A Brighter Solution

# AMP DISPLAY INC.

## SPECIFICATIONS

## 5.0-in COLOR TFT MODULE

| | |
|---|---|
| CUSTOMER: | |
| CUSTOMER PART NO. | |
| AMP DISPLAY PART NO. | A M - 8 0 0 4 8 0 L T M Q W - W 0 H |
| APPROVED BY: | |
| DATE: | |

☐ APPROVED FOR SPECIFICATIONS

☐ APPROVED FOR SPECIFICATION AND PROTOTYPES

**AMP DISPLAY INC**

9856 SIXTH STREET RANCHO CUCAMONGA CA 91730

TEL: 909-980-13410 FAX: 909-980-1419

WWW.AMPDISPLAY.COM

# RECORD OF REVI SION

| Revision Date | Page | Contents | Editor |
|---|---|---|---|
| 2009/01/09 | - | New Release | Emil |
| 2009/02/11 | 8 | Modify the pin definition. | Emil |
| 2009/03/25 | - | Issued the official part No. to AM-800480LTMQW-W0H.\ | Emil |
| 2009/5/7 | - | Modify Color chromaticity | Kokai |
| 2009/07/02 | 7 | Modify the Luminance to 470cd/$m^2$. | Emil |

# 1 Features

5 inch Amorphous-TFT-LCD (Thin Film Transistor Liquid Crystal Display) module. This module is composed of a 5" TFT-LCD panel, LCD controller, power driver circuit, LED driver circuit and backlight unit.

1.1 TFT Panel Feature :

(1) Construction: 5" a-Si color TFT-LCD, White LED Backlight and PCB.
(2) Resolution (pixel): 800(R.G.B) X480
(3) Number of the Colors : Real 262K colors ( R , G , B 6 bit digital each)
(4) LCD type : Transmissive Color TFT LCD ( normally White)
(5) Interface: 40 pin pitch 0.5 FFC
(6) Power Supply Voltage: 3.3V single power input. Built-in power supply circuit.

1.2 LCD Controller Feature:

(1) MCU interface: i80/M68 series MCU interface (default: i80 series).
(2) Pixel data format: 8, 9, 16 and 18 bit.
(3) Display RAM size: Built-in 1215K bytes frame buffer. Support up to 864 x 480 at 24bpp display.
(4) Arbitrary display memory starts position selection.
(5) 16 bit interface support 65K (R5 G6 B5) Color.

# 2 Ph ysical specifications

| Item | Specifications | Unit |
|---|---|---|
| Display resolution(dot) | 2400(W) x 480(H) | dot |
| Active area | 108.0(W) x 64.8(H) | mm |
| Screen size | 5(Diagonal) | inch |
| Pixel size | 0.135 (W) x 0.135(H) | mm |
| Color configuration | R.G.B stripe | |
| Overall dimension | 118.5(W)x77.1.H) x 6.17(D) | mm |
| Weight | T.B.D | g |
| Backlight unit | LED | |

# 3 Electrical specification

## 3.1 Absolute max. ratings

### 3.1.1 Electrical Absolute max. ratings

| Item Sy | mbol | Condition | Min. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| Power voltage | VDD | VSS=0 | -0.3 | 4.6 | V | |
| Input voltege | $V_{in}$ | | -0.3 | VDD+0.3 | V | Note 1 |

Note1: /CS,/WR,/RD,RS,DB0~DN17

### 3.1.2 Environmental Absolute max. ratings

| Item | OPERATING ST | | ORAGE | | Remark |
|---|---|---|---|---|---|
| | MIN | MAX | MIN | MAX | |
| Temperature | -20 | 70 | -30 | 80 | Note2,3,4,5,6,7 |
| Humidity | Note1 | | Note1 | | |
| Corrosive Gas | Not Acceptable | | Not Acceptable | | |

Note1 : Ta <= 40℃ : 85% RH max

Ta > 40℃ : Absolute humidity must be lower than the humidity of 85%RH at 40℃

Note2 : For storage condition Ta at -30℃ < 48h , at 80℃ < 100h

For operating condition Ta at -20℃ < 100h

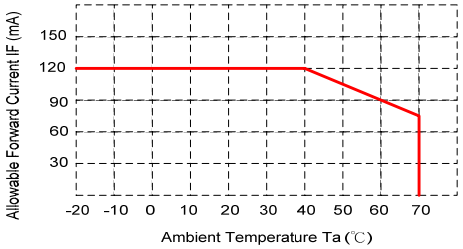
Note3 : Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

Note4 : The response time will be slower at low temperature.

Note5 : Only operation is guarantied at operating temperature. Contrast , response time, another display quality are evaluated at +25℃

Note6 :

- LED BL : When LCM is operated over 40℃ ambient temperature, the $I_{LED}$ of the LED back-light should be follow :




Note7 : This is panel surface temperature, not ambient temperature.

Note8 :

- LED BL: When LCM be operated over than 40℃, the life time of the LED back-light will be reduced.

## 3.2 Electrical characteristics

### 3.2.1 DC Electrical characteristic of the LCD

Typical operting conditions (VSS=0V)

| Item | | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|
| Power supply | | VDD | 3.0 | 3.3 | 4 | V | |
| Input Voltage for logic | H Level | $V_{IH}$ | 0.7 VDD | -- | VDD | V | Note 1 |
| | L Level | $V_{IL}$ | VSS | -- | 0.3 VDD | V | |
| Power Supply current | | IDD | - | T.B.D | - | mA | Note 2 |

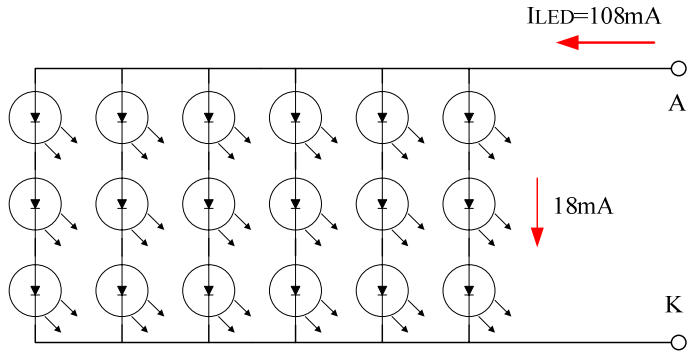
Note 1: MCU Interface controller and I/O pin.

Note 2: fV =60Hz , Ta=25℃ , Display pattern : All Black

*:Will be reference only

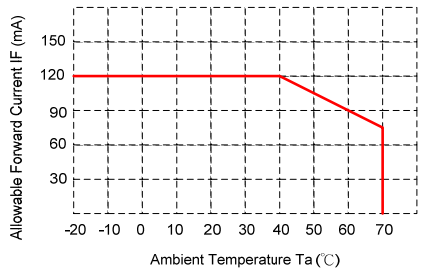
### 3.2.2 Electrical characteristic of LED Back-light

| Paramenter | Symbol | Min. | Typ. | Max. | Unit | Condiction |
|---|---|---|---|---|---|---|
| LED voltage | $V_{AK}$ | -- | 9.9 | 10.8 | V | $I_{LED}$ =108mA,Ta=25℃ |
| LED forward current | $I_{LED}$ | -- | 108 | 120 | mA | Ta=25℃ |
| Lamp life time | | -- | T.B.D. | - | Hr | $I_{LED}$ =40mA,Ta=25℃ |

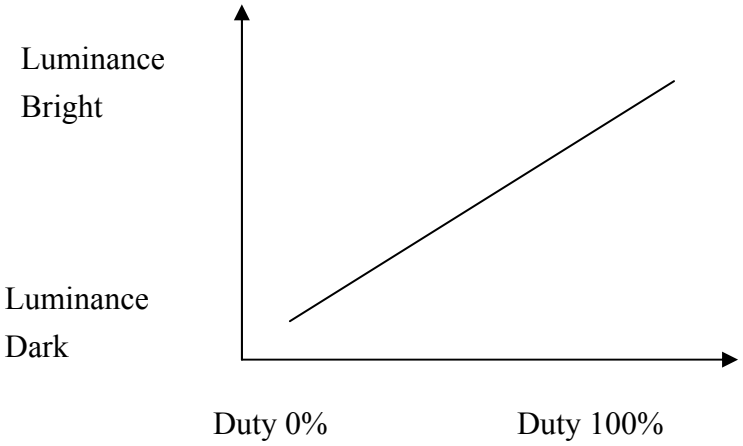


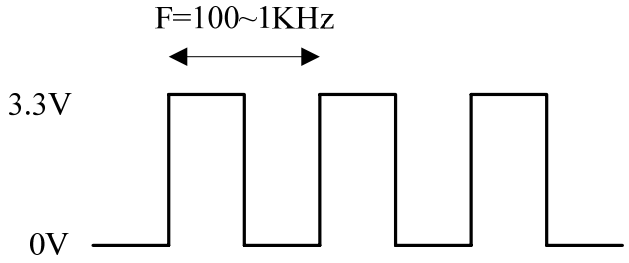

■ The constant current source is needed for white LED back-light driving.

