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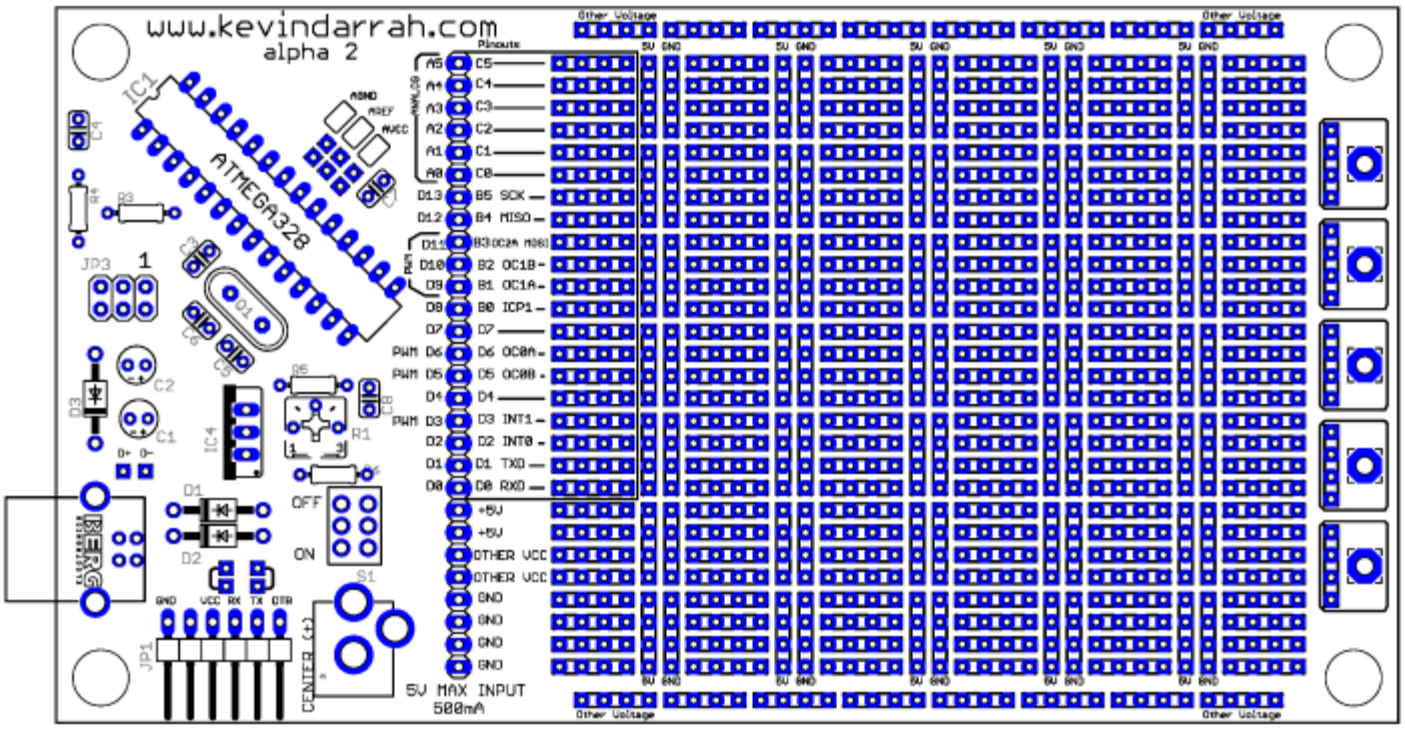
Design Specification

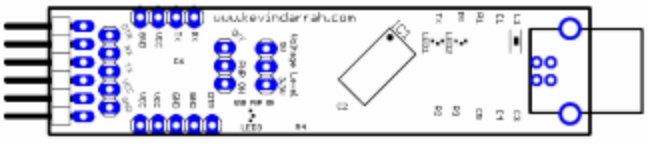
Ultimate Arduino Prototype Board

Ultimate Arduino Programmer Board

Internal Project Code: Lonely Board

Build Version: Alpha2





Introduction

This is the design specification for the Ultimate Arduino Prototype Board and Programmer Board. This document contains information pertaining to usage of the boards, construction of the boards, troubleshooting, and general design information. NOTE: This document is IN-WORK. Not all elements are completed at this time. Feedback on packaging, installation/conxruction, and usage is desired. Email the design engineer with all feedback – kevin(at)kevindarrah.com Please remember, the alpha 2 boards are not tested. All feedback is requested.

