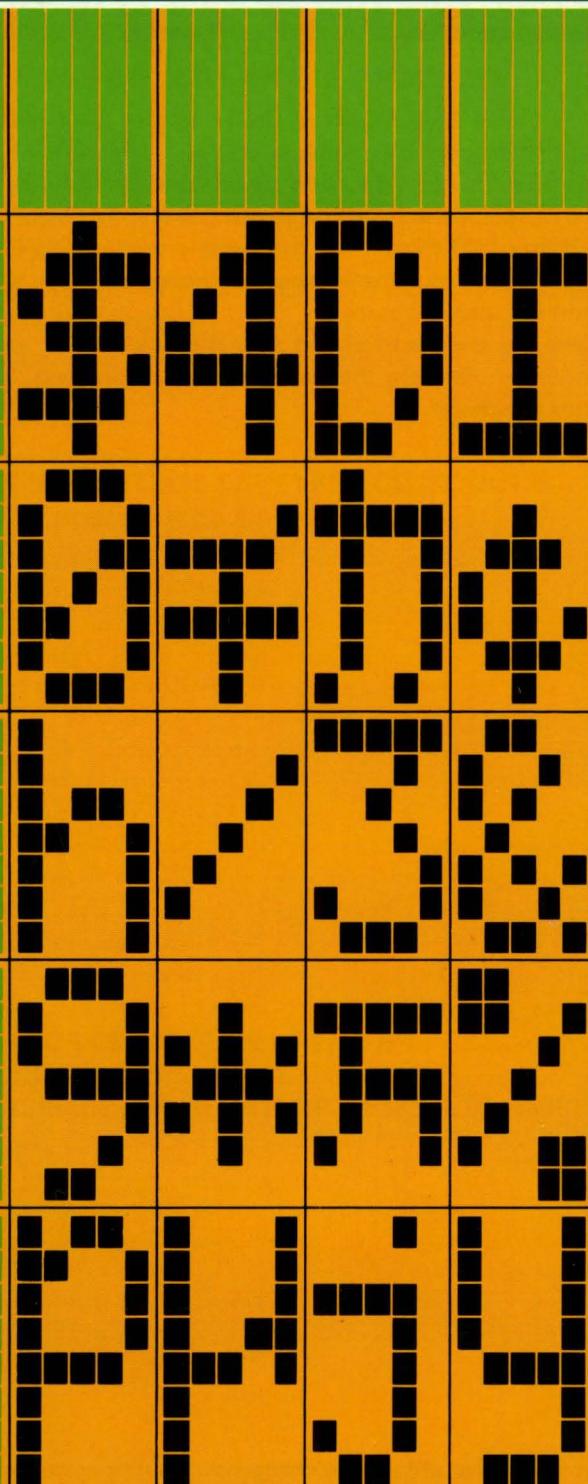


HITACHI DOT MATRIX LIQUID CRYSTAL DISPLAY



PREFACE

Hitachi Dot Matrix Liquid Crystal Display (LCD) Module was developed to display numerals, alphabet, symbols, graphics, etc.

The twist-nematic type liquid crystal, with a high contrast ratio was used. Due to its small size, light weight, low voltage, low power consumption, easy handling, etc., the Hitachi Dot Matrix LCD Module has been widely used as a display component for portable data terminal equipment, word processors and high class electronic tabletop calculators in Japan and abroad.

This brochure describes the electrical and optical characteristics, external dimensions and precautions in handling the standard type of products, and it can be used when selecting equipment.

Note: The information contained herein is tentative and may be changed without prior notice. It is therefore advisable to contact Hitachi before proceeding with the design of equipment incorporating this product.

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| LM215 | 100 |

TABULATED DATA FOR HITACHI DOT MATRIX LIQUID CRYSTAL

| Type | Type No. | Number of display character | External dimensions W x H x T (mm) | Effective viewing area W x H (mm) | Character dimensions W x H (mm) | Driving method duty | |
|--|----------|-----------------------------|---------------------------------------|--------------------------------------|------------------------------------|---------------------|--|
| Character type (Control LSI attachment type) | H2532A | 16 x 1 line | 84 x 44 x 15 max. | 61 x 15.8 | 2.9 x 5.5 | 1/8 D | |
| | H2535 | 16 x 2 lines | 84 x 44 x 15 max. | 61 x 15.8 | 2.9 x 4.1 | 1/16 D | |
| | H2538A | 40 x 1 line | 220 x 50 x 15 max. | 163 x 17 | 3.15 x 5.5 | 1/8 D | |
| | H2539 | 40 x 2 lines | 220 x 50 x 15 max. | 163 x 17 | 3.15 x 4.45 | 1/16 D | |
| Character type (Built-in control LSI type) | LM054 | 8 x 1 line | 84 x 44 x 13 max. | 61 x 15.8 | 6.45 x 9.4 | 1/8 D | |
| | H2570 | 16 x 1 line | 80 x 36 x 12 max. | 64.5 x 13.8 | 3.15 x 7.9 | 1/11 D | |
| | LM015 | 16 x 1 line | 80 x 36 x 12 max. | 64.5 x 13.8 | 3.15 x 5.5 | 1/8 D | |
| | LM020L | 16 x 1 line | 80 x 36 x 12 max. | 64.5 x 13.8 | 3.07 x 5.73 | 1/16 D | |
| | LM038 | 20 x 1 line | 182 x 35.5 x 13 max. | 154.4 x 15.8 | 6.7 x 9.4 | 1/8 D | |
| | LM027 | 24 x 1 line | 126 x 36 x 12 max. | 100 x 13.8 | 3.15 x 7.9 | 1/11 D | |
| | H2571 | 32 x 1 line | 174.5 x 33 x 13.4 max. | 132.5 x 14 | 3.15 x 7.9 | 1/11 D | |
| | H2572 | 40 x 1 line | 182 x 35.5 x 13 max. | 154.4 x 15.8 | 3.15 x 7.9 | 1/11 D | |
| 4 lines series | LM052L | 16 x 2 lines | 80 x 36 x 12 max. | 64.5 x 13.8 | 2.95 x 3.8 | 1/16 D | |
| | LM016L | 16 x 2 lines | 84 x 44 x 12 max. | 61 x 15.8 | 2.95 x 4.86 | 1/16 D | |
| | LM032L | 20 x 2 lines | 116 x 37 x 13 max. | 83 x 18.6 | 3.2 x 4.85 | 1/16 D | |
| | LM017L | 32 x 2 lines | 174.5 x 33 x 13.4 max. | 141.2 x 16.75 | 3.45 x 4.85 | 1/16 D | |
| | LM018L | 40 x 2 lines | 182 x 35.5 x 13 max. | 154.4 x 15.8 | 3.2 x 4.85 | 1/16 D | |
| | LM041L | 16 x 4 lines | 87 x 60 x 12 max. | 61.8 x 25.2 | 2.95 x 4.15 | 1/16 D | |
| Full dot type (Graphic type) | LM044L | 20 x 4 lines | 98 x 60 x 12 max. | 76 x 25.2 | 2.95 x 4.15 | 1/16 D | |
| | H2525 | 20 dot x 239 dot | 220 x 53 x 15 max. | 163 x 17 | — | 1/20 D | |
| | LM021 | 24 dot x 479 dot | 290 x 60 x 13 max. | 245 x 19 | — | 1/24 D | |
| | LM200 | 64 dot x 240 dot | 180 x 75 x 15 max. | 132 x 39 | — | 1/32 D | |
| | LM213B | 64 dot x 256 dot | 184 x 75 x 12 max. | 149.6 x 43 | — | 1/64 D | |
| | LM211 | 64 dot x 480 dot | 270 x 82 x 13 max. | 240 x 38 | — | 1/64 D | |
| | LM212 | 48 dot x 640 dot | 270 x 63 x 14 max. | 241 x 25 | — | 1/48 D | |
| | LM215 | 128 dot x 480 dot | 270 x 110 x 15 max. | 242 x 69 | — | 1/64 D | |

Note 1. Transflective reflector (T-type), and character display type LCM of wider temperature range (at operating: $-10^{\circ}\text{C} \sim +70^{\circ}\text{C}$, at storage: $-40^{\circ}\text{C} \sim +80^{\circ}\text{C}$) (H-type), are available in request.

Note 2. Applicable only for replacement: LM020, LM016, LM032, LM017, LM018, LM041, LM044

DISPLAY MODULE

| | Recommended power supply | | Power consumption typ. (mW) | Operating temperature °C | Storage temperature °C | Weight (g) | Power supply | LSI for LCD driving (Built in) | Recommendable control LSI | Page |
|--|--|--|--------------------------------|-----------------------------|---------------------------|---------------|--------------|-----------------------------------|-----------------------------------|------|
| | V _{DD} – V _{SS} (V) | V _{EE} – V _{SS} (V) | | | | | | | | |
| | +5 | -5 | 10 | 0 ~ +50 | -20 ~ +60 | 40 | - | HD44100 | HD43160A | 13 |
| | +5 | -5 | | 0 ~ +50 | -20 ~ +60 | 40 | | | | 15 |
| | +5 | -5 | | 0 ~ +50 | -20 ~ +60 | 100 | | | | 17 |
| | +5 | -5 | | 0 ~ +50 | -20 ~ +60 | 100 | | | | 19 |
| | +5 | - | 10 | 0 ~ +50 | -20 ~ +70 | 25 | Single | HD44780 | Built-in type | 31 |
| | +5 | - | | 0 ~ +50 | -20 ~ +70 | 25 | | HD44780 + HD44100 | | 34 |
| | +5 | - | | 0 ~ +50 | -20 ~ +70 | 25 | | HD44780 | | 36 |
| | +5 | - | | 0 ~ +50 | -20 ~ +70 | 25 | | HD44780 + HD44100 | | 39 |
| | +5 | - | | 0 ~ +50 | -20 ~ +70 | 65 | | | | 42 |
| | +5 | - | | 0 ~ +50 | -20 ~ +70 | 40 | | | | 45 |
| | +5 | - | | 0 ~ +50 | -20 ~ +70 | 60 | | | | 48 |
| | +5 | - | | 0 ~ +50 | -20 ~ +70 | 65 | | | | 51 |
| | +5 | - | 15 | 0 ~ +50 | -20 ~ +70 | 25 | Single | HD44780 + HD44100 | Built-in type | 54 |
| | +5 | - | | 0 ~ +50 | -20 ~ +70 | 25 | | | | 57 |
| | +5 | - | | 0 ~ +50 | -20 ~ +70 | 50 | | | | 60 |
| | +5 | - | | 0 ~ +50 | -20 ~ +70 | 60 | | | | 63 |
| | +5 | - | | 0 ~ +50 | -20 ~ +70 | 65 | | | | 66 |
| | +5 | - | | 0 ~ +50 | -20 ~ +70 | 60 | | | | 69 |
| | +5 | - | 15 | 0 ~ +50 | -20 ~ +70 | 65 | Single | HD44780 + HD44104 | Built-in type | 72 |
| | +5 | -5 | | 0 ~ +50 | -20 ~ +60 | 100 | | HD44104 | | 82 |
| | +5 | -5 | | 0 ~ +50 | -20 ~ +60 | 150 | | HD44100 | Attachment type CB1020R (HD61830) | 85 |
| | +5 | -5 | | 0 ~ +50 | -20 ~ +60 | 150 | | HD44104 | | 88 |
| | +5 | -9 | | 0 ~ +40 | -20 ~ +60 | 150 | | HD61830 + HD44104 | | 91 |
| | +5 | -9 | 60 | 0 ~ +40 | -20 ~ +60 | 180 | Single | HD44104 | Attachment type CB1026R (HD61830) | 93 |
| | +5 | - | | 0 ~ +40 | -20 ~ +60 | 170 | | | | 96 |
| | +5 | -10 | (100) | 0 ~ +40 | -20 ~ +60 | 320 | - | HD61100 + HD61103 | Attachment type CB1030R (HD61830) | 100 |

PHOTOGRAPHS OF LCD MODULE PRODUCTS

CONTROL LSI ATTACHMENT TYPE LCD MODULE



• H2532A



• H2538A



• H2535



• H2539

BUILT-IN CONTROL LSI TYPE LCD MODULE



• LM054



• H2570



• LM015



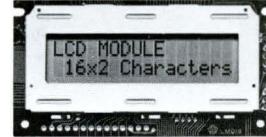
• LM027



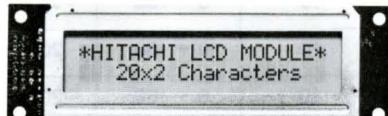
• LM020L



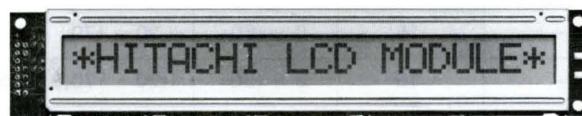
• LM052L



• LM016L



• LM032



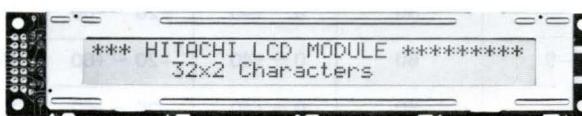
• LM038



• H2571



• H2572



• LM017L



• LM018L



• LM041L



• LM044L

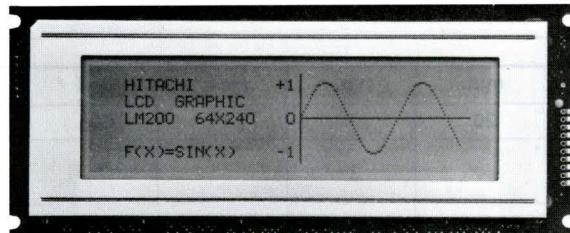
GRAPHIC LCD MODULE



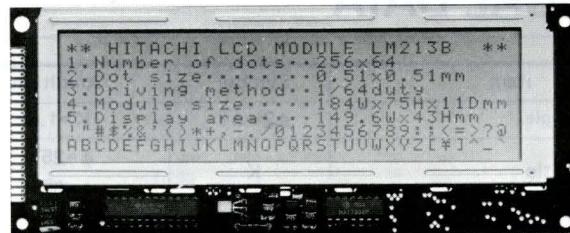
• H2525



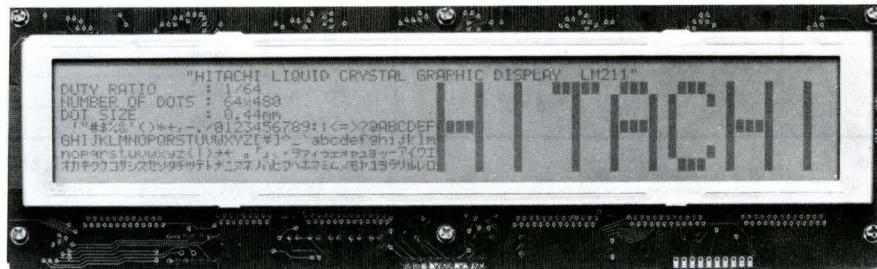
• LM021



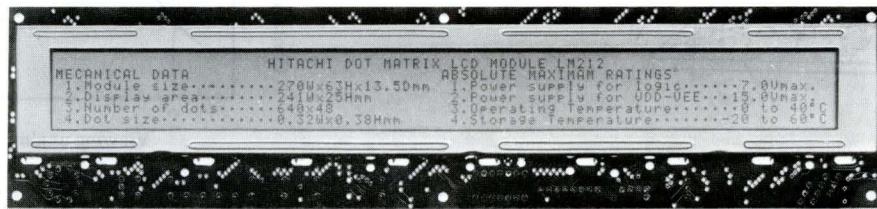
• LM200



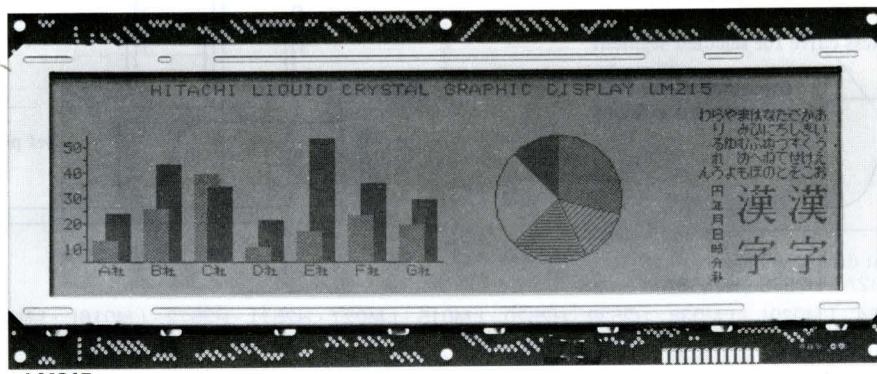
• LM213B



• LM211



• LM212



• LM215

FEATURES

1. By the combination of dots, numerals, alphabets, symbols, graphics, etc. can be displayed.
2. Due to the twist-nematic type liquid crystal, bright and high-contrast displays can be obtained.
3. Due to low drive voltage and low power consumption, this LCD module may be operated by battery.
4. An LSI is loaded exclusively for the LCD element drive. Also, a type containing a control LSI is available.
5. Due to its small size and light weight, compact display equipment can be constructed.
6. Various types are available, from small-sized modules for character display, to large-sized display module for graphics.

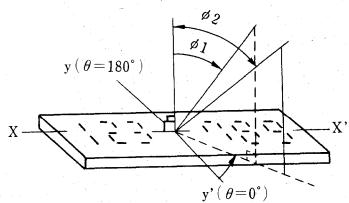
APPLICATIONS

- Portable data terminal equipment
- Word processor
- High class electronic tabletop calculator
- POS terminal equipment
- Measuring instruments
- Other display devices

OPTICAL DATA

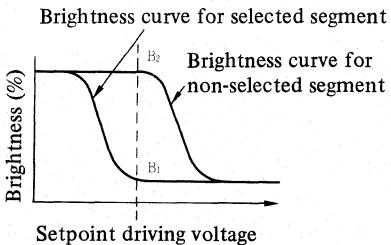
| Item | Symbol | Condition | min. | typ. | max. | Unit | Note |
|----------------------|-------------------|-------------------------------------|------|------|------|------|---------|
| Viewing angle | $\phi_2 - \phi_1$ | $K=1.4$ | 20 | — | — | deg. | 1, 2, 8 |
| Contrast ratio | K | $\phi=25^\circ$ $\theta=0^\circ$ | — | 3 | — | — | 3 |
| Response time (rise) | t_r | $\phi=25^\circ$ $\theta=0^\circ$ | — | 200 | 400 | ms | 4, 5 |
| | | | | 250 | 400 | | 4, 6 |
| | | | | 150 | 250 | | 4, 7 |
| Response time (fall) | t_f | $\phi=25^\circ$ $\theta=0^\circ$ | — | 200 | 400 | ms | 4, 5 |
| | | | | 250 | 400 | | 4, 6 |
| | | | | 150 | 250 | | 4, 7 |

Note 1. Definition of θ and ϕ



Note 3. Definition of contrast "K"

$$K = \frac{\text{Brightness of non-selected segment } (B_2)}{\text{Brightness of selected segment } (B_1)}$$

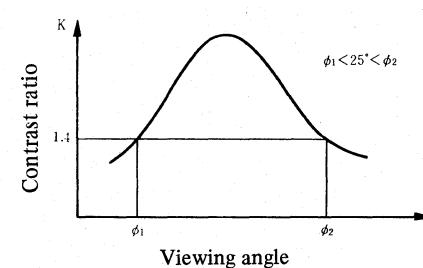


Note 5. Applied type: H2532A · H2535 · H2538A ·

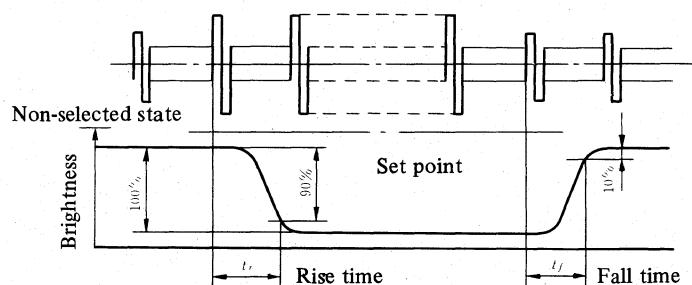
Note 6. Applied type: LM054 · LM020L · LM038 · H2539 · H2570 · LM015 · LM027 · H2571 · H2572 · LM016L · LM032L · LM017L · LM018L · LM041L · LM044L · LM052L

Note 7. Applied type: H2525 · LM200 · LM021 · LM213B · LM211 · LM212 · LM215

Note 8. Viewing angle of LM200 · LM213B · LM211 · LM212 · LM215; typical 20 deg.



Note 4. Definition of optical response



HOW TO HANDLE THE LIQUID CRYSTAL DISPLAY MODULE

This module is composed of the liquid crystal display device and the CMOS LSI drive unit. When using LCM, please observe the following precautions.

1. Since this module uses a CMOS LSI, the same careful attention should be paid to static electricity as for an ordinary CMOS IC.
 - (1) Make certain that you are grounded when handling LCM.
 - (2) Before removing LCM from its packing case or incorporating it into a set, be sure that the module and your body have the same electric potential.
 - (3) When soldering the terminal of LCM, make certain that the AC power source for the soldering iron does not leak.
 - (4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground potential. Try to minimize as much as possible any transmission of electromagnetic waves produced by sparks coming from the commutator of the motor.
 - (5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.
 - (6) To reduce the generation of static electricity, be careful that the air in the work area does not become too dry. (A relative humidity of at least 50% is recommended.)
2. Be sure to handle the module carefully so as not to scratch or damage the glass and polarizer (plastic film) of LCM.
 - (1) Do not drop, bend or twist LCM.
 - (2) Do not strike or rub the display surface with a hard object, because the polarizer can easily be exposed and be damaged. Also, touching the module with bare hands is one cause of contamination.
 - (3) Do not allow any foreign matter like oils and resins to stick to the module.
 - (4) In case any dust or dirt should stick on the display surface, wipe it off gently with soft gauze. Avoid wiping the display surface with solvents including thinner, IPA and trichloroethane. When wiping the display surface, use petroleum benzine (special class) made by Nihon Sekiyu Co. or an equivalent product.
 - (5) Avoid placing any object directly on the display surface for any length of time because it may leave marks.
3. Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.
 - (1) Do not alter, modify or change the shape of the clips on the metal frame.
 - (2) Do not drill attachment holes in the printed circuit board, modify its shape or change the positions of components to be attached.
 - (3) Do not damage or modify the pattern wiring on the printed circuit board.
 - (4) Absolutely do not modify or change the interconnector (conductive rubber) or touch it with another object.
 - (5) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.

The precautions that should be observed when handling LCM have been explained above. If any points are unclear or if you have any requests, please contact Hitachi.

HOW TO HANDLE THE LCD CRYSTAL MODULE

- (1) When handling the LCD module, hold it by the edges. Do not touch the surface of the LCD or the terminals.
- (2) Do not drop, bump or hit the LCD module.
- (3) Do not apply excessive pressure to the surface of the LCD module.
- (4) Do not bend the LCD module.
- (5) Do not expose the LCD module to direct sunlight or heat.
- (6) Do not allow water to come in contact with the LCD module.
- (7) Do not allow the LCD module to come in contact with oil or solvents.
- (8) Do not allow the LCD module to come in contact with sharp metal objects.
- (9) Do not allow the LCD module to come in contact with organic solvents.

CONTROL LSI ATTACHMENT TYPE LCD MODULE

This module consists of LCD device, drive LSI, PC board, and other parts.

By attaching the control LSI HD43160A, numerals, alphabets, Kana, and symbols can be displayed.

Control LSI HD43160AH for LCD Module

| | |
|--------|----------------|
| H2532A | (16 x 1 line) |
| H2535 | (16 x 2 lines) |
| H2538A | (40 x 1 line) |
| H2539 | (40 x 2 lines) |

CONTROL LSI HD43160AH FOR LCD MODULE

- Controller with built-in character generator
- Applicable type: H2532 · H2535 · H2538A · H2539

The HD43160AH receives character data written in the ASCII code or JIS code from microcomputer and stores them in its RAM which has 80 words capacity.

The HD43160AH converts these data into serial character pattern, then transfers them to LCD drivers.

It also generates other signals for LCD.

1. CHARACTER DISPLAY

- Alphanumeric character; A ~ Z, a ~ z, @, #, %, &, etc.
- Japanese Character (katakana)
- 160 characters by internal character generator (ROM).
(Max. 256 characters by external ROM)

2. CHARACTER DOT PATTERNS

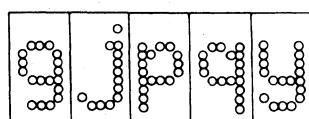
- 5 x 7

The bottom lines of the English small characters "g, i, p, q, y," are on the cursor line.

| | | Character code lower 4 bits (hexadecimal) | | | | | | | | | | | | | | | | | |
|---|---|---|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F | | |
| Character code upper 4 bits (hexadecimal) | 2 | o | o o | o o o | o o o o | o o o o o | o o o o o o | o o o o o o o | o o o o o o o o | o o o o o o o o o | o o o o o o o o o o | o o o o o o o o o o o | o o o o o o o o o o o o | o o o o o o o o o o o o o | o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | | |
| | 3 | 9 1 2 3 4 5 6 7 8 9 | 1 2 3 4 5 6 7 8 9 | 2 3 4 5 6 7 8 9 | 3 4 5 6 7 8 9 | 4 5 6 7 8 9 | 5 6 7 8 9 | 6 7 8 9 | 7 8 9 | 8 9 | 9 | | | | | | | | |
| | 4 | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | Q Q Q Q Q Q Q Q Q Q | |
| | 5 | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | P Q R S T U V W X Y Z | | |
| | 6 | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o |
| | 7 | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o |
| | A | g j p q y | j p q y | p q y | q y | y | | | | | | | | | | | | | |
| | B | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o |
| | C | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o |
| | D | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o | o o o o o o o o o o o o o o o o |

- 5 x 11

Only English small character "g, j, p, q, y," are displayed as below, the others are in the same way as that of 5 x 7.



- Cursor 5 dots: ● ● ● ● ●

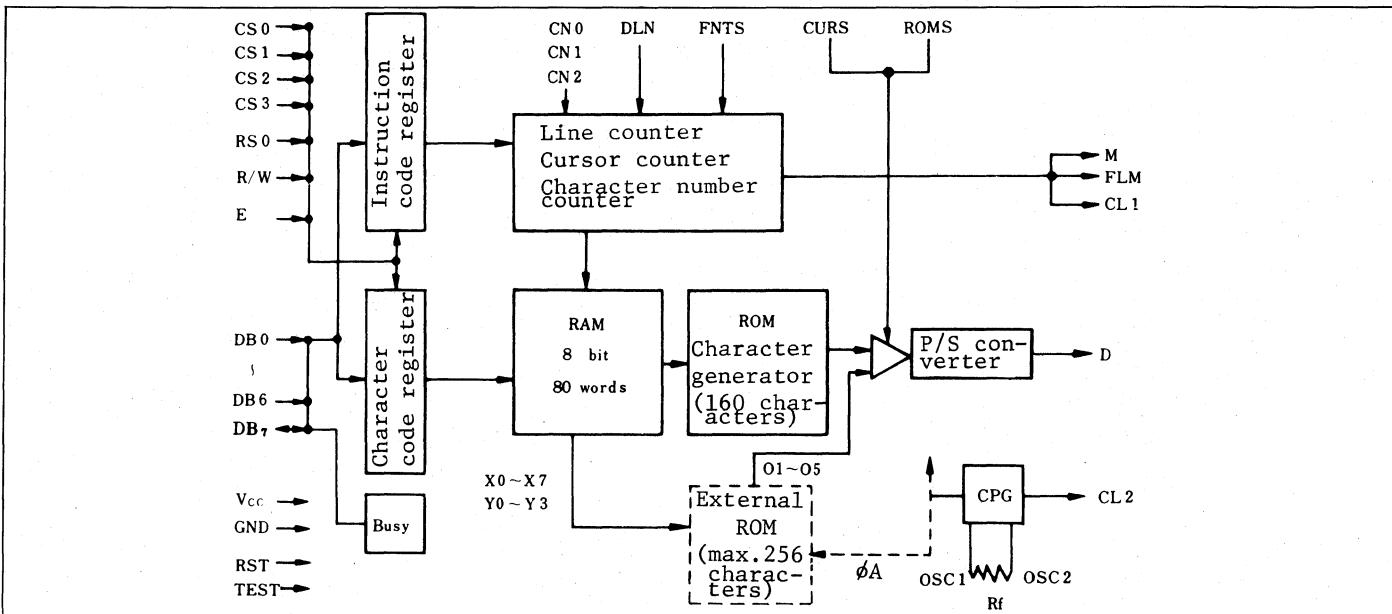
1 dot : ●

The cursor is displayed on the 8th or 12th line.

3. OTHER FUNCTION CONTROLLED BY MICROCOMPUTER

- Display clear
- Cursor ON/OFF
- Cursor position preset (Character position)
- Cursor return

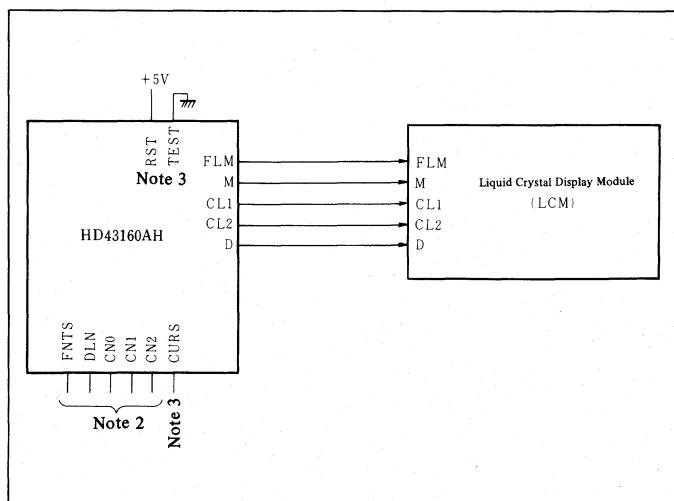
4. BLOCK DIAGRAM



5. The HD43160A is a CMOS LSI developed to control the LCD module described below, and contains a character generator and character data memory.

Applied type: H2532A, H2535, H2538A, H2539, H2555, and H2568.

Example of a connection between HD43160AH and LCD module.



Note 1: When CURS = "1", the cursor has a 5 x 1 dot constitution. (■■■■■)
When CURS = "0", the cursor has a 1 x 1 dot constitution. (□□□□)

Note 2: Treatment examples for all types are shown in the table below.

0: GND
1: V_{DD} (+5V)

| Type No. | Terminal | FNTS | DLN | CN0 | CN1 | CN2 |
|----------|----------|------|-----|-----|-----|-----|
| H2532A | | 0 | 0 | 0 | 1 | 0 |
| H2535 | | 0 | 1 | 0 | 0 | 1 |
| H2538A | | 0 | 0 | 1 | 0 | 1 |
| H2539 | | 0 | 1 | 1 | 1 | 1 |

Note 3: The test terminal is fixed at the "0" level.
The RST terminal is normally at the "1" level.
When set at the "0" level, oscillation is stopped and DC voltage is loaded to the liquid crystal.

H2532A

- 16 Character x 1 line
- Control LSI HD43160AH attachment type (see page 11)

MECHANICAL DATA (nominal dimensions)

| | |
|-------------------------------------|--------------------------|
| Module size | 84W x 44H x 15D (max) mm |
| Effective display area | 61W x 15.8H mm |
| Character size (5x7 dots) | 2.9W x 5.5H mm |
| Pitch | 3.6 mm |
| Dot size | 0.5W x 0.7H mm |
| Weight | about 40 g |

ABSOLUTE MAXIMUM RATINGS

| | |
|--|----------------------------------|
| Supply voltage ($V_{DD} - V_{SS}$) | 7 V max. |
| ($V_{DD} - V_{EE}$) | 13.5 V max. |
| Input voltage (CL1, CL2, D, M, FLM) . . . | $V_{SS} \leq V_{IN} \leq V_{DD}$ |
| Operating temperature (Ta) | 0 to 50°C |
| Storage temperature (Tstg) | -20 to 60°C |

ELECTRICAL CHARACTERISTICS

| | |
|---|---------------------|
| Power supplies ($V_{DD} - V_{SS}$) | +5 ± 0.25V |
| Power supplies ($V_{EE} - V_{SS}$) | -5 ± 0.5 V |
| Current consumption +5V | 1 mA max. |
| -5V | 1 mA max. |
| Input high voltage | 0.7 V_{DD} V min. |
| Input low voltage | 0.3 V_{DD} V max. |
| Power supply for LCD drive (Recommended) ($V_O - V_{EE}$) | |
| at Ta = 0°C | 5.3 V typ. |
| at Ta = 25°C | 4.5 V typ. |
| at Ta = 50°C | 3.7 V typ. |

OPTICAL DATA. See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------|-------|---|
| 1 | FLM | H | The FLM signal indicates the beginning of each display cycle. |
| 2 | M | H/L | Control signal for a.c. driving. |
| 3 | CL1 | H→L | The CL1 latches the serial data in the shift registers. |
| 4 | D | H/L | Serial row data of each character. |
| 5 | CL2 | H→L | Clock signal for shifting the serial data. |
| 6 | V_{DD} | — | Power supply for logic circuit. |
| 7 | V_{SS} | — | Ground. |
| 8 | V_{EE} | — | Power supply for LC driving. |
| 9 | V_O | — | Operating voltage for LC driving. |
| 10 | NC | — | No connection. |

Connector: Module side IL-10P-S3FP2-1
Control side IL-10S-S3L-(N) (Housing)
IL-C2-1-5000 (Socket contact)
Made by JAE (Japan)

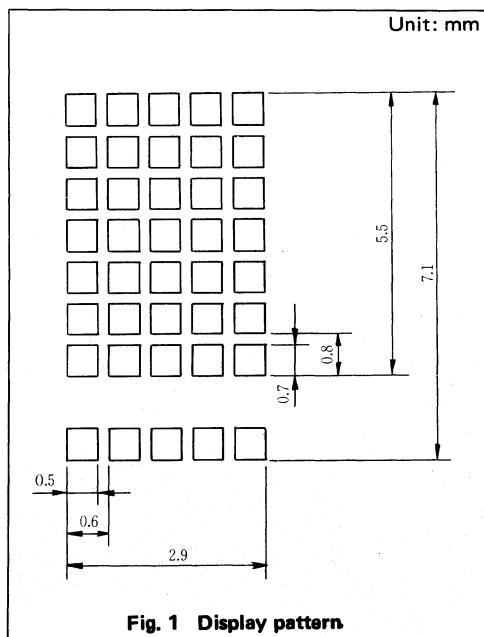


Fig. 1 Display pattern

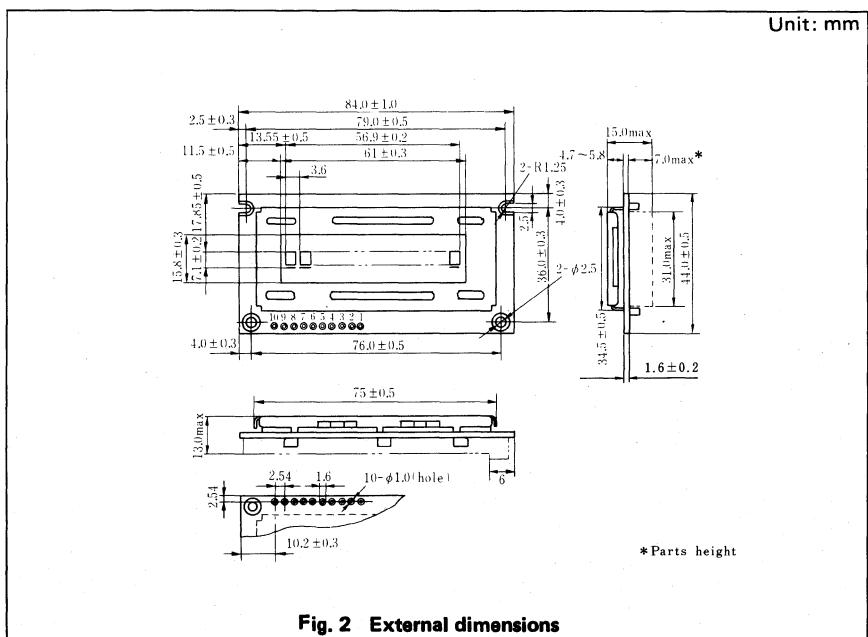


Fig. 2 External dimensions

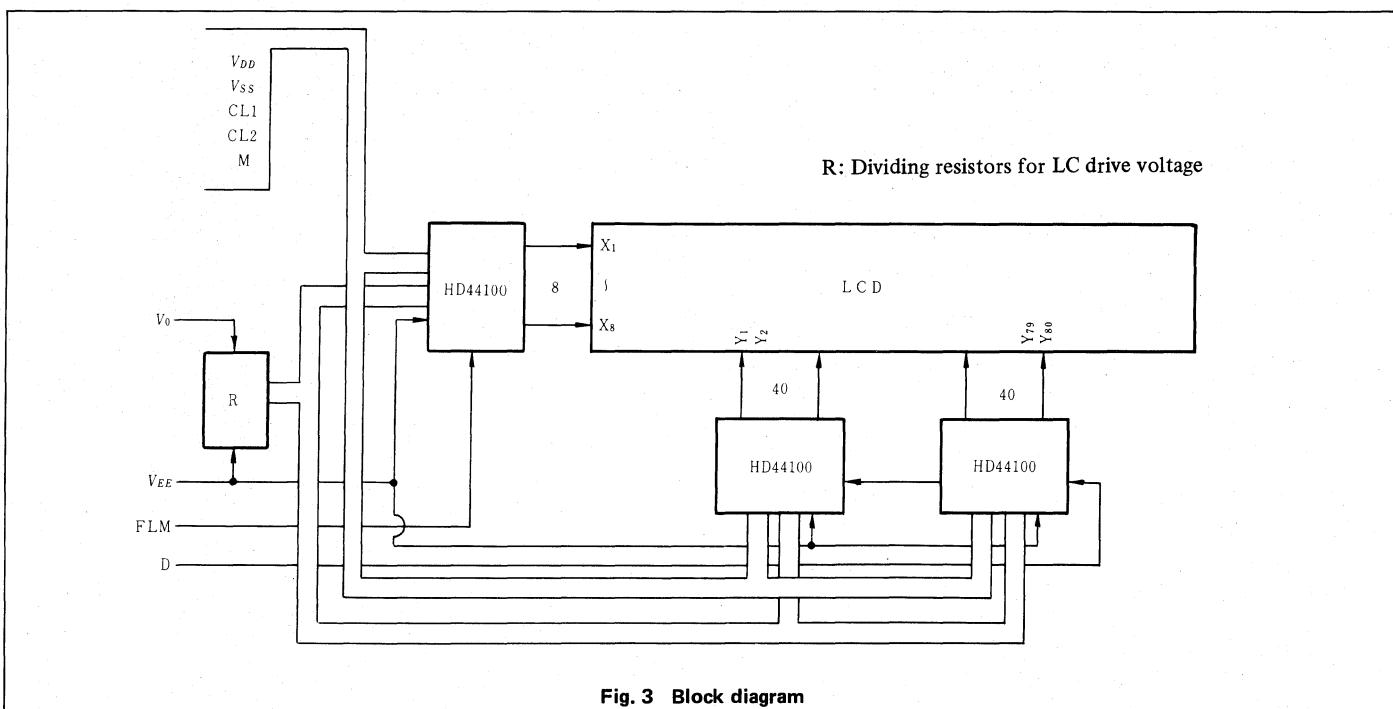


Fig. 3 Block diagram

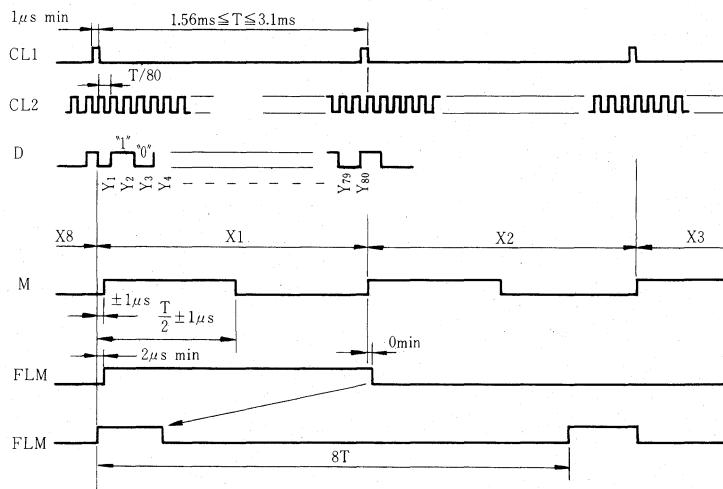


Fig. 4 Timing chart

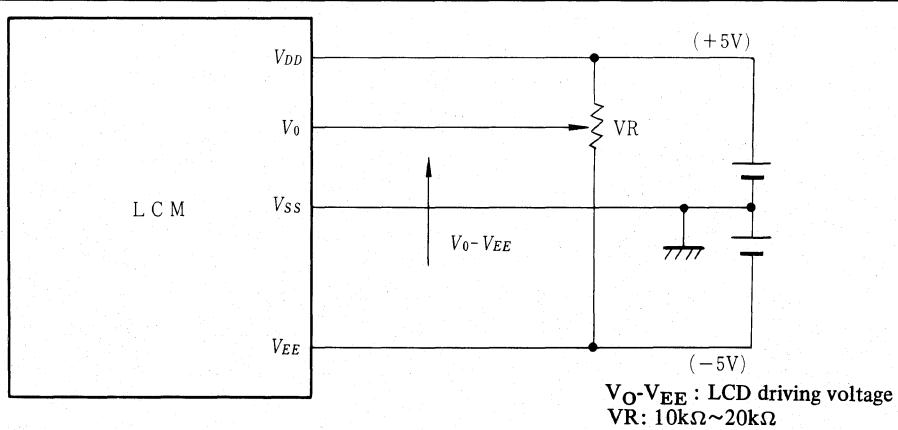


Fig. 5 Power supply

H2535

- 16 Character x 2 lines
- Control LSI HD43160AH attachment type (see page 11)

MECHANICAL DATA (Nominal dimensions)

Module size 84W x 44H x 15D (max) mm
 Effective display area 61W x 15.8H mm
 Character size (5 x 7 dots) 2.9W x 4.1H mm
 Pitch 3.6 mm
 Dot size 0.5W x 0.5H mm
 Weight about 40 g

ABSOLUTE MAXIMUM RATINGS

Supply voltage ($V_{DD}-V_{SS}$) 7 V max.
 $(V_{DD}-V_{EE})$ 13.5 V max.
 Input voltage (CL1, CL2, D, M, FLM) $V_{SS} \leq V_{IN} \leq V_{DD}$
 Operating temperature (T_a) 0 to 50°C
 Storage temperature (T_{stg}) -20 to 60°C

ELECTRICAL CHARACTERISTICS

Power supplies ($V_{DD}-V_{SS}$) $+5 \pm 0.25$ V
 $(V_{EE}-V_{SS})$ -5 ± 0.5 V
 Current consumption +5V 1 mA max.
 -5V 1 mA max.
 Input high voltage 0.7 V_{DD} V min.
 Input low voltage 0.3 V_{DD} V max.
 Power supply for LCD drive (Recommended) (V_O-V_{EE})
 at $T_a = 0^\circ\text{C}$ 6.7 V typ.
 at $T_a = 25^\circ\text{C}$ 5.7 V typ.
 at $T_a = 50^\circ\text{C}$ 4.7 V typ.

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------|-------|---|
| 1 | FLM | H | The FLM signal indicates the beginning of each display cycle. |
| 2 | M | H/L | Control signal for a.c. driving. |
| 3 | CL1 | H→L | The CL1 latches the serial data in the shift registers. |
| 4 | D | H/L | Serial row data of each character. |
| 5 | CL2 | H→L | Clock signal for shifting the serial data. |
| 6 | V_{DD} | — | Power supply for logic circuit. |
| 7 | V_{SS} | — | Ground. |
| 8 | V_{EE} | — | Power supply for LC driving. |
| 9 | V_O | — | Operating voltage for LC driving. |
| 10 | NC | — | No connection. |

Connector: Module side IL-10P-S3FP2-1
 Control side IL-10S-S3L-(N) (Housing)
 IL-C2-1-5000 (Socket contact)
 Made by JAE (Japan)

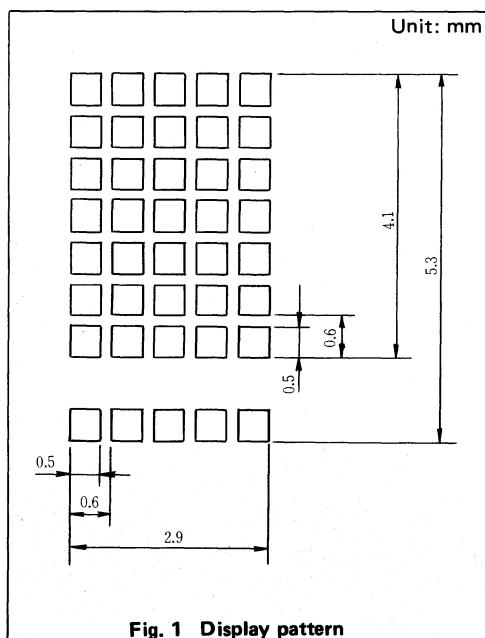


Fig. 1 Display pattern

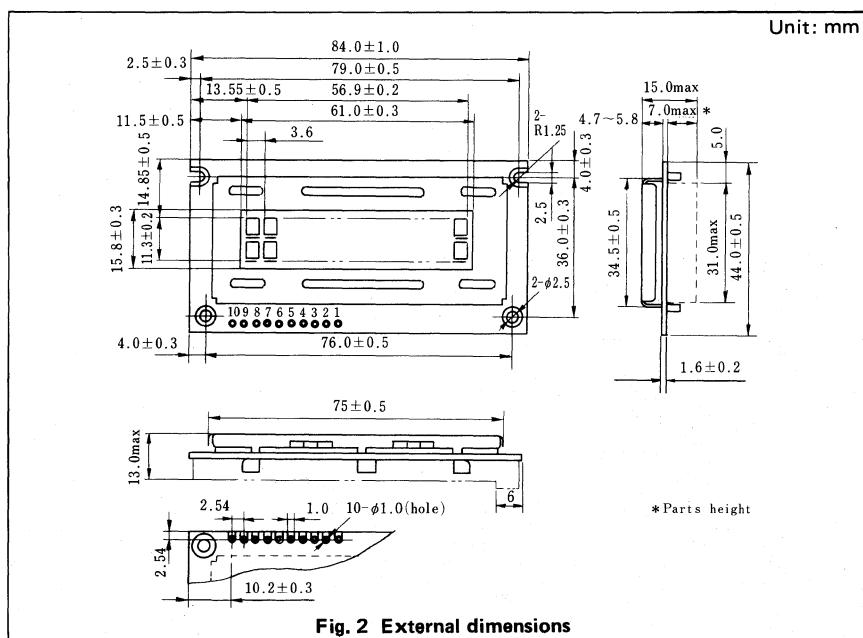


Fig. 2 External dimensions

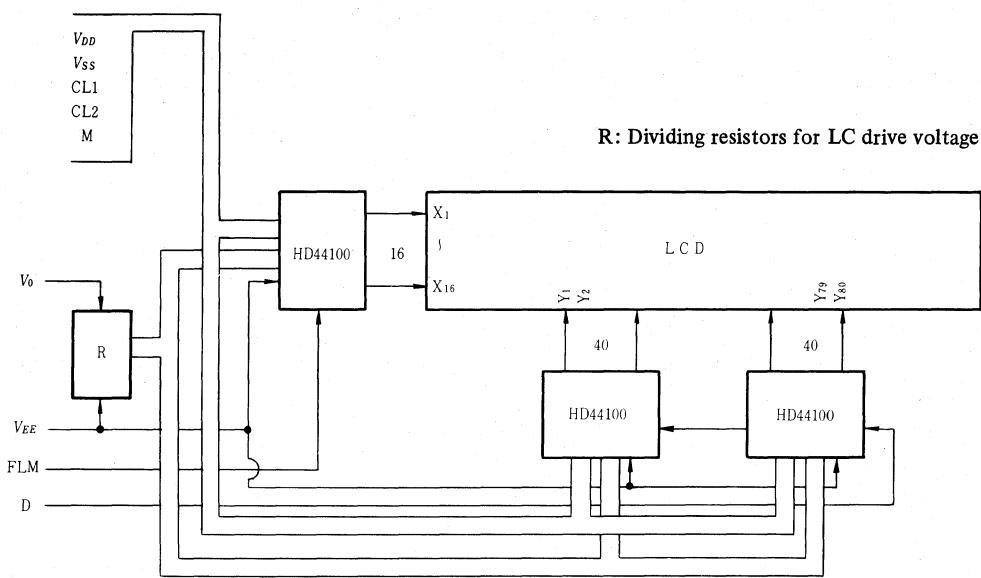


Fig. 3 Block diagram

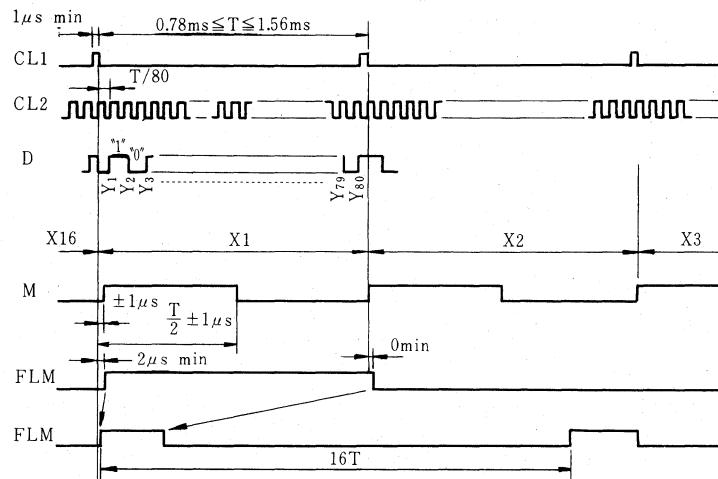
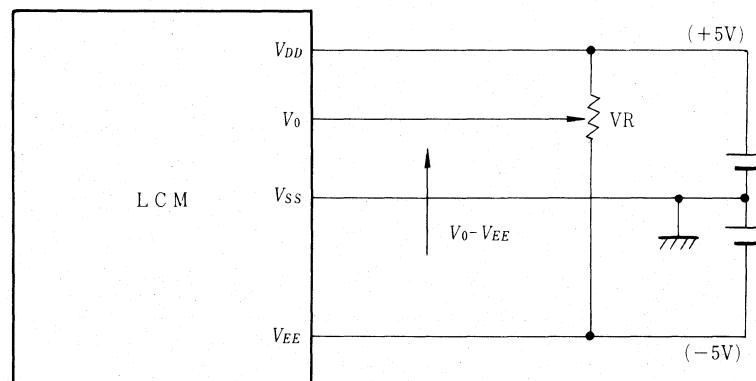


Fig. 4 Timing chart



$V_O - V_{EE}$: LCD driving voltage
VR: $10k\Omega \sim 20k\Omega$

Fig. 5 Power supply

H2538A

- 40 Character x 1 line
- Control LSI HD43160AH attachment type (see page 11)

MECHANICAL DATA (Nominal dimensions)

Module size 220W x 50H x 15D (max) mm
 Effective display area 163W x 17H mm
 Character size (5 x 7 dots) 3.15W x 5.5H mm
 Pitch 3.9 mm
 Dot size 0.55W x 0.7H mm
 Weight about 100 g

ABSOLUTE MAXIMUM RATINGS

Supply voltage ($V_{DD} - V_{SS}$) 7 V max.
 ($V_{DD} - V_{EE}$) 13.5 V max.
 Input voltage (CL1, CL2, D, M, FLM) $V_{SS} \leq V_{IN} \leq V_{DD}$
 Operating temperature (T_a) 0 to 50°C
 Storage temperature (T_{stg}) -20 to 60°C

ELECTRICAL CHARACTERISTICS

Power supplies ($V_{DD} - V_{SS}$) $+5 \pm 0.25$ V
 ($V_{EE} - V_{SS}$) -5 ± 0.5 V
 Current consumption +5V 1 mA max.
 -5V 1 mA max.
 Input high voltage 0.7 V_{DD} V min.
 Input low voltage 0.3 V_{DD} V max.
 Power supply for LCD drive (Recommended) ($V_O - V_{EE}$)
 at $T_a = 0^\circ C$ 5.3 V typ.
 at $T_a = 25^\circ C$ 4.5 V typ.
 at $T_a = 50^\circ C$ 3.7 V typ.

