Eberspächer Electronics

Eberspächer tool-chain for
Remaining Bus Simulation, gateways and signal manipulation

Olaf Schmidt

DRIVING THE MOBILITY OF TOMORROW

Dear customers of Eberspächer Electronics,

the worst of the economy crises has passed and most companies start focusing again on growth of sales. Still, what is left is the immense pressure of cost reduction. Our duty is to support you in meeting these demands through the extension of existing measurement equipment. Inexpensive and manageable solutions are our passion.

A new version of Caromee, the network analyzing software, adresses considerably more users. They are able to enjoy the benefits of this tool. New in the portfolio are the FlexOpto NE and a gateway solution for a wide range of applications involving ECU development.

Especially the topics ECU and network testing are our main focus since ten years. We make sure that our solutions work in your individual surrounding field.

Yours Olaf Schmidt

Eberspächer Electronics GmbH & Co. KG, Robert-Bosch-Straße 6, 73037 Göppingen, DEUTSCHLAND/GERMANY

Phone: +49 7161 9559-0 Mail: olaf.schmidt@eberspaecher.com
Web: www.eberspaecher.com

Eberspächer

About us

About J. Eberspächer Group

Automotive

- **Exhaust systems**
- **Vehicle heaters**
- **Electronic control units & in-vehicle networking**

J. Eberspaecher - Worldwide development partner of the automotive industry

The company founded in 1865 with headquarters in Esslingen am Neckar is independent of any group and concentrates on two core competences: exhaust technology (catalytic converters, particulate filters, silencers) as well as pre-heaters and add-heaters for passenger cars, transporters, trucks, busses, building vehicles and boats.

In exhaust technology we are numbered among the four largest suppliers worldwide. And also in the vehicle heater sector Eberspächer belongs to the leading companies on the world market.

More than 5.200 employees in 19 countries contribute with much commitment and innovative force to solving the automobile technological challenges of today and tomorrow. In close cooperation as partners with the major automotive manufacturers of the world.

Your expert in

1. **PC to CAN/FlexRay network interfaces**

2. **Stand-alone remaining bus simulation and gateway**

3. **Configuration software**
4. **Bus analysis software**

5. **Services**

Eberspächer Electronics is an expert in automotive bus systems, and is among the pioneers of the FlexRay bus system. Even very early on, various hardware platforms for the evaluation of FlexRay were developed and produced in the course of customer projects.

Today, a whole portfolio of different hardware and software products for FlexRay and beyond has been developed from these projects, and is constantly being improved and added to.

Eberspächer Electronics is foremost in sales of FlexRay development hardware, and offers you a wide range of further FlexRay products. Tools like the FlexXCon midget, which combines gateway functionality, prototyping, data logging, remaining bus simulation and monitoring, are included in the portfolio along with the entry platform, FlexDevel. The flexible, successful FlexCard products are designed for many areas of application, and have made their mark as a reliable interface in many development laboratories.

The hardware products are supplemented by software such as FlexConfig, a cost-effective, powerful, operator-friendly design and configuration software product for automobile networks. The Caromee analysis software, an open measurement framework for many bus systems, allows efficient acquisition and evaluation of vehicle communications.

As a professional service partner with well-developed bus system skills, in particular with FlexRay, Eberspächer Electronics supports you with tailor-made engineering services, tools and test functions. The portfolio contains the implementation of Eberspächer Electronics products in your systems, as well as customized development of hardware and software in the area of bus systems. In addition, Eberspächer Electronics offers thorough, practically oriented FlexRay and FIBEX training courses.

Eberspächer Electronics cooperates with a number of technology partners and sells the products through distributors into many countries.

Eberspächer Electronics: Your integration expert for FlexRay and more.
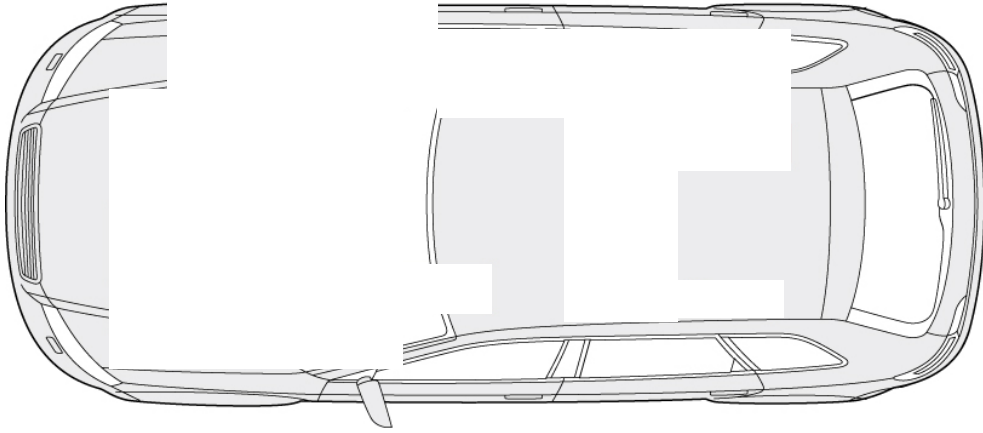
In-vehicle networking

