

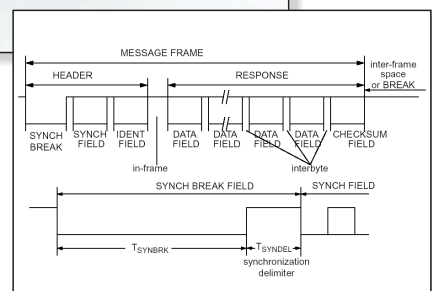
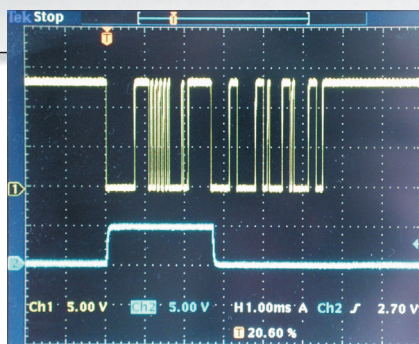
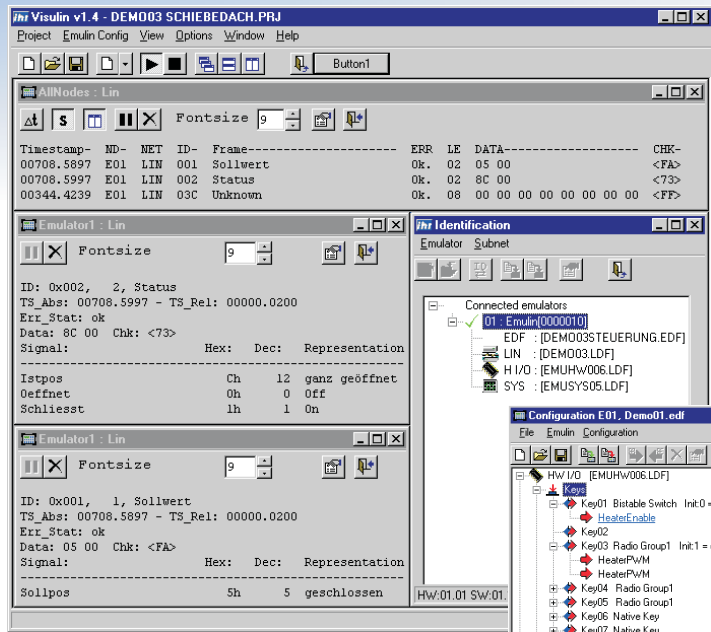
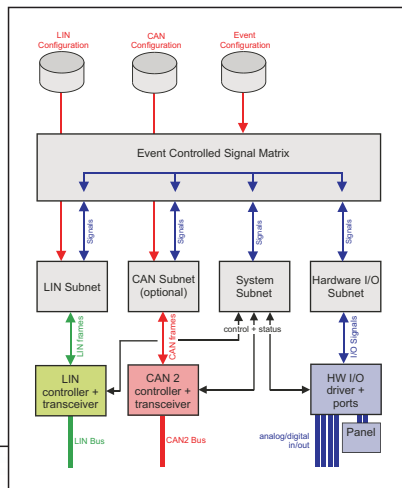


LIN Tools

From Simulation to Production

Test and Emulation Equipment for the LIN Bus





LIN Emulators for Development, Test Stations, Field Tests, and Production

THE family of tools for the entire development process of automobile control devices

Simulate a complete LIN bus in order to get to know and familiarize yourself with the technology. Develop a control device and check the bus protocol. Thoroughly check your development. Simulate errors and create protocols. Qualify your LIN implementation. Test your control device in continuous usage and in actual vehicles. Test your product both in productive and quality assurance environments. You can either use many different tools for these purposes - or just one!

The needs of our users are different --- so are our emulators.

ihr LIN emulators are available in a number of various forms. Whether you need a fully mobile hand-held device or an interface for the assembly line, a slim communication accessory or even a fully equipped high-performance analysis device - we have the solution for your requirements.

Our users want to work together with one another --- our emulators do just that.

All of our emulators are based on the same operating system and emulator core. For you, this translates to effective use of the know-how you acquire. The developers of a control device can pass on the configuration they have created to other users. Your test centers and production lines use devices that are compatible with those used in development. This enables you to save work effort and organize your development processes more efficiently.

