# PRODUCT SPECIFICATION

PART NUMBER # REV: FLC-104GML6000SA2#00

DESCRIPTION: 10.4" TFT 1024x768 1000CD Full View LVDS with LED Dr

(   )    Preliminary Specification

( V )    Approved Specification

| Customer Name: | |
|---|---|
| **Signature:** | **Date:** |
| | |

| | |
|---|---|
| **PREPARED BY** | **REVIEWED BY** |
| *Mia Huang* | *David* |

# Revision History

| Version | Date | Page | Description | Note |
|---------|------|------|-------------|------|
| V1.0 | 2020/09/21 | | 1st initial | |
| V1.1 | 2020/10/10 | | Revised spec ME | |
| V1.2 | 2021/02/02 | | Review details | |
| | | | | |

## Table of Content

# 1. GENERAL DESCRIPTION

## 1.1 Description

10.4" is a Color Active Matrix Liquid Crystal Display Module composed of a TFT LCD panel and LED backlight system. The screen format is intended to support the XGA, 1024 x768 screen and 16.2M colors.

## 1.2 Product Summary

The following items are summary on the table under Ta=25 °C condition:

| No. | Item | Specification | Unit |
|-----|------|---------------|------|
| 1 | Display Size | 10.4" | Inch |
| 2 | Pixel Number | 1024 (H) x RGB x 768 (V) | Pixels |
| 3 | Outline Dimension | 225.5 (H) ×176.3 (V) ×8.7 (D) | mm |
| 4 | Active Area | 210.4 (H) × 157.8 (V) | mm |
| 5 | Display Colors | 16.2M/262K | - - |
| 6 | Pixel Arrangement | RGB vertical stripe | - - |
| 7 | Display Mode | Normally Black / Transmissive | - - |
| 8 | Electrical Interface | LVDS | |
| 9 | Surface Treatment | Anti-Glare | - - |
| 10 | Brightness | 1,000 (Typ.) | cd/m2 |
| 11 | Viewing Direction | All Direction | - - |
| 12 | Contrast Ratio | 1000 (Typ.) | - - |
| 13 | Total Power Consumption (Typ) | TBD | -- |

# 2. ABSOLUTE MAXIMUM RATING

## 2.1 Electrical Absolute Rating

| Item | Symbol | Values | | Unit | Note |
|------|--------|--------|--------|------|------|
| | | Min | Max. | | |
| Power supply voltage | $V_{CC}$ | -0.3 | 4 | V | |
| Logic Input Voltage | $V_{IN}$ | -0.3 | Vcc+0.3 | V | |

## 2.2 LED Backlight Absolute Rating

| Item | Symbol | Value Min. | Value Max. | Unit | Note |
|---|---|---|---|---|---|
| Converter Voltage | Vi | -0.3 | 18 | V | (1), (2) |
| Enable Voltage | EN | -0.3 | 5.5 | V | |
| Backlight Adjust | ADJ | -0.3 | 5.5 | V | |

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for LED light bar

## 2.3 Environment Absolute Rating

| Item | Symbol | Min | Typ | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Operating Temperature | Top | -30 | | 85 | °C | Ta=25℃ |
| Storage Temperature | Tstg | -30 | | 85 | °C | |

# 3. ELECTRICAL CHARACTERISTICS

## 3.1 LCM

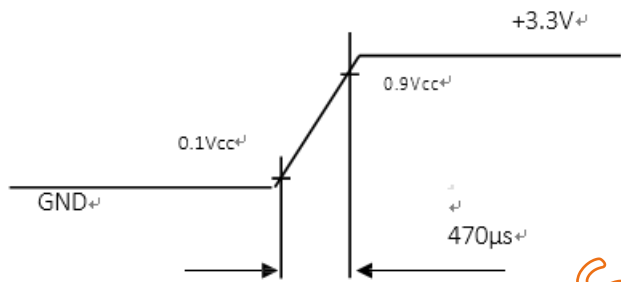| Parameter | | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Power Supply Voltage | | VCC | 3.0 | 3.3 | 3.6 | V | (1) |
| Power Supply Ripple Voltage | | VRP | - | - | 100 | mV | |
| Rush Current | | IRUSH | - | - | 4.0 | A | (2) |
| Power Supply Current | White | - | | TBD | TBD | mA | (3) |
| | Black | | | TBD | TBD | mA | |
| Power Consumption | | $P_L$ | --- | TBD | TBD | W | |
| LVDS differential input voltage | | $V_{ID}$ | 100 | - | 600 | mV | - |
| LVDS common input voltage | | $V_{IC}$ | 1.0 | 1.2 | 1.4 | V | - |
| Logic High Input Voltage | | VIH | 2.3 | - | VCC | V | |
| Logic Low Input Voltage | | VIL | 0 | - | 0.7 | V | |
| LVDS terminating resistor | | RT | - | 100 | - | ohm | |

Note (1) The assembly should be always operated within above ranges.          Ta = 25 ± 2 ºC

Note (2) Measurement Conditions:

FUTURELABS

+3.3V

Q1   2SK1475

Vcc

FUSE

C3

1uF

(LCD Module Input)

R1
47K

(High to Low)
(Control Signal)

