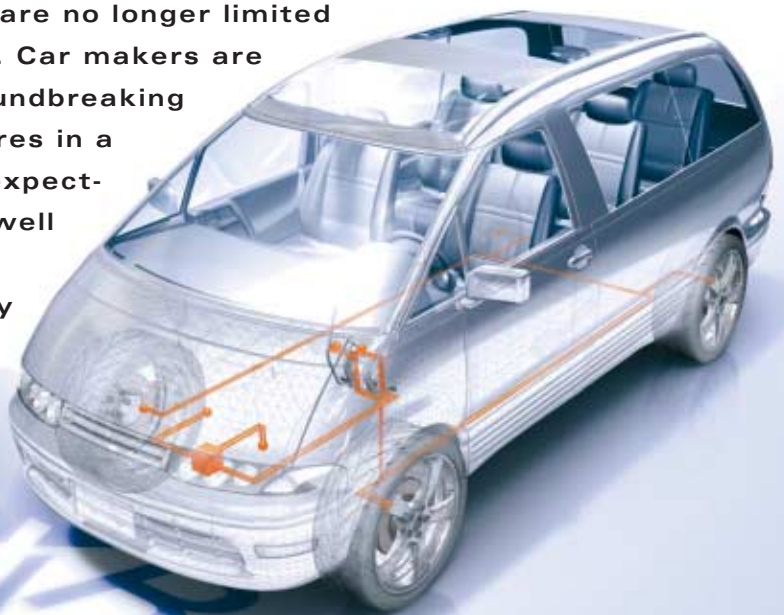


# Complete FlexRay silicon solutions from a single supplier

**FlexRay application fields are no longer limited to steer- or brake-by-wire. Car makers are about to deploy some groundbreaking new chassis control features in a FlexRay network. This unexpected use of FlexRay comes well before steer- or brake-by-wire systems will be ready for production vehicles.**



Philips is the first semiconductor supplier to offer both silicon solutions for the FlexRay physical layer and powerful 32-bit microcontrollers with embedded FlexRay communication controller. This strategy of offering a complete system solution to the automotive industry will maximize performance and interoperability.

As a founding and core member of the FlexRay consortium, Philips has made a significant contribution to the development of the FlexRay physical layer and protocol specification. This broad FlexRay system know-how already enables Philips to present innovative and reliable products, fully compatible with the latest FlexRay standard (Version 2.1). By offering complete system solutions, Philips is helping accelerate the introduction of the FlexRay communications system for in-vehicle networks.

The first commercially available products are the fully featured bus transceiver TJA1080 and the 32-bit ARM microcontroller SJA2510 with embedded FlexRay communication controller (CC). Key features of Philips' FlexRay concept are the outstanding configurability and scalability that allow the FlexRay CC to grow with application needs. In

conjunction with the new and powerful on-chip bus infrastructure, a large amount of message data can be securely handled with short message transfer latencies as required by gateway or x-by-wire applications for example. Philips' family approach for all physical and protocol layer products guarantees the interoperability of future derivatives and maximizes re-use of hardware and software system components.

## ARM microcontroller families with embedded FlexRay

Philips has now enriched its ARM7 and ARM9 families of dedicated automotive microcontrollers with the two-channel FlexRay v2.1 CC. Philips' platform technology allows tailored solutions from low-cost to high-performance – an approach that has been consistently implemented in our FlexRay communication controller. Conformance to the FlexRay protocol specification v2.1 and interoperability of different devices is assured by a Philips and Freescale Semiconductors joint IP development of the Protocol Engine (PE). This PE has been extensively cross-verified with a FlexRay v2.1 compliant executable reference model, developed at Philips.

**Versatile and scalable controller-host-interface**

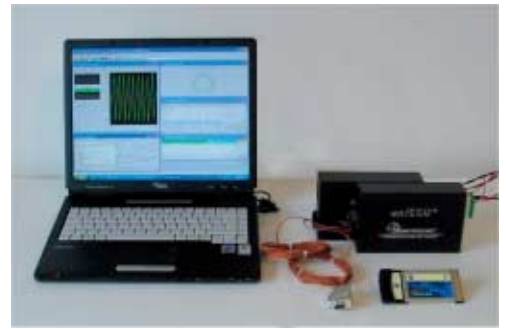
The key to the overall FlexRay system performance is an efficient implementation of the Controller-Host-Interface (CHI). Philips has developed and implemented a CHI concept that optimizes the link between the FlexRay CC and the ARM host system infrastructure, to gain high data throughput and short message latency times. Using the on-chip multi-layer system bus, the communication controller has fast access to the assigned FlexRay memory where the message buffers are directly made available to the FlexRay software stack – i.e. performance bottlenecks arising from potentially slow FlexRay subsystems can be circumvented. Hence, no message buffer locking or additional internal copying processes inside the FlexRay CC are necessary.

