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# 1. Applicable Scope

This specification is applicable to TFT-LCD Module "LQ035Q3DG03".

# 2. General Description

This module is a color active matrix LCD module incorporating amorphous silicon TFT (<u>Thin Film Transistor</u>). It is composed of a color TFT-LCD panel, driver IC, Input FPC and a back light unit. Graphics and texts can be displayed on a 320 × RGB × 240 dots panel with about 16 million colors by supplying 24bit data signals (8bit × RGB), four timing signals, 3wires 24bit serial interface signals, logic (Typ. +3.3V), analog (Typ. +3.3V) supply voltages for TFT-LCD panel driving and supply voltage for back light.

# 3. Mechanical (Physical) Specifications

| Item                      | Specifications                | Unit  |
|---------------------------|-------------------------------|-------|
| Screen size               | 8.8 (3.5")                    | cm    |
| Active area               | 70.56 (H) × 52.92 (V)         | mm    |
| Divel format              | 320 (H) × 240 (V)             | pixel |
| Pixel format              | 1 Pixel = R+G+B dots          | -     |
| Pixel pitch               | 0.2205 (H) × 0.2205 (V)       | mm    |
| Pixel configuration       | R,G,B vertical stripes        | -     |
| Display mode              | Normally white                | -     |
| Unit outline dimensions * | 76.9 (W) × 63.9 (H) × 4.7 (D) | mm    |
| Mass                      | 42                            | g     |
| Surface treatment         | Anti glare                    | -     |

\*The above-mentioned table indicates module sizes without some projections and FPC.

For detailed measurements and tolerances, please refer to Outline Dimensions in page 25.

# 4. Input Terminal Names and Functions

| Pin No. | Symbol | I/O | Description  | Note   |
|---------|--------|-----|--|--------|
| 1       | GND    |     | GND(0V)  |        |
| 2       | GND    | —   | GND(0V)  |        |
| 3       | VDDIO  | —   | +3.3V power source(Logic I/O power supply voltage) |        |
| 4       | VCI    | _   | +3.3V power source(Analog power supply)            |        |
| 5       | R0     | I   | RED data signal (8 bit LSB)                        | Note 1 |
| 6       | R1     | I   | RED data signal(8 bit)                             | Note 1 |
| 7       | R2     | I   | RED data signal(LSB)                               |        |
| 8       | R3     | I   | RED data signal                                    |        |
| 9       | R4     | I   | RED data signal                                    |        |
| 10      | R5     | I   | RED data signal                                    |        |
| 11      | R6     | I   | RED data signal                                    |        |
| 12      | R7     | I   | RED data signal(MSB)                               |        |
| 13      | G0     | I   | GREEN data signal(8 bit LSB)                       | Note 1 |
| 14      | G1     | I   | GREEN data signal(8 bit)                           | Note 1 |
| 15      | G2     | I   | GREEN data signal(LSB)                             |        |
| 16      | G3     | I   | GREEN data signal                                  |        |
| 17      | G4     | I   | GREEN data signal                                  |        |
| 18      | G5     | I   | GREEN data signal                                  |        |
| 19      | G6     | I   | GREEN data signal                                  |        |
| 20      | G7     | I   | GREEN data signal(MSB)                             |        |
| 21      | B0     | I   | Blue data signal(8 bit LSB)                        | Note 1 |
| 22      | B1     | I   | Blue data signal(8 bit)                            | Note 1 |
| 23      | B2     | I   | BLUE data signal(LSB)                              |        |
| 24      | B3     | I   | BLUE data signal                                   |        |
| 25      | B4     | I   | BLUE data signal                                   |        |
| 26      | B5     | I   | BLUE data signal                                   |        |
| 27      | B6     | I   | BLUE data signal                                   |        |
| 28      | B7     | I   | BLUE data signal(MSB)                              |        |
| 29      | GND    | —   | GND(0V)  |        |
| 30      | DOTCLK | I   | Pixel clock signal                                 |        |
| 31      | CSB    | I   | Chip select / Power On                             |        |
| 32      | HSYNC  | Ι   | Horizontal synchronizing signal                    |        |
| 33      | VSYNC  | Ι   | Vertical synchronizing signal                      |        |
| 34      | DEN    |     | Data Enable  |        |
| 35      | GND    | _   | GND(0V)  |        |
| 36      | REST   |     | Reset  |        |
| 37      | SCK    | I   | Serial clock                                       |        |

