

# User's Guide

## **NHD-0116GZ-NSB-FBW**

# **LCM**

(Liquid Crystal Display Module)

**RoHS Compliant**

- NHD-** Newhaven Display
- 0116-** 1 Lines x 16 Characters
- GZ-** Version Line
- N-** Transmissive
- SB-** Side Blue LED B/L
- F-** FSTN (-)
- B-** 6:00 View
- W-** Wide Temperature (-20 ~ +70c)

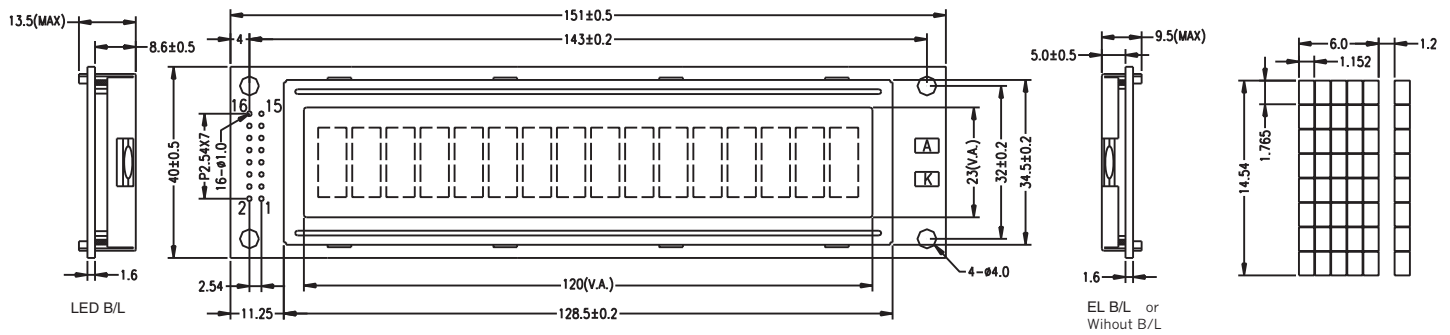
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For product support, contact

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**Outline Dimension**



**Feature**

1. 5x8 dots with cursor
2. Built-in controller (KS0066U or Equivalent)
3. +5V power supply (Also available for +3.0V)
4. 1/16 duty cycle
5. BKL to be driven by pin1, pin2, or pin15, pin16 or A, K
6. N.V. optional

**Interface pin connections**

PIN NO	Symbol	Function
1	VSS □	GND
2	VDD □	+5V
3	V0	Contrast adjustment
4	RS	H/L Register select signal
5	R/W □	H/L Read/Write signal
6	E	H/L Enable signal
7	DB0 □	H/L Data bus line
8	DB1 □	H/L Data bus line
9	DB2 □	H/L Data bus line
10	DB3 □	H/L Data bus line
11	DB4 □	H/L Data bus line
12	DB5 □	H/L Data bus line
13	DB6 □	H/L Data bus line
14	DB7 □	H/L Data bus line
15	A	+4.2V for BKL
16	K	Power supply for BKL(0V)

**Mechanical Data**

Item	Standard	Unit
Module dimension	151.0x40.0	mm
Viewing area	120.0x23.0	mm
Dot size	1.152x1.765	mm
Character size	6.00x14.54	mm

**Absolute Maximum Rating**

Item	Symbol	Standard			Unit
		Min	Typ	Max	
Power supply	VDD-VSS	-0.3	-----	5.5	V
Input voltage	VI	-0.3	-----	VDD	

**Electrical characteristics**

Item	Symbol	Condition	Standard			Unit
			Min	Typ	Max	
Input voltage	VDD	+5V	4.7	5.0	5.5	V
		+3.3V	2.7	3.0	5.3	
Supply current	I <sub>DD</sub>	VDD=5V	-----	2	4	mA
Recommended LCD driving voltage for normal temp version module	VDD-V0	-20°C	-----	-----	-----	
		0 °C	4.7	5.0	5.5	
		25°C	4.3	4.5	4.7	
		50°C	4.1	4.3	4.5	
70°C	-----	-----	-----	-----	-----	
LED forward voltage	V <sub>F</sub>	25°C	-----	4.2	4.6	V
LED forward current	I <sub>F</sub>	25°C	-----	300	-----	mA
EL power supply current	I <sub>EL</sub>	V <sub>EL</sub> =110V AC 400Hz	-----	-----	-----	mA

**Display character address code:**

Display position  
 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16  
 DDRAM address 00 01 02 --- --- --- 40 41 42 --- --- --- 47H

## Absolute Maximum Ratings

Item	Symbol	Min	Max	Unit
Power Voltage	$V_{DD} - V_{SS}$	0	7.0	V
Input Voltage	$V_{in}$	$V_{SS}$	$V_{DD}$	
Operating Temperature Range	$T_{OP}$	-20	+70	°C
Storage Temperature Range	$T_{ST}$	-30	+80	

\*Wide Temperature range is available (operating/storage temperature as wide as -20 ~ +70/-30 ~ +80°C).

