

# PRODUCT SPECIFICATION

TFT LCD MODULE

MODEL : EGO 028 Q02-F05

【    】 Preliminary Specification

【 ♦ 】 Finally Specification

|                     |          |
|---------------------|----------|
| CUSTOMER'S APPROVAL |          |
| SIGNATURE:          | DATE:    |
| <br><br>            | <br><br> |

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## Document Revision History

[illegible]

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## 1. LCM Specification

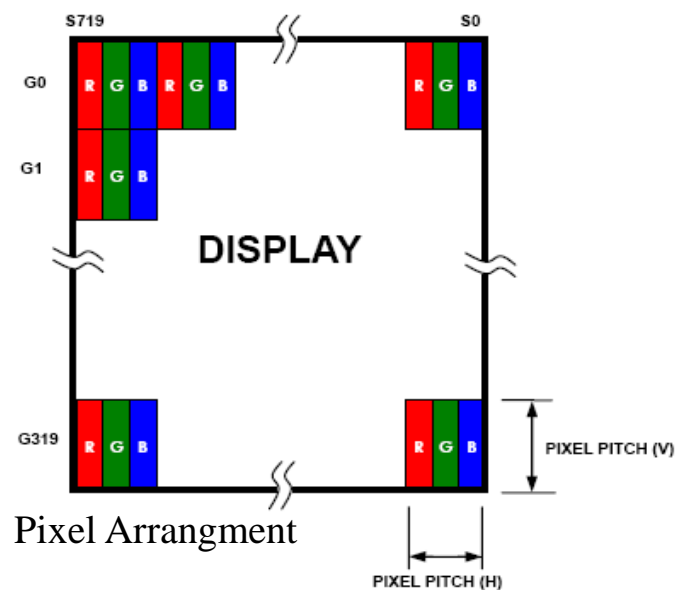
### 1.1 Description

EGO028Q02-F05 is a transmissive type color active matrix liquid crystal display (LCD) which uses amorphous thin film transistor (TFT) as switching devices. This product is composed of a TFT LCD panel, a drive IC, a FPC, and a WLED-backlight unit. The active display area is 2.8 inches diagonally measured and the native resolution is 240\*RGB\*320. Features of this product are listed in the following table.

