





DOCUMENT NUMBER AND REVISION  
**VL-PS- COG-T180MLH-03 REV. A**  
**(COG-T180MLH-03)**

DOCUMENT TITLE:  
**PRELIMINARY SPECIFICATION**  
**OF**  
**LCD MODULE TYPE**

**MODEL NUMBER: COG-T180MLH-03**

| DEPARTMENT  | NAME           | SIGNATURE  | DATE        |
|-------------|----------------|--|-------------|
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DISTRIBUTION LIST: MARKETING



**DOCUMENT REVISION HISTORY**

| DOCUMENT REVISION FROM TO | DATE       | DESCRIPTION    | CHANGED BY        | CHECKED BY |
|---------------------------|------------|----------------|-------------------|------------|
| A                         | 2005.05.18 | First Release. | ZHANG<br>YAN FANG | ICE CHEN   |



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## VARITRONIX LIMITED

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### Preliminary Specification of LCD Module Type Model No.: COG-T180MLH-03

#### 1. General Description

- 128 x RGB x 160 dots 65 K TFT positive transmissive Dot Matrix LCD module.
- Amorphous Silicon TFT active matrix.
- 1.8" (COG type).
- "RENESAS" HD66773R LCD Controller Driver or equivalent.
- Driving scheme: 1/160 duty.
- Viewing angle: 12 o'clock.
- White color LED backlight.
- Normally white.
- Low power.
- Thin thickness.
- With FPC Connection.

#### 2. Mechanical Specifications

The mechanical detail is shown in Fig. 1 and summarized in Table 1 below.

Table 1

| Parameter           | Specifications                                  | Unit |
|---------------------|---|------|
| Outline dimensions  | 43.4(W) x 60.0(H) x 4.4(D)(Including component) | mm   |
| Active area         | 28.416(W) x 35.52(H)                            | mm   |
| Display format      | 128 x RGB x 160                                 | dots |
| Color configuration | R.G.B. stripes                                  | -    |
| Dot size            | 0.218(RGB)(W) x 0.214(H)                        | mm   |
| Dot spacing         | 0.004(W) x 0.008(H)                             | mm   |
| Dot pitch           | 0.222(RGB)(W) x 0.222(H)                        | mm   |
| Weight              | TBD   | gram |