Background

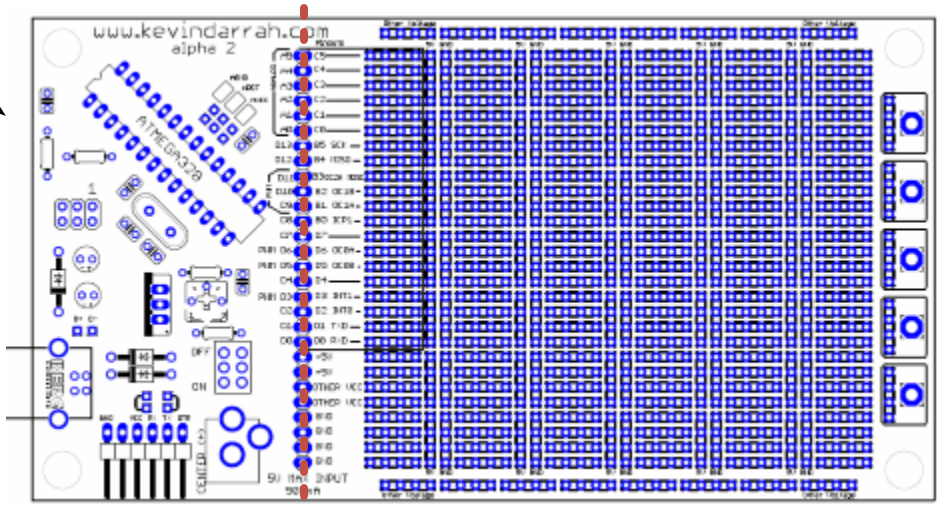
These boards were designed with the intention of providing a prototype platform that is ready to go for Arduino based projects. Typically, a project starts out on a development board alongside a bread board. This phase in the project can be considered feasibility analysis, which can be disregarded generally as experimentation. This is okay, but when a project needs to be 'saved', a more permanent circuit is needed. Too often, experiments are ripped up out of necessity to start another experiment or project. The breadboard and/or the development board are required for the next project. It is due to a lack of resources that projects are not saved. There are several options for 'saving' a project. For the more serious enthusiasts, a PCB(Printed Circuit Board) could be drafted and etched. The PCB's could be professionally manufactured, but these are typically very expensive for a low volume run. Of course, there is a 'Batch' option. This is where a PCB design is combined with other designs on the same panel. When enough designs are entered in to fill up a panel, the PCBs are made. The manufacturer will then cut out the individual PCBs out. This is the lowest cost option, but it comes with the major drawback of having long lead times. It could take some time for all of the different PCB designs to come in and make up an efficient panel. If the PCB outline is typical (squares/rectangles), then a PCB could be delivered within 2-3 weeks. If a customized PCB is still desired, but long wait is not acceptable, then there is the option to etch PCB's at home. There are many methods of doing this, but it typically involves a messy/ tedious process. Quite possibly the most popular option for prototyping involves the use of a proto or perf board. These boards are nothing more than a grid of through holes in which components can be soldered together in a permanent circuit. There exists many variations of proto boards; some with the holes connected to each other, and some even have pads for surface mount components. For Arduino based projects, the same Arduino 'base' circuit is needed, which includes the ATMEGA328, crsyal, caps, programming header, etc. After soldering this same circuit onto countless protoboards, the need for the Ultimate Arduino Prototype board was imagined. Yes, the cost of a custom prototype board is expensive, but with high volumes (>100), the cost per board can be reduced significantly. The board is really the best of both worlds; a custom PCB combined with a proto board. Proto shields are nice, but they still require a sacrifice of an expensive Arduino development board.

