**NEWHAVEN DISPLAY**
INTERNATIONAL

# User's Guide

# NHD-0240BZ-NSW-BTW-P
# LCM

(Liquid Crystal Display Module)
RoHS Compliant

| | |
|---|---|
| **NHD-** | Newhaven Display |
| **0240-** | 2 Lines x 40 Characters |
| **BZ-** | Version Line |
| **N-** | Transmissive |
| **SW-** | Side Lit White LED B/L |
| **B-** | STN-Blue |
| **T-** | 12:00 View |
| **W-** | Wide Temperature (-20 ~ +70c) |

For product support, contact

**Newhaven Display International, LLC**
**2511 Technology Drive, #101**
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September 25, 2007

## DOCUMENT REVISION HISTORY

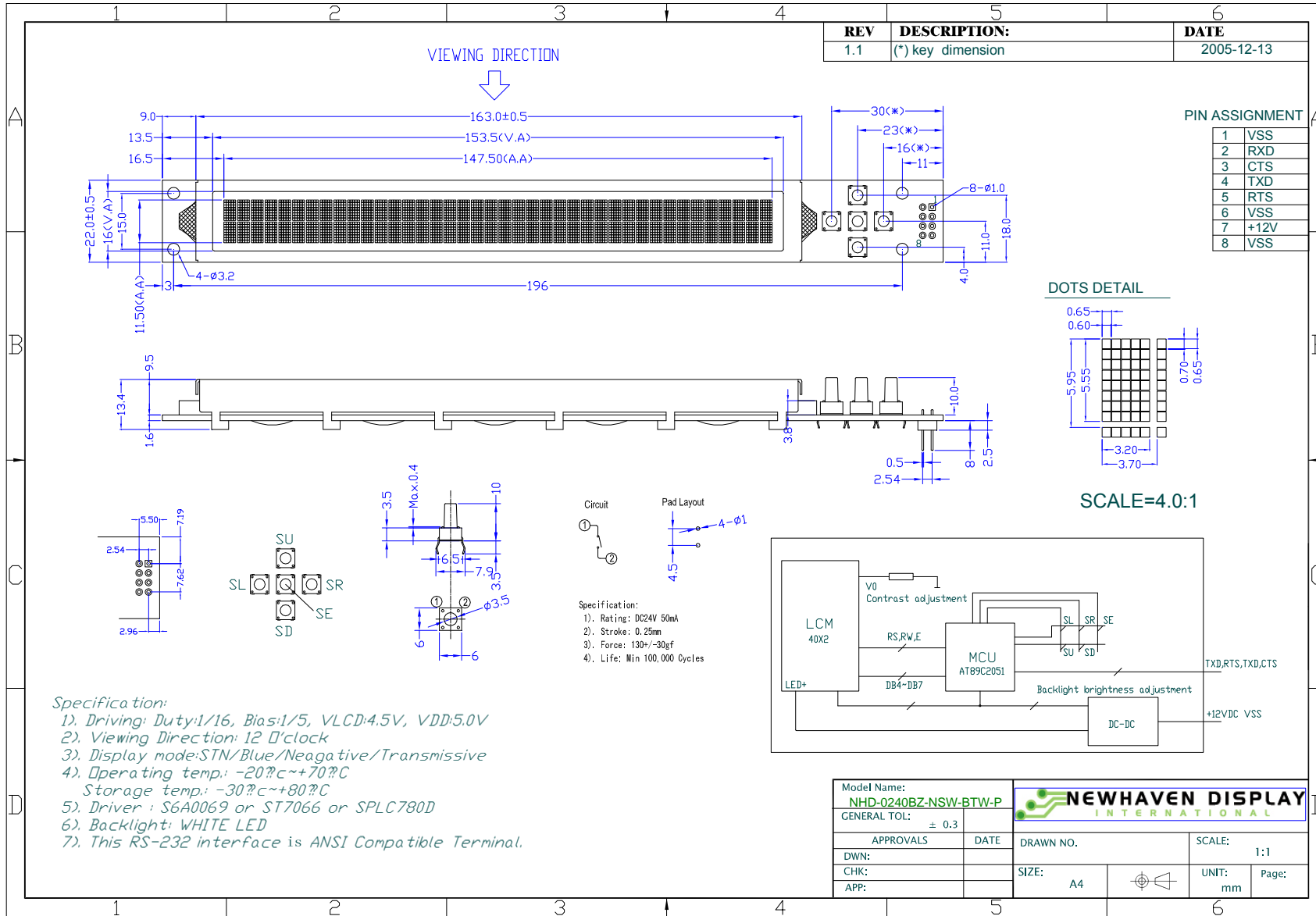| Version | DATE | DESCRIPTION | CHANGED BY |
|:---:|:---:|:---:|:---:|
| 00 | DEC-14-2005 | First issue | |

