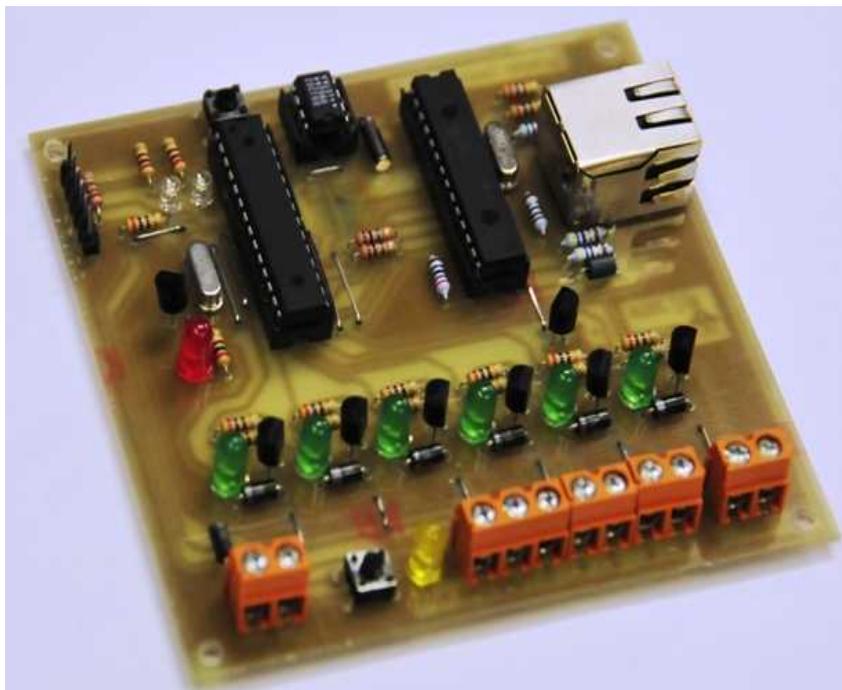# Sprinkler Controller Assembly Manual

V1.0

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Welcome

Thanks for deciding to make this amazing sprinkler controller project.

This project allows you to create a remote sprinkler controller that can operate up to 5 sprinkler solenoids as well as one pump. Each output can be turned on for a specified amount of time, according to a pre-set watering pattern. A special version of the software has been provided to allow compliance with the ACT Governments Odds and Evens watering schedule, where odd numbered houses can only water on odd days, and even houses can only water on even days. Configuration of the board is performed using a computer and a Web Browser.

You will find that construction of the project is very simple. If you are methodical with your construction practices, and careful with you soldering, you will find that the board almost assembles itself.

Parts List

The first thing you need to do is to verify that you have all of the necessary components required to assemble your controller. Here is the complete parts list. Feel free to check off each component as you verify it is present.

Capacitors

10uF SM	4		18pF SM	4
0.1uF SM	3			

Resistors

51R	4		270R	12
470R	6		2K7	1
10K	3			

Semiconductors

AtMega168 micro (DIP)	1		DS1302 RTC (DIP)	1
ENC38J60 Ethernet (DIP)	1		74HC08 AND Gate (SOIC)	1
GREEN LED 5mm	6		YELLOW LED 5mm	1
RED LED 5mm	1		BLUE LED 3mm	2
BC547 Transistor	6		1N4004 Diode	7
6Mhz crystal	1		32768Khz Crystal	1
25 Mhz crystal	1		78L05 Regulator	1
78L33 regulator	1			

Hardware

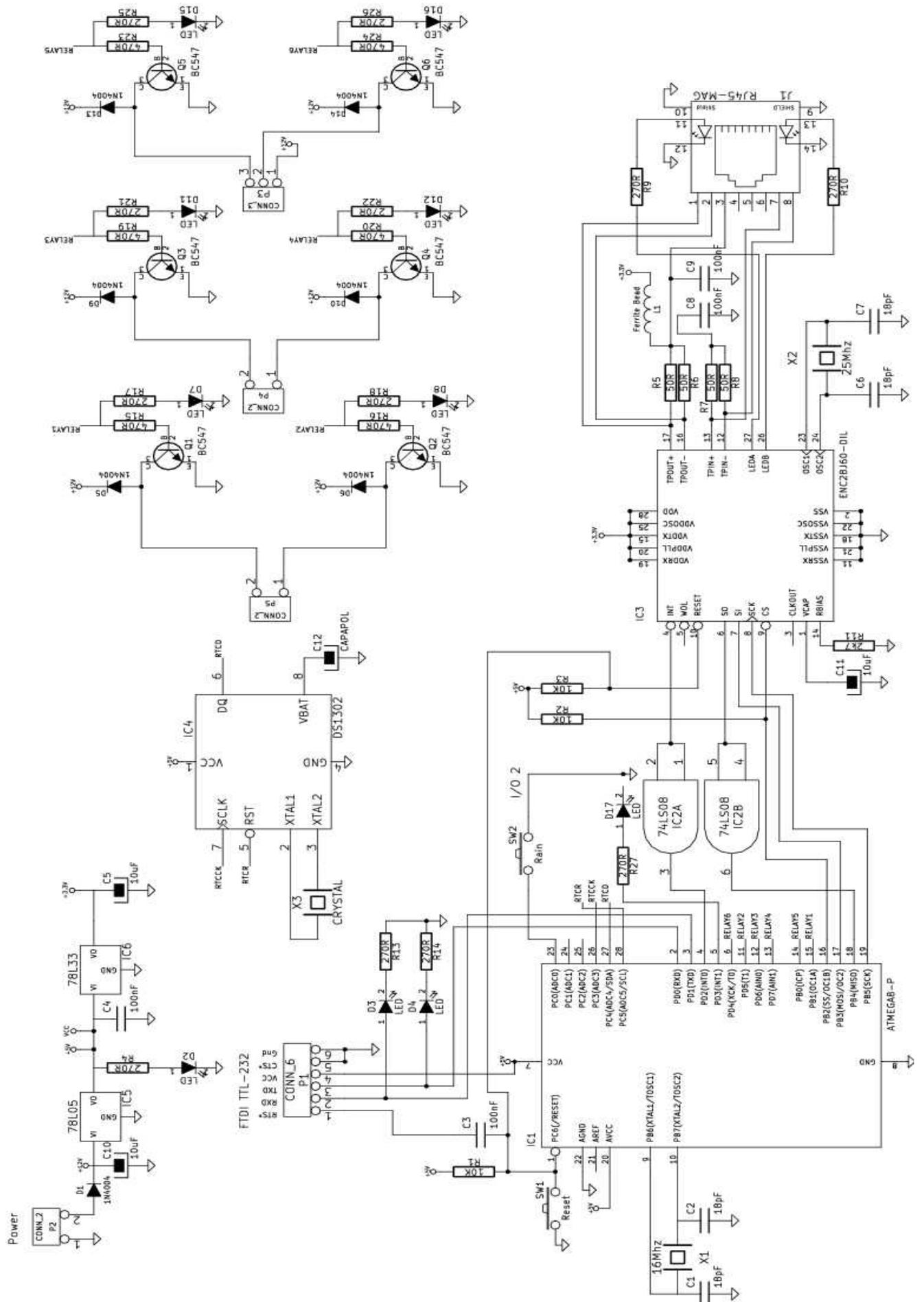|				
2 Pin PCB screw connector	4		3 Pin PCB screw connector	1
6 pin 0.1 inch pin array	1		Small Pushbutton	2
RJ45 MagJack from Sparkfun	1		8 Pin IC Socket 28 Pin IC Socket	1 2

