VECTOR

vMeasure

Product Information

vector.com

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V11 10/2026

Valid for vMeasure as of version 11.0

Product information and technical data for vMeasure options are provided in separate documents.

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1. Overview

1.1 Introduction

vMeasure is a flexible measurement software that efficiently supports you in the laboratory, on the test bench, during test drives and in endurance testing. You conveniently acquire physical quantities via external measurement modules, ECU-internal signals via XCP or the VX1000 measurement hardware from Vector, as well as all signals of the vehicle networks (CAN, CAN FD, FlexRay, LIN, Automotive Ethernet, ...). vMeasure records all of this data time-synchronously and efficiently.

For a meaningful interpretation of the recorded measurement data, vMeasure displays the position of the vehicle on an electronic map and documents the test drive with a context camera. Measuring OBD signals to obtain information about the state of the ECUs is also one of the typical tasks. Configuration tools for third-party measurement technology, e.g. CSMconfig from CSM, are integrated for easy configuration of the signal sources.

vMeasure is part of a tool family based on a common platform:

- CANape is the all-round tool for ECU calibration. In addition to the measurement functions of vMeasure, it offers calibration of ECU parameters, calibration data management, flashing, diagnostics and the verification of ADAS sensor data
- vSignalyzer offers the same extensive data visualization capabilities and manual and automated analysis and reporting functions as CANape

A cloud service for sharing projects is available via the Vector Team Services. You can upload recorded measurement files to the Vector vMDM measurement data management system vMDM in the cloud to administrate, analyze or distribute your recordings.

1.2 The advantages at a glance

- Open and flexible platform through use of standards such as ASAM MDF, XCP, A2L and FMI and open interfaces such as DAIO
- Acquire measurement data from a wide variety of sources synchronously in time and store it in a compact ASAM standard format (MDF/MF4)
- Convenient integration of analog measurement technology from Vector and numerous third-party manufacturers with sampling rates of up to 1 MHz
- Integrated configuration tools from third-party manufacturers (e.g. CSMconfig) simplify the setup of the measurement modules
- Measurement of ECU-internal data via XCP and high-performance access to ECUs via the VX1000 measurement hardware
- Monitoring and recording of all vehicle networks such as CAN, CAN FD, FlexRay, LIN and Automotive Ethernet
- Calculations of specific data, e.g. active power of an inverter in the electric vehicle during measurement and offline
- Vehicle position on electronic maps and video recording with context cameras for a meaningful interpretation of the measurement data
- Offset correction (Tara) of measurement signals directly in the measurement configuration – without opening the configuration tool of the measurement modules
- Live View shows the current values of the connected measurement modules and the current video image even before a measurement is started
- Measurement data evaluation from convenient visualization to export to ASCII, Excel and MATLAB
- The 64-bit architecture allows the use of the entire RAM memory of the computer. This makes it possible to process very large amounts of data without any problems
- Automate processes in vMeasure using the internal programming language "CASL". Extend the range of functions with your own libraries from C/C++ code
- Comfortable collaboration across company boundaries. Create a Team Area on your own and define your team by email addresses. All projects that you upload to the Team Area can be used by the entire team.

