

Product Specification

NHD-C0216BA-FSW-GBW

Chip-On-Glass (COG) Liquid Crystal Display

NHD-	Newhaven Display
C0216-	COG, 2 Lines x 16 Characters
BA-	Model
F-	Transflective
SW-	Side white LED Backlight
G-	STN (+) Gray
B-	6:00 Optimal View
W-	Wide Temperature

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Additional Resources

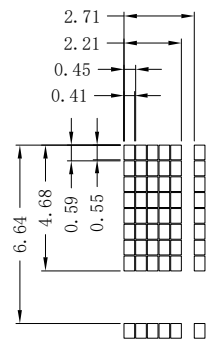
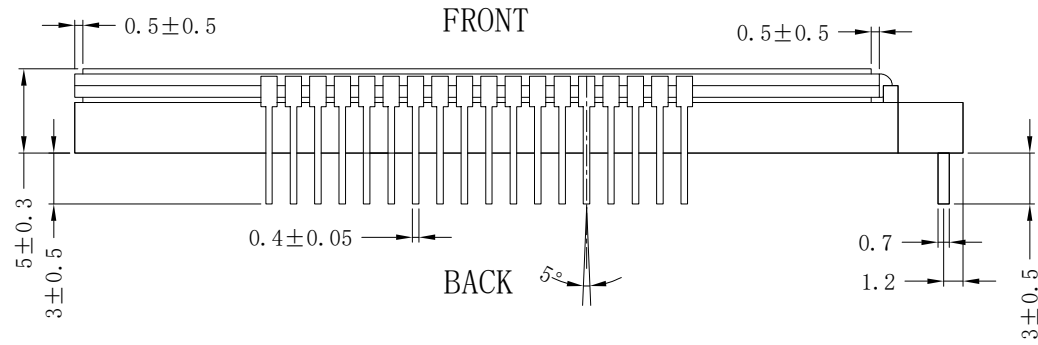
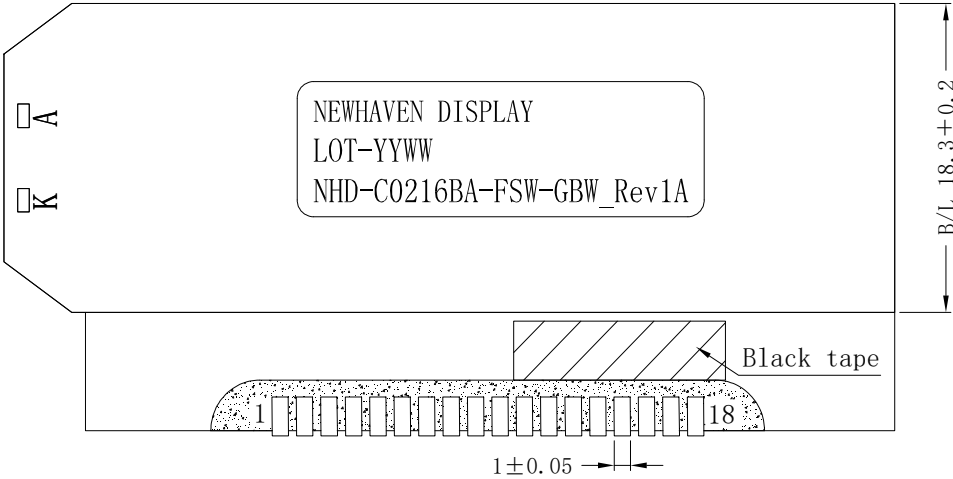
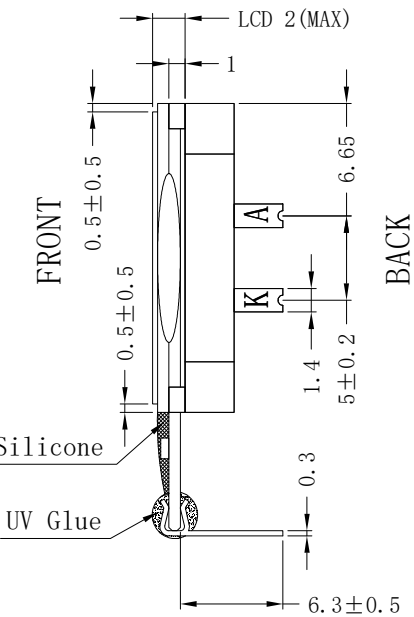
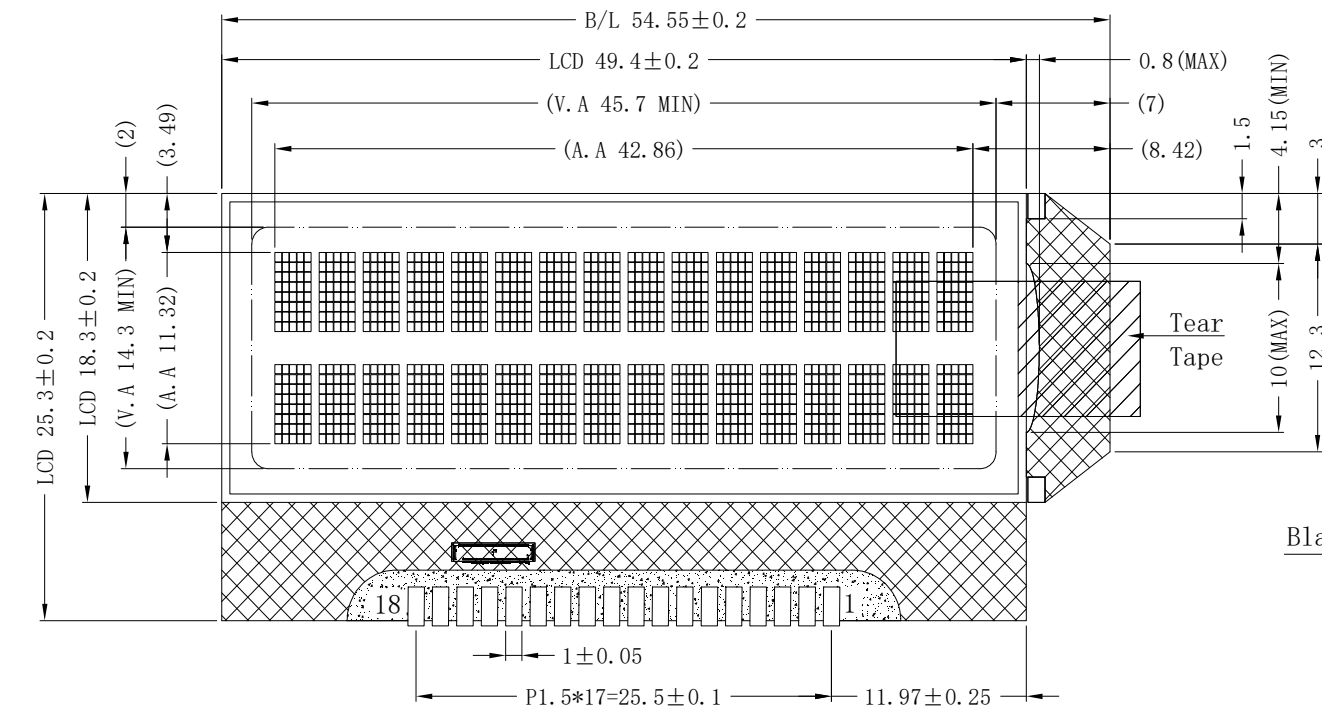
- **Support Forum:** <https://support.newhavendisplay.com/hc/en-us/community/topics>
- **GitHub:** <https://github.com/newhavendisplay>
- **Example Code:** <https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/>
- **Knowledge Center:** https://www.newhavendisplay.com/knowledge_center.html
- **Quality Center:** https://www.newhavendisplay.com/quality_center.html
- **Precautions for using LCDs/LCMs:** <https://www.newhavendisplay.com/specs/precautions.pdf>
- **Warranty / Terms & Conditions:** <https://www.newhavendisplay.com/terms.html>