LED ratings (BLUE) (UAK = 3.1V, TA = 25 °C)

Item	Symbol	Min	Typ.	Max	Unit
Forward Voltage	$V_{AK}$	2.9	3.1	3.3	V
Forward current	IF	-	20	30	mA
Power	P			100	mW
Peak wave length	$\lambda_p$	465		470	nm
Luminance	$L_v$		60		Cd/m <sup>2</sup>

## Description Of Terminals

Pin No.	Pin Name	Input/ Output	External Connection	Function
1	VSS	—	Power Supply	VSS:GND
2	VDD	—		VDD: +5V
3	VO	—		$V_{LCD}$ adjustment
4	RS	INPUT	MPU	Register select signal "0":Instruction register (when writing) Busy flag & address counter (When reading) "1":Data register (when writing & reading)
5	R/W	Input	MPU	Read/write select signal "0" for writing , "1" for reading
6	E	Input	MPU	Operation (data read/write) enable signal
7 / 10	DB0-DB3	Input	MPU	Low-order lines of data bus with 3-state, bi-directional function for use in data transaction with the MPU. These lines are not used when interfacing with a 4-bit microprocessor.
11 / 14	DB4-DB7	Input	MPU	High-order lines of data bus with 3-state, bi-directional function for use in data transactions with the MPU. DB7 may also be used to check the busy flag.
15 / 16	LED " +" LED " -"	Input	LED BACKLIGHT POWER SUPPLY	LED " +" VOLTAGE TYPE:4.2V MAX : 4.5V LED " -" : GND

## Optical Characteristics

for TN Type Display Module ( $T_a=25^{\circ}\text{C}$ ,  $V_{DD}=5.0\text{V}\pm 0.25\text{V}$ )

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing angle	$\theta$	$C_r \geq 4$	-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	ms

for STN Type Display Module ( $T_a=25^{\circ}\text{C}$ ,  $V_{DD}=5.0\text{V}\pm 0.25\text{V}$ )

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

## Electrical Characteristics

### DC Characteristics

Parameter	Symbol	Conditions	Min.	Type	Max.	Unit
Supply voltage for LCD	$V_{DD} - V_O$	$T_A=25^{\circ}\text{C}$	—	4.6	—	V
Input voltage	$V_{DD}$		4.7	—	5.5	V
Supply current	$I_{DD}$	$V_{DD}=5.0\text{V}; T_A=25^{\circ}\text{C}$	—	1.5	2.5	mA
Input leakage current	$I_{LKG}$		—	—	1.0	$\mu\text{A}$
"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	V
"H" level output voltage	$V_{OH}$	LOH= -0.25MA	2.4	—	—	V
"L" level output voltage	$V_{OL}$	LOL=1.6MA	—	—	0.4	V

## AC Characteristics

Read Cycle ( $V_{DD}=5.0V+10\%$ ,  $V_{SS}=0V$ ,  $T_a=25^\circ C$ )

