User's Guide

NHD-12232AZ-NSW-BBW-P
LCM

(Liquid Crystal Display Graphic Module)
RoHS Compliant

NHD-	Newhaven Display
12232-	122 x 32 Dots
AZ-	Version Line
N-	Transmissive
SW-	Side White LED B/L
B-	STN-(negative)Blue
B-	6:00 View
W-	Wide Temperature (-20 ~ +70c)
P-	With Pin Connector

For product support, contact

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December 2, 2008

DOCUMENT REVISION HISTORY

Version	DATE	DESCRIPTION	CHANGED BY
00	June-7-07	First issue	
01	OCT-21-08	Modification controller	Qiu

CONTENTS

1. Features

1. 122x32 dots
2. Built-in controller (SBN1661G_M02)
3. +5V power supply
4. 1/32 duty cycle;1/9bias
5. BKL to be driven pin19, pin20

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	□5.0V input
		□CCFL	☑External Power	□3.3 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-European	□English-Russian	□other

2. MECHANICAL SPECIFICATIONS

Module size	83.53mm(L)*27.5mm(W)* Max15.0(H)mm
Viewing area	60.5mm(L)*18.5mm(W)
Dots size	0.40mm(L)*0.45mm(W)
Dots pitch	0.44mm(L)*0.49mm(W)
Weight	Approx.

83.5±0.5
79.5±0.5
72.7±0.5
65.6±0.3
60.5(V.A.)
53.64(A.A.)

15.64(A.A.)

27.5±0.3
21.3±0.3
18.5(V.A.)

122*32 Dots

2   1

2-∅3.0

9±0.3
7.4±0.3

7

0.4

P1.27*=11.43

3

3.43

15.5±0.3
10.5±0.3

1.8

1.27

8.2

62.5

71.7(PCB)

