

**Preliminary**

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

---



晶采光電科技股份有限公司  
**AMPIRE CO., LTD.**

## **SPECIFICATIONS FOR LCD MODULE**

|                          |                           |
|--------------------------|---------------------------|
| <b>CUSTOMER</b>          |                           |
| <b>CUSTOMER PART NO.</b> |                           |
| <b>AMPIRE PART NO.</b>   | <b>AM240320L8TNQW-00H</b> |
| <b>APPROVED BY</b>       |                           |
| <b>DATE</b>              |                           |

☒ **Approved For Specifications**

☐ **Approved For Specifications & Sample**

AMPIRE CO., LTD.

2F., No.88, Sec. 1, Sintai 5th Rd., Sijhih City, Taipei County 221, Taiwan (R.O.C.)

台北縣汐止市新台五路一段 88 號 2 樓(東方科學園區 D 棟)

TEL:886-2-26967269 , FAX:886-2-86967196 or 26967270

|                    |                   |                     |
|--------------------|-------------------|---------------------|
| <b>APPROVED BY</b> | <b>CHECKED BY</b> | <b>ORGANIZED BY</b> |
|                    |                   |                     |

**Preliminary**

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

---

**RECORD OF REVISION**

| <b>Revision Date</b> | <b>Page</b> | <b>Contents</b>   | <b>Editor</b> |
|----------------------|-------------|---|---------------|
| 2007/08/15           | -           | New Release   | Emil          |
| 2007/08/21           | 12          | Modified Interface Specification (Pin6 and Pin9).               | Emil          |
| 2007/08/21           | -           | Issued official Part No. AM240320L8TNQW-00H                     | Emil          |
| 2007/08/23           | 36          | Modified Mechanical Drawing.(To indicate Backlight Solder PAD). | Emil          |
| 2007/09/20           | 36          | Modified Mechanical Drawing.(Remove bezel)                      | Emil          |
| 2007/09/27           | 4           | Correction the Absolute max ratings of $V_{LED}$ .              | Emil          |
| 2007/12/06           | -           | Addition the Instruction of Interface Mode.                     | Emil          |
| 2008/01/08           | 13          | Correction Selection the System Interface mode.                 | Emil          |
| 2008/04/02           | 12          | Correction the PD0-PD17 definition.                             | Emil          |
| 2008/07/31           | 36          | Addition the recommend connector in mechanical drawing.         | Emil          |

**Preliminary**

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

---

**1. Features**

LCD 2.4 inch Amorphous-TFT-LCD (Thin Film Transistor Liquid Crystal Display) for mobile-phone or handy electrical equipments. The LCD adopts one backlight with High brightness 4-lamps white LED.

- (1) Construction: 2.4" a-Si color TFT-LCD with White LED Backlight and FPC.
- (2) LCD : 2.1 Amorphous-TFT 2.4 inch display, transmissive, Normally white type, 12 o'clock.
  - 2.2 240(RGB)X320 dots Matrix, 1/320 Duty.
  - 2.3 LCD controller is ILI9320.
  - 2.4 Real 262K colors display:
    - Red-5bit, Green-6bit, Blue-5bit (MPU8/16 mode)
    - Red-6bit, Green-6bit, Blue-6bit (MPU9/18, RGB18 mode)
- (3) Low cross talk by frame rate modulation
- (4) Direct data display with display RAM
- (5) Partial display function: You can save power by limiting the display space.
- (6) MPU interface: 8/16/18 bit parallel and 16/18-bit Serial Bus Interface Timing.
- (7) RGB interface: 16/18-bit RGB Interface Circuit Input.

## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

---

## 2. Mechanical specifications

### Dimensions and weight

| Item                      |             | Specifications                      | Unit |
|---------------------------|-------------|-------------------------------------|------|
| External shape dimensions |             | *1 43.6 (W) x 85.5(H) x 2.8 (TMax.) | mm   |
| Main LCD                  | Pixel pitch | 0.153 (W) x 0.153(H)                | mm   |
|                           | Active area | 36.72 (W) x 48.96 (H)               | mm   |
| Weight                    |             | T.B.D.                              | g    |

\*1. This specification is about External shape on shipment from AMPIRE.

## 3. Absolute max. ratings and environment

### 3.1. Absolute max ratings

Ta=25°C GND=0V

| Item                           | Symbol        | Min. | Max.    | Unit | Remarks |
|--------------------------------|---------------|------|---------|------|---------|
| Power Supply for Logic         | VDD – GND     | -0.3 | +4.0    | V    |         |
| Power Input Voltage            | Vci           | -0.3 | +4.6    | V    |         |
| Power Supply for LED backlight | LED A – LED K | -0.5 | +15     | V    |         |
| Input voltage                  | VIN           | -0.5 | VDD+0.5 | V    |         |

### 3.2. Environment

| Item                  | Specifications             | Remarks                   |
|-----------------------|----------------------------|---------------------------|
| Storage temperature   | Max. +70 °C<br>Min. -30 °C | Note 1:<br>Non-condensing |
| Operating temperature | Max. +60 °C<br>Min. -20 °C | Note 1:<br>Non-condensing |

Note 1 : Ta ≤ +40 °C . . . . Max.85%RH

Ta > +40 °C . . . . The max. humidity should not exceed the humidity with 40 °C  
85%RH.

**Preliminary**

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

---

**4. Electrical specifications****4.1. Electrical characteristics of LCD**

( $V_{DD}=2.8V$ ,  $T_a=25\text{ }^{\circ}C$ )

| Item                       | Symbol    | Conditions  | MIN.        | TYP. | MAX.        | Unit |
|----------------------------|-----------|-------------|-------------|------|-------------|------|
| IC power voltage           | $V_{DD}$  |             | 2.4         | 2.8  | 3.3         | V    |
| Power input voltage        | $V_{CI}$  |             | 2.5         | -    | 3.3         | V    |
| High-level input voltage   | $V_{IHC}$ |             | $0.8V_{DD}$ |      | $V_{DD}$    | V    |
| Low-level input voltage    | $V_{ILC}$ |             | 0           |      | $0.2V_{DD}$ | V    |
| Consumption current of VDD | $I_{DD}$  |             | -           | 6    | -           | mA   |
| Consumption current of LED | $I_F$     | $V_F=12.8V$ | -           | 20   | -           | mA   |

※ 1. 1/320 duty

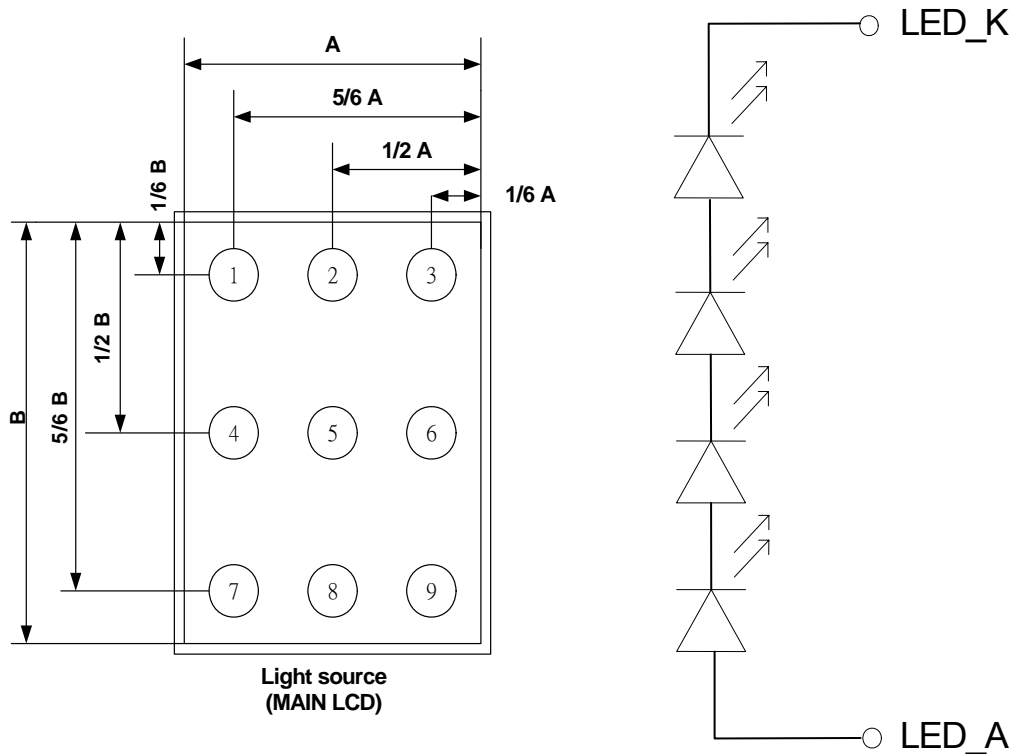
## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

### 4.2. LED back light specification

| Item                        | Symbol                   | Conditions          | MIN.  | TYP. | MAX. | Unit              |
|-----------------------------|--------------------------|---------------------|-------|------|------|-------------------|
| Forward voltage             | $V_f$                    | $I_f = 20\text{mA}$ | 12.3  | 12.8 | 13.8 | V                 |
| Reverse voltage             | $V_r$                    |                     | -     | -    | 12   | V                 |
| Forward current             | $I_f$                    | 4-chip serial       | -     | 20   | -    | mA                |
| Power Consumption           | $P_{BL}$                 | $I_f = 20\text{mA}$ | -     | 256  | 276  | mW                |
| Uniformity (with L/G)       | -                        | $I_f = 20\text{mA}$ | 80%*1 | -    | -    |                   |
| Bare LED Luminous intensity | $V_f$<br>$I_f$           | 13.2V<br>20mA       | 3700  | -    | -    | cd/m <sup>2</sup> |
| Luminous color              | White                    |                     |       |      |      |                   |
| Chip connection             | 4 chip serial connection |                     |       |      |      |                   |

LCM measure position:



\*1 Uniformity (LT):  $\frac{\text{Min}(P1 \sim P9)}{\text{Max}(P1 \sim P9)} \times 100 \geq 80\%$

**Preliminary**

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

---

**5. Optical characteristics****5.1. Optical characteristics**

(1/320 Duty in case except as specified elsewhere Ta = 25°C)

LED backlight transmissive module:

| Item                              | Symbol   | Temp. | Min.                                 | Std. | Max. | Unit        | Conditions  |
|-----------------------------------|----------|-------|--------------------------------------|------|------|-------------|---|
| Response time                     | Tr       | 25 °C | -                                    | 10   | 20   | ms          | $\theta = 0^\circ$ , $\varphi = 0^\circ$<br>(Note 2)  |
|                                   | Tf       | 25 °C | -                                    | 20   | 30   |             |   |
| Contrast ratio                    | CR       | 25 °C | 150                                  | 200  | -    | -           | $\theta = 0^\circ$ , $\varphi = 0^\circ$ LED:ON,<br>LIGHT:OFF<br>(Note 4)                   |
| Transmittance                     | T        | 25 °C | -                                    | 4.7  | -    | %           |   |
| Visual angle range front and rear | $\theta$ | 25 °C | ( $\theta$ f) 70<br>( $\theta$ b) 70 |      |      | De-<br>gree | $\varphi 1 = 0^\circ$ , $\varphi = 0^\circ$ , CR $\geq$ 10 LED:ON<br>LIGHT:OFF<br>(Note 3)  |
| Visual angle range left and right | $\theta$ | 25 °C | ( $\theta$ l) 80<br>( $\theta$ r) 80 |      |      | De-<br>gree | $\varphi 1 = 0^\circ$ , $\varphi = 90^\circ$ , CR $\geq$ 10 LED:ON<br>LIGHT:OFF<br>(Note 3) |
| Visual angle direction priority   |          |       | 12:00                                |      |      |             | (Note 5)  |
| Brightness                        |          |       | 170                                  | 220  | -    | Cd/m2       | I <sub>F</sub> =20mA, Full White pattern  |

**Preliminary**

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

---

**5.2. CIE (x, y) chromaticity (1/320 Duty Ta = 25°C)**

Main LCD: (1/320 Duty Ta = 25°C)

| Item  | Symbol | Transmissive |       |       | Conditions                               |
|-------|--------|--------------|-------|-------|--|
|       |        | Min.         | Std.  | Max.  |  |
| Red   | x      | 0.605        | 0.635 | 0.665 | $\theta = 0^\circ$ , $\varphi = 0^\circ$ |
|       | y      | 0.317        | 0.347 | 0.377 |  |
| Green | x      | 0.314        | 0.344 | 0.374 | $\theta = 0^\circ$ , $\varphi = 0^\circ$ |
|       | y      | 0.562        | 0.592 | 0.620 |  |
| Blue  | x      | 0.129        | 0.159 | 0.189 | $\theta = 0^\circ$ , $\varphi = 0^\circ$ |
|       | y      | 0.132        | 0.162 | 0.192 |  |
| White | x      | 0.283        | 0.313 | 0.343 | $\theta = 0^\circ$ , $\varphi = 0^\circ$ |
|       | y      | 0.322        | 0.352 | 0.382 |  |

