Ixxat®
BY HMS NETWORKS

Electromobility: Communication solutions for production and test benches

Embedded platforms FRC-EP and CANnector

ACT engineering software

HMS

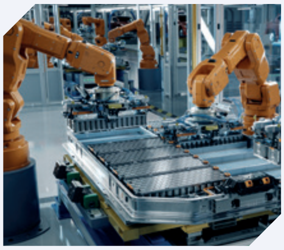
CONTENTS

> The combination of increasing drivetrain electrification and the steadily growing flood of communication data in vehicles poses a challenge, and we are pleased to help companies with our expertise.

MARKUS DEMARIA
Product Manager BU Ixxat – IndustrialCom

FLEXIBLE COMMUNICATION SOLUTIONS FOR PRODUCTION, TEST BENCHES, AND TEST VEHICLES

The amount of software in modern electric vehicles is growing steadily, leading to an increase in data and communication solutions. More and more often, OEMs and their suppliers are confronted with the need to integrate different in-vehicle networks in test and production equipment. From basic control units to battery management systems, from complex motor control systems to vehicle bus systems connected with factory networks, huge amounts of data need to be transferred, read, and interpreted. Both vehicle communication and factory automation protocols are needed for these purposes. HMS can connect the two worlds with a central platform.



E-MOBILITY INCREASES NEED FOR END-OF-LINE TESTS

The transition to electromobility is leading to sweeping changes in end-of-line testing.
New components make it necessary to adapt the test infrastructure to include battery-specific tests, significantly increasing both the scope of and the general need for testing during production.

FLEXIBLE TESTBED COMMUNICATION

There is little in the way of global standardization of the communication between test vehicles and test control stations or for special applications like residual bus simulation; different protocols and technologies call for flexible approaches. HMS solutions are designed for domain architectures and are already prepared for the zonal architectures of the next generation of electric vehicles.

TOP-NOTCH QUALITY ASSURANCE

Thanks to its years of experience in the automotive industry, HMS can help carmakers and suppliers with smart hardware and software solutions for communication in test vehicles. The combination of smart networking for all common in-vehicle communication standards with extensive logging and display functionality makes for a perfect connection between vehicle, message catalog, and analyzing test system.

BETWEEN VEHICLES AND CONTROL STATIONS:

AUTOMOTIVE TEST SYSTEMS

From connecting with in-vehicle networks, communicating with the control station, to simulating individual components, testbed applications need to support a variety of communication standards from the automotive and industrial worlds. Smart gateways from HMS connect both worlds to ensure reliable, high-performance data transfer.

Communication in vehicles

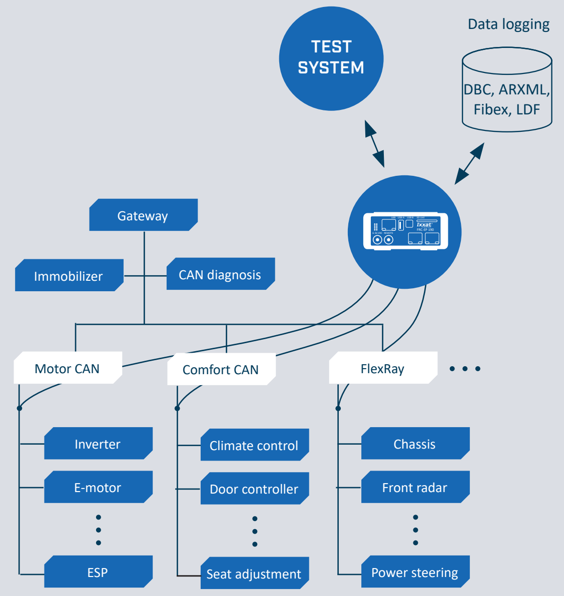
IN-VEHICLE NETWORKS

Networking for electronically controlled vehicle components takes place using a mix of new and established data communication standards. Gateways are needed to provide test systems with access to this closed system's data and signals.
The gateways support the various standards and translate and interpret the data. Access via gateways is possible in both function-based and zonal architectures with an Ethernet backbone. Within the individual zones, the gateway provides access to all of the sub-buses in use, aggregating their data and signals for the test system.

Testbed connection

COMMUNICATION WITH TEST AUTOMATION SYSTEMS

Communication with test automation systems is very different from in-vehicle communication since in this case it is mostly control data that needs to be transferred over greater distances (20 to 50 m) between the vehicle and the control station. The EtherCAT protocol is often used as an interface to the testbed automation system for transferring measurement data. The generic Ethernet protocol developed by HMS provides additional flexibility and diagnostic functionality, making it the ideal interface between in-vehicle networks and testbed automation systems.