Note: (SM) and (SOIC) designate surface mount components

Component Layout

Use the following diagram to assist you in locating components on the Sprinkler Controller PCB:
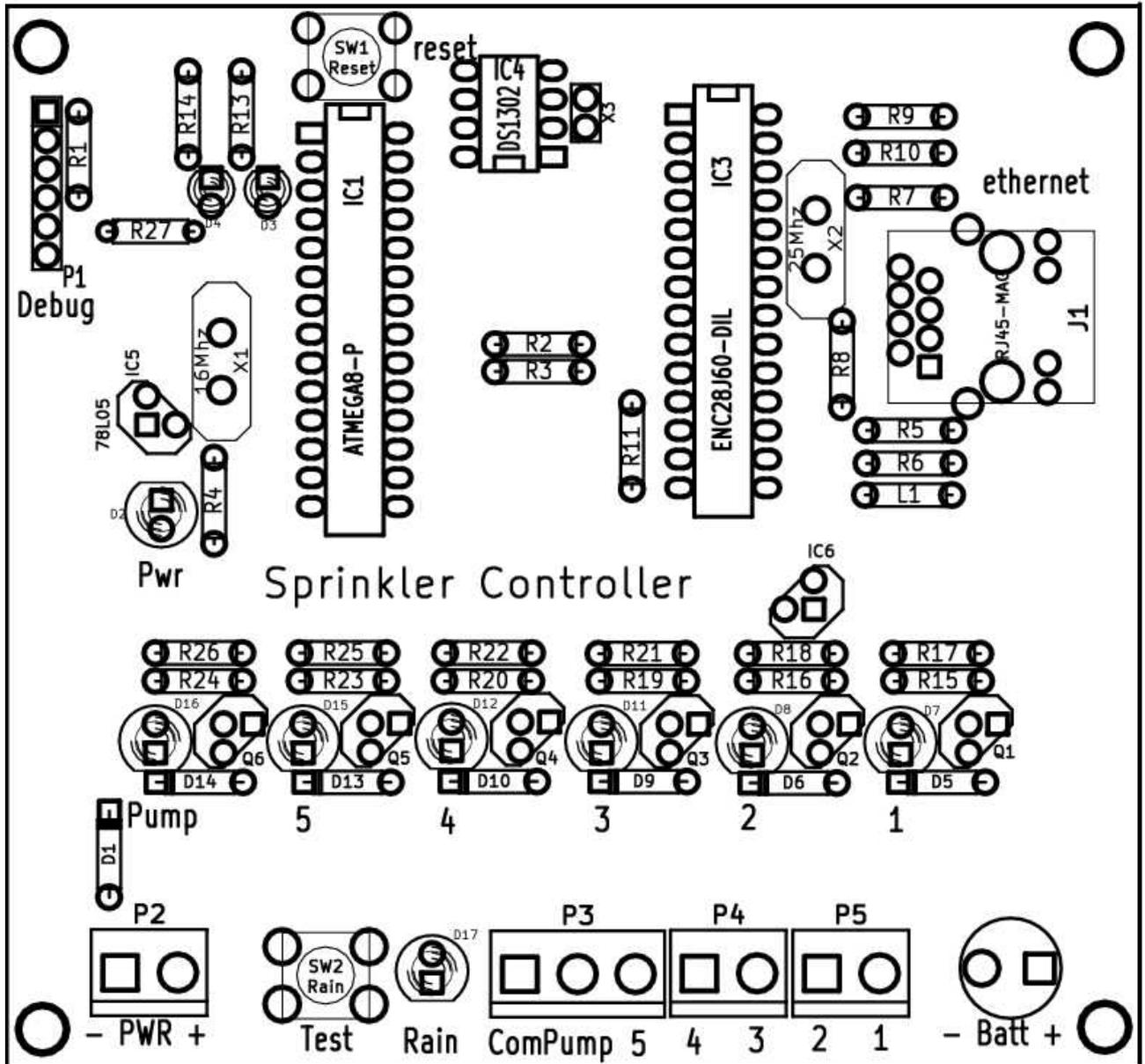
Schematic Diagram

Construction

Assembling the controller board is fairly simple. Start by inserting the links on the component side of the PCB. Care must be taken to ensure that no solder bridges are produced during soldering, linking adjacent tracks on the PCB. In all there are 15 links that have to be installed.

