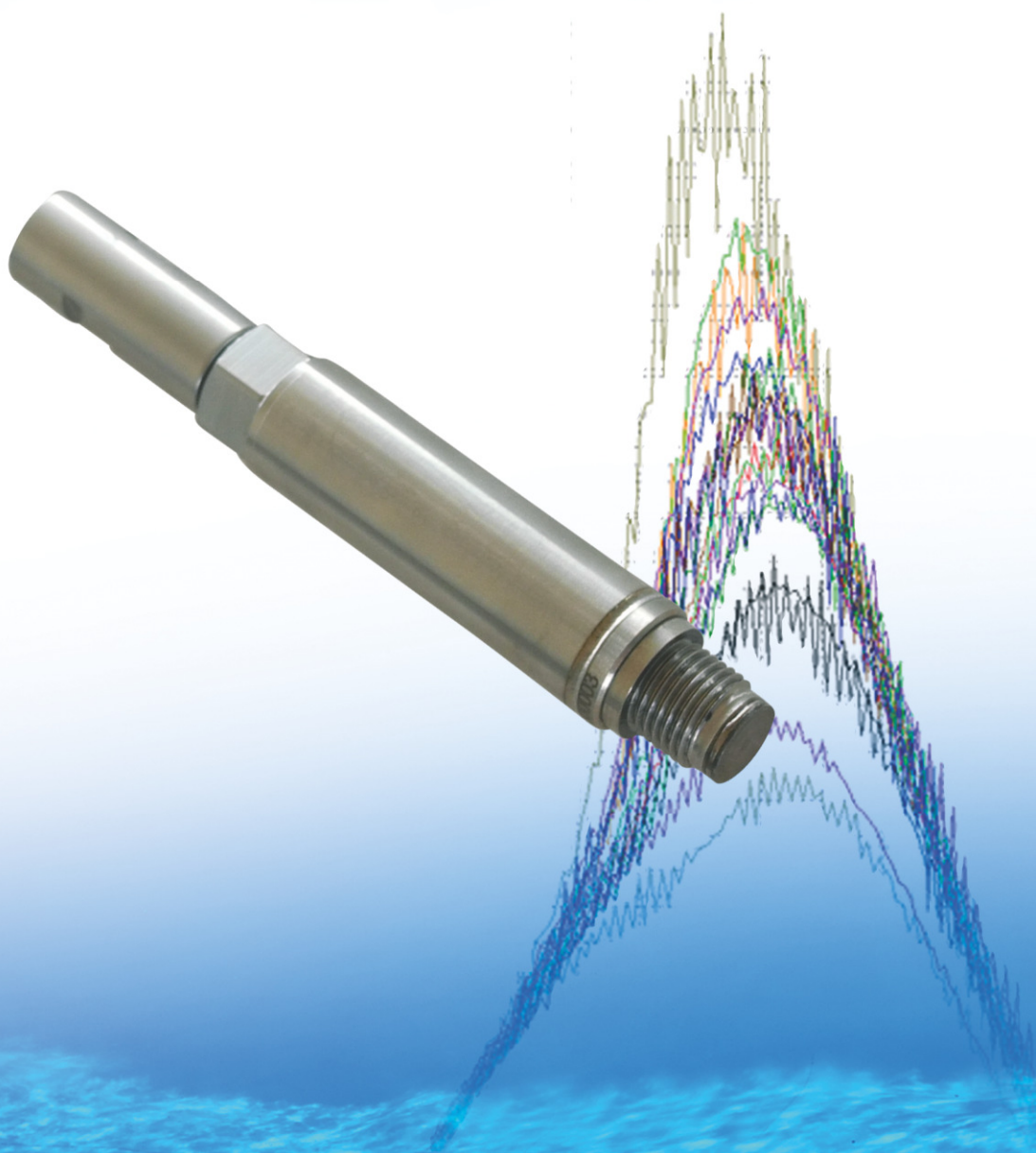




the cylinder pressure people

CCM Gas

for optimal engine control



www.imes.de

CCM Gas

CCM is an easy to use plug and play system, which enables real time data acquisition of cylinder pressure on engines. Data can be recorded from up to 20 cylinders for closed loop control applications and to diagnose malfunctions or to assist in the setting and optimising of engine parameters e.g. balancing cylinders.

CCM Gas is a modern combustion pressure processing system for spark ignited- and dual fuel gas engines. The quick data acquisition and recent evaluation software enables extensive analysis about engine performance. Higher outputs with lower NOx emission can be attained in high efficiency gas engines, combustion knocking can be detected and evaluated and misfiring from over-lean mixtures avoided.

