



WINSTAR Display Co.,Ltd.
華凌光電股份有限公司



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華凌光電股份有限公司



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SPECIFICATION

CUSTOMER : _____

MODULE NO.: WF24HTLAJDNNO#

| | |
|--|---|
| <p>APPROVED BY: (FOR CUSTOMER USE ONLY)</p> | <p>PCB VERSION: _____ DATA: _____</p> |
|--|---|

| SALES BY | APPROVED BY | CHECKED BY | PREPARED BY |
|--------------------------------|-------------|------------|-------------|
| | | | 葉虹蘭 |
| ISSUED DATE: 2017/08/22 | | | |

RECORDS OF REVISION

DOC. FIRST ISSUE

| VERSION | DATE | REVISED PAGE NO. | SUMMARY |
|---------|------------|------------------|----------------------------------|
| 0 | 2017/04/19 | | First issue |
| A | 2017/05/22 | | Modify LED Life Time & Interface |
| B | 2017/06/07 | | Modify LED Life Time. |
| C | 2017/08/22 | | Modify LED Life Time. |

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1.Module Classification Information

W F 24 H T L A J D N N 0 #
 ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬

| | | | | | | | | | | | | |
|---|---|---|---|---------|---|--|---|---------|---|---------|---|---------|
| ① | Brand : WINSTAR DISPLAY CORPORATION | | | | | | | | | | | |
| ② | Display Type : F→TFT Type, J→Custom TFT | | | | | | | | | | | |
| ③ | Display Size : 2.4" TFT | | | | | | | | | | | |
| ④ | Model serials no. | | | | | | | | | | | |
| ⑤ | Backlight Type : | F→CCFL, White S→LED, High Light White | | | | T→LED, White Z→Nichia LED, White | | | | | | |
| ⑥ | LCD Polarize Type/ Temperature range/ Gray Scale Inversion Direction | A→Transmissive, N.T, IPS TFT C→Transmissive, N. T, 6:00 ; F→Transmissive, N.T,12:00 ; I→Transmissive, W. T, 6:00 K→Transflective, W.T,12:00 L→Transmissive, W.T,12:00 N→Transmissive, Super W.T, 6:00 | | | | Q→Transmissive, Super W.T, 12:00 R→Transmissive, Super W.T, O-TFT V→Transmissive, Super W.T, VA TFT X→Transmissive, W.T, VA TFT Y→Transmissive, W.T, IPS TFT Z→Transmissive, W.T, O-TFT | | | | | | |
| ⑦ | A : TFT LCD B : TFT+FR+CONTROL BOARD C : TFT+FR+A/D BOARD D : TFT+FR+A/D BOARD+CONTROL BOARD E : TFT+FR+POWER BOARD | | | | | F : TFT+CONTROL BOARD G : TFT+FR H : TFT+D/V BOARD I : TFT+FR+D/V BOARD J : TFT+POWER BD | | | | | | |
| ⑧ | Resolution: | | | | | | | | | | | |
| | A | 128160 | B | 320234 | C | 320240 | D | 480234 | E | 480272 | F | 640480 |
| | G | 800480 | H | 1024600 | I | 320480 | J | 240320 | K | 800600 | L | 240400 |
| | M | 1024768 | N | 128128 | P | 1280800 | Q | 480800 | R | 640320 | S | 480128 |
| | T | 800320 | U | 8001280 | V | 176220 | W | 1280398 | X | 1024250 | Y | 1920720 |
| | Z | 800200 | 2 | 1024324 | 3 | 7201280 | | | | | | |
| ⑨ | D: Digital L : LVDS M:MIPI | | | | | | | | | | | |
| ⑩ | Interface : N:without control board A:8Bit B:16Bit H: HDMI I:I2C Interface R:RS232 S:SPI Interface U:USB | | | | | | | | | | | |
| ⑪ | TS : N : Without TS T : resistive touch panel C : capacitive touch panel (G-F-F) G : capacitive touch panel(G-G) | | | | | | | | | | | |
| ⑫ | Version | | | | | | | | | | | |
| ⑬ | Special Code | #:Fit in with ROHS directive regulations | | | | | | | | | | |

2.Summary

TFT 2.4”is a TN transmissive type color active matrix TFT liquid crystal display that use amorphous silicon TFT as switching devices. This module is a composed of a TFT_LCD module, It is usually designed for industrial application and this module follows RoHs.

3. General Specifications

| Item | Dimension | Unit |
|--------------------------------|-----------------------------------|-------------|
| Size | 2.4" | |
| Dot Matrix | 240 x RGB x 320(TFT) | dots |
| Module dimension | 42.72(W) x 60.26(H) x 2.25(D) | mm |
| Active area | 36.72 x 48.96 | mm |
| Dot pitch | 0.051 x 0.153 | mm |
| LCD type | TFT, Normally White, Transmissive | |
| View Direction | 6 o'clock | |
| Gray Scale Inversion Direction | 12 o'clock | |
| Aspect Ratio | Portrait | |
| Backlight Type | LED, Normally White | |
| With /Without TP | Without TP | |
| Surface | Glare | |

*Color tone slight changed by temperature and driving voltage.

4. Absolute Maximum Ratings

| Item | Symbol | Min | Typ | Max | Unit |
|-----------------------|--------|-----|-----|-----|------|
| Operating Temperature | TOP | -20 | — | +70 | °C |
| Storage Temperature | TST | -30 | — | +80 | °C |

Note: Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above

1. Temp. $\leq 60^{\circ}\text{C}$, 90% RH MAX. Temp. $> 60^{\circ}\text{C}$, Absolute humidity shall be less than 90% RH at 60°C

5. Electrical Characteristics

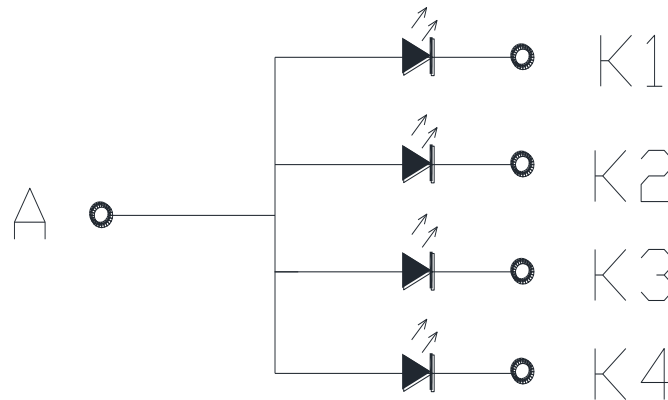
5.1. Operating conditions:

| Item | Symbol | Condition | Min | Typ | Max | Unit |
|---------------------------|--------|-----------|------|-----|-----|------|
| Supply Voltage For Analog | VCC | — | 2.4 | | 3.3 | V |
| Supply Voltage For Logic | VCCIO | | 1.65 | | 3.3 | V |
| Supply Current For LCM | ICC | — | — | 5 | 7.5 | mA |

