Mass Air Flow sensor

Page content:	Pierburg MAF
	Bosch MAF
	Converting mg/stroke to kg/hour

PIERBURG

Pierburg Mass Air Flow sensor

The Pierburg MAF, VW number 074 906 461, has 6 pins. The wire colors and the connections mentioned to the ECU are from a 66kW AGR and a 81kW AHF engine.

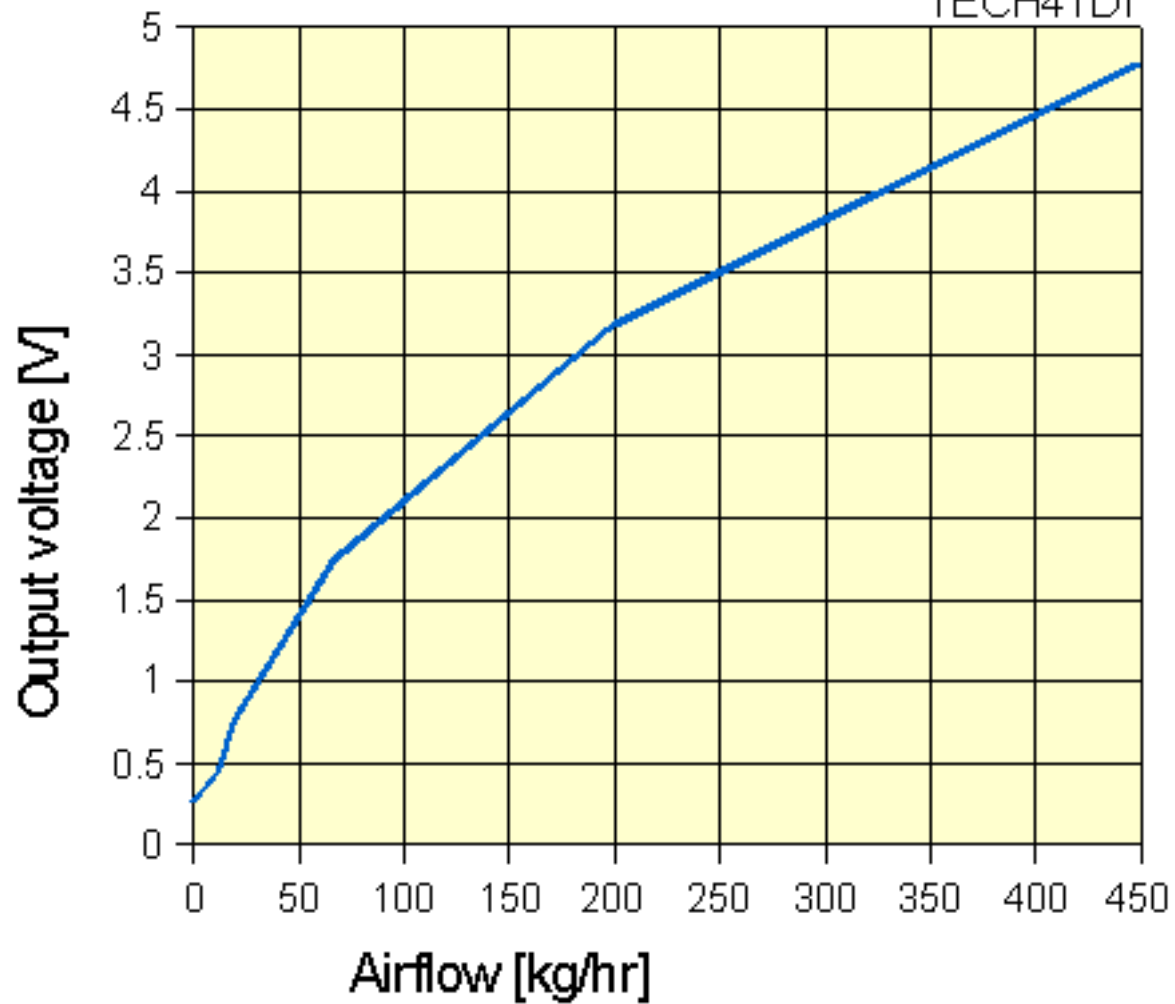| Pin	Description	Wire color	Connected to
1	5V reference input voltage	Red/green	pin 50 of the ECU
2	Signal ground	Brown/blue	pin 25 of the ECU
3	12V supply input	Yellow/black	relay 109
4	Not connected	-	-
5	Power ground	Brown	ground
6	Output voltage	Purple/brown	pin 52 of the ECU

Looking through the MAF

The output voltage is proportional to the air flow through the device as can be seen in the curve below.

Pierburg mass air flow meter

BOSCH ⊕

Bosch Mass Air Flow sensor

VW uses several Bosch MAFs for its TDIs. Bosch number 0 281 002 216, VW number 028 906 461 and also Bosch number 0 280 217 121, VW number 06A 906 461. As far as I know these MAFs are equal. The drawn transfer curve drawn is from a Bosch 0 280 218 018 MAF. I'm pretty sure this curve is equal to the curve of the previous mentioned MAFs. The wire colors and the connections mentioned to the ECU are from a 66kW ALH engine.

A Bosch MAF has 5 pins:

Pin	Description	Wire color	Connected to
1	Temperature sensor output, not used in ALH engine	-	-
2	12V supply input	Yellow/black	relay 109

Pin	Description	Wire color	Connected to
3	Ground	Brown	pin 4 of the ECU
4	5V reference input voltage	Red/green	pin 50 of the ECU
5	Output voltage	Brown/blue	pin 52 of the ECU

Bosch mass air flow meter

TECH4TDI

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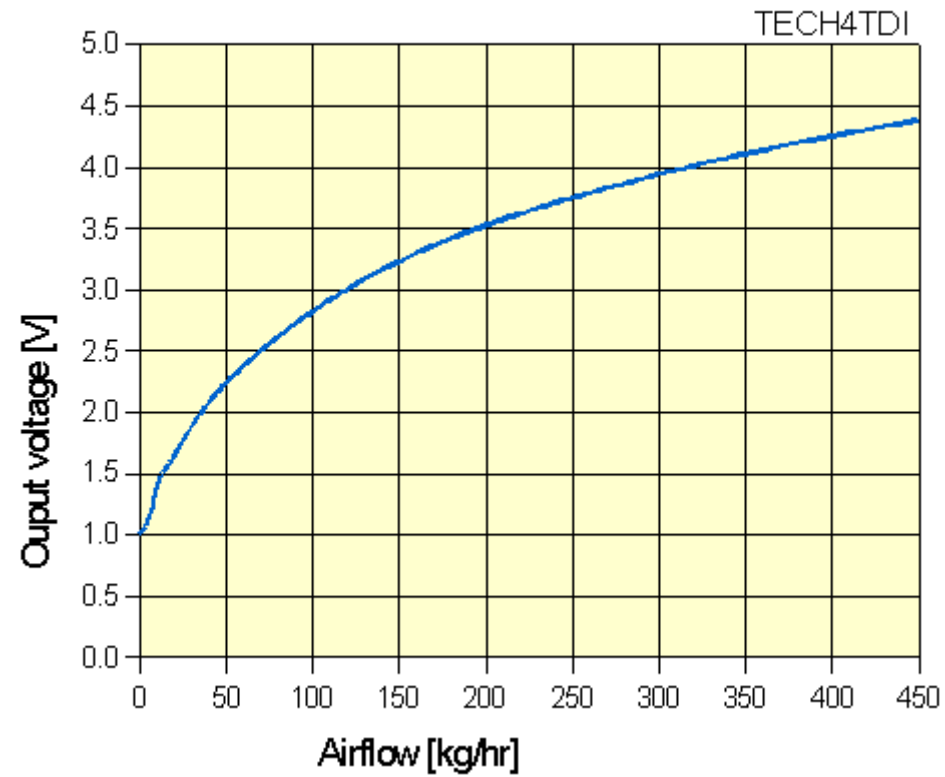
## Converting mg/stroke to kg/hour

When reading data from the ECU, the mass air flow is not reported in kg per hour but in mg per stroke. Converting one value to the other is quite simple:

At 900 RPM a 4 cilinder 4 stroke engine makes 900 RPM * 2 strokes/revolution * 60 minutes in one hour = 108,000 strokes. So if the ECU reads 480 mg/stroke at idle, it equals to 108,000 * 480e-6 = 52 kg/hour air flow.

480 mg/stroke is the value you should read with a 1.9L engine during idle when the EGR is closed. One full cilinder filling is 0.48 liter. Air is about 1290 mg per liter. So one could calculate 0.48 * 1290 = 619 mg/stroke. However, the cilinder is not fully filled as it has to suck in the air in a limited amount of time. Therefore the value is a little lower. (If the turbo would be really working at idle, the air flow could be higher than 619 mg/stroke.)

The output voltage of a Pierburg MAF during idle and closed EGR is about 1.6V. A Bosch MAF reads about 2.2V in this situation. With a closed EGR you should measure about 480mg/stroke. With a 78% opened EGR you should read about 290 mg/stroke. If the values you find are much lower, something is blocking the air flow or the MAF has gone bad. The air flow can be blocked by a clogged air filter, a clogged intercooler, a (partly) closed anti shudder valve, a clogged intake manifold or bad valves. The intake manifold may clog due to soot/oil as exhaust fumes are fed back into the engine by the EGR and oil is fed into the engine by the CCV. It's also possible that the EGR is stuck open.

Below is a curve of the mass air flow of a 1.9L TDI industrial engine (AFD).

Intake mass air flow

TECH4TDI
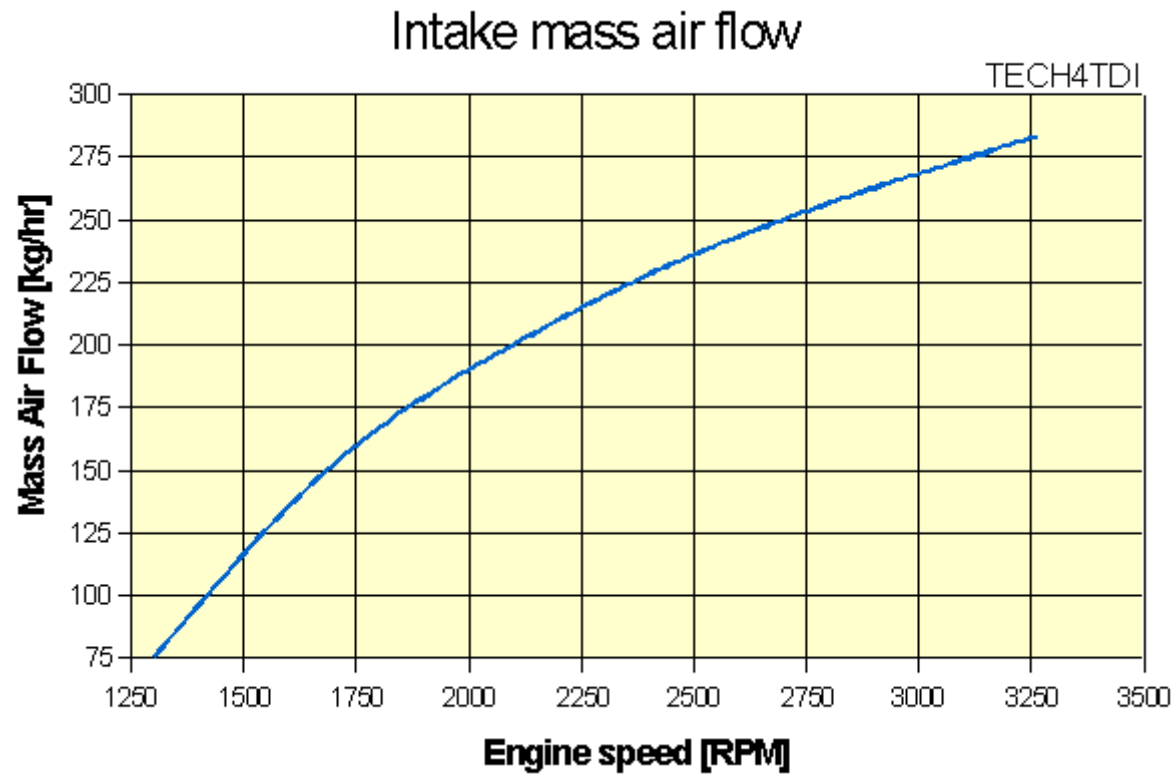
Page Last updated:

Good and faulty MAF

BOSCH ⊕

Page content:	[Faulty Bosch MAF](#)
	[Good Bosch MAF](#)

VW uses several Bosch MAFs for its TDIs. Bosch number 0 281 002 216, VW number 028 906 461 and also Bosch number 0 280 217 121, VW number 06A 906 461. These MAFs are equal, except for the length of the housing.

Faulty Bosch Mass Air Flow sensor

The graph below was measured on a 81kW TDI (engine AFN, after 180,000 km) under WOT (wide open throttle). As can be seen clearly, the specified air flow is much higher than the actual (measured) air flow. Turbo pressure reached 2000mbar, so turbo seems to be fine. Also the intake manifold was not fouled by soot and oil.

