AVL Automation & Control
solutions

AVL TESTMATE II – Digital Controller
AVL TESTMATE II is a complete digital test bed control and monitoring system with excellent torque and speed control for hydraulic, eddy current and AC dynamometers with an intuitive user interface.

AVL BOBCAT – Engine Test Automation & Control
AVL BOBCAT is an affordable and integrated automation system solution dedicated to specific engine testing needs from AVL's COMPACT product line for both existing and new test cell layouts.

AVL PUMA – Powertrain Test Automation & Simulation
AVL PUMA represents an integration platform and provides a powerful environment for all automation components for a broad range of test applications from emission certification to sophisticated vehicle simulation.

AVL COMPACT™

Ready. Set. Go.

AVL BOBCAT automation & control

BOBCAT automation & control
topics

- AVL BOBCAT – automation & control

- System Layout & Components

- Technical specs

- General look and feel

- Result Data Management & Processing

AVL BOBCAT – automation & control
covering needs

Engine Performance Testing

Engine Durability

Engine Overhauling

Component development

Emission Certification for nonroad IC engines

Fuel validation testing

Educational Purposes

AVL BOBCAT

AVL BOBCAT is a test bed automation system dedicated and optimized for defined applications in engine testing, developed at AVL North America.

Your benefits at a glance:

- Intuitive modular structure for creating test cell, engine and test run definition and procedure configuration
- User-friendly experience driven by aesthetic display pages and graphical drag-and-drop test set-up
- Quick operation that allows test runs to be defined and reused easier and initiated faster

system layout

IEEE1394

automation & control

COMPACT I/O Cube

IEEE1394

FFEM-DIO   FFEM-CON Adv.
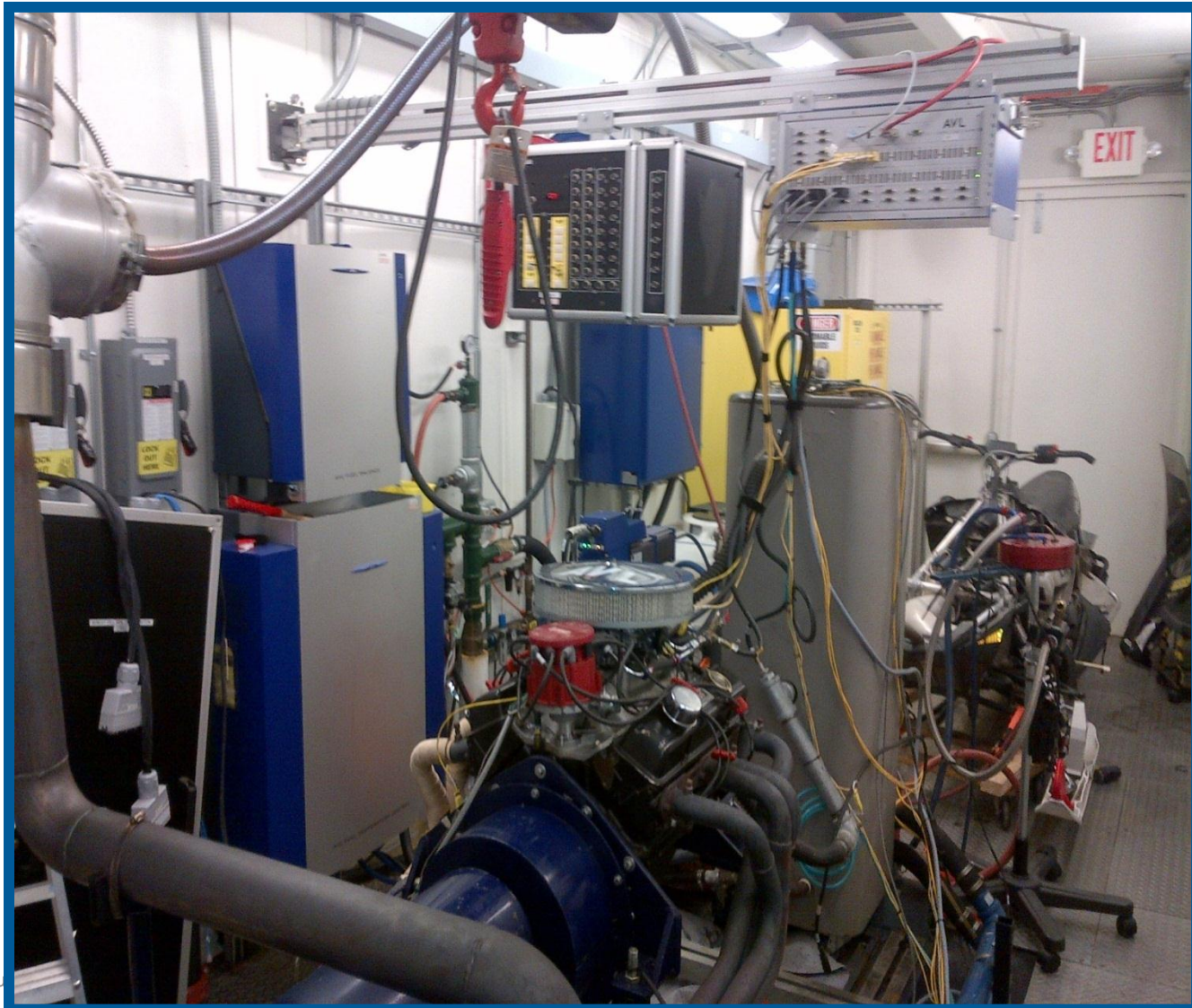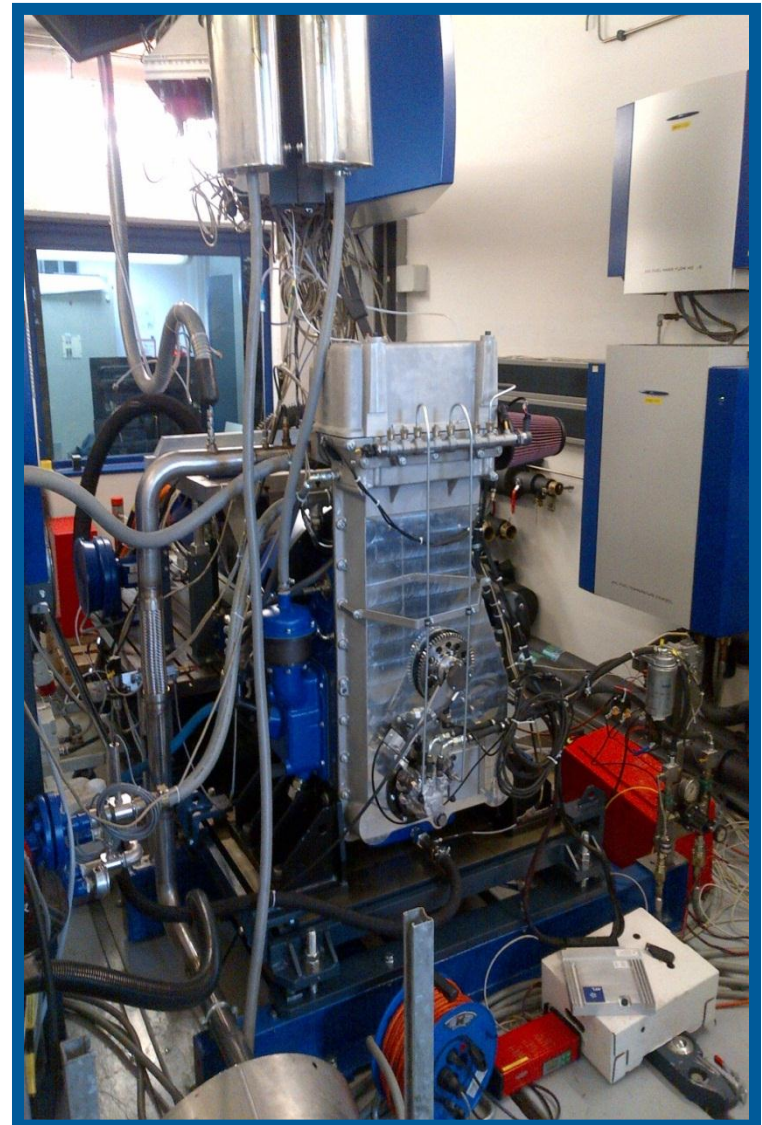
dyno / engine interface
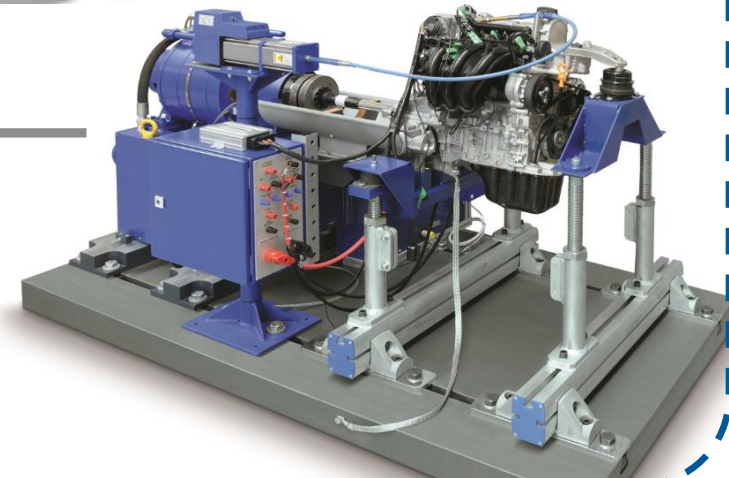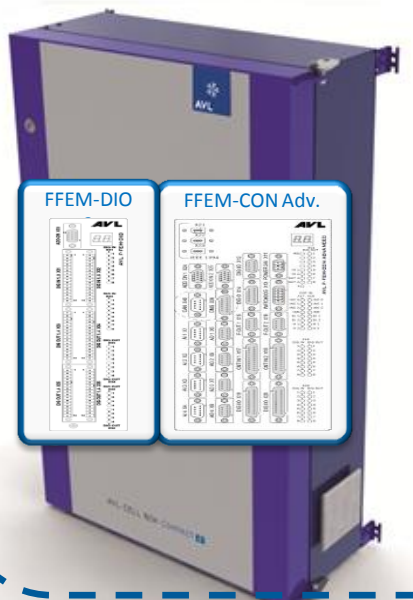
references

