DIAMEX Scandevil

English Manual

MULTI - ANALYZER

TABLE OF CONTENTS

1.0 Scope of Delivery

1. Analyzer Scandevil
2. Black case
3. OBD standard cable
4. USB cable mini
5. Manual
6. Software: full version of moDIAG express as CD

1.1 Technical Description

OBD2 diagnostic adapter as handheld device
3 devices in one:

1. OBD2 diagnostic mode (handheld)
2. Error scanner including deletion function
3. PC interface, compatible with AGV4000

Handheld Functions (without PC):

- Automatic or manual choice of the OBD2 protocol
- Reads and displays the most important vehicle data (depending on the vehicle)
- LIVE data
- displays the VIN if supported by the vehicle
- Vehicle and brand database
- Reads and displays the error code memory
- Reads and displays freeze frame data
- Deletes the error code memory
- Readiness code / vehicle monitoring (appendix E)
- Real time clock
- Special display function

All important OBD2 protocols for cars are supported:

ISO9141-2
ISO14230-4 (KWP2000)
J1850 PWM
J1850 VPWM
ISO15765-4 (CAN, 11/29 Bit, 250/500 kBaud)

- Electricity supply via the OBD2 socket in the vehicle or via USB
- USB2.0 compatible PC interface
- Micro-SD Card interface
- 3,2“ TFT display
- Acoustic signals to support the display
- 2 LEDs to display status and data flux
- 4 buttons to operate the device
- Dimensions of the analyzer: 70x115x30 WxHxD, about 150g

The installed boot loader makes a bios update via USB interface possible. This way, the Scandevil can be improved and functions can be added. Special software is necessary to add updates or upgrades. Please contact your retailer or have a look at our website www.scandevil.de. That is why it is easy to update the Scandevil with a normal Windows PC.

1.2 Security Note

In any EU member states it is not permitted to operate this diagnostic interface while driving.

1.3 Liability Note

The manufacturer is not liable for damages which may be caused by the Diamex Scandevil and the utilized diagnostic software.

2.0 On Board Diagnostic OBD2

(**O**n**B**oard**D**iagnostic) is part of the EU regulations for newly registered and spark ignition engine driven vehicles since 2001. Diesel vehicles were also equipped with this modern diagnostic interface since 2004. EOBD is the European standardization of the OBD2 interface.

The norm allows different protocols to occur. However, the analyzer is able to scan and recognize different protocols on its own. This automatic mode is very useful because one only has to make sure that the car has an OBD2-compatible ECU (engine control unit).

The location of the OBD2 interface is fixed. The norm states that it has to be located within one meter around the driver's seat and that it has to be easily accessible. Unfortunately that is not always the case. Some of the manufacturers tend to hide their OBD2 interface behind covering. There are databases available in the Internet which help you to find the exact location [8].

With the help of OBD2 it is possible to perform extensive diagnostics which span several types of cars. It is disadvantageous that model-specific errors do not need to be provided by the manufacturers. It is possible that specific errors cannot be recognized by the OBD2 diagnostic and then one has to consult special tools from the manufacturer which can only be provided by garages.

The ECU creates different sensor readings. When one combines them one can draw conclusions about the functioning and condition of the vehicle. Even the performance and different variations of current depictions can be derived from sensor data. Sensor data is permanently provided and can be read by an analyzer. The sensor data is being denoted as PID (Parameter Identifier Definition) and is being numbered with a standardized hexadecimal number.

Error codes always indicate that there is a deviation from the normal condition of the vehicle. The ECU automatically saves the error codes when the deviation reaches a certain level. To simplify the search and evaluation of the errors the ECU saves the error environment of every saved error. These so-called freeze-frames show, for example, which velocity, number of revolutions and engine temperature the car had when the error was found. Now one is able to determine which circumstances might have caused the error to occur. In fact, one does receive a list of data but no suggestions for a solution.

