User's Guide

NHD-240128BZ-NSW-BTW

LCM

(Liquid Crystal Display Graphic Module)

RoHS Compliant

NHD-	Newhaven Display
240128-	240 x 128 pixels
BZ-	Version Line
N-	Transmissive
SW-	Side White LED B/L
B-	STN-(negative)Blue
T-	12:00 View
W-	Wide Temperature (-20 ~ +70c)

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CONTENTS

Item	Page
Functions & Features	3
Mechanical specifications	3
Dimensional Outline	4
Absolute maximum ratings	5
Block diagram	5
Pin description	5
Contrast adjust	6
Optical characteristics	6
Electrical characteristics	6
Quality Specifications	7-14
Microprocessor Interface	15-24

1.Features

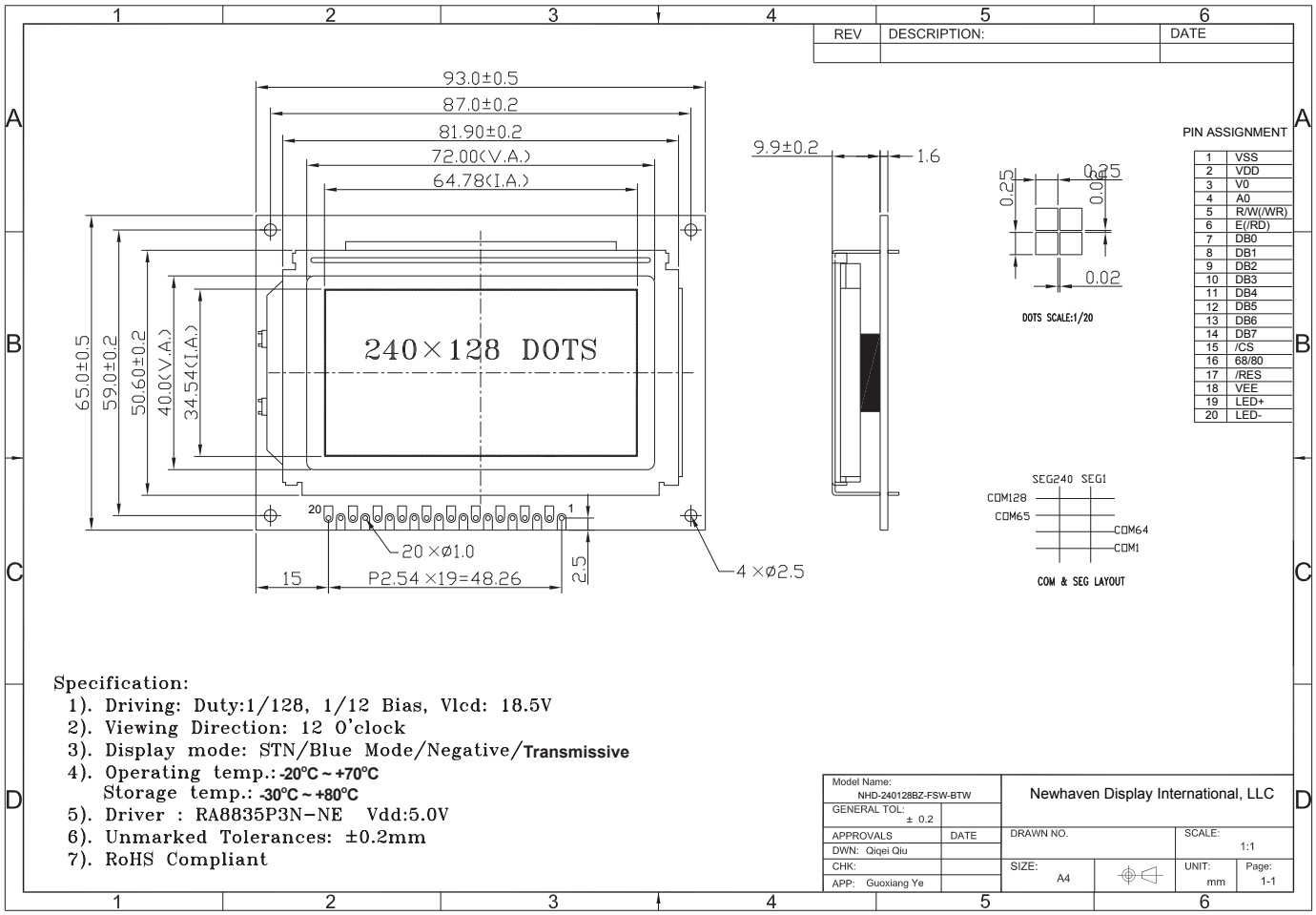
1. 240X128 dots
2. Built-in controller (RA8835P3N)
3. +5V power supply
4. 1/128 duty cycle;1/12bias
5. BKL to be driven by pin9, pin20

LCD type	☐FSTN positive		☐FSTN Negative	
	☐STN Yellow Green	☐STN Gray		☑STN-Blue
View direction	☐6 O'clock	☑12 O'clock		
Rear Polarizer	☐Reflective	☑Transmissive		☐Transflective
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	☑Wide	☐Standard		☐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	93.0mm(L)*65.0mm(W)* Max13.5(H)mm
Viewing area	72.0mm(L)*40.0mm(W)
Dots size	0.25mm(L)*0.25mm(W)
Dots pitch	0.27mm(L)*0.27mm(W)
Weight	Approx.