AVL BOBCAT – automation & control
references

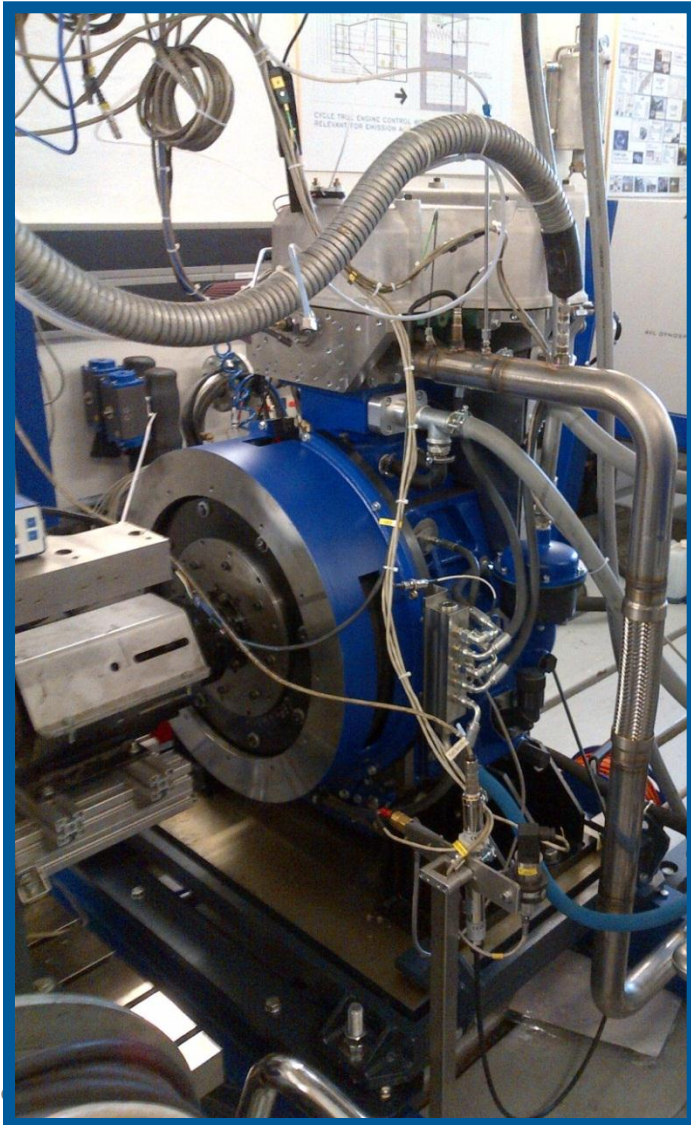# *AVL BOBCAT – automation & control*
references

AVL BOBCAT – automation & control
references

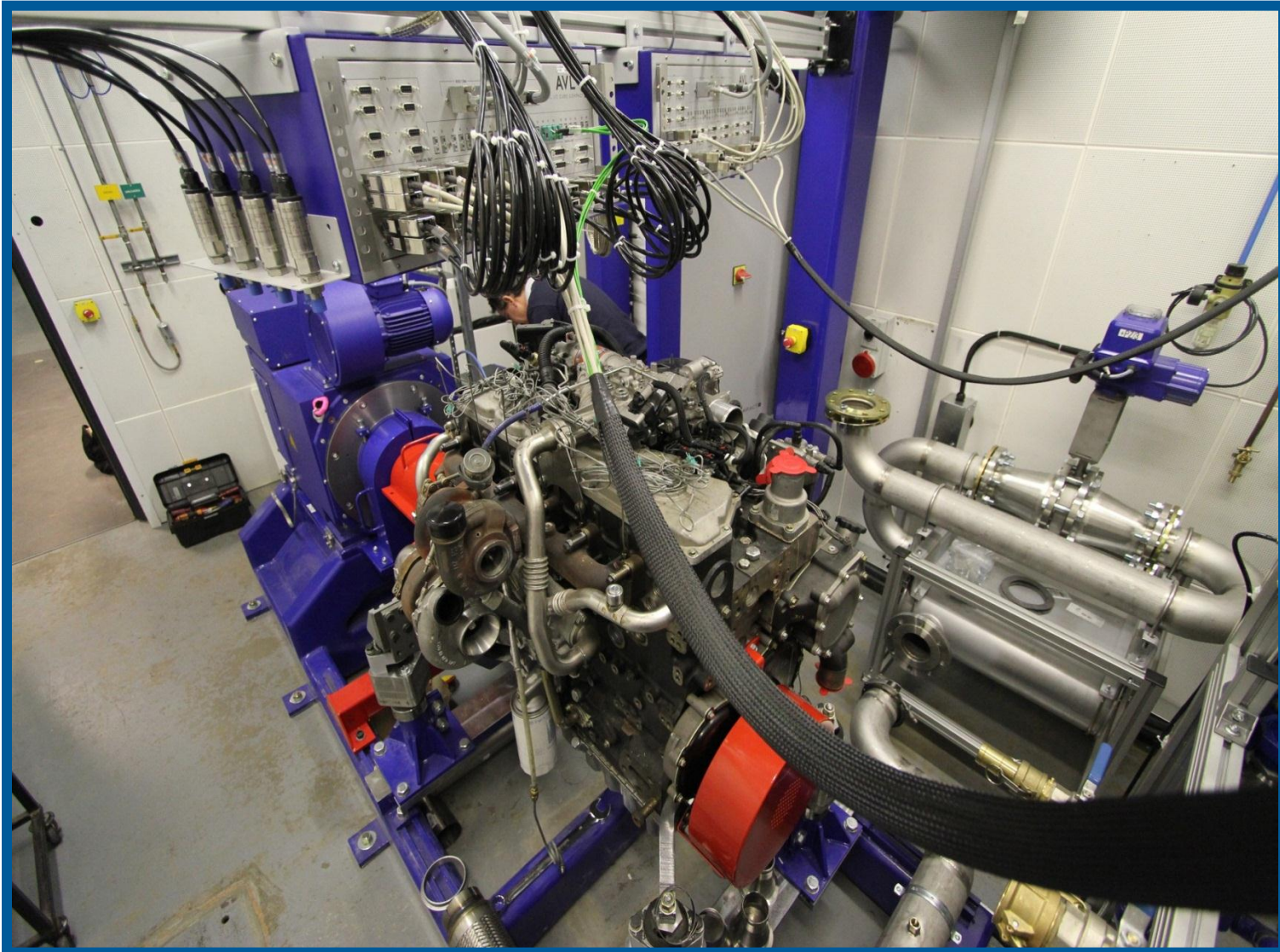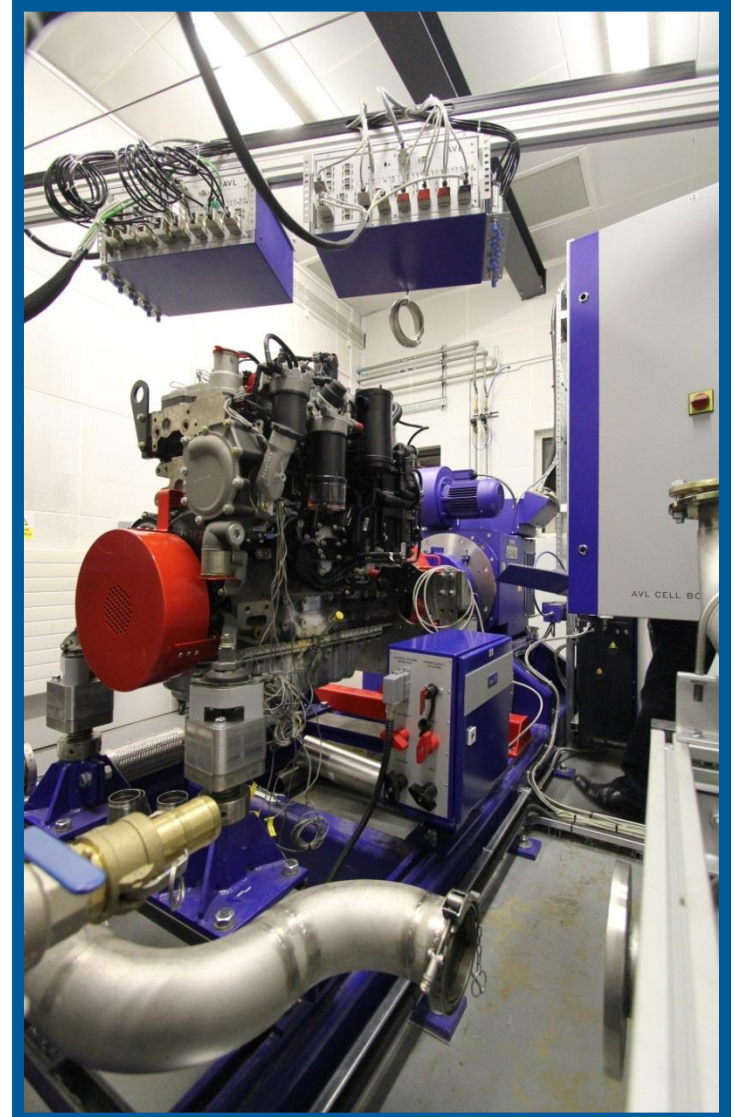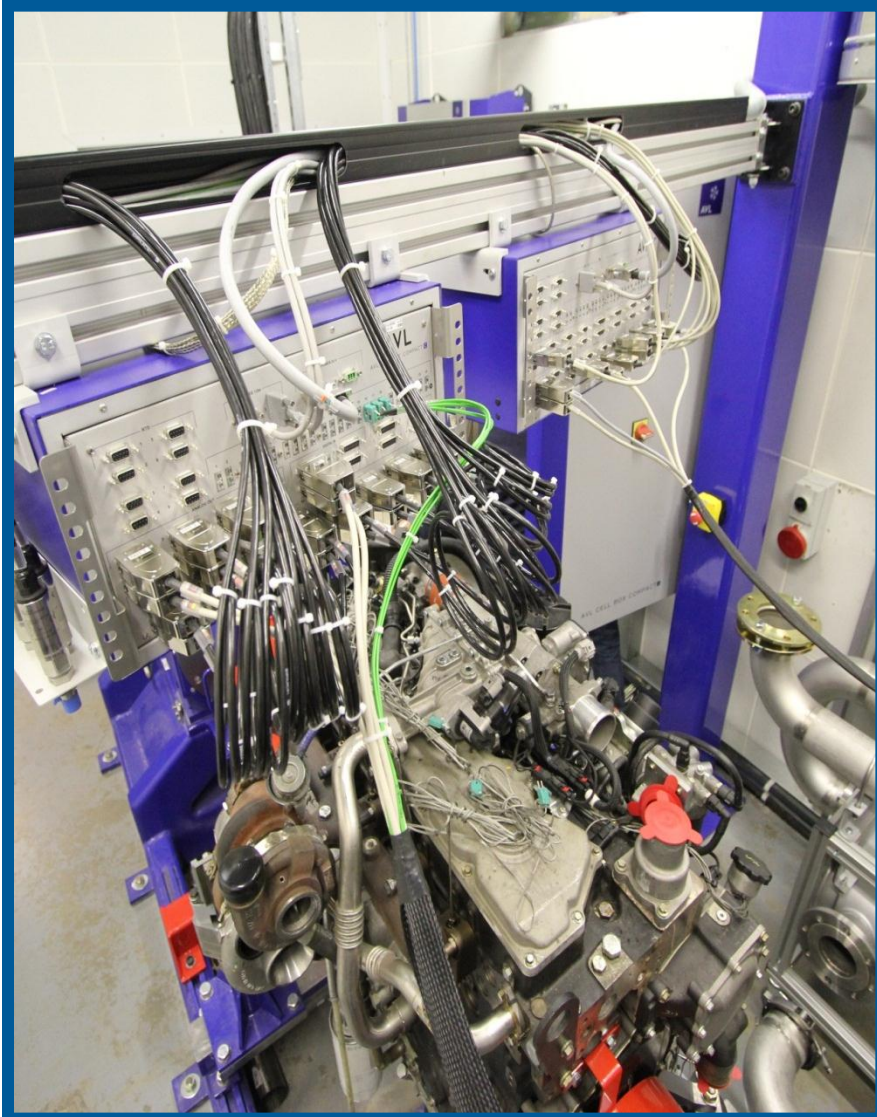# AVL BOBCAT – automation & control
references

