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1. LCD MODULE NUMBERING SYSTEM

PART NUMBER: PL-AB...BC-DEFGHI-JK

PL POWER LIGHT TECHNOLOGY
A DISPLAY CONTENTS S---SEGMENT TYPE
 C---CHARACTER TYPE
 G---GRAPHIC TYPE

B...B SERIALS NUMBER FOR SM
 CHARACTERS Vs. LINES FOR CM

POWER LIGHT

C COLUMNS Vs. ROWS FOR GM
D VERSION OF PCB
 LCD TYPE
 P---POS. TN, N---NEG. TN, Y---YELLOW STN, G---GRAY STN
 B---BLUE STN, F---FSTN
E POLARIZER TYPE
 R---REFLECTIVE, F---TRANSFLECTIVE, T---TRANSMISSIVE
F VIEWING ANGLE S---6 O'CLOCK, T---12 O'CLOCK
G OPERATING TEMPRETURE N---NORMAL, E---EXTENDED
H BACKLIGHT TYPE N---NO BACKLIGHT, D---BOTTOM LED, S---SIDE LED,
 E---EL, C---CCFL
I COLOR OF BACKLIGHT Y---YELLOW/GREEN, G---GREEN
 W---WHITE, B---BLUE, A---AMBER
JK FOR CM, CONTROLLER/DRIVER DESIGNATOR
 J: IC A---KS0066U B---SPLC780
 K: DENOTE DIFFERENT CHARACTER TABLE
 FOR GM. J: BACKLIGHT DRIVER Y---WITH, N---WITHOUT
 K: DC-DC CONVERTER Y---WITH, N---WITHOUT

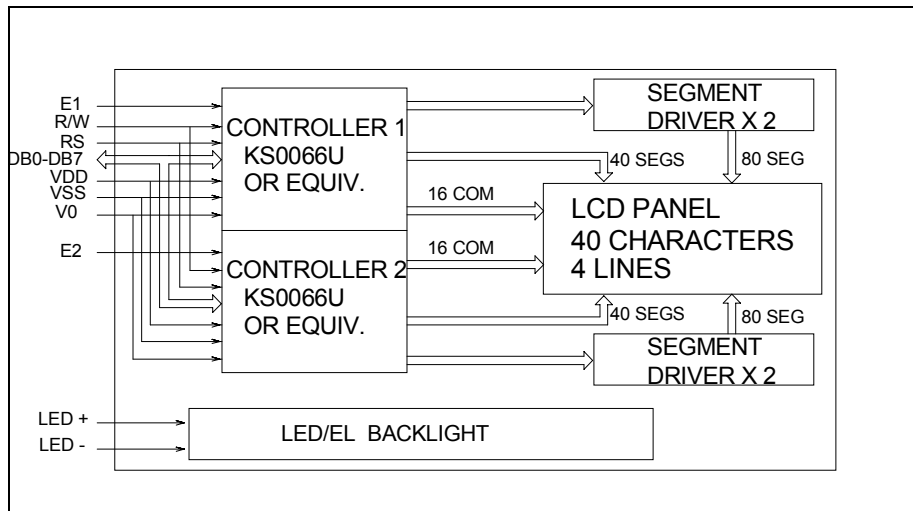
2. MECHANICAL CHARACTERISTICS

2.1 MECHANICAL DATA

| ITEM | STANDARD VALUE | UNIT |
|------------------------|---------------------------------|------|
| NUMBER OF CHARACTERS | 24 CHARACTERS X 4 LINES | |
| CHARACTER FORMAT | 5 X 7 DOTS PLUS CURSOR | |
| OUTLINE DIMENSIONS | 125.0(W)X39.0(H) X 14.0/10.0(T) | mm |
| EFFECTTVE VIEWING AREA | 97.0(W) X 27.0(H) | mm |
| CHARACTER SIZE | 3.20(W) X 5.55(H) | mm |
| CHARACTER PITCH | 3.70(W) X 5.95(H) | mm |
| DOT SIZE | 0.60(W) X 0.650(H) | mm |
| DOT PITCH | 0.65(W) X 0.70(H) | mm |
| APPROX WEIGHT | 80(LED BL VERSION)/60(NO BL) | g |