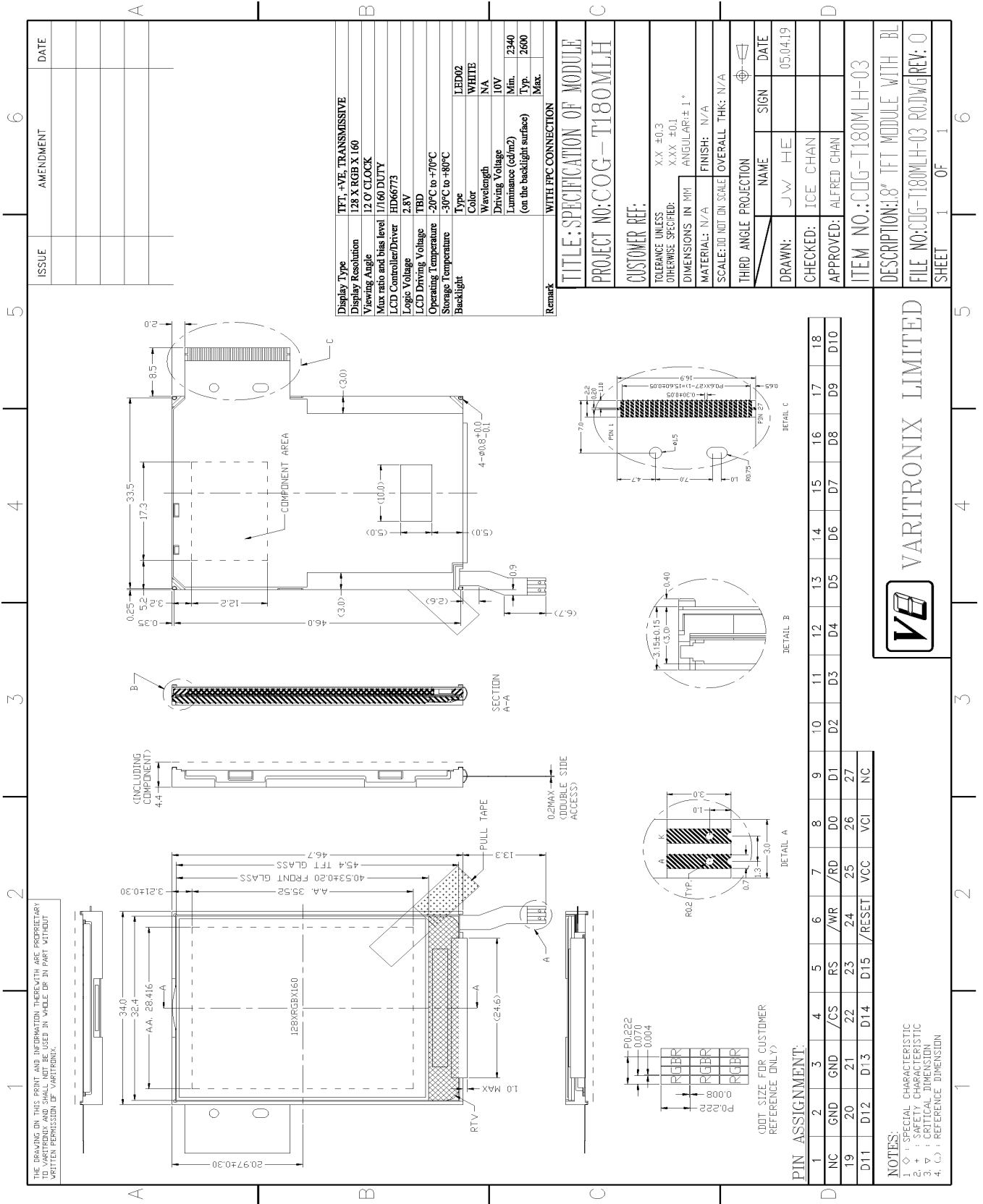


Figure 1: Module Specification

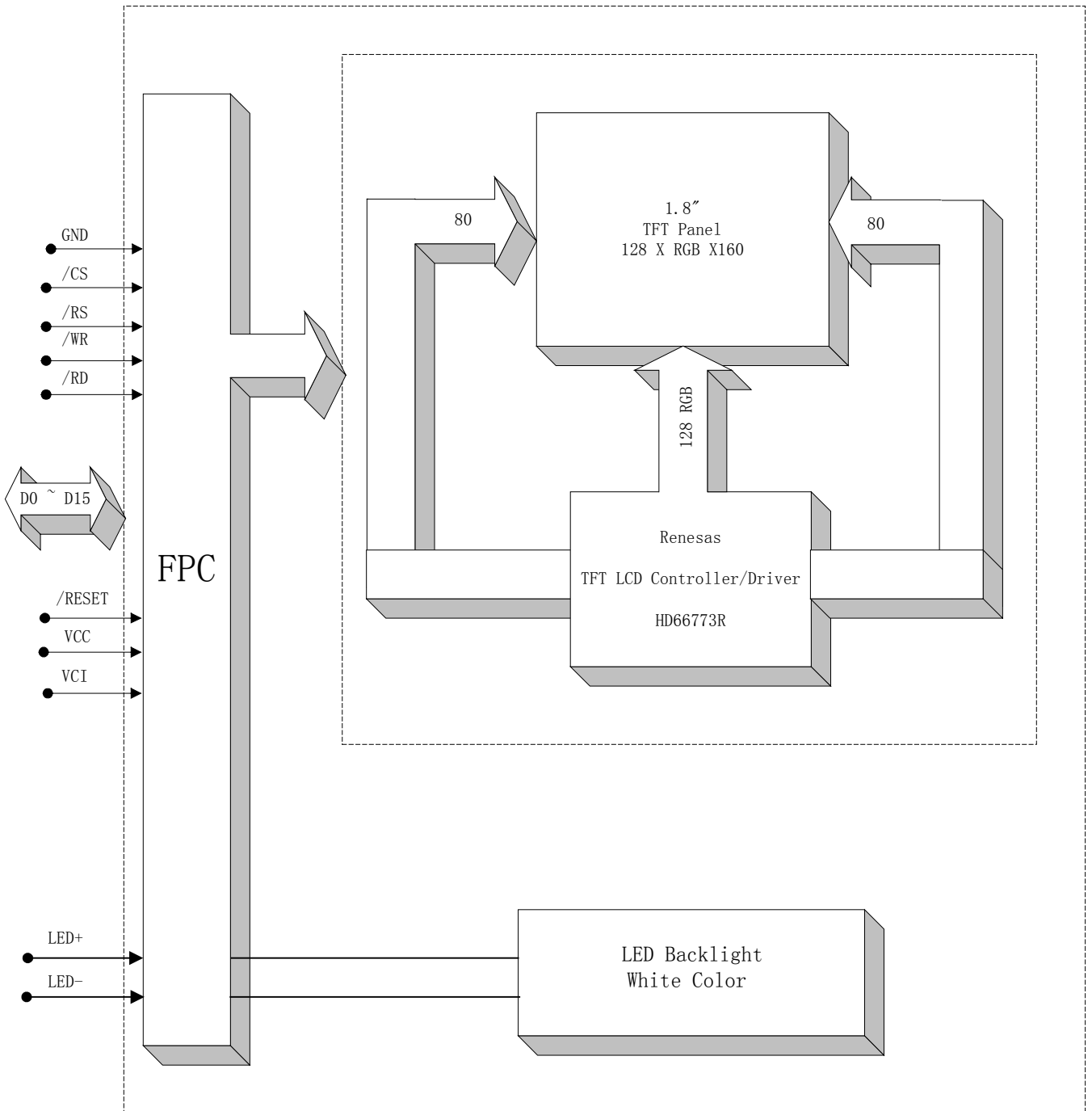


Figure 2: Block Diagram



### 3. Interface signals

#### 3.1 Interface signals for Module Unit

Table 2

| Pin No. | Symbol | Description   |
|---------|--------|---|
| 1       | NC     | No Connection.  |
| 2       | GND    | Logic ground GND:0V.  |
| 3       | GND    | Logic ground GND:0V.  |
| 4       | /CS    | Chip selection signal.<br>Low: Select HD66773R and accessible.<br>High: Not select HD66773R and inaccessible.   |
| 5       | RS     | Register selection signal.<br>Low: Index/status.<br>High: Control.  |
| 6       | /WR    | Write strobe signal in 80-system bus interface, write data at low.  |
| 7       | /RD    | Read strobe signal in 80-system bus interface, read data at low.  |
| 8       | D0     | Data 0  |
| 9       | D1     | Data 1  |
| 10      | D2     | Data 2  |
| 11      | D3     | Data 3  |
| 12      | D4     | Data 4  |
| 13      | D5     | Data 5  |
| 14      | D6     | Data 6  |
| 15      | D7     | Data 7  |
| 16      | D8     | Data 8  |
| 17      | D9     | Data 9  |
| 18      | D10    | Data 10   |
| 19      | D11    | Data 11   |
| 20      | D12    | Data 12   |
| 21      | D13    | Data 13   |
| 22      | D14    | Data 14   |
| 23      | D15    | Data 15   |
| 24      | /RESET | Reset pin. Initialize the LSI at low. Power-on reset required when turning on the power supply. Supply with either one of RESET and the unused pins open. |
| 25      | VCC    | Logic V <sub>CC</sub> : +2.2V to +3.3V.   |
| 26      | VCI    | Power supply for analogue circuits. Connect to an external power supply of 2.5V~3.3V.   |
| 27      | NC     | No Connection.  |

#### 3.2 Backlight Unit (2 Pin FPC Solder Type)

| Symbol | Description                |
|--------|----------------------------|
| A      | Anode. LED Input Terminal. |
| K      | Cathode. Ground            |



**4. Absolute Maximum Ratings**

**4.1 Electrical Maximum Ratings – For IC Only**

Table 3

| Parameter                        | Symbol    | Min. | Max.    | Unit |
|----------------------------------|-----------|------|---------|------|
| Power Supply voltage (Logic)     | VCC-GND   | -0.3 | +4.6    | V    |
| Power Supply voltage (VCI-GND)   | VCI-GND   | -0.3 | +4.6    | V    |
| Power Supply voltage (DDVDH)     | DDVDH-GND | -0.3 | +6.0    | V    |
| Power Supply voltage (GND-VCL)   | GND-VCL   | -0.3 | +4.6    | V    |
| Power Supply voltage (DDVDH-VCL) | DDVDH-VCL | -0.3 | +9.0    | V    |
| Power Supply voltage (VGH-GND)   | VGH-GND   | -0.3 | +18.5   | V    |
| Power Supply voltage (GND-VGL)   | GND-VGL   | -0.3 | +18.5   | V    |
| Input voltage                    | Vin       | -0.3 | VCC+0.3 | V    |

Note:

The modules may be destroyed if they are used beyond the absolute maximum ratings.

All voltage values are referenced to GND = 0V.

**4.2 Environmental Condition**

Table 4

| Item   | Operating Temperature (Topr)   |       | Storage Temperature (Tstg) |       | Remark          |
|--|--|-------|----------------------------|-------|-----------------|
|  | Min.   | Max.  | Min.                       | Max.  |                 |
| Ambient Temperature  | -20°C  | +70°C | -30°C                      | +80°C | Dry             |
| Humidity   | 92% max. RH for Ta ≤ 40°C<br>< 92% RH for Ta > 40°C  |       |                            |       | No condensation |
| Vibration (IEC 68-2-6) cells must be mounted on a suitable connector | Frequency: 10 ~ 55 Hz<br>Amplitude: 0.75 mm<br>Duration: 20 cycles in each direction.  |       |                            |       | 3 directions    |
| Shock (IEC 68-2-27) Half-sine pulse shape                            | Pulse duration: 11 ms<br>Peak acceleration: 981 m/s <sup>2</sup> = 100 g<br>Number of shocks: 3 shocks in 3 mutually perpendicular axes. |       |                            |       | 3 directions    |



5. Electro-Optical Characteristics

Table 5

| Item                 | Symbol            | Temp.<br>°C | Value |       |       | Unit              | Condition   |
|----------------------|-------------------|-------------|-------|-------|-------|-------------------|---|
|                      |                   |             | Min.  | Typ.  | Max.  |                   |   |
| Response Time        | $\tau r + \tau d$ | +25         | -     | 40    | -     | msec              | $\theta = 0^\circ, \phi = 0^\circ$ , Note 1                   |
| Optimum Viewing Area | $\theta 1$        | +25         | -     | 45    | -     | DEG               | $\phi = 0^\circ$<br>C/R>10.<br>$\theta = 0^\circ$             |
|                      | $\theta 2$        |             | -     | 45    | -     |                   |   |
|                      | $\phi 1$          |             | -     | 35    | -     |                   |   |
|                      | $\phi 2$          |             | -     | 15    | -     |                   |   |
| Color Gamut          | S(%)              | +25         | -     | 45    | -     | %                 | Note 2  |
| CIE Color coordinate | Rx                | +25         | 0.576 | 0.596 | 0.616 |                   | Note 3  |
|                      | Ry                | +25         | 0.312 | 0.332 | 0.352 |                   |   |
|                      | Gx                | +25         | 0.285 | 0.305 | 0.325 |                   |   |
|                      | Gy                | +25         | 0.521 | 0.541 | 0.561 |                   |   |
|                      | Bx                | +25         | 0.125 | 0.145 | 0.165 |                   |   |
|                      | By                | +25         | 0.153 | 0.173 | 0.193 |                   |   |
|                      | Wx                | +25         | 0.283 | 0.298 | 0.313 |                   |   |
| Wy                   | +25               | 0.305       | 0.320 | 0.335 |       |                   |   |
| Contrast Ratio       | Cr                | +25         | -     | 250   | -     | -                 | Vop = Optimum voltage<br>$\theta = 0^\circ, \phi = 0^\circ$ . |
| Panel Transmittance  |                   | +25         | -     | 24    | -     | %                 | Note 2  |
| Dot Aperture Ratio   |                   | +25         | -     | 67    | -     | %                 |   |
| Luminance            |                   | +25         | -     | 200   | -     | cd/m <sup>2</sup> | B/L= 2500 cd/m <sup>2</sup>                                   |

Note (1): Response time depends on the temperature.