AVL BOBCAT – automation & control
references

workstation

Included with the AVL BOBCAT automation & control software is a dedicated workstation. The hardware is extensively tested to ensure a failure free operation in a real time environment. As off the shelf PC solutions are limited in support and spare part availability, AVL can provide an extended warranty, to secure the full operation of the test cell.

Your benefits at a glance:

- Tested and proven workstation solution
- Extended warranty and spare parts availability
- Choice between desktop or rack design

operating panel

AVL COMPACT™

The AVL BOBCAT Operating Panel provides manual control of the test cell when not running an automatic test routine. It provides easy access to the most frequently performed tasks such as changing the control mode or turning on/off digital bits.
The panel contains a touch screen display, two knobs for adjusting the set point values, and eight physical pushbutton switches that can be programmed for digital control of the system. The panel can either be connected to the BOBCAT workstation or can be brought into the cell and connected to the Cell Box.

Your benefits at a glance:

- Precise control of engine & dyno set points via two rotary encoders
- Color touch screen for visual feedback & operation
- Programmable buttons for test sequences
- Connection via Ethernet outside or inside the test cell

cell box

The AVL BOBCAT Cell Box is a wall mounted enclosure that is the center of AVL COMPACT automation & control system used for controlling the engine and dyno and connection to other test cell devices. It serves to accommodate system components. It is connected to the BOBCAT workstation and measuring devices in the testcell. An E-stop circuit (located inside the CellBox) is used to safely protect the hardware.

The Cell Box contains the following main components:

- 24VDC PWS for all the I/O in the system and circuit protection for 24 VDC lines

- Power switch and AC power distribution and circuit protection

- PILZ E-Stop system and E-Stop string

- Connector for the Operator Panel

- F-FEM-CON ADVANCED and F-FEM DIO

- Compliance to directives: Compliance with the 2004/108/EC Electromagnetic Compatibility Directive

Public

cell box

- 4 independent counter channels for data acquisition

- 18 digital inputs

- 26 digital outputs

- 4 analog inputs

- 1 analog input for strain gauge

- 4 analog outputs

- 2 frequency outputs

- 1 watchdog function for test bed monitoring

- Connection of 2 F-FEM-DIO modules with 16 digital inputs and

  - 16 digital outputs each

I/O cube

AVL COMPACT™

The COMPACT I/O Cube is designed as a versatile I/O module for the test cell to allow data acquisition and control of a wide variety of I/O devices. The Cube provides various input and output channels. The channel assignment is software-configurable by the user.

Following channels are provided:

- 16 universal measurement channels for the measurement of voltages, currents, resistances and measuring bridges
- 24 temperature measurement channels for measurement of thermo couples
- (types K, J, R, S, T, B, E and N)
- 8 temperature measurement channels for measurement of RTDs (Pt100, Pt1000)
- 8 analog outputs for voltages or currents (for demand value setting)
- 16 digital outputs (8 relay, 8 transistor outputs for digital or PWM)
- 16 digital inputs

TC cube

AVL COMPACT™

The COMPACT T/C Cube is designed as a versatile IO module for the test cell to allow data acquisition and control of a wide variety of IO devices. The Compact Thermo Cube provides 16 universal measurement channels and 64 temperature measurement channels. The channel assignment is software-configurable by the user.

Following channels are provided:

- 16 universal measurement channels can measure voltages, currents, resistances and measuring bridges.
- 64 temperature measurement channels are split into
    - 56 channels for measurement of thermo couples (types K, J, R, S, T, B, E and N)
    - 8 channels for measurement of RTDs (Pt100, Pt1000)
- The signals are first conditioned with a low pass filter and then converted to physical units and transferred to the automation system as physical units via an IEEE1394 interface.
- The acquisition rate is selectable for each channel (1Hz, 10Hz, 100Hz) depending on the sensor type (1Hz, 10Hz for temperature channels).

cube comparison

Modul Name	Type Number	Material Number	Connector Type	Signal Types and Channel Numbers							
				TC	Universal Channel Voltage ± 13,5 V, Current ± 25 mA Low Voltage ± 2.4 V, ± 75 mV TC, Resistance, DMS, RTD	Low Voltage ± 2.4 V, ± 75 mV, TC, RTD	Analog out (± 10.5 V, ±21 mA)	Digital In	Counter[1]	Digital Out	Frequency Out[2]
TC Cube	6260.63	GK0448	DSUB-9		16	8					
			Omega	56							
I/O Cube	6260.64	GK0449	DSUB-9		16	8	8				
			Omega	24							
			DSUB-15					16	8	16	8

throttle actuator

The AVL Throttle Actuator Compact is a Linear Rotary Screw (LRS) type throttle actuator used for controlling the mechanical throttle on an engine. It is equipped with automatic range calibration for easy setup. Force , speed, displacement, and acceleration limiting and definable e-stop position ensure the maximum security and ease of use.

AVL COMPACT™

Throttle Actuator COMPACT	
Max. Force	890N
Linear Stroke	76mm
Time for full stroke	0.1s

AVL BOBCAT – automation & control software
technical specs

Feature	Description
Operating system	Windows XP or Windows 7
Realtime operating system	INtime
Runtime states	Empty, testcell Loaded, engine loaded and test loaded
Application modes	Setup, runtime and data browsing
Modes of operation	Manual and automatic
Channels	Analog IO, digital IO, temperature, formula, filters, PID, limits, custom and dependent
Channel frequencies	1, 10, and 100 Hz (1kHz for F-FEM CON channels)
Calibration type	16-point linear fit and (cRIO only) 6th order polynomial
Calibration history	History maintained, trace maintained
Limit monitoring types	Testcell limit (monitored either in testcell load or engine loaded states), engine limit and group (monitored in when engine has started)
Limit monitoring reactions	Low and high warnings and alarms; SoftStop, HardStop, Message, Idle and Exception on alarms.
Limit Monitoring frequencies	Same frequency as the channel being monitored
Filters types	Cut-off frequency, Integrator, Value changed/not changed, moving average, invalid value and minimum/maximum/range
Maximum number of channels	4750
Maximum number of PID channels	10
Maximum number of formula channels:	Maximum flow rate (summation of all formula channel frequencies) 5000.
Maximum number of filter channels	32 of each filter types (6 filter types)
Maximum number of custom channels:	Limited by performance, not licensed
Maximum number of testcell limit Channels	128
Maximum number of engine limit channels	128
Supported number of displays	2
Maximum number of active recorders	3 concurrently activated recorders and 1 blackbox recorder.
Maximum number of recorder config	32
Recording frequencies	1, 10, 100 Hz (1kHz for F-FEM CON channels)
Maximum number of CAN ports	8 (4 for each CAN card)
Repository table	Provide data array and its runtime dynamic switching
Test result data	Export data as CVS and ATF, and import it to Santorin database
Testmate Contorl modes	Speed/Position, Torque/Position, Dyno/Position, Speed/Torque, Torque/Speed, Dyno/Speed, Dyno/Torque, Speed/Aux, Torque/Aux, Dyno/Aux (only one Aux supported)

supported devices

Name	Description
AVL 733S	Fuel balance meter. It is used to determine fuel consumption based on a pre-selectable measurement time or measurement weight.
AVL 735	Fuel mass consumption meter allows you to measure the fuel consumption of a combustion engine.
AVL 753C	Fuel conditioning system is used to maintain the fuel temperature at a specific setpoint, and within narrow tolerance limits. It is used together with the AVL fuel mass flow meter (AVL 735S) and AVL fuel balance (AVL 733S), and can also be retrofitted to existing fuel consumption measuring devices.
AVL 415	Smoke meter. It is used to measure the soot content of the exhaust gas from diesel engines.
AVL 415S	Smoke meter. It is used to measure the soot content of the exhaust gas from diesel engines.
AVL 439	Opacimeter. It is used to measure the opacity of exhaust gas both in static and dynamic engine state.
AVL 442	Blowby meter serves to continuously measure and monitor the blow by gas.The blow by gas flows through leaks of pistons, piston rings, valve guides, and in case of turbochargers through bearings and bearing seals, into the crankcase and escapes through the casing ventilation.
AVL 483	Micro soot sensor measures the low soot concentrations in the diluted exhaust gas of particle emitting combustion engines.
PEUS CFO	CFO propane injection kit. It is used to check CVS dilution systems in emission gas testing for conformity.
HMT 333	Vaisala Weather Station
PTU 300	Vaisala Weather Station