When LCM is operated over 60℃ ambient temperature, the $I_{LED}$ of the LED back-light should be adjusted to 15mA max(For one dice LED).



### 3.2.3 PWM Dimming Control




Note: the PWM dimming control by register 0xBE (software).

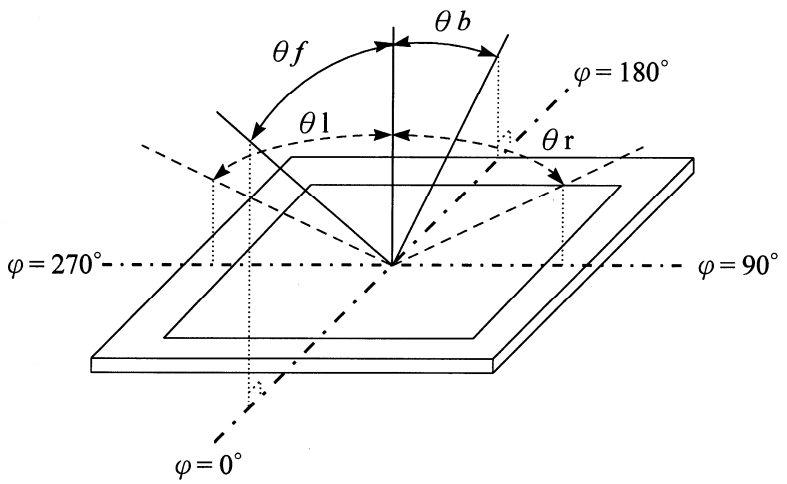
# 4 Optical specification

## 4.1 Optical characteristic:

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Viewing Angle | Front | θ f | CR≧10 | -- | 70 | -- | deg. | (1)(2)(3) |
| | Back | θ b | | -- | 50 | -- | | |
| | Left | θ l | | -- | 70 | -- | | |
| | Right | θ r | | -- | 70 | -- | | |
| Contrast ratio | | CR | Θ=Φ=0° | 150 | 250 | -- | -- | (1)(3) |
| Response Time | | $T_r$ | Θ=Φ=0° | -- | 15 | 30 | ms | (1)(4) |
| | | $T_f$ | | -- | 35 | 50 | ms | (1)(4) |
| Color chromaticity | Red | Rx | Θ=Φ=0° | 0.585 | 0.615 | 0.645 | -- | (1) |
| | | Ry | | 0.314 | 0.344 | 0.374 | | |
| | Green | Gx | | 0.277 | 0.307 | 0.337 | | |
| | | Gy | | 0.532 | 0.562 | 0.592 | | |
| | Blue | Bx | | 0.103 | 0.133 | 0.163 | | |
| | | By | | 0.120 | 0.150 | 0.180 | | |
| | White | Wx | | 0.279 | 0.309 | 0.339 | | |
| | | Wy | | 0.320 | 0.350 | 0.380 | | |
| Luminance | | L | Θ=Φ=0° | - | 470 | -- | $cd/m^2$ | (1)(5) (ILED=125mA) |
| Luminance Uniformity | | ΔL | Θ=Φ=0° | 70 | - | - | % | (1)(5)(6) |

Note 1: Ta=25°C. To be measured on the center area of panel after 10 minutes operation.

Note 2: Definition of Viewing Angle



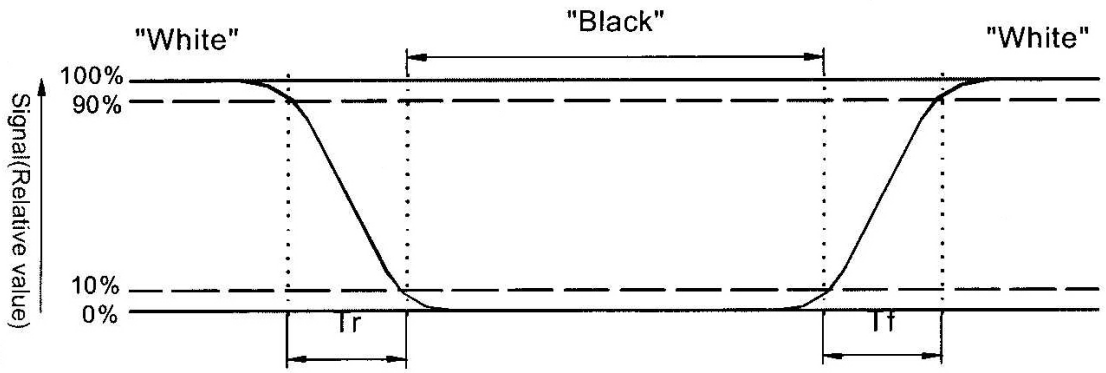

Note 3: Definition of contrast ratio:

Contrast ratio is calculated with the following formula.

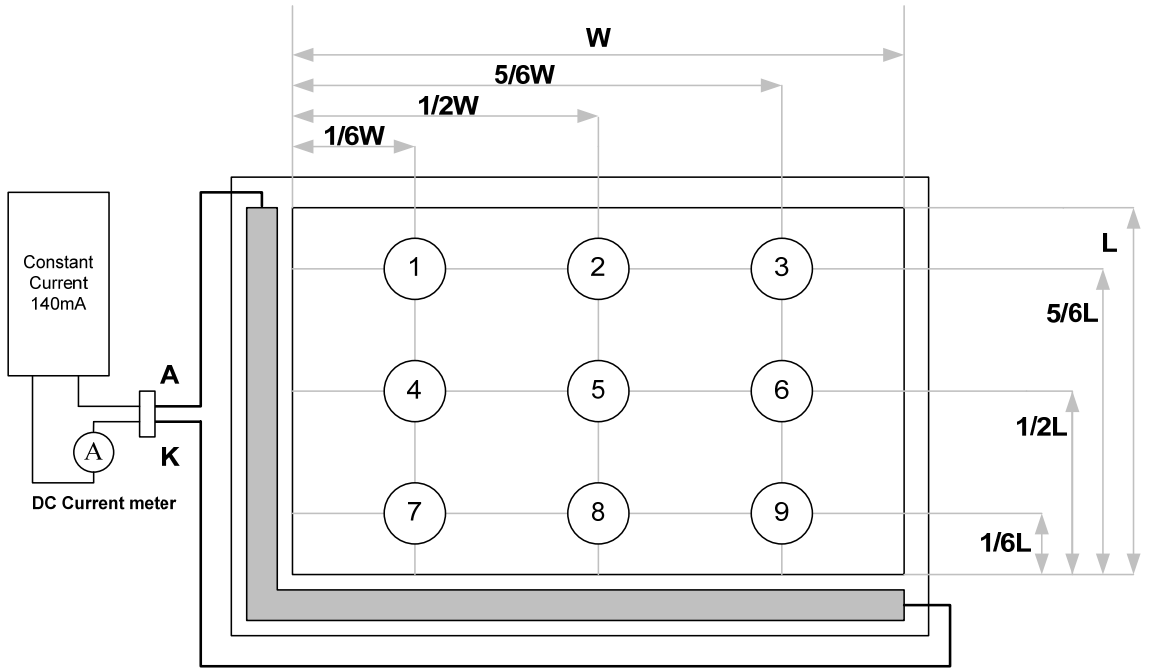
$$\text{Contrast ratio(CR)} = \frac{\text{Photo detector output when LCD is at ”White” state}}{\text{Photo detector Output when LCD is at “Black” state}}$$

Note 4: Definition of response time:

The output signals of photo detector are measured when the input signals are changed from “black“ to “white”(falling time) and from ”white” to “black” (rising time) respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as below.




