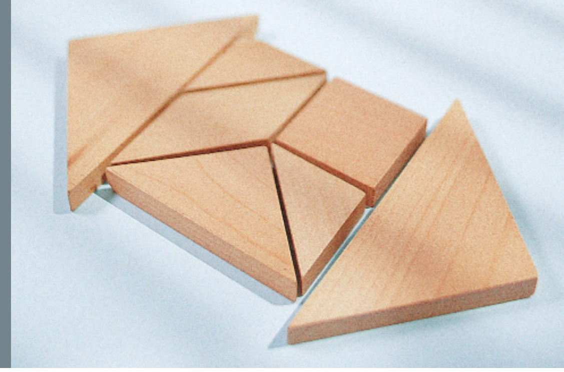
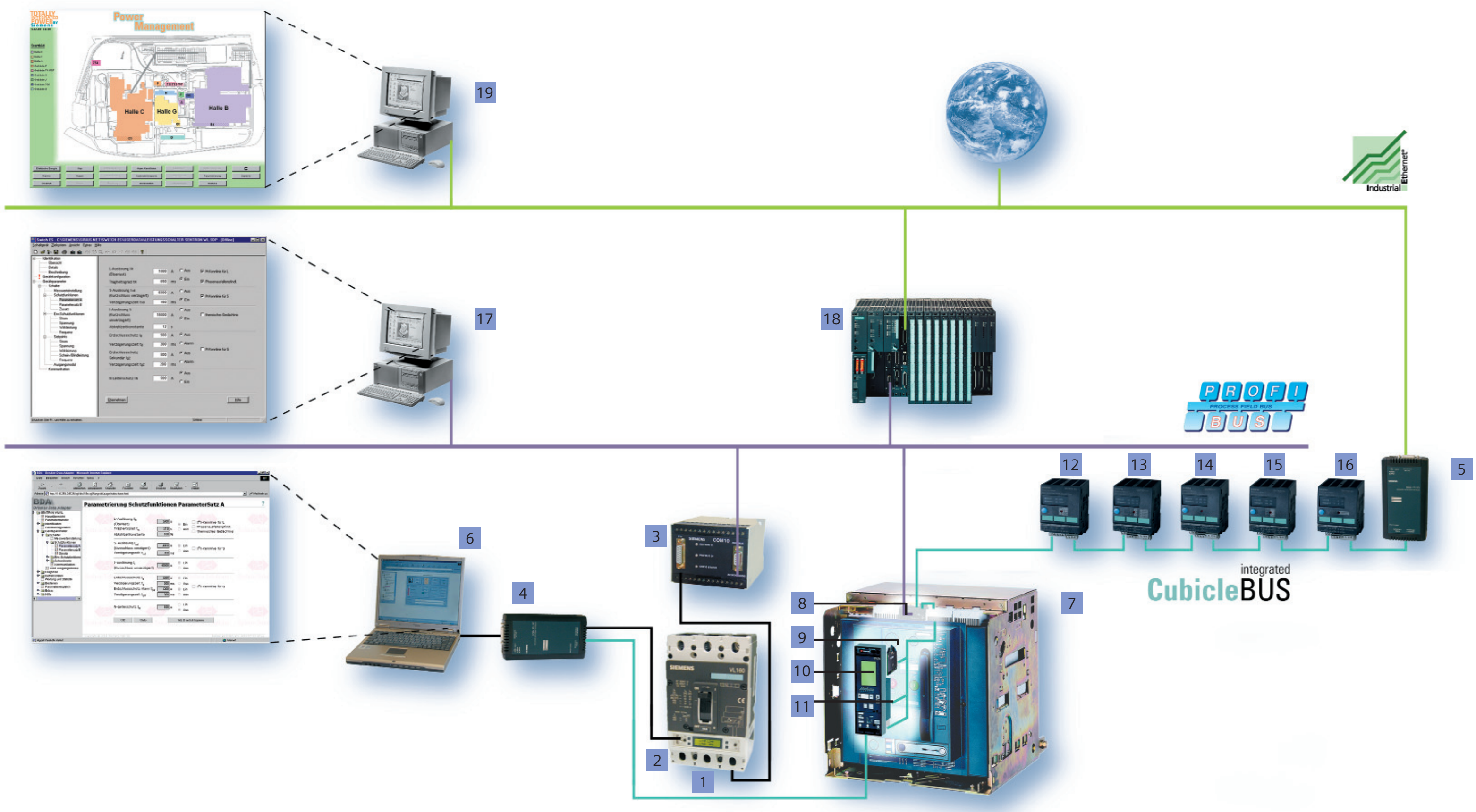
SENTRON • communication manual

User manual for
communication capable SENTRON WL and
SENTRON VL circuit breaker

SIEMENS

Technological leader amongst the circuit-breakers: **SENTRON** Communication





1	SENTRON VL Moulded-Case Circuit-Breaker	11	Metering Function or Metering Function Plus
2	Electronic Trip Unit (ETU/LCD)	12	ZSI (Zone-Selective Interlocking) Module
3	COM10 PROFIBUS Module incl. ZSi	13	Digital Output Module as Relay or Opto-Coupler
4	Breaker Data Adapter (BDA)	14	Digital Output Module as Relay or Opto-Coupler *, Configurable
5	BDA Plus with Ethernet Interface	15	Analoge Output Module
6	Device with web-browser (e. g. notebook)	16	Digitale Input Module
7	SENTRON WL Circuit Breaker	17	Switch ES Power on PC
8	COM15 PROFIBUS Module	18	PLC (e.g. SIMATIC S7)
9	Breaker Status Sensor (BSS)	19	Power Management Software
10	Electronic Trip Unit (ETU)		

*) only a max. of 2 digital output module can be used simultaneously.

Safety guidelines

This manual contains notices which you should observe to ensure your own personal safety, as well as to protect the product and connected equipment. These notices are highlighted in the manual by a warning triangle and are marked as follows according to the level of danger.

Danger

indicates that death, severe personal injury or substantial property damage **will** result if proper precautions are not taken.

Warning

indicates that death, severe personal injury or substantial property damage **can** result if proper precautions are not taken.

Caution

indicates that minor personal injury or property damage can result if proper precautions are not taken.

Attention

draws your attention to particularly important information on the product, handling the product, or to a particular part of the documentation.

Qualified personnel

Only **qualified personnel** should be allowed to install and work on this equipment. Qualified persons are defined as persons who are authorized to commission, to ground, and to tag circuits, equipment, and systems in accordance with established safety practices and standards.

Correct usage

Note the following:

Warning

This device and its components may only be used for the applications described in the catalogue or the technical descriptions, and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens.

This product can only function correctly and safely if it is transported, stored, set up, and installed correctly, and operated and maintained as recommended.

Brands

SIMATIC®, SIMATIC HMI®, SIMATIC NET® und SENTRON® are Brands of SIEMENS AG.

Some other designations used in these documents are also brands; the owner's rights may be violated if they are used by third parties for their own purposes.

Disclaimer of liability

We have checked this manual to ensure that its contents are correct and applicable in relation to the hardware and software it describes. Despite all our endeavors, however, discrepancies cannot be wholly excluded and so we cannot guarantee complete correctness and applicability. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

Technical Assistance:	Telephone:	+49 (0) 9131-7-43833 (8^{00}–16^{00} MEZ)	Fax: +49 (0) 9131-7-42899
	E-mail:	nst.technical-assistance@siemens.com	
	Internet:	www.siemens.de/lowvoltage/technical-assistance	
Technical Support:	Telephone:	+49 (0) 180 50 50 222	

Siemens AG
Bereich Automatisierungs- und Antriebstechnik
Geschäftsgebiet Niederspannungs-Schalttechnik
D-91050 Erlangen

Siemens Aktiengesellschaft

Additional system manuals and technical books:

More information about the technical backgrounds and tips to use and configure PROFIBUS-DP using STEP 7 you find in the Technical book:

- Weigmann, Josef; Kilian, Gerhard; Decentralization with PROFIBUS-DP; Architecture and Fundamentals, Configuration and Use of PROFIBUS-DP with SIMATIC S7; 2000, ISBN 3-89578-144-4

Informations on the selection criteria for low voltage switchgear in main circuits, installation and operation can be found in:

- Siemens-Aktiengesellschaft, Berlin und Munich. Authors: Petra Belzner ... Ed. Georg Schöllhorn. Transl. Jan Domisse; Switching, protection and distribution in low-voltage networks; 2. rev. ed.; Publicis-MCD-Verl. 1994

For more information regarding the SENTRON WL circuit breaker please refer to the

- Operating Instructions; Order No.: 3ZX1812-0WL00-0AN0

Further information around the PROFIBUS can be found in:

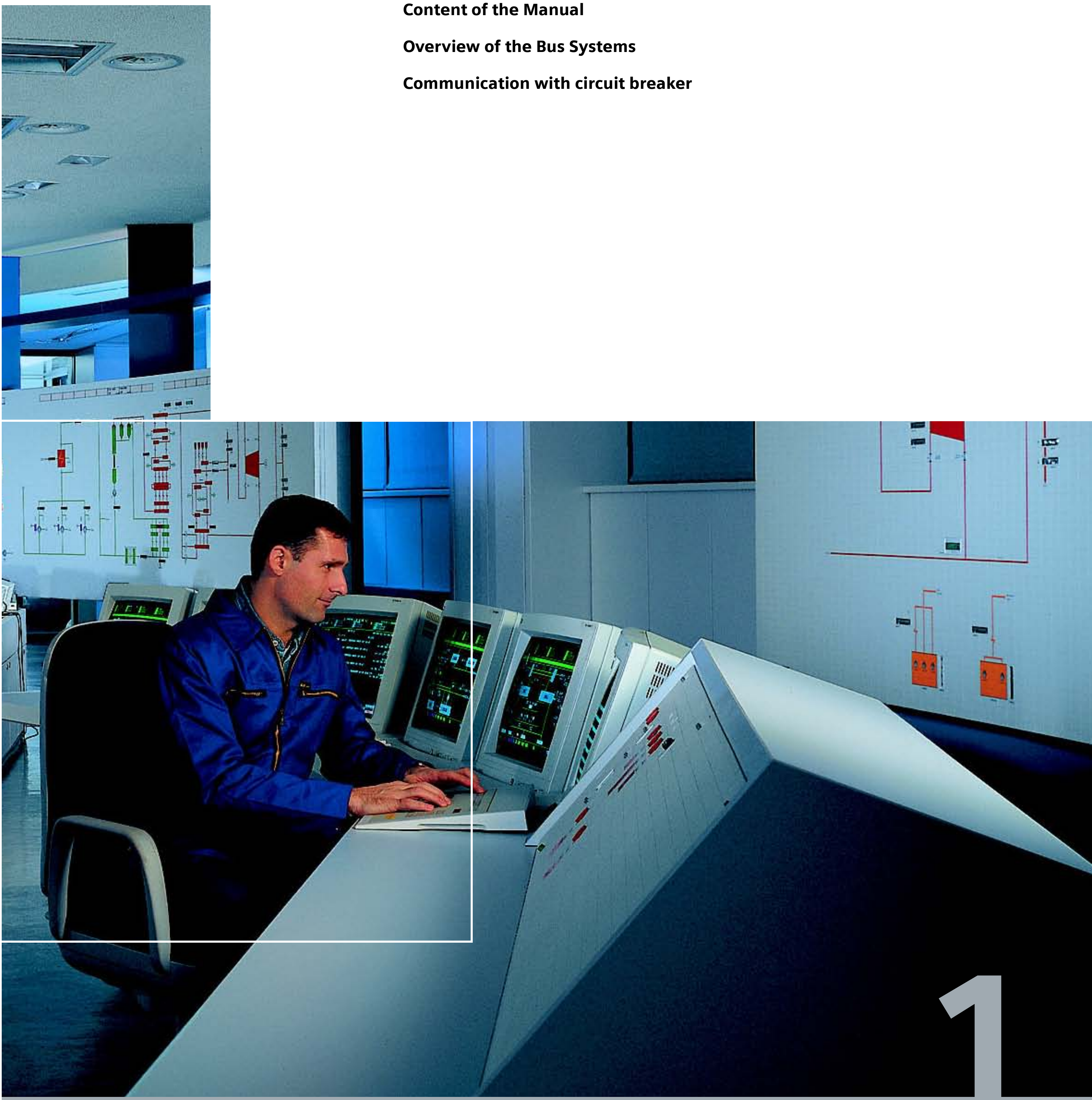
- Profibus User Organization; Version October 2002; PROFIBUS Technology and Application, System Descripition; Order No. 4.002; download under www.profibus.com
- Profibus User Organization; Version 1.0, December 2002; PROFIBUS profile for Low Voltage Switchgear; Only available as Acrobat PDF file, only for PROFIBUS members, download under www.profibus.com
- Profibus User Organization; Version 1.0 September 1998; PROFIBUS Technical Guideline, Installation Guideline for PROFIBUS-DP/FMS; Order No. 2.112; Only available as Acrobat PDF file, only for PROFIBUS members, download under www.profibus.com

Introduction and Overview

Content of the Manual

Overview of the Bus Systems

Communication with circuit breaker



1

Introduction and Overview
General

This manual is aimed at those who want to find out more about the different applications of communications-capable circuit-breakers in power distribution systems. It contains a detailed guide to commissioning, operating, diagnosing, and maintaining the new communications-capable SENTRON WL and SENTRON VL circuit-breakers.

Content of the Manual

Chapter 1 contains a short introduction to communication in power distribution systems, and provides an overview of the benefits and applications of communications-capable circuit-breakers. The chapter concludes with a short description of the most important bus systems.

Chapter 2 contains a detailed description of the open, communications-capable SENTRON WL circuit-breaker. It includes information on the ordering and configuration data, and provides commissioning instructions.

Chapter 3 contains the same information, but this time on the moulded-case communications-capable SENTRON VL circuit-breaker.

Chapter 4 explains how the SENTRON circuit-breakers are integrated in a PROFIBUS-DP system, and describes the joint profile of both circuit-breakers for the PROFIBUS-DP.
The PROFIBUS-DP profile is described in Chapter 4.

Chapter 5 describes the commissioning procedures and possible uses of the Switch ES Power parameterization, diagnosis, and maintenance software with the PROFIBUS-DP.

SENTRON WL and SENTRON VL are the first circuit-breakers that can be parameterized, diagnosed, and maintained remotely without the use of field bus systems and higher-level operator control and monitoring systems. These procedures are carried out using the breaker data adapter (BDA), a state-of-the-art Internet-capable parameterization device for circuit-breakers, which is described in Chapter 6.

The core component of SENTRON circuit-breakers is the shared data dictionary. This describes all the available data points (status, measured values, parameters, and so on), including formats and scaling factors. Chapter 7 contains an easy-to-understand description of the data dictionary.

Introduction

The demands regarding communications-capable systems, data transparency, and flexibility in industrial automation systems are growing all the time. Bus systems and intelligent switchgear are vital to ensure that industrial switchgear systems can meet these demands, since industrial production and building management are now inconceivable without communication technology.
The ever-more stringent requirements regarding the electrical and mechanical aspects of circuit-breakers, the growing need for flexibility and efficiency, and increasing process rationalization and automation have contributed to the recent major innovations in circuit-breaker technology. In power distribution systems, the new, open, communications-capable SENTRON WL circuit-breaker and the moulded-case SENTRON VL circuit-breaker use bus systems to transmit key information for diagnosis, malfunction, commissioning, and burden center management to a central control room. The wide range of applications ensure that these circuit-breakers are more than just simple switching and protection devices.
End to end communication, as well as data entry, transmission, analysis and visualisation are only possible if the automation and the low voltage switchgear technology components can be easily integrated in a communication solution to lever the full range of possiblities available.

In this way, status information, alarm signals, tripping information, and threshold value violations (e.g. overcurrent, phase unbalance, overvoltage) increase transparency in power distribution systems, enabling these situations to be dealt with quickly. Add-on modules (e.g. WinCC and Funk Server Pro) can be used to send important messages via SMS to the cell phones of maintenance personnel. Prompt analysis of this data enables targeted intervention in the process and prevents system failures.

Information for preventative maintenance (e.g. the number of operating cycles or hours) enables timely personnel and material scheduling, which increases system availability and prevents sensitive system components from being destroyed.

Communication helps provide rapid and targeted information on the location and cause of power failures. The precise cause of the fault can be determined by recording the phase currents (e.g. trip as a result of a short-circuit of 2317 A in phase L2 on 08/27/2002 at 14:27). This information can be used to quickly rectify the fault and potentially save a considerable amount of money.

Entering power rating values, work, and the power factor cos φ offers even more scope. The transparency of the power consumption data for business analysis enables power profiles to be created and costs to be clearly assigned. In this way, power costs can be optimized by balancing the peak loads and troughs.

SENTRON Circuit-Breakers - Modular and Intelligent

Thousands of options with just a few components: That's SENTRON. A new generation of circuit-breakers – from 16 A to 6300 A – with a modular design to support every conceivable application in power distribution systems – cost effective and flexible, its communication functionality enables it to be integrated in cross-application system solutions.

Cost Saving

Whatever the configuration, SENTRON does the job where it matters: costs for work processes, rooms, and power. Advantages include simple retrofitting and a compact design benefiting everyone who uses SENTRON, whether in planning, business, or whether they develop or operate switchgear systems.

Easy Planning

The SENTRON circuit-breakers and the SIMARIS deSign planning tool provide a quick and easy method for planning offices and switchgear cabinet constructors to handle long and complex processes.

System Solutions

By integrating SENTRON circuit-breakers in a higher-level communication system, they can be parameterized via PROFIBUS-DP, Ethernet, or the Internet; an integrated power management system even allows you to optimize power distribution right across the board.

Graphic 1-1 *Saving costs increases productivity*

Graphic 1-2 *Simplified planning every step of the way*

Graphic 1-3 *System solutions - committed to simple interoperability of SENTRON circuit-breakers*

Introduction and Overview
Bus Systems

Bus systems are used to connect distributed devices with varying levels of intelligence. With their different structures and mechanisms, certain bus systems are designed for highly specific applications, while others are better suited for more open applications. The following section describes the most important bus systems used in automation and power distribution systems.

PROFIBUS-DP

The PROFIBUS-DP is an open, standardized, multi-vendor field bus system. Standardized to DIN (E) 19424 Part 3 / EN 50170, it is ideally suited to fulfill the stringent requirements for exchanging data in distributed peripheral and field devices. As at June 2002, over 1,100 manufacturers were offering more than 1,700 products, and user organizations in 23 countries providing support for users of over 4 million PROFIBUS installations.

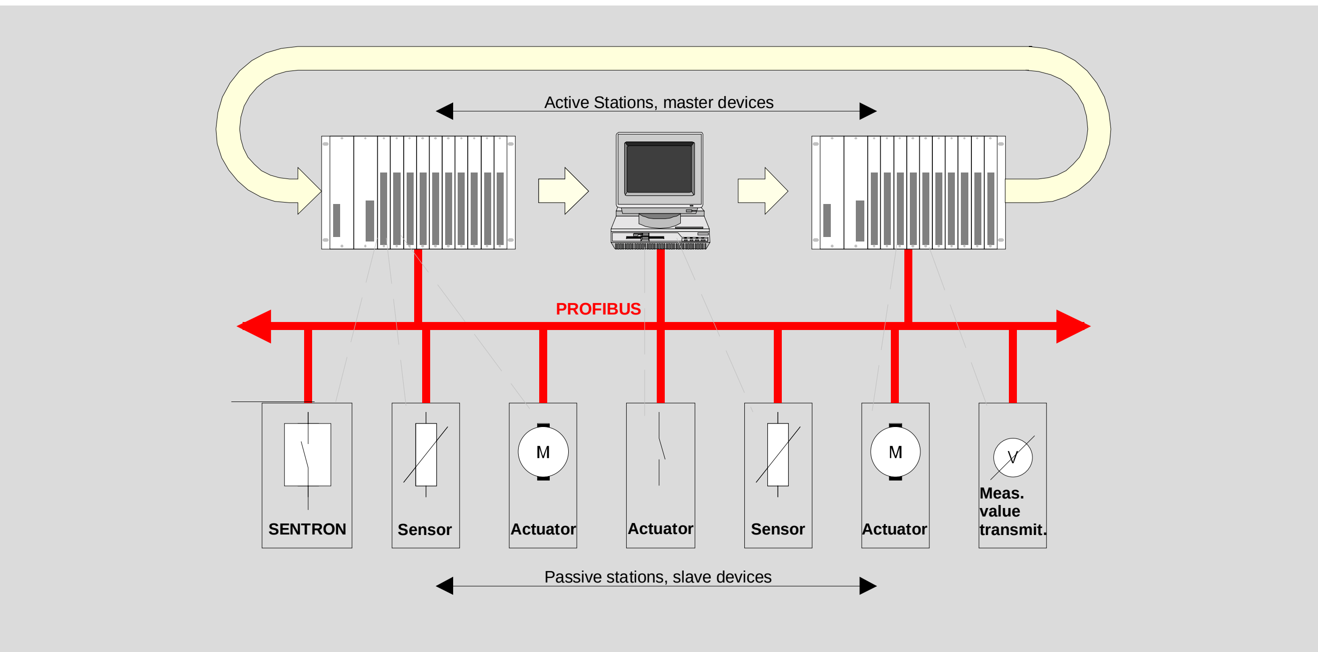
The device can also be easily integrated in and connected to standard automation systems, since all the major manufacturers of programmable control systems offer PROFIBUS-DP master modules, and the high transmission rates of up to 12 MBaud ensure virtually real-time system operation.

The protocol used by the PROFIBUS-DP stations supports communication between the complex, equal-priority programmable controllers (masters). Each station completes its communication task within a defined time frame.

In addition, straightforward, cyclic data exchange is carried out for communication between a master and the simple peripheral devices (slaves) assigned to it.

The PROFIBUS-DP achieves this using a hybrid bus access control mechanism comprising a central token passing procedure between the active stations (masters) and a central master-slave procedure for exchanging data between the active and passive stations.

Bus access control enables the following system configurations to be implemented:



Graphic 1-4 *Communication on the PROFIBUS: token passing between the masters; polling between the master and slave stations*

- Pure master-slave system
- Pure master-master system with token passing
- A system combining both procedures

Graphic 1-4 shows an example with 3 master modules and 7 slaves. The 3 master devices form a logical ring. The MAC (medium access control) monitors the token. It creates the token in the ramp-up phase and monitors whether just one token is really circulating in the ring.

Each slave that communicates cyclically via the PROFIBUS-DP is assigned a class 1 master. Cyclic data exchange is carried out to the standard DP profile (DPV0). A class 1 master is mainly used for automation tasks. In addition to cyclic data exchange, a class 1 master can also establish an acyclic communication connection to its slaves, which enables it to use the extended slave functionality.

A class 2 master is particularly suitable for commissioning, diagnosis, and visualization tasks. In addition to the class 1 master, it is connected to the PROFIBUS-DP and can access slaves and exchange data using acyclic services (providing the slaves allow this).

Acyclic data transmission is carried out via DPV1. The existing PROFIBUS standard has been extended to include DPV1 with a number of additional functions. This enables the slave to be reparameterized during operation, for example, and acyclic data transmission to be carried out. DPV1 also allows data to be read directly from the slave by a class 2 master, even though this is still logically connected to a class 1 master. Both DPV1 and DP standard transmission takes place across one line.

Acyclic data transmission can be used, for example, when operator control and monitoring systems, such as WinCC, or configuration software, such as Switch ES Power (see Chapter 5), are implemented. The PC used with an integrated PROFIBUS-DP interface card then takes on the role of the class 2 master, from which the data records are transmitted via DPV1 and new values set if the tripping current value is changed, for example. Cyclic data exchange between the circuit-breaker and the PLC, however, continues as normal.

Ethernet

The Industrial Ethernet is a high-performance cell network that conforms to IEE 802.3 (ETHERNET). The highly successful 10 Mbit/s technology, which has been used for over a decade now, and the new 100 Mbit/s technology (Fast Ethernet to IEEE 802.3u) in conjunction with Switching Full Duplex and Autosensing enable the required network performance to be adapted to different requirements. The appropriate data rates are selected as required here because complete compatibility enables the technology to be implemented on a step-by-step basis.

Used in 80% of networks, Ethernet is currently the best of its kind in LAN environments.

SIMATIC NET is based on this tried-and-tested technology. Siemens has supplied well over 500,000 connections all over the world in frequently harsh industrial environments with high EMC requirements.

In addition, Internet technology opens up considerable scope for worldwide networking. With Industrial Ethernet, SIMATIC NET provides a tool that can be seamlessly integrated in the new media landscape. The enormous potential offered by intranets, extranets, and the Internet, which are already available in offices of all kinds, can also be implemented in production and process automation environments.

Unlike the PROFIBUS-DP, Ethernet does not work according to a master-slave principle. All the stations have equal priority on the bus, which means that any station can be the sender and/or receiver. A sender can only send on the bus if no other station is sending at that point. This is made possible due to the fact that the stations are always "listening in" to find out whether any messages are being sent to them or any senders are currently active. If a sender has started sending, it checks that the message it has sent is not corrupt. If the message is not changed, the send operation continues.

If the sender detects that its data is corrupt, another sender must have already started sending data. In this case, both senders abort their respective send operations.
After a random time has elapsed, the sender restarts the send operation. This is known as CSMA/CD and, as a "random" access procedure, does not guarantee a response within a certain time frame. This largely depends on the bus load, which means that real-time applications cannot yet be implemented with Ethernet.

A number of options are available for transmitting SENTRON circuit-breaker data on the PROFIBUS-DP to the Ethernet. Two methods using SIEMENS components are described here:

Method 1:

A SIMATIC S7 controller is equipped with a PROFIBUS-DP interface (CPU-internal interface or modules with communication processors) and an Ethernet interface. The data transmitted from the circuit-breaker via the PROFIBUS-DP is "re-sorted" in SIMATIC and communicated via Ethernet. Possible Ethernet communication processors for S7 include:
CP 343-1, CP 343-1 IT, CP 343-1 PN, CP 443-1, and the CP 443-1 IT .

Method 2:

As a standalone component, the IE/PB link provides a seamless transition between Industrial Ethernet and the PROFIBUS-DP. In this way, operator control and monitoring systems, for example, can easily access the PROFIBUS-DP field devices by means of data records being routed via the IE/PB link.

For ordering information and other network gateway options, refer to Chapter 7 of the IK PI catalog.

LON (Local Operating Network).

This bus system is based on VLSI circuits, which control communication between up to 32,385 network nodes. The nodes are arranged in subnetworks, each with a maximum of 64 stations. Routers, which are also based on these circuits (neuron chips), are responsible for connecting the subnetworks. The specifications are available from the manufacturer, ECHELON.

Depending on the data rates, a wide range of transmission media can be used, including current leads, radio and infrared channels, coaxial cables, and optical fibers.

The LON bus is a highly distributed bus system in which each field device features integrated on-site intelligence. LONs are mainly used for building system automation and are often implemented in the production industry.

One disadvantage of gateways, however, is that there is always an additional time delay in the system when data is passed from one bus system to another. This is because the data must be buffered on one side, converted, and then output on the other side. In addition, not all functions provided by the PROFIBUS-DP can be used when they are implemented on the PROFIBUS-DP (e.g. event-driven diagnostic messages).

One or more PROFIBUS-DP-capable circuit-breakers can be integrated in an existing LON bus system. For this purpose, a gateway is required between the two different bus systems, which then makes it possible to communicate with PROFIBUS-DP devices via the LON bus.

Standalone operation is not possible with the LONtoX gateway with the HERMOS PROFIBUS (www.hermos-informatik.de); a SIMATIC S7 is always required on the PROFIBUS side to prepare the data for the gateway.

Modbus

Modbus is an open, serial communications protocol based on a master-slave architecture. Since it is very easy to implement on any kind of serial interface, it can be used in a wide range of applications. Modbus comprises a master and several slaves, whereby communication is controlled exclusively by the master. Modbus features two basic communication mechanisms:

- Question/answer (polling): The master sends an inquiry to a station and waits for a response.
- Broadcast: The master sends a command to all the network stations, which execute the command without confirmation.

The messages enable process data (input/output data) to be written and read either individually or in groups.

The data can either be written in ASCII or transmitted as a package in RTU format. Modbus is used on a wide range of transmission media, in particular, on the RS485 physical bus characteristics, a twisted, shielded two-wire cable with terminating resistors (as with the PROFIBUS-DP).

The Modbus protocol was originally developed for networking control systems, although it is often used for connecting input/output modules too. Due to the low transmission rate of max. 38.4 kBaud, Modbus is particularly recommended for applications with a low number of stations or low time requirements.

A Modem Plus system interface with the PROFIBUS-DP can be established by connecting a communication module (twisted pair) to the SIMATIC S7-300 or S7-400.

To operate the system, however, the Modbus protocol must first be implemented as a driver for the communication module CP 341 or CP 441-2, and the gateway function then implemented in the PLC itself.

This solution is not, however, recommended due to the excessive amount of time and effort involved.

Communication Structure of the SENTRON Circuit-Breakers

The following diagram:

- provides an overview of the different communication options available with SENTRON circuit-breakers and their modules
- illustrates the high level of system flexibility, enabling new and innovative ideas to be implemented...

...starting at the lowest level with simple parameterization of the circuit-breakers, to the field level with a PLC and the Switch ES Power software tool, through to connection to the intranet/Internet, and the associated potential for saving on power costs by means of intelligent power management.

The individual circuit-breakers and their modules are described in the following chapters.

1 SENTRON VL Moulded-Case Circuit-Breaker
2 Electronic Trip Unit (ETU/LCD)
3 COM10 PROFIBUS Module incl. ZSi
4 Breaker Data Adapter (BDA)
5 BDA *Plus* with Ethernet Interface
6 Device with web-browser (e.g. notebook)
7 SENTRON WL Circuit Breaker
8 COM15 PROFIBUS Module
9 Breaker Status Sensor (BSS)
10 Electronic Trip Unit (ETU)
11 Metering Function or Metering Function *Plus*
12 ZSI (Zone-Selective Interlocking) Module
13 Digital Output Module as Relay or Opto-Coupler
14 Digital Output Module as Relay or Opto-Coupler *, Configurable
15 Analoge Output Module
16 Digitale Input Module
17 Switch ES Power on PC
18 PLC (e.g. SIMATIC S7)
19 Power Management Software

Graphic 1-5 *The system architecture of SENTRON circuit-breakers: The identical PROFIBUS-DP communication profile enables the same software tools to be used (Switch ES Power; PCS7 faceplates; PLC programs).*


1 2 3 4 5 6 7 8 9
PROFIBUS
CubicleBUS
PROFIBUS-DP
COM15
3WL9111-0AT15-0AA0


CubicleBUS

SENTRON WL

2

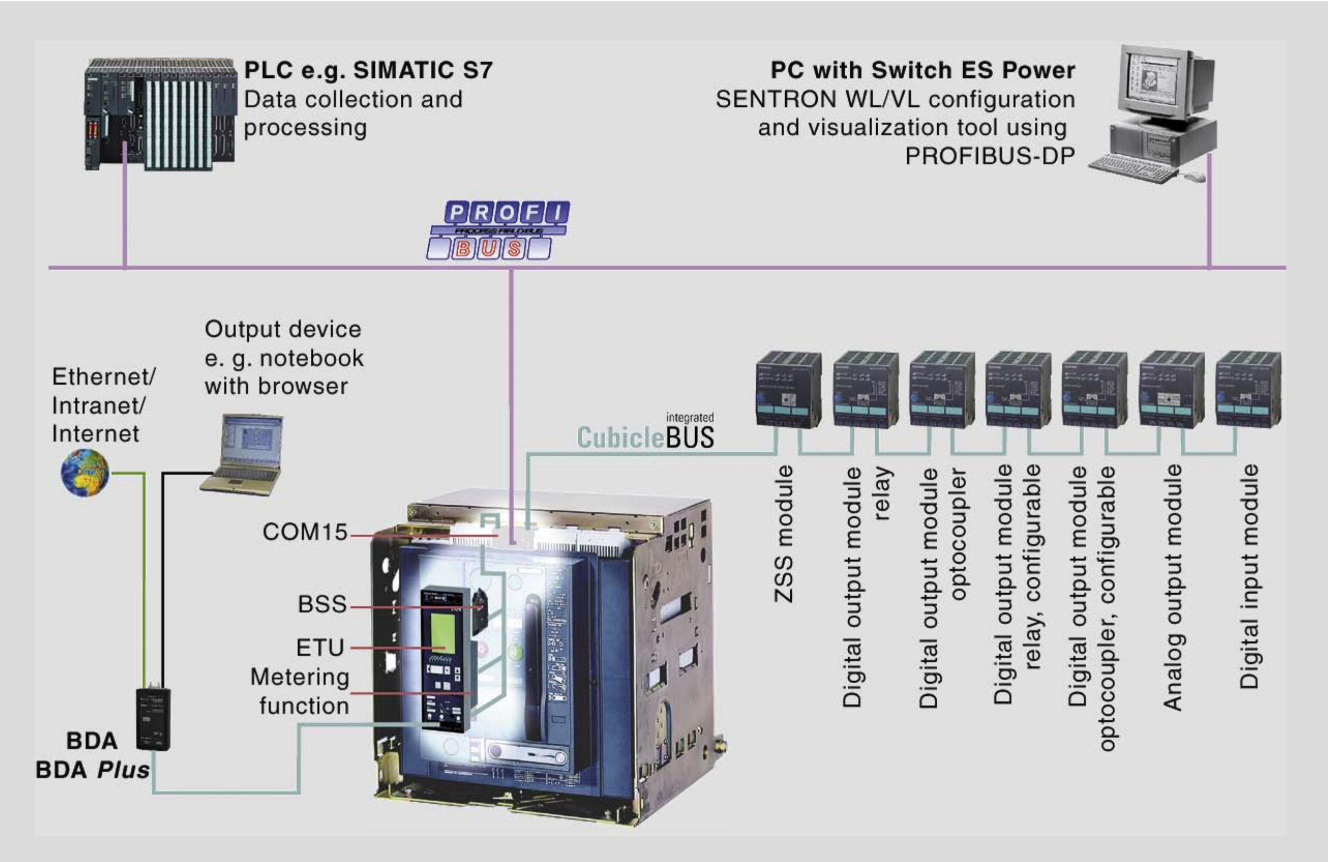
SENTRON WL
Introduction and Overview

The demands regarding communications capability, data transparency, flexibility, and integration in power distribution systems are increasing all the time. The SENTRON WL is the open-design circuit-breaker that fulfills the requirements of the future today.

Brief Description of the SENTRON WL

Circuit-breakers today are no longer simply devices for protecting plants, transformers, generators, and motors. Many users now require a complete overview of the plant from a central control room and round-the-clock access to all available information. Modern power distribution systems are characterized by the methods used to network circuit-breakers – both with each other and other components. The open circuit-breakers in the SENTRON WL family have a lot more to offer: In the future, it will be possible to carry out diagnosis and maintenance procedures remotely on the Internet. Operating staff will be given immediate information on system malfunctions or alarm signals. This is not just a vision of the future, but reality.

Whether in the 3-pole or 4-pole version, fixed-mounted or withdrawable, the SENTRON WL circuit-breaker, which is available in three different sizes, covers the entire range from 250 A to 6300 A. The devices are available with different switching capacity classes, thereby enabling short-circuit currents of up to 150 kA to be interrupted reliably. They can be adapted to any system conditions, which means that, if required, a rating plug can be used to adapt each circuit-breaker to the appropriate rated current, for example. This ensures that optimum protection is



Graphic 2-1 *The system architecture of the SENTRON WL with* **Cubicle**BUS *enables simultaneous communication via the PROFIBUS-DP and BDA with a notebook or Ethernet/intranet/Internet.*

provided, even if changes have been made in the system. The modules can be replaced within seconds without the need for the transformer to be changed. A switchover between two different parameter sets is also possible. This function is particularly useful in the event of a power failure when an automatic switchover is made from on-line to generator operation, a process which can also involve all the release conditions changing.

A wide range of locking systems are available to improve reliability during critical processes. All accessories, such as auxiliary releases, motorized drives, and communication systems, can be retrofitted quickly and easily; this is made all the easier since the accessories are identical across the entire range. The commitment to reducing the overall number of parts results in fewer parts to be ordered and lower storage costs.

The core of each circuit-breaker is the electronic trip unit (ETU). Several versions are available to adapt the protective, metering, and signaling functions to the system requirements: from simple overload and short-circuit protection to trip units that can be parameterized remotely and which feature a wide range of metering and signaling functions.

All circuit-breakers with type ETU45B, ETU55B, and ETU76B trip units are communications capable, and enable additional components to be integrated, which are networked internally via the **Cubicle**BUS.

To provide a SENTRON WL with trip unit ETU15B, ETU25B, or ETU27B with communications capability, the trip unit must be replaced because it cannot be connected to the **Cubicle**BUS.

The circuit-breaker is connected to the PROFIBUS-DP via the RS485 interface of the COM15 module.

The breaker data adapter (see Chapter 6) also supports higher-level networking/communication (intranet/Internet).

The CubicleBUS

The **Cubicle**BUS, which connects all the intelligent components within the SENTRON WL and enables additional external components to be connected quickly and reliably, forms the backbone of the standardized, modular architecture of the SENTRON WL. The **Cubicle**BUS is already integrated in and connected to all complete circuit-breakers with the ETU45B, ETU55B, and ETU76B trip units (integrated **Cubicle**BUS).

The high level of system modularity enables communication functions (e.g. metering function) to be retrofitted at any time. A SENTRON WL that is not yet communications capable can be upgraded (e.g. by exchanging ETU25B for ETU45B with **Cubicle**BUS) quickly and easily on site. All **Cubicle**BUS modules can access the existing source data of the circuit-breaker directly, thereby ensuring rapid access to information and speedy responses to events.

By connecting additional, external modules to the **Cubicle**BUS, cost-effective solutions for automating other devices in the cubicle can be implemented.

Communications Capability of the Electronic Trip Units (ETUs)

The electronic trip units ETU45B, ETU55B, and ETU76B are all communications capable. The **Cubicle**BUS is connected to the circuit-breaker terminals X8:1 to X8:4.

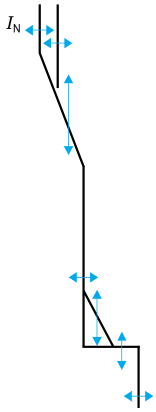
Different versions of communications-capable trip units are available.

The front of the ETU45B is fitted with a rotary coding switch for setting the protection parameters. These can only be read via the communication device. The ETU45B can also be fitted with a four-line display for the measured values.

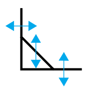
The ETU55B does not have a rotary coding switch or a display. The protection parameters can only be changed via the PROFIBUS-DP or BDA. They can only be changed using a software tool, which is why the ETU55B is known as a safety trip unit. The protection parameters can be set both remotely and on a step-by-step basis.

The ETU76B features a full-graphics display with a clearly-structured, key-driven menu. This not only enables operators to display measured values, status information, and maintenance information, but also to read all the existing parameters and make password-protected changes.

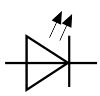
Functional Overview of the Trip Unit System



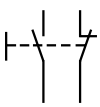
NSE00888a



NSE00889



NSE00890



NSE00891

Basic functions		ETU15B	ETU25B	ETU27B
L	**Overload protection**	✓	✓	✓
	Function can be switched on or off	–	–	–
	Setting range $I_R = I_n \times$ ...	0,5-0,6-0,7-0,8-0,9-1	0,4-0,45-0,5-0,55-0,6-0,65-0,7-0,8-0,9-1	0,4-0,45-0,5-0,55-0,6-0,65-0,7-0,8-0,9-1
	Switchable overload protection (I^2t- or I^4t-dependent function)	–	–	–
	Setting range for trip class t_R at I^2t	10 s fixed	10 s fixed	10 s fixed
	Setting range for trip class t_R at I^4t	–	–	–
	Thermal memory	–	–	–
	Phase failure sensitivity	–	at t_{sd} = 20 ms (M)	at t_{sd} = 20 ms (M)
N	**Neutral conductor protection**	–	–	✓
	Function can be switched on or off	–	–	✓ (per sliding-dolly switch)
	Neutral conductor setting range $I_N = I_n \times$ ...	–	–	0-1
S	**Short-time delayed short-circuit protection**	–	–	–
	Function can be switched on or off	–	–	–
	Setting range $I_{sd} = I_n \times$ ...	–	1,25-1,5-2-2,5-3-4-6-8-10-12	1,25-1,5-2-2,5-3-4-6-8-10-12
	Setting range for delay-time t_{sd}	–	0-M-100-200-300-400	0-M-100-200-300-400
	Switchable short-time delayed short-circuit protection (I^2t-dependent function)	–	–	–
	Setting range for delay-time t_{sd} at I^2t	–	–	–
	Short-time grading control (ZSS)	–	–	–
I	**Instantaneous short-circuit protection**	´	´	´
	Function can be switched on or off	–	–	–
	Setting range $I_i = I_n \times$ ...	2-3-4-5-6-7-8	fixed for $I_i \geq 20 \times I_n$, max. 50 kA	fixed for $I_i \geq 20 \times I_n$, max. 50 kA
G	**Earth-fault protection**	–	–	✓ fixed-mounting
	Release and alarm function	–	–	–
	Release function can be switched on or off	–	–	✓ (per rotary coding switch)
	Alarm function can be switched on or off	–	–	–
	Detection of the earth-fault current via summation current formation with internal or external neutral conductor transformer	–	–	✓
	Detection of the earth-fault current via external PE conductor transformer	–	–	–
	Setting range of the operating current I_g for release	–	–	OFF-A-B-C-D-E
	Setting range of the operating current I_g for alarm	–	–	–
	Setting range for the delay-time t_g	–	–	100-200-300-400-500 ms
	Switchable earth-fault protection (I^2t-dependent function)	–	–	–
	Setting range for delay-time t_g at I^2t	–	–	–
	Zone-selective interlocking function (ZSS-g)	–	–	–
Parameter sets				
	Switchable	–	–	–
LCD				
	Alpha-numeric LCD (4 lines)	–	–	–
	Graphic LCD	–	–	–
Communications				
	CubicleBUS integrated	–	–	–
	Communication-capable via PROFIBUS-DP	–	–	–
Metering function				
	capable with metering or metering function Plus	–	–	–
LED display				
	Tripping unit active	´	✓	✓
	Alarm	´	✓	✓
	Internal release fault	´	✓	✓
	L-release	–	✓	✓
	S-release	–	✓	✓
	I-release	–	✓	✓
	N-release	–	–	✓
	G-release	–	–	✓
	G-alarm	–	–	–
	Release via external signals	–	–	–
	Communications	–	–	–
Signals from signalling switches with external Cubicle BUS modules (optical or relays)				
	Overload warning	–	–	–
	Load shedding, load restorage	–	–	–
	Leading overload signal 200 ms	–	–	–
	Temperature alarm	–	–	–
	Phase unbalance	–	–	–
	Instantaneous short-circuit trip	–	–	–
	Short-time delayed short-circuit trip	–	–	–
	Overload trip	–	–	–
	Neutral conductor trip	–	–	–
	Earth-fault protection trip	–	–	–
	Auxiliary relay	–	–	–
	Trip unit error	–	–	–

Table 2-1 *The functional overview of the trip unit system contains the various functions and options available for the non-communications-capable trip units ETU15B, ETU25B, and ETU27B, as well as for the communications-capable trip units ETU45B, ETU55B, and ETU76B.*

Basic functions	ETU45B	ETU55B	ETU76B
Overload protection	✓	✓	✓
Function can be switched on or off	–	✓ (on/off per Comm)	✓
Setting range $I_R = I_n \times$ ...	0,4-0,45-0,5-0,55-0,6-0,65-0,7-0,8-0,9-1	0,4 bis 1	0,4 bis 1
Switchable overload protection (I^2t- or I^4t-dependent function)	✓ (per sliding-dolly switch)	✓ (per comm)	✓
Setting range for trip class t_R at I^2t	2-3-5-5,5-8-10-14-17-21-25-30 s	2 up to 30 s	2 up to30 s
Setting range for trip class t_R at I^4t	1-2-3-4-5 s	1-5 s	1-5 s
Thermal memory	✓ (on/off per sliding-dolly switch)	✓ (on/off per Comm)	✓ (on/off per menu/comm)
Phase failure sensitivity	at t_{sd} = 20 ms (M)	at t_{sd} = 20 ms (M)	at t_{sd} = 20 ms (M)
Neutral conductor protection	✓	✓	✓
Function can be switched on or off	✓ per sliding-dolly switch	✓ (per Comm)	✓ (per Menü/Comm)
Neutral conductor setting range $I_N = I_n \times$ ...	0-0,5-1	0,5 up to 2	0,5 up to 2
Short-time delayed short-circuit protection	✓	✓	✓
Function can be switched on or off	✓ (per rotary coding switch)	✓ (per Comm)	✓ (per menu/comm)
Setting range $I_{sd} = I_n \times$ ...	1,25-1,5-2-2,5-3-4-6-8-10-12	1,25 up to 12 × I_n (Comm)	1,25 × I_n ... <0,8 × I_{cw}
Setting range for delay-time t_{sd}	M-100-200-300-400-OFF ms	20- up to max. 4000 ms	20- bis max. 4000 ms
Switchable short-time delayed short-circuit protection (I^2t-dependent function)	✓ (per rotary coding switch)	✓ (per Comm)	✓ (per menu/comm)
Setting range for delay-time t_{sd} at I^2t	100-200-300-400 ms	100-400 ms; OFF	100-400 ms; OFF
Short-time grading control (ZSS)	per **Cubicle**BUS module	als **Cubicle**BUS module	als **Cubicle**BUS module
Instantaneous short-circuit protection	✓	✓	✓
Function can be switched on or off	✓ (per rotary coding switch)	✓ (per Comm)	✓ (per menu/Comm)
Setting range $I_i = I_n \times$ ...	1,5-2,2-3-4-6-8-10-12-0,8 × I_{CS}-OFF	1,5 × I_n bis 0,8 × I_{cs}	1,5 × I_n bis 0,8 × I_{cs}
Earth-fault protection	✓ Module can be retro-fitted	✓ Module can be retro-fitted	✓ Module can be retro-fitted
Release and alarm function	✓	✓	✓
Release function can be switched on or off	✓ (per rotary coding switch)	✓ (per comm)	✓ (per menu/comm)
Alarm function can be switched on or off	–	✓ (per comm)	✓ (per menu/comm)
Detection of the earth-fault current via summation current formation with internal or external neutral conductor transformer	✓	✓	✓
Detection of the earth-fault current via external PE conductor transformer	✓	✓	✓
Setting range of the operating current I_q for release	OFF-A-B-C-D-E	10% I_n up to max. 1200 A	10% I_n up to max. 1200 A
Setting range of the operating current I_q for alarm	A-B-C-D-E	10% I_n up to max. 1200 A	10% I_n up to max. 1200 A
Setting range for the delay-time t_q	100-200-300-400-500 ms	100-200-300-400-500 ms	100-200-300-400-500 ms
Switchable earth-fault protection (I^2t-dependent function)	✓	✓	✓
Setting range for delay-time t_q at I^2t	100-200-300-400-500 ms	100 up to 500 ms	100 up to 500 ms
Zone-selective interlocking function (ZSS-g)	per **Cubicle**BUS module	per **Cubicle**BUS module	per **Cubicle**BUS module
Parameter sets			
Switchable	–	✓	✓
LCD			
Alpha-numeric LCD (4 lines)	✓	–	–
Graphic LCD	–	–	✓ ETU76B
Communication			
CubicleBUS integrated	✓	✓	✓
Communication-capable via PROFIBUS-DP	✓	✓	✓
Metering function			
capable with metering or metering function Plus	✓	✓	✓
LED display			
Tripping unit active	✓	✓	✓
Alarm	✓	✓	✓
Internal release fault	✓	✓	✓
L-release	✓	✓	✓
S-release	✓	✓	✓
I-release	✓	✓	✓
N-release	✓	✓	✓
G-release	✓(only w. earth-fault prot. module)	✓(only w. earth-fault prot. module)	✓(only w. earth-fault prot. module)
G-alarm	✓(only w. earth-fault prot. module)	✓(only w. earth-fault prot. module)	✓(only w. earth-fault prot. module)
Release via external signals	✓	✓	✓
Communications	✓	✓	✓
Signals from signalling switches with external CubicleBUS modules (optical or relays)			
Overload warning	✓	✓	✓
Load shedding, load restorage	✓	✓	✓
Leading overload signal 200 ms	✓	✓	✓
Temperature alarm	✓	✓	✓
Phase unbalance	✓	✓	✓
Instantaneous short-circuit trip	✓	✓	✓
Short-time delayed short-circuit trip	✓	✓	✓
Overload trip	✓	✓	✓
Neutral conductor trip	✓	✓	✓
Earth-fault protection trip	✓(only w. earth-fault prot. module)	✓(only w. earth-fault prot. module)	✓(only w. earth-fault prot. module)
Auxiliary relay	✓(only w. earth-fault prot. module)	✓(only w. earth-fault prot. module)	✓(only w. earth-fault prot. module)
Trip unit error	✓	✓	✓

Data Availability on the **Cubicle**BUS

All modules connected to the **Cubicle**BUS can request data from other modules via the bus and generate data themselves that can be read by other modules.

Each data point in the comprehensive SENTRON circuit-breaker data dictionary can only be generated by a single module - the data source. If this data source (module) exists, the data points assigned to it also exist.

This information is described and communicated in the property bytes.

If a data source (module) does not exist, the data point does not exist either.

Again, the relevant property byte contains this information.

The following table provides an overview of the internal **Cubicle**BUS modulesmoduls and the data point groups (collection of several data points) assigned to them.

See Chapter 7 data dictionary for a detailed description of the individual data points.

	CubicleBUS moduls				
Data point group **Data points with the same source**	**ETU as of ETU45B**	**BSS**	**COM15**	**Metering function**	**Met. fct. *Plus***
Protection parameter set A	✓				
Protection parameter set B (not for ETU45B)	✓				
Extended protection parameters				✓	✓
Parameter for setpoints				✓	✓
PROFIBUS communication parameters			✓		
Parameters for metering settings				✓	✓
Device identification data	✓		✓		
Circuit-breaker position specifications			✓		
Status info. (circuit-breaker on/off, storage spring, etc.)		✓			
Alarms	✓				
Trips	✓			✓	✓
Setpoint messages				✓	✓
Maintenance information	✓		✓		
Circuit-breaker temperature		✓			
Temperature in the cubicle			✓		
3-phase currents	✓				
Current in N-conductor, ground-fault current; equip. spec.	✓				
3-phase voltage				✓	✓
Power P, Q, S, energy				✓	✓
cos φ				✓	✓
Frequency, total harm. distortion, form factor, crest factor				✓	✓
Harmonic analysis					✓
Waveform buffer					✓
Log book for events and trips			✓		
System time			✓		

Table 2-2 *The table shows which data points from the data dictionary are generated by which* **Cubicle**BUS *module, enabling you to quickly find out which modules are required for which system.*

SENTRON WL
The PROFIBUS-DP COM15 Module and the BSS

The COM15 module enables the SENTRON WL circuit-breaker to exchange data via the PROFIBUS-DP simultaneously with two masters. The COM15 module retrieves some of the key data on the status of the circuit-breaker (circuit-breaker on/off, storage spring, available etc.) via the CubicleBUS from the BSS (breaker status sensor). Both modules are, therefore, offered together as a PROFIBUS-DP communication package (option F02).

PROFIBUS-DP Module COM15

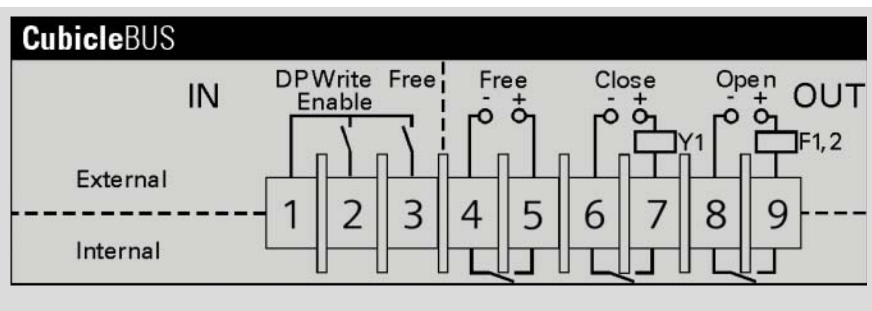
The COM15 module for the SENTRON WL enables the circuit-breaker to be connected to the PROFIBUS-DP. It supports the DP and DPV1 PROFIBUS protocols, which means that it can communicate with two masters simultaneously. This makes it easier, for example, to commission parameterization and diagnostic tools (e.g. Switch ES Power) and operator control and monitoring systems (e.g. WinCC) for the SENTRON WL.

If required, control/write access to the circuit-breaker can, for safety reasons, be locked using hardware and software to prevent any switching operations taking place via PROFIBUS (manual/automatic operation) or parameters from being changed, for example.

All key events are assigned a time stamp from the integrated clock to enable operators to keep track of malfunctions. A simple mechanism allows the clock to be synchronized with the clock in the automation system.

A temperature sensor integrated in the COM15 module measures the temperature in the switchgear cabinet.

Three integrated microswitches located on the underside of the COM15 module are used to detect the position of the circuit-breaker (operating, test, disconnected, and not present) and read it via the PROFIBUS-DP. The circuit-breaker can only be switched on and off in the operating and test position.



Graphic 2-2 *The text on the COM15 module shows the external pin configuration for connecting the closing solenoid and the shunt trips, as well as the PROFIBUS write protection function and the unassigned input/output.*

Pin Configuration

The COM15 module is connected to the auxiliary conductor plug-in system at X7.

The electrical connections to the circuit-breaker and the CubicleBUS connection to the circuit-breaker-internal CubicleBUS moduls (ETU, BSS, metering function) must also be established. This is achieved by connecting the four lines brought out at the rear of the COM15 module to the auxiliary conductor plug-in system at X8.

Interface relays must be used if the opening and closing solenoids are designed for voltages higher than 24 V DC.

Terminals X5:11 and X5:12 must be used if the second auxiliary release (F2, F3, F4) rather than the first auxiliary release (F1) is used to switch off the device via the PROFIBUS-DP.

The unassigned user output can be used as required and must be connected in the same way as a coupling device (see Graph 2-4). It can be used, for example, to activate the F7 solenoid for retrieving the red tripped plunger if option K10 has been installed. As with Open and Close, only voltages of up to 24 V DC are permitted (note the polarity); coupling devices must be used for higher voltages.

The PROFIBUS line must be connected to the 9-pole interface on the front of the COM15 module. The CubicleBUS connection for RJ45 plugs is located at the rear and is used to connect the external CubicleBUS modules. If no external CubicleBUS module is connected, the terminating resistor supplied must be used as an RJ45 plug.

The unassigned user input can be connected using a contact element with the 24 V DC from pin 1 to transmit the status of the contact element.

PROFIBUS Installation Guideline

The COM15 (and COM10) must be assembled and connected to the PROFIBUS as described in the PROFIBUS Installation Guideline (Order No. 2.112 from the PROFIBUS User Organization www.profibus.com). One of the main aspects therefor are the equipotential bonding and shielding.

PROFIBUS Write Protection (DPWriteEnable)

In real power distribution systems, write access via PROFIBUS has to be locked either temporarily or permanently.

The COM15 module features a hardware input for this purpose. Pin 1 provides the 24 V DC supply, which can be fed back to pin 2, for example, (DPWriteEnable) via a contact element.

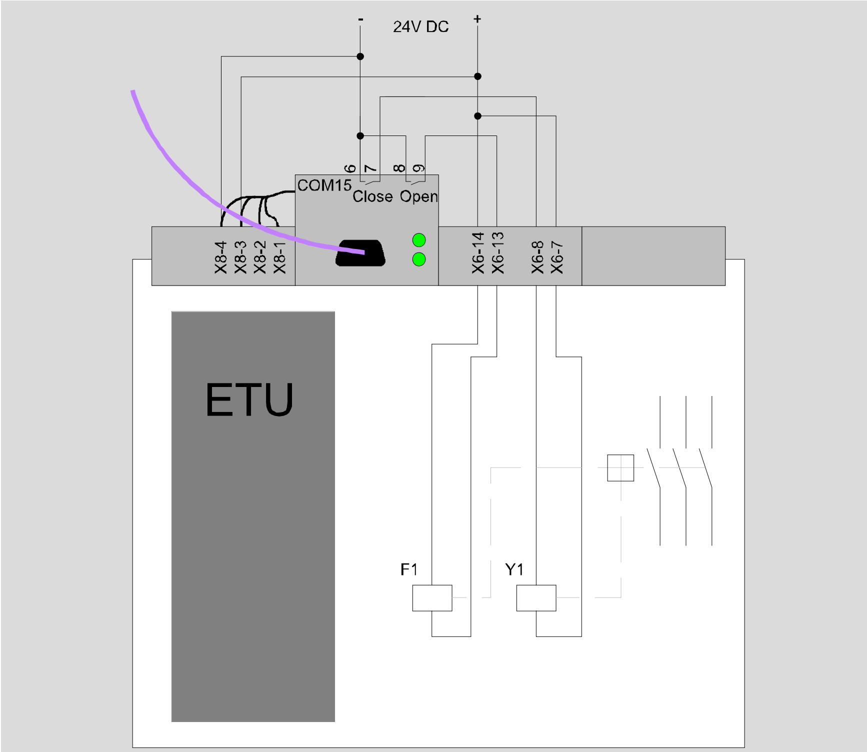
If this input is not bridged (active release), write access is not possible (there are a number of exceptions here).

The following actions are blocked if the input of the write protection function has not been bridged:

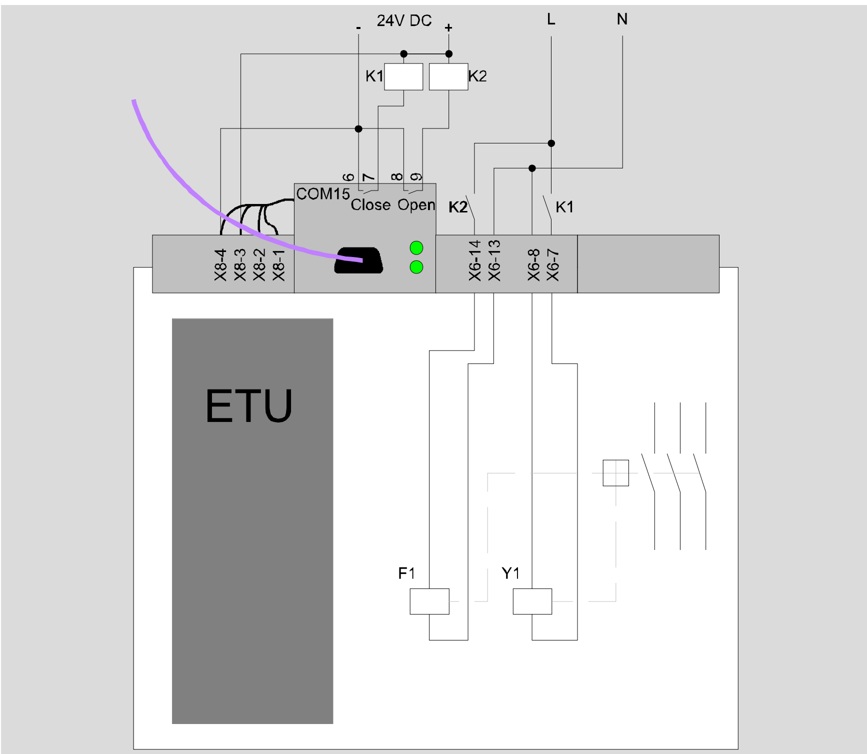
- Switch on/off
- Reset the last trip
- Change the protective parameters
- Change the parameters for the extended protection function (metering function)
- Change the communication parameters
- Settings of the metering options
- Reset maintenance information (counters)
- Force the digital outputs (in the mask Command module in Switch ES Power)
- DPV1 start-up parameters from the Switch ES Power Object Manager

The following control functions are available even if the write protection function has not been bridged:

- Change and set the trigger functions for the waveform buffer
- Read the content of the waveform buffer
- Change the setpoint parameters



Graphic 2-3 *This diagram illustrates how to wire the COM15 module with the auxiliary power plug-in contacts if the PROFIBUS is to be used to switch the device on and off. This diagram only applies to contact elements with 24 V DC.*



Graphic 2-4 *Interface relays are required if contact elements with a voltage different than 24V DC are used. If F1 is not used to switch off the device, terminals X5:11/X5:12 for F2 to F4 must be connected.*

- Set/change the system time
- Change the free texts (comments, system IDs)
- Reset the min./max. values
- Change the unassigned user output

The write protection function ensures that all the required information can be transmitted, but prevents any changes to the status of the circuit-breaker. Changes can only be made by the operator of the power distribution system.

Why does the write protection function permit certain actions?

All actions that are not blocked are for remote diagnosis only and do not have any effect on the current status. Trips and curves can, however, be diagnosed more accurately, even using remote methods.

Data Exchange via the COM15 Module

When the COM15 module is configured to exchange data, it is important to note that it is shipped as standard with the PROFIBUS-DP address 126. This must be changed during system configuration (e.g. with the BDA, Switch ES Power, or ETU76B display).

The COM15 module has two LEDs (PROFIBUS and **Cubicle**BUS) for diagnostic purposes. These indicate the operating state of the PROFIBUS-DP and the **Cubicle**BUS.

Two LEDs are used to determine whether a **Cubicle**BUS in the circuit-breaker is operational. First, the "COMM" LED on the trip unit must be green, that is, the trip unit has recognized at least one other **Cubicle**BUS module. In the worst case scenario, this would only be the metering function/metering function *Plus* if the **Cubicle**BUS was then interrupted. Second, the **Cubicle**BUS LED on the COM15 module must be taken into account. If this is lit with a steady green light, a connection exists from the COM15 module to at least the metering function/metering function *Plus*.

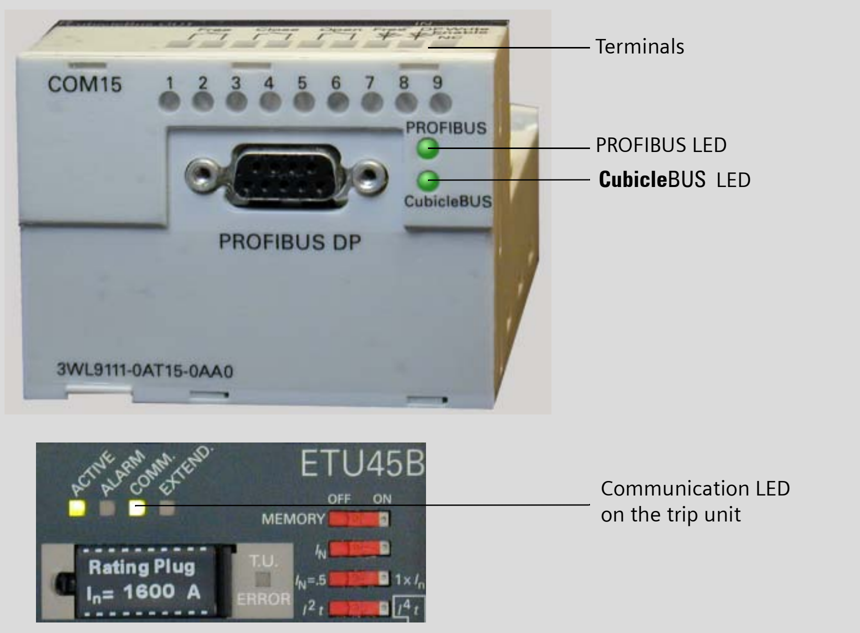


Fig. 2-1 *Front view of the PROFIBUS module for the SENTRON WL with the PROFIBUS connection and the two LEDs. The figure below shows a section of the ETU45B and its LEDs for displaying statuses.*

Fig. 2-2 *Rear view of the COM15 module. The RJ45 connection for the external* **Cubicle**BUS *modules can be clearly seen here. If no external* **Cubicle**BUS *module is connected, the bus must be terminated with the terminating resistor*

Meaning	Position and text on the cable
CubicleBUS -	X8:1
CubicleBUS +	X8:2
24 V DC +	X8:3
24 V DC ground	X8:4

Table 2-3 *The 4 black cables from the COM15 module must be connected to terminal strip X8, which is used to connect the COM15 module to the moduls on the* **Cubicle**BUS *in the circuit-breaker.*

PROFIBUS LED	Meaning
Off	No voltage on the COM15 module
Red	Bus error Communication not possible No communication with class 1 master
Green	PROFIBUS communication OK Cyclic data transmission with class 1 master

Table 2-4 *The PROFIBUS LED provides information on the state of PROFIBUS communication in the COM15 module.*

CubicleBUS LED	Meaning
Off	No **Cubicle**BUS modules found
Red	**Cubicle**BUS error
Green flashing	**Cubicle**BUS module found, but no metering function/metering function *Plus* or trip unit
Steady green light	**Cubicle**BUS module found and connection with the metering function/metering function *Plus* and/or trip unit

Table 2-5 *The **Cubicle**BUS LED provides information on the state of **Cubicle**BUS communication in the COM15 module.*

Position	Rear microswitch (S46)	Middle microswitch (S47)	Front microswitch (S48)
Operating position	1	0	0
Test/check position	0	1	0
Disconnected position	0	0	1
Circ.-breaker not present	0	0	0

Table 2-6 *The COM15 module has 3 microswitches for determining the position of the circuit-breaker in the guide frame. Depending on which switch is actuated, the position described above is communicated via the comm. system (1 = actuated).*

If both LEDs are green (steady light for **Cubicle**BUS on the COM15 module and COMM on the trip unit), communication is fully established between the trip unit and the COM15 module.

