Powertip alphanumeric dot matrix liquid crystal displays


EL types - RS stock numbers 214-3367, 214-3373, 214-3395, 214-3402, 214-3418


Intelligent, alphanumeric, dot matrix modules with integral CMOS microprocessor and LCD display drivers. The modules utilise a $5 \times 7$ dot matrix format with cursor, and are capable of displaying 189 different alphanumeric characters and symbols. The modules are available in twisted nematic and super twisted nematic grey mode. Reflective types are available in TN and STN, EL backlit types in TN, LED backlit transmissive types in TN LED backlit transflective types in STN. Inverters are required to drive the EL backlit types.

Applications
- Data terminals
- Medical instruments
- Hand-held instruments
- Hand-held data terminals
- Electronic typewriters
- Point of sale terminals
- Test instruments
- Word processors.

Features
- Single SV power supply (excluding EL types)
- Wide viewing angle (STN)
- High contrast
- Interfaces to 4 or 8-bit data busses
- ASC11 compatible
- Chip-on-board technology (COB)
- 189 different characters and symbols
- Compact and lightweight
- Low power consumption
- Surface mounted components (SMT).

ATTENTION
OBSERVE PRECAUTIONS FOR HANDLING
ELECTROSTATIC SENSITIVE DEVICES
## Absolute maximum rating

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply voltage</td>
<td>Vdd - Vss</td>
<td>-0.3 ~ + 7.0</td>
<td>V</td>
</tr>
<tr>
<td>Driver supply voltage</td>
<td>Vlcd</td>
<td>Vdd - 13.5 ~ Vdd +0.3</td>
<td></td>
</tr>
<tr>
<td>Input voltage</td>
<td>Vin</td>
<td>-0.3 ~ Vdd +0.3</td>
<td></td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>Top</td>
<td>0 ~ +50</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>Tst</td>
<td>-20 ~ +60</td>
<td></td>
</tr>
</tbody>
</table>

## Description of terminals

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Input/Output</th>
<th>External connection</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS</td>
<td>Input</td>
<td>MPU</td>
<td>Register selection input</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High: Data register (for read and write)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low: Instruction register (for write), Busy flag, address counter (for read)</td>
</tr>
<tr>
<td>R/W</td>
<td>Input</td>
<td>MPU</td>
<td>R/W signal input is used to select the read/write mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High: Read mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low: Write mode</td>
</tr>
<tr>
<td>E</td>
<td>Input</td>
<td>MPU</td>
<td>Start enable signal to read or write the data</td>
</tr>
<tr>
<td>DB4</td>
<td>Input/Output</td>
<td>MPU</td>
<td>Four high order bidirectional three-state data bus lines. Used for data transfer between the MPU and the LCD module. DB7 can be used as a busy flag.</td>
</tr>
<tr>
<td>DB7</td>
<td>Input/Output</td>
<td>MPU</td>
<td>Four low order bidirectional three-state data bus lines. Used for data transfer between the MPU and the LCD module. These four are not used during 4-bit operation.</td>
</tr>
<tr>
<td>Vdd</td>
<td>Power Supply</td>
<td></td>
<td>Vdd : + 5V</td>
</tr>
<tr>
<td>Vss</td>
<td>Power Supply</td>
<td></td>
<td>Vss : GND</td>
</tr>
<tr>
<td>Vo</td>
<td>Power Supply</td>
<td></td>
<td>Contrast adjustment voltage</td>
</tr>
</tbody>
</table>
### Electrical characteristics

