User's Manual

DiagCAT Explorer

and

DiagCAT

I+ME ACTIA GmbH

www.ime-actia.com

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1 Introduction

The DiagCAT is a portable handheld tool for diagnostics on CAN. It offers means to launch diagnostic services and to display the results.
DiagCAT is very easy to handle and comes with the PC based configuration software DiagCAT Explorer. This tool allows the user to create and maintain configurations for DiagCAT in an intuitive way.
DiagCAT is completely configurable, even the texts of the menus can be changed. Thus, it is up to the user which kind of language DiagCAT supports.
The end of line repair section is the main application field of DiagCAT, but with its features it is an ideal general-purpose tester for automotive diagnostics on the single wire CAN, the mid speed CAN and the high speed CAN.
The link between the car and DiagCAT is a 16 pin J1962 connector. The configuration which has been created with DiagCAT Explorer has to be saved to a PC-Card. This PC-Card can be read by DiagCAT in order to load or update a configuration.

DiagCAT supports at the moment the following diagnostic services:

- Read Diagnostic Information ($A9)
- Clear Diagnostic Information ($04)
- Read Data By Packet Identifier ($AA)
- Device Control ($AE)
- Write Data By Identifier ($3B)

If required, Tester Present ($3E) is being sent automatically
This documentation explains the functions and the handling of DiagCAT and DiagCAT Explorer.

2 DiagCAT Explorer

2.1 Getting Started

The DiagCAT Explorer is the tool to create and maintain configurations for DiagCAT.
The application is similar to the MS-Windows Explorer. On the left side of the main window, the three supported physical layers and the ECU which belongs to these busses are shown. The settings of the ECUs are depicted on the right side of the window. Most of these settings can be changed just by double click on the item with the left mouse button.
The user can select an ECU in the left side in order to see the already made settings.
The "Global Settings" menu and the "Configurations" menu allows the user to maintain the current configuration. Beyond that, these functions can be reached by using the tool bar of DiagCAT Explorer.
The status bar informs the user about the currently selected ECU and the physical request CAN identifier is also given.

Creating a new configuration takes only a few steps:

1. Start DiagCAT Explorer
2. Create a new configuration with File | New Configuration
3. Enter a name in the dialog box "Save As" which appears automatically
4. Create an ECU using Configuration | Add ECU
5. Make settings using the "Configuration" menus
6. Save your configuration to a PC-Card using File | Transfer Configuration to PCMCIA
   - Note: DiagCAT Explorer assumes an installed PC-Card drive which can handle SRAM cards!
7. Make sure that DiagCAT is powered
8. Insert PC-Card in DiagCAT and load the configuration

Note: Due to the fact, that DiagCAT Explorer saves configuration data automatically, it is not possible to save settings manually !

2.2 File

2.2.1 New Configuration

Creates a complete new configuration.
A "Save As" dialog box appears automatically and a configuration name has to be determined. A configuration name is necessary, because all configuration related menus are disabled if no name has been defined.
The name of the configuration is up to the user but the extension has to be *.dcc.

2.2.2 Open Configuration

Previously stored configurations can be opened with this menu item.

2.2.3 Save Configuration As

The current configuration can be saved with a different name.

Note : A menu "Save Configuration" is not necessary, because the settings are always saved immediately to the configuration file.

2.2.4 Transfer Configuration to PCMCIA

A configuration which has been created with DiagCAT Explorer has to be saved to a PC-Card. This PC-Card can be read by DiagCAT.
The following issues are important to know.

1. A PC-Card has to be formatted. This has to be done with DiagCAT only.
2. DiagCAT Explorer assumes an installed PC-Card drive which is able to read and write SRAM cards.

When the user has chosen this menu item a dialog box appears. This dialog box shows the PC-Card drives which have been found by DiagCAT. The user has to select the right one and to confirm the choice with OK button. DiagCAT will write the current configuration to the PC-Card.
If no PC-Card drive has been found, the dialog box indicates this.