Data is exchanged according to the following principle: an up-to-date copy of all SENTRON WL data (apart from the waveform buffer) is always stored in the COM15 module. A response to a data query from the COM15 module to the PROFIBUS-DP can, therefore, take just a few milliseconds. Write data from the PROFIBUS-DP is forwarded to the appropriate addressee on the **Cubicle**BUS.

Three microswitches located on the underside of the COM15 module determine the position of a withdrawable circuit-breaker in the guide frame, which is then communicated via the COM15 module. The positions are defined in Table 2-6. When the circuit-breaker is moved, the microswitch that has been actuated must be released before the next key is actuated. No microswitches are actuated in the intervening period. As far as communication is concerned, the "old" state is communicated until a new state is reached when the circuit-breaker is moved (see Table 2-6).

There is no way of determining the direction in which the circuit-breaker is being moved once the "disconnected position" microswitch has been released.

When the circuit-breaker is pushed in, the next key to be actuated is the "test position". The COM15 module communicates "circuit-breaker not present" until the "test position" key is actuated. The diagnosis is delayed by 10 seconds to ensure that it is not triggered when the circuit-breaker is being positioned, despite the message indicating that it is not present; in other words, when the "disconnected position" key is released, "circuit-breaker not present" is communicated immediately via the cyclic channel and via the DPV1 data sets. The diagnostic message is, however, delayed. If the "test position" microswitch is actuated before the 10 seconds have elapsed, no diagnosis is triggered.

When the circuit-breaker is pulled out, no further microswitchs are actuated. "Circuit-breaker not present" is communicated immediately on the cyclic channel and in the DPV1 data sets.

With fixed-mounted circuit-breakers, a heel plate is screwed to the COM15 module to transmit the operating position.

The COM15 module features a built-in temperature sensor, which, on account of the fact that it is installed outside the circuit-breaker, measures the temperature in the cubicle.

It also contains a clock that provides a time stamp for all events, such as minimum and maximum measured values, as well as warnings and trips. Like the clock in the COM10 module of the SENTRON VL (Chapter 3), it can be synchronized via the PROFIBUS-DP.

Like the COM10 module, the COM15 module supports an automatic baud rate search on the PROFIBUS-DP, which means that the baud rate does not have to be set.

Breaker Status Sensor (BSS)

BSS stands for "breaker status sensor". All microswitches that contain information on the state of the circuit-breaker are either fitted directly to the BSS or connected to it. The BSS makes this digital information available on the **Cubicle**BUS.

If the circuit-breaker-internal states on the switchgear cubicle are to be displayed or read via the PROFIBUS-DP, for example, the BSS module and the appropriate signaling switch must be installed (if they are not already). The circuit-breaker must be fitted with an electronic trip unit of type ETU45B or higher.

The BSS can also be retrofitted to the SENTRON WL.

The BSS sets the following information:

- State of the storage spring
- Position of the main contacts (on/off)
- Ready to switch on signal
- Tripped signaling switch on the trip unit (connected to the red tripped plunger)
- Signaling switch on the first auxiliary release
- Signaling switch on the second auxiliary release
- Temperature in the circuit-breaker (on account of the installation location in the circuit-breaker)

The BSS is already included in order option Z=F02 (PROFIBUS-DP communication).

If a BSS is required without PROFIBUS-DP communication (e.g. for operating the BDA), you can specify this when ordering the circuit-breaker with option Z=F01 or order it later as a spare part.

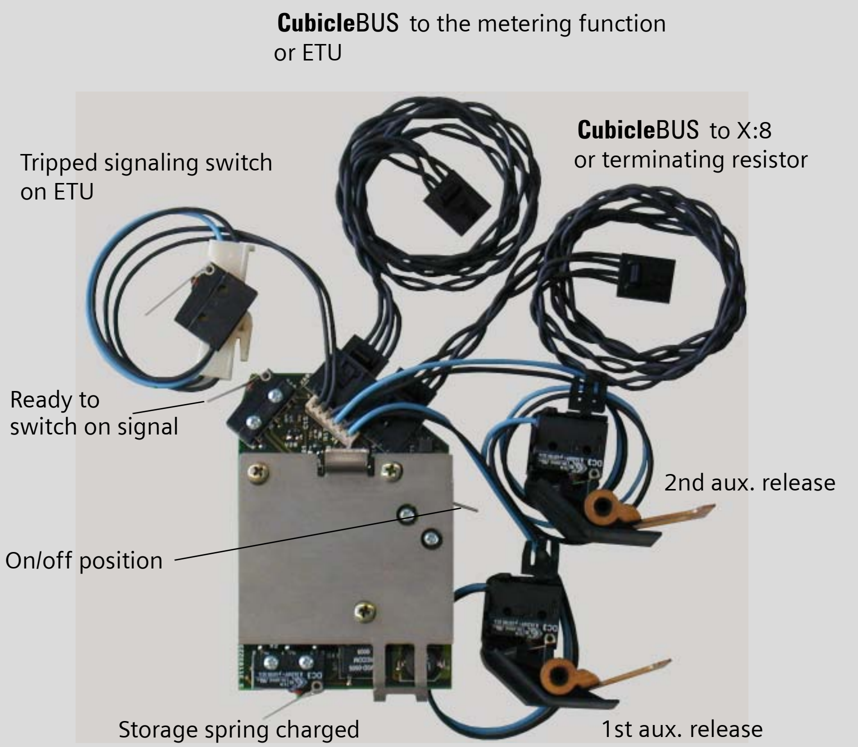


Fig. 2-3 *This picture shows the BSS signaling contacts and how they have to be connected.*

SENTRON WL
Metering Function and Metering Function *Plus*

The integrated metering function can be used with all trip units with a CubicleBUS connection. It not only extends the range of protection functions of the trip unit, but also provides additional warnings and diagnostic options. With its comprehensive range of measured values, the integrated SENTRON WL metering function is an excellent alternative to external multi-function metering devices.

General

In addition to the current values supplied by the trip unit, the metering function provides all the measured values in the power distribution system required for Power Management (voltage, power, and so on). With its extended protection function (e.g. overvoltage), the metering function also provides further options for monitoring and protecting the connected power distribution system. The option of generating warnings if definable setpoints are exceeded speeds up response to system malfunctions or other exceptional situations. As a result, the metering function significantly increases system availability.

The metering function is fitted to the back of the trip unit (ETU), as shown in Fig. 2-4. The trip unit and metering function exchange all current data via a high-speed synchronous interface. The metering function provides all the connected modules (e.g. the COM15 module or BDA) with the parameters for the extended protection function, the setpoints, measured value settings, and the determined measured values via the **Cubicle**BUS so that they can be processed further. Using the two **Cubicle**BUS connections, the metering function is connected to the trip unit and either the BSS or directly to connection block X8. This depends on the circuit-breaker configuration.

The metering function can be implemented with all circuit-breakers with ETU45B, ETU55B, and ETU76B. If the metering function is ordered with order code Z=F04 (metering function) or Z=F05 (metering function *Plus*) together with the circuit-breaker, it will already be installed and ready for operation. The metering function (and metering function *Plus*) can be retrofitted at any time if the circuit-breaker is equipped with one of the above-mentioned trip units. It is simply screwed onto the trip unit and the **Cubicle**BUS lines are snapped in.

Caution: If retrofitted by the customer, the metering function is not calibrated with the trip unit; that is, the accuracy of the specifications in Table 2-7 cannot be ensured.

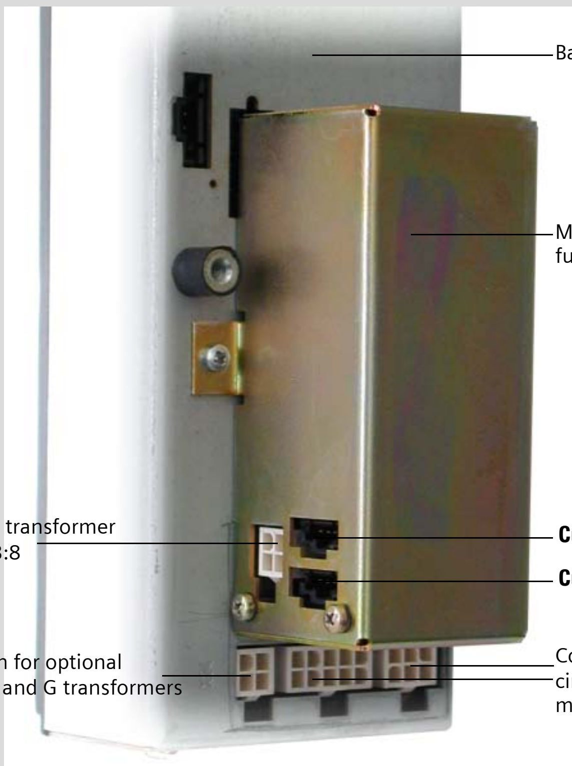


Fig. 2-4 *The metering function/metering function Plus is located on the back of the trip unit. With options F04 and F05, the connections are already properly connected.*

Metering function *Plus*

The metering function *Plus* extends the range of metering functions to include harmonic and waveform analysis.

Harmonic analysis

The metering function *Plus* senses the prevailing current and voltage, saves the measured values, and carries out a fast Fourier transformation. The result of this is the distribution of the harmonics (in %) up to the 29th harmonic. The calculated values are made available via the **Cubicle**BUS and can be displayed via Switch ES Power and the BDA (see Chapters 5 and 6). They can also be saved as an Excel-compatible *.csv file for subsequent diagnosis. On the ETU76B trip unit, the measured and calculated values can also be displayed.

The harmonic analysis enables not only the quality of the network to be analyzed and logged, but also possible reasons for malfunctions to be diagnosed and then eliminated as a precaution.

Waveform buffer

The metering function *Plus* features two independent waveform buffers (A and B). Each one has 8 channels, one each for currents I_{L1}, I_{L2}, I_{L3}, I_N, and I_g, and voltages U_{L1N}, U_{L2N}, and U_{L3N}. Each channel is sensed with a frequency of 1,649 kHz and the values are "pushed" through a shift register (length: 1 second). The process of pushing data through the shift register can be aborted by a parameterizable trigger event. Trigger events include trips, warnings, and setpoint warnings so that the voltage waveform, for example, can be recorded in the event of undervoltage tripping.

The trigger event can be set individually for each waveform buffer. The point at which the trigger event is to take place in the waveform buffer can also be defined. This setting can be used to set the ratio of the pre-event history to the post-event history. If the pre-trigger event history is to be analyzed, the position can be set to 80%. When the

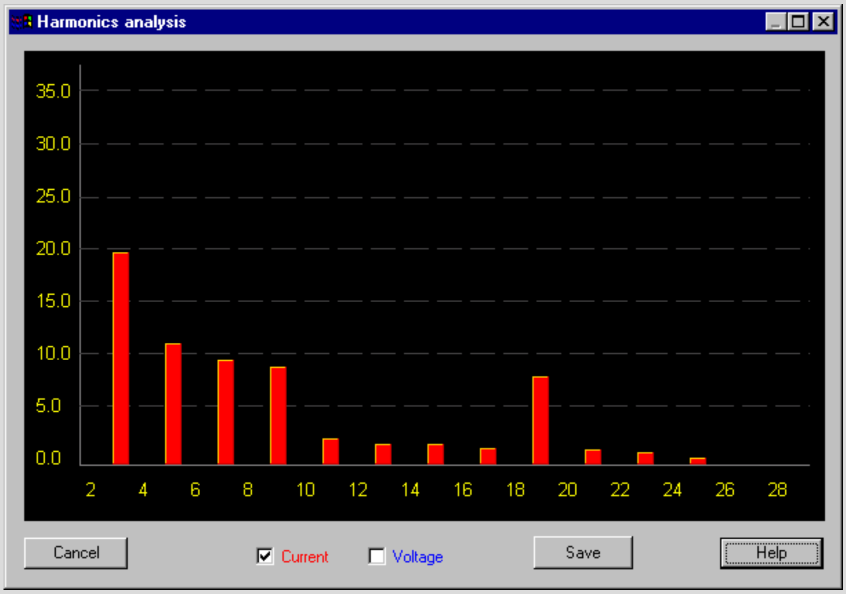


Fig. 2-5 *The metering function Plus analyzes the harmonics. This screenshot from the Switch ES Power system shows how the analysis results are displayed.*

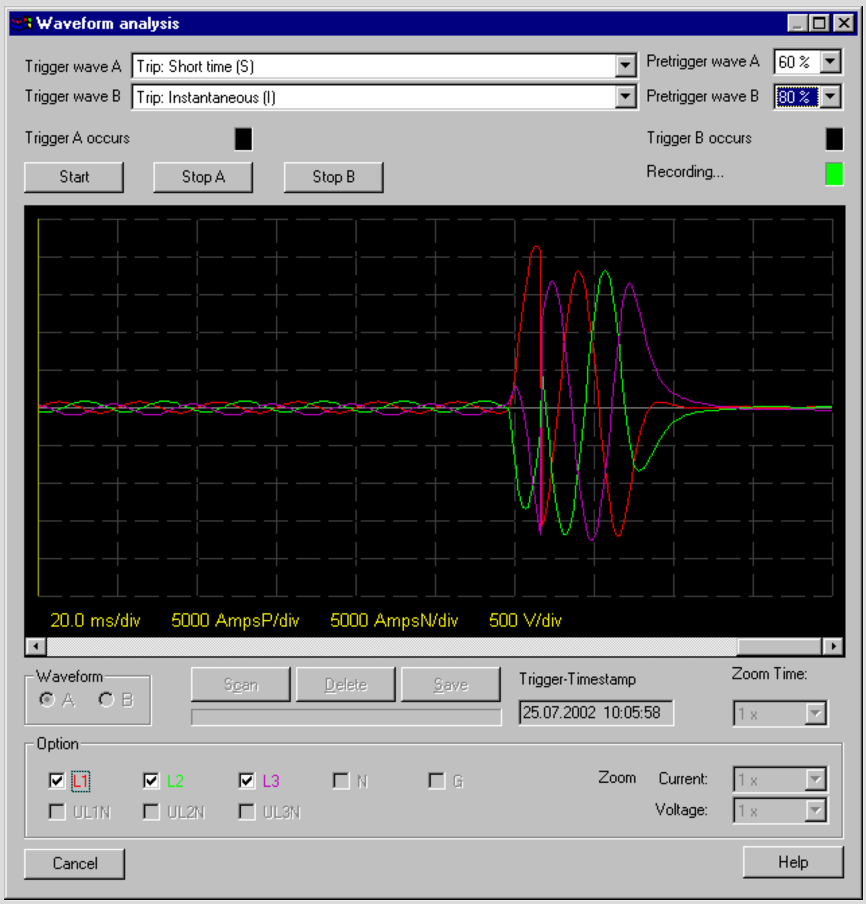


Fig. 2-6 *The metering function Plus can record the current waveform. This can be displayed and exported using Switch ES Power, for example. An I trip is shown here.*

event occurs, 0.8 seconds of pre-event history and 0.2 seconds of post-event history are available in the waveform buffer, and an existing COM15 module adds a time stamp to the trigger event.

Each waveform buffer stops independently depending on the trigger event and can be activated again once the analysis is complete.

The large volume of analysis data (approx. 25 kByte for each waveform) can be downloaded and analyzed using Switch ES Power, the BDA, and the ETU76B display. Depending on the program, a range of zoom options and export functions are available.

Before data is downloaded, the required channels should be selected, since it takes approximately one minute to download the data for each channel. There are two reasons why it takes this long: first, besides recording measured values, calculating the harmonics, and executing the extended protection function, the metering function has a number of higher-priority tasks to complete acyclically; second, a large volume of data is transmitted. A progress bar in Switch ES Power and the BDA displays the progress of the download.

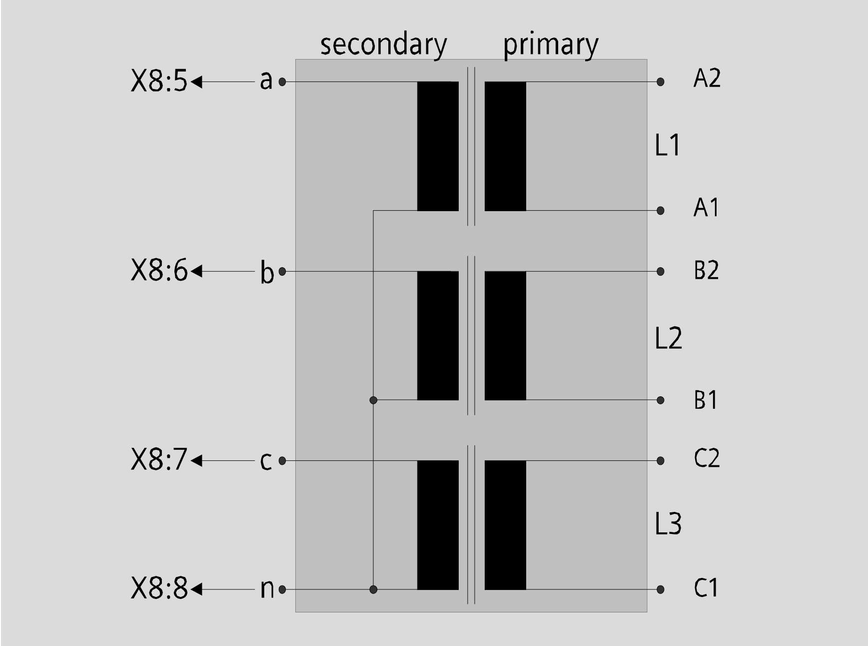
Voltage Transformer

For safety reasons, a voltage transformer is used in conjunction with the metering function and metering function *Plus*. This prevents voltage signals of up to 1 kV from reaching the back of the ETU directly via the auxiliary conductor connections.

The voltage transformer converts the high primary voltage to a secondary voltage of between 100 V and 120 V, depending on the version.

The voltage transformer can be star or delta-connected on the primary side. On the secondary side, a star connection is always used to connect it to the auxiliary conductor plug-in system (X8:5 to X8:8). See Graphic 2-5.

If the level of accuracy specified in the following table is to be attained, a class 0.5 voltage transformer must be used.



Graphic 2-5 *The diagram illustrates how the voltage transformer is connected for operation with a metering function. The transformer can be star or delta-connected on the primary side.*

The burden of the metering function is 27 kΩ, which means that up to 6 metering functions can be connected simultaneously to a voltage transformer with an apparent power of 2.5 VA (pay attention to the accuracy class and length of connection cable!).

The accuracy of the voltage measurement depends on the number of metering functions connected per voltage transformer:

- class 0,5 for 1 to 3 metering functions
- class 3 for 4 to 6 metering functions

This data applies to ambient temperatures from 30°C to 50°C and a primary voltage from 80% to 120% U_n for one year.

Maximal distance from voltage transformer

The maximal distance between the metering function and the voltage transformer depends on the cross-section of the cable and the achieved accuracy class. On an assumed cross-section of 1,5mm^2 the maximal distance should not exceed 50m for class 0,5 and 100m for class 3. In areas with EMC exposure shielded cable must be used.

Parameters for the settings of the metering function

To calculate the measured values, the voltage transformer data must be taken into account and set in the metering function. This data includes:

- Primary voltage of the voltage transformer (factory setting: 400 V)
- Secondary voltage of the voltage transformer (factory setting: 100 V)
- Connection type on the primary side (factory setting: delta)

The following tools and functions are available if the parameters have to be changed:

- Switch ES Power
- BDA/BDA *Plus*
- ETU76B display
- Data set 129 via the PROFIBUS-DP

The metering function provides the following measured values for communication system:

Measured value	Value range	Accuracy (direct order: circuit-breaker + trip unit + met. function or met. function *Plus*)[1]
Currents I_{L1}, I_{L2}, I_{L3}, I_N	30...8000 A	± 1%
Ground-fault current I_g (measure with external G transformer)	100...1200 A	± 5%
Phase-to-phase voltages U_{L12}, U_{L23}, U_{L31}	80...120% U_n	± 1%
Neutral-point displacement voltages U_{L1N}, U_{L2N}, U_{L3N}	80...120% U_n	± 1%
Average value of phase-to-phase voltages U_{LLavg}	80...120% U_n	± 1%
Average value of neutral-point displ. voltages U_{LLavg}	80...120% U_n	± 1%
Apparent power S_{L1}, S_{L2}, S_{L3}	13...8000 kVA	± 2%
Total apparent power S_{total}	13...24000 kVA	± 2%
Active power P_{L1}, P_{L2}, P_{L3}	-8000...8000 kW	± 3% (cosφ > 0.6)
Total active power S_{total}	-24000...24000 kVA	± 3% (cosφ > 0.6)
Reactive power Q_{L1}, Q_{L2}, Q_{L3}	-6400...6400 kvar	± 4% (cosφ > 0.6)
Total reactive power S_{total}	-20000...20000 kvar	± 4% (cosφ > 0.6)
Power factors $\cos\varphi_{L1}$, $\cos\varphi_{L2}$, $\cos\varphi_{L3}$	-0.6...1...0.6	± 0.04
Power factors $\cos\varphi_{avg}$	-0.6...1...0.6	± 0.04
Demand of currents I_{L1}, I_{L2}, I_{L3}	30...8000 A	± 1%
Demand of 3-phase current	30...8000 A	± 1%
Demand of active power P_{L1}, P_{L2}, P_{L3}	13...8000 kW	± 3% (cosφ > 0.6)
Demand of 3-phase active power	13...8000 kW	± 3% (cosφ > 0.6)
Demand of apparent power S_{L1}, S_{L2}, S_{L3}	13...8000 kVA	± 2%
Demand of 3-phase apparent power	13...8000 kVA	± 2%
Demand of 3-phase reactive power	-24000...24000 kvar	± 4% (cosφ > 0.6)
Active energy in normal direction	1...10000 MWh	± 2%
Active energy in reverse direction	1...10000 MWh	± 2%
Reactive energy in normal direction	1...10000 Mvarh	± 4%
Reactive energy in reverse direction	1...10000 Mvarh	± 4%
Frequency	15...440 Hz	± 0.1Hz
Total harmonic distortions for current and voltage	2...100%	± 3% from the meas. range up to the 29th harmonic
Phase unbalance for current and voltage	2...150%	± 1%

Table 2-7 *The metering function provides a minimum and maximum measured value for each measured value specified above. If the metering function is retrofitted by the customer, the accuracy of the values specified cannot be ensured, since it will not have been calibrated with the trip unit.*

1.**Accuracy is specified as follows**: ± (x%) from the upper limit of effective range + 2 LSD (Least Significant Digit)) for one year after calibration; Usage of class 0,5 voltage transformer and three connected metering functions per transfomer at max.

Reference conditions:

Input current	I_{nmax} ± 1%
Input voltage	U_n ± 1%
Frequency	f = 50Hz
Power factor	cos φ = 1
Waveform	Sine, total harmonic distortion≤ 5%; symmetrical load
Ambient temperature	35°C ± 5°C
Auxiliary supply	DC 24 V to DIN 19240 / EN 61131
Warm-up period	2 hours
Relative air humidity	Up to 90%
External fields	None

Metering range:

Current	0.2...1.2 I_{nmax}
Voltage	0.8...1.2 U_{nmax}

The extended protection function of the metering function can monitor the following criteria and initiate a trip if values are exceeded.

Parameter	Setting range	Possible delay
Phase unbalance - current	5...50%	1...15 s
Total harmonic distortion - current	5...50%	5...15 s
Phase unbalance - voltage	5...50%	1...15 s
Undervoltage	100...1100 V	1...15 s
Overvoltage	200...1200 V	1...15 s
Total harmonic distortion - voltage	5...50%	5...15 s
Direction of phase rotation	-	-
Active power in normal direction	13...4000 kW	1...15 s
Active power in reverse direction	13...4000 kW	1...15 s
Under frequency	40...70 Hz	1...15 s
Over frequency	40...70 Hz	1...15 s

Table 2-8 *Additional release criteria can be set using the extended protection function of the metering function. A delay time can be parameterized to prevent events that occur briefly from "clashing". In this way, the circuit-breaker will not trip unless the set event is present for longer than the delay time.*

The metering function provides the following setpoint values:

Parameter	Setting range	Possible delay
Over current	30...10000 A	1...255 s
Over current - ground fault	30...10000 A	1...255 s
Over current - N-conductor	30...10000 A	1...255 s
Phase unbalance - current	5...50%	1...255 s
Demand - current	30...10000 A	1...255 s
Total harmonic distortion - current	5...50%	5...255 s
Unde rvoltage	15...1200 V	1...255 s
Over voltage	200...1200 V	1...255 s
Phase unbalance - voltage	5...50%	1...255 s
Total harmonic distortion - voltage	5...50%	5...255 s
crest factor and form factor	1...3,000	5...255 s
Active power in normal direction	13...10000 kW	1...255 s
Active power in reverse direction	13...10000 kW	1...255 s
Leading power factor	0...-0.99	1...255 s
Lagging power factor	0...0.99	1...255 s
Demand - active power	-10000...10000 kW	1...255 s
Apparent power	13...10000 kVA	1...255 s
Reactive power in normal direction	13...10000 kvar	1...255 s
Reactive power in reverse direction	13...10000 kvar	1...255 s
Demand - apparent power	13...10000 kVA	1...255 s
Demand - reactive power	13...10000 kvar	1...255 s
Underfrequency	40...70 Hz	1...255 s
Overfrequency	40...70 Hz	1...255 s

Table 2-9 *Parameters can be set to define whether a warning is to be generated if a setpoint is overshot or undershot. Like the extended protection function, this can be delayed. These warnings are communicated on the* **CubicleBUS** *(e.g. for the configurable output module or as a trigger for the waveform buffer) and transmitted via the COM15 module.*

SENTRON WL

Description of important functions/parameters for communication with SENTRON WL

Thanks to their modular construction and manifold modules, the SENTRON WL circuit-breakers offer a very large functionality scope which, by are, exceeds the realization of mere protective functions. This scope comprises, among others, load management, threshold values and additional tripping conditions of the extended protective function. Although the utilization of these functions is also possible without the use of communications, their benefits can only be fully exploited when used in communications applications.

Load Management

As of the ETU45B trip unit, the SENTRON WL offers two current threshold values for a local load management, the upper threshold being that of load shedding, the lower threshold being that of load restore.

Important: An exceedance or shortfall of these thresholds will never effect a tripping action!

If, within a phase, the current exceeds the set load shedding parameter, an imminent load shedding warning event will be generated. A ceasing load shedding event will only be generated when this threshold was fallen short of during all three phases. The warning messages are directly displayed as warnings by the BDA and the Switch ES Power and are signaled by a yellow status window background in the main overview. However, they are also stored in the event log where they are labeled with a time stamp.

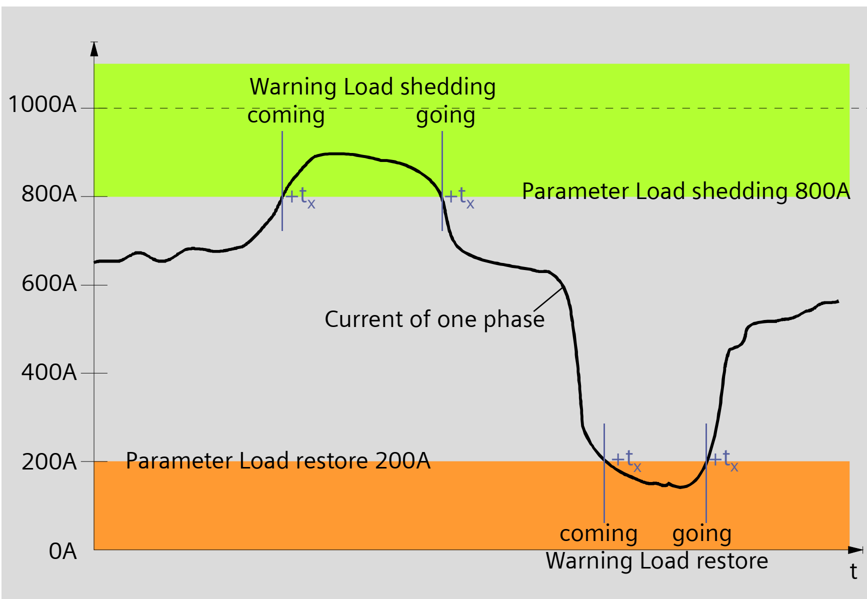
Note: The event log is only available with the COM15!

The respective process for the load restore threshold is reversed. If all three phases fall short of the set parameter, an imminent load absorption warning will be generated. If only one of the three currents exceeds the parameter's value, a ceasing load restore event will be generated.

In order to avoid such generation on the basis of short-time current peaks and valleys, they can be delayed by a delay time t_x which can be set to between 1 s and 15 s.

The load management parameters can be found in the parameter tree of the BDA and the Switch ES Power, path "Device Parameters - Breaker - Protective Function -Additional".

For an automatic disconnection and connection of components, the load shedding/load restore signals are available as outputs of the digital output module, which are provided with a rotary encoding switch. Also the configurable output module can be set in a way which assures that the outputs output the load shedding and load restore states.



Graphic 2-6 *Considering as example the function of load shedding and restore are explained in this graphic. Its based on the assumption of a SENTRON WL with an overload parameter of 1000 A.*

Extended Protective Function

The extended protective function of the metering function or the metering function *Plus* adds further criteria to the tripping criteria. If an additional tripping condition stored in the extended protective function is activated (e.g. phase unbalance voltage > 8%), this will always lead to a tripping event which is initiated by the metering function via the trip unit.

The options listed in table 2-8 can be used as additional monitoring criteria.

Setpoints

Beside the load management option (load shedding/load restore), the metering function or the metering function *Plus* offers a further option for an automatic monitoring of operating data and the generation of a warning upon the exit of a normal state.

In general, the same monitoring functions as for the extended protective function are also available for the setpoint values. However, the largest difference lies within the fact that here, the exceedance of a setpoint value will never effect a tripping event.

This way, together with the extended protective function, two thresholds can be defined (e.g. for overvoltage). With the lower setpoint, merely a warning will be generated via the setpoint value function (e.g. > 410 V), whereas, with a further voltage increase, a tripping event (e.g. > 430 V) will be effected.

Minimum for communicated currents

Despite a very high degree of accuracy with the current detection over a large dynamic area, a breaker with a large nominal current (e.g. 4000 A), will, with an accuracy of 1%, be subject to a residual current in the lower area. This may, among others, lead to the display of a current flow of up to 40 A with the breaker disconnected (main contacts open), which will be transmitted via the communications. In order to avoid this, the "Minimum for communicated currents" parameter offers the option of setting all detected current values smaller than this parameter to zero. In the delivery state, this value is set to 50 A. This means that all values smaller than 50 A are displayed as "0" on the display, interpreted as "0" for internal calculations (power) and also transmitted as "0" via the communications.

If this parameter is changed to "0", this function is deactivated and all detected current measuring values will be directly used.

The respective parameter can be found in the parameter tree of the BDA and the Switch ES Power, path "Device Parameters - Breaker - Metering Settings".

Normal positive power flow direction

The current direction of the energy "flow" and the question, how much energy has, up to now, "flown" into both directions is of particular interest for tie breaker applications. For a determination thereof, it is important to define a "normal direction". This direction can either be "from top to bottom" or "from bottom to top".

In dependence of the respective direction, the measured real power is either assigned to a positive polarity (in normal direction) or a negative polarity (against normal direction). In contrast, the measured currents are always assigned to a positive polarity!

With the energy, the transmitted energy values are incorporated in two counters, real energy and real energy against normal direction. The two energy counters are not assigned to a polarity.

Event and trip log

All events (except for tripping events) are labeled with a time stamp and an coming (+) or going (-) indication and entered in the event log.

The event log has a depth of 10 events and works like a Fifo memory (first in first out), i.e. the last event is deleted from the event log upon the occurrence of a new event.

The tripping log is similar to the event log, however, only the last 5 tripping actions are labeled with a time stamp and entered in the tripping log. In this case, an coming or going message is unnecessary.

Note: The event and the tripping log are only available with the COM15 module!

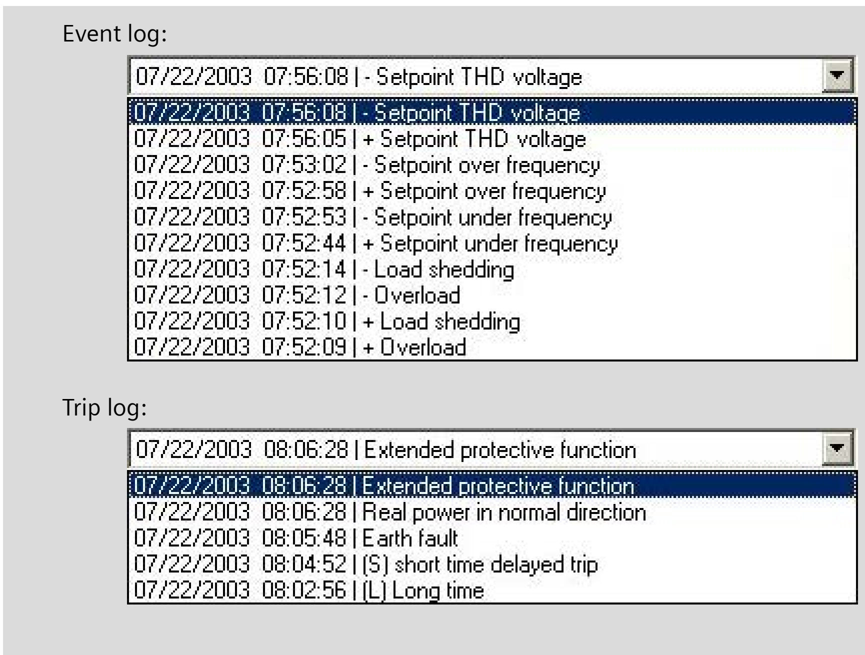


Fig. 2-7 *In the event log the last 10 events on the* **CubicleBUS** *are listed. The trip log contains the last 5 trip reasons. Both of them can be displayed with the BDA or Switch ES Power.*

SENTRON WL
External **Cubicle**BUS Modules

By connecting additional, external modules to the Cubicle BUS, circuit-breaker-internal information can be displayed and data read from the switchgear to the system. This enables cost-effective solutions to be implemented for automating other devices in the switchgear.

General

External **Cubicle**BUS modules enable the SENTRON WL circuit-breaker to communicate with secondary devices in the circuit-breaker cubicle. They can be used, for example, to activate analog displays, transmit circuit-breaker alarm signals and tripping reasons, and read additional control signals. One module is also available for integrating reduced-time discrimination control in the event of a short-circuit.

Five different **Cubicle**BUS modules can output data from the **Cubicle**BUS system (four digital output modules and one analog output module). A digital input module can transmit data from the switchgear cabinet to the PROFIBUS-DP, and a ZSI module enables zone selective interlocking among the circuit-breakers.

Rotary coding switch

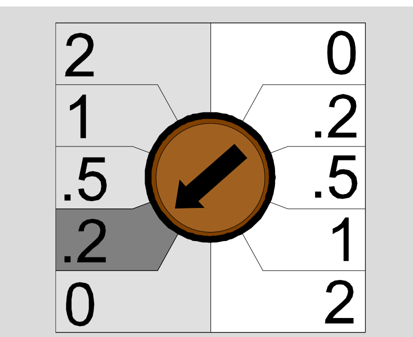
With the exception of the configurable output module, all external **Cubicle**BUS modules are configured using rotary coding switches.

The arrow on the rotary coding switch points to the function that is currently active. With certain modules (e.g. digital output modules), the group selection (e.g. "1st Module" left; highlighted) and then any other factors (e.g. time delay) must be taken into account. More information on this is provided with the descriptions of the individual modules.

Installation

The external **Cubicle**BUS modules are clipped onto a standard 35 mm DIN rail on the panel. The lead for connecting the first module to the circuit-breaker must be no longer than 2 m.

Only the prefabricated lines, which are either ordered separately or supplied, must be used to connect the **Cubicle**BUS modules to each other and to the circuit-breaker. These lines enable the various components to communicate and supply the **Cubicle**BUS modules with 24 V DC.



Graphic 2-7 *In this example, the rotary coding switch has been set to function "0.2".*

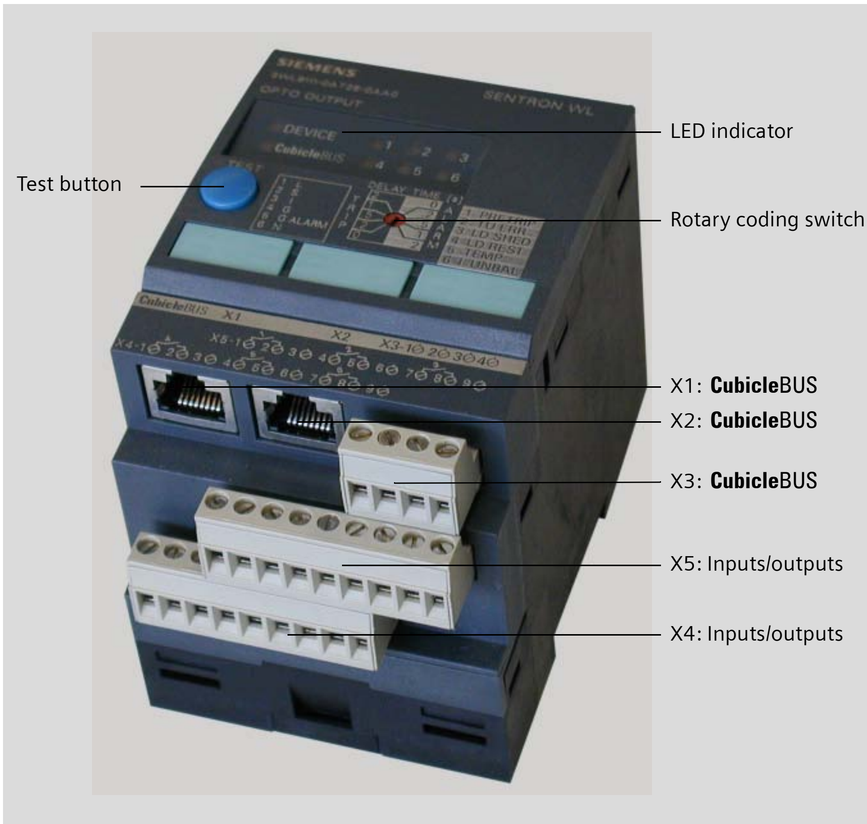


Fig. 2-8 *All external **Cubicle**BUS modules have the same housing. The **Cubicle**BUS can be connected to X1 and X2 with an RJ45 plug or a terminal connection made to X3. This depends on whether a COM15 module is available.*

Power Supply

The **Cubicle**BUS must be supplied with 24 V DC across its entire length. Terminals X8:3 and X8:4 or the 4-pole plug for the external **Cubicle**BUS modules (X3) are available for this purpose. As already mentioned, the 24 V is conducted via the **Cubicle**BUS lines.

The power required for the 24 V DC supply depends on the **Cubicle**BUS configuration. The technical data for the external **Cubicle**BUS modules is provided in this chapter.

The control system (of the **Cubicle**BUS) must be connected to a fused power supply, since the system voltage drops to an unspecified value in the event of a short-circuit.

Caution: Hotplugging of **Cubicle**BUS modules/cables is not permitted.

Maximum CubicleBUS Configuration

The **Cubicle**BUS can comprise up to 13 modules:

- Electronic trip unit (ETU)
- Metering function or metering function *Plus*
- Breaker status sensor (BSS)
- COM15
- BDA or BDA *Plus*
- ZSI module
- Digital output module with switch position to the left (1st module)
- Digital output module with switch position to the right (2nd module)
- Digital configurable output module
- Digital input module with switch position to the left
- Digital input module with switch position to the right
- Analog output module with switch position to the left (1st module)
- Analog output module with switch position to the right (2nd module)

In practice, however, not all of the modules are required.

CubicleBUS Installation Guidelines

- Total length of the **Cubicle**BUS lines: max. 10 m
- Only the prefabricated lines must be used to connect the **Cubicle**BUS modules.
- On the final module, the line must be terminated with a 120Ω terminating resistor (supplied with each module).
- The lines must always be connected from module to module. Spur lines are not permitted.
- The power supply must be provided by 24 V DC power supply unit with standard-tolerance and the properties described on page 2-31 and following.
- The ZSI module must be the first external module to be connected.

Pin Configuration of the X3 on the **Cubicle**BUS Module	
X3:1	24 V DC ground
X3:2	**Cubicle**BUS Communications line -
X3:3	**Cubicle**BUS Communications line +
X3:4	24 V DC +
Table 2-10	*At X3, the **Cubicle**BUS can simply be supplied with 24 V DC.*

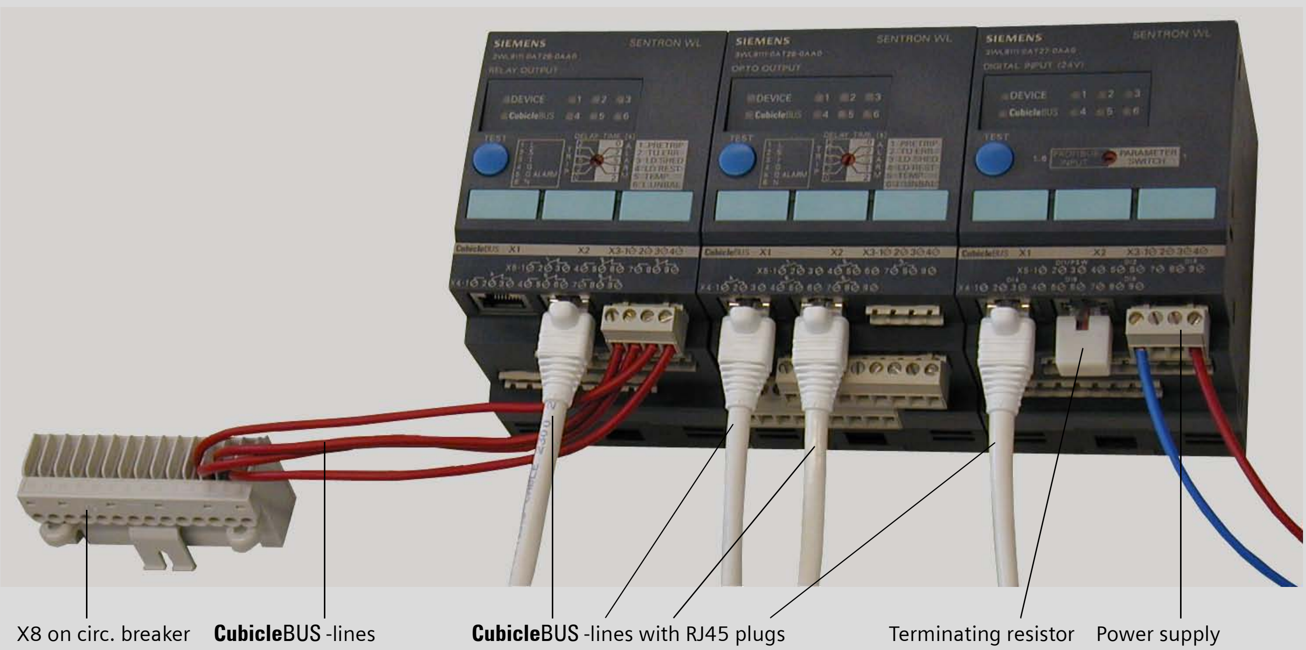


Fig. 2-9 *If external **Cubicle**BUS modules are to be connected to the SENTRON WL and a COM15 module is not available, the first connection must be made with four wires. The **Cubicle**BUS can then be connected with the supplied **Cubicle**BUS lines with RJ45 plugs, and the power supply connected to X3, as shown.*

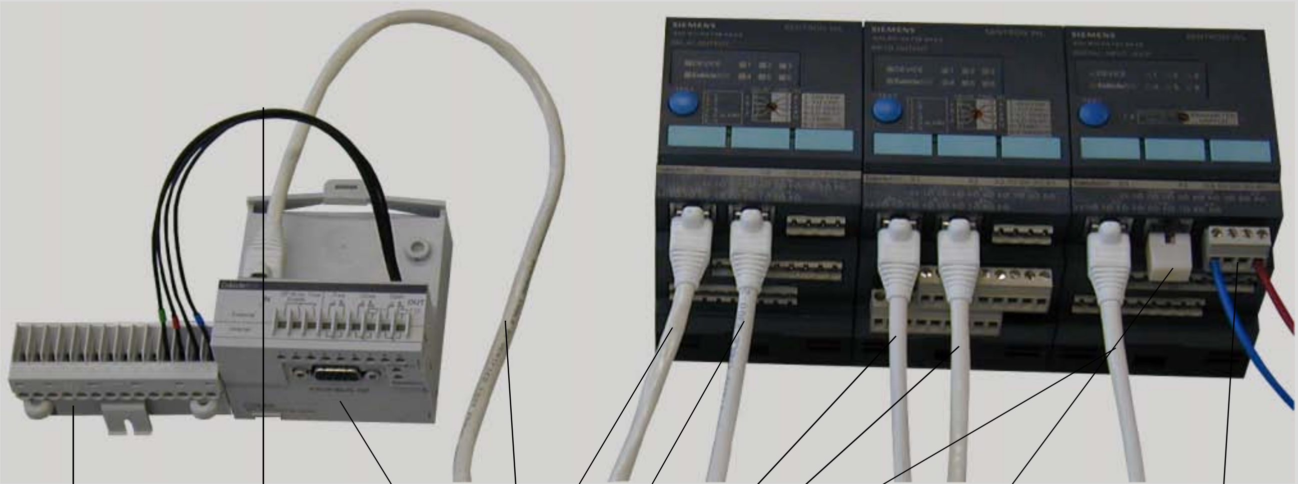


Fig. 2-10 *If a COM15 module is available, the external* ***CubicleBUS*** *modules can be integrated in the system by connecting them to the* ***CubicleBUS*** *lines supplied. The end of the* ***CubicleBUS*** *must be fitted with a terminating resistor. The power supply unit can simply be connected via the X3 interface.*

DEVICE LED	Meaning
Red	Internal fault in the **CubicleBUS** module
Yellow	**CubicleBUS** module in test mode
Green	Module in operation

Table 2-11 *The DEVICE LED indicates the state of the external* ***CubicleBUS*** *module*

CubicleBUS LED	Meaning
Green	Connection exists to a different **CubicleBUS** module
Off	No other **CubicleBUS** module detected

Table 2-12 *The* ***CubicleBUS*** *LEDs on the external* ***CubicleBUS*** *modules indicate whether communication is taking place with other modules. This enables straightforward diagnosis.*

All other LEDs	Meaning
Yellow	On the input module, this indicates a high signal at the corresponding input. With digital output modules, the output is active and the contact closed. With analog output modules, a yellow LED indicates that the full-scale deflection value has been exceeded by 20%.
Off	The LED is gray if none of the above-mentioned conditions is present

Table 2-13 *The LEDs indicate whether the outputs are set or the inputs are supplied with 24 V DC and, therefore, have been activated.*

- If the BDA is connected to the front interface of the trip unit, the cable must be no longer than 0.5 m.

LED Display

The LEDs on the external **CubicleBUS** modules enable straightforward module diagnosis and testing. As explained in Tables 2-11 to 2-13, the internal status and the communications connection can be diagnosed to ensure that they have been wired correctly.

Testing the Digital Input and Output Modules

The test must be performed prior to any commissioning work to determine whether the circuit-breaker and its components function properly.

The test mode can be used to check that the **Cubicle**BUS modules function properly. A distinction must be made between the individual modules.

Actuating the "Test" key on the **Cubicle**BUS module once starts the test mode, and all the inputs, outputs, and associated LEDs are deactivated. The DEVICE LED changes from green to yellow.

If the LED is switched on, actuating the "Test" key several times in quick succession switches the corresponding input or output on and off alternately.

With the input module, not only the input LEDs but also the signals are transmitted via the **Cubicle**BUS and, if connected, the PROFIBUS.

With the digital outputs, the LEDs and the associated outputs are switched through, thereby enabling the connected devices to be checked.

The test mode of the analog output module and the ZSI module is described in the chapter on the appropriate module.

The inputs on the input module, outputs on the output module, the ZSI input, and the ZSI output can be "forced" via the BDA and Switch ES Power communication system; in other words, the test mode can be activated via the communication system and the inputs and outputs overwritten for test purposes.

The system exits the test mode automatically after 30 seconds if the test key is not actuated or no changes have been made via the communication system.

The test scenarios for the analog output module and ZSI are explained in the descriptions.

Checking the inputs and outputs on the digital input/output modules		
Normal operation	DEVICE 1 2 3 **Cubicle**BUS 4 5 6	Normal operating condition of the input/output module. The inputs/outputs are either on or off depending on the wiring or after existing messages.
Actuate the "Test" key	DEVICE 1 2 3 **Cubicle**BUS 4 5 6	The module switches to the test mode, as indicated by the yellow DEVICE LED.
Actuate the "Test" key	DEVICE 1 2 3 **Cubicle**BUS 4 5 6	Actuating once selects input or output 1, as indicated by the green LED 1. The output can then be switched on or off, and the on or off signal of the input can be transmitted by actuating the "Test" key quickly (1 s).
After a pause of more than 2 s, actuate the "Test" key.	DEVICE 1 2 3 **Cubicle**BUS 4 5 6	Input or output 2 selected. As with 1, the output can be switched by actuating the key quickly. With relay modules, you will be able to hear a click.
After a pause of more than 2 s, actuate the "Test" key.	DEVICE 1 2 3 **Cubicle**BUS 4 5 6	Input or output 3 selected. With input modules, the presence of 24 V DC at the corresponding input is simulated and transmitted via the **Cubicle**BUS .
After a pause of more than 2 s, actuate the "Test" key.	DEVICE 1 2 3 **Cubicle**BUS 4 5 6	Input or output 4 selected. The selected input or output can be tested by quickly actuating the "Test" key.
After a pause of more than 2 s, actuate the "Test" key.	DEVICE 1 2 3 **Cubicle**BUS 4 5 6	Input or output 5 selected. The selected input or output can be tested by quickly actuating the "Test" key.
After a pause of more than 2 s, actuate the "Test" key.	DEVICE 1 2 3 **Cubicle**BUS 4 5 6	Input or output 6 selected. The selected input or output can be tested by quickly actuating the "Test" key.
After a pause of more than 2 s, actuate the "Test" key.	DEVICE 1 2 3 **Cubicle**BUS 4 5 6	Overall LED test. If the "Test" key is not actuated within 5 seconds, the system exits test mode.
Actuate the "Test" key within 5 seconds	DEVICE 1 2 3 **Cubicle**BUS 4 5 6	The test procedure can start from the beginning

Table 2-14 *The table shows the test procedure for checking the digital inputs and outputs on the* ***Cubicle*****BUS** *. If the "Test" key is not actuated within 30 seconds, the system exits test mode automatically.*

Digital Input Module

Functional description

The digital input module enables up to six additional binary signals (24 V DC) to be connected. Signals, such as the state of a Buchholz relay, the open/closed signal from the switchgear cabinet door, or a signal indicating that a predefined temperature has been exceeded, can be transmitted directly via the PROFIBUS-DP and processed at field bus level.

The status of an MCCB that is not directly communications capable or a switch-disconnector can also be transmitted on the PROFIBUS-DP. In conjunction with the configurable output module, these protection devices can also be connected to provide a cost-effective alternative to other solutions with additional PROFIBUS-DP input/output modules.

A total of 6 inputs are available in the "Profibus input" switch position. Six inputs are also available if the rotary coding switch is in the "Parameter switch" position, although the first input causes the active parameter set to switch over. If the connected ETU does not have two parameter sets (e.g. ETU45B), this input can also be used without any restrictions.

Functional description of the parameter set switchover

The trip units ETU55B and ETU76B have two different parameter sets for the protection function. This function is particularly important in the event of a power failure when an automatic switchover is made from on-line to generator operation, a process which may involve all the release conditions changing.

The PROFIBUS-DP communication system, the BDA, the ETU76B display, or the digital input module can be used to switch between the two parameter sets.

For this purpose, the first module input is used in the "Parameter Switch" position on the rotary coding switch. If a "1" signal is detected (LED on input 1 is yellow), the switchover to parameter set B is communicated to the trip unit. If the input signal switches back to "0", the switchover to parameter set A is communicated and the LED on input 1 is extinguished.

Since the **Cubicle**BUS is event controlled, trip unit ETU55B or ETU76B switches over to the other parameter set when a swichover request is issued via the **Cubicle**BUS.

This means that if a switchover is made to parameter set B via the BDA, for example, even though the input on the digital input module is set to "0" (parameter set A), the active parameter set in the trip unit switches to parameter set B. A switchover event to parameter set A is not initiated on the **Cubicle**BUS until the input on the digital input module is set first to "1" and then back to "0".

A maximum of two digital input modules can be operated simultaneously on one **Cubicle**BUS: one as a module with the "Profibus input" position and the other as "Parameter switch".

Technical data for the digital input module	
Operating voltage on the **Cubicle**BUS min./max. (V)	19.2/28.8
Current input from the **Cubicle**BUS min./max. (mA)	29/43
No. of floating channels per digital input module	6
Voltage value for reliably detecting a "1" signal (V)	>16V
Current input per input for a "1" signal (mA)	7.5
Voltage value for reliably detecting a "0" signal (V)	<1V
Current input per input for a "0" signal (mA)	0
Max. no. of modules on one **Cubicle**BUS	2
Power loss min./max. (W)	0.72/0.94
Dimensions W/H/D (mm)	70/86/95
Weight (kg)	0.223
Temperature range (°C)	-20/60

Table 2-15 *This table provides accurate technical data for the digital input module on the* **Cubicle**BUS

Fig. 2-11 *The position of the rotary coding switch determines the operating mode.*

Digital Output Module with Rotary Coding Switch

The digital output module can be used to output six items of binary information on the state of the circuit-breaker (warnings and trips) to external signaling units (light, alarm horn), or to switch off specific system components (frequency converters).

The load shedding and load restoring signals enable a load to be switched on or off automatically depending on the work load of the circuit-breaker. This is the first step towards efficient energy management.

The digital output module is available in two versions. The "optocoupler" version features "electronic relays", which can only be used as make contacts. The current carrying capacity of an output is 150 mA, and the maximum voltage is 24 V DC. Only direct voltage can be switched. The "relay" version, however, uses a changeover contact with a maximum load of 12 A. Voltages of up to 230 V and alternating voltage are possible. The relay contacts are floating.

The module is configured using a rotary coding switch, which not only selects one of the two output module versions, but also sets the appropriate delay time.

Switch position to the left

If the rotary coding switch is positioned to the left, outputs 1 to 6 are assigned the following event signals:

- 1: Trip as a result of overload (L)
- 2: Short-time-delayed short-circuit trip (S)
- 3: Instantaneous short-circuit trip (I)
- 4: Ground-fault trip (G)
- 5: Ground-fault alarm signal
- 6: Trip as a result of overload in the neutral conductor (N)

Switch position to the right

If the rotary coding switch is positioned to the right, the 6 outputs are automatically assigned the following functions:

- 1: Leading overload trip signal (delay time 0 s)
- 2: Trip unit fault (ETU)
- 3: Load shedding
- 4: Load restore
- 5: Temperature alarm
- 6: Current phase unbalance

Delay time

As well as assigning the outputs, the rotary coding switch can be used to set an additional delay time. Available times are 0, 0.2 s, 0.5 s, 1 s, and 2 s. These can be used, for example, to suppress events that only last a short time and not output them until they have been present for a long period of time (e.g. phase unbalance). Irrespective of the delay time that has been set, the signal for the leading overload trip, which can be used to prematurely switch off and protect connected frequency converters, is always instantaneous.

A maximum of two digital output modules with rotary coding switches can be operated simultaneously on one **Cubicle**BUS. To this end, they must be configured once in the operating mode with the switch position to the left and once with the switch position to the right.

The LEDs display the current state of the 6 outputs. If the LED is off, the corresponding output is not set. If the LED is yellow, the output is active.

Technical data for the digital output module with the rotary coding switch	
Operating voltage on the **Cubicle**BUS min./max. (V)	19.2/28.8
Current input from the **Cubicle**BUS min./max. (mA) optocoupler	29/63
Current input from the **Cubicle**BUS min./max. (mA) relay	29/250
No. of floating channels per digital output module (optocoupler outputs are non-floating)	6
Max. current for optocoupler output with 24 V DC (mA)	100
Max. current for all 6 outputs together for relay output with 24 V DC/250 V AC/250 V DC (A)	10/10/2,5
Max. current for one relay output with 24 V DC (A)	2,7
Max. no. of modules on one **Cubicle**BUS	2
Power loss min./max. (W)	0.74/5.4
Dimensions W/H/D (mm)	70/86/95
Weight (kg) optocoupler/relay	0.223/0.321
Temperature range (°C)	-20/60

Table 2-16 *This table provides accurate technical data for the digital output module with rotary coding switch on the* **Cubicle**BUS

Fig. 2-12 *Switch positioned to left/right selects events in dark-gray / light-gray fields.*

Digital Configurable Output Module

The digital configurable output module also has six outputs. Like the digital output module with the rotary coding switch, it is available with optocoupler and relay outputs.

Unlike the modules with the rotary coding switch, however, the outputs are assigned using a software tool rather than a selector switch. Switch ES Power and the BDA are used as configuration software. Both tools feature a separate node - 'Config. Output Module' - in the navigation tree, which enables the outputs to be assigned the events in the table opposite using drop-down fields.

The first three module outputs can be assigned up to six events, which are ORed with the output. This triggers, for example, a type of group signal when the circuit-breaker is either in an overload excitation state or a phase unbalance warning is present.

The last three outputs can only be assigned one of the events directly.

Configuration events include status signals, warnings, tripped signals, setpoint violation signals, waveform buffer triggers, the active parameter set, and bits that can be addressed directly via PROFIBUS.

The module outputs can be set directly via the PROFIBUS-DP (e.g. from a PLC) using the PROFIBUS-DP bits, which are transmitted to byte position 13 via data set 69. Switchgear that is not directly communications capable can be integrated in a communications system in conjunction with the digital input module.

The status can be read via the input module, which means that a motorized drive could be switched on or off via the digital configurable output module. Many other applications are, however, also possible.

Unlike the digital output module with the rotary coding switch, a time delay cannot be added to the event. A setpoint can be output with a delay via the digital configurable output module,

These events are available for the digital, configurable output module (part 1)	
Status	Circuit-breaker on
	Circuit-breaker off
	Storage spring charged
	Ready to switch on
	Group warning
	Group trip
	PROFIBUS write protection active
	PROFIBUS communication OK
Alarms	Overload
	Overload in N-conductor
	Load shedding
	Load restore
	Ground-fault alarm
	Overtemperature
	ETU fault
	Phase unbalance - current
Trips	Overload (L)
	Short-time-delay short-circuit (S)
	Instantaneous short-circuit (I)
	Ground fault (G)
	Overload in neutral conductor
	Phase unbalance - current
	Phase unbalance - voltage
	Under frequency
	Over frequency
	Under voltage
	Over voltage
	Active power in normal direction
	Active power in reverse direction
	Total harmonic distortion - current
	Total harmonic distortion - voltage
	Reversal of phase rotation direction
PROFIBUS output bits	PROFIBUS bit 1
	PROFIBUS bit 2
	PROFIBUS bit 3
	PROFIBUS bit 4
	PROFIBUS bit 5
	PROFIBUS bit 6
Active parameter set	Parameter set A active
	Parameter set B active

Table 2-17 *The events in this table (part 1) and the following table (part 2) are available on the* **CubicleBUS** *. These can be output via the configurable digital output module.*

for example, if the setpoint itself is already delayed.

Like the digital output module with the rotary coding switch, this module also indicates the status of the outputs via the labelled LEDs.

Attention: Please do not power off the configurable output module after changing the configuration via BDA or Switch ES Power in the following 15 seconds. It could result in a red DEVICE led and all outputs will be deactived.

Fig. 2-13 *The outputs can only be configured using appropriate software.*

These events are available for the digital, configurable output module (part 2)	
Setpoints	Over current
	Over current in neutral conductor
	Over current - ground fault
	Phase unbalance - current
	Phase unbalance - voltage
	Demand - current
	Under voltage
	Over voltage
	Total harmonic distortion - current
	Total harmonic distortion - voltage
	Crest factor
	Form factor
	Under frequency
	Over frequency
	Active power in normal direction
	Active power in reverse direction
	Apparent power
	Reactive power in normal direction
	Reactive power in reverse direction
	Power factor leading
	Power factor lagging
	Demand - active power
	Demand - reactive power
	Demand - apparent power
Trigger event	Waveform buffer A
	Waveform buffer B

Table 2-18 *Part 2 of the table shows all the events on the **CubicleBUS** that can be output via the digital configurable output module. Configuration is carried out using Switch ES Power or the BDA.*

Technical data for the digital configurable output module	
Operating voltage on the **CubicleBUS** min./max. (V)	19.2/28.8
Current input from the **CubicleBUS** min./max. (mA)	29/39 (250Rel.)
No. of floating channels per digital output module (optocoupler outputs are non-floating)	6
Max. current for optocoupler output with 24 V (mA)	100
Max. curr. f. 6 outp. together for relay outp. w. 24VDC/250VAC/250VDC	10/10/2,5 (A)
Max. current for one relay output with 24 V DC (A)	2,7
Max. no. of modules on one **CubicleBUS**	1
Power loss min./typ./max. (W)	0.74/5.4
Dimensions W/H/D (mm)	70/86/95
Weight (kg) optocoupler/relay	0.223/0.321
Temperature range (°C)	-20/60

Table 2-19 *This table provides accurate technical data for the digital configurable output module on the **CubicleBUS***

Analog Output Module

The analog output module can be used to output the most important measured values issued via the **Cubicle**BUS to analog indicators (e.g. moving-coil instruments) in the switchgear cubicle door. Each analog output module has four channels for this purpose. The signals are available at two physical interfaces: a 4...20 mA and a 0...10 V interface.

The measured values can be picked off as 0...10 V via the X4 connector on the **Cubicle**BUS module (the 4...20 mA interface is available at X5). Both output forms are always active at the same time.