Document Revision History

Revision	Date	Description	Changed By
-	03/06/2025	Initial Release	KL

Mechanical Drawing

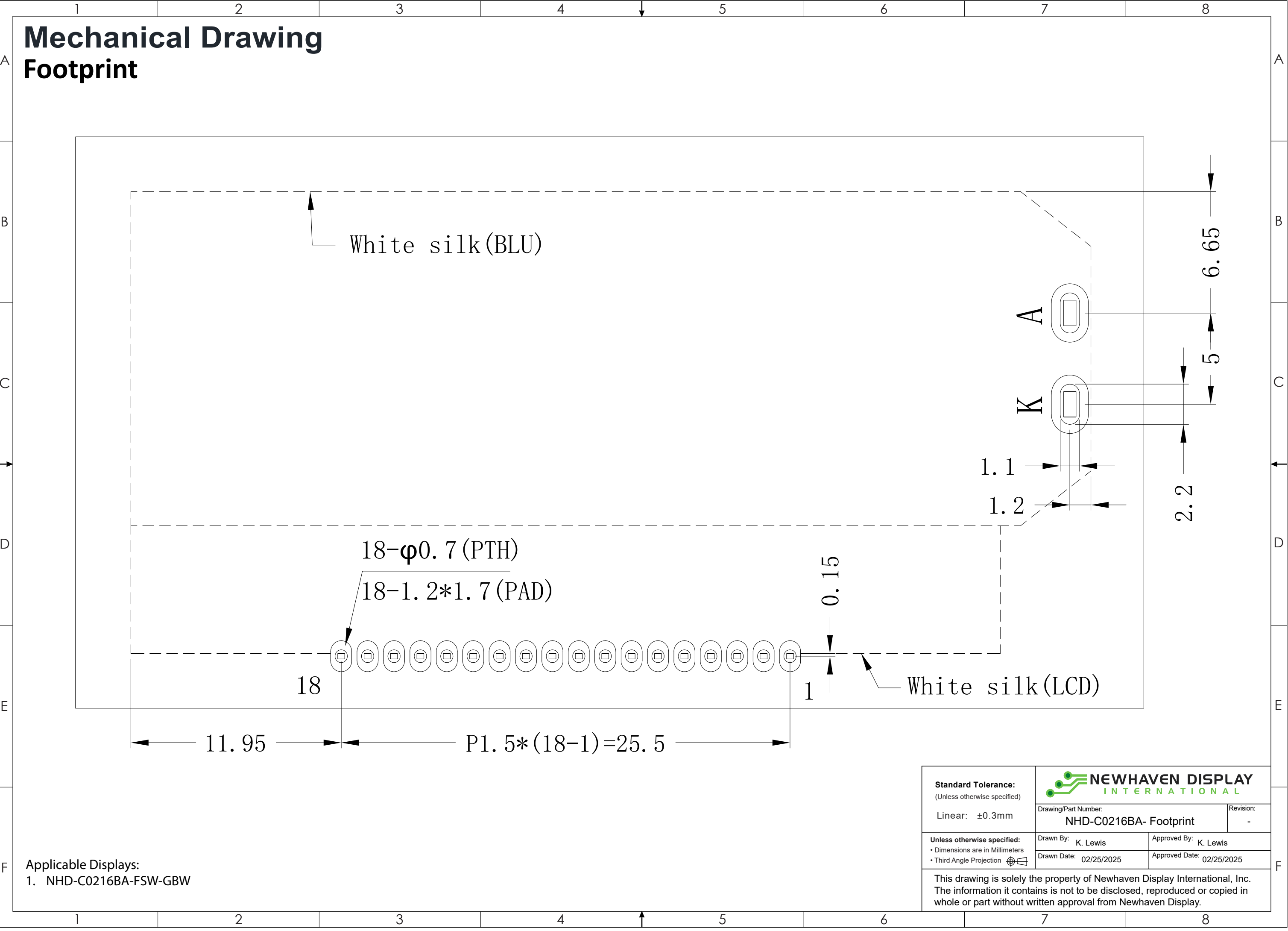


Dots Detail
Scale 2:1

Pin assignment	
NO.	Symbol
1	/XRESET
2	RS
3	CSB
4	R/W
5	E
6	D0
7	D1
8	D2
9	D3
10	D4
11	D5
12	D6
13	D7
14	VSS
15	VDD
16	PSB
17	PSI2B
18	V0

- Product Description: 2x16 Character LCD
1. Driver IC: ST7032
 2. Driving Mode: 1/16 Duty, 1/5 Bias
 3. Interface: 4/8-bit 6800 Parallel, 4-wire SPI
 4. Power Requirement: 5.0V LCD
 5. Optical Features: STN (+) Gray, Transflective, 6:00 View

Standard Tolerance: (Unless otherwise specified)		
	Drawing/Part Number: NHD-C0216BA-FSW-GBW	Revision: 1A
Unless otherwise specified: • Dimensions are in Millimeters • Third Angle Projection 	Drawn By: K. Lewis	Approved By: K. Lewis
	Drawn Date: 03/06/2025	Approved Date: 03/06/2025
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Applicable Displays:
1. NHD-C0216BA-FSW-GBW

Standard Tolerance: (Unless otherwise specified) Linear: ±0.3mm	 NEWHAVEN DISPLAY INTERNATIONAL	
	Drawing/Part Number: NHD-C0216BA- Footprint	Revision: -
Unless otherwise specified: • Dimensions are in Millimeters • Third Angle Projection 	Drawn By: K. Lewis	Approved By: K. Lewis
	Drawn Date: 02/25/2025	Approved Date: 02/25/2025
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Pin Description

Pin No.	Symbol	External Connection	Function Description
1	/XRESET	MPU	Active LOW Reset signal
2	RS	MPU	Register Select: 0=Instruction, 1=Data
3	CSB	MPU	Active LOW Chip Select signal
4	R/W	MPU	Read / Write select: 0=Write, 1=Read
5	E	MPU	Operation Enable Signal.
6-13	D0-D7	MPU	Bi-direction 8-bit data bus
14	Vss	Power Supply	Ground
15	VDD	Power Supply	Supply Voltage for LCD and Logic (5.0V)
16	PSB	MPU	Interface select signal
17	PSI2B	MPU	Interface select signal
18	V0	Adj. Power Supply	Variable Supply Voltage for Contrast
A	LED +	Power Supply	Backlight Anode (15mA @ 3V)
K	LED -	Power Supply	Backlight Cathode (Ground)