**Bad MAF** · specified MAF · actual MAF · RPM · TECH4TDI
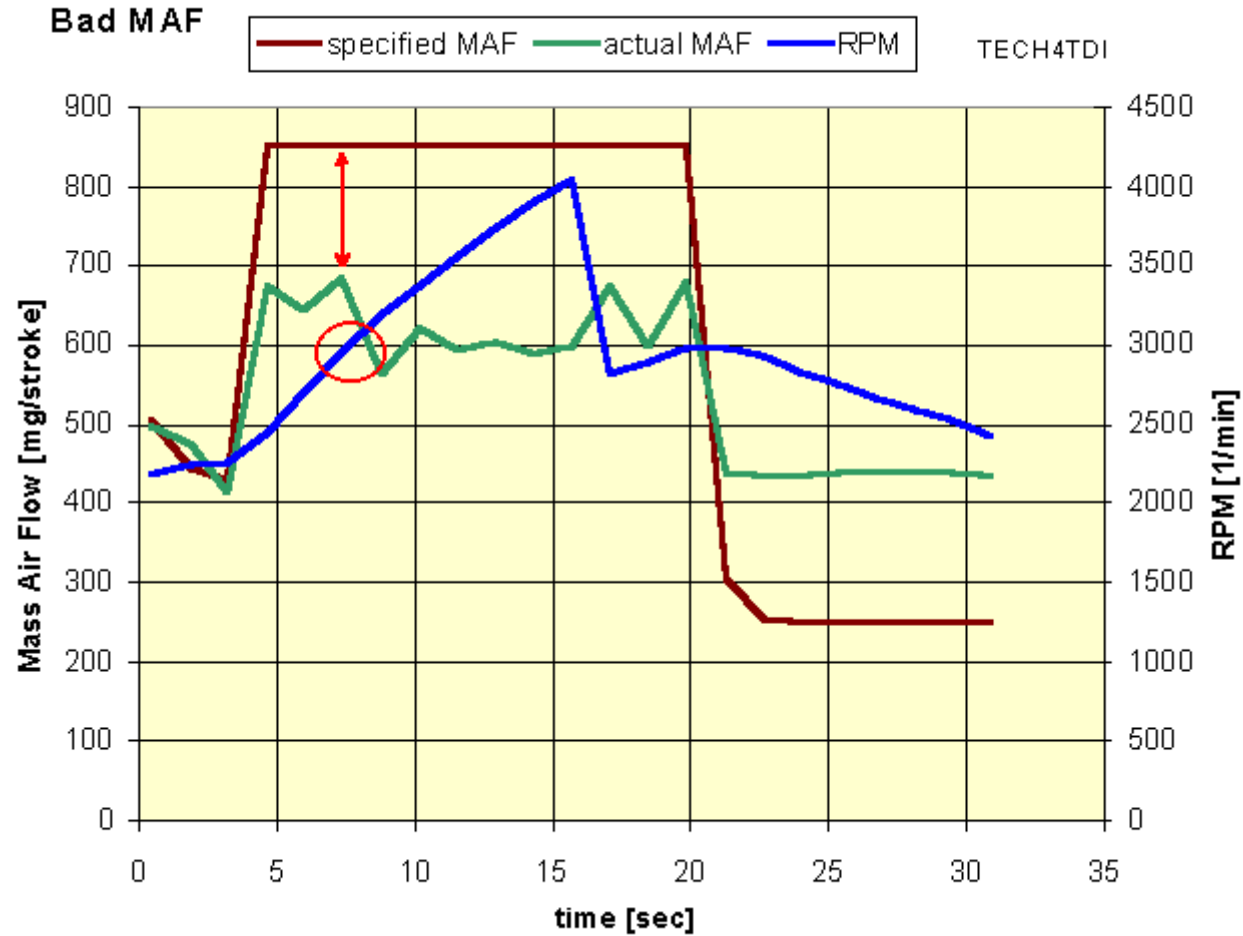
The circle in the graph shows the 3000RPM WOT point. Here you should read 850mg/stroke MAF (specified and actual). Turbo pressure should be 2000mbar. (not in this graph)

Reading the fault memory of the ECU did not show any errors. Still the owner felt his car was lacking response to the go pedal.

Good Bosch Mass Air Flow sensor

A new MAF on the same engine immediately cured the problem. Power returned, specified MAF and actual MAF are equal again.
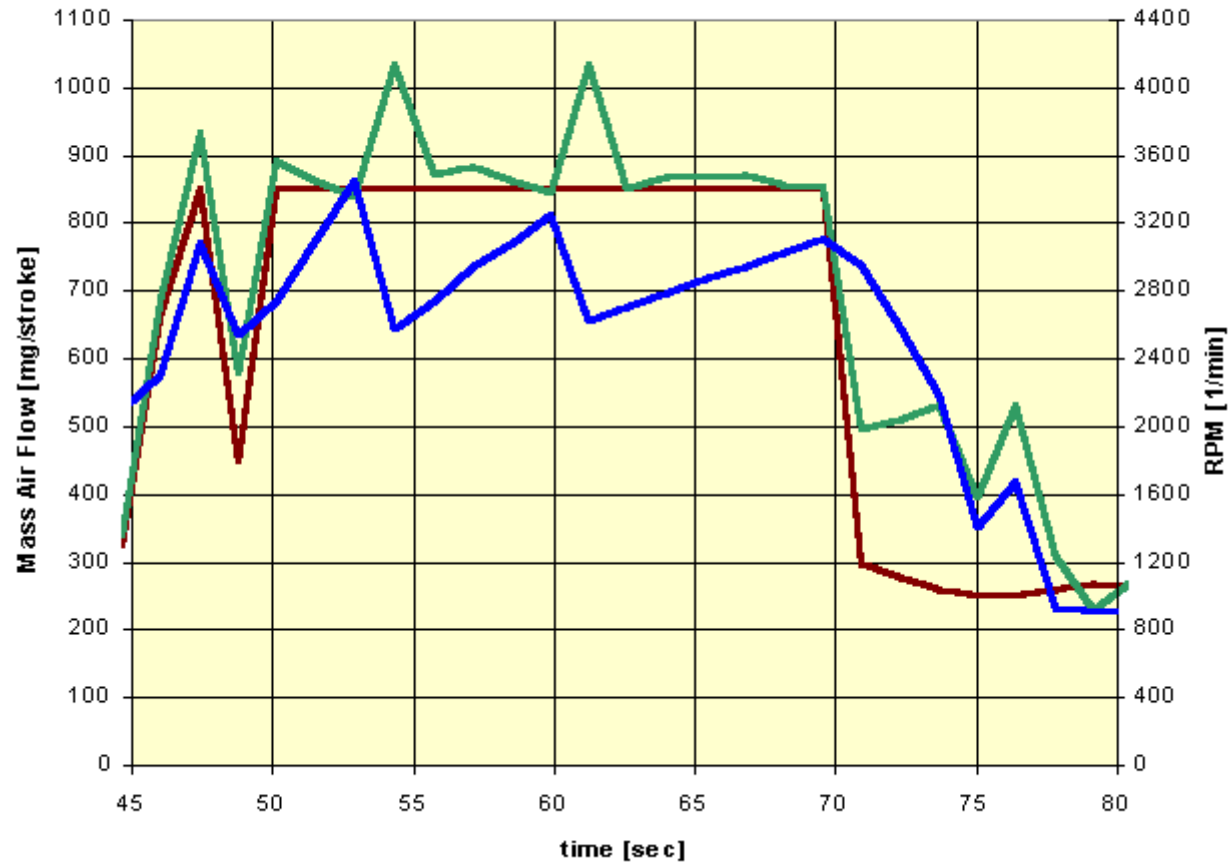
Good MAF

TECH4TDI
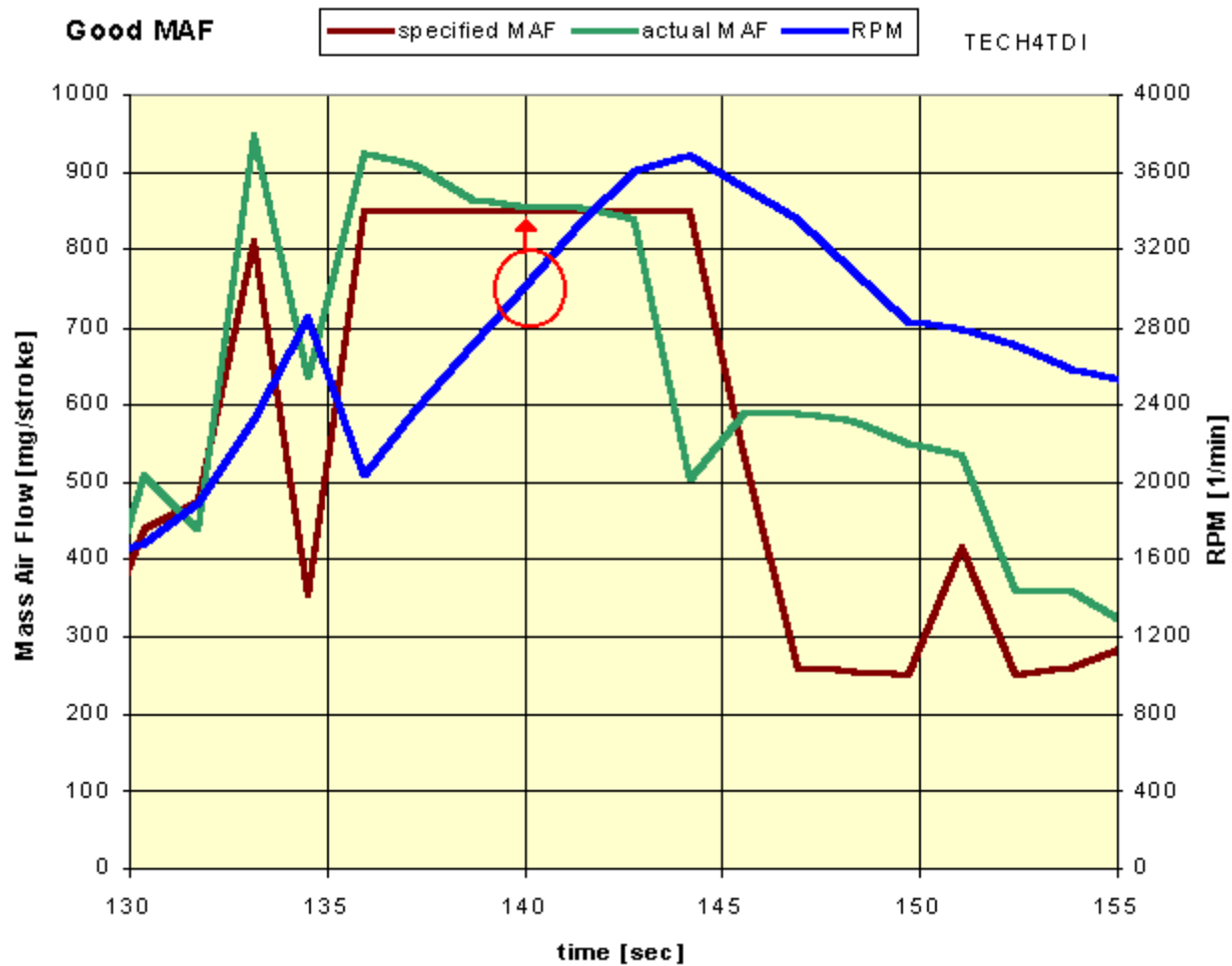
The 3000 RPM WOT point shows 850mg/stroke. As can be seen, actual and specified MAF are not always exactly the same. This is normal.

In the graph below another reading with an AHF engine (same MAF as in AFN) is shown. Full throttle acceleration from first till fourth gear (manual shift). Shift points at 47, 53 and 60 seconds. Specified MAF is 850mg/stroke at 3000 RPM. The actual MAF is also 850mg/stroke: The MAF is okay.

Full throttle acceleration
85 kW TDI

TECH4TDI

Legend: Specified MAF — Actual MAF — RPM

X-axis: time [sec]
Left Y-axis: Mass Air Flow [mg/stroke]
Right Y-axis: RPM [1/min]

Page Last updated:

Using a 2.0L MAF in a TDI

In the TDICLUB discussion forum an extensive discussion is going on (May 2002) about using the 2.0L MAF (06A 906 461A) with a TDI engine. The 2.0L MAF is interesting as it goes for something like $50 (In the US, not in Europe!) in stead of the usual $250! A TDI usually has a 06A 906 461 MAF. (so without the 'A' extension) Also Pierburg MAFs can be found in TDIs (074 906 461), but on this page only the Bosch MAF is discussed. If you have a Pierburg MAF and want to use a Bosch 2.0L MAF, contact me. It can be done.

Some people claim to have excellent results with the 2.0L MAF, but others experience excessive smoke. The smoke is probably caused by a higher output voltage of the 2.0L MAF. The ECU 'thinks' that more air is going into the engine and allows more fuel to be injected. This will result in smoke (and maybe extra power) To compensate for this larger signal, a really simple circuit can be placed between the MAF and the ECU (engine control unit). The circuit is a simple attenuator made by only two resistors. The output wire of the MAF is cut and the circuit is placed between the MAF and the ECU.

4.7k ohm linear

10k ohm = brown - black - orange

<= to ground

<= to ECU

<= to MAF

TECH4TDI
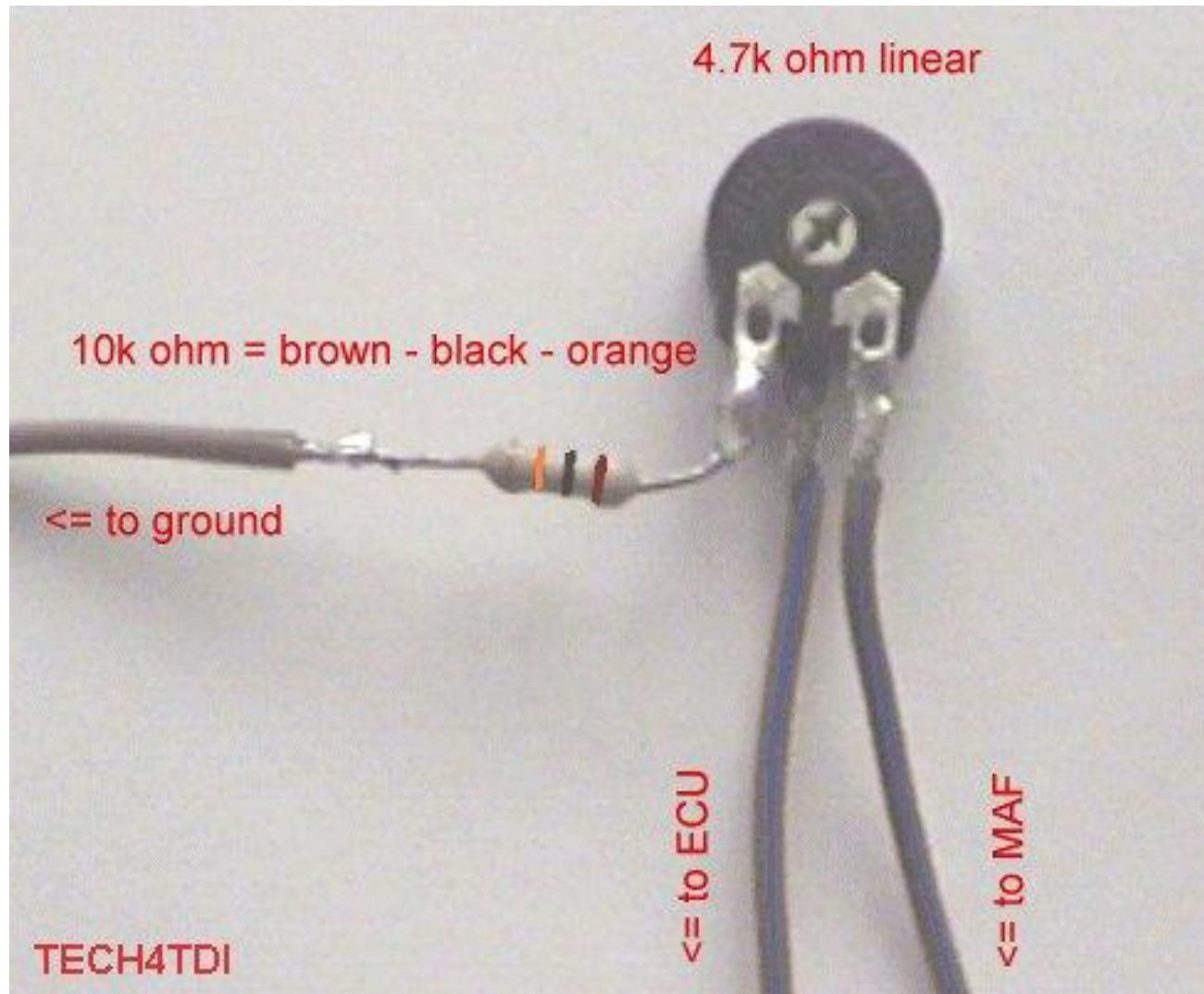
According to my information the MAF signal wire is brown/blue. (your colors may be different) It is pin number 5 of the MAF connector. So the output signal from the MAF is connected to the variable resistor. The signal to the ECU can be adjusted. One more resistor is needed on the other side of the variable resistor (10k ohm). It is connected to ground. (pin 3 of MAF connector – brown)

For best results you need a VAGCOM or similar. Measure the MAF with a TDI MAF and adjust the variable resistor such that the same value is read again with the 2.0L MAF. Also a simple voltage meter will do just fine: measure the output voltage of a TDI MAF and adjust the resistor such that the same voltage is read on the wire going to the ECU when the 2.0L MAF is hooked up. If everything is okay, the smoke should be gone, and the engine is just as powerful as it was with the TDI MAF. Only above 4000 RPM or so, a very small power loss may be experienced, but I don't think anyone will ever notice.

