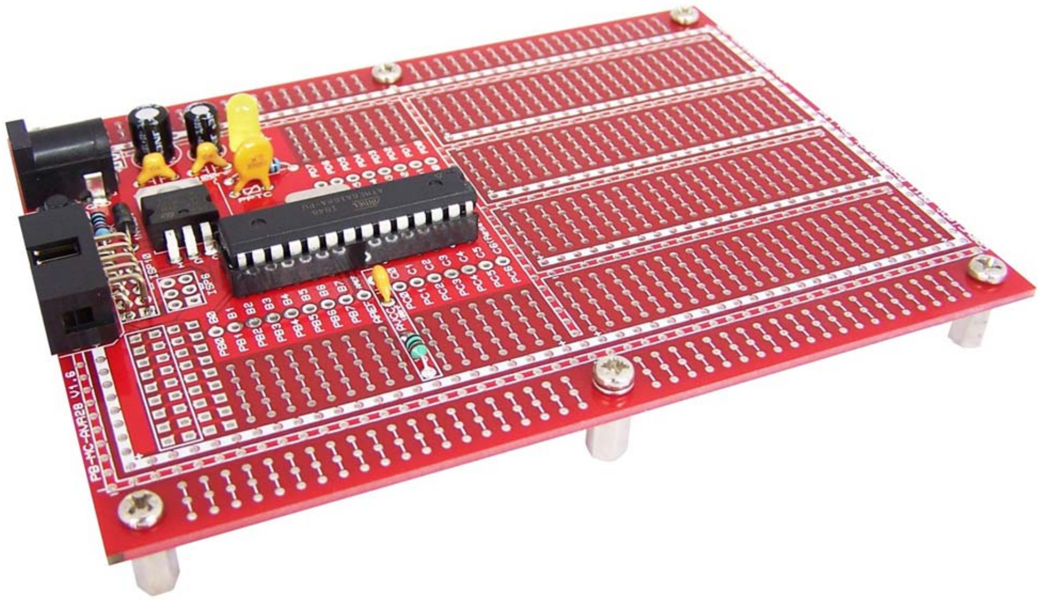
PB-MC-AVR28 28 Pin AVR Full Size Development Board



User's Guide

Version 1.6
17 April 2011

PB-MC-AVR28-UG

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1. Overview

1.1. Introduction

The Protostack 28 Pin AVR Full Size Development Board is designed for ATMEL AVR Microcontrollers that are available in the PDIP 28 pin package. This board performs the following functions:

a. Provides the infrastructure necessary to support the microcontroller,

b. "Untangles" the I/O ports in order to present them in an orderly fashion, and

c. Provides area for the user to add their own circuitry

This board conforms to the Protostack full size board form factor and is able to be stacked with other full size or half size boards.

1.2. References

1.2.1. Board Versions

This user's guide applies to the following versions of the 28 Pin Full Size AVR Board:

a. Version 1.6

1.2.2. Referenced Documents

The documents referenced in this User's Guide are listed in Table 1.

Document	Version	Date
PB-MC-AVR28 Datasheet	1.6	16-April-2011
AT90S2333/AT90LS2333/AT90S4433/AT90LS4433 Datasheet	1042DS–04/99	N/A
ATmega8/ATmega8L Datasheet	2486S–AVR–08/07	N/A
ATmega8A datasheet	8159C–AVR–07/09	N/A
ATmega48P/V, ATmega88P/V, ATmega168P/V and ATmega328P Datasheet	8025F–AVR–08/08	N/A
ATmega48(P)A, ATmega88(P)A, ATmega168(P)A and ATmega328(P) Datasheet	8271B–AVR–04/10	N/A
ATmega48A/48PA/88A/88PA/168A/168PA/328/328 Datasheet	8271C – 08/10	N/A

Table 1. Referenced Documents

1.2.3. Acronyms and Abbreviations

The acronyms and abbreviations utilised in this User's Guide are listed in Table 2.

Acronym and Abbreviation	Description
AVCC	Analogue VCC
AVR	Advanced Virtual RISC
DIL	Dual Inline
DIP	Dual Inline Package
ESR	Equivalent Series Resistance
IC	Integrated Circuit
IDC	Insulation-Displacement Connector
I/O	Input/Output
ISP	In System/Service Programming
LED	Light Emitting Diode
mil	Unit of measure corresponding to $1/1000^{th}$ of an inch
PDIP	Plastic Dual Inline Package
SIL	Single Inline
VCC	Positive supply voltage

Table 2. Acronyms and Abbreviations

1.2.4. Definitions

The definitions utilised in this User's Guide are listed in Table 3.

Term	Definition
Firmware	Firmware is a software program or set of instructions programmed onto the microcontroller. It provides the necessary instructions for how the device communicates with the other hardware.
Flash	Non-volatile computer memory that can be electrically erased and reprogrammed
Protostrip	A strip of 2 or more holes (pad) on a prototyping board that are connected together

Table 3. Definitions

1.3. Supported Microcontrollers

Table 4 lists the microcontrollers that are supported by the 28 Pin AVR Full Size Development Board.

Microcontroller	Flash	EPROM	SRAM	Speed	Vcc (V)	Notes
AT90S2333	2 Kbytes	128 Bytes	128 Bytes	0-8 MHz	4.0 – 6.0	Obsolete
AT90LS2333	2 Kbytes	128 Bytes	128 Bytes	0-4 MHz	2.7 – 6.0	Obsolete
AT90S4433	4 Kbytes	256 Bytes	128 Bytes	0-8 MHz	4.0 – 6.0	Obsolete
AT90LS4433	4 Kbytes	256 Bytes	128 Bytes	0-4 MHz	2.7 – 6.0	Obsolete
ATMEGA8	8 Kbytes	512 Bytes	1 Kbytes	0-16 MHz	4.5 - 5.5	Obsolete
ATMEGA8L	8 Kbytes	512 Bytes	1 Kbytes	0-8 MHz	2. 7 - 5.5	Obsolete
ATMEGA8A	8 Kbytes	512 Bytes	1 Kbytes	0-16 MHz	2.7 - 5.5	
ATMEGA48	4 Kbytes	256 Bytes	512 Bytes	0-20 MHz	2.7 - 5.5	Obsolete
ATMEGA48V	4 Kbytes	256 Bytes	512 Bytes	0-10 MHz	1.8 - 5.5	Obsolete
ATMEGA48A	4 Kbytes	256 Bytes	512 Bytes	0-20 MHz	1.8 - 5.5	
ATMEGA48PA	4 Kbytes	256 Bytes	512 Bytes	0-20 MHz	1.8 - 5.5	
ATMEGA88	8 Kbytes	512 Bytes	1 Kbytes	0-20 MHz	2.7 - 5.5	Obsolete
ATMEGA88V	8 Kbytes	512 Bytes	1 Kbytes	0-10 MHz	1.8 - 5.5	Obsolete
ATMEGA88A	8 Kbytes	512 Bytes	1 Kbytes	0-20 MHz	1.8 - 5.5	
ATMEGA88PA	8 Kbytes	512 Bytes	1 Kbytes	0-20 MHz	1.8 - 5.5	
ATMEGA168	16 Kbytes	512 Bytes	1 Kbytes	0-20 MHz	2.7 - 5.5	Obsolete
ATMEGA168V	16 Kbytes	512 Bytes	1 Kbytes	0-10 MHz	1.8 - 5.5	Obsolete
ATMEGA168A	16 Kbytes	512 Bytes	1 Kbytes	0-20 MHz	1.8 - 5.5	
ATMEGA168PA	16 Kbytes	512 Bytes	1 Kbytes	0-20 MHz	1.8 - 5.5	
ATMEGA328	32 Kbytes	1 Kbytes	2 Kbytes	0-20 MHz	1.8 - 5.5	
ATMEGA328P	32 Kbytes	1 Kbytes	2 Kbytes	0-20 MHz	1.8 - 5.5	

Table 4. Supported Microcontrollers

1.4. Warnings

Some of the components discussed in this document are very sensitive to electrical static discharges. The reader should take precautions to ensure that components are protected against these discharges.

Whilst the voltages typically seen in microcontroller circuits are low, the reader should be aware of the risk of working with electrical circuits and take necessary precautions.

2. Board Schematic

The schematic for the 28 pin AVR full sized board is shown in Figure 1.

