ControlDesk

- Universal, modular experiment and instrumentation software for ECU development
- Synchronized access to ECUs, RCP and HIL platforms, dSPACE VEOS and bus systems
- Powerful layouting, instrumentation, measurement, and postprocessing (ASAM MDF)
ControlDesk
Universal experiment software for electronic control unit (ECU) development

Highlights
- Universal, modular experiment and instrumentation software for ECU development
- Integrated ECU calibration, measurement and diagnostics access (CCP, XCP, ODX)
- Synchronized data capture across ECUs, RCP and HIL platforms, and bus systems
- Powerful layouting, instrumentation, measurement and post-processing (ASAM MDF)
- Support for the entire dSPACE virtual validation tool chain

Application Areas
ControlDesk is the dSPACE experiment software for seamless ECU development. It performs all the necessary tasks and gives you a single working environment, from the start of experimentation right to the end. These are some of the tasks it can be used for:
- Rapid control prototyping (RCP; fullpass, bypass)
- Hardware-in-the-loop simulation (HIL)
- ECU measurement, calibration, and diagnostics
- Access to vehicle bus systems (CAN, CAN FD, LIN, Ethernet)
- Virtual validation with VEOS and SCALEXIO

Key Benefits
ControlDesk unites functionalities that often require several specialized tools. It provides access to simulation platforms as well as to connected bus systems and can perform measurement, calibration and diagnostics on ECUs, e.g., via standardized ASAM interfaces. Its flexible modular structure (p. 4) provides high scalability to meet the requirements of specific application cases. This gives you clear advantages in terms of handling, the amount of training needed, the required computing power, and costs.

1) Please see p. 22 or www.dspace.com/go/viva_en for more information on virtual validation in the dSPACE tool chain.
# Functionality Overview

<table>
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<tr>
<th>Versions</th>
<th>Description</th>
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| ControlDesk            | - Same tool for rapid control prototyping, HIL simulation, offline simulation, ECU calibration, and diagnostics  
                          - Easy creation of layouts and instruments  
                          - Synchronous measurement on all data sources  
                          - Integrated project and experiment management  
                          - Integrated measurement data management (with ASAM MDF 4.1 support for import and export)  
                          - Compatibility with several ASAM standards (such as MDF, XCP, CCP, ASAP2, ODX)  
                          - Powerful tool automation capabilities for user-specific extensions and optimal process integration  
                          - Access bus network data with instruments (CAN, CAN FD and LIN)  
                          - Operator mode (protects your projects and experiments against unauthorized changes)  
                          - Monitoring, logging, and dedicated instruments for CAN and CAN FD  
                          - Support of virtual validation test scenarios (p. 22) with dSPACE VEOS and SCALEXIO  
                          - Built-in access to all dSPACE real-time hardware platforms  
                          - Built-in access to third-party test benches and other hardware by using an ASAM XIL API MAPort server  
                          - Built-in automation functionality using the ASAM MCD-3 standard  |
| ControlDesk – Operator Version¹ | - For using projects and experiment data that were already created with the standard ControlDesk version  
                          - Protection against altering and creating projects and experiments  
                          - Built-in access to all dSPACE real-time hardware platforms  
                          - Built-in access to third-party test benches and other hardware by using an ASAM XIL API MAPort server  |

<table>
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<tr>
<th>Additional Modules</th>
<th>Description</th>
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</table>
| ECU Interface Module   | - AUD, NBD, JTAG/Nexus, JTAG/OCDS, and JTAG/SDI  
                          - CCP (CAN Calibration Protocol)  
                          - XCP on CAN, XCP on CAN FD, XCP on Ethernet² (TCP/IP and UDP/IP)  
                          - Support of structured data types as specified in ASAM A2L 1.7  |
| ECU Diagnostics Module | - Compliance with the ODX database standard (ASAM MCD-2D v2.0.1 and v2.2.0 (ISO 22901-1))  
                          - Support of ISO protocols for CAN, CANFD, K-Line, and Ethernet  
                          - Dedicated instruments for executing diagnostic services and reading or clearing the ECU fault memory  
                          - ECU flash programming via diagnostic interfaces  
                          - Support of ASAM MCD-3D v2.0.2  |
| Signal Editor Module¹ | - For graphical stimulus definition  
                          - Time-synchronous stimulus generation on dSPACE real-time hardware and in Simulink models simulated in dSPACE VEOS  
                          - Replying measured data  
                          - Multiple stimulus patterns can be executed independently  
                          - Support of the XIL API stimulus format (STZ files, i.e., zipped STI files)  
                          - NEW: Support for MicroAutoBox III  |
| Bus Navigator Module⁴  | - Support of CAN, CAN FD, LIN, and Ethernet buses  
                          - Dedicated instruments for CAN, CAN FD and LIN bus objects  
                          - Replaying recorded CAN and CAN FD messages  
                          - CAN, CAN FD, and LIN monitoring and logging for dSPACE hardware, dSPACE VEOS, and PC bus interfaces  
                          - Ethernet bus monitoring (dSPACE SCALEXIO, Vector interfaces, Ethernet interfaces of PCs including loopback)  
                          - CAN bus statistics  
                          - NEW: LIN bus statistics  |

¹ MCD-3 automation functionality not supported.
² Also for access to simulated virtual ECUs.
³ Signal generation not supported for the DS1104.
⁴ Monitoring, logging, and dedicated instruments for CAN and CAN FD are already supported with ControlDesk standard version.
Module Overview

ControlDesk

Versions
(Platform support included)

- ControlDesk1)
- ControlDesk – Operator Version2)

Add-on modules

- ECU Interface Module
- ECU Diagnostics Module
- Signal Editor Module
- Bus Navigator Module

