



Microtips

TECHNOLOGY

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Record of Revision

| Date | Revision No. | Summary |
|------------|--------------|--------------------|
| 2016-12-15 | 1.0 | Rev 1.0 was issued |
| | | |
| | | |

1. Scope

This data sheet is to introduce the specification of **MTD0240LMC-6** active matrix TFT module. It is composed of a color TFT-LCD panel, driver IC, FPC and a backlight unit. The 2.4” display area contains 240(RGB) x320 pixels.

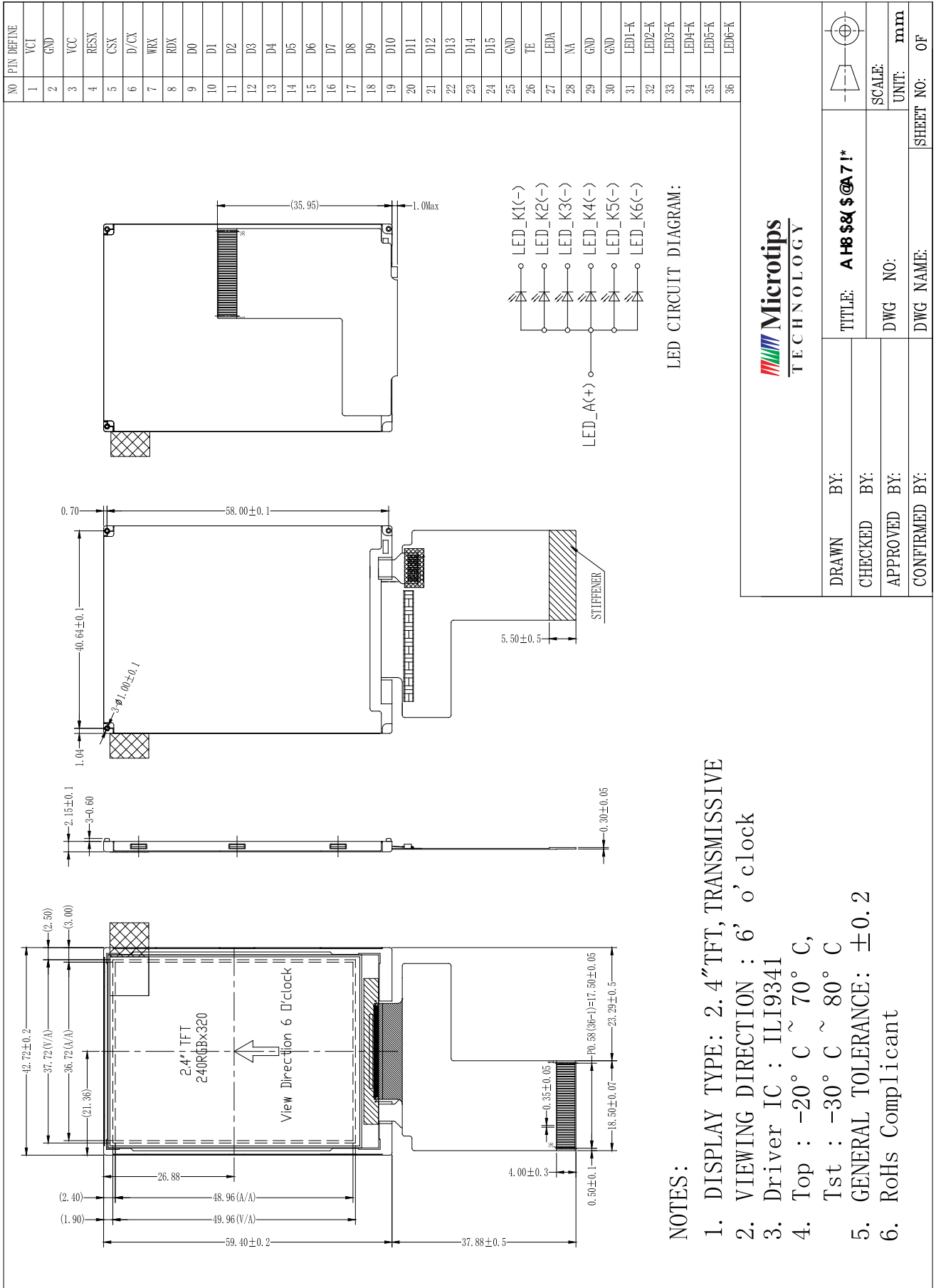
2. Application

Digital equipments which need color display, mobile phone, mobile navigator/video systems.

3. General Information

| Item | Contents | Unit |
|-------------------------------|------------------------------|------|
| Size | 2.4 | inch |
| Resolution | 240(RGB) x 320 | / |
| Interface | CPU 16-bit | / |
| Technology type | a-Si TFT | / |
| Pixel pitch | 0.153 x 0.153 | mm |
| Pixel Configuration | R.G.B. Vertical Stripe | |
| Viewing Direction | 6 o'clock | |
| Outline Dimension (W x H x D) | 42.72 x 59.4 x 2.15 | mm |
| Active Area | 36.72 x 48.96 | mm |
| Display Mode | Transmissive, Normally white | / |
| Surface Polarizer | Clear type | / |
| Backlight Type | 6 LEDs (Parallel) | / |
| Driver IC | ILI9341 | |

4. Outline Drawing



| | | | |
|--------------------------------|---------------|-----------------------------|--------------|
| Microtips TECHNOLOGY | | TITLE: AH\$&@71* | SCALE: |
| DRAWN BY: | CHECKED BY: | DWG NO: | UNIT: mm |
| APPROVED BY: | CONFIRMED BY: | DWG NAME: | SHEET NO: OF |

5. Interface signals

| No | Symbol | I/O | Description | Remarks |
|-------|----------------|-----|--|---------|
| 1 | VCI | P | Power supply for logic circuit | |
| 2 | GND | P | Ground | |
| 3 | VCC | P | Power supply for analog | |
| 4 | RESX | I | This signal will reset the device and must be applied to properly initialize the chip. Signal is active low. | |
| 5 | CSX | I | Chip select input pin ("Low" enable) | |
| 6 | D/CX | I | This pin is used to select data or command | |
| 7 | WRX | I | Serves as a write signal and writes data at the rising edge. | |
| 8 | RDX | I | Serves as a write signal and writes data at the rising edge | |
| 9~24 | D0~D15 | I/O | Data bus pin | |
| 25 | GND | P | Ground | |
| 26 | TE | O | Tearing effect output pin to synchronize MPU to frame writing | |
| 27 | LEDA | P | Power supply for LED | |
| 28 | NA | - | No connection | |
| 29 | GND | P | Ground | |
| 30 | GND | P | Ground | |
| 31~36 | LED1-K~ LED6-K | P | LED cathode | |

Note 1: P ---- Power; I ---- Input; O ---- Output.