The measured values, which are output via the four channels, are selected using a rotary coding switch. The output forms I, U, P, f, and cos φ are available. Up to two analog output modules can be operated on one **Cubicle**BUS. The selection panel on the rotary coding switch is divided vertically. If the switch is set to a value on the left, the module is automatically addressed as module 1. If a second module exists, it must be set to a value on the right. This is the only way to ensure that two analog output modules can operate simultaneously.

All types of moving-coil instrument with an internal resistance of more than 20 kΩ (as a voltage output) and between 50 Ω and 250 Ω (as a current output) can be used as an indicator.

The LEDs for the channels are yellow if the current value exceeds the full-scale deflection by 20% (with U, I, and P), cosφ is greater than 0.8, or the frequency greater than 45 Hz.

Switch position "I"

In switch position "I", the measured current values are output linearly:
A01: Current in phase I_{L1}
A02: Current in phase I_{L2}
A03: Current in phase I_{L3}
A04: Current in the neutral conductor
Since the circuit-breaker can be designed for different rated currents, the full-scale value must be scaled automatically and the maximum output value of the analog output module interpreted. The value of the rating plug currently implemented must be used for this purpose.

The maximum value is calculated by multiplying the value of the rating plug by 1.2 and then rounding the result up to the nearest 100.

Example: With a rating plug of 1600 A, the full-scale value of the moving-coil instrument must be 2000A (1600 x 1.2 = 1920 -> 2000 A). In other words, 0V/4mA = 0A, 10 V/20 mA = 2000 A.

Switch position "U"

When the rotary coding switch is in switch position "U", the following voltages are applied to the four analog outputs:
A01: Phase-to-phase voltage U_{L12}
A02: Phase-to-phase voltage U_{L23}
A03: Phase-to-phase voltage U_{L31}
A04: Phase voltage U_{L1N}
In most cases, the phase-to-phase voltage is output at the switchgear cubicle doors. This is why the first three channels are assigned these measured values. If the voltage is required between a phase and the neutral conductor, this is available via output four.

The full-scale deflection for the moving-coil instrument is calculated by multiplying the rated voltage of the network (primary voltage of the voltage transformer) by 1.1 and then rounding the result up to the nearest 50.

Example: If the rated voltage of the network is 400 V, the full-scale value is 450 V
(400 V x 1.1 = 440 V -> 450 V).

Switch position "P"

If the rotary coding switch is set to position "P", the power measured values are output via the four channels:
A01: Active power phase P_{L1}
A02: Active power phase P_{L2}
A03: Active power phase P_{L3}
A04: Total apparent power S_{ges}
The full-scale deflection of the active power in each phase is calculated by multiplying the value of the rating plug by the rated voltage of the network. The full-scale deflection value is then classified in a value range, as shown in the table below.

Before the full-scale deflection can be determined from the table, the calculated value must be multiplied by 3 for the total apparent power and the total active power (position f).

Example: I_R = 1600 A, rated voltage = 400 V; -> full-scale deflection = 1,000,000 W

Switch position "f"

Since it can generally be assumed that the frequency will be the same across the three phases in all the networks, switch position "f""is used to provide a general overview by outputting the most important measured values (with the exception of the current values). In conjunction with another module in position "I", all the most important measured values can be displayed in this way.

Power value ranges [W/VA]		
From	**To**	**FSD**
0	50,000	50,000
50,000	100,000	100,000
100,000	200,000	200,000
200,000	300,000	300,000
300,000	500,000	500,000
500,000	1,000,000	1,000,000
1,000,000	2,000,000	2,000,000
2,000,000	3,000,000	3,000,000
3,000,000	5,000,000	5,000,000
5,000,000	10,000,000	10,000,000
10,000,000	20,000,000	20,000,000
20,000,000	∞	30,000,000

Table 2-20 *After multiplication, the full-scale deflection of the power is sorted into value ranges.*

A01: Network frequency
A02: Mean value of the phase-to-phase voltages
A03: Total active power
A04: Mean value of the power factors
The scale for displaying the frequency must range from 45 Hz to 65 Hz. This enables the standard frequencies in

countries where IEC and UL standards apply to be displayed.

Example: 45 Hz = 0 V/4 mA and 65 Hz = 10 V/20 mA.

The scalings of the other measured values can be read in the appropriate switch positions.

Switch position "cos φ"

The following measured values are output in switch position "cosφ":
A01: Power factor cos φ_{L1}
A02: Power factor cos φ_{L2}
A03: Power factor cos φ_{L3}
A04: Phase unbalance - current (%)
The power factors are displayed from 0.7 (leading) (= 0 V/4 mA) through 1 (= 5 V/12 mA) to 0.7 (lagging) (= 10 V/20 mA). The phase unbalance of the three currents is displayed from 0% (0 V/4 mA) to 50% (10 V/20 mA).

Ensure that the polarity is correct during connection.

Test function

The test mode is started by actuating the "TEST" key and indicated by the yellow DEVICE LED. Although the measured values continue to be updated in the test mode, they are not output at their respective channels.

- The test mode is started by actuating the "TEST" key.
- Actuating the "TEST" key again selects output 1, which is indicated by LED A01. The test output signal is output. For currents, voltages, and power rating values, this is equivalent to the full-scale value, with cos φ 1 and with a frequency of 55 Hz.
- Actuating the key again selects output 2, which is indicated by LED A02. This automatically deletes the value at output 1 and sets the value at output 2.
- By repeating the above steps, the wiring and scaling of all four outputs can be checked one after the other.
- Selecting output A04 and actuating the "TEST" key activates all four LEDs, but does not output an output. Actuating the key again selects output 1 again.
- If the "TEST" key is not actuated within 30 seconds after an output has been selected, the system exits the test mode automatically and returns to the standard operating mode. The values, which are constantly updated in the background, are then output at the outputs again.

Fig. 2-14 *The analog channels are selected using the rotary coding switch*

Technical data for the analog output module	
Operating voltage on the **Cubicle**BUS min./max. (V)	19.2/28.8
Current input from the **Cubicle**BUS min./max. (mA)	63/150
Internal resistance of moving-coil instrument - min./max. voltage	20 kΩ/∞
Internal resistance of moving-coil instrument - min./max. current	20/250 Ω
Max. no. of modules on one **Cubicle**BUS	2
Power loss min./typ./max. (W)	0.74/5.4
Dimensions W/H/D (mm)	70/86/95
Weight (kg)	0.223/0.321
Temperature range (°C)	-20/60

Table 2-21 *This table provides accurate technical data for the analog output module on the* **Cubicle**BUS

ZSI Module

To use the ZSI function with the SENTRON WL circuit-breaker, the external **CubicleBUS** ZSI module must be implemented.

The zone selective interlocking (ZSI) module provides the complete range of selectivity with the extremely short delay time of t_{ZSI} = 50 ms, irrespective of the number of grading levels and the location of the short-circuit in the distribution system. Its benefits become even more apparent the higher the number of grading levels in large systems and the longer the resulting delay times for standard time grading.

By shortening the break time, the ZSI module significantly reduces stress and damage in the event of a short-circuit in the switchgear.

Operating principle

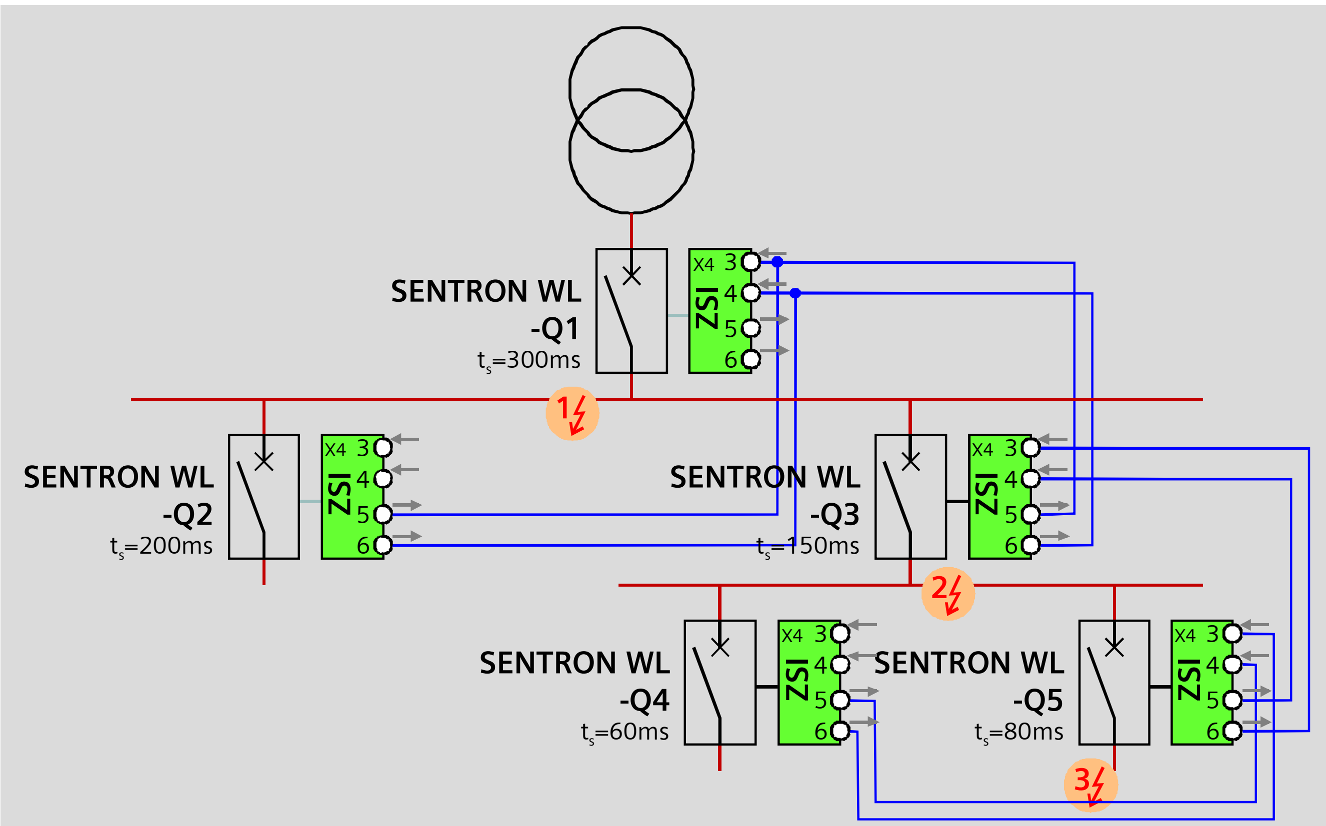
If the ZSI module is used in a distribution system comprising several grading levels, each circuit-breaker affected by a short-circuit interrogates the circuit-breaker directly downstream of it to ascertain whether the short-circuit also occurred in the next grading level below:

- If the short-circuit did occur in the downstream grading level, the upstream circuit-breaker delays tripping to ensure that the circuit-breaker directly upstream of the short-circuit has enough time to interrupt the short-circuit.
- If the circuit-breakers in the downstream grading level do not report a short-circuit, the short-circuit occurred between the two grading levels in question. In this case, one of the two upstream circuit-breakers interrupts the short-circuit once the programmed delay time of t_{ZSI} of 50 ms has elapsed.

Example as illustrated in Graphic 2-7

This shows a section of a power distribution system that has been fitted with the ZSI module.

Short-circuit at 3:
Circuit-breakers -Q5, -Q3, and -Q1 establish that a short-circuit has occurred. -Q5 blocks -Q3 by means of the ZSI signal and, as a result, -Q1 too so that they do not trip in 50 ms. Since -Q5 does not receive a blocking signal from a subordinate circuit-breaker, it itself is responsible for interrupting the short-circuit as quickly as possible. If this does not take place because, for example, the circuit-breaker is no longer operational due to an overcurrent, -Q3, as a backup, trips after the time-discriminating response time of 150 ms.



Graphic 2-8 *This graphic illustrates the operating principle of the ZSI function using an example in a power distribution system. It is also a connection diagram that shows how the ZSI module must be wired.*

Short-circuit at 2:
-Q1 and -Q3 establish that a short-circuit has occurred; -Q5 does not. For this reason, -Q3 does not receive a blocking signal from -Q5, but provides a blocking signal for -Q1. This information tells -Q3 that it is closest to the short-circuit and trips with a delay of t_S = 50 ms instead of t_{sd} = 150 ms.
Time saved = 100 ms.

Short-circuit at 1:
Only -Q1 establishes that a short-circuit has occurred and does not receive a blocking signal from a subordinate grading level. For this reason, it trips after t_{ZSI} = 50 ms. Time saved = 250 ms.

The ZSI function can be used for short-circuits between the phases (S), with respect to ground (G), or for both simultaneously (S+G). The operating mode is set using the rotary coding switch. If the switch is in the "OFF" position, the ZSI is deactivated.

The ZSI module also provides the blocking signal for the medium-voltage level.

The hardware design of the ZSI module is compatible with 3WN6.

If a coupling switch is used in the power distribution system, this can also be equipped with the ZSI function and integrated in the overall concept.

Fig. 2-15 *The function of the ZSI module is selected using the rotary coding switch*

Up to 8 circuit-breakers can be connected to ZSI IN, and up to 20 to ZSI OUT.

The ZSI module must always be the first external **Cubicle**BUS module to be connected to the COM15 module or to X8.

Test function

The outputs are set (that is, a blocking signal is sent to other circuit-breakers) when the rotary coding switch is set to "TEST".

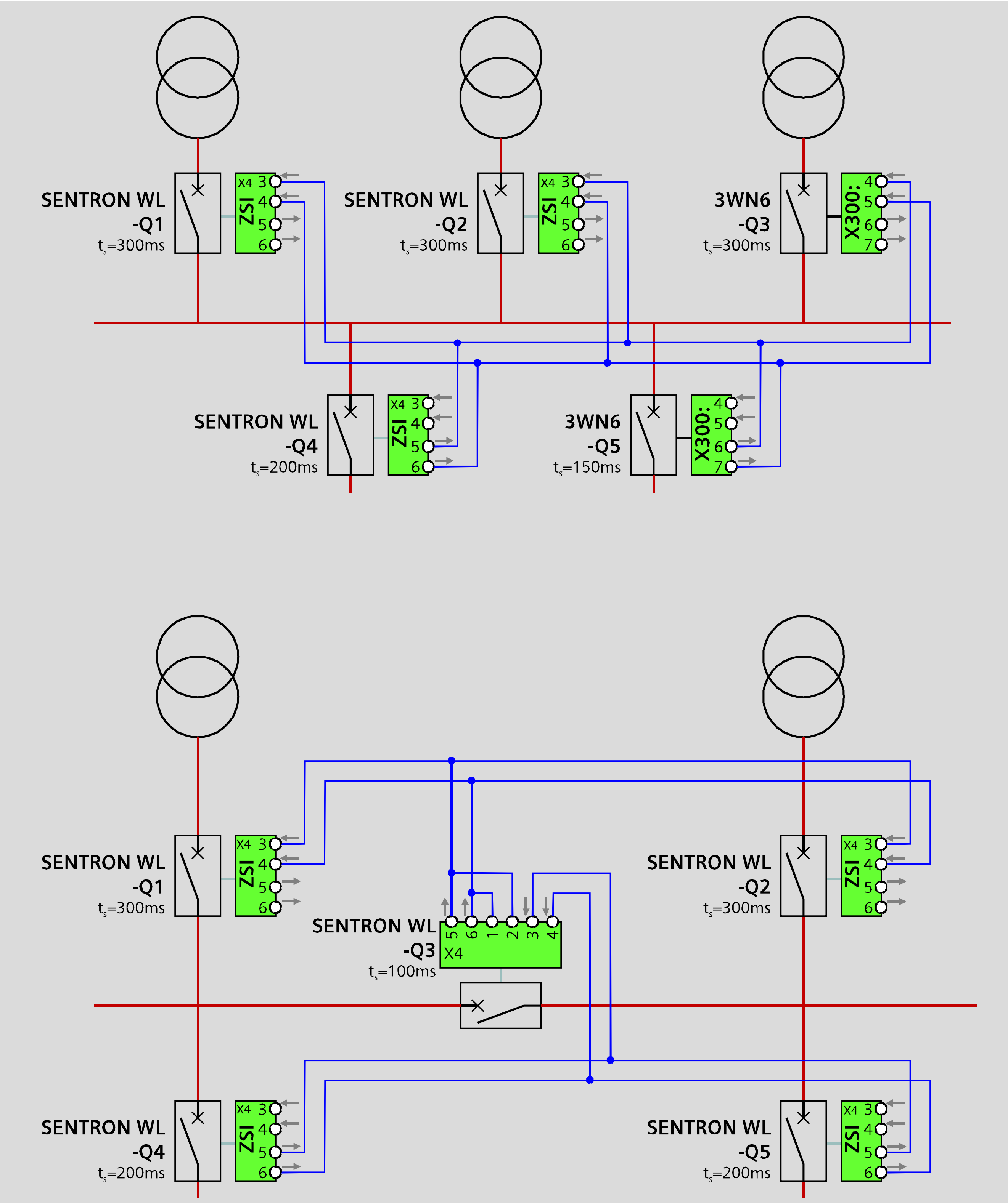
Actuating the "TEST" key switches the ZSI module to test mode, which is indicated by the yellow DEVICE LED. The inputs and outputs are selected in the same way as the digital input/output modules. When the ZSI module input is selected, the input can be toggled internally by actuating and releasing the TEST key. When the outputs are selected, the outputs can be toggled by actuating and releasing the TEST key. This enables the wiring to be checked.

Active inputs and outputs are indicated by a yellow LED.

The ZSI signal should be transmitted via a signal lead twisted in pairs with a cross-section of at least 0.75 mm^2, and no more than 400 m long.
Recommended lead type:
Siemens shielded measuring and control lead LSYCY (2 x 0.75 mm^2)

Technical data for the ZSI module	
Operating voltage on the **Cubicle**BUS min./max. (V)	19.2/28.8
Current input from the **Cubicle**BUS min./max. (mA)	31/61
Automatic output reset after no more than...	3s
Shortest time blocking signal can be present at the outputs LV	100 ms
Shortest time blocking signal can be present at the outputs MV	500 ms
Standard trip time (incl. all delays)	approx. 80 ms
Max. no. of circuit-breakers connectable to ZSI IN	20
Max. no. of circuit-breakers connectable to ZSI OUT	8
Max. no. of modules on one **Cubicle**BUS	1
Max. lead length for 2 x 0.75mm^2	400 m
Power loss min./typ./max. (W)	0.8/1.76
Dimensions W/H/D (mm)	70/86/95
Weight (kg)	0.223
Temperature range (°C)	-20/60

Table 2-22 *This table provides accurate technical data for the ZSI module on the* **Cubicle**BUS



Graphic 2-9 *This diagram consists of two parts: the top half is a connection diagram, which also shows how the ZSI function must be connected to 3WN6 with several supplies and outgoing circuits. The bottom half shows the circuitry when a coupling switch is used.*

SENTRON WL

External power consumption of a SENTRON WL breaker with integrated CubicleBUS

The SENTRON WL circuit-breakers with CubicleBUS are designed to also enable an internal and external communication when the main contacts are open. It is therefore required to connect an external power supply. Within this context, the current demand varies in dependence of the extension degree/options.

General information

The converters of the SENTRON WL circuit-breakers consist of two components. The Rogowski coils deliver the current values, the energy converters provide the releases with energy. With breakers without additional external supply, the releases are already activated and monitor the energy distribution at values of 80 A with sizes 1 and 2 and at values of 150 A with size 3.

The energy from the converters is sufficient to not only activate the protective functions of the ETU45B trip unit, but also to activate the four-line display. Merely the background illumination requires auxiliary energy. If the CubicleBUS has been connected to a 24 V DC voltage supply, the display of the ETU45B is fed with energy from this voltage.

The full graphical display of the ETU76B requires more energy for its operation than can be supplied by the energy converter. Therefore, the display of the ETU76B only functions when an external CubicleBUS supply voltage has been connected. The protective functions are not affected hereby!

If more CubicleBUS components than the mere trip unit are applied within a SENTRON WL circuit-breaker, the breaker must be connected to an external 24 V DC auxiliary voltage.

The CubicleBUS consists of four wires, two for the communications and two for the 24 V DC power supply. The CubicleBUS is connected to the external terminal X8:1 to X8:4.

Table to calculate the power consumption of an CubicleBUS System

CubicleBUS Modules	# of modules per CubicleBUS	Max. continuous current obtained from the CubicleBUS	Max. peak inrush current for each module from the CubicleBUS
Trip unit ETU45B	1	120 mA	2000 mA
Trip unit ETU55B	1	120 mA	2000 mA
Trip unit ETU76B	1	170 mA	2000 mA
Metering function or Metering function *Plus*	1	120 mA	120 mA
Breaker Status Sensor BSS	1	40 mA	110 mA
COM15 PROFIBUS communication module	1	125 mA	280 mA
ZSI module	1	50 mA	125 mA
Digital output module with rotary coding switch, relay output	1 - 2	180 mA	125 mA
Digital output module with rotary coding switch, opto coupler	1 - 2	50 mA	125 mA
Digital output module configurable, relay output	1	180 mA	125 mA
Digital output module configurable, opto coupler	1	50 mA	125 mA
Analog output module	1 - 2	110 mA	800 mA
Digital input module	1 - 2	30 mA	125 mA
BDA or BDA *Plus*	1	250 mA	350 mA
	Summary		

Table 2-23 *To find a suitable external power supply for the SENTRON WL circuit breaker with CubicleBUS the continuous current and the peak inrush current must be observed.*

The + 24 V DC voltage must be connected to X8:3 and the ground of the 24 V DC voltage supply must be connected to X8:4.

In order to select the correct voltage supply, two aspects must be especially focused on.

- First, the maximum continuous current which the **Cubicle**BUS modules draw from the **Cubicle**BUS supply must be calculated.
- As the second measurand, the peak inrush current of all modules must be calculated. The power supply must be capable of bearing the maximum peak inrush current for a period of 100 ms.

A power supply must be selected in accordance with these two characteristic values. Of course, also several SENTRON WL circuit-breakers can be connected to a power supply. For this purpose, however, the total of the continuous currents and starting currents must be considered. The respective power supplies can be selected from the Siemens SITOP Power product range.

Example:

A breaker consists of an ETU45B, a BSS, a COM15, a metering function and an output module with relay contacts.

The maximum continuous current amounts to 585 mA, the maximum starting current amounts to 2635 mA. This means that a SITOP Power 2 is sufficient for the power supply.

Selecting a suitable power supply from the SITOP product range

Max. continuous current	Max. peak inrush current	Type	Order No.
0 to 2 A	up to 7 A for 300 ms	SITOP Power 2	6EP1331-2BA00
2 A to 5 A	up to 20 A for 350 ms	SITOP Power 5	6EP1333-2AA00
5 A to 10 A	up to 38 A for 200 ms	SITOP Power 10	6EP1334-2AA00

Table 2-24 *A power supply from the SITOP product range for one or more SENTRON WL circuit breaker can be selected. For further technical information please refer to catalog KT 10.1 or in the Mall online (http://mall.ad.siemens.de).*


SIEMENS
COM10
ETU
PROFIBUS
SENTRON VL
PROFIBUS
COM10 STATUS
X17
X15
3VL9000-8AR00

SENTRON VL

Brief Description of the SENTRON VL

Connection via the PROFIBUS-DP COM10 Module

Connection via the SIMOCODE-DP

3

SENTRON VL
Brief Description

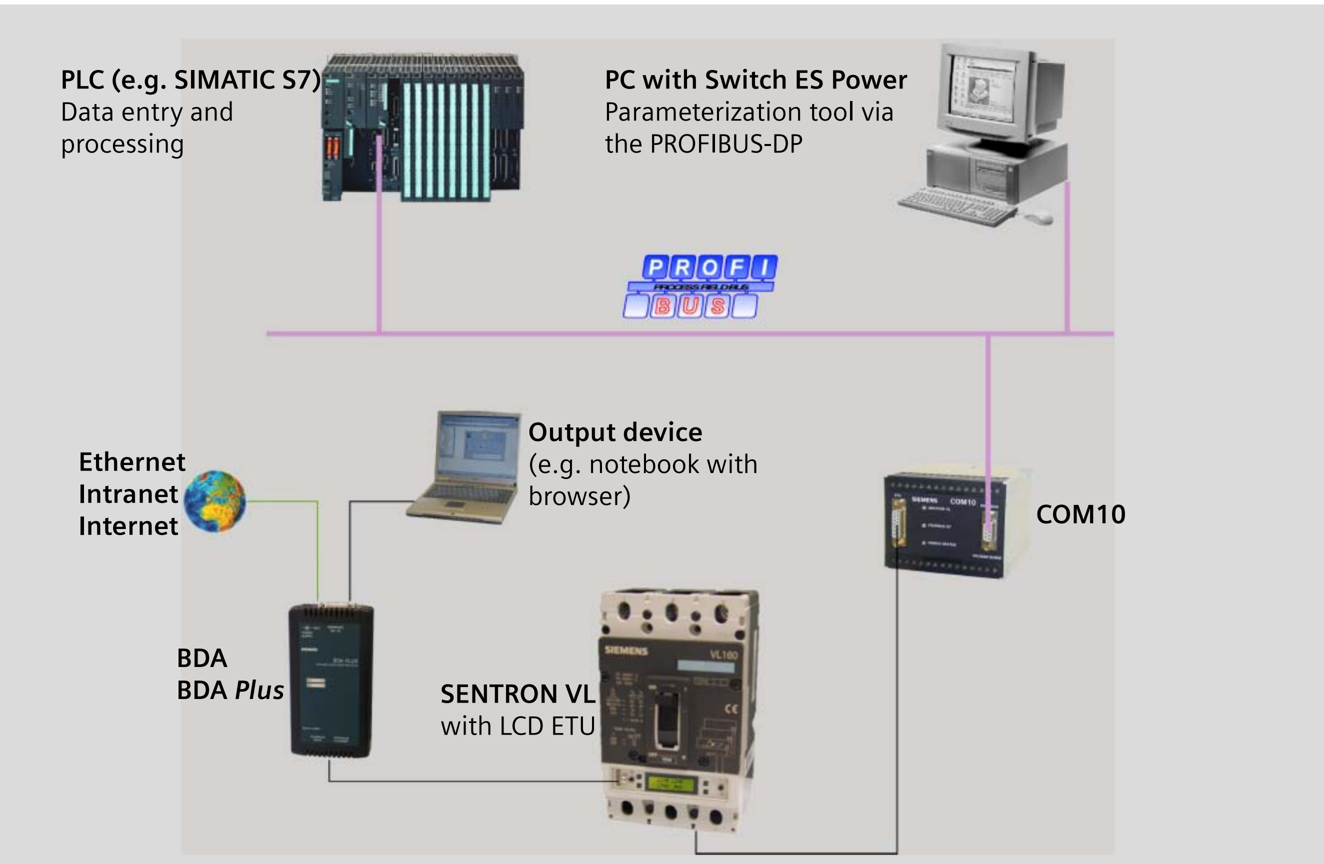
Thanks to their compact design, the SENTRON VL160X to VL1600 range of circuit-breakers fulfill the stringent requirements of modern electrical distribution systems. They are available with thermo-magnetic overcurrent trip units (16 A to 630 A) and electronic overcurrent trip units (63 A to 1600 A). Depending on the variety of data required, the SENTRON VL can be connected to the PROFIBUS-DP via the COM10 module or the SIMOCODE-DP.

Brief Description of the SENTRON VL

The basic version of the SENTRON VL is designed for fixed-mounted applications. With the right assembly kit, however, it can easily be converted for plug-in or withdrawable applications. Available in 3 and 4-pole versions, the SENTRON VL circuit-breakers are ideally suited for plant, motor, or generator protection applications, and can be used in starter combinations or as non-automatic circuit-breakers.

The SENTRON VL can be connected to the PROFIBUS-DP via the PROFIBUS-DP COM10 module or the SIMOCODE-DP. Using the BDA or BDA *Plus* (breaker data adapter), higher-level communication is also possible (Ethernet / intranet / Internet). Both networking types are extremely easy to implement.

A wide range of locking systems are available to improve reliability during critical processes. All accessories, such



Graphic 3-1 *The SENTRON VL system architecture supports communication with a notebook, the Ethernet, intranet, or Internet via both the PROFIBUS-DP and breaker data adapter. A joint PROFIBUS / SENTRON WL profile enables them to share programs in a PLC or on a PC.*

as auxiliary trip units, motorized operating mechanisms, and communication systems, can be retrofitted quickly and easily.

Overview of Accessories

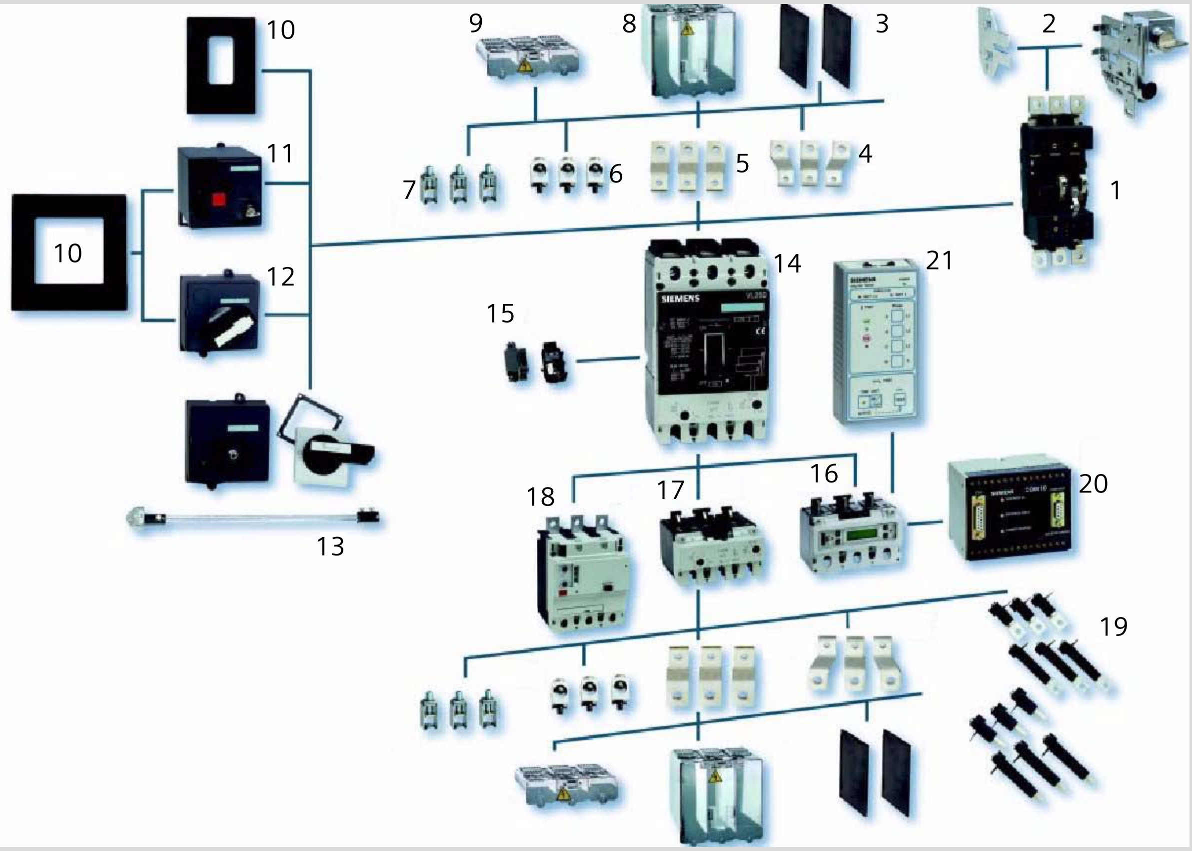
A wide range of accessories are available for the SENTRON VL circuit-breakers.

These include:

- External accessories (e.g. overcurrent trip units, PROFIBUS-DP COM10 module, front rotary drives). External accessories are fitted *outside* the SENTRON VL.
- Internal accessories (e.g. alarm switches, shunt trips). Internal accessories are fitted *inside* the SENTRON VL under the front panel in compartments, which means that they do not need any extra space. The compartments are located on the left and right next to the toggle. Note that certain internal accessories can only be fitted in certain compartments (see "Installing Components in the Accessory Compartments").

The following diagram provides an overview of the accessories:

1. Withdrawable/plug-in socket
2. Plug-in side components
3. Interphase barriers
4. Flared front busbar connection pieces
5. Straight busbars
6. Round cable terminal for Al/Cu
7. Box terminal for Cu
8. Extended terminal cover
9. Standard terminal cover
10. Cover frame for door cutout
11. Motorized operating mechanism with storage spring
12. Front rotary drive
13. Extended front rotary drive
14. SENTRON VL circuit-breaker
15. Internal accessories
16. ETU
17. Thermo-magnetic overcurrent trip unit
18. RCD module
19. Rear terminals (strip and round)
20. PROFIBUS-DP COM10 communication module
21. Hand-held test device for ETUs



Graphic 3-2 *This diagram provides an overview of the accessories available for the SENTRON VL.*

Trip Unit Properties

With the right accessories, all of the SENTRON VL trip units can be made communications capable. They may, however, be equipped differently (display, for example), or feature different setting options for the protection parameters (rotary coding switch, keyboard, software).

The thermo-magnetic overcurrent trip units can be used for rated currents of between 16 A and 630 A. Communication with a SENTRON VL via the PROFIBUS-DP using thermo-magnetic overcurrent trip units is only possible via the SIMOCODE-DP.

The ETUs and LCD ETUs are suitable for rated currents of between 63 A and 1600 A. The ETUs differ from the LCD ETUs in that settings for the operating current, delay time, and so on, must still be made using the rotary coding switch. On a SENTRON VL with an LCD ETU, however, the settings are made via a user-friendly menu-assisted display, which also shows the current values (e.g. individual phase currents) during operation.

With the ETUs, the SIMOCODE-DP is required for the PROFIBUS-DP connection.
The LCD ETUs, however, can be connected to the PROFIBUS-DP via the SIMOCODE-DP or PROFIBUS-DP COM10 module. The COM10 is easier to install, has more functions, and is more flexible than the SIMOCODE-DP.

The table below shows the protection functions of the different trip units and their setting ranges.

Trip Unit	TM	ETU 10	ETU 12	ETU 20	ETU 22	LCD ETU 40	LCD ETU 40M	LCD ETU 42
Version	Thermo-magnetic	Electronic				Electronic with LCD		
Function	LI	LI	LIG	LSI	LSIG	LSI	LSI	LI, LS, LSI, LSIG
Overload protection (L)	0.8–1	0.4–1	0.4–1	0.4–1	0.4–1	0.4–1	0.4–1	0.4–1
Time-lag class t_R		2.5–30	2.5–30			2.5–30	2.5–30	2.5–30
Short-time delay short-circuit protection (S)				1.5–10	1.5–10	1.5–10	1.5–10	1.5–10
Delay time tsd (ms)				0–500	0–500	0–500	0–500	0–500
Instantaneous short-circuit protection (I)		1.25–11	1.25–11	11	11	1.25–11	1.25–11	1.25–11
Earth-fault protection (G)			I_n		I_n			0.4–1
Thermal memory	✓	✓	✓	✓	✓	✓	✓	✓
Phase failure in-rush protection		✓					✓	
Communications capable with SIMOCODE-DP	✓	✓	✓	✓	✓	✓	✓	✓
Communications capable with COM10 module						✓	✓	✓

Table 3-1 *Overview of the trip units and their properties*

Installing Components in the Accessory Compartments

Two accessory compartments, which can be used to integrate additional components, are located under the charcoal gray cover in the middle of the SENTRON VL circuit-breakers. Available accessories include shunt trip units, undervoltage trip units, as well as auxiliary and alarm switches.

Shunt trip units

Shunt trip units are used to trip circuit-breakers remotely. The shunt trip unit coil is designed for short-time operation. A coil trip device is installed internally.

Undervoltage trip units

The circuit-breaker cannot be closed until a voltage has been applied to the undervoltage trip unit. If no voltage has been applied but the circuit-breaker is closed, no-load operations occur. These should be avoided because they can shorten the service life of the circuit-breaker.

Auxiliary switches

Auxiliary switches are used to report the ON/OFF positions.

Alarm switches

Alarm switches report the mechanical position TRIPPED, which is reached when the circuit-breaker has been tripped as a result of an overcurrent (e.g. overload or short circuit). They are also activated, however, if the circuit-breaker has been tripped by a shunt trip unit or undervoltage trip unit.

Installing Components in Circuit-Breakers VL160 to VL250

The compartment on the left contains the tripping solenoid with the ON/OFF signaling contacts. The ON/OFF signaling contacts are connected directly to the LCD ETU. The compartment on the right must contain an alarm switch, which must be connected directly to the COM10. It reports that the switch is in the "Tripped" position.

Note

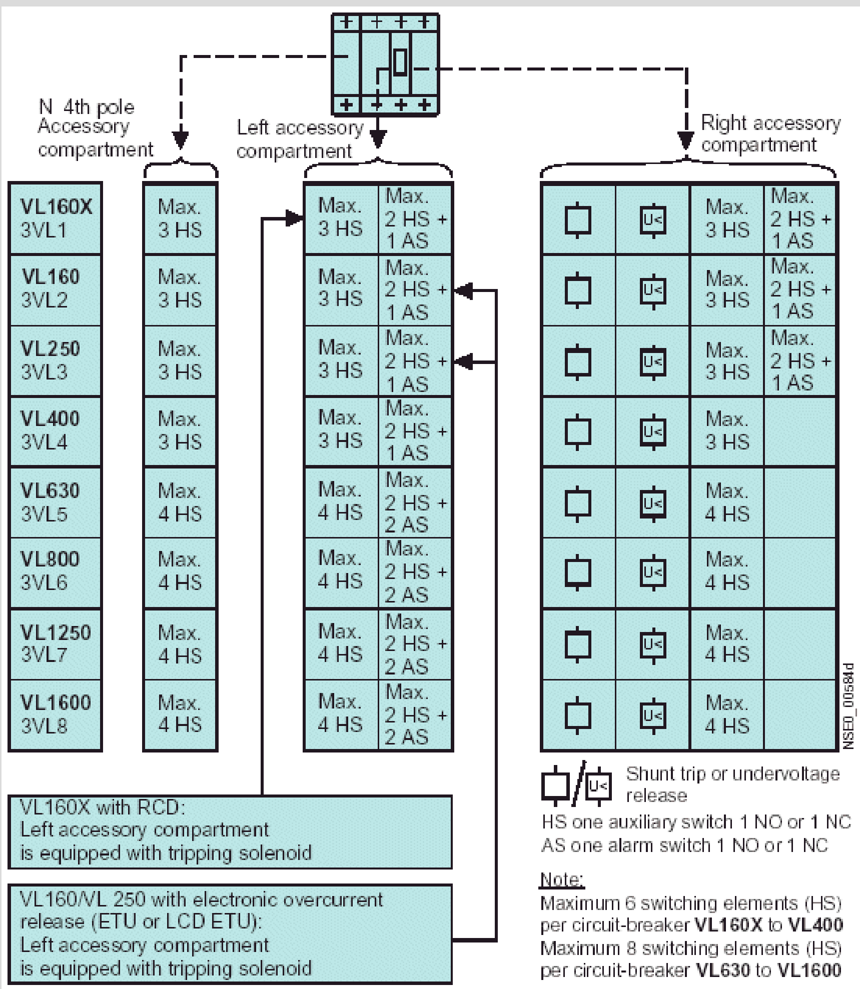
The compartment on the right cannot be equipped with other components (e.g. undervoltage trip units)!

If the SENTRON VL is to be communications capable and equipped with a shunt or undervoltage trip unit, two options are available:

- Generate the "Tripped" state using the PLC software rather than the alarm switch. If the cause of the last trip is reset when the circuit-breaker is closed via communication or when the ON state is detected, a subsequent new entry of the tripping reason in the status information in the cyclic message and a simultaneous OFF message indicate that a trip has occurred.
- Use a four-pole circuit-breaker, which has an extra compartment for the alarm switch.

Circuit-breakers as of VL400

The LCD ETU contains the tripping solenoid. Two wires are routed to the compartment on the left, where an auxiliary switch must be installed to report the ON/OFF positions via the LCD ETU. The required alarm switch can also be installed here: it must be connected directly to the COM10 and reports that the switch is in the "Tripped" position. The alarm switch can also be installed in the compartment on the right.



Graphic 3-3 *Options for equipping the individual accessory compartments*

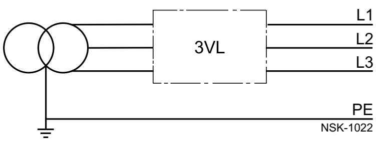
Determining the Current in the Neutral Conductor and with Respect to Earth

The earth fault trip unit (G) detects fault currents, which flow through earth and could start fires in the system. Graded selectivity can be assigned to several circuit-breakers connected in series by means of the definable delay time. The following metering methods can be used to detect neutral conductor and earth fault currents:

Vectorial current summation

Earth fault detection in symmetrically loaded systems

The three phase currents are analysed using vectorial current summation.

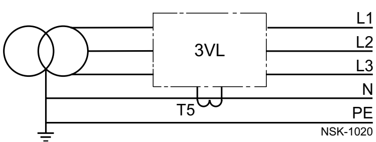


Earth fault detection in asymmetrically loaded systems

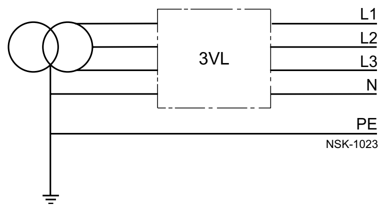
The neutral conductor current is measured directly. With 3-pole circuit-breakers, it is analysed for earth fault protection only; with 4-pole circuit-breakers, it is also analysed for neutral conductor overload protection.

The overcurrent trip unit uses vectorial current summation to calculate the earth fault current of the three phase currents and neutral conductor current.

3-pole circuit-breakers, current transformer in the neutral conductor



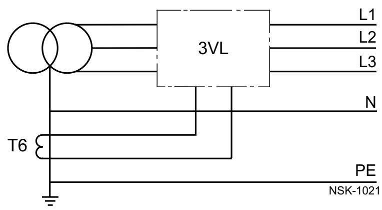
With 4-pole circuit-breakers, the fourth current transformer for the neutral conductor is installed internally.



Direct Earth Fault Current Detection via a Current Transformer in the Earthed Neutral Point of the Transformer

The current transformer is installed directly in the earthed neutral point of the transformer.

3-pole circuit-breakers, current transformer in the earthed neutral point of the transformer



COM10 vs. SIMOCODE-DP

To transmit data from the SENTRON VL circuit-breaker via the PROFIBUS-DP, you can use either the COM10 or the SIMOCODE-DP. The variants differ with regard to the quantity of data that can be processed, flexibility, time and effort involved in installation, and cost.

Connection via the COM10 module

The COM10 module is connected to the LCD ETU of the SENTRON VL. All the available data (see table below) is read from the trip unit via this connection and made available by means of the bus. In this option, the SENTRON VL communicates directly with the PROFIBUS-DP. The mechanical position of the main contacts must be connected to the COM10 separately via an alarm switch to receive a tripped signal. The SENTRON VL circuit-breaker must be equipped with an LCD ETU so that it can be connected to the COM10.

Transmittable data	Trip unit + SIMOCODE	LCD ETU + COM10	BDA / BDA *Plus*
Commands:			
• Switch on/off (in conjunction with motorized operating mechanism)	✓	✓	
• Delete alarm and trip memory		✓	
• Delete min./max. measured values		✓	
• Delete maintenance information		✓	
Operating states:			
• ON / OFF	✓	✓	✓
Event signals:			
• Tripped signal	✓	✓	✓
• Tripped signals with trip reason, operating current, and time stamp		✓	✓
• Alarm signal (e.g. overload)		✓	✓
• Alarm signals with time stamp (e.g. overload, current phase asymmetry, etc.)		✓	✓
• Setpoint value with time stamp (e.g. phase currents)		✓	✓
Measured values:			
• Max. phase current in a phase	✓	✓	✓
• Phase currents with min./max. value and time stamp		✓	✓
• Neutral conductor current with min./max. value and time stamp		✓	✓ *without min./max.*
Parameter values:			
• Read / write LCD ETU		✓	✓
• SIMOCODE-DP set values	✓		
Maintenance information:			
• Number and type of LSIG trips		✓	
• Number of switching cycles	✓	✓	
• Operating hours	✓	✓	
Device identification data			
• Trip unit type: LSIG		✓	✓
• 3/4-pole circuit-breaker		✓	✓
• Current sensor rating		✓	✓
• Trip unit serial number		✓	✓
• Software version of trip unit and COM10		✓	✓
Time synchronization		✓	
Short-time grading control function		✓	

Table 3-2 *Options for connecting the different SENTRON VL trip units to the PROFIBUS-DP via the SIMOCODE-DP and COM10.*

Connection via the SIMOCODE-DP

In this option, the SENTRON VL communicates indirectly with the PROFIBUS-DP. There is no direct communication with the trip unit.
The maximum current is determined by means of the transformer integrated in the SIMOCODE-DP and transmitted as a percentage of the current setting. The circuit-breaker states are applied to the PROFIBUS-DP by means of the auxiliary and alarm switches via the SIMOCODE-DP inputs. The SIMOCODE-DP outputs can be used to close or open the circuit-breaker via an optional motorized operating mechanism.

Connection via the BDA

The BDA is connected directly to the LCD ETU. All the trip unit data and, if available, certain COM10 data, is transmitted to the BDA. An additional BDA power supply is required, which also supplies the LCD ETU.

The circuit-breaker data and the software required for displaying it are transmitted from the BDA to the PC.
A JAVA-equipped browser is sufficient for displaying the SENTRON VL data and, if necessary, setting parameters. A null modem cable is used to connect the BDA to the PC; with the BDA *Plus*, an Ethernet interface is also available for providing direct access to the BDA from the Ethernet, intranet, or Internet.

Chapter 6 contains a detailed description of the BDA and BDA *Plus*.

SENTRON VL
Connection via the PROFIBUS-DP COM10 Module

The COM10 module enables the SENTRON VL circuit-breaker to exchange data via the PROFIBUS-DP simultaneously with two masters. This makes it easier, for example, to commission parameterization and diagnostic tools (e.g. Switch ES Power) and operator control and monitoring systems (e.g. WinCC) for the SENTRON VL.

Data Exchange with the COM10

The COM10 module for the SENTRON VL enables the circuit-breaker to be connected to the PROFIBUS-DP. Since it supports the DP and DPV1 PROFIBUS protocols, it can communicate with two masters simultaneously. This makes it easier, for example, to commission parameterization and diagnostic tools (e.g. Switch ES Power).

Once configured and started, the COM10 communicates with the class 1 PROFIBUS master via the cyclic message. This contains three basic types with variable contents. Larger data blocks (data records) can also be requested from the user program (PC and/or PLC) as required. The pre-assignments in the base types enable quick and easy access/ commissioning, while a high level of flexibility ensures that requirements for more complex systems can be fulfilled. The common PROFIBUS/SENTRON WL profile is described in Chapter 4; the data records are listed in Chapter 7 (Data dictionary).

A hardware pin enables control/write access to the circuit-breaker via hardware or software to be locked for safety reasons, thereby preventing any switching operations from taking place via PROFIBUS-DP (manual/automatic operation) or parameters from being changed, for example.

All key events are assigned a time stamp by the integrated clock to enable operators to keep track of any malfunctions. A simple mechanism is available for synchronizing the clock with the clock in the automation system.

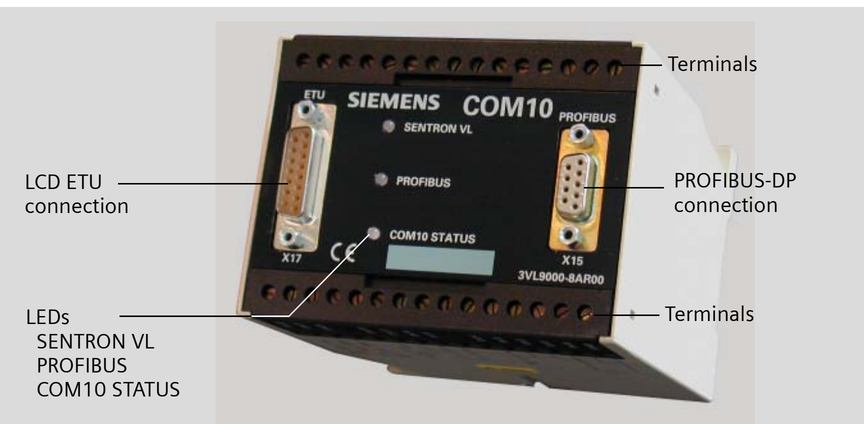


Fig. 3-1 *Front view of the PROFIBUS-DP COM10 module of the SENTRON VL showing the connections and LEDs*

The short-time grading control function (ZSI) is implemented in the COM10 and is compatible with the SENTRON WL and 3WN6/3WN1.

Setting the PROFIBUS Address for the COM10

When you configure the COM10 module to exchange data, note that it is shipped as standard with the PROFIBUS-DP address 126. This must be changed during system configuration (e.g. with the BDA, Switch ES Power, or on the LCD of the ETU).

Changing the COM10 module address (SENTRON VL) using the LCD menu

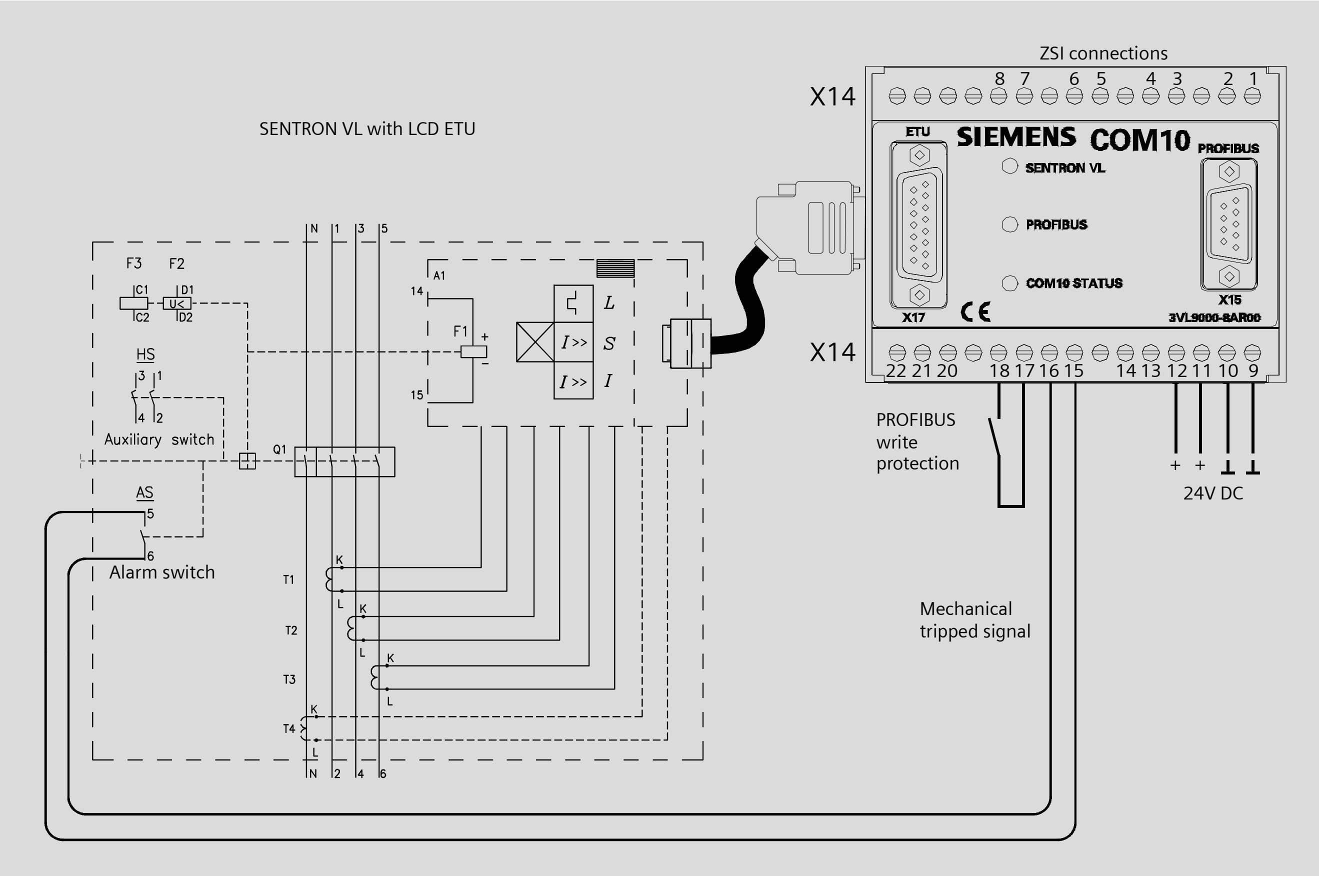
The PROFIBUS-DP address of the COM10 module can also be read and changed locally using the LCD ETU menu of the SENTRON VL. To do so, open the menu from the current display by pressing ESC and then ENTER. Use the Up/Down keys to select the "Change setpoints" option and then "Com change address". You can then use the Up/Down keys to set and confirm the address.

Other methods of changing the PROFIBUS address are described in Chapter 4.

Pin Configuration

The COM10 must be supplied with 24 V DC for it to operate. This voltage is applied to terminals X14.9/X14.10 (earth) and X14.11/X14.12 (+), and conducted via the communications line to the LCD ETU. This ensures that the trip unit is in operation even when the

Fig. 3-2 *You can set the address using the LCD ETU menu of the SENTRON VL circuit-breaker.*



Graphic 3-4 *This graphic shows in principle how to connect the COM10 to SENTRON VL incl. the PROFIBUS write protection DPWriteEnable. In addition to the communcation cable two wires are necessary to receive the information of the mechanical TRIP indication provided by an alarm switch.*

main contacts are open and that the LCD menu is available. Without this supply, the LCD ETU would not be able to communicate diagnostic information, such as the reason for the last trip, if it were not equipped with its own supply.

The alarm switch, which is fitted in one of the SENTRON VL compartments and reports the mechanical tripped signal to the COM10, is connected to terminals X14.15 and X14.16.

PROFIBUS Installation Guideline

The COM10 must be assembled and connected to the PROFIBUS as described in the PROFIBUS Installation Guideline (Order No. 2.112 from the PROFIBUS User Organization www.profibus.com). One of the main aspects therefor are the equipotential bonding and shielding.

PROFIBUS-DP Write Protection (DPWriteEnable)

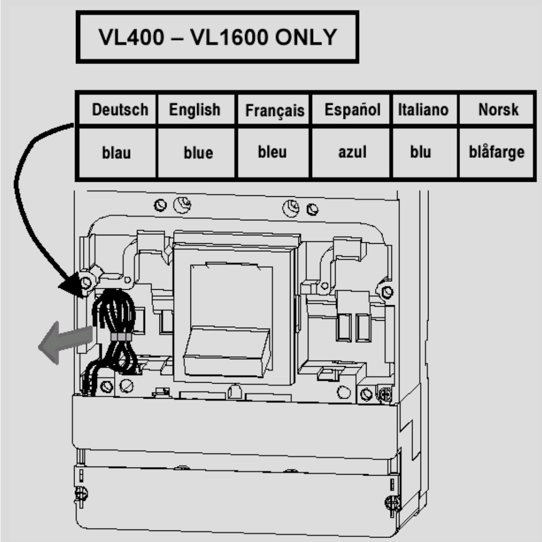
In real power distribution systems, write access via PROFIBUS has to be locked either temporarily or permanently.

The remote access method can be used to set the PROFIBUS-DP address and trip unit values. Inputs X14.17 and X14.18 (DPWriteEnable) on the COM10 must be bridged or closed via a circuit-breaker. If not, settings cannot be written to the COM10 of LCD ETU, and the motorized operating mechanism cannot be operated via the PROFIBUS-DP.

When the COM10 is supplied with 24 V DC, it also supplies the LCD ETU, even if it is not current carrying. In this way, the LCD ETU can be adjusted without switching the system on.

Communication Connection to the LCD ETU

The diagram on the following page shows you how to establish the communication connection from the COM10 to the SENTRON VL with the LCD ETU.

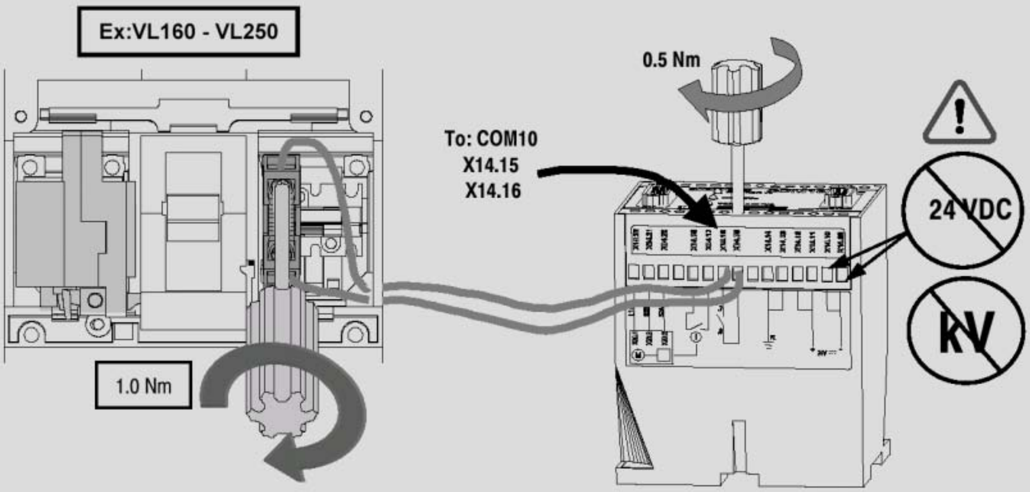


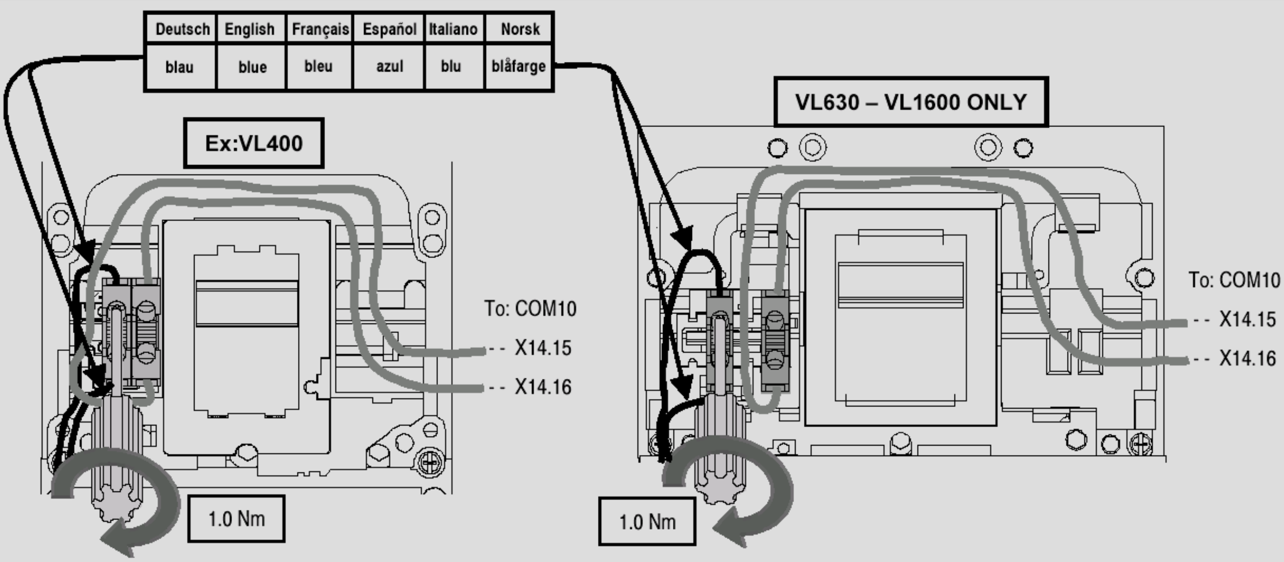
The micro switch for the on/off position in the VL400 up to VL1600 is not integrated in the maglatch like it used to be for the breakers up to VL250.

To get this on/off information an auxilary switch must be placed in the left pocket und connected with the blue stripes.

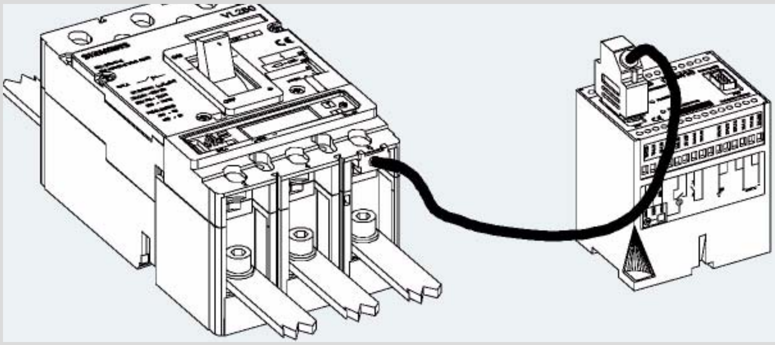
Depending on the frame size an alarm switch (for the mechanical trip position) must be mounted in the right pocket (up to VL250) or in the left pocket (from VL400) and connected with the COM10.

Details can be found in the assembly instructions of the COM10.



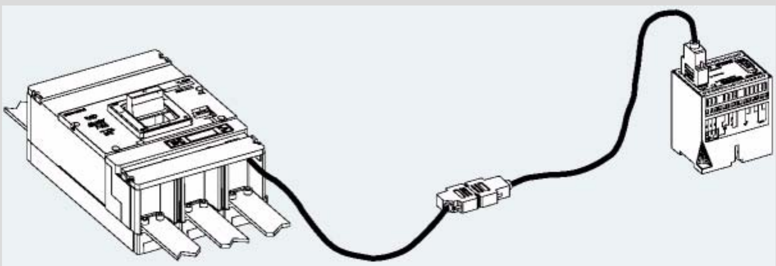


Graphic 3-5 *This graphic explains how to connect the auxilary switch for indicating the ON/OFF position for the VL400 up to the VL1600. This switch is integrated in the maglatch in the left pocket in case of smaller frame sizes.*

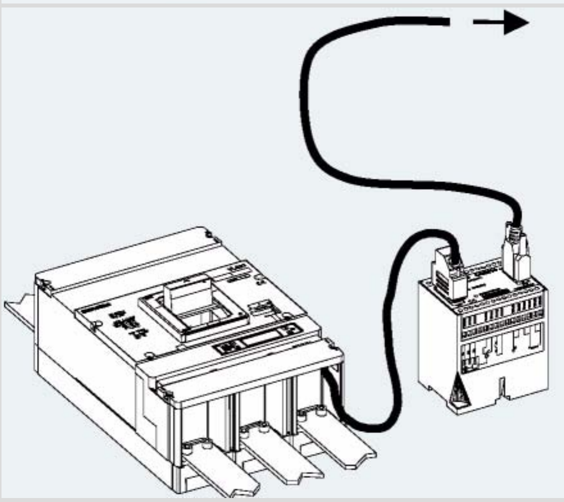


3VL9 0008AQ10 for:
- VL400
- VL630
- VL800

3VL9 0008AQ30 for:
- VL160
- VL250
- VL1250
- VL1600



Extension cable
3VL9 0008AQ20



Field bus cable for the PROFIBUS-DP with 9-pole SUB-D socket on the COM10

Graphic 3-6 *Different plugs must be used depending on the SENTRON VL circuit-breaker. The plugs are provided with every COM10 set. If required, the communication line can be lengthened using the extension cable.*

Connecting the Motorized Operating Mechanism (Optional)

If the circuit-breaker is also to be closed or opened via the bus, the electric motorized operating mechanism with storage spring is required.

