | HV Mode <b>(Default)</b> |
| x1     | DE Mode                  |

Note : If DE Mode, the minimum vertical blanking number is 10.

UD: Vertical shift direction selection

| UD | Function                                                                           |
|----|------------------------------------------------------------------------------------|
| D5 |                                                                                    |
| 0  | Shift from down to up, Last line = G1←G2...G239←G240 = First line                  |
| 1  | Shift from up to down, First line = G1→G2...G239→G240 = Last line <b>(Default)</b> |

SHL: Horizontal shift direction selection

| SHL | Function                                                                              |
|-----|---------------------------------------------------------------------------------------|
| D4  |                                                                                       |
| 0   | Shift from right to left, Last data = S1←S2...S959←S960 = First data                  |
| 1   | Shift from left to right, First data = S1→S2...S959→S960 = Last data <b>(Default)</b> |

GRB: Global reset

| GRB | Function                             |
|-----|--------------------------------------|
| D3  |                                      |
| 0   | Reset all registers to default value |
| 1   | Normal operation <b>(Default)</b>    |

STB: Standby mode setting

| STB | Function                                                                                                                   |
|-----|----------------------------------------------------------------------------------------------------------------------------|
| D2  |                                                                                                                            |
| 0   | Standby (Display OFF); timing control, DAC, and DC/DC converter are off, and register data should be kept <b>(Default)</b> |
| 1   | Normal operation (Display ON), with power on/off sequence                                                                  |

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SHDB: DC-DC converter shutdown setting

| SHDB | Function                                                                   |
|------|----------------------------------------------------------------------------|
| D1   |                                                                            |
| 0    | DC-DC converter is off. <b>(Default)</b>                                   |
| 1    | DC-DC converter is on.<br>DC-DC controls by STB and power on/off sequence. |

SHCB: Charge Pump shutdown setting

| SHCB | Function                                                                                                |
|------|---------------------------------------------------------------------------------------------------------|
| D0   |                                                                                                         |
| 0    | Charge Pump converter is off.                                                                           |
| 1    | Charge Pump converter is on. <b>(Default)</b><br>Charge Pump controls by STB and power on/off sequence. |

R2 Register

| No. | A4 | A3 | A2 | A1 | R/W | D10 | D9 | D8 | D7                 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-----|----|----|----|----|-----|-----|----|----|--------------------|----|----|----|----|----|----|----|
| R2  | 0  | 0  | 1  | 0  | R/W | 0   | 0  | 1  | HBLK<br>(00111101) |    |    |    |    |    |    |    |

HBLK: Horizontal blanking setting.

| HBLK(D7~D0) | HBLK | Unit    | Remark       |
|-------------|------|---------|--------------|
| 00110010    | 50   | DCLK(*) | Parallel RGB |
| 00111111    | 63   |         |              |

R3 Register

| No. | A4 | A3 | A2 | A1 | R/W | D10 | D9 | D8 | D7 | D6 | D5 | D4              | D3 | D2 | D1 | D0 |
|-----|----|----|----|----|-----|-----|----|----|----|----|----|-----------------|----|----|----|----|
| R3  | 0  | 0  | 1  | 1  | R/W | 0   | 0  | 0  | 0  | 0  | 0  | VBLK<br>(10101) |    |    |    |    |

VBLK: Vertical blanking setting

| VBLK(D4~D0) | VBLK | Unit           |
|-------------|------|----------------|
| 00001       | 1    | t <sub>H</sub> |
| 11111       | 31   |                |

### R7 Register

| No. | A4 | A3 | A2 | A1 | R/W | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3              | D2 | D1              | D0 |
|-----|----|----|----|----|-----|-----|----|----|----|----|----|----|-----------------|----|-----------------|----|
| R7  | 0  | 1  | 1  | 1  | R/W | 0   | 0  | 0  | 0  | 0  | 0  | 0  | VGL_SEL<br>(11) |    | VGH_SEL<br>(11) |    |

VGL\_SEL:VGL voltage selection

| VGL_SEL | Function      |
|---------|---------------|
| D3~D2   |               |
| 00      | -8V           |
| 01      | -9V           |
| 10      | -10V(Default) |
| 11      | -11V          |