Note 2: Recommend connector: FH12-36S-0.5SH

6. Absolute maximum Ratings

6.1. Electrical Absolute max. ratings

| Parameter | Symbol | MIN | MAX | Unit | Remark |
|---------------------------|-------------------------------------|------|-----------|------|---------|
| Logic Supply Voltage | VCI | -0.3 | 4.6 | V | |
| Analog Supply Voltage | VCC | -0.3 | 4.6 | V | |
| Input Voltage | CS/RS/WR/RD/D0~D17 RESX,CS,WR,RD | -0.3 | IOVCC+0.3 | V | |
| Backlight Forward Current | If | - | 25 | mA | One LED |

6.2. Environment Conditions

| Item | Symbol | MIN | MAX | Unit | Remark |
|-----------------------|--------|-----|-----|------|--------|
| Operating Temperature | TOPR | -20 | 70 | °C | |
| Storage Temperature | TSTG | -30 | 80 | °C | |

6.3 Backlight LED

| Item | Symbol | MIN | MAX | Unit | Remark |
|-----------------|--------|-----|-----|------|--------|
| Forward current | ILED | - | 25 | mA | |

7. Electrical Specifications

7.1 Electrical characteristics

GND=0V, Ta=25°C

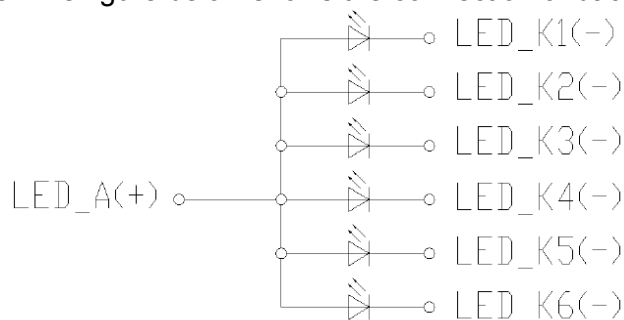
| Item | Symbol | MIN | TYP | MAX | Unit | Remark |
|---------------------------------|---------------|-----------|-----|-----------|------|--|
| Logic supply voltage | VCI | 1.65 | 3.3 | 3.63 | V | |
| Analog supply voltage | VCC | 2.3 | 3.3 | 3.63 | V | |
| Input Signal Voltage | VIL | -- | -- | 0.3xIOVCC | V | CS/RS/WR/RD/D0 ~D17 RES,NS,WR,RD |
| | VIH | 0.7xIOVCC | -- | IOVCC | V | |
| Output Signal Voltage | VOL | -- | -- | 0.2xIOVCC | V | |
| | VOH | 0.8xIOVCC | -- | -- | V | |
| (Panel + LSI) Power Consumption | Black mode | - | 30 | 45 | mW | Sleep mode |
| | Sleeping mode | - | 95 | 142.5 | uW | |

7.2 LED Backlight

Ta=25°C

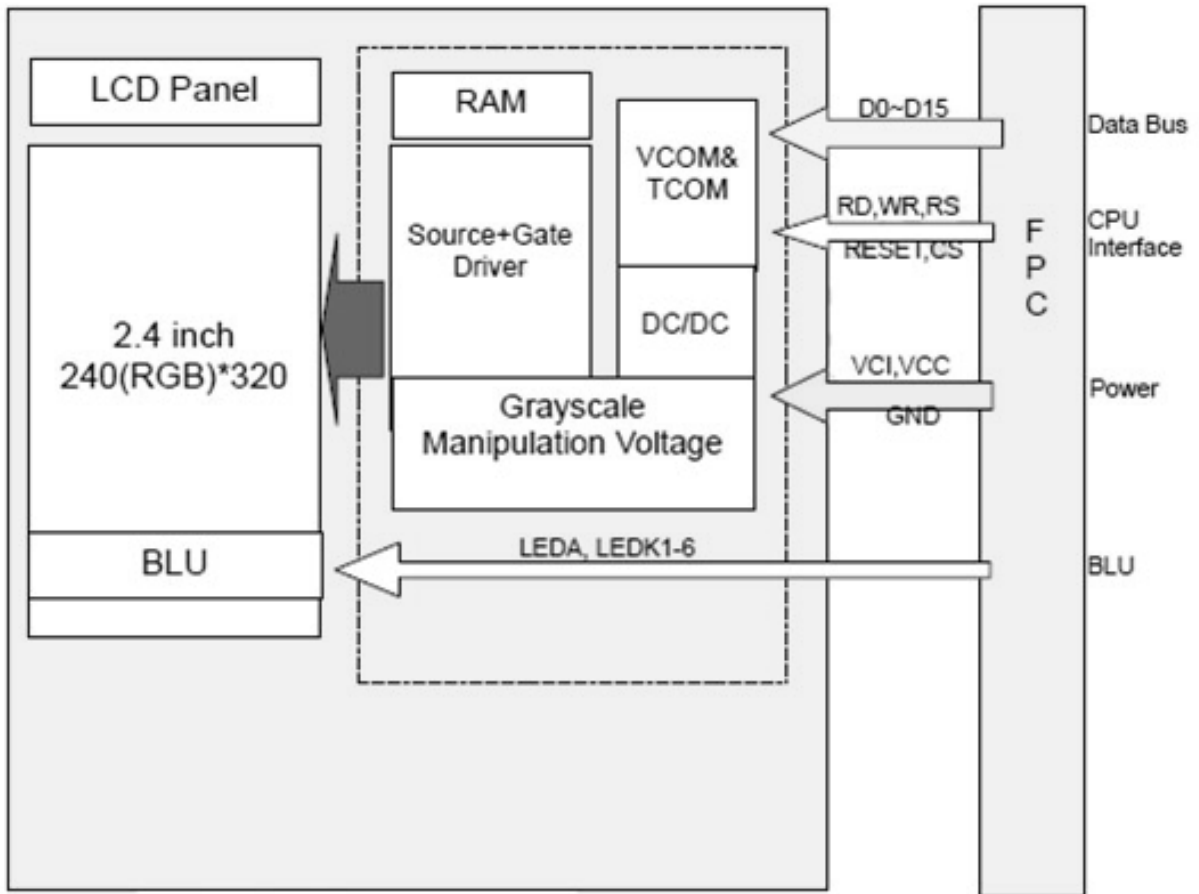
| Item | Symbol | MIN | TYP | MAX | Unit | Remark |
|-----------------------------|--------|-------|-----|-------|------|---------------|
| Forward Current | IF | -- | 20 | -- | mA | |
| Forward Voltage | VF | (2.8) | 3.2 | (3.4) | V | |
| Backlight Power Consumption | WBL | -- | 384 | -- | mW | For reference |

Note: The figure below shows the connection of backlight LED.



