

BDN Automotive® CA-6 EVO Combustion Analyser USER MANUAL



Version: 1.1 (2025.06.02.)

Introduction

Sustainability is the key of the future of motorsport, such as the consumer car market. Thus, advanced development technologies must be used to increase the efficiency of the currently used loud, stinky but thrilling power units. Combustion analysis is the first step on this route, which is currently a privilege of high-class motorsport teams and OEM-s. BDN Automotive® offers a simple and understandable combustion analyser for an affordable price tag. Not only the price, but extraordinary user-friendly graphical interface makes this device remarkable amongst our competitors.

The CA-6 EVO is an easy to use combustion analyser developed mainly for the motorsport sector. It is based on it's predecessor, the BDN CA-6, and contains many upgrades compared to it. Most importantly the EVO has an offline logging and device linking capability. In the following document You will see all the necessary information to be able to use our product immediately, without days or weeks of setup and calibration.

We do not take any responsibility for any damage (direct/indirect/consequential or any kind) caused by BDN Automotive® CA-6, although, this is a measurement only device, does not have any direct control over the ECU parameters!

**BDN Automotive® CA-6 is not certified to be used on public roads, off-road use only!
Use at your own risk!**

Made In EU

Contents

1. General parameters	3
2. Pinout	4
2.1 Sensors	5
3. Additional information	5
3.1. Hall effect sensor	6
3.2. Pressure sensor channel measurement ranges (device specific according to the customer's requirements)	7
3.3. Using with Kistler charge amplifier	7
3.4. Using Optrand Sparkplug	7
4. Software	8
4.1. Setup	8
4.2. Measure	13
4.3. Analyse	15

Changelog

Version number	Date	Feature	Description
6.0.0.52	2024.08.07.	Base software	First release software for the CA6 EVO
6.0.0.128	2025.06.02	Bug fixes, performance updates	

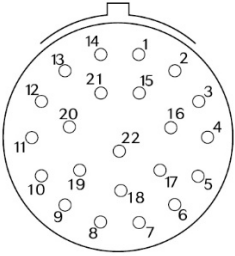
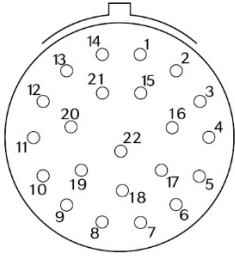
1. General parameters

Description	Value
Dimensions (mm x mm x mm)	167 x 117 x 45
Weight	475 g
Temperature range	-20°C – +50°C
Power supply	13-16 V
Nominal power consumption (without sensors)	3 W
Max. input current	2 A
Ingress protection	IP 67
Pressure transducer inputs	6
Max. sample rate	250 kS/s
Compatible engine speed sensors	Hall effect, variable reluctance
Compatible trigger wheels (contact us for the base calibration of sensors not listed here)	60-2, 36-2, 36-1, 24-2, 24-1, 30-2, 30-1, 60-2 symmetrical, 24X (beta)
Compatible pressure transducers (contact us for the base calibration of sensors not listed here)	Beru PSG, Optrand, Mazda, Kistler, AVL
CAN bus (outputs messages only)	User definable CAN setting
PC Communication	USB (cable included)

2. Pinout

The CA-6 EVO has 2 separate connectors for the input parameters, Signal and Sync. The 3rd connector is only used for PC and device linking communication with cables supplied by BDN Automotive.

We strongly recommend using proper DMC crimping tools to make your harnesses. Contact size: #22D. Recommended wiring: TE Spec55, or MIL 22759/32 AWG22, shielded wires for signal inputs at least! All GND and Shield pins are internally connected.

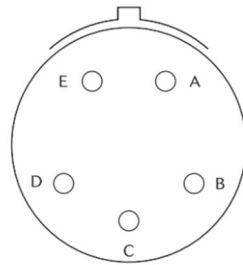
Image	8STA/8TA 12-35		8STA/8TA 12-35	
				
Name	Signal Connector		Sync Connector	
P/N	8STA2-12-35SN		8STA2-12-35SA	
P/N mating	8STA6-12-35PN		8STA6-12-35PA	
Pinout	1	Signal Sensor 1	1	Power supply
	2	GND Sensor 1	2	Hall 1 SHIELD
	3	Signal Sensor 2	3	Hall 1 Power
	4	GND Sensor 2	4	Hall 1 GND
	5	Signal Sensor 3	5	Hall 2 Power
	6	GND Sensor 3	6	Hall 2 GND
	7	Signal Sensor 4	7	VR 1 +
	8	GND Sensor 4	8	VR 1 -
	9	Signal Sensor 5	9	VR 2 +
	10	GND Sensor 5	10	VR 2 -
	11	Signal Sensor 6	11	CAN Low
	12	GND Sensor 6	12	CAN High
	13	SHIELD	13	-
	14	SHIELD	14	Power supply
	15	Signal Power 1 (5V or 12V)	15	Power GND
	16	Signal Power 2 (5V or 12V)	16	Hall 1 Signal
	17	Signal Power 3 (5V or 12V)	17	Hall 2 Signal
	18	Signal Power 4 (5V or 12V)	18	VR 1 SHIELD
	19	Signal Power 5 (5V or 12V)	19	VR2 SHIELD
	20	Signal Power 6 (5V or 12V)	20	CAN SHIELD
	21	SHIELD	21	Power GND
	22	SHIELD	22	Hall 2 SHIELD

