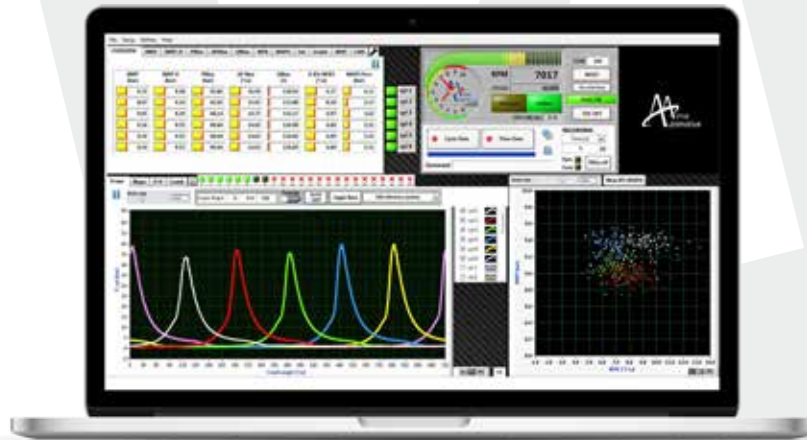


# OBI-M2

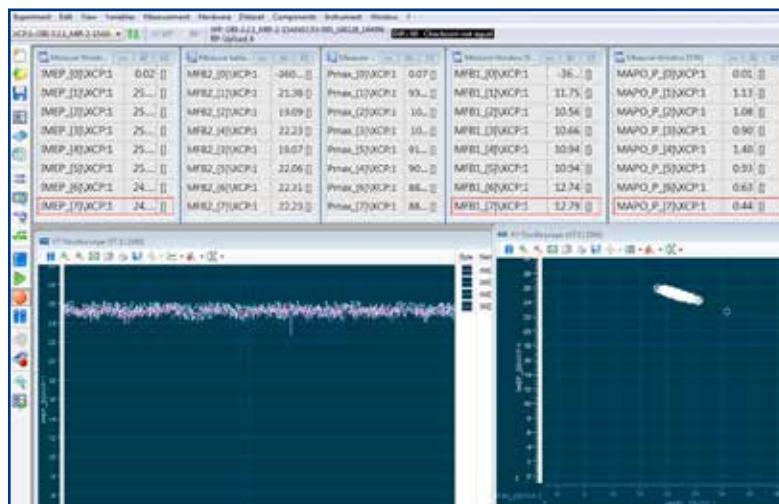
Compact and Rugged Combustion Analysis System  
for use on Vehicles, Motorbikes and Test Benches



**OBI-M2 is an extremely compact and fully featured combustion analysis system suitable for use on test benches and on-board, tested and validated in the most demanding racing world.** Thanks to its rugged and compact package OBI-M2 is the best solution for combustion analysis in vehicles and motorbikes, ideal for on-board engine calibration and control from passenger cars to racing applications.

## Distinctive features at a glance

- **Up to 12 cylinders engine (24 analog inputs overall)**
- **Direct connection to the crankshaft position sensor**
- Extremely easy and quick installation on-board
- Time-based combustion analysis system
- Time-to-Angle conversion performed with the interpolation approach for the highest precision
- Real-time, cycle-by-cycle and cylinder-by-cylinder evaluation of combustion parameters
- Combustion parameters published via CAN and XCP on Ethernet
- Easy integration with ETAS INCA®, VECTOR CANape® and ATI VISION®, or any environment supporting CAN and XCP
- User interface for in-cylinder pressure and combustion data monitoring
- Data acquisition based on analog trigger or event-based (limit value violations)
- Stand-alone ECU-like operation 32 GB on-board storage
- Crank angle-based actuation tracking



Combustion analysis parameters integrated and synchronized in INCA®

# Application

When connected to the application engineer's laptop, OBI-M2 user interface allows real-time streaming of cylinder pressure signals over ethernet and high speed data acquisition for post-processing view and analysis. Among its several usage patterns, OBI-M2 can be used to develop and optimize the engine calibration both on test bench and on vehicle, thanks to the additional information regarding combustion. Furthermore, if the combustion analysis parameters are provided to the ECU, it enables the closed-loop control of combustion

to be performed.

OBI-M2 is also a monitoring system, as it detects any limit value violations defined by user and saves the raw data along with a pre-event and post-event history. Alternatively, OBI-M2 is very well suited for combustion analysis and control in vehicles or motorbikes as a standalone system; thanks to its **32 GB on-board data storage** it enables complete exhaust or fuel economy driving cycle or even long-run test to be recorded.

