



INTERNATIONAL

HYDAC Software Product Catalogue



MATCH Software Suite

Embedded Software Solutions

Remote Access Solutions

Subsystems for Mobile Machinery

Software Development Accessories

ROBUST SOLUTIONS
FOR MOBILE MACHINERY.
FUNCTIONAL SAFETY INCLUDED.



Note

The information in this brochure relates to the operating conditions and applications described.

For applications or operating conditions not described, please contact the relevant technical department.

Subject to technical modifications.

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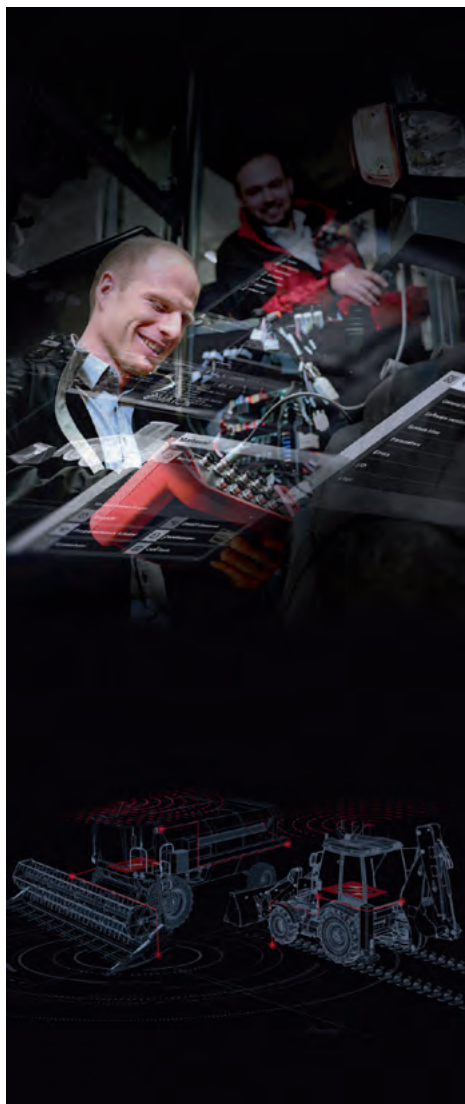
HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15–16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

1 Introduction



HYDAC and HYDAC SOFTWARE – your partner for expertise in mobile machines

HYDAC stands for hydraulics, systems and fluid engineering. The family-owned company, which was founded in 1963, now has over 9,500 employees all over the world.

Our wide range of products, combined with our expertise in development, production, sales and service, enables the diverse requirements of the industry to be met worldwide.

Our quality and environment certifications to ISO 9001/2008, ISO 14001 and ISO 50001 denote first class quality and responsible management of our resources.

Global with local expertise: with over 50 subsidiaries, and more than 500 sales and service partners, HYDAC is your reliable partner worldwide.

HYDAC SOFTWARE

HYDAC SOFTWARE GmbH is a company of the HYDAC group, based at Sulzbach and Großbeeren near Berlin.

We control and automate mobile machinery with the know-how of a global player and the dynamism of a start-up.

The challenges are complex and our solutions forward-looking: we develop drive, control and assistance systems, embedded software and software tools, telematics and cloud applications.

Our core product is MATCH, a software platform for mobile automation.



MATCH – MACHINE APPLICATION TOOLCHAIN

MATCH is a TÜV-certified software suite for the development and maintenance of control software for mobile machinery.

The platform provides optimally coordinated solutions over the entire machine lifecycle and enables rapid realisation of safety functions.

Benefit from a constantly growing number of features, an efficient continuous development process and future-proof application development – with MATCH.

The main highlight: with MATCH, you can incorporate aspects of functional safety into the development of your control systems from the beginning. The embedding of safety standards is consistently supported across the entire development process. All safety-relevant modules are TÜV-certified.

Our portfolio also includes extensive accessories and electro-hydraulic subsystems, which we have developed on the basis of MATCH.



CERTIFIED SAFETY LEVELS

SIL2 acc. to IEC 61508

PLd acc. to EN ISO 13849

AgPLd (SRL2) acc. to

ISO 25119 & DIN EN 16590

1.1 Why choosing MATCH?

CHALLENGES IN MACHINE DEVELOPMENT

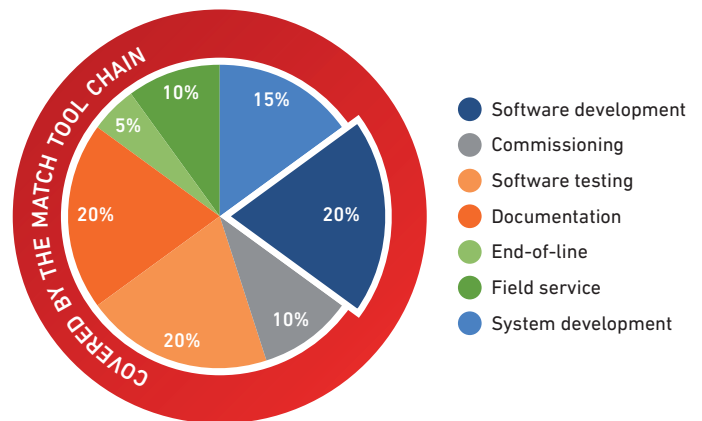
Machine manufacturers are facing great challenges: the dynamics of the market call for increasingly rapid development – with greater demands relating to testing, validation and documentation. On top of this, mobile machinery now needs to meet extensive safety standards. This applies not only to individual components, but across the board to all safety-related functions for machine control systems. Usually these additional expenses cannot be passed on to the end customer via the machinery prices.

To give machine manufacturers the ability to meet these challenges, we have reviewed the entire process: from the design stage and implementation to the maintenance of safety-relevant control. Our aim is a noticeable reduction in the time to market – in compliance with the required safety standards.

Highly efficient application development, servicing, maintenance and repair of mobile control systems calls for perfectly coordinated tools. Robust middleware, extensive toolboxes and the integration of functional safety from the beginning are essential. We have realised all of this in the **MACHINE APPLICATION TOOL CHAIN – MATCH**.

Detailed information on MATCH can be found on the following pages and on our website www.match.hydac.com

MATCH offers an integrated, TÜV-certified solution for the complete lifecycle of mobile machinery: starting from system definition and hardware-independent embedded software development, through documentation, testing, commissioning and optimisation on the vehicle, to diagnosis in the field and service.

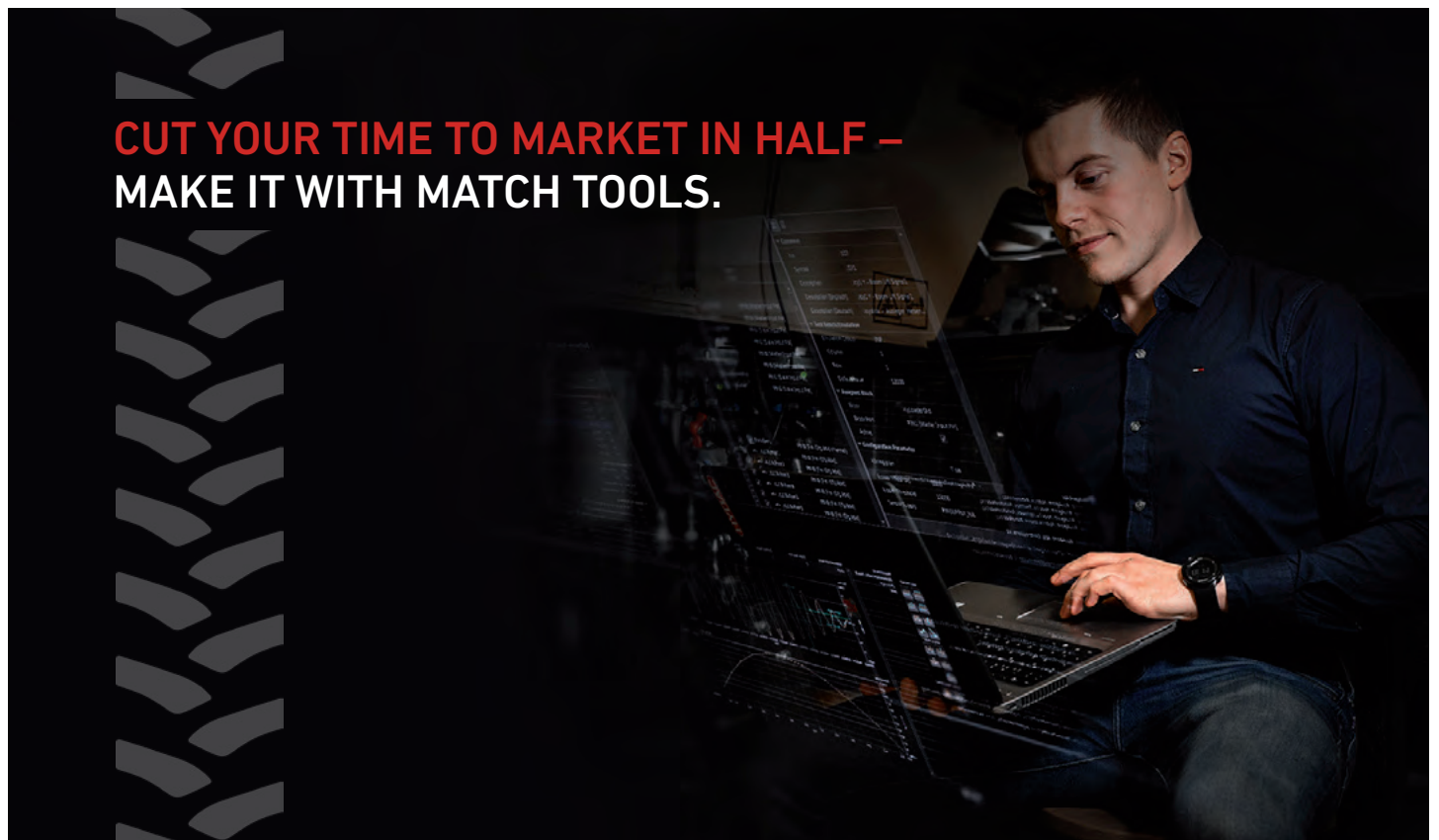


Standard programming environments for mobile automation generally only cover the sub-area of “software development”. 80% of the software development process needs to be implemented with different tools. MATCH offers a consistent solution for all phases of the machine lifecycle.

With MATCH, you can rapidly design and realise new applications for complex vehicle or machine controls, but also quickly redesign existing machines, machine parts and functions – with consistent data and incorporation of functional safety aspects from the beginning.

MATCH enables you to develop safety-related applications in accordance with the V-model – with time savings of up to 50%.

**CUT YOUR TIME TO MARKET IN HALF –
MAKE IT WITH MATCH TOOLS.**



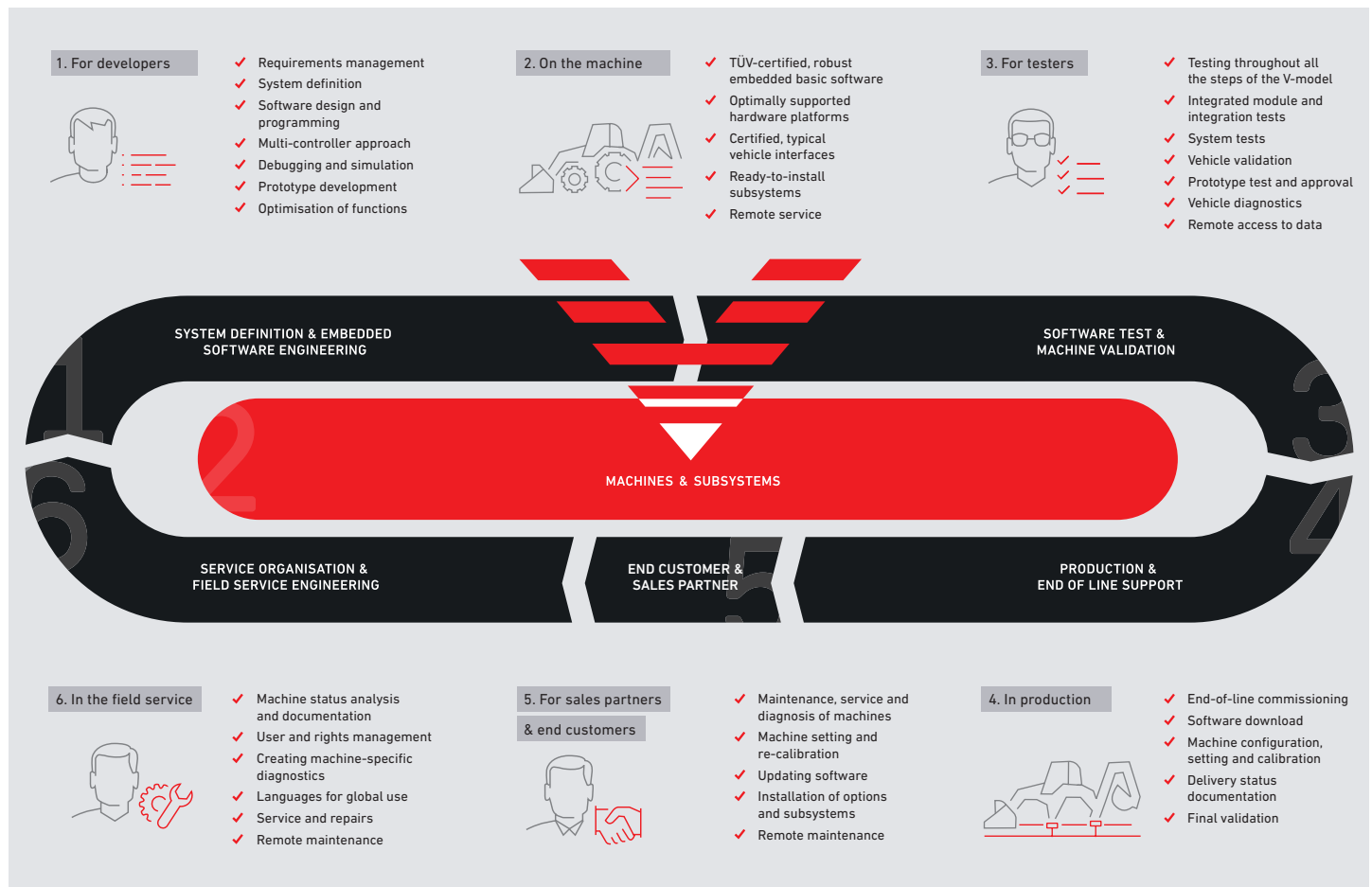
MATCH Software Suite

ONE SYSTEM FOR ALL YOUR SOFTWARE REQUIREMENTS



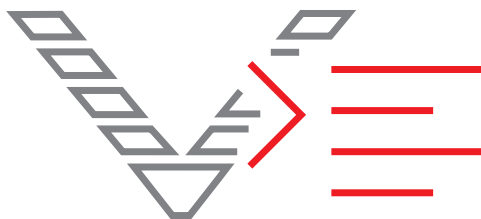
The universal Software Suite makes it possible to consistently develop, test and document safety-related applications for vehicle or machine controls according to the V-model.

The continuous structure enables all users to work in close coordination: starting from system definition and hardware-independent embedded software development, through documentation, testing, commissioning and optimisation on the vehicle, to diagnosis in the field and service.



MATCH. For all users in the lifecycle. For developing safety-related control systems according to the V-model.

DEVELOPMENT ACCORDING TO THE V-MODEL



The V-model is perfect for developing applications according to functional safety standards. MATCH supports all design steps of the V model and provides appropriate tools for all development phases.

MATCH enables you to implement the system software development of mobile working machinery in line with functional safety requirements, up to the levels SIL2, PLd, AgPLd (SRL2).

Functional safety is incorporated into the MATCH projects from the very beginning – this involves, among other things, a precise coverage of the requirements, complete documentation, and comprehensive integration of the required tests.

FOR ALL USERS IN THE LIFECYCLE

MATCH FOR DEVELOPERS

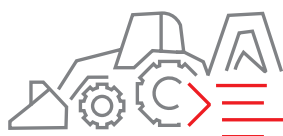


SYSTEM AND SOFTWARE DEVELOPMENT WITH MATCH

MATCH gives you a clear competitive edge in control development: starting with requirements management, applications for complex vehicle or machine controls can be implemented in the shortest possible time. Based on the V-model, with integrated safety standards and consistent data.

All the test processes required in the V-model are included by default. MATCH also guarantees perfect traceability of the requirements management. The specific machine requirements can even be tracked down in the embedded code.

MATCH ON THE MACHINE



SOFTWARE SOLUTIONS AND SUBSYSTEMS

MATCH provides a comprehensive, TÜV-certified basic software which has been proving its value in mobile working machines for many years and in every branch of industry.

In addition to the basic software, the necessary service tools are also offered on PCs and/or displays using the integrated approach of the software platform.

Connecting to the machine software remotely is also possible.

The subsystems developed on the basis of MATCH apply the comprehensive benefits of MATCH and provide ready-to-use, robust and certifiable "plug-and-play" solutions for basic machine functions.

MATCH FOR TESTERS



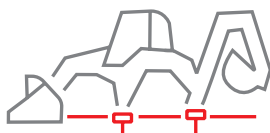
SOFTWARE & SYSTEM TEST AND MACHINE VALIDATION

Efficient testing made easy: MATCH allows quick implementation of all the test levels based on the V-model with integrated safety standards and continually consistent data. The test levels can easily be automated using scripts.

Furthermore, the requirements as well as the use and test cases are available and comprehensibly linked ("traceable") directly in the scripts.

The standard available PC simulation of the source code allows an elegant implementation of the unit and integration tests without any loss of time. All the project data is provided in the automation.

MATCH IN THE PRODUCTION PROCESS



MACHINE CONFIGURATION, ADJUSTMENT, END-OF-LINE COMMISSIONING AND FINAL VALIDATION

Effective optimisation thanks to seamless integration: MATCH Software Suite allows smooth end-of-line commissioning and precise quality control at the time of delivery of the machines.

User management allows manufacturer-specific allocation of responsibilities in production. The consistency of the machine data is fully secured.

Coordinated diagnostics and calibration pages and documentation of the entire machine data optimise both the quality control and the delivery processes.

This creates ideal conditions for the sales partner network and field service.

MATCH FOR SALES PARTNERS AND END CUSTOMERS



CONFIGURATION, OPTIMISATION, AND SERVICING MADE EASY

MATCH provides service, maintenance and repair support to sales partners, rental parks and end customers. Maintain the machines and adjust them to meet the customer requirements using MATCH.

The consistent approach of the MATCH Software Suite eliminates interface losses. The installation of new options and configuration of subsystems on the vehicle can be performed without difficulty.

The user management allows special configuration of the scope of functions tailored to your staff. The possibility of temporary extension of access rights ensures trouble-free work, even in difficult situations.

MATCH IN FIELD SERVICE



SERVICE ORGANISATION AND FIELD SERVICE ENGINEERING

MATCH Software Suite provides all the functions for a modern field service engineering: from basic "plug-and-play" functions – such as pin diagnosis, parameter setting and error management – through specially tailored diagnostic pages to documentation of the machine status.

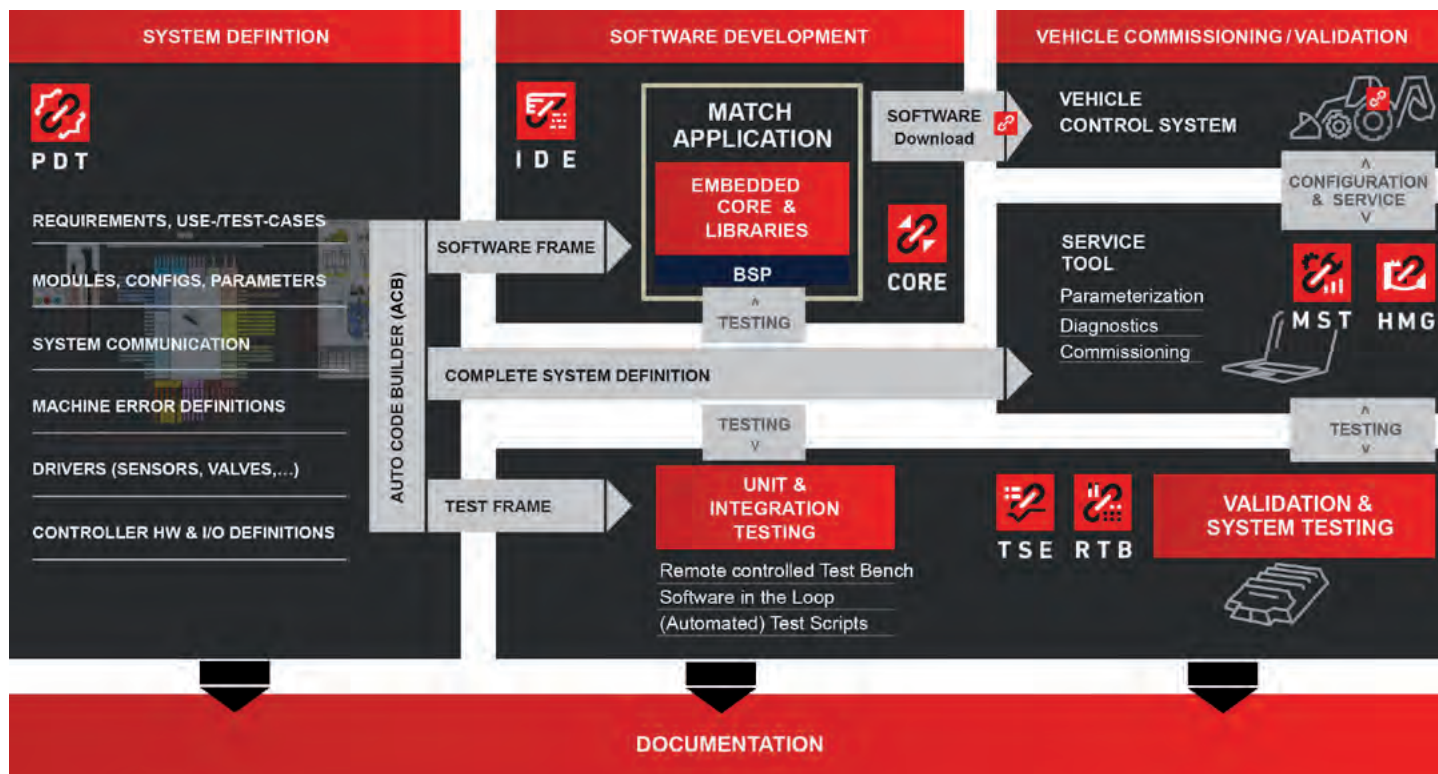
A convenient user administration allows the implementation of various access levels with individual coordination of access rights. In addition to enabling the later installation of options and the download of new software versions, remote access to the machine is also supported.

1.2 MATCH Tools

PLATFORM FOR MOBILE AUTOMATION

The MATCH Software Suite is made up of perfectly coordinated tools.

With the PDT (Project Definition Tool), TSE (Test and Simulation Environment) and MST (Machine Service Tool) tools, a robust middleware (MATCH Core) tailored to suit mobile machinery, extensively tested library modules and an open standard IDE, you can develop and maintain your control systems consistently across their entire lifecycle. Based on the V-model with consistent data, integrated safety standards and time savings of up to 50%.



MATCH Software Suite's integrative approach

MATCH SOFTWARE SUITE TOOLS

 PDT	 MST	 TSE	PC TOOLS The PDT (Project Definition Tool), TSE (Test and Simulation Environment) and MST (Machine Service Tool) tools allow you to develop and test according to the V-model, with continuously consistent data. The package is completed by TÜV-certified library modules combined in toolboxes and extensive protocol stacks. The PC tools can be flexibly enhanced with program add-ons. This means that the tools can be configured to suit your specific requirements.
 TOOLBOX	 STACKS		
 ADD-ON	 ADD-ON	 ADD-ON	



CORE



TOOLBOX



STACKS

SOFTWARE SOLUTIONS: CONTROLLERS

The robust and tried-and-tested middleware is specifically tailored to suit the requirements of mobile working machinery and available to all of the controllers supported by the tool chain.