If you don't want to adjust anything, you can use fixed resistors. The picture below shows the same circuit with fixed resistors. The values should be about right for people experiencing smoke with the 2.0L MAF, but not with the TDI MAF. If the engine is still smoking with this circuit, increase the 820 ohm resistor to 1k ohm or even larger. If the engine starts to feel sluggish, the resistor is too large.

10k ohm = brown - black - orange
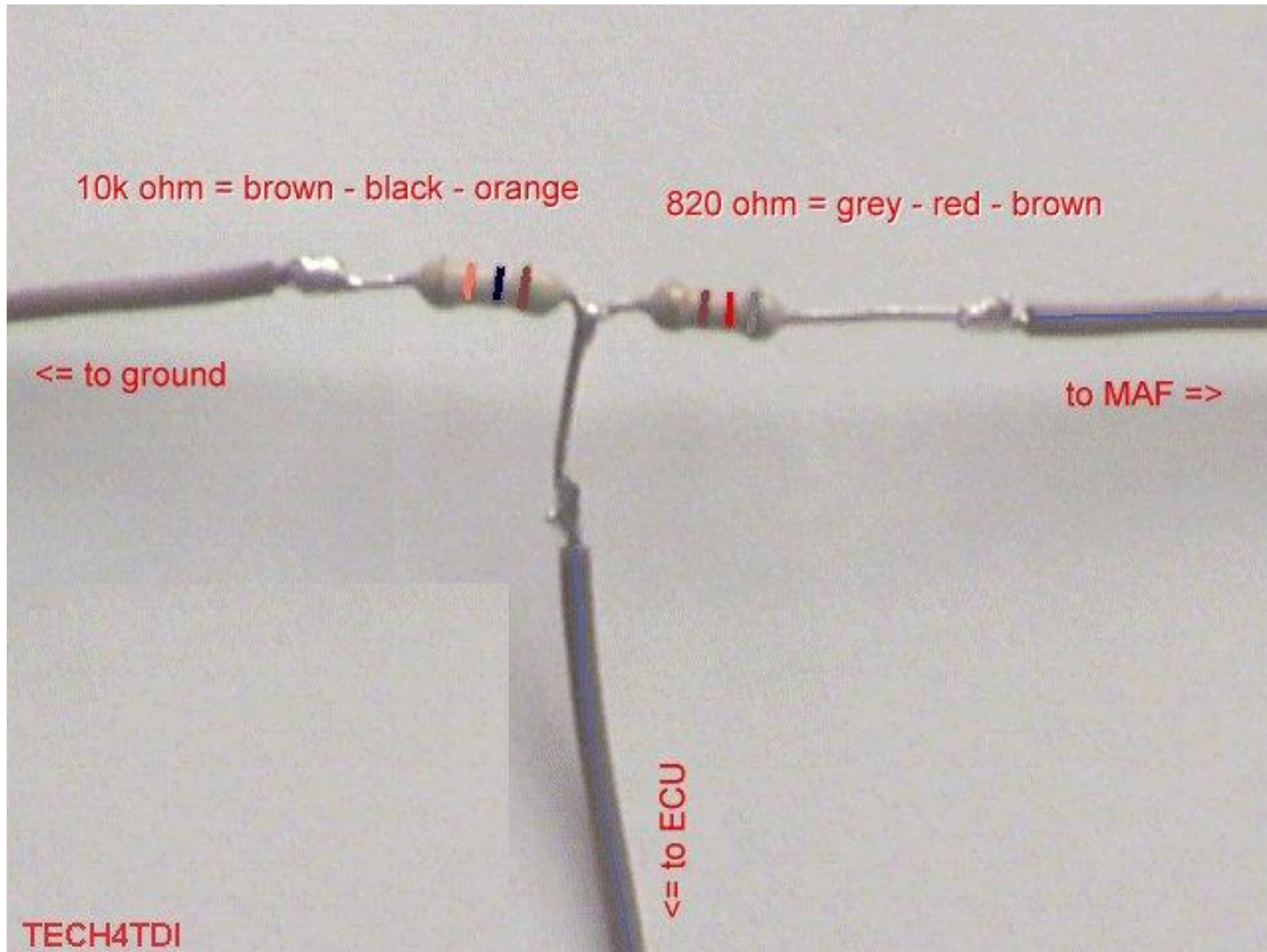
820 ohm = grey - red - brown

<= to ground

to MAF =>

<= to ECU

TECH4TDI

Can I damage the ECU or MAF with these circuits?

No. The ECU will not be damaged by MAF voltages between 0 and 5 volts. These circuits only lower the MAF voltage a little, so no problem. The MAF will not be damaged either: the resistance is very high and the MAF will be fine.

Page Last updated: Sept 1, 2003

Mass Air Flow converters

On a rainy Monday, when you're late for work, suddenly your TDI looses power. I turns out that your MAF has gone bad. You can get another MAF for a small amount of money, but the MAF you need is a Pierburg and the MAF you can get is a Bosch. And when you needed a Bosch, you could only get a Pierburg for a fair price. But you remembered a post on the TDICLUB web page or your search engine found the web pages of TECH4TDI. So here you are.

Below you'll find the schematics of two converters, together with data from the MAF manufacturer and measurement data of the converter. But first some global information:

No IC's, large temperature range

The first thing you may notice looking at the circuits is that it seems quite simple. Just a few resistors, transistors and one or two capacitors. No IC's. You could make the same circuit with IC's, but it would be more expensive, less robust and no better performance. But most of all: the temperature range of normal IC's is too small. The circuits below are fully temperature compensated and can handle a temperature range of -50deg.C. to +125deg.C. without any problem. IC's for this range would be expensive as they have to have military specifications.

Fault tolerant

The circuits are designed to handle all kind of fault conditions. Shorting the inputs or outputs to any voltage between 0 and 12V will not damage the circuits. The supply voltage is 5V, but if you would apply 12V, nothing will go bad in these circuits. Although the circuits here are fault tolerant, I do not know if the MAFs or ECUs are. The ECU can handle voltages between 0 and 5V for sure, but I'm not sure it will not be damaged by voltages above that.

Accurate

The conversion is quite accurate as you can see in the measurements below. It's best to use 2% resistors. You can use 5% resistors, but you may want to check the actual resistance value. Normally 5% resistors are within a few percent, so good enough.

Low cost components

The components used are all very low cost. 0.25W resistors and standard small signal transistors. You can find these at any electronics shop at a cost of something like one dollar in total for the parts. I used BC547/BC557 transistors, but many small signal transistor will do. (2N2222/2N2907 is okay too) Don't waste your time making a beautiful printed circuit board. Just use an experimental PCB. That really is good enough. The circuits are not critical on PCB layout at all.

Casing

For the casing it is important that it is water tight. If not, the circuit will corrode and will go bad in no time. The circuits are so small however that it will fit in a 35mm film container. Just punch small holes in it for the wires and seal it with silicon. The container can be placed next to the MAF.

Intellectual property

You are free to use the information presented here. I do not ask any money for it, but also do not accept any liability. You are not allowed to sell the schematics or printed circuit boards with these converters with a profit. If you find a circuit valuable and are going to use it, I would be happy to hear your experience with it.

Page content:

PIERBURG
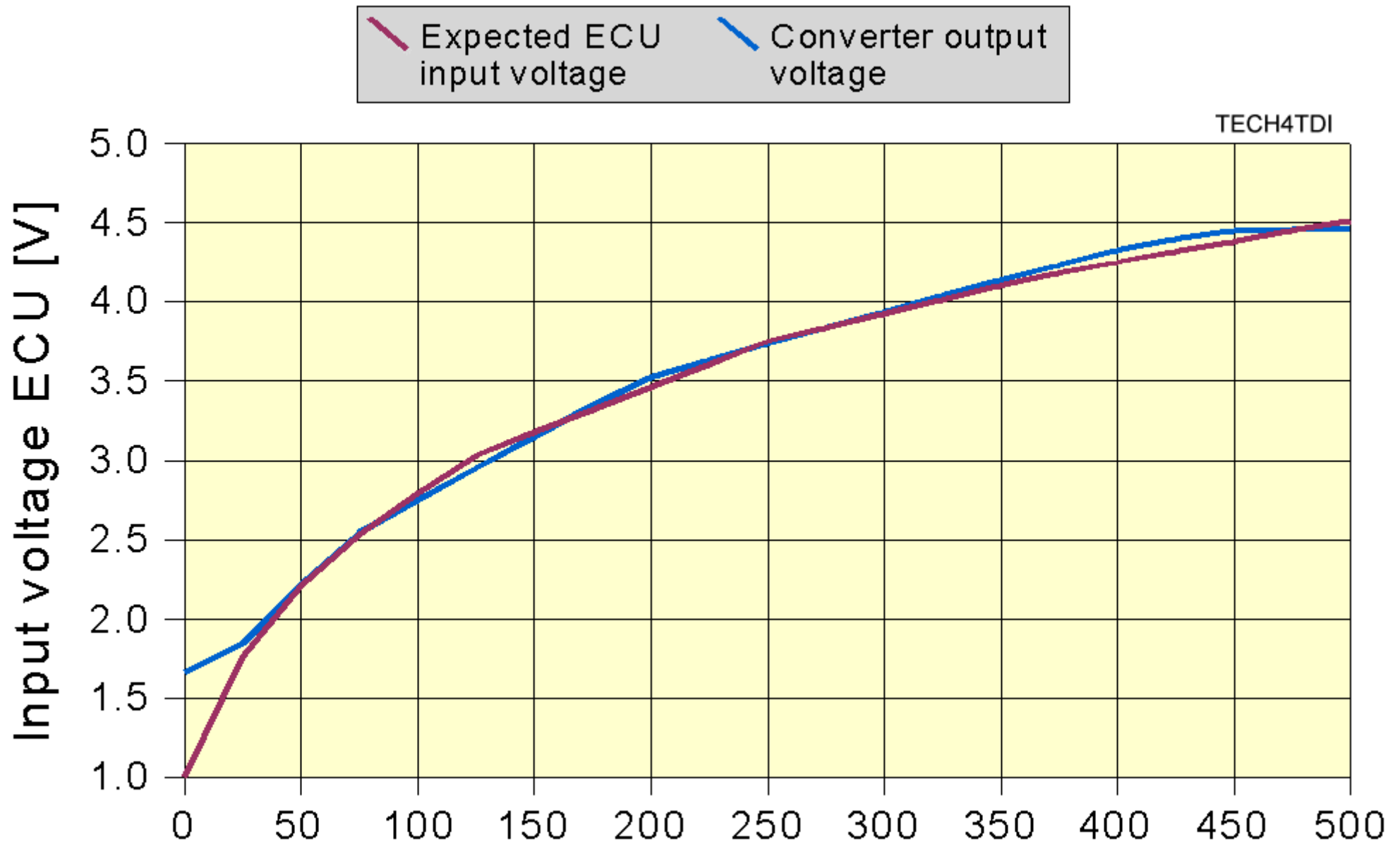
Using a Pierburg Mass Air Flow sensor with an ECU programmed for a Bosch MAF

The schematic is shown [here](#). It basically is an attenuator that also does some level shifting and curve shaping. In the interesting air flow range from idle to full power (50kg/hour to 400kg/hour) the conversion is very accurate. This circuit has been tested for quite some time in a 81kW TDI. It work beautifully. No error codes in the ECU (of course not, the ECU doesn't even see the difference between a Bosch and a Pierburg MAF. So why should it complain when it does get the right signals.)

