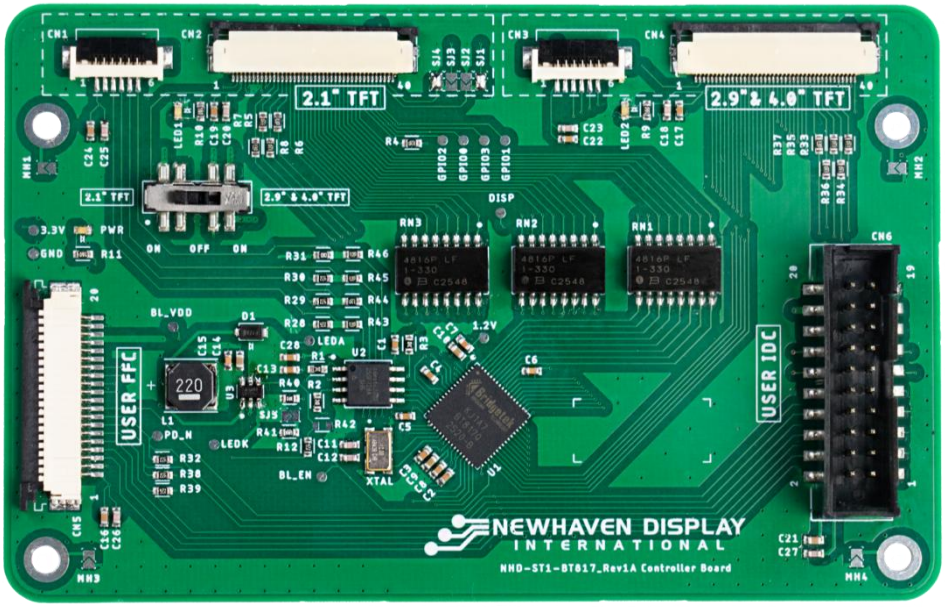
User Guide

NEWHAVEN DISPLAY INTERNATIONAL

NHD-ST1-BT817

TFT Controller Board



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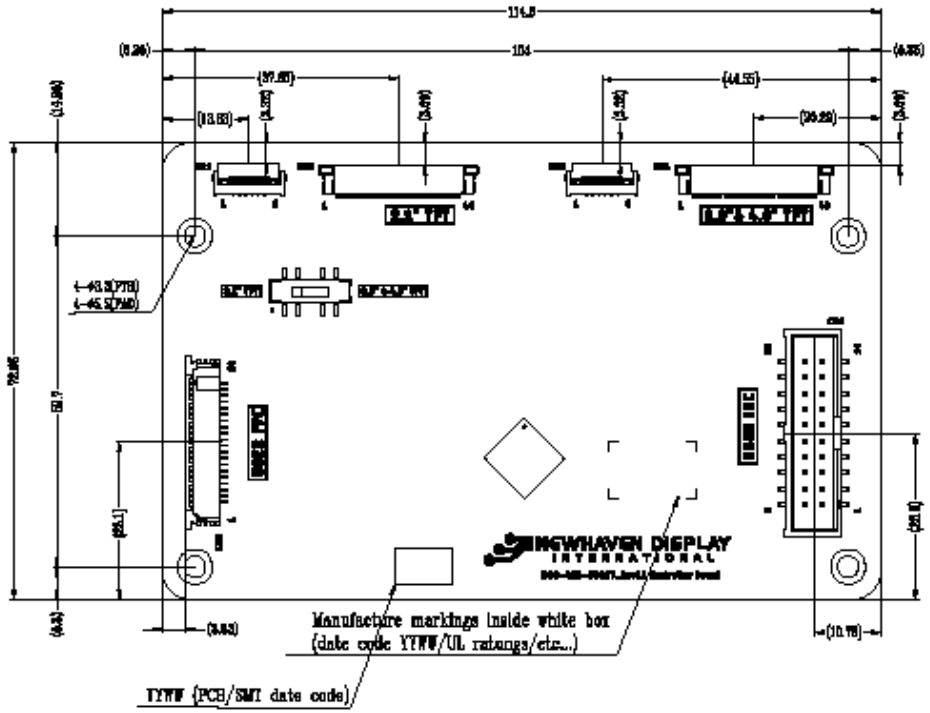
Technical Support:
nhtech@newhavendisplay.com