VGH\_SEL:VGH voltage selection

| VGH_SEL | Function    |
|---------|-------------|
| D1~D0   |             |
| 00      | 12          |
| 01      | 13          |
| 10      | 14          |
| 11      | 15(Default) |

### R8 Register

| No. | A4 | A3 | A2 | A1 | R/W | D10 | D9 | D8 | D7 | D6                 | D5 | D4 | D3 | D2 | D1 | D0 |
|-----|----|----|----|----|-----|-----|----|----|----|--------------------|----|----|----|----|----|----|
| R8  | 1  | 0  | 0  | 0  | R/W | 0   | 0  | 0  | 1  | VCOMH<br>(0111011) |    |    |    |    |    |    |

VCOMH: VCOMH level adjustment

| VCOMH | Voltage(V)          |
|-------|---------------------|
| D6~D0 | MVA/TN Normal TN LV |
| 00h   | 3.162 1.362         |
| :     | :                   |
| 41h   | 4.332 2.532         |
| :     | :                   |
| 7Fh   | 5.448 3.648         |

Note: Step is 18mV/step.

### R9 Register

| No. | A4 | A3 | A2 | A1 | R/W | D10 | D9 | D8 | D7 | D6                 | D5 | D4 | D3 | D2 | D1 | D0 |
|-----|----|----|----|----|-----|-----|----|----|----|--------------------|----|----|----|----|----|----|
| R9  | 1  | 0  | 0  | 1  | R/W | 0   | 0  | 0  | 0  | VCOML<br>(0111100) |    |    |    |    |    |    |

VCOML: VCOML level adjustment

| VCOML | Voltage(V)    |        |
|-------|---------------|--------|
| D6~D0 | MVA/TN Normal | TN LV  |
| 00h   | -2.358        | -2.628 |
| :     | :             | :      |
| 41h   | -1.188        | -1.458 |
| :     | :             | :      |
| 7Fh   | -0.072        | -0.342 |

Note: Step is 18mV/step.

### R10 Register

| No. | A4 | A3 | A2 | A1 | R/W | D10 | D9 | D8 | D7              | D6          | D5                | D4 | D3 | D2 | D1 | D0 |
|-----|----|----|----|----|-----|-----|----|----|-----------------|-------------|-------------------|----|----|----|----|----|
| R10 | 1  | 0  | 1  | 0  | R/W | 0   | 0  | 0  | PWM_400K<br>(0) | DC_F<br>(1) | CLK_ChP_M<br>(10) |    | 0  | 1  | 1  | 0  |

PWM\_400K: PWM frequency selection

| PWM_400K | Function                        |
|----------|---------------------------------|
| D7       |                                 |
| 0        | Around 200KHz. <b>(Default)</b> |
| 1        | Around 400KHz.                  |

DC\_F: DCDC frequency selection

| DC_F | Function                                               |
|------|--------------------------------------------------------|
| D6   |                                                        |
| 0    | Operating frequency is base on 13.5MHz.                |
| 1    | Operating frequency is base on 27MHz. <b>(Default)</b> |

CLK\_ChP\_M: Charge pumping frequency selection

| CLK_ChP_M | Function                                                 |
|-----------|----------------------------------------------------------|
| D5~D4     |                                                          |
| 00        | $F(\text{Chp}) = f(\text{Hsync})/2$                      |
| 01        | $F(\text{Chp}) = f(\text{Hsync})$                        |
| 10        | $F(\text{Chp}) = f(\text{Hsync}) * 2$ . <b>(Default)</b> |
| 01        | $F(\text{Chp}) = f(\text{Hsync}) * 4$                    |

