

User's Guide

VT204D

Liquid Crystal Display Module

厦门维托克光电有限公司

XIAMEN VTRONIC OPTICS CO.,LTD.

361009 厦门市莲花新村龙山工业区 3 号厂房 5 楼

5/F. NO.3 BLDG. LONGSHAN INDUSTRIAL AREA, LIANHUAXINCUN, XIAMEN, P.R.C.

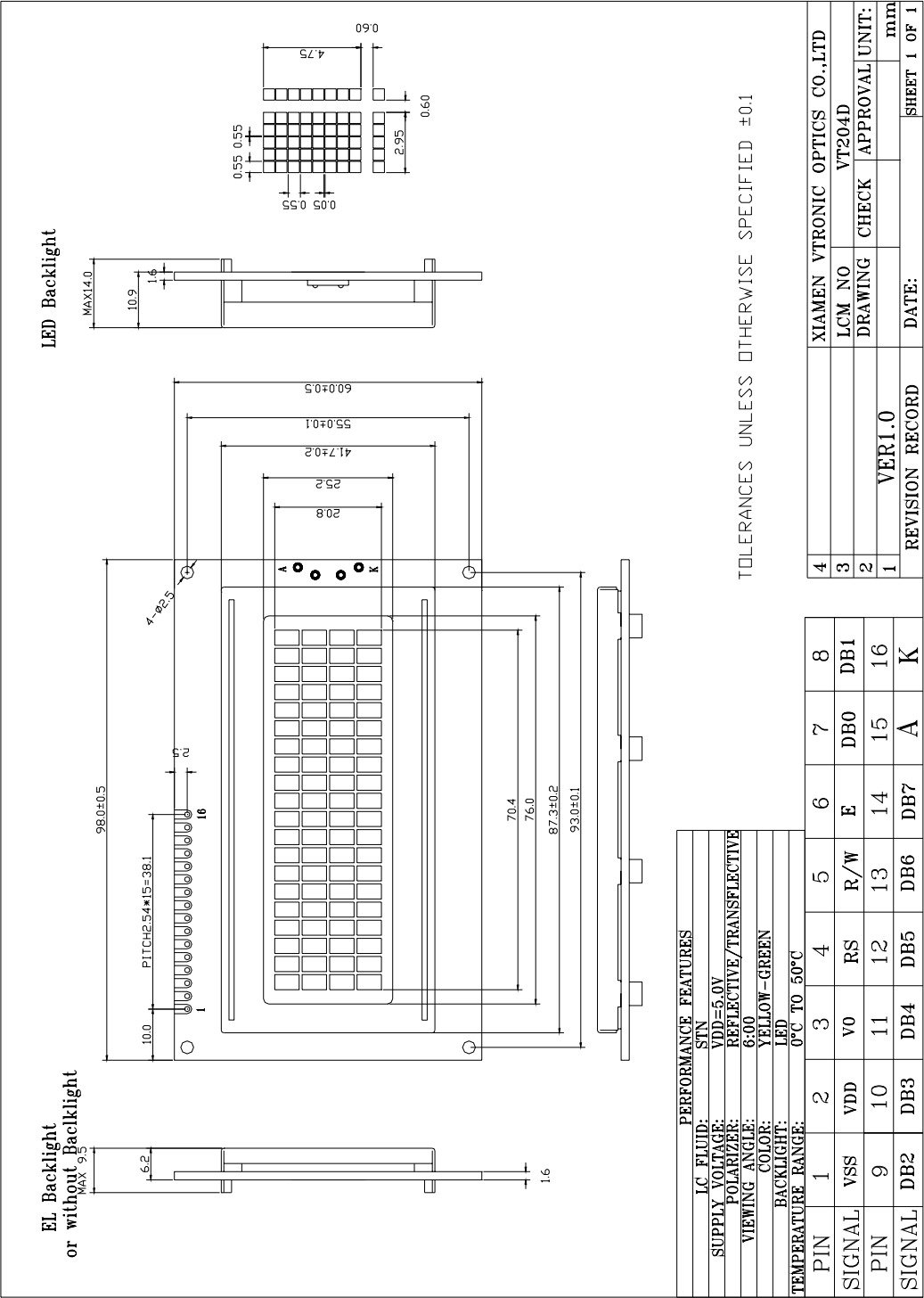
XIAMEN 361009.P.R.CHINA

TEL: 86-592-5550001-15 FAX: 86-592-5561617

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Mechanical Diagram



Absolute Maximum Ratings

| Item | Symbol | Min | Max | Unit |
|-----------------------------|-------------------|----------|----------|------|
| Power Voltage | $V_{DD} - V_{SS}$ | 0 | 7.0 | V |
| Input Voltage | V_{in} | V_{SS} | V_{DD} | |
| Operating Temperature Range | T_{OP} | 0 | +50 | |
| Storage Temperature Range | T_{ST} | -20 | +60 | |

*Wide Temperature range is available

(operating/storage temperature as wide as -20 ~ +70/-30 ~ +80).