Order Information

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<th>Product</th>
<th>Order Number</th>
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<td>CONTROLDESK</td>
</tr>
<tr>
<td>ControlDesk – Operator Version2)</td>
<td>CONTROLDESK_OPERATOR</td>
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<tr>
<td>ECU Interface Module</td>
<td>CONTROLDESK_ECU</td>
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<tr>
<td>ECU Diagnostics Module</td>
<td>CONTROLDESK_DIAG</td>
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<tr>
<td>Signal Editor Module</td>
<td>CONTROLDESK_SE</td>
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<tr>
<td>Bus Navigator Module</td>
<td>CONTROLDESK_BNV</td>
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Relevant Software and Hardware3)

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<th>Software</th>
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<tr>
<td>Required</td>
<td>Operating system: <a href="http://www.dspace.com/go/os_compatibility">www.dspace.com/go/os_compatibility</a></td>
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</tbody>
</table>
| Optional |  dSPACE VEOS for PC-based simulation  
            Failure Simulation Package for working with the XIL API EESPort GUI in ControlDesk |
|          |  FAILURE_SIM |

Hardware

| Required |  Intel® Core™ 2 Duo processor at 2 GHz or equivalent (Intel Core i7 processor or equivalent recommended)  
          |  8 GB RAM (16 GB RAM or more recommended) |

1) Comprehensive standard version.
2) Protection against altering and creating projects and experiments, MCD-3 automation functionality not supported.
3) ControlDesk is also approved for MicroAutoBox Embedded PC with a third-generation Intel® Core™ i7 processor, running on Microsoft® Windows® 7, 64-bit, and for MicroAutoBox Embedded PC with a sixth-generation Intel® Core™ i7 processor, running on Microsoft® Windows® 10, 64-bit.
**NEW: ControlDesk 7.1**

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<th>Area</th>
<th>Improvement</th>
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<tr>
<td>General enhancements</td>
<td>Support of MicroAutoBox III</td>
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<tr>
<td>Project/experiment management</td>
<td>Saving a project in another project root directory</td>
</tr>
<tr>
<td>enhancements</td>
<td></td>
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<tr>
<td>Platform/device enhancements</td>
<td>New platform to support MicroAutoBox III</td>
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<tr>
<td></td>
<td>SCALEXIO: Support of DS6121 Multi-I/O Board and DS6321 UART Board</td>
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<tr>
<td></td>
<td>SCALEXIO: Refreshing the display of client processes</td>
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<td></td>
<td>Ethernet Bus Monitoring device: Support for signals of TCP Ethernet PDUs</td>
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<tr>
<td>Instrument enhancements</td>
<td>New 3-D Viewer</td>
</tr>
<tr>
<td>Measurement and recording</td>
<td>Importing GPX files</td>
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<tr>
<td>enhancements</td>
<td></td>
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<tr>
<td>Bus Navigator enhancements</td>
<td>Support of new and enhanced bus configuration features in Bus Manager apps</td>
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<tr>
<td></td>
<td>Ethernet Bus Monitoring device: Display of Ethernet PDUs and signals</td>
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<tr>
<td></td>
<td>LIN bus statistics</td>
</tr>
<tr>
<td>Additional enhancements</td>
<td>New tutorial videos for the Internal Interpreter</td>
</tr>
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**ControlDesk Product Support Center**

The ControlDesk Product Support Center is the primary online resource for ControlDesk users and provides information about releases, compatibility information, FAQs, additional utilities, etc. The entry gate is [www.dspace.com/controldesk_psc](http://www.dspace.com/controldesk_psc)
ControlDesk Core Functionalities

Convenient Experiment Creation and Management
The standard package “ControlDesk” already offers many fundamental features for experiment creation and management, instrumentation, etc. The range of functionalities can be extended with additional ControlDesk modules. With ControlDesk, you can prepare project/experiment data (such as layouts, data sets, and measurements) for later use in the operator mode or in ControlDesk – Operator Version (p. 23).

Intuitive User Interface
- State-of-the-art GUI technology (ribbons)
- Start page for easy access to most recently opened projects and user documentation
- Search option in Properties controlbar with highlighted results
- Customizing ribbons (ribbon tabs, ribbon groups, ribbon commands)

Description
- Same tool for rapid control prototyping, HIL simulation, offline simulation, ECU calibration, and diagnostics
- Easy creation of layouts and instruments
- Synchronous measurement on all data sources
- Integrated project and experiment management
- Integrated measurement data management (with ASAM MDF 4.1 support for import and export)
- Compatibility with several ASAM standards (such as MDF, XCP, CCP, ASAP2, ODX)
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- Built-in automation functionality using the ASAM MCD-3 standard

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Project Management

Organizing Projects and Experiments

ControlDesk organizes your work in projects and experiments. A project is the outer organizational frame for your work on a topic. Within the project you can have many experiments, for example, each representing a unique hardware setup. You can also assign different variable descriptions to a single platform/device in the experiment and easily switch between them later on. The project level also holds global documents such as specifications or reports. The experiment level is for organizing your instrument panels (layouts), variable descriptions, data sets, signal generators, failure simulation systems, and more. All your data is well structured at all times and easy access is provided by the ControlDesk Project Manager.

Selecting a project and experiment in ControlDesk.

Example project in ControlDesk’s Project Manager.

Layouts can be grouped in folders.
Instrumentation

Visualizing Variables on Layouts
ControlDesk offers two ways to visualize variables on layouts. One possibility is to select variables via the Variable Browser, place them on the layout (via drag & drop or keyboard), and assign instruments to them (suitable instruments like the table editor are shown). Another way is to select an instrument from the Instrument Selector, place it on the layout, configure it, and then assign variables to the instrument. The Variable Browser uniformly shows the variables of the platforms/devices contained in the experiment, and the list can be filtered.