0.49
0.45

0.40
0.44

PIN ASSIGNMENT

| 1	A0
2	CS2
3	CS1
4	CL
5	/RD
6	/WR
7	VSS
8	DB0
9	DB1
10	DB2
11	DB3
12	DB4
13	DB5
14	DB6
15	DB7
16	VDD
17	/RES
18	VEE
19	LED+
20	LED-
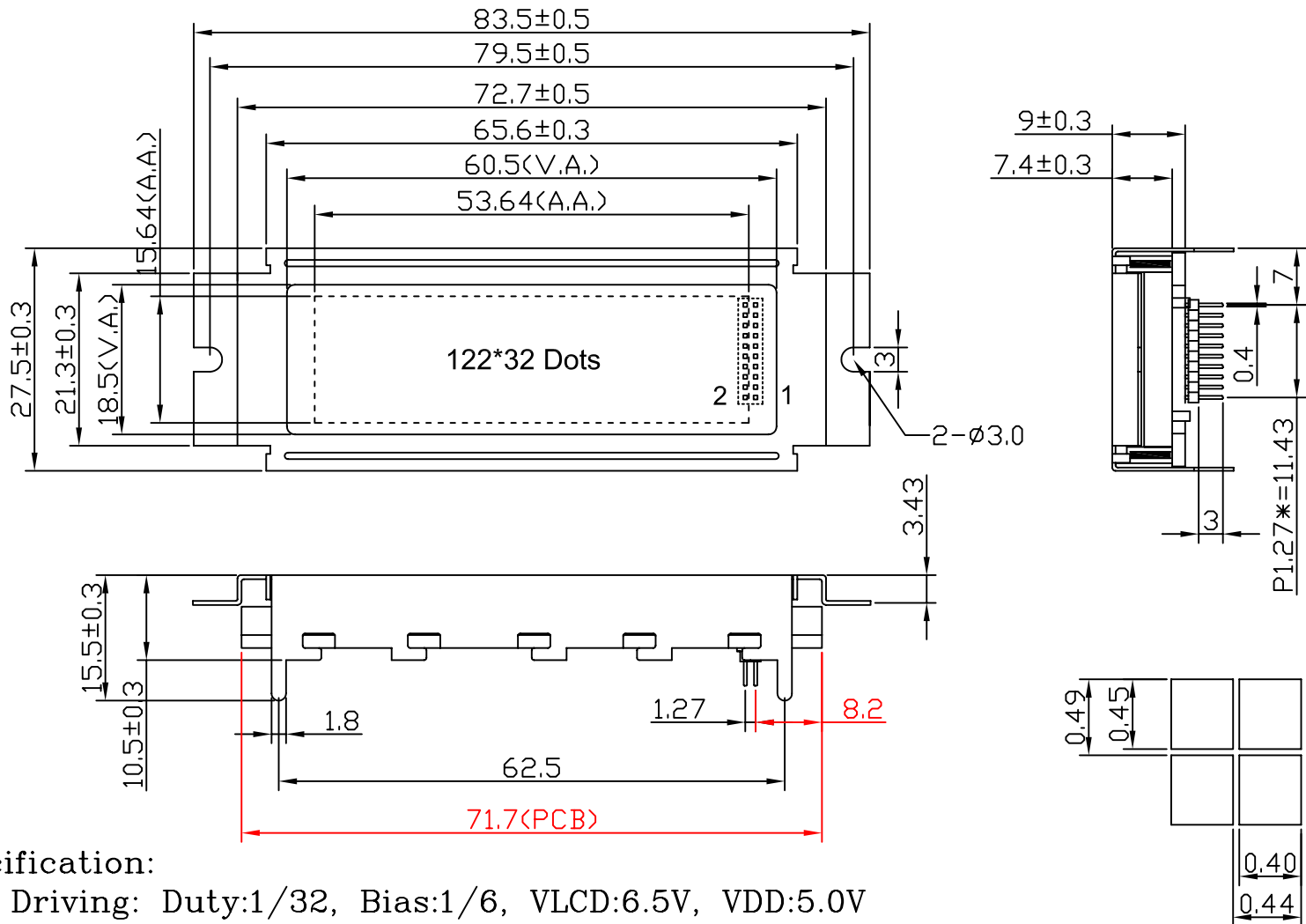
Specification:
  1). Driving: Duty:1/32, Bias:1/6, VLCD:6.5V, VDD:5.0V
  2). Viewing Direction: 12 O'clock
  3). Display mode: STN/Blue/Negative/Transmissive
  4). Operating temp.: −20°c~ +70°C
     Storage temp.: −30°c~ +80°C
  5). Driver : SBN1661G_M02
  6). Backlight: LED Backlight/White