#### DC characteristics (Vdd = +5V ±10%, Vss = 0V, Ta = 25°C)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Application PIN</th>
<th>Min.</th>
<th>Type</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>H level input voltage (1)</td>
<td>Vih 1</td>
<td>-</td>
<td>DB0 ~ DB7</td>
<td>2.2</td>
<td>-</td>
<td>Vdd</td>
<td>V</td>
</tr>
<tr>
<td>L level input voltage (1)</td>
<td>Vil 1</td>
<td>-</td>
<td>RS, R/W, E</td>
<td>-0.3</td>
<td>-</td>
<td>0.6</td>
<td>V</td>
</tr>
<tr>
<td>H level input voltage (2)</td>
<td>Vih 2</td>
<td>-</td>
<td>OSC1</td>
<td>Vdd -1.0</td>
<td>-</td>
<td>Vdd</td>
<td>V</td>
</tr>
<tr>
<td>L level input voltage (2)</td>
<td>Vil 2</td>
<td>-</td>
<td>DBO ~ DB7</td>
<td>-0.2</td>
<td>-</td>
<td>1.0</td>
<td>V</td>
</tr>
<tr>
<td>H level output voltage (1)</td>
<td>Voh 1</td>
<td>ioh = -0.205mA</td>
<td>DB0 ~ DB7</td>
<td>2.4</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>L level output voltage (1)</td>
<td>Vol 1</td>
<td>iol = 1.2mA</td>
<td>OSC1</td>
<td>-</td>
<td>-</td>
<td>0.4</td>
<td>V</td>
</tr>
<tr>
<td>H level output voltage (2)</td>
<td>Voh 2</td>
<td>ioh = -0.40uA</td>
<td>XSC</td>
<td>0.9Vdd</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>L level output voltage (2)</td>
<td>Vol 2</td>
<td>iol = 40uA</td>
<td>LP, DO</td>
<td>-</td>
<td>-</td>
<td>0.1Vdd</td>
<td>V</td>
</tr>
<tr>
<td>I/o leakage current</td>
<td>iil</td>
<td>Vlin = 0 to Vdd</td>
<td>-1</td>
<td>-</td>
<td>-</td>
<td>uA</td>
<td></td>
</tr>
<tr>
<td>Pull-UP Mos current</td>
<td>-ip</td>
<td>Vdd = 5V</td>
<td></td>
<td>50</td>
<td>125</td>
<td>250</td>
<td>uA</td>
</tr>
<tr>
<td>Supply current</td>
<td>Iop</td>
<td>RF oscillation, from external clock</td>
<td>Vdd</td>
<td>-</td>
<td>0.35</td>
<td>0.6</td>
<td>mA</td>
</tr>
</tbody>
</table>

Internal clock operation (Rf oscillation)

<table>
<thead>
<tr>
<th>Oscillation frequency</th>
<th>fosc</th>
<th>RF = 91k Ω ± 2%</th>
<th>OSC1</th>
<th>OSC2</th>
<th>190</th>
<th>270</th>
<th>350</th>
<th>kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscillation frequency</td>
<td>fosc</td>
<td>Ceramic filter</td>
<td>OSC1</td>
<td>OSC2</td>
<td>245</td>
<td>250</td>
<td>255</td>
<td>kHz</td>
</tr>
<tr>
<td>LCD driving voltage</td>
<td>Vlcd</td>
<td>Vdd - V5</td>
<td>V1 ~ V5</td>
<td>3.0</td>
<td>-</td>
<td>11.0</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

#### AC characteristics (Vdd = 5V ±10%, Vss = 0V, Ta = 25°C)

Read cycle

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Type</th>
<th>Max.</th>
<th>Unit</th>
<th>Test PIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable cycle time</td>
<td>tc</td>
<td>500</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>E</td>
</tr>
<tr>
<td>Enable “H” level pulse width</td>
<td>tw</td>
<td>220</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>E</td>
</tr>
<tr>
<td>Enable rise/fall time</td>
<td>tr,tf</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>ns</td>
<td>E</td>
</tr>
<tr>
<td>RS, R/W setup time</td>
<td>tsu</td>
<td>40</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>R/W, RS</td>
</tr>
<tr>
<td>RS, R/W address hold time</td>
<td>th</td>
<td>10</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>R/W, RS</td>
</tr>
<tr>
<td>Read data output delay</td>
<td>td</td>
<td>60</td>
<td>-</td>
<td>120</td>
<td>ns</td>
<td>DBO ~ DB7</td>
</tr>
<tr>
<td>Read data hold time</td>
<td>tdh</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>DBO ~ DB7</td>
</tr>
</tbody>
</table>

Write cycle

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Type</th>
<th>Max.</th>
<th>Unit</th>
<th>Test PIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable cycle time</td>
<td>tc</td>
<td>500</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>E</td>
</tr>
<tr>
<td>Enable H level pulse width</td>
<td>tw</td>
<td>220</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>E</td>
</tr>
<tr>
<td>Enable rise/fall time</td>
<td>tr,tf</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>ns</td>
<td>E</td>
</tr>
<tr>
<td>RS, R/W setup time</td>
<td>tsu</td>
<td>40</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>R/W, RS</td>
</tr>
<tr>
<td>RS, R/W address hold time</td>
<td>th1</td>
<td>10</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>R/W, RS</td>
</tr>
<tr>
<td>Date setup time</td>
<td>tsu2</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>DBO ~ DB7</td>
</tr>
<tr>
<td>Write data hold time</td>
<td>th2</td>
<td>10</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>DBO ~ DB7</td>
</tr>
</tbody>
</table>
## Optical characteristics

