



- Preliminary Specification
- Final Specification

| | |
|------------|----------------------------------|
| Module | 6.5 Inch Color TFT-LCD |
| Model Name | FT065-EDC01 V.0 (AUO G065VN01V2) |

| | |
|--|-------|
| Customer | Date |
| _____ | _____ |
| Checked & Approved by | |
| _____ | |
| <p>Note: This Specification is subject to change without notice.</p> | |

| | |
|---|---------------------|
| Approved by | Date |
| _____ Thomas Hung | _____ 2013/10/11 |
| Prepared by | |
| _____ Vicky Wu | _____ 2013/10/11 |
| Engineering Division / Forenex Tech. | |



Contents

| | |
|--|----|
| 1. Operating Precautions | 4 |
| 2. General Description | 5 |
| 2.1 Display Characteristics | 5 |
| 2.2 Optical Characteristics..... | 6 |
| 3. Functional Block Diagram | 8 |
| 4. Absolute Maximum Ratings..... | 9 |
| 4.1 Absolute Ratings..... | 9 |
| 4.2 Absolute Ratings of Environment..... | 9 |
| 5. Electrical Characteristics..... | 10 |
| 5.1 TFT-LCD Driving | 10 |
| 5.2 Backlight Unit Driving..... | 12 |
| 6. Signal Characteristic..... | 13 |
| 6.1 Pixel Format Image..... | 13 |
| 6.2 Scanning Direction..... | 13 |
| 6.3 The Input Data Format..... | 14 |
| 6.4 TFT- LCD Interface Signal Description..... | 15 |
| 6.5 TFT- LCD Interface Timing..... | 16 |
| 6.6 LED Backlight Unit Interface Signal Description..... | 17 |
| 6.7 Power ON/OFF Sequence..... | 18 |
| 7. Connector & Pin Assignment | 19 |
| 7.1 TFT- LCD Signal (CN1): LCD Connector..... | 19 |
| 7.2 LED Backlight Unit (CN2): Backlight Connector..... | 19 |
| 7.3 LED Driver | |
| 7.4 PIN 1 definition of CN1 and CN2 | 20 |
| 8. Mechanical Characteristics | 22 |



1. Operating Precautions

- 1) Display area (Polarizer) of TFT-LCD Module is easily to be damaged, please be cautious and not to scratch it.
- 2) Be sure to power off your machine before connecting or disconnecting your signal cable to TFT-LCD Module.
- 3) Wipe off water drop on display area immediately. Long contact with water may cause discoloration or spots.
- 4) When the panel surface is soiled, wipe it with absorbent cotton or soft cloth.
- 5) Display area (Glass) of TFT-LCD Module may be broken or cracked if bump Module against hard object.
- 6) To avoid ESD (Electro Static Discharge) damage, be sure to ground yourself before handling TFT-LCD Module.
- 7) Do not open nor modify the TFT-LCD module assembly.
- 8) Do not press the reflector sheet at the back of the module to any direction.
- 9) In case if TFT-LCD module has to be put back into the packing container slot after it was taken out from the container, do not press the center of the LED Reflector edge. Instead, press at the far ends of the LED Reflector edge softly. Otherwise the TFT-LCD Module may be damaged.
- 10) When inserting or removing of your signal cable to TFT-LCD Module, be sure not to apply abnormal force (rotate, tilt...etc.) to the Connector of the TFT-LCD Module.
- 11) TFT-LCD Module is not allowed to be twisted & bent even force is added on module in a very short time. Please design your display product well to avoid external force applying to module by end-user directly.
- 12) Small amount of materials without flammability grade are used in the TFT-LCD module. The TFT-LCD module should be supplied by power complied with requirements of Limited Power Source (IEC60950 or UL1950), or be applied exemption.
- 13) Severe temperature condition may result in different luminance, response time.
- 14) Continuous operating TFT-LCD Module under high temperature environment may accelerate LED light bar exhaustion and reduce luminance dramatically.
- 15) The data on this specification sheet is applicable when TFT-LCD module is placed in landscape position.
- 16) Continuous displaying fixed pattern may induce image sticking. It's recommended to use screen saver or moving content periodically if fixed pattern is displayed on the screen.



2. General Description

FT065-EDC01V0 is designed for industrial display applications with VGA (640 x RGB x 480) resolution and 16.2M (RGB 6-bits + FRC) or 262k colors (RGB 6-bits). It is composed of a TFT-LCD panel, driver ICs, control and power supply circuits board and a backlight unit including LED driving circuit, and offers LVDS interface for display signal input.

2.1 Display Characteristics

The following items are characteristics summary at 25 (Room Temperature).

| Items | Unit | Specifications |
|---|----------|--|
| Screen Diagonal | inch | 6.5 |
| Active Area | mm | 132.48(H)x 99.36(V) |
| Pixels H x V | | 640x3(RGB) x 480 |
| Pixel Pitch | mm | 0.207 x 0.207 |
| Pixel Arrangement | | R.G.B. Vertical Stripe |
| Display Mode | | TN, Normally White |
| Nominal Input Voltage VDD | Volt | 3.3 typ. |
| Typical Power Consumption | Watt | 3.213 W (LCD:0.86W/LED BLU: 2.353W) All black pattern |
| Weight | Grams | 170g (typ.) |
| Physical Size | mm | 153.0(H)x 118.0(V) x 10.9(D) (typ.) |
| Electrical Interface | | 1 channel LVDS |
| Surface Treatment | | Glare, AR, Hardness: 3H |
| Support Color | | 16.2M / 262K colors |
| The most suitable view angle | | 6 o'clock |
| Temperature Range Operating Storage (Non-Operating) | °C °C | -30 to +80* -30 to +80* *Panel surface temperature |
| RoHS Compliance | | RoHS Compliance |



2.2 Optical Characteristics

The optical characteristics are measured under stable conditions at 25 (Room Temperature).