The Programmer board is another story. This came out of the need for a multifunctional programmer. The board is based on an FT232RL, with typical functionality broken out and selectable via jumpers. The board also allows for many interfaces; breadboard mount, header mount, and wire-board connections. The features and functionalities of both boards will be discussed in detail as this document progresses.

How it works

Components for:
-Arduino
-Power Supplies
-Programming
Over on this side

User Components and circuitry placed in the prototyping area

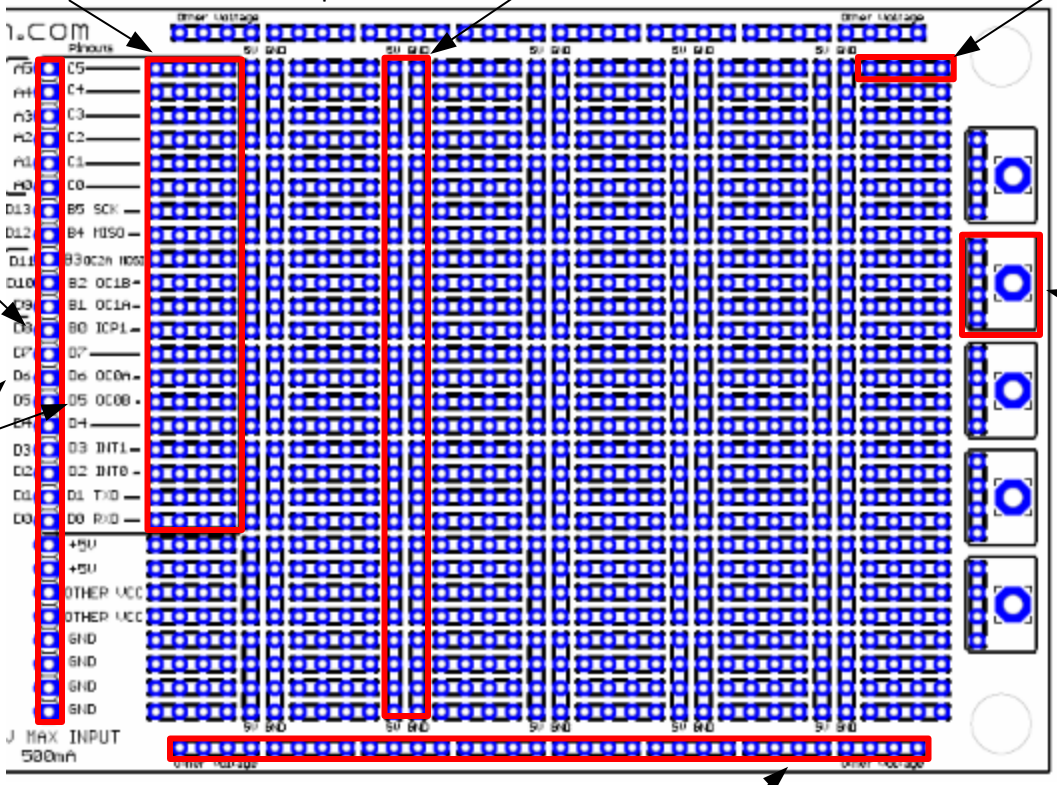


The Prototyping area:

4 through holes connected together for each connection point.
148 of these 4-per busses makes 592 connection points
0.032" Hole
20-24AWG Ready

+5V and Ground Busses
140 points for each Buss

Arduino IO Through Holes
4 Bussed connections for each pin



Female Header with all Arduino Pins for temporary wire connections, split between a 20 pin and an 8 pin header.

Silk-Screen Text on both sides of header; left=Arduino Assignments, Right=Native AVR Assignments of the uController

