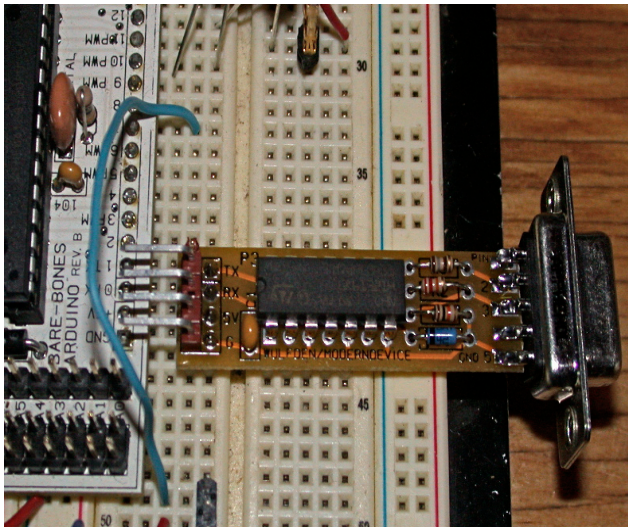

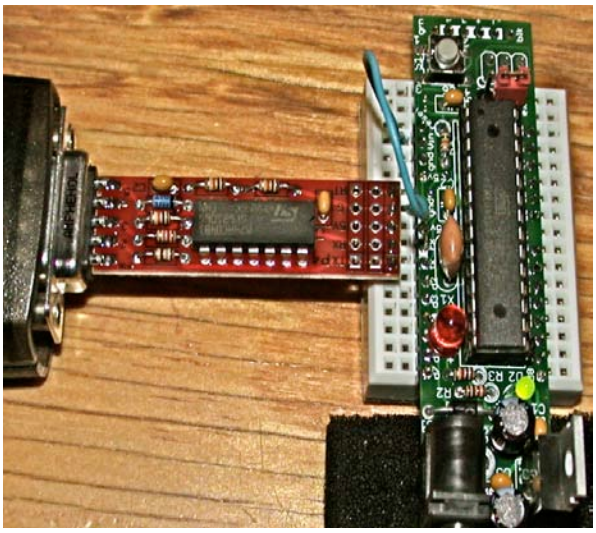

Wulfden/Modern Device
P3/P4 Serial Programming Adapters

freeduino

Totally Open Arduino-Compatible
Hardware Development

Valid for
P3/P4/P4b - 12/26/2008

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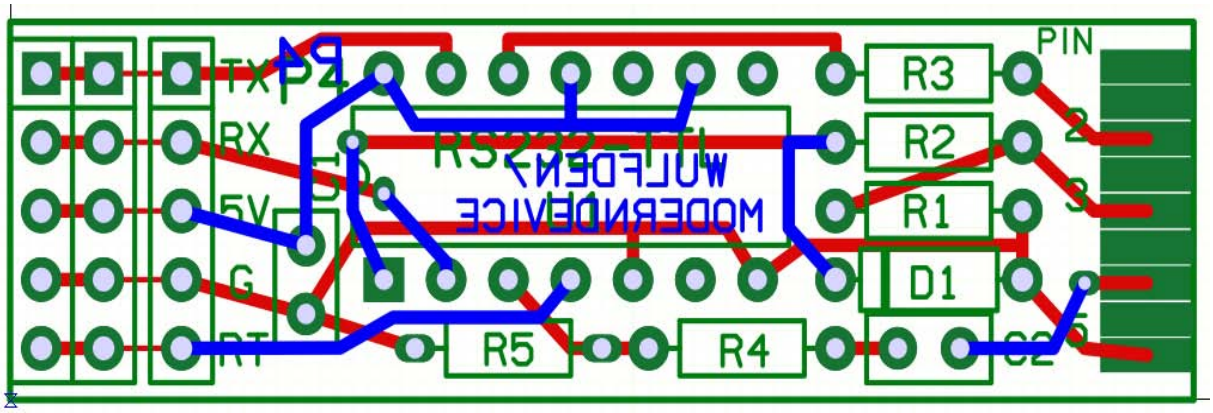
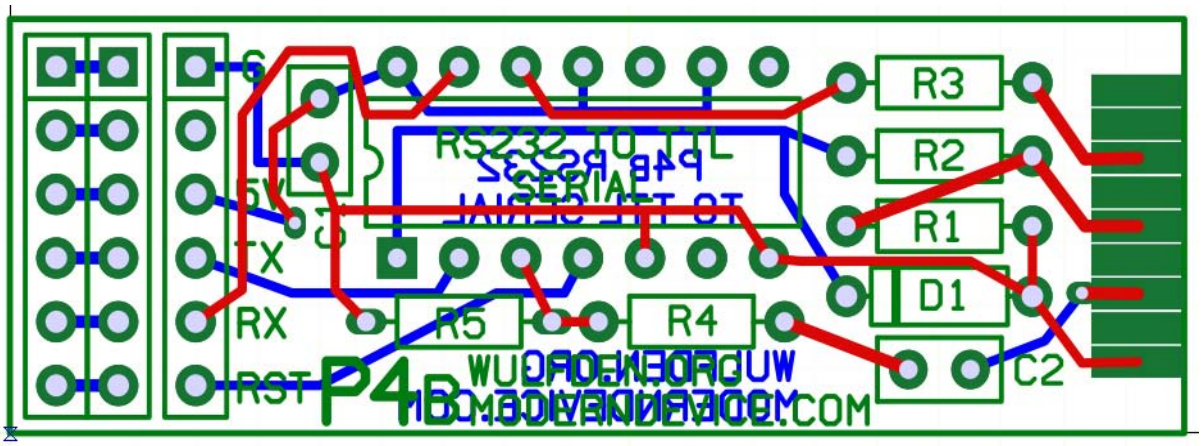
1 P4/P4b Family - Wulfden/Modern Device Serial Programming Adapters

1. The P4 family of RS232/TTL serial programming adapters is distinguished from its near cousin the P3 by supporting control of the DTR signal in addition to TxD and RxD. When the serial port is opened, the DTR signal is asserted. If this were connected directly to the MCU reset, the circuit would be in a constant reset state. By placing C2 in the line, the reset line is pulled low and then released as the capacitor charge state stabilizes(a kind of an 'edge trigger' if you will)
2. The original **P4** (five output pin positions, pictured below) was designed with 3 rows of holes referred, for discussion purposes, row one (nearest the chip through row three (nearest end of pcb) and the pins one (square pad) through five. By cutting all or some of the traces between rows one and two and the use of short scraps of wire to make solder jumpers the builder can easily connect the signals in some different order.



3. The newer **P4b** (six ouput pin positions, pictured top of next page) has its pins aligned to for stright through connections emulating the pinout of the FTDI TTL232 USB serial cable. There is two other major differences. First, rows one and two have no traces connecting corresponding pins. So the builder needs to install the jumpers even for the default pinout. It is easy to do and the trimmed component leads of which there are a dozen, serve more than adequately. Its a tradeoff against having to cut traces. The second difference is the silkscreen labels for TX and RX. The *sense* of them is different between the **P4** and the **P4b**. In the **P4** the sense of the line labeled TX is the data transmitted from the processor board to be received up the RS232 serial line. In the P4b that line is labeled RX in the sense that it receives what is transmitted from the processor board to be received up the RS232 serial line. There are charts with each P4 version detailing signal directions and pin labels.