#### R11~14 Register

| No. | A4 | A3 | A2 | A1 | R/W | D10 | D9           | D8               | D7 | D6 | D5               | D4 | D3 | D2               | D1 | D0 |
|-----|----|----|----|----|-----|-----|--------------|------------------|----|----|------------------|----|----|------------------|----|----|
| R11 | 1  | 0  | 1  | 1  | R/W | 0   | GMA_M<br>(0) | GMA_V4<br>(010)  |    |    | GMA_V1<br>(010)  |    |    | GMA_V0<br>(011)  |    |    |
| R12 | 1  | 1  | 0  | 0  | R/W | 0   | 0            | GMA_V48<br>(011) |    |    | GMA_V36<br>(011) |    |    | GMA_V16<br>(011) |    |    |
| R13 | 1  | 1  | 0  | 1  | R/W | 0   | 0            | 0                | 0  | 0  | GMA_V59<br>(011) |    |    | GMA_V55<br>(011) |    |    |
| R14 | 1  | 1  | 1  | 0  | R/W | 0   | 0            | 0                | 0  | 0  | GMA_V63<br>(010) |    |    | GMA_V62<br>(000) |    |    |

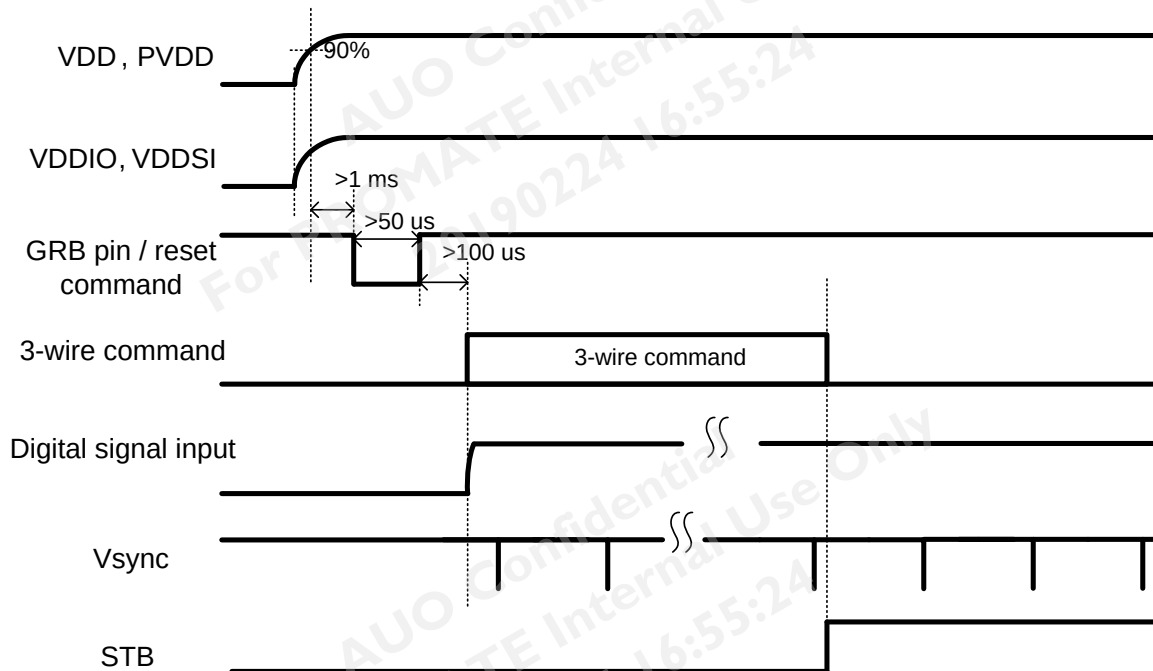
GMA\_M: Gamma adjustment selection

| GMA_M | Function                                           |
|-------|----------------------------------------------------|
| D9    |                                                    |
| 0     | Manual adjust by registers R11~R14.                |
| 1     | Auto set to gamma 2.2 by LC type. <b>(Default)</b> |