2.1 Sensors

All sensors delivered by BDN Automotive are equipped with one of these connectors:

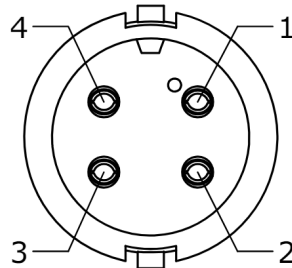
MIL-Spec connector:

- Sensor side: SOURIAU 8STA60635SN (assembled on the wire, or signal conditioner if Optrand)
- Wiring loom side: SOURIAU 8STA10635PN



Conxall connector on signal conditioner (Optrand rugged package):

- Sensor side: CONXALL 7282-4PG-300 (assembled on the signal conditioner)
- Wiring loom side: CONXALL 6280-4SG-318 – **SEE PICTURE**



FACE VIEW
6280-4SG-3XX

	CONXALL 7282-4PG-300	SOURIAU 8STA10635PN
Signal (WHITE)	3	A
+5V (RED)	2	B
Ground (BLACK)	1	C
Diagnostics (GREEN) (for the Optrand sensors only, do not connect on wiring harness side, for calibration purposes only)	4	D

3. Additional information

3.1. Device setup functions

Under the Device setup tab you can change your device parameters:

- Measurement ranges for all channels
- Sensor supply voltage
- Hall sensor supply voltage
- Hall sensor pullup (ON/OFF)
- Mode – **NOTE: Unless you are using the device connected to CA-LINK, please keep these in Normal mode and Master hierarchy**
- RAM settings (Read sections, RAM clear)

3.2. RAM settings

The device is capable of recording 1 channel on 250kHz. Approximate recording time is 13 minutes. Later we plan to introduce configurable recording setup for multiple channels and frequencies.

Under the device setup you can read and delete the RAM sections (up to 5 sections).

During RAM clear, the MIDDLE LED and the pushbutton should flash RED until all sections are deleted.

To activate OFFLINE measurement, press the START button while the USB connector is not connected. To stop the log, please press the STOP button.

You can also delete the logs from the device offline by pressing the pushbutton LONG until it starts flashing, then press it SHORT 3 times. The button and the middle LED should start flashing quick until the process is finished.

3.3. LED indicators

There are 3 LEDs on the front panel of the device, and a pushbutton for the offline logging. The following chapter describes the meaning of the signals shown on those.

	GREEN	BLUE	Light BLUE	RED
TOP	USB connected	USB Link mode (master)	USB Link mode (slave)	
MIDDLE				Measurement ON
BOTTOM	Power ON Sensor power 5V	Power ON Sensor power 12V		

3.4. Hall effect sensor

Compatible sensor type: active low NPN/open-drain output hall effect sensor, e.g.: [Bosch HA-P](#). Do not power the sensor from the CA-6 EVO in case it is already powered by the Engine Control Unit!

3.5. Pressure sensor channel measurement ranges

In the CA-6 EVO the measurement ranges and sensor power supply voltage is also a selectable parameter. The channel settings are independent, however we strongly recommend not using different power supply parameters for the sensors connected.

Channel 1	-10..+10V OR 0..5V
Channel 2	-10..+10V OR 0..5V
Channel 3	-10..+10V OR 0..5V
Channel 4	-10..+10V OR 0..5V
Channel 5	-10..+10V OR 0..5V
Channel 6	-10..+10V OR 0..5V

3.6. Using with Kistler charge amplifier

Charge amplifier setup:

- Drift Compensation(DrCo) mode
- Low-Pass Filter: LP off
- Voltage Output Scaling: Offset 0V

Before starting a measuring cycle with pressing the *Meas* button on the amplifier, the BDN CA-6 must be in powered state (pin 29 and 30 connected to +12V power supply/battery), otherwise the charge amplifier's output signal may cause permanent hardware damages.