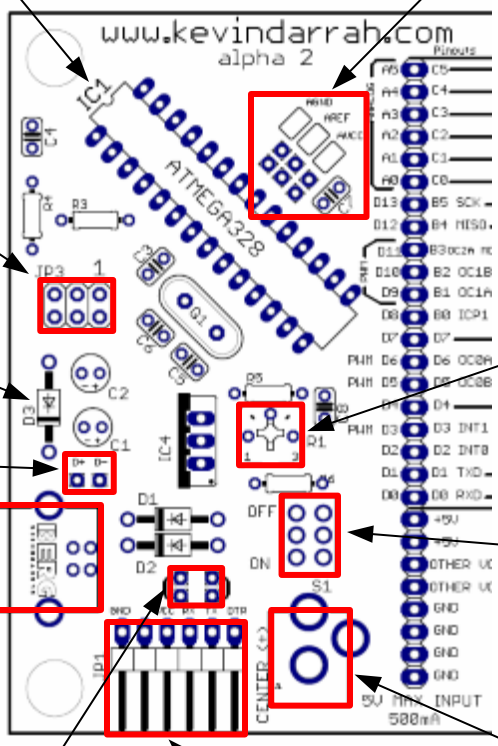
Larger through holes for wire-board connections
5 connection points
0.055" Hole
18AWG Ready

Secondary Voltage Busses (+3.3V)
64 Connection points

Note:

- Hole-Hole Spacing is 0.1" or 2.54mm, which is standard through-hole IC pin-pin spacing.
- This board may be paired with basic proto boards for expansion. This board is not intended to be a major IC stacked proto platform. It can safely support 7 16-pin IC's.

The Arduino (Microcontroller Side)



Every Kit comes with the ATMEGA328-PU 28Pin Microcontroller programmed with the Arduino Bootloader

Analog Configuration Pins broken out to allow for a customized Analog Design

6 pin Standard AVR Programming Header, allowing the board to be used for AVR prototypes or to program Arduino Bootloaders

Diodes on each power source allow for accidental reverse polarity protection and multiple power source protection. Note diode polarity.

"Other Voltage" Trim Potentiometer to fine tune the 3.3V supply. (Should not be used as a Voltage Reference; power source only)

USB Data Signals (D+/D-) broken out for USB projects

Power Switch to control power to the board when either the barrel jack or USB port are used as the power interface

Full Size USB port (Type B) to power the board (Not for programming)

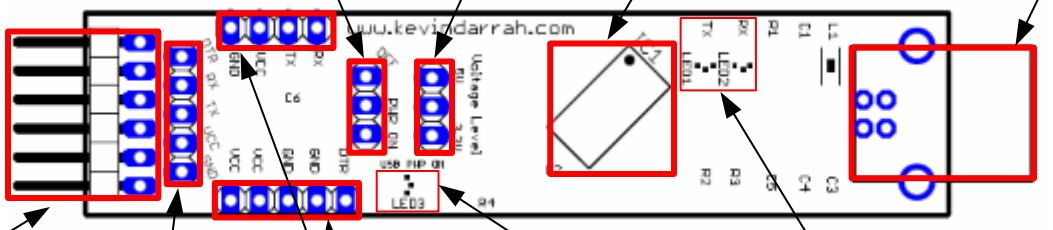
Center Positive Barrel Jack Connection. 2.1mm Plug Compatible. This input powers the board directly, so it must be 5V regulated capable of 500mA output. NOTE: Kit does not include plug or power supply.

Tx and Rx jumpers to allow impedance to be added in series with these signals. Allows the Arduino's UART to be used by the project and for programming at the same time. These jumpers will typically be shorted out with bare wire.

6 pin Programming header compatible with the Ultimate Arduino Programmer board. This is also compatible with the standard "USB Serial Light Adapter" from Arduino (Not Tested Yet)

The Ultimate Arduino Programmer Board

Based on the FT232RL USB-Serial Converter, this can be used to program chips that are running the Arduino Bootloader, or can act as a COM Port for communication with a project with UART peripherals



Suitcase Jumper for Power Output Enable (If target is powered by another source, this jumper allows the programmer to disconnect power)

Suitcase Jumper for Voltage Output Selection 5V or 3.3V This also configures logic levels

FTDI FT232RL USB-Serial Converter (virtual COM Port)

USB Port-Type B (Full Size)