Q2
2SK1470

SW

R2

1K

+12V

VR1   47K   C2

C1

0.01uF

1uF
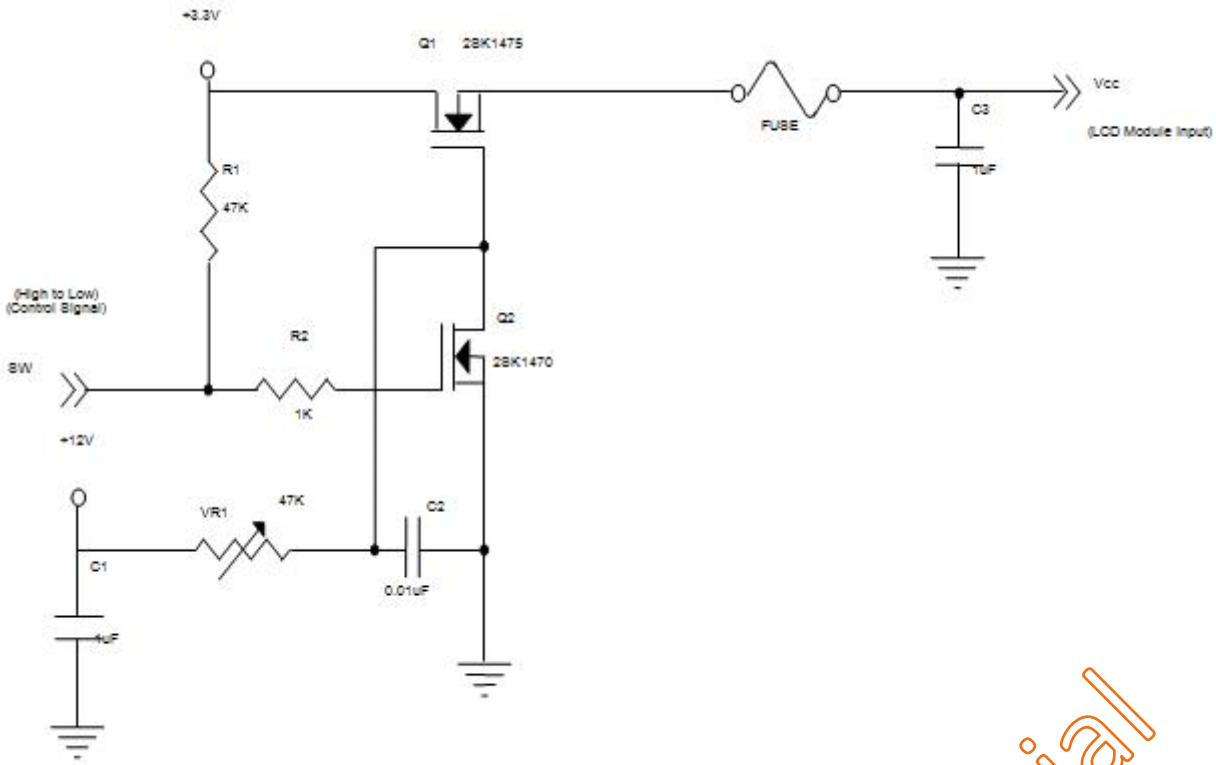
**VCC rising time is 470us**

+3.3V

0.9Vcc

0.1Vcc

GND

470μs

Note (3) The specified power supply current is under the conditions at Vcc = 3.3 V, Ta = 25 ± 2 ºC, f v = 60 Hz, whereas a power dissipation check pattern below is displayed.
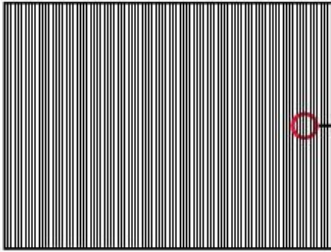
a. White Pattern — Active Area
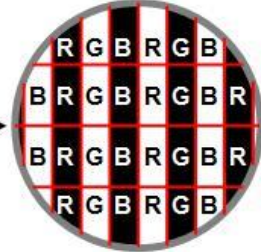


b. Black Pattern — Active Area



c. Vertical Stripe Pattern — Active Area

## 3.2 Backlight Unit

Parameter guideline for LED driving is under stable conditions at 25℃ (Room Temperature):

| Parameter | | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| Converter Power Supply Voltage | | Vi | 10.8 | 12.0 | 13.2 | V | (Duty 100%) |
| Converter Power Supply Ripple Voltage | | ViRP | - | - | | mV | |
| Converter Power Supply Current | | Ii | - | (0.71) | | A | @ Vi = 12V (Duty 100%) |
| Converter Inrush Current | | Ii$_{RUSH}$ | - | - | 3.0 | A | @ Vi rising time = 20ms (Vi =12V) |
| Backlight Power Consumption | | PBL | - | (8.52) | | W | (1),@ Vi = 12V (Duty 100%) |
| EN Control Level | Backlight on | BLON | 2.5 | 3.3 | 5.0 | V | |
| | Backlight off | | 0 | --- | 0.3 | V | |
| PWM Control Level | PWM High Level | E_PWM | 2.5 | 3.3 | 5.0 | V | |
| | PWM Low Level | | 0 | - | 0.15 | V | |
| PWM Noise Range | | VNoise | - | - | 0.1 | V | |
| PWM Control Frequency | | fPWM | 85 | 100 | 20k | Hz | (2) |
| PWM Control Duty Ratio | | - | 1 | | 100 | % | (2), Suggestion@ 190Hz$\leqq$fPWM<1kHz |
| | | | 20 | - | 100 | % | (2), @ 1kHz$\leqq$fPWM$\leqq$20kHz |
| LED Life Time | | LL | 50,000 | - | - | Hrs | (3) |

Note (1) LED current is measured by utilizing a high frequency current meter as shown below:

Note (2) At 100 ~1kHz PWM control frequency, duty ratio range is restricted from 1% to 100%.

1K ~20kHz PWM control frequency, duty ratio range is restricted from 20% to 100%.

If PWM control frequency is applied in the range from 1KHz to 20KHZ, The "non-linear" phenomenon on the Backlight Unit may be found. So It's a suggestion that PWM control frequency should be less than 1KHz.

Note (3) The lifetime of LED is estimated data and defined as the time when it continues to operate under the conditions at Ta = 25 ±2F ℃ and Duty=100% until the brightness becomes ≦ 50% of its original value. Operating LED under high temperature environment will reduce lifetime and lead to color shift.

## 3.2.1 LED Light Bar Connector

LED light bar connector is connected to Back Light Unit with a cable.

| Connector Name / Designation | Lamp Connector / Backlight lamp |
| --- | --- |
| Manufacturer | |
| Type Part Number | A20D/HD2-2P |
| Mating Type Part Number | S2B-PH-SM4-TB |

Light bar cable=25cm

| Connector No. | Pin No. | Input | Color | Function |
| --- | --- | --- | --- | --- |
| | 1 | HV | Red | LED V+ |
| | 2 | LV | Black | LED V- |

LED Light Bar Converter:



← PIN 1
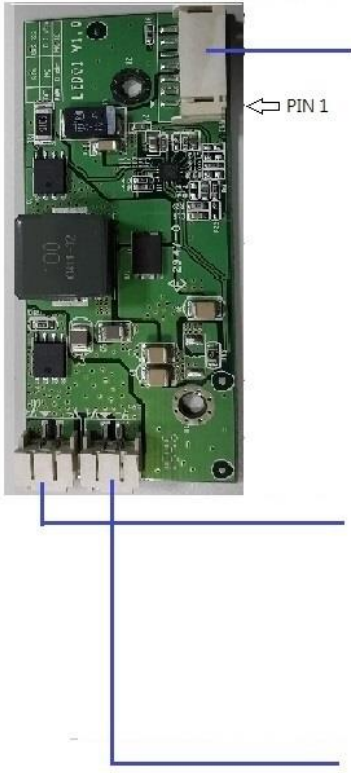
**CN1 : MS24267R / 2.0mm pin pitch (STM)**

| Pin | Description |
|-----|-------------|
| 1 | DC input +12V |
| 2 | DC input +12V |
| 3 | DC input +12V |
| 4 | Ground |
| 5 | PWM Brightness Adj. |
| 6 | Ground |
| 7 | Backlight ON/OFF control |

**CN2 : MS24262R / 2.0mm pin pitch (STM)**

| Pin | Description |
|-----|-------------|
| 1 | LED V+ output |
| 2 | LED V- output |

**CN3 : MS24262R / 2.0mm pin pitch (STM)**

| Pin | Description |
|-----|-------------|
| 1 | LED V+ output |
| 2 | LED V- output |