Connecting to BDN CA-6:

Charge amplifier voltage output BNC connector	BDN CA-6
Negative/Outer conductor	Pressure sensor GND [34]
Positive/Inner conductor	Pressure sensor channel 1..6 (Channel range: -10..+10V)

3.7. Using Oprand Sparkplug

Due to the mechanical construction of the modified sparkplug, the signal shown on the display have to be filtered, which means that **knock cannot be seen real time on the pressure trace! Be aware, that knock is only shown as peak knock pressure number per cycle!**

4. Software

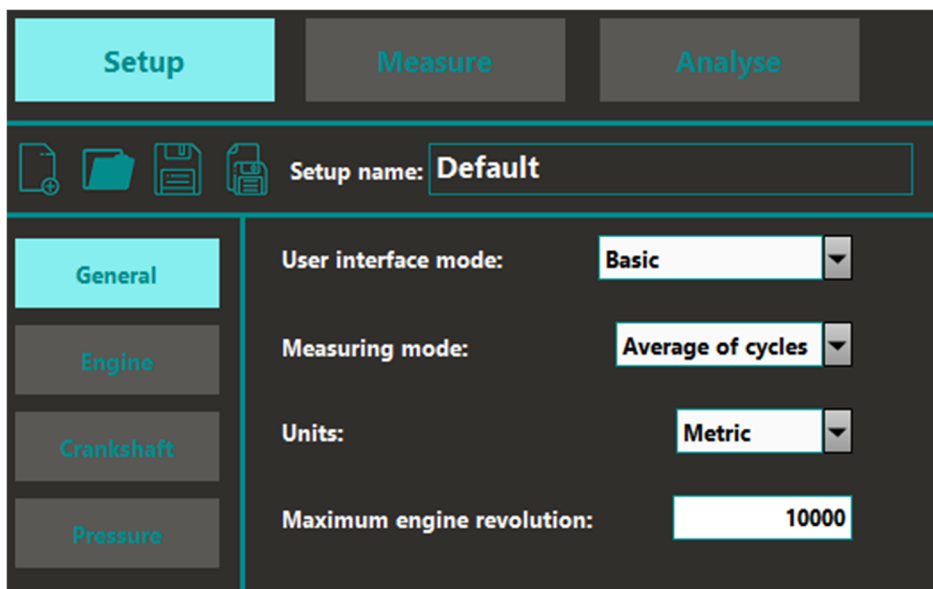
The software has been created to achieve a simple but effective layout in order to maximise the product effectiveness. This is the world' first freely available combustion analysis software, however it is only compatible with BDN Automotive's products.

The software allows the user to perform real-time measurements and also to prepare log files that can be further investigated using the Analyse window. Log files can also be created with the help of the cycle counter that is mainly used for steady state points, and for cycle averaged results.

The software description will be detailed on the following pages.

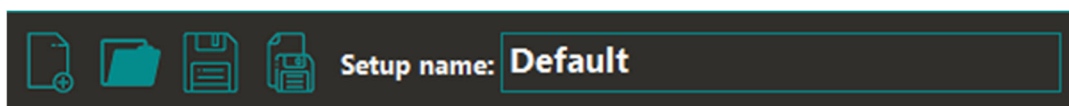
4.1. Setup

The main setup window allows the user to define all necessary engine parameters and measuring modes. ***When defining the engine parameters, a maximum precision needs to be kept as they are heavily influencing combustion analysis parameters.***



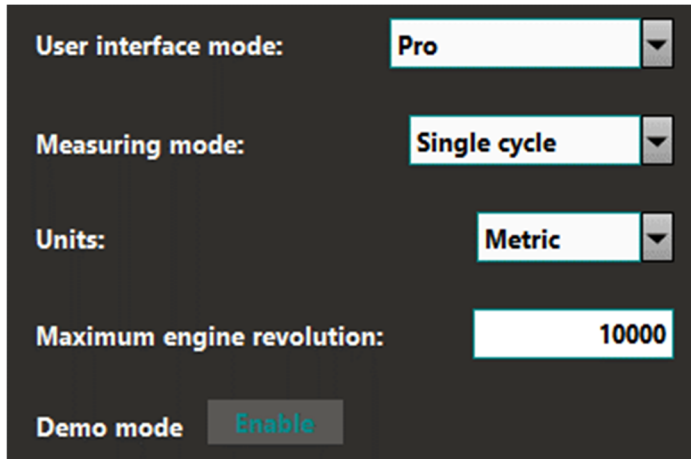
Setup file

All engine parameters can be stored in a setup file in order to make changes easier between engines. Setup files can be stored or loaded via the next icons.



General

Under the General window the user can define the measurement modes and parameters in connection with [Measure](#) window.