(In lower temperature, it becomes longer.).

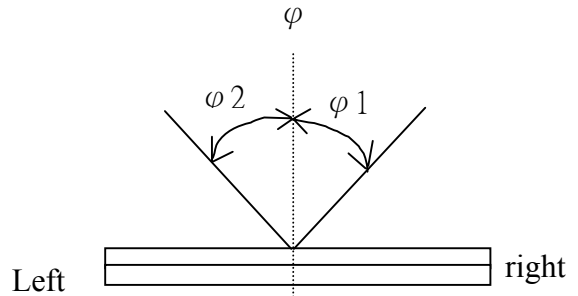
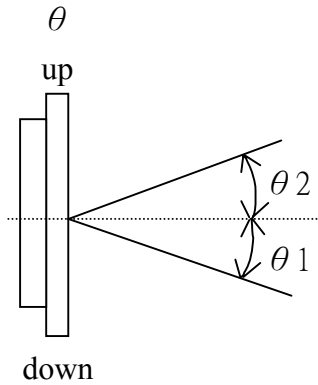
(2): Without polarizer.

(3): Color Filter glass.



**6. Optical Characteristics Definition**

a.) Viewing Angle

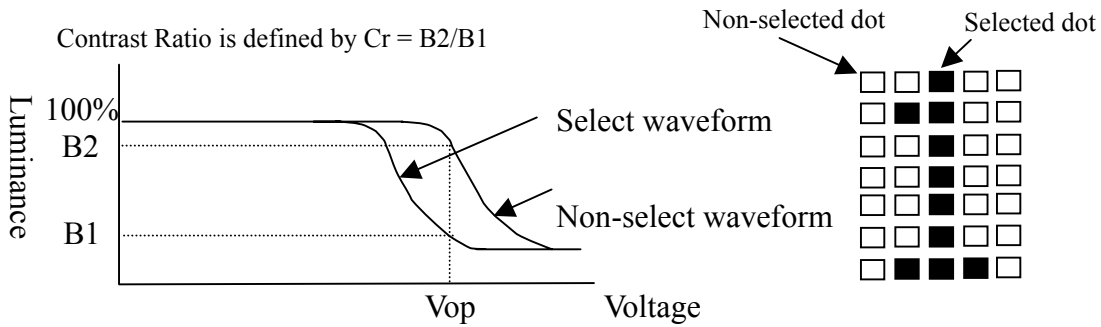


b.) Contrast Ratio

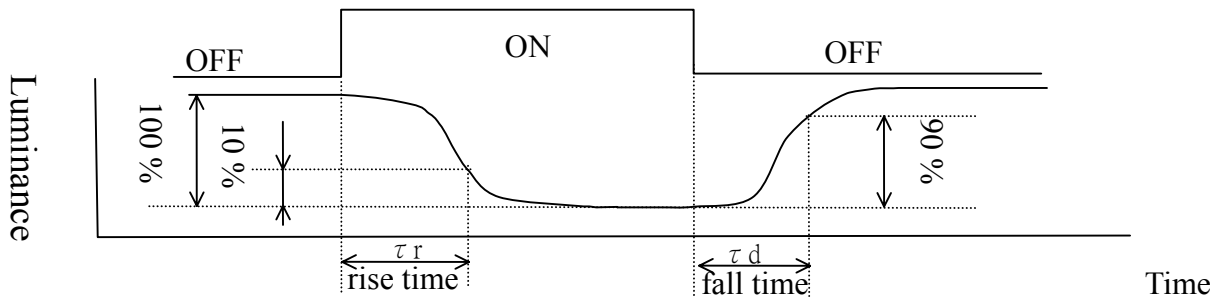
B1 = segments luminance in case of non-selected waveform

B2 = segments luminance in case of selected waveform

Contrast Ratio is defined by  $Cr = B2/B1$

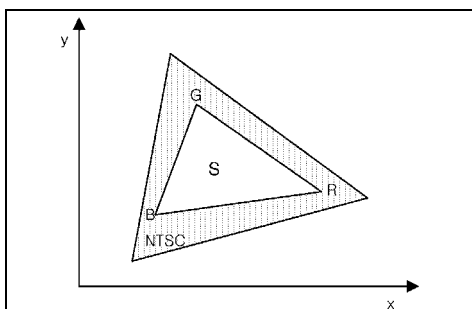


c.) Response Time



d.) Color Gamut

Color Gamut:  $S(\%) = (\text{RGB triangle Area} / \text{NTSC Triangle Area}) \times 100$





## 7. Electrical Specifications

### 7.1 Typical Electrical Characteristics

At Ta = 25 °C, VCC = 2.2V to 3.3V, GND=0V.

Table 6

| Parameter   | Symbol           | Conditions  | Min.   | Typ. | Max.    | Unit              |
|---|------------------|---|--------|------|---------|-------------------|
| Supply voltage (Logic)                                      | VCC-GND          |   | 2.2    | 2.8  | 3.3     | V                 |
| DC/DC supply voltage  | VCI              |   | 2.5    | 2.8  | 3.3     | V                 |
| TFT Gate ON Voltage   | VGH<br>(Note 1)  | At Ta=25°C±5°C<br>(Note 3)                        | 12     | -    | 20      | V                 |
| TFT Gate OFF Voltage  | VGL<br>(Note 2)  |   | -10    | -    | -4      | V                 |
| TFT Common Electrode Voltage                                | Vcom             |   | -2     | -    | 4       | V                 |
| Input signal voltage  | V <sub>IH</sub>  | “H” level,<br>VCC=2.2 to 3.3V                     | 0.7VCC | -    | VCC     | V                 |
|   | V <sub>IL1</sub> | “L” level<br>VCC=2.2 to 3.3V<br>(For OSC1 pin)    | -0.3   | -    | 0.15VCC | V                 |
|   | V <sub>IL2</sub> | “L” level<br>VCC=2.2 to 2.4V<br>(Except OSC1 pin) | -0.3   | -    | 0.15VCC | V                 |
|   |                  | “L” level<br>VCC=2.4 to 3.3V<br>(Except OSC1 pin) | -0.3   | -    | 0.2VCC  | V                 |
| Supply Current (Logic & LCD)                                | ICC+ICI          | Standard mode,<br>VCC=3V                          | -      | 1.32 | -       | mA                |
| Supply voltage of white LED backlight                       | VLED             | Forward current<br>=15 mA                         | -      | 10   | -       | V                 |
| Luminance of white LED backlight (on the backlight surface) |                  | Number of LED dies<br>=3                          | 2340   | 2600 | -       | cd/m <sup>2</sup> |

Note (1): VGH is TFT Gate operating voltage.

(2): VGL is TFT Gate operating voltage, VGL signal must be fluctuated with same phase as Vcom when Storage on Gate structure.