Recommended LCD connector: 2.0mm Pitch 18pins Soldered to PCB

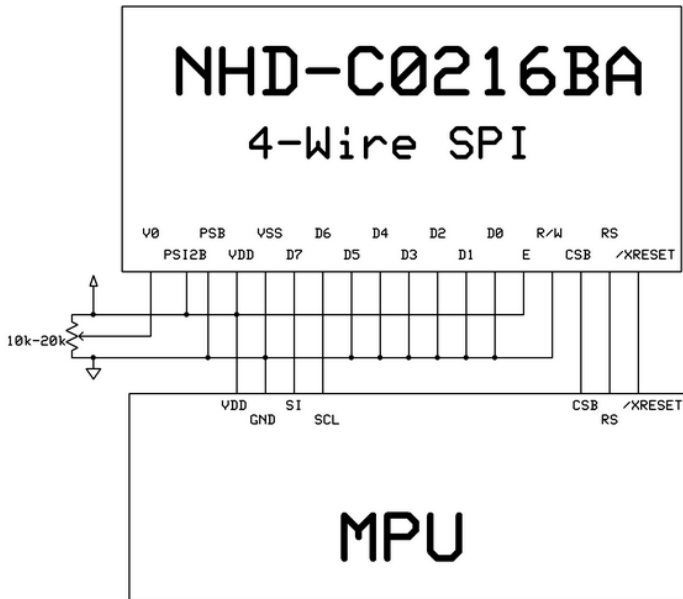
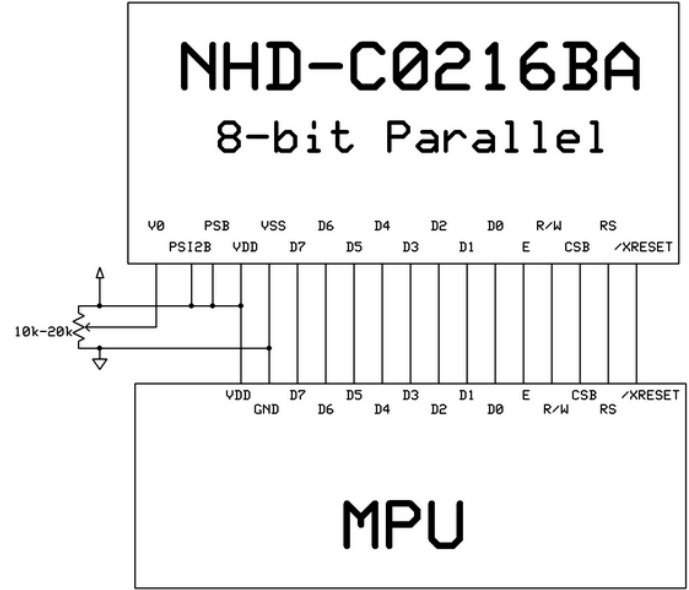
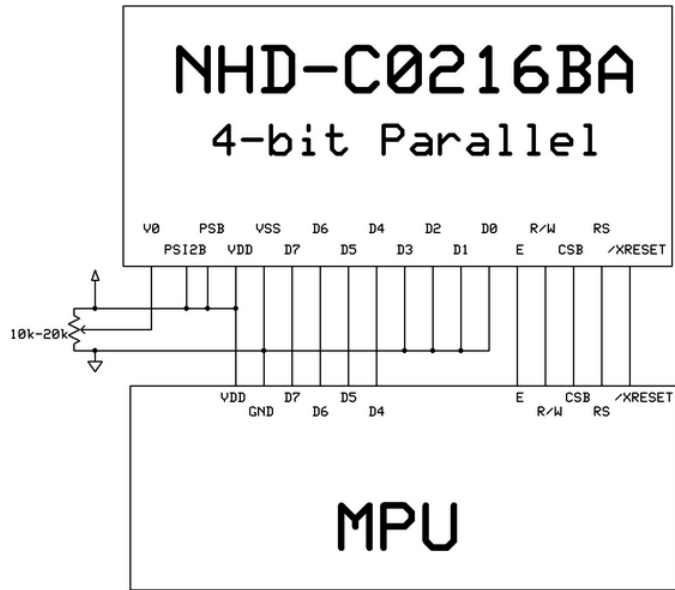
Backlight connector: A and K Pins