AVL BOBCAT – automation & control software

supported devices

Name	Description
CVS	A CVS (Constant Volume Sampler) dilutes the exhaust sampled from a vehicle under test on a chassis dyno or from an engine on an engine test bed. The diluted exhaust is fed into the exhaust analyzers, where the actual exhaust analysis takes place.
Simplex_LB	Simplex load bank (customer specific, not officially supported)
FMU3G	Taylor fuel measurement (customer specific, not officially supported)
Agilent	Agilent power supplier
EBH	It is used to control and communicate with AMA i60 Combi, Horiba MEXA, SESAM FTIR, CEBII bech, etc. See Puma document for more information.
Emissions Benches	It is used to interface with AVL GEM 110, Horiba Mexa 7000, and AVL i60 emissions benches
CAS/ACAP	Interfce to combustion analysis systems from MTS (A&D). It is also used to interface ACAP from MTS as well as CAS from FEV. Specific versions do apply.
SPC	The SPC is a compact partial flow dilution system that extracts engine exhaust, dilutes it with conditioned dilution air (to simulate reactions in the atmosphere), and samples the diluted exhaust over particulate filters. The filters are weighed to determine the amount of particulate matter in the exhaust.
CAN	ASAP2 CAN driver
ASAP3	ASAP3 driver
CUTY	CUTY - Communication Utility, which is enabling communication to Cummins ECUs using ASAP3. A Cummins MC System.
IndiCom	IndiCom is a user interface and control software for AVL Indicating systems.

AVL BOBCAT – automation & control
programs
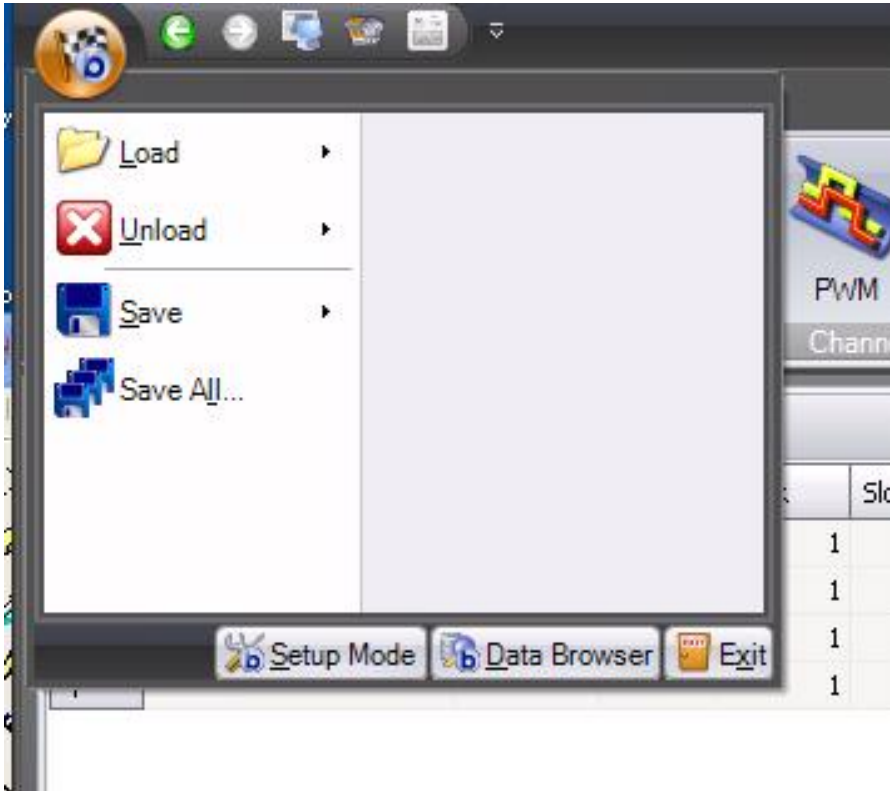
- Setup
  - Set up the Testcell, Engine, and Test Files
- Run Mode
  - Run the Tests on the Engine in the Testcell using the files created in Setup
- Data Browser
  - View the gathered data and export as csv or ATF file

AVL BOBCAT – automation & control
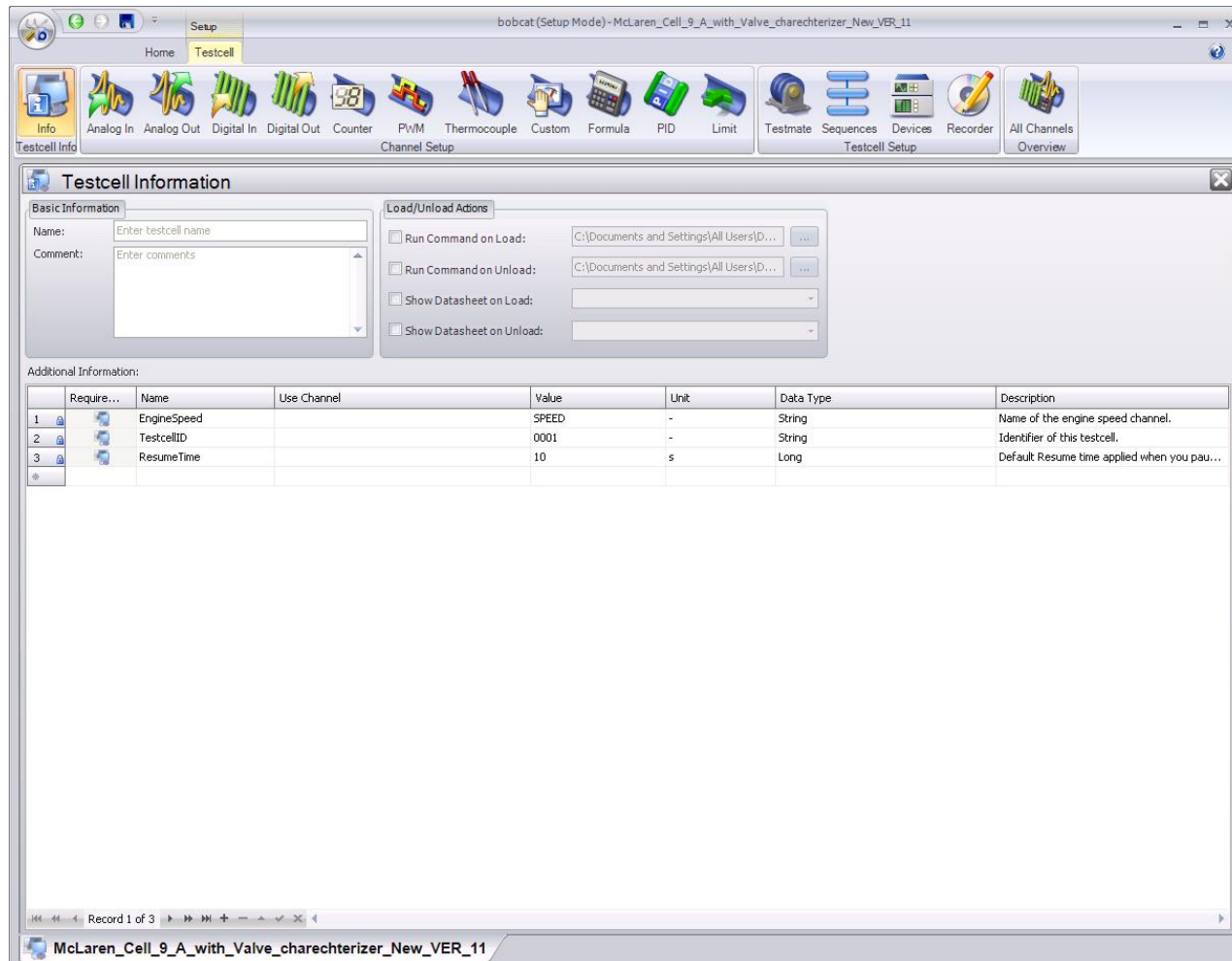
setup

AVL BOBCAT – automation & control
setup – physical channels

Setup the physical I/O channels in the system
- Analog Inputs
- Analog Outputs
- Digital Inputs
- Digital Outputs
- Counter Inputs
- PWM Outputs
- Thermocouples

Set the specifications of the channel
- Units
- Decimal places
- Update frequency (1, 10, 100Hz, 1kHz for FFEM-CON)
- Hardware information
- Calibration

AVL BOBCAT – automation & control
setup – formula

- Uses scripting language for writing simple or complex formulas
- To be replaced with a simple formula editor (conceptually to be like formula editor in Excel)
- Can update formulas at 1, 10, or 100 Hz

AVL BOBCAT – automation & control
setup – devices

- GUI for device driver allows setup of the device and the measurement channels for the device
- Channels from devices can be used throughout BOBCAT
- Device driver GUI's will be added as customers request them and then will be available as standard devices