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| 38 | SDI       | I | Serial data input    |  |
|----|-----------|---|----------------------|--|
| 39 | GND       | — | GND(0V)              |  |
| 40 | X1        | — | Should be Open       |  |
| 41 | Y1        | — | Should be Open       |  |
| 42 | X2        | — | Should be Open       |  |
| 43 | Y2        | — | Should be Open       |  |
| 44 | GND       | — | GND ( 0V )           |  |
| 45 | LED1(-)   | — | LED 1 (Cathode side) |  |
| 46 | NC        | _ | _                    |  |
| 47 | LED1(+)   | _ | LED 1 (Anode side)   |  |
| 48 | LED2(+)   | _ | LED 2 (Anode side)   |  |
| 49 | NC        |   | _                    |  |
| 50 | LED2( - ) | — | LED 2 (Cathode side) |  |

Note 1) Please connect these signals with GND or higher bit, when use 6 bit mode.

# 5. Absolute Maximum Ratings

| Item                           | Symbol            | Conditions | Rated value                   | Unit | Remarks   |
|--------------------------------|-------------------|------------|-------------------------------|------|-----------|
| Input voltage                  | VI                | Ta = 25°C  | -0.3 ~ V <sub>DDIO</sub> +0.3 | V    | Note 2    |
| Logic I/O power supply voltage | V <sub>DDIO</sub> | Ta = 25°C  | -0.3 ~ +4.0                   | V    |           |
| Analog power supply voltage    | V <sub>CI</sub>   | Ta = 25°C  | AGND-0.3 ~ +5.0               | V    |           |
| Temperature for storage        | Tstg              | -          | -30 ~ +80                     | °C   | Note 3    |
| Temperature for operation      | Topr              | -          | -20 ~ +70                     | °C   | Note 3, 4 |
| LED input electric current     | I <sub>LED</sub>  | Ta = 25°C  | 70                            | mA   | Note 5    |
| LED electricity consumption    | P <sub>LED</sub>  | Ta = 25°C  | 238                           | mW   | Note 5    |

Note 2) REST, CSB, SDI, SCK, DEN, B7~B0, G7~G0, R7~R0, VSYNC, HSYNC, DOTCLK

Note 3) Humidity: 95%RH Max. (Ta = 40°C)

Maximum bulb temperature under 39°C (Ta>40°C) See to it that no dew will be condensed.

Note 4) Panel surface temperature prescribes.

Note 5) Power consumption of one LED (Ta =  $25^{\circ}$ C) (use 6 pieces LED)

# 6. Electrical Characteristics

#### Ta = 25°C Min. Max. Item Symbol Тур. Unit Remarks DC voltage +2.5 +3.3 +3.6 V<sub>DDIO</sub> V Logic I/O power supply DC Current -0.35 0.50 Note 6 IVDDIO mΑ +3.0 +3.3 +3.6 DC voltage $V_{CI}$ V Analog power supply DC Current 13 IVCI 18 Note 6 mΑ 100 V<sub>RFVDDIO</sub> \_ Note 7 \_ mVp-p Permissive input Ripple voltage $V_{\mathsf{RFVCI}}$ 100 Note 7 -mVp-p VIH High $0.8 V_{DDIO}$ V<sub>DDIO</sub> V Note 8 -Logic Input Voltage $0.2 \, V_{\text{DDIO}}$ Low VIL 0 -V Note 8 High $I_{\rm H}$ -1 -1 Note 8 μA Logic Input Current Low -1 1 $|_{|L}$ \_ Note 8 μA

6-1. TFT LCD Panel Driving

Note 6)  $V_{DDIO} = V_{CI} = +3.3V$ 

Current situation for  $I_{VDDIO}$ : Black & White checker flag pattern Current situation for  $I_{VCI}$ : All black patterns

Note 7)  $V_{DDIO} = V_{CI} = +3.3V$ 

Note 8) REST, CSB, SDI, SCK, DEN, B7~B0, G7~G0, R7~R0, VSYNC, HSYNC, DOTCLK

Input voltage sequence



# 6-2. Start up sequence

Recommended setting



# 6-3. Power down sequence



- a) Though operation in ( ) is recommended, it never becomes a breakdown even if it omits it.
- b) It is possible to turn off VCI and VDDIO at the same time. But don't turn it off in order of VDDIO and VCI.