Key Features

All devices are designed as development tools for the implementation and test of LIN control devices and entire networks. At the same time, they are multifunctional and can be configured according to your requirements.

Flexibility

The tools can be equally well used as passive analyzers or for the active depiction of single or multiple LIN nodes, irrespective of whether as master or slave (simulation of bus participants not actually present). All devices are fully configurable and programmable. Any kind of LIN networks may be processed as desired. All peripheral resources (entry keys, display LED's, I/O ports, depending on the model) are freely configurable. They can be coupled or linked with LIN signals and also with system variables and events such as, for example, error messages, control parameters and measurement values. A flexible set of commands allows the use of event-based counter and timing functions, arithmetic and logical operations, threshold value checks, and number comparisons with all LIN and system signals. It is even possible to create simple sequence controls.

Mobility

The devices work fully autonomously, without need of being connected to the PC. The large input voltage range allows the unproblematic use in both vehicles and automation areas up to 24V. The robust housing with IP53 protection resists even rough environmental conditions. A connection to the PC need only be established for the download of the previously created configuration of LIN network descriptions and the emulator periphery. The CAN interface required for this is included in the scope of delivery.

Precision

A high-performance 16bit microcontroller operates the LIN protocol in a very precise, but nevertheless highly versatile manner. With an internal access time resolution of 333ns, the emulator can generate and measure every bit edge with a precision of $<1\mu\text{s}$. Baud rates can be created and determined with a precision of $<0.1\%$ in the range from <1000 to >20000 baud. Thanks to extensive sets of parameters and measurement data, the entire protocol timing can be manipulated over a wide range on the transmission side, far exceeding the limits of the LIN specification. Test objects can be tested for their conformity with the specifications together with the analysis of the received timings.

Compatibility

The connection between the emulator and the PC software is actively effected via a high-speed bus in accordance with CAN 2.0B (extended identifiers). The protocol has been made open source. In principle, any other test and analysis systems present that are CAN enabled can also communicate with the LIN emulator. The usability of existing CAN based test and production installations is thus assured. A LabView (National Instruments) software application interface is obtainable for the CAN interfaces in our program.

External CAN systems can be awarded full control over the emulator and the LIN bus. To do this, the LIN master scheduling is taken over either by the emulator or by the CAN system.

Network Capability

Up to 15 emulators of any desired constellation can be operated simultaneously on one CAN measurement bus and be administrated by the PC software. It is thus possible, for example, to synchronously observe multiple LIN subnets of a vehicle, and as a further option, also with the vehicle's CAN bus connected. Alternatively, a test computer can control a whole array of test objects in parallel.

By means of a continuous time synchronization of the individual devices amongst each other, a common time base is assured for all message events. This is an important prerequisite for the correct determination of latency times in gateway control devices, even over several instances (LIN - CAN - LIN). The maximum time deviation of $100\mu\text{s}$ between two devices also corresponds to the resolution of the generated time stamp.



Performance Characteristics

Emulin LINGate
+ basic

Hardware

Basic device with 16bit computer, voltage supply 8..24V, designed for automobile environment and industrial usage (SPS)	✓	✓	✓	✓	✓
LIN interface with transceiver, freely programmable 1000 – 20000 Baud	✓	✓	✓	✓	✓
LIN bus termination variable, can be set by software					
Resistive: 310Ohm .. 30kOhm (15 steps)	✓	×	×	×	×
Capacitive: 100pF .. 13nF (10 steps)					
LIN bus termination selectable via software (4 steps):	×	✓	✓	✓	✓
Master 1kOhm / Slave 30kOhm / Stress 470 Ohm / Overload 310 Ohm					
CAN interface 1MBaud (measurement bus) for communication with PC / external participants, max.15 emulators on the net	✓	✓	✓	✓	✓
RS232 interface for firmware updates	✓	✓	✓	✓	✓
Operating panel with 8 keys and 12 LED's, freely configurable	✓	✓	×	×	×
Menu-based LCD display for adjustment and visualization of parameters, frames and signals	✓	×	×	×	×
Operating panel with control keys and status displays for logging data	×	×	×	✓	×
Card slot for flash memory media	×	×	×	✓	×
Desktop housing cast aluminium, IP53, 195 x 145 x 60mm	✓	✓	✓	✓	×
Top hat rail housing, 210 x 105 x 30mm	×	×	×	×	✓