It often happens that simple solutions are already available for the tasks and applications that we are considering. This is also true in the introduction and use of new systems like FlexRay. Eberspächer Electronics has put together simple solutions for several areas of application in vehicle networking with FlexRay and CAN.

An easy way to FlexRay know-how

Do you want to investigate the FlexRay bus system as part of a research project or study, or in the preliminary phase of development, and ascertain its suitability for use in your products? Are you a project manager or developer in the area of networking, and want to familiarize yourself with FlexRay and evaluate it as a bus system?

> I t is best to start with a small network that you set up as a prototype. That way, you can ascertain whether the system and component requirements can be implemented. If you do not have any ECUs yet, the recommended procedure is to set up a prototype, using FlexDevel development boards as FlexRay nodes.

> The nodes are connected by the active FlexAS star-coupler. We offer you a wide assortment of FlexRay cables to wire up your configuration.

> You can define the communication within the FlexRay network with FlexConfig, and store it in a FIBEX file.

> The second step is to extend the bus by adding a FlexXCon midget with remaining bus simulation. The necessary physical bus elements (transceivers) for each channel are located on a FlexTiny module. Sensor data that are available for purposes of evaluation via Ethernet or CAN connection can be transmitted on the FlexRay bus via CAN/Ethernet/FlexRay gateway.

> The FlexRay system can be qualified for your purposes using electrical measurements. For EMC measurements, we recommend our FlexOpto fiber optic bus extension.

In-vehicle network overview
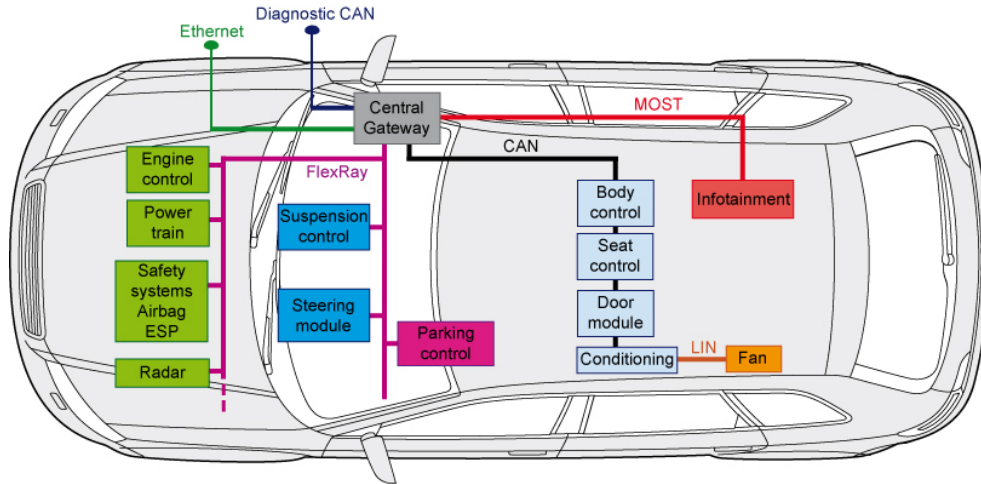
Migrating
CAN à **FlexRay**
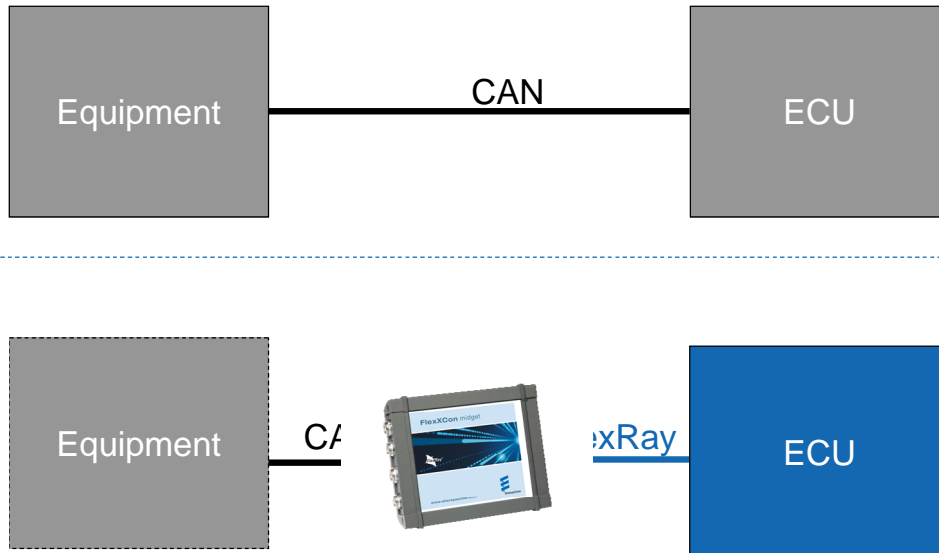
YOUR FIRST SUCCESSFUL FLEXRAY PROJECT