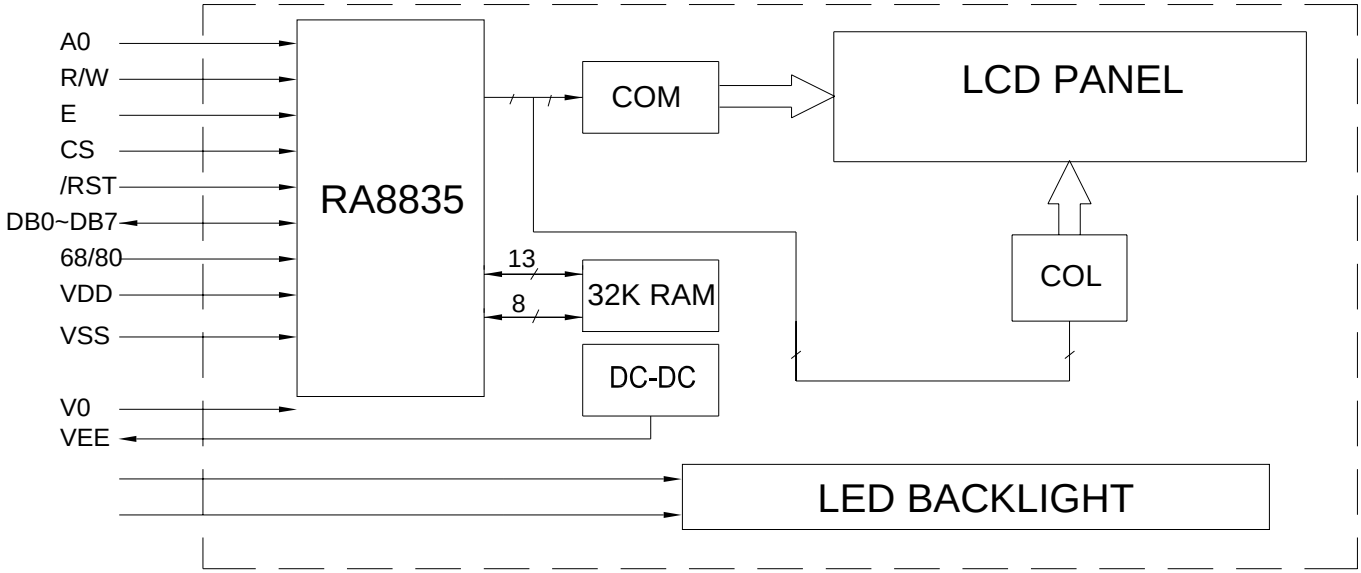
3.**Outline dimension**



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	

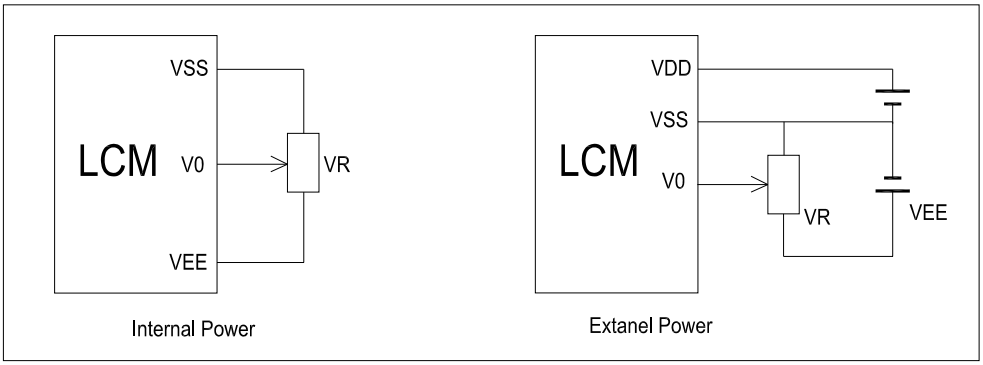
5.Block diagram



6.Interface pin description

Pin no.	Symbol	External connection	Function
1	V_{SS}	Power supply	Signal ground for LCM (GND)
2	V_{DD}		Power supply for logic (+5V) for LCM
3	V_0		Contrast adjust
4	A0	MPU	Register select signal
5	R/W	MPU	Read/write select signal
6	E	MPU	Operation (data read/write) enable signal
7~10	DB0~DB3	MPU	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCM. These four are not used during 4-bit operation.
11~14	DB4~DB7	MPU	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU
15	/CS	MPU	Chip select
16	68/80	MPU	0: 8080 Family 1: 6800 Family
17	/RESET	MPU	Reset signal
18	VEE	OUT	DC-DC OUT
19	LED+	LED BKL power supply	Power supply for BKL
20	LED-		Power supply for BKL