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------|-------|---|
| 1 | FLM | H | The FLM signal indicates the beginning of each display cycle. |
| 2 | M | H/L | Control signal for a.c. driving. |
| 3 | CL1 | H→L | The CL1 latches the serial data in the shift registers. |
| 4 | D | H/L | Serial row data of each character. |
| 5 | CL2 | H→L | Clock signal for shifting the serial data. |
| 6 | V_{DD} | — | Power supply for logic circuit. |
| 7 | V_{SS} | — | Ground. |
| 8 | V_{EE} | — | Power supply for LC driving. |
| 9 | V_O | — | Operating voltage for LC driving. |
| 10 | NC | — | No connection. |

Connector: Module side IL-10P-S3FP2-1
 Control side IL-10S-S3L-(N) (Housing)
 IL-C2-1-5000 (Socket contact)
 Made by JAE (Japan)

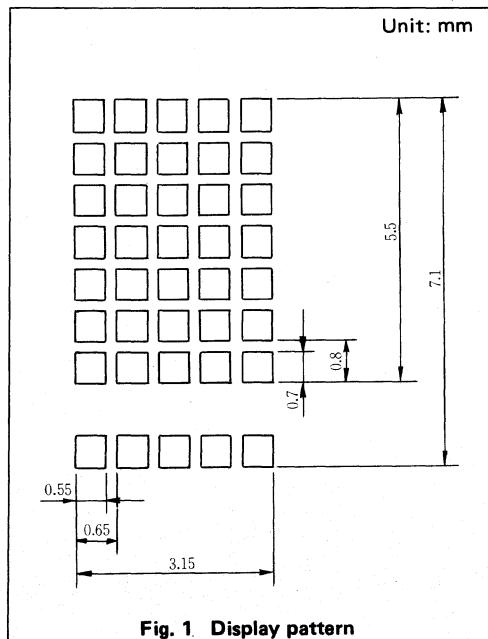


Fig. 1 Display pattern

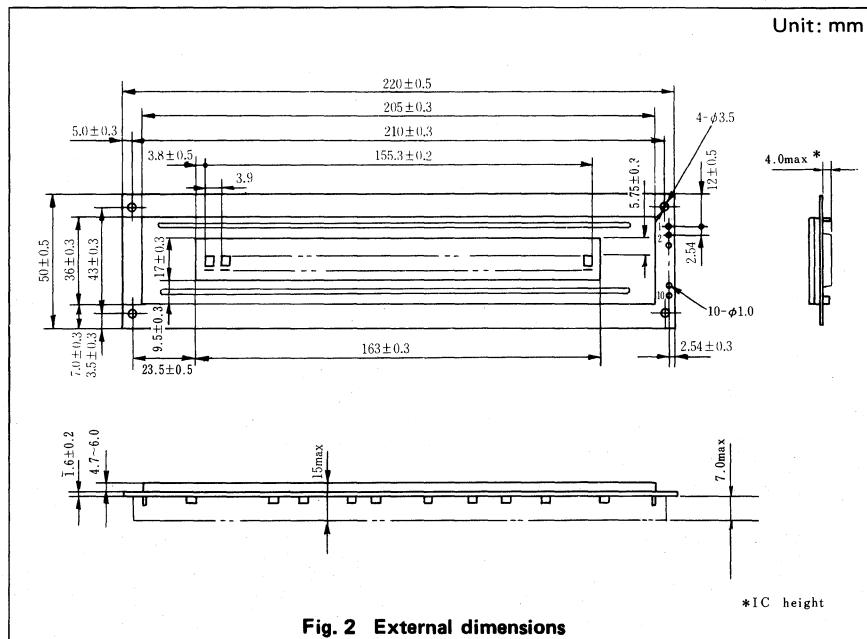


Fig. 2 External dimensions

R: Dividing resistors for LC drive voltage

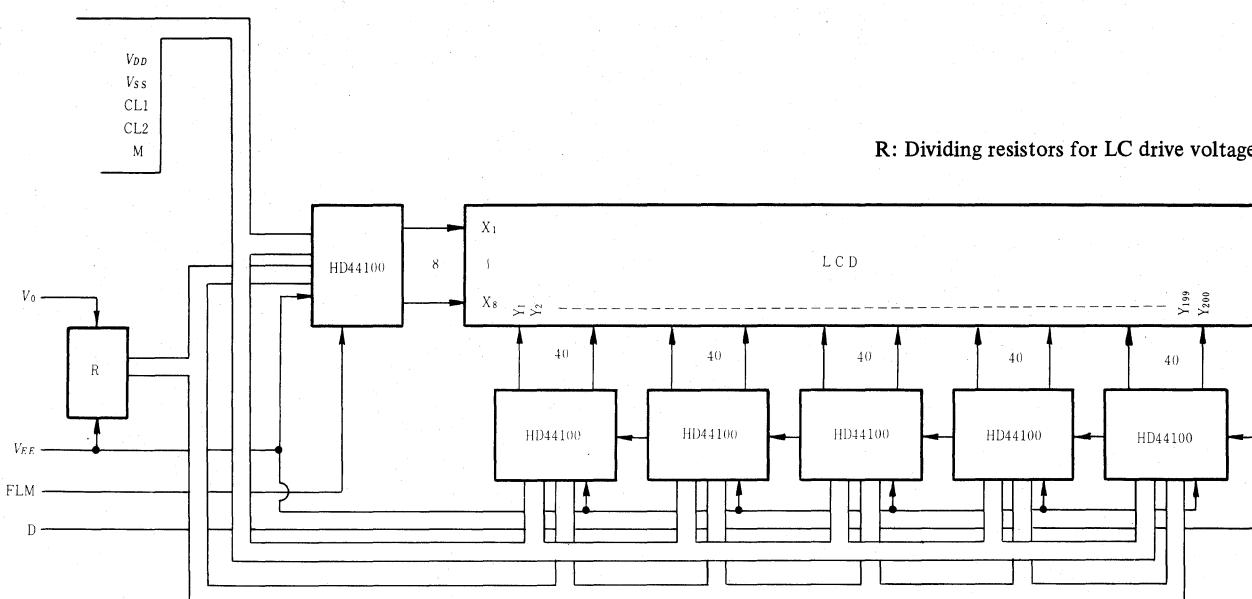


Fig. 3 Block diagram

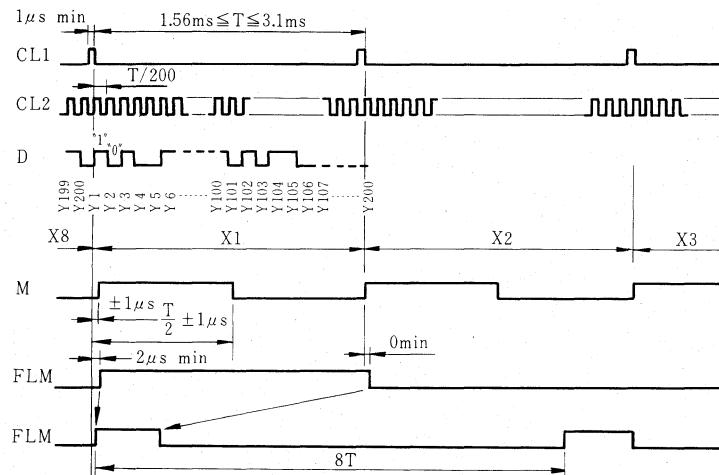
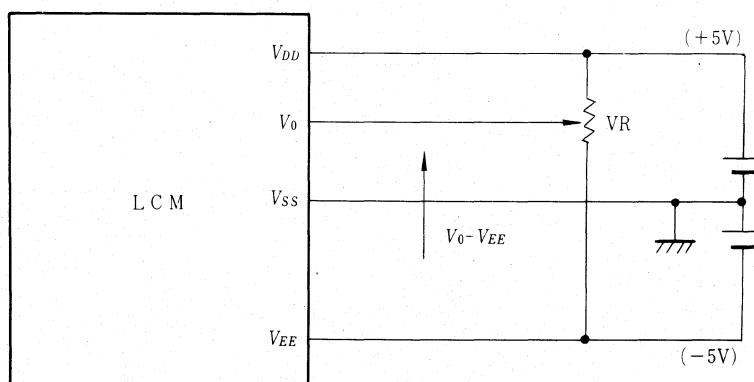


Fig. 4 Timing chart



$V_0 - V_{EE}$: LCD driving voltage
VR: $10k\Omega \sim 20k\Omega$

Fig. 5 Power supply

H2539

- 40 Character x 2 lines
- Control LSI HD43160AH attachment type (see page 11)

MECHANICAL DATA (Nominal dimensions)

Module size 220W x 50H x 15D (max) mm
 Effective display area 163W x 17H mm
 Character size (5 x 7 dots) 3.15W x 4.45H mm
 Pitch 3.9 mm
 Dot size 0.55W x 0.55H mm
 Weight about 100 g

ABSOLUTE MAXIMUM RATINGS

Supply voltage ($V_{DD} - V_{SS}$) 7 V max.
 ($V_{DD} - V_{EE}$) 13.5 V max.
 Input voltage (CL1, CL2, D, M, FLM) $V_{SS} \leq V_{IN} \leq V_{DD}$
 Operating temperature (Ta) 0 to 50°C
 Storage temperature (Tstg) -20 to 60°C

ELECTRICAL CHARACTERISTICS

Power supplies ($V_{DD} - V_{SS}$) $+5 \pm 0.25$ V
 ($V_{EE} - V_{SS}$) -5 ± 0.5 V
 Current consumption +5V 1 mA max.
 -5V 1 mA max.
 Input high voltage 0.7 V_{DD} V min.
 Input low voltage 0.3 V_{DD} V max.
 Power supply for LCD drive (Recommended) ($V_O - V_{EE}$)
 at Ta = 0°C 6.7 V typ.
 at Ta = 25°C 5.7 V typ.
 at Ta = 50°C 4.7 V typ.

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------|-------|---|
| 1 | FLM | H | The FLM signal indicates the beginning of each display cycle. |
| 2 | M | H/L | Control signal for a.c. driving. |
| 3 | CL1 | H→L | The CL1 latches the serial data in the shift registers. |
| 4 | D | H/L | Serial row data of each character. |
| 5 | CL2 | H→L | Clock signal for shifting the serial data. |
| 6 | V_{DD} | — | Power supply for logic circuit. |
| 7 | V_{SS} | — | Ground. |
| 8 | V_{EE} | — | Power supply for LC driving. |
| 9 | V_O | — | Operating voltage for LC driving. |
| 10 | NC | — | No connection |

Connector: Module side IL-10P-S3FP2-1
 Control side IL-10S-S3L-(N) (Housing)
 IL-C2-1-5000 (Socket contact)
 Made by JAE (Japan)

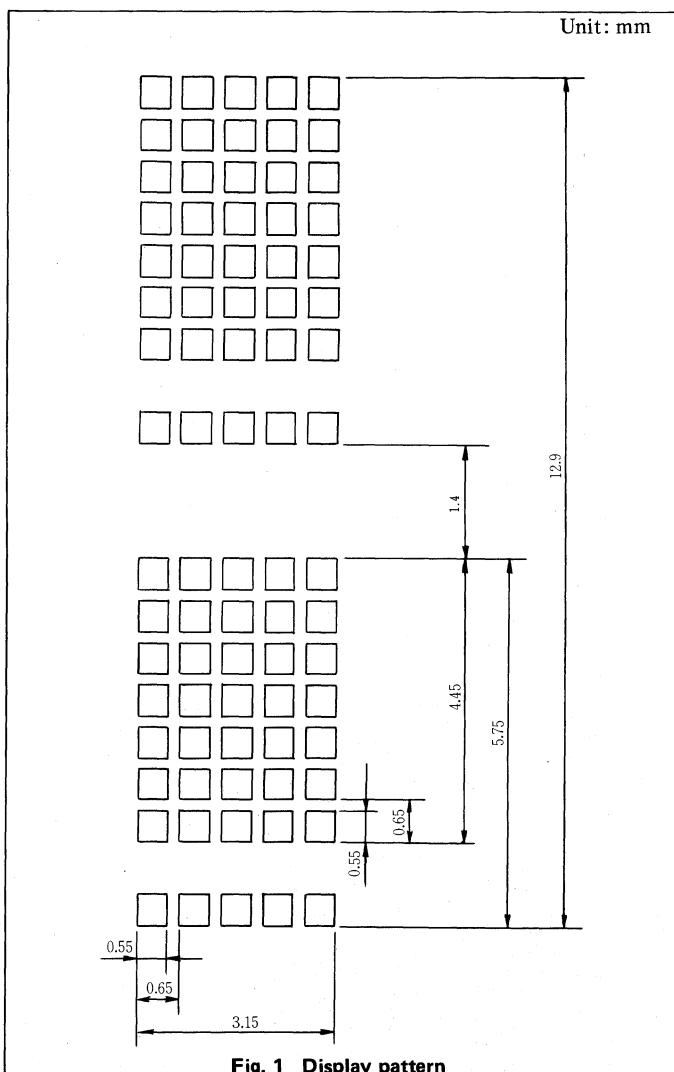
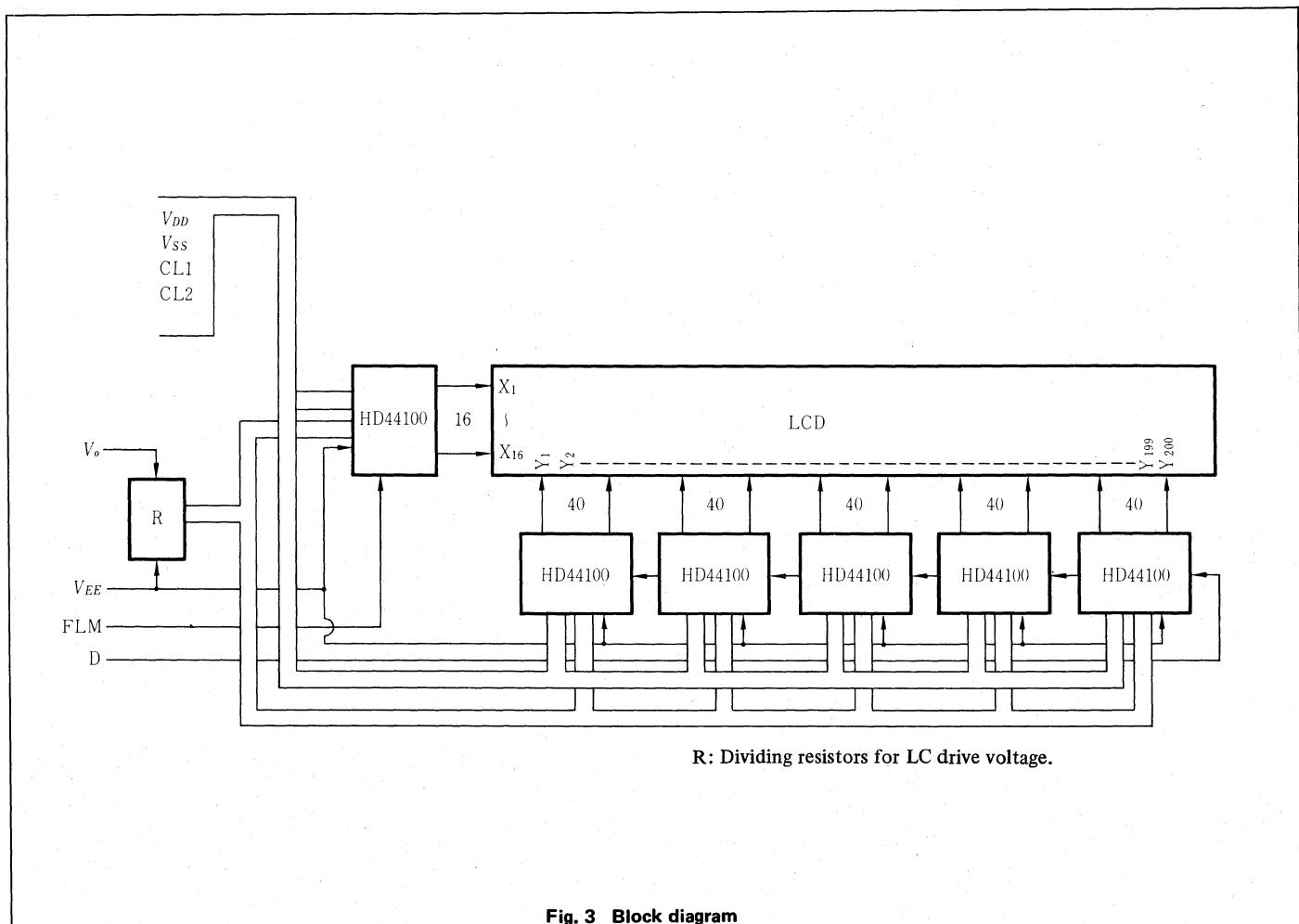
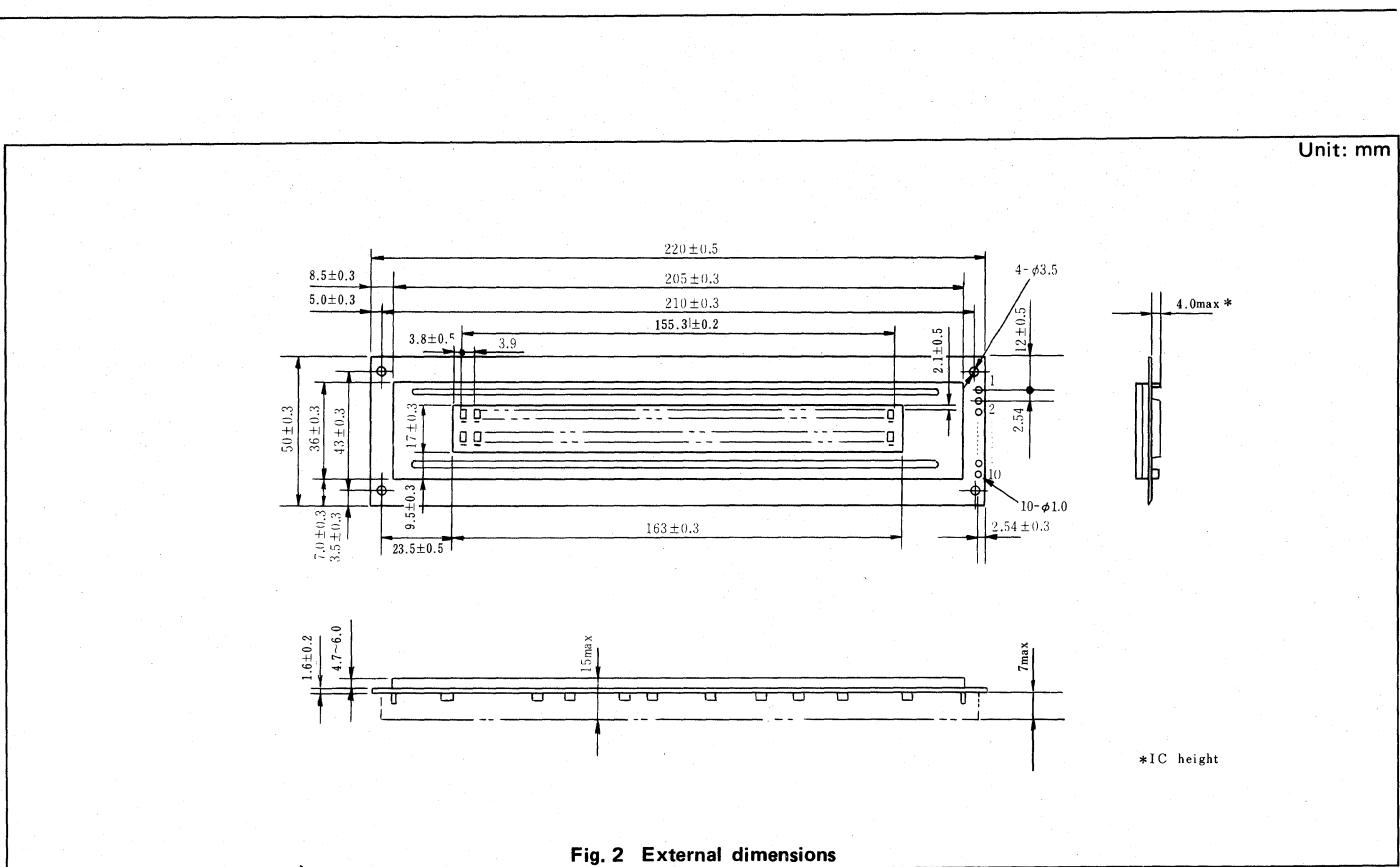


Fig. 1 Display pattern



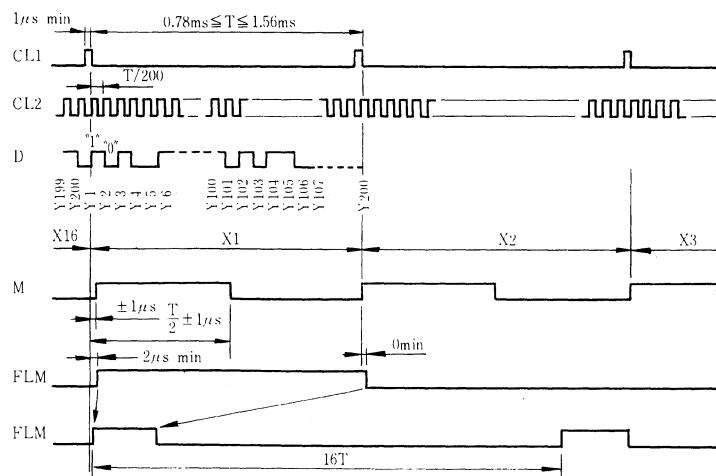


Fig. 4 Timing chart

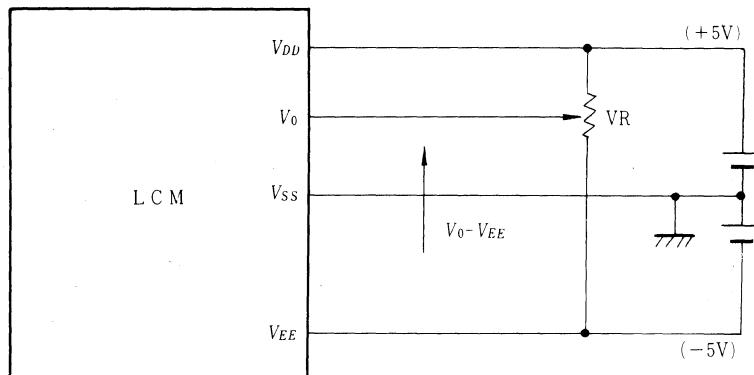


Fig. 5 Power supply

BUILT-IN CONTROL LSI TYPE LCD MODULE

This is a dot matrix LCD module containing the control LSI HD44780 (LCD-II) for character display. Functions such as control, refresh, and display are operated by the built-in control LSI, HD44780 (LCD-II).

This LCD module can display 160 type JIS characters and symbols and 32 type special characters and symbols. This LCD module can be interfaced to the 4-bit or 8-bit MPU, so the character display and the display shift can be easily operated by using control commands. This LCD module also contains the character generator RAM, hence user's patterns can be displayed.

Control LSI HD44780 (LCD-II)

| | |
|----------------------|-----------------------|
| LM054 (8 x 1 line) | LM052L (16 x 2 lines) |
| H2570 (16 x 1 line) | LM016L (16 x 2 lines) |
| LM015 (16 x 1 line) | LM032L (20 x 2 lines) |
| LM020L (16 x 1 line) | LM017L (32 x 2 lines) |
| LM038 (20 x 1 line) | LM018L (40 x 2 lines) |
| LM027 (24 x 1 line) | LM041L (16 x 4 lines) |
| H2571 (32 x 1 line) | LM044L (20 x 4 lines) |
| H2572 (40 x 1 line) | |

CONTROL LSI HD44780 (LCD-II)

- 5 x 7 and 5 x 10 dot LCD module controller driver
- Applicable type: LM054 · H2570 · LM015 · LM020L · LM038 · LM027 · H2571 · H2572 · LM052L · LM016L · LM032L · LM017L · LM018L · LM041L · LM044L

The HD44780 (LCD-II) is a dot matrix liquid crystal display controller & driver LSI that displays alphanumerics, kana characters and symbols. It drives dot matrix liquid crystal display under 4-bit or 8-bit microcomputer or microprocessor control. All the functions required for dot matrix liquid crystal display drive are internally provided on one chip. The user can complete dot matrix liquid crystal display system with less number of chips by using the HD44780. If a driver LSI HD44100H is externally connected to the HD44780, up to 80 characters can be displayed.

The HD44780 is produced in the CMOS process. Therefore, the combination of the HD44780 with a CMOS microcomputer or microprocessor can accomplish a portable battery-drive device with lower power dissipation.

■ FEATURES

- 5 x 7 and 5 x 10 dot matrix liquid crystal display controller driver
- Capable of interfacing to 4-bit or 8-bit MPU.
- Display data RAM . . . 80 x 8 bits (80 characters, max.)
- Character generator ROM
 - Character font 5 x 7 dots: 160 characters
 - Character font 5 x 10 dots: 32 characters

CORRESPONDENCE BETWEEN CHARACTER CODES AND CHARACTER PATTERN

2.1 FONT TABLE

(1) 5 x 10 dot, applied type: H2570, H2571, H2572, LM027

| Higher Lower 4bit 4bit | 0000 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 |
|---------------------------------|------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| xxxx0000 | CG RAM (1) | 0 | 3 | P | P | . | P | — | 9 | 3 | 0 | p | |
| xxxx0001 | (2) | 1 | 1 | A | Q | a | q | 3 | f | 6 | ä | g | |
| xxxx0010 | (3) | 2 | 2 | B | R | b | r | f | 4 | y | x | p | e |
| xxxx0011 | (4) | 3 | 3 | C | S | c | s | o | f | E | c | e | |
| xxxx0100 | (5) | 4 | 4 | D | T | d | t | 、 | I | ト | ト | μ | 2 |
| xxxx0101 | (6) | 5 | 5 | E | U | e | u | ・ | † | † | 1 | is | 0 |
| xxxx0110 | (7) | 6 | 6 | F | U | f | v | † | か | こ | さ | p | z |
| xxxx0111 | (8) | 7 | 7 | G | W | g | w | † | ‡ | ‡ | ‡ | g | π |
| xxxx1000 | (1) | 8 | H | X | h | x | 4 | o | ‡ | Y | ‡ | X | |
| xxxx1001 | (2) | 9 | I | Y | i | y | 8 | † | J | † | J | Y | |
| xxxx1010 | (3) | * | * | J | Z | j | z | ‡ | o | o | o | j | ‡ |
| xxxx1011 | (4) | + | + | K | C | k | c | † | † | b | 0 | + | § |
| xxxx1100 | (5) | , | < | L | Y | l | y | † | † | † | † | † | ¶ |
| xxxx1101 | (6) | — | — | M | J | m | j | ‡ | ‡ | ‡ | ‡ | ‡ | ‡ |
| xxxx1110 | (7) | — | — | N | n | — | n | † | † | † | † | † | ñ |
| xxxx1111 | (8) | ✓ | ✓ | O | o | — | o | † | † | † | † | † | ö |

Note: CGRAM is a CHARACTER GENERATOR RAM having a storage function of character pattern which enable to change freely by users program.

(2) 5 x 7 dot, applied type: LM054, H2570, LM015, LM020L, LM038, LM027, H2571, H2572, LM052L, LM016L, LM032L, LM017L, LM018L, LM041L, LM044L

| Higher Lower 4bit 4bit | 0000 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 |
|------------------------------|------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| xxxxx0000 | CG RAM (1) | | | Q | Q | P | ^ | P | - | g | E | o | p |
| xxxxx0001 | (2) | | | ! 1 | A | Q | a | q | a | P | g | 4 | g |
| xxxxx0010 | (3) | | | " 2 | B | R | b | r | " | Y | x | e | 8 |
| xxxxx0011 | (4) | | | # 3 | C | S | c | s | u | o | t | e | o |
| xxxxx0100 | (5) | | | \$ 4 | D | T | d | t | . | I | f | u | 2 |
| xxxxx0101 | (6) | | | % 5 | E | U | e | u | . | o | t | 1 | 0 |
| xxxxx0110 | (7) | | | 8 6 | F | U | f | u | g | o | z | 3 | o |
| xxxxx0111 | (8) | | | ' 7 | G | W | g | w | ? | x | 2 | q | π |
| xxxxx1000 | (1) | | | (8 | H | X | h | x |) | o | z | u | j |
| xxxxx1001 | (2) | | |) 9 | I | Y | i | y | o | T | J | u | q |
| xxxxx1010 | (3) | | | * 8 | J | Z | j | z | o | N | v | i | + |
| xxxxx1011 | (4) | | | + 8 | K | C | k | { | * | Y | E | 0 | 5 |
| xxxxx1100 | (5) | | | 8 < | L | Y | l | l | o | o | o | o | 8 |
| xxxxx1101 | (6) | | | --- | M | M | m | m | z | z | z | z | + |
| xxxxx1110 | (7) | | | , | > | N | ^ | n | + | a | t | h | ñ |
| xxxxx1111 | (8) | | | / | ? | O | o | o | o | u | u | ? | ö |

Note: CGRAM is a CHARACTER GENERATOR RAM having a storage function of character pattern which enable to change freely by users program.

2.2 INSTRUCTION AND DISPLAY CORRESPONDENCE

(1) 8-bit operation, 8-digit x 1-line display (using internal reset)

Table 2.1 shows an example of 8-bit x 1-line display in 8-bit operation. The HD44780 functions must be set by Function Set prior to display. Since the display data RAM can store data for 80 characters, as explained before, the RAM can be used for displays like the lightening board when combined with display shift operation.

Since the display shift operation changes display position only and DD RAM contents remain unchanged, display data entered first can be output when the return home operation is performed.

(2) 4-bit operation, 8-digit x 1-line display (using internal reset)

The program must set functions prior to 4-bit operation. Table 2.2 shows an example. When power is turned on, 8-bit operation is automatically selected and the first write is performed as an 8-bit operation. Since nothing is connected to $DB_0 \sim DB_3$, a rewrite is then required. However, since one operation is completed in two accesses of 4-bit operation, a rewrite is needed as a function (see Table 8).

Thus, $DB_4 \sim DB_7$ of the function set is written twice.

(3) 8-bit operation, 8-digit x 2-line display

For 2-line display, the cursor automatically moves from the first to the second line after the 40th digit of the 1st line has been written. Thus, if there are only 8 characters in the first line, the DD RAM address must again be set after the 8th character is completed. (See Table 2.3) Note that the first and second lines of the display shift are performed. In the example, the display shift is performed when the cursor is on the second line. However, if shift operation is performed when the cursor is on the first line, both the first and second lines move together. When you repeat the shift, the display of the second line will not move to the first line, the same display will only move within each line many times.

(Note) When using the internal reset, the conditions in "Power Supply Condition Using Internal Reset Circuit" must be satisfied. If not, the HD44780 must be initialized by instruction. (See "Initializing Instruction")

Table 2.1 8-bit Operation, 8-digit 1-line Display Example (Using Internal Reset)

| No. | Instruction | Display | Operation |
|-----|--|-----------------------|--|
| 1 | Power supply ON (HD44780 is initialized by the internal reset circuit) | [] | Initialized. No display appears. |
| 2 | Function Set RS R/W DB ₇ 0 0 0 0 1 1 0 0 * * DB ₀ | [] | Sets to 8-bit operation and selects 1-line display lines and character font. (Number of display lines and character fonts cannot be changed hereafter.) |
| 3 | Display ON/OFF Control 0 0 0 0 0 0 1 1 1 0 | [-] | Turns on display and cursor. Entire display is in space mode because of initialization. |
| 4 | Entry Mode Set 0 0 0 0 0 0 0 1 1 0 | [-] | Sets mode to increment the address by one and to shift the cursor to the right at the time of write to the DD/CG RAM. Display is not shifted. |
| 5 | Write Data to CG RAM/DD RAM 1 0 0 1 0 0 1 0 0 0 | [H -] | Write "H". The DD RAM has already been selected by initialization when the power is turned on. The cursor is incremented by one and shifted to the right. |
| 6 | Write Data to CG RAM/DD RAM 1 0 0 1 0 0 1 0 0 1 | [H I -] | Writes "I". |
| 7 | | [] | |
| 8 | Write Data to CG RAM/DD RAM 1 0 0 1 0 0 1 0 0 1 | [H I T A C H I -] | Writes "I". |
| 9 | Entry Mode Set 0 0 0 0 0 0 0 1 1 1 | [- H I T A C H I -] | Sets mode for display shift at the time of write. |
| 10 | Write Data to CG RAM/DD RAM 1 0 0 0 1 0 0 0 0 0 | [I T A C H I -] | Writes "Space". |
| 11 | Write Data to CG RAM/DD RAM 1 0 0 1 0 0 1 1 0 1 | [T A C H I M -] | Writes "M". |
| 12 | | [] | |
| 13 | Write Data to CG RAM/DD RAM 1 0 0 1 0 0 1 1 1 1 | [M I C R O K O -] | Writes "O". |
| 14 | Cursor or Display Shift 0 0 0 0 0 1 0 0 * * | [M I C R O K O] | Shifts only the cursor position to the left. |
| 15 | Cursor or Display Shift 0 0 0 0 0 1 0 0 * * | [M I C R O K O] | Shifts only the cursor position to the left. |
| 16 | Write Data to CG RAM/DD RAM 1 0 0 1 0 0 0 0 1 1 | [I C R O C O] | Writes "C" (correction). The display moves to the left. |
| 17 | Cursor or Display Shift 0 0 0 0 0 1 1 1 * * | [M I C R O C O] | Shifts the display and cursor position to the right. |
| 18 | Cursor or Display Shift 0 0 0 0 0 1 0 1 * * | [M I C R O C O] | Shifts display and cursor position to the right. |
| 19 | Write Data to CG RAM/DD RAM 1 0 0 1 0 0 1 1 0 1 | [I C R O C O M -] | Writes "M". |
| 20 | | [] | |
| 21 | Return Home 0 0 0 0 0 0 0 1 0 | [H I T A C H I] | Returns both display and cursor to the original position (Address 0). |

Table 2.2 4-bit Operation, 8-digit 1-line Display Example (Using Internal Reset)

| No. | Instruction | Display | Operation |
|-----|--|---------|---|
| 1 | Power supply ON (HD44780 is initialized by the internal reset circuit) | [] | Initialized. No display appears. |
| 2 | Function Set RS R/W DB ₇ DB ₄ 0 0 0 0 1 0 | [] | Sets to 4-bit operation. In this case, operation is handled as 8 bits by initialization, and only this instruction completes with one write. |
| 3 | Function Set 0 0 0 0 1 0 0 0 0 0 * * | [] | Sets 4-bit operation and selects 1-line display and 5 × 7 dot character font. 4-bit operation starts from this point on and resetting is needed. (Number of display lines and character fonts cannot be changed hereafter.) |
| 4 | Display ON/OFF Control 0 0 0 0 0 0 0 0 1 1 1 0 | [—] | Turns on display and cursor. Entire display is in space mode because of initialization. |
| 5 | Entry Mode Set 0 0 0 0 0 0 0 0 0 1 1 0 | [—] | Sets mode to increment the address by one and to shift the cursor to the right, at the time of write, to the DD/CG RAM. Display is not shifted. |
| 6 | Write Data to CG RAM/DD RAM 1 0 0 1 0 0 1 0 1 0 0 0 | [H —] | Writes "H". The cursor is incremented by one and shifts to the right. |

Hereafter, control is the same as 8-bit operation.

Table 2.3 8-bit Operation, 8-digit x 2 line Display Example (Using Internal Reset)

| No. | Instruction | Display | Operation |
|-----|---|---------|--|
| 1 | Power supply ON (HD44780 is initialized by the internal reset circuit) | | Initialized. No display appears. |
| 2 | Function Set RS R/W DB ₇ DB ₀ 0 0 0 0 1 1 0 * * | | Sets to 8-bit operation and selects 2-line display and 5 x 7 dot character font. |
| 3 | Display ON/OFF Control 0 0 0 0 0 0 1 1 1 0 | | Turns on display and cursor. All display is in space mode because of initialization. |
| 4 | Entry Mode Set 0 0 0 0 0 0 1 1 0 | | Sets mode to increment the address by one and to shift the cursor to the right, at the time of write, to the DD/CG RAM. Display is not shifted. |
| 5 | Write Data to CG RAM/DD RAM 1 0 0 1 0 0 1 0 0 0 | | Write "H". The DD RAM has already been selected by initialization when the power is turned on. The cursor is incremented by one and shifted to the right. |
| 6 | | | |
| 7 | Write Data to CG RAM/DD RAM 1 0 0 1 0 0 1 0 0 1 | | Writes "I". |
| 8 | Set DD RAM Address 0 0 1 1 0 0 0 0 0 0 | | Sets RAM address so that the cursor is positioned at the head of the 2nd line. |
| 9 | Write Data to CG RAM/DD RAM 1 0 0 1 0 0 1 1 0 1 | | Writes "M". |
| 10 | | | |
| 11 | Write Data to CG RAM/DD RAM 1 0 0 1 0 0 1 1 1 1 | | Writes "O". |
| 12 | Entry Mode Set 0 0 0 0 0 0 0 1 1 1 | | Sets mode for display shift at the time of write. |
| 13 | Write Data to CG RAM/DD RAM 1 0 0 1 0 0 1 1 0 1 | | Writes "M". Display is shifted to the right. The first and second lines' shift are operated at the same time. |
| 14 | | | |
| 15 | Return Home 0 0 0 0 0 0 0 0 1 0 | | Returns both display and cursor to the original position (Address 0). |

2.3 INSTRUCTION

| Instruction | Code | | | | | | | | | | | Description | Execution time (when fosc is 250 kHz) Note 1 | Execution time (when fosc is 160 kHz) Note 2 |
|----------------------------|---|-----|------------|-----|-----|-----|-----|-----|-----|-----|--|--|--|---|
| | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | | | |
| Clear display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | Clears all display and returns the cursor to the home position (Address 0). | 82 μ s ~ 1.64 ms | 120 μ s ~ 4.9 ms |
| Return home | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | * | | Returns the cursor to the home position (Address 0). Also returns the display being shifted to the original position. DD RAM contents remain unchanged. | 40 μ s ~ 1.6 ms | 120 μ s ~ 4.8 ms |
| Entry mode set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/D | S | | Sets the cursor move direction and specifies or not to shift the display. These operations are performed during data write and read. | 40 μ s | 120 μ s |
| Display ON/OFF control | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | B | | Sets ON/OFF of all display (D), cursor ON/OFF (C), and blink of cursor position character (B). | 40 μ s | 120 μ s |
| Cursor and display shift | 0 | 0 | 0 | 0 | 0 | 1 | S/C | R/L | * | * | | Moves the cursor and shifts the display without changing DD RAM contents | 40 μ s | 120 μ s |
| Function set | 0 | 0 | 0 | 0 | 1 | DL | N | F | * | * | | Sets interface data length (DL) number of display lines (L) and character font (F). | 40 μ s | 120 μ s |
| Set CG RAM address. | 0 | 0 | 0 | 1 | ACG | | | | | | | Sets the CG RAM address. CG RAM data is sent and received after this setting. | 40 μ s | 120 μ s |
| Set DD RAM address | 0 | 0 | 1 | ADD | | | | | | | | Sets the DD RAM address. DD RAM data is sent and received after this setting. | 40 μ s | 120 μ s |
| Read busy flag & address | 0 | 1 | BF | AC | | | | | | | | Reads Busy flag (BF) indicating internal operation is being performed and reads address counter contents. | 1 μ s | 1 μ s |
| Write data to CG or DD RAM | 1 | 0 | Write Data | | | | | | | | | Writes data into DD RAM or CG RAM. | 40 μ s | 120 μ s |
| Read data to CG or DD RAM | 1 | 1 | Read Data | | | | | | | | | Reads data from DD RAM or CG RAM. | 40 μ s | 120 μ s |
| | I/D = 1: Increment (+1) I/D = 0: Decrement (-1) S = 1: Accompanies display shift. S/C = 1: Display shift. S/C = 0: Cursor move R/L = 1: Shift to the right. R/L = 0: Shift to the left. DL = 1: 8 bits DL = 0: 4 bits N = 1: 2 lines N = 0: 1 line F = 1: 5 x 10 dots F = 0: 5 x 7 dots BF = 1: Internally operating BF = 0: Can accept instruction | | | | | | | | | | | DD RAM: Display data RAM CG RAM: Character generator RAM ACG: CG RAM address ADD: DD RAM address Corresponds to cursor address. AC: Address counter used for both of DD and CG RAM address. | Execution time changes when frequency changes. (Example) When fosc is 270 kHz: $40 \mu s \times \frac{250}{270} = 37 \mu s$ | |

Note 1. 1/8 Duty, 1/11 Duty (LM054, H2570, LM015, LM038, LM027, H2571, H2572)

Note 2. 1/16 Duty (LM020L, LM052L, LM016L, LM032L, LM017L, LM018L, LM041L, LM044L)

* Don't care For details, refer to "HITACHI MICROCOMPUTER SYSTEM: DOT MATRIX LIQUID CRYSTAL DISPLAY CONTROLLER & DRIVER LCD-II (HD44780) USER'S MANUAL".

LM054

- 8 Character x 1 line
- Built-in control LSI HD44780 type (see page 23)
- +5 V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 84W x 44H x 11D (max.) mm
 Effective display area 61W x 15.8H mm
 Character size (5 x 7 dots) 6.45W x 9.4H mm
 Pitch 7.15 mm
 Dot size 1.25W x 1.3H mm
 Weight about 25 g

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|---|----------|------------|
| Power supply for logic (V_{DD} – V_{SS}) | 0 | 7.0 V |
| Power supply for LCD drive (V_{DD} – V_O) | 0 | 13.5 V |
| Input voltage (V_i) | V_{SS} | V_{DD} V |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 70°C |

ELECTRICAL CHARACTERISTICS

$T_a = 25^\circ\text{C}$, $V_{DD} = 5.0 \text{ V} \pm 0.25 \text{ V}$

| | |
|---|----------------------------|
| Input "high" voltage (V_{iH}) | 2.2 V min. |
| Input "low" voltage (V_{iL}) | 0.6 V max. |
| Output high voltage (V_{OH}) ($-I_{OH} = 0.2 \text{ mA}$) | 2.4 V min. |
| Output low voltage (V_{OL}) ($I_{OL} = 1.2 \text{ mA}$) | 0.4 V max. |
| Power supply current (I_{DD}) ($V_{DD} = 5.0 \text{ V}$) | 1.0 mA typ. 2.0 mA max. |
| Power supply for LCD drive (Recommended) (V_{DD} – V_O) | Du=1/8 |
| at $T_a = 0^\circ\text{C}$ | 4.2 V typ. |
| at $T_a = 25^\circ\text{C}$ | 3.7 V typ. |
| at $T_a = 50^\circ\text{C}$ | 3.2 V typ. |

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------|--------|---|
| 1 | V_{SS} | — | 0V |
| 2 | V_{DD} | — | +5V |
| 3 | V_O | — | Power supply |
| 4 | RS | H/L | |
| 5 | R/W | H/L | H: Data read (LCD module → MPU) L: Data write (LCD module ← MPU) |
| 6 | E | H, H→L | Enable signal |
| 7 | DB0 | H/L | Data bus line Note (1), Note (2) |
| 8 | DB1 | H/L | |
| 9 | DB2 | H/L | |
| 10 | DB3 | H/L | |
| 11 | DB4 | H/L | |
| 12 | DB5 | H/L | |
| 13 | DB6 | H/L | |
| 14 | DB7 | H/L | |

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_7$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_7$, when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$, when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.

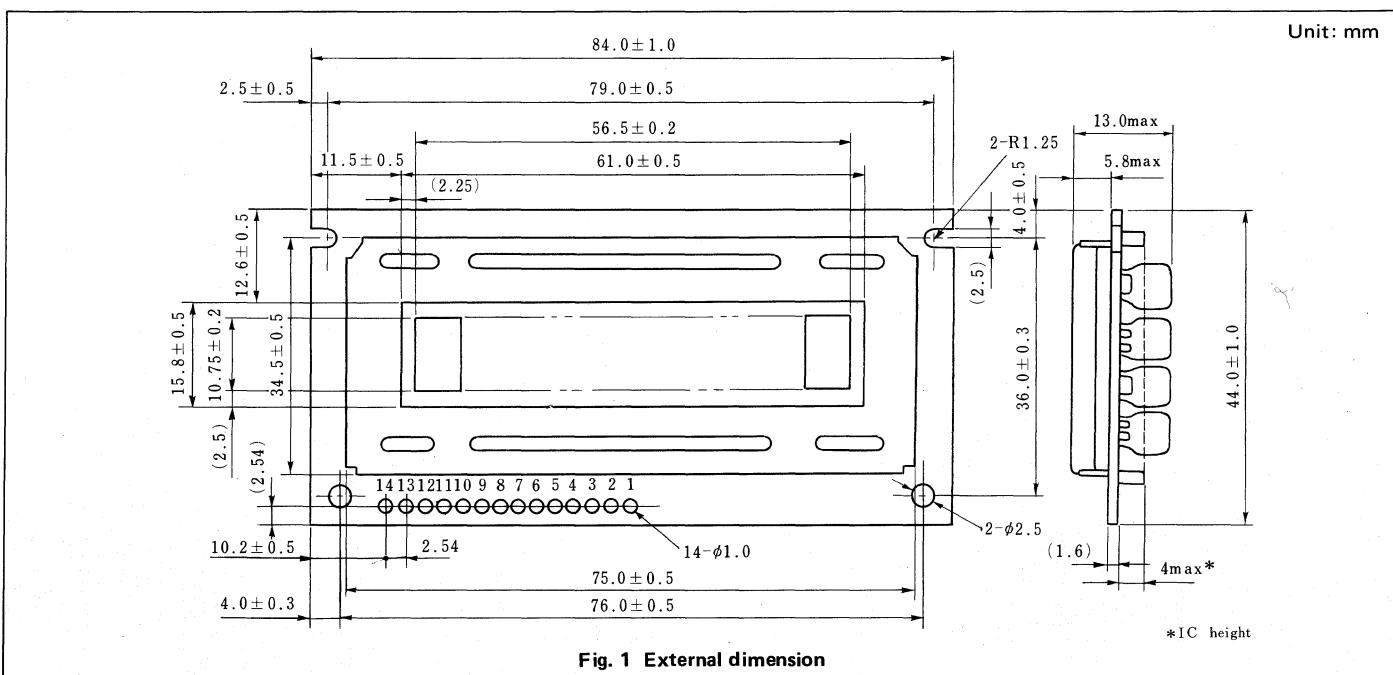
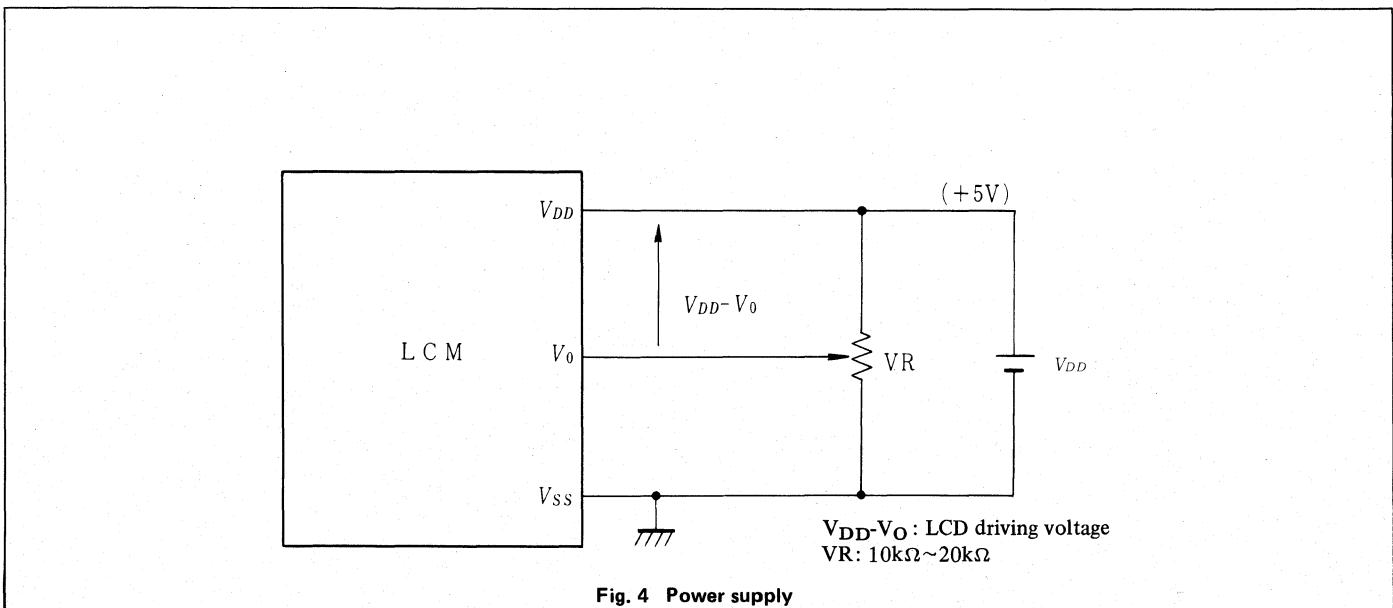
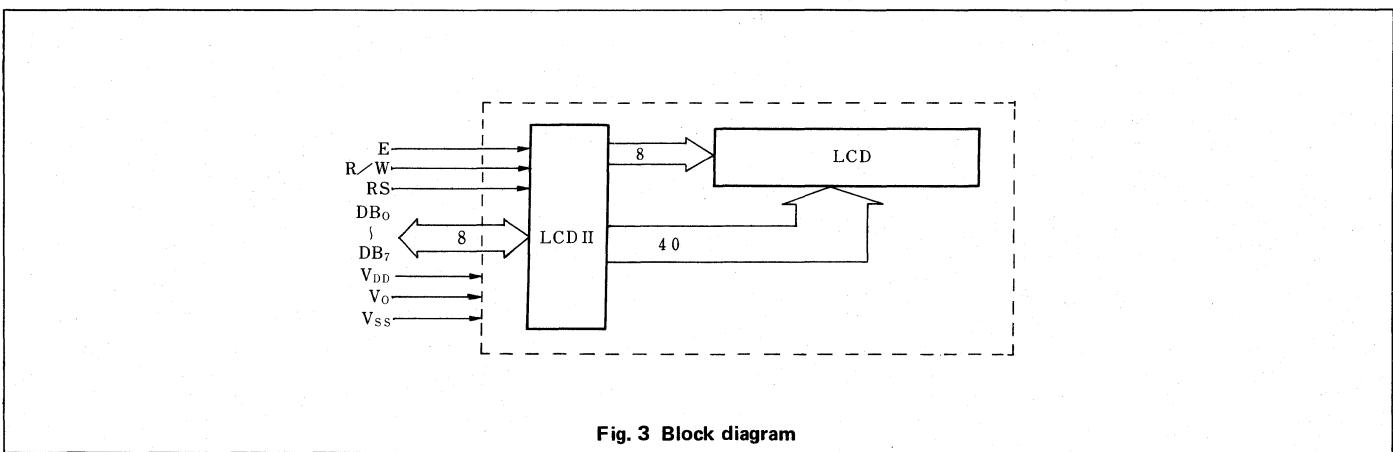
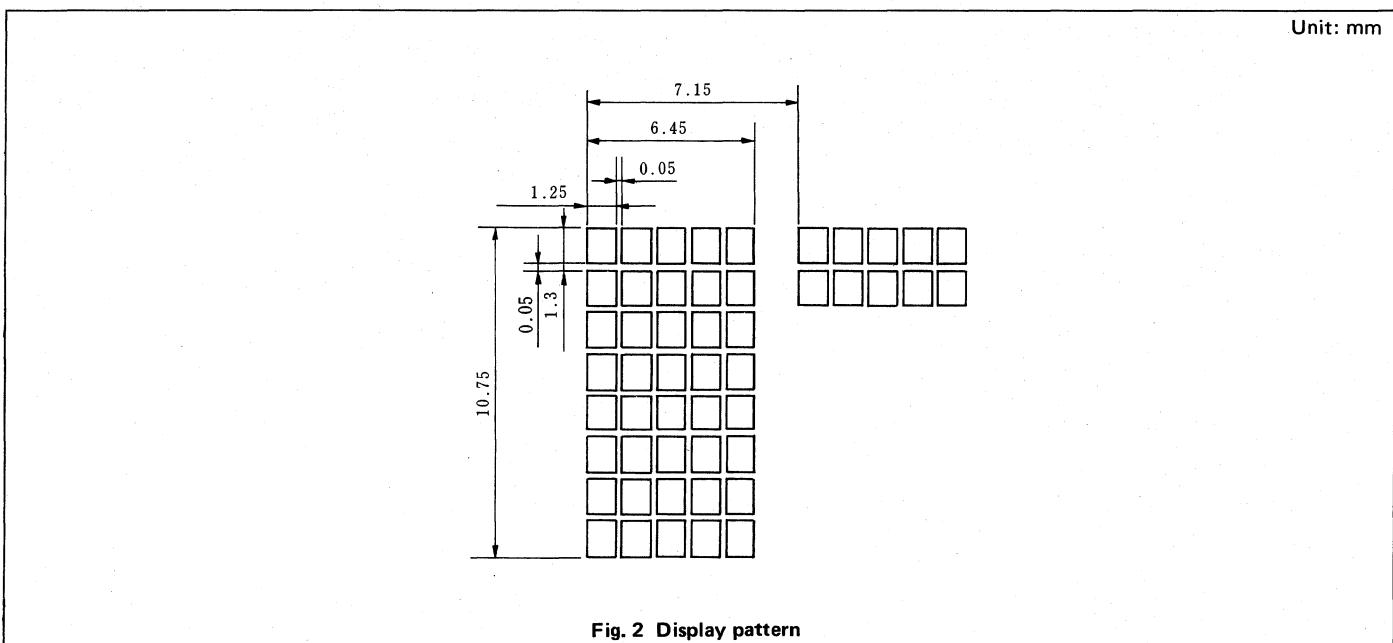


Fig. 1 External dimension



TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{wEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

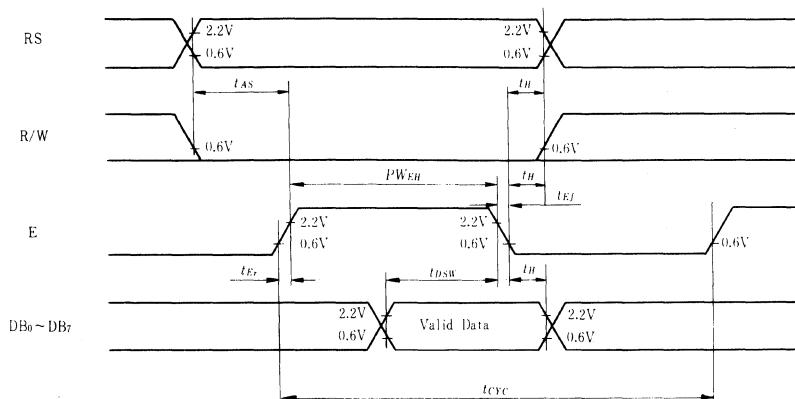


Fig. 5 Interface timing (data write)

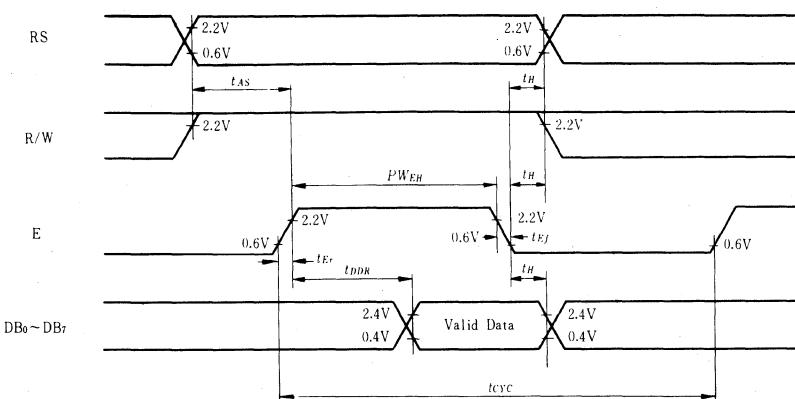


Fig. 6 Interface timing (data read)

H2570

- 16 Character x 1 line
- Built-in control LSI HD44780 type (see page 23)
- +5V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 80W x 36H x 12D (max) mm
 Effective display area 64.5W x 13.8H mm
 Character size (5 x 10 dots) 3.15W x 7.9H mm
 Pitch 3.7 mm
 Dot size 0.55W x 0.7H mm
 Weight about 25g

ABSOLUTE MAXIMUM RATINGS

min. max.

