Digital E85 Adapter
User Manual
(Ver.: 1.00)

The function of the device:

The device can be used for the conversion of gasoline engines provided with electronic engine control unit and electronic individual cylinder pressure injection to a mixed ethanol/gasoline operation, in case of non-low impedance injectors. It is not suitable for the conversion of engines of direct injection (GDI, FSI, TFSI). Simple installation and a wide range of programming designed the adapter into one of the lowest cost but representing the highest technical standards for the conversion of the environmentally friendly bio-ethanol.

Specifications:

- Size: 100 * 40 * 40 mm (length * width * height)
- Weight (with cables): 180 to 240 g (depending model)
- Operating temperature: -20 to +80 °C
- Power supply: 12 VDC (8 to 18VDC) nominal, max. 35 VDC for a short time allowed
- Standby consumption 35 mA – it has a consumption only in case of ignition
- Injector: minimum 10 Ω per channel, up to 1,5 A/channel
- Temperature sensor: 10 kΩ NTC temperature sensor
- Terminals: one male-female slide-shoe for each channel, plus a power source.
- Optional analogue input (E85/gasoline sensor or potentiometer): 0 to 5 VDC

Ordering options:

- 3-cylinder design without external ratio sensor/control signal
- 4-cylinder design without external ratio sensor/control signal (standard)
- 6-cylinder design without external ratio sensor/control signal
- 8-cylinder design without external ratio sensor/control signal

- 3-cylinder design with external ratio sensor/control signal cable
- 4-cylinder design with external ratio sensor/control signal cable
- 6-cylinder design with external ratio sensor/control signal cable
- 8-cylinder design with external ratio sensor/control signal cable

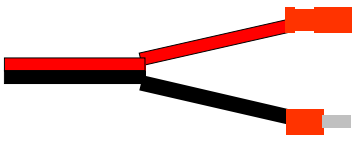
The external ratio sensor/control signal input is built in all of the devices but its cable is not connected, because in most cases there is no need to accurately measure or set the E85/gasoline rate with a potentiometer from the passenger area. This may be required only in case if the device is used in a country where the bio-ethanol filling station network is barely established, so the opportunity to refuel the car with gasoline or bio-ethanol is totally rhapsodic. Normally the conversion to purely bio-ethanol operation is done after the first refill with bio-ethanol, so it is not necessary to pay attention to and adjust the rates.

Wiring Guide

First, check the engine state of the vehicle. It is essential to have the lambda probe, the air mass sensor or MAP sensor, the temperature sender, the injectors and the ignition of the vehicle in a perfect condition in order to ensure the errorless operation of the ethanol-converter and the optimal ethanol consumption. In case the vehicle is not in a perfect engine state, the car may have a hard cold-start and large-scale additional consumption or even power loss may occur when using E85 fuel.

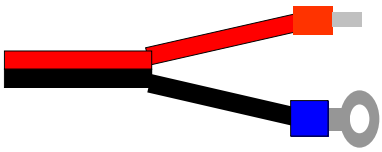
Find the location of the fuel injector valves (shortly: *injectors*) in the engine compartment. They are typically located at the junction of the air intake manifold and the cylinder head. The suction piping design and the location of the injectors may be different in different engine types. In any case, you must know the engine control system. The resistance of the injectors provides also a lot of information. A simple multimeter can also measure if we have to deal with injectors having a resistance higher than 10 Ω. Caution: the device is not recommended to be used for drive of central injectors!

Wiring of the device



Injector signal output with **FEMALE** connector (to injector)

Injector signal input with **MALE** connector (ECU side)



12V power supply (12V ignition switched on) (+)

Battery negative point (–)

(a thinner black-and-red twin wire with a 10 kΩ NTC thermistor in heat shrink tube)

Determination of the control wire of the injector

One of the two wires of the injector is the +12V power supply and the other is the negative control signal. The device processes and forwards this latter, that is why the control wire has to be determined. Typically, the +12V wires are of identical colour and the controlled wires are of different ones.

