

# X-mini LCD Test Activities (v2)

## How to connect an LCD module to the AVR X-mini board

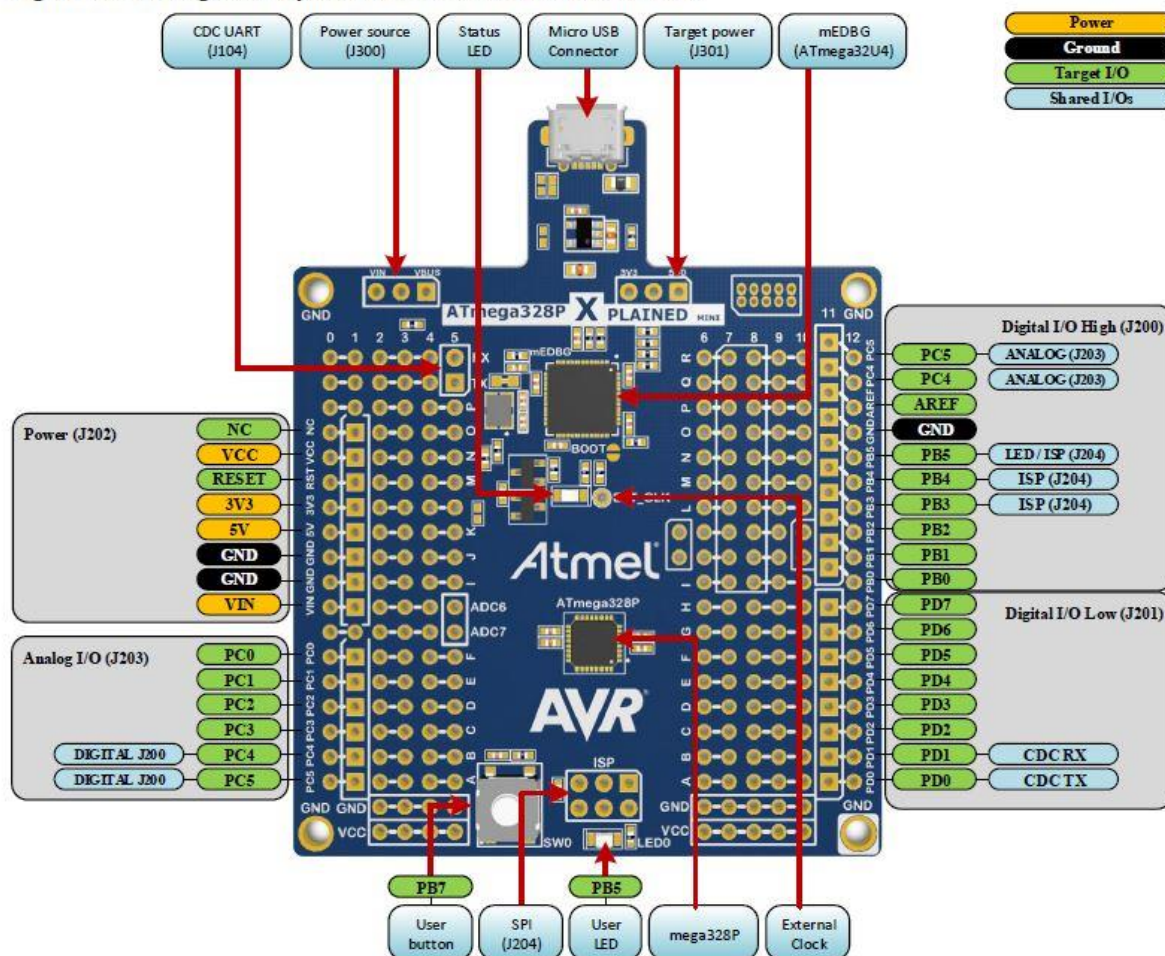
Go to Canvas **Resources & Materials** page and download the "**AVR X-mini code library.ZIP**" package.

Most assignments (from A2 onward) will use the LCD module to display data, so you'll need to connect the LCD (type 1602A, included in your kit) to the ATmega328P "X-plained Mini" board (*abbr.* "X-mini"). There's a schematic diagram in the X-mini kit ZIP package (copied on the next page) showing the LCD signal connections, but not showing connections for LCD power (+5V, GND), contrast trim-pot (Vo) or backlight LED (A, K). You can either build a little "breakout" board or use the supplied solderless bread-board to make these connections. (See photo.)