The package is completed with library modules combined in toolboxes and a wide variety of TÜV-certified communication stacks.



V²BAS



V²LIB

SOFTWARE SOLUTIONS: DISPLAYS

MATCH provides comprehensive libraries for display visualisation solutions in CODESYS 3.x.

Supported are solutions with and without touch.



WAVE

SOFTWARE SOLUTIONS: CONNECTIVITY

MATCH allows remote access to machine data – either through direct access to the service tool via WLAN, or through the use of different mobile communication standards.

In terms of connectivity solutions, MATCH provides extensive libraries for Qt on Linux.



IDE ECU



IDE HMI

IDEs

MATCH uses conventional programming languages for the development of application software, which means it uses standardised or freely accessible IDEs – not only for machine controls but also for visualisation solutions.

Using standardised programming languages means that the developed functional software can be readily transferred to other projects.



EHC



AXS



ADS

SUBSYSTEMS

The electro-hydraulic subsystems are developed based on MATCH according to the V-model and are tested comprehensively in all of the available configurations and ranges of functions. Solutions up to the safety levels PLd and AgPLd (SRL2) are available.

You can use the SCT (Subsystem Configuration Tool) to configure the subsystems – perfectly tailored to suit your specific machine architecture.

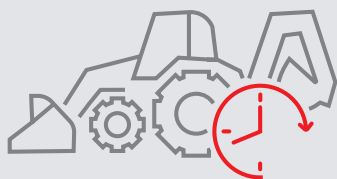


HFC



SCT

1.3 Advantages at a glance



ADVANTAGE THROUGH EFFICIENCY

All MATCH tools mesh seamlessly into each other over the entire lifecycle of the machine.
Documentation components are generated automatically.
The implementation of safety standards is continuously supported.



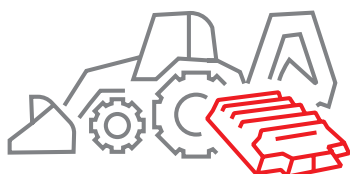
DEVELOPMENT ACCORDING TO THE V-MODEL. TESTING INCLUDED

Development of application software according to the V-model, with continuously consistent data.
All the test procedures required are included by default and can be immediately feasible.
All project information is available in the test environment.



OPEN STANDARD IDE

Freely selectable development environment: with MATCH, the actual functional development of the machine is carried out in standardised, freely available development environments, for example in C under Eclipse or in CODESYS 3.x.



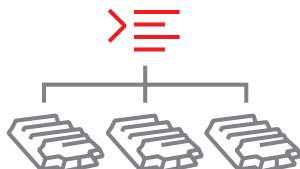
ROBUST, HARDWARE-INDEPENDENT, EASILY PORTABLE

Design of the architecture and basis of the software at the click of a mouse using special middleware tailored to mobile machinery, and robust, tried-and-tested library function blocks.
Standardised software packages run on all the controllers, displays and telematics hardware.
Easy portability to other supported hardware is ensured.



FUNCTIONAL SAFETY INCLUDED

Functional safety is integrated from the beginning.
The embedding of safety standards is supported consistently by the various sections of the program and takes place, so to say, at the touch of a button – right up to safety levels SIL2 / PLd / AgPLd (SRL2).
All safety-relevant modules are TÜV-certified.



MULTI-CONTROLLER CAPABILITY

MATCH supports application development at machine level.
Functions that require the seamless interplay of several control units and displays can be easily implemented.

2 MATCH PC Tools

2.1 PDT – Project Definition Tool



DESCRIPTION

The Project Definition Tool (PDT) supports the development, documentation, testing and production of applications for controllers and displays in complex vehicles and machines. Tried-and-tested and certified toolboxes significantly simplify and accelerate the development of applications.

USE PDT TO:

- define the requirements for the machine control
- describe the control setup and architecture and the resulting software architecture
- define the used controllers, displays as well as telematics hardware
- specify the machine communication and the associated protocols and messages
- define the error management
- set up the data structures for variable parameters

SPECIAL FEATURE: FUNCTIONAL SAFETY

In conjunction with the embedded programming language used and the target hardware, the PDT makes it possible to generate a safety-certified embedded software code according to SIL2, PLd and AgPLd.

After completing the definitions, the integrated, certified Auto Code Builder is used to generate the embedded software code with the click of a mouse – in the programming language of your choice. This is possible for one target, or even several targets simultaneously. The software frame that is created forms the basis for the application development. The embedded code generation is supported for controllers, displays and the telematics hardware.

The PDT also generates extensive project documentation and provides the interface information to the TSE (Test and Simulation Environment) test tool and the MST (Machine Service Tool) maintenance tool.

The PDT is available in three basic versions, tailored to different user groups: PROGRAMMER C, PROGRAMMER CODESYS, STANDARD DEVELOPER. The basic versions can be expanded flexibly, enabling you to configure a version tailored to suit your specific requirements.



SYSTEM ARCHITECTURE | REQUIREMENTS WITH THE PDT

- With the PDT, you record the machine requirements at the vehicle level – with a focus on functional safety from the beginning.
- You define requirements, use cases and test cases, configure controllers, displays and the telematics hardware and describe the system and communication architecture as well as the communication protocols/interfaces that are to be used. All the inputs are automatically assigned to the specification documents.

APPLICATION SOFTWARE DEVELOPMENT WITH THE PDT

- On the basis of the previously specified machine functions and the system/communication architecture, software developers can use the PDT to seamlessly follow the V-model and define the software design, the software modules and their features and interfaces.

PDT – How can I find the suitable version?

BASIC VERSIONS

First select the basic version that suits you.

- Software project with 1 controller for programming in C (e.g. Eclipse) and 1 display in CODESYS 3.x
- Auto Code Builder C for controller (non-safety) and CODESYS for display (non-safety)

- Software project with 1 controller for programming in CODESYS 3.5 and 1 display in CODESYS 3.x
- Auto Code Builder CODESYS for controller and display (both non-safety)

- Software projects with complex architecture (multi controller design, multi display and remote devices)
- Programming language selectable
- Safety ready and service tool ready

PDT PROGRAMMER C



Individual software developers
Machine with max. 1 controller + 1 display
Programming in C

PDT PROGRAMMER CODESYS



Individual software developers
Machine with max. 1 controller + 1 display
Programming in CODESYS

PDT STANDARD DEVELOPER



System developers & requirements managers
Software developers/engineers
Complex control architectures

TOOL SPECIFICATIONS AND ADD-ONS

Expand your basic version in the second step: depending on the area of application and the specific requirements, choose your desired add-ons, the required code builder variant and your ECU and display target.

PDT BASIC VERSION



Selected to meet your requirements



Add-ons – Program Enhancements



ADD-ON

Selection of features to suit your specific requirements and incorporate into your tool landscape via import/export interfaces



Embedded Code Builder Variants

ECUs: C-Code | CODESYS 3.5
Displays: CODESYS 3.x
Remote devices: Qt



Targets – Embedded Software for Target Hardware

ECUs: Middleware(Core) and Standard Toolbox
Displays: V2 MATCH Library
Remote devices: TTConnect Wave, MATCH Target Module



Enhanced Embedded Software Functionalities



TOOLBOX



STACKS

Embedded Software Libraries and Communication Stacks for enhanced software functionalities on the machine

DESKTOP LEVEL

EMBEDDED DEVICE

YOUR INDIVIDUAL DEVELOPMENT PLATFORM

Do I want to generate an embedded code?
If yes: for which device and
in which programming language?

What embedded hardware do I want
to use on the machine?

Do I require additional program
functionalities on the machine?

PDT Features

Program functionalities of the PDT basic versions, add-ons and embedded software enhancements at a glance:

PDT basic version	PROGRAMMER C "CP"	PROGRAMMER CODESYS "CD"	STANDARD DEVELOPER "00"
Functionalities of desktop tool			
Machine project approach			
Single ECU	x	x	x
Single display	x	x	x
Multiple ECUs	–	–	x
Multiple displays	–	–	x
Multiple remote devices	–	–	x
Automatic code generation			
Embedded standard "C" code generation for controllers ^{*1)}	x	–	–
Safety related enhancement (SIL2, PLd, AgPLd SRL2) for embedded standard "C" code generation for controllers	AO-EC2D	–	–
Safety related embedded "C" code generation for controllers (SIL2, PLd, AgPLd)	–	–	AO-ECEN
Embedded "CODESYS 3.5" (standard) code generation for controllers ^{*1)}	–	x	AO-ECD3
Embedded "CODESYS 3.5 SIL2" code generation for safety controllers	–	–	AO-SCD3
Embedded code generation in "CODESYS 3.x" for eVision ² display	x	x	AO-V2C3
Embedded code generation in "Linux Qt" for e.g. remote devices	–	–	AO-D3QT
Documentation			
Generic project documentation	x	x	x
Documents management	–	–	x
Enhanced specification package	–	–	AO-SPCK
Features/functionalities			
Project settings and administration	x	x	x
System layout definition and software design	x	x	x
Vehicle communication (CAN network and message definition)	x	x	x
CANopen user interface and EDS file import	AO-CANO ^{*6)}	x ^{*2)}	^{*6)}
Controller I/O configuration	x	x	x
Error / alarm management, properties, dependencies and reactions	x	x	x
Vehicle database / parameter management	x	x	x
Administration of library blocks, signal elements and communication stacks	x	x	x
Requirements capturing	–	–	AO-RCAP
Project data export to "HMG 4000"	AO-HMG4	AO-HMG4	x
Machine service tool (MST) integration			
Project data export to MST	x	x	x
Service tool access levels (max. 8 level)	x	x	x
Service tool customisation (start page)	AO-STPG	AO-STPG	x
Project languages for service tool data	AO-PRLG	AO-PRLG	x
Test and Simulation Environment (TSE) integration			
Project data export to TSE	x	x	x
Import / export interfaces			
PEAK [®] symbol file (*.sym) export	x	x	x
PEAK [®] symbol file (*.sym) import	AO-ISYM	AO-ISYM	x
VECTOR [®] DBC file export	AO-DBCE	AO-DBCE	AO-DBCE
Requirements management "ReqIF" import & export interface	–	–	AO-RQIF
Embedded software controllers (see section 3)			
Solutions in programming language "C"			
Optional ECU "C" targets	ECU-TARG-CEN ^{*3)}	–	ECU-TARG-CEN ^{*3)}
Optional ECU "C" toolboxes	ECU-TBOX-CEN ^{*3)}	–	ECU-TBOX-CEN ^{*3)}
Optional ECU "C" stacks	ECU-STAC-CEN ^{*3)}	–	ECU-STAC-CEN ^{*3)}
Solutions in programming language "CODESYS"			
Optional ECU "CODESYS 3.5" targets	–	ECU-TARG-CD3 ^{*3)}	ECU-TARG-CD3 ^{*3)}
Embedded software displays (see section 4)			
Solutions in programming language "CODESYS"			
Optional display eVision ² libraries for "CODESYS 3.x" programming	EV2-LIBR-CD3 ^{*4)}	EV2-LIBR-CD3 ^{*4)}	EV2-LIBR-CD3 ^{*4)}
Optional display eVision ² "CODESYS 3.x" targets	EV2-TARG-CD3 ^{*4)}	EV2-TARG-CD3 ^{*4)}	EV2-TARG-CD3 ^{*4)}
Embedded software remote devices (see section 5)			
Solutions in programming language "Linux Qt"			
Optional remote devices "Linux Qt" target modules	–	–	DV3-LIBR-LQT ^{*5)}

Note: x = included, – = not available, AO = required add-on, can be added via model code.

^{*1)} Meets standard quality requirements according to ISO 9001. Does not meet any requirements relating to elevated functional safety.

^{*2)} CANopen/CANopen Safety is provided directly via CODESYS.

^{*3)} Embedded software controllers – see section 3: "MATCH software solutions, controllers"

^{*4)} Embedded software displays – see section 4: "MATCH software solutions, displays"

^{*5)} Embedded software remote devices – see section 5: "MATCH software solutions, connectivity"

^{*6)} For function on the embedded controller hardware, the corresponding CANopen / CANopen safety stack "ECU-STAC-CEN-CANO" is required (see sec. 3)

PRODUCT FEATURES

- SIL2 / PLd / AgPLd certified software
- Software project definition at vehicle and machine level
- Project support for multiple controllers
- Automatic code generation for controllers and displays
- Safety-related development cycle in acc. with V-model supported
- Capturing of requirements, as well as use case and test case management
- Generation of project and development documentation; customer-specific document properties can be configured
- Comprehensive definition of:
 - CAN communication
 - Error messages and reactions
 - Parameter and option lists in NvMem and flash memory
 - I/O pins considering the safety requirements
- Use of certified driver modules to control connected actuators and sensors
- Generation of embedded code for supported controller hardware, as well as for simulating the application on the PC (software in the loop)
- Protocol interface for flexible integration of certified protocols
- Toolbox interface for flexible integration of certified library modules

SCOPE OF DELIVERY

Installation program for:

- PDT desktop application
- Integrated development environment (Eclipse)

ACCESSORIES

Not included in the scope of delivery:

- Cable harnesses for controllers
- Programming cable (CAN)
- PCAN dongle, plug connector

PDT Ordering Information

ORDERING YOUR INDIVIDUALLY CONFIGURED VERSION

The order is placed on the basis of the model code. In addition to the selected basic variant, the desired version and a modification number (as applicable) are specified.

The model designations for the enhancements and add-ons are given on the following pages, and the embedded targets, toolboxes and stacks in sections 3, 4 and 5.

PDT BASIC VERSIONS

MODEL CODE

MATCH PDT – XX – G10 – 000

Program basic version

CP = PROGRAMMER C
CD = PROGRAMMER CODESYS
00 = STANDARD DEVELOPER

Software version

G10 = current version

Modification number

000 = standard

PDT – TECHNICAL DATA

Software system requirements

Supported operating systems	Windows® 7, 8 or 10 (32/64 bit)
Software	.NET 4.6 Framework C-Compiler for the corresponding controllers PDF display program such as Adobe Acrobat® Reader®

Hardware system requirements

Processor	Minimum dual-core processor with 1.6 GHz
RAM memory requirements	Minimum 2 GB (4 GB or more recommended)
Hard drive memory requirements	Minimum 1 GB available memory
Ports	One free USB port
Screen resolution	Minimum 1024 x 768

Meets following standards (in acc. with program scope)

Functional safety	IEC 61508 – SIL2, EN ISO 13849 – PLd, ISO 25119 & EN 16590 – AgPLd (SRL2)
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Ordering the PDT Program Enhancements

ADD-ONS FOR THE PDT BASIC VERSIONS

PDT PROGRAMMER C

Add-ons – Program Enhancements

MODEL CODE

MATCH PDT – CP – G10 – AO – YYYY – 000

Basic version

CP = PROGRAMMER C

Add-on

Enhancement variants

Automatic code generation

EC2D = automatic code generation enhancement for safety related embedded C-code (SIL2, PLd, AgPLd) for controllers

Features/functionalities

CANO = CANOpen user interface and EDS file import

HMG4 = HMG 4000 integration

Service tool integration

STPG = service tool customisation (start page)

PRLG = project languages

Import/export interfaces

ISYM = symbol file import

DBCE = export of DBC files

Modification number

000 = standard

PDT PROGRAMMER CODESYS

Add-ons – Program Enhancements

MODEL CODE

MATCH PDT – CD – G10 – AO – YYYY – 000

Basic version

CD = PROGRAMMER CODESYS

Add-on

Enhancement variants

Features/functionalities

HMG4 = HMG 4000 integration

Service tool integration

STPG = service tool customisation (start page)

PRLG = project languages

Import/export interfaces

ISYM = symbol file import

DBCE = export of DBC files

Modification number

000 = standard

PDT STANDARD DEVELOPER

Add-ons – Program Enhancements

MODEL CODE

MATCH PDT – 00 – G10 – AO – YYYY – 000

Basic version

00 = DEVELOPER

Add-on

Enhancement variants

Automatic code generation

ECEN = automatic code generation of safety related embedded C-code for controllers

ECD3 = automatic code generation in CODESYS 3.5 (standard) for controllers

SCD3 = automatic code generation in CODESYS 3.5 SIL2 for controllers

V2C3 = automatic code generation in CODESYS 3.x for eVision² display

D3QT = automatic code generation in "Linux Qt" for different devices (e.g. remote devices)

Documentation

SPCK = specification package

Features/functionalities

RCAP = requirements capturing

Import/export interfaces

DBCE = export of DBC files

RQIF = ReqIF import/export interface

Modification number

000 = standard

NOTE

Subject to technical modifications and corrections.

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15–16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

2 MATCH PC Tools

2.2 MST – Machine Service Tool



M S T

DESCRIPTION

The Machine Service Tool (MST) supports the machine configuration and machine maintenance of the applications developed using MATCH.

It can be used across the machine's entire life cycle: for developing and testing the application software, for commissioning during production and for service tasks during machine operation and maintenance in the field.

FUNCTIONALITIES OF THE MST

- Connection to the controllers, displays and remote devices via CAN or Ethernet
- Remote access via WLAN or various mobile communication standards
- Application software can be downloaded to various devices
- Writing and reading of factory default settings
- Access to and modification of parameters and options
- Display of machine and controller information
- Calibration and configuration of machine functions
- Access to the error memory in the machine
- Diagnostics for the input and output pins and the application variables and CAN signals of the controllers
- Support for integration tests on the machine

The MST is available in four basic versions:

MST SERVICE, MST DEVELOPER, MST DESIGNER, MST ULTIMATE.

The basic versions can be individually expanded with add-ons and modules.

Furthermore, an MST program version is available for machine and fleet management: MST SERVICE MASTER.

The program versions are optimised for various requirements and user groups:

SYSTEM COORDINATION WITH THE MST

- The DEVELOPER version of the MST enables the coordination of configurations, calibration data and default settings as well as a wide troubleshooting. The DESIGNER version can create machine-specific diagnostic pages, combine graphic elements with parameters and diagnostic data and extend the range of languages. The ULTIMATE version offers all the functionalities of MST.

APPLICATION SOFTWARE DEVELOPMENT WITH THE MST

- The MST DEVELOPER provides – in addition to its function as a service and maintenance tool – assistance during the development of the software, optimisation of the machine functions and commissioning of the machine. MST DESIGNER creates the prerequisites for a function-oriented and efficient system analysis on the vehicle including the creation of machine-specific diagnostic pages. The designed additional elements can be used from the other MST versions for an enhanced vehicle analysis. MST ULTIMATE includes all functionalities.



MACHINE VALIDATION WITH THE MST

- MST DEVELOPER provides support at the time of prototype commissioning and final optimisation.
MST DESIGNER creates the prerequisites for an efficient, function-based system analysis on the vehicle. Diagnostic pages, including graphic elements, can be set up according to the specific functionality and modified. The designed additional elements can be used from the other MST versions for an enhanced vehicle analysis. MST ULTIMATE offers all the functionalities of MST.

PROBLEM ANALYSIS IN THE FIELD WITH THE MST

- MST SERVICE enables access to and modification of all of the controller data which are relevant for service and maintenance as well as for a later modification and enhancement of machine options. The analysis is significantly simplified by means of error lists and synchronous access to all the controllers.
Thanks to its additional features, MST DEVELOPER enables an even more extensive problem analysis in the field.

COMMISSIONING AND END-OF-LINE SUPPORT WITH THE MST

- All the hardware and software information of the controllers can be accessed at the time of commissioning using the SERVICE version. This means that machine equipment can be configured, parameters can be adjusted, calibration values can be set and error lists can be processed. The initial commissioning is made significantly simpler with specially developed diagnostic and calibration pages – in addition to the pin diagnosis.

SERVICE ORGANISATION WITH THE MST

- MST DESIGNER can be used to extend the range of service languages, create specific diagnostic/calibration pages and add help documents to the project start page. Any software state variables can be conveniently integrated via "drag & drop". Access and rights management guarantees a perfect fit with sales partners, plant service or customers.
Worldwide service is organised using the SERVICE MASTER module.

FIELD SERVICE ENGINEERING

- MST SERVICE enables access to and modification of all of the controller data which is relevant for service and maintenance and for the later installation of machine options. This ensures efficient maintenance and easy adaptation to special customer requirements.

MST – Program Version Selection

BASIC VERSIONS

First select the basic version that suits you.

MST SERVICE



For field service organisation,
as well as commissioning during production

MST DEVELOPER



For system development.
Diverse support for optimising machine functions
and for tests on the machine

MST DESIGNER



For the project-specific design of diagnostic tasks,
parameterisation pages and the management
of service languages

MST ULTIMATE



For power users.
The complete package with all MST features

ENHANCEMENTS

Enhance your basic version in the second step: depending on the area
of application and requirements, select the add-on (functionalities in the tool)
and the required module (structural enhancements).

MST PROGRAM VERSION



Selected to meet your requirements



Add-ons – Program Enhancements



ADD-ON

MPDL – Machine Project Download (SERVICE)



Modules – Enhancement Components



MODULE

MFLS – Machine Fleet Repository Service
EOLD – End-of-line Service DLL

SCOPE OF DELIVERY

- Installation program

ACCESSORIES

Not included in the scope of delivery:

- Programming cable (CAN),
part number: 6149786,
for HY-TTC 50 / 60 / 90 / 94 or
- Programming cable (CAN),
part number: 61499787
for HY-TTC 77
- 7" display with GSM support
HY eVision² 7.0 -CD-R-00-07-01-E-000,
part number: 923775
- PCAN dongle ZBS PCAN-USB,
connector, part number: 6163719

- Project selection in the MST UI,
sorted by machine group
- Download of software for all controllers and
displays installed on a machine – with just one
click of the mouse

- The MFLS module is required for the availability
and use of the fleet service and remote access
to the machines in the field
- With the MATCH end-of-line library EOLD,
you can integrate the production data into
your product lifecycle platform

PROGRAM VERSION FOR ADMINISTRATION

The program version MST SERVICE MASTER can be used for managing machines and fleets.

MST SERVICE MASTER



Management of user accounts and their access rights and management of remote access to machines



Modules – Enhancement Components



MODULE

MFLS – Machine Fleet Repository Service

- The MST SERVICE MASTER is for the administration of a service network; it does not provide access to the machine data

- The MST-MFLS module is a prerequisite to use the MST SERVICE MASTER for administration of remote access

MST Features

Program functionalities of the MST basic versions at a glance:

MST version	ADMINISTRATION	BASIC VERSIONS			
	SERVICE MASTER "SM"	SERVICE "SV"	DEVELOPER "DP"	DESIGNER "DS"	ULTIMATE "UT"
Access management					
User administration	x	–	–	–	–
User access control	–	x	x	x	x
Different access levels (max. 8)	x	x	x	x	x
Vehicle protection code	x	x	x	–	x
Machine / fleet administration	o ^{*1)}	–	–	–	–
Machine remote access	–	o ^{*1)}	o ^{*1)}	o ^{*1)}	o ^{*1)}
Project administration					
Project file creation	–	–	x	x	x
Project file handling	–	x	x	x	x
Project data import (from PDT)	–	x	x	x	x
Languages					
Multiple languages	–	x	x	x	x
Interfaces to vehicle					
CAN	–	x	x	–	x
Remote access	–	x	x	–	x
Vehicle hardware & software information					
Multiple controllers	–	x	x	–	x
Software download					
Controller software download	–	x	x	–	x
Machine project download	–	AO-MPDL	x	–	x
Common functionality					
Write factory default settings	–	x	x	–	x
Parameter management access	–	x	x	x	x
Error management access	–	x	x	x	x
Error information	–	x	x	x	x
I/O diagnostics	–	x	x	x	x
CAN signal value access	–	x	x	x	x
Other					
Machine data backup	–	x	x	–	x
Restore machine data	–	x	x	–	x
Customisation					
Individual start page and spec. documents	–	x	x	x	x
Custom page designer	–	–	–	x	x
Software test features					
Debug console	–	–	x	–	x
Forcing error codes	–	–	x	–	x
Forcing error management interfaces (SC, RC & RM)	–	–	x	–	x
Pin value forcing	–	–	x	–	x

Note: x = included, – = not available, AO = required add-on, can be added via model code, o = optional

^{*1)} The MST telematics module "MATCH MST-MO-TS-MFLS" is required for the functionality (see further below in this section)

MST Ordering Information

ORDERING THE PROGRAM VERSION

Ordering is based on a model code whereby the basic variant and/or the administration (SERVICE MASTER) are selected.