Public
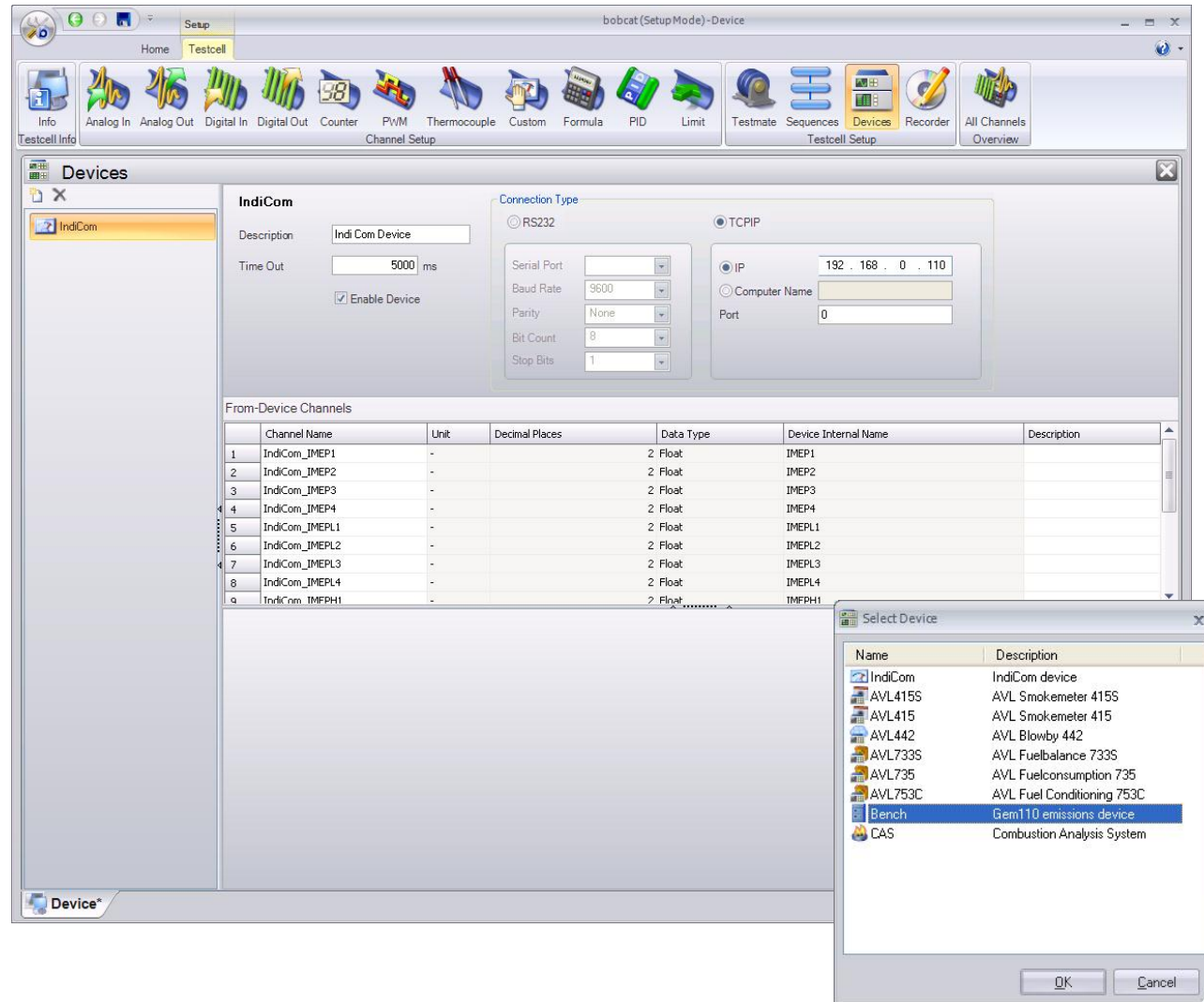
AVL BOBCAT – automation & control
calibration

- Calibrate analog input channels
- Up to 16 point calibration possible
- Done during runtime so sampling actual points possible
- Can vary the sample time for accurate snapshot of point
- Calibration is applied immediately to the channel

AVL BOBCAT – automation & control
sequence/test run editor

- Create test sequences quickly and easily
- Can be simple or complex
- Uses simple "drag and drop" technology
- Create loops, parallel paths, sub routines, grids, measurements, etc.
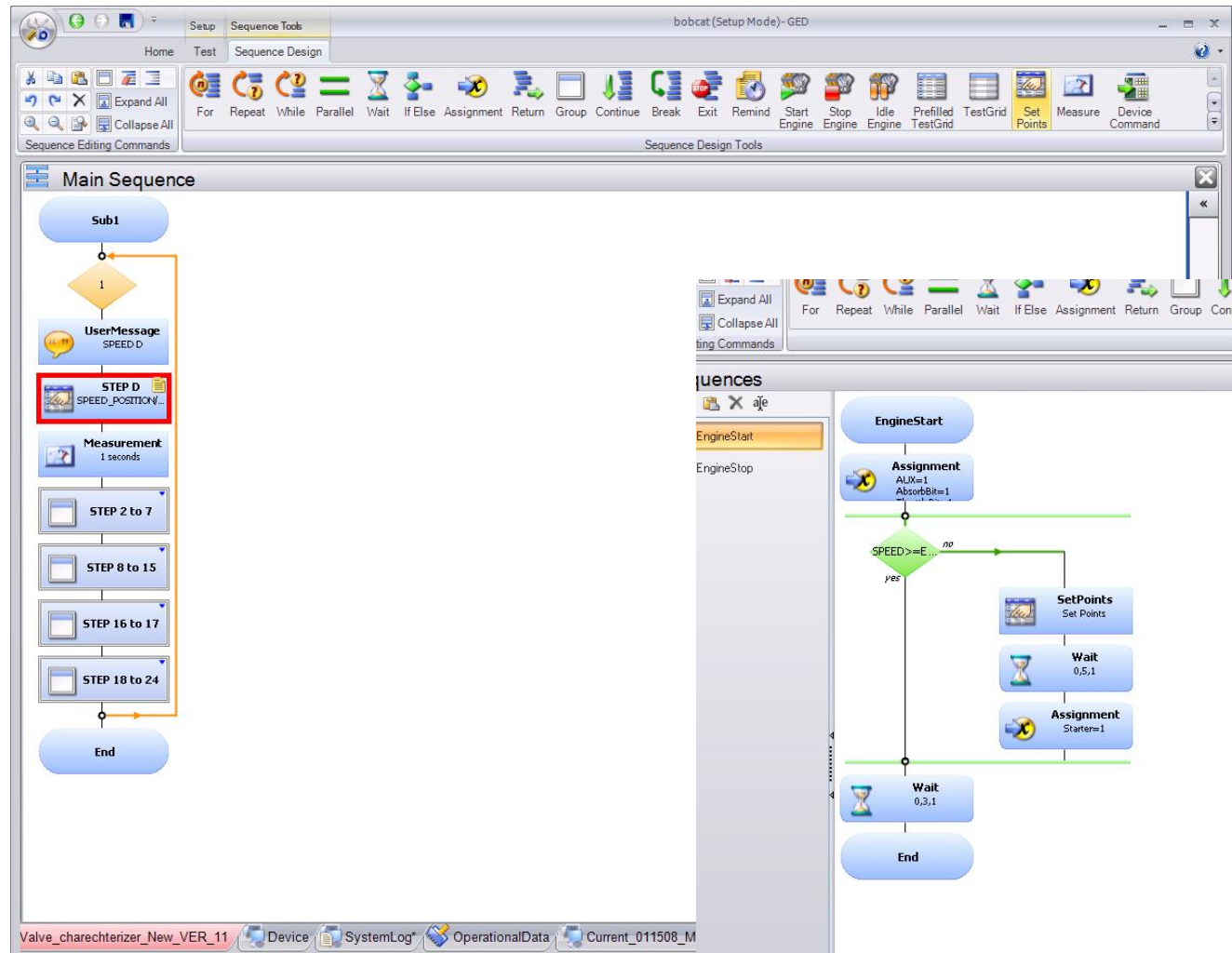
AVL BOBCAT – automation & control
recorder