LED connection for Backlight 6 LED in Parallel.

7.3 Schematic of LCD module system



8 Command/AC Timing

8.1 Parallel (CPU18/16 bit) interface timing characteristics

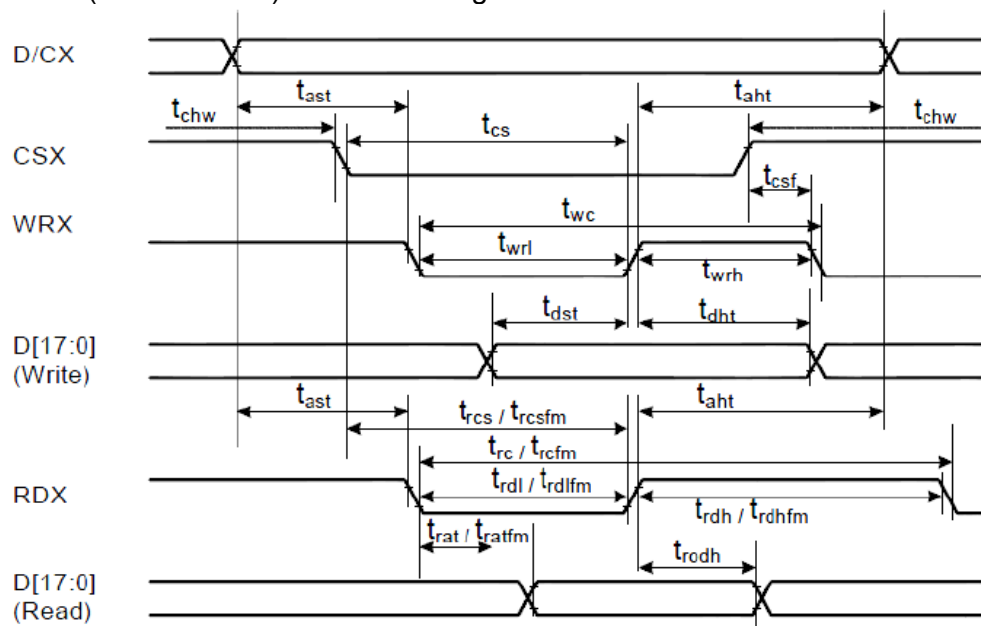


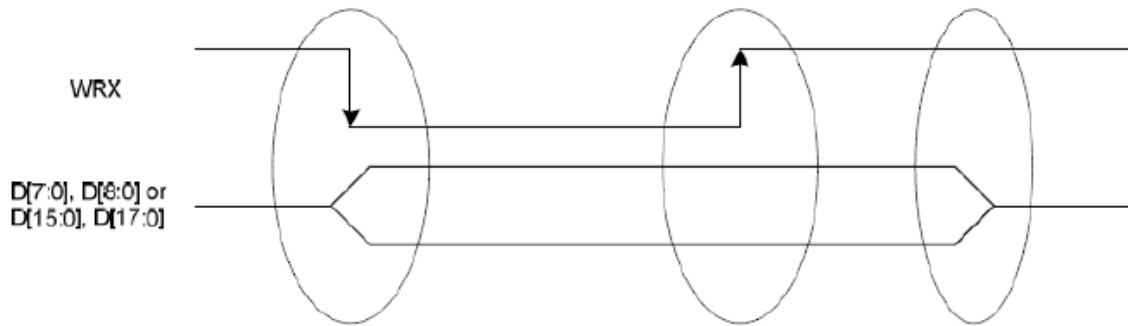
Figure 8.1 Parallel (CPU18/16 bit) interface characteristics

| 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 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[17:10]&[8:1] D[17:10] D[17:9] | Tdst | Write data setup time | 10 | - | ns | For maximum CL =30pF For minimum = 8 pF |
| | Tdht | Write data hold time | 10 | - | ns | |
| | Trat | Read access time | - | 40 | ns | |
| | Tratfm | Read access time | - | 340 | ns | |
| | trod | Read output disable time | 20 | 80 | ns | |

Table 8.1 Parallel (CPU 18/ 16bit) interface parameter

8.2 Parallel (CPU 18/16 bit) write/read to register or GRAM

The following figure shows a write cycle for the 8080-I MCU interface



The host asserts D[17:0], D[15:0],D[8:0] or D[7:0] lines when there is falling edge of WRX

ILI9341 reads D[17:0] D[15:0],D[8:0] or D[7:0] when there is rising edge of WRX

The host negates D[17:0] D[15:0],D[8:0] or D[7:0] line

Note :WRX is an unsynchronized signal (it can be stopped)

