KNOCKDETECT

Operating instructions

09/08/2021 – Version 2.4
Software version: 2.1.07-210527

I. General information

Type of document	Operating instructions
Version of document	2.4
Date	09.08.2021
Complementary documents	• Assembly instructions KNOCKDETECT • Engine types KNOCKDETECT

II. Revision status

Revision	Date	Software version	Modification
1.0	07.03.2014	1.0.01-140327	Initial draft
1.1.34	15.03.2014	1.0.01-140327	Chapter III: „Checking the engine settings“ added
1.1.35	08.09.2014	1.0.01-140327	Password for role “user” corrected
1.2	05.10.2015	1.2.5-20151009	Adjustments due to new software version
1.3	11.01.2016	1.2.06-160111	Adjustments due to new software version
1.4	21.01.2016	1.2.06-160120	Adjustments and revisions
1.5	29.01.2016	1.3.00-160122	Adjustments due to new software version
1.6	16.02.2016	1.4.00-160216	Adjustments due to new software version
1.7	17.02.2016	1.4.00-160216	New engine data added
1.8	14.03.2016	1.4.00-160314	Adjustments due to new software version
1.9	13.06.2016	2.0.00-160613	Adjustments due to new software version
2.0	27.06.2016	2.0.00-160617	New engine data added
2.1	07.07.2016	2.0.01-160707	New engine data added Software version added
2.2	26.01.2017	2.0.02-170126	New engine data added
2.3	19.12.2017	2.0.04-171219	Adjustments due to new software version Engine data removed and integrated into assembly instructions
2.4	09.08.2021	2.1.07-210527	Adjustments due to new software version Engine types transferred to separate document

These instructions have been created with great care. Nevertheless, we cannot guarantee the accuracy of the information presented. Errors excepted.

Table of contents

III. Important note

The KNOCKDETECT is meant as a tool to detect and analyse abnormal operating conditions. The setting of the parameters and the various reaction chains should only be carried out by trained personnel.
However, it is not possible to foresee all circumstances that might pose a danger. Thus, the KNOCKDETECT recognizes engine knocking within the scope of possibilities, but not compulsory.

IV. Communication with the KNOCKDETECT

1. IP address

To access the web interface of the KNOCKDETECT, connect the device to the network.

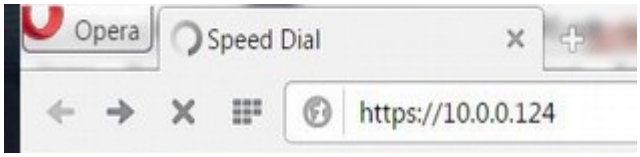
Caution!

- You may have to change the network address of your computer for the first contact with the device.
- The KNOCKDETECT and the PC must be in the same address range.
- The standard IP address ex factory is: 10.0.0.124

You can always retrieve the IP address via the display by pressing the “MENU” button on the upper side of the unit.

The current IP address is displayed. If you have changed the IP address ex factory in the meantime, please enter the displayed IP address in your browser.

Enter the following address into the address bar of your browser: **https://10.0.0.124**



Pay attention to the **https://** - this establishes a tap-proof connection between your PC and the device.

If you are on the IP address page, you can reset the IP address to the delivery status by pressing and holding (> 10s) the “MENU” button on the unit.

2. Security certificate

Your browser (here OPERA) informs you, that the security certificate of the device is unknown to him:

Only registered certificates are known to the browser.

The use of a registered certificate is an important requirement for authentication during data transfer between unknown senders / receivers on the Internet. These certificates incur ongoing costs.

However, this is not necessary for communication within your own network with known participants (e.g. control PC system, KNOCKDETECT).

The certificate generated by KNOCKDETECT complies with the current security standards (SSL1024) but is not registered.

Note!

- The KNOCKDETECT system does not install or change any software on your system!
- The visualisation runs exclusively via the existing functionality of your web browser!
- The KNOCKDETECT provides the browser with a web page containing the measurement data – nothing more.

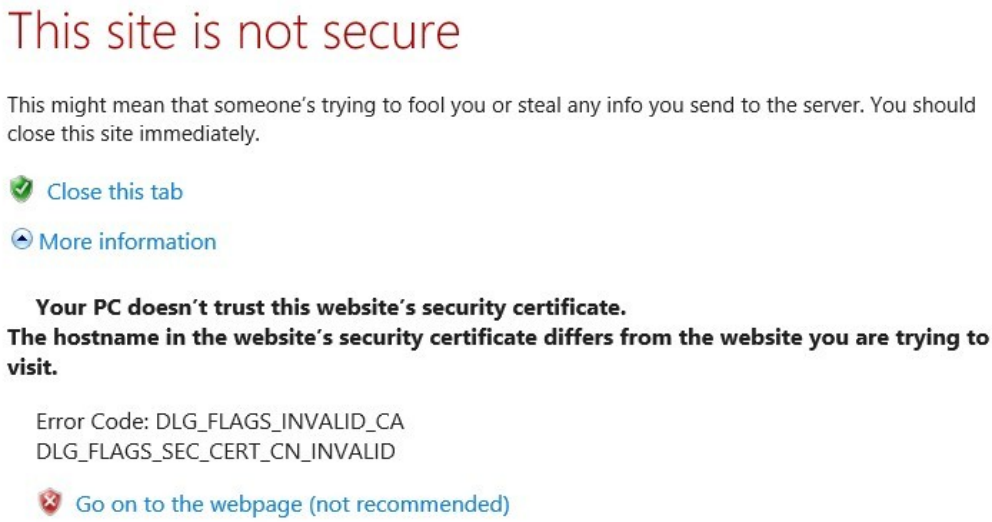
Major parts of the software and communication are written in accordance with the latest security standards and recommendations of the BSI (German Federal Office for Information Security) – as for example the connection via the encrypted "https" protocol, that requires a security certificate.

To go to the home page of the KNOCKDETECT, please select "Continue Anyway".

In other browsers, the procedure behaves in the same way, but may be named differently.

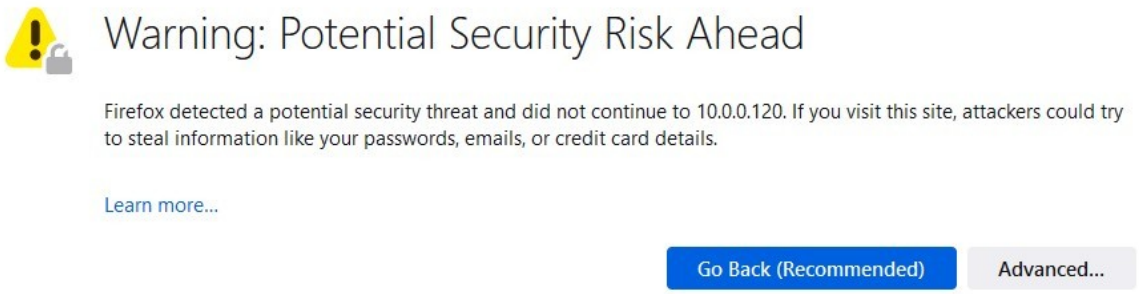
Example 2: Microsoft Internet Explorer

Please select „More information“. The following message appears:



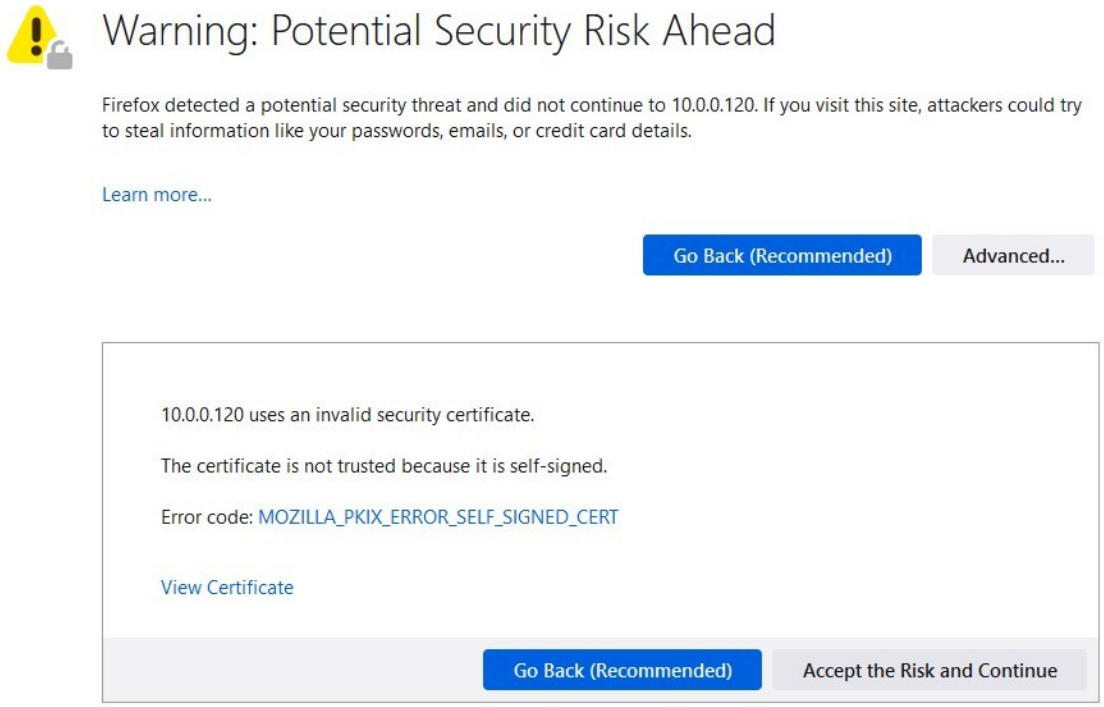
Now click on "Go on to the webpage" – you will then be taken to the home page of the KNOCKDETECT.

Example 3: Mozilla Firefox



Please select “Advanced…”.