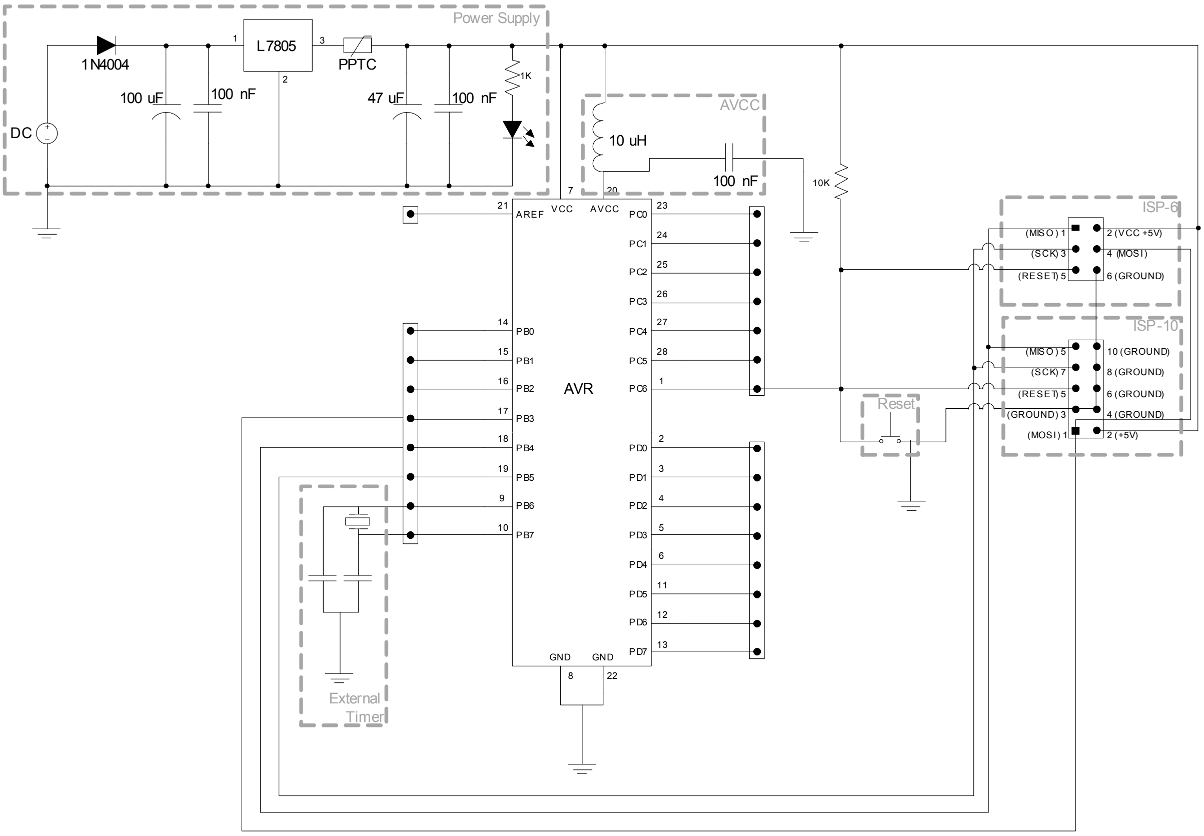

Figure 1. Board Schematic

3. Board Layout

Figure 2 shows the AVR specific features of the Protostack 28 Pin AVR Full Size Development Board, whilst Figure 3 shows the general features of the board.

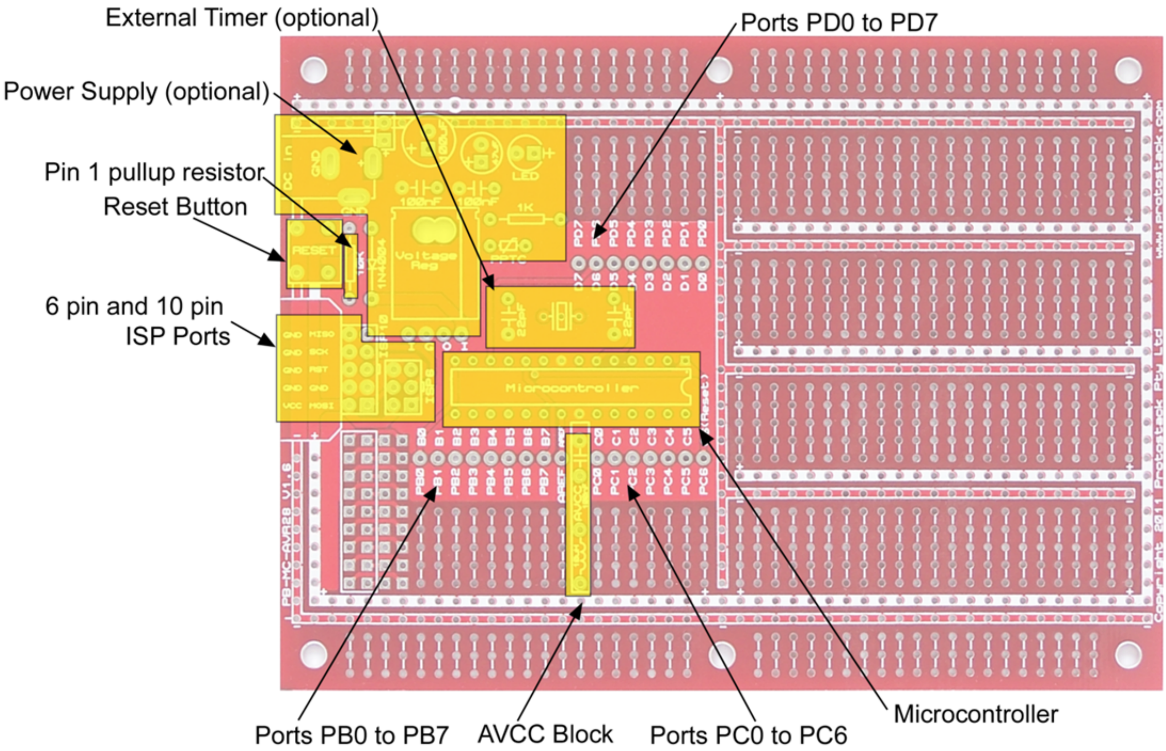

Figure 2. Board layout – AVR Specific features

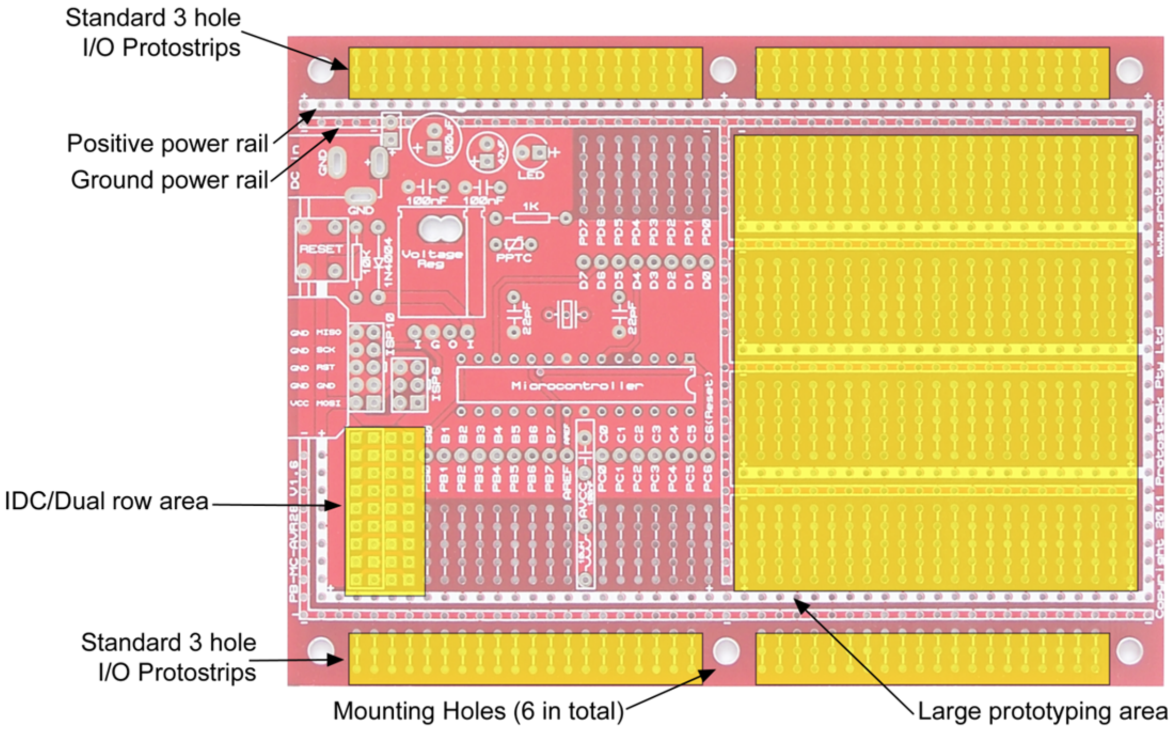

Figure 3. Board layout – General Specific features

3.1. Microcontroller

The microcontroller is the heart of this board. Figure 4 shows the microcontroller section on the board and identifies the location of pin 1. The screen printing on the board also show the location of the "dimple" on the microcontroller PDIP package.

