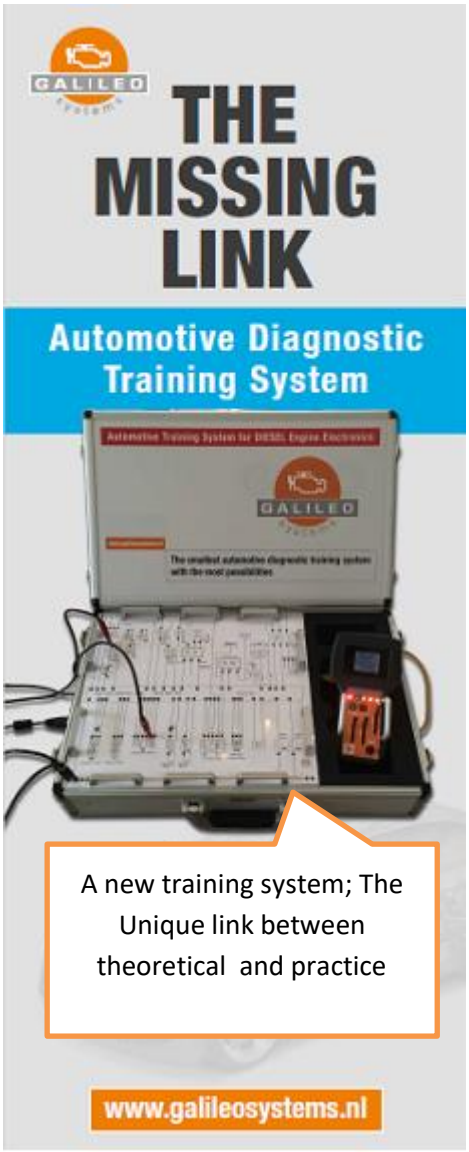
GALILEO VW Golf System Description

The Galileo training system was developed out of the need to get as high a return as possible from Automotive (Diagnostic) Trainings with as few resources as possible.



The Galileo system is ideal for gathering the right basic knowledge on levels 2, 3 and 4 as effectively as possible but also for finding the very difficult problems in the electronic control systems during the Diagnosis Specialist training.

V1.05

Subject:	*Page*
Start/stop system	4
Crankshaft Sensor	4 en 21
Running Test	4
Camshaft Sensor	6
Accelerator Sensor	6
Engine Temperatuur Sensor	6
Injectors	8
Fuel Pressure controle Valve	9
Fuel Pressure Sensor	10
Turbo Pressure Elektric Motor	11
Turbo Pressure Position Sensor	12
Trottle Elektric Motor	12
Trottle valve Positie Sensor	13
Clutch Pedal Sensor	13
Brake Pedal Sensor	14
Broadband Lambda Sensor	14
Heating element Lambda Sensor	16
Ignition Moduul	16
CAN-Bus	18
Fuel Pump	19
Crankshaft Sensor	21
HC Absorption Valve	22
Coollant Controle Valve	22
Inlet Pressure Sensor	23
Knock Sensor	23
Lambda Sensor behind Catalyst	23
System-relay	24
4-Gas analyzer under several faults	24

Start the engine

Start/stop system

This CBZB engine has a start /stop system where the clutch pedal must be pressed to start the engine. If after that the car has driven faster than 20 km/h the system will become active and the LED will light up in the START /STOP switch. At idle speed and the gear in neutral, the engine will automatically drop out. The motor starts automatically when the clutch pedal is depressed. The start /stop system can be switched off by pressing the the START / STOP push button in the wiring diagram, so that the LED goes out.

Crankshaft-sensor (HALL-effect)

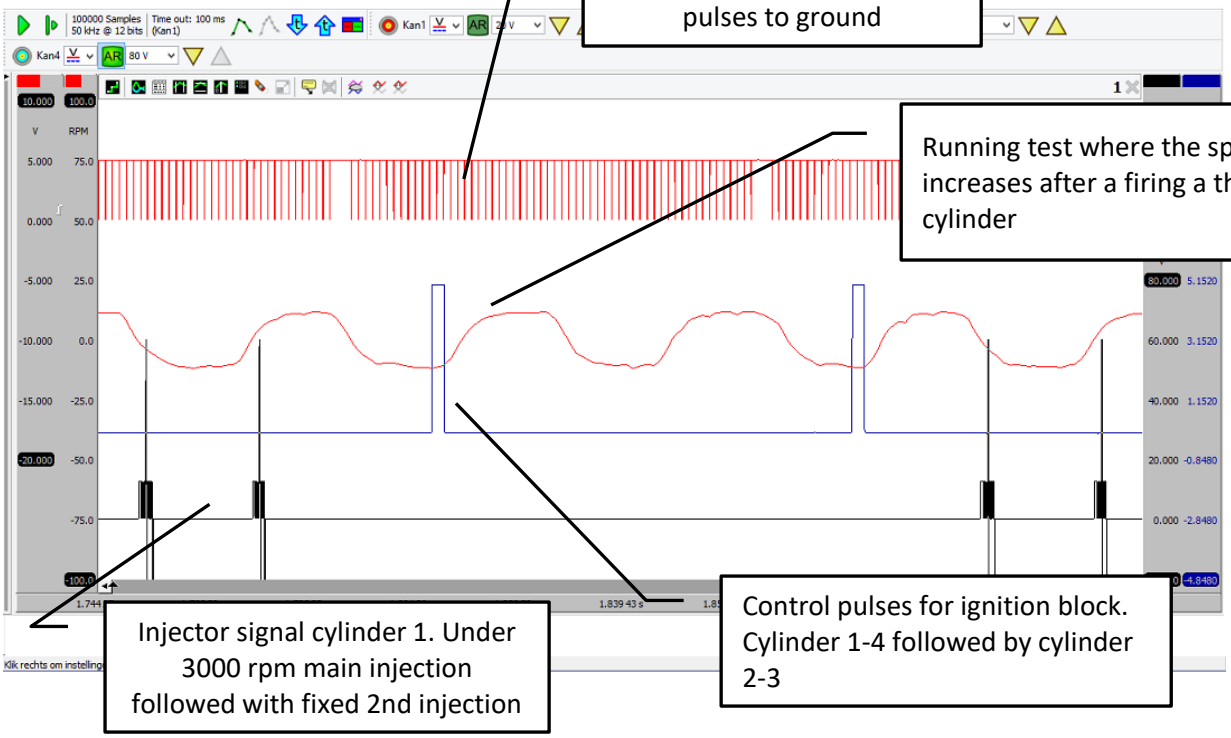
The signal from the HALL sensor switches between 5 Volts and ground and has a supply voltage of 5 Volts. The HALL signal of this CBZB engine differs from the "normal" HALL signals. The signal is mainly 5 Volts with very short periods to ground. These ground switched periods are no longer than 60 microseconds. Normally HALL signals have a 50% on / off ratio. The marking point in this signal (1 revolution) is 3.5 milliseconds at idling speed and is 5 Volts at that time.

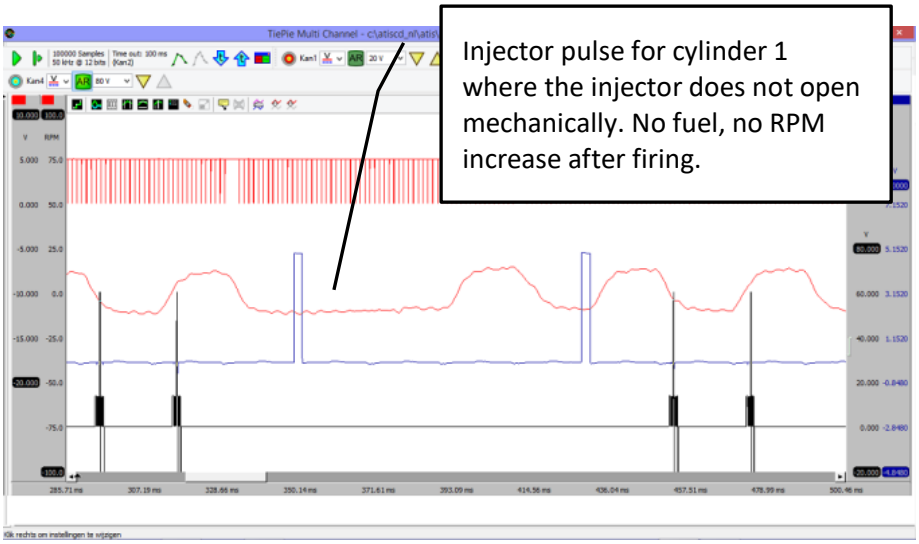
Measuring this signal in combination with the ignition coil signal shows that the ignition timing is advanced at higher loads. Advance is about 30-40 degrees at maximum load.

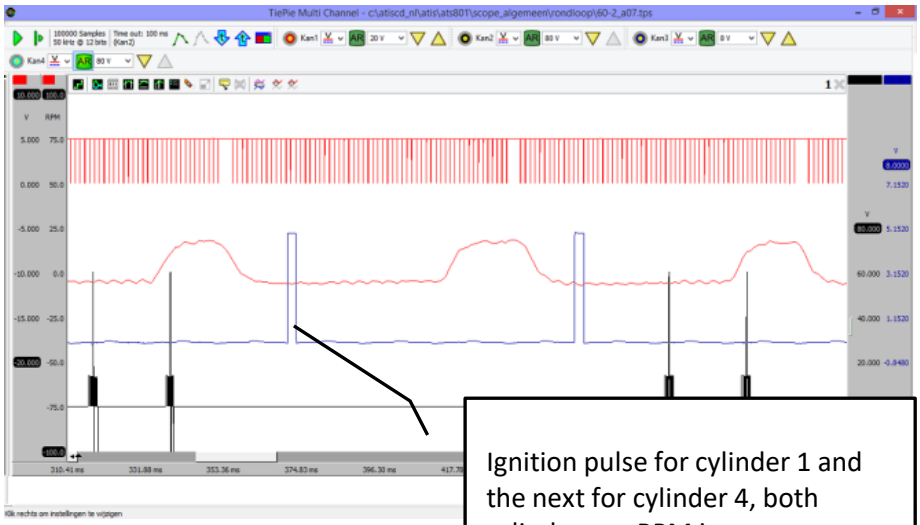
Specials:

Push switches (Open Circuit):
A switch is placed in the signal wire in the wiring diagram. This switch simulates a open wire to detect the operation of a HALL sensor. This switch only works when the ignition is ON and the engine is OFF (so when the engine is running, this button will NOT work). Place a measuring device between signal wire (on sensor) and ground. Turn on the ignition and press the "open circuit" button. The measured voltage will drop from battery voltage to zero. Now measure the signal wire on the ECU side and signal voltage will remain when the button is pressed. This proves that the signal voltage comes from the ECU and not from the sensor. Sensor only switches the signal voltage to ground and does not send out voltage.

Engine running test:
Galileo is the same as a "real" engine, so the "running" of the engine is also simulated and can be measured on the crankshaft sensor. This means that the engine speed increases during ignition in a cylinder and decreases again during the compression stroke. If the scope is equipped with running test software, the ups and downs in RPM can be made visible.







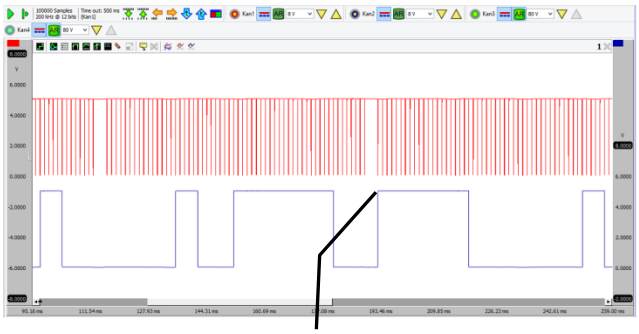
At error x/x, with injector 1 not opening, a speed increase will NOT take place after ignition spark of cylinder 1. Defect code Pxxxx is stored. After the Fueltrim on cylinder 1 has increased to above 20%. Fault code Pxxxx and Pxxxx occurs. In case of error x/x, cylinders 1 and 4 are not ignited by a defective coil ignition coil of these cylinders. Fault code Pxxxx, Pxxxx and Pxxxx.