- Can view the Application Recorder in Run Mode
- Can add Application Recorder channels to the plot
- Can zoom, pan, print, and save the plot
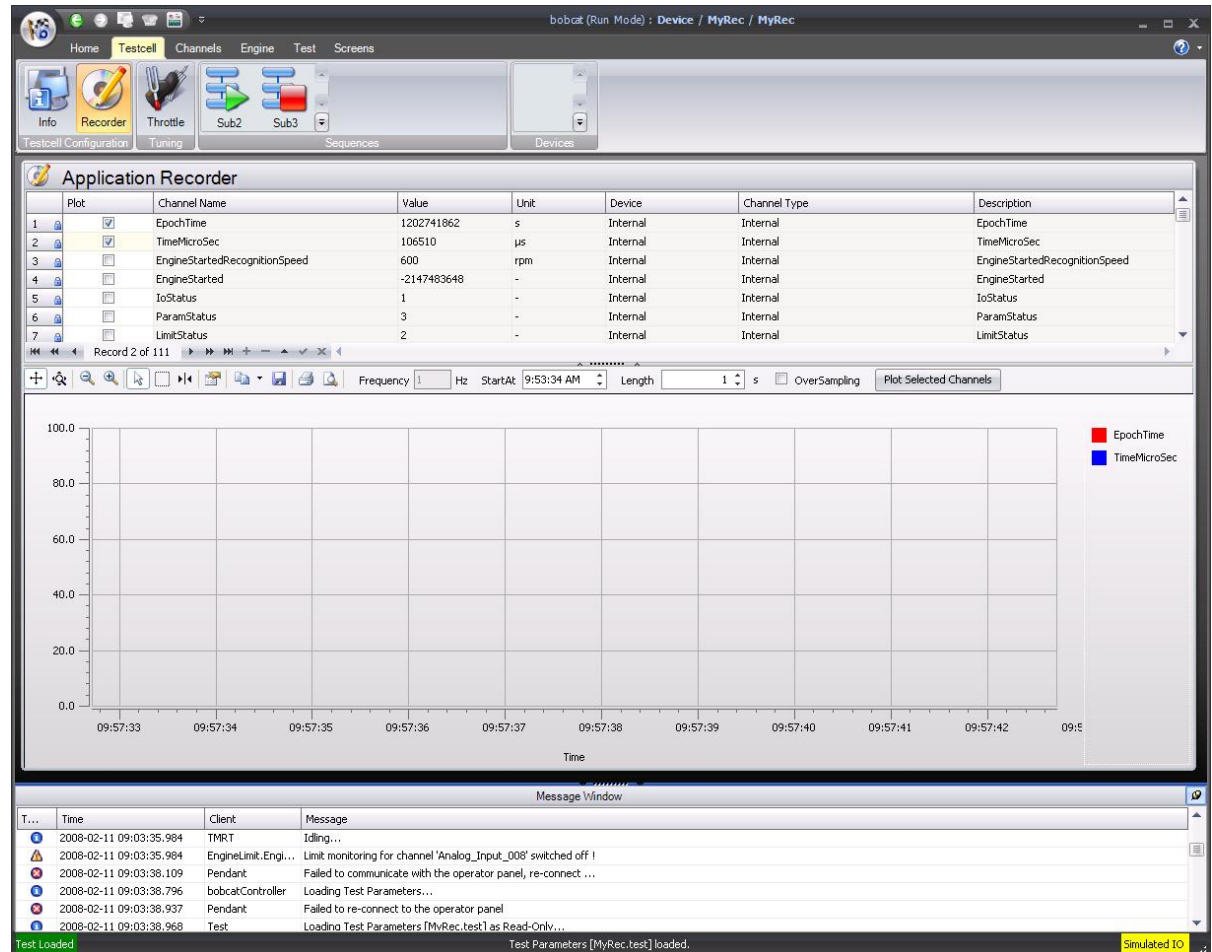
AVL BOBCAT – automation & control
screen builder
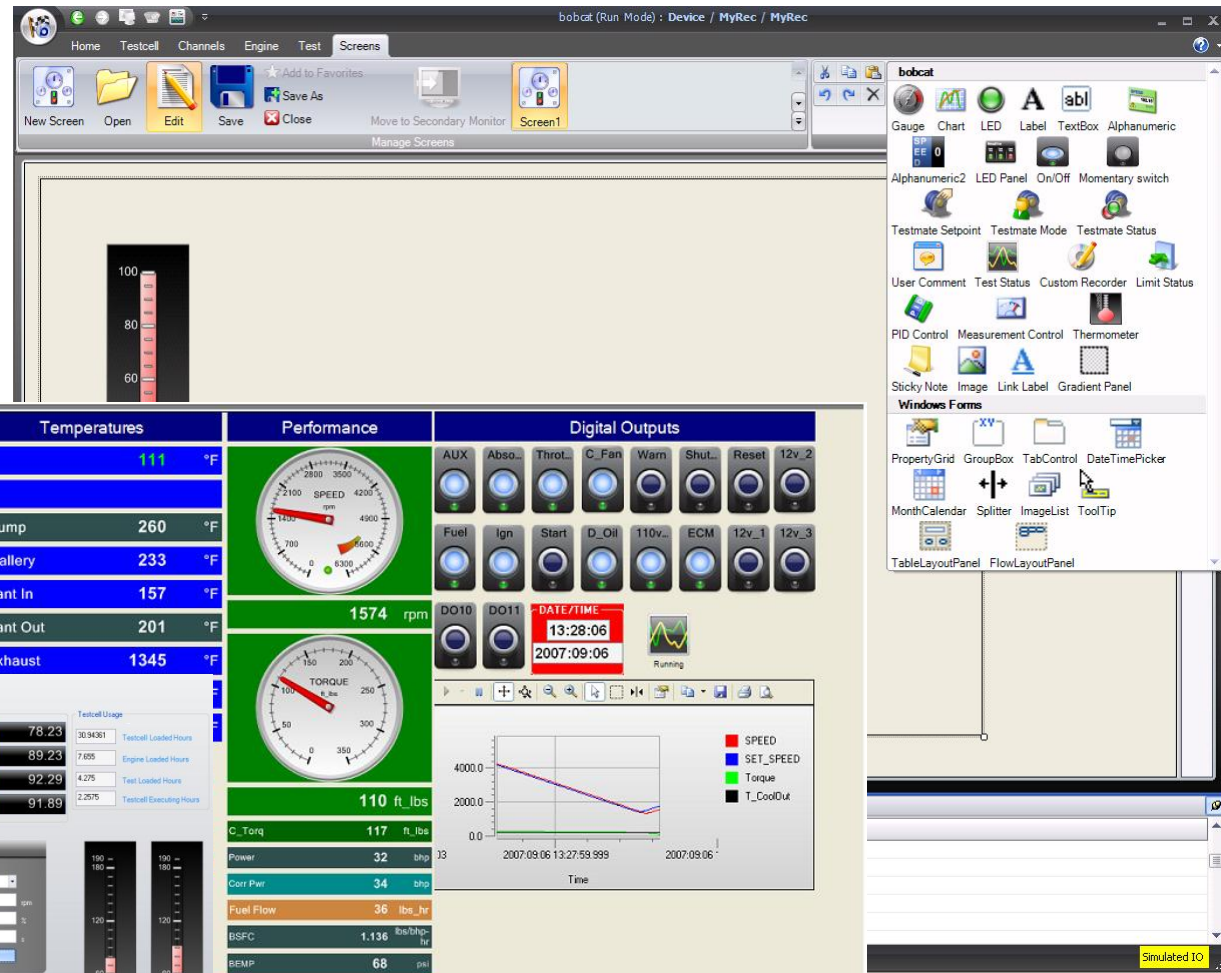
AVL BOBCAT – automation & control
run mode
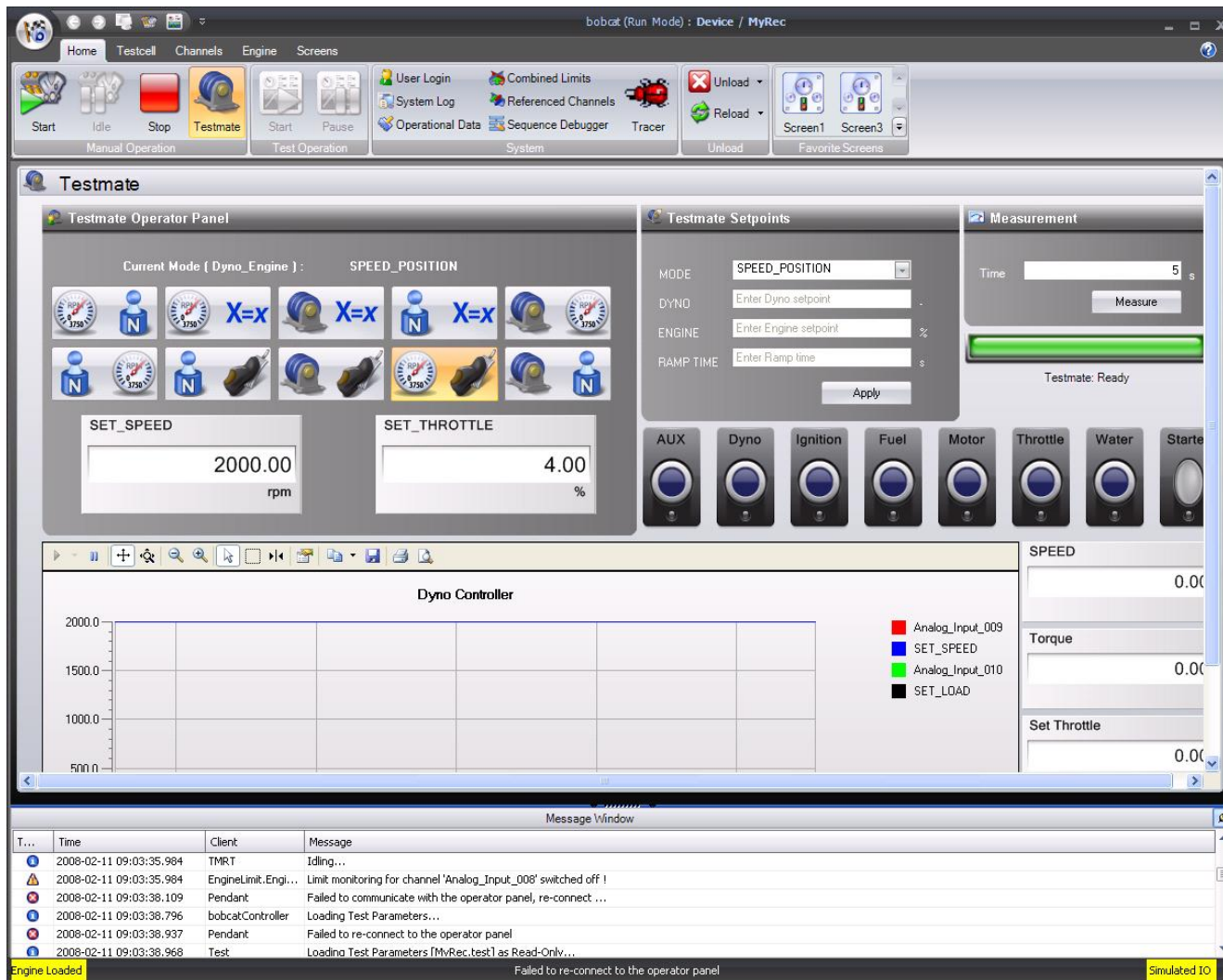
- View status and control in Run Mode
- Change operating modes and setpoints
- Toggle digital output bits
- View input and output signals on chart object
- Integrated with optional Operator Panel

AVL BOBCAT – automation & control
data browser

- Can pick and choose the channels to be selected and exported
- Can export as few or as many channels as desired

