

EA-D16025 Series

■ Features

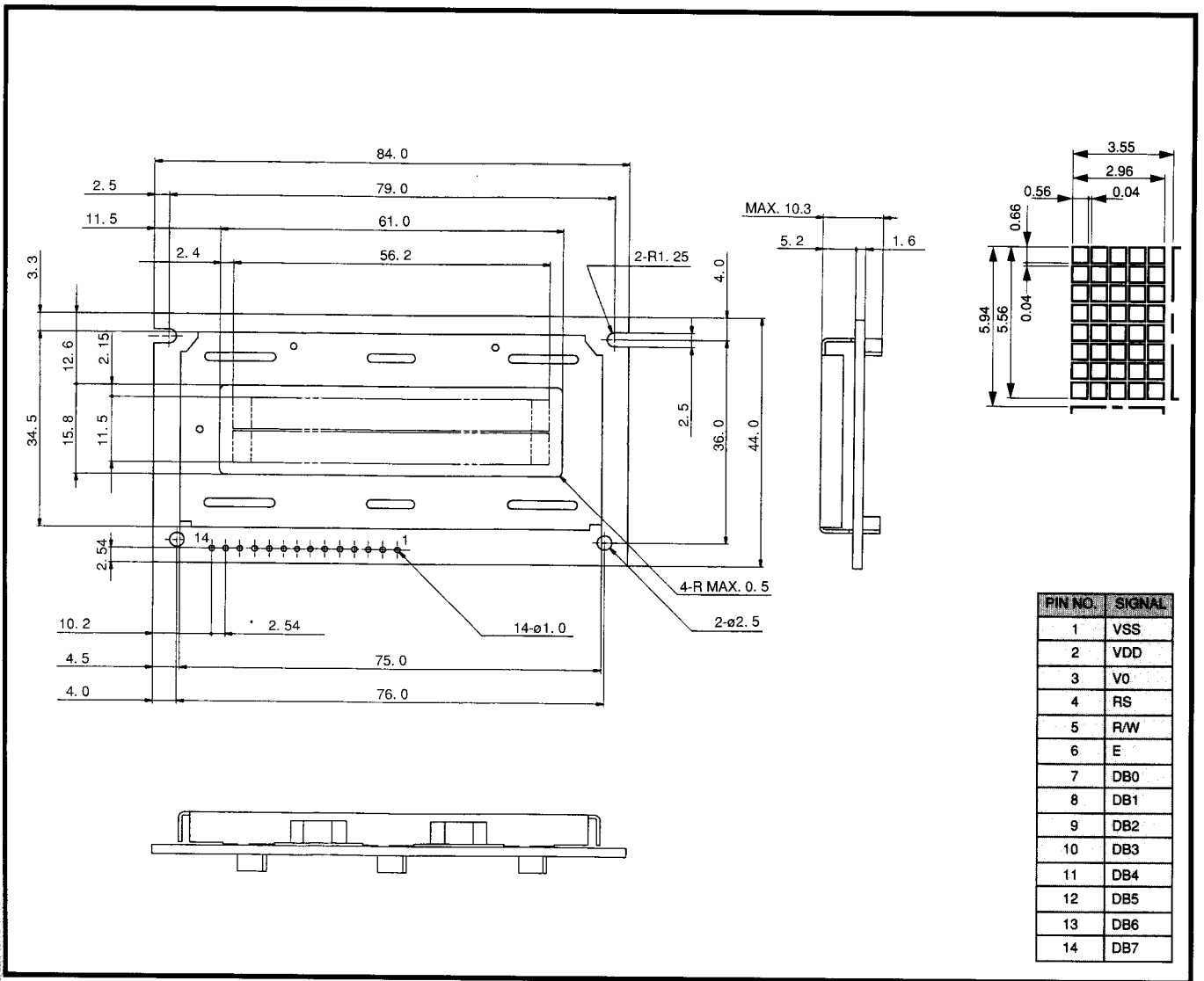
| Model name | LCD Mode | B/L |
|---------------|-------------------|-----|
| EA-D16025AR | TN Reflective | - |
| EA-D16025AR-S | STN Reflective | - |
| EA-D16025ER | TN Transflective | EL |
| EA-D16025ER-S | STN Transflective | EL |
| EA-D16025PR-S | STN Transmissive | LED |

- Number of Character : 16 x 2
- Character Font : 5 x 8 Dots
- Duty : 1/16
- Type : Positive Type