You have just been awarded your first FlexRay project, or will be starting it shortly? You are the project manager and want to ensure that the schedule and the quality goals can be met economically. We want the project to be a success. To do that, you and your team will first have to get a kick-start in the new technology, and then get development off the ground and running smoothly.

> In a training course, you can qualify your employees and save a lot of time and costs during the learning phase. The practical training ensures a professional approach to the new topics.

> With FlexDevel and FlexXCon midget, you can set up prototypes before your ECU hardware is available, and you can gain first experience.

> FlexXCon midget provides you with a gateway solution for migrating from CAN to FlexRay. With it, you can simply connect the existing units and systems to the FlexRay bus using CAN.

> As soon as the first software is developed, you want to analyze the new network. A PC can be connected to the network via a FlexCard. Caromee is the recommended choice for analyzing the FlexRay and CAN bus traffic, offering online and offline analysis of bus data and comprehensive display and filtering capabilities. This makes documentation of the development status very simple, eases the exchange of information between your developers and other departments, and simplifies problem analysis, removal and documentation.

> In a project context, we support you in tasks relating to specifications, selection of tools, project management and engineering. We contribute our years of experience in FlexRay projects. You are the specialist in your application. Together, we will ensure the success of the project.

Migrating from CAN to FlexRay

Equipment — CAN — ECU

Equipment — CAN — FlexRay — ECU
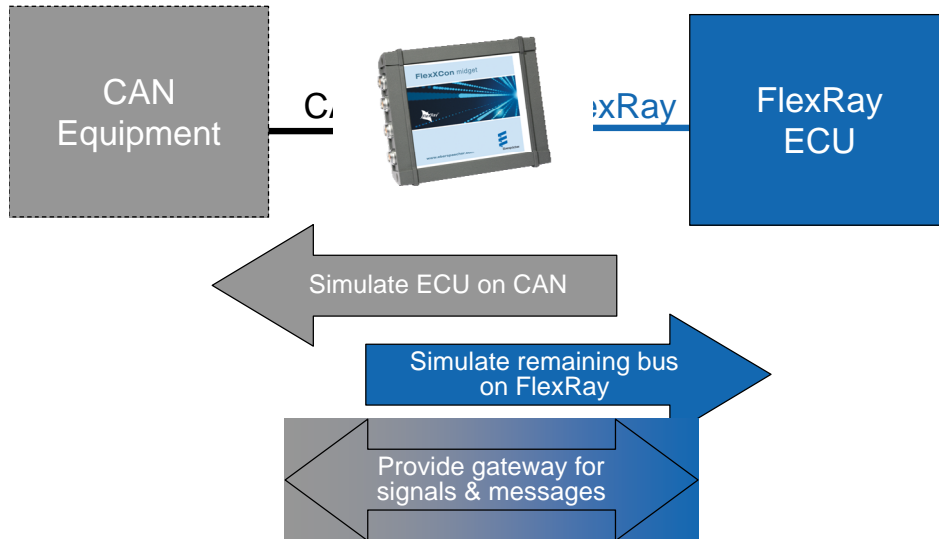
© J. Eberspächer GmbH & Co. KG

When migrating your ECUs and equipment from CAN to FlexRay-only you will experience, that the new FlexRay is similar to CAN when looking from a 10000 feet level. Coming closer will show, that there are many differences.

One possible step is to keep your changes at minimum. Keep your existing development and test equipment and migrate only your ECU at first.

Eberspächer FlexXCon will be the man-in-the-middle for a while.

CAN / FlexRay Gateway

Eberspächer

CAN Equipment — CAN — FlexXCon midget — FlexRay — FlexRay ECU

Simulate ECU on CAN

Simulate remaining bus on FlexRay

Provide gateway for signals & messages

RBS, GATEWAY AND SIGNAL MANIPULATION

The FlexXCon midget solution supports multiple CAN and FlexRay channels in a flexible way. It has a robust IP67 housing and can be powered via the vehicle battery. FlexXCon midget starts like an ECU within 100 ms and is optimized for extremly short gateway routing times.

