DIYPNP F60-K

ASSEMBLY, FIRMWARE LOADING, STARTUP MAPS & INITIAL CONFIGURATION & APPLICATION DOCUMENT

12/15/2013 Final, Rev. 1

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The vehicle used for creating this document was a USDM 1993 Ford Mustang 5.0L with a manual transmission. All factory electronics/ignition system components were in place and the factory wiring harness was in perfect condition. MAF was in place & GT40P heads installed.

This document was created by Monte Smith, original owner of a 1988 Mustang GT and is specific to the Ford Fox body Mustang 5.0L, 1987-93, although it will apply to other models & years, i.e. 1986 Mustang 5.0L

It is primarily a compilation of the following web pages along with additional information not contained on them & some, but not all, non-relevant information removed.

Overview http://www.diyautotune.com/diypnp/docs.htm#1overview
Main Assy http://www.diyautotune.com/diypnp/docs1_5/main_assembly.html
Basic Jumpers http://www.diyautotune.com/diypnp/docs1_5/basic_jumpers.html
Ignition Control http://www.diyautotune.com/diypnp/docs1_5/ignition_control.html
Extra Outputs http://www.diyautotune.com/diypnp/docs1_5/extra_outputs.html
Proto Areas http://www.diyautotune.com/diypnp/docs1_5/proto_area.html
Firmware Load http://www.diyautotune.com/diypnp/docs1_5/loading_firmware.html
Application Docs
http://www.diyautotune.com/diypnp/apps/f60/usdm-ford-mustang-8893-5_0-mt.html

DIYAutoTune.com Sitemap http://www.diyautotune.com/catalog/m1_sitemap.php

INTRODUCTION

The DIYPNP board lets you build your own plug and play engine management system. The core of the DIYPNP kit is a MicroSquirt module that plugs into an expansion main board with on board circuits for many features, including direct coil control, boost control, knock control, and several general purpose inputs and outputs. You assemble this board and jumper it to a “connector board” which includes a connector to plug into your existing wiring harness. Now you no longer have to solder together awkward adapter harnesses, or hack up a factory ECU case to get a build-it-yourself, plug and play MegaSquirt ECU.

Note that for the purposes of this documentation most of these directions assume you will be running MS2/Extra code, version 2.1.0 or higher.

Some boards have extra components on the adapter board that you may want to assemble as well. This document is focused on the Ford 60 pin-TFI output adapter board.

If you have an older V1.1 board (marked "DIYPNP V1.1 BY DIYAUTOTUNE.COM" on the upper edge of the underside of the board), see the V1.1 assembly documents.

Read the Manuals, You are Responsible for your own results!

This Application Document is intended to assist you in your DIYPNPF60-K Installation. DIYAutoTune has done a fair amount of research, and actually tested on a similar vehicle to help ensure we can provide the most accurate information possible to make your installation go as smoothly as possible. That said, there are certain things you could do incorrectly, or certain things you could change, that could cause you to run into issues. DIYAutoTune tech support department will be glad to assist you working through any issues you might have, please contact us and give us that opportunity and we should be able to work things out for you.

Startup Maps referred to in this document are intended only to help you get your engine started so that you can properly tune your engine. The map was setup properly for a stock 1993 Ford Mustang 5.0L-HO-V8 with manual transmission. 1986-1993 were nearly identical, as were many other Ford models that contained the SEFI 5.0L-V8 engine which can include the Lincoln Town Car, Ford Crown Victoria/Mercury Grand Marquis, Mark VII, & Thunderbird/Cougar.

1994-95 SN-95 used the same 5.0L HO engine with minor changes & the same 60-pin connector. The MAFs were changed from 4-pins to 6-pins to accommodate the relocation of the ACT sensor from the lower intake to the MAF housing. If you remove the MAF, the ACT will have to be relocated.

Note that some are standard output engines and others are high output (HO) engines. For purposes regarding the DIYPNPF60-K, they all are the same, even though the firing orders are different. In general, if the vehicle originally contained the Ford EEC-IV engine control module (ECM) with the unique 60-pin connector, the DIYPNPF60-K can be made to replace it.

If you have made any changes to your wiring, your ignition system, or other related components, this map may not be ideal for your vehicle. You will then need to check and confirm the appropriate settings and properly configure your DIYPNPF60-K for your altered vehicle. Some maps offered may be more completely tuned that others, some may be just setup enough to get the car to fire up and idle with a little help from the throttle. That's when the tuning begins.

In short, we've provided you with the building blocks for an incredible Engine Management System (EMS). You are responsible for the implementation and your own successes or lack thereof, but rest assured, that we're here for you and we're going to do everything in our power to make sure your project is a success.

For more information on configuring and tuning your DIYPNPF60-K, and for information on adding and tuning custom MS2/Extra features, read up at http://www.msextra.com/ms2extra/. In fact, everyone implementing this system should read that manual from front to back if you want to harness the power of the DIYPNPF60-K.

Required Item

DIYPNPF60-K Kit. This is the main DIYPNP Kit including the Ford EEC-IV style 60-pin connector and all components, case, etc.

Optional Items

Tuning Cable
This is the same DB9 serial tuning cable used in other MegaSquirt applications.

USB Adapter
This is a DB9 serial to USB adapter. The adapter is needed when the laptop or PC you are using does not have a built in DB9 serial port.

Stim Power **(Highly Recommended)**
This is a power supply that is normally sold to power a stimulator, but another use is it can be plugged directly into the DIYPNP main board to power the ECU directly, allowing you to load the base maps and do limited testing on the ECU prior to installing the ECU in your vehicle. It allows you to flash the firmware and load your configuration on the bench instead of in the vehicle, and there is less risk of damaging something on the vehicle due to incorrect settings. Power supply is 12VDC @ 500ma. If you already have one with a higher amperage rating, it will also work. Plug may have different outside diameter/inside diameter, but most 12VDC power bricks use the same plug & polarity (+ in center). See if it fits & the polarity is correct before you connect it.

PNP_IAT-A or PNP_IAT-S AFM/MAF Delete kit
(Not needed for Fox body models, only needed for SN95 models)
This is a simple kit with an IAT sensor, wire pigtail, crimp pins to poke into the AFM Connector to run the signal back to the ECU, and a steel or aluminum bung (hence the -A and -S in the part numbers). Perfect for getting rid of a restrictive AFM/MAF with your DIYPNP install.

Tools Needed

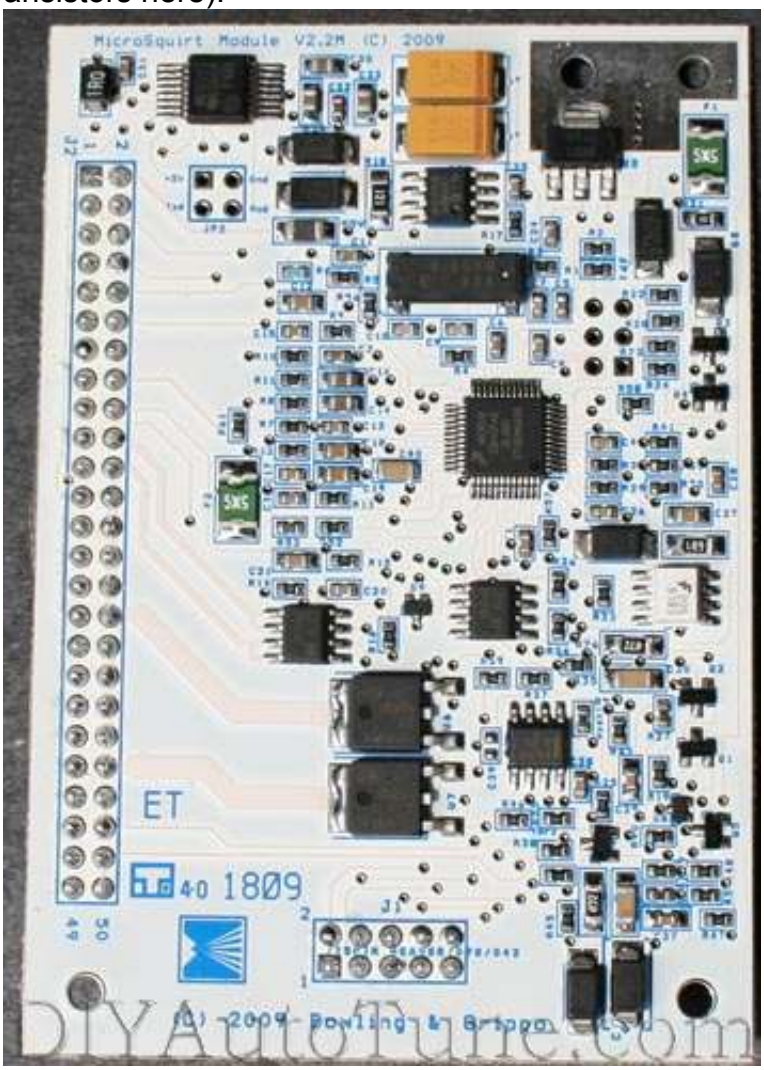
Soldering Iron, solder, maybe some de-soldering braid in case you make a mistake, small Phillips screwdriver, needle nose pliers, small diagonal cutters. We recommend using 63/37 tin/lead solder. Lead free solder is not as reliable or easy to use, and automotive parts are ROHS exempt anyway.

Overview

MicroSquirt Module

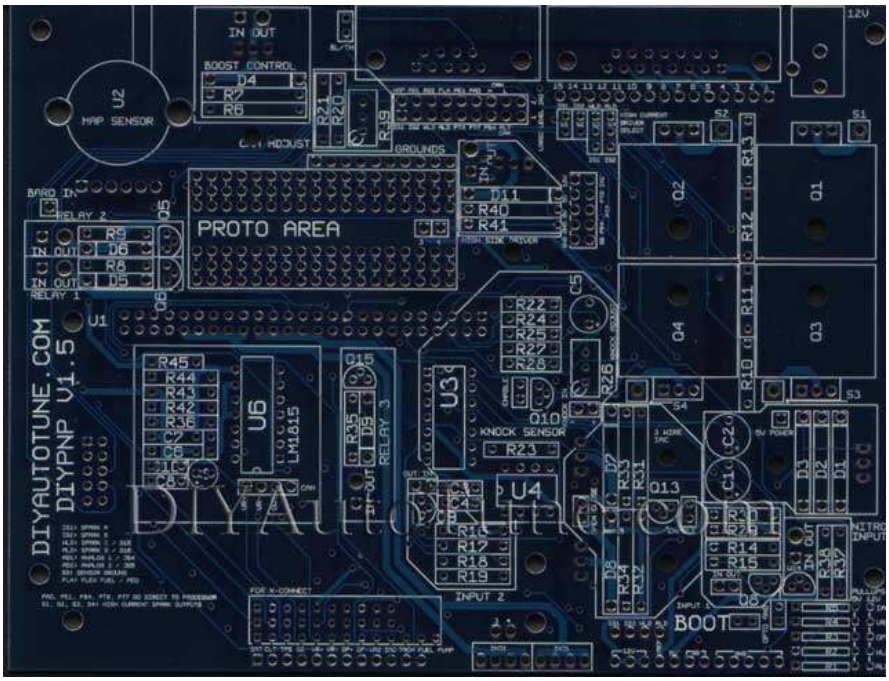
The MicroSquirt Module board includes the processor, many of the sensor conditioners, and two injector drivers, each injector driver capable of running one low impedance or four high impedance injectors.

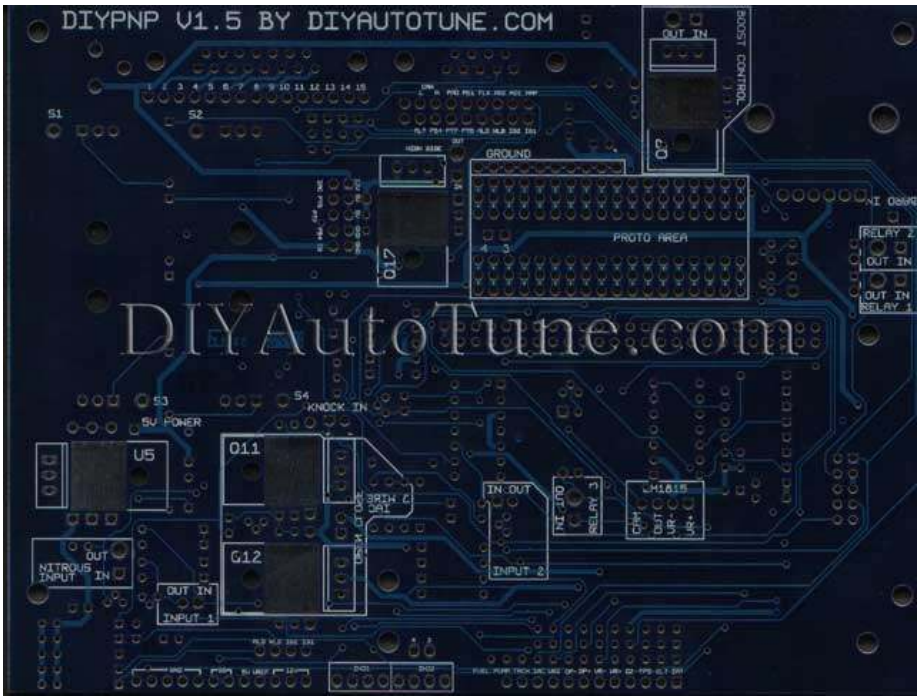
The MicroSquirt Module which is a MegaSquirt-II Processor based ECU on a credit card sized PCB. The DIY element of this EMS comes from the fact that you assemble it yourself from a kit of components, soldering the unit together and then adding wire jumpers to route the signals to the connector board to match the needs of your car. The assembly is not nearly as complex or time consuming as a standard MegaSquirt ECU kit assembly, there are fewer components and all components are sized so that they are easy to solder (no tiny transistors here).



Main Board

The main board that the MicroSquirt Module bolts to adds several new circuits of its own to provide you with all the features you need to run many popular engines, and room to add more circuits if you need something not originally on the board. There are more features in the V1.5 DIYPNP main board, including 3 wire IAC control, 12 volt input and output, an extra relay control.





Since the MicroSquirt does not have an onboard MAP sensor, we have added a MAP sensor in the upper left hand corner. The kit ships with a 2.5 bar sensor, which can be upgraded to our MapDaddy 4 bar sensor with barometric correction for high boost engines and real time altitude correction.

Other circuits include:

Below the MAP sensor, there are two relay control outputs. These can be used for fan control, variable intake solenoids, nitrous output, or other low current draw, on/off applications. Each has a maximum current of 1 amp. They can also be jumpered to work with ground triggered ignition modules. The boost control transistor provides PWM control for boost control solenoids. A third relay control output sits under the module.

We've added a cam sensor adjustment space below the boost control. This allows you to change the triggering threshold of the VR2 circuit with either fixed resistors or a trim pot.

There are three connectors at the top of the DIYPNP board. The DB9 allows you to connect a regular serial cable to plug the DIYPNP into your laptop; the "BL/TH" jumper allows you to send 5 volts to pin 9 to power Bluetooth or wireless RS232 adapters. The DB15 connector is for adding additional circuits not included in a factory wiring harness. Note that the top row of pins has somewhat thicker traces; if you are going to be running spark control or boost control out the DB15, we recommend using the upper row of pins.

Lastly, we've provided a 12 volt jack that allows you to power the DIYPNP without plugging it into your wiring harness. This can be useful for both diagnostics and loading firmware to the unit.

The high side driver located next to the DB9 connector can power 12 volt relays or solenoids that need voltage instead of ground. It has a maximum output current of 5 amps. This can be used with other devices that need power from the ECU.

You can add up to four BIP373 transistors for direct coil control. Each can drive a single coil, allowing for wasted spark on a V8 or coil per plug ignition on a four cylinder. Each BIP373 is provided with its own heat sink, removing the need for mica insulators. There is a jumper to allow using the standard MicroSquirt ignition input or to allow you to switch to a different input circuit if needed. The output connections are numbered S1 through S4. One BIP373 is included as standard equipment on the Bosch 55 pin version; on other DIYPNP models, these are sold separately.

We've put a separate 5 volt power supply on the DIYPNP main board that can be used to power 5 volt circuits. Noise in this power circuit will not affect the processor or cause resets. It can supply up to 500 mA of current. Its use is purely optional in the event you're adding additional functionality and either need the additional power capacity or need a 'dirty' power source, separate from the 5v source used by the processor which must be kept clean.

There are five spots for pull-up resistors in the lower right hand corner of the board. They allow you to apply a 5 or 12 volt pull up to several inputs and outputs, in order to accommodate different ignition control and output setups.