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	

6. Block diagram

VDD-Vo:LCD DRIVING VOLTAGE

VR:10K~20K
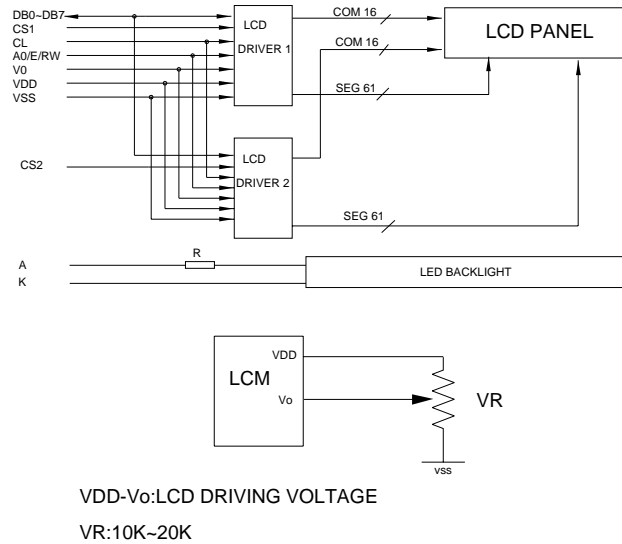
6. Interface pin description

Pin no.	Symbol	External connection	Function
1	A0	MCU	Register select input "0":Instruction register (when writing) Busy flag address counter (When reading) "1":Data register (when writing & reading)
2	CS2	MCU	Chip enable active "L", SEG(1~60)
3	CS1	MCU	Chip enable active "L", SEG(61~120)
4	CL		Input signal effective with a chip using external clocks
5	E	MCU	Chip interfaced with 68 family MPU Enable clock signal input for the 68 family MPU
6	R/W	MCU	Read/write select signal "0" for writing, "1" for reading
7	V_{SS}	Power supply	Signal ground for LCM (GND)
8-15	DB0-DB7	MCU	8–bit, tri-state, bi-directional I/O bus. Normally, connected to the data bus of an 8–/16–bit standard microcomputer.
16	V_{DD}	Power supply	Power supply for logic (+5V) for LCM
17	/RES	MCU	1: Interface with 68 family MPU 0: Interface with 80 family MPU
18	V_{EE}	Power supply	Contrast adjust
19	LED+	Power supply	Power supply for BKL
20	LED-		Power supply for BKL

7. Optical characteristics

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

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing angle		C_r 3	10	-	60	deg
			-45	-	45	
Contrast ratio	C_r		-	5	-	-
Response time (rise)	T_r	-	-	100	150	ms
Response time (fall)	T_r	-	-	150	200	

8. Electrical characteristics

DC characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage for LCD	V_{DD}-V_0	Ta =25	-	6.5	-	V
Input voltage	V_{DD}		4.7	-	5.5	
Supply current	I_{DD}	Ta=25 , V_{DD}=5.0V	-	2	3.0	mA
Input leakage current	I_{LKG}		-	-	1.0	uA
"H" level input voltage	V_{IH}		2.2	-	V_{DD}	
"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	-	-	V
"L" level output voltage	V_{OL}	LOH=1.6mA	-	-	0.4	
Backlight supply voltage	V_F		-	5.0	-	
Backlight supply current	I_F		-	45	-	mA

9. Timing Characteristics

MPU bus read/write 1(80-family MPU)

Item	symbol	Conditions	Min.	Max.	unit
System cycle time	t cyc8	—	1000	—	ns
Address setup time	t aw8	—	20	—	ns
Address hold time	t ah8	—	10	—	ns
Data setup time	t ds8	—	80	—	ns
Data hold time	t dh8	—	10	—	ns
Control pulse width	t cc	—	200	—	ns
RD access time	t cc8	CL=100pf	—	90	ns
Output disable time	t ch8		10	60	ns

MPU bus read/write 2(68-family MPU)

Item	symbol	Conditions	Min.	Max.	unit
System cycle time	t cyc8	—	1000	—	ns
Address setup time	t aw8	—	20	—	ns
Address hold time	t ah8	—	10	—	ns
Data setup time	t ds8	—	80	—	ns
Data hold time	t dh8	—	10	—	ns
Control pulse width	t cc	—	200	—	ns
RD access time	t cc8	CL=100pf	—	90	ns
Output disable time	t ch8		10	60	ns
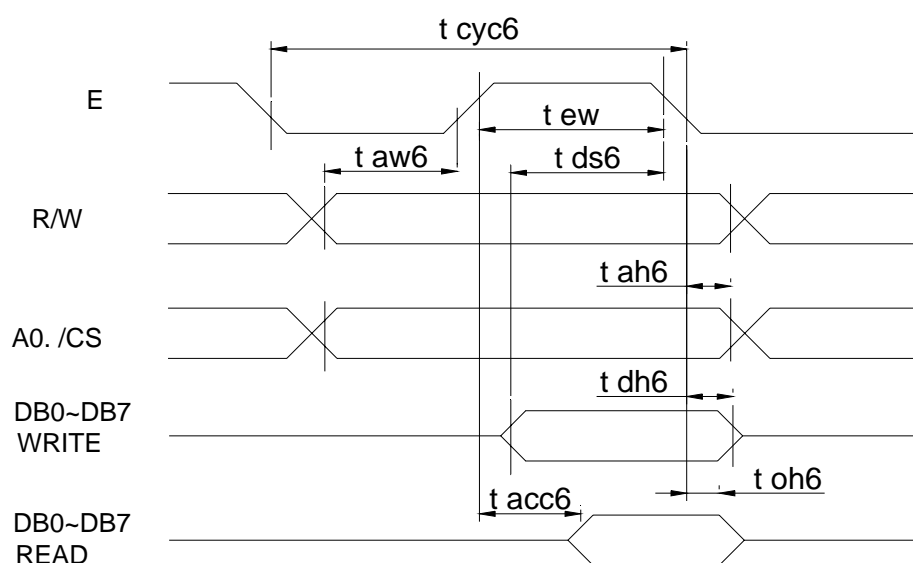
10. Display command