Note 5 : Luminance is measured at point 5 of the display.




Note 6 : Definition of Luminance Uniformity

ΔL = [ L(min.) of 9 points / L(max.) of 9 points] X 100%

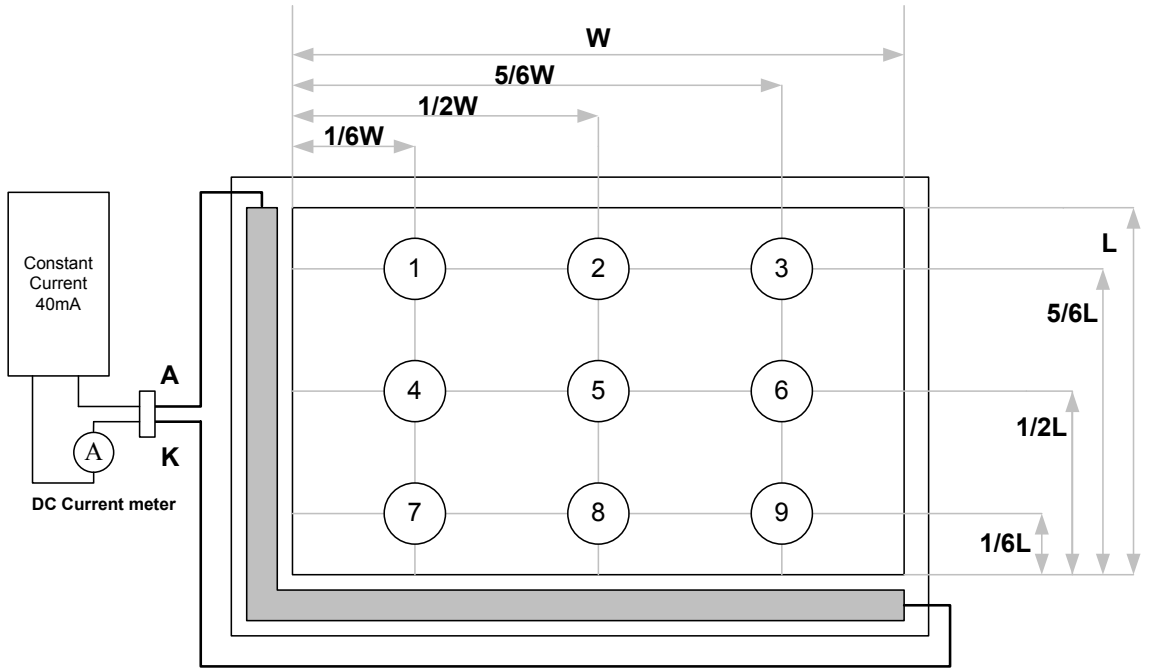
### 4.2 Optical characteristic of the LED Back-light

| ITEM MIN | | TYP | MAX | UNIT | Condition |
|---|---|---|---|---|---|
| Bare Brightness | 2800 | -- | -- | Cd/m2 | $I_{LED}$ =40mA,Ta=25℃ |
| AVG. X of 1931 C.I.E. | 0.26 | 0.30 | 0.34 | -- | $I_{LED}$ =40mA,Ta=25℃ |
| AVG. Y of 1931 C.I.E. | 0.27 | 0.31 | 0.35 | -- | $I_{LED}$ =40mA,Ta=25℃ |
| Brightness Uniformity | 75 | -- | -- | % | $I_{LED}$ =40mA,Ta=25℃ |

( )For reference only. These data should be update according the prototype.

Note1 : Measurement after 10 minutes from LED BL operating.

Note2 : Measurement of the following 9 places on the display.