FlexXCon midget runs multiple remaining bus simulations simultaneously - one for each channel. These can be connected via a signal or message gateway. During routing the user can manipulate the signals.

For simple and fast configuration of the RBS and gateway we provide a new FlexConfig application suite. It supports all common database formats.

Reference project: AUTOMATICALLY GENERATED GATEWAY

For a German OEM, we have developed a dynamic gateway application based on the FlexXCon midget.

The application allows to create a gateway application automatically for any ECU, using a FIBEX database. Different gateway configurations, such as FlexRay/FlexRay, CAN/FlexRay and CAN/CAN, are possible. This means that, for instance, FlexRay ECUs can be tested on existing CAN HiL systems, both during development and on commissioning of the ECU on the test stand.

Reference project: PORTING THE REMAINING BUS SIMULATION

For a large automotive supplier, we have integrated our remaining bus simulation in the real-time operating system of the company's

test stand hardware.

With the help of a remaining bus simulation configuration generated from FIBEX or AUTOSAR, our customer can test their development

and series ECUs on their test stands. The customer can now make the adaptation for new ECUs or ECU variants in a few minutes themselves.

The flexibility thus achieved speeds up development and significantly shortens the time taken for adaptation to changed software variants, for example.
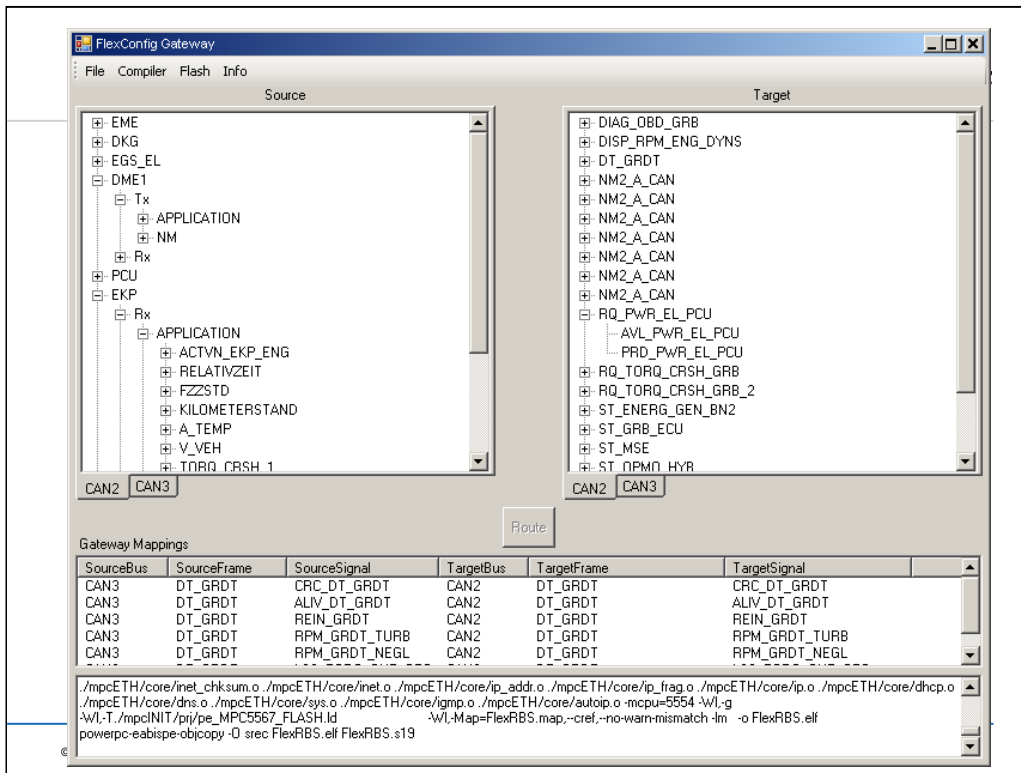
Here is an impression of our new FlexConfig gateway configurator tool.

APPLICATION AREAS

FlexRay/FlexRay gateway

In a network with multiple FlexRay ECUs, each ECU is sometimes tested separately. In this case the ECU is separated from the network

and then connected via FlexXCon midget. The FlexXCon midget works as a gateway device and transfers all messages between both ECU

and remaining network. Both sides of the FlexXCon midget have a RBS and the gateway transfers the message signals.

During the test signals can be changed, canceled or generated. The behavior of the ECU under test is verified.