Parameter	A0	E	R/W	D7	D6	D5	D4	D3	D2	D1	D0	Note
Display ON /OFF	0	1	0	1	0	1	0	1	1	1	0/1	Turns display on or off 1: ON ; 0 : OFF
Display start line	0	1	0	1	1	0	Display start address (0 to 31)					Specifies RAM line corresponding to top line of display
Set page address	0	1	0	1	0	1	1	1	0	Page (0 to 3)		Sets display RAM page in page address register
Set column (segment) address	0	1	0	0	Column address (0 to 79)							Sets display RAM column address in column address register
Read status	0	0	1	Busy	ADC	ON/OFF	RESET	0	0	0	0	Reads the following status: BUSY 1: Busy 0: Ready ADC 1: CW output 0: CCW output ON/OFF 1: Display off 0: Display on RESET 1: Being reset 0: Normal
Write display data	1	1	0	Write data								Write data from data bus into display RAM
Read display data	1	0	1	Read data								Read data from display RAM onto data bus
Select ADC	0	1	0	1	0	1	0	0	0	0	0/1	0: CW output 1: CCW output
Static driver ON/OFF	0	1	0	1	0	1	0	0	1	0	0/1	Selects static driving operation. 1: static driver, 0: Normal driving
Select duty	0	1	0	1	0	1	0	1	0	0	0/1	Select LCD duty cycle 1: 1/32, 0: 1/16
Read-modify write	0	1	0	1	1	1	0	0	0	0	0	Read-modify-write ON
End	0	1	0	1	1	1	0	1	1	1	0	Read-modify-write OFF
Reset	0	1	0	1	1	1	0	0	0	1	0	Software reset

Table 3 is the command table. The SBN1661 series identifies a data bus using a combination of A0 and R/W (RD or WR signals. As the MPU translates a command in the internal timing only (independent from the external clock). Its speed is very high. The busy check is usually not required.

Display ON/OFF (AEH, AFH)

A0	E (RD)	R/W (/WR)	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	0	1	1	1	D

The command turns the display on and off
D=1: display ON   D=0: display OFF

Display start line (C0H~DFH)
This command specifies the line address shown if Figure 3 and indicates the display line that corresponds to COM0. the display area begins at the specified line address and continues the line address increment direction. This area having the number of lines of the specified display duty is displayed. If the line address is changed dynamically by this command the vertical smooth scrolling and paging can be used.

A0	E (RD)	R/W (/WR)	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	0	A4	A3	A2	A1	A0

This command loads the display start line register.

A4	A3	A2	A1	A0	Line address
0	0	0	0	0	0
0	0	0	0	1	1
/	/	/	/	/	/
1	1	1	1	1	1F

Set page address (B8H~BBH)
This command specifies the page address that corresponds to the low address of the display data RAM when it is accessed by the MPU. Any bit of the display data RAM can be accessed when its page address and column address are specified. The display status is not changed even when the page address is changed.

A0	E (RD)	R/W (/WR)	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	1	1	0	A1	A0

This command loads the page address register.