MST BASIC VERSIONS

MODEL CODE

MATCH MST – XX – G10 – 000

Program basic version

SM = SERVICE MASTER
SV = SERVICE
DP = DEVELOPER
DS = DESIGNER
UT = ULTIMATE

Software version

G10 = current version

Modification number

000 = standard

For the SERVICE version, various discounted company licences can be purchased for the service organisation:

MST SERVICE Company Licences

MODEL CODE

MATCH MST – SV – G10 – AO – XXXX – 000

Basic version

SV = SERVICE

Number of licences

C050 = approval of up to 50 licences
C150 = approval of up to 150 licences
C000 = unlimited number of licences

Modification number

000 = standard

PRODUCT FEATURES, BASIC VERSIONS

- Flashing controllers
- Available for different user groups in different basic versions
- Language management
- MST supports several languages
- Service project information can be made available in as many languages as desired
- Comprehensive user management with project-specific rights for up to eight access levels. User rights can be set for each individual parameter or error
- The data is transmitted to the controller via the CAN bus or TCP/IP.
- Simultaneous access to all controllers and displays available in the vehicle project
- Machine-dependent homepage in the context of project management
- Extensive machine information can be incorporated as PDF
- Reading and writing of the NvMem, parameter and option lists
- Reading and writing of default settings (flash memory)
- Diagnosis of input and output pins and other system variables
- Clear access to error information
- Support with integration tests performed on the machine, e.g. by setting individual error numbers and other error properties

PRODUCT FEATURES, COMPANY LICENCES

- For limited versions (C050, C150) it is possible for the user (OEM) to approve the licences either individually or automatically
- For unlimited versions (C000), the licences need to be approved by the user (OEM)

PRODUCT FEATURES, SERVICE MASTER

- In the operating interface of the MST SERVICE MASTER, the VPN certificates required for remote access to the machines and service tools are managed in a secure network

FUNCTIONALITIES, REMOTE ACCESS WITH MST

The following MST functionalities/services are made possible online, for example:

- Reading software and hardware information of the controllers on the machine
- Access to the management of machine parameters, configuration and default settings
- Access to the management of error codes
- Pin diagnostics
- Access to the CAN signals
- Download of hex files

Ordering MST Program Enhancements

SERVICE ADD-ONS FOR THE MST BASIC VERSIONS

MST

Add-on – Program Enhancements

MODEL CODE

MATCH MST – XX – G10 – AO – YYYY – 000

Program basic version

SV = SERVICE
DP = DEVELOPER
DS = DESIGNER
UT = ULTIMATE

Add-on

Enhancement variants

MPDL = machine project download (only SV)

Modification number

000 = standard

Ordering MST Enhancement Components

MODULES FOR THE MST PROGRAM VERSIONS

MST MODULES

Module Group – Telematic Services

MODEL CODE

MATCH MST – MO – XX – YYYY – ZZZZ – 000

Module

Module group

TS = Telematic Services

Enhancement components

MFLS = Machine Fleet Repository Service

Details

0050 = 50 participants, 3 simultaneous online connections
0120 = 120 participants, 5 simultaneous online connections
0240 = 240 participants, 10 simultaneous online connections
1000 = 1000 participants, 25 simultaneous online connections
0000 = further details on request

Modification number

000 = standard

MST MODULES

Module Group – Extended Services

MODEL CODE

MATCH MST – MO – XX – YYYY – ZZZZ – 000

Module

Module group

ES = Extended Services

Enhancement components

EOLD = End-of-line Service DLL

Details

0000 = no specific details

Modification number

000 = standard

MST – TECHNICAL DATA

Software system requirements	
Supported operating systems	Windows® 7, 8 or 10 (32/64 bit)
Other software	.NET 4.6 framework
Hardware system requirements	
Processor	Minimum dual-core processor with 1.6 GHz
RAM memory requirements	Minimum 2 GB (4 GB or more recommended)
Hard drive memory requirements	Minimum 200 MB available memory
Ports	One free USB port
Screen resolution	Minimum 1024 x 768
CAN USB interface	
PCAN-USB (additional dongles on request, see Accessories)	
Interface, remote access	
TTConnect Wave on the machine	
MST access to the machine fleet repository service (MFLS module)	

PRODUCT FEATURES TELEMATIC SERVICES

- Management of module infrastructure in any “docker” environment

The module provides a secure machine network with the following features:

- Scalable backend infrastructure for setting up a secure network that is able to access any machines in the field online remotely by means of corresponding remote devices (e.g. TTConnect Wave) via mobile communication standard, thus enabling machine fleet management
- This requires a mobile communication connection (possibly with a fee) or a TCP/IP-based network connection (Ethernet/WIFI)
- Table-based online management of the available machines in a specific fleet
- Management of the machines based on names
- VPN tunnel ensures secure communication

PRODUCT FEATURES END-OF-LINE SERVICE DLL

With the MATCH end-of-line library, you can integrate the production data into your product lifecycle platform.

The module makes it possible to implement your own Windows applications for production that grant access to the service area of the (MATCH-based) controllers in the machine.

The service DLL establishes a connection via CAN to whichever machine controller is active and supports the following functions:

- Controller software download
- Installation of factory default settings on the controller
- Access to and modification of parameters, calibration values and options

To check the user inputs, the service DLL provides functions for validating comparative input values to the value ranges defined in the machine project file (*.mpf).

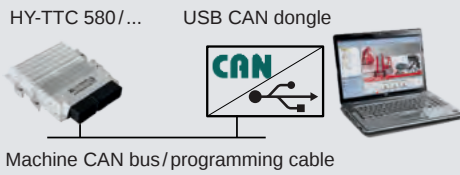
For the conclusive documentation of the machine configuration in the factory, all of the MATCH application's software and hardware information and parameters can be exported in a text-based XML format. This makes it easy to document the machine's delivery status and to restore it if a controller is changed.

System requirements for Service DLL:
Windows 8.0, .Net 4.6, Peak CAN driver

MST – Connection to the Controller

Ways of establishing the connection to the controller.

Connection via PCAN Dongle

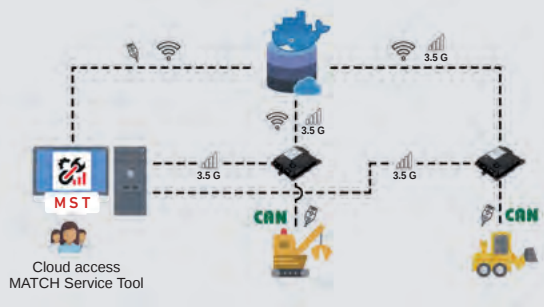


Connection to the controller via PCAN dongle:
You can connect the dongle directly to the controller with a programming cable (available separately).

NOTE

Subject to technical modifications and corrections.

Connection via TTConnect Wave Mobile Communication Standards



Connection via various mobile communication standards established via the TTConnect Wave interfaces.

WLAN



WLAN connection of service laptop via "TTConnect Wave"

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15-16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

2 MATCH PC Tools

2.3 TSE – Test and Simulation Environment



TSE

DESCRIPTION

The MATCH application is tested with the Test and Simulation Environment (TSE) – during development as well as after completion.

TSE supports all the test levels based on the V-model and enables module, integration, system and application tests. All the application information created in PDT, including the information of the requirements management, can be provided using import functions with the click of a mouse in TSE.

For practical tests directly on the controller hardware, one or several Remote Test Benches can be used, for example. In addition to the real RTB, the TSE also provides a “virtual” test bench.

The system is “Ready for Test” once the data is imported and the test bench environment (RTB) is set up. The integrated interfaces ensure direct access and modification of parameters, options and default settings of the application project as well as error management and CAN communication.

USE TSE TO:

- create, manage and document your test projects
- control and configure the Remote Test Bench (RTB) for machine simulation
- combine the controllers into one machine test project
- simulate your embedded application on the PC and to implement software tests on the virtual test bench
- automate your tests with the test script interface and combine them in test suites
- generate documents with the test results at the click of a button

TSE is available in five versions, tailored to suit various user groups:

BASIC BENCH CONTROL, BASIC SIMULATION CONTROL, STANDARD BENCH CONTROL, VIRTUAL TEST ENVIRONMENT, AUTOMATED TEST & SIMULATION ENVIRONMENT.

The versions (apart from BASIC BENCH) can be enhanced with add-ons. This enables you to configure a version customised to suit your needs.



TESTING SOFTWARE WITH THE TSE

- TSE can be used for the test processes required in the V-model. The project data is provided in the test environment. This means that the test project can be documented easily. Depending on the selected TSE version, you can either perform tests with real test bench hardware or test your software projects virtually on your PC. Tests with one or several controllers are supported.

MACHINE VALIDATION WITH THE TSE

- The TSE makes the project information available in the test environment. To validate the application software on the vehicle, the test procedures can be defined. Vehicle validation lists can also be created and managed.

TSE – Selection of Program Versions

BASIC VERSIONS

First select the basic version that suits you.

TSE BASIC BENCH CONTROL



Developer

Manual bench control w/ one controller target

- Free version, included in the scope of delivery of the remote test bench (RTB)
- For manual control of an RTB in conjunction with the test of a controller

TSE BASIC SIMULATION CONTROL



Developer

Manual simulation control ("virtual testing") w/ multiple controller targets

- Multiple controllers simulated on the PC
- Project import from PDT
- Manual control of simulated pins for debugging embedded software on the PC

TSE STANDARD BENCH CONTROL



Test engineer

Automated bench control w/ multiple controllers for system testing on machine level

- Multiple RTBs and one/several connected controllers
- Project import from PDT including CAN residual bus simulation
- Script-based automation

TSE VIRTUAL TEST ENVIRONMENT



Test engineer or developer

Automated virtual testing on PC: system ("pin to pin"), integration and module test levels

- Multiple controllers simulated in the virtual test environment
- System, integration and module tests
- Script-based automation

TSE AUTOMATED TEST & SIMULATION ENVIRONMENT



Test department

Automated bench and virtual testing on system, integration and module test level

- Complete solution for test automation
- Multiple RTBs and the virtual test environment, each with multiple controllers
- System, integration and module tests

ENHANCEMENTS

Expand your basic version in the second step: choose the add-ons that suit the area of application and any specific requirements.

We also offer the test sequence editor as an add-on for simplified step-by-step definition/programming of system sequences.

TSE BASIC VERSION



Selected to meet your requirements



Add-ons – Program Enhancements



ADD-ON

Test sequence editor (standard version)
Specification package
Requirements management
Pin simulation

SCOPE OF DELIVERY

- Installation program

ACCESSORIES

Not included in the scope of delivery:

- PCAN dongle ZBS PCAN USB
- Plug connector
- Controller test bench (RTB)
ZBS RTB-RACK-43-VGKS-A0-00-000
ZBS RTB-RACK-63-VGKS-A0-00-000
is fitted according to controller

TSE Features

Program functionalities of the TSE basic versions at a glance:

TSE basic version	Basic Bench Control "BB"	Basic Simulation Control "BS"	Standard Bench Control "SB"	Virtual Test Environment "VTE"	Automated Test & Simulation "AE"
Common					
Test project administration	–	x	x	x	x
Machine data management	–	x	x	x	x
PDT project data import	–	x	x	x	x
Features / functionalities					
Residual CAN bus simulation	–	AO-RCAN	x	x	x
Requirements management (incl. ReqIF inter.)	–	–	AO-REQM	AO-REQM	AO-REQM
Test methods					
Validation testing	x	–	x	–	x
System testing	x	–	x	x	x
Integration & unit / module testing	–	–	–	x	x
Test automation					
Python test script environment	–	–	x	x	x
Test sequence editor "standard version"	–	–	AO-SQES	AO-SQES	x
Remote test bench (RTB)					
Single test bench control	x	–	x	–	x
Multiple (combined) test benches	–	–	x	–	x
Multiple controllers on test bench(es)	–	–	x	–	x
Manual test bench control	x	–	x	–	x
Loading / saving of different RTB projects	x	–	x	–	x
Virtual test bench					
Multiple connected simulated controllers	–	x	–	x	x
Debugging of simulated embedded controllers	–	x	–	x	x
Automated pin simulation (w/ Python scripts)	–	AO-APIN	–	x	x
Pin based fault injection	–	AO-FINJ	–	x	x
Documentation					
Generic project documentation	–	x	x	x	x
RTB configuration document	x	–	x	–	x
Test cases & results specification	–	–	x	x	x
Specification package	–	–	AO-SPCK	AO-SPCK	AO-SPCK
Import/export interfaces					
Symbol file import	–	x	x	x	x

Note: x = included, – = not available, AO = required add-on, can be added via model code.

TSE Ordering Information

ORDERING THE PROGRAM VERSION

The order is placed on the basis of the model code. Please specify the software version and a modification number (as applicable) in addition to the selected basic variant.

TSE BASIC VERSIONS

MODEL CODE

MATCH TSE – XX – G10 – 000

Program basic version

BB = basic bench control
BS = basic simulation control
SB = standard bench control
VT = virtual test environment
AE = automated test & simulation environment

Software version

G10 = current version

Modification number

000 = standard

PRODUCT FEATURES

- Enables implementation of various levels of the software tests in accordance with demanding safety and quality standards
- Shortens the development times
- Enables consistent test quality

Configuration

- Import of application data from the PDT project definition
- Allocation of controller pins to respective channel on the test bench
- Set-up and monitoring of all the test bench plug-ins/channels
- Automation of test configuration and test sequences with Python or via the sequence editor

“Software in the loop”

- Complete simulation of the RTB on the PC
- Stimulation of input and output pins with little effort and in the early stage of development
- Virtual function and error tests from “pin to pin” by means of PC simulation (application can run on the PC)

“Hardware in the loop”

- Stimulation of the electrical behaviour of the input and output PINs on the controller test bench (HYDAC remote test bench – RTB) from the PC
- Pin and component information display (e.g. equipment ID) live on the test bench
- Function and error mode tests at machine level
- Automation of test sequences Python or via the sequence editor

Support of all test levels

- Unit or module tests based on test frame generated from the source code with Python integration testing
- Integration tests are carried out in a similar way to the unit and module tests based on the MATCH Core functions
- Residual bus simulation on the CAN bus
- Automation of unit/module test sequences using Python

Ordering TSE Program Enhancements

ADD-ONS FOR THE TSE BASIC VERSIONS

TSE

Add-on – Program Enhancements

MODEL CODE

MATCH TSE – XX – G10 – AO – YYYY – 000

Program basic version

BS = basic simulation control
SB = standard bench control
VT = virtual test environment
AE = automated test & simulation environment

Add-on

Extension variant

RCAN = residual CAN bus simulation (BS only)
APIN = automated pin simulation (BS only)
FINJ = pin based fault injection (BS only)
SPCK = specification package (SB, VT, AE only)
SQES = test sequence editor “standard version” (SB, VT only)
REQM = requirements management incl. ReqIF interface (SB, VT, AE only)

Modification number

000 = standard

PRODUCT FEATURES

Test automation

- Create automatic test cases with Python integration testing
- Python integration testing provides all the project and test bench data, incl. CAN residual bus simulation
- Generate and monitor automatic tests

Automatic generation of test documentation

- Test results as XML or PDF
- Test documentation as PDF

TEST SEQUENCES

You can carry out the unit/module tests and the integration test of your C source code by implementing the following steps:

- Generate the unit test frameworks from the C files
- Program the test cases in the TSE with Python
- Carry out the tests and check the results log

Use the Test and Simulation Environment (TSE) for the following work steps of the validation or system tests:

- Simulation of the entire machine's controller inputs and outputs at early stages of the development process
- Performance of function and error tests
- Use and control of the remote controllable controller test benches (RTBs) with a TSE bench control version
- Software emulation of a complete machine project with the virtual test environment
- Residual bus simulation on the CAN bus

TSE – TECHNICAL DATA

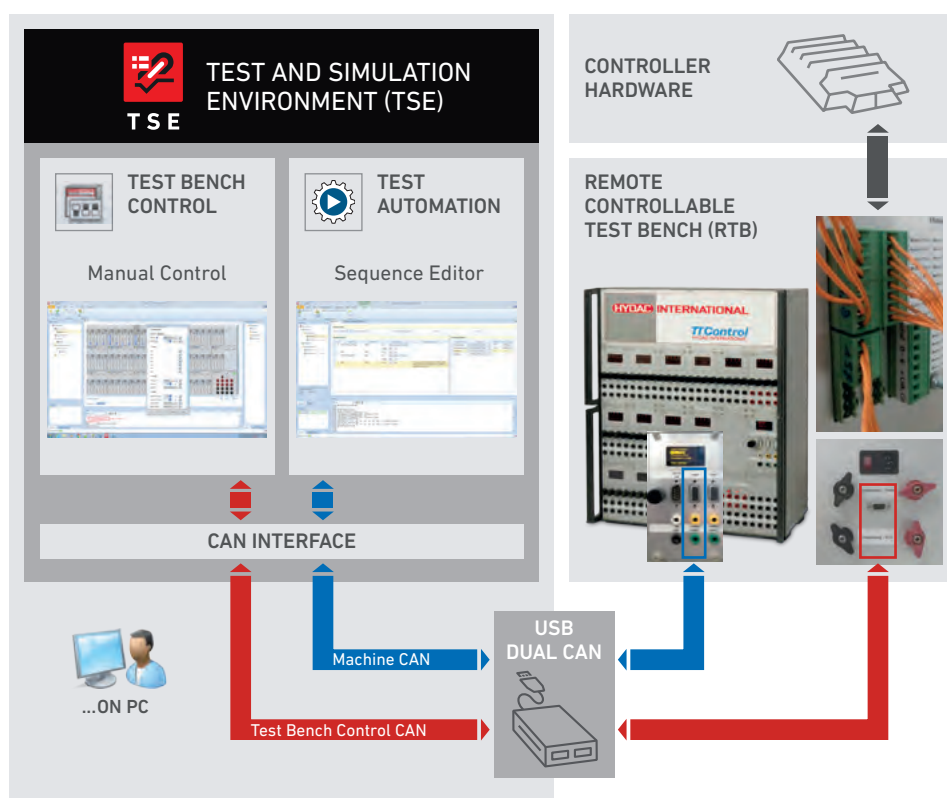
Software system requirements	
Supported operating systems	Windows® 8 or 10 (32/64 bit)
Other software	.NET 4.6 framework, Python 3.2
Hardware system requirements	
Processor	Minimal 4-core processes with 1.6 GHz
RAM memory requirements	Minimum 2 GB (4 GB or more recommended)
Hard drive memory requirements	Minimum 300 MB available memory
Ports	One free USB port
Screen resolution	Minimum 1024 x 768
CAN USB interface	
PCAN USB or PCAN USB Pro interface	
Controller test bench	
Remote Test Bench (RTB) for the bench control version	ZBS RTB-RACK-43-VGKS-A0-00-000 ZBS RTB-RACK-63-VGKS-A0-00-000

Application Examples

USING THE TSE IN CONJUNCTION WITH AN RTB

The TSE makes it possible to configure and remote-control states (manual control) and test sequences (e.g. via sequence editor) on the remote controllable test bench (RTB) via a CAN connection, the "Test Bench Control CAN". The interface module installed on the front side also provides full access to the machine's communication (e.g. "Machine CAN"), enabling this data to be incorporated into the test sequences and test results and a residual bus simulation to be performed.

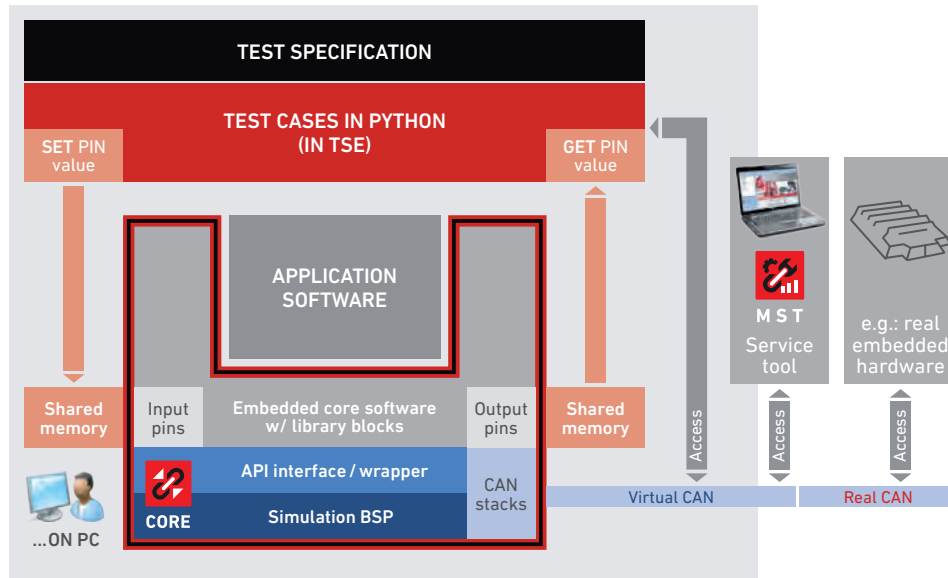
Multiple test benches can also be combined for a complete test with a large number of controllers at machine level.



VIRTUAL TESTING WITH THE TSE

The TSE makes it possible to control the pins of the embedded controller software in a virtual environment on the PC. In addition to performing the tests, debugging is also possible (on C or C++).

The pin values and error states can be simulated. The CAN signals from the controllers can be easily incorporated into the simulation. A virtual residual bus simulation can also be realised. Connection of real and virtual controllers is also easy via CAN.



NOTE

Subject to technical modifications and corrections.

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15-16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

3 MATCH Software Solutions: Controllers



CERTIFIED SAFETY LEVELS

SIL 2 acc. to IEC 61508
PLd acc. to EN ISO 13849
AgPLd (SRL2) acc. to
ISO 25119 & DIN EN 16590

MATCH provides optimised software solutions for the programming of embedded controllers in various development environments.

The targets for the various controllers are composed of the embedded middleware, the MATCH CORE and the specific standard toolbox. They are TÜV-certified and have been used successfully in mobile equipment for many years and in every branch of industry.

To enhance the software functionalities on the embedded controller, we offer additional toolboxes, libraries and communication stacks.

The toolboxes and stacks are also usually TÜV-certified – to the safety levels SIL 2, PLd and AgPLd (SRL2).

The corresponding targets, library modules and stacks are managed in the project definition tool (PDT). From there, they can be added as needed to the particular development environment (IDE), together with the other project data, and then joined with the machine's specific application software.