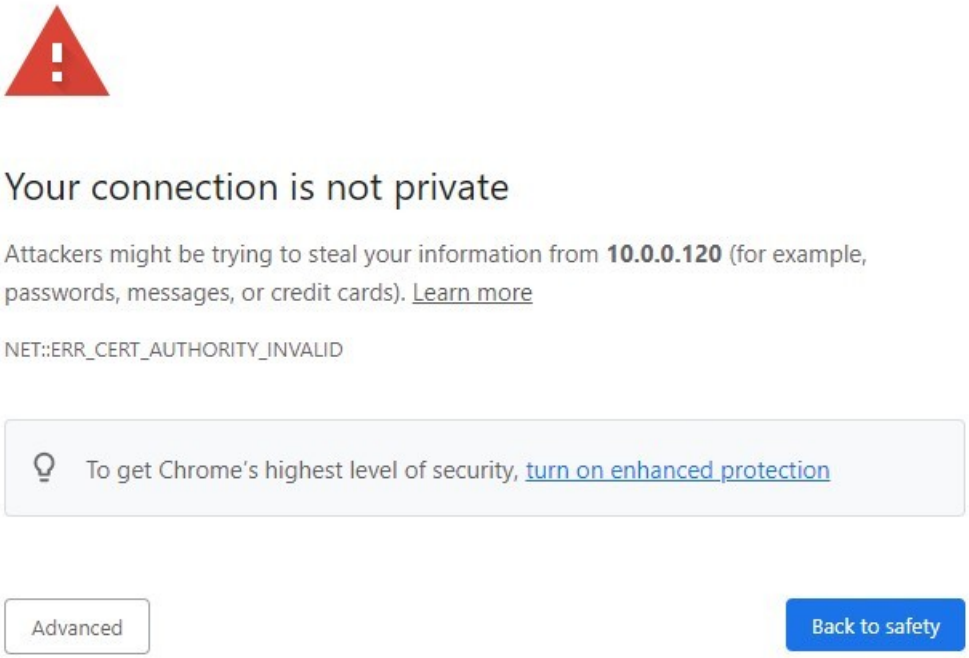
The following message appears:



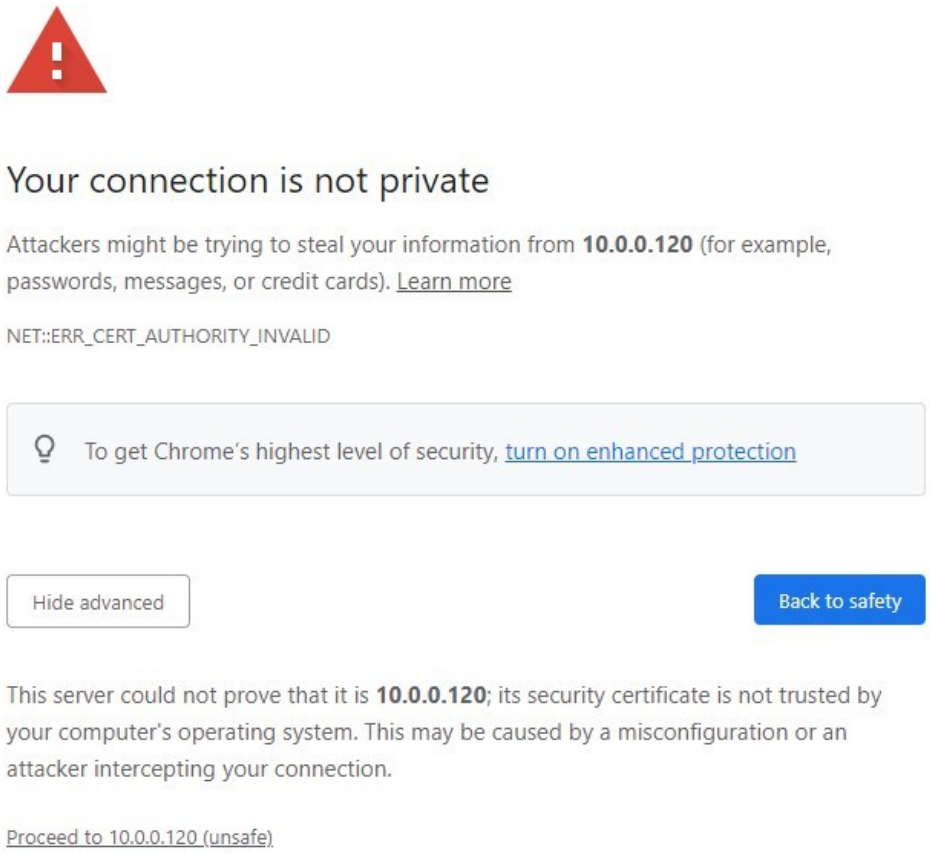
Click on „Accept the Risk and Continue“.

By doing so, you add an exception to the general rules of the browser.
With this option, the developers of the browser are aiming precisely at applications similar to the KNOCKDETECT.

Example 4: Google Chrome



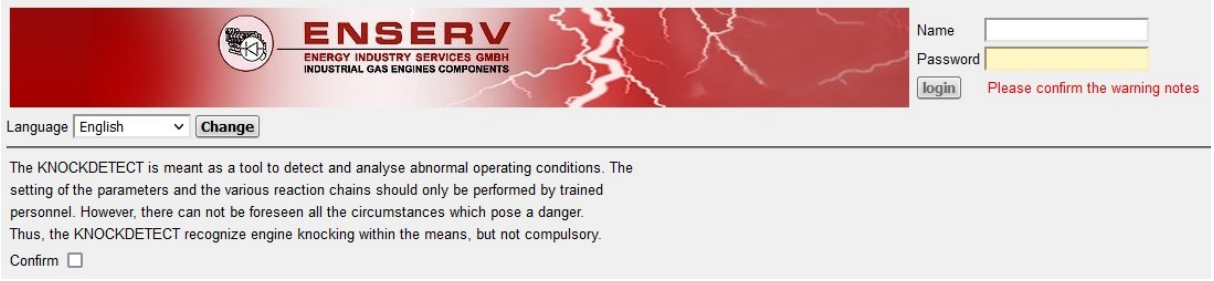
Now click on “Advanced”.



Select „Proceed to 10.0.0.120“ (the IP address depends on the settings of your device).

3. User roles

Completing procedures described above will lead you to the home page of the KNOCKDETECT:



Here you can first set the language of the web interface. The following options are possible: German, English, French.

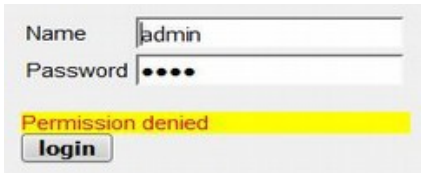
To access the system of the KNOCKDETECT, you must log in with one of 3 possible user roles and confirm the warning displayed below.

Possible user roles:

- user
- service
- admin

Each role has different permissions and a different password.

If the entered password is wrong, the following message is shown.



The 3 roles have different levels of authority:

user
This is the lowest level. The user can view all pages, but cannot change anything except his own password.

service
One level above the user level.
The service can view all pages, change various settings as well as change his own password.

admin
This role is provided with all rights.
An admin may change any setting (e.g. also all passwords) and "update" the system.

If you have forgotten your passwords, you can reset them by pressing and holding (> 10s) the “MENU” button on the unit. During this, it is important that you are on the start page – not the IP address page!

4. Passwords ex factory

At the time of delivery the following passwords are assigned:

Role	Password
user	Giz0thah=
service	mah6bie:N
admin	ea8iL=in6

Note the exact uppercase and lowercase letters in name and password.

Caution!

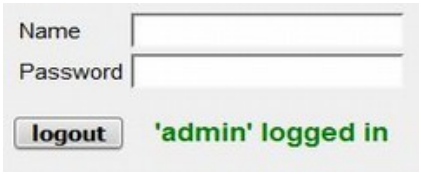
- Please handle your passwords with care! Manipulation (e.g. incorrect settings) can impair the correct functioning of the unit and damage the engine.
- Assign new passwords of your own and keep them in a safe place.

If you are on the start page, you can reset your passwords to the delivery status by pressing and holding (> 10s) the “MENU” button on the unit.

V. Setting up the device

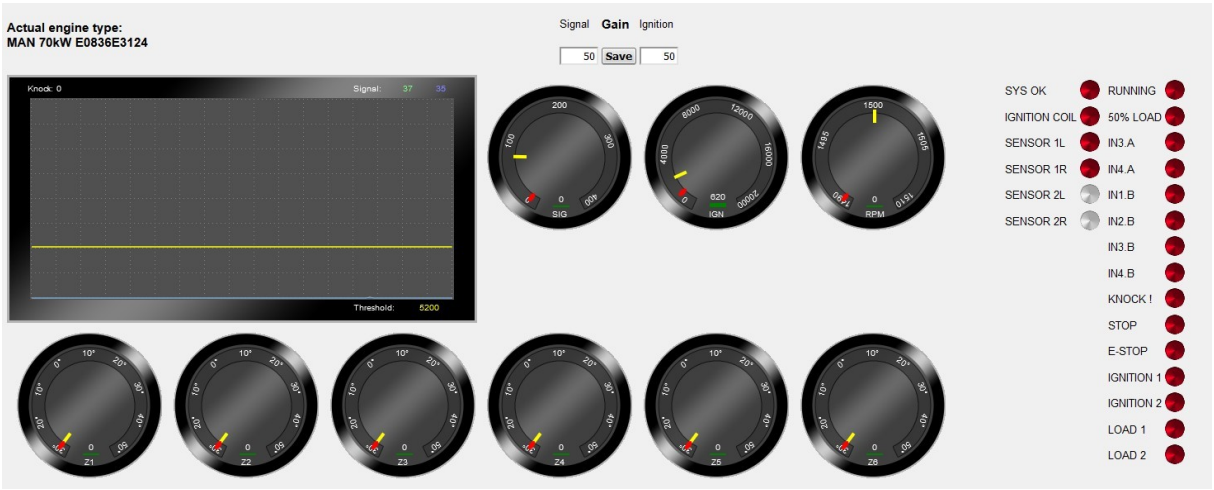
1. Logging in as admin

To set up the KNOCKDETECT, you need to log in with the admin role.
As admin you have full authorisation to manage the device's settings.



The registered role appears in green letters underneath the log-in input fields.

After logging in, you will be taken to the status page of the KNOCKDETECT interface:



You can switch between the following tabs:

This page shows the current readings for each cylinder, the sum signal of all knocking events, the trigger signal of the ignition, the measured speed and the status of the digital inputs and outputs are displayed.

With the buttons at the bottom of the page the automatic update of the website is switched on (–-+) and off (Stop).

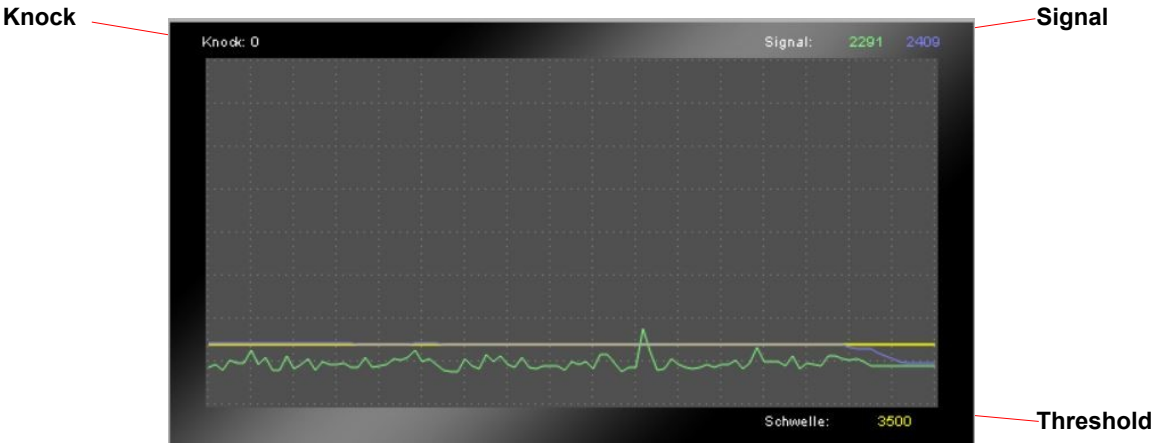
2. State tab

The currently valid engine type is shown at the top left below the tab display:

In this case it is a MAN 4-cylinder engine of the type E0834E302. The following number (here 2) stands for the second engine in the list.

a) The signal oscilloscope

Directly under the tab bar is a rectangular image section, similar to an oscilloscope.
It shows the course of the knocking signal (= number of all knocking events per time unit).