1. **STN type**

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viewing angle</td>
<td>Ø2 - Ø1</td>
<td>K = 1.4</td>
<td>40</td>
<td>-</td>
<td>-</td>
<td>deg.</td>
<td>*1, *2</td>
</tr>
<tr>
<td>Contrast ratio</td>
<td>K</td>
<td>Ø = 10°C, θ = 0°C</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td></td>
<td>*3</td>
</tr>
<tr>
<td>Response time (rise)</td>
<td>tr</td>
<td>Ø = 10°C, θ = 0°C</td>
<td>-</td>
<td>150</td>
<td>250</td>
<td>ms</td>
<td>*4</td>
</tr>
<tr>
<td>Response time (fall)</td>
<td>tf</td>
<td>Ø = 10°C, θ = 0°C</td>
<td>-</td>
<td>200</td>
<td>300</td>
<td>ms</td>
<td>*4</td>
</tr>
</tbody>
</table>

2. **TN type**

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viewing angle</td>
<td>Ø2 - Ø1</td>
<td>K = 1.4</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>deg.</td>
<td>*1, *2</td>
</tr>
<tr>
<td>Contrast ratio</td>
<td>K</td>
<td>Ø = 25°C, θ = 0°C</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td></td>
<td>*3</td>
</tr>
<tr>
<td>Response time (rise)</td>
<td>tr</td>
<td>Ø = 25°C, θ = 0°C</td>
<td>-</td>
<td>80</td>
<td>120</td>
<td>ms</td>
<td>*4</td>
</tr>
<tr>
<td>Response time (fall)</td>
<td>tf</td>
<td>Ø = 25°C, θ = 0°C</td>
<td>-</td>
<td>60</td>
<td>90</td>
<td>ms</td>
<td>*4</td>
</tr>
</tbody>
</table>

*1. Definition of Θ and Ø

*2. Contrast vs viewing angle

*3. Definition of contrast ratio

*4 Definition of optical response
Timing characteristics

Interface between data bus line and 4-bit or 8-bit MPU is available. Data transfer is made in twice in case of 4-bit MPU, and once in case of 8-bit MPU.

If interface data is 4-bit long

Data transfer is made through 4 bus lines from DB4 to DB7 while the rest of 4 bus lines from DB0 to DB3 are not used. Data transfer with MPU is completed when 4-bit data is transferred in twice, first upper 4-bit data then lower 4-bit data.

If interface data is 8-bit long

Data transfer is made through all of 8 bus lines from DB0 to DB7.

Example of interface with 4-bit MPU (Z80)

Features
1. Interface with 8-bit or 4-bit MPU is available.
2. 192 kind of alphabets, numerals, symbols and special characters can be displayed by built-in character generator (ROM).
3. Other preferred characters can be displayed by character generator (RAM).
4. Various functions of instruction are available by programming.
   - Clear display
   - Cursor at home
   - On/off cursor
   - Blink character
   - Shift display
   - Shift cursor
   - Read/write display data etc.
5. Compact and light design which can be easily assembled in devices.
6. Single power supply +5 drive
7. Low power consumption.

Example of power supply

Note: If VEE varies from recommended value, you cannot get proper contrast on viewing angle.
Instructions