See also : PC Card Drive and SRAM Card

2.2.5 Most Recently Used Configuration

When DiagCAT Explorer has been started, it tries to open the recently used Configuration in order to ease the handling.
This list of menu items contains up to 4 entries with the most recently used configuration files.

2.2.6 Exit

Quit the application.
Due to the fact, that the settings are stored immediately when changed, the application will never ask whether the current configuration has to be saved.

2.3 Global Settings

2.3.1 CAN Setup

Three physical layers are supported by DiagCAT. The single wire CAN (SWCAN), the mid speed CAN (MSCAN) and the high speed CAN (HSCAN).
For all these busses the user has to determine the baudrate using the "CAN Setup" dialog box.
Note : The three busses are not available in parallel. Only one at a time is possible. The selection of the physical layer is done automatically by DiagCAT.

2.3.2 Tester Present

The diagnostic service Tester Present ($3E) is being sent automatically each 2 s with the following diagnostic services:

- Read Data By Packet Identifier ($AA)
- Device Control ($AE)

The dialog box "Tester Present" is the place where the user has to determine whether physical addressing has to be used or functional addressing.
If "Enable" is marked functional addressing is chosen.
In case of physical addressing the physical request CAN identifier of the selected ECU will be taken.

2.3.3 Menu Configuration

The content of global menus can be configured with this dialog box. These entries are not ECU related, therefore they are called global menus.
The DiagCAT has in fact 3 hierarchical menu levels. Level 1 is the ECU selection, the selection of diagnostic services is level 2 and level 3 are the results of the currently chosen diagnostic service.
These levels and the meaning of each entry are mentioned within the dialog box.
Additionally to this menu entries the DiagCAT will show status information which can be configured within the "Information Text" dialog box.

2.3.4 Information Text

The content of global status information can be configured with this dialog box. These entries are not ECU related.
It is also possible to configure the global menu entries. See Menu Configuration for further information.

2.4 Configuration

2.4.1 Add ECU

This dialog box creates a new ECU and add it to the current configuration.
The ECU name and the CAN identifier for diagnosis have to be specified. Additionally the physical layer of the ECU has to be selected.
It is necessary to define all three CAN identifier. The CAN Identifier can not be generated automatically, because of the different possible identifier ranges. (e.g. OBD/EOBD)
It is necessary to input 3 characters for each CAN identifier. Otherwise the dialog box can not be closed with "OK".
If the dialog box has been closed with "OK" button the ECU has been added to the configuration and is visible in the left area of the main window.
Furthermore the diagnostic services "Read Diagnostic Information" and "Clear Diagnostic Information" are already defined. The settings for "Read Diagnostic Information" can be changed afterwards. "Clear Diagnostic Information" has no dialog box for changing parameters, because this service does not have any parameters.
The other supported services are not added automatically because of the complex parameters they have. This has to be done manually using the corresponding dialog boxes.

2.4.2 Edit ECU

Edit ECU works similar to Add ECU. The user has to select an ECU within the left area of the main window, then he can open this dialog box in order to change the parameters of the ECU.
It is necessary to input 3 characters for each CAN identifier. Otherwise the dialog box can not be closed with "OK".

2.4.3 Remove ECU

If an ECU has been selected in the left area of the main window, the menu item becomes enabled and the chosen ECU can be removed from the current configuration.
The DiagCAT Explorer warns the user whether the ECU shall really be removed, because this will delete all ECU related data and all related diagnostic services.

This menu item has to be used carefully !

2.4.4 Read Diagnostic Information

2.4.4.1 Read Diagnostic Information

The "Read Diagnostic Information" offers means to set up the service $A9. The dialog allows to chose one of the three possible sub function parameters. In accordance to the chosen sub function parameter the remaining parameters can be set.
The DiagCAT will show the diagnostic trouble code (DTC) is SAE format, furthermore an information whether the DTC is current or not is given.