You may find that the protective coating that has been applied to the hand made PCB (to prevent oxidation) requires additional time to allow a proper solder bond. This is normal.
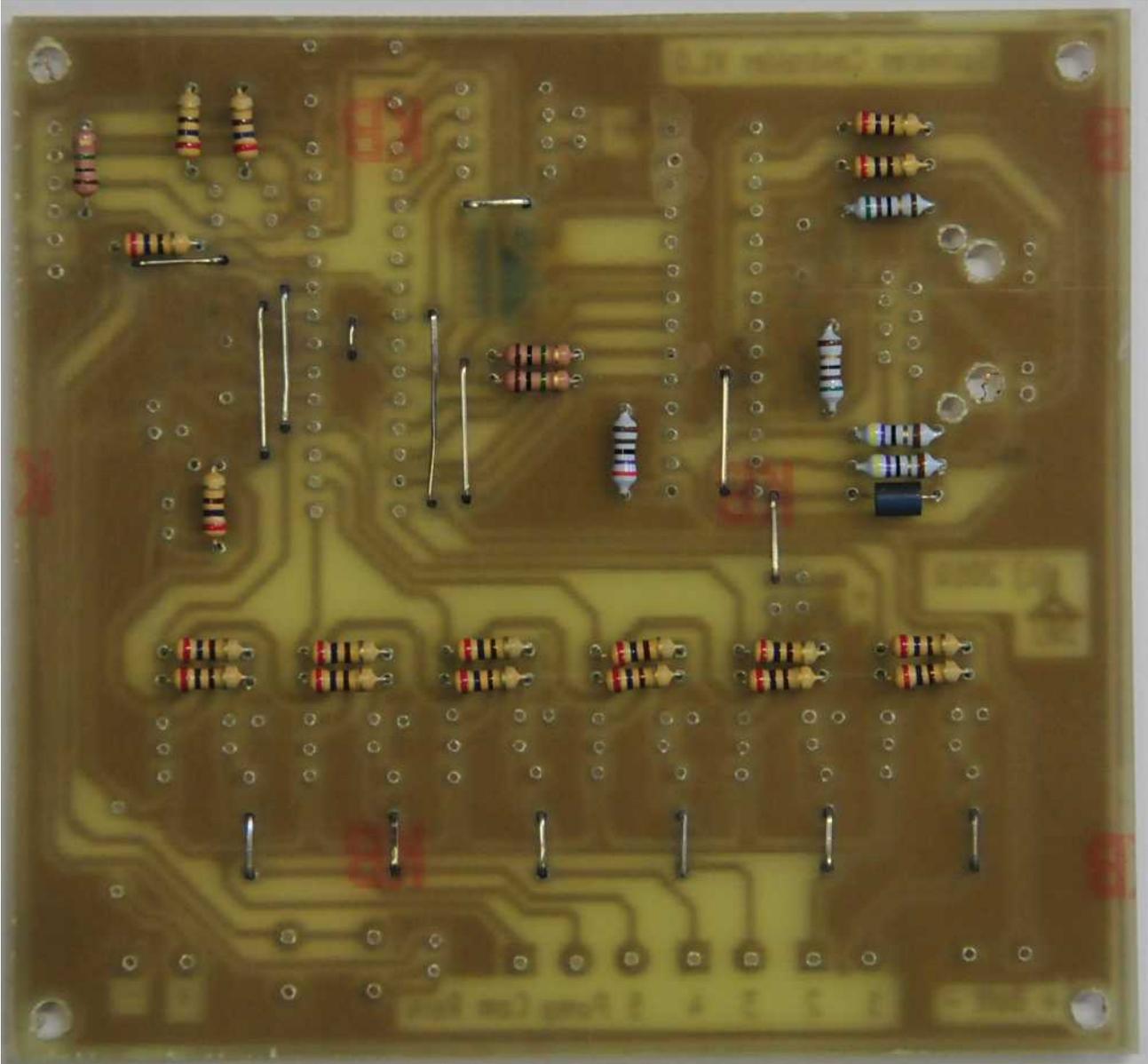
The below picture shows the location of the jumper wires. I use of offcuts of component leads which have been