2.2 MECHANICAL DRAWINGS

POWER LIGHT

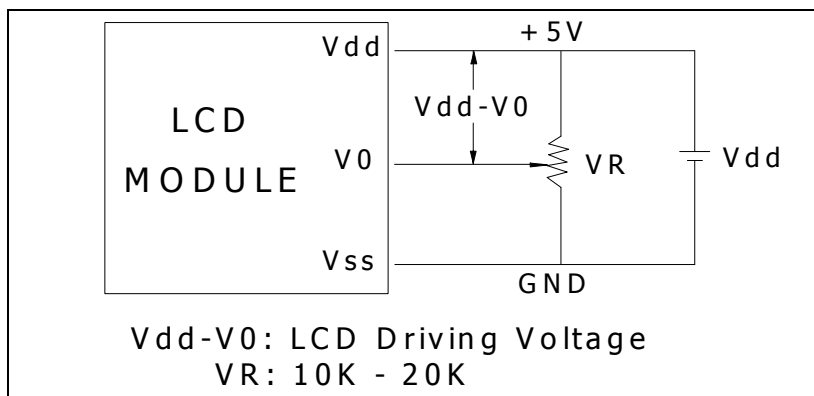


3.2 Pins Definition

| PIN | SYMBOL | FUNCTION |
|-----|--------|----------------------------------|
| 1 | VSS | Power Supply(GND) |
| 2 | VDD | Power Supply for LED B/L(+) |
| 3 | V0 | Contrast Adjust |
| 4 | RS | Instruction/Data Register Select |
| 5 | R/W | Read/Write Control |
| 6 | E1 | Enable Signal for Controller 1 |
| 7 | DB0 | Data Bus |
| 8 | DB1 | |
| 9 | DB2 | |
| 10 | DB3 | |
| 11 | DB4 | |
| 12 | DB5 | |
| 13 | DB6 | |
| 14 | DB7 | |
| 15 | E2 | Enable Signal for Controller 2 |
| 16 | NC | No Connect |
| 17 | LED+ | Power Supply for LED B/L(+) |
| 18 | LED- | Power Supply for LED B/L(-) |

3.3 Power Supply For LCM Driving

POWER LIGHT



3.4 Display Character Address Code

| POSITION | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | ... | ... | 20 | 21 | 22 | 23 | 24 |
|----------|-------|----|----|----|----|----|----|----|----|----|-----|--------------|----|----|----|----|----|
| ADDRESS | LINE1 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | Controller 1 | 13 | 14 | 15 | 16 | 17 |
| | LINE2 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | | 53 | 54 | 55 | 56 | 57 |
| | LINE3 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | Controller 2 | 13 | 14 | 15 | 16 | 17 |
| | LINE4 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | | 53 | 54 | 55 | 56 | 57 |

*NOTE: ALL OF THE NUMBERS ARE IN HEX FORMAT

4. ABSOLUTE MAXIMUM RATINGS

4.1 Electrical Absolute Maximum Ratings

| ITEM | SYMBOL | CONDITION | MIN | MAX | UNIT |
|----------------------------|-----------|-----------|------|----------|------|
| Supply Voltage (Logic) | Vdd - Vss | - | 0 | 7.0 | V |
| Supply Voltage (LCD Drive) | Vdd - V0 | - | 0 | 13.0 | V |
| Input Voltage | Vi | - | -0.3 | Vdd +0.3 | V |

4.2 Environmental Absolute Maximum Ratings

| ITEM | SYMBOL | CONDITIONS | MIN | MAX | UNIT |
|--------------------|--------|-------------------------------------|-----|-----------------|-------|
| Operating Temp | Topr | -Normal temp. version- | 0 | 50 | deg C |
| Storage Temp | Ttsg | | -20 | 70 | deg C |
| Operating Temp | Topr | Extended temp. version | -20 | 70 | deg C |
| Storage Temp | Ttsg | | -30 | 80 | deg C |
| Humidity Endurance | RH | no ondensation Ta<=40 deg | - | 95 | % |
| Vibration | - | 100-300Hz, X/Y/Z directions, 1 hour | - | 4.9m/ss 0.5g | - |

| | | | | |
|-------|---|---|------------------|---|
| Shock | - | 10 mS X/Y/Z direction 1 time each | 29.4m/ss 3.0g | - |
|-------|---|---|------------------|---|

5. ELECTRICAL CHARACTERISTICS

5.1 DC Characteristics

Electrical Characteristics at Ta=25 deg C, Vdd = 5V + / - 5%

| ITEM | SYMBOL | CONDITION | MIN | TYP | MAX | UNIT |
|--|---------|-----------|------|------|------|------|
| Supply Voltage (logic) | Vdd-Vss | - | 4.5 | 5.0 | 5.5 | V |
| Supply Voltage (LCD) | Vdd-V0 | Vdd = 5V | - | 4.9 | - | V |
| Input signal Voltage (for E, DB0-7,R/W,RS) | V-ih | "H" level | 2.2 | - | Vdd | V |
| | V-il | "L" level | 0 | - | 0.6 | V |
| Supply Current (logic) | Icc | - | - | 1 | 1.2 | mA |
| Supply Current (LCD) | Io | - | 0.15 | 0.22 | 0.27 | mA |

5.2 AC Characteristics

TIMING SPECIFICATIONS at Ta = 25 deg C, Vdd = 5V+/-10%, Vss =0V

For Write mode

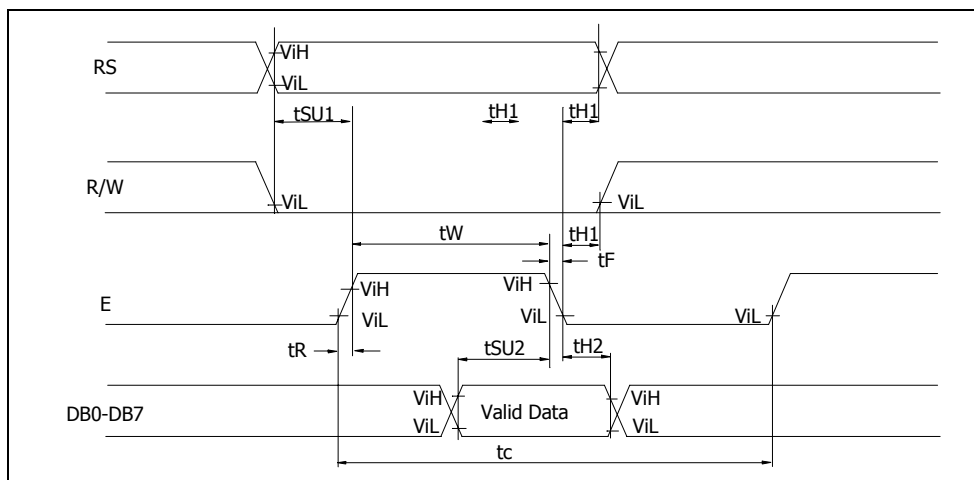
| ITEM | SYMBOL | MIN | MAX | UNIT |
|------------------------|--------|-----|-----|------|
| E cycle time | tc | 500 | - | ns |
| E rise time | tR | - | 25 | ns |
| E fall time | tF | - | 25 | ns |
| E-pulse width (H, L) | tw | 220 | - | ns |
| R/W and RS set-up time | tsul | 40 | - | ns |
| R/W and RS hold time | tH1 | 10 | - | ns |
| Data set-up time | tsu2 | 60 | - | ns |
| Data hold time | tH2 | 10 | - | ns |