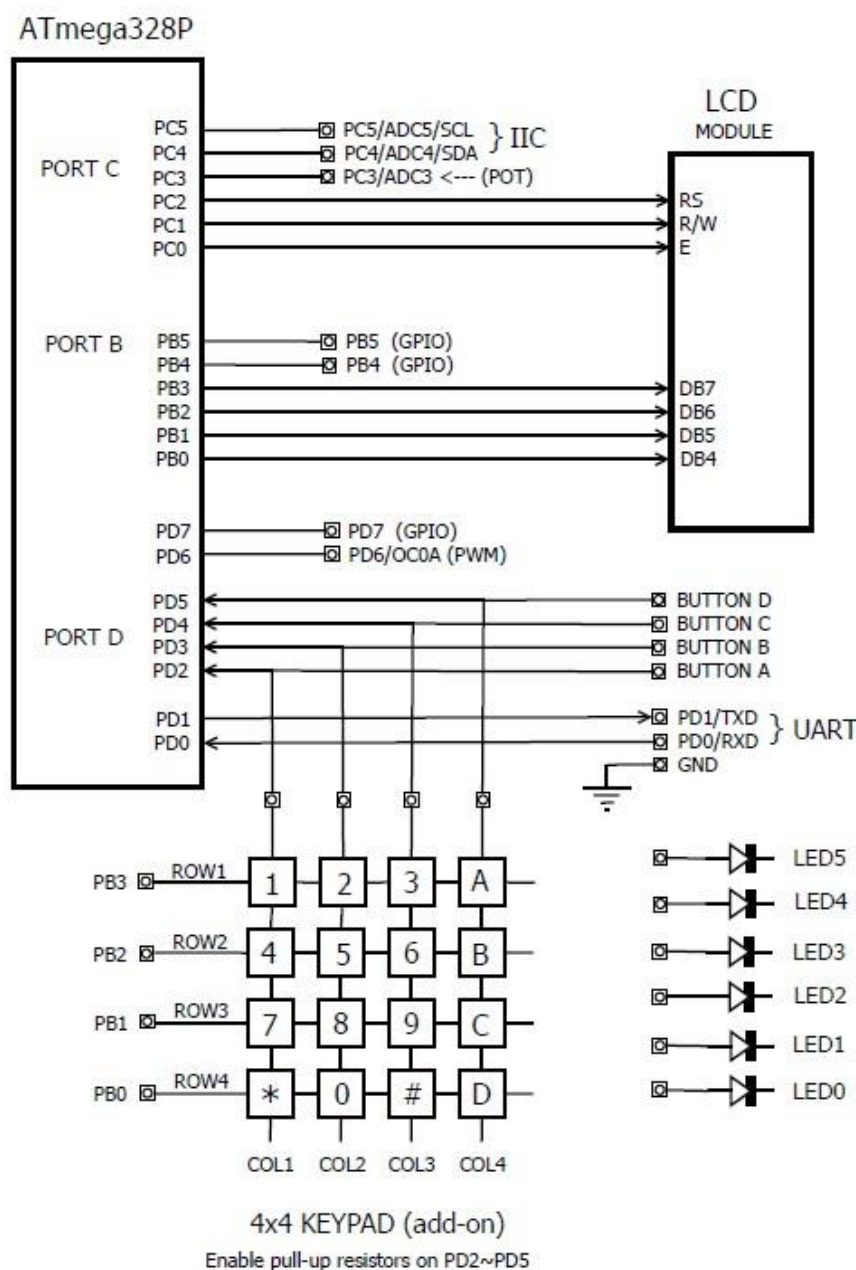
Refer to the LCD data-sheet (1602A) for pin numbers of signals, power supply and trim-pot (Vo). Some extracts from the data-sheet are copied below. There is a diagram showing the required connections, but you need to add the pin numbers.

Use the (yellow) multi-turn trim-pot. If you have an LCD panel with a DIL (2 x 8 pin) connector, be sure to observe the pin numbering shown on the bottom side of the PCB.

Figure 1-1. ATmega328P Xplained Mini Headers and Connectors



**Fig. 1.2. General peripheral wiring scheme for AVR X-mini board**



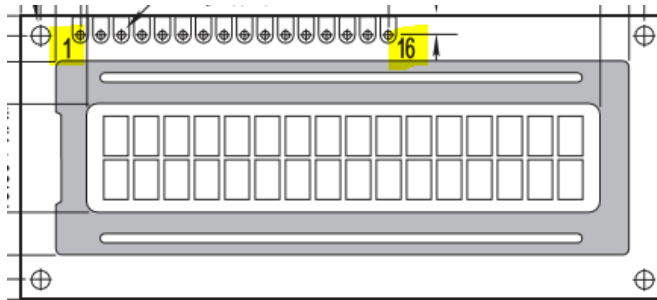
**Note:** This is a simplified schematic – it does not show LCD power connections, contrast adjust trim-pot, LCD backlight circuit, LED current-limiting resistors, push-button connections, etc.