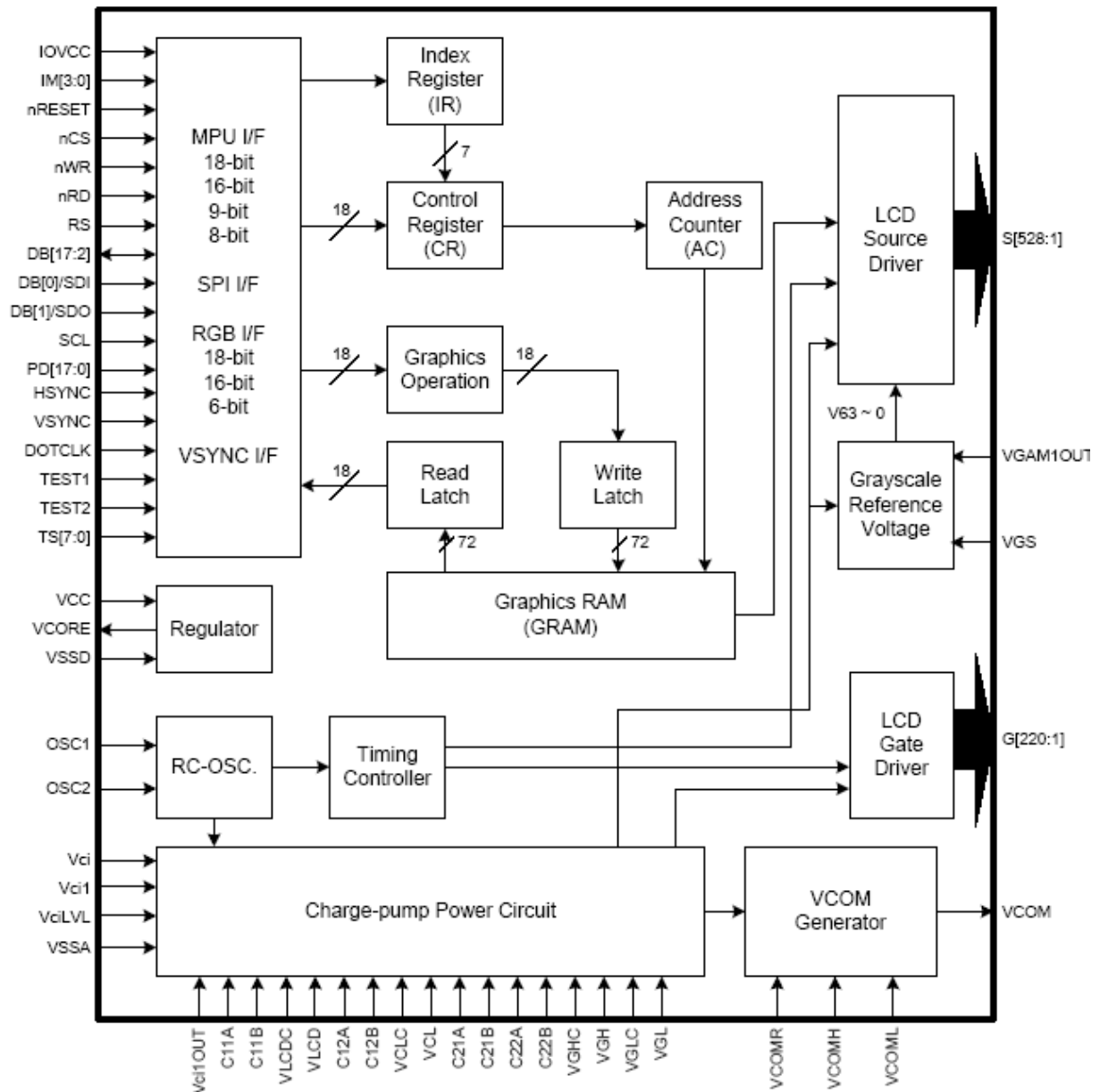
### 1.2 Functions & Features

**Table1.1 Module Functions & Features**

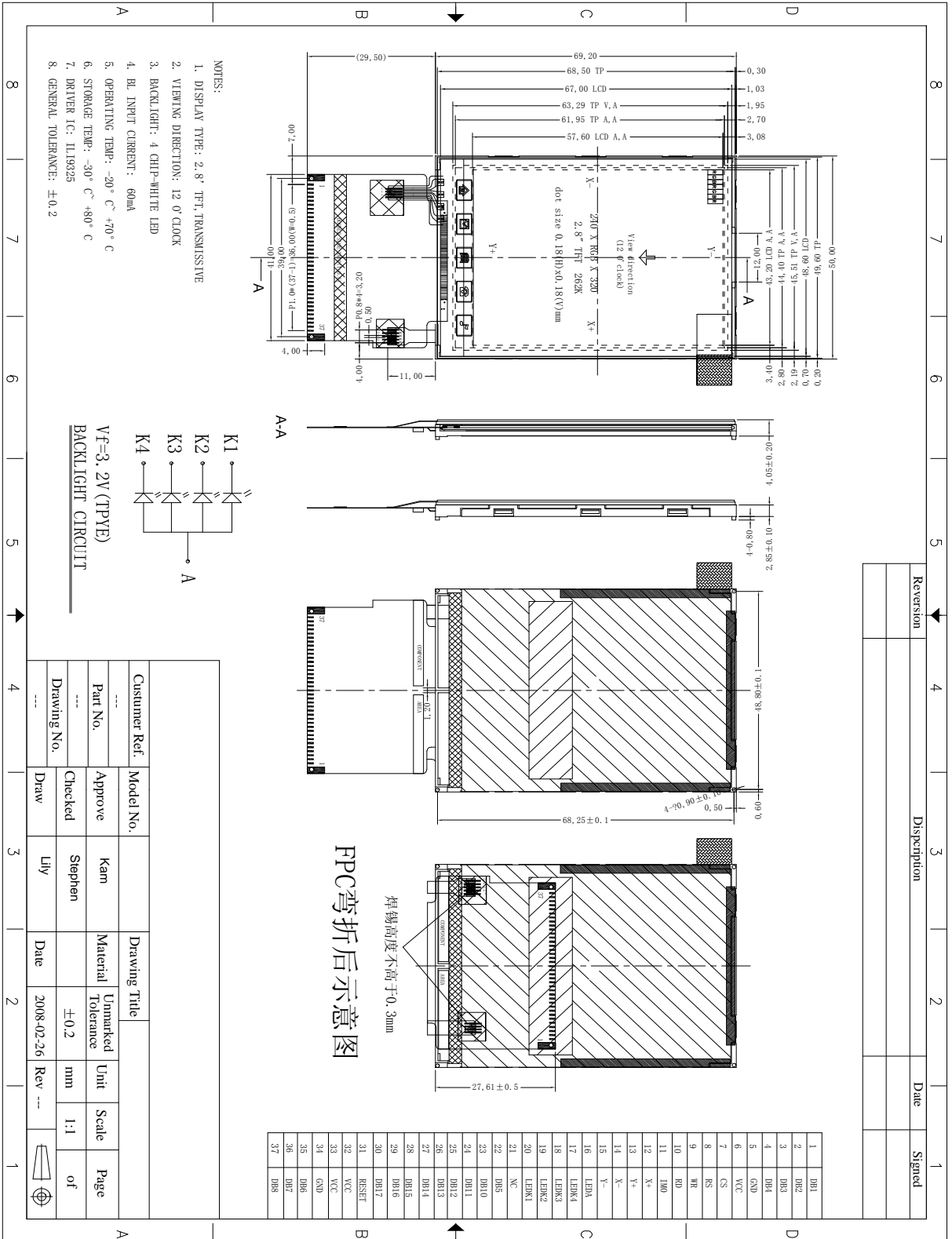
| Parameter             | Value                                    | Unit   |
|-----------------------|--|--------|
| LCD Mode              | a-Si TFT/transmissive                    | -      |
| Color                 | 262K                                     | -      |
| Display Resolution    | 240*RGB*320                              | pixels |
| OUTLINE DIMENSIONS    | 50.00(W) x69.20(H) x4.05(T)              | mm     |
| Active Area(A.A)      | 43.20 (W) x 57.60(H)                     | mm     |
| Pixel Arrangement     | RGB-stripe                               | -      |
| Viewing Direction     | 12 O'clock                               |        |
| Display Mode          | Normally white                           |        |
| LCD Controller/Driver | ILI9325                                  | -      |
| IC Package Type       | COG                                      | -      |
| MPU interface         | Standard 8080 system 18-/16-bit parallel | -      |
| Power Supply Voltage  | 2.5~3.3                                  | V      |
| Back-light            | White LED*4                              | pcs    |