LED Converter Dimension

**LED Driving Board Outline Dimension**
**Dimension : 75(L)*30(W)*8.65(H)mm**
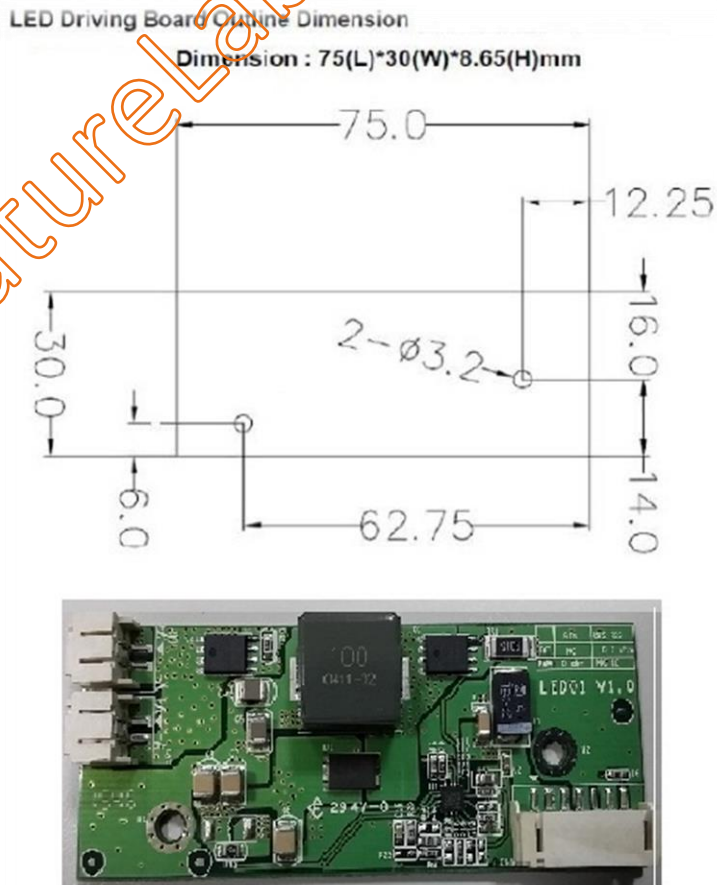
# 4. SIGNAL CHARACTERISTICS

## 4.1 Interface Timing

| Signal | Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|--------|------|--------|------|------|------|------|------|
| LVDS Clock | Frequency | Fc | 57.6 | 65 | 74.5 | MHz | - |
| | Period | Tc | 13.4 | 15.4 | 17.4 | ns | |
| | Input cycle to cycle jitter | $T_{rcl}$ | --- | --- | 200 | ns | (a) |
| | Input Clock to data skew | TLVCCS | -0.02*Tc | --- | 0.02*Tc | ps | (b) |
| | Spread spectrum modulation range | $F_{clkin\_mod}$ | --- | --- | 1.02*Fc | MHz | (c) |
| | Spread spectrum modulation frequency | $F_{SSM}$ | --- | --- | 200 | KHz | |
| | High Time | $T_{ch}$ | --- | 4/7 | --- | $T_{ch}$ | |
| | Low Time | $T_{cl}$ | --- | 3/7 | --- | $T_{ch}$ | |
| Vertical Display Term | Frame Rate | Fr | --- | 60 | --- | Hz | Tv=Tvd+Tvb |
| | Total | Tv | 774 | 806 | 848 | Th | - |
| | Active Display | Tvd | 768 | 768 | 768 | Th | - |
| | Blank | Tvb | 6 | 38 | 80 | Th | - |
| Horizontal Display Term | Total | Th | 1240 | 1344 | 1464 | Tc | Th=Thd+Thb |
| | Active Display | Thd | 1024 | 1024 | 1024 | Tc | - |
| | Blank | Thb | 216 | 320 | 440 | Tc | - |

Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

Note (2) The Tv(Tvd+Tvb) must be integer, otherwise, the module would operate abnormally.

**INPUT SIGNAL TIMING DIAGRAM**



**TIMING DIAGRAM of LVDS**

| | RxOUT23, | RxOUT17, | RxOUT16, | RxOUT11, | RxOUT10, | RxOUT5, | RxOUT27, |
| Rx IN3 | RESERVED | B07 | B06 | G07 | G06 | R07 | R06 |
| | RxOUT26, | RxOUT25, | RxOUT24, | RxOUT22, | RxOUT21, | RxOUT20, | RxOUT19, |
| Rx IN2 | DE | GND | GND | B05 | B04 | B03 | B02 |
| | RxOUT18, | RxOUT15, | RxOUT14, | RxOUT13, | RxOUT12, | RxOUT9, | RxOUT8, |
| Rx IN1 | B01 | B00 | G05 | G04 | G03 | G02 | G01 |
| | RxOUT7, | RxOUT6, | RxOUT4, | RxOUT3, | RxOUT2, | RxOUT1, | RxOUT0, |
| Rx IN0 | G00 | R05 | R04 | R03 | R02 | R01 | R00 |
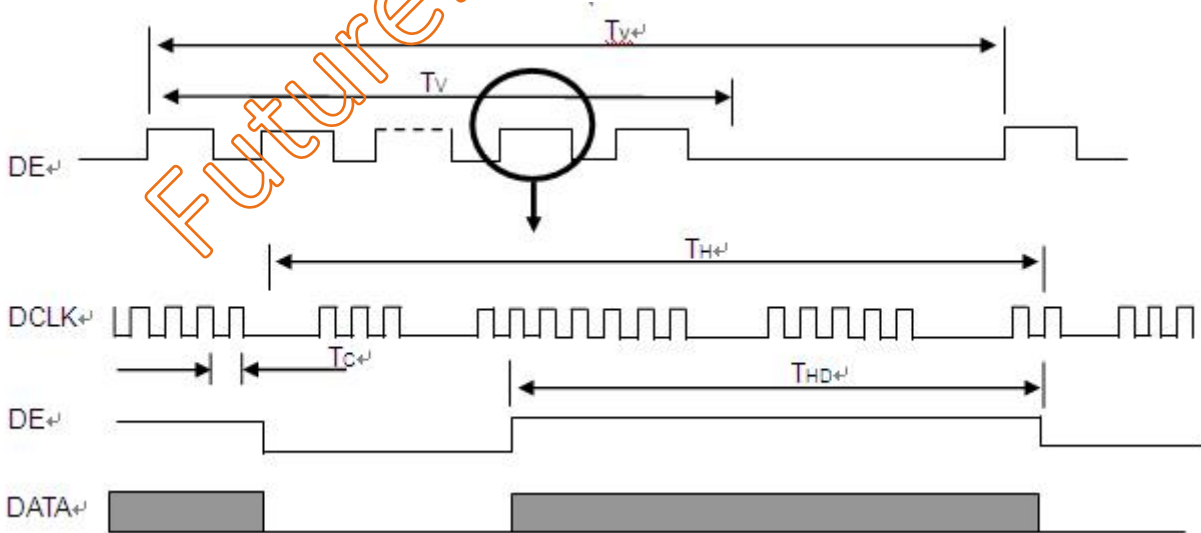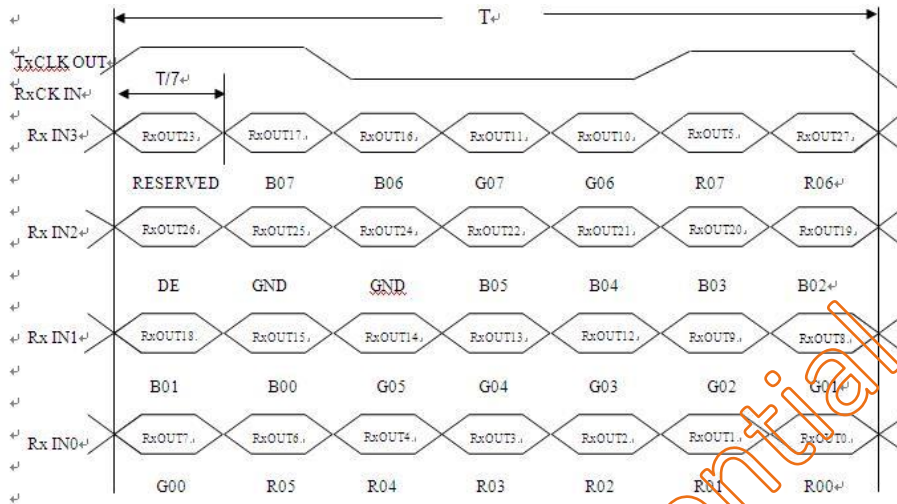
Note (a) The input clock cycle-to-cycle jitter is defined as below figures. Tjcl = I T1 − TI
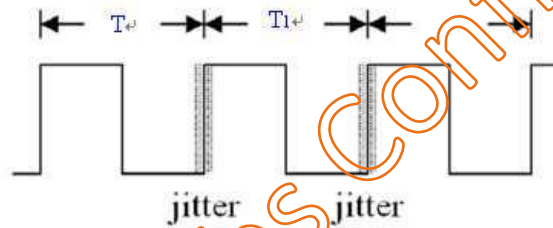
Note (b) Input Clock to data skew is defined as below figures.

