

VT System

I/O Interface Modules for the ECU Test

Overview of Advantages

- > All relevant test components are integrated into a single device:
 - Measurement hardware with signal conditioning
 - Relays e.g. for switching short-circuits
 - Electronic load for actuator simulation
 - Resistance decade for simulation of a sensor
- > Minimal cabling effort for test setups
- > Voltage range for automotive applications
- > Seamless integration into CANoe

An ECU has numerous I/O interfaces to which actuators and sensors can be connected. A modern and flexible test system must operate these interfaces and acquire data during the function test.

Application Areas

With the VT system you assemble test systems for the function test of ECUs and vehicle networks. CANoe is the associated test automation software. The modular design of the VT System allows you to build test solutions ranging from simple testing setups to complex testing equipment:

- > Dedicated test systems for individual ECUs
- > Universal function testers for ECUs and subsystems
- > Flexible test hardware for the developer's work station

Functions

The VT System is connected to the ECU in place of the actuators or sensors. The loads and sensors are simulated by the VT System modules. However, the signals can also be connected to the original actuators and sensors.

All components required for testing the connected ECU's inputs or outputs are integrated into the VT System modules:

- > Relays for switching various signal paths (e.g. internal or external load)
- > Creation of short-circuits between the two signal lines, to ground or battery voltage
- > Simulation of loads or sensors
- > Measuring unit with signal conditioning
- > Connection of additional measurement and test devices via two additional bus bars
- > Clear status display on the front panel

As all channels are connected via two wires, the system supports all relevant input and output types, even motors controlled in the ECU via an H-bridge circuit, for instance.

The characteristic technical data of the modules like the allowable current and voltage ranges have been specially configured for the requirements of testers in the automotive field.



Fully populated rack of the VT System
 – up to 12 modules and one backplane
 fit in a 19" rack

Project Work

As part of our support and service range, we offer you the assembly of test systems with CANoe and VT System by project contracts.

Please get in touch with us:
E-mail: sales@vector.com

Integration into CANoe

The VT System adds the following functions to the test automation features of the CANoe Test Feature Set:

- > Automatic recognition of the modules of a connected VT System
- > Easy configuration via specific dialogs in CANoe
- > Management of the entire VT System in CAPL and XML test modules, access to all measurement and stimulation signals
- > Measurement signals are displayed in the Analysis windows (Graphics window, Data window) and the Logging Block of CANoe

PC Connection

The PC with CANoe or CANoe RT is connected via the real-time industrial Ethernet protocol EtherCAT® using 100 Mbit/s Ethernet. The Ethernet interface available on the PC can be used.

VT8012 Backplane

Using the VT8012 backplane, you can install 12 VT System modules in a 19-inch housing or in a 19-inch frame (4 U). Vector can offer complete racks based on project work. The backplane provides the Ethernet connection for the PC and supplies the VT modules with the 12 V operating voltage. You can also cascade several backplanes.

VT8006 Backplane

The VT8006 backplane is a shorter variant of the VT8012. Mounted in a 9.5-inch desktop case you can install six VT modules.

Technical Data (VT8012, VT8006)