Power supply for logic ($V_{DD} - V_{SS}$) 0 7.0 V
 Power supply for LCD drive ($V_{DD} - V_O$) 0 13.5 V
 Input voltage (V_i) V_{SS} V_{DD} V
 Operating temperature (T_a) 0 50°C
 Storage temperature (T_{stg}) -20 70°C

ELECTRICAL CHARACTERISTICS

$T_a = 25^\circ\text{C}$, $V_{DD} = 5.0 \text{ V} \pm 0.25 \text{ V}$

Input "high" voltage (V_{iH}) 2.2 V min.
 Input "low" voltage (V_{iL}) 0.6 V max.
 Output high voltage (V_{OH}) ($-I_{OH} = 0.2 \text{ mA}$) 2.4 V min.
 Output low voltage (V_{OL}) ($I_{OL} = 1.6 \text{ mA}$) 0.4 V max.
 Power supply current (I_{DD}) ($V_{DD} = 5.0 \text{ V}$) 0.5 mA typ.
 2.0 mA max.
 Power supply for LCD drive (Recommended) ($V_{DD} - V_O$)
 Du=1/8 Du=1/11
 at $T_a = 0^\circ\text{C}$ 4.0 4.2 V typ.
 at $T_a = 25^\circ\text{C}$ 3.7 3.8 V typ.
 at $T_a = 50^\circ\text{C}$ 3.3 3.3 V typ.

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function | |
|---------|----------|--------|---|--------------|
| 1 | V_{SS} | — | 0V | Power supply |
| 2 | V_{DD} | — | +5V | |
| 3 | V_O | — | — | |
| 4 | RS | H/L | L: Instruction code input H: Data input | |
| 5 | R/W | H/L | H: Data read (LCD module → MPU) L: Data write (LCD module ← MPU) | |
| 6 | E | H, H→L | Enable signal | |
| 7 | DB0 | H/L | | |
| 8 | DB1 | H/L | | |
| 9 | DB2 | H/L | | |
| 10 | DB3 | H/L | | |
| 11 | DB4 | H/L | | |
| 12 | DB5 | H/L | | |
| 13 | DB6 | H/L | | |
| 14 | DB7 | H/L | | |

Data bus line
Note (1), Note (2)

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_7$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_7$, when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$ when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.

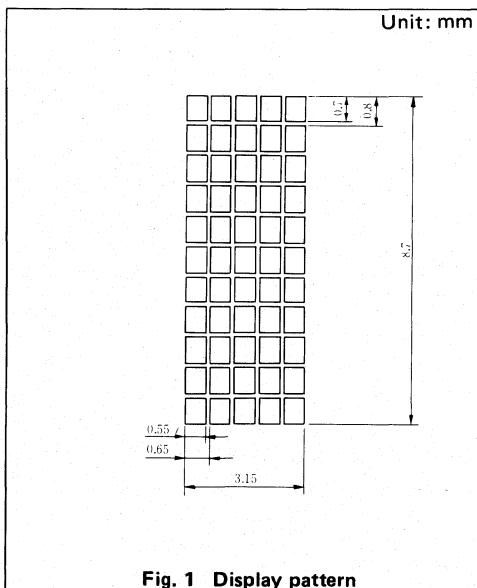


Fig. 1 Display pattern

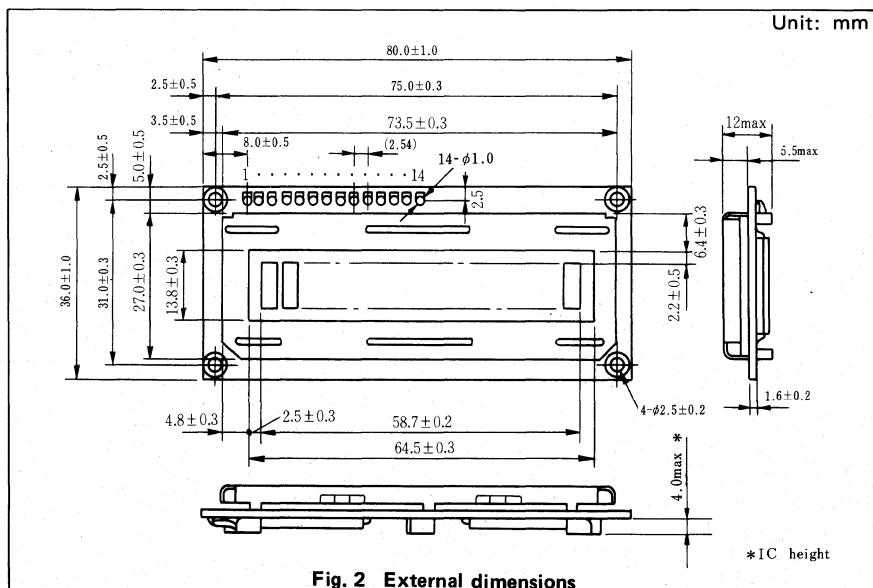


Fig. 2 External dimensions

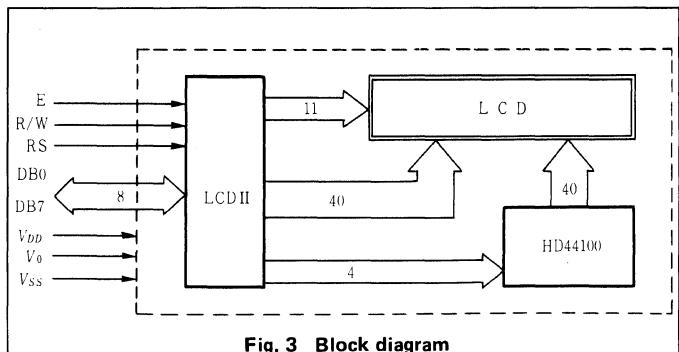


Fig. 3 Block diagram

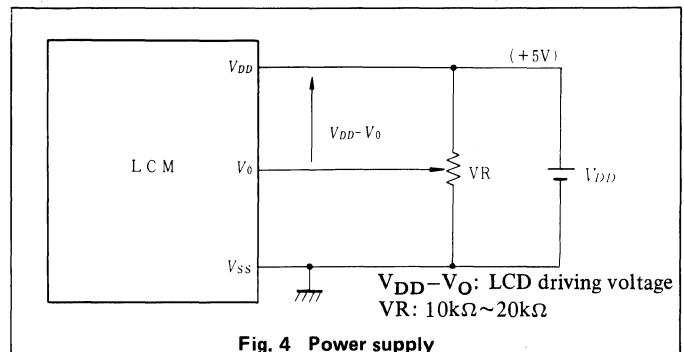


Fig. 4 Power supply

TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|---------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{wEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

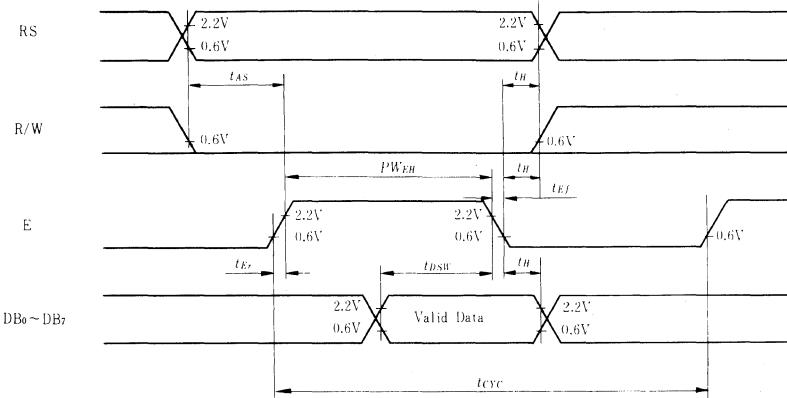


Fig. 5 Interface timing (data write)

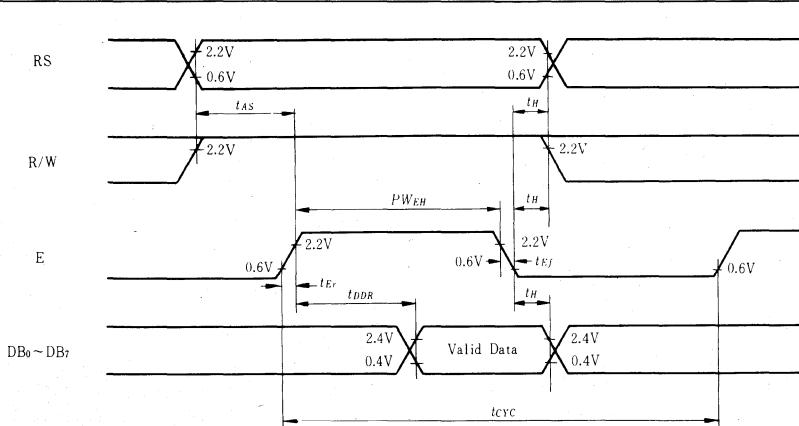


Fig. 6 Interface timing (data read)

LM015

- 16 Character x 1 line
- Built-in control LSI HD44780 type (see page 23)
- +5V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 80W x 36H x 12D (max) mm
 Effective display area 64.5W x 13.8H mm
 Character size (5 x 7 dots) 3.15W x 5.5H mm
 Pitch 3.7 mm
 Dot size 0.55W x 0.7H mm
 Weight about 25 g

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|---|----------|------------|
| Power supply for logic ($V_{DD} - V_{SS}$) | 0 | 7.0 V |
| Power supply for LCD drive ($V_{DD} - V_O$) | 0 | 13.5 V |
| Input voltage (V_i) | V_{SS} | V_{DD} V |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 70°C |

ELECTRICAL CHARACTERISTICS

| | |
|--|----------------------------|
| Ta = 25°C, $V_{DD} = 5.0V \pm 0.25V$ | |
| Input "high" voltage (V_{IH}) | 2.2 V min. |
| Input "low" voltage (V_{IL}) | 0.6 V max. |
| Output high voltage (V_{OH}) ($-I_{OH} = 0.2\text{ mA}$) . . | 2.4 V min. |
| Output low voltage (V_{OL}) ($I_{OL} = 1.6\text{ mA}$) | 0.4 V max. |
| Power supply current (I_{DD}) ($V_{DD} = 5.0\text{ V}$) . . . | 1.0 mA typ. 2.0 mA max. |
| Power supply for LCD drive (Recommended) ($V_{DD} - V_O$) | Du=1/8 |
| at $T_a = 0^\circ\text{C}$ | 4.0 V typ. |
| at $T_a = 25^\circ\text{C}$ | 3.7 V typ. |
| at $T_a = 50^\circ\text{C}$ | 3.3 V typ. |

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function | |
|---------|----------|--------|---|--------------|
| 1 | V_{SS} | — | 0V | Power supply |
| 2 | V_{DD} | — | +5V | |
| 3 | V_O | — | — | |
| 4 | RS | H/L | L: Instruction code input H: Data input | |
| 5 | R/W | H/L | H: Data read (LCD module → MPU) L: Data write (LCD module ← MPU) | |
| 6 | E | H, H→L | Enable signal | |
| 7 | DB0 | H/L | | |
| 8 | DB1 | H/L | | |
| 9 | DB2 | H/L | | |
| 10 | DB3 | H/L | | |
| 11 | DB4 | H/L | | |
| 12 | DB5 | H/L | | |
| 13 | DB6 | H/L | | |
| 14 | DB7 | H/L | | |

Data bus line
Note (1), Note (2)

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_7$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_7$, when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$, when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.

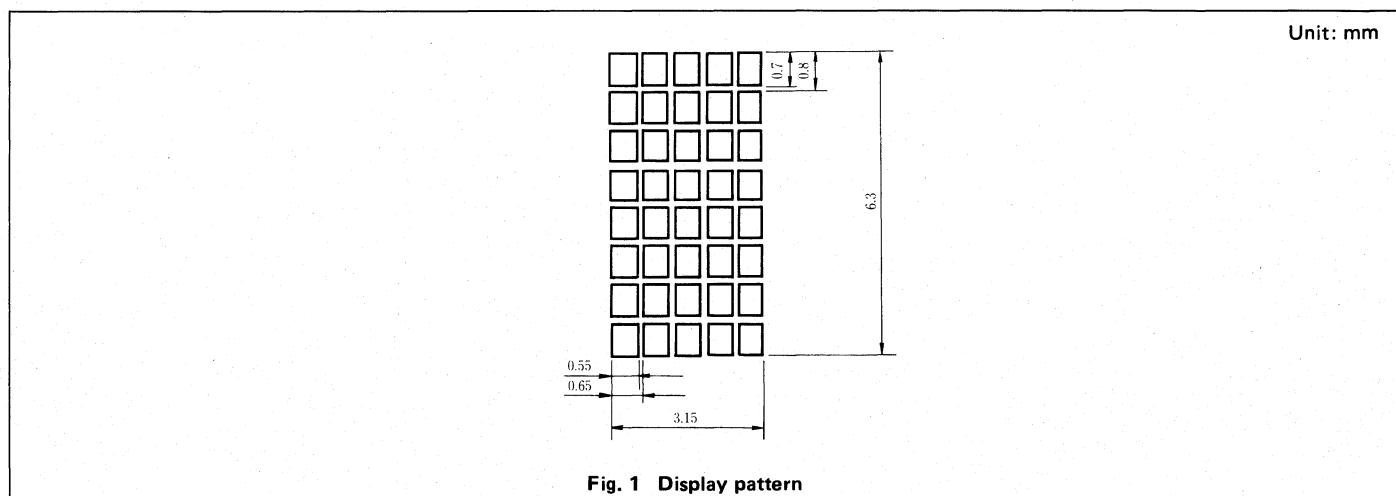


Fig. 1 Display pattern

Unit: mm

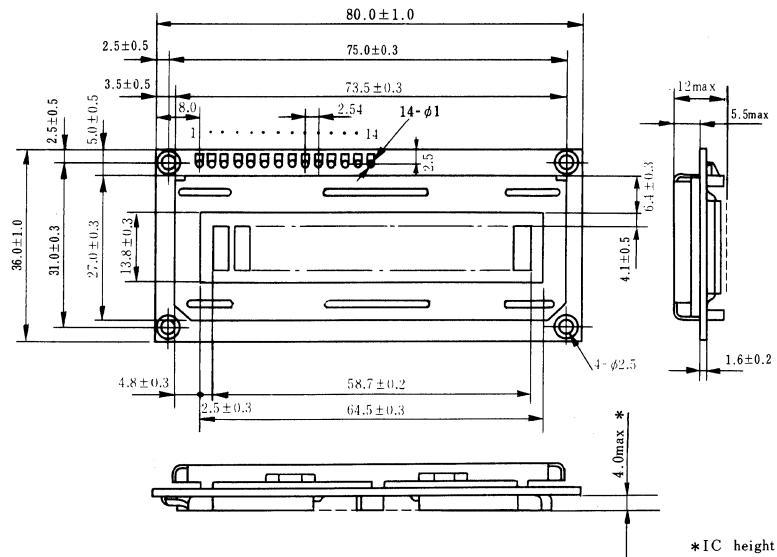


Fig. 2 External dimensions

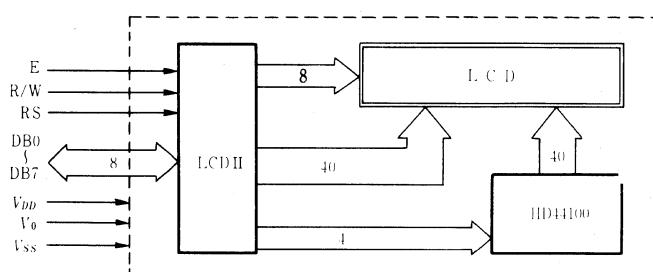


Fig. 3 Block diagram

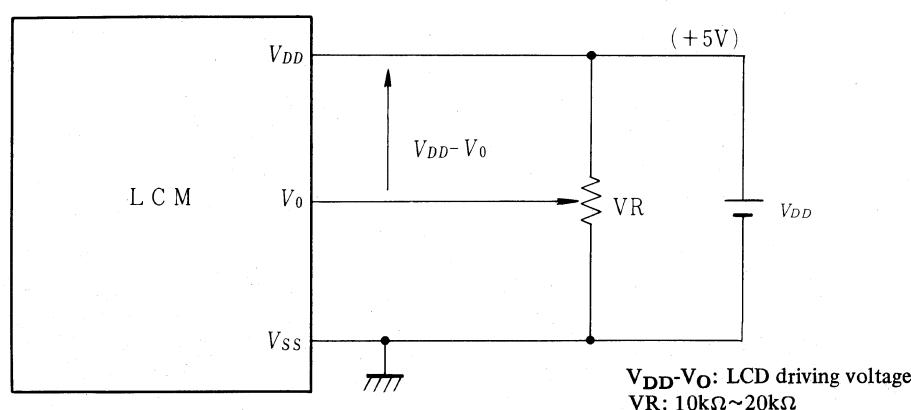


Fig. 4 Power supply

TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{wEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

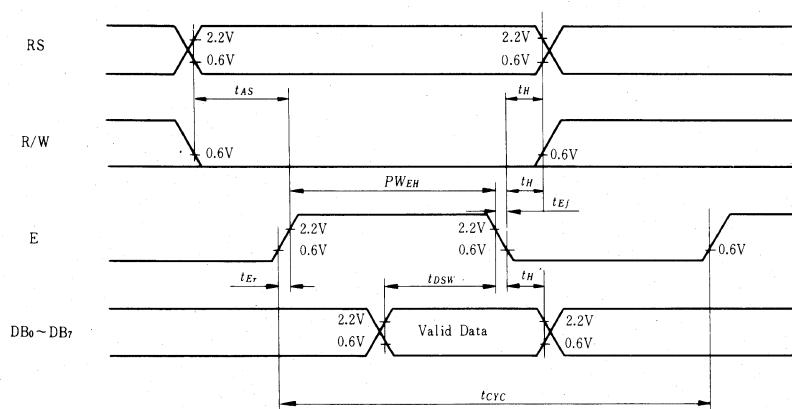


Fig. 5 Interface timing (data write)

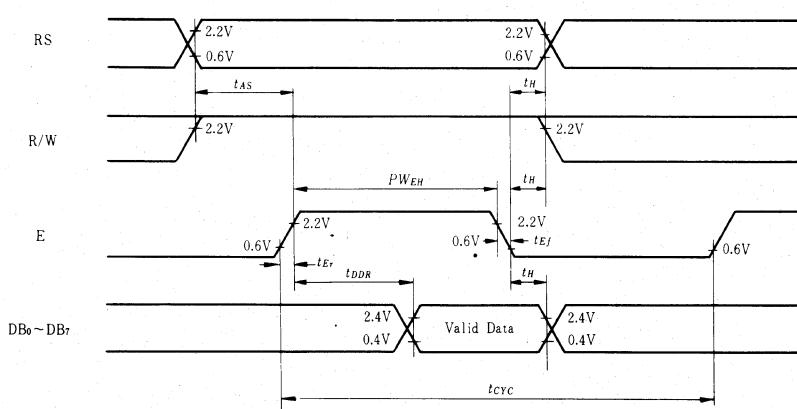


Fig. 6 Interface timing (data read)

LM020L

- 16 Character x 1 line
- Built-in control LSI HD44780 type (see page 23)
- +5V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 80W x 36H x 12D (max.) mm
 Effective display area 64.5W x 13.8H mm
 Character size (5 x 7 dots) 3.07W x 6.56H mm
 Pitch 3.77 mm
 Dot size 0.55W x 0.75H mm
 Weight about 25 g

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|---|----------|------------|
| Power supply for logic (V_{DD} – V_{SS}) | 0 | 7.0 V |
| Power supply for LCD drive (V_{DD} – V_O) | 0 | 13.5 V |
| Input voltage (V_i) | V_{SS} | V_{DD} V |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 70°C |

ELECTRICAL CHARACTERISTICS

$T_a = 25^\circ\text{C}$, $V_{DD} = 5.0 \text{ V} \pm 0.25 \text{ V}$

| Input "high" voltage (V_{iH}) | 2.2 V min. |
|--|----------------------------|
| Input "low" voltage (V_{iL}) | 0.6 V max. |
| Output high voltage (V_{OH}) ($I_{OH} = 0.2 \text{ mA}$) | 2.4 V min. |
| Output low voltage (V_{OL}) ($I_{OL} = 1.2 \text{ mA}$) | 0.4 V max. |
| Power supply current (I_{DD}) ($V_{DD} = 5.0 \text{ V}$) | 1.0 mA typ. 2.0 mA max. |
| Power supply for LCD drive (Recommended) (V_{DD} – V_O) | Du=1/16 |
| at $T_a = 0^\circ\text{C}$ | 4.6 V typ. |
| at $T_a = 25^\circ\text{C}$ | 4.4 V typ. |
| at $T_a = 50^\circ\text{C}$ | 4.2 V typ. |

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------|--------|-------------------------------------|
| 1 | V_{SS} | — | 0V |
| 2 | V_{DD} | — | +5V |
| 3 | V_O | — | Power supply |
| 4 | RS | H/L | |
| 5 | R/W | H/L | |
| 6 | E | H, H→L | Enable signal |
| 7 | DB0 | H/L | Data bus line Note (1), Note (2) |
| 8 | DB1 | H/L | |
| 9 | DB2 | H/L | |
| 10 | DB3 | H/L | |
| 11 | DB4 | H/L | |
| 12 | DB5 | H/L | |
| 13 | DB6 | H/L | |
| 14 | DB7 | H/L | |

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_7$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_7$, when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$ when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.

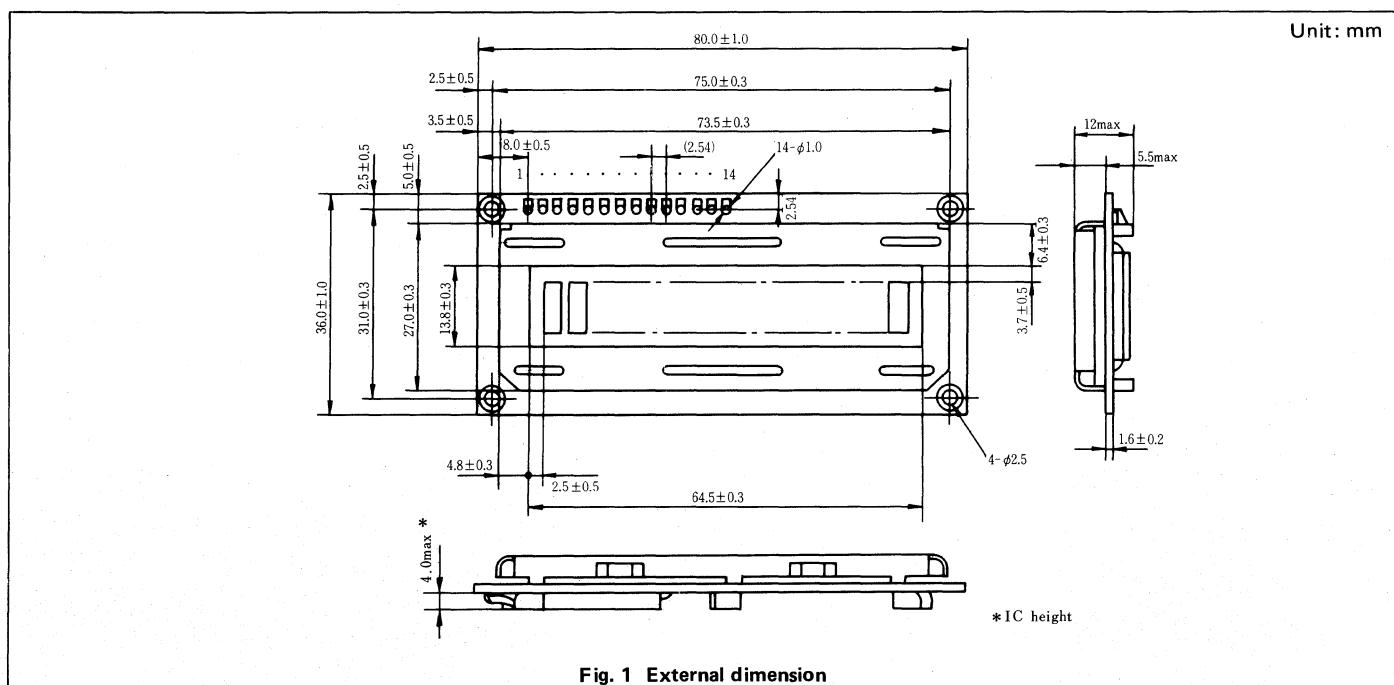


Fig. 1 External dimension

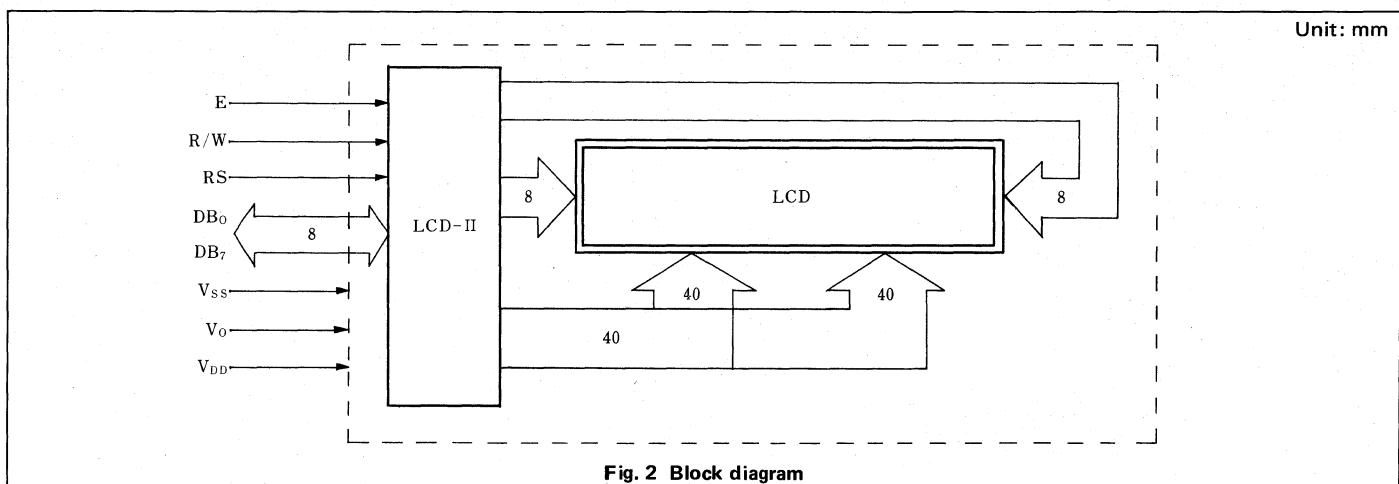


Fig. 2 Block diagram

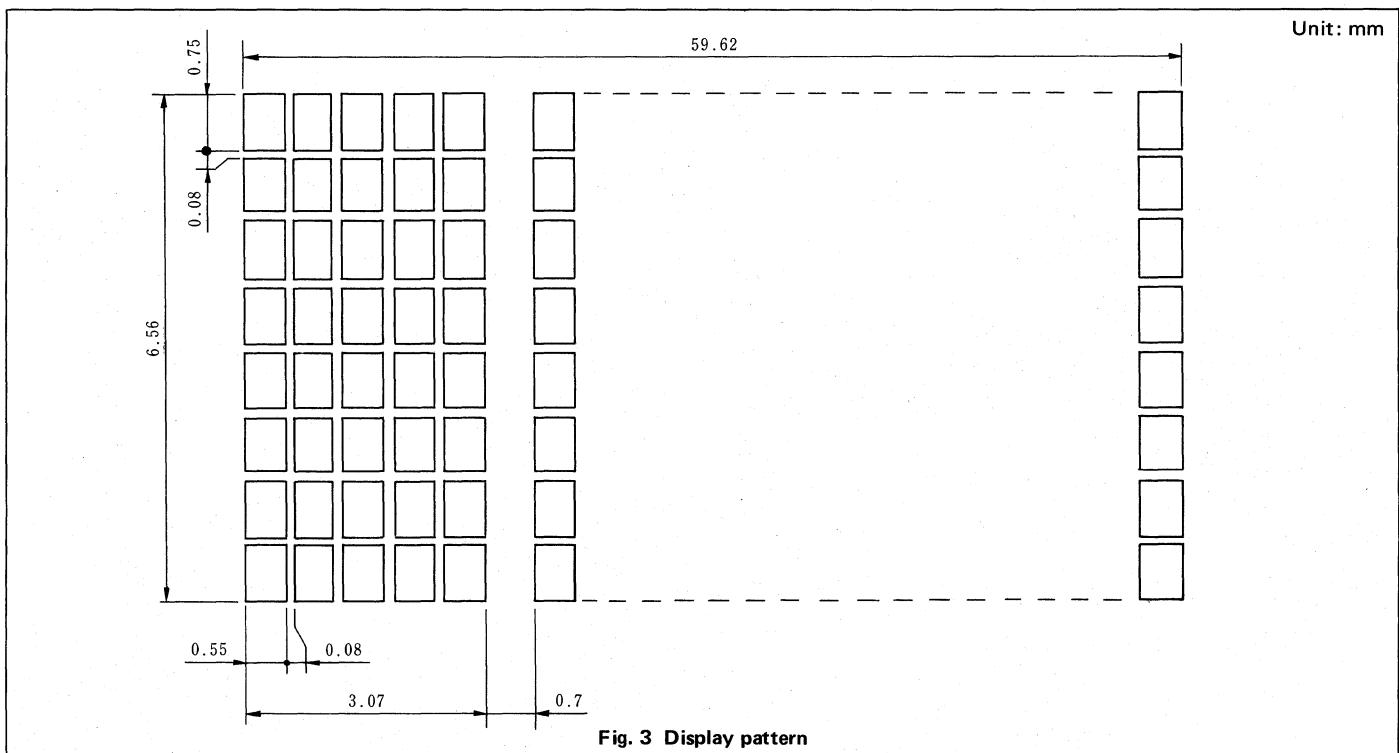


Fig. 3 Display pattern

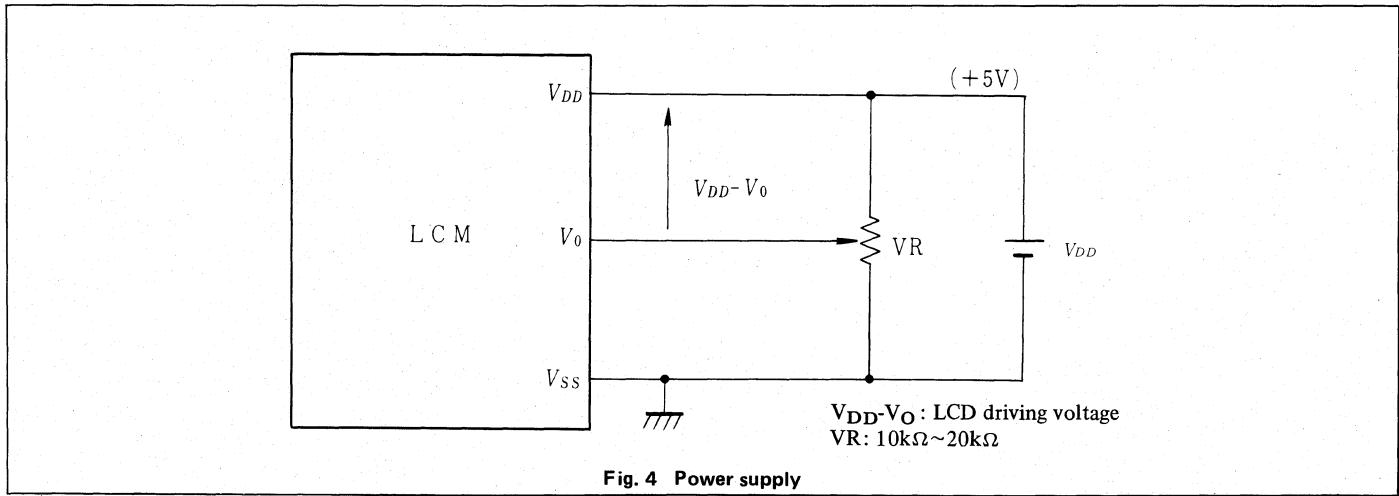


Fig. 4 Power supply

TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|---------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{WEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{ER}, t_{EF} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

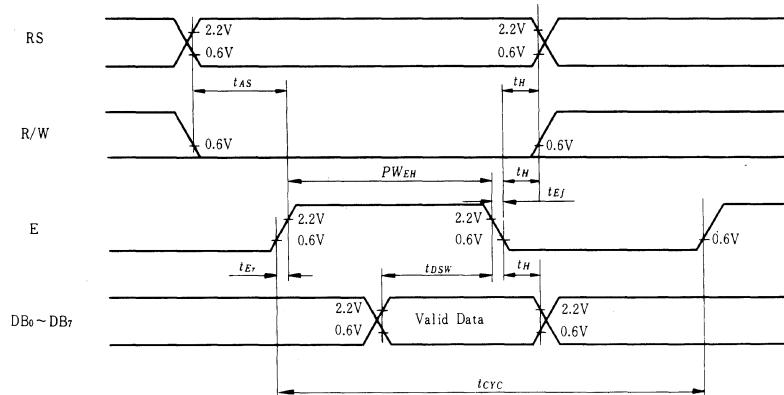


Fig. 5 Interface timing (data write)

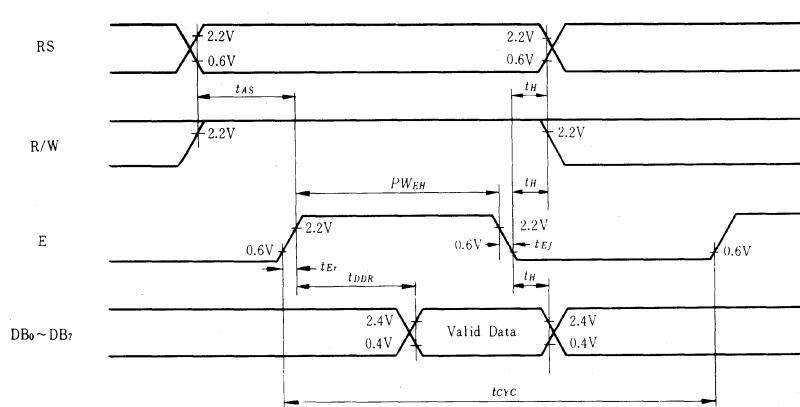


Fig. 6 Interface timing (data read)

LM038

- 20 Character x 1 line
- Built-in control LSI HD44780 type (see page 23)
- +5V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 182W x 35.5H(max.) x 13D (max.) mm
 Effective display area 154.4W x 15.8H mm
 Character size (5 x 7 dots) 6.7W x 9.4H mm
 Pitch 7.4 mm
 Dot size 1.3W x 1.3H mm
 Weight about 65 g

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|---|----------|------------|
| Power supply for logic (V_{DD} – V_{SS}) | 0 | 7.0 V |
| Power supply for LCD drive (V_{DD} – V_O) | 0 | 13.5 V |
| Input voltage (V_i) | V_{SS} | V_{DD} V |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 70°C |

ELECTRICAL CHARACTERISTICS

$T_a = 25^\circ\text{C}$, $V_{DD} = 5.0 \text{ V} \pm 0.25 \text{ V}$

| | |
|---|----------------------------|
| Input "high" voltage (V_{iH}) | 2.2 V min. |
| Input "low" voltage (V_{iL}) | 0.6 V max. |
| Output high voltage (V_{OH}) ($-I_{OH} = 0.2 \text{ mA}$) | 2.4 V min. |
| Output low voltage (V_{OL}) ($I_{OL} = 1.2 \text{ mA}$) | 0.4 V max. |
| Power supply current (I_{DD}) ($V_{DD} = 5.0 \text{ V}$) | 1.0 mA typ. 2.0 mA max. |
| Power supply for LCD drive (Recommended) (V_{DD} – V_O) | $D_u = 1/8$ |
| at $T_a = 0^\circ\text{C}$ | 4.1 V typ. |
| at $T_a = 25^\circ\text{C}$ | 3.7 V typ. |
| at $T_a = 50^\circ\text{C}$ | 3.1 V typ. |

OPTICAL DATA See page 8

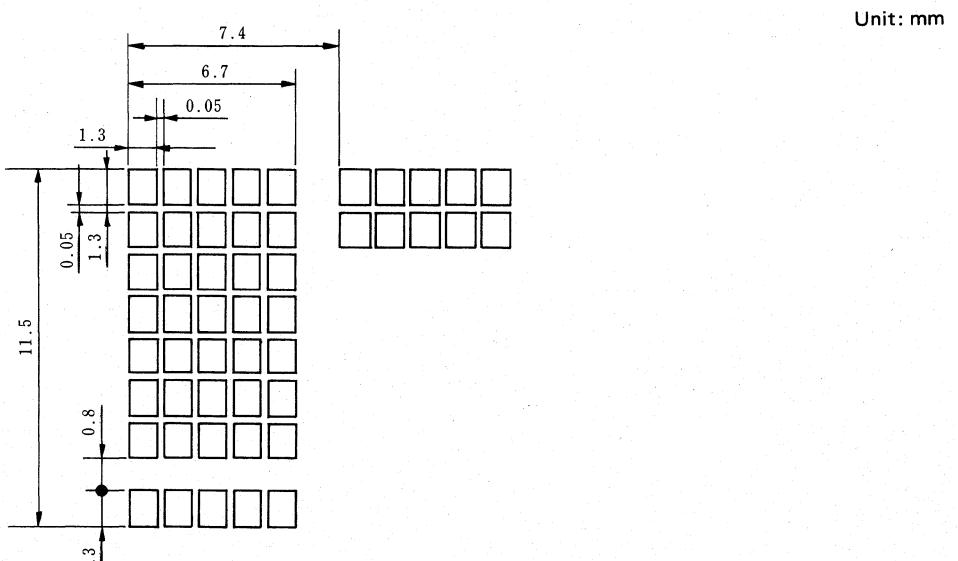
INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function | |
|---------|----------|--------|---|-------------------------------------|
| 1 | V_{SS} | — | 0V | Power supply |
| 2 | V_{DD} | — | +5V | |
| 3 | V_O | — | — | |
| 4 | RS | H/L | L: Instruction code input H: Data input | |
| 5 | R/W | H/L | H: Data read (LCD module→MPU) L: Data write (LCD module←MPU) | |
| 6 | E | H, H→L | Enable signal | |
| 7 | DB0 | H/L | | |
| 8 | DB1 | H/L | | |
| 9 | DB2 | H/L | | |
| 10 | DB3 | H/L | | |
| 11 | DB4 | H/L | | Data bus line Note (1), Note (2) |
| 12 | DB5 | H/L | | |
| 13 | DB6 | H/L | | |
| 14 | DB7 | H/L | | |

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_7$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_7$, when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$ when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.



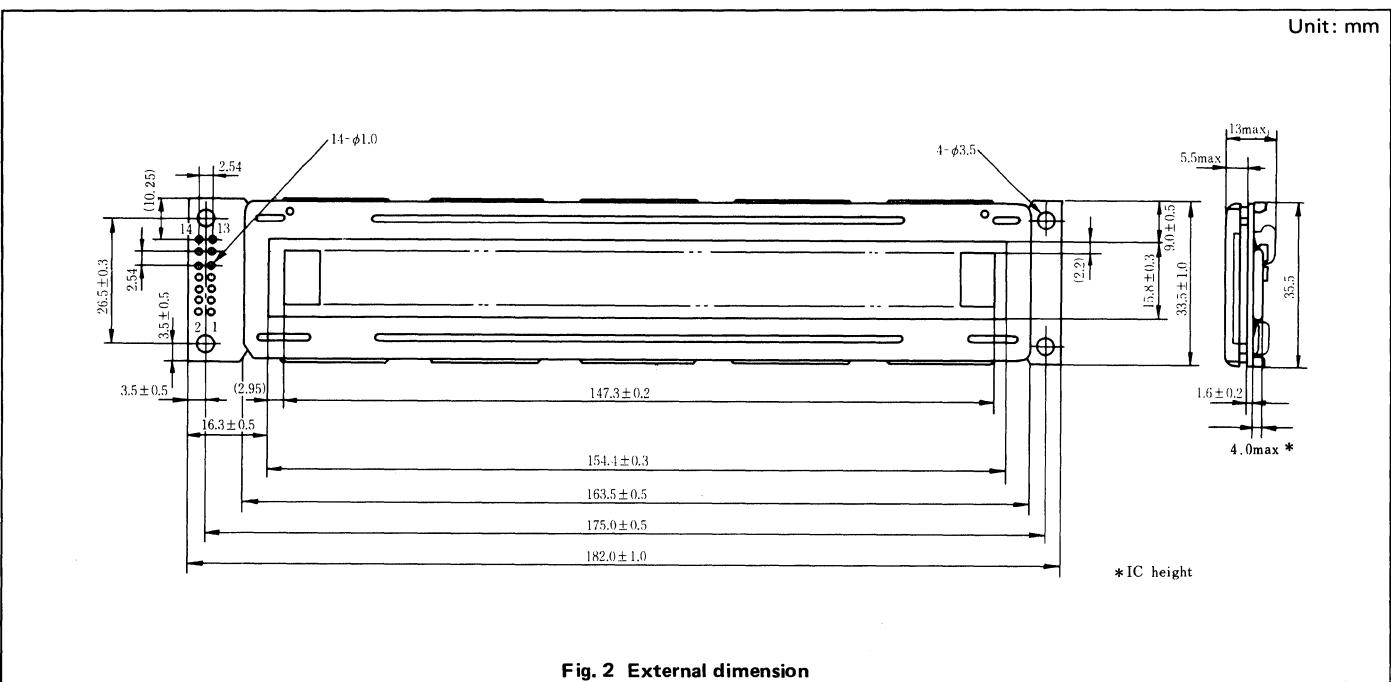


Fig. 2 External dimension

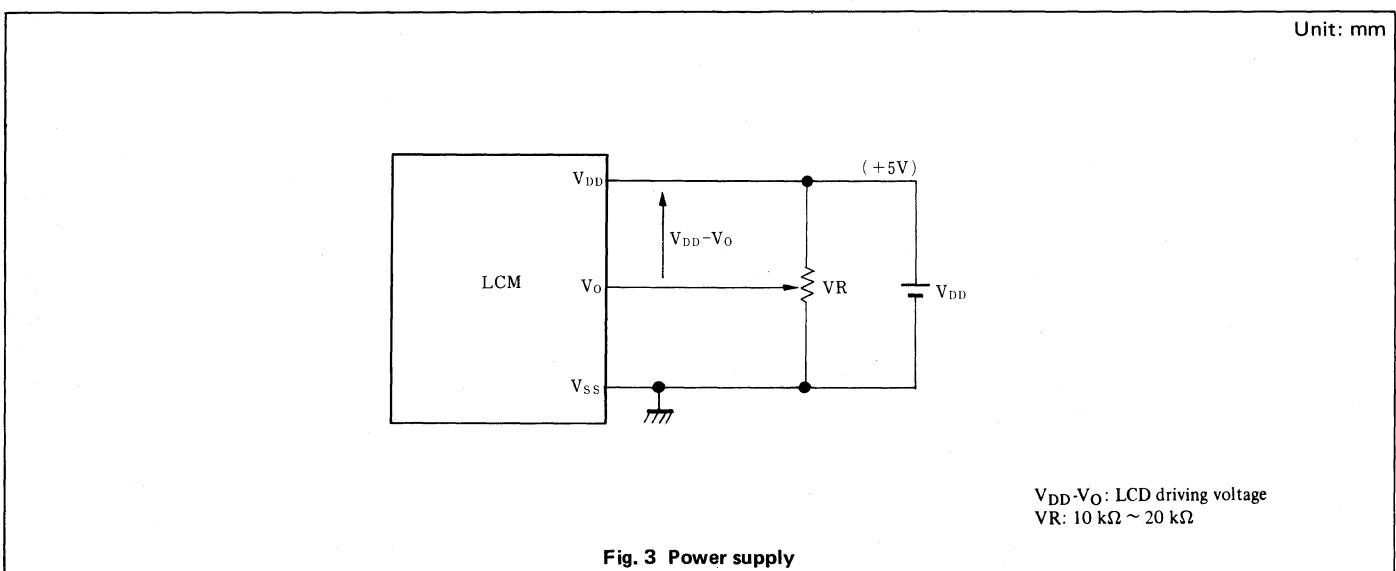


Fig. 3 Power supply

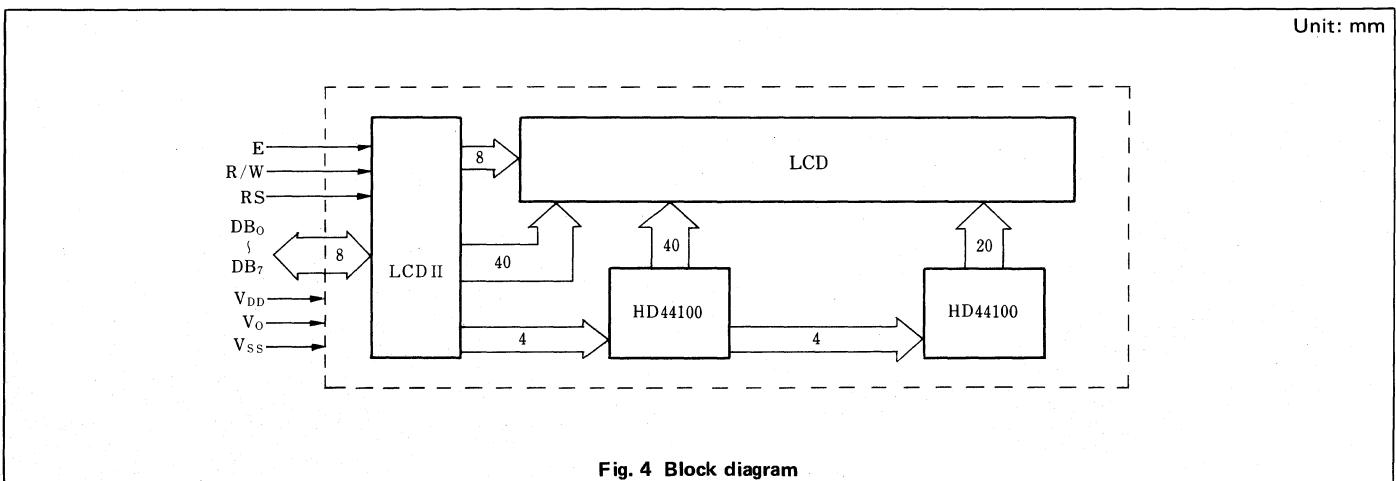


Fig. 4 Block diagram

TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|---------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{WEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

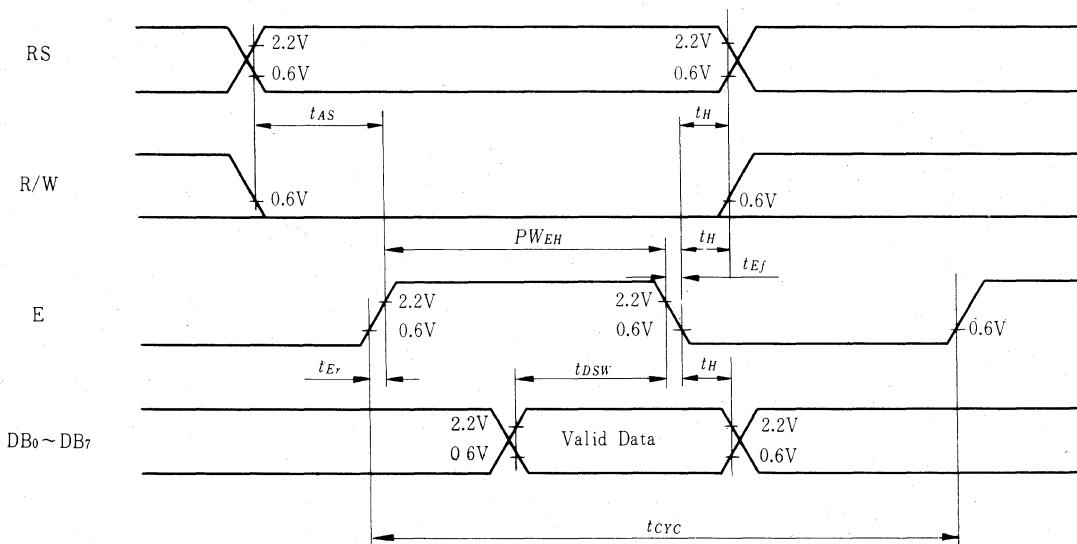


Fig. 5 Interface timing (data write)

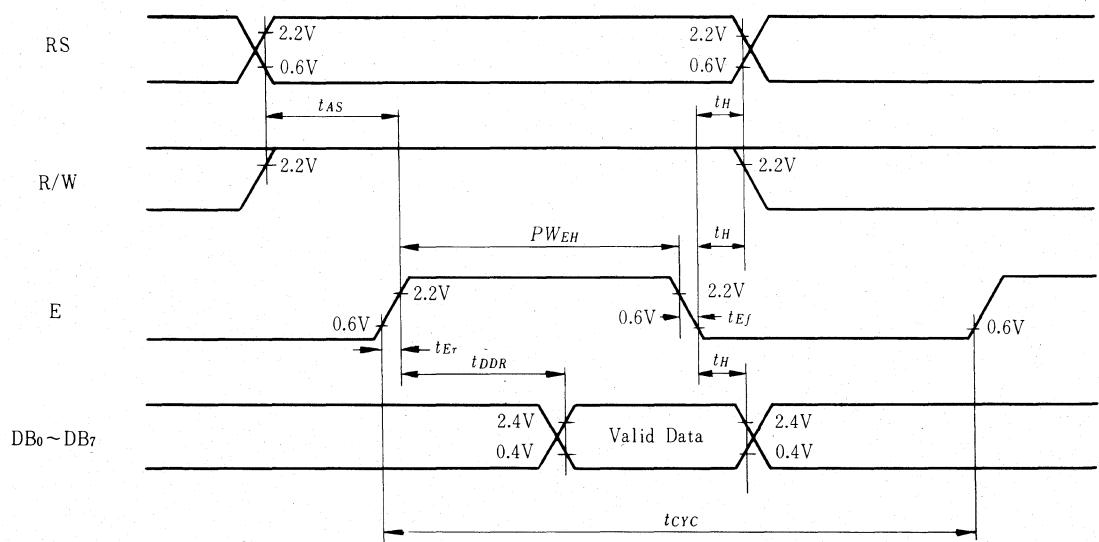


Fig. 6 Interface timing (data read)

LM027

- 24 Character x 1 line
- Built-in control LSI HD44780 type (see page 23)
- +5V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 126W x 36H x 12D (max) mm
 Effective display area 100W x 13.8H mm
 Character size (5 x 10 dots) 3.15W x 7.9H mm
 Pitch 3.75 mm
 Dot size 0.55W x 0.7H mm
 Weight about 40 g

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|---|----------|------------|
| Power supply for logic ($V_{DD} - V_{SS}$) | 0 | 7.0 V |
| Power supply for LCD drive ($V_{DD} - V_O$) | 0 | 13.5 V |
| Input voltage (V_i) | V_{SS} | V_{DD} V |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 70°C |

ELECTRICAL CHARACTERISTICS

$T_a = 25^\circ\text{C}$, $V_{DD} = 5.0 \text{ V} \pm 0.25 \text{ V}$

| | |
|--|----------------------------|
| Input "high" voltage (V_{iH}) | 2.2 V min. |
| Input "low" voltage (V_{iL}) | 0.6 V max. |
| Output high voltage (V_{OH}) ($-I_{OH}=0.2 \text{ mA}$) | 2.4 V min. |
| Output low voltage (V_{OL}) ($I_{OL} = 1.2 \text{ mA}$) | 0.4 V max. |
| Power supply current (I_{DD}) ($V_{DD} = 5.0 \text{ V}$) | 0.5 mA typ. 2.0 mA max. |
| Power supply for LCD drive (Recommended) ($V_{DD} - V_O$) | $D_u=1/8$ $D_u=1/11$ |
| at $T_a = 0^\circ\text{C}$ | 4.0 4.2 V typ. |
| at $T_a = 25^\circ\text{C}$ | 3.7 3.8 V typ. |
| at $T_a = 50^\circ\text{C}$ | 3.3 3.3 V typ. |

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function | |
|---------|----------|----------------------|--|-------------------------------------|
| 1 | V_{SS} | — | 0V | Power supply |
| 2 | V_{DD} | — | +5V | |
| 3 | V_O | — | — | |
| 4 | RS | H/L | L: Instruction code input H: Data input | |
| 5 | R/W | H/L | H: Data read (LCD module \rightarrow MPU) L: Data write (LCD module \leftarrow MPU) | |
| 6 | E | H, H \rightarrow L | Enable signal | |
| 7 | DB0 | H/L | | |
| 8 | DB1 | H/L | | |
| 9 | DB2 | H/L | | |
| 10 | DB3 | H/L | | |
| 11 | DB4 | H/L | | Data bus line Note (1), Note (2) |
| 12 | DB5 | H/L | | |
| 13 | DB6 | H/L | | |
| 14 | DB7 | H/L | | |

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_1$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_1$, when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$, when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.

