

AZ DISPLAYS, INC.

COMPLETE LCD SOLUTIONS

SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY

PART NUMBER:

ACM 1602T SERIES

DATE:

August 9, 1999

ACM1602T SERIES LCD MODULE

1.0 MECHANICAL SPECS

| | |
|------------------------------|--|
| 1. Overall Module Size | 85.0mm(W) x 32.6mm(H) x max 13.5mm(D) for LED backlight version 85.0mm(W) x 32.6mm(H) x max 9.5mm(D) for reflective version |
| 2. Dot Size | 0.56mm(W) x 0.61mm(H) |
| 3. Dot Pitch | 0.61mm(W) x 0.66mm(H) |
| 4. Duty | 1/16 |
| 5. Controller IC | KS0066 |
| 6. LC Fluid Options | TN, STN |
| 7. Polarizer Options | Reflective, Transflective, Transmissive |
| 8. Backlight Options | LED |
| 9. Temperature Range Options | Standard (0°C ~ 50°C),Wide(-20°C ~ 70°C) |

2.0 ABSOLUTE MAXIMUM RATINGS

| Item | Symbol | Min | Typ | Max | Unit |
|--|----------|-----|-----|-----|------|
| Operating temperature (Standard) | Top | 0 | - | 50 | °C |
| Storage temperature (Standard) | Tst | -10 | - | 60 | °C |
| Operating temperature (Wide temperature) | Top | -20 | - | 70 | °C |
| Storage temperature (Wide temperature) | Tst | -30 | - | 80 | °C |
| Input voltage | Vin | Vss | | Vdd | V |
| Supply voltage for logic | Vdd- Vss | 2.7 | - | 5.5 | V |
| Supply voltage for LCD drive | Vdd- Vo | 3.0 | 4.6 | 6.5 | V |

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3.0 ELECTRICAL CHARACTERISTICS

| Item | Symbol | Condition | Min | Typ | Max | Unit |
|--|----------------------------------|--|-----|-----|-----------------|------|
| Input voltage (high) | V _{ih} | H level | 2.2 | - | V _{dd} | V |
| Input voltage (low) | V _{il} | L level | 0 | - | 0.6 | V |
| Recommended LC Driving Voltage (Standard Temp) | V _{dd} - V _o | 0°C | - | 4.8 | 5.4 | V |
| | | 25°C | 4.2 | 4.6 | - | |
| | | 50°C | 3.9 | 4.3 | - | |
| Recommended LC Driving Voltage (Wide Temp) | V _{dd} - V _o | -20°C | - | 6.4 | 7.2 | V |
| | | 0°C | - | 4.8 | - | |
| | | 50°C | - | 4.2 | - | |
| | | 70°C | 3.5 | 4.0 | - | |
| Power Supply Current | I _{dd} | V _{dd} =5.0V, f _{osc} =270kHz | - | 0.8 | 1.8 | mA |
| LED Power Supply Voltage | V _{fled} | R=6.8Ω | - | 4.6 | 5.0 | V |
| LED Power Supply Current | I _{fled} | R=6.8Ω | - | 120 | 300 | mA |