Subsequently utilized database software generates possible solutions. It contains type-specific and general information plus extensive instructions. This kind of software has to be updated frequently and that is why it is only useful for commercial users, for example, "autodata" [6].

2.1 What is OBD2 incapable of?

Airbag, ABS, maintenance interval and comfort resets cannot be implemented with OBD2.

OBD2 analyzers are generally not suited to read or reset security-relevant notifications or error entries. This also relates to maintenance intervals and comfort electronics.

Neither ABS nor airbag displays can be turned off. Maintenance intervals are being reset by a garage or by a specialized analyzer.

Changes of the comfort electronics can only be performed by special manufacturer-specific aids.

These actions are not connected to OBD2. They were purposely not included in the OBD specifications. That is why no manufacturer has to make the necessary commands available.

Quotation: "But garages can change it over the OBD2 socket, too."

The OBD2 socket has lots of pins which are not being used for OBD protocols. Usually the communication with the ABS and airbag control units separately runs through these pins. This communication is encrypted and secured several times so that a simple OBD2 access is impossible.

2.2 Operational Range

The main area of an OBD2 analyzer is reading the saved error codes of the ECU and the related error environment (freeze frames). Altogether this leads to a dynamic evaluation of the occurred error. If an error occurs and it is being stored in the error memory, important sensor data at the instant of the occurrence of the error is also being saved.

2.3 Protection of the OBD2 interface

The OBD2 interface in the vehicle is protected very well by special protectors. It is not known of damage which was inflicted by an inserted diagnostic device yet.

OBD-DIAG analyzers contain robust exits and entrances that are reliable. Nevertheless one should keep a certain order of actions to avoid static discharges. It suffices to hold the diagnostic device in one hand and to touch the bodywork of the car with the other hand ***before*** inserting the analyzer. This way no static voltage can build up.

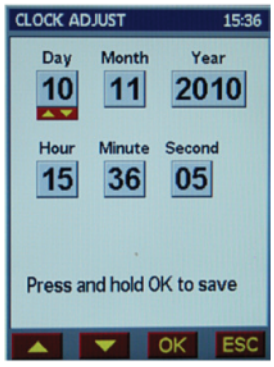
3.0 Manual OBD2-Analyzer Scandevil

3.1 Functioning of the Display

The OBD Analyzer is a diagnostic instrument which works with different types of vehicles. Based on the EOBD2 specification there are basically different approaches for a vehicle diagnostic. A more complex diagnostic always requires a longer time to familiarize oneself with it. This depends on the chosen mode.

When the Scandevil is inserted in the USB or diagnostic interface for the first time the language selection is displayed. Please choose the language and press OK.

The menus are divided into main and submenus. Select “settings” in the main menu. There, several parameters can be adjusted, for example, the display’s brightness or the settings of the real time clock.

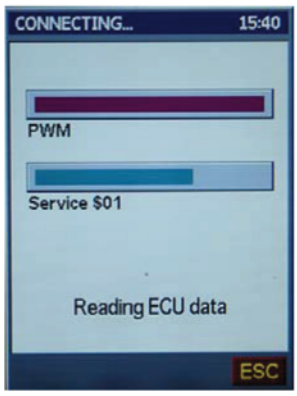


3.2 Functioning of the Keyboard

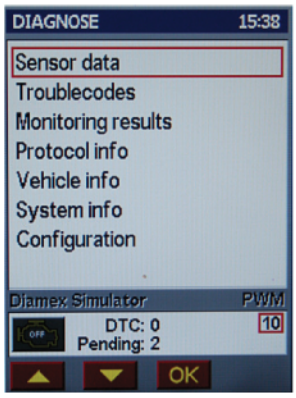
There are four buttons for an effective operation. The selectable options depend on the different menus and are displayed above the button.
The buttons also have master functions:

- Press the right button longer – system reset and restart
- Press the button in the middle and insert a USB cable – bootloader for updates (OBD not connected)
- Press left button and the left button in the middle, then connect with USB or OBD – master reset, original delivery condition