| Item | Unit | Conditions | Min. | Typ. | Max. | Remark |
|---|-------------------|--|----------|----------|--------|--------------|
| White Luminance | cd/m ² | F _{PWM} = 100% (center point) | 900 | 1000 | - | Note 1 |
| Uniformity | % | 5 Points | | - | 1.25 | Note 1, 2, 3 |
| Contrast Ratio | | | 400 | 600 | - | Note 4 |
| Response Time | msec | Rising | - | 15 | 20 | Note 5 |
| | msec | Falling | - | 10 | 15 | |
| | msec | Rising + Falling | - | 25 | 35 | |
| Viewing Angle | degree degree | Horizontal (Right) CR = 10 (Left) | 70 70 | 80 80 | - - | Note 6 |
| | degree degree | Vertical (Upper) CR = 10 (Lower) | 60 60 | 70 70 | - - | |
| Color / Chromaticity Coordinates (CIE 1931) | | White x | 0.263 | 0.313 | 0.363 | |
| | | White y | 0.279 | 0.329 | 0.379 | |
| | | Red x | 0.559 | 0.609 | 0.659 | |
| | | Red y | 0.314 | 0.364 | 0.414 | |
| | | Green x | 0.285 | 0.335 | 0.385 | |
| | | Green y | 0.554 | 0.604 | 0.654 | |
| | | Blue x | 0.099 | 0.149 | 0.159 | |
| | | Blue y | 0.055 | 0.105 | 0.155 | |
| Color Gamut | % | | 50 | 55 | - | |

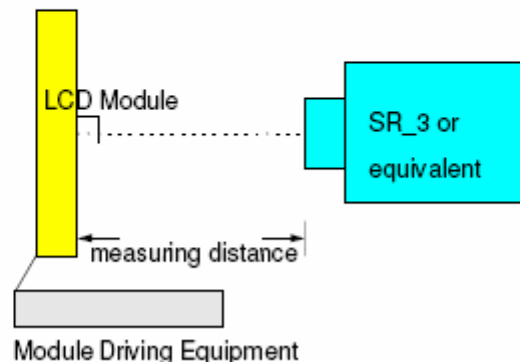
Note 1: Measurement method

Equipment Pattern Generator, Power Supply, Digital Voltmeter, Luminance meter (SR_3 or equivalent)

Aperture

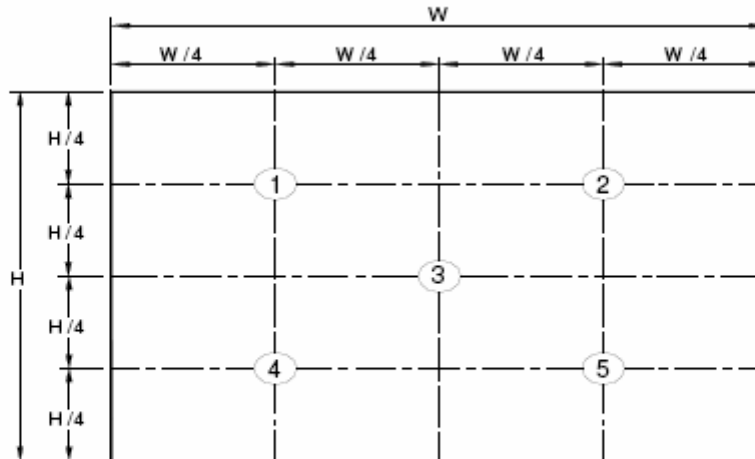
Test Point Center

Environment < 1 lux





Note 2: Definition of 5 points position (Display active area: 132.48mm(W) x 99.36mm(H))



Note 3:

The luminance uniformity of 5 points is defined by dividing the maximum luminance value by the minimum luminance value at full white condition.

$$\epsilon_{w5} = \frac{\text{Maximum Brightness of five points}}{\text{Minimum Brightness of five points}}$$

Note 4: Definition of contrast ratio (CR):

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness @ "White" state}}{\text{Brightness @ "Black" state}}$$

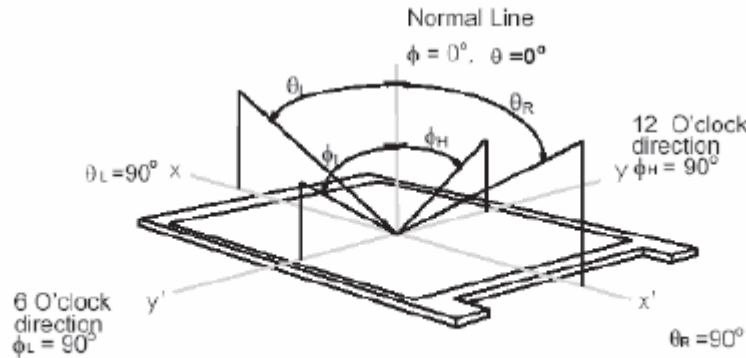
Note 5: Definition of response time:

The output signals of photo detector are measured when the input signals are changed from "White" to "Black" (falling time) and from "Black" to "White" (rising time), respectively. The response time interval definition is between 10% and 90% of amplitude. Please refer to the figure as below.