The controlled wire can be:

- one-coloured but different colour for each injector, diameter equal or thicker than the others (e.g. grey, white, orange, black; or there can be e.g. two grey and two black ones, in this case two-two cylinders get identical control, so it is enough to have only two channels connected.)
- two-coloured but different colour for each injector, diameter equal or thicker than the others (e.g. grey and blue, grey and green, grey and white)
- one and two coloured mixed

Identification can be done with a LED light continuity test. A 12 V LED lamp or a LED with a current limiter resistance is to be cut in between the controlled wire and the +12V of the battery, its polarity of course to be taken into account. The tester ends with a reasonably robust pin or needle. With the engine running you should see the flashes. Bulbs are not suitable for this purpose, because they cannot display the short term idling flashes.

Preparation of wires

In case you made sure of having found the controlled wires and you have no vehicle-specific cable installer set with special connectors matching injectors, you need to:

- ► Cut them with cutting pliers
- ► Skin both ends (thick wire: in ca. 5-6 mm length then twined; thin wire: in 10-12 mm length then twined and folded in half to ensure sufficient thickness for bearing a shoe)
- ► Put MALE shoes on the injectors side
- ► Put FEMALE shoes on ECU side
- ► Press the shoes professionally with shoeing/crimping pliers (e.g. HandyTools) onto the wire ends and ensure the stability of the joints. Check by pulling the wires that they do not slip off from the shoes.
- ► Seek an ignition switched 12V for the device (it can be the positive strand of the injectors, the power supply of the ignition module, but it CANNOT be the supply of the throttle valve). This should remain on after the start of the engine. (it can be tested easily but carefully with a pin) A permanently switched-on 12V or a direct battery branch is not suitable, first because it discharges the battery in idle state, second because the device would not detect the ignition.
- ► Make a T-junction from this 12V with a FEMALE shoe; the device will receive the power from here.
- ► Insert the wires of the device to the appropriate places, the FEMALE shoe of the black and red injector wires should be connected to the injector, their MALE shoe should be connected to the ECU (pay attention to the adequate pairing for each cylinder).
- ► Connect the power supply, grounding and heat sensor wires of the device. When connecting the grounding, select the location very carefully, because in extreme case, even 5-6A peak current can flow here, so if the grounding wire is long or of high resistance, the voltage drop can disturb the proper operation. The grounding wire – contrarily to the supply line – can be connected directly to the battery, under one of the battery clamp screws.

Positioning of the device

Place the device in a way that it is not exposed to splashing water and radiant heat (exhaust tube, turbo bent tube). The wires should reach the injectors up to the grounding-point, and ensure enough place that the heat sensor could be fixed onto the heater pipe.

Positioning of the temperature sensor

Place the heat sensor to a location (e.g. heater pipe, cylinder head) where it can detect the engine temperature and the wind does not cool it back. It is recommended to wrap tightly with aluminium foil and then with a hairy fabric bandaging tape. Plastic binding thread can also be used for fixing.

Bandage, fixing wires

When fixing the wires, make sure that they do not touch sharp corners, moving parts, that there are no cracks in them, that their contacts are not pressed by anything and that the wires are not strained. Use in every case hairy fabric bandaging tape and binding thread. Conventional PVC insulating tape is not suitable: it does not tolerate nether heat nor oily media, so it becomes slimy and deliquescent, and after a short time it unreels automatically and drops off.

Inspection, first start

Examine the connected wires, check if all cylinders are connected, the control wire and the +12V are not changed over, the power wire is in place and the grounding wire of the device is carefully grounded.

The device should be in gasoline mode by default, so the engine should start immediately.

Typical errors

- Wrongly determined motor type, Peak&Hold motor control.
- The +12V and the control wire are reversed
- Bad grounding
- Temperature sensor is not connected (it has no role in gasoline operation)
- The ignition-switched supply is not switched on or is terminated after the start of the engine. (This is the case of the supply not taken from the injector). To be checked.
- If one cylinder does not work, the cause can be a wire torn out of the shoe or the +12V and the control wire are reversed.
- The device is switched to ethanol operation, but there is still gasoline in the tank (In gasoline operation state, all LED lights have to be off after ignition, ethanol level should be zero).