4.0 Operation as a Handheld Analyzer (Stand-Alone Mode, Handheld Mode)



1. Firstly, locate the OBD socket of the vehicle (appendix D).
2. Now the analyser is connected to the diagnostic socket. The analyzer boots and shows that it is ready to be operated.
3. **Turn the ignition on.**
4. "Start diagnostic" with the **OK** button – in the automatic mode the protocol is displayed automatically and exhibited for an instant.
5. If it was successfully connected the diagnostic menu is visible.
6. Error memory, the error environment (freeze frames) and vehicle identification number (only if supported) can be read now.
7. **Start the engine.**
8. Sensor data which is supported by the vehicle can be read and displayed live.
9. A graph display is freely selectable. Hint: this function will be expanded step by step with forthcoming updates.

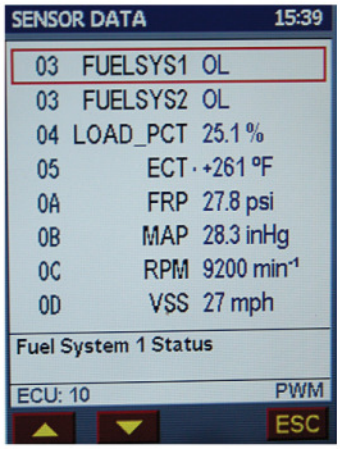


For error codes see appendix. "No connection to ECU" hints at a vehicle which is not OBD2 capable.

*) there is a peculiarity about vehicles with an empty PID list: some vehicles display a list filled with zeros after the sensors were read. The norm states that this condition is not allowed. That is why all PIDs can be selected after one another. If the chosen PID does not respond with any values there is the error message "no data".

10. MIL=On error 1/1 means that error codes which include at least one severe error were saved.
11. Error codes (DTC) can be selected individually then. The error text is exhibited on the display. The error text of approximately 15,000 error codes is included. Errors which are only displayed as codes can be identified with the help of an error code list (see table or Internet database).
12. The error environment variables for every single error are saved in the error memory. Thereby one can recognize at which point of time and under which conditions (environment) the error appeared for the first time. Every error can be related to several of these variables. With buttons **1** and **2** once can scroll through "freeze frames" for the respective error.
13. After the error was fixed physically the error memory can be reset and therewith deleted. Please note appendix E: readiness code.

4.1 Protocol Selection



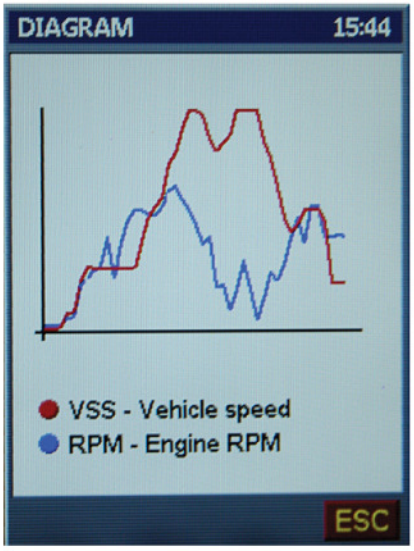
Possible scan modes:

- 0: car – automatic mode – recommended type of operation
- By using **>>** the manual mode can be selected.

In the manual mode the following protocols can be pre-selected:

- 1: J1850 PWM
- 2: J1850 VPWM
- 3: ISO9141-2
- 4: KWP2000 5-Baud (slow init)
- 5: KWP2000 fast (fast init)
- 6: CAN 11b/500kb
- 7: CAN 29b/500kb
- 8: CAN 11b/250kb
- 9: CAN 29b/250kb

Hint: Some manufacturers only enable reading the vehicle identification number if the ignition is turned on and the engine was not started.



Measuring the battery voltage is possible in the menu "system info".