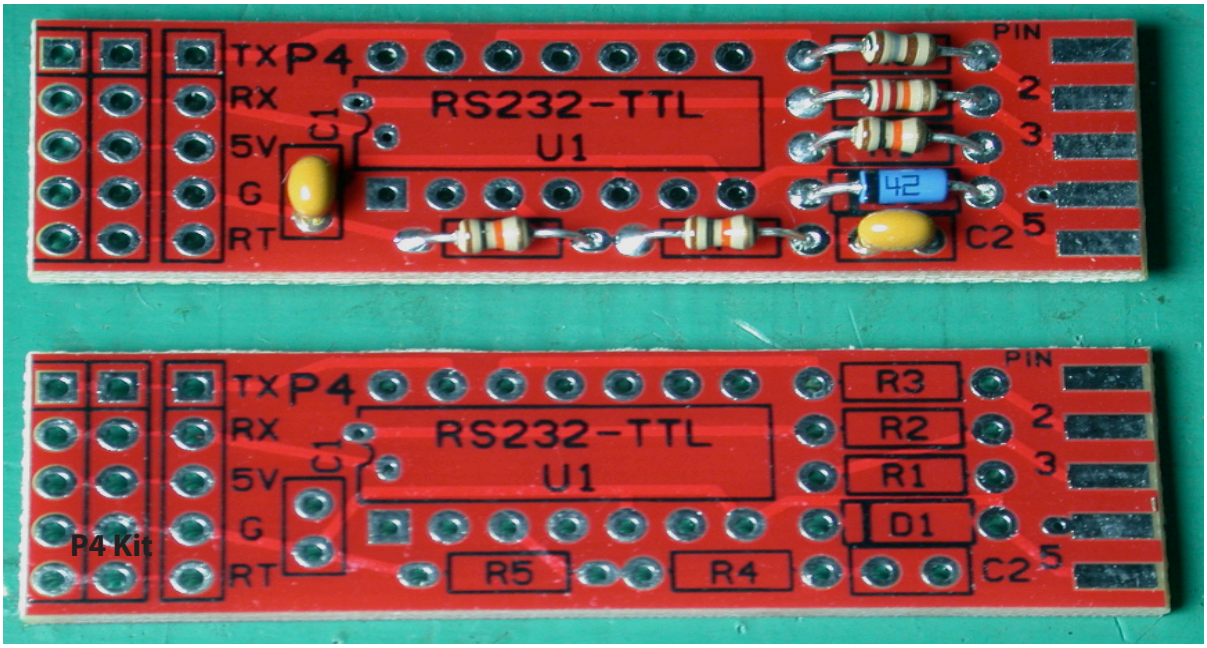
4. The P4 and P4b are wired *functionally* identically from row one back to the DB9F RS232 connector. I specifically used the word *functionally* because different gates were used for RXD, TxD, and DTR in order to accomodate the changes in pin alignments. The parts lists for both adapters is the same, excepting, of course the myriad varieties of connectors that can be used to interface to the processor board.

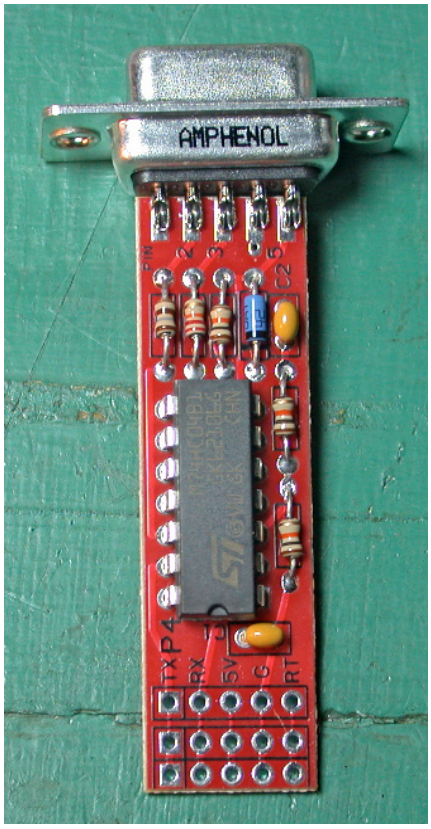
1.	C1	0.1 uF monolithic capacitor (“104”)	Mouser 80-C315C104M5U
2.	C2	0.1 uF monolithic capacitor (“104”)	Mouser 80-C315C104M5U
3.	D1	BAT42 or 1N914 or 1N4148 Diode	Mouser 512-1N4148
4.	R1	carbon film resistor 10 Kohm 1/8 w (brwn-blk-org)	Mouser 299-10K-RC
5.	R2	carbon film resistor 22 Kohm 1/8 w (red-red-org)	Mouser 299-22K-RC
6.	R3	carbon film resistor 180 ohm 1/8 w (brwn-gry-brwn)	Mouser 299-180-RC
7.	R4	carbon film resistor 10 Kohm 1/8 w (brwn-blk-org)	Mouser 299-10K-RC
8.	R5	carbon film resistor 10 Kohm 1/8 w (brwn-blk-org)	Mouser 299-10K-RC
9.	U1	Hex Inverter 74HC04	Mouser 511-M74HC04
10.	J1	DB9F - solder cups	Mouser 523-G17S0900110EU

5. The P3 and P4 are essentially the same device. The board for the P4 was widened by an eight of an inch or so to make room for two additional resistors and a capacitor to hook to one of the unused gates of the 74HC04 hex inverter and the pin out was expanded to five pins from four. At the heart of it the two are the same

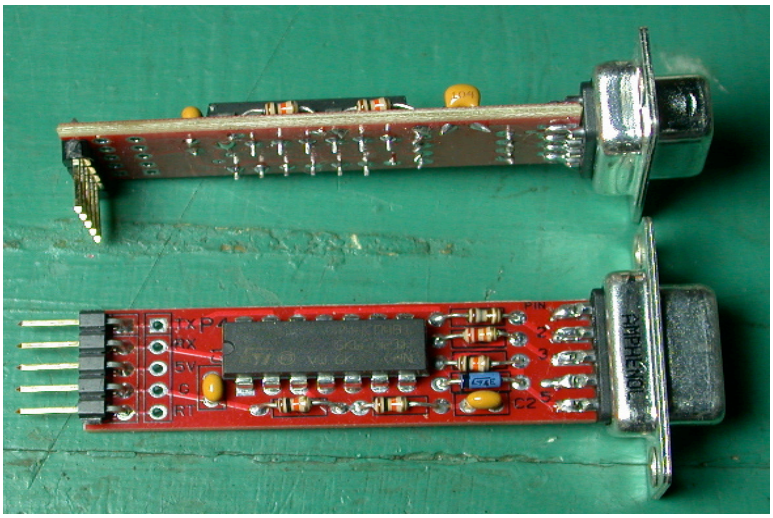
6. The units have been tested at 115,200 baud and the high speed cmos part handled it without dropping a character. The device works 100% at 5 volts. Generally it will work right down to 3.3 volts. Below that you get into the realm of whose serial port are you talking to and how does it behave as you get very near to the RS232C definition threshold of three volts.