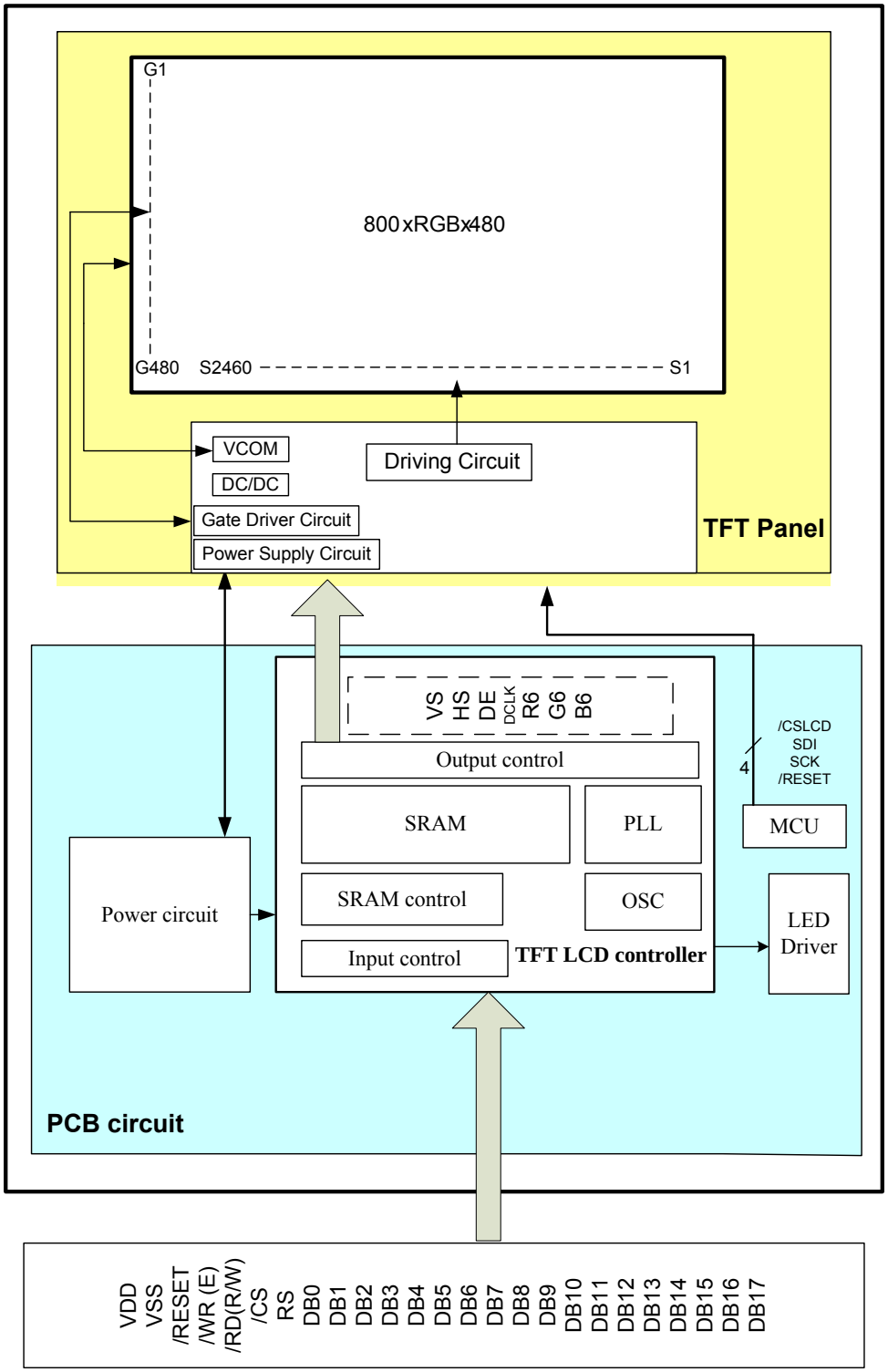

Note3: The Uniformity definition

(Min Brightness / Max Brightness) x 100%

## 5 Interface specifications

| Pin no | Symbol | I/O | Description | Remark |
|---|---|---|---|---|
| 1 | DGND | - | GND | |
| 2 | | | | |
| 3 | VLED | - | Power supply for the LED driver IC (3.3V-5V). | |
| 4 | NC | - | Must be floating. | |
| 5 | /RESET | I | Reset signal for TFT LCD controller. | |
| 6 | RS | I | Register and Data select for TFT LCD controller. | |
| 7 | /CS | I | Chip select low active signal for TFT LCD controller. | |
| 8 | /WR | I | 80mode: /WR low active signal for TFT LCD controller.<br>68mode: E signal latch on rising edge. | |
| 9 | /RD | I | 80mode: /RD low active signal for TFT LCD controller.<br>68mode: R/W signal Hi: read, Lo: write. | |
| 10 | DB0 | I | Data bus. | |
| 11 | DB1 | I | | |
| 12 | DB2 | I | | |
| 13 | DB3 | I | | |
| 14 | DB4 | I | | |
| 15 | DB5 | I | | |
| 16 | DB6 | I | | |
| 17 | DB7 | I | | |
| 18 | DB8 | I | | |
| 19 | DB9 | I | | |
| 20 | DB10 | I | | |
| 21 | DB11 | I | | |
| 22 | DB12 | I | | |
| 23 | DB13 | I | | |
| 24 | DB14 | I | | |
| 25 | DB15 | I | | |
| 26 | DB16 | I | | |
| 27 | DB17 | I | | |
| 28 | NC | - | Must be floating. | |
| 29 | DGND | - | GND | |
| 30 | SK/X1 | - | Must be floating.<br>For Touch Panel. | |
| 31 | DO/X2 | - | | |
| 32 | DI/Y1 | - | | |
| 33 | TPCS/Y2 | - | | |
| 34 | IRQ | - | | |
| 35-37 | VDD | - | Power supply for the logic (3.3V). | |
| 38-40 | DGND | - | GND. | |

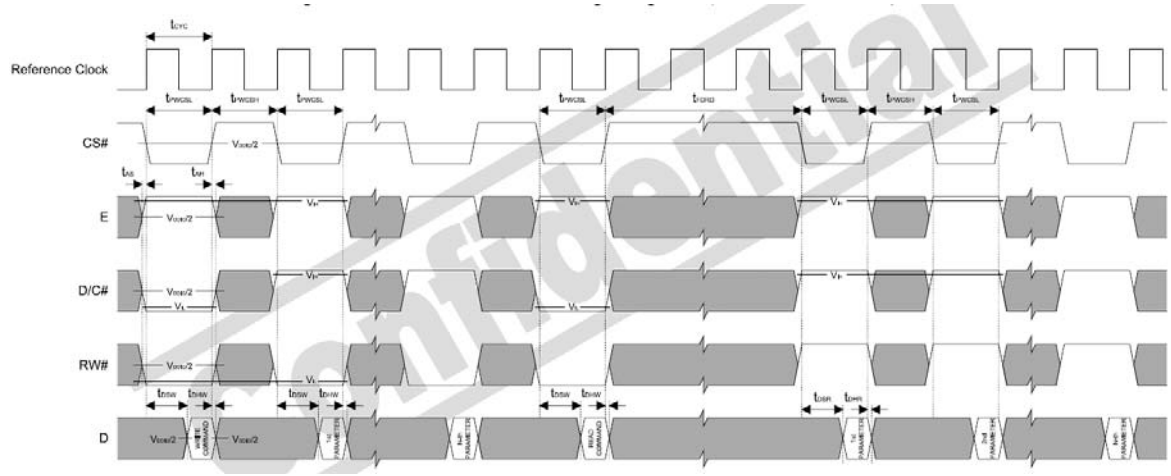
# 6 NBLOCK DIAGRAM



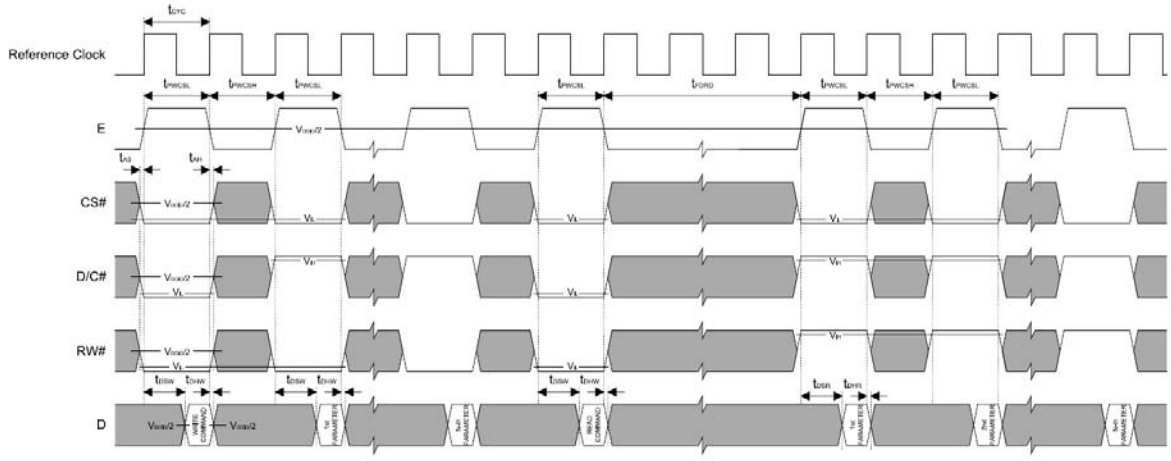
# 7 Interface Protocol

## 7.1 M68 Series

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $t_{CYC}$ | Reference Clock Cycle Time | 9 | - | - | ns |
| $t_{PWCSL}$ | Pulse width CS# or E low | 1 | - | - | $t_{CYC}$ |
| $t_{PWCSH}$ | Pulse width CS# or E high | 1 | - | - | $t_{CYC}$ |
| $t_{FDRD}$ | First Data Read Delay | 5 | - | - | $t_{CYC}$ |
| $t_{AS}$ | Address Setup Time | 1 | - | - | ns |
| $t_{AH}$ | Address Hold Time | 1 | - | - | ns |
| $t_{DSW}$ | Data Setup Time | 4 | - | - | ns |
| $t_{DHW}$ | Data Hold Time | 1 | - | - | ns |
| $t_{DSR}$ | Data Access Time | - | - | 5 | ns |
| $t_{DHR}$ | Output Hold time | 1 | - | - | ns |