Pierburg to Bosch converter

## Using a Bosch Mass Air Flow sensor with an ECU programmed for a Pierburg MAF

The schematic is shown here. It basically is a low gain amplifier that also does some level shifting. In the interesting air flow range from idle to full power (50kg/hour to 400kg/hour) the conversion is very accurate. This circuit was tested, but only on the lab table. As the conversion is very good too, there's no reason to suspect that this circuit will not work.
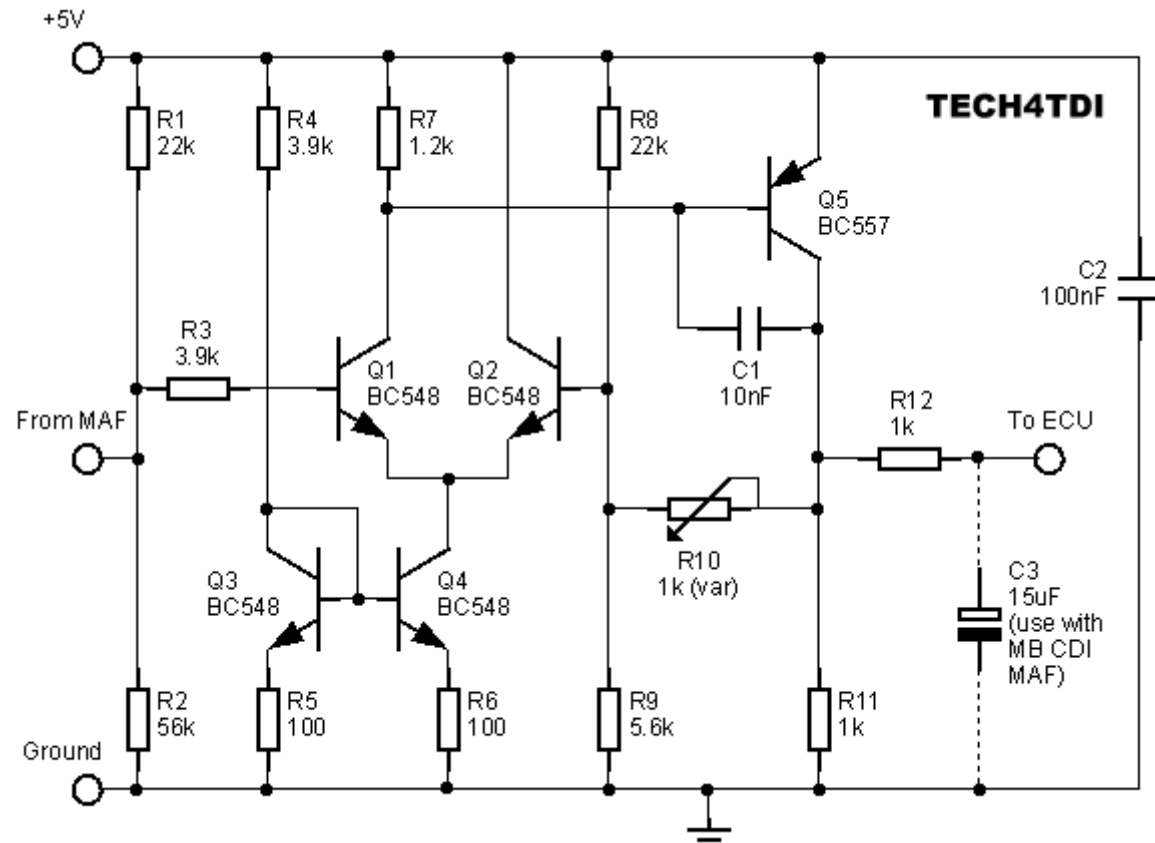
Bosch to Pierburg converter
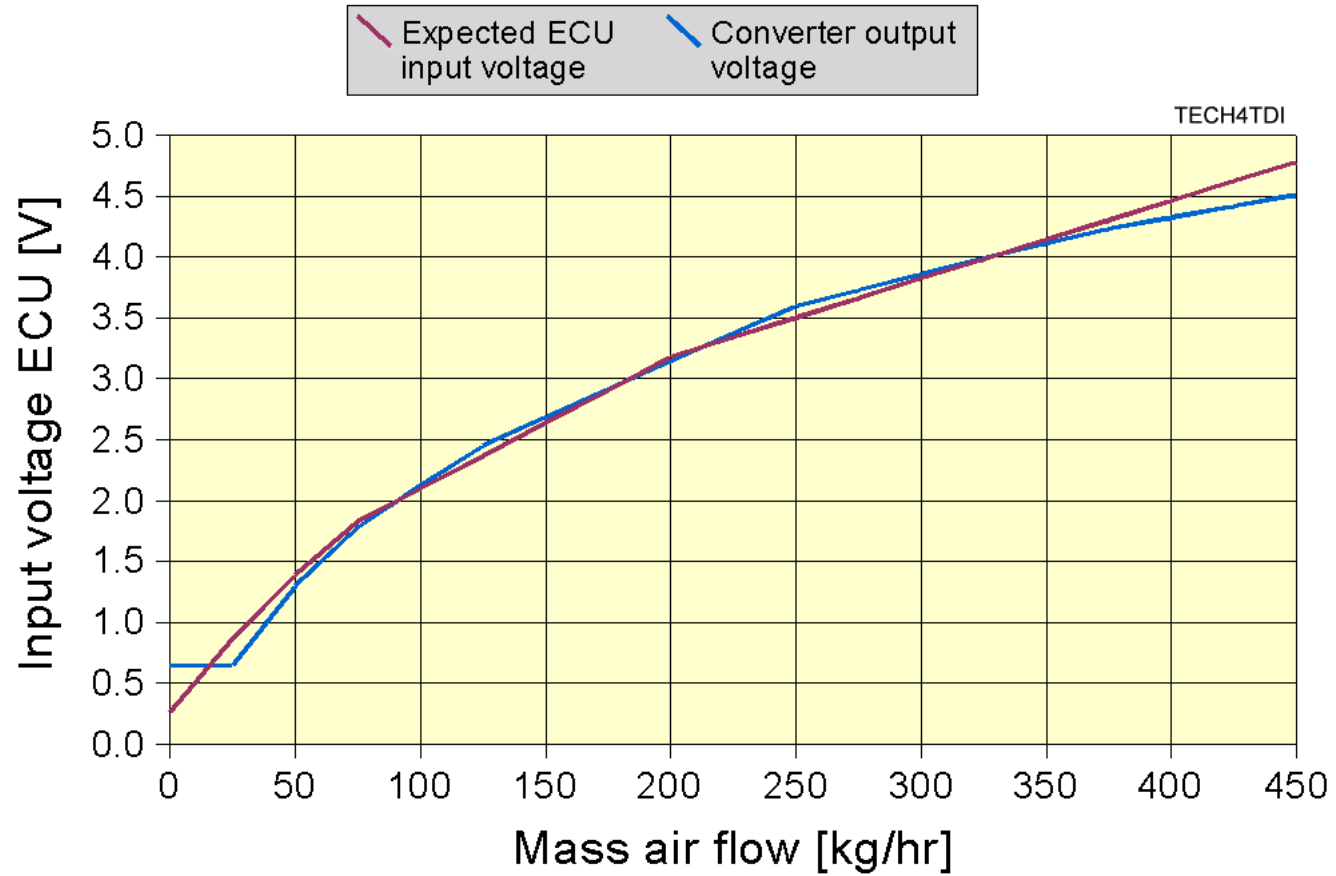
Dead MAF Booster

After measuring a very dead MAF which reported 600mg/stroke in stead of the required 850mg/stroke at 3000 RPM WOT on the bench, I realized that this MAF was 15% off from 0 to about 200 kg/hr. I couldn't get more than 200kg/hr airflow on the bench, so I just concluded that this 15% would be there for the full airflow range.

Measured MAF transfer

Legend: Umaf Good — Umaf Bad — Bad MAF 15% Boosted

TECH4TDI
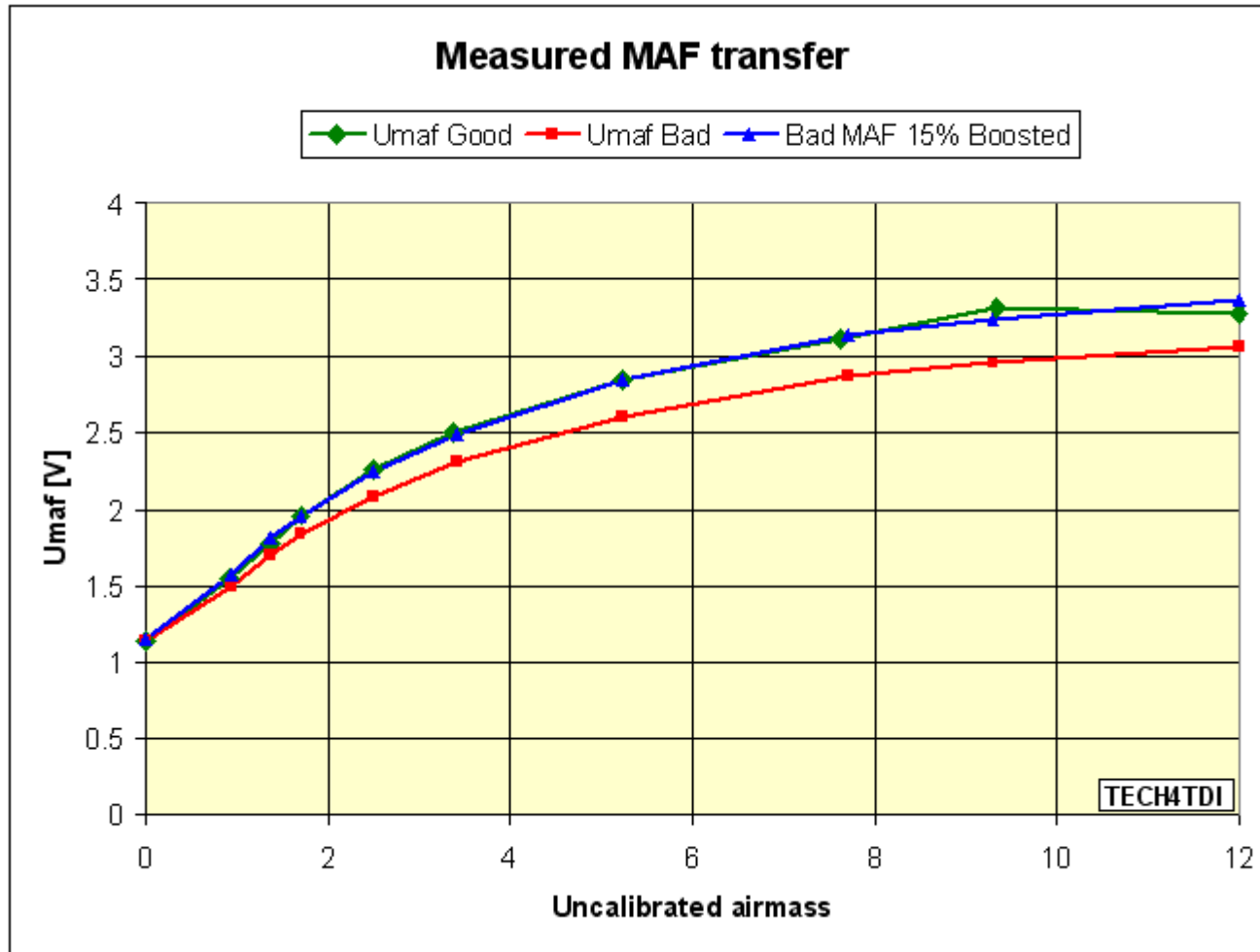
With that conclusion I made a circuit that simply amplified the MAF output voltage with 15% starting from 0 airmass or rather 1 volts:

TECH4TDI

Circuit labels:
- +5V
- R1 22k
- R4 3.9k
- R7 1.2k
- R8 22k
- Q5 BC557
- C2 100nF
- R3 3.9k
- Q1 BC548
- Q2 BC548
- C1 10nF
- R12 1k
- To ECU
- From MAF
- Q3 BC548
- Q4 BC548
- R10 1k (var)
- C3 15uF (use with MB CDI MAF)
- R2 56k
- R5 100
- R6 100
- R9 5.6k
- R11 1k
- Ground

The circuit is made with a differential pair Q1 and Q2 driven by a current source made of Q3 and Q4. The output stage consists of Q4 with Miller capacitor C1 for loop stability. The gain of the circuit can be adjusted by R10. Tune R10 all the way to zero ohms for a good MAF and when the MAF gets older (bad) increase R10. With the bad MAF I had, I had to set R10 to about 600 ohms (about half way) to get the reported airflow back on target.

Again all bipolar transistors. This to make sure that the circuit will work under any condition. Commercial available integrated circuits are normally not specified over the automotive temperature range. So they may deviate or even fail when temperatures are outside the specification.
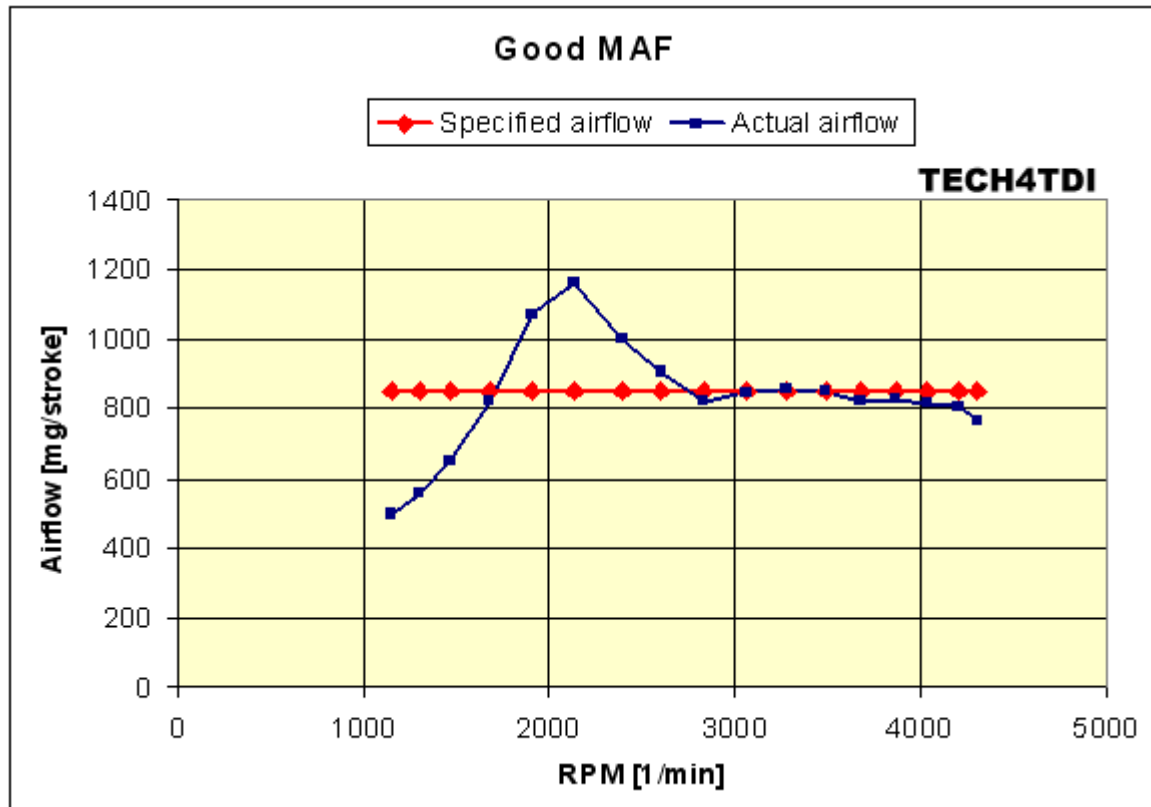
Road test