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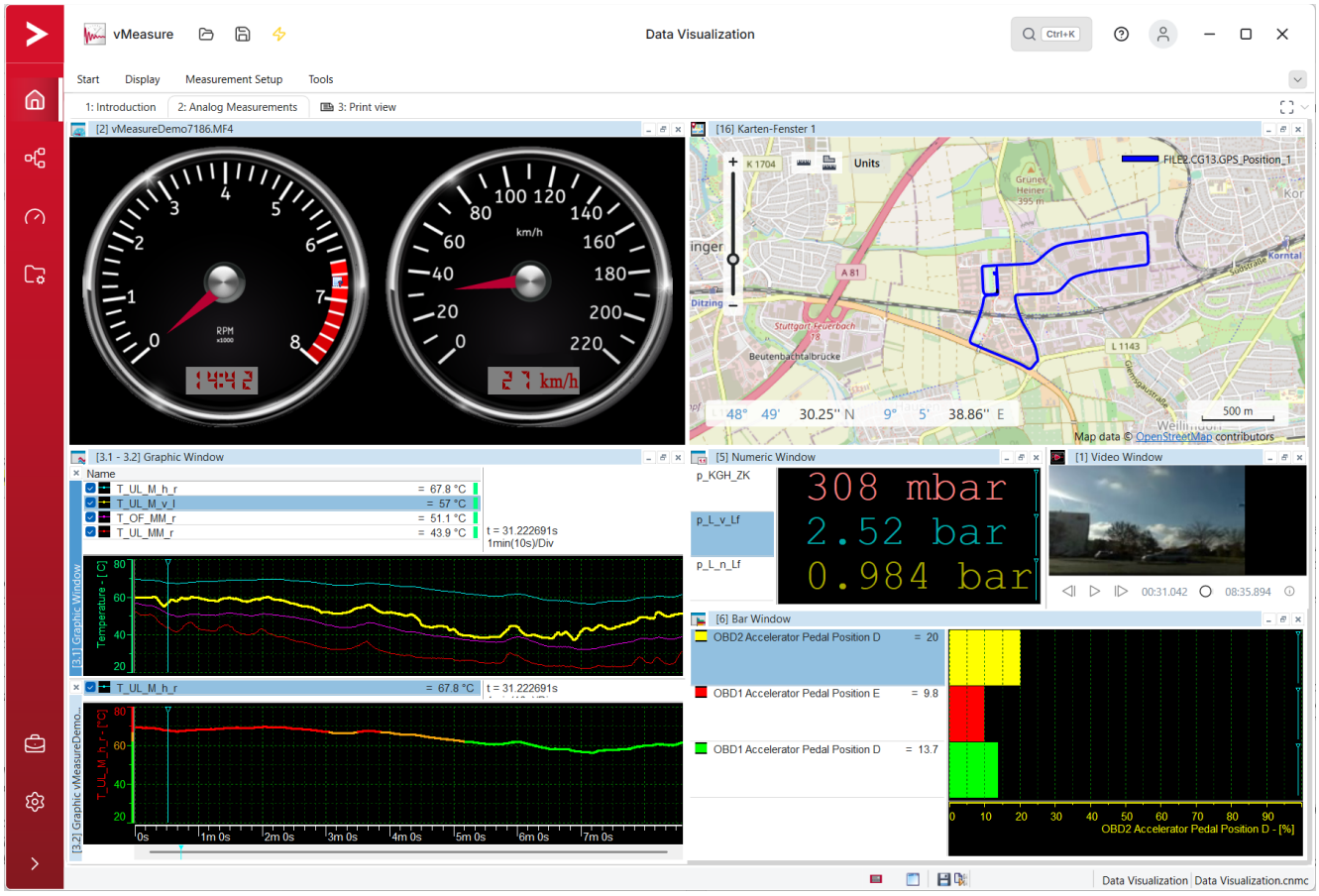


FIGURE 1: Example of the vMeasure user interface

1.3 Fields of application

vMeasure is the flexible tool for measurement tasks in vehicle development and validation. All tasks in this environment can be solved conveniently and reliably with vMeasure:

- acquisition of physical quantities such as temperatures, pressures, voltages, currents, vibrations and exhaust-relevant data
- at the workplace, in the laboratory, on the test bench, on test drives and in endurance tests
- in data recording of ECU-internal signals and bus communication, monitoring of vehicle networks, OBD measurements and high-voltage measurements on electric drives

1.4 Features

During the measurement, vMeasure captures data from external measurement modules, ECUs, buses, GNSS receivers, video cameras and much more. Communication between vMeasure and the ECUs takes place via protocols such as XCP or via microcontroller-specific interfaces with the VX1000 measurement hardware. Virtual signals are calculated online with the integrated function library, and several independent recorders store the data in the desired file format. Convenient visualization, measurement data evaluation and export make vMeasure a complete tool for your measurement tasks.

1.5 System Requirements

The system requirements can be found on the vMeasure page on our website.

