NEWHAVEN DISPLAY
INTERNATIONAL

User's Guide

NHD-C160100AZ-RN-GBW
LCM

(Liquid Crystal Display Chip-on-Glass Module)
RoHS Compliant

NHD - Newhaven Display
160100- 160 x 100 Pixels
AZ - Version Line
RN - Reflective
N - No B/L
G - STN-Gray
B - 6:00 View
W - Wide Temperature (-10 ~ +60c)

For product support, contact

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November 17, 2008

DOCUMENT REVISION HISTORY

Version	DATE	DESCRIPTION	CHANGED BY
00	OCT-31-2007	First issue	

CONTENTS

1.Features

1. 160X100 dots
2. Built-in controller (ST7528)
3. +3.0V power supply
4. 1/100 duty cycle;1/11 bias

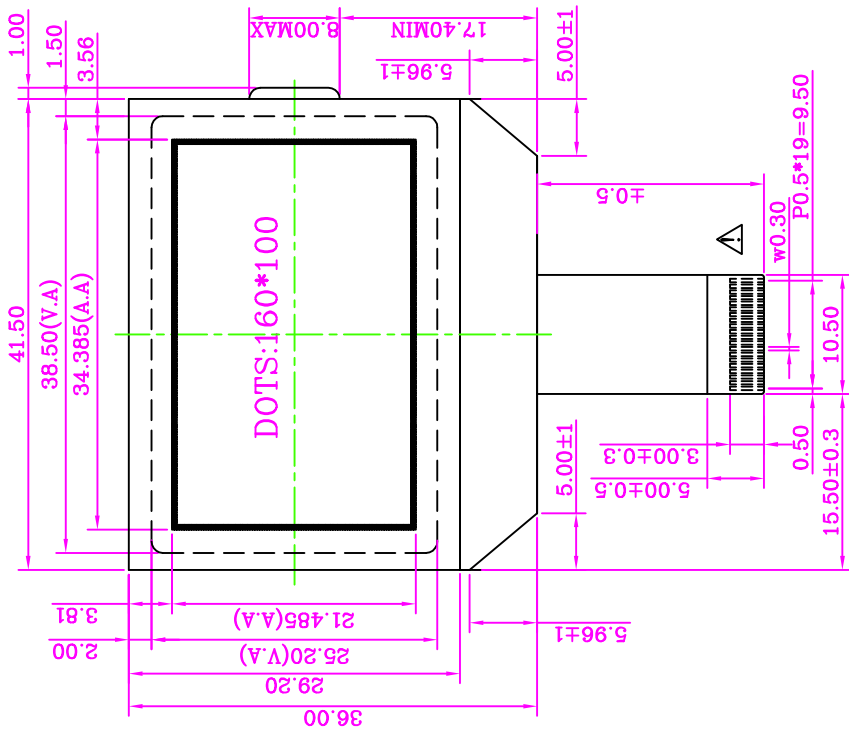| LCD type	☐FSTN positive		☐FSTN Negative	
	☐STN Yellow Green	☑STN Gray		☐STN-Blue
View direction	☑6 O'clock	☐12 O'clock		
Rear Polarizer	☑Reflective	☐Transflective		☐Transmissive
Backlight Type	☐LED	☐EL	☐Internal Power	☐4.2V input
		☐CCFL	☐External Power	☐3.3 input
Backlight Color	☐White	☐Amber	☐Blue-Green	☐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-Europen	☐English-Russian	☑other

2. MECHANICAL SPECIFICATIONS

Module size	36.0mm(L)*41.5mm(W)* Max2.1(H)mm
Viewing area	25.2mm(L)*38.5mm(W)
Dots size	0.2mm(L)*0.2mm(W)
Dots pitch	0.215mm(L)*0.215mm(W)
Weight	Approx.

Newhaven Display

REV	DESCRIPTION:	DATE
1.0	**Modify Pinout and Thickness**	Y.G.X.