Figure 4. Microcontroller location on Board

3.2. Pull-up resistor and Reset Button

Pin 1 can be used either for a Reset switch or as port PC6 on most 28 pin AVRs. The function of pin1 is set by the RSTDISBL fuse on the ATMEGA8/48/88/168/328 and pin 1 for reset is the default microcontroller configuration. The rest of this document will assume that pin 1 is used in this manner.

Pin 1 is held high for normal operation. To achieve this, a 10KΩ resistor is added to the board. This is shown in Figure 5. The reset switch momentarily grounds pin 1. The location of this switch is also show in Figure 5.

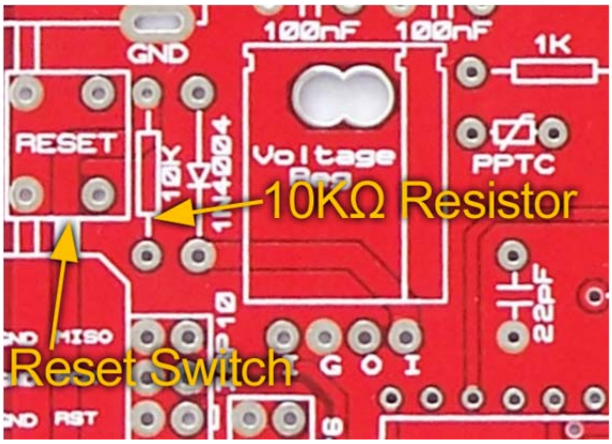

Figure 5. Pull-up resistor and reset switch

3.3. ISP Ports

The ISP connector allows you to load firmware onto the microcontroller. This is achieved by connecting an AVR programmer up to the computer's USB or serial port then running software such as AVRDude to load the firmware.

This board has 2 ISP interfaces:

a. A 10 pin (2x5) interface suitable for a 10 pin IDC connector; and

b. A 6 pin (2x3) interface

Figure 6 shows the pinout for the 10 pin interface whilst Figure 7 shows the pinout for the 6 pin interface.

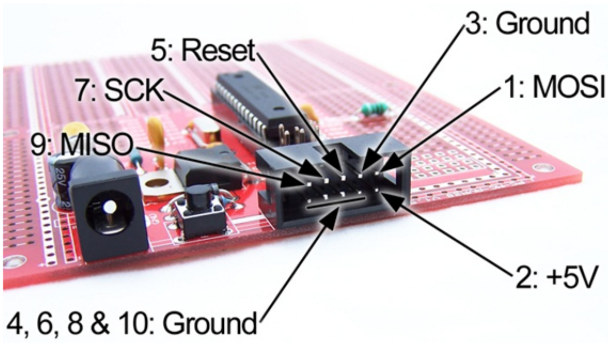

Figure 6. 10 pin ISP port pinout

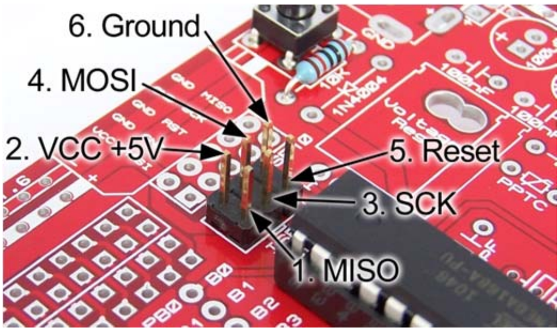

Figure 7. 6 pin ISP port pinout

Note: The ISP connector requires Pin 1 to be configured as a reset pin and not a data port. This is the default and most common configuration.

3.4. AVCC Block

The AVCC pin (pin 20) provides power to the AD Converter. Although this can be connected directly to VCC it is recommended that a low pass filter be installed as AVCC must stay within the VCC +/- 0.3V.

The ATMEL Datasheets for the supported AVR Microcontrollers recommend that the low pass filter comprise of a 10µH inductor and a 100nF Capacitor as show in Figure 8.

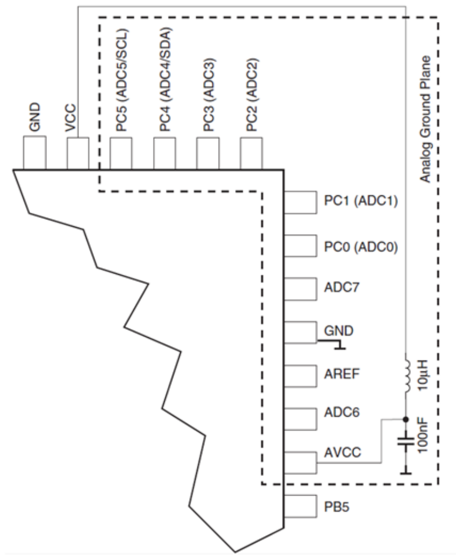

Figure 8. AVCC Low Pass Filter

The 28 Pin AVR full size development board allows the user to connect AVCC directly to VCC by installing a jumper or to install a low pass filter.

3.5. External Oscillator

The microcontrollers this board supports all have excellent internal timers. There are times when more precision is required and hence the need for an external Oscillator.

Using an external oscillator involves the setting of fuses and is beyond the scope of this document. The board however does support the oscillator hardware which comprises of a crystal and 2 capacitors.

Note: The pins used by the external oscillator (XTAL1/XTAL2) are used as data ports (PB6/PB7) on most of the 28 pin AVR microcontrollers. When an external oscillator is in use, these pins cannot be used as data ports.

3.6. Ports PD0-PD7, PB0-PB7 and PC0-PC6

One of the important functions of this board is to "untangle" the data ports and present them in a more orderly fashion. Data ports are presented in 3 groups on the board:

a. PB0 to PB7,

b. PC0 to PC6, and

c. PD7 to PD0.

Although these ports are identified by port numbers, the microcontroller pins that they correspond to may be used for other purposes. Table 5 lists the data ports and their uses on the various microcontrollers.

As Identified on Board	Microcontroller Pin (PDIP 28)	AT90S2333 AT90LS2333 AT90S4433 AT90LS4433	ATMEGA8 ATMEGA8L ATMEGA8A	ATMEGA48, ATMEGA48V, ATMEGA48A, ATMEGA48PA, ATMEGA88, ATMEGA88V, ATMEGA88A, ATMEGA88PA, ATMEGA168, ATMEGA168V, ATMEGA168A, ATMEGA168PA, ATMEGA328, ATMEGA328P
PB0	14	PB0 (ICP)	PB0 (ICP1)	PB0 (ICP1/PCINT0/CLKO)
PB1	15	PB1 (OC1)	PB1 (OC1A)	PB1 (OC1A/PCINT1)
PB2	16	PB2 (SS)	PB2 (SS/OC1B)	PB2 (SS/OC1B/PCINT2)
PB3	17	PB3 (MOSI)	PB3 (MOSI/OC2)	PB3 (MOSI/OC2A/PCINT3)
PB4	18	PB4 (MISO)	PB4 (MISO)	PB4 (MISO/PCINT4)
PB5	19	PB5 (SCK)	PB5 (SCK)	PB5 (SCK/PCINT5)
PB6	9	XTAL1 [1]	PB6 (XTAL1/TOSC1)	PB6 (XTAL1/TOSC1/PCINT6)
PB7	10	XTAL2 [2]	PB7 (XTAL2/TOSC2)	PB7 (XTAL2/TOSC2/PCINT7)
PC0	23	PC0 (ADC0)	PC0 (ADC0)	PC0 (ADC0/PCINT8)
PC1	24	PC1 (ADC1)	PC1 (ADC1)	PC1 (ADC1/PCINT9)
PC2	25	PC2 (ADC2)	PC2 (ADC2)	PC2 (ADC2/PCINT10)
PC3	26	PC3 (ADC3)	PC3 (ADC3)	PC3 (ADC3/PCINT11)
PC4	27	PC4 (ADC4)	PC4 (ADC4/SDA)	PC4 (ADC4/SDA/PCINT12)
PC5	28	PC5 (ADC5)	PC5 (ADC5/SCL)	PC5 (ADC5/SCL/PCINT13)
PC6	1	RESET [3]	PC6 (RESET)	PC6 (RESET/PCINT14)
PD0	2	PD0 (RXD)	PD0 (RXD)	PD0 (RXD/PCINT16)
PD1	3	PD1 (TXD)	PD1 (TXD)	PD1 (TXD/PCINT17)
PD2	4	PD2 (INT0)	PD2 (INT0)	PD2 (INT0/PCINT18)
PD3	5	PD3 (INT1)	PD3 (INT1)	PD3 (INT1/OC2B//PCINT19)
PD4	6	PD4 (T0)	PD4 (XCK/T0)	PD4 (XCK/T0//PCINT20)
PD5	11	PD5 (T1)	PD5 (T1)	PD5 (T1/ PCINT21/OC0B)
PD6	12	PD6 (AIN0)	PD6 (AIN0)	PD6 (AIN0/PCINT22/OC0A)
PD7	13	PD7 (AIN1)	PD7 (AIN1)	PD7 (AIN1/PCINT23)

Table 5. Data Port Mappings

1 – Pin 9 on the AT90(L)S2333 and AT90(L)S4433 is not available as data port PB6
2 – Pin 10 on the AT90(L)S2333 and AT90(L)S4433 is not available as data port PB7
3 – Pin 1 on the AT90(L)S2333 and AT90(L)S4433 is not available as data port PC6

Each I/O port is terminated to a single hole. There is a 300 mil gap between this hole and a 5-hole protostrip which is shown in Figure 9. This gap can be used to place a piece of wire, resistor, dip switch or other component of your choice.