■ Mechanical Specifications

| Parameter | Dimensions (mm) |
|-----------------|--------------------|
| Overall Size | 84.0 x 44.0 x 10.3 |
| Viewing Area | 61.0 x 15.8 |
| Character Size | 2.96 x 5.56 |
| Character Pitch | 3.55 x 5.94 |
| Dot Size | 0.56 x 0.66 |
| Weight | 40 (g) |

■ Outline Dimensions



■ Characteristics

EA-D Series

- Incorporates an LSI exclusive for character display, equivalent to HD44780 or HD66780.
- Interface for Types 68/80.
- Built-in character generator ROM, 160 characters (JIS) and 32 characters (special characters).
- Built-in character generator RAM, 8 characters.
- 5V single power supply

■ Absolute Maximum Rating

| Item | Symbol | Min | Max | Unit |
|-----------------------------|---------|-----|-----|------|
| Power voltage | VDD-VSS | 0 | +7 | V |
| Input voltage | VIN | VSS | VDD | |
| Operating temperature range | TOP | 0 | +50 | °C |
| Storage temperature range | TST | -20 | +60 | |

■ Optical Characteristics

| Item | Symbol | TN | | | STN | | | Unit |
|---------------|----------|-----|-----|-----|-----|-----|-----|--------|
| | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Response Time | tr | | 100 | 150 | | 200 | 300 | msec |
| | tf | | 100 | 150 | | 200 | 300 | |
| Viewing Cone | θ | 10 | | 30 | 10 | | 40 | degree |
| | ϕ | -30 | | 30 | -30 | | 30 | |
| Contrast | Cr | | 3 | | | 5 | | |

■ Description of Terminals

| Signal Name | Input/Output | External Connection | Function |
|-------------|--------------|---------------------|--|
| RS | Input | MPU | Register select signal "0": Instruction register (when writing) Busy flag and address counter (when reading) "1": Data register (when writing and reading) |
| R/W | Input | MPU | Read/write select signal "0": Writing "1": Reading |
| E | Input | MPU | Operation (data read/write) enable signal |
| DB4-DB7 | Input/Output | MPU | High-order lines of data bus with three-state, bidirectional function for use in data transactions with the MPU. DB7 may also be used to check the busy flag. |
| DB0-DB3 | Input/Output | MPU | Low-order lines of data bus with three-state, bidirectional function for use in data transactions with the MPU. These lines are not used when interfacing with a 4-bit microprocessor. |
| VDD, VSS | | Power Supply | VDD: +5V, VSS: GND |
| V0 | | Power Supply | Contrast adjustment voltage |

DC Characteristics

$V_{DD} = 5V \pm 5\%$
 $V_{SS} = 0V$, $T_{op} = 0 \sim 50^{\circ}C$

| Item | Symbol | Condition | Standard value | | | Unit | Applicable terminal |
|------------------------|--------|------------------------|----------------|------|------|---------|------------------------|
| | | | MIN | TYP | MAX | | |
| Power voltage | VDD | | 4.75 | 5.00 | 5.25 | V | VDD |
| Input H-level voltage | VIH | | 2.2 | | VDD | V | RS, R/W, E, DB0~DB7 |
| Input L-level voltage | VIL | | VSS | | 0.6 | V | |
| Output H-level voltage | VOH | $-I_{OH}=0.205mA$ | 2.4 | | | V | DB0~DB7 |
| Output L-level voltage | VOL | $I_{OL}=1.2mA$ | | | 0.4 | V | |
| I/O leak current | ILI | $V_{IN}=0 \sim V_{DD}$ | | | 1.0 | μA | RS, R/W,E, DB0~DB7 |
| Power current | IDD | $V_{DD}=5V$ | | 1.0 | 3.0 | mA | VDD |
| LC operating voltage | VLCD | $V_{DD}-V_0$ | 3.46 | | 4.86 | V | V0 |