PIN ASSIGNMENT

CSB	
RST	
A0	
RW	
E	
DB0	
DB1	
DB2	
DB3	
DB4	
DB5	
DB6	
DB7	
VDD	
VSS	
VOUT	
V4	
V3	
V2	
V1	

DOTS SCALE:1/20

0.215
0.2
0.215
0.2

COM & SEG LAYOUT

SEG0 SEG159
COM99
COM50
COM49
COM0

2.1MAX

FRONT GLASS

IC(ST7528)
TAPE
SILICON
CONDUCT SIDE
STIFFENER
0.3±0.05

3.Outline dimension

DOTS:160*100

1.00
1.50
3.56
41.50
38.50(V.A)
34.385(A.A)
8.00MAX
17.40MIN
5.96±1
5.00±1
±0.5
w0.30
P0.5*19=9.50
10.50
0.50
3.00±0.3
5.00±0.5
5.00±1
15.50±0.3

3.81
2.00
21.485(A.A)
25.20(V.A)
29.20
36.00
5.96±1

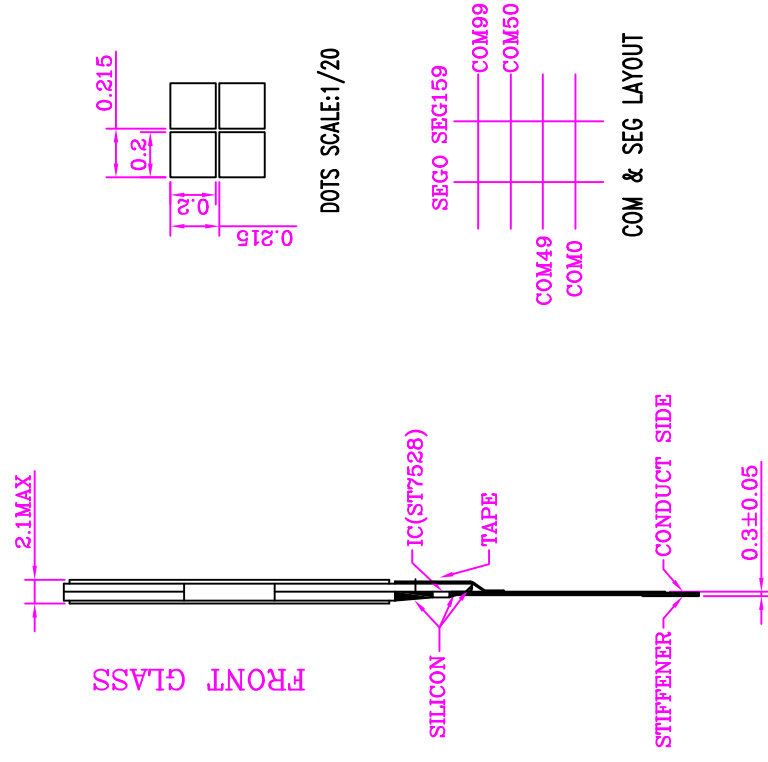**Specification:**
1). Driving: Duty:1/100, 1/11 Bias, Vlcd: 11.5V
2). Viewing Direction: 6 o'clock
3). Display mode: STN/Gray Mode/Positive/Reflective
4). Operating temp.: −10°c~+60°C
   Storage temp.: −20°c~+70°C
5). Driver : ST7528 Vdd:3.0V
6). Unmarked Tolerances: ±0.2mm
7). RoHS Compliant

Model Name:
NHD-C160100AZ-RN-GBW

GENERAL TOL:	± 0.3		
APPROVALS		DATE	
DWN: YE.GUO.XIANG			
CHK:			
APP:			

DRAWN NO.

SIZE: A4

SCALE: 1:1

UNIT: mm

Page: 1-1

4.Absolute maximum ratings

Item	Symbol	Standard			Unit
Power voltage	$V_{DD}-V_{SS}$	0	-	3.3	V
Input voltage	V_{IN}	VSS	-	VDD	
Operating temperature range	V_{OP}	-10	-	+60	℃
Storage temperature range	V_{ST}	-20	-	+70	

5.Interface pin description

Pin no.	Symbol	External connection	Function
1	V1	I/O	LCD driver supply voltages
2	V2		
3	V3		
4	V4		
5	Vout	I/O	Internal voltage generator output
6	VSS	Power Supply	Signal ground for LCM (GND)
7	VDD	Power Supply	Power supply for logic for LCM (+3.0V)
8-15	DB7~BD0	MPU	Standard 8-bit microprocessor data bus
16	E/RD	MPU	Operation enable pin or Read enable
17	RW/WR	MPU	Read/Write select pin or Write enable
18	A0	MPU	Data/Instruction select pin
19	RST	MPU	LCM reset pin
20	CSB	MPU	Chip select pin

6.Optical characteristics

STN type display module (Ta=25℃, VDD=3.0V)

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

7.Electrical characteristics

DC characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage for LCD	V_{lcd}	Ta =25℃	-	11.5	-	V
Input voltage	V_{DD}		-	3.0	-	
Supply current	I_{DD}	Ta=25℃, V_{DD}=3.0V	-	1.5	2.5	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	
Backlight supply voltage	V_F		-	3.0	-	
Backlight supply current	I_{LED}	$V_{F=}$0V				

