

CAN - CONTROLLER AREA NETWORK

C&S Activities

University of Applied Sciences
Fachhochschule Braunschweig/Wolfenbüttel
communication & systems group

CAN

TTCAN

FlexRay

LIN

MOST





CAN Physical Layer Conformance Testing

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CAN Physical Layer Conformance Testing intends to ensure correct interoperability of CAN transceivers in complex CAN networks that use transceivers from different suppliers.

Test Specification

Test conditions have been derived by an international group of automotive OEMs and semiconductor suppliers – the GIFT group, started in 1999 and managed by C&S. As a result, specifications were forwarded to ISO for standardization.

Test System

The tester consists of a well defined standardized network, where the ECUs communicate under various system conditions. Supervisor software controls system states and test sequences. CAN communication is supervised and controlled by cali-

brated measurement equipment. Test results – including raw data – are stored for later analysis, which is required according to ISO17025.

Test Execution

At the very beginning of the design phase C&S helps to integrate testability. Pre-testing during the design can show up problems early. During the conformance test exact reproducibility ensures fast traceability in case of problems. This procedure – called customer coaching - is established to avoid problems during the development process.

Test Results

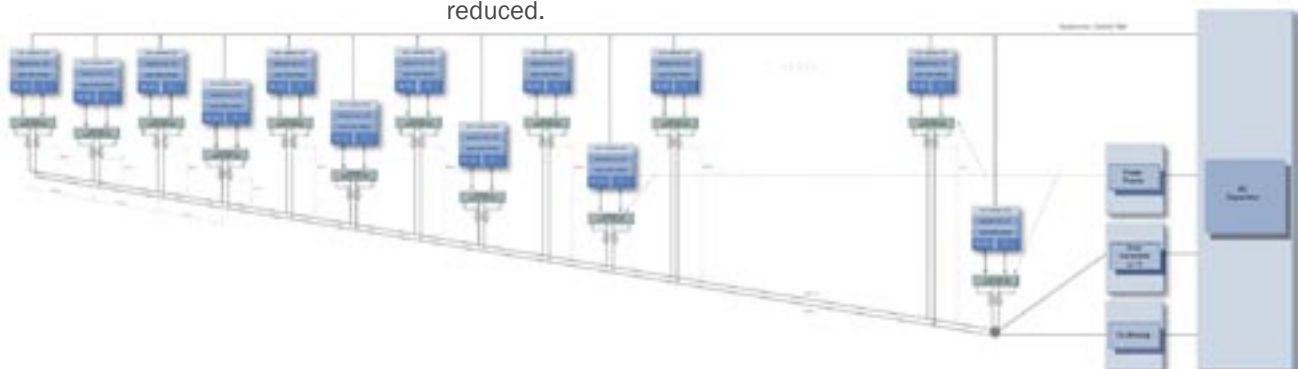
Automotive OEMs require the authentication sheet as a precaution for the release of CAN transceiver devices. OEMs have stated that trouble with malfunction of transceiver devices has been dramatically reduced.



■ The **C&S group**, – managed by director Prof. Lawrenz – has a wide range of experience in the area of communication protocols for networked controllers.

Since 1995 C&S has expanded its expertise especially towards testing and certification of network protocols of different kinds and on various layers.

As such C&S has significantly contributed to e.g. the ISO CAN conformance test standard ISO 16845, the becoming TTCAN ISO test standard, the de facto test standards for CAN high speed transceiver testing, CAN low speed transceiver testing and others. Being part of a university, C&S is a neutral and independent test house with a worldwide recognition in conformance testing of protocols.



01 CAN Physical Layer Architecture of the Test Environment



02 CAN Physical Layer Conformance Test



Test System

In 1995 the first test system was built by C&S and many conformance tests have been executed since then. The test system was redesigned in the meantime and semiconductor developers worldwide use the C&S CAN CT system for their validation – prior to the Conformance Test. The test coordination is performed by a PC with C&S supervisor software. Agilent™ equipment is integrated for calibrated measurements.

CAN were different in their abilities – single-/multiple message buffers such as FullCan - but also in their behaviour on the bus side resulting in compatibility problems.