Mates With: PCB Thru-Hole

Interface Selection

Pin Name	Parallel	4-wire SPI
PSB	1	0
PSI2B	1	1

Wiring Diagram



Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T _{OP}	Absolute Max	-20	-	+70	°C
Storage Temperature Range	T _{ST}	Absolute Max	-30	-	+80	°C
Supply Voltage	V _{DD}	-	4.5	5.0	5.5	V
Supply Current	I _{DD}	V _{DD} = 5.0V	0.15	0.37	1.0	mA
Supply for LCD (Contrast)	V _{LCD}	T _{OP} = 25°C	4.2	4.5	4.8	V
"H" Level input	V _{IH}	-	0.7 * V _{DD}	-	V _{DD}	V
"L" Level input	V _{IL}	-	V _{SS}	-	1.0	V
"H" Level output	V _{OH}	-	3.8	-	V _{DD}	V
"L" Level output	V _{OL}	-	V _{SS}	-	0.8	V
Backlight Supply Current	V _{LED}	-	-	15	25	mA
Backlight Supply Voltage*	I _{LED}	I _{LED} = 15mA	2.8	3.0	3.2	V

*The LED of the backlight is driven by current drain; drive voltage is for reference only. Drive voltage must be selected to ensure backlight current drain is below MAX level stated.

Optical Characteristics

	Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	φY+	CR ≥ 2	-	50	-	°
	Bottom	φY-		-	50	-	°
	Left	θX-		-	37	-	°
	Right	θX+		-	37	-	°
Contrast Ratio	CR	-	-	2.5	3.2	-	-
Response Time (Rise)	T _R	T _{OP} = 25°C	-	110	220	-	-
Response Time (Fall)	T _F		-	240	480	-	-

Controller Information

Built-in ST7032 Controller: <https://support.newhavendisplay.com/hc/en-us/articles/4414860490903--ST7032>

DDRAM Address

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F

Table of Commands

Instruction	Instruction code										Description	Instruction Execution Time		
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		OSC=380kHz	OSC=540kHz	OSC=700kHz
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM and set DDRAM address to "00H" from AC	1.08 ms	0.76 ms	0.59 ms
Return Home	0	0	0	0	0	0	0	0	1	X	Set DDRAM Address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.08 ms	0.76 ms	0.59 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift. These parameters are performed during data write and read.	26.3 μs	18.5 μs	14.3 μs
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1: Entire display on C=1: Cursor on B=1: Blinking cursor on	26.3 μs	18.5 μs	14.3 μs
Function set	0	0	0	0	1	DL	N	DH	IS2	IS1	DL: Interface data is 8/4 bits N: Number of lines is 2/1 DH: Double Height Font IS 2~1: Instruction Table Select	26.3 μs	18.5 μs	14.3 μs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	26.3 μs	18.5 μs	14.3 μs
Read busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0	0	0
Write data To Address	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	26.3 μs	18.5 μs	14.3 μs
Read data From RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM/ICONRAM).	26.3 μs	18.5 μs	14.3 μs

Instruction Table 0 (IS[2:1] = [0,0])

Cursor or Display shift	0	0	0	0	0	1	S/C	R/L	X	X	Sets cursor moving and display shift control bit, and the direction without changing DDRAM data.	26.3 μs	18.5 μs	14.3 μs
Set CGRAM	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter	26.3 μs	18.5 μs	14.3 μs

Instruction Table 1 (IS[2:1] = [0,1])

Internal OSC Frequency	0	0	0	0	0	1	BS	F2	F1	F0	BS = 1 : 1/4 bias BS = 0 : 1/5 bias F2~0 : Adjust internal OSC frequency for FR frequency	26.3 μs	18.5 μs	14.3 μs
Set ICON Address	0	0	0	1	0	0	AC3	AC2	AC1	AC0	Set ICON address in address counter	26.3 μs	18.5 μs	14.3 μs
Power/ICON control/Contrast set	0	0	0	1	0	1	Ion	Bon	C5	C4	Ion: ICON display on/off Bon: Set booster circuit on/off C5,C4: Contrast set for internal follower mode	26.3 μs	18.5 μs	14.3 μs
Follower Control	0	0	0	1	1	0	Fon	Rab ₂	Rab ₁	Rab ₀	Fon: Set follower circuit on/off Rab 2~0: select follower amplified ratio	26.3 μs	18.5 μs	14.3 μs
Contrast Set	0	0	0	1	1	1	C3	C2	C1	C0	Contrast set for internal follower mode.	26.3 μs	18.5 μs	14.3 μs

Instruction Table 2 ((IS[2:1] = [0,0]))

Double Height Position Select	0	0	0	0	0	1	UD	X	X	X	UD: Double height position Select	26.3 μs	18.5 μs	14.3 μs
Reserved	0	0	0	1	X	X	X	X	X	X	Do not use (Reserved for Test)	26.3 μs	18.5 μs	14.3 μs

*Instruction Table 3 (IS[2,1] = [1,1]): Do not use (Reserved for Test)