5.2. LED driving conditions

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remark |
|-------------------|--------|------|--------|------|------|------------|
| LED current | | - | 80 | - | mA | |
| Power Consumption | | - | 256 | - | mW | |
| LED voltage | VBL+ | 2.8 | 3.2 | 3.4 | V | Note 1 |
| LED Life Time | | - | 30,000 | - | Hr | Note 2,3,4 |

Note 1 : There are 1 Groups LED



Note 2 : $T_a = 25\text{ }^\circ\text{C}$

Note 3 : Brightness to be decreased to 50% of the initial value

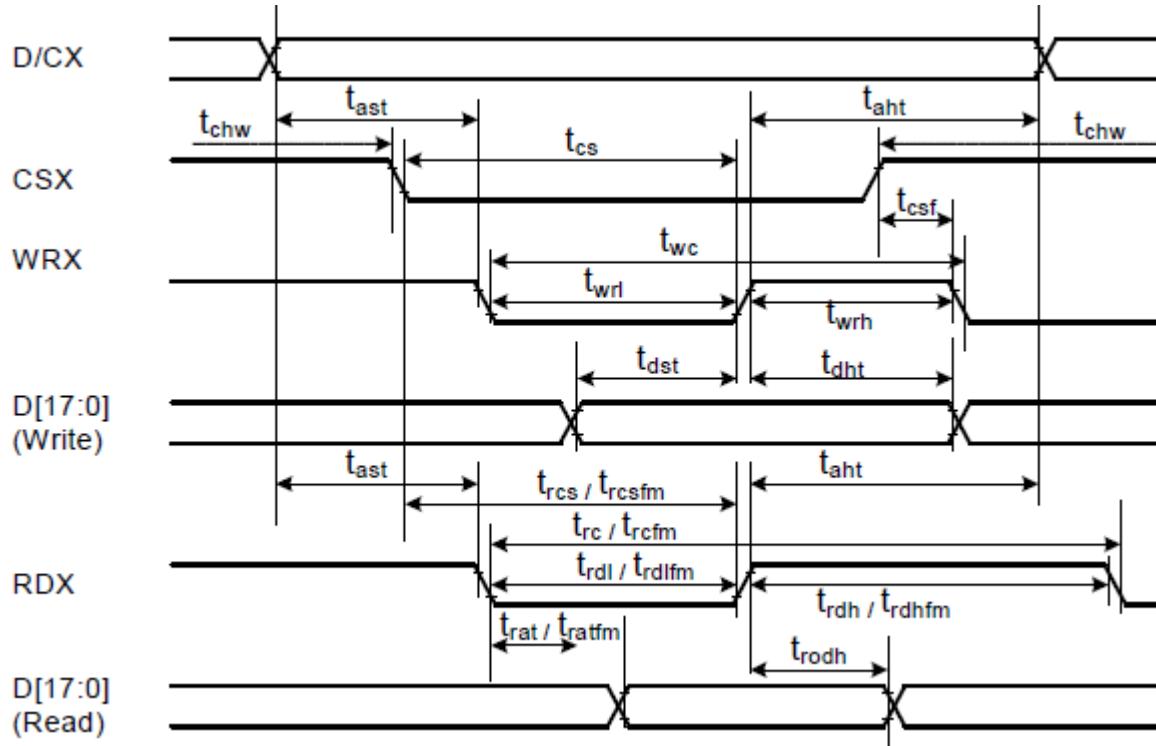
Note 4 : The single LED lamp case

6.DC CHARATERISTICS

| Parameter | Symbol | Rating | | | Unit | Condition |
|--------------------------|----------|--------|-----|--------|------|-----------|
| | | Min | Typ | Max | | |
| Low level input voltage | V_{IL} | 0 | - | 0.3VCC | V | |
| High level input voltage | V_{IH} | 0.7VCC | - | VCC | V | |

7.AC Characteristics

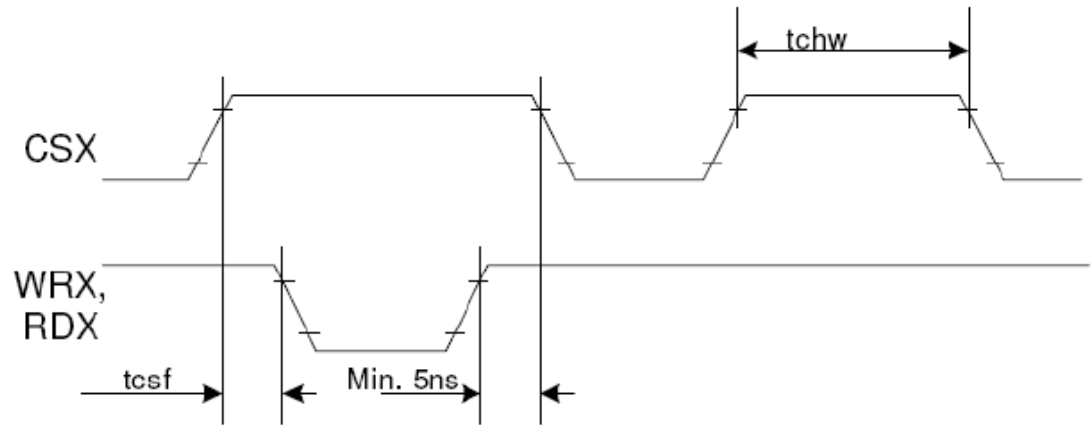
7.1. 8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus



| Signal | Symbol | Parameter | min | max | Unit | Description |
|---|--------|------------------------------------|-----|-----|------|---|
| DCX | tast | Address setup time | 0 | - | ns | |
| | taht | Address hold time (Write/Read) | 0 | - | ns | |
| CSX | tchw | CSX "H" pulse width | 0 | - | ns | |
| | tcs | Chip Select setup time (Write) | 15 | - | ns | |
| | trcs | Chip Select setup time (Read ID) | 45 | - | ns | |
| | trcsfm | Chip Select setup time (Read FM) | 355 | - | ns | |
| | tcsf | Chip Select Wait time (Write/Read) | 10 | - | ns | |
| WRX | twc | Write cycle | 66 | - | ns | |
| | twrh | Write Control pulse H duration | 15 | - | ns | |
| | twrl | Write Control pulse L duration | 15 | - | ns | |
| RDX (FM) | trcfm | Read Cycle (FM) | 450 | - | ns | |
| | trdhfm | Read Control H duration (FM) | 90 | - | ns | |
| | trdlfm | Read Control L duration (FM) | 355 | - | ns | |
| RDX (ID) | trc | Read cycle (ID) | 160 | - | ns | |
| | trdh | Read Control pulse H duration | 90 | - | ns | |
| | trdl | Read Control pulse L duration | 45 | - | ns | |
| D[17:0], D[15:0], D[8:0], D[7:0] | tdst | Write data setup time | 10 | - | ns | For maximum CL=30pF For minimum CL=8pF |
| | tdht | Write data hold time | 10 | - | ns | |
| | trat | Read access time | - | 40 | ns | |
| | tratfm | Read access time | - | 340 | ns | |
| | trodh | Read output disable time | 20 | 80 | ns | |