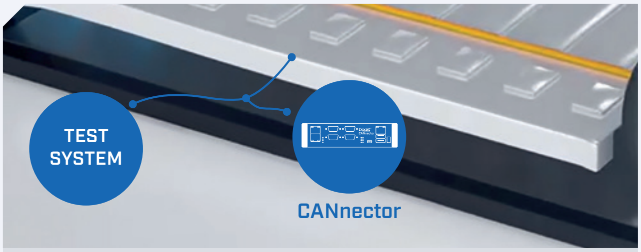
Secure access to the various in-vehicle networks for data transfer and logging.

Test bench connection over greater distances with Ethernet or EtherCAT

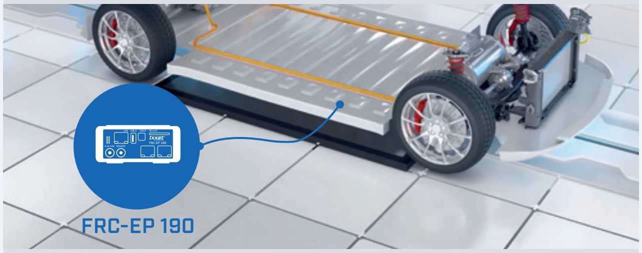
Simulation

RESIDUAL BUS SIMULATION (RBS)

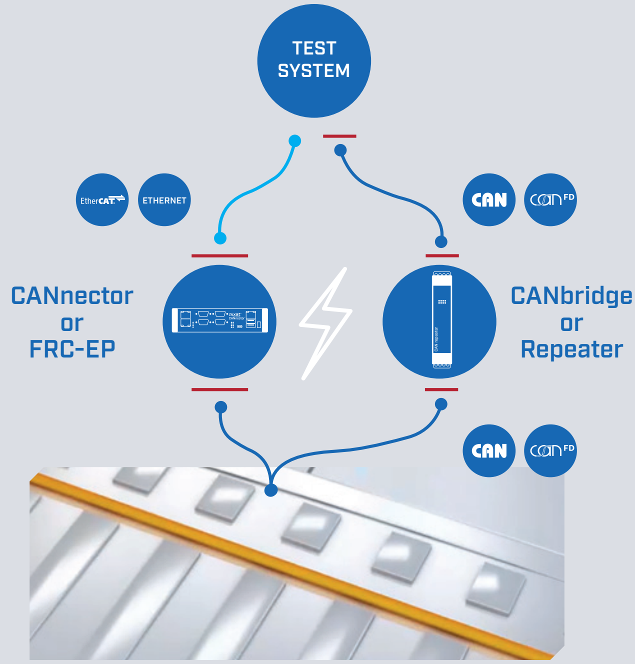
Residual bus simulation is used to generate signals and messages from control units that are not yet physically connected to the system. For example, it can be used to test new or independently operating components that depend on signals from neighboring components. Not only can smart gateways connect different protocols and systems, they can also perform an RBS based on functional models by using control data from the testbed automation system.



Simulating a system environment to enable testing of a DUT.



Simulating new or missing components so that an overall system can be started for testing.



Galvanic isolation

PROTECTING TEST SYSTEMS FROM OVERVOLTAGE AND EM DISTURBANCES

Data communication in end-of-line test benches often takes place in high-voltage environments. Access to the data needs to be simple and reliable even with voltages between 400 V and 1200 V affecting the communication lines. These high voltages can have a direct impact on the test system and damage it or neighboring compo-nents if there are malfunctions or defects.

Along with a grounding scheme with a central ground point, galvanic isolation of the CAN communication interface can effectively prevent damage. If galvanic isolation is not already built into a test system, it can be implemented later with galvanically isolated gateways or by using repeaters.

Inexpensive protective components like repeat-ers or gateways can be used to protect valuable system components from damage.

BETWEEN VEHICLES AND PRODUCTION AUTOMATION SYSTEMS:

END-OF-LINE TESTS

In end-of-line tests for battery-powered vehicles, different systems have to communicate with each other under difficult conditions. In addition to communicating across technologies and protocols when connecting vehicles to automation systems, protecting components from high voltages and EM disturbances is also important.