**TLVCCS**

LVDS_DATA_3

LVDS_DATA_2

LVDS_DATA_1

LVDS_DATA_0

LVDS_CLOCK
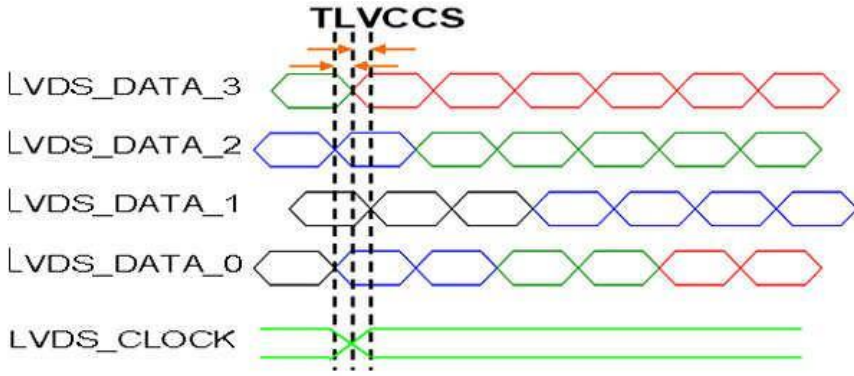
Note (c) The SSCG (Spread spectrum clock generator) is defined as below figures.

$1/F_{SSM}$

$F_{clkin\_mod(max)}$

$F_{clkin}$

$F_{clkin\_mod(min)}$
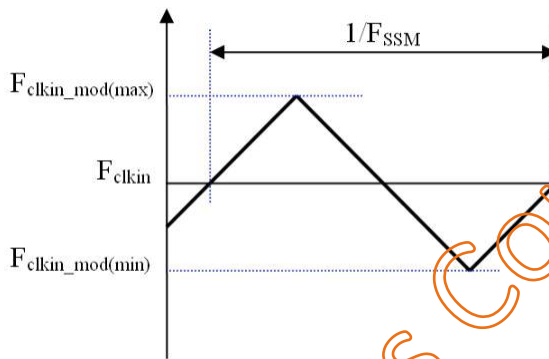
## 4.1.2 Power ON/OFF Sequence

To prevent a latch-up or DC operation of LCD assembly, the power on/off sequence should be as the diagram below.
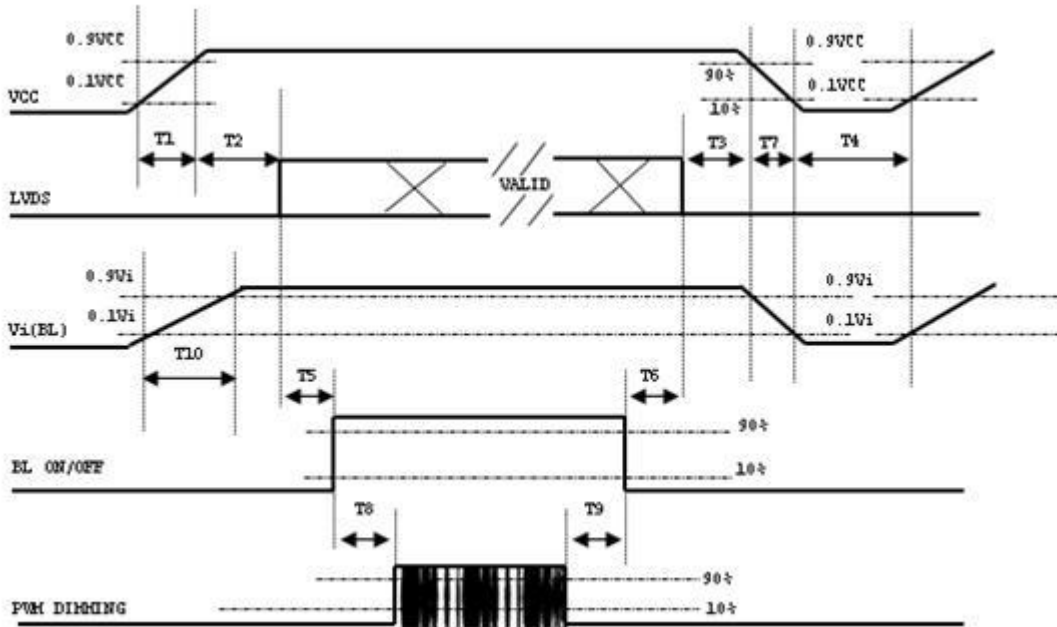
Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

| Parameter | Value | | | Units |
|---|---|---|---|---|
| | Min | Typ | Max | |
| T1 | 0.5 | --- | 10 | ms |
| T2 | 0 | --- | 50 | ms |
| T3 | 0 | --- | 50 | ms |
| T4 | 500 | --- | --- | ms |
| T5 | 450 | --- | --- | ms |
| T6 | 200 | --- | --- | ms |
| T7 | 10 | --- | 100 | ms |
| T8 | 10 | --- | --- | ms |
| T9 | 10 | --- | --- | ms |
| T10 | 20 | --- | 50 | ms |