With the circuit I did a road test. The performance was good. The air mass reported was back to 850mg/stroke at 3000RPM WOT and also a Butt Dyno (see www.tdiclub.com) showed that the performance was back.
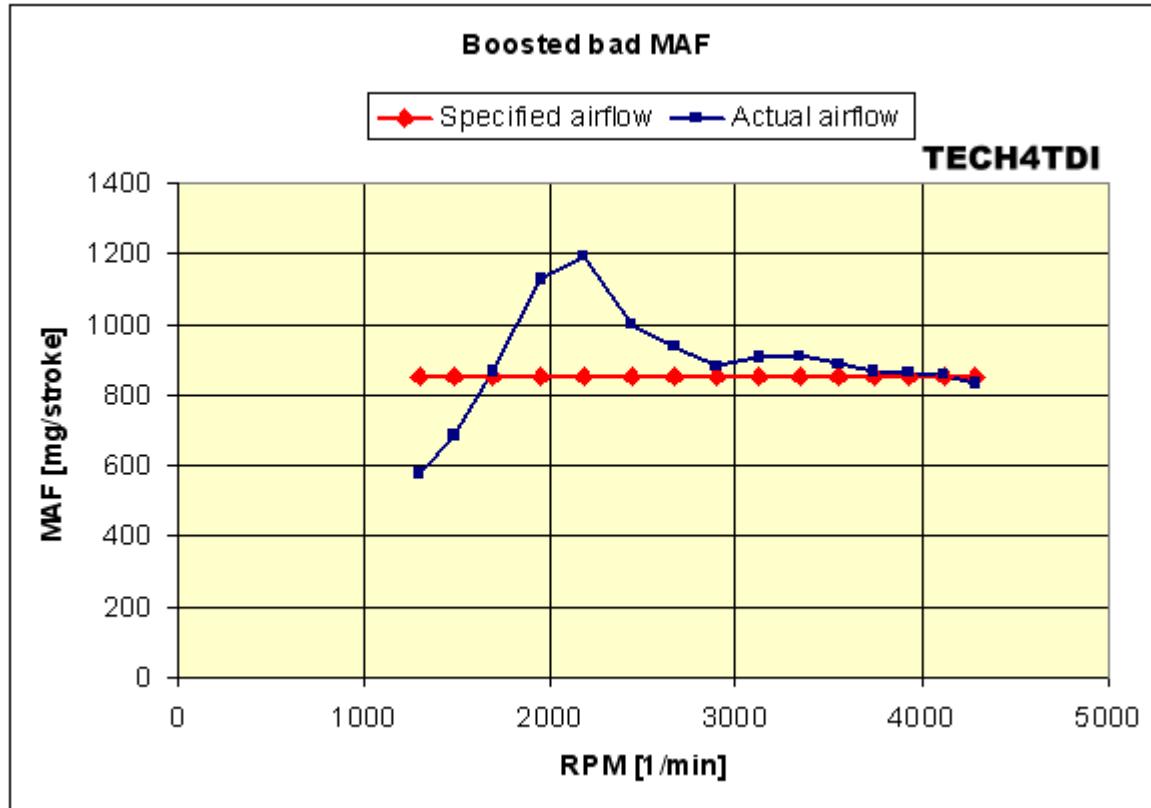
Logging results

First I did a log with the bad MAF:
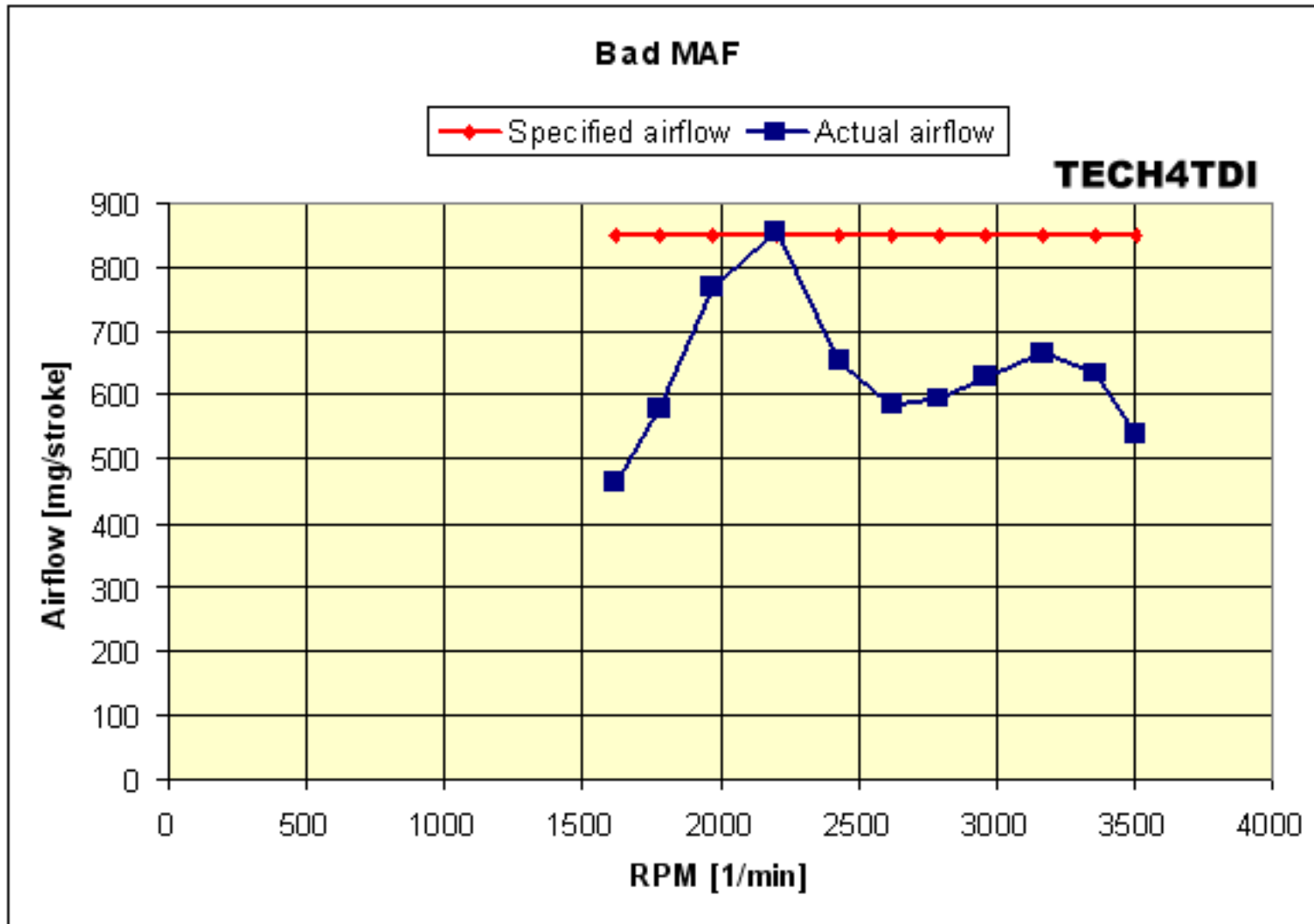
After than with a good MAF:

And finally with the boosted bad MAF:

Boosted bad MAF

TECH4TDI

Pretty amazing, even for me. All loggings were done with the same '98 81kW TDI on the same day.

Conclusion? It seems that even a very old and very bad MAF is still usable and will perform like a new one with a little help of a tiny boost circuit.

How is it connected

The output wire of the MAF (pin 5 of Bosch MAF) is cut and the circuit below is inserted. The wire coming from the MAF connects to the wire with label 'From MAF' and the wire that goes to the ECU is connected to the wire 'To ECU'. The 5V supply voltage of this circuit is taken from the MAF connector too. It only draws a current of a few mA.

Parts

The transistors drawn are BC548B and BC557B, but you can also use 2N2222 and 2N2907 type transistors or similar small signal types. The resistors are all 1/4W types (1/8W is okay too). C1 and C2 are a ceramic capacitor. C3 is a 15uF/16V electronic capacitor. Use it only if you use a Mercedes CDI Pierburg MAF. The capacitor filters the signal which may prevent problems during idle with EGR action. Total cost of parts will only be a few dollar.

By the way: the circuit is not intended to be used with a Pierburg TDI MAF (A3 hot wire MAF). I don't know how a failing A3 MAF behaves, so the booster circuit may not help in that situation.

If you like to use it, make sure you place it in a water tight housing. Otherwise corrosion will occur. A 35mm film container will do. Stick the wires through small holes and seal it with silicon.

Intellectual property

You are free to use the information presented here. I do not ask any money for it, but also do not accept any liability. You are not allowed to sell the schematics or printed circuit boards with a profit. If you find the circuit valuable and are going to use it, I would be happy to hear your experience with it.

Page Last updated:

# Manifold Pressure Sensor

Manifold Pressure and Temperature sensor

The intake pressure and temperature sensor is located just after the intercooler. The sensor has 4 pins.The VW number is 038 906 051 and Bosch number 0 281 002 177 for a 66kW and 85KW TDI. The wire colors and the connections mentioned to the ECU are from a 66kW ALH or AGR and a 81kW AHF engine.

| Pin	Description	Wire color	Connected to
1	Signal ground	Brown/blue	pin 25 of the ECU
2	Temperature output voltage	Grey/green	pin 13 of the ECU
3	5V supply and reference voltage	Purple/red	pin 39 of the ECU
4	Pressure output voltage	Yellow/black	Pin 40 of the ECU

Intake air pressure sensor — TECH4TDI
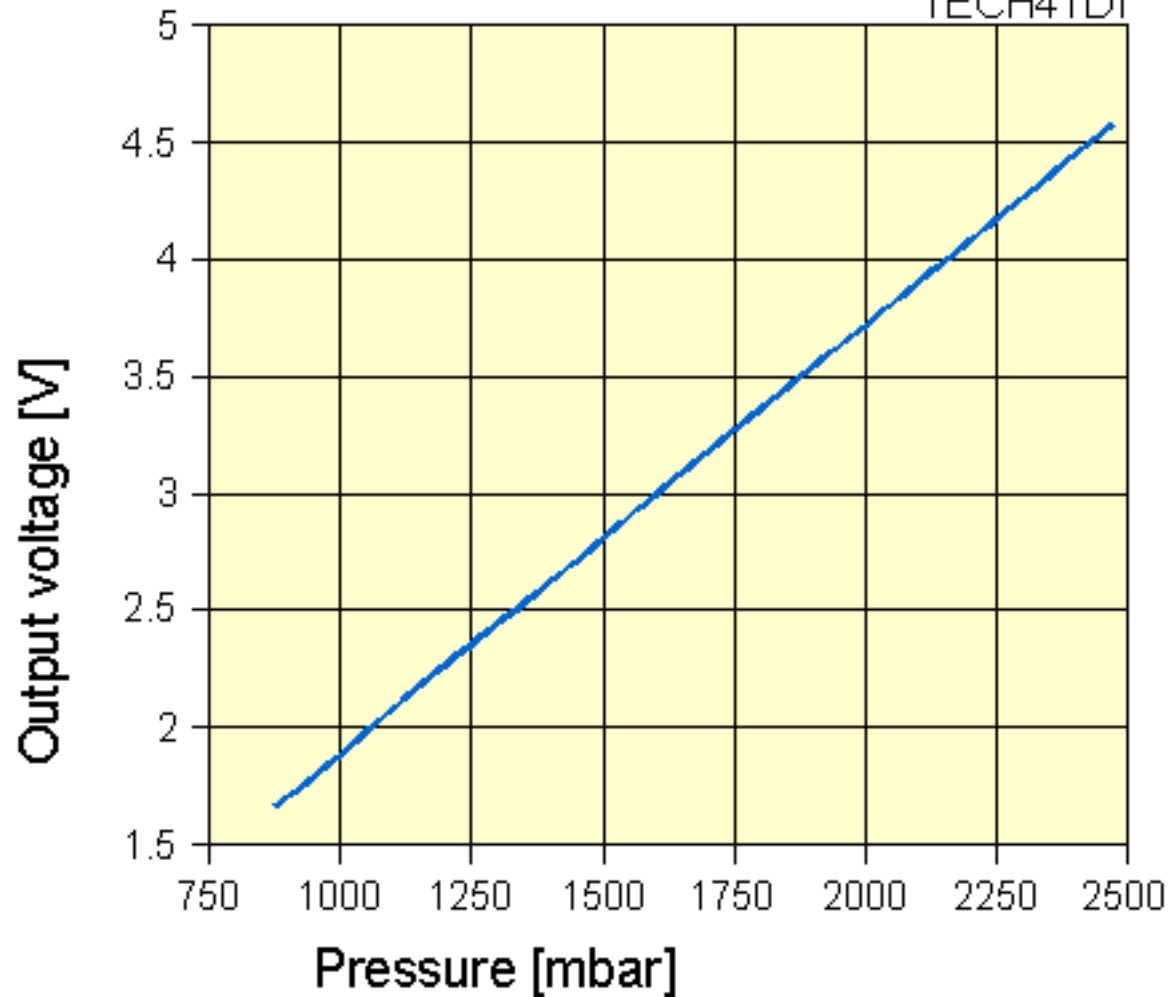
The intake temperature sensor is a simple NTC resistor connected between pin 1 and 2. The resistance is 2000 ohms at 25 degrees centigrade. Measurements indicate that inside the ECU a 730 ohms resistor is placed, connected to the 5V supply on one side and to the NTC on the other.

Intake temperature sensor

TECH4TDI

Output voltage [V] vs Temp [deg.C]

Page Last updated:
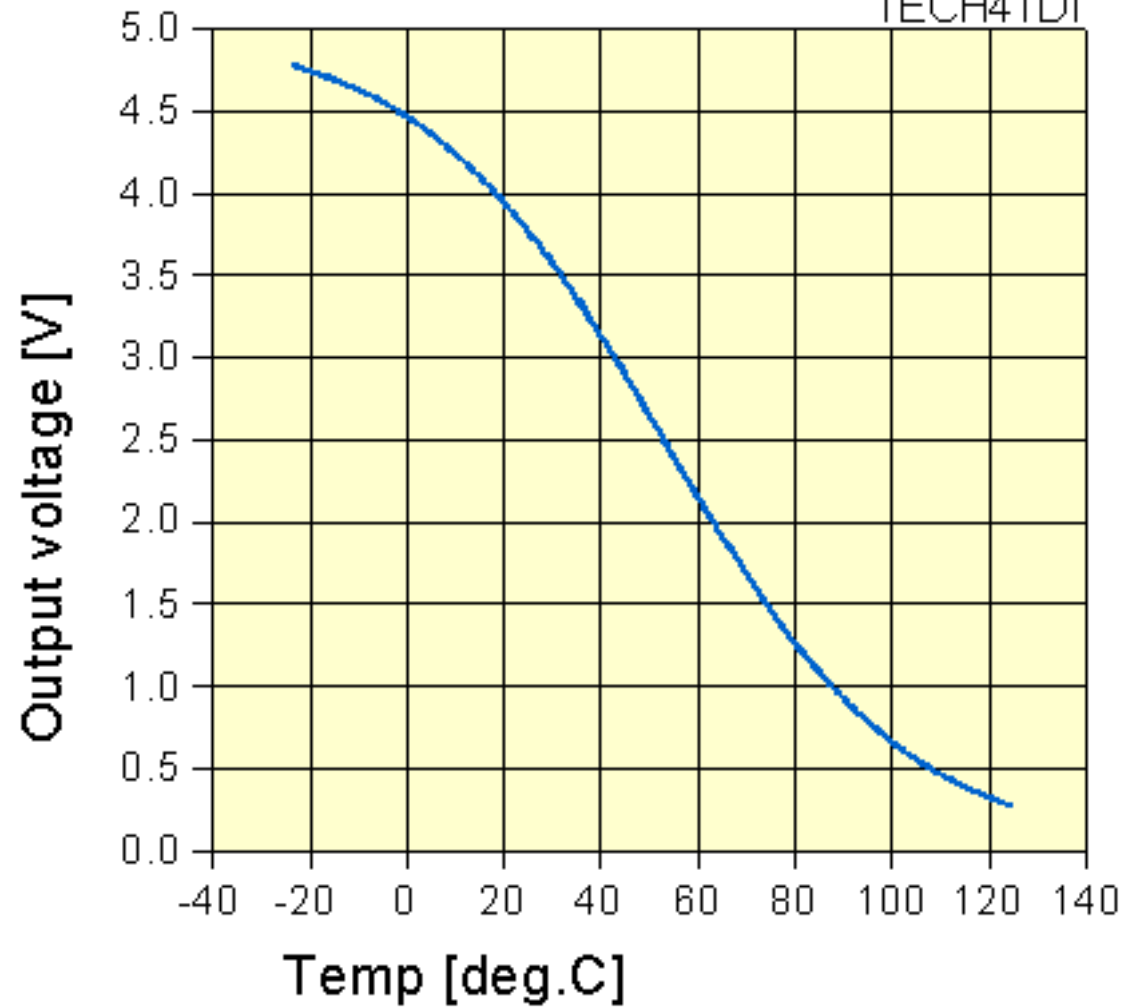
Engine coolant temperature sensor

Coolant Temperature sensor

The coolant temperature sensor are actually two sensors: one for the engine control unit and one for the instruments control unit. The sensors are both simple NTC (negative temperature coefficient) resistors. The ECU sensor has a constant signal, the other sensor is sampled.