2 P4 - Wulfden/Modern Device Serial Programming Adapter





1. Assembling the P4 is almost trivial in its simplicity. The five resistors and two capacitors are inserted as shown in the first picture of this section. Solder and then trim excess leads, the resistors and caps are not polarized and can go in any fashion. The Blue Schottky diode must go in with its black band matching the silk-screen for D1.
2. Next take U1, the 74HC04 hex inverter and align the notch on it with the notch on the silk-screen. The pins will need to be bent so they go straight down perpendicular to the chip body instead of splayed slightly outward. Bend pins 1 and 8 (diagonally opposite each other) over to hold the chip in place and turn the board over and solder. Heat each pin and flow the solder quickly to avoid damage to the chip.
3. Take the board and the DB9F connector, insert the end edge of the board between the two rows of solder cups aligning the five solder cups with the five pads on the top of the board and the four cups with the four pads on the bottom of the board. See photo to the left. Even though we are only using DB9F pins 2,3,4, & 5, solder ALL



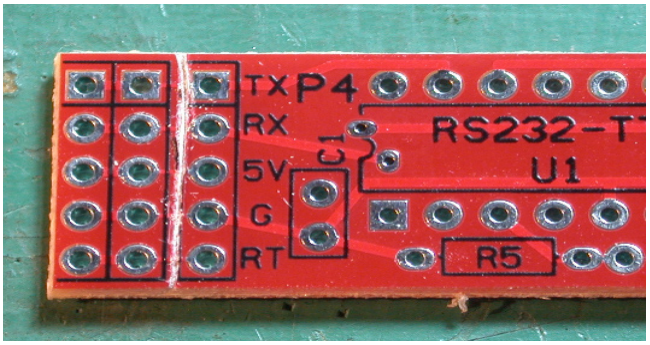
the cups to the pads to improve the strength of the mating of the connector and the pcb.

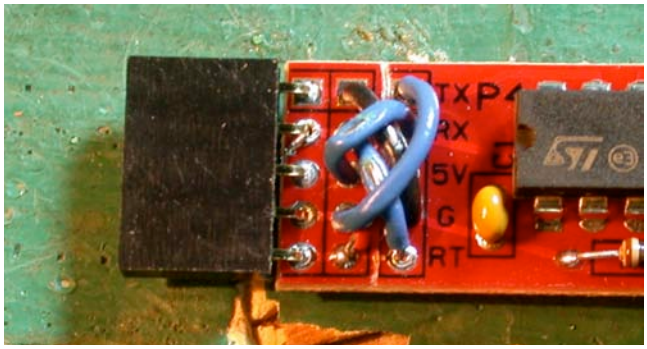
4. Now insert J2. There are many configurations. The kit comes with a single 5 pin straight header, which is most often used. Inserting from the solder side of the board so that the pins face down to plug into a breadboard. See the top unit in the photo below left. The user may supply additional or alternate connectors such as the right angle header shown in the lower unit below.

5. J2 is setup by default with the following pin assignments to the right:

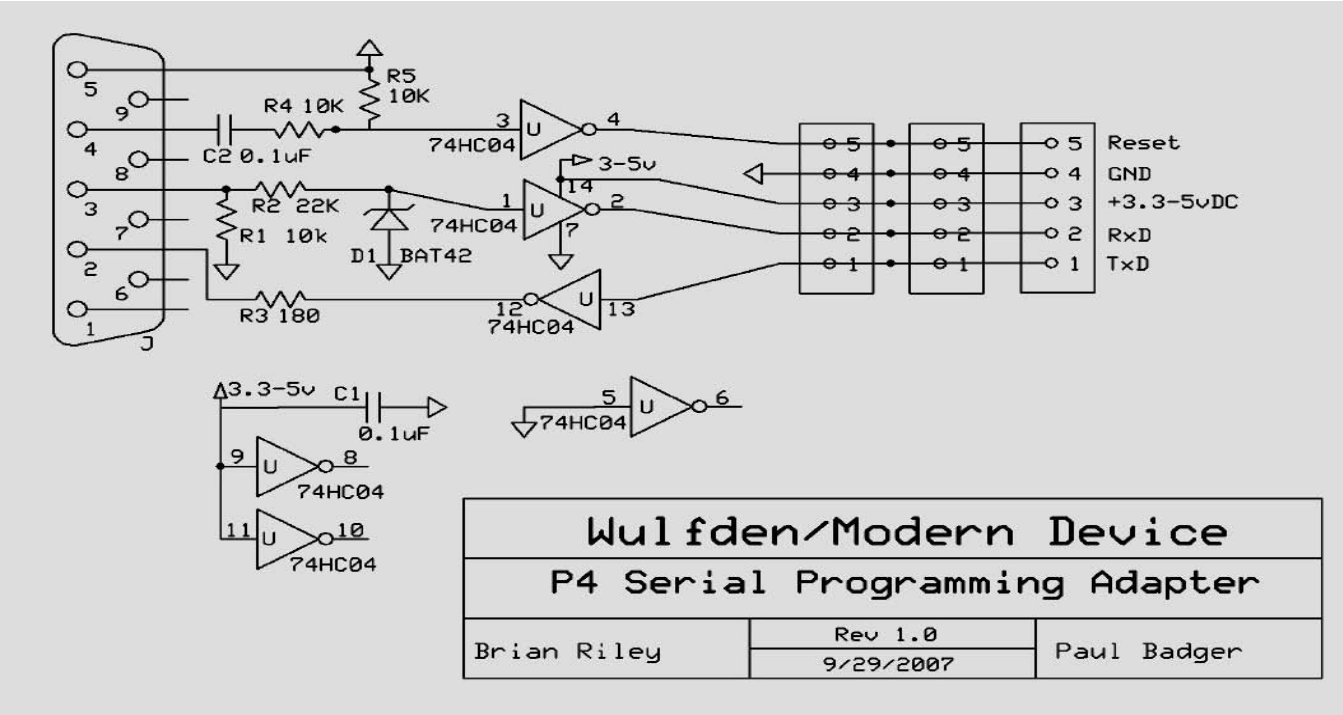
- Pin 1 - TxD
- Pin 2 - RxD
- Pin 3 - +5v
- Pin 4 - GND
- Pin 5 - DTR

6. The aforementioned pin assignments match up to the Modern Device's Bare Bones Board, and Really Bare Bones Board as well as Adafruit Industries Breaduino boards. However, by slicing the traces between the first and second rows of holes as shown in the photos to the left one can uses jumpers wires to rearrange the pin outs.