## 4.1.3 The Input Data Format

**SEL 6/8 = "High" for 6 bits LVDS Input**
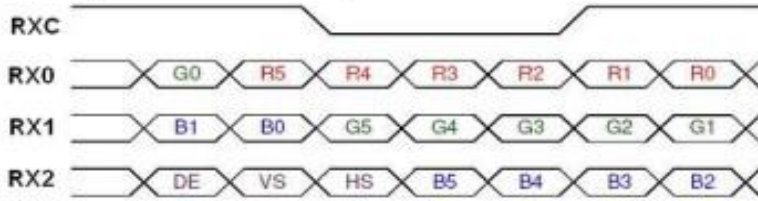


**SEL 6/8 = "Low" or "NC" for 8 bits LVDS Input**
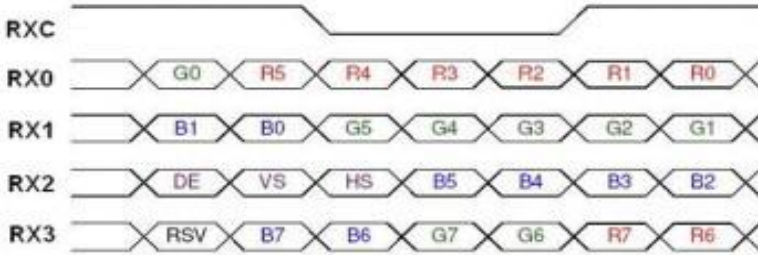


Note (1) R/G/B data 7: MSB, R/G/B data 0: LSB

Note (2) Please follow PSWG

| Signal Name | Description | Remark |
|---|---|---|
| R7 | Red Data 7 (MSB) | Red-pixel Data |
| R6 | Red Data 6 | Each red pixel's brightness data consists of these 8bits pixel data. |
| R5 | Red Data 5 | |
| R4 | Red Data 4 | |
| R3 | Red Data 3 | |
| R2 | Red Data 2 | |
| R1 | Red Data 1 | |
| R0 | Red Data 0 (LSB) | |
| G7 | Green Data 7 (MSB) | Green-pixel Data |
| G6 | Green Data 6 | Each red pixel's brightness data consists of these 8bits pixel data. |
| G5 | Green Data 5 | |
| G4 | Green Data 4 | |
| G3 | Green Data 3 | |
| G2 | Green Data 2 | |
| G1 | Green Data 1 | |
| G0 | Green Data 0 (LSB) | |
| B7 | Blue Data 7 (MSB) | Blue-pixel Data |
| B6 | Blue Data 6 | Each red pixel's brightness data consists of these 8bits pixel data. |
| B5 | Blue Data 5 | |
| B4 | Blue Data 4 | |
| B3 | Blue Data 3 | |
| B2 | Blue Data 2 | |
| B1 | Blue Data 1 | |
| B0 | Blue Data 0 (LSB) | |
| RXCLKIN+ | LVDS Clock Input | |
| RXCLKIN- | | |
| DE | Display Sync | |
| VS | Vertical Sync | |
| HS | Horizontal Sync | |

Note (3) Output Signals from any system shall be low or Hi-Z state when VCC is off.
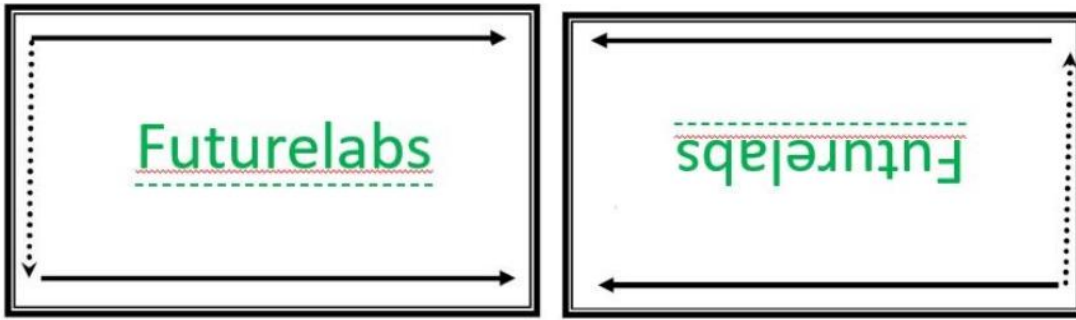
# 5. INTERFACE PIN DESCRIPTION

## 5.1 LCM Connector PIN Assignment

LVDS

CN1 Connector Pin Assignment

| Pin No. | Symbol | Description | Note |
|---------|--------|-------------|------|
| 1 | VCC | Power supply: +3.3V | - |
| 2 | VCC | Power supply: +3.3V | - |
| 3 | VCC | Power supply: +3.3V | - |
| 4 | GND | Ground | - |
| 5 | GND | Ground | - |
| 6 | GND | Ground | - |
| 7 | RPFI | Reverse Panel Function (Display Rotation) | ( 2 ) |
| 8 | NC | No Connection | ( 2 ) |
| 9 | NC | No Connection | ( 2 ) |
| 10 | NC | No Connection | ( 2 ) |
| 11 | SEL6/8 | LVDS 6/8 bit select function control,<br>Low or NC     8 bit Input Mode<br>High     6bit Input Mode | ( 2 ) |
| 12 | GND | Ground | - |
| 13 | NC | No Connection | ( 2 ) |
| 14 | GND | Ground | - |
| 15 | RX0- | Negative transmission data of pixel 0 | - |
| 16 | RX0+ | Positive transmission data of pixel 0 | - |
| 17 | GND | Ground | - |
| 18 | RX1- | Negative transmission data of pixel 1 | - |
| 19 | RX1+ | Positive transmission data of pixel 1 | - |
| 20 | GND | Ground | - |
| 21 | RX2- | Negative transmission data of pixel 2 | - |
| 22 | RX2+ | Positive transmission data of pixel 2 | - |
| 23 | GND | Ground | - |
| 24 | RXCLK- | Negative of clock | - |
| 25 | RXCLK+ | Positive of clock | - |
| 26 | GND | Ground | - |
| 27 | RX3- | Negative transmission data of pixel 3 | - |
| 28 | RX3+ | Positive transmission data of pixel 3 | - |
| 29 | GND | Ground | - |
| 30 | NC | No Connection | ( 2 ) |

Note (1) Connector Part No.: STM, MSCK2407P30.D or compatible connector

Note (2) "Low" stands for 0V. "High" stands for 3.3V. "NC" stands for "No Connected".