- Adding variables to instruments via context menu
- Copying the current value of a variable that is visualized in an instrument

Instrument Selector
The Instrument Selector offers the entire set of instruments that can be placed on the layout (drag & drop). From there, the instrument can be configured, and variables can be assigned to it. You can define favorite instruments to be offered every time you work with the variable-based layouting. Pre-configured instruments (e.g., background color definable) can be saved as custom instruments.

- Add/remove instrument categories to/from the Instrument Selector.
- Apply changes to a custom instrument by dragging it to the original custom instrument in the Instrument Selector.
- Add custom instruments to any instrument category in the Instrument Selector.
- Exchange custom instruments by exporting the related instrument category.

Creation of combined filters
Variable Array

With the Variable Array instrument it is easy to quickly visualize multiple variables. Each variable is displayed in a row of the instrument. The variables are marked via multi-selection and dragged to the layout. The Variable Array provides different column and cell types. This combination of both lets you individually specify what is displayed in the instrument cells and how you can change a parameter value.

Multiswitch Instrument

- Instrument for changing variable values by clicking sensitive areas in the instrument and for visualizing different states, depending on the current value of the connected variable
- You can easily implement different switch types, e.g., rotary switches (with different positions, optionally spring-loaded), manual and automatic gearshifts, ignition locks

Variable Array

Five-dimensional (5-D) table data in the Table Editor.

Tab with individual background color

Selectable chart types (scatter plot, bar, surface)

Multiswitch instrument

Editing 3-D Maps

ControlDesk features the powerful Table Editor for conveniently editing 3-D maps with functionalities such as:
- Interpolation when axis values are changed
- Interpolation of all maps related to the same shared axis
- XZ and YZ projections of 3-D maps
- Easy exchange of data with Microsoft® Excel®
- 3 selectable chart types for 3-D maps (scatter plot, bar, surface)
- Display of multidimensional table data (n-D tables)
- Support of multiple working points

Selectable chart types (scatter plot, bar, surface)
Plotter Instruments
The plotter instruments in ControlDesk are the central components for measurement data visualization. With plotters, the measured data can be compared to online data. Similar to an oscilloscope, plotter data can be displayed continuously or triggered. ControlDesk offers three different plotter instruments with the following main purposes:

- The Time Plotter for visualizing signals in relation to the measurement time.
- The XY Plotter for visualizing signals in relation to other signals.
- The Index Plotter for visualizing signals in relation to events.

Plotter instruments provide an enormous variety of features dedicated to efficient data analysis:

- Easily zoom or move by mouse wheel or touch gesture (animation continues while zooming)
- Add bookmarks for interesting events during measurement
- Use data and time cursors to analyze measurement data
- Automatically calculate maximum, minimum, mean value, and standard deviation over the displayed time interval
- Synchronize time intervals of multiple plotters
- Use various triggers to focus on special events in your data
- Set individual background colors/pictures for customization
- Move and copy signals from one y-axis to another, or to another instrument (drag & drop)
- Display multiple y-axes in a stacked view
- Save selected signals and time interval to a new measurement file, with or without data reduction
- Use hardware acceleration (live data) and ASAM MDF 4.1 reduction data (postprocessing of large files) for high plot performance

NEW: 3-D Viewer
The 3-D Viewer lets you display items in a 3-D environment. These items can be stationary or be connected to variables. This opens up new possibilities to cover further use cases.

Time Plotter
The Time Plotter displays one or more measured signals in relation to the measurement time. You can connect a signal that is measured in an event-based measurement raster to the Time Plotter. The Time Plotter’s scroll bar lets you preview the measured data.
**XY Plotter**

The XY Plotter displays one or more signals in relation to other signals. You can connect more than one signal to the x-axis and define several curves in one plot. In addition, the XY Plotter checks whether the signals that are connected to a curve have the same measurement raster. This lets the XY Plotter display triggered signals in the XY plot. Arrays with 1-dimensional measurement are also supported.

![XY Plotter Image]

**Index Plotter**

The Index Plotter displays one or more signals in relation to corresponding event numbers (index plots). It uses the x-axis as an event axis that displays indices for each captured sample. The Index Plotter is typically used for signals with event-based rasters. The Time Plotter’s scroll bar lets you preview the measured data.

![Index Plotter Image]

- **NEW**: Undo & Redo for zooming is supported by the time and index plotter instruments.
Avionics Instruments
The Primary Flight Display (PFD) for aerospace applications offers an altimeter, an artificial horizon, a heading indicator, and an airspeed indicator.

Browser Instrument
The Browser instrument allows you to integrate objects such as web pages and other documents (like PDF files) directly on ControlDesk layouts.
- Variable connections
- File archive function
- Customizable properties

Steering Controller
The Steering Controller provides a graphical representation of a connected game controller device and lets you calibrate scalar parameters by moving the device or pressing its buttons or switches. The instrument provides force feedback support.
Map Instrument

ControlDesk provides the Map instrument, which can be used to display GPS motion data. This allows you, for example, to track the motion of a car in relation to the time stamps of recorded signals.

GPS motion data displayed in the Map Instrument.

Sound Controller

The Sound Controller can be used to play simple sounds or complex sounds in relation to specific variable values. So you can create realistic sounds for your simulation model (engine sounds, horns, wipers, etc.).

Sound controller

Extending Instrument Functionalities via Python

You can add a Python script to each instrument and assign Python code to the events of the selected instrument. This lets you extend the instrument’s functionality via automation more flexibly. As one example, the stopwatch instrument was created by using the new Python script feature for instrument extension as described above.

Instrument Navigator

The Instrument Navigator displays a tree with all the instruments of the active layout and all the variables that are connected to them, which simplifies the selection of instruments in complex layouts. For even more convenience, the Instrument Navigator now also provides an option to highlight search matches in the layout.