The screenshot shows a settings window with a dark background. It contains five rows of controls: 1. 'User interface mode:' with a dropdown menu showing 'Pro'. 2. 'Measuring mode:' with a dropdown menu showing 'Single cycle'. 3. 'Units:' with a dropdown menu showing 'Metric'. 4. 'Maximum engine revolution:' with a text input field containing '10000'. 5. 'Demo mode' with a button labeled 'Enable'.

User Interface Mode

User interface mode allows to select between “Basic” and “Pro” modes. The selection influences the layout of [Measure](#) window. “Basic” mode shows only the vital parameters for a quick overlook and “Pro” allows to capture more information for an engineer with more experience. Important to mention that the interface mode selection is not influencing the information recorded in log files!

Measuring mode

Measuring mode allows to select between “single cycle” and “average of cycles” functions. That has influence on [Measure](#) window. In “single cycle” mode every cycles are separately visible and can be recorded. In “average of cycles” mode only the averaged values of a given amount of cycles is visible. That mode is usually used for steady state points on rolling roads or engine dynos. More differences shown under the description of [Measure](#) window.

Units

The user can switch between Metric or Imperial units.

Maximum engine revolution

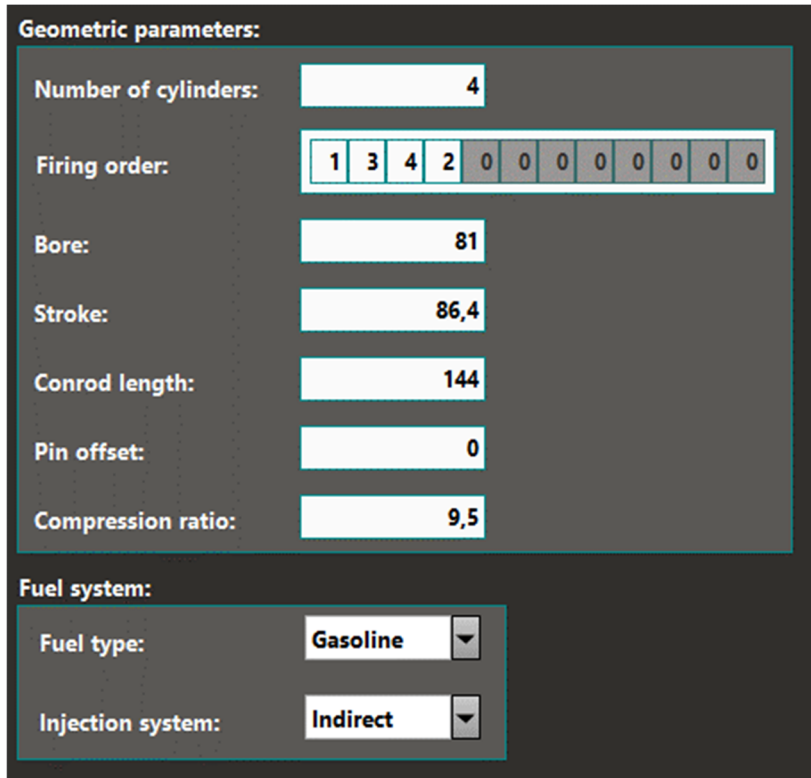
Defines the tacho limits under [Measure](#) window.

Demo mode

By enabling Demo mode, previously saved raw logs can be reloaded and replayed in the [Measure](#) window. If Demo mode enabled, a file browser will appear when measurement started.

Engine

Under Engine window the vital parameters of the given engine needs to be specified. All geometric parameters have to be defined within the tolerance of +/- 0.1mm, in order to get the most accurate results from the background computations.



Geometric parameters:

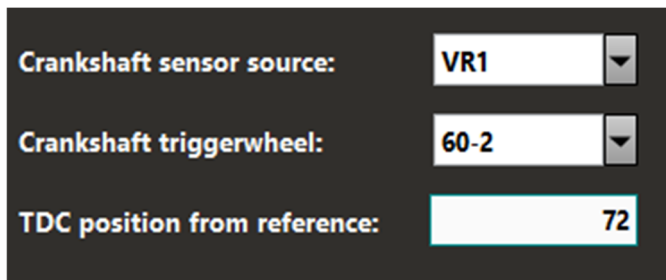
Number of cylinders:	4
Firing order:	1 3 4 2 0 0 0 0 0 0 0 0
Bore:	81
Stroke:	86,4
Conrod length:	144
Pin offset:	0
Compression ratio:	9,5

Fuel system:

Fuel type:	Gasoline
Injection system:	Indirect

Crankshaft

Under the crankshaft window the crankshaft sensor and trigger wheel parameters needs to be defined. BDN CA-6 supports both variable reluctant and Hall type sensors. As there is a multiple option to connect trigger sensors the connected channel also need to be selected. (e.g.: VR1/VR2) At crankshaft triggerwheel setup the user can select from the most widespread OEM patterns. (Upon request unique patterns can be defined. However, **we highly recommend to use 60-2 pattern to increase accuracy.**) It is recommended to use the nominal TDC reference position for a given engine. That value will be overridden during the TDC initialization process in [Pressure](#) function.