## 2. Functional Block Diagram



### 3. Mechanical Specificatin



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## 4. Electrical Units

### 4.1 Electrical Specification

#### 4.1.1 Absolute Maximum Ratings

The absolute maximum ratings are list on Table 4.1. When used out of the absolute maximum ratings, the LCM may be permanently damaged. Using the LCM within the following electrical characteristics limit is strongly recommended for normal operation. If these electrical characteristic conditions are exceeded during normal operation, the LCM will malfunction and cause poor reliability.

**Table 4.1 Module Absolute Maximun Ratings**

| Item                    | Symbol  | Unit | Value           | Note |
|-------------------------|---------|------|-----------------|------|
| Power supply Voltage(1) | Vcc     | V    | -0.3~4.0        |      |
| Power supply Voltage(2) | Vci~VSS | V    | 2.5~3.3         |      |
| Power supply Voltage(3) | VGH~Vss | V    | 10~20           |      |
| Power supply Voltage(4) | VSS~VGH | V    | 10~20           | -    |
| Inout Voltage           | Vi      | V    | -0.3 to Vcc+0.3 |      |
| Operating Temperature   | Top     | °C   | -20 to +70      |      |
| Storage Temperature     | Tst     | °C   | -30 to +80      |      |

(VSS=0V)

### 4.2 Pin Descriptions

#### 4.2.1 TFT LCD Panle interface FPC Pin Descripton

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| No. | Symbol | Functional                           | Remark |
|-----|--------|--------------------------------------|--------|
| 1   | DB1    | Data bus                             |        |
| 2   | DB2    | Data bus                             |        |
| 3   | DB3    | Data bus                             |        |
| 4   | DB4    | Data bus                             |        |
| 5   | GND    | Ground                               |        |
| 6   | VCC    | Power                                |        |
| 7   | CS     | Chip select pin of serial inter face |        |
| 8   | RS     | Data or command                      |        |
| 9   | WR     | Write signal                         |        |
| 10  | RD     | Read signal                          |        |
| 11  | IMO    | Interface mode select                |        |
| 12  | X+     | Touch panel X+                       |        |
| 13  | Y+     | Touch panel Y+                       |        |
| 14  | X-     | Touch panel X-                       |        |
| 15  | Y-     | Touch panel Y-                       |        |
| 16  | LED-A  | LED A                                |        |
| 17  | LED-K4 | LED K4                               |        |
| 18  | LED-K3 | LED K3                               |        |
| 19  | LED-K2 | LED K2                               |        |
| 20  | LED-K1 | LED K1                               |        |
| 21  | NC     | No connection                        |        |
| 22  | DB5    | Data bus                             |        |
| 23  | DB10   | Data bus                             |        |
| 24  | DB11   | Data bus                             |        |
| 25  | DB12   | Data bus                             |        |
| 26  | DB13   | Data bus                             |        |
| 27  | DB14   | Data bus                             |        |
| 28  | DB15   | Data bus                             |        |
| 29  | DB16   | Data bus                             |        |
| 30  | DB17   | Data bus                             |        |
| 31  | REST   | Reset din                            |        |
| 32  | VCC    | Power                                |        |
| 33  | VCC    | Power                                |        |
| 34  | GND    | Ground                               |        |
| 35  | DB6    | Data bus                             |        |
| 36  | DB7    | Data bus                             |        |
| 37  | DB8    | Data bus                             |        |



### 4.3 Electrical characteristics (Ta=25°C)

#### 4.3.1 DC characteristics

**Table 4.2:DC Characteristic(Vcc=2.4~3.3V,Ta=0~60°C)**

| Item  | Symbol   | Unit | Test Conditon  | Min           | Typ.     | Max               | Note |
|---|----------|------|--|---------------|----------|-------------------|------|
| Input hight voltage                                     | VIH      | V    | Vcc=1.8~3.3V   | 0.8xIOV<br>CC | -        | IOV<br>cc         | -    |
| Input low voltage                                       | VIL      | V    | Vcc=1.8~3.3V   | -0.3V         | -        | 0.2xI<br>OVc<br>c | -    |
| I/O leakage current                                     | ILi      | mA   | Vin=0~Vcc  | -0.1          | -        | 0.1               | -    |
| Current consumption during normal operation(Vcc-VSS)    | IOP(Vcc) | mA   | Vci=Vcc=2.8V,Ta=25°C,fOSC=376KHz(Line )GRAM data=0000h,Frame rate=70Hz,REV=0,SAP=100,AP=100,DC0=000,DC1=010,B/C=0,BT=001,VC=001,VRH=0011,VCM=10011,VDV=10000,VCOMG=1,CL=0, No panel load | -             | 100(VCC) | -                 | -    |
| Current consumption during normal operation ( Vci -VSS) | IOP(Vci) | mA   |  |               | 100(VCC) | -                 |      |
| Currentconsumption during standby mode ( Vcc -VSS)      | Ist(Vcc) | mA   | Vcc=2.8V,Ta=25°C   | -             | 5        | 10                |      |
| Current consumption during standby mode ( Vci -VSS)     | Ist(Vci) | mA   |  |               | 5        | 10                |      |
| Output voltage deviation                                | -        | mV   | -  | -             | 5        | -                 | -    |
| Dispersion of the Average Output Voltage                | V        | mV   | -  | -             | -        | 35                | -    |