The circuits marked Input 1 and Input 2 are general purpose on/off inputs, with a buffer circuit to protect the processor. They are designed for ground triggered inputs, but with some protection for the processor if you accidentally connect them to 12 volts. The output is 5 volts when the input wire is disconnected, 0 volts when the input signal is pulled to ground. These can be used for launch control or table switching. The V1.5 board adds a 12 volt input that is used with the MS2/Extra nitrous control circuit and can also be used for other features like launch control.

The 3 wire IAC driver next to the power supply converts the signal from the IAC output into one that alternately drives an opening and closing coil of certain idle control valves.

We have put a basic knock control circuit in the center of the board. This is an untuned knock input circuit that normally puts out a 5 volt signal. When it detects knock, it pulls the signal to 0 volts for 0.4 seconds. The trim pot allows you to tune its sensitivity.

The V1.5 board adds an LM1815 VR conditioner for certain crankshaft and camshaft position sensor designs.

The board has several sets of headers, most of which are clustered around the lower edge or near the proto area at the top of the board. Generally, the ones at the lower edge are intended for jumpers to the adapter board, while the ones in the center are for connections to the circuits inside the board. Here are the headers and what their pins do.

Edge connections:

IAT - Intake air temperature sensor input
CLT - Coolant temperature sensor input
TPS SIG - Throttle position sensor signal
O2 SENSOR - Oxygen sensor input
VR IN - and VR IN + - Input for a variable reluctor crankshaft position sensor
OPTO IN - and OPTO IN + - Input for a Hall effect or optical crankshaft position sensor
VR2 IN + - Input for a camshaft position sensor.
IAC - Output for a 2 wire idle air control valve.
TACH OUT - 12 volt tach drive output.
FUEL PUMP - Signal to drive a fuel pump relay.
INJ 1 and INJ 2 - Each of these headers has four connections and can drive four high impedance injectors.
12V - Use these connections to supply 12 volt power to the board.
VREF - 5 volt reference voltage for sensors.
5V - 5 volt power voltage from the main board voltage regulator.
SG - Signal ground, for sensor returns.
GND - Power ground.
IGN1 and IGN2 - Logic level ignition outputs.

WLED - Warm up LED output, which can be used as the 3rd spark output or as a relay control.

ALED - Acceleration LED, which can be used as the 4th spark output or as a relay control.

OPTO GND - Connecting this jumper connects the negative optical input terminal to ground.

18 pin center header:

IG1 - Logic level spark output 1.

IG2 - Logic level spark output 2.

WLD - Warm up LED output, which can be used as the 3rd spark output or as a relay control.

ALD - Acceleration LED, which can be used as the 4th spark output or as a relay control.

PT6 - General purpose output port, equivalent to IAC1 on a MS2. Can be used for general purpose outputs, boost control, or nitrous output stage 1.

PT7 - General purpose output port, equivalent to IAC2 on a MS2. Can be used for general purpose outputs, boost control, or nitrous output stage 2.

PIB4 - On a full sized MS2, used to control a stepper chip. Useful if you are building a stepper IAC circuit in the proto area.

ALTCAM - Use for adjusting the VR2 circuit sensitivity. Pulling this voltage up or down changes the trigger threshold.

MAP - Manifold absolute pressure input, used if not using the onboard MAP sensor.

ADC1 - Analog to digital input 1, equivalent to JS4 on a full sized MS2. The knock input circuit connects to this one, or can be used for a second O2 sensor, launch control, or nitrous input.

ADC2 - Analog to digital input 2, equivalent to JS5 on a full sized MS2. The baro correction pin near the MAP sensor connects here. Other uses include a second O2 input, launch contro1, or nitrous input.

FLEX - Flex fuel input. Connects to PE0 on the processor, and can be used for flex fuel sensors or launch control.

PA0 - Equivalent to JS11 on a MS2. Can be used for launch control input, a general purpose output, or boost control.

CANH and CANL - Connections for CANBUS output.

LOGIC LEVEL INJ - We've brought the injector driver signals out as 5 volt logic level signals for peak and hold devices or other alternate injection drivers.

10 pin center header (handy for the plug-in upgrade modules):

Potential uses for this header are for an IAC Stepper Board, or a 4-cyl Sequential Fuel Injection Upgrade Module.

12V - 12v Power Supply for upgrade modules using this header.

VREF - 5 volt reference voltage for sensors.

5V - 5 volt power voltage from the main board voltage regulator.

GND - Power ground.

IAC - Output for a 2 wire idle air control valve.

PT6 - General purpose output port, equivalent to IAC1 on a MS2. Can be used for general purpose outputs, boost control, or nitrous output stage 1.

PT7 - General purpose output port, equivalent to IAC2 on a MS2. Can be used for general purpose outputs, boost control, or nitrous output stage 2.

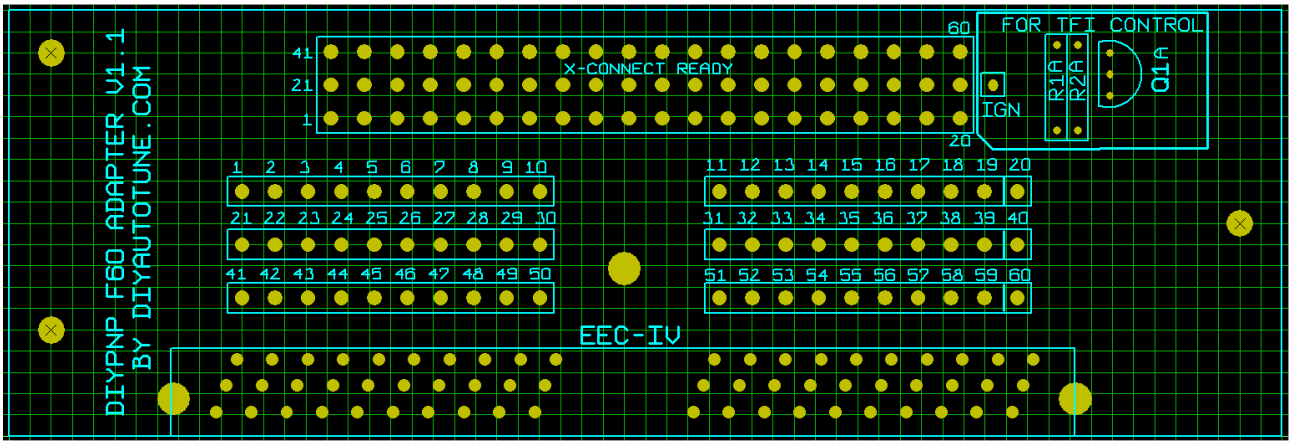
PIB4 - On a full sized MS2, used to control a stepper chip. Useful if you are building a stepper IAC circuit in the proto area.

SG - Signal ground, for sensor returns.

Connector Board

This is a small PCB that slides into the same slot as the main board and lines up right next to it. It's not much more than a breakout board for the OEM connector.

Detailed information is contained in section 15, DIYPNP Ford 60 Pin Adapter Board Assembly



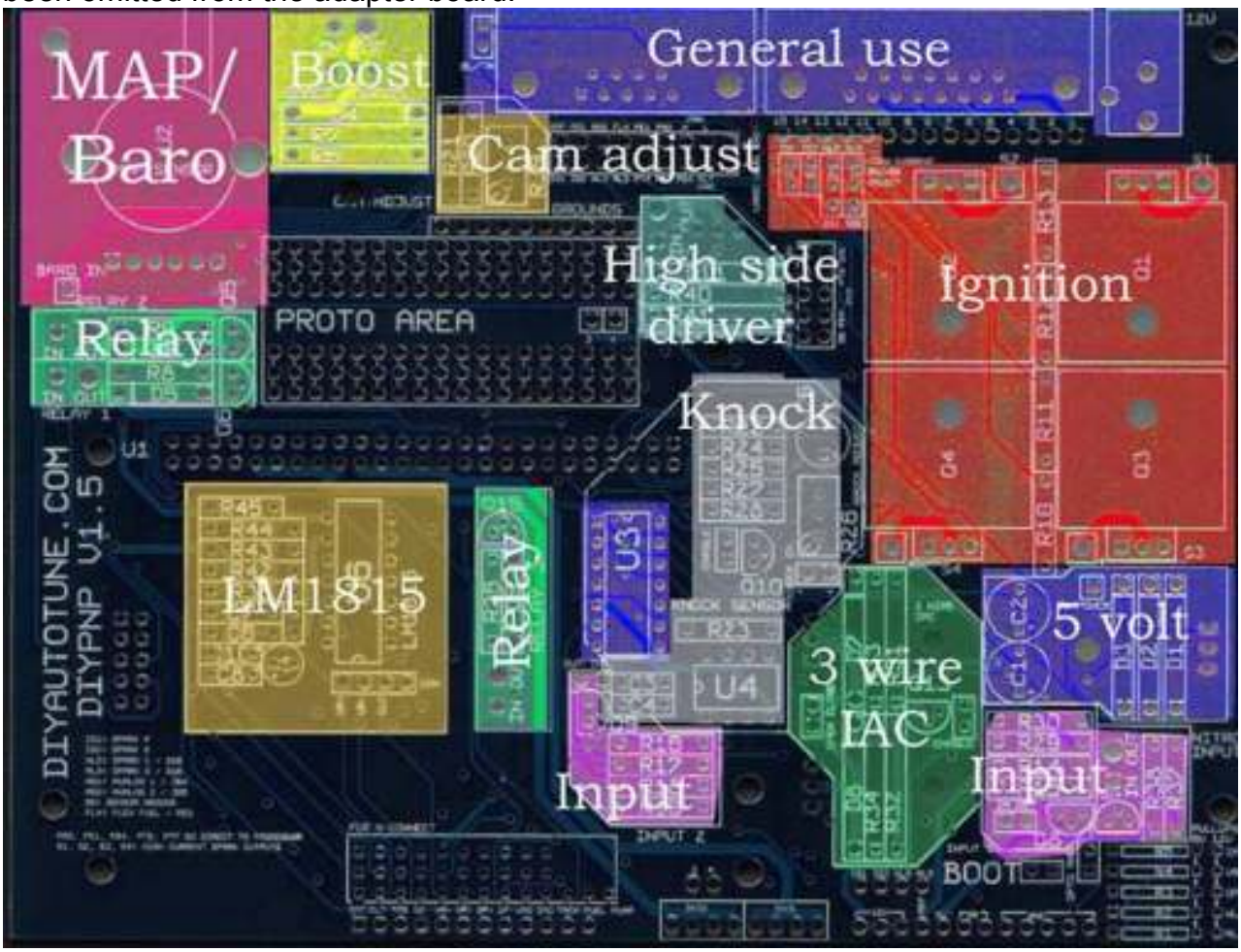
V1.5 Main Board Assembly

Board Layout

First, you will want to decide which components you will be using, as not all installations need all components. Here is a list of what parts go with what circuit. Note that U3 is used for multiple circuits, and must be installed for any of the circuits to work. There are a couple parts that we've included in the kit, marked in green on the component labels, that are for common mods that may not be needed and do not go in one of the usual designated holes. These will be covered in later sections on ignition control and extra outputs.

Note that some boards have extra components on the adapter board that you may want to assemble as well. See these pages for adapter boards with special components.

Note that the 3 wire IAC driver is now standard on the v1.5 main board, so it has been omitted from the adapter board.



All applications:

- U1 MicroSquirt module
- U5 voltage regulator
- D1, D2, D3
- Bootloader, Opto GND, and BL/TH jumpers
- C1 and C2
- DB9, DB15, 12V jack

Internal MAP sensor: U2

Internal Ignition Modules: (optional for most installs)

- Spark A: Q1, R13
- Spark B: Q2, R12
- Spark C: Q3, R11, R1 (100 ohm)
- Spark D: Q4, R10, R2 (100 ohm)

Note that the above spark outputs are only used when high current ignition outputs are needed; that is, when your coil does not have a built in ignition module and your vehicle does not have an external module. Most applications do not need these, with the main exception being Bosch applications. The Nipponsenso and JECS kits do not include any of these transistors in order to keep your costs down, while the Bosch 55 pin kit includes one transistor for distributor based spark output. Extra spark output transistors are sold separately here.

Relay 1: Q5, D6, R9
Relay 2: Q6, D5, R8
Relay 3: Q15, D9, R35

12 volt output: R40, R41, Q17, D11

Input 1: R14, R15, R29, R30, Q8, U3
Input 2: R16, R17, R18, R19, Q9, U3

Nitrous / +12V input: R37, R38, Q14

Knock: C3, C4, C5, Q10, R22, R23, R24, R25, R26, R27, R28, U3, U4

Boost control: D4, R6, R7, Q7

Camshaft position sensor adjustment: R20, R21, R39 (note: It's very rare you will use all three of these, these are for fine tuning the cam ignition input.)

3 wire IAC driver: R31, R32, R33, R34, Q11, Q12, Q13, D7, D8

LM1815 VR Conditioner: C6, C7, C8, C9, C10, R36, R42, R43, R44, R45, U6

Assembly Directions

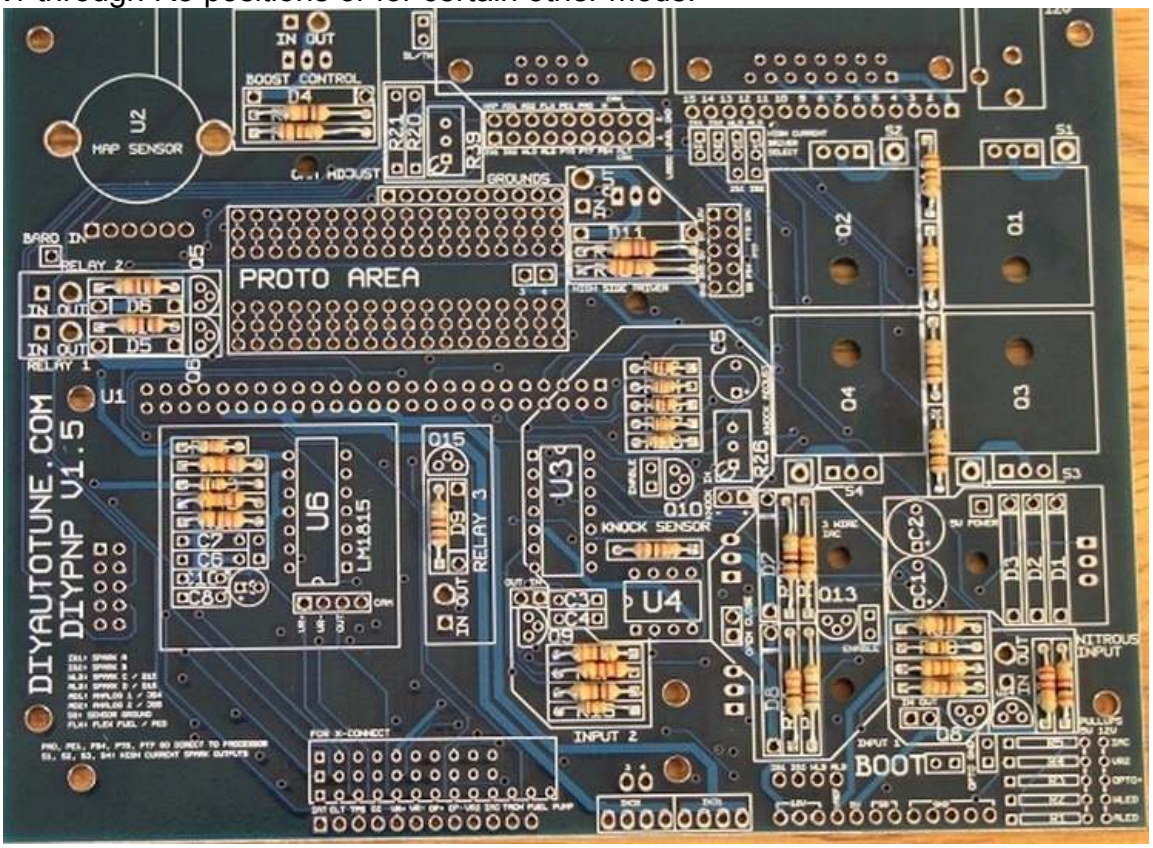
These directions assume you will be using all circuits; feel free to omit any components your build does not need, as listed above. This assembly procedure takes you through a quick assembly process. Generally speaking that means you'll be installing the shortest components first, then the next tallest, on up to the tallest components on the board. This way you can install the components, flip the PCB over on a flat surface which will hold all of the components in place while you solder them in. Then install the next taller set of components and repeat until the board is finished. Note that there are few components where orientation is important and this is noted below;
Take care to properly insert these polarized components marked with a (+/-).