Knock:
On the top left you can see the absolute number of knocks (Knock) in parts per mille.

This number is calculated from the maximum possible knocking events. By definition, 100% is reached when the engine knocks on every cylinder with every ignition. In practice, an engine already shows strong knocking when only about 2-3% of all ignitions can be assigned a knocking event.
To achieve the finest possible resolution without point representation, the knock number is scaled in 1/1000.The correct presentation are 0..1000 ‰ (read: per mille).

In the example above, 0‰ exceeds the yellow knock threshold (green signal train above the yellow line) during the observation period.

Signal:
On the top left you can see the signal. It is proportional to the energy of the knocking event.
The numerical value corresponds to the current Y-value of the green line at the first coordinate on the right edge of the window.

Green curve:
It rolls from right to left and represents the signal strength of the knocking event.

Blue curve:
It runs from right to left and represents the average signal strength of the knocking event.

Threshold:
On the bottom right you can see the current trigger level (threshold specified as a number) that has to be exceeded for the detection of a knocking event. This number corresponds to the level of the yellow line.

b) Operation of the oscilloscope

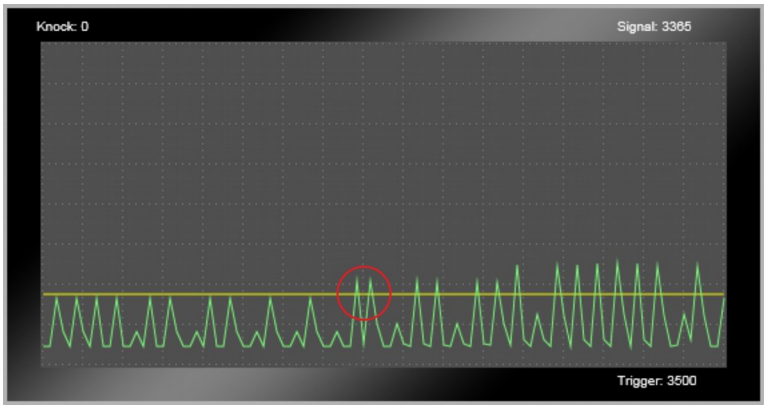
The oscilloscope acquires the knocking events in their chronological sequence.

The current measured value of the knocking signal (signal) is displayed as a green dot, far left in the picture. Every second 50 points are recorded and displayed on the screen. This creates a continuous line, which corresponds to the time curve of the signal strength.

The current trigger level (threshold) is indicated by the yellow line.

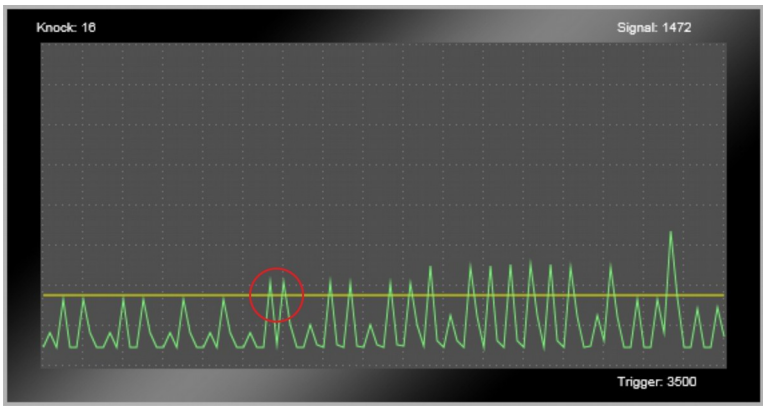
The oldest values are far left. The newest values are far right.

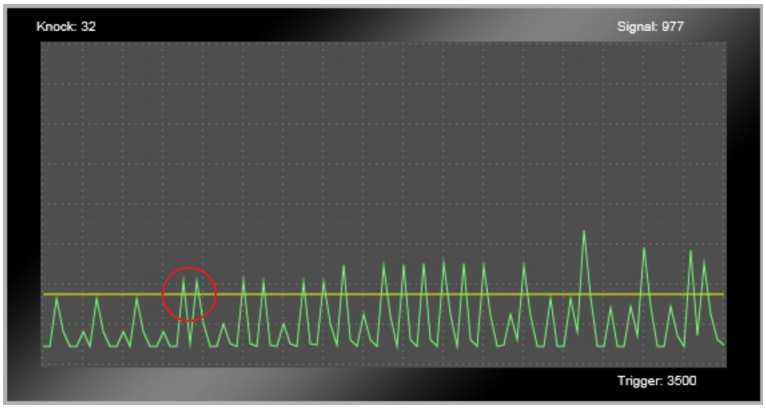
The signal energy is plotted on the Y-axis (from bottom to top: 0-16000 points).



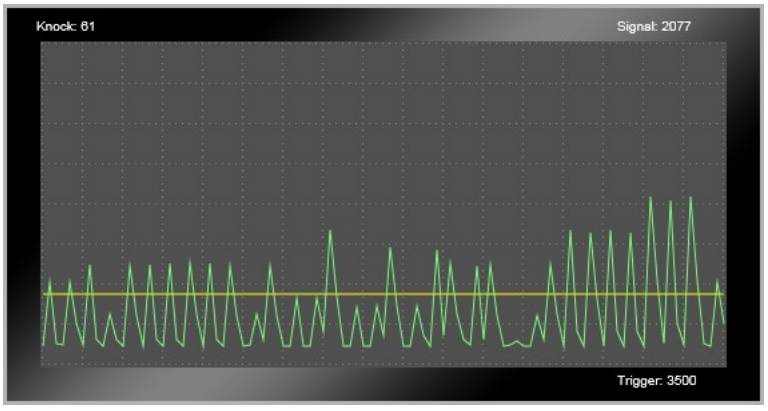
All screens were taken at intervals of about 1 second.

You can clearly see how the highlighted areas migrate to the left. The complete sweep from right to left is approximately 15s.



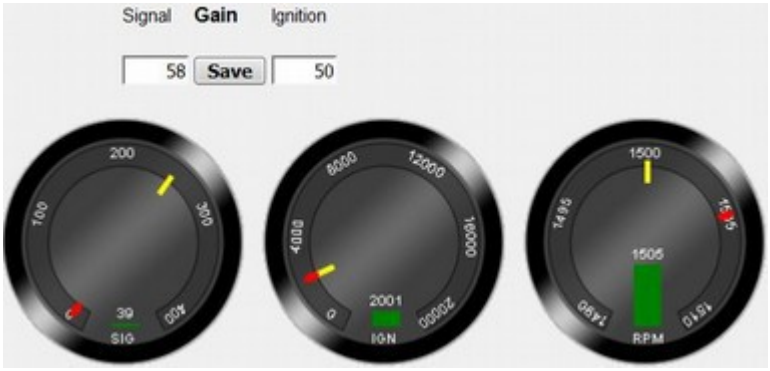


In the last image, the marked detail is no longer visible - it has shifted out of view to the left.



c) Indicator instruments for Signal, Trigger and Speed (RPM)

Next to the oscilloscope are three indication instruments:



Instrument „SIG“

This instrument visualizes the average energy content of the currently measured knocking events.

The outer scale ranges from 0-400 ‰.

Red dot:
The red dot represents the current, filtered sum value of all the knocking events.

Yellow line:
The yellow line indicates the minimum threshold which switches the digital output “STOP”.

Green bar:
The green bar in the middle shows the current value of the knocking signal.

The number above the green bar shows the last peak. In the upper instrument peak and current value are the same (6745).

The lower instrument shows a peak value of 7580 while the current measured value is far lower.

The peak indicator stores the last maximum for about 2 seconds. After 2s the new current peak value is displayed.

The colour of the bar changes from green (0-8000) to yellow (8001-12000) to red (12001-16000).

Gain of the knocking signals:

With the input fields the gain of the knocking signal (Signal) and the trigger signal (Ignition) can be adapted to the specifics of the engine assembly. Please press the button “Save” after each change.

Adjustment instruction:
Adjust the gain so that in normal operation (50% load, no knocking) an energy content (green bar “SIG”) of approx. 2000 points is achieved.

Instrument „IGN“

This instrument shows the signal energy of the trigger signal.

The trigger signal is taken parallel to the ignition coil 1.

All calculations regarding phasing of knocking events relate to the trigger signal.

Caution!

- Without a valid trigger signal, the evaluation will not work!
- Make sure that the polarity of the signal pick-up is correct.
- If there is no trigger signal or it is below the set threshold, the output SYS OK switches off.
- If the gain is set too high, the trigger input is overdriven and incorrect measurements occur - pay attention to the adjustment instruction!

The outer scale ranges from 0-20000.

Red dot:
The red dot represents the current filtered value.

Yellow line:
The yellow line indicates the set trigger level needed to detect the signal.

Green bar:
The green bar in the middle indicates the current measured value.
The number above the bar (here 6122) indicates the current peak value.
As long as this is not exceeded, it remains stored for 2s. After this time has elapsed, the new peak value is displayed.

The colour of the bar changes from green (0-10000) to yellow (10001-15000) to red (15001-20000).

Gain of the trigger signal:

With the input fields the gain of the knocking signal (Signal) and the trigger signal (Ignition) can be adapted to the specifics of the engine assembly. Please press the button “Save” after each change.

Adjustment instruction:
Adjust the gain to achieve between 6000 and 7000 points on the green bar (IGN) in normal operation (50% load, no knocking).

Instrument „RPM“

This instrument displays the rotational speed determined from the trigger pulses.

The outer scale ranges from 1490 to 1510 Rotations per Minute (RPM).

Red dot:
The red dot represents the current value.

Yellow line
The yellow line indicates the target speed.

Green bar:
The green bar in the middle shows the current average of the last measurements.

The number above the green bar (1500) shows the last peak. The peak indicator stores the last maximum for about 2 seconds. After 2s the new current peak value is displayed.