## CONTENTS

# 1.Features

1. 5x8 dots with cursor
2. Built-in LCD controller & MCU
3. +12V power supply
4. STN Blue display mode 1/16 duty cycle;1/5bias
5. With low power consumption white LED backlight.
6. 40characters *2lines display with cusor
7. with RS232 Interface

| LCD type | ☐FSTN positive | | ☐FSTN Negative | | |
|---|---|---|---|---|---|
| | ☐STN Yellow Green | | ☐STN Gray | | ☑STN-Blue |
| **View direction** | ☐6 O'clock | | ☑12 O'clock | | |
| **Rear Polarizer** | ☐Reflective | | ☐Transflective | | ☑Transmissive |
| **Backlight Type** | ☑LED | ☐EL | ☑Internal Power | | ☐4.2V input |
| | | ☐CCFL | External Power | | ☐13.8 input |
| **Backlight Color** | ☑White | ☐Amber | ☐Blue-Green | | ☐Yellow-Green |
| **Temperature Range** | ☐Normal | | ☑Wide | | ☐Super Wide |
| **DC to DC circuit** | ☐Build-in | | ☑Not Build-in | | |
| **El Driver IC** | ☐Build-in | | ☑Not Build-in | | |
| **Touch screen** | ☐With | | ☑Without | | |
| **Font type** | ☑English-Japanese | | ☐English-Europen | ☐English-Russian | ☐other |

# 2. MECHANICAL SPECIFICATIONS

| | |
|---|---|
| Module size | 210.0mm(L)*22.0mm(W)* Max25.0(H)mm |
| Viewing area | 153.5mm(L)*16.0mm(W) |
| Character size | 3.20mm(L)*5.55mm(W) |
| Character pitch | 3.7mm(L)*5.95mm(W) |
| Weight | Approx. |

# 3.Outline dimension

VIEWING DIRECTION

| REV | DESCRIPTION: | DATE |
|-----|--------------|------|
| 1.1 | (*) key  dimension | 2005-12-13 |

PIN ASSIGNMENT

| 1 | VSS |
|---|-----|
| 2 | RXD |
| 3 | CTS |
| 4 | TXD |
| 5 | RTS |
| 6 | VSS |
| 7 | +12V |
| 8 | VSS |

DOTS DETAIL

SCALE=4.0:1

Circuit    Pad Layout

SU
SL    SR
SE
SD

Specification:
1). Rating: DC24V 50mA
2). Stroke: 0.25mm
3). Force: 130+/-30gf
4). Life: Min 100,000 Cycles

LCM
40X2

V0
Contrast adjustment

RS,RW,E

LED+       DB4~DB7

MCU
AT89C2051

SL  SR  SE
SU  SD

TXD,RTS,TXD,CTS

Backlight brightness adjustment

DC-DC

+12VDC VSS

Specification:
1). Driving: Duty:1/16, Bias:1/5, VLCD:4.5V, VDD:5.0V
2). Viewing Direction: 12 O'clock
3). Display mode:STN/Blue/Neagative/Transmissive
4). Operating temp.: -20℃c~+70℃C
   Storage temp.: -30℃c~+80℃C
5). Driver : S6A0069 or ST7066 or SPLC780D
6). Backlight: WHITE LED
7). This RS-232 interface is ANSI Compatible Terminal.