Crankshaft sensor source:	VR1
Crankshaft triggerwheel:	60-2
TDC position from reference:	72

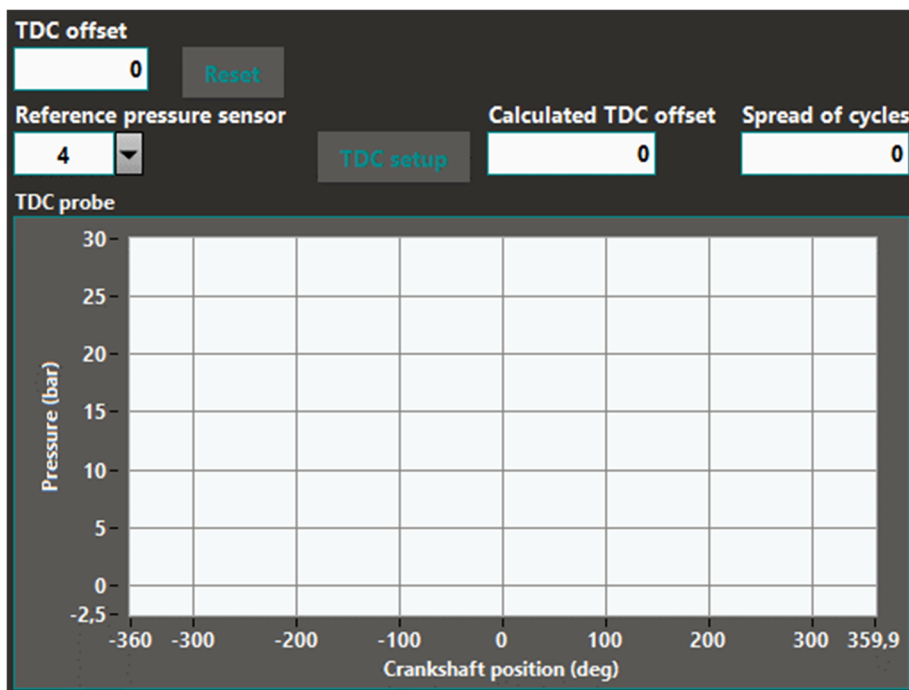
Pressure

This window allows the user to define the pressure sensors built in the given engine and to define the exact TDC reference point used for the given setup file.

Pressure sensor parameters							
1		Optrand Drill-in	▼	5V	▼	200	0
2		Optrand Drill-in	▼	5V	▼	200	0
3		Optrand Drill-in	▼	5V	▼	200	0
4	✓	Optrand Drill-in	▼	5V	▼	200	4
5		Optrand Drill-in	▼	5V	▼	200	0
6		Optrand Drill-in	▼	5V	▼	200	0

TDC reference point determination mode:

For the TDC reference point determination the engine needs to be used for a short period in fuel-cut (without combustion) mode. Speed the engine up to 2000-2500 Rpm, than inhibit injection in the ECU for 2-3 s. Press TDC setup button in the software while the injection is inhibited. The reference point position will be instantly updated. **Only cylinders with pressure sensors can be for reference cylinders!**