# 6-4. Register Setting

Please confirm the display quality enough to the register setting when you use the module by the frequencies other than DOTCLK=5MHz.

| Reg. # | Register              | Data   | Remark  |
|--------|-----------------------|--------|---------|
| R01 h  | Driver output control | 2AEF h | Note 9  |
| R02 h  | LCD drive AC control  | 0300 h |         |
| R03 h  | Power control (1)     | 080E h |         |
| R0B h  | Frame cycle control   | D000 h |         |
| R0C h  | Power control (2)     | 0005 h |         |
| R0D h  | Power control (3)     | 000F h |         |
| R0E h  | Power control (4)     | 2C00 h |         |
| R16 h  | Horizontal Porch      | 9F86 h | Note 10 |
| R17 h  | Vertical Porch        | 0002 h | Note 11 |
| R1E h  | Power control (5)     | 0000 h |         |
| R10 h  | Power control (6)     | 00DE h |         |
| R28 h  | Extended command 1    | 0006 h |         |
| R2A h  | Extended command 2    | 0187 h |         |
| R30 h  | Gamma control (1)     | 0000 h |         |
| R31 h  | Gamma control (2)     | 0103 h |         |
| R32 h  | Gamma control (3)     | 0001 h |         |
| R33 h  | Gamma control (4)     | 0501 h |         |
| R34 h  | Gamma control (5)     | 0607 h |         |
| R35 h  | Gamma control (6)     | 0406 h |         |
| R36 h  | Gamma control (7)     | 0707 h |         |
| R37 h  | Gamma control (8)     | 0305 h |         |
| R3A h  | Gamma control (9)     | 0F0F h |         |
| R3B h  | Gamma control (10)    | 0F02 h |         |

Note 9) Flip vertical and horizontal function (TB、RL)









# Driver output control (R01h)

| R/W | DC | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|-----|----|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| W   | 1  | CF1  | CF0  | REV  | MOD  | BGR  | SM   | ΤB  | RL  | 1   | 1   | 1   | 0   | 1   | 1   | 1   | 1   |
| PC  | )R | 0    | 0    | 1    | 0    | 1    | 0    | х   | х   | 1   | 1   | 1   | 0   | 1   | 1   | 1   | 1   |

Flip vertical Flip horizontal

Note 10)

| Horiz | Horizontal porch (R16h) |      |      |      |      |      |      |     |     |     |     |      |      |      |      |      |      |
|-------|-------------------------|------|------|------|------|------|------|-----|-----|-----|-----|------|------|------|------|------|------|
| R/W   | DC                      | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5  | IB4  | IB3  | IB2  | IB1  | IB0  |
| W     | 1                       | XL8  | XL7  | XL6  | XL5  | XL4  | XL3  | XL2 | XL1 | XL0 | 0   | HBP5 | HBP4 | HBP3 | HBP2 | HBP1 | HBP0 |
| PC    | )R                      | 1    | 0    | 0    | 1    | 1    | 1    | 1   | 1   | 1   | 0   | 0    | 0    | 0    | 1    | 1    | 0    |

HBP5-0 : Horizontal back porch set up



#### Note 11)

# Vertical porch (R17h)(POR=0002h)

| R/W | DC | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8  | IB7  | IB6  | IB5  | IB4  | IB3  | IB2  | IB1  | IB0  |
|-----|----|------|------|------|------|------|------|-----|------|------|------|------|------|------|------|------|------|
| W   | 1  | 0    | 0    | 0    | 0    | 0    | 0    | 0   | VBP8 | VBP7 | VBP6 | VBP5 | VBP4 | VBP3 | VBP2 | VBP1 | VBP0 |
| PC  | )R | 0    | 0    | 0    | 0    | 0    | 0    | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 1    | 0    |

# VBP8-0 : Vertical back porch set up



### 6-5. Back light driving

The back light system has 6 LED (3LED × 2 circuits)

| Parameter         | Symbol   | Min. | Тур.             | Max.             | Unit | Remark  |
|-------------------|----------|------|------------------|------------------|------|---------|
| Rated Voltage     | $V_{BL}$ | -    | 9.45 / 1 circuit | 10.2 / 1 circuit | V    |         |
| Rated Current     | ١L       | -    | 40 / 1 circuit   | 60 / 1 circuit   | mA   | Ta=25°C |
| Power consumption | WL       | -    | 378 / 1 circuit  | 612 / 1 circuit  | mW   |         |