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1.6 Functional expansion through additional options

> Thermodynamic State Charts option for displaying thermodynamic state diagrams (e.g. of cooling circuits) overlaid with measured values for online and offline analysis as well as calculation of thermodynamic variables such as enthalpy and entropy.

1.7 License terms

1.7.1 vMeasure as a stand-alone solution

vMeasure is a single-user solution that is used on Windows computers. Different licensing methods are available for this purpose. To find out which licensing method best suits your requirements, please contact your Vector sales representative.

1.8 Further information

Various documents are available on the Internet for vMeasure, such as fact sheet, release notes and system requirements. With the demo version, you receive sample configurations for the various application areas as well as detailed help that describes all vMeasure functions. You also benefit from valuable know-how in the form of KnowledgeBase articles, product videos and e-learning modules. You can find more information on the vMeasure page at vector.com.

2. Basic functions

vMeasure's basic functions include:

> Time-synchronous real-time acquisition of all input variables
> Acquisition of physical quantities with measurement modules from Vector (VIO System, Vector IO) and third-party manufacturers such as CSM, ETAS, IPETRONIK or National Instruments
> Measurement of ECU-internal data via XCP and CCP, including support of the seed & key procedure
> High-performance measurement of ECU data via the VX1000 measurement hardware
> Monitoring and recording of CAN, CAN FD, FlexRay, LIN, Automotive Ethernet and SAE J1939 networks
> Access to the OBD-II data of the vehicle
> The function library "eMobilityAnalyzer" calculates all relevant data of an electric drive at runtime (with sampling rates of up to 1 MHz)
> Integrated function library enables, among other things, real-time evaluations, calculation of virtual signals at runtime and filtering of noisy signals
> Offset correction (Tara) of measurement signals
> Multi-recorder concept with up to 16 independent recorders, extensive trigger and event options
> Time-synchronous recording of context and reference cameras as well as audio comments
> Visualization of the current GNSS/GPS vehicle position on electronic maps (also for offline use) significantly facilitates the interpretation of the recorded measurement data
> Offline measurement data evaluation from manual evaluation to automated with the integrated function language "CASL" (Calculation and Scripting Language) or self-developed DLLs.
> Automation of processes through the integrated function language CASL and the Task Manager
> Easy creation and integration of specific display and control elements with the Panel Designer
> Export of measurement data to ASCII, Excel and MATLAB formats
> Extensive printing and reporting functionalities. Window contents or entire display pages can be inserted into Word and PowerPoint via drag-and-drop

2.1 Efficient collaboration across company boundaries

With the help of Vector Team Services, you can easily share your vMeasure projects with others. Create a Vector Team Area. Invite other participants and share your vMeasure projects with them. The invitation is made via e-mail addresses, so that you can also exchange projects with people from other companies - such as development partners. You do not need to set up or operate your own IT infrastructure.

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3. Measurement data acquisition

vMeasure uses the XCP and CCP measurement protocols to record ECU-internal measurement variables synchronously with ECU processes. The measurement data from the ECUs is recorded synchronously in time with the other measurement data (from external measurement modules, serial bus systems, GPS, video or other measurement devices) and displayed in a wide variety of ways. With the multi-recorder concept, up to 16 recorders can be configured and simultaneously started and stopped independently of each other. Each recorder saves the measured values in a separate file – for example, one recorder records the entire measurement continuously while another records only when a trigger event occurs.

Features of measurement data acquisition and visualization in vMeasure:

- The ASAM measurement data format MDF 4.1 supports measurement files without size limitation and offers compression of measurement data. Metadata and attachments can be stored in the measurement file
- CAN bus messages are recorded either in BLF or MDF 4.x format
- Analysis of the CAN bus communication in the trace window
- Various window types and user-definable panels are available for graphical display
- Extensive trigger options for targeted data recording incl. pre- and post-trigger times
- Flexible measurement modes: DAQ events, polling, cyclic as well as event-, key- and signal-triggered acquisition
- Time-synchronous acquisition of scalar values, arrays and structures
- Offset correction (Tara) of sensor signals with a linear conversion rule before the start of the measurement
- Measurement comments and audio comments during the measurement; file names and measurement file comments are freely definable via macros
- Video cameras are integrated via USB, Ethernet (e.g. GigE Vision, RTSP, Axis) or AVB
- Precise PTP time synchronization of interfaces, CSM measurement modules and other measurement technology with the Vector Time Synchronization Service (VTSS)

