Diagnostic System MDS4500
System Architecture and FAQ's

Modul	Description

Hardware Elements

DU 4500.00

Diagnostic unit for embedded systems.
The unit contains the processor, the memory for the storage of the program and diagnostic results as well as the connection interfaces.

- ARM Cotrex A8 720 MHz
- 256 MB DDR2-Ram
- Disk Space 1 GB Flash file system
  2 GB memory (USB)
- Ethernet
- CAN 2.0 CANopen
- 8 digital inputs
- 8 digital outputs
- 4 inputs for speed sensors
- 24 VDC Power supply
- OS: LINUX
- Webserver available

DU 4500.10

Same unit but with a cover over the terminals and with robust connectors for all external elements such as supply and sensor inputs.

DU 4500.20

Same unit but with a cover as above plus a display on the top surface.

GSM 4500.00

Hardware GSM communication module.
Enables the remote access to the MDS box for exchange of diagnostic data as well as for commissioning and software maintenance.

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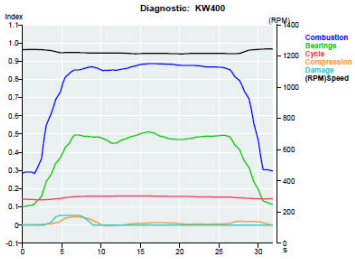
Software Modules

S4500 BASE.00

Diagnostic SW including Parameter input module. The software contains all the necessary elements for a full diagnosis of combustion engines. With the parameter input module the specific properties of the installation such as number of cylinders, arrangement of the engine, firing-order but also sequence and conditions of the planned measurement cycles can be commissioned.
Results are stored in the internal drives in the format of relevant indicators for combustion, bearing load, compression, mechanical damage and cyclic behavior.

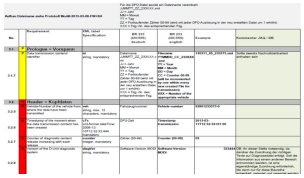


S4500 CAN

The software package that is needed in addition should the system communicate with a CAN-bus environment that is existing on the installation. Through this interface data can be received from the installation (i.e. temperatures, leaver position of throttle etc.) but also information (such as diagnostic results) can be delivered to the environment.

S4500 XML

Diagnostic results can be converted in an XML-file format and stored/communicated in this format to the application. Specific form and content of the XML-file can be adapted to the needs and requirements of the application.

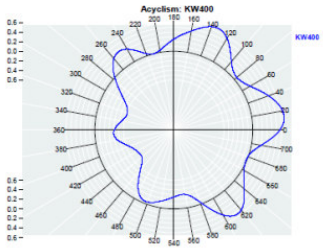


S4500 GSM

In conjunction with the hardware module GSM 4500.00 this software allows a remote access to the diagnostic system. Especially for mobile application like locomotives or marine engines this is an interesting way to make the results of the diagnose system remotely available.

S4500 DSP

In conjunction with the hardware system with display DU 4500.20 this software part is controlling the display. Various display variants can be selected/activated. Mainly this version is used should the it be desired that the local maintenance crew has an immediate information about the condition of the engine.

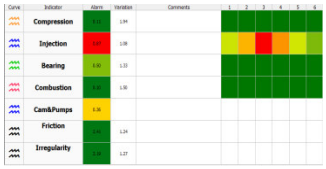


S4500 BIN

This software package activates and assign the functionality of the binary in- and outputs. For example this can be used to set alarm points or to inform the driver about specific conditions of the system and or the engine. Inputs can be used to control activities from remote (i.e. request for sending data to a remote structure)

S4500 GYR

A very popular way to display and deliver diagnostic data is the REEN-YELLOW-RED format. This software package allows to set the specific values for the G-Y-R form and prepares the reports for a direct export.



S4500 ERRC

This software package allows to translate diagnostic relevant findings into customer specific error-codes. In this format the customer can directly use the results of the diagnostic system in existing failure/maintenance structures.