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## 4.4 Back-light Specification

**Table 4.3 Back-light Specification**

| Item              | Symbol | Min. | Typ. | Max. | Unit | Remark |
|-------------------|--------|------|------|------|------|--------|
| Supply Voltage    | VBAT   | -    | 3.2  | 3.4  | V    | Note   |
| Formard current   | If     | -    | 15   | -    | mA   |        |
| Power Consumption | PBL-   |      | 180  | -    | mW   | Note   |

**Note:**

**Table 4.4 Back-light Specification**

| Item   | Symbol | Conditions                   | Min.    | Typ. | Max. | Unit  |
|--|--------|------------------------------|---------|------|------|-------|
| Supply Voltage                               | VF     | Only Backlight               | 3.0     | 3.2  | 3.4  | V     |
| Supply Current                               | IF     |                              | 15x4=60 |      |      | mA    |
| Average Brightness<br>(With LCD dots all on) | IV     | Backlight Current<br>IF=15mA | -       | 2800 | -    | Cd/m2 |
| CIE Color Coordinate<br>(Without LCD)        | X      | Backlight Current<br>IF=15mA | 0.24    | -    | 0.29 | -     |
|  | Y      |                              | 0.24    | -    | 0.29 |       |
| Uniformity                                   | B      | Backlight Current<br>IF=15mA | 80      | -    | -    | (%)   |
| Color  | White  |                              |         |      |      |       |

## 5. AC Characteristics

### 5.1.1 Clock Characteristics

| Item                      | Symbol | Unit | Min.  | Typ. | Max.  | Test Condition     |
|---------------------------|--------|------|-------|------|-------|--------------------|
| External clock frequency  | Fcp    | KHz  | T.B.D | 335  | T.B.D | Vcc=2.4~3.3V       |
| External clock duty ratio | Duty   | %    | 45    | 50   | 55    | Vcc=2.4~3.3V       |
| External clock rise time  | Trcp   | s    | -     | -    | 0.2   | Vcc=2.4~3.3V       |
| External clock fall time  | Tfcp   | s    | -     | -    | 0.2   | Vcc=2.4~3.3V       |
| R-C oscillation clock     | fOSC   | KHz  | 275   | 335  | 395   | Rf=130KΩ, Vcc=2.8V |

**Table 5.1:Clock Characteristics (Vcc=2.4~3.3V)**

### 5.1.2 8080 System(16bits)Bus Interface Timing Characteristics

| Item                          |                        | System     | Unit | Min. | Typ. | Max. | Test Condition |
|-------------------------------|------------------------|------------|------|------|------|------|----------------|
| Bus cycle time                | Write                  | tCYCW      | ns   | 300  | -    | -    | Figure5.1      |
|                               | Read                   | tCYCW      | ns   | 500  | -    | -    | Figure5.1      |
| Write low-level pulse width   |                        | PWLW       | ns   | 40   | -    | -    | Figure5.1      |
| Read low-level pulse width    |                        | PWLR       | ns   | 250  | -    | -    | Figure5.1      |
| Write high-level pulse width  |                        | PWHW       | ns   | 30   | -    | -    | Figure5.1      |
| Read high-level pulse width   |                        | PWHR       | ns   | 200  | -    | -    | Figure5.1      |
| Write / Read rise / fall time |                        | TWRr, TwRf | ns   | -    | -    | 25   | Figure5.1      |
| Setup time                    | Write(RS to NCS,E_NWR) | tAS        | ns   | 5    | -    | -    | Figure5.1      |
|                               | Read(RS to NCS,RW_NRD) | tAS        |      | 5    | -    | -    | Figure5.1      |
| Address hold time             |                        | tAH        | ns   | 5    | -    | -    | Figure5.1      |
| Write data setup time         |                        | tDSW       | ns   | 15   | -    | -    | Figure5.1      |
| Write data hold time          |                        | tH         | ns   | 15   | -    | -    | Figure5.1      |
| Read data delay time          |                        | tDDR       | ns   | -    | -    | 80   | Figure5.1      |
| Read data hold time           |                        | tDHR       | ns   | 5    | -    | -    | Figure5.1      |