7.Contrast adjust



$V_{0\sim}V_{SS}$: LCD Driving voltage
VR: 10k~20k

8.Optical characteristics

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

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing angle	θ	$C_r \geq 2$	-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	

9.Electrical characteristics

DC characteristics

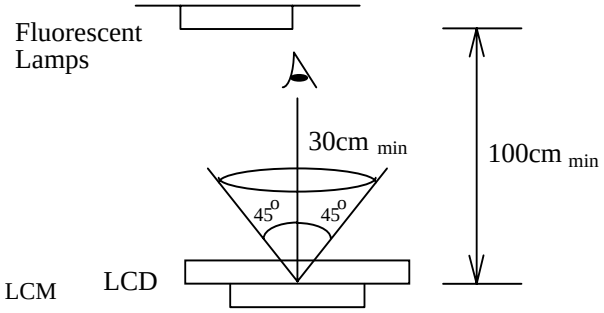
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage for LCD	V_0	Ta =25℃	-	12	-	V
Input voltage	V_{DD}		4.7	5.0	5.5	
Supply current	I_{DD}	Ta=25℃, V_{DD}=5.0V	-	3.5	5.5	mA
Input leakage current	I_{LKG}		-	-	1.0	uA
“H” level input voltage	V_{IH}		2.2	-	V_{DD}	V
“L” level input voltage	V_{IL}	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		-	3.2	-	
Backlight supply current	I_{LED}	V_F=3.2V	-	36	-	mA

10.QUALITY SPECIFICATIONS

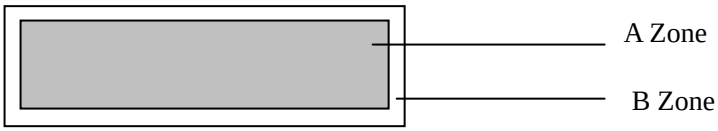
10.1 Standard of the product appearance test

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.



Definition of zone:



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

10.2 Specification of quality assurance

AQL inspection standard

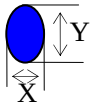
Sampling method: MIL-STD-105E, Level II, single sampling

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

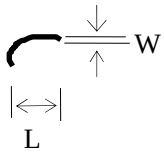
Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
		Back-light	1,8	
	Non-display	Flat cable or pin reverse	10	
		Wrong or missing component	11	
Minor	Display state	Background color deviation	2	1.0
		Black spot and dust	3	
		Line defect, Scratch	4	
		Rainbow	5	
		Chip	6	
		Pin hole	7	
	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

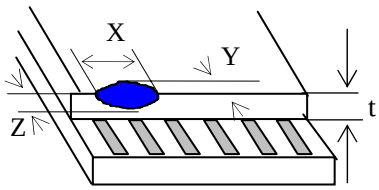
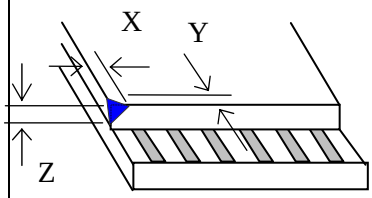
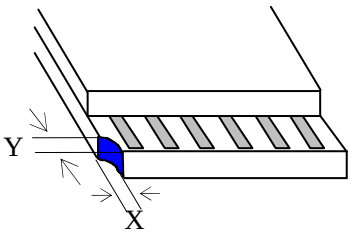
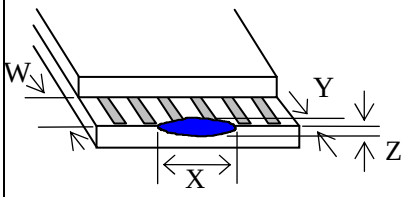
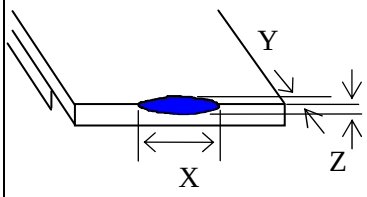
<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td rowspan="6">1</td><td>Short or open circuit</td><td rowspan="6">Not allow</td></tr>
<tr><td>LC leakage</td></tr>
<tr><td>Flickering</td></tr>
<tr><td>No display</td></tr>
<tr><td>Wrong viewing direction</td></tr>
<tr><td>Wrong Back-light</td></tr>
<tr><td rowspan="2">2</td><td>Contrast defect</td><td rowspan="2">Refer to approval sample</td></tr>
<tr><td>Background color deviation</td></tr>
<tr><td>3</td><td>Point defect,
Black spot, dust
(including Polarizer)

