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Documenting ECU Software with the ETAS EHANDBOOK

From function development to calibration, all phases of ECU development require detailed knowledge of how functions for the control and diagnosis of electronic systems operate and interact. Conventional ECU software documentation is becoming more extensive and confusing due to the increasing number of functions and the growing capabilities, and complexity of ECU logic. With EHANDBOOK, ETAS provides a new format for documenting electronic control systems that uses interactive graphics to display functions and signal flows in their proper context.

Model-based software development (MBSE) models the algorithms of an electronic system's logical functions graphically instead of manually programming them. Generally built using ETAS ASCET or MATLAB®/Simulink®, MBSE models can specify ECU software with great precision. These graphical models are in themselves a suitable means of documenting software development. Whether for the calibration of electronic controls in vehicle systems or for the prototyping of supplementary control, regulation, or diagnostic functions, developers currently provide software documentation in the form of PDF files. These contain static content in the form of texts, images, and tables as well as hyperlinks for navigation. As with a road atlas, which depicts a large area at a small scale on many individual pages, the ECU logic's circuit diagram is also spread over individual pages in the form of graphical displays of submodels and model components. This means the documentation is usually very extensive. For engine controls, it can comprise 10,000 to 30,000 pages. In view of such large volumes, this format cannot be used to clearly present functional relationships such as the interdependencies of functions and signals. In addition, it makes looking for specific information contained in the PDF documents very unspecific and, in the case of extensive documentation, too slow.

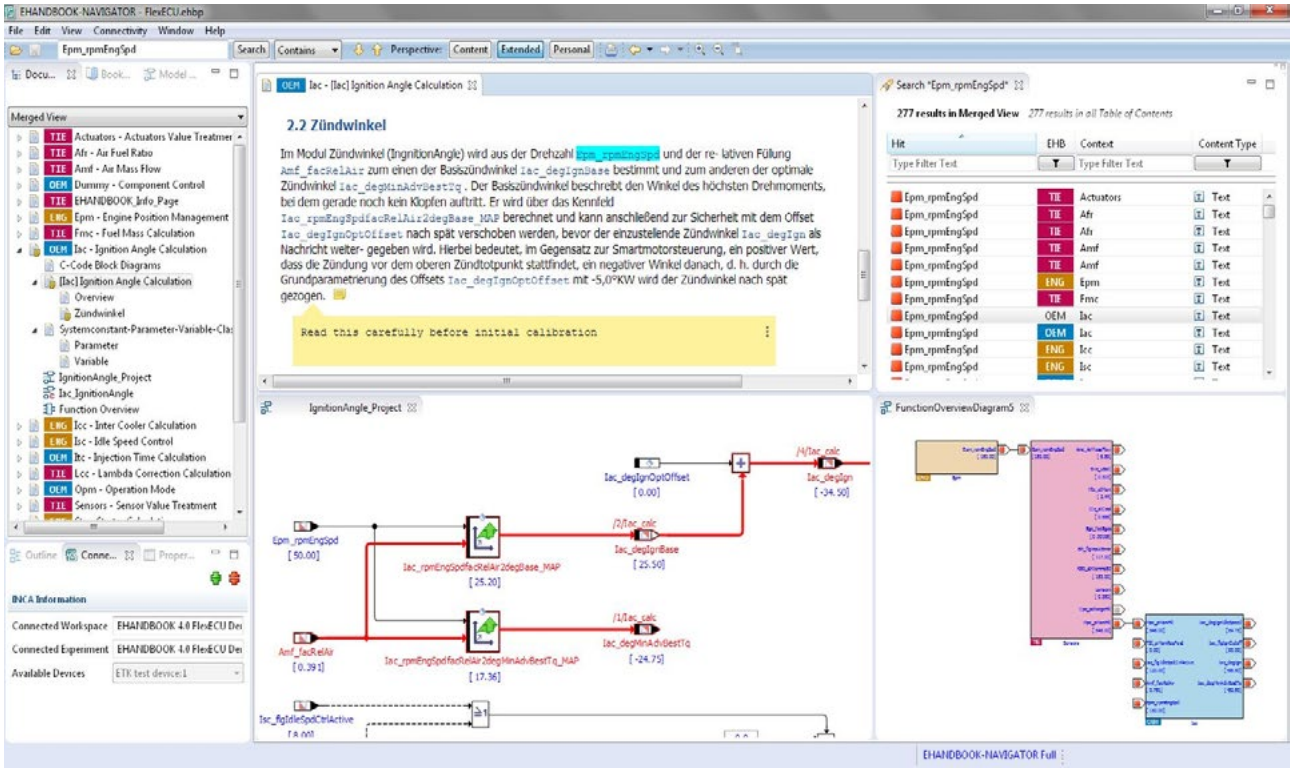
ECU documentation for calibration and function development

In order to efficiently tackle the calibration and development of new ECU functions, engineers need ECU software documentation to be presented in the most easy, clear, and comprehensive manner possible, so that they can find relevant information quickly. With the award-winning EHANDBOOK [1] solution, ETAS provides a new format and new tools for documenting ECU software that allow for an interactive graphical display of functions and signal flows at varying levels of abstraction [2].

This format makes the ECU software's functional relationships much easier to understand than with conventional PDF documentation. EHANDBOOK documentation helps users focus on their core task. Engineers who need a precise understanding of ECU logic for their work in calibration or function development benefit enormously from the interactive and flexible graphical displays in EHANDBOOK documentation. It provides the user with an overview of the functioning of an ECU on the one hand, and quick access to important details on the other.