Caution!
The display shows 0 RPM when the trigger signal continuously remains below the trigger threshold.

d) Cylinder indicators

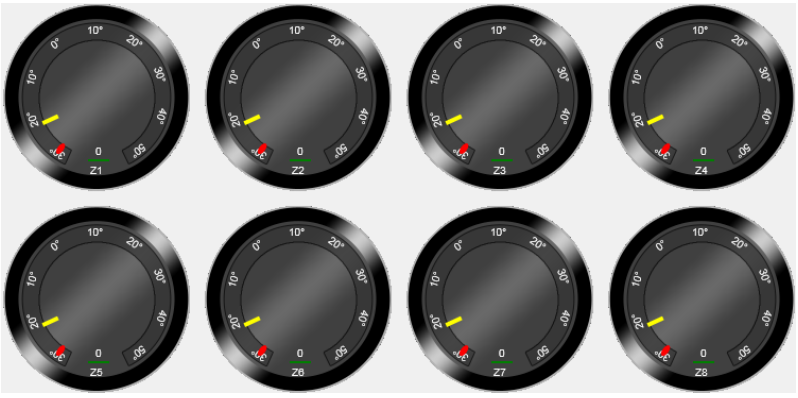
Directly below the three instruments for signal, trigger and engine speed are 4 to 12 single indicators for each cylinder.

The number of instruments varies depending on the engine type (R4, R6. V8, V12).

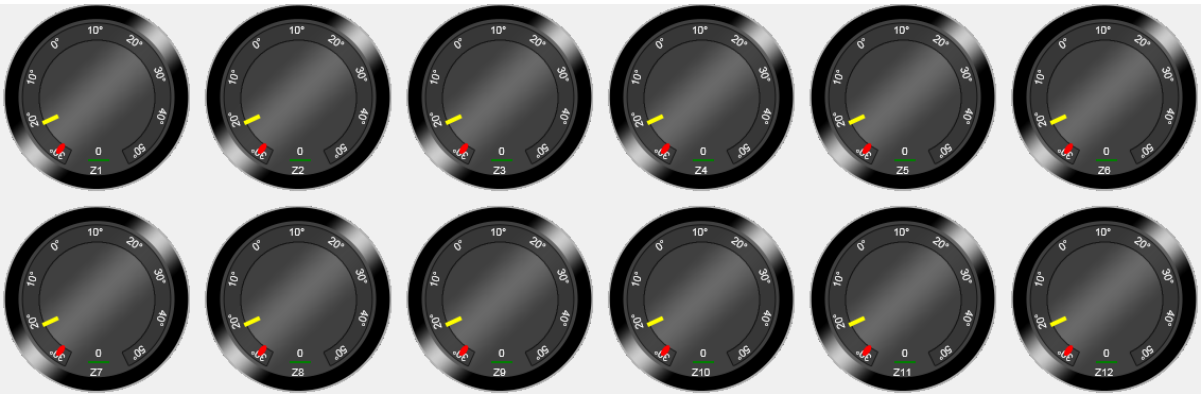
4-cylinder engine:

6-cylinder engine:

8-cylinder V-engine:



12-cylinder V-engine:



Each indicator is labelled according to the assigned cylinder (Z1, Z2, Z3, etc.).

Top left is always the cylinder 1 (Z1). On the right (or bottom right for V machines) is always the last cylinder (Z4, Z6, Z8 or Z12). The cylinders are counted in order.

The software analyses the knocking signals in relation to their phase position to cylinder 1.
The ignition sequence and the ignition timing are respected and taken into account.

e) Cylinder indicator in detail

At the bottom in the middle is the name of the cylinder: Z1

Red dot:
The scale on the outer ring ranges from 30° before TDC to 50 ° after TDC.
The red dot indicates the position (relative to TDC) of the knocking event for this cylinder.
In this case, 10 ° after TDC.

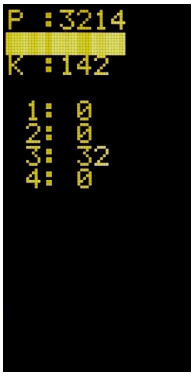
Yellow line:
The yellow line shows the ignition timing (read in from the engine file or Modbus interface).

To get reliable information, set up the actual ignition timing in the Engine tab.
The actual ignition timing must, if it is not transmitted via digital interface, be entered in the KNOCKDETECT. In the engine files are values which may differ from the actual ignition timing.

Green bar:
The bar in the middle shows the energy content of the knocking event. It is scaled from 0 to 32.

The colour of the bar changes from green (0-16) to yellow (17-24) to red (25-32).

The number above the green bar (9) shows the last peak. As long as no higher value is measured, the reading remains stored for approx. 2s. After 2s, the new peak value is displayed.



On the front display of the device the ignition level (P), the resulting knock number (K) and the intensity of the knocking events of the individual cylinders (1-12) is displayed.

The picture shows the display for a 4-cylinder engine.
The trigger signal (P) from the ignition has an intensity of 3214 points.
The knock number (K) is currently 14.2%
The cylinder no. 3 shows maximum knock intensity (32).

Caution!
Signals that fall outside the range from 10° before TDC to 50° after TDC are not considered as knocking events by definition!

The noises in the dead zone are nevertheless measured – their sum can be read off the bar of the “SIG” instrument.

Knocking events – dead zones:

At 4-, 6- and 8-cylinder engines, there is a dead zone in which, by definition, no knocking occurs. These zones are becoming smaller with an increasing number of cylinders.
In a 12-cylinder engine, there is no dead zone.

The dead zones are calculated as follows: $$Blind\ spot\,(^\circ)=\frac{720}{(number\ of\ cylinders)}-60$$

The values are:
R4: 120.0°
R6: 60.0°
V8: 30.0°
V12: 0.0°

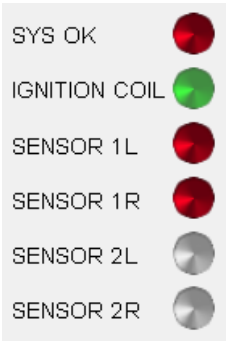
This shows that the exact assignment of the knock signals is most difficult with the 12-cylinder engine. In this engine, there is no gap between two consecutive cylinders in the firing order.

Caution!

- If you detect noises in dead zones, they are most likely not coming directly from the combustion process.
- In this case, be sure to consult an engine specialist.

f) Sensor status indicators

On the right-hand side there are two columns of status LEDs.



The LEDs in the first column are used for setting up and controlling the system.

Only if the system is properly connected and configured, the LED SYS OK lights up. Only then the knock detection works!

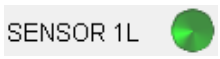
The LEDs Ignition Coil and Sensor 1L to 2R show whether the corresponding input is connected according to the specifications in the engine file.

Depending on the engine type you need 1-4 knock sensors and always the trigger pulse from ignition coil 1.

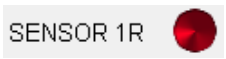
Installation help:
When you have selected the engine, the corresponding inputs on the unit flash as long as no cable is connected.

If an original sensor or trigger cable is connected, the LED next to the connection remains lit in green and the display on the status page of the web interface changes from red to green.

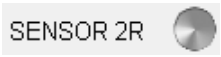
Not required sensors are displayed in grey.



Sensor is required, the cable is plugged in and has been recognised.



Sensor is required, the cable is not plugged in or has not been recognised.



Sensor is not required for the evaluation, the input is not monitored.

Caution!
This procedure helps you to install the sensors. It does not constitute monitoring of the sensor function.

SYS OK LED:
If the wiring is correct and a sufficient trigger signal is present, the SYS OK LED changes from red to green. Only then, the system ready.

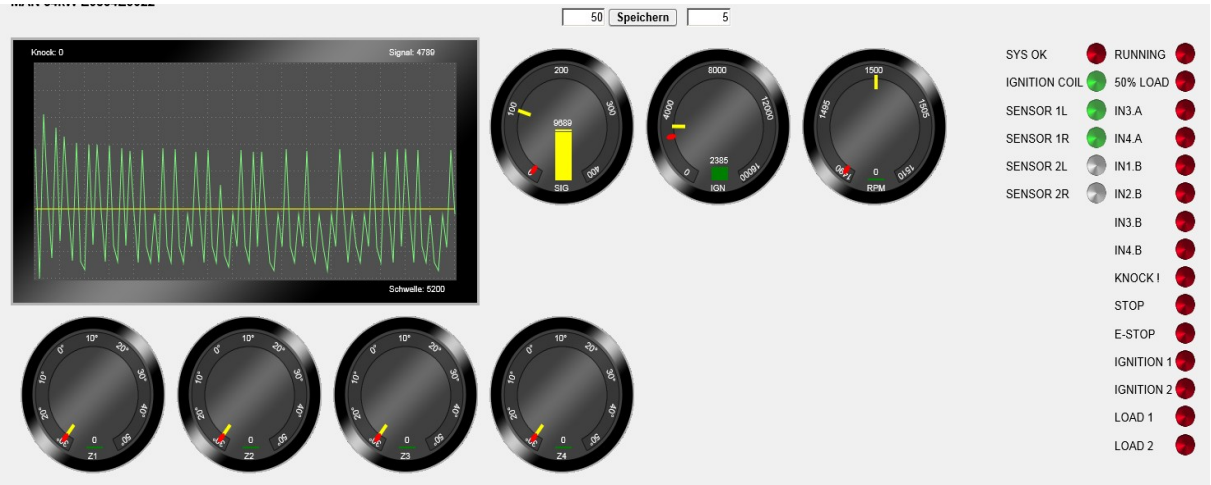
SYS OK output:
Similar to the SYS OK LED, the SYS OK output is switched on when it is green.
This output can be read out by a higher-level controller.

It is used to signal a fault, making it suitable for the permanent monitoring of the system function.

Caution!
- Without SYS OK signal the evaluation is not active!
- Monitor this signal to an external controller and / or integrate it into the control circuit for power reduction.