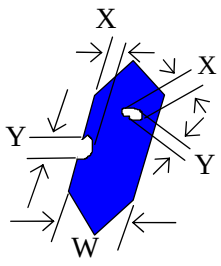
$\phi = (X+Y)/2$</td><td> 

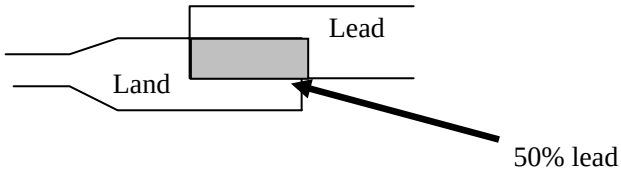
<table>
<tr><th>Point Size</th><th>Acceptable Qty.</th></tr>
<tr><td>$\phi \leq 0.10$</td><td>Disregard</td></tr>
<tr><td>$0.10 < \phi \leq 0.20$</td><td>3</td></tr>
<tr><td>$0.20 < \phi \leq 0.25$</td><td>2</td></tr>
<tr><td>$0.25 < \phi \leq 0.30$</td><td>1</td></tr>
<tr><td>$\phi > 0.30$</td><td>0</td></tr>
</table>
Unit：mm</td></tr>
<tr><td>4</td><td>Line defect,

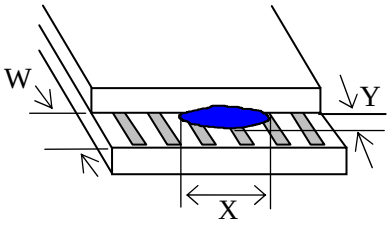
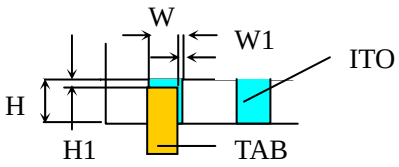
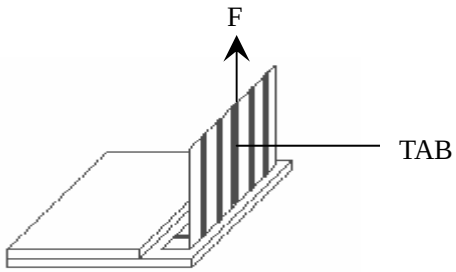
Scratch</td><td> 

<table>
<tr><th colspan="2">Line</th><th>Acceptable Qty.</th></tr>
<tr><td>L</td><td>W</td><td></td></tr>
<tr><td>---</td><td>$0.015 \geq W$</td><td>Disregard</td></tr>
<tr><td>$3.0 \geq L$</td><td>$0.03 \geq W$</td><td rowspan="2">2</td></tr>
<tr><td>$2.0 \geq L$</td><td>$0.05 \geq W$</td></tr>
<tr><td>$1.0 \geq L$</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>
</table>
Unit: mm</td></tr>
<tr><td>5</td><td>Rainbow</td><td>Not more than two color changes across the viewing area.</td></tr>
</table>

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

<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td>7</td><td>Segment
pattern
W = Segment width
ϕ = (X+Y)/2</td><td>(1) Pin hole
ϕ < 0.10mm is acceptable.
 

<table>
<tr><th>Point Size</th><th>Acceptable Qty</th></tr>
<tr><td>ϕ≤1/4W</td><td>Disregard</td></tr>
<tr><td>1/4W< ϕ≤1/2W</td><td>1</td></tr>
<tr><td>ϕ>1/2W</td><td>0</td></tr>
</table>
Unit: mm</td></tr>
<tr><td>8</td><td>Back-light</td><td>(1) The color of backlight should correspond its specification.
(2) Not allow flickering</td></tr>
<tr><td>9</td><td>Soldering</td><td>(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.
 
</td></tr>
<tr><td>10</td><td>Wire</td><td>(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.</td></tr>
<tr><td>11*</td><td>PCB</td><td>(1) Not allow screw rust or damage.
(2) Not allow missing or wrong putting of component.</td></tr>
</table>

No	Item	Criterion
12	Protruded W: Terminal Width	 Acceptable criteria: Y ≤ 0.4
13	TAB	1. Position  W1≤1/3W H1≤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.

10.3 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.

14.4 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.