A1	A0	Page
0	0	0
0	1	1
1	0	2
1	1	3

Set column address (00H~4FH)
This command specifies a column address of the display data RAM. When the display data RAM is accessed by the MPU continuously, the column address is incremented by 1 each time it is accessed from the set address. Therefore, the MPU can access to data continuously. The column address stops to be incremented at address 80, and the page address is not changed continuously.

A0	E (RD)	R/W (/WR)	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	0	A6	A5	A4	A3	A2	A1	A0

This command loads the column address register.

A6	A5	A4	A3	A2	A1	A0	Column address
0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	1
/	/	/	/	/	/	/	/
1	0	0	1	1	1	1	4F

Read status

A0	E (RD)	R/W (/WR)	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	Busy	ADC	On/off	Reset	A3	A2	A1	A0

Reading the command I/O register (A0=0) yields system status information.
 The busy bit indicates whether the driver will accept a command or not.
 Busy=1: the driver is currently executing a command or is resetting. No new command will be accepted.
 Busy=0: the driver will accept a new command.
 The ADC bit indicates the way column addresses are assigned to segment drivers.
 ADC=1 Normal. Column address n   segment driver n.
 ADC=0 Inverted. Column address 79 u   segment driver u.
 The ON/OFF bit indicates the current status of the display.
 It is the inverse of the polarity of the display ON/OFF command.
 ON/OFF=1: display off
 ON/OFF=0: display on
 The RESET bit indicates whether the driver is executing a hardware or software reset or if it is in normal operating mode.
 Reset=1: currently executing reset command.
 Reset=0: normal operation

Write display data

A0	E (RD)	R/W (/WR)	D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	Write data							

Writes 8-bit of data into the display data RAM, at a location specified by the contents of the column address and page address registers and then increments the column address register by one.

Read display data

A0	E (RD)	R/W (/WR)	D7	D6	D5	D4	D3	D2	D1	D0
1	0	1	Read data							

Reads 8-bit of data from the data I/O latch, updates the contents of the I/O latch with display data from the display data RAM location specified by the contents of the column address and page address registers and then increments the column address register.
After loading a new address into the column address register one dummy read is required before valid data is obtained.

Select ADC (A0H, A1H)

A0	E (RD)	R/W (/WR)	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	0	0	0	0	D

This command selects the relationship between display data RAM column addresses and segment drivers.
    D=1: SEG0   column address 4FH,…(inverted).
    D=0: SEG0   column address 00H,…(normal).
This command is provided to reduce restrictions on the placement of driver ICs and routing of traces during printed circuit board design. See Figure 2 go a table of segments and column addresses for the two values of D.

Static drive ON/OFF (A4H, A5H)

A0	E (RD)	R/W (/WR)	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	0	0	1	0	D

Forces display on and all common outputs to be selected.
D=1:static drive on
D=0:static drive off

Select duty (A8H; A9H)

A0	E (RD)	R/W (/WR)	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	0	1	0	0	D

This command sets the duty cycle of the LCD drive and is only valid for the SBN1661 and SED1522F.it is invalid for the SED1521F, which performs passive operation. The duty cycle of the SED1521F is determined by the externally generated FR signal.

SBN1661

D=: 1/32 duty cycle   1/16 duty cycle

D=: 1/16 duty cycle   1/8 duty cycle

When using the SBN1661, SED1522F0A (having a built-in oscillator) and the SED1521F0A continuously, set the duty as follows:

		SED1521FOA
SBN1661	1/32	1/32
	1/16	1/16
SED1522FOA	1/16	1/32
	1/8	1/16

READ-MODIFY-WRITE (E0H)

A0	E (RD)	R/W (/WR)	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	0	0	0	0

This command defeats column address register auto-increment after data reads. The current contents of the column address register are saved. This mode remains active until an end command is repeated.

Operation sequence during cursor display

When the end command is entered, the column address is returned to the one used during input of read-modify-write command. This function can reduce the load of MPU when data change is repeated at a specific

Display area (such as cursor blinking).