Examples for the SYS OK function

Trigger signal too low

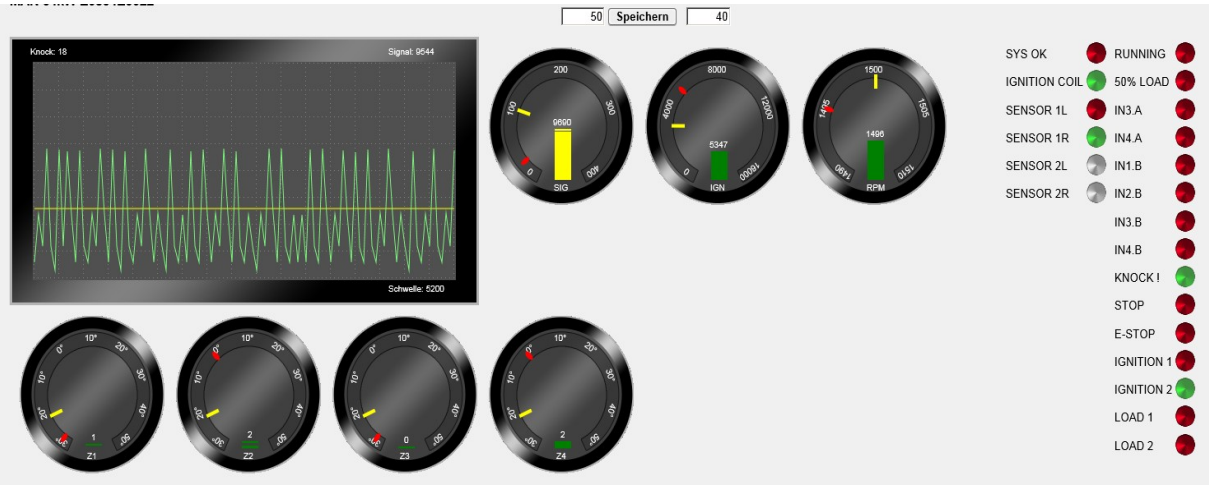


SYS OK is lit up red because the trigger signal IGN (2385 points) is below the threshold of 3,000 points (yellow line in IGN instrument).
Without a valid trigger, there is no evaluation.

SENSOR 1R is missing

SYS OK is lit up red because the SENSOR 1R indicates red.
This means that no sensor cable has been detected at the input 1R (here 4-cylinder with 2 sensors: 1L + 1R), although the engine setup expects this.
SENSOR 2L and 2R are grey, as they are not required for the evaluation of the 4 cylinder.

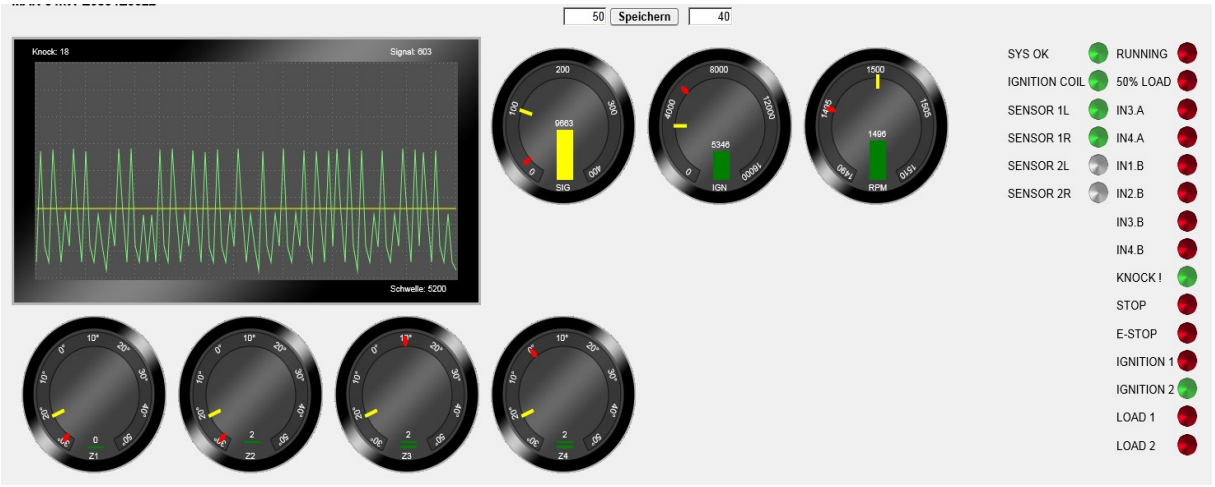
SENSOR 1L is missing



SYS OK is red because SENSOR 1L is missing.
1R measures strong knocking signals but the evaluation does not run because the specified sensors are not present!

In any case the digital output SYS OK should be evaluated by the engine control.
This is the only way to ensure that the engine is stopped reliably in the event of a malfunction of the KNOCKDETECT.

All sensors available, trigger signal sufficiently – SYS OK signal is green.



SYS OK is lit up green.
The system has all the required inputs and the level of the trigger signal is above the threshold.

The SYS OK output is closed.

g) Status displays of the digital inputs and outputs

Next to the sensor signals, the status of the digital inputs and outputs is shown:

Inputs:

The device has 8 digital inputs.

Two of these are assigned fixed functions:
"RUNNING" indicates to the unit that the engine is running synchronously with the grid.
"50% LOAD" indicates that the power output of the engine is less than or equal to 50% of the nominal power.

Both inputs can be used for evaluation.
To do this, the check mark must be set next to the relevant input (see interface tab).
The inputs IN 3.A to IN4.B are for future extensions and are currently only displayed, but can be read via Modbus.

Outputs:

The following 7 LEDs (KNOCK! to LOAD 2) indicate the status of the respective digital outputs.

Each output has its own adjustable window with minimum and maximum values. The value range refers to all signals on the summed, averaged knocking events (see display oscilloscope).

The outputs turn on when the knocking value is within the specified range. Two or more outputs can be configured to overlap.

A sensible range selection allows the user to choose his own sequence of countermeasures.

Control strategy:

In practice, the following procedure has proven successful:

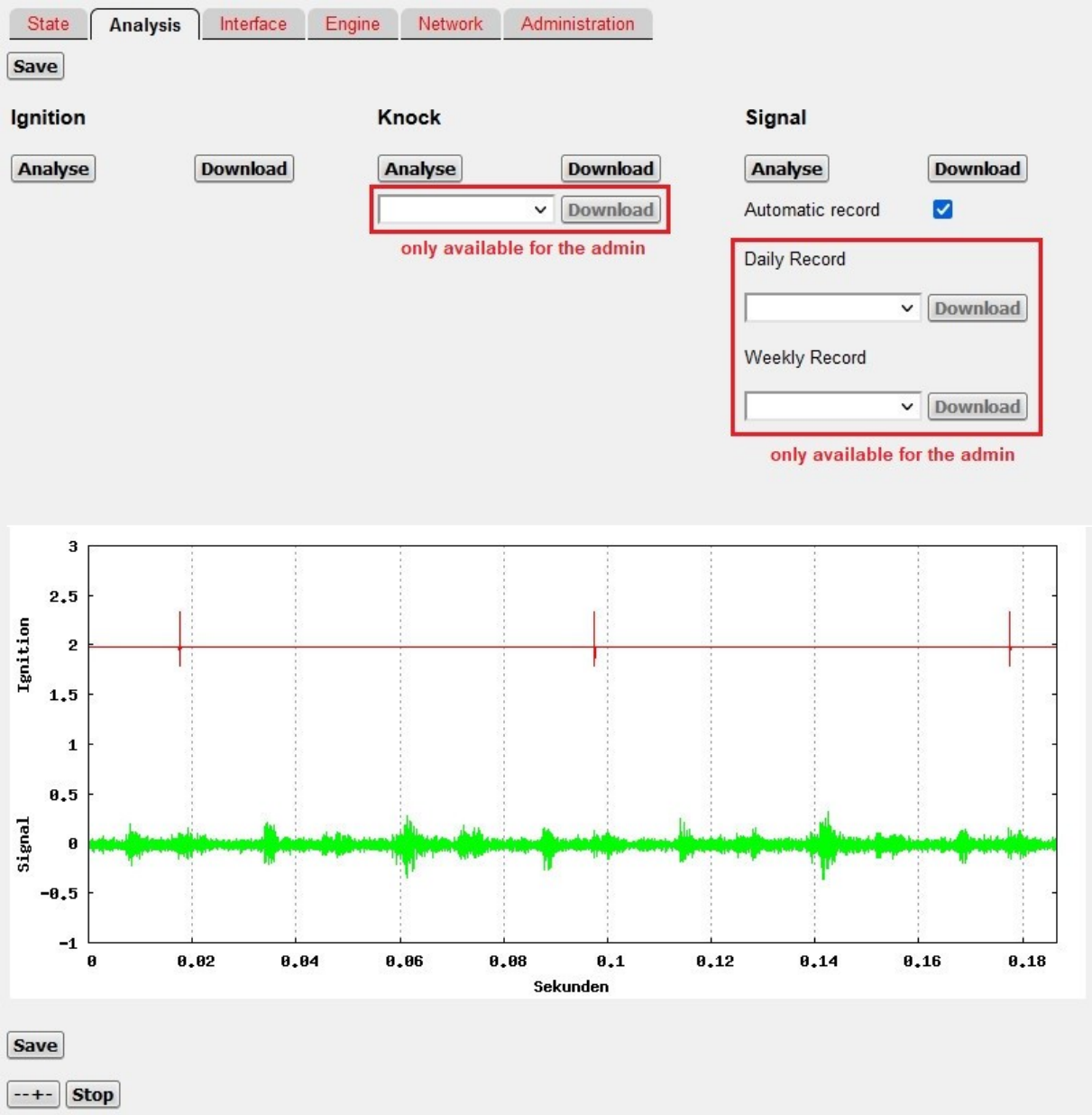
First step: When knocking events occur, the ignition timing should be adjusted.
Second step: If the knock noises continue to increase, the engine power should be reduced.

In the case of particularly sensitive engine / gas combinations, it may be necessary to reduce the power immediately at the first occurrence of knocking signals.

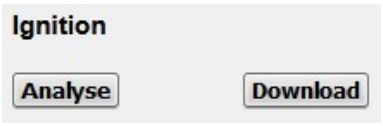
Caution!
The control strategy depends on the design and intended purpose of the system and should be selected with the greatest care. Consult with your CHP / engine manufacturer!

3. Analysis tab

In this tab you will find tools with which the trigger signal and the knocking signals can be saved and subsequently analysed.



a) Ignition – Analysis of the trigger and the knocking signal



Analyse:
By pressing the button “Analyse”, you get the stored signal curve between three consecutive Z1 trigger pulses.

At a nominal speed of 1500 rev/min, this corresponds to 2x 80ms.
The computer triggers on the next Z1 pulse, saves the data and creates a chart.

The Y-axis shows the knocking signal (green) and the trigger pulse (red) in normalised representation.
+/- 1 corresponds to the maximum signal amplitude.

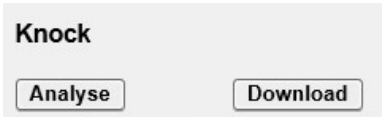
The X-axis is scaled in seconds.
An auxiliary line is plotted every 20 ms.

In the picture above you can see that knocking occurs at 0.06 and at 0.14 seconds.

Download:
With the button "Download" you can load the memory dump of the two signals as a file onto the PC.

The file contains 2-channel, 16bit linearly coded data and can be processed further with appropriate software.

b) Knock – Detailed analysis of the knocking signal



Analyse:
The analysis of the knocking signal shows the exact signal curve in a time range from 0 to 2.5 ms.