2.4.5 Read Data By Packet Identifier

2.4.5.1 Read Data By Packet Identifier

The "Read Data By Packet Identifier" dialog contains a list of up to five DPIDs. These DPID can be requested from the ECU. The user can create, edit or remove those DPIDs. This has to be done with the corresponding buttons. The symbolic name of the DPID will not appear in a DiagCAT menu. This name is just for the user, because he can distinguish the DPID within the current configuration.
The way the DPIDs are requested from the ECU can also be defined in this dialog. It is possible to retrieve the data as on shot or with different periodic rates.
When a new DPID shall be created or an existing one shall be changed, the DPID Definition dialog appears. Within this dialog a DPID can be defined, that means the signals mapped on this DPID can be defined.
A double click with the left mouse button on a DPID opens also the DPID Definition dialog.

2.4.5.2 DPID Definition

The "DPID Definition" dialog allows the user to define a symbolic name for the DPID and the DPID number. The symbolic name is not used within DiagCAT. It is just to distinguish the DPIDs within the configuration.
Furthermore a list of signals are shown. This list can be maintained by using the "Create", "Edit" and "Remove" button.
If "Create" or "Edit" have been chosen, the Signal Definition dialog pops up. Even a double click with the left mouse button on a signal opens this dialog.

2.4.5.3 Signal Definition

The "Signal Definition" dialog offers several means to set up a signal and to map it on a DPID.
The following settings are necessary.

Symbolic name	This will be used in the DiagCAT result screen
Start Byte	It is possible to define byte 1 to 7 of a CAN frame as the start byte. Byte 0 contains the DPID number
Start Bit	Defines the start bit within the start byte. Possible are values from 7 to 0. Bit 7 is the MSB and will be sent out at first
Length	The signal length given in bit. Except strings, they are given in byte
Type	Signed integer, unsigned integer, engineering, boolean and string are possible
Format	Depends on the chosen type. Possible are decimal, hexadecimal, binary, float, bool and ASCII
Resolution	Each signal will be multiplied with this resolution value
Offset	Offset will be added to each signal after the multiplication with resolution
Unit	This will be used in the DiagCAT result screen

The following expression will be used for each signal:

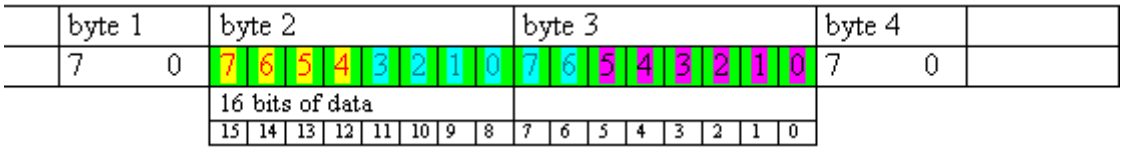
S : signal; R : resolution; O : offset; V : value to be displayed.

$$V = (S * R) + O$$

Note:
It is important to know that the number of digits per signal is limited to 8, including a precision of 2 digits (e.g.: 12345.78).
The values for resolution and offset have to be chosen in that way, that the result will fit into this format.
If more than the available digits are necessary, DiagCAT will display the value with an exponent.

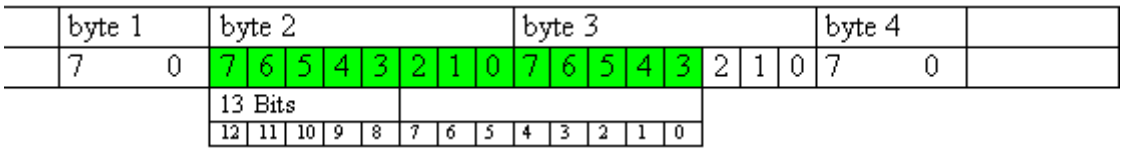
In order to understand how a signal is mapped on a CAN frame the samples below will certainly help.
Condition: Data byte 1 of the frame below will be sent out first to the bus.