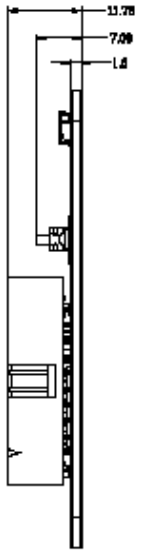
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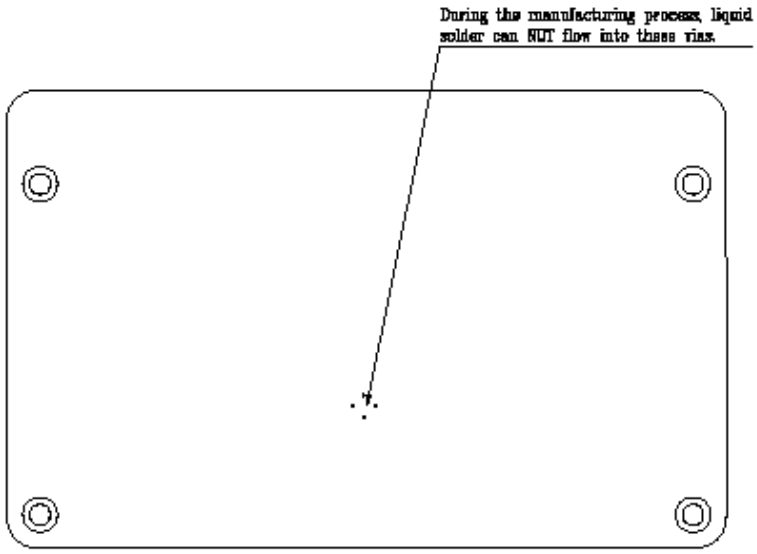
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Mechanical Drawing



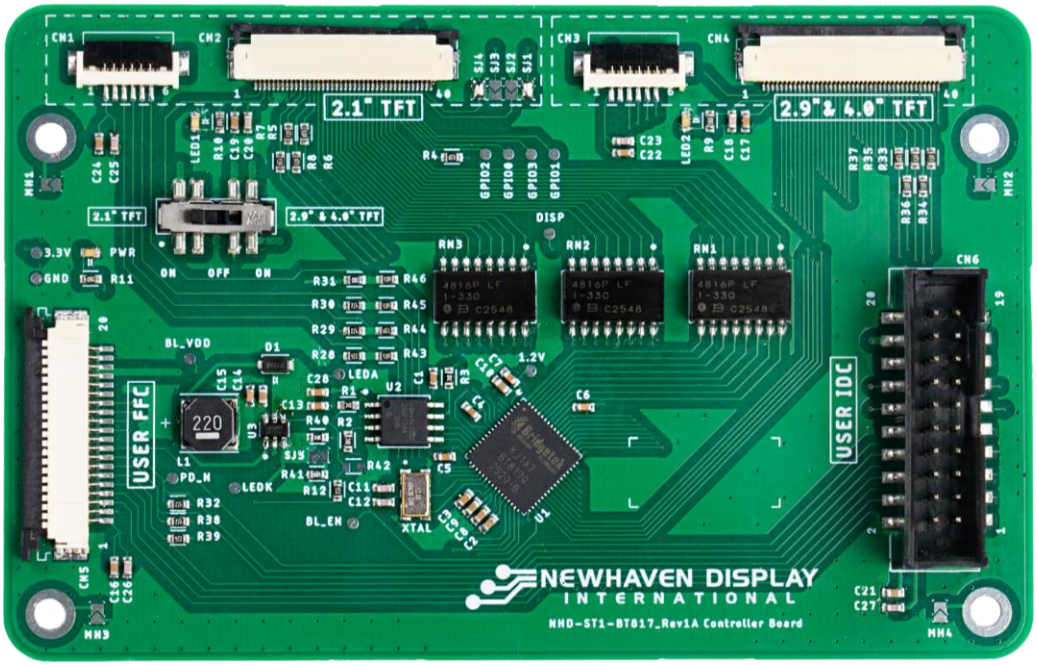




Standard Tolerance: (Unless otherwise specified) Linear: ±0.3mm	NEWHAVEN DISPLAY INTERNATIONAL	
	Drawing/Part Number: NHD-ST1-BT817 Controller Board	Revision: 1A
Unless otherwise specified: • Dimensions are in Millimeters • Third Angle Projection	Drawn By: K. Lewis	Approved By: K. Lewis
	Drawn Date: 06/23/2026	Approved Date: 06/23/2026

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Overview



The NHD-ST1-BT817 is a TFT display controller board designed around the BT817Q video engine IC from Bridgetek. Engineered for seamless integration with Newhaven Display 2.1", 2.9", and 4.0" TFT models, delivering a compact and easy-to-setup prototyping tool with capacitive touch and non-touch support.