Highlighted search matches in the Instrument Navigator
Measurement

**Easy Configuration of Measurements**

To handle measurements and recordings, ControlDesk provides the Measurement Configuration tool. Using ASAM MDF 4.1 as the primary data format, the Measurement Configuration tool gives you access to all the variables selected for measurement and recording, lets you configure measurements and recordings, and helps you define and manage triggers for measurement. All the variables of all the platforms and devices in the active experiment that are selected for recording can be listed. Multiraster measurements can be performed. Moreover, you can simultaneously record to different destination files using multiple recorders with independent start/stop triggering.

**Improved Handling of Large ASAM MDF 4.1 Files**

ControlDesk offers various improvements for handling large ASAM MDF 4.1 (MF4) files:

- Partial loading of signals to reduce the loading time and the required memory
- Support of ASAM MDF 4.1 reduction data to improve the visualization and postprocessing performance
- DSSIGCONV command line tool provides an option to add reduction data, even to existing ASAM MDF 4.x files
- Support of incremental saving of MF4 files: Modifications to an MF4 file are saved much faster as long as you do not remove signals from the MF4 file. Incremental saving is supported when you modify contents such as description, x-axis offset, MDF properties (department, project, measurement object), and bookmarks.
Continuous Measurement as Default Setting
Performing continuous (untriggered) measurements is the default for dSPACE platforms that are added to an experiment. This is done to give unexperienced users a more common and intuitive measurement setting for standard applications. For special applications (such as high-frequency measurements) both the plotter and the default setting can be easily switched to triggered measurements.

Triggred Measurements
You can define real-time triggers to influence the data stream between the PC and the dSPACE hardware. The plotter can be synchronized with these settings for an oscilloscope-like presentation.

- Measuring and recording complex parameters (maps and curves) in XCP event rasters
- Option to disable the Variable Observer to increase recording data throughput

NEW: Import GPX-Files
Be more flexible by using ControlDesk for postprocessing of your own recorded GPS positioning data or from 3rd party tools.
**Measurement Data Pool**

The Measurement Data Pool gives you an overview of all the measurement files loaded in ControlDesk and displays the variables and bookmarks associated with each file. Powerful filter options make it easy to find and show the relevant information. Complete measurement files can be assigned to an existing layout. Data can be imported and exported in standard formats (such as ASAM MDF).

**Bookmarks**

You can set bookmarks during a measurement or recording to mark certain measurement points you want to analyze later. Bookmarks can be set either manually or automatically, for example, by definable triggers. The bookmark navigator gives you a list of all the bookmarks in the current measurement and in the measurement files loaded in ControlDesk.

The bookmark navigator is linked with the visualization in the Plotter instrument. When a bookmark is selected in the navigator, the correct time context is displayed in the plotter and the associated bookmark is highlighted. You can edit and search for bookmarks in the navigator.

**Calculated Variables**

You can create new variables, called calculated variables, whose values are calculated from other variables in the associated description file. A formula editor helps you define the calculation method. It is even possible to access previous values in order to implement filters, derivations, integrations or statistical functions such as mean values. Calculated variables can be connected to instruments in ControlDesk and recorded in measurement files just like normal measurement variables. You can also create calculated variables based on variables in measurement files during postprocessing. Import and export options for calculated variables and formulas makes it easy to reuse them in different experiments and projects.
Tool Automation

ControlDesk API
An object model in ControlDesk lets you access many of its functions by automation scripts. The Application Programming Interface is accessible from .NET programming languages (e.g., Visual Basic and C#) and COM/DCOM-based programming languages (e.g., Python and C++). With scripts you can perform your complex workflows in no time, such as creating a project and experiment with your custom settings.

The API also lets you implement individual functionality, such as exporting data sets in a custom file format, to ensure that ControlDesk integrates perfectly into your existing development process. (For automation based on the ASAM MCD-3 standard, please see p. 20, MCD-3 automation functionality).

Key Benefits
- Automated processing of recurrent, time-consuming tasks, such as parameter studies
- Automated experiment creation and configuration
- Powerful event mechanism to react to tool and user events, for example
- ControlDesk tool automation library available with AutomationDesk
- Native 64-bit support of both AutomationDesk and ControlDesk enables more complex application scenarios

Use Case Examples for Tool Automation
- Layout and instrument handling
- Data set handling
- Experiment handling
- Platform handling
- Project handling
- Failure simulation
- Controlling monitoring, logging, and replay of Bus Navigator
- Read and write variables directly without instruments
- Importing and exporting internal events

Advanced ControlDesk Automation
- Event handling: React by automation scripts or external tools (such as AutomationDesk to tool events from ControlDesk (such as “start measurement”))
- Procedural and object-oriented programming features
- Manual modification of generated scripts for advanced operations with built-in Source Code Editor

Python Editor
ControlDesk has an integrated Python 3.6 editor with syntax highlighting and automatic code completion (IntelliSense). In conjunction with the Python interpreter, which also ships with ControlDesk, you have all you need to write automation scripts efficiently. The interactive command line interpreter in ControlDesk lets you test your lines of code on the go while scripting.

Available with AutomationDesk: Tool Automation Library for ControlDesk
Data Sets

Data Structures with Parameter Values
Different operations can be performed on data sets loaded in ControlDesk. You can copy and rename data sets and export them as a CDF file (Calibration Data Format, primary data format as standardized by ASAM CDF 2.0, CDFX), DCM file, or Microsoft® Excel®-compatible file. Data sets can also be write-protected.

Calibrating Variables
ControlDesk offers many input instruments for adjusting parameter values. Of course, it is possible to calibrate scalar as well as multidimensional parameters. Parameter changes can be made as physical values or as represented on the target platform, as HEX, decimal, or binary values.
Failure Insertion and Simulation

XIL API EESPort GUI

The XIL API EESPort (Electrical Error Simulation port) GUI replaces ControlDesk’s Failure Simulation Module. It not only provides for a convenient control of electrical failure insertion hardware (via the XIL API EESPort server), it also allows for an interactive graphical configuration of error sets and error configurations (equivalent to failure patterns) directly from ControlDesk as the XIL API EESPort client. By complying with the ASAM XIL API standard, this solution offers uniform support for all dSPACE SCALEXIO and PHS Failure Insertion Units (FIU).