5.0 Operation as a Computer Interface

5.0.1 USB Driver Setup

Windows XP, Win7 compatible

Attention! Please load the latest driver "Scandevil.inf" at your retailer or at www.scandevil.de. Save the file to your desktop. Then the Scandevil can be inserted into the notebook via USB cable.

Select the item "PC interface mode" in the main menu and press the OK button. Now the Scandevil is found by Windows.

Attention: Windows installs a virtual driver for a COM interface. Even if the laptop does not have a COM interface, one is displayed in the device manager. It is problematic that Windows selects the next unused number

according to the internal database. This number is only known in rare cases. But to establish a communication link it is necessary to check the exact COM port number in the device manager:

Please open the device manager (Windows Control Panel), and selects the COM ports. There is the number of the COM port mentioned in brackets. Add this COM port to the user programs. If there is the error message „COM-Port not found“ or „Interface not responding“ in the user software, please read the additional information provided on the CD or on the Internet.

5.0.2 Connection and Operation as a PC Interface

Insert the OBD2 interface cable into the OBD2 socket of the vehicle. Now connect the **Scandevil** to the laptop's USB 2.0 interface.

1. Now switch the laptop on and boot it. Start the already installed diagnostic software e.g. "moDIAG“ [2] and, thereafter, turn the ignition on. Please pay attention to the fact that data is only being exchanged when the ignition is turned on. To receive sensor data which can be evaluated one partly needs a running engine.
2. Please pay attention to the configuration instructions of the software, especially the right configuration of the virtual serial port – if necessary use the illustrated manual. Usually the software displays the recognized analyzer.
3. Depending on the extent of functions of the utilized software one can now read the vehicle data, get to know about error messages and codes and if necessary delete the error memory. Please pay attention to the instructions of the software or use its built-in help.
4. Please give serious consideration to clearing the error memory of a vehicle because it may contain important data about the driving behavior. The vehicle has to "re-learn“ this and it will only be restored after several kilometers. Please note the instructions about the readiness code in appendix E.

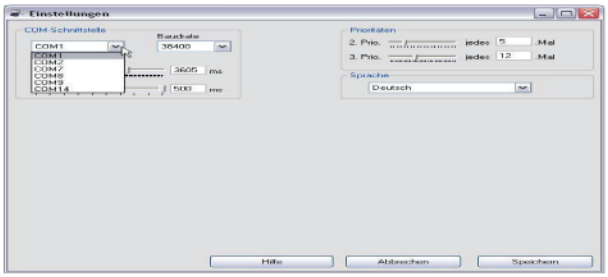
6.0 Operation as a Computer Interface with the Software "moDIAG express“

To utilize the analyzer as OBD2-capable computer interface select the "PC interface mode“. Please read the instructions in 5.0.
The ideal software for the analyzer is "moDiag express" or "expert" which is decribed in more detail below.

"moDiag express" is an OBD scan software which can read and visualize live data from the ECU in connection with the Scandevil. It can also read and delete the error memory as well as reading the status of the internal vehicle surveillance of the exhaust gas-relevant components. Additionally, "moDiag express" provides a wizard to measure acceleration (0 – 100 km/h).

6.0 Establish a Connection

First one has to enter into the program with which interface the analyzer is used. Start "moDiag" and open the "settings“ menu by selecting the item "settings" in the upper toolbar. There "moDiag" displays all COM interfaces found during the start in a list. Select the interface where your analyzer is inserted. Clicking on „save“ saves this setting permanently.