Programmer Power ON LED

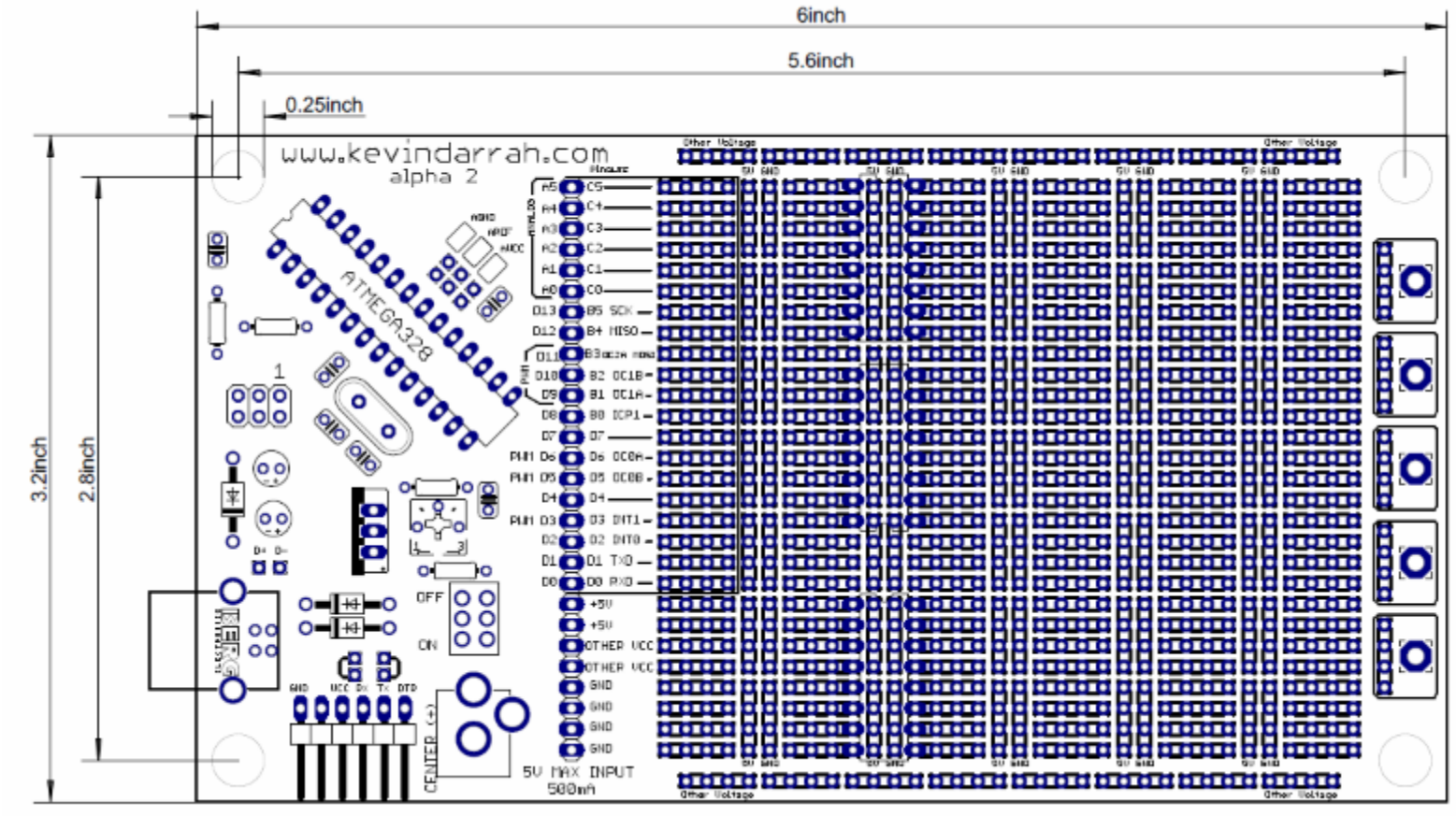
TX/RX LEDs
TX = This board is Transmitting to Arduino
RX = This Board is Receiving from Arduin