**Table 5.2:Normal Write Mode(HWM=0)/(Vcc=2.4~3.3V)**

| Item                         |                        | System       | Unit | Min. | Typ. | Max. | Test Condition |
|------------------------------|------------------------|--------------|------|------|------|------|----------------|
| Bus cycle time               | Write                  | tCYCW        | ns   | 100  | -    | -    | Figure5.1      |
|                              | Read                   | tCYCW        | ns   | 500  | -    | -    | Figure5.1      |
| Write low-level pulse width  |                        | PWLW         | ns   | 40   | -    | -    | Figure5.1      |
| Read low-level pulse width   |                        | PWLR         | ns   | 250  | -    | -    | Figure5.1      |
| Write high-level pulse width |                        | PWHW         | ns   | 30   | -    | -    | Figure5.1      |
| Read high-level pulse width  |                        | PWHR         | ns   | 200  | -    | -    | Figure5.1      |
| Write Read/ rise/fall time   |                        | WRr,<br>tWRF | ns   | -    | -    | 25   | Figure5.1      |
| Setup time                   | Write(RS to NCS,E_NWR) | tAS          | ns   | 5    | -    | -    | Figure5.1      |
|                              | Read(RS to NCS,RW_NRD) |              | ns   | 5    | -    | -    | Figure5.1      |
| Address hold time            |                        | tAH          | ns   | 5    | -    | -    | Figure5.1      |
| Write data setup time        |                        | tDSW         | ns   | 15   | -    | -    | Figure5.1      |
| Write data hold time         |                        | tH           | ns   | 20   | -    | -    | Figure5.1      |
| Read data delay time         |                        | tDDR         | ns   | -    | -    | 200  | Figure5.1      |
| Read data hold time          |                        | tDHR         | ns   | 5    | -    | -    | Figure5.1      |

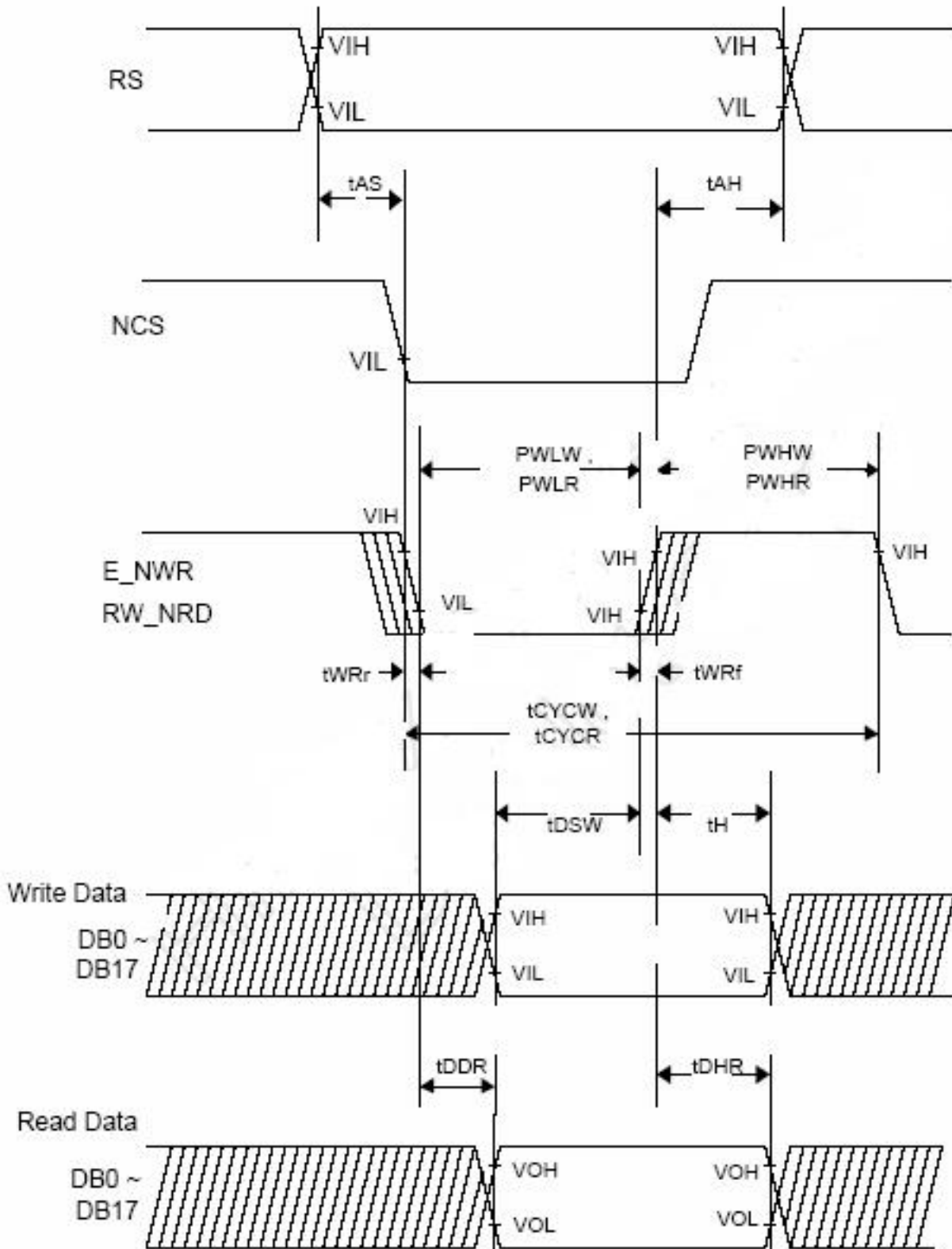
**Table 5.3 High-Speed Write Mode (HWM=1)/(Vcc=2.4~3.3V)****5.1.3 80-system(8Bits) Bus Interface Timing Characteristics**