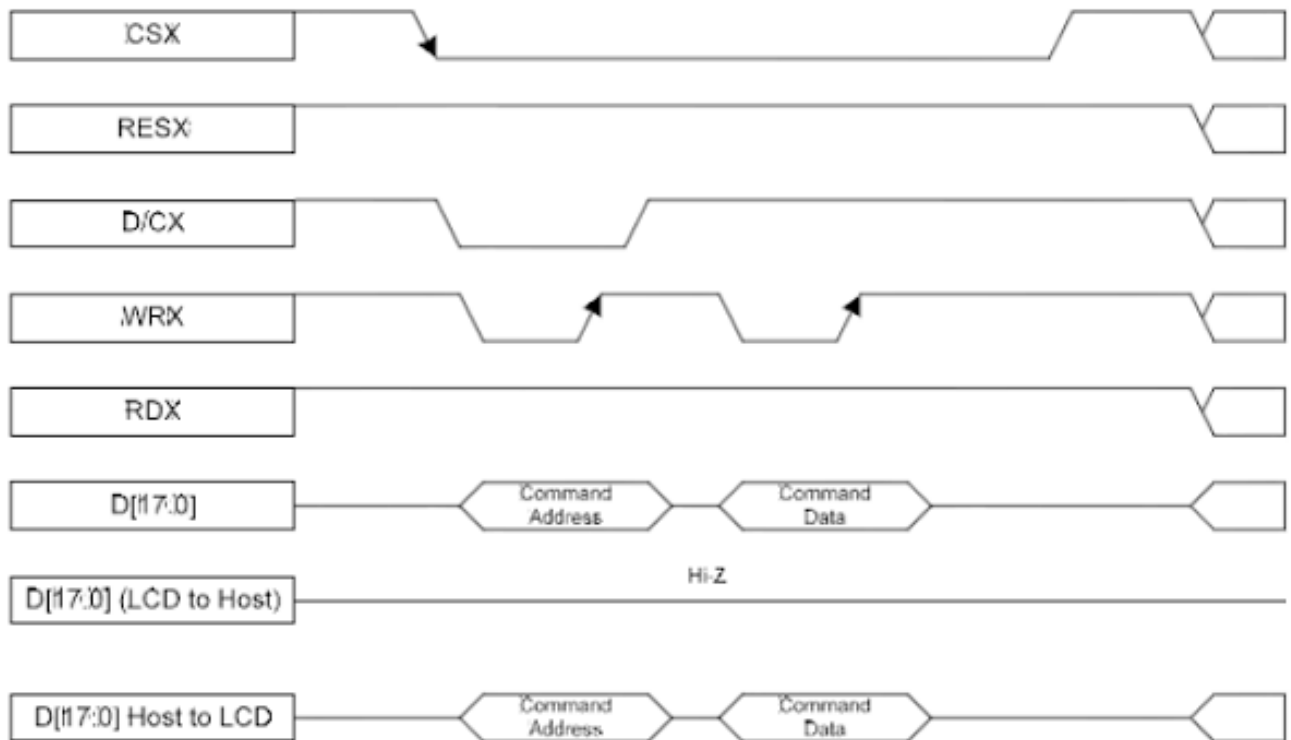
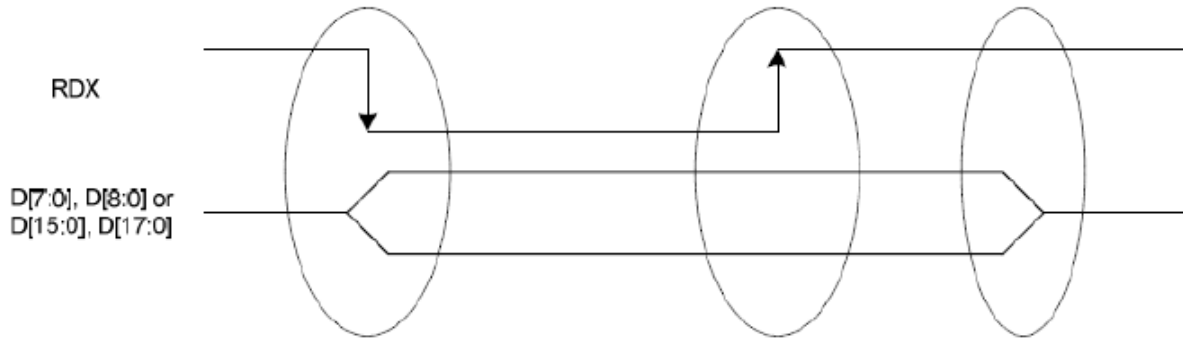


Figure 8.2.1 parallel (CPU 18/16 bit) write to register or GRAM

The following figure shows a read cycle for the 8080-I MCU interface



ILI9341 asserts D[17:0], D[15:0], D[8:0] or D[7:0] lines when there is falling edge of RDX

The host reads D[17:0] D[15:0], D[8:0] or D[7:0] when there is rising edge of RDX

The ILI9341 negates D[17:0] D[15:0], D[8:0] or D[7:0] lines

Note : RDX is an unsynchronized signal (It can be stopped)