## 6. Power On/Off Characteristics

### a. Recommended Power On Sequence

#### Power On (Standby Enabling)

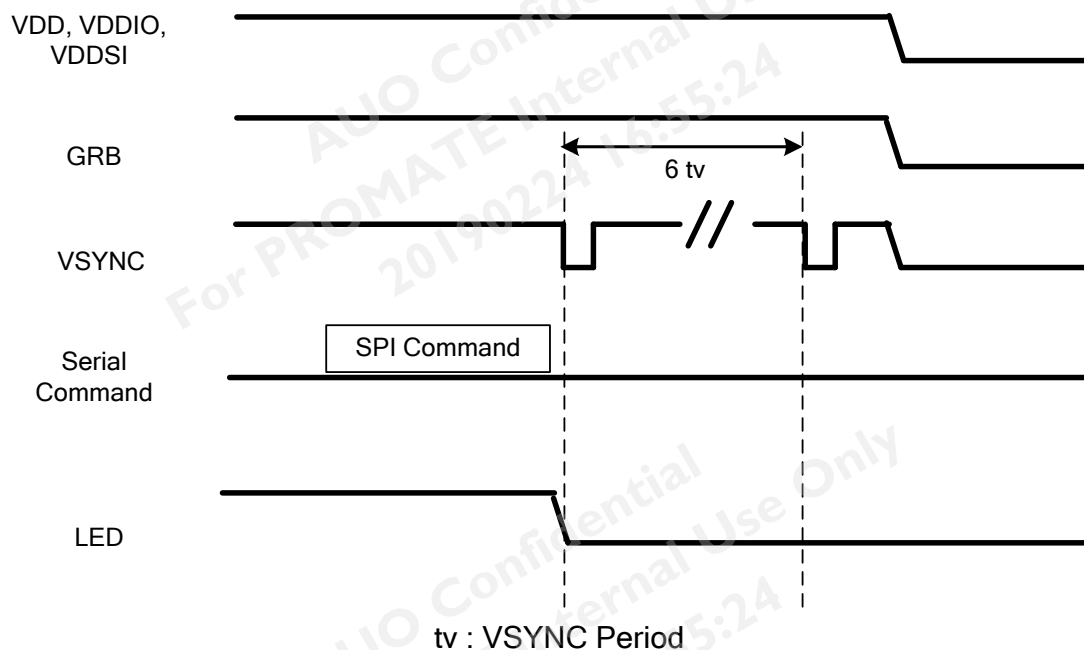


#### Note

- 1: After Setting Recommended Register, the driver enters into the normal operating mode.
- 2: RESET signal is necessary for power on, Please refer to the POWER ON sequence.  
You can use HW GRB PIN or SW Reset command to do this.
- 3: After the driver enters into the normal operating mode, The minimum cycle time of LED ON is 10 frames.

## b. Recommended Power Off Sequence

### Power Off (Standby Enabling)



#### Note

- 1: After Setting Recommended Register, the driver enters into standby mode.
- 2: Please Let LED OFF after the driver enters into the standby mode,
- 3: When enters into standby mode, The minimum cycle time of VDD OFF is 6 frames.

## D. Optical Specification

All optical specification is measured under typical condition (Note 1, 2)

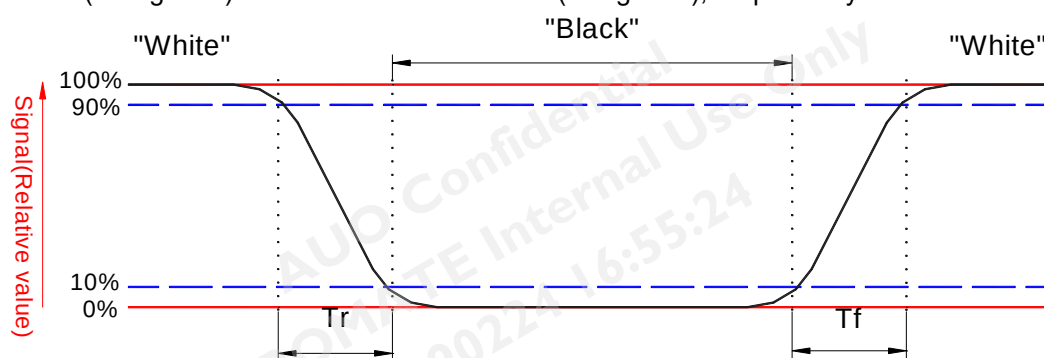
| Item               | Symbol | Condition                  | Min. | Typ. | Max. | Unit              | Remark    |
|--------------------|--------|----------------------------|------|------|------|-------------------|-----------|
| Response Time      |        |                            |      |      |      |                   |           |
| Rise               | Tr     | $\theta=0^\circ$           | -    | 10   | 15   | ms                | Note 3    |
| Fall               | Tf     |                            | -    | 15   | 30   | ms                |           |
| Contrast ratio     | CR     | At optimized viewing angle | 150  | 300  | -    |                   | Note 5, 6 |
| Viewing Angle      |        |                            |      |      |      |                   |           |
| Top                |        | $CR \geq 10$               | 35   | 50   | -    | deg.              | Note 7, 8 |
| Bottom             |        |                            | 40   | 55   | -    |                   |           |
| Left               |        |                            | 45   | 60   | -    |                   |           |
| Right              |        |                            | 45   | 60   | -    |                   |           |
| Brightness         | $Y_L$  | $\theta=0^\circ$           | 350  | 430  | -    | cd/m <sup>2</sup> | Note 9    |
| NTSC               |        |                            | 50   | 60   |      | %                 |           |
| White Chromaticity | X      | $\theta=0^\circ$           | 0.26 | 0.31 | 0.36 |                   |           |
|                    | y      | $\theta=0^\circ$           | 0.28 | 0.33 | 0.38 |                   |           |