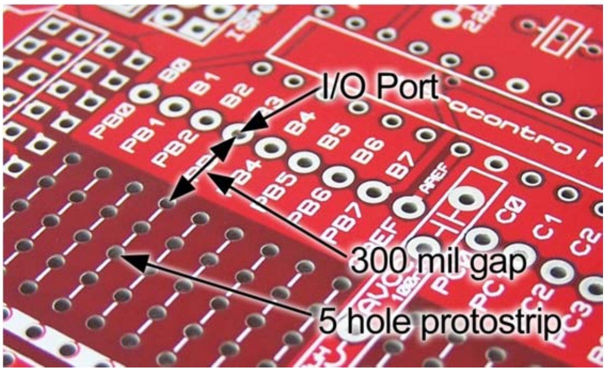

Figure 9. 300 mil gap between I/O port and protostrip

3.7. Power Supply

The power supply block allows you to build many different power supply circuits including an L7805 base circuit and a CR2032 battery clip. The following photos show examples of what can be done. Section 4.6 goes into this area in much greater detail.

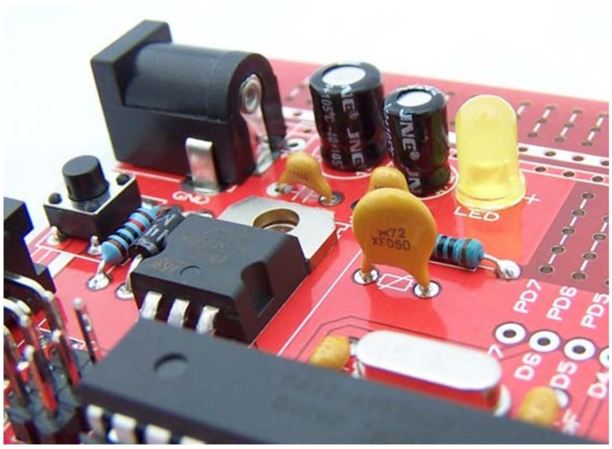

Figure 10. Power supply block with 2.1 x 5.5mm barrel connector

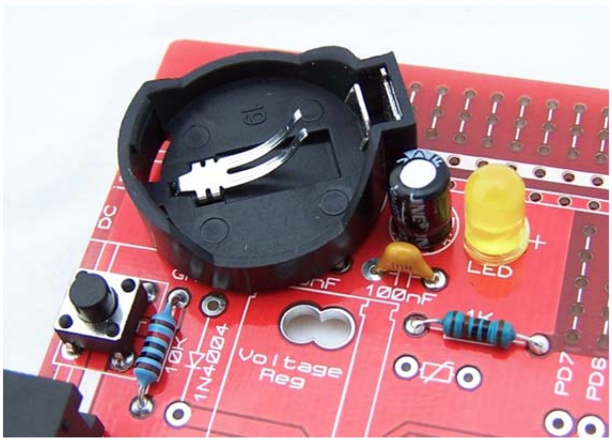

Figure 11. Power supply block with CR2032 battery clip

3.8. IDC/Dual Row area

Breadboards are great and so are protoboards that are based on breadboard layouts. Well most of the time . They both have problems when you need to use IDC connectors, dual row headers or any other component that has 2 rows of connectors on a 0.1" (2.54mm) grid. The problem is due to the fact, that you need the connectors on each row to connect to a different terminal strip or protostrip. This cannot be done because each set of terminal strips/protostrips is separated by a 0.3" (7.62mm) gap.

Protostack has a board that deal specifically with this issue (PB-CE-FS2), and on this AVR board we have use the same feature but on a smaller scale.

The IDC/Dual row section allows you to add IDC connectors, Dual row headers or another other components that has dual row connectors.

Figure 12, Figure 13 and Figure 14 all show different uses for this area. In the last example (Figure 14), we cut the lugs on the front of the connector off.

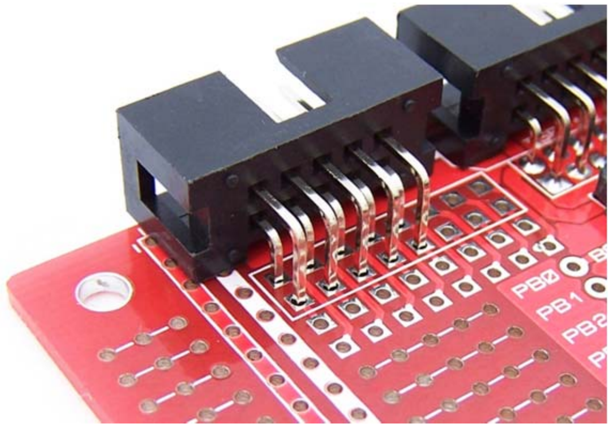

Figure 12. IDC/Dual row area with IDC connector

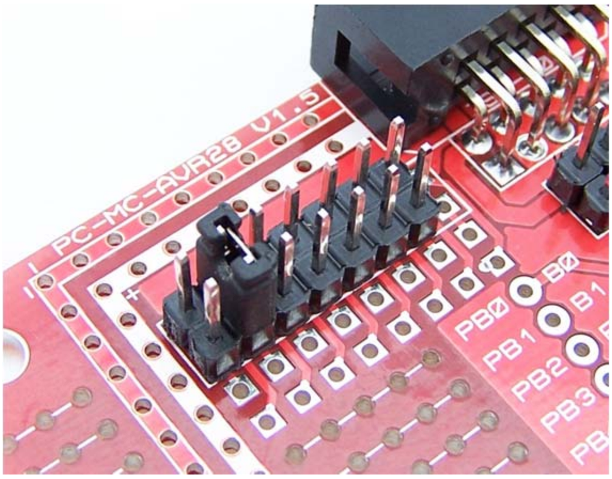

Figure 13. IDC/Dual row area with dual row headers and jumpers

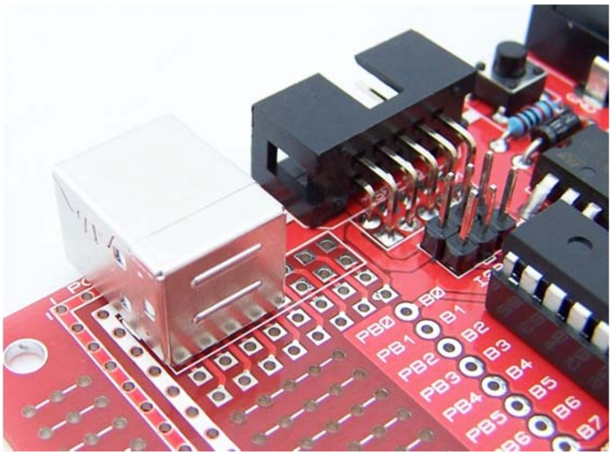

Figure 14. IDC/Dual row area with USB type B connector

3.9. Positive and Ground power rails

As with other Protostack boards, positive and ground power rails are routed throughout the board. The positive rail is identified with a solid strip whilst the ground rail is identified with a hollow strip. This is show in Figure 15

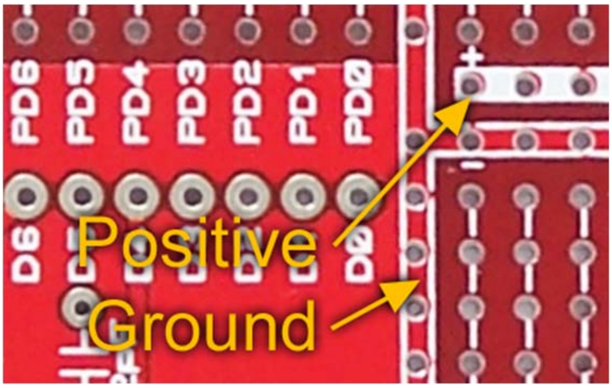

Figure 15. Positive and ground power rails

3.10. 3 hole I/O Protostrips

Like other Protostack boards, this board has 3-hole I/O protostrips on the top and bottom edges. Although you can used these strips for many other purposes there were designed to be used for::

a. Getting data or power to the board from outside the system, and/or

b. Interfacing to other layers in the stack using stacking headers.

Figure 16 shows a 3board stack with a set of 10 pin stacking headers running data up and down the stack. Figure 17 shows a 12 pin polarised header on the 2 hole I/O protostrips.