Description Of Terminals

| Pin No. | Pin Name | Input/Output | External Connection | Function |
|---------|----------|--------------|---------------------|--|
| 1 | VSS | — | Power Supply | VSS:GND |
| 2 | VDD | — | | VDD: +5V |
| 3 | VO | — | | V_{LCD} adjustment |
| 4 | RS | INPUT | MPU | Register select signal "0": Instruction register (when writing) Busy flag & address counter (When reading) "1": Data register (when writing & reading) |
| 5 | R/W | Input | MPU | Read/write select signal "0" for writing , "1" for reading |
| 6 | E | Input | MPU | Operation (data read/write) enable signal |
| 7 / 10 | DB0-DB3 | Input | MPU | Low-order lines of data bus with 3-state, bi-directional function for use in data transaction with the MPU. These lines are not used when interfacing with a 4-bit microprocessor. |
| 11 / 14 | DB4-DB7 | Input | MPU | High-order lines of data bus with 3-state, bi-directional function for use in data transactions with the MPU. DB7 may also be used to check the busy flag. |
| 15 | A | | LED+ | |
| 16 | K | | LED- | |

Optical Characteristics

for TN Type Display Module ($T_a=25$, $V_{DD}=5.0V \pm 0.25V$)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---------------------|--------|-----------|------|------|------|------|
| Viewing angle | | C_r 4 | -25 | - | - | deg |
| | | | -30 | - | 30 | |
| Contrast ratio | C_r | | - | 2 | - | - |
| Response time(rise) | T_r | - | - | 120 | 150 | ms |
| Response time(fall) | T_r | - | - | 120 | 150 | ms |

for STN Type Display Module ($T_a=25$, $V_{DD}=5.0V \pm 0.25V$)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---------------------|--------|-----------|------|------|------|------|
| Viewing angle | | C_r 2 | -60 | - | 35 | deg |
| | | | -40 | - | 40 | |
| Contrast ratio | C_r | | - | 6 | - | - |
| Response time(rise) | T_r | - | - | 150 | 250 | ms |
| Response time(fall) | T_r | - | - | 150 | 250 | ms |

Electrical Characteristics

DC Characteristics

| Parameter | Symbol | Conditions | Min. | Type | Max. | Unit |
|--------------------------|----------------|-----------------------------|------|------|----------|---------|
| Supply voltage for LCD | $V_{DD} - V_O$ | $T_A=25$ | — | 4.6 | — | V |
| Input voltage | V_{DD} | | 4.7 | — | 5.5 | V |
| Supply current | I_{DD} | $V_{DD}=5.0V; T_A=25$ | — | 1.5 | 2.5 | mA |
| Input leakage current | I_{LKG} | | — | — | 1.0 | μA |
| "H" level input voltage | V_{IH} | | 2.2 | — | V_{DD} | V |
| "L" level input voltage | V_{IL} | Twice initial value or less | 0 | — | 0.6 | V |
| "H" level output voltage | V_{OH} | LOH= -0.25MA | 2.4 | — | — | V |
| "L" level output voltage | V_{OL} | LOL= 1.6MA | — | — | 0.4 | V |
| Backlight supply power | V_F | | — | 4.2 | 4.5 | V |

AC Characteristics

Read Cycle ($V_{DD}=5.0V+10\%$, $V_{SS}=0V$, $T_a=25$)