| Model Name: | | | |
|-------------|---|---|---|
| NHD-0240BZ-NSW-BTW-P | | NEWHAVEN DISPLAY INTERNATIONAL | |
| GENERAL TOL: ± 0.3 | | | |
| APPROVALS | DATE | DRAWN NO. | SCALE: 1:1 |
| DWN: | | | |
| CHK: | | SIZE: A4 | UNIT: mm |
| APP: | | | Page: |

## 4.Absolute maximum ratings

| Item | Symbol | Standard | | | Unit |
|---|---|---|---|---|---|
| Power voltage | $V_{DD}$-$V_{SS}$ | 0 | - | 7.0 | V |
| Input voltage | VIN | VSS | - | VDD | |
| Operating temperature range | VOP | -20 | - | +70 | ℃ |
| Storage temperature range | VST | -30 | - | +80 | |

## 5.Block diagram
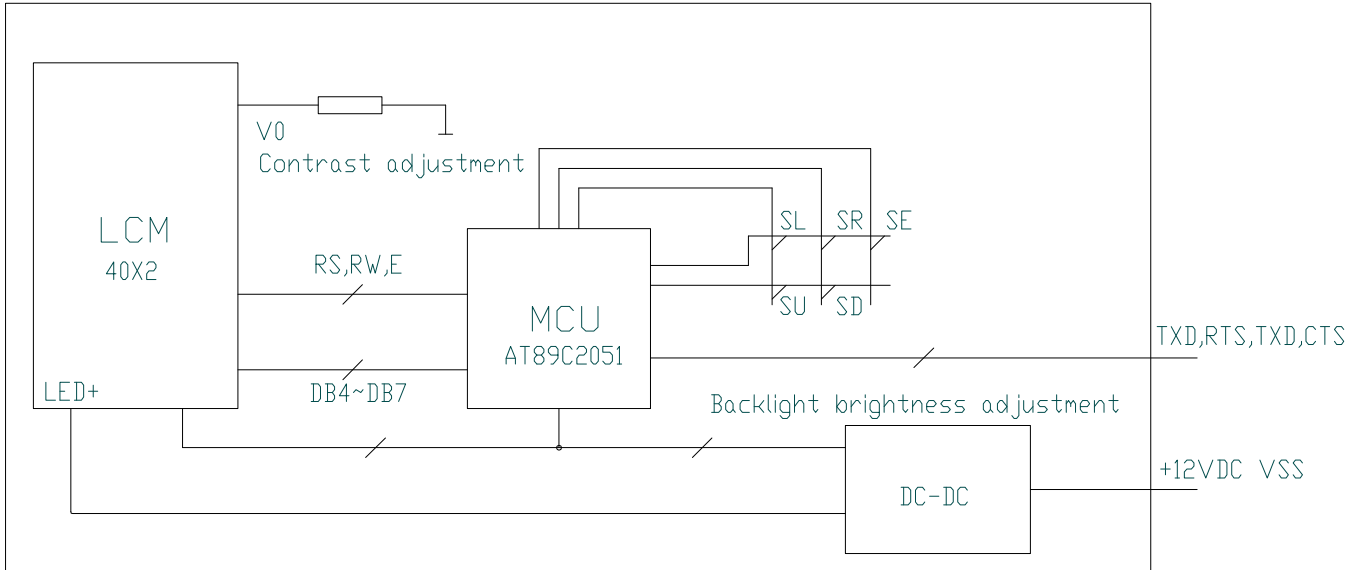


## 6.Interface pin description

| Pin no. | Symbol | External connection | Function |
|---|---|---|---|
| 1 | VSS | Power supply | Power supply GND(0V) |
| 2 | RXT | RS232 interface | Receive data |
| 3 | CTS | | NC |
| 4 | TXD | | Transfer data |
| 5 | RTS | | NC |
| 6 | VSS | Power supply | Power supply GND(0V) |
| 7 | +12V | | Power supply (+12V) |
| 8 | VSS | | Power supply GND(0V) |