| Item                         |                        | Symbol       | Unit | Min. | Typ. | Max. | Test Condition |
|------------------------------|------------------------|--------------|------|------|------|------|----------------|
| Bus cycle time               | Write                  | tCYCW        | ns   | 300  | -    | -    | Figure5.1      |
|                              | Read                   | tCYCW        | ns   | 500  | -    | -    | Figure5.1      |
| Write low-level pulse width  |                        | PWLW         | ns   | 40   | -    | -    | Figure5.1      |
| Read low-level pulse width   |                        | PWLR         | ns   | 250  | -    | -    | Figure5.1      |
| Write high-level pulse width |                        | PWHW         | ns   | 30   |      | -    | Figure5.1      |
| Read high-level pulse width  |                        | PWHR         | ns   | 200  |      | -    | Figure5.1      |
| Write Read/ rise/fall time   |                        | WRr,<br>tWRF | ns   | -    | -    | 25   | Figure5.1      |
| Setup time                   | Write(RS to NCS,E_NWR) | tAS          | ns   | 5    | -    | -    | Figure5.1      |
|                              | Read(RS to NCS,RW_NRD) |              | ns   | 5    | -    | -    | Figure5.1      |
| Address hold time            |                        | tAH          | ns   | 5    | -    | -    | Figure5.1      |
| Write data setup time        |                        | tDSW         | ns   | 15   | -    | -    | Figure5.1      |
| Write data hold time         |                        | tH           | ns   | 20   | -    | -    | Figure5.1      |
| Read data delay time         |                        | tDDR         | ns   | -    | -    | 120  | Figure5.1      |
| Read data hold time          |                        | tDHR         | ns   | 5    | -    | -    | Figure5.1      |

**Table 5.4 Normal Write Mode(HWM=0)/(Vcc=2.4~3.3V)**

## 5.2 Timing Characteristic

### 5.2.1 8080 System Bus Operation



**Figure 5.1:8080 System Bus Timing**

## 6. Optical Specifications

| Item           |       | Symbol         | Conditions  | Specifications |       |       | Unit | Note  |
|----------------|-------|----------------|---|----------------|-------|-------|------|---|
|                |       |                |   | Min.           | Typ.  | Max.  |      |   |
| Transmittance  |       | T%             | Viewing normal angle<br>$\theta_X = \theta_Y = 0^\circ$ |                | 6.0   |       | %    | All left side data are based on CMO's following condition --<br>Type 6<br>NTSC: 58%<br>LC: 5001<br>Light : C light<br>(Machine:BM5A)<br>Polarizer without DBEF<br><b>Reference Only</b> |
| Contrast Ratio |       | CR             |   | 150            | 250   | -     | --   |   |
| Response Time  |       | T <sub>R</sub> |   | -              | 15    | 30    | ms   |   |
|                |       | T <sub>F</sub> |   | -              | 35    | 50    | ms   |   |
| Chromaticity   | Red   | X <sub>R</sub> |   | 0.610          | 0.640 | 0.670 |      |   |
|                |       | Y <sub>R</sub> |   | 0.314          | 0.344 | 0.374 |      |   |
|                | Green | X <sub>G</sub> |   | 0.268          | 0.298 | 0.328 |      |   |
|                |       | Y <sub>G</sub> |   | 0.553          | 0.583 | 0.613 |      |   |
|                | Blue  | X <sub>B</sub> |   | 0.102          | 0.132 | 0.162 |      |   |
|                |       | Y <sub>B</sub> |   | 0.107          | 0.137 | 0.167 |      |   |
|                | White | X <sub>W</sub> |   | 0.282          | 0.312 | 0.342 |      |   |
|                |       | Y <sub>W</sub> |   | 0.319          | 0.349 | 0.379 |      |   |
| Viewing Angle  | Hor.  | $\theta_{X+}$  | Center<br>CR≥10   | -              | 45    |       | deg. |   |
|                |       | $\theta_{X-}$  |   | -              | 45    |       |      |   |
|                | Ver.  | $\theta_{Y+}$  |   | -              | 35    |       |      |   |
|                |       | $\theta_{Y-}$  |   | -              | 15    |       |      |   |

**NOTE (1)Definition of Contrast Ratio(CR):**

The contrast ratio can be calculated by the following expression. Contrast Ratio (CR) = L63 / L0