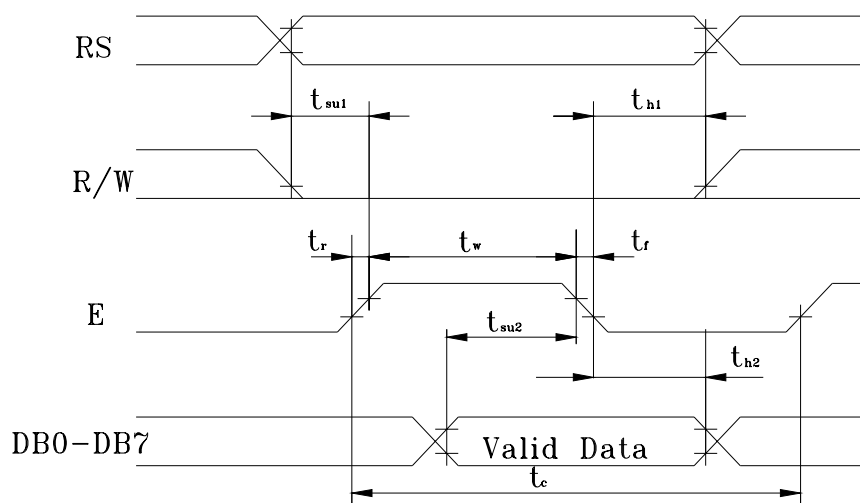
| Parameter | Symbol | Test pin | Min. | Type | Max. | Unit |
|--------------------------|------------|----------|------|------|------|------|
| Enable cycle time | t_c | E | 500 | - | - | ns |
| Enable pulse width | t_w | E | 300 | - | - | |
| Enable rise/fall time | t_r, t_f | E | - | - | 25 | |
| RS,R/W setup time | t_{su} | RS; R/W | 100 | - | - | |
| RS,R/W address hold time | t_h | RS; R/W | 10 | - | - | |
| Read data output delay | t_D | DB0-DB7 | 60 | - | 190 | |
| Read data hold time | t_{DH} | DB0-DB7 | 20 | - | - | |

Write Cycle

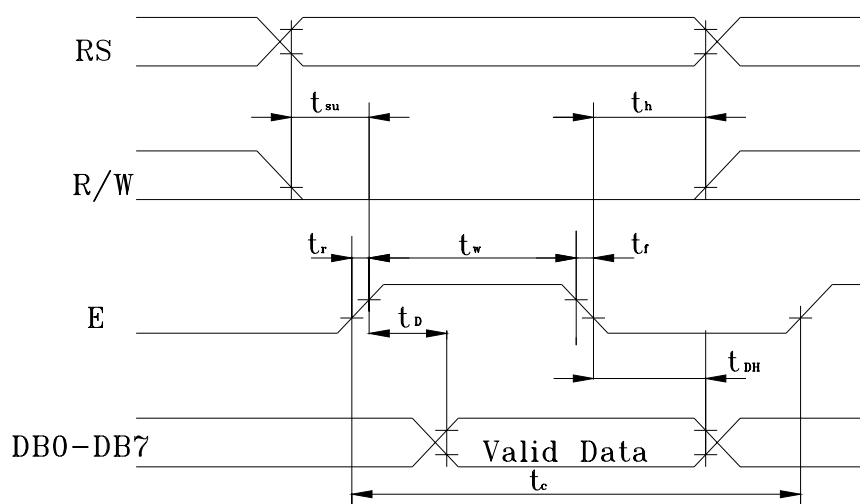
| Parameter | Symbol | Test pin | Min. | Type | Max. | Unit |
|--------------------------|------------|----------|------|------|------|------|
| Enable cycle time | t_c | E | 500 | - | - | ns |
| Enable pulse width | t_w | E | 300 | - | - | |
| Enable rise/fall time | t_r, t_f | E | - | - | 25 | |
| RS,R/W setup time | t_{su1} | RS; R/W | 100 | - | - | |
| RS,R/W address hold time | t_{h1} | RS; R/W | 10 | - | - | |
| Data setup time | t_{su2} | DB0-DB7 | 60 | - | - | |
| Data hold time | t_{h2} | DB0-DB7 | 10 | - | - | |