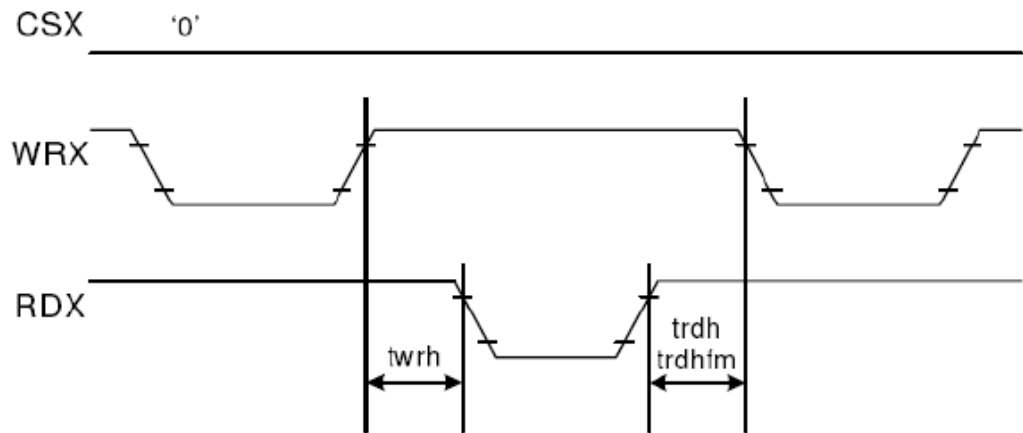
Note: $T_a = -30$ to 70 °C, $V_{DDI} = 1.65V$ to $3.3V$, $V_{CI} = 2.5V$ to $3.3V$, $V_{SS} = 0V$

CSX timings :



Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

Write to read or read to write timings:



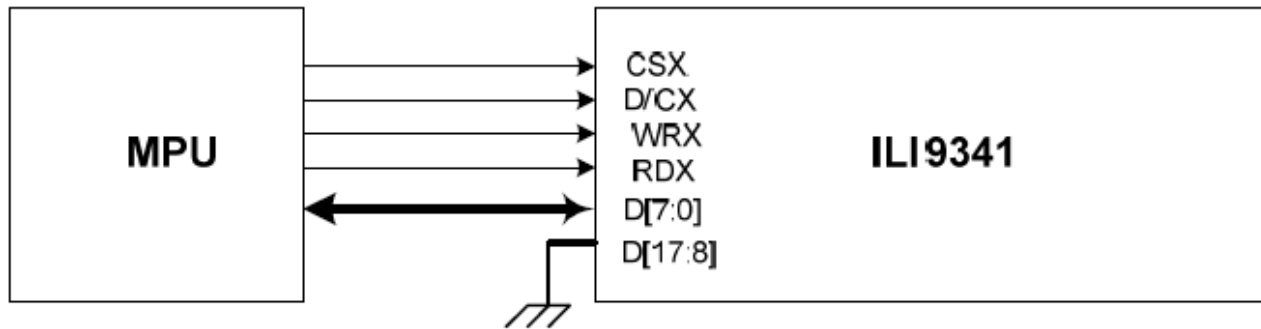
Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

7.2. Interface Pixel Format

| 3Ah | PIXSET (Pixel Format Set) | | | | | | | | | | | | |
|---|--|-----|-----|----------------------|----|-----------|-----------|----|----|----------------------|----|----|-----|
| | D/CX | RDX | WRX | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |
| Command | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 3Ah |
| Parameter | 1 | 1 | ↑ | XX | 0 | DPI [2:0] | | | 0 | DBI [2:0] | | | 66 |
| Description | This command sets the pixel format for the RGB image data used by the interface. DPI [2:0] is the pixel format select of RGB interface and DBI [2:0] is the pixel format of MCU interface. If a particular interface, either RGB interface or MCU interface, is not used then the corresponding bits in the parameter are ignored. The pixel format is shown in the table below. | | | | | | | | | | | | |
| | DPI [2:0] | | | RGB Interface Format | | | DBI [2:0] | | | MCU Interface Format | | | |
| | 0 | 0 | 0 | Reserved | | | 0 | 0 | 0 | Reserved | | | |
| | 0 | 0 | 1 | Reserved | | | 0 | 0 | 1 | Reserved | | | |
| | 0 | 1 | 0 | Reserved | | | 0 | 1 | 0 | Reserved | | | |
| | 0 | 1 | 1 | Reserved | | | 0 | 1 | 1 | Reserved | | | |
| | 1 | 0 | 0 | Reserved | | | 1 | 0 | 0 | Reserved | | | |
| | 1 | 0 | 1 | 16 bits / pixel | | | 1 | 0 | 1 | 16 bits / pixel | | | |
| | 1 | 1 | 0 | 18 bits / pixel | | | 1 | 1 | 0 | 18 bits / pixel | | | |
| | 1 | 1 | 1 | Reserved | | | 1 | 1 | 1 | Reserved | | | |
| If using RGB Interface must selection serial interface. | | | | | | | | | | | | | |
| X = Don't care | | | | | | | | | | | | | |

7.3. 8-bit Parallel MCU Interface

The 8080- I system 8-bit parallel bus interface of ILI9341V can be used by setting external pin as IM [3:0] to "0000". The following shown figure is the example of interface with 8080- I MCU system interface.



Different display data formats are available for two color depths supported by listed below.

- 65K-Colors, RGB 5, 6, 5 -bits input data.
- 262K-Colors, RGB 6, 6, 6 -bits input data.