Pin	Description	Wire color (may vary)	Connected to
1	Ground* (*: low resistance to ground)	Brown/Green (Brown/blue)	pin 54 of the ECU

Pin	Description	Wire color (may vary)	Connected to
3	Coolant temperature output	Brown/Blue (Brown/yellow)	pin 70 of the ECU
2	Ground	Brown White (Brown)	ground
4	Coolant temperature output	Purple	pin 8 of the instruments ECU

It is calculated that there is a 730 ohm resistor connected between 5V and pin 70 in the ECU.

Coolant temperature sensor (ECU)

TECH4TDI
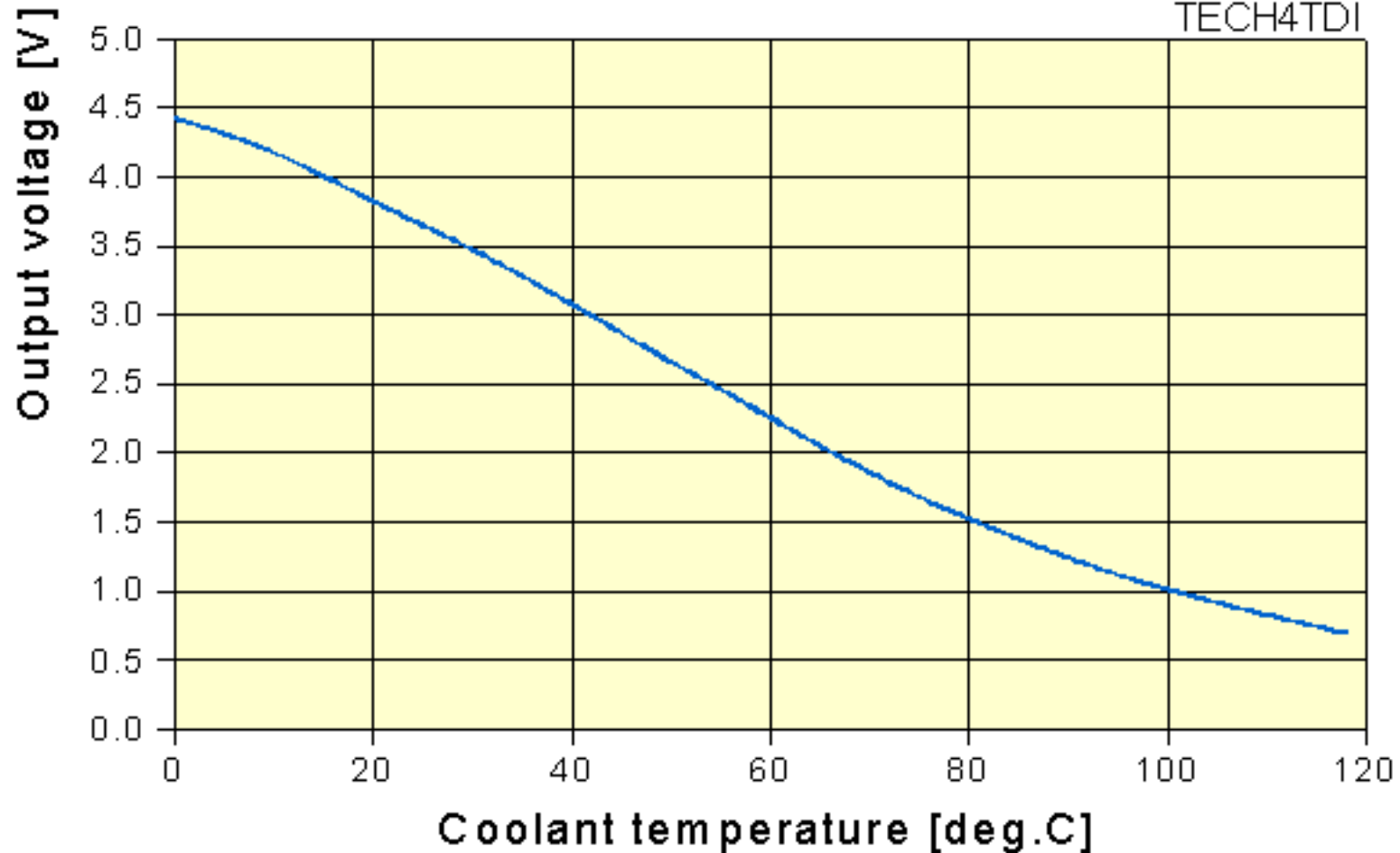
The instruments computer reads the coolant temperature sensor 40 times a second. The voltage on the sensor is high for about 4-6 msec every time it is read. Therefore the sensor voltage can not be measured with a normal voltage meter. One would need an oscilloscoop or a (fast) voltage meter with a maximum voltage function. It is calculated that there is a 230 ohm resistor connected between 5V and pin 8 in the instruments computer.

Coolant temperature sensor (instruments)

TECH4TDI
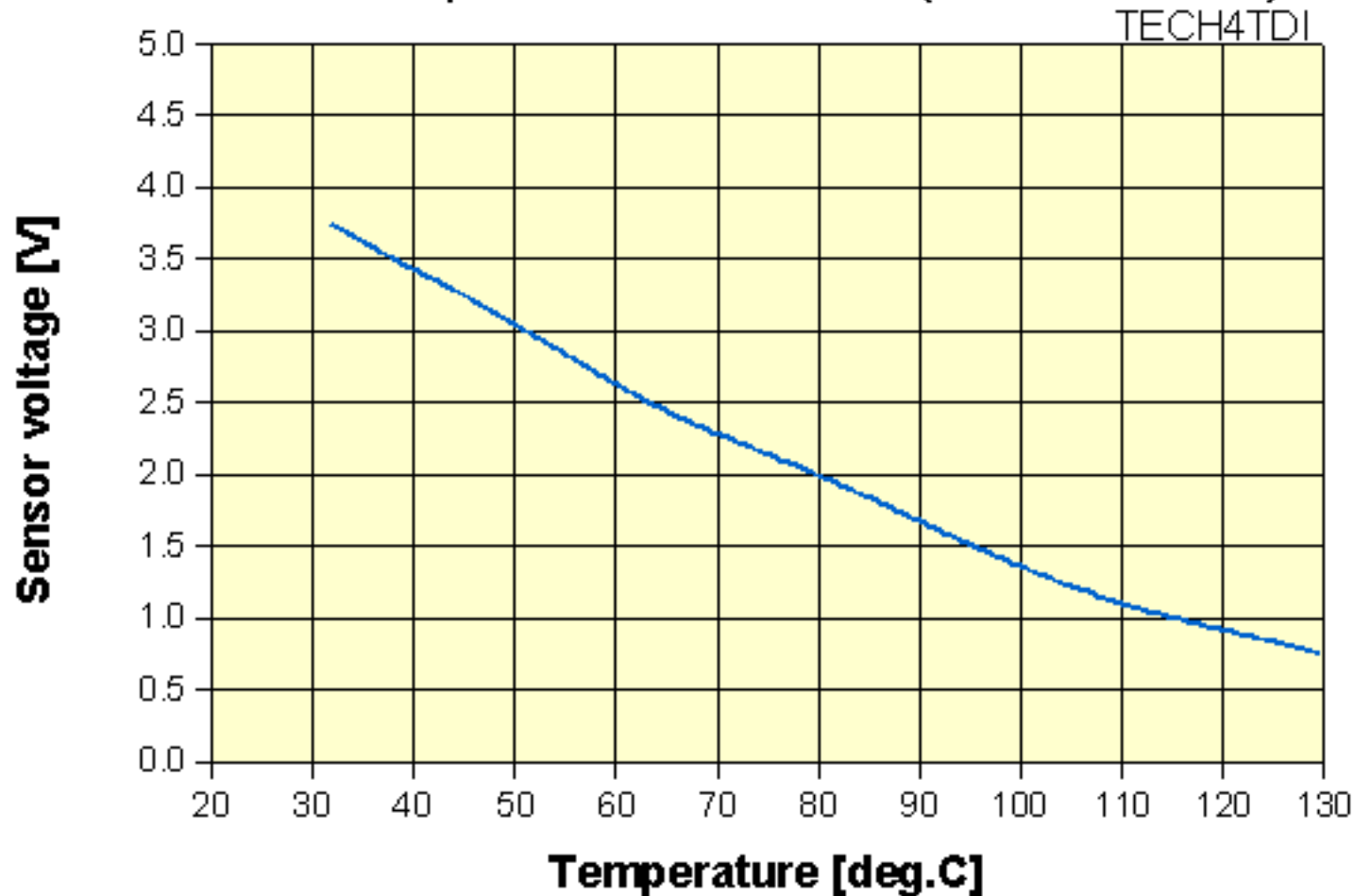
To check the sensors one can easily measure the resistance with an multi-meter. The resistance measured should be according to the figure below. Note that the resistance has a log-scale. As the instruments ECU doesn't report values below 30 deg.C., the curve stops here. The curve can be extended, so at 0 deg.C. it is expected that the instruments NTC is about 2200 ohms.
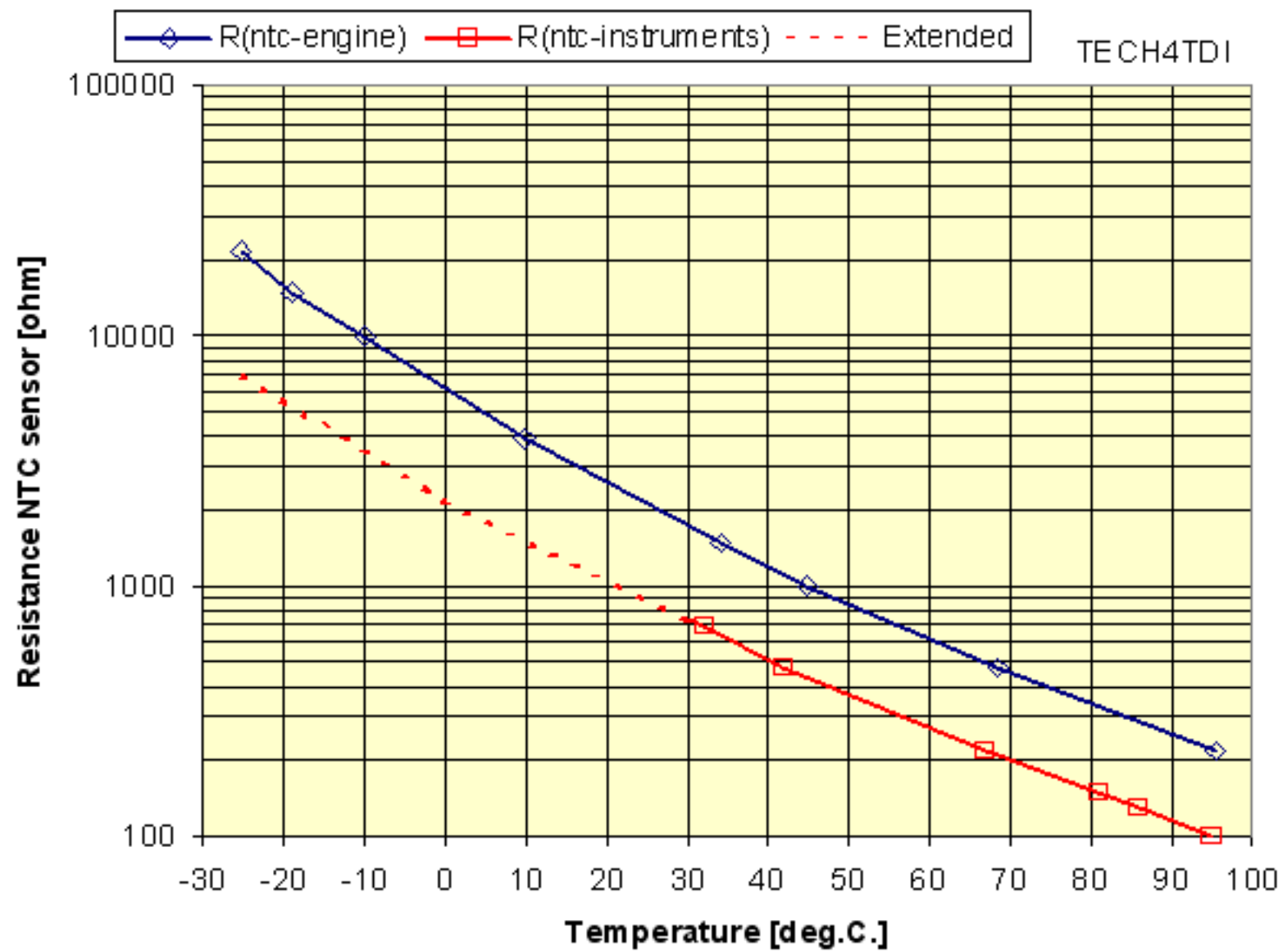
Example: If the engine is 90 deg.C. the instruments NTC should read about 115 ohms and the engine NTC should read about 250 ohms.

Page last updated:09/25/2004

Temporary EGR fix

Actually it's not a fix, it's just a way to be able to drive without a functioning EGR. Sometimes the EGR gets stuck or one of the related components fail and the ECU decides that you should limp home. This will happen at a moment you really need your car...