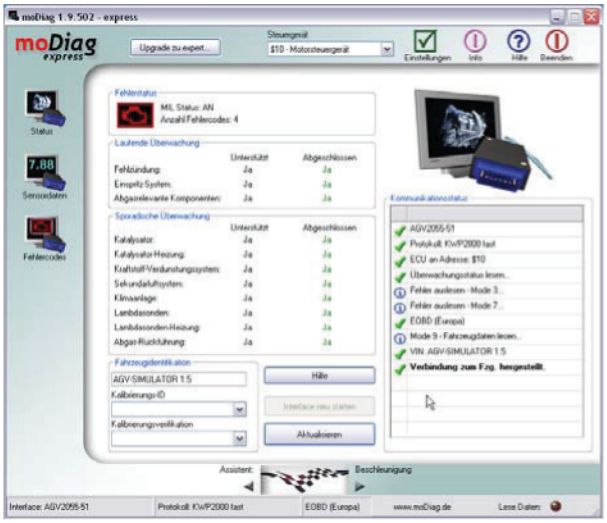
Before starting "moDiag" the USB driver of the analyzer has to be installed. Please follow the manufacturer's instructions. After installing the driver continue as described above to select the interface.

Another important setting is the baud rate. This setting is irrelevant to the Scandevil. It is always transmitted with the highest possible data rate to the PC.

When everything is set correctly one can connect it to the vehicle. The analyzer has to be connected to the OBD2 socket of the vehicle (usually in the floor room on the driver's side or at the central console e.g. underneath the ashtray). Now turn the ignition on. Then click on "connect" in "moDiag". In the "communication

status“ area “moDiag” displays the establishment of the connection link. First the analyzer is reset and searches for the protocol employed by the vehicle. As soon as the protocol is found the amount of responding ECUs is determined (Usually one, the ECU. At automatic vehicles often also the gearbox control unit). Then “moDiag” requests the status of the “On Board Surveillance“, possibly saved diagnostic errors and the vehicle identification. Not all vehicles display the VIN via the OBD interface. With some vehicles it is only displayed if the ignition is turned on but the engine is not running.

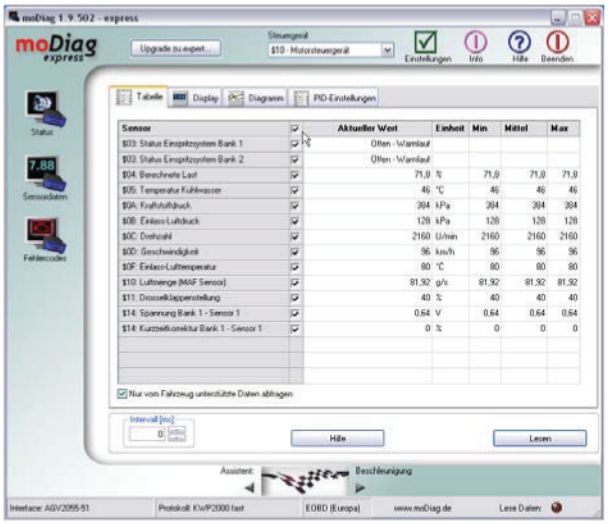
6.2 The Status Screen



After the connection to the vehicle was established the “moDiag” status screen displays the following information: status of the MIL (**M**alfunction **I**ndicator **L**amp), the amount of errors saved by the vehicle, the status of the running surveillance of exhaust gas-relevant components and the vehicle identification. Important: the displayed informationen are always related to the ECU selected in the list “ECU“! Reading the status of another ECU one has to select it in the list and the status screen is refreshed.

The status of the running surveillance is important for an OBD exhaust gas examination! All tests supported by the vehicle have to be completed to pass inspections.