4.0 OPTICAL CHARACTERISTICS (T_a=25°C, V_{dd}= 5.0V±0.25V, TN LC fluid)

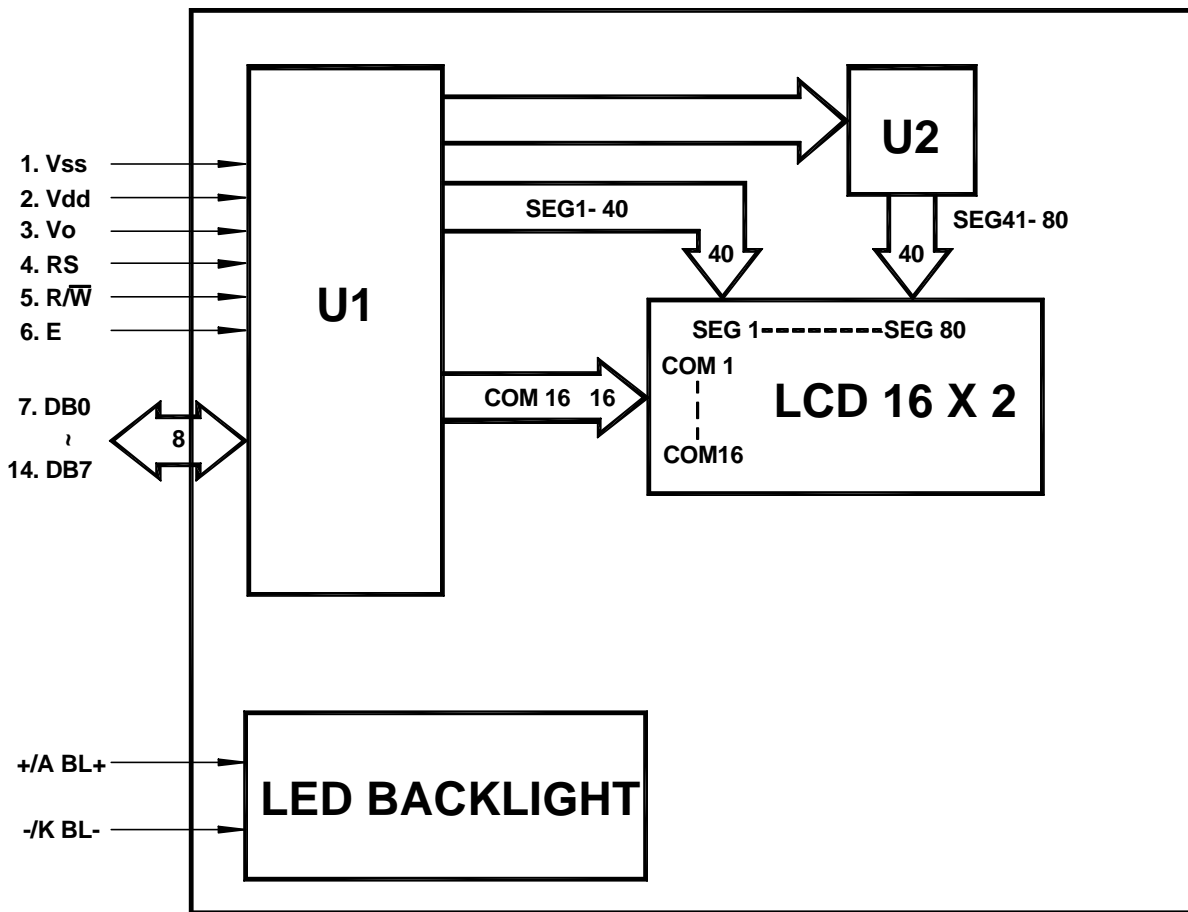
| Item | Symbol | Condition | Min | Typ | Max | Unit |
|----------------------------|----------------|------------|-----|-----|-----|------|
| Viewing angle (horizontal) | θ | Cr ≥ 4.0 | -25 | - | - | deg |
| Viewing angle (vertical) | φ | Cr ≥ 4.0 | -30 | - | 30 | deg |
| Contrast Ratio | Cr | φ=0°, θ=0° | - | 2 | - | |
| Response time (rise) | T _r | φ=0°, θ=0° | - | 120 | 150 | ms |
| Response time (fall) | T _f | φ=0°, θ=0° | - | 120 | 150 | ms |

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4.1 OPTICAL CHARACTERISTICS (Ta=25°C, Vdd= 5.0V±0.25V, STN LC fluid)

| Item | Symbol | Condition | Min | Typ | Max | Unit |
|----------------------------|----------|--------------------------------|-----|-----|-----|------|
| Viewing angle (horizontal) | θ | $Cr \geq 2.0$ | -60 | - | 35 | deg |
| Viewing angle (vertical) | ϕ | $Cr \geq 2.0$ | -40 | - | 40 | deg |
| Contrast Ratio | Cr | $\phi=0^\circ, \theta=0^\circ$ | - | 6 | - | |
| Response time (rise) | Tr | $\phi=0^\circ, \theta=0^\circ$ | - | 150 | 250 | ms |
| Response time (fall) | Tf | $\phi=0^\circ, \theta=0^\circ$ | - | 150 | 250 | ms |