- At the heart of the NHD-ST1-BT817 controller board is the BT817Q IC, which integrates display, audio, and touch functionality into a single chip.
- Two user connectors are available for use. A 20-pin FFC connector and a 20-pin IDC connector.
- The NHD-ST1-BT817 controller board supports 4-Wire SPI, D-SPI, and Q-SPI



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Supported TFT Modules

Part Number	Resolution	Diagonal Size	Display Technology	TFT Driver
NHD-2.1-480480AF-ASXP	480 x 480 Pixels	2.1"	IPS	ST7701S
NHD-2.1-480480AF-ASXP-CTP				
NHD-2.9-376960AF-ASXP	376 x 960 Pixels	2.9"		ST7701SN
NHD-2.9-376960AF-ASXP-CTP				
NHD-4.0-480480AF-ASXP	480 x 480 Pixels	4.0"		
NHD-4.0-480480AF-ASXP-CTP				

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Pin Description

User Connectors

CN6, CN5

Pin No.	Symbol	External Connection	Function Description
1	VDD	Power Supply	Input Voltage for TFT and FT81x (3.3V)
2	GND	Power Supply	Ground
3	SCK	MCU	SPI Clock (Input)
4	MISO/IO1	MCU	**SPI Single Mode:** SPI MISO (Output) **SPI Dual/Quad Mode:** SPI Data Line 1 (IO1)
5	MOSI/IO0	MCU	**SPI Single Mode:** SPI MOSI (Input) **SPI Dual/Quad Mode:** SPI Data Line 0 (IO0)
6	/CS	MCU	SPI Chip Select (Input), Active LOW
7	/INT	MCU	Interrupt to host (Output), Active LOW
8	/PD	MCU	Power Down control (Input), Active LOW
9	AUDIO_L	Filter/Amplifier	Audio PWM out (Output)
10	N.C.	-	No Connect
11	TFT_INIT_SCL	MCU	**SPI Single/Dual Mode:** SCL signal for TFT SPI Initialization **SPI Quad Mode:** SPI Data Line 2 (IO2)
12	TFT_INIT_SDA	MCU	**SPI Single/Dual Mode:** SDA signal for TFT SPI Initialization **SPI Quad Mode:** SPI Data Line 3 (IO3)
13	TFT_INIT_/CS	MCU	/CS signal for TFT SPI Initialization
14	TFT_INIT_/DC	MCU	D/C signal for TFT SPI Initialization
15 - 16	N.C.	-	No Connect
17 - 18	VBL	Power Supply	Input Voltage for LED Backlight Driver (3.3V/5V)
19 - 20	GND	Power Supply	Ground

CN6: Male IDC Box Header - 20-Pin, 2x10, 2.54mm pitch.
CN5: FFC Connector - 20-Pin, 1.0mm pitch, Top-contact.

CTP Connectors

CN1, CN3

Pin No.	Symbol	Function Description
1	VDD	Supply voltage for logic (3.3V)
2	GND	Ground
3	SCL	Serial I2C Clock
4	SDA	Serial I2C Data
5	INT	Interrupt signal from touch panel module to host
6	RST	Active LOW Reset signal

CN1: FFC Connector - 6-Pin, 1.0mm pitch, Bottom-contact.
CN3: FFC Connector - 6-Pin, 1.0mm pitch, Bottom-contact.