bent using a pair of needle nose pliers for jumpers. There is no need to use insulated wire.
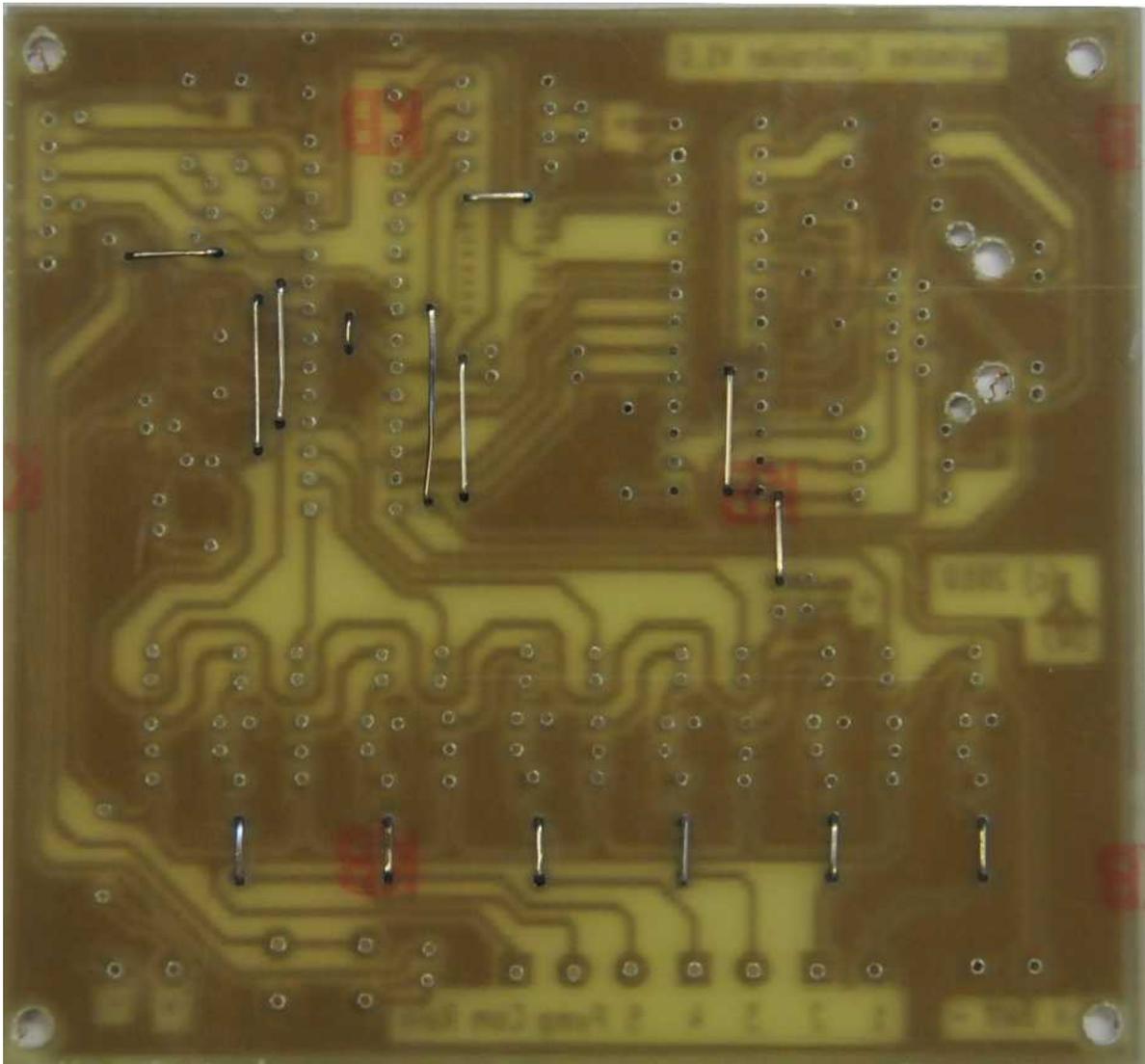
Continue assembly by soldering the suface mount components on the reverse side of the PCB.
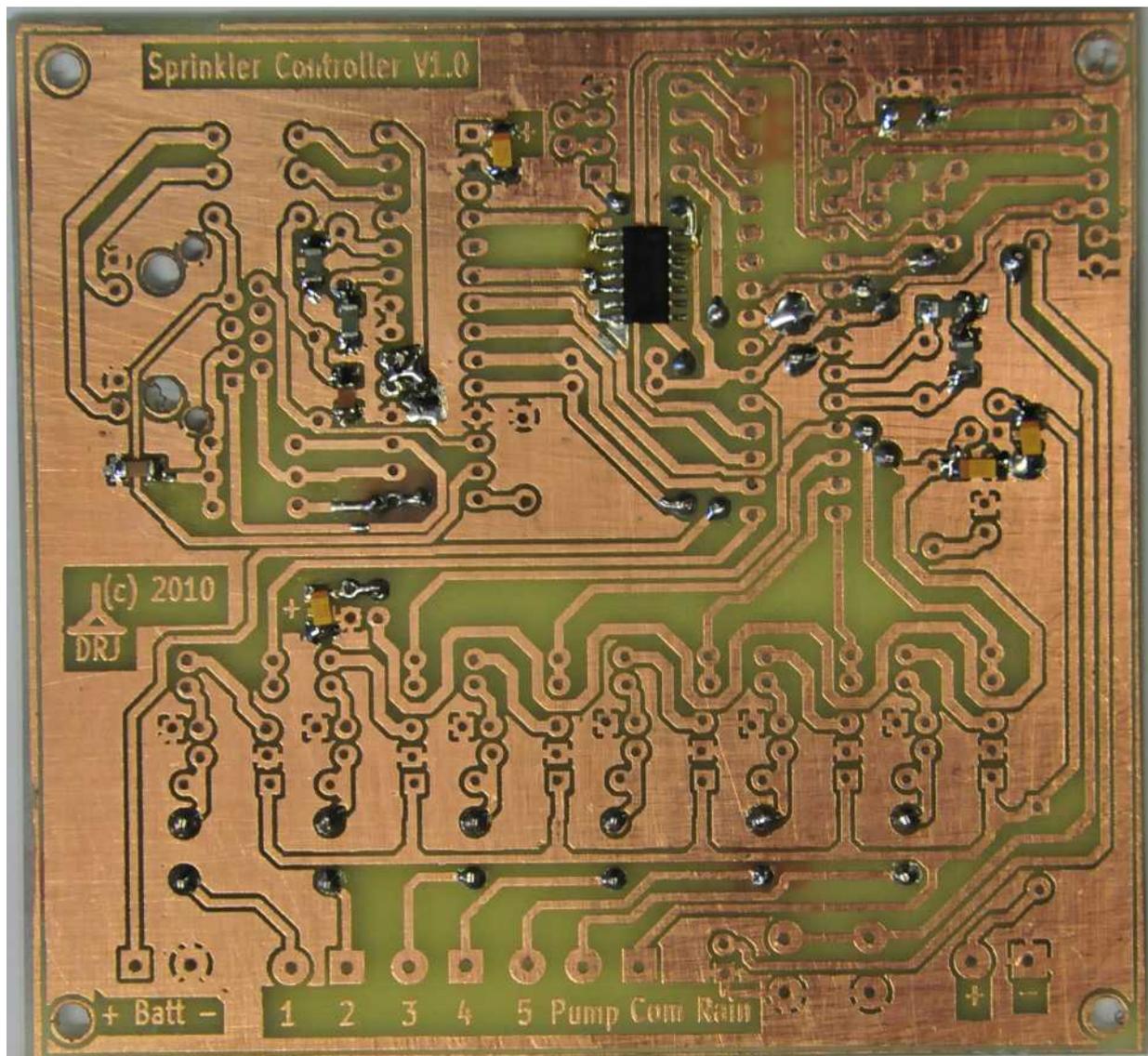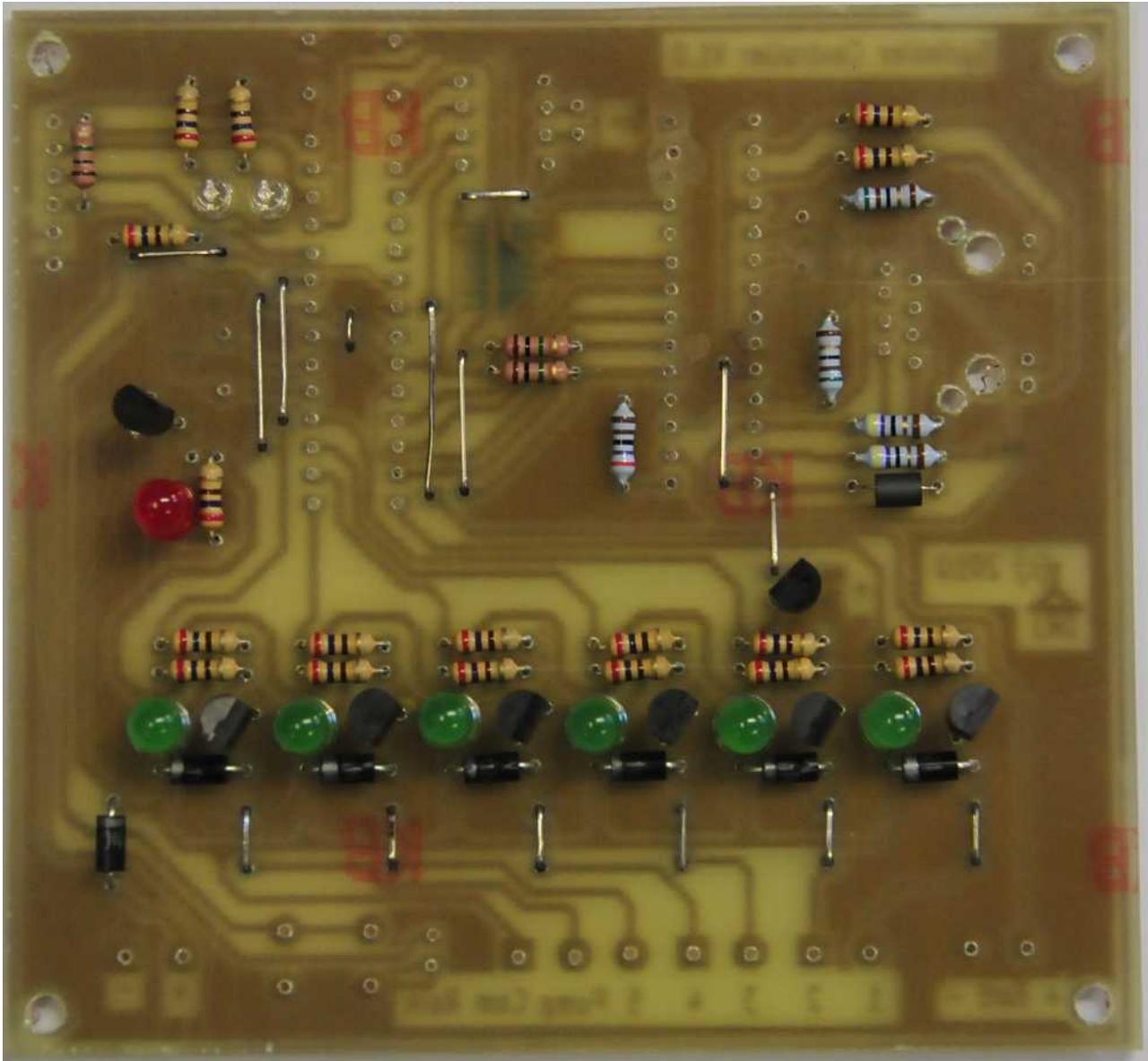
Next, insert the resistors.