Precautions

- Be careful when installing the device, keep in mind that there are electrical cables, brake fluid and fuel pipes in the engine compartment. Find in advance an appropriate installation place where the device is not exposed to direct moisture and excessive heat as far as possible.
- When cabling and fixing cables, watch that the cables do not touch hot surfaces, moving parts and sharp corners. The cables should not be able to resonate or to move, because vibration causes cracking in course of time.
- The device should never be blown off with high-pressure washer because it can drench and that may cause a damage to the product.
- Before installation, always remove the ignition of the car, or disconnect the negative battery connector (except when you want to check the injector polarity).
- Check the fuel pipes and seals and if you observe cracks or leaks, replace them immediately.

The seller and the distributor do not assume any responsibility for the damages occurred in the car or in the product caused by faulty installation, and due to faulty installation of the device the product warranty may also be compromised.

Wiring of E85/gasoline rate sensor (optional)

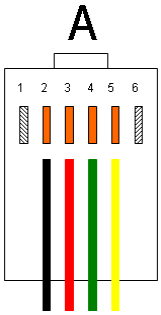
The rate sensor has three outlets:

- Red: +12V supply line. It is to be connected either to the ignition switched +12V or to the +12V power output of the E85 adapter (yellow wire).
- Green: Ration sensor output (0 to 5V i.e. 0 to100% E85 rate)
- Black: ground wire

Wiring of E85/benzin rate adjustment potentiometer (optional)

The rate adjustment potentiometer is a linear potentiometer of 1 to10 kΩ resistance that should be connected between the +5V and the ground; its central contacts gives the signal output. It is proposed to use a twin-core shielded cable (known as microphone cable) for the connection where the shielding is the grounding wire as well.

Wiring of E85/benzin rate sensor/control signal cable (optional)



The control signal cable has four outlets:

- Yellow: +12V supply line, not fused!
- Red: +5V supply line, max. 10 mA!
- Green: Input (0 to 5V i.e. 0 to 100% E85 rate)
- Black: Ground wire

Its connector is a standard 6-pin RJ11 plug connector; known as “phone jack”. Its counterpart can be easily acquired in any electronics/computer specialist shop, installed in outlet-box, with screw clamps.

Control signal input enabling (optional)

Enter service mode by pressing both buttons at the same time for at least 5 seconds during operation. When releasing the buttons, all LED-s have to be off; this is the E85 rate adjustment option in the menu. Now shift with the + button so many that all four LED-s blink. After restart, the current E85 content can be tracked by the LED-s of the device.

Programming description

There are two buttons and four LED-s on the front panel of the device. You can handle a menu system with them that helps setting and controlling the device, and it allows you to set the E85/gasoline rate during operation. The device is operates in two modes: in **normal** mode only the E85/gasoline rate can be set and there is no menu system; in **service** mode all functions of the device are accessible. Service mode can be enabled by pressing both buttons at the same time during operation for at least 5 seconds. Moving in the menu is also performed by continuously pressing the buttons; in such case it steps to the next screen in 0.3 seconds; the active display is shown by the blinking LED pattern. There is no exit from the service mode, for exit, you have to disconnect i.e. remove the ignition. There are two further specific states, they are diagnostic modes: when switching on the device, if you keep pressed the + button, the device will show the cabling test, and if you keep pressed the – button, the heat sensor's test is displayed. The possible setting in **service** mode of the device:

0 LED blinks:	Selection and display of E85 rate
1 LED blinks:	Set extra opening time for running mode belonging to 100% E85
2 LED-s blink:	Set maximum of cold start extra opening time
3 LED-s blink:	Set cold start time interval length
4 LED-s blink:	Set cold start mode

When entering in normal mode, after switching on, the device displays the firmware version for 3 seconds by blinking LED-s. The LED-s should be read from the left, from the direction of the smallest value. The possible versions are:

○○○○ code 0., versions prior to 1.00 ✸○○○ code 1., version 1.00

0 LED blinks: set and display E85 rate

If the external input is not activated or you are in service mode, shortly pressing the +/– buttons will step forward the E85 rate value. Stepping varies between 0% and 100% with 25% steps. In service mode, there is a further setting as well, when all LED-s are blinking. The external E85 sensor or potentiometer can be enabled by that. In case of this function enabled, pressing the button has no effect, only the display function is on, showing also in 25% steps the E85 rate.