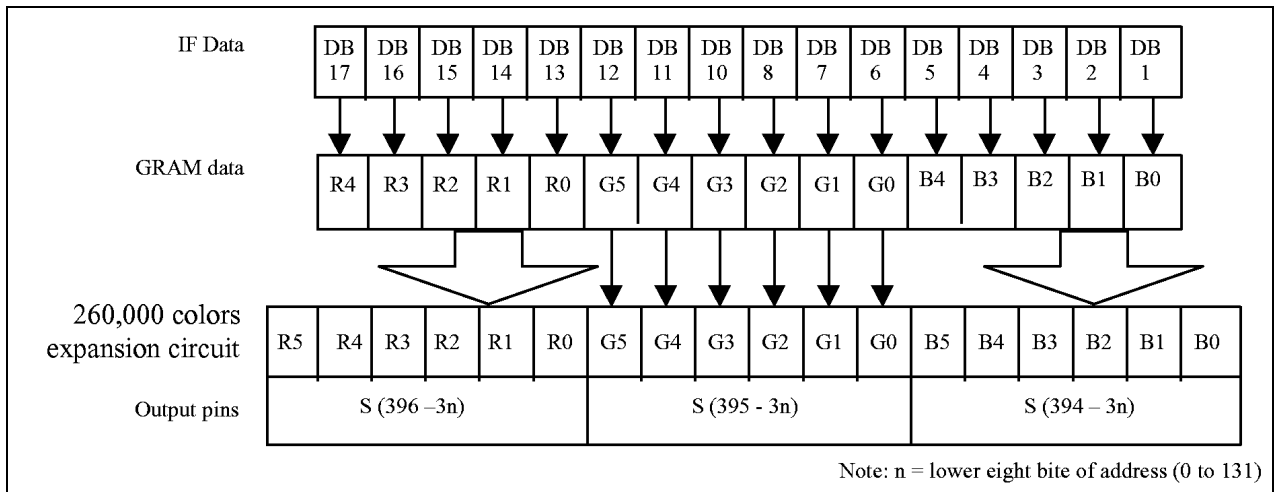
(3): Vcom must be adjusted to optimize display performance such as: crosstalk, contrast ratio and etc.



## 7.2 Register Selection

| 80-system |     | RS | Operation  |
|-----------|-----|----|--|
| WR*       | RD* |    |  |
| 0         | 1   | 0  | Writes indexes into IR                             |
| 1         | 0   | 0  | Reads internal status                              |
| 0         | 1   | 1  | Writes into control registers and GRAM through WDR |
| 1         | 0   | 1  | Reads from GRAM through RDR                        |

## 7.3 16-bit interface



## 7.4 Reset Function

The HD66773R makes internal initial settings with RESET input. During the RESET, the HD66773R is in a busy state, and no instructions from the MPU AND ACCESS TO gram are accepted. The time required for the RESET input is at least 1 ms. In case of power-on reset, wait at least 10ms after the power is turned on until the R-C oscillation frequency becomes stabilized. While waiting, do not make initial settings for the instruction set, nor access to GRAM.



## 7.5 Initial State of Instructions

- a. Start oscillation
- b. Driver output control (NL4-0 = "10101", SS = "0", CS = "0")
- c. Liquid crystal AC drive control (FLD1-0 = "01", B/C = "0", EOR = "0", NW5-0 = "00000")
- d. Power control 1 (BT2-0 = "000", DC2-0 = "000", AP2-0 = "000": liquid crystal power supply off, SLP = "0", STB = "0" : Standby mode off)
- e. Power control 2 (CAD = "0")
- f. Entry mode set (DIT = "0", BGR = "0", HWM = "0", I/D1-0 = "11": Increment by 1, AM = "0": Horizontal direction, LG2-0 = "000": Replace mode)
- g. Compare register (CP15-0 : "0000 0000 0000 0000")
- h. Display control (PT1-0 = "00", VLE2-1 = "00": No vertical scroll, SPT = "0", GON = "0", DTE = "0", CL = "0": 262,144 colors, REV = "0", D1-0 = "00": Display OFF)
- i. Power control 3 (VC2-0 = "000")
- j. Power control 4 (VRL3-0 = "0000", PON = "0", VRH3-0 = "0000")
- k. Power control 5 (VDV4-0 = "00000", VCOMG = "0", VCM4-0 = "00000")
- l. Frame cycle control (NO1-0 = "00", SDT1-0 = "00", EQ1-0 = "00" : No equalization, DIV1-0 = "00": clock/1, RTN3-0 = "0000" : 16 clocks in 1H period)
- m. Gate scan starting position (SCN4-0 = "00000")
- n. Vertical scroll (VL7-0 = "00000000")
- o. 1st split-screen (SE17-10 = "11111111", SS17-10 = "00000000")
- p. 2nd split-screen (SE27-20 = "11111111", SS27-20 = "00000000")
- q. Horizontal RAM address position (HEA7-0 = "10000011", HSA7-0 = "00000000")
- r. Vertical RAM address position (VEA7-0 = "10101111", VSA7-0 = "00000000")
- s. RAM write data mask (WM15-0 = "0000"H: No mask)
- t. RAM address set (AD15-0 = "0000"H)
- u.  $\gamma$  control  
(PKP02-00 = "000", PKP12-10 = "000", PKP22-20 = "000", PKP32-30 = "000",  
PKP42-40 = "000", PKP52-50 = "000", PRP02-00 = "000", PRP12-10 = "000")  
(PKN02-00 = "000", PKN12-10 = "000", PKN22-20 = "000", PKN32-30 = "000",  
PKN42-40 = "000", PKN52-50 = "000", PRN02-00 = "000", PRN12-10 = "000")  
(VRP14-10 = "00000", VRP03-00 = "0000", VRN14-10 = "00000", VRN12-10 = "000")

### GRAM Data Initialization

## 7.6

The data in GRAM are not initialized with the RESET input. Initialize through software during the display OFF (D1-0 = "00").

## 7.7 Initial State of Output Pin

- a. Liquid crystal driver output pins (source outputs): Output GND level  
Liquid crystal driver output pins (gate outputs): Output VGH level
- b. Oscillator output pin (OSC2): Output oscillation signal



**7.8 Timing Characteristics**

At Ta=-20°C to +70°C

| <b>80-system Bus Interface Timing Characteristics</b>     |       |                |             |            |            |            |
|---|-------|----------------|-------------|------------|------------|------------|
| <b>Normal Write Mode (HWM=0) (Vcc = 2.2 to 2.4 V)</b>     |       |                |             |            |            |            |
| <b>Item</b>   |       | <b>Symbol</b>  | <b>Unit</b> | <b>Min</b> | <b>Typ</b> | <b>Max</b> |
| Bus cycle time  | Write | $t_{CYCW}$     | ns          | 600        | —          | —          |
|   | Read  | $t_{CYCR}$     | ns          | 800        | —          | —          |
| Write low-level pulse width                               |       | $PW_{LW}$      | ns          | 90         | —          | —          |
| Read low-level pulse width                                |       | $PW_{LR}$      | ns          | 350        | —          | —          |
| Write high-level pulse width                              |       | $PW_{HW}$      | ns          | 300        | —          | —          |
| Read high-level pulse width                               |       | $PW_{HR}$      | ns          | 400        | —          | —          |
| Write/Read rise/fall time                                 |       | $t_{WRr, WRf}$ | ns          | —          | —          | 25         |
| Setup time<br>(RS to CS*, WR*, RD*)                       |       | $t_{AS}$       | ns          | 10         | —          | —          |
| Address hold time   |       | $t_{AH}$       | ns          | 5          | —          | —          |
| Write data set up time                                    |       | $t_{DSW}$      | ns          | 60         | —          | —          |
| Write data hold time                                      |       | $t_H$          | ns          | 15         | —          | —          |
| Read data delay time                                      |       | $t_{DDR}$      | ns          | —          | —          | 200        |
| Read data hold time                                       |       | $t_{DHR}$      | ns          | 5          | —          | —          |
| <b>High-Speed Write Mode (HWM=1) (Vcc = 2.2 to 2.4 V)</b> |       |                |             |            |            |            |
| <b>Item</b>   |       | <b>Symbol</b>  | <b>Unit</b> | <b>Min</b> | <b>Typ</b> | <b>Max</b> |
| Bus cycle time  | Write | $t_{CYCW}$     | ns          | 200        | —          | —          |
|   | Read  | $t_{CYCR}$     | ns          | 800        | —          | —          |
| Write low-level pulse width                               |       | $PW_{LW}$      | ns          | 90         | —          | —          |
| Read low-level pulse width                                |       | $PW_{LR}$      | ns          | 350        | —          | —          |
| Write high-level pulse width                              |       | $PW_{HW}$      | ns          | 90         | —          | —          |
| Read high-level pulse width                               |       | $PW_{HR}$      | ns          | 400        | —          | —          |
| Write/Read rise/fall time                                 |       | $t_{WRr, WRf}$ | ns          | —          | —          | 25         |
| Set up time<br>(RS to CS*, WR*, RD*)                      |       | $t_{AS}$       | ns          | 10         | —          | —          |
| Address hold time   |       | $t_{AH}$       | ns          | 5          | —          | —          |
| Write data set up time                                    |       | $t_{DSW}$      | ns          | 60         | —          | —          |
| Write data hold time                                      |       | $t_H$          | ns          | 15         | —          | —          |
| Read data delay time                                      |       | $t_{DDR}$      | ns          | —          | —          | 200        |
| Read data hold time                                       |       | $t_{DHR}$      | ns          | 5          | —          | —          |