Software Functions

Operating system with active independent LIN emulator,					
- Capable of stand-alone operation, configurable via PC					
- LIN environment can be loaded (from LIN description file)	✓	✓	✓	✓	✓
- Event-based function sequences (Event Description Files) can be created					
- Static configuration of the system and protocol parameters (start values)					
- Automatic time synchronization of the emulators on common CAN					
Number of the configuration data sets / locally switchable	2/✓	1/-	1/-	1/-	1/-
Read and write LIN messages and signals via emulator-CAN	✓	✓	✓	✓	✓
Read system states, measurement values from LIN protocol via emulator-CAN	✓	✓	✓	✓	✓
Read and write protocol parameters during runtime via emulator-CAN	✓	✓	×	✓	✓
Wakeup – Sleep capable / Power – Down capable					
(Power-Down only possible with LIN transceiver, otherwise only bus sleep when emulator running)	✓/✓	✓/✓	✓/×	✓/✓	✓/×
Local parameter adjustment, measurement, signal visualization and adjustment	✓	×	×	×	×
Read and write hardware ports via emulator-CAN	✓	○	○	✓	✓
Read and write vehicle CAN bus data via emulator-CAN, Event-based function configuration for vehicle CAN	○/■	○	○	○/■	○

Periphery Options

Port interface: 2 digital/analog inputs, 2 digital/analog outputs (BNC) of which 1 output configurable as frame trigger	✓	○	○	✓	✓
Digital I/O module: 16 optically isolated I/O connections, 2 separate voltage ranges 5..24V, row clamp connectors (available only together with port interface)	○/■	○	○	×	✓
Secondary CAN interface for vehicle bus: selectable high-speed/low-speed, for monitoring and emulation of gateway control devices	○/■	○	○	○/■	○

Scope of Delivery

LIN Emulator in desktop/handheld housing	✓	✓	✓	✓	
LIN Emulator in industrial housing for top hat rail assembly					✓
PC software "Visulin" for configuration and analysis	✓	✓	✓	✓	✓
For Windows 9x/ME/NT4/2000/XP					
CAN interface adapter for PC parallel port (in standard scope of delivery)	✓	✓	✓	✓	✓
CAN interface for PC ISA / PCI / USB (on request)	○	○	○	○	○
Cable set for CAN and LIN	✓	✓	✓	✓	✓
Additional mains supply adapter unit 12V	✓	✓	✓	✓	×

- ✓ included in standard
- optional when placing new order
- can be upgraded (upgrade package)
- ×
- not present / not available

Development Tools



Emulin

The top model Emulin is an autonomous test and simulation device. Almost all test and control tasks on a LIN bus can be carried out with complete mobility. Primary fields of use are the developer's workplace, the test station, and the direct measurement in the vehicle. Above all, users appreciate the direct access to all timing parameters and signals during the measurement. This permits rapid error finding on site -- without the bother of connecting to the PC.

Performance Characteristics:

- Emulation and Analysis of LIN nodes / LIN subsystems, simulation of bus participants not actually present
- Local monitoring of the bus traffic
- Local adjustment and measurement of all control parameters, message signals, frame timing
- Two independent configuration data sets, locally switchable
- Wakeup / Sleep / Power Down
- Event-based signal configuration and sequence control
- Detailed LIN bus error recognition and monitoring
- PC program Visulin for recording and displaying measurement data, and also for configuring the emulator
- Simple integration into automated test environments (LabView, HP VEE, and others)
- Simulation of erroneous bus adjustment (stress, overload)

Equipment:

- Menu-based illuminated Display
- Operating panel with 8 keys and 12 LED's, freely configurable
- Port interface with 2 analog / digital inputs and outputs
- Frame-based trigger pulse creation via digital output
- Highly variable bus termination ranges (resistive + capacitive)
- High-speed CAN measurement bus for PC communication

Accessories:

- Secondary CAN interface for vehicle bus and gateway emulation, fully configurable
- Digital I/O module
- CAN I/O periphery extension

LINgate+

Not all applications need the full functionality of control parameters and analysis functions. LINgate+ is perfectly adapted for use as an operating and display device where real control devices are missing. It can simulate masters and /or slaves, and thus physically rounds off a LIN network. The configurable signal processing makes it possible to simulate genuine control device behavior, ranging from direct reactions to simple sequence controls to adjustment controllers. LINgate+ is thus much more than just an operating interface.