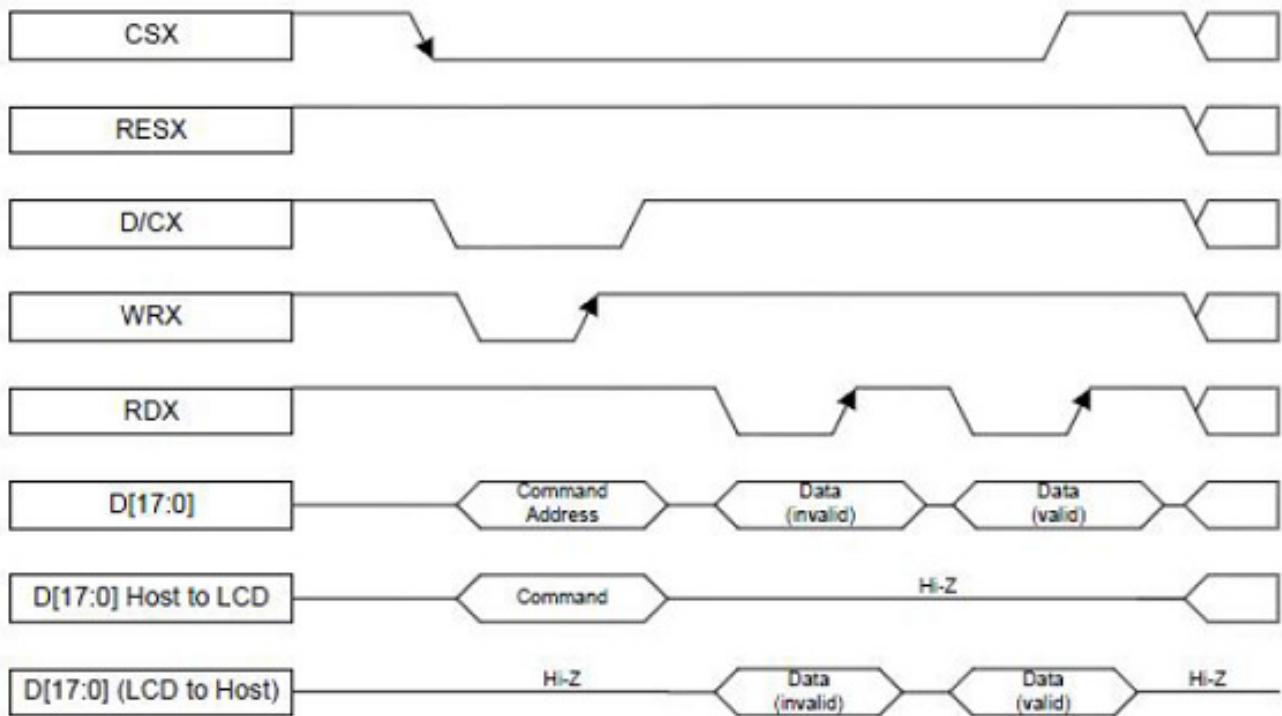


Figure 8.2.2 Parallel (CPU 18/16 bit) read to register or GRAM

8.3 Parallel (CPU 18/16 bit) Interface data color coding

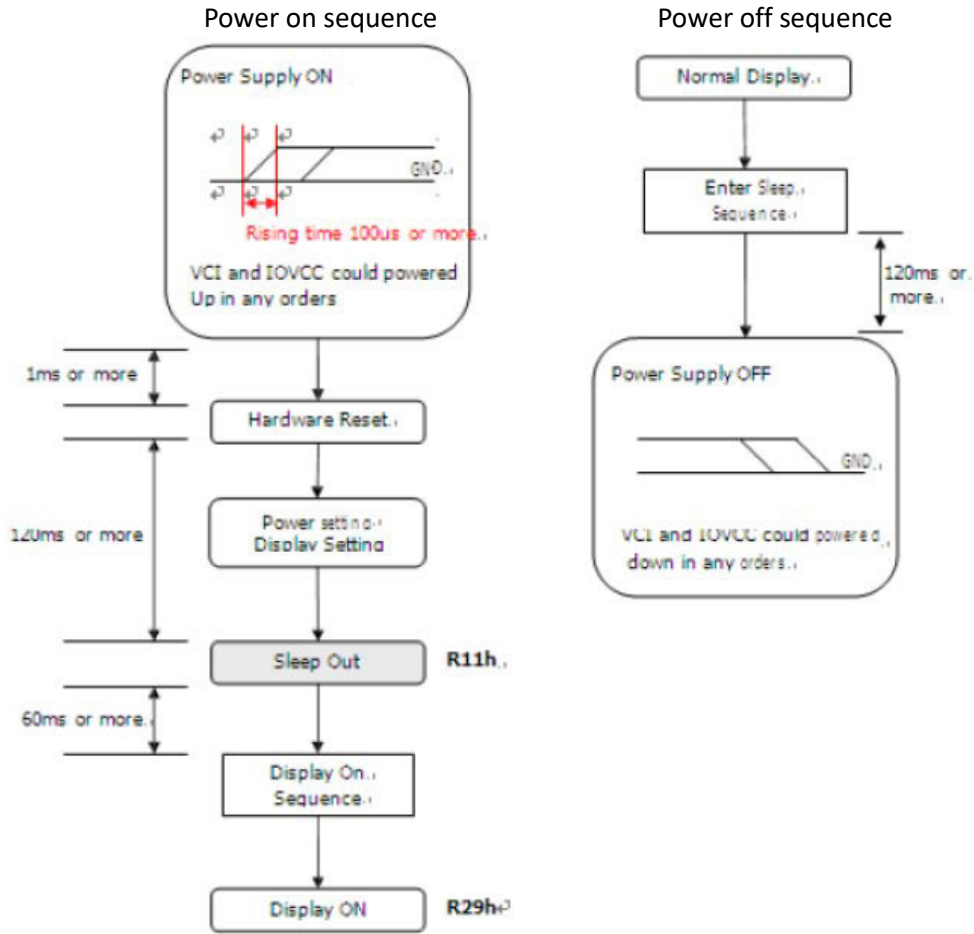
65K color : 16-bit/pixel (RGB 5-6-5 bits input)

One pixel (3 sub-pixels) display data is sent by 1 transfer when DB[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 |

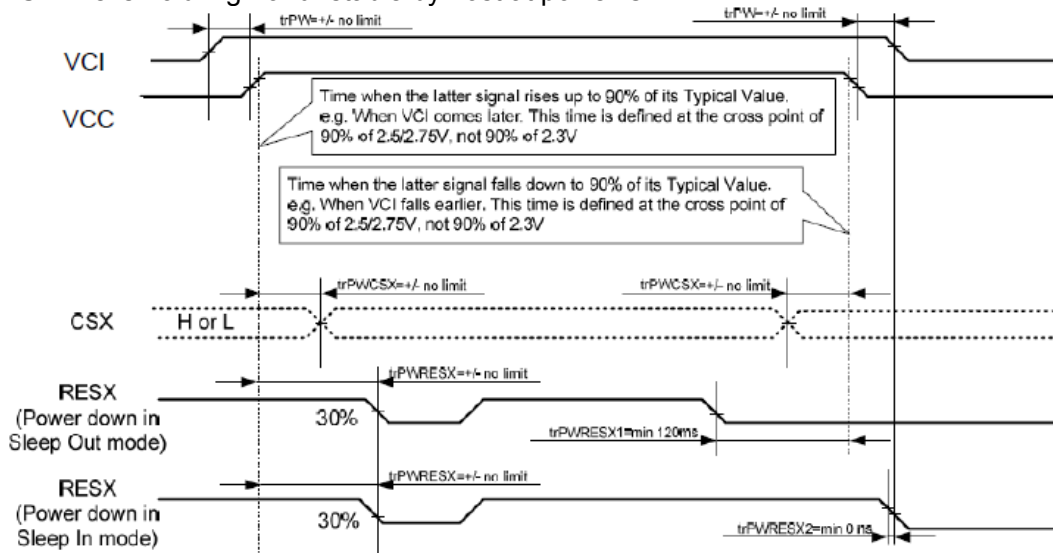
Table 8.3.1 65K color :16-bit display data