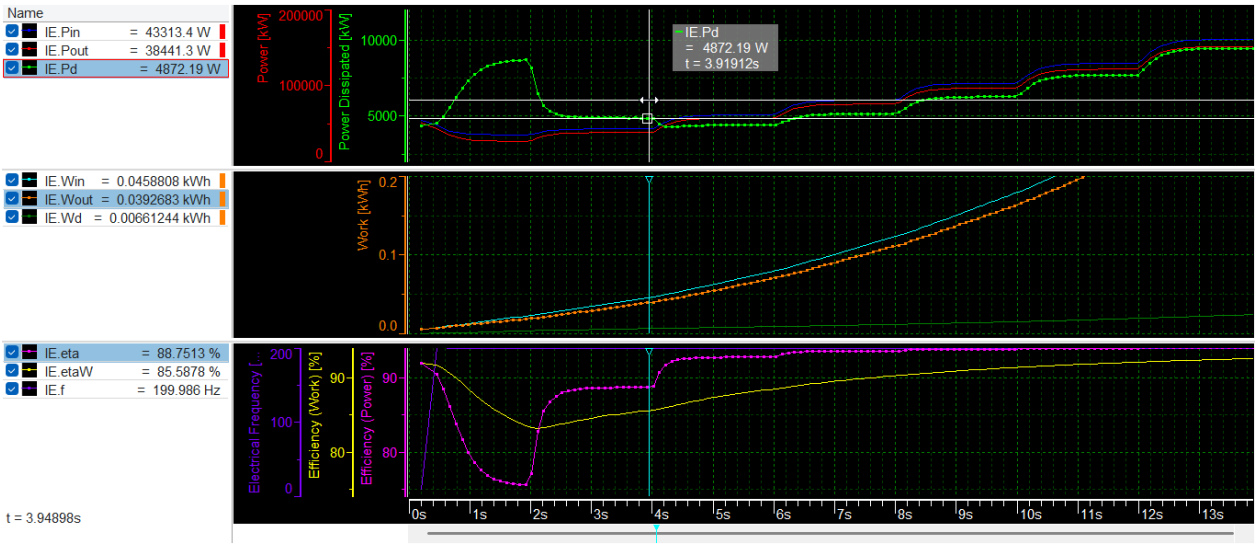


FIGURE 2: Visualize and comparison of signals in one or more windows

3.1 Measurement hardware with high transmission rates

The VX1000 system is a modular solution to access internal ECU data. A so-called POD (Plug On Device) is directly connected to a debugging or data trace interface (Aurora, DAP2, Nexus, JTAG ...) of the microcontroller. The data of the controller is forwarded to the VX1000 base module via the POD and converted into an XCP-on-Ethernet data stream.

By using the standardized XCP-on-Ethernet protocol, you can also connect other measurement tools in addition to vMeasure. Depending on the controller used, measurements practically do not affect the runtime of the controller.

Depending on the VX1000 base module used, network and streaming interfaces are also available.

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FIGURE 3: VX1000 Family Hardware - High Performance Measurement Data Processing Modules with XCP on Ethernet Interface

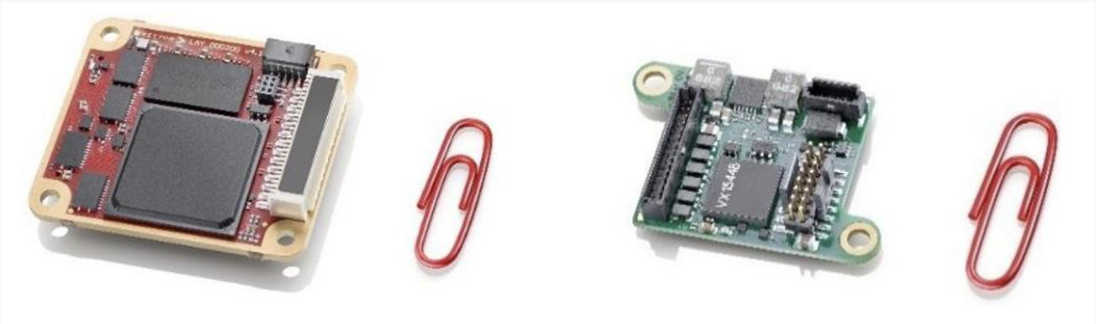


FIGURE 4: The VX1000 measurement hardware is connected to the control unit via a compact POD (Plug-On Device).

