

Connecting the RepRapDiscount LCD Interface to the RAMBo 3D Printer Controller

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Based upon the original work of os1r1s (Sonny).

The first thing to understand when wiring up the LCD interface is that it's wired a bit weird. If you're coming at this task as an electronics neophyte, you'll have no problem at all. If you've got a few years of electronics experience under your belt, it will blow your mind. I ask that you read this entire guide before beginning the task of assembling the wiring for the LCD interface. There will be relevant information sprinkled throughout that while very useful, is not necessarily in task-order.

The LCD interface package should contain at a minimum, the LCD interface itself and two lengths of 10 pin ribbon cable with connectors on either end. If you're reading this guide, chances are that the connector interface board that mates to the RAMBo isn't available yet, or you don't have one.

In order to connect the LCD interface to the RAMBo, you're going to have to buy some connector shells and pins for them. You'll need one 8 pin DIP connector and one 20 pin DIP connector. Jameco sells them very inexpensively. Here's a list of the part numbers you'll need.

103254	8 pin header (1 each)
103230	20 pin header (1 each)
100766	Female connector pins (28+ each)

I would recommend that you get four or five extra connector pins on the chance that you may ruin a few during the assembly process. I will say right now that crimping those pins on to the tiny gauge wire used on the ribbon cables can be problematic. I soldered mine because the crimp couldn't grab the wire properly. The best route to take with this is to build yourself a completely new wiring harness using 24ga wire and an additional two 10 pin header connectors. If you would like to do that, the 10 pin header connector part number is 157421. You'll need two of those and another 20 pins (or so).

I'll cover how to make up the cable using the supplied ribbon cable first. Label the two cables, "A" and "B". Mark the back of the LCD interface board as shown below:

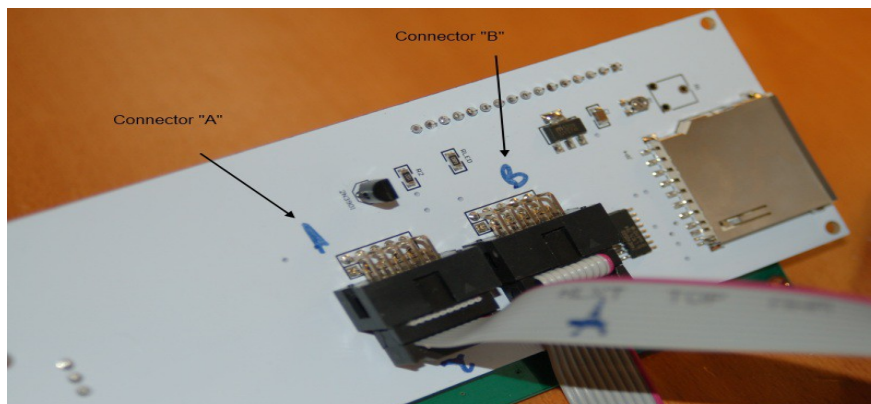


Fig. 1 - Board labeling.

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It's important that you mark it as shown in order to ensure that the wiring on the other end is correct.

Prepare the "B" cable first by cutting off the connector from one end of the ribbon cable and then split the 10 wires out enough so that you can strip the insulation and add connectors to them.

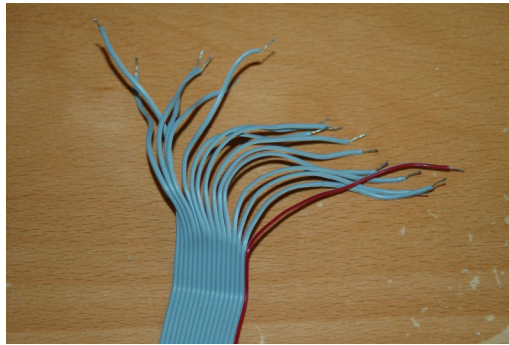


Fig. 2 - Stripped wires.

The connectors you're going to be using were designed to be crimped and not soldered, so the first thing you're going to need to do is clip off the strain relief portion of the pin.



Fig. 3 - Strain relief crimp removed.

As you can see above the connector is pretty small, so you'll need to be careful with it in order to not crush the end that grips the pin.

When you've got the strain relief clipped off, you'll want to use a small pair of pliers to gently close the second set of "ears" a tiny amount. This will help them clear the pin throat of the connector shell. Figure 4 on the following page illustrates the "squeeze" as it were.

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Fig. 4 - Connector end squeezed together a small amount.

