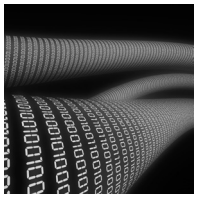

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# The methods of diagnosis of the innovatory management systems in cars

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**ABSTRACT**
The article describes the methods of diagnosis of the integrated management systems in vehicles. BLIS safety system is presented. The methods of diagnosis which are wider than systems of control in the process of self diagnosis have been prepared and discussed as well. The authoritative method of the punctual diagnosis of the system, which puts theory into practice is discussed. It has been approved and accepted by many car services in the whole country

**KEYWORDS: management systems, disturbance of the work of the system, unknown mistake, the punctual diagnosis of the system, gateway**

## 1. Introduction

Nowadays, a car has not only to be catchy, but at the same time it must meet a number of various customers' needs. Apart from the basic needs, a car is to be characterized by: comfort, space, usefulness and safety; it seems important to focus on the innovatory solutions of integrated safety systems (Combined Active & Passive Safety). These systems take control over Adaptive Cruise Control (ACC), Collision Mitigation System (CMS), Driver Alert Control (DAC), Lane Departure Warning (LDW), as well as Emergency Brake Assistance (EBA) [3, 4]. What is more, those systems should also be easy for the drive to use and read useful information from them, in other words, the communication between a driver and a car must be as easy as possible. Additionally, the systems should be predictable in the use. The processes of fixing a car in a car service, leading to diagnosis and post made program of the system, can be difficult and can demand to have a deeper understanding of a problem. However, exchanging parts of a car can be left for the less qualified service workers.

## 2. Dependence of the management systems

Different systems in vehicles must be able to exchange information between themselves. It happens due to the fact that they use the same information but in the proper order. This communication is possible due to gateway which can join Drivetrain CAN-bus, comfort CAN-bus, Diagnosis CAN-bus, Multimedia CAN-bus, Instrument Cluster CAN-bus, can cooperate with LIN (Local InterConnect Network), TTP (Time-Triggered Protocol), MOST (Media Oriented Systems Transport) and FlexRay (the name is taken after FlexRay).

Due to the use of various solutions and technologies, different levels of voltage and speed, it is impossible to achieve direct contact between signals coming from various data transmission networks. Gateway is a place where various signals coming from different networks meet. Due to the fact that gateway possesses all the needed information about the data of control systems, it can be easily used as the diagnostic interface.

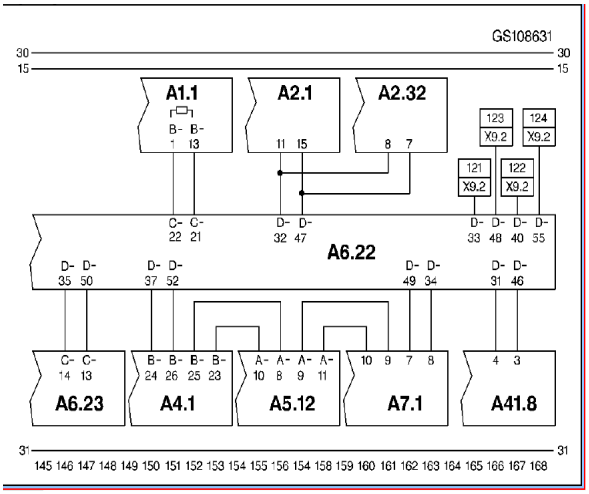


**Fig.1. The link of systems in Volvo management V70 II 2,5T AWD. A1.1- the engine control unit, A2.1- the ABS control unit, A2.32- the AWD control unit, A4.1 – the SRS control unit, A41.8- the multifunctional steering wheel control unit, A5.12-AC, A6.22- electronic central system, A7.1 - instrument cluster**
**Source:[5]**

These systems, when joined into one, as presented on figure 1, cause a disturbance between the systems (non-conventional faults), since when the fault is found in the one system, it causes unknown mistakes in the work of the other one.

Although codes of the types of the faults (P, B, C, U) are numbered, standardised and specified, such mess does not give any guarantee that the faults will be found and fixed. It turned out that the found faults are unknown for the system, which means that they are not described as most of them have not been found as possible to occur. The Authoritative solution to this problem is the punctual diagnosis of the system . It means that diagnosis is done with the use of the specific parameters which were chosen by the engineers while preparing the project of the system. Catalogues with the specific data of components can be found by engineers in Bosch company 1 987 721 021 - AA/MKM3 – „Sensoren catalogue" or directly on their websites.