# 7.Optical characteristics

TN type display module (Ta=25℃, VDD=5.0V)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Viewing angle | $\theta$ | $C_r{\geqslant}4$ | -25 | - | - | deg |
| | $\Phi$ | | -30 | - | 30 | |
| Contrast ratio | $C_r$ | | - | 2 | - | - |
| Response time (rise) | $T_r$ | - | - | 120 | 150 | ms |
| Response time (fall) | $T_r$ | - | - | 120 | 150 | |

STN type display module (Ta=25℃, VDD=5.0V)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Viewing angle | $\theta$ | $C_r{\geqslant}2$ | -60 | - | 35 | deg |
| | $\Phi$ | | -40 | - | 40 | |
| Contrast ratio | $C_r$ | | - | 6 | - | - |
| Response time (rise) | $T_r$ | - | - | 150 | 250 | ms |
| Response time (fall) | $T_r$ | - | - | 150 | 250 | |

# 8.Electrical characteristics

DC characteristics

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Supply voltage for LCD | $V_{DD}-V_0$ | Ta =25℃ | - | 4.5 | - | V |
| Power Input | $V_{CC}$ | | - | 12.0 | - | |
| Supply current | $I_{CC}$ | Ta=25℃, $V_{DD}$=5.0V | - | 30 | 40 | mA |

# Protocol and Keypad function definition

This ANSI subset protocol should allow the display to be used as a limited ANSI terminal with scrolling. The display consists of 2 lines of 40 characters.

The following ANSI protocol commands shall be supported:

## Backspace (BS)

Value (ASCII 8 decimal / 08 hex) Receipt of this character causes the display to move the cursor one position to the left.

## Horizontal Tab (HT)

Value (ASCII 9 decimal / 09 hex) Receipt of this character causes the display to move the cursor right to the next tab stop.
Moving past the rightmost tab stop causes the cursor to move to the beginning of the following line with display scrolling up
if the cursor was on the last line. There are 4 tab stops per line at positions 4, 8, 12 and 16.

## Line Feed (LF)

Value (ASCII 10 decimal / 0A hex) Receipt of this character causes the display to move the cursor down to the next line in
the same column. The display will scroll up if the cursor was on the last line.

## Vertical Tab (VT)

Value (ASCII 11 decimal / 0B hex) Receipt of this character causes the display to move the cursor down to the next line in
the same column. The display will scroll up if the cursor was on the last line.

## Form Feed (FF)

Value (ASCII 12 decimal / 0C hex) Receipt of this character causes the display to move the cursor down to the next line in
the same column. The display will scroll up if the cursor was on the last line.

## Carriage Return (CR)

Value (ASCII 13 decimal / 0D hex) Receipt of this character causes the display to move the cursor left to the first column on
the current line. There is a User Configuration setting that will automatically add receipt of a Line Feed (LF) character after a
carriage return if required.

## Cancel (CAN)

Value (ASCII 24 decimal / 18 hex) Receipt of this character causes the display to abort any escape sequence that may be in
process. No other action is taken.