Both message buffer configuration and message filtering benefit from the versatile configurability of the CHI. Message buffers can be individually configured for queuing-type, payload length, buffer depth and other features. Message filtering for an individual message buffer can be based on either a single slot value or

several slot ranges. The total number of buffers is only limited by the available amount of system memory assigned to FlexRay, adapted according to the application requirements.

**Figure 1** illustrates the Philips FlexRay concept. The FlexRay communication matrix that defines which slots are subscribed for transmission or reception on each channel is efficiently mapped to message buffers with a structure of linked lists. This list structure represents, in the classical sense, message buffers and message filter rules guaranteeing that buffer updates are always consistent. Consistency is also supported by inherent properties of the multi-layer system bus, for example through atomic multi-word memory accesses. The communication controller works autonomously on the list structure via a dedicated layer of the multi-layer system bus per FlexRay channel. Additionally message handling and filtering are realized in hardware without CPU involvement. Therefore FlexRay communication via the multi-layer system bus is transparent to other system resources, e.g. the CPU can simultaneously access any linked subsystem like the other in-vehicle net-

**Flexray™ Monitoring Solutions**



**FR-AnalyzerPro V 2.0**

- Realtime monitoring of Flexray™ bus traffic
- Filter/Trigger/Trace of Flexray bus data
- Offline analysis of previously captured data
- Import of car data bases (FIBEX, XML)
- Numeric/Graphic display of physical car signals
- Statistical functions, ID-Preview
- User based script functions (e.g. offline search)
- Language switching on the fly
- Supports TZM Flexcard® and Decomsys® Busdoctor®
- Export into ASCII or Matlab™ (\*.mat) files **New**
- Remote Control API **New**
- FIBEX Editor **New**

**Flexray™ Monitoring-Kit**

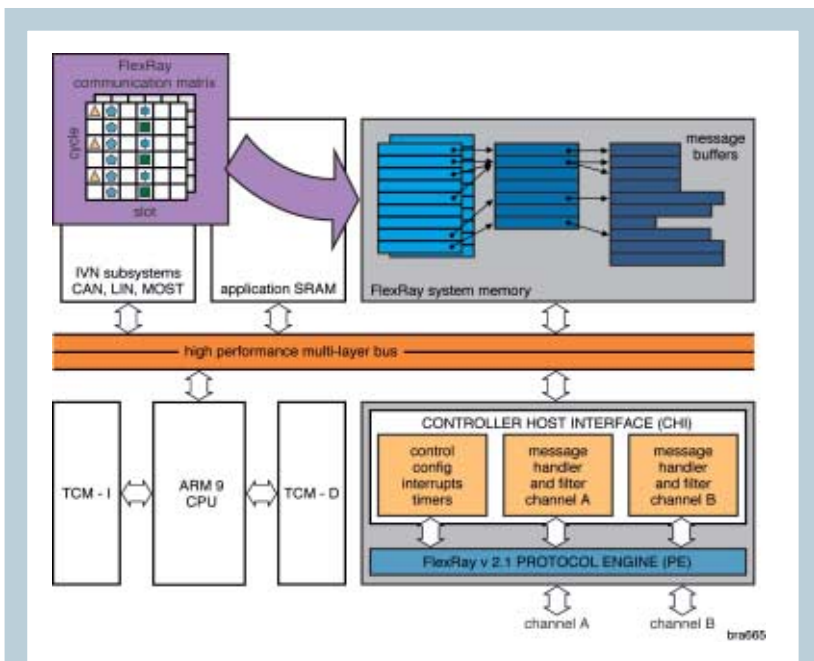
The CRST Flexray™ Monitoring-Kit is a complete hardware/ software solution for all users who want to evaluate a Flexray™ bussystem. The Flexray Monitoring-Kit is based on the CRST *FR-AnalyzerPro* monitoring software and the TZM *FlexCard*® as notebook interface to the Flexray Bus.