Camshaft Sensor (HALL)

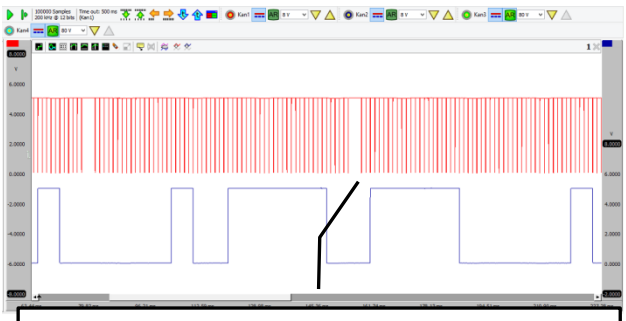
The signal from the HALL sensor switches between 5 Volts and ground. The camshaft signal has a pattern of two short and two long pulses per two crankshaft rotations. If the GMTO scope is measured with the "Combi" setting, it will be seen that the camshaft signal of the example signal has two crankshaft teeth "past" than the measured signal (figure below). In fact, the camshaft is 12 ° too late (360 ° / 60 crankshaft teeth = 6 ° x 2 = 12 °). We use this "late" setting to provide instructive assignments. The ground wire of this sensor is interrupted at fault 4/1. Engine keeps running but does not start after shut off. Codes Pxxxx, Pxxxx are set.

Specials:

Switch on interference x/x. Carry out the same measurements as described above. Determine the camshaft timing. Now it can be seen that the camshaft has 2 crankshaft pulses (teeth) RETARD (mechanical problem in distribution). Fault code P0013 is set.



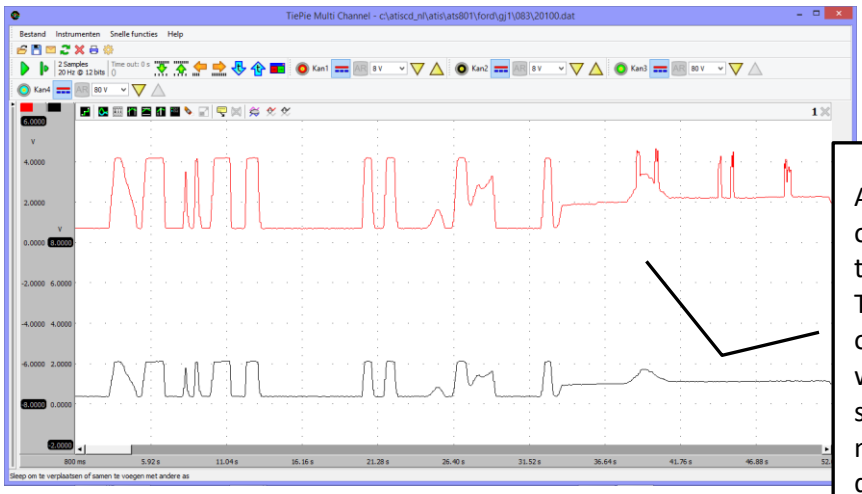
Use this point to determine the position of the camshaft in relation to the crankshaft



Engine has too little power with a camshaft signal drop on pulse 2. Camshaft timing is too late. Problem in distibution belt timing

Accelerator Sensor

The signal from the accelerator sensor is formed with two potentiometers. When moving the accelerator, both signals vary from low to high. The signal voltage at terminal 4 (potentiometer 1) is double the signal voltage at terminal 6 (potentiometer 2). Under error x/x potentiometer track P1 is defective, resulting in defect code Pxxxx.



At failure x/x, the first potentiometer occasionally has a bad ground, causing the signal voltage to rise erratically. The ground is good when measuring on the ECU. So a problem with the wire connection between ECU and sensor ground. The scope can also be measured over the ground wire to detect this problem. No fault code.

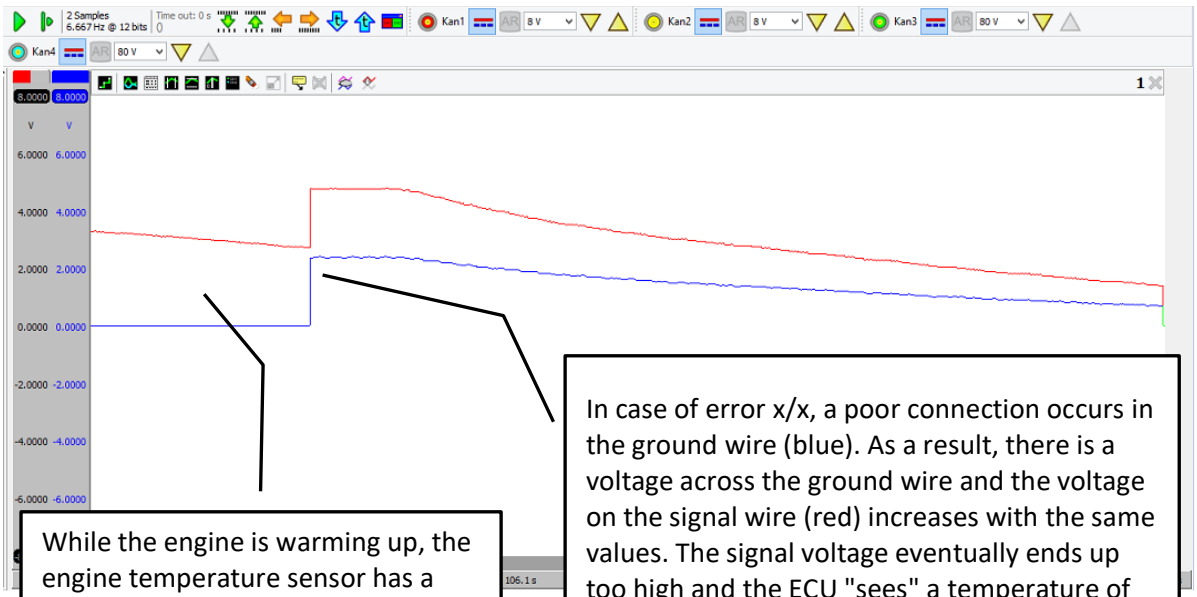
Engine Temperature-sensor

The signal from the temperature sensor is formed by a series connection of two resistors. A fixed resistor in the ECU in series with the variable resistor as the temperature sensor and is designed as an NTC element. This circuit has a supply voltage of 5 volts. The wire between the fixed ECU resistor and the variable temperature resistor is named as the signal wire. The signal wire in side the ECU is connected to the microprocessor.

Specials:

A push button "Open Circuit" is placed in the signal wire. With this push button the signal wire can be interrupted to discover the operation of this circuit. Turn on the ignition but do not start the engine. Connect the measuring instrument to the signal wire (sensor side) and the ground. Press the "Open Circuit" button. It can be seen that the voltage drops to 0 Volt. Now place the measuring wire on the signal wire ECU side. Press the button again. The voltage now goes to 5 Volts. It is clear that if the series circuit is interrupted, the voltage on the ECU goes to 5 Volts (despite the internal measuring resistor, and no current anymore) and on the sensor to 0 Volts.

The following scope image shows a poor wire connection in the ground wire. Under fault x/x there is a continuous poor wire connection between the ECU and the earth wire of the engine temperature sensor. No fault code is set.



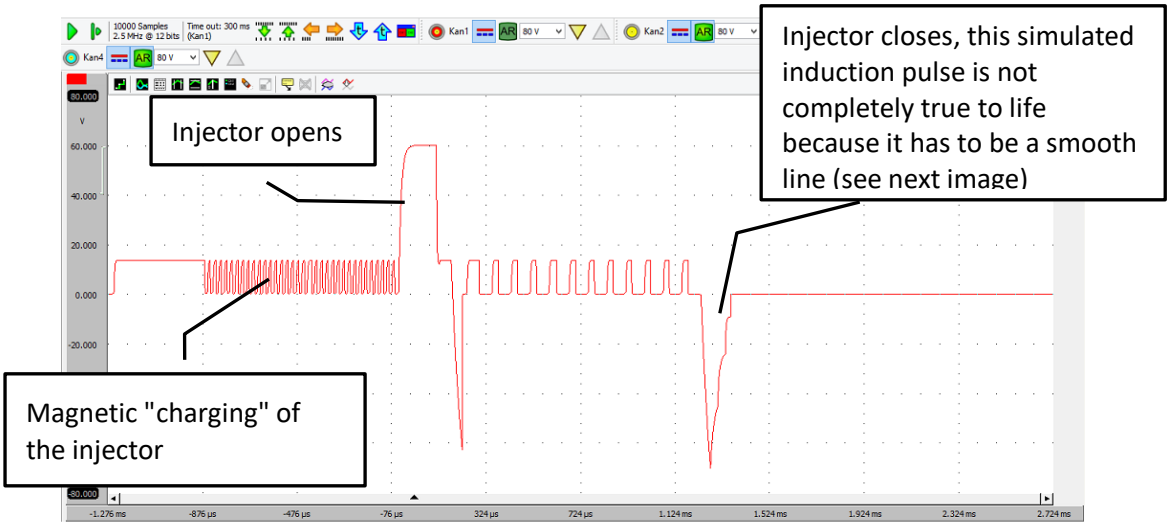
While the engine is warming up, the engine temperature sensor has a normal voltage gradient and a good ground (blue signal)

In case of error x/x, a poor connection occurs in the ground wire (blue). As a result, there is a voltage across the ground wire and the voltage on the signal wire (red) increases with the same values. The signal voltage eventually ends up too high and the ECU "sees" a temperature of no more than 60 ° with a warm engine.

Under error x/x, the sensor is occasionally interrupted. Voltage on the sensor AND on the ECU then goes to 5 Volt. Engine hold for a moment. No error codes.

Injectors

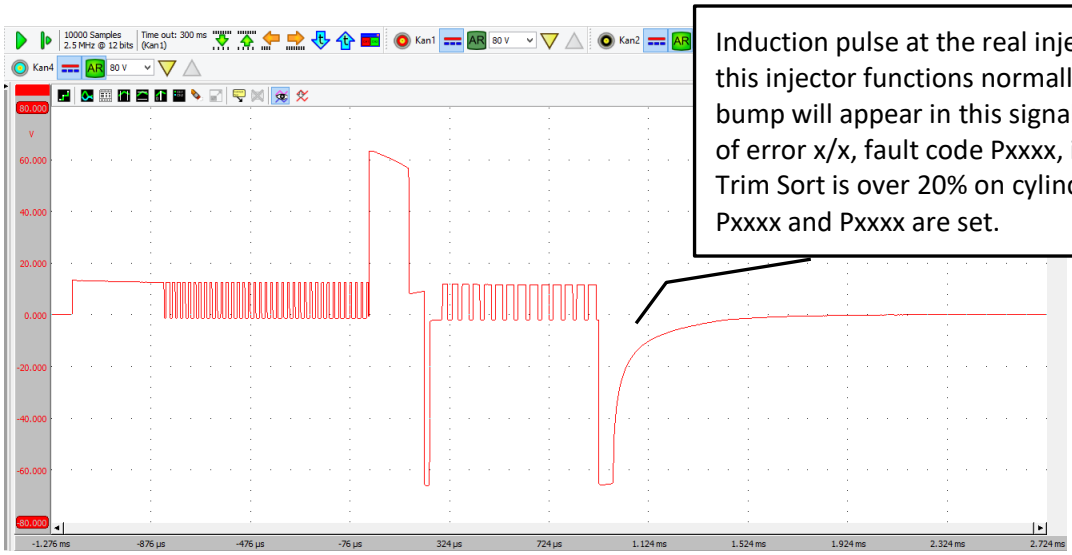
The injectors are of the coil type with low internal resistance. Opening the injectors of this directly injected engine is very precise (opening moment) and that is done by first "magnetically charging" the injector. This charging is done by transferring the full battery voltage across the coil over a period of 380 microseconds (0.38 milliseconds). Followed by a period of 800 Microseconds where the voltage (and current) through the ECU with a frequency of 1.8 kHz between battery voltage and 0 Volt switches. During this period, the injector is "magnetically charged". The injector is still closed after this period. The injector opens immediately when, through the ECU, and pulse of 60 volts (160 µs) is connected. After the lowering of this pulse a short negative induction plus of -60 volts is produced. After the injector is opened, the battery voltage is pulsed (1.2 kHz) on the injector to control the current at an acceptable level. After the correct amount of fuel has been injected, the injector closes and a negative induction pulse is the result of switching off the current. The injector signal must be measured with a differential scope and with the test probes over the injector coil. There is a signal on both wires.