8. Timing Characteristics
8.1 System bus read/write characteristics 1 (for the 8080 series MPU)
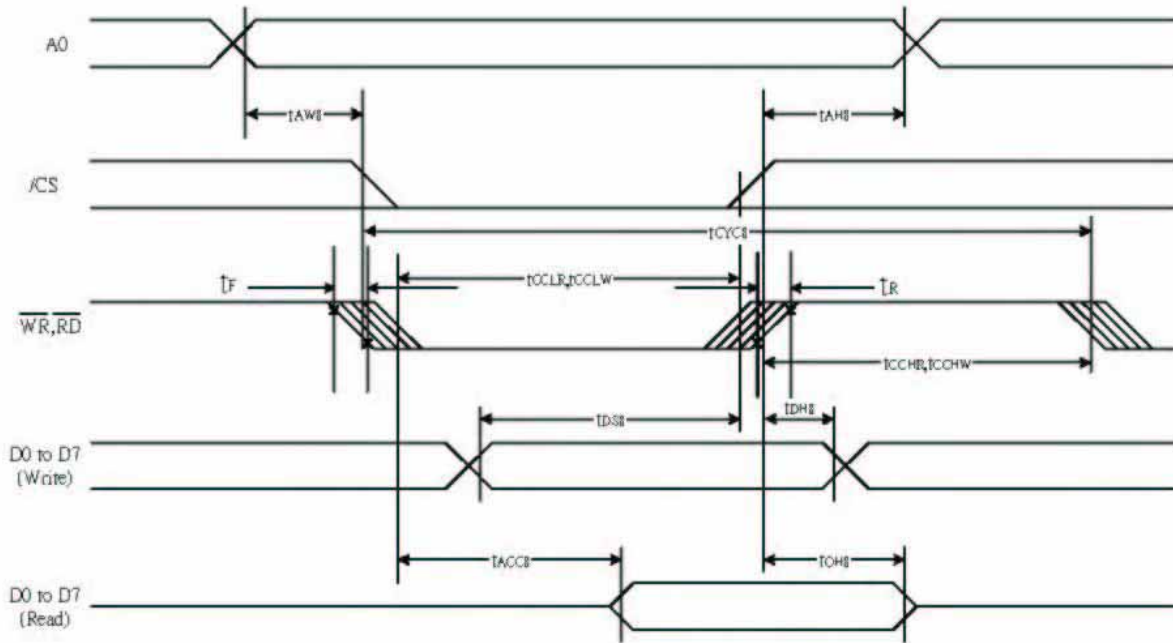
Figure 26.

(VDD = 3.3V , Ta = -30~85°C)

Item	Signal	Symbol	Condition	Rating Min.	Rating Max.	Units
Address hold time	A0	tAH8		0	—	ns
Address setup time	A0	tAW8		0	—	ns
System cycle time		tCYC8		240	—	ns
Enable L pulse width (WRITE)	WR	tCCLW		80	—	ns
Enable H pulse width (WRITE)	WR	tCCHW		80	—	ns
Enable L pulse width (READ)	RD	tCCLR		140	—	ns
Enable H pulse width (READ)	RD	tCCHR		80	—	ns
WRITE Data setup time	D0 to D7	tDS8		40	—	ns
WRITE Data hold time	D0 to D7	tDH8		10	—	ns
READ access time	D0 to D7	tACC8	CL = 100 pF	—	70	ns
READ Output disable time	D0 to D7	tOH8	CL = 100 pF	5	50	ns
tF				—	10	ns
tR				—	10	ns