**Light source**

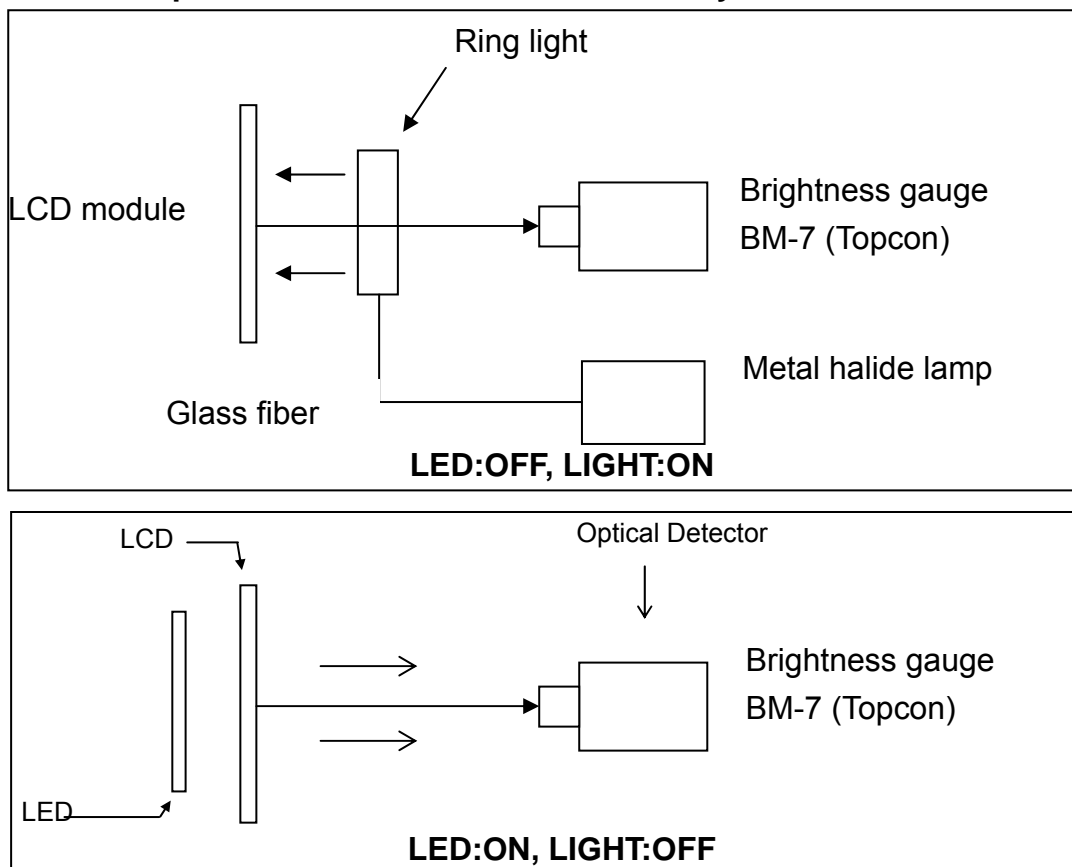
| Item           | Symbol | Value |      |      | Conditions  |
|----------------|--------|-------|------|------|---|
|                |        | Min.  | Std. | Max. |   |
| Light source   | x      | 0.26  | 0.29 | 0.34 | $\theta = 0^\circ$ , $\varphi = 0^\circ$          |
|                | y      | 0.26  | 0.29 | 0.34 |   |
| LED brightness |        | 3700  | -    | -    | Unit: cd/m <sup>2</sup><br>(I <sub>F</sub> =20mA) |



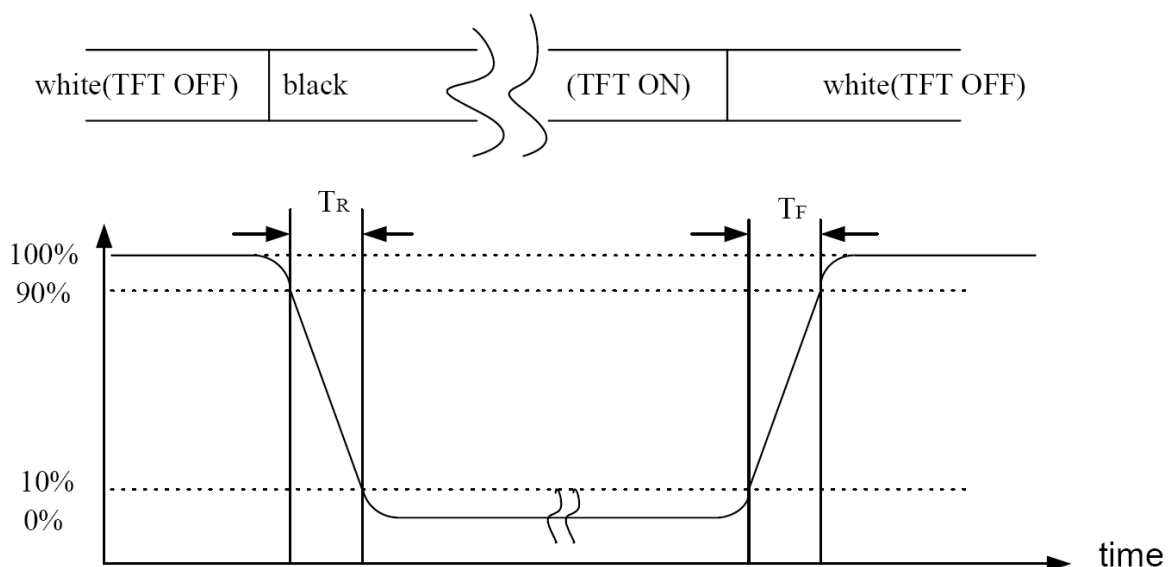
## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

### NOTE 1: Optical characteristic measurement system



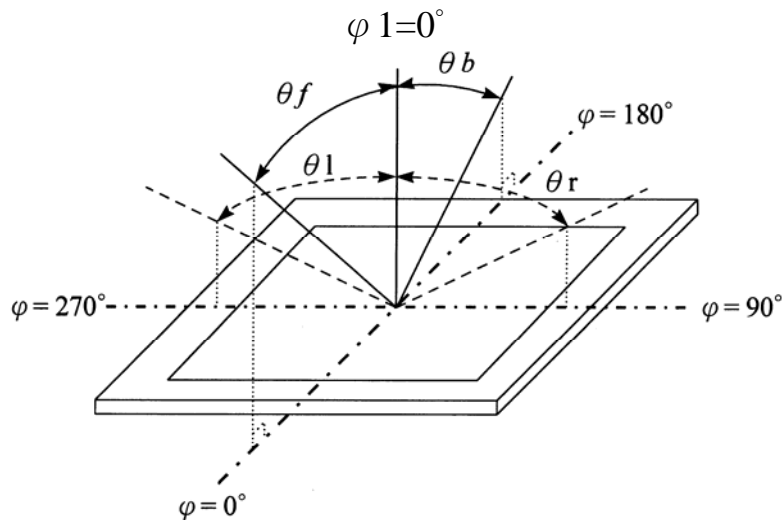
### NOTE 2: Definition of Response Time : Sum of TR and TF



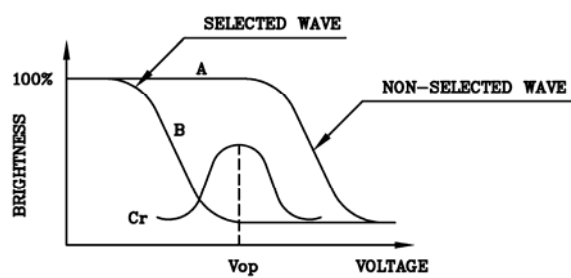
## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

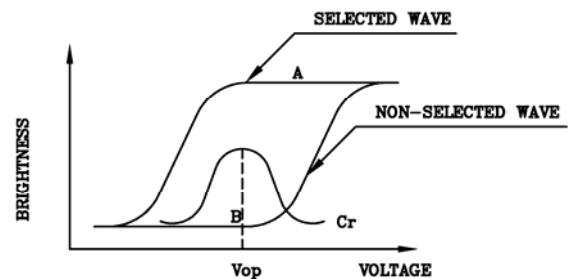
### NOTE 3: $\varphi$ 、 $\theta$ definition



### NOTE 4: Contrast definition



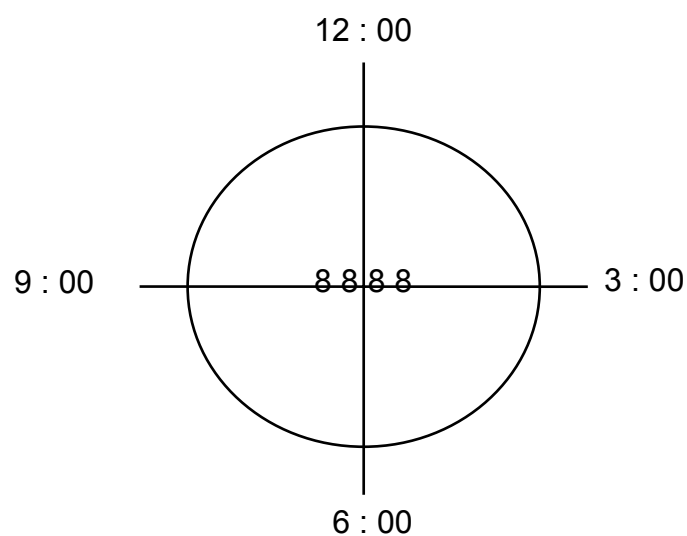
(positive type)



(negative type)

Contrast Ratio :  $Cr = A/B$

### NOTE 5: Visual angle direction priority

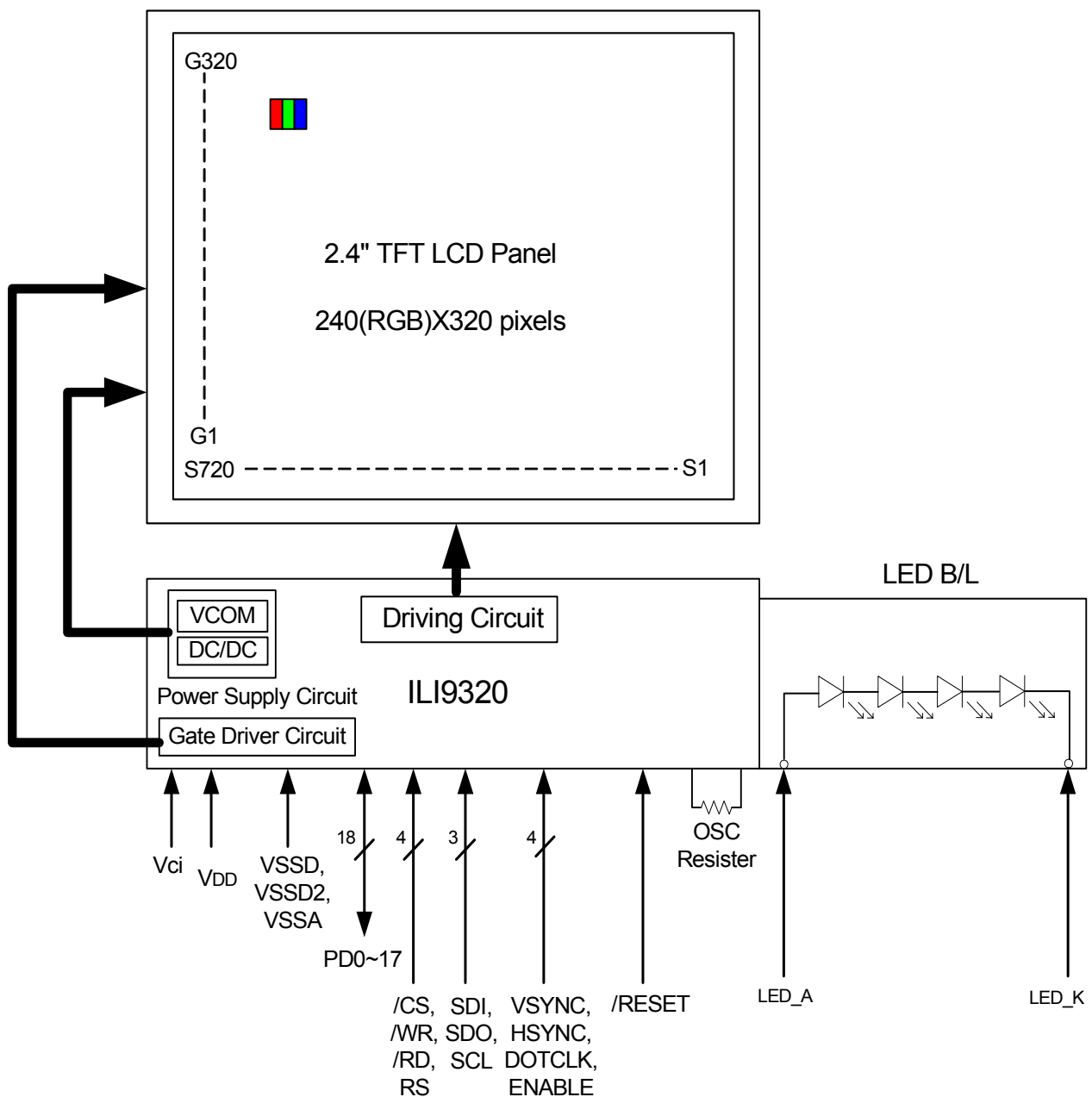


## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

## 6. Block Diagram

Display format: A-Si TFT transmissive, Normally white type, 12 o'clock.  
Display mode: Normally white  
Display composition: 240 x RGB x 320 pixels  
LCD Driver : ILI9320  
Back light: White LED x 4 ( $I_F=20\text{mA}$ )



## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

## 7. Interface specifications

| Pin No.                                | Terminal   | Functions  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
|--|--|--|--|------|---------------|------------|-----------|------------|---------------------|-----------|-----------|-----------|------------|--|--|
| 1                                      | ENABLE   | A data ENABLE signal in RGB I/F mode.  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 2                                      | DOTCLK   | Dot clock signal in RGB I/F mode.  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 3                                      | HSYNC  | Frame synchronizing signal in RGB I/F mode.  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 4                                      | VSYNC  | Frame synchronizing signal in RGB I/F mode.  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 5                                      | /CS  | Chip select signal.  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 6                                      | WR/SCL   | Write enable signal/Serial bus interface clock input pin.  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 7                                      | SDI  | Serial bus interface data input pin.   |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 8                                      | RS   | Command/display Data Selection.  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 9                                      | NC   | NC   |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 10                                     | /RD  | Read enable signal.  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 11                                     | /RESET   | Reset pin. Setting either pin low initializes the LSI.<br>Must be reset the chop after power being supplied.   |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 12                                     | PD0  | <table><tr><th>Mode</th><th>DB Pin in use</th></tr><tr><td>MCU 18-bit</td><td>PD [17:0]</td></tr><tr><td>MCU 16-bit</td><td>PD [17:10], DB[8:1]</td></tr><tr><td>MCU 9-bit</td><td>PD [17:9]</td></tr><tr><td>MCU 8-bit</td><td>PD [17:10]</td></tr><tr><td>Serial Mode/Digital RGB Interface Mode</td><td>SDI, SDO/ PD [17:0]<br/>R[5:0]=PD[17:12]<br/>G[5:0]=PD[11:6]<br/>B[5:0]=PD[5:0]</td></tr></table> |  | Mode | DB Pin in use | MCU 18-bit | PD [17:0] | MCU 16-bit | PD [17:10], DB[8:1] | MCU 9-bit | PD [17:9] | MCU 8-bit | PD [17:10] | Serial Mode/Digital RGB Interface Mode | SDI, SDO/ PD [17:0]<br>R[5:0]=PD[17:12]<br>G[5:0]=PD[11:6]<br>B[5:0]=PD[5:0] |
| Mode                                   | DB Pin in use  |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| MCU 18-bit                             | PD [17:0]  |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| MCU 16-bit                             | PD [17:10], DB[8:1]  |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| MCU 9-bit                              | PD [17:9]  |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| MCU 8-bit                              | PD [17:10]   |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| Serial Mode/Digital RGB Interface Mode | SDI, SDO/ PD [17:0]<br>R[5:0]=PD[17:12]<br>G[5:0]=PD[11:6]<br>B[5:0]=PD[5:0] |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 13                                     | PD1  |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 14                                     | PD2  |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 15                                     | PD3  |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 16                                     | PD4  |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 17                                     | PD5  |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 18                                     | PD6  |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 19                                     | PD7  |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 20                                     | PD8  |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 21                                     | PD9  |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 22                                     | PD10   |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 23                                     | PD11   |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 24                                     | PD12   |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 25                                     | PD13   |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 26                                     | PD14   |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 27                                     | PD15   |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 28                                     | PD16   |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |
| 29                                     | PD17   |  |  |      |               |            |           |            |                     |           |           |           |            |  |  |

(To be continued)

**Preliminary**

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

|    |     |   |
|----|-----|---|
| 30 | VDD | Power supply for the internal logic circuit. (VDD=2.2~3.3V) |
| 31 | VCI | Power supply for Step-up circuit. (VCI=2.5~3.3V)            |
| 32 | VCI |   |
| 33 | NC  | NC  |
| 34 | NC  |   |
| 35 | NC  |   |
| 36 | NC  |   |
| 37 | NC  |   |
| 38 | NC  |   |
| 39 | NC  |   |
| 40 | GND | GND-terminal  |
| 41 | NC  | NC  |
| 42 | NC  |   |
| 43 | NC  |   |
| 44 | NC  |   |
| 45 | GND | GND-terminal  |
| 46 | SDO | Serial bus interface data output pin.                       |
| 47 | NC  | NC  |
| 48 | NC  |   |
| 49 | NC  |   |
| 50 | GND | GND-terminal  |
| 51 | GND |   |

**Selection the System Interface mode**

| Mode                                    | IM3<br>(JP4) | IM2<br>(JP3) | IM1<br>(JP2) | IM0<br>(JP1) |
|---|--------------|--------------|--------------|--------------|
| MCU-18Bit                               | H            | L            | H            | L            |
| MCU-16 Bit                              | L            | L            | H            | L            |
| MCU-9 Bit                               | H            | L            | H            | H            |
| MCU-8 Bit                               | L            | L            | H            | H            |
| *Serial Mode/Digital RGB Interface Mode | L            | H            | L            | L            |

**\*Jumper Default: JP1= “L” JP2= “L” JP3= “H” JP4= “L”**

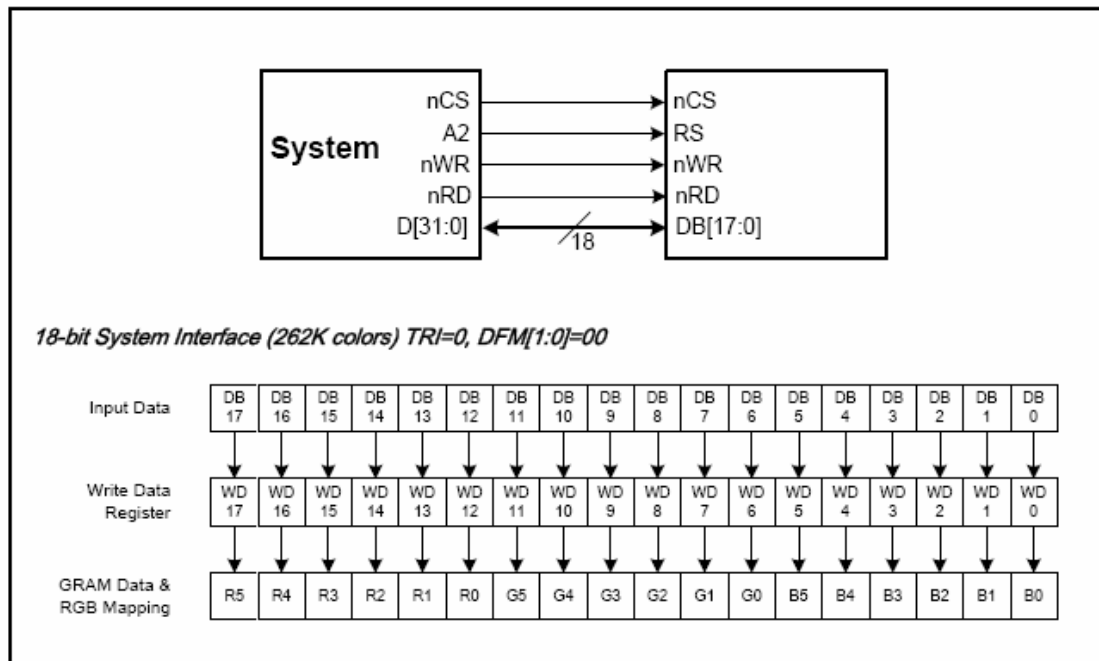
## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

## 8. System interface and RGB interface

### 8.1. 80-system 18-bit interface

The i80/18-bit system interface is selected by setting the IM[3:0] as "1010" levels.

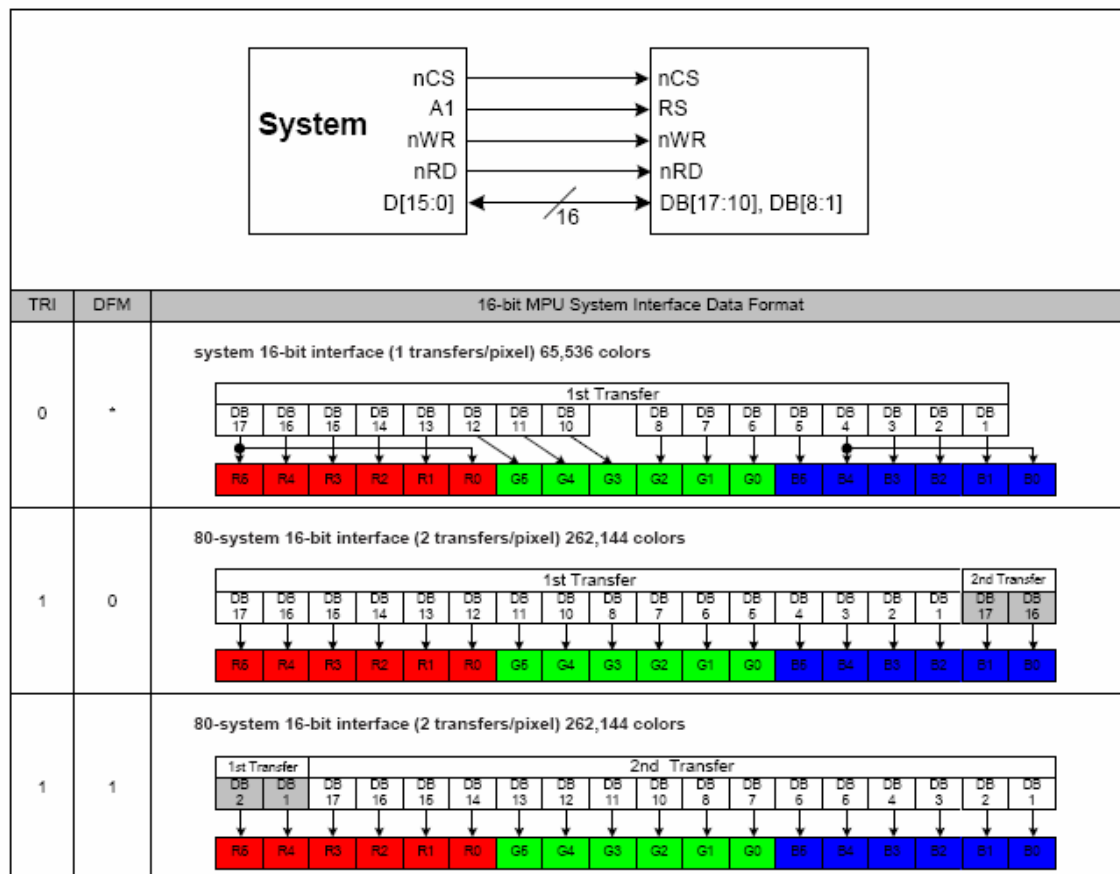


## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

## 8.2. 80-system 16-bit interface

The i80/16-bit system interface is selected by setting the IM[3:0] as "0010" levels. The 262K or 65K color can be display through the 16-bit MPU interface. When the 262K color is displayed, two transfers (1<sup>st</sup> transfer: 2 bits, 2<sup>nd</sup> transfer: 16 bits or 1<sup>st</sup> transfer: 16 bits, 2<sup>nd</sup> transfer: 2 bits) are necessary for the 16-bit CPU interface.

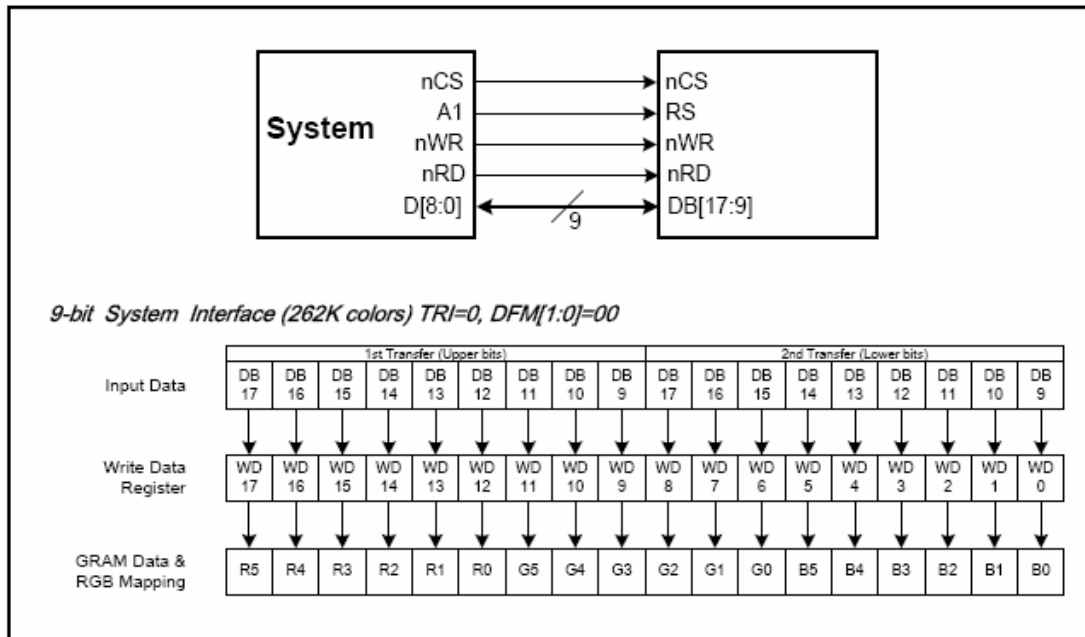


## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

### 8.3. 80-system 9-bit interface

The i80/9-bit system interface is selected by setting the IM[3:0] as "1011" and the DB17~DB9 pins are used to transfer the data. When writing the 16-bit register, the data is divided into upper byte (8 bits and LSB is not used) lower byte and the upper byte is transferred first. The display data is also divided in upper byte (9 bits) and lower byte, and the upper byte is transferred first. The unused DB[8:0] pins must be tied to either Vcc or AGND.



### 8.4. 80-system 8-bit interface

The i80/8-bit system interface is selected by setting the IM[3:0] as "0011" and the DB17~DB10 pins are used to transfer the data. When writing the 16-bit register, the data is divided into upper byte (8 bits and LSB is not used) lower byte and the upper byte is transferred first. The display data is also divided in upper byte (8 bits) and lower byte, and the upper byte is transferred first. The written data is expanded into 18 bits internally (see the figure below) and then written into GRAM. The unused DB[9:0] pins must be tied to either Vcc or AGND.



## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

| TRI | DFM | 8-bit MPU System Interface Data Format                              |
|-----|-----|---|
| 0   | *   | <p>system 8-bit interface (2 transfers/pixel) 65,536 colors</p>     |
| 1   | 0   | <p>80-system 8-bit interface (3 transfers/pixel) 262,144 colors</p> |
| 1   | 1   | <p>80-system 8-bit interface (3 transfers/pixel) 262,144 colors</p> |

### Data transfer synchronization in 8/9-bit bus interface mode

ILI9320 supports a data transfer synchronization function to reset upper and lower counters which count the transfers numbers of upper and lower byte in 8/9-bit interface mode. If a mismatch arises in the numbers of transfers between the upper and lower byte counters due to noise and so on, the "00" register is written 4 times consecutively to reset the upper and lower counters so that data transfer will restart with a transfer of upper byte. This synchronization function can effectively prevent display error if the upper/lower counters are periodically reset.

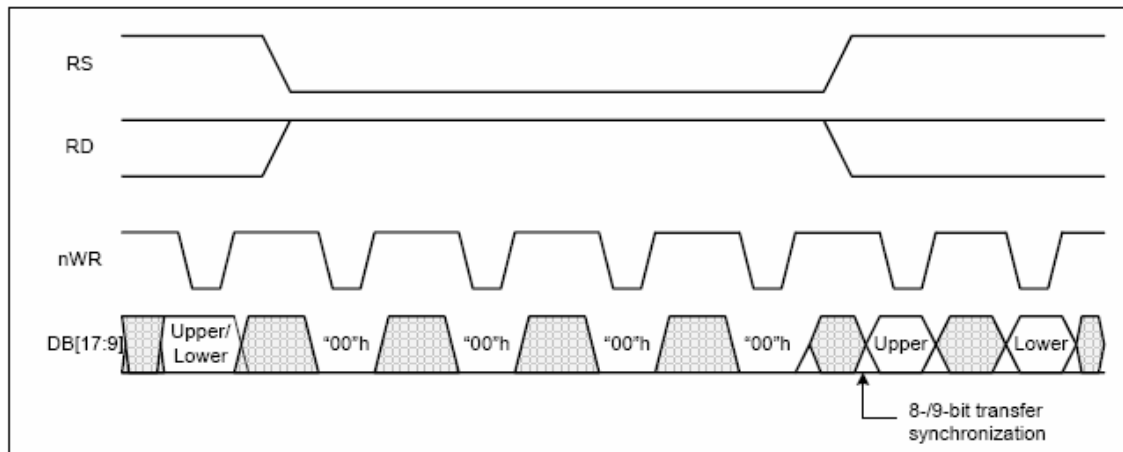


Figure6 Data Transfer Synchronization in 8/9-bit System Interface

## Preliminary

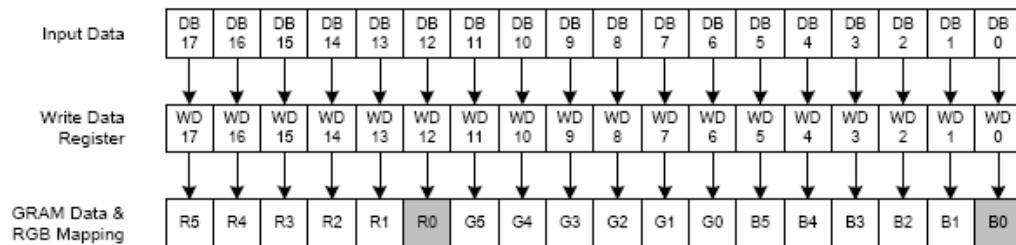
The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

## 8.5. RGB interface

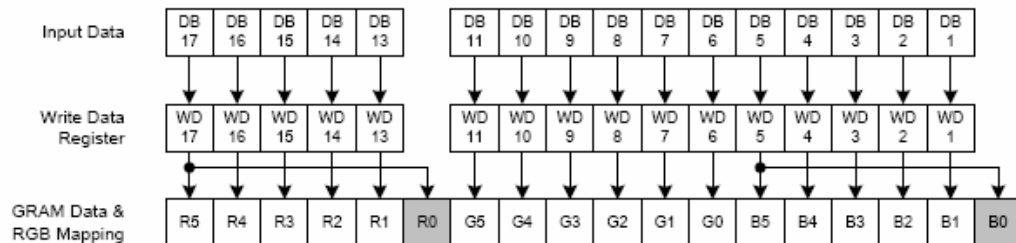
The RGB Interface mode is available for ILI9320 and the interface is selected by setting the RIM[1:0] bits as following table.

| RIM1 | RIM0 | RGB Interface        | DB pins             |
|------|------|----------------------|---------------------|
| 0    | 0    | 18-bit RGB Interface | DB[17:0]            |
| 0    | 1    | 16-bit RGB Interface | DB[17:13], DB[11:1] |
| 1    | 0    | 6-bit RGB Interface  | DB[17:12]           |
| 1    | 1    | Setting prohibited   |                     |

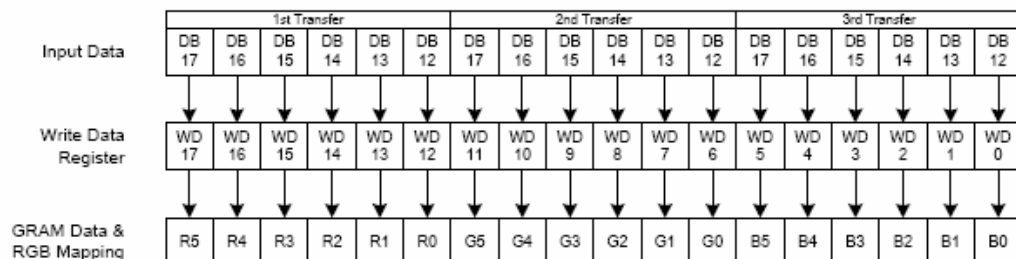
### 18-bit RGB Interface (262K colors)



### 16-bit RGB Interface (65K colors)



### 6-bit RGB Interface (262K colors)

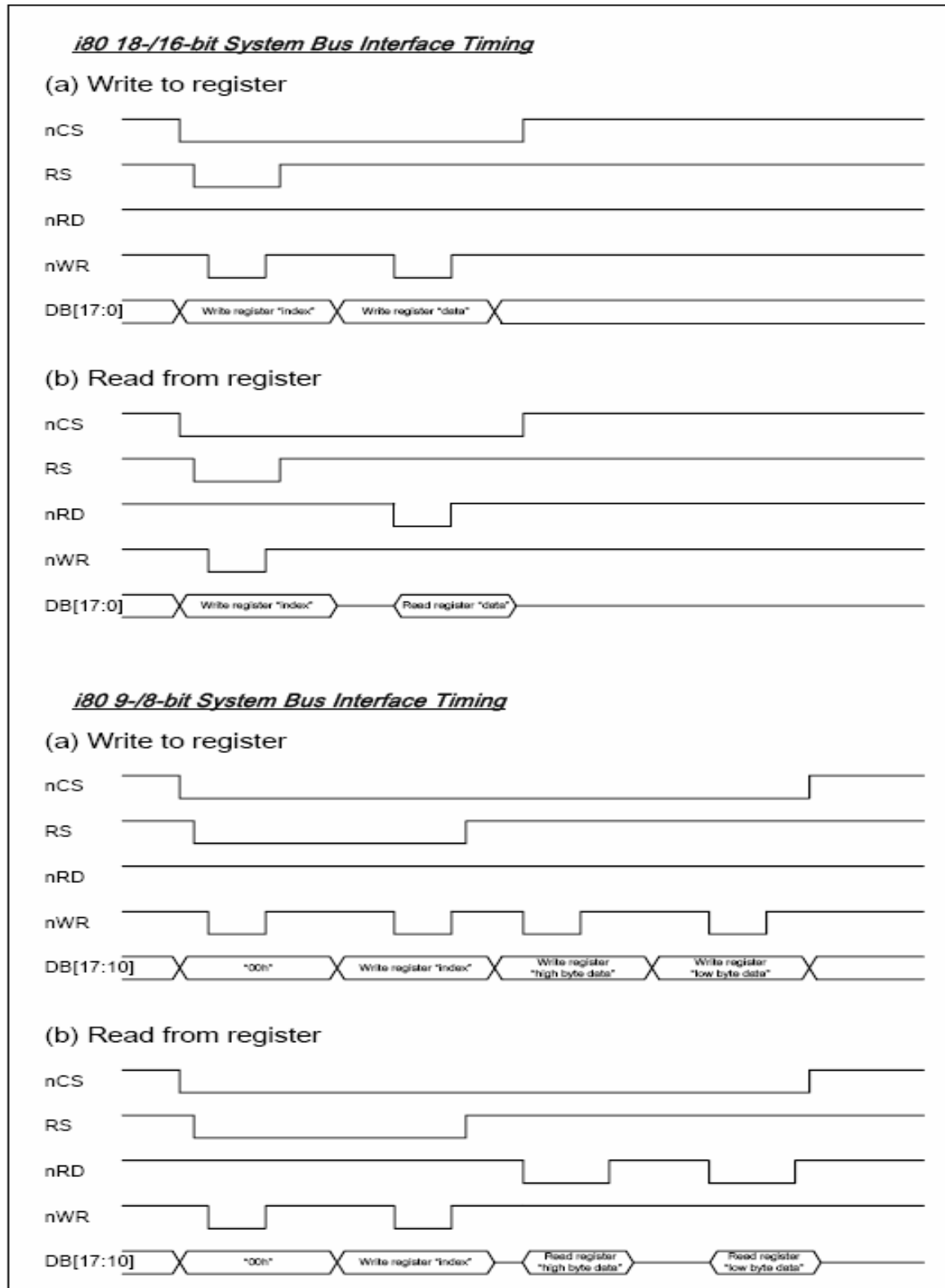


## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

## 8.6. Timing of System Interface and RGB Interface

### a. System Interface



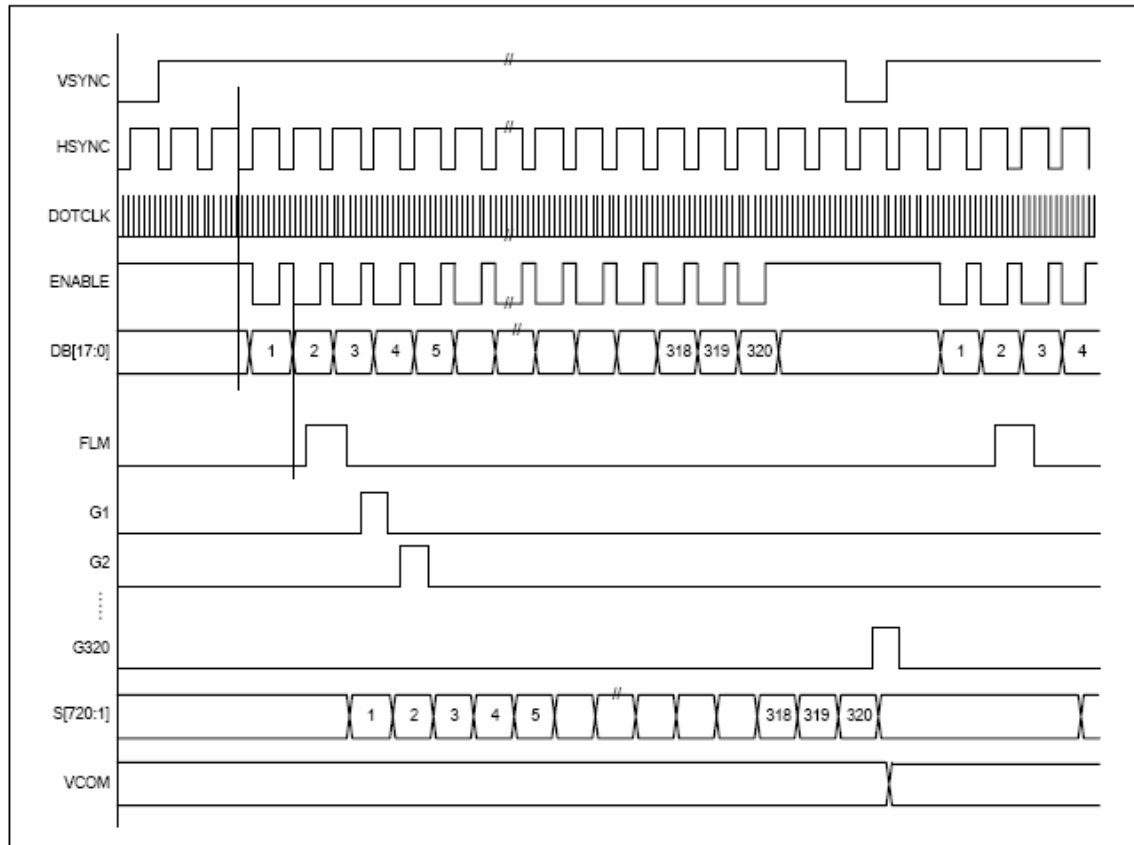
## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

---

### b. RGB Interface

The following are diagrams of interfacing timing with LCD panel control signals in internal operation and RGB interface modes.



## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

## 9. INSTRUCTION DESCRIPTIONS

### 9.1. Instruction List

#### Main LCD Driver IC:ILI9320

| No. | Registers Name                  | R/W | RS | D15  | D14   | D13    | D12    | D11  | D10     | D9      | D8      | D7    | D6    | D5       | D4       | D3        | D2      | D1      | D0      |
|-----|---------------------------------|-----|----|--|-------|--------|--------|------|---------|---------|---------|-------|-------|----------|----------|-----------|---------|---------|---------|
| IR  | Index Register                  | W   | 0  | -  | -     | -      | -      | -    | -       | -       | -       | ID7   | ID6   | ID5      | ID4      | ID3       | ID2     | ID1     | ID0     |
| SR  | Status Read                     | R   | 0  | L7   | L6    | L5     | L4     | L3   | L2      | L1      | L0      | 0     | 0     | 0        | 0        | 0         | 0       | 0       | 0       |
| 00h | Driver Code Read                | R   | 1  | 1  | 0     | 0      | 1      | 0    | 0       | 1       | 0       | 0     | 0     | 1        | 0        | 0         | 0       | 1       | 0       |
| 00h | Start Oscillation               | W   | 1  | -  | -     | -      | -      | -    |         | -       | -       |       | -     | -        | -        | -         | -       | -       | OSC     |
| 01h | Driver Output Control 1         | W   | 1  | 0  | 0     | 0      | 0      | 0    | SM      | 0       | SS      | 0     | 0     | 0        | 0        | 0         | 0       | 0       | 0       |
| 02h | LCD Driving Control             | W   | 1  | 0  | 0     | 0      | 0      | 0    | 1       | B/C     | EOR     | 0     | 0     | 0        | 0        | 0         | 0       | 0       | 0       |
| 03h | Entry Mode                      | W   | 1  | TRI  | DFM   | 0      | BGR    | 0    | 0       | HWM     | 0       | ORG   | 0     | I/D1     | I/D0     | AM        | 0       | 0       | 0       |
| 04h | Resize Control                  | W   | 1  | 0  | 0     | 0      | 0      | 0    | 0       | RCV 1   | RCV 0   | 0     | 0     | RCH 1    | RCH 0    | 0         | 0       | RSZ1    | RSZ0    |
| 07h | Display Control 1               | W   | 1  | 0  | 0     | PTD E1 | PTD E0 | 0    | 0       | 0       | BAS EE  | 0     | 0     | GON      | DTE      | CL        | 0       | D1      | D0      |
| 08h | Display Control 2               | W   | 1  | 0  | 0     | 0      | 0      | FP3  | FP2     | FP1     | FP0     | 0     | 0     | 0        | 0        | BP3       | BP2     | BP1     | BP0     |
| 09h | Display Control 3               | W   | 1  | 0  | 0     | 0      | 0      | 0    | PTS2    | PTS1    | PTS0    | 0     | 0     | PTG1     | PTG0     | ISC3      | ISC2    | ISC1    | ISC0    |
| 0Ah | Display Control 4               | W   | 1  | 0  | 0     | 0      | 0      | 0    | 0       | 0       | 0       | 0     | 0     | 0        | 0        | FMA RKO E | FMI2    | FMI1    | FMI0    |
| 0Ch | RGB Display Interface Control 1 | W   | 1  | ENC 2  | ENC 1 | ENC 0  | 0      | 0    | 0       | 0       | RM      | 0     | 0     | DM1      | DM0      | 0         | 0       | RIM1    | RIM0    |
| 0Dh | Frame Maker Position            | W   | 1  | 0  | 0     | 0      | 0      | 0    | 0       | 0       | FMP 8   | FMP 7 | FMP 6 | FMP 5    | FMP 4    | FMP 3     | FMP 2   | FMP 1   | FMP 0   |
| 0Fh | RGB Display Interface Control 2 | W   | 1  | 0  | 0     | 0      | 0      | 0    | 0       | 0       | 0       | 0     | 0     | 0        | VSPL     | HSP L     | 0       | DPL     | EPL     |
| 10h | Power Control 1                 | W   | 1  | 0  | 0     | 0      | SAP    | BT3  | BT2     | BT1     | BT0     | APE   | AP2   | AP1      | AP0      | 0         | DST B   | SLP     | 0       |
| 11h | Power Control 2                 | W   | 1  | 0  | 0     | 0      | 0      | 0    | DC12    | DC11    | DC10    | 0     | DC02  | DC01     | DC00     | 0         | VC2     | VC1     | VC0     |
| 12h | Power Control 3                 | W   | 1  | 0  | 0     | 0      | 0      | 0    | 0       | 0       | VCM R   | 0     | 0     | 0        | PON      | VRH 3     | VRH 2   | VRH 1   | VRH 0   |
| 13h | Power Control 4                 | W   | 1  | 0  | 0     | 0      | VDV4   | VDV3 | VDV2    | VDV1    | VDV0    | 0     | 0     | 0        | 0        | 0         | 0       | 0       | 0       |
| 20h | Horizontal GRAM Address Set     | W   | 1  | 0  | 0     | 0      | 0      | 0    | 0       | 0       | 0       | AD7   | AD6   | AD5      | AD4      | AD3       | AD2     | AD1     | AD0     |
| 21h | Vertical GRAM Address Set       | W   | 1  | 0  | 0     | 0      | 0      | 0    | 0       | 0       | AD16    | AD15  | AD14  | AD13     | AD12     | AD11      | AD10    | AD9     | AD8     |
| 22h | Write Data to GRAM              | W   | 1  | RAM write data (WD17-0) / read data (RD17-0) bits are transferred via different data bus lines according to the selected interfaces. |       |        |        |      |         |         |         |       |       |          |          |           |         |         |         |
| 29h | Power Control 7                 | W   | 1  | 0  | 0     | 0      | 0      | 0    | 0       | 0       | 0       | 0     | 0     | 0        | VCM 4    | VCM 3     | VCM 2   | VCM 1   | VCM 0   |
| 2Bh | Frame Rate and Color Control    | W   | 1  | 0  | 0     | 0      | 0      | 0    | 0       | 0       | 0       | EXT_R | 0     | FR_S EL1 | FR_S EL0 | 0         | 0       | 0       | 0       |
| 30h | Gamma Control 1                 | W   | 1  | 0  | 0     | 0      | 0      | 0    | KP1[ 2] | KP1[ 1] | KP1[ 0] | 0     | 0     | 0        | 0        | 0         | KP0[ 2] | KP0[ 1] | KP0[ 0] |
| 31h | Gamma Control 2                 | W   | 1  | 0  | 0     | 0      | 0      | 0    | KP3[ 2] | KP3[ 1] | KP3[ 0] | 0     | 0     | 0        | 0        | 0         | KP2[ 2] | KP2[ 1] | KP2[ 0] |
| 32h | Gamma Control 3                 | W   | 1  | 0  | 0     | 0      | 0      | 0    | KP5[ 2] | KP5[ 1] | KP5[ 0] | 0     | 0     | 0        | 0        | 0         | KP4[ 2] | KP4[ 1] | KP4[ 0] |
| 35h | Gamma Control 4                 | W   | 1  | 0  | 0     | 0      | 0      | 0    | RP1[ 2] | RP1[ 1] | RP1[ 0] | 0     | 0     | 0        | 0        | 0         | RP0[ 2] | RP0[ 1] | RP0[ 0] |

## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

|     |                 |   |   |   |   |   |         |         |         |         |         |   |   |   |         |         |         |         |         |
|-----|-----------------|---|---|---|---|---|---------|---------|---------|---------|---------|---|---|---|---------|---------|---------|---------|---------|
| 36h | Gamma Control 5 | W | 1 | 0 | 0 | 0 | VRP1[4] | VRP1[3] | VRP1[2] | VRP1[1] | VRP1[0] | 0 | 0 | 0 | VRP0[4] | VRP0[3] | VRP0[2] | VRP0[1] | VRP0[0] |
| 37h | Gamma Control 6 | W | 1 | 0 | 0 | 0 | 0       | 0       | KN1[2]  | KN1[1]  | KN1[0]  | 0 | 0 | 0 | 0       | 0       | KN0[2]  | KN0[1]  | KN0[0]  |

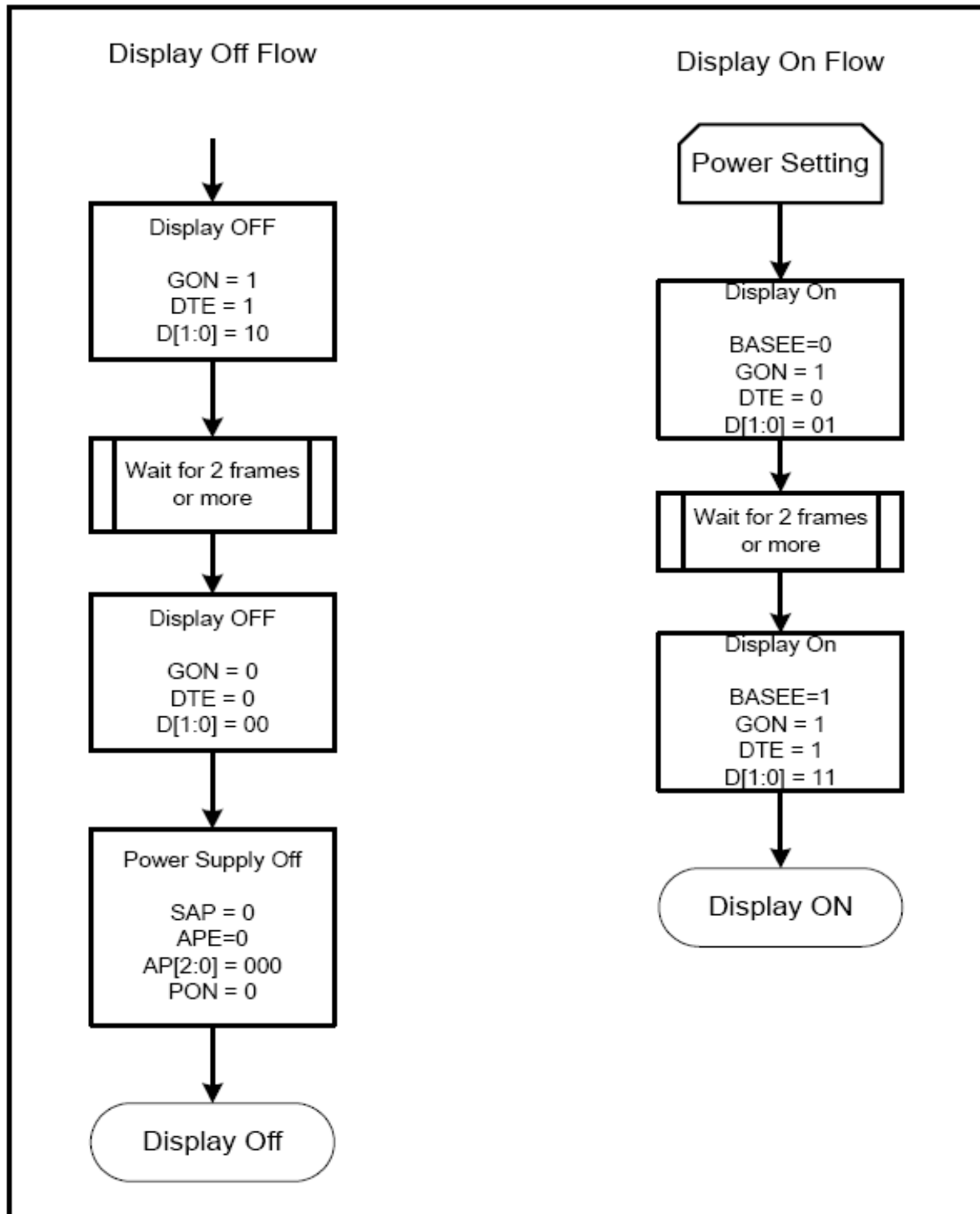
| No. | Registers                         | R/W | RS | D15 | D14 | D13 | D12     | D11     | D10     | D9      | D8      | D7      | D6      | D5      | D4      | D3      | D2      | D1      | D0      |
|-----|-----------------------------------|-----|----|-----|-----|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 38h | Gamma Control 7                   | W   | 1  | 0   | 0   | 0   | 0       | 0       | KN3[2]  | KN3[1]  | KN3[0]  | 0       | 0       | 0       | 0       | 0       | KN2[2]  | KN2[1]  | KN2[0]  |
| 39h | Gamma Control 8                   | W   | 1  | 0   | 0   | 0   | 0       | 0       | KN5[2]  | KN5[1]  | KN5[0]  | 0       | 0       | 0       | 0       | 0       | KN4[2]  | KN4[1]  | KN4[0]  |
| 3Ch | Gamma Control 9                   | W   | 1  | 0   | 0   | 0   | 0       | 0       | RN1[2]  | RN1[1]  | RN1[0]  | 0       | 0       | 0       | 0       | 0       | RN0[2]  | RN0[1]  | RN0[0]  |
| 3Dh | Gamma Control 10                  | W   | 1  | 0   | 0   | 0   | VRN1[4] | VRN1[3] | VRN1[2] | VRN1[1] | VRN1[0] | 0       | 0       | 0       | VRN0[4] | VRN0[3] | VRN0[2] | VRN0[1] | VRN0[0] |
| 50h | Horizontal Address Start Position | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | 0       | 0       | HSA7    | HSA6    | HSA5    | HSA4    | HSA3    | HSA2    | HSA1    | HSA0    |
| 51h | Horizontal Address End Position   | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | 0       | 0       | HEA7    | HEA6    | HEA5    | HEA4    | HEA3    | HEA2    | HEA1    | HEA0    |
| 52h | Vertical Address Start Position   | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | 0       | VSA8    | VSA7    | VSA6    | VSA5    | VSA4    | VSA3    | VSA2    | VSA1    | VSA0    |
| 53h | Vertical Address End Position     | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | 0       | VEA8    | VEA7    | VEA6    | VEA5    | VEA4    | VEA3    | VEA2    | VEA1    | VEA0    |
| 60h | Driver Output Control 2           | W   | 1  | GS  | 0   | NL5 | NL4     | NL3     | NL2     | NL1     | NL0     | 0       | 0       | SCN5    | SCN4    | SCN3    | SCN2    | SCN1    | SCN0    |
| 61h | Base Image Display Control        | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | NDL     | VLE     | REV     |
| 6Ah | Vertical Scroll Control           | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | 0       | VL8     | VL7     | VL6     | VL5     | VL4     | VL3     | VL2     | VL1     | VL0     |
| 80h | Partial Image 1 Display Position  | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | 0       | PTD P08 | PTD P07 | PTD P06 | PTD P05 | PTD P04 | PTD P03 | PTD P02 | PTD P01 | PTD P00 |
| 81h | Partial Image 1 Area (Start Line) | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | 0       | PTSA 08 | PTSA 07 | PTSA 06 | PTSA 05 | PTSA 04 | PTSA 03 | PTSA 02 | PTSA 01 | PTSA 00 |
| 82h | Partial Image 1 Area (End Line)   | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | 0       | PTEA 08 | PTEA 07 | PTEA 06 | PTEA 05 | PTEA 04 | PTEA 03 | PTEA 02 | PTEA 01 | PTEA 00 |
| 83h | Partial Image 2 Display Position  | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | 0       | PTD P18 | PTD P17 | PTD P16 | PTD P15 | PTD P14 | PTD P13 | PTD P12 | PTD P11 | PTD P10 |
| 84h | Partial Image 2 Area (Start Line) | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | 0       | PTSA 18 | PTSA 17 | PTSA 16 | PTSA 15 | PTSA 14 | PTSA 13 | PTSA 12 | PTSA 11 | PTSA 10 |
| 85h | Partial Image 2 Area (End Line)   | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | 0       | PTEA 18 | PTEA 17 | PTEA 16 | PTEA 15 | PTEA 14 | PTEA 13 | PTEA 12 | PTEA 11 | PTEA 10 |
| 90h | Panel Interface Control 1         | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | DIV1    | DIV10   | 0       | 0       | 0       | 0       | RTNI 3  | RTNI 2  | RTNI 1  | RTNI 0  |
| 92h | Panel Interface Control 2         | W   | 1  | 0   | 0   | 0   | 0       | 0       | NOW 12  | NOW 11  | NOW 10  | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       |
| 93h | Panel Interface Control 3         | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | MCPI 2  | MCPI 1  | MCPI 0  |
| 95h | Panel Interface Control 4         | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | DIVE 1  | DIVE 0  | 0       | 0       | RTN E5  | RTN E4  | RTN E3  | RTN E2  | RTN E1  | RTN E0  |
| 97h | Panel Interface Control 5         | W   | 1  | 0   | 0   | 0   | 0       | NOW E3  | NOW E2  | NOW E1  | NOW E0  | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       |
| 98h | Panel Interface Control 6         | W   | 1  | 0   | 0   | 0   | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | MCP E2  | MCP E1  |         |

## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

# 10. Application

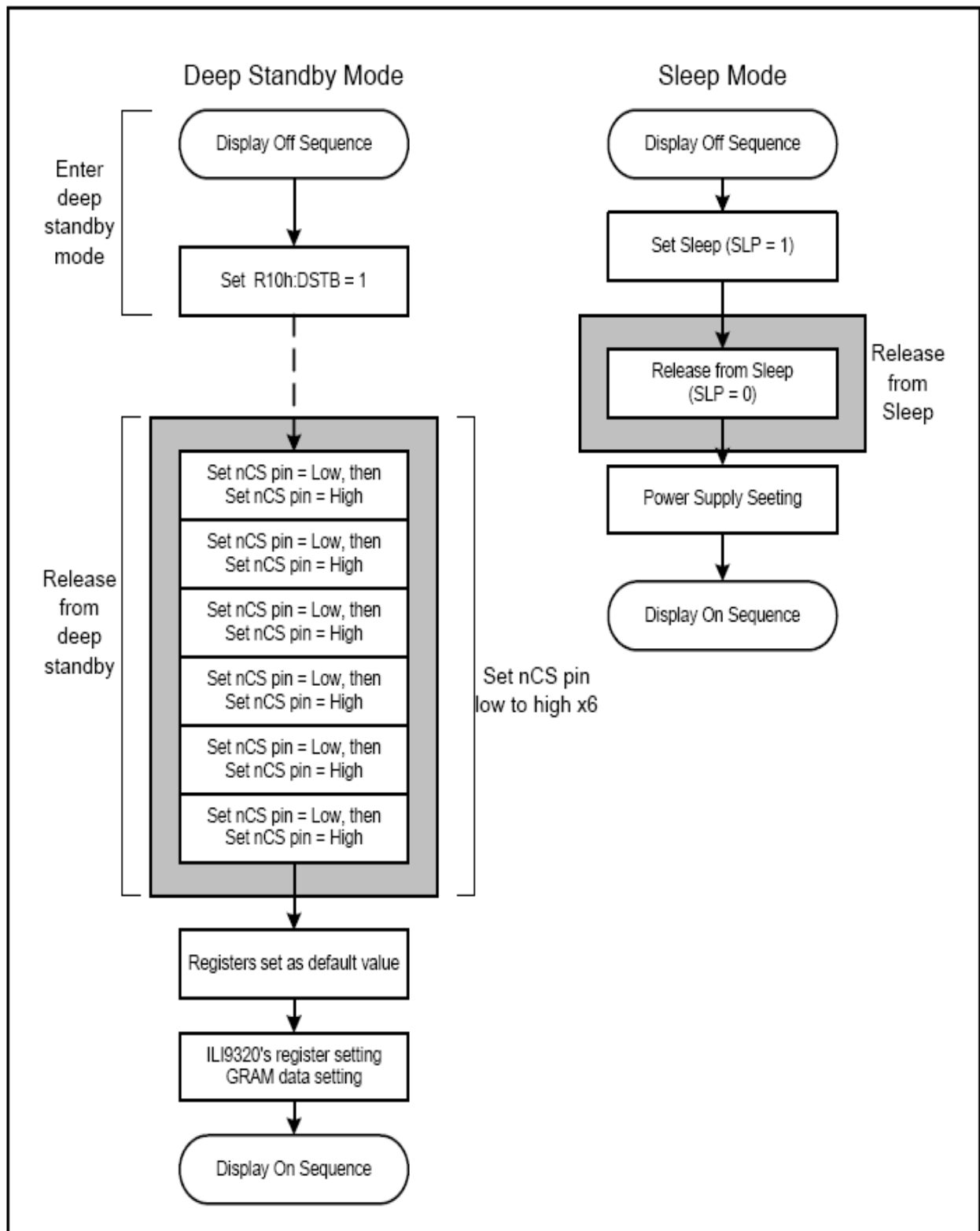
## 10.1 Display ON / OFF



## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

## 10.2 Deep Standby and Sleep Mode



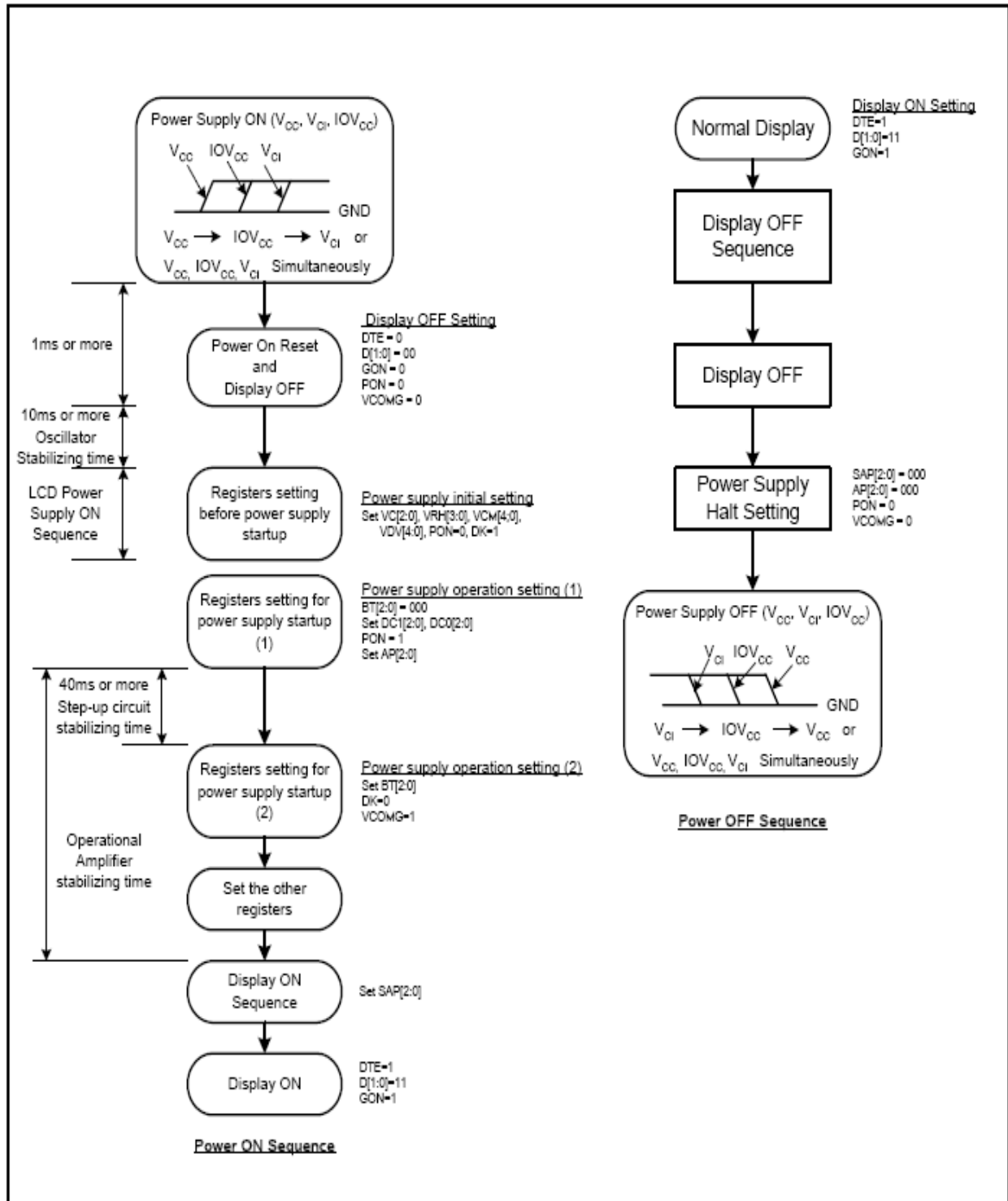


## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

## 10.3 Power Supply Configuration

When supplying and cutting off power, follow the sequence below. The setting time for oscillators, step-up circuits and operational amplifiers depends on external resistance and capacitance.



## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

# 11. Timing Characteristics

## 11.1 Clock Characteristics

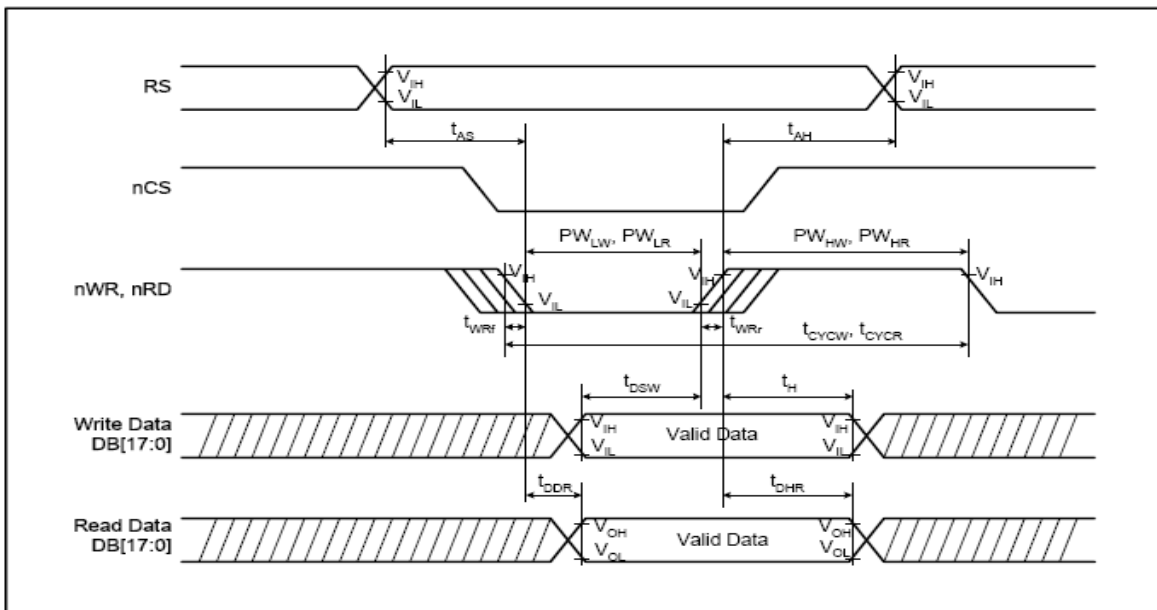
VCC = 2.40 ~ 3.30V, IOVCC = 1.65 ~ 3.30V

| Item                        | Symbol            | Test Condition         | Min. | Typ. | Max. | Unit |
|-----------------------------|-------------------|------------------------|------|------|------|------|
| External Clock Frequency    | f <sub>cp</sub>   | VCC = 2.4 ~ 3.3V       | 450  | 550  | 650  | KHz  |
| External Clock Duty         | f <sub>duty</sub> | VCC = 2.4 ~ 3.3V       | 45   | 50   | 55   |      |
| External Clock Rising Time  | Trcp              | VCC = 2.4 ~ 3.3V       | -    | -    | 0.2  | μs   |
| External Clock Falling Time | Tfcp              | VCC = 2.4 ~ 3.3V       | -    | -    | 0.2  | μs   |
| RC oscillation clock        | f <sub>osc</sub>  | Rf = 100KΩ, VCC = 2.8V | 450  | 550  | 650  | KHz  |