Under the 3000 rpm, after the main injection, a next injection is generated with a fixed injection duration. The main injection takes place at the beginning of the "intake stroke". The second injection takes place at the beginning of the "compression stroke"

Specials:

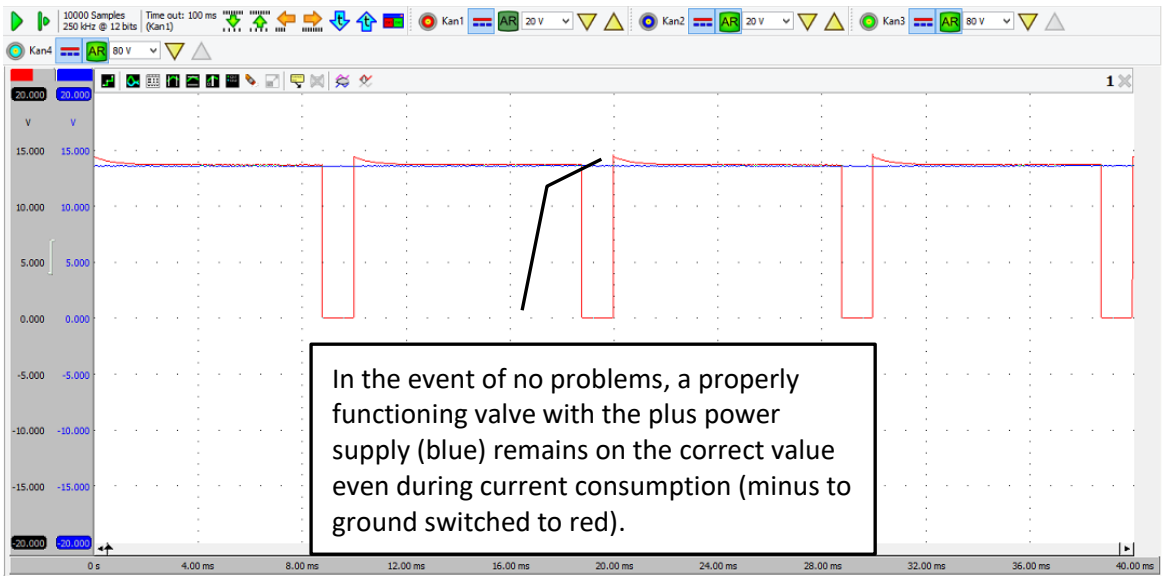
In case of error x/x the injector cylinder 1 is activated but does not open mechanically. The special thing here is that opening or not opening of this injector is NOT visible in the image. With other types of injectors (systems) this can be seen as a bump in the last induction pulse.

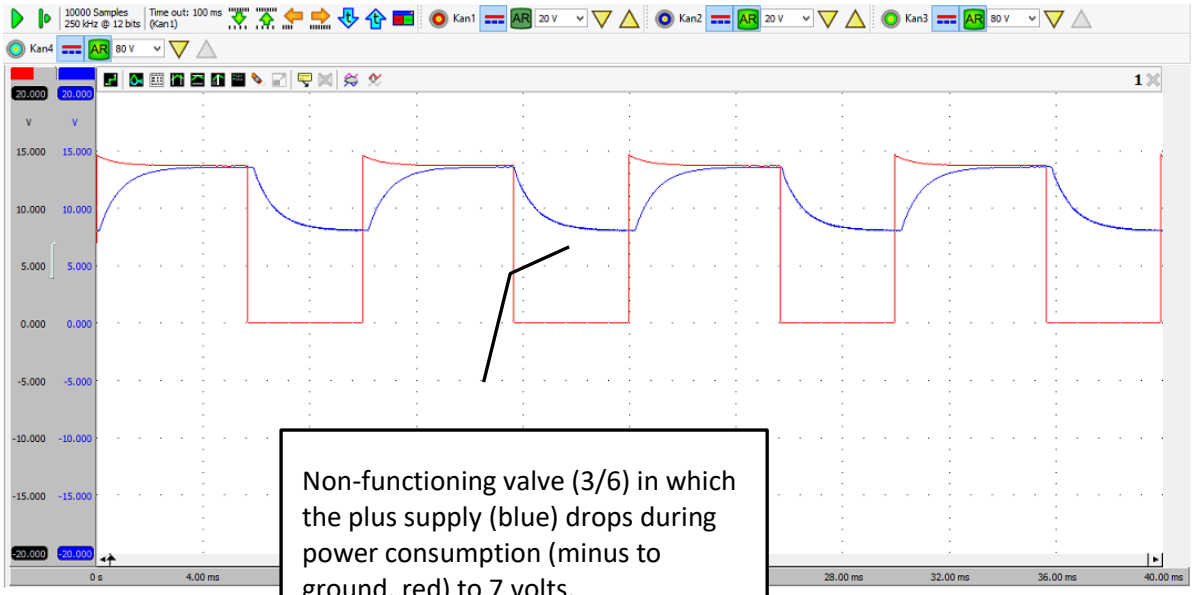


Fuel Pressure Control Valve

The fuel pressure control valve works in conjunction with the information from the fuel pressure sensor and the software in the ECU. The valve is controlled by a Duty Cycle (DC) and a higher DC results in a higher pressure. Under error x/x, this valve is mechanically defect and the engine will fail and stop running. Fault code Pxxxx is set.

Under error x/x, the engine only runs at a higher idling speed. After the engine is switched off, it will no longer be switched on. This fault is a poor connection in the positive supply wire of this valve. Usually by technicians very bad to find because on the DC is nothing to find. fault code Pxxxxc.

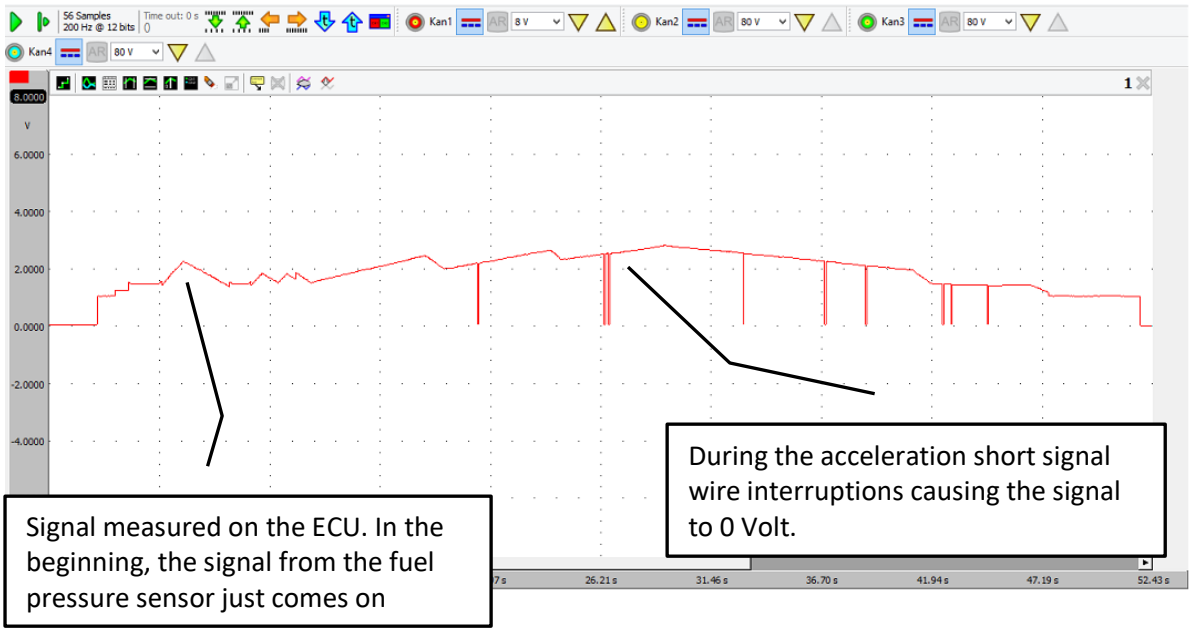




If the blue power supply line was not visible with channel 2, this fault could not be found by measuring only the DC (red line). The ECU adjusts to a higher DC during this failure because the fuel pressure has fallen down.

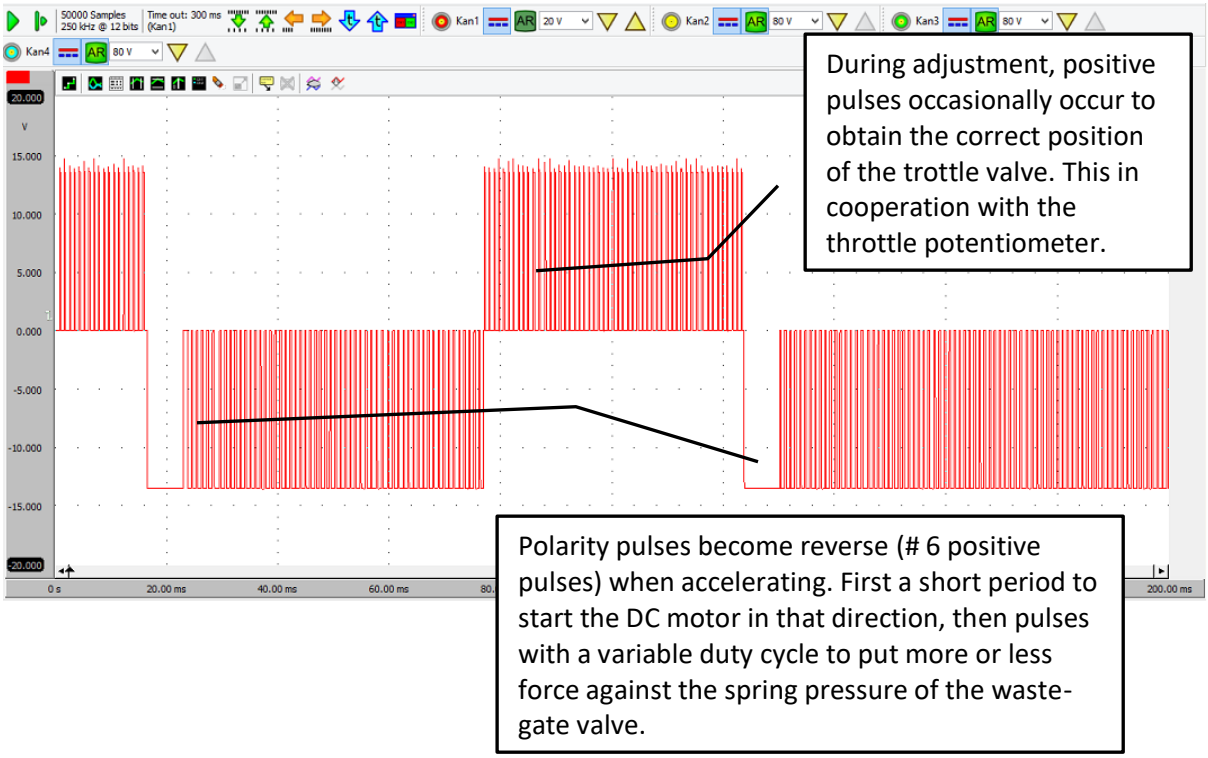
Fuel Pressure Sensor (rail pressure)

The signal from the fuel pressure sensor controls between 0 and 5 Volts. When the RPM is going up and down, the pressure is doing the same. The signal wire is occasionally interrupted under error x/x. The malfunction is so short that the ECU “sees” a slight change in the signal voltage but does not set an fault code in the memory. The engine stops for a short time because the ECU want to react.