Note: if a polarised header is to be used to bring data and/or power to the board then a better way would be to use a right angle header and connect it to the 5 hole protostrips or directly to the AVR ports.

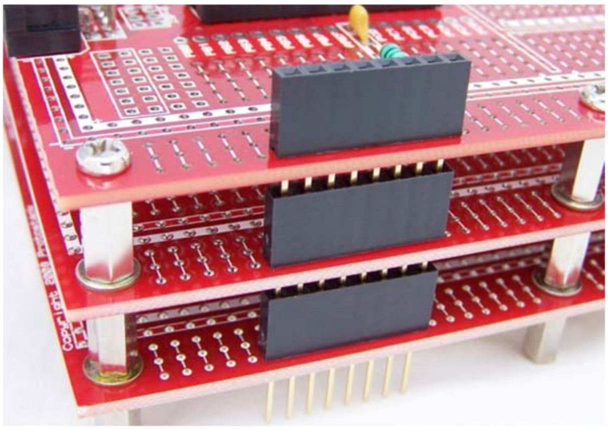

Figure 16. Stacking headers used in a 3 board stack

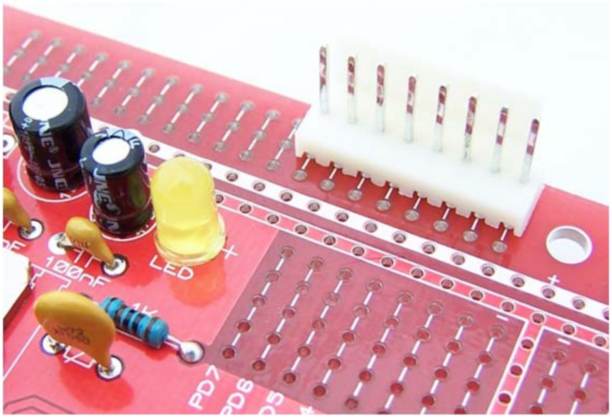

Figure 17. Polarised header used in 3 hole protostrips

3.11. Small and large prototyping areas

The prototyping areas are based on the layout of a breadboard and consist of:

a. Positive Power Rail,

b. Ground power rail, and

c. A number of 5-hole protostrips arranged parallel to each other.

This is shown in Figure 18.

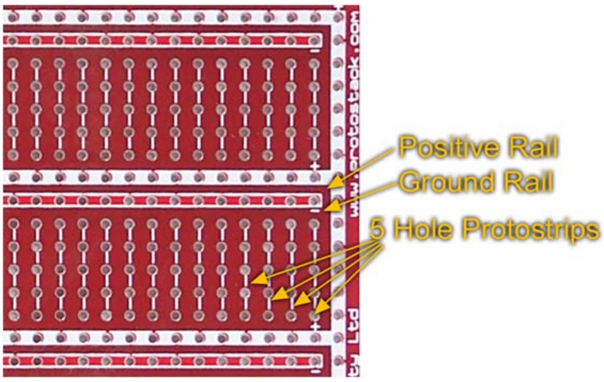

Figure 18. Prototyping areas

3.11.1. Using the prototyping area to interface to the board

In general the 3 hole I/O protostrips on the top and bottom of the board are used for interfacing between boards in a stack or to the outside world. A useful exception is the use of right angled polarised headers directly onto the 5 hole protostrips.

Mounting these onto tho 5 hole protostrips allows them to sit further back, thereby not hanging over the edge of the board.

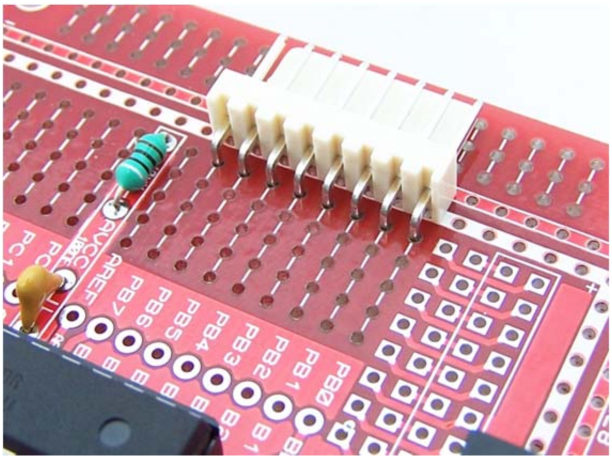

Figure 19. Right angle polarised header on board

3.12. Mounting Holes

This board conforms to the standard form factor for full size protostack boards. This includes 6 mounting holes which can be used for stacking boards together with hexagonal spacers and/or mounting the boards to a faceplate or case.

4. Board Setup

This section describes the process involved to get your board operational.

4.1. Attach the microcontroller

Like most ICs using a PDIP package, the AMTEL AVR series of Microcontrollers has a small dimple on one end showing you how to orient the chip and the location of pin 1. Figure 20 shows the location of the dimple and pin 1.

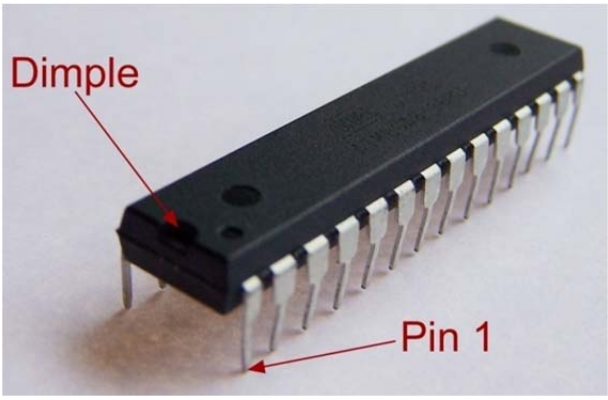

Figure 20. Microcontroller markings and orientation

To make IC orientation easier, a white outline on the board shows the location of the dimple and pin 1 is further highlighted with a square pad and a dot next to the pin.

Figure 21. Microcontroller location on board

Although the microcontroller can be soldered directly onto the board, many people prefer to solder an IC socket onto the board then insert the microcontroller into the socket. This option does not expose the microcontroller to the high temperatures of soldering. This approach also allows for the removal and substitution of the microcontroller in the event that your project requires more flash memory or additional microcontroller features.

Figure 22 shows the IC socket on the board.

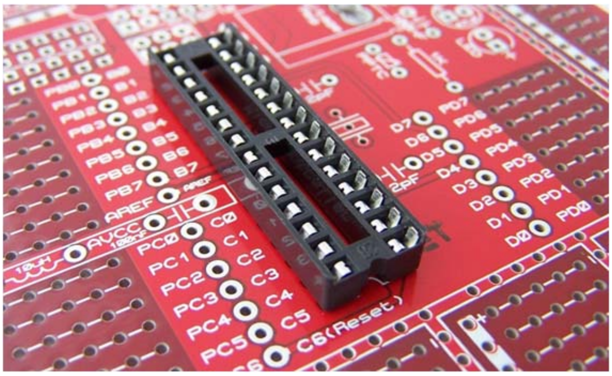

Figure 22. IC Socket on board

Once the IC Socket is soldered in, you will need to bend the pins on the microcontroller inwards slightly in order to be able to push it into the socket.

Figure 23 shows the Microcontroller in the IC Socket.

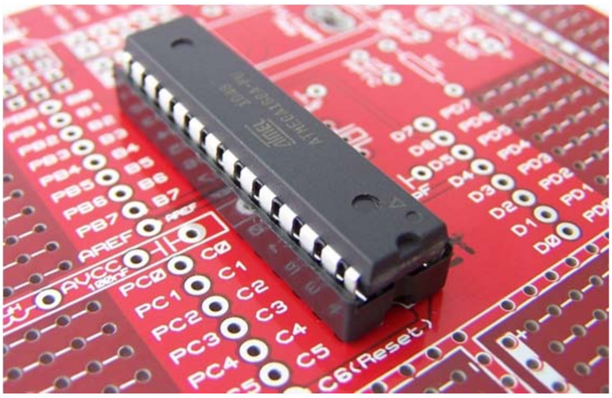

Figure 23. Microcontroller in socket

4.2. Add the pull-up resistor and reset switch

Add a 10KΩ pull-up resistor as shown in Figure 24.

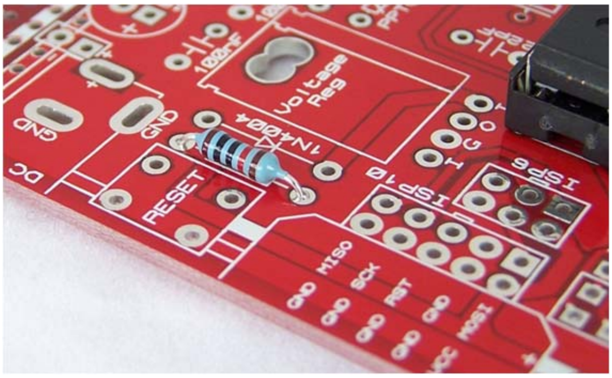

Figure 24. 10KΩ pull-up resistor for reset (pin 1)

The next step is to add a reset switch. This board is designed to use a 4 pin micro tactile switch. This switch has 2 pairs of pins with each pin in the pair connected to each other. When the button is pressed, then each pair is momentarily connected to each other. This is shown in Figure 25.