Timing Characteristics

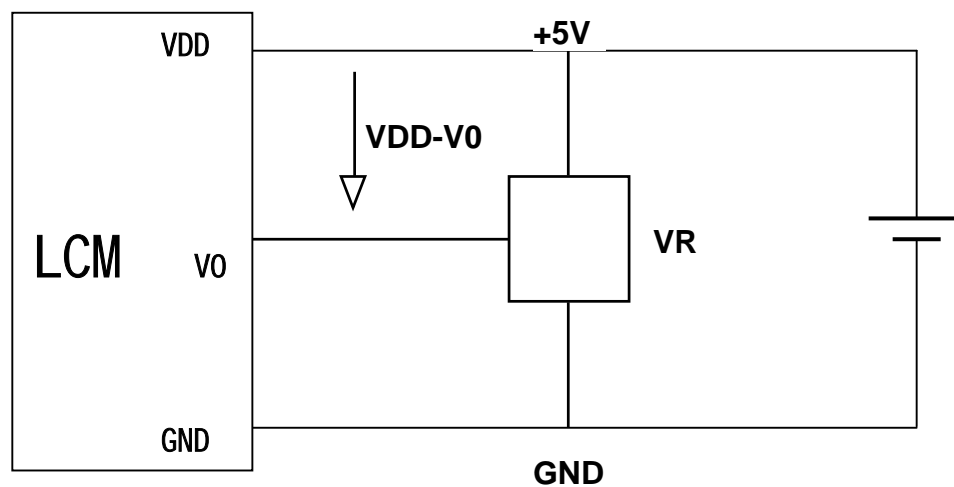
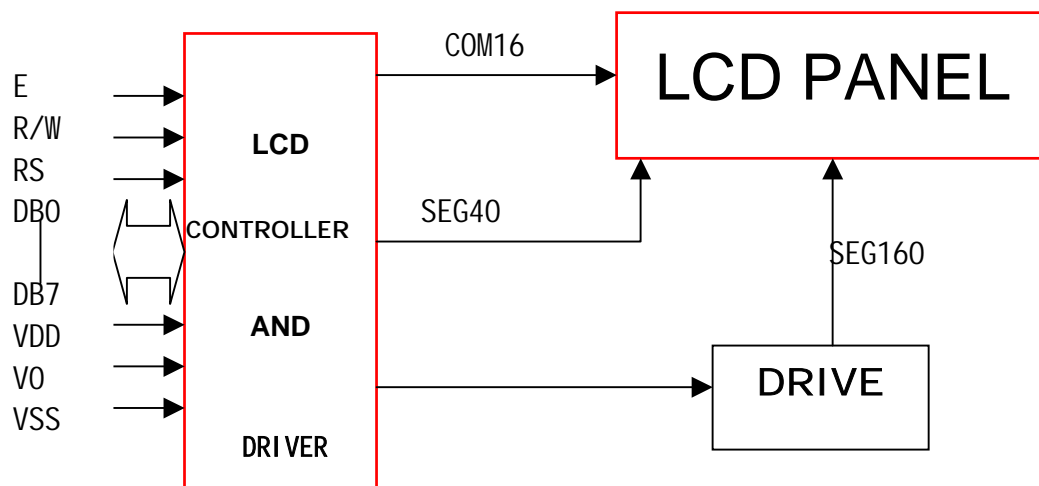
Write Timing



Read Timing



Block Diagram



VDD-V₀: LCD DRIVING VOLTAGE

VR: 10K-20K

Display command

| Parameter | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | Note | Executing time fosc=250kHz |
|--------------------------------|----|-----|------------|---|--|-----|-----|-----|-----|-----|---|-------------------------------|
| Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | 1.64ms |
| Cursor home | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | * | | 1.64ms |
| Entry Mode Set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1/D | S | DB1=1:Increment DB1=0:Decrement DB0=1:The display is shifted DB0=0:The display is not shifted | 40 μ s |
| Display on/off | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | B | DB2=1:Display on DB2=0: Display off DB1=1:Cursor on DB1=0: Cursor off DB0=1:Brinking on DB0=0: Brinking off | 40 μ s |
| Cursor / Display Shift | 0 | 0 | 0 | 0 | 0 | 1 | S/C | R/L | * | * | DB3=1:Shifts display one character DB2=1:Right shift DB2=0:Left shift | 40 μ s |
| System Set | 0 | 0 | 0 | 0 | 1 | DL | N | F | * | * | DB4=1:8 bits DB4=0:4 bits DB3=1:2 lines display (1/16 duty) DB3=0:1 line display DB2=1:5 × 10 dots , 1/11 duty DB2=1:5 × 7 dots , 1/8 duty | 40 μ s |
| Set CG RAM Address | 0 | 0 | 0 | 1 | CG RAM address corresponds to cursor address | | | | | | The address length that can be set is 64 address | 40 μ s |
| Set DD RAM Address | 0 | 0 | 1 | DD RAM address | | | | | | | The address length that can be set is 80 address | 40 μ s |
| Read Busy Flag/Address Counter | 0 | 1 | BF | Address counter used for both DD&CG RAM address | | | | | | | DB7=1:Busy (instruction not accepted) DB7=0:Ready(for instruction) | 0 μ s |
| Write Data | 1 | 0 | Write data | | | | | | | | | 46 μ s |
| Read Data | 1 | 1 | Read data | | | | | | | | | 46 μ s |