Some of the included components are only used for a few installations. Expect to have a couple parts left over on most builds. So if you have some parts and the instructions didn't tell you to install them, don't worry, this is normal so long as you followed all directions.

NOTE: Most components are normally inserted into the top of the board, except when noted as a few transistors do get installed on the underside of the PCB. The top of the board is the side with all of the components labeled in the silkscreen.

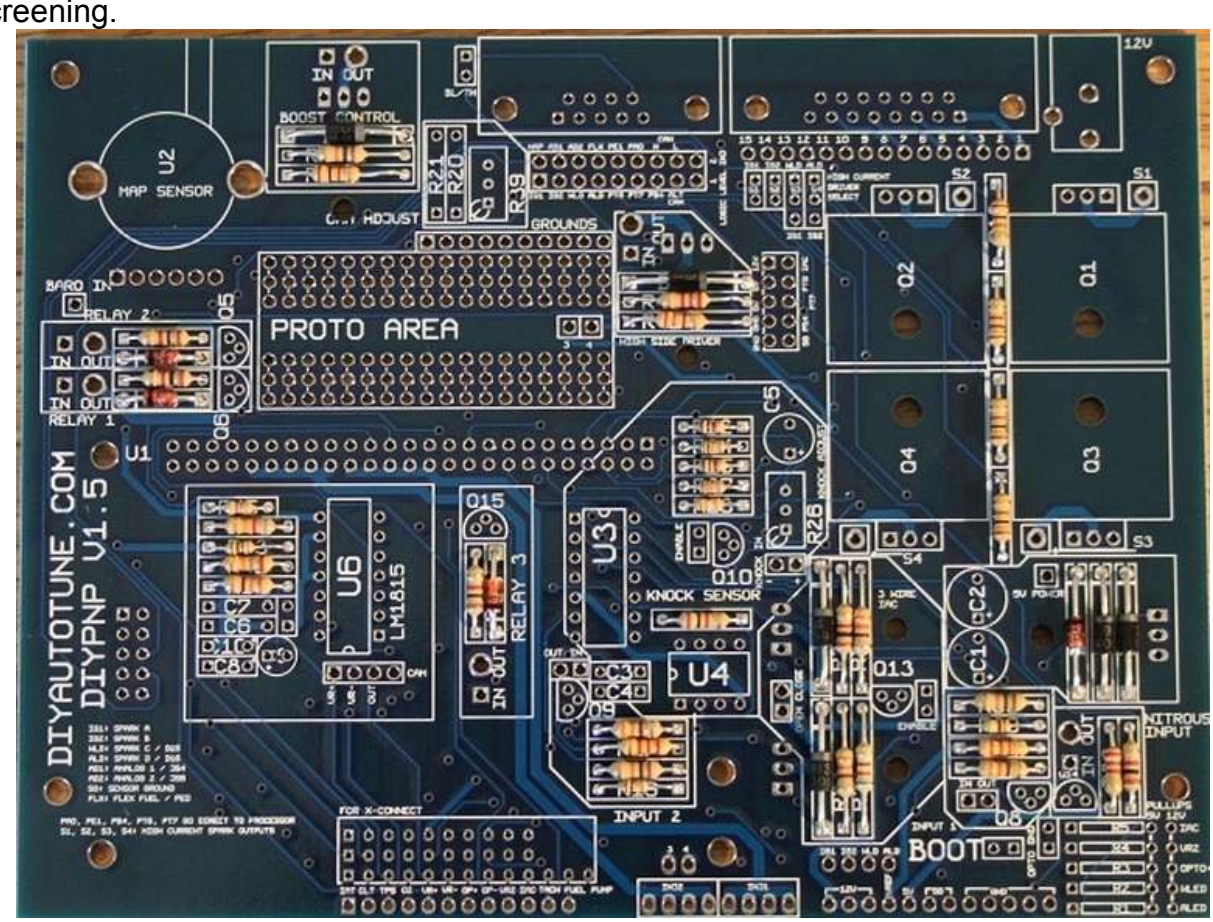
1. Install all resistors in the locations marked on the board except R26 (the knock sensor trim pot), R39 (camshaft signal adjustment), and R1 through R5. Note that R20 and R21 are application specific; do not install anything there unless you have model specific directions for your car saying which ones to use. See the build guide for your specific model on the DIYPNP Available Models page for details.

Note: you will have a couple extra resistors reserved for 'pull-ups'. These can be used in the R1 through R5 positions or for certain other mods.



01-resistors

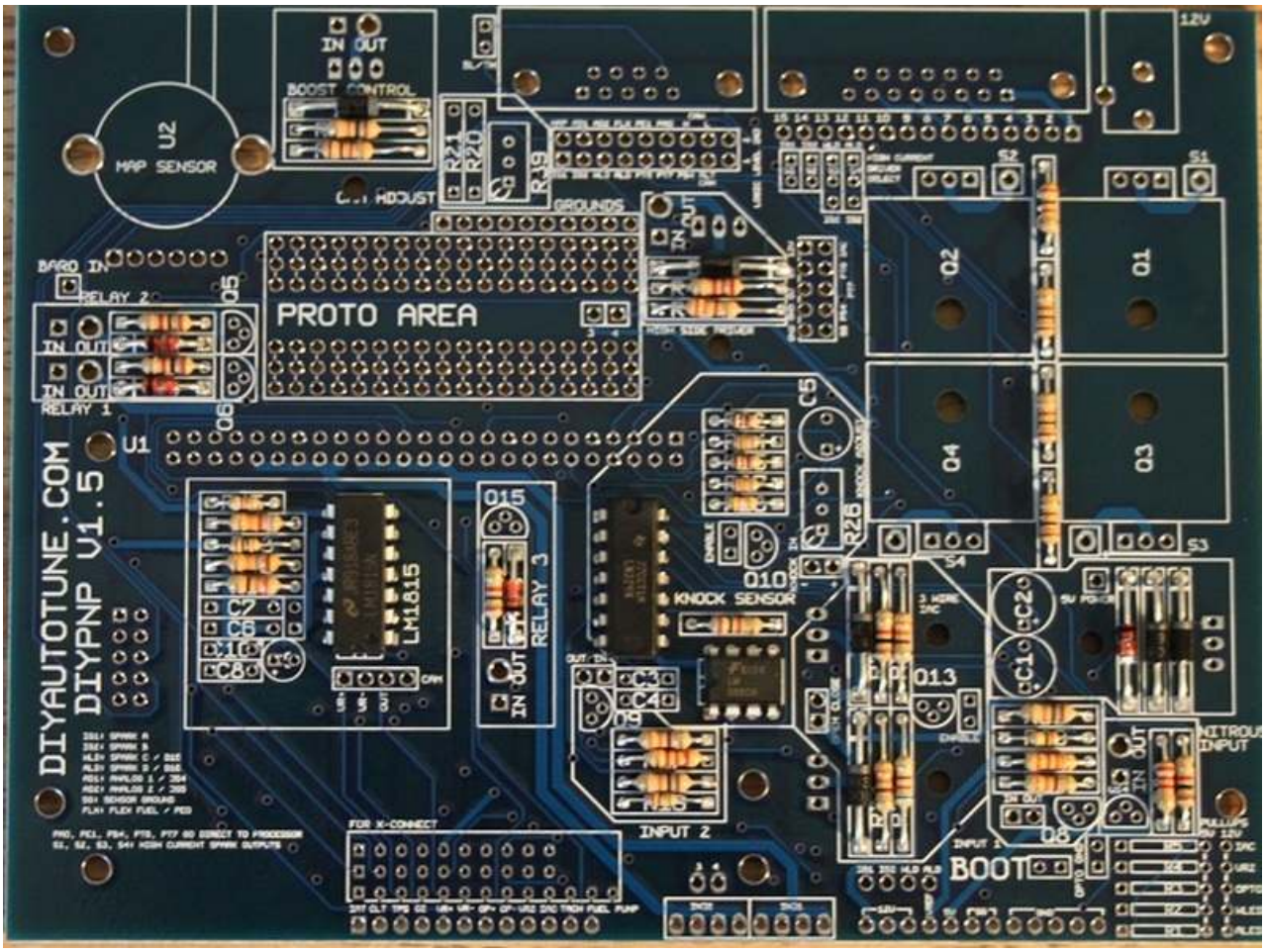
2. (+/-) Install all diodes, taking care to match the banded end to the band on the silk screening.



02-diodes

3. If you are using the high current ignition outputs (Q1 through Q4 - only used when you do not have an external ignition module), add the "ENABLE" jumper next to each output you are using. If you are using the knock sensor, add the "ENABLE" jumper in the knock area. To jumper these connections, use a short piece of a snipped lead from one of the resistors or capacitors you've already installed, bend it into a U shape and solder it in place jumpering the circuit on.

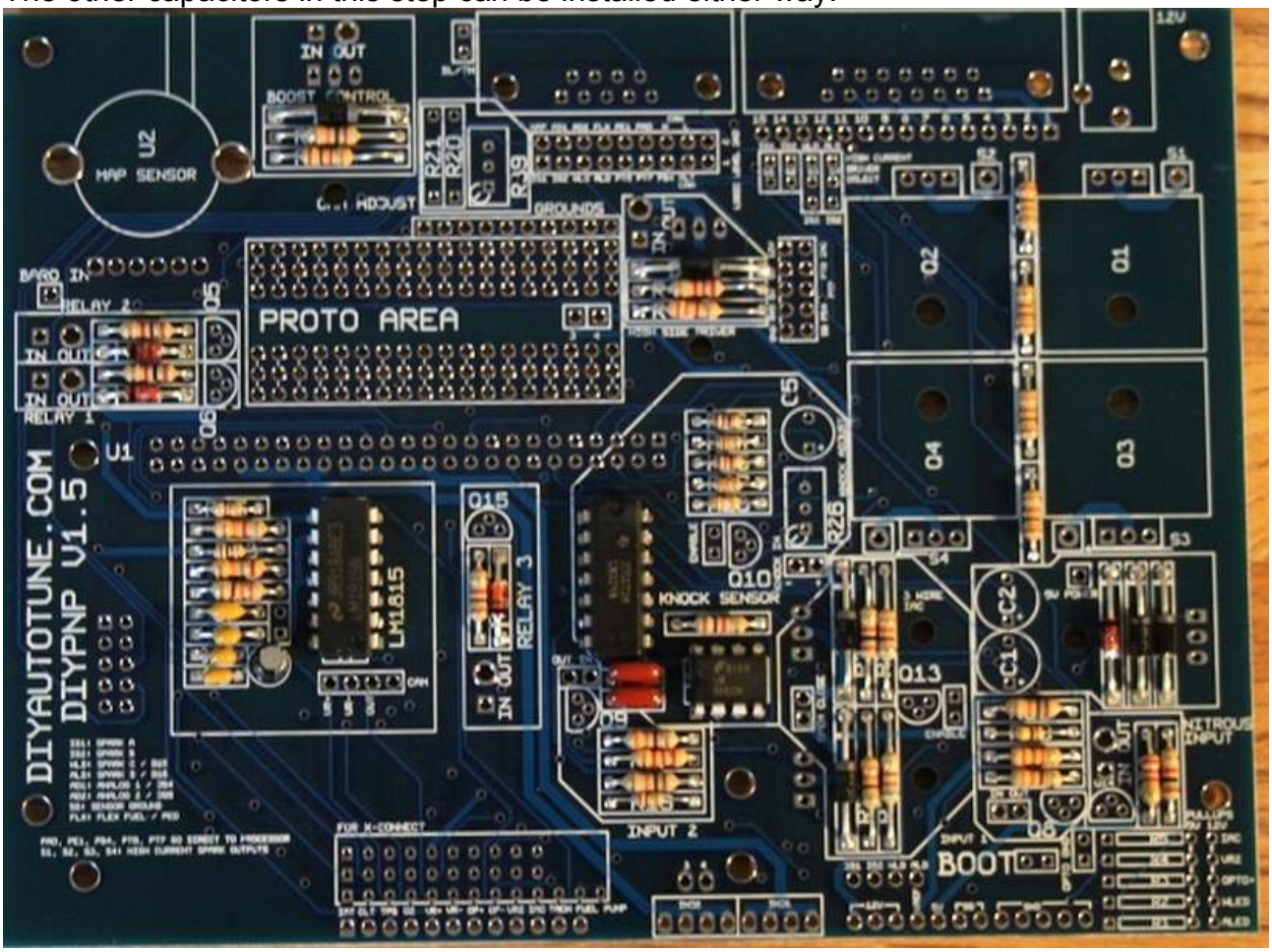
4. (+/-) Install U3, U4, and U6. Taking care to align the notch on the chip with the notch on the PCB's silkscreen.



04-ic

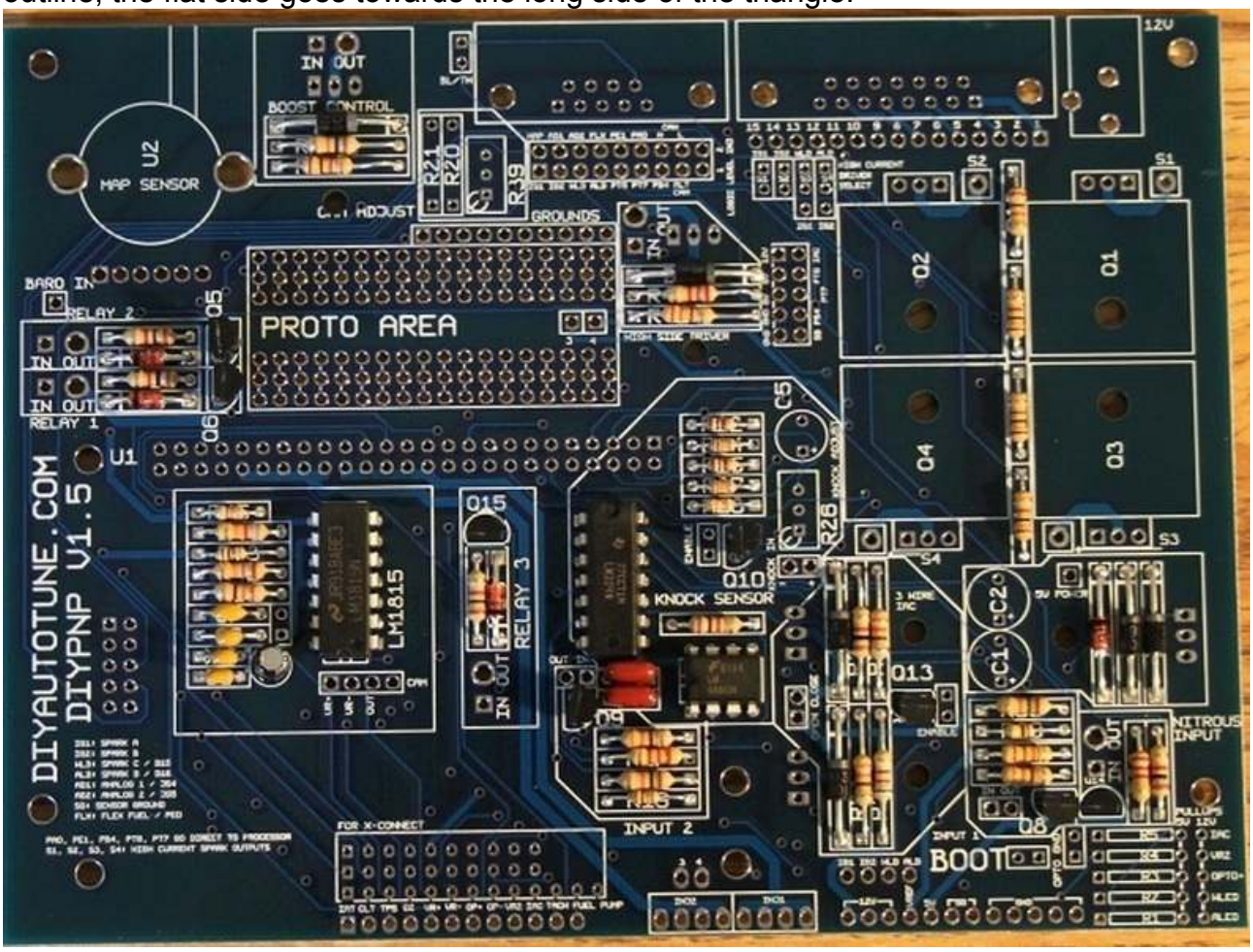
5. Install C3, C4, C6, C7, C8, C9 and C10. Note - the C9 and C10 silk screen touches the holes. C9 is in the circle next to C8, while C10 is above C8.
C9 is polarized; make sure the + lead (unmarked) is in the holes marked +.
The marked lead will be the negative (noted by the "-" symbol on the white stripe)

The other capacitors in this step can be installed either way.