ID	Code gelb	Code rot		Schaden	Realisierung
1	0611 - 0616 061A - 061F	0711 - 0716 071A - 071F	A1-6 B1-6	Funktionseinschränkung der Einspritzanlage inkl. deren Ausfall (je Zylinder)	mangelnde Kraftstoffzufuhr je Zylinder kann detektiert werd
2	0621 - 0626 062A - 062F	0721 - 0726 072A - 072F	A1-6 B1-6	Funktionseinschränkung der Einspritzdüse inkl. deren Ausfall (je Zylinder)	mangelnde Kraftstoffzufuhr je Zylinder kann detektiert werd
3	0631 - 0636 063A - 063F	0731 - 0736 073A - 073F	A1-6 B1-6	Funktionseinschränkung der Einspritzpumpe inkl. deren Ausfall (je Zylinder)	mangelnde Kraftstoffzufuhr je Zylinder kann detektiert werd
4	0641 - 0646 064A - 064F	0741 - 0746 074A - 074F	A1-6 B1-6	Funktionseinschränkung der Düsenleitung inkl. deren Ausfall (je Zylinder)	noch offen
5	0651 - 0656 065A - 065F	0751 - 0756 075A - 075F	A1-6 B1-6	Funktionseinschränkung der Einspritzregelung inkl. deren Ausfall (je Zylinder)	noch offen
6	0661 - 0666 066A - 066F	0761 - 0766 076A - 076F	A1-6 B1-6	Funktionseinschränkung der Kompression im Zylinder (je Zylinder)	mangelnde Kompression je Z kann detektiert werden
7	0671 - 0676 067A - 067F	0771 - 0776 077A - 077F	A1-6 B1-6	Veränderung der Kompression im Zylinder, herrührend aus der Paarung Kolben / Zylinderlaufbuchse (je Zylinder)	noch offen
8	0681 - 0686 068A - 068F	0781 - 0786 078A - 078F	A1-6 B1-6	Veränderung der Kompression im Zylinder, herrührend von den Ventilen (je Zylinder)	noch offen
9	0691 - 0696 069A - 069F	0791 - 0796 079A - 079F	A1-6 B1-6	Veränderung der Reibwerte der Reibpaarung Kolben / Zylinderlaufbuchse (je Zylinder)	erfüllbar, durch Abschaltung Auslauf des Motors
10	0601	0701		Starke Drehzahlschwankungen des Abgasturboladers	erfüllbar
11	0602	0702		Veränderung der Reibwerte in der Lagerung des Rotors des Abgasturboladers (Schwergang)	erfüllbar, durch Abschaltung Auslauf des Motors
12	06Ax...	...06Cx		20 Meldungen vom Heinzmannregler	

S4500 TORQ

Additionally to the diagnostic function also dynamic torque information can be processed and gained. On a shaft 2 pole wheels or similar target structures are placed in a defined distance to each other. These structures are detected by two additional speed sensors and the phase-shift resulting from the two signals is a direct measure for the torque. This software module is needed to calculate and deliver information about the instant toque values of such installations.

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JAQUET TECHNOLOGY GROUP

Frequently asked questions about MDS4500:

	Question	Answer
1	How many sensors are required for MDS4500	Normally 2 sensors, one for the crank and one for the cam shaft, are required. The most important sensor is the the one of the crank shaft. With just this sensor a result can be measured but not assigned to the correct cylinder.
2	What sensors are recommended	The easiest to be used sensors are DSE .. or GreenLine E .. type sensors. For cam shaft it can be an advantage to use a Hall-effect sensor such as a DSS or GreenLine F.. series.
3	What are the needed properties of the target (pole wheel)	The target should be as close as possible at the engine crank shaft (that means not after flexible couplings and or gear boxes). There must be a minimum of regular teeth on that pole wheel that depends from the number of cylinders of the engine. As a thumb rule for a 4-stroke engine a minimum of 15 x #of cylinders should be available (i.e 15 * 4 = 60 teeth for a 4-cylinder 4 stroke engine)
4	Must there be a constant speed for a proper measuring – and how long must it be constant	Basically the software can also cope with variable speed during the measured time. In the embedded systems the measured time (normally between 10 .. 30 seconds) as well as the conditions under which the measuring should take place can be set during commissioning of the system
5	What are the modules required to access the date from remote location	In stationary installation a Ethernet connection to the system is the only need. In mobile application additionally a the Hardware module **GSM4500.00** as well as the software package **S4500GSM** is required.
6	Which is the basic embedded system	Two speed sensors of the GreenLine E.. series The diagnostic unit **DU 4500.00** The software package **S4500 BASE.00**
7	What can be achieved/realized with the basic embedded system	Automatic capturing of data, analysis of the captured data and storage of the raw files as well as the basic diagnostic results. The data can be accessed by a PC and used as a basic condition information of the engine.
8	What is the "system for the expert"	This is the full software **VIB360 Windows** which has the routines to analyze and display measured data from engines and other rotating machines. To be able to measure and capture data from an engine a data acquisition box such as the **NI USB-4432**, is additionally required.
9	What is the "service unit"	This is a customized industrial PC which contains the acquisition card as well as the VIB 360 Windows software as well as some pre-configured reports and result sheets.
10	What is an "embedded system"	A diagnostic unit **DU4500.xx** that is installed permanently on the engine that need to be diagnosed. Data can be accessed by maintenance personal through remote access or locally from the storage.
11	What is an error code	One of the possibilities to indicate a failure is with a failure code instead of a text or a picture. The customer can create an own code for failure analysis. For this functionality, the Software module **S4500 ERRC** is required.
12	What are the engine condition which are needed to get reliable results	Both a cold engine and also an idling engine will not give very significant results. Best results can be achieved with an engine at normal temperature and preferably minimum half load.
13	Can the system also measure the delivered torque	Yes, the dynamic torque can be measured in parallel to the engine diagnostic. The software module **S4500 TORQ** is required. The setup needs 2 measuring points along the mechanical drive. That means 2 sensors that are looking at a target (i.e. a pole band or a pole wheel) on the axle driven by the engine. For calibration the torque needs to be measured externally or the elasticity an length of the measured axle needs to be known exactly.
14	How are the data accessed from the MDS	Either through the Ethernet connection with a local PC or through a network. Via a CAN bus. In this case the Software module **S4500 CAN** is required. Via GSM. In this case the GSM Hardware module **GSM 4500** and Software module **S4500 GSM** is required.

15	How many speed sensors can be connected to the embedded system	4 speed sensors. Typical installation examples are: 2 sensors are used to measure the torque of the system and the engine diagnostic is based on 1 cam and 1 crank shaft sensor. 2 engines (i.e. in a ship portside and starboard engine) can share one diagnostic unit with 1 cam and 1 crank shaft sensor each.
16	How many sensors are needed for a demonstration	For a first easy and simple demonstration only one sensor at the crank shaft is recommendable.
17	What are the information needed about the engine	- The concept of the engine (2-stroke or 4-stroke design) - Number of cylinders - Arrangement of the cylinders (V or In-Line) - Number of teeth of the crank-shaft pole wheel - Firing sequence in case of cylinder analyze
18	Are there analogue inputs	No there are no analogue inputs available at the embedded system. Analogue data can however be transmitted through the CAN interface.
19	What is the price of the MDS and what is the estimated pay-back time	Assuming a standard embedded system with 2 sensors the price for one single installation will be about 10'000 €. Depending of the detailed requirements and the number of installations planned this figure can be varying. Generally one can assume a pay-back time of about 1..2 years depending on the specific use and maintenance concept of the engine.
20	What is the pay-back mechanism	There are 3 major contribution to pay-back: - Fuel consumption: the MDS avoid that failures or malfunction in one cylinder to be compensated by the other cylinders generating an increase of fuel consumption. - Preventive maintenance cycles can be optimized (extended) depending on the information collected with the MDS. - A severe failure between two preventive maintenance cycles can be detected and corrected before damage to the engine occurs.