Performance Characteristics of LINgate+:

- Emulation and analysis of LIN nodes / LIN subsystems, simulation of bus participants not actually present
- Wakeup / Sleep / Power Down
- Event-based signal configuration and sequence control
- Detailed LIN bus error recognition, LED display possible
- PC software Visulin for recording and displaying measurement data, and also for configuring the emulator
- Simple integration into automated test environments (LabView, HP VEE, and others)

Equipment:

- Operating panel with 8 keys and 12 LED's, freely configurable
- Resistive bus termination (master/slave/stress/overload) switchable by means of software

Accessories:

- Secondary CAN interface for vehicle bus and gateway emulation, fully configurable
- Port interface with 2 analog / digital inputs and outputs, trigger creation
- Digital I/O module
- CAN I/O periphery extension

Test Field and Continuous Run



LIN log

The mobile LIN data logger monitors the bus traffic in the lab or in the moving vehicle. Flash memory cards serve as an exchangeable recording medium. These are then read into the PC and processed and analyzed by the integrated user interface Visulin. Trigger conditions are configured on the PC and loaded to the logger together with the LIN description. The devices can be cascaded, so that the time synchronous parallel recording of several separate vehicle buses (LIN and CAN mixed) is possible. The recorded data from all sources are always time synchronous with one another.

Performance Characteristics:

- Monitoring of LIN nodes / LIN subsystems
- Recording of LIN bus traffic, system and measurement data, optional vehicle CAN bus traffic
- Wakeup / Sleep monitoring
- PC software Visulin for recording and displaying measurement data, and also for configuring the logger

Equipment:

- Operating interface with keys and LED's for direct logger control
- Card slot for insertion of compact flash media
- Memory depth of up to 128MB, permits the recording of more than 6 million messages
- Bus termination (master/slave/stress/overload) switchable by means of software
- Port interface with 2 analog / digital inputs and outputs, trigger creation

Accessories:

- Secondary CAN interface for vehicle bus and gateway emulation, fully configurable
- CAN I/O periphery extension



LINGate basic

Program controlled test runs on test stations, whether continuous runs or end-of-line, rarely need an operating interface. In the case of computer-supported applications in which the PC or other CAN enabled automatic device takes over the control, the LINGate basic represents the most favorable alternative from a price point of view. LINGate basic provides a LIN-CAN message transfer to and from the measurement bus and takes care of the protocol. Passive operation is possible, whereby an external test computer takes over the LIN scheduling via CAN.

Performance Characteristics:

- Emulation and analysis of LIN nodes / LIN subsystems, simulation of bus participants not actually present
- Wakeup / Sleep
- Event-based signal configuration and sequence control
- LIN bus error recognition, monitoring via CAN and LED possible
- PC software Visulin for recording and displaying measurement data, and also for configuring the emulator
- Simple integration into automated test environments (LabView, HP VEE, and others)

Equipment:

- Status display via 3 LED's
- Bus termination (master/slave/stress/overload) switchable by means of software

Accessories:

- Secondary CAN interface for vehicle bus and gateway emulation, fully configurable
- Port interface with 2 analog / digital inputs and outputs, trigger creation
- Digital I/O module
- CAN I/O periphery extension

For Production and Automatic Testing Devices

This device variation has been conceived for fixed installation on a rail or in a switch cabinet. LIN I/O is the intelligent communication adapter between production automation and the LIN test object. The connection to the tester or automation system is effected optionally via high-speed CAN and/or 24V digital I/O - in both cases optically isolated from the LIN test object. The test object can be fed in a short-circuit protected manner via the LIN I/O. As a unique feature, the current consumption of the device under test is measured and can be used in the process.