For Read mode

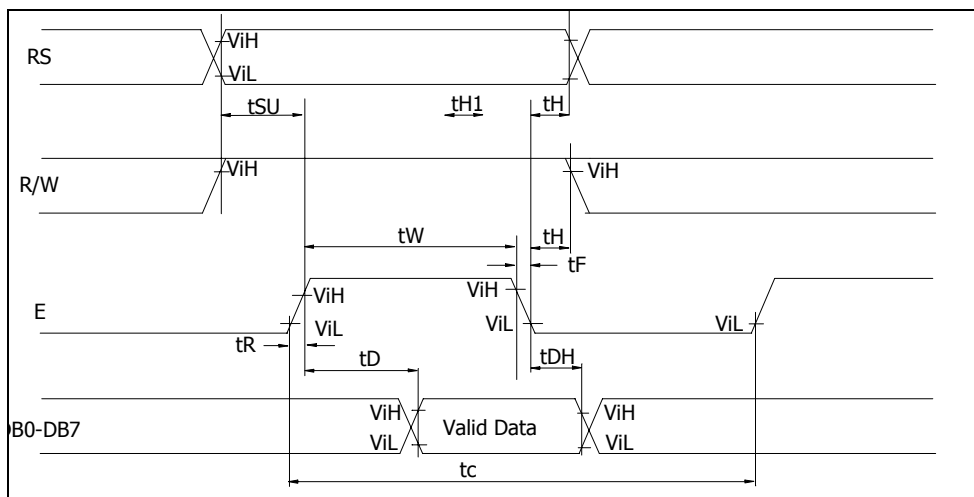
| ITEM | SYMBOL | MIN | MAX | UNIT |
|------|--------|-----|-----|------|
|------|--------|-----|-----|------|

| | | | | |
|------------------------|----------|-----|-----|----|
| E cycle time | t_c | 500 | - | ns |
| E rise time | t_R | - | 25 | ns |
| E fall time | t_F | - | 25 | ns |
| E-pulse width (H, L) | t_w | 220 | - | ns |
| R/W and RS set-up time | t_{su} | 40 | - | ns |
| R/W and RS hold time | t_h | 10 | - | ns |
| Data output delay | t_D | - | 120 | ns |
| Data hold time | t_{DH} | 20 | - | ns |

WRITE MODE TIMING DIAGRAM



READ MODE TIMING DIAGRAM



6. BACKLIGHT CHARACTERISTICS

6.1 Absolute Maximum Ratings

| ITEM | SYMBOL | CONDITION | MIN | MAX | UNIT |
|------|--------|-----------|-----|-----|------|
|------|--------|-----------|-----|-----|------|

| | | | | | |
|-------------------|-----|---|---|------|----|
| Forward Current | Ifm | - | - | 300 | mA |
| Reverse Voltage | Vr | - | - | 8 | V |
| Power Dissipation | Pd | - | - | 1200 | mW |

6.2 Operating Parameters

| ITEM | SYMBOL | CONDITION | MIN | TYP. | MAX | UNIT |
|-----------------|-----------|-----------|------|------|-----|------|
| Forward Voltage | Vf | If=300mA- | 4.0- | 4.2 | 4.4 | V |
| Peak Wavelength | λ | If=300mA- | - | 568 | - | nm |

7. ELECTRO-OPTICAL CHARACTERISTICS

(S) FOR STN TYPE, (T) FOR TN TYPE

| ITEM | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT | REF. |
|-----------------|---|-----------|---------------------|------------|----------------------------|------|--------|
| Contrast | CR | 25°C | -- | 12(S)/3(T) | -- | | Note1 |
| Rise Time | tr | 25°C | -- | 160 | 240 | ms | Note2 |
| Fall Time | tf | 25°C | -- | 100 | 150 | ms | note 2 |
| Viewing Angle | $\theta 1 - \theta 2$ $\emptyset 1, \emptyset 2$ | 25°C | -- -40(S)/-15(T) | -- | 60(S)/20(T) 40(S)/15(T) | DEG | Note 3 |
| Frame Frequency | Ff | 25°C | -- | 70 | -- | Hz | note 2 |