| <b>Normal Write Mode (HWM=0)</b>     |       |                |      |     |     |     |                            |
|--------------------------------------|-------|----------------|------|-----|-----|-----|----------------------------|
| <b>(Vcc = 2.4 to 3.3 V)</b>          |       |                |      |     |     |     |                            |
| Item                                 |       | Symbol         | Unit | Min | Typ | Max | Note                       |
| Bus cycle time                       | Write | $t_{CYCW}$     | ns   | 200 | —   | —   |                            |
|                                      | Read  | $t_{CYCR}$     | ns   | 300 | —   | —   |                            |
| Write low-level pulse width          |       | $PW_{LW}$      | ns   | 40  | —   | —   |                            |
| Read low-level pulse width           |       | $PW_{LR}$      | ns   | 150 | —   | —   |                            |
| Write high-level pulse width         |       | $PW_{HW}$      | ns   | 100 | —   | —   |                            |
| Read high-level pulse width          |       | $PW_{HR}$      | ns   | 100 | —   | —   |                            |
| Write/Read rise/fall time            |       | $t_{WRr, WRf}$ | ns   | —   | —   | 25  |                            |
| Set up time<br>(RS to CS*, WR*, RD*) |       | $t_{AS}$       | ns   | 10  | —   | —   | When using status read     |
|                                      |       |                |      | 0   | —   | —   | When not using status read |
| Address hold time                    |       | $t_{AH}$       | ns   | 2   | —   | —   |                            |
| Write data setup time                |       | $t_{DSW}$      | ns   | 60  | —   | —   |                            |
| Write data hold time                 |       | $t_H$          | ns   | 2   | —   | —   |                            |
| Read data delay time                 |       | $t_{DDR}$      | ns   | —   | —   | 100 |                            |
| Read data hold time                  |       | $t_{DHR}$      | ns   | 5   | —   | —   |                            |
| <b>High-Speed Write Mode (HWM=1)</b> |       |                |      |     |     |     |                            |
| <b>(Vcc = 2.4 to 3.3 V)</b>          |       |                |      |     |     |     |                            |
| Item                                 |       | Symbol         | Unit | Min | Typ | Max | Note                       |
| Bus cycle time                       | Write | $t_{CYCW}$     | ns   | 100 | —   | —   |                            |
|                                      | Read  | $t_{CYCR}$     | ns   | 300 | —   | —   |                            |
| Write low-level pulse width          |       | $PW_{LW}$      | ns   | 40  | —   | —   |                            |
| Read low-level pulse width           |       | $PW_{LR}$      | ns   | 150 | —   | —   |                            |
| Write high-level pulse width         |       | $PW_{HW}$      | ns   | 40  | —   | —   |                            |
| Read high-level pulse width          |       | $PW_{HR}$      | ns   | 100 | —   | —   |                            |
| Write/Read rise/fall time            |       | $t_{WRr, WRf}$ | ns   | —   | —   | 25  |                            |
| Set up time<br>(RS to CS*, WR*, RD*) |       | $t_{AS}$       | ns   | 10  | —   | —   | When using status read     |
|                                      |       |                |      | 0   | —   | —   | When not using status read |
| Address hold time                    |       | $t_{AH}$       | ns   | 2   | —   | —   |                            |
| Write data set up time               |       | $t_{DSW}$      | ns   | 60  | —   | —   |                            |
| Write data hold time                 |       | $t_H$          | ns   | 2   | —   | —   |                            |
| Read data delay time                 |       | $t_{DDR}$      | ns   | —   | —   | 100 |                            |
| Read data hold time                  |       | $t_{DHR}$      | ns   | 5   | —   | —   |                            |

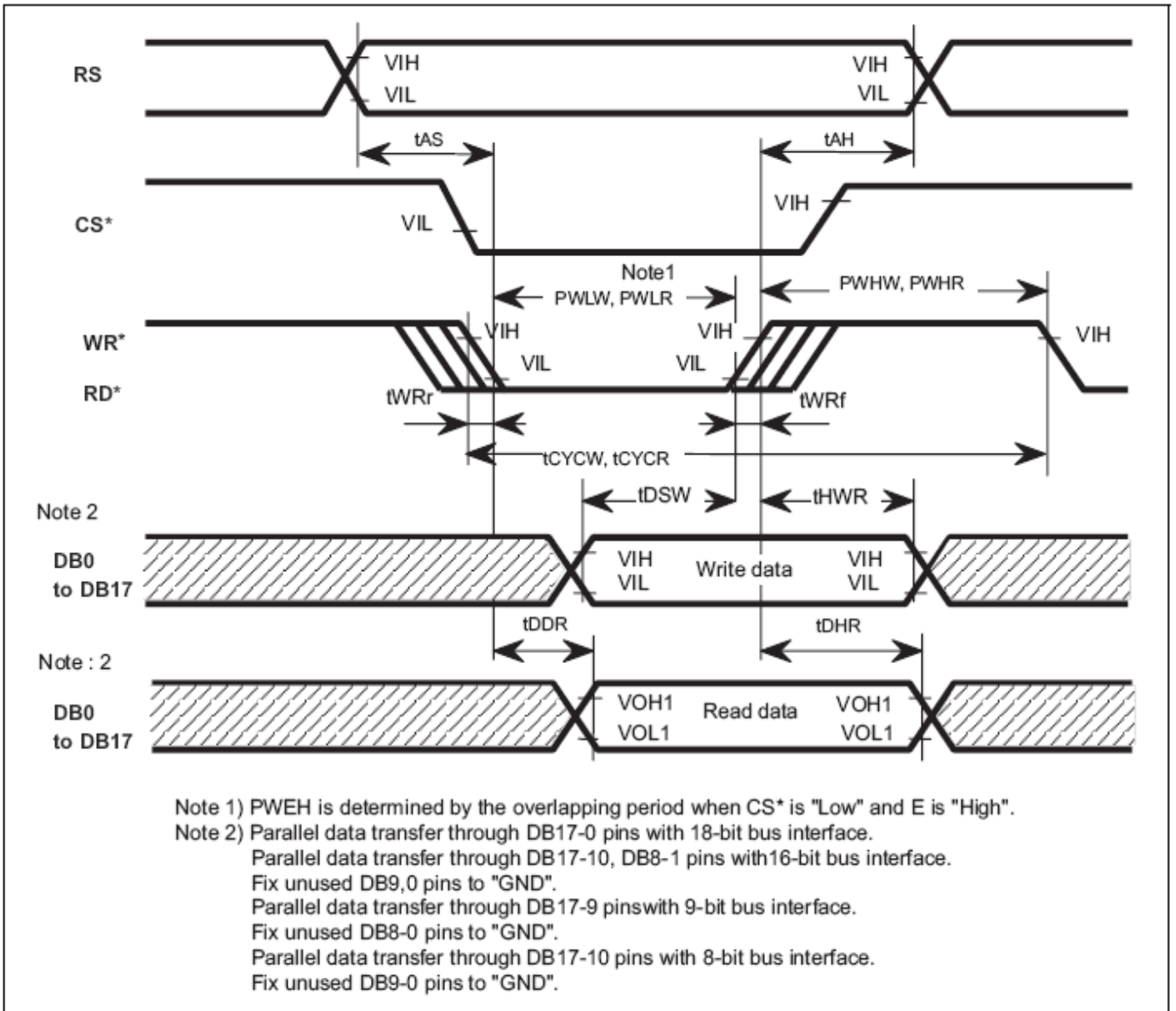


Figure 3: 80-system Bus Timing Diagram



## 8. Programming Reference

| <b>Initialization function 1</b> |
|----------------------------------|
|----------------------------------|