I know it's kind of hard to see, but the end result should leave the two crimp ears parallel with one another.

Next up, you'll solder the two together. I recommend stripping about 1/4" or 6mm of insulation from the wire and then "tin" it, or apply a little solder to the wire before installing it.

When you're done, you'll have something that looks like Figure 5 below.

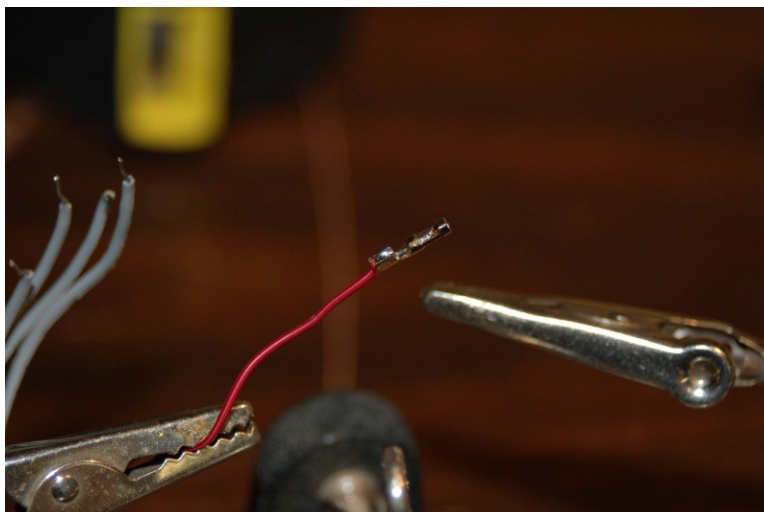


Fig. 5 - Connector soldered up and ready to go.

The alligator clips you see in the photo make this soldering task very simple to do. I would recommend you buy a set if at all possible. Your local Radio Shack should carry them – they're called "helping hands" and should be less than \$10.

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For the “B” cable, you’re going to add female connectors to 8 of the wires. Here’s the crazy part – ***THE RED WIRE ON THE CABLE INDICATES PIN 10, NOT PIN #1!*** This applies to the “A” cable as well. Don’t ask me why – it’s just one of those things we have to roll our eyes at, suck it up and deal with it. The wires on each cable will be referred to by their cable name followed by the pin number, so “A10” refers to pin #10 on the cable marked “A”.

Once the “B” cable is pinned, go ahead and wire up the “A” cable. All 10 wires on the “A” cable get connectors.

The 8 pin connector shell is for the SPI connector on the RAMBo board. Please refer to this image of the RAMBo on the RepRap wiki: <http://www.reprap.org/mediawiki/images/8/8b/Rambo-conn-main.jpg>

The connectors you’ll be using are the ones marked “EXT2” and “SD/SPI”. On the board, the SPI connector is going to look like this:

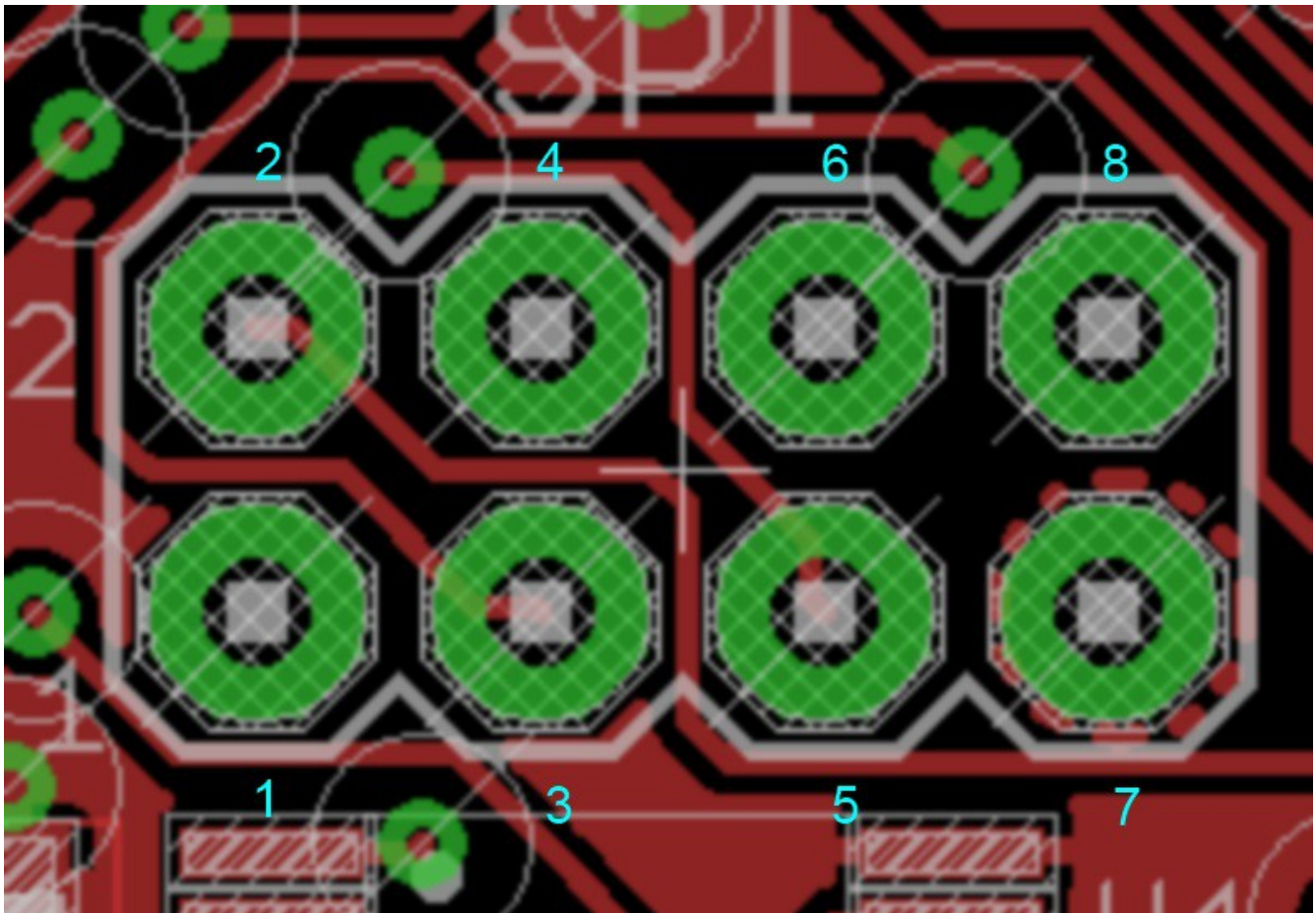


Fig. 6 - SPI Connector pin arrangement.

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You'll notice that pin #1 is at the lower left edge of the connector and all the odd numbered pins are on the bottom row and the even numbered pins are along the top row.

Let's go ahead and wire up the SPI connector at this time – it will use two wires (A10 and A9) from the “A” cable and four wires (B1, B2, B4 and B6) from the “B” cable. Insert the connectors into the 8 pin shell using the following table:

Wire	RAMBo Pin Description	SPI Pin #
A10	Vcc	1
	N/C	2
B1	MISO	3
B6	MIS1	4
B2	SCK	5
B4	SS	6
A9	GND	7
	N/C	8

Fig. 7 - SPI Connector Pinout.

Note that items marked as “N/C” have no connection and are unused.

To insert the connectors into the shell, orient the pin as shown below and shove it in to the connector throat until you hear two tiny clicks or the pin is obviously fully seated.

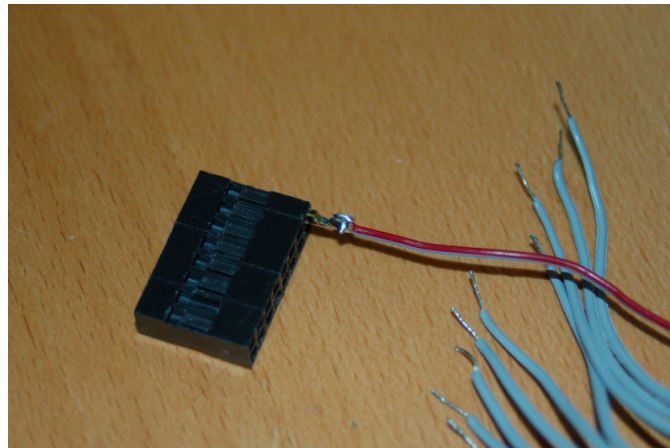


Fig. 8 - Setting a pin in a connector.

The figure above is simply for illustrative purposes – it was spare and doesn't represent any specific configuration in this guide.

Once you've got the **SPI** connector populated, you can move on to the **EXT2** connector. This is a 20 pin connector that carries most of the data to and from the LCD panel.

