

User's Guide

NHD-0116AZ-FL-GBW

LCM

(Liquid Crystal Display Module)

RoHS Compliant

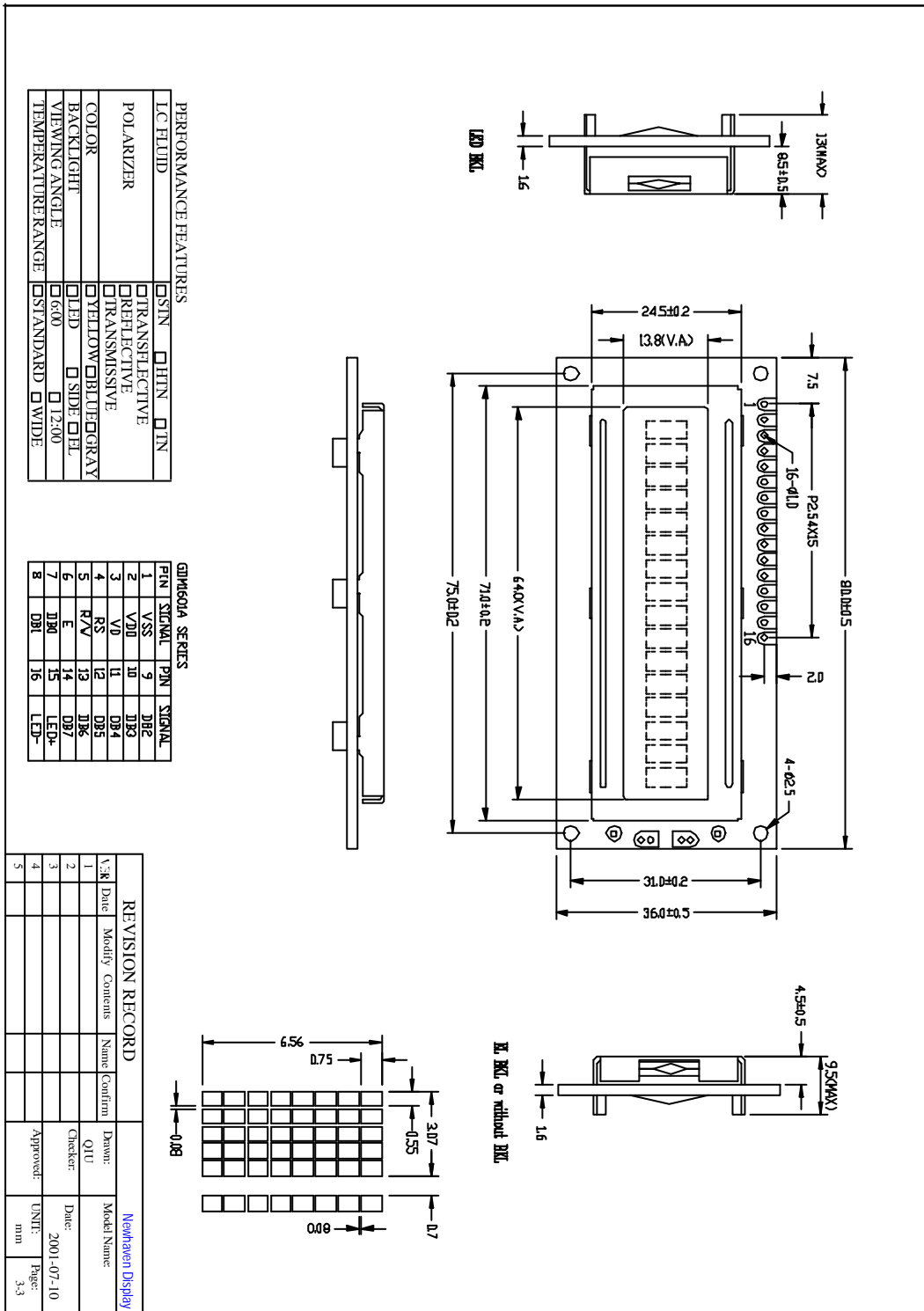
- NHD-** Newhaven Display
- 0116-** 1 Lines x 6 Characters
- AZ-** Version Line
- F-** Transflective
- L-** Yellow/Green LED B/L
- G-** STN-Gray
- B-** 6:00 View
- W-** Wide Temperature (-20 ~ +70c)

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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} | -20 | +70 | °C |
| Storage Temperature Range | T_{ST} | -30 | +80 | |

*Wide Temperature range is available (operating/storage temperature as wide as -20~+70/-30~+80°C).