|           |
|-----------|
| R01←0115h |
|-----------|

|           |
|-----------|
| R02←0700h |
|-----------|

|           |
|-----------|
| R05←0230h |
|-----------|

|           |
|-----------|
| R06←0000h |
|-----------|

|           |
|-----------|
| R07←0104h |
|-----------|

|           |
|-----------|
| R0B←0000h |
|-----------|

| <b>Initialization function 2</b> |
|----------------------------------|
|----------------------------------|

|           |
|-----------|
| R21←0100h |
|-----------|

|           |
|-----------|
| R30←0000h |
|-----------|

|           |
|-----------|
| R31←0000h |
|-----------|

|           |
|-----------|
| R32←0000h |
|-----------|

|           |
|-----------|
| R33←0000h |
|-----------|

|           |
|-----------|
| R34←0000h |
|-----------|

|           |
|-----------|
| R35←0707h |
|-----------|

|           |
|-----------|
| R36←0707h |
|-----------|

|           |
|-----------|
| R37←0000h |
|-----------|

|           |
|-----------|
| R0F←0000h |
|-----------|

|           |
|-----------|
| R11←0000h |
|-----------|

|           |
|-----------|
| R14←5C00h |
|-----------|

|           |
|-----------|
| R15←A05Dh |
|-----------|

|           |
|-----------|
| R16←7F00h |
|-----------|

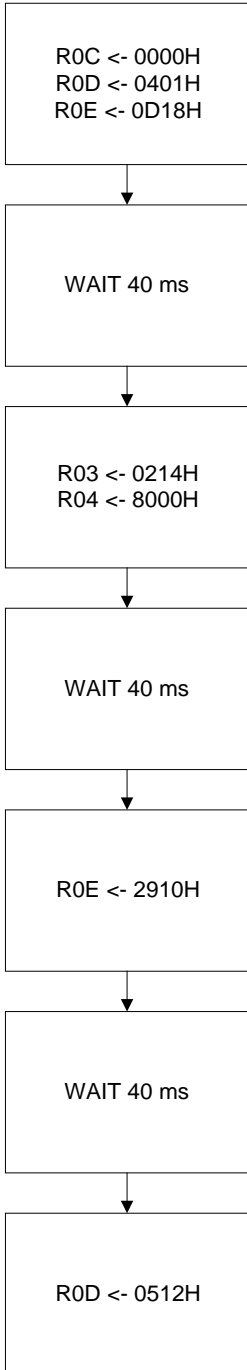
|           |
|-----------|
| R17←A000h |
|-----------|

|           |
|-----------|
| R3A←0000h |
|-----------|

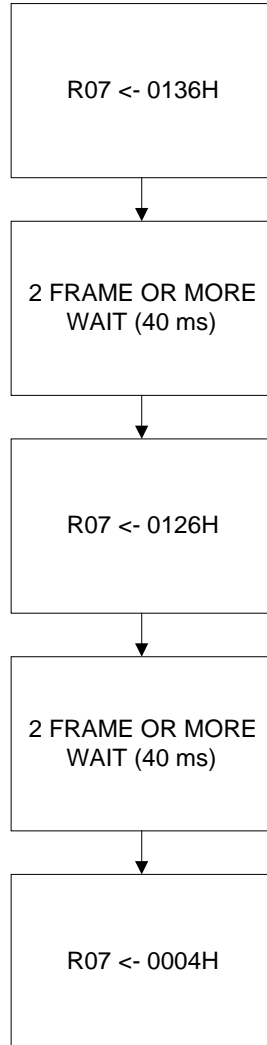
|           |
|-----------|
| R3B←0000h |
|-----------|