AVL BOBCAT – automation & control
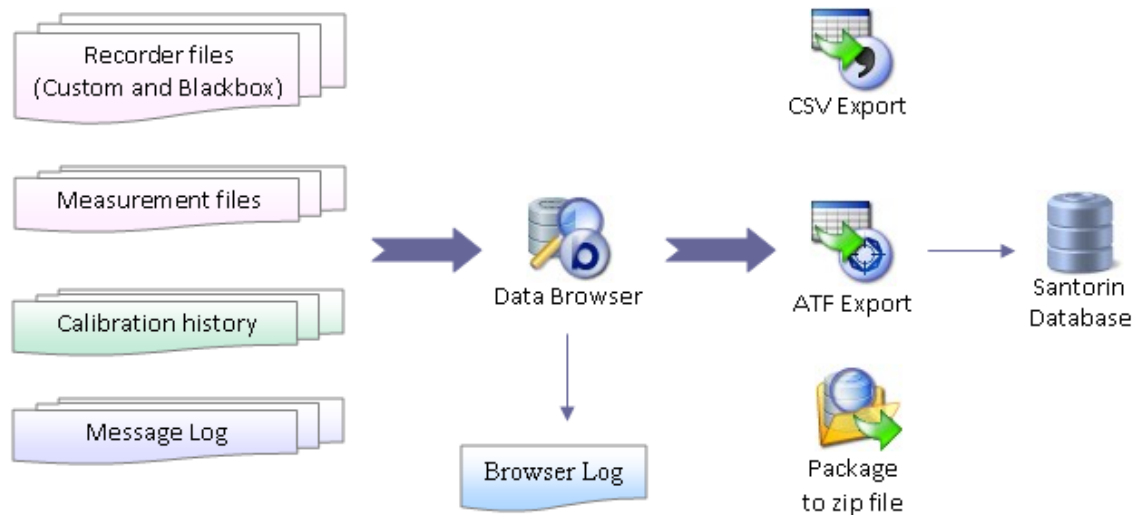## **data browser**
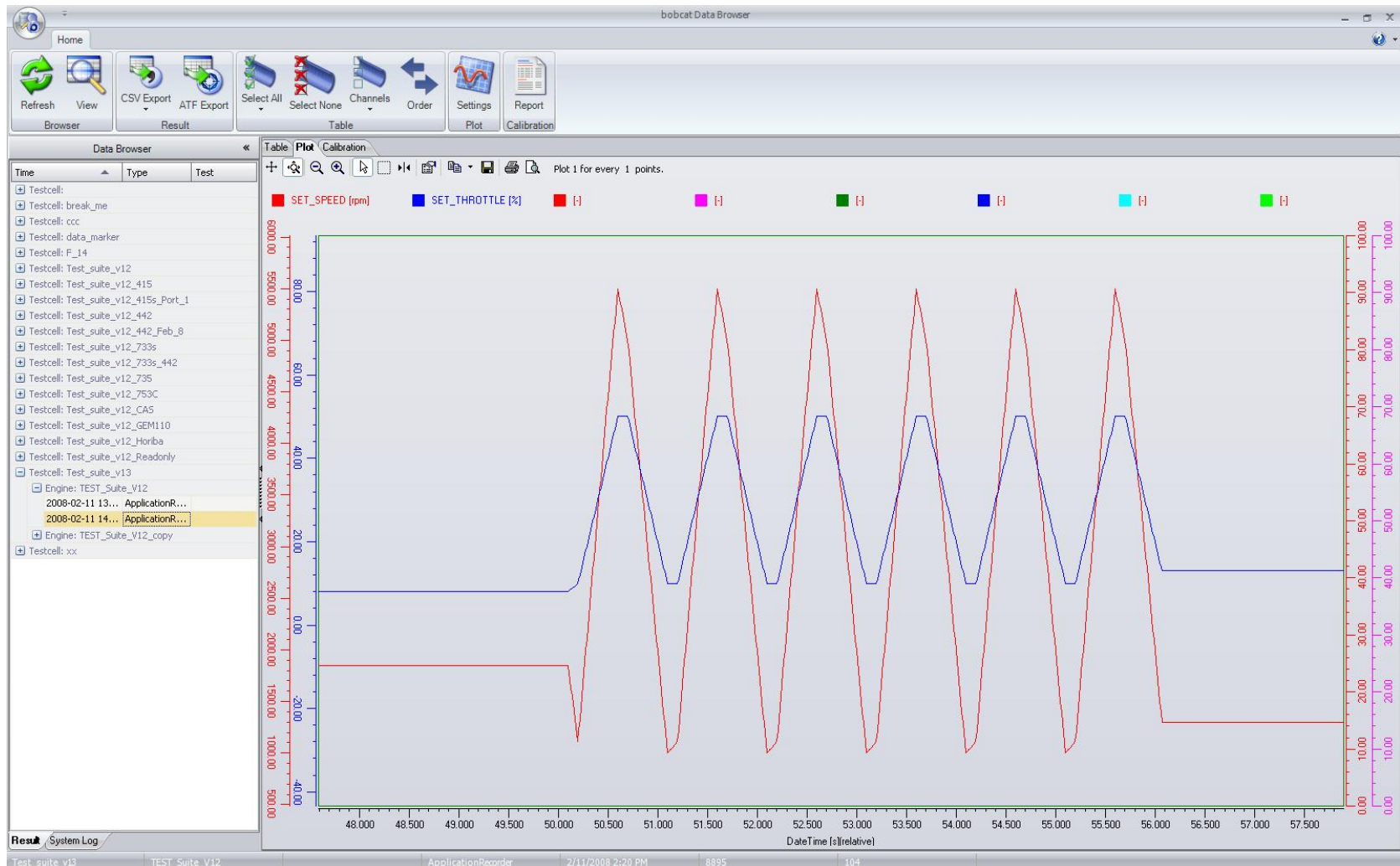
AVL automation & control – BOBCAT & PUMA
platform
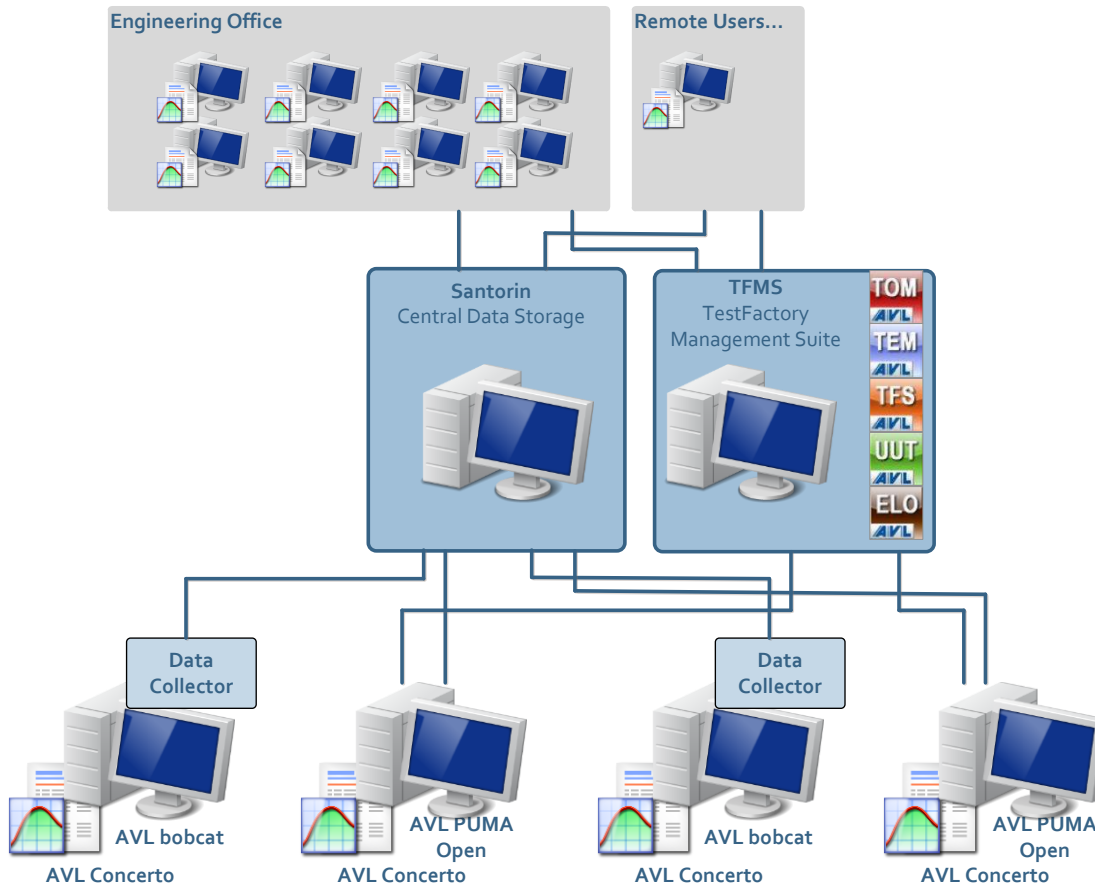
- BOBCAT can coexist in the testfield with PUMA Open

- Data logged at BOBCAT can be stored at Santorin central host by using a Data Collector interface

BOBCAT automation & control
data browser

Data Browser that can be used to **view the result data files** (custom recorder, blackbox recorder and measurement files)

The browser provides a better analytical view of the data displaying it in different formats, such **as tables and plots**

The browser can be used to **export the data files** to CSV (Comma Separated Values) or ATF (ASAM Transport Format) formats, or to a Santorin database. The data files can also be packaged into zip files for distribution

The Data Brower browser logs details of all errors during operations, such as loading of data files to an **error log** which can be viewed in the browser itself. The browser can also be used to **view calibration history** and message log

BOBCAT DataBrowser
user interface

Tools & Functions Ribbon

File Browser
(Data sorted by Testcell,
then by Engine)

Data Display Area
(tables, plots, template, calibration, message log)

BOBCAT DataBrowser
table

BOBCAT DataBrowser
plot

BOBCAT DataBrowser
data export
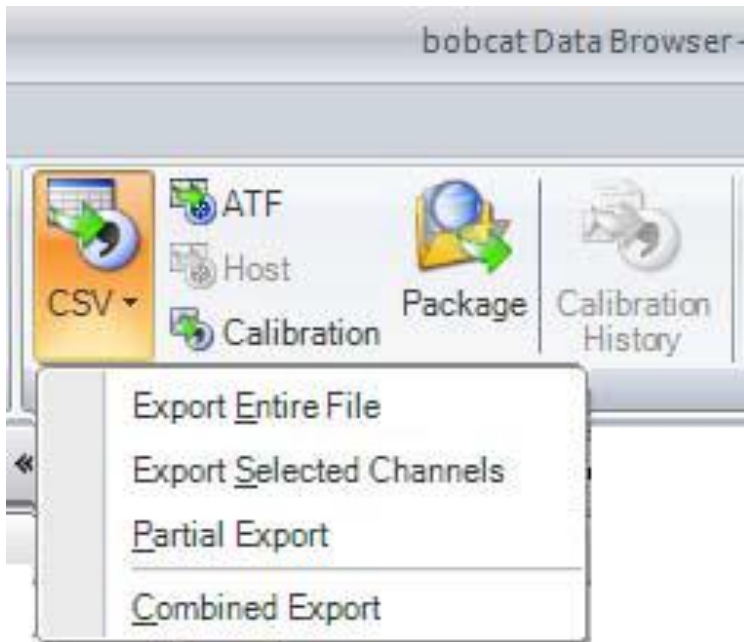
Using the Data Browser, it is possible to export result files and calibration history to **CSV and ATF files**. It is also possible to export result data to a **Santorin host** using the Data Browser.

