

LONGTECH OPTICS

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SPECIFICATIONS OF LCD MODULE

MODULE NO : LCM1602S3-FL-GBW

DOC.REVISION: 00

| | SIGNATURE | DATE |
|------------------------------|-----------|------------|
| PREPARED BY (RD ENGINEER) | LAN | 2011-12-19 |
| CHECKED BY | | 2011-12-19 |
| APPROVED BY | | 2011-12-19 |

DOCUMENT REVISION HISTORY

| VERSINO | DATE | DESCRIPTION | CHANGED BY |
|---------|-------------------|-------------|------------|
| 00 | December 19, 2011 | First issue | |

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1.Features

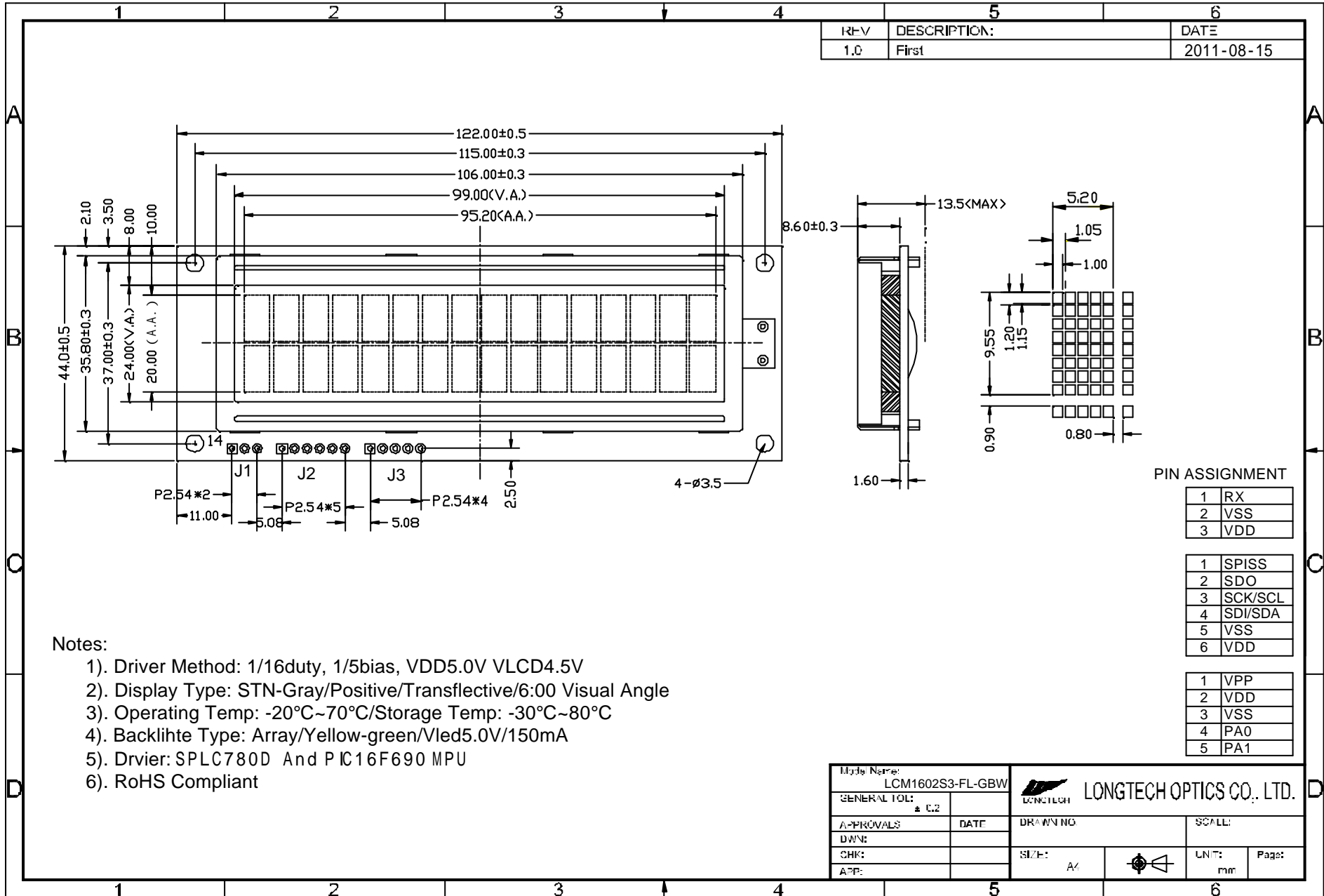
1. 5x8 dots with cursor
2. Built-in controller (S6A0069 or equivalent)
3. +5V power supply
4. Serial Interface I²C, SPI or RS232/TTL
5. 16characters *2lines display