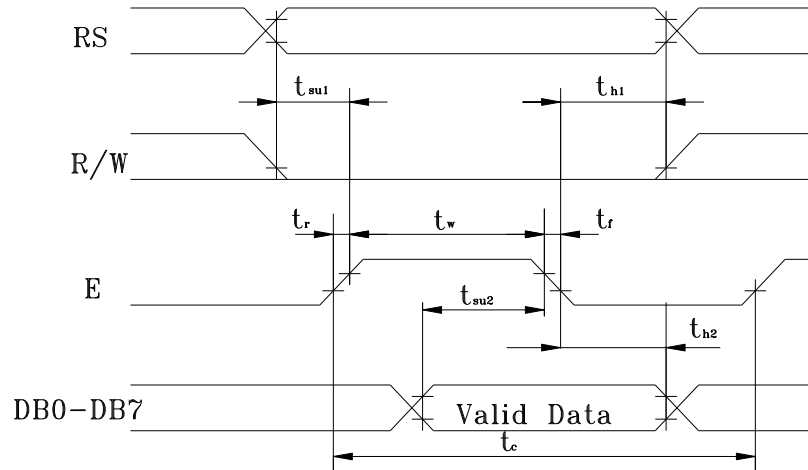
Parameter	Symbol	Test pin	Min.	Type	Max.	Unit
Enable cycle time	$t_c$	E	500	-	-	ns
Enable pulse width	$t_w$	E	300	-	-	
Enable rise/fall time	$t_r, t_f$	E	-	-	25	
RS,R/W setup time	$t_{su}$	RS; R/W	100	-	-	
RS,R/W address hold time	$t_h$	RS; R/W	10	-	-	
Read data output delay	$t_D$	DB0-DB7	60	-	190	
Read data hold time	$t_{DH}$	DB0-DB7	20	-	-	

## Write Cycle

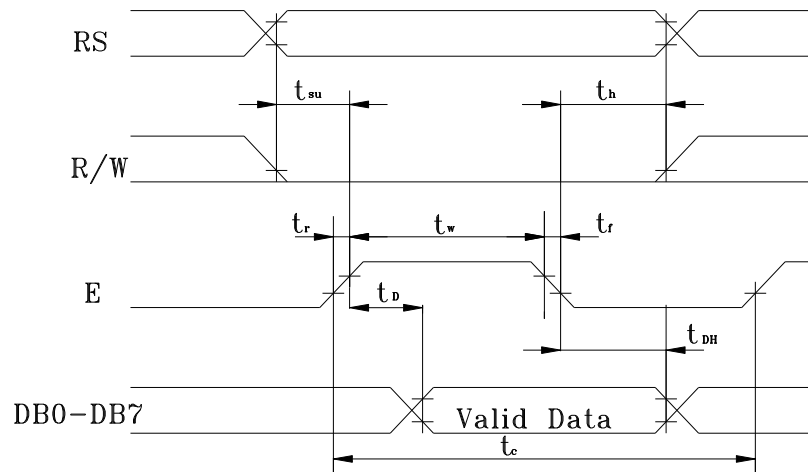
Parameter	Symbol	Test pin	Min.	Type	Max.	Unit
Enable cycle time	$t_c$	E	500	-	-	ns
Enable pulse width	$t_w$	E	300	-	-	
Enable rise/fall time	$t_r, t_f$	E	-	-	25	
RS,R/W setup time	$t_{su1}$	RS; R/W	100	-	-	
RS,R/W address hold time	$t_{h1}$	RS; R/W	10	-	-	
Data setup time	$t_{su2}$	DB0-DB7	60	-	-	
Data hold time	$t_{h2}$	DB0-DB7	10	-	-	

## Timing Characteristics

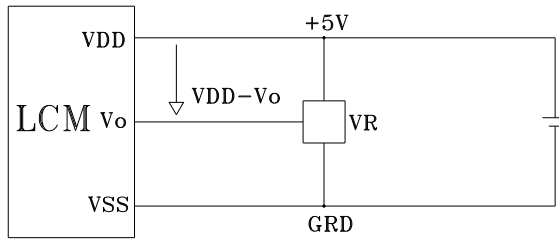
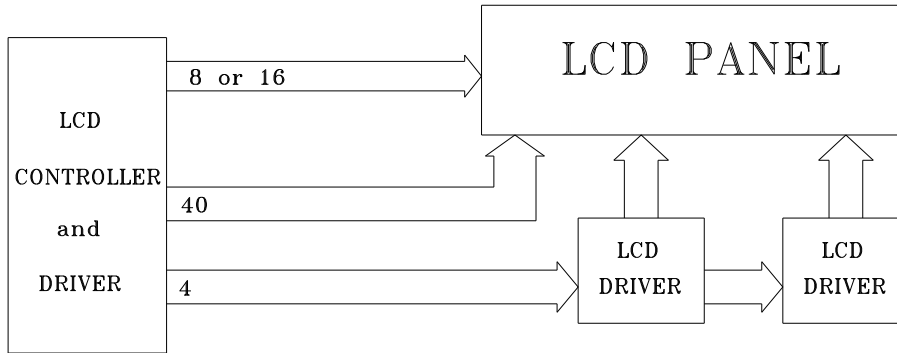
### Write Timing