Turbo Pressure Electric Motor (Waste Gate)

The turbocharger electric motor is a (DC) motor that is controlled at both wires, from the ECU. With a frequency of about 1 kHz 12 Volt pulses are put on one connection while the other connection is connected to earth and vice versa. If it is measured with a differential scope, it is best to place the two test leads over the motor connections. This clearly shows the tension and the effect on the engine. When the engine is idling, positive pulses are generally present on the motor. When accelerating, the polarity reverses (12 Volt pulses come on minus side) and the motor closes the Waste-gate valve. The turbo pressure can now rise to the regulated pressure. Note: the turbo pressure is not high when there is no load. Even when accelerating in the 1st gear, the turbo pressure does not rise to the maximum. Only in the 2nd gear, and higher, the maximum turbo pressure is present at full power.



The wire connection between ECU and # 6 is interrupted under error x/x. Measured with a 2-channel scope, the same pulses to the ground are measured at # 5 and # 6 of the electric motor. Defect code Pxxxx and too short engine power.

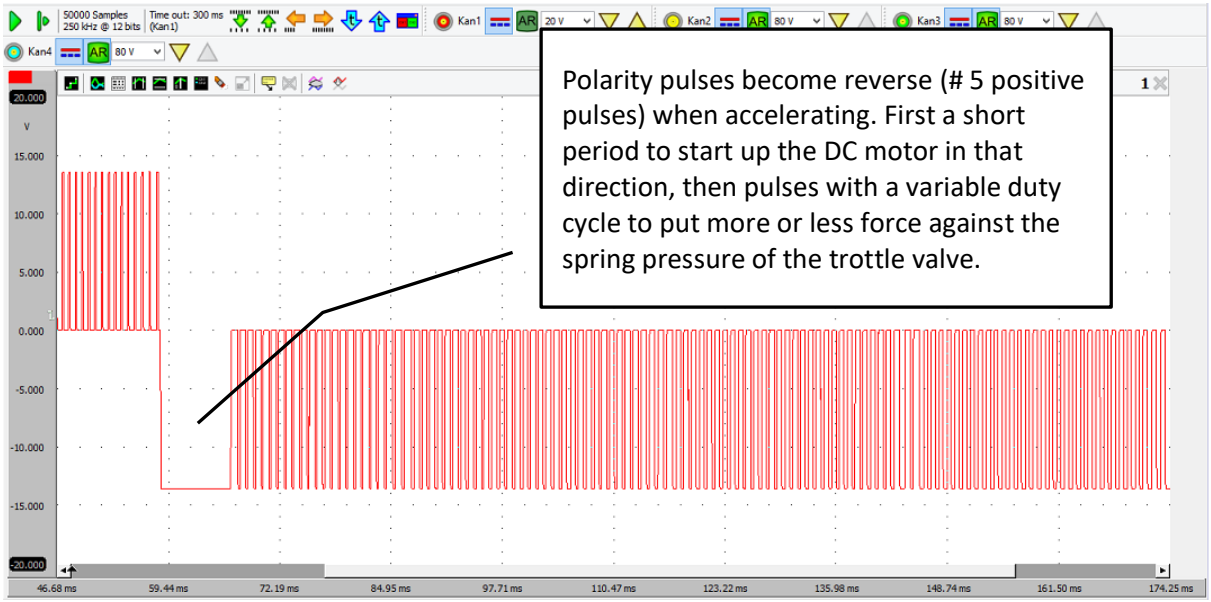
Under the error x/x, the turbocharged electric motor itself is broken (interrupted coil). With the scope over the wires # 5 and # 6 a positive and negative switched voltage can be measured but there is no mechanical reaction. As a result, the turbo pressure does not rise during acceleration and the corresponding turbo pressure position sensor does not indicate changes. Motor has too short power. fault code during this error is Pxxxx and Pxxxx.

Turbo Pressure Position Sensor

This position sensor is connected to the turbo pressure electric motor. When the waste gate is controlled to close, the voltage of the position sensor is low. The Waste-Gateklep is fixed under error x/x. Position sensor no longer shows any voltage variations.

Trottle Electric Motor

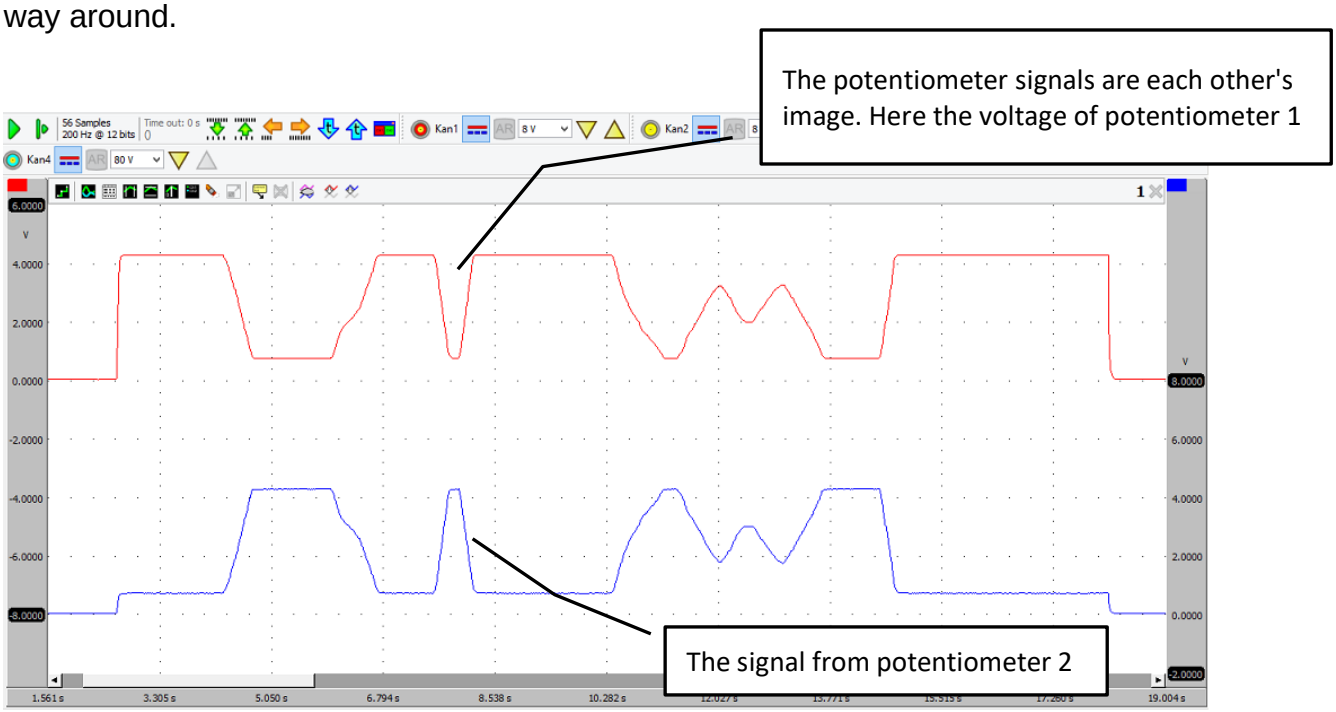
The throttle electric motor is a (DC) motor that is controlled at both wires, from the ECU. With a frequency of about 1 kHz 12 Volt pulses are put on one connection while the other connection is connected to ground and vice versa. If it is measured with a differential scope, it is best to place the two test leads over the motor connections. This clearly shows the tension and the effect on the motor. When the engine is idling, positive pulses are generally present on the motor. When accelerating, the polarity reverses (12 Volt pulses come on minus side) and the electric motor turns the throttle valve open. This can be seen on the moving LED line.



The control wire between ECU and # 5 is interrupted under error x/x. The engine goes to a lower RPM and does not respond to the accelerator. The engine does not start after stopping the engine. Measured with a 2-channel scope, the same pulses with respect to ground are measured at # 3 and # 5 of the electric motor. Fault code Pxxxx is set.

Trottle Valve Positie Sensor

The throttle valve position sensor consists of two potentiometers that are each other's opposite pole in terms of signal. The voltages at the signal outputs are at # 4 - 4.3 Volt and at # 1 - 0.7 Volt and with fully open throttle the voltages are exactly the other way around.

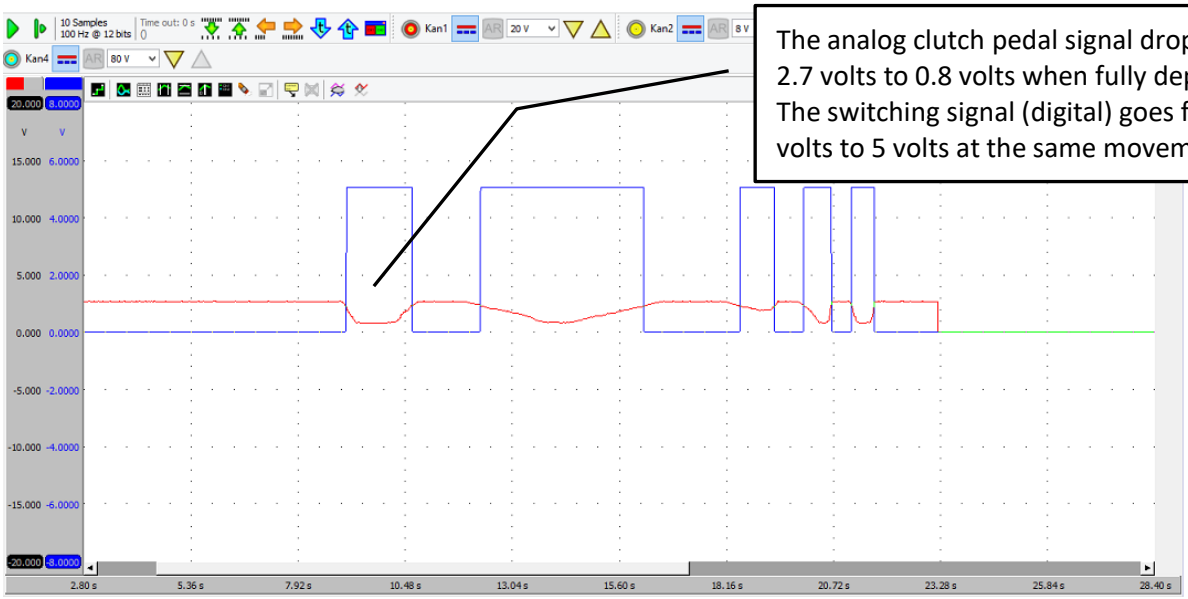


Under error x/x, the supply wire is interrupted so that both potentiometers no longer send out a signal. Because the ECU no longer has control of the position of the throttle but allows the possibility to get home with the car, the RPM goes up slightly (throttle opens a bit). If the engine is stopped, it can no longer be started because of safety. Fault code Pxxxx is set.