## The combustion analysis toolchain



### Alfa Centauri

Up to 10 channels charge amplifier system

### OBI-M2

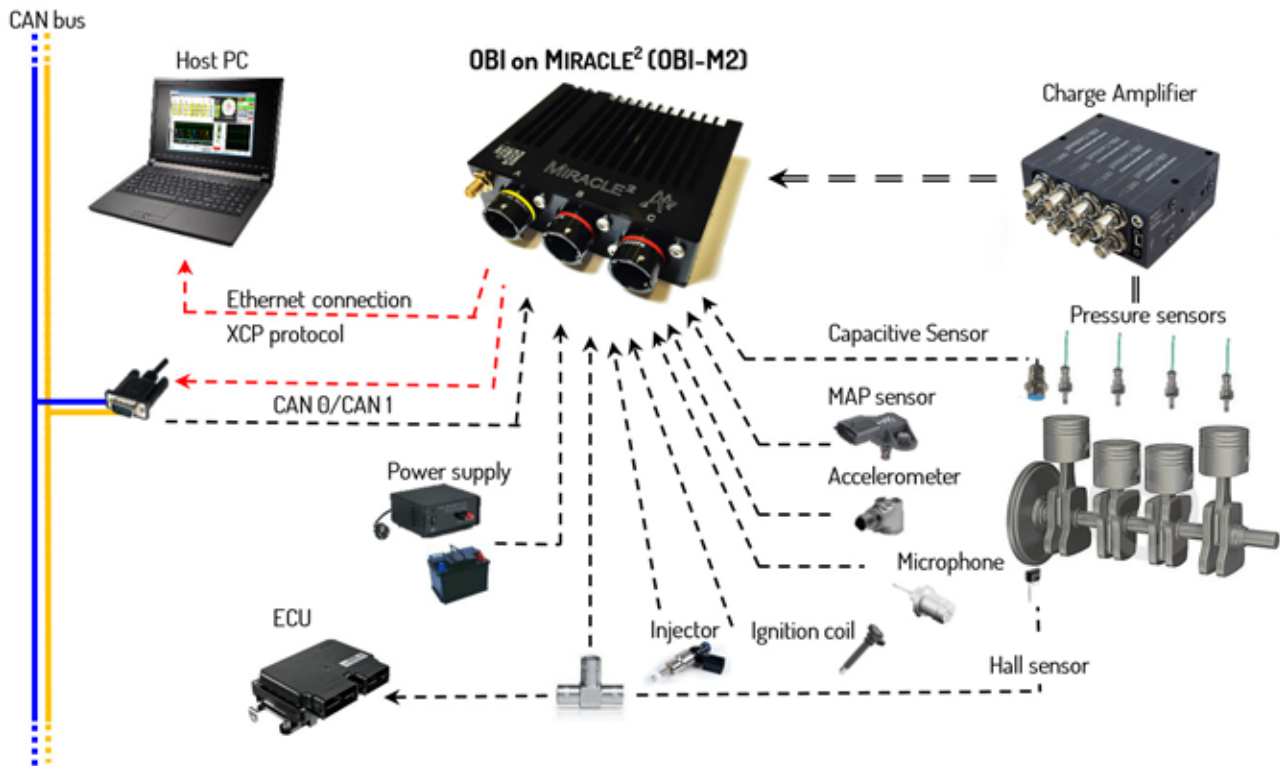
### Wiring harness

Custom wiring on request

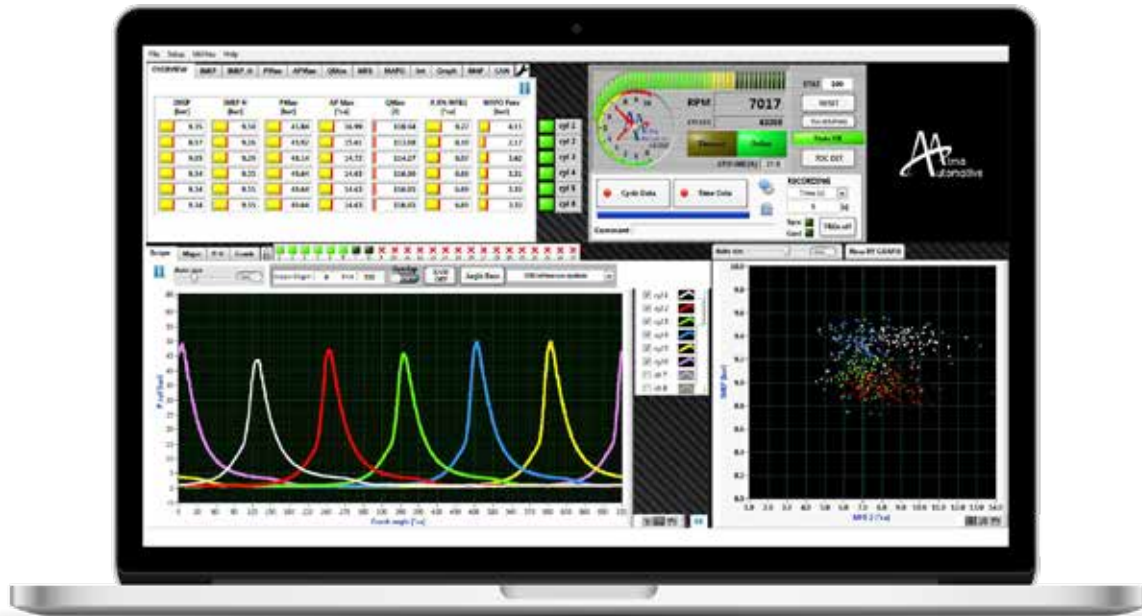
# System components

Overview of the complete combustion analysis system:

1. Cylinder pressure sensors
2. Miniature charge amplifier **Alfa Centauri** (by Alma Automotive)
3. Engine position sensor connector
4. Power supply 6-26 VDC
5. Host PC for run time visualization and data acquisition (standalone operation without PC is also possible)



Layout of the system components with connection to the application engineer's PC



## Real-Time combustion analysis

The combustion analysis system evaluates in Real-Time and publishes on the CAN network:

- IMEP, IMEPH
- Pmax, APmax
- Cumulative Heat Release
- MFBxx angles (xx defined by user, for example: MFB10, MFB50, MFB90)
- Knock indexes (MAP0 and integral)
- Crank angle-based actuation tracking

Configuration of the algorithms includes (but is not limited to):

- Engine geometry
- Low-pass and high-pass digital filtering of pressure data (IIR, 2nd order)
- Angular windowing for knock analysis
- Crankshaft position sensor and analog input filter delays (delay compensations)

# Software Specifications

- Oscilloscope-like chart, for cylinder pressure signals monitoring, with overlap and time-based functionality
- Main page with moving average values of combustion parameters
- Tabs with statistical analysis (CoV, max, min, average, percentile) of combustion parameters
- Chart with selectable combustion parameters trend over the last x engine cycles (x up to 1000)
- **Automatic TDC determination procedure**, based on peak pressure angular position monitoring during misfire or motoring, with loss-angle input from the user. Alternatively with capacitive TDC sensor
- X-Y graphs with IMEP vs MFB50 and MAP0 vs MFB50 (X and Y axis can alternatively be defined by user)
- All parameters are tunable from the user interface and then downloaded on the real-time unit for standalone operation
- **Unlimited acquisition** on host PC of high frequency data for off-line analysis
- **Synchronous acquisition of cycle-based data and high frequency data** on separate files for easy viewing and reporting.

# Hardware Specifications

- CNC machined aluminum case, completely sealed with the availability of customization on user specs
- Designed and tested to withstand use in environment with high vibration levels
- All signals are cabled with user defined termination (Race connectors are used by default)
- **Powered by National Instruments SOM** (Xilinx Zynq™, with Dual Core ARM® processor, Artix-7 FPGA on top and 512 MB RAM)
- 2 Variable Reluctance Sensor interfaces for direct reading of CRANK and CAM signals
- **CAN bus output** of all the combustion parameters and status information



- High accuracy over the full operating envelope (temperature and voltage)
- Possible integration of high fidelity microphones (audio)
- Ethernet port for monitoring and configuration

## Technical data

Dimensions	105x85x30 mm
Weight	400 g
Temperature range	-40 ... 85 °C (-40 ... 185 °F)
Power supply	6-26 VDC (typical power 6 W)

## Analog inputs for any voltage signals

Number	24 channels (12 channels for combustion analysis)
Input voltage range	-10 ... 10 V (2 high voltage channels -40 ... 40 V)
ADC sample rate	16 bit, 400 kHz (kS/s) differential, simultaneous sampling
Antialiasing filter	100 kHz $\pm$ 0.1% accuracy

## Data files/file format

Read/write	Configuration file
Data export	1 file (AVL binary file format), .bin (raw data), ASCII tables, .mat

## Connectivity

Gigabit Ethernet, WiFi 150N, 2xCAN (1 Mbit/s), RS232, USB, optional GPS, motorsport high density connectors.

## Auxiliary sensors

Accelerometer, Magnetometer, Gyroscope (9 axis total), audio microphone.

## Accessories (Optional)

Custom wiring	
Charge amplifier 6 channels	<b>Champion-6B</b> (by Alma Automotive)
IEPE conditioner	For piezoelectric transducers with IEPE output
Current probe 4 channels	For ignition and injection actuations tracking

## Training

OBI-M2 basic user training
Fundamentals of cylinder pressure measurement
Knock detection and analysis algorithms
Combustion optimization and control

# Customization / Software requirements

User defined functions can be implemented on request.

The software is provided as a royalty free compiled executable, which means that no other licenses are required (i.e. National Instruments LabVIEW), apart from Alma Automotive's.

*For pricing, demo versions and further information, please contact us.*



Originally established as a spin-off of University of Bologna, Alma Automotive represents the synergy between knowledge acquired in academic research activities and years of experience in developing applied solutions. The company has now evolved to offer both ready-to-use products and engineering services supported by bespoke hardware and software solutions.

Highly oriented towards new challenges, Alma Automotive's mission is to provide innovative solutions

and tools to help customers in the development of ever more efficient engines and powertrains. Our partnership with National Instruments and the strong relationship we have with top-tier automotive companies is testimonial to the high level of skill and quality of services offered to our clients.



---

Alma Automotive s.r.l.  
Via Terracini 2/c - 40131 Bologna - Italy  
Tel. +39 051 9923806 / +39 051 0548470 / Fax +39 051 0544839  
info@alma-automotive.it - [www.alma-automotive.it](http://www.alma-automotive.it)



[www.alma-automotive.it](http://www.alma-automotive.it)