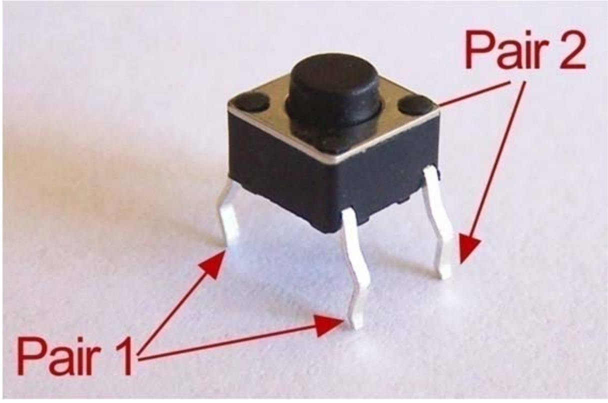

Figure 25. Pin pairs on micro tactile switch

Using the continuity tester function on a multimeter, determine which pin corresponds to each pair and connect the switch to the board as per Figure 26.

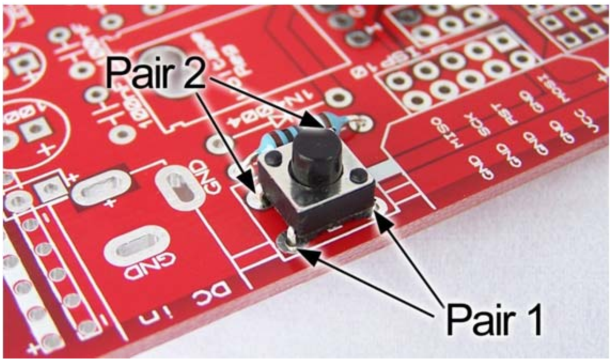

Figure 26. Reset button on board

4.3. Add the ISP Connector

Connect the 10 pin connector to the board in the location provided. Figure 27 shows the orientation of a right angle connector whilst Figure 28 shows the orientation of a standard straight pin connector. In both cases take note of the notch in the connector box.

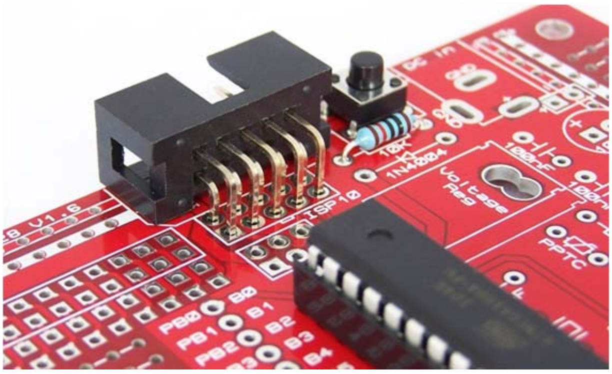

Figure 27. ISP Right Angle Connector

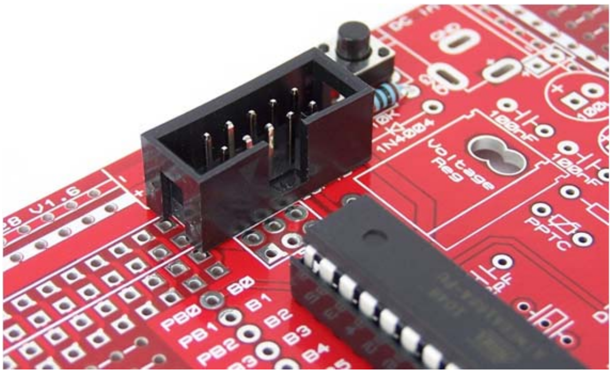

Figure 28. ISP Straight Pin Connector

Note: The right angle connector is preferred if you are using a multi board stack as it can be accessed from the side of the stack.

You can also wire up a 6 pin ISP connector. This is shown in Figure 29 below.

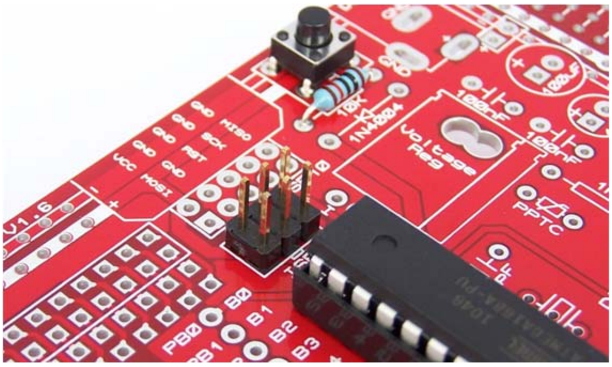

Figure 29. 6 pin ISP connector

4.4. Wire up the AVCC Block

This board allows AVCC to be connected directly to VCC or connected via a low pass filter. Figure 30 shows AVCC connected to VCC with the low pass filter (10µH inductor and 100nF capacitor).

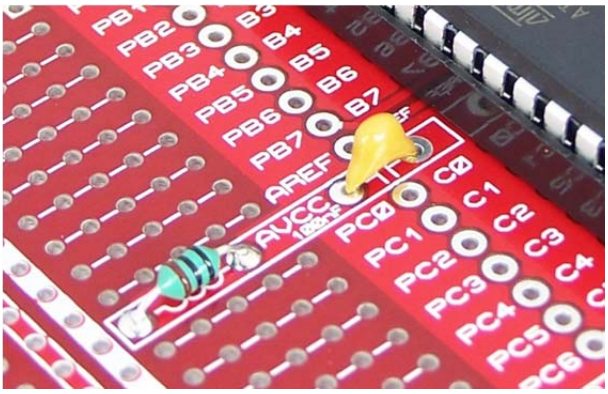

Figure 30. AVCC Connected to VCC with Inductor and capacitor

4.5. Add an external Oscillator

Add the crystal oscillator and capacitors to the board as per Figure 31.

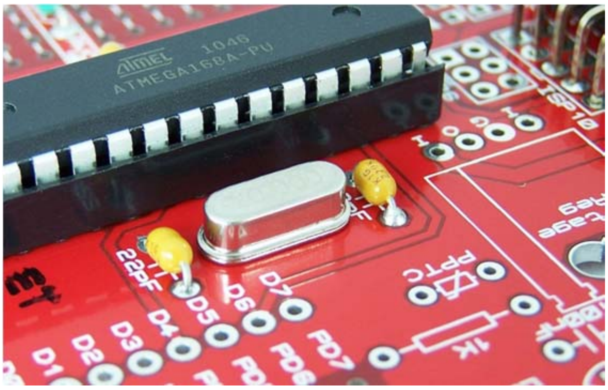

Figure 31. External Oscillator on board

Please consult your microcontroller data sheet for Capacitor sizes and fuse settings.

⚠ *Note: Incorrect fuse settings can leave your microcontroller inoperable, so be careful.*

4.6. Add a power source

One of the strength of this board is the many ways you can bring power to it. The different methods can be summarised as:

a. Mount a CR2032 battery clip directly to the board (see section 4.6.3),

b. Bring regulated power to the board from an external source (see section 4.6.4), or

c. Step down and regulate the power from an external source (see section 4.6.5).

4.6.1. Add power indicator LED (optional)

Regardless of which method you choose, you will probably want an LED which indicates if the board is powered on.

We now solder the LED and the resistor than drives it onto the board. Remember that LEDs are diodes, so they have to go in the right way. Like the electrolytic capacitors, the LED has the positive lead a bit longer than the negative one. The positive lead goes into the whole that is marked with a "+".

The recommended resistor size is 1KΩ which provides 3ma of current through the LED at 5V. Depending on the type of LED you are using, how bright you want it and the voltage you are using, anything from 40Ω to 1KΩ will work. Use the following LED resistor calculator to determine the best size for you.

http://www.ohmslawcalculator.com/led_resistor_calculator.php

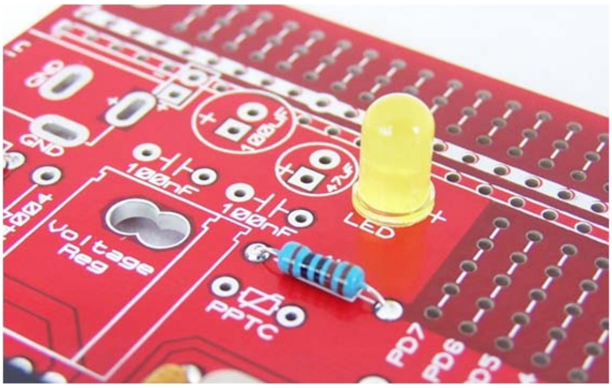

Figure 32. Power indicator LED and resistor

4.6.2. Add Vcc side capacitors

Microcontroller circuits typically have power requirements that fluctuate dramatically over time. We deal with this by adding 2 capacitors. The suggested sizes are:

a. 47uF electrolytic, and

b. 100nF ceramic.

