

SIGMATEK

VARAN Product Overview



VARAN Bus System

Designed for tasks in hard real-time Ethernet communication and completely implemented in the hardware, the VARAN bus is the perfect solution in machine and plant automation.

Task

The demands on modern automation technology increase from year to year. To achieve the fastest possible production cycles and highest product quality, increasingly larger amounts of data must be exchanged in less time. Important factors also

include a modular machine structure as well as simple maintenance and comfortable service. A modern communication system must meet all these requirements, be economic and still offer enough performance reserves for the future.

Solution

During the development of the VARAN bus, the focus was placed on exactly these criteria: hard real time, speed, low costs and simple implementation.

The VARAN bus is based on the Manager-Client principle. This means, that the VARAN Manager initiates all communication; collisions in the bus are therefore avoided.

For the manager, the entire VARAN bus network represents a virtual memory space of up to 4 gigabytes. During the system start-up, the manager automatically assigns each participant a defined memory area. The participants can thereby be accessed with simple read/write instructions from the manager.

Performance data

Bus cycle times	< 100 μ s	
Jitter	< 100 ns	
Isochronous access time	1-byte r/w	2.18 μ s
	16-byte r/w (1 drive)	5.05 μ s
Asynchronous direct access	128-byte r/w	< 25 μ s

Portable to Gigabit Ethernet without protocol changes

Your Advantages

Highlights

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Hard real-time
 Cycle times < 100 μ s, jitter < 100 ns - each instruction is immediately confirmed by the receiver
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High data reliability and error tolerance
 Unacknowledged messages are repeated within the same bus cycle
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⇒
Flexible network topology
 Modular machine structures using star, line or tree topologies
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⇒
Economic
 Costs comparable to a field bus connection through the use of inexpensive FPGAs for managers and clients
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⇒
Open standard
 The VARAN BUS USER ORGANIZATION (VNO) manages the open VARAN bus technology

Further Advantages at a Glance

- **Automatic addressing**
 Minimal network administration costs
- **Speed**
 High data transfer rates - higher scan rates
 - higher performance - increasing quality
- **Deterministic behavior**
 Bus participants are accessed in each bus cycle at exactly the same time
- **Direct access**
 Fast asynchronous direct access at any time
- **Hot plug capability**
 Participants can be added or removed during operation
- **Protocol completely implemented in the hardware**
 No additional load on the CPU
- **Simple implementation**
 Also in small sensors/actuators
- **Synchronization over PLL**
 Distributed clocks according to IEEE 1588 are not required
- **Multi Manager capable**
 RT-Networking of several autonomously operating systems
- **Tunneling of standard Ethernet**
 Standard TCP/IP communication is possible even with the shortest cycle times
- **Bus and power supply in one cable**
 Simple signal and power transmission through VNO-certified connectors and cables is possible
- **CANopen[®] mapping on the VARAN bus**
 Simple connection to existing CANopen[®] devices
- **Analysis and service made simple**
 With comfortable diagnostic and service tools

Basics

The VARAN Bus in Detail

With the VARAN bus, all the demands of hard real-time communication were combined with those of automation and implemented with Ethernet technology. Through the use of the Manager/Client principle, collisions are avoided. The VARAN bus reaches the highest speeds, shortest cycle times and minimal synchronicity jitter. In addition, it offers the unique possibility of asynchronous direct access. Unconfirmed messages are repeated within the same bus cycle. Data is therefore guaranteed to be valid at the end of each bus cycle. To perfectly integrate existing networks, TCP/IP packets are tunneled. The technology is open and can be used by anyone. The VARAN Manager oversees the entire bus memory area, which can consist of up to 65,280 participants. During start-up, each participant is assigned