5.0 BLOCK DIAGRAM

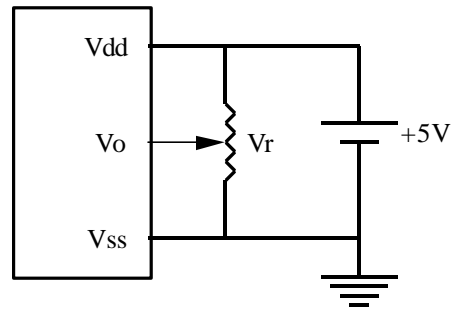


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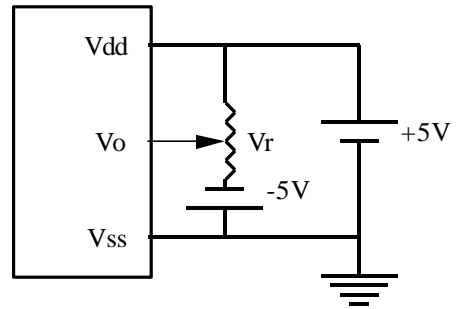
6.0 PIN ASSIGNMENT

| Pin No. | Symbol | Function |
|---------|--------|----------------------|
| 1 | Vss | Ground |
| 2 | Vdd | +5V |
| 3 | Vo | LCD contrast adjust |
| 4 | RS | Register select |
| 5 | R/W | Read / write |
| 6 | E | Enable |
| 7 | DB0 | Data bit 0 |
| 8 | DB1 | Data bit 1 |
| 9 | DB2 | Data bit 2 |
| 10 | DB3 | Data bit 3 |
| 11 | DB4 | Data bit 4 |
| 12 | DB5 | Data bit 5 |
| 13 | DB6 | Data bit 6 |
| 14 | DB7 | Data bit 7 |
| +A | BL+ | Power Supply for BL+ |
| -K | BL- | Power Supply for BL- |

7.0 POWER SUPPLY



STANDARD TEMP RANGE



WIDE TEMP RANGE

$$V_r = 10K\Omega \sim 20K\Omega$$

8.0 TIMING CHARACTERISTICS

| Item | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|-----------------------|------------|----------------|------|------|------|------|
| Enable cycle time | t_c | Fig. a, Fig. b | 500 | - | - | ns |
| Enable pulse width | t_w | Fig. a, Fig. b | 220 | - | - | ns |
| Enable rise/fall time | t_r, t_f | Fig. a, Fig. b | - | - | 25 | ns |
| RS, R/W set up time | t_{su} | Fig. a, Fig. b | 40 | - | - | ns |
| RS, R/W hold time | t_h | Fig. a, Fig. b | 10 | - | - | ns |
| Data delay time | t_d | Fig. b | - | - | 120 | ns |
| Data set up time | t_{dsu} | Fig. a | 60 | - | - | ns |
| Data hold time | t_{dh} | Fig. a, Fig. b | 20 | - | - | ns |

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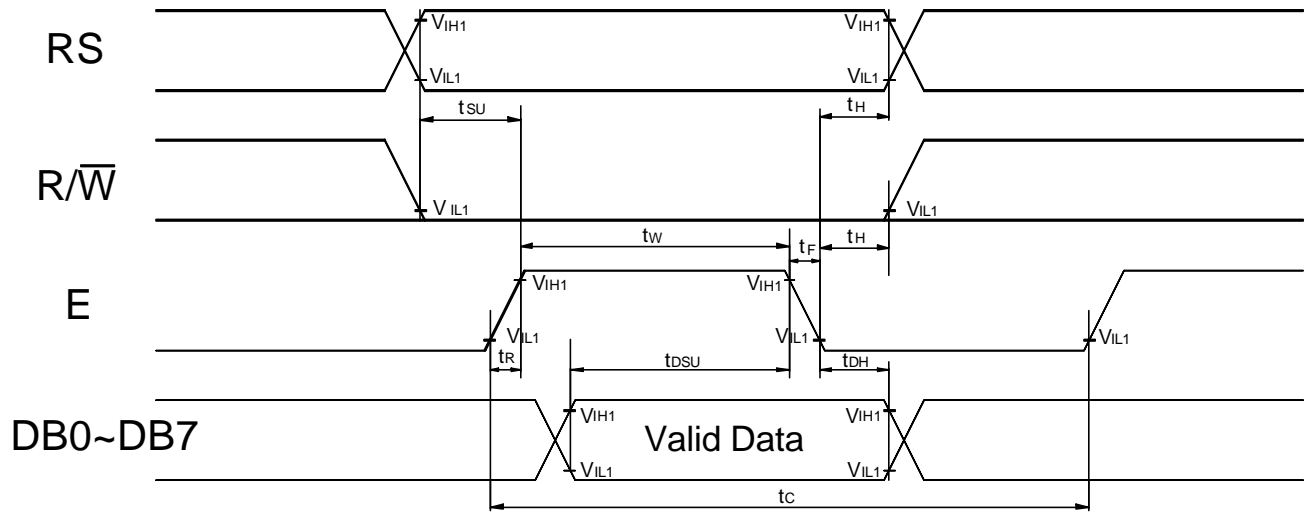