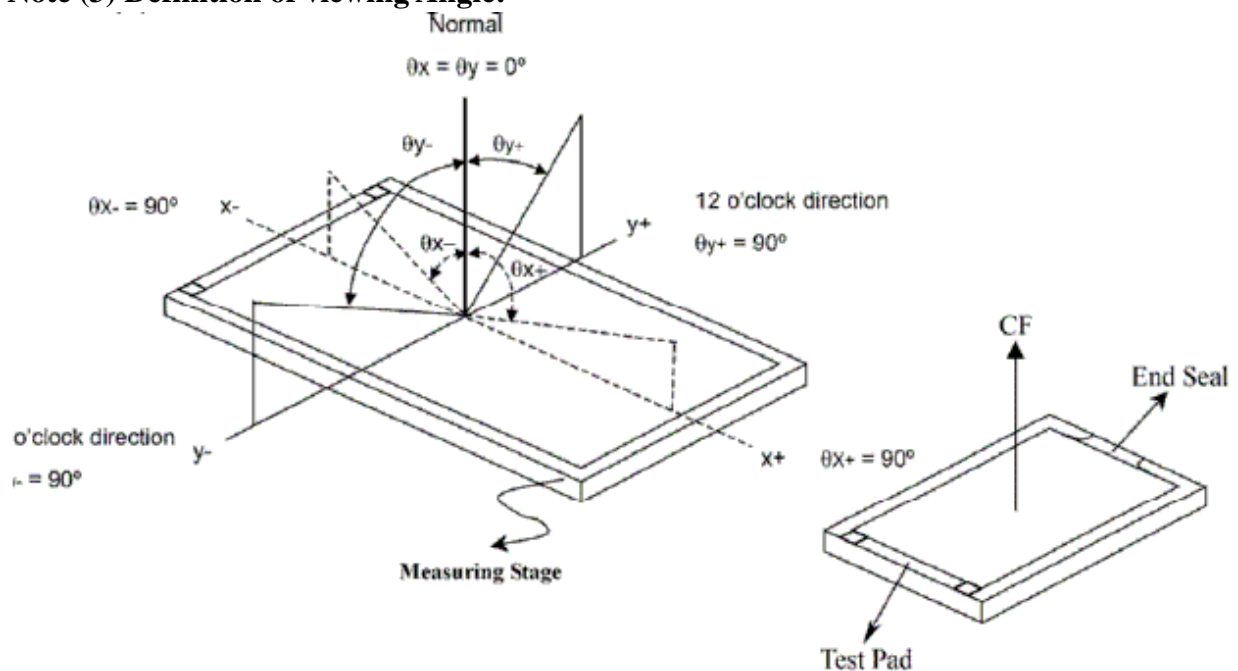
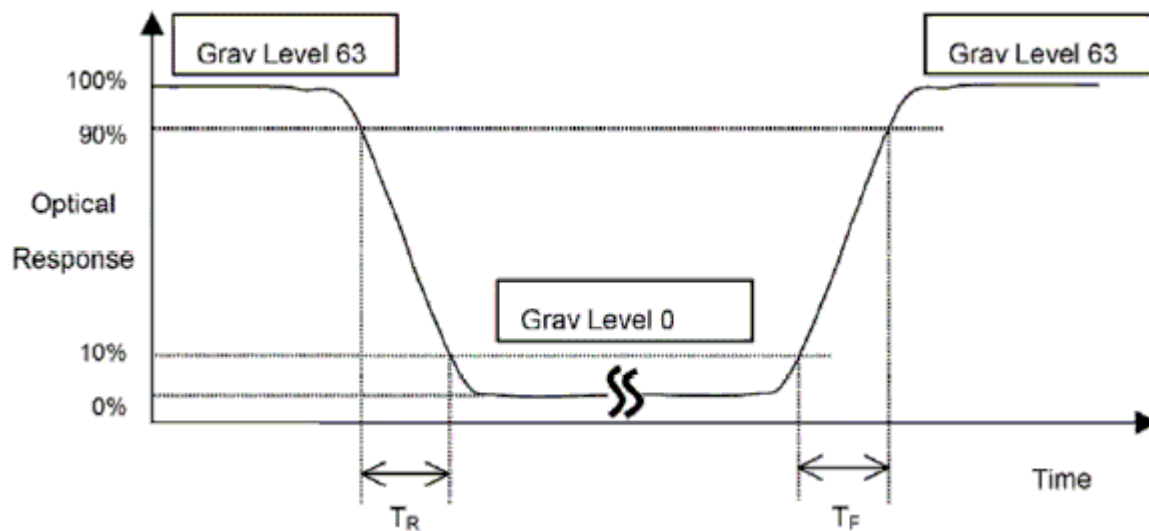
L63: Luminance of gray level 63

L0: Luminance of gray level 0

CR = CR (10)