8.2 System bus read/write characteristics 1 (for the 6800 series MPU)
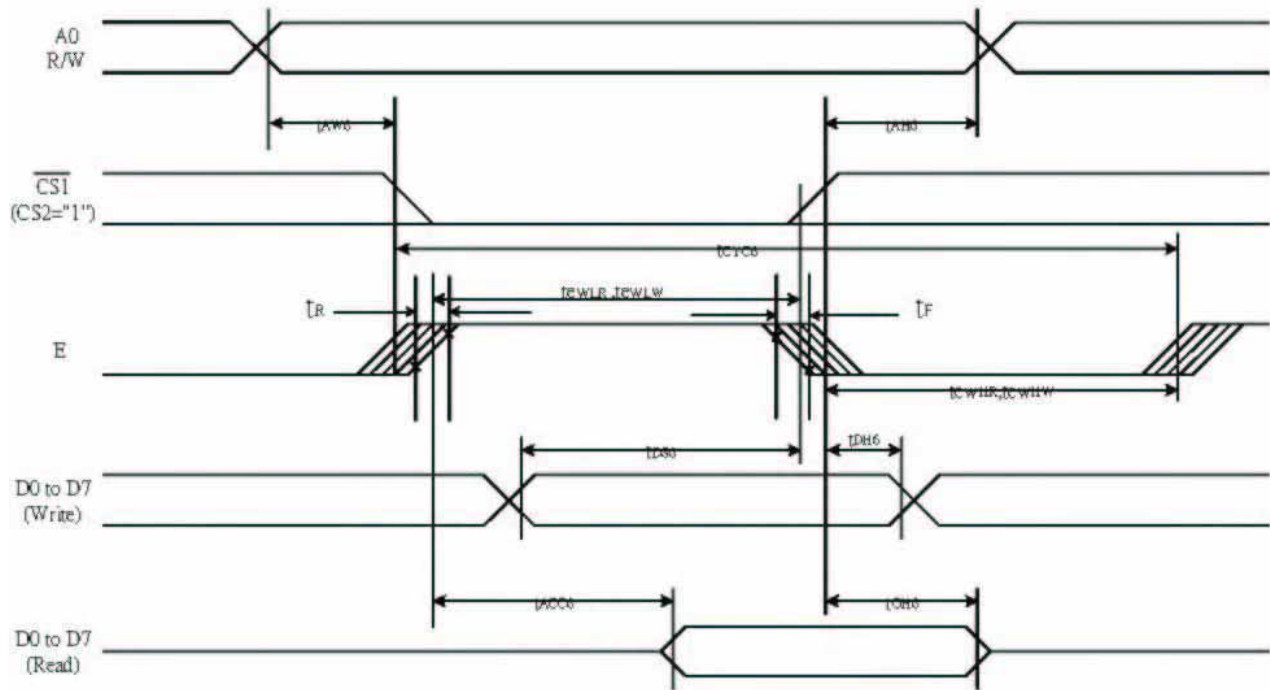
Figure 30

(VDD = 3.3 V, Ta = -30~85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time		tAH6		0	—	
Address setup time	A0	tAW6		0	—	
System cycle time		tCYC6		240	—	
Enable L pulse width (WRITE)	E_WR	tEWLW		80	—	
Enable H pulse width (WRITE)		tEWHW		80	—	
Enable L pulse width (READ)	E_RD	tEWLR		80	—	
Enable H pulse width (READ)		tEWHR		140		ns
WRITE Data setup time		tDS6		40	—	
WRITE Data hold time	D0 to D7	tDH6		10	—	
READ access time		tACC6	CL = 100 pF	—	70	
READ Output disable time		tOH6	CL = 100 pF	5	50	
tF				—	10	
tR				—	10	

10. Table of LCM commands

Instruction	A0	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
EXT=0 or 1											
Mode Set	0	0	0	0	1	1	1	0	0	0	2-byte instruction to set Mode and FR(Frame frequency control) BE(Booster efficiency control)
	0	0	FR3	FR2	FR1	FR0	0	BE	x'	EXT	
EXT=0											
Read display data	1	1				Read data					Read data into DDRAM
Write display data	1	0				Write data					Write data into DDRAM
Read status	0	1	BUSY	ON	RES	MF2	MF1	MF0	DS1	DS0	Read the internal status
ICON control register ON/OFF	0	0	1	0	1	0	0	0	1	ICON	ICON=0: ICON disable(default) ICON=1: ICON enable & set the page address to 16
Set page address	0	0	1	0	1	1	P3	P2	P1	P0	Set page address
Set column address MSB	0	0	0	0	0	1	Y9	Y8	Y7	Y6	Set column address MSB
Set column address LSB	0	0	0	0	0	0	Y5	Y4	Y3	Y2	Set column address LSB
Set modify-read	0	0	1	1	1	0	0	0	0	0	Set modify-read mode
Reset modify-read	0	0	1	1	1	0	1	1	1	0	release modify-read mode
Display ON/OFF	0	0	1	0	1	0	1	1	1	D	D=0: Display OFF D=1: Display ON
Set initial display line register	0	0	0	1	0	0	0	0	x'	x'	2-byte instruction to specify the initial display line to realize vertical scrolling
	0	0	x'	S6	S5	S4	S3	S2	S1	S0	
Set initial COM0 register	0	0	0	1	0	0	0	1	x'	x'	2-byte instruction to specify the initial COM0 to realize window scrolling
	0	0	x'	C6	C5	C4	C3	C2	C1	C0	
Select partial display line	0	0	0	1	0	0	1	0	x'	x'	2-byte instruction to set partial display duty ratio
	0	0	D7	D6	D5	D4	D3	D2	D1	D0	
Set N-line inversion	0	0	0	1	0	0	1	1	x'	x'	2-byte instruction to set N-line inversion register
	0	0	x'	x'	x'	N4	N3	N2	N1	N0	
Release N-line inversion	0	0	1	1	1	0	0	1	0	0	Release N-line inversion mode
Reverse display ON/OFF	0	0	1	0	1	0	0	1	1	REV	REV=0: normal display REV=1: reverse display
Entire display ON/OFF	0	0	1	0	1	0	0	1	0	EON	EON=0: normal display EON=1: entire display ON