## Displayed Characters

Values (ASCII 32 decimal / 20 hex through ASCII 127 decimal / 7F hex) Receipt of these characters cause the display to show the character on the screen at the current cursor location, and then move the cursor right to the next position. There is a User Configuration setting that will automatically wrap the cursor to the beginning of the next line, if required, scrolling up if the cursor was on the last line. The following characters are displayed:

| | Upper Bits | | | | | |
|---|---|---|---|---|---|---|
| Lower Bits | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 0000 | space | 0 | @ | P | ` | p |
| 0001 | ! | 1 | A | Q | a | q |
| 0010 | " | 2 | B | R | b | r |
| 0011 | # | 3 | C | S | c | s |
| 100 | $ | 4 | D | T | d | t |
| 101 | % | 5 | E | U | e | u |
| 110 | & | 6 | F | V | f | v |
| 111 | ' | 7 | G | W | g | w |
| 1000 | ( | 8 | H | X | h | x |
| 1001 | ) | 9 | I | Y | i | y |
| 1010 | * | : | J | Z | j | z |
| 1011 | + | ; | K | [ | k | { |
| 1100 | , | < | L | \ | l | \| |
| 1101 | - | = | M | ] | m | } |
| 1110 | . | > | N | ^ | n | ? |
| 1111 | / | ? | O | _ | o | ? |

## *ANSI Escape Sequences (ESC [ )*

Values (ASCII 33, 91 decimal / 1B, 5B hex) Receipt of this character sequence causes the display to attempt to decode one or more of the following characters as an ANSI control sequence. These sequences can have 1 or 2 parameters that are expressed as decimal numbers separated by a semicolon. The absence of a parameter in a control sequence causes it to assume a default value of zero.

What you have to do is send the "escape code" to the screen. These codes are often several characters long, but they all begin with ^[. This isn't the two characters ^ and [, but rather a representation of the ASCII code ESC (which is why these are called escape codes).

ESC has the value: ^[ and should be sent before the rest of the code, which is simply an ASCII string.

As an example of how to use this information, here's how to clear the screen in C, using the VT100 escape codes:

```
 #define ASCII_ESC 27
```

printf( "%c[2J", ESC );

*or*

puts( "\033[2J" );

## *Reset Display (ESC c)*

Values (ASCII 33, 99 decimal / 1B, 63 hex) Receipt of this character sequence causes the display to clear, the cursor position
to move to the upper left corner and the backlight to turn off.

## *Cursor Up n lines (ESC [ n A)*

Values (ASCII 33, 91, 48-57, 65 decimal / 1B, 5B, 30-39, 41 hex) Receipt of this character sequence causes the display to move the cursor up 'n' lines in the same column. The cursor will not move up past the first line in the display.

# Cursor Up n lines to column 1 (ESC [ n F)

Values (ASCII 33, 91, 48-57, 70 decimal / 1B, 5B, 30-39, 46 hex) Receipt of this character sequence causes the display to
move the cursor up 'n' lines and to the first column. The cursor will not move up past the first line in the display.

# Cursor Down n lines (ESC [ n B)

Values (ASCII 33, 91, 48-57, 66 decimal / 1B, 5B, 30-39, 42 hex) Receipt of this character sequence causes the display to
move the cursor down 'n' lines in the same column. The cursor will not move past the bottom line in the display and the
display will not scroll up.

# Cursor Down n lines to column 1 (ESC [ n E)

Values (ASCII 33, 91, 48-57, 69 decimal / 1B, 5B, 30-39, 45 hex) Receipt of this character sequence causes the display to
move the cursor down 'n' lines and to the first column. The cursor will not move past the bottom line in the display and the
display will not scroll up.

# Cursor Right n characters (ESC [ n C)

Values (ASCII 33, 91, 48-57, 67 decimal / 1B, 5B, 30-39, 43 hex) Receipt of this character sequence causes the display to
move the cursor right 'n' characters on the same line. The cursor will not move past the end of the current line.

# Cursor Left n characters (ESC [ n D)

Values (ASCII 33, 91, 48-57, 68 decimal / 1B, 5B, 30-39, 44 hex) Receipt of this character sequence causes the display to
move the cursor left 'n' characters on the same line. The cursor will not move past the beginning of the current line.