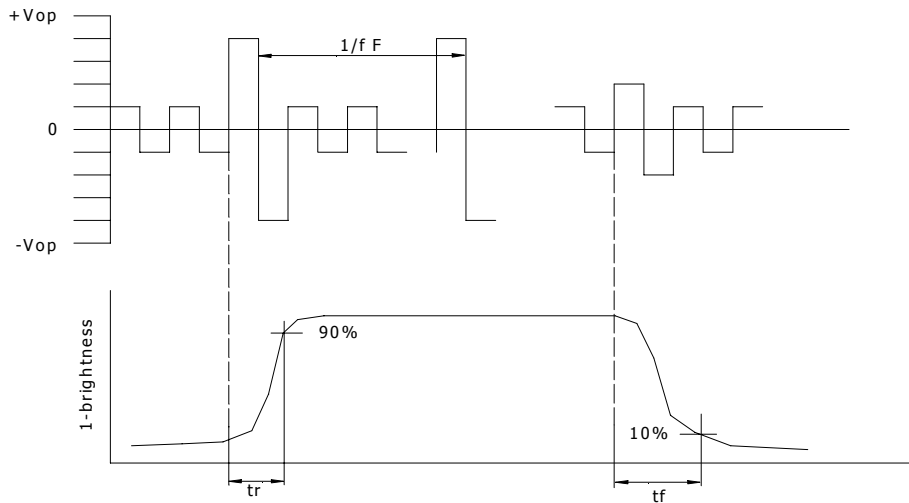
Note(1): Contrast ratio is defined under the following condition:

CR= $\frac{\text{brightness of selected condition}}{\text{brightness of non-selected condition}}$

- Temperature-----25C
- Frame Frequency-----64Hz
- Viewing angle----- $\theta = 0, \emptyset = 0$
- Operating Voltage---5.0V

Note(2): definition of response time:

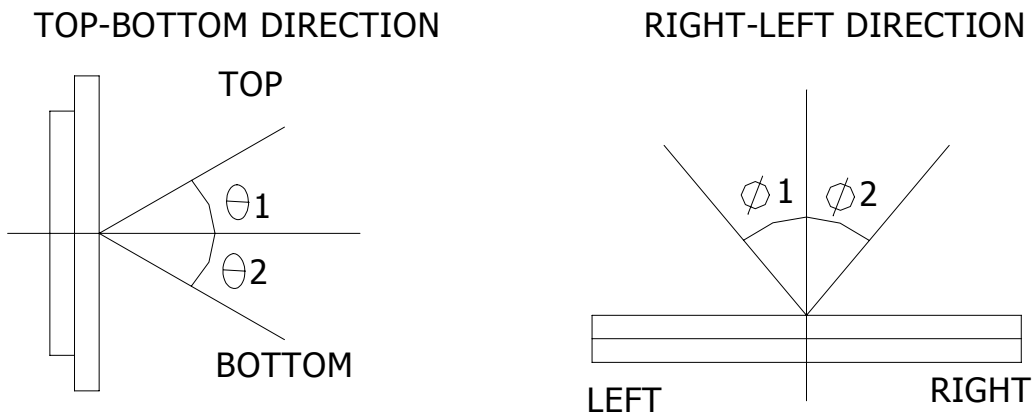
POWER LIGHT



Condition:

- (a). Temperature-----25C
- (b). Frame Frequency-----64Hz
- (c). Viewing angle----- $\theta = 0, \phi = 0$
- (d). Operating Voltage---5.0V

Note(3): definition of view angle:



8. DISPLAY CONTROL INSTRUCTION

8.1 INSTRUCTION TABLE

| Function | RR | CC | CC | CC | CC | CC | CC | CC | CC | CC | CC | CC | CC | CC | CC | CC | CC | CC | CC | Description | Execution Time |
|----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-------------|----------------|
| | S | A | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | | |

| | | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | Time* (Max) | | | |
|-------------------------|---|---|---|---|---|---|---|---|---|---|---|---|-----------------------------------|----------------------------------|----------|
| Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Clears entire display and returns the cursor to home position (address 0) | 1.64mS | | | |
| Return Home | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | X | Return the cursor to the home position. DD RAM contents remain unchanged. Set DD RAM address to zero. | 1.64mS | | |
| Entry mode set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | S | Set cursor moving direction and enable the shift of the display. These operations are performed during data write/read of DD RAM/CG RAM. 1/D=1: increment; 1/D=0: decrement; S=1: whole display shift when data is written. | 40 μ S | | |
| Display ON/OFF control | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | B | Set display (D), cursor (C) and blinking of cursor (B) ON/OFF. D=1: display ON; D=0: display OFF. C=1: Cursor ON; C=0: cursor OFF. B=1: Blink ON; B=0, Blink OFF. | 40 μ S | | |
| Cursor or Display shift | 0 | 0 | 0 | 0 | 0 | 1 | S | R | X | X | X | Move the cursor and shift the display without changing DDRAM contents. S/C=1: Display Shift; S/C=0: Cursor move. R/L=1: shift to right; R/L=0: shift to left. | 40 μ S | | |
| Function Set | 0 | 0 | 0 | 0 | 1 | D | N | F | X | X | X | Set interface data length (DL), number of display lines (N) and character font (F). DL=1: 8 bits; DL=0: 4 bits. N=1: 2 lines; N=0: 1 lines. F=1: 5X11 dots; F=0: 5X7 dots. | 40 μ S | | |
| Set CG RAM add | 0 | 0 | 0 | 1 | | | A | C | G | | | Set CG RAM address. CG RAM data is sent and received after this setting. | 40 μ S | | |
| Set DD RAM Add | 0 | 0 | 1 | | | | A | D | D | | | Set DD RAM address. DD RAM data is sent and received after this setting. | 40 μ S | | |
| Read BF & Addr | 0 | 1 | B | | | | A | C | | | | Read BUSY FLAG (BF) and the contents of the address counter. BF=1: internal operation; BF=0: can accept instruction. | 0 μ S | | |
| Write Data to RAM | 1 | 0 | | | | | | | | | | WRITE DATA | Write data into DD RAM or CG RAM. | 40 μ S** | |
| Read Data from RAM | 1 | 0 | | | | | | | | | | | READ DATA | Read data from DD RAM or CG RAM. | 40 μ S** |