Also, ensure that peripheral devices connected to PB3, PB4 and PB5 cannot interfere with these signals because they are used for device programming in ISP mode. The recommended precaution is to connect 470Ω series resistors from PB3, PB4 and PB5 to their respective external circuits.

To determine the finer details of LCD wiring connections, please refer to data sheets for the components supplied in your AVR X-mini kit. These data-sheets may be found in a ZIP folder named "Swinburne-AVR-Xmini-dev-kit-data.zip" which can be downloaded from Canvas "Resources and Materials" page.

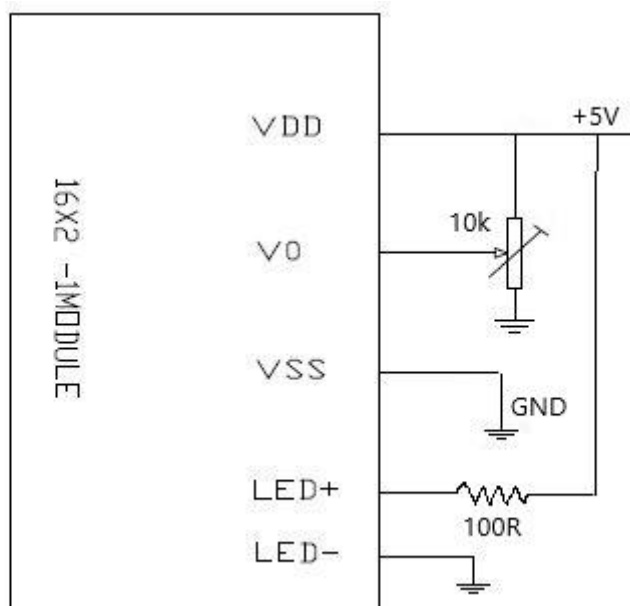
## LCD module (part # 1602A, FDCC1602N or PC1602LRS-HWB)

Pins 1 – 16:



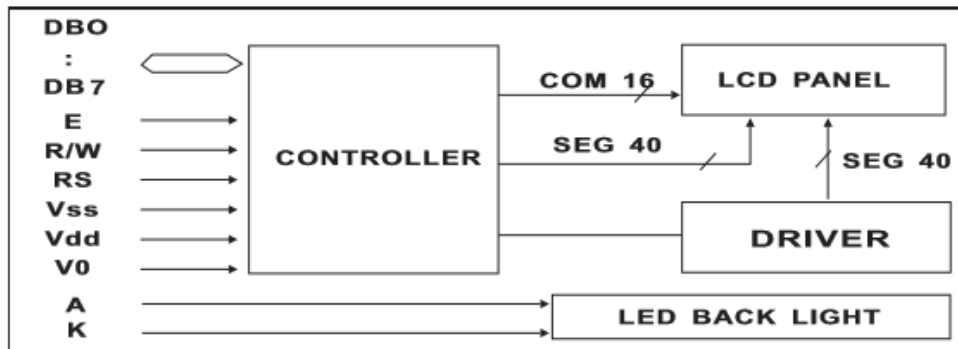
PIN ASSIGNMENT		
PIN	SYMBOL	FUNCTION
1	Vss	GND
2	Vdd	Power Supply
3	V0	Contrast Adjust
4	RS	Register Select Signal
5	R/W	Data Read/Write
6	E	Enable Signal
7-14	DB0-DB7	Data Bus Line
15(A)	LED+	Power supply for BKL(+)
16(K)	LED-	Power supply for BKL(-)

Power connections... (pin numbers to be added from above table)