From this data, the frequency spectrum and the energy content of the knocking signal can be calculated.

The Y-axis shows the knocking signal (green) in normalised representation.
+/- 1 corresponds to the maximum signal amplitude.

The X-axis is scaled in seconds.
An auxiliary line is plotted every 5 ms.

Download:
With the button "Download" you can load the memory dump as a file onto the PC.

Download CSV – Log files (only possible with the admin role!):
With the download function you can load the memory dump as a file onto the PC. To do this, you have to choose a file and click on “Download”.

In this file, the values for knock number, signal strength and speed are entered at 5s intervals. After 7 days, a new file is created and the old file is saved. The data is available for one year.

The file name is structured as follows: 00008_ 21_ 15 .csv
ongoing number_year_calendar week.csv

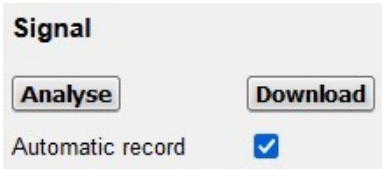
The log file is structured as a text file with a semicolon (;) as text separator and can, for example, be imported into a spreadsheet programme (e.g. Microsoft Excel) for further analysis.

The format of the log file is structured as follows:

Date	Time	Knocking events	Signal energy	RPM (U/min)	Input RUNNING	Input 50% LOAD
09.08.21	16:35:16	1	4082	1500	0	0
08.08.21	16:35:21	3	6161	1500	0	0
09.08.21	16:35:26	20	4984	1500	0	0
09.08.21	16:35:31	40	2958	1500	0	0
09.08.21	16:35:36	45	3903	1500	0	0
09.08.21	16:35:41	39	3109	1421	0	0
09.08.21	16:35:46	36	315	573	0	0
09.08.21	16:35:51	0	55	0	0	0
09.08.21	16:35:56	0	73	0	0	0

In this example, you can see that the number of knocking events increases and the engine is stopped at a knock count of 45 (engine speed drops to 0).

c) Signal – Analysis and storage of the signal for evaluation by the service



Analyse:
By pressing the button “Analyse”, the incoming signal is recorded for 10 seconds and then captured. As long as the text "Processing analyse" is displayed, the unit is processing the stored data.

Download:
With the button "Download" you can load the memory dump of the two signals as a file onto the PC.

The file contains 2-channel, 16bit linearly coded data and can be processed further with appropriate software.

Automatic record:

If the check mark is set, the automatic recording is activated.

Caution!
Once you have ticked the box, you still have to press "Save"!

Functionality:

- Once per day a six second long recording is created and saved. All recordings of one week are stored on the device. After 7 days, the oldest file will be overwritten.
- In addition, once per week a six second long recording is created and stored. A total of two years can be recorded in the weekly cycle. After two years, the oldest week is overwritten.

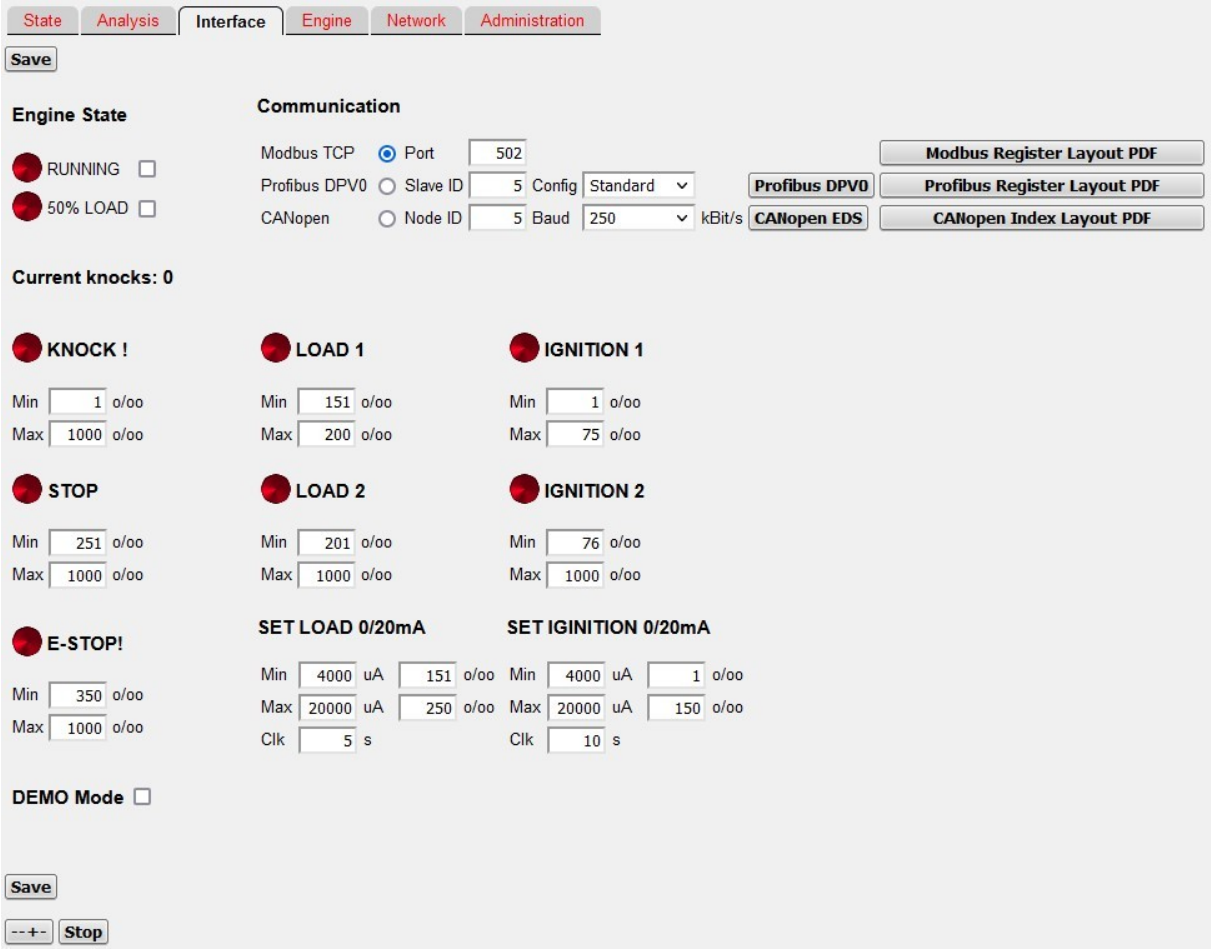
Daily and Weekly Record (only possible with the admin role!):
With the download function you can load the memory dump as a file onto the PC. To do this, you have to choose a file and click on “Download”.

The file contains 2-channel, 16bit linearly coded data and can be processed further with appropriate software.

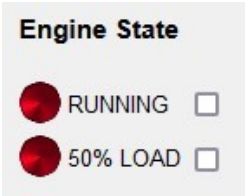
4. Interface tab

In this tab you can configure the analogue and digital outputs as well as the data interface.

As an example, the screen of a MODCON001C001 unit is shown. It has different digital interfaces than a MODCON001B001 unit. See d) for more details on this.



Knock monitoring can be switched on or off depending on 2 external digital signals:



The input RUNNING and / or the input 50% LOAD determine the function of the evaluation.

If no check mark is set, then the evaluation (depending on the state of SYS OK) is always active.

Caution!

- If the check mark is set, then the corresponding input must be triggered.
- There must be a voltage above 10V for the input to be recognised as ON. Only then will the LED light up green and only then will the result of the knock outputs be forwarded to the outputs of the unit.

If both check marks are set, both inputs must be supplied with current so that the outputs of the knock monitoring are enabled.

This makes it possible to switch off the evaluation, e.g. during the engine start-up process.

a) Status outputs

There are 3 digital outputs provided to signal to the CHP controller that:

KNOCK! - the engine is knocking.
STOP - the engine has to be stopped (normal stop).
E-STOP! - the engine has to be stopped immediately (emergency stop).

Each output has its own min. and max. field.
If the measured number of knocks is within the specified range, the output switches on and the corresponding LED will turn green.

The outputs can be configured as desired (i.e. also overlapping).

Each output can be loaded with 0-36 AC/DC and max. 100 mA.
All four outputs share a common return conductor.

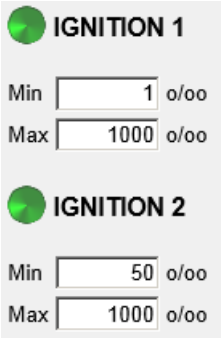
All digital outputs are short-circuit proof!

Caution!

- After a short circuit, the relevant output switches off!
- To reactivate this output, resolve the short circuit and remove the device from the power source.

b) Adjustment of the ignition timing

The digital ignition outputs:



There are two dedicated digital outputs for adjusting the ignition timing.

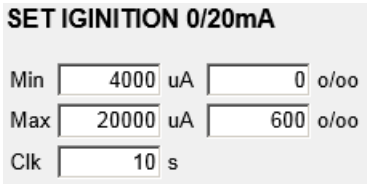
These outputs can be set so that, from a specified knock window on, one output switches and adjusts the ignition timing.

The selection of the values for the knock window must be done carefully.

As with all outputs, these two outputs can be configured to overlap.

The green LED indicates that the output is switched on.

The analogue SET IGNITION output:



The optimal solution is the continuous, analogue control of the ignition timing.

For this purpose, an analogue output with a range of 0 to 20mA is available.
The output can be configured as desired via the Min and Max fields.

The current is entered in uA (20mA = 20000uA).

In the example, a 4-20 mA signal has been set:
At 0‰ knocking are 4000uA (= 4mA) present at the analogue output.
At 600‰ knocking are 20000uA (= 20mA) present at the analogue output.

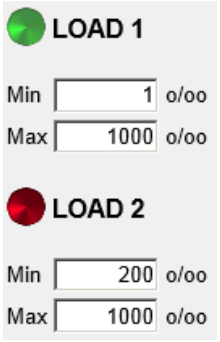
It is also possible to invert the output. Simply enter the larger number (for example 20000) in the Min field and the smaller number in the Max field.
This would achieve that at 0‰ knocking exactly 20mA and at 600‰ knocking only 4mA are present at the analogue output.

At Clk the control time constant (here 10s) is entered.
A Clk of 10s means that every 10 seconds the knock value is reviewed and the output is adjusted.

Caution!
Please press the button “Save” after each change.

c) Reduction of the **engine** power

The digital load outputs:



There are two dedicated digital outputs for adjusting the engine power.

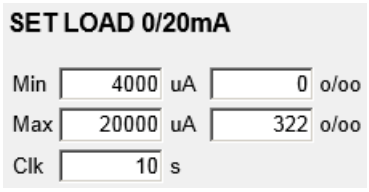
These outputs can be set so that, from a specified knock window on, one output switches and adjusts the ignition timing.