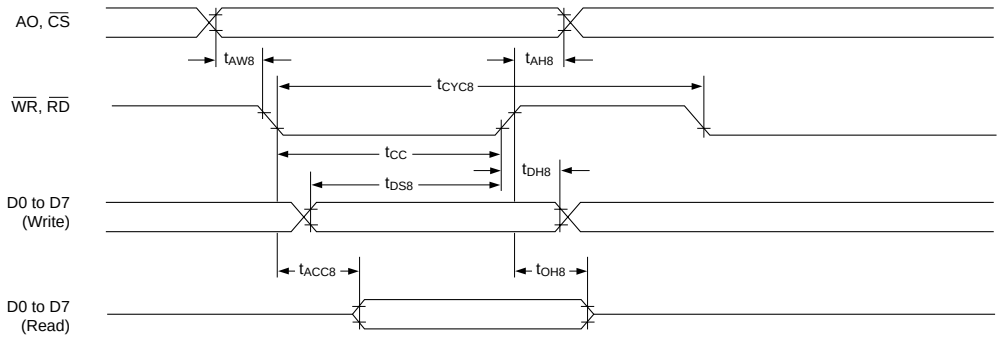
Limited Warranty

Newhaven's 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.

Timing Diagrams

8080 family interface timing



T_a = –20 to 75°C

Signal	Symbol	Parameter	V_{DD} = 4.5 to 5.5V		V_{DD} = 2.7 to 4.5V		Unit	Condition
			min	max	min	max		
A0, $\overline{CS}$	t_{AH8}	Address hold time	10	—	10	—	ns	CL = 100pF
	t_{AW8}	Address setup time	0	—	0	—	ns	
$\overline{WR}$, $\overline{RD}$	t_{CYC8}	System cycle time	See note.	—	See note.	—	ns	
	t_{CC}	Strobe pulsewidth	120	—	150	—	ns	
D0 to D7	t_{DS8}	Data setup time	120	—	120	—	ns	
	t_{DH8}	Data hold time	5	—	5	—	ns	
	t_{ACC8}	$\overline{RD}$ access time	—	50	—	80	ns	
	t_{OH8}	Output disable time	10	50	10	55	ns	

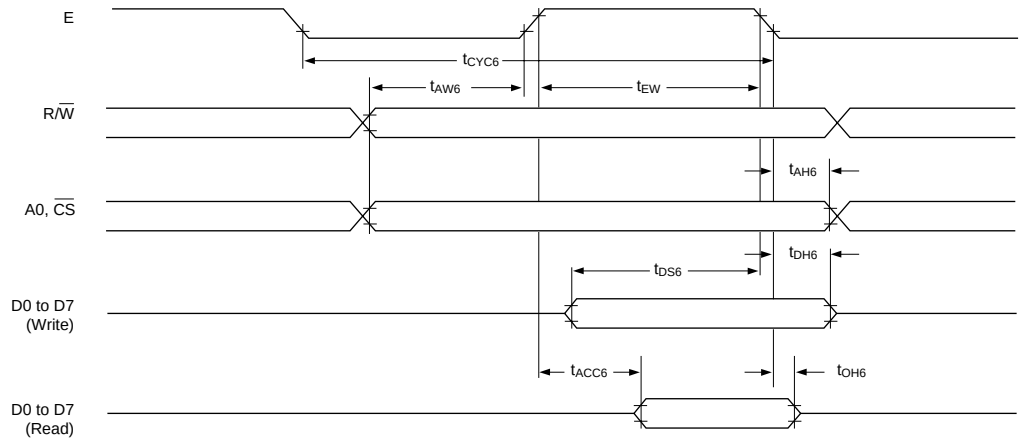
Note: For memory control and system control commands:

$t_{CYC8} = 2t_C + t_{CC} + t_{CEA} + 75 > t_{ACV} + 245$

For all other commands:

$t_{CYC8} = 4t_C + t_{CC} + 30$

6800 family interface timing



Note: t_{CYC6} indicates the interval during which CS is LOW and E is HIGH.

Ta = –20 to 75°C

Signal	Symbol	Parameter	VDD = 4.5 to 5.5V		VDD = 2.7 to 4.5V		Unit	Condition
			min	max	min	max		
A0, CS, R/W	tCYC6	System cycle time	See note.	—	See note.	—	ns	CL = 100 pF
	tAW6	Address setup time	0	—	10	—	ns	
	tAH6	Address hold time	0	—	0	—	ns	
D0 to D7	tDS6	Data setup time	100	—	120	—	ns	
	tDH6	Data hold time	0	—	0	—	ns	
	tOH6	Output disable time	10	50	10	75	ns	
	tACC6	Access time	—	85	—	130	ns	
E	tEW	Enable pulsewidth	120	—	150	—	ns	