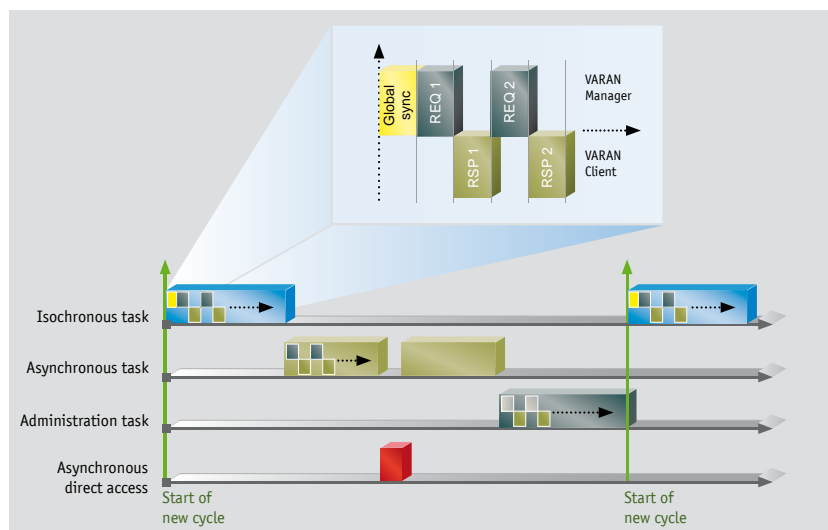


its own defined linear address space of 65,536 bytes. The exchange of information is principally based on two operations: "write the following data to address x" and "read the following number of bytes starting from address x".

Different Task Priorities

The manager has several areas divided into different priorities. At the start of each bus cycle, the manager sends a global SYNC function, then the isochronous real-time data followed by the asynchronous objects

and then finally, the administration task data are sent. In the administration task, other operations such as scanning for new participants or Ethernet packets to be transmitted are performed. Asynchronous direct access



interrupts the active tasks to execute a client update during the bus cycle. Each data transfer is initiated and centrally managed by the VARAN Manager exclusively. All protocol-specific tasks of the VARAN Manager are processed in the FPGA. This reduces the burden on the control CPU.

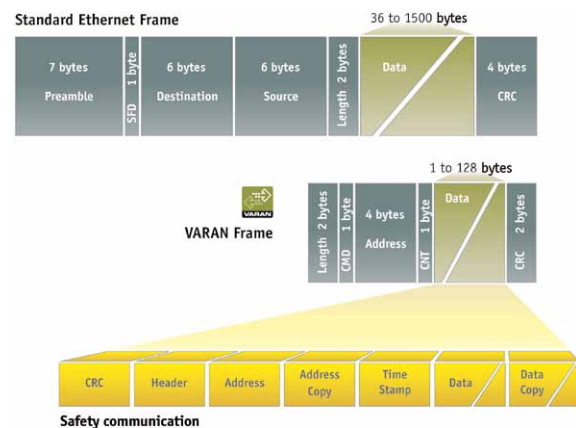
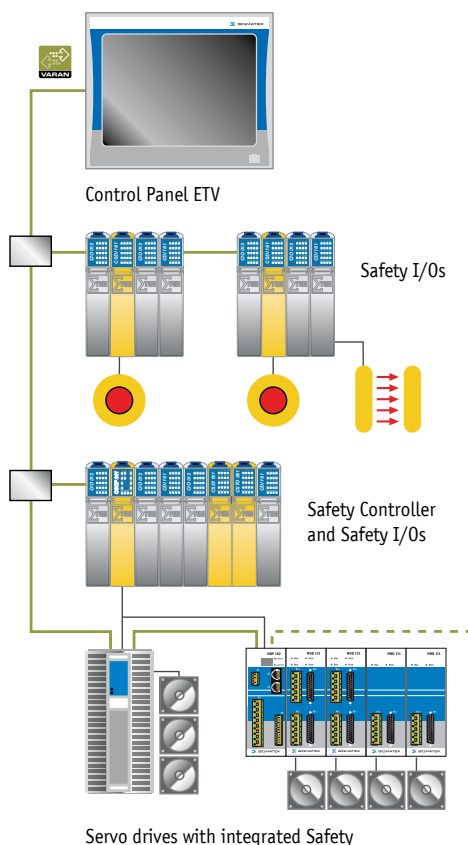
Error Tolerance Through Short Packets

The VARAN bus is especially suited for applications, which require guaranteed data consistency. Through the use of short packets with a maximum data length of 128 bytes, the probability of communication errors is minimized. With individual frames, each bus participant can be addressed individually by the VARAN Manager. All messages are confirmed by the client components in same bus cycle. Communication errors are

detected immediately and unacknowledged messages can be repeated in the same bus cycle. The consistency of all process data is therefore guaranteed at the end of the bus cycle. This is a significant advantage over other real-time Ethernet systems, in which retransmission of data is normally possible in the following bus cycle only.