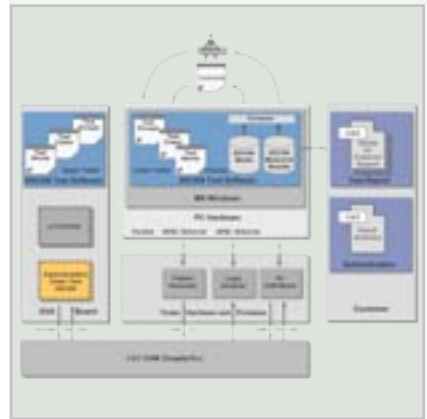
Test Specification

To ensure interoperability in multi-vendor systems – based on the CAN specification – a conformance test specification was developed. C&S was member of this stand-

Test Execution

The tester is stimulating the device under test in real-time and data acquisition is also performed with very high sample rate in order to guarantee the correct timing relations and to enable exact reproduction of the test scenario. Although many simulations are performed during the chip development, wrong behaviour on the CAN bus or malfunction on the host interface can be found in new implementations. This is caused by narrow timing conditions or silicon process influences.

**CAN
Data Link Layer
Conformance
Testing**



04 CAN DLL Tester Architecture

Very early in the CAN history, silicon implementations of the protocol were offered from multiple chip suppliers. Prof. Lawrenz has been active in the first steps of CAN being consultant for INTEL™ during the development of the first CAN communication controller. He later founded the C&S group. The specification of the CAN Bus Protocol was provided by BOSCH™ and it became an ISO standard. The various silicon implementations of

ardization group which set up ISO 16845. During the following years, C&S has made a lot of experience with test execution and additional tests have been derived for the processor interface and for non deterministic testing – called stress tests. Both test groups are C&S specific extensions to the ISO test cases.

Test Results

As many functions of today's cars are based on the CAN data exchange, the OEM rely on the Conformance Test results. In an 'authentication sheet' the testing results are summarized and silicon suppliers use this document to proof their quality and they use it for their marketing purposes. Every unexpected behaviour is depicted in detail in the test report in order to give the semiconductor manufactures all the necessary information to localize and solve the problem.



03 View of the CAN Conformance Test System

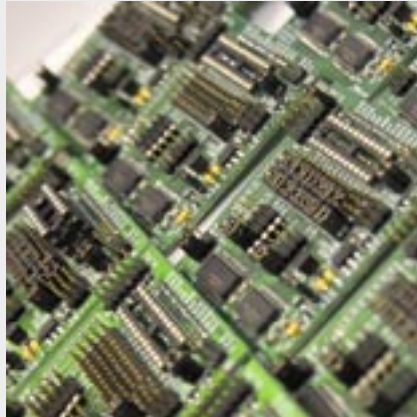
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Standardization

Quality Management

■ The goal of C&S group is to comply with increasing requirements regarding quality and reliability of electronic systems with both, qualified and professional service. In order to achieve this goal, C&S group has established a quality management system according to ISO 17025 guide lines. The process of accreditation through a DAR certified organization is in progress. In 2006, the LIN Steering Group has accredited C&S group as a LIN conformance test center.










100% part of University of Applied Sciences Wolfenbüttel,
Department of Computer Science
Founded 1995 by Professor
Dr.-Ing. Wolfhard Lawrenz, Director
C&S group

> Some Figures by 1Q/2006 :

- 40 employees staff
 - 1.700 m² laboratories, incl. 550 m² test garage for cars, etc.
 - 1.500.000 € investment in lab equipment
 - 2.000.000 € project turn over in 2005
 - major research income contribution to University
 - Univ. of Wolfenbüttel dept. of Computer Sc. is no. 1 in Germany
- > Expertise and R&D in Networked Electronic Systems for Testing, System Analysis and Design Applied to:
- Vehicles (90% of all All Activities)
 - Industrial Control,
 - Air Conditioning, etc.

> Active Contributor to Various Standardization Committees
> Teaching (Automotive) Networked Systems



	ISO Member Vehicles: System, Net, Diagnose
	SAE International Member Vehicles: System, Net, Diagnose
	GIFT/ICT Chairman Vehicles: Net Physical Layer
	CiA e.V. Member CAN Systems Networking
	FlexRay Consortium Premium Assoc. Member Vehicles: FlexRay Networking
	LIN Consortium Member Vehicles: LIN Networking
	MOST Consortium Member Vehicles: MOST Networking
	Konnex Association Member Facility Networking
	Autosar Development Member