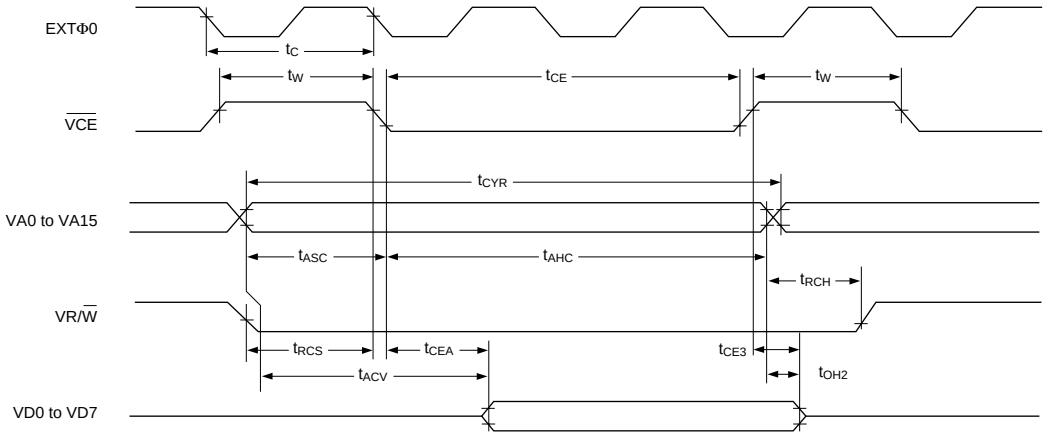
Note: For memory control and system control commands:

$t_{CYC6} = 2t_C + t_{EW} + t_{CEA} + 75 > t_{ACV} + 245$

For all other commands:

$t_{CYC6} = 4t_C + t_{EW} + 30$

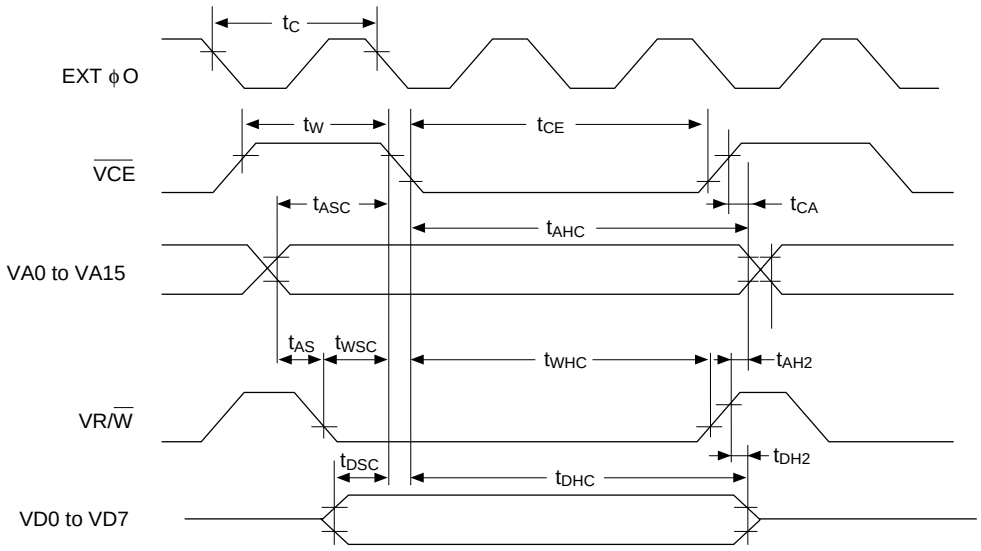
Display memory read timing



Ta = –20 to 75°C

Signal	Symbol	Parameter	VDD = 4.5 to 5.5V		VDD = 2.7 to 4.5V		Unit	Condition
			min	max	min	max		
EXT ϕ0	tC	Clock period	100	—	125	—	ns	CL = 100 pF
VCE	tW	VCE HIGH-level pulsewidth	tC – 50	—	tC – 50	—	ns	
	tCE	VCE LOW-level pulsewidth	2tC – 30	—	2tC – 30	—	ns	
VA0 to VA15	tCYR	Read cycle time	3tC	—	3tC	—	ns	
	tASC	Address setup time to falling edge of VCE	tC – 70	—	tC – 100	—	ns	
	tAHC	Address hold time from falling edge of VCE	2tC – 30	—	2tC – 40	—	ns	
VRD	tRCS	Read cycle setup time to falling edge of VCE	tC – 45	—	tC – 60	—	ns	
	tRCH	Read cycle hold time from rising edge of VCE	0.5tC	—	0.5tC	—	ns	
VD0 to VD7	tACV	Address access time	—	3tC – 100	—	3tC – 115	ns	
	tCEA	VCE access time	—	2tC – 80	—	2tC – 90	ns	
	tOH2	Output data hold time	0	—	0	—	ns	
	tCE3	VCE to data off time	0	—	0	—	ns	