Clutch Pedal Sensor

The signal from the clutch pedal sensor consists of two signals. An analogue and a digital signal. This dual function is important because the ECU wants to know exactly how and if this sensor works in connection with the START / STOP system.

Under error x/x, the analog part of this sensor is defective. Because of this problem, the engine does not want to start because the ECU no longer trusts the signal. Fault code Pxxxx is set.



Brake Pedal Sensor

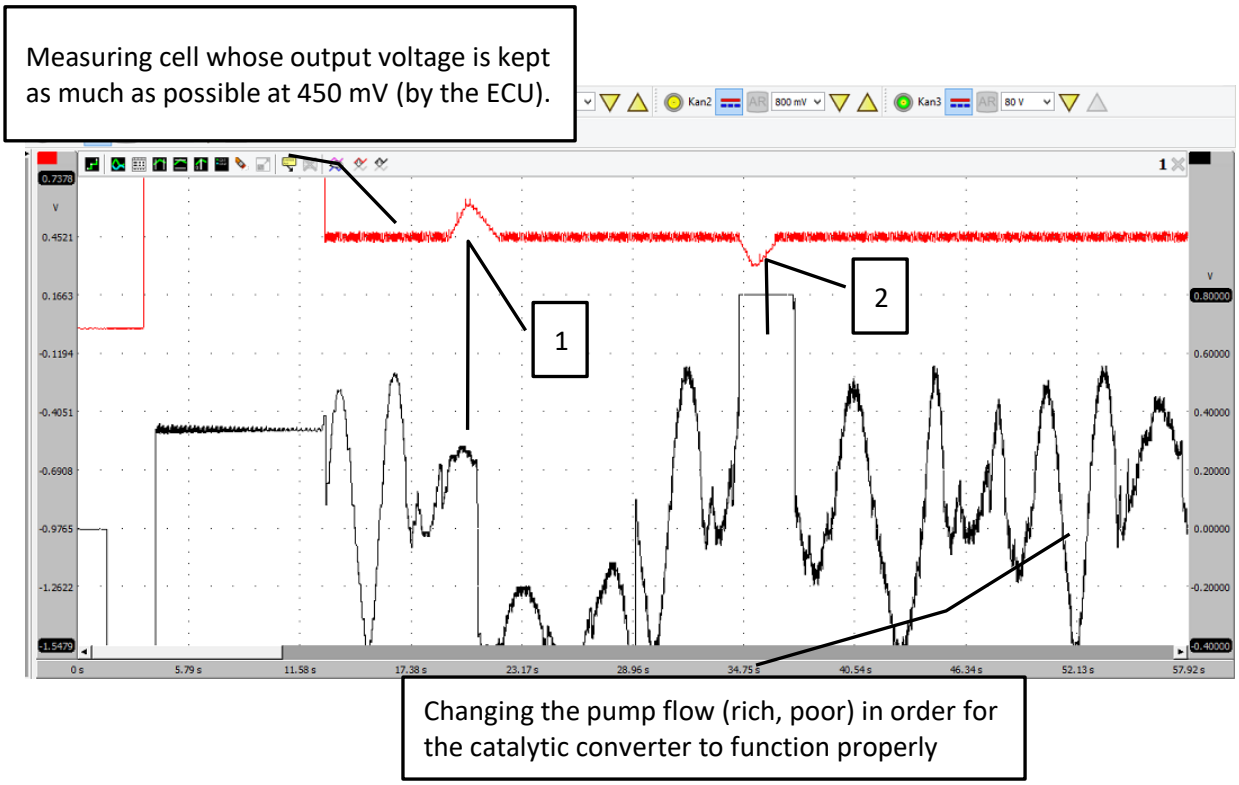
The brake pedal sensor works identical to the clutch sensor. No fault has been made in this sensor.

Broadband lambda Sensor

The broadband lambda sensor is an improved leap Lambda sensor (only lambda = 1 detection) that has been in use since the 80s of the last century. Due to the arrival of "Lean burn" engines, another type of sensor had to come which could detect the mixture over a wide area. This resulted in a lambda sensor that can switch the tilting point of the measuring cell from arm to rich mixture by means of a control current (pump current). In other words, the ECU has a sensor with which the mixture ratio can be "viewed" over a wide range. The sensors are also so fast that even the mixture ratio per cylinder can be detected. The sensor consists of two parts: 1- The measuring sensor where the signal is kept as much as possible at 450mV. 2 - An oxygen pump (ion pump) that can supply more or less oxygen ions to the inside of the pump sensor. Depending on the exhaust gas ratio, the ECU will, by means of the oxygen pump, always keep the voltage of the measuring sensor at 450 mV. The pump current (mA) is then the measure for the ratio of the exhaust gases. To obtain a negative pump current, the voltage on terminal 2 must also be negative with respect to the sensor ground wire # 6.

It is difficult to create a voltage that is lower than the battery ground. This has been realized in a different way, namely by bringing the ground of this sensor to 2 volts. By bringing the voltage of the pump current below this 2 Volt a negative current is created.

Use the two scope channels. Connect both minus wires of the scope to the ground wire of the lambda sensor (# 6 and the same wire on the ECU) place the probe of channel 1 to # 4 and the probe of channel 2 to # 2 of the lambda sensor.



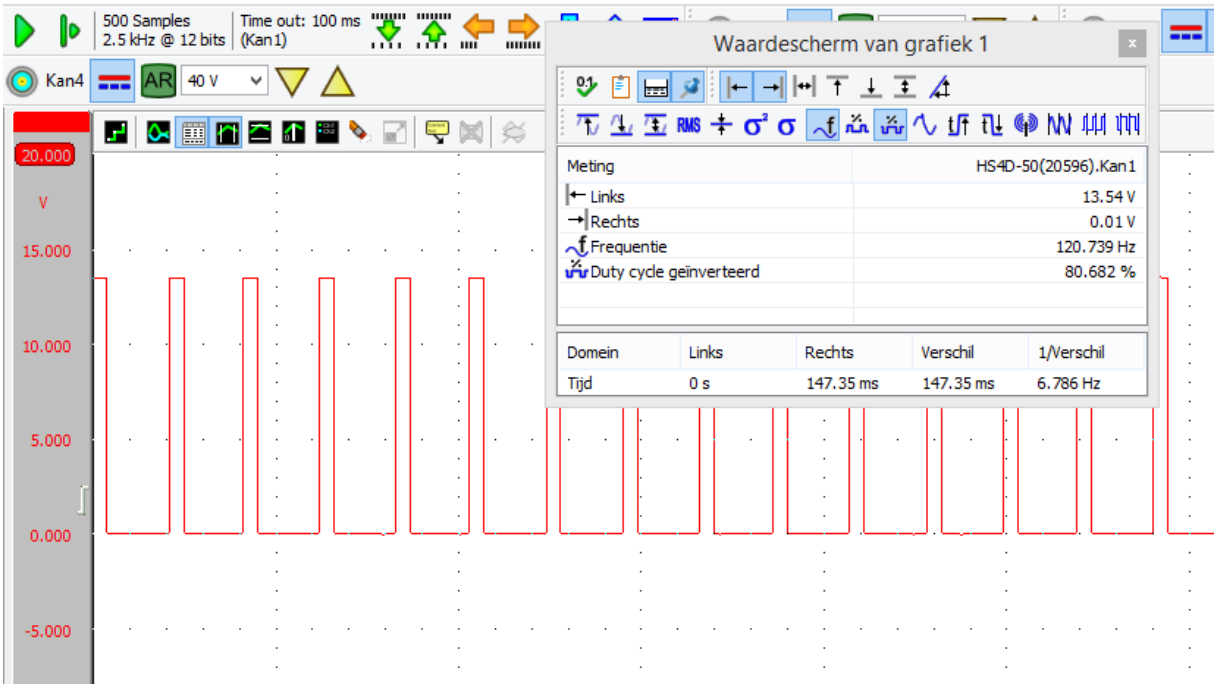
At point 1 there is acceleration whereby the mixture is sent to rich. The voltage of the measuring cell (red) goes for a moment to a slightly higher voltage. The ECU reacts directly by directing the pump voltage (current) to negative, in order to get 450 mV of the measuring cell again. Thereafter, the pump flow stabilizes in relation to the measuring cell. The pump flow, and the associated mixture ratio, is always changing. These changing blend compositions are necessary for the catalyst to function optimally. Then again a slightly too poor mixture (O2 storage). Then again a slightly too rich mixture (O2 react with HC and CO).

When trottle is released, there is no longer a mixture and the signals from the sensor react completely the other way around (point 2). Until the engine runs stable again, this period continues.

This sensor is defective in case of error x/x. The measuring cell is no longer able to send out the 450 mVolt. The pump flow goes to a continuous positive current. This will generate the faulty Pxxxx.

Heating Element Lambda Sensor

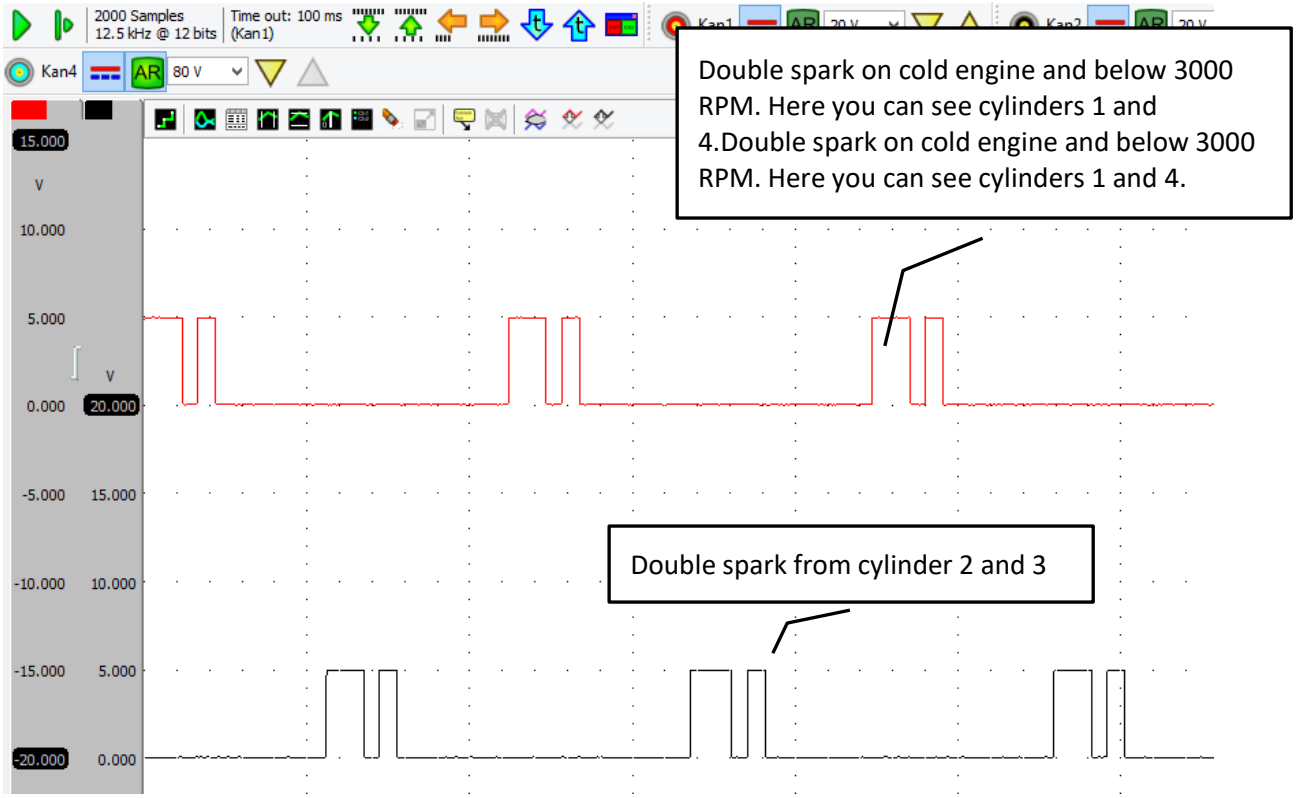
Lambda sensors only work when they are at temperature. The faster the sensor is on temperature, the faster the mixture is controlled. The heating element of both Lambda sensors operate on battery voltage. This battery voltage is on one side of the heating element. The other side of the heating element is switched to ground by the ECU by means of a pulsed Duty Cycle. This pulse has a frequency of 3 Hz and a Duty Cycle of 80% when the engine is cold. When the sensor is warmed up (after 1 minute) the Duty Cycle runs back to 10% so that this sensor does not overheat. In addition, this heating element is a so-called PTC so that the resistance increases during heating.