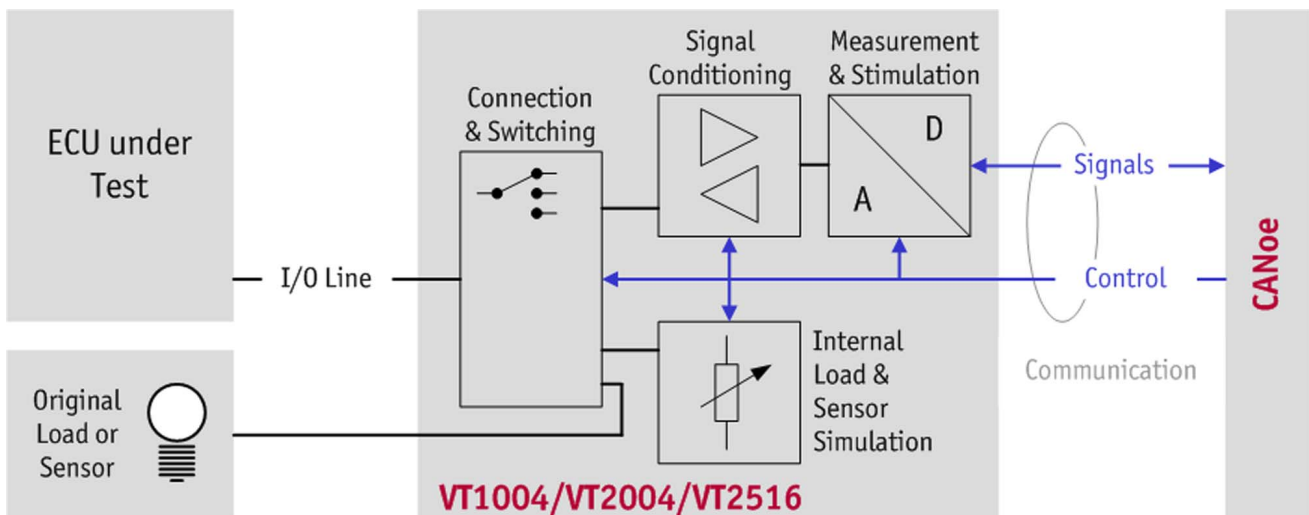
No. of slots	12 (VT8012), 6 (VT8006)
Supply voltage	12 V ±10 %
Input current	Max. 16 A, depends on type and number of plugged-in VT modules
Power consumption (backplane only)	Approx. 3.8 W
Temperature range	0 ... 55 °C
Dimensions (L x W x H)	427 x 46 x 35 mm (VT8012) 211 x 46 x 35 mm (VT8006)

Setup and Wiring

The backplane takes up the lower quarter of the housing height. In the space above, the plug-in modules of the VT system are directly accessible from the back. There the ports for connecting DUTs, original loads or sensors, and bus bars are located on the modules. They interface the associated wire harnesses directly to the modules. This setup keeps contact resistances low. It also enables high currents in the load modules.

All ports are plug connections, making it easy to use different wire harnesses for different ECUs. You can also produce wire harnesses without soldering, since the provided plug connectors have screw terminals.

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The VT System modules contain all components required for the function test.

Load and Measurement Module VT1004

The VT1004 module is connected to up to four outputs of an ECU, which drive in real in-vehicle operation actuators such as servo motors or lamps.

Functions for each channel:

- > Various signal paths to the original loads and bus bars are switched via relays. The relays may be used, for example, to generate short circuits to ground or to battery voltage via a bus bar, or to break the line to an original load (broken wire simulation).
- > Relay for short circuits between the input lines
- > Electronic load for predefined current or resistance with electronic overload protection
- > Voltage measurement with calculation of instantaneous values, average values and effective values
- > Determination of PWM signal parameters (frequency, duty cycle, high and low voltage levels)

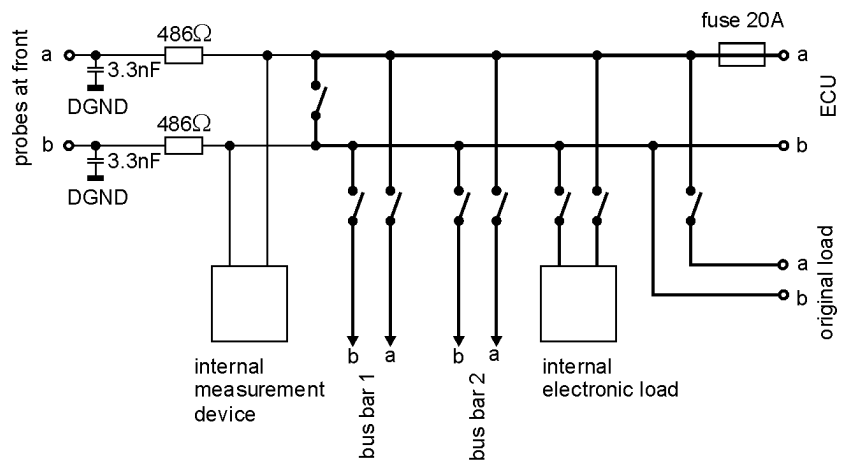
Furthermore, it is possible to reverse the two line connections of the two bus bars via relays (combined for all channels of a module).