BOBCAT DataBrowser 2
new functions

…Data Comparison Mode
  overlay up to 25 data files with a single click
  export the average data
…Manage configurations for automatic reporting
  define up to 5 tables and 5 plots and generate a report based on a user definable template
  window
…Data Binning
  create a new data file based on a reference channel This is helpful when the result file
  contains multiple runs of the same ramp, and the user would like to get an average value of
  all the runs based on specific rpm values
…Data Splitting
  split a data file into multiple files based on a reference channel. This is helpful when the result
  file contains multiple runs of the same ramp, and the user would like to overlay all the ramps
…Formula Calculator
  create up to 20 calculated channels per configuration with the easy to use formula calculator
…Data Browser Test Block
  Perform data binning, Open the latest data set and Automatically print the template using the
  default printer directly out of the testrun

Backup & Restore

Results Evaluation

Data & Security Administration

AVL SANTORIN COMPACT™

Results

AVL PUMA

AVL BOBCAT

3rd Party System
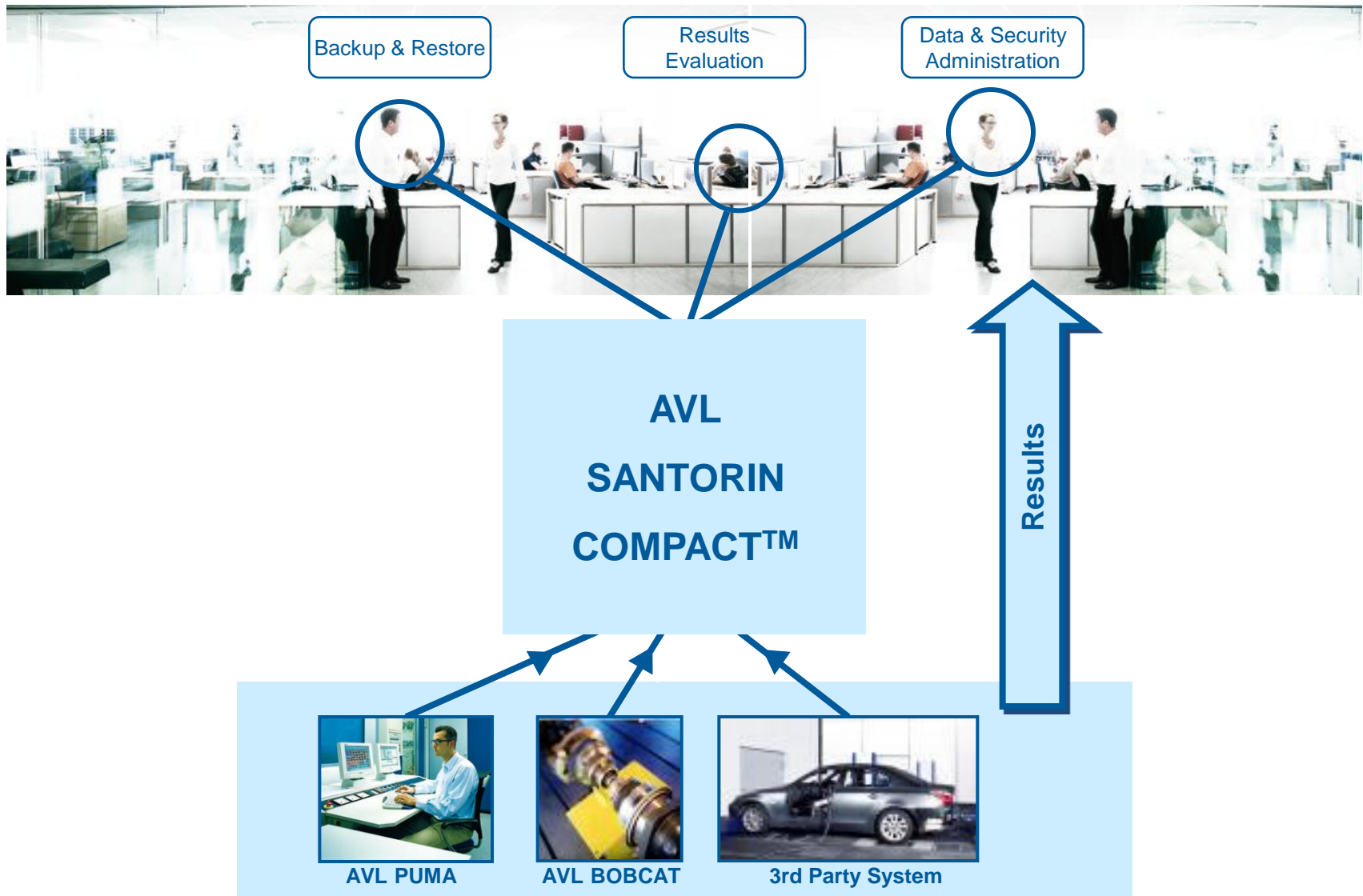
APPLICATIONS – RESULTS EVALUATION

Backup & Restore

Results Evaluation

Data & Security Administration

- ❑ Comparable result data from different sources enables the comparison of results across the entire test facility with test bed from different suppliers.

- ❑ Common data evaluation based on common normnames / units is ensured by automatic data conversion during the import for PUMA Open , EDACS and 3rd party test beds

- ❑ SANTORIN COMPACT^{TM} in combination with CONCERTO provides a seamless workflow from result data storage to result data visualization.
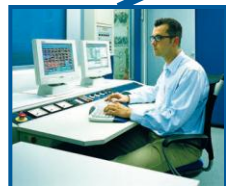
AVL PUMA   **AVL BOBCAT**   **3rd Party System**

APPLICATIONS – BACKUP & RESTORE

Backup & Restore

Results Evaluation

Data & Security Administration

- ❑ The automatic and time trigged data backup includes all result data stored in the SANTORIN COMPACT™ data base.

- ❑ In case of an unexpected damage of the hardware or in case of data loose the guided restore helps you to re-establish your SANTORIN COMPACT™ and the stored result data.
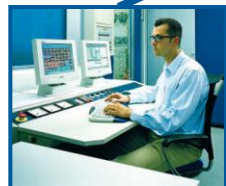
AVL PUMA

AVL BOBCAT

3rd Party System

APPLICATIONS – DATA & SECURITY ADMINISTRATION

Backup & Restore

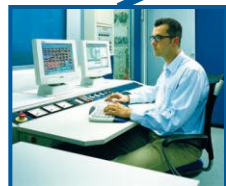Results Evaluation

Data & Security Administration

❑ Central management of project access rights and user accounts throughout the test facility ensures secure and consistent project operation.

❑ Easy integration into enterprise's IT environment is ensured by using proven standards like Oracle database, MS Windows Server software and TCP/IP.

AVL PUMA

AVL BOBCAT

3rd Party System

BOBCAT automation & control
CONCERTO
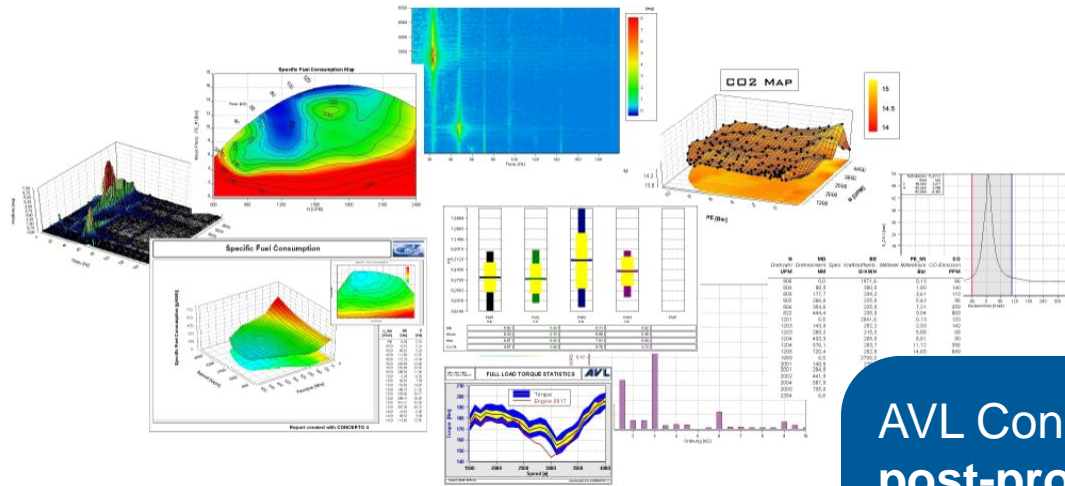
AVL Concerto is a **generic data analysis & post-processing tool**. It is a standalone product which is independent of BOBCAT.

Concerto includes an extensive collection of file format filters, providing you with **access to data from both AVL and non-AVL test systems and instruments**.

To correctly access bobcat data, a minimum version of 4.3 is required.

CONCERTO
post-processing platform

Generic Data Acquisition Systems (e.g. Yokogawa Recorder)

File storage system

Indicating System (e.g. AVL IndiSet)

File storage system

ECU Application System (e.g. Etas INCA)

File storage system

ASAM ODS Database

Automation System (e.g. AVL PUMA)

AVL CONCERTO
central data correlation, comparison and evaluation

Vehicle Simulation System (e.g. AVL InMotion)

File storage system