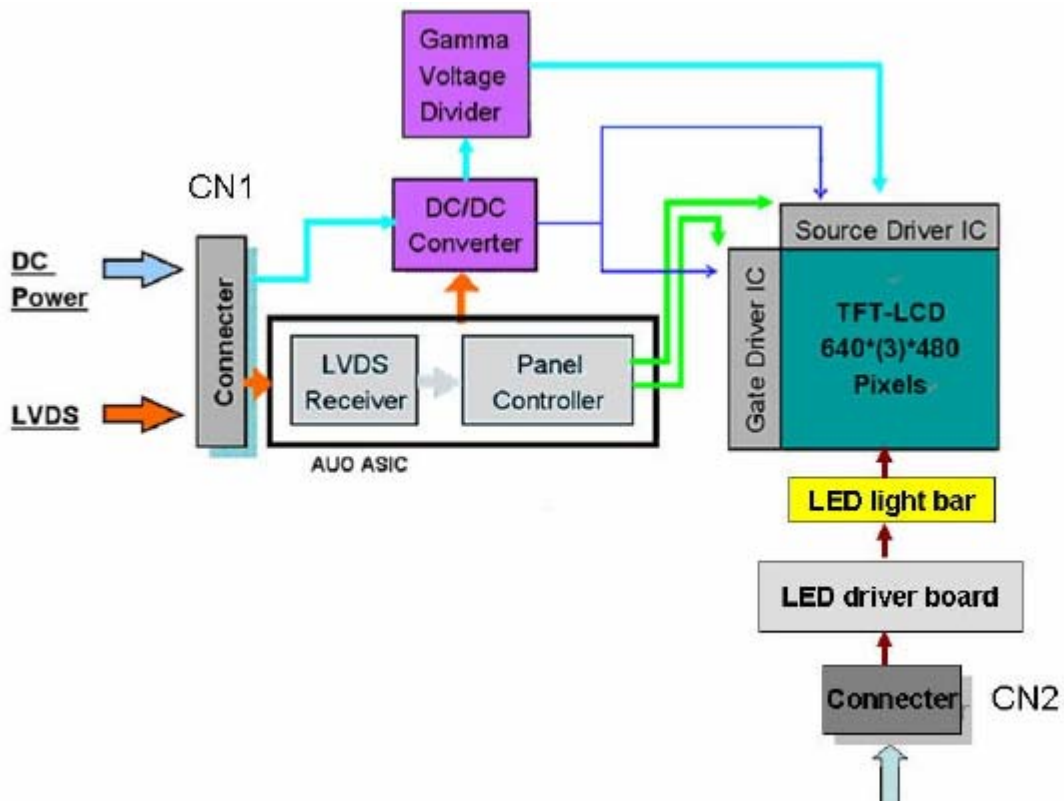
Note 6: Definition of viewing angle

Viewing angle is the measurement of contrast ratio ≥ 10 , at the screen center, over a 180° horizontal and 180° vertical range (off-normal viewing angles). The 180° viewing angle range is broken down as below: 90° (θ) horizontal left and right, and 90° (ϕ) vertical high (up) and low (down). The measurement direction is typically perpendicular to the display surface with the screen rotated to its center to develop the desired measurement viewing angle.



3. Functional Block Diagram

The following diagram shows the functional block of the V0color TFT/LCD module.





4. Absolute Maximum Ratings

4.1 Absolute Ratings

| Item | Symbo | Min | Max | Unit | Remark |
|---------------------------|------------------|------|------|------|----------|
| Logic/LCD Drive Voltage | VDD | -0.3 | +4.0 | Volt | Ta= 25°C |
| LCD Input Signal Voltage | VIN | -0.3 | +4.0 | Volt | Ta= 25°C |
| LED BLU Drive Voltage | V _{LED} | 0 | 16 | Volt | Ta= 25°C |
| LED Dimming Input Voltage | V _{PWM} | 0 | 6 | Volt | Ta= 25°C |

4.2 Absolute Ratings of Environment

| Item | Symbol | Min | Max | Unit | Remark |
|-----------------------|--------|-----|------|------|-----------|
| Operating Temperature | TOP | -30 | +80* | °C | Note 1, 2 |
| Operation Humidity | HOP | 5 | 95 | %RH | Note 1, 2 |
| Storage Temperature | TST | -30 | +80* | °C | Note 1 |
| Storage Humidity | HST | 5 | 95 | %RH | Note 1 |

Note 1: Maximum Wet-tion.

Note 2: Only operation is guaranteed. Optical and display performance should be evaluated at 25 only.

*: Panel surface temperature



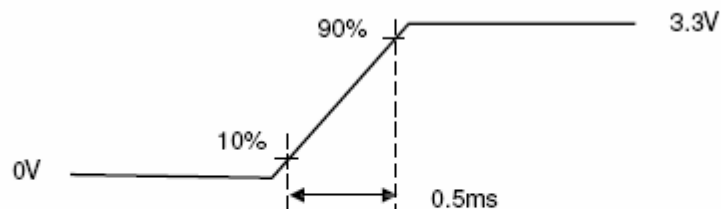
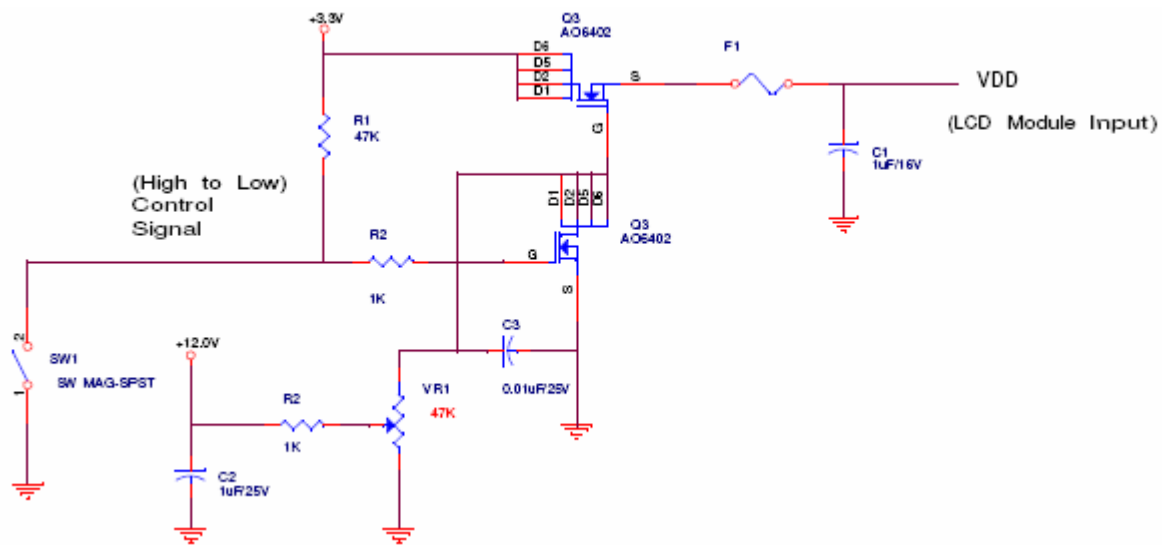
5. Electrical Characteristics