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The 20 pin **EXT2** connector looks like this:

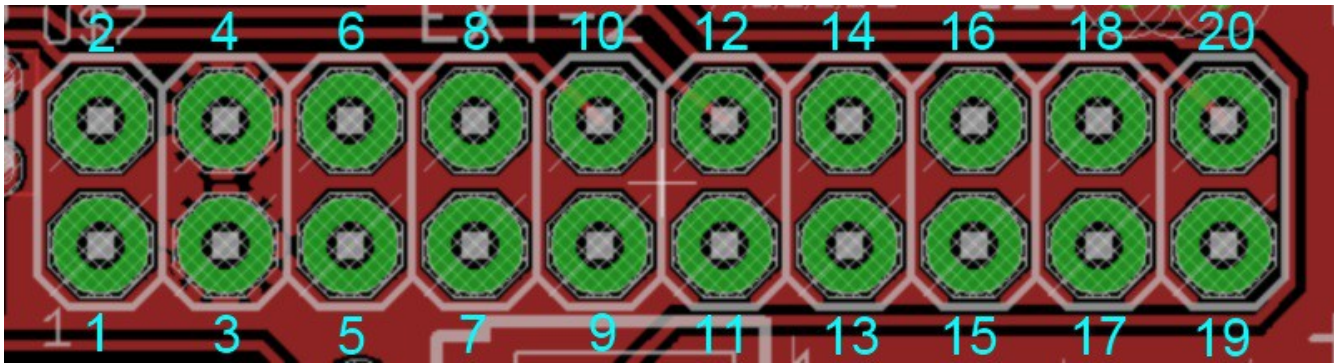


Fig. 9 - EXT2 Connector arrangement.

As with the **SPI** connector, pin #1 is on the far left of the bottom row. Below you'll find the wiring guide for the **EXT2** connector.

Wire	RAMBo Pin Description	EXT2 Pin #
	N/C	1
	N/C	2
	N/C	3
	N/C	4
A4	PG4	5
	N/C	6
A3	PG3	7
	N/C	8
A5	PJ2	9
	N/C	10
A6	PJ3	11
	N/C	12
A7	PJ7	13
B7	PD4	14
A8	PJ4	15
B8	PE7	16
B3	PJ5	17
A1	PE6	18
B5	PJ6	19
A2	PE2	20

Fig. 10 - EXT2 Connector Pinout

As with the **SPI** connector, locations marked “N/C” are not connected and shouldn't have a pin inserted at that location.

At the end of this guide is a table that lists all 18 connections and their descriptions. I did this to

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make quality-checking your work a bit easier.

This completes the wiring task for the LCD panel installation guide. Up next is making modifications to your Arduino environment and the Marlin firmware.

Please note that these instructions apply only to the 0023 version of the Arduino environment. More up to date versions may be different and the instructions that follow may not work properly.

The Arduino 0023 environment doesn't know about all the pins that are available with the RAMBo controller board, so it needs to be told. The simplest way to do this is to download the zip file here: http://www.reprap.org/mediawiki/images/c/c0/Update_arduino_pins.zip and unpack the contents to your Arduino directory – the path would be “arduino-0023/hardware/arduino/cores/arduino” - you're replacing the file called “arduino_pins.c”. Please make a backup copy of this file before you unpack the downloaded zip file.

You'll want to check the directory to ensure that the new file has in fact been placed in the right place – when you unpack the zip file, it should have queried you about over-writing an existing file.

Once you've got the Arduino file changed, you'll need to load up the Marlin firmware project into the Arduino IDE and navigate to the tab that is marked “fastio.h”. Search for the text “**#define DIO69_PWM NULL**” and insert the code below Figure 11 at the point marked.