Graphical user interface for interactive handling of electrical error simulation compliant to ASAM AE XIL API standard (EESPort)
Creation of error configurations, error sets and errors
Performing electrical error simulation (like downloading and activating error configurations, and triggering of error sets)
Covers dSPACE SCALEXIO, dSPACE Simulators Mid-Size and Full-Size
Convenient and uniform use of XIL API Error Configurations and Error Sets across different types of failure insertion units
Requires the Failure Simulation Package (see relevant product information).
Support for FIU tracing of activated XIL API EESPort error sets
Support of real-time failure insertion with software triggers
Error configuration commands also available in full-screen mode
EESPort creation based on non-dSPACE EESPort implementations
Support of Ethernet-to-RS232 converters to control dSPACE failure simulation hardware
Tutorial videos

Definition of various error sets with the XIL API EESPort GUI.
MCD-3 Automation Functionality\textsuperscript{1,2)}

**Remote Control of ControlDesk**
The MCD-3 automation functionality enables users to automate ControlDesk via the ASAM MCD-3 standard.
- Automation interface for measurement, calibration, and diagnostics according to the ASAM MCD-3 standard
- Continuous data acquisition in real-time raster
- Remote control of ControlDesk via COM/DCOM API
- Validation of diagnostic functions
- ECU test automation
- Optimization of control strategies on rapid control prototyping systems

**Application Areas**
The MCD-3 automation functionality makes it possible to automate measurement, calibration, and diagnostic tasks with ControlDesk. It is typically used for:
- Automated optimization of calibration parameters at test benches
- Data capturing, data analysis, and tuning of calibration parameters in MATLAB® or other COM/DCOM-capable applications

**Key Benefits**
The MCD-3 automation functionality features a COM/DCOM interface based on the ASAM MCD-3 standard for automating measurement, calibration and diagnostic tasks. The interface lets you perform tasks such as uploading variables associated with a device in ControlDesk and capturing data in your automation system synchronously to given real-time rasters. The MCD-3 automation functionality provides the same automation interface for access to rapid control prototyping systems, ECUs and vehicle buses. The diagnostic part of the automation interface lets you access the ECU via its diagnostic interface. During test automation, this allows verification of the ECU diagnostics interface itself, besides providing assistance to comprehensive ECU function testing.

**Usage Without Graphical User Interface**
You can use ControlDesk without a graphical user interface so that automation scenarios can be remote-controlled completely by your automation system. This way, engineers responsible for automation do not have to get used to using the ControlDesk user interface.

\textsuperscript{1)} The MCD-3 automation functionality contains the activation for the automation interface, but not for the device/diagnostic access to the hardware. Other modules are needed for this.

\textsuperscript{2)} Please note: The MCD-3 automation functionality is not included in or supported by ControlDesk – Operator Version.
Automation of measurement, ECU calibration and diagnostics with the ASAM MCD-3 MC and ASAM MCD-3 D standard automation interfaces.

Application example: AutomationDesk and ControlDesk with the MCD-3 automation functionality, the ECU Interface Module, and the ECU Diagnostics Module for ECU access via calibration and diagnostic interfaces during test automation.

1) It is also possible to access dSPACE hardware.
Virtual Validation

ControlDesk’s Role in the Tool Chain
Using virtual validation allows developers to frontload a significant number of design, verification and validation tasks to earlier stages in the development process, saving time and money as well as increasing product maturity and safety. In doing so, virtual validation moreover reduces the number of additional test systems and ECU prototypes required.

The seamless dSPACE development and testing tool chain offers virtual validation capabilities in line with two simulation platforms: dSPACE VEOS for PC-based simulation or dSPACE SCALEXIO for hardware-in-the-loop (HIL) simulation. Models, data, layouts and experiments from ControlDesk can be conveniently exchanged and reused between the different simulation platforms.

VEOS is the dSPACE platform for virtual validation in the development of electronic control units (ECUs). The software tool makes it possible to validate ECU software early by PC-based simulation and to realistically simulate ECU network communication. ControlDesk and VEOS together allow you to run and access a wide range of different models: function models, virtual ECUs (V-ECUs), and vehicle/environment models.

Adding Multiple Platforms/Devices
For virtual validation scenarios, ControlDesk offers a simplified way to add and configure multiple platforms and devices that refer to an application containing virtual ECUs and, optionally, an environment model executed on VEOS or SCALEXIO. When working without an environment model, applications (*.rta or *.osa) can be added instead of a variable description.

Support of VEOS Remote
ControlDesk supports remote access from multiple clients to multiple VEOS simulations. ControlDesk and the simulation can be executed on separate PCs, which makes distributed development easier.

Support of simulations executed as fast as possible
ControlDesk supports loss-free data recording for dSPACE VEOS offline simulations that are executed as fast as possible. This lets users benefit from VEOS simulation speed without losing capture data in ControlDesk.

PC-based simulation with VEOS and ControlDesk.
ControlDesk – Operator Version

Protection Against Unauthorized Changes
ControlDesk – Operator Version is a cost-effective version of ControlDesk that provides a subset of functionality for running existing experiments. It features the vast majority of functions from the standard ControlDesk package (except the MCD-3 automation functionality), but you can use only project/experiment data (such as layouts, data sets and measurements) that was previously created and saved with the standard ControlDesk package (p. 6). The Operator Version provides the same functionalities as the operator mode of the standard package.