CAN/FlexRay gateway

When introducing FlexRay as a new technology there is often the task to adapt new FlexRay ECUs to a CAN-only infrastructure. The FlexXCon midget is used as a CAN/FlexRay gateway. The configuration of the gateway is done via FlexConfig Gateway.

CAN / FlexRay Gateway

Eberspächer

CAN Equipment — CAN — FlexXCon midget — FlexRay — FlexRay ECU

FlexXCon midget + FlexConfig:
- **RBS & gateway & signal manipulation**
- **Fast routing**
- **Fast start-up**
- **Robust housing**
- **Easy to configure**
- **Affordable**

© J. Eberspächer GmbH & Co. KG

The FlexXCon family offers a hardware platform for typical applications in the networking environment. These include gateways between different bus systems, remaining bus simulation, signal manipulation and rapid prototyping. Eberspächer Electronics offers suitable products for different performance classes and uses.

APPLICATION AREAS
-Gateway
-Remaining bus simulation
-I/O
-Test sequencer
-Signal manipulation
-Rapid prototyping

FLEXXCON BENEFITS
> Universal hardware for networking
> Very short signal routing times, short ISR latencies
> Starts in <100 ms like an ECU
> IP 67 housing
> Flexible FlexRay, CAN and LIN interfaces
> Unit and housing designed for use in the vehicle
> Integration of FlexRay ECUs in a CAN environment
> Wake-up via bus and/or local I/O
> Example files included
> Complete development environment included
> PC connection via Ethernet and USB
> Applications: Gateway, prototype ECU, remaining bus simulation, signal manipulation, monitoring

FlexRay ECU testing

EFFICIENT DEVELOPMENT TEST STAND

In your development planning, you have identified the need for a component test stand. We support you in the design, development and implementation of test stands. If you wish, we can take your existing systems into consideration.

> For the connection between your test stand and the FlexRay and/or CAN bus of the test device we offer the FlexCard PMC and PMC II. These fit in a mezzanine slot, and are equipped with multiple FlexRay A/B or CAN high-speed channels. For PCI systems, there is a PCI and PCIe adapter available.

> Integration in your test stand is handled by the FlexCard drivers for Windows, Linux, Xenomai or LabVIEW.

> As part of a test stand project, we provide optimal operating and evaluation software that is oriented towards your needs for efficient utilisation of the test stand.

Reference project: INERTIAL RATE SENSOR TEST STAND

For a large automotive supplier, we have developed an inertial rate sensor test stand with real-time evaluation of 12 ECUs via FlexRay with time-stamping to a precision of 1 •s.
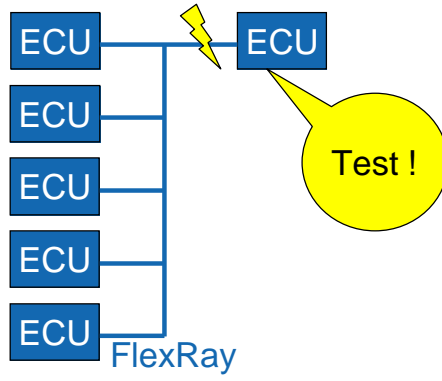
This test stand serves to test ECUs with acceleration sensors, and revs sensors with integrated acceleration sensor elements, during development.
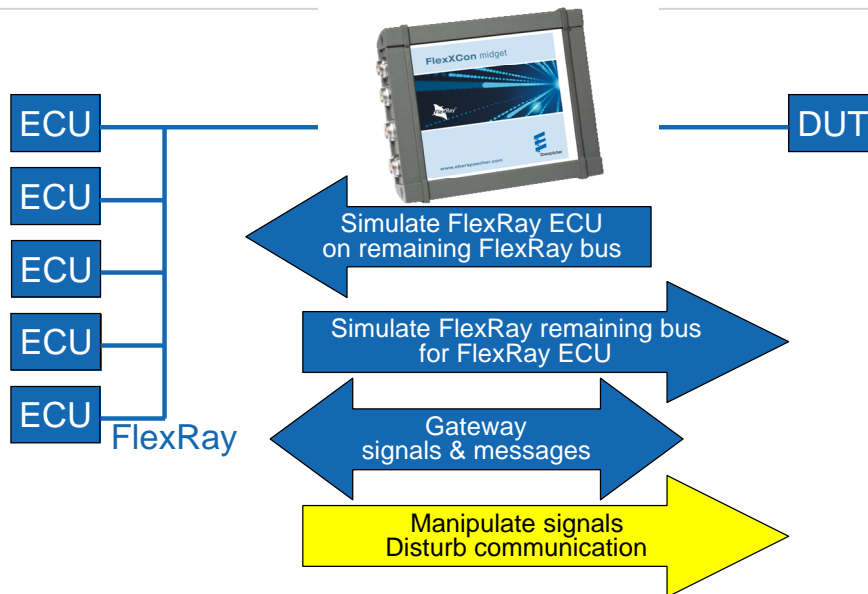
The tilting table used in the test stand allows the sensors to be rotated by $\pm90°$ to the field of gravity and an acceleration of ±1 g. The sensors can be subjected to a temperature between -40 – 85 °C during the test. The measurement is fully automatic and results are printed out in a report and are automatically evaluated. In addition, they are stored in various formats for further evaluation.