Technical Data (VT1004)

Input voltage	-32.7 ... +32.7 V
Continuous current (relay closed)	16 A
Current ≤ 10s (relay closed)	30 A
Switched current at voltage ≤ 18 V	25 A
Switched current at voltage ≤ +32.7 V	8 A
Electronic load	
Constant resistance mode	1.5 ... 1,000 Ω
Constant current mode	0.1 ... 10 A
Tolerance of set values	5 %
Dynamic range of input signal (analog)	0 ... 1 Hz
Dynamic range of input signal (PWM)	0 ... 1 kHz
Load capacity (all channels together)	Typ. 30 W
Peak load	Max. 120 W
Voltage measurement	
Resolution	1 mV
Accuracy at 10 ... 40 °C	0.5 %
Zero point error	-10 ... +10 mV
Sampling rate for each channel (internally)	250 kSamples/s
PWM frequency for PWM measurement	10 mHz ... 25 kHz
Supply voltage (via backplane)	12 V ±10 %
Power consumption (all relays off)	Typ. 4.5 W
Power consumption (12 relays active)	Typ. 20 W
Temperature range	0 ... 55 °C
Dimensions (L x W x H)	300 x 173 x 36 mm
Weight	Approx. 1.150 g



Load and Measurement Module VT1004



Schematic of one channel of the VT1004

Stimulation Module VT2004

The VT2004 manages up to four inputs of an ECU, to which vehicle sensors such as temperature probes or switches are connected.

Functions for each channel:

- > Various signal paths to the original sensors and bus bars are switched via relays. The relays may be used, for example, to generate short circuits to ground or to battery voltage via a bus bar, or to break the line to an original sensor (broken wire simulation).
- > Relay for short circuit between the input lines
- > Voltage stimulation
- > Decade resistor for the sensor simulation
- > Generation of a PWM signal as input signal for the ECU
- > Simulation of a potentiometer as a sensor (on channel 1)

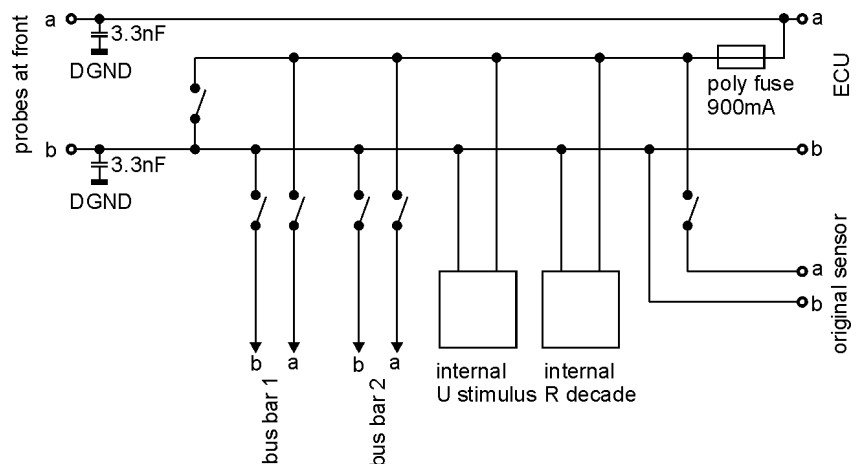
Furthermore, it is possible to reverse the two line connections of the two bus bars via relays (combined for all channels of a module).