| | | | | |
|--------------------------|--|--|---|--|
| LCD type | <input type="checkbox"/> TN | | | |
| | <input type="checkbox"/> FSTN | <input type="checkbox"/> FSTN Negative | | |
| | <input type="checkbox"/> STN Yellow Green | <input checked="" type="checkbox"/> STN Gray | <input type="checkbox"/> STN Blue Negative | |
| View direction | <input checked="" type="checkbox"/> 6 O'clock | | <input type="checkbox"/> 12 O'clock | |
| Rear Polarizer | <input type="checkbox"/> Reflective | | <input checked="" type="checkbox"/> Transflective | <input type="checkbox"/> Transmissive |
| Backlight Type | <input checked="" type="checkbox"/> LED Array | | <input type="checkbox"/> EL | <input type="checkbox"/> Internal Power |
| | <input type="checkbox"/> LED Edge | | <input type="checkbox"/> CCFL | <input checked="" type="checkbox"/> External Power |
| Backlight Color | <input type="checkbox"/> White | <input type="checkbox"/> Blue | <input type="checkbox"/> Amber | <input checked="" type="checkbox"/> Yellow-Green |
| Temperature Range | <input type="checkbox"/> Normal | | <input checked="" type="checkbox"/> Wide | <input type="checkbox"/> Super Wide |
| DC to DC circuit | <input type="checkbox"/> Build-in | | <input checked="" type="checkbox"/> Not Build-in | |
| Touch screen | <input type="checkbox"/> With | | <input checked="" type="checkbox"/> Without | |
| Font type | <input checked="" type="checkbox"/> English-Japanese | <input type="checkbox"/> English-Europen | <input type="checkbox"/> English-Russian | <input type="checkbox"/> Other |

2.MECHANICAL SPECIFICATIONS

| | |
|-----------------|------------------------------------|
| Module size | 122.0mm(L)*44.0mm(W)* Max13.5(H)mm |
| Viewing area | 99.0mm(L)*24.0mm(W) |
| Character size | 5.20mm(L)*9.55mm(W) |
| Character pitch | 6.00mm(L)*10.45mm(W) |
| Weight | Approx. |

3.Outline dimension



Notes:

- 1). Driver Method: 1/16duty, 1/5bias, VDD5.0V VLCD4.5V
- 2). Display Type: STN-Gray/Positive/Transflective/6:00 Visual Angle
- 3). Operating Temp: -20°C~70°C/Storage Temp: -30°C~80°C
- 4). Backlihte Type: Array/Yellow-green/Vled5.0V/150mA
- 5). Drvier: SPLC780D And P IC16F690 MPU
- 6). RoHS Compliant

| | | | | |
|---------------------------------|------|----------|---------------------------|--------|
| Model Name: LCM1602S3-FL-GBW | | LONGTECH | LONGTECH OPTICS CO., LTD. | |
| GENERAL TOL: ± 0.2 | | | DRAWN NO | SCALE: |
| A-PROVALS | DATE | | | |
| DWN: | | SIZE: A/ | UNIT: mm | |
| CHK: | | | Page: | |
| A*P: | | | | |

4. Absolute maximum ratings

| Item | Symbol | Standard | | | Unit |
|-----------------------------|-----------------|----------|---|-----|------|
| Power voltage | $V_{DD}-V_{SS}$ | 0 | - | 7.0 | V |
| Input voltage | V_{IN} | VSS | - | VDD | |
| Operating temperature range | V_{OP} | -20 | - | 70 | |
| Storage temperature range | V_{ST} | -30 | - | 80 | |

5. Interface pin description

| Pin no. | Symbol | External connection | Function |
|---------|----------|---------------------|--------------------------------------|
| 1 | RX | O | RS232 Serial input port |
| 2 | V_{SS} | Power supply | Signal ground for LCM (GND) |
| 3 | V_{DD} | | Power supply for logic (+5V) for LCM |
| 1 | SPISS | O | SPI or I2C input port |
| 2 | SDO | O | SPI or I2C input port |
| 3 | SCK/SCL | O | SPI or I2C input port |
| 4 | SDI/SDA | O | SPI or I2C input port |
| 5 | V_{SS} | Power supply | Signal ground for LCM (GND) |
| 6 | V_{DD} | | Power supply for logic (+5V) for LCM |
| 1 | VPP | I | Programmed voltage |
| 2 | V_{DD} | Power supply | Power supply for logic (+5V) for LCM |
| 3 | V_{SS} | | Signal ground for LCM (GND) |
| 4 | PA0 | I | Port A0 |
| 5 | PA1 | I | Port A1 |

6. Optical characteristics

STN type display module ($T_a=25$, $V_{DD}=5.0V$)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|----------------------|--------|-----------|------|------|------|------|
| Viewing angle | | C_r 3 | 10 | - | 60 | deg |
| | | | -45 | - | 45 | |
| Contrast ratio | C_r | | - | 3 | - | - |
| Response time (rise) | T_r | - | - | 100 | 150 | ms |
| Response time (fall) | T_r | - | - | 150 | 200 | |

7. Electrical characteristics

DC characteristics

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|--------------------------|-----------|-----------------------------|------|------|----------|------|
| Input voltage | V_{DD} | | 4.7 | 5.0 | 5.5 | |
| Supply current | I_{DD} | $T_a=25$, $V_{DD}=5.0V$ | - | 125 | - | mA |
| Input leakage current | I_{LKG} | | - | - | 1.0 | uA |
| "H" level input voltage | V_{IH} | | 2.2 | - | V_{DD} | V |
| "L" level input voltage | V_{IL} | Twice initial value or less | 0 | - | 0.6 | |
| "H" level output voltage | V_{OH} | LOH=-0.25mA | 2.4 | - | - | |
| "L" level output voltage | V_{OL} | LOH=1.6mA | - | - | 0.4 | |

8. Communications

I2C Communication

To enter the I²C mode, a jumper is placed on R2 of the interface board and 2 pull-up resistors (nominal value of 1K to 10K Ohm), must be placed on SDA and SCK communication lines, R7 and R8.