Ignition Module

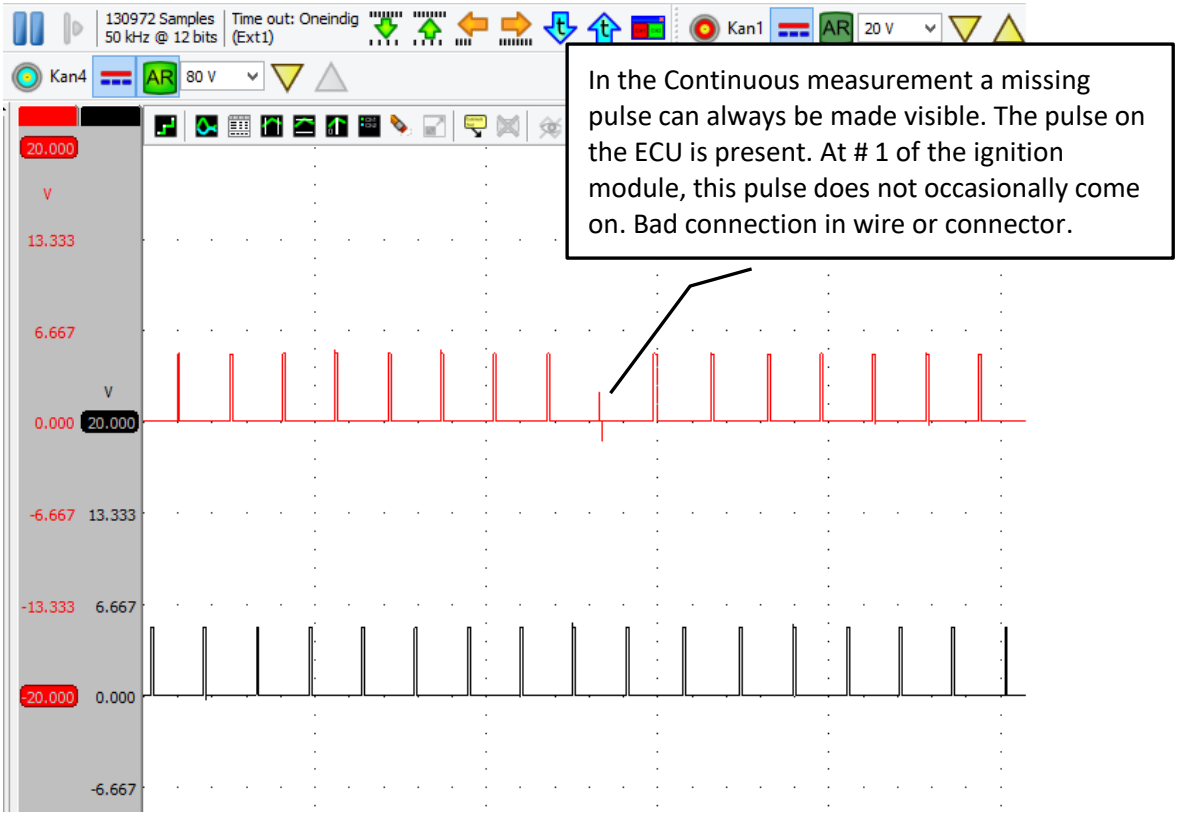
The ignition module of this engine is designed as a DIS ignition coil integrated with the output stages. The pulses from the ECU are 5 volts and the dwell angle is also processed at the same time. When the flank rises, the current rises in the relevant ignition coil. When the flank is falling, the spark arises, in this case sparks cylinder 1-4 simultaneously, and a half crankshaft turn later, the cylinders 2-3.

There is something special present in this management. When the engine is cold (<40 °) and a lower speed (<3000 rpm), the spark plugs ignite twice. This double spark can be seen in the following figure.



Between the first spark and the second is a delay of about 3 mSec.

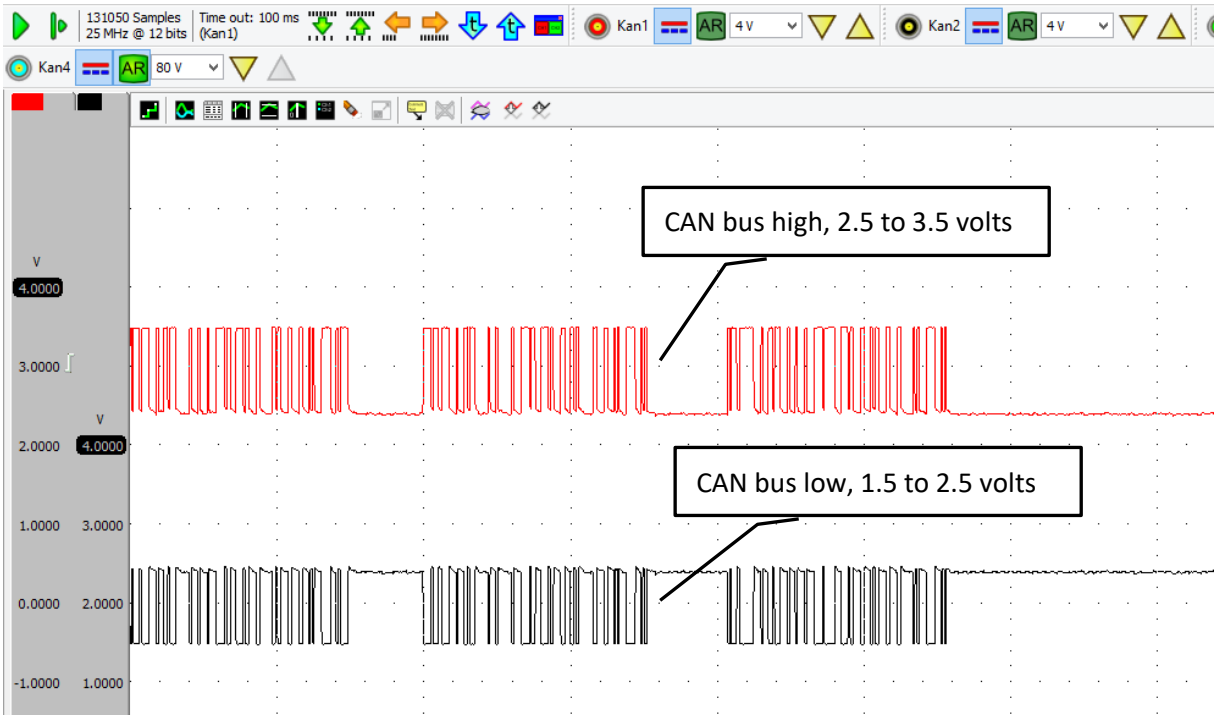
In case of error x/x, the wire between the ECU and connection # 1 of the ignition module is occasionally interrupted. This is clearly visible with the GMTO scope in the "Continuous" measurement. No fault codes are stored in this case.



In case of error x/x, the ignition coil is partially defective. As a result, the cylinders 1 - 4 are not ignited. The fault codes Pxxxx, Pxxxx and Pxxxx are stored.

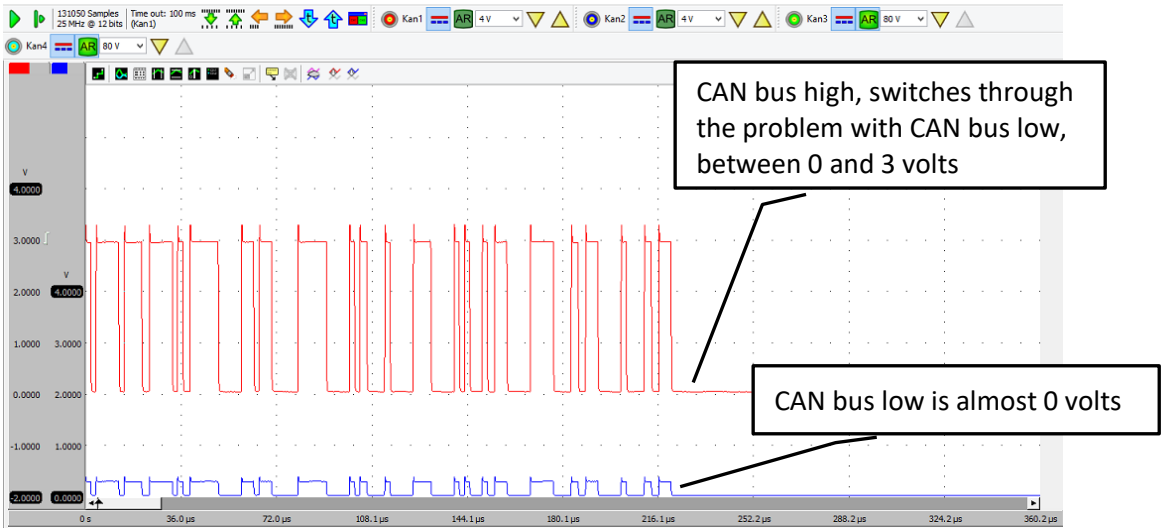
CAN-Bus

The CAN-Bus signal can be easily measured with a 2-channel scope. In the following figure CAN-Bus can be seen high and low.



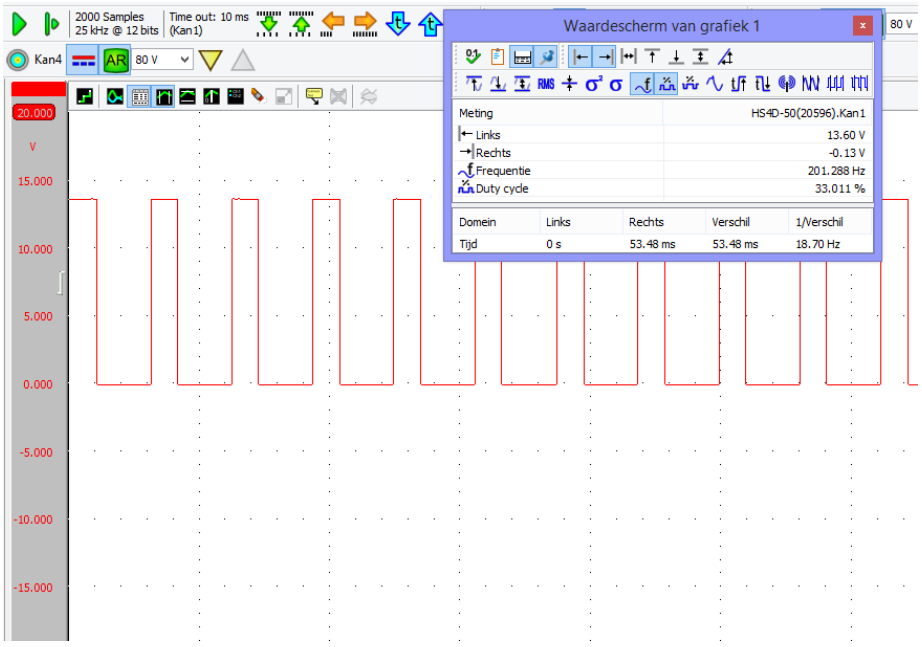
It can clearly be seen that CAN-high switches between 2.5 Volt and 3.5 Volt. CAN low switches between 1.5 Volts and 2.5 Volts. Here you can see a data packet of 3 variable.