Fig. a Interface timing (data write)

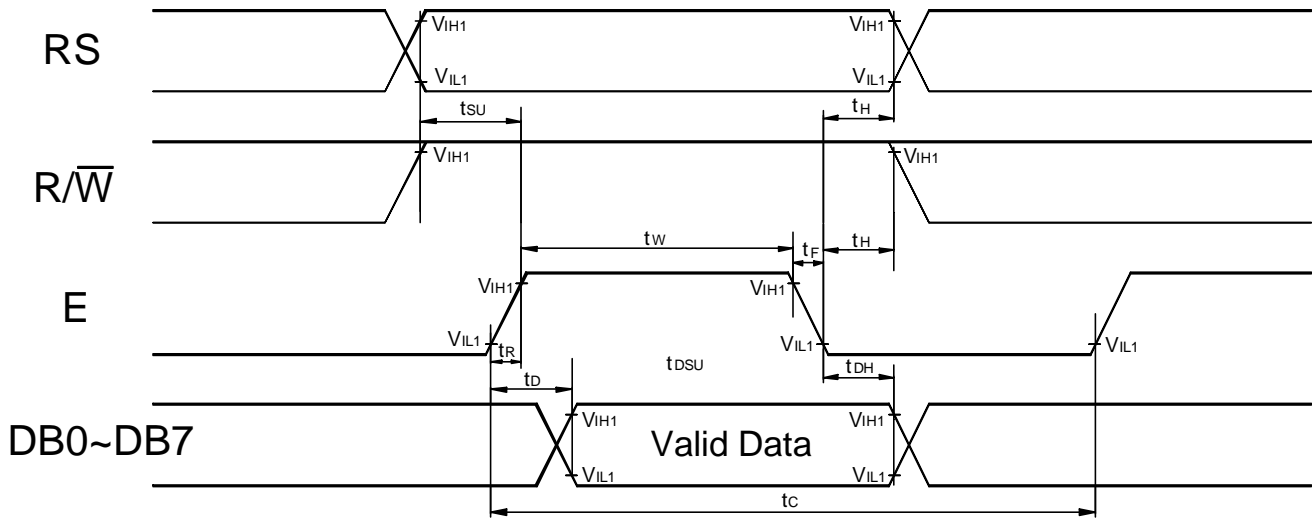
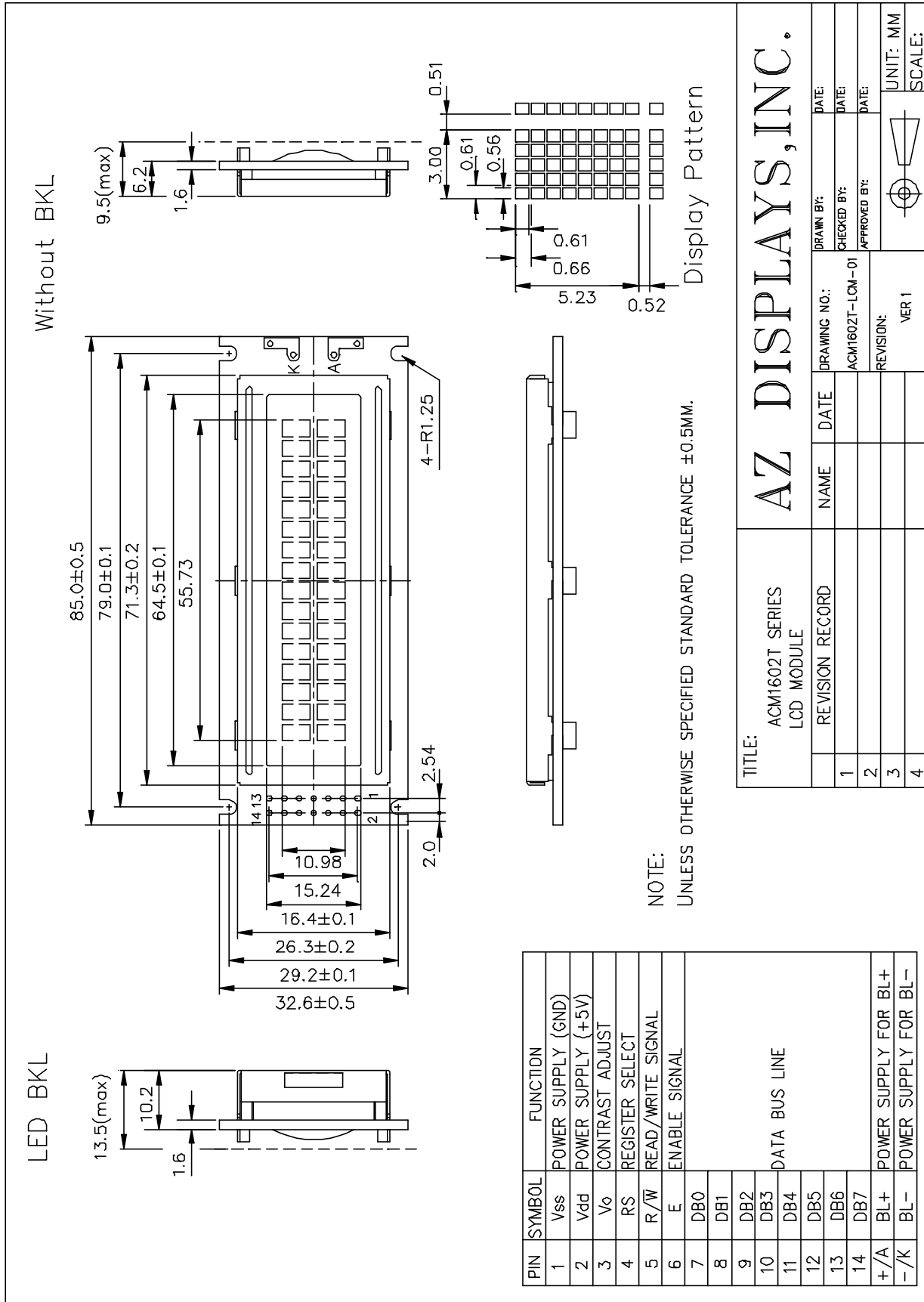


Fig. b Interface timing (data read)

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9.0 MECHANICAL DIAGRAM



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10.0 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.

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11.0 DISPLAY INSTRUCTION TABLE