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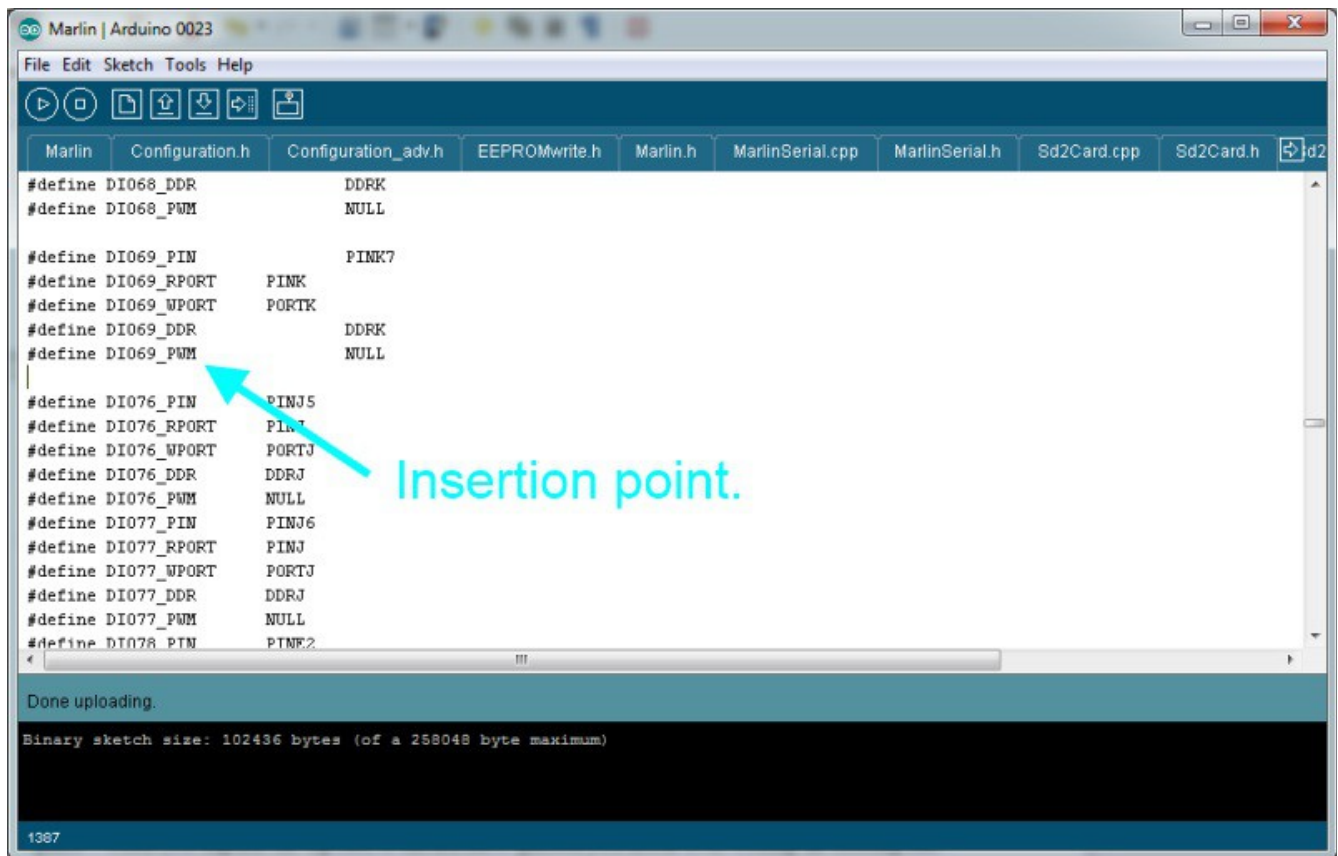


Fig. 11 - Updating fastio.h

Code to insert:

```
#define DIO76_PIN      PINJ5
#define DIO76_RPORT    PINJ
#define DIO76_WPORT    PORTJ
#define DIO76_DDR      DDRJ
#define DIO76_PWM      NULL
#define DIO77_PIN      PINJ6
#define DIO77_RPORT    PINJ
#define DIO77_WPORT    PORTJ
#define DIO77_DDR      DDRJ
#define DIO77_PWM      NULL
#define DIO78_PIN      PINE2
#define DIO78_RPORT    PINE
#define DIO78_WPORT    PORTE
#define DIO78_DDR      DDRE
#define DIO78_PWM      NULL
```