Note 1: Measurement should be performed in the dark room, optical ambient temperature =25°C, and backlight current  $I_L=20$  mA

Note 2: To be measured on the center area of panel with a field angle of 1° by Topcon luminance meter BM-7, after 10 minutes operation.

Note 3: Definition of response time:

The output signals of photo detector are measured when the input signals are changed from "black" to "white"(falling time) and from "white" to "black"(rising time), respectively.



Note 4. From liquid crystal characteristics, response time will become slower and the color of panel will become darker when ambient temperature is below 25°C.

Note 5. Contrast ratio is calculated with the following formula.

$$\text{Contrast ratio} = \frac{\text{Photo detector output when LCD is at "White" state}}{\text{Photo detector output when LCD is at "Black" state}}$$

Note 6. White  $V_i = V_{i50} \pm 1.5V$

Black  $V_i = V_{i50} \pm 2.0V$

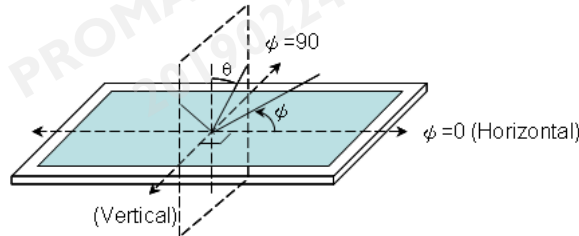
“ $\pm$ ” means that the analog input signal swings in phase with COM signal.

“ $\mp$ ” means that the analog input signal swings out of phase with COM signal.

$V_{i50}$  :The analog input voltage when transmission is 50%

The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

Note 7. Definition of viewing angle: refer to figure as below.



Note 8. The viewing angles are measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

Note 9. Brightness is measured at the center point of the display area.