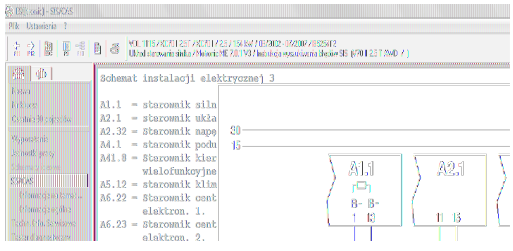

**Fig. 2. Visualisation of the work of the BLIS system. A –active parts of the BLIS system. B – worning sign in the steering wheel**
**Source: [3]**

Such way of acting is very often the only way to make diagnoses thanks to which it is possible to reduce the costs of exchanging the good elements/parts of a car into different ones in order to make the system work again. This way of making diagnosis in known as the punctual diagnosis of the system.

The authors of the project (1) have described chosen innovations

of the intelligent systems of the steering wheel. They have presented functions of the systems CAPS, ACC, CMS, DAC, LDW, EBA as well as the ways of communication between a driver and these systems. This innovatory set of solutions includes also BLIS used to inform a driver about another user of the road visible for the vehicle. This system becomes active after the engine of a car starts working. It works during a day and night.

In the mirrors there are movement sensors which are to find out an another user of the road not visible for the driver when the latter comes closer to the area of the work of the sensors. In VOLVO XC60 this area measures about 10 metres after the vehicle as well as at the left and right side of it. The system can be switched off with the use of the button placed on the multifunctional panel of the vehicle.

Because of the great variety (1) and modernity of the management systems (fig. 2) it seems a need to prepare the way of diagnosis of them in order to please a customer with the correctly working systems.

## 3. Diagnosis of the management systems

The link between the diagnostic appliances and a OBDII/EOBD system is done with the use of one out of five official records of communication which have been described in detail by the authors [2]. However, there is a problem as it very often happens that communication between the diagnostic appliance and separate systems of the vehicle is impossible to achieve. In this situation there is a need to focus on the systems possessing the same line of transmission for all the control units

K-LINE which code is 7 in the joint DLC for the ISO diagnosis [fig 3].

The problem appears when there is an attempt to communicate with any control units of the system. When one of them is broken (the plug is burnt or there is the fuse on the joint) it blocks the work of all the control units . When the individual control units are disconnected from the system the problem is solved. In the case when the broken control unit is unrelated to the system, the communication between the diagnostic appliance and the left control unit of the vehicle is possible again thanks to DLC joint.

| System / sterownik | Bus+ | Bus- | UNI2 | UNI1 | K | L | - | + |
|---|---|---|---|---|---|---|---|---|
| -- | nieb/zie | nieb/żół | nieb/bia | niebies. | zielony | żółty | czarny | czerwony |
| Oznaczenie przewodów w "Wskazówki dotyczące podłączenia". | BL/GN | BL/GE | BL/WS | BL | GN | GE | SW | RT |
| Sterowanie silnika | -- | -- | | | 7 | | 4/5 | 16 |
| ABS | -- | -- | | | 7 | | 4/5 | 16 |
| Airbag | -- | -- | | | 7 | | 4/5 | 16 |
| Zestaw wskaźników | -- | -- | | | 7 | | 4/5 | 16 |
| Sterowanie skrzyni biegu | -- | -- | | | 7 | | 4/5 | 16 |
| OGRZEW./KLIMAT | -- | -- | | | 7 | | 4/5 | 16 |
| Podgrzewanie postojowe/dodatkowe | -- | -- | | | 7 | | 4/5 | 16 |
| Elektron.blokada odjazdu | -- | -- | | | 7 | | 4/5 | 16 |
| Regulacja zasięgu świateł reflektorów (LWR) | -- | -- | | | 7 | | 4/5 | 16 |
| Centralny zamek | -- | -- | | | 7 | | 4/5 | 16 |
| Moduł centralny komfortu | -- | -- | | | 7 | | 4/5 | 16 |
| Elektryka central. | -- | -- | | | 7 | | 4/5 | 16 |
| System nawigacji | -- | -- | | | 7 | | 4/5 | 16 |
| Audio | -- | -- | | | 7 | | 4/5 | 16 |
| System nagłośnienia | -- | -- | | | 7 | | 4/5 | 16 |
| Szyna CAN | -- | -- | | | 7 | | 4/5 | 16 |
| Wspomaganie parkowania | -- | -- | | | 7 | | 4/5 | 16 |