5.1 TFT-LCD Driving

5.1.1 Power Specification

| Symbol | Parameter | Min | Typ | Max | Units | Remark |
|--------|--|-----|------|-----|-------|--|
| VDD | Logic/LCD Drive Voltage | 3.0 | 3.3 | 3.6 | Volt | |
| IDD | VDD Current | - | 260 | 300 | mA | All Black Pattern (VDD=3.3V, at 60Hz) |
| Irush | LCD Inrush Current | - | - | 1.5 | A | Note 1 |
| PDD | VDD Power | - | 0.86 | | Watt | All Black Pattern (VDD=3.3V, at 60Hz) |
| VDDrp | Allowable Logic/LCD Drive Ripple Voltage | - | - | 100 | mVp-p | All Black Pattern (VDD=3.3V, at 60Hz) |

Note 1: Measurement condition:



VDD rising time



5.1.2 Signal Electrical Characteristics

Input signals shall be low or Hi-Z state when VDD is off.

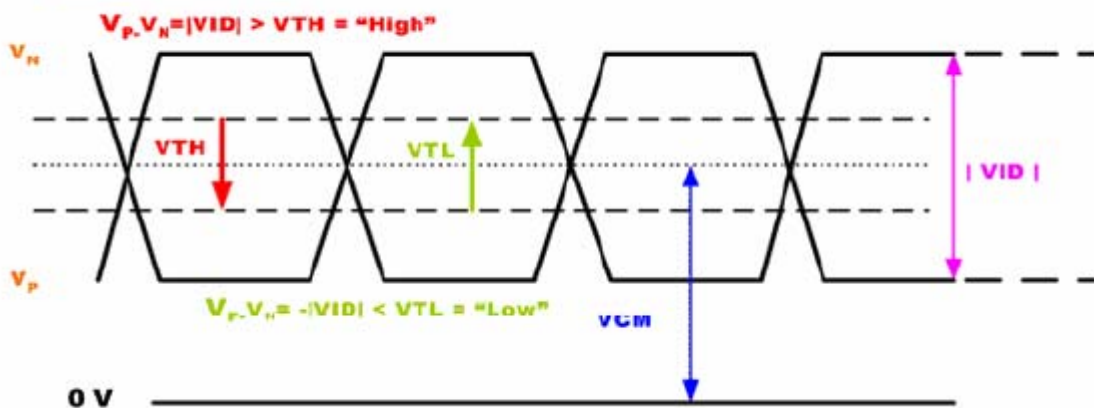
LVDS signal (Note 1)

LVDS Transmitter: THC63LVDM83A (THINE) or equivalent

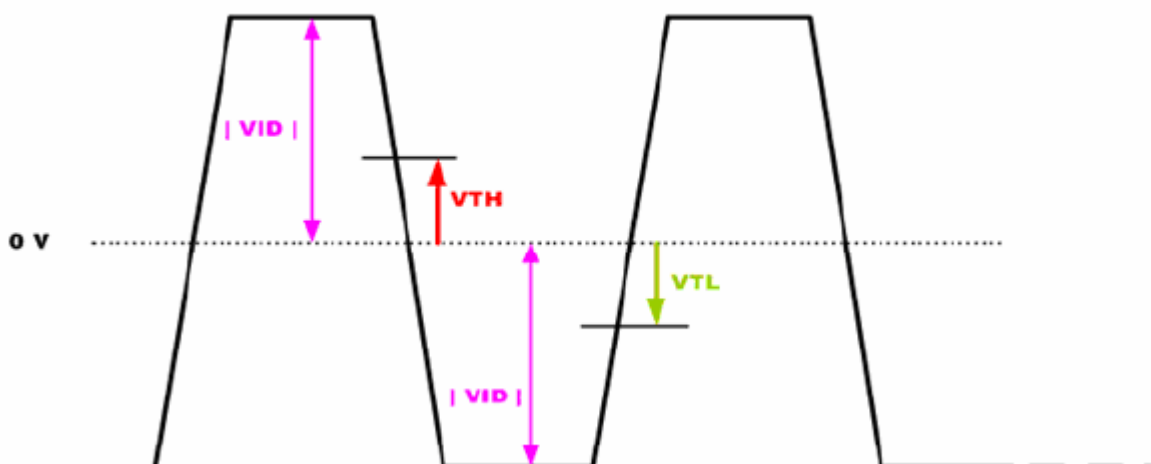
| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remark |
|--|--------|------|------|------|------|------------------|
| Differential Input High Threshold | VTH | - | - | 100 | mV | VCM=1.20V |
| Differential Input Low Threshold | VTL | -100 | - | - | mV | VCM=1.20V |
| Input Differential Voltage | VID | 100 | 400 | 600 | mV | |
| Differential Input Common Mode Voltage | VCM | 1.1 | - | 1.45 | V | VTH, VTL= ±100mV |

Note 1: LVDS Signal Waveform.

Single-end Signal



Differential Signal





5.2 Backlight Unit Driving

5.2.1 Parameter guideline for LED driver

Following characteristics are measured under stable condition at 25°C Temperature).

| Symbol | Parameter | Min | Typ | Max | Units | Remark |
|-------------------|------------------------------|-------|-------|------|-------|---------------|
| V_{LED} | LED Input Voltage | 9 | 18.1 | 13 | Volt | |
| I_{LED} | LED Input Current | - | 0.13 | | A | 100% PWM duty |
| P_{LED} | LED Power Consumption | - | 2.353 | | W | 100% PWM duty |
| $I_{rush_{LED}}$ | Inrush Current | - | 0.37 | 0.41 | A | 100% PWM duty |
| $V_{LED\ On/Off}$ | On Control Voltage | 3.0 | 3.3 | 5.0 | Volt | |
| | Off Control Voltage | 0 | | 0.15 | Volt | |
| V_{PWM} | Dimming control Voltage High | 3.0 | 3.3 | 5.0 | Volt | |
| | Dimming control Voltage Low | 0 | | 0.1 | Volt | |
| F_{PWM} | Dimming Frequency | 200 | | 30K | Hz | |
| D_{PWM} | Dimming duty cycle | 1 | | 100 | % | |
| Operating Life | | 50000 | | | Hrs | Note 2, 3 |

Note 1: See Section 6.6 for LED Backlight Unit Interface Signal Description.