Note:

The contact between X14.17 and X14.18 must be closed before the remote function can be used. Without this bridge, the SENTRON VL cannot be closed or opened via the PROFIBUS-DP.

Note:

To enable switching via the PROFIBUS-DP, the motorized operating mechanism must be in automatic mode.

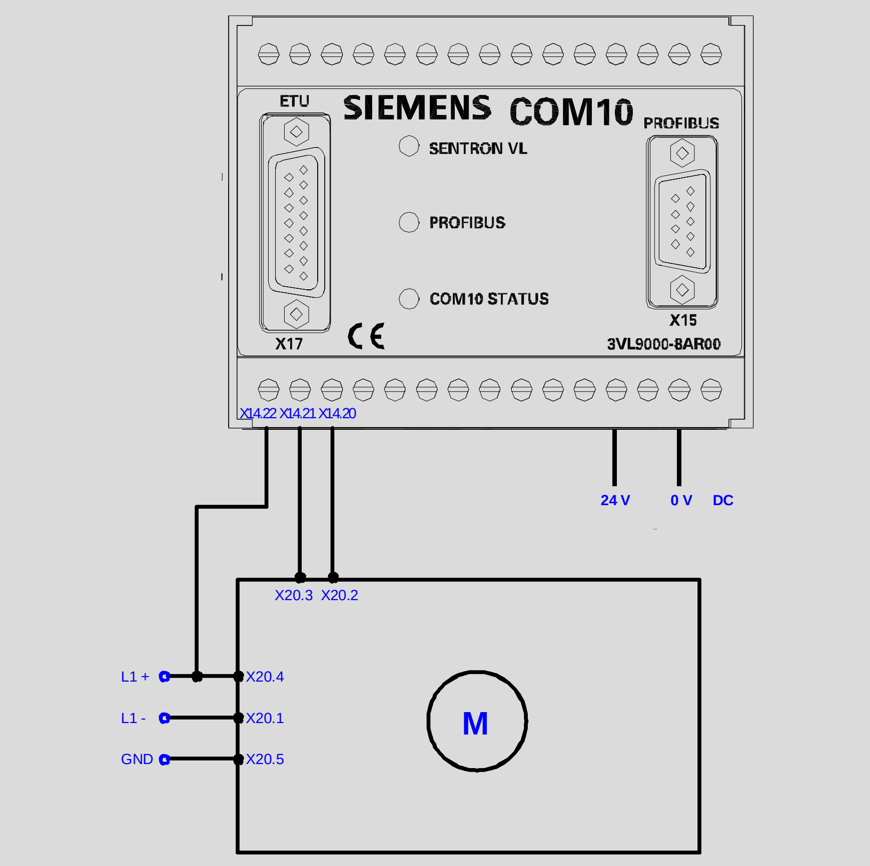
For more information on installing the motorized operating mechanism, refer to the appropriate installation instructions.

	Motor	COM10	extern
L2-	X20.1		0 V
S2A	X20.2	X14.20	
S2B	X20.3	X14.21	
L1+	X20.4	X14.22	
PE	X20.5		GND

Table 3-3 *Connecting the motorized operating mechanism*

Technical data of the COM10	
Operating voltage min./max. (V)	18/30
Current Input incl. connected LCD ETU on 24 V DC (mA)	110
Power loss min./max. (W)	1,5/4,1
Temerature range min./max. (°C)	-20/75

Table 3-4 *The table lists the necessary technical data to select a compatible power supply.*



Graphic 3-7 *Connection diagram for the COM10 and the motorized operating mechanism.*

Fig. 3-3 *If the SENTRON VL is to be connected via the COM10, the motorized operating mechanism must be in AUTO mode.*

COM10 LED Indicators

Three LEDs (SENTRON VL, PROFIBUS, and COM10 STATUS) located on the front panel of the COM10 indicate whether the COM10 is ready for operation and data is being exchanged. Users can read these LEDs to determine the operating states, which are explained in the table opposite.

COM10 Module: Short-Time Grading Control Function (ZSI)

ZSI (zone selective interlocking) provides the complete range of selectivity with an extremely short delay time of max. 100 ms, irrespective of the number of grading levels and the location of the short-circuit in the distribution system.

Its benefits become even more apparent the higher the number of grading levels in large systems and the longer the resulting delay times for standard time grading.

By shortening the break time, the ZSI module significantly reduces stress and damage in the event of a short-circuit in the switchgear.

Operating principle

If the ZSI module is used in a distribution system comprising several grading levels, each circuit-breaker affected by a short-circuit interrogates the circuit-breaker directly downstream of it to ascertain whether the short-circuit also occurred in the next grading level below:

- If the short-circuit did occur in the downstream grading level, the upstream circuit-breaker delays tripping to ensure that the circuit-breaker directly upstream of the short-circuit has enough time to interrupt the short-circuit.
- If the circuit-breakers in the downstream grading level do not report a short-circuit, the short-circuit occurred between the two grading levels in question. In this case, one of the two upstream circuit-breakers interrupts the short-circuit once the programmed delay time of t_{ZSI} of 100 ms has elapsed.

SENTRON VL LED	Meaning
Off	No voltage on the COM10
Red	No communication with the SENTRON VL
Green	Communication established with the SENTRON VL

Table 3-5 *The SENTRON VL LED provides information on the extent to which communication has been established with a SENTRON VL circuit-breaker.*

PROFIBUS LED	Meaning
Off	No voltage on the COM10
Red	Bus error No communication with class 1 master
Green	PROFIBUS communication OK Cyclic data transmission with class 1 master

Table 3-6 *The PROFIBUS LED provides information on the extent to which the COM10 has established communication with the PROFIBUS-DP.*

COM10 STATUS LED	Meaning
Off	No voltage on the COM10
Red	Internal fault Communication not possible
Green flashing	Internal self-test completed successfully

Table 3-7 *The COM10 STATUS LED provides information on the status of the COM10.*

- When the ZSI function is used, the ZSI output (ZSI OUT) on the COM10 must be connected to a ZSI input (ZSI IN) on the COM10 of the next highest grading level.

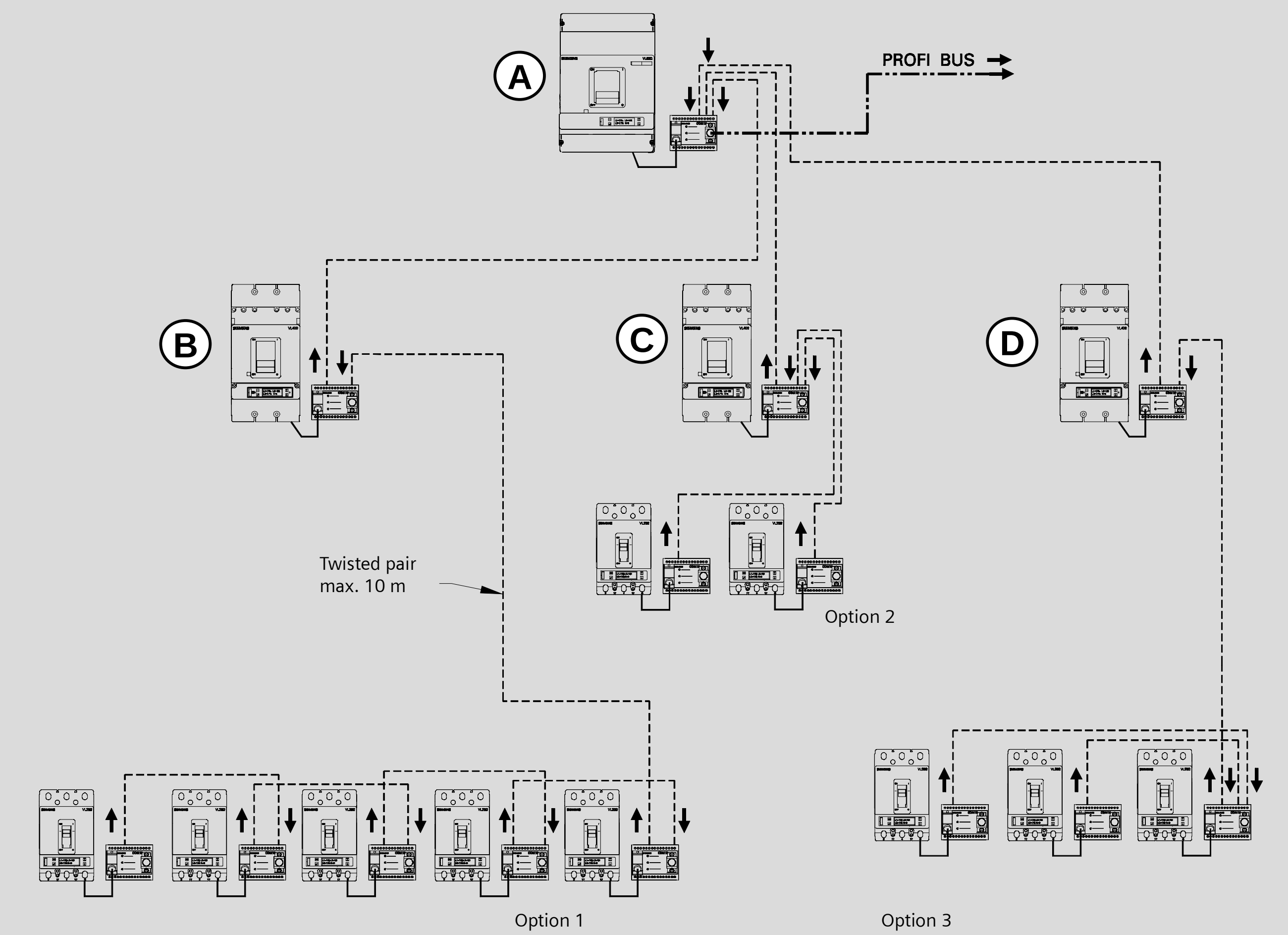
The ZSI function can be structured in one of three different ways:

- **Option 1:**
  Option 1 shows the circuit-breakers at the lowest level (level 3) with the COM10, which are connected via the ZSI terminals. At level 3, "only ZSI-OUT" is set in the LCD ETUs. By ORing the individual signals and setting "only ZSI-OUT", a ZSI signal that occurs at level 3 is forwarded to the next highest level. At levels 1 and 2, the LCD ETUs are set to "ZSI IN&OUT".
- **Option 2:**
  Level 3 is set to "only ZSI-OUT"; at levels 1 and 2, "ZSI IN&OUT" mode is used.
- **Option 3:**
  The same settings as in options 1 and 2 apply here.

Note:

- No more than one line can be connected to each ZSI input on the COM10. A maximum of three additional signals from other COM10 modules can be detected by each COM10. The connection between the ZSI interfaces is established using a twisted pair lead, which must be no longer than 10 meters.
- With the SENTRON VL, the ZSI only functions up to the maximum

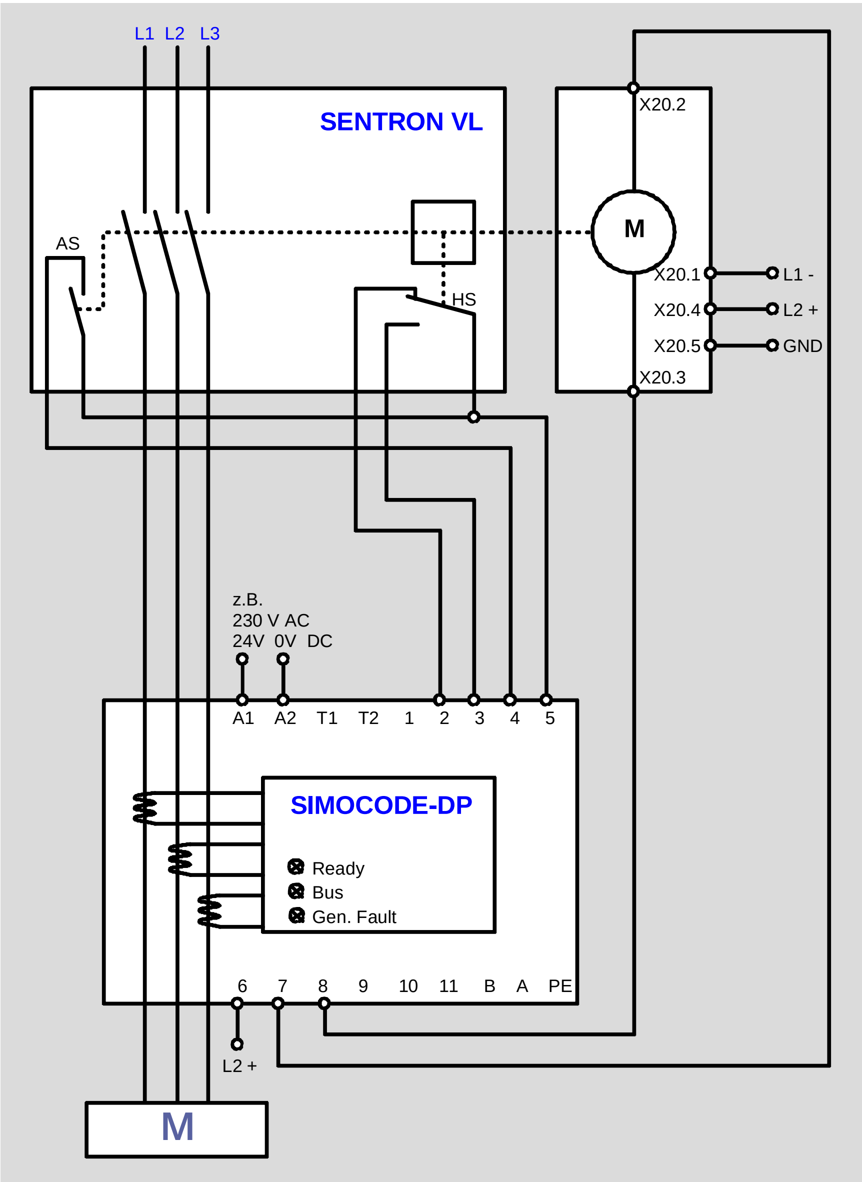
short-circuit current of the circuit-breaker affected by the short-circuit. If the short-circuit current exceeds the maximum permissible value, the circuit-breaker is tripped immediately.



Graphic 3-8 *The three different methods for connecting the COM10 ZSI- function*

SENTRON VL
Connection via the SIMOCODE-DP

Another method of transmitting SENTRON VL data to the PROFIBUS is to connect it to a SIMOCODE-DP. The volume of data involved with this method is much smaller, since no direct connection to the trip unit exists. For this reason, however, it can also be used for the ETU and thermo-magnetic trip unit.



Graphic 3-9 *Circuit diagram for connecting the SENTRON VL to the SIMOCODE-DP motor protection and control device.*

Connection to the SIMOCODE-DP

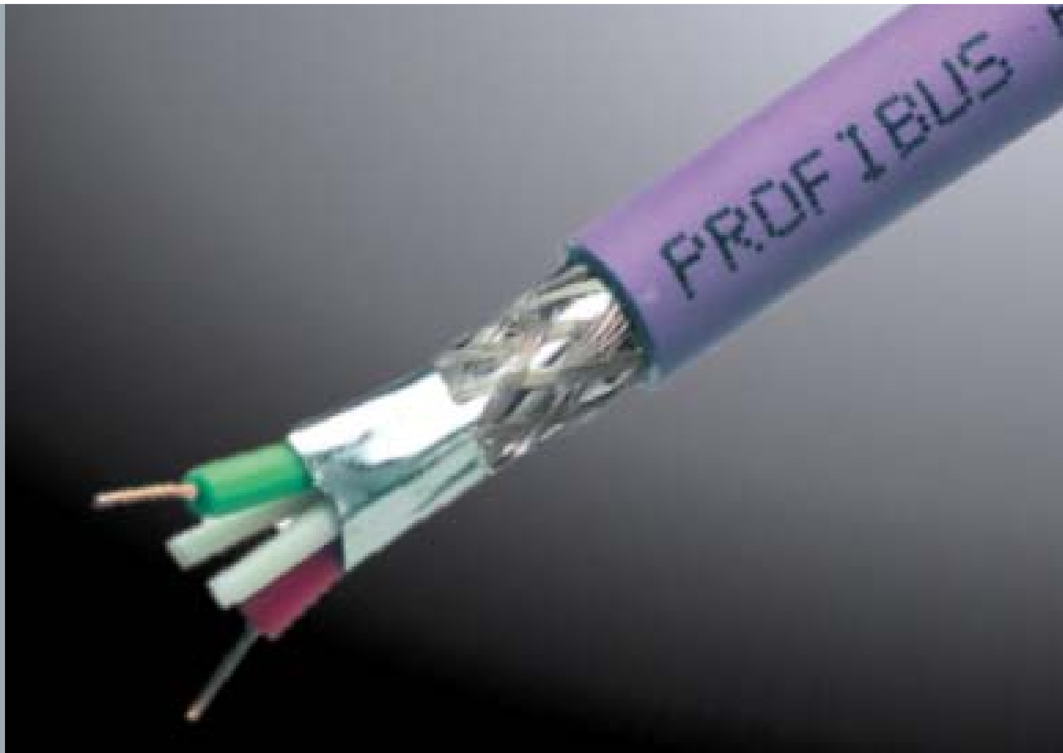
In this option, the SENTRON VL communicates indirectly with the PROFIBUS-DP. There is no direct communication with the trip unit. The maximum current is determined by means of the transformer integrated in the SIMOCODE-DP and transmitted as a percentage of the current setting. The circuit-breaker states are applied to the PROFIBUS-DP by means of the auxiliary switches (ON/OFF) and alarm switches (tripped) via the SIMOCODE-DP inputs. The SIMOCODE-DP outputs can be used to close or open the circuit-breaker via a motorized operating mechanism (optional).

The SIMOCODE-DP is only available up to 800A. If a higher-rating SENTRON VL is to be connected, an additional current transformer must be used. To measure the current, the SIMOCODE-DP must be installed in the main circuits, which, when compared with the COM10 solution, is a disadvantage because more space is required and the wiring is more complex.

The inputs and outputs, as well as the maximum phase current, are assigned using the Win-Simocode-DP software. A predefined parameter file can be downloaded from

http://www4.ad.siemens.de/csinfo/livelink.exe

For more information on the PROFIBUS-DP configuration of the SIMOCODE-DP, refer to the SIMOCODE-DP manual (order no.: 3UF57-00-0AA00-0).


PROFIBUS

PROFIBUS Communication with SENTRON WL and SENTRON VL

How to integrate the circuit breakers into plc´s

PROFIBUS Profile for the SENTRON circuit breaker

Data transmission via DPV1

Diagnostic

Programming samples

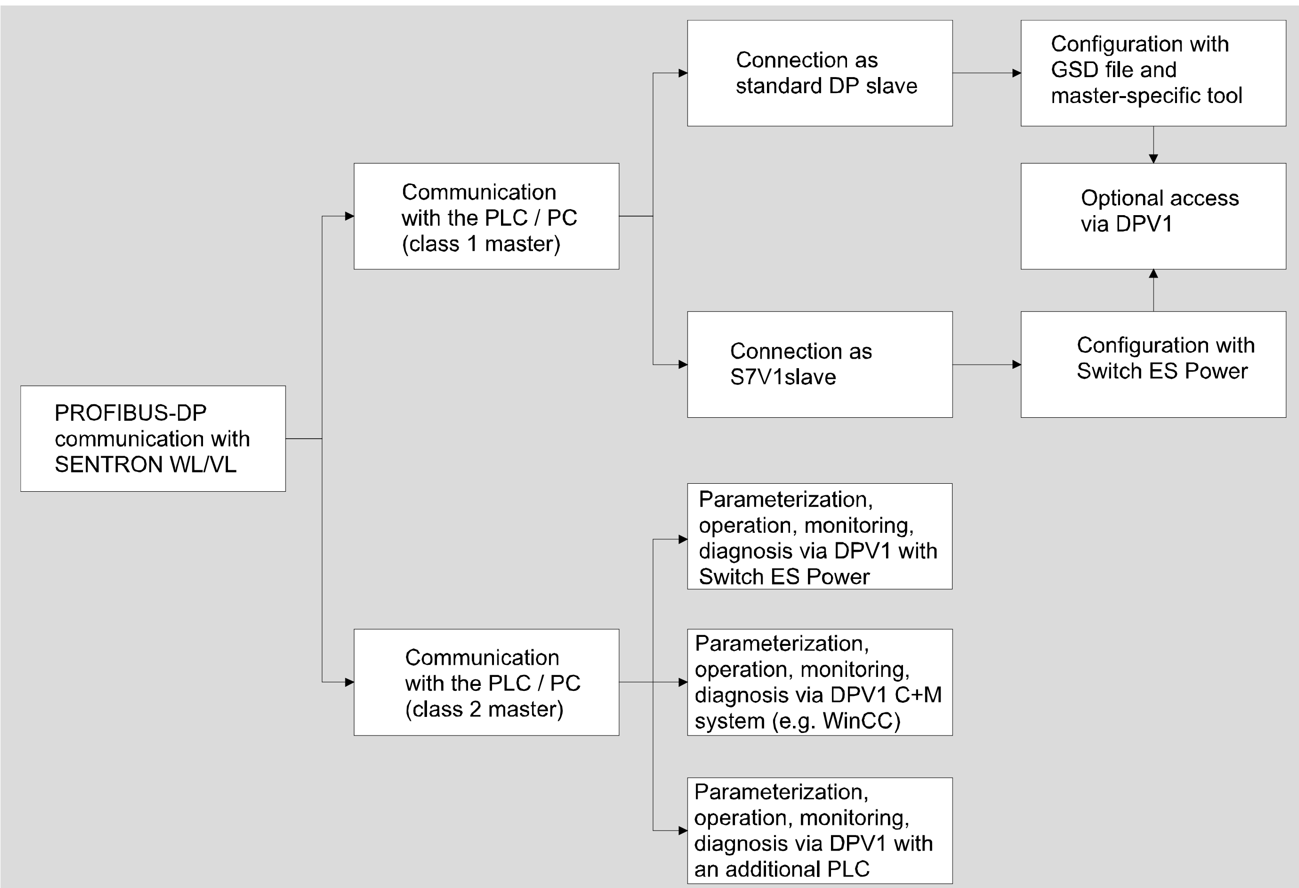
4

PROFIBUS-DP Communication with SENTRON WL and SENTRON VL
Integration into an Automation System

A wide range of options are available for integrating SENTRON circuit-breakers in automation systems. Newcomers to the system will, in particular, appreciate the straightforward and quick start-up options, while professional users will find that the flexible mechanisms meet all their requirements. In addition, a joint profile (data transmission type and content) for SENTRON WL and SENTRON VL enables identical programs to be used at the automation and PC level.

Communication Options

The previous chapters provided a brief description of the PROFIBUS-DP COM15 module for the SENTRON WL and the COM10 module for the SENTRON VL. Both modules act as interfaces between the circuit-breakers and the information environment. In this respect, the COM15 and COM10 modules behave in exactly the same way as far as the PROFIBUS-DP is concerned. One advantage of this is that a joint device master file (GSD) can be used for integration in PROFIBUS-DP systems for all circuit-breakers from 16 A to 6300 A. A distinction cannot and does not have to be drawn. Of course, with an identical PROFIBUS-DP profile, the circuit-breaker that is addressed can be accurately identified (e.g. device description, order number, inspection date, and so on).



Graphic 4-1 *This diagram shows a chart of the different communication options. A class 1 master is the "configuration master", which transmits either the settings from the GSD file or the Object Manager to the slave during start-up.*

Another major advantage of a joint communication profile is that the same software can be used for the automation systems, PCs, and operator control and monitoring software (e.g. WinCC).

The profile is based on the PROFIBUS profile for low voltage switchgear (LVSG) of the PROFIBUS user organisation (order no. 3.122).

Communication with a PROFIBUS-DP Class 1 Master

A class 1 master is the "configuration master", which, during start-up, determines the mode that the slave is to use for communication. In most cases, a class 1 master is a PLC, such as a SIMATIC S7 with a PROFIBUS-DP interface.

The following tools are available for configuration:

- GSD file
- Object Manager

A detailed description of both methods is provided on the following pages.

It must always be possible, however, to integrate an additional communication system with DPV1 and read or write data records acyclically, irrespective of the method chosen.

Communication with a PROFIBUS-DP Class 2 Master

PCs with PROFIBUS-DP cards are usually class 2 masters (e.g. when Switch ES Power is used).

Communication with a class 2 master always takes place via DPV1.

Integration with the GSD File

You can download a constantly updated version of the GSD file for SENTRON circuit-breakers from A&D Service and Support Homepage.

http://www4.ad.siemens.de/csinfo/live ink.exe

Press "Search" in the blue header, type "sentron gsd" and press "go".

The device parameters are configured using a configuration tool, which is available with every PROFIBUS-DP master. If you are using a SIMATIC S7 as the master, this is the HWConfig tool provided with the SIMATIC STEP7 package. If you are not using a SIMATIC S7, configuration can be carried out, for example, with COM PROFIBUS, depending on the master.

Installing the GSD file

If you have not yet installed the GSD file, which contains the master data for the circuit-breaker, you have to integrate it in the configuration tool beforehand.

You can use the hardware configuration editor "HWConfig" to integrate the GSD file in the SIMATIC development environment. To do so, open the "Hardware" object in the SIMATIC Manager and select "Install new GSD ..." from "Extras". You then have to select the source (e.g. disk) and the 'Siem80C0.gs*' file. The placeholder ('*') stands for the relevant language index (g = German, e = English). Once you have completed this step, SENTRON WL/VL is available for further configuration in the hardware catalog under "PROFIBUS-DP\Other field devices\Switchgear".

Note: The GSD file can be used for both the DP standard and extended data exchange with DPV1. You cannot set device-specific parameters using the PROFIBUS-DP during start-up.

If this is necessary, however, SENTRON WL/VL must be integrated as an S7 slave using the Switch ES Power Object Manager.

You can, of course, also control parameter settings using the S7 program. A range of system functions are available here to transmit data records to the slave via the DPV1 channel.

Creating a master system

You first have to create a DP master system using the HWConfig editor.

- Assign a master address between 1-125 (e.g. 11)
- Select the required transmission rate (e.g. 1.5 Mbit/s)
- Select the PROFIBUS-DP profile

Note: Depending on the PROFIBUS-DP configuration, you may have to make further settings in the master system. These will not be explained here, however.

Inserting and addressing the slave

First select "SENTRON WL/VL" in the "Hardware Catalog" and drag it to the master system.

Note: When the 'SENTRON WL/VL' slave is selected, only a machine-readable product designation number (e.g. 3WL9111-0AT15-0AA0) is displayed for information purposes. This does not affect the system function.

You then have to select a basic type, which you confirm with OK.

To run the slave on the PROFIBUS-DP, you still have to assign and set a unique address on this PROFIBUS-DP line.

If the properties are to be changed, select the slave and choose "Properties - DP slave".

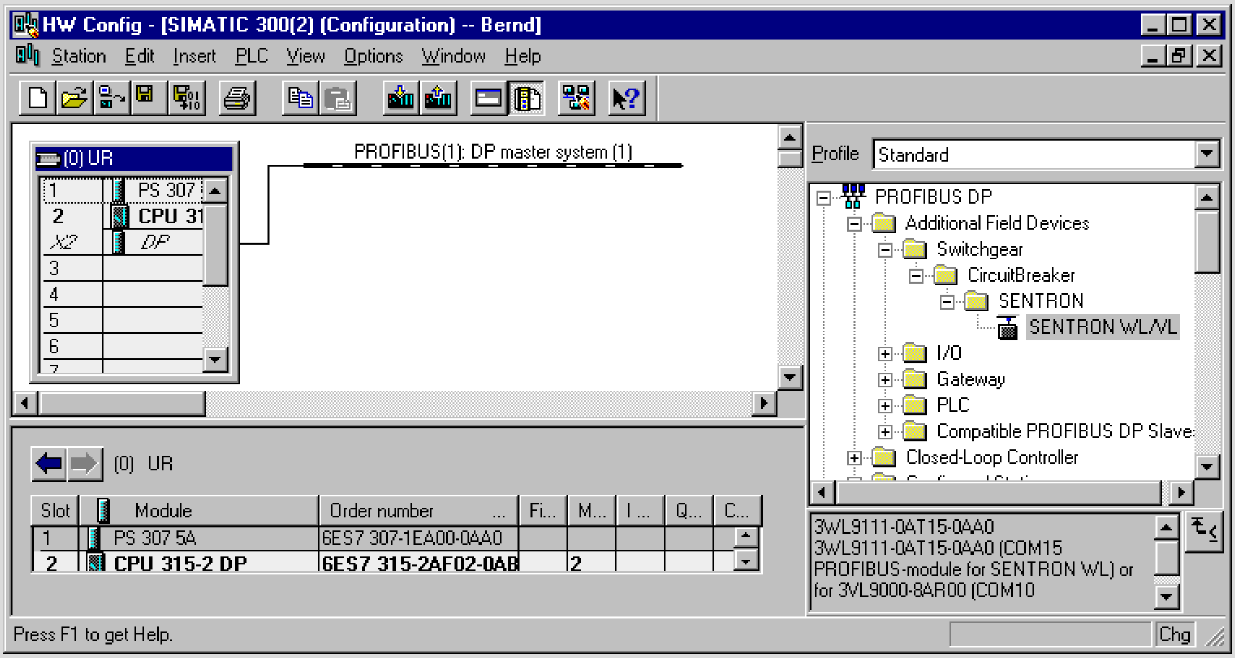


Fig. 4-1 *You can use the STEP7 hardware configuration tool to configure the S7 automation system and its field buses. To add a SENTRON circuit-breaker, you have to configure either a CPU with an integrated PROFIBUS-DP interface or a PROFIBUS-DP CP card in the rack and then assign it to the PROFIBUS-DP.*

Note: You do not have to take the settings on the "Hex parameterisation" tab page into account here. You cannot assign the PROFIBUS-DP addresses 0 and 126. Address 0 is for the PG (class 2 master), while 126 is mainly used for commissioning and as the "as shipped" status of DP slaves.

Integrating the SENTRON circuit-breaker using the GSD file means that it is always integrated as a standard DP slave. You can, however, also transmit other data and change parameters quickly and easily via DPV1.

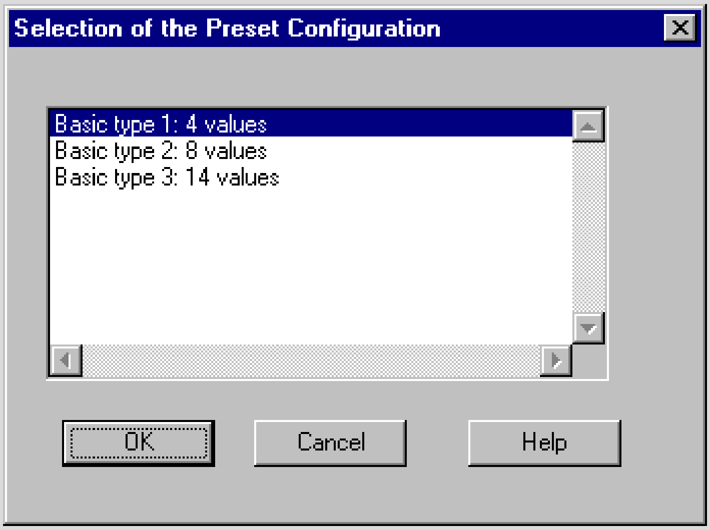


Fig. 4-2 *After you have dragged & dropped the SENTRON VL/WL from the device library, the system displays this pop-up. You have to select the circuit-breaker basic type, which the PLC uses to configure the circuit-breaker.*

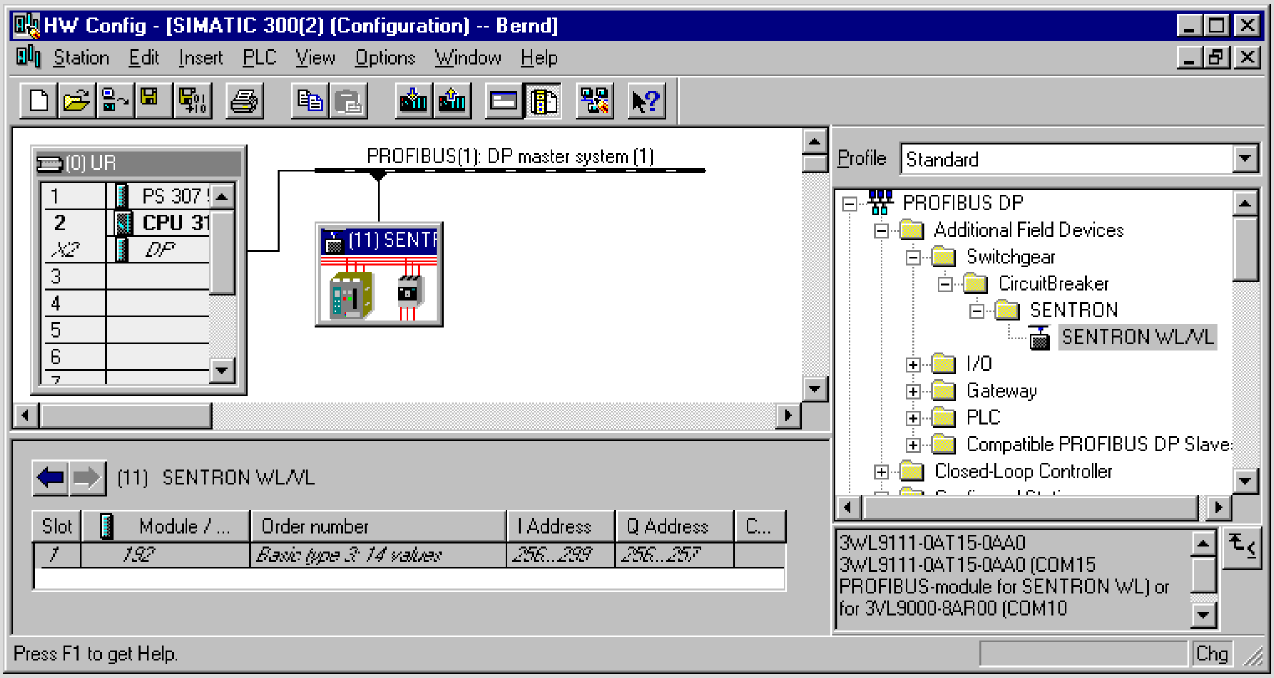


Fig. 4-3 *Once you have selected the basic type, a SENTRON circuit-breaker icon appears next to the PROFIBUS-DP. In the lower part of the split window, you can/must set the S7 input/output address that can be accessed in the STEP7 program.*

Integration with the Switch ES Power Object Manager

Note: For information on the program and how to install Switch ES Power and the Object Manager, see Chapter 6.

Integration with the Object Manager is only possible using a SIMATIC S7 controller with STEP7 software. HWConfig does not have to contain a GSD file when configuration is carried out using the Switch ES Power Object Manager. During installation, the Object Manager adds the PROFIBUS devices it recognizes to the HWConfig hardware catalog, which means that you can make all the settings using the Object Manager.

To parameterise the SENTRON circuit-breaker, double-click the Object Manager in HWConfig. Once it has started, all the PROFIBUS-DP-relevant settings for the SENTRON are automatically set to the required values. Other device parameters can be set afterwards.

When you return to HWConfig, the parameters that have been set are copied to the HWConfig database.

When the project is imported to the SIMATIC S7, this data is transmitted and sent to the slaves.

A hybrid configuration comprising the GSD file and the Switch ES Power Object Manager is supported by a SIMATIC S7.

Benefits of the Object Manager

If a SENTRON circuit-breaker is integrated in a PROFIBUS-DP system using the GSD file, only the basic type information and the PROFIBUS-DP address is saved in the STEP7 database and transmitted to the slave during start-up.

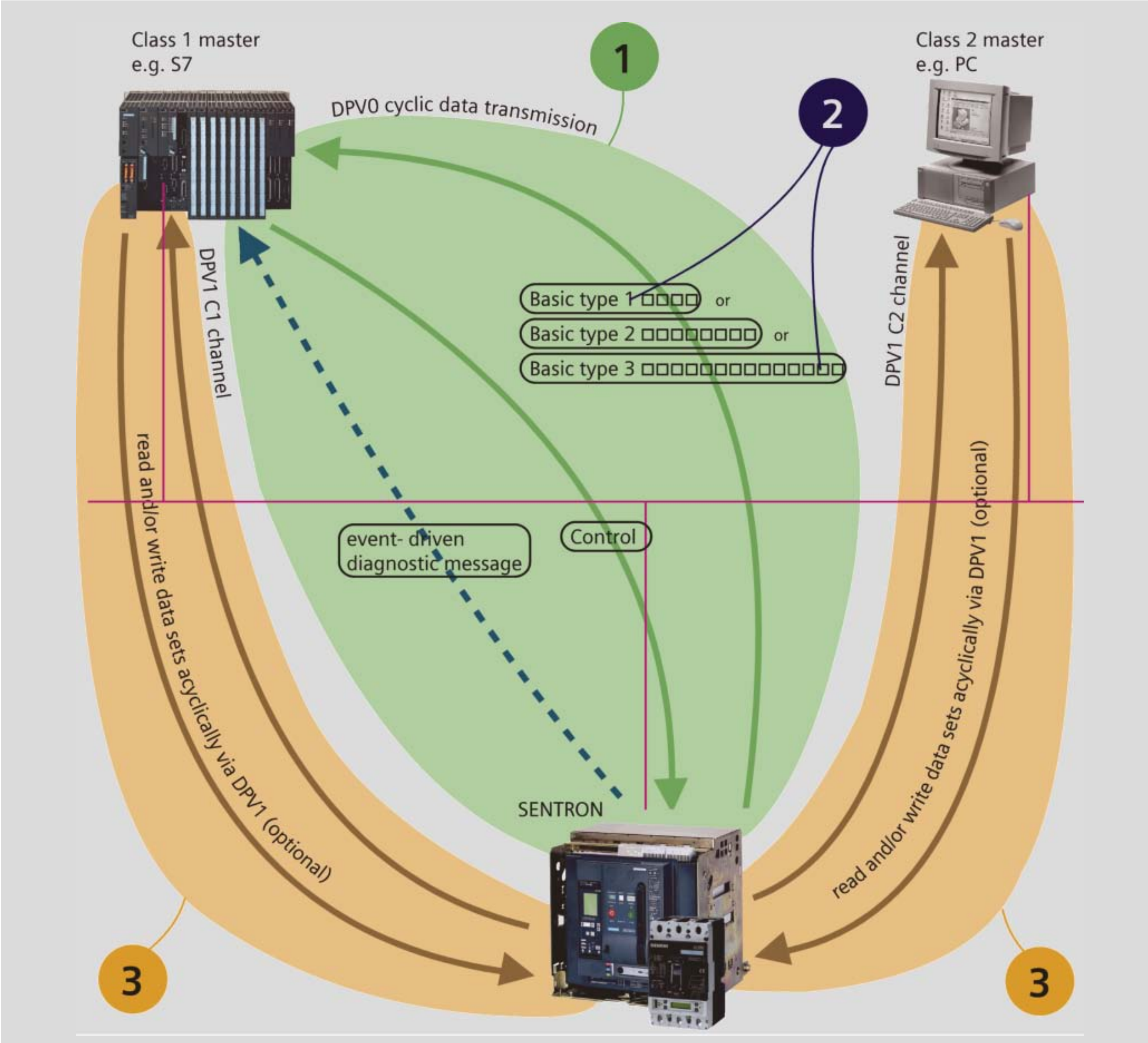
When the Object Manager is used, all the parameters set in Switch ES Power are saved in the STEP7 database and transmitted to the circuit-breaker during start-up. These include:

- Measured value parameters
- Protection parameters
- Extended protection function parameters
- Setpoint parameters
- Identification data
- Communication parameters (e.g. the data selected in the cyclic channel)
- Settings for the configurable output module

Using the Object Manager, therefore, ensures that all the settings for the automation process and the PROFIBUS-DP, as well as those for the power distribution system, are stored in a joint database. This means that the right information is always available in the right place.

This is particularly important, for example, when a circuit-breaker is replaced. After the new circuit-breaker has been installed and the **Cubicle**BUS power supply switched on again, it automatically receives all the data and parameters from the SIMATIC that were set previously using the Switch ES Power Object Manager, thereby significantly reducing downtime.

Integration in the STEP7 database and automatic parameterisation ensures that the SENTRON circuit-breakers conform to the Totally Integrated Automation (TIA) concept.



Graphic 4-2 *The 3-stage communication concept not only enables quick and easy access, but also ensures that the system can be adapted for more complex demands. Step 1 is mandatory; steps 2 and 3 optional.*

The 3-Step Communication Concept

This concept provides quick and easy access to the PROFIBUS-DP communication system with SENTRON circuit-breakers.

Step **1**

Step 1 provides quick and easy access to the PROFIBUS-DP communication system. This step already includes sufficient data to fulfill most requirements. Communication in step 1 is always carried out with a master 1 class.

Step **2**

The cyclic data contains certain predefined content. It can be changed in the three basic types and, therefore, easily adapted to prevailing requirements (e.g. replacing phase-to-phase voltage UL12 with the number of operating hours). This is an additional option to step 1.

Step **3**

In step 3, acyclic data records can, if required, be read or written by a class 1 or class 2 master. This is useful for requesting a large volume of data, for example. It does not have to be read cyclically (e.g. waveform buffer data). Switch ES Power uses this step to communicate with the circuit-breaker.

Setting the PROFIBUS Address for the COM10/COM15 Modules

The PROFIBUS-DP addresses are stored in the PROFIBUS-DP modules COM10 and COM15 of the circuit-breakers. The system is shipped with the default address 126. All the stations on the PROFIBUS-DP must have a unique address, which means that a new address must be assigned when the PROFIBUS-DP modules are commissioned.

The COM10 module of the SENTRON VL adopts the new address. The old address, however, remains valid until the connection with a class 1 master is interrupted. If no cyclic data exchange is taking place with a class 1 master, the new address becomes effective immediately. With Switch ES Power, the process is as follows: While the parameters are being downloaded with a new address, the address is copied and activated and, as a result, the connection with Switch ES Power is interrupted immediately. As of this point, the slave can be accessed at the new address and Switch ES Power must be restarted.

The COM15 module of the SENTRON WL adopts the new address, although it cannot be used until the 24 V DC supply voltage for the **CubicleBUS** has been interrupted briefly. The address is not active until the voltage is restored.

Changing the address with Switch ES Power

To change the PROFIBUS-DP address using Switch ES Power, you first have to ensure that the current address (e.g. 126 at initial commissioning) has only been assigned once. For this reason, all of the new COM10/COM15 modules must never be connected to the PROFIBUS-DP at the same time, otherwise all modules with the same address would adopt the new one. It is, therefore, important to ensure that the new modules are connected to the PROFIBUS-DP one after the other and addressed individually.

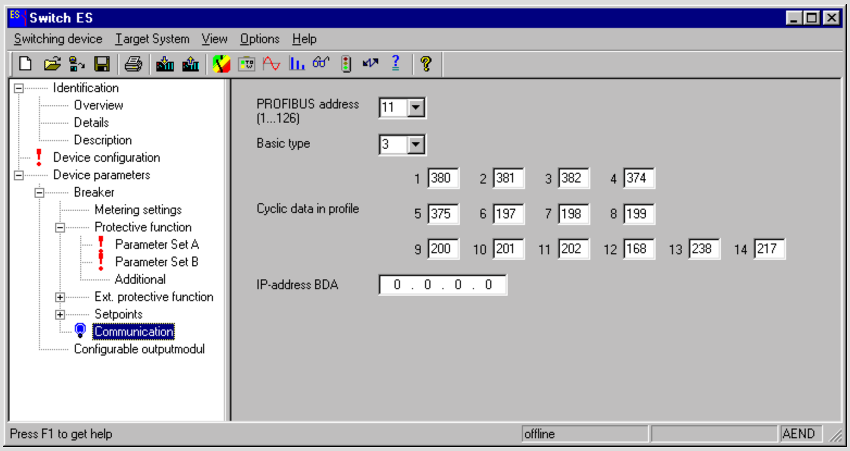


Fig. 4-4 *You can set the PROFIBUS address and the content of cyclic data transmission using Switch ES Power.*

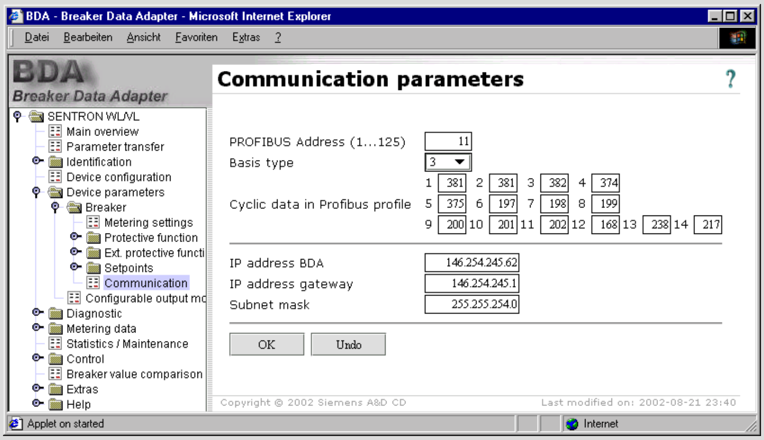


Fig. 4-5 *You can also set the same communication parameters using the BDA, as well as the parameters for operation on the Ethernet/intranet/Internet.*

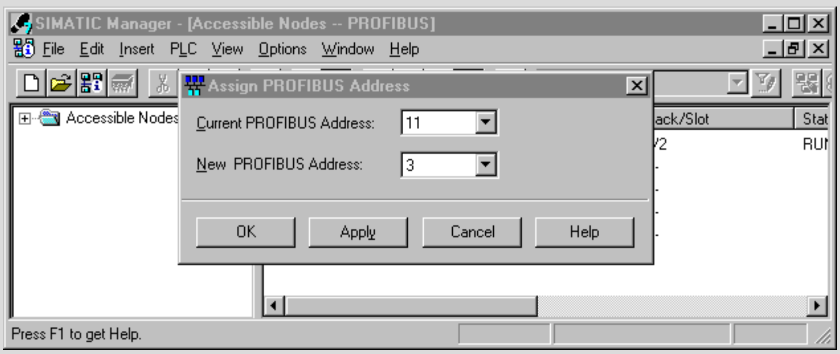


Fig. 4-6 *You can also use STEP7 to change the PROFIBUS address. To do so, however, the PC with STEP7 must be connected to the slave by means of an MPI or PROFIBUS interface.*

To change the address, select the "Open online" option in the "Switching device" menu. In the dialog box that then appears, use the relevant application access point and the selected PROFIBUS-DP interface to select the PROFIBUS-DP slave address that is currently active and that you want to change. With new PROFIBUS-DP COM10/COM15 modules, you have to select 126. When you click OK, all the parameters, including the communication parameters, are loaded from the device to Switch ES Power, where they can then be changed. Select the "Communication" option in the tree on the right-hand side and search for the new address in the drop-down field.

Then choose the "Load to switching device" option in the "Target system" menu. This transmits all the parameters currently displayed in Switch ES Power to the switchgear.

Caution: If the PROFIBUS write protection is active on the COM10/COM15 modules, the changes you make to the address are rejected.

Changing the address via the BDA or BDA Plus (see also Chapter 6)

Once a connection with the circuit-breaker has been established (e.g. via a local point-to-point (PPP) communication system or the Ethernet), choose "Device parameters - Breaker - Communication" (as with Switch ES Power) and change the address here. Unlike access via the PROFIBUS-DP, it does not matter whether the PROFIBUS-DP write protection is on or off. As described in Chapter 6, write actions from the BDA to the circuit-breaker are password protected. The changes become effective when the correct password is entered.

Changing the address via STEP7 (Set_Slave_Address)

Both PROFIBUS-DP modules support the PROFIBUS-DP function Set_Slave_Add. This class 2 master function can be used to change the address of a PROFIBUS-DP slave.

The address can be changed either in the SIMATIC Manager or in HWConfig in the STEP7 software package. To change the address, choose the "Assign PROFIBUS address" option in the "Target system" menu in either of the programs. A window is then displayed that enables you to change the DP slave addresses once the system has recognized the stations that are connected.

The address can only be changed in the Wait_Prm status; in other words, the slave must not be cyclically connected to a class 1 master. The address is then changed immediately.

Changing the address via DR160

The PROFIBUS-DP address of the appropriate slave is located in data record 160 at byte position 5. This can not only be read but also changed by writing the DR160; in other words, the address can be changed by triggering a single job to write the DR160 acyclically in the PLC user program. See also the example at the end of this chapter.

Changing the COM15 module (SENTRON WL) address with the ETU76B

With its structured menu, the ETU76B can also be used to change the PROFIBUS-DP address. To do so, first exit the "screensaver" displaying the current values by pressing ESC twice. Pressing ESC once (or any one of the other three keys) activates the backlight, and pressing it twice calls up the main menu. You then use the Up/Down keys to choose the "Change parameters" option. Confirm your selection by pressing ENTER. Choose "PROFIBUS" in the "Communication" sub-menu.

Changing the COM10 module (SENTRON VL) address with the LCD menu

The PROFIBUS-DP address of the COM10 module can also be read and changed locally using the LCD ETU menu of the SENTRON VL. To do so, open the menu from the current display with ESC and then ENTER. Use the Up/Down keys to select the "Change setpoints" option and then "Com change address". You can then use the Up/Down keys to set and confirm the address.

Fig. 4-7 *The ETU76B display also enables you to change the communication parameters*

Fig. 4-8 *You can set the address via the LCD ETU menu of the SENTRON VL circuit-breaker.*

PROFIBUS communication with SENTRON WL and SENTRON VL
PROFIBUS Profile for SENTRON Circuit-Breakers

The PROFIBUS User Organization promotes the use of joint, multi-vendor profiles for different device classes, such as motor starters and measuring instruments. For low-voltage switchgear and controlgear, a separate profile has been defined for circuit-breakers. This forms the basis for the common PROFIBUS profile for the SENTRON VL and SENTRON WL circuit-breakers. The PROFIBUS User Organization profile has been extended to include diagnostic functions and DPV1 enhancements.

Cyclic Data Transmission

With cyclic data transmission, a defined quantity of user data is transmitted with each message. When the slave (in this case, the SENTRON WL or SENTRON VL) is parameterised, the quantity of data to be transmitted cyclically between the circuit-breaker and PLC must be defined. Cyclic data transmission is the best method of transferring information that is needed quickly and on a continuous basis. The interval between two values depends on the number of stations involved, the quantity of data, and the baud rate.

The quantity of data cannot be changed during operation. For this reason, data transmission that is exclusively cyclic is suitable for communication that generally handles small volumes of user data. Cyclic data transmission, however, is not suitable when larger data packages are to be transmitted, for example, for occasional setting and maintenance checks.

This capacity, which is only required occasionally, would, therefore, have to be taken into account for each message. As a result, the messages would become very long and take a long time to transmit.

Basic Types for Cyclic Data Transmission

Because of the large amount of data provided by SENTRON circuit-breakers, a compromise had to be reached between the data volume and performance on the PROFIBUS-DP. If only a small amount of information is used every time a large amount of data is transmitted in each exchange (Data_Exchange), the performance of the PROFIBUS-DP can be affected.

For this reason, three base types are available to enable efficient and flexible data transmission. Depending on the application, the most suitable base type and accompanying bus configuration can be selected during configuration. This is carried out using a PROFIBUS-DP configuration tool, such as COM PROFIBUS or HWConfig in SIMATIC S7. The base types are pre-assigned and enable rapid commissioning without the need for additional configuration or parameterisation.

A user-defined configuration can, of course, also be created within a base type using Switch ES Power or the BDA.

Note: Data that is not required all the time can also be transmitted via DPV1.

PROFIBUS User Organization Profile

The PROFIBUS-DP communication profile for the SENTRON circuit-breakers was included in the profile for low-voltage switchgear and controlgear (circuit-breakers) by the PROFIBUS User Organization and adopted accordingly.

As a result, both SENTRON circuit-breakers communicate using state-of-the-art technology.

The document can be downloaded from the PROFIBUS User Organization at:

http://www.profibus.com

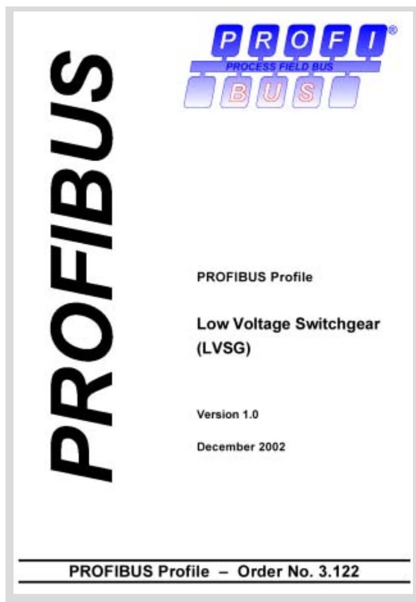


Fig. 4-9 *SENTRON WL/VL are conform to the PROFIBUS profile for circuit breakers*

Byte	Definition of basic type 1
0/1	Binary status information
2/3	Data block 1
4/5	Data block 2
6/7	Data block 3
8/9	Data block 4
10	PB of data block 1
11	PB of data block 2
12	PB of data block 3
13	PB of data block 4

Table 4-1 *basic type 1 comprises the binary status information and four data blocks*

Byte	Definition of basic type 2
0/1	Binary status information
2/3	Data block 1
4/5	Data block 2
6/7	Data block 3
8/9	Data block 4
10/11	Data block 5
12/13	Data block 6
14/15	Data block 7
16/17	Data block 8
18	PB of data block 1
19	PB of data block 2
20	PB of data block 3
21	PB of data block 4
22	PB of data block 5
23	PB of data block 6
24	PB of data block 7
25	PB of data block 8

Table 4-2 *Each data block has its own property byte*

Byte	Definition of basic type 3
0/1	Binary status information
2/3	Data block 1
4/5	Data block 2
6/7	Data block 3
8/9	Data block 4
10/11	Data block 5
12/13	Data block 6
14/15	Data block 7
16/17	Data block 8
18/19	Data block 9
20/21	Data block 10
22/23	Data block 11
24/25	Data block 12
26/27	Data block 13
28/29	Data block 14
30	PB of data block 1
31	PB of data block 2
32	PB of data block 3
33	PB of data block 4
34	PB of data block 5
35	PB of data block 6
36	PB of data block 7
37	PB of data block 8
38	PB of data block 9
39	PB of data block 10
40	PB of data block 11
41	PB of data block 12
42	PB of data block 13
43	PB of data block 14

Table 4-3 *Byte 44 of basic type 3 contains PLC input data*

Byte	Default assignment basic type 1
0/1	Binary status information
2/3	Current in phase 1
4/5	Current in phase 2
6/7	Current in phase 3
8/9	Max. current in phase under highest load
10	PB of current phase 1
11	PB of current phase 2
12	PB of current phase 3
13	PB of max. current in phase under highest load

Table 4-4 *The default selection of basic type 1 is specially designed for current transmission*

Byte	Default assignment basic type 2
0/1	Binary status information
2/3	Current in phase 1
4/5	Current in phase 2
6/7	Current in phase 3
8/9	Max. current in phase under highest load
10/11	Current in neutral conductor
12/13	Phase-to-phase voltage average value
14/15	Average value of power factors of 3 phases
16/17	Total active energy of 3 phases
18	PB of current phase 1
19	PB of current phase 2
20	PB of current phase 3
21	PB of max. current in phase under highest load
22	PB of current in neutral conductor
23	PB of phase-to-phase voltage average value
24	PB of average value of 3 power factors
25	PB of total active energy

Table 4-5 *Basis type 2 with default selections*

Byte	Default assignment basic type 3
0/1	Binary status information
2/3	Current in phase 1
4/5	Current in phase 2
6/7	Current in phase 3
8/9	Max. current in phase under highest load
10/11	Current in neutral conductor
12/13	Phase-to-phase voltage L_{12}
14/15	Phase-to-phase voltage L_{23}
16/17	Phase-to-phase voltage L_{31}
18/19	Neutral-point star voltage L_{1N}
20/21	Neutral-point star voltage L_{2N}
22/23	Neutral-point star voltage L_{3N}
24/25	Mean value of power factors of 3 phases
26/27	Total active energy of 3 phases
28/29	Total apparent power of 3 phases
30	PB of current phase 1
31	PB of current phase 2
32	PB of current phase 3
33	PB of max. current in phase under highest load
34	PB of current in neutral conductor
35	PB of phase-to-phase voltage L_{12}
36	PB of phase-to-phase voltage L_{23}
37	PB of phase-to-phase voltage L_{31}
38	PB of neutral-point star voltage L_{1N}
39	PB of neutral-point star voltage L_{2N}
40	PB of neutral-point star voltage L_{3N}
41	PB of mean value of 3 power factors
42	PB of total active energy
43	PB of total apparent power

Table 4-6 *The default selection for basic type 3 contains 14 measured values and their property*

Pre-Assignment of the Three Basic Types

Once a basic type has been selected with the PROFIBUS-DP master configuration tool, the configured slave is requested by the master to communicate in the set basic type at start-up.

Each SENTRON circuit-breaker can be configured individually with a different basic type.

Selecting the basic type first defines the quantity of data and, therefore, the length of the message.

The key circuit-breaker data can now be transmitted without the need to make any further settings. The status of the circuit-breaker is the same for all three basic types. This information field is 2 bytes in size and will be explained in more detail later. In line with the status field, the basic types comprise between 4 and 14 data blocks, which are pre-assigned.

The format for all the pre-assigned measured values is a one-word **integer**. This must be interpreted in **Motorola** format, which can be regarded as the "standard" on the PROFIBUS-DP.

Basic type 1

In line with the 2-byte status information, basic type 1 comprises four data blocks. These are pre-assigned in such a way that they are designed for use with a SENTRON VL and SENTRON WL without a metering function. The most important phase currents are transmitted here. This pre-assignment can be changed if necessary. It is not advisable to transmit the current in the neutral conductor with a 3-pole SENTRON VL. A different value from the data dictionary can be transmitted in its place (e.g. the number of operating cycles). Instead of the current in the neutral conductor, this value is transmitted in the cyclic message in place of the fourth data block.

The content can be reconfigured or the default values changed using Switch ES Power or the BDA.

Basic type 1 is particularly suitable for the SENTRON VL and/or the SENTRON WL without a metering function.

Basic type 2

Basic type 2 comprises 8 data blocks, which are pre-assigned for a SENTRON WL with a metering function. Not all of the voltages are transmitted in full, however; only the mean values are transmitted, which, in most cases, is sufficient.

Basic type 3

With basic type 3, the 14 data blocks are assigned measured values. This basic type has also been pre-assigned in such a way that it is only practical to use it with the SENTRON WL with a metering function (if unmodified). As described above, however, basic type 3 can be selected and the pre-assigned measured values that are not available (e.g. phase-to-phase voltage) can be replaced by maintenance or parameter data as required. The pre-assigned data can be replaced with all information that is no more than 2 bytes long. All the other values are "cast", that is, truncated and adapted so that only the 2 least significant bytes are transmitted.

Property Byte (PB)

In each of the basic types, the assigned data blocks are followed by the accompanying property bytes. Each data block has its own property byte.

The property byte provides additional information on the accompanying data block. Although it does not have to be analyzed, it may contain important information for the application. A property byte is also available for each data point in the DPV1 data records. If the content of one or more data blocks in the cyclic message is replaced, the property byte is adapted automatically.

Property bytes can be used to determine whether a value is available, for example. If the standard assignment of basic type 2 and a SENTRON VL are used, the voltage values are marked as "not available". This means, for example, that a standard interface can be created in an operator control and monitoring system that displays or hides the field depending on the bit. Measured values are always "read only", while certain maintenance information is "read only, but can be reset". Depending on their source (e.g. ETU), parameters are either "read and writable" or "read only".

All this information can be determined from the property bytes.

Definition of the Property Byte

	Value	Data point is ...
Less significant nibble	0x□0	Read and writable
	0x□1	Read only, but can be reset (e.g. maintenance)
	0x□2	Read only, writable in factory only
	0x□3	Read only
More significant nibble	0x0□	Not available
	0x4□	Available, but option deactivated
	0x5□	Available, but option deactivated and outside the area
	0x6□	Available and activated, but outside the area
	0x7□	Available, activated, within the area, and valid

Table 4-7 *The property byte describes the properties of the accompanying data point*

Binary Status Information in the Cyclic Channel

The binary status information in the cyclic channel is transmitted each time data is exchanged. The status information is always identical and always transmitted at the start of the data message, irrespective of the basic type that has been selected.

The binary status information comprises two bytes (not one word, that is, the bytes do not have to be reversed so that they can be displayed in Motorola format). For more information on data formats, see Chapter 7 "Data Dictionary".

The information coding is identical in SENTRON WL and SENTRON VL, provided the data is available.

Binary Status Information in the Cyclic Message

Byte	Bit	SENTRON WL	SENTRON VL
Byte n	0/1	Position of circuit-breaker 0 = Disconnected position 1 = Operating position 2 = Test position 3 = Circuit-breaker not present	Position of circuit-breaker 1 = Operating position always transmitted
	2/3	Status of circuit-breaker 0 = Not ready 1 = OFF (main contacts disconnected) 2 = ON (main contacts closed) 3 = Circuit-breaker has tripped	Status of circuit-breaker 0 = Not ready 1 = OFF (main contacts disconnected) 2 = ON (main contacts closed) 3 = Circuit-breaker has tripped
	4	Ready to switch on	Not available
	5	Voltage applied to undervoltage release	Not available
	6	Storage spring is charged	Not available
	7	Overload warning present	Overload warning present
Byte n+1	0	An activated setpoint value has been exceeded	An activated setpoint value has been exceeded
	1	An alarm signal is currently present	An alarm signal is currently present
	2	PROFIBUS write protection block DPWriteEnable is activated; write operations are prohibited	PROFIBUS write protection block DPWriteEnable is activated; write operations are prohibited
	3	Status of the free user input on the COM15 module	Not available
	4/5/6	Reason for last trip 0 = No trip / last trip acknowledged 1 = Overload tripping (L) 2 = Instantaneous short-circuit (I) 3 = Short-time-delay short-circuit (S) 4 = Ground fault (G) 5 = Trip as a result of extended protection function 6 = Overload in neutral conductor	Reason for last trip 0 = No trip / last trip acknowledged 1 = Overload tripping (L) 2 = Instantaneous short-circuit (I) 3 = Short-time-delay short-circuit (S) 4 = Ground fault (G) 5 = Not available 6 = Overload in neutral conductor
	7	Load shedding warning	Not available

Table 4-8 *The binary status information is identical in all three basic types, and cannot be changed. It is transmitted with each message from the circuit-breaker. Two bytes provide information on the most important circuit-breaker-related status data.*

Control Bytes

The three basic types differ with regard to the quantity and content of the data reported from the circuit-breaker to the class 1 master (e.g. PLC) with each Data_Exchange. In accordance with the standard definitions, this data is referred to input data from the point of view of the PLC.

The output data of the class 1 master is identical in all three basic types. The control bytes to the circuit-breaker are always two bytes long. These control bytes can be used to switch the circuit-breaker on and off, acknowledge trips, and reset memory contents.

It is sufficient to set the bits for all the controllers to between 0.5 and 5 seconds because setting the outputs is edge triggered. The control bits must then be reset to prevent any unwanted actions from subsequently being triggered.

PROFIBUS Write Protection (DPWriteEnable)

All important write accesses can be prevented from the PROFIBUS-DP. For this purpose, a hardware input is available on both the COM10 and COM15 modules.