Description
- Use projects and experiment data that were previously created with the standard version “ControlDesk”
- Protect against altering and creating projects and experiments
- Perform measurements on platforms/devices (corresponding device module licenses needed)
- Use existing layouts (without modification)
- Reload variable descriptions
- Record data files (automatically added to the experiment)
- Export measurement data files
- Change the working data set
- Duplicate and export data sets
- Use tool automation (for all functionality available with the Operator Version)
- Work with Bus Navigator instruments included on existing layouts
- Monitor, log and replay bus data with the Bus Navigator (Bus Navigator Module required)
- Perform signal generation with existing signal descriptions (Signal Editor Module required)
- Work with fault patterns of existing fault simulation systems (Failure Simulation Package required)
- Built-in access to all dSPACE real-time hardware platforms
- Built-in access to third-party test benches and other hardware by using an ASAM XIL API MAPort server
- Please note: The MCD-3 automation functionality is not supported by the Operator Version.

Order Information

<table>
<thead>
<tr>
<th>Product</th>
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<tbody>
<tr>
<td>ControlDesk – Operator Version</td>
<td>CONTROLDESK_OPERATOR</td>
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</table>
Access to dSPACE Hardware with ControlDesk

Wide Range of Supported Real-Time Systems
All versions of ControlDesk provide convenient access to the dSPACE real-time hardware, thereby supporting basic single-core processor applications as well as more complex multicore processor setups if more computing power is required for comprehensive simulations. For very high computing power demands, ControlDesk also supports multiprocessor networks, for example, the coupling of two or more SCALEXIO hardware-in-the-loop (HIL) simulators. With this access, it is possible to conveniently perform measurements and adjust parameter values on the dSPACE hardware directly from ControlDesk.

Supported dSPACE Real-Time Platforms

<table>
<thead>
<tr>
<th>Supported dSPACE Real-Time Platforms</th>
<th>General Support</th>
<th>Multicore Support</th>
<th>Multiprocessor Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS1104</td>
<td>✓</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DS1006</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>DS1007</td>
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<td>✓</td>
<td>✓</td>
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<tr>
<td>MicroLabBox</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>MicroAutoBox</td>
<td>✓</td>
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<tr>
<td>MicroAutoBox III</td>
<td>✓</td>
<td>✓</td>
<td>–</td>
</tr>
<tr>
<td>dSPACE Simulator</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SCALEXIO Processing Unit</td>
<td>✓</td>
<td>✓</td>
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</tr>
<tr>
<td>DS6001</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Multiprocessor examples:
- DS1104
- MicroAutoBox III
- MicroLabBox
- DS1007 (dual-core)
- DS1006 (quad-core)
- DS1006 (single-core)
- DS1007
- dSPACE Simulator
- SCALEXIO Processing Unit
- DS6001
- Giganlink
- 3 x DS1006 (single-core) or 3 x DS1007
Access to Third-Party Hardware with ControlDesk

XIL API MAPort Platform
With the included XIL API MAPort Platform, ControlDesk provides access to third-party test benches and other hardware by using an ASAM XIL API MAPort server for reading, writing and capturing variables.

Third-party test bench data supported by the ASAM XIL API standard can be visualized on ControlDesk layouts and can be integrated in synchronous measurements and recordings together with other platform or device data. An example showing how to access third-party hardware by using the XIL API MAPort platform is included in ControlDesk.

Cross-Testing with Third-Party Products
The interoperability of ASAM XIL API-compliant products, such as ControlDesk, is checked on a regular basis. For this purpose, major vendors of development tools for automotive applications meet with dSPACE regularly to carry out so-called cross tests on their products. During these tests, they connect their test tools to third-party test benches to evaluate if their test software is able to communicate with test hardware from other manufacturers without issues. www.dspace.com/go/xil_crosstests

To ensure optimal interfacing, dSPACE offers comprehensive consulting and engineering support for the ControlDesk XIL API MAPort Platform. Please enquire.
ECU Interface Module

Calibration and Measurement
The ECU Interface Module is an optional software module for calibration and measurement access to electronic control units.

- Support of ASAM A2L files (ASAM MCD-2 MC) up to version 1.7 (support of structured data types)
- ECU access (CCP, XCP on CAN) via SCALEXIO CAN controllers
- Online and offline calibration
- Support of single-page and two-page concepts with a working and reference page
- Automatic reconnect to unplugged ECUs for resuming measurement
- Seed & key access to ECU for XCP and CCP
- Calibration of ECUs without dedicated data segments
- Support of CAN FD (CCP and XCP on CAN)

Overview of ECU interfaces and protocols of ControlDesk.

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<table>
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<tr>
<th>Product</th>
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<tbody>
<tr>
<td>ECU Interface Module</td>
<td>CONTROLDESK_ECU</td>
</tr>
</tbody>
</table>
ECU Diagnostics Module

ECU Diagnostics with ControlDesk
The ECU Diagnostics Module is an optional software module that facilitates the calibration and validation of ECU diagnostic functions.

- Compliance with the ODx database standard
- Support of ISO protocols for Ethernet, CAN, and K-Line
- Dedicated instruments to execute diagnostic services and to read or clear the ECU fault memory
- ECU flash programming via diagnostic interfaces
- Support of ASAM MCD-3D v2.0.2 (COMPARAMs according to PDU API v2.2, ISO 22900-2)
- Support of ControlDesk’s application programming interface (API) for access to diagnostics functions (p. 17)
- Support of CAN and CAN FD channels on dSPACE VEOS and SCALEXIO

Application Areas
ECUs can be interfaced via the ISO-standardized diagnostic protocols KWP2000 (ISO 14230), Diagnostics on CAN (ISO 15765), UDS (Unified Diagnostic Services) (ISO 14229-1), OBD (ISO 15031), and Transport Protocol (TP 2.0) on CAN. The ECU Diagnostics Module is fully compliant with ODx (Open Diagnostic Data Exchange), the ASAM MCD-2D standard (v2.0.1 and v2.2.0 (ISO 22901-1)). Combined with the ControlDesk MCD-3 automation functionality, a standard automation interface according to ASAM MCD-3 D (v2.0.2) is provided for the remote control of diagnostic tasks. Alternatively, many of ControlDesk’s diagnostics functions can be accessed by automation script via a dedicated application programming interface (API) (p. 17).