05-capacitors

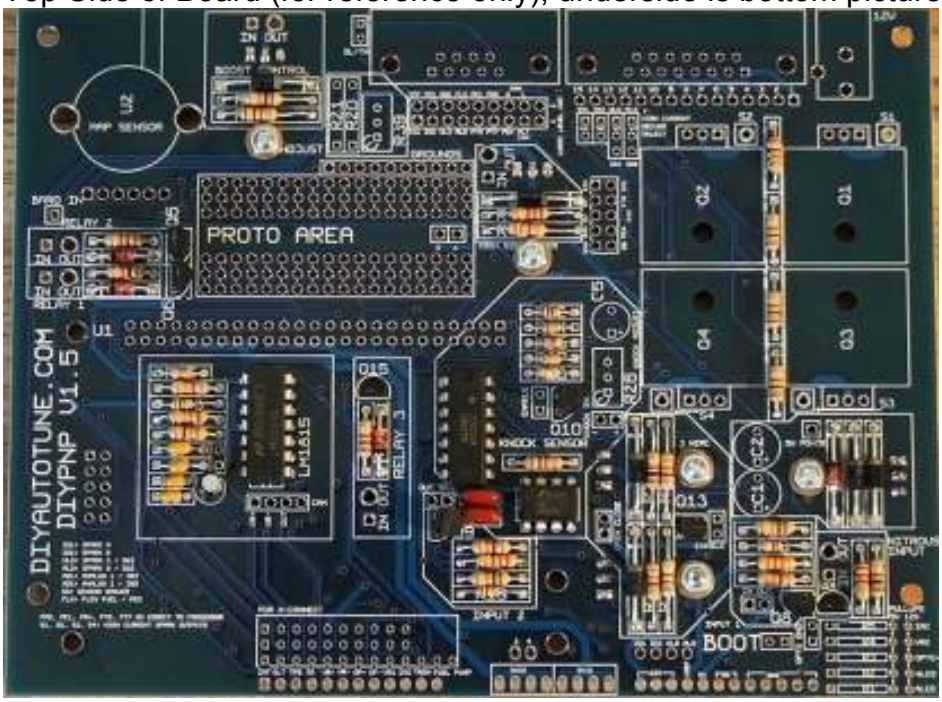
6. Install transistors Q5, Q6, Q8, Q9, Q10, and Q13 through Q15. On transistors with no outline, the flat side goes towards the long side of the triangle.



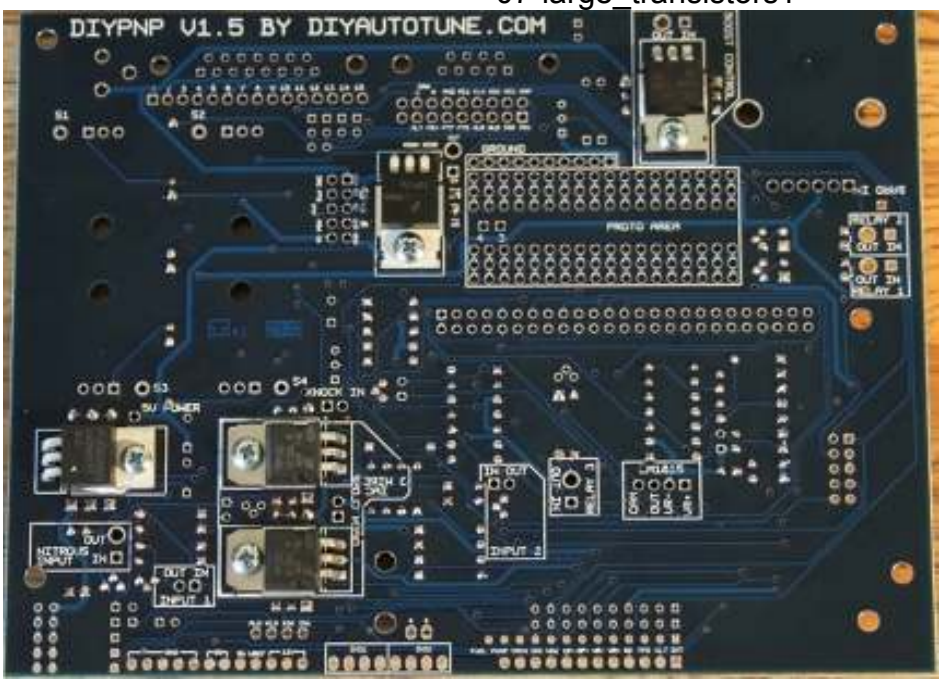
06-transistors

7. U5, Q7, Q11, Q12, and Q17 all install on the underside of the board. Put a dab of heat sink compound on the metalized area of the board and bolt them into place with the provided hardware before soldering them down. Note that on V1.5B revision boards, you need a mica insulator under Q17 as there's a small hole in the board that, in rare instances, the transistor can get shorted to if the mica insulator is not installed. The hardware that comes with the mica insulator is not needed.

Top Side of Board (for reference only), underside is bottom picture.

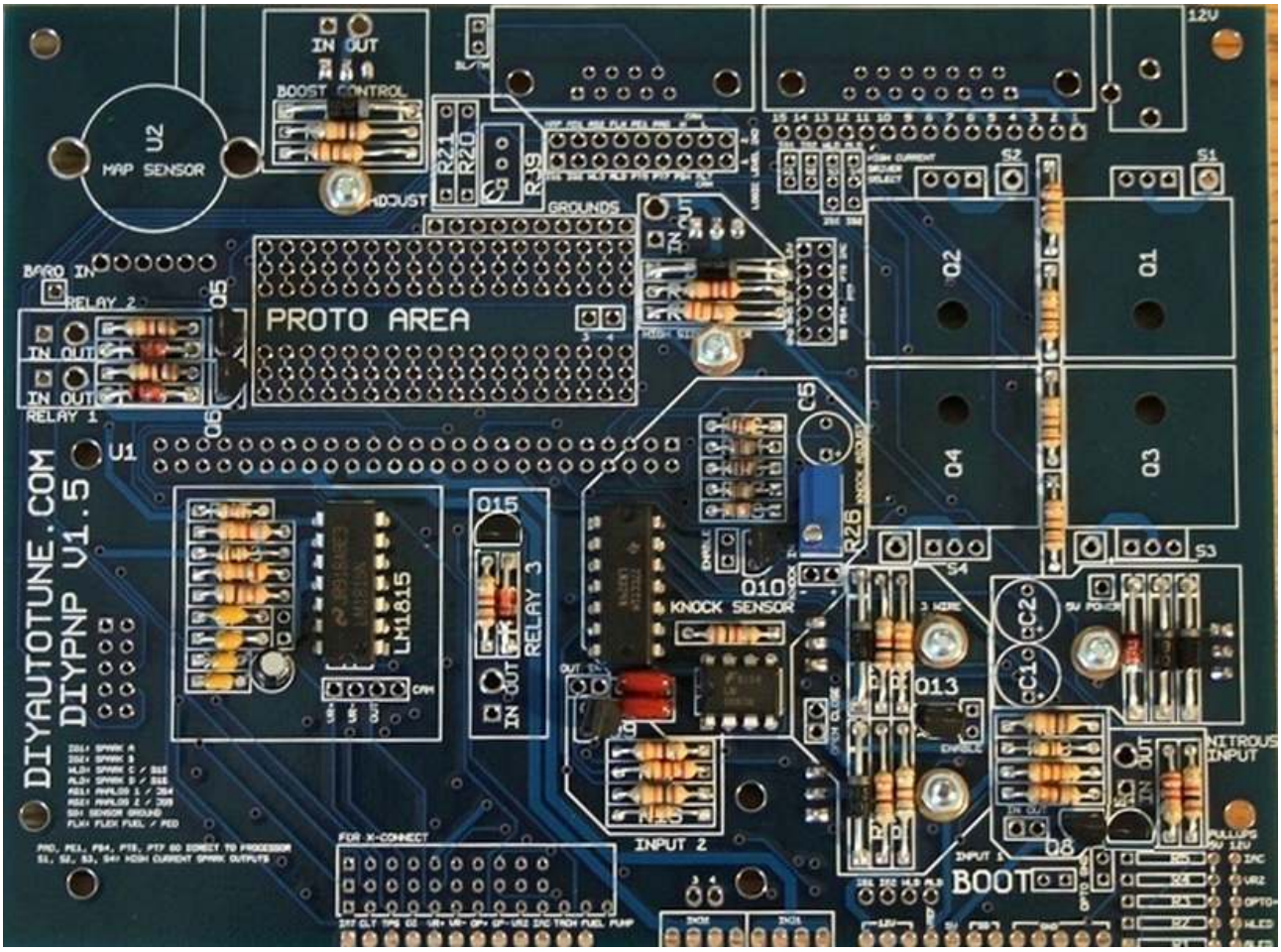


07-large_transistors1



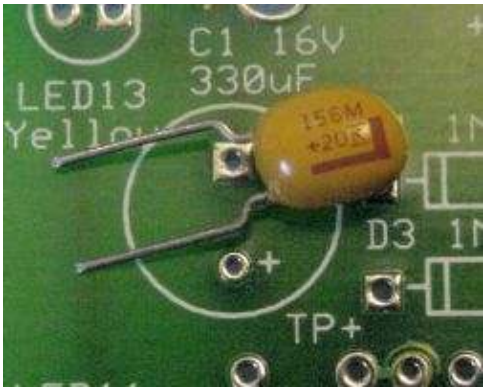
07-large_transistors2

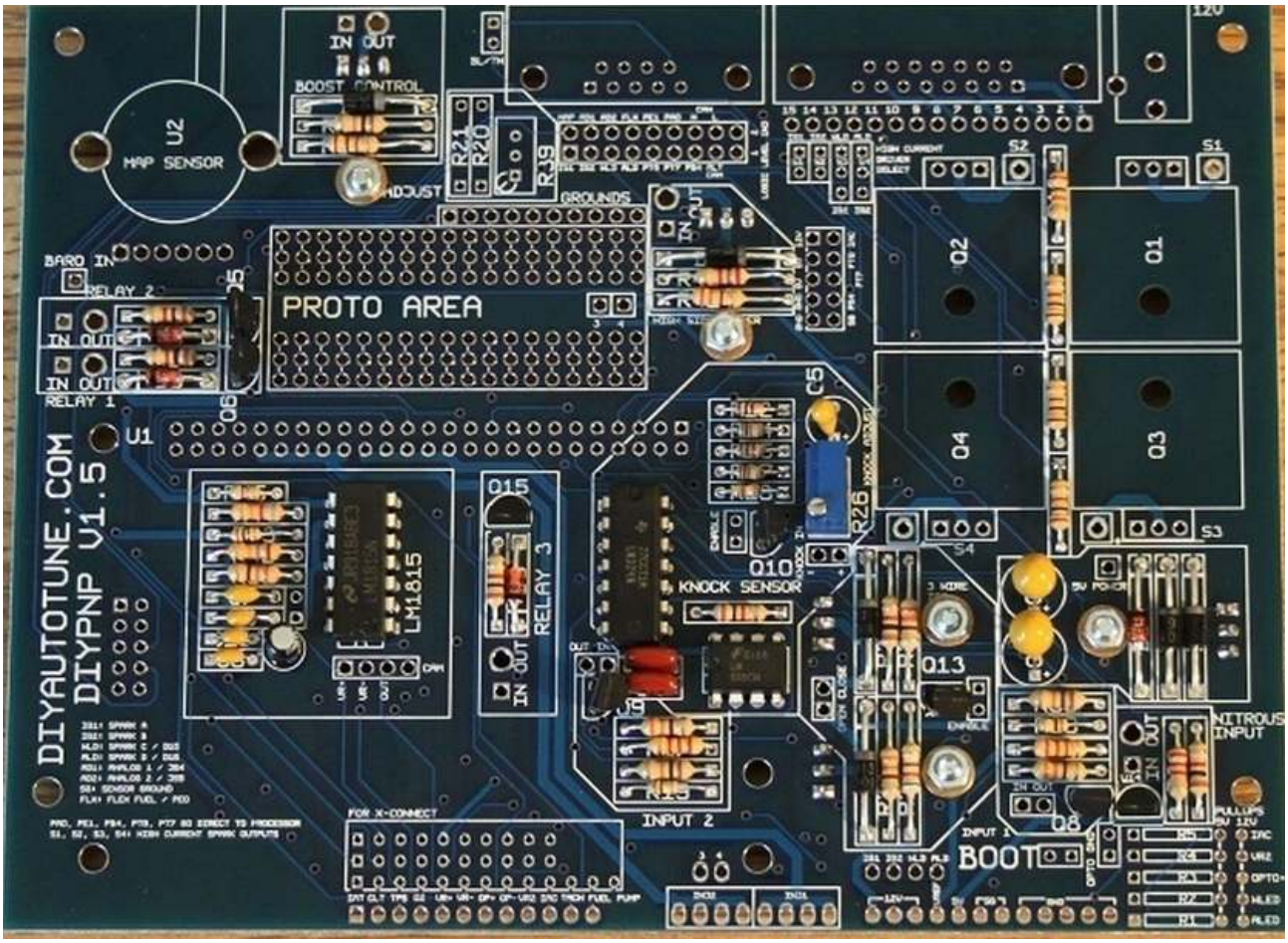
8. Install R26. The side where the "wheel" goes is marked on the silk screen. If using R39, install this too.



08-potentiometer

9. (+/-) Install C1, C2, and C5. Note that all these capacitors are polarized. The + lead goes in the square hole. The + lead is the one with the dark band. In this picture the + is the round hole.