Integrated Safety

The VARAN real-time Ethernet bus is perfectly suited for automation systems, which must meet SIL3 standards according to IEC 61508 and Performance Level PL e standards according to ISO 13849 respectively. The safety-relevant and standard data are exchanged in the same bus cycle without affecting the data transfer speed with the shortest cycle times.



For Safety data communication, the "Black Channel" principle is used, by which the bus does not assume any safety-related tasks but rather serves as a transfer medium only. The Safety protocol is embedded in the standard VARAN frame. In the VARAN Safety telegram, the data is double coded and verified through a checksum (CRC).

Safety-relevant control tasks can be implemented centrally or decentrally. The safe in- and output modules can be distributed in the VARAN network as desired. Several Safety controllers can be placed in one network, each of which can also control several safe networks.

VARAN Manager Components

From expansion cards to intelligent terminals, VARAN Manager components that cover all the requirements of machine manufacturing are available. Software components for customer-specific solutions are also provided.

ETV Control Panels



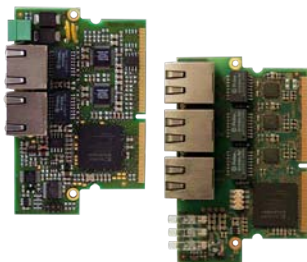
The ETV control panels are intelligent terminals with an integrated VARAN Manager for visualization of automated processes; process diagnosis, operation and monitoring are simplified. Available sizes: 5.7" / 8.4" / 12.1" / 17" and 19" TFT color display. All control panels are equipped with the following interfaces: 1 x VARAN Out , 1 x Ethernet, 1 x CAN, 2 x USB, 1 x USB Mini.

C-DIAS CCP 511 / CCP 521 Processor Modules



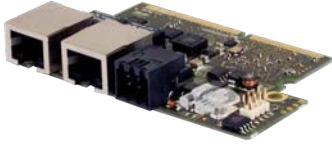
The CCP 511 (800 MHz) and CCP 521 (500 MHz) with EDGE technology run the control program. The integrated VARAN Manager controls all VARAN I/O modules in the automation solution. Power is supplied to all local C-DIAS modules over the backplane. The CPU modules are equipped with the following interfaces: 1 x VARAN Out, 1 x Ethernet, 1 x CAN, 1 x USB, 1 x USB Mini.

VM 051 / VM 052 C-IPC Expansion Cards



These expansion cards for the C-IPC are equipped with a VARAN Manager. To achieve a high degree of flexibility, a VARAN splitter is integrated into both expansion cards. The VM 051 has a double splitter (2 x VARAN Out) and the VM 052 has a triple splitter (3 x VARAN Out).

C-IPC VM 053 Expansion Card



With this expansion card, the C-IPC can be extended with a VARAN Manager, Ethernet and TTY (6-pin) interface. This special design allows easy mounting and fixation.

PCV 521 PCI Insert Card



The PCI insert card PVC 521 has an integrated VARAN Manager and can be used in any standard PC. VARAN modules can therefore be connected directly to the PC and activated in hard real-time. With the integrated VARAN splitter, the insert card is equipped with 2 VARAN Out ports.

PCV 531 PCI Insert Card



The PCI insert card PCV 531 (with integrated VEB 031) can be used in any standard PC and serves as an interface between the PC and VARAN bus. With the PCV 531, VARAN modules can be controlled directly from the PC. Through the integrated VARAN splitter, the insert card is equipped with 2 VARAN Out ports.

VARAN Client Components

The VARAN client components guarantee a great deal of freedom for machine and plant design. All SIGMATEK standard I/O components can be connected to VARAN with the following coupler modules and guarantee safe, highly available machine control.

C-DIAS CIV 512 / CIV 513 Control Modules



The CIV 512 serves as the Gateway between the VARAN and C-DIAS bus. Decentralized C-Dias module groups can therefore be easily integrated in a VARAN bus network. It also serves as the voltage supply for the decentralized modules. To achieve a high degree of flexibility, the CIV 512 has a VARAN In and a VARAN Out interface, which allow the configuration of line structures. The CIV 513 also offers the possibility to manage the I/O data of the connected C-DIAS modules independently, thereby reducing the burden on the VARAN bus.