8.4 Power on/off sequence
Power on/off sequence



Note1: VCI: Logic power supply
VCC: Analog power supply

RESX line is hold high or unstable by host at power ON



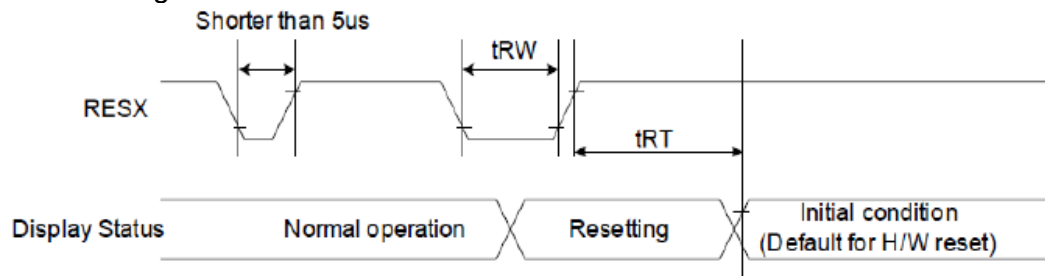
trPWRESX1 is applied to RESX falling in the sleep out mode
trPWRESX2 is applied to RESX falling in the sleep in mode

Note1: Unless otherwise specified, timings herein show cross point at 50% of signal power level.

Note2: VCI is logic power supply.

VCC is analog power supply.

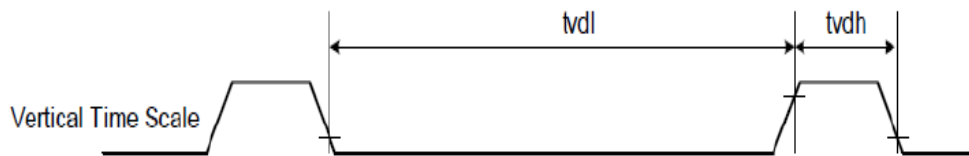
8.5 Reset Timing



| Signal | Symbol | Parameter | Min | Max | Unit |
|--------|--------|----------------------|-----|-----|------|
| RESX | tRW | Reset pulse duration | 10 | | us |
| | iRT | Reset cancel | | 5 | ms |
| | | | | 120 | ms |

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

8.6 Tearing Effect output

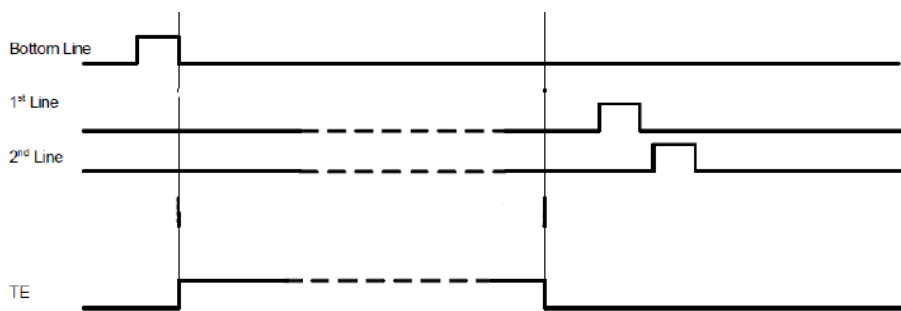


tvdh = The LCD display is not updated from the Frame Memory

tvdl = The LCD display is updated from the Frame Memory (except invisible line -see below)

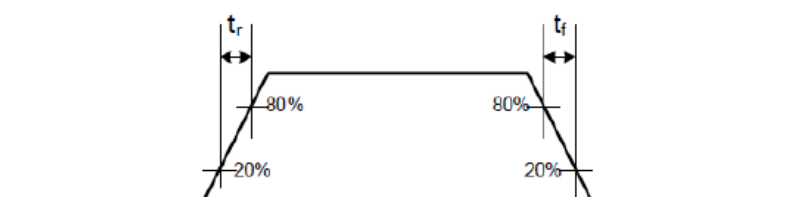
AC characteristics of Tearing Effect Signal (Frame Rate = 60Hz)

| Symbol | Parameter | Min | Typ | Max | Unit | Description |
|--------|-------------------------------|------|-----|-----|------|-------------|
| Tvdl | Vertical timing low duration | -- | -- | -- | ms | |
| tvdh | Vertical timing high duration | 1000 | -- | -- | us | |



Note :

1. The timings in tables as above apply when MADCTL B4=0 and B4=1
2. The signal's rise and fall times (t_r , t_f) are stipulated to be equal to or less than 15ns.



The tearing effect output line is fed back to the MCU and should be used to avoid tearing effect.

9 Optical Specification

Ta=25°C

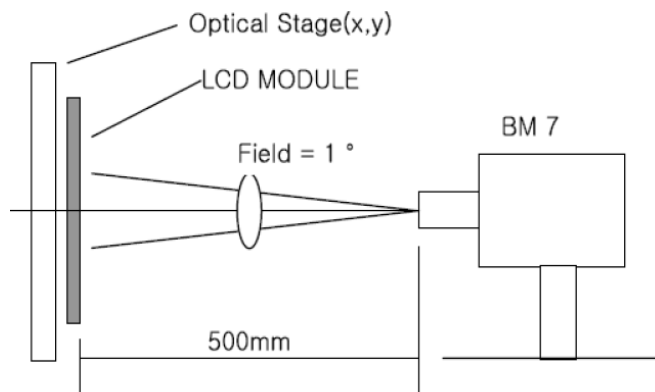
| Item | Symbol | Condition | Min | Typ. | Max. | Unit | Remark |
|----------------|------------|------------------|-----------------|----------|----------|--------|------------------|
| Contrast Ratio | CR | $\theta=0^\circ$ | 400 | 500 | - | | Note1 Note3 |
| Response Time | Tr + Tf | 25°C | - | 20 | 30 | ms | Note1 Note4 |
| View Angles | θT | $CR \geq 10$ | 60 | 70 | - | Degree | Note 2 |
| | θB | | 50 | 60 | - | | |
| | θL | | 60 | 70 | - | | |
| | θR | | 60 | 70 | - | | |
| Chromaticity | White | x | Backlight is on | Typ-0.05 | Typ+0.05 | | Note 1 Note 5 |
| | | y | | | | | |
| | Red | x | | | | | |
| | | y | | | | | |
| | Green | x | | | | | |
| | | y | | | | | |
| | Blue | x | | | | | |
| | | y | | | | | |
| NTSC | S | | - | 50 | - | % | Note 5 |
| Luminance | L | | 600 | 800 | - | cd/m2 | Note1 Note6 |
| Uniformity | U | | 75 | 80 | - | % | Note1 Note7 |

Test condition: IF= 20mA (LED current), VF=19.2V, the ambient temperature is 25 °C.