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```
#define DIO79_PIN      PINE6
#define DIO79_RPORT    PINE
#define DIO79_WPORT    PORTE
#define DIO79_DDR      DDRE
#define DIO79_PWM      NULL
#define DIO80_PIN      PINE7
#define DIO80_RPORT    PINE
#define DIO80_WPORT    PORTE
#define DIO80_DDR      DDRE
#define DIO80_PWM      NULL
#define DIO81_PIN      PIND4
#define DIO81_RPORT    PIND
#define DIO81_WPORT    PORTD
#define DIO81_DDR      DDRD
#define DIO81_PWM      NULL
```

Click the Save icon in the IDE and navigate to the **Configuration.h** file. Scroll down to around line 250 and look for code that matches what you see below in Fig. 12.

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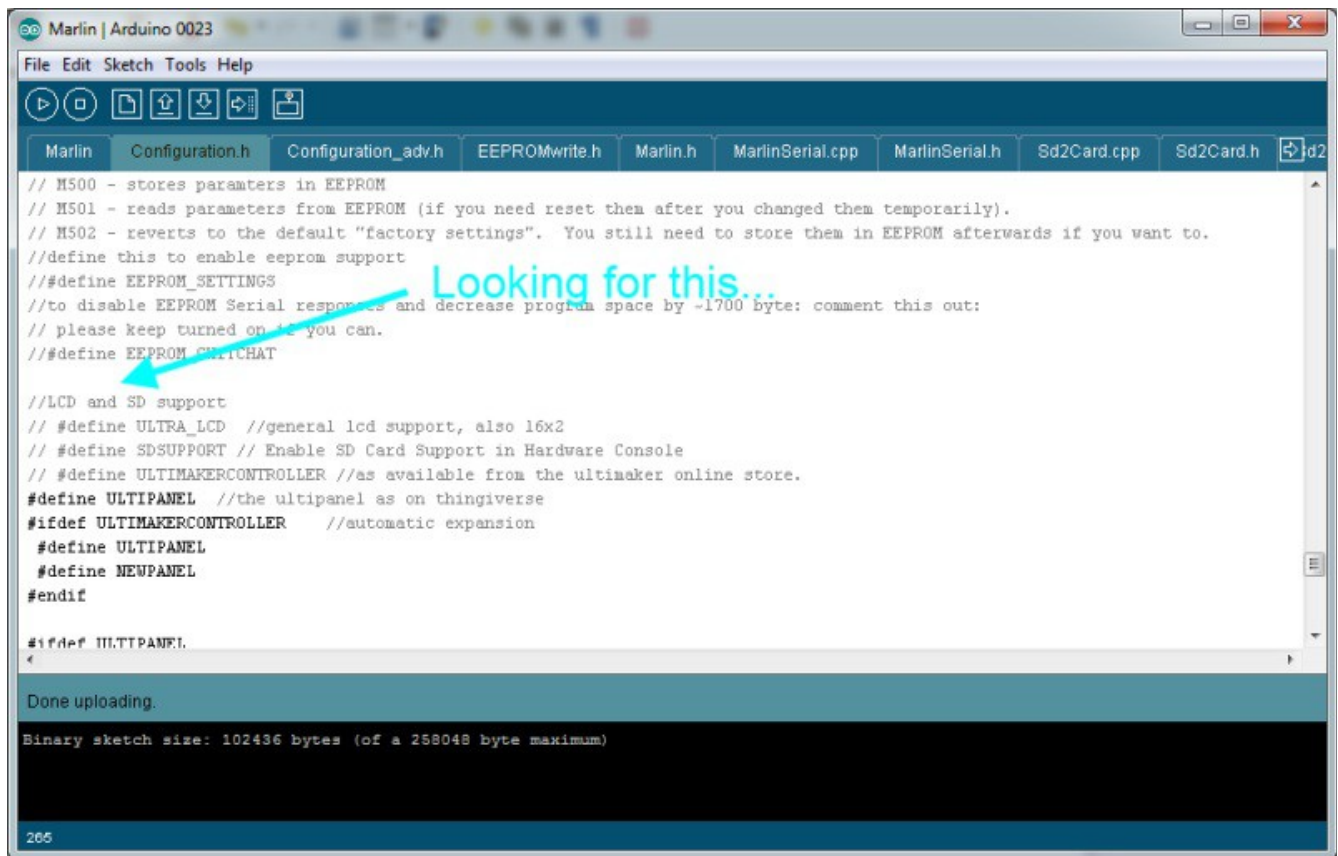


Fig. 12 - Modifying Configuration.h

Once you've found that section, please make sure that it matches the below code snippet *exactly*.

```
//LCD and SD support
// #define ULTRA_LCD //general lcd support, also 16x2
// #define SDSUPPORT // Enable SD Card Support in Hardware Console
// #define ULTIMAKERCONTROLLER //as available from the ultimaker online store.
#define ULTIPANEL //the ultipanel as on thingiverse
#ifdef ULTIMAKERCONTROLLER //automatic expansion
  #define ULTIPANEL
  #define NEWPANEL
#endif

#ifdef ULTIPANEL
#define NEWPANEL //enable this if you have a click-encoder panel
  #define SDSUPPORT
  #define ULTRA_LCD
  #define LCD_WIDTH 20
  #define LCD_HEIGHT 4

// Preheat Constants
#define PLA_PREHEAT_HOTEND_TEMP 170
#define PLA_PREHEAT_HPB_TEMP 60
#define PLA_PREHEAT_FAN_SPEED 0 // Insert Value between 0 and 255
```

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```
#define ABS_PREHEAT_HOTEND_TEMP 240
#define ABS_PREHEAT_HPB_TEMP 100
#define ABS_PREHEAT_FAN_SPEED 255 // Insert Value between 0 and 255
#else //no panel but just lcd
#ifdef ULTRA_LCD
    #define LCD_WIDTH 16
    #define LCD_HEIGHT 2
#endif
#endif
```

Once you've made the needed changes, click the Save icon to commit your changes.