8.2 Character Table
ENGLISH/JAPANESE -B1

POWER LIGHT

| Upper 4 bit Lower 4 bit | LLLL | LLHH | LHLL | LHHL | HLHL | HLHL | HLHL | HLHL | HLHL | HLHL | HLHL | HLHL | HLHL | HLHL | HLHL | HLHL |
|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL | | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C |
| LLHH | | | ! | 1 | Q | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C |
| LHLL | | | " | 2 | R | B | R | B | R | B | R | B | R | B | R | B |
| LLHH | | | # | 3 | C | S | C | S | C | S | C | S | C | S | C | S |
| LHLL | | | \$ | 4 | D | T | d | t | D | T | d | t | D | T | d | t |
| LHHL | | | % | 5 | E | U | e | u | E | U | e | u | E | U | e | u |
| LHHL | | | & | 6 | F | V | f | v | F | V | f | v | F | V | f | v |
| LHHH | | | ' | 7 | G | W | g | w | G | W | g | w | G | W | g | w |
| HLLL | | | (| 8 | H | X | h | x | H | X | h | x | H | X | h | x |
| HLLH | | |) | 9 | I | Y | i | y | I | Y | i | y | I | Y | i | y |
| HLHL | | | * | : | J | Z | j | z | J | Z | j | z | J | Z | j | z |
| HLHH | | | + | ; | K | L | k | l | K | L | k | l | K | L | k | l |
| HLLL | | | , | < | L | Y | l | y | L | Y | l | y | L | Y | l | y |
| HLLH | | | - | = | N | I | n | i | N | I | n | i | N | I | n | i |
| HHHL | | | . | > | N | ^ | n | ^ | N | ^ | n | ^ | N | ^ | n | ^ |
| HHHH | | | / | ? | O | L | o | l | O | L | o | l | O | L | o | l |

ENGLISH/CYRILLIC CHARACTER SET -B2

POWER LIGHT

| Upper 4 bit Lower 4 bit | LLLL | LLLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HOLL | HOHL | HOHL | HOOH |
|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL | | | | 8 | 9 | P | ' | F | | | B | W | 4 | . | 8 | 8 |
| LLLH | | | ! | 1 | Q | 8 | 9 | | | | 7 | 9 | W | ! | W | 8 |
| LLHL | | | " | 2 | R | 6 | 7 | | | | 8 | 6 | 6 | W | W | 8 |
| LLHH | | | # | 3 | C | S | C | S | | | W | 6 | W | ! | 8 | 4 |
| LHLL | | | # | 4 | D | T | t | t | | | 3 | 7 | 6 | 7 | 6 | 7 |
| LHLH | | | % | 5 | E | U | 6 | W | | | H | 6 | 6 | 8 | W | 7 |
| LHHL | | | & | 6 | F | V | 7 | V | | | W | 8 | W | 7 | W | 6 |
| LHHH | | | ^ | 7 | G | W | 6 | W | | | J | 3 | 9 | I | ' | 6 |
| HLLL | | | 0 | 8 | H | X | H | X | | | 7 | W | 8 | W | ' | 6 |
| HLLH | | | X | 9 | I | Y | i | Y | | | Y | 8 | 8 | 7 | ' | 6 |
| HLHL | | | # | 0 | J | Z | j | Z | | | 0 | K | 6 | 7 | 6 | 6 |
| HLHH | | | # | 1 | K | [| K | [| | | 4 | 9 | " | W | 6 | 6 |
| HHLL | | | , | < | L | 0 | 1 | 2 | | | W | H | W | 6 | 6 | 6 |
| HHLH | | | - | = | M | J | M | 5 | | | 6 | H | 0 | H | 6 | 6 |
| HHHL | | | . | > | N | ^ | N | 4 | | | 6 | 7 | 7 | 7 | 6 | 6 |
| HHHH | | | / | ? | O | _ | O | 6 | | | 3 | T | E | . | 0 | 6 |