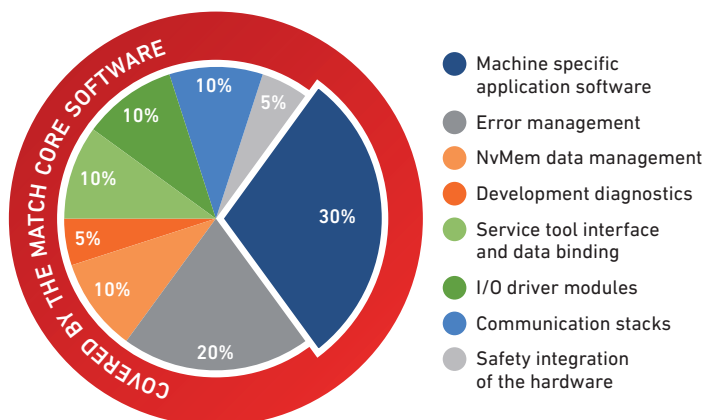
AVAILABLE SOLUTIONS

Software solutions for C

- Targets (middleware/MATCH CORE and standard toolbox)
- Enhancement of the software functionalities by means of additional toolboxes, libraries and communication stacks.

Software solutions for CODESYS 3.5

- The targets include the MATCH CORE and the standard toolbox
- The standard CAN stack, the service tool interface and the "DM(x) basic" stack are also integrated



Significant reduction of the entire programming workload by up to 70 % thanks to the software frame autogenerated by MATCH

3 MATCH Software Solutions: Controllers

3.1 Targets

CORE – Embedded Middleware



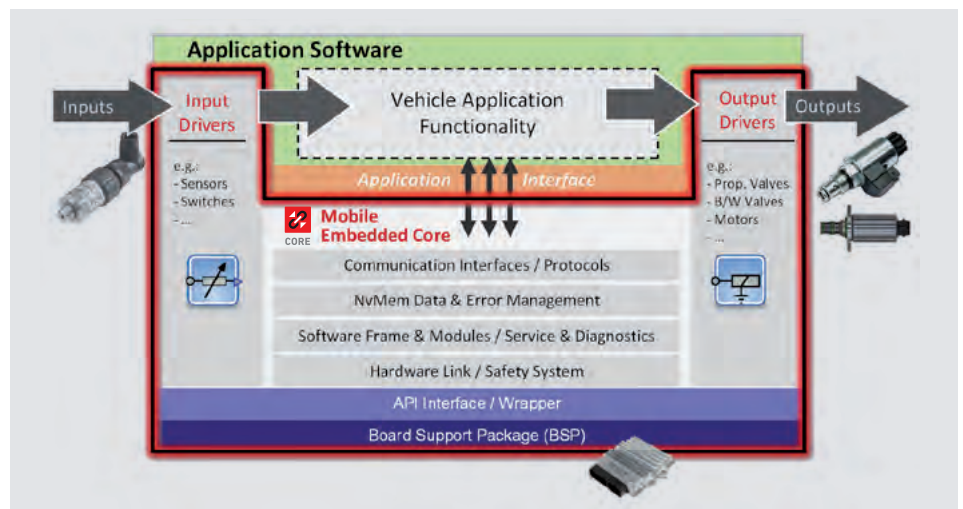
DESCRIPTION

The embedded middleware, the MATCH CORE, provides the basic software of the application project – enhanced by comprehensive libraries. The basic software has been extensively tested, TÜV-certified and perfected for mobile working machinery.

You therefore benefit from sophisticated error and parameter management and extensive diagnostics functions and service tool interfaces. Library modules and communication stacks are easily and modular addable.

USE THE CORE TO:

- define the requirements for the machine control
- significantly simplify the implementation of the functional safety requirements
- use comprehensive functions to access the controller
- program almost independently of the hardware in an approved and extensively tested environment
- save considerably on development costs



Autogenerated software frame

The CORE is available for all the controllers in the tool chain. The robust middleware is installed on the controller's board support package (BSP). It addresses any hardware integrated in MATCH with its specific requirements and abstracts its functionalities. CORE therefore offers a standardized interface to all supported controllers – and therefore the possibility of hardware-independent programming.

MATCH CORE also provides a large number of functionalities for the application. These include the functional safety integration of the hardware and an interface for managing the library modules and communication stacks.

The middleware is selected in the Project Definition Tool (PDT). The Auto Code Builder, which is also also certified, generates out of the PDT a project structure for the controller application.



- Evaluation of analogue current and voltage signals
- Evaluation of resistance and frequency signals
- Drivers for standard sensors and sensors with enhanced functional safety requirements
- Support of single and redundant switches
- Control of digital and proportional outputs
- Current-controlled proportional valve control
- Configuration of transfer characteristics (look-up tables)
- Basic time and signal elements

DESCRIPTION

The standard toolbox provides essential modules for a simple control of actuators and sensors. These include valves, analogue sensors and switching and control elements.

The standard toolbox is available for every controller platform in MATCH.

It is managed in the Project Definition Tool (PDT). The library modules are tailored to the specific application out of the PDT using the certified Auto Code Builder.

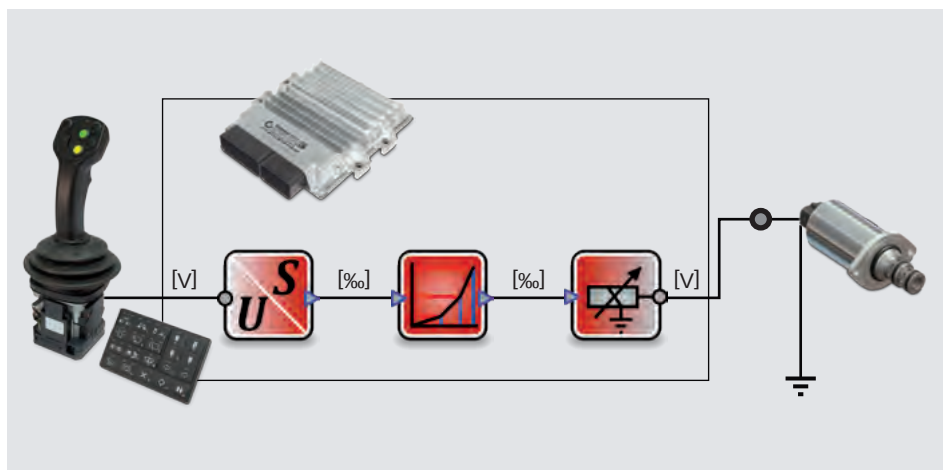
All the library modules of the standard toolbox are TÜV-certified pursuant to the safety levels SIL2, PLd and AgPLd (SRL2).

With the standard toolbox you can noticeably reduce your development workload – while complying with the standards of functional safety.

STANDARD TOOLBOX LIBRARY MODULES



Application example of a valve control based on the “proportional valve output” (BloPro).



NOTE

Subject to technical modifications
and corrections.

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15-16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

3 MATCH Software Solutions: Controllers

3.2 Toolboxes – additional Embedded Software Libraries



SIGNAL ELEMENTS

Signal elements are software modules that provide basic functions for your application. They are completely encapsulated and may contain state variables.

Signal elements can be used in "C" code like complex variables:
you initialise the signal elements with access functions and they can then be adapted or used in the application.

BLOCKS

Blocks are created in the PDT and generated using the Auto Code Builder with the MATCH software frame. They can be connected to controller input/output pins.

Input blocks enable e.g. frequency, current or voltage to be measured with the appropriate error detection, diagnostic options and value conversions.

Output blocks control different valve types, lamps or other electric actuators, also here with integrated diagnostic functionalities.

Every block can:

- include single/multiple error detection and therefore be connected to the error management system
- be connected to one or more input/output pins or no pin
- use parameters connected to the database lists
- include signal elements

DESCRIPTION

As a supplement to the standard toolbox, we offer additional embedded software libraries for application development with MATCH.

The MATCH toolboxes combine several thematically identical library modules. Toolboxes include blocks and signal elements.

A large number of access functions exist at the code level. This enables the library modules to be used in a highly customised way that is coordinated with the specific application.

All toolboxes are managed in the Project Definition Tool (PDT). The certified Auto Code Builder (ACB) is used to generate and parameterise the library modules from PDT which are tailored to the specific application.

The library modules are generally TÜV-certified to the safety levels SIL2, PLd and AgPLd (SRL2).

AVAILABLE TOOLBOXES

Signal control toolbox

Contains a wide range of basic control elements such as signal elements of 1st and 2nd order, closed-loop controllers or signal ramps.

I/O module toolboxes

Provides driver modules for an efficient control and error detection of the inputs and outputs located on the supported I/O modules.

For a CANopen/CANopen Safety I/O module, the corresponding CANopen stack is also required.

Fan control toolbox

Contains extensive modules for the implementation of fan controls for cooling applications.

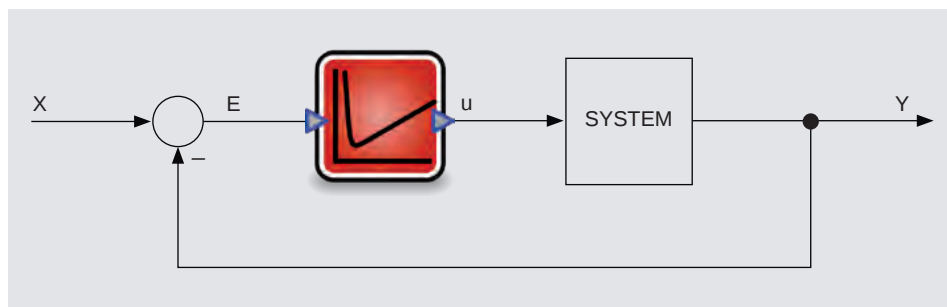
Signal control toolbox

Signal control box library modules



Application example

Application example of a closed-loop control using the “PID controller” block (BloPid).



FEATURES

- Support of advanced closed-loop control functions
- Convenient filter configuration
- Control of signal runtimes
- Analogue and digital noise suppression
- Simulation of dead time behaviour

I/O module toolboxes

I/O module toolbox library modules

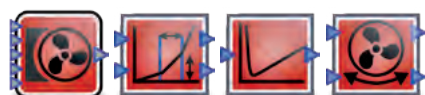


FEATURES

- Support of CANOpen I/O modules
- Besides the signal values the error states of the I/O module pins are also processed
- In this case, the blocks are connected via signals, rather than being directly connected to the hardware contacts of the I/O modules

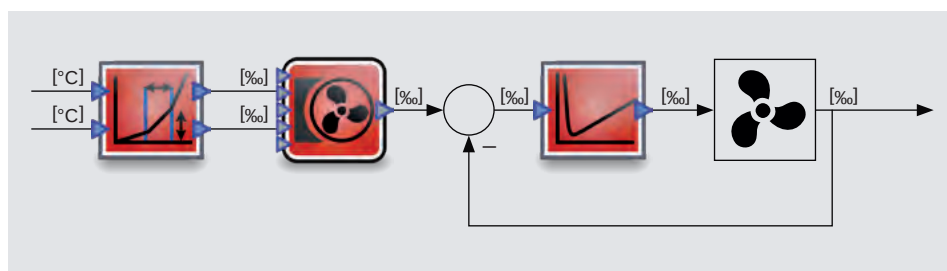
Fan control toolbox

Fan control box library modules



Application example

Application example of a fan speed closed-loop control system using the “fan control” block (BloFanCtrl).



FEATURES

- Various fan control modes
- Multiple-channel signal scaling
- Closed-loop control of fan speed
- Reversal of rotation

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HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15-16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

3 MATCH Software Solutions: Controllers

3.3 Stacks – Communication Interfaces



DESCRIPTION

MATCH offers a large range of TÜV-certified communication stacks: from standard CAN via CANopen/CANopen Safety, as well as specific communication protocols such as DM(x), UDS, service tool protocol (based on KWP2000) up to the ISOBUS.

The stacks and protocols necessary for an application are selected and configured in the Project Definition Tool (PDT). The stacks are then generated tailored to the specific application using the certified Auto Code Builder (ACB) – customised to suit your specific hardware and selected programming environment (IDE).

There are a large number of access functions at the code level, allowing the stack behaviour on the controller to be individually adapted to the requirements of the specific application during initialisation and runtime.

The stacks and protocols are only functional for the selected IDE in conjunction with the corresponding hardware target.

AVAILABLE STACKS

CANopen/CANopen Safety

The CANopen stack was implemented in accordance with Standard CiA 301. Standard CiA 304 forms the basis of the CANopen Safety stack.

Sensors or actuators can be connected to a controller and operated via CANopen I/O modules. The configuration of the external devices is provided by the manufacturer via an object dictionary. The PDT reads the corresponding parameters, allows them to be adjusted and uses them to communicate with the remote station. TPDO, RPDO, SRDO mapping can also be set up easily with PDT.

The CANopen stack provides the possibility of network management (NMT). For CANopen, the classic 11-bit address scheme is recommended for the CAN IDs. Data types with a floating decimal are not supported.

UDS Basic

UDS Basic was implemented in accordance with Standard ISO 14229 (bus-independent protocol part) and ISO 15765-3 (CAN-specific protocol part). This version is backwards-compatible with previous UDS implementations on MATCH CORE. UDS Basic provides the following management services:

- Diagnostic Session Control (\$10): for activating default or extended diagnostics sessions on the controller
- Security Access (\$27): for authenticating the client with the seed & key method
- Tester-Present (\$3E): for maintaining the particular diagnostics session
- Controller reset (\$11): for performing a software-based restart of the controller
- Read/Write-Data By Identifier (Read Data by Identifier \$22, Write Data by Identifier \$2E): for reading and writing database values (parameters, configurations etc.).

All UDS stacks enable access to the service tool area in the controller.

UDS Selected Services

UDS Selected Services was implemented in accordance with the standards ISO 14229 and ISO 15765-3. The version UDS Selected Services adds the following additional services to the UDS Basic version:

- Reading and deleting application errors (Clear Diagnostic Information \$14, Read Diagnostic Information \$19),
- Reading and writing database values with optional application functions (Read Data by Identifier \$22 and Write Data by Identifier \$2E),
- Control of inputs and outputs via an identifier (Input Output Control by Identifier \$2F),
- Performing special application functions (Routine Control \$31).
- The HY-TTC 30 family can be flashed via UDS, i.e. an application and/or factory default settings update is also possible via the UDS protocol.
The parameters for the controller bootloader are set in "branding blocks". *1)

DMX Basic

Diagnostic Messages Basic is a CAN protocol in line with the standard SAE J1939-73 for transmitting and managing error states on the controller via the CAN bus, e.g. to a connected display. Supported services:

- DM1 sends one or more active errors to the application via the CAN bus
- On request, DM2 sends all errors that are no longer active
- On request, DM3 deletes inactive errors from the application

The access rights (access level) for the DMx services are set in the application. MATCH CORE supports up to eight different access rights. The required access rights must be in place for the performance of the particular commands.

DMX Selected Services

DMx Selected Services are an extension of the original DM1, DM2 and DM3 implementation of MATCH CORE in accordance with the standard SAE J1939-73. In addition to DMX Basic, the following services are available:

- DM4 – Freeze Frame Parameters, provides application-specific parameters for the time that an error occurs. A special parameter set is allocated to each error code
- DM11 – deletes active errors from the controller
- DM14, 15 and 16 – enable writing of database variables
- DM31 – allocates existing error codes to the machine's diagnostics lamps

ISOBUS

Protocol stack according to ISO 11783 for agricultural machinery. The application of an implement communicates via the ISOBUS interface with, for example, a virtual terminal and/or other control elements and controllers of a tractor.

Additional licence fees apply for each controller when this stack is used.

All DMX stacks enable access to the service tool area in the controller.

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HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15-16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

*1) A UDS flashloader must also be available on the controller.

3 MATCH Software Solutions: Controllers

3.4 Software Solutions for C

Embedded targets for the target hardware, advanced embedded software functionalities (grouped in toolboxes) and corresponding communication stacks or protocols are available as MATCH software solutions for C.

The targets include the following functionalities of the MATCH CORE (Middleware):

- Generic interface for application programming
- Safety connection of the hardware platform (for safety platform)
- Main state machine and software modules
- Parameter management
- Error management
- Block and communication stack administration
- Abstraction of the communication interfaces and I/Os

They also include standard toolbox modules:

- Input/output driver for sensors, switches, actuators etc.

As well as the following protocols:

- Standard CAN stack (incl. scaling and safety features)
- DM(x) Basic
- KWP2000-compatible service tool interface

MATCH C Controller Targets



CORE



TOOLBOX

MATCH CORE (Middleware)
Standard Toolbox
Standard CAN, DM(x) Basic,
KWP2000 (Selected Services)

To enhance the software functionalities on the embedded controller, additional toolboxes, libraries and communication stacks are available.

Enhanced Embedded Software Functionalities



TOOLBOX



STACKS

Additional software libraries:
Toolboxes
Communication stacks

They can only be used with an Auto Code Builder, which provides the project code in the programming language C for the target, toolboxes and stacks.

Embedded Code Builder Variants



A C B

C-Code

Once the application software has been developed in the IDE, the entire software project (target/libraries/stacks + application code) is compiled for the target hardware. The generated HEX file can then be flashed to the hardware with the MST downloader.

If the software project was translated for the simulation, the corresponding EXE file can be used for more in-depth analyses or tests on the PC.

Ordering information

ORDERING SOFTWARE SOLUTIONS FOR C

The targets can be ordered for the particular target hardware via the following model code.

TARGETS for C

CORE, Standard Toolbox, Service Tool Interface...

MODEL CODE

MATCH ECU – TARG – CEN – X – YYYYY – Z – 00

Target

Programming language

CEN = programming language C

Number of targets

0 = single hardware

B = predefined bundle

Target hardware

“0” single hardware

0-00030 = ECU target for HY-TTC 30H C programming
0-0030S = ECU target for HY-TTC 30SH C programming
0-00032 = ECU target for HY-TTC 32 C programming
0-0032S = ECU target for HY-TTC 32S C programming
0-00050 = ECU target for HY-TTC 50 C programming
0-00060 = ECU target for HY-TTC 60 C programming
0-00071 = ECU target for HY-TTC 71 C programming
0-00077 = ECU target for HY-TTC 77 C programming
0-00090 = ECU target for HY-TTC 90 C programming
0-00094 = ECU target for HY-TTC 94 C programming
0-00508 = ECU target for HY-TTC 508 C programming
0-00510 = ECU target for HY-TTC 510 C programming
0-00540 = ECU target for HY-TTC 540 C programming
0-00580 = ECU target for HY-TTC 580 C programming
0-00590 = ECU target for HY-TTC 590 programming

“B” predefined bundles

B-00030 = HY-TTC 3x bundle C programming
(HY-TTC 30H, HY-TTC 30SH, HY-TTC 32, HY-TTC 32S)
B-00050 = HY-TTC5x bundle C programming
(HY-TTC 50, HY-TTC 60, HY-TTC 90, HY-TTC 94)
B-00500 = HY-TTC5xx standard bundle C programming
(HY-TTC 510, HY-TTC 540, HY-TTC 580)
B-00501 = HY-TTC5xx agricultural bundle C programming
(HY-TTC 508, HY-TTC 590)

Hardware addition

0 = no addition

Modification number

00 = standard

The toolboxes can be added to a particular target hardware in addition to the existing target.

The following model code explains what targets a particular toolbox is available for.

Enhanced Embedded Software Functionalities for C

Toolboxes

MODEL CODE

MATCH ECU – TBOX – CEN – XX – YYY – ZZZ – 00

Toolbox

Programming language

CEN = programming language C

Controller range

00 = available for all controller targets in language C

Toolbox variant

FAN = fan control toolbox

IOM = I/O module toolboxes

SCT = signal control toolbox

YYY = further toolboxes on request

Further information

000 = no further information

“IOM” I/O modules

IOM - B30 = I/O module toolbox bundle for HY-TTC 30XH & HY-TTC 30XSH C programming

IOM - B48 = I/O module toolbox bundle for HY-TTC 48X & HY-TTC 48XS C programming

Modification number

00 = standard

NOTE

Subject to technical modifications and corrections.

Enhanced Embedded Software Functionalities for C

Communication Stacks

MODEL CODE

MATCH ECU – STAC – CEN – YY – ZZZZ – 00

Communication stack

Programming language

CEN = programming language C

Controller range

00 = available for all controller targets in language C

Stack variant

CANO = “CANopen/CANopen Safety” stack for controller C programming

DMXS = “DM(x) Selected Services” stack for controller C programming

UDSB = “UDS Basic” for controller C programming

UDSS = “UDS Selected Services” for controller C programming

ISOB = “ISOBUS” stack for controller C programming

Modification number

00 = standard

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15–16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

3 MATCH Software Solutions: Controllers

3.5 Software Solutions for CODESYS 3.5

As MATCH software solutions for CODESYS 3.5, the following embedded targets are available for the target hardware.

The targets include the following functionalities of the MATCH CORE (Middleware):

- Generic interface for application programming
- Safety connection of the hardware platform (for SIL2 targets)
- Main state machine
- Parameter management
- Error management
- Block and communication stack administration
- Abstraction of the communication interfaces and I/Os

and the modules of the standard toolbox:

- Input/output driver for sensors, switches, actuators etc.

As well as the following protocols:

- Standard CAN stack (incl. scaling and safety features)
- DM(x) Basic
- KWP2000-compatible service tool interface

MATCH CODESYS 3.5 Controller Targets



CORE



TOOLBOX

MATCH CORE (Middleware)

Standard Toolbox

Standard CAN, DM(x) Basic,
KWP2000 (Selected Services)

They can only be used with an Auto Code Builder, which provides the project code in the corresponding programming language CODESYS 3.5 for the target.

Embedded Code Builder Variants



A C B

CODESYS 3.5 code

CODESYS 3.5 SIL2 code

The MATCH target is translated with the particular CODESYS 3.5 or CODESYS 3.5 SIL2 runtime system and provided for the particular target hardware as an HEX file.

Once the application code has been developed in the CODESYS 3.5 or CODESYS 3.5 SIL2 IDE, the application code generated in the IDE is translated for download to the control of the integrated compilers in native machine code (binary code) and downloaded to the runtime environment on the target hardware.

The CODESYS runtime environment offers corresponding options for online debugging on the target hardware, for example.

Ordering Information

ORDERING SOFTWARE SOLUTIONS FOR CODESYS 3.5

The CODESYS 3.5 or CODESYS 3.5 SIL2 targets can be ordered for the particular target hardware. Please use the following model code for this.

TARGETS for CODESYS 3.5

CORE, Standard Toolbox, Service Tool Interface ...

MODEL CODE

MATCH ECU – TARG – CD3 – X – YYYYY – Z – 00

Target

Programming language

CD3 = programming language CODESYS 3.5

Number of targets

0 = standard hardware targets

S = safety hardware targets

Target hardware

"0" standard targets CODESYS 3.5

0-00510 = ECU target for HY-TTC 510 CODESYS 3.5 programming

0-00540 = ECU target for HY-TTC 540 CODESYS 3.5 programming

0-00580 = ECU target for HY-TTC 580 CODESYS 3.5 programming

"S" safety targets CODESYS 3.5 SIL2

S-00510 = ECU target for HY-TTC 510 CODESYS 3.5 SIL2 programming

S-00540 = ECU target for HY-TTC 540 CODESYS 3.5 SIL2 programming

S-00580 = ECU target for HY-TTC 580 CODESYS 3.5 SIL2 programming

Hardware addition

0 = no addition

Modification number

00 = standard

NOTE

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HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15–16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

4 MATCH Software Solutions: Displays

For the embedded programming of HY-eVision² displays, MATCH provides optimised software solutions for development in CODESYS 3.x:

The MATCH eVISION² BASIC LIBRARY enables you to abstract hardware access to the CODESYS system by means of countless auxiliary and convenience functions. This allows you to concentrate fully on the business logic of the display.

MATCH Display – CODESYS Basic Library



eVision² Basic Library

V²BAS

As an advanced variant for efficient programming of HY-eVision² displays, corresponding targets are available in the form of the eVision² MATCH Library.