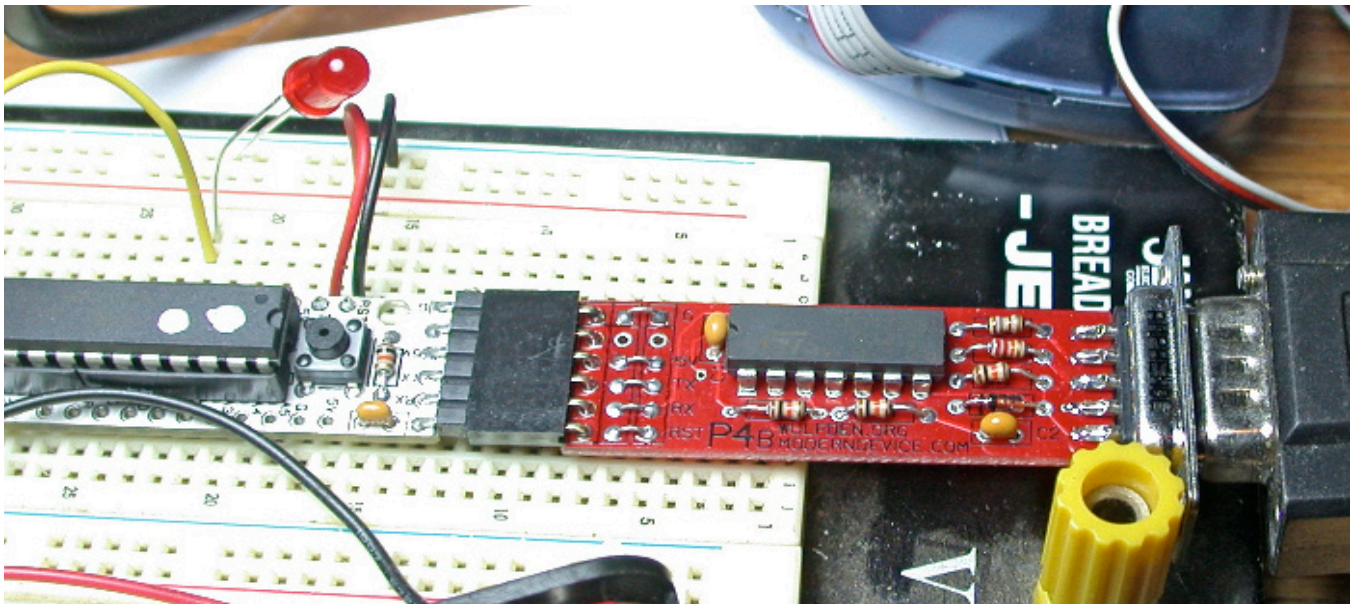




TTL Label	TTL Pin	Description	DB9 Pin	DB9 Label
TX	1	TTL ==> RS232	2	RxD
RX	2	TTL < == RS232	3	TxD
3.3-5V	3	requires power		
G	4	ground (common)	5	GND
RT	5	TTL < == RS232	4	DTR


R5
10K
R4 10K
C2 0.1uF
74HC04
3-5v
R2 22K
R1 10k
D1 BAT42
R3 180
Reset
GND
+3.3-5vDC
RxD
TxD
J
3.3-5v
C1
0.1uF
Wulfden/Modern Device
P4 Serial Programming Adapter
Brian Riley
Rev 1.0
9/29/2007
Paul Badger

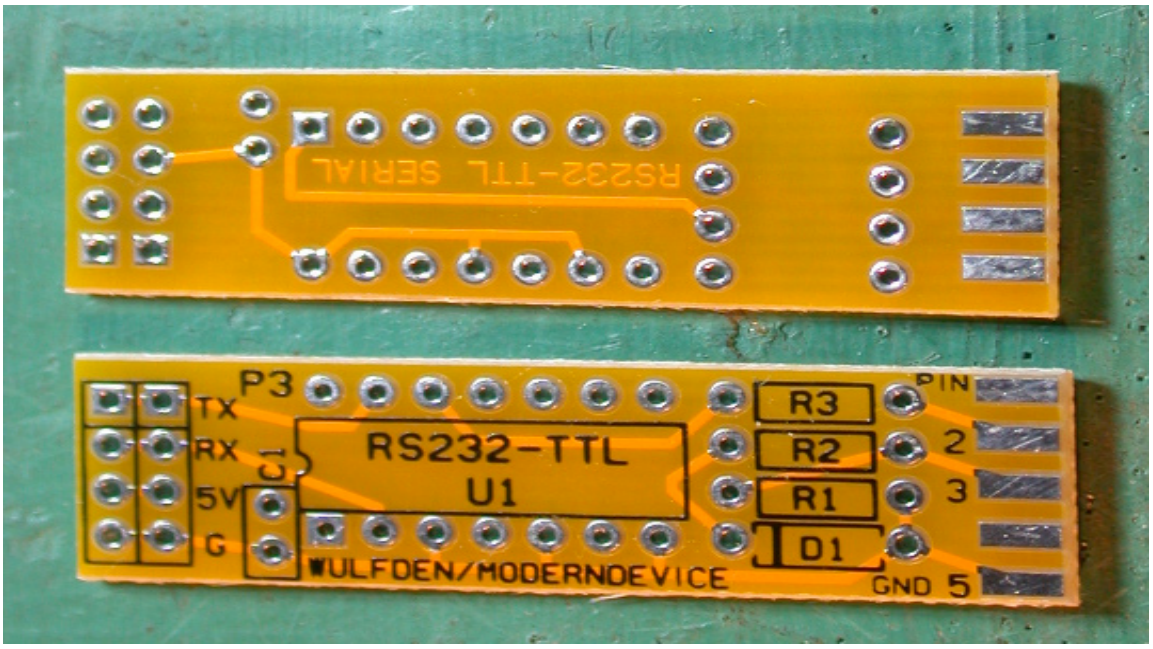
3 P4b - Wulfden/Modern Device Serial Programming Adapter



1. Initial assembly of the P4b is identical to the assembly of the P4 detailed in Section 2 above.
2. From this perspective there are three columns of 6 holes each. Column one holes , closest to the chip, **ARE NOT** connected to column 2 holes, unlike the original P4. You must insert and solder jumpers to make the connections.
3. Pin 2 in column 1 is superfluous. It connects to nothing when emulating the FTDI cable arrangement. Pins 2 in columns 2 and 3 maybe be needed for alternate configurations.
4. If you are doing a default assembly, emulating the FTDI cable pinout, you take 5 short clippings from the resistor leads and insert them in pins 1,3,4,5, and 6 jumpering each pin in column one to the same pin in column two. There is no connection on pin 2 so that may be left out.