The default I²C address is 50 (32 hex). The I²C address can be changed to any 8-bit value by command function, with the exception that the LSB (least significant bit) must always be '0'. Once the I²C address has been changed, it will be saved in the system memory, and it will revert back to the default address if either RS232 or SPI protocol is selected.

The I2C interface is capable of receiving data at up to 400KHz-clock rate.

SPI Communication

To enter the SPI mode, a jumper is placed on R1 of the interface board.

The SPI mode has a normally high level idle clock; data sampled on the rising edge of the clock and Slave Select is enabled.

RS232 Communication

To enter the RS232 mode, both jumpers, R1 and R2 are removed.

The RS232 signal must be 5V, TTL compatible. The communication format is 8-bit data, one stop bit, no parity and no hand shaking. The default BAUD rate is 9600, and it is changeable with a command function, once the BAUD rate is changed, it will be saved in the system memory, and it can be reverted back to default BAUD rate if either I²C or SPI protocol is selected.

Changing the I2C Slave Address

Syntax hexadecimal 0xFE 0x62 [adr]

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|---|
| [adr] | | 1 byte | New I ² C address, 0x00 – 0xFE The LSB is always '0'. |

Description This command sets the I2C address, the address must be an even number, (LSB = 0). The address change requires 20 microsecond to take effect; therefore, the subsequent input must have an appropriate delay. The default I2C address can be restored if SPI or RS232 is selected as the communication mode.
Default 0x50

Changing BAUD Rate

Syntax hexadecimal 0xFE 0x61 [baud]

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|----------------------------|
| [baud] | | 1 byte | New RS232 BAUD Rate, 1 - 8 |

Description This command sets the RS232 BAUD rate, the single byte parameter select the desired BAUD rate as in the table below. The new BAUD rate requires 20 microsecond to take effect, therefore, the subsequent input must have an appropriate delay. The default BAUD rate can be restored if I2C or SPI is selected as the communication mode. Illegal parameter input will be discarded.
Default 9600 BAUD

| Parameter | BAUD |
|-----------|--------|
| 1 | 300 |
| 2 | 1200 |
| 3 | 2400 |
| 4 | 9600 |
| 5 | 14400 |
| 6 | 19.2K |
| 7 | 57.6K |
| 8 | 115.2K |

9. Build-In Functions

Introduction

There several build-in functions in the serial interface to facilitate the LCD control, These functions eliminate the needs for end user to understand the HD44780 instruction set and timing requirements. It also provides control for features that are not accessible with a serial connection.

Turn On Display

Syntax hexadecimal 0xFE 0x41

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|--------------------|
| None | None | None | Turn on LCD screen |

Description This command turn on the LCD display screen, the display text is not altered.
 Default LCD screen is on

Turn Off Display

Syntax hexadecimal 0xFE 0x42

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|---------------------|
| None | None | None | Turn off LCD screen |

Description This command turn off the LCD display screen, the display text is not altered.
 Default LCD screen is on

Set Cursor Position

Syntax hexadecimal 0xFE 0x45 [pos]

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|---|
| [pos] | [pos] | 1 byte | Put cursor at location specified by [pos], 0x00 to 0x67 |

Description This command moves the cursor to a specified location where the next character will be displayed. A typical cursor position for a 4-line display is show below; a cursor position outside these ranges will not be viewable.

| | Column1 | Column20 |
|--------|---------|----------|
| Line1 | 0x00 | 0x13 |
| Line 2 | 0x40 | 0x53 |
| Line 3 | 0x14 | 0x27 |
| Line 4 | 0x54 | 0x67 |

Default After a reset, the cursor is on position 0x00.

Home Cursor

Syntax hexadecimal 0xFE 0x46

| Parameter | Parameter | Length | Description |
|-------------|--|--------|------------------------------------|
| | None | None | Position cursor at line 1 column 1 |
| Description | This command move the cursor to line 1, column 1 of the LCD screen, the display text is not altered. | | |
| Default | None | | |

Turn On Underline Cursor

Syntax hexadecimal 0xFE 0x47

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|--------------------------|
| | None | None | Turn on underline cursor |

Description This command turn on the underline cursor, the cursor position is where the next character will appear.

Default The underline cursor is off.

Turn Off Underline Cursor

Syntax hexadecimal 0xFE 0x48

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|---------------------------|
| | None | None | Turn off underline cursor |

Description This command turn off the underline cursor.