Functionality of the targets is only provided in conjunction with the eVision² Basic Library (V²BAS) and an Auto Code Builder (ACB, see sec. 2.1), which provides the project code for the target in the corresponding programming language CODESYS 3.x.

MATCH Display – CODESYS Basic Library



eVision² Basic Library

V²BAS

+

MATCH Display Target



eVision² MATCH Library

V²LIB

+

Embedded Code Builder Variants



CODESYS 3.x

A C B

4 MATCH Software Solutions: Displays

4.1 V²BAS – eVision² Basic Library



V²BAS

DESCRIPTION

MATCH eVision² BASIC (V²BAS) is the MATCH basic library for an effective, generic programming approach of the displays in CODESYS 3.x.

The library offers a number of graphic, flexibly configurable base elements for implementing modern human-machine interfaces (HMI) and for up-to-date data management on the Vision² displays.

THE eVISION² BASIC LIBRARY

- provides generic and special classes for graphic display elements – such as buttons, texts, lists, check boxes, progress bars, input fields, windows etc.
- simplifies access to low-level system functionalities due to the introduction of consistent high-level APIs
- simplifies access to hardware components of eVision² displays (such as buzzers, keys, ambient light sensors, LEDs, GSM, GPS, USB, externally connected cameras) and externally connected rotary encoders
- provides initialisation, access and management functionalities for the CAN bus and CAN bus messages
- offers generic tool classes such as timer, byte management counter, stack, checksum, file system and logging class
- enables the initialisation of applications via language management classes (including UTF-8 support)

Ordering Information

Please use the following model code when placing your order.

MATCH eVision² Basic Library

MODEL CODE

	MATCH	EV2	LIBR	CD3	YYY	G10	000
Hardware variant							
EV2		= HY-eVision ² display					
Library							
Programming language							
CD3			= programming language CODESYS 3.x				
Libraries							
BAS			= eVision ² Basic Library for CODESYS 3.x				
Software version							
G10					= current version		
Modification number							
000							= standard

4 MATCH Software Solutions: Displays

4.2 V²LIB – eVision² MATCH Library



DESCRIPTION

The eVision² MATCH Library (V²LIB) expands the concepts of the eVision² basic Library to include function modules and configurable function templates. V²LIB uses CODESYS 3.x and connects the display application to/with the project data available in the PDT and via corresponding communication interfaces to the MATCH Core on the controllers.

The available modules considerably simplify application development on the display: the automatically generated, robust CAN stack therefore enables error-free communication to be established without difficulty with other controllers, displays and sub-systems on the machine.

Using the integrated service module, the controller data can be modified based on the requirements of the machine. Error lists, parameters and configurations can be modified and stored. The user-oriented approach of supporting any language and character set ensures that the display software that has been developed can be used worldwide.



Service Tool homepage



Parameterisation using the service tool functionality



Example of access to the parameterisation in the controllers



Language selection

FEATURES OF THE eVISION² MATCH LIBRARY

- Eliminates repetitive tasks due to internal library observer classes and allows for rapid development progress.
- The PDT generates data for the display, e.g.:
 - Automatic generation of CAN communication, parameter management, error detection and I/O diagnosis
 - Flexible language support from the PDT with as many language versions for the application as desired
- Errors shown on the display:
 - Error messages and responses
 - Error properties regarding display, signal messaging and user confirmations are taken into account
 - J1939-compliant, DM1-based error display: current pending errors (filterable by user level/severity), error history with up to 10,000 error entries, fully automatic audiovisual display of errors with descriptive texts and auditory signals
 - Decoding of proprietary error messages
 - Manual control of error processing possible at any time
- Service Tool functionality on the display:
 - User management: permanent login of users known in the system via password, time-limited login of users known in the system, temporary login of users not known in the system via one-off code, time-limited extension of user rights (8 levels)
 - Parameter display, import and export in accordance with user rights
 - Error access, confirmation and list management
 - Flashing of controllers via the display and via remote access
 - I/O diagnostics / pin diagnostics / CAN diagnostics

Ordering Information

Please use the following model code when placing your order.

MATCH eVision² Targets

MODEL CODE

MATCH – EV2 – TARG – CD3 – X – YYYYY – Z – 00

Hardware variant

EV2 = eVision² display

Target

Programming language

CD3 = programming language CODESYS 3x

Number of targets

0 = single hardware

B = predefined bundle

Target hardware

“0” single hardware

0-07.0z = HY-eVision² 7" target CODESYS 3.x

0-10.4z = HY-eVision² 10.4" target for CODESYS 3.x

Hardware addition

0 = no addition

Modification number

00 = standard

SCOPE OF DELIVERY

- Libraries and quickstart guide

ACCESSORIES

- PCAN dongle ZBS PCAN USB
- Plug connector

TECHNICAL DETAILS

Software system requirements		
Software	PDT CODESYS 3.x	
Displays	With touchscreen	Without touchscreen
	HY-eVision ² 7.0	HY-eVision ² 7.0
	HY-eVision ² 10.4	HY-eVision ² 10.4
CAN USB interface		
PCAN USB (additional dongles on request)		

NOTE

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66280 Sulzbach/Saar
Germany

Zum Kiesberg 15–16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

5 MATCH

Software Solutions: Connectivity

The MATCH Software Suite also includes remote device/connectivity solutions. With the hardware TTConnect Wave, data can be shared with the outside world – either via cloud services that record and analyse data or by services that enable remote access to individual machines in a fleet. The transmission of the data is supported by Ethernet or wireless technologies (3.5 G/WLAN).

With TTConnect Wave and the HY-eVision² displays, MATCH offers both the hardware and the client and server software (Wave: remote software stack and server: docker container) for smooth remote access.

You also have the ability to program your own software for TTConnect Wave on the basis of our MATCH Qt Library and make full use of the advantages of development with MATCH: MATCH enables you to abstract hardware access to the Linux system by means of countless auxiliary and convenience functions. This allows you to concentrate fully on the business logic of your TTConnect Wave Box.

MATCH Remote Device – Qt Library

MATCH Qt Library	Wave Linux Qt environment
	Access CAN hardware
	Abstraction of CAN messages
	Slot based message processing

We also recommend using the Auto Code Builder (ACB, see sec. 2.1) for the TTConnect Wave. This means your CAN bus system defined in the Project Definition Tool (PDT) will be also generated automatically as a Qt code (C++ on Linux) and will be available in the Qt Creator IDE (see sec. 7.2) including all corresponding signals.

Embedded Code Builder Variants



ACB

Generation of C++ code for Linux Qt

The functionality of the code on the remote device is reliant on the corresponding embedded target module for the particular functionality. In this way you can e.g. read, change and/or forward CAN messages.

MATCH remote device – Qt target modules

MATCH Qt Target Modules	Support of PDT CAN settings (e.g. cyclic, event)
	Pin diagnostics
	Version information
	User authentication

5 MATCH Software Solutions: Connectivity

5.1 TTConnect WAVE – Remote Device Software



WAVE

DESCRIPTION

Use our connectivity solution and the TTConnect Wave Gateway for remote access to your machines. The gateway provides a programming environment via an embedded Linux system in combination with our newly developed MATCH Qt Libraries, where you can begin with the application logic immediately – time-consuming preparation work is performed by the libraries automatically.

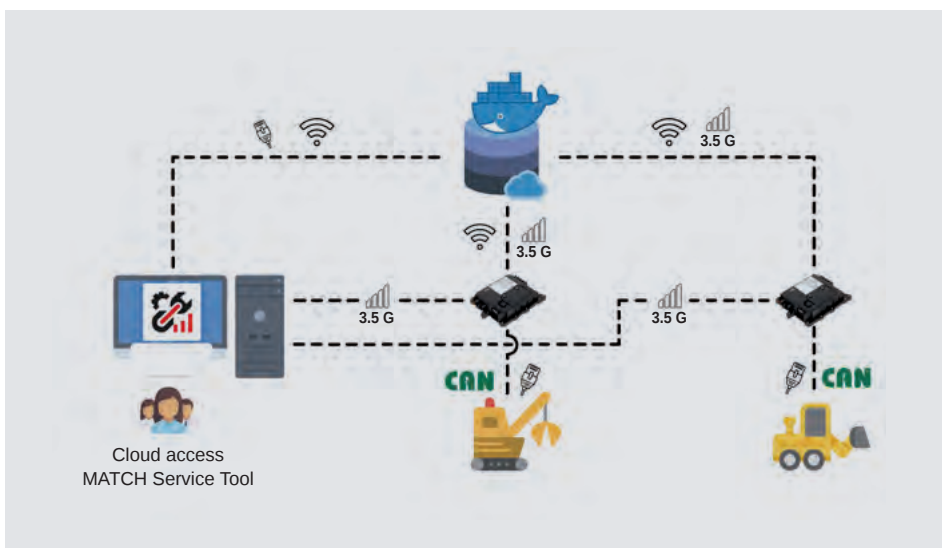
To make it possible for you to create your own software for TTConnect Wave, we supply an embedded Linux system with each Wave, where you can immediately develop your own applications for your machines in the standard programming languages (C/C++/Python etc.).

So you can start the development quick and easy. The scope of delivery for our connectivity solution includes both a demo project and documentation of all our Qt classes. These give you helpful tips and programming examples for overcoming the initial obstacles with TTConnect Wave.

SUPPORTED FEATURES

- Tunneling of the MST protocol via gateway on the display: provides the MATCH features present on the display via remote access via the MST. Access your machines in the field comfortably from your desk: you can check current errors or the status of controller pins, read or write parameters, flash controllers and much more.
- Generation of the CAN interface: CAN signals and structures are generated from the PDT and made available on the gateway by the stack in conjunction with the Auto Code Builder (ACB). The CAN messages and signals can be processed, filled and sent immediately with Qt and our other libraries – either cyclically or event-based depending on the settings in the PDT.

REMOTE ACCESS TO MACHINE FLEET VIA MST AND REMOTE DEVICE



Ordering Information

Please use the following model code when placing your order.

NOTE
Subject to technical modifications and corrections.

MATCH Qt Libraries

MODEL CODE

MATCH – XXX – TRGM – LQT– YYY – G10 – 000

Hardware variant

WV3 = TTConnect Wave device

Library

Programming language

LQT = programming language Qt on Linux

Libraries

BCA = Qt basic CAN access

BPA = Qt basic pin access

BUA = Qt basic user access

Software version

G10 = current version

Modification number

000 = standard

MATCH Remote Device Target Module

MODEL CODE

MATCH – XXX – TRGM – LQT– YYY – G10 – 000

Hardware variant

WV3 = TTConnect Wave device

Target module

Programming language

LQT = programming language Qt on Linux

Software module

MCA = MATCH CAN module

MPD = Qt MATCH pin diagnostics

MVI = Qt MATCH version information

MUA = Qt MATCH user authentication

Software version

G10 = current version

Modification number

000 = standard

TECHNICAL DETAILS

Software system requirements – Qt Libraries	
Software	Qt
Software system requirements – Qt Target Module	
Software	MATCH Qt Libraries, PDT with ACB, Qt
Remote device	
Hardware	TTConnect Wave
CAN USB interface	
PCAN USB (additional dongles on request)	

HYDAC SOFTWARE GmbH
Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany
Zum Kiesberg 15–16
14979 Großbeeren (near Berlin)
Germany
Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

6 MATCH IDE Controllers



For the development of application software for machine controllers, MATCH uses common, standardised and freely accessible IDEs (integrated software development environments).

Using standardised programming languages enables the developed application software to be easily reused in other projects.

The standard development environments supported by MATCH have been specially enhanced with perfectly tailored features to make handling easier.

The following IDEs are used:

- Eclipse for application development in C
- CODESYS 3.5 for application development in CODESYS

For application development in C, other C/C++ IDEs can, of course, also be used.

6.1 Eclipse

DESCRIPTION

The freely available development environment Eclipse has been adjusted to the individual requirements of control device programming in MATCH. The same features can therefore be used each time – irrespective of special compilers and processors.

Additionally, features are provided for further optimisation of work in Eclipse. For example, the makefile is automatically adjusted or expanded.

Thanks to the integrated online help, appropriate help for the selected variable or function can be accessed immediately.

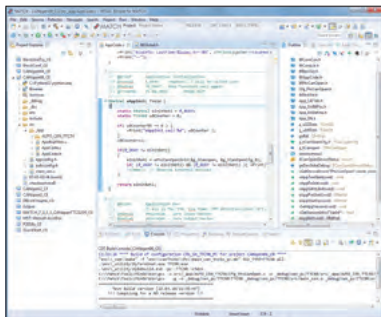
The practical auto-complete function allows you to access previously defined variables, functions and core functions easily.

A further time-saving feature is that the particular build process can be started in parallel mode.

The development environment enables a seamless use of the embedded software framework generated by the certified “Auto Code Builder” (ACB) (see sec. 2.1). The code generation requires a target in programming language C for the corresponding target hardware.

The translation into an executable code is enabled by default, not only for the target hardware in the form of the relevant hex file but also for the simulation of the embedded source code on the PC as an executable file. The hex file can only be generated with a controller-specific compiler (potentially subject to a fee).

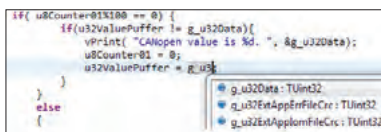
The simulation on the PC allows an error-free execution of the unit and integration tests for the application software – including the embedded middleware (core software) and library modules, whereby the simulation must be supported by a corresponding MATCH feature.



Eclipse IDE for C Version: “Oxygen” including MATCH extension



Integrated online help via mouse roll-over



Selection list auto-complete

AVAILABLE PLUG-INS

- Toolbar for simplified makefile influence (control of release-build, activation of “PC-Lint®” check and project naming)
- Simplified MATCH general settings view: settings grouped in one menu
- Provision of particular compiler error parsers (to jump to faulty code in Eclipse)

FUNCTIONAL SAFETY

In release mode (see “toolbar” plug-in), the components required for compiling the HEX files (makefile, BSP environment, include & library files and autocode) are checked for any modifications. This ensures that nothing is altered by mistake.

INTERACTION WITH OTHER TOOLS

GDB debugger

The MinGw compiler makes it possible to use the debugger to set breakpoints in the PC simulation. View of the variable content and function call sequence (call-stack) at the pause points (breakpoint or stops).

Static code analysis

The development environment is prepared for use of “PC-Lint® (Version 9.00)”, a tool for static code analysis. Alternatively, the free SPLINT analysis tool (Version 3.1.1) can be used. Other code analysis tools can also be incorporated – see the notes in the manual.

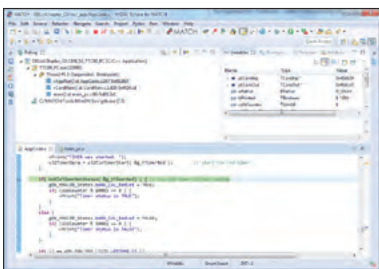
CUnit test environment

In the MATCH Cen PC simulation, the CUnit test framework is provided for usage.

Requirements in XML

Programming work is supported by interruption-free work in the IDE. The requirements needed during the function implementation are generated from requirements management in the PDT directly and stored there in ReqIf-XML format.

The requirements are depicted within the IDE and are available from the C code via internal hyperlinks. Context changes between the programming environment and requirements document are avoided.



Eclipse debugger view
(callstack + variable monitoring)

6 MATCH IDE Controllers

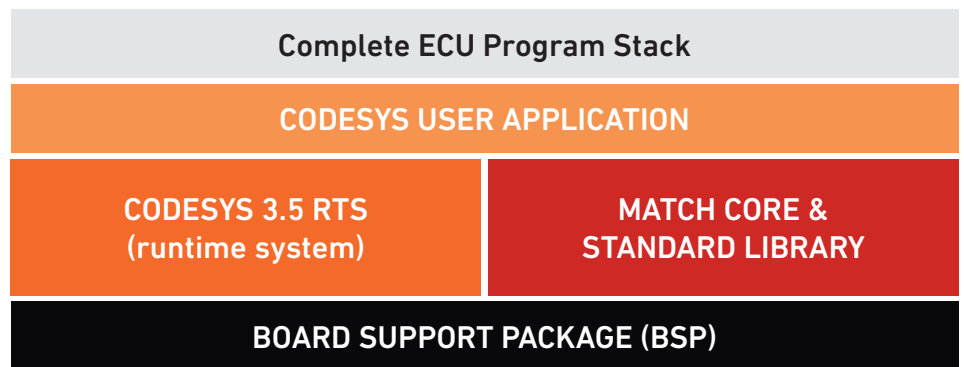
6.2 CODESYS 3.5

DESCRIPTION

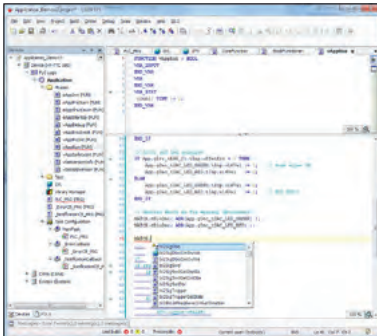
CODESYS was developed in accordance with the standard IEC 61131-3 of the International Electro-technical Commission for programming controllers and is widespread in application development, even/also in mobile applications.

Both the CODESYS 3.5 runtime system and the MATCH Core and Standard Library are installed together on the controller.

The application's embedded program code is – as usual with CODESYS – transferred to the controller directly from the IDE and can be executed there.



ECU program architecture of CODESYS 3.5 in conjunction with MATCH



CODESYS 3.5 Development environment
(selection list auto-complete)

The IDE enables a seamless use of the embedded software framework generated by the “Auto Code Builder” (ACB) (see sec. 2.1) after the data import.

The code generation from the PDT requires a target in programming language CODESYS 3.5 for the corresponding target hardware.

MATCH generates the embedded code from the PDT in structured text (ST), an object-oriented programming language commonly used for programming under CODESYS, based on Pascal.

In the following creation of the application software in the CODESYS IDE (for example in ST, structured text), direct access is therefore possible to the software framework generated with the PDT, as well as to the functions of the MATCH CORE and the library modules.

The autocompletion is, of course, also available on CODESYS.

NOTE

Subject to technical modifications
and corrections.

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15-16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

7 MATCH IDE Displays/Remote Devices



For the development of application software for visualisation solutions, MATCH uses standardised, freely accessible IDEs (integrated software development environments).

Powerful MATCH Libraries can be incorporated into these IDEs that speed up your development, especially in the start and alteration phases, helping you to focus on the important application logic.

The following libraries are available:

- MATCH Libraries for CODESYS
- MATCH Libraries for Qt

7.1 CODESYS 3.5

DEVELOPMENT WITH THE CODESYS IDE

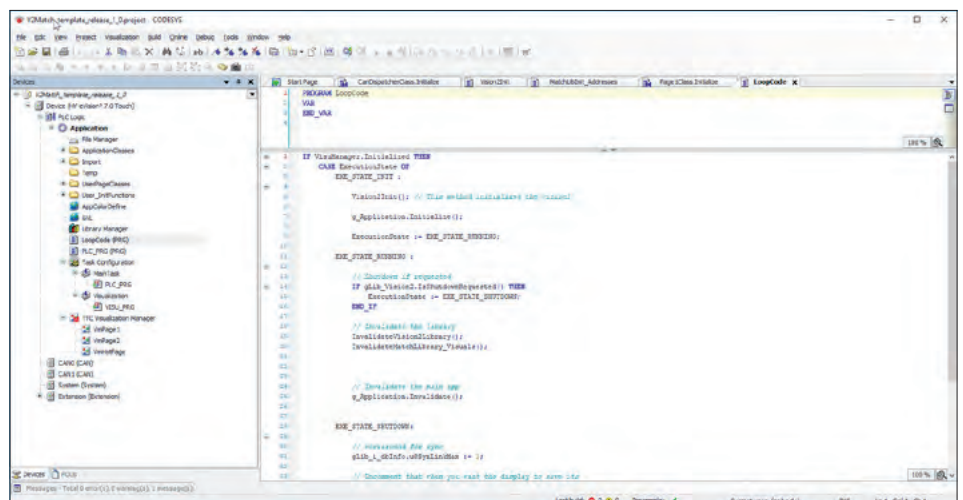
With our MATCH Libraries for CODESYS, you have access to the extensive capacities of the CODESYS development environment such as code auto-completion, automatic creation of variables and classes and intuitive configuration of the connection hardware.

Thanks to our consistent use of standardised import mechanisms such as PlcOpenXML, we enable you to export all your CAN messages, errors, controllers and many other system components from the PDT and incorporate them into the CODESYS project.

After successful import, these data are available as objects and can be easily processed via CODESYS-ST (structured text).

Demo projects introduce you to development with MATCH within CODESYS and simplify your entry into the world of MATCH on the display.

MATCH Libraries in the CODESYS development environment



7 MATCH IDE Displays/Remote Devices

7.2 Qt

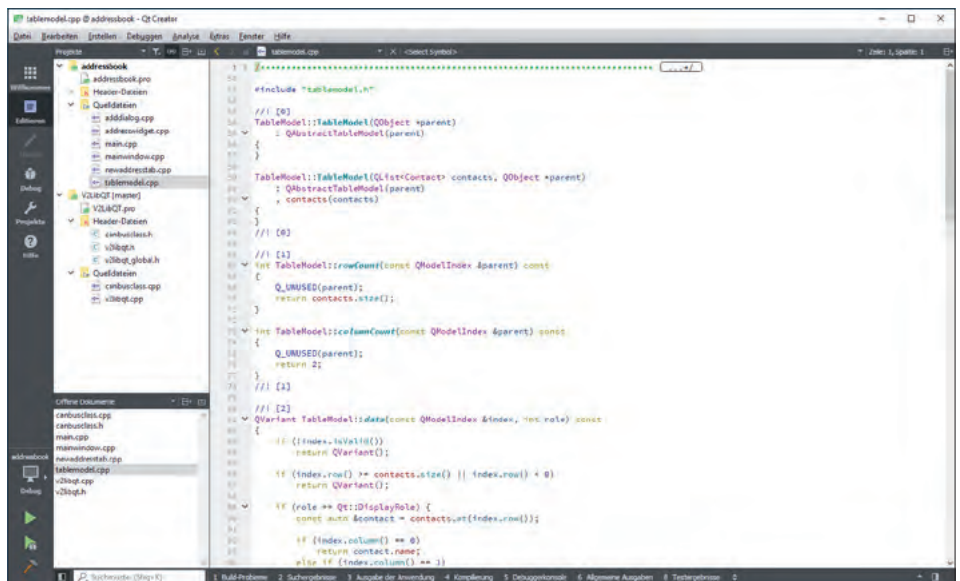
DEVELOPMENT WITH THE Qt IDE

With our MATCH Libraries for Qt, you enhance the enormous world of the Qt framework with all aspects of MATCH. The Qt Creator development environment actively supports you with powerful tools: code auto-completion, code refactoring, code snippets and a UI designer help you to write error-free code quickly and build attractive user interfaces.

MATCH supports you with automatically generated C++ code that depicts all your CAN messages, errors, controllers and many other system components in code. These can be grouped in a project file and imported directly into the Qt Creator or added to existing projects as a library.

The development of Qt-based MATCH applications with the Qt Creator and MATCH can then be easily learnt on the basis of an example project (included with every MATCH Qt installation) and the supplied documentation.

MATCH Libraries in the Qt development environment



NOTE

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HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15-16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

8 Accessories

Our accessory products provide efficient support, both for software development and software testing and problem analysis at the machine.

8.1 BOB – Break-out Box

DESCRIPTION

To simplify the commissioning process and to speed up field diagnostics, we can offer various break-out boxes which are compatible with our controllers.

The boxes can be integrated into the existing cabling directly with the 1.5 m long connection cable.