65K color: 16-bit/pixel (RGB 5-6-5 bits input)

One pixel (3 sub-pixels) display data is sent by 2 byte transfers when DBI [2:0] bits of 3Ah register are set to "101".

| | | | | | | | | | | |
|-------|----|-----|-----|-----|-----|-----|-------|-------|-------|-------|
| Count | 0 | 1 | 2 | 3 | 4 | ... | 477 | 478 | 479 | 480 |
| D/CX | 0 | 1 | 1 | 1 | 1 | ... | 1 | 1 | 1 | 1 |
| D7 | C7 | 0R4 | 0G2 | 1R4 | 1G2 | ... | 238R4 | 238G2 | 239R4 | 239G2 |
| D6 | C6 | 0R3 | 0G1 | 1R3 | 1G1 | ... | 238R3 | 238G1 | 239R3 | 239G1 |
| D5 | C5 | 0R2 | 0G0 | 1R2 | 1G0 | ... | 238R2 | 238G0 | 239R2 | 239G0 |
| D4 | C4 | 0R1 | 0B4 | 1R1 | 1B4 | ... | 238R1 | 238B4 | 239R1 | 239B4 |
| D3 | C3 | 0R0 | 0B3 | 1R0 | 1B3 | ... | 238R0 | 238B3 | 239R0 | 239B3 |
| D2 | C2 | 0G5 | 0B2 | 1G5 | 1B2 | ... | 238G5 | 238B2 | 239G5 | 239B2 |
| D1 | C1 | 0G4 | 0B1 | 1G4 | 1B1 | ... | 238G4 | 238B1 | 239G4 | 239B1 |
| D0 | C0 | 0G3 | 0B0 | 1G3 | 1B0 | ... | 238G3 | 238B0 | 239G3 | 239B0 |

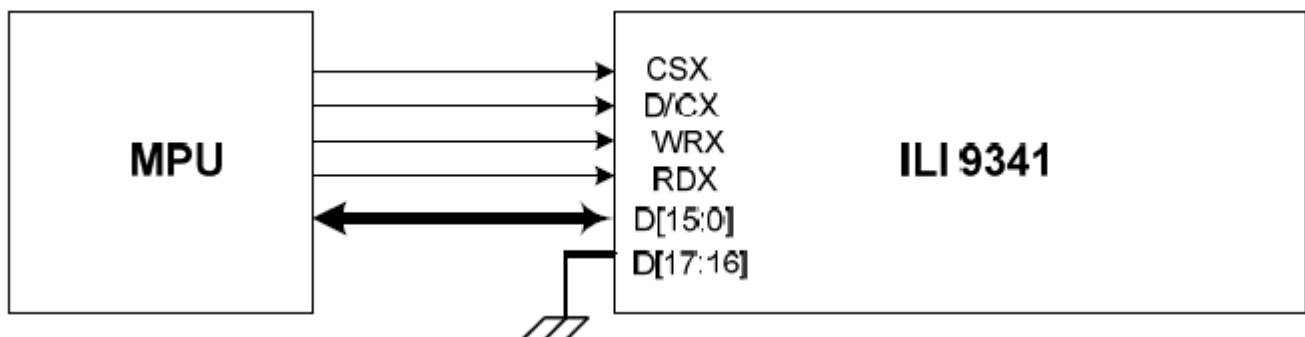
262K color: 18-bit/pixel (RGB 6-6-6 bits input)

One pixel (3 sub-pixels) display data is sent by 3 bytes transfer when DBI [2:0] bits of 3Ah register are set to "110".

| | | | | | | | | |
|-------|----|-----|-----|-----|-----|-------|-------|-------|
| Count | 0 | 1 | 2 | 3 | ... | 718 | 719 | 720 |
| D/CX | 0 | 1 | 1 | 1 | ... | 1 | 1 | 1 |
| D7 | C7 | 0R5 | 0G5 | 0B5 | ... | 239R5 | 239G5 | 239B5 |
| D6 | C6 | 0R4 | 0G4 | 0B4 | ... | 239R4 | 239G4 | 239B4 |
| D5 | C5 | 0R3 | 0G3 | 0B3 | ... | 239R3 | 239G3 | 239B3 |
| D4 | C4 | 0R2 | 0G2 | 0B2 | ... | 239R2 | 239G2 | 239B2 |
| D3 | C3 | 0R1 | 0G1 | 0B1 | ... | 239R1 | 239G1 | 239B1 |
| D2 | C2 | 0R0 | 0G0 | 0B0 | ... | 239R0 | 239G0 | 239B0 |
| D1 | C1 | | | | ... | | | |
| D0 | C0 | | | | ... | | | |

16-bit Parallel MCU Interface

The 8080- I system 16-bit parallel bus interface of ILI9341V can be selected by setting hardware pin IM[3:0] to "0001". The following shown figure is the example of interface with 8080- I MCU system interface.



Different display data format is available for two colors depth supported by listed below.

- 65K-Colors, RGB 5, 6, 5 -bits input data.
- 262K-Colors, RGB 6, 6, 6 -bits input data.

65K color: 16-bit/pixel (RGB 5-6-5 bits input)

One pixel (3 sub-pixels) display data is sent by 1 transfer when DBI [2:0] bits of 3Ah register are set to "101".

| | | | | | | | | |
|-------|----|-----|-----|-----|-----|-------|-------|-------|
| Count | 0 | 1 | 2 | 3 | ... | 238 | 239 | 240 |
| D/CX | 0 | 1 | 1 | 1 | ... | 1 | 1 | 1 |
| D15 | | 0R4 | 1R4 | 2R4 | ... | 237R4 | 238R4 | 239R4 |
| D14 | | 0R3 | 1R3 | 2R3 | ... | 237R3 | 238R3 | 239R3 |
| D13 | | 0R2 | 1R2 | 2R2 | ... | 237R2 | 238R2 | 239R2 |
| D12 | | 0R1 | 1R1 | 2R1 | ... | 237R1 | 238R1 | 239R1 |
| D11 | | 0R0 | 1R0 | 2R0 | ... | 237R0 | 238R0 | 239R0 |
| D10 | | 0G5 | 1G5 | 2G5 | ... | 237G5 | 238G5 | 239G5 |
| D9 | | 0G4 | 1G4 | 2G4 | ... | 237G4 | 238G4 | 239G4 |
| D8 | | 0G3 | 1G3 | 2G3 | ... | 237G3 | 238G3 | 239G3 |
| D7 | C7 | 0G2 | 1G2 | 2G2 | ... | 237G2 | 238G2 | 239G2 |
| D6 | C6 | 0G1 | 1G1 | 2G1 | ... | 237G1 | 238G1 | 239G1 |
| D5 | C5 | 0G0 | 1G0 | 2G0 | ... | 237G0 | 238G0 | 239G0 |
| D4 | C4 | 0B4 | 1B4 | 2B4 | ... | 237B4 | 238B4 | 239B4 |
| D3 | C3 | 0B3 | 1B3 | 2B3 | ... | 237B3 | 238B3 | 239B3 |
| D2 | C2 | 0B2 | 1B2 | 2B2 | ... | 237B2 | 238B2 | 239B2 |
| D1 | C1 | 0B1 | 1B1 | 2B1 | ... | 237B1 | 238B1 | 239B1 |
| D0 | C0 | 0B0 | 1B0 | 2B0 | ... | 237B0 | 238B0 | 239B0 |

262K color: 18-bit/pixel (RGB 6-6-6 bits input)

One pixel (3 sub-pixels) display data is sent by 2 transfers when DBI [2:0] bits of 3Ah register are set to "110".