# 7. Timing characteristics of input signals

# 7-1. Pixel clock timing

|                | Item               | Symbol                         | Min | Тур | Max | Units               |
|----------------|--------------------|--------------------------------|-----|-----|-----|---------------------|
| Clock          | Frequency          | f <sub>DOTCLK</sub>            | -   | 5.0 | 8.0 | MHz                 |
|                | Period             | t <sub>DOTCLK</sub>            | 125 | 200 | -   | ns                  |
|                | High time          | t <sub>скн</sub>               | 62  | -   | -   | ns                  |
|                | Low time           | t <sub>CKL</sub>               | 62  | -   | -   | ns                  |
| Data           | Set up time        | t <sub>ds</sub>                | 30  | -   | -   | ns                  |
|                | Hold time          | t <sub>dh</sub>                | 30  | -   | -   | ns                  |
| Vsync          | Set up time        | t <sub>vsys</sub>              | 20  | -   | -   | ns                  |
|                | Hold time          | t <sub>vsyh</sub>              | 20  | -   | -   | ns                  |
| Hsync          | Set up time        | t <sub>hsys</sub>              | 20  | -   | -   | ns                  |
|                | Hold time          | t <sub>hsyh</sub>              | 20  | -   | -   | ns                  |
| Phase differe  | nce of Sync Signal | t <sub>hv</sub>                | 0   | -   | 320 | t <sub>DOTCLK</sub> |
| Falling Edge   |                    |                                |     |     |     |                     |
| Reset pulse v  | vidth              | t <sub>RES</sub>               | 10  | -   | -   | ns                  |
| Rise/Fall time | ;                  | t <sub>r</sub> /t <sub>f</sub> | 5   | -   | 100 | ns                  |

7-2. Data timing characteristics (262k color)



| b' | ) Vertical | Data | Transaction | Timina |
|----|------------|------|-------------|--------|
| ~  | / * 01000  | 0000 | righterer   |        |

| Item                       |                   | Symbol                             | Min | Тур  | Max   | Units |
|----------------------------|-------------------|------------------------------------|-----|------|-------|-------|
| Clock                      | Clock Frequency f |                                    |     | 5.0  | 8.0   | MHz   |
|                            | Period            | t <sub>DOTCLK</sub>                | 125 | 200  | -     | ns    |
| Horizontal                 | Frequency         | f <sub>h</sub>                     | -   | 14.9 | 18.18 | kHz   |
| synchronized signal        | Period            | H <sub>cycle</sub>                 | -   | 336  | -     | Clock |
| Vertical                   | Frequency         | f <sub>v</sub>                     | 50  | 60.1 | -     | Hz    |
| synchronized signal Period |                   | V <sub>cycle</sub>                 | -   | 244  | -     | line  |
| Horizontal back porc       | h                 | t <sub>HBP</sub>                   | -   | 8    | -     | Clock |
| Horizontal front porch     | า                 | t <sub>HFP</sub>                   | -   | 8    | -     | Clock |
| Horizontal blank peri      | od                | t <sub>HBP</sub> +t <sub>HFP</sub> | -   | 16   | -     | Clock |
| Horizontal display are     | ea                | HDISP                              | -   | 320  | -     | Clock |
| Vertical back porch        |                   | t <sub>VBP</sub>                   | -   | 2    | -     | line  |
| Vertical front porch       |                   | t <sub>VFP</sub>                   | -   | 2    | -     | line  |
| vertical blank period      |                   | t <sub>HBP</sub> +t <sub>HFP</sub> | -   | 4    | -     | line  |
| Vertical display area      |                   | VDISP                              | -   | 240  | -     | line  |

It becomes the horizontal data beginning position after the horizontal backing porch period from falling edge of HSYNC. It becomes a vertical data beginning position after the vertical backing porch period from falling edge of VSYNC.

# 7-3. Power ON Sequence



| Item                        | Symbol    | Min | Тур | Max | Units |
|-----------------------------|-----------|-----|-----|-----|-------|
| V <sub>DDIO</sub> ON - SHUT | tp-shut   | 1   | -   | -   | us    |
| DOTCLK                      | tclk-shut | 1   | -   | -   | clk   |
| SHUT - LCD ON               | tshut-lcd | -   | -   | 164 | ms    |
| SHUT - diplayON             |           | -   | -   | 10  | frame |
| - 1 line : 336clk           |           |     |     |     |       |
| - 1frame : 244line          | tshut-on  | -   | 164 | -   | ms    |
| - DOTCLK: 5.0MHz            |           |     |     |     |       |

Note12) Please input DOTCLK before making SHUT Low.