Note 1: Definition of optical measurement system.

Temperature = 25°C(±3°C)

LED back-light: ON, Environment brightness < 150 lx

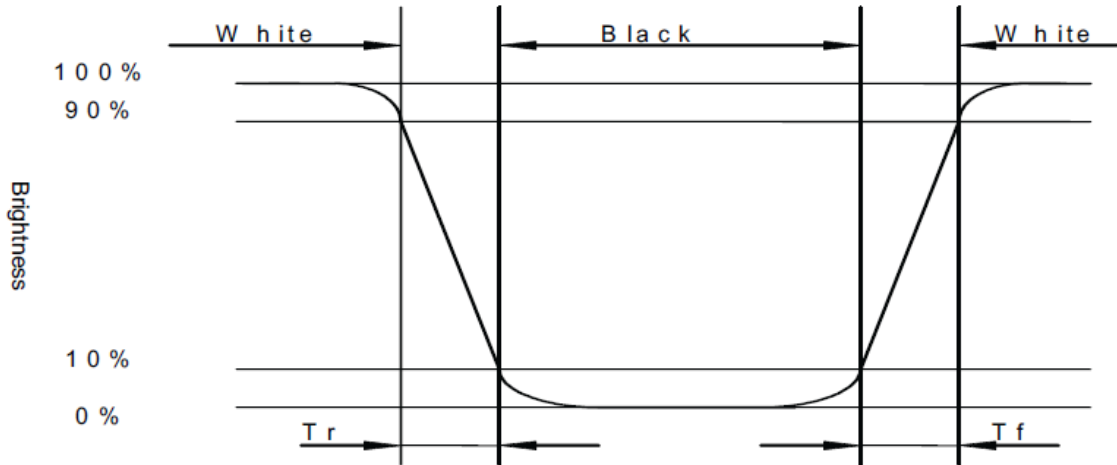


Note 2: Contrast ratio is defined as follow:

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

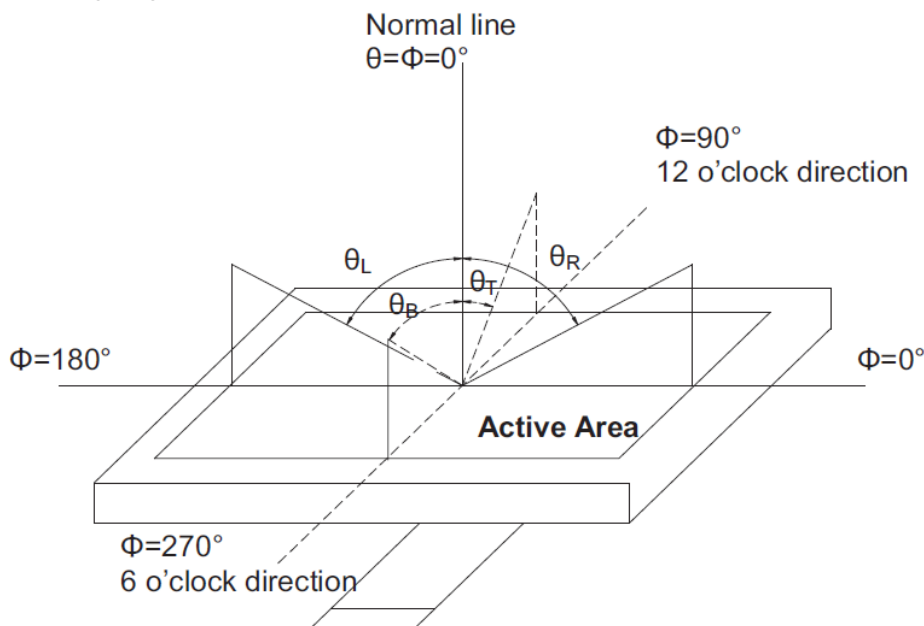
Note 3: Response time is defined as follow:

Response time is the time required for the display to transition from black to white (Rise Time, T_r) and from white to black (Decay Time, T_f).



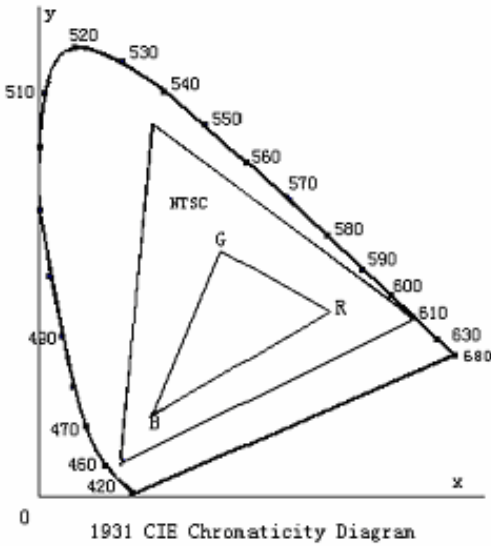
Note 4: Viewing angle range is defined as follow:

Viewing angle is measured at the center point of the LCD.



Note 5: Color chromaticity is defined as follow: (CIE1931)

Color coordinates measured at center point of LCD.



$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$

Note 6: Luminance is defined as follow:

Luminance is defined as the brightness of all pixels “White” at the center of display area on optimum contrast.

Note 7: Luminance Uniformity is defined as follow:

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

$$\text{Uniformity}(U) = \frac{\text{Minimum Luminance(brightness) in 9 points}}{\text{Maximum Luminance(brightness) in 9 points}}$$