Built-In Font Table

ST7032-0D (ITO option OPR1=1, OPR2=1)

b7-b4 b3-b0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	f	R		0	0	P	^	P	9	e		-	9	E	A	
0001	J	t	l	1	0	0	a	a	0	a	.	7	7	A	i	
0010	w	S	"	2	B	R	b	r	e	E	T	Y	W	X	Δ	%
0011	P	7	#	3	C	S	c	S	A	Δ	J	0	7	E	Δ	
0100	4	7	*	4	D	T	d	t	A	Δ	\	I	I	P	Δ	
0101	↑	Δ	%	5	E	U	e	U	A	Δ	.	7	7	Δ	E	B
0110	↓	B	&	6	F	V	F	V	A	0	7	0	Δ	Δ	Δ	W
0111	÷	A	'	7	G	W	g	w	S	0	7	7	7	Δ	R	X
1000	+	E	<	8	H	X	H	X	E	9	4	0	7	7	7	÷
1001	7	7	>	9	I	Y	i	W	e	0	e	7	7	7	7	Δ
1010	7	Δ	*	*	J	Z	j	z	e	0	e	0	0	Δ	Δ	Δ
1011	L	7	+	;	K	E	k	<	i	R	4	0	E	0	Δ	*
1100	U	Δ	,	<	L	*	l	l	i	R	4	0	7	7	7	*
1101	.	7	-	=	M	J	m	>	i	Δ	Δ	Δ	Δ	Δ	Δ	*
1110	0	0	.	>	N	Δ	n	>	Δ	0	0	E	7	Δ	Δ	7
1111	0	0	/	?	0	Δ	0	*	Δ	Δ	W	U	7	7	Δ	7

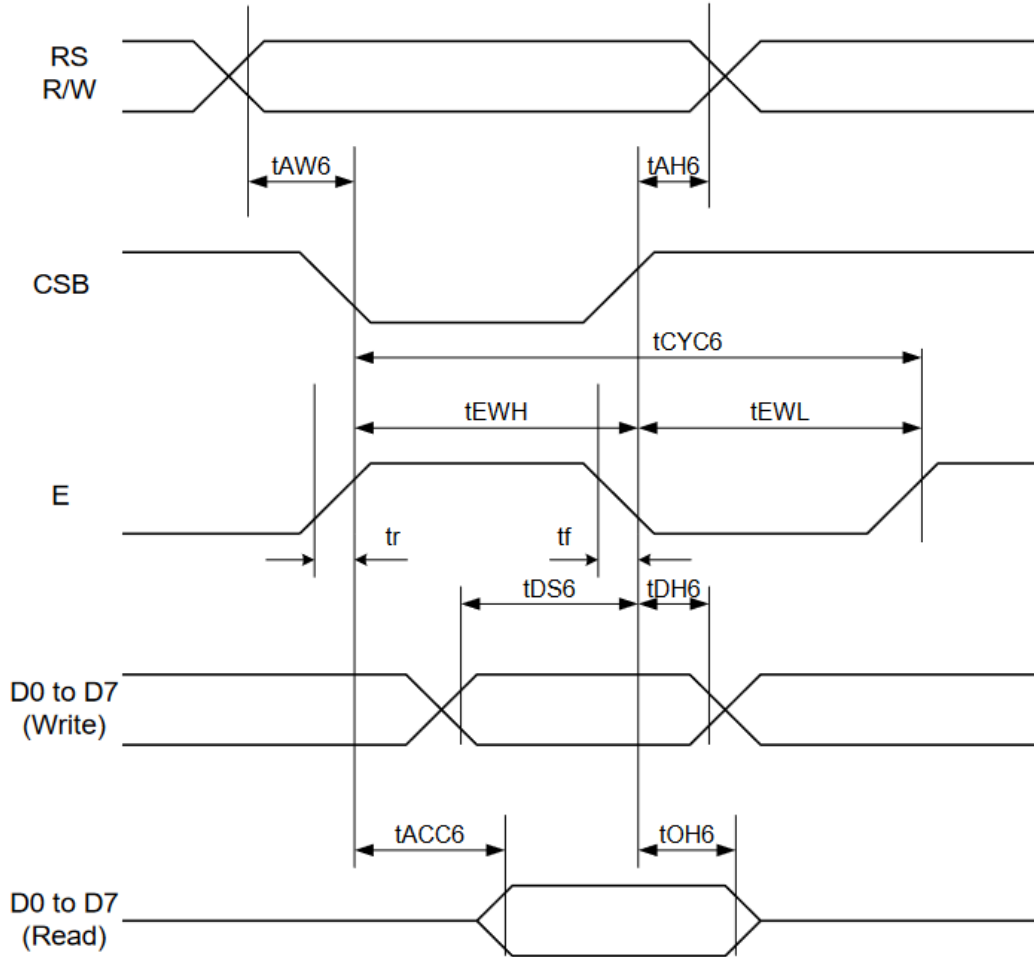
Table A2. Select display pattern in CGRAM or CGROM (use OPR1, OPR2)