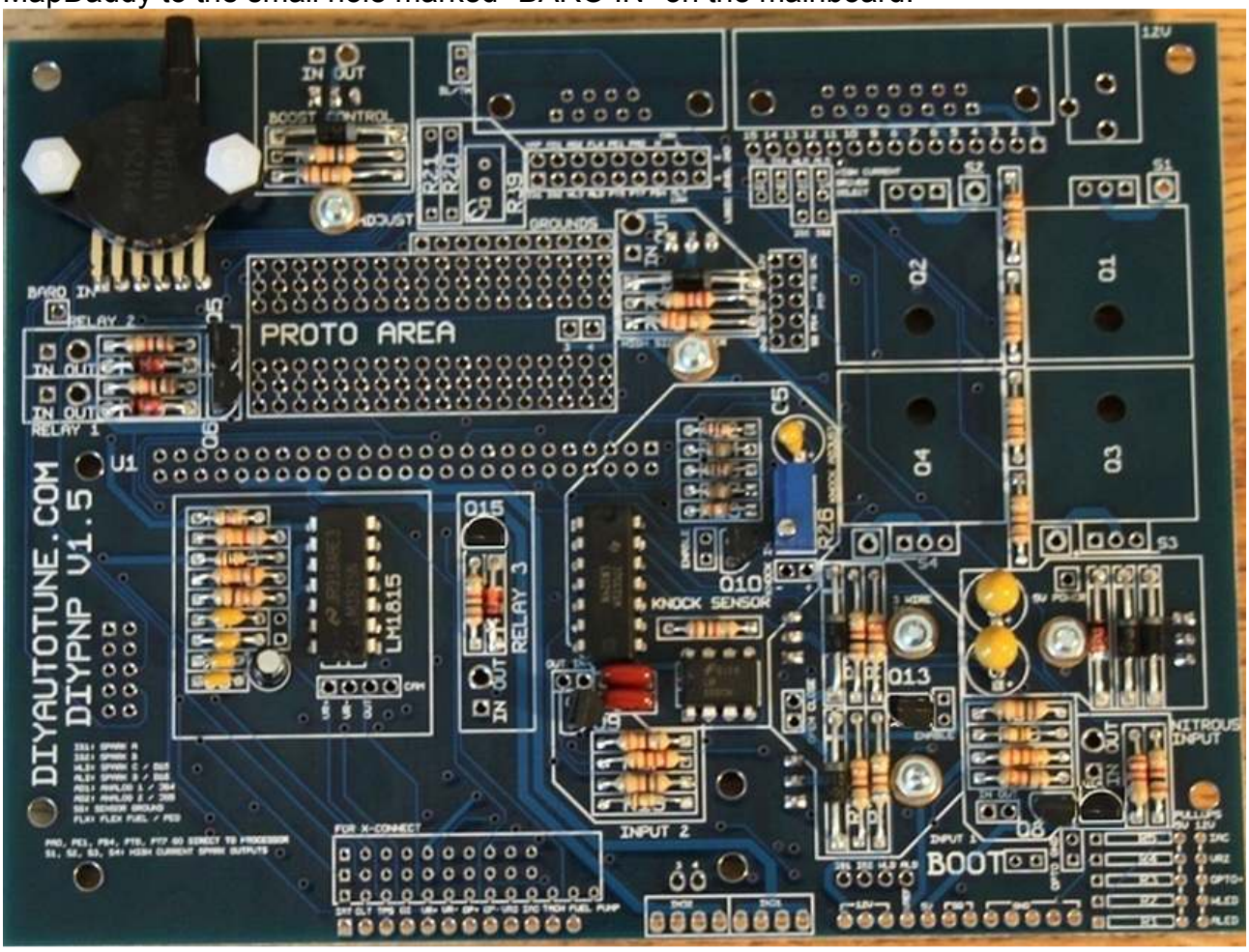




09-capacitors

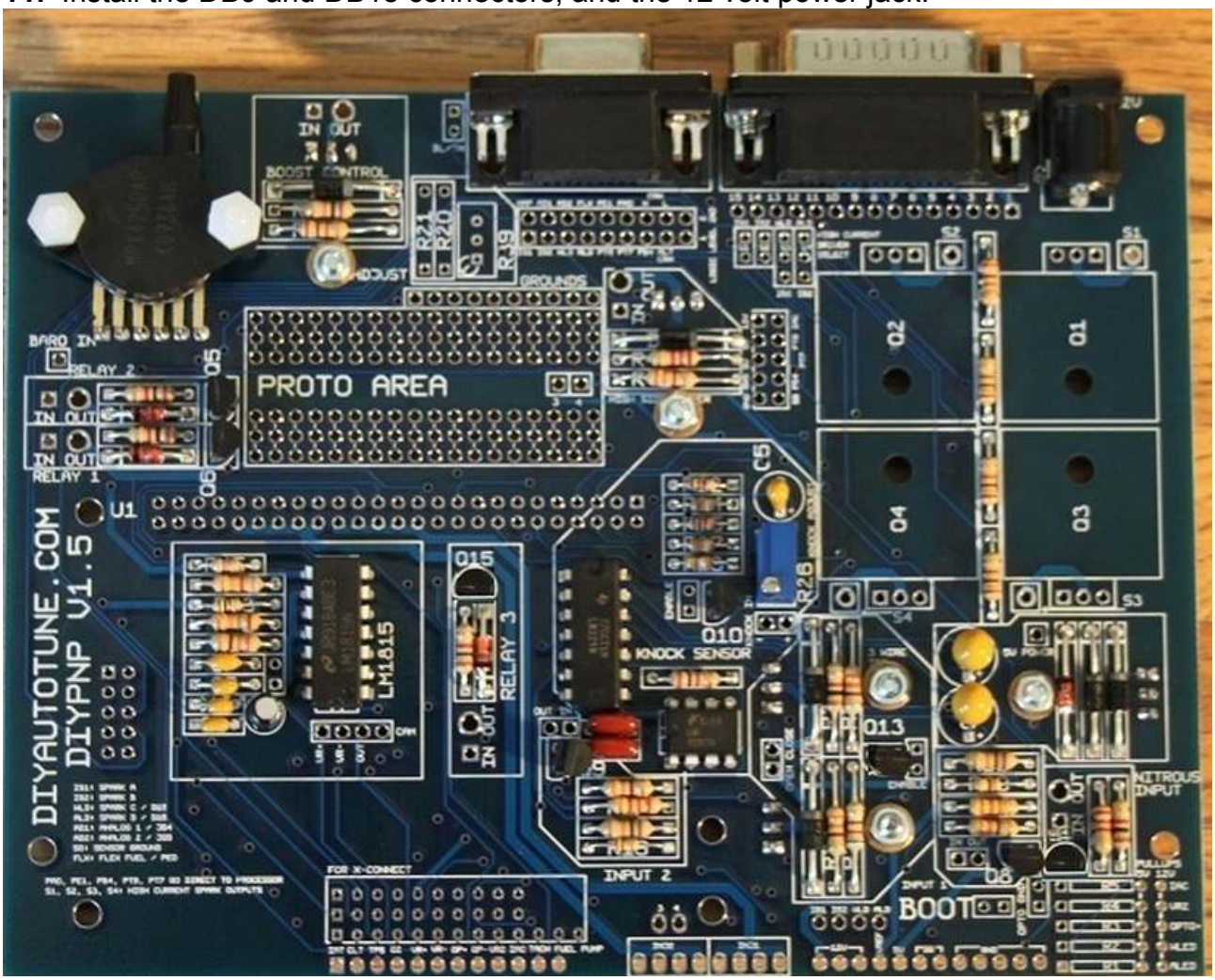
10. Install U2. It mounts on the top side of the PCB, with the vacuum port facing AWAY from where you will be placing the MicroSquirt Module. The leads are bent 90deg towards the PCB. The notch on the lead indicates pin#1 and should fit into the square hole on the PCB.

If using a MapDaddy, use a bit of jumper wire to connect the baro output pin on the MapDaddy to the small hole marked "BARO IN" on the mainboard.



10-map_sensor

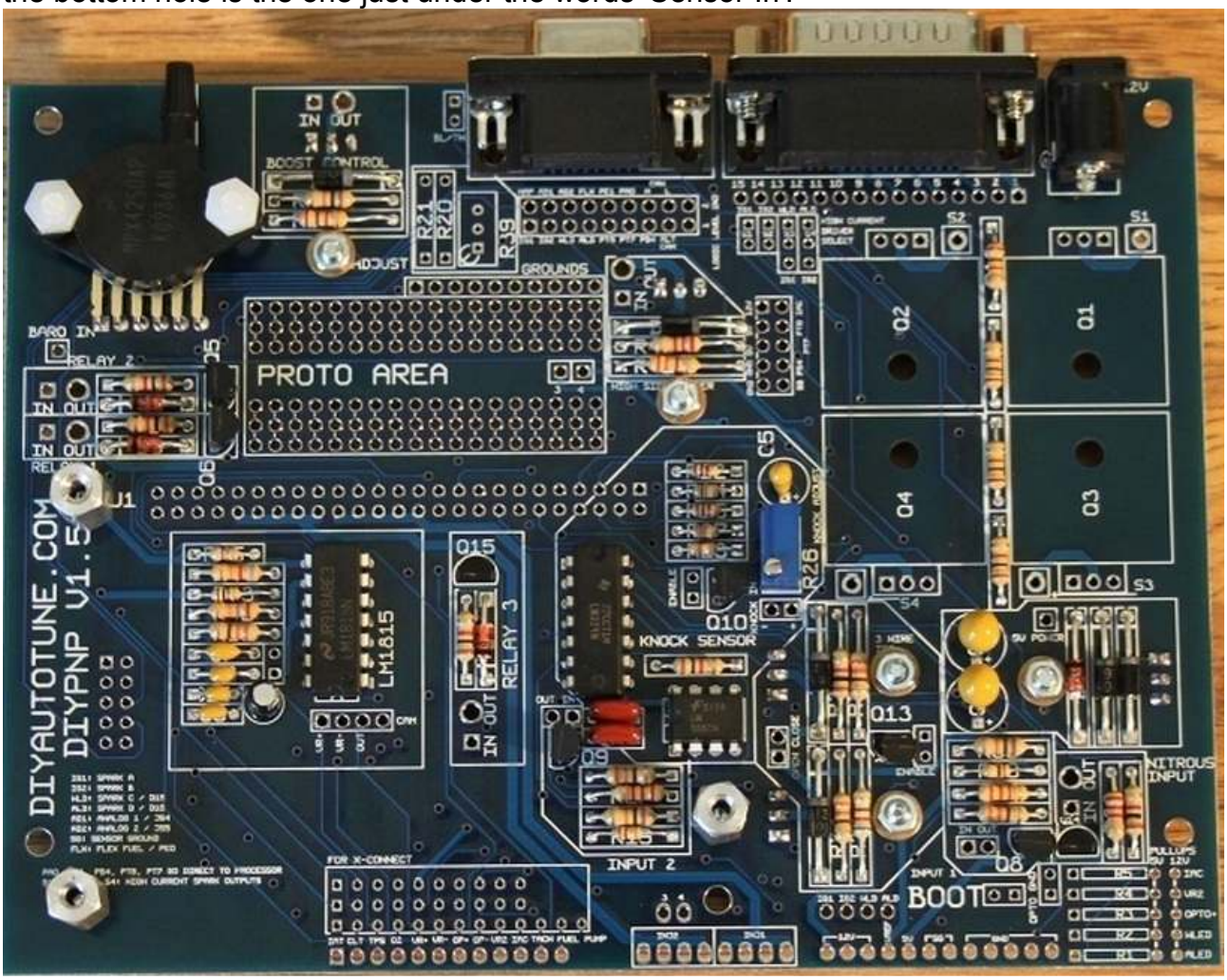
11. Install the DB9 and DB15 connectors, and the 12 volt power jack.



11-db9_db15_12v

12. The DIYPNPF60 does not include any of the transistors Q1 through Q4.

13. Install the hex standoffs on the mainboard. To do this put a screw through from the bottom of the mainboard into the hex standoff and tighten until nice and snug. **Do not over tighten.** You want to install these standoffs in the holes that will align with the two top corners of the MicroSquirt module, and in one of the holes at the bottom, the hole closer to the middle of the PCB. On the main board, the top two holes are pretty obvious; the bottom hole is the one just under the words 'Sensor In'.

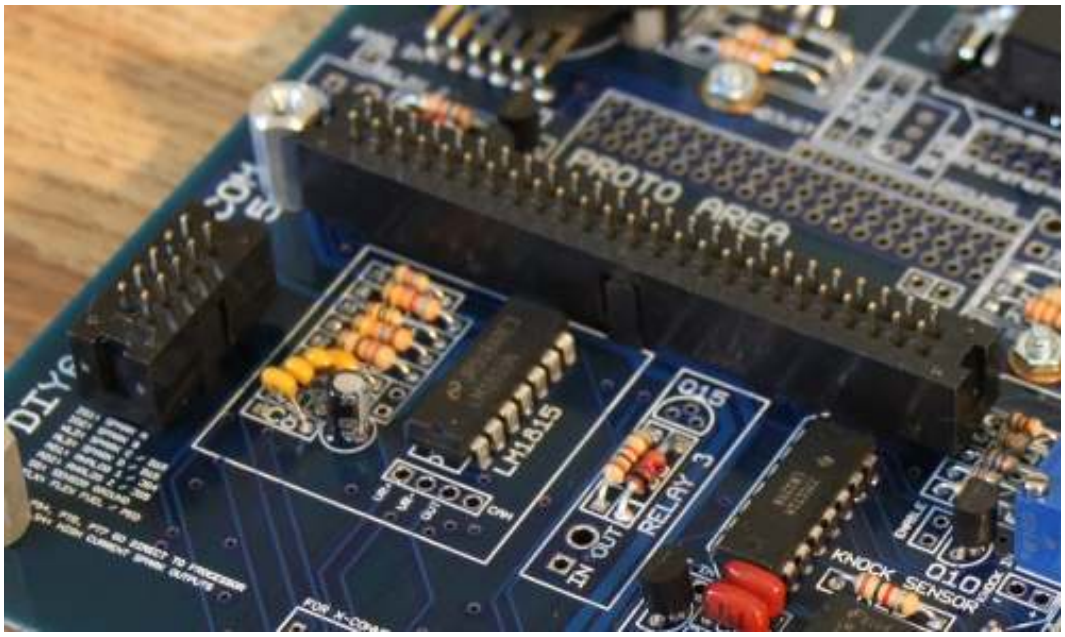


13-standoffs

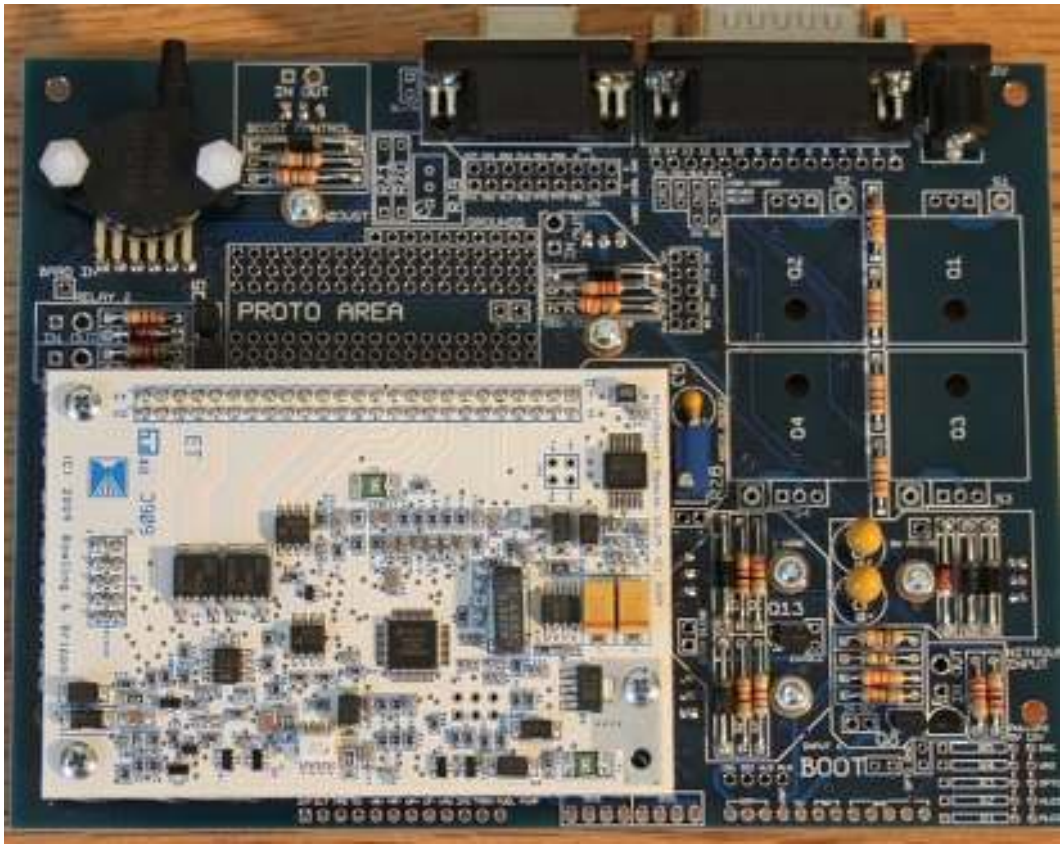
14. Now, for the headers that mate the MicroSquirt Module to the Mainboard. The only trick with these is you must make sure they are flush with the PCB they are soldered into. If they sit at an angle then they will not mate properly with the opposing pair of headers. The simplest way to ensure this is the following:

1. Snap the Male 50 pin (2x25) header and the Female 50 pin (2x25) header together. Do the same with the male/female 10 pin (2x5) headers.
2. Insert the female end of these two header assemblies into the mainboard. That would be the side with the now mostly-hidden header (hidden by the male header that surrounds it - the male female reference refers to the metal pins, not the plastic, confusing I know).
3. Take another look at how you've inserted the headers into the mainboard. Check and see that the 'keyway' side of the header, the side with the notch and key, face towards the inside of the MicroSquirt module. **Don't solder anything yet.**
4. Place the MicroSquirt Module in its new home lining it up with the Hex Standoffs and the Headers you've just placed, and slipping the header's pins thru the module leaving it resting in place. Still unsecured. **Still not soldered.**
5. Insert the remaining three screws into the hex standoffs in and tighten until snug. This will bolt the MicroSquirt to the main board using the hex standoffs and sandwich the headers tightly in between ensuring they don't move when you solder them and maintain proper alignment.
6. Now, solder the 50pin (2x25) and 10pin (2x5) headers into place. From the top of the MicroSquirt Module, and from the bottom of the mainboard.