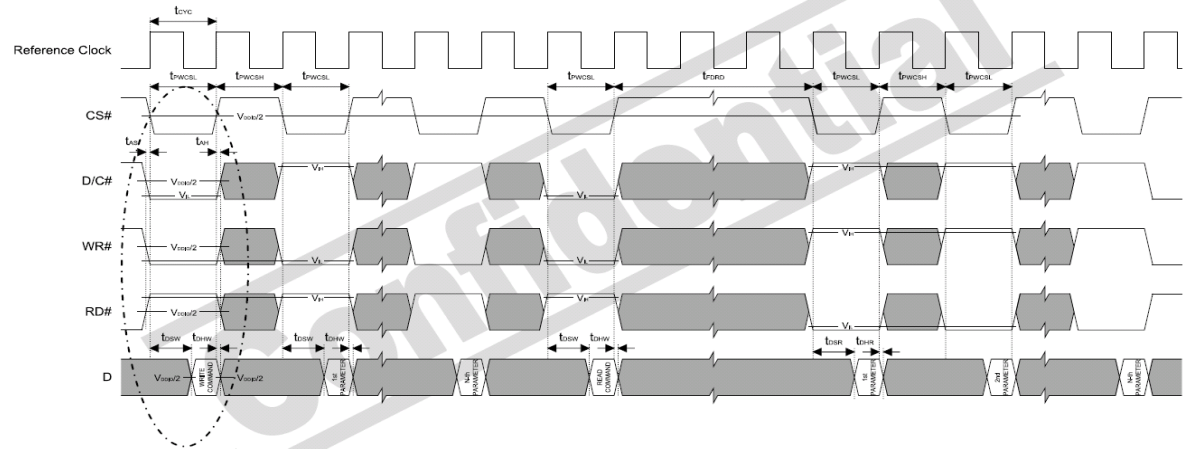

**6800 Mode Timing Diagram (Use CS# as Clock)**

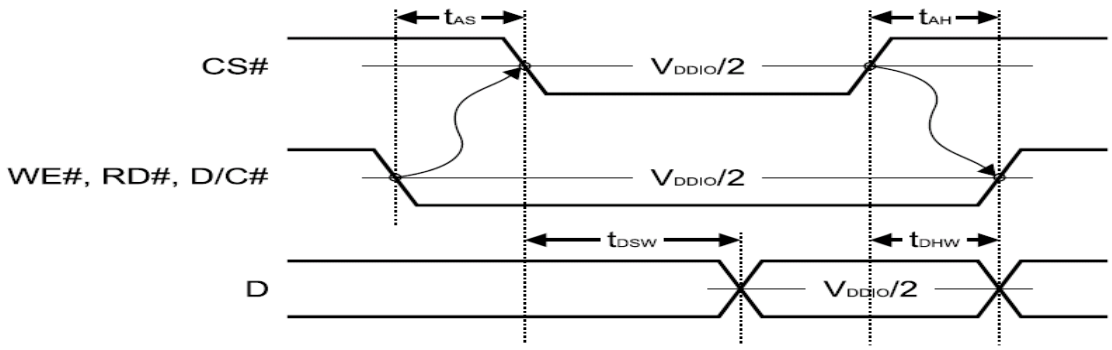



**6800 Mode Timing Diagram (Use E as Clock)**

## 7.2 i80 Series

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $t_{CYC}$ | Reference Clock Cycle Time | 9 | - | - | ns |
| $t_{PWCSL}$ | Pulse width CS# low | 1 | - | - | $t_{CYC}$ |
| $t_{PWCSH}$ | Pulse width CS# high | 1 | - | - | $t_{CYC}$ |
| $t_{FDRD}$ | First Read Data Delay | 5 | - | - | $t_{CYC}$ |
| $t_{AS}$ | Address Setup Time | 1 | - | - | ns |
| $t_{AH}$ | Address Hold Time | 1 | - | - | ns |
| $t_{DSW}$ | Data Setup Time | 4 | - | - | ns |
| $t_{DHW}$ | Data Hold Time | 1 | - | - | ns |
| $t_{DSR}$ | Data Access Time | - | - | 5 | ns |
| $t_{DHR}$ | Output Hold time | 1 | - | - | ns |



## 7.3 Data transfer order Setting

| Interface | Cycle | D[23] | D[22] | D[21] | D[20] | D[19] | D[18] | D[17] | D[16] | D[15] | D[14] | D[13] | D[12] | D[11] | D[10] | D[9] | D[8] | D[7] | D[6] | D[5] | D[4] | D[3] | D[2] | D[1] | D[0] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 bits | 1st | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| 18 bits | 1st | | | | | | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| 16 bits (565 format) | 1st | | | | | | | | | R5 | R4 | R3 | R2 | R1 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 |
| 16 bits | 1st | | | | | | | | | R5 | R4 | R3 | R2 | R1 | R0 | X | X | G5 | G4 | G3 | G2 | G1 | G0 | X | X |
| | 2nd | | | | | | | | | B5 | B4 | B3 | B2 | B1 | B0 | X | X | R5 | R4 | R3 | R2 | R1 | R0 | X | X |
| | 3rd | | | | | | | | | G5 | G4 | G3 | G2 | G1 | G0 | X | X | B5 | B4 | B3 | B2 | B1 | B0 | X | X |
| 9 bits | 1st | | | | | | | | | | | | | | | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 |
| | 2nd | | | | | | | | | | | | | | | | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| 8 bits | 1st | | | | | | | | | | | | | | | | | R5 | R4 | R3 | R2 | R1 | R0 | X | X |
| | 2nd | | | | | | | | | | | | | | | | | G5 | G4 | G3 | G2 | G1 | G0 | X | X |
| | 3rd | | | | | | | | | | | | | | | | | B5 | B4 | B3 | B2 | B1 | B0 | X | X |

X: Don't Care

# 8 Command Table

| Hex Code | Command | Description |
|---|---|---|
| 0x 00 | nop | No operation |
| 0x 01 | soft_reset | Software Reset |
| 0x 0A | get_power_mode | Get the current power mode |
| 0x 0B | get_address_mode | Get the frame memory to the display panel read order |
| 0x 0C | get_pixel_format | Get the current pixel format |
| 0x 0D | get_display_mode | The display module returns the Display Signal Mode. |
| 0x 0E | get_signal_mode | Get the current display mode from the peripheral |
| 0x 10 ent | er_sleep_mode T | urn off the panel.<br>This command will pull low the GPIO0.<br>If GPIO0 is configured as normal GPIO or LCD miscellaneous signal with command set_gpio_conf, this command will be ignored. |
| 0x 11 | exit_sleep_mode | Turn on the panel.<br>This command will pull high the GPIO0.<br>If GPIO0 is configured as normal GPIO or LCD miscellaneous signal with command set_gpio_conf, this command will be ignored. |
| 0x 12 | enter_partial_mode | Part of the display area is used for image display. |
| 0x 13 | enter_normal_mode | The whole display area is used for image display. |
| 0x 20 | exit_invert_mode | Displayed image colors are not inverted. |
| 0x 21 | enter_invert_mode | Displayed image colors are inverted. |
| 0x 26 | set_gamma_curve | Selects the gamma curve used by the display device. |
| 0x 28 | set_display_off | Blanks the display device. |
| 0x 29 | set_display_on | Show the image on the display device. |
| 0x 2A | set_column_address | Set the column extent. |
| 0x 2B | set_page_address | Set the page extent. |
| 0x 2C | write_memory_start | Transfer image information from the host processor interface to the peripheral starting at the location provided by set_column_address and set_page_address. |
| 0x 2E | read_memory_start | Transfer image data from the peripheral to the host processor interface starting at the location provided by set_column_address and set_page_address. |
| 0x 30 | set_partial_area | Defines the partial display area on the display device. |
| 0x 33 | set_scroll_area | Defines the vertical scrolling and fixed area on display area. |
| 0x 34 | set_tear_off | Synchronization information is not sent from the display module to the host processor. |
| 0x 35 | set_tear_on | Synchronization information is sent from the display module to the host processor at the start of VFP. |
| 0x 36 | set_address_mode | Set the read order from frame buffer to the display panel. |
| 0x 37 | set_scroll_start | Defines the vertical scrolling starting point. |
| 0x 38 | exit_idle_mode | Full color depth is used for the display panel. |
| 0x 39 | enter_idle_mode | Reduce color depth is used on the display panel. |
| 0x 3A | set_pixel_format | Defines how many bits per pixel are used in the interface. |
| 0x 3C | write_memory_continue | Transfer image information from the host processor interface to the peripheral from the last written location. |
| 0x 3E | read_memory_continue | Read image data from the peripheral continuing after the last read_memory_continue or read_memory_start. |
| 0x 44 | set_tear_scanline | Synchronization information is sent from the display module to the host processor when the display device refresh reaches the provided scan line. |
| 0x 45 | get_scanline | Get the current scan line. |
| 0x A1 | read_ddb | Read the DDB from the provided location. |
| 0x B0 | set_lcd_mode_pad_size | Set the LCD panel mode (RGB TFT or TTL). |
| 0x B1 | get_lcd_mode_pad_size | Get the current LCD panel mode, pad strength and resolution. |
| 0x B4 | set_hori_period | Set front porch. |
| 0x B5 | get_hori_period | Get current front porch settings. |
| 0x B6 | set_vert_period | Set the vertical blanking interval between last scan line and next LFRAME pulse. |
| 0x B7 | get_vert_period | Set the vertical blanking interval between last scan line and next LFRAME |