RPFI pin:
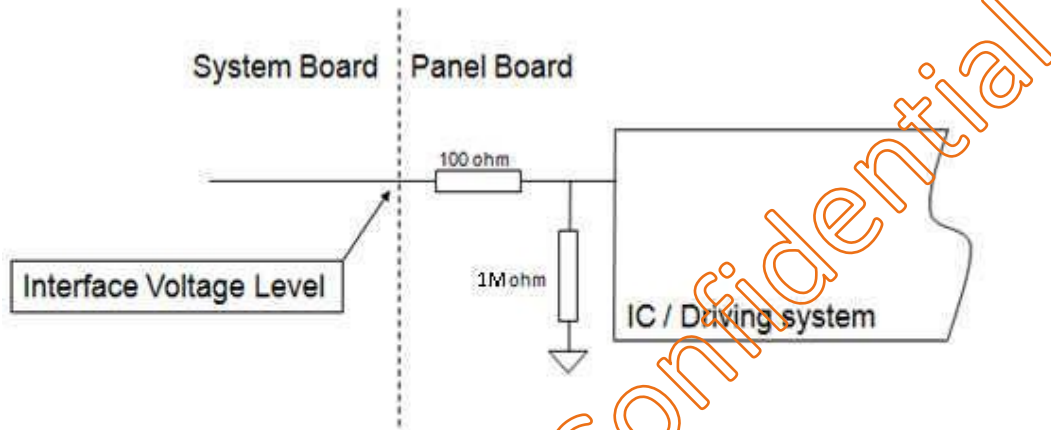


SEL6/8 pin:

## 5.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color.

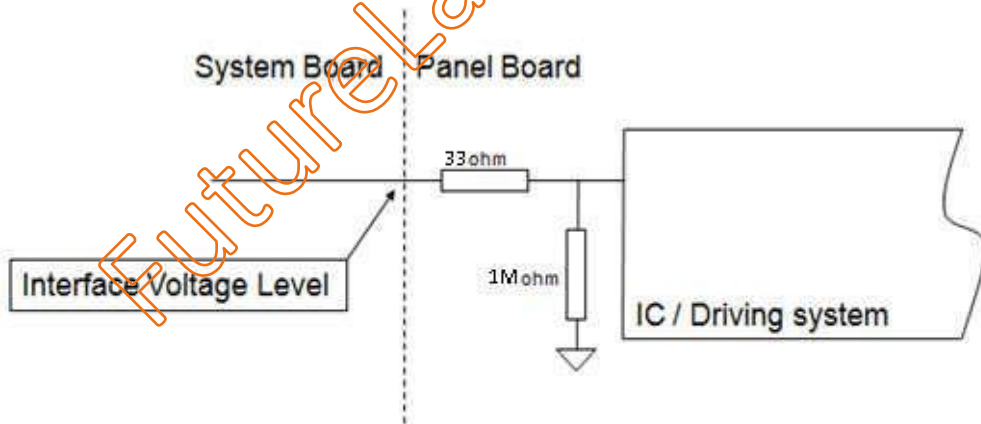| Color | | Red | | | | | | Green | | | | | | Blue | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
| | Green | 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 | 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 |
| Gray Scale Of Red | Red(0)/Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(1) | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(2) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Red(61) | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(62) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(63) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale Of Green | Green(0)/Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Green(61) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(62) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(63) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale Of Blue | Blue(0)/Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Blue(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Blue(61) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue(62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

Note (1) 0: Low Level Voltage, 1: High Level Voltage

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

| Color | | Data Signal | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Red | | | | | | | | Green | | | | | | | | Blue | | | | | | | |
| | | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 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 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gray Scale Of Red | Red(0) / Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(2) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Red(253) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(254) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(255) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale Of Green | Green(0) / Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Green(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale Of Blue | Blue(0) / Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Blue(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Blue(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Note (1) 0: Low Level Voltage, 1: High Level Voltage

# 6. BLOCK DIAGRAM

The following diagram shows the functional block of the TFT module:
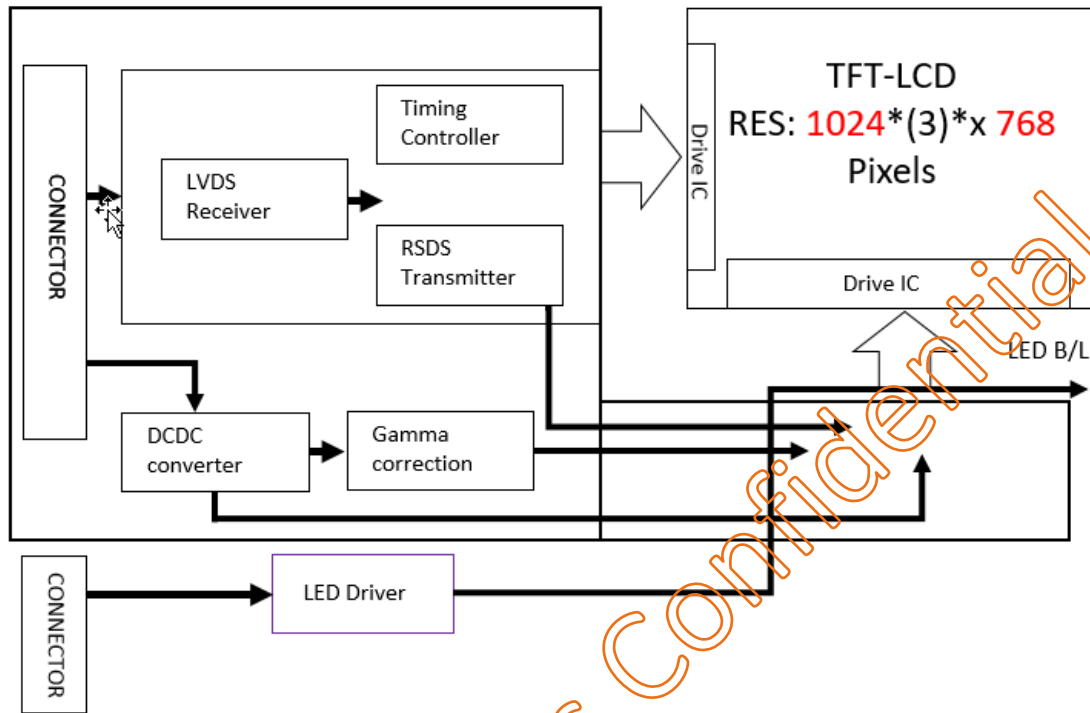
# 7. OPTICAL CHARACTERISTIC

The optical characteristics are measured under stable conditions at room temperature.