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 / 16 | LED ⁺ LED ⁻ | Input | LED BACKLIGHT POWER SUPPLY | LED ⁺ VOLTAGE TYP:5.0V MAX : 5.0V LED ⁻ : GND |

Optical Characteristics

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

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---------------------|----------|--------------|------|------|------|------|
| Viewing angle | θ | $C_r \geq 4$ | -25 | — | — | deg |
| | Φ | | -30 | — | 30 | |
| Contrass 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 ($T_a=25^{\circ}\text{C}$, $V_{DD}=5.0\text{V} \pm 0.25\text{V}$)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---------------------|----------|--------------|------|------|------|------|
| Viewing angle | θ | $C_r \geq 2$ | -60 | — | 35 | deg |
| | Φ | | -40 | — | 40 | |
| Contrass 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 | $V_{DD}-V_O$ | $T_A=25^{\circ}\text{C}$ | — | 4.6 | — | V |
| Input voltage | V_{DD} | | 4.7 | — | 5.5 | V |
| Supply current | I_{DD} | $V_{DD}=5.0\text{V}; T_A=25^{\circ}\text{C}$ | — | 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 |

AC CharacteristicsRead Cycle ($V_{DD}=5.0V+10\%$, $V_{SS}=0V$, $T_a=25^\circ C$)

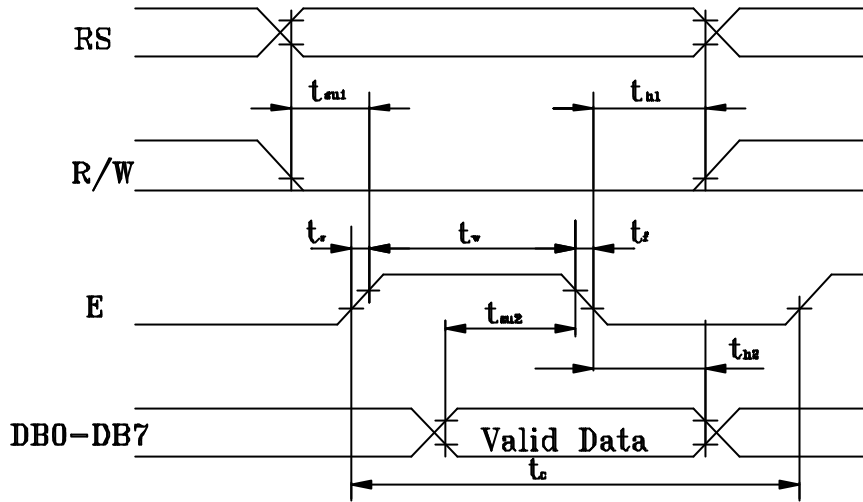
| Parameter | Symbol | Test pin | Min. | Type | Max. | Unit |
|--------------------------|------------|----------|------|------|------|------|
| Enable cycle time | t_c | E | 500 | — | — | ns |
| Enable pulse width | t_w | E | 300 | — | — | |
| Enable rise/fall time | t_r, t_f | E | — | — | 25 | |
| 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

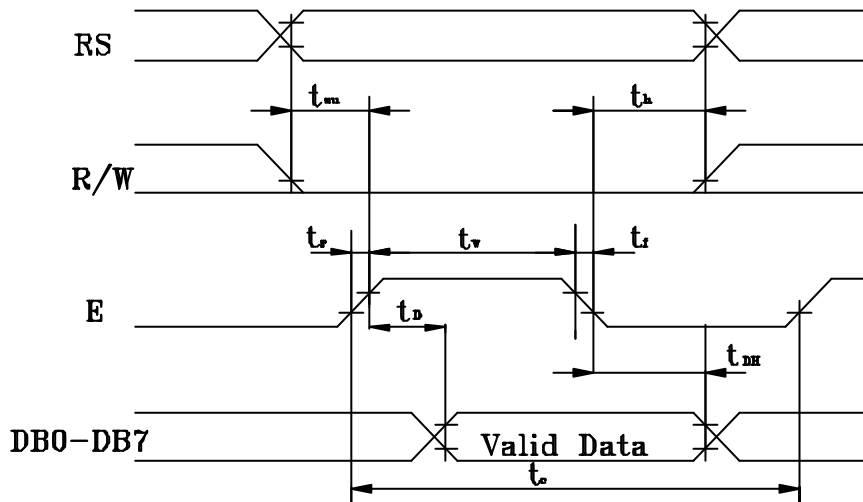
| Parameter | Symbol | Test pin | Min. | Type | Max. | Unit |
|--------------------------|------------|----------|------|------|------|------|
| Enable cycle time | t_c | E | 500 | — | — | ns |
| Enable pulse width | t_w | E | 300 | — | — | |
| Enable rise/fall time | t_r, t_f | E | — | — | 25 | |
| 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