Before going on:
Driving without a functioning EGR will increase the NOx output, which is an environment issue. In some countries this may be illegal. So before you decide to use this fix, check if you legally can do so.
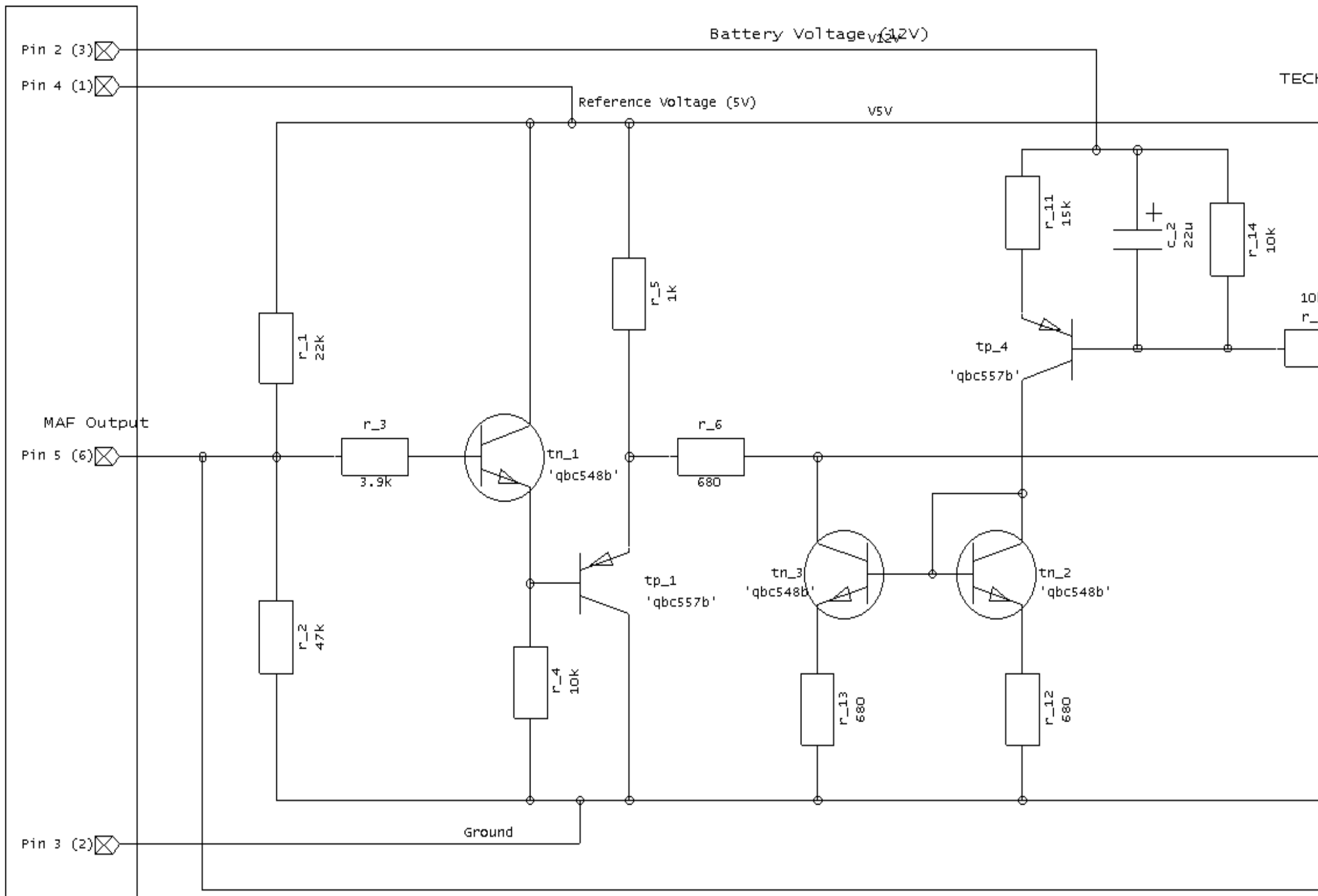
How is it connected

The output wire of the MAF (pin 5 of Bosch MAF and pin 6 of Pierburg MAF) is cut and the circuit below is inserted. The wire coming from the MAF connects to the wire with label 'MAF Output' and the wire that goes to the ECU is connected to the wire 'To ECU'. The supply voltages of this circuit are taken from the MAF connector too. It only draws a current of a few mA. One more wire is connected to the EGR. Wire colors may differ, but it mostly is red/yellow. The other wire (black/yellow) of the EGR is connected to the infamous relay 109, it's the 12V supply. This circuit doesn't need this black/yellow wire. The flip switch X1 is set to the upper position to enable the circuit. If the circuit is enabled, the EGR valve should stay closed. If it is stuck open, close it by hand and plug the vacuum hose so it doesn't open again. Do not disconnect the EGR wires, the ECU will again force limp mode. If the EGR coil is burned, connect a 100 ohm 2W resistor across the EGR wires. The lower switch position is used to return to normal operation.

How does it work

Basically this circuit modulates the MAF output voltage dependent on the duty cycle of the EGR valve. With a working EGR valve, the MAF output voltage is modulated too, but only because the airflow through the MAF is really lowered if the EGR duty-cycle is increased. This circuit doesn't change the actual airflow, but it changes the airflow value that is reported to the ECU.

First the MAF output voltage is buffered by transistors tn_1 and tp_1. The emitter voltage of tp_1 is equal to the MAF output voltage. This is needed as the MAF doesn't seem to allow much load on it's output. The new MAF output voltage is connected to the ECU via r_6. This voltage can be lowered by drawing some current through r_6. This current simulates the opening of the EGR valve. The EGR duty-cycle is converted to a voltage by r_14, r_15 and c_2. The voltage across c_2 equals Battery_voltage*EGR_duty/2. (The divide by 2 is needed for circuit reasons.) This EGR duty_cycle value is converted to a current by tp_4 and r_11. The current is 'mirrored' by tn_2 and tn_3 (r_12 and r_13 are added for increased accuracy) such that the collector current of tn_3 is equal to the collector current of tp_4, only the direction is inverted. Now the signal going to the ECU is modulated by the tn_3 collector current, which is dependent on the EGR duty-cycle.

Pin number Bosch (Pierburg)

Pin 2 (3) ⊠

Battery Voltage (12V)

Pin 4 (1) ⊠

TECH

Reference Voltage (5V)

V5V

r_11
15k

c_2
22u

r_14
10k

r_5
1k

10
r_

r_1
22k

tp_4

'qbc557b'

MAF Output

r_3

tn_1

r_6

Pin 5 (6) ⊠

3.9k

'qbc548b'

680

tp_1

tn_3

tn_2

'qbc557b'

'qbc548b'

'qbc548b'

r_2
47k

r_4
10k

r_13
680

r_12
680

Ground

Pin 3 (2) ⊠

MAF output voltage modulation by the EGR duty-cycle

The voltage across c_2 is equal to Uc2=Battery voltage*EGR_duty/2. So the collector current of tp_4 is equal to (Uc2-Ube)/r_11. Ube is the base emitter voltage of tp_4. The collector current of tn_3 is equal to this value. So the output voltage Uecu=Umaf-(Uc2-Ube)/r_11*r_6.

With some numbers: At idle with closed EGR Umaf=2.2V (for a Bosch), EGR duty is 80%, Battery voltage is 14V => Uecu=2.0V (so the MAF voltage is lowered by 0.2V due to EGR action)

Can I adjust the circuit

Yes. Change the value of r_11 (only!) in small steps to increase (lower r_11 value) or decrease (higher r_11 value) the modulation of the MAF voltage. Do not go below 6.8k ohm or above 100k ohm. Below 6.8k ohm the modulation is very large, above 100k ohm there's hardly any modulation left.

Parts

The transistors drawn are bc548b and bc557b, but you can also use 2n2222 and 2n2907 type transistors or similar small signal types. The resistors are all 1/4W types. C_2 is a 22uF/16V electronic capacitor, C_1 is a ceramic capacitor. Total cost of parts will only be a few dollar.

If you like to use it, make sure you place it in a water tight housing. Otherwise corrosion will occur. A 35mm film container will do. Stick the wires through small holes and seal it with silicon.

Intellectual property

You are free to use the information presented here. I do not ask any money for it, but also do not accept any liability. You are not allowed to sell the schematics or printed circuit boards with a profit. If you find the circuit valuable and are going to use it, I would be happy to hear your experience with it.

Page Last updated:

MB CDI Mass Air Flow sensor

There was a time when VW asked 280 euro for a MAF... As Mercedes only asked 90 euro, quite a few people switched over to the Mercedes CDI MAF. VW has now lowered its price to something like 90 euro. So there is no real need to buy a CDI MAF anymore to fix your VW.
The page is still here. If my MAF ever breaks down, I may still use the CDI MAF I have or I will fix it with a MAF booster circuit.

In the Mercedes 200 and 220 CDI a Pierburg Mass Air Flow Sensor (MAF) is used that mechanically fits perfectly in the housing of a VW Bosch MAF. The electrical connection is the same (no other connector is needed).
There's been quite some discussion already on this sensor on the webpages of www.tdiclub.com.
Some people report perfect results, other have doubts. One of the tdiclub members, LeeM, provided a CDI sensor so that I could do some measurements. Thanks LeeM!

The measurements were done in two ways:
1. On the bench, which is the most accurate as conditions can be held the same. 0..200 kg/hour
2. On the road, used for higher air flow numbers that could not be achieved on the bench. > 200 kg/hour

In the picture below you'll see the workbench measurement setup. Some home build electronics and original VW parts like the airfilter to make the measurement as accurate as possible (real airflow). Note the small fan motor on the bottom: as I needed a huge airflow I pushed the motor over the limit by supplying the poor thing with 80V, while the rating was only 28V. The poor thing lasted quite some time, but eventually blew at 100 kg/hour and needed to be replaced by a powerful 12V motor which could push the airflow up to almost 200 kg/hour. Large enough to get the PWM regulator hot.

5V and 12V supply for MAF sensor

MB CDI and VW TDI sensors
waiting to be tested

DUT (VW A3 MAF)

Fan with new po

Fan power supply

MAF
housing

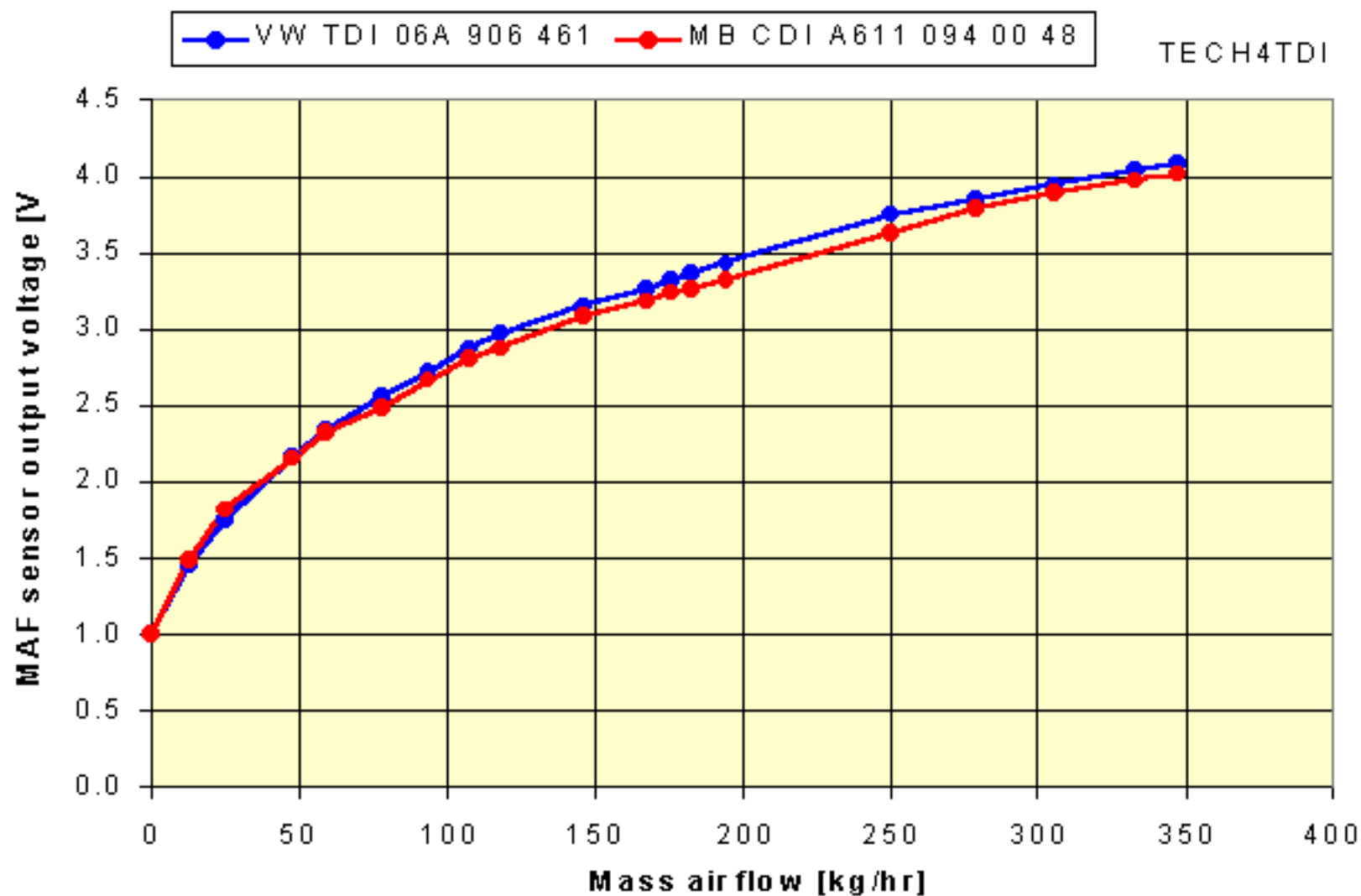Airfilte

PWM fan motor con

Original fan
motor

Voltage meters

Security torx

A VW Bosch TDI MAF sensor (06A 906 461), which is believed to be good, is used as a reference. The air flow is measured with this sensor while the output voltage of the CDI MAF is measured.

VW TDI MAF vs MB CDI MAF (measured)

Clearly the difference can be seen between the two sensors. The original VW sensor outputs a slightly higher output voltage, which will produce a higher airflow reading in the ECU. At 350kg/hour the curves seem to be closer than at 200kg/hour, but still the TDI ECU will calculate a difference of about 25kg/hour.(7% difference)
Also remember that the readings above 200kg/hour are done on the road. These will be less accurate as conditions will never be perfectly the same. The output voltage of the CDI MAF is calculated by reading the RPM and actual MAF value and by the use of the known Bosch TDI MAF curve.

The picture below shows a typical VAGCOM logging results (Fourth gear, WOT). One is with a CDI MAF, the other with a TDI MAF. The time scale is corrected (time shifting) for one logging to get a good comparison.
Two things are clear (I think).
1. The MB CDI MAF outputs a lower reading. This is in agreement with the curve above.
2. As RPMs climb at the same rate, there's no significant difference in engine power in this condition.