- 3 signals in bytes 2 and 3, 16 bits total which start in byte 2 bit 7

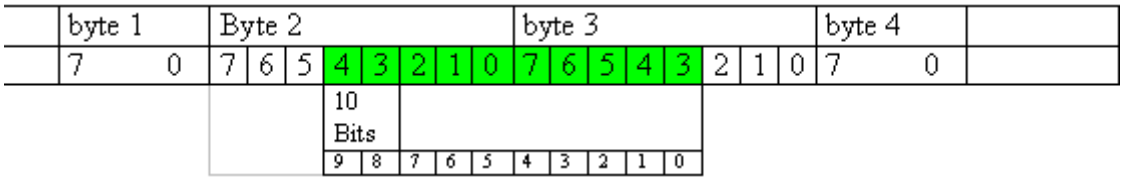


As shown there could be 3 different signals embedded in bytes 2 and 3. For presentation on the bus the important thing is that byte 2 bit 7 is sent first and byte 3 bit 0 is sent last. The location of the signals in the bytes is only important for encoding/decoding signals of frames (see below).

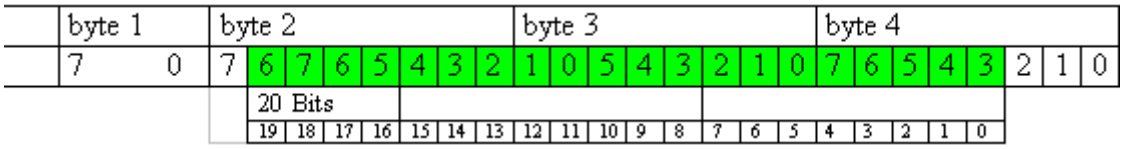
- A 13 bit unsigned integer which starts in byte 2 bit 7



- A 10 bit unsigned integer which starts in byte 2 bit 4



- A 20 bit unsigned integer which starts in byte 2 bit 6



2.4.6 Device Control

2.4.6.1 Device Control

Within the "Device Control" dialog box all defined CPID of the chosen ECU are depicted. This dialog allows the user to create a CPID, to edit an already existing CPID and to remove a CPID.
This has to be done with the corresponding buttons.
The symbolic names of the CPID will be taken as menu items in the corresponding DiagCAT menu.
If the user creates a new CPID or if he edits an existing CPID, the CPID Definition dialog appears where the settings can be adjusted.
It is also possible to open the CPID Definition with a left mouse button double click on a CPID.

2.4.6.2 CPID Definition

In order to define a CPID the "CPID Definition" dialog is being used. This dialog can be reached in two different ways. Normally the dialog appears when the "Create" or "Edit" button of the "Device Control" dialog has been pressed. Another way is to double click with the left mouse button on a CPID displayed in the right area of the main window, this is possible if the CPID already exists.
The "CPID Definition" dialog allows to change the symbolic name, the CPID number and up to five values.

2.4.7 Write Data By Identifier

2.4.7.1 Write Data By Identifier

The "Write Data By Identifier" dialog contains all DIDs for the current ECU. It is possible the create, edit and remove DIDs by using the corresponding buttons. The symbolic name will be used in DiagCAT as a menu item.
When the user wants to create or to edit he has to use the "Create" or the "Edit" button. The DID Definition dialog appears in order to change a DID.
It is also possible to double click with the right mouse button on a DID to open the DID Definition dialog.

2.4.7.2 DID Definition

The "DID Definition" dialog specifies the DID. A symbolic name and the DID number is needed, furthermore the real data to be sent to the ECU has to be entered. An input up to 100 bytes is possible.

2.5 Help

2.5.1 Help System

The help system of DiagCAT Explorer is context-sensitive. When ever the user needs help he just has to press F1.
Additionally to this context sensitive help, the complete DiagCAT user’s manual is included.

2.5.2 About

Shows the "About" dialog box which contains the version of DiagCAT Explorer

2.6 Trouble Shooting

2.6.1 PC Card Drive

The DiagCAT Explorer expects an installed PC Card drive which is able to read and write SRAM cards
If the drive is not properly installed DiagCAT Explorer can not save the configuration.

Below some hints to configure a PC Card drive for SRAM cards:

Windows 95/98 :

The first time a SRAM card has been inserted into the drive, Windows shows dialog boxes and wants to install the right drivers. Therefore the corresponding Windows CD-ROM is necessary. When the driver has been installed it is not possible to read and write SRAM cards, because the following entries have to be added to Config.sys:
For example:

```
device = C:\WINDOWS\system\csmapper.sys
device = C:\WINDOWS\system\carddrv.exe
```

Be sure that the path is correct and that the files are present.
Unfortunately, Windows does not make these changes!