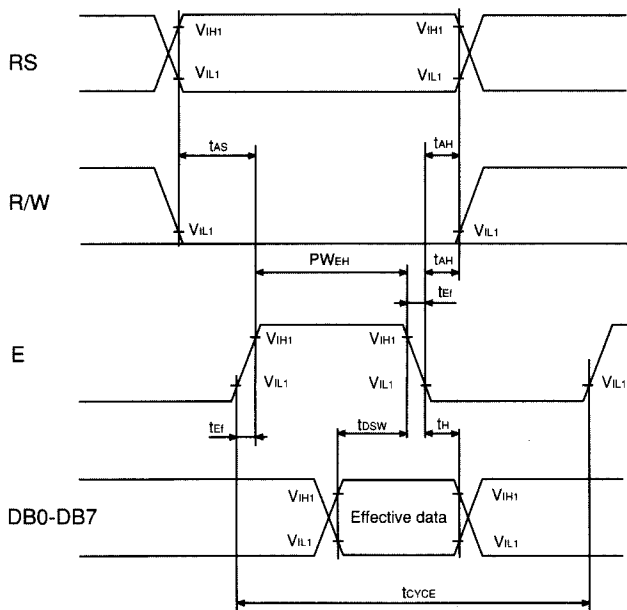
AC Characteristics

$V_{DD} = 5V \pm 5\%$
 $V_{DD} = 0V$, $T_{op} = 0 \sim 50^{\circ}C$

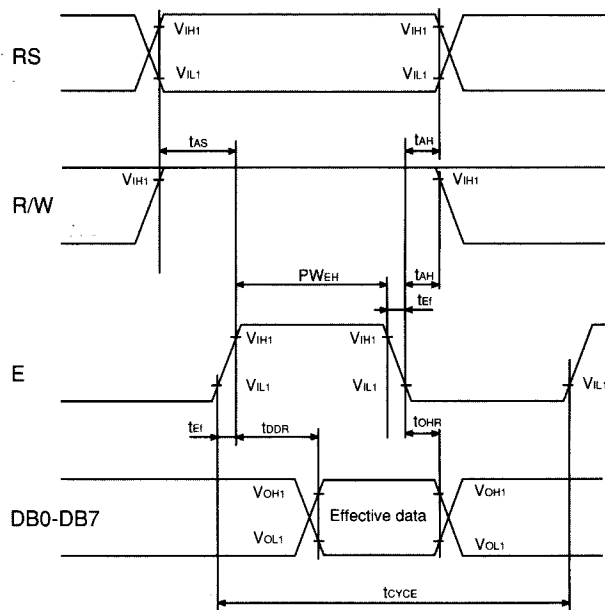
| Item | Symbol | MIN | MAX | Unit |
|-----------------------------|----------------------|------------|-----|------|
| Enable cycle time | tCYCE | 500 | — | ns |
| Enable pulse width | “High” level PWEH | 220 | — | ns |
| Enable rise/fall time | tEr, tEf | — | 25 | ns |
| Set-up time | RS, R/W-E tAS | 60 | — | ns |
| Address hold time | tAH | 10 | — | ns |
| Data set-up time | tDSW | 100 | — | ns |
| Data delay time | tDDR | — | 170 | ns |
| Data hold time (writing) | tH | 10 | — | ns |
| Data hold time (reading) | tDHR | 20 | — | ns |
| Clock oscillating frequency | fOSC | 270 (TYP.) | | KHz |

■ Timing Characteristics

Writing Timing

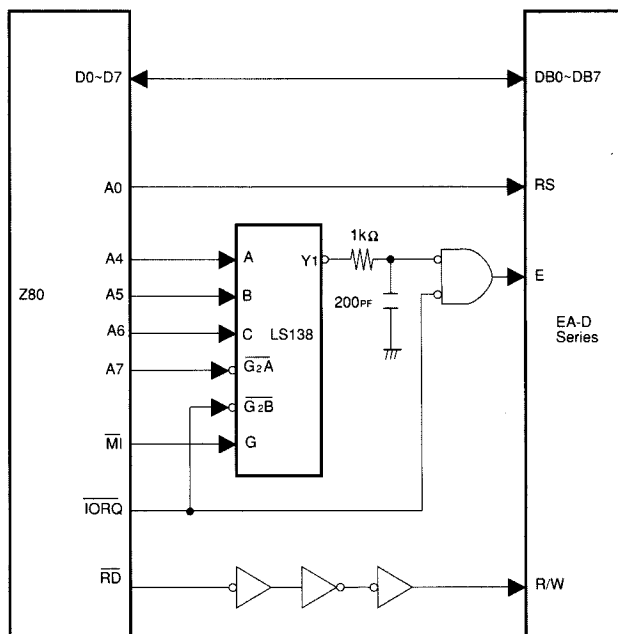
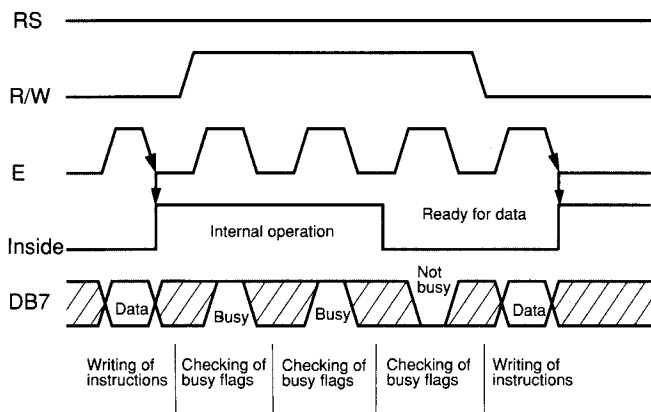


