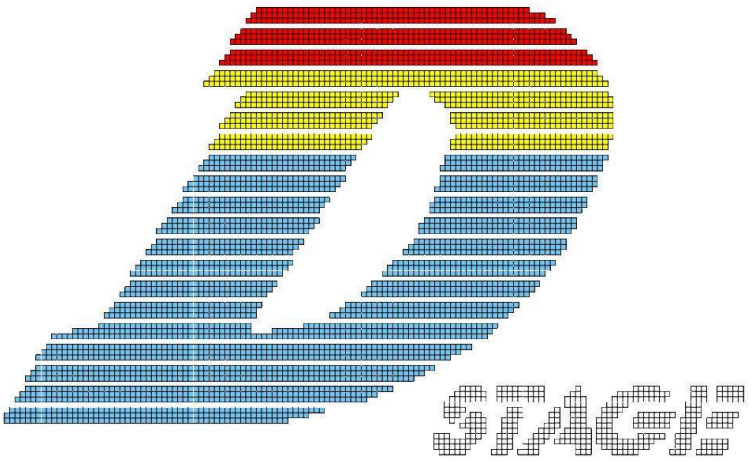


Electronic Throttle Controller

a.k.a.

Drive by Wire

ETC v1.3

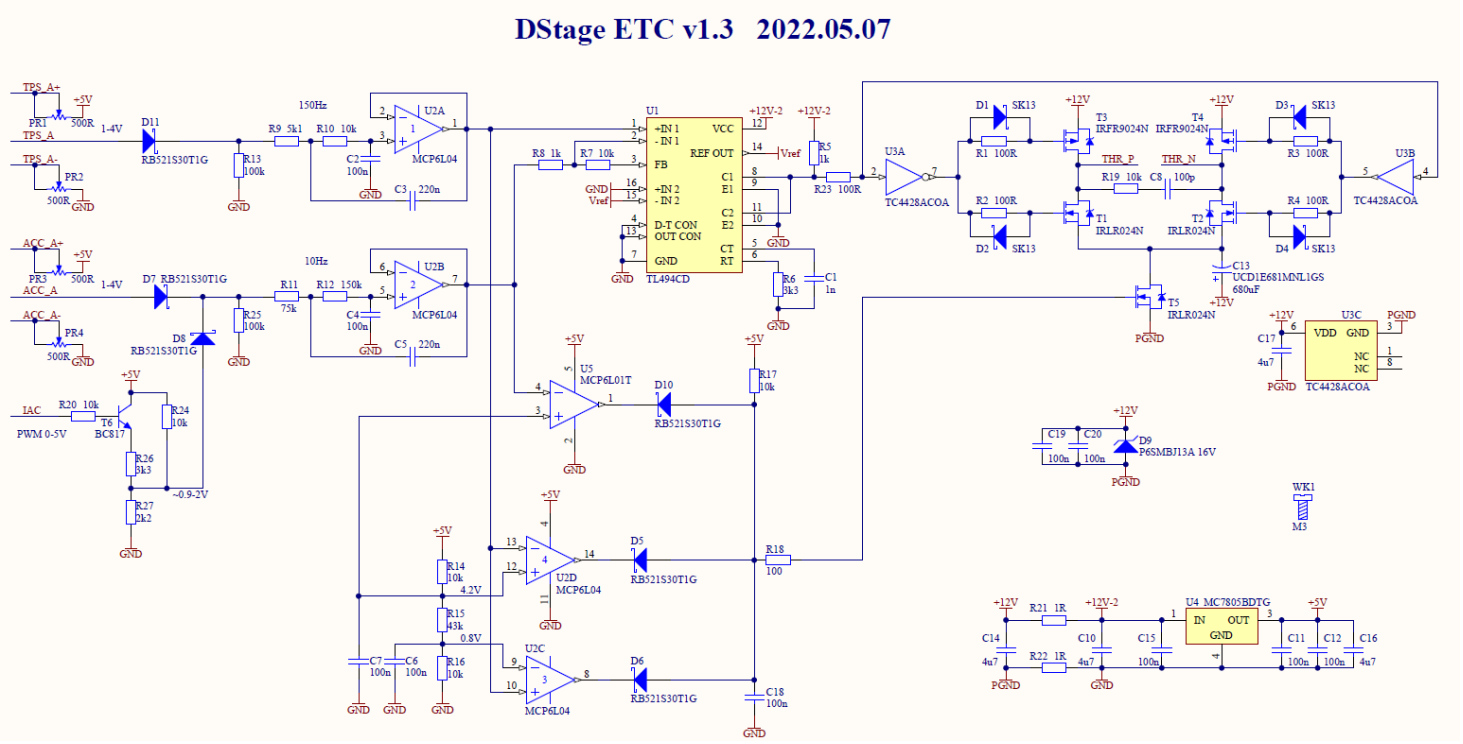
1. Introduction

The ETC v1.2 is an open project of a controller for electronic throttle for internal combustion engines. It allows control of the throttle by electronic gas pedal (accelerator) which is sometimes referred to as „drive by wire”. These are some of the features:

- Controls a DC motor based electronic throttle with H-bridge allowing for fast movement in both directions and closing the throttle beyond stationary position,
- Works with gas pedal incorporating potentiometers or voltage based output, highly adjustable input levels,
- IAC input allowing for ECU idle control with 5V PWM signal,
- Build in fail-safes for detecting broken connections or short circuits on wires connecting gas pedal and TPS,
- analogue circuit – no programming required, no risk of program failure, no risk of CPU going into race condition or resetting due to electromagnetic noise in hursh near-engine environment,
- PCB designed for enhancing immunity to noise.

DISCLAIMER:
This device is dedicated for stationary engines and vehicles driving on private closed properties. It should not be used on public roads!

2. Principle of operation



T.B.D.

3. Assembly / Ordering

3.1 Automated assembly via JLCPCB

Automated assembly ordered in JLCPCB is by far the easiest option to get the controller in your hands. To order your PCBs together with components and assembly you will need to visit project repository site at https://github.com/DStageGarage/ElectronicThrottleController and download 3 files:

- DStage_ETC_v1.3_gerbers.rar
- DStage_ETC_v1.3_BOM.xlsx
- DStage_ETC_v1.3_PnP.txt

Then you can log into your account at JLCPCB and start the ordering process during which you will be asked for the above files (gerbers, bill of materials, pick and place file).

Please note that JLCPCB is not related to the ETC project in any way. It is just mentioned here as they provide an easy and convenient way of ordering printed circuit boards with assembly.

In case of issues such as component shortages or file problems please contact us at dstagegarage@gmail.com for help.

3.2 Manual assembly

The figure 3.1 shows the ETC v1.1 PCB view (v1.3 is nearly identical in components placement) with extra designators overlayed for clarity. All components are surface mounted on the top layer only.