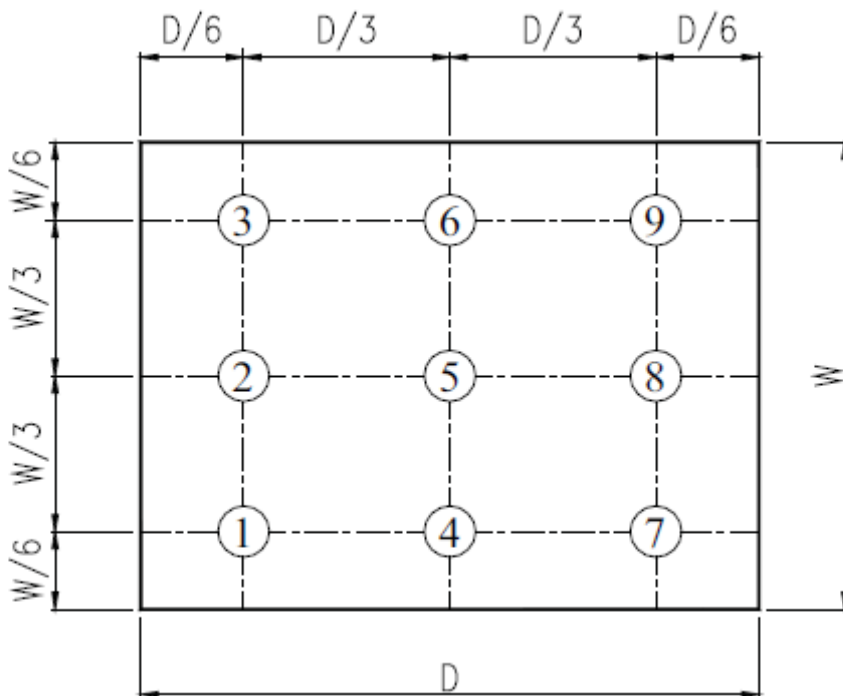


Fig. 2 Definition of uniformity

10 Environmental / Reliability Tests

| No | Test Item | Condition | Judgment criteria |
|----|-----------------------------------|--|---|
| 1 | High Temp Operation | Ts=+70°C, 120hrs | Per table in below |
| 2 | Low Temp Operation | Ta=-20 °C, 120hrs | Per table in below |
| 3 | High Temp Storage | Ta=+80°C, 120hrs | Per table in below |
| 4 | Low Temp Storage | Ta=-30 °C, 120hrs | Per table in below |
| 5 | High Temp & High Humidity Storage | Ta=+60°C, 90% RH 120 hours | Per table in below (polarizer discoloration is excluded) |
| 6 | Thermal Shock (Non-operation) | -30°C 30 min~+80°C 30 min, Change time:5min, 10 Cycles | Per table in below |
| 7 | ESD (Operation) | C=150pF, R=330Ω · 5points/panel Air:±8KV, 5times; Contact:±4KV, 5 times; | Per table in below |
| 8 | Vibration (Non-operation) | Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. | Per table in below |
| 9 | Shock (Non-operation) | 60G 6ms, ±X,±Y,±Z 3times, for each direction | Per table in below |
| 10 | Package Drop Test | Height:80 cm, 1 corner, 3 edges, 6 surfaces | Per table in below |

| INSPECTION | CRITERION(after test) |
|------------------------|---|
| Appearance | No Crack on the FPC, on the LCD Panel |
| Alignment of LCD Panel | No Bubbles in the LCD Panel No other Defects of Alignment in Active area |
| Electrical current | Within device specifications |
| Function / Display | No Broken Circuit, No Short Circuit or No Black line No Other Defects of Display |

11 Precautions for Use of LCD Modules

11.1 Safety

The liquid crystal in the LCD is poisonous. Do not put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.

11.2 Handling

- A. The LCD and touch panel is made of plate glass. Do not subject the panel to mechanical shock or to excessive force on its surface.
- B. Do not handle the product by holding the flexible pattern portion in order to assure the reliability
- C. Transparency is an important factor for the touch panel. Please wear clear finger sacks, gloves and mask to protect the touch panel from finger print or stain and also hold the portion outside the view area when handling the touch panel.
- D. Provide a space so that the panel does not come into contact with other components.
- E. To protect the product from external force, put a covering lens (acrylic board or similar board) and keep an appropriate gap between them.
- F. Transparent electrodes may be disconnected if the panel is used under environmental conditions where dew condensation occurs.
- G. Property of semiconductor devices may be affected when they are exposed to light, possibly resulting in IC malfunctions.
- H. To prevent such IC malfunctions, your design and mounting layout shall be done in the way that the IC is not exposed to light in actual use.

11.3 Static Electricity

- A. Ground soldering iron tips, tools and testers when they are in operation.
- B. Ground your body when handling the products.
- C. Power on the LCD module before applying the voltage to the input terminals.
- D. Do not apply voltage which exceeds the absolute maximum rating.
- E. Store the products in an anti-electrostatic bag or container.

11.4 Storage

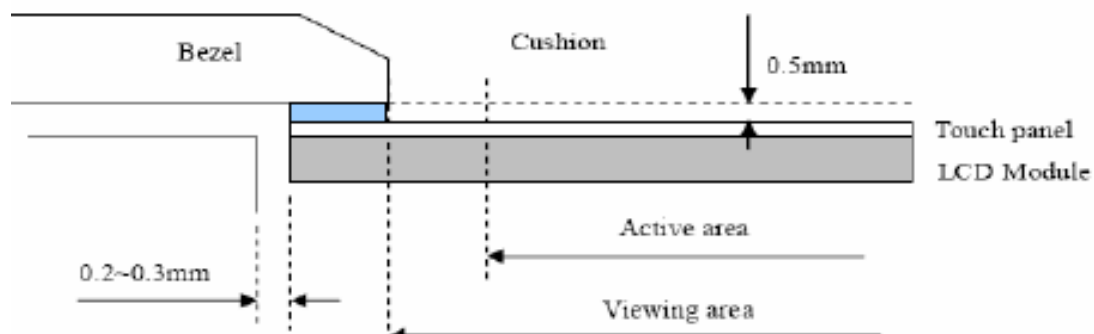
- A. Store the products in a dark place at $+25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ with low humidity (40% RH to 60% RH). Don't expose to sunlight or fluorescent light.
- B. Storage in a clean environment, free from dust, active gas, and solvent.

11.5 Cleaning

- A. Do not wipe the touch panel with dry cloth, as it may cause scratch.
- B. Wipe off the stain on the product by using soft cloth moistened with ethanol. Do not allow ethanol to get in between the upper film and the bottom glass. It may cause peeling issue or defective operation. Do not use any organic solvent or detergent other than ethanol.

11.6 Cautions for installing and assembling

Bezel edge must be positioned in the area between the Active area and View area. The bezel may press the touch screen and cause activation if the edge touches the active area. A gap of approximately 0.5mm is needed between the bezel and the top electrode. It may cause unexpected activation if the gap is too narrow. There is a tolerance of 0.2 to 0.3mm for the outside dimensions of the touch panel and tail. A gap must be made to absorb the tolerance in the case and connector.



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Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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