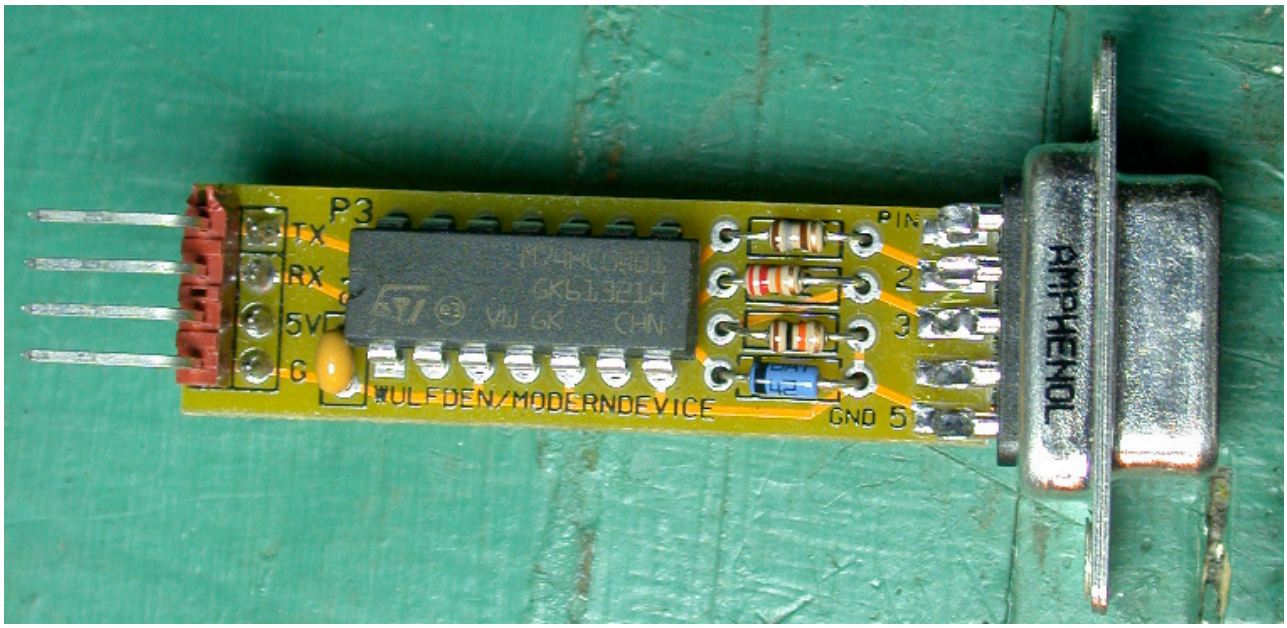
TTL Label	TTL Pin	Description	DB9 Pin	DB9 Label
G	1	ground (common)	5	GND
--	2	no connection		
3.3-5V	3	requires power		
TX	4	TTL ==> RS232	3	TxD
RX	5	TTL <== RS232	2	RxD
RST	6	TTL <== RS232	4	DTR

4 P3 - Wulfden/Modern Device Serial Programming Adapter



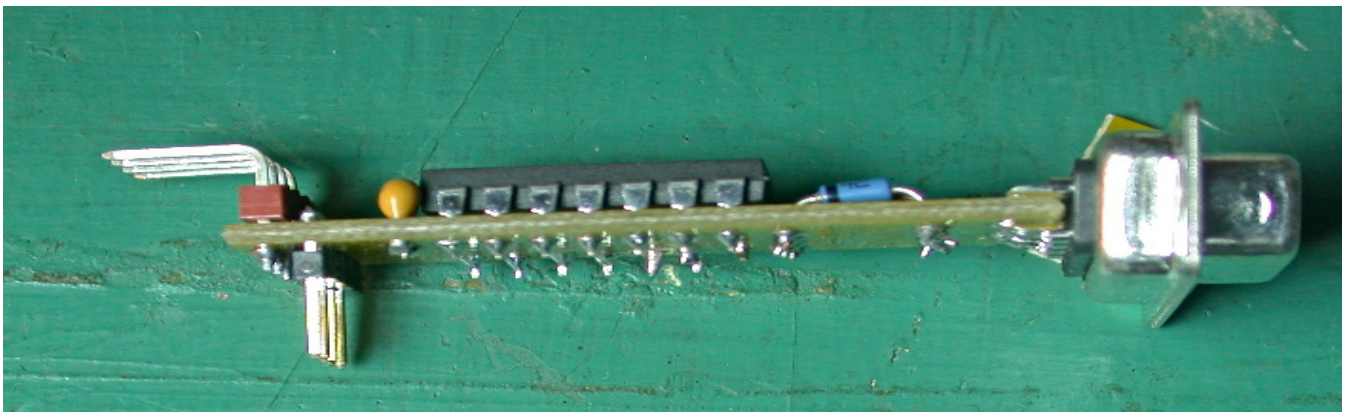
1.	C1	0.1 uF monolithic capacitor (“104”)	Mouser 80-C315C104M5U
2.	D1	BAT42 or 1N914 or 1N4148 Diode	Mouser 512-1N4148
3.	R1	carbon film resistor 10 Kohm 1/8 w (brwn-blk-org)	Mouser 299-10K-RC
4.	R2	carbon film resistor 22 Kohm 1/8 w (red-red-org)	Mouser 299-22K-RC
5.	R3	carbon film resistor 180 ohm 1/8 w (brwn-gry-brwn)	Mouser 299-180-RC
6.	U1	Hex Inverter 74HC04	Mouser 511-M74HC04
7.	J1	DB9F - solder cups	Mouser 523-G17S0900110EU
8.	J2	4 pin header	Mouser 511-6111TG

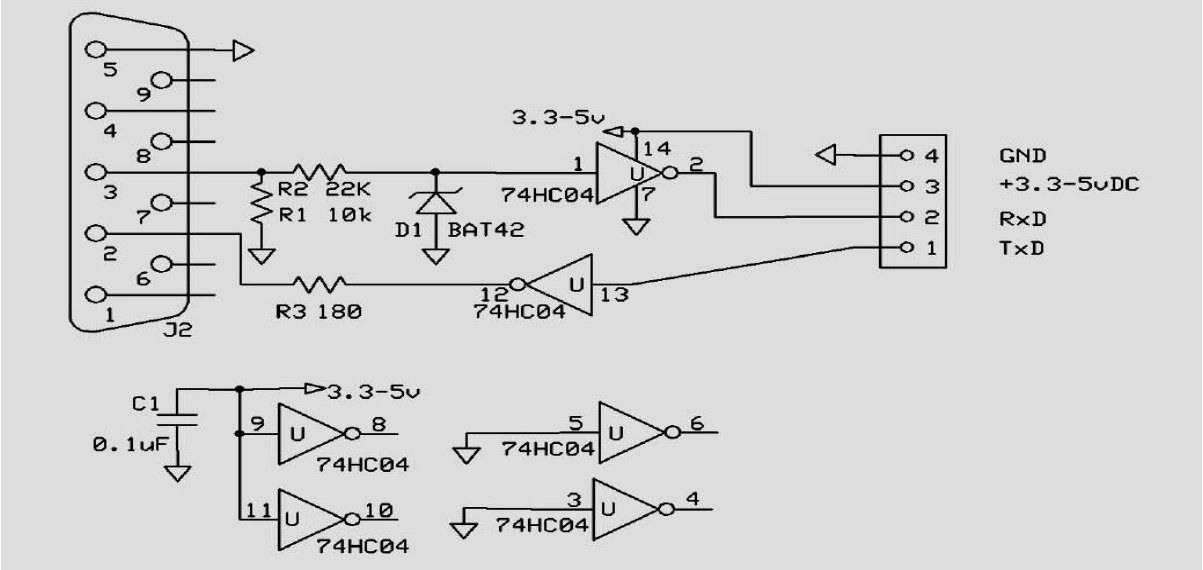
1. If assembling the P4 was almost trivial in its simplicity, assembly of the P3 is even simpler. The are only three resistors and one capacitor are inserted in the board in the places shown by the silk-screen as you can see in the photo. As with the P4 be sure of the alignment of the black band on the BAT42 diode above. Solder and clip excess leads
2. Next take U1, the 74HC04 hex inverter and align the notch on it with the notch on the silk-screen. The pins will need to be bent so they go straight down perpendicular to the chip body instead of splayed slightly outward. Bend pins 1 and 8 (diagonally opposite each other) over to hold the chip in place and turn the board over and solder. Heat each pin and flow the solder quickly to avoid damage to the chip.