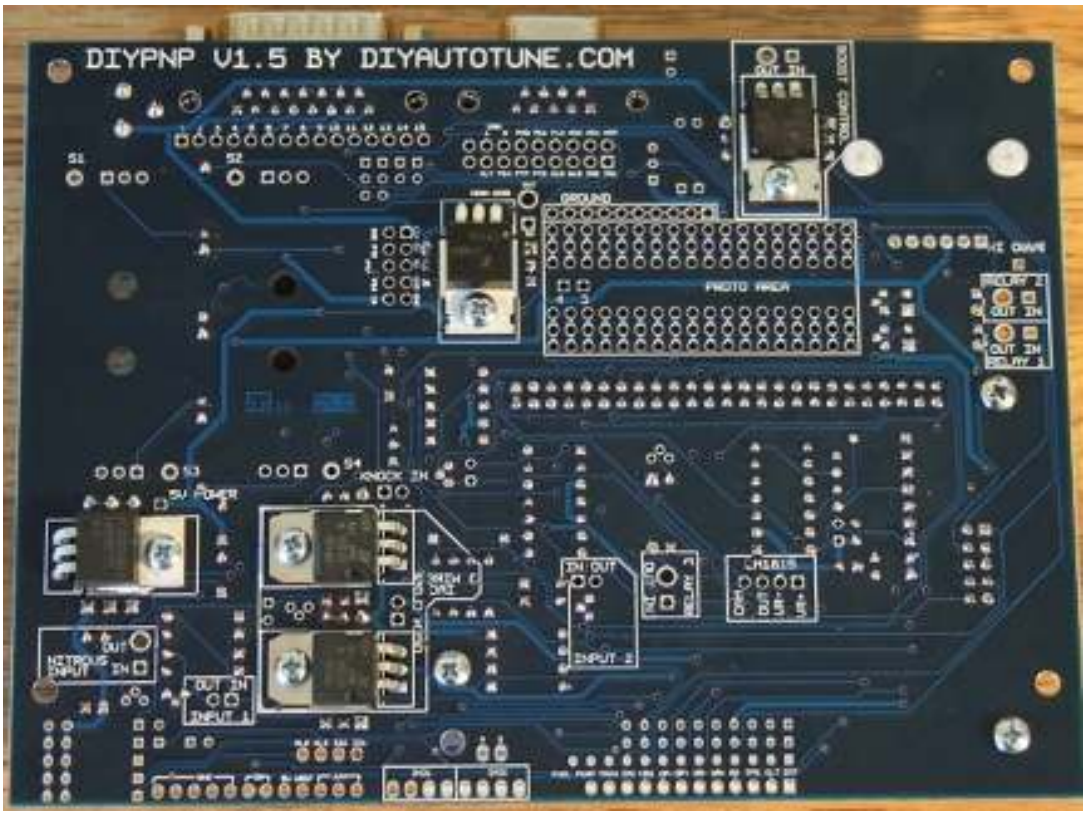
14-headers1



14-headers2



14-headers3



14-headers4

15. Header Pins

Mount jumper headers for Boot, BL/TH, Opto to Gnd. Make sure they are soldered perpendicular to the board.

16. DIYPNP Ford 60 Pin Adapter Board Assembly

We've put a little step-up circuit on the F60 adapter board for TFI ignition control. This takes the 5 volt IGN signal, inverts it, and steps it up to 12 volts **for TFI distributors**. ***Do not*** *install this circuit on EDIS-equipped cars*. All Fox body V8's are TFI.

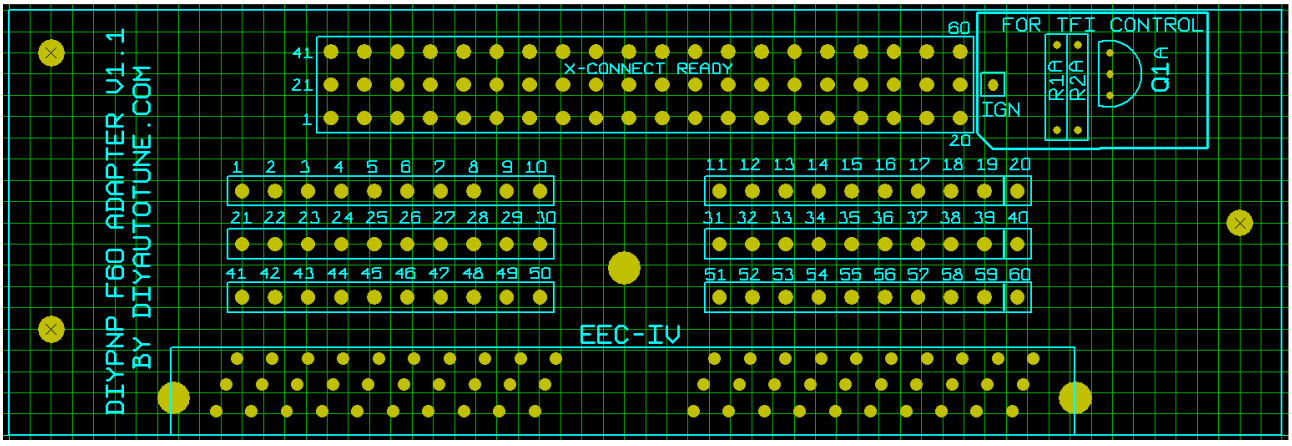
TFI Ignition Control

1. Install the R1A and R2A resistors on the adapter board.

2. Install Q1A, with the curved side facing the curve on the silk screen.

3. Jumper IG1 on the main board to IGN on the adapter board. The rest of the connections are routed inside the PCB.

4. Attach the 60-pin Ford connector on the same side of the board with the included screw, nut & washer. Then solder the connector to the main board.



Basic Wire Jumpers

The following steps assume you will be using a Stimulator Power Supply which plugs into the front panel of the box so you are able to power up the DIYPNP off the vehicle on a power supply connected to the power jack next to the DB15 connector.

This step takes place before you power your car up (with the key) with the DIYPNP installed. This is to prevent damage to your ignition system in case the default settings are not correct. Note that you can power up the DIYPNP off the vehicle on a power supply connected to the power jack next to the DB15 connector.

Now that we've assembled the main board and adapter board, we'll install the basic jumpers to provide the DIYPNP with power, grounding, sensor inputs, and injector outputs. These jumpers simply run from a pin on the lower edge of the DIYPNP main board to the appropriate holes in the connector board.

The matching of pins from connector board to main board has already been identified for you. Here are the pins we're going to focus on for now, and what the pins do. You'll be able to find them all along the lower edge of the main board.

IAT - Intake air temperature sensor input

CLT - Coolant temperature sensor input

TPS SIG - Throttle position sensor signal

O2 SENSOR - Oxygen sensor input

OPTO IN+ - Profile Ignition Pickup (TFI-PIP)

IAC – Idle Air Control

FUEL PUMP - Signal to drive a fuel pump relay.

INJ1 and INJ2 - Each of these headers has four connections and can drive four high impedance injectors. All four holes for each injector function the same.

12V - Use these connections to supply 12 volt power to the board.

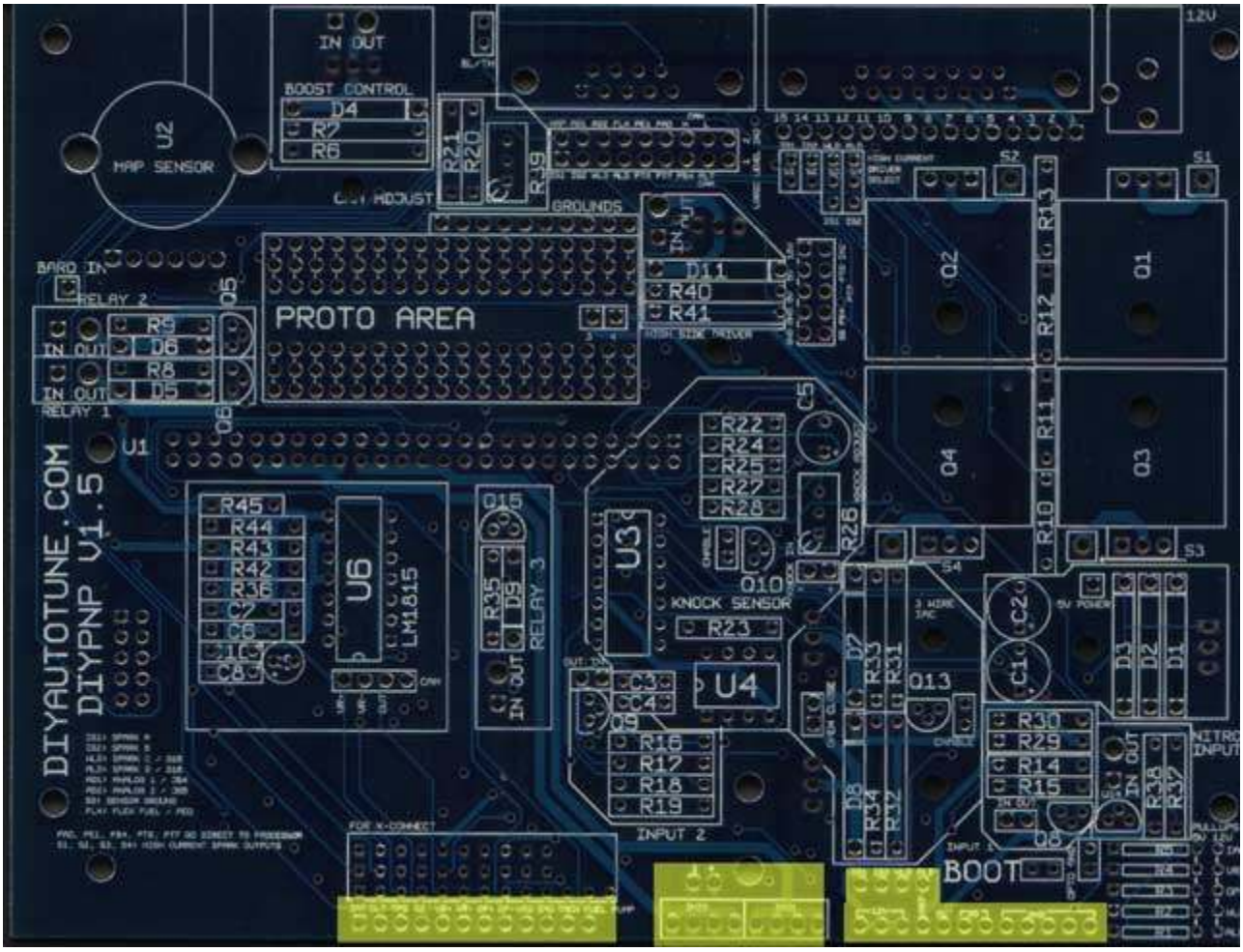
VREF - 5 volt reference voltage for sensors.

5V - 5 volt power voltage from the main board voltage regulator.

SG - Signal ground, for sensor returns.

GND - Power ground.

The locations of the jumpers on the main board that you'll be using in this step are marked in yellow on the picture below.



Power and Ground

As you've noticed, there are five separate types of power and ground connections on the DIYPNP. Each of them has its own specific purpose. Here is what each connection does. The information in this section is to better help you understand the functioning. For the DIYPNPF60 we have already determined the pins for you to use. See the charts below.

12V: This connection powers the DIYPNP. Connect it to the pin(s) which get 12 volt power when the ignition key is in the Run and Start positions. We've provided you with several 12V pins in case your ECU has more than one. These should not be connected to any pin that receives 12 volt power when the key is off, but only to 12 volt switched power connections.

VREF: This connection provides a 5 volt reference voltage for the throttle position sensor, and can be used for some other types of sensors, such as external MAP sensors. These connections are usually marked with something like "5V," "VREF," or "Reference Voltage" in the factory wiring diagram. Caution: Do not let the VREF connection be shorted to ground - this will shut down the DIYPNP.

5V: The DIYPNP has a second power supply for 5 volt circuits that are isolated from the main reference voltage. Usually you won't need to connect this to any external wires (it's more useful for onboard circuits), though if you run across a Hall effect or optical sensor in the external wiring that needs to be supplied 5 volt power, use this jumper.

SG: Sensor ground. If you have common ground wires coming back from external sensors, connect the pins these wires use to the SG jumper. This is to reduce the amount of noise in signal wires.

GND: Power ground. Connect any ground wires that go to the engine block, battery terminal, or chassis ground to the GND jumpers.

Sensors

The throttle position sensor, temperature sensors, and O2 sensors are fairly straightforward to hook up. The VREF and sensor grounds are covered above; now here's what to do with the sensor input pins themselves.

IAT: The intake air temperature sensor may be a freestanding sensor, or it may be built into an air flow meter. It generally has two wires, the signal wire and the sensor ground wire. The signal wire goes to IAT and the ground wire goes to SG. Usually the ground wire will merge into another ground wire in the external wiring; in the rare event that you find an IAT sensor where neither wire connects to others or has a clear function, it can be wired up either way.

CLT: The coolant temperature sensor wires up exactly the same way as the IAT sensor.

O2 Sensor: Narrow band O2 sensors come in one, three, and four wire flavors. With a one wire sensor, simply connect that one wire to the O2 SENSOR jumper. Sensors with more wires will also need the signal ground connected to SG, but they'll generally work okay without the heater circuit connected. It just takes them longer to warm up. The DIYPNP does not read wideband sensors directly, requiring an external controller. If using one of these, wire the controller's analog output to the O2 SENSOR jumper.

TPS: The TPS's signal wire goes here. It is usually marked in the diagram about which is the signal wire. If it isn't, you'll need to test the TPS with an ohmmeter. Observe the resistance as the throttle opens and closes. Each pair of pins will behave differently:

The resistance between the VREF and ground pins will remain constant.
The resistance between the ground and signal pins will be low with the throttle closed and high with the throttle wide open.
The resistance between the VREF and signal pins will be high with the throttle closed and low with the throttle wide open.

If your sensor behaves like this, it will be pretty straightforward to connect it to Megasquirt.

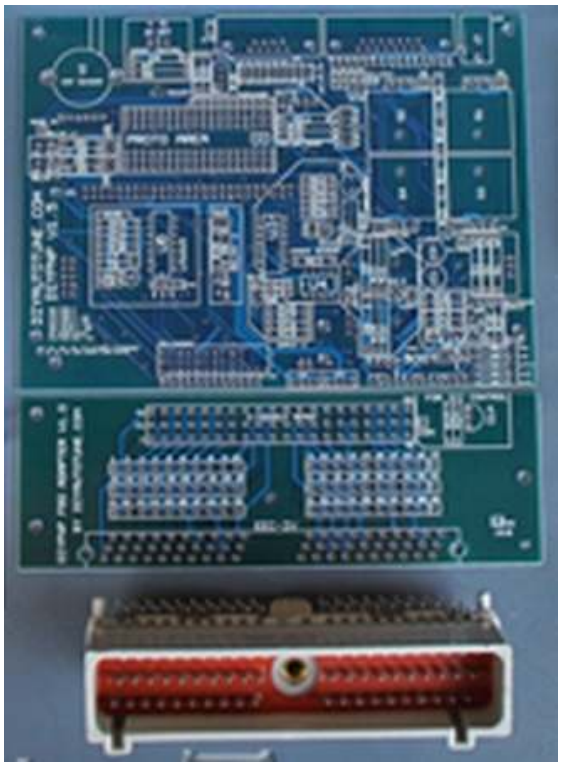
If the resistance jumps from infinite (or near infinite) to near zero, you have a switch type throttle position sensor, or possibly a seriously defective potentiometer type TPS. These do not provide very much information that Megasquirt needs, as it can tell if you are at idle or full throttle by the MAP sensor information. You can still use MAP based acceleration enrichment and ground the TPS signal pin through a resistor.

Fuel Control

INJ1 and INJ2: These are your injector outputs. The DIYPNP is batch fire normally, so you will be using two outputs, each of which can drive one low impedance or four high impedance injectors, so each of the four INJ1 holes are the same, and each of the four INJ2 holes are the same. The INJ1 and INJ2 jumpers connect to the injector wires on the adapter board. Usually the best way to pair them is by firing order - connect the first cylinder to fire to INJ1, the second to INJ2, the third to INJ1 again, and so forth. This isn't a hard and fast rule, and some harnesses will make the injector pairing choice for you. Usually it'll run fine with pretty much any injector pairing anyway, though some pairings may be a little bit smoother.

Note that there are holes marked 3 and 4 above the INJ2 header. These are wired to the holes marked 3 and 4 in the proto area. These let you jumper a sequential add-on board to the holes in the proto area, making for fewer awkward long runs of wiring.

Fuel Pump: This pin supplies a ground for the fuel pump relay. Most ECUs will have a ground pin for the fuel pump relay wired straight to the ECU, so you just have to find this wire on the adapter board and connect it to the FUEL PUMP pin on the main board.