Technical Data (VT2004)

Input voltage	-32.7 ... +32.7 V
Input current	Max. 800 mA
Voltage stimulation	
Output voltage	0 ... 27 V
Voltage resolution	2 mV
Current	-30 ... +30 mA
Decade resistor	
Resistance, channels 1 - 3	10 ... 10 kΩ
Resistance, channel 4	1 ... 250 kΩ
Tolerance	±2 % or ±2 Ω
(higher tolerance value applies)	
Current	Max. 200 mA
Load capacity	Max. 3.5 W
Switching time between two resistance values	Max. 500 μs
Potentiometer simulation (channel 1 only)	
Input potentiometer ref. voltage	0 ... 20 V
Input impedance	Typ. 5 kΩ
Frequency of generated PWM signal	0.1 Hz ... 25 kHz
Supply voltage (via backplane)	12 V ±10 %
Power consumption (all relays off)	Typ. 2.5 W
Power consumption (10 relays active)	Typ. 5.5 W
Temperature range	0 ... 55 °C
Dimensions (L x W x H)	300 x 173 x 36 mm
Weight	Approx. 400 g



Stimulation Module VT2004



Schematic of one channel of the VT2004

Digital Module VT2516

The VT2516 module is connected to up to 16 mainly digitally used I/Os of an ECU, i.e. for signals with two states. For example, they may connect to these pins, switches or signal lamps.

Features offered on each channel:

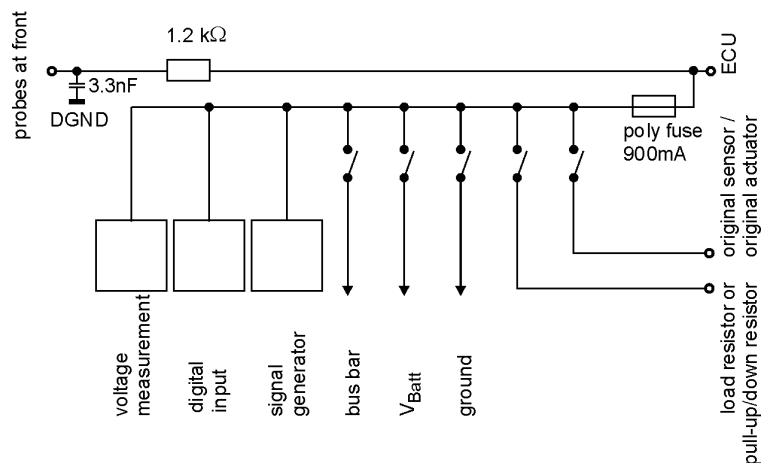
- > Various signal paths to the original sensor or the original actuator are switched via relays and are connected to a bus bar. The relays may be used, for example, to disconnect the line (broken wire simulation).
- > Relay for short circuit between an input line and ground or battery voltage
- > Relay for a connected external load, pull-up or pull-down resistor
- > Sampling of a digital input value with configurable voltage threshold
- > Determination of PWM signal parameters (frequency and duty cycle)
- > Voltage measurement with calculation of instantaneous and average values
- > Digital output with configurable high and low levels
- > Autonomous output of a bit stream loaded into module
- > Generation of a PWM signal
- > The bus bar has a two-pole design, where the second pole may be selected as ground or battery potential.

Technical Data (VT2516)

Input voltage	-40 V ... +40 V
Current via relays	Max. ±800 mA
Input of digital signal	
Threshold	0 ... 25 V
Hysteresis	Ca. 1 V
Sampling interval	50 µs
PWM frequency (PWM measurement)	15 mHz ... 25 kHz
Voltage measurement	
Accuracy	±2 %
Sampling rate	1 kSample/s
Output of digital signal	
High level, low level	0 ... 25 V
Accuracy	±2 %
Output current	-30 ... +30 mA
Length of bit stream	2 ... 4,096 Bit
Output of interval	2 µs ... 65 ms
Frequency of generated PWM signal	0.1 Hz ... 25 kHz
Supply voltage (via backplane)	12 V ±10%
Power consumption (all relays off)	Typ. 8 W
Power consumption (32 relays active)	Typ. 13 W
Temperature range	0 ... 55 °C
Dimensions (L x W x H)	300 x 173 x 36 mm
Weight	Approx. 540 g



Digital Module VT2516



Schematic of one channel of the VT2516

Real-time Modules VT6010 and VT6050

The two real-time modules VT6010 and VT6050 handle the execution of the real-time test and simulation part of CANoe and drive the VT System hardware. The user's PC is connected to the real-time module by Ethernet and does not affect the real-time behavior of the test system.