ENGLISH/HEBREW CHARACTER SET -B14

POWER LIGHT

| Upper 4 bit Lower 4 bit | LLLL | LLLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL | | | | 0 | 1 | 2 | 3 | 4 | | | | | | | | |
| LLLH | | | ! | 1 | 2 | 3 | 4 | | | | | | | | | |
| LLHL | | | " | 2 | 3 | 4 | 5 | | | | | | | | | |
| LLHH | | | # | 3 | 4 | 5 | 6 | | | | | | | | | |
| LHLL | | | 4 | 5 | 6 | 7 | 8 | | | | | | | | | |
| LHLH | | | 5 | 6 | 7 | 8 | 9 | | | | | | | | | |
| LHHL | | | 6 | 7 | 8 | 9 | A | | | | | | | | | |
| LHHH | | | 7 | 8 | 9 | A | B | | | | | | | | | |
| HLLL | | | 8 | 9 | A | B | C | | | | | | | | | |
| HLLH | | | 9 | A | B | C | D | | | | | | | | | |
| HLHL | | | A | B | C | D | E | | | | | | | | | |
| HLHH | | | B | C | D | E | F | | | | | | | | | |
| HHLL | | | C | D | E | F | G | | | | | | | | | |
| HHLH | | | D | E | F | G | H | | | | | | | | | |
| HHHL | | | E | F | G | H | I | | | | | | | | | |
| HHHH | | | F | G | H | I | J | | | | | | | | | |

8.3 INITIALIZATION BY INSTRUCTION

8-bits

4-bits

POWER LIGHT

Power On



Wait for more than 15 ms
after Vdd rises to 4.5V



RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
0 0 0 0 1 1 X X X X

Function set: interface is 8 bit long



Wait for more than 4.1 Ms

RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
0 0 0 0 1 1 X X X X

Function set



Wait for more than 0.1 Ms



RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
0 0 0 0 1 1 X X X X

Function set

RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
0 0 0 0 1 1 X X X X

Function set: DL=1,8 bit interface data



RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
0 0 0 0 0 0 1 0 0 0

Display Off



RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
0 0 0 0 0 0 0 0 0 1

Clear all display and return cursor to home position



RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
0 0 0 0 0 0 0 1 I/D S

Entry mode set

END OF INITIALIZATION

Power On



Wait for more than 15 ms
after Vdd rises to 4.5V



RS R/W DB7 DB6 DB5 DB4
0 0 0 0 1 1

Function set: DL=1,8 bit interface data.



Wait for more than 4.1 Ms

RS R/W DB7 DB6 DB5 DB4
0 0 0 0 1 1

DL=1,8 bit interface data



Wait for more than 0.1 Ms



RS R/W DB7 DB6 DB5 DB4
0 0 0 0 1 0

DL=0,4 bit interface data

RS R/W DB7 DB6 DB5 DB4
0 0 0 0 1 0

0 0 N F X X

Function set: DL=0,4 bit interface data



RS R/W DB7 DB6 DB5 DB4
0 0 0 0 0 0

0 0 1 0 0 0

Display Off



RS R/W DB7 DB6 DB5 DB4
0 0 0 0 0 0

0 0 0 0 0 1

Function set: DL=0,4 bit interface data



RS R/W DB7 DB6 DB5 DB4
0 0 0 0 0 0

0 0 0 1 I/D S

Entry mode set

END OF INITIALIZATION

8.4 SOFTWARE EXAMPLES

8-BIT OPERATION 20 characters X 4 lines

POWER LIGHT

| Function | RS RW D7 D6 D5 D4 D3 D2 D1 D0 | DISPLAY | DESCRIPTION |
|-------------------------|-------------------------------|------------------------|---|
| Power on delay | | | Initialization. No display appears. |
| Function set | 0 0 0 0 1 1 0 0 X X | ----- ----- | Sets 8-bit operation, 2-line display and 5*7 dots character font. |
| Display OFF | 0 0 0 0 0 0 1 0 0 0 | | Turn off display. |
| Display ON | 0 0 0 0 0 0 1 1 1 0 | | Turn on display and cursor. |
| Entry Mode set | 0 0 0 0 0 0 0 1 1 0 | =----- ----- | Set 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. |
| Write data to CG/DD RAM | 1 0 0 1 0 0 1 1 1 0 | N----- ----- | Write "N". Cursor incremented by one and shift to right. |
| Write data to CG/DD RAM | 1 0 0 1 0 0 0 1 0 1 | NA----- ----- | Write "A". Cursor incremented by one and shift to right |
| Write data to CG/DD RAM | | NAME----- ----- | Write "M" "E" |
| Set DDRAM address | 0 0 1 1 0 0 0 0 0 0 | NAME----- =----- | Set RAM address so that the cursor is positioned at the head of the 2 nd line |
| Write data to CG/DD RAM | | NAME----- TC----- | Write "T" "C". |
| Cursor or display shift | 0 0 0 0 0 1 0 0 X X | NAME----- TC----- | Shift only the cursor position to the left. |
| Write data to CG/DD RAM | | NAME----- TECH----- | Write "E" "C" "H" |

4-bit operation (4-bits 1 line)

| Function | RS RW D7 D6 D5 D4 | Display | Description |
|----------------|-------------------|---------|-------------------------------------|
| power on delay | | █ | Initialization. No display appears. |

POWER LIGHT

| | | | |
|-------------------------|----------------------------|--|--|
| Frnction set | 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. |
| Frnction set | 0 0 0 0 1 0 0 0 0 0 X X | | Sets 4-bit operation, 1-line display and 5*7 dot character font. (number of display lines and character font cannot be changed hence after.) |
| Display ON/OFF Control | 0 0 0 0 0 0 0 0 1 1 1 0 | | Turn on display and cursor. |
| Entry Mode Set | 0 0 0 0 0 0 0 0 0 1 1 0 | | Turn on display and cursor. |
| Write data to CG/DD/ARM | 1 0 0 1 0 0 1 0 1 1 1 1 | | Write "O". Curaor incrementer by one and shift to right. |
| same as 8-bit operation | | | |

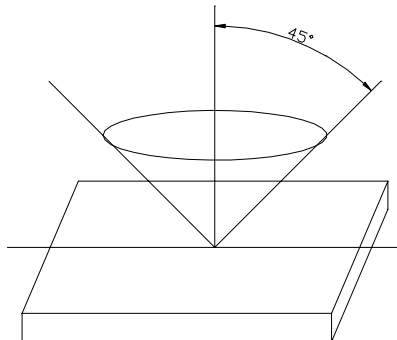
9. INSPECTION STANDARDS

9.1 Inspection Conditions

The LCD shall be inspected under 40W white fluorescent light.