Windows NT 4.0 :

It is necessary to install drivers which enable Windows NT 4.0 to read or write SRAM cards.

Windows 2000 :

The first time a SRAM card has been inserted into the drive, Windows shows a dialog box and installs the right drivers. If this process has been finished the SRAM card can be written and read.

2.6.2 SRAM Card

The SRAM Card has to be formatted before a configuration can be saved.
This has to be done with DiagCAT only. It is not possible to do this with a PC.
The size of the SRAM card can be 1, 2 or 4 Mbyte. Other sizes are not supported.

3 DiagCAT

3.1 Getting Started

The DiagCAT is a portable handheld tool for diagnostics on CAN.
The tool is very easy to use, because of its simple display structure and the less number of keys.

In order to understand the tool, it is recommended to read the pages dealing with the display structure.

The DiagCAT is driven by a configuration. This configuration contains all necessary information about the ECUs where to user wants to communicate with. The configuration has to be created with the DiagCAT Explorer and has to be stored on a PC Card.

A PC Card with a configuration is absolutely necessary to get the DiagCAT working. With such a PC Card it is easy to start with DiagCAT. The following steps are necessary to work with DiagCAT.

1. Connect DiagCAT with the car using the connection cable. Use the 19 pin connector for DiagCAT and the OBD connector for the car
2. When connected, the display of DiagCAT shows the entry screen and the back light is on.
3. Insert the PC Card with a configuration into DiagCAT
4. The "Configuration" display appears
5. Choose "Load Configuration"
6. After the configuration has been loaded the ECU selection menu becomes visible

3.2 Using DiagCAT

3.2.1 Display

The display of DiagCAT can show 5 lines and 21 characters per line at a time. If more information are available, the user can scroll through the display content.
The display itself can be subdivided into a title area and a content area. The title area is the first line and the content area are the remaining 4 lines. It depends on the screen and the data to be displayed whether a title area is present or not.
The first character within the title shows whether the user can scroll or whether the whole information fits into the content area.
The following signs are possible:
- means that the information fits into the content area and scrolling is not possible
↓ means that the top of the information list is reached
↑ means that the bottom of the information list is reached
↕ means that it is possible to scroll the content

When the user scrolls through the content area the current item is being highlighted.

3.2.2 Keyboard

DiagCAT comes with a numeric keyboard which have some function key.
For using DiagCAT four (4) keys are necessary only.
↓ scrolls down
↑ scrolls up
↵ confirms a choice or goes to the next display
ESC cancels a choice or goes to the previous display

3.2.3 Connection between DiagCAT and the car

DiagCAT has to be connected to the car using the connection cable. This cable has an OBDII connector (J1962) which has to be connected to the car and a 19 pin connector which has to be connected to DiagCAT.
It is important to know, that DiagCAT is powered by this cable. This cable enables you to work with DiagCAT.
When DiagCAT is linked to the car it is ready to use. (plug and play)

Below mentioned is the pinning of the J1962 connector:

	16 pin SAE-J1962 DLC male Pin #
Dual Wire CAN 1, High	6
Dual Wire CAN 1, Low	14
Dual Wire CAN 2, High (mid speed)	3
Dual Wire CAN 2, Low (mid speed)	11
Single Wire CAN (SWC)	1
Gnd (Power Feed & SWC Reference)	5
+ Batt	16

The physical layer is automatically chosen by DiagCAT in accordance to the settings of the current ECU.
The baudrates have also be defined within the DiagCAT Explorer. The default values are:

- High speed CAN: 500 kbps
- Mid speed CAN : 95.2 kbps
- Single wire CAN: 33.33 kbps

3.2.4 Power Supply

The Power Supply is realized as a regulated power supply.
DiagCAT has an input voltage range of 7.5V .. 32V-
DiagCAT is powered by the connection cable only.