FIRMWARE FLASHING

Vehicle access

IXXAT FRC-EP 170

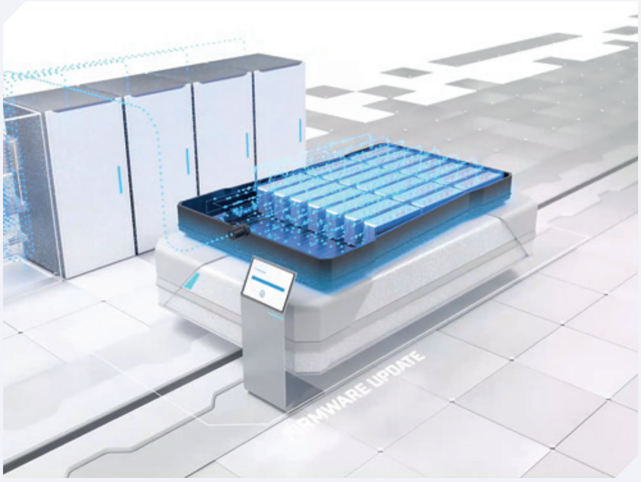
PC

EOL TEST

Connecting to test automation system with RBS and SECoc

IXXAT FRC-EP 190

PROTOCOLS



BMS COMMUNICATION AND FLASHING

The DUT and the automation system are connected to read out the firmware status and to flash current firmware for the battery management system (BMS).

CONNECTING TO AUTOMATION SYSTEM

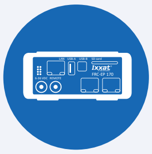
Connecting automotive networks with factory automation systems enables data exchange between DUT and automation systems.

INCREASING RANGE

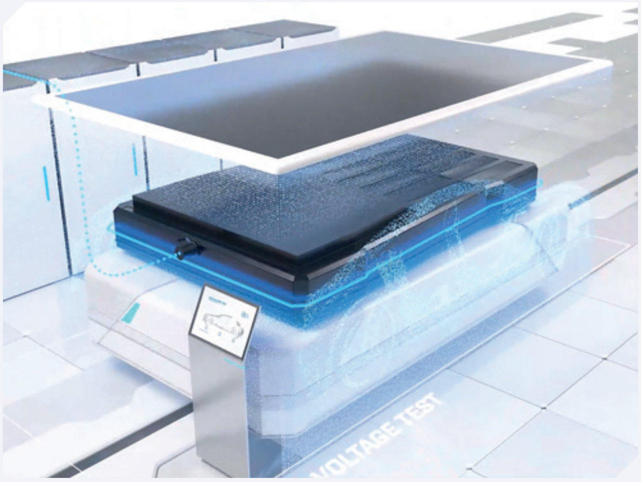
Greater distances can be covered using bridges and gateways in CAN and CAN FD networks with Ethernet/EtherCAT.

EOL TEST – HIGH VOLTAGE

Data connection with RBS and SECoc functionality and galvanic isolation



IXXAT FRC-EP 190



OVERVOLTAGE PROTECTION

Galvanically isolated components and repeaters (including optical data transfer) enable protection of test equipment against overvoltage and EM disturbances.

RESIDUAL BUS SIMULATION

Simulating all required signals for the BMS environment results in a complete in-vehicle system for smooth operation.

BETWEEN VEHICLES AND TEST SYSTEMS:

DATA LOGGING IN TEST VEHICLES

In test vehicles, data needs to be read out, written, and stored during vehicle operation. This calls for compact and energy-efficient gateways that "understand" different bus systems and enable reliable access to vehicle signals.

1

RECORDING DATA AND SIGNALS

For test and analysis purposes, vehicle data needs to be recorded during operation; analysis is performed later offline. The very large amounts of data require smart data limitation mechanisms. These include selective logging of individual signals or messages using filters, an event-triggered start/stop feature, and automatic overwriting of old data that is no longer needed. In addition, the data logging feature has an energy-saving standby mode that can be ended quickly during use of the product with wake-on function.

2

READING AND WRITING DATA

In-vehicle networks are closed systems within a vehicle. Descriptions of these systems are not based on individual devices as in industrial systems but on networks, using message catalogs (DBC, Fibex, ARXML, LDF, A2L, and others). The recorded data can be decoded and analyzed using these descriptions. By using HMS products, users have the choice of message-based or signal-based data recording to achieve the optimum results for each use case.

Zone GW
Zone GW
Zone GW
2
Zone GW
1
1
1
lin
CAN
can FD

EMBEDDED PLATFORM:

FRC-EP 170/190

The FRC series was developed for very demanding end-of-line test applications and for the communication needs of testbed tests. This product family can be used for gateway and simulation tasks (residual bus simulation and/or Simulink models) in various degrees of complexity. The smart FRC products enable access to the most common automotive protocols, such as FlexRay, CAN, CAN FD, LIN, and K-Line. These networks can be quickly and easily configured with the ACT (Advanced Configuration Tool) engineering software.