The internal signal processing makes it possible to preprocess the LIN data, for example for checking limiting values or signal plausibility, or for the end-of-line calibration of the control devices. The automation system can thus be freed up and the LIN interface can independently carry out simple sequences and deliver - for example - "good/bad" evaluations to the tester.

In spite of the deviation in hardware appearance, the LIN I/O is compatible with the other members of the family of tools.

LIN I/O



Performance Characteristics of LIN I/O:

- Emulation and Analysis of LIN nodes / LIN subsystems, simulation of bus participants not actually present
- Wakeup / Sleep
- Event-based signal configuration and sequence control
- LIN bus error recognition, monitoring via CAN, LED and port possible
- PC software Visulin for recording and displaying measurement data, and also for configuring the emulator
- Simple integration into automated test environments (LabView, HP VEE, and others)

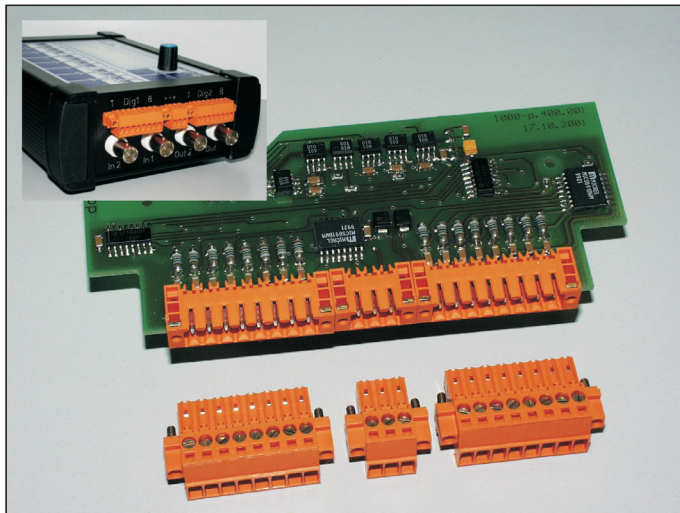
Equipment:

- Status display via LED's
- Bus termination (master/slave/stress/overload) switchable by means of software
- 16 galvanically separated digital inputs/outputs (like digital I/O module)
- LED status display for digital ports
- 4 analog inputs
- 2 analog outputs, trigger creation
- 1 current measurement channel (1A) for current draw of the test object
- Housing for the top hat rail assembly, 200 x 105 mm
- Connectors designed as detachable row clamps

Accessories:

- Secondary CAN interface for vehicle bus (optional when placing a new order)
- CAN I/O periphery extension

Accessories for the Emulators



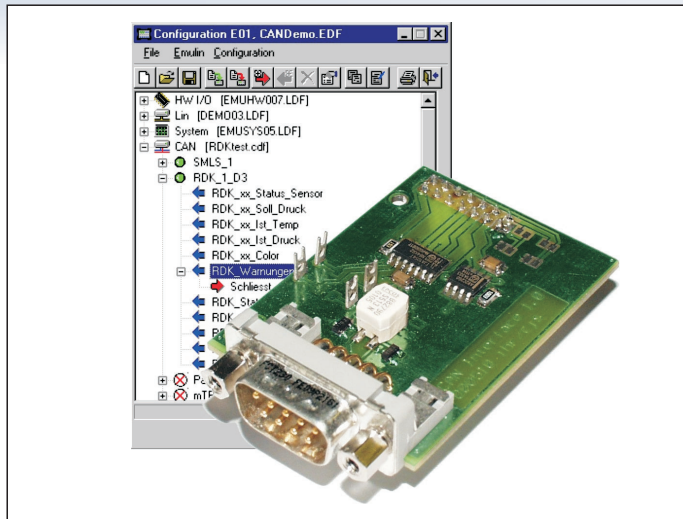
Digital I/O Module

This module can extend the emulators Emulin, LINGate+ and LINGate basic to take account of high demands on the number of digital inputs and outputs. All 16 bidirectional inputs and outputs can be individually programmed and integrated into the emulator configuration. Thanks to optical isolation, a testing device or automation system can be connected in their own galvanic domains. The connection to digital sensors/actors provides endless possibilities for the simulation of a control device or the realization of a "black box" functional pattern.