1 LED blinks: Set extra opening time for running mode belonging to 100% E85

You can step forward the extra opening time belonging to 100% E85 from 24%, in +2% steps by shortly pressing the +/– buttons. This means 24% in case of 0 LED, 32% in case of 4 LED-s while the default 2 LED-s will mean 28% extra opening time for running mode.

2 LED-s blink: Set maximum of cold start extra opening time

You can step forward the cold start extra opening time curve peak by shortly pressing the +/– buttons in the following manner:

In Boost mode: starting from 320%, in 20% steps that is the cold start extra opening time curve peak will be 320% for 0 LED and 400% for 4 LED-s.

In injection mode: starting from 180%, in 20% steps that is the cold start extra opening time curve peak will be 180% for 0 LED and 260% for 4 LED-s.

The cold start extra decay time can be set in the next option; these two parameters have to be set on the basis of the size/weight of the engine depending on how fast the engine is able to reach its operating temperature and on what level can it work under operating temperature..

3 LED-s blink: Set cold start time interval length

You can step forward the cold start decay time interval from 90 seconds in +30 seconds steps. This means that the cold start decay time will be 90 sec in case of 0 LED, it will be 210 sec in case of 4 LED-s while the default 2 LED-s will mean 150 sec cold start decay time.

4 LED-s blink: Set cold start mode

You can step forward to the four possible settings of the cold start mode by shortly pressing the +/– buttons as follows:

0 LED on:	No cold start mode
1 LED on:	Immediate injection algorithm
2 LED-s on:	Ignition injection algorithm
3 LED-s on:	Boost mode, 4 seconds decay time (default)
4 LED-s on:	Boost mode, 10 seconds decay time

Injection mode is a function facilitating the cold start. It provides an injection to each of the four cylinders an injection of time interval specified in a table in function of the start-p temperature in order to ensure the immediate start of the engine.

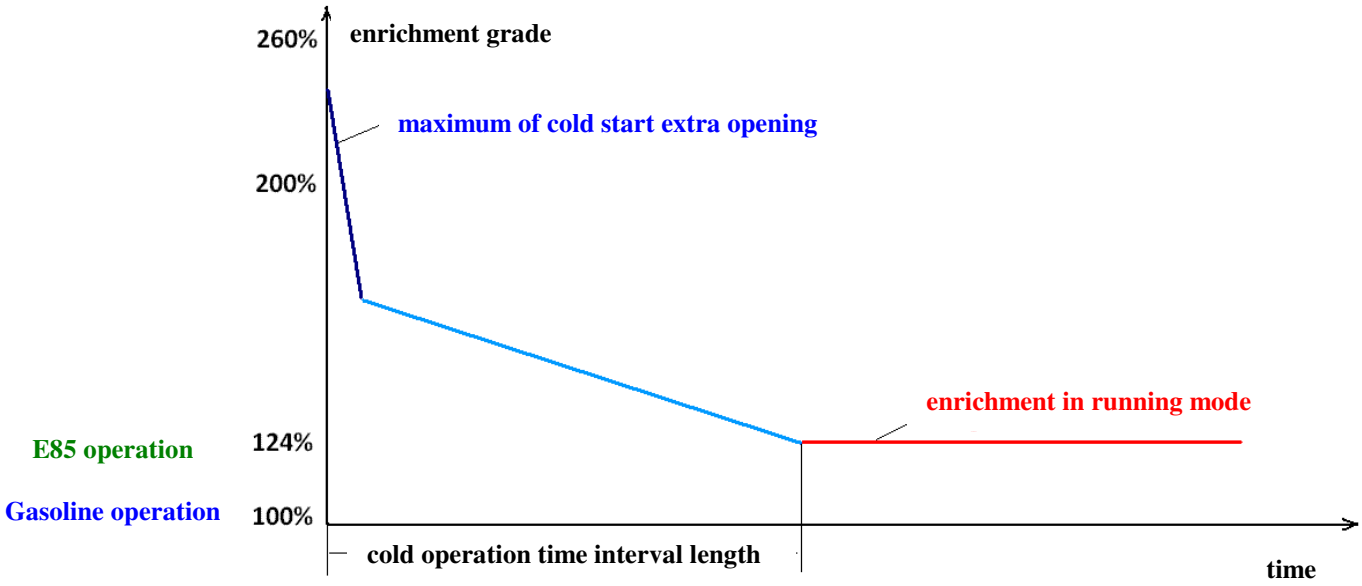
In the **Immediate** injection position, the device gives a shorter injection immediately when switching the ignition, and after that it adds the normal cold start enrichment to the injection given by the ECU. These two together should be sufficient for the sure start. However, in need of fine-tuning, it can be furthermore modified in 75-135% extent by changing the cold start enrichment.