If this input is not bridged (active release), write access is not possible (there are, however, a number of exceptions here). For more information on the precise assignment of the write protection inputs (DPWriteEnable), see the SENTRON VL and SENTRON WL chapters.

The following actions are blocked if the input of the write protection function has not been bridged:

- Switch on/off
- Reset the current trip
- Change the protection parameters
- Change the parameters for the extended protection function (metering function)
- Change the communication parameters
- Change the parameters for the measured value setting (metering function)
- Reset maintenance information (counters)
- Force the digital outputs (in the Module Operation screen in Switch ES Power)
- DPV1 start-up parameters from the Switch ES Power Object Manager (see Chapter 5 "Switch ES Power")

Control bytes to the SENTRON circuit-breaker

Byte	Bit	SENTRON WL	SENTRON VL
Byte n	0/1	Switch circuit-breaker 0 = Not defined (no action) 1 = Switch off (open the main contacts) 2 = Switch on (close the main contacts) 3 = Not defined (no action)	Switch circuit-breaker 0 = Not defined (no action) 1 = Switch off (open the main contacts) 2 = Switch on (close the main contacts) 3 = Not defined (no action)
	2	A current trip is acknowledged and reset	A current trip is acknowledged and reset
	3	Not used	Not used
	4	Activate the free user output on the COM15 module	Not used
	5	Not used	Not used
	6	Not used	Not used
	7	Not used	Not used
Byte n+1	0/1	Not used	Not used
	2	Delete trip and event log	Delete trip and event log
	3	Reset all min./max. value memories (except temperature)	Reset all min./max. value memories
	4	Reset min./max. temperatures	Not available
	5	Not used	Not used
	6	Reset all resettable maintenance information and counters	Reset all resettable maintenance information and counters
	7	Bit for synchronizing the system time to the current half hour	Bit for synchronizing the system time to the current half hour

Table 4-9 *All three basic types contain a 2-byte block featuring the most important binary information transmitted with the message for controlling the circuit-breaker.*

The following control functions are available even without a bridge:

- Change and set the trigger functions for the waveform buffer.
- Read the content of the waveform buffer.
- Change the setpoint parameter.
- Set/change the system time.
- Change the free texts (comments, system IDs).
- Reset the min./max. values.
- Change the free user output on the COM15 module.

Write protection ensures that all the required information is available at the automation level, but prevents any changes to the status of the circuit-breaker. Changes can only be made by the operator of the power distribution system.

Why does the write protection function permit certain actions?

All actions that are not blocked are for remote diagnosis only and do not have any effect on the current status. Trips and curves can, however, be diagnosed more accurately, even using remote methods.

SYNC and FREEZE

The PROFIBUS-DP features the control commands SYNC (synchronize outputs) and FREEZE (freeze inputs) to enable data exchange to be coordinated.

A DP master with the appropriate functionality can send the SYNC and/or FREEZE control commands (broadcast messages) to a group of DP slaves simultaneously. For this purpose, the DP slaves are arranged in SYNC and FREEZE groups. A maximum of 8 groups can be created for a master system. Each DP slave, however, cannot be assigned to more than one group.

SFC11 *DPSYNC_FR* is used to trigger the control commands from the S7 user program. Not every master supports this function.

The SYNC control command enables users to synchronize the outputs on several slaves simultaneously. When the control command SYNC is received, the addressed DP slaves switch the data from the last Data_Exchange message from the DP master in their transfer buffer to the outputs. This enables output data to be activated (synchronized) simultaneously on several DP slaves.

The UNSYNC control command cancels the SYNC mode of the addressed DP slaves. The DP slave then resumes cyclic data transmission, that is, the data sent from the DP master is immediately switched to the outputs.

The FREEZE control command enables the user to "freeze" the input data of DP slaves. If a FREEZE command is sent to a group of DP slaves, all of these slaves simultaneously freeze the signals currently present at their inputs. These can then be read by the DP master. The input data in the DP slaves is not updated until a new FREEZE command has been received.

The UNFREEZE control command cancels the FREEZE mode of the addressed DP slaves so that these resume cyclic data transmission with the DP master. The input data is immediately updated by the DP slave and can then be read by the DP master.

Note that once a DP slave has been restarted or is started for the first time, it does not switch to SYNC or FREEZE mode until it has received the first SYNC or FREEZE commands from the DP master.

The SENTRON circuit-breakers VL and WL support both SYNC and FREEZE mode.

Time Synchronization

Each SENTRON circuit-breaker is equipped with an internal clock integrated in the PROFIBUS-DP modules COM10 and COM15. The system time cannot be buffered during a power failure.

The time must be specified accurately to keep track of sources of errors if several trips occur, for example (identify the source of error). The saved messages and the minimum/maximum values are also assigned a time stamp and saved. Without a system time in the terminal, events could only be assigned time stamps in a connected PLC and with limited accuracy.

To ensure that an accurate time stamp is provided in conjunction with all the other circuit-breakers, the clock in every device must be synchronized regularly with the other circuit-breakers to the correct time. This is carried out as follows:

First import the current time from the PLC to each circuit-breaker. To do so, send data record 68 with the current system time to all the circuit-breakers via the acyclic DPV1 channel services (see Chapter 7 for the exact assignment). The time does not have to be completely accurate at this stage as this is looked after during synchronization.

Shortly before the half hour has elapsed (29:50), a SYNC command is sent to all the devices in question. The bit for synchronizing the clocks (bit 7 of byte 1 of the control byte) is then set (29:55).

With millisecond accuracy, a SYNC command is sent again on the half hour (30:00). In this way, the clocks for all the devices within the SYNC group are rounded up or down to the half hour. Synchronization is not carried out on the hour because clocks that are fast would then be one hour ahead of clocks that are slow.

An UNSYNC command must then be sent and the synchronization bit (bit 7 of byte 1 of the control byte) reset so that data exchange can continue.

This procedure should be carried out regularly on a time-controlled basis, for example, by GPS in an S7.

Diagnostic Message

By requesting the diagnostic data, the DP master checks at start-up whether the DP slave exists and is ready to be parameterised. The diagnostic data from the DP slave comprises a diagnostic data part defined in EN50170 and specific DP slave diagnostic information. The DP slave uses the diagnostic data to report its operating status (PROFIBUS-DP) to the DP master and, in the event of a diagnosis, the reason for the diagnostic message. A DP slave can report a local diagnostic event to the DP master via the layer-2 message priority "high prio" of the Data_Exchange response message in layer 2. The DP master then requests the diagnostic data from the DP slave for analysis. If no current diagnostic events are present, the Data_Exchange response message is "low prio". The diagnostic data of a DP slave can be requested at any time by a DP master without necessarily reporting diagnostic events.

Diagnostic message for S7 stations

Diagnostics-capable modules in distributed peripheral devices can report events, such as a partial station failure, wire breakage in signal modules, periphery channel short-circuit/overload, or a load voltage supply failure, using a diagnostic alarm. With an incoming and outgoing diagnostic alarm, the organizational block for diagnostic alarm OB82 is called by the CPU operating system. If a diagnostic alarm occurs and OB82 is not programmed, the CPU switches to the STOP status.

A failure (incoming event) or restoration (outgoing event) of a DP slave is reported by the operating system of the S7 CPU via OB86. If OB86 has not been programmed, the S7 CPU switches to the STOP status if an event occurs.

Diagnosing the SENTRON WL

In accordance with the relevant standards, the slave reports an external diagnostic message to the PLC master when it sets byte 0 to "08" instead of "00". This is generated automatically by the ASIC.
If an external diagnostic message is present, byte 7 is set to "01" instead of "00" to indicate that an external diagnosis is present.

The external diagnosis in the SENTRON WL is only triggered in one of the following statuses:

- The COM15 module is not ready for operation
- Bit 18.2 and/or 18.3 report a number that is not 0 (a maintenance message).
- Bit 18.4 is set, that is, the circuit-breaker is not present
- One of the bits in byte 19 = "1"

In bytes 24 to 27, the presence of a module is entered on the **Cubicle**BUS.
If a module is added, removed, or identified as faulty, the corresponding bit in byte 19 (19.2, 19.3, 19.4) is set and the affected module indicated in bytes 20 to 23. An incoming (i.e. ***08*** *0C 00 xx 80 C0 42* ***01*** *05 82 00 00 00 0F 81 01 00* ....) diagnostic message is then triggered on the PROFIBUS-DP. If the module that triggered the diagnosis does not change in any other way, the message becomes an outgoing message after 10 seconds (provided that no other reasons for a diagnosis exist:
00 *0C 00 xx 80 C0 42* ***00*** *05 82 00 00 00 0F 81 01 00* ....). The information on the last change (19.2, 19.3, or 19.4 plus module number bytes 20 to 24) remains until another message is received.
If a module is added, the corresponding module is indicated in bytes 20 to 24. In the list of modules present, the module that has been added will not appear until after the outgoing diagnostic message has been processed (10 seconds). The user can always see which module was last added to the **Cubicle**BUS.

Structure of the PROFIBUS Diagnosis Function			
Part of the diagnosis	**Byte.Bit**	**Meaning for SENTRON WL**	**Meaning for SENTRON VL**
DP standard	0	Station status 1	Station status 1
	1	Station status 2	Station status 2
	2	Station status 3	Station status 3
	3	PROFIBUS master address	PROFIBUS master address
	4	ID no. of high byte (0x80)	ID no. of high byte (0x80)
	5	ID no. of low byte (0xC0)	ID no. of low byte (0xC0)
ID-related diagnosis	6	0x42 fixed	0x42 fixed
	7	0x00 when no device-specific diagnosis is present 0x01 when a device-specific diagnosis is present	0x00 when no device-specific diagnosis is present 0x01 when a device-specific diagnosis is present
	8	0x05 fixed	0x05 fixed
	9	0x82 fixed	0x82 fixed
	10	0x00 fixed	0x00 fixed
	11	0x00 fixed	0x00 fixed
	12	0x00 fixed	0x00 fixed
Additional header	13	0x0F fixed	0x0F fixed
	14	0x81 fixed	0x81 fixed
	15	0x01 fixed	0x01 fixed
	16	0x00 fixed	0x00 fixed
Device-specific diagnosis	17	0x00 not used	0x00 not used
	18.0	The COM15 module is not ready for operation	The COM10 module is not ready for operation
	18.1	Not used	Not used
	18.2 / 18.3	State of the main contacts 0 = OK 1 = Perform visual inspection on main contacts 2 = Immediate inspection of main contacts 3 = Not used	Not used
	18.4	Circuit-breaker is not present	Not used
	18.5 - 18.7	Not used	Not used
	19.0	**Cubicle**BUS not connected	SENTRON VL communication with the COM10 module interrupted
	19.1	Not used	Not used
	19.2	Last action on the **Cubicle**BUS : Module removed	Not used
	19.3	Last action on the **Cubicle**BUS : Module added	Not used
	19.4	Last action on the **Cubicle**BUS : Fault detected	Not used
	19.5 - 19.7	Not used	Not used
	20.0 - 23.7	**Cubicle**BUS module, which is removed, added, or reports fault (19.2 to 19.4)	Not used
	24.0 - 27.7	Module presence list on the **Cubicle**BUS	Not used

Table 4-10 *The structure of the diagnosis function for the SENTRON VL and WL circuit-breakers is identical, although the SENTRON VL does not support all of the functions (see* **Cubicle**BUS *Module Presence)*

Explanation of bytes 20 to 27 in the SENTRON WL diagnostic message								
Byte / Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
20/24	Not assigned	Not assigned	Not assigned	Not assigned	Not assigned	Not assigned	Not assigned	Not assigned
21/25	Not assigned	Metering function or metering function *Plus*	Analog output module Module #1	Analog output module Module #2	ETU76B graphic display	Not assigned	BDA/BDA *Plus*	Not assigned
22/26	Not assigned	Digital input module position PROFIBUS inputs	Digital output module rotary coding switch Module #1	Breaker status sensor	Digital input module position parameter set switchover	Digital output module rotary coding switch Module #2	Not assigned	Configurable output module
23/27	Not assigned	Not assigned	Not assigned	Not assigned	Not assigned	ZSI module	ETU	COM15

Table 4-11 *This table explains bytes 20 to 23 and 24 to 27 of the device-specific diagnosis of the SENTRON WL. Bytes 20 to 23 indicate the module that is referenced for diagnostic message 19.2 to 19.4. The bytes indicate all the modules connected to the* **CubicleBUS**.

The same applies to removing modules, except here, modules that are to be removed are not removed until the outgoing diagnostic message has been deleted from the list of modules present.

If a fault is reported on a module, the **CubicleBUS** module remains in the list of modules present.

Diagnosing the SENTRON VL

The SENTRON VL does not have as many diagnostic messages as the SENTRON WL. Like the SENTRON WL, however, it does have incoming and outgoing diagnostic messages.

If a diagnostic message is not present:
__00__ 0C 00 xx 80 C0 42 __00__ 05 82 00 00 00 0F 81 01 00 00 __00 00__ 00 00 00 00 00 00 00 00

The COM10 module is out of operation:
__08__ 0C 00 xx 80 C0 42 __01__ 05 82 00 00 00 0F 81 01 00 00 __01 00__ 00 00 00 00 00 00 00 00

The communication connection between the COM10 module and SENTRON VL is interrupted:

__08__ 0C 00 xx 80 C0 42 __01__ 05 82 00 00 00 0F 81 01 00 00 __00 01__ 00 00 00 00 00 00 00 00

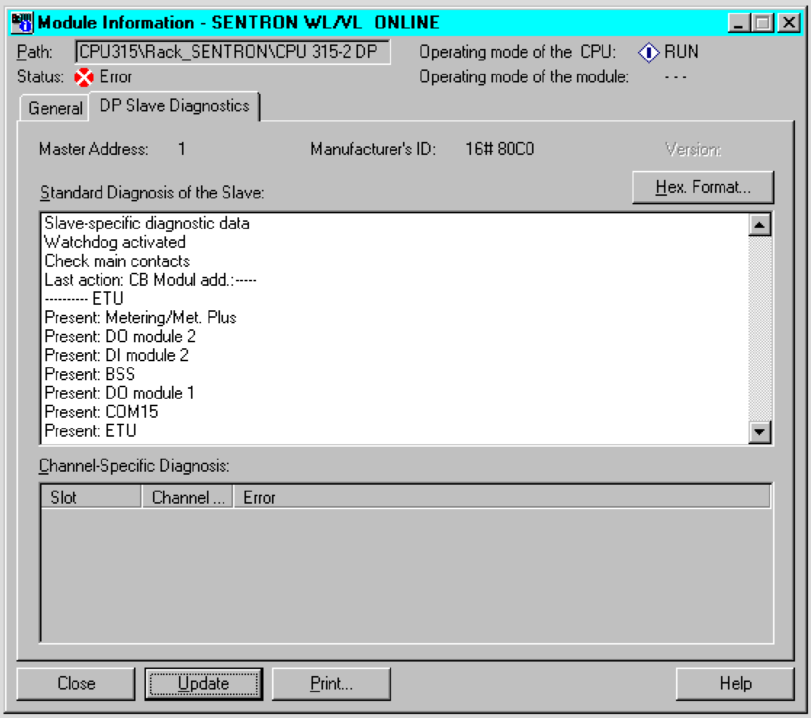


Fig. 4-10 *Online diagnosis in the STEP7 HWConfig tool displays the diagnostic information in text form. The modules recognized on the* **CubicleBUS** *and the last action on the* **CubicleBUS** *are indicated. Maintenance information is also available.*

Diagnostic Alarm for S7 and Operating Mode S7V1

If the SENTRON circuit-breakers are configured using the Object Manager, they are activated in operating mode S7V1. In this case, a diagnostic message does not automatically result in OB82 being executed. Diagnostic alarms are not supported.

The diagnostic information can, however, be read at any time by the slave via SFC13.

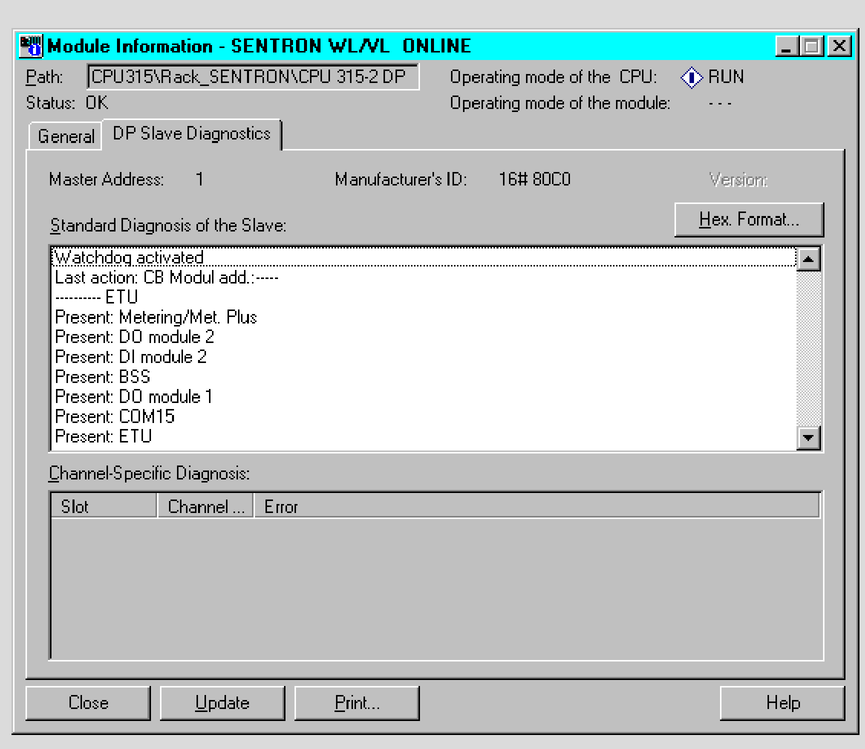


Fig. 4-11 *The SENTRON WL diagnostic information is currently in the S7 diagnosis buffer. An incoming diagnostic message is not present.*

Data Exchange via DPV1

PROFIBUS-DPV1 (DPV1) is an enhancement of the PROFIBUS-DP protocol. PROFIBUS-DP and DPV1 devices can be connected to one line. Being downwards compatible, the PROFIBUS-DP and DPV1 protocol can run on the same line. With DPV1, additional data records with up to 240 bytes of user data can be transmitted acyclically by means of user programs, such as STEP7, Switch ES Power, or WinCC.

In this way, the DPV1 protocol can be used to transmit parameter, diagnostic, control, and test data quickly and easily.

One prerequisite here is that a DPV1-capable class 1 master or class 2 master is available. These can be used to transmit the above data via an additional channel.

With the class 2 master, a communication link can even be established to slaves that have not been configured or parameterised by this master and are still connected to a class 1 master. A class 2 master is particularly suitable for commissioning, diagnosis, and visualization tasks with the programs Switch ES Power or WinCC, for example.

Special system functions that enable data records to be sent and received are available in SIMATIC S7 for enhanced data transmission via DPV1.
The following example illustrates how a data record is read and written from SENTRON WL/VL. System functions SFC58 (write) and SFC59 (read) are used.

Note: The value specified for parameter "IOID" depends on the logical base address "LADDR". The smaller input or output address, which is displayed or was entered under DP Slave Properties on the "Address / ID" tab page, is always used as the logical base address. Depending on whether an input or output address exists, the IDs 'B#16#54' for the input and 'B#16#55' for the output are specified for the 'IOID' parameter. If the input and output addresses are identical, the ID 'B#16#54' for inputs is also parameterised.

For more information on the system functions, refer to the reference manual 'System Software for S7-300/400 System and Standard Functions'.

Cyclic (recurring) use of acyclic services

If data is to be read via the C1 channel (DPV1 class 1 master) or C2 channel (DPV1 class 2 master, e.g. Switch ES Power) in a recurring time frame, the minimum interval between two read requests for each channel must be **200ms**.

Write requests via the C1 or C2 channel should generally be sent on an event-controlled basis rather than in a recurring time frame.

If these intervals are undershot, resource problems can occur in the communication interfaces, which could, in turn, result in communication on the C1 and/or C2 channels being interrupted.

Example: Reading and Writing Data Records with an S7

This example is based on an S7-300 CPU with an integrated DP interface and STEP7 Version 5.1.

Writing data records

In this example, SFC58 is used to write the protection parameters to DS129. The data is stored in DB 129 and contains the current parameters, which are to be sent to the circuit-breaker. In this example, the logical base address is the same for the inputs and outputs, that is, ID 'W#16#54' is specified. The request is triggered with an edge on marker M20.0 and reset with an edge on M20.1 once it has been processed successfully, enabling the user to control how the data record is written. The time required to process the request depends on the system configuration and may take several CPU cycles.

If a fault occurs, MW22 is available for information purposes. For more information, refer to the reference manual "System Manual for S7 300/400 System and Standard Functions".

Reading data records

In this example, DR94 (operating data) is read using SFC59. The data is stored in DB 94 and contains the current circuit-breaker operating data.

Since the operating principle and parameters are identical to system function SFC58, it will not be discussed in any further detail here.

```
CALL  "WR_REC"
 REQ    :=M20.0
 IOID   :=B#16#54
 LADDR  :=W#16#100
 RECNUM :=B#16#81
 RECORD :=P#DB129.DBX 0.0 BYTE 139
 RET_VAL:=MW22
 BUSY   :=M20.1

U     M     20.0
UN    M     20.1
R     M     20.0
```

Fig. 4-12 *The STEP7 program code shows how the entire DR129 is written from DB129 to the device. The write process is triggered once by marker M20.0.*

```
CALL  "RD_REC"
 REQ    :=M20.4
 IOID   :=B#16#54
 LADDR  :=W#16#100
 RECNUM :=B#16#5E
 RET_VAL:=MW24
 BUSY   :=M20.5
 RECORD :=P#DB94.DBX 0.0 BYTE 197

U     M     20.4
UN    M     20.5
R     M     20.4
```

Fig. 4-13 *This program example shows how DR94 is read and stored in DB94 in STEP7. The process is triggered by setting marker M20.4. Cyclic updates are not carried out.*

Certificate

PROFIBUS Nutzerorganisation e.V. grants to

Siemens AG, A&D CD PD VM
Werner-von-Siemens-Str. 50, D-91052 Erlangen
the Certificate No.: **Z00723** for the following product:

Name:	**SENTRON WL, SENTRON VL**
Model:	**PROFIBUS DP Modul für den offenen Leistungsschalter SENTRON WL; Switchgear**
Revision:	**V1.0; SW: V1.0**
GSD:	**SIEM80C0.gsd**

This certificate confirms that the device has successfully passed the conformance tests for PROFIBUS-DP Slave devices.

The tests were executed in accordance with "Test Specifications for PROFIBUS DP Slaves, Version 2.0, February 2000" based on EN 50170-2 at Siemens AG in Fürth and PROFIBUS Interface Center in Johnson City, USA, which is an authorized test laboratory of PROFIBUS Nutzerorganisation. The detailed test procedure and the test results are recorded in the inspection report 320-1 (Fürth) and 069-1 (USA).

This certificate is granted according to the PNO guideline for testing and certification (PRZ) dated August 1, 1999 and is valid for 3 years, i.e. until October 11, 2004.

Karlsruhe, March 13, 2002

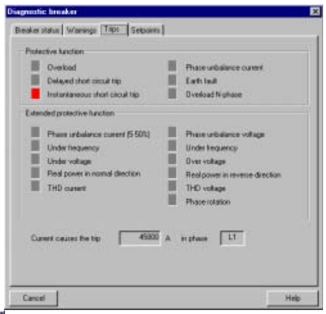
(Official in Charge)

Board of PROFIBUS Nutzerorganisation e. V.

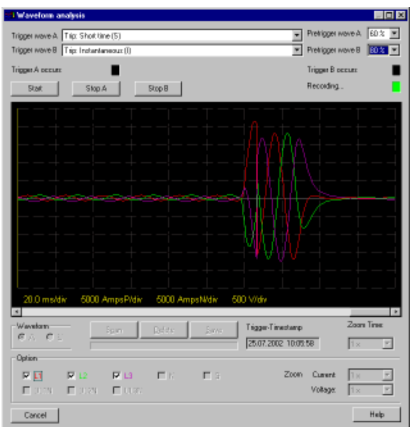
(K.-P. Willems)

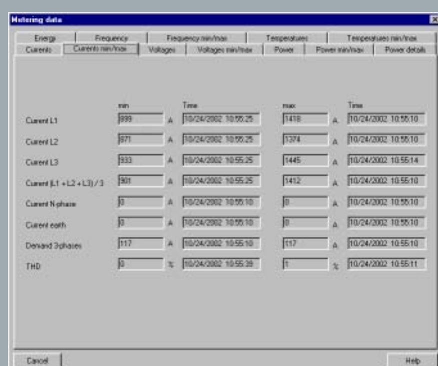
(Prof. K. Bender)

Fig. 4-14 *It has recently been decided to issue separate certificates for SENTRON WL and SENTRON VL. It used to be the case that two products tested in two different test centers (Fürth, Germany, and Johnson City, USA) were issued a common PROFIBUS certificate.*


Diagnostic breaker


Main overview


Waveform analysis


Metering data

Switch ES Power

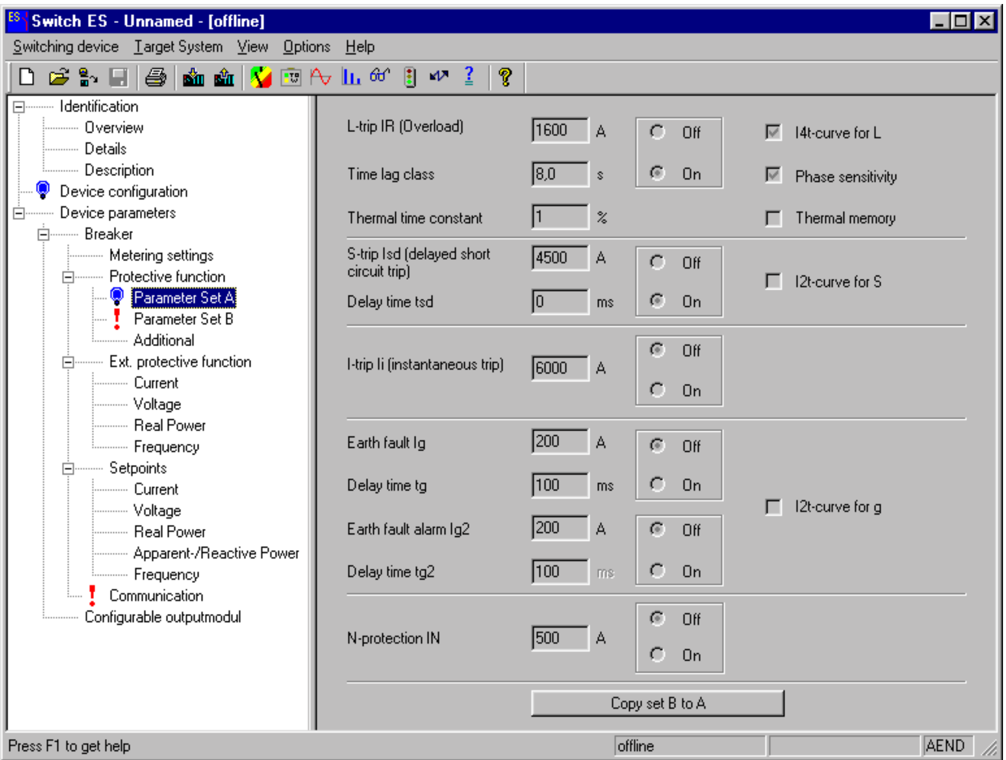
Type of delivery, system requirements and installation

Integration of SENTRON circuit breakers into S7 using the object manager

Creating a Switch ES Power file

The Switch ES Power User Interface

Menu structure of Switch ES Power



5

Switch ES Power

Parameterising, Operating, Monitoring, and Testing SENTRON Circuit-Breakers via the PROFIBUS-DP

As a joint software platform for device-specific versions of communications-capable switching devices, Switch ES Power enables you to parameterise, operate, monitor, and diagnose SENTRON VL and SENTRON WL circuit-breakers. With the Object Manager provided, you can fully integrate the SENTRON circuit-breakers in STEP7.

What is Switch ES Power?

Switch ES Power is a user-friendly tool that enables you to parameterise communications-capable circuit-breakers during commissioning and monitor them during operation. It also provides detailed information for diagnostic purposes during servicing. For preventative maintenance purposes, it enables you to read a wide range of statistical data (e.g. operating hours, current causing the trip, etc.) and supports many different auxiliary functions and plain-text displays.

Switch ES Power uses the new DPV1 communication protocol to communicate with the SENTRON circuit-breakers via the PROFIBUS-DP. Acyclic communication channels enable the SENTRON circuit-breakers to communicate with a class 1 PROFIBUS-DP master (e.g. PLC) and Switch ES Power simultaneously.

Switch ES Power can be used either as a stand-alone program or integrated in STEP7 (as of V5.1 SP3) via the Object Manager.

Switch ES Power enables you to save a great deal of time during both commissioning and operation. All the parameters are displayed and set in plain text, and detailed information on each parameter is available in the online help. This helps prevent mistakes and incorrect entries right from the start.

Type of Delivery

Switch ES Power is available on CD-ROM (order no.: 3WL6 111-0AS01)
The CD-ROM also features:

- Internet Explorer for displaying the HTML online help and printing data
- Acrobat Reader for opening manuals / operating instructions in PDF format
- Communication manual for SENTRON circuit-breakers
- GSD file

About this Chapter

This chapter describes the Switch ES functions. Basic Windows functions (such as "Print" and "Save") are not described. To use Switch ES Power, you must ensure that the following requirements and prerequisites are fulfilled:

Software Requirements

- Operating systems: Microsoft Windows 95/98, NT 4.x, 2000, or ME, XP Professional
- Internet Explorer V4.01 (or higher) for online help (on CD-ROM).
- Switch ES Power V 1.0 as a stand-alone program
  – for parameterising, monitoring, diagnosing, and testing the circuit-breakers.
- STEP7 Object Manager for integrating the circuit-breakers as an S7 slave in SIMATIC S7
  – for accessing Switch ES from STEP7
  – System requirements:
  – SIMATIC: S7, M7, C7, PCS7
  – STEP7: Version 5.1 SP3 or higher

Hardware Requirements

- PROFIBUS-DP interface: CP5411 (ISA), CP5412 (ISA), CP5511 (PCMCIA), CP5611 (PCI), CP5613, CP5614, and MPI interface on PG7xx and its driver software (see the interactive CA01 catalog)
- CD-ROM drive

Notes/ Required Knowledge

- Read the operating instructions / device manuals for the SENTRON circuit-breakers
- You will require a knowledge of Microsoft Windows®
- Grayed-out buttons indicate that a particular function is not active/ not available.

Online with Switch ES Power

For online operation, the circuit-breaker must be connected to the PC/PG via the PROFIBUS-DP.

Two different access types are supported in online mode:

- Access via the appropriate menu command only (e.g. with **Switching device > Open online**). Switch ES reads the data from the circuit-breaker once. The parameters are processed in the main memory of the PC/PG.
  With **Target system > Load to switching device**, Switch ES writes the data back.
- Cyclic access (e.g. with **Target system > Circuit-breaker diagnosis**.
  The diagnostic data is updated every second.

Offline with Switch ES Power

For offline operation, the circuit-breaker must not be connected to the PC/PG. In this case, the menu commands for online mode are grayed out (not active).

In offline mode, device parameters can be entered, processed, and stored in a file before commissioning.

Installing the Software

Read the "readme.txt" file before installing Switch ES Power.

The installation program starts automatically after you have inserted the CD. If the automatic startup function is deactivated on your computer, proceed as follows when installing Switch ES, OM Switch (integration in STEP7), and/or the other components:

1. Insert the Switch ES CD in the CD-ROM drive.
2. Open the root directory in this drive.
3. Start the setup program by double-clicking the "setup.exe" file.
   The setup program guides you through the complete procedure for installing Switch ES, OM Switch, and the other components.

If the Switch ES Power Object Manager is to be installed, Switch ES must already be installed on your computer. When you install the Object Manager, the settings for the SENTRON circuit-breakers are included in the STEP7 hardware configuration on the computer. Once you have installed the Object Manager, the new meta files are generated when you start the SIMATIC Manager. The SENTRON circuit-breakers are now available in the hardware catalog under "PROFIBUS - Switching devices - Circuit-breakers".

Caution: To install Switch ES Power and the Object Manager, administrator rights are required on computers with the Windows NT4.0, 2000, and XP Professional operating systems.

Fig. 5-1 *Installing Switch ES Power and other components. Before integrating into STEP7 Switch ES Power must be installed first.*

Once you have closed the setup program and, if necessary, restarted your computer, start Switch ES as follows:

Starting the Switch ES Power program on the PC

- Double-click the "Switch ES" icon on the desktop
- Choose **Start > SIRIUS NET > Switch ES**

Starting the Switch ES Power program from HWConfig in STEP7 (integration via the Object Manager)

Proceed as follows:

- Start the SIMATIC Manager and, from here, HWConfig.
- When you install the Object Manager, the SENTRON nodes are inserted under "PROFIBUS - Switching devices". Drag and drop the SENTRON circuit-breaker you require and the base type you have selected to the PROFIBUS-DP line.
- Right-click the address line. The Properties window is now displayed.
- Choose the "Parameters" tab page. The data is transferred from STEP7 to Switch ES Power.
- Now start Switch ES Power. You first have to configure the appropriate circuit-breaker in the device configuration.
- Then set the parameters for this circuit-breaker.
- End Switch ES Power by choosing Switching device > End, and return to STEP7. The parameters that you have set are now stored in STEP7 and will be transferred to the circuit-breaker when you start the system.
- Proceed in the same way to configure further circuit-breakers.
- If parameters are to be modified, you have to call up Switch ES Power again from HWConfig to ensure that data is stored consistently.

Caution:

If the PROFIBUS write protection function on the circuit-breaker is active when the PROFIBUS-DP starts (automatic parameter download), the downloaded parameters will be ignored.

Example of Operation

The following example shows you how to use Switch ES Power. See Fig. 5-3.

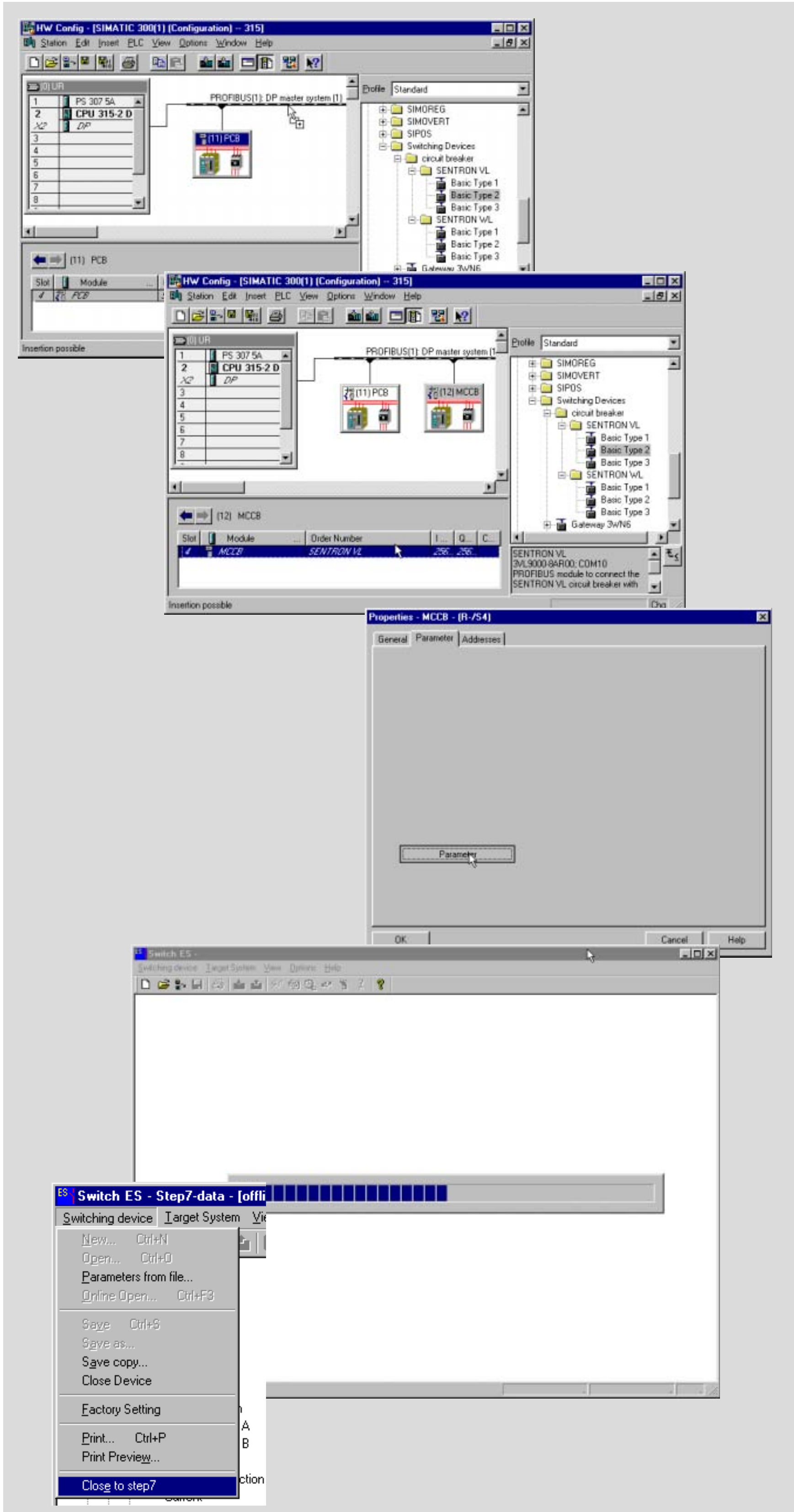
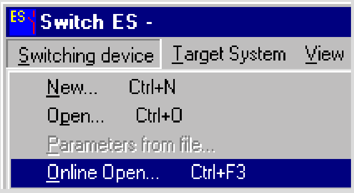


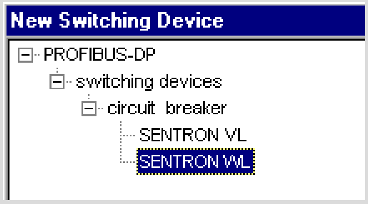
Fig. 5-2 *You can integrate Switch ES Power in STEP7 using the Object Manager provided. The parameters that you set here are copied to the STEP7 data storage system and loaded to the circuit-breaker when you restart the system.*

Example:
Creating a Switch ES File

1. Switching device > New

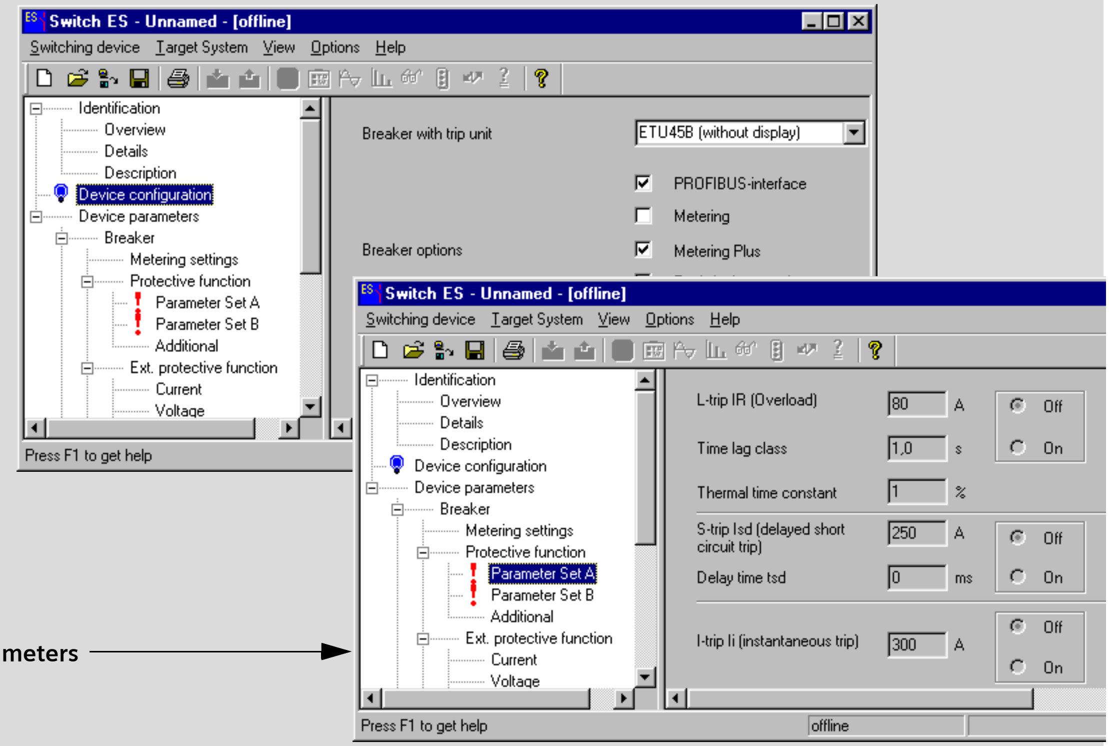
Select a new switching device



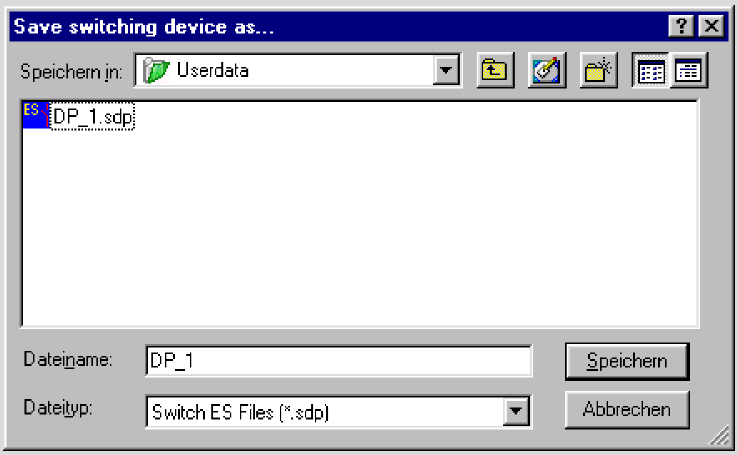


2. Configure the device

3. Enter the parameters



4. Save the file



Required entries (!):

- Device configuration
- Parameter set A/B
- Communication

Fig. 5-3 *Creating a Switch ES file.*

Switch ES User Interface

Title Bar

The title bar contains:

- The path for the sdp file (**S**witching **D**evice **P**arameters).
- The device status (online / offline). In online mode, the title bar is light blue.
- The PROFIBUS-DP address when the device is in online mode.

Menu Bar

The menu bar contains the following menus:

- Switching device
- Target system
- View
- Extras
- Help

Toolbar

The toolbar contains icons that you can click to call up certain menu options. When you place the cursor on an icon for approx. one second, the system displays a plain-text description of the function.

Main Window

The optional parameters are displayed on the right-hand side of the main window, while the required parameters are displayed on the left-hand side (e.g. with **Switching device > New** or **Switching device > Factory setting**, and indicated with a !).

Once you have modified and confirmed these values, the system displays a in the window on the left.

Status Bar

The status bar contains:

- The message "Press F1 for help".
- The device status (online or offline). When Switch ES is in online mode, the text "Online" scrolls across this line.

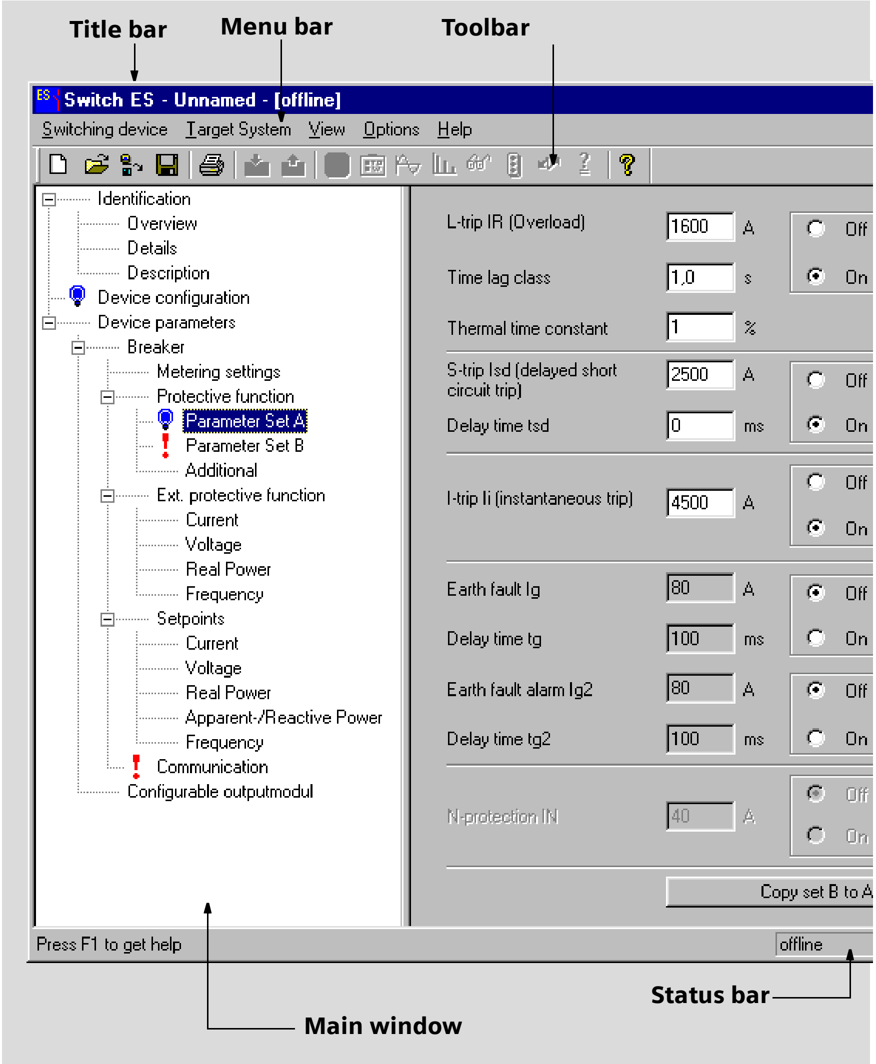


Fig. 5-4 *Switch ES user interface*

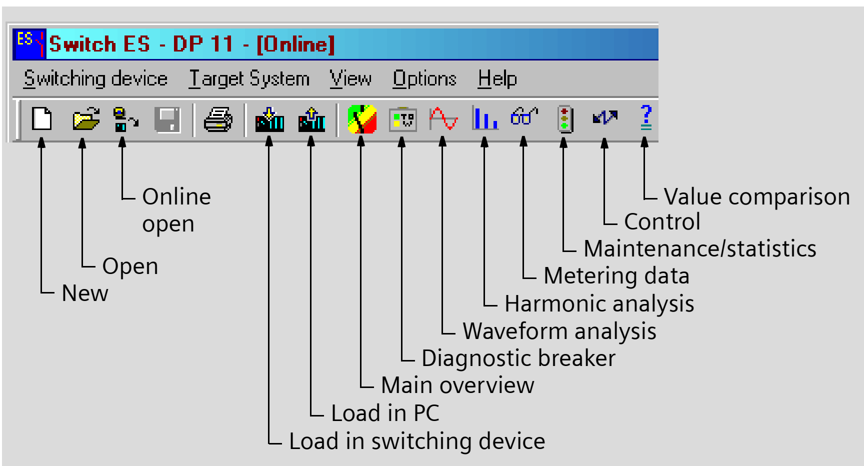


Fig. 5-5 *The most important functions of Switch ES Power can directly be reached by pressing the buttons in the toolbar.*

Switch ES Menu Structure

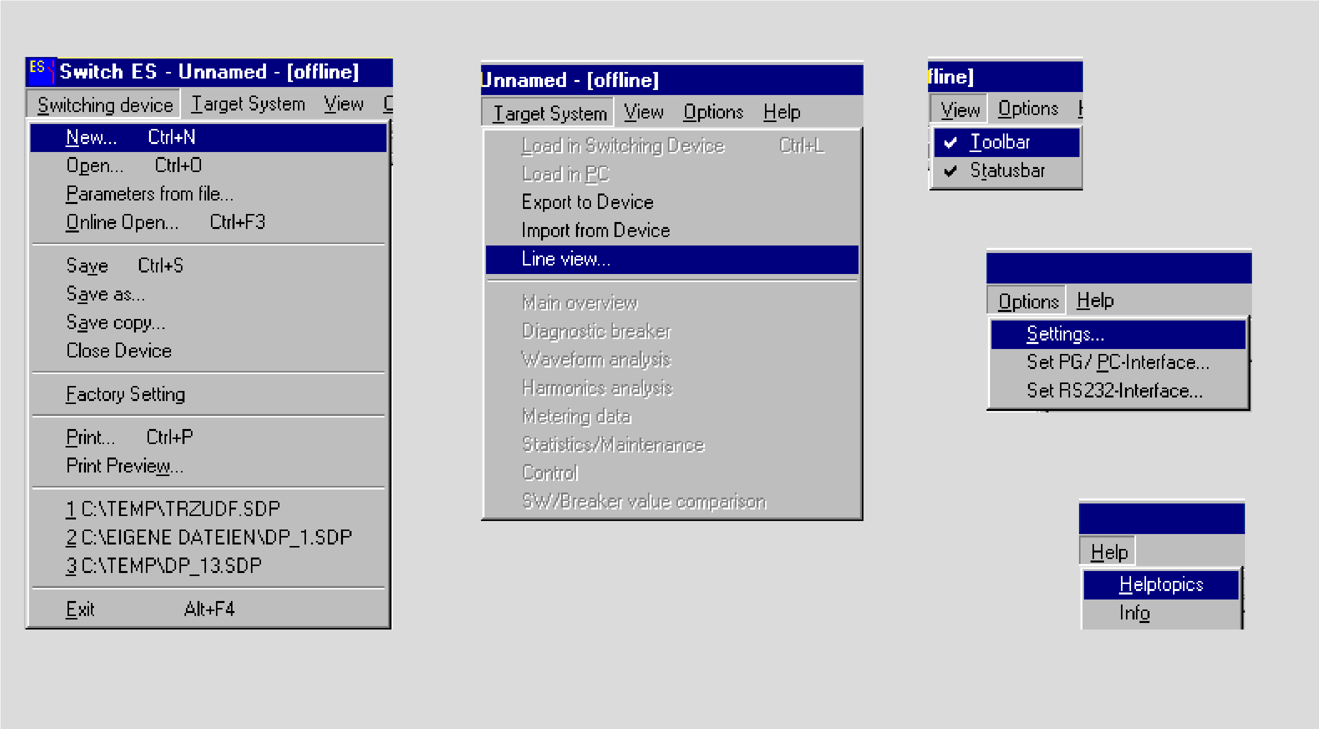


Fig. 5-6 *These screenshots show how the Switch ES Power menus are structured. Under "Switching device", you can save or print parameters, for example. Under "Target system", you can activate the online windows.*

Switching Device

- New...
  Display the existing switching devices and select one to edit it.
- Open...
  Open files. All Switch ES files have the extension *.sdp (switching device parameters).
- Parameters from file... (import)
  Read parameters from a Switch ES file and edit them.
  Note
  When you choose this menu option, the system does not prompt you to confirm this action and the parameters in the main memory are overwritten immediately.
- Open online...
  Read data records from a switching device to the main memory. This command requires a connection between your PC and the switching device.
- Save
  Save parameters in standard format (*.sdp) on a storage medium.
- Save as...
  Save the current data under a new name.
- Save copy as...(export)
  Copy data from the main memory to a Switch ES file.
- Close switching device
  Close the switching device. If the parameters have been modified, they can be
  – saved in a file if they were opened with Switching device > New or Switching device > Open
  – loaded to the switching device if they were opened with Switching device >Open online
- In both cases, the system displays a safety prompt asking you whether the switching device is to be saved or loaded.

Target System

- Load to switching device
  Load the current parameters to the switching device.
- Load to PC
  Load the current parameters from the switching device to the PC.
- Export to switching device
  Load the current parameters via the PROFIBUS-DP to a switching device (except the PROFIBUS-DP address). This menu option enables you to duplicate device parameters in other switching devices.
- Import from switching device
  Load the current parameter via the PROFIBUS-DP from a switching device to the PC (except the PROFIBUS-DP address).
- Line view
  The line view shows the slaves that are connected to the PROFIBUS-DP line on one screen. This enables you to easily identify which devices can be opened and processed with Switch ES.

Target System *(continued)*

• Main Overview

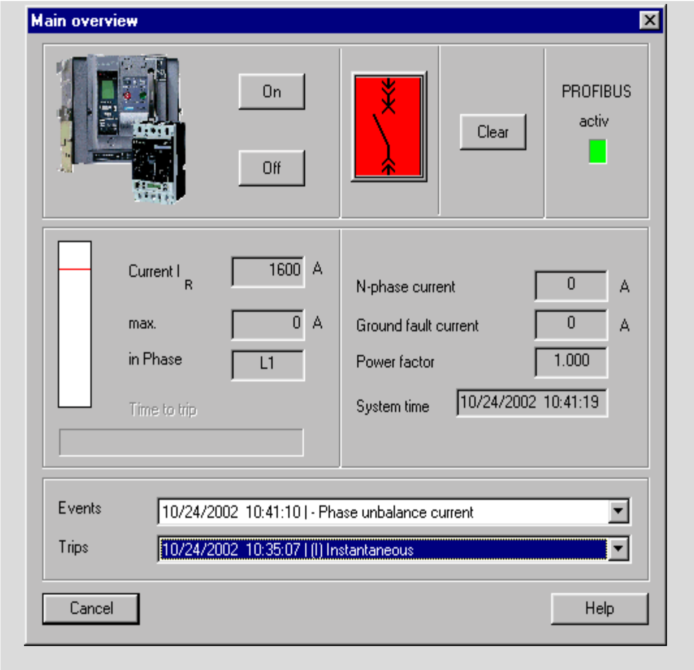


Fig. 5-7 *The "Main Overview" window displays all the key information on the SENTRON circuit-breaker.*

The "Main Overview" window displays all the key information on the circuit-breaker, and is divided into different sections.

- Status window (circuit-breaker closed/open, position in the frame); when the background color is green, no warning, trip, or threshold value warning is present; red, however, indicates that the last trip has not yet been acknowledged, while yellow indicates that a warning or threshold value warning is present.
- The current bar shows the ratio of the current to overload parameter I_R (indicated by the red line). It also takes into account whether parameter set A or B is active.
- Time remaining until trip (in the event of an overload)
- Measured values and time
- PROFIBUS communication shows the connection status with a class 1 PROFIBUS-DP master (green = active; red = no communication)
- Event log containing the last ten events
- Tripped log containing the last five trips
- The circuit-breaker status can be changed using the Closed/Open/Clear buttons.

• Circuit-Breaker Diagnosis

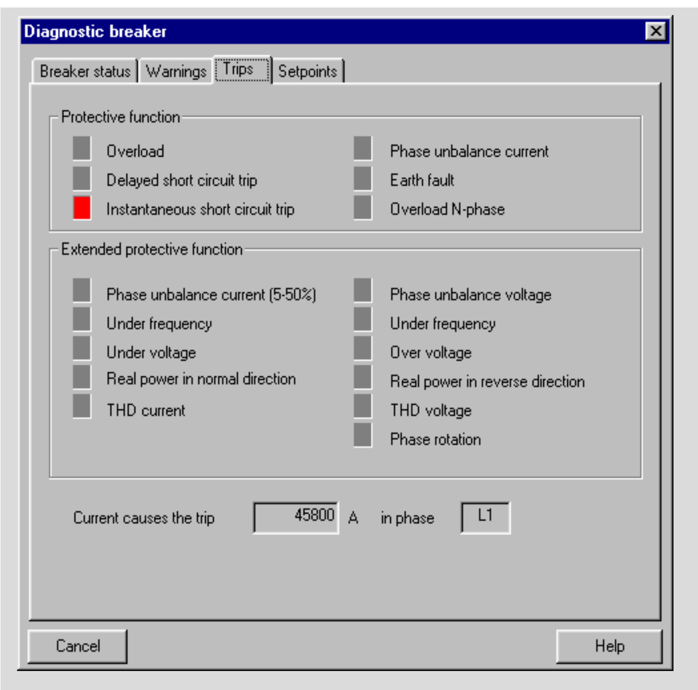


Fig. 5-8 *The four tab pages in the "Circuit-Breaker Diagnosis" window enable you to diagnose the current status of the circuit-breaker.*

The online "Circuit-Breaker Diagnosis" window comprises four tab pages:

- The "Circuit-breaker status" tab page displays key information on the status: status of the storage spring, PROFIBUS write protection block, **Cubicle**BUS communication, ready-to-close, general warnings and tripped signals, etc.
- A yellow LED on the "Warnings" tab page indicates warnings that are currently present.
- The "Trips" tab page (see Fig. 5-7) displays the last trip (if it has not yet been acknowledged).
- Activated (green) and exceeded threshold values (yellow) are displayed on the "Setpoints" tab page. These are only available in conjunction with the measurement function or measurement function *Plus*.

Target System *(continued)*

- Waveform Analysis

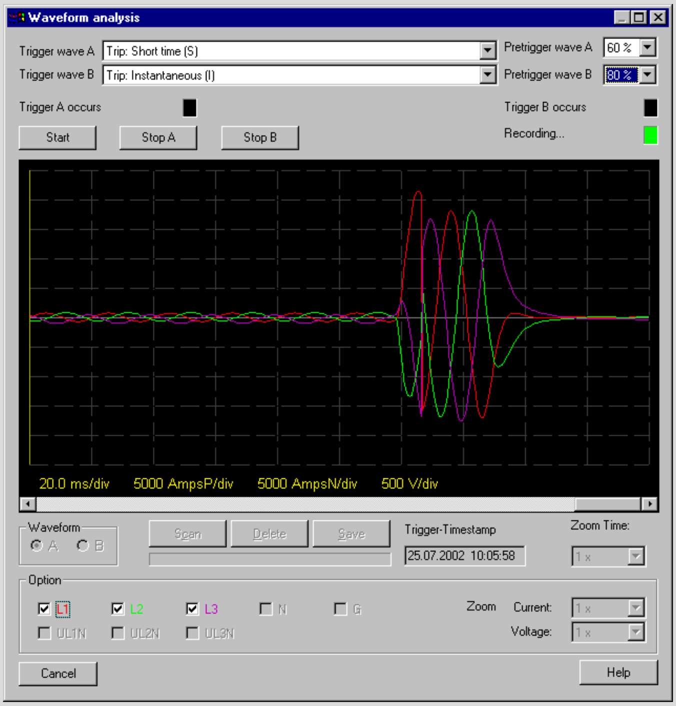


Fig. 5-9 *The two available waveform buffer enable currents and voltages to be recorded on an event-controlled basis.*

The waveform analysis function is only available if the SENTRON WL circuit-breaker is equipped with the metering function *Plus*. The metering function *Plus* features two waveform memories. The current values (I_{L1}, I_{L2}, I_{L3}, I_N and I_g) and the three phase-to-phase voltages (U_{L12}, U_{L23} and U_{L31}) are continuously "pushed" through the two buffers. This process can be stopped by means of user-defined events, thereby creating an instantaneous "snapshot" of the network.

Each buffer can be stopped individually and restarted manually. Both buffers (A and B) contain 1,649 values for each current phase or phase to phase voltage. These are distributed uniformly over a period of 1 second, which means that a measured value is present approximately every 0.6ms. So with a network frequency of 50Hz, approximately 33 measured values exist per fundamental wave (2π).

When the buffers are "frozen", all eight channels are always stopped simultaneously. You can set the position of the trigger event anywhere between 0% and 100%, so you can decide whether your analysis focuses on the pre-history or post-event history.

Trigger events include all tripped signals, alarm signals, and threshold value warnings. The data can also be exported.

- Harmonic Analysis

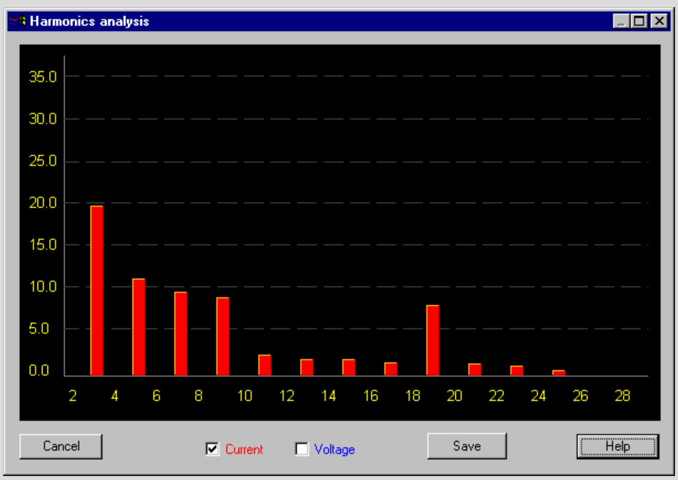


Fig. 5-10 *The metering function Plus analyzes the current and voltage harmonics and displays the results.*

This function is only available with the SENTRON WL and metering function *Plus*. The metering function *Plus* calculates the current and voltage harmonics separately and displays them in this window, which is updated approximately every five seconds.

The data for the calculated harmonics is output in the Excel-compatible *.csv format and stored in the "\UserData" sub-directory. The measurement results can then be integrated in a log file.

Target System *(continued)*

• Operating Data

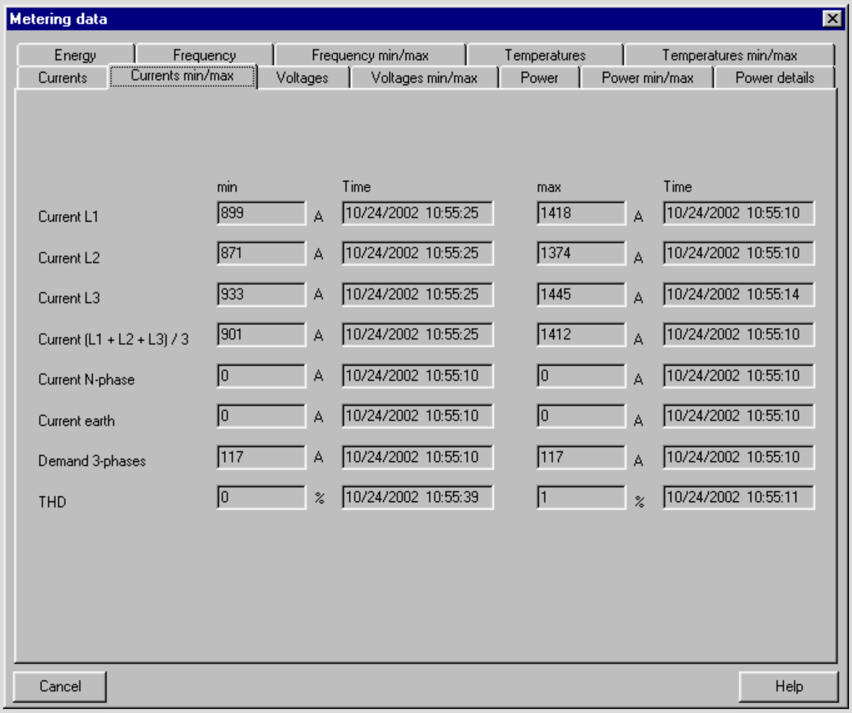


Fig. 5-11 *The online "Operating Data" window displays the current measured values.*

The amount of operating data available depends on how the circuit-breaker is equipped. Data that is not available is grayed out.

The current measured values and the minimum/maximum measured values (with time stamp) are displayed on twelve different tab pages.