As an additional benefit, emissions of the green house gas carbon dioxide can be reduced which is of high importance in times where environmental regulations are becoming increasingly stringent (e.g. IMO TIER III limitations in Emission Control Areas).



Combustion control Module CCM

The main component of our CCM systems is the combustion control module. It is a smart combustion signal processing device for marine engines and stationary gas engines. Its function is to acquire and process in real time data from cylinder pressure sensors. Every combustion cycle will be evaluated on every cylinder to calculate key parameters engine builders need to implement cylinder pressure based control on engines.

CCM is designed as a plug and play module, that means CCM communicates via CAN bus with the engine control system and it can be integrated to the engine management system. A further important function is that all data can be transmitted via internet to the server of the engine operator. This enables to control the engine from land.



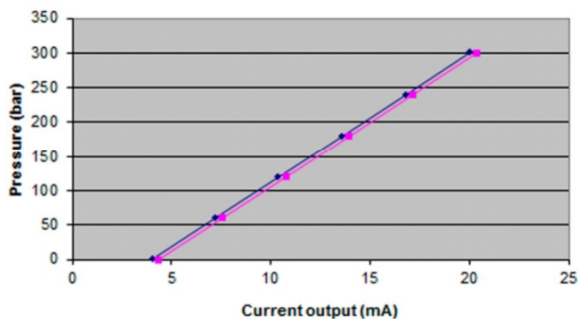
CCM combustion control module- the heart of our CCM systems

for optimal engine control

High precision cylinder pressure sensors

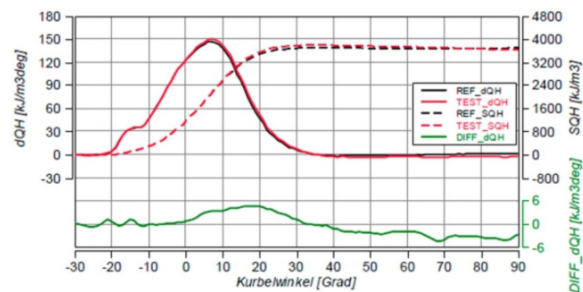
Our various types of cylinder pressure sensors are suitable for installation on 2- and 4-stroke engines and mesh with our CCM systems. Depending on engine type we offer sensors with various thread (M8 x 0,75, M10 x 1, M14 x 1,25), various sleeve and cable length and different measuring cells.

They all convince with their long term accuracy with minimal signal drift over long periods. Designed for a minimum of 16,000 operating hours they enable the acquisition of highly accurate processable data during periodic checks and during continuous monitoring of combustion pressure.



— IMES HTT-04 sensor 2008 — IMES HTT-04 sensor 2012

Long-term stability of IMES sensor HTT-04. Evaluation after more than 10,000 operating hours.



Thermodynamic comparison of IMES sensor CPS-01 to watercooled piezo electric sensor.

Marine Type Approvals

Large engine manufacturers are required to fulfil numerous international safety standards. Marine Type Approval is therefore a mandatory requirement for voyage and safety critical devices installed on any ship.

Our sensor types have received Marine Type Approval from all significant international classification societies, such as Bureau Veritas, DNV GL, ABS, Lloyd's Register, Class NK or China Classification Society.

For our combustion control module CCM, Marine Type Approval from Bureau Veritas and Class Nk are in preparation. Other approvals will follow shortly.

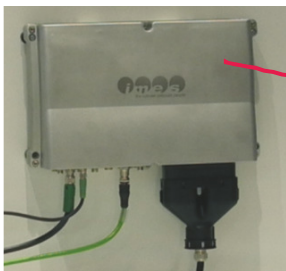


CCM Gas Engine Control

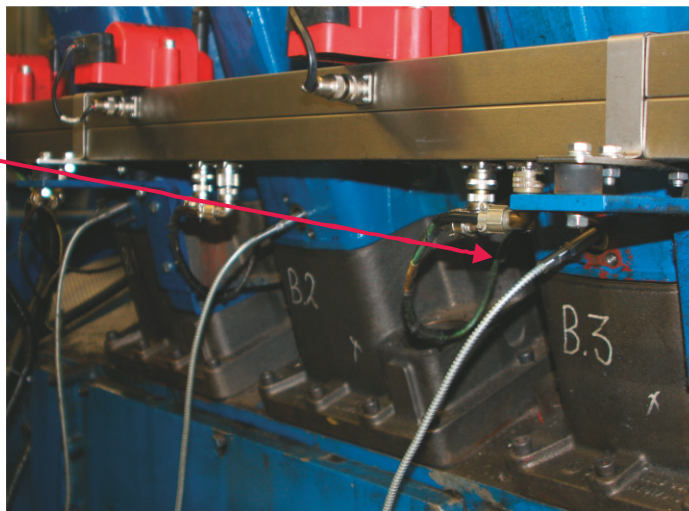
CCM Gas Engine control is designed for pressure control in a closed loop system. It enables continuously cylinder balancing to increase the engine operating stability and to keep the peak- and IMEP value of cylinder pressure at a suitable level.