Functions common to both modules:

- > The backplane and VT6104 network modules are connected directly to the real-time module; no interfaces are needed for them on the user's PC.
- > Easy to configure, no special actions necessary on the real-time module
- > Separate Ethernet interface for connecting the user's PC
- > Two USB Master Ports enable the use of other interfaces such as the VN2610 for MOST or the VN3600 for FlexRay.

Functions VT6010:

- > COM Express PC module with Intel® Atom™ processor
- > 2 PCI Express cable ports for 2 VT6104 network modules
- > Passively cooled

Functions VT6050:

- > High-performance COM Express PC module with Core™ 2 Duo processor for a high number of network channels
- > 4 PCI Express cable ports for 4 VT6104 network modules

Technical Data (VT6010)

CPU	Intel® Atom™ N270, 1,6 GHz
Main memory (RAM)	1 GByte
Flash memory	2 GByte
USB at front	2 x USB 2.0
LAN (Ethernet to PC)	10/100/1000 MBit/s
Supply voltage (via backplane)	12 V ±5 %
Power consumption (standby)	Typ. 11 W
Power consumption (full load)	Typ. 15 W
Temperature range	0 ... 55 °C
Dimensions (L x W x H)	300 x 173 x 36 mm
Weight	Approx. 680 g

Technical Data (VT6050)

CPU	Intel® Core™ 2 Duo SP9300, 2,26 GHz
Main memory (RAM)	2 GByte
Flash memory	2 GByte
USB at front	2 x USB 2.0
LAN (Ethernet to PC)	10/100/1000 MBit/s
Supply voltage (via backplane)	12 V ±5 %
Power consumption (standby)	Typ. 12 W
Power consumption (full load)	Typ. 35 W
Temperature range	0 ... 55 °C
Dimensions (L x W x H)	300 x 173 x 47 mm (two slots)
Weight	Approx. 660 g



Real-time Module VT6010



Real-time Module VT6050

Network Module VT6104

The four-channel CAN/LIN network module VT6104 is a high-performance interface module for the VT System. As on other VT System modules, faults can be fed onto the signal lines. The module offers high performance and low latency times, because a PCI Express cable is used to connect the network interface to the VT6010/VT6050 real-time module or a PC.

Module features:

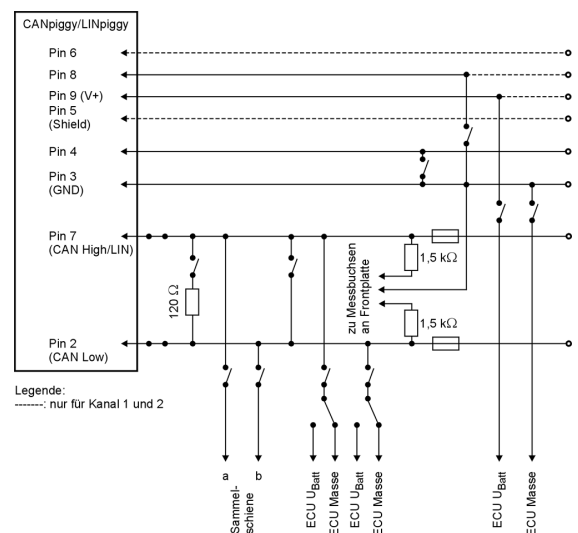
- > Network interface with four independent channels
- > Each channel may be individually configured as a CAN or LIN interface.
- > Proven, interchangeable Vector CAN/LINpiggies may be used as bus transceivers.
- > Hardware synchronization of the network interfaces with the VT System
- > Relays for line breaks and short circuits between signal lines, to ground or to battery voltage
- > Switched termination resistors
- > All channels can be connected by using the internal bus bar.