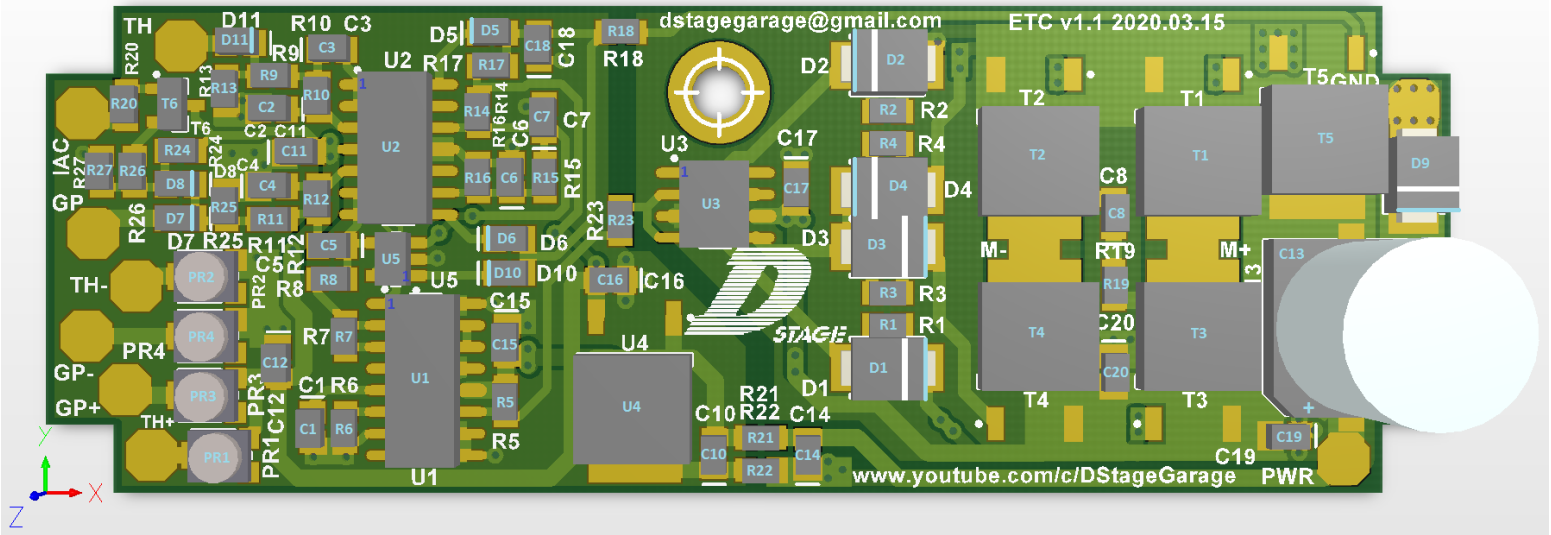


Figure 3.1 PCB assembly

For ease of assembly it is recommended to start with integrated circuits paying attention to correct positioning of pin #1. On SO cases (U1, U2, U3) there are a few different ways to mark this pin.

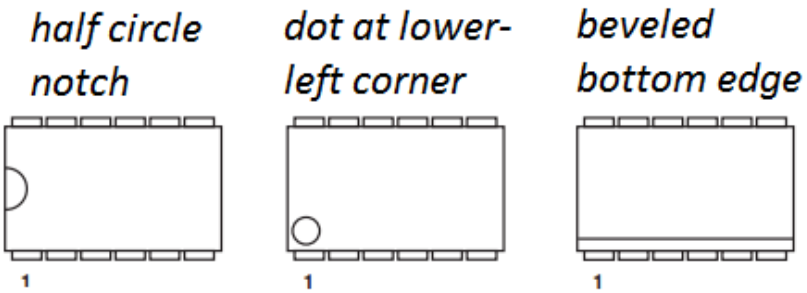


Figure 3.2 How to recognize pin #1 on ICs

There can be a notch on the left side, printed or molded dot in the left bottom corner or beveled bottom side. Refer to figure 3.2 for hints. On PCB silkscreen there is a dot marking where pin #1 should be. You can also check figure 3.1 for clarity. Positioning of U5 is easy as it has 2 pins on one side and 3 on the other.

Assembly can be followed-up by small passive components i.e. resistors and ceramic capacitors as well as diodes and T6 transistor. Resistors and ceramic capacitors are non polarized components so it does not matter how you orient them on pads (line to the side of capacitors footprints is only there to easier distinguish them from resistors). In case of diodes it is important to match the bar on case with the bar/line printed on silksreen. Please refer to figure 3.1. Positioning of T6 is self explanatory (1 pin on one side, 2 on the other).

Now the assembly can be finished by populating potentiometers, bigger transistors T1-T5 and electrolytic capacitor C13 as the last component as it's the largest one. Such capacitors are polarized so it is important to place them in the correct way. It usually has a

black bar at the negative side (-) and notched corners at the base on the positive side (+). Please check figure 3.1 for clarity.

4. Wiring (connecting to the vehicle/engine/ECU)

To keep PCB compact there are no connectors. Instead all wiring is done via direct soldering of wires to 11 pads. Figure 4.1 shows the layout of those pads and wires for particular functions.

On the right side there are two power pads – ground at the top and 12V power at the bottom. Please make sure that the power is fed with a fuse not larger than 5A to ensure safe operation in case of the throttle motor failure etc.

The motor of the electronic throttle is connected to pads located very close to H-bridge. Please note that in ETC v1.1 the M+ and M- pad markings will be most likely reversed for most types of electronic throttles. Figure 4.1 already shows that the polarity should be reversed. The markings on later versions of PCB have been corrected.

On the left hand side there are 7 pads in total. The one marked as IAC should be connected to the ECU idle PWM signal.

The group of 3 pads marked GP, GP+ and GP- is meant for connecting the gas pedal (accelerator). Usually electronic gas pedals have 6 pins, 3 for one potentiometer or circuit imitating the potentiometer and 3 for another one. Those two outputs depending on a particular type of gas pedal can be configured in different manner. The output signal can have different offset, direction or characteristics (slope, especially in models using voltage output instead of true potentiometers). What is important is to make sure the output used with ETC has the voltage increasing when the pedal is pushed (pot slider going towards positive side) and decreasing when released (pot slider going towards negative side). More on different accelerator types in one of the following chapters.