CIV 521 C-DIAS Interface Module



The CIV 521 serves as the gateway between the VARAN and DIAS bus. The interface module expands the VARAN bus network with various standard interfaces. The module has an integrated VARAN splitter (1 x VARAN In and 1 x VARAN Out) as well as numerous interface connections: standard Ethernet, CAN bus, RS232, RS422, RS485, C-DIAS and TTY.

DIV 511 VARAN Interface Module



The DIV 511 serves as the voltage supply and connection for decentralized module groups to a CPU over the VARAN bus.

VARAN Client Components

VSV 041 / VSV 043 / VSV 046 Splitter Modules



These splitter modules allow the configuration of star and combined topologies. The VSV 041 and 043 each have one VARAN In and 4 VARAN Out ports. An IP port, which enables the connection of service devices and the integration of standard Ethernet networks is also integrated. In addition, the VARAN Out ports of the VSV 043 has an internal 24 V supply. This allows periphery devices to be connected and powered with only 1 cable. The VSV 046 has a VARAN In port and 5 VARAN Out ports. Optionally, a VARAN Out port can be used as an IP interface.

VSP 042 Splitter Module



The VSP 042 covers several requirements in one module. It serves as a VARAN splitter with a VARAN In and 3 VARAN Out ports as well as an interface to the Office world through an integrated IP port. The most important feature of the VSP 042 however, is the integrated VARAN PROFINET gateway: a PROFINET port enables the integration of PROFINET IRT drives into the VARAN bus network.

VDM 086 Digital Mixed Module



The VARAN VDM 086 module has 8 +24 V / 2 A digital outputs (positive switching). These outputs are short-circuit protected and back-readable. They can be used as digital inputs with a +24 V level. In addition to the VARAN In port, a VARAN Out port is integrated to allow line structures.

Digital IP67 PVDM 085 Mixed Module



The PVDM 086 was designed for raw industrial environments (IP67). It has 8 digital outputs +24 V / 2 A (positive switching), which are back-readable and can therefore be used as inputs. The outputs are short-circuit proof. In addition to the VARAN In port, a VARAN Out port is integrated to enable line structures. The module is powered either over the VARAN In port or optionally, over a separate power connector.

VARAN Client Components

MSR System



The innovative MSR system is, through its modularity, suited for the most varying tasks in measurement and control technology. It can be equipped with up to 8 base modules, each of which has 8 measuring channels. A flexible configuration is therefore created with up to 192 digital or 64 analog I/Os. The various channels of the measuring modules can be assembled for recording various measurement values (4..20 mA, +/- 10 V, etc.) specific to the application.

DEE 021 Energy Recording Module



The DEE 021 records the use of energy directly on the machine. The voltages of the three input phases are measured and up to 12 currents are also recorded. The module has a real-time Ethernet VARAN, DIAS and CAN bus interface and can therefore communicate perfectly with the automation world. With the 4 independent 3-phase channels, the following functions can be defined and analyzed: Effective value of current or voltage, power, Cos φ , total energy consumption and peak current value.

Protected VARAN PVAI 011 DMS Module



The PVAI 011 measuring bridge module is used for precision measurements in hard real time. The IP65-protected transducer can be placed near the sensor in the field level directly. A measuring bridge with a resolution of 1.1 mV/V can be connected with 4-wire technology. The module is connected using M12 connection technology. In addition to the bus signal, the power supply for the PVAI 011 is integrated into a hybrid cable.

VST 011 Stepper Module



The VST 011 is an ultra-compact power board used to control stepper motors with a rated voltage of 18-70 V DC. Per motor, 6.4 A of continuous current and 9 A peak current is possible. The VST 011 supports microstepping. An incremental encoder interface and 4 digital in- and outputs are standard integrated components. Position control and parameterization data is exchanged in real time over the fast VARAN bus. Thereby, the position controller circuit is connected to the bus system with the highest data security.

VARAN Client Components

DIAS Drives 100



The DIAS Drive 100 is a modular servo drive system that was especially designed for multi-axis applications. Per system, up to 8 servo axes are possible, 8 axes require only 300 mm x 155 mm x 152 mm (W x H x D) in the control cabinet. 2 supply modules are available as well as axis modules for 1 or 2 servo drives in a power range of up to 2 KW. The DIAS Drives 100 are equipped with 2 VARAN ports (1 x VARAN In and 1 x VARAN Out).