• Maintenance and Statistics

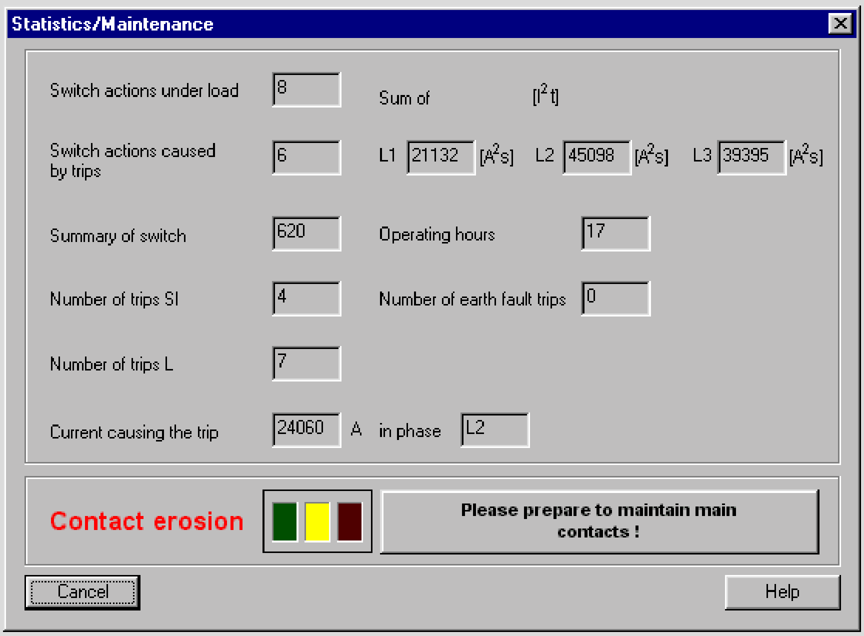


Fig. 5-12 *Statistical data and maintenance notes enable preventative maintenance measures to be taken and are required to prevent costly downtimes.*

Preventative maintenance is carried out on the basis of the maintenance and statistical data available. This allows the state of the main SENTRON WL contacts to be determined empirically and maintenance notes to be issued.

Certain statistical data can be reset via the online "General Operation" window.

Target System *(continued)*

- Control general

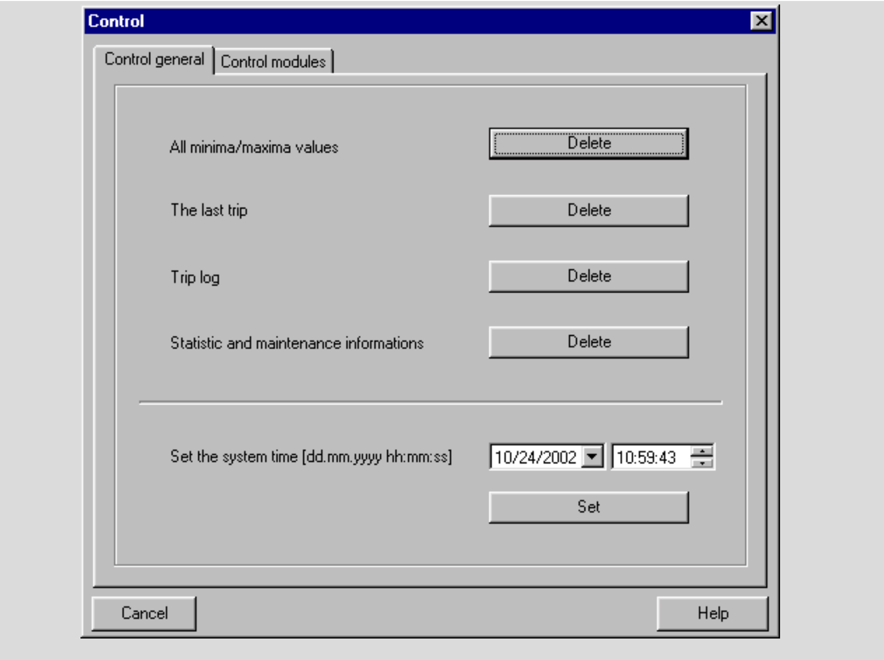


Fig. 5-13 *The online "General Operation" window enables you, for example, to reset the min./max. memories and set the system time.*

This window enables you to delete different memories and set the system time. It also displays the current computer time, which is transferred to the circuit-breaker either as it is or after it has been adjusted with "Set".

Caution:

If the maintenance data is reset without the main contacts having been replaced, the status determined for the main contacts no longer matches the actual status. This can destroy the main contacts.

- Control modules

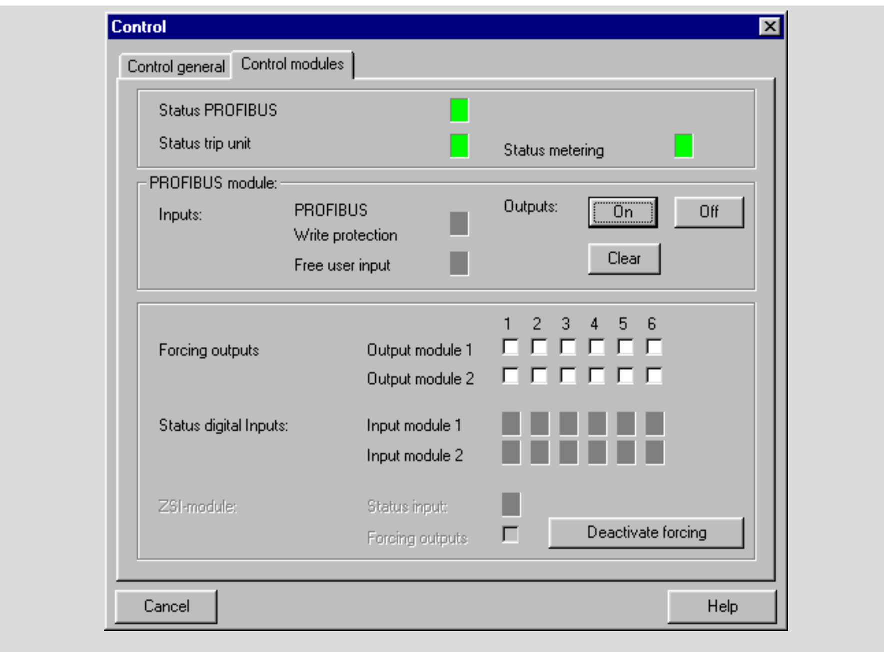


Fig. 5-14 *This window enables you, for example, to test the wiring of the digital output modules.*

This window is used for diagnostic purposes and supports you during commissioning. It displays the status of the PROFIBUS-DP modules, the trip unit, and the measurement function. It also displays the inputs and outputs of the **Cubicle**BUS modules. The outputs can be forced (overwritten) to check the external wiring. After 30 seconds, the outputs are reset to their original value.

Target System *(continued)*

- Setpoint/Actual Value Comparison

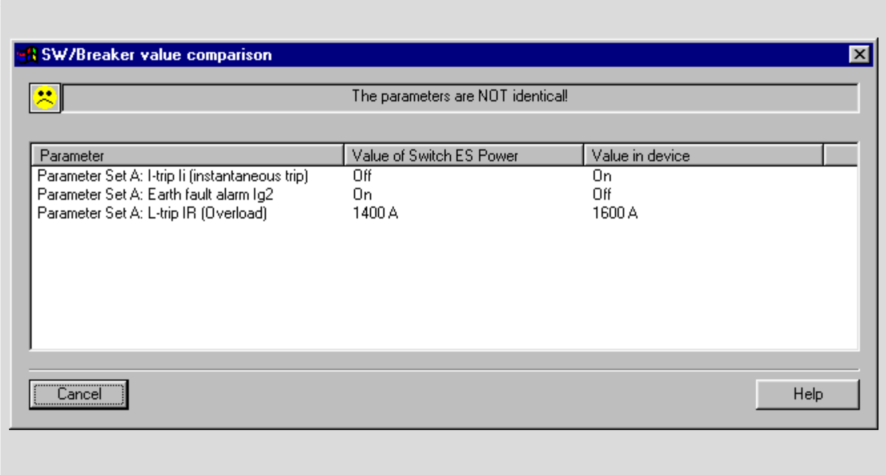


Fig. 5-15 *A setpoint/actual value comparison enables the circuit-breaker and Switch ES Power parameters to be compared online.*

A setpoint/actual value comparison compares the current parameters in the computer with those in the device. This enables you to check, for example, whether:

- all the parameters that were downloaded have been copied
- the parameters still match the data documented during commissioning
- the parameters match the parameters in other circuit-breakers

View

- Status bar
  Display/hide the status bar at the bottom of the application window
- Toolbar
  Display/hide the toolbar at the top of the application window

Extras

- Settings
  By choosing Extras> Settings, you can change different application settings.
  – Language
  – Directory
  – Display the startup screen
- Set PC/PG interface

Help

- Help topics
  Help topics on parameterising switching devices.
- Info
  Here, you can find information on:
  – The Switch ES version
  – Copyright
  – Software support

Different Data Displays

Switch ES Power can be used for all communications-capable SENTRON VL and SENTRON WL circuit-breakers. They differ considerably with regard to the parameters, measured values, and status information available.

The amount of data available depends on the type of circuit-breaker that has been configured. Switch ES Power displays the data in different ways to take this into account. Fig. 5-15 illustrates this using overload parameter I_R as an example.

Setting Parameters

When you leave a parameter input field, the system automatically checks the value that you entered. The following is checked:

- The format: you cannot enter letters in a number field
- Has the minimum or maximum defined value been violated? If so, the system enters the minimum or maximum value automatically.
- "Invalid" values (e.g. 1423 A) are rounded up or down using an increment table. In this example, 1423 A becomes 1400 A.

Caution:

Parameters that you enter are not written to the program-internal memory until they have been checked. If, when you have completed an entry, you do not move to another parameter input field using, for example, the TAB key or the mouse, the parameter is not confirmed and will, therefore, not be downloaded to the device.

Caution:

In the SENTRON VL, incorrect values are not adjusted automatically. Parameters defined as invalid in the SENTRON VL are ignored. Table 5-1 shows which parameters are valid.

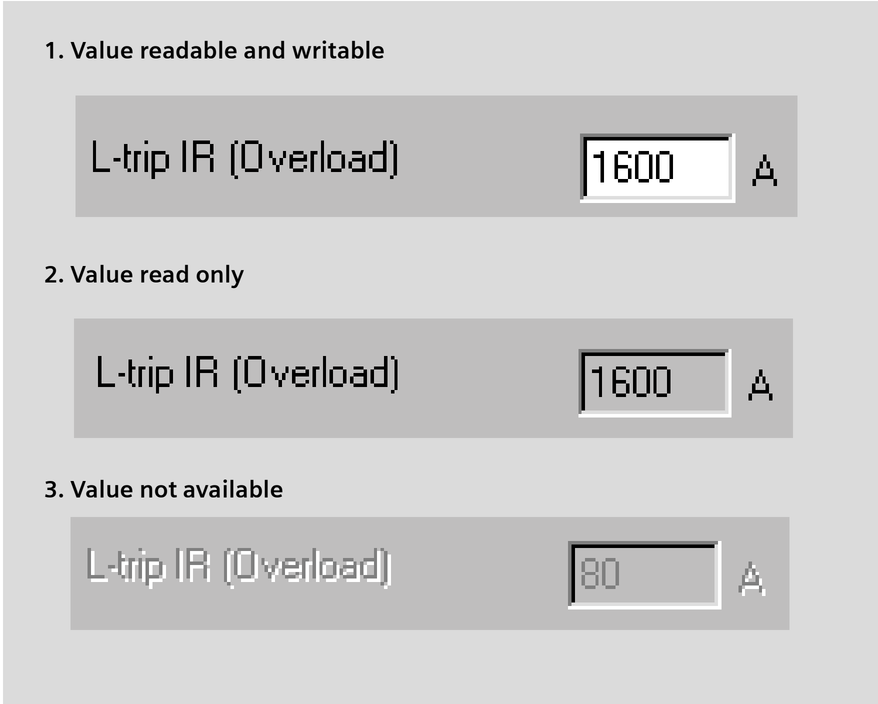
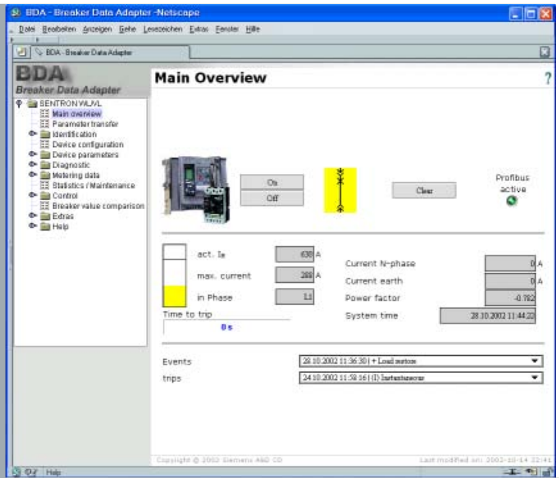
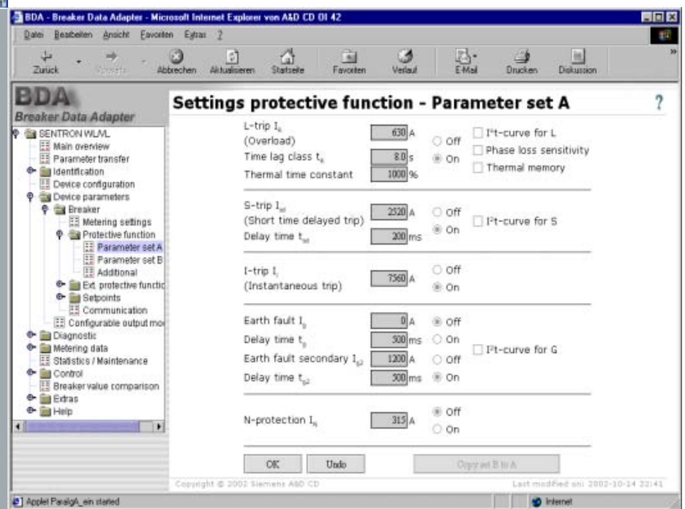


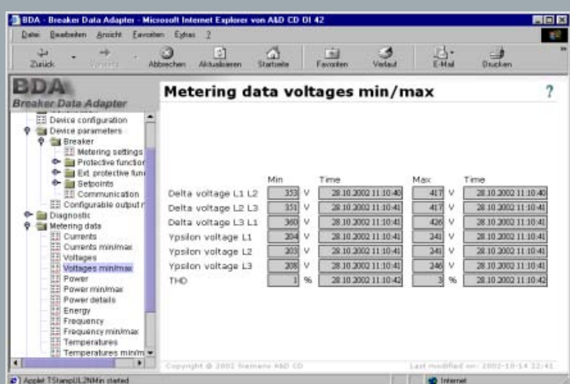
Fig. 5-16 *This display indicates which data in the extensive data library is available when the circuit-breaker is connected (online) or selected (offline).*

Valid SENTRON VL parameters	
Current phase asymmetry	5 to 50% in steps of 5%
Overload parameter I_R	0.4 to 1.0 x rated circuit-breaker current
Time-lag class t_R	25, 40, 60, 80, 100, 140, 170, 200, 250, or 300 s
Instantaneous short-circuit protection I_i	78 to 17600 (1.25 to 11 x rated circuit-breaker current)
Delayed short-circuit protection I_i	94 to 1600 (1.5 to 10 x rated circuit-breaker current)
Short-circuit protection delay time t_{sd}	100, 200, 300, 400, or 500 ms
Earth fault protection I_g	25 to 1600 (0.4 to 1.0 x rated circuit-breaker current)
Earth fault protection delay time t_g	100, 200, 300, 400, or 500 ms
Neutral conductor overload protection I_N	0.5 to 1.0x rated circuit-breaker current in steps of 5% (0.05)

Table 5-1 *This table shows which SENTRON VL parameters are valid. The SENTRON VL will not copy any parameters that do not match the possible values.*


BDA - Breaker Data Adapter -Netscape
Main Overview
SENTRON WL/VL
Main overview
Parameter transfer
Identification
Device configuration
Device parameters
Diagnostic
Metering data
Statistics / Maintenance
Control
Breaker value comparison
Extras
Help
On
Off
Clear
Profibus active
act. Ia
max. current
in Phase
Time to trip
Current N-phase
Current earth
Power factor
System time
Events
trips


BDA - Breaker Data Adapter - Microsoft Internet Explorer von A&D CD DI 42
Settings protective function - Parameter set A
L-trip
(Overload)
Time lag class
Thermal time constant
Phase loss sensitivity
Thermal memory
S-trip
(Short time delayed trip)
Delay time
I-trip
(Instantaneous trip)
Earth fault
Delay time
Earth fault secondary
Delay time
N-protection
Off
On
OK
Undo
Main overview
Parameter transfer
Identification
Device configuration
Device parameters
Breaker
Metering settings
Protective function
Parameter set A
Parameter set B
Additional
Setpoints
Communication
Diagnostic
Metering data
Statistics / Maintenance
Control
Breaker value comparison
Extras
Help


BDA - Breaker Data Adapter - Microsoft Internet Explorer von A&D CD DI 42
Metering data voltages min/max
Min
Time
Max
Time
Delta voltage L1 L2
Delta voltage L2 L3
Delta voltage L3 L1
Ypsilon voltage L1
Ypsilon voltage L2
Ypsilon voltage L3
THD
Device configuration
Device parameters
Breaker
Metering settings
Setpoints
Communication
Diagnostic
Metering data
Currents
Currents min/max
Voltages
Voltages min/max
Power
Power min/max
Power details
Energy
Frequency
Frequency min/max
Temperatures


SENTRON BreakerDataAdapter - Microsoft Internet Explorer provided by A&D CD
SENTRON BreakerDataAdapter
bda
SIEMENS
Java Information
Deutsch
English

Breaker Data Adapter (BDA) Breaker Data Adapter *Plus* (BDA *Plus*)

6

The Breaker Data Adapter (BDA) and BDA *Plus*

Brief Description and System Requirements

The breaker data adapter (BDA) is the first circuit-breaker parameterisation device to feature an integrated webserver to parameterise, operate, monitor, and diagnose the SENTRON WL and SENTRON VL circuit-breakers. The BDA *Plus* also features an Ethernet interface for connection to the Ethernet, intranet, or Internet.

Description

The BDA can be used to read and change the parameters of the SENTRON WL and SENTRON VL circuit-breakers, display measured values, as well as visualise, analyse, and store diagnostic data.

It comprises a microcomputer on which an embedded Linux operating system featuring a web server application runs. The HTML pages and the Java program codes are stored in the internal flash and can be displayed on a browser. The browser itself displays the HTML pages, while the more complex functions are implemented using Java applets. A Java Virtual Machine (VM) is required to run the Java applets. This is available free of charge for a wide range of browsers and operating systems.

All the pages that can be displayed are stored on the BDA in German and English; the language is selected when the data is called up in the browser for the first time. A new language can be selected during operation when "SENTRON WL/VL" at the top of the hierarchy is selected.

The cable supplied is used to connect the BDA to the SENTRON circuit-breaker. With the SENTRON WL, the BDA can either be connected directly to the trip unit or to the last **Cubicle**BUS module. With the SENTRON VL, it is connected directly to the trip unit. The indicator with the browser application (e.g. notebook) is connected to the BDA using a null modem cable.

The breaker data adapter *Plus* features an additional Ethernet interface, which means that the BDA *Plus* can also be addressed via the intranet or Internet. The communication options available via the intranet or Internet are restricted only by the network administration.

All write actions (changing parameters or switching actions) are password protected.

When connected temporarily, the BDA can be used to read and change parameters, perform diagnoses, or display measured values. For this reason, a magnet is supplied with the BDA so that it can be attached to doors and other elements containing iron. The DIN rail installation kit supplied can be used to connect the BDA permanently. Depending on the application, the BDA *Plus* is normally used for a permanent connection. In this way, it can be accessed via the Ethernet, intranet, or Internet.

If the SENTRON WL is to be switched on or off via the BDA, the PROFIBUS-DP COM15 module must also be installed. This contains the connections for activating the opening and closing solenoids and the motorised drive.

The PROFIBUS-DP communication function does not have to be started here.

Benefits of the BDA:

- No special software has to be installed; the display software is supplied with the circuit-breaker data directly from the BDA. The appropriate help pages are also stored directly in the BDA, which means they are always available when they are needed.
- The comprehensive use of Java technology ensures the systems can operate regardless of the operating system. This means that the BDA can be used with all Windows versions, Linux, and all other operating systems provided by the corresponding Java Virtual Machine.
- Smaller hand-held devices with PocketPC as the operating system can also be used as can PCs or notebooks, provided they fulfill the system requirements.
- The way the data is structured and formatted for display in the BDA and Switch ES Power is largely identical, so the pages have the same look and feel.
- The memory formats for storing and documenting the circuit-breaker parameters that have been set are identical to those in Switch ES Power. Files generated in Switch ES Power can also be transmitted to the circuit-breaker and vice versa using the BDA. This saves time and effort in documenting data and makes it easier to replace circuit-breakers, for example.

BDA in Offline Mode (or BDA Plus)

In offline mode, the BDA or BDA *Plus* is only connected to a notebook (represents all input/output devices). All the required parameters can be set in this operating mode and saved for later use (download to the circuit-breakers). The memory format is identical to that of the PROFIBUS-DP software Switch ES Power. No power is supplied via the notebook COM interface, which means that an additional power supply unit (24 V DC) must be connected to the BDA.

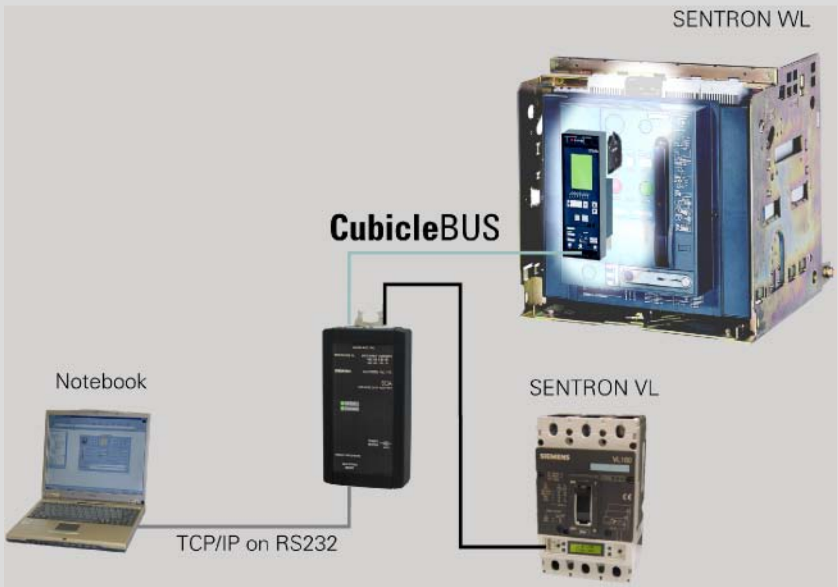
Graphic 6-1 *In offline mode, the BDA must be supplied externally with 24 V DC. Parameters can be set, stored, and printed out.*

BDA as a Hand-Held Controller (or BDA *Plus*)

As a hand-held controller, the BDA is operated by connecting it temporarily to the appropriate SENTRON VL/WL trip unit interface.

All SENTRON circuit-breakers in a system can be parameterised one after the other using just one BDA, and the parameter data saved to a notebook for further processing. In addition, all the diagnostic data of the circuit-breaker can be read via the BDA. The parameter data can also be exchanged with the PROFIBUS-DP parameterisation software Switch ES Power.

An additional 24 V DC power supply is required if the circuit-breaker is not yet supplied with power (e.g. by means of a current on the main circuit; with SENTRON WL by an external 24 V DC on the c; with SENTRON VL, an additional 24 V DC power supply usually has to be connected).

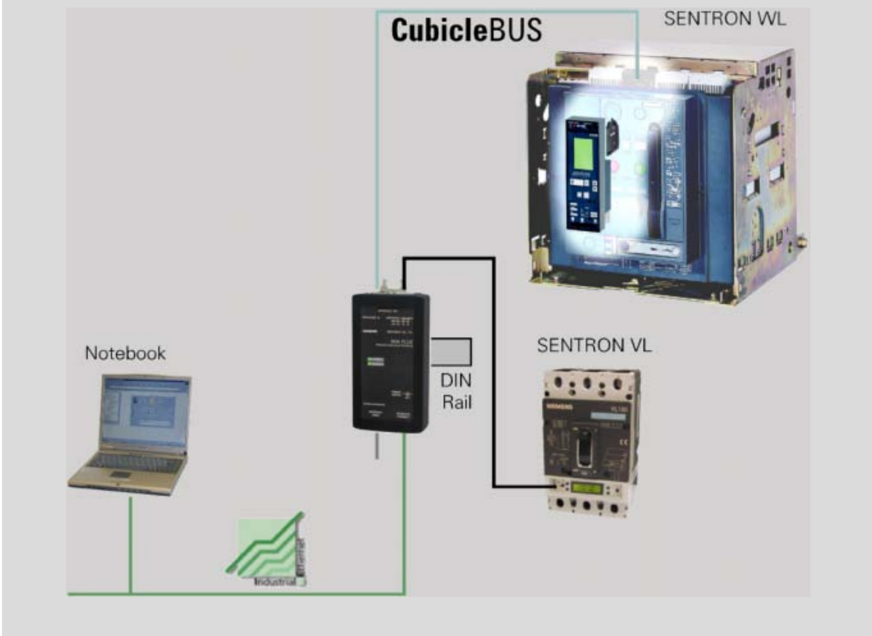


Graphic 6-2 *In temporary mode, the BDA is normally attached using magnets.*

BDA Plus as an Ethernet Interface

In addition to the above-mentioned functions, the BDA *Plus* enables data to be accessed via the Ethernet. In this case, the circuit-breaker data is not transmitted as net data, but displayed on HTML pages in an application-specific format. The BDA/BDA *Plus* cannot be used to integrate the circuit-breakers in higher level visualisation systems, such as WinCC. If it is to be possible to display several SENTRON VL/WL circuit-breakers round-the-clock online using the communication system in a switchgear unit without the PROFIBUS-DP, one BDA *Plus* is required for each circuit-breaker. In this case, the circuit-breaker is selected by entering the BDA-specific IP address in the browser. Password protection in the BDA and BDA *Plus* prevents unauthorised access.

By making the appropriate settings on the firewall, the SENTRON VL/WL circuit-breakers can also be accessed via the intranet and Internet.



Graphic 6-3 *Depending on the network settings (routing tables and firewall entries), the circuit-breaker can be diagnosed by all PCs with an Internet connection.*

System Requirements

Certain prerequisites have to be fulfilled before the BDA or BDA *Plus* can be operated. One of the two standard browsers (Internet Explorer as of V5.5 or Netscape Navigator as of V6.2) must be installed on the output device (e.g. notebook). Compatibility with other browsers cannot currently be guaranteed.

To ensure independence between the operating systems and browsers, all the pages have been written in HTML code and Java applets. A Java Virtual Machine is required to display the pages.

What is Java?

Java is a platform-neutral object-oriented programming language originally developed by Sun Microsystems. Java is implemented in all IT areas of the commercial, industrial, and administrative sectors, and is available free of charge for many operating systems and platforms - from cell phones to real-time mainframe systems.

Unlike most compiler languages, Java applets are not directly translated into a set of commands that can be understood by a "real processor". Instead, they are first converted to the "Java byte code". Although this byte code is highly machine-oriented, a "Java Virtual Machine" (VM), which emulates a standardised processor for all Java applets, is required on the target computer.

Since Java normally compiles data twice (once with the developer and once with the user), this principle is known as the Just-In-Time (JIT) compiler. Despite the advantages already mentioned, however, Java applets take longer to start, since the machine code is generated during initialisation.

The same Java applet, however, can run on all supported systems without modifications.

The Java Virtual Machine V2 V1.4.0_01 is required to display the BDA pages. When these pages are called up for the first time, the BDA checks whether Java VM2 is available on the browser. If not, the system automatically displays a window informing the user of this and automatically links the user to the appropriate Sun Microsystems page. An Internet connection must be established to ensure the automatic installation procedure functions properly. If this is not the case, the Virtual Machine required for the Microsoft Windows operating systems can be downloaded from the following address:

http://java.sun.com/products/archive/j2se/1.4.0_01/index.html

Once installed, the option Java 2VM V1.4.0_01 must be activated in the browser (if it is not already).

To avoid conflicts with other Java versions, you are recommended to de-install older Java versions and delete the cache in the browser.

The target system with the browser also requires one or both of the following communication interfaces:

- A serial interface with RS232 design, such as that usually integrated on standard PCs (e.g. COM1) for point-to-point (PPP) communication with the BDA.
- A LAN interface for communicating with the BDA *Plus* via the Ethernet

Connectable circuit-breakers

The BDA can be connected to all SENTRON WL circuit-breakers with **Cubicle**BUS. These are all the circuit-breakers with the following trip units: ETU45B, ETU55B, and ETU76B. It can be connected either directly to the trip unit or to the last external **Cubicle**BUS module. Circuit-breakers can also communicate with the BDA if they have been retrofitted with the communication function.

With SENTRON VL circuit-breakers, the BDA can only communicate with trip units with the ETU LCD (ETU40M, ETU40, or ETU42). The connection is established via the front interface.

Getting started with the BDA *Plus*

If the BDA *Plus* is installed the first time, the settings for the IP address and the standard gateway as well as the subnet mask must be set using the serial communication via RS232. After this the BDA *Plus* must boot again to load the ethernet driver with the specified parameters.

The Breaker Data Adapter (BDA) and BDA *Plus*
Connection to SENTRON Circuit-Breakers

To operate the BDA, it must be connected to the target system (e.g. a PC) on one side and a SENTRON circuit-breaker on the other. Different scenarios are possible here depending on the application.

SENTRON WL

With SENTRON WL, two basic methods are available for connecting the BDA.

Temporary

If the BDA is to be used as a local parameterisation tool and several circuit-breakers are to be set in succession, the local front interface of the trip unit can be used.

The cable required is supplied with the BDA. An additional 24 V DC power supply unit is also required if the circuit-breaker is not yet supplied with power via the **Cubicle**BUS. For this purpose, a voltage connection is located on the top of the BDA next to the interface to the SENTRON circuit-breaker.

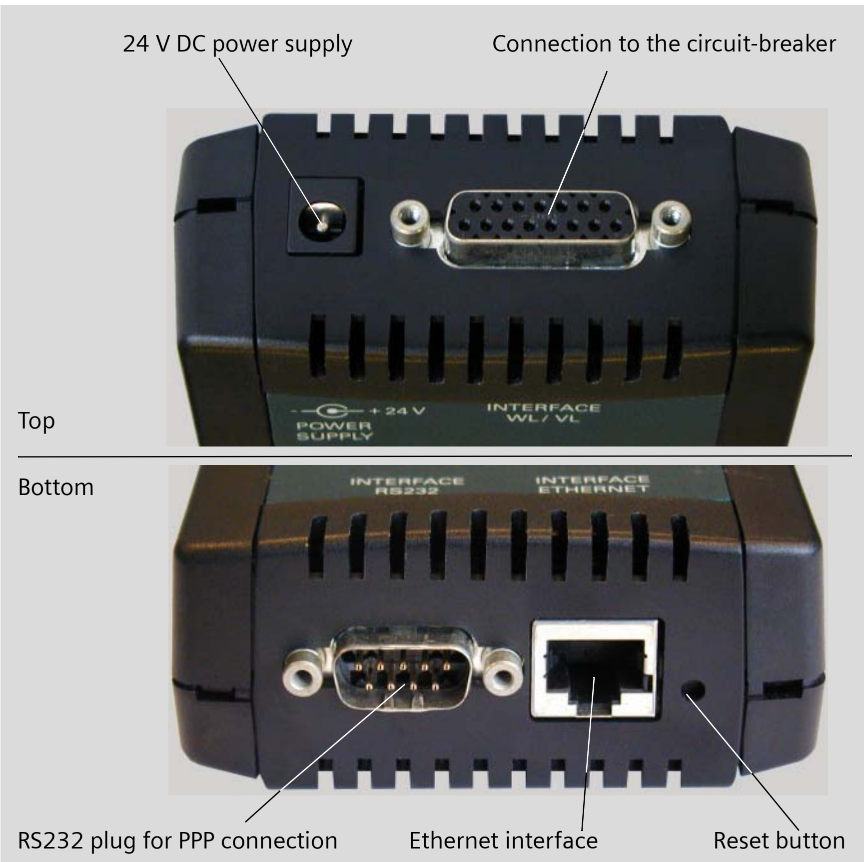


Fig. 6-1 *The physical BDA interfaces. The connection to the circuit-breaker and optional power supply are on the top, while the RS232 interface (or the Ethernet interface in the case of BDA Plus) and the reset button are on the bottom.*

In temporary mode (as a replacement for the hand-held controller), the BDA can be quickly secured to all switchgear cubicle using magnets fitted on the back.

Permanent

The trip unit interface through the front connection is not suitable if a BDA or BDA Plus is to be permanently connected to a SENTRON WL circuit-breaker. The connection on the last **Cubicle**BUS module, such as the COM15 module, or one of the other modules, is much more suitable. In this case, a cable is supplied with the BDA that can be connected directly to the RJ45 plug-in contact of the **Cubicle**BUS module. In most cases, a BDA Plus is used for permanent installation. The DIN rail installation kit supplied ensures that the device is permanently secured.

The principle regarding the power supply is the same as for temporary operation: if the **Cubicle**BUS is supplied with power, the BDA will also operate without an extra power supply unit. Otherwise, the BDA must also be connected to a 24 V DC power supply unit.

SENTRON VL

If the BDA is connected to the front interface of the ETU LCD, it must always be operated with a 24 V DC power supply, since it is not supplied by the circuit-breaker.

Operation

As a microcomputer, the BDA is booted in the same way as a PC. This takes approximately 40 seconds and is started automatically when the power supply is switched on. During this time, the content is loaded from the Flash memory to the main memory, an internal self test is carried out, the operating system (embedded Linux) is booted, and the web server application started.

The reset button on the underside enables the BDA to be restarted manually at any time.

The LEDs indicate the operating status during the boot-up process. The upper DEVICE LED is first red/green, while the lower **Cubicle**BUS LED is red only. After about 10 seconds, this also changes to red/green. During the load process, the Ethernet connection is checked for a connected network. Only then is the appropriate driver loaded. Since the BDA *Plus* is to be operated with an Ethernet connection, a physical connection to the Ethernet must already exist during the boot-up process.

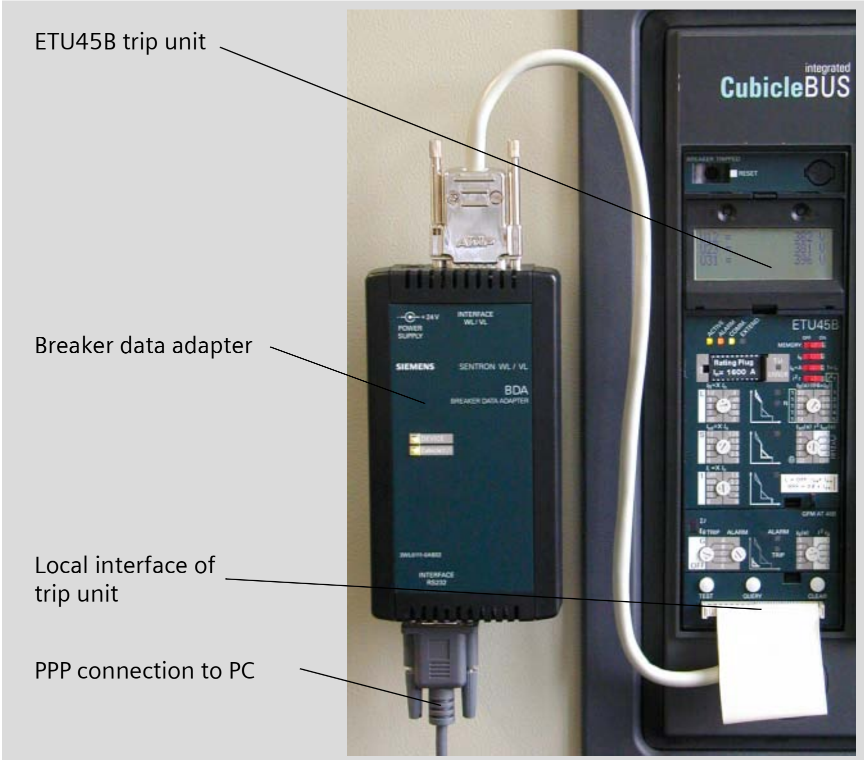


Fig. 6-2 *For operation over a short period of time, the BDA can be connected to the local interface of the trip unit. In this configuration, only the RS232 connection to the PC is generally used.*

Meaning of the LEDs on the BDA

LED	Display	Meaning
DEVICE	red	BDA out of order
	green	BDA in operation
	red/ green	BDA booting up
CubicleBUS	red	BDA in online mode and connection to circuit-breaker interrupted
	green	Connection exists to **Cubicle**BUS or SENTRON VL
	red/ green	BDA booting up
	off	BDA in offline mode, even if circuit-breaker is connected.

Table 6-1 *The LEDs on the BDA indicate the current operating status.*

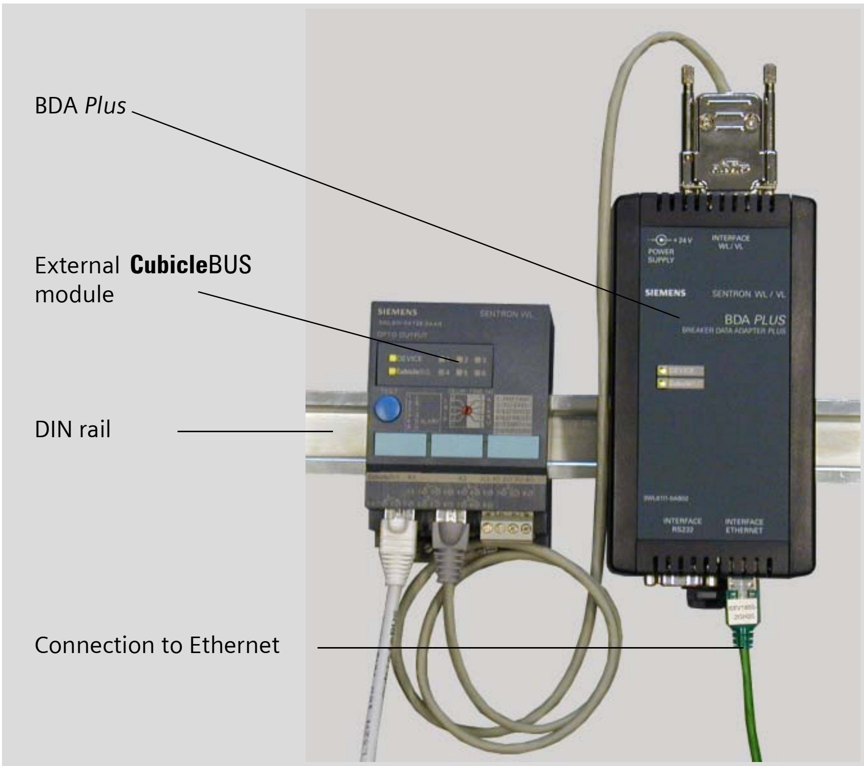


Fig. 6-3 *In a permanent installation, the BDA should be connected to the last external* **Cubicle**BUS *module. It can be secured using either a magnet or a DIN rail, as shown above.*

When the boot-up process is complete, the DEVICE LED switches to green, while the **Cubicle**BUS LED switches to green or is extinguished, depending on the connection.

If the BDA is not supplied via the **Cubicle**BUS of the SENTRON WL, it must be activated via an external 24 V DC power supply. The power supply unit used to run serial communication of the 3WN6 with Win3WN6, if the 3WN6 is not supplied externally, can be used for this purpose. The order number is: 3WX3647-6JA02.

Other 24 V DC power supply units that supply the required power can also be used.

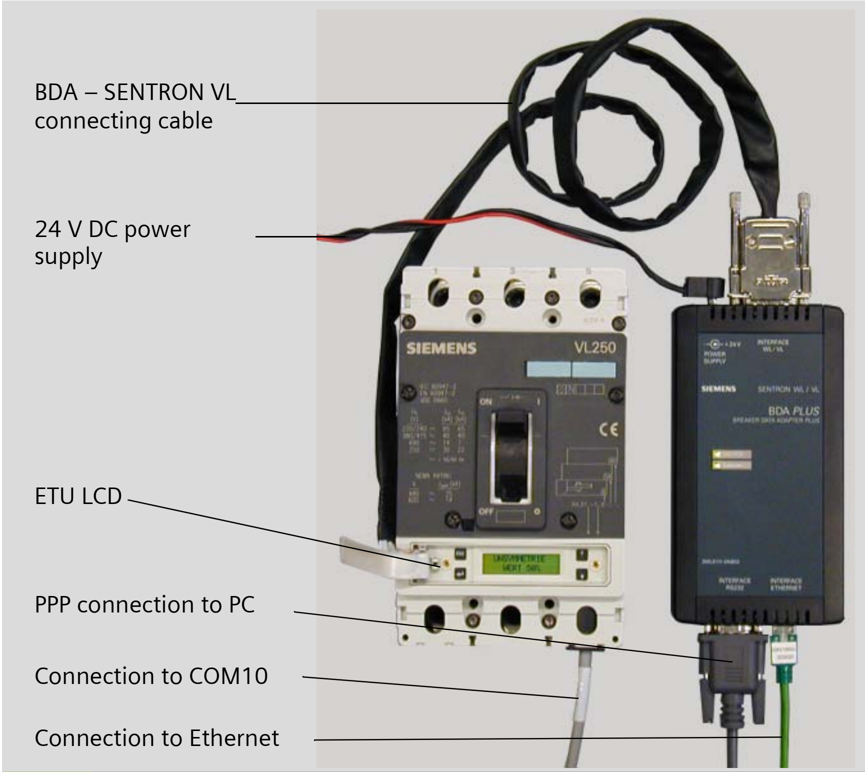


Fig. 6-4 *If the BDA is operated with the SENTRON VL, a 24 V DC power supply is essential. With the BDA Plus, the Ethernet interface can also be used.*

Technical data for the BDA and BDA *Plus*	
Max./min. operating voltage (V)	19.2/28.8
Current input from the **Cubicle**BUS or power supply unit min./typ./max. (mA)	100 mA/300 mA
Power loss min./typ./max. (W)	3/5/7
Dimensions W/H/D (mm)	82/153/38
Weight (kg)	0.38
Temperature range (°C)	0 to 55°C

Table 6-2 *This table provides accurate technical data for the BDA and BDA Plus*

The Breaker Data Adapter (BDA) and BDA *Plus*

Connection to the BDA via the Serial Communication System

To operate the BDA, it must be connected to the target system (e.g. a PC) on one side and a SENTRON circuit-breaker on the other. A range of options is available, depending on the application and operating system.

To ensure that serial communication is possible between the target system and the BDA, you have to carry out the following steps:

- Connect the BDA to the circuit-breaker and supply with power.
- Connect the BDA to the COM interface of the target system (e.g. PC) using a fully assigned null modem cable.
  Caution: With a null modem cable, pins 2 and 3, 4 and 6, and 7 and 8 must be assigned and reversed with respect to each other.

  The COM port used must not be being used by a different application (e.g. synchronisation program).
- Installing a standard modem.
  Once the physical connection has been established using a null modem cable, a standard modem must be installed **once** on each PC. The procedure for installing the modem varies slightly depending on the operating system. The screenshots on the following pages provide a step-by-step guide to the procedure. The standard modem to be selected - 28800 bps - is not related to the actual transmission rate. The examples illustrate the connection to the COM1 interface; other interfaces must be set accordingly. The installation process always begins in the Control Panel of the operating system. The default settings in the "Properties" windows of the modem do not usually have to be changed. They are only shown as a reference if any problems arise.
  The screenshots on the following pages for Windows98 are identical for Windows95, WindowsNT, and WindowsME. WindowsXP screens are virtually the same as those in Windows2000.
- Installing a data communications connection.
  Once a standard modem has been installed, a communications link must be established **once** via this modem. To do so, a data communications connection must be set up via "Workstation > Data Communications Network". Once the appropriate modem has been selected, the maximum rate has to be selected again. The name of the connection is user defined, while the user name must be "ppp" and the address signal "555". A preselection code and password must not be entered.
  All of these settings are shown on the following pages. Windows98 screenshots are used to represent the operating systems Windows95, Windows98; WindowsNT, and WindowsME. Only the screenshots from WindowsXP are used for Windows2000 and WindowsXP.
- Establishing the connection.
  A communications link is established by activating the installed data communications connection.
  Once the user name and password have been checked (a password must not be entered), the window for establishing the connection disappears from the Windows systray. The systray is the area on the bottom right next to the system clock in the toolbar. A small icon with two computers appears here.
  Double-clicking this opens a window displaying the properties of this connection.
  A test ping can also be used to check that the connection has been established correctly. Once you have opened the entry screen (Start > Execute) and entered "ping 2.2.2.1", a DOS box appears that displays either "Reply from 2.2.2.1 after..." (connection OK) or "Reply timed out" (connection not available).
- Start the browser (Internet Explorer or Netscape Navigator)
- Entering the target IP address 2.2.2.1. You have to enter 2.2.2.1 in the address line. The usual "http://" does not have to be entered. When you press ENTER, the pages will be loaded from the BDA.
  Note: You may have to include the address 2.2.2.1 in the list of addresses that do not use a proxy server. The use of a proxy server is optional and depends on the network.

A desktop link can be created if the BDA connection is used frequently. To create an Internet Explorer link with the local IP address of the BDA on the desktop, you have to drag the Internet Explorer icon in the address line to the left of the address to the desktop. Alternatively, the BDA start icon can be used. To do so, press the left mouse button to save it on the hard disk as a bitmap and specify it as an icon in the properties window of the link saved on the desktop.

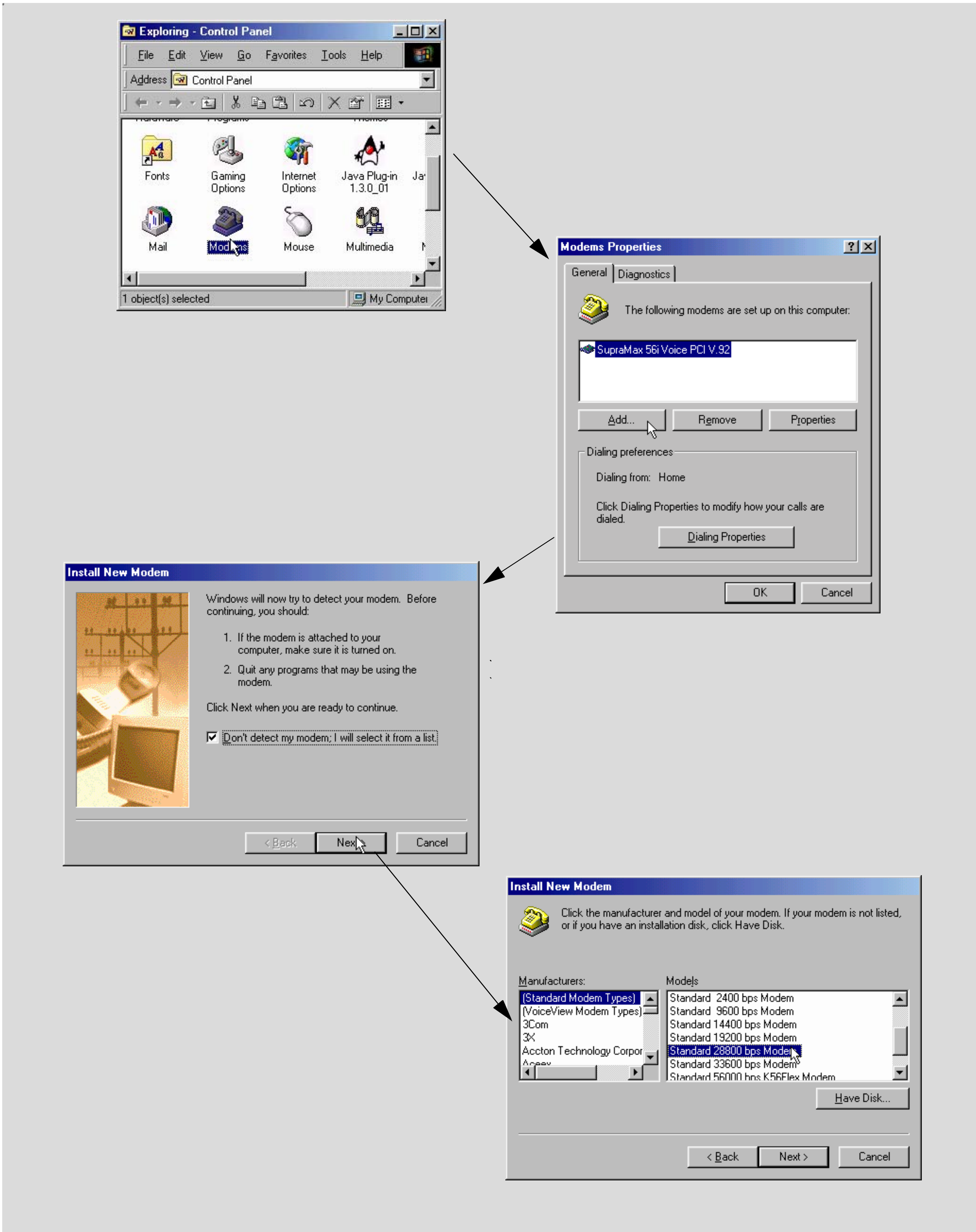


Fig. 6-5 ***Installing a standard modem with Windows98, part 1 (identical to Windows95, WindowsNT, and WindowsME):***
A standard modem (28800 bps) is selected and installed in the Control Panel. The automatic identification function must be switched off for this purpose.

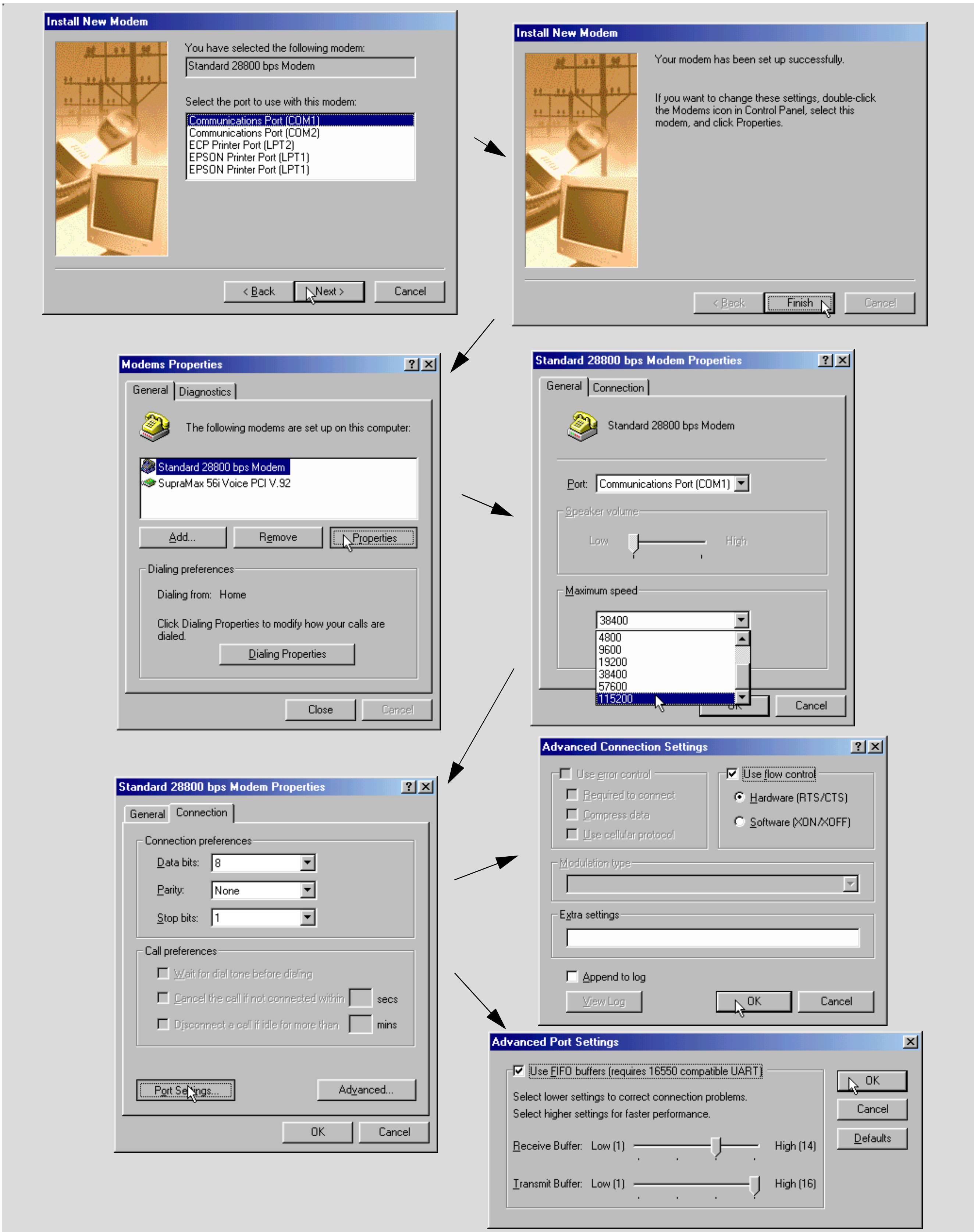


Fig. 6-6 ***Installing a standard modem with Windows98, part 2 (identical to Windows95, WindowsNT, and WindowsME):***
Once you have installed the standard modem, you have to set it to the maximum rate of 115200; the default settings in the other windows are retained.

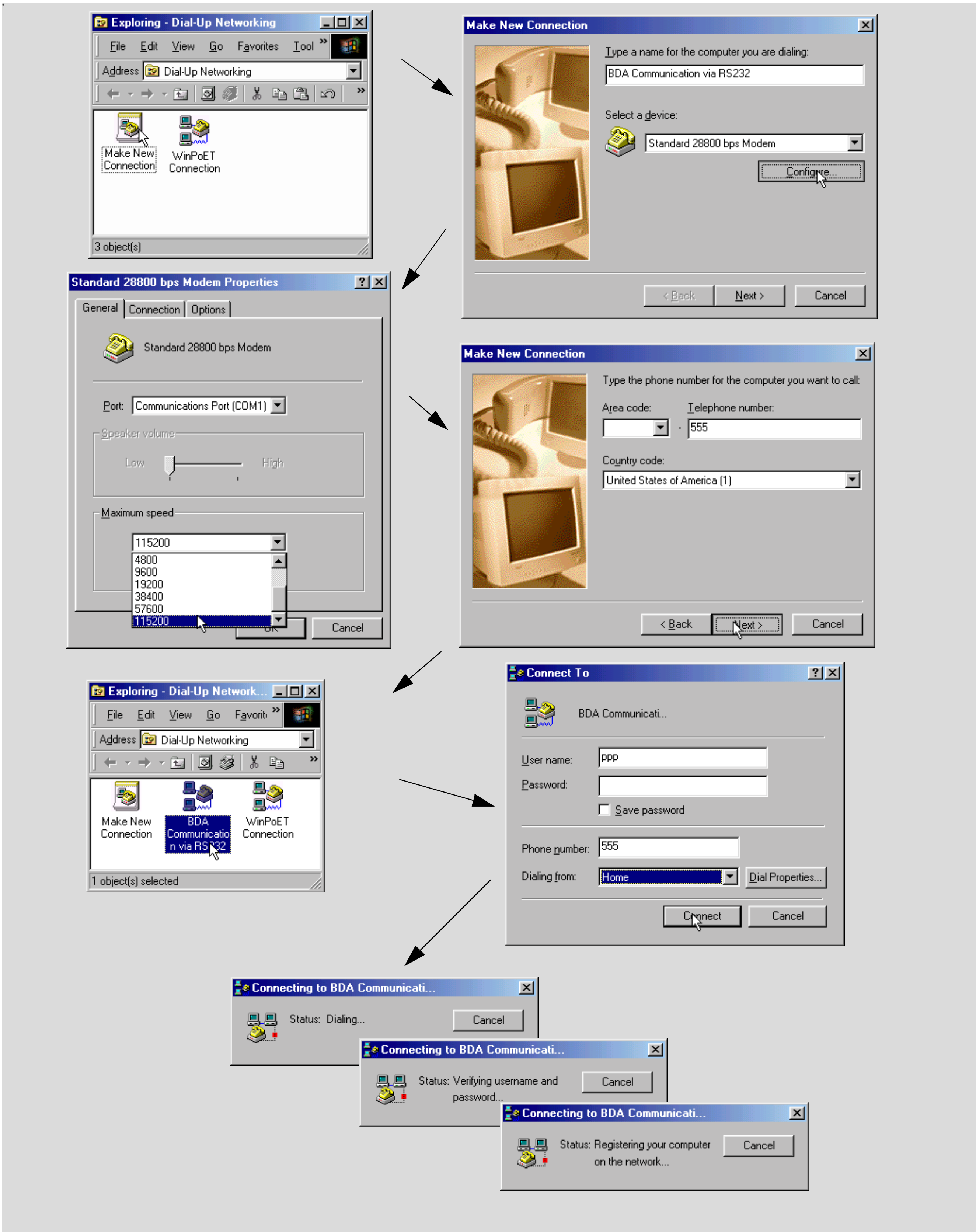


Fig. 6-7

Installing a data communications connection to the BDA with Windows98, part 1 (identical to Windows95 and WindowsME): *You now have to establish a data communications connection to the BDA. To do so, double-click "Establish new connection" in the Control Panel and then maintain the windows as shown.*

Fig. 6-8

Installing a data comm. connection to the BDA with Windows98, part 2 (identical to Windows95 and WindowsME):
Once communication has been established, the connection window disappears from the Windows systray. To display the BDA pages, enter address 2.2.2.1 in the browser. To call up the connection window, double-click the relevant icon in the systray.

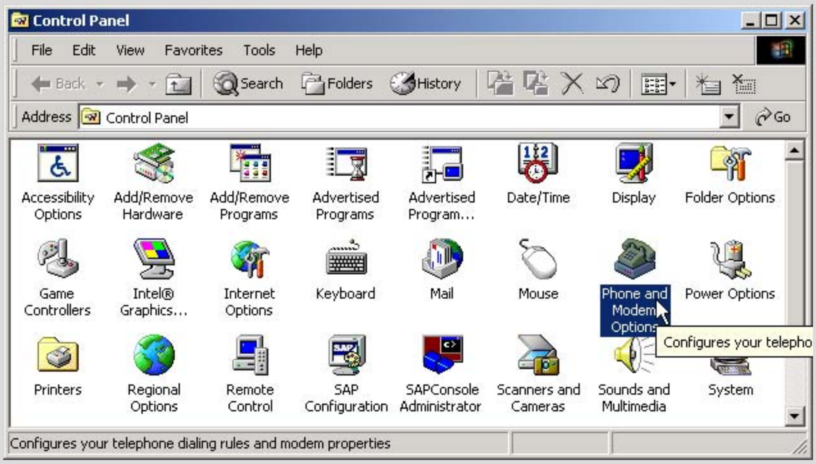


Fig. 6-9

Installing a standard modem with Windows2000, part 1 (identical to WindowsXP):
To install a standard modem in WindowsXP, double-click the "Telephone and modem options" icon in the Control Panel.

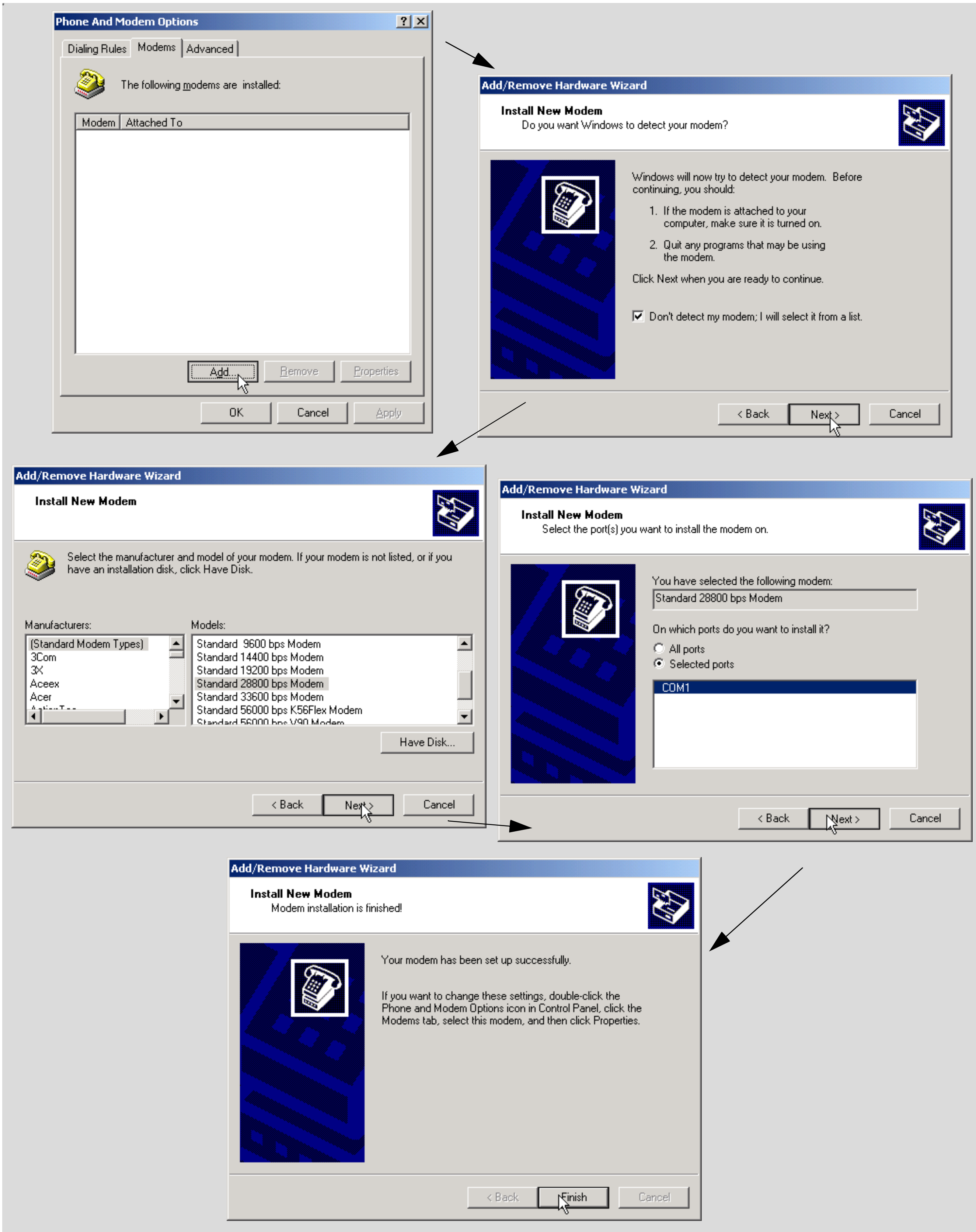


Fig. 6-10 ***Installing a standard modem with Windows2000, part 2 (identical to WindowsXP):***
Select the standard modem (28800) and assign it to a free COM interface.