### Read Timing



# Block Diagram



VDD-Vo: LCD DRIVING VOLTAGE

VR: 10K-20K $\Omega$

## Display Command

Parameter	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Note	Executing time fosc=250kHz
Clear Display	0	0	0	0	0	0	0	0	0	1		1.64ms
Cursor home	0	0	0	0	0	0	0	0	1	*		1.64ms
Entry Mode Set	0	0	0	0	0	0	0	1	1/D	S	DB1=1:Increment DB1=0:Decrement DB0=1:The display is shifted DB0=0:The display is not shifted	40μ s
Display on/off	0	0	0	0	0	0	1	D	C	B	DB2=1:Display on DB2=0: Display off DB1=1:Cursor on DB1=0: Cursor off DB0=1:Brinking on DB0=0:Brinking off	40μ s
Cursor / Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	DB3=1:Shifts display one character DB2=1:Right shift DB2=0:Left shift	40μ s
System Set	0	0	0	0	1	DL	N	F	*	*	DB4=1:8 bits DB4=0:4 bits DB3=1:2 lines display (1/16 duty) DB3=0:1 line display DB2=1:5×10 dots , 1/11 duty DB2=1:5×7 dots , 1/8 duty	40μ s
Set CG RAM Address	0	0	0	1	CG RAM address corresponds to cursor address						The address length that can be set is 64 address	40μ s
Set DD RAM Address	0	0	1	DD RAM address						The address length that can be set is 80 address	40μ s	
Read Busy Flag/Address Counter	0	1	BF	Address counter used for both DD&CG RAM address						DB7=1:Busy (instruction not accepted) DB7=0:Ready(for instruction)	40μ s	
Write Data	1	0	Write data									46μ s
Read Data	1	1	Read data									46μ s

DD RAM Address:

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>
<b>Address for line</b>	00	01	02	03	04	05	06	07	40	41	42	43	44	45	46	47



## Reliability and Life Time

### 1. Reliability Test

Storage Condition	Content	Evaluations and Assessment*			
		Current consumption	Oozing	Contrast	Other appearances
Operation at high temperature and humidity	40°C,90% RH,240hrs	Twice initial value or less	none	More than 80% of initial value	No abnormality
High temperature storage	60°C, 240hrs	Twice initial value or less	none	More than 80% of initial value	No abnormality
Low temperature storage	-20°C, 240hrs	Twice initial value or less		More than 80% of initial value	No abnormality

\*Evaluations and assessment to be made two hours after returning to room temperature (25°C±5°C).

\*The LCDs subjected to the test must not have dew condensation.

### 2. Liquid crystal panel service life

50,000 hours minimum at 25±10°C,45±20%RH.

# Standard Character Pattern

Lower 4 Bits \ Upper 4 Bits	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
xxxx0000	CG RAM (1)			0	a	P	`	P				-	夕	ミ	α	P
xxxx0001	(2)		!	1	A	Q	a	q			。	ア	チ	△	≡	q
xxxx0010	(3)		"	2	B	R	b	r			「	イ	ツ	×	β	θ
xxxx0011	(4)		#	3	C	S	c	s			」	ウ	テ	E	ε	∞
xxxx0100	(5)		\$	4	D	T	d	t			、	エ	ト	†	μ	∞
xxxx0101	(6)		%	5	E	U	e	u			・	オ	ナ	1	ε	ü
xxxx0110	(7)		&	6	F	V	f	v			ヲ	カ	ニ	ヨ	ρ	Σ
xxxx0111	(8)		'	7	G	W	g	w			ア	キ	ヌ	ラ	g	π
xxxx1000	(1)		(	8	H	X	h	x			イ	ウ	ネ	リ	γ	∞
xxxx1001	(2)		)	9	I	Y	i	y			ウ	ケ	ル	ル	'	γ
xxxx1010	(3)		*	:	J	Z	j	z			エ	コ	ハ	レ	j	千
xxxx1011	(4)		+	:	K	[	k	<			オ	サ	ヒ	ロ	*	万
xxxx1100	(5)		,	<	L	¥	l	l			カ	シ	フ	ワ	φ	円
xxxx1101	(6)		-	=	M	]	m	}			ユ	ズ	ハ	ン	も	÷
xxxx1110	(7)		.	>	N	^	n	‡			ヨ	セ	ホ	°	ん	
xxxx1111	(8)		/	?	O	_	o	†			ウ	ソ	マ	°	ö	■

**Note:** The user can specify any pattern for character-generator RAM.