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Executed time (max.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0</td>
<td>Clear display 0 0 0 0 0 0 0 0 0 1</td>
<td>1.64mS</td>
</tr>
<tr>
<td></td>
<td>Cursor at home 0 0 0 0 0 0 0 0 0 1 *</td>
<td>1.64mS</td>
</tr>
<tr>
<td></td>
<td>Entry mode set 0 0 0 0 0 0 0 0 1 0 0 0</td>
<td>40µS</td>
</tr>
<tr>
<td></td>
<td>Display On/off control 0 0 0 0 0 0 0 0 0 1 0 0 0</td>
<td>40µS</td>
</tr>
<tr>
<td></td>
<td>Cursor/display shift 0 0 0 0 0 0 0 0 0 1 0 0 0</td>
<td>40µS</td>
</tr>
<tr>
<td></td>
<td>Function set 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>40µS</td>
</tr>
<tr>
<td></td>
<td>CGRAM address set 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>40µS</td>
</tr>
<tr>
<td></td>
<td>DDRAM address set 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>40µS</td>
</tr>
<tr>
<td></td>
<td>Busy flag/address read 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>0µS</td>
</tr>
<tr>
<td></td>
<td>CGRAM/DDRAM Data write 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>40µS</td>
</tr>
<tr>
<td></td>
<td>CGRAM/DDRAM Data read 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>40µS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Executed time (max.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/D=1: Increment DL=0:4-bit</td>
<td>DDRAM: Display data RAM</td>
<td>fcp or fosc=250kHz</td>
</tr>
<tr>
<td>I/D=0: Decrement N=1:2 lines</td>
<td>CGRAM: Character generator RAM</td>
<td>However, when frequency changes, execution time also changes</td>
</tr>
<tr>
<td>S=1: Display shift N=0:1 line</td>
<td>ADD: DDRAM address corresponds to cursor address.</td>
<td>Ex</td>
</tr>
<tr>
<td>S/C=1: Shift to the right F=1.5 x 10dots</td>
<td>AC: Address counter, used for both DDRAM and CGRAM.</td>
<td>If fcp or fosc is 270kHz, 40µS x 250/270 = 37µS</td>
</tr>
<tr>
<td>S/C=0: Cursor movement F=0.5 x 7dots</td>
<td>*Invalid</td>
<td></td>
</tr>
<tr>
<td>R/L=1: Shift to the left BF=1: Internal operation is being performed and reads address counter contents.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R/L=0: Shift to the left BF=0: Instruction acceptable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Power supply reset

The internal reset circuit will be operated properly when the following power supply conditions are satisfied. If it is not operated properly, please perform initial setting along with the instruction.

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Measuring Condition</th>
<th>Standard value min. typ. max. Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply turn on time</td>
<td>trcc</td>
<td>-</td>
<td>0.1 - 10</td>
</tr>
<tr>
<td>Power supply OFF time</td>
<td>toff</td>
<td>-</td>
<td>1 -</td>
</tr>
</tbody>
</table>

Note: toff defines period that power supply is off when power shuts down momentarily or repeats on/off state.
Reset function
- Initialisation made by Internal Rest Circuit
  KS0066 automatically initialise (resets) when power is supplied (built-in internal rest circuit).
  The following instructions are executed in initialisation. The busy flag (BF) is kept in a busy state until initialisation ends. (BF=1) The busy state is 10ms after Vdd reach to 4.5V.
  1. Display clear
  2. Function set
     DL = 1:8bit long interface data
     DL = 0:4bit F=0:5 x dot character font
     N =1: 2lines
     N =0: 1line
  3. Display ON/OFF control
     D=0:display OFF C=0:cursor OFF B=0:blink OFF
  4. Entry mode set
     1/D=1: + 1 (increment) S=0:No shift

Note: When conditions stated in Power Supply Conditions Using Internal Reset Circuit are not satisfied, the internal reset circuit will not operate properly and initialisation will not be performed. Please make initialisation using MPU along with instructions.

Initialisation along with instructions
If power supply conditions are not satisfied, for proper operation of internal rest circuit, it is required to make initialisation along with instruction. Please make following procedures:-

**Power ON**
- Wait more than 15ms after Vcc rise to 4.5V
- **When interface is 4-bit long**
  - RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
  - 0 0 0 0 0 1 1
  - Wait more than 4.1ms
  - RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
  - 0 0 0 0 0 1 1
  - Wait more than 100µs

- **When interface is 8-bit long**
  - RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
  - 0 0 0 0 0 1 1
  - Wait more than 4.1ms
  - RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
  - 0 0 0 0 0 1 1
  - Wait more than 100µs

**Initialisation ends**
Application example
All modules except 20 x 4 and 40x4

Example of interfacing to Z80 MPU running at 2 Mhz
AØ is connected to RS of module
where AØ = 1: Instruction register is selected
where AØ = Ø: Data register is selected
A1 is connected to R/W of module
where A1 = Ø: Module in write mode
where A1 = 1: Module in read mode