Reference project: REENGINEERING TEST STAND SOFTWARE

We are reworking the test stand software of a large automotive supplier. This software is used worldwide on all the company's test stands. It has been growing for more than 15 years, and was developed on a now obsolete Borland 5 compiler.

As part of a current project, the software is being reconstructed using modern methods, ported to Qt and given multi-language capability. This means that the software is back under maintenance, and can be easily extended. The user does not have to relearn anything, and can continue to use the existing test procedures and hardware components.

FlexRay / FlexRay Gateway

Eberspächer

ECU
ECU
ECU
ECU
ECU
FlexRay

DUT

Simulate FlexRay ECU
on remaining FlexRay bus

Simulate FlexRay remaining bus
for FlexRay ECU

Gateway
signals & messages

Manipulate signals
Disturb communication

© J. Eberspächer GmbH & Co. KG

REMAINING BUS SIMULATION

In the course of developing a complete vehicle, every ECU owner comes to a point where he would like to integrate his first prototype in the target network for test purposes. Unfortunately, not all the relevant ECUs are available during development – so an equivalent substitution at signal level is needed.

Remaining bus simulation (RBS) applies the messages and signals from the ECUs to the bus. Eberspächer Electronics offers a real-time system through hardware-based simulation of FlexRay communication with the FlexConfig RBS Module in combination with the FlexXCon midget.

This puts you in a position to be able to work with and test all the ECUs "virtually" before they become available. Control capabilities are available via Ethernet, e.g. RBS signal values or disabling ECU blocks in the RBS.

GATEWAY

If you have multiple bus systems in your application, information mostly has to be exchanged among them. This is handled by a gateway application that receives messages, signals and/or entire data streams (packaged in the transport protocol layer) on one bus, processes them, and sends them to another bus.

Gateways can be implemented in many ways with only one bus system, such as FlexRay, or among CAN, LIN and FlexRay. For example, purely CAN-based test stands can be extended to include FlexRay signal manipulation by means of a "CAN to FlexRay" gateway and a stimulation protocol between the CAN bus and the FlexRay bus.

SIGNAL MANIPULATION

Signal manipulation is an indispensable tool in the test process when you are developing an ECU. Whether the focus is on safety aspects in the context of an error-tolerant system, or quite simply the robustness and reliability of the overall system is in the foreground; signal manipulation can be used to stimulate an ECU into any designable system state.

Depending on how your test stand is built up, it may be necessary to manipulate the branches of the network that you are investigating – which may consist of one or more ECUs – transparently at signal level. For this purpose, we offer the option of a "FlexRay to FlexRay" gateway, which can exceed the technical obstacles of FlexRay signal manipulation.

Eberspächer Tool-Chain

FLEXCONFIG

FlexConfig provides a comprehensive configuation tool suite for automotive network applications. It is mainly based on the FIBEX database format. FlexConfig includes viewer & editor, remaining bus simulation, gateway, signal manipulation and CHI generation.

> FlexConfig Network Designer allows you to create FIBEX files from the scratch and edit existing files. Besides FIBEX, CANdb and AUTOSAR XML files can be imported.

> With FlexConfig RBS a remaining bus simulation can be generated from multiple FIBEX files. A hex file ist generated and directly loaded to FlexXCon midget.
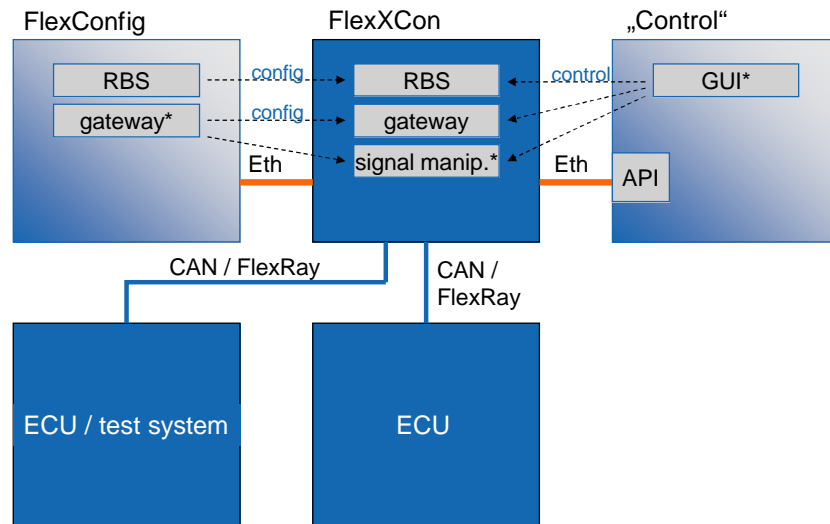
> The FlexConfig Gateway module allow you configure a gateway between multiple networks and to configure signal manipulation.