3.2 Analog measurement to complete the measurement task

The VIO System is a modular, measurement card-based analog / digital measurement hardware. The individual VIO System measurement cards can either be equipped in dedicated VIO System housing or as an extension to the VX1161, to measure analog signals synchronized to the ECU data (as depicted in Figure 3).

The configuration of VIO Systems is fully integrated in vMeasure. A connected VIO System can be added semi-automatically, and all its measurement signals are added to the measurement list without further configuration. With offline VIO Systems, you prepare your measurement project even before the hardware is physically available.

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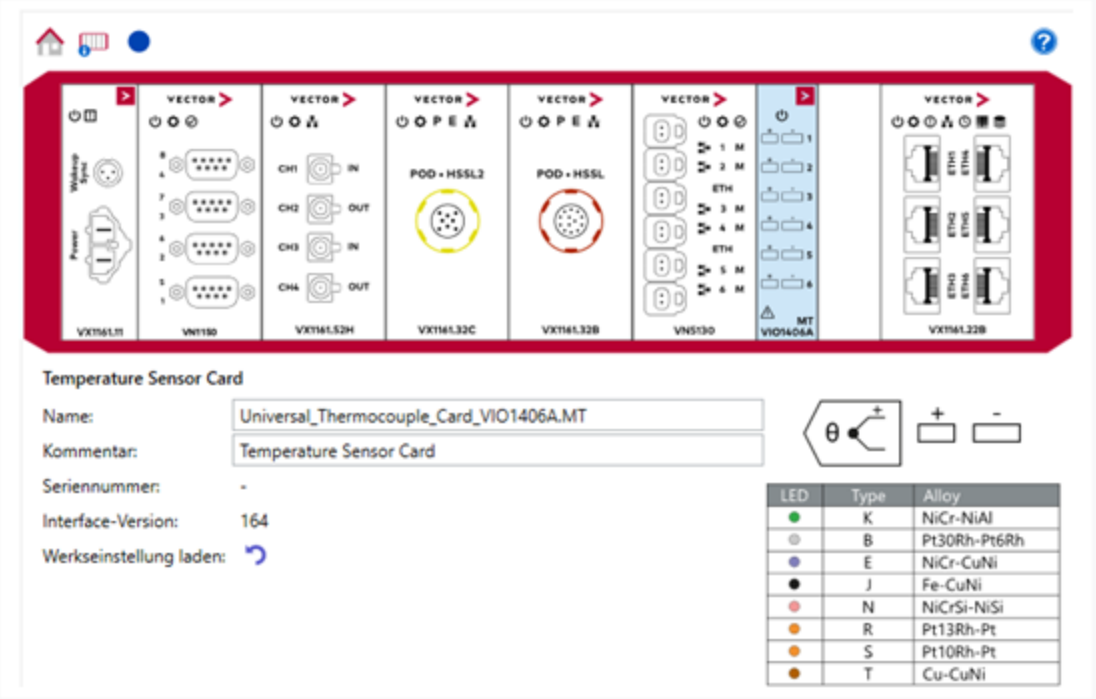


FIGURE 5: Hardware configuration dialog for VIO System in vMeasure. The depicted hardware is a VX1161 with network interface, streaming, POD and a VIO1406A.MT card.