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TFT Connectors

CN2

Pin No.	Symbol	Function Description
1	LED_K	Backlight Cathode
2	LED_A	Backlight Anode
3	VDD	Supply Voltage for LCD and Logic
4 - 10	GND	Ground
11	VS	Frame Synchronizing signal for RGB interface
12	HS	Line Synchronizing signal for RGB interface
13	PCLK	Dot Clock signal for RGB interface
14	DE	Data Enable signal for RGB interface
15-20	B0-B5	Blue Data signals
21-26	G0-G5	Green Data signals
27-32	R0-R5	Red Data signals
33	RESETX	Active LOW Reset signal
34	CSX	Active LOW Chip Select signal
35	SCL	Serial Clock signal for SPI interface (rising edge)
36	DCX	Data/Command select for SPI: '1' = Data; '0' = Command
37	SDA	Serial Data Input signal for SPI interface
38	IM0	Interface Mode Select signal
39	IM1	Interface Mode Select signal
40	IM2	Interface Mode Select signal

CN2: FFC Connector - 40-Pin, 0.5mm pitch, Top-contact.

CN4

Pin No.	Symbol	Function Description
1	LED_K	Backlight Cathode
2	LED_A	Backlight Anode
3	GND	Ground
4	VDD	Supply Voltage for LCD and Logic
5-12	R0-R7	Red Data signals
13-20	G0-G7	Green Data signals
21-28	B0-B7	Blue Data signals
29	GND	Ground
30	PCLK	Dot Clock signal for RGB interface
31	RESETX	Active LOW Reset signal
32	HS	Line Synchronizing signal for RGB interface
33	VS	Frame Synchronizing signal for RGB interface
34	DE	Data Enable signal for RGB interface
35	NC	No connect
36	GND	Ground
37	CSX	Active LOW Chip Select signal
38	DCX	Data/Command select for SPI: '1' = Data; '0' = Command
39	SCL	Serial Clock signal for SPI interface (rising edge)
40	SDA	Serial Data Input signal for SPI interface

CN4: FFC Connector - 40-Pin, 0.5mm pitch, Top-contact.

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Electrical Characteristics

2.1" TFT

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T_{OP}	Absolute Max	-20	-	+70	^{0}C
Storage Temperature Range	T_{ST}	Absolute Max	-30	-	+80	^{0}C
Supply Voltage	V_{DD}	-	3.0	3.3	3.5	V
Supply Current	I_{DD}	V_{DD} = 3.3V	-	54	-	mA
"H" Level input	V_{IH}	-	0.7 * V_{DD}	-	V_{DD}	V
"L" Level input	V_{IL}	-	GND	-	0.3* V_{DD}	V
"H" Level output	V_{OH}	-	0.8* V_{DD}	-	V_{DD}	V
"L" Level output	V_{OL}	-	GND	-	0.2* V_{DD}	V
Supply Voltage for Backlight Driver	V_{BL}	-	2.7		5.5	V
Supply Current for Backlight Driver	I_{BL}	V_{BL} = 3.3V	-	218	-	mA
		V_{BL} = 5.0V	-	140	-	mA

2.9" TFT

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T_{OP}	Absolute Max	-20	-	+70	^{0}C
Storage Temperature Range	T_{ST}	Absolute Max	-30	-	+80	^{0}C
Supply Voltage	V_{DD}	-	3.0	3.3	3.5	V
Supply Current	I_{DD}	V_{DD} = 3.3V	-	80	-	mA
"H" Level input	V_{IH}	-	0.7 * V_{DD}	-	V_{DD}	V
"L" Level input	V_{IL}	-	GND	-	0.3* V_{DD}	V
"H" Level output	V_{OH}	-	0.8* V_{DD}	-	V_{DD}	V
"L" Level output	V_{OL}	-	GND	-	0.2* V_{DD}	V
Supply Voltage for Backlight Driver	V_{BL}	-	2.7		5.5	V
Supply Current for Backlight Driver	I_{BL}	V_{BL} = 3.3V	-	218	-	mA
		V_{BL} = 5.0V	-	140	-	mA