## 11.2 AC Characteristics ( i80 – system Interface Timing Characteristics )

Normal Write Mode (IOVCC = 1.65~3.3V, VCC=2.4~3.3V)

| Item                          | Symbol                             | Unit              | Min. | Typ. | Max. | Test Condition |
|-------------------------------|------------------------------------|-------------------|------|------|------|----------------|
| Bus cycle time                | Write                              | t <sub>CYCW</sub> | ns   | 100  | -    | -              |
|                               | Read                               | t <sub>CYCR</sub> | ns   | 300  | -    | -              |
| Write low-level pulse width   | PW <sub>LW</sub>                   | ns                | 50   | -    | 500  | -              |
| Write high-level pulse width  | PW <sub>HW</sub>                   | ns                | 50   | -    | -    | -              |
| Read low-level pulse width    | PW <sub>LR</sub>                   | ns                | 150  | -    | -    | -              |
| Read high-level pulse width   | PW <sub>HR</sub>                   | ns                | 150  | -    | -    | -              |
| Write / Read rise / fall time | t <sub>WRP</sub> /t <sub>WRF</sub> | ns                | -    | -    | 25   | -              |
| Setup time                    | Write ( RS to nCS, E/nWR )         | t <sub>AS</sub>   | ns   | 10   | -    | -              |
|                               | Read ( RS to nCS, RW/nRD )         |                   | ns   | 5    | -    | -              |
| Address hold time             | t <sub>AH</sub>                    | ns                | 5    | -    | -    | -              |
| Write data set up time        | t <sub>DSW</sub>                   | ns                | 10   | -    | -    | -              |
| Write data hold time          | t <sub>H</sub>                     | ns                | 15   | -    | -    | -              |
| Read data delay time          | t <sub>DDR</sub>                   | ns                | -    | -    | 100  | -              |
| Read data hold time           | t <sub>DHR</sub>                   | ns                | 5    | -    | -    | -              |



## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

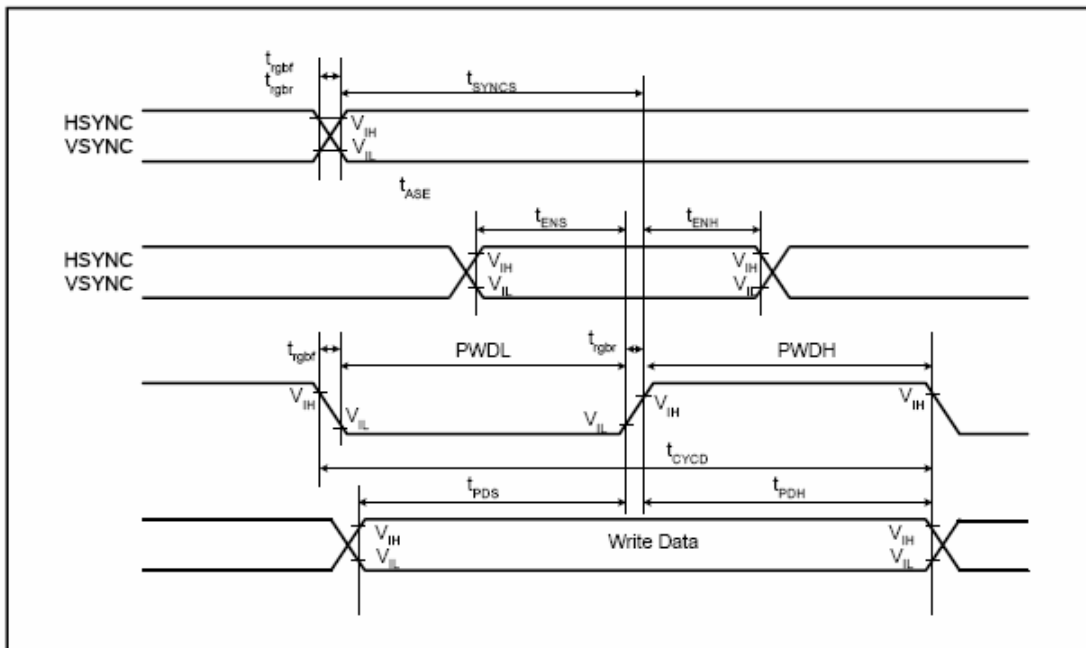
## 11.3 AC Characteristics ( RGB Interface Timing Characteristics )

18/16-bit Bus RGB Interface Mode (IOVCC = 1.65 ~ 3.3V, VCC=2.4~3.3V)

| Item                                 | Symbol               | Unit | Min. | Typ. | Max. | Test Condition |
|--------------------------------------|----------------------|------|------|------|------|----------------|
| VSYNC/HSYNC setup time               | $t_{SYNCS}$          | ns   | 0    | -    | -    | -              |
| ENABLE setup time                    | $t_{ENS}$            | ns   | 10   | -    | -    | -              |
| ENABLE hold time                     | $t_{ENH}$            | ns   | 10   | -    | -    | -              |
| PD Data setup time                   | $t_{PDS}$            | ns   | 10   | -    | -    | -              |
| PD Data hold time                    | $t_{PDH}$            | ns   | 40   | -    | -    | -              |
| DOTCLK high-level pulse width        | PWDH                 | ns   | 40   | -    | -    | -              |
| DOTCLK low-level pulse width         | PWDL                 | ns   | 40   | -    | -    | -              |
| DOTCLK cycle time                    | $t_{CYCD}$           | ns   | 100  | -    | -    | -              |
| DOTCLK, VSYNC, HSYNC, rise/fall time | $t_{rghr}, t_{grhf}$ | ns   | -    | -    | 25   | -              |

6-bit Bus RGB Interface Mode (IOVCC = 1.65 ~ 3.3V, VCC=2.4~3.3V)

| Item                                 | Symbol               | Unit | Min. | Typ. | Max. | Test Condition |
|--------------------------------------|----------------------|------|------|------|------|----------------|
| VSYNC/HSYNC setup time               | $t_{SYNCS}$          | ns   | 0    | -    | -    | -              |
| ENABLE setup time                    | $t_{ENS}$            | ns   | 10   | -    | -    | -              |
| ENABLE hold time                     | $t_{ENH}$            | ns   | 10   | -    | -    | -              |
| PD Data setup time                   | $t_{PDS}$            | ns   | 10   | -    | -    | -              |
| PD Data hold time                    | $t_{PDH}$            | ns   | 30   | -    | -    | -              |
| DOTCLK high-level pulse width        | PWDH                 | ns   | 30   | -    | -    | -              |
| DOTCLK low-level pulse width         | PWDL                 | ns   | 30   | -    | -    | -              |
| DOTCLK cycle time                    | $t_{CYCD}$           | ns   | 80   | -    | -    | -              |
| DOTCLK, VSYNC, HSYNC, rise/fall time | $t_{rghr}, t_{grhf}$ | ns   | -    | -    | 25   | -              |



## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

---

# 12 QUALITY AND RELIABILITY

## 12.1 TEST CONDITIONS

Tests should be conducted under the following conditions :

Ambient temperature :  $25 \pm 5^{\circ}\text{C}$

Humidity :  $60 \pm 25\% \text{ RH}$ .

## 12.2 SAMPLING PLAN

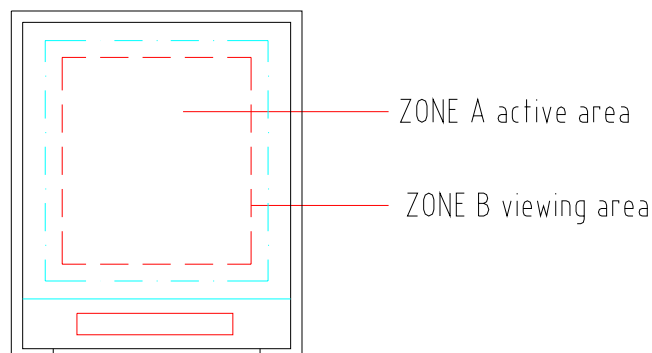
Sampling method shall be in accordance with MIL-STD-105E , level II, normal single sampling plan .

## 12.3 ACCEPTABLE QUALITY LEVEL

A major defect is defined as one that could cause failure to or materially reduce the usability of the unit for its intended purpose. A minor defect is one that does not materially reduce the usability of the unit for its intended purpose or is an infringement from established standards and has no significant bearing on its effective use or operation.

## 12.4 APPEARANCE

An appearance test should be conducted by human sight at approximately 30 cm distance from the LCD module under fluorescent light. The inspection area of LCD panel shall be within the range of following limits.



**Preliminary**

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

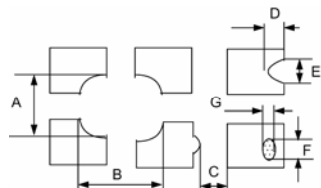
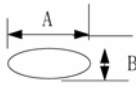
---

**12.5 INSPECTION QUALITY CRITERIA**

| No.                  | Item                   | Criterion for defects  | Defect type |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
|----------------------|------------------------|--|-------------|-------------------|-------------------|----------|----------------------|---|----------------------|----------------------|------------|--------------------|----------------------|---|--------------|----------------------|---|-------|
| 1                    | Non display            | No non display is allowed  | Major       |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| 2                    | Irregular operation    | No irregular operation is allowed  | Major       |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| 3                    | Short                  | No short are allowed   | Major       |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| 4                    | Open                   | Any segments or common patterns that don't activate are rejectable.  | Major       |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| 5                    | Black/White spot (I)   | <table><tr><th>Size D (mm)</th><th>Acceptable number</th></tr><tr><td><math>D \leq 0.15</math></td><td>Ignore</td></tr><tr><td><math>0.15 &lt; D \leq 0.20</math></td><td>3</td></tr><tr><td><math>0.20 &lt; D \leq 0.30</math></td><td>2</td></tr><tr><td><math>0.30 &lt; D</math></td><td>0</td></tr></table>  | Size D (mm) | Acceptable number | $D \leq 0.15$     | Ignore   | $0.15 < D \leq 0.20$ | 3 | $0.20 < D \leq 0.30$ | 2                    | $0.30 < D$ | 0                  | Minor                |   |              |                      |   |       |
| Size D (mm)          | Acceptable number      |  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $D \leq 0.15$        | Ignore                 |  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $0.15 < D \leq 0.20$ | 3                      |  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $0.20 < D \leq 0.30$ | 2                      |  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $0.30 < D$           | 0                      |  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| 6                    | Black/White line (I)   | <table><tr><th>Length(mm)</th><th>Width (mm)</th><th>Acceptable number</th></tr><tr><td><math>10 &lt; L</math></td><td><math>0.03 &lt; W \leq 0.04</math></td><td>5</td></tr><tr><td><math>5.0 &lt; L \leq 10</math></td><td><math>0.04 &lt; W \leq 0.06</math></td><td>3</td></tr><tr><td><math>1.0 &lt; L \leq 5.0</math></td><td><math>0.06 &lt; W \leq 0.07</math></td><td>2</td></tr><tr><td><math>L \leq 1.0</math></td><td><math>0.07 &lt; W \leq 0.09</math></td><td>1</td></tr></table> | Length(mm)  | Width (mm)        | Acceptable number | $10 < L$ | $0.03 < W \leq 0.04$ | 5 | $5.0 < L \leq 10$    | $0.04 < W \leq 0.06$ | 3          | $1.0 < L \leq 5.0$ | $0.06 < W \leq 0.07$ | 2 | $L \leq 1.0$ | $0.07 < W \leq 0.09$ | 1 | Minor |
| Length(mm)           | Width (mm)             | Acceptable number  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $10 < L$             | $0.03 < W \leq 0.04$   | 5  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $5.0 < L \leq 10$    | $0.04 < W \leq 0.06$   | 3  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $1.0 < L \leq 5.0$   | $0.06 < W \leq 0.07$   | 2  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $L \leq 1.0$         | $0.07 < W \leq 0.09$   | 1  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| 7                    | Black/White sport (II) | <table><tr><th>Size D (mm)</th><th>Acceptable number</th></tr><tr><td><math>D \leq 0.30</math></td><td>Ignore</td></tr><tr><td><math>0.30 &lt; D \leq 0.50</math></td><td>5</td></tr><tr><td><math>0.50 &lt; D \leq 1.20</math></td><td>3</td></tr><tr><td><math>1.20 &lt; D</math></td><td>0</td></tr></table>  | Size D (mm) | Acceptable number | $D \leq 0.30$     | Ignore   | $0.30 < D \leq 0.50$ | 5 | $0.50 < D \leq 1.20$ | 3                    | $1.20 < D$ | 0                  | Minor                |   |              |                      |   |       |
| Size D (mm)          | Acceptable number      |  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $D \leq 0.30$        | Ignore                 |  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $0.30 < D \leq 0.50$ | 5                      |  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $0.50 < D \leq 1.20$ | 3                      |  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $1.20 < D$           | 0                      |  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| 8                    | Black/White line (II)  | <table><tr><th>Length (mm)</th><th>Width (mm)</th><th>Acceptable number</th></tr><tr><td><math>20 &lt; L</math></td><td><math>0.05 &lt; W \leq 0.07</math></td><td>5</td></tr><tr><td><math>10 &lt; L \leq 20</math></td><td><math>0.07 &lt; W \leq 0.09</math></td><td>3</td></tr><tr><td><math>5.0 &lt; L \leq 10</math></td><td><math>0.09 &lt; W \leq 0.10</math></td><td>2</td></tr><tr><td><math>L \leq 5.0</math></td><td><math>0.10 &lt; W \leq 0.15</math></td><td>1</td></tr></table>  | Length (mm) | Width (mm)        | Acceptable number | $20 < L$ | $0.05 < W \leq 0.07$ | 5 | $10 < L \leq 20$     | $0.07 < W \leq 0.09$ | 3          | $5.0 < L \leq 10$  | $0.09 < W \leq 0.10$ | 2 | $L \leq 5.0$ | $0.10 < W \leq 0.15$ | 1 | Minor |
| Length (mm)          | Width (mm)             | Acceptable number  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $20 < L$             | $0.05 < W \leq 0.07$   | 5  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $10 < L \leq 20$     | $0.07 < W \leq 0.09$   | 3  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $5.0 < L \leq 10$    | $0.09 < W \leq 0.10$   | 2  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| $L \leq 5.0$         | $0.10 < W \leq 0.15$   | 1  |             |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |
| 9                    | Back Light             | 1. No Lighting is rejectable<br>2. Flickering and abnormal lighting are rejectable   | Major       |                   |                   |          |                      |   |                      |                      |            |                    |                      |   |              |                      |   |       |