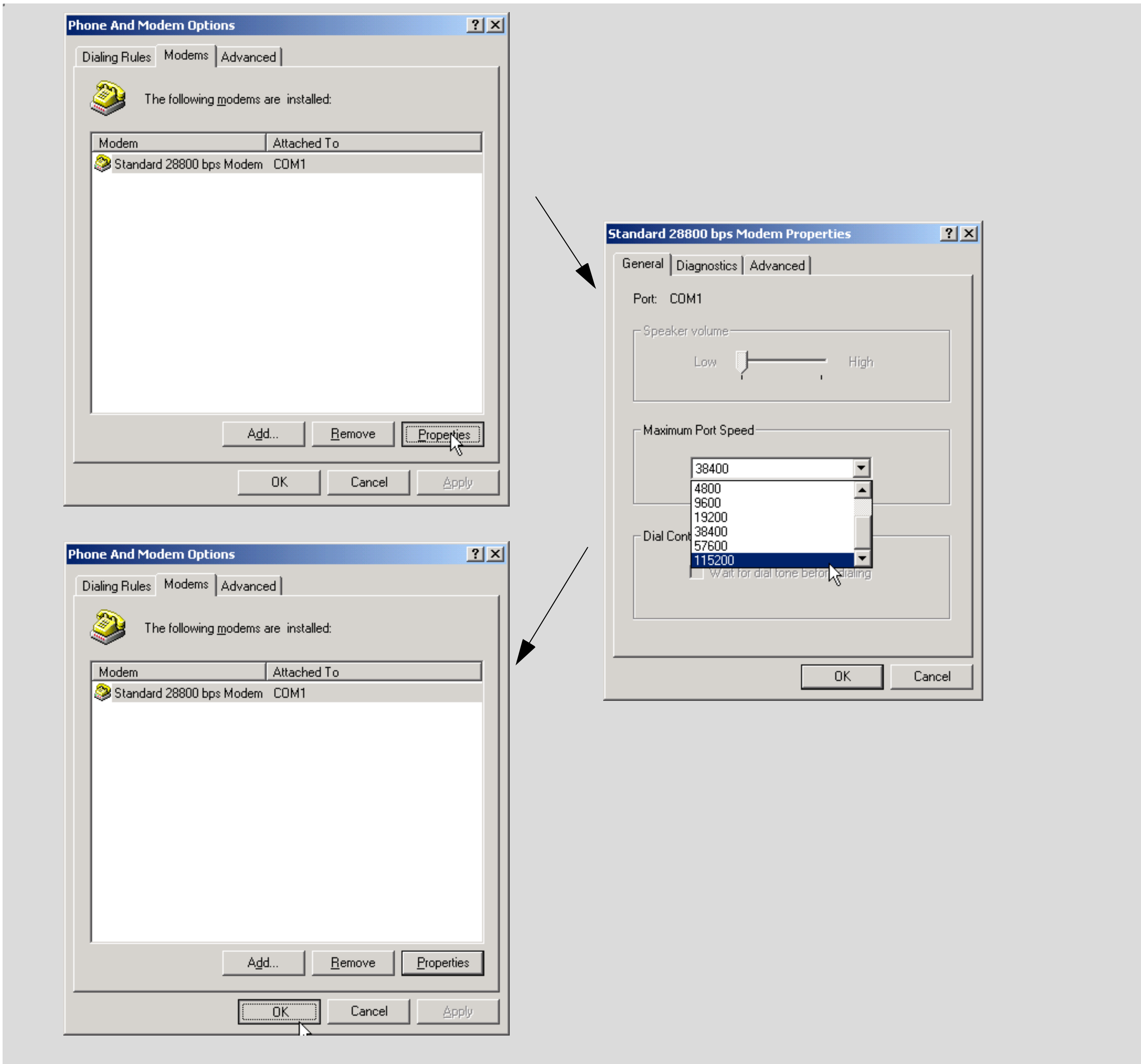


Fig. 6-11

Installing a standard modem with Windows2000, part 3 (identical to WindowsXP):
After installation, you have to set the maximum rate to 115200. This completes the installation procedure.

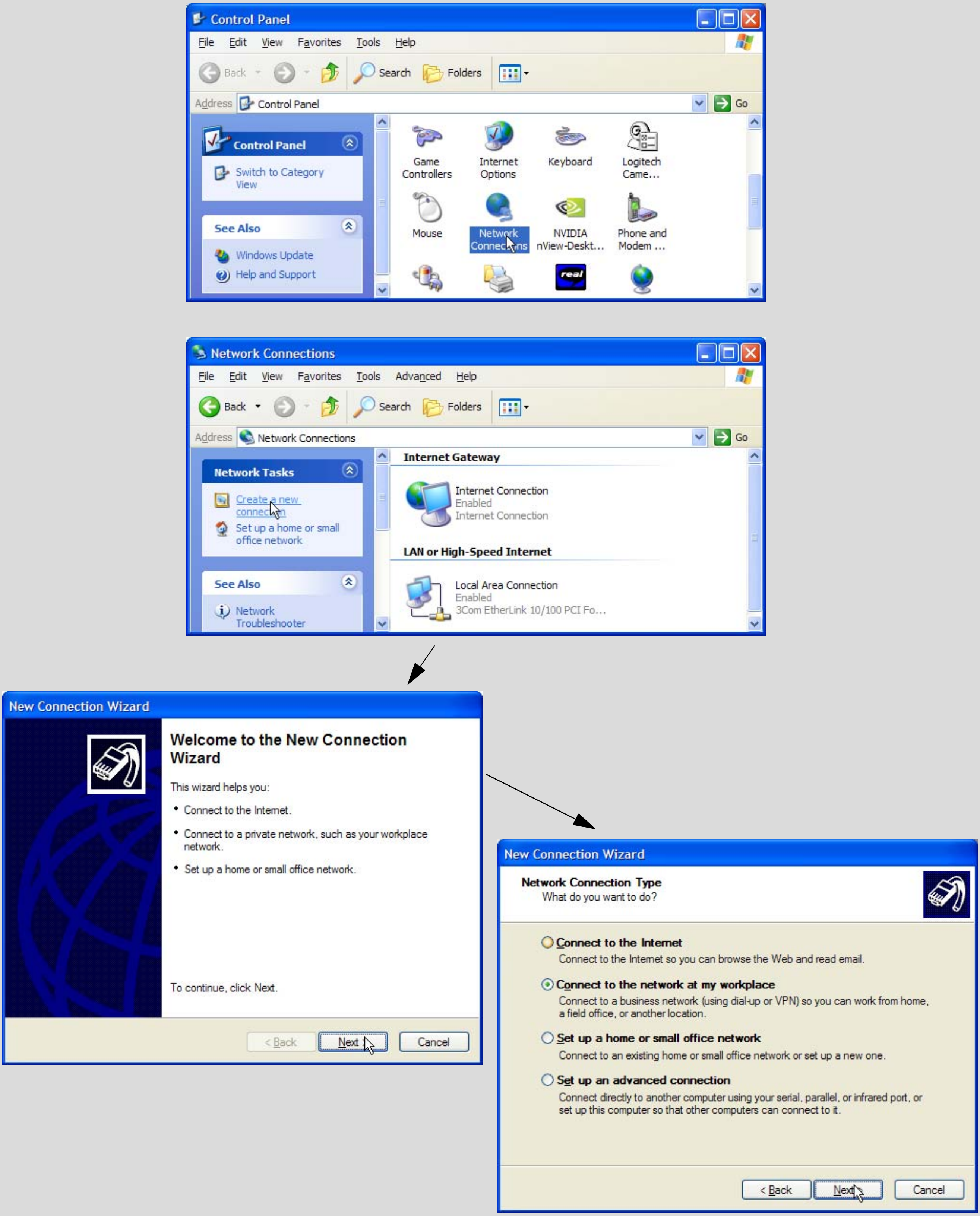


Fig. 6-12 ***Setting up a data communications connection to the BDA with WindowsXP, part 1:***
Go from the Control Panel to "Network environments" and click "Establish new connection", as shown above.
Then follow the instructions provided by the Installation Wizard.

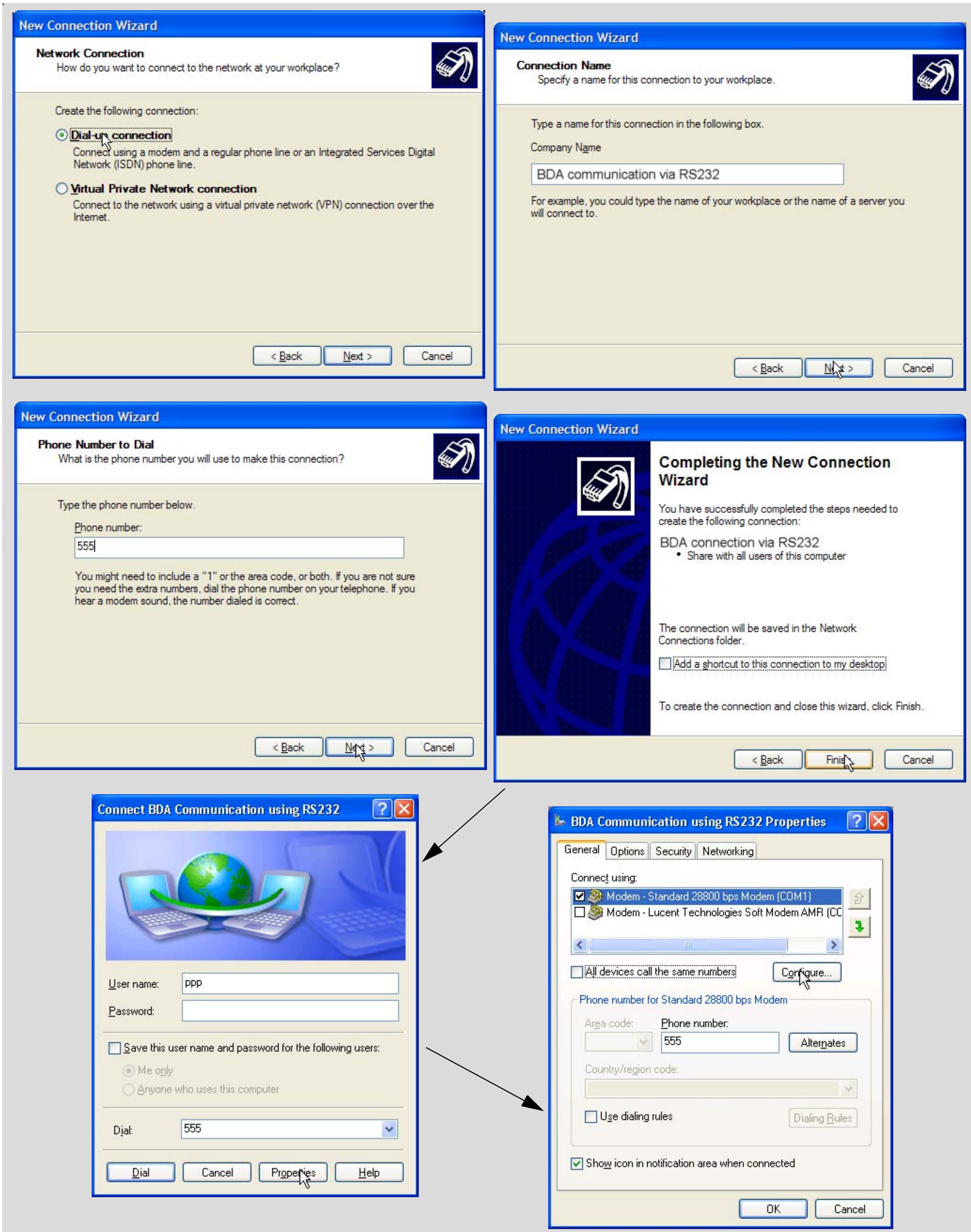


Fig. 6-13 ***Setting up a data communications connection to the BDA with WindowsXP, part 2:***
Continue following the instructions and maintain the windows as shown above.

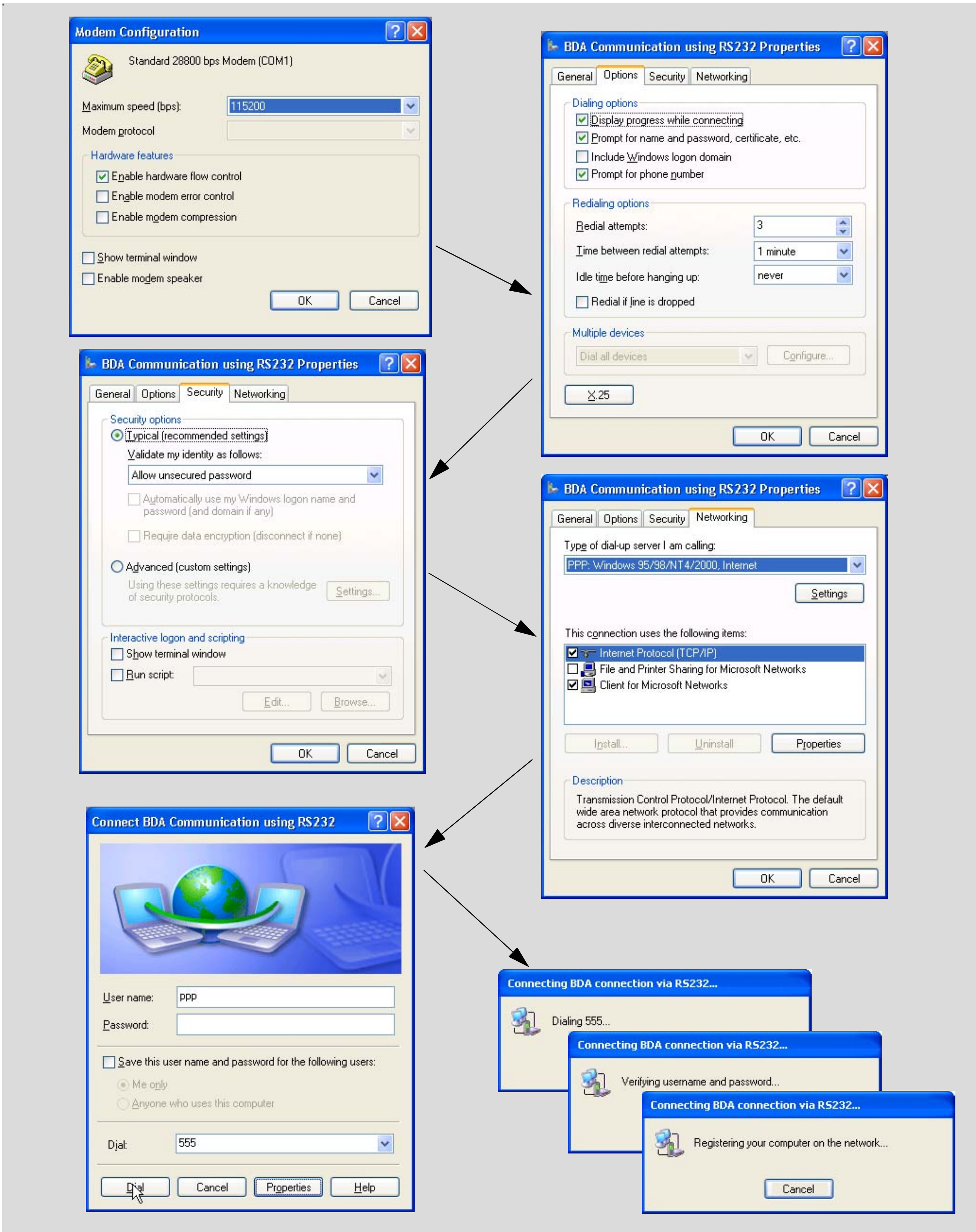


Fig. 6-14 ***Setting up a data communications connection to the BDA with WindowsXP, part 3:***
Once the data communications connection has been successfully set up, WindowsXP establishes a connection with the BDA when you click "Dial".

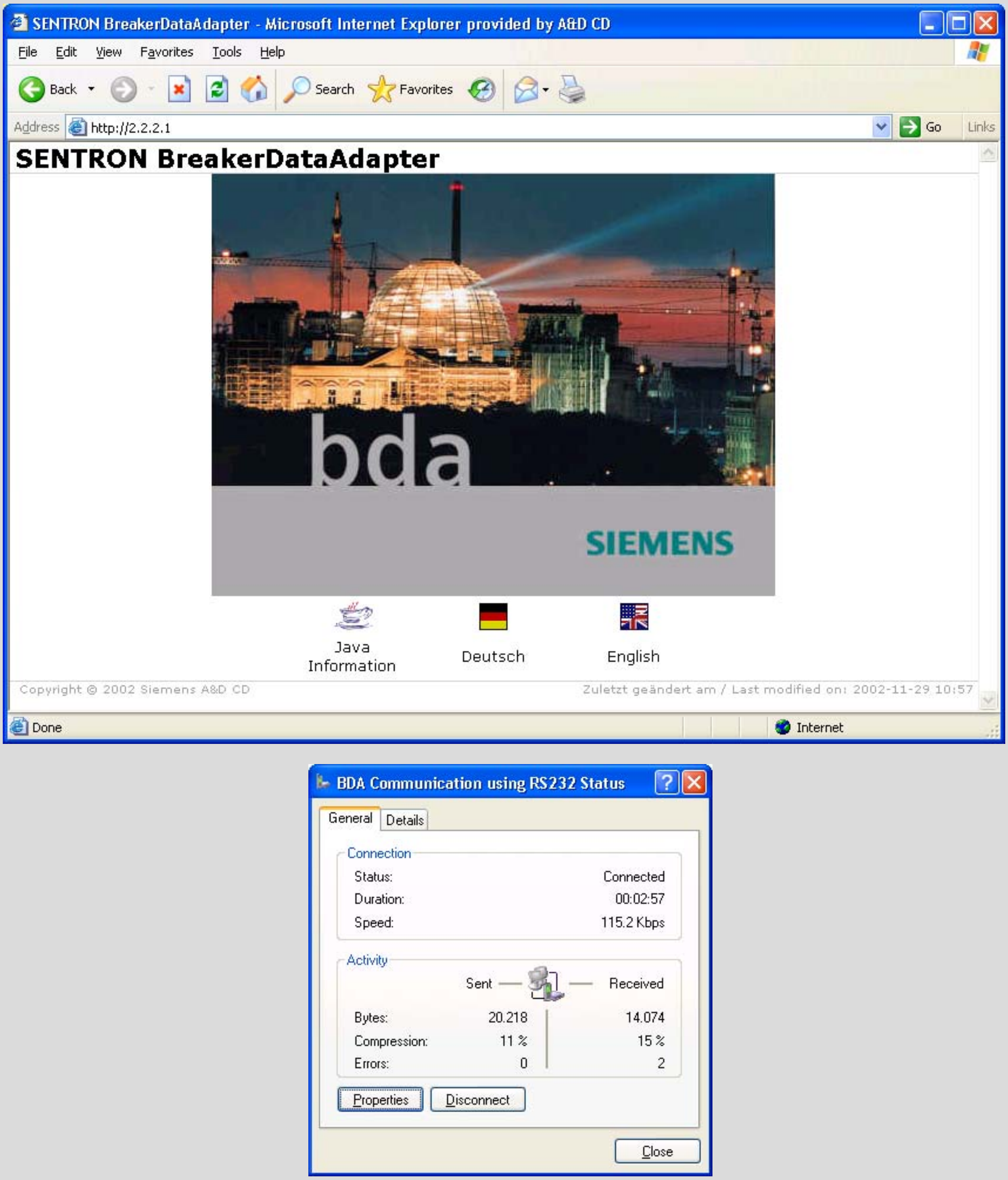


Fig. 6-15 ***Setting up a data communications connection to the BDA with WindowsXP, part 4:***
Once the connection has been established, start the browser and enter the address 2.2.2.1. To display the connection properties so that you can check them, double-click the appropriate icon in the systray.

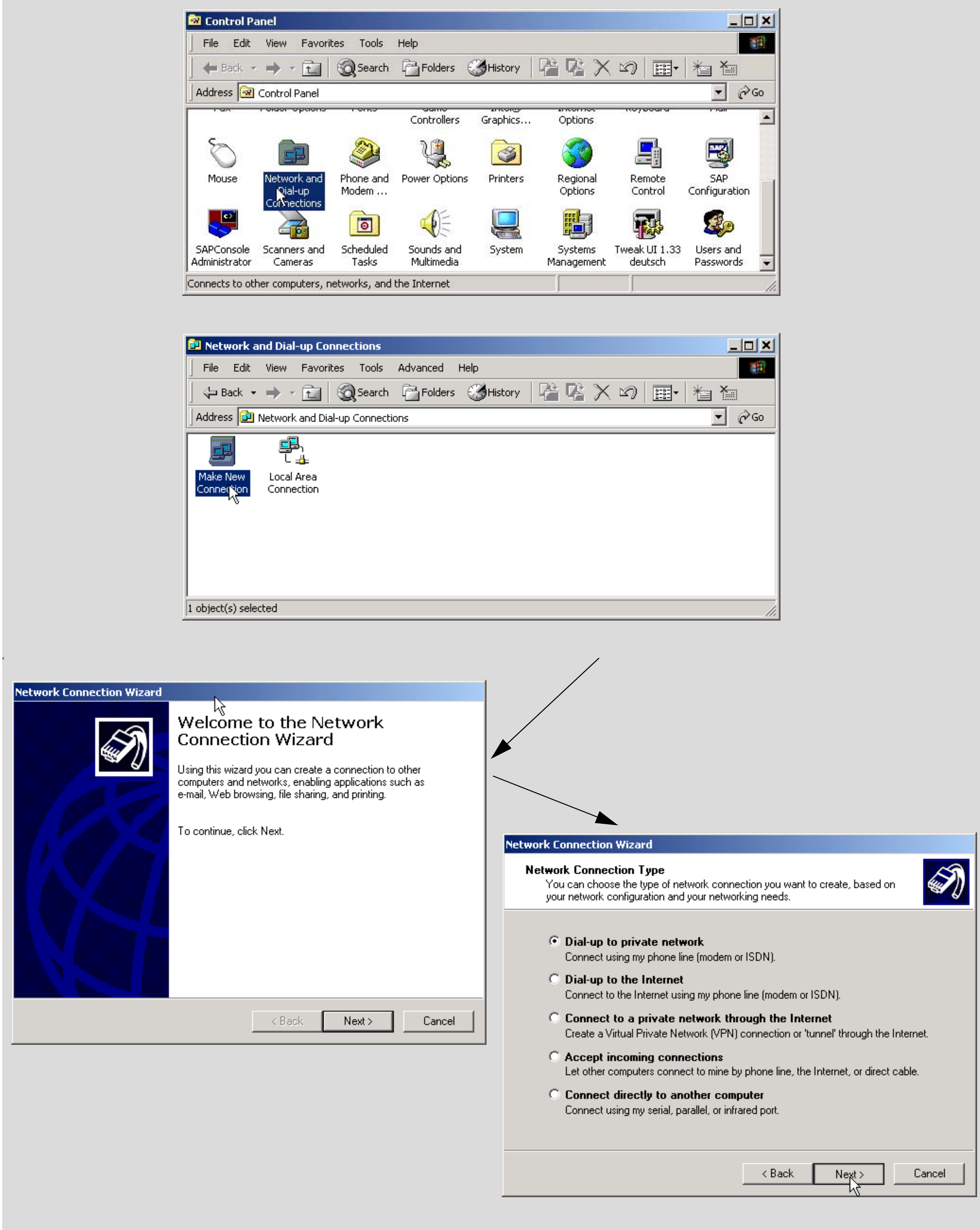


Fig. 6-16 ***Setting up a data communications connection to the BDA with Windows2000, part 1 (similar to WindowsNT):*** *A modem is installed for Windows2000 in the same way as for WindowsXP. You then have to set up the data communications connection to the BDA. To do so, proceed as shown in the screenshots.*

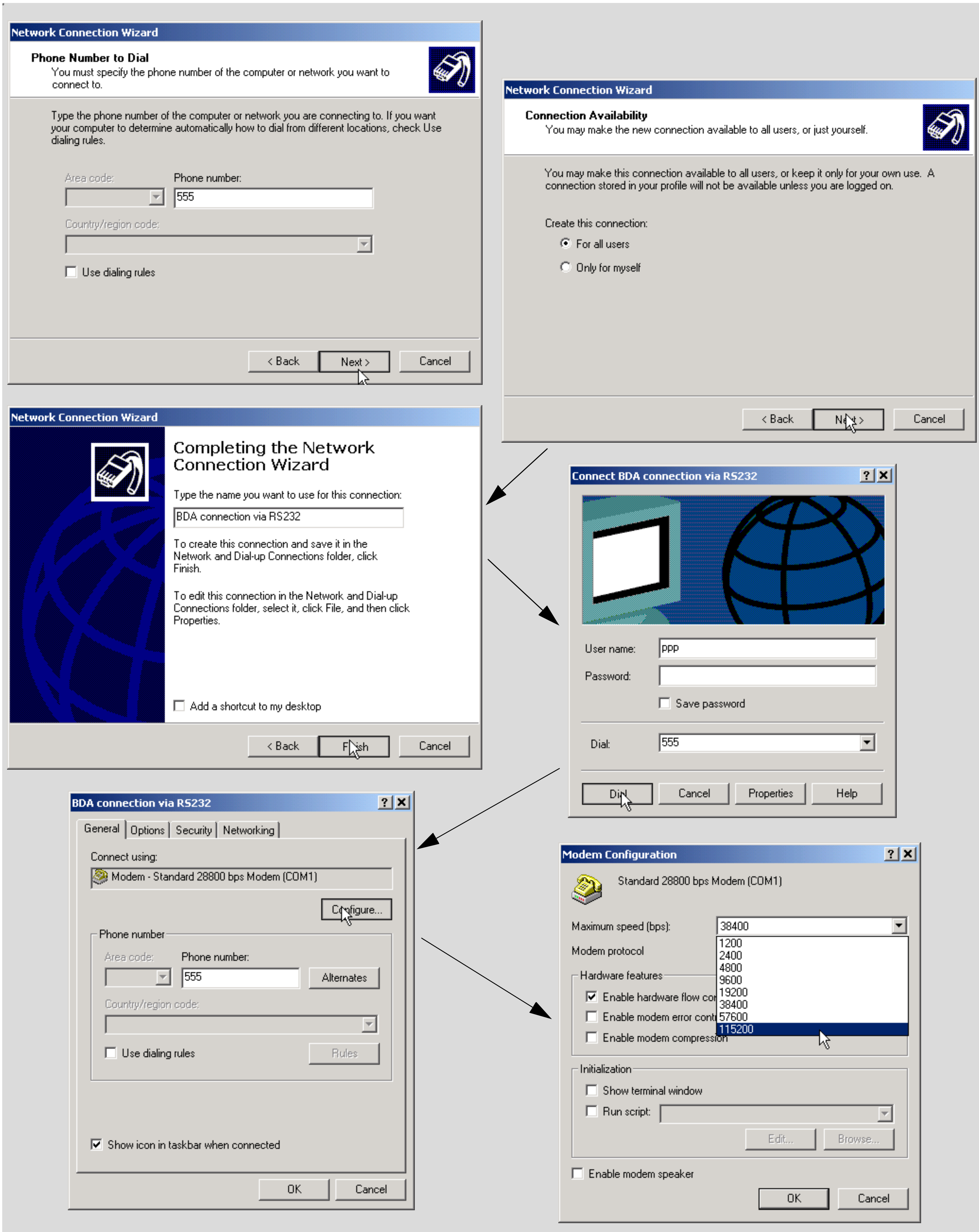


Fig. 6-17 ***Setting up a data communications connection to the BDA with Windows2000, part 2 (similar to WindowsNT):***
The procedure for setting up the data communications connection for WindowsNT is largely the same as the example shown above for Windows2000.

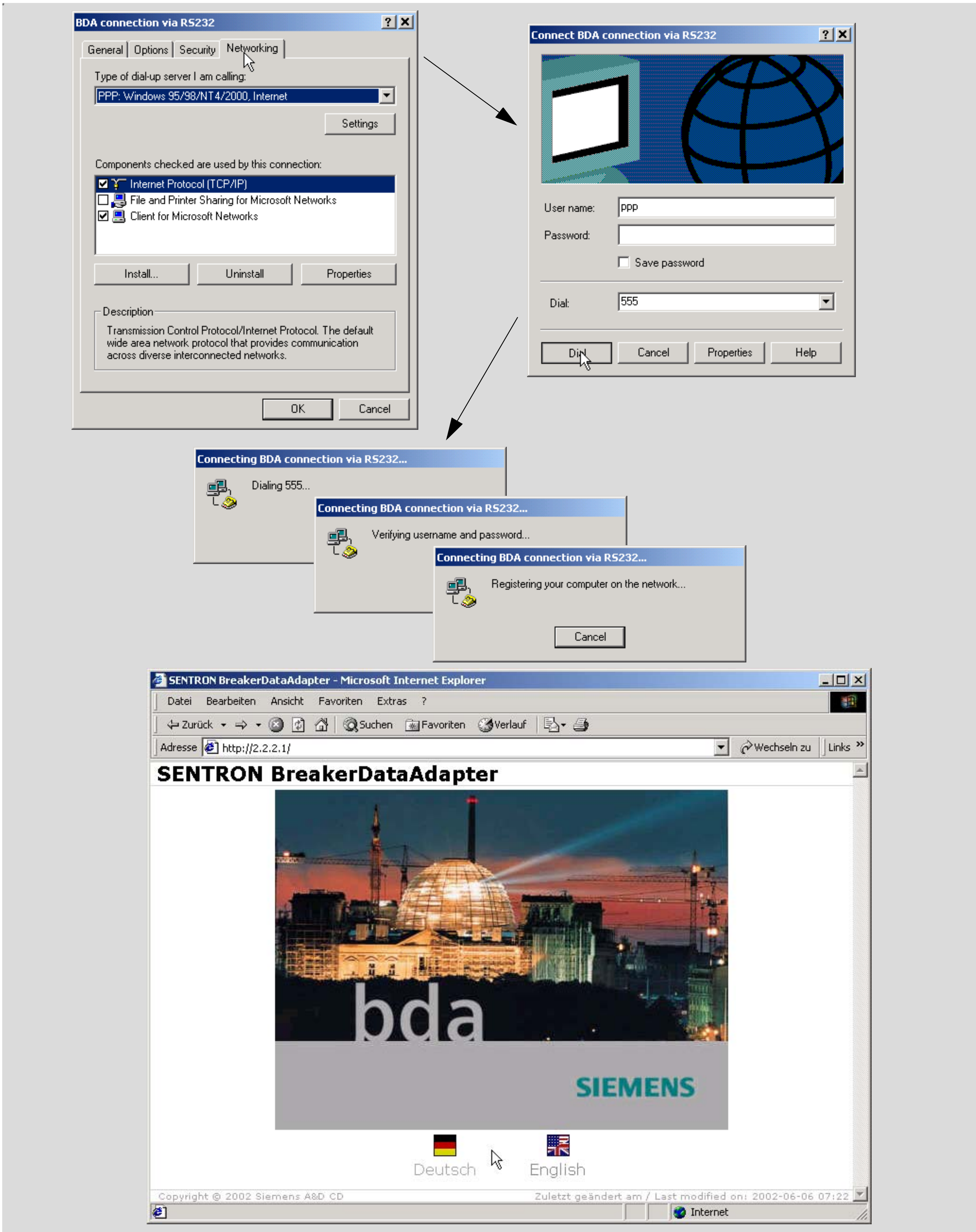


Fig. 6-18

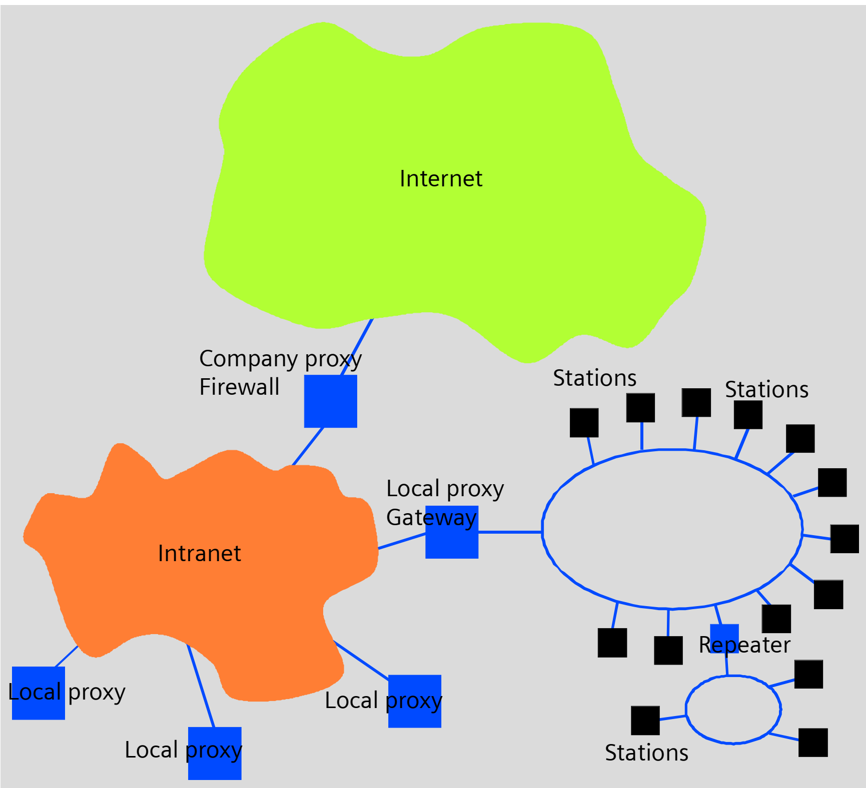
Setting up a data communications connection to the BDA with Windows2000, part 3 (similar to WindowsNT):
Once the installation is complete and the connection has been established via the null modem cable, start the browser by entering the address 2.2.2.1. The PC temporarily adopts the address 2.2.2.2.

The Breaker Data Adapter (BDA) and BDA *Plus*
Connection to the BDA *Plus* via the Ethernet Interface

In addition to communication via the serial RS232 channel, the BDA *Plus* features an Ethernet interface. If the BDA Plus is to be addressed via this interface, it must be integrated in the local Ethernet (LAN). This chapter explains a number of key terms and settings.

Ethernet

Unlike the PROFIBUS-DP, Ethernet does not function according to a master-slave principle. All the stations have equal priority on the bus, which means that any station can be the sender and/or receiver.
A sender can only send on the bus if no other station is sending at that point. This is made possible due to the fact that the stations are always "listening in" to find out whether any messages are being sent to them or any senders are currently active. If a sender has started sending, it checks that the message it has sent is not corrupt. If the message is not corrupt, the send operation continues. If the sender detects that its data is corrupt, it must abort the send operation because a different sender has already started sending data.
After a random time has elapsed, the sender restarts the send operation.



Graphic 6-4 *This diagram illustrates the structure of an Ethernet, how an intranet is integrated, and how this is connected to the Internet.*

This is known as CSMA/CD and, as a "random" access procedure, does not guarantee a response within a certain time frame. This largely depends on the bus load, which means that real-time applications cannot yet be implemented with Ethernet.

Definition of Key Terms

An intranet system comprises several Ethernet lines connected to each other via gateways within a company. The structure of an intranet system can be just as heterogeneous as that of the Internet: it can be restricted to one location or distributed worldwide.

Ethernet/intranet lines are connected to each other using repeaters, bridges/switches, routers, and gateways. These modules work at different levels in the ISO/OSI 7-layer model.

The repeater (or star coupler) only regenerates and strengthens the electrical signal; it does not interpret bits. The bridge (or switch) physically separates the networks and performs fault and load disconnection. Filtering and guidance mechanisms are usually implemented. The router decouples the networks at the logical level (protocol level) by means of the specified addresses. Using routing tables it knows which messages are to be sent to which address. It continues to work, however, on a protocol-dependent basis. The gateway also enables the router to convert services.

This means that it can act as a security mechanism, such as a firewall, while functioning as a proxy.

A proxy is a program in a gateway that acts as both the server and client. It processes requests, translates them if necessary, and forwards them to the addressees. Proxies are also used to control access (firewall) and forward

requests for protocols that are not supported. Intranet users in particular are familiar with the Internet/intranet page caching function offered by proxies.

The intranet is connected to the Internet via a company proxy, which can also act as a firewall. If a PC (user) wants to access an area of the intranet from the Internet, the firewall must be informed of which addresses can be accessed from outside.

IP Addresses

The partner must have a unique address so that it can be addressed in the extensive intranet/Internet system. The IP address format is used for this purpose, which, as of Version 4, comprises four figures from 0 to 255, separated by a decimal point. Example: 146.254.245.62

The address is 32 bits long. Three classes have been created to enable the addresses to be structured on a world-wide basis and to ensure that the same address does not exist twice. The IP address comprises a small header, which describes the class, a network number, and a host number. The address of a subnetwork (intranet, for example) is encoded in the network number. The host number is basically the unique address of a station in a network of class X and subnetwork Y.

The first byte of class A IP addresses contains a number from 0 to 127: e.g. 98.x.x.x. This class can support up to 128 subnetworks, each with around 16 million connections. Since class A networks are very limited in number, these addresses are only available for large global companies and organisations. A Network Information Center (NIC) is responsible for assigning the classes and network numbers.

Class B networks (these begin with 128.x.x.x to 191.x.x.x) support up to 16,384 subnetworks, each with up to 65,535 stations. The majority of large companies and providers have a class B address.

With around 2.1 million subnetworks, each with up to 256 stations, class C addresses are often used by smaller providers and companies with no more than 256 connections in their corporate network. The IP addresses start from 192.x.x.x to 223.x.x.x

Subnet Mask

The subnet mask provides information on the size of the subnetwork (intranet) and its address band. In this way, each station knows whether the IP address to be addressed is located in the same subnetwork or whether it has to be addressed via a gateway.

Example:

IP address 1st BDA:	206.150.100.89
IP address 2nd BDA:	206.150.102.32
IP address gateway:	206.150.100.1
IP address browser:	206.150.100.50
Subnet mask:	255.255.255.0

Subnet mask 255.255.255.0 means that all addresses whose first three bytes are the same as the station address are located on the line of that station. These can be addressed directly (in the example above, from the browser of the first BDA). A comparison of the address of the second BDA with the subnet mask shows that this address is not on the same line as the station. This means that the gateway must be addressed, via which the request is then forwarded to the second BDA. The subnet mask must be obtained from the network administrator (usually 255.255.255.0).

BDA IP Address

The BDA must be assigned its own unique IP address that has not been used before so that it can run on the Ethernet. This address must be in the same band as the other addresses on this line. You may have to contact the network administrator here.

Gateway IP Address

If an address that is not located in the subnetwork is addressed in the browser, the request is forwarded to the gateway. The gateway knows the location to which the request has to be forwarded on account of the configuration. The IP address of the gateway must be obtained from the network administrator.

If 0.0.0.0 is set as the gateway IP address, no access to a gateway has been configured.

Operation

Once the addresses have been set, it should be possible to call up the BDA *Plus* via the Ethernet. This can be checked using a test ping. To do so, enter "ping x.x.x.x" in Start > Execute (x.x.x.x is the placeholder for the IP address of the BDA to be addressed). The DOS box that then appears tells you either that a reply from the "pinged" IP address is received, or that the request has been timed out. In this case, no connection has yet been established from the BDA *Plus* to the target system.

Note: You may have to include the IP address of the BDA *Plus* in the list of addresses that do not use a proxy server. The use of a proxy server is optional and depends on the network.

Once a connection has been established, start the browser and enter the IP address of the BDA *Plus* in the address line.

The Breaker Data Adapter (BDA) and BDA *Plus*
Operating Instructions and Troubleshooting

The BDA supports state-of-the-art communications technology. It can be implemented regardless of the operating system and browser used, and its structured tree and the pages it displays are harmonised with the Switch ES Power tool. The instructions provided here aim to show you how to make particular settings. A troubleshooting table is included at the end to help you solve any problems.

Languages and Help

The BDA interface is in German and English. The language is selected every time the browser is started. If you want to switch the language during operation, choose the option "SENTRON WL/VL" at the top of the tree. The language selection window then appears on the right-hand side of the screen.

In addition to the HTML pages and Java applets, the BDA stores the accompanying help pages in different languages. The help pages can be called up where they are available via the question mark icon in the top right-hand corner of the screen. They are available whenever the BDA is activated.
The help pages are available in German and English.

Offline/Online Mode

The BDA (and BDA Plus) can be run in two different operating modes.

Online mode

Online mode is activated automatically when the BDA is connected to a circuit-breaker. In this mode, the current operating and diagnostic data, as well as the parameters are displayed and loaded directly to the circuit-breaker after they have been changed. Online mode is indicated by a green **Cubicle**BUS LED.

If the connection to the circuit-breaker is interrupted, the BDA switches to offline mode. This also occurs if a file has been opened under "Parameter transfer" or received from the circuit-breaker.

Offline mode

If the BDA is supplied with 24 V DC and is not connected to a circuit-breaker, the BDA starts in offline mode, indicated by the fact that the **Cubicle**BUS LED is not illuminated. Offline mode is used to configure the BDA even if it is not connected to a circuit-breaker, and save this file for later use. Files created by Switch ES Power can also be opened and edited.
To switch from offline to online mode, you first have to connect a circuit-breaker. You then press either the "Online" or "Send parameters" button in "Parameter transfer".

Displaying Data

SENTRON VL and SENTRON WL use "property bytes", which provide information on the required value, such as whether it is available, or readable and/or writable. The display then changes depending on the property byte.

If a value is not available, for example, because the circuit-breaker does not have any neutral conductor protection (N-conductor protection parameter), it is displayed as an empty white field with no outline.

If a value is available, the system differentiates between whether it is only readable or also writable. Read only data is displayed in black on a gray background in a black, outlined field. If the value is also writable, the background is white.

Values that are available but not currently valid are displayed in red. This could be the case, for example, if the number of measured values available for calculating the long-term mean values of the current is insufficient because the circuit-breaker has only just been switched on.

Parameter: read and writable	PROFIBUS Address (1...125)	11
Measured value: read only	Current L1	439 A
Parameter: read only	N-protection I_N	315 A
Parameter not available	N-protection I_N	A
Measured value not valid	Demand L1	0 A

Fig. 6-19 *The way data is displayed on the BDA pages depends on the property byte. This tells you which data is read only, which data can be written, and which data is not available.*

Password Protection

All write actions that would result in a change to the status or a parameter in the circuit-breaker are password protected. This ensures that parameters cannot be changed and switching is impossible without this password.

Note: The electronic relays of the COM15 module are required to switch the SENTRON WL on and off via the BDA.

The default password is

"**sentron**"

This can be changed by choosing "Extras > Password" in the BDA tree (strongly recommended). You have to enter the new password twice. When you click OK, the BDA asks you for the old password.

If you have forgotten it, it can be reset by means of a master password. To do so, contact Technical Assistance at SIEMENS AG, A&D CD.

Tel.: +49 9131 743833

E-mail:
nst.technical-assistance@siemens.com

Operation Example

This example aims to describe the functionality of the BDA. You want to set the PROFIBUS-DP address of the COM15 module for a SENTRON WL. To do so, open the Communication node by choosing "Device Parameters > Circuit-Breaker". Then click the input/output field next to the PROFIBUS address and edit it in accordance with the new address. Once you have changed this parameter and exited the field, the outline turns blue to indicate parameters that have not yet been transferred to the circuit-breaker.

You can then change other parameters. If you want to transfer the modified parameters to the circuit-breaker, click OK on this page.

If the parameter transfer process is the first write action in this session, the system prompts you to enter the password. Once you have entered the password successfully, the data is transmitted to the circuit-breaker.

If you want to reset the modified parameters, click the "Undo" button.

If you exit the parameters page without clicking OK, the changes are ignored.

Printing

Since Java applets are used, the normal print function in your browser on the parameter pages will not provide a satisfactory printout.

If you want to print the parameters for documentation purposes, open the pages to be printed from the tree in the BDA. All the parameter pages are displayed again under "Extras > Print", and you can print them individually as required using the print menu in your browser.

Comparing Parameters

The parameter comparison function is used to check whether the parameters set in Switch ES Power or the BDA match those in the device. The following parameters are checked:

- Protection parameters A and B
- Extended protection function parameters
- Threshold value settings
- Measurement function settings
- Communication parameters
- Settings for the configurable output module

The parameter comparison function can be used, for example, to ensure that the set parameters are transferred without any errors once they have been downloaded to the device.

Due to the complex nature of SENTRON circuit-breakers, it is impossible to judge accurately whether the parameters and settings loaded to the device have actually been transferred. This is because, for example:

- BDA just forwards parameter changes. Whether a parameter is correct can only be verified in the memory location (e.g. in the trip unit). If this changes the value because one has exceeded the maximum value, for example, the modified value is reported back to the BDA. This discrepancy would be detected when a subsequent parameter comparison is performed.
- In the BDA interface, not all eventualities regarding the dependencies between minimum/maximum values and other parameters are checked. This means that a parameter could be entered that cannot be copied in the protection device in its current form.

SENTRON WL/VL	Root, language change possible
Main overview	*shows the most important information of the breaker at a glance*
Parameter transfer	*Saves and opens parameter files*
Identification	
Overview	*It is important to know which breaker is connected*
Details	*Detail information of the breaker, e.g. ident number or order number*
Description	*User comments like equipment identifier*
Device configuration	Shows which options the breaker has
Device parameters	
Breaker	
Metering settings	Contains settings for the metering function incl. for the voltage transformer
Protective function	
Parameter set A	*All protective parameters are covered (ETU45B, ETU55B und ETU76B)*
Parameter set B	*ETU55B and ETU76B do possess an additional parameter set B*
Additional	*Parameter for load shedding and load restore*
Ext. protective function	Ext. protective function (only with metering unit) **always** leads to a trip
Current	*e.g. due to phase unbalance current*
Voltage	*e.g. due to over voltage, under voltage, phase unbalance voltage*
Real power	*e.g. due to real power in and against normal direction*
Frequency	*e.g. due to under frequency, over frequency*
Setpoints	Setpoints (only with metering function) **never** leads to a trip, only a warning!
Current	*e.g. due to overload, phase unbalance current*
Voltage	*e.g. due to over voltage, under voltage, THD voltage*
Real power	*e.g. due to real power in and against normal direction*
Apparent- / Reactive power	*e.g. due to apparent power*
Frequency	*e.g. due to under frequency, over frequency*
Communication	*Parameter for communication, e.g. PROFIBUS address, IP address BDA Plus*
Configurable output module	*Configuration of the outputs of the configurable output module*
Diagnostic	
Breaker	
Status	*On/Off, breaker position in the frame, trip log, event log etc.*
Warnings	*All active warnings will be displayed here*
Trips	*The last trip will be shown if not cleared yet*
Setpoints	*Displays the active setpoint warnings*
Curves	
Waveform analysis	*Shows the waveform of voltage and current, only with metering function Plus*
Harmonics analysis	*Analysis the harmonics of voltage and current*
Metering data	
Currents	*Currents per phase*
Currents min/max	*Min. and max. currents per phase incl. timestamp*
Voltages	*Voltages, star and delta*
Voltages min/max	*Min. and max. voltages per phase incl. timestamp*
Power	*Power values and power factor*
Power min/max	*Min. and max. power values incl. timestamp*
Power details	*Power values per phase*
Energy	*Energy values*
Frequency	*Current frequency*
Frequency min/max	*Min. and max. frequency with timestamp*
Temperatures	*Temperature in the breaker and in the cubicle*
Temperatures min/max	*Min. and max. temperatures with time stamp*
Statistics / Maintenance	*No. of trips, no. of operations, operating hours etc.*
Control	
General	*Reset of min./max. values, set the system time etc.*
Modules	*Status of the CubicleBUS modules*
Breaker value comparison	*Compare the current parameter in the breaker with the content of a file*
Extras	
Password	*Set and reset of the BDA password*
Print	*All parameter pages are listed in a printable version*
Help	
Email	*Generates an e-mail for question about the BDA*
Manual	*Extracts from this manual are stored in the BDA*

Fig. 6-20 *The tree of the BDA was extracted in this picture so all items can be seen at a glance. The part with the black text is identical to the tree content of Switch ES Power. The "blue" part contains the Online masks of Switch ES Power which are accessable via the menu "Target system" of Switch ES Power. This is not possible within the BDA, therefor the online masks are placed in the tree.*

Troubleshooting List	
Fault description	**Solution**
An error message appears (e.g. Modem not initialised, etc.) a PPP connection is established with the BDA.	Ensure that you are using a fully-assigned null modem cable. With a null modem cable, pins 2 and 3, 4 and 6, and 7 and 8 must be assigned and reversed with respect to each other. Before starting the BDA, disconnect the null modem cable from the BDA and reboot the BDA (DEVICE LED is green). Then reconnect the cable. The COM port that you are using on the target system must not be being used by a different application (free it up, if necessary). Check the modem and data communications connection settings. You must choose "555". Only the user name "ppp" works. In the Control Panel, you also have to set the baud rate for the COM interface that you are using to 115200.
Nothing happens after you select the language on the first page.	Ensure that the option "Use Java v1.4.0 <applet>" is active in the browser. Delete the cache memory of the browser. Open the Java plug-in operator panel in the Control Panel. Check that the plug-in is active and Version 1.4.0 is selected under "Extended". On the "Browser" tab page, the browser that you are using must be active, and the Java VM cache can be deleted to be on the safe side. Then restart the system. If the problem persists, remove any older versions of Java you may have.
You cannot establish a connection to the BDA Plus via the Ethernet.	Check the settings for the gateway, the subnet mask, and the proxy. Enter the address of the BDA to be addressed in the proxy so that it is not routed via the proxy. This then only works if the BDA is located in the network specified by the subnet mask. Ping the BDA address to check whether TCP/IP communication is established to the BDA. If the ping does not work, check the network configuration again with your network administrator. If the BDA replies to a ping but not to a request to call up the browser, reset the BDA. The BDA must have already been booted with a connected Ethernet cable so that the Ethernet interface is activated. To solve the problem, connect the active Ethernet cable and boot up the BDA.
The system displays a message about security settings and the BDA pages stop loading.	The security level of the browser is set to "secure" and stops Java applets from running, for example. For this reason, you have to reduce the security level to a level where the security message no longer appears and the BDA pages are displayed.

Table 6-3 *This troubleshooting list helps you solve any problems you may encounter communicating with the BDA. If you have any other problems, Technical Assistance of SIEMENS AG, A&D CD (+49 9131 743833) will be happy to help.*

index.htm - Microsoft Internet Explorer
Data Adapter
L-Auslösung IR
(Überlast)
Aus
Ein
thermisches Gedächtnis
SIEMENS

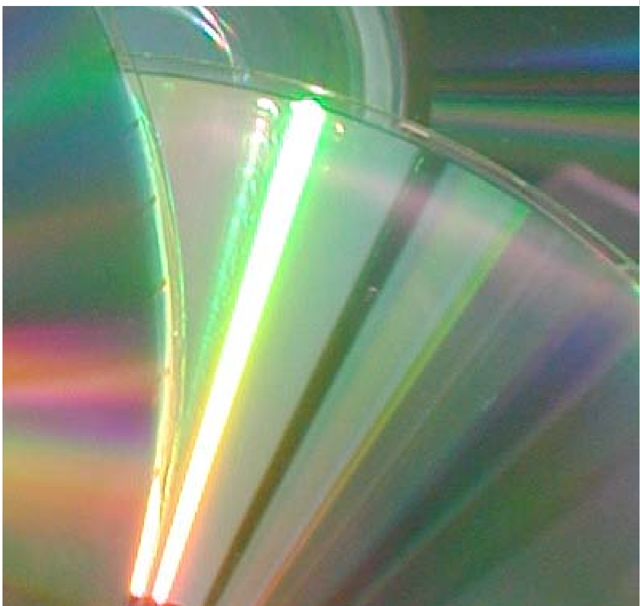
Data Dictionary

All available data of the SENTRON circuit breakers sorted by

- function groups

- DPV1 data sets

Definition of common and special data format



7

Data Dictionary
Introduction and Partition into Function Groups

The communction of the SENTRON circuit breaker is very versatile and flexible. Many of the huge amount of data points which can be read and partly written can also be integrated into the cyclic PROFIBUS telegram. In this chapter the data points will be described in detail as well as their properties.

General

The backbone of the common PROFIBUS profile of the SENTRON circuit breaker is the comprehensive data base, the so called data dictionary. The data dictionary describes the availablity of the data points in relation to the circuit breaker. In addition to that it explains the following properties of the data points:

- The name and unique number of the data point
- The source of this data point
- The format
- The size of the data point
- The scale of the data point
- In which data set is the data point available

In this chapter all available data points will be described. The first part devides the data point into different functional groups. These are for example data for the identification, parameters or measured values. Knowing the function and using the tables in the first part the user is able to find the requested data point very fast.

In the second part of this chapter the content of the read- and writeable data sets are described which themselve consist of the data mentioned in the first part. With this the data sets transferred via the PROFIBUS can be interpreted in the master.

The third part of this chapter deals with explanations of the different formats of the data points. Content of this is the description of the used Motorola formats suc as „int“ and „unsigned int“ as well as the description of the special formats. One example for a special format s the binary coded reason of the last trip in 2 Bytes.

Scaling

Non of the measured values will be transmitted as REAL format. Instead of this the format INT (with or without sign) will be used because of saving 2 bytes in the communication channel. To do so some of the data points must be scaled to ensure the correct interpretation.

Example Frequency:

The metering value of the current frequency (data point #262) varied betwenn 15.00 and 440.00 Hz. The digits behind the „.“ can´t be communicated via the INT format without scaling the data point. Therefore the metering value is muliplied with 10^2, the range is now from 1500 up to 44000.

The receiver (PROFIBUS master) has to rescale this data point by mulitplicating with 10^x (in this case x = -2) The value of x is always listed in the column „scale“.

Short name of the data point sources

- ETU = Electronic trip unit
- Metering = metering or metering function *Plus*
- DI = digital input module
- DO = digital output module
- BDA = Breaker Data Adapter or Breaker Date Adapter *Plus*
- BSS = Breaker status sensor
- Conf. DO = configurable digital output module

Units of the data points

As long as not mentioned different, all currents does have the unit A, all voltages V, all power kW/kVA or kvar, all energies MWh or Mvarh, all temperatures in °C, all crest-/form factors and THD in % and frequencies in Hz. Delay times always have the unit s (seconds). This declaration is also valid for the min./max. of the measured values.

Data points to control the SENTRON circuit breaker							
Description	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**	**content of DS.Byte**
Controls the buffers (e.g. min./max. values) of the communication module	18	COM15	COM10	Format (18)	8	-	DS51.181 DS93.10
Controls the outputs of the communication module (e.g. to switch the breaker)	19	COM15	COM10	Format (19)	8	-	DS51.182 DS93.11
Date of the last parameter change	84	COM15	-	Time	64	-	DS91.10
System time of the circuit breaker	90	COM15	COM10	Time	64	-	DS51.194 DS68.4
Controls the first digital output module	121	DO1	-	Format (121)	8	-	DS93.8
Controls the second digital output module	126	DO2	-	Format (121)	8	-	DS93.9
Controls the trip unit	406	ETU	-	Format (406)	16	-	DS93.4
6 PROFIBUS Bits for the configurable digital output module	426	COM15	-	Format (426)	6	-	DS69.13 DS93.13

Table 7-1 *The SENTRON circuit breaker can be controlled using the data points in this table. Examples are switching the breaker on or off, setting and resetting the outputs of the digitial output moduls as well as to control the trip unit.*

Data points for detailled diagnostic of the SENTRON circuit breaker							
Description	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**	**content of DS.Byte**
PROFIBUS write protection (DPWriteEnable)	14	COM15	COM10	Format (14)	1	-	DS69.11
Triplog of the last 5 trips with time stamp	15	COM15	COM10	Format (15)	480	-	DS51.0
Eventlog of the last 10 events with time stamp	16	COM15	COM10	Format (16)	960	-	DS51.60 DS92.42
# of switch actions ander load	80	COM15	COM10	unsigned int	16	0	DS91.0
# of switch actions caused by a trip	81	COM15	COM10	unsigned int	16	0	DS91.2
# of switch actions (complete cycle on/off)	82	COM15	-	unsigned int	16	0	DS91.4
Operating hours (breaker on and current > 0)	83	COM15	-	unsigned long	32	0	DS91.6
# of short circuit trips (SI)	104	ETU	COM10	unsigned int	16	0	DS91.18
# of overload trips (L)	105	ETU	COM10	unsigned int	16	0	DS91.20
# of earth fault trips (G)	106	ETU	COM10	unsigned int	16	0	DS91.22
Sum of I^2t-values L1, L2, L3, N	107	ETU	COM10	Format (107)	128	0	DS91.24
Trips of the extended protective function	307	Metering	-	Format (307)	16	-	DS92.28
Setpoint warnings	308	Metering	-	Format (308)	32	-	DS92.30
Harmonics of current/voltage up to the 29th	309	Metering *Pl.*	-	Format (309)	928	0	DS64.0
Order No. of the trip unit	371	ETU	-	18 x char	144	-	DS97.126
Time till the breaker trips caused by overload	379	ETU	-	unsigned int	16	0	DS51.1
Current, not yet cleared trip of the trip unit	401	ETU	ETU	Format (401)	8	-	DS92.26
Active warnings	402	ETU	ETU	Format (402)	16	-	DS92.24
Current that causes the trip	403	ETU	ETU	unsigned int	16	0(VL)/1	DS92.34
Phase number of the trip	404	ETU	ETU	Format (373)	3	-	DS92.36
Rotary switch pos. of the 1st dig. input module	111	DI1	-	Format (111)	8	-	DS69.3
Rotary switch pos. of the 2nd dig. input module	115	DI2	-	Format (111)	8	-	DS69.4
Rotary switch pos. of the 1st dig. output module	119	DO1	-	Format (119)	8	-	DS69.5
Rotary switch pos. of the 2nd dig. output mod.	124	DO2	-	Format (119)	8	-	DS69.6
Phase number with the maximum current	373	ETU	ETU	Format (373)	3	-	DS51.183
Position of the breaker in the frame	24	COM15	COM10	Format (24)	4	-	DS100.202 DS92.37
Connected **Cubicle**BUS modules	88	COM15	-	Format (88)	32	-	DS92.20 DS91.48
Status of the 1st dig. input module	110	DI1	-	Hex	8	-	DS69.0
Status of the 2nd dig. input module	114	DI2	-	Hex	8	-	DS69.1
Status of the outputs of the 1st dig. output mod.	118	DO1	-	Hex	8	-	DS68.14
Status of the outputs of the 2nd dig. outp. mod.	123	DO2	-	Hex	8	-	DS68.15
Status of the connected PROFIBUS	17	COM15	COM10	Format (17)	3	-	DS51.180
Status circuit breaker (on/off/storage spring etc.)	328	BSS	COM10	Format (328)	8	-	DS51.203 DS92.40
Maintenance information for the main contacts	405	ETU	-	Format (405)	2	-	DS91.40

Table 7-2 *The SENTRON circuit breaker provide various data points for a detailled diagnostic. This data points for diagnostic are shown in this table.*

Data points for the identification of the SENTRON circuit breaker							
Description	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**	**content of DS.Byte**
User comment	20	COM15	-	64 x char	512	-	DS165.4
Equipment identifier	21	COM15	-	64 x char	512	-	DS165.68
Date (free for user edit)	22	COM15	-	Time	64	-	DS165.132
Author (free for user edit)	23	COM15	-	30 x char	240	-	DS165.140
Ident number of the COM15/COM10	91	COM15	COM10	16 x char	128	-	DS162.4
Market of the circuit breaker	95	ETU	-	Format (95)	2	-	DS97.47
Ident number of the circuit breaker	96	ETU	-	20 x char	160	-	DS97.48
Last test date breaker	98	ETU	-	Time	64	-	DS97.74 DS100.4
Switching capacity	99	ETU	-	Format (99)	4	-	DS97.82
Frame size	100	ETU		Format (100)	2	-	DS97.83
Rated voltage of the circuit br. (Phase2Phase)	101	ETU	-	unsigned int	16	0	DS97.84
Rated current groand fault transformer	102	ETU	-	unsigned int	16	0	DS97.86 DS129.70
Order No. of the circuit breaker (... of the trip unit in case of SENTRON VL)	103	ETU	ETU	Format (103)	160	-	DS162.20 DS97.88
# of poles	108	ETU	ETU	Format (108)	3	-	DS97.144
Type (Metering, Metering *Plus*)	138	Metering	-	Format (138)	8	-	DS162.40
Rating Plug	377	ETU	ETU	unsigned int	16	0	DS51.208 DS97.146
Sensor Rating	378	ETU	ETU	unsigned int	16	0	DS97.148
Order No. of the trip unit	407	ETU	ETU	16 x char	144	-	DS97.0
Manufactoring date of trip unit	408	ETU	-	Time	64	-	DS97.18
Ident number of the trip unit	409	ETU	ETU	17 x char	136	-	DS97.26
N-Sensor activated/deactivated	411	ETU	ETU	Format (411)	1	-	DS97.45
Type of trip unit	412	ETU	ETU	Format (412)	5	-	DS162.41
Order No. COM10	424	-	COM10	16 x char	128	-	DS97.154
Serial No. COM10	425	-	COM10	16 x char	128	-	DS97.170

Table 7-3 *In purpose of communication the correct identification of the device is very important. The SENTRON circuit breaker supplies many data points to assure the correct identification.*

Data points for measured current

Description	Data point	Source WL	Source VL	Format	Length (Bit)	Scale	content of DS.Byte
Phase unbalance current (in %)	172	Metering	ETU	unsigned char	8	0	DS94.0
Demand current 3-phases	193	Metering	ETU	unsigned int	16	0	DS94.2
Demand current L1	194	Metering	ETU	unsigned int	16	0	DS94.4
Demand current L2	195	Metering	ETU	unsigned int	16	0	DS94.6
Demand current L3	196	Metering	ETU	unsigned int	16	0	DS94.8
Minimum demand current	244	Metering	-	unsigned int	16	0	DS72.24
Maximum demand current	245	Metering	-	unsigned int	16	0	DS72.26
Current max. L1, L2, L3, LN	374	ETU	ETU	unsigned int	16	0	DS51.186
Current N-phase	375	ETU	ETU	unsigned int	16	0	DS51.190 DS94.18
Earth fault current	376	ETU	ETU	unsigned int	16	0	DS51.192 DS94.20
Current Phase 1	380	ETU	ETU	unsigned int	16	0	DS94.10
Current Phase 2	381	ETU	ETU	unsigned int	16	0	DS94.12
Current Phase 3	382	ETU	ETU	unsigned int	16	0	DS94.14
Current demand over three phases	383	ETU	ETU	unsigned int	16	0	DS94.16
Minimum current inPhase 1	384	ETU	ETU	unsigned int	16	0	DS72.0
Maximum current in Phase 1	385	ETU	ETU	unsigned int	16	0	DS72.2
Minimum current in Phase 2	386	ETU	ETU	unsigned int	16	0	DS72.4
Maximum current in Phase 2	387	ETU	ETU	unsigned int	16	0	DS72.6
Minimum current in Phase 3	388	ETU	ETU	unsigned int	16	0	DS72.8
Maximum current in Phase 3	389	ETU	ETU	unsigned int	16	0	DS72.10
Minimum current N-phase	390	ETU	ETU	unsigned int	16	0	DS72.12
Maximum current N-phase	391	ETU	ETU	unsigned int	16	0	DS72.14
Minimum earth fault current	392	ETU	ETU	unsigned int	16	0	DS72.16
Maximum earth fault current	393	ETU	ETU	unsigned int	16	0	DS72.18
Minimum demand current over three phases	394	ETU	ETU	unsigned int	16	0	DS72.20
Maximum demand current over three phases	395	ETU	ETU	unsigned int	16	0	DS72.22

Table 7-4 *The SENTRON circuit breaker supplies a wide range of metering values. To find the requested data point as fast as possible they were categorised in different tables. This table contains all possible current.*