MDT[1:0]="00"

| | | | | | | | | |
|-------|----|-----|-----|-----|-----|-------|-------|-------|
| Count | 0 | 1 | 2 | 3 | ... | 358 | 359 | 360 |
| D/CX | 0 | 1 | 1 | 1 | ... | 1 | 1 | 1 |
| D15 | | 0R5 | 0B5 | 1G5 | ... | 238R5 | 238B5 | 239G5 |
| D14 | | 0R4 | 0B4 | 1G4 | ... | 238R4 | 238B4 | 239G4 |
| D13 | | 0R3 | 0B3 | 1G3 | ... | 238R3 | 238B3 | 239G3 |
| D12 | | 0R2 | 0B2 | 1G2 | ... | 238R2 | 238B2 | 239G2 |
| D11 | | 0R1 | 0B1 | 1G1 | ... | 238R1 | 238B1 | 239G1 |
| D10 | | 0R0 | 0B0 | 1G0 | ... | 238R0 | 238B0 | 239G0 |
| D9 | | | | | ... | | | |
| D8 | | | | | ... | | | |
| D7 | C7 | 0G5 | 1R5 | 1B5 | ... | 238G5 | 239R5 | 239B5 |
| D6 | C6 | 0G4 | 1R4 | 1B4 | ... | 238G4 | 239R4 | 239B4 |
| D5 | C5 | 0G3 | 1R3 | 1B3 | ... | 238G3 | 239R3 | 239B3 |
| D4 | C4 | 0G2 | 1R2 | 1B2 | ... | 238G2 | 239R2 | 239B2 |
| D3 | C3 | 0G1 | 1R1 | 1B1 | ... | 238G1 | 239R1 | 239B1 |
| D2 | C2 | 0G0 | 1R0 | 1B0 | ... | 238G0 | 239R0 | 239B0 |
| D1 | C1 | | | | ... | | | |
| D0 | C0 | | | | ... | | | |

MDT[1:0]= " 01 "

| Count | 0 | 1 | 2 | 3 | ... | 357 | 358 | 479 | 480 | |
|-------|----|-----|-----|-----|-----|-------|-------|-------|-------|-------|
| D/CX | 0 | 1 | 1 | 1 | ... | | 1 | 1 | 1 | |
| D15 | | 0R5 | 0B5 | 1R5 | 1B5 | ... | 238R5 | 238B5 | 239R5 | 239B5 |
| D14 | | 0R4 | 0B4 | 1R4 | 1B4 | ... | 238R4 | 238B4 | 239R4 | 239B4 |
| D13 | | 0R3 | 0B3 | 1R3 | 1B3 | ... | 238R3 | 238B3 | 239R3 | 239B3 |
| D12 | | 0R2 | 0B2 | 1R2 | 1B2 | ... | 238R2 | 238B2 | 239R2 | 239B2 |
| D11 | | 0R1 | 0B1 | 1R1 | 1B1 | ... | 238R1 | 238B1 | 239R1 | 239B1 |
| D10 | | 0R0 | 0B0 | 1R0 | 1B0 | ... | 238R0 | 238B0 | 239R0 | 239B0 |
| D9 | | | | | ... | | | | | |
| D8 | | | | | ... | | | | | |
| D7 | C7 | 0G5 | | 1G5 | ... | 238G5 | | 239G5 | | |
| D6 | C6 | 0G4 | | 1G4 | ... | 238G4 | | 239G4 | | |
| D5 | C5 | 0G3 | | 1G3 | ... | 238G3 | | 239G3 | | |
| D4 | C4 | 0G2 | | 1G2 | ... | 238G2 | | 239G2 | | |
| D3 | C3 | 0G1 | | 1G1 | ... | 238G1 | | 239G1 | | |
| D2 | C2 | 0G0 | | 1G0 | ... | 238G0 | | 239G0 | | |
| D1 | C1 | | | | ... | | | | | |
| D0 | C0 | | | | ... | | | | | |

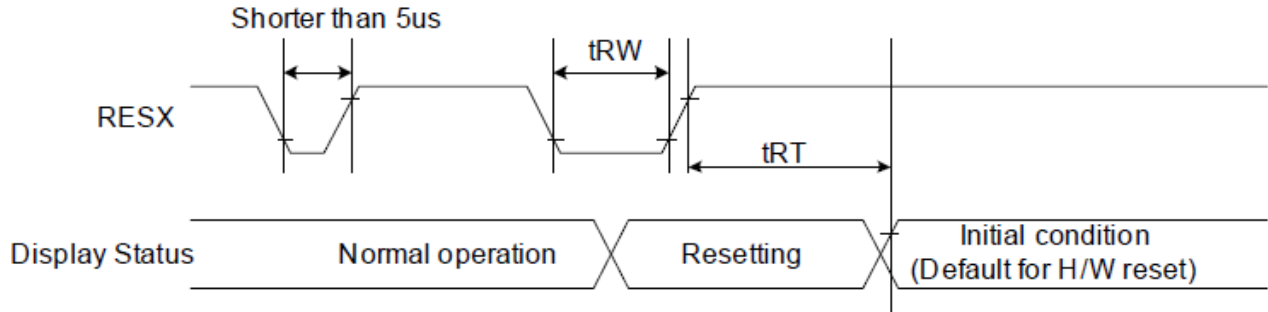
MDT[1:0]= " 10 "