HIGHLIGHTS

- Up to 8 CAN channels (of which 4 are CAN FD compatible)
- FlexRay
- EtherCAT communication, e.g., for testbed automation
- Fast gateway throughput (< 300 µs)
- Sleep mode with wake-on CAN
- 4 digital inputs and outputs
- 2 analog inputs (12-bit)

PRODUCT FEATURES

The products in the FRC-EP family are very compact and rugged. They feature various in-vehicle interfaces depending on the model. The units are equipped with additional digital and analog inputs and outputs for basic measurement or control tasks. Connection and communication with higher-level control tasks can be implemented via a standard Ethernet interface or an EtherCAT slave interface. Multiple tasks can be performed in parallel using a real-time operating system. In addition, the FRC series can perform real-time residual bus simulations; Matlab/Simulink models can be integrated. Required functionality and signal-based data manipulation can also be performed using special code written by the user.

APPLICATIONS

Basic FRC series functionality includes high-performance gateway functions that enable CAN/CAN, CAN/LIN, or EtherCAT/CAN conversions in message-based, signal-based, or mixed modes.

The basic functionality also includes transmitting any messages and signals from all in-vehicle networks via Ethernet so that data can be transmitted over almost any distance. The data can then either be read into PC or control applications or mapped on in-vehicle networks. Length restrictions of the kind that can occur with CAN FD or FlexRay as soon as DUTs are connected with the remote control station can thus be avoided.

Messages can be recorded based on data or signals with the integrated logging functionality. Logging can be started or stopped via triggers, and pre-trigger recording is also possible. Data can be displayed using the integrated web server.

The FRC series is also remarkable for its simulation capability, which enables Matlab-based models to be imported for data manipulation. A residual bus simulation is created using the ACT software and runs autonomously on the product.

All applications can run in parallel so that, for example, a gateway can be created that will simultaneously record data and transmit it to a remote control station.

We provide additional information about the interfaces on page 18. A description of the Advanced Configuration Tool (ACT) and detailed information about its functions begins on page 14.

FRC-EP 170/190

PROTOCOLS

- FlexRay
- CAN
- CAN FD
- LIN
- K-Line
- AIN
- DIN
- DOUT
- EtherCAT
- USB
- LAN
- WLAN

EMBEDDED PLATFORM:

CANnector

The CANnector enables simple automotive gateway and logging applications. It was specially designed for engineering work, test bench, and EoL tests in production where a residual bus simulation is not needed. The CANnector has interfaces for CAN, CAN FD, and LIN and digital inputs and outputs, while the FRC series also supports FlexRay and K-Line.

HIGHLIGHTS

- Up to 8 CAN channels (of which 4 are CAN FD compatible)
- Can be mounted on a top-hat rail
- EtherCAT communication, e.g., for connection to testbed automation system
- Fast gateway throughput (< 300 µs)
- Sleep mode with wake-on CAN
- 2 digital inputs and outputs

PRODUCT FEATURES

The CANnector has a compact housing and can be mounted on a top-hat rail. Various in-vehicle interfaces are available depending on model. The unit is equipped with additional digital inputs and outputs for basic measurement or control tasks.

Connection and communication with higher-level control systems can be implemented via a standard Ethernet interface or an EtherCAT slave interface.

The real-time operating system enables dynamic processing of multiple tasks.

APPLICATIONS

The CANnector features high-performance gateway functionality that enables CAN/CAN, CAN/LIN, or EtherCAT/CAN conversions in message-based, signal-based, or mixed modes.

Its functionality also includes transmitting any messages and signals from all in-vehicle networks via Ethernet so that data can be transmitted over almost any distance. The data can be read in PC or control applications or used on in-vehicle networks. Length restrictions of the kind that can occur with CAN FD or FlexRay as soon as DUTs are connected with the remote control station can thus be avoided.

CAN nector

PROTOCOLS

CAN · CAN FD · LIN · DIN · DOUT

EtherCAT · USB · LAN · WLAN

SMART CONFIGURATION WITH ENGINEERING SOFTWARE:

ADVANCED CONFIGURATION TOOL (ACT)

The FRC-EP and CANnector product families are the hardware foundation for numerous automotive applications, but their full performance can only be realized in combination with our configuration software, the Advanced Configuration Tool (ACT). We developed it with the goal of helping users implement their applications with maximum flexibility and ease of use.