Instruction	A0	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
Ext=0											
Power control	0	0	0	0	1	0	1	VC	VR	VF	Control power circuit operation
Select DC-DC step-up	0	0	0	1	1	0	0	1	DC1	DC0	Select the step-up of internal voltage converter
Select regulator register	0	0	0	0	1	0	0	R2	R1	R0	Select the internal resistance ratio of the regulator resistor
Select electronic volumn register	0	0	1	0	0	0	0	0	0	1	2-byte instruction to specify the reference voltage
	0	0	x'	x'	EV5	EV4	EV3	EV2	EV1	EV0	
Select LCD bias	0	0	0	1	0	1	0	B2	B1	B0	Select LCD bias
Set Bias Power Save Mode	0	0	1	1	1	1	0	0	1	1	Bias Power save Save the Bias current consumption
	0	0	0	0	0	0	0	0	0	0	
Release Bias Power Save Mode	0	0	1	1	1	1	0	0	1	1	Bias Power save release set the Bias power to normal
	0	0	0	0	0	0	0	1	0	0	
SHL select	0	0	1	1	0	0	SHL	x'	x'	x'	COM bi-directional selection SHL=0: normal direction SHL=1: reverse direction
ADC select	0	0	1	0	1	0	0	0	0	ADC	SEG bi-direction selection ADC=0: normal direction ADC=1: reverse direction
Oscillator on start	0	0	1	0	1	0	1	0	1	1	Start the built-in oscillator
Set power save mode	0	0	1	0	1	0	1	0	0	P	P=0: normal mode P=1: sleep mode
Release power save mode	0	0	1	1	1	0	0	0	0	1	release power save mode
Reset	0	0	1	1	1	0	0	0	1	0	initial the internal function
Set data direction & display data length(DDL)	x'	x'	1	1	1	0	1	0	0	0	2-byte instruction to specify the number of data bytes (SPI mode)
	x'	x'	D7	D6	D5	D4	D3	D2	D1	D0	
Select FRC and PWM mode	0	0	1	0	0	1	0	FRC	PWM1	PWM0	FRC(1:3FRC, 0:4FRC) PWM1 PWM0 0 0 45PWM 0 1 45 PWM 1 0 60PWM 1 1 ---
NOP	0	0	1	1	1	0	0	0	1	1	No operation
Test Instruction	0	0	1	1	1	1	x'	x'	x'	x'	Don't use this instruction

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
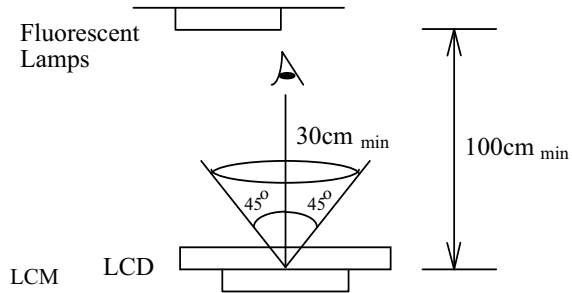
Definition of zone:
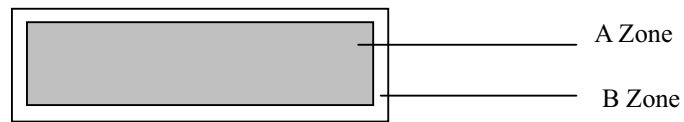
A Zone