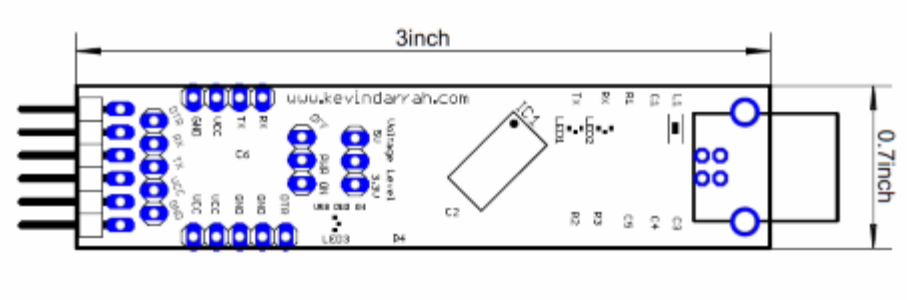
Right Angle Female Header compatible with the Ultimate Arduino ProtoType Board. This can also be used to program various Arduino Boards and clones.

Male Headers allow for breadboard programming or to power projects (same pinout as the older Arduino Mini Programmer)

Female Header Allow for wire to board connections

Board Dimensions





Minimum Tools needed to construct the kits

- Soldering Iron – A fine tip is preferred. Surface mount soldering is not required for these kits, so no need for any 'special' soldering tools. Just make sure the soldering iron is for electronics, not plumbing or residential/commercial electrical work.

- Solder – Recommended solder is 0.032" Diameter, 60/40 Rosin-Core Solder. NOTE: This is not lead free.

- Side Cutters – Simple wire cutters to trim the leads away after soldering. The closer the cut can be made to the board, the better.

Tools that could make life easier

- Desoldering Wick – This is a reel of finely copper wire braid. If any mistakes are made by soldering a part incorrectly, it may be necessary to desolder the component. This wick can be used to wick solder away from the solder joint into the wick.

- Organized and prepared workspace – Good lighting, good ventilation, and clean bench are all things you should make happen prior to taking this on.

Components:

Ultimate Programmer Board

Reference Designator	Description
C1	.01uF 1206
C3	10uF 1206
C4	1uF 1206
C2,C5,C6	0.1uF 1206
R1,R2,R3,R4	1kOhm 1206
LED3	Green LED 1206
LED1,LED2	Orange LED 1206
IC1	FT232RL USB-Serial Converter
L1	Ferrite 500mA 1206
Male Header	0.1" 4&5 Pin
Female Header	0.1" 6 pin Right Angle and 5 pin Straight
USB	Type B Full Size

Ultimate Prototype Board

Reference Designator	Description
Barrel Jack	2.1mm DC Power Male
Switch	Slide Switch
D1,D2,D3	Protection Diodes (polarity sensitive)
C1	10uF Radial Electrolytic (polarity sensitive)
C2	1uF Radial Electrolytic (polarity sensitive)
C3,C4,C7,C8	0.1uF Ceramic (104)
C5,C6	15pF Ceramic (150)
Q1	16MHz Crystal
IC4	LM317 Voltage Regulator (line up with tab with board)
R5,R6	1k Ohm 1/4W Brown/Black/Red
R3,R4	10k Ohm 1/4W Brown/Black/Orange
Female Header	28 pin 0.1" Header (20 pin and 8 pin)
IC1	ATMEGA328PU
Socket	28 Pin Narrow Socket
Male Header	0.1" 6 pin right angle header and 6 pin AVR programming header
Trim Pot	10k Square Potentiometer

Notes/Tips – Ultimate Arduino Prototype Board

Power Sources – The Barrel Jack and full size USB connector should never be sourcing power at the same time. There is no protection if both are delivering 5V to the board. Protection does exist if power is being sourced via the USB/Barrel Jack AND a programmer is also sourcing power. The two programming ports are the 6 pin AVR header and 6 pin right-angle Arduino header. The board does not give precedence to any voltage source, only the source with the highest voltage. For projects that draw more than 500mA, the power source should be connected in the prototyping area. If a power source is connected in the prototyping area, the source can power the Arduino microcontroller side easily, by connecting the source to the +5V and ground busses. Special care should be taken so that the programmer is not sourcing power to the project. For example, if the project was a high quantity LED display, the power for the entire project should not be sourced by the programmer. The Ultimate Arduino Programmer board has a convenient jumper that allows power to be disconnected from the programmer.

The switch on the prototype board only interrupts power that is sourced via the USB port or the barrel jack. The switch has no effect on the power sourced by the programming headers.