# Move cursor to n (ESC [ n G)

Values (ASCII 33, 91, 48-57, 71 decimal / 1B, 5B, 30-39, 47 hex) Receipt of this character sequence causes the display to move the cursor to column 'n' on the current line. The cursor will not move past the beginning or end of the current line.

# Move cursor to r, c (ESC [ r ; c H)

Values (ASCII 33, 91, [[48-57], 59, [48-57]], 72 decimal / 1B, 5B, [[30-39], 3B, [30-39]], 48 hex) Receipt of this character
sequence causes the display to move the cursor to row 'r', column 'c'. The value for 'r' ranges from 0 – 7, the value for 'c'
ranges from 0 – 20.

# Erase all or part of display (ESC [ n J)

Values (ASCII 33, 91, 48-50, 74 decimal / 1B, 5B, 30-32, 4A hex) Receipt of this character sequence causes part or all of the
display to clear. If 'n' = 0, the display is cleared from the cursor position to the end. If 'n' = 1, the display is cleared from the beginning to the cursor position. If 'n' = 2 the entire display is cleared, and the cursor is moved to the upper left (0, 0).

For example:

    Description          ESC Code

Clear screen from cursor down      ^[[J
Clear screen from cursor down      ^[[0J
Clear screen from cursor up        ^[[1J
Clear entire screen               ^[[2J

# *Erase all or part of line (ESC [ n K)*

Values (ASCII 33, 91, 48-50, 75 decimal / 1B, 5B, 30-32, 4B hex) Receipt of this character sequence causes part or all of the line that the cursor is on to clear. If 'n' = 0, the line is cleared from the cursor position to the end of the line. If 'n' = 1, the line is cleared from the beginning to the cursor position. If 'n' = 2 the entire line is cleared. The position of the cursor is not affected by this command.

For example:

| Description | ESC Code |
|---|---|
| Clear line from cursor right | ^[[K |
| Clear line from cursor right | ^[[0K |
| Clear line from cursor left | ^[[1K |
| Clear entire line | ^[[2K |

# *Save cursor position (ESC [ n s)*

Values (ASCII 33, 91, 114 decimal / 1B, 5B, 73 hex) Receipt of this character sequence causes the display to save the current cursor position.

# *Restore cursor position (ESC [ n u)*

Values (ASCII 33, 91, 116 decimal / 1B, 5B, 75 hex) Receipt of this character sequence causes the display to restore the previously saved cursor position.

# *Enter alternate keypad mode (ESC =)*

Allows the keypad to enter into alternate mode

# *Enter alternate keypad mode (ESC >)*

Exits the keypad from alternate mode

# *Keypad Codes*

These are sent from the LCD display back to the computer when the particular key is pressed. Note that the codes sent in the alternate mode are different codes than in the default mode. See escape codes above to change keypad mode.

| Keypad Key | Default mode (reset) | Alternate (set) |
|---|---|---|
| **UP** (SU in drawing) | **ESC A** (^[A) | **ESC OA** (^[OA) |
| **DOWN** (SD in drawing) | **ESC B** (^[B) | **ESC OB** (^[OB) |
| **RIGHT** (SR in drawing) | **ESC C** (^[C) | **ESC OC** (^[OC) |
| **LEFT** (SL in drawing) | **ESC D** (^[D) | **ESC OD** (^[OD) |
| **ENTER** (SE in drawing) | **^M** | **ESC OM** (^[OM) |