HIGHLIGHTS

- Easy drag-and-drop operation
- Intuitive configuration
- Maximum compatibility with various message catalogs (DBC, ARXML, FIBEX, A2L, etc.)
- All use cases in one tool
- Compatible with all FRC-EP and CANnector products
- No programming required
- Functionality can be expanded with own
- C code or Simulink models

All of the following modes can be used in combination. Configurations are always set up on a Windows PC.

GATEWAY MODE

Gateway mode is the product's core functionality. It can be used to exchange data between different bus systems and other functions (logging or display).

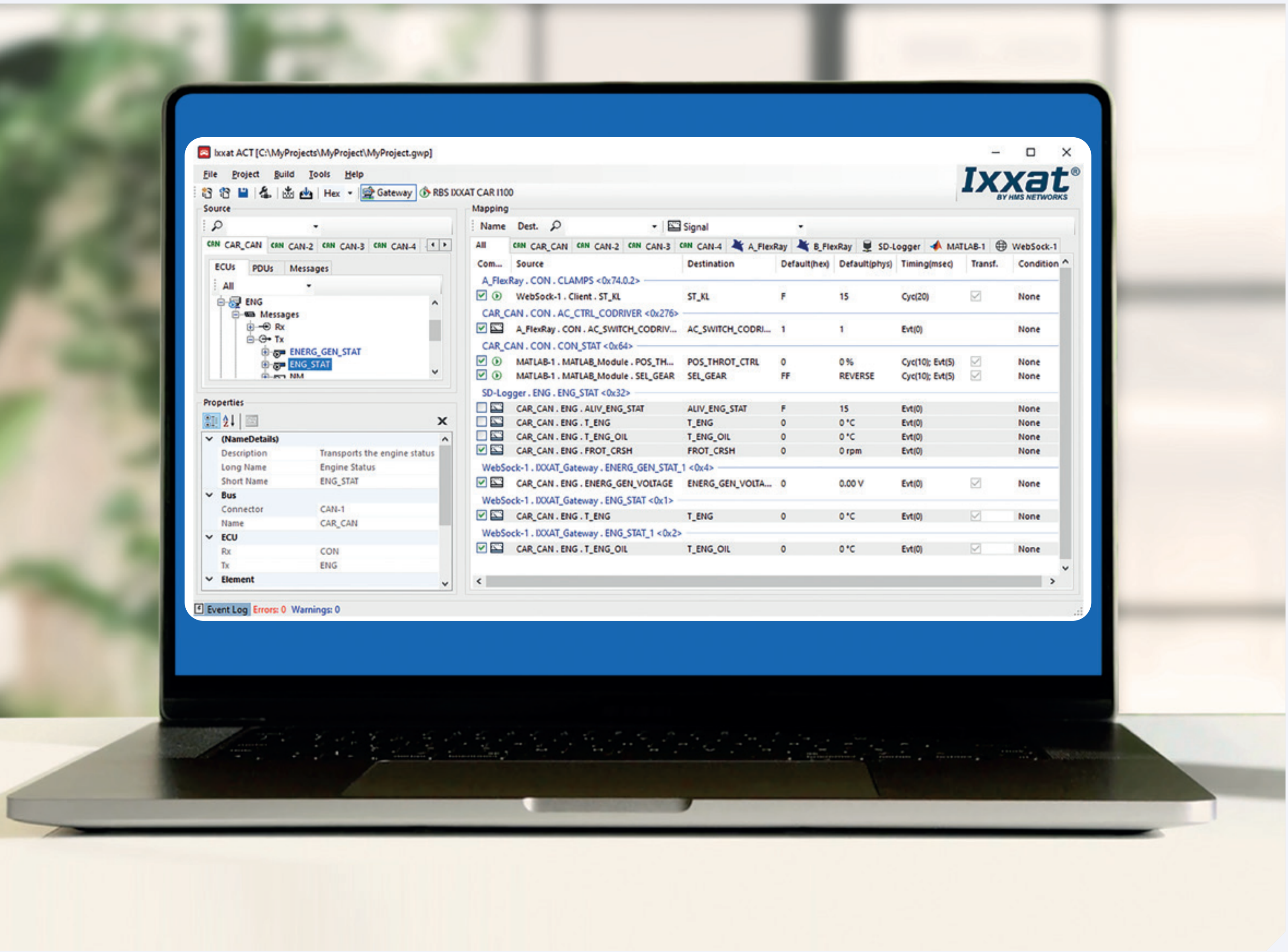
Certain communication settings can be made and links to message catalogs (DBC, ARXML, FIBEX) established during configuration of the input and output buses. The subsequent definition of the data stream is done in the ACT by drag-and-drop and can be done at the message, PDU, and signal levels. Various filter and mapping rules can be applied, including message manipulation with user code or Simulink models. RBS data can also be fed in.