Thanks to the 4 mm safety lab connector, conventional measurement equipment can be used. The safety lab connectors reduce the risk of unwanted short cuts when connectors are plugged in/disconnected (e.g. caused by the cable falling onto the vehicle floor).

The short-circuit plug jumper has a double pick-up. This means that measurements and manipulations are possible simultaneously.

Perfectly matching break-out boxes are available for the various controller sizes.

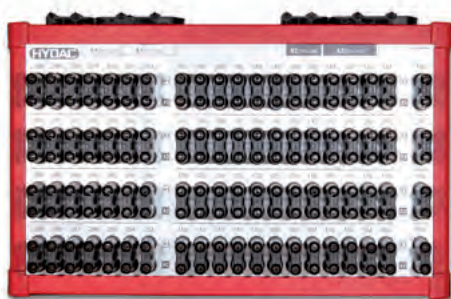
TECHNICAL DETAILS

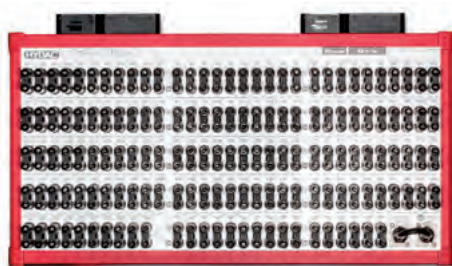
ZBS BOB-048-000

Ambient conditions		
Operating temperature	-35 to +85 °C (with full load)	
Operation voltage	0 to 40 V	
Currents	Pin L-M	10 A
	Pin A-K	8 A
Complies with the following standards		
CE mark	Compliant with 2011/65/EU	
Dimensions and weight		
Housing dimensions (WxDxH)	251 x 255 x 92 mm	
Weight of housing	2.7 kg	
Length of connection cable	1 m	
Connection cable weight	0.65 kg	

ZBS BOB-080-000

Ambient conditions		
Operating temperature	-35 to +85 °C (with full load)	
Operation voltage	0 to 40 V	
Currents	Pin 101-102, 127-128	10 A
	Pin 103-126, 129-152, 253-280	8 A
Complies with the following standards		
CE mark	Compliant with 2011/65/EU	
Dimensions and weight		
Housing dimensions (WxDxH)	401 x 256 x 92 mm	
Weight of housing	4.2 kg	
Length of connection cable	0.8 m	
Connection cable weight	0.9 kg	





PRODUCT FEATURES

- 4 mm safety lab connector
- Each pin can be manipulated (apart from Ethernet pins of variant BOB-154)
- Wear-resistant, laser-inscribed lettering
- Stable IP54 aluminium housing
- Includes connection cable for controller
- Input and output interchangeable

ACCESSORIES

Not included in the scope of delivery:

- 3 m connection cable extension
ZBS-AKV-xxx-3.0-000

NOTE

Subject to technical modifications and corrections.

TECHNICAL DETAILS

ZBS BOB-154-000

Ambient conditions	
Operating temperature	-35 to +85 °C (with full load)
Operation voltage	0 to 40 V
Currents	Pin 201-206 10 A
	Pin 101-196, 207-217, 220-230, 233-258 8 A
	Pin 218-219, 231-232 50 mA
Complies with the following standards	
CE mark	Compliant with 2011/65/EU
Dimensions and weight	
Housing dimensions (WxDxH)	565 x 319 x 92 mm
Weight of housing	7.6 kg
Length of connection cable	1.5 m
Connection cable weight	2.9 kg

Ordering Information

Please use the following model code when placing your order.

BOB – Break-out Boxes

MODEL CODE

ZBS BOB – XXX – 000

Product group

Accessories for controllers

Product type

BOB = Break-out Box

Number of controller pins

048 = HY-TTC 30/32 controller family
080 = HY-TTC 48X/48XS/50/60/71/77/90/94 controllers
154 = HY-TTC 500 controller family

Modification number

000 = standard
07x = connection cable for HY-TTC 7x controller family
(only in conjunction with ZBS BOB-080)

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15-16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

8 Accessories

8.2 AKV – Connection Cable Extension

DESCRIPTION

As an accessory for the break-out boxes (BOB) and as an extension for controller cables, we supply connection cable extensions (AKV) – compatible with our controllers. This means, for example, that the break-out box can be used within the vehicle cabin with greater flexibility.

Perfectly matching connection cable extensions are available for the various controller sizes.

TECHNICAL DETAILS

ZBS AKV-048-3.0-000

Ambient conditions		
Operating temperature	-35 to +85 °C (with full load)	
Operation voltage	0 to 40 V	
Currents	Pin L-M	10 A
	Pin A-K	8 A
Complies with the following standards		
CE mark	Compliant with 2011/65/EU	
Dimensions and weight		
Housing dimensions (WxDxH)	110 x 114 x 45 mm	
Weight of housing	1.7 kg	

ZBS AKV-080-3.0-000

Ambient conditions		
Operating temperature	-35 to +85 °C (with full load)	
Operation voltage	0 to 40 V	
Currents	Pin 101-102, 127-128	10 A
	Pin 103-126, 129-152, 253-280	8 A
Complies with the following standards		
CE mark	Compliant with 2011/65/EU	
Dimensions and weight		
Housing dimensions (WxDxH)	170 x 140 x 55 mm	
Weight of housing	2.8 kg	

ZBS AKV-154-3.0-000

Ambient conditions		
Operating temperature	-35 to +85 °C (with full load)	
Operation voltage	0 to 40 V	
Currents	Pin 201-206	10 A
	Pin 101-196, 207-217, 220-230, 233-258	8 A
	Pin 218-219, 231-232	50 mA
Complies with the following standards		
CE mark	Compliant with 2011/65/EU	
Dimensions and weight		
Housing dimensions (WxDxH)	170 x 163 x 55 mm	
Weight of housing	5.6 kg	



PRODUCT FEATURES

- Stable IP54 aluminium housing
- 3 m connection cable for controller

NOTE

Subject to technical modifications and corrections.

Ordering Information

Please use the following model code when placing your order.

AKV – Connection Cable Extension

MODEL CODE

	ZBS	AKV	–	XXX	–	3.0	–	000
Product group Accessories for controllers								
Product type AKV = Connection Cable Extension								
Number of controller pins 048 = HY-TTC 30/32 controller family 080 = HY-TTC 48X/48XS/50/60/71/77/90/94 controllers 154 = HY-TTC 500 controller family								
Cable length 3.0 = cable length in metres								
Modification number 000 = standard 07x = connection cable for HY-TTC 7x controller family (only in conjunction with ZBS AKV-080)								

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15–16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

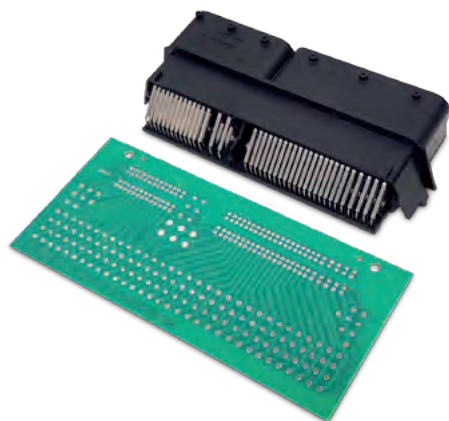
8 Accessories

8.3 AKK – Connection Cable Kit

DESCRIPTION

As an accessory for controllers and to meet the demand for customised adapter solutions, we supply connection cable kits that are compatible with our controllers. This means, for example, that you can implement your own cable extensions/test setups. The kit comprises of the circuit board and matching connector.

TECHNICAL DETAILS



ZBS AKK-048

Ambient conditions	
Operating temperature	-35 to +85 °C (with full load)
Operation voltage	0 to 40 V
Currents	Pin L-M 10 A
	Pin A-K 8 A
Complies with the following standards	
CE mark	Compliant with 2011/65/EU
Dimensions and weight	
Circuit board dimensions (WxDxH)	95 x 37.5 x 1.6 mm

ZBS AKK-080

Ambient conditions	
Operating temperature	-35 to +85 °C (with full load)
Operation voltage	0 to 40 V
Currents	Pin 101-102, 127-128 10 A
	Pin 103-126, 129-152, 253-280 8 A
Complies with the following standards	
CE mark	Compliant with 2011/65/EU
Dimensions and weight	
Circuit board dimensions (WxDxH)	160 x 48 x 1.6 mm

ZBS AKK-154

Ambient conditions	
Operating temperature	-35 to +85 °C (with full load)
Operation voltage	0 to 40 V
Currents	Pin 201-206 10 A
	Pin 101-196, 207-217, 220-230, 233-258 8 A
	Pin 218-219, 231-232 50 mA
Complies with the following standards	
CE mark	Compliant with 2011/65/EU
Dimensions and weight	
Circuit board dimensions (WxDxH)	160 x 70 x 1.6 mm

Ordering Information

Please use the following model code when placing your order.

AKK – Connection Cable Kit

MODEL CODE

ZBS **AKK** – **XXX** – **000**

Product group

Accessories for controllers

Product type

AKK = Connection Cable Kit

Number of controller pins

048 = HY-TTC 30 controller family

080 = HY-TTC 48/50/60/71/77/90/94 controller family

154 = HY-TTC 500 controller family

Modification number

000 = standard

NOTE

Subject to technical modifications and corrections.

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15–16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

8 Accessories

8.4 RCI – Rail Connection Interface

DESCRIPTION

For rapid development at the workstation and for commissioning prototypes without a ready cable harness, we supply various rail connection interfaces (RCIs) that are compatible with our controllers.

The interfaces can be directly connected to the controller with the enclosed 1.5 m long connection cable. WAGO terminals enable cables with various diameters of up to 2.5 mm² to be connected. This means that each pin of the connector can be reached.

The connections on the right side of the interface are not connected to the connector. This means that various controller types can be operated in the field. The components are then wired by the user in accordance with the particular application.

The top-hat rail bracket attached on the back makes it easy to be mounted (e.g. in test vehicles).

Perfectly matching rail connection interfaces are available for the various controller sizes.



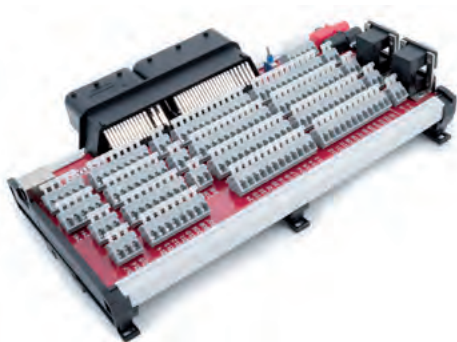
TECHNICAL DETAILS

ZBS RCI-048-000

Ambient conditions		
Operating temperature	-35 to +85 °C (with full load)	
Operation voltage	0 to 40 V	
Currents	Pin L-M	10 A
	Pin A-K	8 A
Complies with the following standards		
CE mark	Compliant with 2011/65/EU	
Dimensions and weight		
Housing dimensions (WxDxH)	135 x 165 x 61 mm	
Weight of housing	0.3 kg	
Length of connection cable	1 m	
Connection cable weight	0.65 kg	

ZBS RCI-080-000

Ambient conditions		
Operating temperature	-35 to +85 °C (with full load)	
Operation voltage	0 to 40 V	
Currents	Pin 101-102, 127-128	10 A
	Pin 103-126, 129-152, 253-280	8 A
Complies with the following standards		
CE mark	Compliant with 2011/65/EU	
Dimensions and weight		
Housing dimensions (WxDxH)	193 x 154 x 66 mm	
Weight of housing	0.35 kg	
Length of connection cable	0.8 m	
Connection cable weight	0.9 kg	



PRODUCT FEATURES

- Pick-up is possible for every pin (apart from Ethernet pins of variant RCI-154)
- WAGO terminals with clamp
- Top-hat rail holder
- Includes connection cable for controller

NOTE

Subject to technical modifications and corrections.

TECHNICAL DETAILS

ZBS RCI-154-000

Ambient conditions		
Operating temperature	-35 to +85 °C (with full load)	
Operation voltage	0 to 40 V	
Currents	Pin 201-206	10 A
	Pin 101-196, 207-217, 220-230, 233-258	8 A
	Pin 218-219, 231-232	50 mA
Complies with the following standards		
CE mark	Compliant with 2011/65/EU	
Dimensions and weight		
Housing dimensions (WxDxH)	284 x 168 x 63 mm	
Weight of housing	0.65 kg	
Length of connection cable	1.5 m	
Connection cable weight	2.9 kg	

Ordering Information

Please use the following model code when placing your order.

RCI – Rail Connection Interface

MODEL CODE

ZBS RCI – XXX – 000

Product group

Accessories for controllers

Product type

RCI = Rail Connection Interface

Number of controller pins

048 = HY-TTC 30/32 controller family

080 = HY-TTC 48X/48XS/50/60/71/77/90/94 controllers

154 = HY-TTC 500 controller family

Modification number

000 = standard

07x = connection cable for HY-TTC 7x controller family (only in conjunction with ZBS RCI-080)

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15–16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

8 Accessories

8.5 ESI-D – Motor Simulator acc. to SAE J1939

DESCRIPTION

The motor simulator/engine simulator (ESI-D) was developed to support the application development of mobile working machinery.

It simulates the typical CAN messages of a diesel engine in accordance with SAE J1939 and simulates the voltage boost and drop of the on-board power supply (in conjunction with an analogue remote-control power pack) during engine start-up.

The engine simulation can be integrated as an additional module for an application and used regardless of the project.

SPECIFICATION

- Transmitting of typical diesel engine CAN messages acc. to SAE J1939 (see below for list)
- Voltage manipulation of on-board power supply during start-up (in conjunction with an analogue remote-control power pack)
- Configuration by means of included configuration tool SCT (subsystem configuration tool)
- Engine speed and load torque can be changed
- Activation and deactivation of individual CAN messages
- Manual setting of CAN message values
- Simulation of error states
- Configurable torque/rot. speed characteristic

IMPLEMENTED CAN MESSAGES ACC. TO SAE J1939

Bus participants (CAN nodes) can use CAN IDs to identify the engine simulator messages. A CAN ID includes the PGN, the priority of the message and the source address. ^{*1)}

Message	PGN	CAN ID	Parameter (signal)	SPN
EEC1	61444	0CF00400	Driver's Demand Engine - Percent Torque	512
			Actual Engine - Percent Torque	513
			Engine Speed	190
			Source Address of Controlling Device for Engine Control	1483
			Engine Starter Mode	1675
EEC2	61443	0CF00300	Engine Percent Load At Current Speed	92
ET1	65262	18FEEE00	Engine Coolant Temperature	110
			Engine Fuel1 Temperature ^{*1)}	174
			Engine Oil Temperature ^{*1)}	175
HOURS	65253	18FEE500	Engine Total Hours Of Operation	247
IC1	65270	18FEF600	Engine Intake Manifold1 Temperature	105
AMB	65269	18FEF500	Ambient Air Temperature	171
PropB_43	65347	18FF430B	Manufacturer Defined Usage (Inchpedal)	2551

^{*1)} The numbers used by the parameter groups (PGN) and the individual parameters (signals) with the corresponding parameter numbers (SPN) are taken from the SAE document "The J1939 Digital Annex".



PRODUCT FEATURES

- Transmitting of CAN messages acc. to J1939
- On-board voltage simulation at engine start-up by means of power pack remote control
- Modifiable torque/rot. speed curve
- Configurable CAN messages
- K15, K50, D+ pick-up via 4 mm safety lab connector
- K30 can be switched via power pack remote control
- Can be used in 12 V or 24 V systems

SCOPE OF DELIVERY

- Engine simulator
- Configuration tool SCT

ACCESSORIES

Not included in the scope of delivery:

- PCAN dongle
- 32 V, 30 A lab power pack

NOTE

Subject to technical modifications and corrections.

TECHNICAL DETAILS

System specification	
Controller	HY-TTC 30H
CAN protocol	J1939
Power supply	8 to 32 V / 0.5 A
Complies with the following standards	
CE mark	Compliant with 2011/65/EU
Dimensions and weight	
Dimensions (WxDxH)	225 x 295 x 62 mm
Weight	2.4 kg

Ordering Information

Please use the following model code when placing your order.

ESI-D – Motor Simulator

MODEL CODE

	ZBS	ESI	D	000
Product group				
Accessories for controllers				
Product type				
ESI = Engine Simulator				
Specification				
D = diesel				
Modification number				
000 = standard				

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15–16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

9 MATCH Subsystems

Our electrohydraulic subsystems are developed based on MATCH and are tested comprehensively in all of the available configurations and ranges of functions. In terms of functional safety, we offer solutions up to the safety levels PLd or AgPLd (SRL2).

Our portfolio includes software for electro-hydraulic machine control, for electro-hydraulic auxiliary steering systems, electro-hydraulic additional steering systems and electro-hydraulic or electric fan controls.

We also provide the subsystem configuration tool SCT for the users of the subsystem software. The SCT enables configuration of the functionalities, parametrization and calibration of the software.

A licence is required on the controller to operate the software. This can be managed with the SCT.

9.1 EHC – Software for Electro-hydraulic Machine Control



DESCRIPTION

The software for electro-hydraulic control (EHC) is a machine application software for manual control of mobile valves that are controlled by proportional valves. The valve spool can be controlled directly by solenoid or pilot-controlled via proportional pressure-reducing valves. The application is available on the controllers HY-TTC 32/HY-TTC 32S – depending on the required level of functional safety.

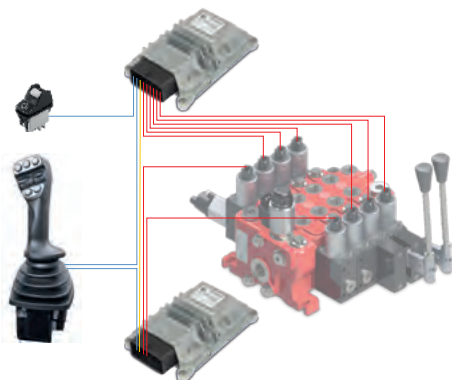
The EHC software makes it easy to develop a system for machine control: you can apply the signals from analogue joysticks, push-buttons or switches to the controller inputs, combine the current outputs in pairs with pilot valves of the mobile valve axis and then configure the software functionalities to suit the system behaviour you require.

The subsystem configuration tool SCT can be used to commission and service the EHC software – see section 9.5. The SCT USER, standard version, is included in delivery.

APPLICATION EXAMPLES

Loader crane

- Implementation of the four proportional functions that can, for example, be controlled via joystick, through a combination of two controllers in versions BASIC and BASICplus
- With flowsharing technology for continuous movement with parallel control of multiple functions even under maximum pump demand



AVAILABLE EHC VERSIONS

The following EHC software variants, which build on each other, are available, with each one working on its own controller HY-TTC 32(S):

BASIC

Proportional and/or on/off valve control, with evaluation of a large number of different analogue joystick signals. Your machine can be operated safely in combination with the implemented release functions.

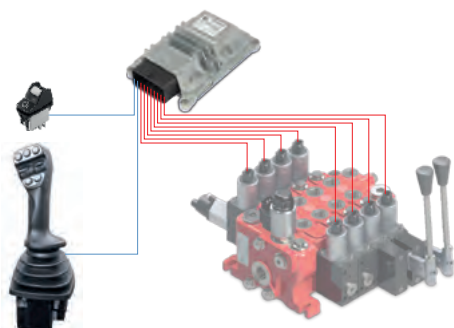
BASICplus

BASICplus contains the entire function range of the BASIC version. A continuous hydraulic function is also provided, which provides much greater ease of use thanks to its adjustable and retrievable flow rate adjustment. The electronic flowsharing makes it possible for you to operate a classic load-sensing valve – such as one from the HYDAC LX family – like a valve with downstream pressure compensators.

APPLICATION EXAMPLES

Front loader

- Proportional joystick operation of tilt and lift cylinders
- Third (continuous) function via push-button
- Release via roadlock switch



UPGRADEassist

The upgrade version provides assistance functions to increase the operating efficiency of your machine: for example, sensor-based work area restrictions and even parallel proportional control of two functions with just one joystick command.

Versions with elevated requirements for functional safety

On request, application versions (software or software on a certified controller) that meet the requirements of an increased level of functional safety in accordance with EN ISO 13849 PLb or PLd are available.

EHC HIGHLIGHTS

- Release via **seat contact/safety lever**: you can choose for each individual signal path whether the seat needs to be continuously occupied for function operation or only when the function is activated (e.g. for continuous functions).
- Release via **roadlock switch**: for each signal path, you can choose whether the function should stop when the roadblock is switched to active.
- An optional **float position of the spool** can be activated by switch actuation.
- A **quick coupler lock-valve** can also be activated at the same time as the assigned actuation direction of a proportional function.
- The **flowsharing functionality** can be used for hydraulic load-sensing systems with variable or fixed displacement pumps. The function behaviour when the valve is undersupplied from the pump can be adjusted. In classic flowsharing, all spool strokes are reduced equally, so all actuated functions continue to be supplied. The classic functionality can be expanded with staggered priorities, e.g. to supply main functions or continuous functions reliably.
- **Functional safety** to EN ISO 13849 up to PLd.
- **Increasing number of available inputs and outputs**: up to three controllers can be combined to form one overall system.

ACCESSORIES

Compatible accessories are available for the EHC. Accessories can be added via the application's "Accessories" model code (see under ordering).

Display

An optional (HY-eVision² 7") display can be used.

The display supports the following features, for example:

- System status display
- Pin, CAN and system diagnostics functions
- Configuration and parameterisation
- Error display and analysis
- Calibration of valve flows and sensors

Cable harnesses

In addition to the application software on the corresponding controller, various cable harness variants, such as main and adapter cable harnesses, can be ordered. The main cable harness covers the area from the controller's connector to the adapter connectors of the inputs and outputs. Adapter cable harnesses can be used both to adjust the specific cable length to suit the vehicle and to accommodate the various connector types of the connected components.

Advanced subsystem accessories

HYDAC can provide additional accessories on request, e.g. sensors, valve technology and even a complete, integratable subsystem.

HYDAC Diagnostik			
Strahlensperre	Signal 1 1254 mV Signal 2 110 mV	Stützkontakt	Signal 1 234 mV Signal 2 - mV
Joysticksignal 1	2034 mV	Vertikalausgang 1	3123 mA/10
Joysticksignal 2	2513 mV	Vertikalausgang 2	2880 mA/10
SP1	Joysticksignal 1 4479 mV Joysticksignal 2 2614 mV	Vertikalausgang 1	14129 mA/10
SP2	Joysticksignal 1 4479 mV Joysticksignal 2 2614 mV	Vertikalausgang 2	3012 mA/10
SP3	Joysticksignal 1 123 mA/10 Joysticksignal 2 121 mA/10	Vertikalausgang 1	3039 mA/10
		Vertikalausgang 2	3010 mA/10
SP4	Joysticksignal 1 2034 mV Joysticksignal 2 2513 mV	Vertikalausgang 1	193 % DC
		Vertikalausgang 2	139 % DC

FUNCTIONAL SAFETY

To achieve the desired safety level in the overall system, full implementation of all requirements of the particular functional safety standard is required. HYDAC SOFTWARE can provide targeted support for these requirements. Additional costs may be incurred for this.

FEATURES

Available functionalities of the individual software versions when they are flashed on a HY-TTC 32(S) controller.

EHC software version Feature per installed controller	BASIC	BASICplus	UPGRADE assist ^{*3)}
Proportional joystick axes	max. 3	max. 3	max. 2
Proportional control of valve axes (also with optional on/off control) ^{*1)}	max. 3	max. 3	max. 2
On/off control of valve axes ^{*1)}	max. 1	max. 1	max. 1
"Roadblock" release ^{*2)}	x	x	—
"Seat contact" / "safety lever" release ^{*2)}	x	x	x
Unloading valve, pilot pressure	—	—	x
Float position of a proportional valve axis	x	x	x
Adjustable continuous flow	—	x	—
Flowsharing (in combination with LS valves)	—	x	x
LS pressure cut-off	—	—	x
Adjustable work area restrictions	—	—	max. 2
Proportional control of two proportional axes	—	—	x
LED display of error status	x	x	—
CAN error transmission via DM1 protocol	x	x	x

Comments:

The letter "x" refers to an existing or configurable feature.