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Contrast Ratio | | CR | | 700 | 1000 | | - | (2) |
| Response Time | | $T_R$ | | - | 14 | 19 | ms | (3) |
| | | $T_F$ | | - | 11 | 16 | ms | |
| Center Luminance of White | | $L_C$ | | 900 | 1000 | - | cd/m$^2$ | (4) |
| White Variation | | $\delta W$ | | - | 1.25 | 1.4 | - | (7) |
| Chromaticity | Red | Rx | $\theta_X=0°, \theta_Y=0°$ Viewing angle at normal direction | Typ. -0.05 | 0.652 | Typ. +0.05 | - | (6) |
| | | Ry | | | 0.338 | | - | |
| | Green | Gx | | | 0.326 | | - | |
| | | Gy | | | 0.608 | | - | |
| | Blue | Bx | | | 0.150 | | - | |
| | | By | | | 0.053 | | - | |
| | White | Wx | | | 0.313 | | - | |
| | | Wy | | | 0.329 | | - | |
| Viewing Angle | Horizontal | $\theta_X+$ | CR≥10 | 80 | 88 | - | Deg. | (1) |
| | | $\theta_X-$ | | 80 | 88 | - | | |
| | Vertical | $\theta_Y+$ | | 80 | 88 | - | | |
| | | $\theta_Y-$ | | 80 | 88 | | | |

The following optical specifications shall be measured in a darkroom or equivalent state (ambient luminance <2 lux, and at room temperature).

The room temperature is 25°C±2°C and LED Backlight Current IL=460mA.

Note 1:    Definition of Viewing Angle

Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or the vertical clock direction with respect to the optical axis which is normal to the LCD surface
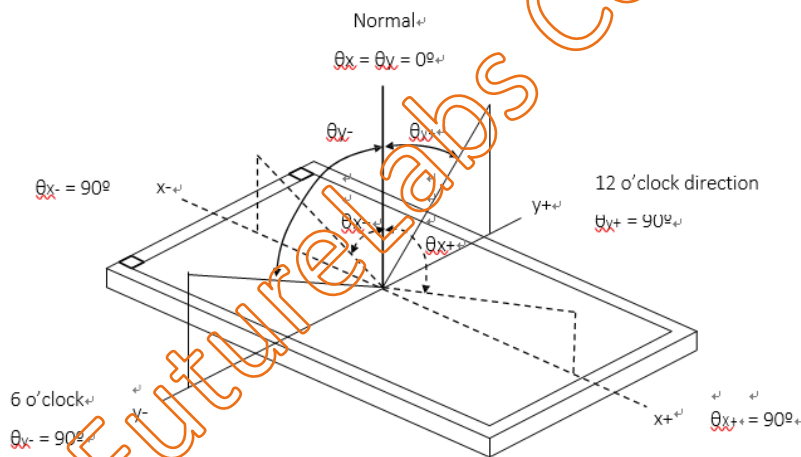


Note 2:    Definition of Contrast Ratio (CR)

Measure the viewing angle of Θ= 0 and at the center of the LCD surface. Luminance with all pixels in white state divide by Luminance with all pixels in Black state

Note 3    Definition of Response Time:

The response time is set initially by defining the "Rising Time (Tr)" and the "Falling Time (Tf)" respectively. The response time interval is between 10% and 90% of amplitudes, please refer the figure to the followings:
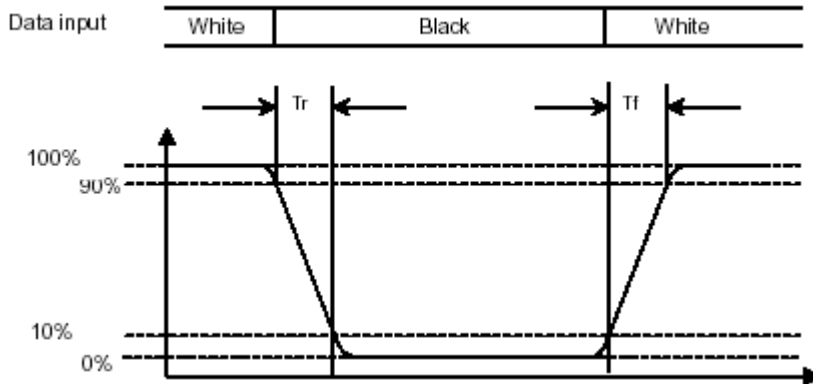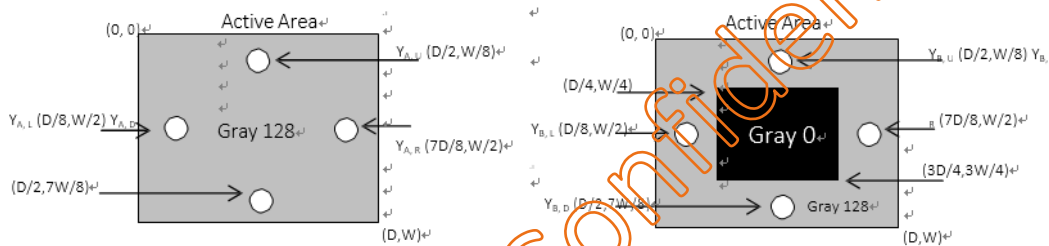


Note 4:    Definition of Brightness (L)

Measure the center area of the panel and the viewing angle of the $\theta x = \theta y = 0°$
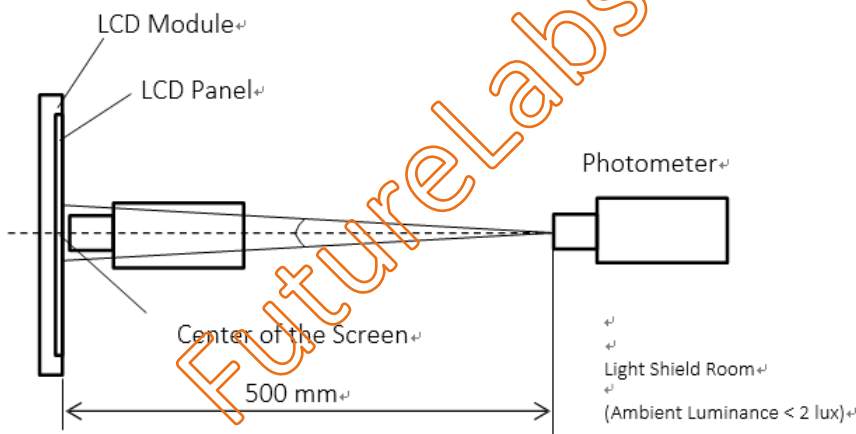
Note 5:    Definition of Cross Talk $CT = | Y_B - Y_A | / Y_A \times 100$ (%) Where:

$Y_A$ = Luminance of measured location without gray level 0 pattern (cd/m$^2$)

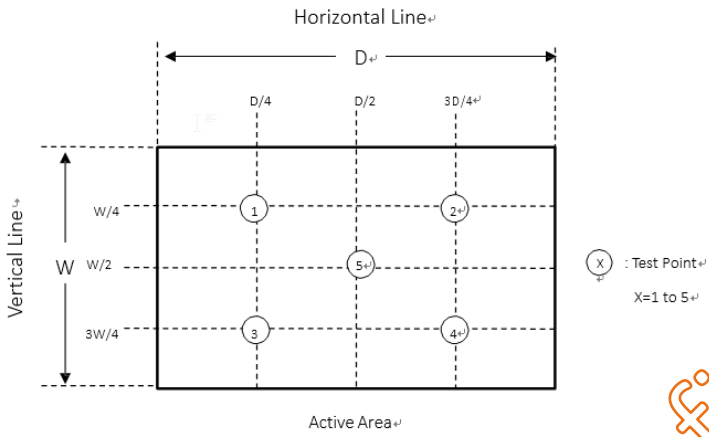$Y_B$ = Luminance of measured location with gray level 0 pattern (cd/m$^2$)