Send triggers and default values can be defined for in-vehicle networks (CAN, FlexRay, LIN). The send time can also be influenced on a case-by-case basis (event-driven on receipt or change, cyclic, specific trigger, or combinations of these). If the message catalogs of the source and destination buses differ, a signal transformation will take place automatically.

An EtherCAT interface is available for communication with control or SCADA systems. Once the data to be exchanged has been defined and configured per EtherCAT master, the ACT automatically generates the necessary ESI file.

Fewer cables and bridging greater distances

HMS supports the generic Ethernet protocol to help reduce the number of cables or bridge greater distances. The ACT is used to map the required data to the generic Ethernet bus system. The data is transferred via Ethernet. Conversion back to the other in-vehicle network is done with a second product from the FRC-EP or CANnector family. If the data stream is directly connected to a PC, the VCI driver enables the product's use as a remote PC interface.



FUNCTION MODELS BASED ON MATLAB/SIMULINK

If function models based on Matlab or Simulink are available, ACT can integrate them into the overall configuration. If needed, ACT can automatically generate a base model that contains all required signal values and the framework for signal transformation from raw values to physical signal values.

The user only needs to develop the desired functions with Matlab or Simulink or copy the existing model into the base model. In the end, the executable module is automatically generated from this model and integrated into the overall configuration running autonomously on the device.

USER CODE AND SIMULINK

Manipulating data on the fly

With the C user code module, the ACT automatically generates a C code skeleton containing all of the signals and frames to be manipulated. The module generates the framework for the signal transformation from raw values to physical signal values, depending on the defined bus description files. Then the user has to finish by adding the desired functionality, signal- or frame-based, event-driven or cyclic, to the C code skeleton. This takes place in the integrated development tool.

SIMPLE RESIDUAL BUS SIMULATION

Residual bus simulation (RBS) is used to simulate electronic control units (ECUs) or parts of a vehicle. Common practice has been to program these simulations in a scripting language.

The ACT makes it considerably easier to create a residual bus simulation by automatically generating it using a description database in the integrated vehicle editor. In the tool, the user only needs to select the ECUs to be simulated.

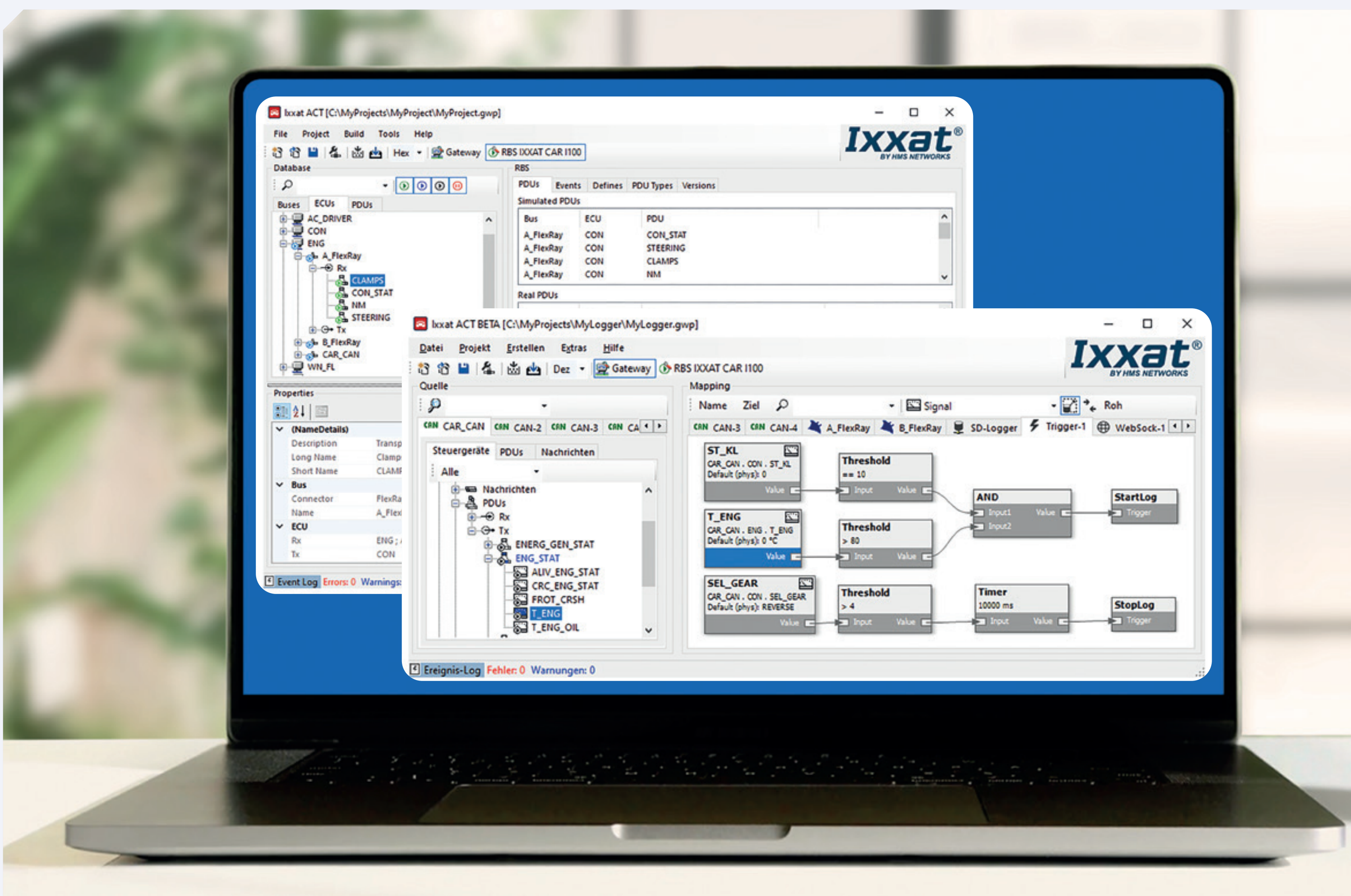
All programming work is done automatically by the ACT. The software detects the messages that need to be sent, or which messages include CRCs or alive counters. With other plugins, algorithms for cross-product generation of CRCs can be defined so that CRC and alive counter computation is done automatically.