Unit: mm

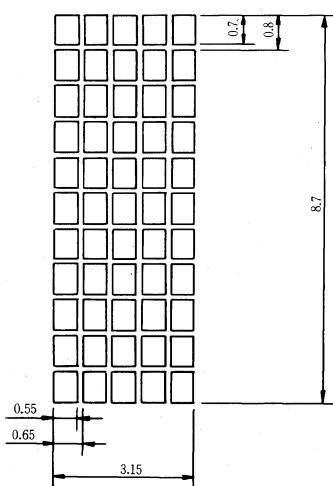


Fig. 1 Display pattern

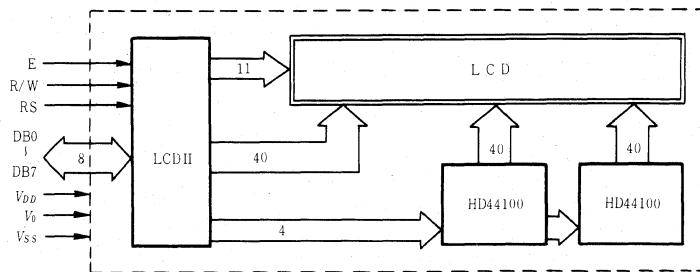
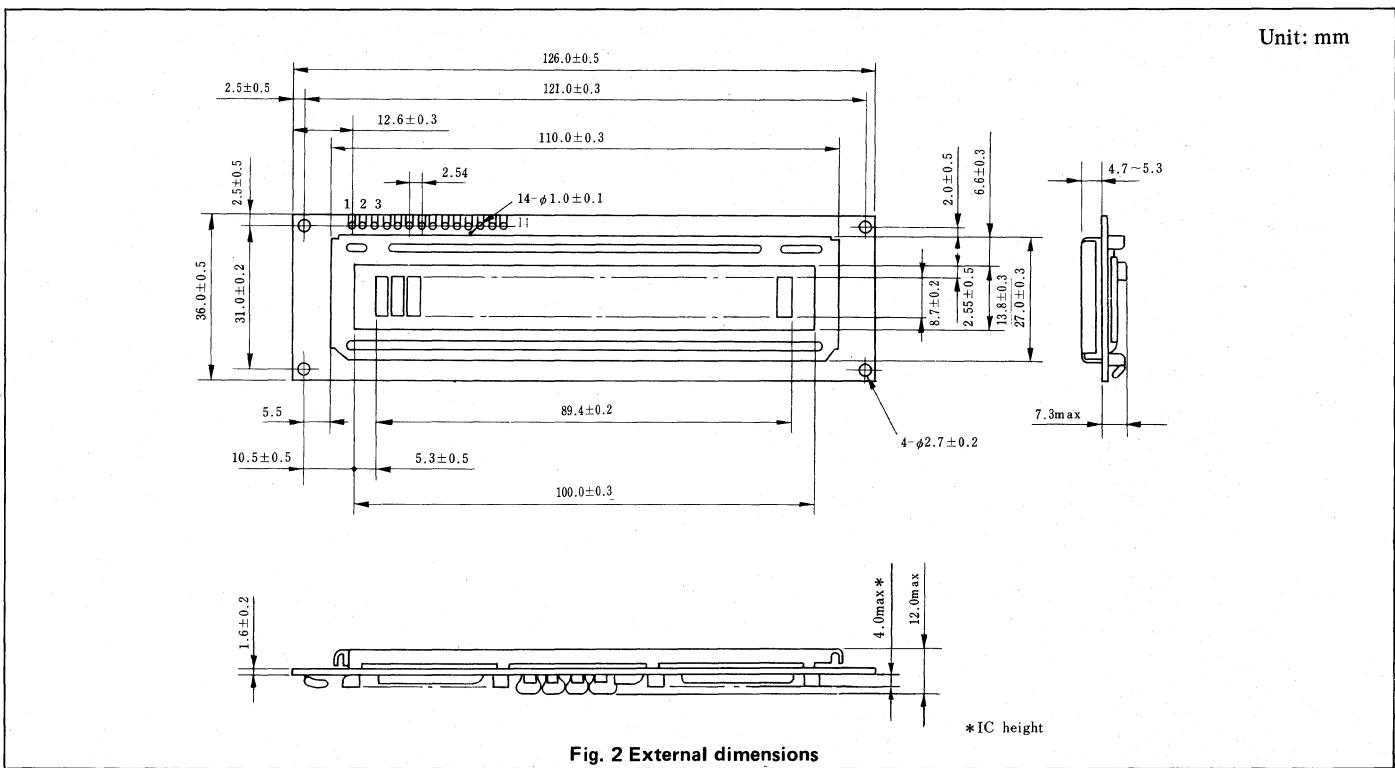


Fig. 3 Block diagram

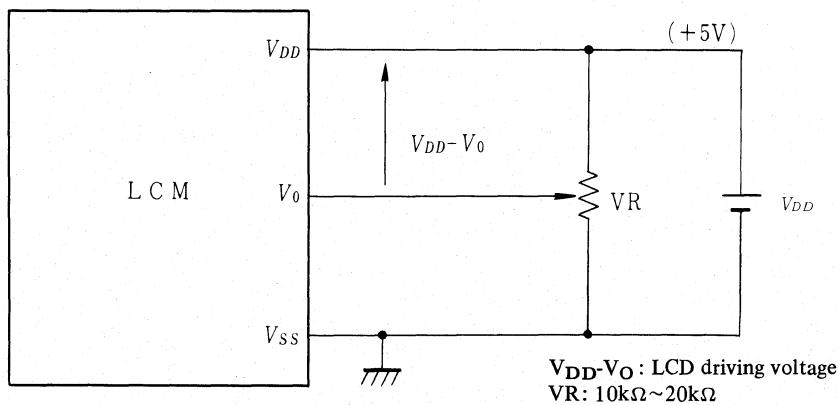


Fig. 4 Power supply

TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|---------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{WEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

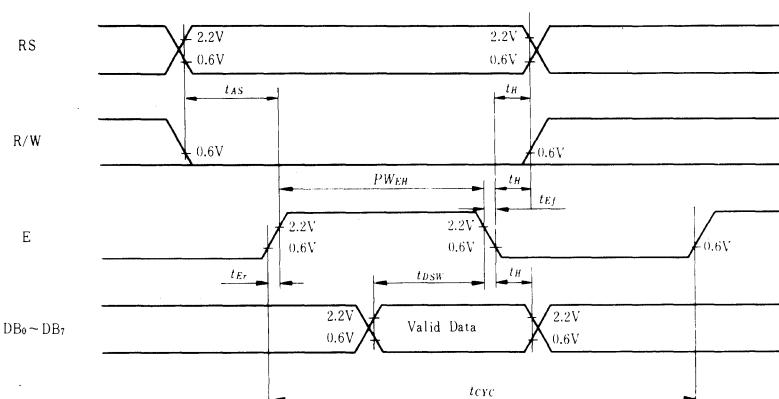


Fig. 5 Interface timing (data write)

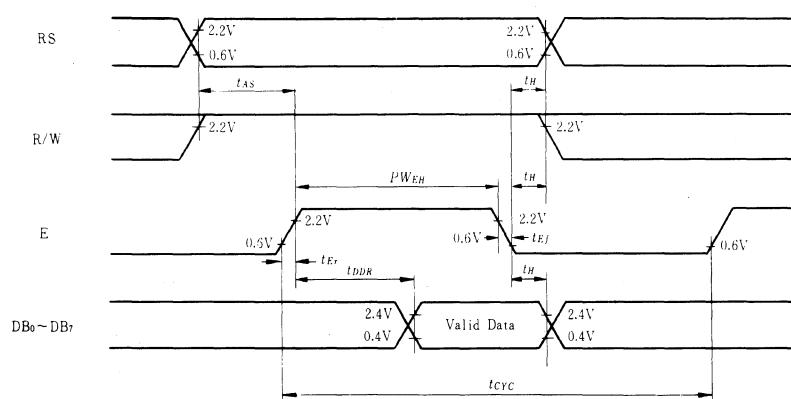


Fig. 6 Interface timing (data read)

H2571

- 32 character x 1 line
- Built-in control LSI HD44780 type (see page 23)
- +5V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 174.5W x 33.0H (max.) x 13.4D (max.) mm
 Effective display area 132.5W x 14.0H mm
 Character size (5 x 10 dots) 3.15W x 7.9H mm
 Pitch 3.85 mm
 Dot size 0.55W x 0.7H mm
 Weight about 60 g

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|---|----------|------------|
| Power supply for logic ($V_{DD} - V_{SS}$) | 0 | 7.0 V |
| Power supply for LCD drive ($V_{DD} - V_O$) | 0 | 13.5 V |
| Input voltage (V_i) | V_{SS} | V_{DD} V |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 70°C |

ELECTRICAL CHARACTERISTICS

$T_a = 25^\circ C$, $V_{DD} = 5.0 V \pm 0.25 V$

| Input "high" voltage (V_{IH}) | 2.2 V min. |
|--|----------------------------|
| Input "low" voltage (V_{IL}) | 0.6 V max. |
| Output high voltage (V_{OH}) ($-I_{OH} = 0.2mA$) | 2.4 V min. |
| Output low voltage (V_{OL}) ($I_{OL} = 1.6 mA$) | 0.4 V max. |
| Power supply current (I_{DD}) ($V_{DD} = 5.0 V$) | 1.0 mA typ. 2.0 mA max. |
| Power supply for LCD drive (Recommended) ($V_{DD} - V_O$) | |
| Du=1/8 Du=1/11 | |
| at $T_a = 0^\circ C$ | 4.0 4.2V typ. |
| at $T_a = 25^\circ C$ | 3.7 3.8V typ. |
| at $T_a = 50^\circ C$ | 3.3 3.3V typ. |

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function | |
|---------|----------|----------------------|--|-------------------------------------|
| 1 | V_{SS} | — | 0V | Power supply |
| 2 | V_{DD} | — | +5V | |
| 3 | V_O | — | — | |
| 4 | RS | H/L | L: Instruction code input H: Data input | |
| 5 | R/W | H/L | H: Data read (LCD module \rightarrow MPU) L: Data write (LCD module \leftarrow MPU) | |
| 6 | E | H, H \rightarrow L | Enable signal | |
| 7 | DB0 | H/L | | Data bus line Note (1), Note (2) |
| 8 | DB1 | H/L | | |
| 9 | DB2 | H/L | | |
| 10 | DB3 | H/L | | |
| 11 | DB4 | H/L | | |
| 12 | DB5 | H/L | | |
| 13 | DB6 | H/L | | |
| 14 | DB7 | H/L | | |

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_1$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_1$, when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$, when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.

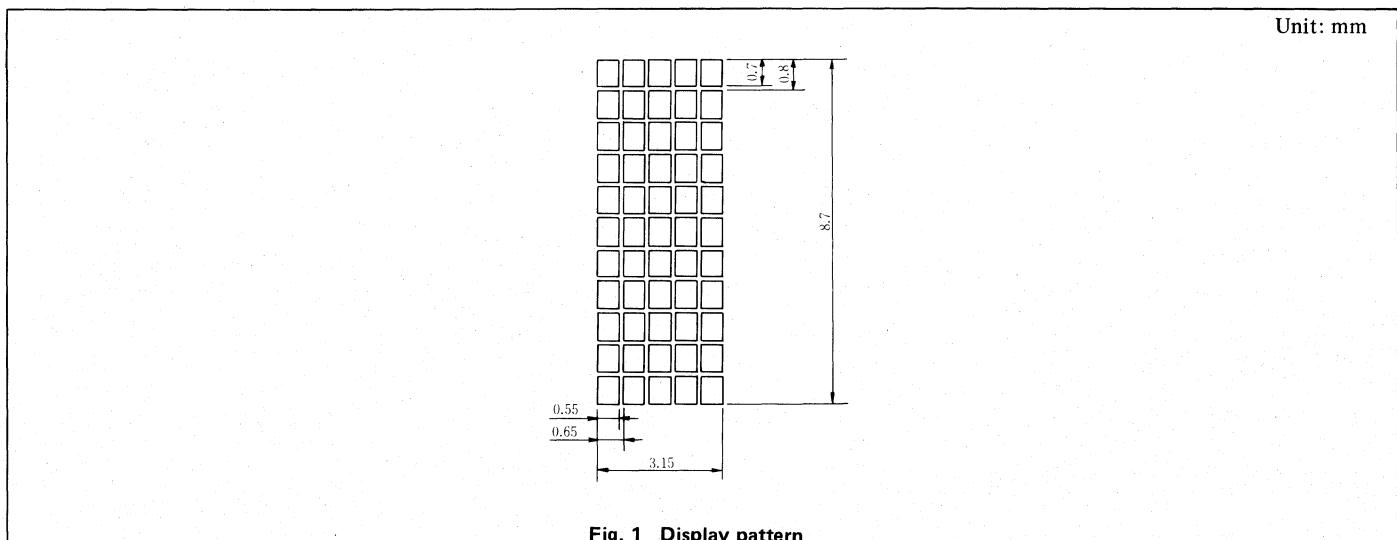


Fig. 1 Display pattern

Unit: mm

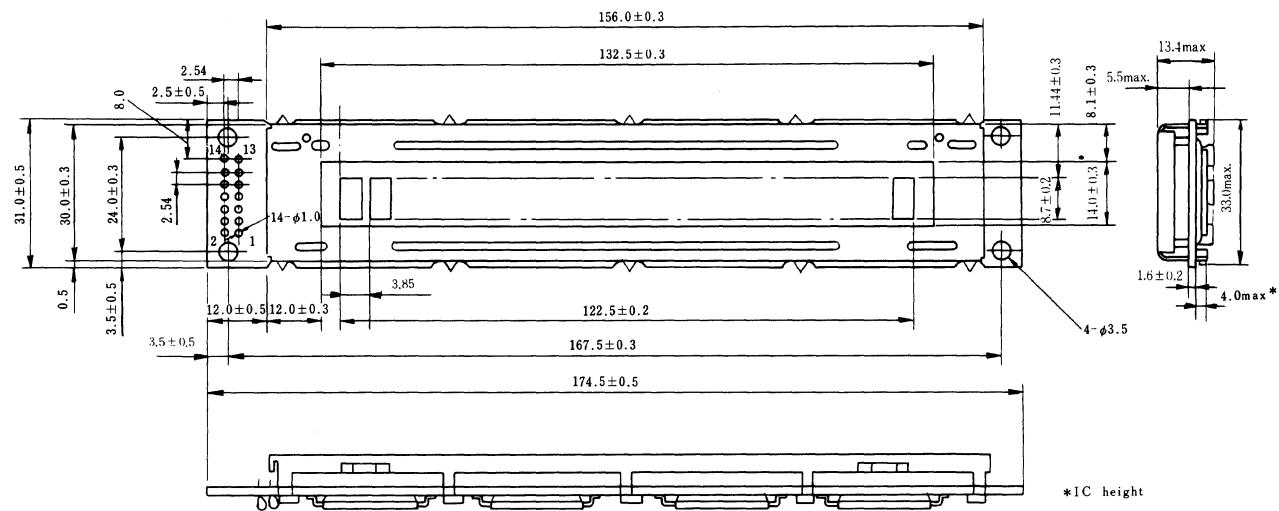


Fig. 2 External dimensions

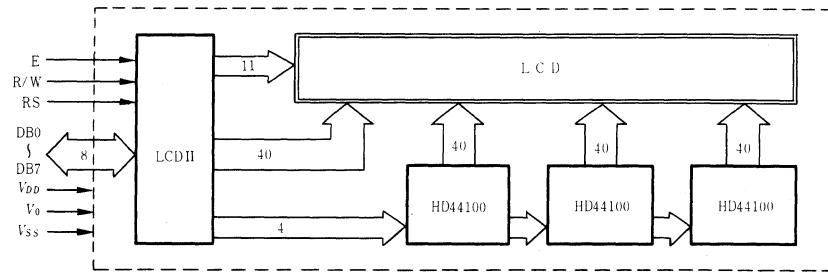


Fig. 3 Block diagram

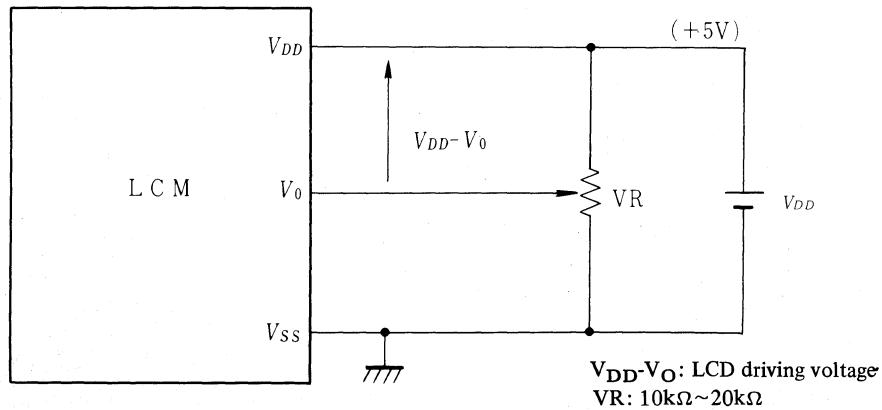


Fig. 4 Power supply

TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{WEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{ER}, t_{EF} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

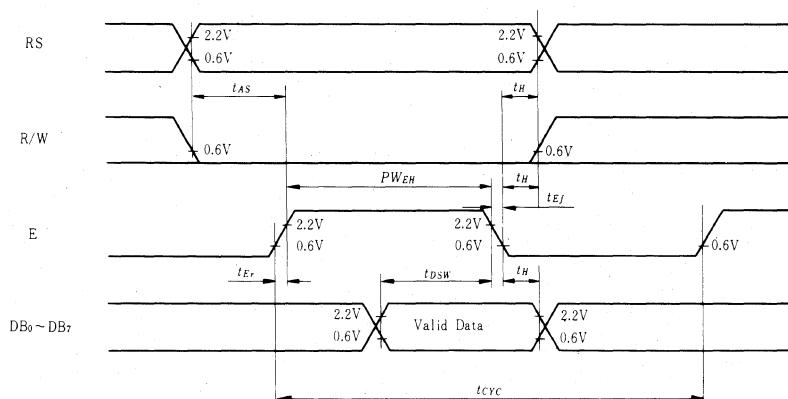


Fig. 5 Interface timing (data write)

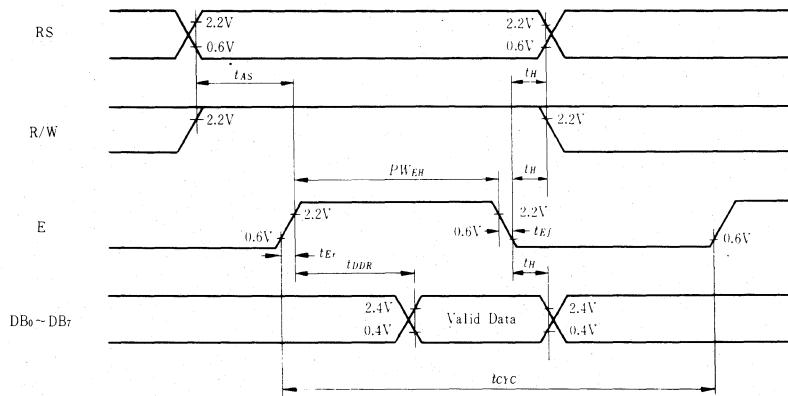


Fig. 6 Interface timing (data read)

H2572

- 40 Character x 1 line
- Built-in control LSI HD44780 type (see page 23)
- +5V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 182W x 35.5H (max.) x 13D (max.) mm
 Effective display area 154.4W x 15.8H mm
 Character size (5 x 10 dots) 3.15W x 7.9H mm
 Pitch 3.75 mm
 Dot size 0.55W x 0.7H mm
 Weight about 65 g

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|--|----------|------------|
| Power supply for logic ($V_{DD} - V_{SS}$) | 0 | 7.0 V |
| Power supply for LCD drive ($V_{DD} - V_O$) | 0 | 13.5 V |
| Input voltage (V_i) | V_{SS} | V_{DD} V |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 70°C |

ELECTRICAL CHARACTERISTICS

| | |
|---|----------------------------|
| Ta = 25°C, $V_{DD} = 5.0$ V ± 0.25 V | |
| Input "high" voltage (V_{iH}) | 2.2 V min. |
| Input "low" voltage (V_{iL}) | 0.6 V max. |
| Output high voltage (V_{OH}) ($-I_{OH}=0.2$ mA) . . . | 2.4 V min. |
| Output low voltage (V_{OL}) ($I_{OL} = 1.6$ mA) . . . | 0.4 V max. |
| Power supply current (I_{DD}) ($V_{DD} = 5.0$ V) . . . | 1.0 mA typ. 2.0 mA max. |
| Power supply for LCD drive (Recommended) ($V_{DD} - V_O$) | |
| Du=1/8 Du=1/11 | |
| at $T_a = 0^\circ\text{C}$ | 4.0 4.2 V typ. |
| at $T_a = 25^\circ\text{C}$ | 3.7 3.8 V typ. |
| at $T_a = 50^\circ\text{C}$ | 3.3 3.3 V typ. |

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------|--------|-------------------------------------|
| 1 | V_{SS} | — | 0V |
| 2 | V_{DD} | — | +5V |
| 3 | V_O | — | Power supply |
| 4 | RS | H/L | |
| 5 | R/W | H/L | |
| 6 | E | H, H→L | Enable signal |
| 7 | DB0 | H/L | Data bus line Note (1), Note (2) |
| 8 | DB1 | H/L | |
| 9 | DB2 | H/L | |
| 10 | DB3 | H/L | |
| 11 | DB4 | H/L | |
| 12 | DB5 | H/L | |
| 13 | DB6 | H/L | |
| 14 | DB7 | H/L | |

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_7$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_7$, when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$ when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.

Unit: mm

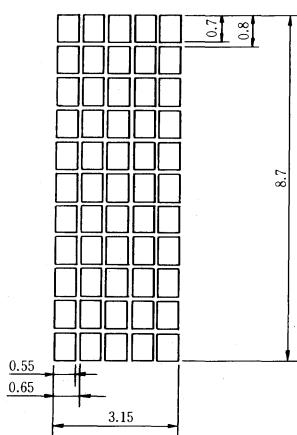


Fig. 1 Display pattern

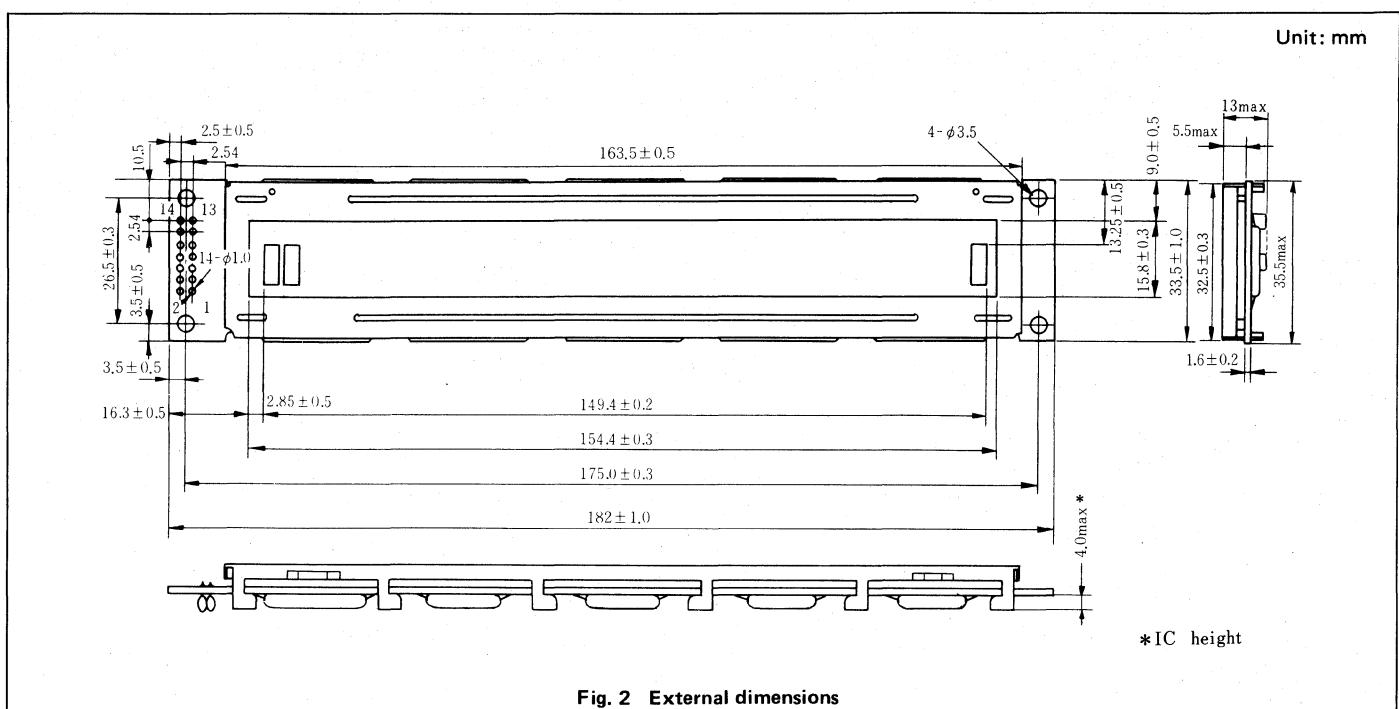


Fig. 2 External dimensions

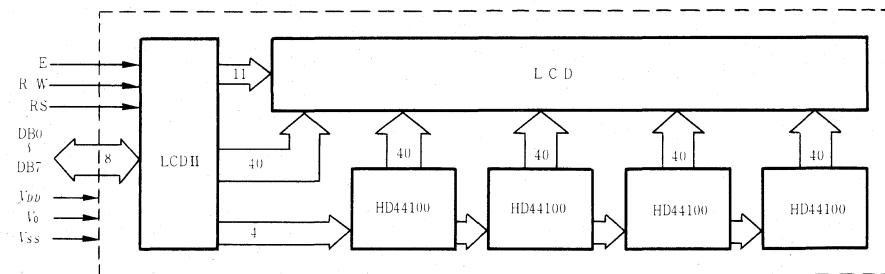


Fig. 3 Block diagram

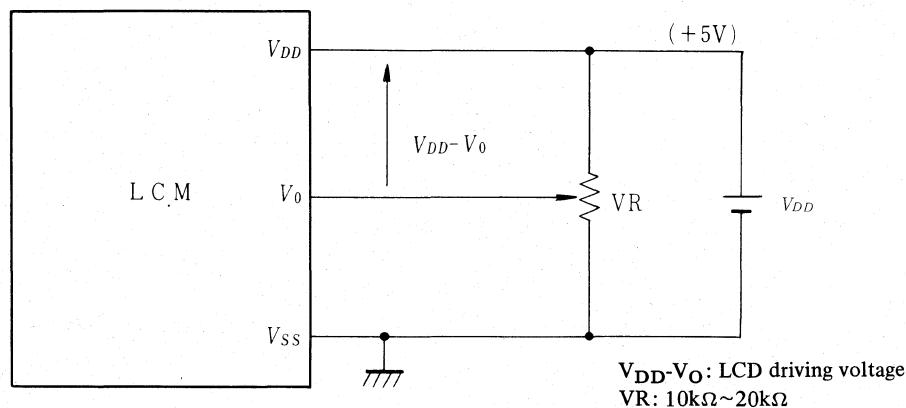


Fig. 4 Power supply

TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{WEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

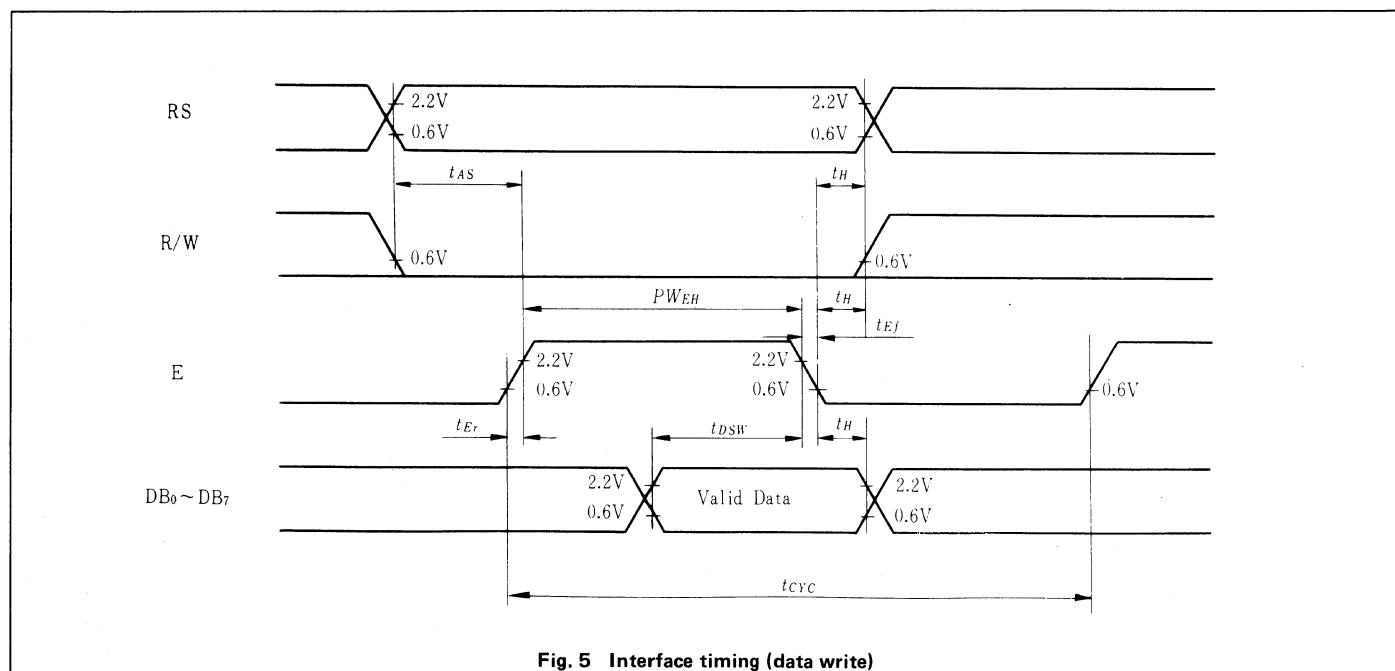


Fig. 5 Interface timing (data write)

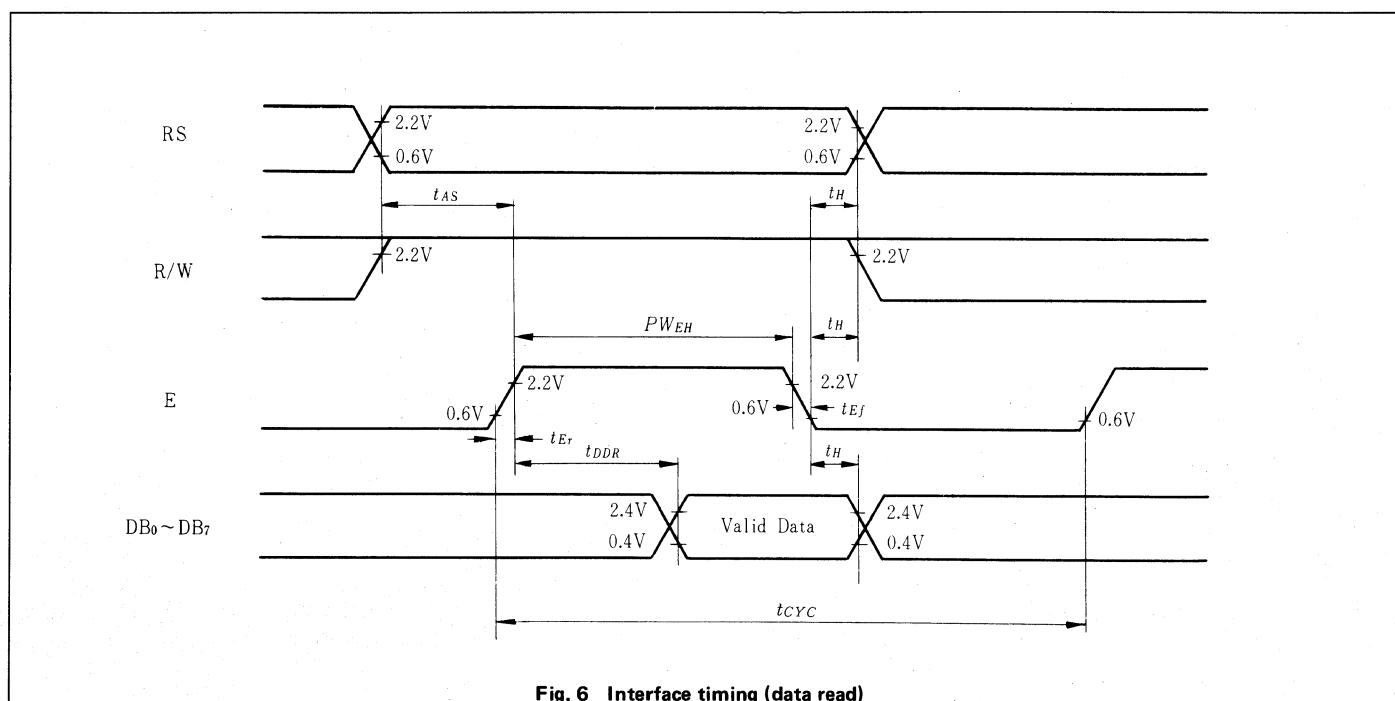


Fig. 6 Interface timing (data read)

LM052L

- 16 Character x 2 lines
- Built-in control LSI HD44780 type (see page 23)
- +5V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 80W x 36H x 12D (max.) mm
 Effective display area 64.5W x 13.8H mm
 Character size (5 x 10 dots) 2.95W x 3.8H mm
 Pitch 3.65 mm
 Dot size 0.55W x 0.5H mm
 Weight about 25 g

ABSOLUTE MAXIMUM RATINGS

min. max.

Power supply for logic ($V_{DD}-V_{SS}$) 0 7.0 V
 Power supply for LCD drive ($V_{DD}-V_O$) 0 13.5 V
 Input voltage (V_i) V_{SS} V_{DD} V
 Operating temperature (T_a) 0 50°C
 Storage temperature (T_{stg}) -20 70°C

ELECTRICAL CHARACTERISTICS

$T_a = 25^\circ C$, $V_{DD} = 5.0 V \pm 0.25 V$

Input "high" voltage (V_{iH}) 2.2 V min.
 Input "low" voltage (V_{iL}) 0.6 V max.
 Output high voltage (V_{OH}) ($I_{OH} = 0.2$ mA) 2.4 V min.
 Output low voltage (V_{OL}) ($I_{OL} = 1.2$ mA) 0.4 V max.
 Power supply current (I_{DD}) ($V_{DD} = 5.0 V$) 1.0 mA typ.
 3.0 mA max.
 Power supply for LCD drive (Recommended) ($V_{DD}-V_O$)
 Du=1/16
 at $T_a = 0^\circ C$ 4.2 V typ.
 at $T_a = 25^\circ C$ 4.0 V typ.
 at $T_a = 50^\circ C$ 3.6 V typ.

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------|--------|-------------------------------------|
| 1 | V_{SS} | - | 0V |
| 2 | V_{DD} | - | +5V |
| 3 | V_O | - | Power supply |
| 4 | RS | H/L | |
| 5 | R/W | H/L | |
| 6 | E | H, H-L | Enable signal |
| 7 | DB0 | H/L | Data bus line Note (1), Note (2) |
| 8 | DB1 | H/L | |
| 9 | DB2 | H/L | |
| 10 | DB3 | H/L | |
| 11 | DB4 | H/L | |
| 12 | DB5 | H/L | |
| 13 | DB6 | H/L | |
| 14 | DB7 | H/L | |

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_7$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_7$, when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$, when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.

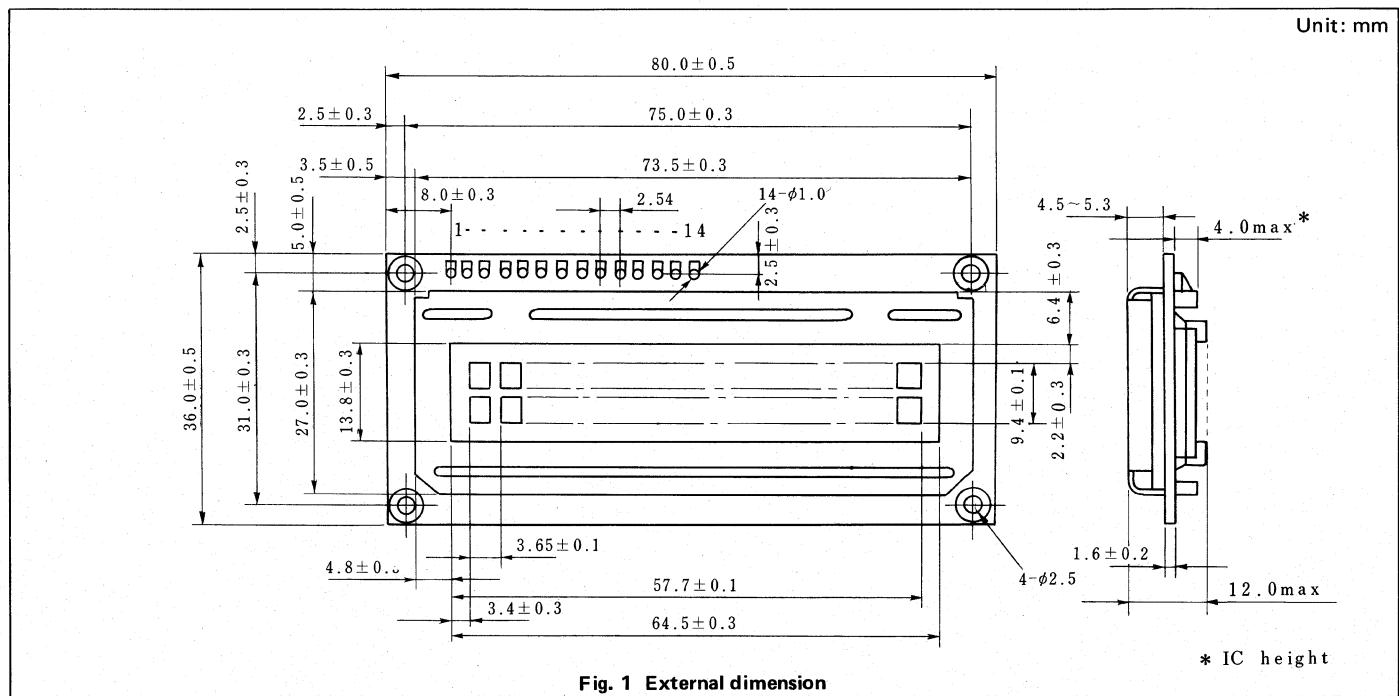


Fig. 1 External dimension

Unit: mm

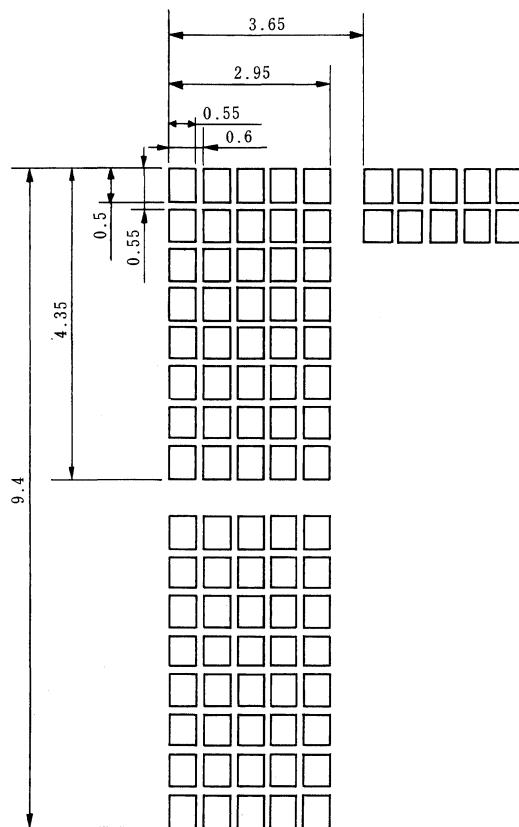


Fig. 2 Display pattern

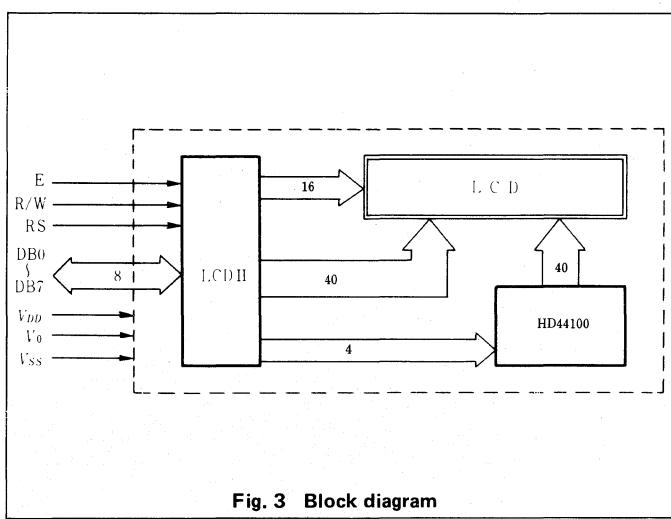


Fig. 3 Block diagram

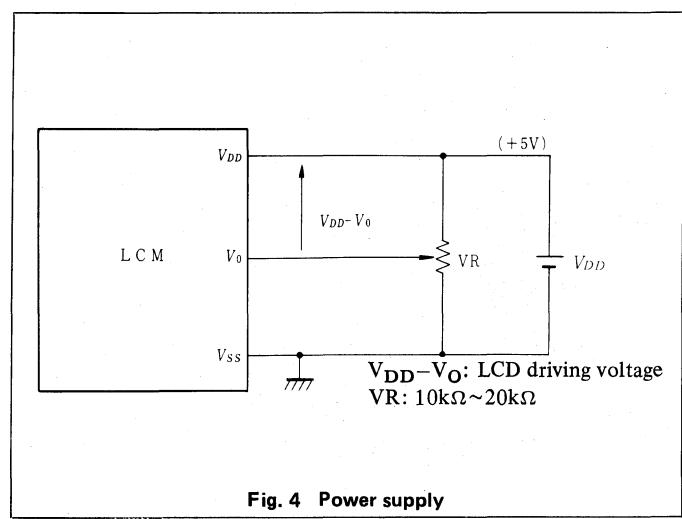


Fig. 4 Power supply

TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|---------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{WEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

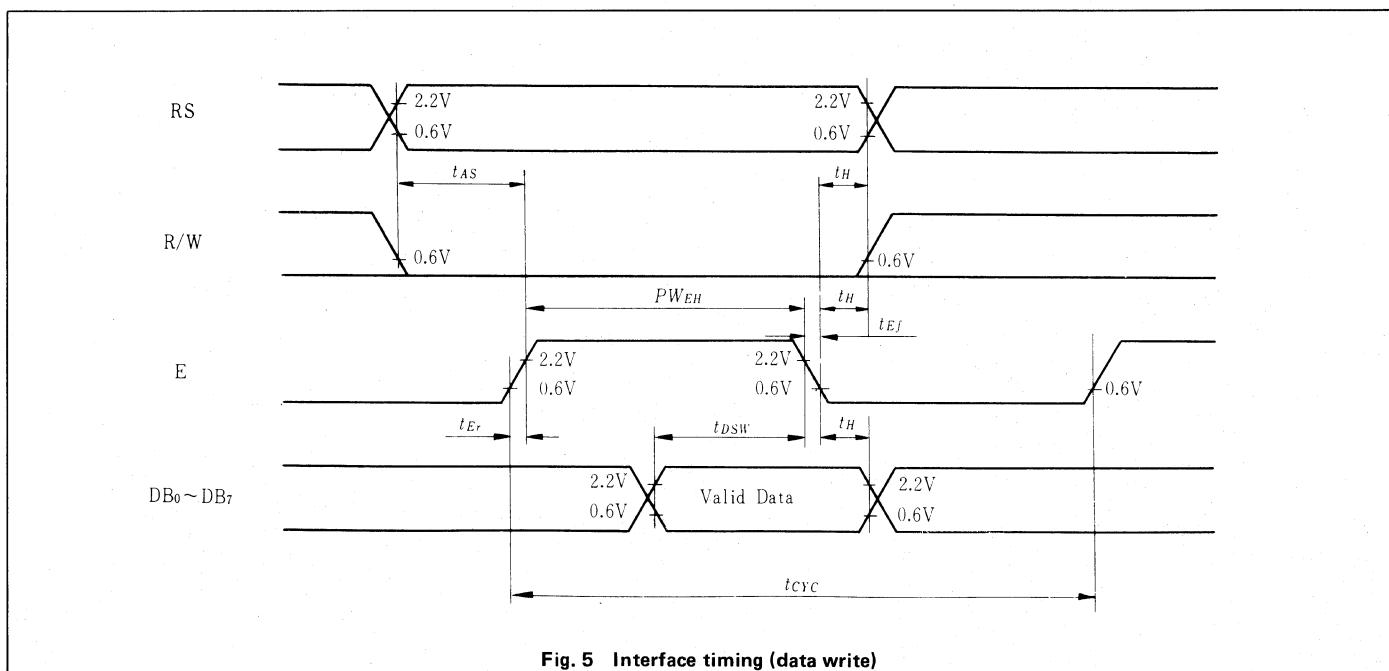


Fig. 5 Interface timing (data write)

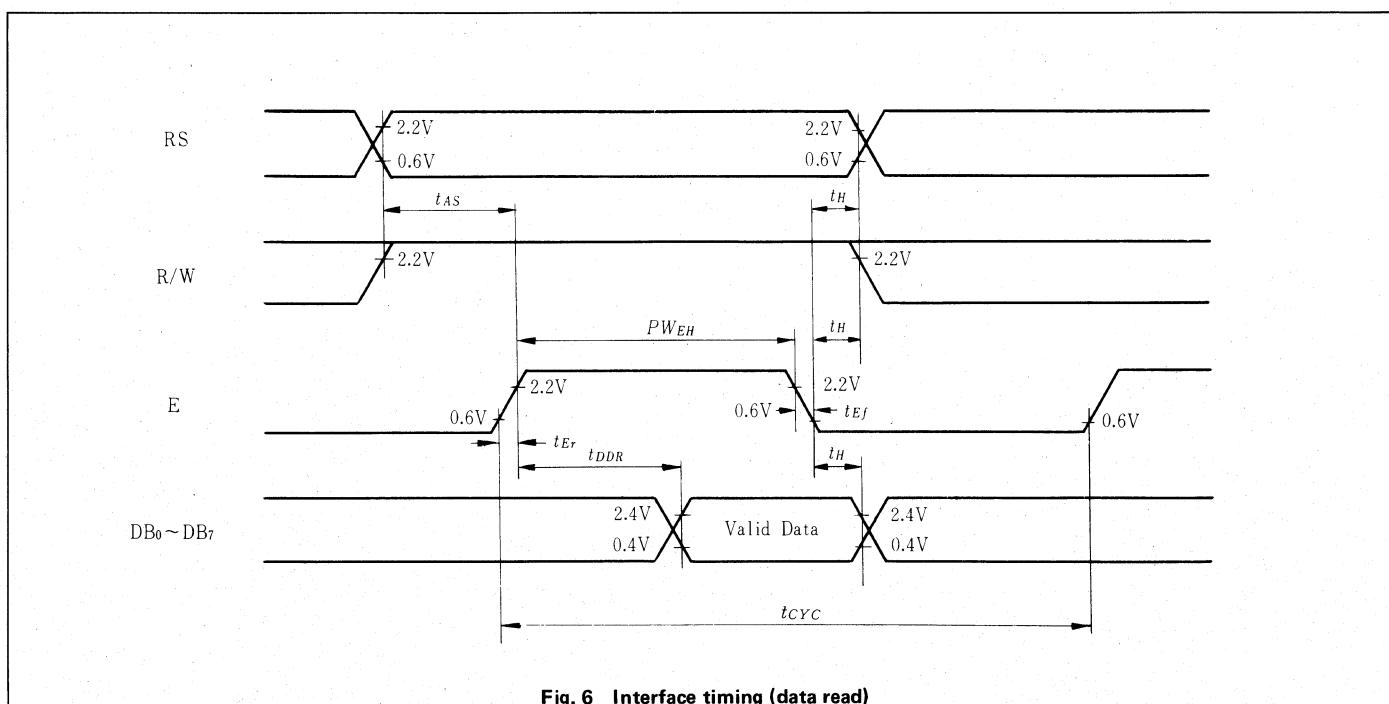


Fig. 6 Interface timing (data read)

LM016L

- 16 Character x 2 lines
- Built-in control LSI HD44780 type (see page 23)
- +5V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 84W x 44H x 12D (max.) mm
 Effective display area 61W x 15.8H mm
 Character size (5 x 7 dots) 2.96W x 4.86H mm
 Pitch 3.55 mm
 Dot size 0.56W x 0.66H mm
 Weight about 25 g

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|--|----------|----------|
| Power supply for logic ($V_{DD} - V_{SS}$) | 0 | 7.0 V |
| Power supply for LCD drive | | |
| ($V_{DD} - V_O$) | 0 | 13.5 V |
| Input voltage (V_i) | V_{SS} | V_{DD} |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 70°C |

ELECTRICAL CHARACTERISTICS

$T_a = 25^\circ C$, $V_{DD} = 5.0 V \pm 0.25 V$
 Input "high" voltage (V_{iH}) 2.2 V min.
 Input "low" voltage (V_{iL}) 0.6 V max.
 Output high voltage (V_{OH}) ($-I_{OH} = 0.2 \text{ mA}$) 2.4 V min.
 Output low voltage (V_{OL}) ($I_{OL} = 1.2 \text{ mA}$) 0.4 V max.
 Power supply current (I_{DD}) ($V_{DD} = 5.0 V$) 1.0 mA typ.
 3.0 mA max.
 Power supply for LCD drive (Recommended) ($V_{DD} - V_O$)
 Du=1/16
 at $T_a = 0^\circ C$ 4.6 V typ.
 at $T_a = 25^\circ C$ 4.4 V typ.
 at $T_a = 50^\circ C$ 4.2 V typ.

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------|--------|---|
| 1 | V_{SS} | — | Power supply |
| 2 | V_{DD} | — | |
| 3 | V_O | — | |
| 4 | RS | H/L | L: Instruction code input H: Data input |
| 5 | R/W | H/L | H: Data read (LCD module → MPU) L: Data write (LCD module ← MPU) |
| 6 | E | H, H→L | Enable signal |
| 7 | DB0 | H/L | Data bus line Note (1), Note (2) |
| 8 | DB1 | H/L | |
| 9 | DB2 | H/L | |
| 10 | DB3 | H/L | |
| 11 | DB4 | H/L | |
| 12 | DB5 | H/L | |
| 13 | DB6 | H/L | |
| 14 | DB7 | H/L | |

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_7$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_7$, when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$, when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.