Note 2: If ED065C01 V0 module is driven at high ambient temperature & humidity condition. The operating life will be reduced.

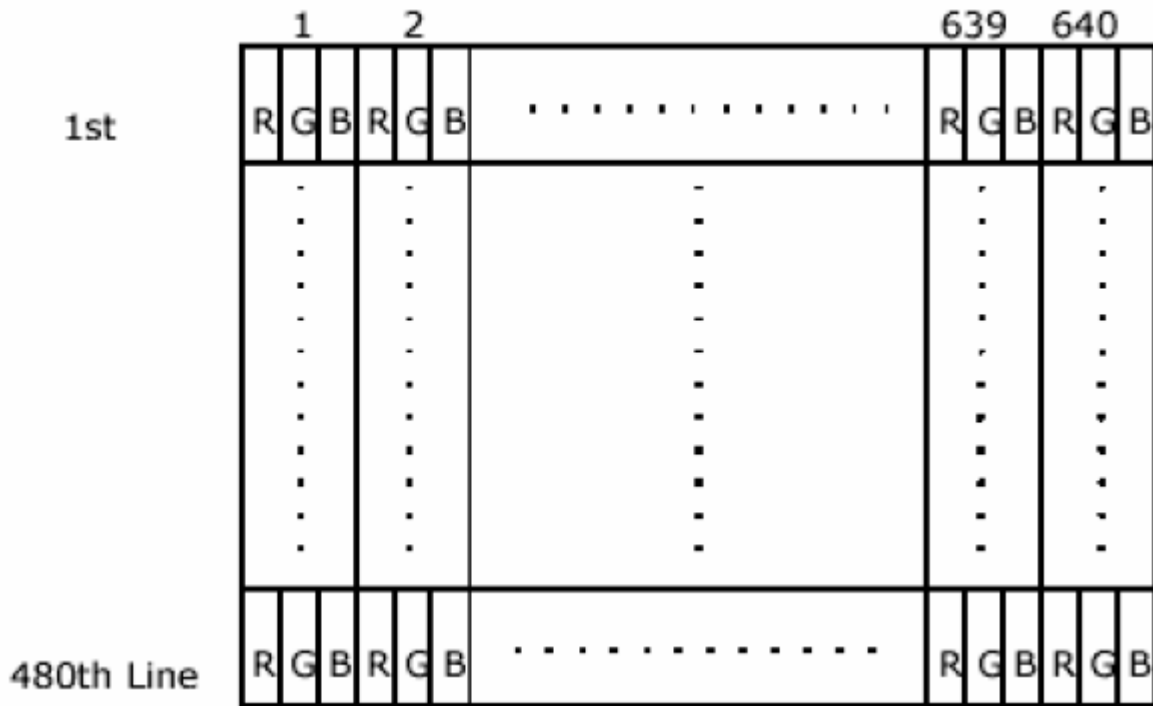
Note 3: Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.



6. Signal Characteristic

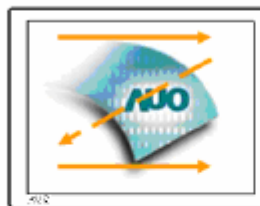
6.1 Pixel Format Image

Following figure shows the relationship between input signal and LCD pixel format.



6.2 Scanning Direction

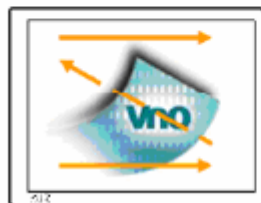
The following figures show the image seen from the front view. The arrow indicates the direction of scan.