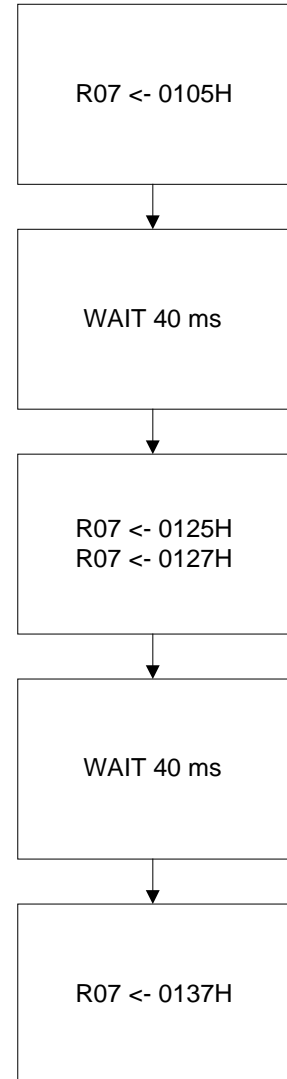
### Power Setting Function



### Display Off Function

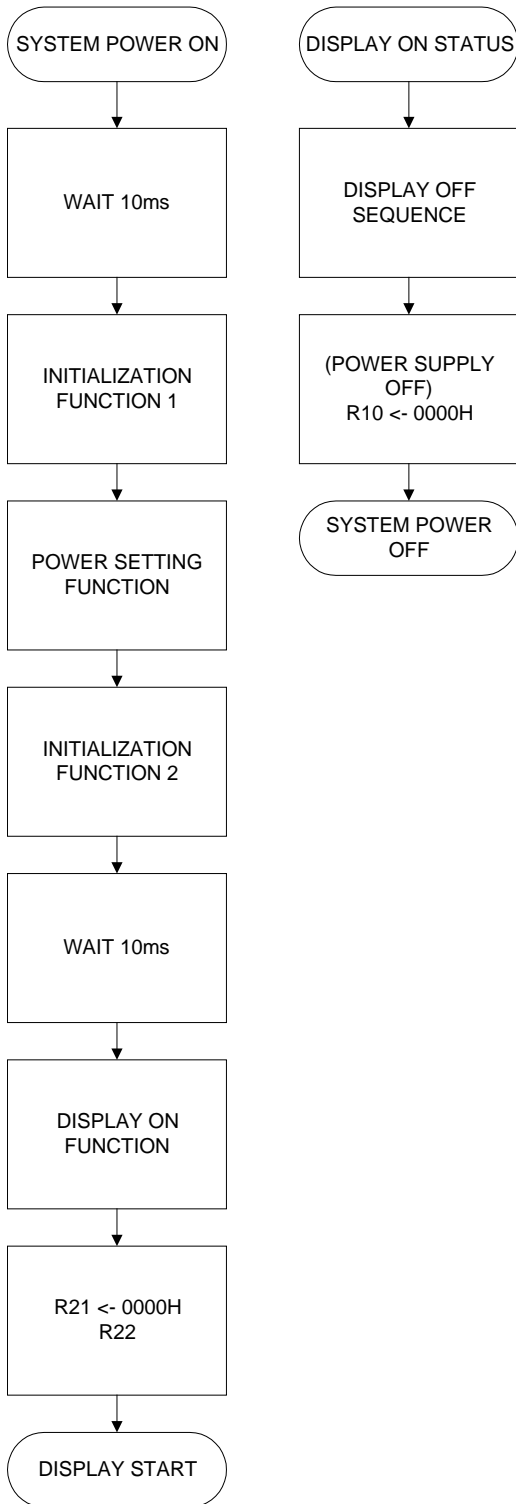


### Display On Function

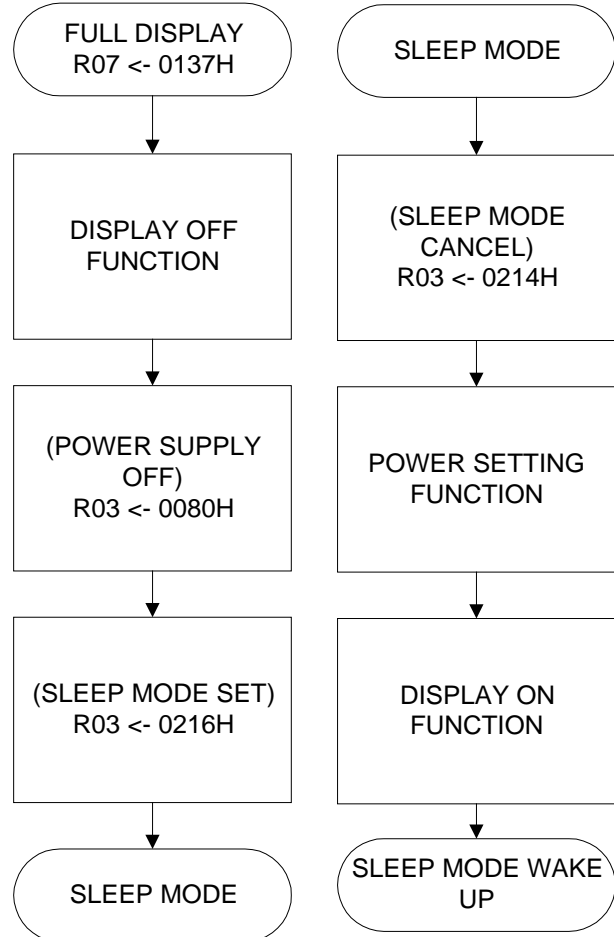




### Power On/Off Sequence



### Sleep Mode/ Wake Up Sequence (Oscillator is ON)

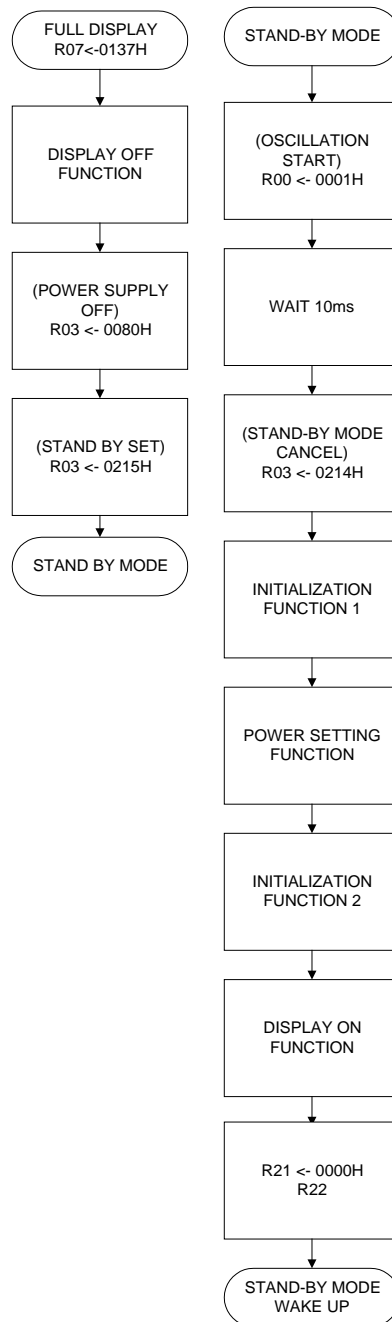


Note: 1) During sleep mode, GRAM data and instructions are retained.

2.) In the sleep mode, the system must stop sending CPU I/F signals.




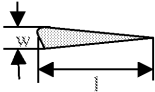
### Stand By Mode / Wake Up Sequence (Oscillator is OFF)

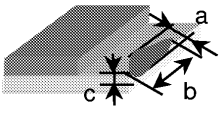
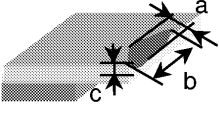
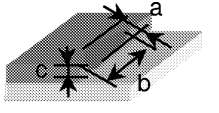




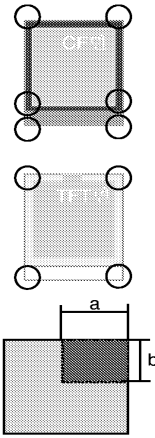
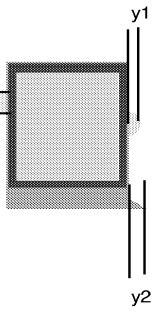
## 9. Incoming Inspection Standard

### 9.1 Inspection Criteria

| Item  | Criterion for Defects  | Defect Type      | Remark            |                 |        |                       |              |                     |              |       |  |
|---|--|------------------|-------------------|-----------------|--------|-----------------------|--------------|---------------------|--------------|-------|--|
| Non Display   | Non Display is not allowed   | Major            |                   |                 |        |                       |              |                     |              |       |  |
| Line Defect   | All Kinds of Line defects Such as Vertical, Horizontal, Cross are not allowed  | Major            |                   |                 |        |                       |              |                     |              |       |  |
| Dot   | <table border="1"> <thead> <tr> <th>Item</th> <th>Acceptable No</th> </tr> </thead> <tbody> <tr> <td>Bright Dot</td> <td>0</td> </tr> <tr> <td>Dark Dot</td> <td>1</td> </tr> </tbody> </table>  | Item             | Acceptable No     | Bright Dot      | 0      | Dark Dot              | 1            | Minor               |              |       |  |
| Item  | Acceptable No  |                  |                   |                 |        |                       |              |                     |              |       |  |
| Bright Dot  | 0  |                  |                   |                 |        |                       |              |                     |              |       |  |
| Dark Dot  | 1  |                  |                   |                 |        |                       |              |                     |              |       |  |
| [ Spot ]<br>Black Spot<br>White Spot<br>Bright Spot<br>Pinhole<br>Foreign Particle<br>Scratch |  <table border="1"> <thead> <tr> <th>Size <math>\Phi</math> (mm)</th> <th>Acceptable Number</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.1</math></td> <td>Ignore</td> </tr> <tr> <td><math>0.1 &lt; \Phi \leq 0.2</math></td> <td>1</td> </tr> <tr> <td><math>\Phi &gt; 0.2</math></td> <td>0</td> </tr> </tbody> </table>   | Size $\Phi$ (mm) | Acceptable Number | $\Phi \leq 0.1$ | Ignore | $0.1 < \Phi \leq 0.2$ | 1            | $\Phi > 0.2$        | 0            | Minor |  |
| Size $\Phi$ (mm)  | Acceptable Number  |                  |                   |                 |        |                       |              |                     |              |       |  |
| $\Phi \leq 0.1$   | Ignore   |                  |                   |                 |        |                       |              |                     |              |       |  |
| $0.1 < \Phi \leq 0.2$   | 1  |                  |                   |                 |        |                       |              |                     |              |       |  |
| $\Phi > 0.2$  | 0  |                  |                   |                 |        |                       |              |                     |              |       |  |
| [Line]<br>Black Line<br>White Line<br>Foreign Particle<br>Scratch                             | <p>* If we cannot see any Scratch through Backside of scratched area, It is Acceptable</p>  <table border="1"> <thead> <tr> <th>Width (mm)</th> <th>Length (mm)</th> </tr> </thead> <tbody> <tr> <td><math>W \leq 0.03</math></td> <td>Ignore</td> </tr> <tr> <td><math>0.03 &lt; W \leq 0.05</math></td> <td><math>L \leq 3.0</math></td> </tr> <tr> <td><math>0.05 &lt; W \leq 0.1</math></td> <td><math>L \leq 2.0</math></td> </tr> </tbody> </table> | Width (mm)       | Length (mm)       | $W \leq 0.03$   | Ignore | $0.03 < W \leq 0.05$  | $L \leq 3.0$ | $0.05 < W \leq 0.1$ | $L \leq 2.0$ | Minor |  |
| Width (mm)  | Length (mm)  |                  |                   |                 |        |                       |              |                     |              |       |  |
| $W \leq 0.03$   | Ignore   |                  |                   |                 |        |                       |              |                     |              |       |  |
| $0.03 < W \leq 0.05$  | $L \leq 3.0$   |                  |                   |                 |        |                       |              |                     |              |       |  |
| $0.05 < W \leq 0.1$   | $L \leq 2.0$   |                  |                   |                 |        |                       |              |                     |              |       |  |