3. Take the board and the DB9F connector, insert the end edge of the board between the two rows of solder cups aligning the five solder cups with the five pads on the top of the board and the four cups with the four pads on the bottom of the board. See photo to the left. Even though we are only using DB9F pins 2,3,4, & 5, solder ALL the cups to the pads to improve the strength of the mating of the connector and the pcb.
4. Now insert J2. J2 on the P3 has the same pinouts as on the P4 except that there are only 4 pins and no DTR/Reset, The pin assignments also match up to the Modern Device's Bare Bones Board, and Really Bare Bones Board as well as Adafruit Industries Breaduino boards. There are a number of possibilities. The kit comes with a single 4 pin straight header, which is most often used by inserting from the solder side of the board so that the pins face down to plug into a breadboard.
5. The user may supply additional or alternate connectors such as the right angle header. The P3 cannot have its pins reassigned, but with two rows of holes one can have connectors oriented in variety of fashions and even multiple connectors. See the pictures on this page.
6. The P3 can be used not just for programming but as an auxiliary RS232 port for the processor

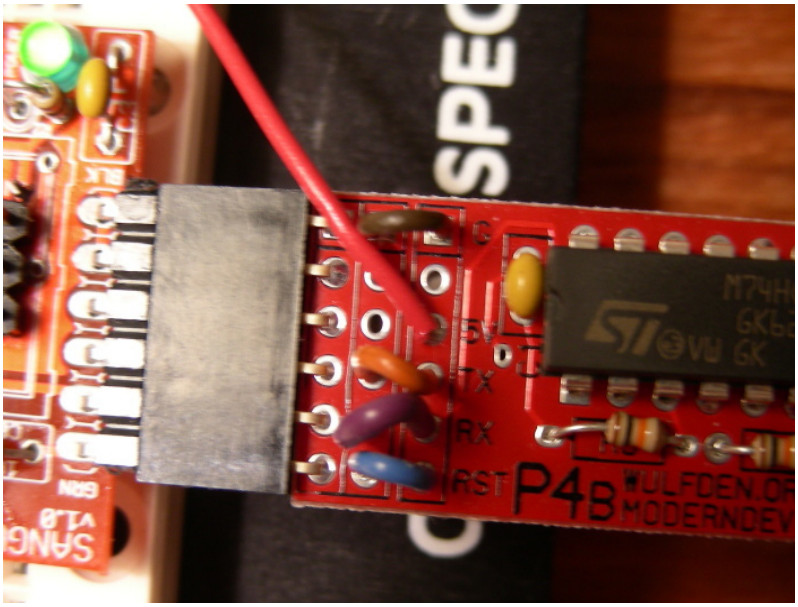
- Pin 1 - TxD
- Pin 2 - RxD
- Pin 3 - +5v
- Pin 4 - GND

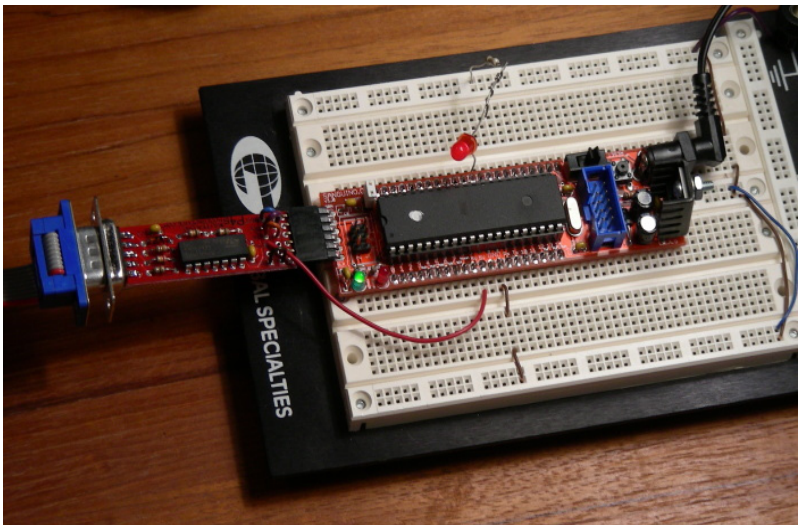




TTL Label	TTL Pin	Description	DB9 Pin	DB9 Label
TX	1	TTL ==> RS232	2	RxD
RX	2	TTL < == RS232	3	TxD
5V	3	requires power		
G	4	ground (common)	5	GND

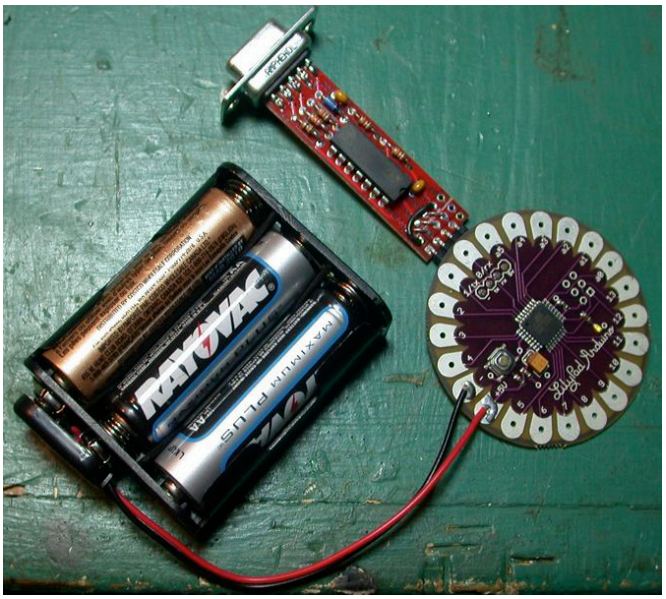
5 The P4B for use with the Sanguino(R)





1. The Sanguino board poses a small problem. When the power select switch is set to take power from the on-board supply, the 5 volt pin on the one by six pin programming connector is disconnected. There are two solutions for this, neither particularly elegant.
2. The first solution is a kluge. Solder a small jumper across the three pins of the switch.
3. The second solution (thanks to Bob Cochcran for the idea and pix) is only a small bit more elegant. Instead of a jumper on the pin 3 row, solder a 4-5 inch red wire to the 3rd hole of column 1 (+Vcc). Strip the remaining end and after placing the connector of the P4B onto the Sanguino board, insert the wire end into a hole with 5 volts.