Equipment:

- 16 bidirectional input/outputs, divided into 2 ports with separate power supply
- Signal level and voltage supply ranges from 5V to 24V
- Galvanic separation from the emulator
- High-side driver, output performance max. 100mA/channel, cumulative up to 250mA/port
- Detachable row clamp connectors

CAN Interface



This module extends all emulators by an additional, freely usable CAN interface, intentionally for the vehicle bus. High-speed and low-speed connections can be selected with the same component. Gateway control devices can be fully monitored and emulated. The PC software extension supports the use of CAN configuration files in DBC format. The emulators can autonomously exchange data between CAN and LIN. CAN messages can be preferentially filtered and are displayed on the CAN measurement bus together with the LIN data and system data.

The CAN operation is completely independent from the presence of a LIN connection. Emulators with the CAN module can thus naturally also be used as pure CAN application tools and have the same possibilities for standalone and mobile operation.

Performance Characteristics:

- Freely configurable CAN environment, Baud rates from 25K to 1Mbaud
- Support for up to 14 active CAN messages with direct signal access
- Emulable gateway functions, signal and message transfer between CAN and LIN

Equipment:

- Dual transceiver for selectable high-speed / low-speed operation
- Exchangeable termination resistors for low-speed connection
- Firmware extension for the emulator, Software support through Visulin

CAN I/O

CAN I/O is a periphery adapter for distributed process communication for automation on a 24Volt net. The place of assembly is the carry rail. Baud rates and applied standard CAN identifiers can be freely assigned. The device can thus be unproblematically integrated in existing CAN networks.

If there is a high demand on input and output resources, CAN I/O can be connected to any LIN emulator via the high-speed CAN measurement bus. In this case the device functions as an external periphery module. The signal coupling/linking and processing are effected with the emulator as master.



Performance Characteristics:

- Configurable CAN message parameters and identifiers for transmission and reception
- All I/O signals can be addressed by the emulator

Equipment:

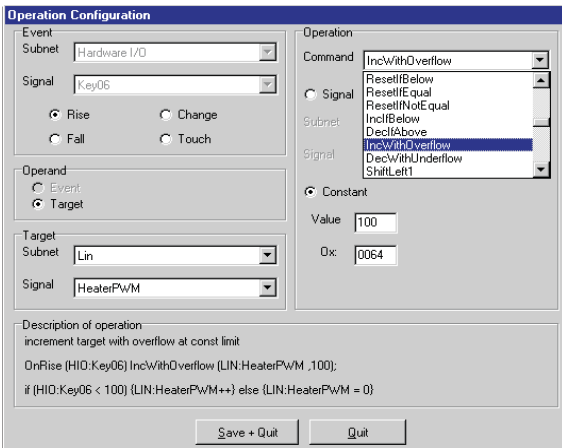
- 16 digital inputs with LED status display
- 16 digital input/outputs with LED status display
- 2 analog inputs
- 2 analog outputs
- High-speed CAN interface
- Power supply 24V +/- 10%
- Housing for top hat rail assembly, 185 x 105 mm

Visulin

All functions for the configuration and analysis are combined under the integrated Visulin environment. The communication with one or more emulators is effected via a highspeed CAN measurement bus.