The next step is to insert and solder the voltage regulators, transistors, diodes and LEDs . Be careful that the correct orientation is used for the components. The short lead of the LEDs should be inserted into the square hole on the PCB.

The following photo will help.

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Continue assembly by installing the crystals. Be very careful to install the 16Mhz crystal on the left of the board, and the 25Mhz crystal on the right.
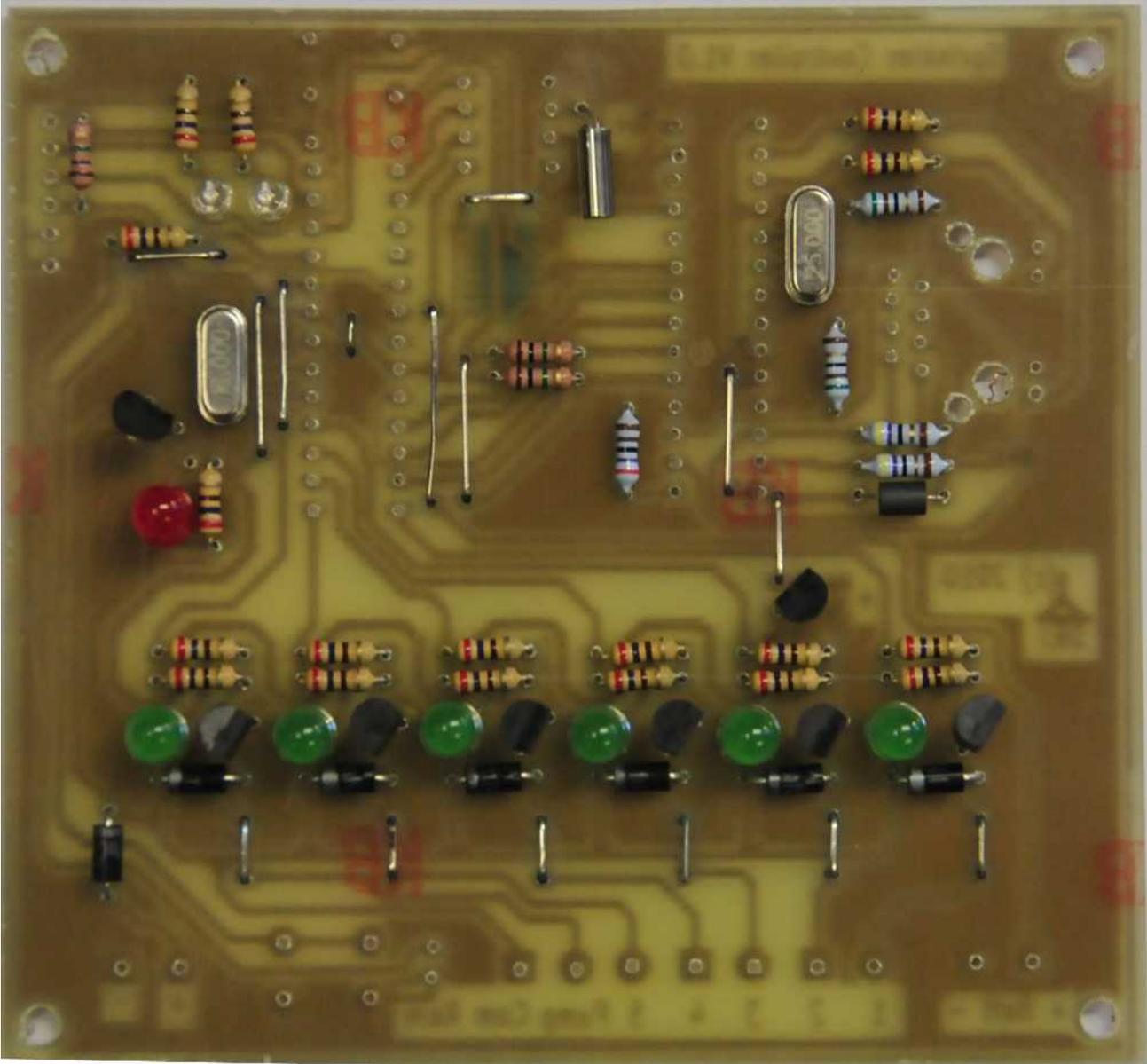
Next, insert the puchbutton switches, the IC sockets, the Ethernet socket andthe 6 pin header. Be careful that pin one of the IC sockets in located in the square pin on the PCB. The 8 pin socket is mounted upside down in relation to the other sockets.