Navigate to the tab for the pins.h file. Around line 1200, you'll see definitions for **SDSS** and for **KILL_PIN**. Change the definition for **SDSS** to 53 and the definition of **KILL_PIN** to 80 as shown below in Figure 13.

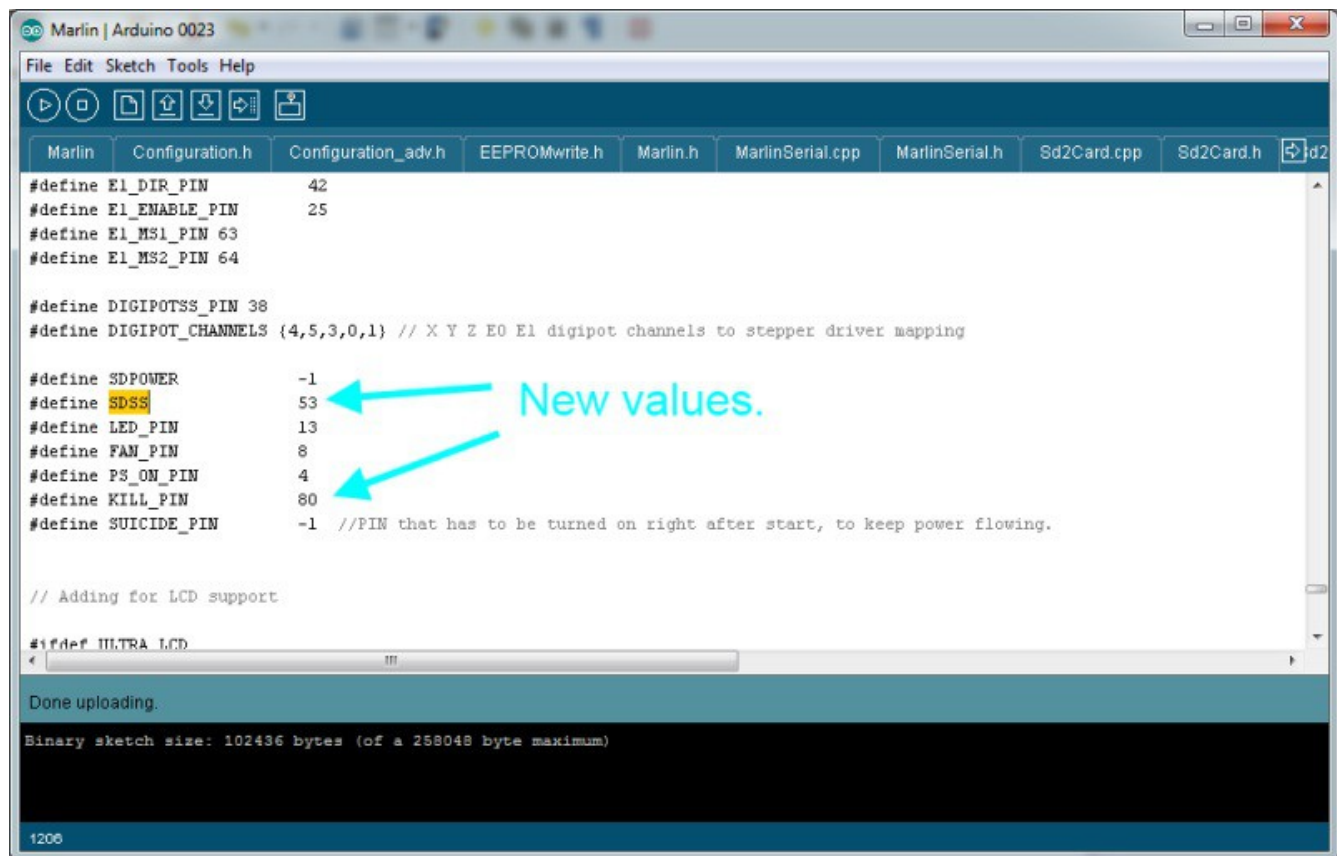


Fig. 13 - Updating pin definitions in pins.h

After those two items are changed, insert the code on the next page, right after the **SUICIDE_PIN** definition show in Fig. 13.

```
#ifdef ULTRA_LCD
    #ifdef NEWPANEL
```