Note13) Display starts after ten frames, after the falling edge of SHUT.

# 7-4. Power OFF Sequence



| Item  | Symbol    | Min  | Тур | Max | Units |
|---|-----------|------|-----|-----|-------|
| Rising of SHUT - Display OFF<br>1 line = 336 clk          |           | 2    | -   | -   | frame |
| 1 frame = 244 line  | tshut-off | 22.0 |     |     |       |
| DOTCLK = 5.0 MHz  |           | 32.8 | -   | -   | ms    |
| Input signal OFF - V <sub>CI</sub> /V <sub>DDIO</sub> OFF | toff-vdd  | 1    | -   | -   | us    |

Note14) DOTCLK must be maintained at lease 2 frames after the rising edge of SHUT.

Note15) Display becomes off at the 2<sup>nd</sup> falling edge of VSYNC after the falling edge of SHUT.

Note16) If RESET signal is necessary for power down, provide it after 2 frames edge of the SHUT period.

# 7-5. SPI Interface Timing Diagram & Transaction Example (3-wires 24 bit)



| Characteristics             | Symbol | Min | Тур | Max | Units |
|-----------------------------|--------|-----|-----|-----|-------|
| Serial Clock Frequency      | felk   | -   |     | 20  | MHz   |
| Serial Clock Cycle Time     | telk   | 50  | -   | -   | nsec  |
| Clock Low Width             | tsl    | 25  |     |     | nsec  |
| Clock High Width            | tsh    | 25  | -   | -   | nsec  |
| Chip Select Setup Time      | tess   | 0   | -   | -   | nsec  |
| Chip Select Hold Time       | tesh   | 10  |     |     | nsec  |
| Chip Select High Delay Time | tesd   | 20  |     |     | nsec  |
| Data Setup Time             | tds    | 5   | -   | -   | msec  |
| Data Hold Time              | tdh    | 10  | -   | -   | nsec  |

Sample) When driver output control (R28h) (1264h) is writing



7-6. Input Data Signals and Display Position on the screen



Please refer to [4.Input Terminal Names and Functions].