Combustion knock can be realised and operating parameters can be adjusted immediately. The misfire detection prevents incomplete combustion which makes the engine unstable and decreases the efficiency.

The data can be transmitted for evaluation directly via LAN / Ethernet to a PC where the CCM software is installed. The software allows an easy collection, management and comparison of engine performance data. This enables a quick overview about engine condition for an optimal engine performance. Furthermore the data can be transmitted from CCM by CAN-Bus to an automation system which acts to stabilise engine operation. In the future it will be also possible to transmit the data via satellite to the server of the engine operator. This allows engine control from land and the active regulation of emission as well as cost optimisation.



Installation of CCM Gas Engine Control mounted near engine



Cylinder pressure sensors CPS-01CA® installed on a gas engine and connected to CCM module via terminal box

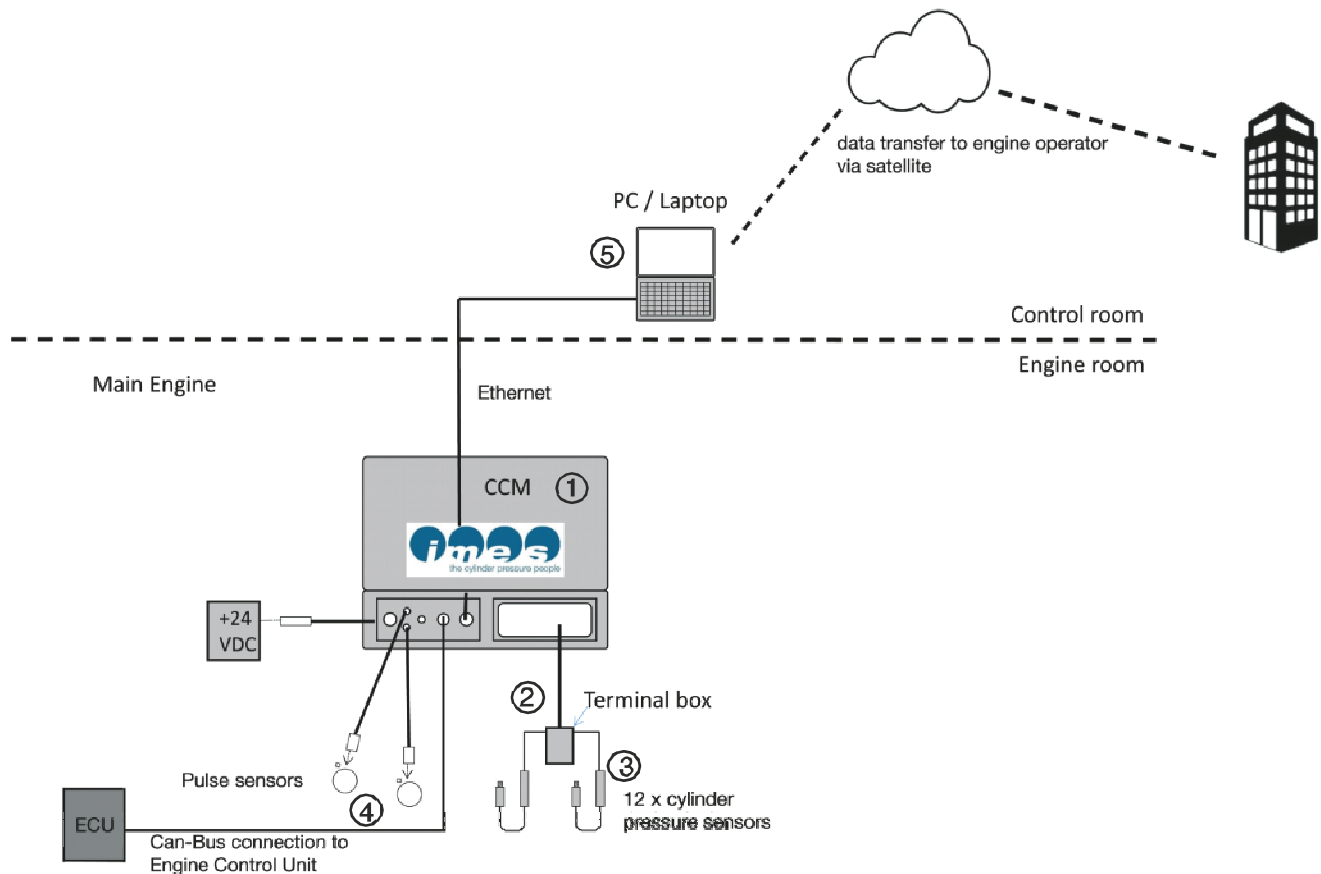
Technical data:

CCM Combustion Control Module	
Multichannel data acquisition unit	Max. 12 analog inputs
	Resolution: 0.1° CA
	Interface: Can-Bus, Ethernet
	Power supply: 24 VDC

Cylinder pressure sensors	
Measuring range pressure	0...300 bar
Over pressure	400 bar, 1200 bar, 1500 bar
Thermal shock 1500 RPM pmi=9bar	<+/- 0.5 bar
Accuracy error	≤ 1% Full scale

for continuous operation

CCM Gas Engine control can be directly installed at the engine. A sophisticated plug- and play concept enables an easy fitting of cylinder pressure sensors and pulse inputs to the CCM housing.



System overview - example for connection to 12 cylinders

Main components:

- ① Combustion Control Module CCM - high speed data acquisition unit
- ② Terminal box with 4 to 12 connectors for IMES pressure sensors
- ③ IMES high precision cylinder pressure sensors - various types for 4-stroke gas engines available
- ④ Pulse sensors for phase signal from camshaft and for rotation signal from crankshaft or camshaft
- ⑤ PC / Laptop with installed data acquisition- and visualisation software and performance evaluation software

IMEP: IMEP calculation enables to optimise the combustion process by cylinder output balancing. This can reduce fuel consumption up to 2%.

for modern combustion control solutions

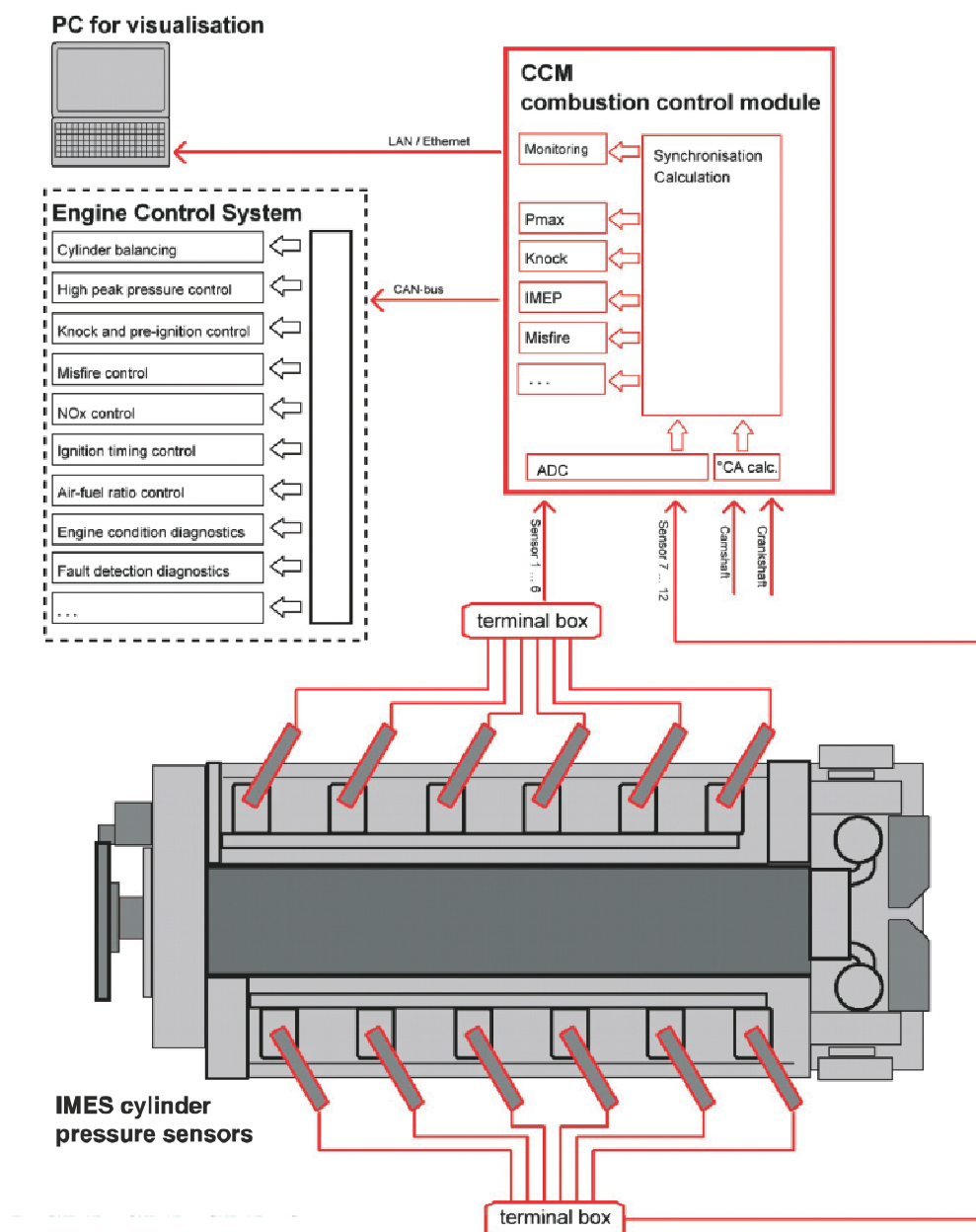
Main benefits

Cost effectiveness due to:

- reduced gas consumption
- less wear and tear
- reliable detection of irregular combustion
- maximising power and efficiency

Environmental protection due to:

- minimising NOx emission