## E. Reliability Test Items

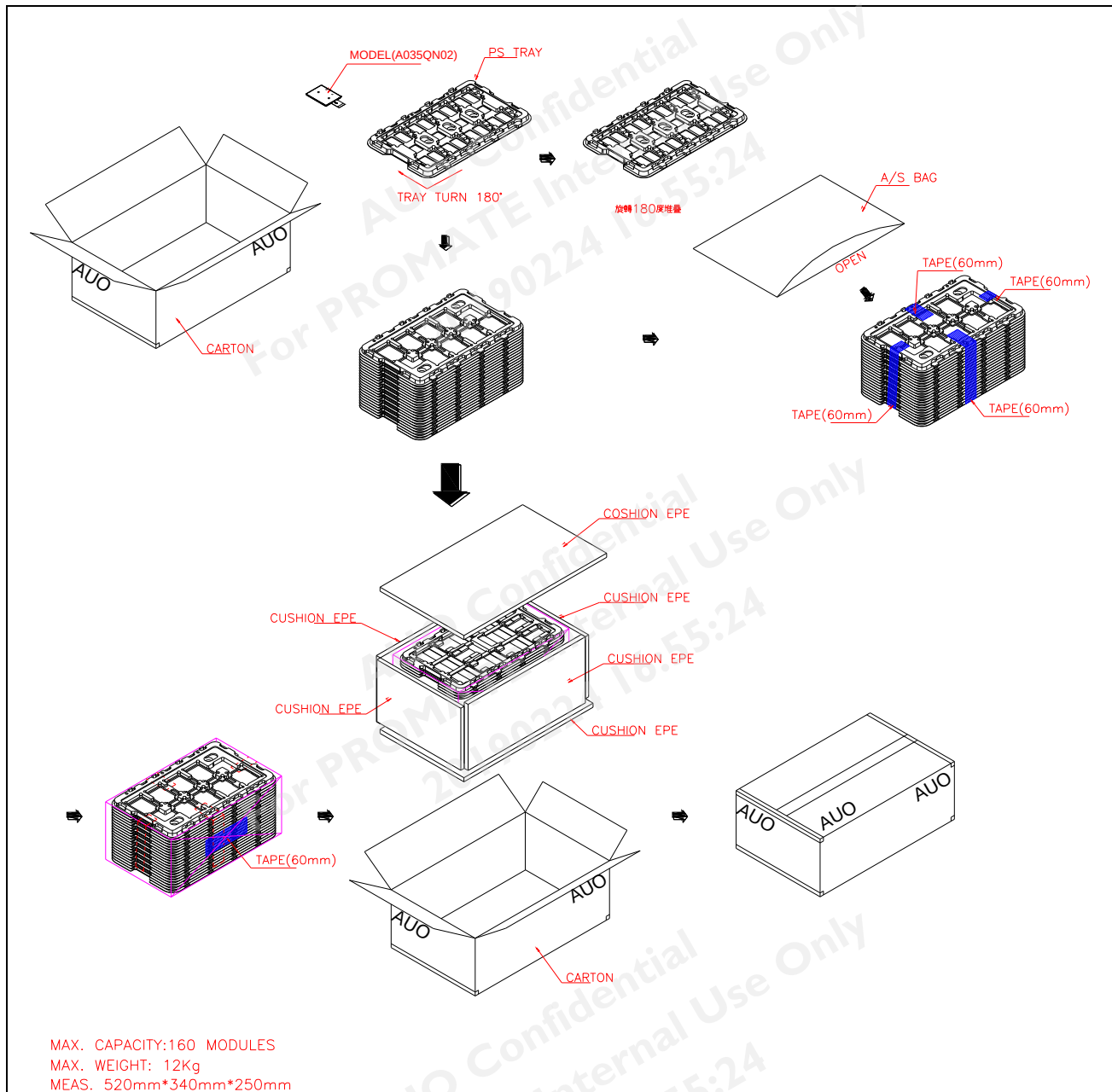
| No. | Test items                       | Conditions                                                                                              | Remark                                                         |
|-----|----------------------------------|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| 1   | High Temperature Storage         | Ta= 80°C 240Hrs                                                                                         |                                                                |
| 2   | Low Temperature Storage          | Ta= -40°C 240Hrs                                                                                        |                                                                |
| 3   | High Temperature Operation       | Tp= 70°C 240Hrs                                                                                         |                                                                |
| 4   | Low Temperature Operation        | Ta= -20°C 240Hrs                                                                                        |                                                                |
| 5   | High Temperature & High Humidity | Tp= 60°C 90%RH 240Hrs                                                                                   | Operation                                                      |
| 6   | Heat Shock                       | -25°C~70°C, 50 cycle, 2Hrs/cycle                                                                        | Non-operation                                                  |
| 7   | Electrostatic Discharge          | Contact = ± 4 kV, class B<br>Air = ± 8 kV, class B                                                      | Note 5                                                         |
| 8   | Vibration                        | Frequency range: 10Hz~55Hz<br>Stoke: 1.5mm<br>Sweep: 10Hz~55Hz~10Hz<br>±x, ±y, ±z 2 hours for each axis | Non-operation<br>JIS C7021, A-10<br>condition A: 15<br>minutes |
| 9   | Mechanical Shock                 | 100G . 6ms, ±X,±Y,±Z<br>3 times for each direction                                                      | Non-operation<br>JIS C7021,A-7<br>condition C                  |
| 10  | Vibration (With Carton)          | Random vibration:<br>0.015G <sup>2</sup> /Hz from 5~200Hz<br>-6dB/Octave from 200~500Hz                 | IEC 68-34                                                      |
| 11  | Drop (With Carton)               | Height: 60cm<br>1 corner, 3 edges, 6 surfaces                                                           |                                                                |
| 12  | Pressure                         | 5kg, 5sec                                                                                               | Note 6                                                         |