*Any command other than data read or write can be used in the read-modify-write mode. However, the column address set command cannot be used.
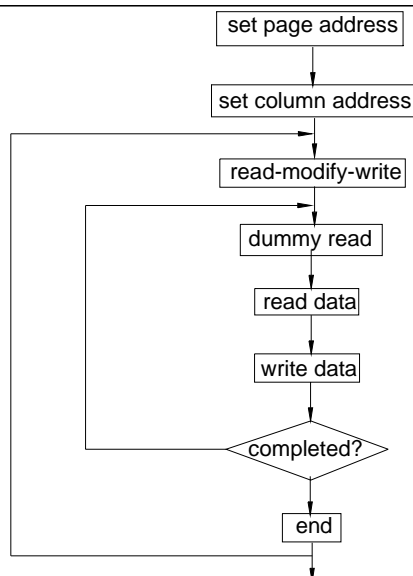
END (EEH)

A0	E (RD)	R/W (/WR)	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	1	1	1	0

This command cancels read-modify-write mode and restores the contents of the column address register to their value prior to the receipt of the read-modify-write command.
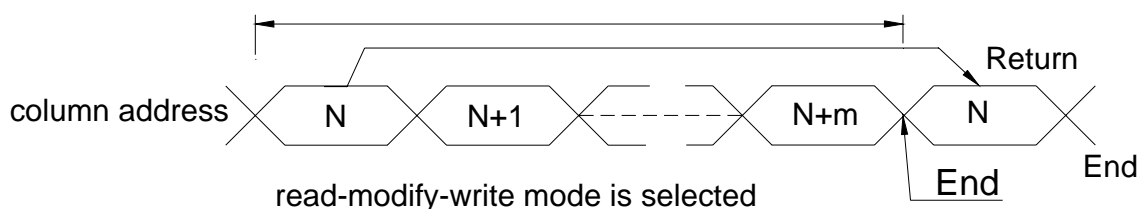
RESET (E2H)

A0	E (RD)	R/W (/WR)	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	1	1	1	0

This command clears
   The display start line register.
   And set page address register to 3 page.
  It does not affect the contents of the display data RAM.
When the power supply is turned on, a Reset signal is entered in the RES pin. The Reset command cannot be used instead of this Reset signal.

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.

Fluorescent Lamps

30cm min   100cm min

45° 45°

LCM   LCD
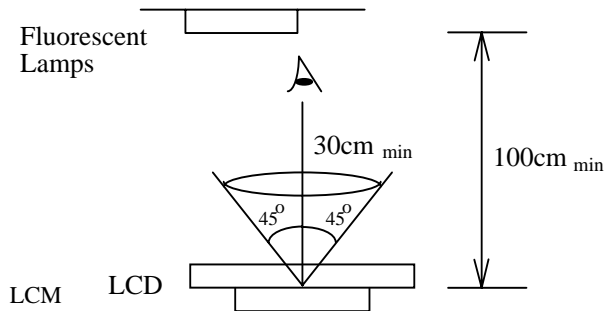
Definition of zone:
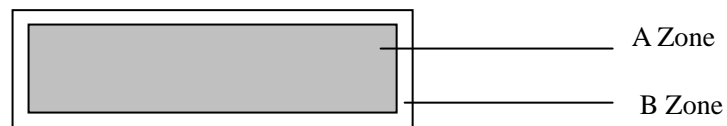
A Zone