- compliance with IMO TIER III emission limits in Emission Control Areas (ECAs)

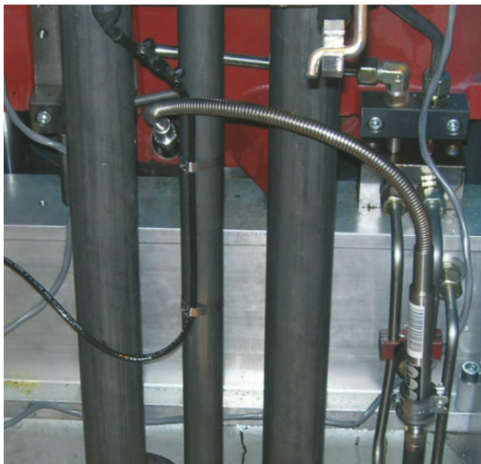


CCM Gas portable for cylinder balancing and

CCM Gas portable for periodic operation is a comprehensive system which can be rapidly installed on-site to enable acquisition of cylinder pressure data on spark ignited- and dual-fuel engines in the field. Data can be recorded from up to 20 cylinders. Using CCM Gas portable for cylinder balancing and the adjustment of the knock detection system is much easier than using the traditional method which operates with an acceleration sensor.



The easy installation of CCM Gas portable enables a quick data acquisition. The recorded data can be transferred via Ethernet to a PC where the visualisation software can be used to monitor and analyse the measured knock intensity and misfiring of each cylinder. The information on knock intensity is used to adjust the engine combustion parameters.



HTT-04CA® installed on a gas engine

The cylinder pressure sensors are installed near to the combustion chamber.

The traditional method of knock detection system adjustment needs highly skilled staff. The adjustment is done acoustically on the engine. Using CCM Gas portable for the adjustment of the knock detection system is both, easier and more accurate. The engine specific knock parameters are permanently stored in the manufacturer's engine settings.

The knock detection limits of a knock detection system with acceleration sensors can be calibrated by using knock signal trends from the CCM.