The selection of the values for the knock window must be done carefully.

As with all outputs, these two outputs can be configured to overlap.

The green LED indicates that the output is switched on.

The analogue SET LOAD output:



The optimal solution is the continuous, analogue control of the engine power.

For this purpose, an analogue output with a range of 0 to 20mA is available.
The output can be configured as desired via the Min and Max fields

The current is entered in uA (20mA = 20000uA).

In the example, a 4-20 mA signal has been set:
At 0‰ knocking are 4000uA (= 4mA) present at the analogue output.
At 600‰ knocking are 20000uA (= 20mA) present at the analogue output.

It is also possible to invert the output. Simply enter the larger number (for example 20000) in the Min field and the smaller number in the Max field.
This would achieve that at 0‰ knocking exactly 20mA and at 600‰ knocking only 4mA are present at the analogue output.

At Clk the control time constant (here 10s) is entered.
A Clk of 10s means that every 10 seconds the knocking value is reviewed and the output is adjusted.

Caution!
Please press the button “Save” after each change.

d) Digital interfaces

The KNOCKDETECT has various digital interfaces with which all relevant data can be read and written.

CAUTION! Depending on the hardware version of your device, different interfaces are available.

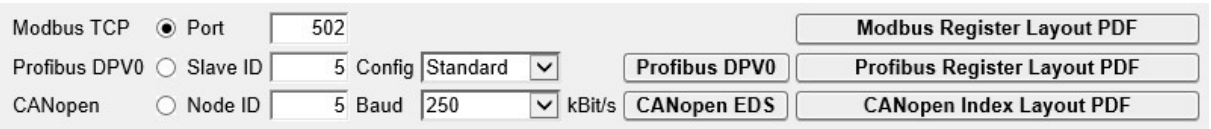
The MODCON001B001 unit has the following interfaces:

- For Modbus TCP, set the point at TCP and select your desired port. You can set the IP address in the Network tab.
- For Modbus RTU, set the point at RTU and select the desired baud rate.
  The following parameters apply: 8 data bits, no parity, 1 stop bit.
  The client ID is the subscriber number of the device on the Modbus RTU and can range from 1 to 255.

  To view the currently valid register assignment for Modbus, press the button:

The MODCON001C001 unit has the following interfaces:



- For Modbus TCP see above.
- For Profibus DPV0, set the point at DPV0 and set the Profibus slave address. Various predefined standards can be set via the field "Config".

  To obtain more detailed information, press on the following button:

- For CANopen, set the point, set the NodeID and select the desired baud rate.
  Click on the button "CANopen EDS" to download the CANopen object for import.

  To obtain more detailed information, press on the following button:

Caution!
Please press the button “Save” after each change.

e) Demo mode

To activate the demonstration mode, you have to tick the box and press “Save”.

This simulates a running engine. If you now plug in the knock sensors and gently tap them, you should be able to see a deflection of the curve in the State tab.

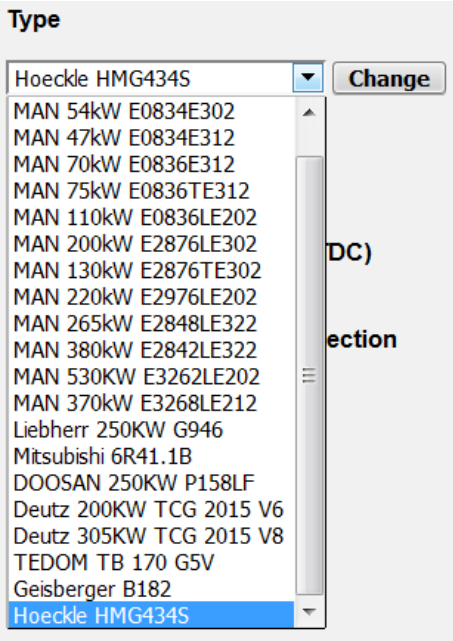
The demo mode is only active for two minutes. If a trigger signal is present, the demo mode also switches off.

5. Engine tab

On this page you can select the engine type and make basic settings. In addition, you will see suggestions for mounting the sensors for each engine type (red arrows in the pictures).

a) Engine selection

Click on the engine designation and select your engine type from the list.



Once you have made your selection, you have to press the button “Change” to confirm the selection and to load the engine file.

The engine database is constantly being expanded.

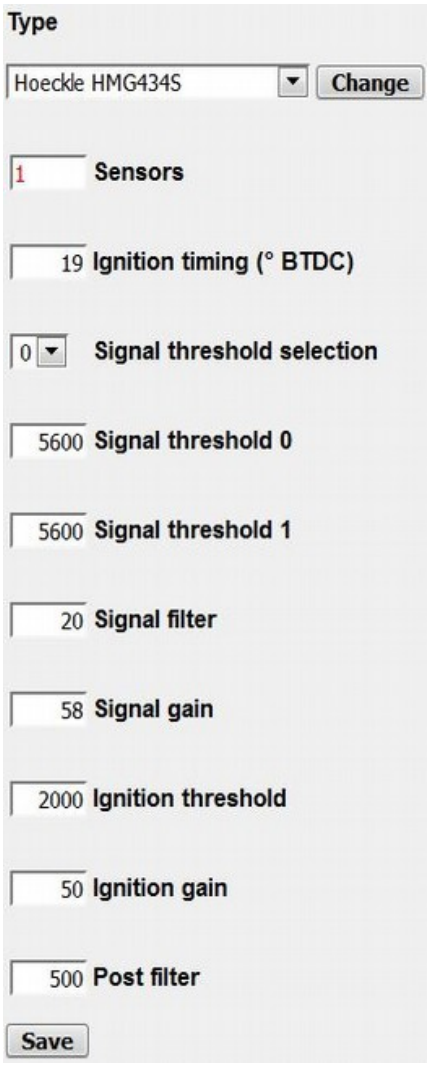
If your engine type is not available, please contact your dealer.

We are pleased to measure new engines in on request.

Note!
A list of all engine types already measured can be found in a separate document.

b) **Engine** data set

The engine data set contains some data that can be changed by the user.



Type:
With this roll-up the stored engine types can be selected from the database.

Sensors:
The number of required knock sensors is specified here. This setting is fixed and can not be changed.

Ignition timing (° BTDC):
Here, the ignition timing (ZZP) recommended by the manufacturer is given. If your machine is running another IP you have to correct this value.
If your machine runs with a different ZZP, correct this value.
The ZZP is given in° before TDC. The software uses it to calculate the exact position of the knocking events in relation to TDC.

Signal threshold selection:
Preselection of the signal threshold.
Additionally, the signal threshold can be selected via the external interface.
For example, a different threshold can be selected for engine start than for normal operation.

Signal threshold 0:
This value represents the threshold above which the signal from the knock sensors is recognised as knocking.
Reasonable values have to be 20-40% higher than the basic level of the engine and at the same time less than 8000.

Signal threshold 1:
Compare Signal threshold 0.

Signal filter:
The knocking signal passes through a multi-stage special filter before the trigger stage. This prevents interference signals from causing false triggering.
Reasonable values are in the range from 5 to 30. Higher values make the system less sensitive and lower values more susceptible to interference.

Signal gain:
The signal from the knock sensors must be amplified before digitisation. Adjust the signal gain so that the average value of the signal on the oscilloscope (50% engine power, no knocking) is about 2000.

Ignition threshold:
This value represents the threshold above which the signal of the ignition coil is recognised as a trigger.
Reasonable values are at 40-70% of the IGN signal.

Ignition gain:
The signal of the ignition must be amplified before digitisation. Adjust the signal gain so that the average value of the signal on the IGN instrument is about 5000 to 6000.

Post filter:
Use the post filter to set the monitoring length of the knocking signal.
It allows a range from 50 to 500 which corresponds to a period of 260µs to 2083µs.
A practicable value is about 200 points.

Caution!

- Change the engine data sets carefully and check every change for function!
- Incorrect settings can interfere with the evaluation!
- Please press the button “Save” after each change.

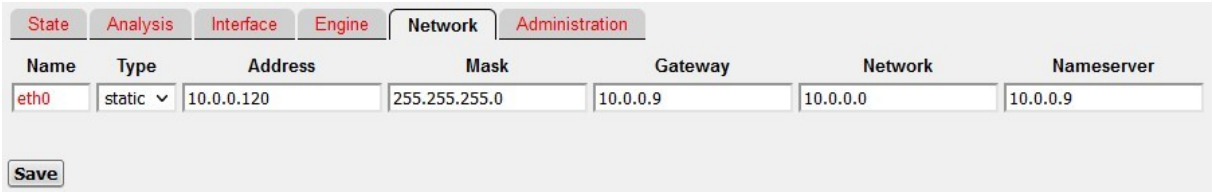
c) Engine types

For a list of all engine types already measured, see:

Motortypen_MODCON001_Vx-z*(current version of document)*_*(date)*_ENG

6. Network tab

On this page you can configure the Ethernet interface of the KNOCKDETECT.



You can choose between static IP address and DHCP (address assignment by a DHCP server).

We recommend setting a static IP address. This way, the unit can always be reached under the same address.

If you operate a DHCP in the same network, you must configure it so that it does not assign the static IP address assigned to the KNOCKDETECT.

With the fields Address, Mask, Gateway, Network and Nameserver (DNS) you can configure the interface. This allows the KNOCKDETECT to automatically synchronise its time with the NTP service.