DIAS Drives 300



The DIAS Drives 300 are equipped with 2 VARAN ports (1 x VARAN In and 1 x VARAN Out). This allows the simple integration of the drives into the VARAN bus network and the configuration of line structures. The DIAS Drives also enable the control of up to three drives and are available in various versions with rated outputs from 5 A to 20 A per drive.

VKI 022 VARAN KEB F5 Interface



The VARAN KEB F5 VKI 022 interface is used for the communication between the F5 frequency converter from KEB and a VARAN control. The module has 1 VARAN In and 1 VARAN Out interface, which allow the configuration of linear structures.

VBI 021 VARAN Baumüller Interface



The VBI 021 Interface card expands a Baumüller servo amplifier from the series "bmaXX - 4000" with a VARAN bus interface. Each drive from the series can be easily equipped or upgraded with a VARAN bus connection. Internally, the card connects to the Baumüller "BACI" bus.

VAC 012 VARAN Interface



This VARAN interface is used for the communication between a DIAS Drive 300 and a control over the VARAN bus. In addition, the VAC 012 has connections for the Safety circuit, with which the DIAS Drive can be placed in a safe status. The interface also has digital inputs. These can be used as fast latch inputs.

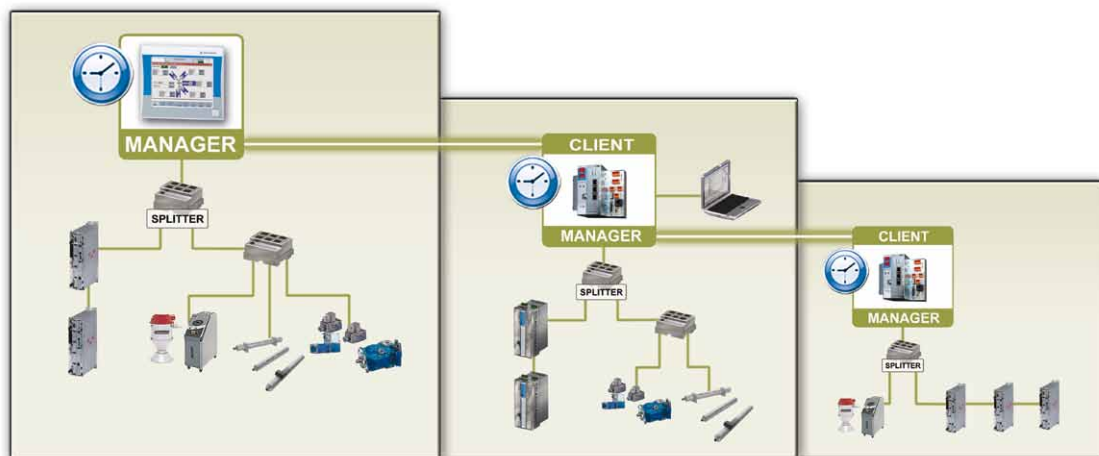
Multi Manager Networks

With the VARAN Multi Manager modules, high modularity and flexibility with machine and plant design are achieved. Network segments communicate in hard real-time with strict deterministic behavior.

Synchronization of several VARAN Networks

With the Multi Manager modules, several autonomous VARAN systems can be connected to a complete network. For the user, a high degree of modularity is achieved for machine and plant

design. The network segments are synchronized automatically with a jitter of < 100 ns. Entire production cells can be connected and synchronized during operation.



VMC 052 VARAN Manager Client



The VMC 052 is a standard VARAN Manager module with an integrated double splitter (2 x VARAN Out). In addition to the standard manager function, the VMC 052 has an integrated VARAN Client. Data can therefore be exchanged between two VARAN bus networks.

VBC 021 VARAN Bus Coupler Module

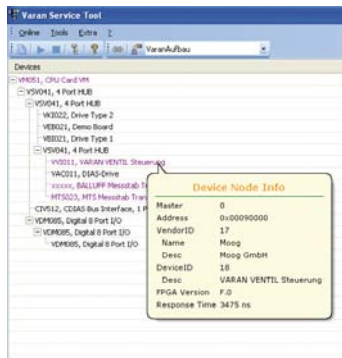


The VBC 021 bus coupler module connects two independent VARAN networks at the field level. Data is exchanged in hard real-time over a simple DPRAM function. Different cycle times can also be implemented in the network segments. The two independent VARAN Managers communicate over easy to implement driver components. The connection to the company network is made over the IP port.