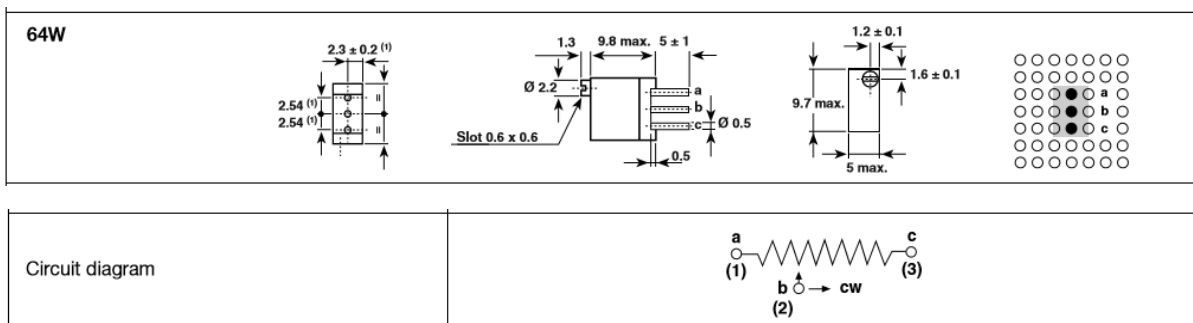


Note: A 100 ohm resistor in series with the backlight LED reduces brightness to a suitable level.

## LCD Block Diagram (external and internal signals):



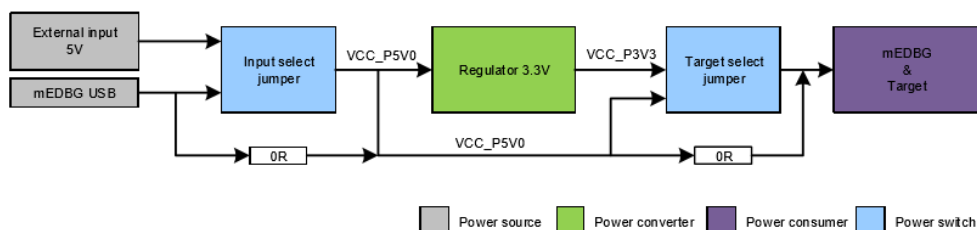
## Trim-pot for LCD contrast (10kΩ, 10 turn)



STANDARD RESISTANCE ELEMENT DATA				
STANDARD RESISTANCE VALUES	LINEAR LAW			TYPICAL TCR -55 °C +125 °C ppm/°C
	MAX. POWER AT 70 °C	MAX. WORKING VOLTAGE	MAX. CURRENT THROUGH WIPER	
Ω	W	V	mA	
10	0.5	2.2	224	± 100
20	0.5	3.2	158	
50	0.5	5	100	
100	0.5	7.1	71	
200	0.5	10	50	
250	0.5	11.2	45	
500	0.5	15.8	32	
1K	0.5	22.4	22	
2K	0.5	31.6	16	
2.5K	0.5	35.4	14	
5K	0.5	50	10	
10K	0.5	70.7	7.1	
20K	0.5	100	5	
25K	0.5	112	4.5	
50K	0.5	158	3.2	
100K	0.5	224	2.2	
200K	0.31	250	1.3	
250K	0.25	250	1	
500K	0.125	250	0.5	
1M	0.063	250	0.25	
2M	0.031	250	0.13	

## ATmega328P Xplained Mini

Figure 4-2. Power Supply Block Diagram



We will use the default power source from the USB port (Vbus) which is 5.0V

The USB port is protected with a 500mA PTC resettable fuse.

4.3.2 Board Power Header

The J202 header enables connection to the ATmega328P Xplained Mini power system.