6.3 Reading Live Data



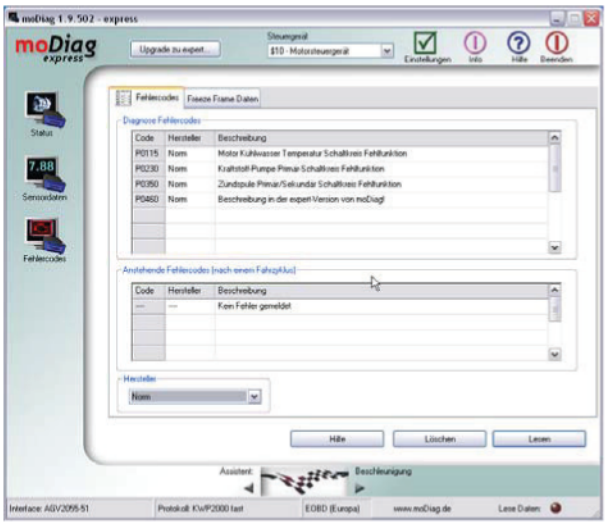
To read live data from the vehicle, click on the icon “sensor data“ in the left toolbar. Then you will see a screen with four tabs. The first tab „table“ contains a table displaying all sensors supported by the currently selected ECU. To read one of these sensors mark the sensor with a checkmark next to its designation. “moDiag” then immediately begins to read. To read all sensors simultaneously click on the small box in the heading. “moDiag” displays the values in the column “current value“. At the same time it calculates the average, the minimum and maximum value of the sensors.
A distinctive feature is the checkbox „scan sensors supported by the vehicle only“. If it is deactivated in the table and all other displays at the tabs there are all possible OBD norm sensors offered. No matter whether the vehicle supports them or not. These sensors can then be examined by “moDiag”. Usually the vehicle only answers to sensors which are supported.

The tab “display“ contains three digital displays which make the display of the sensor values readable more easily. With the list box above the displays the sensors which are supposed to be read can be set for the display. The procedure starts immediately.

If the timeline of live data is supposed to be displayed the third tab “diagram“ is helpful. There are two diagrams available. The displayed value has to be selected in the list box above the diagram.

The fourth tab “PID settings“ enables the individual configuration of the sensors. So one can set the minimum and maximum values for the diagram display as well as the priority of the sensors. The priority can be set between 1 and 3. A priority of 1 means that the sensor is checked in every run. A priority of 3 means that the sensor is checked in every 12th run (can be changed at “settings“). Generally, sensors with slowly-changing values e.g. the cooling water temperature should be checked with priority 3 so other sensors whose values change more rapidly (e.g. rpm) can be refreshed more often.

6.4 Reading and Deleting the Error Memory



One of the main functions of "moDiag" consists of reading and deleting the error memory of the vehicle. Click on the icon "error codes" in the left toolbar. There are two tabs. The first one shows "moDiag" in the upper box the "saved diagnostic error codes" and in the lower one the "upcoming error codes". Saved error codes are the errors which lead to a lit-up MIL because they last for several driving cycles and depict permanent errors. The upcoming errors are the ones which only appeared in one driving cycle and wait to be either be deleted again because they do not appear again or become saved errors because they appear again.

The tab "freeze frame data" displays in which parameters (rpm, velocity etc.) an error occurred. This can be helpful throughout the diagnostic. To read the data the button "read" has to be selected. In the upper area the error which led to the saving of the parameters is displayed. In the table underneath there are the parameters which were saved. With the "frame" box several sets of parameters can be read while the OBD norms only dictate the frame 0 (a set of parameters).

With the help of the button "delete" all saved errors of the vehicle can be deleted. This should be done carefully! All freeze frame data and the status of the on-board surveillance (status screen) is reset. This can lead to not passing an inspection right after deleting the error memory because the vehicle cannot finish its internal tests.

6.5 Acceleration Measurement

"moDiag" provides a wizard to measure acceleration. Simply click on the image of the checkered flag. If there is no connection to the vehicle yet "moDiag" will establish it. The wizard measures the time needed from 0 to 100 km/h. Click on "start" while there is an established link and a stationary vehicle. The measurement starts automatically as soon as the vehicle is moving and ends automatically when 100 km/h are reached. Then the period of time in-between is displayed. Please note item "1.2 Security Note".

6.6 Upgrade Possibility to "moDiag expert" and "professional"

"moDiag expert" contains some interesting extra features. There are two further wizards for a fuel consumption display and a performance measurement. The acceleration wizard permits the free selection of the velocity at the beginning and end. Moreover, there are additional digital displays and diagrams available and there is the possibility to record the sensor values as *.csv files, e.g. to analyze them later with a spreadsheet. This version can also create and print diagnostic reports.