## Preliminary

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

| 10                        | Display pattern   | <div></div> <div><table><tr><td><math>\frac{A+B}{2} \leq 0.30</math></td><td><math>0 &lt; C</math></td><td><math>\frac{D+E}{2} \leq 0.25</math></td><td><math>\frac{F+G}{2} \leq 0.25</math></td></tr></table></div> <div>Note: 1. Acceptable up to 3 damages<br/>2. NG if there're two or more pinholes per dot</div>   | $\frac{A+B}{2} \leq 0.30$ | $0 < C$           | $\frac{D+E}{2} \leq 0.25$ | $\frac{F+G}{2} \leq 0.25$ | Minor                |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
|---------------------------|---|---|---------------------------|-------------------|---------------------------|---------------------------|----------------------|--------|----------------------|--------------|------------|---|-----------|---|----------------------|-----------|---|--|--------------|--------|------------|----------|---------|-------|
| $\frac{A+B}{2} \leq 0.30$ | $0 < C$   | $\frac{D+E}{2} \leq 0.25$   | $\frac{F+G}{2} \leq 0.25$ |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| 11                        | Blemish & Foreign matters<br><br>Size:<br>$D = \frac{A+B}{2}$   | <table><tr><th>Size D (mm)</th><th>Acceptable number</th></tr><tr><td><math>D \leq 0.15</math></td><td>Ignore</td></tr><tr><td><math>0.15 &lt; D \leq 0.20</math></td><td>3</td></tr><tr><td><math>0.20 &lt; D \leq 0.30</math></td><td>2</td></tr><tr><td><math>0.30 &lt; D</math></td><td>0</td></tr></table>   | Size D (mm)               | Acceptable number | $D \leq 0.15$             | Ignore                    | $0.15 < D \leq 0.20$ | 3      | $0.20 < D \leq 0.30$ | 2            | $0.30 < D$ | 0 | Minor     |   |                      |           |   |  |              |        |            |          |         |       |
| Size D (mm)               | Acceptable number   |   |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| $D \leq 0.15$             | Ignore  |   |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| $0.15 < D \leq 0.20$      | 3   |   |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| $0.20 < D \leq 0.30$      | 2   |   |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| $0.30 < D$                | 0   |   |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| 12                        | Scratch on Polarizer<br><br> | <table><tr><th>Width (mm)</th><th>Length (mm)</th><th>Acceptable number</th></tr><tr><td><math>W \leq 0.03</math></td><td>Ignore</td><td>Ignore</td></tr><tr><td><math>0.03 &lt; W \leq 0.05</math></td><td><math>L \leq 2.0</math></td><td>Ignore</td></tr><tr><td></td><td><math>L &gt; 2.0</math></td><td>1</td></tr><tr><td><math>0.05 &lt; W \leq 0.08</math></td><td><math>L &gt; 1.0</math></td><td>1</td></tr><tr><td></td><td><math>L \leq 1.0</math></td><td>Ignore</td></tr><tr><td><math>0.08 &lt; W</math></td><td>Note (1)</td><td>Note(1)</td></tr></table> <div>Note(1) Regard as a blemish</div> | Width (mm)                | Length (mm)       | Acceptable number         | $W \leq 0.03$             | Ignore               | Ignore | $0.03 < W \leq 0.05$ | $L \leq 2.0$ | Ignore     |   | $L > 2.0$ | 1 | $0.05 < W \leq 0.08$ | $L > 1.0$ | 1 |  | $L \leq 1.0$ | Ignore | $0.08 < W$ | Note (1) | Note(1) | Minor |
| Width (mm)                | Length (mm)   | Acceptable number   |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| $W \leq 0.03$             | Ignore  | Ignore  |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| $0.03 < W \leq 0.05$      | $L \leq 2.0$  | Ignore  |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
|                           | $L > 2.0$   | 1   |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| $0.05 < W \leq 0.08$      | $L > 1.0$   | 1   |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
|                           | $L \leq 1.0$  | Ignore  |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| $0.08 < W$                | Note (1)  | Note(1)   |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| 13                        | Bubble in polarizer   | <table><tr><th>Size D (mm)</th><th>Acceptable number</th></tr><tr><td><math>D \leq 0.20</math></td><td>Ignore</td></tr><tr><td><math>0.20 &lt; D \leq 0.50</math></td><td>3</td></tr><tr><td><math>0.50 &lt; D \leq 0.80</math></td><td>2</td></tr><tr><td><math>0.80 &lt; D</math></td><td>0</td></tr></table>   | Size D (mm)               | Acceptable number | $D \leq 0.20$             | Ignore                    | $0.20 < D \leq 0.50$ | 3      | $0.50 < D \leq 0.80$ | 2            | $0.80 < D$ | 0 | Minor     |   |                      |           |   |  |              |        |            |          |         |       |
| Size D (mm)               | Acceptable number   |   |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| $D \leq 0.20$             | Ignore  |   |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| $0.20 < D \leq 0.50$      | 3   |   |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| $0.50 < D \leq 0.80$      | 2   |   |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| $0.80 < D$                | 0   |   |                           |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| 14                        | Stains on LCD panel surface   | Stains that cannot be removed even when wiped lightly with a soft cloth or similar cleaning too are rejectable.   | Minor                     |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| 15                        | Rust in Bezel   | Rust which is visible in the bezel is rejectable.   | Minor                     |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| 16                        | Defect of land surface contact (poor soldering)   | Evident crevices which is visible are rejectable.   | Minor                     |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |
| 17                        | Parts mounting  | 1. Failure to mount parts<br>2. Parts not in the specifications are mounted<br>3. Polarity, for example, is reversed  | Major<br>Major<br>Major   |                   |                           |                           |                      |        |                      |              |            |   |           |   |                      |           |   |  |              |        |            |          |         |       |

**Preliminary**

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

---

|    |   |   |                         |
|----|---|---|-------------------------|
| 18 | Parts alignment                                       | 1. LSI, IC lead width is more than 50% beyond pad outline.<br>2. Chip component is off center and more than 50% of the leads is off the pad outline.  | Minor<br>Minor          |
| 19 | Conductive foreign matter (Solder ball, Solder chips) | 1. $0.45 < \varphi$ , $N \geq 1$<br>2. $0.30 < \varphi \leq 0.45$ , $N \geq 1$<br>$\varphi$ : Average diameter of solder ball (unit: mm)<br>3. $0.50 < L$ , $N \geq 1$<br>$L$ : Average length of solder chip (unit: mm)  | Major<br>Minor<br>Minor |
| 20 | Faulty PCB correction                                 | 1. Due to PCB copper foil pattern burnout, the pattern is connected, using a jumper wire for repair; 2 or more places are corrected per PCB.<br>2. Short circuited part is cut, and no resist coating has been performed. | Minor<br>Minor          |

**Preliminary**

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

---

**12.6 RELIABILITY**

| Test Item                  | Test Conditions   | Note |
|----------------------------|---|------|
| High Temperature Operation | 70±3°C , t=96 hrs   |      |
| Low Temperature Operation  | -20±3°C , t=96 hrs  |      |
| High Temperature Storage   | 80±3°C , t=96 hrs   | 1,2  |
| Low Temperature Storage    | -30±3°C , t=96 hrs  | 1,2  |
| Humidity Test              | 40°C , Humidity 90%, 96 hrs   | 1,2  |
| Thermal Shock Test         | -30°C ~ 25°C ~ 70°C<br>30 min. 5 min. 30 min. ( 1 cycle )<br>Total 5 cycle  | 1,2  |
| Vibration Test (Packing)   | Sweep frequency : 10~55~10 Hz/1min<br>Amplitude : 0.75mm<br>Test direction : X.Y.Z/3 axis<br>Duration : 30min/each axis | 2    |
| Static Electricity         | 150pF 330 ohm ±8kV, 10times air discharge   |      |

Note 1 : Condensation of water is not permitted on the module.

Note 2 : The module should be inspected after 1 hour storage in normal conditions

(15-35°C , 45-65%RH).

Definitions of life end point :

- Current drain should be smaller than the specific value.
- Function of the module should be maintained.
- Appearance and display quality should not have degraded noticeably.
- Contrast ratio should be greater than 50% of the initial value.



**Preliminary**

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

---

## **13 USE PRECAUTIONS**

### **13.1 Handling precautions**

- 1) The polarizing plate may break easily so be careful when handling it. Do not touch, press or rub it with a hard-material tool like tweezers.
- 2) Do not touch the polarizing plate surface with bare hands so as not to make it dirty. If the surface or other related part of the polarizing plate is dirty, soak a soft cotton cloth or chamois leather in benzine and wipe off with it. Do not use chemical liquids such as acetone, toluene and isopropyl alcohol. Failure to do so may bring chemical reaction phenomena and deteriorations.
- 3) Remove any spit or water immediately. If it is left for hours, the suffered part may deform or decolorize.
- 4) If the LCD element breaks and any LC stuff leaks, do not suck or lick it. Also if LC stuff is stuck on your skin or clothing, wash thoroughly with soap and water immediately.

### **13.2 Installing precautions**

- 1) To prevent breaking by static electricity from the human body and clothing, earth the human body properly using the high resistance and discharge static electricity during the operation. In this case, however, the resistance value should be approx.  $1M\Omega$  and the resistance should be placed near the human body rather than the ground surface. When the indoor space is dry, static electricity may occur easily so be careful. We recommend the indoor space should be kept with humidity of 60% or more. When a soldering iron or other similar tool is used for assembly, be sure to earth it.
- 2) When installing the module and ICs, do not bend or twist them. Failure to do so may crack LC element and cause circuit failure.
- 3) To protect LC element, especially polarizing plate, use a transparent protective plate (e.g., acrylic plate, glass etc) for the product case.
- 4) Do not use an adhesive like a both-side adhesive tape to make LCD surface (polarizing plate) and product case stick together. Failure to do so may cause the polarizing plate to peel off.

## **Preliminary**

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

---

### **13.3 Storage precautions**

- 1) Avoid a high temperature and humidity area. Keep the temperature between 0°C and 35°C and also the humidity under 60%.
- 2) Choose the dark spaces where the product is not exposed to direct sunlight or fluorescent light.
- 3) Store the products as they are put in the boxes provided from us or in the same conditions as we recommend.

### **13.4 Operating precautions**

- 1) Do not boost the applied drive voltage abnormally. Failure to do so may break ICs. When applying power voltage, check the electrical features beforehand and be careful. Always turn off the power to the LC module controller before removing or inserting the LC module input connector. If the input connector is removed or inserted while the power is turned on, the LC module internal circuit may break.
- 2) The display response may be late if the operating temperature is under the normal standard, and the display may be out of order if it is above the normal standard. But this is not a failure; this will be restored if it is within the normal standard.
- 3) The LCD contrast varies depending on the visual angle, ambient temperature, power voltage etc. Obtain the optimum contrast by adjusting the LC drive voltage.
- 4) When carrying out the test, do not take the module out of the low-temperature space suddenly. Failure to do so will cause the module condensing, leading to malfunctions.
- 5) Make certain that each signal noise level is within the standard (L level: 0.2Vdd or less and H level: 0.8Vdd or more) even if the module has functioned properly. If it is beyond the standard, the module may often malfunction. In addition, always connect the module when making noise level measurements.
- 6) The CMOS ICs are incorporated in the module and the pull-up and pull-down function is not adopted for the input so avoid putting the input signal open while the power is ON.
- 7) The characteristic of the semiconductor element changes when it is exposed to

**Preliminary**

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

---

light emissions, therefore ICs on the LCD may malfunction if they receive light emissions. To prevent these malfunctions, design and assemble ICs so that they are shielded from light emissions.

- 8) Crosstalk occurs because of characteristics of the LCD. In general, crosstalk occurs when the regularized display is maintained. Also, crosstalk is affected by the LC drive voltage. Design the contents of the display, considering crosstalk.

**13.5 Other**

- 1) Do not disassemble or take the LC module into pieces. The LC modules once disassembled or taken into pieces are not the guarantee articles.
- 2) The residual image may exist if the same display pattern is shown for hours. This residual image, however, disappears when another display pattern is shown or the drive is interrupted and left for a while. But this is not a problem on reliability.
- 3) AMIPRE will provide one year warrantee for all products and three months warrantee for all repairing products.

The contents of this document are confidential and must not be disclosed wholly or in part to any third part without the prior written consent of AMPIRE CO., LTD

## 14 OUTLINE DIMENSION

[illegible]