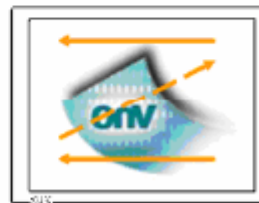
R/L=Low or NC; U/D= Low or NC



R/L=High; U/D= Low or NC



R/L=Low or NC; U/D= High

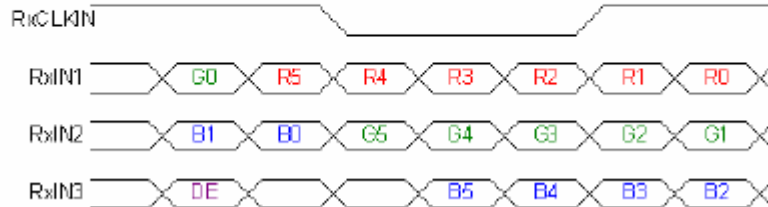


R/L=High; U/D= High

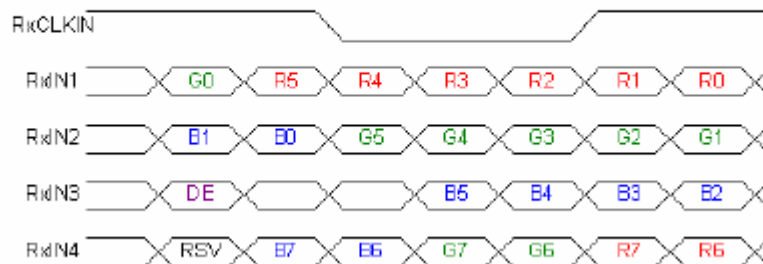


6.3 The Input Data Format

SEL68 = "Low" or "NC" for 6 bits LVDS Input



SEL68 = "High" for 8 bits LVDS Input



| Signal Name | Description | Remark |
|-------------|--------------------|--|
| R7 | Red Data 7 | Red-pixel Data For 8Bits LVDS input MSB: R7 ; LSB: R0 For 6Bits LVDS input MSB: R5 ; LSB: R0 |
| R6 | Red Data 6 | |
| R5 | Red Data 5 | |
| R4 | Red Data 4 | |
| R3 | Red Data 3 | |
| R2 | Red Data 2 | |
| R1 | Red Data 1 | |
| R0 | Red Data 0 | |
| G7 | Green Data 7 | Green-pixel Data For 8Bits LVDS input MSB: G7 ; LSB: G0 For 6Bits LVDS input MSB: G5 ; LSB: G0 |
| G6 | Green Data 6 | |
| G5 | Green Data 5 | |
| G4 | Green Data 4 | |
| G3 | Green Data 3 | |
| G2 | Green Data 2 | |
| G1 | Green Data 1 | |
| G0 | Green Data 0 | |
| B7 | Blue Data 7 | Blue-pixel Data For 8Bits LVDS input MSB: B7 ; LSB: B0 For 6Bits LVDS input MSB: B5 ; LSB: B0 |
| B6 | Blue Data 6 | |
| B5 | Blue Data 5 | |
| B4 | Blue Data 4 | |
| B3 | Blue Data 3 | |
| B2 | Blue Data 2 | |
| B1 | Blue Data 1 | |
| B0 | Blue Data 0 | |
| RxCLKIN | LVDS Data Clock | |
| DE | Data Enable Signal | When the signal is high, the pixel data shall be valid to be displayed. |
| RSV | Reserved Signal | "High" or "Low" is acceptable |

Note 1: Output signals from any system shall be low or Hi-Z state when VDD is off.

**6.4 TFT- LCD Interface Signal Description**

G065VN01 V2 TFT-LCD module includes LVDS receiver. LVDS is a differential signal technology for high-speed data transfer LCD interface. LVDS Transmitter shall be THC63LVDM83A (THINE) or equivalent.

| Pin No. | Signal | Description |
|----------------|---------------|--|
| 1 | VDD | Power supply 3.3V(Typical) |
| 2 | VDD | Power supply 3.3V(Typical) |
| 3 | GND | Ground |
| 4 | SEL68 | LVDS 6/8bit select function control Low or NC → 6 bit input mode High → 8 bit input mode |
| 5 | RxIN1- | LVDS differential data input Pair 1 |
| 6 | RxIN1+ | |
| 7 | GND | Ground |
| 8 | RxIN2- | LVDS differential data input Pair 2 |
| 9 | RxIN2+ | |
| 10 | GND | Ground |
| 11 | RxIN3- | LVDS differential data input Pair 3 |
| 12 | RxIN3+ | |
| 13 | GND | Ground |
| 14 | RXCLKIN- | LVDS differential Clock input Pair |
| 15 | RXCLKIN+ | |
| 16 | NC | No connection |
| 17 | UD | Vertical reverse scan control Low or NC → Normal mode High → Vertical reverse scan |
| 18 | RL | Horizontal reverse scan control Low or NC → Normal mode High → Horizontal reverse scan |
| 19 | RxIN4- | LVDS differential data input Pair 4 |
| 20 | RxIN4+ | |

Note : "Low" stands for 0V. "High" stands for 3.3V. "NC" stands for "No Connected."



6.5 TFT- LCD Interface Timing

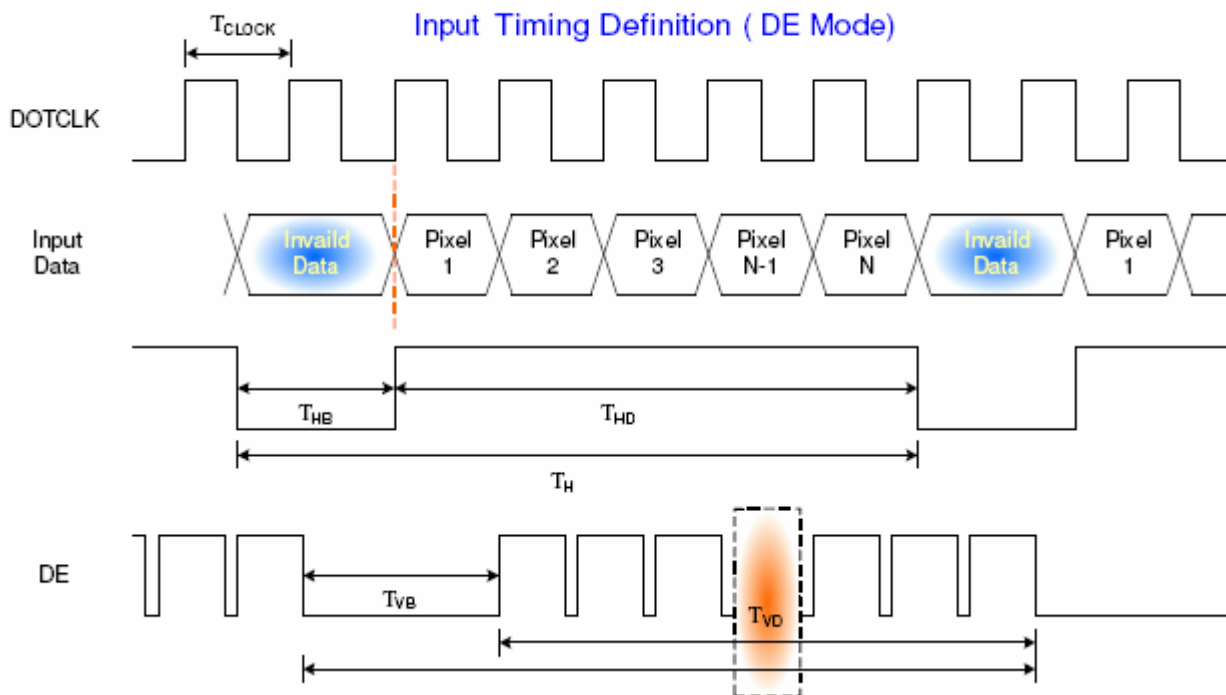
6.5.1 Timing Characteristics

DE mode only

| Signal | Symbol | Min. | Typ. | Max. | Unit | Remark | |
|--------------------------|----------------------|-----------------|------|------|------|--------------------|-------|
| Clock frequency (DOTCLK) | $1/T_{\text{CLOCK}}$ | 20 | 25.2 | 50 | MHz | Note1 | |
| Horizontal Section | Period | T_{H} | 770 | 800 | 1070 | T_{CLOCK} | Note1 |
| | Active | T_{HD} | 640 | | | | |
| | Blanking | T_{HE} | 130 | 160 | 430 | | |
| Vertical Section | Period | T_{V} | 520 | 525 | 622 | T_{LINE} | Note1 |
| | Active | T_{VD} | 480 | | | | |
| | Blanking | T_{VE} | 40 | 45 | 142 | | |

Note 1: Recommended frame rate is 60 Hz.