CAN-bus

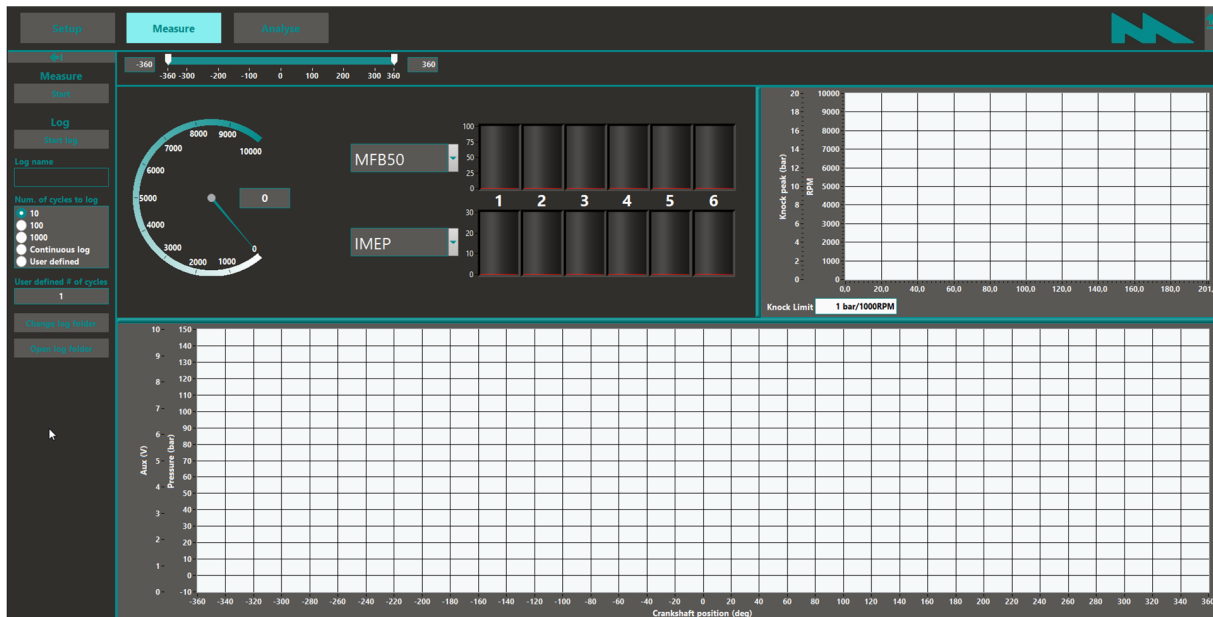
Once CAN communication is enabled, a DBC file can be generated using a user selected base ID, from where the software generates the messages for every cylinder separately. In order to get the CAN communication working, a PC must be connected to the CA-6!

Software configuration	Hardware configuration												
Software enable: Enabled	Standby: Disabled												
Base ID: d 0	Termination: Enabled												
Channel enable: <table border="1"><tr><td>Channel 1</td><td>☐</td></tr><tr><td>Channel 2</td><td>☐</td></tr><tr><td>Channel 3</td><td>☐</td></tr><tr><td>Channel 4</td><td>☒</td></tr><tr><td>Channel 5</td><td>☐</td></tr><tr><td>Channel 6</td><td>☐</td></tr></table>	Channel 1	☐	Channel 2	☐	Channel 3	☐	Channel 4	☒	Channel 5	☐	Channel 6	☐	Baud rate: 1000kbps
Channel 1	☐												
Channel 2	☐												
Channel 3	☐												
Channel 4	☒												
Channel 5	☐												
Channel 6	☐												
Generate DBC: Generate	Apply configuration: Apply												

4.2. Measure

Measure window is used for data display under real-time measuring conditions and creating log files. The measure window has different layouts depending on the chosen modes in [Setup](#) window. The different functions and possibilities will be detailed separately for all conditions.

Basic UIM, Single cycle:



This measuring mode is generally used for real time, transient measurements, when the only the most important variables needs to be displayed.

The window's left side features the log creation with the following possibilities:

Log files can be created with different length. For a given amount of data the limited length of log can be used, where a log counter creates the end of the log file. For other kinds of measurements "Continuous log" can be used, where the user defines the log file end by pressing "Stop log".

The mid part of the window shows the most important cycle variables and the pressure curve real time per each cycle.

The cursor on the top helps to set the demanded area of the pressure curve graph, therefore it is possible to focus on the most important part of the cycle. (gas exchange, combustion, etc.) Beside that the demanded cylinders can be selected for data display. By double clicking on the graphs' limiting numbers and setting the new limits the graph can be reshaped.

The tachometer and the table below shows the current cycle data, such as Peak Pressure, Knock Peak Amplitude [bar], and MassFractionBurned50 [CrA°] for every cylinders.