DD RAM Address:

| | | | | | | | | | | | | |
|--------------------|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | --- | --- | --- | --- | --- | -20 |
| Address for line 1 | 00 | 01 | 02 | 03 | 04 | 05 | | | | | 12 | 13 |
| Address for line 2 | 40 | 41 | 42 | 43 | 44 | 45 | | | | | 52 | 53 |
| Address for line 3 | 14 | 15 | 16 | 17 | 18 | 19 | | | | | 26 | 27 |
| Address for line 4 | 54 | 55 | 56 | 57 | 58 | 59 | | | | | 46 | 47 |

Reliability and Life Time

1. Reliability Test

| Storage Condition | Content | Evaluations and Assessment* | | | |
|--|----------------------|-----------------------------|--------|--------------------------------|-------------------|
| | | Current consumption | Oozing | Contrast | Other appearances |
| Operation at high temperature and humidity | 40 ℃, 90% RH, 240hrs | Twice initial value or less | none | More than 80% of initial value | No abnormality |
| High temperature storage | 60 ℃, 240hrs | Twice initial value or less | none | More than 80% of initial value | No abnormality |
| Low temperature storage | -20 ℃, 240hrs | Twice initial value or less | | More than 80% of initial value | No abnormality |

*Evaluations and assessment to be made two hours after returning to room temperature (25 ± 5 ℃).

*The LCDs subjected to the test must not have dew condensation.

2. Liquid crystal panel service life

50,000 hours minimum at 25 ± 10 ℃, 45 ± 20%RH.

Standard Character Pattern

| Lower 4 Bits | Upper 4 Bits | 0000 | 0001 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1000 | 1001 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 | |
|-----------------|------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|---|
| xxxx0000 | CG RAM (1) | | | | 0 | a | P | ` | P | | | | 一 | 夕 | 三 | α | p | |
| xxxx0001 | (2) | | | ! | 1 | A | Q | a | q | | | | 。 | ア | チ | 厶 | ≡ | q |
| xxxx0010 | (3) | | | " | 2 | B | R | b | r | | | | 「 | イ | ツ | × | ⌘ | ⊖ |
| xxxx0011 | (4) | | | # | 3 | C | S | c | s | | | | 」 | ウ | テ | モ | ε | ∞ |
| xxxx0100 | (5) | | | \$ | 4 | D | T | d | t | | | | 、 | エ | ト | ⌘ | μ | Ω |
| xxxx0101 | (6) | | | % | 5 | E | U | e | u | | | | ・ | オ | ナ | 1 | ε | Ü |
| xxxx0110 | (7) | | | & | 6 | F | V | f | v | | | | ヲ | カ | ニ | ヨ | ρ | Σ |
| xxxx0111 | (8) | | | ' | 7 | G | W | g | w | | | | ア | キ | ヌ | う | g | π |
| xxxx1000 | (1) | | | (| 8 | H | X | h | x | | | | イ | ク | ネ | リ | フ | ⌘ |
| xxxx1001 | (2) | | |) | 9 | I | Y | i | y | | | | ウ | ケ | ル | ル | ´ | Y |
| xxxx1010 | (3) | | | * | : | J | Z | j | z | | | | エ | コ | ハ | レ | j | ≠ |
| xxxx1011 | (4) | | | + | ; | K | [| k | [| | | | オ | サ | ヒ | ロ | × | ⌘ |
| xxxx1100 | (5) | | | , | < | L | ¥ | l | l | | | | ヤ | シ | フ | ワ | ⌘ | ⌘ |
| xxxx1101 | (6) | | | - | = | M |] | m | } | | | | ユ | ズ | ハ | ン | も | ÷ |
| xxxx1110 | (7) | | | . | > | N | ^ | n | ÷ | | | | ヨ | セ | ホ | ゝ | ⌘ | |
| xxxx1111 | (8) | | | / | ? | O | _ | o | + | | | | ッ | リ | マ | □ | ○ | ■ |

Note: The user can specify any pattern for character-generator RAM.