# 8. Input Signals, Basic Display Colors and Gray Scale of Each Color (8bit)

|       |                        |               | Data signal |    |                           |    |    |    |    |    |    |    |    |      |     |              |       |       |       |      |      |      |       |       |    |    |
|-------|------------------------|---------------|-------------|----|---------------------------|----|----|----|----|----|----|----|----|------|-----|--------------|-------|-------|-------|------|------|------|-------|-------|----|----|
|       | Colors &<br>Gray scale | Gray<br>Scale | R0          | R1 | R2                        | R3 | R4 | R5 | R6 | R7 | G0 | G1 | G2 | G3   | G4  | G5           | G6    | G7    | В0    | B1   | B2   | B3   | B4    | В5    | B6 | B7 |
|       | 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  |
|       | 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  |
| B     | 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  |
| asic  | 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  |
| Colc  | 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  |
| ٥r    | 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  |
|       | Black                  | GS0           | 0           | 0  | 0                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0   | 0            | 0     | 0     | 0     | 0    | 0    | 0    | 0     | 0     | 0  | 0  |
|       | 仓                      | GS1           | 1           | 0  | 0                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0   | 0            | 0     | 0     | 0     | 0    | 0    | 0    | 0     | 0     | 0  | 0  |
| iray  | Darker                 | GS2           | 0           | 1  | 0                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0   | 0            | 0     | 0     | 0     | 0    | 0    | 0    | 0     | 0     | 0  | 0  |
| Scal  | Û                      | $\downarrow$  |             |    | $\downarrow$ $\downarrow$ |    |    |    |    |    |    | r  |    |      |     | $\checkmark$ |       |       |       |      |      |      |       |       |    |    |
| le of | Û                      | $\downarrow$  |             |    |                           | `` | r  |    |    |    |    |    |    |      | r   |              |       |       |       |      |      |      | r     |       |    |    |
| Rec   | Brighter               | GS253         | 1           | 0  | 1                         | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0    | 0   | 0            | 0     | 0     | 0     | 0    | 0    | 0    | 0     | 0     | 0  | 0  |
|       | Û                      | GS254         | 0           | 1  | 1                         | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0    | 0   | 0            | 0     | 0     | 0     | 0    | 0    | 0    | 0     | 0     | 0  | 0  |
|       | Red                    | GS255         | 1           | 1  | 1                         | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0    | 0   | 0            | 0     | 0     | 0     | 0    | 0    | 0    | 0     | 0     | 0  | 0  |
|       | Black                  | GS0           | 0           | 0  | 0                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0   | 0            | 0     | 0     | 0     | 0    | 0    | 0    | 0     | 0     | 0  | 0  |
| G     | 仓                      | GS1           | 0           | 0  | 0                         | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0    | 0   | 0            | 0     | 0     | 0     | 0    | 0    | 0    | 0     | 0     | 0  | 0  |
| ray S | Darker                 | GS2           | 0           | 0  | 0                         | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0    | 0   | 0            | 0     | 0     | 0     | 0    | 0    | 0    | 0     | 0     | 0  | 0  |
| Scale | 仓                      | $\checkmark$  |             |    |                           | `` | r  |    |    |    |    |    |    | 1    | r   |              |       |       |       |      |      |      | r     |       |    |    |
| of (  | Û                      | $\checkmark$  |             |    |                           | `` | r  |    |    |    |    |    |    | 1    | r   |              |       |       |       |      |      |      | r     |       |    |    |
| Gree  | Brighter               | GS253         | 0           | 0  | 0                         | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 1  | 1    | 1   | 1            | 1     | 1     | 0     | 0    | 0    | 0    | 0     | 0     | 0  | 0  |
| n     | Û                      | GS254         | 0           | 0  | 0                         | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1    | 1   | 1            | 1     | 1     | 0     | 0    | 0    | 0    | 0     | 0     | 0  | 0  |
|       | Green                  | GS255         | 0           | 0  | 0                         | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1    | 1   | 1            | 1     | 1     | 0     | 0    | 0    | 0    | 0     | 0     | 0  | 0  |
|       | Black                  | GS0           | 0           | 0  | 0                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0   | 0            | 0     | 0     | 0     | 0    | 0    | 0    | 0     | 0     | 0  | 0  |
| G     | Ŷ                      | GS1           | 0           | 0  | 0                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0   | 0            | 0     | 0     | 1     | 0    | 0    | 0    | 0     | 0     | 0  | 0  |
| ray   | Darker                 | GS2           | 0           | 0  | 0                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0   | 0            | 0     | 0     | 0     | 1    | 0    | 0    | 0     | 0     | 0  | 0  |
| Scal  | Ŷ                      | $\downarrow$  |             |    |                           | `` | r  |    |    |    |    |    |    | 1    | r   |              |       |       |       |      |      |      | r     |       |    |    |
| e of  | Û                      | $\checkmark$  |             |    |                           | 、  | r  |    |    |    |    |    |    |      | L   |              |       |       |       |      |      |      | L     |       |    |    |
| Blue  | Brighter               | GS253         | 0           | 0  | 0                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0   | 0            | 0     | 0     | 1     | 0    | 1    | 1    | 1     | 1     | 1  | 1  |
| CD    | Û                      | GS254         | 0           | 0  | 0                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0   | 0            | 0     | 0     | 0     | 1    | 1    | 1    | 1     | 1     | 1  | 1  |
|       | Blue                   | GS255         | 0           | 0  | 0                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0   | 0            | 0     | 0     | 1     | 1    | 1    | 1    | 1     | 1     | 1  | 1  |
|       |                        |               |             |    |                           |    |    |    |    |    |    |    |    | 0: L | .ow | leve         | el vo | oltac | ie. ´ | 1: H | liah | leve | el vo | oltac | ie |    |

Each basic color can be displayed in 256 gray scales from 8 bit data signals. According to the combination of total 24 bit data signals, the 16-million-color display can be achieved on the screen.

# 9. Optical Characteristics

| Ta = 2 | 5°C, V <sub>D</sub> | ינס = +3.3 | V, V <sub>CI</sub> = | +3.3V |
|--------|---------------------|------------|----------------------|-------|
|--------|---------------------|------------|----------------------|-------|