Table 4-3. J202 Power Header

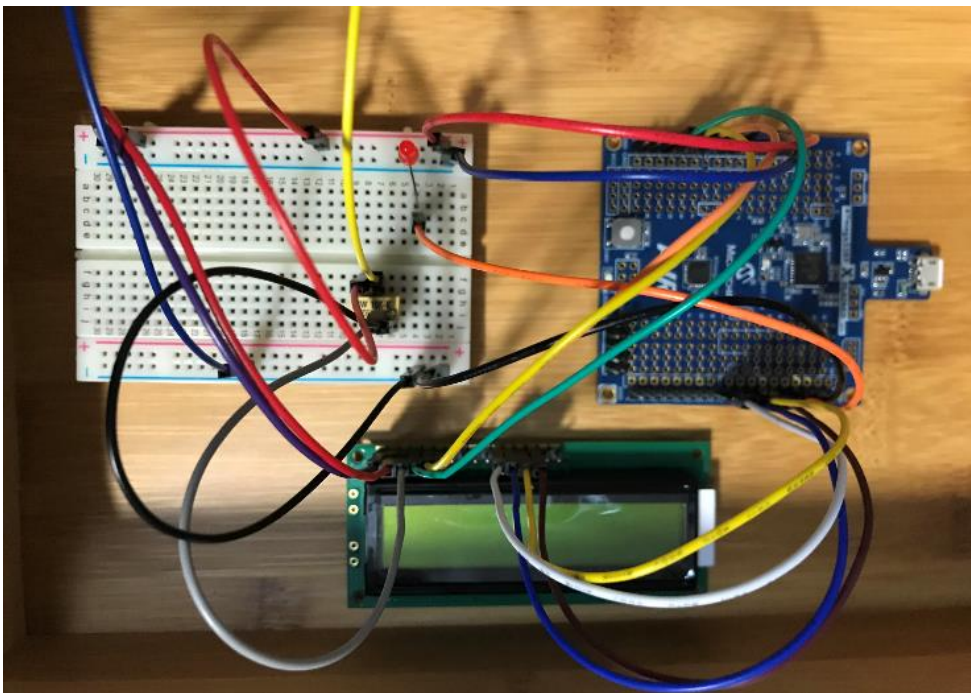
J202 pin	Signal	Description
1	NC	
2	VCC_TARGET	The power source selected for the target (selected by J301)
3	RESET_SENSE	This is a RESET signal monitored by the mEDBG, if pulled low the target RESET line will be pulled low by the mEDBG. The ATmega32U4 internal pull-up is enabled. This signal is not available during debugging.
4	VCC_P3V3	The 3.3V regulator output
5	VCC_P5V0	The selected power source (VIN or VBUS selected by J300)

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J202 pin	Signal	Description
6	GND	
7	GND	
8	VCC_VIN	The external power source connection

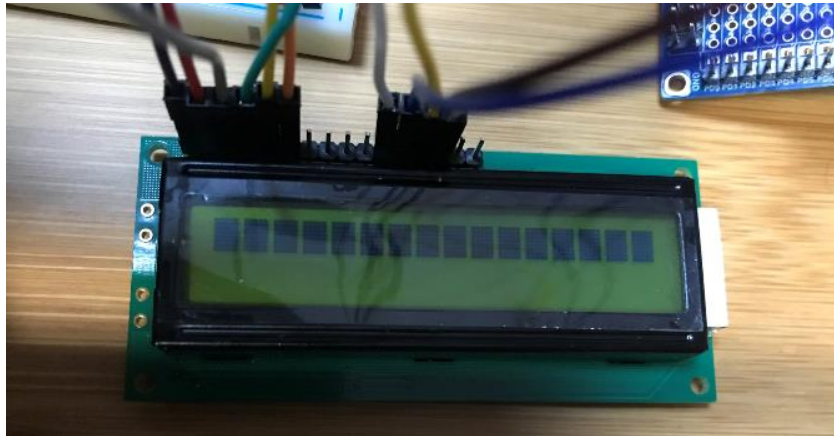
Testing the LCD module

When you have your LCD wired up to the X-mini board, try loading and running the test program, “x-mini-LCD-test-v1-2” (found in the code library ZIP pack). Instructions for programming the board are in the “Quick Start Guide” (also posted on Canvas Resources & Materials). You do not need to create a new Atmel Studio project for this test... simply load the “hex” object file into the Programming Tool in the field named “Flash program (32kB)” and hit “Program”.





Make sure the LCD contrast is adjusted for the display to work. When properly adjusted, the voltage on Vo (pin 3) should be between 0V and 1V. It is recommended to set the voltage on Vo to about 0.7V before loading and running the test program. The picture below shows the LCD screen after the USB cable is connected, but before the test program is loaded and running.



When the program is operating and text is visible on the LCD screen, adjust the contrast again for best display quality.

The test program does a little more than just display some text on the screen. It prompts you to “Press button A”. To see what happens then, you’ll need to wire a push-button from the X-mini pin PD2 to GND (and press it).

## Next steps

Once you have your LCD module operating successfully, examine the C source code for the test program and try to understand how it works. Note that the LCD “driver” functions are contained in a “code library”, which is a pre-built object code file named “**lib\_avrXmini.a**”. Comments in the associated header file “**lib\_avrXmini.h**” explain how to use the LCD functions (and macros) in your programs.

To get a deeper understanding of the workings of the LCD library functions, examine the source code in file “**lib\_avrXmini.c**” in conjunction with the LCD controller (HD44780) data-sheet.

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Now you are ready to write your own programs to display data on the LCD panel.

Begin by working through **Lesson #2** in the “**AVR Embedded C Tutorial**” (download from Canvas). The tutorial explains how to incorporate the necessary AVR code library into your projects. The tutorial refers to various AVR development platforms. Be sure to use the particular code library required for the **X-mini board**.