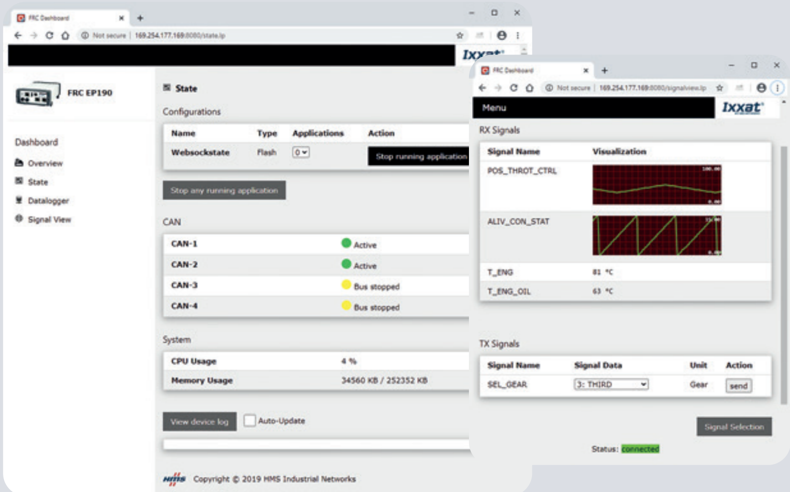
MULTIFUNCTION LOGGING

Logging functionality can be added to any configuration to record data from any origin (in-vehicle network, EtherCAT, I/O ports, and synthetic data from RBS, user code, or simulation).

The data can be stored in various formats (BLF, MDF4, ASC, or CSV) on an SD or USB storage medium.

To start and stop logging, the ACT's trigger module provides a number of options, including pre-triggering at configurable times. The fault condition to be investigated often precedes an event that can be used as a trigger, so the pre-trigger function logs relevant troubleshooting data before the triggering event occurs.





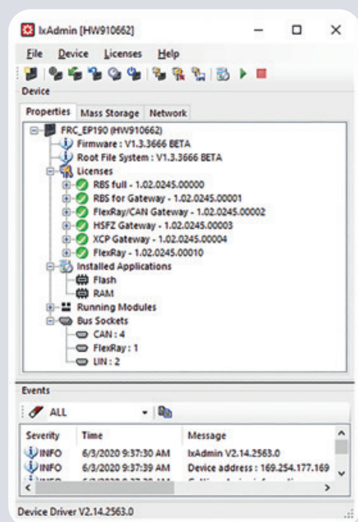
WEB-BASED DATA DISPLAY

With the integrated web browser, products from the FRC-EP and CANnector families can dynamically display signals graphically or numerically.