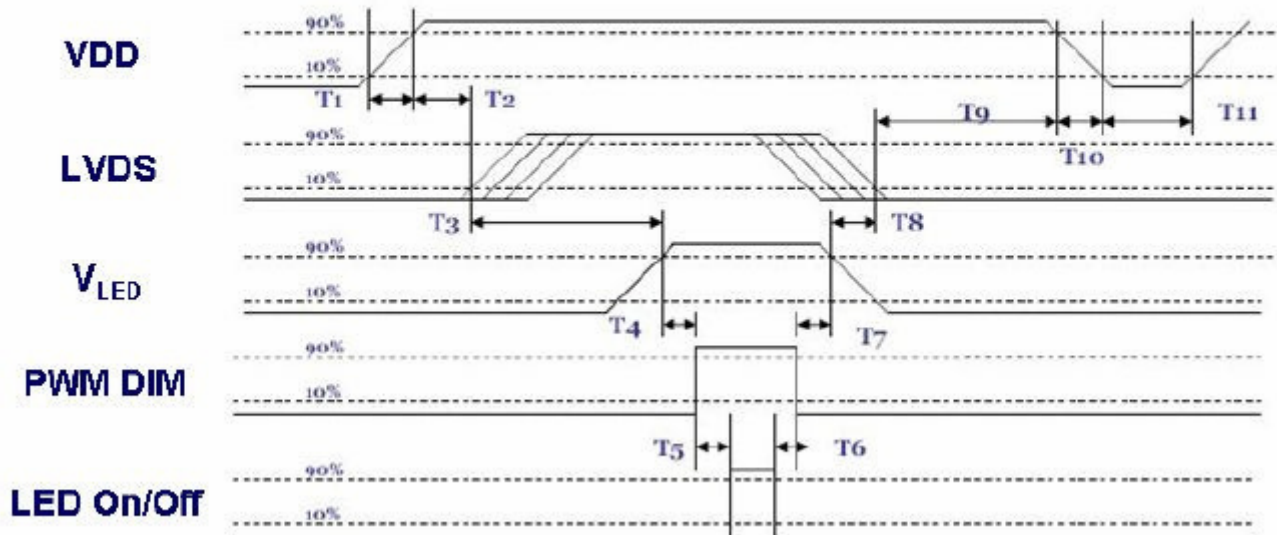
6.5.2 Input Timing Diagram

**Note1:** Please follow PSWG.**Note2:** R/G/B data 7:MSB, R/G/B data 0:LSB



6.6 Power ON/OFF Sequence

VDD power, LCD interface signals and backlight on/off sequence are shown in the following chart. Signals from any system shall be Hi-Z state or low level when VDD is off.



Power ON/OFF sequence timing

| Parameter | Value | | | Units |
|-----------|-------|------|------|-------|
| | Min. | Typ. | Max. | |
| T1 | 0.5 | - | 10 | ms |
| T2 | 30 | 40 | 50 | ms |
| T3 | 200 | - | - | ms |
| T4 | 10 | - | - | ms |
| T5 | 10 | - | - | ms |
| T6 | 0 | - | - | ms |
| T7 | 10 | - | - | ms |
| T8 | 100 | - | - | ms |
| T9 | 0 | 16 | 50 | ms |
| T10 | - | - | 10 | ms |
| T11 | 1000 | - | - | ms |

ON/OFF sequence should be applied to avoid abnormal function in the display. Please make sure to turn off the power when you plug the cable into the input connector or pull the cable out of the connector.



7. Connector & Pin Assignment

7.1 TFT- LCD Signal (CN1): LCD Connector

| | |
|-------------------------------|---|
| Manufacturer | STM |
| Connector Model Number | MSB24013P20, compatible with I-PEX 20268-020E |
| Mating Connector Model Number | Hirose DF19 -20S-1C or compatible |

| Pin# | Symbol | Pin# | Symbol |
|------|--------|------|----------|
| 1 | VDD | 11 | RxIN3- |
| 2 | VDD | 12 | RxIN3+ |
| 3 | GND | 13 | GND |
| 4 | SEL68 | 14 | RxCLKIN- |
| 5 | RxIN1- | 15 | RxCLKIN+ |
| 6 | RxIN1+ | 16 | NC |
| 7 | GND | 17 | U/D |
| 8 | RxIN2- | 18 | R/L |
| 9 | RxIN2+ | 19 | RxIN4- |
| 10 | GND | 20 | RxIN4+ |

7.2 LED Backlight Unit (CN2): Backlight Connector

Physical interface is described as for the connector on module. These connectors are capable of accommodating the following signals and will be following components.

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

| Pin # | Symbol | Cable Color | Pin Description |
|-------|--------|-------------|-----------------|
| 1 | +12V | Red | Power +12V |
| 2 | GND | Black | GND |



7.3 LED Driver Board

7.3.1 Input connector : J1

Model Name : S7B-PH-SM4-TB(JST)

(J1)

Connector Type: 2.0mm 7pin Wafer (SMD)

| Pin No. | Description |
|---------|----------------|
| 1 | +12V |
| 2 | +12V |
| 3 | +12V |
| 4 | Ground |
| 5 | PWM Control |
| 6 | Ground |
| 7 | ON/OFF Control |



(pin1)

7.3.2 Output connector : J2 , J3

Model Name : S2B-PH-SM4-TB(JST)

(J2)

Connector Type: 2.0mm 2pin Wafer (SMD)

| Pin No. | Description |
|---------|-------------|
| 1 | VLED+ |
| 2 | VLED- |

(J3)