Unit: mm

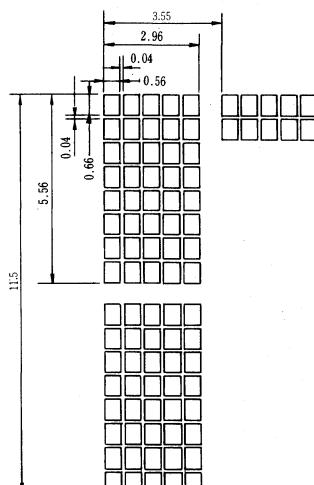
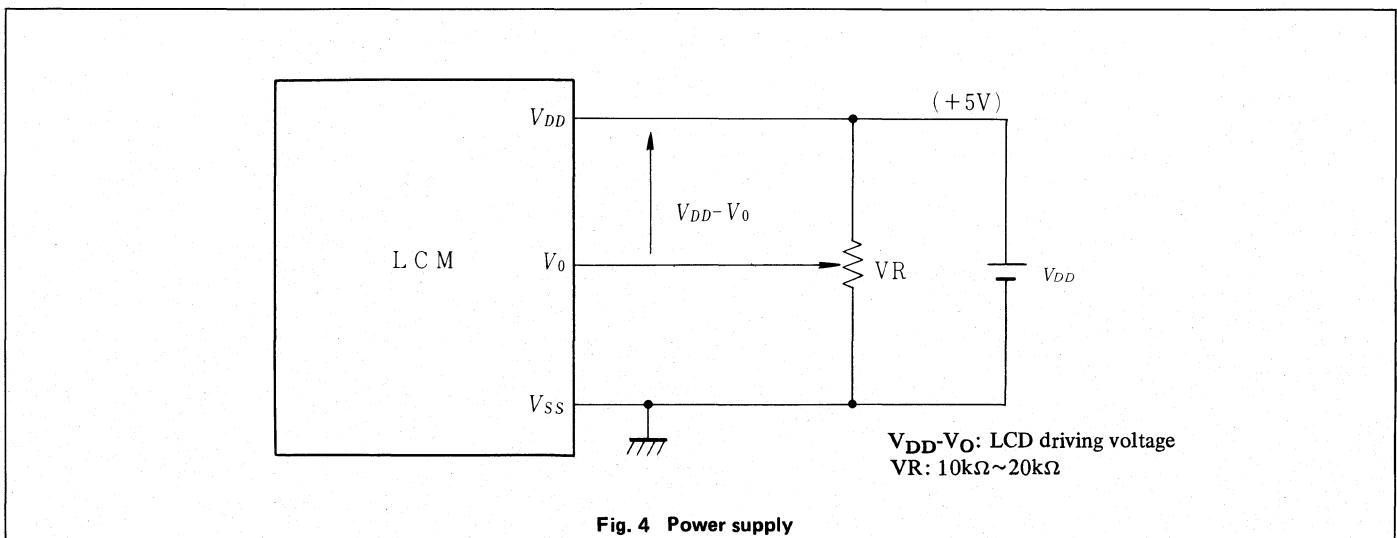
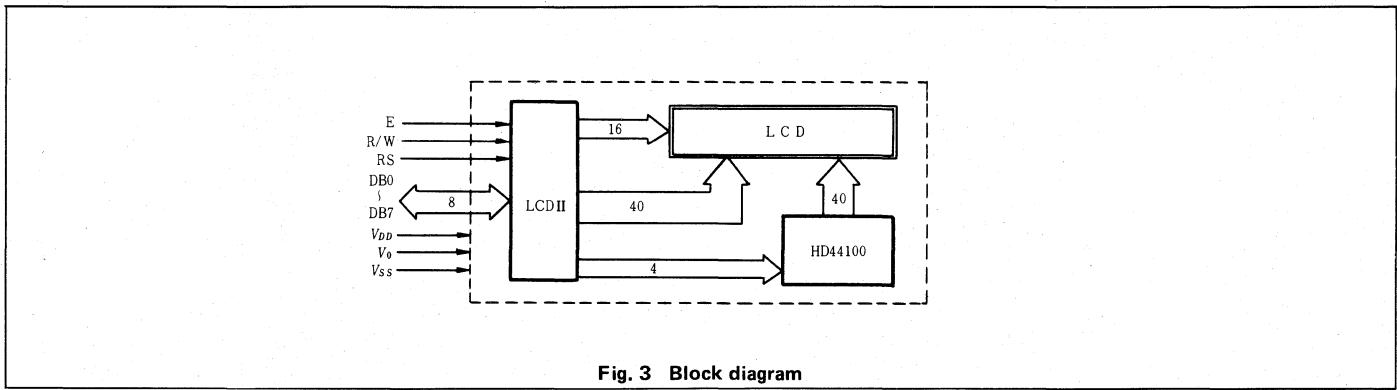
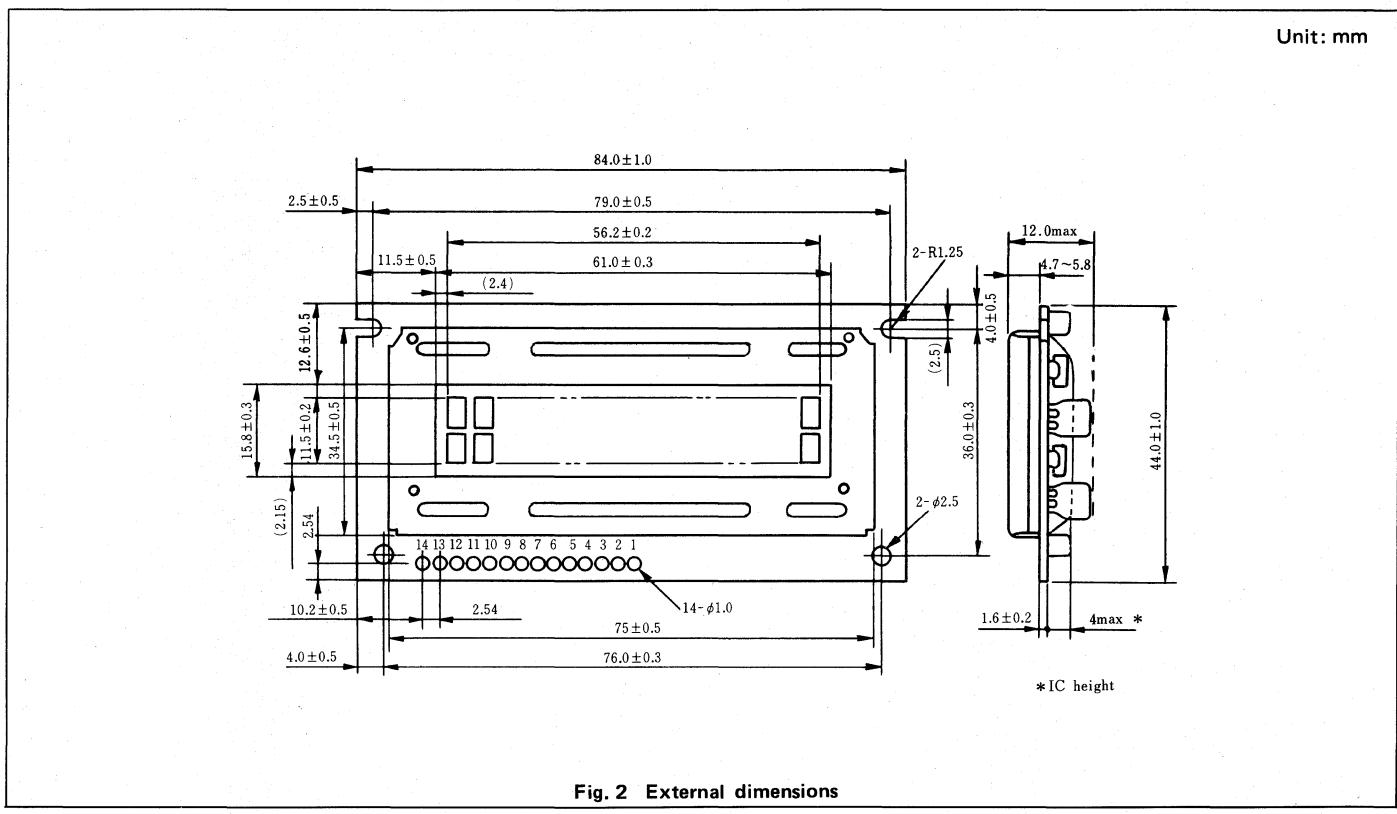


Fig. 1 Display pattern



TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|---------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{WEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

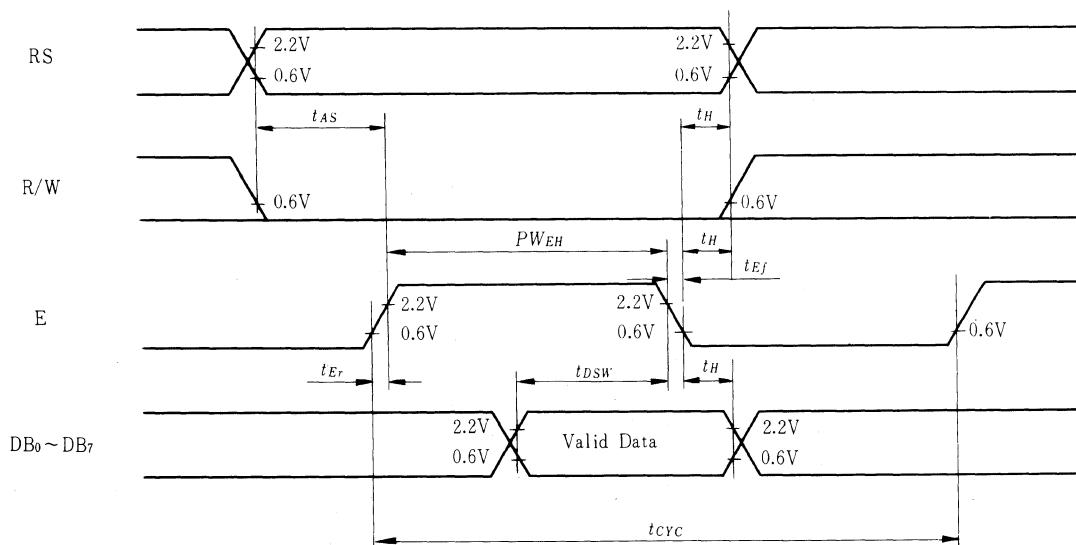


Fig. 5 Interface timing (data write)

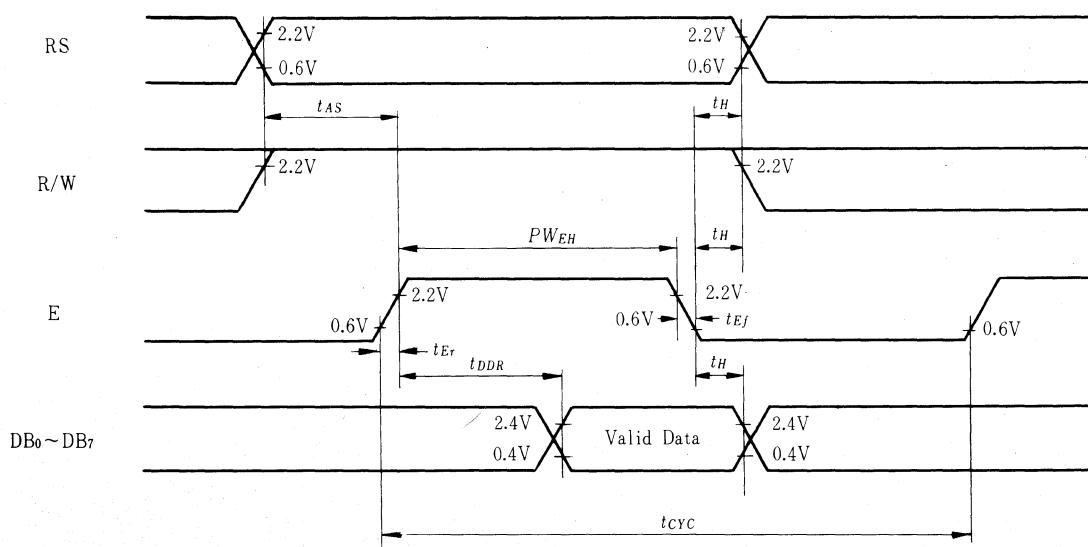


Fig. 6 Interface timing (data read)

LM032L

- 20 Character x 2 lines
- Built-in control LSI HD44780 type (see page 23)
- +5V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 116W x 39H (max.) x 13D (max.) mm
 Effective display area 83W x 18.6H mm
 Character size (5 x 7 dots) 3.2W x 4.85H mm
 Pitch 3.7 mm
 Dot size 0.6W x 0.65H mm
 Weight about 50 g

| | min. | max. |
|--|----------|------------|
| Power supply for logic ($V_{DD} - V_{SS}$) | 0 | 7.0 V |
| Power supply for LCD drive ($V_{DD} - V_O$) | 0 | 13.5 V |
| Input voltage (V_i) | V_{SS} | V_{DD} V |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 70°C |

ELECTRICAL CHARACTERISTICS

$T_a = 25^\circ C$, $V_{DD} = 5.0 V \pm 0.25 V$

| | |
|---|----------------------------|
| Input "high" voltage (V_{iH}) | 2.2 V min. |
| Input "low" voltage (V_{iL}) | 0.6 V max. |
| Output high voltage (V_{OH}) ($-I_{OH} = 0.2 mA$) . . | 2.4 V min. |
| Output low voltage (V_{OL}) ($I_{OL} = 1.2 mA$) . . . | 0.4 V max. |
| Power supply current (I_{DD}) ($V_{DD} = 5.0 V$) . . | 2.0 mA typ. 3.0 mA max. |
| Power supply for LCD drive (Recommended) ($V_{DD} - V_O$) | $D_u = 1/16$ |
| at $T_a = 0^\circ C$ | 4.8 V typ. |
| at $T_a = 25^\circ C$ | 4.4 V typ. |
| at $T_a = 50^\circ C$ | 3.6 V typ. |

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------|----------------------|--|
| 1 | V_{SS} | — | 0V Power supply |
| 2 | V_{DD} | — | |
| 3 | V_O | — | |
| 4 | RS | H/L | L: Instruction code input H: Data input |
| 5 | R/W | H/L | H: Data read (LCD module \rightarrow MPU) L: Data write (LCD module \leftarrow MPU) |
| 6 | E | H, H \rightarrow L | Enable signal |
| 7 | DB0 | H/L | Data bus line Note (1), Note (2) |
| 8 | DB1 | H/L | |
| 9 | DB2 | H/L | |
| 10 | DB3 | H/L | |
| 11 | DB4 | H/L | |
| 12 | DB5 | H/L | |
| 13 | DB6 | H/L | |
| 14 | DB7 | H/L | |

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_7$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_7$, when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$, when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.

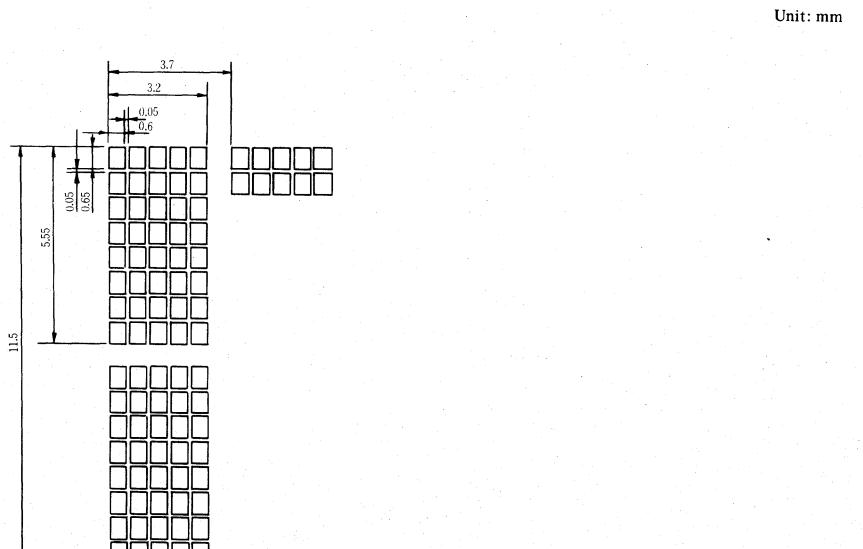


Fig. 1 Display pattern

Unit: mm

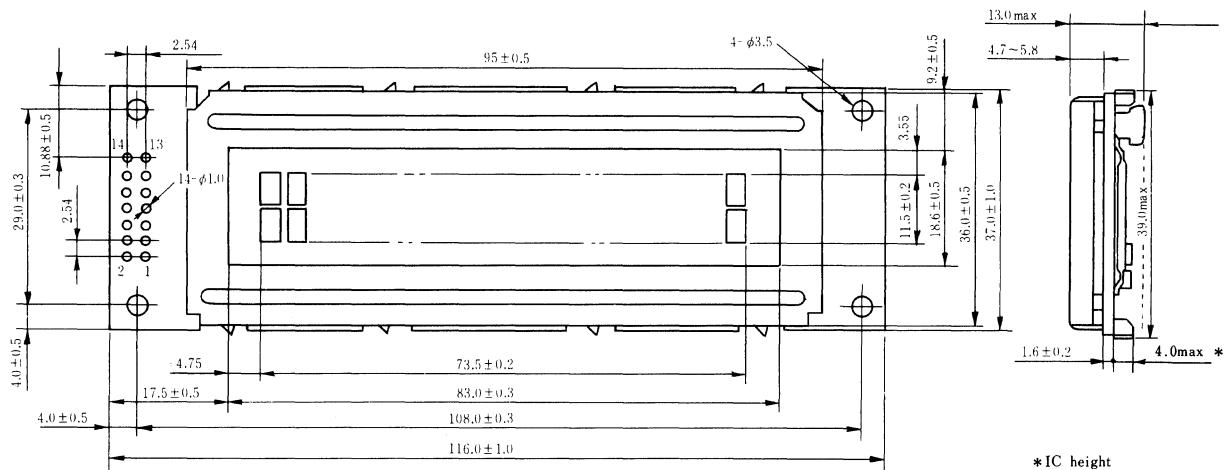


Fig. 2 External dimensions

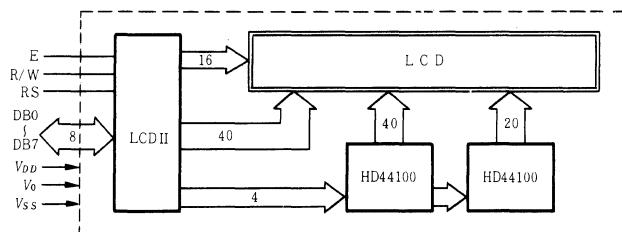


Fig. 3 Block diagram

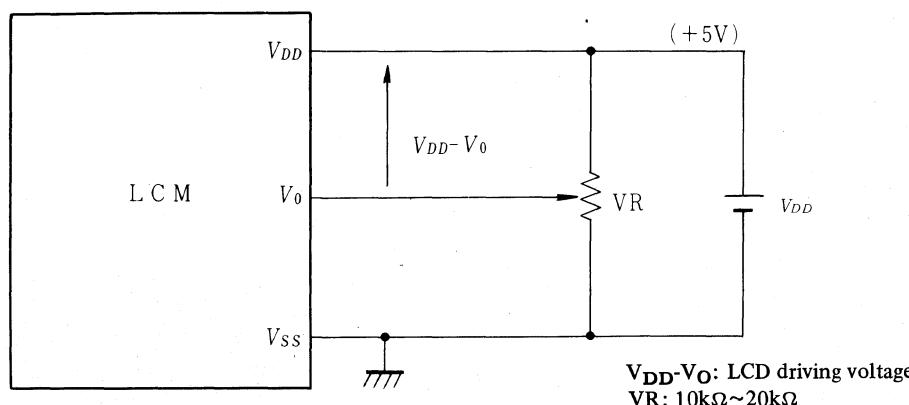


Fig. 4 Power supply

TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|---------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{WEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

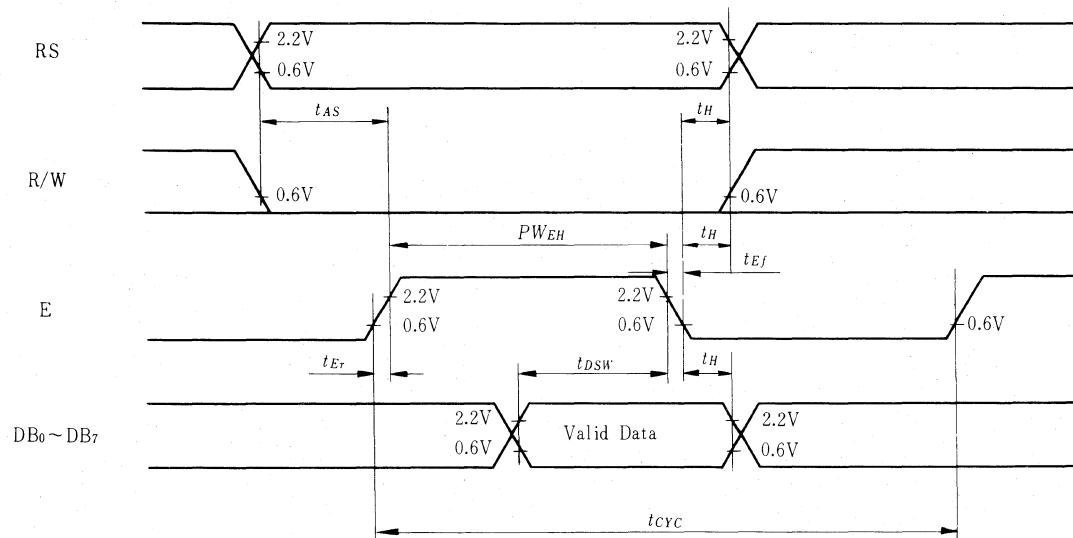


Fig. 5 Interface timing (data write)

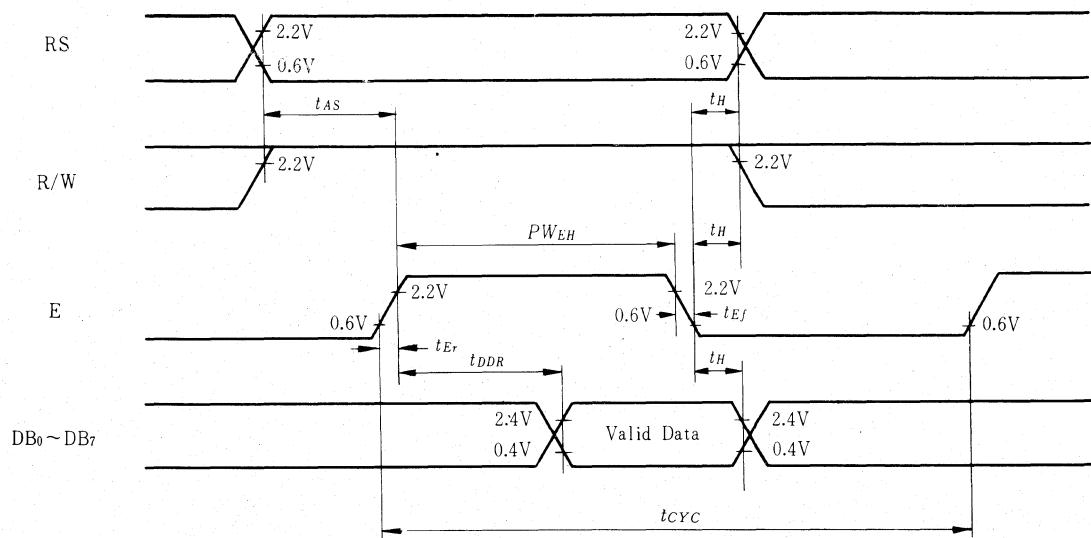


Fig. 6 Interface timing (data read)

LM017L

- 32 Character x 2 lines
- Built-in control LSI HD44780 type (see page 23)
- +5V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 174.5W x 33H (max.) x 13.4D (max.) mm
 Effective display area 141.19W x 16.75H mm
 Character size (5 x 7 dots) 3.45W x 4.85H mm
 Pitch 4.2 mm
 Dot size 0.65W x 0.65H mm
 Weight about 60g

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|---|----------|----------|
| Power supply for logic ($V_{DD} - V_{SS}$) | 0 | 7.0V |
| power supply for LCD drive ($V_{DD} - V_O$) | 0 | 13.5V |
| Input voltage (V_i) | V_{SS} | V_{DD} |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20°C | 70°C |

ELECTRICAL CHARACTERISTICS

| | |
|--|----------------------------|
| Ta=25°C, $V_{DD}=5.0V \pm 0.25V$ | |
| Input "high" voltage (V_{IH}) | 2.2V min. |
| Input "low" voltage (V_{IL}) | 0.6V max. |
| Output high voltage (V_{OH}) ($-I_{OH}=0.2mA$) | 2.4V min. |
| Output low voltage (V_{OL}) ($I_{OL}=1.2mA$) | 0.4V min. |
| Power supply current (I_{DD}) ($V_{DD}=5.0V$) | 1.0 mA typ. 3.0 mA max. |
| Power supply for LCD drive (Recommended) ($V_{DD} - V_O$) | Du=1/16 |
| at $T_a=0^\circ C$ | 4.6 V typ. |
| at $T_a=25^\circ C$ | 4.4 V typ. |
| at $T_a=50^\circ C$ | 4.2 V typ. |

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------|--------|--|
| 1 | V_{SS} | — | 0V |
| 2 | V_{DD} | — | +5V |
| 3 | V_O | — | — |
| 4 | RS | H/L | L: Instruction code input H: Data input |
| 5 | R/W | H/L | |
| 6 | E | H, H→L | Enable signal |
| 7 | DB0 | H/L | Data bus line Note (1), Note (2) |
| 8 | DB1 | H/L | |
| 9 | DB2 | H/L | |
| 10 | DB3 | H/L | |
| 11 | DB4 | H/L | |
| 12 | DB5 | H/L | |
| 13 | DB6 | H/L | |
| 14 | DB7 | H/L | |

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_7$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_7$ when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$ when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.

Unit: mm

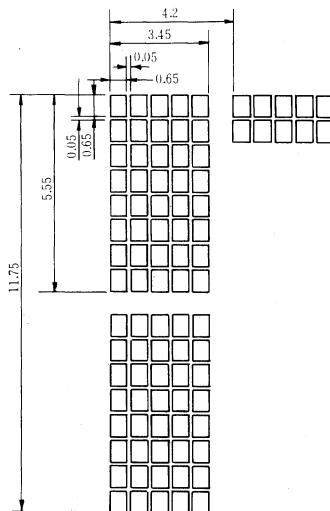


Fig. 1 Display pattern

Unit: mm

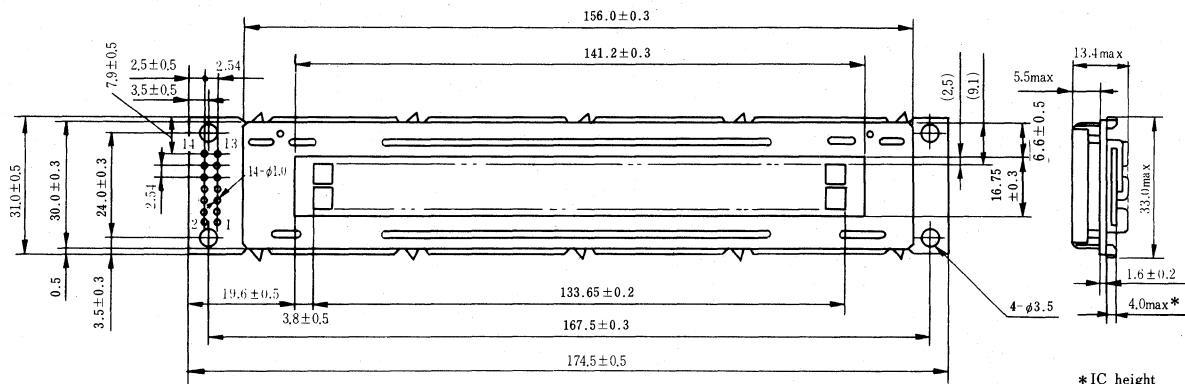


Fig. 2 External dimensions

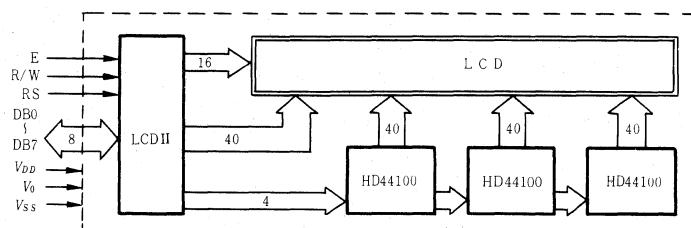


Fig. 3 Block diagram

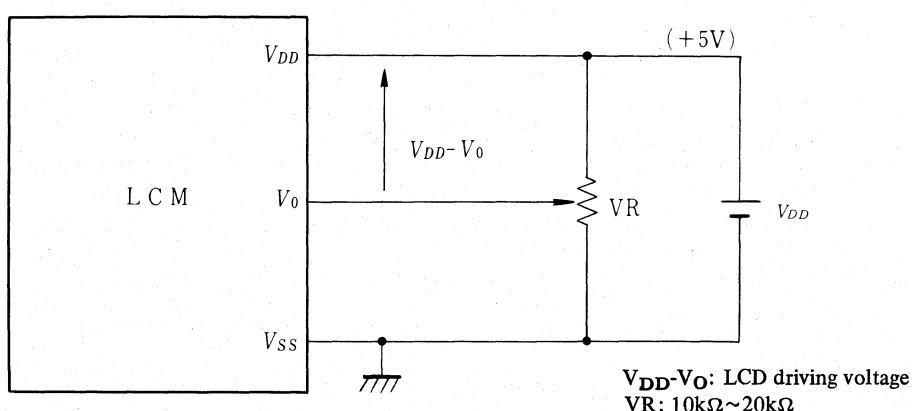


Fig. 4 Power supply

TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|---------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{WEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

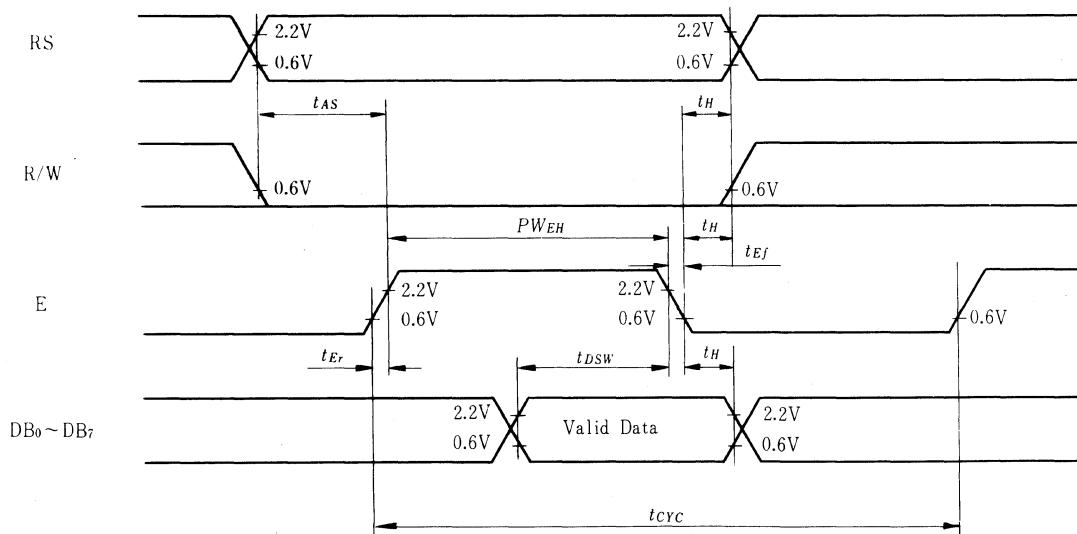


Fig. 5 Interface timing (data write)

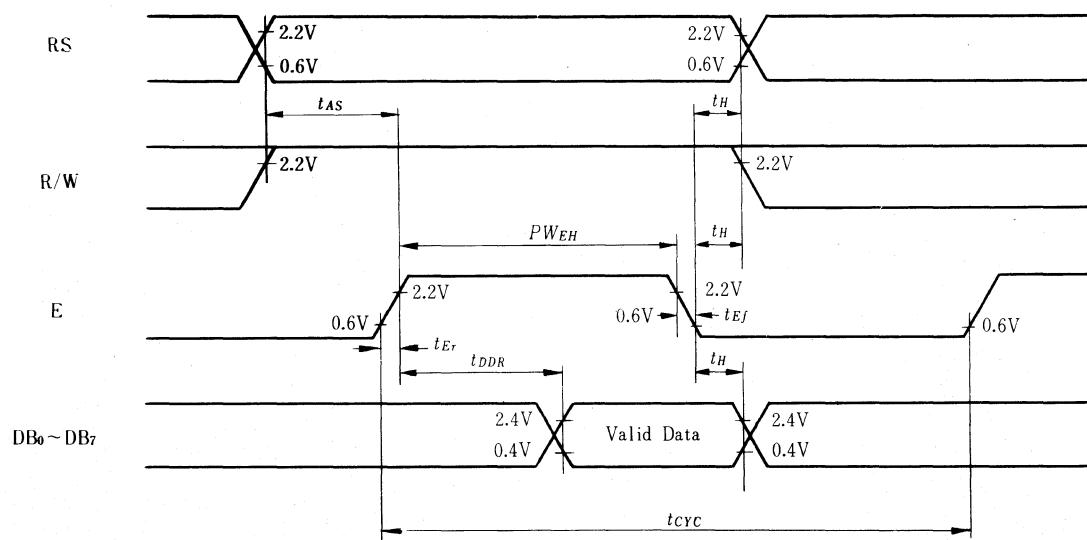


Fig. 6 Interface timing (data read)

LM018L

- 40 Character x 2 lines
- Built-in control LSI HD44780 type (see page 23)
- +5V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 182W x 35.5H (max.) x 13D (max.) mm
 Effective display area 154.4W x 15.8H mm
 Character size (5 x 7 dots) 3.2W x 4.85H mm
 Pitch 3.7 mm
 Dot size 0.6W x 0.65H mm
 Weight about 65g

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|---|----------|----------|
| Power supply for logic ($V_{DD} - V_{SS}$) | 0 | 7.0V |
| Power supply for LCD drive ($V_{DD} - V_O$) | 0 | 13.5V |
| Input voltage (V_i) | V_{SS} | V_{DD} |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 70°C |

ELECTRICAL CHARACTERISTICS

| | |
|---|---------------------------|
| Ta=25°C, $V_{DD}=5.0V \pm 0.25V$ | |
| Input "high" voltage (V_{IH}) | 2.2V min. |
| Input "low" voltage (V_{IL}) | 0.6V max. |
| Output high voltage (V_{OH}) ($-I_{OH}=0.2mA$) . . . | 2.4V min. |
| Output low voltage (V_{OL}) ($I_{OL}=1.2mA$) . . . | 0.4V max. |
| Power supply current (I_{DD}) ($V_{DD}=5.0V$) . . . | 1.0 mA typ. 3.0mA max. |
| Power supply for LCD drive (Recommended) ($V_{DD} - V_O$) | Du=1/16 |
| at $T_a=0^\circ C$ | 4.6 V typ. |
| at $T_a=25^\circ C$ | 4.4 V typ. |
| at $T_a=50^\circ C$ | 4.2 V typ. |

OPTICAL DATA See page 8

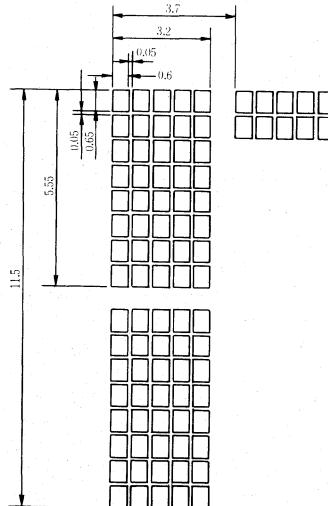
INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function | |
|---------|----------|--------|---|--------------|
| 1 | V_{SS} | — | 0V | Power supply |
| 2 | V_{DD} | — | +5V | |
| 3 | V_O | — | — | |
| 4 | RS | H/L | L: Instruction code input H: Data input | |
| 5 | R/W | H/L | H: Data read (LCD module → MPU) L: Data write (LCD module ← MPU) | |
| 6 | E | H, H→L | Enable signal | |
| 7 | DB0 | H/L | Data bus line Note (1), Note (2) | |
| 8 | DB1 | H/L | | |
| 9 | DB2 | H/L | | |
| 10 | DB3 | H/L | | |
| 11 | DB4 | H/L | | |
| 12 | DB5 | H/L | | |
| 13 | DB6 | H/L | | |
| 14 | DB7 | H/L | | |

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_1$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_1$, when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$ when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.



Unit: mm

Fig. 1 Display pattern

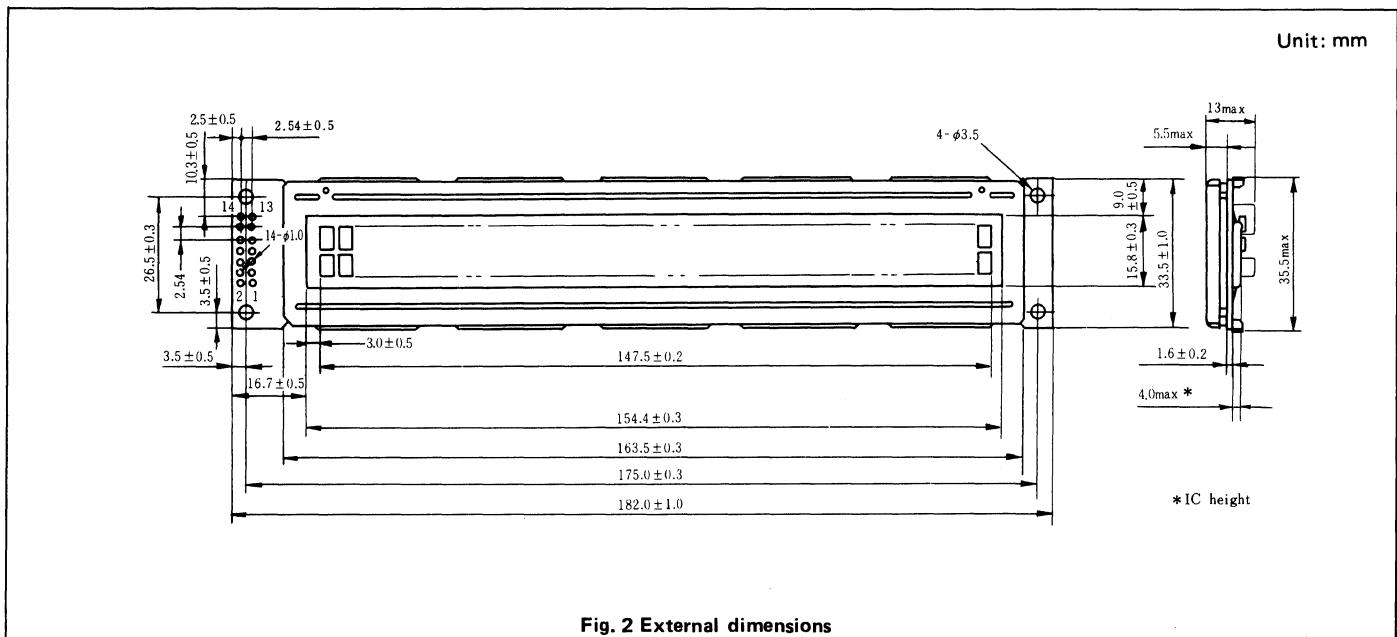


Fig. 2 External dimensions

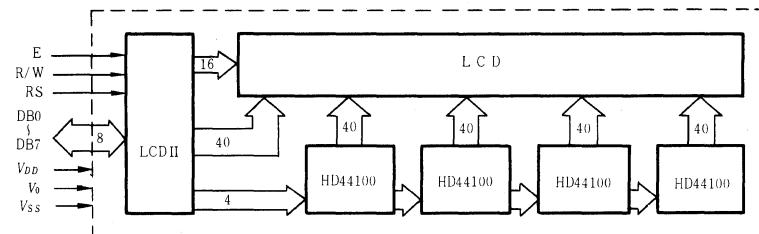


Fig. 3 Block diagram

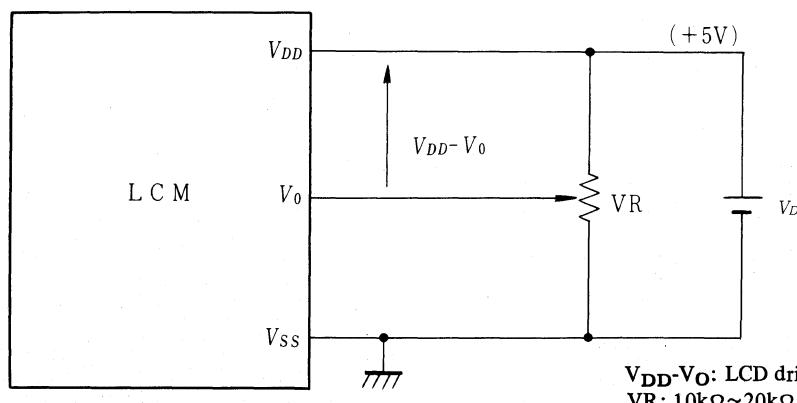


Fig. 4 Power supply

TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|---------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{wEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

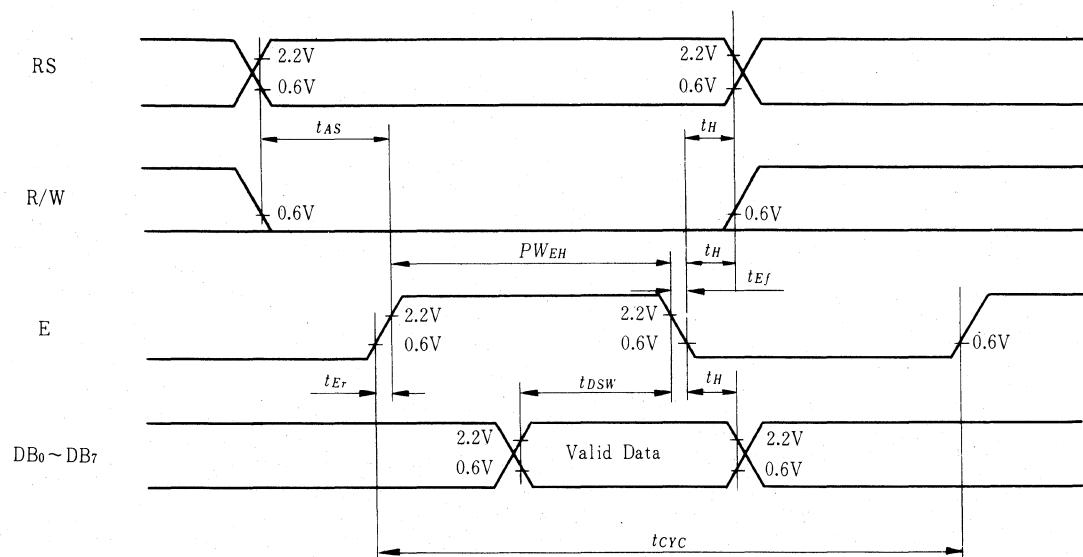


Fig. 5 Interface timing (data write)

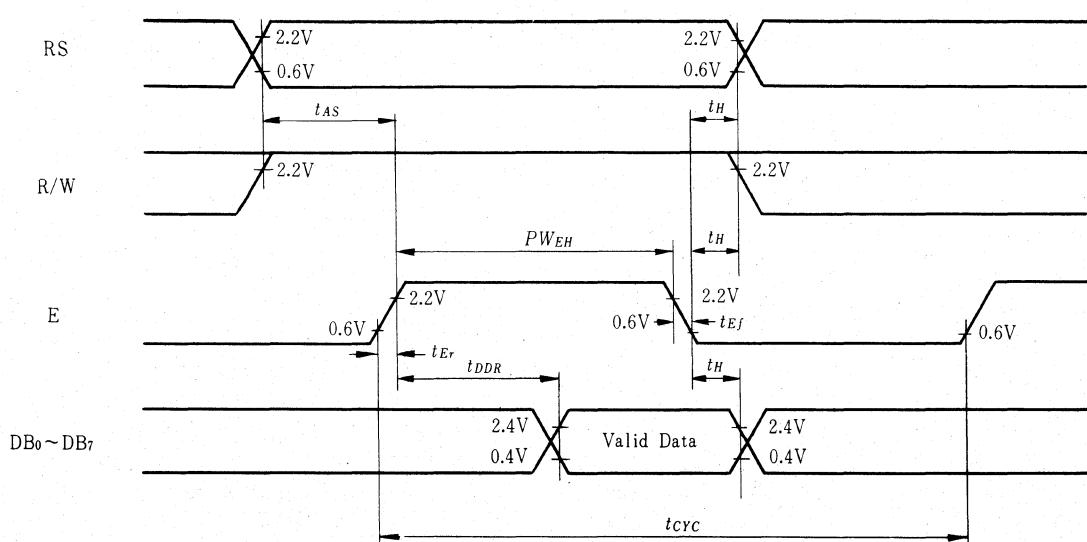


Fig. 6 Interface timing (data read)

LMO41L

- 16 Character x 4 lines
- Built-in control LSI HD44780 type (see page 23)
- +5V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 87W x 60H x 12D (max.) mm
 Effective display area 61.8W x 25.2H mm
 Character size (5 x 7 dots) 2.95W x 4.15H mm
 Pitch 3.55 mm
 Dot size 0.55W x 0.55H mm
 Weight about 60g

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|---|----------|----------|
| Power supply for logic ($V_{DD} - V_{SS}$) | 0 | 7.0V |
| Power supply for LCD drive ($V_{DD} - V_O$) | 0 | 13.5V |
| Input voltage (V_i) | V_{SS} | V_{DD} |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 70°C |

ELECTRICAL CHARACTERISTICS

| | |
|--|---------------------------|
| Ta=25°C, $V_{DD}=5.0V \pm 0.25V$ | |
| Input "high" voltage (V_{IH}) | 2.2V min. |
| Input "low" voltage (V_{IL}) | 0.6V max. |
| Output high voltage (V_{OH}) ($-I_{OH}=0.2mA$) | 2.4V max. |
| Output low voltage (V_{OL}) ($I_{OL}=1.2mA$) | 0.4V max. |
| Power supply current (I_{DD}) ($V_{DD}=5.0V$) | 1.0 mA typ. 3.0mA max. |
| Power supply for LCD drive (Recommended) ($V_{DD} - V_O$) | Du=1/16 |
| at $T_a=0^\circ C$ | 4.6 V typ. |
| at $T_a=25^\circ C$ | 4.4 V typ. |
| at $T_a=50^\circ C$ | 4.2 V typ. |

OPTICAL DATA See page 8

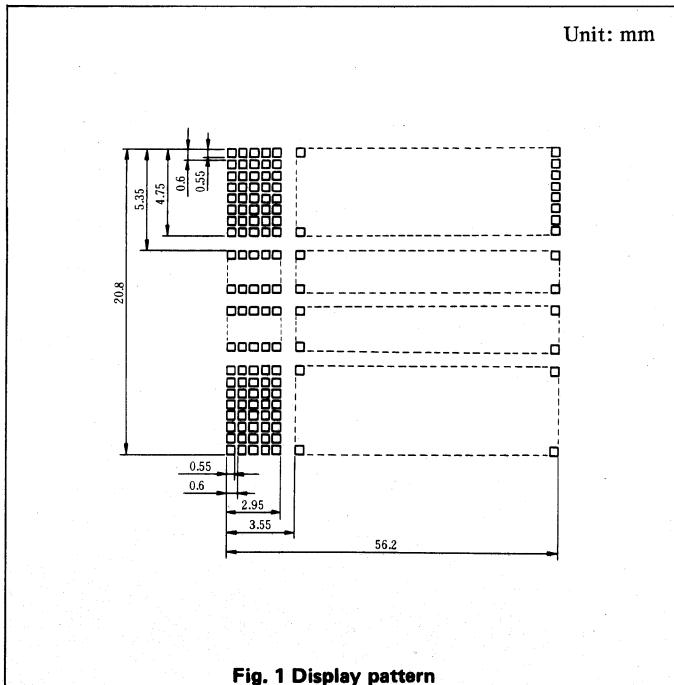


Fig. 1 Display pattern

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------|--------|-------------------------------------|
| 1 | V_{SS} | — | 0V |
| 2 | V_{DD} | — | +5V |
| 3 | V_O | — | Power supply |
| 4 | RS | H/L | |
| 5 | R/W | H/L | |
| 6 | E | H, H→L | Enable signal |
| 7 | DB0 | H/L | Data bus line Note (1), Note (2) |
| 8 | DB1 | H/L | |
| 9 | DB2 | H/L | |
| 10 | DB3 | H/L | |
| 11 | DB4 | H/L | |
| 12 | DB5 | H/L | |
| 13 | DB6 | H/L | |
| 14 | DB7 | H/L | |

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_1$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_1$, when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$ when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.

DISPLAY POSITION AND DD RAM ADDRESS

| Character No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1st line | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 8A | 8B | 8C | 8D | 8E | 8F |
| 2nd line | C0 | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | CA | CB | CC | CD | CE | CF |
| 3rd line | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 9A | 9B | 9C | 9D | 9E | 9F |
| 4th line | D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | DA | DB | DC | DD | DE | DF |

Note:

- (1) 80 ~ DF are described in hexadecimal for DD RAM address.
- (2) The set to HD44780 are "N = "1", F = "0" (2 lines 5 x 7 + cursor)."'
- (3) DD RAM address is no series in line. Address set is necessary to change the lines.
- (4) Circuit is equal to 32 characters by 2 lines type.
- (5) In case of executing shift, first line and third line are shifted continuously, also second line and fourth line. Therefore it happens that display of third line is transferred to first line.

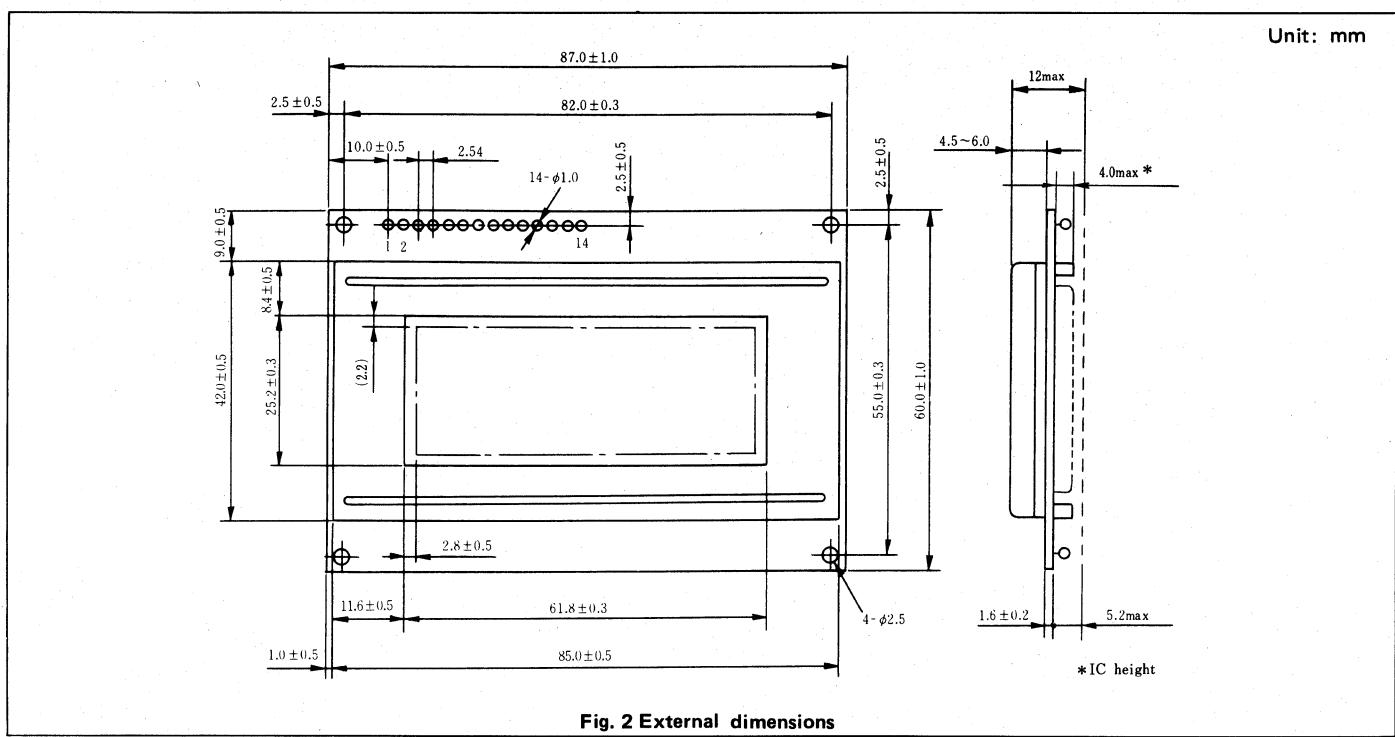


Fig. 2 External dimensions

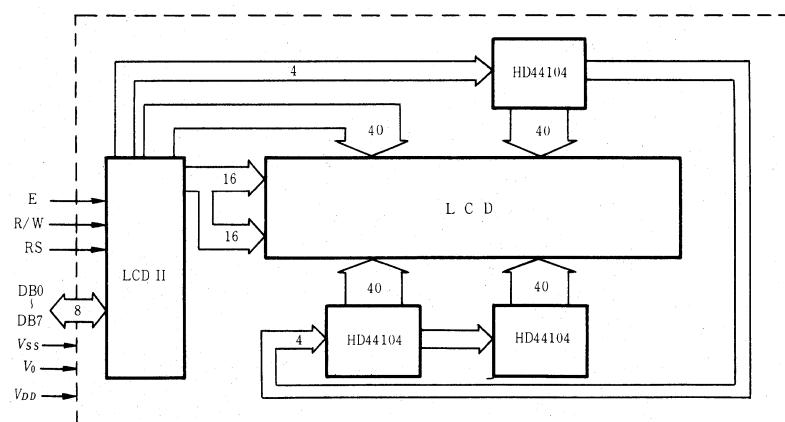


Fig. 3 Block diagram

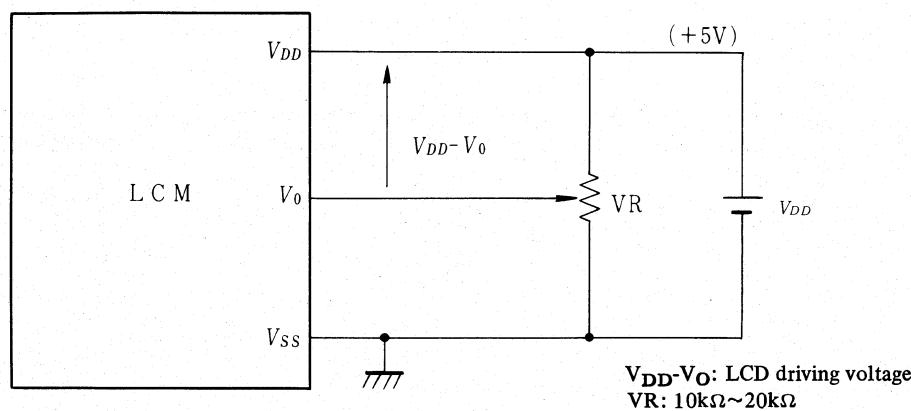


Fig. 4 Power supply

TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{WEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

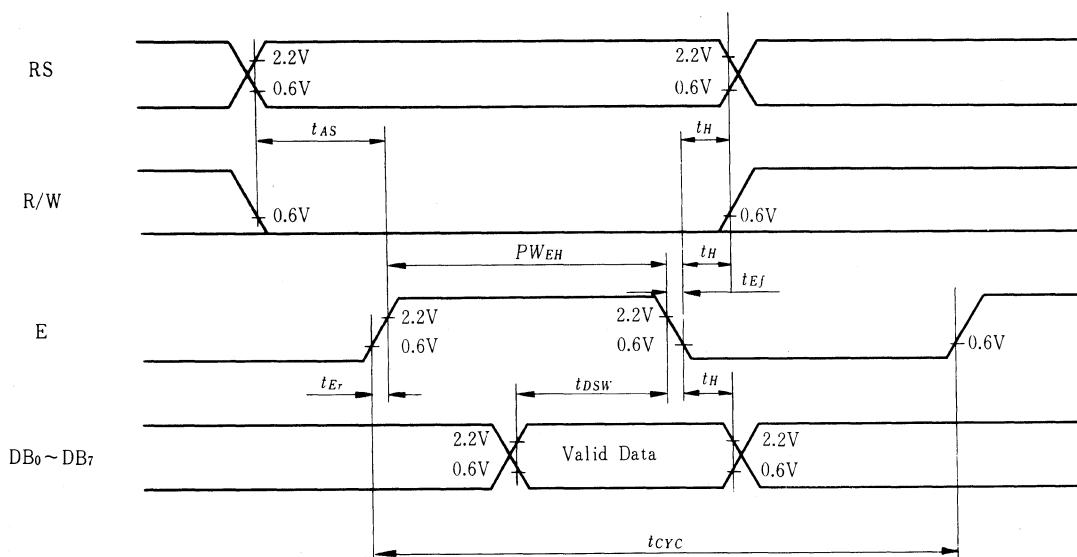


Fig. 5 Interface timing (data write)

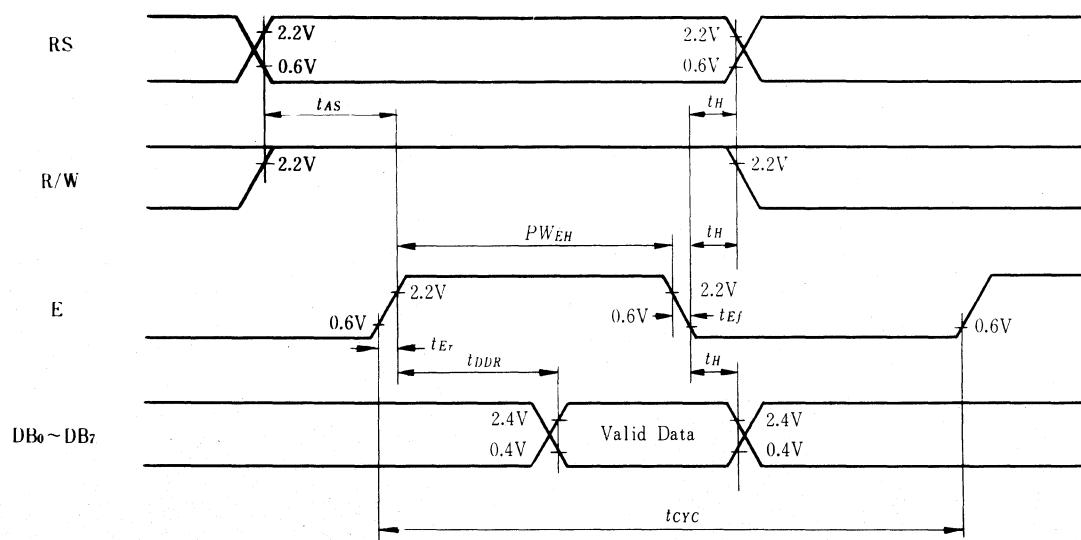


Fig. 6 Interface timing (data read)

LM044L

- 20 Character x 4 lines
- Built-in control LSI HD44780 type (see page 23)
- +5V single power supply

MECHANICAL DATA (Nominal dimensions)

Module size 98W x 60H x 12D (max.) mm
 Effective display area 76.0W x 25.2H mm
 Character size (5 x 7 dots) 2.95W x 4.15H mm
 Pitch 3.55 mm
 Dot size 0.55W x 0.55H mm
 Weight about 65 g

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|---|----------|------------|
| Power supply for logic (V_{DD} – V_{SS}) | 0 | 7.0 V |
| Power supply for LCD drive (V_{DD} – V_O) | 0 | 13.5 V |
| Input voltage (V_I) | V_{SS} | V_{DD} V |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 70°C |

ELECTRICAL CHARACTERISTICS

| | |
|---|----------------------------|
| Ta = 25°C, V_{DD} = 5.0 V ± 0.25 V | |
| Input "high" voltage (V_{IH}) | 2.2 V min. |
| Input "low" voltage (V_{IL}) | 0.6 V max. |
| Output high voltage (V_{OH}) ($I_{OH} = 0.2$ mA) | 2.4 V min. |
| Output low voltage (V_{OL}) ($I_{OL} = 1.2$ mA) | 0.4 V max |
| Power supply current (I_{DD}) ($V_{DD} = 5.0$ V) | 1.0 mA typ. 3.5 mA max. |
| Power supply for LCD drive (Recommended) (V_{DD} – V_O) | Du=1/16 |
| at $T_a = 0^\circ\text{C}$ | 4.6 V typ. |
| at $T_a = 25^\circ\text{C}$ | 4.4 V typ. |
| at $T_a = 50^\circ\text{C}$ | 4.2 V typ. |

OPTICAL DATA See page 8

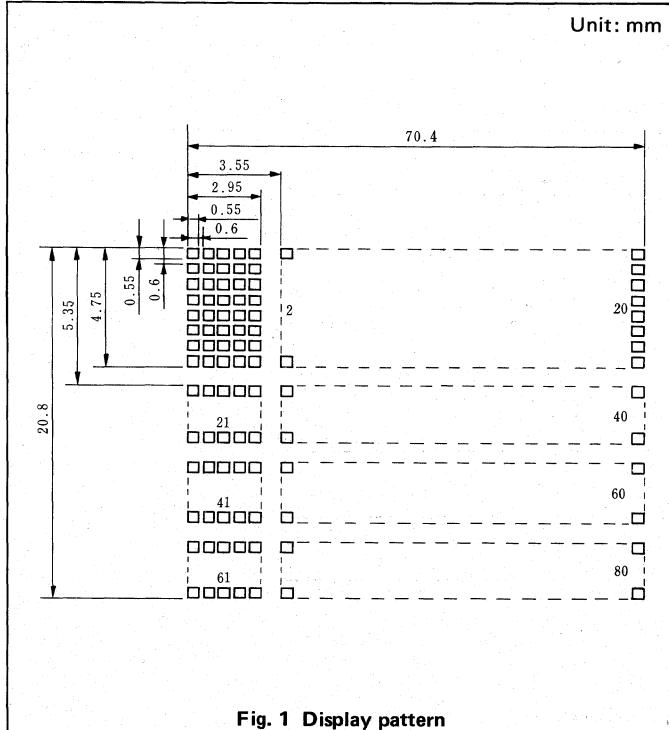


Fig. 1 Display pattern

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function | |
|---------|----------|--------|---|--------------|
| 1 | V_{SS} | — | 0V | Power supply |
| 2 | V_{DD} | — | +5V | |
| 3 | V_O | — | — | |
| 4 | RS | H/L | L: Instruction code input H: Data input | |
| 5 | R/W | H/L | H: Data read (LCD module → MPU) L: Data write (LCD module ← MPU) | |
| 6 | E | H, H→L | Enable signal | |
| 7 | DB0 | H/L | | |
| 8 | DB1 | H/L | | |
| 9 | DB2 | H/L | | |
| 10 | DB3 | H/L | | |
| 11 | DB4 | H/L | | |
| 12 | DB5 | H/L | | |
| 13 | DB6 | H/L | | |
| 14 | DB7 | H/L | | |

Data bus line
Note (1), Note (2)

Note:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of $DB_4 \sim DB_7$, and $DB_0 \sim DB_3$ are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of $DB_4 \sim DB_7$, when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of $DB_0 \sim DB_3$, when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of $DB_0 \sim DB_7$.