VW TDI Bosch MAF vs MB CDI Pierburg MAF
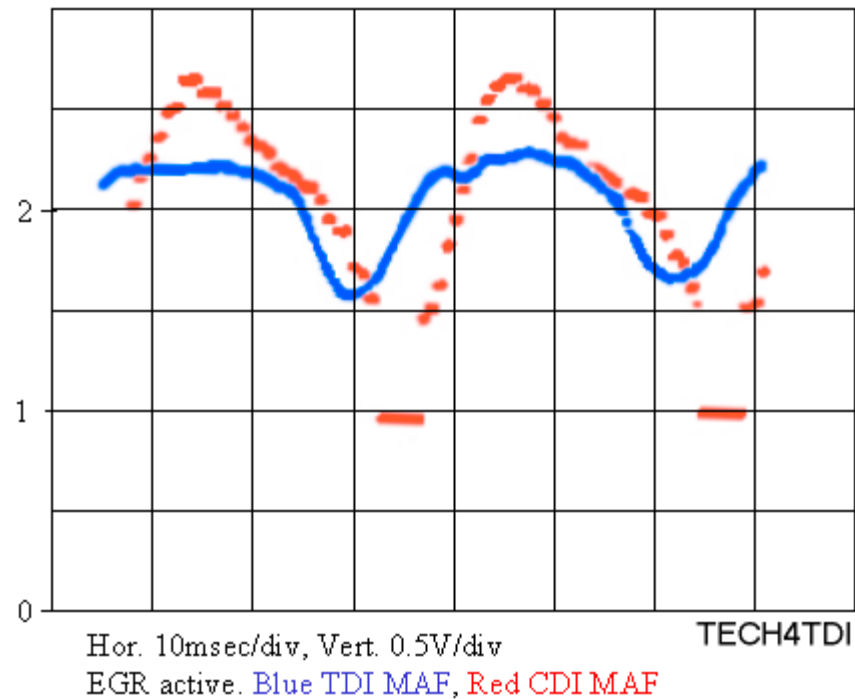(logging with VAGCOM)

TECH4TDI
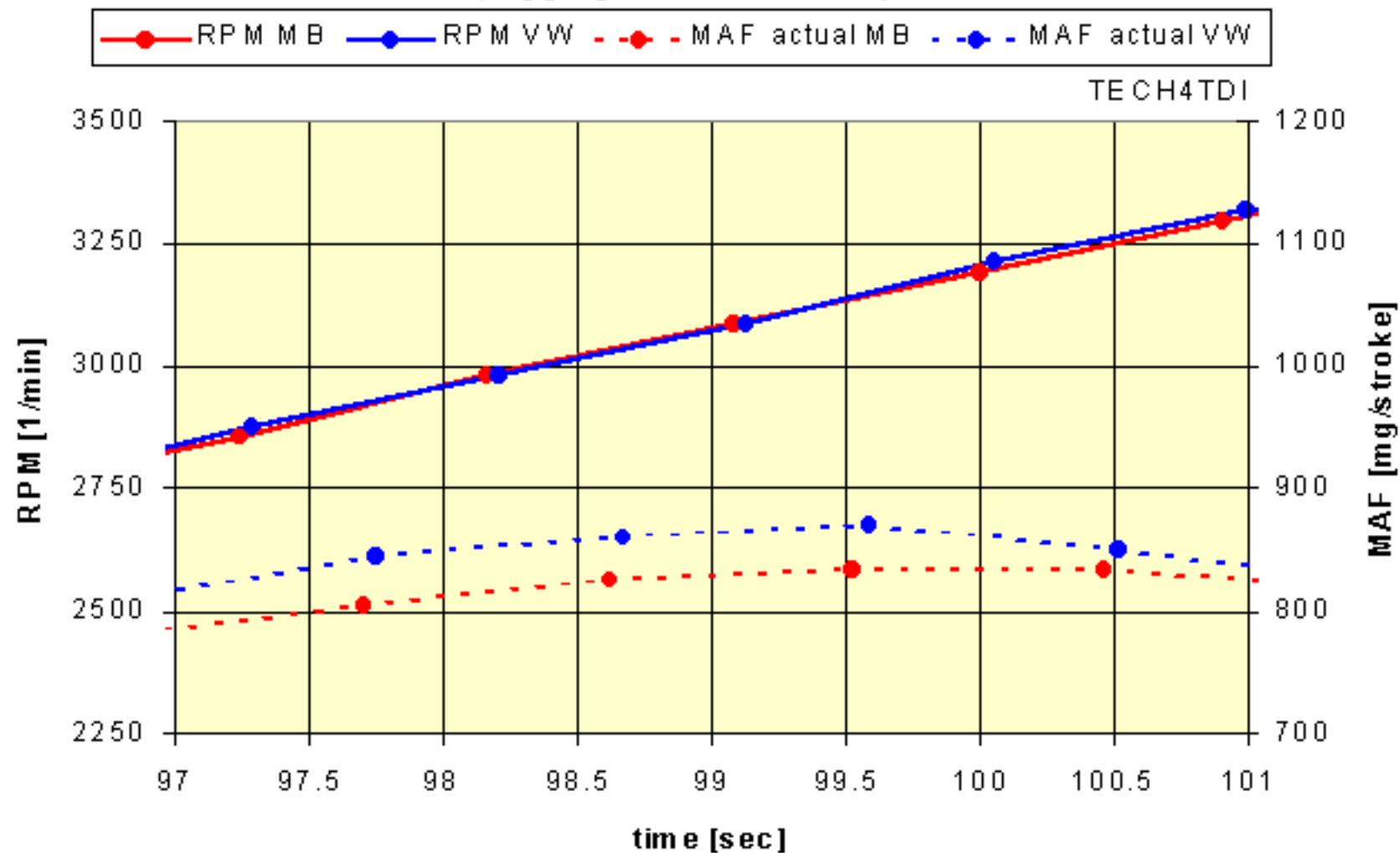
During normal driving conditions the ECU will compensate for the lower MAF output voltage of the CDI MAF. If found that the ECU closed the EGR by an extra 10% at 120km/hr (75mph). This way the ECU regulates the actual MAF value to the expected value. So the engine gets more fresh air and less recirculated exhaust gasses. As this will result in more NOx, this may be an environmental issue. So beware!
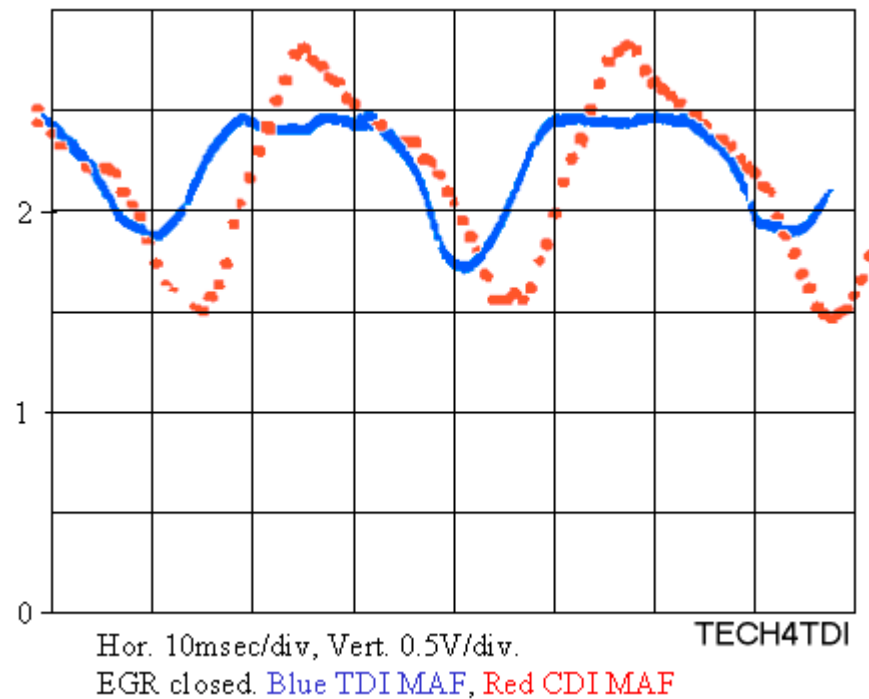
So how good is it?
It is pretty close, and I cannot tell the difference when I'm driving. (81kW TDI) The readings are not perfect of course, but it is much better to use a MB CDI MAF in a TDI than a VW 2.0L MAF. The 2.0L MAF produces really high reading which may result in smoke.

Update Sept 7, 2003

Before doing more measurements, I wanted to see the MAF output signals on an oscilloscoop. This showed some remarkable results.

Hor. 10msec/div, Vert. 0.5V/div
EGR active. Blue TDI MAF, Red CDI MAF
TECH4TDI

Hor. 10msec/div, Vert. 0.5V/div.
EGR closed. Blue TDI MAF, Red CDI MAF

TECH4TDI

First thing to notice is that the CDI MAF will drop its output signal all the way to 1V when the EGR is active during idle. 1V indicates that the airflow is zero at that moment. Also the amplitude of the signal is larger than the TDI MAF. The average signal is slightly lower (as expected). Secondly the CDI output signal is clearly made by a digital to analog converter. Notice the steps in the signal. So most likely the analog signal from the actual sensor element is digitalized, maybe digitally trimmed to get the calibration right, and after that converted to an analog signal again. I don't think the ECU will mind the steps in the signal. But as some people are getting fault codes while using this MAF, the ECU may not like the signal drops to 1V. Maybe the signal drops can be avoided by doing the EGR adjustment as is discussed on the webpages of www.tdiclub.com. I may try it later.

By the way: It is fully normal that the MAF signal is not a steady line: the airflow going into the engine isn't! When a cilinder is breathing air, the airflow is up. When all valves are closed, the airflow will drop.

To test the MAFs while driving I measured simultaneous both MAFs. One MAF is connected to the ECU, while both are connected to an analog logging system.

It's difficult to draw a good conclusion as it seems that the airflow is dependent on the position of the MAF sensor. Although of course the total airflow is the same, the uniformity of the airflow isn't. It seems that the mass air flow graph above is accurate, but above 250 kg/hr the curves may cross again.

Page last updated: Jan 12, 2005

J1962 Connector
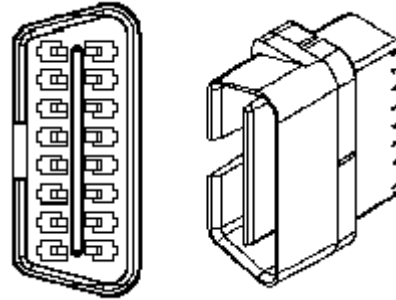
If you can get a J1962 connector for a reasonable price, don't read any further. Just buy one. If not, continue reading.

 A J1962 connector is about 15 to 25 euro at the places I looked. To much I think (I'm cheap). So in stead I bought a female connector at the VW dealer for 4 euro and changed it into a male.

I got part number 3 A0 972 695 from my dealer and stuck a few pins in it:
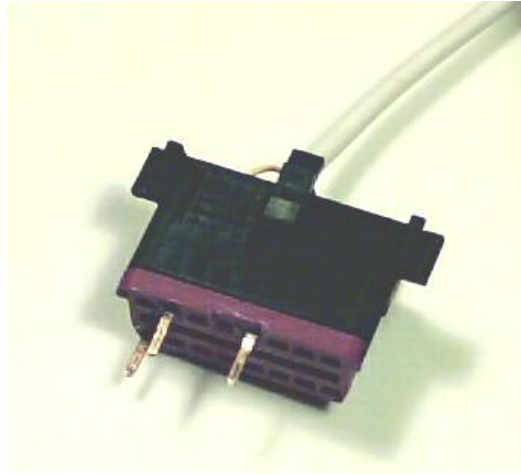
After that I glued a few plastic parts on it and connected it to my OBDII interface:
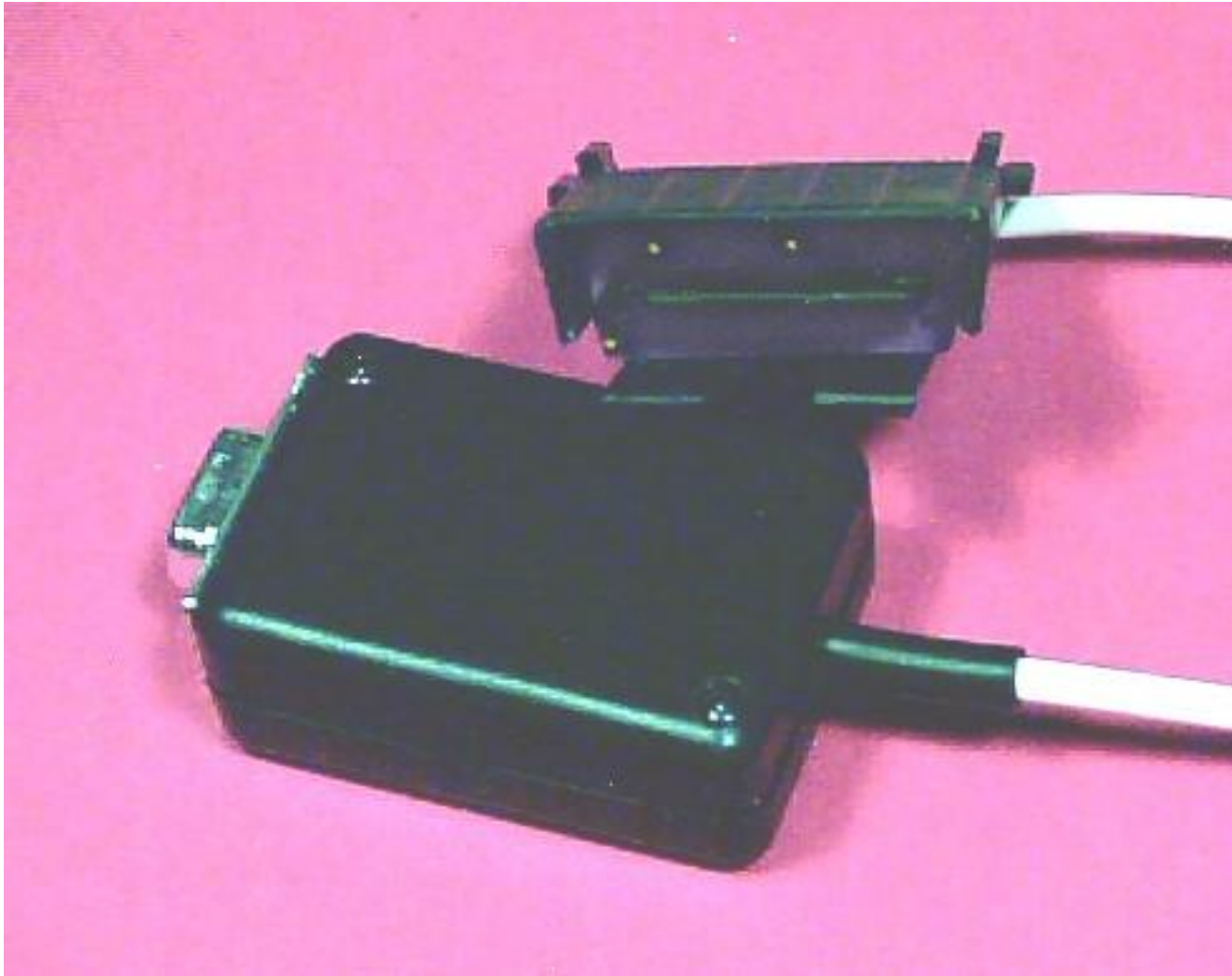
Doesn't look as good as a commercial connector, but works just as well.