| Para               | meter      | Symbol | Condition                   | Min. | Тур.   | Max. | Unit              | Remark                 |
|--------------------|------------|--------|-----------------------------|------|--------|------|-------------------|------------------------|
|                    | Horizontal | θ3     |                             | -    | 60     | -    | deg.              |                        |
| Viewing            | TIONZONIA  | θ9     | CR > 10                     | -    | 60     | -    | deg.              | Noto17.00              |
| range              | Vertical   | θ12    |                             | -    | 40     | -    | deg.              | NOLET 7.20             |
|                    | Vertical   | θ6     |                             | -    | 60     | -    | deg.              |                        |
| Contrast ratio     |            | CR     | Optimum<br>viewing<br>angle | 100  | 300    | -    | -                 | Note18,20              |
| Response           | Rise       | тг     |                             | -    | 30     | 45   | ms                | Note10.00              |
| Time               | Fall       | тd     |                             | -    | 30     | 45   | ms                | Note 19,20             |
| Chroma             | aticity of | x      |                             | 0.26 | 0.31   | 0.36 | -                 | Nete 20                |
| White              |            | у      | θ=0°                        | 0.29 | 0.34   | 0.39 | -                 | Note20                 |
| Luminance of white |            |        |                             |      |        |      |                   | I <sub>LED</sub> =40mA |
|                    |            | XL1    |                             | 300  | 450    | -    | cd/m <sup>2</sup> | / 1 circuit            |
|                    |            |        |                             |      |        |      |                   | Note20                 |
| LED li             | fe time    | L      | continuation                | -    | 50,000 | -    | hour              | Note21                 |

\*The optical characteristic measurements are operated by using the measuring method of the figure below in the darkroom or in the same situation as the darkroom.



measurement method

Note17) Definitions of viewing angle range



6 o'clock direction

Note18) Definition of contrast ratio

The contrast ratio is defined as the following Contrast ratio (CR) =  $\frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$ 

Note19) Definition of response time

The response time is defined as the following figure and shall be measured by switching the input signal for "Black" and "White"



Note20) It shall be measured at center of the screen.

Note21) This is the reference value. The LED life time is defined as a time when brightness not to become under 50% of the original value(at Ta=25  $\$  I<sub>LED</sub>=40mA/ 1 circuit)

- 10. Handling of modules
- 10-1. Inserting the FPC into its connector and pulling it out
- 1) Be sure to turn off the power supply and the signals when inserting or disconnecting the cable.
- 2) Please insert for too much stress not to join FPC in the case of insertion of FPC.
- 10-2. About handling of FPC
- 1) The bending radius of the FPC should be more than 1.4mm, and it should be bent evenly.
- 2) Do not dangle the LCD module by holding the FPC, or do not give any stress to it.
- 10-3. Mounting of the module
- 1) The module should be held on to the plain surface. Do not give any warping or twisting stress to the module.
- 2) Please consider that GND can ground a modular metal portion etc. so that static electricity is not charged to a module.

10-4. Cautions in assembly / Handling pre cautions

As the polarizer can be easily scratched, be most careful in handling it.

- 1) How to peel off lamination on the polarizer
  - A) Work environments in assembly.

Working under the following environments is desirable:

a) Implement more than  $1M\Omega$  conductive treatment (by placing a conductive mat or applying conductive paint) on the floor or tiles.

b) No dusts come in to the working room. Place an adhesive, anti-dust mat at the entrance of the room.

- c) Humidity of 50 to 70% and temperature of 15 to 27°C are desirable.
- d) All workers wear conductive shoes, conductive clothes, conductive fingerstalls and grounding belts without fail.

B) Work method



a )Use a blower for electrostatic removal. Set it in a direction slightly tilt downward so that each module can be well subjected to its wind. Set the blower at an optimum distance between the

blower and the module. (Refer to above figure.)

- b )Because the polarizing plate is not scratched, the tape of the strong sticking is held to lamination part near the blower. (Refer to above figure.)
- c )Peel off lamination while pulling the cellophane tape forward. The time of peeling off is five seconds or more.
- d ) Please move the module after peeling off to the following work at once so that dust dose not attach.
- 2) How to remove dust on the polarizer
- a) Blow out dust by the use of an N2 blower with antistatic measures taken. Use of an ionized air Gun is recommendable.
- b) When the panel surface is soiled, wipe it with soft cloth.
- 3) In the case of the module's metal part (shield case) is stained, wipe it with a piece of dry, soft cloth.

If rather difficult, give a breath on the metal part to clean better.

- 4) If water dropped, etc. remains stuck on the polarizer for a long time, it is apt to get discolored or cause stains. Wipe it immediately.
- 5) As a glass substrate is used for the TFT-LCD panel, if it is dropped on the floor or hit by something hard, it may be broken or chipped off.
- 6) Since CMOS LSI is used in this module, take care of static electricity and take the human earth into consideration when handling.