| Count | 0 | 1 | 2 | 3 | ... | 357 | 358 | 479 | 480 | |
|-------|----|-----|-----|-----|-----|-------|-------|-------|-------|-------|
| D/CX | 0 | 1 | 1 | 1 | ... | | 1 | 1 | 1 | |
| D15 | | 0R5 | 0B1 | 1R5 | 1B1 | ... | 238R5 | 238B1 | 239R5 | 239B1 |
| D14 | | 0R4 | 0B0 | 1R4 | 1B0 | ... | 238R4 | 238B0 | 239R4 | 239B0 |
| D13 | | 0R3 | | 1R3 | | ... | 238R3 | | 239R3 | |
| D12 | | 0R2 | | 1R2 | | ... | 238R2 | | 239R2 | |
| D11 | | 0R1 | | 1R1 | | ... | 238R1 | | 239R1 | |
| D10 | | 0R0 | | 1R0 | | ... | 238R0 | | 239R0 | |
| D9 | | 0G5 | | 1G5 | ... | 238G5 | | 239G5 | | |
| D8 | | 0G4 | | 1G4 | ... | 238G4 | | 239G4 | | |
| D7 | C7 | 0G3 | | 1G3 | ... | 238G3 | | 239G3 | | |
| D6 | C6 | 0G2 | | 1G2 | ... | 238G2 | | 239G2 | | |
| D5 | C5 | 0G1 | | 1G1 | ... | 238G1 | | 239G1 | | |
| D4 | C4 | 0G0 | | 1G0 | ... | 238G0 | | 239G0 | | |
| D3 | C3 | 0B5 | | 1B5 | ... | 238B5 | | 239B5 | | |
| D2 | C2 | 0B4 | | 1B4 | ... | 238B4 | | 239B4 | | |
| D1 | C1 | 0B3 | | 1B3 | ... | 238B3 | | 239B3 | | |
| D0 | C0 | 0B2 | | 1B2 | ... | 238B2 | | 239B2 | | |

MDT[1:0]=” 11”

| Count | 0 | 1 | 2 | 3 | | ... | 357 | 358 | 479 | 480 |
|-------|----|-----|-----|-----|-----|-----|-------|-------|-------|-------|
| D/CX | 0 | 1 | 1 | 1 | | ... | | 1 | 1 | 1 |
| D15 | | | 0R3 | | 1R3 | ... | | 238R3 | | 239R3 |
| D14 | | | 0R2 | | 1R2 | ... | | 238R2 | | 239R2 |
| D13 | | | 0R1 | | 1R1 | ... | | 238R1 | | 239R1 |
| D12 | | | 0R0 | | 1R0 | ... | | 238R0 | | 239R0 |
| D11 | | | 0G5 | | 1G5 | ... | | 238G5 | | 239G5 |
| D10 | | | 0G4 | | 1G4 | ... | | 238G4 | | 239G4 |
| D9 | | | 0G3 | | 1G3 | ... | | 238G3 | | 239G3 |
| D8 | | | 0G2 | | 1G2 | ... | | 238G2 | | 239G2 |
| D7 | C7 | | 0G1 | | 1G1 | ... | | 238G1 | | 239G1 |
| D6 | C6 | | 0G0 | | 1G0 | ... | | 238G0 | | 239G0 |
| D5 | C5 | | 0B5 | | 1B5 | ... | | 238B5 | | 239B5 |
| D4 | C4 | | 0B4 | | 1B4 | ... | | 238B4 | | 239B4 |
| D3 | C3 | | 0B3 | | 1B3 | ... | | 238B3 | | 239B3 |
| D2 | C2 | | 0B2 | | 1B2 | ... | | 238B2 | | 239B2 |
| D1 | C1 | 0R5 | 0B1 | 1R5 | 1B1 | ... | 238R5 | 238B1 | 239R5 | 239B1 |
| D0 | C0 | 0R4 | 0B0 | 1R4 | 1B0 | ... | 238R4 | 238B0 | 239R4 | 239B0 |

7.4. Reset Timing



| Signal | Symbol | Parameter | Min | Max | Unit |
|--------|----------|----------------------|-----|-------------------------------------|------|
| RESX | t_{RW} | Reset pulse duration | 10 | | us |
| | t_{RT} | Reset cancel | | 5 (Note 1, 5) 120 (Note 1, 6, 7) | ms |

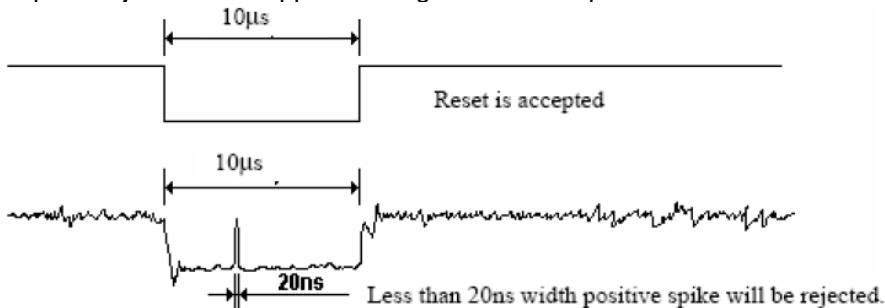
VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, $T_a = -30 \sim 70 \text{ } ^\circ\text{C}$

Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (t_{RT}) within 5 ms after a rising edge of RESX.
2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

| RESX Pulse | Action |
|----------------------|----------------|
| Shorter than 5us | Reset Rejected |
| Longer than 10us | Reset |
| Between 5us and 10us | Reset starts |

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.
4. Spike Rejection also applies during a valid reset pulse as shown below:



5. When Reset applied during Sleep In Mode.
6. When Reset applied during Sleep Out Mode.
7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

8. Optical Characteristics

| Item | Symbol | Condition. | Min | Typ. | Max. | Unit | Remark | |
|--|--------|-----------------------------------|------------|------|------|-------------------|-------------------|------------|
| Response time | Tr | $\theta=0^\circ$ 、 $\Phi=0^\circ$ | - | 4 | 8 | ms | Note 3,5 | |
| | Tf | | - | 12 | 24 | ms | | |
| Contrast ratio | CR | At optimized viewing angle | 400 | 500 | - | - | Note 4,5 | |
| Color Chromaticity | White | $\theta=0^\circ$ 、 $\Phi=0^\circ$ | Wx | 0.26 | 0.31 | 0.36 | | Note 2,6,7 |
| | | | Wy | 0.28 | 0.33 | 0.38 | | |
| Viewing angle (Gray Scale Inversion Direction) | Hor. | $CR \geq 10$ | Θ_R | 35 | 45 | - | Deg. | Note 1 |
| | | | Θ_L | 35 | 45 | - | | |
| | Ver. | | Φ_T | 35 | 45 | - | | |
| | | | Φ_B | 10 | 20 | - | | |
| Brightness | - | - | 400 | 500 | - | cd/m ² | Center of display | |