Key Benefits
The ControlDesk ECU Diagnostics Module enhances ControlDesk to a comprehensive, integrated measurement, calibration, and diagnostics tool (MCD tool). Additional instruments for working with an ECU’s fault memory, and diagnostic services and jobs, are seamlessly integrated into ControlDesk. The easy generation of diagnostic variables from ODx allows you to use DTCs, measurements and parameters with the standard instruments and together with signals from other sources. The integrated ECU flash programming support lets you update the ECU with the latest software version or calibration data via diagnostic protocols.

Fault Memory Instrument
With the Fault Memory instrument you can read and display the fault memory of one or multiple ECUs, either on demand or cyclically. Status and environment information can be displayed for each diagnostic trouble code entry. The fault memory can be cleared either completely or partially. The fault memory information can be saved to file in an ASCII or XML format for documentation purposes. ControlDesk can also indicate any changes in the number of diagnostic trouble code entries in the Plotter instrument and also saves a list of all current entries to your measurement file as a bookmark.
Diagnostics Instrument
With ControlDesk's Diagnostics instrument, you can work with diagnostic services and Java jobs described in the ODX database. The available services and jobs are presented concisely in a tree structure for easy finding and selection. You can select a service or job, parameterize and execute it, and monitor the associated ECU responses and results. You can perform execution once or cyclically. Diagnostic communication can be logged and saved to file.

Diagnostics over Internet Protocol (DoIP)
ControlDesk’s ECU Diagnostics device now also supports DoIP (Diagnostics over Internet Protocol). DoIP is a transport protocol for UDS. For the Ethernet-based UDS on DoIP protocol, ControlDesk uses available Ethernet interfaces of the host PC to access the ECU. No further interface module is required.

Instrumentation of Diagnostic Variables
With ControlDesk you can handle diagnostic identifiers from an ODX database in the same way as variables from other sources such as the ASAM MCD-2 MC file. For instance, diagnostic measurement identifiers can be displayed together with signals from other sources on a common time base in the same Plotter instrument and can be saved to the same measurement file. Diagnostic parameter identifiers can be adapted with ControlDesk’s regular calibration instruments such as the Alphanumeric Input instrument. This makes it easy to handle measurement and calibration, including the use of ECU diagnostics identifiers, and you do not need to know the details of the diagnostics protocol implementation on the ECU.

Flash Programming
To perform a flash programming task in ControlDesk, you simply select the logical link to be flashed and the appropriate flash session, and then execute it. Optionally, another flash data file, such as a HEX file with the latest calibration data, can also be selected. Before executing a flash job, you can adjust the input parameters. The progress and status of the flash sequence can be monitored on screen.

Remote Access via ASAM MCD-3 D API or ControlDesk’s Automation API
A COM/DCOM implementation of the standard automation interface according to ASAM MCD-3 D (v2.0.2) is provided in conjunction with the MCD-3 automation functionality (p. 20). ControlDesk experiments are used as MCD-3 D projects, but MCD-3 D requires the experiments to be preconfigured. Alternatively, many of ControlDesk's diagnostics functions can be accessed by automation script via a dedicated application programming interface (API) (p. 17). For example, ControlDesk's tool automation feature provides the complete configuration of experiments and extended and improved functionality for MCD-3 D. This allows ECU diagnostic tasks to be performed during test automation, e.g., via AutomationDesk, which has separate libraries for the two remote access options.

Order Information

<table>
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<tr>
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<tbody>
<tr>
<td>ECU Diagnostics Module</td>
<td>CONTROLDESK_DIAG</td>
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Signal Editor Module

Graphical Stimulus Definition

The Signal Editor Module is an optional software module used to graphically define and execute signal generators. The signal generators stimulate model variables of real-time applications that run on dSPACE real-time hardware or are used in PC-based simulation with dSPACE VEOS (including V-ECUs).

- Powerful editor for graphical stimulus definition
- Easy replay of measured data (incl. ASAM MDF)
- Dynamic stimulus options (e.g., segment switching, properties)
- Independent execution of several signal generators
- Signals can easily be used by AutomationDesk
- Signal generators can be executed concurrently on all nodes of a multiprocessor system

Support of ASAM XIL API standard, including a new Data File Segment type that lets you replay referenced ASAM MDF 4.x data with a flexible start time and duration
- Condition watcher for data file segments
- Specifying general Signal Editor settings
- Enhanced zooming signals

Defining Time-Synchronous Stimulus Signals

You can define several time-synchronous stimulus signals such as sine, ramp and noise in the graphical Signal Editor, and couple changes in signal form to conditions (e.g., “Generate a sine signal as long as the vehicle speed is lower than 50 km/h.”). It is possible to use recorded signals from the measurement data pool in the Signal Editor for real-time data replay. The Signal Editor saves the specified signal behaviors according to the ASAM XIL API standard.

Order Information

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<tbody>
<tr>
<td>Signal Editor Module</td>
<td>CONTROLDESK_SE</td>
</tr>
</tbody>
</table>

1) Signal generation not supported for DS1104.
Bus Navigator Module

Overview of Bus Communication

The Bus Navigator is a ControlDesk component that lets you handle various types of items for all platforms in a project: CAN and CAN FD messages (incl. J1939), LIN and Ethernet frames that are configured by the Bus Manager, by blocks of the RTI CAN MultiMessage Blockset or by blocks of the RTI LIN MultiMessage Blockset. You can manipulate messages, frames, and PDUs before transmission, exclude them from being transmitted, etc. The Bus Navigator Module supports dSPACE hardware, dSPACE VEOS, PC bus interfaces (by dSPACE, Vector, and Kvaser), and Ethernet interfaces of PCs (including loopback).