In the case of error x/x, the wire of the data line CAN low is almost 0 Volt, this may be caused by a faulty ECU somewhere in the system or if the wire has partial sort to ground. Communication is still possible during this failure. If CAN bus high is sort to ground, communication between the different ECUs is NO longer possible.

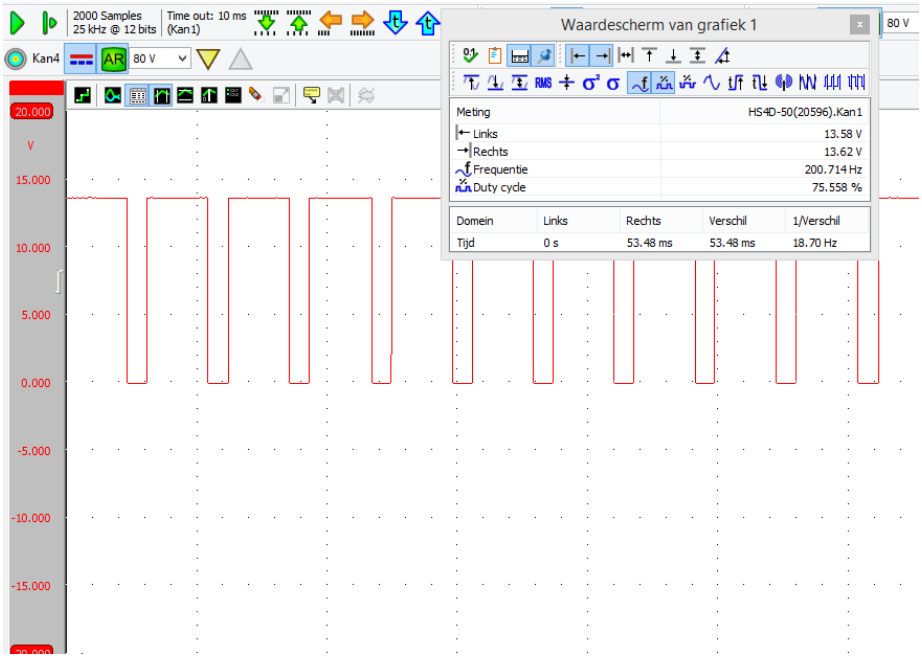


Fuel Pump

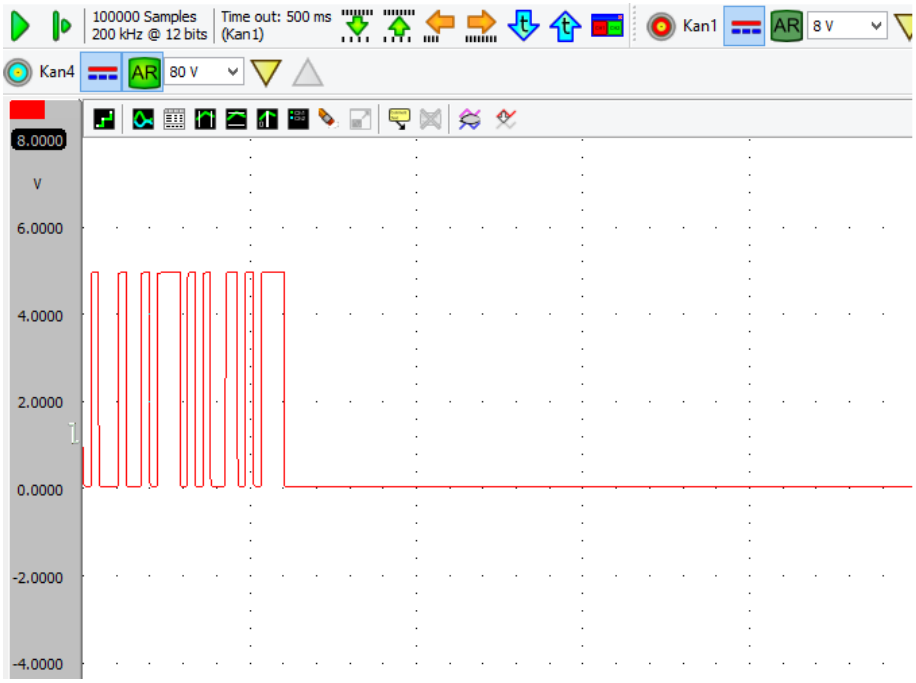
The fuel pump is controlled by an electronic module that can vary the Duty Cycle on this pump according to the engine load. For example, at low load the Duty Cycle will be low and vice versa at high load (fuel requirement). The pump is connected on one side with the battery plus. The other side is switching to ground by means of a variable Duty Cycle. Measure over both fuel pump connections.



At low load, the Duty Cycle is also low (33%) so a low load on the pump. At full power during acceleration, the pump is controlled to the maximum. Here the Duty Cycle is 75%.



The fuel pump-ECU (# 2) has a communication wire with the ECU. On this wire is a serial communication coding of pulses between 0 and 5 volts.



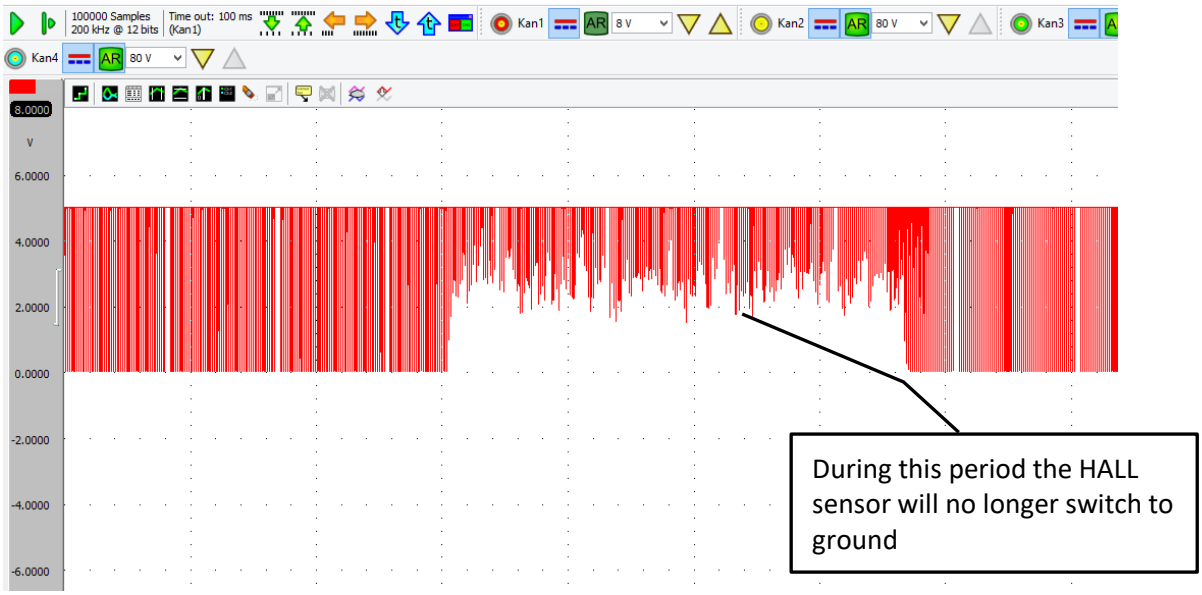
During acceleration a clear change can be observed from the "Datapack". On the basis of these data, the pump-ECU determines the duty cycle on the fuel pump.

After the error x/x has been activated, the engine is switched off. fault code P0627 is read out. A good, stable supply voltage can be measured on wire # 1 of the fuel pump during starting. At # 5 of the fuel pump, 0 Volts is measured during starting. This may indicate a full ground connection, but then the pump must run at maximum speed and the engine must certainly run.

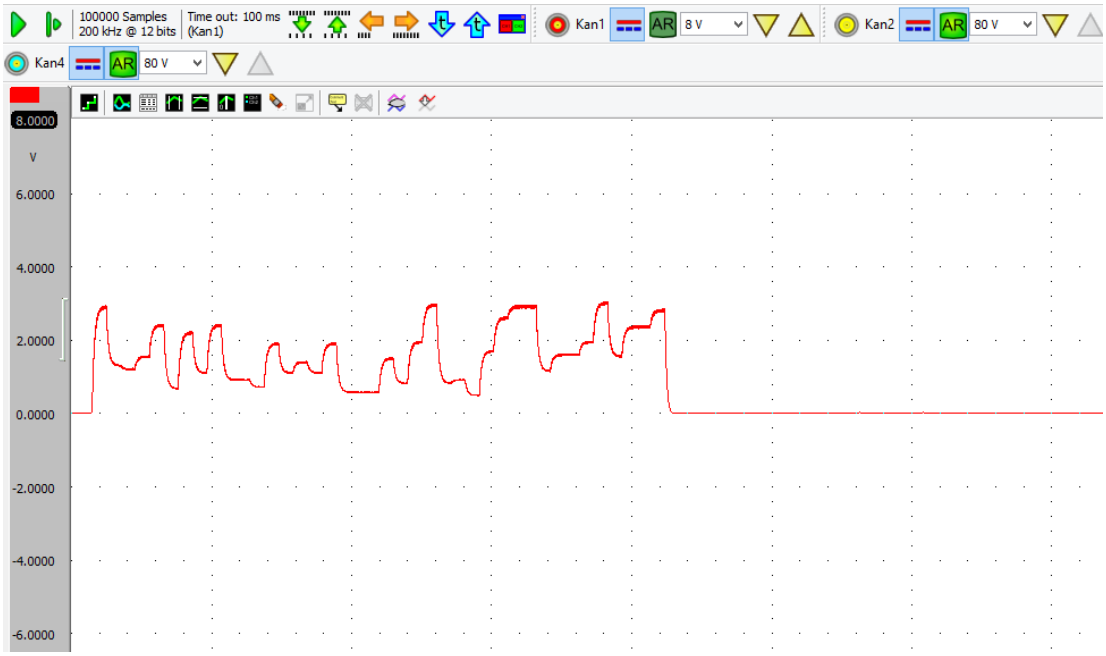
In this case the pump coil is interrupted so that no battery voltage is measured through the pump coil (13.6 Volts part in the Duty Cycle pulse).

Crankshaft Sensor

The crankshaft sensor is of type HALL. The operation is already explained in the first part of this description. With error x/x, the ground of this sensor is occasionally bad. A bad sensor ground ALWAYS gives a signal increase of a sensor, also in this case. The engine stops for a moment when the fault occurs. The car must be driven above 20 km / h to get the malfunction. This has to do with vibrations in the engine at higher loads. This is an, occasionally, bad ground wire between the ECU and sensor.



Here you can see that the ground switching of the HALL sensor sometimes fails. This can be a problem of the sensor itself. To establish this, first the ground and plus connection of this sensor must be measured. From the first part we know that the 5 Volt signal always comes from the ECU and not from the sensor. After checking we arrive at the next measurement.



This voltage is measured at the ground connection of the HALL sensor during the error. We also checked that the ground wire from the ECU is ok. Measurements between the sensor ground wire and the battery ground, with the scope, must normally be 0 volts. A bad connection in a wire will ALWAYS result in a voltage over this wire.