B Zone

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

11.2 Specification of quality assurance
AQL inspection standard
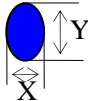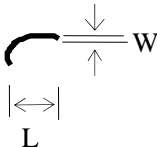
Sampling method: MIL-STD-105E, Level II, single sampling
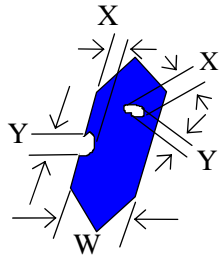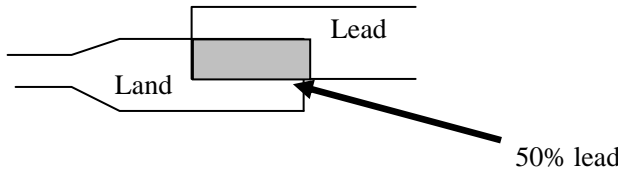
Defect classification   **(Note: * is not including)**
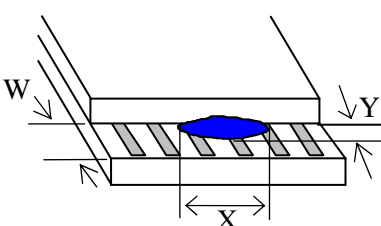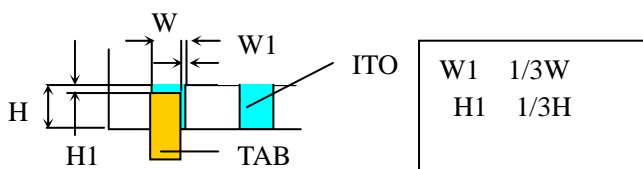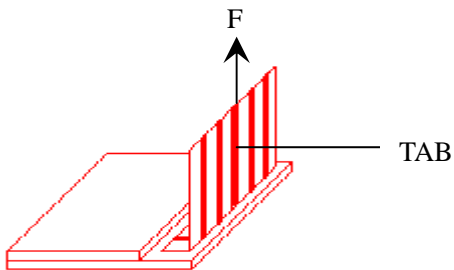
Classify		Item	Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
		Back-light	1,8	
	Non-display	Flat cable or pin reverse	10	
		Wrong or missing component	11	
Minor	Display state	Background 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) $\phi = (X+Y)/2$	 Unit: mm
4	Line defect, Scratch	 Unit: mm
5	Rainbow	Not more than two color changes across the viewing area.

Point defect table:

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

Line defect table:

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

No	Item	Criterion

6	Chip
	
	Remark:
	  X: Length direction
	  Y: Short direction
	  Z: Thickness direction
	  t: Glass thickness
	  W: Terminal Width	

Acceptable criterion

X	Y	Z
2	0.5mm	t/2

Acceptable criterion

X	Y	Z
2	0.5mm	t

Acceptable criterion

X	Y	Z
3	2	t
shall not reach to ITO		

Acceptable criterion

X	Y	Z
Disregard	0.2	t

Acceptable criterion

X	Y	Z
5	2	t/3

No.	Item	Criterion
7	Segment pattern W = Segment width $\phi = (X+Y)/2$	(1) Pin hole ϕ < 0.10mm is acceptable. 	Point Size	Acceptable Qty	 ϕ 1/4W : Disregard 1/4W< ϕ 1/2W : 1 ϕ 1/2W : 0 Unit: mm
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	W, Y, X diagram Acceptable criteria: $Y \leq 0.4$
13	TAB	1. Position W, W1, H, H1, ITO, TAB diagram $W1 \quad 1/3W$ $H1 \quad 1/3H$ 2 TAB bonding strength test F, TAB diagram P (=F/TAB bonding width) 650gf/cm ,(speed rate: 1mm/min) 5pcs per SOA (shipment)
14	Total no. of acceptable Defect	A. Zone Maximum 2 minor non-conformities per one unit. Defect distance: each point to be separated over 10mm B. Zone It is acceptable when it is no trouble for quality and assembly in customer's end product.

11.3 Reliability of LCM

Reliability test condition:

Item	Condition	Time (hrs)	Assessment
High temp. Storage	80°C	48	
High temp. Operating	70°C	48	No abnormalities
Low temp. Storage	-30°C	48	in functions
Low temp. Operating	-20°C	48	and appearance
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$\pm$8°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light.

11.4 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 Display
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: $280°C\pm10°C$
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 Display LCDs and modules are not consumer products, but may be incorporated by Newhaven Display's customers into consumer products or components thereof, Newhaven Display does not warrant that its LCDs and components are fit for any such particular purpose.

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