When installing the Mag Jack, be very careful that none of the pins are folded under the connector.
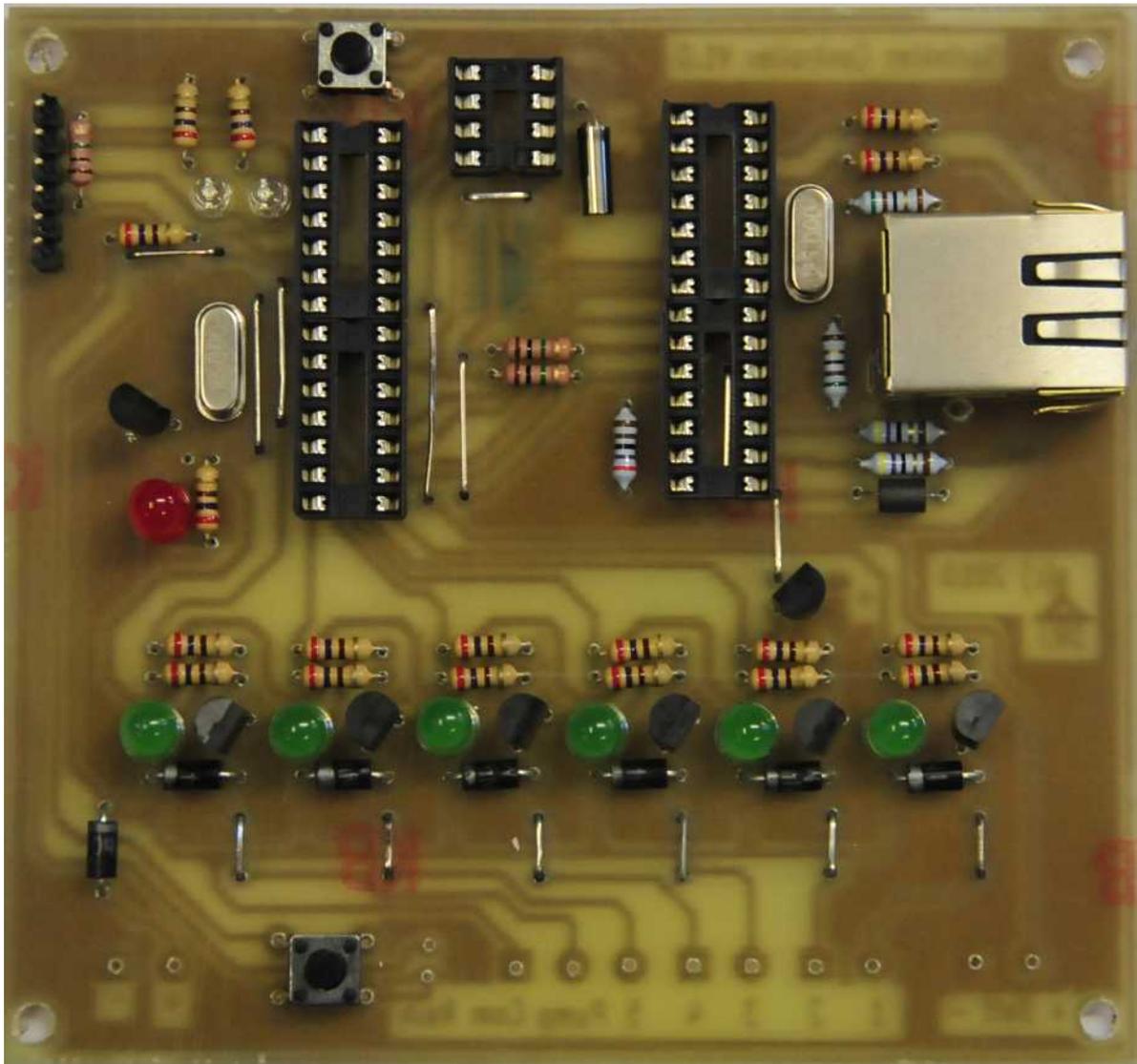
Next install the screw terminal sockets, and the Yellow LED that I missed in the description before :-)
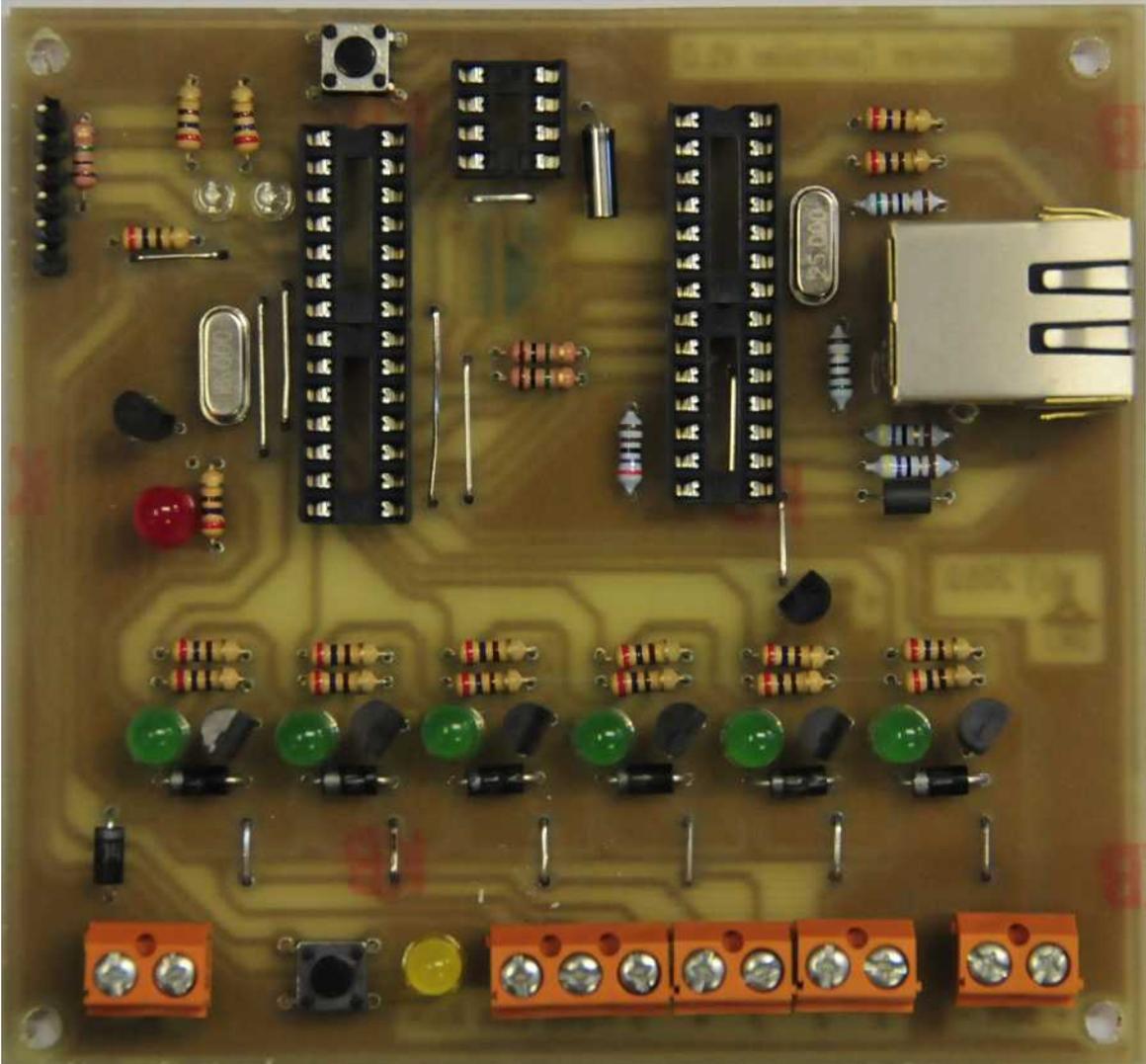
Finally, insert the IC packages. Be very carefull that the Ics are oriented so that pin one of the IC is in the correct location (matching the square hole on the PCB).