b7-b4 b3-b0	0000	0001	...	b7-b4 b3-b0	0000	0001	...	b7-b4 b3-b0	0000	0001	...	b7-b4 b3-b0	0000	0001	...
0000	Replaced By CGRAM Pattern		...	0000	Replaced By CGRAM Pattern		...	0000	Replaced By CGRAM Pattern		...	0000			...
0001			...	0001			...	0001			...	0001			...
0010			...	0010			...	0010			...	0010			...
0011			...	0011			...	0011			...	0011			...
0100			...	0100			...	0100			...	0100			...
0101			...	0101			...	0101			...	0101			...
0110			...	0110			...	0110			...	0110			...
0111			...	0111			...	0111			...	0111			...
1000	Replaced By CGRAM Pattern		...	1000	Replaced By CGRAM Pattern		...	1000	Replaced By CGRAM Pattern		...	1000			...
1001			...	1001			...	1001			...	1001			...
1010			...	1010			...	1010			...	1010			...
1011			...	1011			...	1011			...	1011			...
1100			...	1100			...	1100			...	1100			...
1101			...	1101			...	1101			...	1101			...
1110			...	1110			...	1110			...	1110			...
1111			...	1111			...	1111			...	1111			...

OPR2,OPR1=(0,0) OPR2,OPR1=(0,1) OPR2,OPR1=(1,0) OPR2,OPR1=(1,1)