| Item                               | Criterion for Defects   | Defect Type | Remark       |            |               |       |  |
|------------------------------------|---|-------------|--------------|------------|---------------|-------|--|
| Glass Chipping [ Pad Area ]        |  <table border="1"> <thead> <tr> <th>Size (mm)</th> </tr> </thead> <tbody> <tr> <td><math>a \leq 0.5</math></td> </tr> <tr> <td>b : Ignore</td> </tr> <tr> <td><math>c \leq 0.45</math></td> </tr> </tbody> </table> | Size (mm)   | $a \leq 0.5$ | b : Ignore | $c \leq 0.45$ | Minor |  |
| Size (mm)                          |   |             |              |            |               |       |  |
| $a \leq 0.5$                       |   |             |              |            |               |       |  |
| b : Ignore                         |   |             |              |            |               |       |  |
| $c \leq 0.45$                      |   |             |              |            |               |       |  |
| Glass Chipping [Rear of Pad Area ] |  <table border="1"> <thead> <tr> <th>Size (mm)</th> </tr> </thead> <tbody> <tr> <td><math>a \leq 0.5</math></td> </tr> <tr> <td>b : Ignore</td> </tr> <tr> <td><math>c \leq 0.45</math></td> </tr> </tbody> </table> | Size (mm)   | $a \leq 0.5$ | b : Ignore | $c \leq 0.45$ | Minor |  |
| Size (mm)                          |   |             |              |            |               |       |  |
| $a \leq 0.5$                       |   |             |              |            |               |       |  |
| b : Ignore                         |   |             |              |            |               |       |  |
| $c \leq 0.45$                      |   |             |              |            |               |       |  |
| Glass Chipping [ Except Pad Area ] |  <table border="1"> <thead> <tr> <th>Size (mm)</th> </tr> </thead> <tbody> <tr> <td><math>a \leq 0.5</math></td> </tr> <tr> <td>b : Ignore</td> </tr> <tr> <td><math>c \leq 0.45</math></td> </tr> </tbody> </table> | Size (mm)   | $a \leq 0.5$ | b : Ignore | $c \leq 0.45$ | Minor |  |
| Size (mm)                          |   |             |              |            |               |       |  |
| $a \leq 0.5$                       |   |             |              |            |               |       |  |
| b : Ignore                         |   |             |              |            |               |       |  |
| $c \leq 0.45$                      |   |             |              |            |               |       |  |



| Item  | Criterion for Defects  | Defect Type | Remark            |              |       |              |   |       |  |
|---|--|-------------|-------------------|--------------|-------|--------------|---|-------|--|
| <p><b>Glass Chipping [ Corner ]</b></p>  | <table border="1" data-bbox="790 481 965 593"> <thead> <tr> <th>Size (mm)</th> </tr> </thead> <tbody> <tr> <td><math>a \leq 3.0</math></td> </tr> <tr> <td><math>b \leq 3.0</math></td> </tr> </tbody> </table> <p>No Touch Sealant and Gate Line<br/>No Touch Signal line<br/>No Touch Customers Align Mark</p> | Size (mm)   | $a \leq 3.0$      | $b \leq 3.0$ | Minor |              |   |       |  |
| Size (mm)   |  |             |                   |              |       |              |   |       |  |
| $a \leq 3.0$  |  |             |                   |              |       |              |   |       |  |
| $b \leq 3.0$  |  |             |                   |              |       |              |   |       |  |
| <p><b>Glass burr</b></p>                | <table border="1" data-bbox="710 996 1061 1108"> <thead> <tr> <th>Size (mm)</th> <th>Acceptable Number</th> </tr> </thead> <tbody> <tr> <td>x : Ignore</td> <td></td> </tr> <tr> <td><math>y \leq 0.2</math></td> <td>4</td> </tr> </tbody> </table> <p>If <math>y1 &gt; y2</math> then <math>y = y1</math></p>  | Size (mm)   | Acceptable Number | x : Ignore   |       | $y \leq 0.2$ | 4 | Minor |  |
| Size (mm)   | Acceptable Number  |             |                   |              |       |              |   |       |  |
| x : Ignore  |  |             |                   |              |       |              |   |       |  |
| $y \leq 0.2$  | 4  |             |                   |              |       |              |   |       |  |

## 9.2 Inspection Method

### 9.2.1 Ambient conditions

- a. Temperature : **25±5°C**
- b. Humidity : **65±10% RH**
- c. Illumination : **Single fluorescent lamp non-directive (300 to 700 Lux)**
- d. LCM Brightness : **Minimum 120 cd/m<sup>2</sup> (with Polarizer)**

### 9.2.2 Viewing distance

The distance between the LCD and the inspector's eyes shall be at least 30-50 cm.

### 9.2.3 Viewing Angle

Display Quality: The inspection shall be conducted within normal viewing angle range.



### 9.3 Classification of defects

Defects are classified as either a major defect or a minor defect based on the degree of defect defined herein.

#### 9.3.1 Major defect

The major defect is a defect that is likely to result in product failure, or reduction in the product's intended usage.

#### 9.3.2 Minor defect

The minor defect is a defect that has little bearing on the effective use or operation of the product. The Customer shall return the rejected LCD to the place to be designated by the Supplier and the Supplier shall screen all of the products in the lot and repair or replace the defective LCDs.

### 9.4 Incoming inspection Right

The Customer shall have the right to conduct at its own cost and expense, an incoming inspection of the LCDs at the destination specified in the relevant B/L(Bills of Lading) in accordance with the LCD's specifications separately agreed upon and the inspection criteria set forth in this article.

The Customer shall notify the Supplier in writing of the inspection results(acceptance or rejectance) in accordance with the said Incoming Inspection Standard within 40 days from the date of the B/L. Should the Customer fail to notify the results to Supplier within 40 days period, the right to reject the LCDs shall then lapse, and the said LCDs shall be deemed to have been accepted by the Customer.

### 9.5 Handling Precautions

- LCD Devices are made of fragile material such as Glass and may be broken or cracked if dropped it, so **PLEASE** handle them with care.
- Please **DO NOT** touch the surface of the Glass.
- **PLEASE** wear the Wrist Strap when handling.  
Semiconductive devices are included in the LCD and they should be handled with care to prevent any electrostatic discharge(ESD).
- **PLEASE** keep the LCDs in the specified, original packing boxes when storage.
- Before use the LCDs, **PLEASE** check the Engineering specification.
- LCDs contain a small amount of Liquid Crystal. **PLEASE** follow local ordinances or regulations for disposal.

“Varitronix Limited reserves the right to change this specification.”

URL:<http://www.varitronix.com>

- END -