Reading Timing



■ Connecting Block Diagram

• Example of interface with 8-bit MPU (Z80)



■ Display Commands

| No. | Instruction | Code | | | | | | | | | | Description | |
|-----|-----------------------------|------|-----|------------|-----|-----|-----|-----|-----|------------------------------------|---|---|---|
| | | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | |
| 1 | Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Clears all display and returns the cursor to the home position (Address 00H). |
| 2 | Return Home | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | * | Returns the cursor to the home position (Address 00H). Also returns the display being shifted to the original position. DD RAM contents remain unchanged. |
| 3 | Entry Mode Set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/D | S | Sets the cursor move direction and specifies to shift the display or not. These operations are performed during data write and read. |
| 4 | Display ON/OFF Control | 0 | 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). |
| 5 | Cursor or Display Shift | 0 | 0 | 0 | 0 | 0 | 0 | 1 | S/C | R/L | * | * | Moves the cursor and shifts the display without changing DD RAM contents. |
| 6 | System Set | 0 | 0 | 0 | 0 | 1 | IF | N | F | * | * | * | Sets interface data length (IF), number of display Lines (L), and character front (F). |
| 7 | Set CG RAM Address | 0 | 0 | 0 | 1 | ACG | | | | | | Sets the CG RAM address. CG RAM data is sent and received after this setting. | |
| 8 | Set DD RAM Address | 0 | 0 | 1 | ADD | | | | | | Sets the DD RAM address. DD RAM data is sent and received after this setting. | | |
| 9 | Read Busy Flag & Address | 0 | 1 | BF | AC | | | | | | Reads Busy flag (BF), and address counter contents. | | |
| 10 | Write data to CG or DD RAM | 1 | 0 | Write Data | | | | | | Writes data into DD RAM or CG RAM. | | | |
| 11 | Read Data from CG or DD RAM | 1 | 1 | Read Data | | | | | | Reads data from DD RAM or CG RAM. | | | |

* : No effect

[Note 1]

I/D=1 : Increment
 I/D=0 : Decrement
 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 : Busy
 BF=0 : Not Busy

[Note 2]

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

■ Character Code Map

| | | Upper 4 bit (D4 ~ D7) of Character Code (Hexadecimal) | | | | | | | | | | | | |
|---|---|---|----|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 2 | 3 | 4 | 5 | 6 | 7 | A | B | C | D | E | F |
| Lower 4 bit (D0 ~ D3) of Character Code (Hexadecimal) | 0 | CG RAM (1) | | 0 | a | P | ` | F | | - | 9 | 3 | 0 | P |
| | 1 | (2) | ! | 1 | A | Q | a | 4 | o | 7 | 7 | 4 | ä | q |
| | 2 | (3) | " | 2 | B | R | b | r | r | ı | ı | ı | ß | 0 |
| | 3 | (4) | # | 3 | C | S | c | s | ı | ı | ı | ı | ı | ı |
| | 4 | (5) | \$ | 4 | D | T | d | t | \ | I | t | t | ı | ı |
| | 5 | (6) | % | 5 | E | U | e | u | . | o | o | ı | ı | ı |
| | 6 | (7) | & | 6 | F | V | f | v | ı | ı | ı | ı | ı | ı |
| | 7 | (8) | ' | 7 | G | W | g | w | ı | ı | ı | ı | ı | ı |
| | 8 | (1) | (| 8 | H | X | h | x | ı | ı | ı | ı | ı | ı |
| | 9 | (2) |) | 9 | I | Y | i | y | ı | ı | ı | ı | ı | ı |
| | A | (3) | * | : | J | Z | j | z | ı | ı | ı | ı | ı | ı |
| | B | (4) | + | ; | K | [| k | (| ı | ı | ı | ı | ı | ı |
| | C | (5) | , | < | L | ¥ | ı | ı | ı | ı | ı | ı | ı | ı |
| | D | (6) | - | = | M |] | m |) | ı | ı | ı | ı | ı | ı |
| | E | (7) | . | > | N | ^ | n | ı | ı | ı | ı | ı | ı | ı |
| | F | (8) | / | ? | O | _ | o | ı | ı | ı | ı | ı | ı | ı |

- Note 1)** CG RAM is a character generator RAM which can store the character pattern rewriting with a program freely by a user.
- 2)** 32 characters of upper bit "1110" and "1111" are character pattern. And some kinds of font will be jugged out at some portion in the LCD unit of 5 x 7 dot font. So don't use them.