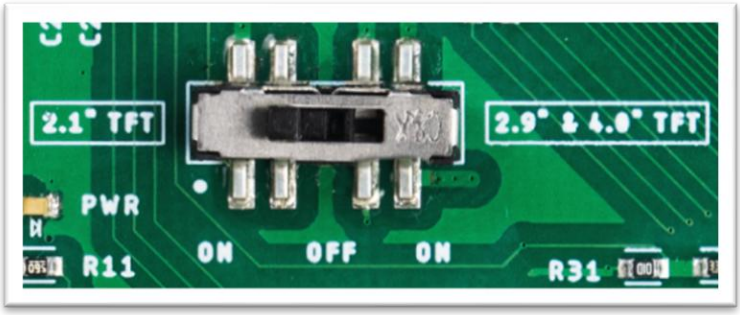
4.0" TFT

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T_{OP}	Absolute Max	-20	-	+70	^{0}C
Storage Temperature Range	T_{ST}	Absolute Max	-30	-	+80	^{0}C
Supply Voltage	V_{DD}	-	3.0	3.3	3.5	V
Supply Current	I_{DD}	V_{DD} = 3.3V	-	70	-	mA
"H" Level input	V_{IH}	-	0.7 * V_{DD}	-	V_{DD}	V
"L" Level input	V_{IL}	-	GND	-	0.3* V_{DD}	V
"H" Level output	V_{OH}	-	0.8* V_{DD}	-	V_{DD}	V
"L" Level output	V_{OL}	-	GND	-	0.2* V_{DD}	V
Supply Voltage for Backlight Driver	V_{BL}	-	2.7		5.5	V
Supply Current for Backlight Driver	I_{BL}	V_{BL} = 3.3V	-	309	-	mA
		V_{BL} = 5.0V	-	198	-	mA

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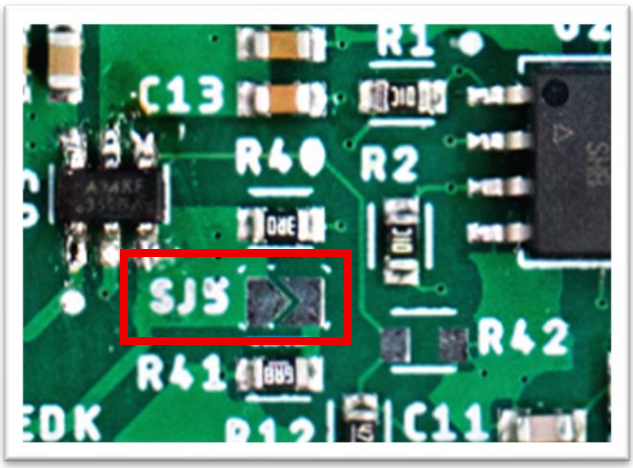
Setup

1. Configuring the board



A three-way switch controls the currently active connector group and only one can be active at a time. **The switch should be configured for the proper connector group where the display is connected before powering.**

The backlight circuit also needs to be configured if the **4.0" TFT display** is paired with the controller board because this requires more current. The **SJ5 jumper pad** should be jumped if used with this size:

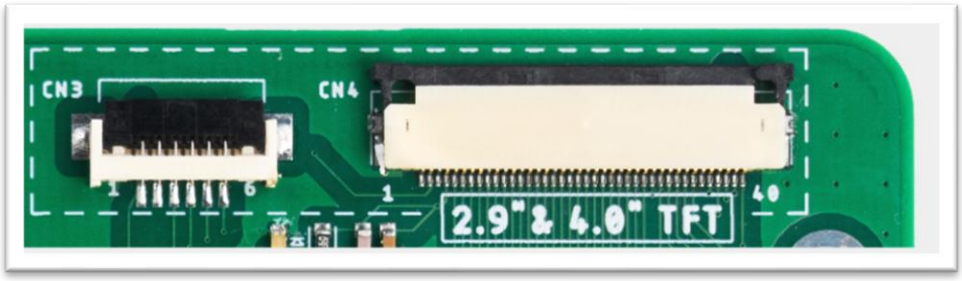


2. Connecting the display

There are two display connectors on the NHD-ST1-BT817 controller board. **Only one display should be connected at a time**. One group is for the **2.1" TFT:**



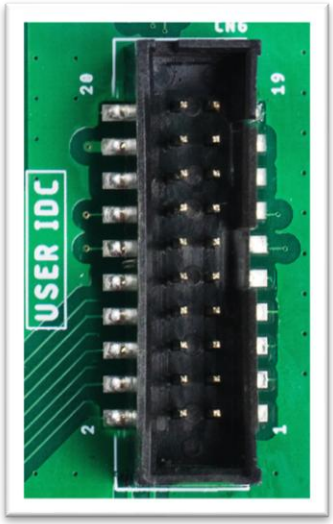
The other group is for the **2.9" and the 4.0" TFTs:**