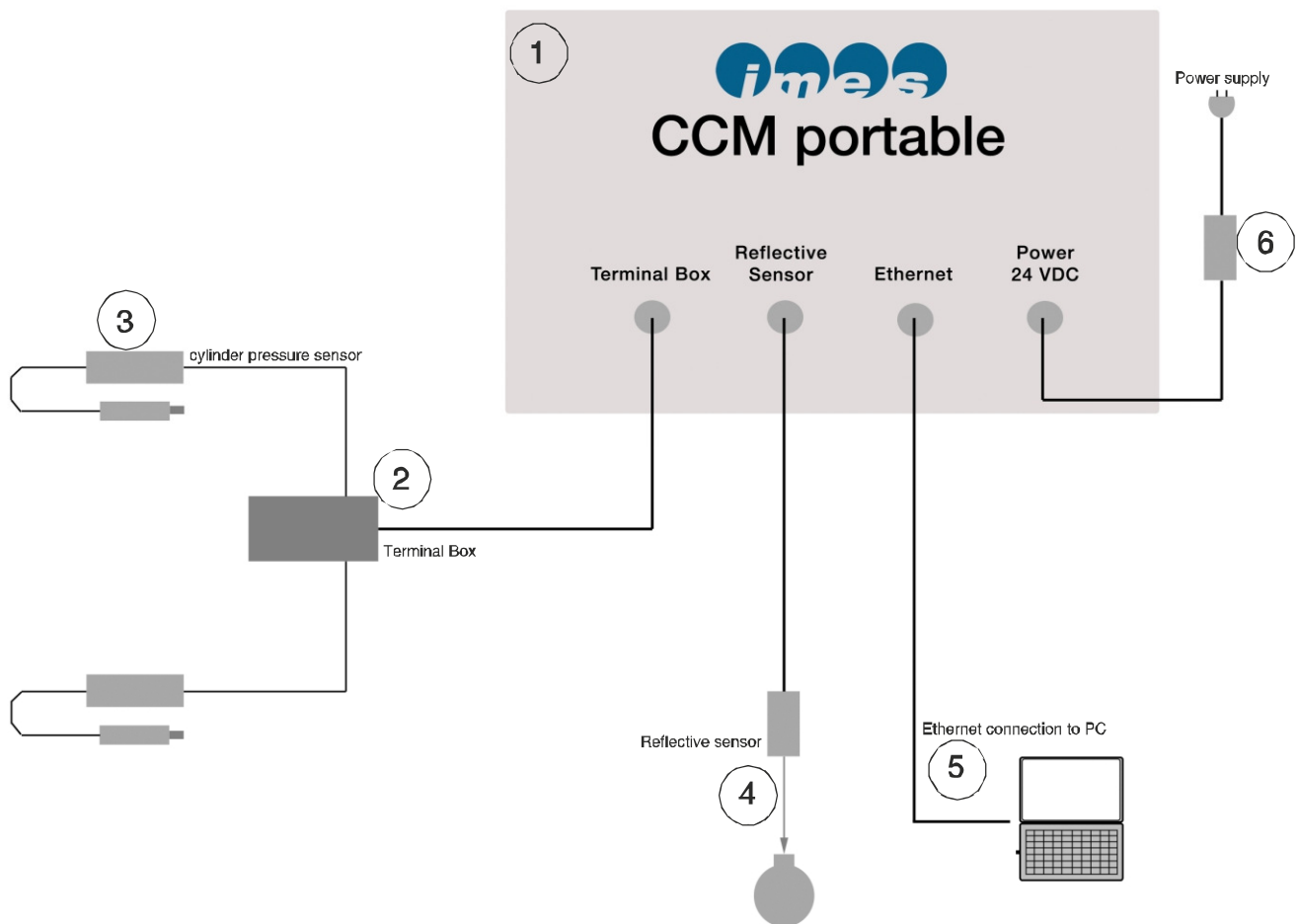
Technical data:

CCM Combustion control unit
Max. 12 analog inputs (option: extension to 24 analog inputs)
Resolution: 0.1°C
Interface: Fast Ethernet LAN 100 Mbits/s
Wide range power supply 90...264VAC
Optical Pickup for TDC position

Cylinder pressure sensors	
Measuring range pressure	0...300 bar
Over pressure	1200 bar,
Thermal shock 1500 RPM pmi=9bar	<+/- 0.5 bar
Accuracy error	≤ 1% Full scale

optimal adjustment of traditional knock detection system

The easy installation of CCM Gas portable enables periodic simultaneous balancing of all of an engine's cylinders in the field.



System overview - example for connection for up to 12 cylinders

Main components and technical data:

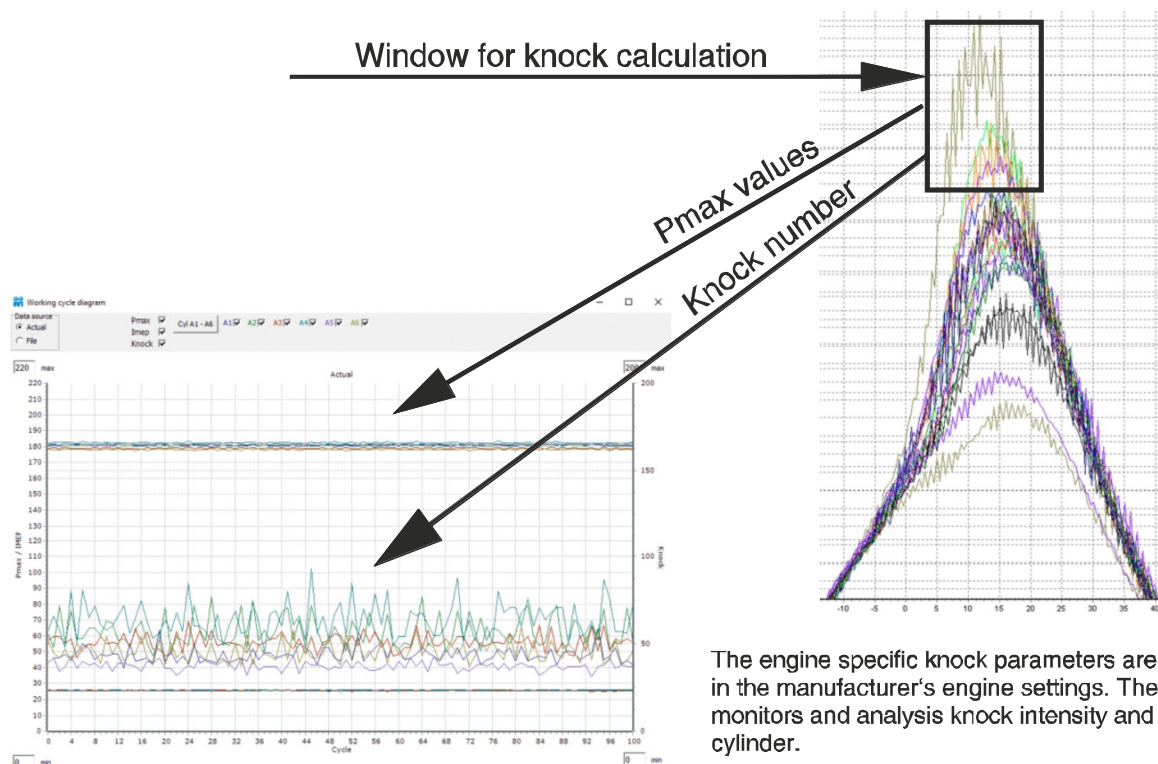
- ① CCM Gas portable box
- ② Terminal box with 4 to 12 connectors for IMES pressure sensors, option: extension to 24 analog inputs
- ③ IMES cylinder pressure sensor: various types for 4-stroke gas engines available
- ④ Reflective sensor: Pick-up sensor providing a position signal from crankshaft or camshaft
- ⑤ PC / Laptop with installed CCM Visualisation software connected via 100Mbit/s industrial Ethernet cable
- ⑥ Wide range power supply : 90...264 VAC

Advanced visualisation software with event record

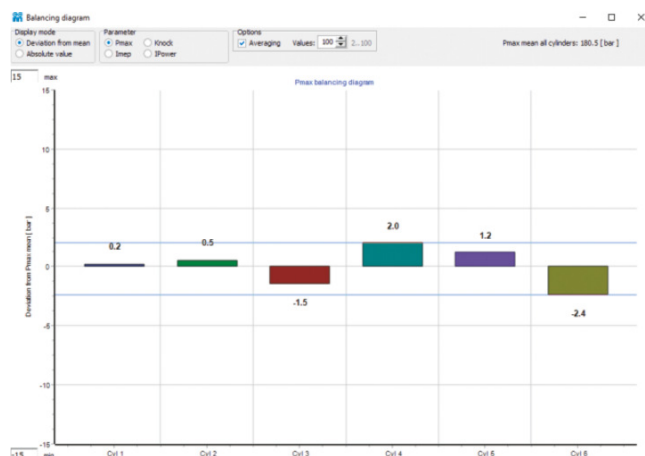
The CCM Gas PC software is a modernised version for online combustion monitoring on gas engines. The recorded data can be used to diagnose malfunctions or to assist in the setting and optimising of engine operating parameters.