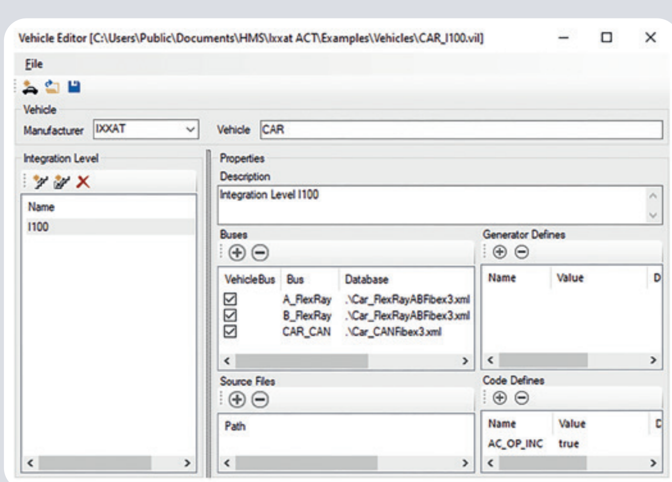
Any HTML5 browser can be used to display the data on PCs, smartphones, or tablets.

SIMPLE DEVICE MANAGEMENT WITH ixADMIN

IxAdmin is the administration tool for products connected to the ACT. It can be used to load configurations onto a device, perform updates, manage runtime licenses, and make basic settings. The IxAdmin tool can be connected to a device via USB, Ethernet, or WLAN.



EVERYTHING AT A GLANCE WITH THE VEHICLE EDITOR



Most in-vehicle communication solutions are based on bus descriptions in CANdB, FIBEX, or AUTOSAR XML format. Often they do not have all of the information needed.
With the vehicle editor, all information belonging to a certain vehicle, integration stage, or test configuration can be easily grouped together. This data can be accessed easily during further configuration of the residual bus simulation.

IN-VEHICLE COMMUNICATION MEETS FACTORY AUTOMATION:

PRODUCT SUMMARY

HMS offers a broad portfolio of products for testing and developing electronic components based on CAN, CAN FD, LIN, K-Line, and FlexRay. From repeaters for overvoltage protection to high-performance gateway and RBS solutions, HMS is your single source.

	CANnector	FRC-EP170	FRC-EP190
Product description	CAN platform for gateway and logging applications	CAN/FlexRay platform for gateway, logging, and RBS applications	CAN/FlexRay platform for gateway, logging, and RBS applications
FlexRay A/B channel	-	1×	1×
High-speed CAN	4× (max.)	4× (max.)	4× (max.)
Switchable high-speed CAN / CAN FD (additional)	4× (max.)	2× (max.)	4× (max.)
Low-speed CAN	-	1× (max.)	2× (max.)
LIN	2×	1×	2×
K-Line	-	1×	1×
USB	3× (host and device)	2× (host and device)	2× (host and device)
Digital I/O ports	2× (max.)	4× (max.)	4× (max.)
Analog input (12-bit)	-	-	2× (max.)
Other interfaces	Optional EtherCAT slave	-	Optional EtherCAT slave
SDHC card slot	-	1×	1×
External extensions	WLAN (Wi-Fi), USB devices (e.g., GPS), 4G modem		
PC connection	Ethernet, USB 2.0, WLAN (Wi-Fi)		
Ingress protection	IP40	IP42	IP42
Galvanic isolation	Up to 2 kV	-	Up to 2 kV
Configuration	ACT	ACT	ACT

	CAN@netNT 420	CANbridge 420	CAN-CR 120/HV	CAN-CR 110/FO	USB-to-CAN FD automotive	USB-to-CAN V2 automotive
Product description	CAN-ETH-CAN bridge and PC interface	CAN-to-CAN bridge	CAN repeater with high galvanic isolation	CAN repeater with optical fiber	CAN-PC interface for USB	CAN-PC interface for USB
High-speed CAN	2×	2×	-	-	-	2×
Switchable high-speed CAN / CAN FD (additional)	2×	2×	2×	1× copper 1× optical fiber (duplex)	2×	-
Low-speed CAN	-	-	-	-	-	1×
LIN	-	-	-	-	1×	1×
Ethernet	1×	-	-	-	-	-
Protection class	IP20	IP20	IP20	IP20	IP40	IP40
Galvanic isolation	1 kV	1 kV	3 kV	Unlimited with CAN optical fiber	800 V	1 kV
Configuration / PC connection	Windows tool / Windows and Linux drivers	Windows tool / -	Not required	Not required	- / Windows and Linux drivers	- / Windows and Linux drivers
Certification	CE, FCC, UL	CE, FCC, UL	CE, FCC	CE, FCC	CE, FCC	CE, FCC

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