Network Module VT6104

Technical Data (VT6104)

Number of channels	Up to 4 CAN or 4 LIN
CAN channels	Sending and receiving 100% bus load Certified Vector CAN controller (FPGA)
LIN channels	Sending and receiving 100% bus load
Transceivers (Piggy)	All magnetically decoupled piggybacks, and J1708 opto
CAN Identifier	11/29 bit
Max. baud rate	1 Mbit/s
Time stamp accuracy	1 μs
Supply voltage (via backplane)	12 V ±10 %
Power consumption	Typ. 4 W
Temperature range	0 ... 55 °C
Dimensions (L x W x H)	300 x 173 x 36 mm
Weight (without Piggies)	Approx. 500 g



Schematic of one channel of the VT6104

Power Supply Module VT7001

The VT7001 module can be used to control up to two power supply inputs of an ECU (e.g. terminals 15 and 30). As an alternative, two ECUs may be supplied separately, e.g. in testing differences in voltage supplies.

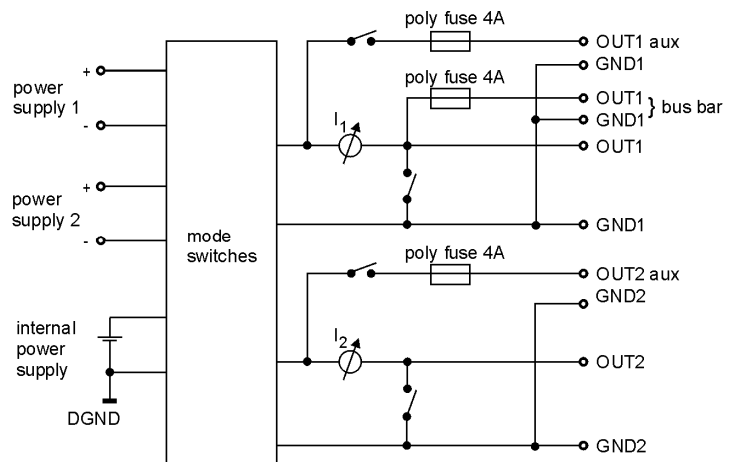
Module features:

- > Two external power supplies can be connected
- > Internal power supply generates voltage for the ECU from the VT System power supply.
- > Two external and one internal power supplies may be connected to the two outputs to the ECU in various combinations.
- > Ground lines of outputs can be interrupted (line break of terminal 31)
- > Relays for producing short circuits between the output lines
- > Measurement of output currents over a very wide range
- > Measurement of input and output voltages
- > Control of two external power supplies via control voltage or via electrically isolated serial interfaces
- > Generation of arbitrary control voltage curve
- > Serial interface for driving an external display
- > Hardware synchronization with Vector network interfaces
- > The module supplies ground and battery voltage to the bus bars at additional pins.

Technical Data (VT7001)	
Input voltage	-40 ... +40 V
Current at outputs 0 to 35°C both outputs	Max. 70 A, Max. 100 A
Internal power supply	
Output voltage	3 ... 18 V
Tolerance of set output voltage (at 7 ... 18 V, 2 A)	±5 %
Output current	Max. 2 A
Current measurement	
Measure range	7 (100 µA ... 100 A)
Sensitivity error	±1 %
Zero point error	-5 ... +5 µA
Accuracy of voltage measurement	±1 %
Control voltage of external power supply	
Control voltage for voltage/current	-10 ... +10 V
Accuracy	±1 %
Output current	Max. 30 mA
Supply voltage (via backplane)	12 V ±10%
Power consumption (all relays off)	Typ. 7 W
Power consumption (8 relays active, output 12 V/1 A via internal power supply)	Typ. 33 W
Temperature range	0 ... 55 °C
Dimensions (L x W x H)	300 x 173 x 36 mm
Weight	Approx. 1.240 g



Power Supply Module VT7001



Schematic of the VT7001 showing power supply inputs and outputs for the ECU.