Ta=25±2°C

Note 1: Definition of viewing angle range

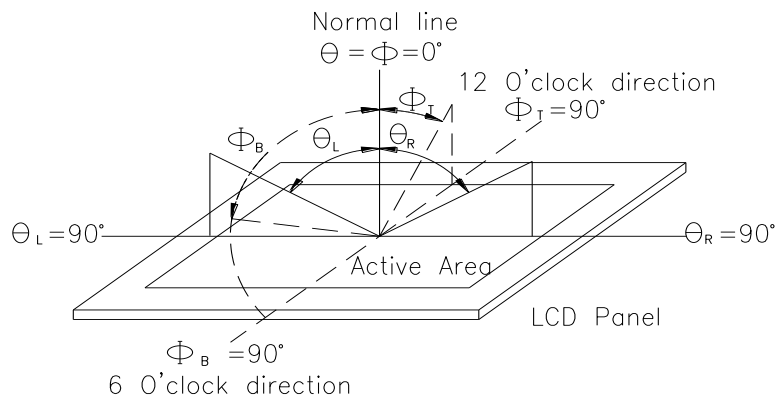


Fig. 8.1. Definition of viewing angle

Note 2: Test equipment setup:

After stabilizing and leaving the panel alone at a driven temperature for 10 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7 or BM-5 luminance meter 1.0° field of view at a distance of 50cm and normal direction.

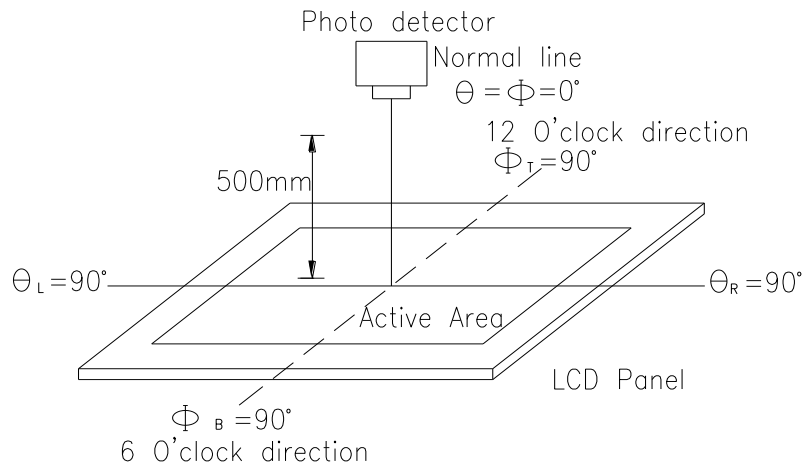
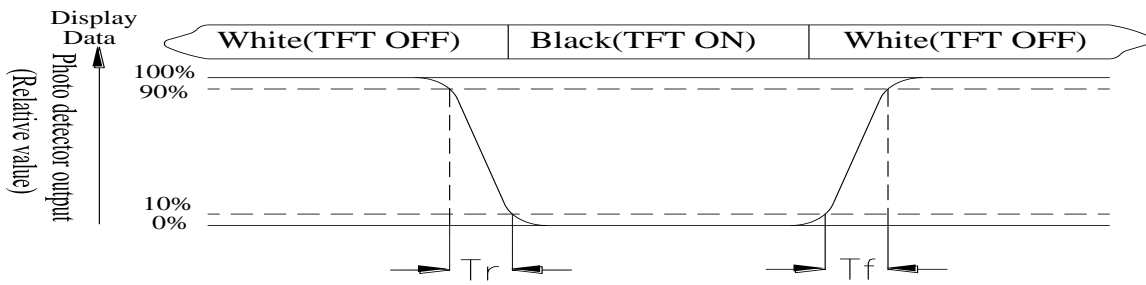


Fig. 8.2. Optical measurement system setup

Note 3: Definition of Response time:

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time, T_r , is the time between photo detector output intensity changed from 90% to 10%. And fall time, T_f , is the time between photo detector output intensity changed from 10% to 90%



Note 4: Definition of contrast ratio:

The contrast ratio is defined as the following expression.

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

Note 5: White $V_i = V_{i50} \pm 1.5V$

Black $V_i = V_{i50} \pm 2.0V$

“±” means that the analog input signal swings in phase with VCOM signal.

“±” means that the analog input signal swings out of phase with VCOM signal.

The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

Note 6: Definition of color chromaticity (CIE 1931)

Color coordinates measured at the center point of LCD

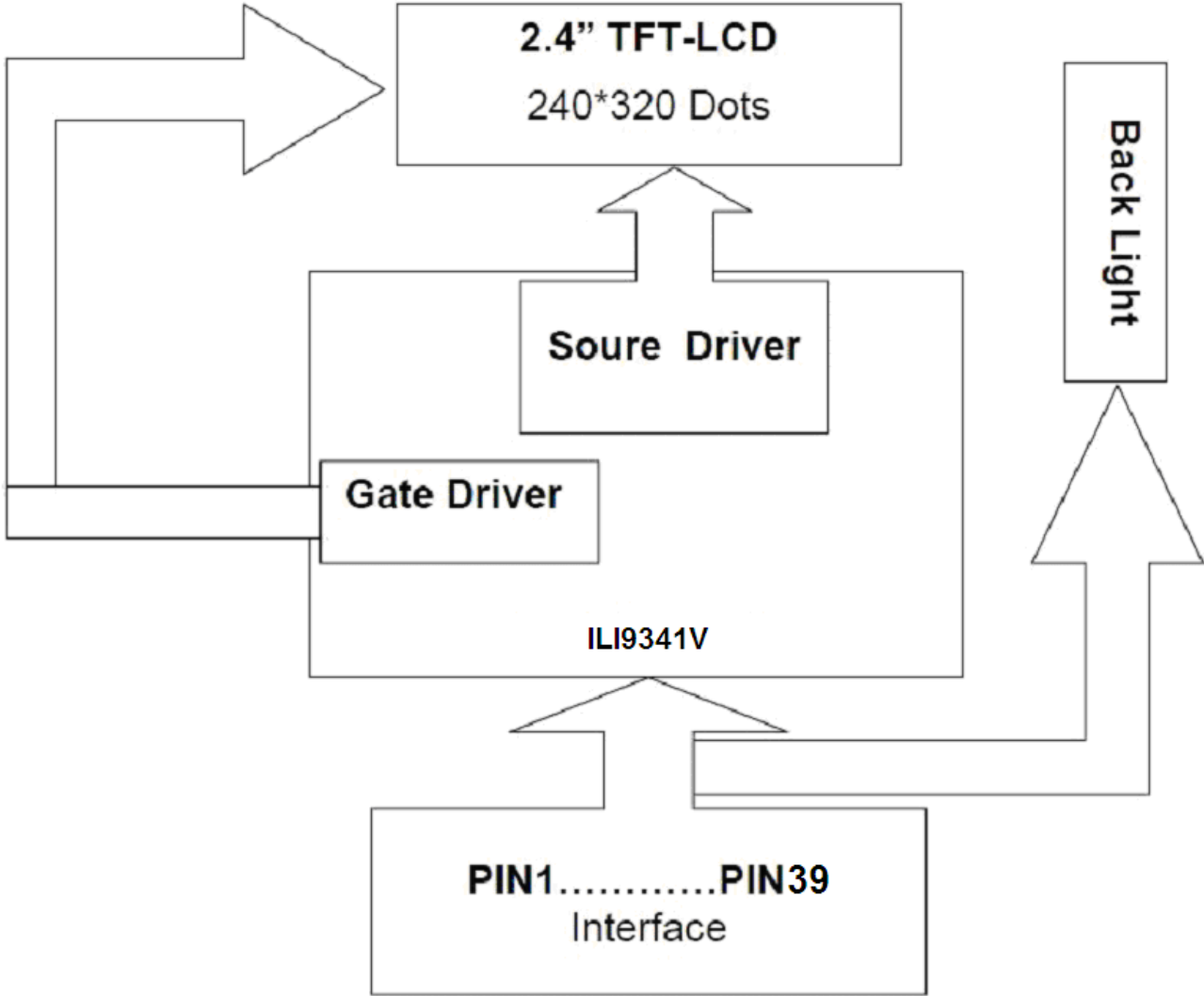
Note 7: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