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
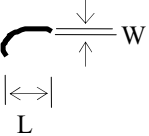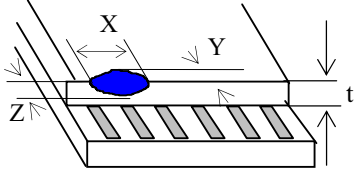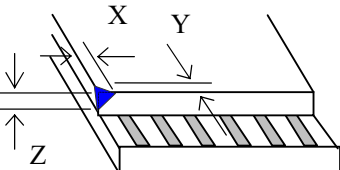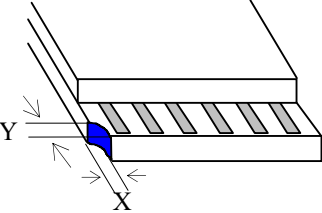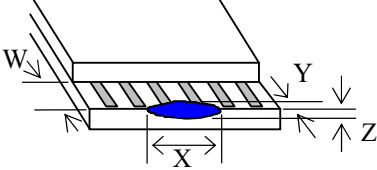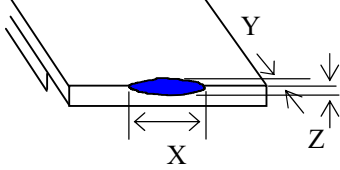
Sampling method: MIL-STD-105E, Level II, single sampling
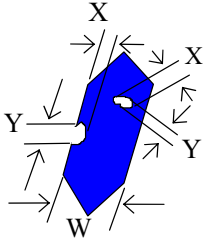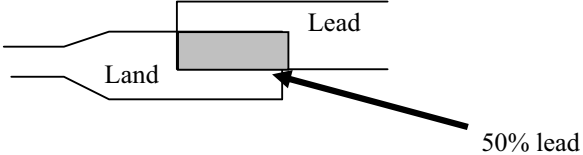
Defect classification   **(Note: * is not including)**
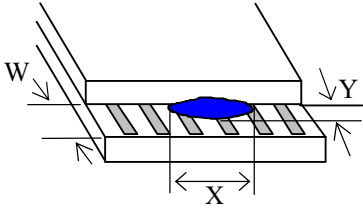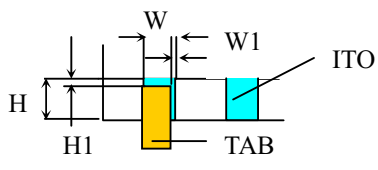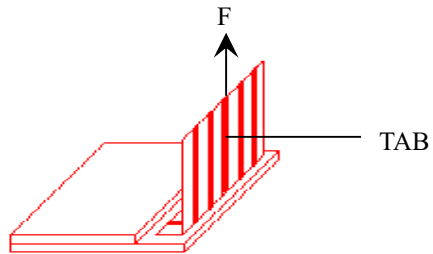
Classify		Item	Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
		Back-light	1,8	
	Non-display	Flat cable or pin reverse	10	
		Wrong or missing component	11	
Minor	Display state	Background color deviation	2	1.0
		Black spot and dust	3	
		Line defect, Scratch	4	
		Rainbow	5	
		Chip	6	
		Pin hole	7	
	Polarizer	Protruded	12	
		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.

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

Unit: mm

Line defect table:

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
	
	Remark:
	   X: Length direction
	   Y: Short direction
	   Z: Thickness direction
	   t: Glass thickness
	   W: Terminal Width
		Acceptable criterion
		
		| X
			Y	Z

---	---	---
$\leqslant 2$	0.5mm	$\leqslant t/2$ | Acceptable criterion | X	Y	Z
---	---	---
$\leqslant 2$	0.5mm	$\leqslant t$ | Acceptable criterion | X	Y	Z
---	---	---
$\leqslant 3$	$\leqslant 2$	$\leqslant t$
shall not reach to ITO		| Acceptable criterion | X	Y	Z
---	---	---
Disregard	$\leqslant 0.2$	$\leqslant t$ | Acceptable criterion | X	Y	Z
---	---	---
$\leqslant 5$	$\leqslant 2$	$\leqslant t/3$	

No.	Item	Criterion
7	Segment pattern W = Segment width $\phi = (X+Y)/2$	(1) Pin hole ϕ < 0.10mm is acceptable. X X Y Y W | Point Size	Acceptable Qty
$\phi \leqslant 1/4W$	Disregard
$1/4W < \phi \leqslant 1/2W$	1
$\phi > 1/2W$	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. Lead Land 50% lead
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	 Acceptable criteria: $Y \le 0.4$
13	TAB	1. Position $W1 \le 1/3W$ $H1 \le 1/3H$ 2 TAB bonding strength test 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	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.

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.
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.