> For online manipulation a GUI can be written using our API.

> The CHI Generator tools can be used to create CHI files from FIBEX files.

> A free demo version is available.

Eberspächer Electronics RBS/Gateway Tool-Chain

FlexConfig · FlexXCon · „Control"

RBS — config --→ RBS ←-- control -- GUI*
gateway* — config --→ gateway
Eth → signal manip.* → Eth · API

CAN / FlexRay · CAN / FlexRay

ECU / test system · ECU

* user code

© J. Eberspächer GmbH & Co. KG

FLEXCONFIG NETWORK DESIGNER

The complexity of FlexRay makes it essential to use tools that support you in the design and configuration of FlexRay networks. FlexConfig Network Designer offers functions for the design and configuration of FlexRay networks, such as simple parameterization of the cluster and node parameters, definition of static and dynamic messages, data export in various formats, and interactive design of FlexRay communications.
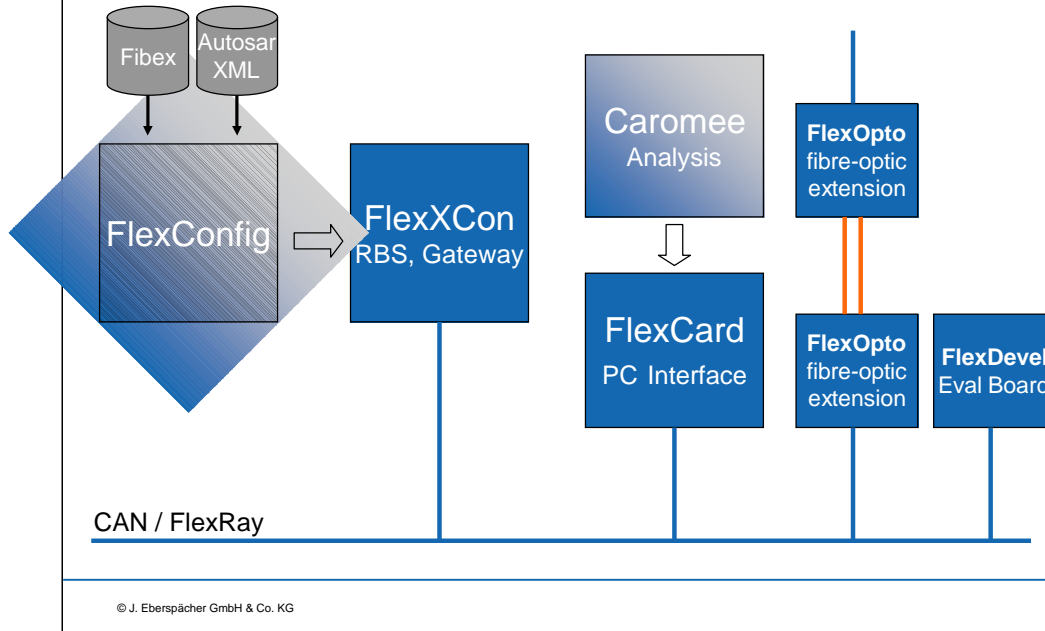
FLEXCONFIG RBS

FlexConfig RBS is an extension of the FlexConfig Network Designer configuration software. It is used to generate hardware-based remaining bus simulations (RBS) out of a FIBEX bus description file. In combination with the FlexXCon midget, it can be used to build-up a cost-effective testing environment (PC + hardware platform + RBS). Based on a FIBEX file, this module offers fast configuration and automatic generation of the RBS application with a few clicks. The RBS runs completely self-sufficiently on the target system FlexXCon midget, and can be used as a very small stand alone device.

FLEXCONFIG GATEWAY

FlexConfig Gateway is the configuration tool for the gateway functionality of FlexXCon midget. It works together with FlexConfig RBS. FlexConfig Gateway is an easy-to-use Windows software to map signals from two RBSs between two interfaces. The signal gateway transfers signal values between CAN and/or FlexRay interfaces of FlexXCon midget.