9.Interface

9.1. LCM PIN Definition

| NO | Symbol | Function | I/O |
|-------|-----------|--|-----|
| 1 | GND | Ground | P |
| 2-5 | NC | No connect | - |
| 6 | LCD_ID | No connect | - |
| 7 | VCC | power supply(TYP:2.8V). | P |
| 8 | IOVCC | power supply(TYP:1.8V/2.8V). | P |
| 9 | FMARK | Synchronies MCU to frame rate | I |
| 10 | CS | Chip select signal. | I |
| 11 | RS | register select | I |
| 12 | WR | Write data when WRX is Low. | I |
| 13 | RD | Read strobe signal. Read out data when RDX is Low. | I |
| 14-29 | DB0- DB15 | Data bus | I/O |
| 30 | RESET | System reset pin. | I |
| 31 | IM0 | Data interface select IM0= IOVCC 16Bit DB0-DB15 IM0= GND 8Bit DB8-DB15 | I |
| 32 | NC | No connect | - |
| 33 | GND | Ground | P |
| 34-37 | LEDK1-K4 | Cathode of LED backlight. | P |
| 38 | LEDA | Anode of LED backlight. | P |
| 39 | GND | Ground | P |

10. Block Diagram



11. Reliability

Content of Reliability Test (Wide temperature, -20°C ~70°C)

| Environmental Test | | | |
|--------------------------------------|--|---|------|
| Test Item | Content of Test | Test Condition | Note |
| High Temperature storage | Endurance test applying the high storage temperature for a long time. | 80°C 96hrs | 2 |
| Low Temperature storage | Endurance test applying the low storage temperature for a long time. | -30°C 96hrs | 1,2 |
| High Temperature Operation | Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time. | 70°C 96hrs | — |
| Low Temperature Operation | Endurance test applying the electric stress under low temperature for a long time. | -20°C 96hrs | 1 |
| High Temperature/ Humidity Operation | The module should be allowed to stand at 60 °C ,85%RH max | 60°C ,85%RH 96hrs | 1,2 |
| Thermal shock resistance | The sample should be allowed stand the following 10 cycles of operation <div style="text-align: center;"> <p style="margin: 0;">-20°C 25°C 60°C</p> <p style="margin: 0;">30min 5min 30min</p> <p style="margin: 0;">1 cycle</p> </div> | -20°C /60°C 10 cycles | — |
| Vibration test | Endurance test applying the vibration during transportation and using. | Total fixed amplitude : 1.5mm Vibration Frequency : 10~55Hz One cycle 60 seconds to 3 directions of X,Y,Z for Each 15 minutes | 3 |
| Static electricity test | Endurance test applying the electric stress to the terminal. | VS=±600V(contact), ±800v(air), RS=330Ω CS=150pF 10 times | — |

Note1: No dew condensation to be observed.

Note2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after remove from the test chamber.

Note3: The packing have to including into the vibration testing.



1、Panel Specification :

- 1. Panel Type : Pass NG , _____
- 2. View Direction : Pass NG , _____
- 3. Numbers of Dots : Pass NG , _____
- 4. View Area : Pass NG , _____
- 5. Active Area : Pass NG , _____
- 6. Operating Temperature : Pass NG , _____
- 7. Storage Temperature : Pass NG , _____
- 8. Others : _____

2、Mechanical Specification :

- 1. PCB Size : Pass NG , _____
- 2. Frame Size : Pass NG , _____
- 3. Material of Frame : Pass NG , _____
- 4. Connector Position : Pass NG , _____
- 5. Fix Hole Position : Pass NG , _____
- 6. Backlight Position : Pass NG , _____
- 7. Thickness of PCB : Pass NG , _____
- 8. Height of Frame to PCB : Pass NG , _____
- 9. Height of Module : Pass NG , _____
- 10. Others : Pass NG , _____

3、Relative Hole Size :

- 1. Pitch of Connector : Pass NG , _____
- 2. Hole size of Connector : Pass NG , _____
- 3. Mounting Hole size : Pass NG , _____
- 4. Mounting Hole Type : Pass NG , _____
- 5. Others : Pass NG , _____

4、Backlight Specification :

- 1. B/L Type : Pass NG , _____
- 2. B/L Color : Pass NG , _____
- 3. B/L Driving Voltage (Reference for LED Type) : Pass NG , _____
- 4. B/L Driving Current : Pass NG , _____
- 5. Brightness of B/L : Pass NG , _____
- 6. B/L Solder Method : Pass NG , _____
- 7. Others : Pass NG , _____

>> **Go to page 2** <<



Winstar Module Number : _____

Page: 2

5、Electronic Characteristics of Module :

- | | | |
|------------------------------|-------------------------------|-------------------------------------|
| 1. Input Voltage : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. Supply Current : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. Driving Voltage for LCD : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4. Contrast for LCD : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. B/L Driving Method : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6. Negative Voltage Output : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7. Interface Function : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 8. LCD Uniformity : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 9. ESD test : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 10. Others : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |

6、Summary :

Sales signature : _____

Customer Signature : _____

Date : / / _____