3.3 Supported measuring systems for analog/digital measured variables

The following measurement systems can be integrated into vMeasure:

- Vector I/O solutions in the different network interfaces
- Vector VIO System
- All CSM measurement and high-voltage modules connected to the computer via CAN or XCP on Ethernet – configured with the integrated CSMconfig
- All measurement data acquisition devices that are connected to the computer via the CAN bus, e.g. devices from CSM, ECM, IMC or IPETRONIK
- IPETRONIK measurement modules via XCP on Ethernet
- ETAS measuring modules of the ES400 series (via XCP on Ethernet) and ES600 series
- Analog and digital NI-DAQmx series measurement cards from National Instruments
- Trion and Orion from DEWETRON, QuantumX and SoMat eDAQ from HBM as well as ADwin systems from Jäger Computerized Measurement Technology via the DAIO interface
- KiBox2 indicating system from Kistler
- GNSS/GPS receivers via USB or CAN
- Inertial systems from GeneSys and OXTS for vehicle dynamics and position measurements

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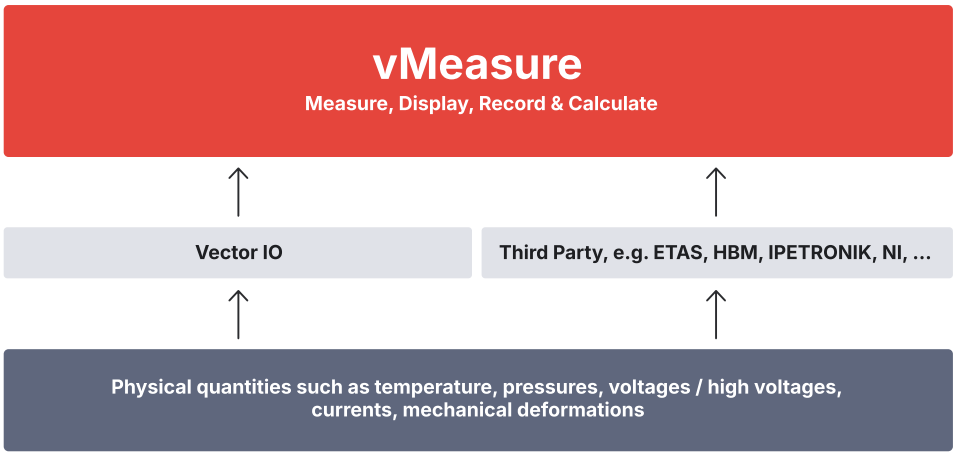


FIGURE 6: vMeasure supports many measurement solutions from a wide range of manufacturers. The DAIO interface is an open interface for connecting almost any input and output system.

An open interface is available for the integration of further measuring systems: The DAIO interface (digital/analog I/O) for high-performance measurement solutions. You can create the necessary drivers yourself with the free DAIO SDK. Vector supports you during development with sample programs, documentation, and services.

4. Measurement data visualization

vMeasure provides many different display windows: graphic, text, numeric, bar and digital windows, characteristic curve/map windows and chart windows as well as map, video, panel, browser, trace and write windows. In the configuration that you use to record measurement data, you can also display existing measurement data or carry out evaluations.

vMeasure distinguishes between the following display modes:

- Live View: active after the program start. Shows the current values of the connected measurement modules and the current video image – without starting a measurement
- Measurement: the currently measured values and signal curves are displayed
- Display from measurement buffer: after a measurement without recording, the data from the display buffer is shown
- Display from measurement file: the data of the last recorded or of any older measurement file recorded with currently loaded project is displayed

During a measurement, a recorder records data in the form of a measurement file. For long measurements or large amounts of data, the recorder writes several measurement files in succession. If you are working with more than one recorder for a measurement, each recorder can write several files in succession. vMeasure allows you to view the measurement as a whole during visualization and evaluation. You do not have to worry about the relationships between the recorders and the files.

5. Measurement data management and analysis

vMeasure offers a wide range of options for data evaluation. From manual evaluation, the use of existing functions for filtering and calculating, to the development of your own functions, to automated evaluations with functions and scripts. The measurement data can be stored on the local hard disk or – with the vMDM – in the cloud.

In order to select the correct measurement files for the evaluation, an indexing of the signal names and metadata (e.g. license plate number of the vehicle, specification of the test bench, weather conditions, ...) is performed. This metadata is freely configurable and is written directly to the measurement files by vMeasure when the measurements are recorded.