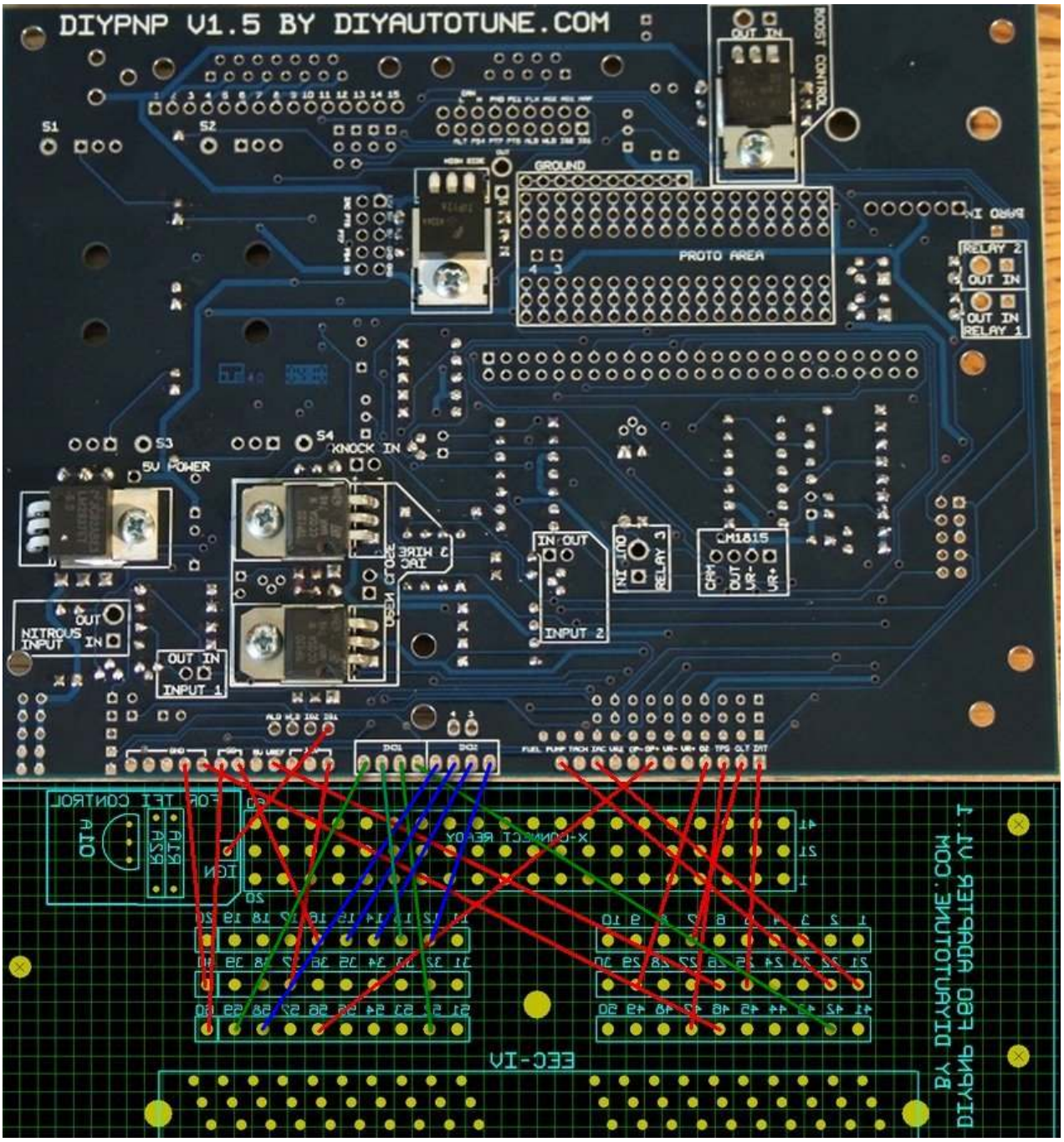
15-adapter

For Adapter Board to Main Board wiring, see table below.

Edge Pin Connections Specific to Ford 60-pin Connector

Main Board	FORD NAME (Generic Name)	Adapter Board
IAT	Air Charge Temperature (ACT)	25
CLT	Engine Coolant Temperature (ECT)	7
TPS SIGNAL	Throttle Position Sensor (TPS)	47
O2 SENSOR	Heated Exhaust Gas Oxygen Sensor (HEGO-R)	29
OPTO IN +	Profile Ignition Pickup (TFI-PIP)	56
IAC	Idle Speed Control (ISC, IAB, IAC)	21
FUEL PUMP	Fuel Pump Relay	22
INJ1	#3-Inj, #5-Inj, #6-Inj, #1-Inj	12, 14, 15, 58
INJ2	#4-Inj, #7-Inj, #8-Inj, #2-Inj	13, 42, 52, 59
12V	CF1 Power Relay (+12VDC)	37
VREF	Manifold Absolute Pressure - MAP (Vref)	26
SG	TFI Module (Ignition Gnd)	16
SG	Pwr Gnd (Battery Ground)	60
GND	HEGO Heater Gnd	40
GND	Manifold Absolute Pressure - MAP (Sig Rtn)	46
IGN1	IGN1 to TFI circuit on Connector Board *	36 *

The X-Connect section on the connector board is for future hardware.



Warning:
It is best to use the charts above & below, for wiring, rather than attempt to follow them in the picture above. Placement of the wires can be accomplished in a number of ways. Your goal is to reduce the number of crossovers & keep everything flat & neat as possible. Also, soldering with a previous wire laying over the solder hole will cause the insulation to melt, creating a possible short circuit. Plan your layout ahead, so this does not occur.

DIYPNP F60-K
ASSEMBLY, FIRMWARE LOADING & APPLICATION DOCUMENT

DIYPNP Jumper Configuration

Vehicle information		System Information
Market:	USDM	DIYPNP v1.5
Make:	Ford	
Model:	Mustang	**Code Version:**
Year:	1987-93	MS2/Extra 3.0.3U
Engine:	5.0L V8	
Tranny:	5 spd	
Trim:	GT/LX	

Edge Pin Connections	
Main	**Adapter**
IAT	25
CLT	7
TPS SIG	47
O2 SENSOR	29
VR IN +	
VR IN -	
OPTO IN +	56
OPTO IN -	
VR2 IN +	
IAC	21
TACH OUT	
FUEL PUMP	22
INJ1	12, 14, 15, 58
INJ2	13, 42, 52, 59
12V	37
12V	
12V	
VREF	26
5V	
SG	16
SG	60
GND	40
GND	46
GND	
GND	
GND	
IGN1	* 36
IGN2	
WLED	
ALED	

Pull Ups		
Connection	**Resistance**	**Voltage**
ALED		
WLED		
OPTO+		
VR2		
IAC	Flyback Diode	Banded end to 12V

High Current Drivers		
Output	**Enabled**	**To Pin**
S1		
S2		
S3		
S4		

Knock Circuit		
Enabled	**Sensor +**	**Sensor -**

I/O Circuits			
	Input From	**Out Pin To**	**Purpose**
Relay 1			
Relay 2			
Boost			
Input 1			
Input 2			

Misc Jumpers		
	On	**Off**
OPTO GND	X	
BL/TH		X

Ignition Settings	
Spark Mode	Basic Trigger
Trigger Angle	4
Main/Return	
Oddfire Angle	
GM HEI/DIS	
Use Cam Signal	
Ignition Input Capture	Falling Edge
Spark Output	Going High (Inverted)
Number of Coils	Single Coil
Dwell type	Standard Dwell
Cranking Dwell	8
Cranking Advance	10
Maximum Dwell	8
Maximum Spark Duration	0.7
Trigger wheel arrangement	
Trigger wheel teeth	
Missing teeth	
Tooth #1 angle	
Wheel speed	
Second trigger active on	
and every rotation of	

Notes

* IGN1 to TFI circuit on connectorboard

Assembly Into Case

The top & bottom of the case are identical. Chose one for partial assembly. Get the panel with the 4 cutouts (power DB-15, DB-9, MAP sensor. Notice that the end panel screw holes are countersunk on one side. With the flange on the bottom, mount the end panel to the bottom with the supplied self-tapping screws. This takes quite a bit of force, don't strip the Philips head.

It's best to assemble the 4 case parts without the boards installed to tap all 8 holes for easier assembly when the boards are installed. Then only remove the 4 screws holding the top & the 2 screws holding the end panel for the Ford 60-pin.

Before mounting the assembly into the case, remove the stand-offs from the DB-9 & D-15 connectors, they will get reinstalled from the outside of the end panel, with the remaining flat washers from the kit.

The main board & connector board assemblies use the bottom guide rail of the case. Slide it all the way in & verify that everything lines up properly with the end panel. Reinstall the 4 DB connector mount screws, together with a flat washer. Attach the opposite end panel over the Ford 60-pin connector.

The top & bottom of the case have a specific orientation, the tongue of one fit into the groove of the other. It would be a good idea to mark the orientation with a piece of tape on both halves.

Firmware Loading

Step 1 -- Download the firmware

The first thing we'll want to do is make sure we've downloaded the firmware version that we are planning to upload to the DIYPNP ECU. You can always find all of the MS2 Extra download files here:

http://www.msextra.com/doc/ms2extra/files/release/

On this web page, click on this:
Click here to confirm you are using licensed hardware and download your file.

It may just download the file or take you here:
http://www.msextra.com/doc/ms2extra/files/release/

Current filename as of the date of this document is: ms2extra_3.2.5_release.zip

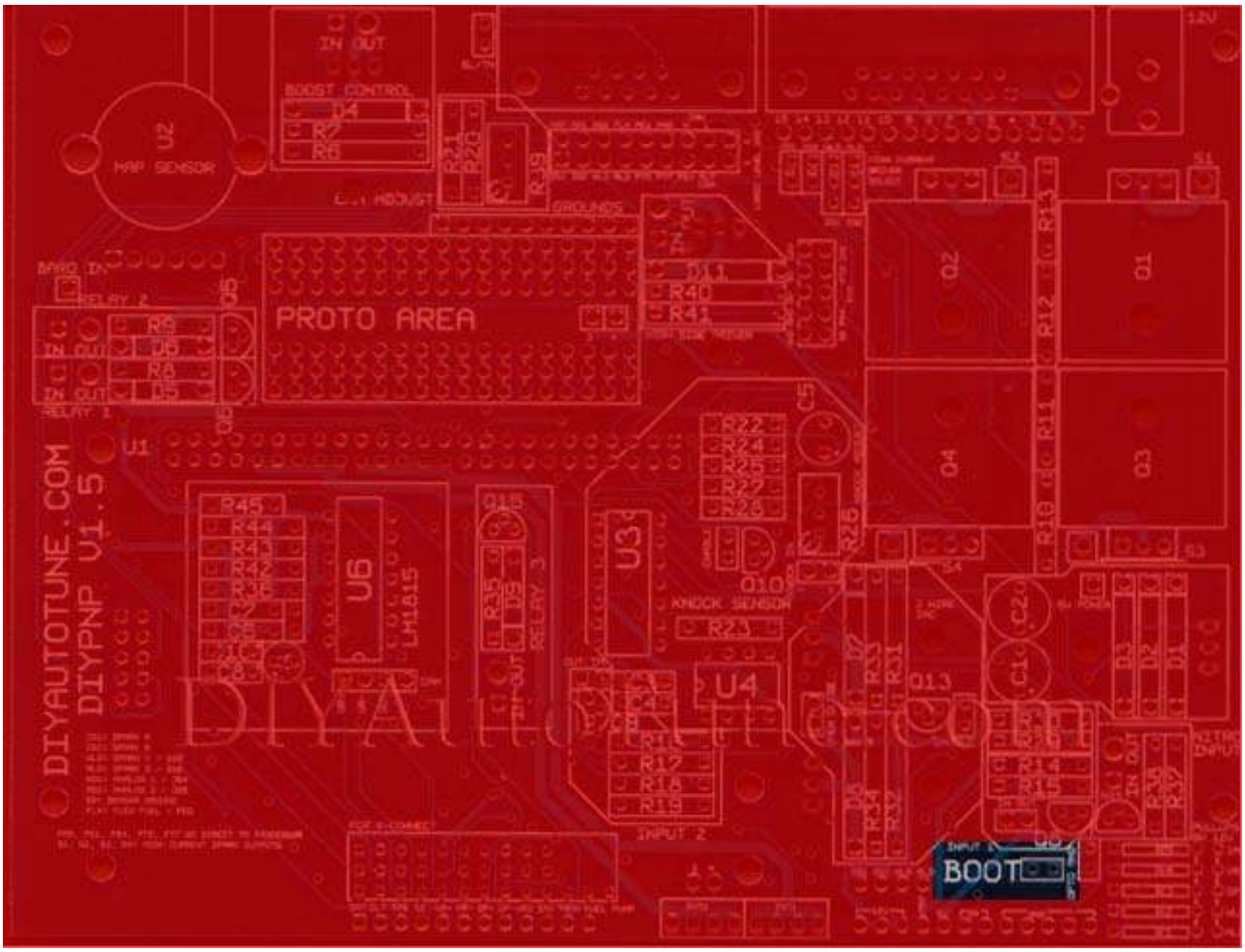
Note: this filename could be updated in the future, so verify first that you are getting the correct version.

The firmware versions are sorted on this page from oldest at top to newest at bottom. Generally speaking, you'll want to choose the newest version of the firmware at the bottom. However, if you planning on using one of our start up maps for your application, you will need to make sure that you install into your DIYPNP the same firmware version that our start up map was built on in order for the base map to load in 100% clean with no errors. For example, if our start up map was built on 3.0.3H, and you wish to use our start up map, please load 3.0.3H into your ECU. Alternately you can choose a newer firmware version from the same series (maybe 3.0.3J for example, which would be a later release of the 3.03 firmware), and in many cases most all of the settings from our base map will load right in, though it may give you a couple warnings to review that often can be disregarded (though you should review them to verify).

If you are starting your own map from scratch, then choose the most recent release at the bottom. Download the firmware folder of your choice, make sure you unzip it, and move the folder to your C/Program Files/MegaSquirt directory for safekeeping and to make it easy to find later.

Step 2 -- Installing the Boot Jumper

Next we will want to add the boot jumper to the ECU. The boot jumper is located near the bottom right corner of the main board. You should have soldered a 2-pin male header into the boot jump pins during assembly. What we'll do here is add a cap/jumper on top of the standoff, which will short the two pins together and put the ECU into Boot Loader mode on the next power-up.



DIYPNP Boot Header Location

Step 3 -- Connecting to your DIYPNP ECU

Connect the DIYPNP to the serial port on your laptop. If your laptop does not have a serial port and you're using a USB adapter, be sure that the adapter's drivers have already been installed and is working properly before proceeding. Also make note of the COM Port that your USB Adapter installed to.

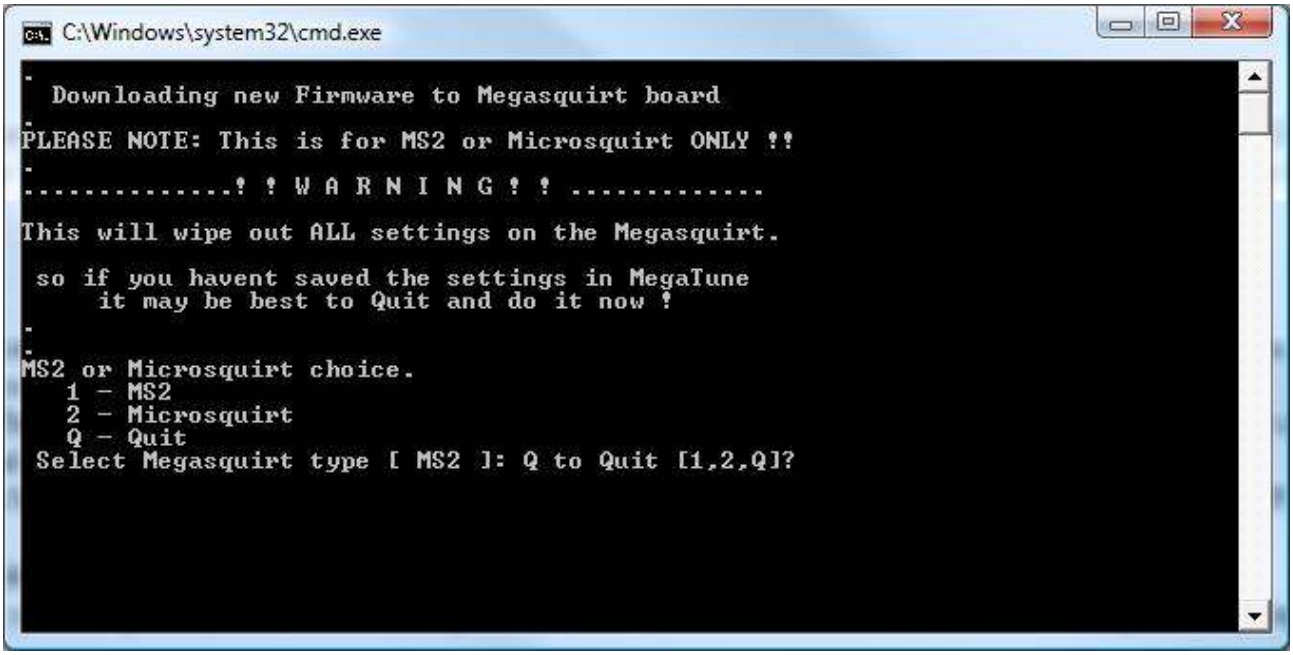
Now we'll need to get 12 volts to your DIYPNP. The easiest and safest way to do this would be to use our power supply, which will plug into the ECU next to the DB15 jack. If you do not have a power supply and are using your car to power the ECU, be sure that power to your ignition coils are unplugged for the remainder of this procedure.