Features of the Bus Navigator

The Bus Navigator has numerous features and lets you perform many tasks:

- Support of CAN (incl. J1939), CAN FD, LIN, and Ethernet buses
- Support of dSPACE hardware, dSPACE VEOS, PC bus interfaces (by dSPACE, Vector, and Kvaser), and Ethernet interfaces of PCs (including loopback)
- Dedicated bus instrument to view RX messages, frames, and PDUs as well as to configure and trigger TX messages, frames, and PDUs (for CAN, CAN FD, LIN)
- Monitor and log bus data (CAN, LIN, and Ethernet)
- Replay logged CAN/CAN FD bus communication
- Automation support for creating bus instruments and controlling bus monitoring, logging, and replay
- Switch between decimal and hexadecimal view (tree, monitoring, layouts)
- Time cursor support in monitoring view
- Comprehensive bus analysis (bus load, frame count) and logging of bus statistics for CAN/CAN FD on SCALEXIO and VEOS
- Manipulate the bus communication independently from the involved ECUs and for each cluster and channel separately
- Enable/disable different bus configurations during runtime
- VEOS: Support of Ethernet channels
- Ethernet Bus Monitoring device: Wireshark decoder support
- NEW: LIN bus statistics

Monitoring, logging, and dedicated instruments for CAN and CAN FD are already supported with ControlDesk standard version. Monitoring and Logging not yet supported by MicroAutoBox III.
Ethernet Bus Monitoring and Logging

ControlDesk provides the Ethernet Bus Monitoring device, which can be used to monitor and log Ethernet communication. It enables a comprehensive network packet analysis and supports the following protocols: Ethernet II, IPv4, IPv6, UDP, TCP/IP as well as SOME/IP-SD. The time cursor lets you compare the monitored Ethernet traffic data with measurement data and other protocols, such as CAN and LIN, at a specific point in time. Furthermore, the included Ethernet filter lets you specify the Ethernet packets to be captured. Ethernet monitoring data can be stored as PCAP NG file.

The Ethernet Bus Monitoring device: The time cursor is used to compare Ethernet traffic data with data from other sources.

The Ethernet filter.
Support for dSPACE Hardware and Software

**PC Bus Interface Hardware**
- DCI-CAN2 (USB-to-CAN and USB-to-CAN FD interface)
- DCI-CAN/LIN1 (USB-to-CAN, USB-to-CAN FD, and USB-to-LIN interface)
- Calibration Hub (USB hub with two USB-to-CAN interfaces)
- Ethernet interfaces in various dSPACE hardware products
- Ethernet interfaces of host PCs (including loopback)

**PC-Based Simulation Platform**
- VEOS

**Real-Time Bus Interface Hardware**
- MicroAutoBox II
- MicroLabBox
- DS2202 HIL I/O Board
- DS2211 HIL I/O Board
- DS4302 CAN Interface Board
- DS4330 LIN Interface Board
- DS4505 Interface Board
- DS2671 Bus Board
- DS2680 I/O Unit (with bus support)
- DS6301 CAN/LIN Board
- DS6331-PE Ethernet Board
- DS6341 CAN Board
- DS6351 LIN Board
- DS6333-CS Automotive Ethernet Board
- DS6333-PE Automotive Ethernet Board
- DS6334-PE Ethernet Board
- DS6335-CS Ethernet Board
Support for Third-Party Hardware

**PC CAN Interface Hardware**
- Kvaser Leaf Light HS interface
- Kvaser Leaf Professional
- Kvaser Memorator Professional
- Kvaser USBcan II
- Kvaser USBcan Professional
- Vector CANcaseXL
- Vector VN16xx series
- Vector VN5610
- Vector VN7600
- Vector VN89xx

**PC LIN Interface Hardware**
- Kvaser Leaf Professional LIN
- Vector CANcaseXL
- Vector VN16xx series
- Vector VN89xx

**Order Information**

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<thead>
<tr>
<th>Product</th>
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<tbody>
<tr>
<td>Bus Navigator Module¹</td>
<td>CONTROLDESK_BNV</td>
</tr>
</tbody>
</table>

¹ Monitoring, logging, and dedicated instruments for CAN and CAN FD are already supported with ControlDesk standard version.
Variable Editor
Visualize, edit, and create ECU description files

Highlights
- Create and edit ECU description files (A2L files)
- Update address information of ECU variables from map files
- Automate address update and A2L file generation via a command line

Application Areas
An A2L file according to the ASAM MCD-2 MC standard (formerly ASAP2) contains all the information about measurement and calibration variables in the ECU. This includes information on the variables’ memory addresses and conversion methods, the memory layout and data structures in the ECU and communication parameters for the measurement and calibration interface. The automotive industry has widely adopted the A2L file format as a de-facto standard.

Key Benefits
The dSPACE Variable Editor is a stand-alone tool especially tailored to the ECU software development phase. New A2L files can be created from scratch or existing ones can be imported and modified. The editor is fully compatible with the ASAM MCD-2 MC standard.

In addition, the Variable Editor allows selected variables to be exported and imported and new or modified variables to be exchanged between users.
Main Features

- Import of any number of A2L files
- Export of ECU description files according to the ASAM MCD-2 MC standard
- Visualization, editing, and creation of A2L files
- Export and import of selected variables
- Option to copy and paste variables and groups between A2L files and to create subsets
- Map File Manager to assign any number of map files to a variable description
- Option to automatically create variables from symbols in map files
- Address updates from map files at a click
- Dialog-based configuration of variables
- Convenient filter and search mechanisms
- Command line interface to automate address update and ECU description file generation

Order Information

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<thead>
<tr>
<th>Product</th>
<th>Order Number</th>
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<tbody>
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