The last group of 3 pads is dedicated to the feedback position of the throttle. Usually electronic throttles use double potentiometer with combined ends and separate outputs which results in 4 pins being used for that purpose. Typically one potentiometer travels one direction and the second one in the opposite direction with throttle movement. Again, make sure to use the output that increases the voltage (pot slider traveling towards the positive side) when the throttle is opened more. This can be checked by measuring resistance change across the pins while manually moving the throttle. More on that in one of the following chapters.

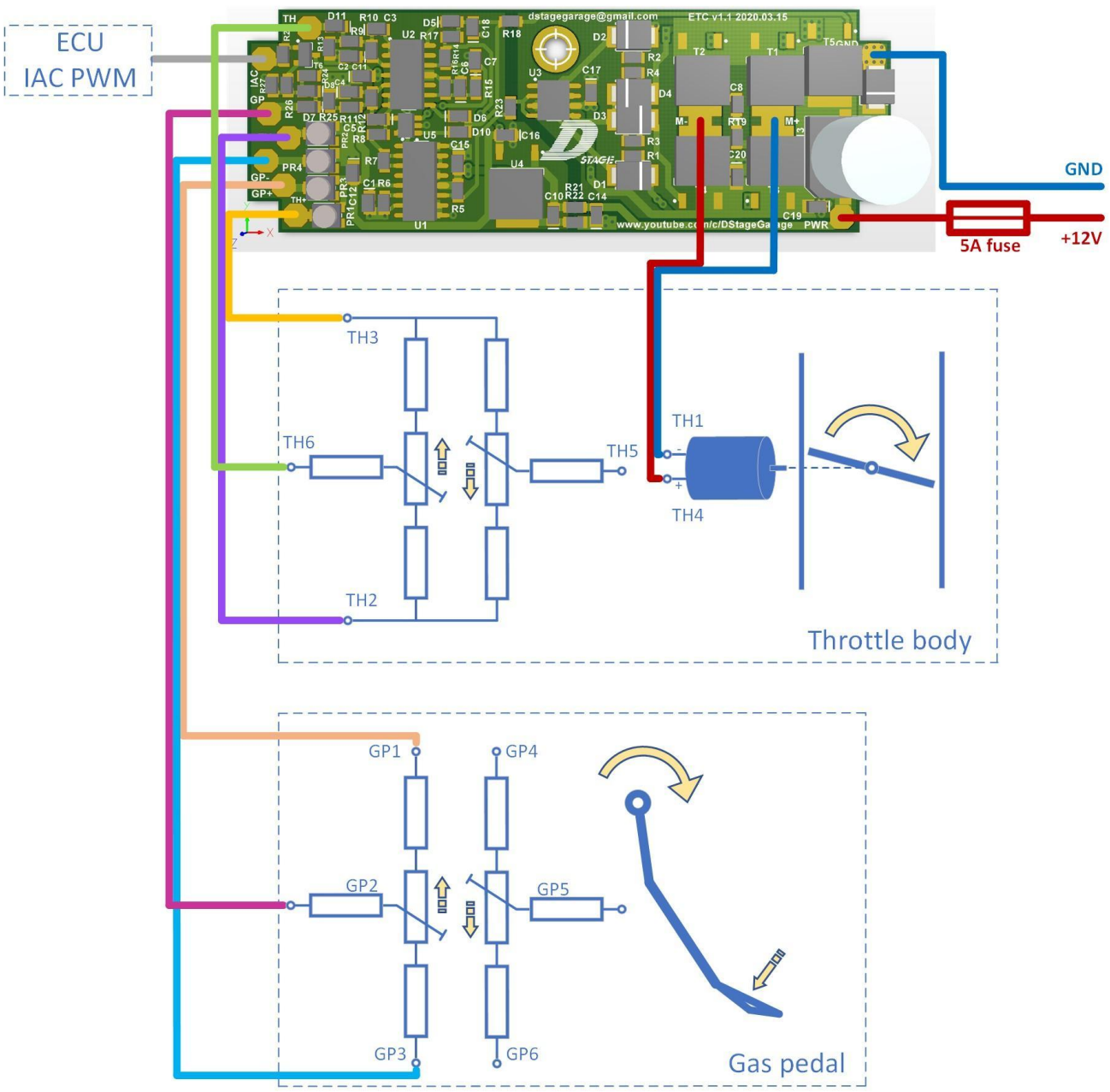


Figure 4.1 Wiring diagram

5. Calibration

We start with the throttle position sensing:

1. Connect the TH, TH+ and TH- to the throttle but DO NOT yet connect the motor (M+ and M-).

2. With throttle closed measure the voltage at TH and adjust PR2 so the voltage is close to 1V (doesn't have to be spot on as long it is reasonably higher than 0.8V).