Default The underline cursor is off.

Move Cursor Left One Space

Syntax hexadecimal 0xFE 0x49

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|--------------------------|
| | None | None | Move cursor left 1 space |

Description This command move the cursor position left 1 space, regardless the cursor is displayed or not, and the displayed character is not altered

Default None

Move Cursor Right One Space

Syntax hexadecimal 0xFE 0x4A

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|---------------------------|
| | None | None | Move cursor right 1 space |

Description This command move the cursor position right 1 space, regardless the cursor is displayed or not, and the displayed character is not altered

Default None

Turn On Blinking Cursor

Syntax hexadecimal 0xFE 0x4B

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|-----------------------------|
| | None | None | Turn on the blinking cursor |

Description This command turn on the blinking cursor, both the cursor and the character on the cursor will blink.

Default The blinking cursor is off.

Turn Off Blinking Cursor

Syntax hexadecimal 0xFE 0x4C

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|------------------------------|
| | None | None | Turn off the blinking cursor |

Description This command turn off the blinking cursor.

Default The blinking cursor is off.

Back Space

Syntax hexadecimal 0xFE 0x4E

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|--|
| | None | None | Move cursor back one space and delete the character on the cursor. |

Description This command is destructive backspace, the cursor is moved back one space and the character on the cursor is deleted.

Default None.

Clear Screen

Syntax hexadecimal 0xFE 0x51

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|---|
| | None | None | Clear LCD and move cursor to line 1 column 1. |

Description This command clears the entire display and place the cursor at line 1 column 1.

Default None.

Set Display Contrast

Syntax hexadecimal 0xFE 0x52 [contrast]

| Parameter | Parameter | Length | Description |
|-----------|------------|--------|---|
| | [contrast] | 1 byte | Set the display contrast, value between 1 to 50 |

Description This command set the LCD character display contrast, the contrast setting is between 1 to 50, where 50 is the highest contrast.

Default Default contrast value is 40.

Set Backlight Brightness

Syntax hexadecimal 0xFE 0x53 [brightness]

| Parameter | Parameter | Length | Description |
|-----------|--------------|--------|---|
| | [brightness] | 1 byte | Set the LCD backlight brightness level, value between 1 to 16 |

Description This command set the LCD display backlight brightness level, the value is between 1 to 16.

Default Default contrast value is 8.

Load Custom Characters

Syntax hexadecimal 0xFE 0x54 [addr] [d0 ..d7]

| Parameter | Parameter | Length | Description |
|-----------|-----------|---------|----------------------------------|
| | [addr] | 1 byte | Custom character address, 0 – 7 |
| | [D0..D7] | 8 bytes | Custom character pattern bit map |

Description There are space for eight user defined custom characters, this command load the custom character into one of the eight locations. The custom character pattern is bit mapped into 8 data bytes, the bit map for Spanish character ‘¿’ is shown in table below, to display the custom character, user simply enter the address of the character (0 to 8).

Default None.

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Hex |
|--------|---|---|---|---|---|---|---|---|------|
| Byte 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0x04 |
| Byte 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0x00 |
| Byte 3 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0x04 |
| Byte 4 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0x08 |
| Byte 5 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0x10 |
| Byte 6 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0x11 |
| Byte 7 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0x0E |
| Byte 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0x00 |

Shift Display to the Left

Syntax hexadecimal 0xFE 0x55

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|---|
| | None | None | Shift the LCD screen to the left one Place. |

Description This command shift the display one place to the left, the cursor position also moves with the display, and the display data is not altered.

Default None

Shift Display to the Right

Syntax hexadecimal 0xFE 0x56

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|--|
| | None | None | Shift the LCD screen to the right one Place. |

Description This command shift the display one place to the right, the cursor position also moves with the display, and the display data is not altered.

Default None

Display Firmware Version Number

Syntax hexadecimal 0xFE 0x70

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|--------------------------------------|
| | None | None | Display the firmware version number. |

Description This command display the micro-controller firmware version number.

Default None.

Display RS232 Baud Rate

Syntax hexadecimal 0xFE 0x71

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|-------------------|
| | None | None | Display Baud Rate |

Description This command display the current RS232 BAUD rate.

Default None.

Display I²C Address

Syntax hexadecimal 0xFE 0x72

| Parameter | Parameter | Length | Description |
|-----------|-----------|--------|----------------------------------|
| | None | None | Display I ² C Address |

Description This command display the current I²C slave address.

Default None.

Direct HD44780 Command

Syntax hexadecimal 0xFE 0xFE [cmd]

Parameter Parameter Length Description
 [cmd] 1 byte Direct interface to the LCD controller, HD44780.

Description This command is for advanced programmer, it allows LCD instruction to send directly to the SPLC780D controller.

Default None.

ASCII TEXT

To display normal text, just enter its ASCII number, a number from 0x00 to 0x07 displays the user defined custom character, 0x20 to 0x7F displays the stand set of characters. And numbers from 0xA0 to 0xFD display characters and symbols that are factory-masked on the SPLC780D controller and 0xFE is reserved for function command.