Connector Type: 2.0mm 2pin Wafer (SMD)

| Pin No. | Description |
|---------|-------------|
| 1 | VLED+ |
| 2 | VLED- |

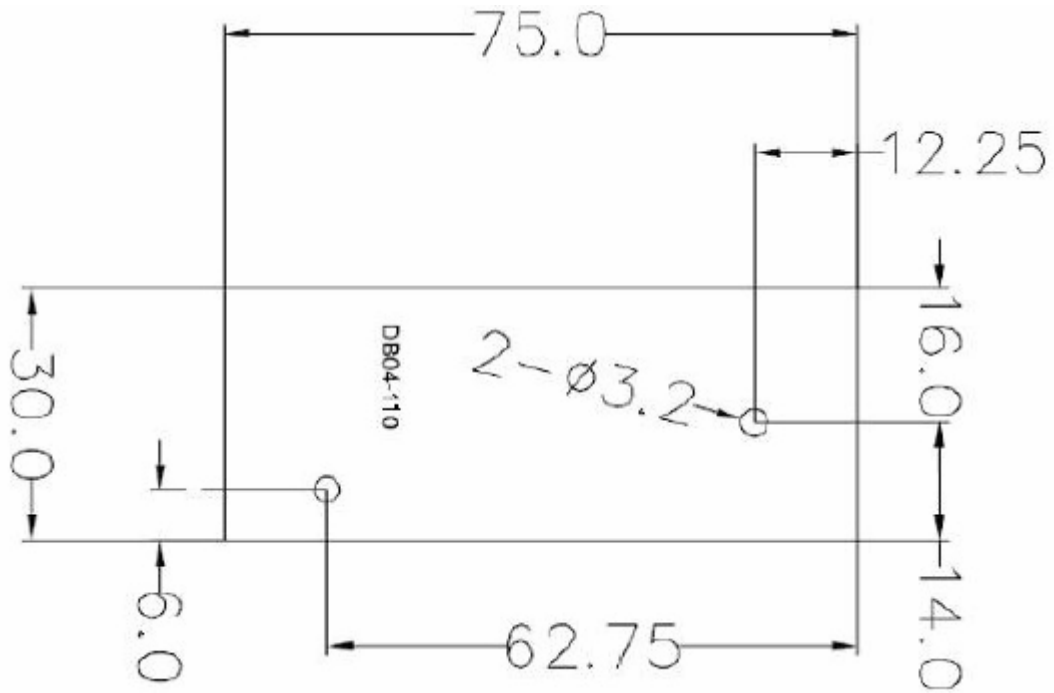


(pin1)



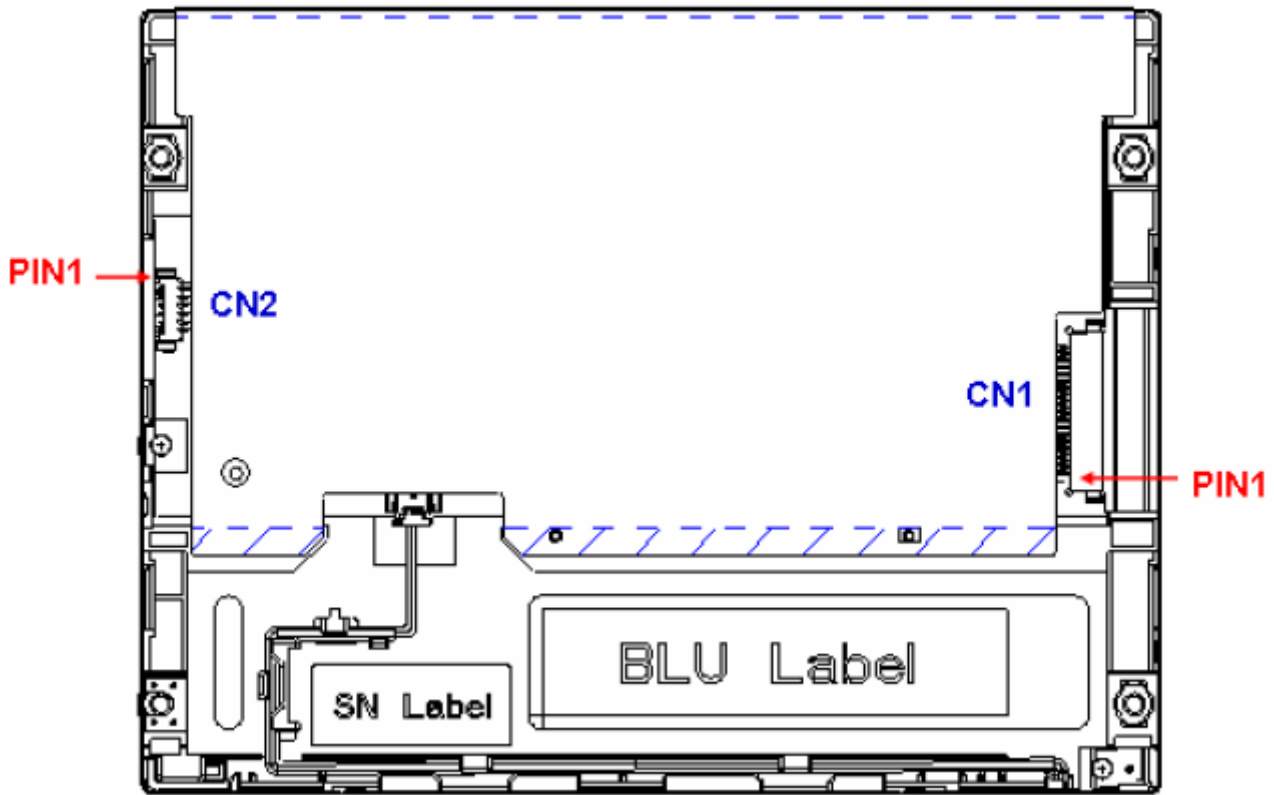
LED Driving Board Outline Dimension (Rear View)

Dimension : 75(L)*30(W)*8.65(H)mm





7.4 PIN 1 definition of CN1 and CN2



(Rear side of TFT-LCD)



8. Mechanical Characteristics