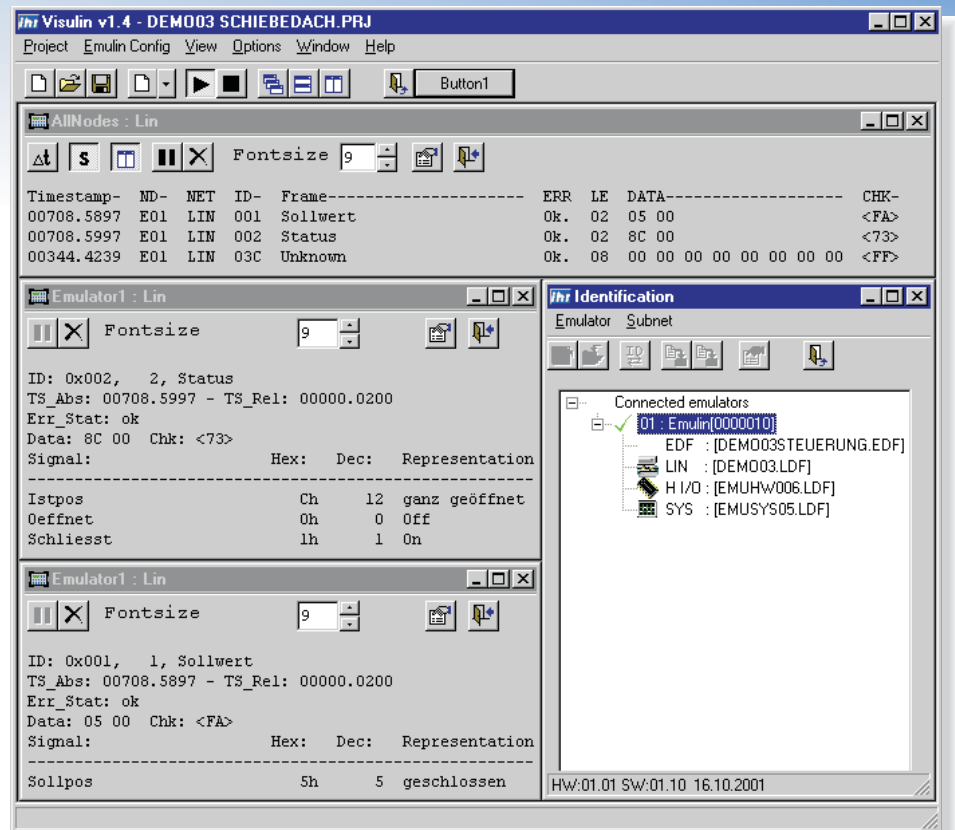
Configuration:

The LIN Emulator needs to be initially prepared for the task at hand. After selection of the environment description for LIN and CAN bus description files, supplementary settings are made and periphery resources assigned. The emulator behavior is set by the creation of event-based command linking. When configuration is completed, Visulin transfers the complete config table to the emulator memory. There it can either be stored permanently in the



Flexible event based operations

flash ROM, or kept volatile in RAM for test purposes. After this an emulator can work fully autonomously with its configured application. All setting adjustments are managed and stored in project files.



Real-time Monitoring:

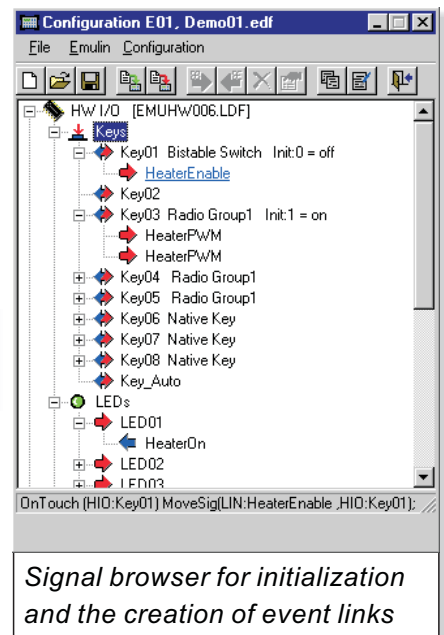
If the emulator remains connected with the PC during operation, then Visulin can read and display the entire LIN and CAN data traffic. The data is displayed in multiple message lists together with aquired timestamps. The signal contents are decoded and listed with the correct logical and physical representation as defined within the LIN description file. Signals, control parameters and hardware resources can be written and read interactively.

Data Storage and Processing:

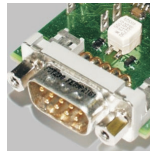
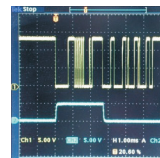
Visulin processes both the files created from LIN log as well as the real-time data from the CAN measurement bus. Data streams can be filtered and then re-written to log files.

Software Maintenance

Visulin is under continual further development. More complex analysis functions and graphical visualization are currently in preparation. Visulin is an integral component of all emulator packages of the LINTools family. Updates and supplementary documents are available to all users via the internet.



Signal browser for initialization and the creation of event links



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