Command Summary

| Prefix | CMD | Param | Description |
|--------|------|--------|-------------------------------------|
| 0xFE | 0x41 | None | Display on |
| 0xFE | 0x42 | None | Display off |
| 0xFE | 0x45 | 1 Byte | Set cursor |
| 0xFE | 0x46 | None | Cursor home |
| 0xFE | 0x47 | None | Underline cursor on |
| 0xFE | 0x48 | None | Underline cursor off |
| 0xFE | 0x49 | None | Move cursor left one place |
| 0xFE | 0x4A | None | Move cursor right one place |
| 0xFE | 0x4B | None | Blinking cursor on |
| 0xFE | 0x4C | None | Blinking cursor off |
| 0xFE | 0x4E | None | Backspace |
| 0xFE | 0x51 | None | Clear screen |
| 0xFE | 0x52 | 1 Byte | Set contrast |
| 0xFE | 0x53 | 1 Byte | Set backlight brightness |
| 0xFE | 0x54 | 9 Byte | Load custom character |
| 0xFE | 0x55 | None | Move display one place to the left |
| 0xFE | 0x56 | None | Move display one place to the right |
| 0xFE | 0x61 | 1 Byte | Change RS232 BAUD rate 232 |
| 0xFE | 0x62 | 1 Byte | Change I2C address |
| 0xFE | 0x70 | None | Display firmware version number |
| 0xFE | 0x71 | None | Display RS232 BAUD rate |
| 0xFE | 0x72 | None | Display I2C address |
| 0xFE | 0xFE | 1 Byte | Send control byte to |

10. Standard character pattern

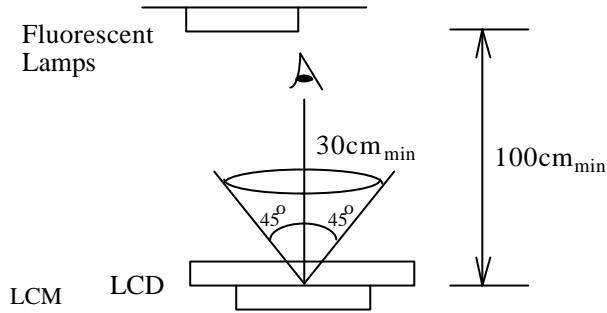
| Lower 4 Bits | Upper 4 Bits | | | | | | | | | | | | | | | |
|--------------|--------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | 0000 | 0001 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1000 | 1001 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 |
| xxxx0000 | CG RAM (1) | | 0 | @ | P | ` | P | | | | - | 9 | ≡ | α | ρ | |
| xxxx0001 | (2) | | ! | 1 | A | Q | a | q | | | 。 | ア | チ | △ | △ | 9 |
| xxxx0010 | (3) | | " | 2 | B | R | b | r | | | 「 | イ | ツ | × | ρ | θ |
| xxxx0011 | (4) | | # | 3 | C | S | c | s | | | 」 | ウ | テ | ε | ε | ε |
| xxxx0100 | (5) | | \$ | 4 | D | T | d | t | | | 、 | エ | ト | † | μ | ε |
| xxxx0101 | (6) | | % | 5 | E | U | e | u | | | ・ | オ | ナ | ∟ | ε | ε |
| xxxx0110 | (7) | | & | 6 | F | V | f | v | | | ヲ | カ | ニ | ヨ | ρ | μ |
| xxxx0111 | (8) | | ' | 7 | G | W | g | w | | | フ | キ | ヌ | ラ | 9 | μ |
| xxxx1000 | (1) | | < | 8 | H | X | h | x | | | イ | ク | ネ | リ | ε | μ |
| xxxx1001 | (2) | | > | 9 | I | Y | i | y | | | ウ | ケ | ∟ | ル | ∟ | ε |
| xxxx1010 | (3) | | * | : | J | Z | j | z | | | エ | コ | ∟ | レ | J | μ |
| xxxx1011 | (4) | | + | : | K | [| k | { | | | オ | サ | ヒ | ロ | * | μ |
| xxxx1100 | (5) | | , | < | L | ¥ | ∟ | ∟ | | | カ | シ | フ | ワ | ε | μ |
| xxxx1101 | (6) | | - | = | M | ∟ | m | } | | | ユ | ヌ | ∟ | ∟ | μ | ∟ |
| xxxx1110 | (7) | | . | > | N | ^ | n | ‡ | | | ヨ | セ | ホ | ∟ | ∟ | |
| xxxx1111 | (8) | | / | ? | O | _ | o | † | | | ツ | リ | マ | ∟ | ∟ | ■ |

11.QUALITY SPECIFICATIONS

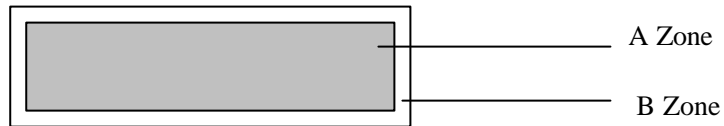
11.1 Standard of the product appearance test

Manner of appearance test: The inspection should be performed in using 20W x 2 fluorescent lamps. Distance between LCM and fluorescent lamps should be 100 cm or more. Distance between LCM and inspector eyes should be 30 cm or more.