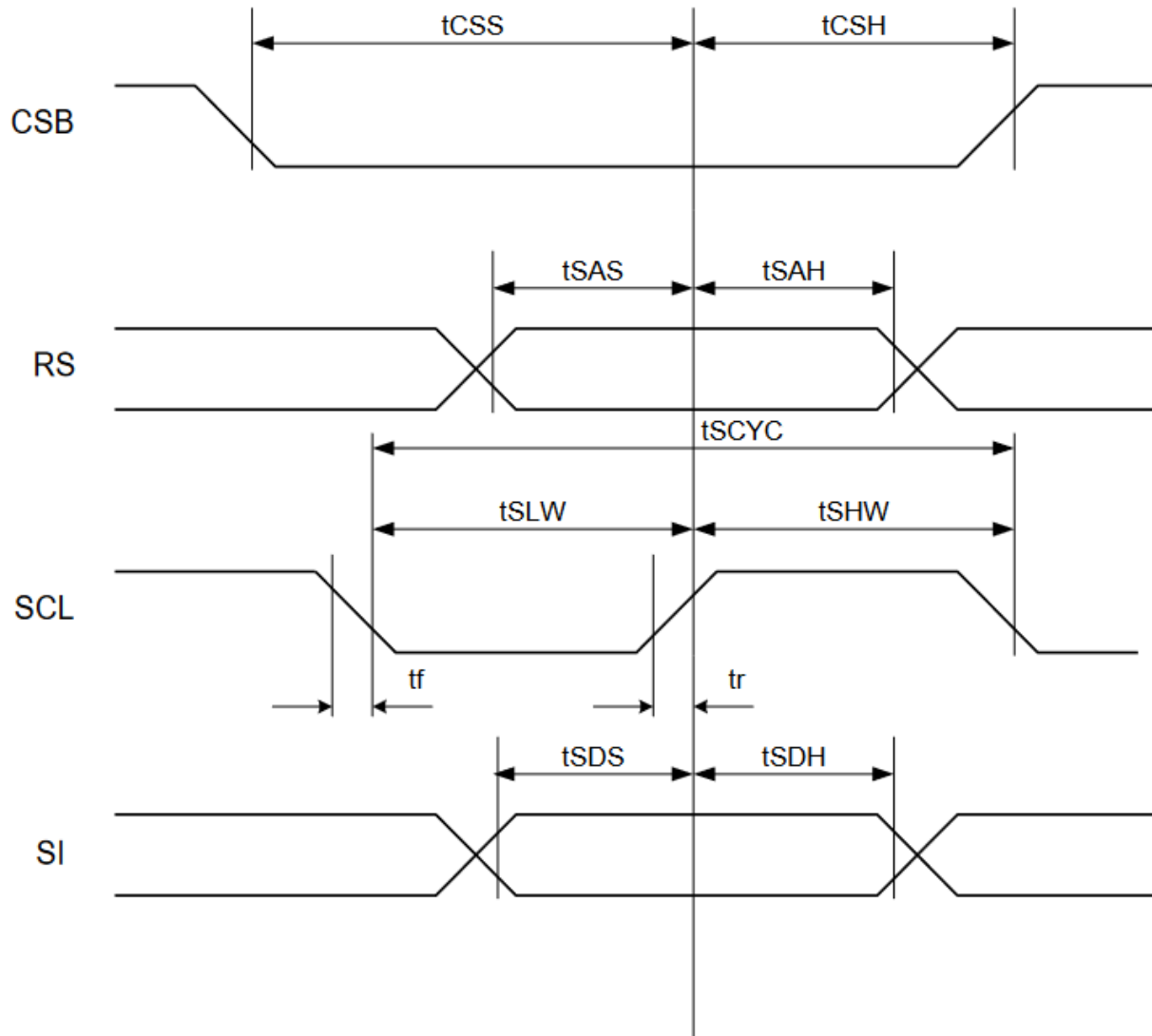
Timing Characteristics

4-8-bit 6800 Parallel Interface



Item	Signal	Symbol	Condition	VDD=2.7 to 4.5V Rating		VDD=4.5 to 5.5V Rating		Units
				Min.	Max.	Min.	Max.	
Address hold time	RS	tAH6	—	20	-	20	-	ns
Address setup time	RS	tAW6		20	-	20	-	
System cycle time	RS	tCYC6	—	400	-	280	-	ns
Data setup time	D0 to D7	tDS6	—	100	-	80	-	ns
Data hold time	D0 to D7	tDH6		40	-	20	-	
Access time	D0 to D7	tACC6	CL = 100 pF	-	500	-	400	ns
Output disable time	D0 to D7	tOH6		300	-	150	-	
Enable Rise/Fall time	E	tr,tf	—	-	20	-	20	ns
Enable H pulse time	E	tEWH	—	200	-	120	-	ns
Enable L pulse time	E	tEWL	—	150	-	130	-	ns

4-wire SPI Interface



Item	Signal	Symbol	Condition	VDD=2.7 to 4.5V Rating		VDD=4.5 to 5.5V Rating		Units
				Min.	Max.	Min.	Max.	
Serial Clock Period	SCL	tscyc	—	200	-	100	-	ns
SCL "H" pulse width		tshw		20	-	20	-	
SCL "L" pulse width		tslw		160	-	120	-	
SCL Rise/Fall time	SCL	tr,tf	—	-	20	-	20	ns
Address setup time	RS	tsas	—	10	-	10	-	ns
Address hold time		tsah		250	-	150	-	
Data setup time	SI	tsds	—	10	-	10	-	ns
Data hold time		tsdh		10	-	20	-	
CS-SCL time	CS	tcss	—	20	-	20	-	ns
		tcsH		350	-	200	-	

Example Initialization Program

```

void init()
//initialize the LCD
{
  P3 = 1;
  P1 = 1;
  RST = 0;                      //RESET
  delay(2);
  RST = 1;                      //end reset
  delay(20);
  Writecom(0x30);               //wake up
  delay(2);
  Call writecom(0x30);          //wake up
  Call writecom(0x30);          //wake up
  Call writecom(0x39);          //function set
  Call writecom(0x14);          //internal osc frequency
  Call writecom(0x56);          //power control
  Call writecom(0x6D);          //follower control
  Call writecom(0x70);          //contrast
  Call writecom(0x0C);          //display on
  Call writecom(0x06);          //entry mode
  Call writecom(0x01);          //clear
  delay(10);
}

void writecom(int d)
{
  CS = 0;                      //CS