DISPLAY POSITION AND DD RAM ADDRESS

| Character No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1st line | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 8A | 8B | 8C | 8D | 8E | 8F | 90 | 91 | 92 | 93 |
| 2nd line | C0 | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | CA | CB | CC | CD | CE | CF | D0 | D1 | D2 | D3 |
| 3rd line | 94 | 95 | 96 | 97 | 98 | 99 | 9A | 9B | 9C | 9D | 9E | 9F | A0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 |
| 4th line | D4 | D5 | D6 | D7 | D8 | D9 | DA | DB | DC | DD | DE | DF | E0 | E1 | E2 | E3 | E4 | E5 | E6 | E7 |

Note:

- (1) 80 ~ E7 are described in hexadecimal for DD RAM address.
- (2) The set to HD44780 are "N = "1", F = "0" (2 lines 5 x 7 + cursol)."'
- (3) DD RAM address is no series in line. Address set is necessary to change the lines.
- (4) Circuit is equal to 40 characters by 2 lines type.
- (5) In case of executing shift, first line and third line are shifted continuously, also second line and fourth line. Therefore it happens that display of third line is transferred to first line.

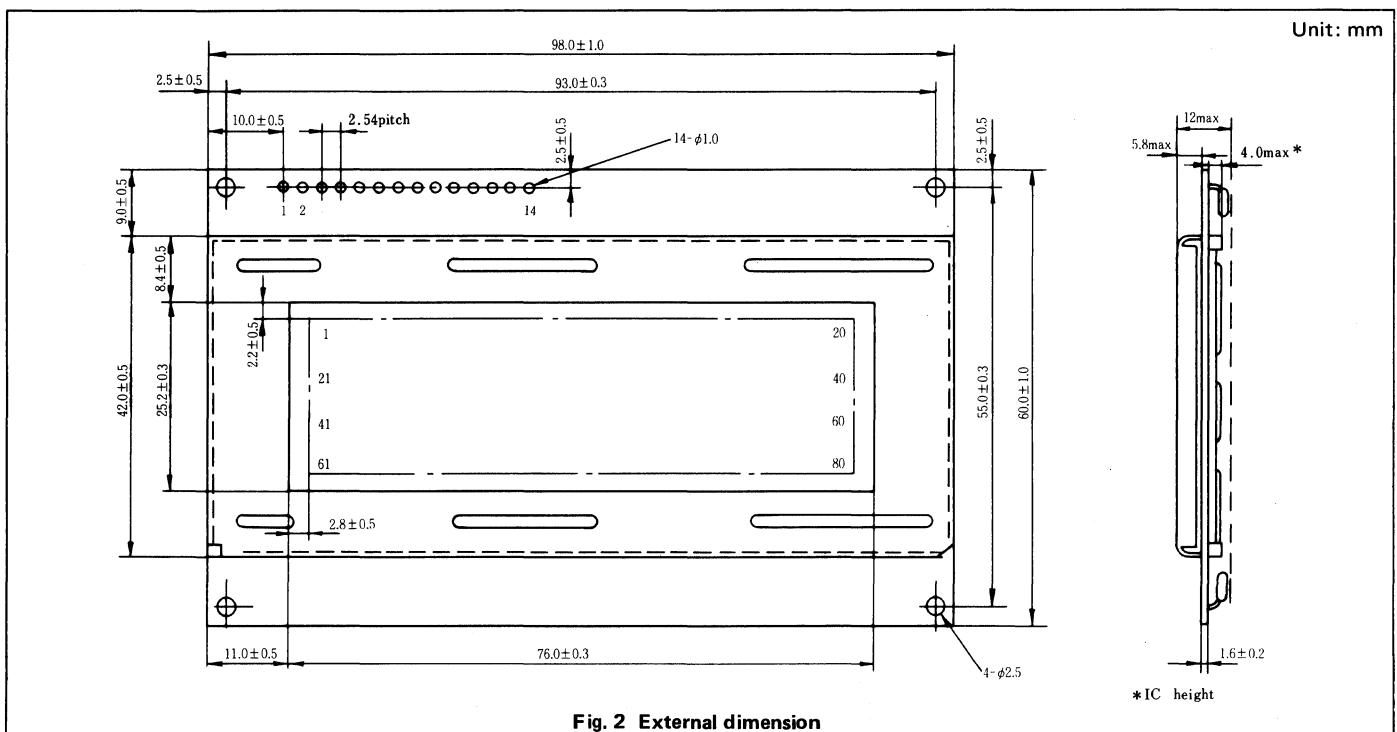


Fig. 2 External dimension

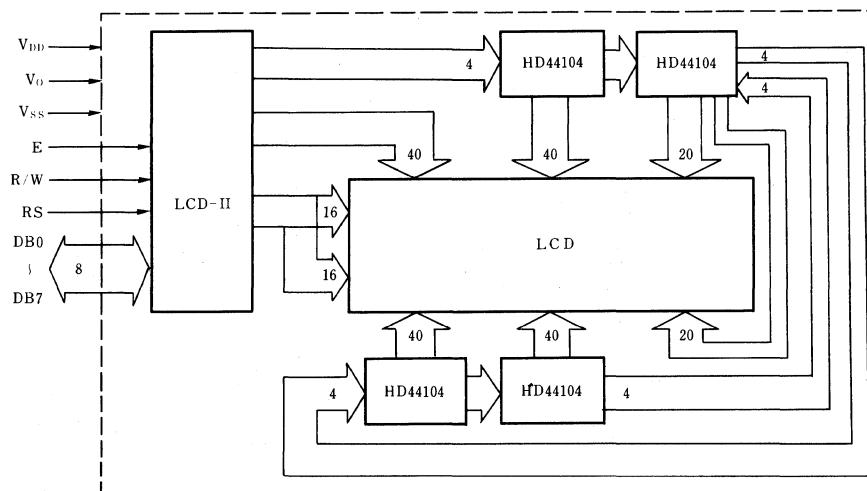
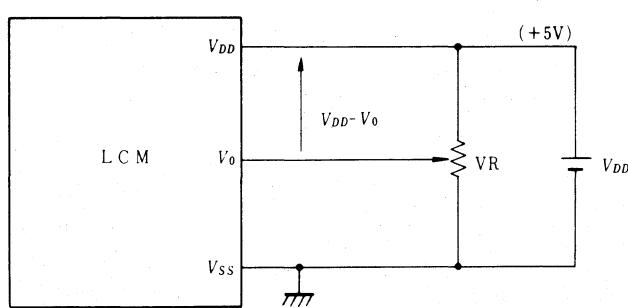


Fig. 3 Block diagram



$V_{DD}-V_0$: LCD driving voltage
 VR : $10k\Omega \sim 20k\Omega$

Fig. 4 Power supply

TIMING CHARACTERISTICS

| Item | Symbol | Test condition | min. | typ. | max. | Unit |
|-----------------------|------------------|----------------|------|------|------|---------|
| Enable cycle time | t_{cyc} | Fig. 5, Fig. 6 | 1.0 | — | — | μs |
| Enable pulse width | P_{wEH} | Fig. 5, Fig. 6 | 450 | — | — | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | Fig. 5, Fig. 6 | — | — | 25 | ns |
| RS, R/W set up time | t_{AS} | Fig. 5, Fig. 6 | 140 | — | — | ns |
| Data delay time | t_{DDR} | Fig. 6 | — | — | 320 | ns |
| Data set up time | t_{DSW} | Fig. 5 | 195 | — | — | ns |
| Hold time | t_H | Fig. 5, Fig. 6 | 20 | — | — | ns |

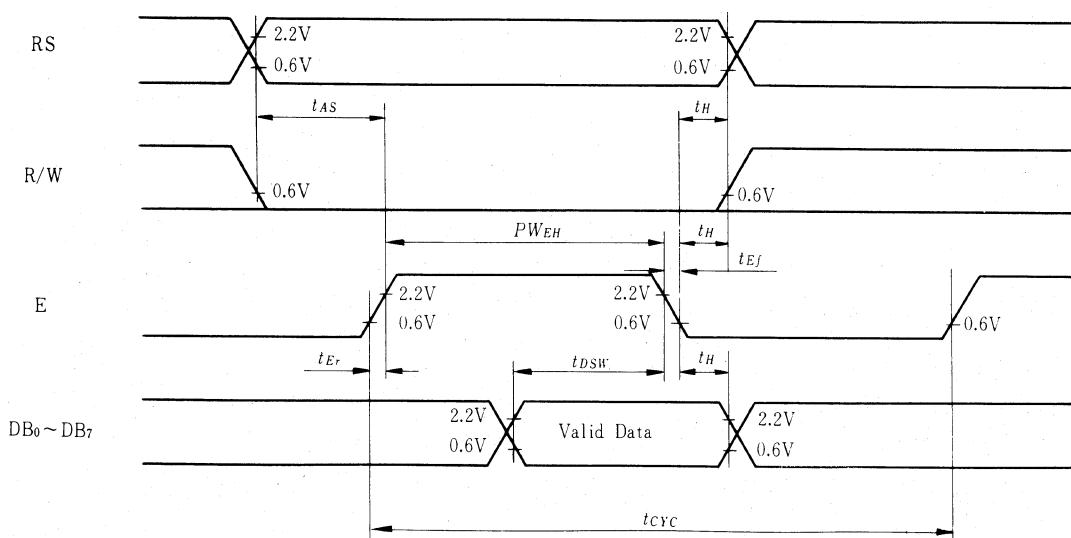


Fig. 5 Interface timing (data write)

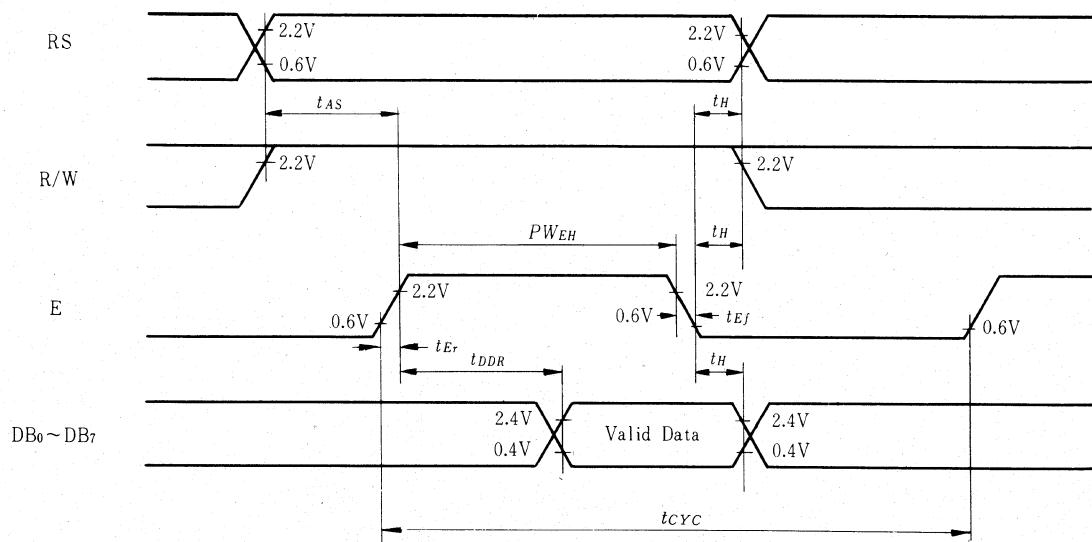


Fig. 6 Interface timing (data read)

CONTROL LSI HD61830

• Graphics LCD module controller IC
• Addressable area: 320x256 dots
• Display resolution: 256x256 dots
• Built-in RAM: 1Kbytes
• RAM: 16Kbytes
• ROM: 32Kbytes
• ROM: 64Kbytes
• ROM: 128Kbytes
• ROM: 256Kbytes
• ROM: 512Kbytes
• ROM: 1Mbytes
• ROM: 2Mbytes
• ROM: 4Mbytes
• ROM: 8Mbytes

* FEATURES

- Digital control circuit
- Digital memory area (128x256 dots)
- Character area (128x256 dots)
- ROM characters area (320x256 dots)

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GRAPHIC LCD MODULE

This module consists of LCD device, drive LSI, PC board, and other parts.

By attaching the control LSI HD61830, graphics, numerals, alphabets, Japanese, and symbols can be displayed.

CONTROL LSI HD61830

CONTROL CIRCUIT BOARD CB-SERIES (CB1020R, CB1026R, CB1030R)

H2525 (239 x 20 DOT)
LM021 (479 x 24 DOT)
LM200 (240 x 64 DOT)
LM213B (256 x 64 DOT, BUILT-IN CONTROLLER)
LM211 (640 x 64 DOT)
LM212 (640 x 48 DOT)
LM215 (480 x 128 DOT)

CONTROL LSI HD61830

- Graphic LCD Module controller driver
- Applicable type: H2525 · LM021 · LM200 · LM211 · LM212 · LM215
LM213B (Built-in controller)

The HD61830 is a dot matrix liquid crystal graphic display controller LSI that stores the display data sent from an 8-bit microcomputer in the external RAM to generate dot matrix liquid crystal driving signals.

It is possible to select the graphic mode in which the 1-bit data of the external RAM corresponds to the ON/OFF state of 1 dot on liquid crystal display and the character mode in which characters are displayed by storing character codes in the external RAM and developing them into the dot patterns with the internal character generator ROM. Both modes can be provided for various applications.

The HD61830 is produced in the CMOS process. Thus, the combination with a CMOS microcomputer can accomplish a liquid crystal display device with lower power dissipation.

■ FEATURES

- Dot matrix liquid crystal graphic display controller
- Display control capacity
 - Graphic mode 512 k dots (2¹⁶ bytes)
 - Character mode 4096 characters (2¹² characters)
- Internal character generator ROM 7360 bits
 - 160 types of 5 × 7 dot character fonts
 - 32 types of 5 × 10 dot character fonts

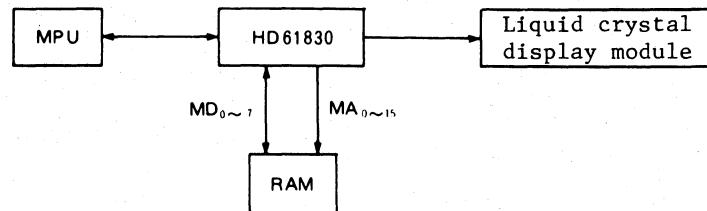
(Can be extended to 256 types (4 k bytes max.) by external ROM)
- Interfaceable to 8-bit MPU
- Display duty (Can be selected by a program)
 - Static to 1/128 duty selectable
- Various instruction functions
 - Scroll, Cursor ON/OFF/blink, Character blink, Bit manipulation
- Display method Selectable A or B types
- Internal oscillator (with external resistor and capacitor)
- Low power dissipation
- Power supply: Single +5V
- CMOS process
- 60-pin flat plastic package

Internal Character Generator Patterns and Character Codes

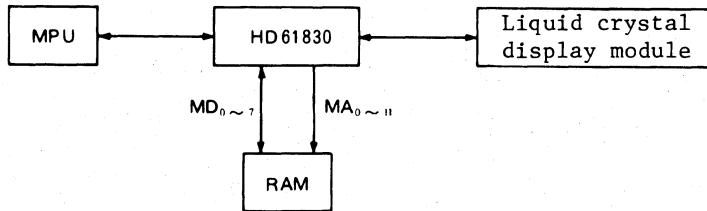
| | Higher Lower 4bit 4bit | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 |
|----------|---------------------------------|-------------------------|------|------|---------|------|------|------|------|------|------|------|------|
| xxxx0000 | | Ø Ø P ^ P | | --- | g E Ø P | | | | | | | | |
| xxxx0001 | | ! 1 A Q a q , T ? 6 a q | | | | | | | | | | | |
| xxxx0010 | | " 2 B R b r " 4 9 x | | | | | | | | | | | |
| xxxx0011 | | # 3 C S c s , J @ T E S | | | | | | | | | | | |
| xxxx0100 | | \$ 4 D T d t , I T P S | | | | | | | | | | | |
| xxxx0101 | | % 5 E U e u , @ + I S O | | | | | | | | | | | |
| xxxx0110 | | & 6 F U f v @ b C B p Z | | | | | | | | | | | |
| xxxx0111 | | ? 7 G W g w , @ z Z g | | | | | | | | | | | |
| xxxx1000 | | (8 H X h x , @ z Z U | | | | | | | | | | | |
| xxxx1001 | |) 9 I Y i y , @ T J b | | | | | | | | | | | |
| xxxx1010 | | * ; J Z j z , @ n V | | | | | | | | | | | |
| xxxx1011 | | + ; K C K { @ Y b D | | | | | | | | | | | |
| xxxx1100 | | : < L * U I , @ S Z D | | | | | | | | | | | |
| xxxx1101 | | = M M m) , @ Z N D | | | | | | | | | | | |
| xxxx1110 | | > N ^ n + a t b ^ | | | | | | | | | | | |
| xxxx1111 | | / ? 0 _ o + w y Z ^ | | | | | | | | | | | |

EXAMPLE OF CONFIGURATION

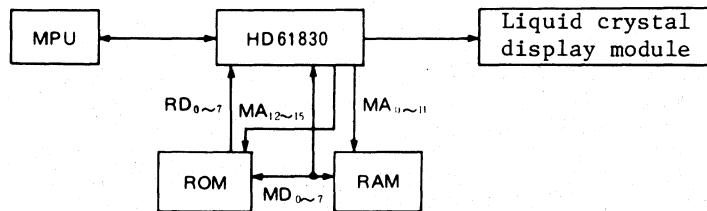
- Graphic Mode



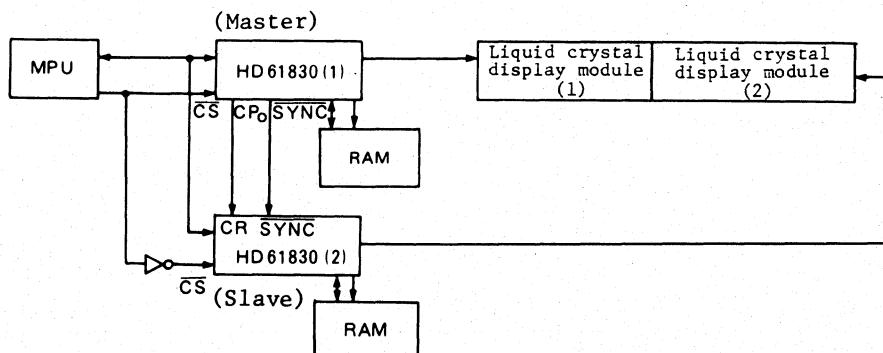
- Character Mode (1) (Internal Character Generator)



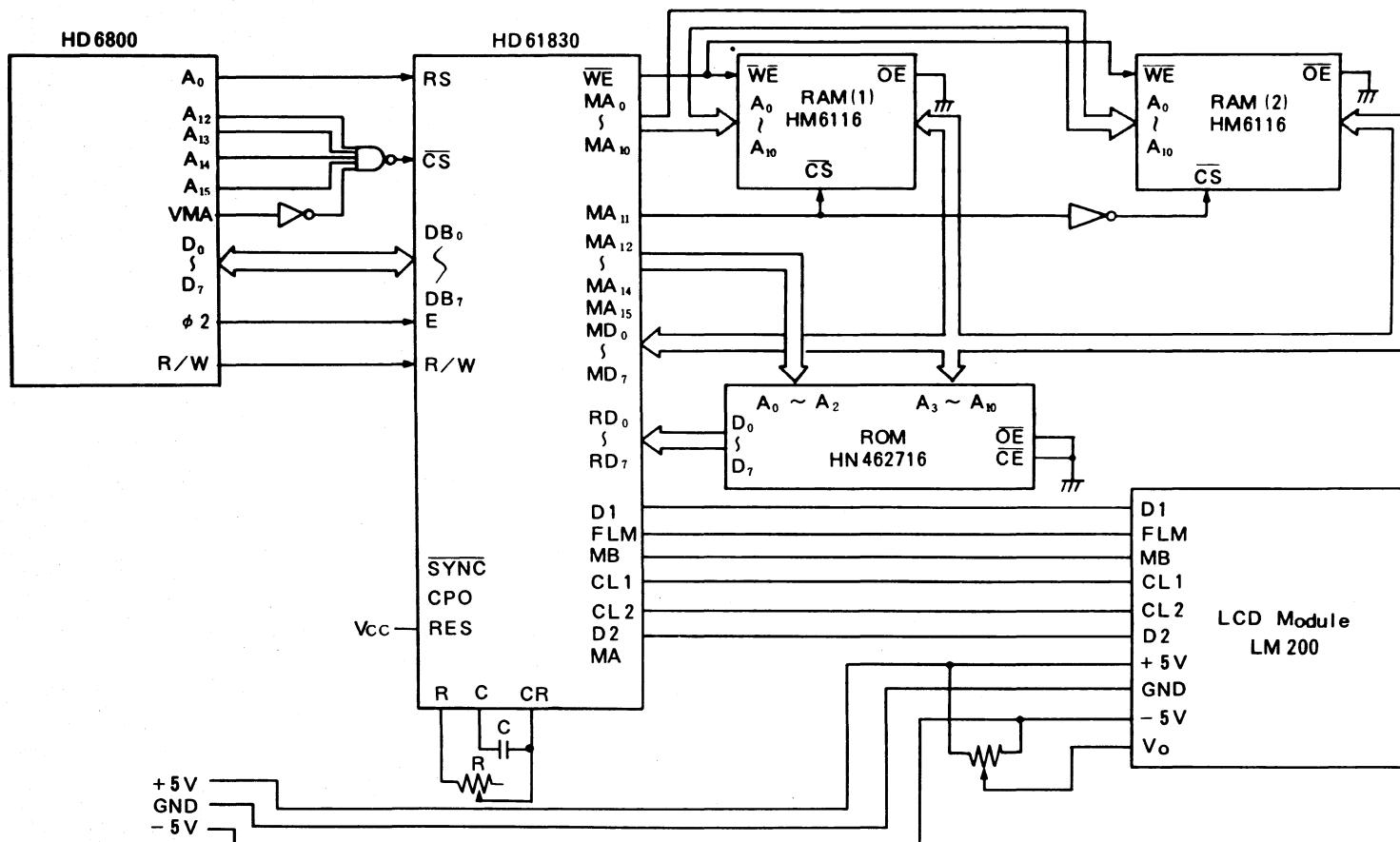
- Character Mode (2) (External Character Generator)



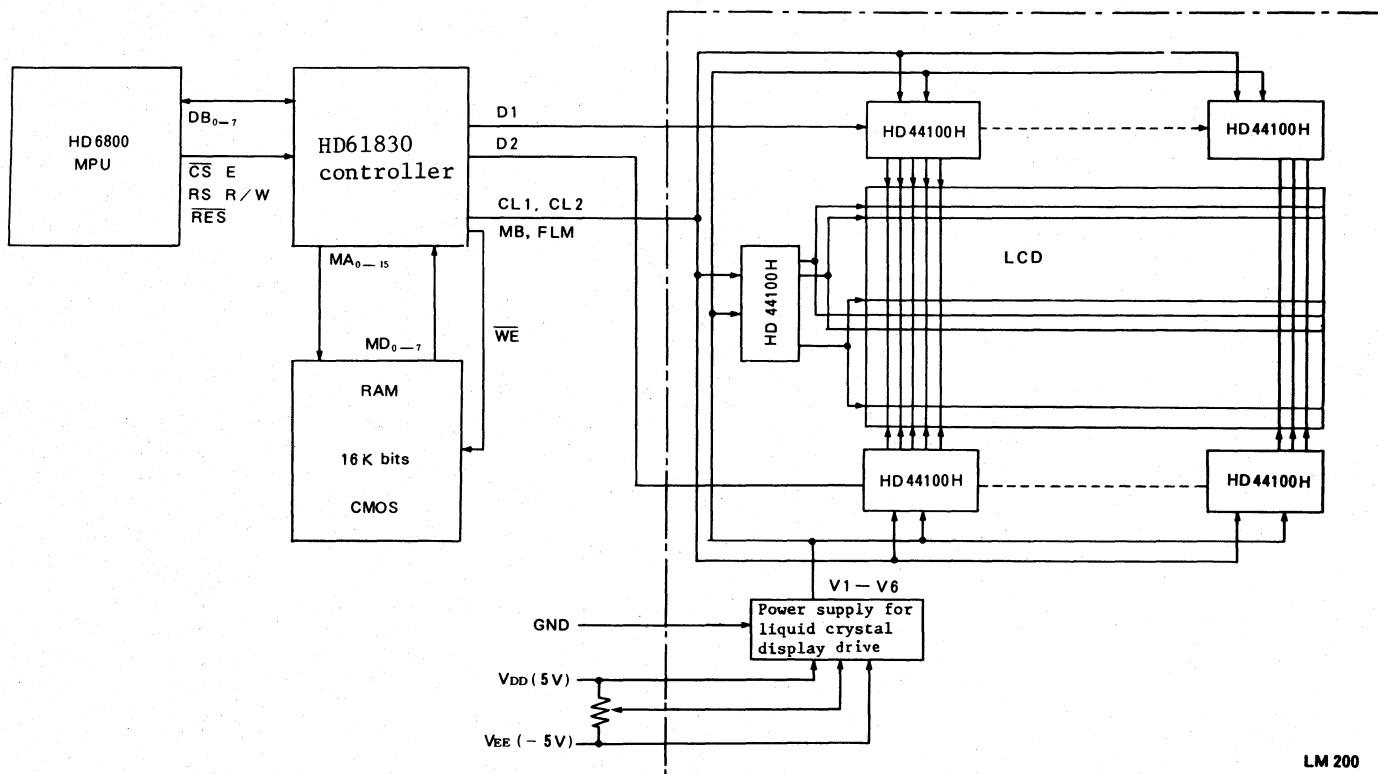
- Parallel Operation



APPLICATION (Character Mode, External CG, Character Font 8x8)



APPLICATION (Graphic Mode)



CONTROL CIRCUIT BOARD CB-SERIES CB1020R・CB1026R・CB1030R

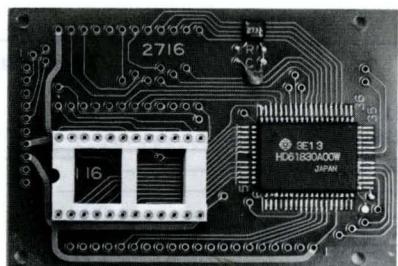
These CB-SERIES (mounted with control LSI HD61830 and a socket for the refresh memory) is a control circuit board for graphic display modules.

These CB-SERIES allows direct connection to the MPU bus line. The HD61830 controls timing signal generation and data conversion required for a liquid crystal display (LCD) module, resulting in simplification of the graphic display system configuration. These CB-SERIES operates in the graphic and character modes. In the graphic mode, the con-

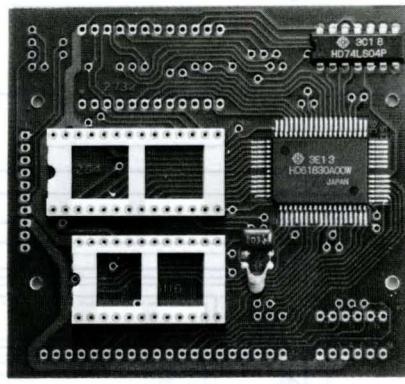
tents of the refresh memory are displayed as is on the LCD to allow display of figures, graphs, and pictures.

In the character mode, the 8-bit parallel code for each character is converted to the corresponding dot pattern by the character generator in these CB-SERIES and displayed on the LCD. The built-in character generator converts 192 characters consisting of 160 JIS characters and 32 special pattern characters. An additional character general for character patterns required by the customer may also be mounted.

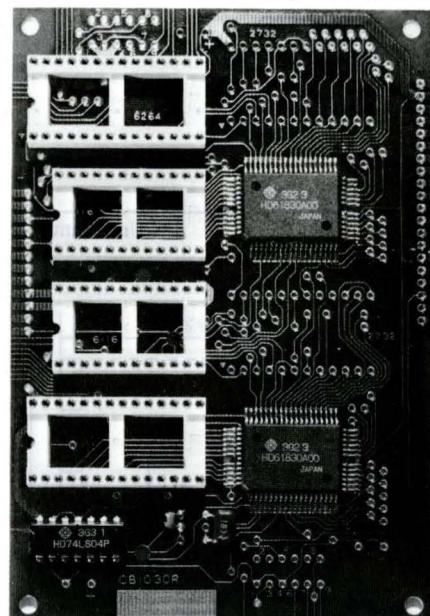
| Item | Type No. | CB1020R | CB1026R | CB1030R |
|--------------------|----------|---------------------|--------------------------------------|---|
| Controller | | HD61830, 1 piece | HD61830, 1 piece | HD61830D, 2 pieces |
| Refresh RAM | | 2 k bytes | 4 k bytes | 8 k bytes |
| Attachable ROM | | 2 k bytes | 4 k bytes | 4 k bytes |
| External dimension | | 78 x 53 mm | 82 x 76 mm | 125 x 85 mm |
| Object of LCM | | LM021, H2525, LM200 | LM021, H2525, LM200, LM211, LM212 | LM021, H2525, LM200, LM211, LM212, LM215 |



CB1020R



CB1026R



CB1030R

H2525

- 239dot (W) x 20 dot (H) graphic and alpha-numeric display
- Control LSI HD61830 attachment type (see page 76)

MECHANICAL DATA (Nominal dimensions)

| | |
|----------------------------------|---------------------------|
| Module size | 220W x 53H x 15D (max) mm |
| Effective display area | 163W x 17H mm |
| Number of dots | 239W x 20H dot |
| Dot size | 0.55W x 0.55H mm |
| Pitch | 0.65W x 0.65H mm |
| Weight | about 100g |

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|--|----------|------------|
| Power supply for logic ($V_{DD} - V_{SS}$) | 0 | 7.0V |
| Power supply for LCD drive ($V_{DD} - V_{EE}$) | 0 | 13.5V |
| Input voltage (V_i) | V_{SS} | V_{DD} V |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 60°C |

ELECTRICAL CHARACTERISTICS

| | |
|---|--|
| Ta=25°C, $V_{DD}=5.0V \pm 0.25V$, $V_{EE}=-5.0V \pm 0.25V$ | |
| Input "high" voltage (V_{IH}) | 0.7 x V_{DD} V min. |
| Input "low" voltage (V_{IL}) | 0.3 x V_{DD} V max. |
| Clock frequency (f_{CL2}) | 210 kHz min. 300 kHz typ. 390 kHz max. |
| Power supply current (I_{DD}) | 3mA typ. |
| (I_{EE}) | 1 mA typ. |

D1, D2 = GND, $f_{CL2} = 300$ kHz

Power supply for LCD drive (Recommended) ($V_O - V_{EE}$)
 $D_u = 1/20$

| | |
|---------------------------------------|-----------|
| at $T_a = 0^\circ\text{C}$ | 5.5V typ. |
| at $T_a = 25^\circ\text{C}$ | 5.0V typ. |
| at $T_a = 50^\circ\text{C}$ | 4.0V typ. |

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|---------------|-------|--|
| 1 | FLM | H | The FLM single indicates the begining of each display cycle. |
| 2 | M | H/L | Control signal for a.c. driving |
| 3 | CL1 | H→L | The CL1 latches the serial data in the shift registers. |
| 4 | D1 | H/L | Serial row data |
| 5 | CL2 | H→L | Clock signal for shifting the serial data |
| 6 | $V_{DD}(+5V)$ | — | Power supply for logic circuit |
| 7 | $V_{SS}(GND)$ | — | Ground |
| 8 | $V_{EE}(-5V)$ | — | Power supply for LC driving |
| 9 | V_O | — | Operating voltage for LC driving |
| 10 | NC | — | No connection |

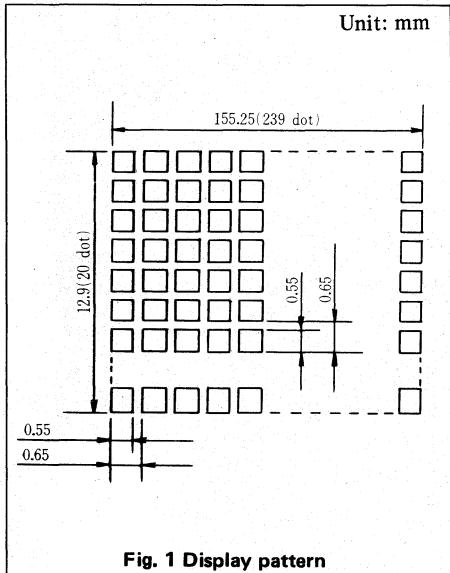


Fig. 1 Display pattern

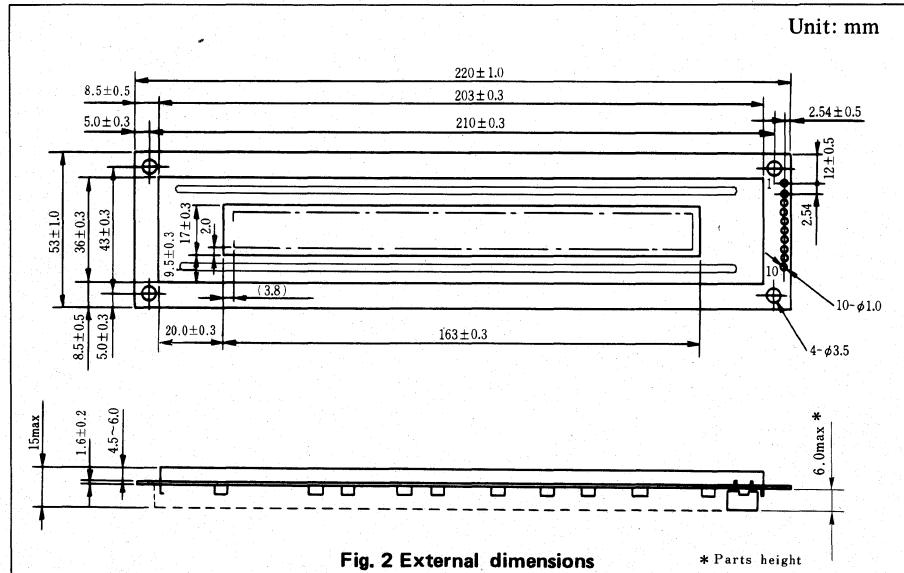


Fig. 2 External dimensions

* Parts height

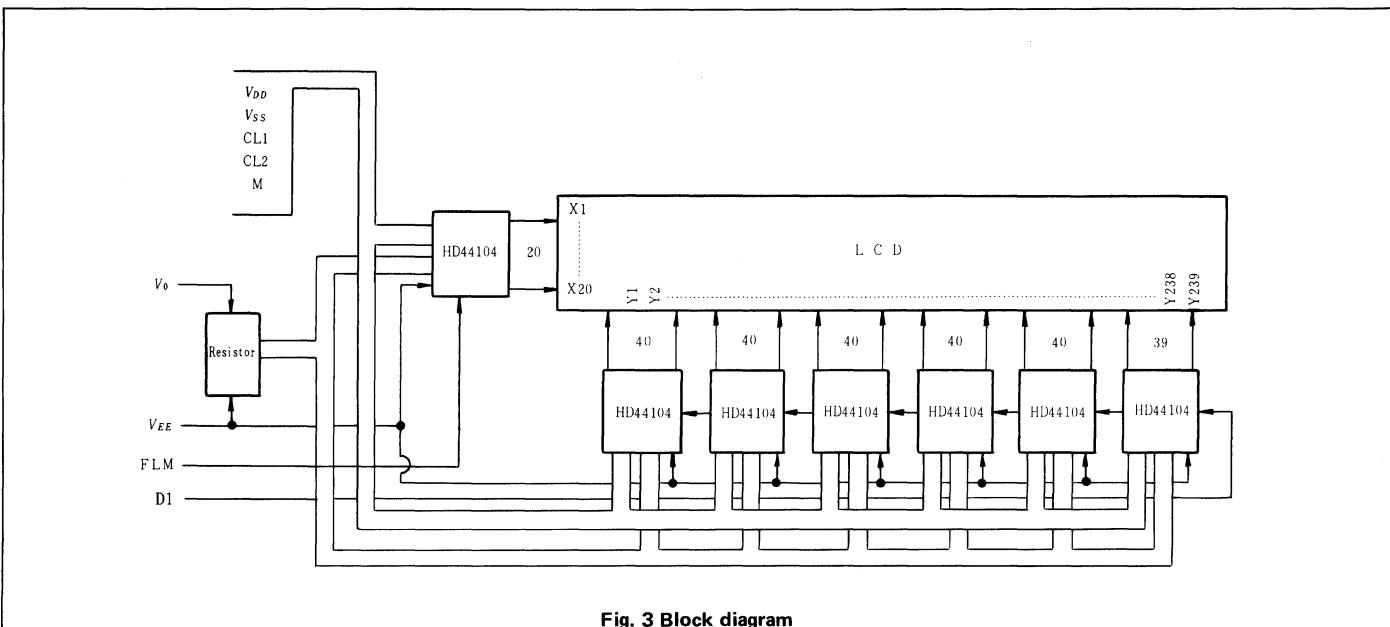


Fig. 3 Block diagram

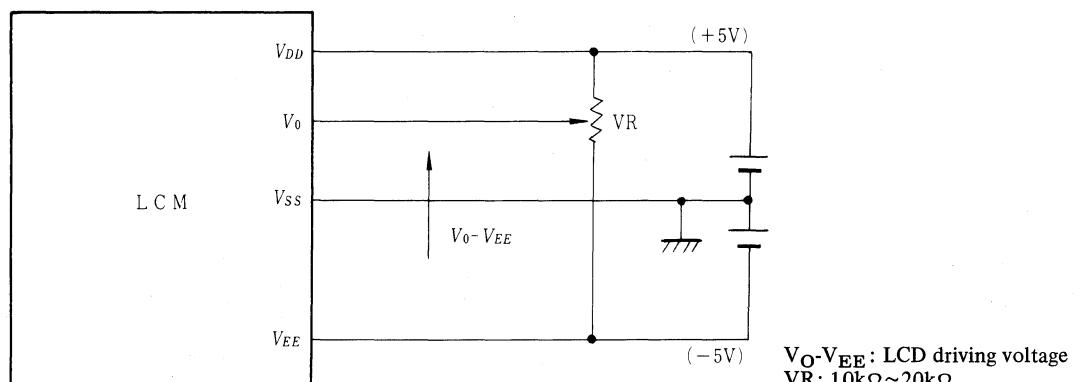


Fig. 4 Power supply

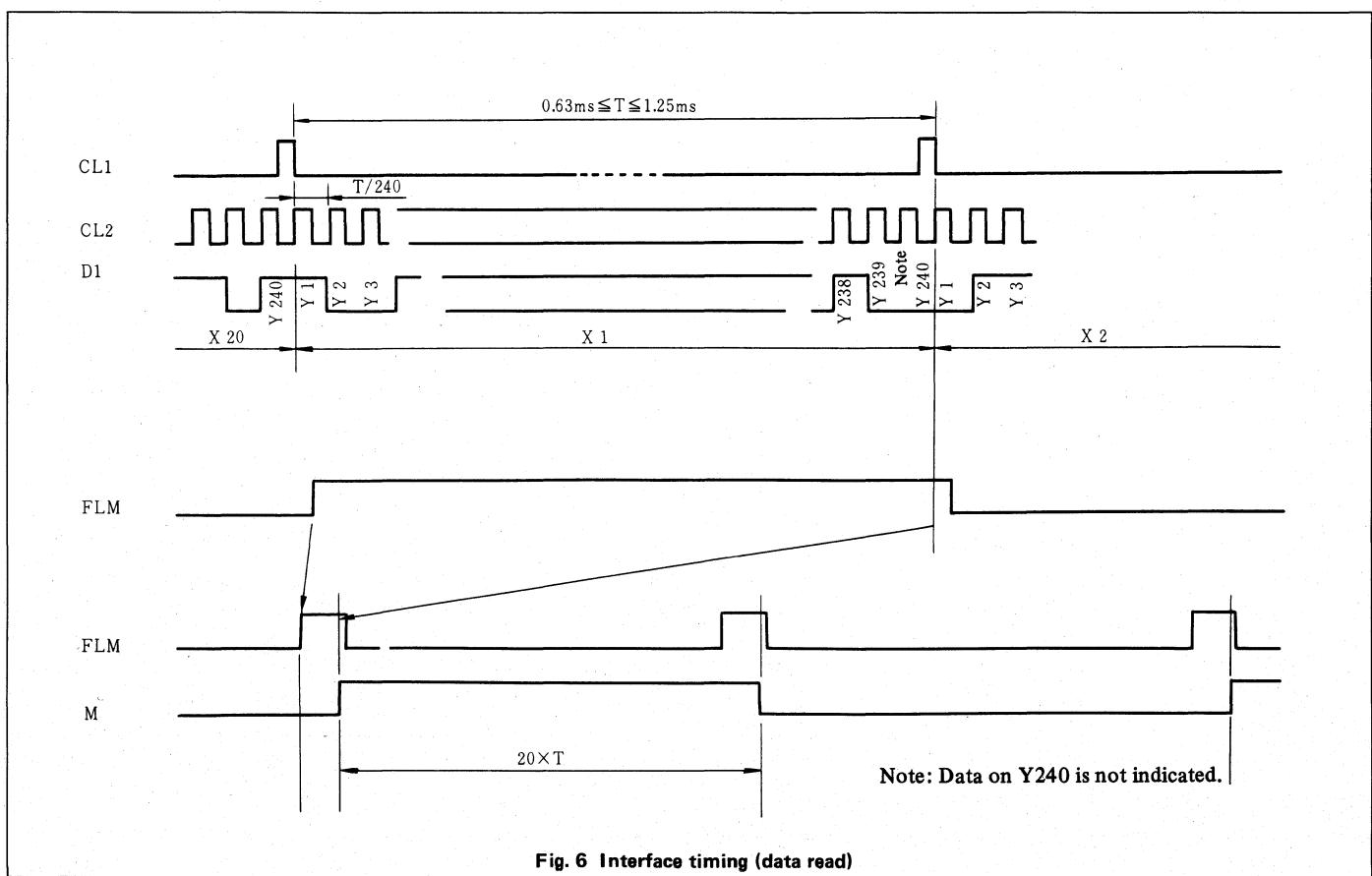
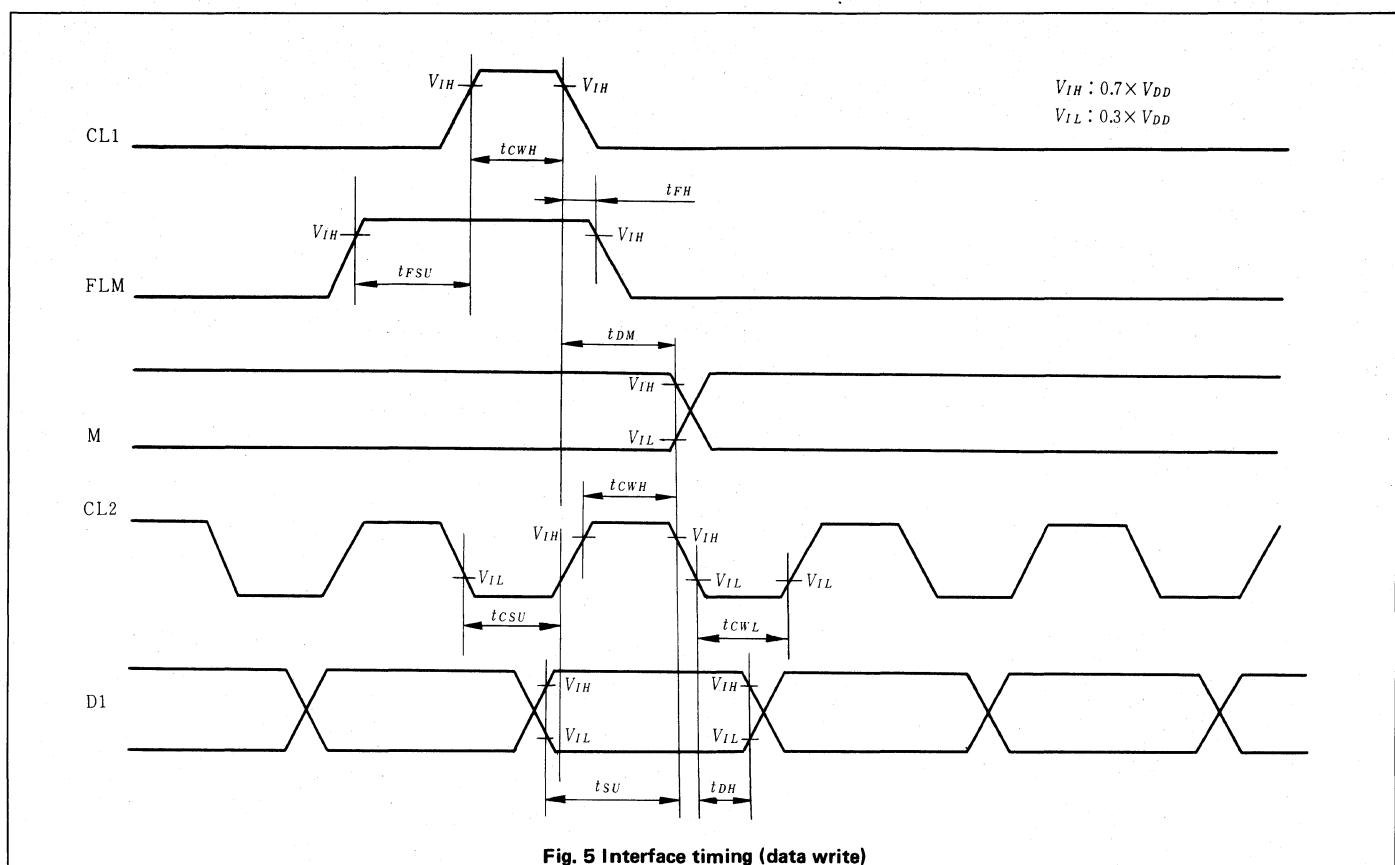
TIMING CHARACTERISTICS

| Item | Symbol | min. | typ. | max. | Unit |
|-----------------------------------|-----------|-------|------|-------|--------------|
| Clock frequency | f_{CL2} | — | — | 500 | kHz (Note 1) |
| Clock pulse width (High level) | t_{CWH} | 800 | — | — | ns |
| Clock pulse width (Low level) | t_{CWL} | 800 | — | — | ns |
| Clock set up time | t_{CSU} | 500 | — | — | ns |
| Data set up time | t_{SU} | 300 | — | — | ns |
| FLM set up time | t_{FSU} | 300 | — | — | ns |
| M delay time | t_{DM} | -1000 | 0 | +1000 | ns (Note 2) |
| FLM hold time | t_{FH} | 0 | — | — | ns |
| Data hold time | t_{DH} | 300 | — | — | ns |

Note 1. Optimum frequency for the highest contrast is different by the type of module.

Note 2. Timing of M signal to CLI may be in the range of ± 1000 ns.

Note 3. In adjusting FLM frequency, avoid setting it around the commercial frequency (50Hz \pm 2Hz or 60Hz \pm 2Hz) to prevent LCD flicker.



LMO21

- 479 dot (W) x 24 dot (H) graphic and alpha-numeric display
- Control LSI HD61830 attachment type (see page 76)

MECHANICAL DATA (Nominal dimensions)

Module size 290W x 60H x 13D (max) mm
 Effective display area 245W x 19H mm
 Number of dots 479W x 24H dot
 Dot size 0.43W x 0.55H mm
 Pitch 0.48W x 0.6H mm
 Weight about 150g

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|--|----------|----------|
| Power supply for logic ($V_{DD} - V_{SS}$) | 0 | 7.0V |
| Power supply for LCD drive ($V_{DD} - V_{EE}$) | 0 | 13.5V |
| Input voltage (V_i) | V_{SS} | V_{DD} |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 60°C |

ELECTRICAL CHARACTERISTICS

$T_a=25^\circ\text{C}$, $V_{DD}=5.0\text{V}\pm0.25\text{V}$, $V_{EE}=-5.0\text{V}\pm0.25\text{V}$
 Input "high" voltage (V_{IH}) $0.7 \times V_{DD}$ V min.
 Input "low" voltage (V_{IL}) $0.3 \times V_{DD}$ V max.
 Clock frequency (f_{CL2}) 230 kHz min.
 350 kHz typ.
 460 kHz max.
 Power supply current (I_{DD}) 4mA typ.
 (I_{EE}) 2mA typ.
 (D₁, D₂=GND, $f_{CL2}=350$ kHz)
 Power supply for LCD drive (Recommended) ($V_O - V_{EE}$)
 Duty = 1/24
 at $T_a=0^\circ\text{C}$ 6.0 V typ.
 at $T_a=25^\circ\text{C}$ 5.4 V typ.
 at $T_a=50^\circ\text{C}$ 4.4 V typ.