Extension Module VT7900

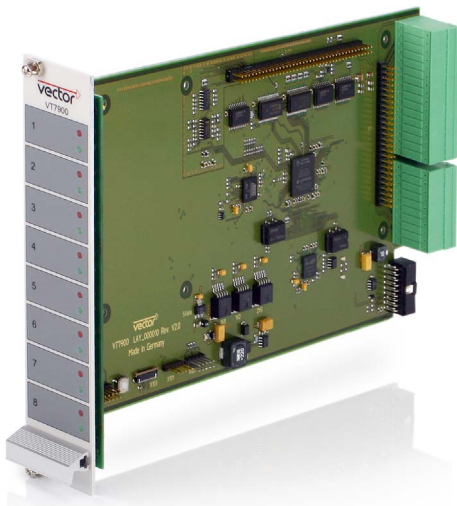
The VT7900 is used to extend the VT System by adding modules with task-specific circuits. The VT7900 serves as the main board, on which an application board is inserted. The application board can be developed by the user or by Vector in the context of a customer project.

Module features:

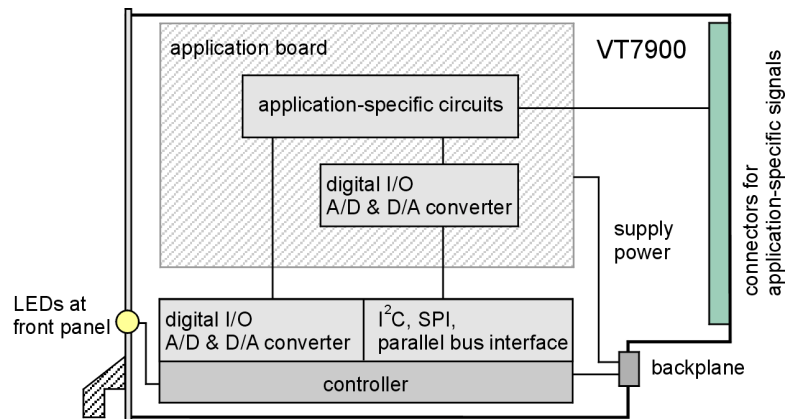
- > Includes firmware for controlling the application board
- > Automatic integration in CANoe via a configuration saved on the application board
- > Interfaces for directly driving the electronics on the application board:
 - > 4 digital inputs
 - > 4 digital outputs
 - > 4 analog inputs
 - > 4 analog outputs
- > Support for additional digital and analog interfaces on the application board, which are driven via I²C, SPI, or a 16-bit parallel bus
- > Signal lines from the application board to the DUT or other parts of the test system are accessible via connectors on the back.
- > 16 LEDs for indicating device states on the front panel

Technical Data (VT7900)

Application board	
Dimensions (L x W)	160 x 100 mm or (two board formats possible) 220 x 100 mm
Height incl. all populated components	Max. 26 mm
Power supply to application board	
Supply voltage 12 V	12 V ±10 %, max. 1,8 A
Supply voltage 3.3 V	3.3 V ±5 %, max. 1 A
Power consumption, total	Max. 25 W
Signal lines to application board	
Number	52
Voltage to GND	Max. ±60 V
Current per line	Max. 2 A
Analog inputs	
Input voltage	0 ... 4 V
Accuracy	±0.5 %
Resolution	8 Bit
Sampling rate	10 kSamples/s
Analog outputs	
Output voltage	0 ... 4 V
Output resistance	< 100 kΩ
Supply voltage (via backplane)	12 V ±10 %
Power consumption (without application module)	Typ. 1.5 W
Temperature range	0 ... 55 °C
Dimensions (L x W x H)	300 x 173 x 36 mm
Weight	Approx. 340 g



Extension Module VT7900



Block circuit diagram of the Extension Module VT7900 with application board