3. Now fully open the throttle manually and check the voltage on TH. Then adjust PR1 so the voltage is close to 4V (doesn't have to be spot on as long it is reasonably lower than 4.2V).

4. Close the throttle and repeat point number 2 and then number 3 a few times until voltage on TH is close to 1V with the throttle closed and 4V with the throttle open without further touching of the pots.

Now the gas pedal/accelerator - basically same procedure:

1. Connect the GP, GP+ and GP- to one of the gas pedal potentiometers.
2. With the gas pedal unpressed measure the voltage at GP and adjust PR4 so the voltage is close to 1V (doesn't have to be spot on as long it is reasonably higher than 0.8V).

3. Now press the gas pedal and check the voltage on TH. Then adjust PR3 so the voltage is close to 4V (doesn't have to be spot on as long it is reasonably lower than 4.2V).

4. De-press the gas pedal and repeat point number 2 and then number 3 a few times until voltage on GP is close to 1V with the pedal unpressed and 4V with the pedal fully pressed without further touching of the pots.Ideally those voltages should be closely matching those measured at the end of TPS calibration procedure.

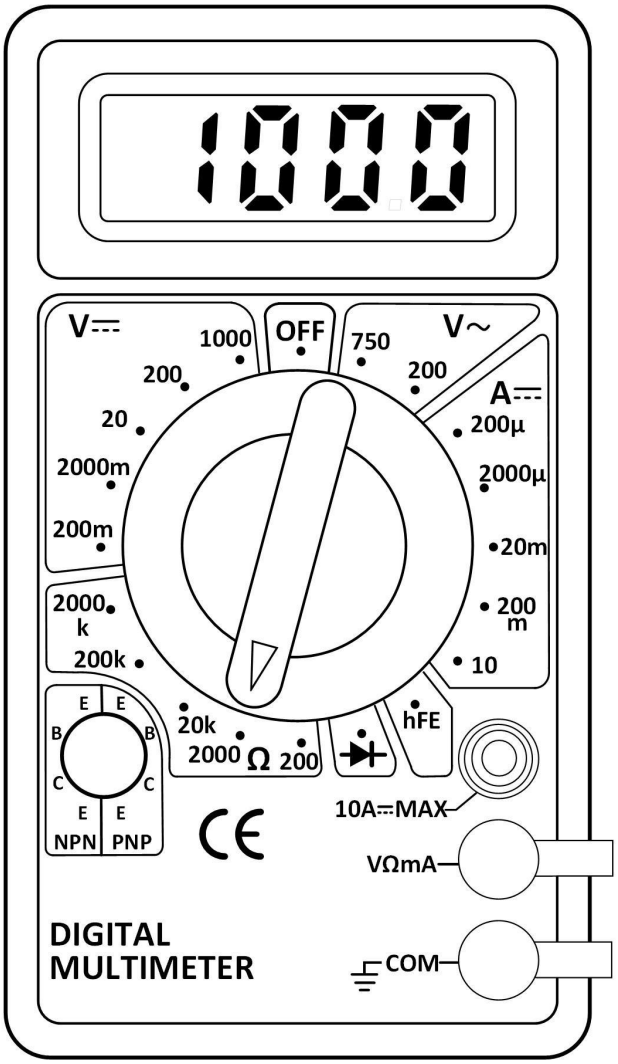
Now you can connect the M+ and M- and fingers crossed it should work.
In case of issues please contact us for help at dstagegarage@gmail.com.

6. Different gas pedal (accelerator) types and how to use them

T.B.D.

7. Basic multimeter measurements.

T.B.D.



8. History of changes.

Date	By	Changes
2022.01.05	DStage	Spelling checked ;-)
2022.05.08	DStage	automated assembly chapter, calibration