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------------------|-------|---|
| 1 | FLM | H | The FLM signal indicates the beginning of each display cycle. |
| 2 | M | H/L | Control signal for a.c. driving. |
| 3 | CL1 | H→L | The CL1 latches the serial data in the shift registers. |
| 4 | D1 | H/L | Serial row data |
| 5 | D2 | H/L | Serial row data |
| 6 | CL2 | H→L | Clock signal for shifting the serial data |
| 7 | $V_{DD}(+5\text{V})$ | — | Power supply for logic circuit |
| 8 | $V_{SS}(\text{GND})$ | — | Ground |
| 9 | $V_{EE}(-5\text{V})$ | — | Power supply for LC driving |
| 10 | V_O | — | Operating voltage for LC driving |

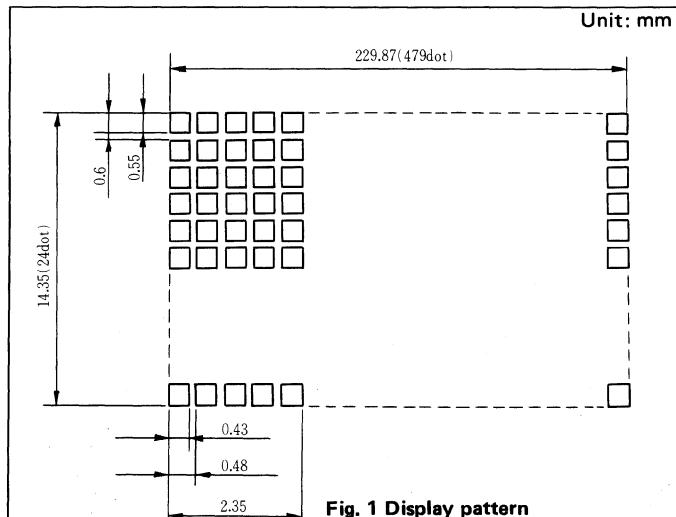


Fig. 1 Display pattern

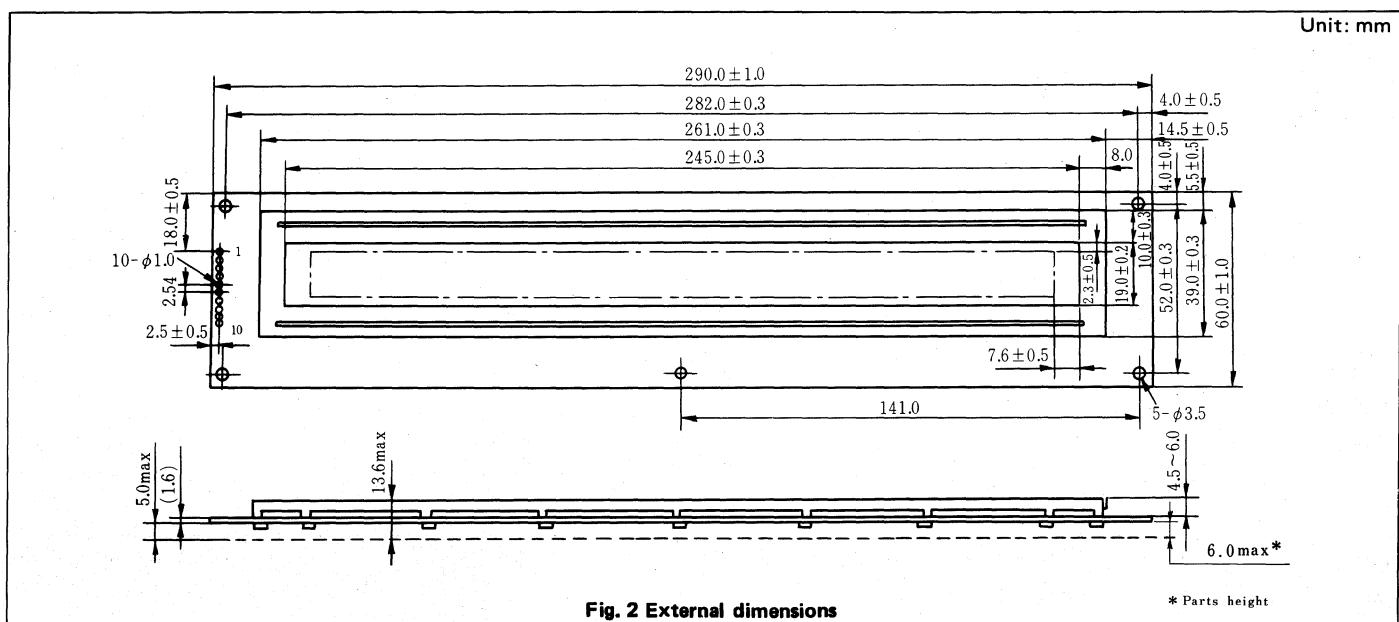


Fig. 2 External dimensions

* Parts height

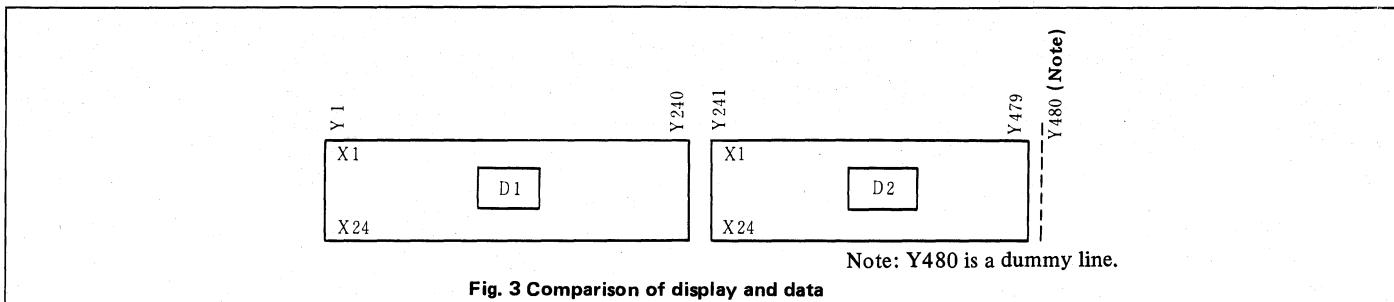


Fig. 3 Comparison of display and data

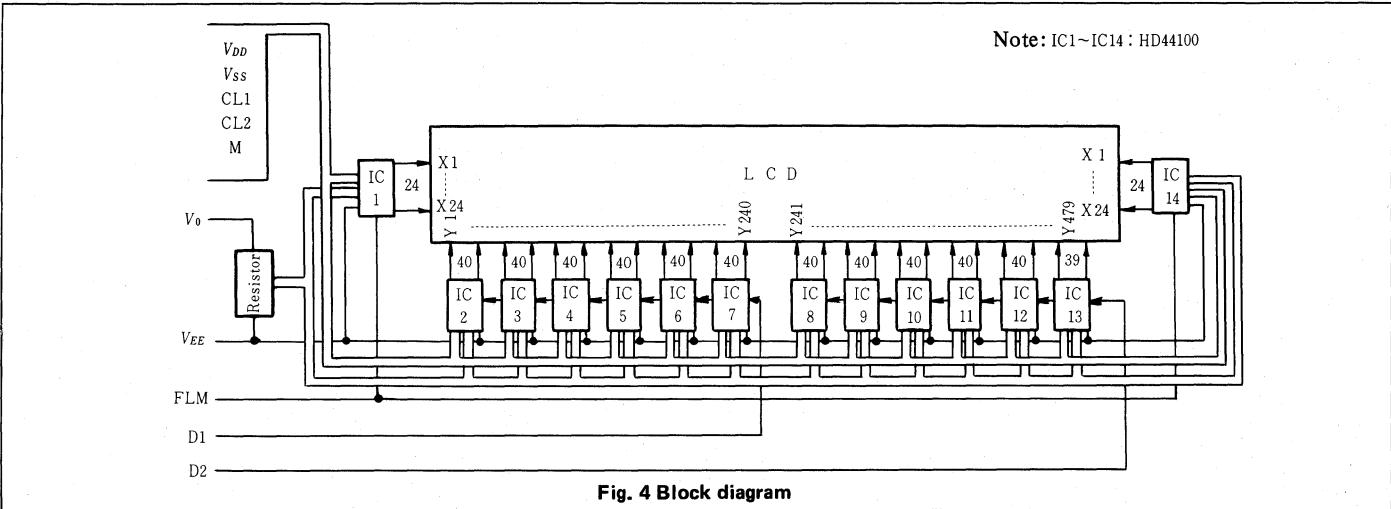


Fig. 4 Block diagram

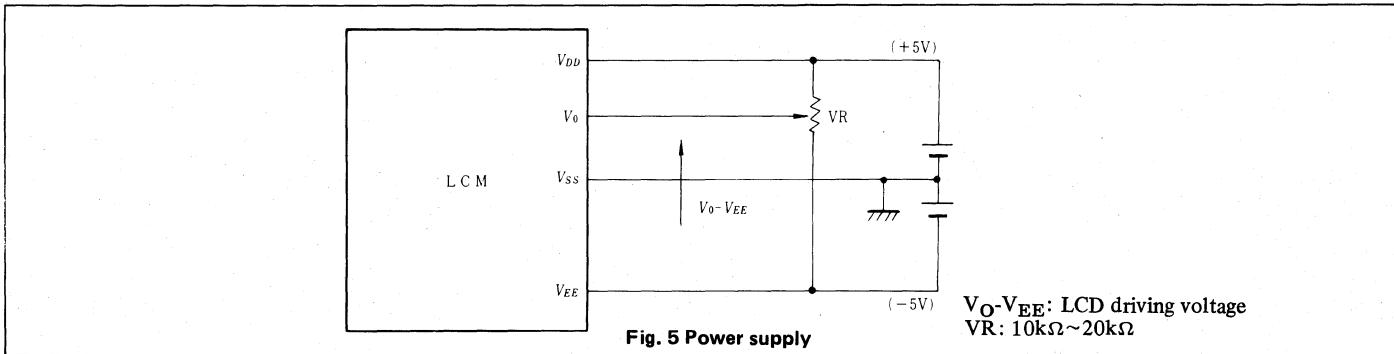
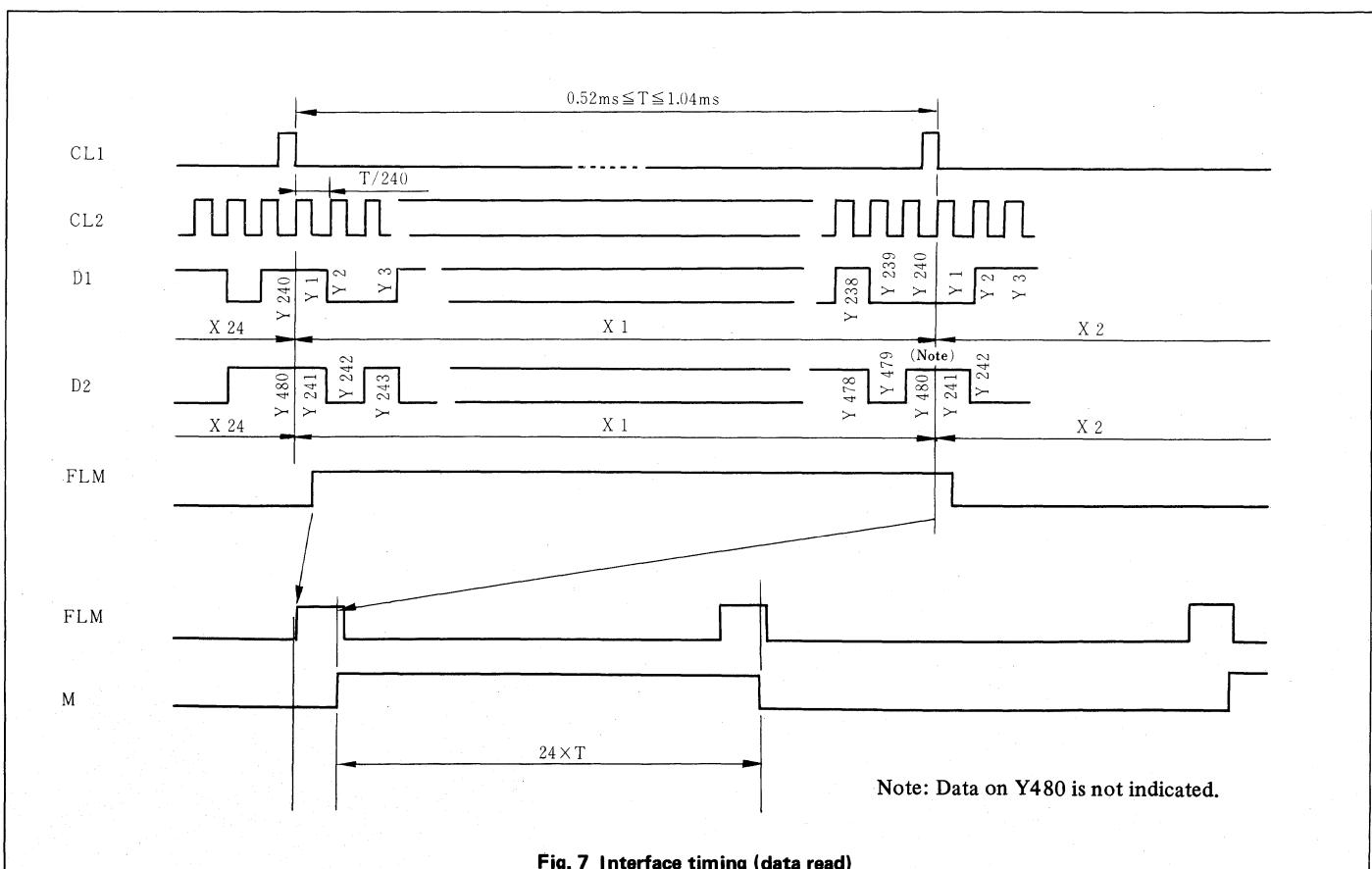
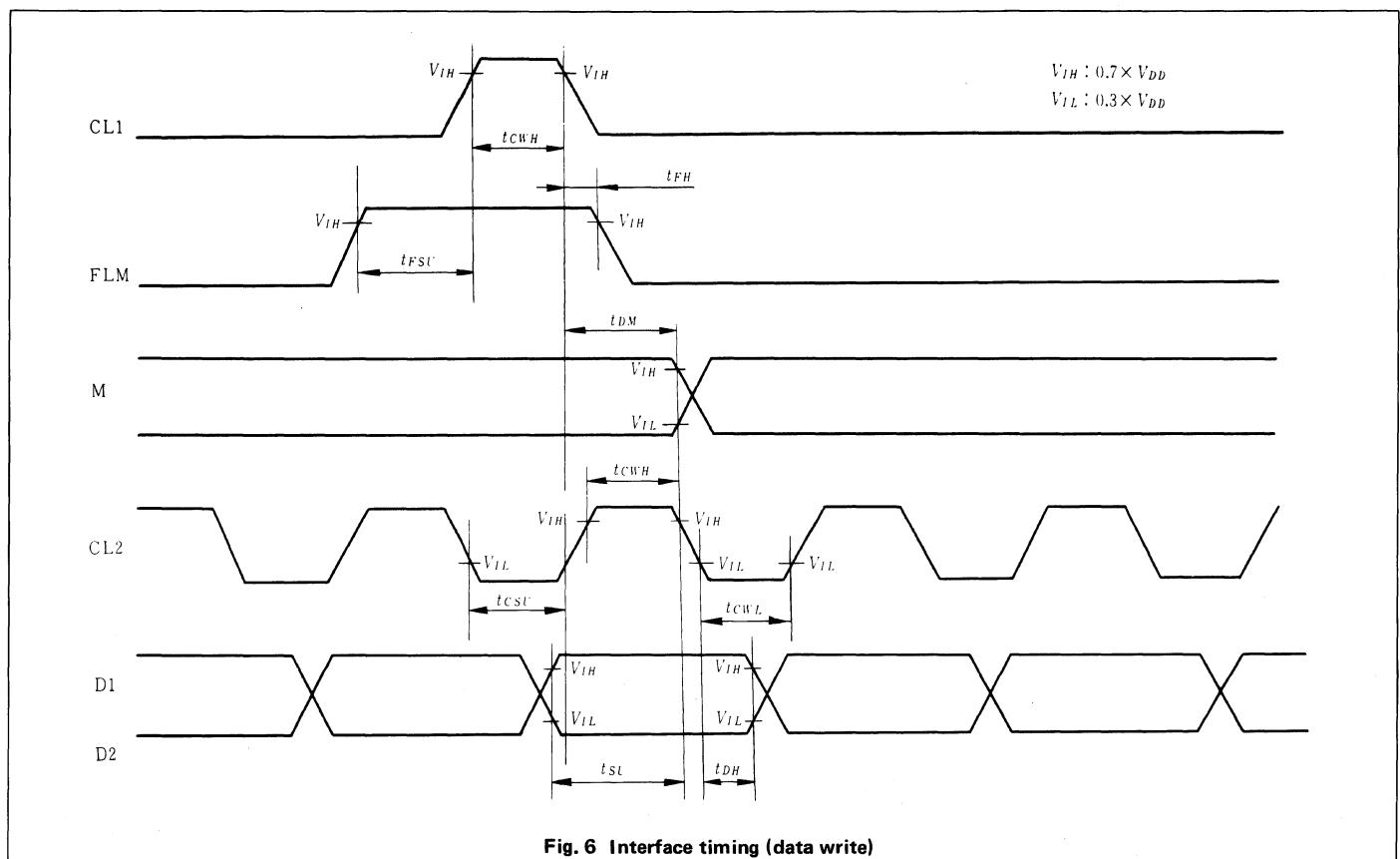


Fig. 5 Power supply

TIMING CHARACTERISTICS

| Item | Symbol | min. | typ. | max. | Unit |
|-----------------------------------|-----------|-------|------|-------|--------------|
| Clock frequency | f_{CL2} | — | — | 500 | kHz (Note 1) |
| Clock pulse width (High level) | t_{CWH} | 800 | — | — | ns |
| Clock pulse width (Low level) | t_{CWL} | 800 | — | — | ns |
| Clock set up time | t_{CSU} | 500 | — | — | ns |
| Data set up time | t_{SU} | 300 | — | — | ns |
| FLM set up time | t_{FSU} | 300 | — | — | ns |
| M delay time | t_{DM} | -1000 | 0 | +1000 | ns (Note 2) |
| FLM hold time | t_{FH} | 0 | — | — | ns |
| Data hold time | t_{DH} | 300 | — | — | ns |

Note 1. Optimum frequency for the highest contrast is different the type of module.
 Note 2. Timing of M signal to CLI may be in the range of ±1000ns.
 Note 3. In adjusting FLM frequency, avoid setting it around the commercial frequency (50Hz±2Hz or 60Hz ±2Hz) to prevent LCD flicker.



LM200

- 240 dot (W) x 64 dot (H) graphic and alpha-numeric display
- Control LSI HD61830 attachment type (see page 76)

MECHANICAL DATA (Nominal dimensions)

Module size 180W x 75H x 15D (max) mm
 Effective display area 132W x 39H mm
 Number of dots 240W x 64H dot
 Dot size 0.48W x 0.48H mm
 Pitch 0.53W x 0.53H mm
 Weight about 150g

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|--|----------|----------|
| Power supply for logic ($V_{DD} - V_{SS}$) | 0 | 7.0V |
| Power supply for LCD drive ($V_{DD} - V_{EE}$) | 0 | 13.5V |
| Input voltage (V_i) | V_{SS} | V_{DD} |
| Operating temperature (T_a) | 0 | 50°C |
| Storage temperature (T_{stg}) | -20 | 60°C |

ELECTRICAL CHARACTERISTICS

| | |
|---|--|
| $T_a=25^\circ C$, $V_{DD}=5.0V \pm 0.25V$, $V_{EE}=-5.0V \pm 0.25V$ | |
| Input "high" voltage (V_{iH}) | $0.7 \times V_{DD}$ V min. |
| Input "low" voltage (V_{iL}) | $0.3 \times V_{DD}$ V max. |
| Clock frequency (f_{CL2}) | 390 kHz min. 460 kHz typ. 520 kHz max. |
| Power supply current (I_{DD}) | 5mA typ. ($D_1, D_2 = GND, f_{CL2} = 460$ kHz) |
| Power supply for LCD drive (Recommended) ($V_O - V_{EE}$) | |
| at $T_a = 0^\circ C$ | 8.0 V typ. |
| at $T_a = 25^\circ C$ | 7.4 V typ. |
| at $T_a = 50^\circ C$ | 6.5 V typ. |

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|---------------|-------|---|
| 1 | D1 | H/L | Serial row data |
| 2 | FLM | H | The FLM signal indicates the beginning of each display cycle. |
| 3 | M | H/L | Control signal for a.c. driving |
| 4 | CL1 | H→L | The CL1 latches the serial data in the shift registers. |
| 5 | CL2 | H→L | Clock signal for shifting the serial data |
| 6 | D2 | H/L | Serial row data |
| 7 | $V_{DD}(+5V)$ | | Power supply for logic circuit |
| 8 | $V_{SS}(GND)$ | — | Ground |
| 9 | $V_{EE}(-5V)$ | — | Power supply for LC driving |
| 10 | V_O | — | Operating voltage for LC driving |

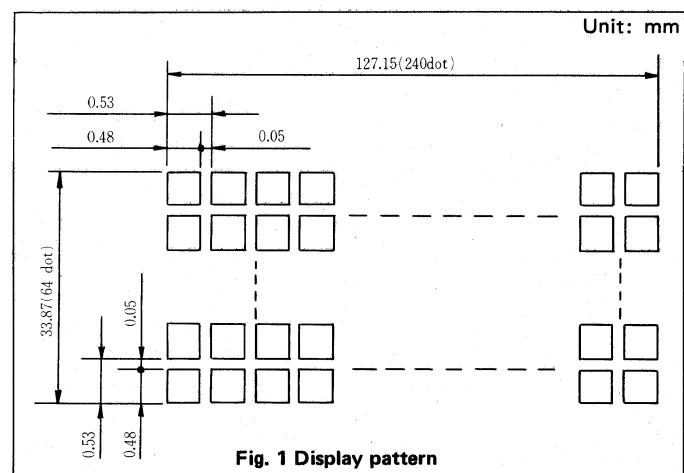


Fig. 1 Display pattern

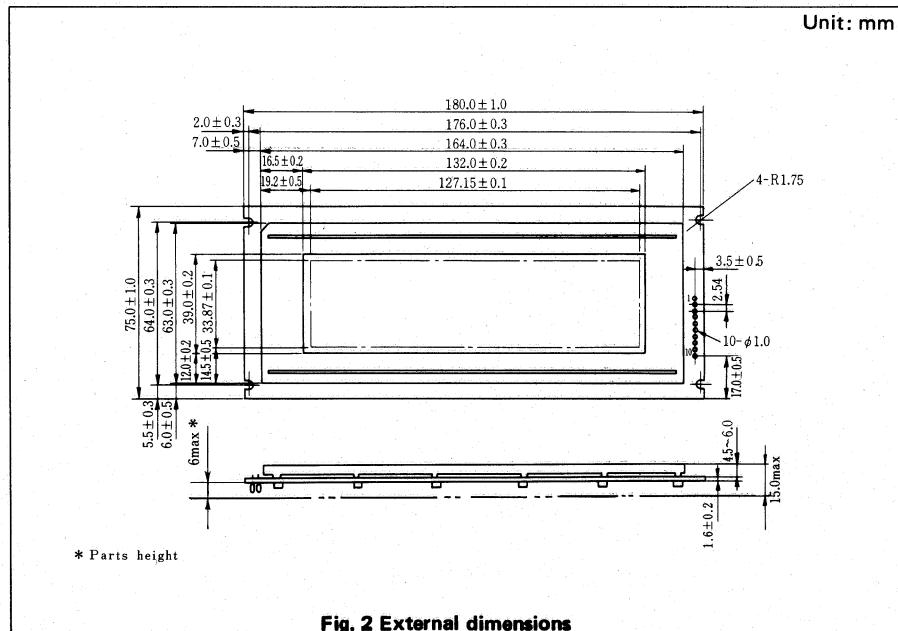


Fig. 2 External dimensions

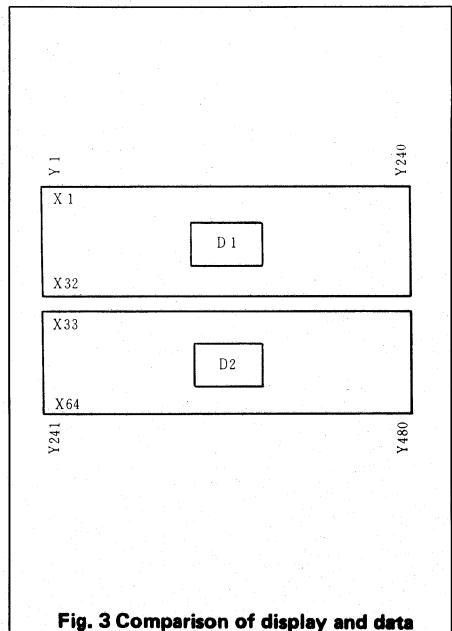


Fig. 3 Comparison of display and data

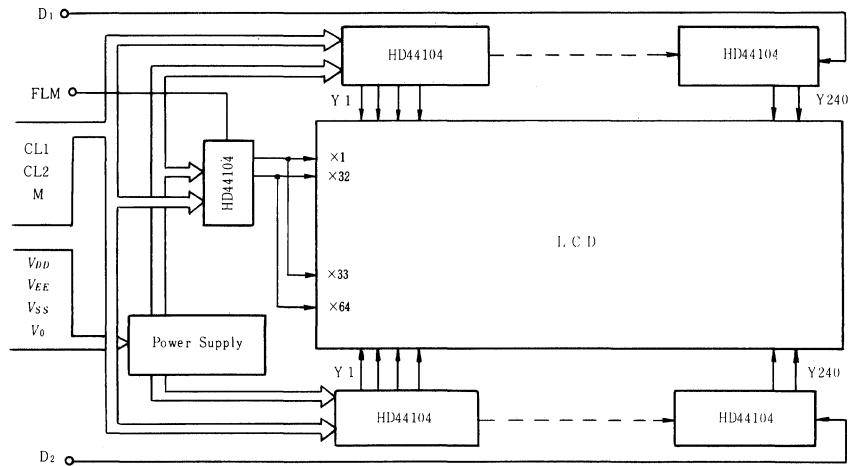


Fig. 4 Block diagram

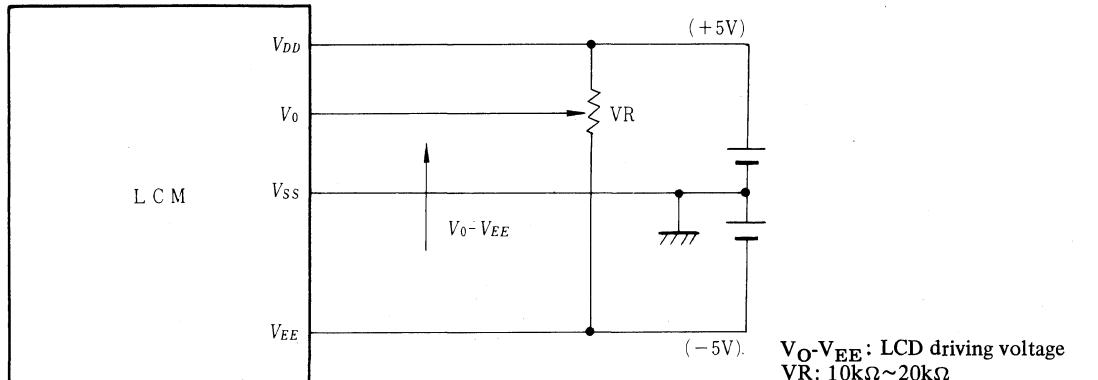


Fig. 5 Power supply

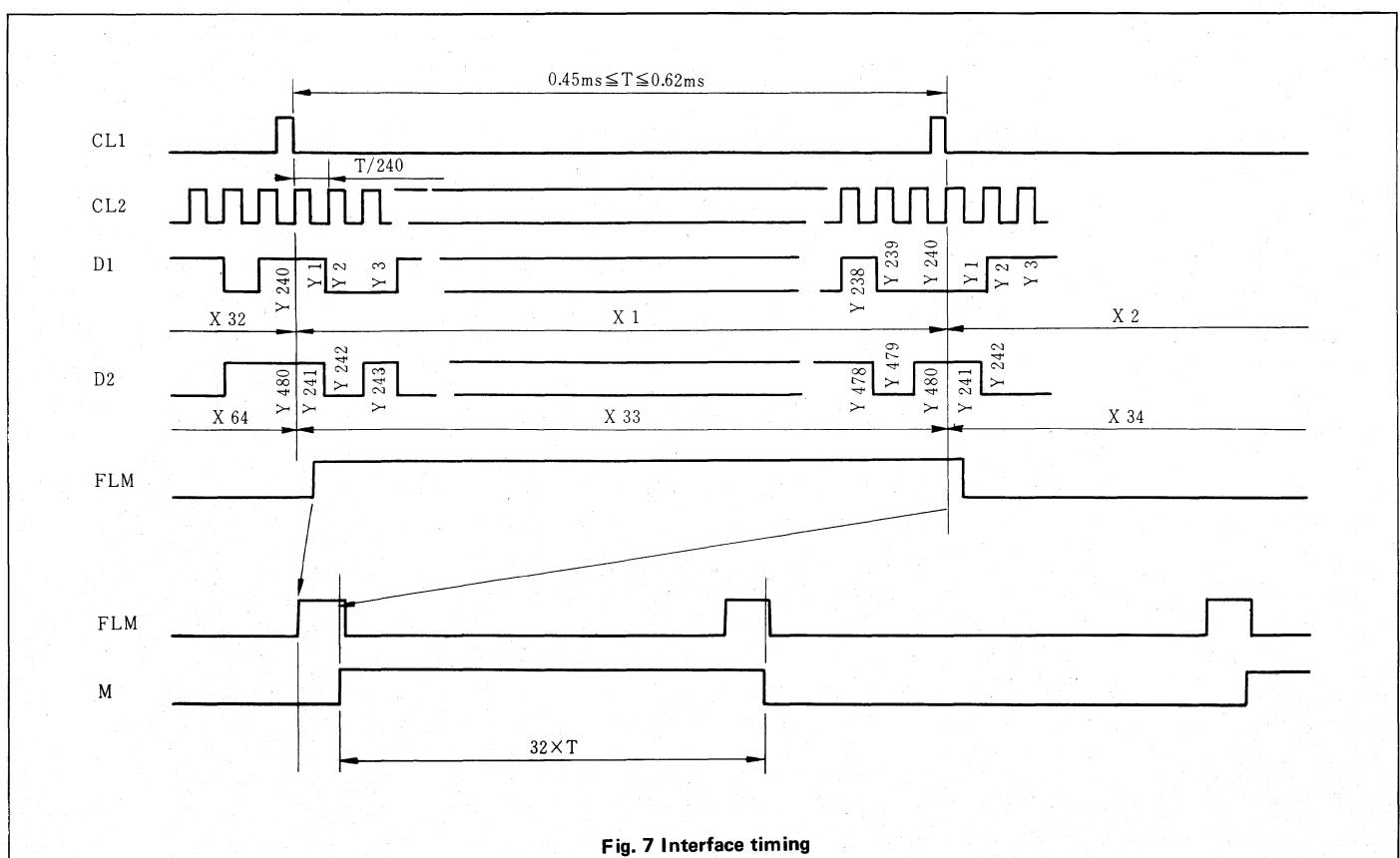
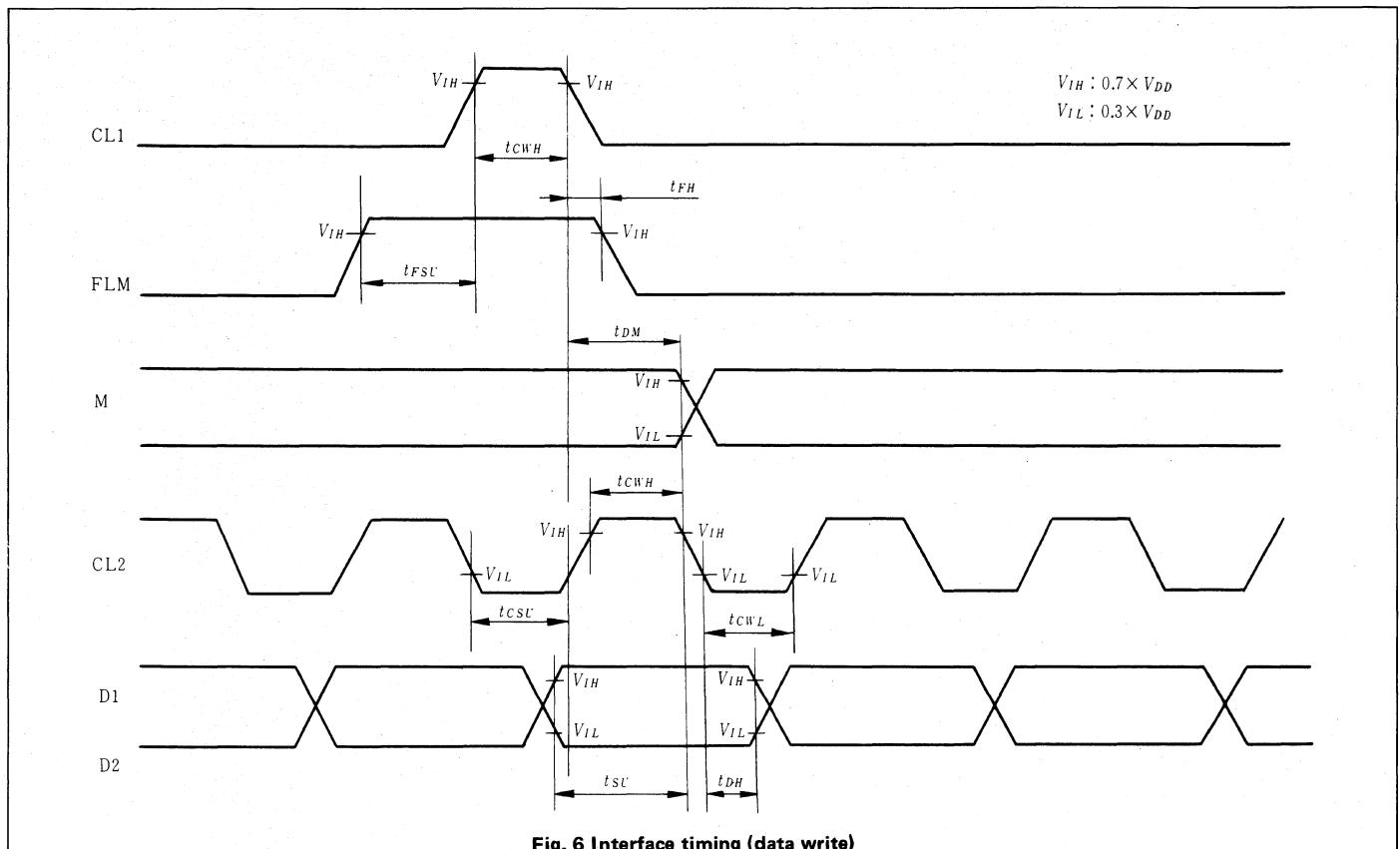
TIMING CHARACTERISTICS

| Item | Symbol | min. | typ. | max. | Unit |
|--------------------------------|-----------|-------|------|-------|--------------|
| Clock frequency | f_{CL2} | — | — | 520 | kHz (Note 1) |
| Clock pulse width (High level) | t_{CWH} | 800 | — | — | ns |
| Clock pulse width (Low level) | t_{CWL} | 800 | — | — | ns |
| Clock set up time | t_{CSU} | 500 | — | — | ns |
| Data set up time | t_{SU} | 300 | — | — | ns |
| FLM set up time | t_{FSU} | 300 | — | — | ns |
| M delay time | t_{DM} | -1000 | — | +1000 | ns (Note 2) |
| FLM hold time | t_{FH} | 0 | — | — | ns |
| Data hold time | t_{DH} | 300 | — | — | ns |

Note 1. Optimum frequency for the highest contrast is different by the type of module.

Note 2. Timing of M signal to CLI may be in the range of ± 1000 ns.

Note 3. In adjusting FLM frequency, avoid setting it around the commercial frequency (50Hz ± 2 Hz or 60Hz ± 2 Hz) to prevent LCD flicker.



LM213B

- 256 dot(W) x 64 dot(H) graphic and alpha-numeric display
- Built-in control LSI HD61830 type (see page 76)

MECHANICAL DATA (Nominal dimensions)

Module size 184W x 75H x 12D (max.) mm
 Effective display area 149.6W x 43H mm
 Number of dots 256W x 64H mm
 Dot size 0.51W x 0.51H mm
 Pitch 0.56W x 0.56H mm
 Weight about 150 g

| | min. | max. |
|--|----------|------------|
| Power supply for logic (V_{DD} - V_{SS}) | 0 | 7.0 V |
| Power supply for LCD drive (V_{DD} - V_{EE}) | 0 | 15.0 V |
| Input voltage (V_i) | V_{SS} | V_{DD} V |
| Operating temperature (T_a) | 0 | 40°C |
| Storage temperature (T_{stg}) | -20 | 60°C |

ELECTRICAL CHARACTERISTICS

$T_a = 25^\circ C$, $V_{DD} = 5.0 V \pm 0.25 V$,
 $V_{EE} = -9.0V \pm 5\%$
 Operating internal frequency F_{CP1} 500 kHz
 F_{CP2} 1.2 MHz
 Dissipation current 80 mW
 Power supply for LCD drive (Recommended) ($V_{DD} - V_o$)
 $D_u = 1/64$
 at $T_a = 0^\circ C$ 13.2 V typ.
 at $T_a = 25^\circ C$ 11.7 V typ.
 at $T_a = 40^\circ C$ 10.2 V typ.

OPTICAL DATA See page 8

INTERFACE TABLE

| Pin No. | Symbol | Pin No. | Symbol |
|---------|----------------|---------|------------------|
| 1 | V_{SS} (GND) | 11 | DB4 |
| 2 | V_{DD} (5 V) | 12 | DB5 |
| 3 | V_o | 13 | DB6 |
| 4 | RS | 14 | DB7 |
| 5 | R/W | 15 | \overline{CS} |
| 6 | E | 16 | \overline{RES} |
| 7 | DB0 | 17 | V_{EE} (-9 V) |
| 8 | DB1 | 18 | N.C |
| 9 | DB2 | 19 | N.C |
| 10 | DB3 | 20 | N.C |

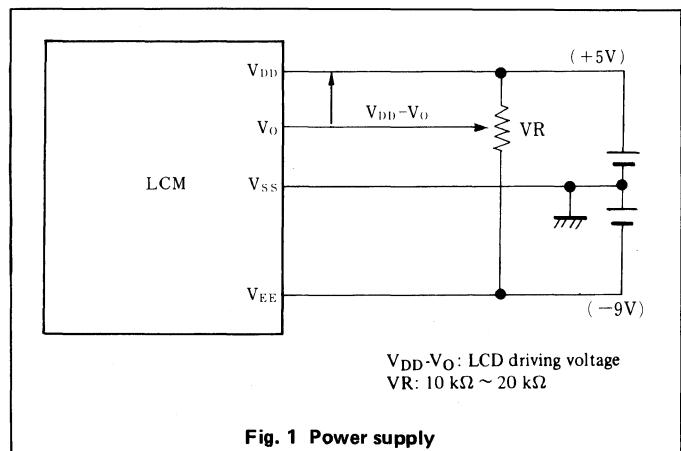


Fig. 1 Power supply

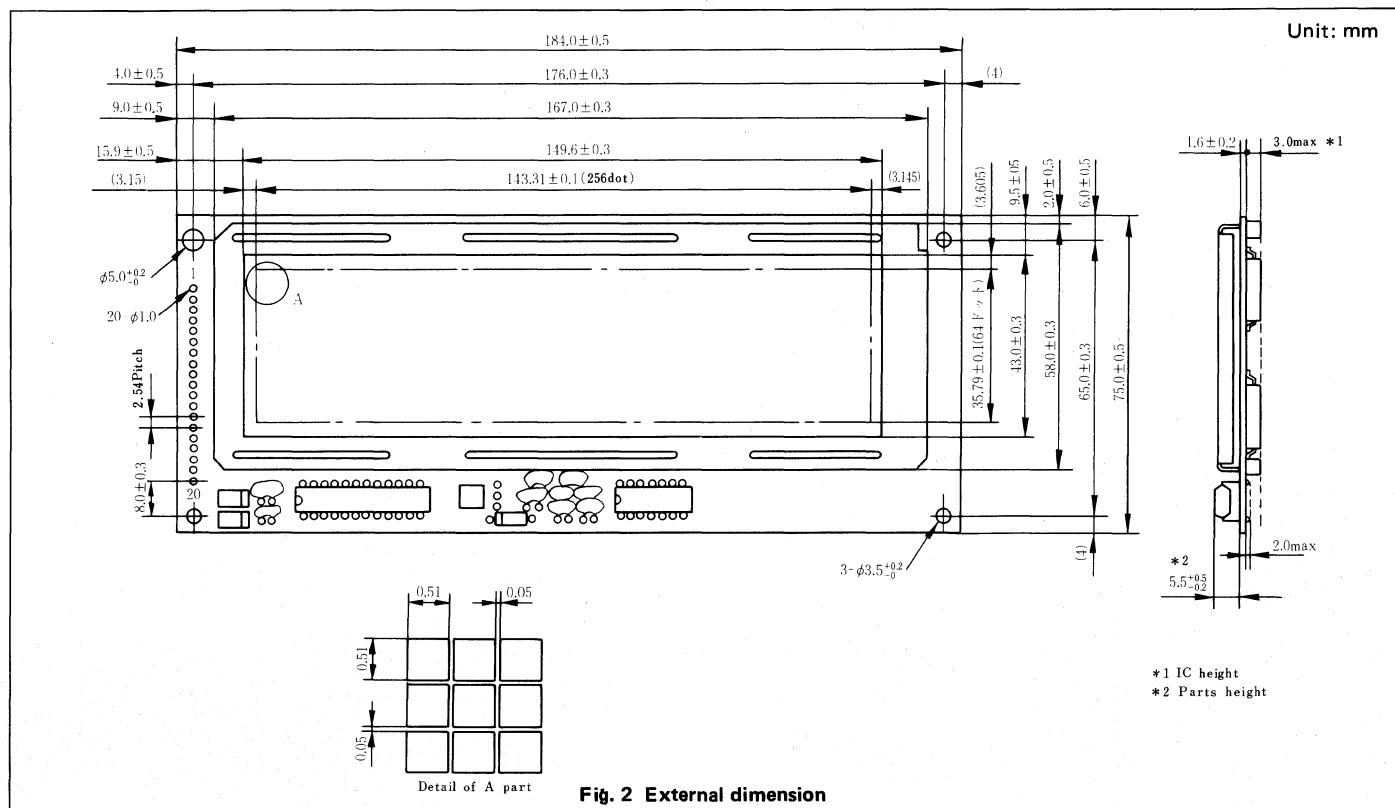


Fig. 2 External dimension

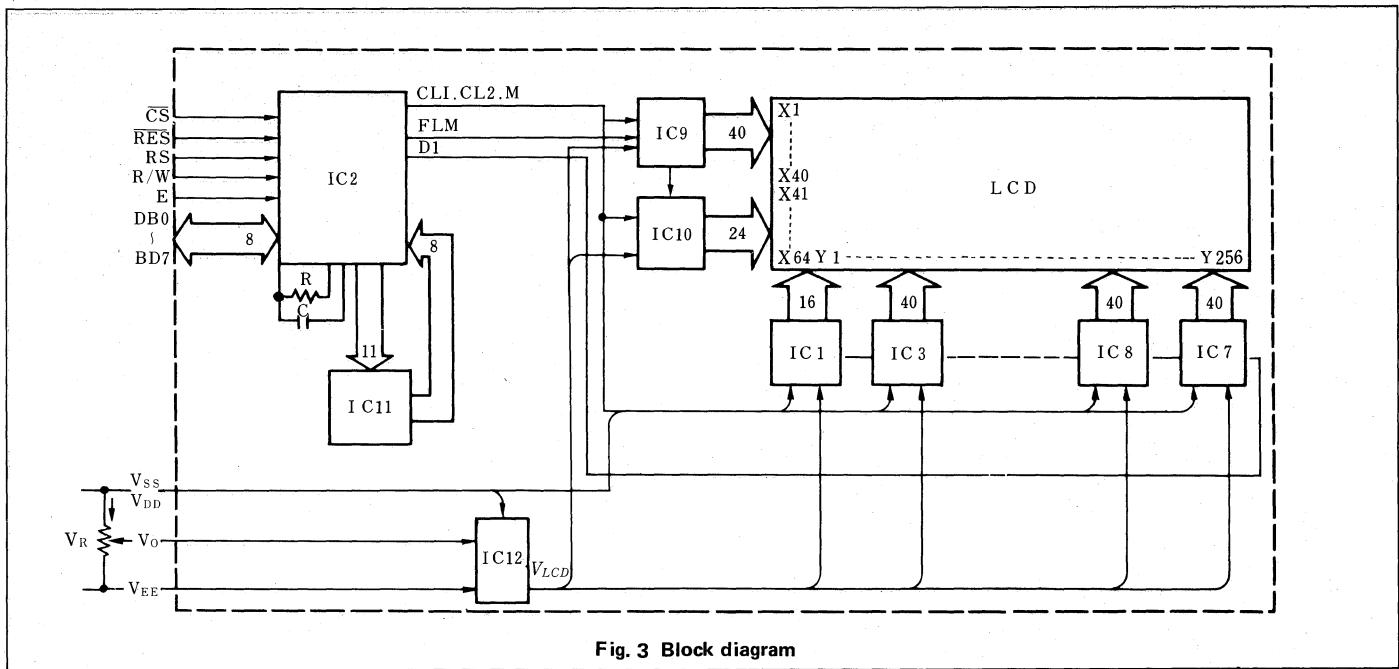


Fig. 3 Block diagram

TIMING CHARACTERISTICS

| Item | Symbol | min. | typ. | max. | Unit |
|----------------------------|-----------|------|------|------|---------|
| Cycle time of 'E' | t_{CYC} | 1.0 | — | — | μs |
| Pulse width of 'E' | t_{WEH} | 0.45 | — | — | μs |
| | t_{WEL} | 0.45 | — | — | μs |
| Pulse raise time of 'E' | t_{ER} | — | — | 25 | ns |
| Pulse fall time of 'E' | t_{EF} | — | — | 25 | ns |
| Set up time of CS, R/W, RS | t_{AS} | 140 | — | — | ns |
| Set up time of Input Data | t_{DIS} | 225 | — | — | ns |
| Data delay time | t_{DD} | — | — | 225 | ns |
| Hold time of Data | t_H | 10 | — | — | ns |
| Hold time of CS, R/W, RS | t_{AH} | 10 | — | — | ns |

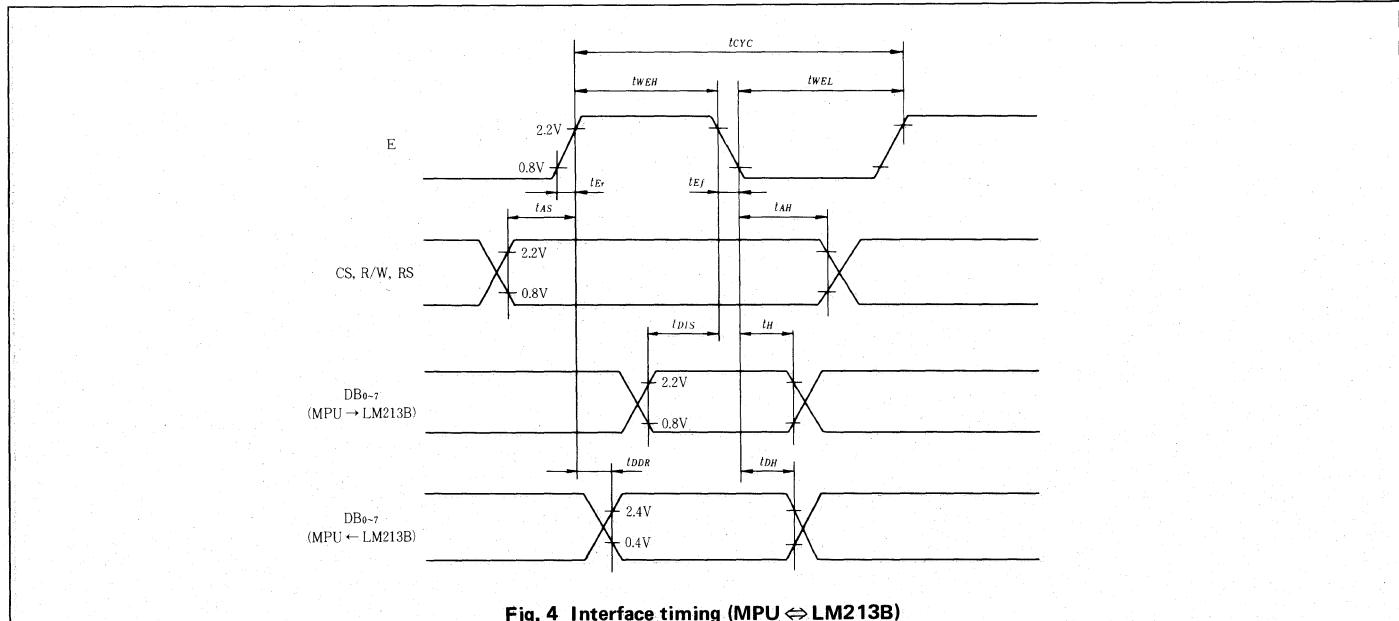


Fig. 4 Interface timing (MPU \leftrightarrow LM213B)

LM211

- 480 dot(W) x 64 dot(H) graphic and alpha-numeric display
- Recommendable control LSI HD61830 type (see page 76)

MECHANICAL DATA (Nominal dimensions)

| | |
|----------------------------------|----------------------------|
| Module size | 270W x 82H x 13D (max.) mm |
| Effective display area | 240W x 38H mm |
| Number of dots | 480W x 64H dot |
| Dot size | 0.44W x 0.44H mm |
| Pitch | 0.49W x 0.49H mm |
| Weight | about 180 g |

ABSOLUTE MAXIMUM RATINGS

| | min. | max. |
|--|----------|------------|
| Power supply for logic ($V_{DD}-V_{SS}$) | 0 | 7.0 V |
| Power supply for LCD drive ($V_{DD}-V_{EE}$) | 0 | 15 V |
| Input voltage (V_i) | V_{SS} | V_{DD} V |
| Operating temperature (T_a) | 0 | 40°C |
| Storage temperature (T_{stg}) | -20 | 60°C |

ELECTRICAL CHARACTERISTICS

| | |
|---|---|
| Ta = 25°C, $V_{DD} = 5.0$ V ± 0.25 V, $V_{EE} = -9.0$ V ± 0.45 V | |
| Input "high" voltage (V_{IH}) | 0.7 x V_{DD} V min. |
| Input "low" voltage (V_{IL}) | 0.3 x V_{DD} V max. |
| Clock frequency (f_{CL2}) | 610 kHz min. 920 kHz typ. 1200 kHz max. |
| Power supply current (I_{DD}) | 16 mA typ. |
| (I_{EE}) | 6 mA typ. |

Power supply for LCD drive (Recommended) ($V_{DD}-V_O$)
Du=1/64

| | |
|---------------------------------------|-------------|
| at $T_a = 0^\circ\text{C}$ | 13.3 V typ. |
| at $T_a = 25^\circ\text{C}$ | 11.9 V typ. |
| at $T_a = 40^\circ\text{C}$ | 10.6 V typ. |

OPTICAL DATA See page 8

INTERFACE TABLE

| Pin No. | Symbol | Level | Function |
|---------|----------|-------|--|
| 1 | D1 | H/L | Serial row data (left half) |
| 2 | FLM | H | The FLM signal indicates the beginning of each display cycle |
| 3 | M | H/L | Control signal for AC driving |
| 4 | CL1 | H/L | The CL1 latches the serial data in the shift registers |
| 5 | CL2 | H/L | Clock signal for shifting the serial data |
| 6 | D2 | H/L | Serial row data (right half) |
| 7 | V_{DD} | — | Power supply for logic circuit |
| 8 | V_{SS} | — | Ground |
| 9 | V_{EE} | — | Power supply for LC driving |
| 10 | V_O | — | Operating voltage for LC driving |