# 10.QUALITY SPECIFICATIONS
## 10.1 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.

Fluorescent
Lamps

$30cm_{min}$        $100cm_{min}$

$45^o$    $45^o$

LCM    LCD
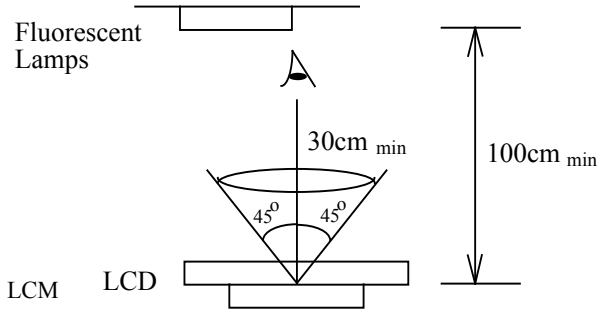
Definition of zone:
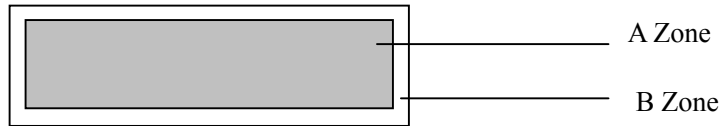
A Zone

B Zone

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

2005-12-14

## 10.2 Specification of quality assurance
AQL inspection standard
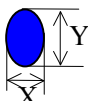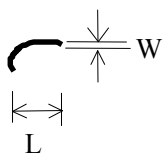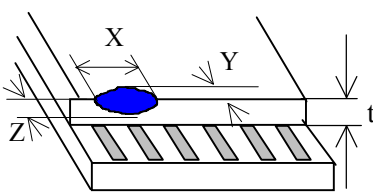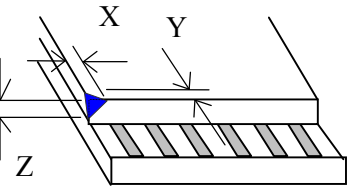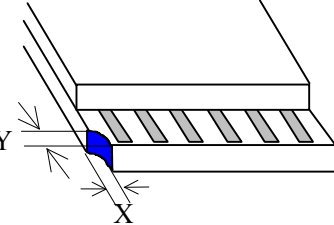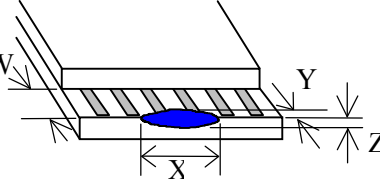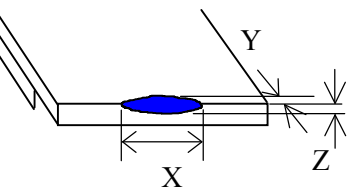
Sampling method: MIL-STD-105E, Level II, single sampling
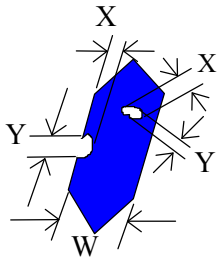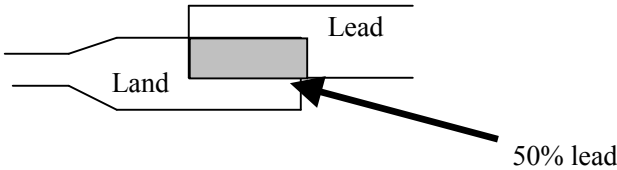
Defect classification   **(Note: * is not including)**
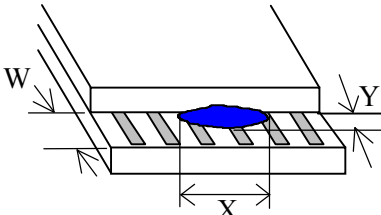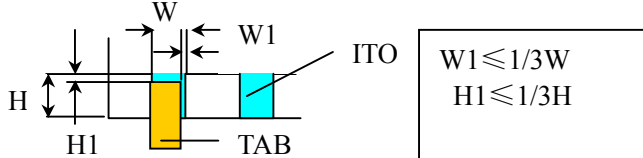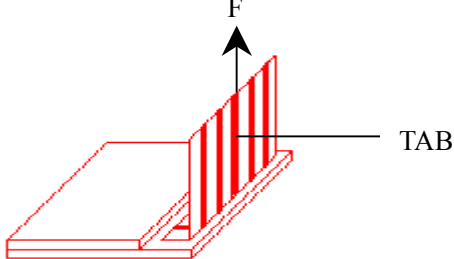
| Classify | | Item | Note | AQL |
|---|---|---|---|---|
| Major | Display state | Short or open circuit | 1 | 0.65 |
| | | LC leakage | | |
| | | Flickering | | |
| | | No display | | |
| | | Wrong viewing direction | | |
| | | Contrast defect (dim, ghost) | 2 | |
| | | Back-light | 1,8 | |
| | Non-display | 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) $\phi = (X+Y)/2$ | |
| 4 | Line defect, Scratch | |
| 5 | Rainbow | Not more than two color changes across the viewing area. |