Using both capacitors together is recommended because the electrolytic capacitor gives you the reserve you need, whilst the ceramic capacitor has a low ESR and will therefore has a faster response time.

The electrolytic capacitor is polarised, so you need to make sure you insert it in the right way. You will notice that one of the leads is longer than the other. This is the positive lead and it goes into the square hole.

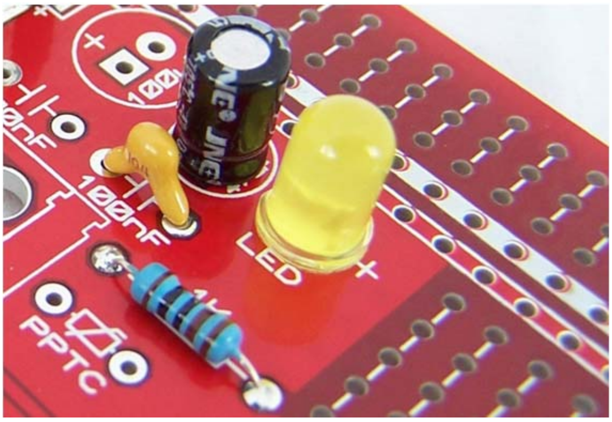

Figure 33. Vcc side capacitors

4.6.3. Method 1: Mount a CR2032 battery clip directly to the board

The first method is to mount a CR2032 battery clip directly to the circuit board. The positive power rail has a circle where the positive pin of the battery clip goes. This is shown in Figure 34 below.

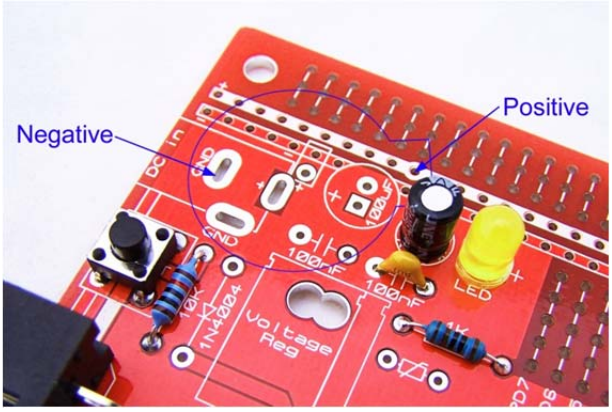

Figure 34. Placement of CR2032 battery clip on PCB

Figure 35 shows the battery clip soldered in place.

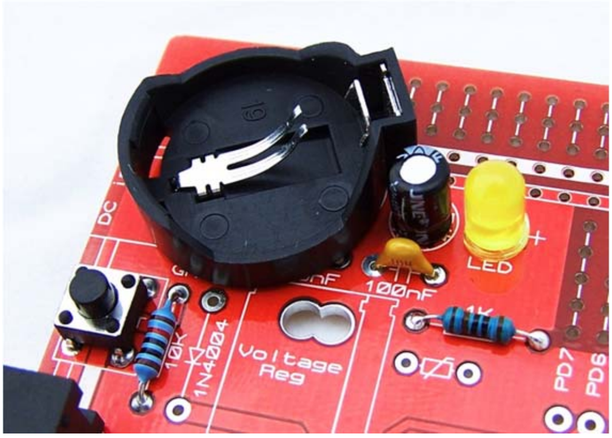

Figure 35. CR2032 battery clip on PCB

When using this method it is important to note that many microcontrollers run at a lower speed on 3V. Please consult the microcontroller datasheet.

4.6.4. Method 2: Bring regulated power to the board from an external source

If you have regulated power at the right voltage level you can connect it directly to the board. This will most commonly be 5V but depending on the microcontroller used, anything between 1.8V and 6.0V might work (see Table 4).

The figures below show different types of connectors being used for this purpose.

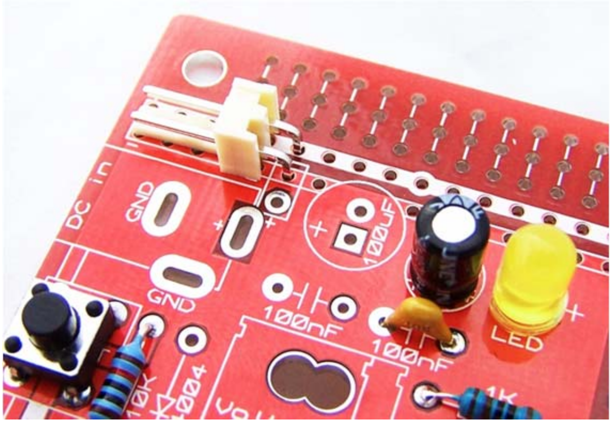

Figure 36. Polarized header for regulated power

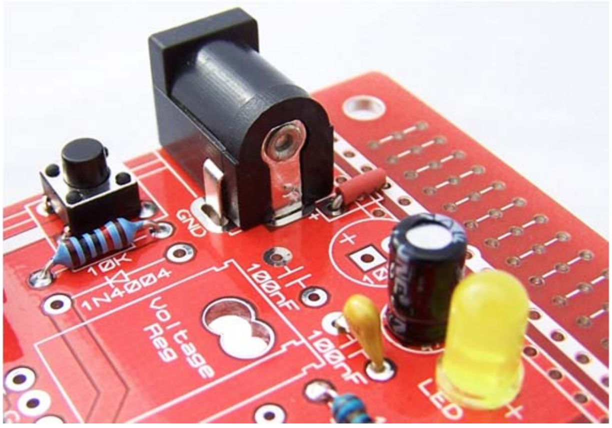

Figure 37. 2.1 x 5.5mm barrel jack for regulated power

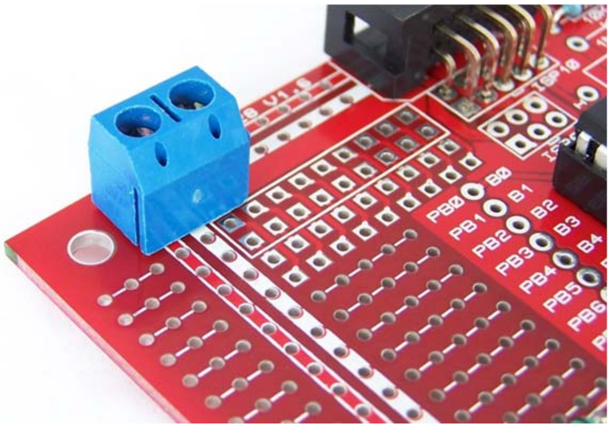

Figure 38. Terminal block for regulated power

4.6.5. Method 3: Step down and regulate the power from an external source

This last and most common method is to bring power from a battery or wall wart and regulated it down to the desired voltage. It is important to understand that you will have a voltage drop from both the diode and regulator, so consult your datasheets and factor these in when choosing your power source.

The first step is to solder your connector. As in the previous method, there are many options available.