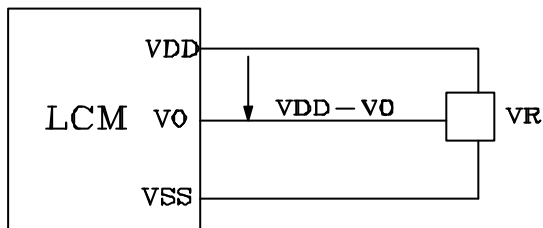
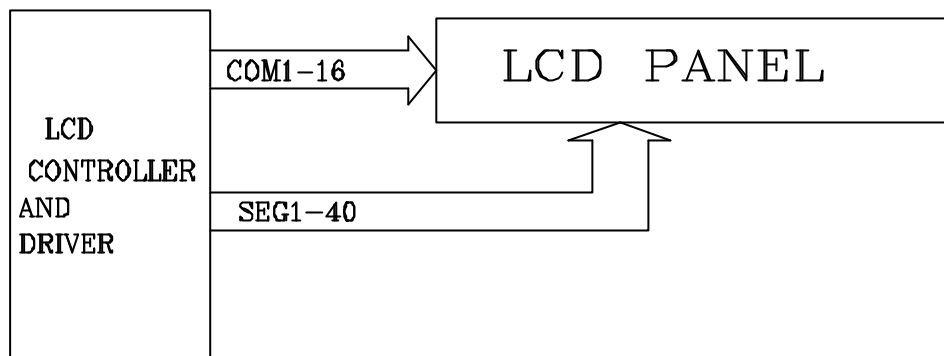
Write Timing



Read Timing



Block Diagram



VDD-Vo: LCD DRIVING VOLTAGE

VR: 10K-20K Ω

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 μs |
| 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 μs |
| 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 μs |
| 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=0: 5 × 7 dots , 1/8 duty | 40 μs |
| 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 μs |
| Set DD RAM Address | 0 | 0 | 1 | DD RAM address | | | | | | The address length that can be set is 80 address | 40 μs | |
| Read Busy Flug/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 μs | |
| Write Data | 1 | 0 | Write data | | | | | | | | | 46 μs |
| Read Data | 1 | 1 | Read data | | | | | | | | | 46 μs |

DD RAM Address:

| | | | | | | | | | | | | | | | | |
|-------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Address for line | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 40 | 41 | 42 | 43 | 44 | 45 | 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°C, 90% RH, 240hrs | Twice initial value or less | none | More than 80% of initial value | No abnormality |
| High temperature storage | 60°C, 240hrs | Twice initial value or less | none | More than 80% of initial value | No abnormality |
| Low temperature storage | -20°C, 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°C±5°C).

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

2. Liquid crystal panel service life

50,000 hours minimum at 25 ± 10°C, 45 ±

Standard Character Pattern

| Layer 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 | | | | - | 9 | 3 | ε | ρ | |
| xxxx0001 | (2) | | ! | 1 | A | Q | a | 4 | | | o | ア | チ | △ | ◊ | 9 | |
| xxxx0010 | (3) | | " | 2 | B | R | b | r | | | 「 | イ | ツ | × | ρ | θ | |
| xxxx0011 | (4) | | # | 3 | C | S | c | s | | | 」 | ウ | テ | モ | ε | ε | |
| xxxx0100 | (5) | | \$ | 4 | D | T | d | t | | | 、 | エ | ト | 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 | π | |
| xxxx0111 | (8) | | ' | 7 | G | W | g | w | | | ア | キ | ヌ | ラ | 9 | π | |
| xxxx1000 | (1) | | (| 8 | H | X | h | x | | | イ | ク | ネ | リ | 、 | × | |
| xxxx1001 | (2) | |) | 9 | I | Y | i | y | | | ウ | ケ | ル | ル | ' | γ | |
| xxxx1010 | (3) | | * | : | J | Z | j | z | | | エ | コ | ン | レ | J | キ | |
| xxxx1011 | (4) | | + | ; | K | [| k | [| | | オ | サ | ヒ | ロ | * | π | |
| xxxx1100 | (5) | | , | < | L | ¥ | l | l | | | カ | シ | フ | ワ | ε | π | |
| xxxx1101 | (6) | | - | = | M |] | m |] | | | ユ | ス | ハ | ン | ε | ÷ | |
| xxxx1110 | (7) | | . | > | N | ^ | n | + | | | ヨ | セ | ホ | ウ | π | | |
| xxxx1111 | (8) | | / | ? | O | _ | o | + | | | ウ | ソ | マ | ° | ö | ■ | |

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