HC Absorption Valve

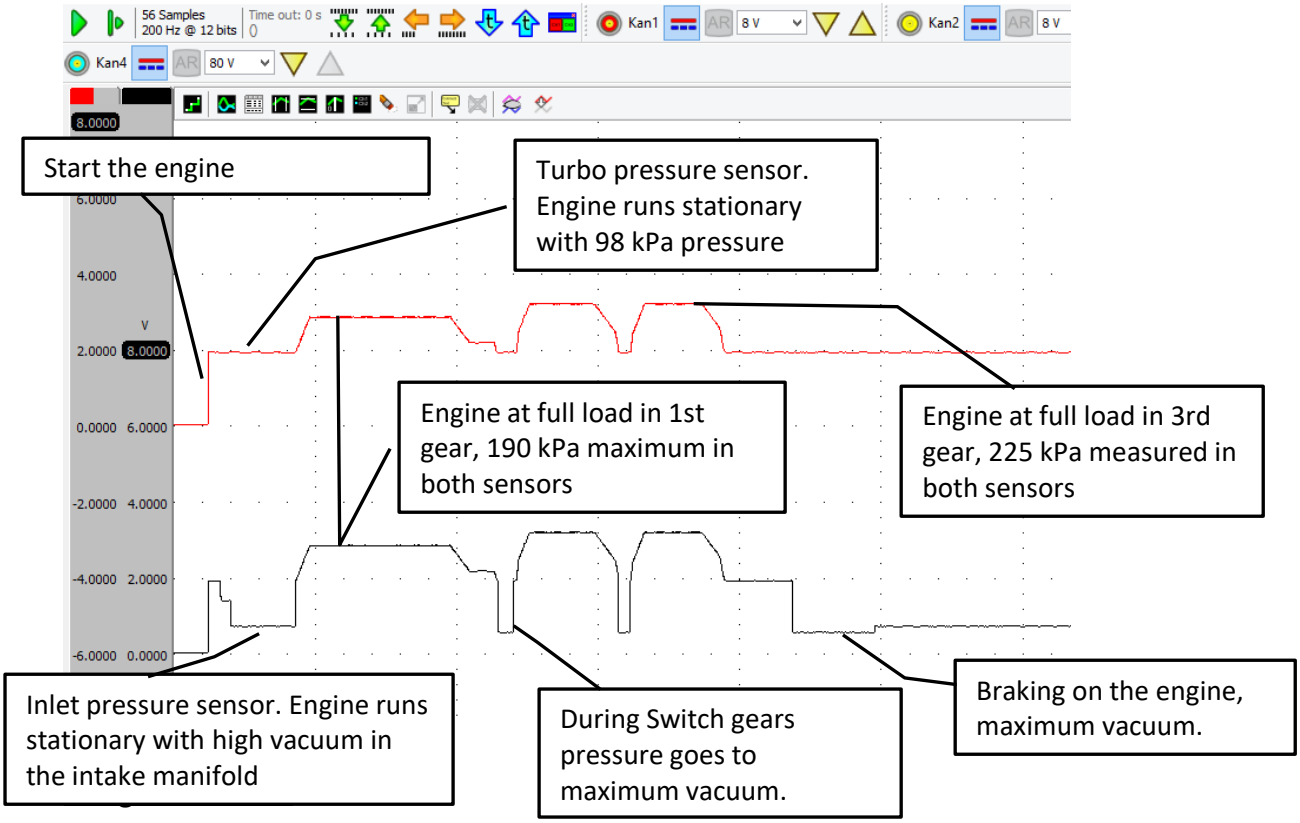
The absorption valve is a valve that, under certain conditions, allows the HC vapor from the tank vent and stored in the active carbon filter to be dosed into the inlet manifold. The cleaning of this filter may only take place at part load and often also in the higher gears. With this engine, this valve opens in 3rd gear and higher. The engine speed must also be higher than 2500 RPM and run at part load. When accelerating, this valve closes immediately. The signal is a variable Duty Cycle of 3 Hz.

Coollant Control Valve

The coolant control valve controls the flow of fluid through the engine. With cold engine, there is hardly any flow through the engine block to allow the engine to reach operating temperature more quickly. The Duty Cycle has a frequency of 100Hz and starts with cold duty with a Duty Cycle of 25%. During warming up, this Duty Cycle slowly increases to about 70% at a warm engine.

Inlet Pressure Sensor

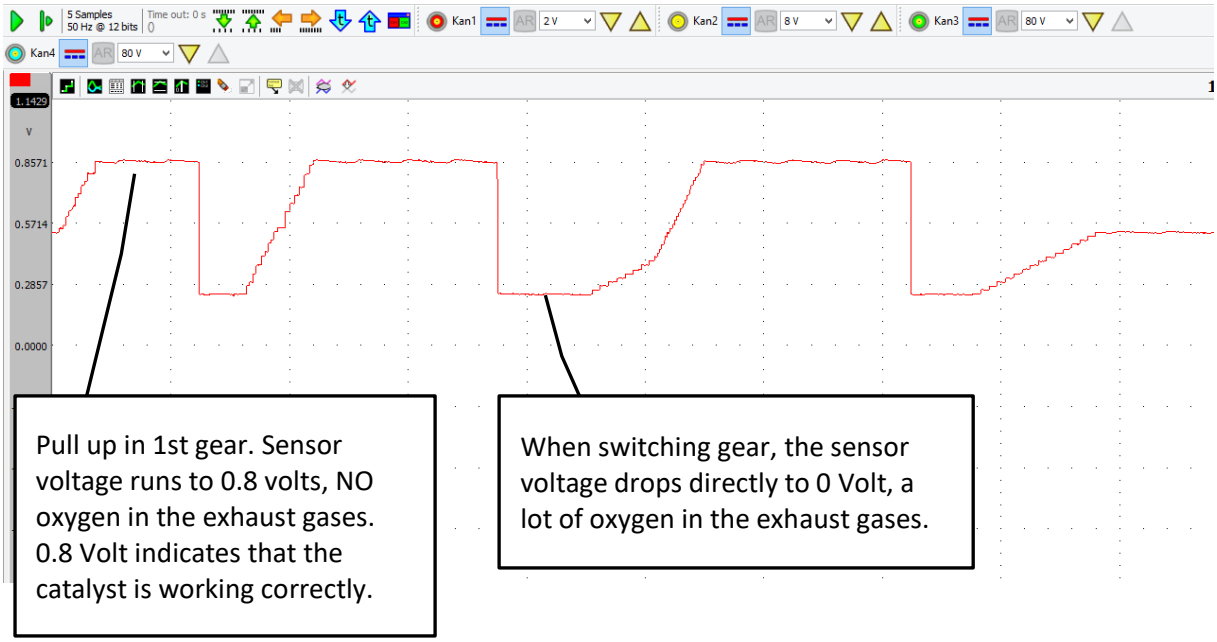
The inlet pressure sensor indicates completely different values when the engine is running at idling than the turbo pressure sensor. After all, the inlet pressure sensor is located behind the trottle valve and the turbo pressure sensor between the turbo and the trottle valve.



The knock sensor is a piezo element sensor that transmits vibrations in the engine to the ECU with AC voltage. Specific engine vibrations that occur during the "knock" are recognized by the ECU, after which the ignition timing is regulated again. This sensor delivers a fixed vibration number. In the next up-date the frequencies will be variable on the engine run.

Lambda Sensor behind the Catalyst

The lambda sensor behind the catalytic converter only has a monitoring function. The used sensor is the well-known "two-jump" lambda sensor that can only detect rich or poor mixture. If the catalytic converter is functioning properly, NO oxygen may come out of this catalyst. After all, all oxygen must have reacted with the HC and CO gases. In practice, the sensor voltage fluctuates around 0.5 volts when the engine is idling.



System Relay

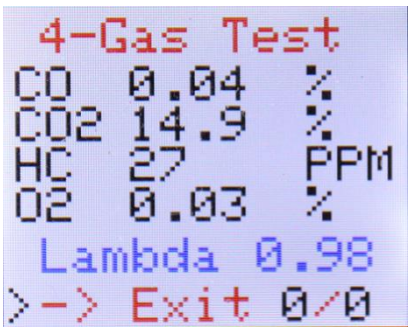
The system relay is switched by the ECU at the moment the ignition switch is turned on (see wire from 15 ignition switch to the ECU). Connection # 86 is switched to ground so that the relay switches on. The voltage on this wire goes to 0.6 Volt (transistor threshold voltage).

When the ignition is switched off, the battery voltage is measured on this wire.

4-Gas analyzer

A 4-Gas analyzer is integrated into the control module. This 4-Gas analyzer can be seen as a real tester and reacts the same as in practice. For example, the gas values vary with cold start, acceleration, deceleration and with malfunctions (including occasional malfunctions). The 4-Gas analyzer can only be used when the car is in the garage, after all, in practice the 4-Gas analyzer can not be driven with.

The screen of the 4-Gas analyzer looks like this



The displayed gas values are from a well running engine.

When decelerating, the gas values go to 0. Only oxygen goes to 20% because it is in the air.

The reaction of the gas values goes faster than in practice. You not have to wait long for changes every time.

In case of error x/x the injector of cylinder 1 is broken and get NOT open. The other 3 cylinders do get normal fuel and there is a normal explosion. As a result, CO and HC values are low. CO2 is lower than normal because cylinder 1 has no share in the firing. Oxygen is high because cylinder 1 only pumps air through the engine and exhaust.

Gas values for this failure are:

CO: 0,04 %
CO2: 11,00 %
HC: 7 PPM
O2: 7,00 %
Lambda figure: 1,40

In case of error x/x, the coil part for cylinders 1 and 4 is broken. This will NOT ignite these cylinders and the engine will not run ok. The other 2 cylinders do have a spark and a normal firing takes place there. As a result, CO and HC values are low. CO2 is lower than normal because the cylinders 1 and 4 do not have a share in the firing. Oxygen is high because it is not used in cylinders 1 and 4. The HC value is much too high because it is injected into two cylinders but no firing takes place.

Gas values for this failure are:

CO: 0,10 %
CO2: 8,00 %
HC: 900 PPM
O2: 7,00 %
Lambda figure: 1,43

In case of error x/x, the control on the ignition block for cylinders 1 and 4 is occasionally interrupted. This will NOT ignite these cylinders and the engine will stop particle for a moment. The other 2 cylinders do have a spark and a normal firing takes place there. As a result, the CO and HC values are low for a moment. CO2 is lower than normal because the cylinders 1 and 4 do not have a share in the firing. Oxygen is high because it is not used in cylinders 1 and 4. The HC value is much too high because it is injected into two cylinders but no firing takes place.

Gas values for this failure are:
CO: 0,10 %
CO2: 8,00 %
HC: 900 PPM
O2: 7,00 %
Lambda figure: 1,43

The Lambda sensor itself is defective in case of error x/x. As a result, the engine runs in limp home mode and has gone to a safe mixture composition and that lies in the rich area. As a result, all gas values are too high.

Gas values for this failure are:

CO: 0,53 %
CO2: 14,50 %
HC: 100 PPM
O2: 0,52 %
Lambda figure: 0,96

Various faults where the exhaust gases also change

At various occasional errors stop the injection. The result is that the gases go to very ARM for a moment. Only in case of error 4/4 (firing on cylinder 1 - 4 not present) the mixture will contain a lot of HC.

In case of error 4/6, the camshaft timing is not correct (too late). The corresponding gas values can be seen in the 4-gas analyzer.

These assignments are dealt with extensively in the assignments, whereby the student gets a good idea of how to use a 4-gas tester when making a first diagnosis.

Freese function at the gas reading

When the engine is running, the 4-gas display can be frozen to see what the gases are under that particular circumstance. To do so, press the "Start" button. Press the "Start" button again to return the current gases to the display.