6 The P4 for use with the LilyPad Arduino(R)

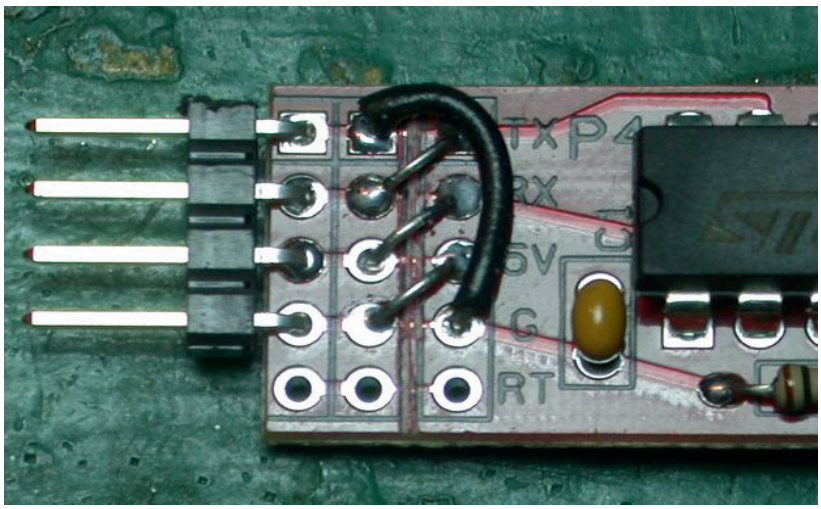


In October 2007 when the LilyPad Arduino was introduced there was no clear plug and play way to load a sketch. All the methods discussed involved compromises and kluges such as alligator clip jumper wires being hacked up.

A little inspection showed that the P4, with its *re-programmable* pinouts was the perfect candidate.

The three rows of output pins are referenced by calling the row nearest the 74HC04 chip as row one, the middle row is row two and the row along the end of the board is row three.

(for the following steps refer to picture to the right)



(1) slice the five traces connecting each hole/pad in row one to those in row two.

(2) run bare jumpers from a. TX Row 1 to RX Row 2, b. RX Row 1 to +5V Row 2, and c. +5V Row 1 to G Row 2

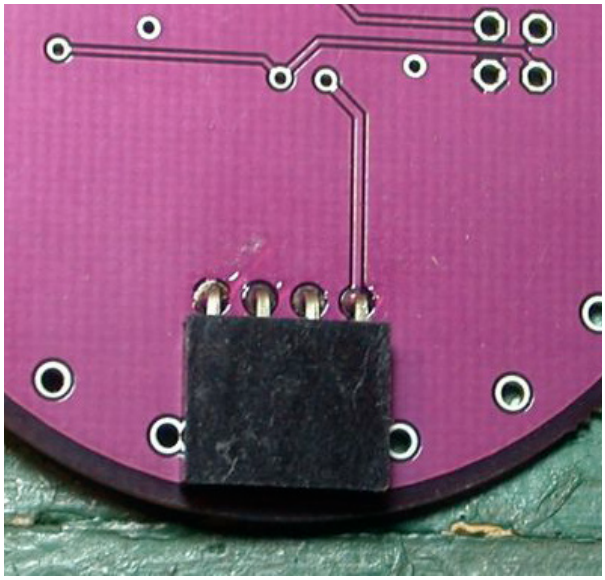
(3) run an insulated jumper from G Row 1 to TX Row 2

(4) Insert and solder four (4) pin right angle header in holes one through four.

(5) Assemble the P4 using the instructions on page iii. Leave out R4, R5, and C2.

(6) Insert and solder a bare wire jumper in place of R5. This grounds the input of the now unused gate for DTR and prevents it from possibly oscillating

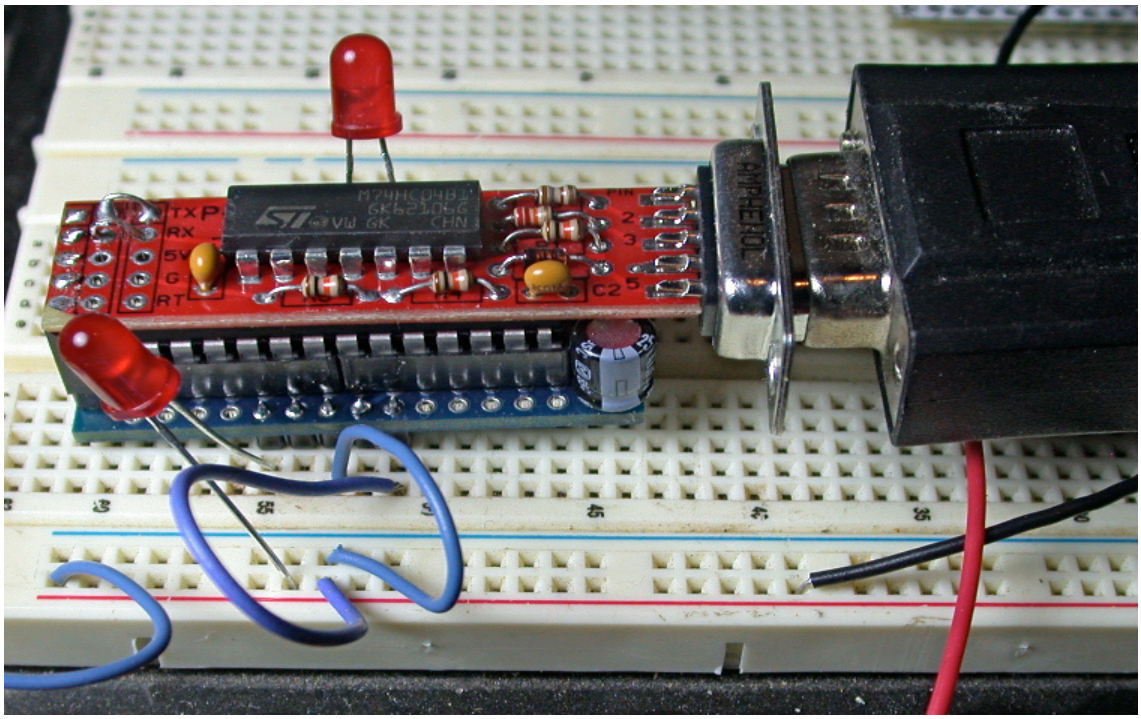
(7) Insert and solder the four pin ight angle socket header on the bottom of the LilyPad unit. The header should lay flush with the bottom, there is some play with the pins in the holes so take care to center it. Use a minimal amount of solder and clip the pins off flush so they do not snag on onything brushing the top.