Analysis and Service

With the VARAN Service Tool and VARAN Analyzer, efficient tools are provided for monitoring and analysis of the real-time Ethernet bus system.

Analysis and Service made Simple



In the VARAN tree, the bus structure is detected and displayed automatically. In addition, detailed information on bus participants can be accessed. User data can be stored in each VARAN bus participant. Module documentation, for example, can therefore be read at the machine directly from the individual bus participants. Other useful features include the processing of electronic type labels and firmware programming of bus participants in serial production and maintenance. The service tool also has an effective function for network analysis, by which filter functions can be defined as desired.

VARAN Analyzer



With the VARAN Analyzer, the transmission behavior of the bus system can be analyzed in the machine directly. The data packets are recorded in real time and then decoded. This handy and robust device is operated using the 5.7" touchscreen. The data is displayed in a clear tabular and graphic form. Numerous trigger and filter functions support the user. The analyzer can be connected to the machine during operation - at any location in the network. The analysis unit can also be connected in line topologies over the 2 VARAN interfaces. For further analyses, data can be exported over the USB interface or over TCI/IP.

VA 062 C-IPC Expansion Card



With this expansion card, the C-IPC can be expanded with an analysis tool for the VARAN bus. The VARAN Analyzer can be operated using the VARAN Service tool. The special design allows the expansion card to be easily mounted and secured.

VARAN Evaluation Boards

When deciding which real-time Ethernet bus system to use, it's not only important to know all the performance data and system facts; a significant criterion is the labor connected to the implementation of a bus system. The VARAN bus is by far the easiest system to implement, service and maintain.

VEB 011 / VEB 011-SPI Client Boards



The VEB 011 VARAN client board enables the simple and quick implementation of the VARAN bus in all periphery devices. Data can be exchanged over DPRAM or a bus interface. Additionally, direct setting and reading I/Os in the I/O mode is possible. With the VEB 011-SPI, a micro controller can be connected over the SPI interface. For data exchange a DPRAM and an exchange buffer are provided. Operating temperature 0 - 70 °C (commercial grade).

VEB 011-C Client Board



This client board is used to easily equip all types of periphery modules with the VARAN bus. Data can be exchanged over CANopen[®] or DPRAM. Operating temperature 0 - 83 °C (industrial grade).

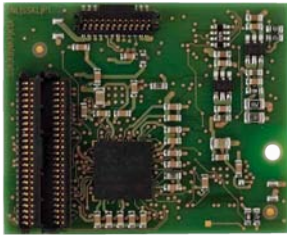
VEB 012 Client Board



The VEB 012 VARAN client board enables the simple and quick implementation of the VARAN bus in all periphery devices. Data can be exchanged over DPRAM or a bus interface. Additionally, direct setting and reading I/Os in the I/O mode is possible. Operating temperature 0 - 85 °C (industrial grade).

VARAN Evaluation Boards

VEB 013 / VEB 013-SPI Client Boards



This client board serves to easily equip all types of periphery modules with the VARAN bus. With help from the integrated splitter function, the module is equipped with two VARAN ports (VARAN In and VARAN Out). With the VEB 013-SPI, a micro controller can be connected over the SPI interface. For data exchange, DPRAM and an exchange buffer are provided.

Operating temperature 0 - 70 °C (commercial grade).

VEB 021 / VEB 022 Evaluation Boards



With the VARAN evaluation boards, sensor and actuator manufacturers are given a fast and simple introduction to VARAN bus technology. The VEB 021 board has 3 analog inputs and an analog output as well as 8 digital in- and outputs. Primarily, a micro controller from a periphery module is connected to the VEB 022 over the multi-pin connector. The connection to the VARAN bus is made over the VEB 011 client board.

VEB 031 Manager Board



With this manager board, modules can be equipped with a VARAN manager. Using an integrated PCI interface, the module can be easily connected to a host CPU. To further increase the flexibility, a double VARAN splitter is integrated that allows the addition of two VARAN Out ports.



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