| | | |
|---|---|---|
| | | pulse. |
| 0x B8 | set_gpio_conf | Set the GPIO configuration.<br>If the GPIO is not used for LCD, set the direction.<br>Otherwise, they are toggled with LCD signals. |
| 0x B9 | get_gpio_conf | Get the current GPIO configuration. |
| 0x BA | set_gpio_value | Set GPIO value for GPIO configured as output. |
| 0x BB | get_gpio_status | Read current GPIO status.<br>If the individual GPIO was configured as input, the value is the status of the corresponding pin.<br>Otherwise, it is the programmed value. |
| 0x BC | set_post_proc | Set the image post processor. |
| 0x BD | get_post_proc | Set the image post processor. |
| 0x BE | set_pwm_conf | Set the image post processor. |
| 0x BF | get_pwm_conf | Set the image post processor. |
| 0x C0 | set_lcd_gen0 | Set the rise, fall, period and toggling properties of LCD signal generator 0 |
| 0x C1 | get_lcd_gen0 | Get the current settings of LCD signal generator 0 |
| 0x C2 | set_lcd_gen1 | Set the rise, fall, period and toggling properties of LCD signal generator 1. |
| 0x C3 | get_lcd_gen1 | Get the current settings of LCD signal generator 1. |
| 0x C4 | set_lcd_gen2 | Set the rise, fall, period and toggling properties of LCD signal generator 2. |
| 0x C5 | get_lcd_gen2 | Get the current settings of LCD signal generator 2. |
| 0x C6 | set_lcd_gen3 | Set the rise, fall, period and toggling properties of LCD signal generator 3. |
| 0x C7 | get_lcd_gen3 | Get the current settings of LCD signal generator 3. |
| 0x C8 | set_gpio0_rop | Set the GPIO0 with respect to the LCD signal generators using ROP3 operation. No effect if the GPIO0 is configured as general GPIO. |
| 0x C9. | get_gpio0_rop | Get the GPIO0 properties with respect to the LCD signal generators. |
| 0x CA | set_gpio1_rop | Set the GPIO1 with respect to the LCD signal generators using ROP3 operation. No effect if the GPIO1 is configured as general GPIO. |
| 0x CB | get_gpio1_rop | Get the GPIO1 properties with respect to the LCD signal generators. |
| 0x CC | set_gpio2_rop | Set the GPIO2 with respect to the LCD signal generators using ROP3 operation. No effect if the GPIO2 is configured as general GPIO. |
| 0x CD | get_gpio2_rop | Get the GPIO2 properties with respect to the LCD signal generators. |
| 0x CE | set_gpio3_rop | Set the GPIO3 with respect to the LCD signal generators using ROP3 operation. No effect if the GPIO3 is configured as general GPIO. |
| 0x CF | get_gpio3_rop | Get the GPIO3 properties with respect to the LCD signal generators. |
| 0x D0 | set_abc_dbc_conf | Set the ambient back light and dynamic back light configuration. |
| 0x D1 | get_abc_dbc_conf | Get the ambient back light and current dynamic back light configuration. |
| 0x D4 | set_dbc_th | Set the threshold for each level of power saving. |
| 0x D5 | get_dbc_th | Get the threshold for each level of power saving. |
| 0x E0 | set_pll_start | Start the PLL. Before the start, the system was operated with the crystal oscillator or clock input. |
| 0x E2 | set_pll_mnk | Set the PLL. |
| 0x E3 | get_pll_mnk | Get the PLL settings. |
| 0x E4 | get_pll_status | Get the current PLL status. |
| 0x E5 | set_deep_sleep | Set deep sleep mode. |
| 0x E6 | set_lshift_freq | Set the LSHIFT (pixel clock) frequency. |
| 0x E7 | get_lshift_freq | Get current LSHIFT (pixel clock) frequency setting. |
| 0x F0 | set_pixel_data_interface | Set the pixel data format of the parallel host processor interface. |
| 0x F1 | get_pixel_data_interface | Get the current pixel data format settings. |

About the further detail, please refer the datasheet of SSD1963.