WRINST EQU 6ØØØH ;write instruction
WRDATA EQU 6ØØ1H ;write data
RDBUSY EQU 6ØØ2H ;read busy

Initialisation
LD B,Ø ;power up delay
DJNZ $ ;
LD SP,27FFH ;stack pointer
LD HL, INITBL ;init table pointer
LD B,15 ;15ms delay
CALL INSTR ;o/p instruction to module
LD B,5 ;5ms delay
CALL INSTR ;o/p instruction to module
LD B,1 ;one ms delay
CALL INSTR ;o/p instruction to module

Function set
function set
LD B,4 ;four modes
MODSET; CALL BUSY ;check for not busy
INC HL ;inc table pointer
LD A,(HL) ;get data
LD (WRINST),A ;and sent to module
DJNZ MODSET ;next mode

Write message to module
LD HL,MESSAGE ;get message table
;turn on display, blinking cursor
CALL BUSY
LD A,00001111B ;display on, cursor
LD (WRINST), A ;;blink
;set DDRAM address to 00H
LD A,10000000B ;set to 00H
CALL MESG ;o/p message

;set DDRAM address to 40H
LD A,11000000B ;set to 40H
CALL MESG ;o/p message
HALT ;program stop here......

; subroutine to set DDRAM addr and o/p message
MESH: CALL BUSY
LD (WRINST), A
;write message to module
LD B,8 ;no. of byte to be sent
WRITE2: CALL BUSY
LD A,(HL) ;get character
LD (WRDATA), A ;write to module
INC HL ;inc pointer
DJNZ WRITE2 ;next byte
RET

; subroutine : busy check
BUSY: PUSH AF
BUSY1: LD A, (RDBUSY)
BIT 7, A
JR NZ, BUSY1
POP AF
RET

; subroutine : o/p instruction to module
INSTR: CALL DELAY ;time delay
LD A,(HL) ;get data
LD (WRINST), A ;o/p to module
RET

; time delay subroutine
; Total delay time = B* 1mS
; Register destroyed : DE
DELAY: PUSH HL
LD DE,-1
LOOP1: LD HL, 431/5
LOOP2: ADD HL, DE
JR NZ, LOOP2
DJNZ LOOP1
POP HL
RET

; data table for initialisation routine
INITBL: DEFB 00110000B ;set DL to high
DEFB 00111000B ;8-bit, 2 lines, 5x7 dots
DEFB 00000100B ;display off
DEFB 00000010B ;clear display, return cursor
DEFB 00000110B ;set shift mode (entry mode set)

; message
MESSG: DEFB ‘DISPLAY MODULES’ END
Example of interfacing to Z8Ø MPU running at 2 Mhz
AØ is connected to RS of module
where AØ = 1: Instruction register is selected
where AØ = Ø: Data register is selected
A1 is connected to R/W of module
where A1 = Ø: Module in read mode
where A1 = 1: Module in read mode

WRINST EQU 6ØØØH ;write instruction
WRDATA EQU 6ØØ1H ;write data
RDBUSY EQU 6ØØ2H ;read busy

Initialisation
LD B,Ø ;power up delay
DJNZ $ ;
LD SP,27FFH ;stack pointer
LD HL, INITBL ;init table pointer
LD B,15 ;15ms delay
CALL INSTR ;o/p instruction to module
LD B,5 ;5ms delay
CALL INSTR ;o/p instruction to module

Function set
LD B,1 ; one mS delay
CALL INSTR ;o/p instruction to module

Function set
LD B,4 ; four modes
MODSET: CALL BUSY ;check for not busy
INC HL ;inc table pointer
LD A,(HL) ;get data
LD (WRINST), A ;and sent to module
DJNZ MODSET ;next mode

Write message to module
; turn on display, blinking cursor
CALL BUSY
LD A,Ø00001111B ;display on, cursor
LD (WRINST), A ;blank
;send message to display module
LD HL,MESSAGE ;get message table
OUTMSG: LD A,(HL) ;get data from message table
Flat surface light source offers simple and even illumination over large area. It has an extremely thin structure type of illumination with little heat up.