For No. 3:

| 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 |

Unit: mm

For No. 4:

| Line | | Acceptable Qty. |
|---|---|---|
| L | W | |
| --- | $0.015 \geq W$ | Disregard |
| $3.0 \geq L$ | $0.03 \geq W$ | 2 |
| $2.0 \geq L$ | $0.05 \geq W$ | |
| $1.0 \geq L$ | $0.1 > W$ | 1 |
| --- | $0.05 < W$ | Applied as point defect |

Unit: mm

| No | Item | Criterion |
|----|------|-----------|
| 6 | Chip<br><br>Remark:<br>　X: Length direction<br><br>　Y: Short direction<br><br>　Z: Thickness direction<br><br>　t: Glass thickness<br><br>　W: Terminal Width | <br><br>Acceptable criterion<br><br>| X | Y | Z |<br>|---|---|---|<br>| ≤2 | 0.5mm | ≤t/2 |<br><br><br><br>Acceptable criterion<br><br>| X | Y | Z |<br>|---|---|---|<br>| ≤2 | 0.5mm | ≤t |<br><br><br><br>Acceptable criterion<br><br>| X | Y | Z |<br>|---|---|---|<br>| ≤3 | ≤2 | ≤t |<br>| shall not reach to ITO | | |<br><br><br><br>Acceptable criterion<br><br>| X | Y | Z |<br>|---|---|---|<br>| Disregard | ≤0.2 | ≤t |<br><br><br><br>Acceptable criterion<br><br>| X | Y | Z |<br>|---|---|---|<br>| ≤5 | ≤2 | ≤t/3 | |

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

2005-12-14

| No | Item | Criterion |
|----|------|-----------|
| 12 | Protruded<br><br>W: Terminal Width | Acceptable criteria:<br>$Y \le 0.4$ |
| 13 | TAB | 1. Position<br><br>$W1 \le 1/3W$<br>$H1 \le 1/3H$<br><br>2  TAB bonding strength test<br><br>P (=F/TAB bonding width)  $\geq$650gf/cm ,(speed rate: 1mm/min)<br>5pcs per SOA (shipment) |
| 14 | Total no. of acceptable Defect | A.  Zone<br><br>Maximum 2 minor non-conformities per one unit.<br>Defect distance: each point to be separated over 10mm<br><br>B. Zone<br><br>It is acceptable when it is no trouble for quality and assembly in customer's end product. |

## 10.3 Reliability of LCM
Reliability test condition:

| Item | Condition | Time (hrs) | Assessment |
|------|-----------|------------|------------|
| High temp. Storage | 80°C | 48 | |
| High temp. Operating | 70°C | 48 | |
| Low temp. Storage | -30°C | 48 | No abnormalities in functions and appearance |
| 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.

## 10.4 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 isoproply alcohol, ethyl alcohol or trichlorotriflorothane, 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 NEWHAVEN
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°C±10°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 Vo.
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

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

1. The liability of NEWHAVEN is limited to repair or replacement on the terms set forth below. NEWHAVEN 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 NEWHAVEN and the customer, NEWHAVEN will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with NEWHAVEN 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.