Viewing direction for inspection is 45° from vertical against LCM.



Definition of zone:



- A Zone: Active display area (minimum viewing area).
- B Zone: Non-active display area (outside viewing area).

11.2 Specification of quality assurance

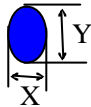
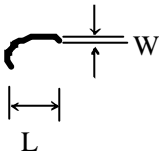
AQL inspection standard

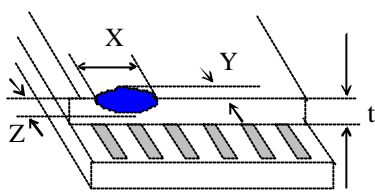
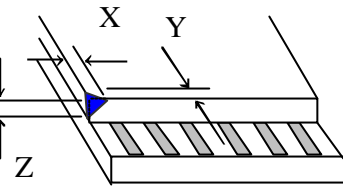
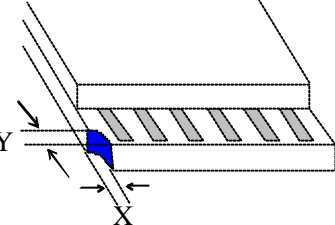
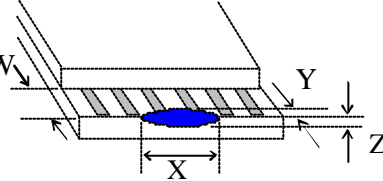
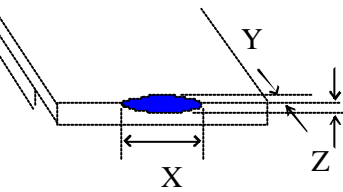
Sampling method: MIL-STD-105E, Level II, single sampling

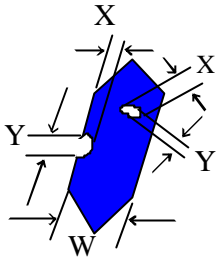
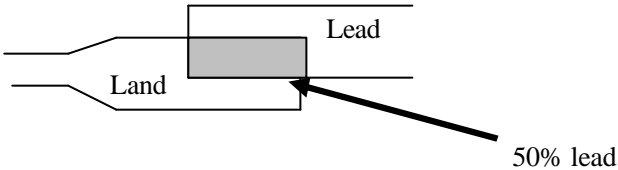
Defect classification **(Note: * is not including)**

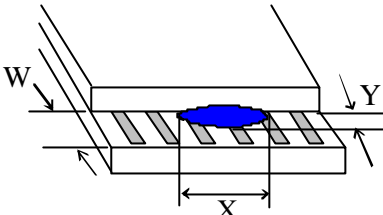
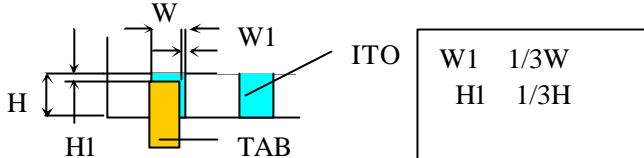
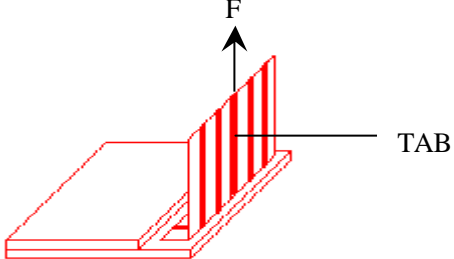
| Classify | Item | | Note | AQL |
|----------------------------|---------------|------------------------------|------|------|
| Major | Display state | Short or open circuit | 1 | 0.65 |
| | | LC leakage | | |
| | | Flickering | | |
| | | No display | | |
| | | Wrong viewing direction | | |
| | | Contrast defect (dim, ghost) | 2 | |
| | | Back-light | 1,8 | |
| | Non-display | Flat cable or pin reverse | 10 | |
| Wrong or missing component | | 11 | | |
| Minor | Display state | Background color deviation | 2 | 1.0 |
| | | Black spot and dust | 3 | |
| | | Line defect, Scratch | 4 | |
| | | Rainbow | 5 | |
| | | Chip | 6 | |
| | | Pin hole | 7 | |
| | | Protruded | 12 | |
| | Polarizer | Bubble and foreign material | 3 | |
| | Soldering | Poor connection | 9 | |
| | Wire | Poor connection | 10 | |
| | TAB | Position, Bonding strength | 13 | |