^{*1)} One valve axis means: two current outputs per axis.

^{*2)} The specified functionality or one that switches in a similar way can be realised.

^{*3)} Available on request.

COMBINATIONS OF MULTIPLE CONTROLLERS

If multiple HY-TTC 32(S) are combined in the realised control systems, the number of available inputs/outputs increases accordingly. A maximum of three controllers (in the same or different EHC software versions) can be combined to form one overall system.

PRODUCT FEATURES

- For 12 V or 24 V on-board voltage
- Up to three HY-TTC 32(S) controllers can be combined
- Proportional inputs:
 - Voltage signals 0.5 to 4.5 V, single, parallel or crossed
 - Current signals 4 to 20 mA, single, parallel or crossed
- Single, double (NO/NC) or voltage level (Naur) evaluation of switch signals
- Diverse adjustment options for proportional outputs, e.g. PWM frequencies and current thresholds
- Adjustable current ramps for smooth machine operation
- Simple system configuration thanks to free allocation of input signals to current outputs
- The response to the release functions can be set for each function path
- Functions actuated by push-button can be configured with detent functionality
- Detection of engine state on basis of voltage level or CAN J1939
- Error management and error registration dependent on engine state
- Available safety level:
 - standard acc. to ISO 9001 and
 - PLb or PLd acc. to EN ISO 13849
- Flashable default settings for simple software configuration on assembly line
- Adjusted menu pages and installation assistance in HYDAC SCT



SCOPE OF DELIVERY

- Flashable application file
- SCT USER "standard" configuration, analysis and download tool

ACCESSORIES

Not included in the scope of delivery:

- Joysticks
- Cable harness
- Sensors
- Valves/actuators
- Display

Ordering Information

Please use the following model code when ordering the electro-hydraulic machine control.

EHC – Electro-hydraulic Machine Control

MODEL CODE

HSW EHC – XXX – YY – ZZ – G10 – 000

Program variant

BAS = BASIC
BPL = BASICplus
UGA = UPGRADEassist

Performance level

00 = standard acc. to ISO 9001
0B = PLb acc. to EN ISO 13849 *3) *4) *5)
0D = PLd acc. to EN ISO 13849 *3) *4) *5)

Delivery variants

SW = software
HW = software flashed on the controller
matched to the safety level and program variant

Software version

G10 = current version

Modification number

000 = standard

*3) Available on request.

*4) The specified safety level stated applies to the embedded software in conjunction with the safety controller used. The safety level that can be realised in the application is also dependent on the specific configured system and the other components used. Information on the realised safety functions is available on request.

*5) Full implementation of all requirements of the particular functional safety standard is required to achieve the desired safety level. HYDAC SOFTWARE can provide targeted support for these requirements. Additional costs may be incurred for this.

Ordering Accessories

The accessories for the electro-hydraulic machine control (EHC) can be ordered on the basis of the following model code.

EHC Accessories

Display

MODEL CODE

HSW EHC – AO – DSP – XXX – YY – ZZZ – 000

Accessories (add-ons)

Display

Program variant

000 = standard

Delivery variants

SW = software
HW = software flashed on 7" HY-eVision² display

Software version

G10 = current version

Modification number

000 = standard

EHC Accessories

Main Cable Harness

MODEL CODE

HSW EHC – AO – HNM – XXX – YY – ZZZ – 000

Accessories (add-ons)

Main Cable Harness

Program variant

BAS = EHC BASIC
BPL = EHC BASICplus
UGA = EHC UPGRADEassist ^{*1)}

Safety level variant

00 = standard acc. to ISO 9001
0B = PLb acc. to EN ISO 13849
0D = PLd acc. to EN ISO13849

Connector variant

000 = open ends
DT4 = with Deutsch DT04-12 connectors
(for connection of adapter cable harnesses)

Modification number

000 = standard

^{*1)} Available on request.

EHC Accessories

Adapter Cable Harness

MODEL CODE

HSW EHC – AO – HNA – XXX – YYYYY – ZZZ – 000

Accessories (add-ons)

Adapter Cable Harness

Program variant

EHC = electro-hydraulic machine control

Type and connector variant

OUTDT = valve-side cable harness with Deutsch connectors DT04
OUTJT = valve-side cable harness with AMP Junior Timer connectors
INMOX = sensor/joystick-side cable harness with Molex connectors
INCRL = switch-side cable harness with Carling connectors

Cable length

010 = 1.0 m
020 = 2.0 m
030 = 3.0 m

Modification number

000 = standard

NOTE

Subject to technical modifications and corrections.

TECHNICAL DETAILS

Hardware system specification	
Controller	HY-TTC 32 or HY-TTC 32S
Functional safety	EN ISO 13849 to PLd
CAN protocol	J1939
CAN source addresses	0x22 (standard), 0x80, 0x82 ^{*1)}

^{*1)} Source addresses are set via pin wiring.

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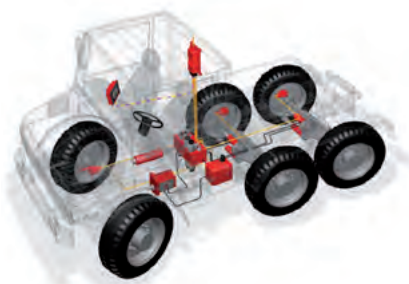
Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15–16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

9 MATCH Subsystems

9.2 AXS – Software for Electro-hydraulic Auxiliary Steering



Electro-hydraulic auxiliary steering

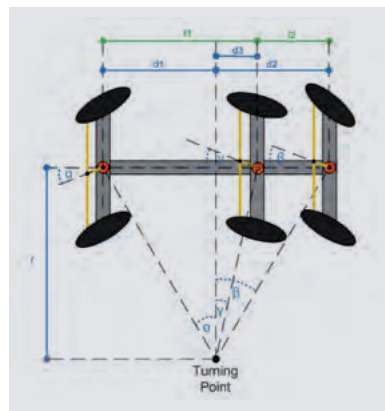


Diagram of steering angle calculation

DESCRIPTION

The machine application software for electro-hydraulic auxiliary steering systems (AXS) enables control of one or two auxiliary steering axles via electro-hydraulic proportional valves. Depending on the machine's specific electronics architecture, the software is available as an individual application on controllers HY-TTC 90CM and HY-TTC 32S or as a library module on an HY-TTC 580.

The current steering angle is detected by means of the reference axle (generally the main steering axle) and the target angle for the auxiliary steering axle(s) is calculated on the basis of the configured steering type and the selected steering mode.

The auxiliary steering axles are moved to the target position electro-hydraulically via proportional valves. Position and/or angle sensors are needed to detect the current position at each axle.

The subsystem configuration tool SCT can be used to commission and service the AXS software – see section 9.5. The SCT USER, standard version, is included in delivery.

There are many advantages of using auxiliary steering for the rear axles in vehicle operation, including:

- Increased manoeuvrability with reduced tyre wear
- Various steering programs to support different applications
- Speed-based steering behaviour

The following steering types are possible with the application (two auxiliary steered axes are used in this example):

- Front wheel-rear wheel steering



- All-wheel steering



- Hoisting unit steering



- Overdrive (left/right)





Examples of steering types for two steered rear axles

You can select or switch between the following operating modes:

- Automatic steering
- Manual steering
- External, fixed target angle set value
- Overdrive

FUNCTIONAL SAFETY

The application (software or software on certified controller) enables the requirements of an elevated level of functional safety acc. to EN ISO 13849 PLd to be met. ^{*1)}

The software makes it possible to implement the following four different “**safe system states**” in the event of an error:

- **No requirements:** There are no specific requirements for a “safe state”. The axle remains in the last state.
- **Block:** The axle(s) are held in their current position. One or two additional shut-off valves per axle are required for this.
- **Release:** The auxiliary axle(s) are released and steered on the basis of the coasting properties. One release valve per axle is needed for this, which hydraulically short-circuits the cylinder(s).
- **Forced centring:** The auxiliary axle(s) are forcibly centred in the event of an error by a separate centring circuit incl. hydraulic accumulator. One centring circuit is needed with several valves, an energy accumulator and one release valve and one centring cylinder per axle.

^{*1)} The specified safety level stated applies to the embedded software in conjunction with the safety controller used. The safety level that can be realised in the application is also dependent on the specific configured system and the other components used. Information on the realised safety functions is available on request.

HIGHLIGHTS

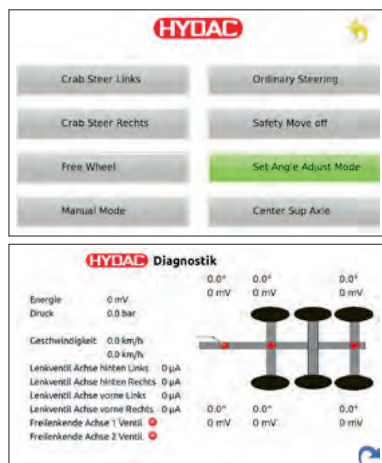
- Various steering modes and operating modes
- Different safe states can be selected
- Release functionalities
- Very good system diagnosis and error identification through permanent monitoring functions and start-up check
- Speed- and/or vehicle-state-based (e.g. on-road) blockage of mode change (safety function)
- Sensors for filter clogging and oil level can be integrated
- Steering characteristics can be parameterised
- DM1 protocol available, error lamps can be depicted
- Functional safety to EN ISO 13849 to PLd
- Increased number of controlled auxiliary steering axles: multiple controllers (HY-TTC 90CM or HY-TTC 32S) can be combined to form one overall control system

ACCESSORIES

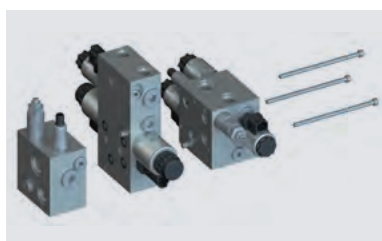
Compatible accessories are available for the AXS. Accessories can be added via the application’s “Accessories” model code (see under ordering).

Display

An optional (HY-eVision² 7") display can be used for initial start-up, prototypes or even the series.



Example depictions on the optional 7" display



Direct-acting hydraulic valve module, auxiliary steering



Linear position and angle sensors with safety certification to PL d

The display supports the following features, for example:

- System status display
- Pin, CAN and system diagnostics functions
- Configuration and parameterisation
- Error display and analysis
- Mode selection and operation
- Calibration of the steering angle sensors
- Individual override of outputs

Valve module

A valve module for steering applications enables simple, modular implementation of the functionalities implemented by software.

Sensors

An extensive range of sensors are available to implement the functional and safety requirements. In addition to pressure sensors, other sensors with the required functional safety level certificates are available for detecting the steering angle, including linear position sensors and/or angle sensors, position, angle, fill-level, clogging and speed sensors.

Cable harnesses

In addition to the application software on the corresponding controller, various cable harness variants can be ordered.

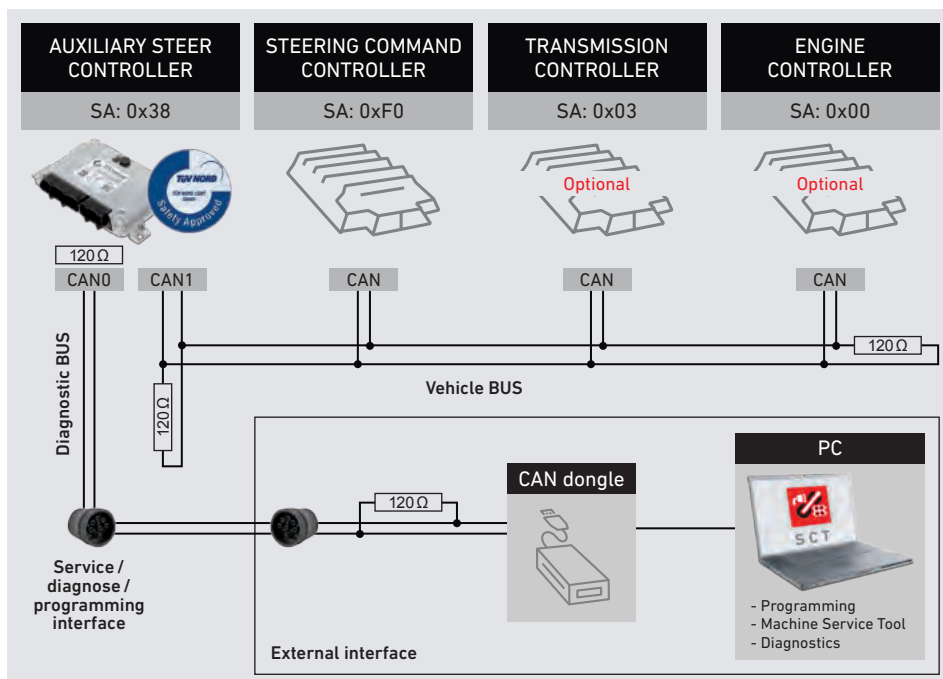
Advanced subsystem accessories

HYDAC can provide additional accessories on request, e.g. sensors, valve technology and even a complete, integratable subsystem.

FUNCTIONAL SAFETY

To achieve the desired safety level in the overall system, full implementation of all requirements of the particular functional safety standard is required. The requirements can be implemented by HYDAC SOFTWARE. Additional costs may be incurred for this.

EXAMPLE COMMUNICATION STRUCTURE



PRODUCT FEATURES

- For 12 V or 24 V on-board voltage
- Redundant position/angle sensors:
 - Analogue input can be configured for current or voltage
 - Range can be parameterised
 - Redundant output signals
 - Calibration function
- Pressure sensors for system diagnosis:
 - Analogue input can be configured for current or voltage
 - Range can be parameterised
- Speed detection:
 - Hardware inputs and/or CAN signals
 - Cross-comparison with parameterisable tolerances and times
- Detection of engine state:
 - Hardware inputs and/or CAN signals
- Proportional valves:
 - Parameterisable start-point, maximum and standby current
- Predefined interfaces to vehicle controllers:
 - Operation/mode selection via CAN
 - Status output via CAN
 - Error output:
 - CAN J1939-DM1
 - Error lamp (optional)
- Target angle calculation:
 - Parameterisable to vehicle geometry
 - Parameterisable restrictions
 - Parameterisable target value change
 - Parameterisable speed-based reduction of target steering angle
- Closed loop position control:
 - Parameterisable controller
 - Parameterisable deadband

SCOPE OF DELIVERY

- Flashable application file or integratable library module
- Subsystem configuration tool
SCT USER "Standard"

ACCESSORIES

Not included in the scope of delivery:

- Angle sensors
- Pressure sensors
- Speed sensors
- Cable harness
- Controller
- Display
- Hydraulic manifolds incl. valves/actuators (module system present)

Ordering Information

Please use the following model code when ordering the electro-hydraulic auxiliary steering.

AXS – Electro-Hydraulic Auxiliary Steering

MODEL CODE

	HSW	AXS	-	XXXX	-	YY	-	ZZ	-	G10	-	000
Program variant												
090C												
032S												
0580												
Performance level												
00												
0D												
Delivery variants												
SW												
H1												
Software version												
G10												
Modification number												
000												

*1) Available with specific function scope on request.

*2) The specified safety level stated applies to the embedded software in conjunction with the safety controller used. The safety level that can be realised in the application is also dependent on the specific configured system and the other components used. Information on the realised safety functions is available on request.

*3) Full implementation of all requirements of the particular functional safety standard is required to achieve the desired safety level. The implementation of the requirements can be supported by HYDAC SOFTWARE. Additional costs may be incurred for this.

*4) Predefined subapplication with predefined pins on the controller.

Ordering Accessories

The accessories for the electro-hydraulic auxiliary steering (AXS) can be ordered on the basis of the following model code.

AXS Accessories

Display

MODEL CODE

	HSW	AXS	-	AO	-	DSP	-	XXX	-	YY	-	ZZZ	-	000
Accessories (add-ons)														
Display														
Program variant														
000														
Delivery variants														
SW														
HW														
Software version														
G10														
Modification number														
000														

AXS Accessories

Main Cable Harness

MODEL CODE

HSW AXS – AO – HNM – XXXX – YY – ZZZ – 000

Accessories (add-ons)

Main Cable Harness

Program variant

090C = AXS on HY-TTC 90CM

032S = AXS on HY-TTC 32S

Design variant

00 = standard

Connector variant

000 = open ends

DT4 = with Deutsch DT04-12 connectors
(for connection of adapter cable harnesses)

Modification number

000 = standard

NOTE

Subject to technical modifications and corrections.

TECHNICAL DETAILS

Hardware system specification

Controller	HY-TTC 90CM for flashable application file/ HY-TTC 32S for flashable application file/ HY-TTC 580 for library file
Functional safety	EN ISO 13849 to PLd
CAN protocol	J1939/proprietary
CAN source addresses	0x38

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15–16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

9 MATCH Subsystems

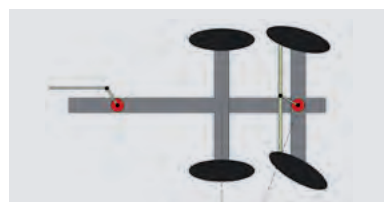
9.3 ADS – Software for Electro-hydraulic Additional Steering



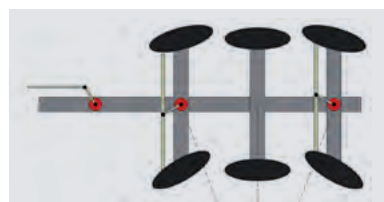
ADS



Trailer steering system



Tandem trailer



Tridem trailer

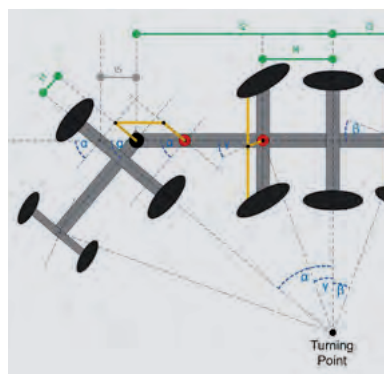


Diagram of steering angle calculation

DESCRIPTION

The machine application software for electro-additional steering systems (ADS) enables control of one or two additional steering axles of a trailer via electro-hydraulic proportional valves. The application software is available on the HY-TTC 32S controller. The software can be used for tandem and tridem trailers with a rigid axle.

The **reference angle** for the target value calculation of the individual axle angle can be detected in two ways:

- Drawbar with mechanical connection to towing vehicle
- via a rate sensor mounted on the trailer (with no connection to towing vehicle)

The current steering angle is detected on the basis of the reference axle and the target angle for the additional steering axle(s) is calculated on the basis of the configured steering type and the selected steering mode. The additional steering axles are moved to the target position electro-hydraulically via proportional valves. Position and/or angle sensors are needed to detect the current position at each axle.

The subsystem configuration tool SCT can be used to commission and service the ADS software – see section 9.5. The SCT USER, standard version, is included in delivery.

There are many advantages of using additional steering for the trailer axles in vehicle operation, including:

- Increased manoeuvrability with reduced tyre wear
- Various steering programs to support different applications
- Speed-based steering behaviour

The following steering types are possible with the application (two auxiliary steered axes are used in this example):

- Automatic steering
- Manual steering
- Centring (or crab steering for the steerable axles)

Functional safety

The application (software or software on certified controller) enables the requirements of an elevated level of functional safety acc. to EN ISO 13849 PLd to be met.^{*1)}

The software makes it possible to implement the following two different “**safe system states**” in the event of an error:

- **No requirements:** There are not specific requirements for a “safe state”. The axle remains in the last state.
- **Release:** The additional axle(s) are released and steered on the basis of the coasting properties. One release valve is needed per axle, which hydraulically short-circuits the cylinder(s).

^{*1)} The specified safety level stated applies to the embedded software in conjunction with the safety controller used. The safety level that can be realised in the application is also dependent on the specific configured system and the other components used. Information on the realised safety functions is available on request.



Display



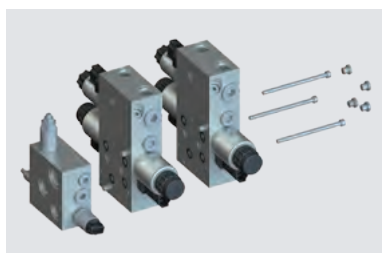
Control unit



Rate sensor



Rot. speed sensor



Direct-acting hydraulic valve module,
additional steering

HIGHLIGHTS

- A rate sensor can be used on the drawbar in place of an angle sensor; no mechanical coupling with the towing vehicle necessary
- Various steering modes and operating modes
- Different safe states can be selected
- Very good system diagnosis and error identification through permanent monitoring functions and start-up check
- Speed-dependent steering angle reduction
- Control unit optionally available
- Optional valve technology and sensors are available
- Steering characteristics can be parameterised
- DM1 protocol available
- Functional safety to EN ISO 13849 to PLd

ACCESSORIES

Compatible accessories are available for the ADS. Accessories can be added via the application's "Accessories" model code (see under ordering).

Display

An optional (HY-eVision² 7") display can be used for initial start-up, prototypes or even the series. The display supports the following features, for example:

- System status display
- Pin, CAN and system diagnostics functions
- Configuration and parameterisation
- Error display and analysis
- Mode selection and operation
- Calibration of the steering angle sensors
- Individual override of outputs

Advanced subsystem accessories

HYDAC can provide additional accessories on request, e.g. Sensors, valve technology, handheld terminals etc. and even a complete, integratable subsystem.

Valve module

A valve module for steering applications enables simple, modular hydraulic implementation of the functionalities implemented by software.

Sensors

An extensive range of sensors are available to implement the functional and safety requirements. In addition to the sensors which are used to detect the steering angle, such as angle sensors, rate and/or linear position sensors (incl. the required functional safety certificates), other sensors are available for the implementation of the application, e.g. tilt, fill-level, clogging and even speed sensors.

Cable harnesses

In addition to the application software on the corresponding controller, various cable harness variants can be ordered.

FUNCTIONAL SAFETY

To achieve the desired safety level in the overall system, full implementation of all requirements of the particular functional safety standard is required. The requirements can be implemented by HYDAC SOFTWARE. Additional costs may be incurred for this.

PRODUCT FEATURES

- For 12 V or 24 V on-board voltage
- Redundant position/angle sensors:
 - Analogue input can be configured for current or voltage
 - Range can be parameterised
 - Redundant output signals
 - Calibration function
- Pressure sensors for system diagnosis:
 - Analogue input can be configured for current or voltage
 - Range can be parameterised
- Speed detection:
 - 2 x hardware inputs
 - Cross-comparison with parameterisable tolerances and times
- Detection of engine state:
 - Pressure sensor and voltage monitoring
- Proportional valves:
 - Parameterisable start-point, maximum and standby current
- Predefined interfaces to vehicle controllers:
 - Operation/mode selection via CAN
 - Status output via CAN
 - Error output:
 - CAN J1939-DM1
 - Error lamp (optional)
- Target angle calculation:
 - Parameterisable to vehicle geometry
 - Parameterisable restrictions
 - Parameterisable target value change
 - Parameterisable speed-based reduction of target steering angle
- Closed loop position control:
 - Parameterisable controller
 - Parameterisable deadband

SCOPE OF DELIVERY

- Flashable application file
- Subsystem configuration tool
SCT USER "Standard"

ACCESSORIES

Not included in the scope of delivery:

- Angle sensors
- Pressure sensors
- Rate sensors
- Speed sensors
- Cable harness
- Controller
- Display/control unit
- Hydraulic manifolds incl. valves/actuators (module system present)

Ordering Information

Please use the following model code when ordering the electro-hydraulic additional steering.