# 9 Initial sequence

```
void SSD1963_initial(void)
{
    u16 i;
    // Set PLL frequency
    LCD_WRITE_A0(0xe2);                                    //Set PLL:
VCO (> 250MHz) = OSC x (N + 1)
    LCD_WRITE_A1(MULTIPLIER_N);
//Multiplier N, VCO = 360MHz
    LCD_WRITE_A1(DIVIDER_M);                               //Divider
M, PLL = 120MHz (Standard)
    LCD_WRITE_A1(0x54);                                    //dummy
write, no meaning. PLL = VCO / (M + 1)

    LCD_WRITE_A0(0xe0);
//Command: Set SSD1961 PLL
    LCD_WRITE_A1(0x01);                                    //Turn on
PLL
    Delay(50);                                             // Delay for
PLL stable
    LCD_WRITE_A0(0xe0);
//Command: Set SSD1961 PLL
    LCD_WRITE_A1(0x03);                                    //Switch
the clock source to PLL

    LCD_WRITE_A0(0x01);                                    //Command:
Soft reset SSD1963
    Delay(50);                                             // Delay for
RESET
    LCD_WRITE_A0( 0xE6);                                   // pclk = pll
freq * (setting + 1) / 0x100000        //Set LSHIFT frequency
    LCD_WRITE_A1( (LCDC_FPR&0x000F0000)>>16);              //Remark:
0x100000 must be divided by (setting+1), otherwise, pclk may oscilate
    LCD_WRITE_A1( (LCDC_FPR&0x0000FF00)>>8);               //pclk =
5MHz
    LCD_WRITE_A1( (LCDC_FPR&0x000000FF));                  //refresh
rate = 5MHz / (336 * 244) = 60.98Hz
```

```
    LCD_WRITE_A0( 0xb0);                                    // display
period          //Set LCD mode / pad strength
    LCD_WRITE_A1( Polarity);                                // [B5:0] -
18Bit [B2:1] LSHIFT data latch falling edge [B1:0] LLINE active low [B0:0] -
LFRAME active low
    LCD_WRITE_A1( 0x00);
    LCD_WRITE_A1( ((Resolution_X-1)&0xFF00)>>8);            //0x13F =
320 - 1 (Horizontal)
    LCD_WRITE_A1( (Resolution_X-1)&0x00FF);
    LCD_WRITE_A1( ((Resolution_Y-1)&0xFF00)>>8);            //0x0ef = 240
- 1 (Vertical)
    LCD_WRITE_A1( (Resolution_Y-1)&0x00FF);



    LCD_WRITE_A0( 0xb4);                                    // hsync
    LCD_WRITE_A1( ((H_Sync_total-1)&0xFF00)>>8);            // ht
LCD_TOTAL_WIDTH - 1
    LCD_WRITE_A1( (H_Sync_total-1)&0x00FF);
    LCD_WRITE_A1( (H_Sync_to_DE&0x0700)>>8);
    LCD_WRITE_A1( (H_Sync_to_DE)&0x00FF);                       //
Horizontal Start 8 pclks
    LCD_WRITE_A1( H_Sync_Pluse_Wide - 1);                       // pulse
width = setting + 1 clock = 2 clock
    LCD_WRITE_A1( 0x00);
    LCD_WRITE_A1( 0x00);

    LCD_WRITE_A0( 0xb6);                                    // vsync
    LCD_WRITE_A1( ((V_Sync_total-1)&0xFF00)>>8);            // vt 244-1
    LCD_WRITE_A1( (V_Sync_total-1)&0x00FF);
    LCD_WRITE_A1( (V_Sync_to_DE&0x0700)>>8);
    LCD_WRITE_A1( (V_Sync_to_DE)&0x00FF);                       // Vertical
Start Position: 2 line
    LCD_WRITE_A1( V_Sync_Pluse_Wide - 1);                   // pulse width
= setting + 1 line = 2 line
    LCD_WRITE_A1( 0x00);
    LCD_WRITE_A1( 0x00);

    LCD_WRITE_A0( 0x29); // display on
```

```
    Delay(50);

    LCD_WRITE_A0( 0xb8);                                    // config gpio
    LCD_WRITE_A1( 0x0f);
    LCD_WRITE_A1( 0x01);

    LCD_WRITE_A0( 0xb9);                                    // config gpio
    LCD_WRITE_A1( 0x0f);
    LCD_WRITE_A1( 0x01);




    LCD_WRITE_A0( 0xba);        // Set GPIO
    LCD_WRITE_A1( 0x03);          // [GPIO3,GPIO2,GPIO1,GPIO0]

    //Set X Address
    LCD_WRITE_A0( 0x2a);
    LCD_WRITE_A1( 0x00);
    LCD_WRITE_A1( 0x00);
    LCD_WRITE_A1( ((Resolution_X-1) & 0xFF00)>>8);
    LCD_WRITE_A1( ((Resolution_X-1) & 0x00FF));

    //Set Y Address
    LCD_WRITE_A0( 0x2b);
    LCD_WRITE_A1( 0x00);
    LCD_WRITE_A1( 0x00);
    LCD_WRITE_A1( ((Resolution_Y-1) & 0xFF00)>>8);
    LCD_WRITE_A1( ((Resolution_Y-1) & 0x00FF));

    //Set the read order from frame buffer to the display panel
    LCD_WRITE_A0( 0x36);
    LCD_WRITE_A1( 0x00);
    /*
    //Set the pwm configuration
    LCD_WRITE_A0( 0xBE);
    LCD_WRITE_A1( 0x08);     //Set the PWM frequency in system clock
00h = Fastest    FFh = Slowest
    LCD_WRITE_A1( 0xFF);     //Set the PWM duty cycle   00h = Always low
```

```
FFh = Always high
      LCD_WRITE_A1( 0x01);
                */
      LCD_WRITE_A0( 0xbe);//pwm config
      LCD_WRITE_A1( 0x08);
      LCD_WRITE_A1( 0xff);
      LCD_WRITE_A1( 0x01);//dbc control pwm
//    LCD_WRITE_A1( 0xff);//D[7:0] : DBC manual brightness (00 Dimmest FF
brightest)
//    LCD_WRITE_A1( 0x00);//D[7:0] : DBC minimum brightnesss (00 Dimmest
FF brightest)
//    LCD_WRITE_A1( 0x0F);// F[3:0] : Brightness prescaler (0 Dimmest F
brightest)




      LCD_WRITE_A0( 0xd4);//set threshold;
      LCD_WRITE_A1( 0x00);
      LCD_WRITE_A1( 0x16);
      LCD_WRITE_A1( 0x80);
      LCD_WRITE_A1( 0x00);
      LCD_WRITE_A1( 0x38);
      LCD_WRITE_A1( 0x40);
      LCD_WRITE_A1( 0x00);
      LCD_WRITE_A1( 0x87);
      LCD_WRITE_A1( 0x00);

      LCD_WRITE_A0( 0xd0);//enable dbc
      LCD_WRITE_A1( 0<<6 | 1<<5 | 1<<2 | 1<<0);
                              // A[6] : ABC bypass 0: ABC is not bypassed 1 ABC
is bypassed
                              // A[5] : Transition effect
                                    // 0 Transition effect disable    1 Transition
effect enable
                              // A[3:2] : Energy saving selection for DBC (POR =
00)
                              //            00 DBC is disable    01 Conservative
mode 10 Normal mode 11 Aggressive mode
```

```
                                    // A[0] : Master enable of ABC and DBC
                                    // 0 DBC/ABC is not enabled 1 DBC/ABC is enabled
    // Set
      LCD_WRITE_A0( 0xf0);
      LCD_WRITE_A1( 0x03);

      /*
      LCD_WRITE_A0( 0x30);    //set_partial_area
      LCD_WRITE_A1( 000);
      LCD_WRITE_A1( 100);
      LCD_WRITE_A1( 000);
      LCD_WRITE_A1( 200);
      LCD_WRITE_A0( 0x12); //enter_partial_mode
      */
}
```

# 10 DISPLAYED COLOR AND INPUT DATA

| | Color & Gray Scale | DATA SIGNAL | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R5 | R4 | R3 | R2 | | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | | B1 | B0 |
| Basic Color | Black | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | Red(0) | 1 | 1 | | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | Green(0) | 0 | 0 | | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | Blue(0) | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | | 1 | 1 |
| | Cyan | 0 | 0 | | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 |
| | Magenta | 1 | 1 | | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | | 1 | 1 |
| | Yellow | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | White | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 |
| Red | Black | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | Red(62) | 0 | 0 | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | Red(61) | 0 | 0 | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | : | : | : | : | : | | : | : | : | : | : | : | : | : | : | : | : | : | | : | : |
| | Red(31) | 0 | 1 | | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | : | : | : | : | : | | : | : | : | : | : | : | : | : | : | : | : | : | | : | : |
| | Red(1) | 1 | 1 | | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | Red(0) | 1 | 1 | | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Green | Black | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | Green(62) | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | Green(61) | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | : | : | : | : | : | | : | : | : | : | : | : | : | : | : | : | : | : | | : | : |
| | Green(31) | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | : | : | : | : | : | | : | : | : | : | : | : | : | : | : | : | : | : | | : | : |
| | Green(1) | 0 | 0 | | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | Green(0) | 0 | 0 | | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Blue | Black | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | Blue(62) | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 1 |
| | Blue(61) | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 1 | 0 |
| | : | : | : | : | : | | : | : | : | : | : | : | : | : | : | : | : | : | | : | : |
| | Blue(31) | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | | 1 | 1 |
| | : | : | : | : | : | | : | : | : | : | : | : | : | : | : | : | : | : | | : | : |
| | Blue(1) | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | | 1 | 0 |
| | Blue(0) | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | | 1 | 1 |

# 11 QUALITY AND RELIABILITY

## 11.1 TEST CONDITIONS

Tests should be conducted under the following conditions :

Ambient temperature : 25 ± 5°C

Humidity : 60 ± 25% RH.

## 11.2 SAMPLING PLAN

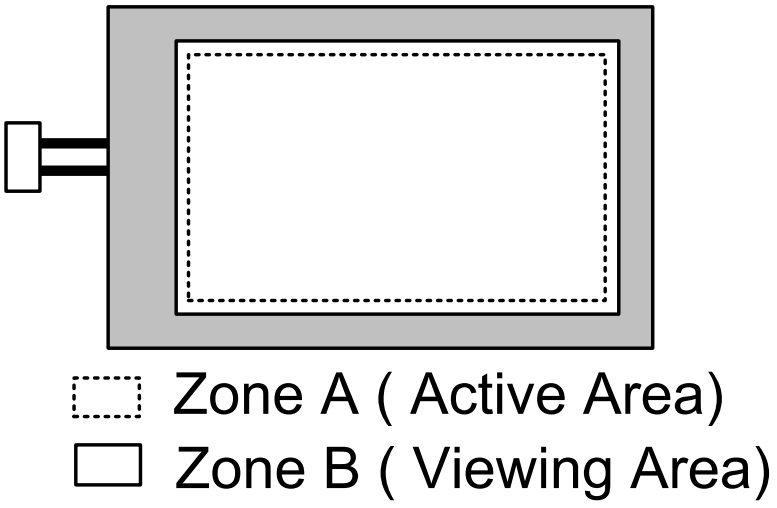
Sampling method shall be in accordance with MIL-STD-105E , level II, normal single sampling plan .