Display memory write timing



INSTRUCTION SET

The Command Set

Table 1. Command set

Class	Command	Code											Hex	Command Description	Command Read Parameters	
		$\overline{RD}$	$\overline{WR}$	A0	D7	D6	D5	D4	D3	D2	D1	D0			No. of Bytes	Section
System control	SYSTEM SET	1	0	1	0	1	0	0	0	0	0	0	40	Initialize device and display	8	8.2.1
	SLEEP IN	1	0	1	0	1	0	1	0	0	1	1	53	Enter standby mode	0	8.2.2
Display control	DISP ON/OFF	1	0	1	0	1	0	1	1	0	0	D	58, 59	Enable and disable display and display flashing	1	8.3.1
	SCROLL	1	0	1	0	1	0	0	0	1	0	0	44	Set display start address and display regions	10	8.3.2
	CSRFORM	1	0	1	0	1	0	1	1	1	0	1	5D	Set cursor type	2	8.3.3
	CGRAM ADR	1	0	1	0	1	0	1	1	1	0	0	5C	Set start address of character generator RAM	2	8.3.6
	CSRDIR	1	0	1	0	1	0	0	1	1	CD 1	CD 0	4C to 4F	Set direction of cursor movement	0	8.3.4
	HDOT SCR	1	0	1	0	1	0	1	1	0	1	0	5A	Set horizontal scroll position	1	8.3.7
	OVLAY	1	0	1	0	1	0	1	1	0	1	1	5B	Set display overlay format	1	8.3.5
Drawing control	CSRW	1	0	1	0	1	0	0	0	1	1	0	46	Set cursor address	2	8.4.1
	CSRR	1	0	1	0	1	0	0	0	1	1	1	47	Read cursor address	2	8.4.2
Memory control	MWRITE	1	0	1	0	1	0	0	0	0	1	0	42	Write to display memory	—	8.5.1
	MREAD	1	0	1	0	1	0	0	0	0	1	1	43	Read from display memory	—	8.5.2

Notes:

1. In general, the internal registers of the SED1335 series are modified as each command parameter is input. However, the microprocessor does not have to set all the parameters of a command and may send a new command before all parameters have been input. The internal registers for the parameters that have been input will have been changed but the remaining parameter registers are unchanged.

   2-byte parameters (where two bytes are treated as 1 data item) are handled as follows:

   a. CSRW, CSRR: Each byte is processed individually. The microprocessor may read or write just the low byte of the cursor address.

   b. SYSTEM SET, SCROLL, CGRAM ADR: Both parameter bytes are processed together. If the command is changed after half of the parameter has been input, the single byte is ignored.

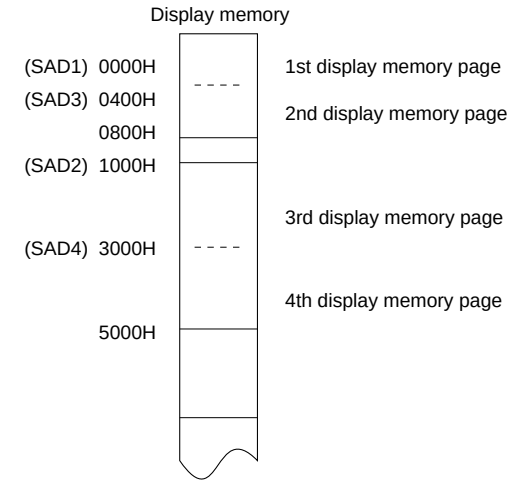
2. APL and APH are 2-byte parameters, but are treated as two 1-byte parameters.

Initialization procedure

No.	Command	Operation
1	Power-up	
2	Supply	
3	SYSTEM SET	
	C = 40H	
	P1 = 38H	M0: Internal CG ROM M1: CG RAM is 32 characters maximum M2: 8 lines per character W/S: Two-panel drive IV: No top-line compensation
	P2 = 87H	FX: Horizontal character size = 8 pixels WF: Two-frame AC drive
	P3 = 07H	FY: Vertical character size = 8 pixels
	P4 = 3FH	C/R: 64 display addresses per line
	P5 = 49H	TC/R: Total address range per line = 90 f_{OSC} = 6.0 MHz, f_{FR} = 70 Hz
	P6 = 7FH	L/F: 128 display lines
	P7 = 80H P8 = 00H	AP: Virtual screen horizontal size is 128 addresses
4	SCROLL	
	C = 44H	
	P1 = 00H P2 = 00H	First screen block start address Set to 0000H
	P3 = 40H	Display lines in first screen block = 64
	P4 = 00H P5 = 10H	Second screen block start address Set to 1000H
	P6 = 40H	Display lines in second screen block = 64
	P7 = 00H P8 = 04H	Third screen block start address Set to 0400H