The ATMega328 in installed in the left 28 pin socket, abd the ENC28J60 is installed in the right socket. Remember that the RTC chip (the DS1302) is installed upside down compared to the other IC's.
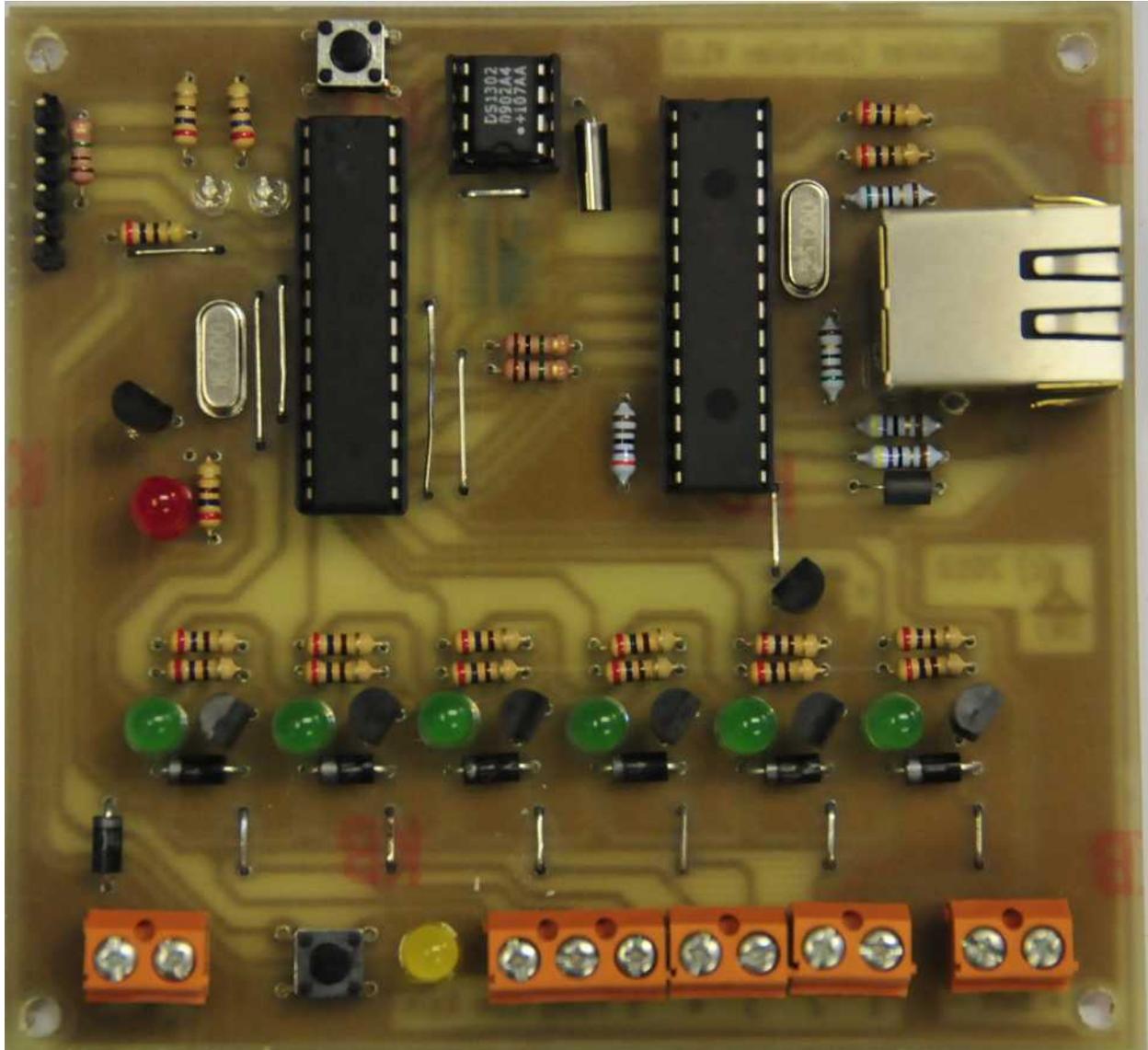
That completes assembly – Now, take a couple of minutes to make sure that there are no short circuits on the back of the PCB.