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FIGURE 7: Depiction of a time series of measurement files. The sum of all files provides complete insights in the measurement.

Different methods are available as evaluation options:

- Measurement files are written directly in the formats MF4 and BLF.
- Export to ASCII, Excel and MATLAB formats as well as batch conversion of MDF files – manually, automatically after the measurement, via scripts or via the command line (CallConverter)
- Supplied function libraries (eMobilityAnalyzer, signal analysis, filters, statistics) provide extensive possibilities for logical and arithmetic evaluation
- You can develop your own evaluation functions. Be it via the integrated function language CASL, own C/C++ code
- Signal display over time or in XY representation
- Manual examination of signal curves using zoom and search functions as well as measurement cursor, difference cursor and markers
- Statistical evaluation of signals in the graphic window
- Inserting comments for offline analysis
- Use customizable print templates and export display pages as graphics or PDF
- Export sequences from measurement files with synchronous video editing

No programming knowledge is required to run ready-made evaluations. When creating evaluations, you also do not need any programming knowledge in simple cases that are limited to the use of existing mathematical functions. Programming knowledge is required to create elaborate and complex evaluations.

6. E-mobility analysis in the high-voltage network

The function library eMobilityAnalyzer is the core of scalable measurement solutions in the high-voltage environment and covers the entire range of high-voltage use cases, such as e-motors, inverters and chargers. The voltage and current signals recorded by CSM measurement modules with a sampling rate of up to 1 MHz are converted online into the relevant parameters of the drive, the HV components or the on-board network. Among other things, you can very precisely calculate the efficiency and the effective, apparent and reactive powers.

The following functions are available:

- eMobilityAnalyzer: DCAnalysis, PWMPowerAnalysis, eMotorPowerAnalysis, eMotorYdelta, DCEfficiency, ChargerEfficiency, Inverter Efficiency, Harmonics, Ripple, ShaftPower, AxlePower
- Signal analysis: PWMAnalysis, Slope
- Filters: low-pass, high-pass, band-pass, band-stop, downsampling
- Statistics: LinearMean, TrueRMS

7. Integrated function and script language

The C-like function and scripting language CASL (Calculation And Scripting Language) can be used both to calculate virtual signals and to automate processes in vMeasure. The integrated editor offers a convenient

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development environment including script debugger. With the Task Manager, scripts are linked to events and executed automatically – e.g. to wake up external measurement technology via a CAN message before the measurement starts or to check whether sufficient disk space is available.

8. Automation interfaces

vMeasure can be controlled via command line options. In addition, actions in vMeasure can be triggered via links in HTML documents that are displayed in the browser window – ideal for integrating work instructions for test drives directly into the project. External programs and scripts can be integrated as add-ons.

9. Database editors

To be able to edit the different description files conveniently vMeasure provides an installation of the CANdb++ Editor for CAN description files in DBC format

10. Diagnosis

vMeasure provides full access to the OBD data of the vehicle. A virtual OBD device sends the available requests to all ECUs (network scan) and displays the responses in the OBD window. The OBD signals can be recorded time-synchronously with all other measurement data.

11. Visualize the vehicle position in a map

For in-vehicle measurements, vMeasure records the position data and visualizes the vehicle's current position on a map. The position data is acquired either via bus messages or via a separate GPS receiver. In offline evaluation, the vehicle position is displayed time-synchronously with the measurement data. Interpretation of the recorded measurement data is made much easier because the geographic conditions can be taken into account in the evaluation.

Additional object information, e.g. road users detected by a radar sensor, can also be shown in the map.



FIGURE 8: The total distance with the current position of the vehicle is displayed.

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11.1 Fields of application

The option of synchronizing measurement data from a test drive with a geographical position and displaying this on a map makes it much easier to assign certain events. The behavior of your control unit can be reliably tracked with this additional information, for example when shifting up on a hill.