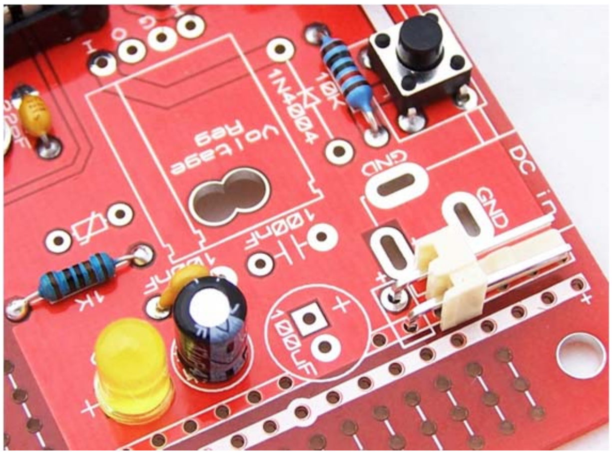

Figure 39. Polarized header for unregulated power

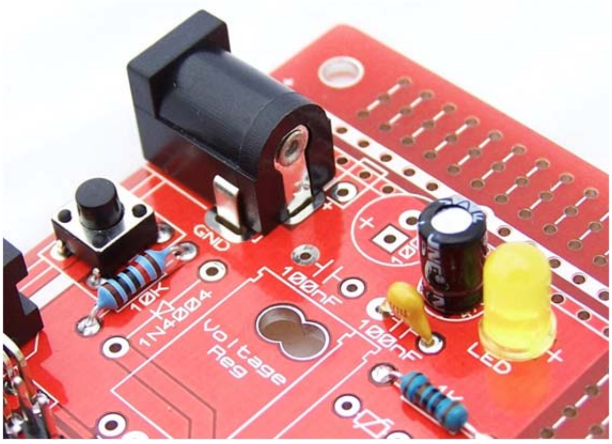

Figure 40 2.1 x 5.5mm barrel jack for unregulated power

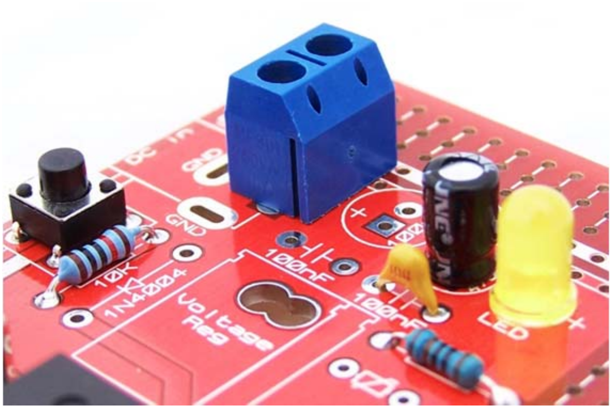

Figure 41. Terminal block for unregulated power

Now that the connector is in place, solder a 1N4004 rectifier diode. This diode is used to protect the circuit against reverse polarity. If you do not need this protection just solder a piece of wire instead.

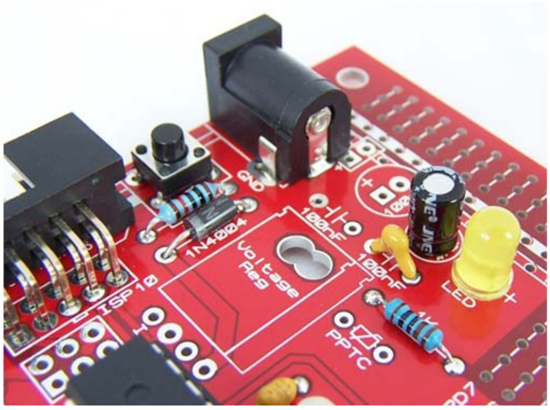

Figure 42. 1N4004 diode soldered into place

The next step is to solder in a voltage regulator. This board supports 2 different regulator pinouts

a. Input/Ground/Output –IOG (e.g. L7805)

b. Ground/Output/Input – OGI (e.g. LD1117)

Figure 43 and Figure 44 below show both styles of regulator on the board.

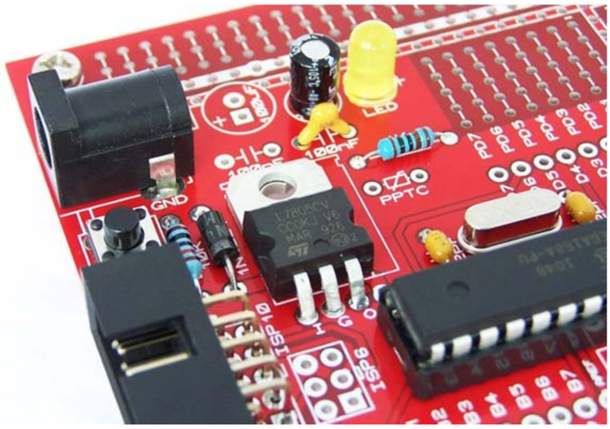

Figure 43. IGO style voltage regulator

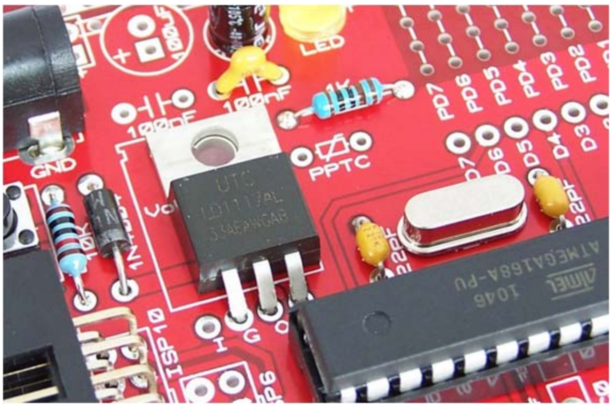

Figure 44. GOI style voltage regulator

Now we add some input side capacitors. A 100uF electrolytic and 100nF ceramic capacitor is recommended here.

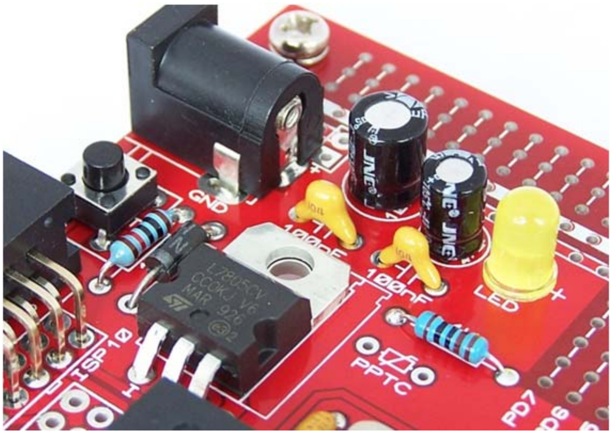

Figure 45. Input side power capacitors

Lastly we add a resettable fuse. We used a 500ma fuse PPTC fuse here, but use a value that suits your own requirements. If you don't want any protection, just use a piece of wire.

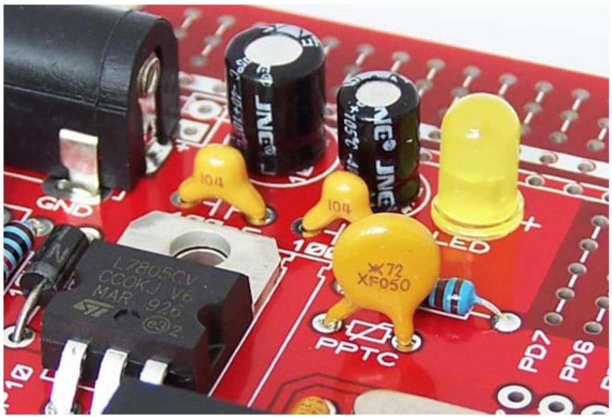

Figure 46. PPTC resettable fuse

4.7. Add some I/O

If you have made it this far you will have a microcontroller that can be programmed with firmware and can execute the loaded firmware. However if the microcontroller is unable to receive inputs or all outputs are ignored, then it isn't all that useful. This is where the real fun begins.

There is plenty of room in the prototyping sections to build circuits that can interface to the microcontroller. If more space is needed then additional boards can be added and a stack created. Data and power between the boards in the stack can be share using stacking headers.

5. Board Release Notes

5.1. Version 1.6

Version 1.6 of the 28 pin AVR full size board includes the following changes:

a. Size increase of IDC/Dual row section from 2x8 to 2x9 pin,

b. Addition of square and circular pads on top layer for polarised headers,

c. Additional labels for ISP-10 connector, and

d. Crystal oscillator holes have pads only on bottom now. This fixes a problem where the oscillator case was making contact with the pads.

5.2. Version 1.5

Version 1.5 of the 28 pin AVR full size board includes the following changes:

a. Addition of diode to power supply block,

b. Addition of resettable fuse to power supply block,

c. Support for both IGO and GOI style regulators in power supply block,

d. Size increase of IDC/Dual row section from 2x7 to 2x8 pin,

e. Additional labels for I/O ports, and

f. Small circular mark to identify mounting point for CR2032 battery clip.

5.3. Version 1.4

Version 1.4 of the 28 pin AVR full size board includes the following changes:

a. Addition of a dedicated power supply section,

b. Removal of 6 pin SIL ISP interface,

c. Addition of a 2x3 pin ISP interface, and

d. Addition of section for mounting IDC or Dual row connectors.

5.4. Version 1.3

Version 1.3 of the 28 pin AVR full size board includes the following changes:

a. External crystal block has been completely redesigned. It is now closer to the microcontroller and sits within a ground plane. This provides more stable operation;

b. Addition of 6 pin SIL ISP interface;

c. Redesign of I/O ports with termination on a single hole, with a 300 mil gap to a 5 hole protostrip (see Figure 9);

d. Changes in AVCC block to support (physically) bigger inductors;

e. Small changes to the mounting holes for the reset switch. These changes mean that the switch now clips into place more easily;

f. Power rails are now double sided with 60 mil tracks on the bottom and 50 mil on the top. This provides almost twice the current handling capacity and a little more capacitance; and

g. Better labelling of I/O ports.

5.5. Version 1.1

Initial public release

6. Comment and Questions

If you have any questions or comments regarding this documentation or any of our products, please contact us at http://www.protostack.com/index.php?main_page=contact_us