Testing

The board is able to be tested by connecting a 9 - 12V DC supply to the power input (Bottom left 2 pin wire header).

As soon as power is applied, the power LED should illuminate. If it does not, verify that the supply polarity is correct, and that the 78L05 has been installed correctly. There should be +12V on the input of the 78L05, and +5V on the output.

After the bootloader stops, the LEDs on the ethernet socket should pulse twice, and the rain LED should pulse three times to indicate that the board is operating. If this doesn't happen, then there is a problem – look for missing jumpers, solder shorts, upside down semiconductors, etc!

Programming

The sprinkler controller is programmed using a standard web browser. I use Firefox.

By default, the software is set to specify an address of 192.168.1.2 for the controller board. It is a simple matter to modify the address using the Arduino IDE and re-program the chip for other addresses.

Make sure that the controller is connected into your home network before continuing. When it is correctly connected, the lights inside the Ethernet socket should light and flash with network traffic.

Start configuring the board by typing http://192.168.1.2 into your web browser and the following screen should be displayed:

Well done – You have control of your new sprinkler controller. The following sections of the manual will tell you how to operate the various functions of your new controller.

Manual Control

The sprinkler controller is able to be operated manually by connecting to the base address (in the default case 192.168.1.2) or by selecting the 'Manual' option that is located on the right hand side of the menu.

Sprinkler Controller

Program   Time   Manual

Manual Control

Zone	Status	Toggle
1	OFF	Toggle
2	OFF	Toggle
3	OFF	Toggle
4	OFF	Toggle
5	OFF	Toggle
Pump	OFF	Toggle
Timer	OFF	ON

In order to enable manual control, the internal timer must be turned off. This is done by selecting "off" on the Timer option at the bottom of the screen. If the timer is not turned off, any manual settings will be automatically overwritten by the timer logic.

Once the timer has been disabled, any output can be turned on by simply selecting the "Toggle" label beside the desired output. An output can be turned off by also selecting the "Toggle" option again. Remember when selecting an output, that your watering system may have a separate pump. This needs to be enabled separately using the "Toggle" option beside the pump output.

Once you have finished selecting outputs manually, remember to turn the timer back on so that the sprinkler controller will operate automatically again.

Time Controls

The time setting functions are able to be accessed from the Time menu – Simply clock on the 'Time' option at the top of the screen, and the following menu will be shown;

This is one of the busyins screens in the controller, and it is worth spending a little bit of time understanding the various menu options.

Firstly, the time set within the controller is able to be changed by entering new values into the Hour and Minute fields – simply press the Modify button to make the changes permanent.

Secondly, the date can be changed by entering Day, Month, and Year information into the form and selecting 'Modify'.

Finally, the time to start watering can be set be entering values into the 'Start Hour' and 'Start Minute' form fields. Odd/Even if used to select wether the house is an odd numbered house or an even numbered house – My house is No35, so I would enter 1 for odd, Ruths house is No34, so she would enter 0 for even. Again, simply press "modify" to make the changes permanent.

You do not have to complete all fields – only complete what you need to change – if you are only changing the time, there is no need to enter data for the date or the start time.

Program Controls

The program setting controls are available by selecting 'Program' from the menu.

The following screen will be shown;

Sprinkler Controller

Program Time Manual

Current Program

Zone #	Water Time (Minutes)	Water every x days 2,4,6,8,10
1	1	2
2	2	4
3	0	0
4	0	0
5	0	0

Start at: 12:32

Zone: [   ] [Modify]

The program shown will water zone one for one minute every second day, and zone 2 for 2 minutes every fourth day. I.e. Assuming Monday was the 5th of the month, zone one would be watered for 1 minute, followed by zone 2. The following Wednesday, only zone one would be watered, but the next Friday, zone one and zone two would be watered.

To change a zone, enter the zone to change into the zone text box, and select 'Modify'

Make the changes on the following screen, and they will be permanently written into the controller.

Sprinkler Controller

Program Time Manual

Zone #	Water Time (Minutes)	Water every x days (2,4,6,8,10)
1	1	2

Water Time: [   ]   Water Days: [   ]

[Modify]

Raining

If you notice that it is raining, simply press the rain button located on the bottom of the PCB beside the yellow LED, and the watering controller will be prevented from watering. He yellow LED will be illuminated to show that the controller is in rain mode to remind you that it won't water.

Re-programming

The sprinkler controller is designed to be programmed using a FTDI USB-TTL programming cable (available from evilmadscience.com)

http://evilmadscience.com/partsmenu/130-usbttl

The board is fully arduino compatable, and is able to be programmed from the Arduino IDE.

Source code is available from the instructables.com project website.