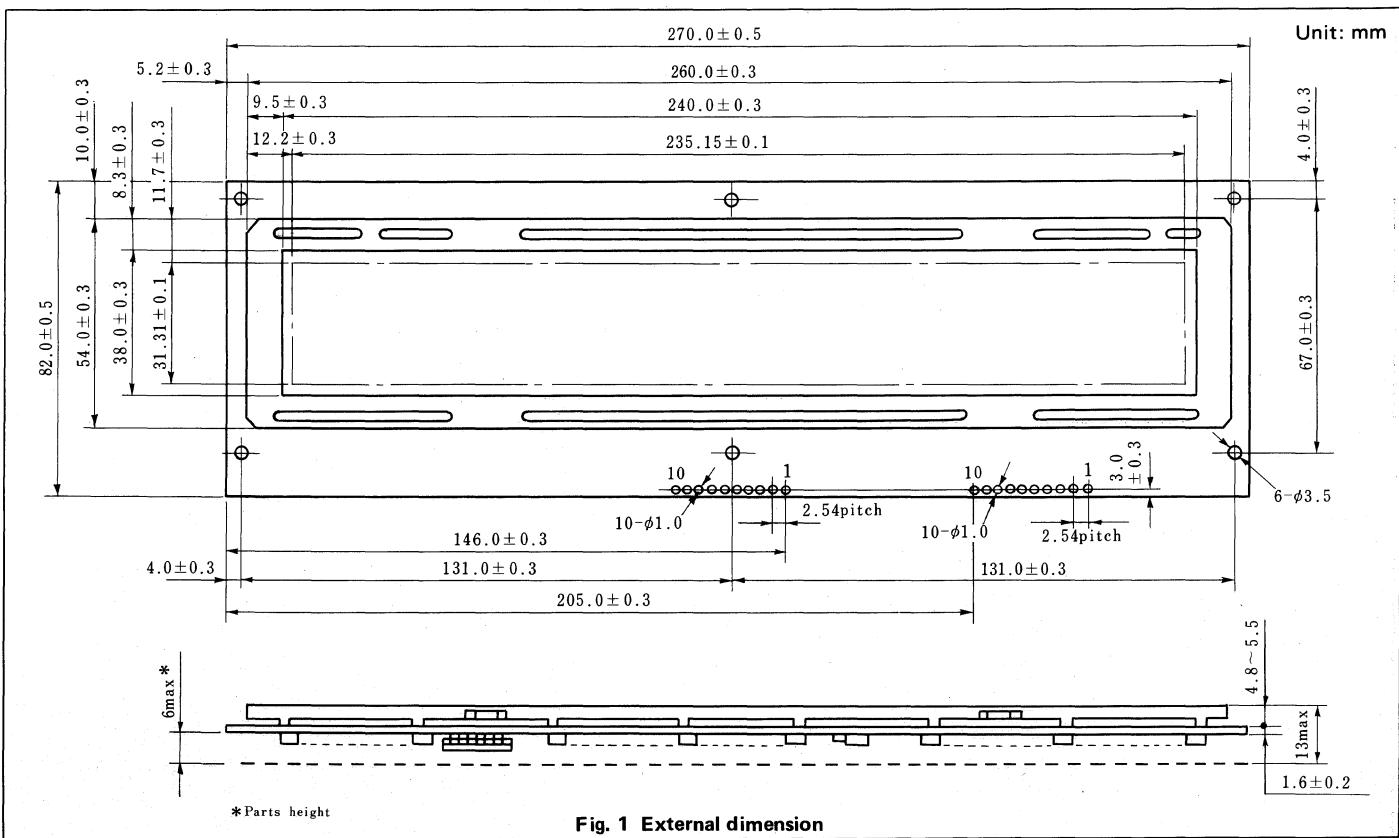


Fig. 1 External dimension

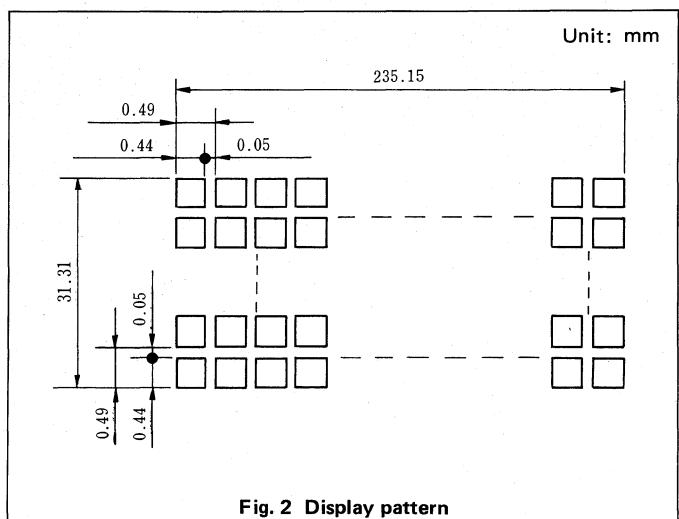


Fig. 2 Display pattern

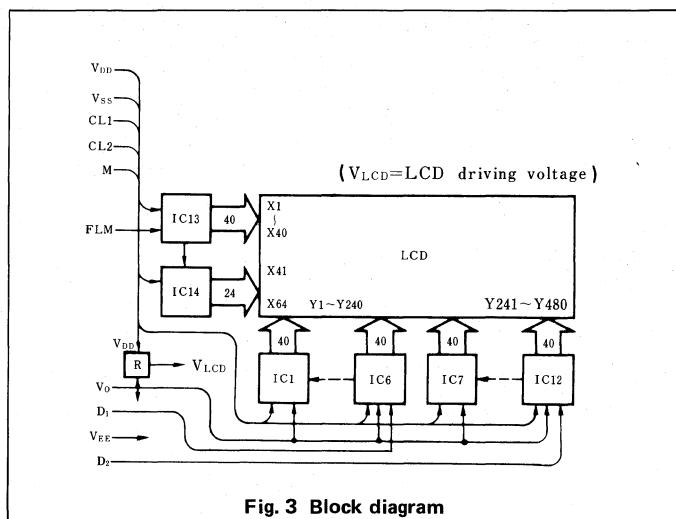


Fig. 3 Block diagram

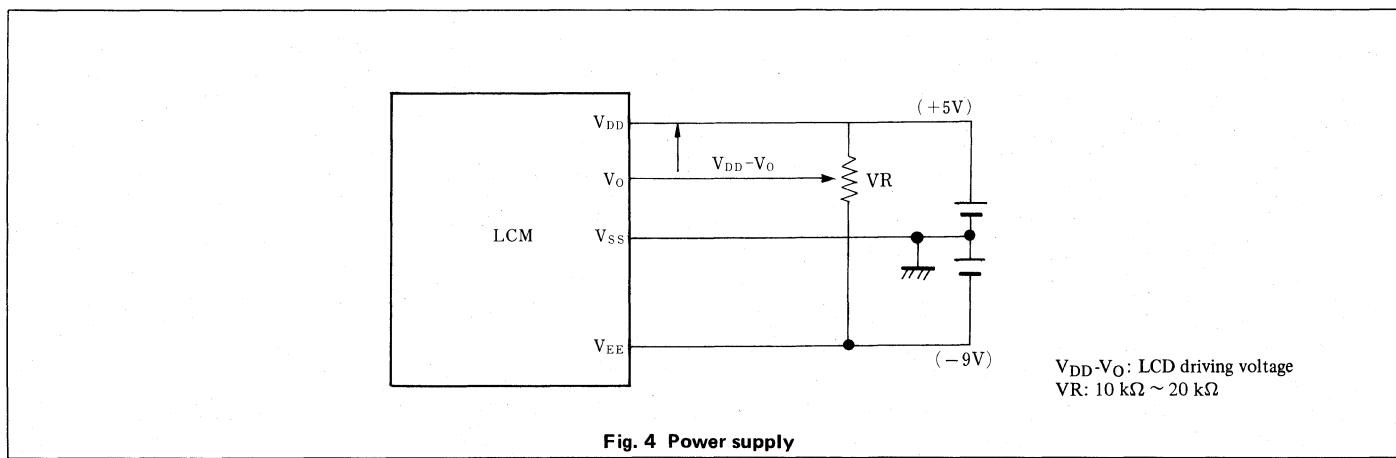


Fig. 4 Power supply

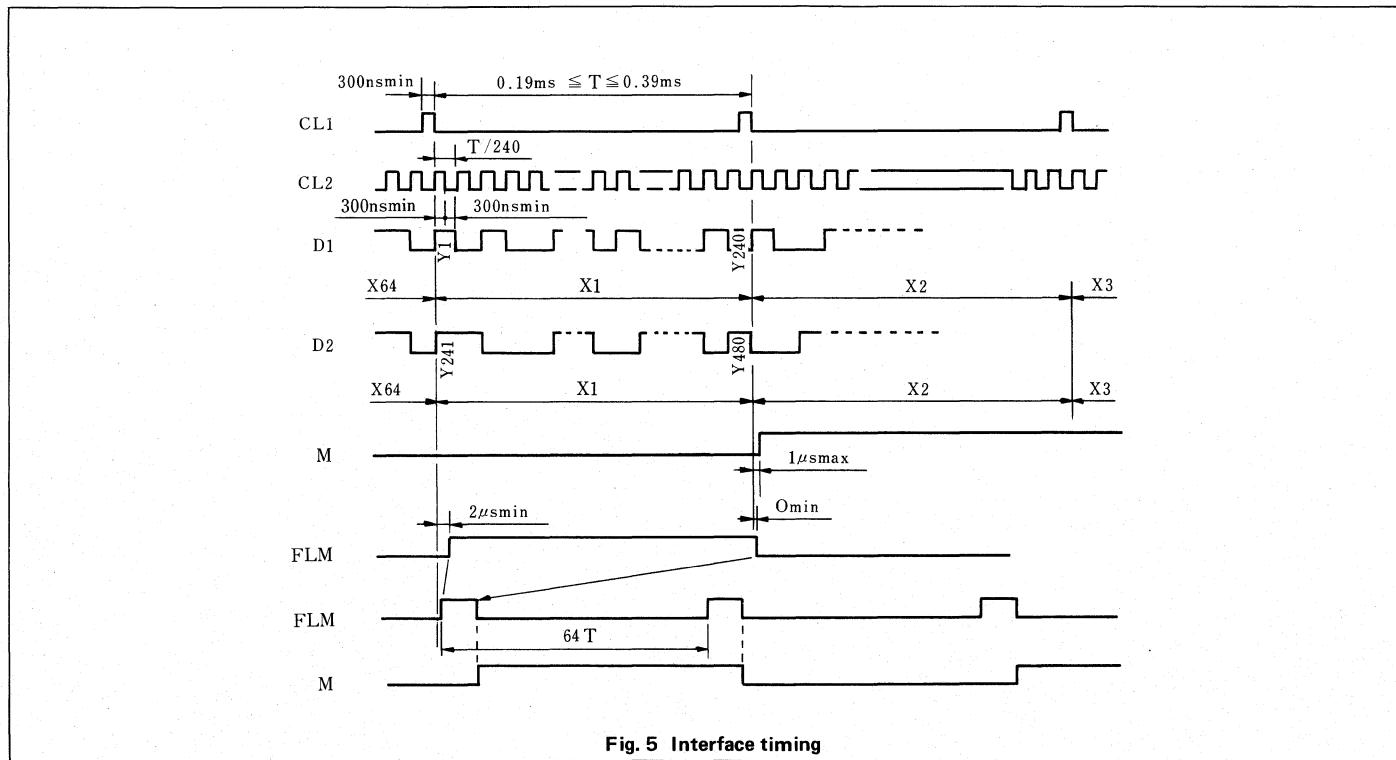


Fig. 5 Interface timing

TIMING CHARACTERISTICS

| Item | Symbol | min. | typ. | max. | Unit |
|--------------------------------|-----------|-------|------|-------|--------------|
| Clock frequency | f_{CL2} | — | — | 1200 | kHz (Note 1) |
| Clock pulse width (High level) | t_{CWH} | 300 | — | — | ns |
| Clock pulse width (Low level) | t_{CWL} | 300 | — | — | ns |
| Clock set up time | t_{CSU} | 300 | — | — | ns |
| Data set up time | t_{SU} | 200 | — | — | ns |
| FLM set up time | t_{FSU} | 200 | — | — | ns |
| M delay time | t_{DM} | -1000 | — | +1000 | ns (Note 2) |
| FLM hold time | t_{FH} | 0 | — | — | ns |
| Data hold time | t_{DH} | 200 | — | — | ns |

Note 1. Optimum frequency for the highest contrast is different by the type of module.

Note 2. Timing of M signal to CL1 may be in the range of ± 1000 ns.

Note 3. In adjusting FLM frequency, avoid setting it around the commercial frequency (50 Hz ± 2 Hz or 60 Hz ± 2 Hz) to prevent LCD flicker.

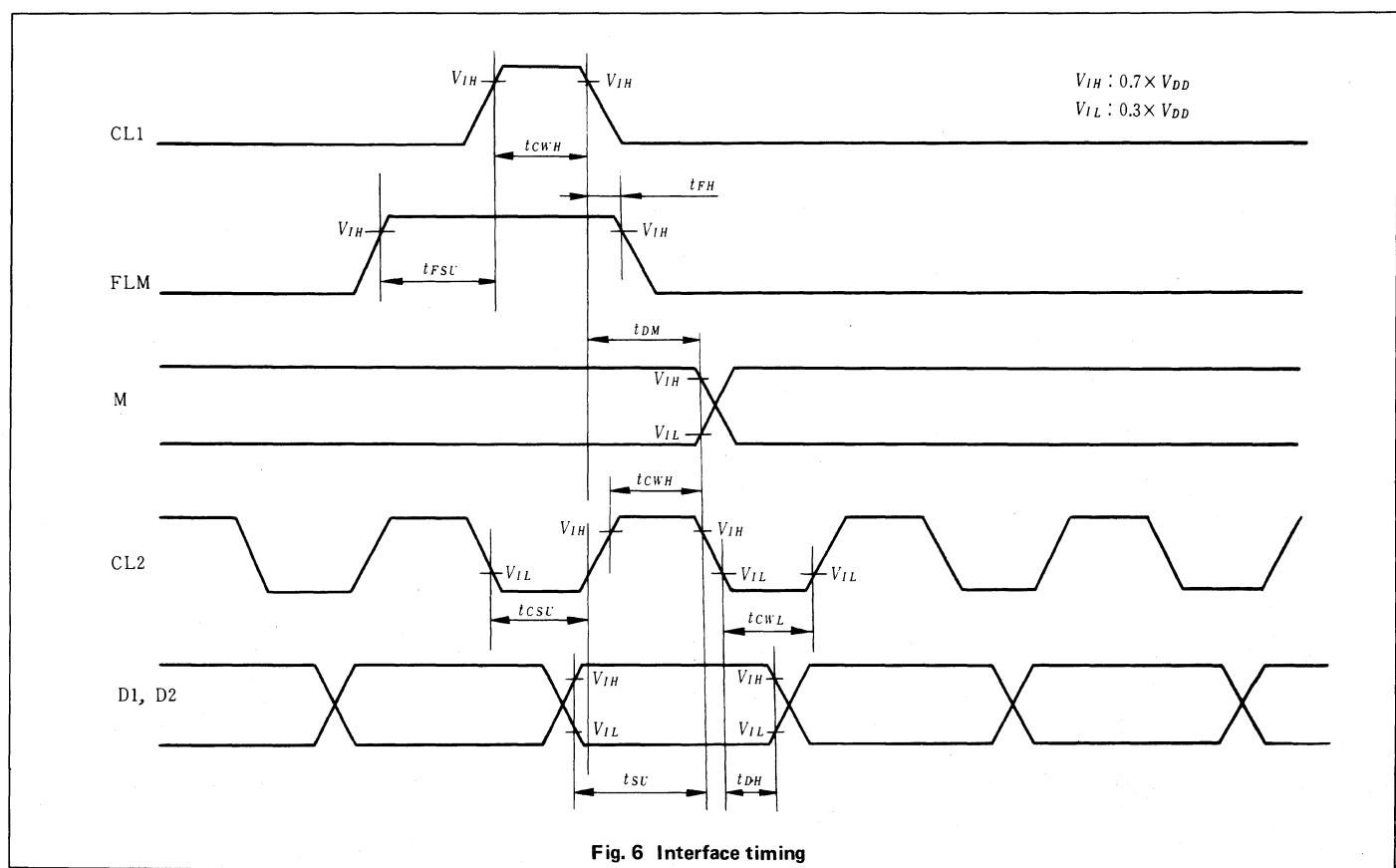


Fig. 6 Interface timing

LM212

- 640 dot(W) x 48 dot(H) graphic and alpha-numeric display
- Recommendable control LSI HD61830 type (see page 76)

MECHANICAL DATA (Nominal dimensions)

Module size 270W x 63H x 13.5D (max.) mm
 Effective display area 241W x 25H mm
 Number of dots 640W x 48H dot
 Dot size 0.32W x 0.38H mm
 Pitch 0.37W x 0.43H mm
 Weight about 175 g

ABSOLUTE MAXIMUM RATINGS

min. max.

Power supply for logic (V_{DD} - V_{SS}) 0 7.0 V
 Power supply for LCD drive (V_{DD} - V_{EE}) 0 15.0 V
 Input voltage (V_i) V_{SS} V_{DD} V
 Operating temperature (T_a) 0 40°C
 Storage temperature (T_{stg}) -20 60°C

ELECTRICAL CHARACTERISTICS

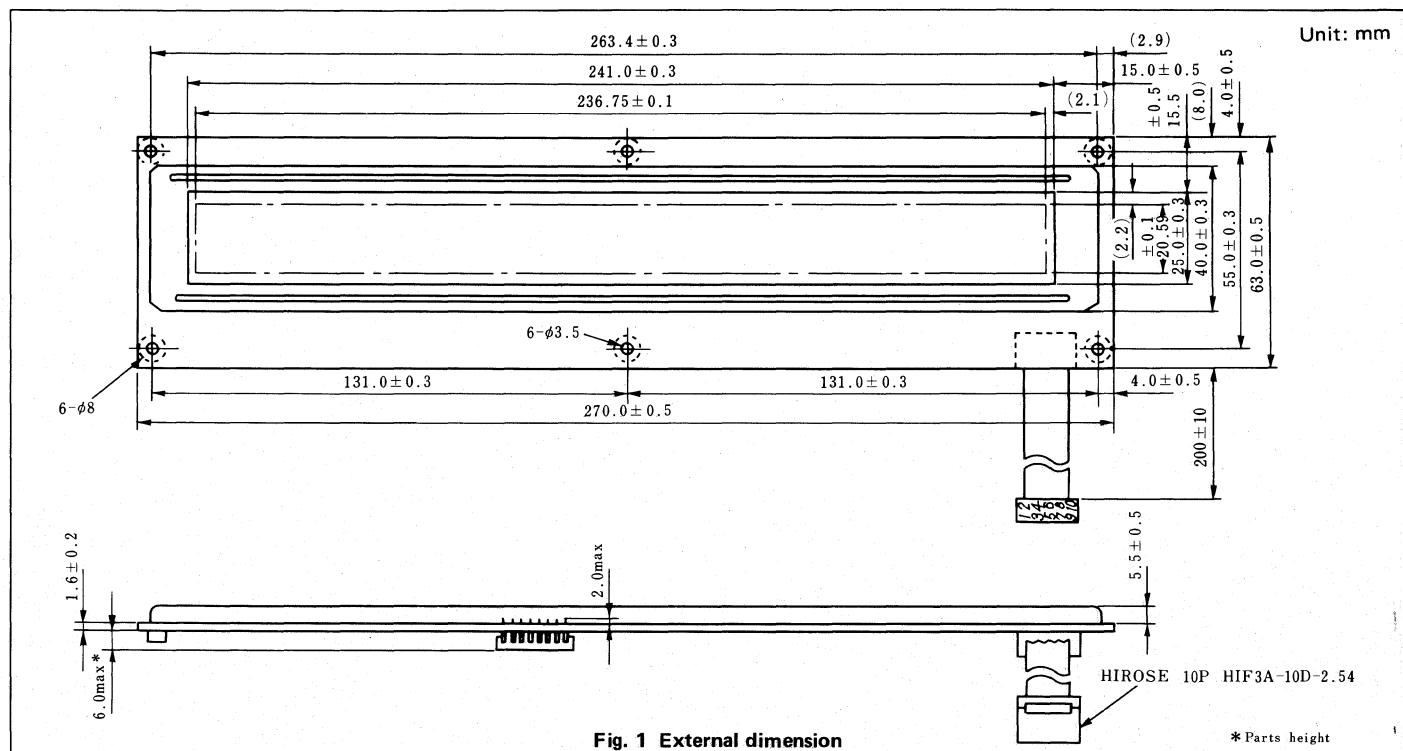
$T_a = 25^\circ\text{C}$, $V_{DD} = 5.0 \text{ V} \pm 0.25 \text{ V}$,
 $V_{EE} = -10.0 \text{ V} \pm 0.25 \text{ V}$
 Input "high" voltage (V_{iH}) $0.7 \times V_{DD}$ V min.
 Input "low" voltage (V_{iL}) $0.3 \times V_{DD}$ V max.
 Clock frequency (f_{CL2}) 1,075 kHz min.
 1,152 kHz typ.
 1,228 kHz max.
 Power supply current (I_{DD}) 10 mA typ.
 (D₁, D₂ = GND, $f_{CL2} = 1,152 \text{ kHz}$)

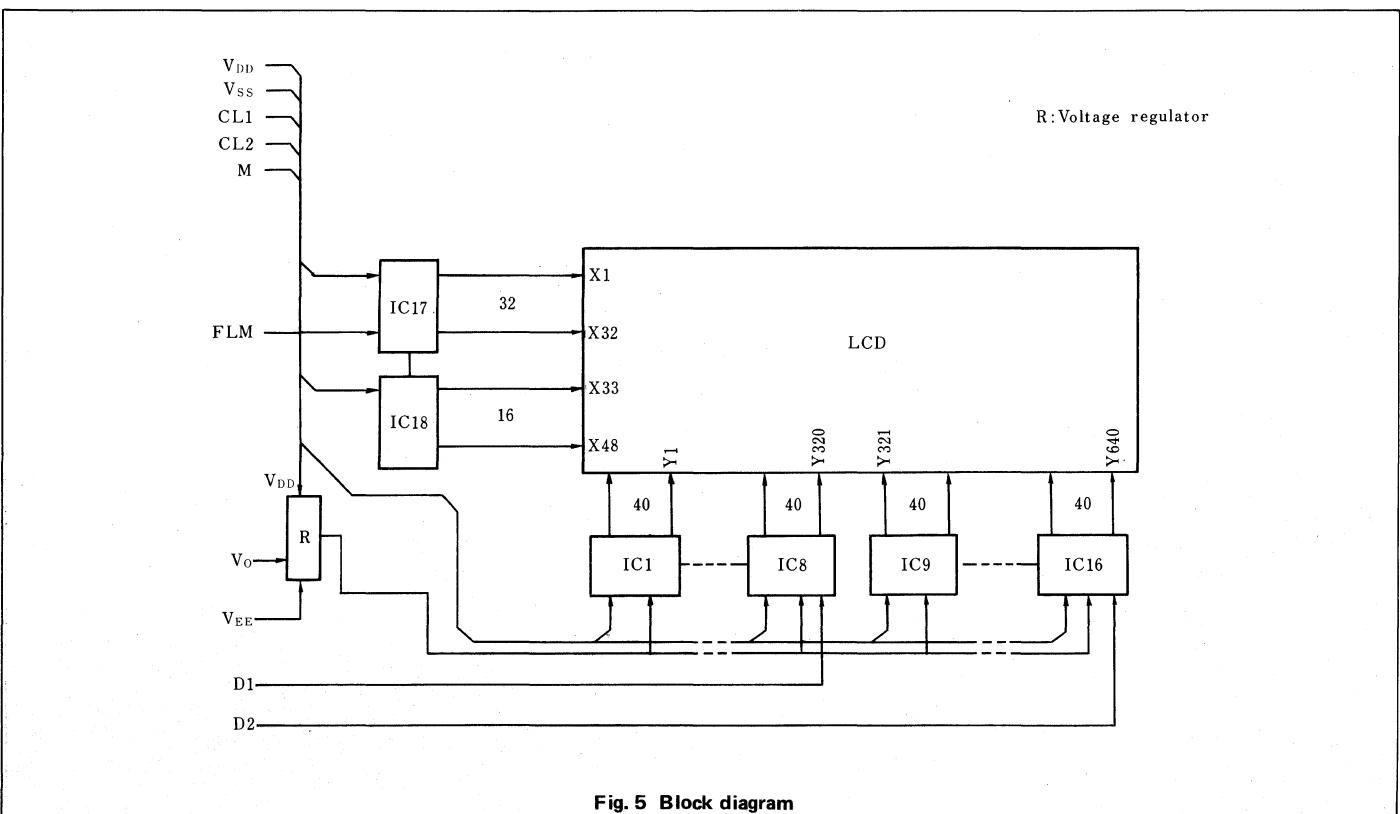
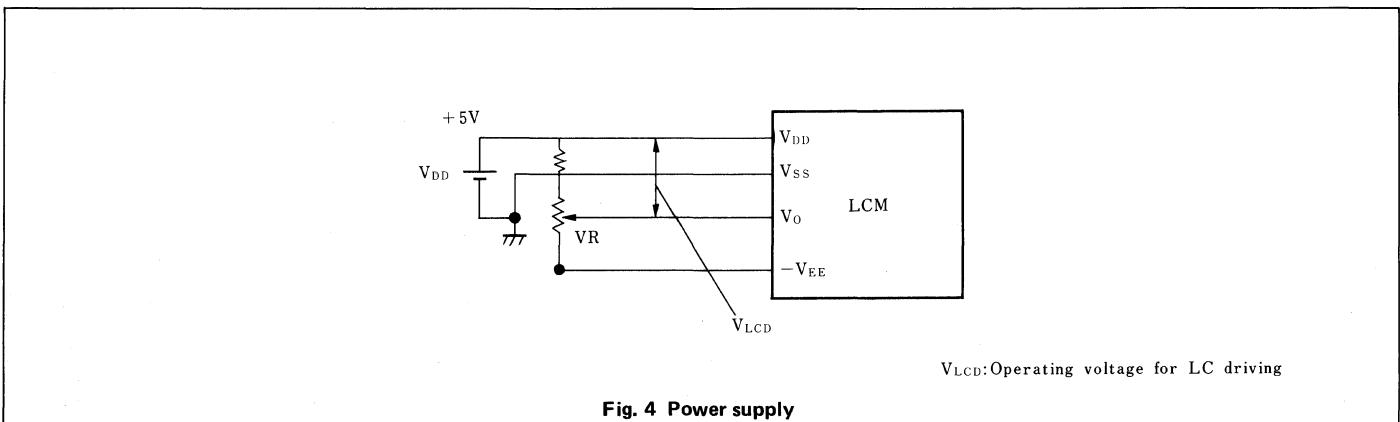
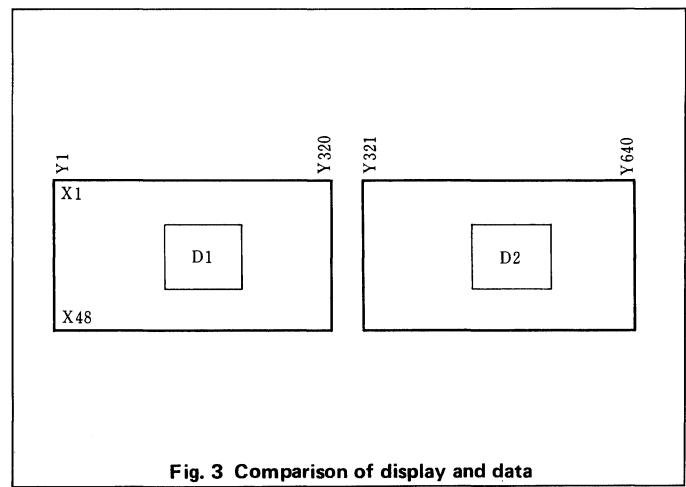
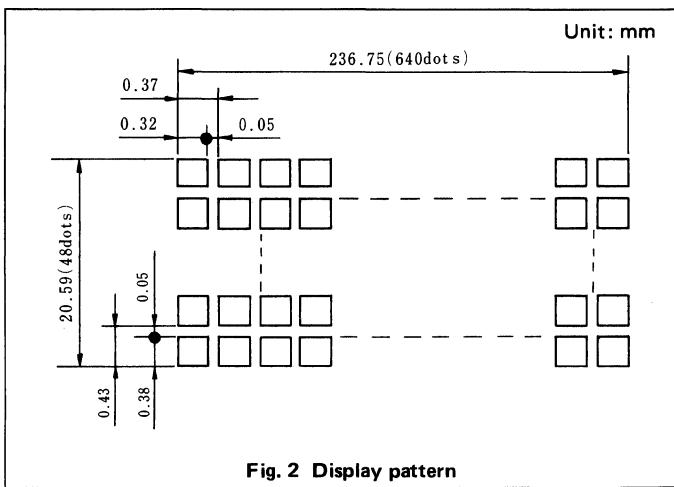
Power supply for LCD drive (Recommended) ($V_{DD} - V_O$)
 Du=1/48
 at $T_a = 0^\circ\text{C}$ 12.5 V typ.
 at $T_a = 25^\circ\text{C}$ 11.0 V typ.
 at $T_a = 40^\circ\text{C}$ 9.7 V typ.

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------|-------|--|
| 1 | D1 | H/L | Serial row data (left half) |
| 2 | FLM | H | The FLM signal indicates the beginning of each display cycle |
| 3 | M | H/L | Control signal for AC driving |
| 4 | CL1 | H → L | The CL1 latches the serial data in the shift registers |
| 5 | CL2 | H → L | Clock signal for shifting the serial data |
| 6 | D2 | H/L | Serial row data (right half) |
| 7 | V_{DD} | — | Power supply for logic circuit |
| 8 | V_{SS} | — | Ground |
| 9 | V_{EE} | — | Power supply for LC driving |
| 10 | V_O | — | Operating voltage for LC driving |





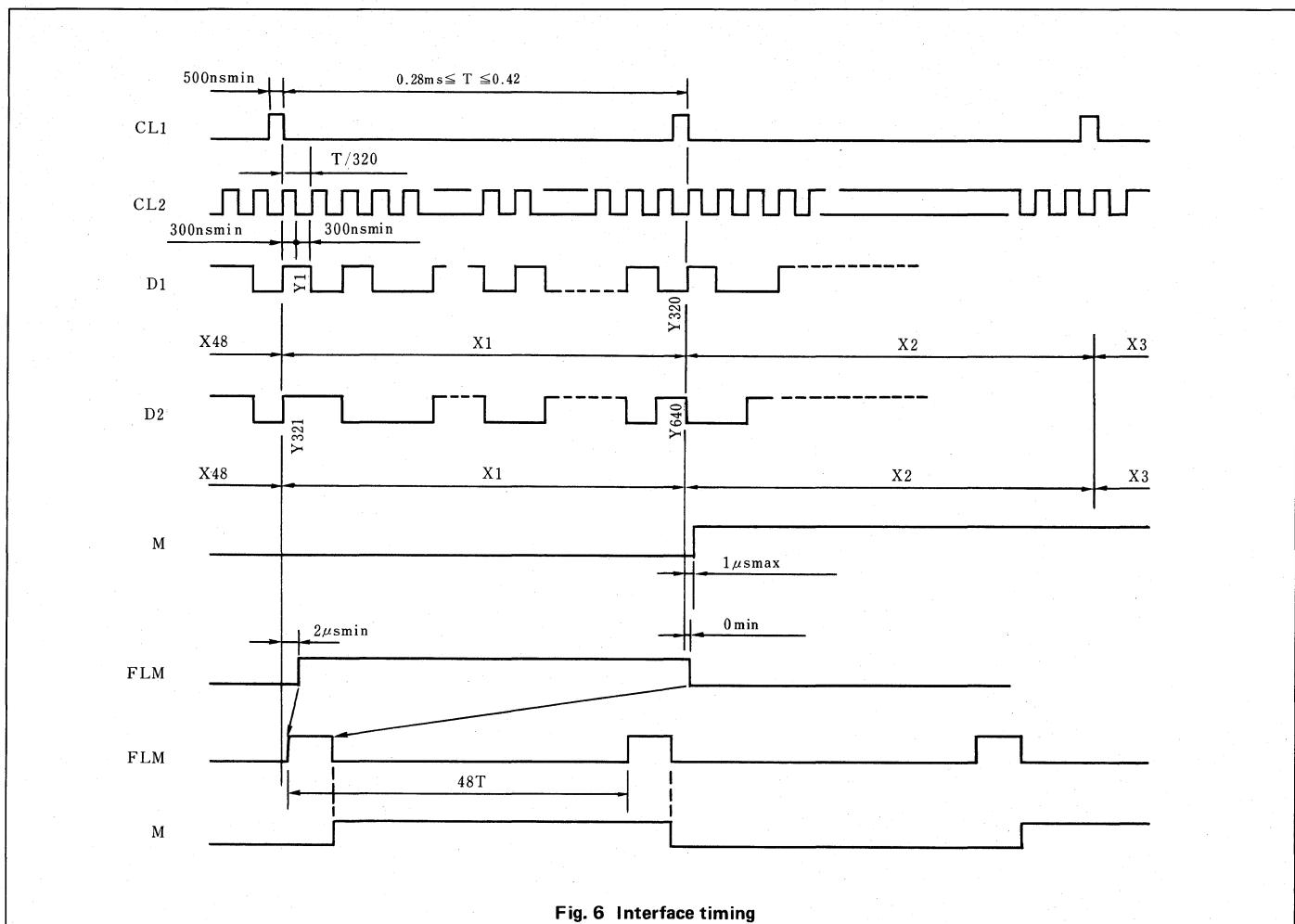


Fig. 6 Interface timing

TIMING CHARACTERISTICS

| Item | Symbol | min. | typ. | max. | Unit |
|--------------------------------|-----------|-------|------|-------|--------------|
| Clock frequency | f_{CL2} | — | — | 1228 | kHz (Note 1) |
| Clock pulse width (High level) | t_{CWH} | 200 | — | — | ns |
| Clock pulse width (Low level) | t_{CWL} | 300 | — | — | ns |
| Clock set up time | t_{CSU} | 500 | — | — | ns |
| Data set up time | t_{SU} | 40 | — | — | ns |
| FLM set up time | t_{FSU} | 100 | — | — | ns |
| M delay time | t_{DM} | -1000 | — | +1000 | ns (Note 2) |
| FLM hold time | t_{FH} | 800 | — | — | ns |
| Data hold time | t_{DH} | 400 | — | — | ns |

Note 1. Optimum frequency for the highest contrast is different by the type of module.

Note 2. Timing of M signal to CL1 may be in the range of ± 1000 ns.

Note 3. In adjusting FLM frequency, avoid setting it around the commercial frequency (50 Hz ± 2 Hz or 60 Hz ± 2 Hz) to prevent LCD flicker.

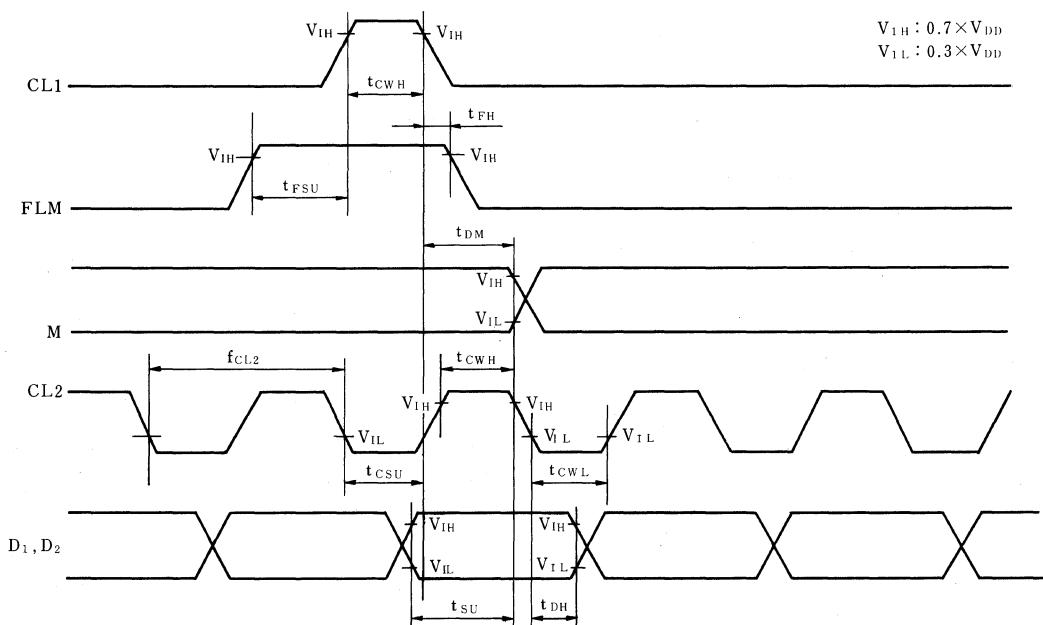


Fig. 7 Interface timing

LM215

- 480 dot(W) x 128 dot(H) graphic and alpha-numeric display
- Recommendable control LSI HD61830 type (see page 76)

MECHANICAL DATA (Nominal dimensions)

Module size 270W x 110H x 11.5D (max.) mm
 Effective display area 242W x 69H mm
 Number of dots 480W x 128H dot
 Dot size 0.43W x 0.43H mm
 Pitch 0.48W x 0.48H mm
 Weight about 320 g

ABSOLUTE MAXIMUM RATINGS

min. max.

Power supply for logic (V_{DD} - V_{SS}) 0 7.0 V
 Power supply for LCD drive (V_{DD} - V_{EE}) 0 16.0 V
 Input voltage (V_i) V_{SS} V_{DD} V
 Operating temperature (T_a) 0 40°C
 Storage temperature (T_{stg}) -20 60°C

ELECTRICAL CHARACTERISTICS

$T_a = 25^\circ\text{C}$, $V_{DD} = 5.0 \text{ V} \pm 0.25 \text{ V}$,
 $V_{EE} = -10.0 \text{ V} \pm 0.25 \text{ V}$

Input "high" voltage (V_{iH}) 0.7 x V_{DD} V min.
 Input "low" voltage (V_{iL}) 0.3 x V_{DD} V max.
 Clock frequency (f_{CL2}) 1.08 MHz min.
 1.15 MHz typ.
 1.23 MHz max.
 Power supply current (I_{DD}) 6 mA typ.
 (I_{EE}) 3 mA typ.
 ($D_1, D_2 = \text{GND}$) ($f_{CL} = 1.15 \text{ MHz}$) ($V_{DD} - V_O = 12.0 \text{ V}$)
 ($D_3, D_4 = \text{GND}$)
 Power supply for LCD drive (Recommended) ($V_O - V_{EE}$)
 Du=1/64
 at $T_a = 0^\circ\text{C}$ 13.6 V typ.
 at $T_a = 25^\circ\text{C}$ 12.0 V typ.
 at $T_a = 40^\circ\text{C}$ 10.8 V typ.

OPTICAL DATA See page 8

INTERNAL PIN CONNECTION

| Pin No. | Symbol | Level | Function |
|---------|----------|-------|--|
| 1 | D1 | H/L | Serial row data (upper left half) |
| 2 | D2 | H/L | Serial row data (lower left half) |
| 3 | FLM | H | The FLM signal indicates the beginning of each display cycle |
| 4 | M | H/L | Control signal for AC driving |
| 5 | CL1 | H → L | The CL1 latches the serial data in the shift registers |
| 6 | CL2 | H → L | Clock signal for shifting the serial data |
| 7 | D3 | H/L | Serial row data (upper right half) |
| 8 | D4 | H/L | Serial row data (lower right half) |
| 9 | V_{DD} | — | Power supply for logic circuit |
| 10 | V_{SS} | — | Ground |
| 11 | V_{EE} | — | Power supply for LC driving |
| 12 | V_O | — | Operating voltage for LC driving |

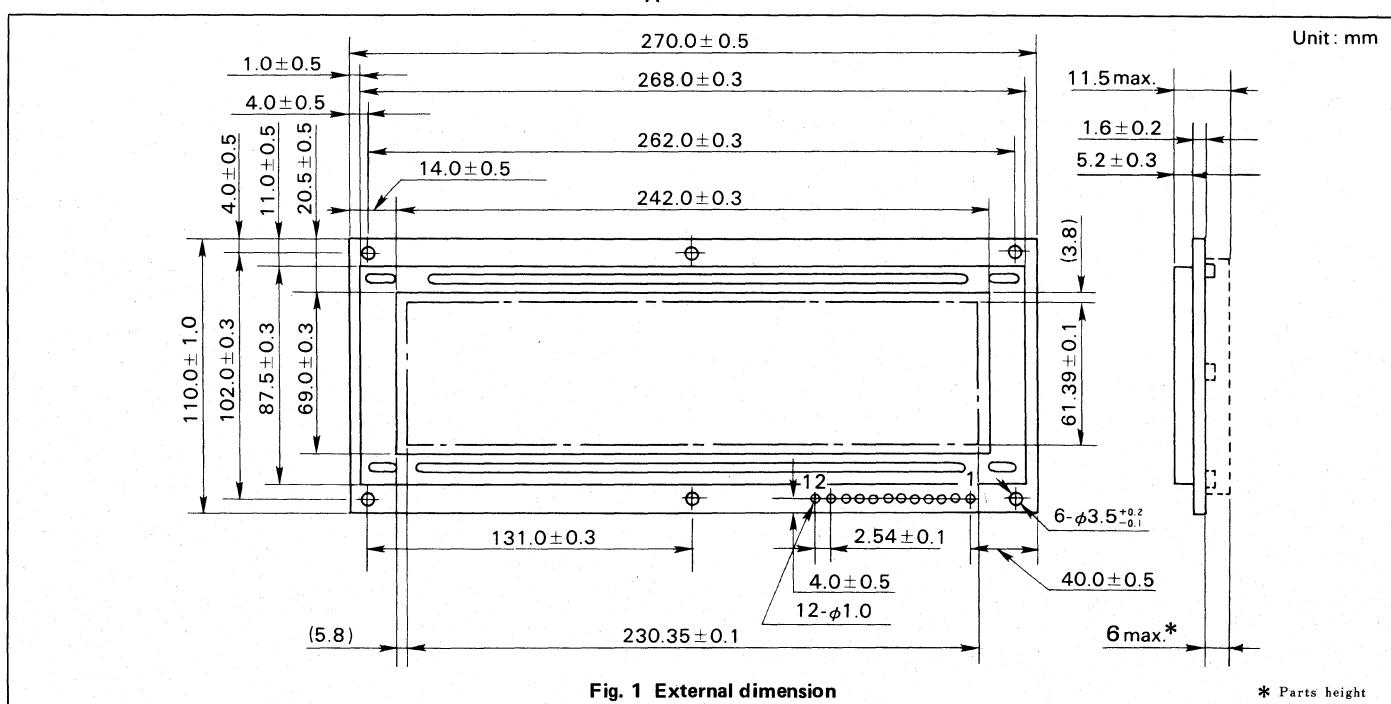


Fig. 1 External dimension

* Parts height

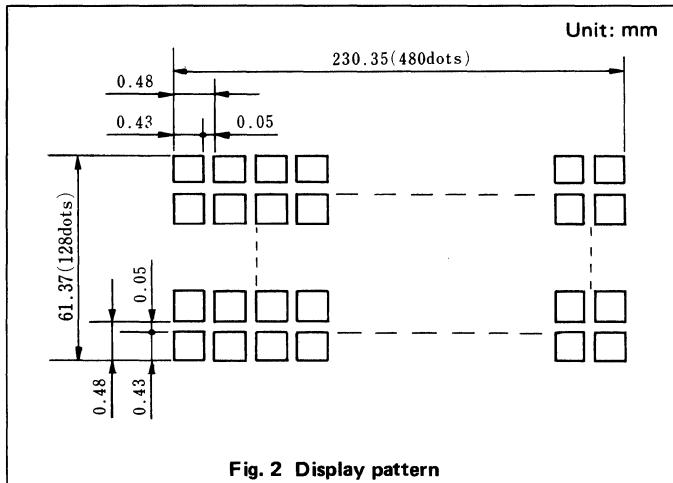


Fig. 2 Display pattern

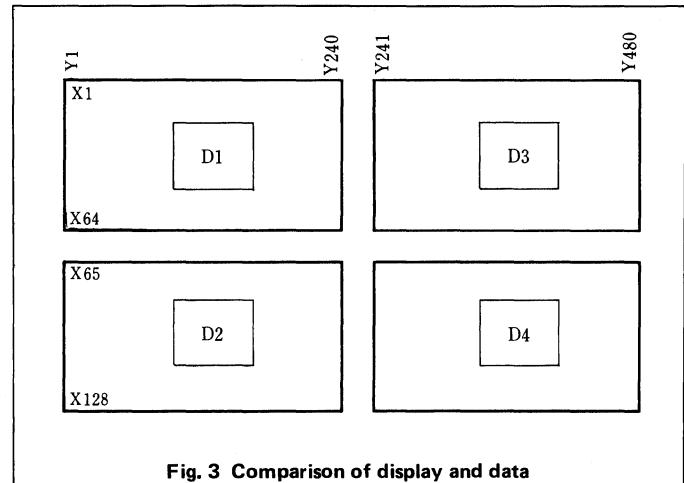


Fig. 3 Comparison of display and data

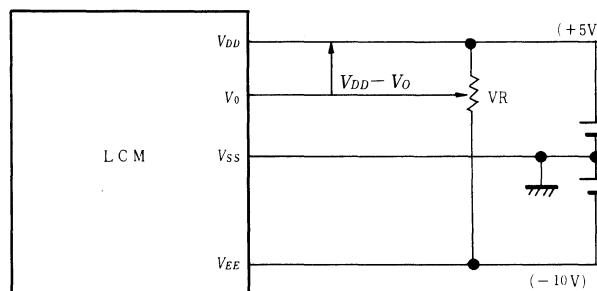


Fig. 4 Power supply

$V_{DD} - V_0$: Operating Voltage for LC driving

VR: $10\text{ k}\Omega \sim 20\text{ k}\Omega$

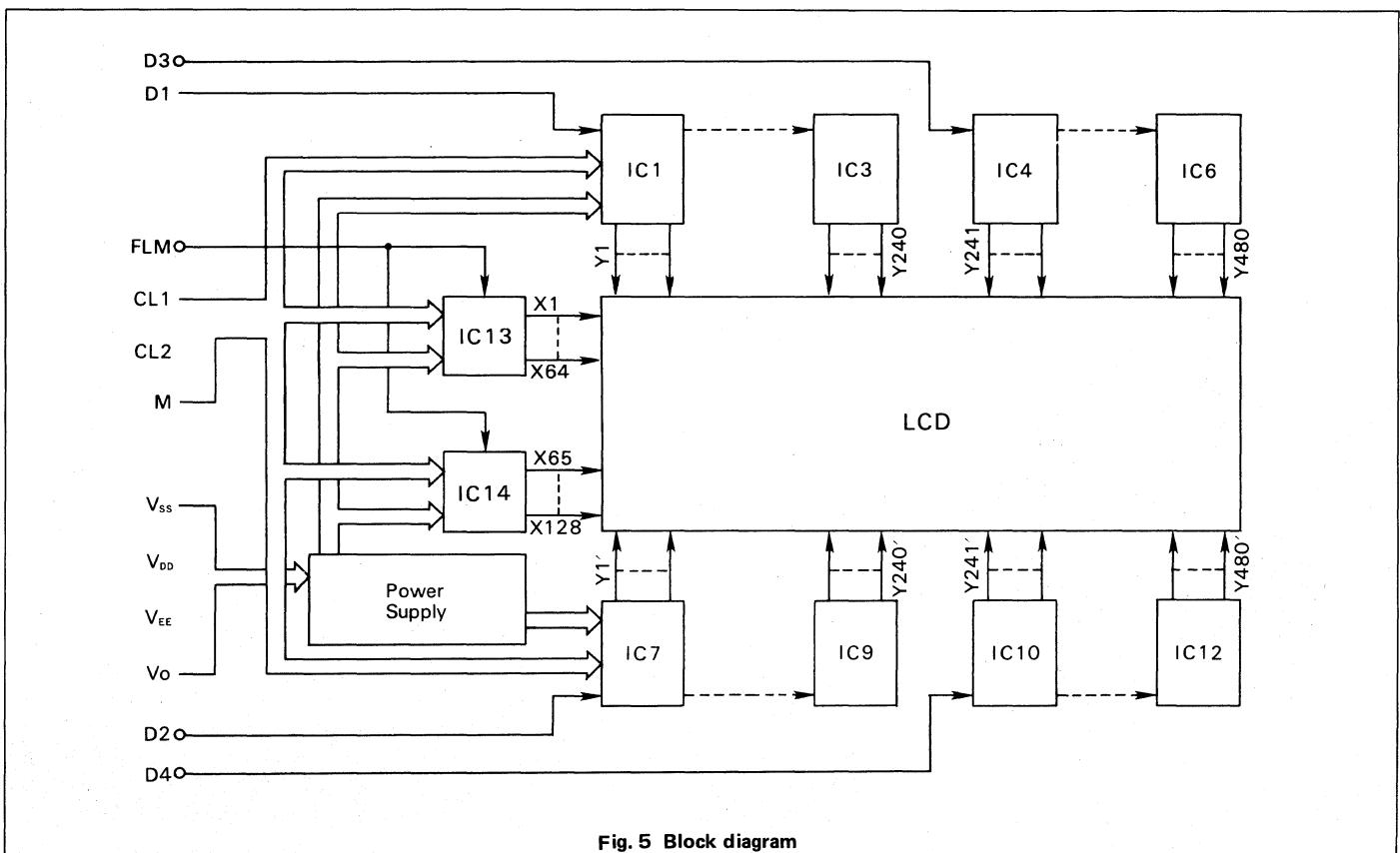


Fig. 5 Block diagram

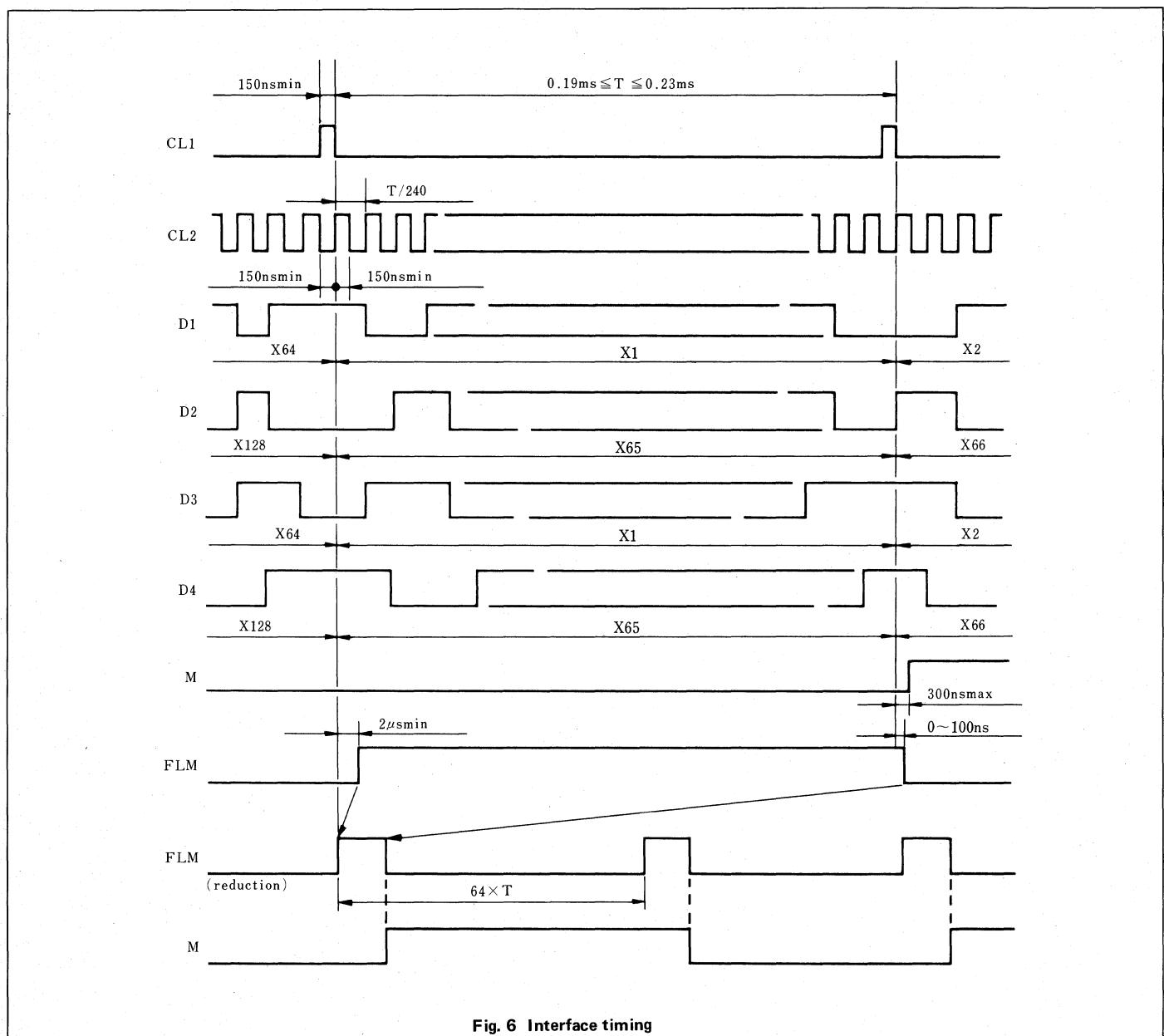


Fig. 6 Interface timing

TIMING CHARACTERISTICS

| Item | Symbol | min. | typ. | max. | Unit |
|----------------------|------------|------|------|------|------|
| CL2 cycle time | t_{CYC} | 810 | — | — | ns |
| CL2 pulse width (H) | t_{CWH} | 150 | — | — | ns |
| CL2 pulse width (L) | t_{CWL} | 150 | — | — | ns |
| CL1 set up time (1) | t_{SCL1} | 150 | — | — | ns |
| CL1 set up time (2) | t_{HCL1} | 150 | — | — | ns |
| Clock rise/fall time | t_r, t_f | — | — | 30 | ns |
| Data set up time | t_{DSU} | 100 | — | — | ns |
| Data hold time | t_{DH} | 100 | — | — | ns |
| CL1 delay time | t_{CL} | 150 | — | — | ns |
| M delay time | t_{CM} | — | — | 300 | ns |
| FLM set up time | t_{FS} | 100 | — | — | ns |
| FLM hold time | t_{FH} | 100 | — | — | ns |

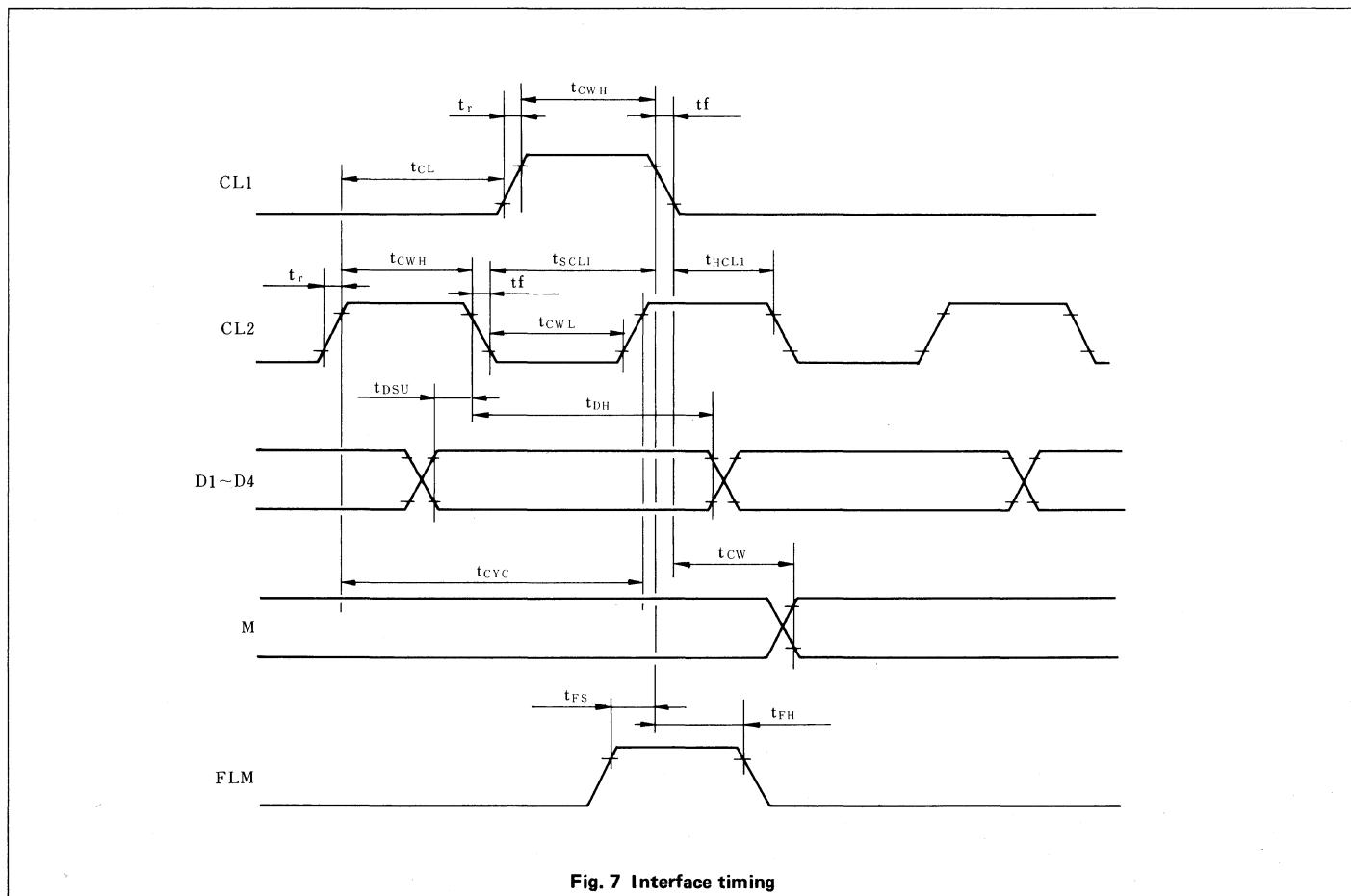


Fig. 7 Interface timing



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