## 11.3 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.

## 11.4 APP EARANCE

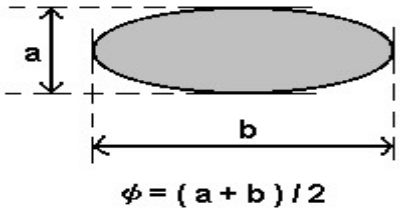
An appearance test should be conducted by human sight at approximately 30 cm distance from the LCD module under flourescent light. The inspection area of LCD panel shall be within the range of following limits.



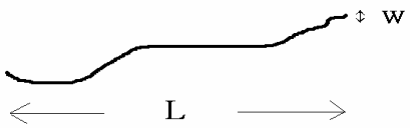
## 11.5 INSPECTION QUALITY CRITERIA

| Defect Type | | | Limit | | | | | | Note |
|---|---|---|---|---|---|---|---|---|---|
| Visual Defect | Internal | Spot | φ＜0.15mm | | | Ignore | | | (1) |
| | | | 0.15mm≦φ≦0.5mm | | | N≦4 | | | |
| | | | 0.5mm＜φ | | | N=0 | | | |
| | | Fiber | 0.03mm<W≦0.1mm, L≦5mm | | | N≦3 | | | (1) |
| | | | 1.0mm＜W, 1.5mm＜L | | | N=0 | | | |
| | | Polarizer Bubble | φ＜0.15mm | | | Ignore | | | (1) |
| | | | 0.15mm≦φ≦0.5mm | | | N≦2 | | | |
| | | | 0.5mm＜φ | | | N=0 | | | |
| | | Mura | It' OK if mura is slight visible through 6%ND filter | | | | | | |
| Electrical Defect | Bright Dot | | A Grade | | | B Grade | | | |
| | | | C Area | O Area | Total | C Area | O Area | Total | (3) |
| | | | N≦0 | N≦2 | N≦2 | N≦2 | N≦3 | N≦5 | (2) |
| | Dark Dot | | N≦2 | N≦3 | N≦3 | N≦3 | N≦5 | N≦8 | |
| | Total Dot | | N≦4 | | | N≦5 | N≦6 | N≦8 | (2) |
| | Two Adjacent Dot | | N≦0 | N≦1 pair | N≦1 pair | N≦1 pair | N≦1 pair | N≦1 pair | (4) |
| | Three or More Adjacent Dot | | Not Allowed | | | | | | |
| | Line Defect | | Not Allowed | | | | | | |

**[Note1]** W : Width[mm], L : Length[mm], N : Number, φ : Average Diameter

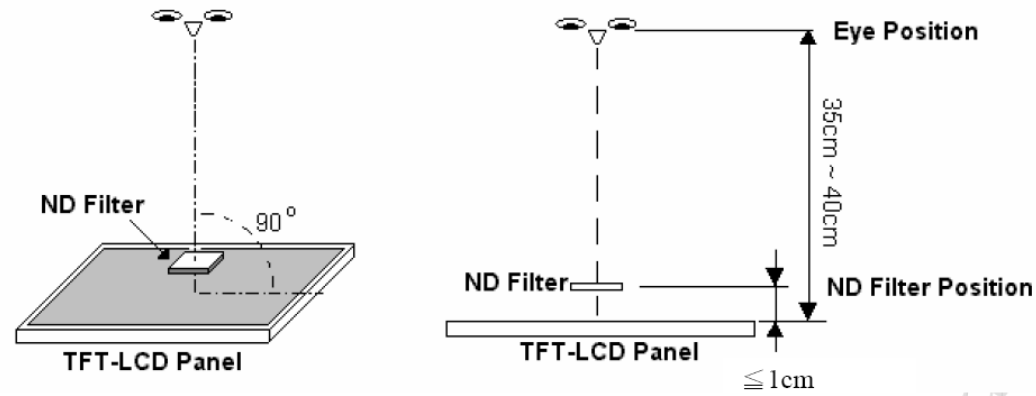



1. (White, black) Spot
2. Polarizer Bubble

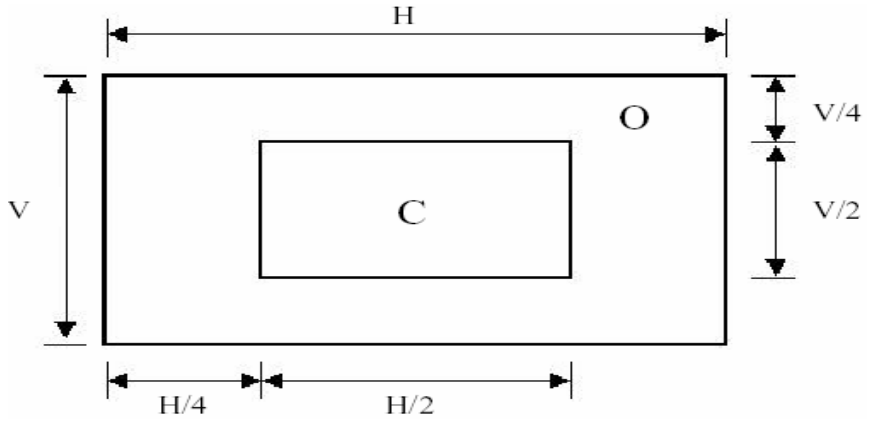



1. fiber

**[Note2]** Bright dot is defined through 6% transmission ND Filter as following.




**[Note3]**

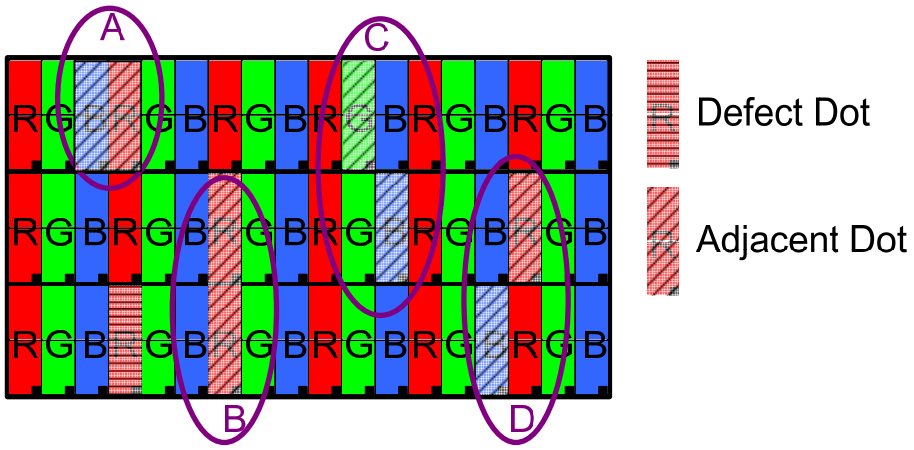



**C Area: Center of display area**

**C Area: Outer of display area**

**[Note4]**

Judge defect dot and adjacent dot as following. Allow below (as A, B, C and D status) adjacent defect dots, including bright and dart adjacent dot. And they will be counted 2 defect dots in total quantity.




(1) The defects that are not defined above and considered to be problem shall be reviewed and discussed by both parties.

(2) Defects on the Black Matrix, out of Display area, are not considered as a defect or counted.

## Reliability test items :

| 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 ~ 80°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<br>150pF 330 ohm ±4kV, 10times contact 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.

# 12 USE PRECAUTIONS

## 12.1 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.

## 12.2 Installing precautions

1) The PCB has many ICs that may be damaged easily by static electricity. 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. 1MΩ 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.

### 12.3 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.

### 12.4 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 dive 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 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.

### 12.5 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.

# 13 OUTLINE DIMENSION

## 13.1 OUTLINEDIMENSION