Especially for garages which are specialized in retrofitting vehicles to gas-fuelled engines the "moDiag professional" version offers some special functions to facilitate adjusting LPG devices in OBD vehicles. It is compatible with all widely-known adjustment programs for LPG devices. It contains a powerful database to completely record the retrofitting.

Table B OBD2 Protocols

Protocol	Norm Designation	Data Rate	Characteristics
PWM	SAE J1850	41.600 baud	very fast data transfer and connection
VPWM	SAE J1850	10.400 baud	susceptible to interferences
ISO9141-2	ISO9141-2	10.400 baud	slow data transfer and connection
KWP2000 5-Baud	ISO14230	10.400 baud	slow data transfer and connection
KWP2000 fast	ISO14230-4	10.400 baud	slow data transfer, fast connection
CAN 11b/500kb	ISO15765-4	500.000 baud	very fast and secure
CAN 29b/500kb	ISO15765-4	500.000 baud	very fast and secure
CAN 11b/250kb	ISO15765-4	250.000 baud	very fast and secure
CAN 29b/250kb	ISO15765-4	250.000 baud	very fast and secure

PWM is mainly included in Ford and Mazda models (petrol cars) built from 1997 to 2003. VPWM was employed in Japan and the USA from 1996 to about 2003. ISO and KWP 2000 are the main protocols in Europe – petrol cars employ it from about 2000 and diesel cars from 2003. CAN can be found in middle or high class vehicles from about 2005 on. Opel employs OBD2 from about 2002, respectively 2004 (diesel).
In Europe OBD2 is mandatory for new vehicles from 2001 respectively 2004 (diesel vehicles). Some vehicle manufacturers had special authorization to delay the use of OBD2.
There are many exceptions. An Internet database is usually very helpful [4].
From 2008 on CAN is the only protocol permitted because of its resistance to interference.

Table C Error Code Composition

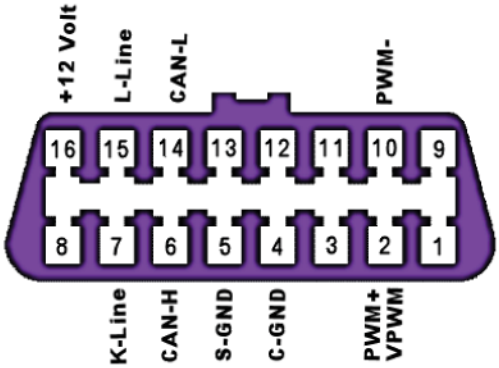
The composition and designation of the error codes DTC (diagnostic trouble codes) according to SAE-J2012:

P 0	1	1 0
Bx – vehicle body Cx – chassis Px – engine Ux – netzwork communication X designates sub-categories 0,1, 2, or 3 e.g. P1xxxx designates a special error code of the vehicle manufacturer P0,2,3 are cross-platform error designations.	origin of the error As an example for the P0 engine: 1. fuel / air / lambda probes 2. air intake and pressure systems 3. ignition system, misfire control 4. emission and exhaust gas control 5. vehicle velocity and braking control system 6. engine management / board computer 7. gearbox / hydraulic sensors 8. gearbox / hydraulic pressuree 9. automatic gearbox	error number (hexadecimal) e.g. P0110 intake air temperature circuit malfunction

There is a list available on the Internet [5]

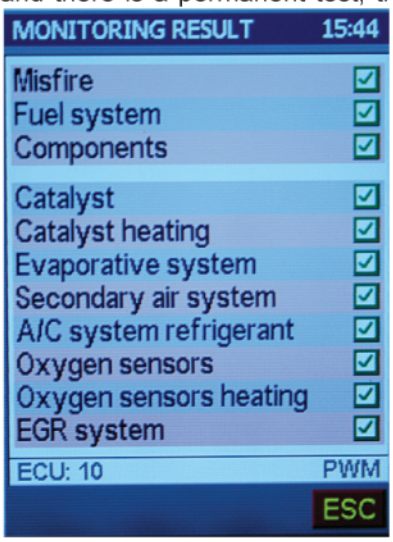
Table D OBD Socket Layout

OBD2 Diagnostic Socket (DLC)		Designation
1		*
2		PWM+ / VPWM
3		* e.g. airbag
4		Chassis GND
5		Signal GND
6		CAN-High
7		K-Line
8		* e.g. service interval
9		*
10		PWM-
11		*
12		* e.g. ABS
13		*
14		CAN-Low
15		L-Line
16		on-board voltage (12V)