3.2.5 Physical CAN Interface

The DiagCAT supports three physical layers:

1. Dual wire high speed CAN using a 82C251 transceiver
2. Dual wire mid speed CAN using a 82C251 transceiver
3. Single wire CAN using a TLE 6255 transceiver

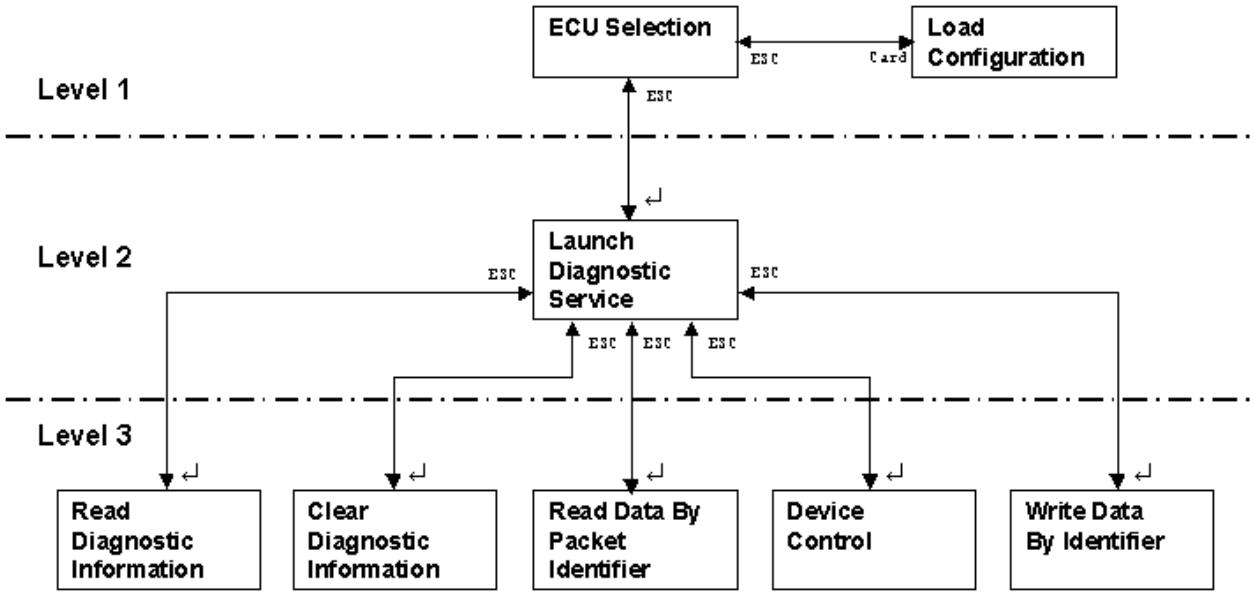
The physical layer is automatically chosen by DiagCAT in accordance to the settings of the current
ECU.
The bausrates have also be defined within the DiagCAT Explorer. The default values are:

- High speed CAN: 500 kbps
- Mid speed CAN : 95.2 kbps
- Single wire CAN: 33.33 kbps

3.3 Display Structure

3.3.1 Display Structure

The displays of DiagCAT are hierarchical structured. DiagCAT knows 3 display levels. The level 1 contains the ECU selection and the PC Card handling. Level 2 offers the configured diagnostic services to be launched and level 3 displays the results of the performed diagnostic services.
The picture below depicts this structure and the keys to be pressed to change the display.
Note: There is no key defined to get to the "Load Configuration" display, this display appears when a PC Card has been inserted.



3.3.2 Information Displays

When working with DiagCAT it is possible that so called information displays appears.
When the communication via the CAN bus is disturbed DiagCAT informs the user by displaying an error message.
It is also possible that an ECU sends an negative response. This is also shown in an information display.

This kind of displays can be left with the ESC key.

3.3.3 Level 1

3.3.3.1 ECU Selection

The display is shown when a configuration has been loaded and the DiagCAT has been powered. That means the DiagCAT is connected to the car via the connection cable.
Within this display all ECUs which have been defined with the DiagCAT Explorer are selectable.
An ECU can be selected using the ↓ or ↑ key. The current selected ECU is highlighted. If the right ECU is selected the ↵ key opens the Launch Diagnostic Services display.