Note 1: In the standard conditions, there is no display function NG issue occurred. All the cosmetic specification is judged before the reliability stress.

Note 2: Ta: Ambient temperature.

Note 3: According to EN61000-4-2, ESD class B: Some performance degradation allowed. No data lost. Self-recoverable. No hardware failures.

## F. Packing and Marking



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## G. Application note

### 1. Recommended Register Settings

#### 8-bit Serial Interface HV Sync.

Power On

| No.          | Command   |          | NOTE  |
|--------------|-----------|----------|-------|
|              | High byte | Low byte |       |
| 1            | 00h       | 31h      | NOTE1 |
| Whait 50 us  |           |          |       |
| 2            | 00h       | 39h      |       |
| Whait 100 us |           |          |       |
| 3            | 10h       | 3Bh      | NOTE2 |
| 4            | 20h       | 3Dh      |       |
| 5            | 30h       | 15h      |       |
| 6            | 43h       | C9h      |       |
| 7            | 50h       | 08h      |       |
| 8            | 60h       | 40h      |       |
| 9            | 70h       | 0Fh      |       |
| 10           | 80h       | BCh      |       |
| 11           | 90h       | 3Dh      |       |
| 12           | A0h       | 66h      |       |
| 13           | B0h       | 93h      |       |
| 14           | C0h       | DBh      |       |
| 15           | D0h       | 1Bh      |       |
| 16           | E0h       | 10h      |       |
| 17           | 00h       | 3Dh      |       |

Power Off

| No. | Command   |          | NOTE  |
|-----|-----------|----------|-------|
|     | High byte | Low byte |       |
| 1   | 00h       | 39h      | NOTE3 |

NOTE 1. Please add these commands if you don't use the HW Reset.

NOTE 2. Please refer to the POWER ON sequence section for register setting timing as power-on.

NOTE 3. Please refer to the POWER OFF sequence section for register setting timing as power-off.

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## H. Precautions

1. Do not twist or bend the module and prevent the unsuitable external force for display module during assembly.
2. Adopt measures for good heat radiation. Be sure to use the module with in the specified temperature.
3. Avoid dust or oil mist during assembly.
4. Follow the correct power sequence while operating. Do not apply the invalid signal, otherwise, it will cause improper shut down and damage the module.
5. Less EMI: it will be more safety and less noise.
6. Please operate module in suitable temperature. The response time & brightness will drift by different temperature.
7. Avoid to display the fixed pattern (exclude the white pattern) in a long period, otherwise, it will cause image sticking.
8. Be sure to turn off the power when connecting or disconnecting the circuit.
9. Polarizer scratches easily, please handle it carefully.
10. Display surface never likes dirt or stains.
11. A dewdrop may lead to destruction. Please wipe off any moisture before using module.
12. Sudden temperature changes cause condensation, and it will cause polarizer damaged.
13. High temperature and humidity may degrade performance. Please do not expose the module to the direct sunlight and so on.
14. Acetic acid or chlorine compounds are not friends with TFT display module.
15. Static electricity will damage the module, please do not touch the module without any grounded device.
16. Do not disassemble and reassemble the module by self.
17. Be careful do not touch the rear side directly.
18. No strong vibration or shock. It will cause module broken.
19. Storage the modules in suitable environment with regular packing.
20. Be careful of injury from a broken display module.
21. Please avoid the pressure adding to the surface (front or rear side) of modules, because it will cause the display non-uniformity or other function issue.