Measure

Start

Log

Start log

Log name

Num. of cycles to log

☒ 10
 ☐ 100
 ☐ 1000
 ☐ Continuous log
 ☐ User defined

User defined # of cycles

1

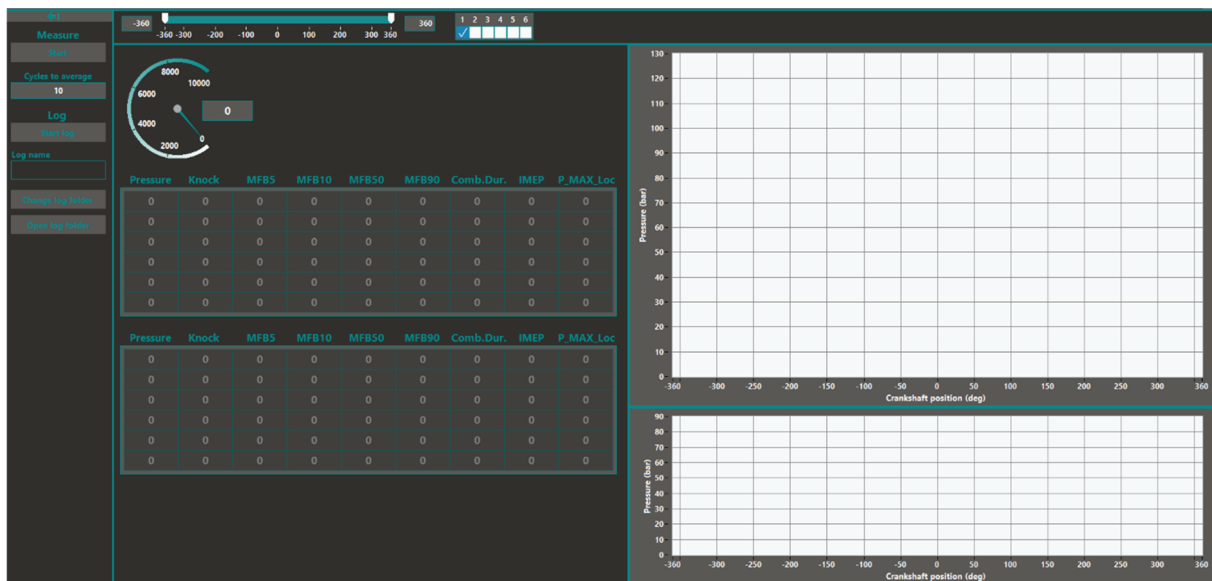
Change log folder

Open log folder

On the right side of the window the history graphs are displayed. There the most important recent cycle values can be traced back, in order not to miss any events.

Average of cycles mode

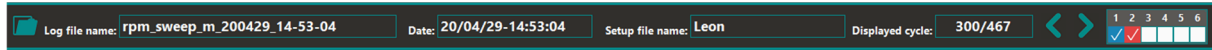
In the average of cycles mode has been created to better observe and evaluate calibration changes in steady state points. Parameter fluctuations due to cycle variance is commonly observable, therefore real-time data evaluation could be problematic.



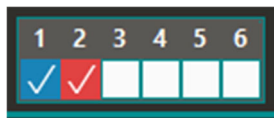
The page layout seems very similar to the previous UIMs. The upper table and graph show the averaged values and the lower ones show the fluctuation of the parameters. **It is highly recommended to average at least 100 cycles to ensure accuracy and repeatability!**

4.3. Analyse

Analyse window allows the user to evaluate log files created under **Measure** window. Log files can be loaded through the next part of the window.

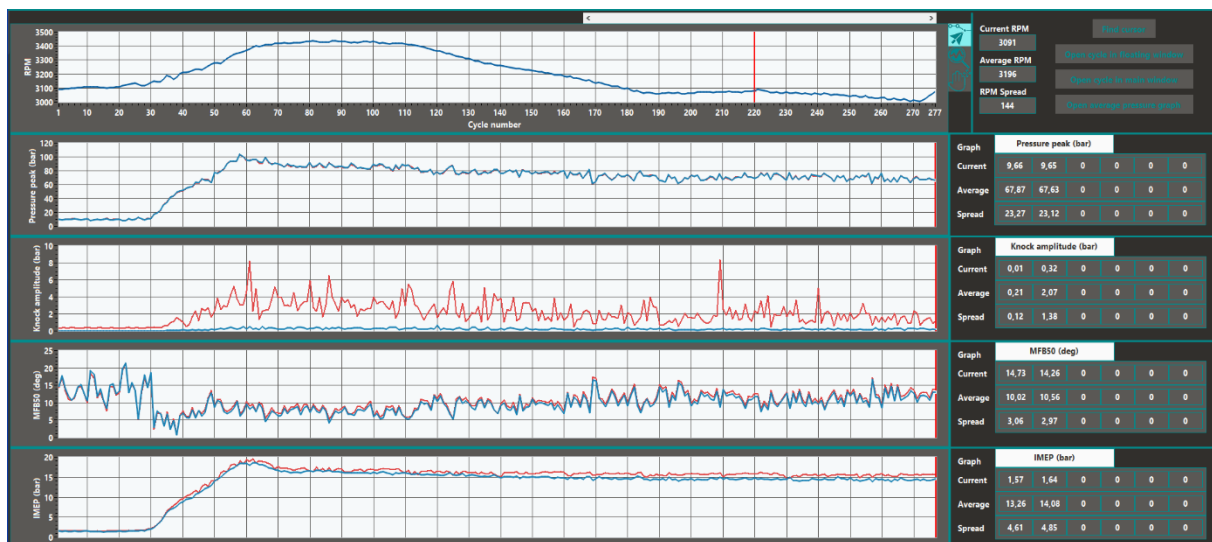


The analysed cylinders can be selected through the cylinder selector part. The selected cylinders will be displayed with the tick's colour.