Users can consult EHANDBOOOK by using the EHANDBOOK NAVIGATOR software tool (fig. 1). This tool provides intelligent search and visualization functions. All relevant sections of a function can if necessary be merged into a clear overview on the user interface with a single mouse click. EHANDBOOK documentation features an integrated database to support targeted navigation through the entire documentation, contextual display of additional information regarding the ECU software's individual parameters and variables, as well as powerful search functions. The efficiency of the new documentation solution is further enhanced in practice through the seamless coupling of EHANDBOOK-NAVIGATOR with the ETAS INCA measuring and calibration tool. For example, INCA can easily take over the measurements and parameters from EHANDBOOK-NAVIGATOR. Conversely, values measured in an INCA experiment can be shown live in EHANDBOOK-NAVIGATOR.

Fig. 1: User interface of EHANDBOOK-NAVIGATOR. Left: table of contents of the complete documentation. Top center: function description in text format with user comments. Bottom center: interactive model with marking of dependencies and online display of INCA measured values. Top right: display of search results. Bottom right: graphical overview of functional relationships.



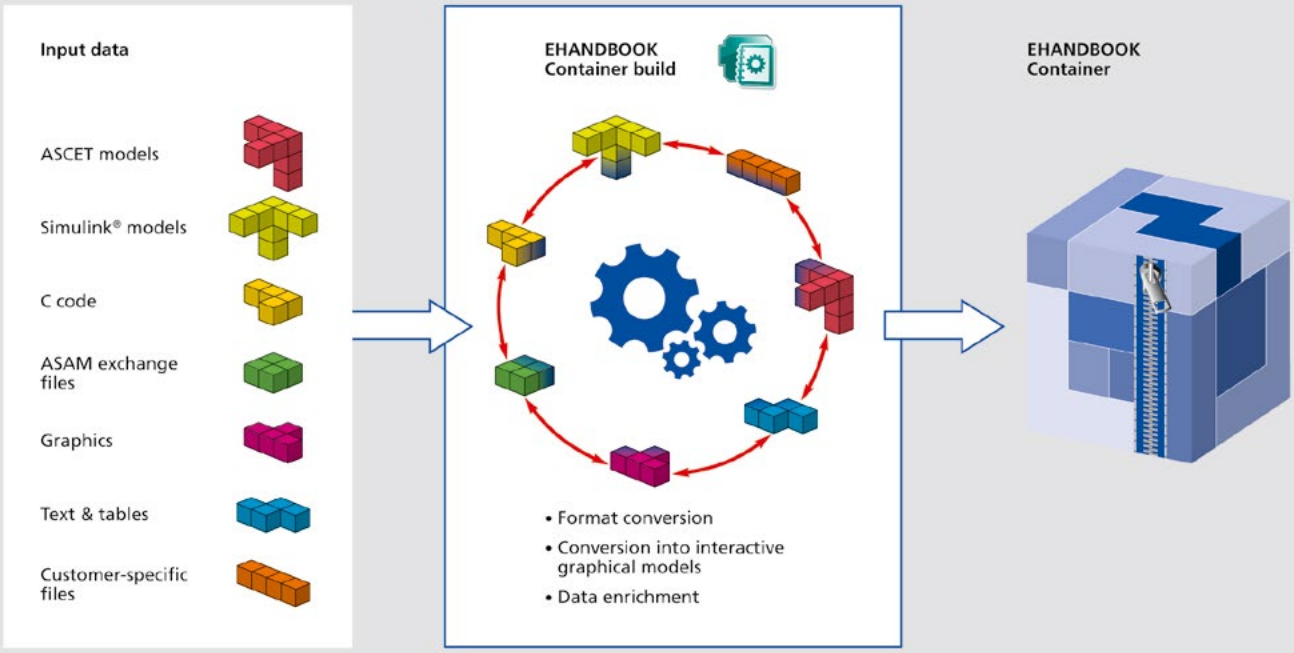


Fig. 2: The EHANDBOOK Container-Build tool generates ECU documentation from relevant input data that is contained in condensed form in EHANDBOOK.

Comprehensive documentation despite the variety of sources

The ECU documentation, or EHANDBOOK Container, is produced from different sources in a generation process that can be flexibly adapted to the development environment using the EHANDBOOK Container-Build tool (Fig. 2). MBSE models built using ETAS ASCET or MATLAB®/Simulink® are translated into interactive graphical models optimized for documentation purposes. Functions that were manually coded in C can also be displayed in the form of such models. In addition, the documentation contents are supplemented by data from different sources. Here, measurements (such as ECU variables and parameters) contained in texts, images, and interactive models are automatically identified and indexed; links are also created between these objects, and function overviews are generated.

EHANDBOOK-NAVIGATOR is capable of flexibly merging several EHANDBOOK Containers. It can seamlessly integrate individual sets of software documentation from several automotive and ECU manufacturers into a comprehensive documentation of the entire software embedded into an electronically controlled system.

Know-how protection included

EHANDBOOK aims to present the functional interactions in an ECU in a comprehensive and clearly organized way. Key to this are special interactive graphical models built using various innovative technologies – such as graphically displaying C code logic in the form of block diagrams. As a result, EHANDBOOK is particularly suitable for the documentation of software being developed by manufacturers and suppliers in joint projects. However, this kind of collaboration calls for protection for companies' intellectual property rights over their software. The interactive models guarantee such protection, since they can neither generate code nor be modified by software development tools.

Distribution

ETAS is continuing to develop EHANDBOOK in close collaboration with its customers. Bosch provides EHANDBOOK documentation of engine control software upon request. Aside from that, several automotive and ECU manufacturers are already using this award-winning solution to document their own content.

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[1] Weka Fachmedien GmbH, „Produkte des Jahres 2016 - Automotive", 2016. (Online). www.elektroniknet.de/halbleiter/sonstiges/artikel/128480/2/

[2] ETAS GmbH, „EHANDBOOK", 2016. [Online]. www.etas.com/EHANDBOOK