Note on defect classification

| No. | Item | Criterion | | | | | | | | | | | | | | | | | | | | |
|-------------------------|--|--|-----------------|-----------------|------------------|-----------|-------------------------|---|-------------------------|----------------|-------------------------|-------|---------------|---|-------|---------------|-------|-----------|---|-----|------------|-------------------------|
| 1 | Short or open circuit | Not allow | | | | | | | | | | | | | | | | | | | | |
| | LC leakage | | | | | | | | | | | | | | | | | | | | | |
| | Flickering | | | | | | | | | | | | | | | | | | | | | |
| | No display | | | | | | | | | | | | | | | | | | | | | |
| | Wrong viewing direction | | | | | | | | | | | | | | | | | | | | | |
| | Wrong Back-light | | | | | | | | | | | | | | | | | | | | | |
| 2 | Contrast defect | Refer to approval sample | | | | | | | | | | | | | | | | | | | | |
| | Background color deviation | | | | | | | | | | | | | | | | | | | | | |
| 3 | Point defect, Black spot, dust (including Polarizer) $\phi = (X+Y)/2$ |  <table border="1"> <thead> <tr> <th>Point Size</th> <th>Acceptable Qty.</th> </tr> </thead> <tbody> <tr> <td>$\phi \leq 0.10$</td> <td>Disregard</td> </tr> <tr> <td>$0.10 < \phi \leq 0.20$</td> <td>3</td> </tr> <tr> <td>$0.20 < \phi \leq 0.25$</td> <td>2</td> </tr> <tr> <td>$0.25 < \phi \leq 0.30$</td> <td>1</td> </tr> <tr> <td>$\phi > 0.30$</td> <td>0</td> </tr> </tbody> </table> <p style="text-align: right;">Unit : mm</p> | Point Size | Acceptable Qty. | $\phi \leq 0.10$ | Disregard | $0.10 < \phi \leq 0.20$ | 3 | $0.20 < \phi \leq 0.25$ | 2 | $0.25 < \phi \leq 0.30$ | 1 | $\phi > 0.30$ | 0 | | | | | | | | |
| | | Point Size | Acceptable Qty. | | | | | | | | | | | | | | | | | | | |
| $\phi \leq 0.10$ | Disregard | | | | | | | | | | | | | | | | | | | | | |
| $0.10 < \phi \leq 0.20$ | 3 | | | | | | | | | | | | | | | | | | | | | |
| $0.20 < \phi \leq 0.25$ | 2 | | | | | | | | | | | | | | | | | | | | | |
| $0.25 < \phi \leq 0.30$ | 1 | | | | | | | | | | | | | | | | | | | | | |
| $\phi > 0.30$ | 0 | | | | | | | | | | | | | | | | | | | | | |
| 4 | Line defect, Scratch |  <table border="1"> <thead> <tr> <th colspan="2">Line</th> <th>Acceptable Qty.</th> </tr> <tr> <th>L</th> <th>W</th> <th></th> </tr> </thead> <tbody> <tr> <td>---</td> <td>$0.015 \leq W$</td> <td>Disregard</td> </tr> <tr> <td>3.0 L</td> <td>$0.03 \leq W$</td> <td rowspan="2">2</td> </tr> <tr> <td>2.0 L</td> <td>$0.05 \leq W$</td> </tr> <tr> <td>1.0 L</td> <td>$0.1 > W$</td> <td>1</td> </tr> <tr> <td>---</td> <td>$0.05 < W$</td> <td>Applied as point defect</td> </tr> </tbody> </table> <p style="text-align: right;">Unit: mm</p> | Line | | Acceptable Qty. | L | W | | --- | $0.015 \leq W$ | Disregard | 3.0 L | $0.03 \leq W$ | 2 | 2.0 L | $0.05 \leq W$ | 1.0 L | $0.1 > W$ | 1 | --- | $0.05 < W$ | Applied as point defect |
| | | Line | | Acceptable Qty. | | | | | | | | | | | | | | | | | | |
| L | W | | | | | | | | | | | | | | | | | | | | | |
| --- | $0.015 \leq W$ | Disregard | | | | | | | | | | | | | | | | | | | | |
| 3.0 L | $0.03 \leq W$ | 2 | | | | | | | | | | | | | | | | | | | | |
| 2.0 L | $0.05 \leq W$ | | | | | | | | | | | | | | | | | | | | | |
| 1.0 L | $0.1 > W$ | 1 | | | | | | | | | | | | | | | | | | | | |
| --- | $0.05 < W$ | Applied as point defect | | | | | | | | | | | | | | | | | | | | |
| 5 | Rainbow | Not more than two color changes across the viewing area. | | | | | | | | | | | | | | | | | | | | |