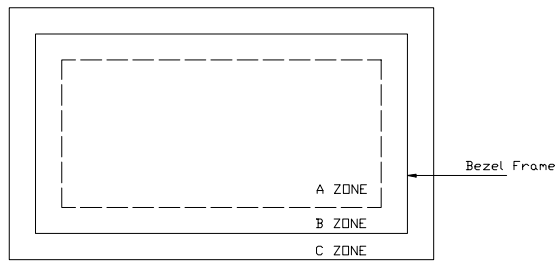
The distance between the eyes and the samples shall be more than 30cm.

All directions for inspecting the sample should be within 45 degree against perpendicular line.



9.2 Definition of Applicable Zone

POWER LIGHT

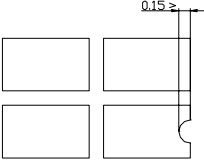
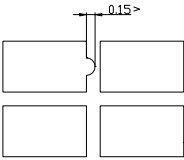
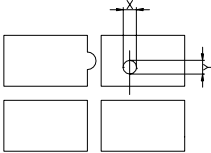


A Zone: Active Display Area
 B Zone: Area from Bezel Frame to A Zone
 C Zone: Rest Area of Bezel
 A Zone + B Zone=Effective Viewing Area

9.3 Standards

| NO | PARAMETER | CRITERIA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|--|-------------------|-------------------|-------------------|-------|-------|---|---|---------------|--------------|---------------|---|--------------|---|--------------------|---------------|--------------------|---|---|--------------------|--------------------|---|---|---|--------------|---------------|---|---|---|---|------------|----------------|--|--|
| 1 | Black and White Spots, Foreign Substances | Round Shape <table border="1"> <thead> <tr> <th rowspan="2">Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>DIMENSION(MM)</td> <td></td> <td></td> <td></td> </tr> <tr> <td>$D \leq 0.1$</td> <td>*</td> <td>*</td> <td>*</td> </tr> <tr> <td>$0.1 < D \leq 0.2$</td> <td>5</td> <td>5</td> <td>*</td> </tr> <tr> <td>$0.2 < D \leq 0.3$</td> <td>0</td> <td>1</td> <td>*</td> </tr> <tr> <td>$0.3 < D$</td> <td>0</td> <td>0</td> <td>*</td> </tr> </tbody> </table> <p>$D = (\text{long} + \text{short}) / 2$ * Disregard</p> | Zone | Acceptable Number | | | A | B | C | DIMENSION(MM) | | | | $D \leq 0.1$ | * | * | * | $0.1 < D \leq 0.2$ | 5 | 5 | * | $0.2 < D \leq 0.3$ | 0 | 1 | * | $0.3 < D$ | 0 | 0 | * | | | | | | |
| | | Zone | | Acceptable Number | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | B | | C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DIMENSION(MM) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $D \leq 0.1$ | * | * | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.1 < D \leq 0.2$ | 5 | 5 | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.2 < D \leq 0.3$ | 0 | 1 | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.3 < D$ | 0 | 0 | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Line Shape <table border="1"> <thead> <tr> <th colspan="2">Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th>X(mm)</th> <th>Y(mm)</th> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>$0.02 \geq W$</td> <td>*</td> <td>*</td> <td>*</td> </tr> <tr> <td>$2.0 \geq L$</td> <td>$0.03 \geq W$</td> <td>3</td> <td>3</td> <td>*</td> </tr> <tr> <td>$1.0 \geq L$</td> <td>$0.04 \geq W$</td> <td>1</td> <td>2</td> <td>*</td> </tr> <tr> <td>$1.0 \geq L$</td> <td>$0.05 \geq W$</td> <td>0</td> <td>2</td> <td>*</td> </tr> <tr> <td>-</td> <td>$0.05 < W$</td> <td colspan="3">Not acceptable</td> </tr> </tbody> </table> <p>X: Length Y: Width * Disregard Total defects shall not exceed 5.</p> | Zone | | Acceptable Number | | | X(mm) | Y(mm) | A | B | C | - | $0.02 \geq W$ | * | * | * | $2.0 \geq L$ | $0.03 \geq W$ | 3 | 3 | * | $1.0 \geq L$ | $0.04 \geq W$ | 1 | 2 | * | $1.0 \geq L$ | $0.05 \geq W$ | 0 | 2 | * | - | $0.05 < W$ | Not acceptable | | |
| Zone | | Acceptable Number | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X(mm) | Y(mm) | A | B | C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - | $0.02 \geq W$ | * | * | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $2.0 \geq L$ | $0.03 \geq W$ | 3 | 3 | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $1.0 \geq L$ | $0.04 \geq W$ | 1 | 2 | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $1.0 \geq L$ | $0.05 \geq W$ | 0 | 2 | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - | $0.05 < W$ | Not acceptable | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Air Bubbles (Between glass and polarizer) | <table border="1"> <thead> <tr> <th rowspan="2">Dimension(mm)</th> <th rowspan="2">Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$D \leq 0.1$</td> <td></td> <td>*</td> <td>*</td> <td>*</td> </tr> <tr> <td>$0.1 < D \leq 0.2$</td> <td></td> <td>5</td> <td>5</td> <td>*</td> </tr> <tr> <td>$0.2 < D \leq 0.3$</td> <td></td> <td>0</td> <td>1</td> <td>*</td> </tr> <tr> <td>$0.3 < D$</td> <td></td> <td>0</td> <td>0</td> <td>*</td> </tr> </tbody> </table> | Dimension(mm) | Zone | Acceptable Number | | | A | B | C | $D \leq 0.1$ | | * | * | * | $0.1 < D \leq 0.2$ | | 5 | 5 | * | $0.2 < D \leq 0.3$ | | 0 | 1 | * | $0.3 < D$ | | 0 | 0 | * | | | | | |
| Dimension(mm) | Zone | Acceptable Number | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | A | B | C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $D \leq 0.1$ | | * | * | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.1 < D \leq 0.2$ | | 5 | 5 | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.2 < D \leq 0.3$ | | 0 | 1 | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.3 < D$ | | 0 | 0 | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