The visualisation software offers the possibility of selecting advanced monitoring functions in the following diagrams: **Pressure /CA, Pmax balance, IMEP balance and event recording**

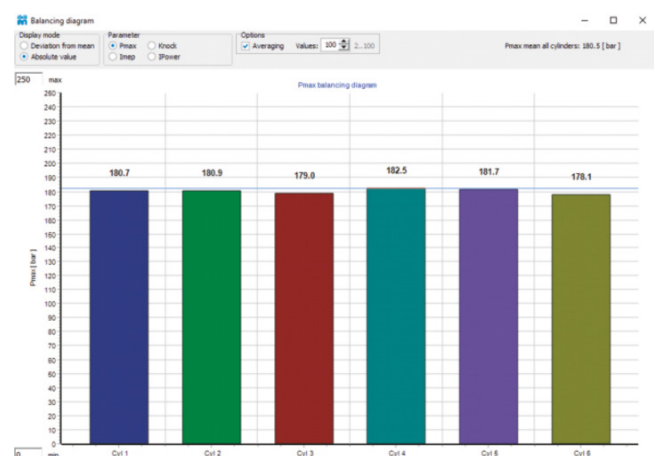
The visualisation data delivered can be used for much more than combustion monitoring, the main focus is periodic simultaneous balancing of all of an engine's cylinders. Since unbalanced engines use more fuel than well balanced engines, the process has come into sharp focus at a time when shipowners are being squeezed by low freight rates and higher and higher fuel prices.



The engine specific knock parameters are permanently stored in the manufacturer's engine settings. The CCM software monitors and analysis knock intensity and misfire of each cylinder.



Pmax deviation from mean



Pmax balancing diagram

for best possible power and performance

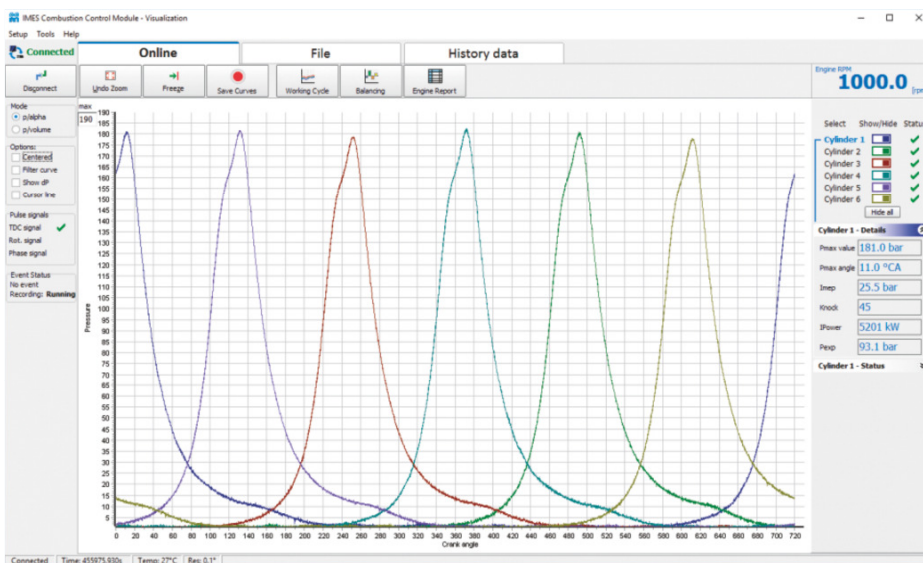
Event Record

CCM Gas offers an event storing, this means that a large memory buffer records combustion data and pressure curves from the latest 40 combustion cycles on 4-stroke engines.

In case of deviation from engine performance parameters set by the engine operator or engine builder CCM Gas automatically records the failure cycle plus the latest 39 cycles before. This means all combustion data are stored in CCM hardware and the CCM Gas visualisation software is able to compare and analyse the cause of the malfunction.

Besides the user has the possibility to save the latest 40 cycles manually under different load or different environmental conditions, e.g. during shop test, sea trial or voyage. He can use the recorded data for later comparison or analysis of engine performance under various conditions.

The CCM event record enables to analyse the data before, during and after a failure. So it is possible to determine the cause of failure and to find solutions how to prevent it in the future.



CCM visualisation software displays all combustion processes before, at and after a failure.

Economic and environmental advantages

The stored data enable to adjust engine optimally. An engine report shows the measurement results of each cylinder and the complete engine as an average.

By continuously analysing combustion parameters of every cylinder in real time, combustion control module (CCM) enables instant detection of combustion knock, misfire, Peak pressure and IMEP. Operation parameters can be adjusted immediately to achieve the best possible power and performance irrespective of the gas quality.

The result are extensive savings due to minimising fuel consumption up to 3%, reduction of maintenance and service costs and a more durable engine.

Also the environmental aspect plays an important role. An optimally adjusted engine operates cleaner, this means improved emission values due to NO_x and CO₂ reduction which is of great importance to fulfil the different environmental regulations (e.g. IMO TIER III).



We deliver worldwide!

Professional support worldwide due to our global sales organisation.

www.imes.de/sales-team.html