Note 6:    The method of optical measurement:

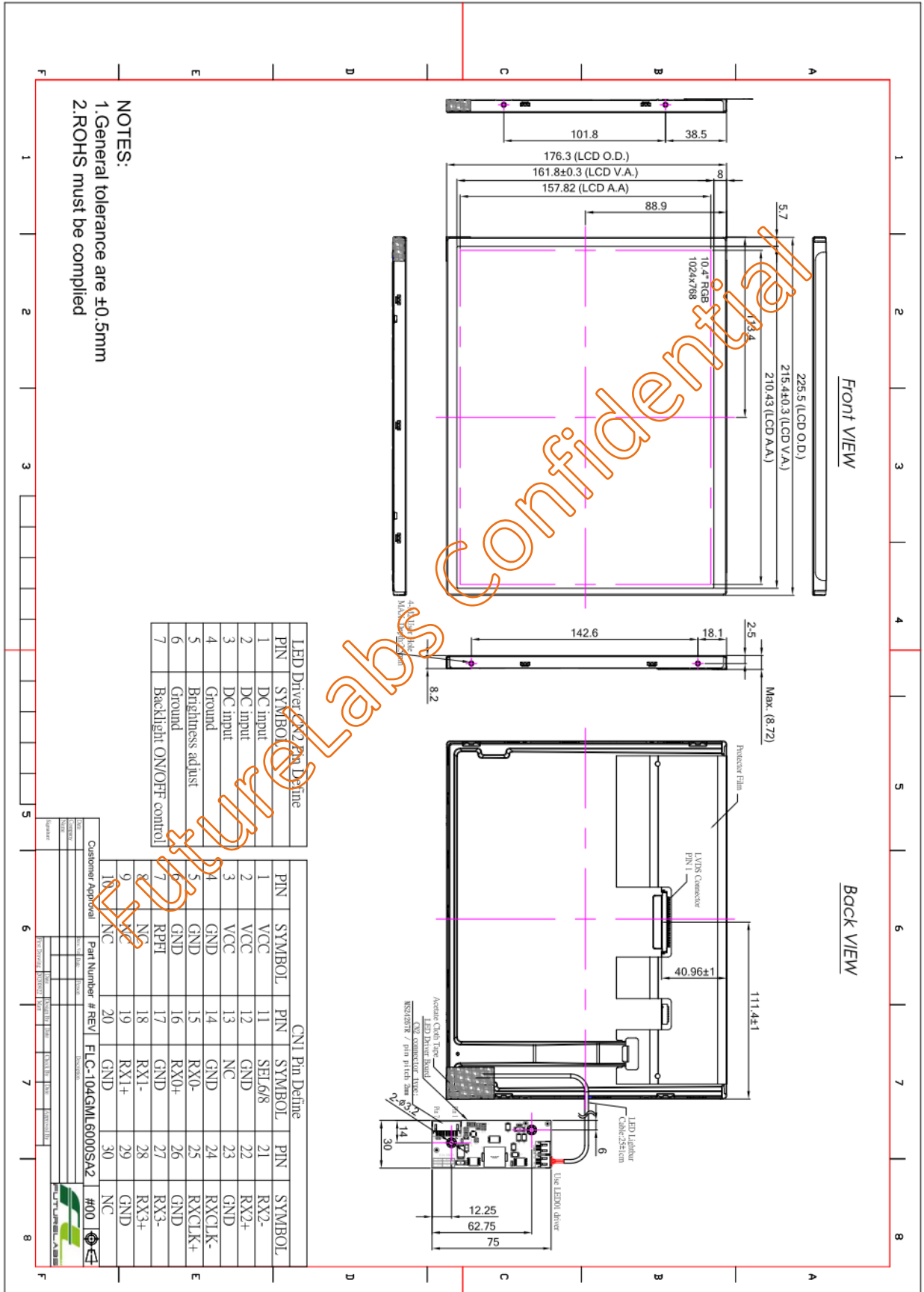Note 7:     Definition of White Variation (δW):

Measure the luminance of gray level 255 at 5 points

δW = Maximum [L (1), L (2), L (3), L (4), L (5)] / Minimum [L (1), L (2), L (3), L (4), L (5)]

**NOTES:**
1. General tolerance are ±0.5mm
2. ROHS must be complied

**LED Driver CN2 Pin Define**

| PIN | SYMBOL |
|-----|--------|
| 1 | DC input |
| 2 | DC input |
| 3 | DC input |
| 4 | Ground |
| 5 | Brightness adjust |
| 6 | Ground |
| 7 | Backlight ON/OFF control |

**CN1 Pin Define**

| PIN | SYMBOL | PIN | SYMBOL | PIN | SYMBOL |
|-----|--------|-----|--------|-----|--------|
| 1 | VCC | 11 | SEL6/8 | 21 | RX2- |
| 2 | VCC | 12 | GND | 22 | RX2+ |
| 3 | VCC | 13 | NC | 23 | GND |
| 4 | GND | 14 | GND | 24 | GND |
| 5 | GND | 15 | RX0- | 25 | RXCLK+ |
| 6 | GND | 16 | RX0+ | 26 | GND |
| 7 | RPFI | 17 | GND | 27 | RX3- |
| 8 | NC | 18 | RX1- | 28 | RX3+ |
| 9 | NC | 19 | RX1+ | 29 | GND |
| 10 | NC | 20 | GND | 30 | NC |

Customer Approval

Part Number # REV : FLC-104GML6000SA2 #00

Front VIEW

Back VIEW

# 9. PRECAUTION AND PRODUCT HANDLING

- Do not apply the external force such as bending or twisting to the LCD panel and backlight during assembly.
- Do not insert and plug out the input connector while the LCD panel is operating.
- Do not take apart the panel or frame from LCD module assembly or insert anything into the backlight unit.
- Do not keep the same pattern in a long period of time, it may cause image sticking on LCD panel. Can use shuffle content periodically if fixed pattern is displayed on the screen.
- Do not touch the display area with bare hands, this will stain the display area.
- Pay attention to handle lead wire of backlight, that is not tugged in connect with LED driver.
- Do not change variable resistance settings in LCD panel, it may cause not satisfy of LCD characteristics specification.
- The surface of LCD panel's polarizer is very soft and easily scratched, please use a very soft dry cloth without chemicals for cleaning.
- To avoid the static electricity to damage the CMOS LSI, the operator should be grounded when in contact with the LCD panel, and also to all electrical equipment.
- Need to follow the correct power frequency when LCD panel is connecting and operating, this can avoid damage to CMOS LSI during latch-up.
- Need to store the LCD panel indoor without the exposure of sunlight where the temperature is 25°C ± 5°C and the humidity is below 60% RH.