11.2 Supported map material

The following map material is supported:

> OpenStreetMap (also allows offline use of the previously downloaded map material, e.g. for test drives without an Internet connection).
> Purchased or installed map data
> Embedding your own content in the form of additional layer files

11.3 Functions

> Create freely configurable and scalable Map display windows
> Displaying the vehicle position in the Map window
> Configurable display of the distance driven so far
> Simultaneous visualization of geographical and vehicle-specific data in the various display windows
> Synchronization of the measurement cursor with the vehicle position on the map
> Simultaneous display of several positions, routes and objects
> Level of detail of the map display changes depending on the zoom setting

12. Hardware interfaces and protocols

vMeasure supports all standard interfaces and protocols relevant in the automotive sector (others on request) via the Vector hardware families:

> Bus monitoring of CAN, CAN FD, Automotive Ethernet, FlexRay, LIN, K-Line and SAE J1939
> Capture Module Protocol CMP
> Observation of gPTP/PTP time domains
> XCP on CAN, CAN FD, FlexRay, Ethernet, Automotive Ethernet, LIN, SxI and USB
> CAN Calibration Protocol CCP
> Fast controller interfaces such as JTAG, DAP, LFAST, RTP/DMM, Nexus AUX and AURORA via Vector's VX1000 measurement hardware
> Analog measurement technology with sampling rates of up to 1 MHz via Ethernet
> OBD-II
> Video: USB cameras, Axis, GigE Vision, RTSP, AVB, ...
> Audio and GNSS/GPS receivers
> Integration of measurement technology and hardware interfaces from third-party manufacturers

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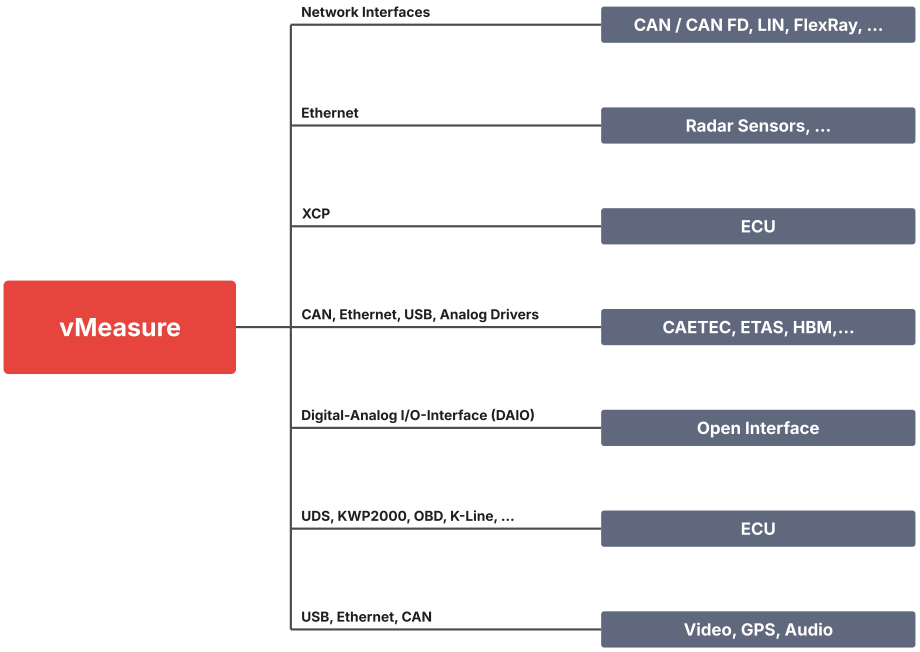


FIGURE 9: High flexibility due to versatile hardware interfaces

12.1 ECU integration via third-party manufacturer

The FETK and XETK solutions from ETAS also support measurement via XCP on Ethernet. This makes them compatible with vMeasure.

13. Engineering services

So that you can concentrate fully on your measurement tasks, Vector supports you both with know-how and with customized complete solutions for your tasks. Our services range from consulting services, e.g. for the setup of your measurement technology, to the development of data evaluations and DAIO drivers, to a field application engineer at your site.

14. Trainings

As part of our training offering, we provide training and workshops for our products and various technologies.

For information on training, visit: https://academy.vector.com.

You can also use our free e-learning platform at https://elearning.vector.com.

You can find a lot more information about products and solutions on YouTube:
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