**Fig.3. The example of the electronic joints of the particular systems in DLC joint in VW Group vehicles**
**Source: [5]**

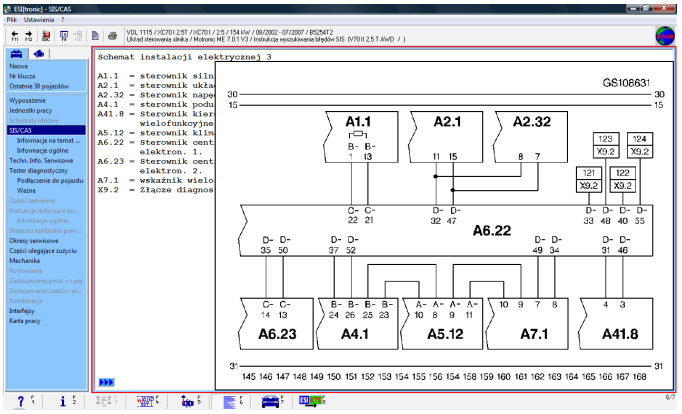


Fig. 4. Visualisation of getting the specific data in the process of punctual diagnosis of the system [taken from ESI platform [tronic] Bosch company
**Source: [5]**

If it turns out that this way of acting to solve a problem is not correct and appropriate, a fault should be found with the use of the transmission line K-line.

Rules:

- Check if the ignition is turned on and any other electric and electronic protection is turned off.
- Check the electric mass of the DLC joint encoded 4/5 and energy"+"of 16
- Measure the voltage between the K transmission pipe lines (7) and pipes of electric mass in the DLC joint (4/5)
  - › It should be lower about 1-2V from the voltage of the diagnostic joint
  - › If there is lack of the voltage a fault can be the result of the fuse between the transmission line and the mess/weight or a gap in the circuit.
  - › If the voltage is exactly the same as the voltage of the power (between 4/5- 16) the reason is the fuse of K line and '+"
  - › If there is a voltage measuring about few volts – it means that there is a fuse of the line and another circuit- e.g. Unprofessional setting of the LPG
  - › If there is a voltage measuring about 0,1V it means that one of the plugs of the control unit is burnt.

## 3.1. Unconventional diagnosis of the data CAN-bus

In Cars possessing the European homologation dating from 2008, the diagnosis must be done with the use of the CAN official record encoded 6 and 14. For these systems there is a need to control all the specific data, e.g. impedance which finishes the CAN-bus of data that is data bus terminal. According to the ISO 11898 norm, the value for CAN-bus till 40 metres should achieve 124 Ω for the pipes with the field of surface wiring 0,25-0,34 $mm^2$.

In practice, those values are stated by experiments so they very often have different values ranging between 115-125 Ω. For the specific solutions presented values as well as the specific ones are not commonly used as basic values.

It is impossible to find them in the tables showing the "actual values". Using the information platforms to set the specific values, e.g. ESI [tronic] of BOSCH can be the solution to the problem. However, it is not easy to get the access to the specific data. In order to get it the table of codes and faults of the given system or the table of the codes of Gateway can be used.

Here, it is important to find out the fault that is possible to record and "which is not visible for the memory of the control unit as well as it is connected with the diagnosis of the system and dependent system. In this diagnostic process it is a need to decode possibilities of the hypothetic mistakes connected with the network of the data transmission e.g. "Incorrect sign". It is possible to find out the records connected with the specific values of a given fault e.g. Data bus terminal and their localisation. Possessing such information it is easy to solve a problem with the use of the procedures described in this paper. [6]

# 4. Conclusion

All the managing systems in a vehicle must work correctly for the safety and comfort of passengers as well as for the functionalism of mechanisms and components. Due to the fact that the systems are highly modified and developed they need well qualified service workers to work on them. It is impossible to repair the car without the specific data and information. The knowledge of how the specific systems are built and what their functions are is

not enough to make correct diagnoses. It is a need to have specific data of each system. Consequently, methods helping to analyse diagnostic signs and programming control units become highly interesting and desirable for the masters of the car industry. It seems that such a tendency can be present on the market for a long time.

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