| No | Item | Criterion | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------------|--|---|---|---|---|---|-------|-----|---|---|---|---|-------|---|---|---|---|---|---|---|------------------------|--|--|---|---|---|-----------|-----|---|---|---|---|---|---|-----|
| 6 | <p>Chip</p> <p>Remark:</p> <p>X: Length direction</p> <p>Y: Short direction</p> <p>Z: Thickness direction</p> <p>t: Glass thickness</p> <p>W: Terminal Width</p> |  <p>Acceptable criterion</p> <table border="1"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>0.5mm</td> <td>t/2</td> </tr> </tbody> </table>  <p>Acceptable criterion</p> <table border="1"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>0.5mm</td> <td>t</td> </tr> </tbody> </table>  <p>Acceptable criterion</p> <table border="1"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>2</td> <td>t</td> </tr> <tr> <td colspan="2">shall not reach to ITO</td> <td></td> </tr> </tbody> </table>  <p>Acceptable criterion</p> <table border="1"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>Disregard</td> <td>0.2</td> <td>t</td> </tr> </tbody> </table>  <p>Acceptable criterion</p> <table border="1"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>2</td> <td>t/3</td> </tr> </tbody> </table> | X | Y | Z | 2 | 0.5mm | t/2 | X | Y | Z | 2 | 0.5mm | t | X | Y | Z | 3 | 2 | t | shall not reach to ITO | | | X | Y | Z | Disregard | 0.2 | t | X | Y | Z | 5 | 2 | t/3 |
| X | Y | Z | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 0.5mm | t/2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X | Y | Z | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 0.5mm | t | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X | Y | Z | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 2 | t | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| shall not reach to ITO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X | Y | Z | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Disregard | 0.2 | t | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X | Y | Z | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 2 | t/3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| No. | Item | Criterion | | | | | | | | |
|----------------------|---|--|------------|----------------|---------------|-----------|----------------------|---|---------------|---|
| 7 | Segment pattern $W = \text{Segment width}$ $\phi = (X+Y)/2$ | (1) Pin hole $\phi < 0.10\text{mm}$ is acceptable.  <table border="1"> <thead> <tr> <th>Point Size</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td>$\phi < 1/4W$</td> <td>Disregard</td> </tr> <tr> <td>$1/4W < \phi < 1/2W$</td> <td>1</td> </tr> <tr> <td>$\phi > 1/2W$</td> <td>0</td> </tr> </tbody> </table> <p style="text-align: right;">Unit: mm</p> | Point Size | Acceptable Qty | $\phi < 1/4W$ | Disregard | $1/4W < \phi < 1/2W$ | 1 | $\phi > 1/2W$ | 0 |
| Point Size | Acceptable Qty | | | | | | | | | |
| $\phi < 1/4W$ | Disregard | | | | | | | | | |
| $1/4W < \phi < 1/2W$ | 1 | | | | | | | | | |
| $\phi > 1/2W$ | 0 | | | | | | | | | |
| 8 | Back-light | (1) The color of backlight should correspond its specification. (2) Not allow flickering | | | | | | | | |
| 9 | Soldering | (1) Not allow heavy dirty and solder ball on PCB. (The size of dirty refer to point and dust defect) (2) Over 50% of lead should be soldered on Land.  | | | | | | | | |
| 10 | Wire | (1) Copper wire should not be rusted (2) Not allow crack on copper wire connection. (3) Not allow reversing the position of the flat cable. (4) Not allow exposed copper wire inside the flat cable. | | | | | | | | |
| 11* | PCB | (1) Not allow screw rust or damage. (2) Not allow missing or wrong putting of component. | | | | | | | | |

| No | Item | Criterion |
|----|--------------------------------|---|
| 12 | Protruded W: Terminal Width |  <p>Acceptable criteria: $Y \leq 0.4$</p> |
| 13 | TAB | <p>1. Position</p>  <p>2. TAB bonding strength test</p>  <p> $P (=F/TAB \text{ bonding width})$ 650gf/cm ,(speed rate: 1mm/min) 5pcs per SOA (shipment) </p> |
| 14 | Total no. of acceptable Defect | <p>A. Zone</p> <p>Maximum 2 minor non-conformities per one unit. Defect distance: each point to be separated over 10mm</p> <p>B. Zone</p> <p>It is acceptable when it is no trouble for quality and assembly in customer's end product.</p> |

11.3 Reliability of LCM

Reliability test condition:

| Item | Condition | Time (hrs) | Assessment |
|----------------------|---|------------|--|
| High temp. Storage | 80°C | 48 | No abnormalities in functions and appearance |
| High temp. Operating | 70°C | 48 | |
| Low temp. Storage | -30°C | 48 | |
| Low temp. Operating | -20°C | 48 | |
| Humidity | 40°C/ 90%RH | 48 | |
| Temp. Cycle | 0°C ← 25°C → 50°C (30 min ← 5 min → 30min) | 10cycles | |

Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (20±8°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light.

12.4 Precaution for using LCD/LCM

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

General Precautions:

1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isopropyl alcohol, ethyl alcohol or trichlorotrifluoroethane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not make any modification on the PCB without consulting LONGTECH
5. 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.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

Static Electricity Precautions:

1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
2. Do not 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.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or

defective insulation of terminals.

4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

Soldering Precautions:

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: $280^{\circ}\text{C}\pm 10^{\circ}\text{C}$
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

Operation Precautions:

1. The viewing angle can be adjusted by varying the LCD driving voltage V_o .
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over 40°C is required, the relative humidity should be kept below 60%, and avoid direct sunlight.

Limited Warranty

LONGTECH LCDs and modules are not consumer products, but may be incorporated by LONGTECH's customers into consumer products or components thereof, LONGTECH does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of LONGTECH is limited to repair or replacement on the terms set forth below. LONGTECH will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between LONGTECH and the customer, LONGTECH will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with LONGTECH general LCD inspection standard . (Copies available on request)
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.