CHI GENERATOR

Eberspächer Electronics offers the CHI Generator for the configuration of FlexRay Communication Controllers from the FIBEX data.

Eberspächer Electronics complete tool-chain

Eberspächer

Fibex | Autosar XML

FlexConfig

FlexXCon
RBS, Gateway

Caromee
Analysis

FlexOpto
fibre-optic
extension

FlexCard
PC Interface

FlexOpto
fibre-optic
extension

FlexDevel
Eval Board

CAN / FlexRay

© J. Eberspächer GmbH & Co. KG

CAROMEE

Caromee is a software product that provides the basic functions for measuring and analyzing networks in vehicles. It has a large number of open interfaces in several directions, thus reconciling individual requirements with high cost-efficiency. It can not only be adapted to different interface hardware from different manufacturers, but also integrated in existing process sequences and can have specially adapted evaluation functions added on. Whether on a test stand in the car plant or with special laboratory vehicles, Caromee helps you to acquire network data in many areas of vehicle development.

FLEXCARD

Eberspächer Electronics offers the FlexCard family products to connect your PC or notebook to automotive bus systems such as FlexRay or CAN. The FlexCards are used to record and filter the data traffic in these systems. All FlexCards can also be used as active bus participants. The modular design of the hardware allows future firmware updates on the part of the user. Drivers for different operating systems and variable triggers round off the FlexCard package.

FLEXOPTO

FlexOpto is a bidirectional media converter which transmits electrical FlexRay, CAN or LIN signals via optical fibre. For an independent use, high capacity lithium ion batteries allowing an operation up to 40 h without charging. The PCB design is optimized for EMC tests, emits very little noise and is unsusceptible against high levels of electromagnetic noise.

FLEXDEVEL

FlexDevel is an evaluation board for automotive FlexRay, CAN and LIN bus systems. This platform makes it easy to build FlexRay, CAN and LIN systems. A large number of interfaces allow solutions for a wide range of applications. The host processor of FlexDevel is programmed via an easy-to-use function library (C-code).

Summary

Eberspächer

1. **Complete FlexRay simulation and analysis tool chain**

2. **FlexXCon / FlexConfig RBS+gateway solution**
    1. Starts in <100 ms
    2. IP67 housing
    3. Hundreds of successful installations
    4. Easy to use
    5. Affordable

Visit us at

hall 1 – booth 1242

- **More information**
- **New catalog**
- **Demo**

PROFESSIONAL SERVICES

For your projects we are a professional service partner with specialized bus system skills, particularly in FlexRay. We offer you a quick response to your inquiries. You are supported in your development projects, from the requirements document through the specifications, architecture, design, implementation to integration and testing. We support you in extending your systems and test stands or to integrate our products in your development and test stand environment. To get started with FlexRay, or enhance your knowledge in that area, we can help you effectively with our training courses. The reference projects described below give you an idea of the tasks in which we can support you. Challenge us!

YOUR BENEFITS

> Profit from our skills

> Relieve your capacity bottlenecks with the work of our engineers

> Simplify your development process by integrating our tools

> Reduce your development risks

> Ease your entry to FlexRay and vehicle networking

> Grasp the opportunities offered by the most comprehensive portfolio of FlexRay products

OUR EXPERTISE

> Integration of our products in existing customer systems

> Adaptation of our products to our customers' demands

> Hardware and software development for all aspects of automotive bus systems, especially FlexRay

> Development that embraces everything from hardware development through FPGA programming, micro-controller programming and driver programming to application programming
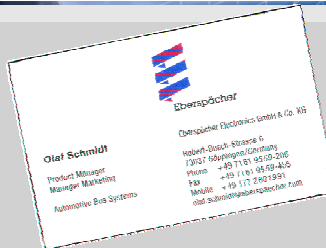
Eberspächer Electronics I Automotive Bus Systems

Hall 1 booth 1242

Thank you for your attention!

QUESTIONS?

DRIVING THE MOBILITY OF TOMORROW

SALES CONTACT:
Phone: +49 7161 9559-345
Fax: +49 7161 9559-455
E-Mail: ebel-sales@eberspaecher.com

SUPPORT CONTACT:
Phone: +49 7161 9559-222
Fax: +49 7161 9559-455
E-Mail: ebel-support@eberspaecher.com

DISTRIBUTORS:
England: Warwick Control
France, Spain, Italy: NSI
Japan: Gailogic Corporation
USA: Dearborn Group Technology
Korea: CANsystem
China: Maiweitek

SYSTEM INTEGRATORS:
Germany: IPG Automotive GmbH
Germany: XKrug GmbH