Cycles in main window

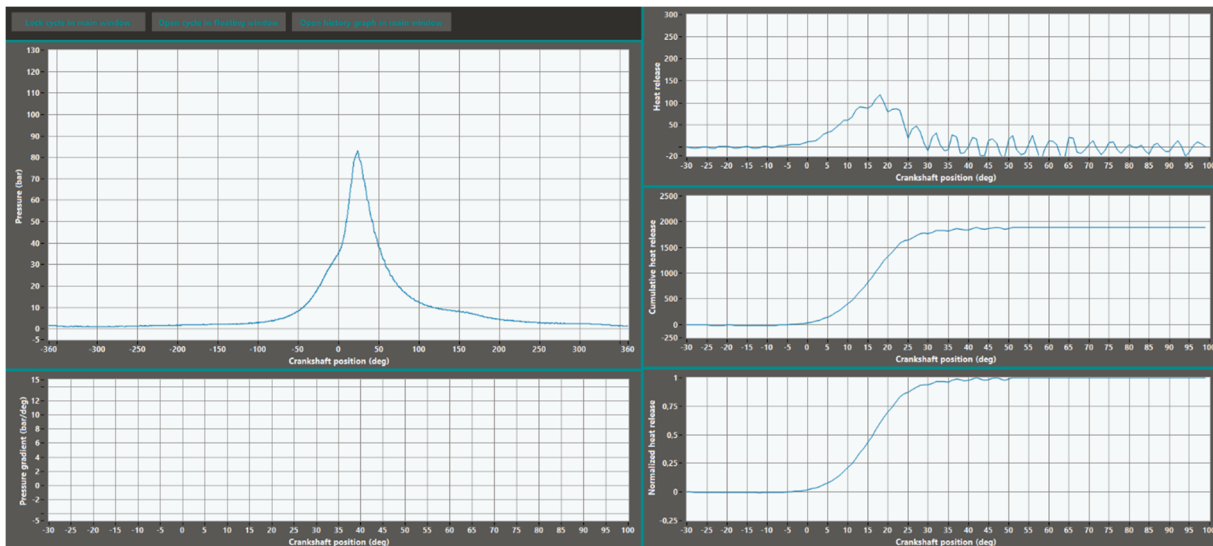
The analyse main window features a list of history graphs that indicate the most important recorded variables through the measurement. The cursor that selects the given cycle can be moved in the RPM window.



On the right side of the window the current average (throughout the measurement) values are indicated for each variable. Content of the graphs can be changed by clicking on the textbox with white background. By right clicking on the graphs the data from the windows can be copied and used in other programs.

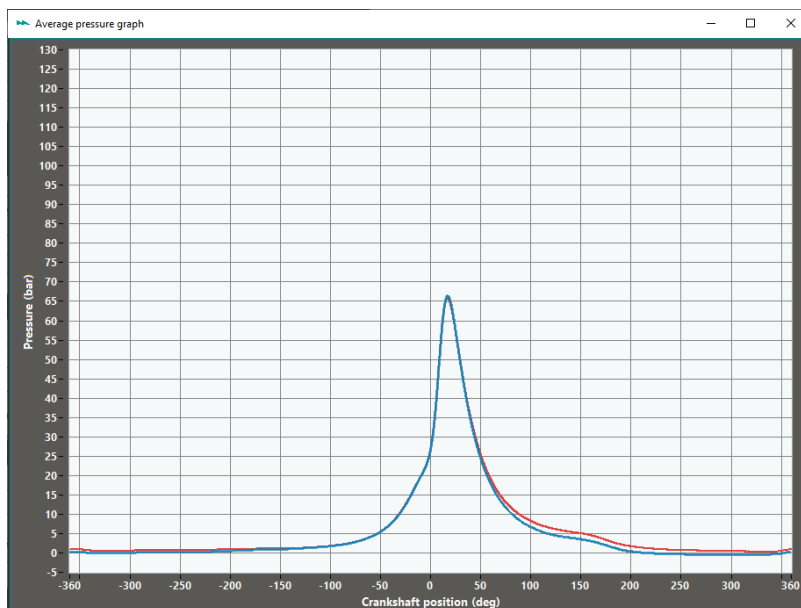
Cycles in floating window

The main window shows the history graphs of a given log file and gives insight only to cycle variables. Sometimes, a detailed insight into a cycle is also necessary, therefore cycles can be opened in a floating window as well. By moving the cursor in the main window the current cycle always refreshes. The data from the floating window can be copied in the same way as from the main window.



Average pressure graph

This graph is a point-by-point pressure average of every cycle in the measurement. This can be useful for steady-state measurements, to see an average pressure trace without cycle variance.



In case you have any other questions or inquiries, please contact us at info@bdn-automotive.com