Close any open tuning software, as well as any other software which may want to use a com port. This can include PDA synch applications that may use a COM Port.

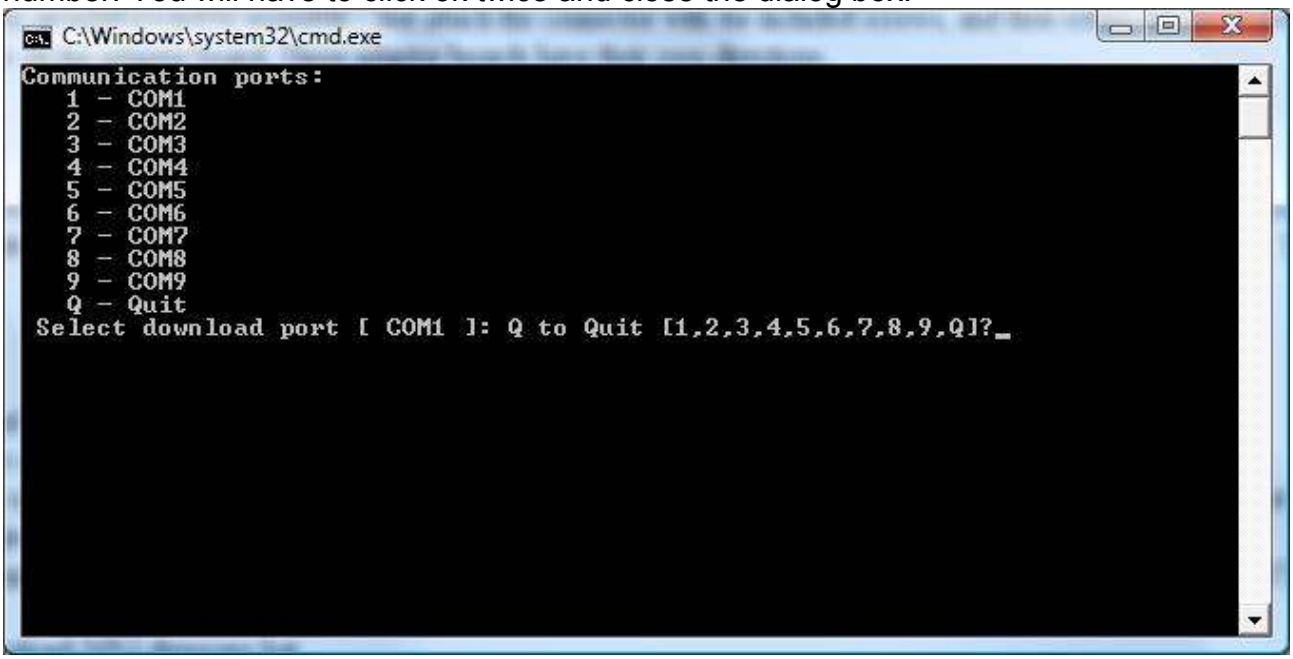
Step 4 -- Flashing the DIYPNP Firmware

Open your C/Program Files/MegaSquirt directory and browse over to the ms2extra_3.2.5_release folder that you moved above. Open this folder, and then open the file program installed called "ms2loader_win32.exe".

This program will prompt you through the process. The first prompt is to choose MS2 or Microsquirt specific firmware. Press 2 for Microsquirt.

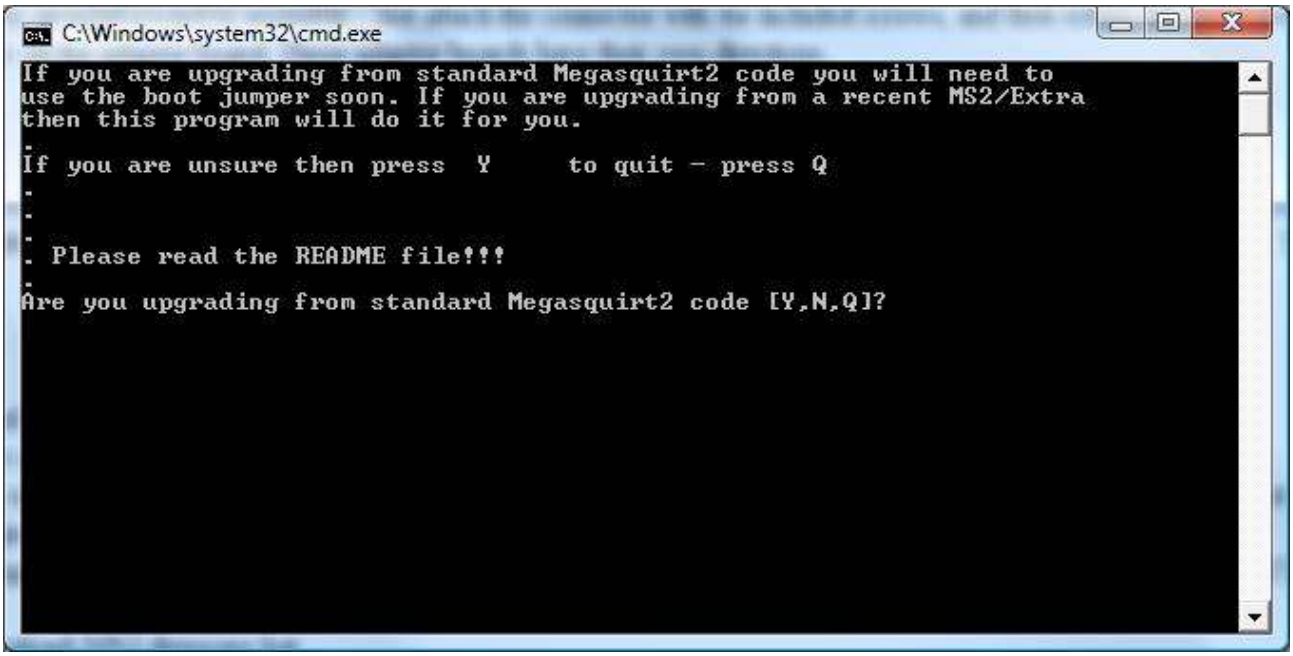


Next we will select the com port that our DIYPNP is connected to. If you are using a serial cable, generally this will be on COM1, sometimes COM2. If you are using a USB adapter, it could be on a different port. If you are unsure of your port assignment, you'll need to open up your Windows Device Manager, and check under Ports (COM & LPT) the port assignment of your USB adapter. We recommend setting the USB adapter to COM4 or lower for best results. This can be done by right clicking on the USB adapter's assignment, tabbing over to Port Settings, Advanced, and then specifying a different, lower port number. You will have to click ok twice and close the dialog box.

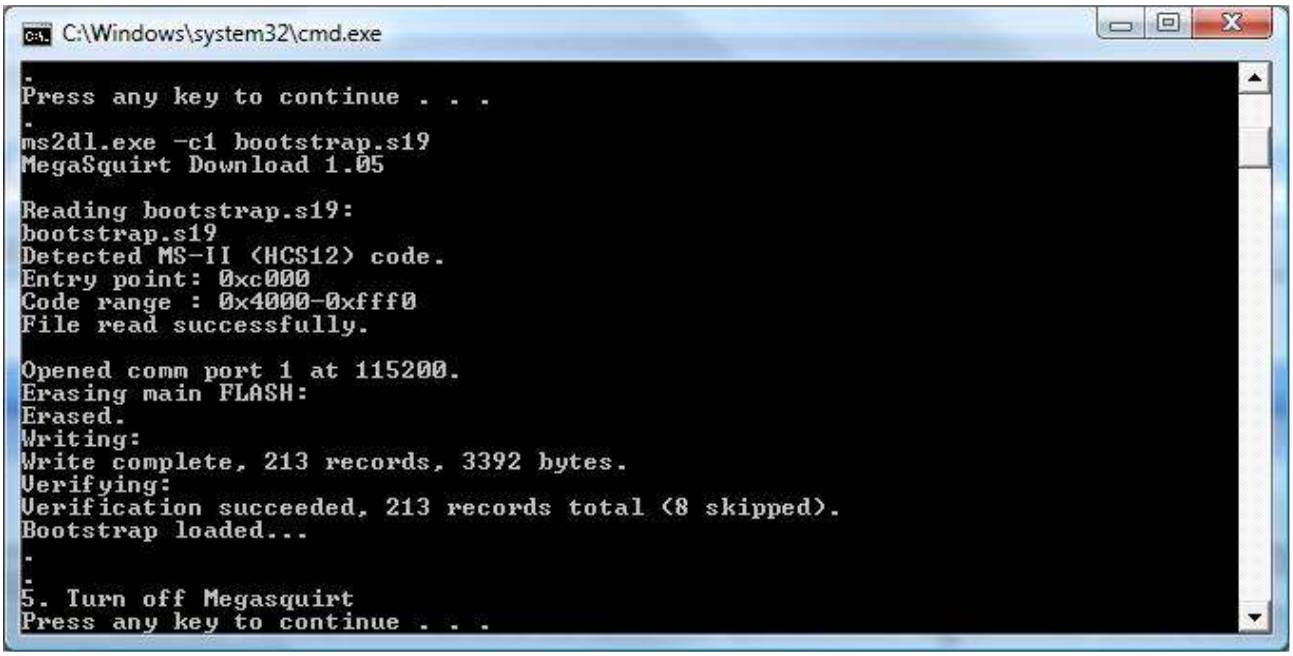


After the above prompt, the next prompt will ask about debug options. Press 1 for No debug. (We don't have a screenshot of this, but if you press 1 you're good)

The next step is important. Since this is our first time installing Extra firmware into our DIYPNP ECU, press Y for Yes. We will then be prompted to install the boot jumper in the ECU, which we have already done. This step needs only be done the first time installing Extra code in the ECU. If you ever need to update or reload code in the future, you can press N for No at this step, and you will not need to have the boot jumper installed.



The firmware installer at this point will begin loading the firmware into your DIYPNP. When finished, it will ask you to remove power from your ECU, remove the boot jumper, and supply power to the DIYPNP again.



The firmware installer will then load firmware into your DIYPNP. This is what the screen will look like when finished.

That's it!!

Your DIYPNP ECU is now loaded with firmware. You are now ready to begin configuring your basemap, or you can load one of our startup maps to help get you going in the right direction.

Startup Maps

Base configuration **.msq** files to help you get your car fired up safely and quickly, ready to tune.

The base ignition settings contained in these maps should be loaded on your DIYPNP before you power your car up (with the key) with the DIYPNP installed. This is to prevent damage to your ignition system in case the default settings are not correct for your vehicle. Note that you can power up the DIYPNP off the vehicle on a power supply connected to the power jack next to the DB15 connector.

So here's our recommendation –
After you complete basic assembly, power up your DIYPNP one of two ways.

1. Either plug a Stimulator Power Supply into the front panel of the box (the easiest way), or,
2. Unplug your coils from their power connectors before plugging the DIYPNP into your factory harness and powering it from there.

Then and only then, you can flash the firmware on your DIYPNP to the MS2/Extra firmware if you haven't already, and then load the startup map provided to help you get your vehicle started.

Startup Map for this Vehicle
Filename: usdm-ford-mustang-8893-5_0-mt.zip
http://www.diyautotune.com/diypnp/apps/f60/usdm-ford-mustang-8893-5_0-mt.zip

Once the vehicle is started, you will need to use the MS2/Extra manuals to set the base timing and begin to tune the vehicle! This is critical! Do not drive an untuned vehicle!

Connect the Vacuum Line

When installing the DIYPNPF60, don’t forget to connect a vacuum line to the onboard MAP sensor.

Other Changes/Considerations

This section will cover changes that need to be made to the DIYPNP that go beyond the standard I/O jumpering, such as intake valve butterfly activation, on/off VVT activation, or other customizations to address the specific needs of a vehicle.

Ignition System Notes

The 'SPOUT' connector on the front of the distributor can be removed to lock the TFI system at its default advance of 10 degrees, assuming the distributor is adjusted correctly. This also stops the ECU from controlling ignition advance if you need to try to pinpoint any issues.

To set and verify base timing with the trigger wizard, we found a fixed angle of 20 degrees to be the easiest to read on our crankshaft.

Sensor Calibration

1. This vehicle has a variable TPS. You should calibrate it properly from TunerStudio in the 'Tools' menu. Choose 'Calibrate TPS'.

- Make sure the engine is off, and the key is on.
- With your foot off of the throttle, click the 'Closed Throttle ADC Count - GET CURRENT' Button.
- Put the throttle to the floor. With your foot fully depressing the throttle, click the 'Full Throttle ADC Count - GET CURRENT' Button.
- Click Close.

2. Calibrate your CLT Sensor and IAT Sensor.

Again from TunerStudio, click 'Tools > Calibrate Thermistor Tables'. Make sure 'Coolant Temperature Sensor' is selected at the top.

For the CLT, use the following table with a bias resistor setting of 2490 ohms:

Temperature ºF	Temperature ºC	Resistance In Ohms
50º	10º	58750Ω
176º	80º	3840Ω
230º	110º	1550Ω

Enter these values, and click 'Write to Controller'.

Now you'll do the same for the IAT. Select 'Intake Temperature Sensor' at the top in the drop down box.

(NOTE - If you are removing your MAF/AFM as a part of the DIYPNP installation process, do not recalibrate your IAT Sensor now)

For the IAT, use the following table with a bias resistor setting of 2490 ohms:

Temperature ºF	Temperature ºC	Resistance In Ohms
50º	10º	58750Ω
176º	80º	3840Ω
230º	110º	1550Ω

Enter these values, and click 'Write to Controller'. Now click Close to Exit.

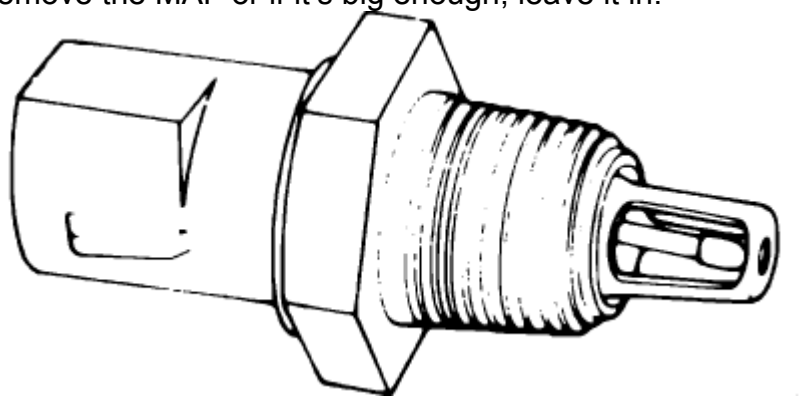
Finally, you should calibrate your O2 Sensor to the ECU.
To do this, click 'Tools > Calibrate AFR Table'.

Choose your O2 Sensor from the list. Choose Narrowband for the stock O2 Sensor. Or select your wideband and the proper configuration of said wideband from the drop-down list.

Click 'Write to Controller'. Once finished writing, click 'Close'.

Deleting the MAF

The IAT sensor is located in the intake path, rather than inside the MAF like some other setups. Simply remove the MAF or if it's big enough, leave it in.



IAT Sensor

Assembled Pictures

NOTE:

I did the injector wiring a bit differently. I soldered an 8-pin header at INJ1 & INJ2, tilted it a little bit away from the Microsquirt. I had some wire jumpers & removed the 26ga wire & substituted the orange 22ga wire that came with the kit. These fit much tighter than the plastic jumper you used for the Boot header above. They will allow easy remapping of injectors, should the need arise.

There is a side benefit, in that it makes the wiring on the bottom less crowded.

Connections shown are this:

Main Board	Edge Pin Connections	Adapter Board
INJ1 (Bank A)	#3-Inj, #5-Inj, #6-Inj, #1-Inj (1-3, 6-5)	12, 14, 15, 58
INJ2 (Bank B)	#4-Inj, #7-Inj, #8-Inj, #2-Inj (7-2, 4-8)	13, 42, 52, 59

The 5.0 HO engine firing order is 1-3, 7-2, 6-5, 4-8, alternating banks. Other combinations will also alternate banks.


DIYPNP
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Built on MicroSquirt Technology


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