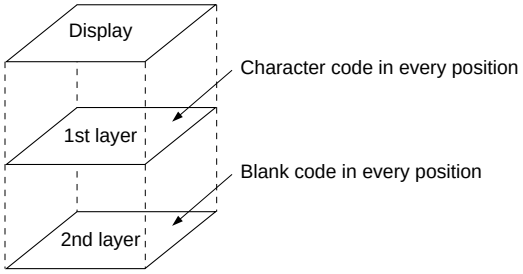
(continued)

Initialization procedure (continued)

No.	Command	Operation
	P9 = 00H	Fourth screen block start address
	P10 = 30H	Set to 3000H
		
5	HDOT SCR	
	C = 5AH	
	P1 = 00H	Set horizontal pixel shift to zero
6	OVLAY	
	C = 5BH	
	P1 = 01H	MX 1, MX 0: Inverse video superposition DM 1: First screen block is text mode DM 2: Third screen block is text mode
7	DISP ON/OFF	
	C = 58H	D: Display OFF
	P1 = 56H	FC1, FC0: Flash cursor at 2 Hz FP1, FP0: First screen block ON FP3, FP2: Second and fourth screen blocks ON FP5, FP4: Third screen block ON
8	Clear data in first layer	Fill first screen layer memory with 20H (space character)

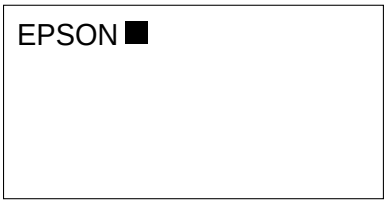
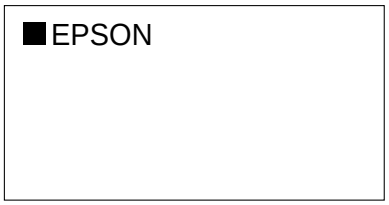
(continued)

Initialization procedure (continued)

No.	Command	Operation
9	Clear data in second layer	Fill second screen layer memory with 00H (blank data) 
10	CSRW C = 46H P1 = 00H P2 = 00H	Set cursor to start of first screen block
11	CSR FORM C = 5DH P1 = 04H P2 = 86H	CRX: Horizontal cursor size = 5 pixels CRY: Vertical cursor size = 7 pixels CM: Block cursor
12	DISP ON/OFF C = 59H	Display ON 
13	CSR DIR C = 4CH	Set cursor shift direction to right

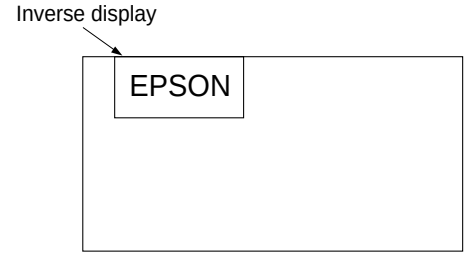
(continued)

Initialization procedure (continued)

No.	Command	Operation
14	MWRITE	
	C = 42H	
	P1 = 20H	‘ ’
	P2 = 45H	‘E’
	P3 = 50H	‘P’
	P4 = 53H	‘S’
	P5 = 4FH	‘O’
	P6 = 4EH	‘N’
		
15	CSRW	
	C = 46H	
	P1 = 00H P2 = 10H	Set cursor to start of second screen block
16	CSR DIR	
	C = 4FH	Set cursor shift direction to down
17	MWRITE	
	C = 42H	
	P1 = FFH ↓ P9 = FFH	Fill in a square to the left of the ‘E’
		
18	CSRW	
	C = 46H	
	P1 = 01H P2 = 10H	Set cursor address to 1001H
19	MWRITE	
	C = 42H	

(continued)

Initialization procedure (continued)

No.	Command	Operation
	P1 = FFH	Fill in the second screen block in the second column of line 1
	↓	
	P9 = FFH	
20	CSRW	Repeat operations 18 and 19 to fill in the background under 'EPSON'
↓		
29	MWRITE	
30	CSRW	
	C = 46H	
	P1 = 00H	Set cursor to line three of the first screen block
	P2 = 01H	
31	CSR DIR	
	C = 4CH	Set cursor shift direction to right
32	MWRITE	
	C = 42H	
	P1 = 44H	'D'
	P2 = 6FH	'o'
	P3 = 74H	't'
	P4 = 20H	' '
	P5 = 4DH	'M'
	P6 = 61H	'a'
	P7 = 74H	't'
	P8 = 72H	'r'
	P9 = 69H	'i'
	P10 = 78H	'x'
	P11 = 20H	' '
	P12 = 4CH	'L'
	P13 = 43H	'C'
	P14 = 44H	'D'