Appendix E Readiness Code

To make sure that all exhaust gas relevant components work correctly and there is a permanent test, there are flags set in the ECU. To examine all surveillance sensors in the vehicle these sensors report after deleting the error memory and the MIL with a bit in a fixed digital sequence. Sensors which are not part of this, are not reported by the ECU and, therefore, no flag is set. Shortly after the deletion all existing check sensors are visible. Every sensor goes through a special customized program while driving afterwards. As a consequence, there is an analysis within or outside of the comparison value. If the values are within tolerance the flag is taken out and the bit for the check is reset to zero. So the flags vanish one after each other while driving until the complete examination sequence is reset to zero. Then the driving cycle is completed. The readiness code now allows to judge whether the the vehicle was moved a longer distance, e.g. before an inspection. Only if all tests were completed properly the error memory is considered a valid criterion.



If the error memory is deleted pre-emptively before a vehicle inspection it is possible that the vehicle does not pass the inspection because not all self-checks were conducted and electronically recorded properly. **Do not use the analyzer to delete the error memory shortly before a technical inspection.** To create a valid readiness code it generally suffices to drive approximately 40 km.

Table F Troubleshooting

Error Characteristics	Error Message	Troubleshooting
PC interface does not work	the software says „Com-Port not found"	• Check the USB driver installation. Check whether the virtual COM port in the device manager and in the user software match. • Simple test without vehicle: open the device manager -> connection -> communication link -> The USB serial port (COM XX) has to be registered when the device is disconnected from the USB interface and it is re-connected afterwards. Enter the COM port XX in the user software. • Vehicle not OBD2-capable • The Scandevil is not in the PC mode

ISO / KWP: no connection to ECU	the analyzer says "no connection to ECU"	• The vehicle is not OBD2-capable • Timeout problem – start the engine, insert the analyzer, conduct the diagnostic • Select manual protocol mode (select 3, 4, or 5)

Table G Links and Further Reading

	Links to Free- and Shareware:	Content
[1]	http://www.scandevil.de	current information, update tool and PC driver
[2]	http://www.modiag.de	software download "moDIAG"
[3]	http://www.scantool.net	software download "Scantool"
[4]	http://www.obd-diag.com	software download "OBD-DIAG", "moDIAG"
[5]	http://www.blafusel.de/misc/obd2_scanned.php	OBD2 vehicle list / database
[6]	http://www.autodata-deutschland.com	information about the software "Autodata"
[7]	"Fahrzeugdiagnose mit OBD"	Florian Schäffer, published by Elektor, German, ISBN 978-3-89576-173-7
[8]	http://obdclearinghouse.com/oemdb/	OBD2 socket locations in the vehicles

Appendix H Hints and Maintenance

The device can be operated within a temperature range from -18 to +60 degrees Celsius.
Opening the device leads to a loss of guarantee.

Appendix J Glossary

DLC	Data Link Connector
DTC	Diagnostic Trouble Codes
Freezeframes	Error environment saved when an error occurs
MIL	Malfunction Indication Lamp (yellow)
OBD	On-Board Diagnostic
EOBD	European OBD norm

Appendix Y Company Information

DIAMEX is a registered trademark (Germany) of
www.diamex.de
DIAMEX Produktions- und Handels GmbH
Alberichstrasse 57, 12683 Berlin

Info Phone: 030-51739222
Technical Support: 030-51739222

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