7 The P4 for use with the AmQRP NUE-PSK Modem

1. Holding the board with the solder tabs towards you, from right to left insert the three resistors; 180 ohms (brown-gray-brown), 22 Kohms (red-red-orange, 10 Kohms (brown-black-orange), then the Diode (black band towards chip)
2. solder and clip these leads off
3. We will not use the hexgate for the reset circuit. But we must either ground or pull up its input line to prevent the gate from randomly oscillating. So, along the left edge where you would place C2, R4, and R5. Leave out C2 ("104") and R4 (10K). Insert a clipped resistor lead as a jumper in place of R5 (10K), effectively grounding the gate input. Place C1 0.1 uF ("104"), solder, and clip excess leads
4. Carefully lay the chip on its side and push it evenly from both sides so the legs are more perpedicular to the chip rather than splayed outward as it comes from the factory. Then turn the chip on its other side and do the same
5. Align the chip with its notch towards the three rows of 5 holes end. (if you hold the PCB so you can read the words "Wulfden/ModernDevice", then the writing on the chip will be upside down). Now carefully insert the chip into the 14 holes.
6. check that all pins are through their respective holes, bend a two pins over at diagonally opposite points to hold the chip in place while you solder.
7. Solder and clip these leads.
8. Push the DB9 plug pins over the edge of the board. With some of these connectors they do not line up absolutely perfectly but well enough that they can be soldered on without making any unwanted solder bridges.
9. The Pinouts of the P4 header connector as as follows. Rows number 1 (nearest chip), 2, & 3. Pins number 1(square pad), 2, 3, 4, & 5. To wire for the NUE-PSK you will want to
10. Cut the trace between the pads of Pin 1/Row1 and Pin 1/Row2
11. Cut the trace between the pads of Pin 3/Row1 and Pin 3/Row2
12. Insert jumper wire to connect Pin 1/Row 1 - TX (data to RS232) to Pin 3/Row 2
13. Insert jumper wire to connect Pin 3/Row 1 - +3.3-5.5 vdc (power from host) to Pin 3/Row 2
14. HINT - do one jumper on top of the board, the other on the bottom
15. Pin 5/Row 1 - Reset - there is no connection
16. Insert the 4 pin socket header facing down, pins up though pcb inot the row three holes for pins 1-4 and solder on the top component sde, make sure its perpendicular to the plane of the pcb,

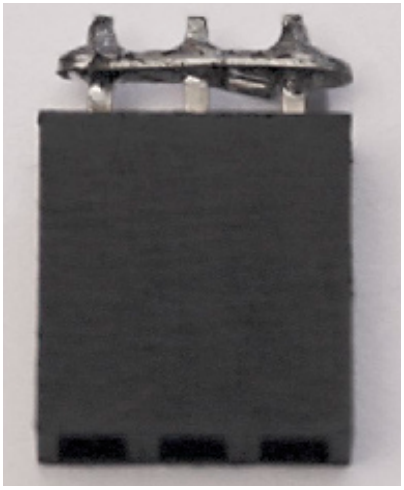
8 The P4 for use with the Dorkboard(R)



The DorkBoard, from Don Davis out at **DorkBot PDX** (Portland, OR) has a 5 pin connector that aligns perfectly with the P4. If the DorkBoard is assembled with a straight 5 pin header inserted vertically and the P4 is assembled in default configuration (no cuts no jumpers) with a 5 pin socket header mounted vertically downward, the P4 will program t he Arduino chip on the Dorkboard.

**** Note** - for auto-reset to work you must remember to solder the jumper pads on the bottom of the DorkBoard (see the Dorkboard assembly instructions

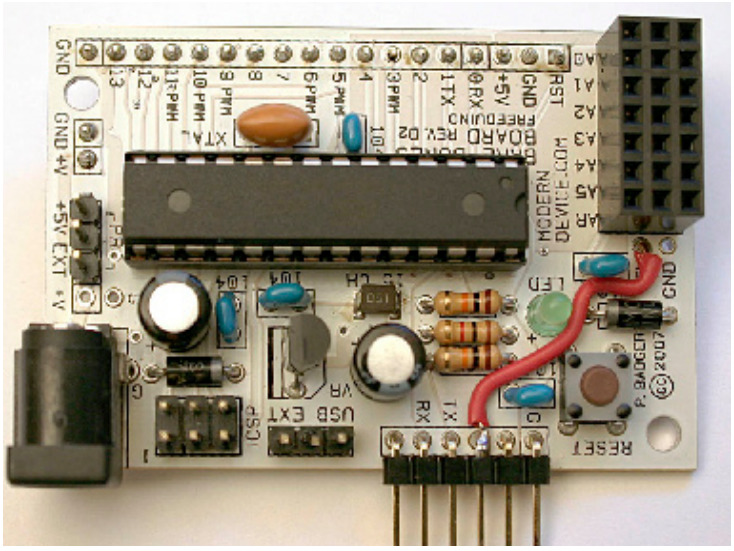
9 The P4B for use with the BBB(R)



The Bare Bones Board (BBB) from Modern Device offers the same problem as the Sanguino board. The jumper selection of power sources, isolates the +Vcc (pin 3 of the 6 pin connector). Also like the Sanguino two not very elegant solutions offer themselves.

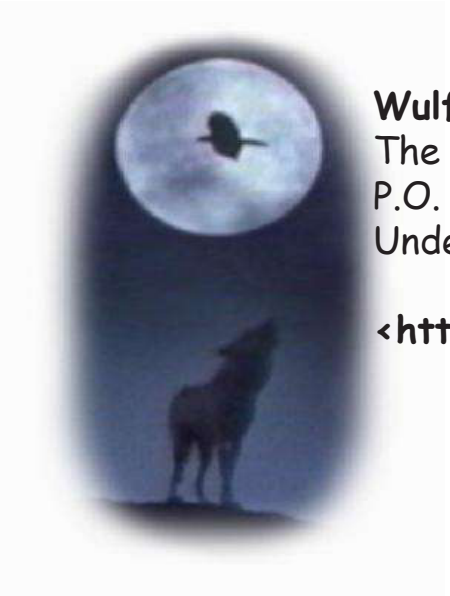
The first, is simple and straight forward. On the assumption that you are supplying +5v to the board. Prepare a three pin socket header with all 3 pins shorted together, and place it on the power selector 3 pin header in place of the standard two pin jumper."

This will allow the P4 to be powered from the external power supply. Take care to limit the voltage of the external supply to 6 volts maximum, or you'll damage the chip on the P4. **Note** that many linear wall adapters (the heavy kind) will be rated at 6 volts and 500 mA, for example, while their unloaded voltage will be close to 9 volts. So check the voltage at the output, before using the triple header method and move to another method if you don't have a suitable power supply.



The second solution involves taking a wire and wrapping it about pin 3 on the programming connector and soldering in place, and the snaking it over to the Analog port connectors and stripping, inserting and soldering into the spare +5v hole. This has the disadvantage of bypassing the VR when a real FTDI cable is used and the jumper is in the USB position.

Two variations on this would be, first, to cut the wire a little longer, strip the unused end and insert into the middle pinhole of the near row on the Analog connector only when needed. The second would be to adopt the solution suggested above for the Sanguino, attaching the wire to the P4B and plugging it in to the Analog connector when needed.



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