POWER LIGHT

| | | |
|---|---------------------|---|
| | | *: Disregard Total defects shall not exceed 3. |
| 3 | The Shape of Dot | <p>(1) Dot Shape(with dent)</p>  <p>As per the sketch of left hand.</p> <p>(2) Dot Shape(with Projection)</p>  <p>Should not connect to next dot.</p> <p>(3) Pin Hole</p>  <p>$(X+Y)/2 < 0.2\text{mm}$ (less than 0.1mm is not counted)</p> <p>Total defects shall not exceed 5.</p> |
| 4 | Polarizer Scratches | Not to be conspicuous defects. |
| 5 | Polarizer Dirts | If the stains are removed easily from LCD surface, the module is not defective. |
| 6 | Color Variation | Not to be conspicuous defects. |

10. PRECAUTIONS IN USING LCM

1. LIQUID CRYSTAL DISPLAY (LCD)

LCD is made up of glass, organic sealant, organic fluid, and polymer based polarizers. The following precautions should be taken when handing,

- (1). Keep the temperature within range of use and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel off or bubble.
- (2). Do not contact the exposed polarizers with anything harder than an HB pencil lead. To clean dust off the display surface. Wipe gently with cotton. Chamois or other soft material soaked in petroleum benzine.
- (3). Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause polarizer deformation or color fading, while an active LCD with water condensation on its surface will cause corrosion of ITO electrodes.
- (4). Glass can be easily chipped or cracked from rough handling. especially at corners and

edges.

- (5). Do not drive LCD with DC voltage.

2. Liquid Crystal Display Modules

2.1 Mechanical Considerations

LCM are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modifications. The following should be noted.

- (1). Do not tamper in any way with the tabs on the metal frame.
- (2). Do not modify the PCB by drilling extra holes, changing its outline, moving its components or modifying its pattern.
- (3). Do not touch the elastomer connector, especially insert a backlight panel (for example, EL).
- (4). When mounting a LCM make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
- (5). Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels.

2.2. Static Electricity

LCM contains CMOS LSI's and the same precaution for such devices should apply, namely

- (1). The operator should be grounded whenever he/she comes into contact with the module. Never touch any of the conductive parts such as the LSI pads, the copper leads on the PCB and the interface terminals with any parts of the human body.
- (2). The modules should be kept in antistatic bags or other containers resistant to static for storage.
- (3). Only properly grounded soldering irons should be used.
- (4). If an electric screwdriver is used, it should be well grounded and shielded from commutator sparks.
- (5). The normal static prevention measures should be observed for work clothes and working benches; for the latter a conductive (rubber) mat is recommended.
- (6). Since dry air is inductive to statics, a relative humidity of 50-60% is recommended.

2.3. Soldering

- (1). Solder only to the I/O terminals.
- (2). Use only soldering irons with proper grounding and no leakage.
- (3). Soldering temperature: $280\text{ }^{\circ}\text{C} \pm 10^{\circ}\text{C}$
- (4). Soldering time: 3 to 4 sec.
- (5). Use eutectic solder with resin flux fill.
- (6). If flux is used, the LCD surface should be covered to avoid flux spatters. Flux residue should be removed afterwards.

2.4. Operation

- (1). The viewing angle can be adjusted by varying the LCD driving voltage V_0 .
- (2). Driving voltage should be kept within specified range; excess voltage shortens display life.
- (3). Response time increases with decrease in temperature.
- (4). Display may turn black or dark blue at temperatures above its operational range; this is (however not pressing on the viewing area) may cause the segments to appear "fractured".
- (5). Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear "fractured".

2.5. Storage

If any fluid leaks out of a damaged glass cell, wash off any human part that comes into

contact with soap and water. Never swallow the fluid. The toxicity is extremely low but caution should be exercised at all the time.

End

POWER LIGHT