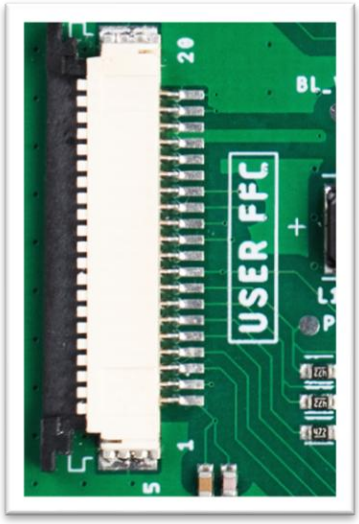


The 6-pin flip style connectors are for the CTP cable, and the 40-pin connectors are for the main TFT cable. **The correct connector group must be used to avoid damaging the display and controller board**. For non-touch versions of the displays, the CTP connector can be left unconnected.

3. Connecting to the board

Communication with the controller board can be done by connecting to the **20-Pin male IDC box header (CN6)**, or using the **20-Pin FFC connector (CN5):**



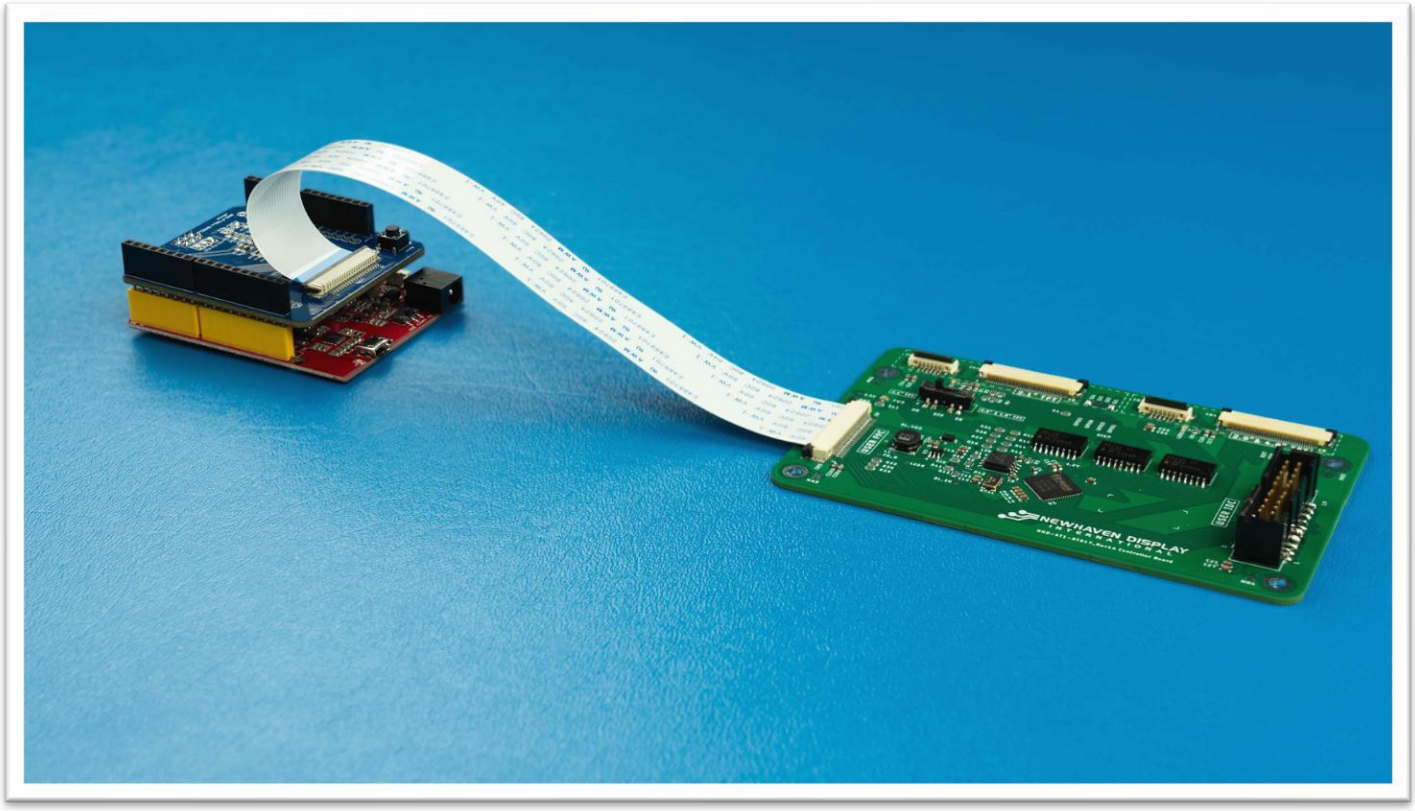


Connecting to the IDC box header requires jumper cables to access the pins for communication between the customer's MCU and the embedded video controller IC, as well as the pins for SPI initialization and backlight supply.