ADS – Electro-hydraulic Additional Steering

MODEL CODE

HSW ADS – XXXX – YY – ZZ – G10 – 000

Program variant

032S = flashable application file for HY-TTC 32S

Performance level

00 = standard acc. to ISO 9001 ^{*1)}
0D = PLd acc. to EN ISO 13849 ^{*2)} ^{*3)}

Delivery variants

SW = software
H1 = software flashed on controller HY-TTC 32S

Software version

G10 = current version

Modification number

000 = standard

^{*1)} Available on request.

^{*2)} The specified safety level stated applies to the embedded software in conjunction with the safety controller used. The safety level that can be realised in the application is also dependent on the specific configured system and the other components used. Information on the realised safety functions is available on request.

^{*3)} Full implementation of all requirements of the particular functional safety standard is required to achieve the desired safety level. The implementation of the requirements can be supported by HYDAC SOFTWARE. Additional costs may be incurred for this.

Ordering Accessories

The accessories for the electro-hydraulic additional steering (ADS) can be ordered on the basis of the following model code.

ADS Accessories

Display

MODEL CODE

HSW ADS – AO – DSP – XXX – YY – ZZZ – 000

Accessories (add-ons)

Display

Program variant

000 = standard

Delivery variants

SW = software
HW = software flashed on 7" HY-eVision² display

Software version

G10 = current version

Modification number

000 = standard

ADS Accessories

Main Cable Harness

MODEL CODE

HSW ADS – AO – HNM – XXXX – YY – ZZZ – 000

Accessories (add-ons)

Main Cable Harness

Program variant

032S = ADS on HY-TTC 32S

Design variant

00 = standard

Connector variant

000 = open ends

DT4 = with Deutsch DT04-12 connectors
(for connection of adapter cable harnesses)

Modification number

000 = standard

NOTE

Subject to technical modifications and corrections.

TECHNICAL DETAILS

Hardware system specification

Controller	HY-TTC 32S for flashable application file
Functional safety	EN ISO 13849 to PLd possible
CAN protocol	J1939/proprietary

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15–16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

9 MATCH Subsystems

9.4 HFC – Software for Electro-hydraulic / Electric Fan Control



H F C

DESCRIPTION

HYDAC fan control (HFC) is a standard software application for HY-TTC 30H-CP controllers. This application can be used to configure and realise fan control without programming.

Hydrostatic and electric fan drives are supported. Temperature sensors can be connected to the controller either directly by means of analogue inputs or via CAN. PID controllers monitor the desired rotary speed of up to two hydrostatically powered fans in the closed-loop control circuit.

The target rotary speed for the fan is specified in accordance with a minimum of one temperature sensor and a maximum of five. Various temperature characteristics can be used.

The HFC application contains extensive error detection. It detects broken cables and short-circuits at the controller outputs. Error states can be either displayed by signal lamps or sent to the vehicle display via CAN DM1 messages.

For the standard software HFC, the program subsystem configuration tool SCT USER (see section 9.5) is available for the following tasks:

- Update the application on the controller (flash)
- Commissioning of the application (default settings)
- Licensing of the application
- Configuration and calibration of the HYDAC fan control application via the graphic interface
- Management of the application's database (backup/restore)
- Display of application information
- Error handling (display, reset)



SCT settings dialogue with overview of required and optional settings



Dialogue for configuring sensors, switches and other parameters



Output of states of sensors, drives and displays of application

HARDWARE FOR DEVELOPMENT

For more in-depth development activities with the HYDAC fan control solution, the following hardware modules are available:

- Controller HY-TTC 30H
- Cable harness with connector for HY-TTC 30H
- Test setup, prototype board
- PCAN USB dongle Peak USB
- Break-out Box for the HY-TTC 30H
- Components for the test setup (sensors, switches, valve coils, signal lamps)
- 12 V / 24 V power pack with maximum load of 25 A / 15 A

SOFTWARE

The configuration tools subsystem (SCT USER) is required for configuration, calibration, production and operation. The HYDAC fan control application must be licensed for each installation on a controller with the SCT. The SCT USER, standard version, is included in delivery.

FAN TYPES

- Max. 5 electric fans
or
- max. 2 hydrostatic fans
or
- max. 2 viscosity-coupling-controlled fans
or
- combination of electric, hydrostatic and viscosity-coupling-controlled fans with a maximum of five fans in total

REVERSING

Hydrostatic fans allow a periodic (automatic) or manual reversing procedure via a 4/2 or 4/3 directional valve.

CONTROL VIA DIGITAL INPUTS

Optional digital inputs can be switched directly or via CAN signals. The following switching operations are supported:

- Manual dump – switches the dump valve on directly (e.g. as energy-saving function during fan standstill)
- Manual speed – switches to fixed fan power
- Manual reverse – changes the fan's direction of rotation

EVALUATION OF THE ENGINE STATE

Optional evaluation of the engine state makes it possible to save energy during start.

- Operating mode selection (cranking) by evaluation of the control inputs, the starter motor signal and/or the engine speed.
- Engine monitoring via J1939 CAN messages

SYSTEM MONITORING

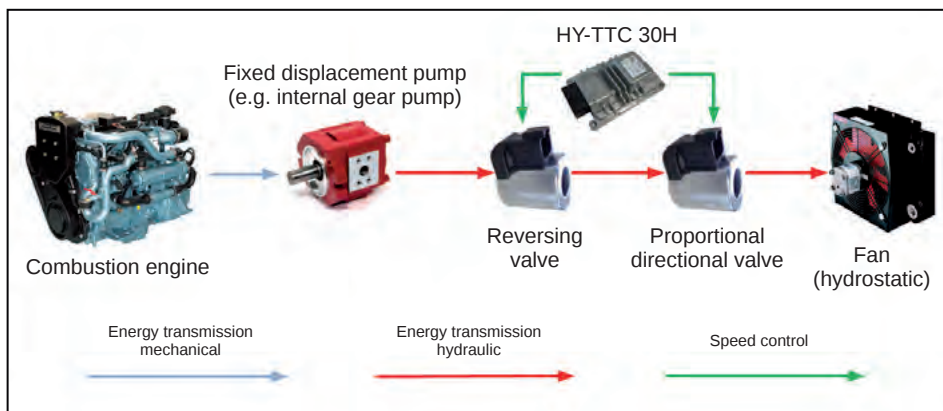
- Fill-level monitoring (oil, cooling water)
- Clogging monitoring (oil filter)

SYSTEM DIAGNOSIS

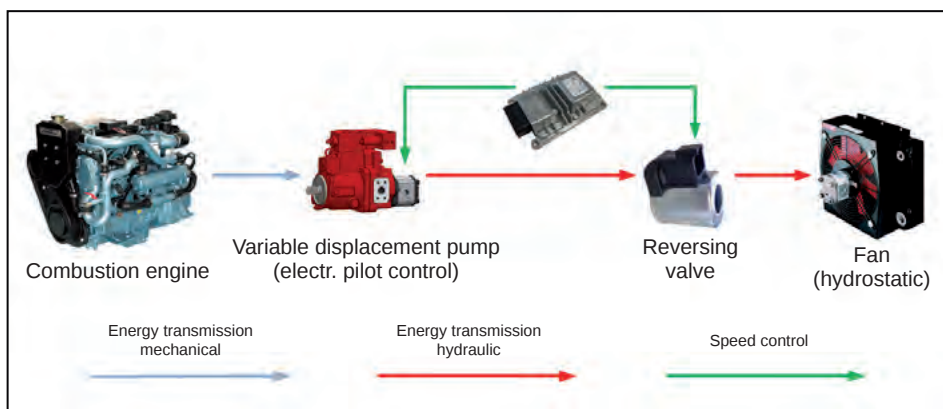
- Operating mode
- States of the reversing function
- Engine state
- States of the proportional valve outputs
- Temperature input signals
- Current fan powers
- Output states of all electric fans
- Error states

EXAMPLE DRIVE ARCHITECTURES

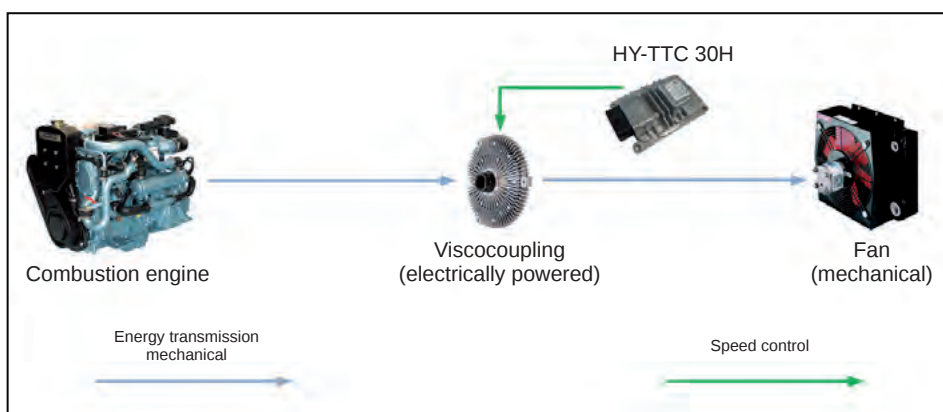
Hydrostatic fan drive with fixed displacement pump



Hydrostatic fan drive with variable displacement pump



Fan drive with visco-coupling



Electric fan drive



SCOPE OF DELIVERY

- Flashable application file
- SCT USER "Standard" configuration, analysis and download tool

ACCESSORIES

- Temperature sensors
- Sensor, fill level (oil, cooling water)
- Sensor, clogging (oil filter)
- Speed sensors
- Cable harness
- Controller
- Signal displays
- Valves/actuators
- Hydraulic manifolds

ACCESSORIES

Compatible accessories are available for the HFC. Accessories can be added via the application's "Accessories" model code (see under ordering).

Valve module

A HYDAC valve module enables simple, modular implementation of the functionalities implemented by software.

Sensors

HYDAC supplies an extensive range of sensors.

In addition to temperature sensors and/or fill level and clogging switches, rotary speed sensors, for example, are available for detecting the fan's rotary speed.

Cable harnesses

In addition to the application software on the controller, cable harness elements can also be ordered.

Ordering Information

Please use the following model code when placing your order.

HFC – Fan Control

MODEL CODE

HSW HFC – XXXX – YY – G10 – 000

Program variant

030H = fan application for HY-TTC 30H

Delivery variants

SW = software

H1 = software flashed on controller HY-TTC 30H

Software version

G10 = current version

Modification number

000 = standard

Ordering Accessories

The accessories for the electro-hydraulic/electric fan control (HFC) can be ordered on the basis of the following model code.

HFC Accessories

Display

MODEL CODE

HSW HFC – AO – DSP – XXX – YY – ZZZ – 000

Accessories (add-ons)

Display

Program variant

000 = standard

Delivery variants

SW = software

H1 = software flashed on 7" HY-eVision² display

Software version

G10 = current version

Modification number

000 = standard

HFC Accessories

Main Cable Harness

MODEL CODE

HSW HFC - AO - HNM - XXXX - YY - ZZZ - 000

Accessories (add-ons)

Main Cable Harness

Program variant

030H = HFC on HY-TTC 30H

Design variant

00 = standard

Connector variant

000 = open ends

DT4 = with Deutsch DT04-12 connectors
(for connection of adapter cable harnesses)

Modification number

000 = standard

NOTE

Subject to technical modifications and corrections.

TECHNICAL DETAILS

Hardware system specification	
Controller	HY-TTC 30H for flashable application file
Functional safety	Standard to ISO 9001
CAN protocol	J1939/proprietary
CAN source address	4E

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15-16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com

9 MATCH Subsystems

9.5 SCT – Subsystem Configuration Tool



SCT

DESCRIPTION

The subsystem configuration tool (SCT) is the tool for the HYDAC subsystem applications. It can be used across the entire life cycle of the subsystem: for adjustment of the application during the machine's development phase, end-of-line during commissioning in production and in the subsequent adaptation, maintenance and servicing performed by sales partners and in the field.

The USER version of the SCT enables both the actual download of the application software, licensing of the subsystem on the controller, functional adjustment, configuration and parameterisation of the controller and subsequent diagnosis and error analysis.

The SCT MASTER can be used to manage up to three user groups and personalise and license the tool users accordingly. This enables the OEM to easily monitor access to its subsystem applications during development, production and service in the field.

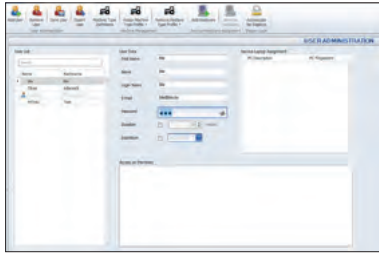
SCT USER “STANDARD” FUNCTIONALITIES

- Connection to the controller via CAN
- Three fixed logins to the SCT
- Installing embedded application software of the subsystem on the controllers (hex file download)
- License management of the application on the controller
- Writing, reading and saving of default settings
- Access to and modification of parameters and options
- Display of subsystem and controller information
- Calibration and configuration of subsystem functions
- Access to the error memory in the subsystem
- Diagnostics for the input and output pins and the application variables
- Diagnosis of the controllers' CAN signals
- Support while validation of the subsystem in the machine

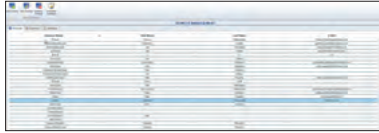
SCT USER “ENHANCED” FUNCTIONALITIES

- Functionalities of the SCT USER “Standard” version
- User access management
- Different access levels (developer/production/field service)
- Creation of production data
- Add project languages
- Export of application state as CSV (IO, errors, DB variables)
- Remote access to the machine via corresponding mobile communications standard (in conjunction with TTConnect Wave)

The SCT function scopes may vary depending on the access level. Full access is granted as standard. Differentiation between the access options per user login is possible via SCT MASTER.



SCT login management



Remote access monitoring

FUNCTIONALITIES OF SCT MASTER

- Management and issue of SCT logins for members of individual user groups
- Management and allocation of users to the three different user groups (access levels): development/production/field service
- Individual adjustment of machine access codes of the subsystem to protect subsystem from third-party access
- Management of remote access data via mobile communication standards

USER GROUPS

OEM DEVELOPMENT DEPARTMENT (MACHINE MANUFACTURER)

- The SCT USER enables the coordination of configurations, calibration data and default settings to suit the customer-specific subsystem in the machine.
- The coordinated data for the particular machine type can be saved on the PC.
- On the SERVICE PAGES, text information, such as the equipment ID, can be adjusted to suit the machine and internationalised.

PRODUCTION

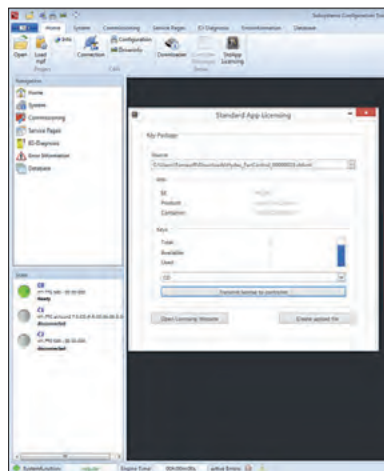
- The SCT makes it possible to install subsystem applications on the controller, license the embedded application on the controller and configure it and set end-of-line parameters (e.g. vehicle number, options, calibration values).
- The vehicle data can be saved at the end of commissioning.

FIELD SERVICE

- The SCT enables extensive diagnostics of the application in the field.
- In addition to the visualisation of system states, parameters can be edited, advanced options can be added and default settings can be reset. Error analysis is also possible by means of reading error codes.

PRODUCT FEATURES, LICENSING

- Activation of the subsystem on the controller
- Overview of used controllers for each activated subsystem licence in web licence area



Licensing of the software application on the controller

SCOPE OF DELIVERY

- Installation program SCT version USER/MASTER
- Project file for specific subsystem

ACCESSORIES

Not included in the scope of delivery:

- Programming cable (CAN)
- PCAN dongle ZBS PCAN-USB plug connector

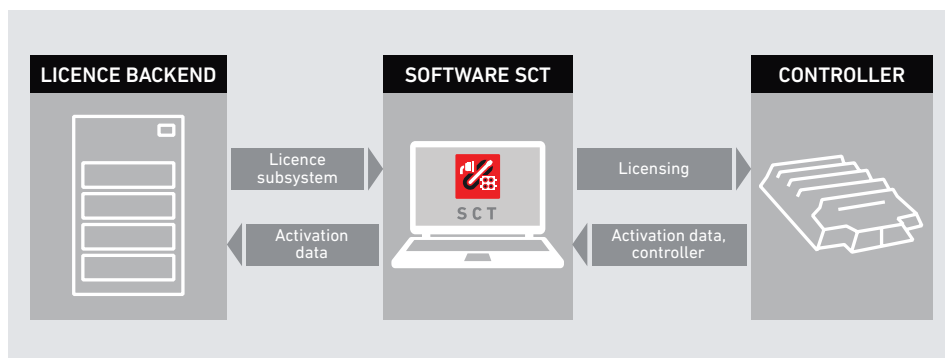
NOTICE

If you have acquired a licence for a subsystem, you can access the SCT in the download section of the MATCH website at <https://match.hydac.com>

LICENSING OF THE SOFTWARE APPLICATION

For the licensing of the subsystem software on the controller, the acquired licences are provided in the licence backend of the MATCH website. The license keys can be accessed and managed from there via the SCT.

The activation data generated during licensing of the subsystem software can be exported into the web system from the SCT. You therefore have an overview of the licences that are being used at all times.



Ordering Information

Please use the following model codes when placing your order.

SCT USER VERSIONS

MODEL CODE

MATCH SCT – XXX – YYY – G10 – 000

Software version

STA = Standard
 ENH = Enhanced

Subsystem

EHC = electro-hydraulic machine control
 AXS = electro-hydraulic auxiliary steering
 ADS = electro-hydraulic additional steering
 HFC = electro-hydraulic/electric fan control

Software version

G10 = current version

Modification number

000 = standard

SCT MASTER

MODEL CODE

MATCH SCT – MAS – XXX – G10 – 000

SCT Master

Software version

000 = standard

Software version

G10 = current version

Modification number

000 = standard

TECHNICAL DETAILS

Software system requirements	
Supported operating systems	Windows® 8 or 10 (32/64 bit)
Other software	.NET 4.6 framework
Hardware system requirements	
Processor	Minimum dual-core processor with 1.6 GHz
RAM memory requirements	Minimum 2 GB (4 GB or more recommended)
Hard drive memory requirements	Minimum 200 MB available memory
Ports	One free USB port
Screen resolution	Minimum 1024 x 768
CAN USB interface	
PCAN-USB (additional dongles on request, see Accessories)	

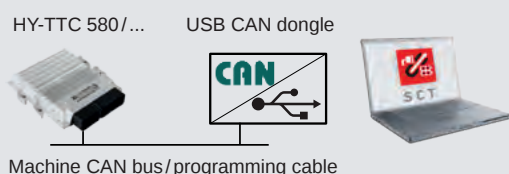
NOTE

Subject to technical modifications and corrections.

SCT CONNECTION TO THE CONTROLLER

Ways to establish the connection to the controller.

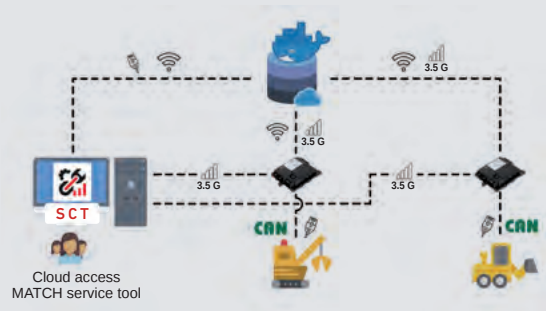
Connection via PCAN Dongle



Connection to the controller via PCAN dongle:
You can connect the dongle directly to the controller with a programming cable (available separately)

Connection via TTConnect Wave

Mobile communication standards (only in SCT USER "Enhanced")



Connection via various mobile communication standards:
established via the TTConnect Wave interfaces

WLAN



WLAN connection of service laptop via "TTConnect Wave"



Connection via WLAN via display:
on request

HYDAC SOFTWARE GmbH

Industriestr. (plant 15)
66280 Sulzbach/Saar
Germany

Zum Kiesberg 15-16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com



Accumulator Technology 30.000



Filter Technology 70.000



Control Technology 18.500



Filter Systems 79.000



Compact Hydraulics 53.000



Accessories 61.000

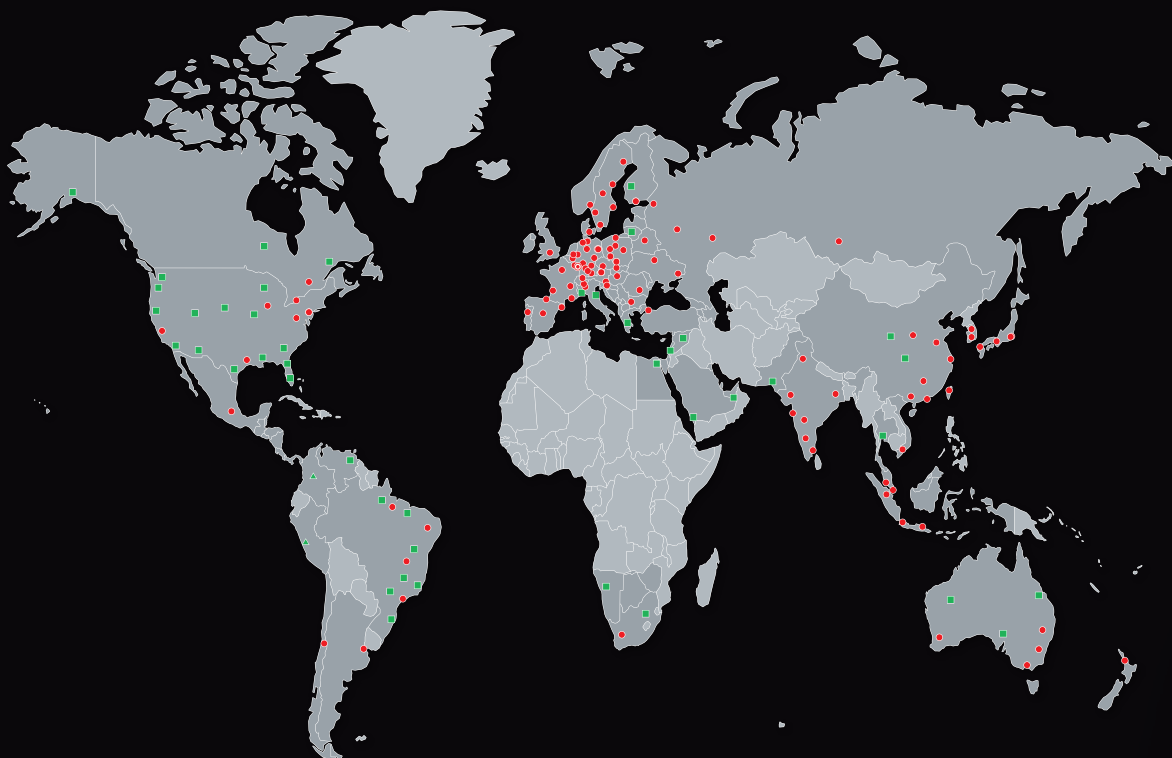


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Industriestr. (plant 15)
66280 Sulzbach / Saar
Germany

Zum Kiesberg 15-16
14979 Großbeeren (near Berlin)
Germany

Tel.: +49 33701 3389-4410
E-mail: info.software@hydac.com
Internet: www.match.hydac.com