In **Ignition** injection position, the device waits for the injection of the ECU and then "replaces" it to its own one. In this case, as well, it can be fine-tuned in 75-135% extent by changing the cold start enrichment.

In **Boost** position, the device does not give injection, but first it lengthens the impulses given by the ECU with the set, high amount cold start enrichment, and after that, continuously reduces the cold start enrichment extent to its one-third in 4 or 10 seconds. After that, it reduces this value to zero in the set cold start decay time interval.

Finally, in **None** position, the engine starts only with the normal cold start enrichment, there is no injection or Boost mode.

Explanation of enrichments:



+ button: Injection inputs status

When connecting the black wire of any of the inputs to ground (by touching the car body or any metallic part with it), the LED allocated to the input should give light. It serves mainly for testing and debugging purposes.

– button: Temperature display mode

The device can display 7 temperature ranges as follows:

①②③❹	above +60 °C
①②❸❹	+45 to +60 °C
①②❸④	+30 to +45 °C
①❷❸④	+15 to +30 °C
①❷③④	0 to +15 °C
❶❷③④	–15 to 0 °C
❶②③④	below –15 °C

In case of NTC resistor higher than 470 kΩ it indicates a break, i.e. the ❶②③④ display is blinking. In case of NTC resistor lower than 680 Ω it indicates a short-circuit, i.e. the ①②③❹ display is blinking. In principle, it could occur in case of a temperature exceeding +100 °C because the maximal measurement range of the thermometer is –55 to + 150 °C, but in practice, it is not imaginable that the engine temperature reaches this value.

Control: in room temperature: ①❷❸④ display, put under the tongue: ①②❸④ display, pressed between ice cubes taken out of the freezer (-18 °C): ❶❷③④ display, gently heated with a lighter: blinking ①②③❹ display.

Other comments

The device manages the injector dead time (DeadTime); its value is 0,6 ms. This means that the ECU detects the current running-up on the injector and it considers the injector status open only when the current has reached a certain level, so it measures the injection length from that point. But as the input of the E85 adapter does not have any inductance, contrarily to a real injector, the current running-up will be immediate, so the ECU gives shorter pulses to the E85 adapter than it should. That is why the E85 adapter always adds this dead time to the calculated opening time. If the incoming pulse width is shorter than the dead time, the device does not change the pulse width.

When using the device, the ECU may display error signal on its diagnostic display. It is likely in case if the E85 adapter sets too small or too large change in the injection. Based on the signals of the lambda probe, the ECU detects and corrects it. In case of proper setting, the ECU does not detect any abnormality, so the error signals are eliminated. Based on the experience to date, no case of incidental failure of the ECU was attributed to operation or circuit implementation of the E85 adapter, so you don't have to be afraid of this or of any error signals displayed.

The E85 adapter is prepared with various fuel injection algorithms helping start-up. This algorithm calculates from a curve family an enrichment at the start-up in function of the engine temperature and the gasoline/E85 ratio. Then, it starts with cold-start enrichment and after that, it uses only the running enrichment. This ensures that the engine starts surely and possibly at first try in all weather conditions, but the fuel consumption also remains optimal.

Although some manufacturers exclude any warranty claim if the car was converted and used in bio-ethanol operation, currently there is no real observation as to whether any amount of pure bio-ethanol fuel is harmful to the operation of automobiles. It is not likely anyway, because bio-ethanol is already mixed into the gasoline in a 5-15% ratio in many countries, so "pure" gasoline fuel does not mean complete exemption from bio-ethanol. There is only one exception: certain contaminations may have accumulated in the fuel system of a car used in gasoline operation for a longer time. These contaminations are not disturbed by gasoline, but the bio-ethanol dissolves them. It has already occurred that this caused the fuel filter of the vehicle clogged and requiring a cleaning after conversion to bio-ethanol operation. Subsequently, this phenomenon is not repeated again.