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```
//arduino pin which triggers an piezzo beeper
#define BEEPER 79          // Beeper on AUX-4
#define LCD_PINS_RS 70
#define LCD_PINS_ENABLE 71
#define LCD_PINS_D4 72
#define LCD_PINS_D5 73
#define LCD_PINS_D6 74
#define LCD_PINS_D7 75

//buttons are directly attached using AUX-2
#define BTN_EN1 76
#define BTN_EN2 77
#define BTN_ENC 78  //the click

#define BLEN_C 2
#define BLEN_B 1
#define BLEN_A 0

#define SDCARDDTECT 81    // Ramps does not use this port

//encoder rotation values
#define encrot0 0
#define encrot1 2
#define encrot2 3
#define encrot3 1
#else //old style panel with shift register
//arduino pin witch triggers an piezzo beeper
#define BEEPER 33    No Beeper added
//buttons are attached to a shift register
// Not wired this yet
// #define SHIFT_CLK 38
// #define SHIFT_LD 42
// #define SHIFT_OUT 40
// #define SHIFT_EN 17

#define LCD_PINS_RS 75
#define LCD_PINS_ENABLE 17
#define LCD_PINS_D4 23
#define LCD_PINS_D5 25
#define LCD_PINS_D6 27
#define LCD_PINS_D7 29

//encoder rotation values
#define encrot0 0
#define encrot1 2
#define encrot2 3
#define encrot3 1

//bits in the shift register that carry the buttons for:
// left up center down right red
#define BL_LE 7
#define BL_UP 6
#define BL_MI 5
#define BL_DW 4
```

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```
#define BL_RI 3
#define BL_ST 2
#define BLEN_B 1
#define BLEN_A 0
#endif
#endif //ULTRA_LCD
```

Now save your changes and click the Verify icon in the IDE. If the code compiles without error, disconnect the USB cable and install the new wiring harness you built to the RAMBo and to the LCD panel. Take special care to make sure you're installing the connectors properly. It won't hurt anything if the connector is installed backwards (that I know of!), but the RAMBo may not boot and the LCD won't function. Once you've got everything connected, re-connect the RAMBo to your computer and upload the new firmware to it.

After the upload is complete, the RAMBo will reset and you should see a display similar to the following example:



Fig. 14 - LCD initialized and ready to rock!

To get the most out of the LCD please download the companion document <http://www.geneb.org/rostock-max/lcd-menu-tree.pdf>. That PDF file was originally included with the SeeMeCNC distribution of the LCD-enabled Marlin firmware. It can be found here: <https://github.com/johnoly99/Marlin-for-rostockmax-ramboLCD>

The table below was created in order to assist you in checking your work – it's much easier to go straight down the list in origin pin order than it is to hop all over the place using the two tables you wired from originally. You could also use this table if you're planning on building a wiring harness from scratch like I did.

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LCD Wire	Description	RAMBo Wire	Description
A1	Beeper	EXT2-18	PE6
A2	BTN_ENC	EXT2-20	PE2
A3	EN	EXT2-7	PG3
A4	RS	EXT2-5	PG4
A5	D4	EXT2-9	PJ2
A6	D5	EXT2-11	PJ3
A7	D6	EXT2-13	PJ7
A8	D7	EXT2-15	PJ4
A9	GND	SPI-7	GND
A10	Vcc	SPI-1	Vcc
B1	MISO	SPI-3	MISO
B2	SCK	SPI-5	SCK
B3	BTN_ENC1	EXT2-17	PJ5
B4	SS	SPI-6	SS
B5	BTN_ENC2	EXT2-19	PJ6
B6	MOSI	SPI-4	MOSI
B7	SDCARDDET	EXT2-14	PD4
B8	KILL_PIN	EXT2-16	PE7
B9	N/C		
B10	N/C		

. Fig. 15 - Complete wiring table.

This is the wiring harness I built. I'm not a fan of delicate wiring connections and that's what you'll end up with if you use crimp-on connectors with that very tiny ribbon cable wire unless you're able to crimp them properly. The harness shown was built using the parts I list from Jameco and 18, 18" long 24ga wires.



Fig. 16 - Hand-built wiring harness for the LCD panel