# 10-5. Others

- 1) Regarding storage of LCD modules, avoid storing them at direct sunlight-situation.
- 2) If stored at temperatures below the rated values, the inner liquid crystal may freeze, causing cell destruction. At temperatures exceeding the rated values for storage, the liquid crystal may become isotropic liquid, making it no longer possible to come back to its original state in some cases.
- 3) If the LCD is broken, the liquid crystal in the panel might leak. Please wash in water at once when it enters eyes and mouths by mistake.
- 4) If a water drop or dust adheres to the polarizer, it is apt to cause deterioration. Wipe it immediately.
- 5) Be sure to observe other caution items for ordinary electronic parts and components.
- 6) When handling LCD modules and assembling them into cabinets, that long-terms storage in the environment of oxidization or deoxidization gas and the use of such materials as reagent, solvent, adhesive, resin, etc. which generate these gasses, causes corrosion and discoloration of the modules. Therefore, please avoid these use. Epoxy resin (amine series curing agent), silicone adhesive material (dealcoholization series and oxime series), tray forming agent (azo compound) etc, in the cabinet
- or the packing materials may induce abnormal display with polarizer film deterioration regardress of contact or noncontact to polarizer film. Be sure to confirm the component of them.
- 7) In case of attaching protective board over the LCD, be careful about the optical interface fringe etc. which degrades display quality.
- 8) The LED used for this product is very sensitive to the temperature. Luminance decreases rapidly when it issued for a long time under the environment of the high temperature. Please consult our company when it is used under the environment like the above mentioned.
- 9) Be careful when using it for long time with fixed pattern display as it may cause afterimage. (Please use a screen saver etc., in order to avoid an afterimage.)
- 10) Notice:Never dismantle the module , because it will cause failure. Moreover, please do not peel off the tapes other than the creped paper tape (yellow tape) of a protection film pasted to the product.
- 11) If a minute particle enters in the module and adheres to an optical material, it may cause display non-uniformity issue, etc. Therefore, fine-pitch filters have to be installed to cooling and inhalation hole if you intend to install a fan.
- 12) VCOM must be adjusted on condition of your final product. No adjustment causes the deterioration for display quality.
- 13) Be sure to use a power supply with the safety protection circuit such as the fuse for the excess voltage, excess current, electric discharge waveform and or Latch-up occurring.

# 11. Reliability test items

| No. | Test item  | Conditions  |
|-----|--|---|
| 1   | High temperature storage test                      | Ta = 80°C 240h  |
| 2   | Low temperature storage test                       | Ta = -30°C 240h   |
| 3   | High temperature<br>& high humidity operation test | Tp = 40°C ; 95%RH 240h<br>(No condensation)   |
| 4   | High temperature operation test                    | Tp= 70°C 240h   |
| 5   | Low temperature operation test                     | Ta = -20°C 240h   |
| 6   | Vibration test<br>(non- operating)                 | Frequency range: 10 to 55Hz<br>Stroke: 1.5mm<br>Sweep time: 1minutes<br>Test period: 2 hours<br>(for each direction of X,Y,Z 40minites) |
| 7   | Shock test   | Direction: ±X, ±Y, ±Z, Time: Third for each direction.<br>Impact value: 980m/s², Action time 6ms  |
| 8   | Thermal shock test                                 | Ta=-30°C to 80°C /10 cycles<br>(30 min) (30min)   |

# 【Check items】

In the standard condition, there shall be no practical problems that may affect the display function.

# 12. Display Grade

The standard regarding the grade of color LCD displaying modules should be based on the incoming inspection standard.

#### 13. Delivery Form

- 13-1. Carton storage conditions
  - 1) Carton piling-up: Max 8 rows
  - 2) Environments

```
Temperature: 0 ~ 40°C
```

Humidity: 65% RH or less (at 40°C)

There should be no dew condensation even at a low temperature and high humidity.

3) Packing form: As shown in 15. LCD module packing carton

# 14. Lot No. marking

The lot No. will be indicated on individual inkjet. The location is as shown



# 15. LCD module packing carton

| Product countries / Areas       | CHINA                               |
|---------------------------------|-------------------------------------|
| Piling number of cartons        | 8                                   |
| Package quantity in one carton  | 120pcs                              |
| Carton size(TYP)                | $525 \times 360 \times 225(H)$ [mm] |
| Total mass of one carton filled | 6.2 Kg (typ)                        |
| with full modules               |                                     |