  RS = 0;                      //A0 = Command
  for(serialcounter = 1; serialcounter <= 8; serialcounter++) //send 8 bits
  {
    if((d&0x80)==0x80)          //get only the MSB
      SI=1;                    //if 1, then SI=1
    else
      SI=0;                    //if 0, then SI=0
    d=(d<<1);                  //shift data byte left
    SCL = 0;
    SCL = 1;
    SCL = 0;                    //SCL
  }
  CS = 1;
}

void writedata(int d)
{
  CS = 0;                      //CS
  RS = 1;                      //A0 = Data
  for(serialcounter = 1; serialcounter <= 8; serialcounter++) //send 8 bits
  {
    if((d&0x80)==0x80)          //get only the MSB
      SI=1;                    //if 1, then SI=1
    else
      SI=0;                    //if 0, then SI=0
    d=(d<<1);                  //shift data byte left
    SCL = 0;
    SCL = 1;
    SCL = 0;                    //SCL
  }
  CS = 1;
}

```

Quality Information

Test Item	Content of Test	Test Condition	Note
High Temperature storage	Endurance test applying the high storage temperature for a long time.	+80°C , 96hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C , 96hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C , 96hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C , 96hrs	1,2
High Temperature / Humidity Operation	Endurance test applying the electric stress (voltage & current) and the high thermal with high humidity stress for a long time.	+50°C , 90% RH , 96hrs	1,2
Thermal Shock resistance	Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.	-20°C,60min -> 70°C,60min = 1 cycle 20 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10-50Hz, 5G Acceleration. 60 sec in each of 3 directions X,Y,Z for 30 minutes	3
Static electricity test	Endurance test applying electric static discharge.	Air: ±8KV 150pF/330Ω Contact: ±4KV 150pF/330 5 times	

Note 1: No condensation to be observed.

Note 2: Conducted after 4 hours of storage at 25°C, 0%RH.

Note 3: Test performed on product itself, not inside a container.