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

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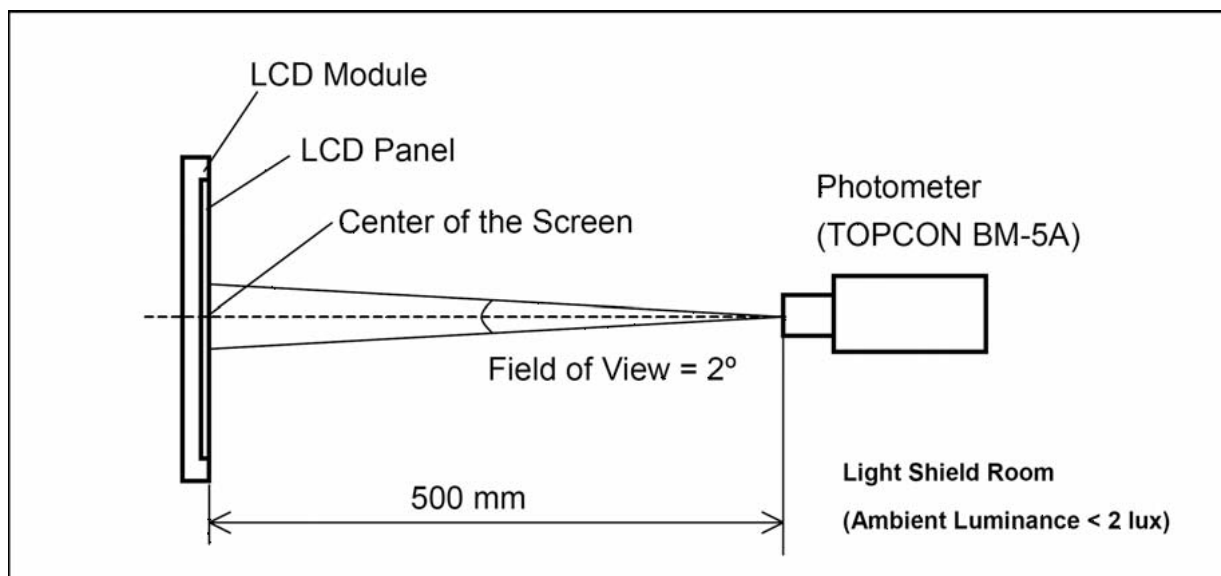
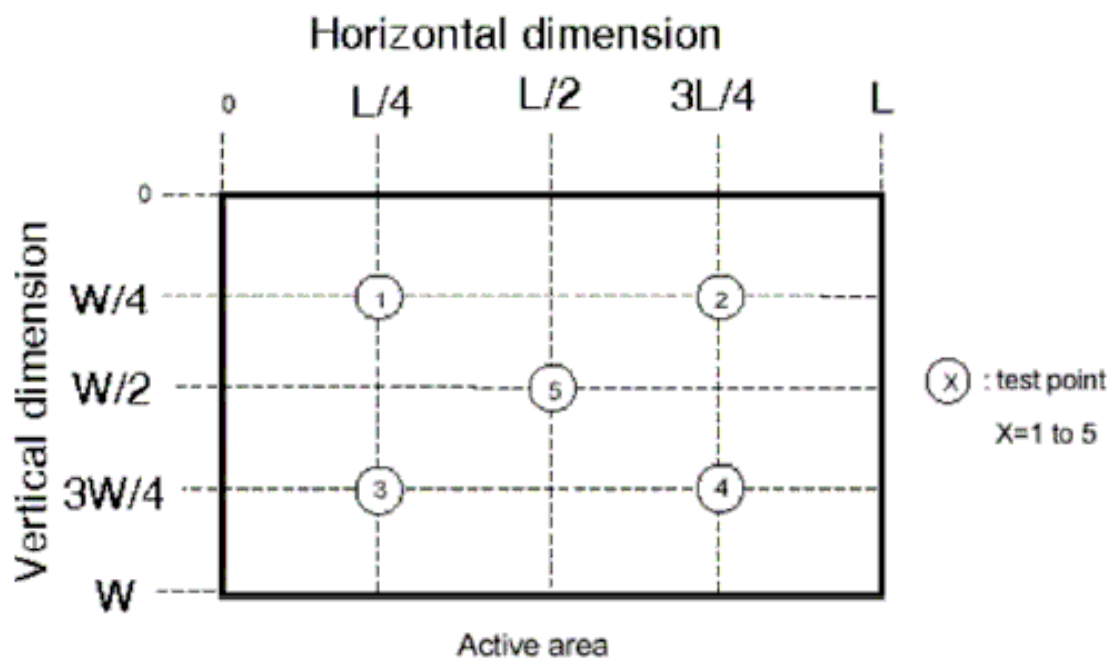
\*\*\* The above “Viewing Angle” is the measuring position with Largest Contrast Ratio; not for good image quality.

View Direction for good image quality is 6 O'clock. Module maker can increase the "Viewing Angle" by applying Wide View Film.

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**Note (4) Measurement Set-Up:**

The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.

**Note(5)**



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## 7. Reliability Test Items

| No. | Test Item                 | Test Condition | Check Time |
|-----|---------------------------|----------------|------------|
| 1   | High temp storage         | T= 80°C        | 240 hrs    |
| 2   | Low temp storage          | T= -30°C       | 240 hrs    |
| 3   | High temp operation       | T= 70°C        | 240 hrs    |
| 4   | Low temp operation        | T= -20°C       | 240 hrs    |
| 5   | High temp & high humidity | T=60°C H=90%   | 240 hrs    |

Reliability Test Criteria:

Display function should be no change under normal operating condition.

## 8. Package(TBD)

## 9. Handling Precautions

### 9.1 Safety

The liquid crystal in the LCD is poisonous. Keep away from your mouth and eyes. If the liquid crystal contacts with your skin, mouse or clothes, use soap to wash it off immediately.

### 9.2 Handling

- i. The LCD panel is made by thin glass. Prevent the panel from mechanical shock or putting excessive force on its surface.
  - ii. The polarizer attached on the display is very easy to be damaged, handle it with special attention.
  - iii. To avoid contamination on the display surface, do not touch the display surface with bare hands.
  - iv. The transparent electrodes may be disconnected if you use the LCD panel under
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dew-condensing environment.

v. The characteristics of the semiconductor devices may be affected when they are exposed to light, possibly resulting in malfunctioning of the ICs. To prevent such malfunctioning of the ICs, make sure the application and the mounting of the panel are designed so that the IC is not exposed to light.

### **9.3 Static Electricity**

Ground soldering iron tips, tools and testers when you operate. Also ground your body when handling the products and store the products in an anti-electrostatic container.

### **9.4 Storage**

Store the products in a dark place where the temperature is within the range of  $25\pm 10$  and with low humidity (65%RH or less). Do not store the LCD product in an atmosphere containing organic solvents or corrosive gases.

### **9.5 Cleaning**

Do not wipe the polarizer with dry cloth, as it might cause scratching. Wipe the polarizer with a soft cloth soaked with petroleum IPA. Other chemical might damage the panel.