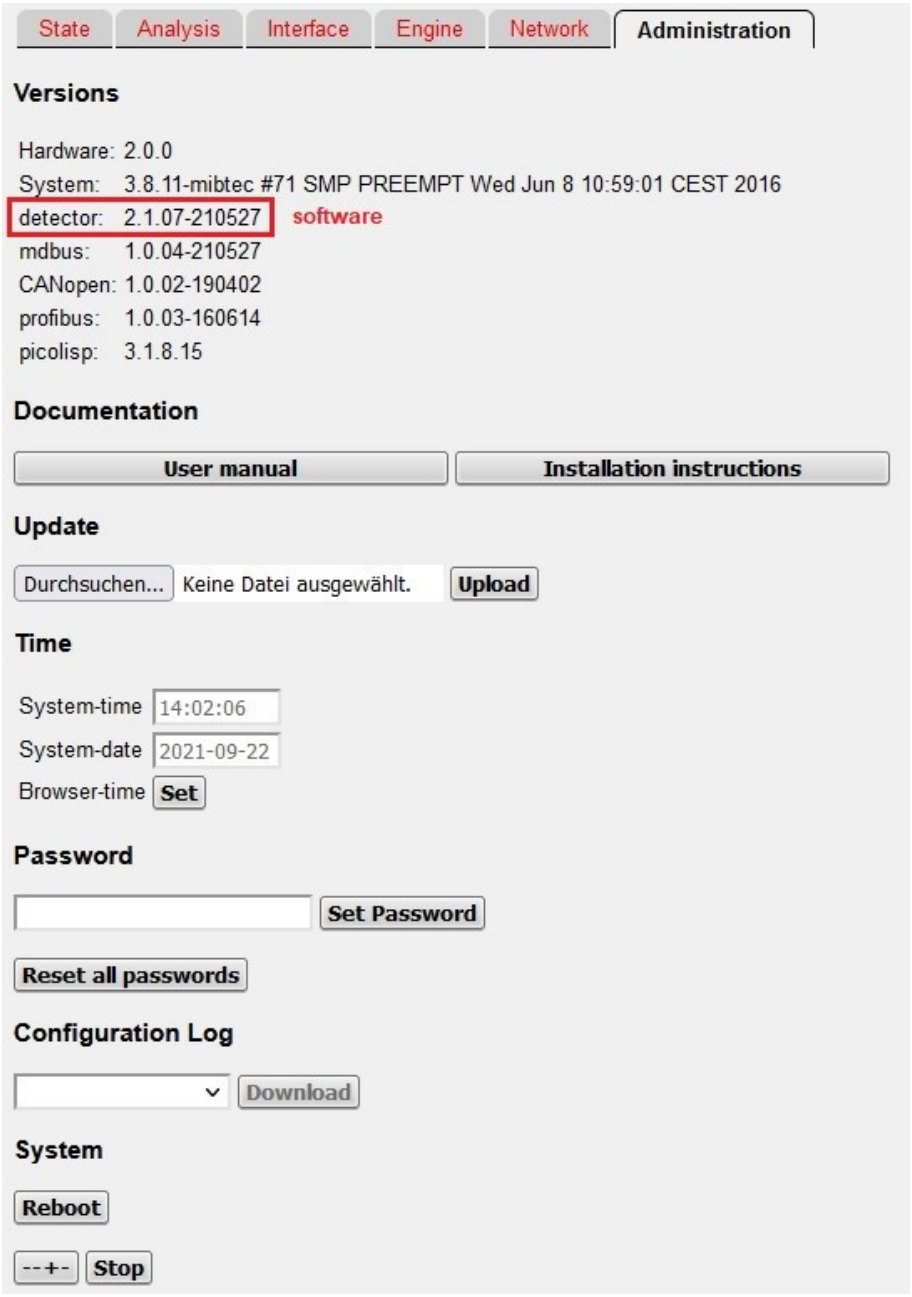
You can retrieve the current IP address via the service display by pressing the "MENU" button on the top of the unit.

Caution!
Please press the button “Save” after each change.

7. Administration tab

In this tab you will find the system information (versions: depend on hardware).

Documentation:
Additionally, you can download the latest version of the operating instructions and assembly instructions here.



There are also some functions for updating the software and setting up the unit.

Update:
With the update function, it is possible to flash the device to a newer software version.

To do this, select the update file via the button “Browse” and press “Upload”.
The file is uploaded to the device and once this is completed, the following message appears:

Now you can press “Reboot” on the bottom of the page.

Time:
This function synchronises the real-time clock (and the date) of the device with that of your PC.

Password:
The password function allows you to assign passwords (you must be logged in as admin for this) as well as reset all passwords to the factory settings.

Configuration Log:
This function is used for internal diagnostic purposes. The administrator can download all changes made to the system here.

The file name is structured as follows: 00003_ 21_ 15.csv
ongoing number_year_calendar week.csv

System:
The button “Reboot” is used to restart the device to perform an update.

Caution!
Make sure that the unit is not disconnected from the power supply during an update!

With the buttons at the bottom of the page the automatic update of the website is switched on (—-+) and off (Stop).

VI. Setting the **engine** values and check-up

The values for the engines included in the database were determined in test series. The data represent the optimal mean of the measured engines of one type.

Nevertheless, measurement errors may occur due to production-related deviations or mechanical effects on the engines.

When commissioning KNOCKDETECT on an engine for the first time, you should proceed according to the following scheme:

1. Sensor mounting:

- If possible, select the predefined sensor positions or the best possible ones (i.e. positions geometrically located between the cylinders to be monitored). Read the installation instructions before selecting the position.
- Prepare the mounting surfaces well! They must be ground flat and free of paint.
- The sensor must be tightened with 22Nm (+/-2Nm).

Once the sensors are mounted, wire the system.

2. Cabling:

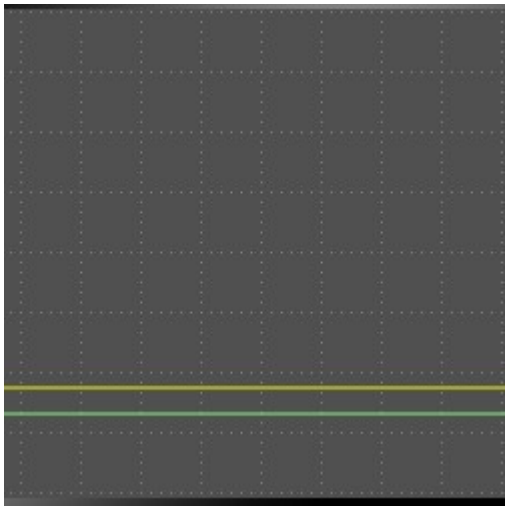
- When routing the cable, ensure sufficiently large bending radii and avoid sharp edges!
- Secure the sensor cables to the engine block with cable ties! The cables must not swing!
- Run a separate power cable directly from the power source to the unit.
- Do not install the unit near devices with high power (e.g. ignitions or power supplies)!
- Do not mount the cables parallel to ignition cables!

When the entire system is mounted and wired, connect your PC to the device and make the basic settings.

3. Connection and basic settings:

- Log in as admin, then select and set the appropriate engine from the database.
- Switch to the State tab.
- Start the engine and check the ignition signal (the value must be in the green range of the IGN instrument and above the preset threshold).
- The SYS-OK LED should now light up green.

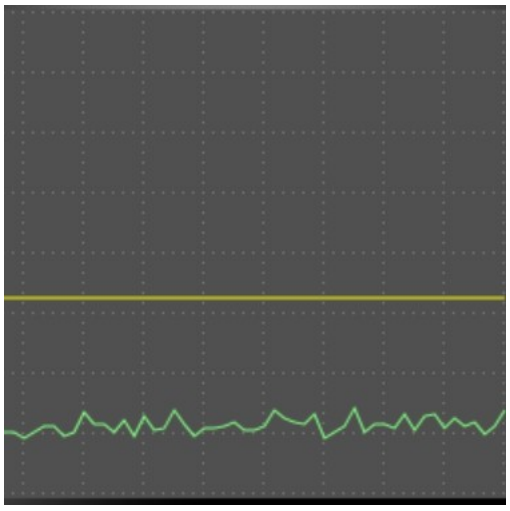
Now use the signal oscilloscope to asses the state of the system and the engine.
When the sensors are connected and the engine is at standstill, the signal should look like this:



The green line must lie absolutely still (without any recognizable deflections) in the lower third of the screen image. The absolute level depends on the manufacturing tolerances of the sensors and the installation conditions.

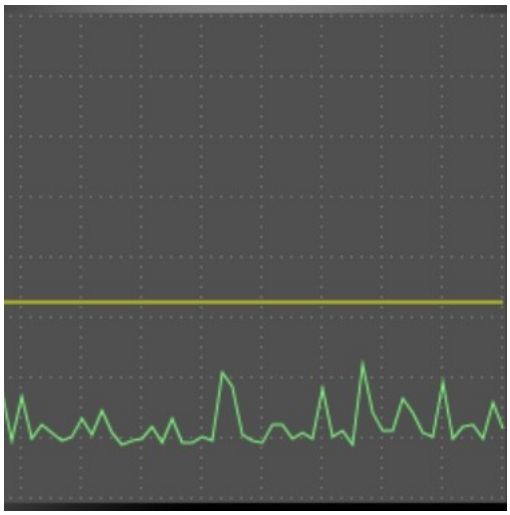
If, contrary to expectations, you detect signal fluctuations, check the wiring and the installation of the sensor cable. These should not be laid together with the ignition wiring harness or other power cables.

When the sensors are connected, the engine is running with 50% load and there is no knocking or other mechanical noises (e.g. from the valve train), the signal should look like this:



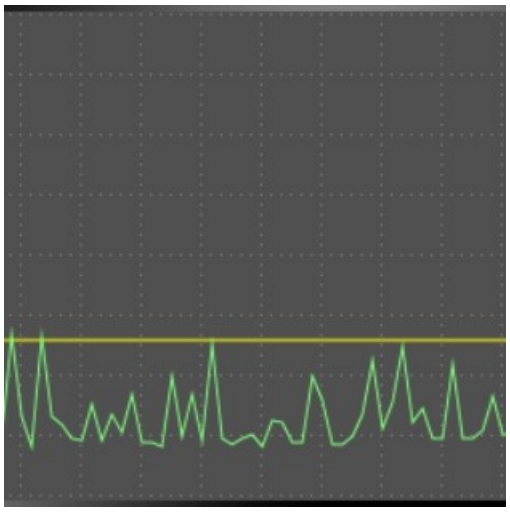
With increasing engine power the entire noise level increases slightly. However, the picture remains harmonious without extreme outliers.

The signal of the same engine at 100% load with properly connected sensors but without knocking should look like this:



The basic level has increased significantly, but up to a normal level. There are individual, discrete events, but they are not significantly high.

The following picture shows the same engine at 50% load with incorrectly set valve clearance.



In this case, the valve clearance on one cylinder was too low.

The signal (slight ringing) can be described as follows:

- Permanent occurrence at very short intervals.
- Power reduction to below 50% does not reduce the signal amplitude or the frequency.
- Adjusting the ignition timing also does not cause any change.
- The signal peaks are only marginally above the basic level of the engine.
- Signal amplitude decreases slightly with increasing engine power.

In this case, the display of the cylinder in question only showed a few signals at the lower end of the TDC range.

The following picture shows an engine at 100% load with incorrect ignition timing (engine is knocking):

You can see two knocking events at an interval of approximately 1.8 seconds.

Typical for knocking events are:

- The amplitude of the individual signals is clearly above the noise of the engine.
- In the case of strong knocking, the signal amplitude can stretch over the entire height of the screen.
- Reducing the engine power also reduces the number and height of the knocking signals.
- Adjusting the ignition timing reduces the number and height of the knocking signals.

Caution!

- Determine the knock limit of your engine together with an expert.
- Set the gain (GAIN) of the sensors and the detection threshold (YELLOW LINE) accordingly.
- Check your actions based on the function of the device.
- Save all settings.
- Disconnect the unit from the power supply and check the setting again after restarting.

Index