Features
- Max. 1.3mm thickness (max. 1.5mm for lead portion)
- Wide driving condition of 60-1,000Hz and 150Vac max., with inverter, step-up voltage from 1.5V battery is available
- Emitted colour is white
- Temperature range: operating 0°C ~ + 50°C Storage - 20°C ~ + 60°C

Inverter for EL back light drive
It is necessary to use inverter an when you need to operate EL with battery or a dc power supply.
- Low inverter loss and high light efficiency because it is designed as suitable for EL.
- Less change of power consumption during operation under temperature change or extended hours, which is realised by characteristics of constant supply current, minimises brightness change of EL.

Inverter connections

<table>
<thead>
<tr>
<th>RS stock no. 585-062</th>
<th>RS stock no. 585-078</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>V&lt;sub&gt;i&lt;/sub&gt;</td>
<td>V&lt;sub&gt;i&lt;/sub&gt;</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>V&lt;sub&gt;f&lt;/sub&gt;</td>
<td>V&lt;sub&gt;f&lt;/sub&gt;</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Ground</td>
<td>Ground</td>
</tr>
</tbody>
</table>

LED backlight types
Features
- Low voltage driving (dc) is available without inverter
- Long life time 100,000 hours (average)
- No noise occurrence.
Electrical characteristics (reference data)

- Forward current derating curve

Mechanical dimensions

8 x 2 LCD modules

RS stock no. 214-3288  STN reflective
RS stock no. 214-3367  TN with EL backlighting
RS stock no. 214-3424  TN transmissive with LED backlighting
RS stock no. 214-3480  STN transflective with LED backlighting.
**12 x 2 LCD module**

RS stock no. 214-3496 STN transflective with LED backlighting

**16 x 1 LCD modules**

RS stock no. 214-3238  TN reflective
RS stock no. 214-3294  STN reflective
RS stock no. 214-3373  TN with EL backlighting
RS stock no. 214-3430  TN transmissive with LED backlighting
RS stock no. 214-3519  STN transflective with LED backlighting.
RS stock no. 214-3244  TN reflective
RS stock no. 214-3301  STN reflective
RS stock no. 214-3395  TN with EL backlighting
RS stock no. 214-3452  TN transmissive with LED backlighting
RS stock no. 214-3525  STN transreflective with LED backlighting.

RS stock no. 214-3531  STN transreflective with LED backlighting.
RS stock no. 214-3323  STN reflective
RS stock no. 214-3553  STN transflective with LED backlighting.

RS stock no. 214-3250  TN reflective
RS stock no. 214-3339  STN reflective
RS stock no. 214-3402  TN with EL backlighting
RS stock no. 214-3468  TN transmissive with LED backlighting
RS stock no. 214-3569  STN transflective with LED backlighting.
40 x 2 LCD modules

RS stock no. 214-3266  TN reflective
RS stock no. 214-3345  STN reflective
RS stock no. 214-3418  TN with EL backlighting
RS stock no. 214-3474  TN transmissive with LED backlighting
RS stock no. 214-3575  STN transflective with LED backlighting.

20 x 2 LCD modules

RS stock no. 214-3317  STN reflective
RS stock no. 214-3547  STN transflective
Precaution for using

1. Handling
   a) Do not touch, press or rub the display panel with a hard, stiff tool or object (e.g. tweezers) as the polarisers in the panel are easily scratched.
   b) Never use organic solvents to clear the display panel as these solvents may adversely affect the polariser. To clean the display panel and dampen a bit of absorbent cotton with petroleum benzine and gently wipe the panel.
   c) Never touch terminals of electrodes of PCB or LSI leads.
   d) Avoid using or storing the LCM under high temperature and high humidity conditions. When in storage it is recommended that the device is packaged in a conductive polyethylene bag and placed under the condition where the temperature is relatively lower (10 -30°C), and direct sunlight or fluorescent lamp must be cut off.
   e) The casing for the module is designed taking account the temperature because of the heat from the backlight so that good quality of images can be provided on the screen.

2. Operation
   a) Never connect or disconnect the LCM from the main system while power is being supplied.
   b) If the operating temperature drops below the temperature limits, the blinking speed of the display will decrease, while if it rises above the prescribed limits, the entire display will turn black. When the temperature returns to within normal limits, the display will operate normally.

3. Workmanship
   a) Never disassemble the module.
   b) Anti static precautions must be taken, as the circuit of the module contains a CMOS LSI.

RS stock no. 214-3272  TN reflective
RS stock no. 214-3351  STN reflective
RS stock no. 215-3617  STN transflective with LED backlighting

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