Protection Diodes – The prototype board contains three diodes that allow for reverse polarity protection and accidental multiple power sources. If the programmer is powering the project and the barrel jack or USB port is also connected, the diodes will make sure that only one source is actually sourcing power. This is determined by which source is at the highest voltage. The diodes also protect against accidental reverse polarity connections that could destroy the electronics. The AVR programming header and Arduino Programming header could potentially be plugged in backwards or off by a few pins. If this should ever occur, the diodes give a first line of defense, though prevention of damage to the board is not guaranteed.

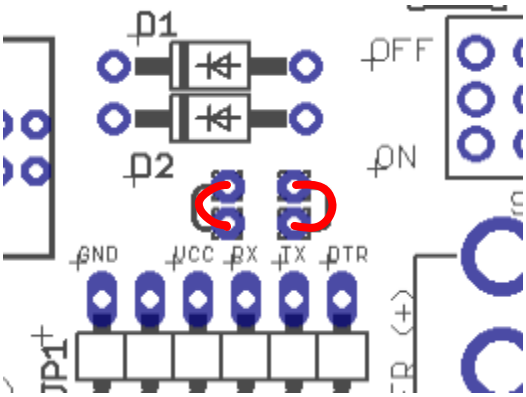
The drawback of the diodes is the forward voltage drop of the diodes. If the source voltage is 5V to the board, then the Arduino will likely see a voltage of around 4.3V with heavy loads. This shouldn't be a major disadvantage, but if precise voltage measurements are required by the design, then an Analog Reference Voltage should be used. Otherwise, the analog measurements will be full-scale referenced to the Arduino's supply voltage which will swing from 5V to 4.3V depending on loading. If this is a problem, the diodes can be replaced by wire jumpers. The jumper can be any loose wire available. The voltage source will then equal the voltage supplied to the Arduino and Power Busses.

3.3V Supply – The 'Other Voltage' Busses are sourced by an on-board voltage regulator (LM317). Included in the kit is two 1k Ohm Resistors and a potentiometer, which allows the 3.3V to be calibrated. The potentiometer should be adjusted prior to connecting any circuitry to the 'other voltage'. Voltage that is hazardous to 3.3V rated components could be present if the circuit is not calibrated. If voltage other than what can be supplied by the LM317 is needed, then do not populate R1, R5, R6, and IC1. C8 is the 0.1uF decoupling capacitor for the 'other voltage'. Once these components are removed, any voltage can be applied to the bus for use on the 'other voltage' bus.

Analog – The solder pads labeled AGND, AREF, and AVCC are connected to these corresponding pins on the ATMEGA328 on one side. The other side of the solder pad is connected to GND, and +5V. These pads are simply jumpers that are made by melting solder across the bridge. On the Arduino UNO, AVCC and AGND are connected to +5V and GND respectively. If this is the desired operation, then melt solder across these two solder jumpers. Leave the AREF solder jumper open. There are also through-holes tied to the three analog pins, which can be used to configure the analog inputs in other ways. Refer to the ATMEGA328 datasheet for more information. The ultimate Arduino Prototype board was designed for this flexibility.

Notes/Tips – Ultimate Arduino Prototype Board

Programming **IMPORTANT** – The kit is shipped with an ATMEGA328 programmed with an Arduino Duemilanove Bootloader. The default program blinks digital pin 13! Keep this in mind as external circuitry is connected. THIS IS IMPORTANT- The Protoboard will not accept a program until a jumper has been placed across the TX and RX through holes. Use a lead cut off from another component for this. There should be two jumpers placed. These jumpers connect the programmer board's TX and RX to the prototype board's TX and RX. These jumpers are given so the UART (Serial Port) on the Arduino can be used for both programming and as a communication interface to other devices at the same time. Examples of this will/are given on Kevin's YouTube page, but in most cases, they can just be shorted with jumpers.



Getting more connection points – Each loose connection point is connected by 4 through-holes. If more is needed, the trace that connects the 4 through-holes can be cut via a cutting tool. Ensure with a continuity tester that the trace was cut prior to connecting circuitry.