3.3.3.2 Load Configuration

This display appears when the ECU selection display is visible and a PC Card is being inserted.
The purpose of this display is to load a new configuration from the PC Card and to format a PC Card.

Note: The configuration will remain in DiagCAT even if DiagCAT is not powered. Loading a configuration is necessary in case of update only.

3.3.4 Level 2

3.3.4.1 Launch Diagnostic Services

DiagCAT supports five (5) diagnostic services and this display offers these services. It is important to know that these services have to be configured prior with the DiagCAT Explorer. Only those services which have been set up are available in this display. Thus not all five services might be accessible.
The services are:

1. Read Diagnostic Information
2. Clear Diagnostic Information
3. Read Data By Packet Identifier
4. Device control
5. Write Data By Identifier

To launch a service the user has to select the service using the ↑ or ↓ key and press the ↵ when the wished service is highlighted.
DiagCAT will launch the service in accordance to the settings made with DiagCAT Explorer and will get into the next display level 3. Within a level 3 display it depends on the launched diagnostic service how the result display will look alike.

3.3.5 Level 3

3.3.5.1 Read Diagnostic Information Display

When this menu appears DiagCAT has launched the Read Diagnostic Information service. All Diagnostic Trouble Codes (DTC) the addressed ECU is sending are shown in this display.
DiagCAT uses for each DTC a new line. This DTC will be shown in SAE format and the current / not current status will also be displayed.
In most of the cases the number of DTCs exceeds the number of visible lines of the DaigCAT display. In this case the user can scroll through the list using the ↑ and ↓ key.
The ESC key quits this display and goes back to the level 2 display. (Launch Diagnostic Service)

3.3.5.2 Clear Diagnostic Information Display

When this menu appears DiagCAT has launched the Clear Diagnostic Information service.
DiagCAT reports whether the ECU has cleared its Diagnostic Trouble Codes.
The ESC key quits this display and goes back to the level 2 display. (Launch Diagnostic Service)

3.3.5.3 Read Data By Packet Identifier Display

When this menu appears DiagCAT has launched the Read Data By Packet Identifier service. All signals which are mapped on DPIDs are shown in this display. Which kind of signal are being shown depends on the configuration made with DiagCAT Explorer.
DiagCAT uses for each signal a new line. In most of the cases the number of signals exceeds the number of visible lines of the DiagCAT display. In this case the user can scroll through the list using the ↑ and ↓ keys.
The ESC key quits this display and goes back to the level 2 display. (Launch Diagnostic Service)

3.3.5.4 Device Control Display

When this menu appears DiagCAT shows a list of all CPIDs which have been defined for the current ECU within DiagCAT Explorer.
Up to this point the Device Control service has not been launched.
The user has to select a CPID from the list using the ↑ and ↓ key. When the wished CPID is highlighted the user can press the ↵ key to launch the Device Control service with the chosen CPID. If the service has been launched successfully DiagCAT reports this within the same line. (e.g. with "OK"). If the service was not accepted by the ECU DiagCAT reports this also in the same line. (e.g. with "NOK").
The text for "OK" and "NOK" is configurable within DiagCAT Explorer.
The ESC key quits this display and goes back to the level 2 display. (Launch Diagnostic Service)

3.3.5.5 Write Data By Identifier Display

When this menu appears DiagCAT shows a list of all DIDs which have been defined for the current ECU within DiagCAT Explorer.
Up to this point the Write Data By Identifier service has not been launched.
The user has to select a DID from the list using the ↑ and ↓ key. When the wished DID is highlighted the user can press the ↵ key to launch the Write Data By Identifier with the chosen DID. If the service has been launched successfully DiagCAT reports this within the same line. (e.g. with "OK"). If the service was not accepted by the ECU DiagCAT reports this also in the same line. (e.g. with "NOK").
The text for "OK" and "NOK" is configurable within DiagCAT Explorer.
The ESC key quits this display and goes back to the level 2 display. (Launch Diagnostic Service)