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Alternatively, using the NHD-FT81x-SHIELD handles all the level shifting and connections for communication. Only a 20-pin 1mm pitch FFC cable is needed to connect the shield to the board.

To use the NHD-FT81x-SHIELD with the controller board, simply place and connect it onto your Arduino as shown below:



4. Initializing the display

The 2.1", 2.9", and 4.0" TFT needs to be initialized first through SPI before sending any pixel data to the display. This can be done either through the BT817 IC, or by connecting an external 4-Wire SPI channel through the IDC box connector.

Before sending any initialization commands to the TFT through SPI, a **2000ms delay is needed for the TFT to fully power on after power cycling.**

Initializing the display through the BT817 IC is preferred and will only require software commands without needing any additional external connections to the board.

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5. Setting up the library

A useful library for Arduino that can be implemented with this controller board is the Gameduino 2 library. A download link for this Arduino library can be found here:

https://support.newhavendisplay.com/hc/en-us/article_attachments/14632743787031/Gameduino2.zip

Some modification is required of the library to be compatible with the NHD-FT81x-Shield for displaying images through the SD card:

1. Navigate to **Documents > Arduino > libraries > Gameduino2 > GD2.cpp**.
2. Open **GD2.cpp** in your preferred code editor.
3. Ensure **//if (STORAGE && (options & GD_STORAGE))** is commented out.
4. Save the changes and close the modified file.

```
void GDClass::tune(void)
{
  uint32_t f;
  for (byte i = 0; (i < 31) && ((f = measure_freq()) < LOW_FREQ_BOUND); i++) {
    GDTR.wr(REG_TRIM, i);
  }
  GDTR.wr32(REG_FREQUENCY, f);
}

void GDClass::begin(uint8_t options, int cs, int sdcs) {
#if defined(ARDUINO) || defined(ESP8266) || defined(ESP32) || defined(SPIDRIVER)
  GDTR.begin0(cs);
  //if (STORAGE && (options & GD_STORAGE))
    SD.begin(sdcs);
#endif
```

Arduino Example Code

Example code with the Arduino UNO paired with the NHD-FT81x-Shield can be found here:

2.1" Sketch Demo:
https://support.newhavendisplay.com/hc/en-us/articles/41806820351511

2.9" Sketch Demo:
https://support.newhavendisplay.com/hc/en-us/articles/41929867148823

4.0" Sketch Demo:
https://support.newhavendisplay.com/hc/en-us/articles/41930372738455

All example code initializes the TFT through the BT817 EVE IC.

Additional Information/Resources

The NHD-ST1-BT817 controller board is supported by Newhaven Display. Any issues regarding the hardware itself, please contact the Newhaven Display Support Team via the Newhaven Display website, or on the Newhaven Display Forum (also accessible from the Newhaven Display website):

http://www.newhavendisplay.com/

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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^{0}C , 96hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30^{0}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^{0}C , 96hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20^{0}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.	+60^{0}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^{0}C,30min -> 25^{0}C,5min ->70^{0}C,30min = 1 cycle 10 cycles	
Static electricity test	Endurance test applying electric static discharge.	VS=800V, RS=1.5kΩ, CS=100pF One time	

Note 1: No condensation to be observed.
Note 2: Conducted after 4 hours of storage at 25^{0}C, 0%RH.

Precautions for using LCDs/LCMs

See Precautions at https://newhavendisplay.com/quality/product-usage-guidelines/

Warranty Information

See Terms & Conditions at https://newhavendisplay.com/terms-and-conditions/

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Document Revision History

Revision	Date	Comments	Changed By
1	7/14/2026	Initial	JC
2	7/31/2026	Changed Precautions and Warranty Links	JC