| COMMAND | R S | R/ W | DB 7 | DB 6 | DB 5 | DB 4 | DB 3 | DB 2 | DB 1 | DB 0 | DESCRIPTION | Executing time fosc=250khz |
|--------------------------|--------|---------|------------|---|--------------------------------------|---------|---------|----------------------------------|---|---|---|----------------------------------|
| Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Clears Display & Returns to Address 0. | 1.64ms |
| Cursor at Home | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | x | Returns Cursor to Address 0. Also returns the display being shifted to the original position. DDRAM contents remain unchanged. | 1.64ms |
| Entry Mode Set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/D | S | I/D: Set Cursor Moving Direction I/D=1: Increment I/D=0: Decrement S: Specify Shift of Display S=1: The display is shifted S=0: The display is not shifted | 40μs |
| Display ON/OFF Control | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | B | Display D=1: Display on D=0: Display off Cursor C=1: Cursor on C=0: Cursor off Brink B=1: Brink on B=0: Brink off | 40μs |
| Cursor / Display Shift | 0 | 0 | 0 | 0 | 0 | 1 | S/C | R/L | x | x | Moves cursor or shifts the display w/o changing DD RAM contents S/C=0: Cursor Shift (RAM unchanged) S/C=1: Display Shift (RAM unchanged) R/L=1: Shift to the Right R/L=0: Shift to the Left | 40μs |
| Function Set | 0 | 0 | 0 | 0 | 1 | DL | N | F | x | x | Sets data bus length (DL), # of display lines (N), and character fonts (F). DL=1: 8 bits F=0: 5x7 dots DL=0: 4 bits F=1: 5x10 dots N=0: 1 line display N=1: 2 lines display | 40μs |
| Set CG RAM Address | 0 | 0 | 0 | 1 | Character Generator (CG) RAM Address | | | | | Sets CG RAM address. CG RAM data is sent and received after this instruction. | | 40μs |
| Set DD RAM Address | 0 | 0 | 1 | Display Data (DD) RAM Address / Cursor Address | | | | | Sets DD RAM address. DD Ram data is sent and received after this instruction. | | 40μs | |
| Busy Flag / Address Read | 0 | 1 | B F | Address counter used for both DD & CG RAM address | | | | | Reads Busy Flag (BF) and address counter contents. | | 40μs | |
| Write Data | 1 | 0 | Write Data | | | | | Writes data into DDRAM or CGRAM. | | 46μs | | |
| Read Data | 1 | 1 | Read Data | | | | | Reads data from DDRAM or CGRAM. | | 46μs | | |

x: Don't Care

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12.0 STANDARD CHARACTER PATTERNS

| 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 | | | | - | 夕 | 三 | ⊗ | P |
| xxxx0001 | (2) | | ! | 1 | A | Q | a | q | | | 。 | ア | チ | △ | ⊗ | Q |
| xxxx0010 | (3) | | " | 2 | B | R | b | r | | | 「 | イ | ツ | × | ⊗ | ⊗ |
| xxxx0011 | (4) | | # | 3 | C | S | c | s | | | 」 | ウ | テ | ⊗ | ⊗ | ⊗ |
| xxxx0100 | (5) | | \$ | 4 | D | T | d | t | | | 、 | エ | ト | ⊗ | ⊗ | ⊗ |
| xxxx0101 | (6) | | % | 5 | E | U | e | u | | | ・ | オ | ナ | 1 | ⊗ | ⊗ |
| xxxx0110 | (7) | | & | 6 | F | V | f | v | | | ヲ | カ | ニ | ヨ | ⊗ | ⊗ |
| xxxx0111 | (8) | | ' | 7 | G | W | g | w | | | ア | キ | ヌ | ラ | ⊗ | ⊗ |
| xxxx1000 | (1) | | (| 8 | H | X | h | x | | | イ | ク | ネ | リ | ⊗ | ⊗ |
| xxxx1001 | (2) | |) | 9 | I | Y | i | y | | | ウ | ケ | ル | ル | ⊗ | ⊗ |
| xxxx1010 | (3) | | * | : | J | Z | j | z | | | エ | コ | ハ | レ | ⊗ | ⊗ |
| xxxx1011 | (4) | | + | ; | K | [| k | [| | | オ | サ | ヒ | 〇 | ⊗ | ⊗ |
| xxxx1100 | (5) | | , | < | L | ¥ | l | l | | | カ | シ | フ | ワ | ⊗ | ⊗ |
| xxxx1101 | (6) | | - | = | M |] | m |] | | | ユ | ス | ハ | ン | ⊗ | ⊗ |
| xxxx1110 | (7) | | . | > | N | ^ | n | ^ | | | ヨ | セ | ホ | 〇 | ⊗ | ⊗ |
| xxxx1111 | (8) | | / | ? | O | _ | o | + | | | ウ | ソ | マ | 〇 | ⊗ | ■ |

Note: The character generator RAM is the RAM with which the user can rewrite character patterns by program.