**Flexray™ Starter-Kit**

The CRST Flexray™ Starter-Kit is a comprehensive "ready to run" hardware/ software solution for all users who want to get familiar with the new Flexray™ Technology. The Flexray Starterkit is based on the CRST *FR-AnalyzerPro* monitoring software, the TZM *FlexCard*® as notebook interface to the Flexray bus and a Flexray cluster including two "Flexray-talking" Gigatronik *uniECUs*®



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**Figure 1: Philips FlexRay v2.1 embedded controller.**

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Philips SJA2510 feature list
32-bit ARM968 CPU with tightly coupled memory and 80MHz clock frequency
High performance, multi-layer system bus for concurrent data transfer
Up to 1 Mbyte embedded flash memory
More than 48 kbytes SRAM
2-channel FlexRay Communication Controller, FlexRay v2.1 compliant, up to 10 Mbits/s
6 x CAN 2.0B controller
8 x LIN 2.0 master controller
External bus interface
24 16-bit universal PWM outputs
32 analog inputs
Asynchronous and synchronous serial interfaces
AEC Q100 grade I qualification, -40°C to +125°C ambient
LQFP100, LQFP128 and LQFP144 packages

Figure 2: Philips SJA2510 – feature list.

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**TJA1080 – first fully featured FlexRay transceiver**

The TJA1080 is already setting the standard for a FlexRay transceiver and offers the first opportunity to implement FlexRay systems. It can be used in FlexRay nodes as well as in active stars. In both operation modes the TJA1080 implements the standardized features along with any optional features specified by the latest FlexRay electrical physical layer specification v2.1. Philips has also added further functional enhancements to facilitate a straightforward system realization and implementation. For example the host interface also allows access to diagnosis information in star mode and the ECU's power saving capabilities were improved by a second inhibit switch, allowing the device to be switched off in standby mode.

work (IVN) sub-systems (CAN, LIN, MOST), a strong benefit not only for Gateway applications.

**SJA2510 – first microcontroller with embedded FlexRay**

In our family of ARM9 microcontrollers, the first embedded FlexRay microcontroller is now available. High system performance is achieved by using a 32-bit ARM968 CPU operating at up to 80 MHz and incorporating tightly coupled memories, a multi-layer system bus and more than 48 kbytes SRAM and up to 1 Mbyte flash memory. In addition to the 2-channel FlexRay v2.1 CC, the SJA2510 provides an IVN sub-system consisting of 6 CAN and 8 LIN master controllers with strong hardware support. A large number of further digital and analog interfaces, a temperature range of -40 °C to 125 °C and several package variants make the SJA2510 the right choice for a wide range of automotive applications.

**The physical layer devices family**

Running the FlexRay protocol in an automotive environment demands a specialized physical layer, which was developed by the consortium. With a leading role in this development, Philips is consequently the first supplier on the market offering silicon solutions for this new physical layer. We have risen to the challenge of developing a transmitter for 10 Mbits/s that meets OEM requirements on RF-emission and a receiver that successfully copes with ground shifts, RF-injection and ISO 7637 pulses.

Several thousand TJA1080 engineering samples have been shipped to and tested by OEMs over the last two years. This guarantees the final silicon, which is available now, is technically mature. As the 'golden' device, the fully equipped TJA1080 is the best basis from which to derive a family of specialized and cost optimized chips. In line with Philips FlexRay roadmap the family will soon be extended with additional devices. Some of the technical highlights of these products include 42 V board net compatibility and a solid ESD barrier to the bus wires.

**Complete system solution**

Philips is the first semiconductor manufacturer offering and supporting complete FlexRay system solutions. Our ARM based microcontrollers with embedded FlexRay communication controller and transceivers for FlexRay nodes and active stars cover the entire range of necessary silicon devices for FlexRay systems. Through a leading role in the FlexRay consortium combined with a broad know-how in automotive power management, system design, EMC and automotive data protocols (CAN, LIN and now FlexRay), Philips is peerless in supporting their customers in a competent and comprehensive manner. Jointly developed or optimized system solutions can now be realized with innovative and future-proof products from a growing FlexRay product family.

Lutz Leutelt and Bernd Elend are working at Philips Semiconductors.