Data points for measured voltages

Description	Data point	Source WL	Source VL	Format	Length (Bit)	Scale	content of DS.Byte
Phase unbalance voltage (in %)	173	Metering	-	unsigned char	8	0	DS94.22
Delta voltage between Phase L1 and L2	197	Metering	-	unsigned int	16	0	DS94.24
Delta voltage between Phase L2 and L3	198	Metering	-	unsigned int	16	0	DS94.26
Delta voltage between Phase L3 and L1	199	Metering	-	unsigned int	16	0	DS94.28
Star voltage Phase L1	200	Metering	-	unsigned int	16	0	DS94.30
Star voltage Phase L2	201	Metering	-	unsigned int	16	0	DS94.32
Star voltage Phase L3	202	Metering	-	unsigned int	16	0	DS94.34
Demand of the delta voltage	203	Metering	-	unsigned int	16	0	DS94.36
Demand of the star voltage	204	Metering	-	unsigned int	16	0	DS94.38
Minimum of the delta voltage between Phase L1 and Phase L2	205	Metering	-	unsigned int	16	0	DS73.0
Maximum of the delta voltage between Phase L1 and Phase L2	206	Metering	-	unsigned int	16	0	DS73.2
Minimum of the delta voltage between Phase L2 and Phase L3	207	Metering	-	unsigned int	16	0	DS73.4
Maximum of the delta voltage between Phase L2 and Phase L3	208	Metering	-	unsigned int	16	0	DS73.6
Minimum of the delta voltage between Phase L3 and Phase L1	209	Metering	-	unsigned int	16	0	DS73.8
Maximum of the delta voltage between Phase L3 and Phase L1	210	Metering	-	unsigned int	16	0	DS73.10
Minimum of the star voltage Phase L1	211	Metering	-	unsigned int	16	0	DS73.12
Maximum of the star voltage Phase L1	212	Metering	-	unsigned int	16	0	DS73.14
Minimum of the star voltage Phase L2	213	Metering	-	unsigned int	16	0	DS73.16
Maximum of the star voltage Phase L2	214	Metering	-	unsigned int	16	0	DS73.18
Minimum of the star voltage Phase L3	215	Metering	-	unsigned int	16	0	DS73.20
Maximum of the star voltage Phase L3	216	Metering	-	unsigned int	16	0	DS73.22

Table 7-5 *The SENTRON circuit breaker supplies a wide range of metering values. To find the requested data point as fast as possible they were categorised in different tables. This table contains all possible voltages.*

Data points for measured power

Description	Data point	Source WL	Source VL	Format	Length (Bit)	Scale	content of DS.Byte
Sum of apparent power	217	Metering	-	unsigned int	16	0	DS94.40
Apparent power in Phase L1	218	Metering	-	unsigned int	16	0	DS94.62
Apparent power in Phase L2	219	Metering	-	unsigned int	16	0	DS94.64
Apparent power in Phase L3	220	Metering	-	unsigned int	16	0	DS94.66
Sum of real power	221	Metering	-	signed int	16	0	DS94.42
Real power in Phase L1	222	Metering	-	signed int	16	0	DS94.44
Real power in Phase L2	223	Metering	-	signed int	16	0	DS94.46
Real power in Phase L3	224	Metering	-	signed int	16	0	DS94.48
Sum of Reactive poweren	225	Metering	-	signed int	16	0	DS94.50
Reactive power in Phase L1	226	Metering	-	signed int	16	0	DS94.76
Reactive power in Phase L2	227	Metering	-	signed int	16	0	DS94.78
Reactive power in Phase L3	228	Metering	-	signed int	16	0	DS94.80
Demand of the real power 3-phases	229	Metering	-	signed int	16	0	DS94.52
Demand of the real power in Phase L1	230	Metering	-	signed int	16	0	DS94.54
Demand of the real power in Phase L2	231	Metering	-	signed int	16	0	DS94.56
Demand of the real power in Phase L3	232	Metering	-	signed int	16	0	DS94.58
Demand of the apparent power 3-phases	233	Metering	-	unsigned int	16	0	DS94.60
Demand of the apparent power in Phase L1	234	Metering	-	unsigned int	16	0	DS94.68
Demand of the apparent power in Phase L2	235	Metering	-	unsigned int	16	0	DS94.70
Demand of the apparent power in Phase L3	236	Metering	-	unsigned int	16	0	DS94.72
Demand of the reactive power 3-phases	237	Metering	-	signed int	16	0	DS94.74
Minimum demand of the apparent power	246	Metering	-	unsigned int	16	0	DS74.4
Maximum demand of the apparent power	247	Metering	-	unsigned int	16	0	DS74.6
Minimum demand of the reactive power	248	Metering	-	signed int	16	0	DS74.12
Maximum demand of the reactive power	249	Metering	-	signed int	16	0	DS74.14
Minimum demand of the real power	250	Metering	-	signed int	16	0	DS74.8
Maximum demand of the real power	251	Metering	-	signed int	16	0	DS74.10

Table 7-6 *The SENTRON circuit breaker supplies a wide range of metering values. To find the requested data point as fast as possible they were categorised in different tables. This table contains all possible power values.*

Data points for all other measured values (power factor, temperature, frequency, energy etc.)							
Description	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**	**content of DS.Byte**
Demand of the power factor	168	Metering	-	signed int	16	-3	DS51.184 DS94.98
Power factor in Phase L1	169	Metering	-	signed int	16	-3	DS94.100
Power factor in Phase L2	170	Metering	-	signed int	16	-3	DS94.102
Power factor in Phase L3	171	Metering	-	signed int	16	-3	DS94.104
Minimum demand of the Power factor	242	Metering	-	signed int	16	-3	DS74.0
Maximum demand of the Power factor	243	Metering	-	signed int	16	-3	DS74.2
Temperature in the cubicle (det. in the COM15)	71	COM15	-	unsigned char	8	0	DS94.114
Minimal temperature in the cubicle	72	COM15	-	unsigned char	8	0	DS77.0
Maximal temperature in the cubicle	73	COM15	-	unsigned char	8	0	DS77.1
Temperature in the circuit breaker (det. in BSS)	330	BSS	-	unsigned char	8	0	DS94.115
Minimal temperature in the circuit breaker	74	COM15	-	unsigned char	8	0	DS77.2
Maximal temperature in the circuit breaker	75	COM15	-	unsigned char	8	0	DS77.3
Real energy in normal direction	238	Metering	-	unsigned long	32	0	DS94.82
Real energy in reverse direction	239	Metering	-	unsigned long	32	0	DS94.86
Reactive energy in normal direction	240	Metering	-	unsigned long	32	0	DS94.90
Reactive energy in reverse direction	241	Metering	-	unsigned long	32	0	DS94.94
Frequency	262	Metering	COM10	unsigned int	16	-2	DS94.106
Minimum of the Frequency	252	Metering	COM10	unsigned int	16	-2	DS76.2
Maximum of the Frequency	253	Metering	COM10	unsigned int	16	-2	DS76.0
THD of the current	254	Metering	-	unsigned char	8	0	DS94.108
Minimum of the THD of the current	255	Metering	-	unsigned char	8	0	DS76.4
Maximum of the THD of the current	256	Metering	-	unsigned char	8	0	DS76.5
THD of the voltages	257	Metering	-	unsigned char	8	0	DS94.109
Minimum of the THD of the voltages	258	Metering	-	unsigned char	8	0	DS76.6
Maximum of the THD of the voltages	259	Metering	-	unsigned char	8	0	DS76.7
Crest factor	260	Metering	-	unsigned char	8	-1	DS94.111
Minimum of the crest factor	263	Metering	-	unsigned char	8	-1	DS72.28
Maximum of the crest factor	264	Metering	-	unsigned char	8	-1	DS72.29
Form factor	261	Metering	-	unsigned char	8	-1	DS94.110
Minimum of the form factor	265	Metering	-	unsigned char	8	-1	DS72.30
Maximum of the form factor	266	Metering	-	unsigned char	8	-1	DS72.31

Table 7-7 *The SENTRON circuit breaker supplies a wide range of metering values. To find the requested data point as fast as possible they were categorised in different tables. This table contains all other measured values not included in the tables before.*

Data point for the timestamps (TS) of the measured values part 1							
Description	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**	**content of DS.Byte**
TS Minimum current in Phase L1	25	COM15	COM10	Time	64	-	DS72.32
TS Maximum current in Phase L1	26	COM15	COM10	Time	64	-	DS72.40
TS Minimum current in Phase L2	27	COM15	COM10	Time	64	-	DS72.48
TS Maximum current in Phase L2	28	COM15	COM10	Time	64	-	DS72.56
TS Minimum current in Phase L3	29	COM15	COM10	Time	64	-	DS72.64
TS Maximum current in Phase L3	30	COM15	COM10	Time	64	-	DS72.72
TS Minimum current N-phase	33	COM15	COM10	Time	64	-	DS72.112
TS Maximum current N-phase	34	COM15	COM10	Time	64	-	DS72.120
TS Minimum earth fault current	35	COM15	COM10	Time	64	-	DS72.128
TS Maximum earth fault current	36	COM15	COM10	Time	64	-	DS72.136
TS Minimum demand over three phases	31	COM15	COM10	Time	64	-	DS72.80
TS Maximum demand over three phases	32	COM15	COM10	Time	64	-	DS72.88
TS Minimum demand current	55	COM15	-	Time	64	-	DS72.96
TS Maximum demand current	56	COM15	-	Time	64	-	DS72.104
TS Minimum of the delta voltage between Phase L1 and Phase L2	37	COM15	-	Time	64	-	DS73.24
TS Maximum of the delta voltage between Phase L1 and Phase L2	38	COM15	-	Time	64	-	DS73.32
TS Minimum of the delta voltage between Phase L2 and Phase L3	39	COM15	-	Time	64	-	DS73.40
TS Maximum of the delta voltage between Phase L2 and Phase L3	40	COM15	-	Time	64	-	DS73.48
TS Minimum of the delta voltage between Phase L3 and Phase L1	41	COM15	-	Time	64	-	DS73.56
TS Maximum of the delta voltage between Phase L3 and Phase L1	42	COM15	-	Time	64	-	DS73.64
TS Minimum of the star voltage Phase L1	43	COM15	-	Time	64	-	DS73.72
TS Maximum of the star voltage Phase L1	44	COM15	-	Time	64	-	DS73.80
TS Minimum of the star voltage Phase L2	45	COM15	-	Time	64	-	DS73.88
TS Maximum of the star voltage Phase L2	46	COM15	-	Time	64	-	DS73.96
TS Minimum of the star voltage Phase L3	47	COM15	-	Time	64	-	DS73.104
TS Maximum of the star voltage Phase L3	48	COM15	-	Time	64	-	DS73.112
TS Minimum demand of the apparent power	57	COM15	-	Time	64	-	DS74.16
TS Maximum demand of the apparent power	58	COM15	-	Time	64	-	DS74.24
TS Minimum demand of the real power	49	COM15	-	Time	64	-	DS74.32
TS Maximum demand of the real power	50	COM15	-	Time	64	-	DS74.40
TS Minimum demand of the reactive power	51	COM15	-	Time	64	-	DS74.48
TS Maximum demand of the reactive power	52	COM15	-	Time	64	-	DS74.56

Table 7-8 *The SENTRON circuit breaker supplies a wide range of metering values. To find the requested data point as fast as possible they were categorised in different tables. This table contains the timestamps of the min/max metering values. Part 1*

Data point for the timestamps (TS) of the measured values part 2

Description	Data point	Source WL	Source VL	Format	Length (Bit)	Scale	content of DS.Byte
TS Minimum demand of the Power factor	53	COM15	-	Time	64	-	DS74.64
TS Maximum demand of the Power factor	54	COM15	-	Time	64	-	DS74.72
TS Minimal temperature in the cubicle	76	COM15	-	Time	64	-	DS77.4
TS Maximal temperature in the cubicle	77	COM15	-	Time	64	-	DS77.12
TS Minimal temperature in the circuit breaker	78	COM15	-	Time	64	-	DS77.20
TS Maximal temperature in the circuit breaker	79	COM15	-	Time	64	-	DS77.28
TS Minimum of the Frequency	59	COM15	-	Time	64	-	DS76.8
TS Maximum of the Frequency	60	COM15	-	Time	64	-	DS76.16
TS Minimum THD of the current	61	COM15	-	Time	64	-	DS76.24
TS Maximum THD of the current	62	COM15	-	Time	64	-	DS76.32
TS Minimum THD of the voltages	63	COM15	-	Time	64	-	DS76.40
TS Maximum THD of the voltages	64	COM15	-	Time	64	-	DS76.48
TS Minimum of the Crest factor	65	COM15	-	Time	64	-	DS72.144
TS Maximum of the Crest factor	66	COM15	-	Time	64	-	DS72.152
TS Minimum of the Form factor	67	COM15	-	Time	64	-	DS72.160
TS Maximum of the Form factor	68	COM15	-	Time	64	-	DS72.168

Table 7-9 *The SENTRON circuit breaker supplies a wide range of metering values. To find the requested data point as fast as possible they were categorised in different tables. This table contains the timestamps of the min/max metering values. Part 2*

Parameter for the SENTRON circuit breaker (primary protective function) part 1							
Description	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**	**content of DS.Byte**
Active parameter set	370	ETU	-	Format (370)	1	-	DS129.65
Trip class (only SENTRON VL LCD ETU40M)	331	-	ETU	Format (331)	8	0	DS129.68
Overload parameter I_R parameter set A (PS A)	333	ETU	ETU	unsigned int	16	0	DS129.4
Time lag class t_R PS A	335	ETU	ETU	unsigned int	16	–1	DS129.8
Instantaneous protection parameter I_i PS A	336	ETU	ETU	unsigned int	16	1/ 0(VL)	DS129.10
Short time delayed prot. parameter I_{sd} PS A	337	ETU	ETU	unsigned int	16	1/ 0(VL)	DS129.12
Delay time for S-trip t_{sd} PS A	338	ETU	ETU	unsigned int	16	–3	DS129.14
Overload N-Phase I_N PS A (WL)	334	ETU	-	unsigned int	16	0	DS129.6
Overload N-Phase I_N (VL)	365	-	ETU	unsigned char	8	0	DS129.66
Earth fault protection parameter I_{g1} PS A	339	ETU	ETU	unsigned int	16	0	DS129.16
Delay time earth fault protection t_{g1} PS A	340	ETU	ETU	unsigned int	16	–3	DS129.18
Earth fault protection parameter I_{g2} PS A	341	ETU	ETU	unsigned int	16	0	DS129.20
Delay time earth fault protection t_{g2} PS A	342	ETU	ETU	unsigned int	16	–3	DS129.22
I^4t curve for overload protection PS A	345	ETU	-	Format (345)	1	-	DS129.26
I^2t curve for delayed S-trip PS A	343	ETU	ETU	Format (343)	1	-	DS129.24
I^2t curve for earth fault protection PS A	344	ETU	ETU	Format (344)	1	-	DS129.25
Thermal memory PS A	346	ETU	ETU	Format (346)	1	-	DS129.27
Phase loss sensitivity PS A	347	ETU	-	Format (347)	1	-	DS129.28
Thermal time constant PS A	348	ETU	-	unsigned int	16	0	DS129.30
Overload parameter I_R parameter set B (PS B)	349	ETU	-	unsigned int	16	0	DS129.32
Time lag class t_R PS B	351	ETU	-	unsigned int	16	–1	DS129.36
Instantaneous protection parameter I_i PS B	352	ETU	-	unsigned int	16	1	DS129.38
Short time delayed prot. parameter I_{sd} PS B	353	ETU	-	unsigned int	16	1	DS129.40
Delay time for S-trip t_{sd} PS B	354	ETU	-	unsigned int	16	–3	DS129.42
Overload N-Phase I_N PS B (WL)	350	ETU	-	unsigned int	16	0	DS129.34
Earth fault protection parameter I_{g1} PS B	355	ETU	-	unsigned int	16	0	DS129.44
Delay time earth fault protection t_{g1} PS B	356	ETU	-	unsigned int	16	–3	DS129.46
Earth fault protection parameter I_{g2} PS B	357	ETU	-	unsigned int	16	0	DS129.48
Delay time earth fault protection t_{g2} PS B	358	ETU	-	unsigned int	16	–3	DS129.50
I^4t curve for overload protection PS B	361	ETU	-	Format (345)	1	-	DS129.54
I^2t curve for delayed S-trip PS B	359	ETU	-	Format (343)	1	-	DS129.52
I^2t curve for earth fault protection PS B	360	ETU	-	Format (344)	1	-	DS129.53
Thermal memory PS B	362	ETU	-	Format (346)	1	-	DS129.55
Phase loss sensitivity PS B	363	ETU	-	Format (347)	1	-	DS129.56
Thermal time constant PS B	364	ETU	-	unsigned int	16	0	DS129.58

Table 7-10 *The property of the protective parameters are depending on the options of the SENTRON circuit breaker. The SENTRON WL supplies two different parameter sets A and B for ETU55B and ETU76B. To differentiate between the parametes of the two sets, they are marked with PS A (for set A) and PS B (for set B). Part 1*

Parameter for the SENTRON circuit breaker (primary protective function) part 2							
Description	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**	**content of DS.Byte**
Load shedding	367	ETU	-	unsigned int	16	0	DS129.60
Load restorage	368	ETU	-	unsigned int	16	0	DS129.62
Delay time load shedd./restorage	366	ETU	-	unsigned char	8	0	DS129.64
Pre alarm for overcurrent (VL only)	369	-	ETU	unsigned int	16	0	DS128.44

Table 7-11 *The parameters load shedding and load restorage are two current levels which generates in case of exceeding or falling below them two different warnings. These warnings can be delayed with the data point #366.*

Parameter for the SENTRON circuit breaker (extended protective function)							
Description	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**	**content of DS.Byte**
Phase unbalance current	139	Metering	ETU	unsigned char	8	0	DS128.41
Delay time for Phase unbalance current	140	Metering	ETU	unsigned char	8	0	DS128.42
Real power in normal direction	141	Metering	-	unsigned int	16	0	DS128.14
Delay time for Real power in normal direction	142	Metering	-	unsigned char	8	0	DS128.18
Real power in reverse direction	143	Metering	-	unsigned int	16	0	DS128.16
Delay time for Real power in reverse direction	144	Metering	-	unsigned char	8	0	DS128.19
Under frequency	147	Metering	-	unsigned int	16	0	DS128.22
Delay time for Under frequency	148	Metering	-	unsigned char	8	0	DS128.25
Over frequency	149	Metering	-	unsigned int	16	0	DS128.26
Delay time for Over frequency	150	Metering	-	unsigned char	8	0	DS128.24
Phase unbalance voltage	151	Metering	-	unsigned char	8	0	DS128.32
Delay time for Phase unbalance voltage	152	Metering	-	unsigned char	8	0	DS128.33
Under voltage	153	Metering	-	unsigned int	16	0	DS128.34
Delay time for Under voltage	154	Metering	-	unsigned char	8	0	DS128.38
Over voltage	155	Metering	-	unsigned int	16	0	DS128.36
Delay time for Over voltage	156	Metering	-	unsigned char	8	0	DS128.39
THD of the current	158	Metering	-	unsigned char	8	0	DS128.28
Delay time for THD of the current	159	Metering	-	unsigned char	8	0	DS128.29
THD of the voltages	160	Metering	-	unsigned char	8	0	DS128.30
Delay time for THD of the voltages	161	Metering	-	unsigned char	8	0	DS128.31

Table 7-12 *The extended protective function supplies additional criteria to protect the power distribution plant. Almost all of the optional parameters can be set with an additional delay time to ignore time limeted peaks.*

Parameter for the SENTRON circuit breaker (setpoint warnings) part 1							
Description	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**	**content of DS.Byte**
Over current	267	Metering	ETU	unsigned int	16	0	DS130.48
Delay time for Over current	268	Metering	ETU	unsigned char	8	0	DS130.56
Earth fault current	269	Metering	ETU	unsigned int	16	0	DS130.50
Delay time for earth fault current	270	Metering	ETU	unsigned char	8	0	DS130.57
Over current N-phase	271	Metering	ETU	unsigned int	8	0	DS130.52
Delay time for Over current N-phase	272	Metering	ETU	unsigned char	8	0	DS130.58
Phase unbalance current	273	Metering	ETU	unsigned char	8	0	DS130.59
Delay time for Phase unbalance current	274	Metering	ETU	unsigned char	8	0	DS130.60
Demand of the current	275	Metering	ETU	unsigned int	16	0	DS130.54
Delay time for demand of the current	276	Metering	ETU	unsigned char	8	0	DS130.61
Under voltage	277	Metering	-	unsigned int	16	0	DS130.62
Delay time for Under voltage	278	Metering	-	unsigned char	8	0	DS130.64
Phase unbalance voltage	279	Metering	-	unsigned char	8	0	DS130.65
Delay time for Phase unbalance voltage	280	Metering	-	unsigned char	8	0	DS130.66
Over voltage	281	Metering	-	unsigned int	16	0	DS130.68
Delay time for Over voltage	282	Metering	-	unsigned char	8	0	DS130.70
Real power in normal direction	283	Metering	-	unsigned int	16	0	DS130.4
Delay time for Real power in normal direction	284	Metering	-	unsigned char	8	0	DS130.12
Real power in reverse direction	285	Metering	-	unsigned int	16	0	DS130.6
Delay time for Real power in reverse direction	286	Metering	-	unsigned char	8	0	DS130.13
Power factor capacitive	287	Metering	-	signed int	16	–3	DS130.8
Delay time for Power factor capacitive	288	Metering	-	unsigned char	8	0	DS130.14
Power factor inductive	289	Metering	-	signed int	16	–3	DS130.10
Delay time for Power factor inductive	290	Metering	-	unsigned char	8	0	DS130.15
Demand Real power	291	Metering	-	unsigned int	16	0	DS130.30
Delay time Demand of the real power	292	Metering	-	unsigned char	8	0	DS130.34
Demand Apparent power	293	Metering	-	unsigned int	16	0	DS130.32
Delay time Demand of the apparent power	294	Metering	-	unsigned char	8	0	DS130.35
Demand Reactive power	295	Metering	-	unsigned int	16	0	DS130.36
Delay time Demand of the reactive power	296	Metering	-	unsigned char	8	0	DS130.40
Reactive power in normal direction	297	Metering	-	unsigned int	16	0	DS130.38
Delay time for Reactive power in normal direction	298	Metering	-	unsigned char	8	0	DS130.41

Table 7-13 *Almost all of the setpoint parameters are only available @ SENTRON WL with metering function or metering function Plus. If an activated setpoint is exceeded a setpoint warning will be generated after the selected delay time. Part 1*

Parameter for the SENTRON circuit breaker (setpoint warnings) part 2							
Description	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**	**content of DS.Byte**
Reactive power in reverse direction	299	Metering	-	unsigned int	16	0	DS130.42
Delay time for Reactive power in reverse direction	300	Metering	-	unsigned char	8	0	DS130.46
Apparent power	301	Metering	-	unsigned int	16	0	DS130.44
Delay time for Apparent power	302	Metering	-	unsigned char	8	0	DS130.47
Over frequency	303	Metering	-	unsigned char	8	0	DS130.16
Delay time for Over frequency	304	Metering	-	unsigned char	8	0	DS130.17
Under frequency	305	Metering	-	unsigned char	8	0	DS130.18
Delay time for Under frequency	306	Metering	-	unsigned char	8	0	DS130.19
THD current	319	Metering	-	unsigned char	8	0	DS130.20
Delay time for THD current	320	Metering	-	unsigned char	8	0	DS130.21
THD voltage	321	Metering	-	unsigned char	8	0	DS130.22
Delay time for THD voltage	322	Metering	-	unsigned char	8	0	DS130.23
Crest factor	323	Metering	-	unsigned int	16	–2	DS130.24
Delay time for Crest factor	324	Metering	-	unsigned char	8	0	DS130.28
Form factor	325	Metering	-	unsigned int	16	–2	DS130.26
Delay time for Form factor	326	Metering	-	unsigned char	8	0	DS130.29

Table 7-14 *Almost all of the setpoint parameters are only available @ SENTRON WL with metering function or metering function Plus. If an activated setpoint is exceeded a setpoint warning will be generated after the selected delay time. Part 2*

Parameter for the SENTRON circuit breaker (communication, metering settings etc.)							
Description	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**	**content of DS.Byte**
PROFIBUS address	5	COM15	COM10	unsigned int	8	0	DS160.5
Basic type for the cyclic data transmission	6	COM15	COM10	Hex	2	-	DS160.6
Changeable data points in the cyclic telegram	7	COM15	COM10	Format (7)	224	-	DS160.8
IP address of the BDA/BDA *Plus*	10	BDA	-	Format (10)	40	-	DS160.42
Events for the configurable dig. output module	129	konf. DO	-	Format (129)	168	-	DS128.46
Defintion of the normal energy direction	145	Metering	-	Format (145)	1	-	DS128.20
Phase rotation	146	Metering	-	Format (146)	1	-	DS128.21
Primary connection of the voltage transformer Ypsilon or Delta	162	Metering	-	Format (162)	1	-	DS128.4
Rated operational voltage (Phase2Phase)	164	Metering	-	unsigned int	16	0	DS128.6
Secondary voltage of the voltage transformer	165	Metering	-	unsigned char	8	0	DS128.8
Period length for calculating demands	166	Metering	-	unsigned char	8	0	DS128.9
No. of sub periods for calculating demands	167	Metering	-	unsigned char	8	0	DS128.10
Current transmission limit; below this all currents will be set to 0	372	ETU	-	unsigned int	16	0	DS128.12
Determination of earth fault current (transformer or/and vectorial sum)	410	ETU	ETU	Format (410)	2	-	DS97.44 DS129.69

Table 7-15 *All parameters which were not mentioned in the previous tables are listed here. These are parameters for communication, settings for the metering function etc.*

Data Dictionary
Content of the DPV1 data sets

Via the cyclic protocol of the PROFIBUS-DP the SENTRON circuit breaker communicates with a class 1 master, e.g. a plc. In addition to the data transmitted in the cyclic channel the master can request the slave for further data in DPV1 data sets triggered by an event. Writing to the slave and controlling it using DPV1 data sets is also possible. This section of the chapter explains the content of all available data sets.

The data sets were explained chronologically in ascending order. In the head of each table is mentioned the content, how long the data set is and whether the data set is read only or read and writeable.

DS0: S7-V1 System diagnostic (Length 4 Byte, read only)

Byte	Description	Data point	Source WL	Source VL	Format	Length (Bit)	Scale
0	0x0F, if there is an external diagnostic message 0x00, if there is no external diagnostic message	-	COM15	COM10	-	8	-
1	Fixed to 0x03	-	COM15	COM10	-	8	-
2	Fixed to 0x00	-	COM15	COM10	-	8	-
3	Fixed to 0x00	-	COM15	COM10	-	8	-

Table 7-16 *The data set 0 contains the information whether an external diagnostic message is available.*

DS1: System diagnostic (Length 16 Byte, read only)

Byte	Description	Data point	Source WL	Source VL	Format	Length (Bit)	Scale
0	Identical to DS0	-	COM15	COM10	-	32	-
4	Channel type; Fixed to 0x7D	-	COM15	COM10	-	8	-
5	Length of the channel diagnostic message ; Fixed to 0x20	-	COM15	COM10	-	8	-
6	No. of channels; Fixed to 0x01	-	COM15	COM10	-	8	-
7	1 Bit for each channel; Fixed to 0x01	-	COM15	COM10	-	8	-
8	Reserved; Fixed to 0x00	-	COM15	COM10	-	64	-

Table 7-17 *The data set 1 contains the system diagnostic message. The length is 16 Byte and inludes in the first four Byte the complete data set 0. Additional diagnostic messages are in data set 92.*

DS51: Main overview (Length 238 Byte, read only)							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Triplog of the last 5 trips with time stamp	15	COM15	COM10	Format (15)	480	-
60	Eventlog of the last 10 events with time stamp	16	COM15	COM10	Format (16)	960	-
180	Status of the connected PROFIBUS	17	COM15	COM10	Format (17)	3	-
181	Controls the buffers (e.g. min./max. values) of the communication module	18	COM15	COM10	Format (18)	8	-
182	Controls the outputs of the communication module (e.g. to switch the breaker)	19	COM15	COM10	Format (19)	8	-
183	Phase number with the maximum current	373	ETU	ETU	Format (373)	3	-
184	Demand of the power factor	168	Metering	-	signed int	16	–3
186	Current max. L1, L2, L3, LN	374	ETU	ETU	unsigned int	16	0
188	Time till the breaker trips caused by overload	379	ETU	-	unsigned int	16	0
190	Current N-phase	375	ETU	ETU	unsigned int	16	0
192	Earth fault current	376	ETU	ETU	unsigned int	16	0
194	System time of the circuit breaker	90	COM15	COM10	Time	64	-
202	Position of the breaker in the frame	24	COM15	COM10	Format (24)	4	-
203	Status circuit breaker (on/off/storage spring etc.)	328	BSS	COM10	Format (328)	8	-
204	Overload parameter I_R parameter set A (PS A)	333	ETU	ETU	unsigned int	16	0
206	Overload parameter I_R parameter set B (PS B)	349	ETU	-	unsigned int	16	0
208	Rating Plug	377	ETU	ETU	unsigned int	16	0
210	Active parameter set	370	ETU	-	Format (370)	1	-
211	Reserved	-	-	-	-	72	-
220	Property for Byte 0	-	COM15	COM10	EB	8	-
221	Property for Byte 60	-	COM15	COM10	EB	8	-
222	Property for Byte 180	-	COM15	COM10	EB	8	-
223	Property for Byte 181	-	COM15	COM10	EB	8	-
224	Property for Byte 182	-	COM15	COM10	EB	8	-
225	Property for Byte 183	-	ETU	ETU	EB	8	-
226	Property for Byte 184	-	Metering	-	EB	8	-
227	Property for Byte 186	-	ETU	ETU	EB	8	-
228	Property for Byte 188	-	ETU	-	EB	8	-
229	Property for Byte 190	-	ETU	ETU	EB	8	-
230	Property for Byte 192	-	ETU	ETU	EB	8	-
231	Property for Byte 194	-	COM15	COM10	EB	8	-
232	Property for Byte 202	-	COM15	COM10	EB	8	-
233	Property for Byte 203	-	BSS	COM10	EB	8	-
234	Property for Byte 204	-	ETU	ETU	EB	8	-
235	Property for Byte 206	-	ETU	-	EB	8	-
236	Property for Byte 208	-	ETU	ETU	EB	8	-
237	Property for Byte 210	-	ETU	-	EB	8	-

Table 7-18 *The data set 51 copies the important information from other data sets to supplies an overview at a glance. Switch ES Power uses this data set to display the main overview.*

DS64: Harmonic analysis (Length 131 Byte, read only)							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Harmonics of current/voltage up to the 29th	309	Metering	-	Format (309)	928	0
116	Reserved	-	-	-	-	112	-
130	Property for Byte 0	-	Metering	-	EB	8	-

Table 7-19 *The data set 64 contains the data of the harmonics of current and voltage. The data point 309 is explained in the section „special format" in this chapter. The harmonic analysis is only available for SENTRON WL circuit breaker with metering Plus function.*

DS68: Data points of the CubicleBUS Modules (Length 45 Byte, read and writeable)							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Header; fixed to 0x00 00 00 00	-	COM15	COM10	-	32	-
4	System time of the circuit breaker	90	COM15	COM10	Time	64	-
12	Controls the outputs of the communication module (e.g. to switch the breaker)	19	COM15	COM10	Format (19)	8	-
13	Reserved	-	-	-	-	8	-
14	Status of the outputs of the 1st dig. output mod.	118	DO1	-	Hex	8	-
15	Status of the outputs of the 2nd dig. output mod.	123	DO2	-	Hex	8	-
16	Reserved	-	-	-	-	192	-
40	Property for Byte 4	-	COM15	-	EB	8	-
41	Property for Byte 12	-	COM15	-	EB	8	-
42	Reserved	-	-	-	-	8	-
43	Property for Byte 14	-	DO1	-	EB	8	-
44	Property for Byte 15	-	DO2	-	EB	8	-

Table 7-20 *Using the data set 68 the outputs of the digital output modules can be read and also be chanded as well as the to read and set the system time. For open and close the main contacts of the breaker via PROFIBUS communication data point 19 in this data set must be set.*

Byte	Description	Data point	Source WL	Source VL	Format	Length (Bit)	Scale
DS69: Status of the Modules (Length 43 Byte, read only)							
0	Status of the 1st dig. input module	110	DI1	-	Hex	8	-
1	Status of the 2nd dig. input module	114	DI2	-	Hex	8	-
2	Controls the outputs of the communication module (e.g. to switch the breaker)	19	COM15	COM10	Format (19)	8	-
3	Rotary switch pos. of the 1st dig. input module	111	DI1	-	Format (111)	8	-
4	Rotary switch pos. of the 2nd dig. input module	115	DI2	-	Format (111)	8	-
5	Rotary switch pos. of the 1st dig. output module	119	DO1	-	Format (119)	8	-
6	Rotary switch pos. of the 2nd dig. output module	124	DO2	-	Format (119)	8	-
7	Reserved	-	-	-	-	32	-
11	PROFIBUS write protection (DPWriteEnable)	14	COM15	COM10	Format (14)	1	-
12	Reserved	-	-	-	-	8	-
13	6 PROFIBUS Bits for the configurable digital output module	426	COM15	-	Format (426)	6	-
14	Reserved	-	-	-	-	120	-
29	Property for Byte 13	-	COM15	-	EB	8	-
30	Property for Byte 0	-	DI1	-	EB	8	-
31	Property for Byte 1	-	DI2	-	EB	8	-
32	Property for Byte 2	-	COM15	COM10	EB	8	-
33	Property for Byte 3	-	DI1	-	EB	8	-
34	Property for Byte 4	-	DI2	-	EB	8	-
35	Property for Byte 5	-	DO1	-	EB	8	-
36	Property for Byte 6	-	DO2	-	EB	8	-
37	Reserved	-	-	-	-	32	-
41	Property for Byte 11	-	COM15	COM10	EB	8	-
42	Reserved	-	-	-	-	8	-

Table 7-21 *The status of the inputs of the digital input module as well as of the COM15 is transmitted in the data set 69. In addition the position of the rotary switches of the external* **CubicleBUS** *modules is also available.*

DS72: Min./Max. values of the current and the corresponding time stamps (Length 236 Byte, read only) part 1							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Minimum current in Phase 1	384	ETU	ETU	unsigned int	16	0
2	Maximum current in Phase 1	385	ETU	ETU	unsigned int	16	0
4	Minimum current in Phase 2	386	ETU	ETU	unsigned int	16	0
6	Maximum current in Phase 2	387	ETU	ETU	unsigned int	16	0
8	Minimum current in Phase 3	388	ETU	ETU	unsigned int	16	0
10	Maximum current in Phase 3	389	ETU	ETU	unsigned int	16	0
12	Minimum current N-phase	390	ETU	ETU	unsigned int	16	0
14	Maximum current N-phase	391	ETU	ETU	unsigned int	16	0
16	Minimum earth fault current	392	ETU	ETU	unsigned int	16	0
18	Maximum earth fault current	393	ETU	ETU	unsigned int	16	0
20	Minimum demand current over three phases	394	ETU	ETU	unsigned int	16	0
22	Maximum demand current over three phases	395	ETU	ETU	unsigned int	16	0
24	Minimum demand current	244	Metering	-	unsigned int	16	0
26	Maximum demand current	245	Metering	-	unsigned int	16	0
28	Minimum of the crest factor	263	Metering	-	unsigned char	8	–1
29	Maximum of the crest factor	264	Metering	-	unsigned char	8	–1
30	Minimum of the form factor	265	Metering	-	unsigned char	8	–1
31	Maximum of the form factor	266	Metering	-	unsigned char	8	–1
32	TS Minimum current in Phase L1	25	COM15	COM10	Time	64	-
40	TS Maximum current in Phase L1	26	COM15	COM10	Time	64	-
48	TS Minimum current in Phase L2	27	COM15	COM10	Time	64	-
56	TS Maximum current in Phase L2	28	COM15	COM10	Time	64	-
64	TS Minimum current in Phase L3	29	COM15	COM10	Time	64	-
72	TS Maximum current in Phase L3	30	COM15	COM10	Time	64	-
80	TS Minimum demand over three phases	31	COM15	COM10	Time	64	-
88	TS Maximum demand over three phases	32	COM15	COM10	Time	64	-
96	TS Minimum demand current	55	COM15	-	Time	64	-
104	TS Maximum demand current	56	COM15	-	Time	64	-
112	TS Minimum current N-phase	33	COM15	COM10	Time	64	-
120	TS Maximum current N-phase	34	COM15	COM10	Time	64	-
128	TS Minimum earth fault current	35	COM15	COM10	Time	64	-
136	TS Maximum earth fault current	36	COM15	COM10	Time	64	-
144	TS Minimum of the Crest factor	65	COM15	-	Time	64	-
152	TS Maximum of the Crest factor	66	COM15	-	Time	64	-
160	TS Minimum of the Form factor	67	COM15	-	Time	64	-
168	TS Maximum of the Form factor	68	COM15	-	Time	64	-
176	Reserved	-	-	-	-	192	-
200	Property for Byte 0	-	ETU	ETU	EB	8	-
201	Property for Byte 2	-	ETU	ETU	EB	8	-

Table 7-22 Content of the data set 72 are the measured minimal and maximal values of current and the corresponding timestamps. Part 1

DS72: Min./Max. values of the current and the corresponding time stamps (Length 236 Byte, read only) part 2

Byte	Description	Data point	Source WL	Source VL	Format	Length (Bit)	Scale
202	Property for Byte 4	-	ETU	ETU	EB	8	-
203	Property for Byte 6	-	ETU	ETU	EB	8	-
204	Property for Byte 8	-	ETU	ETU	EB	8	-
205	Property for Byte 10	-	ETU	ETU	EB	8	-
206	Property for Byte 12	-	ETU	ETU	EB	8	-
207	Property for Byte 14	-	ETU	ETU	EB	8	-
208	Property for Byte 16	-	ETU	ETU	EB	8	-
209	Property for Byte 18	-	ETU	ETU	EB	8	-
210	Property for Byte 20	-	ETU	ETU	EB	8	-
211	Property for Byte 22	-	ETU	ETU	EB	8	-
212	Property for Byte 24	-	Metering	-	EB	8	-
213	Property for Byte 26	-	Metering	-	EB	8	-
214	Property for Byte 28	-	Metering	-	EB	8	-
215	Property for Byte 29	-	Metering	-	EB	8	-
216	Property for Byte 30	-	Metering	-	EB	8	-
217	Property for Byte 31	-	Metering	-	EB	8	-
218	Property for Byte32	-	COM15	COM10	EB	8	-
219	Property for Byte 40	-	COM15	COM10	EB	8	-
220	Property for Byte 48	-	COM15	COM10	EB	8	-
221	Property for Byte 56	-	COM15	COM10	EB	8	-
222	Property for Byte 64	-	COM15	COM10	EB	8	-
223	Property for Byte 72	-	COM15	COM10	EB	8	-
224	Property for Byte 80	-	COM15	COM10	EB	8	-
225	Property for Byte 88	-	COM15	COM10	EB	8	-
226	Property for Byte 96	-	COM15	-	EB	8	-
227	Property for Byte 104	-	COM15	-	EB	8	-
228	Property for Byte 112	-	COM15	COM10	EB	8	-
229	Property for Byte 120	-	COM15	COM10	EB	8	-
230	Property for Byte 128	-	COM15	COM10	EB	8	-
231	Property for Byte 136	-	COM15	COM10	EB	8	-
232	Property for Byte 144	-	COM15	-	EB	8	-
233	Property for Byte 152	-	COM15	-	EB	8	-
234	Property for Byte 160	-	COM15	-	EB	8	-
235	Property for Byte 168	-	COM15	-	EB	8	-

Table 7-23 Content of the data set 72 are the measured minimal and maximal values of current and the corresponding timestamps. Part 2

DS73: Min./Max. values of the voltages and the corresponding time stamps (Length 174 Byte, read only) part 1							
Byte	Description	Data point	Source WL	Source VL	Format	Length (Bit)	Scale
0	Minimum of the delta voltage between Phase L1 and Phase L2	205	Metering	-	unsigned int	16	0
2	Maximum of the delta voltage between Phase L1 and Phase L2	206	Metering	-	unsigned int	16	0
4	Minimum of the delta voltage between Phase L2 and Phase L3	207	Metering	-	unsigned int	16	0
6	Maximum of the delta voltage between Phase L2 and Phase L3	208	Metering	-	unsigned int	16	0
8	Minimum of the delta voltage between Phase L3 and Phase L1	209	Metering	-	unsigned int	16	0
10	Maximum of the delta voltage between Phase L3 and Phase L1	210	Metering	-	unsigned int	16	0
12	Minimum of the star voltage Phase L1	211	Metering	-	unsigned int	16	0
14	Maximum of the star voltage Phase L1	212	Metering	-	unsigned int	16	0
16	Minimum of the star voltage Phase L2	213	Metering	-	unsigned int	16	0
18	Maximum of the star voltage Phase L2	214	Metering	-	unsigned int	16	0
20	Minimum of the star voltage Phase L3	215	Metering	-	unsigned int	16	0
22	Maximum of the star voltage Phase L3	216	Metering	-	unsigned int	16	0
24	TS Minimum of the delta voltage between Phase L1 and Phase L2	37	COM15	-	Time	64	-
32	TS Maximum of the delta voltage between Phase L1 and Phase L2	38	COM15	-	Time	64	-
40	TS Minimum of the delta voltage between Phase L2 and Phase L3	39	COM15	-	Time	64	-
48	TS Maximum of the delta voltage between Phase L2 and Phase L3	40	COM15	-	Time	64	-
56	TS Minimum of the delta voltage between Phase L3 and Phase L1	41	COM15	-	Time	64	-
64	TS Maximum of the delta voltage between Phase L3 and Phase L1	42	COM15	-	Time	64	-
72	TS Minimum of the star voltage Phase L1	43	COM15	-	Time	64	-
80	TS Maximum of the star voltage Phase L1	44	COM15	-	Time	64	-
88	TS Minimum of the star voltage Phase L2	45	COM15	-	Time	64	-
96	TS Maximum of the star voltage Phase L2	46	COM15	-	Time	64	-
104	TS Minimum of the star voltage Phase L3	47	COM15	-	Time	64	-
112	TS Maximum of the star voltage Phase L3	48	COM15	-	Time	64	-
120	Reserved	-	-	-	-	240	-
150	Property for Byte 0	-	Metering	-	EB	8	-
151	Property for Byte 2	-	Metering	-	EB	8	-
152	Property for Byte 4	-	Metering	-	EB	8	-
153	Property for Byte 6	-	Metering	-	EB	8	-
154	Property for Byte 8	-	Metering	-	EB	8	-
155	Property for Byte 10	-	Metering	-	EB	8	-

Table 7-24 Content of the data set 73 are the measured minimal and maximal values of voltages and the corresponding timestamps. Part 1

DS73: Min./Max. values of the voltages and the corresponding time stamps (Length 174 Byte, read only) part 2							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
156	Property for Byte 12	-	Metering	-	EB	8	-
157	Property for Byte 14	-	Metering	-	EB	8	-
158	Property for Byte 16	-	Metering	-	EB	8	-
159	Property for Byte 18	-	Metering	-	EB	8	-
160	Property for Byte 20	-	Metering	-	EB	8	-
161	Property for Byte 22	-	Metering	-	EB	8	-
162	Property for Byte 24	-	COM15	-	EB	8	-
163	Property for Byte 32	-	COM15	-	EB	8	-
164	Property for Byte 40	-	COM15	-	EB	8	-
165	Property for Byte 48	-	COM15	-	EB	8	-
166	Property for Byte 56	-	COM15	-	EB	8	-
167	Property for Byte 64	-	COM15	-	EB	8	-
168	Property for Byte 72	-	COM15	-	EB	8	-
169	Property for Byte 80	-	COM15	-	EB	8	-
170	Property for Byte 88	-	COM15	-	EB	8	-
171	Property for Byte 96	-	COM15	-	EB	8	-
172	Property for Byte 104	-	COM15	-	EB	8	-
173	Property for Byte 112	-	COM15	-	EB	8	-

Table 7-25 Content of the data set 73 are the measured minimal and maximal values of voltages and the corresponding timestamps. Part 2

DS74: Min./Max. values of the power and the corresponding time stamps (Length 136 Byte, read only) part 1							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Minimum demand of the Power factor	242	Metering	-	signed int	16	–3
2	Maximum demand of the Power factor	243	Metering	-	signed int	16	–3
4	Minimum demand of the apparent power	246	Metering	-	unsigned int	16	0
6	Maximum demand of the apparent power	247	Metering	-	unsigned int	16	0
8	Minimum demand of the real power	250	Metering	-	signed int	16	0
10	Maximum demand of the real power	251	Metering	-	signed int	16	0
12	Minimum demand of the reactive power	248	Metering	-	signed int	16	0
14	Maximum demand of the reactive power	249	Metering	-	signed int	16	0
16	TS Minimum demand of the apparent power	57	COM15	-	Time	64	-
24	TS Maximum demand of the apparent power	58	COM15	-	Time	64	-
32	TS Minimum demand of the real power	49	COM15	-	Time	64	-
40	TS Maximum demand of the real power	50	COM15	-	Time	64	-
48	TS Minimum demand of the reactive power	51	COM15	-	Time	64	-
56	TS Maximum demand of the reactive power	52	COM15	-	Time	64	-
64	TS Minimum demand of the Power factor	53	COM15	-	Time	64	-

Table 7-26 Content of the data set 74 are the measured minimal and maximal values of power and the corresponding timestamps. Part 1

DS74: Min./Max. values of the power and the corresponding time stamps (Length 136 Byte, read only) part 2							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
72	TS Maximum demand of the Power factor	54	COM15	-	Time	64	-
80	Reserved	-	-	-	-	320	-
120	Property for Byte 0	-	Metering	-	EB	8	-
121	Property for Byte 2	-	Metering	-	EB	8	-
122	Property for Byte 4	-	Metering	-	EB	8	-
123	Property for Byte 6	-	Metering	-	EB	8	-
124	Property for Byte 8	-	Metering	-	EB	8	-
125	Property for Byte 10	-	Metering	-	EB	8	-
126	Property for Byte 12	-	Metering	-	EB	8	-
127	Property for Byte 14	-	Metering	-	EB	8	-
128	Property for Byte 16	-	COM15	-	EB	8	-
129	Property for Byte 24	-	COM15	-	EB	8	-
130	Property for Byte 32	-	COM15	-	EB	8	-
131	Property for Byte 40	-	COM15	-	EB	8	-
132	Property for Byte 48	-	COM15	-	EB	8	-
133	Property for Byte 56	-	COM15	-	EB	8	-
134	Property for Byte 64	-	COM15	-	EB	8	-
135	Property for Byte 72	-	COM15	-	EB	8	-

Table 7-27 Content of the data set 74 are the measured minimal and maximal values of power and the corresponding timestamps. Part 2

DS76: Min./Max. values of the frequency/distortion and the corresponding time stamps (Length 92 Byte, read only)							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Maximum of the Frequency	253	Metering	COM10	unsigned int	16	–2
2	Minimum of the Frequency	252	Metering	COM10	unsigned int	16	–2
4	Minimum of the THD of the current	255	Metering	-	unsigned char	8	0
5	Maximum of the THD of the current	256	Metering	-	unsigned char	8	0
6	Minimum of the THD of the voltages	258	Metering	-	unsigned char	8	0
7	Maximum of the THD of the voltages	259	Metering	-	unsigned char	8	0
8	TS Minimum of the Frequency	59	COM15	-	Time	64	-
16	TS Maximum of the Frequency	60	COM15	-	Time	64	-
24	TS Minimum THD of the current	61	COM15	-	Time	64	-
32	TS Maximum THD of the current	62	COM15	-	Time	64	-
40	TS Minimum THD of the voltages	63	COM15	-	Time	64	-
48	TS Maximum THD of the voltages	64	COM15	-	Time	64	-
56	Reserved	-	-	-	-	192	-
80	Property for Byte 0	-	Metering	COM10	EB	8	-
81	Property for Byte 2	-	Metering	COM10	EB	8	-
82	Property for Byte 4	-	Metering	-	EB	8	-
83	Property for Byte 5	-	Metering	-	EB	8	-
84	Property for Byte 6	-	Metering	-	EB	8	-
85	Property for Byte 7	-	Metering	-	EB	8	-
86	Property for Byte 8	-	COM15	-	EB	8	-
87	Property for Byte 16	-	COM15	-	EB	8	-
88	Property for Byte 24	-	COM15	-	EB	8	-
89	Property for Byte 32	-	COM15	-	EB	8	-
90	Property for Byte 40	-	COM15	-	EB	8	-
91	Property for Byte 48	-	COM15	-	EB	8	-

Table 7-28 Content of the data set 76 are the measured minimal and maximal values of THD, frequency and the corresponding timestamps.

DS77: Min./Max. values of the temperatures and the corresponding time stamps (Length 58 Byte, read only)							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Minimal temperature in the cubicle	72	COM15	-	unsigned char	8	0
1	Maximal temperature in the cubicle	73	COM15	-	unsigned char	8	0
2	Minimal temperature in the circuit breaker	74	BSS	-	unsigned char	8	0
3	Maximal temperature in the circuit breaker	75	BSS	-	unsigned char	8	0
4	TS Minimal temperature in the cubicle	76	COM15	-	Time	64	-
12	TS Maximal temperature in the cubicle	77	COM15	-	Time	64	-
20	TS Minimal temperature in the circuit breaker	78	COM15	-	Time	64	-
28	TS Maximal temperature in the circuit breaker	79	COM15	-	Time	64	-
36	Reserved	-	-	-	-	112	-
50	Property for Byte 0	-	COM15	-	-	-	-
51	Property for Byte 1	-	COM15	-	EB	8	-
52	Property for Byte 2	-	BSS	-	EB	8	-
53	Property for Byte 3	-	BSS	-	EB	8	-
54	Property for Byte 4	-	COM15	-	EB	8	-
55	Property for Byte 12	-	COM15	-	EB	8	-
56	Property for Byte 20	-	COM15	-	EB	8	-
57	Property for Byte 28	-	COM15	-	EB	8	-

Table 7-29 Content of the data set 77 are the measured minimal and maximal values of temperatures and the corresponding timestamps.

DS91: Informations for statistic and maintenance (Length 84 Byte, read only)							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	# of switch actions ander load	80	COM15	COM10	unsigned int	16	0
2	# of switch actions caused by a trip	81	COM15	COM10	unsigned int	16	0
4	# of switch actions (complete cycle on/off)	82	COM15	-	unsigned int	16	0
6	Operating hours (breaker on and current > 0)	83	COM15	-	unsigned long	32	0
10	Date of the last parameter change	84	COM15	-	Time	64	-
18	# of short circuit trips (SI)	104	ETU	COM10	unsigned int	16	0
20	# of overload trips (L)	105	ETU	COM10	unsigned int	16	0
22	# of earth fault trips (G)	106	ETU	COM10	unsigned int	16	0
24	Sum of I^2t-values L1, L2, L3, N	107	ETU	COM10	Format (107)	128	0
40	Maintenance information for the main contacts	405	ETU	-	Format (405)	2	-
41	Reserved	-	-	-	-	56	-
48	Connected **Cubicle**BUS modules	88	COM15	-	Format (88)	32	-
52	Reserved	-	-	-	-	144	-
70	Property for Byte 0	-	COM15	COM10	EB	8	-
71	Property for Byte 2	-	COM15	COM10	EB	8	-
72	Property for Byte 4	-	COM15	-	EB	8	-
73	Property for Byte 6	-	COM15	-	EB	8	-
74	Property for Byte 10	-	COM15	-	EB	8	-
75	Property for Byte 18	-	ETU	COM10	EB	8	-
76	Property for Byte 20	-	ETU	COM10	EB	8	-
77	Property for Byte 22	-	ETU	COM10	EB	8	-
78	Property for Byte 24	-	ETU	COM10	EB	8	-
79	Property for Byte 40	-	ETU	-	EB	8	-
80	Reserved	-	-	-	-	32	-

Table 7-30 *In the data set 91 statistic informations to the SENTRON circuit breakers are transmitted. Also as known from all the other data sets the properties of each data point is also contained in this data set.*

DS92: Diagnostic (Length 194 Byte, read only)							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Device status 1 (identical to DP norm diagnostic)	-	COM15	COM15	DP Norm	8	-
1	Device status 2 (identical to DP norm diagnostic)	-	COM15	COM15	DP Norm	8	-
2	Device status 2 (identical to DP norm diagnostic)	-	COM15	COM15	DP Norm	8	-
3	Address of the class 1 master	-	COM15	COM10	unsigned char	8	0
4	Ident number SENTRON (0x80C0)	-	COM15	COM10	hex	16	-
6	Fixed to 0x42	-	COM15	COM10	hex	8	-
7	External diagnostic bit; 1 = diagnostic; 0 = no diagn.	-	COM15	COM10	hex	1	-
8	fixed header; 0x05 82 00 00 00	-	COM15	COM10	hex	40	-
13	Reserved	-	-	-	-	8	-
14	Diagnostic messages	-	COM15	COM10	refer to chapt 4	16	-
16	From the diagnostic message affected module	-	COM15	COM10	refer to chapt 4	32	-
20	Connected **Cubicle**BUS modules	88	COM15	-	refer to chapt 4	32	-
24	Active warnings	402	ETU	ETU	Format (402)	16	-
26	Current, not yet cleared trip of the trip unit	401	ETU	ETU	Format (401)	8	-
27	Reserved	-	-	-	-	8	-
28	Trips of the extended protective function	307	Metering	-	Format (307)	16	-
30	Setpoint warnings	308	Metering	-	Format (308)	32	-
34	Current that causes the trip	403	ETU	ETU	unsigned int	16	0(VL)/1
36	Phase number of the trip	404	ETU	ETU	Format (373)	3	-
37	Position of the breaker in the frame	24	COM15	COM10	Format (24)	4	-
38	Reserved	-	-	-	-	16	-
40	Status circuit breaker (on/off/storage spring etc.)	328	BSS	COM10	Format (328)	8	-
41	Reserved	-	-	-	-	8	-
42	Eventlog of the last 10 events with time stamp	16	COM15	COM10	Format (16)	960	-
162	Reserved	-	-	-	-	144	-
180	Property for Byte 20	-	COM15	-	EB	8	-
181	Property for Byte 24	-	ETU	ETU	EB	8	-
182	Property for Byte 26	-	ETU	ETU	EB	8	-
183	Property for Byte 28	-	Metering	-	EB	8	-
184	Property for Byte 30	-	Metering	-	EB	8	-
185	Property for Byte 34	-	ETU	ETU	EB	8	-
186	Property for Byte 36	-	ETU	ETU	EB	8	-
187	Property for Byte 37	-	COM15	COM10	EB	8	-
188	Reserved	-	-	-	-	8	-
189	Property for Byte 40	-	BSS	COM10	EB	8	-
190	Property for Byte 42	-	COM15	COM10	EB	8	-
191	Reserved	-	-	-	-	24	-

Table 7-31 *The data set 92 contains the information for a detailled diagnostic.*

DS93: Control the circuit breaker (Length 27 Byte, write only)							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Header; fixed to 0x00 00 00 00	-	COM15	COM10	-	32	-
4	Controls the trip unit	406	ETU	-	Format (406)	16	-
6	Reserved	-	-	-	-	16	-
8	Controls the first digital output module	121	DO1	-	Format (121)	8	-
9	Controls the second digital output module	126	DO2	-	Format (121)	8	-
10	Controls the buffers (e.g. min./max. values) of the communication module	18	COM15	COM10	Format (18)	8	-
11	Controls the outputs of the communication module (e.g. to switch the breaker)	19	COM15	COM10	Format (19)	8	-
12	Reserved	-	-	-	-	8	-
13	6 PROFIBUS Bits for the configurable digital output module	426	COM15	-	Format (426)	6	-
14	Reserved	-	-	-	-	40	-
19	Property for Byte 13	-	COM15	-	EB	8	-
20	Property for Byte 4	-	ETU	-	EB	8	-
21	Property for Byte 6	-	Metering	-	EB	8	-
22	Property for Byte 8	-	DO1	-	EB	8	-
23	Property for Byte 9	-	DO2	-	EB	8	-
24	Property for Byte 10	-	COM15	COM10	EB	8	-
25	Property for Byte 11	-	COM15	COM10	EB	8	-
26	Reserved	-	-	-	-	8	-

Table 7-32 *Data set 93 is the data set to control the circuit breaker. Via this the breaker can be switched on and off, buffers can be deleted and the outputs of the digital output modules can be forced.*

DS94: Current metering values (Length 197 Byte, read only) part 1							
Byte	Description	Data point	Source WL	Source VL	Format	Length (Bit)	Scale
0	Phase unbalance current (in %)	172	Metering	ETU	unsigned char	8	0
1	Reserved	-	-	-	-	8	-
2	Demand current 3-phases	193	Metering	ETU	unsigned int	16	0
4	Demand current L1	194	Metering	ETU	unsigned int	16	0
6	Demand current L2	195	Metering	ETU	unsigned int	16	0
8	Demand current L3	196	Metering	ETU	unsigned int	16	0
10	Current in Phase L1	380	ETU	ETU	unsigned int	16	0
12	Current in Phase L2	381	ETU	ETU	unsigned int	16	0
14	Current in Phase L3	382	ETU	ETU	unsigned int	16	0
16	Current demand over three phases	383	ETU	ETU	unsigned int	16	0
18	Current N-phase	375	ETU	ETU	unsigned int	16	0
20	Earth fault current	376	ETU	ETU	unsigned int	16	0
22	Phase unbalance voltage (in %)	173	Metering	-	unsigned char	8	0
23	Reserved	-	-	-	-	8	-
24	Delta voltage between Phase L1 and L2	197	Metering	-	unsigned int	16	0
26	Delta voltage between Phase L2 and L3	198	Metering	-	unsigned int	16	0
28	Delta voltage between Phase L3 and L1	199	Metering	-	unsigned int	16	0
30	Star voltage Phase L1	200	Metering	-	unsigned int	16	0
32	Star voltage Phase L2	201	Metering	-	unsigned int	16	0
34	Star voltage Phase L3	202	Metering	-	unsigned int	16	0
36	Demand of the delta voltage	203	Metering	-	unsigned int	16	0
38	Demand of the star voltage	204	Metering	-	unsigned int	16	0
40	Sum of apparent power	217	Metering	-	unsigned int	16	0
42	Sum of real power	221	Metering	-	signed int	16	0
44	Real power in Phase L1	222	Metering	-	signed int	16	0
46	Real power in Phase L2	223	Metering	-	signed int	16	0
48	Real power in Phase L3	224	Metering	-	signed int	16	0
50	Sum of Reactive poweren	225	Metering	-	signed int	16	0
52	Demand of the real power 3-phases	229	Metering	-	signed int	16	0
54	Demand of the real power in Phase L1	230	Metering	-	signed int	16	0
56	Demand of the real power in Phase L2	231	Metering	-	signed int	16	0
58	Demand of the real power in Phase L3	232	Metering	-	signed int	16	0
60	Demand of the apparent power 3-phases	233	Metering	-	unsigned int	16	0
62	Apparent power in Phase L1	218	Metering	-	unsigned int	16	0
64	Apparent power in Phase L2	219	Metering	-	unsigned int	16	0
66	Apparent power in Phase L3	220	Metering	-	unsigned int	16	0
68	Demand of the apparent power i. d. Phase L1	234	Metering	-	unsigned int	16	0
70	Demand of the apparent power i. d. Phase L2	235	Metering	-	unsigned int	16	0
72	Demand of the apparent power i. d. Phase L3	236	Metering	-	unsigned int	16	0

Table 7-33 *The data set 94 contains all current measured values. The additional property bytes provides the properties of each data point in this data set. Part 1*

DS94: Current metering values (Length 197 Byte, read only) part 2							
Byte	Description	Data point	Source WL	Source VL	Format	Length (Bit)	Scale
74	Demand of the reactive power 3-phases	237	Metering	-	signed int	16	0
76	Reactive power in Phase L1	226	Metering	-	signed int	16	0
78	Reactive power in Phase L2	227	Metering	-	signed int	16	0
80	Reactive power in Phase L3	228	Metering	-	signed int	16	0
82	Real energy in normal direction	238	Metering	-	unsigned long	32	0
86	Real energy in reverse direction	239	Metering	-	unsigned long	32	0
90	Reactive energy in normal direction	240	Metering	-	unsigned long	32	0
94	Reactive energy in reverse direction	241	Metering	-	unsigned long	32	0
98	Demand of the power factor	168	Metering	-	signed int	16	–3
100	Power factor in Phase L1	169	Metering	-	signed int	16	–3
102	Power factor in Phase L2	170	Metering	-	signed int	16	–3
104	Power factor in Phase L3	171	Metering	-	signed int	16	–3
106	Frequency	262	Metering	COM10	unsigned int	16	–2
108	THD of the current	254	Metering	-	unsigned char	8	0
109	THD of the voltages	257	Metering	-	unsigned char	8	0
110	Form factor	261	Metering	-	unsigned char	8	–1
111	Crest factor	260	Metering	-	unsigned char	8	–1
112	Reserved	-	-	-	-	16	-
114	Temperature in the cubicle (det. in the COM15)	71	COM15	-	unsigned char	8	0
115	Temperature in the circuit breaker (det. in BSS)	330	BSS	-	unsigned char	8	0
116	Reserved	-	-	-	-	192	-
140	Property for Byte 0	-	Metering	ETU	EB	8	-
141	Property for Byte 2	-	Metering	ETU	EB	8	-
142	Property for Byte 4	-	Metering	ETU	EB	8	-
143	Property for Byte 6	-	Metering	ETU	EB	8	-
144	Property for Byte 8	-	Metering	ETU	EB	8	-
145	Property for Byte 10	-	ETU	ETU	EB	8	-
146	Property for Byte 12	-	ETU	ETU	EB	8	-
147	Property for Byte 14	-	ETU	ETU	EB	8	-
148	Property for Byte 16	-	ETU	ETU	EB	8	-
149	Property for Byte 18	-	ETU	ETU	EB	8	-
150	Property for Byte 20	-	ETU	ETU	EB	8	-
151	Property for Byte 22	-	Metering	-	EB	8	-
152	Property for Byte 24	-	Metering	-	EB	8	-
153	Property for Byte 26	-	Metering	-	EB	8	-
154	Property for Byte 28	-	Metering	-	EB	8	-
155	Property for Byte 30	-	Metering	-	EB	8	-
156	Property for Byte 32	-	Metering	-	EB	8	-
157	Property for Byte 34	-	Metering	-	EB	8	-

Table 7-34 *The data set 94 contains all current measured values. The additional property bytes provides the properties of each data point in this data set. Part 2*

DS94: Current metering values (Length 197 Byte, read only) part 3							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
158	Property for Byte 36	-	Metering	-	EB	8	-
159	Property for Byte 38	-	Metering	-	EB	8	-
160	Property for Byte 40	-	Metering	-	EB	8	-
161	Property for Byte 42	-	Metering	-	EB	8	-
162	Property for Byte 44	-	Metering	-	EB	8	-
163	Property for Byte 46	-	Metering	-	EB	8	-
164	Property for Byte 48	-	Metering	-	EB	8	-
165	Property for Byte 50	-	Metering	-	EB	8	-
166	Property for Byte 52	-	Metering	-	EB	8	-
167	Property for Byte 54	-	Metering	-	EB	8	-
168	Property for Byte 56	-	Metering	-	EB	8	-
169	Property for Byte 58	-	Metering	-	EB	8	-
170	Property for Byte 60	-	Metering	-	EB	8	-
171	Property for Byte 62	-	Metering	-	EB	8	-
172	Property for Byte 64	-	Metering	-	EB	8	-
173	Property for Byte 66	-	Metering	-	EB	8	-
174	Property for Byte 68	-	Metering	-	EB	8	-
175	Property for Byte 70	-	Metering	-	EB	8	-
176	Property for Byte 72	-	Metering	-	EB	8	-
177	Property for Byte 74	-	Metering	-	EB	8	-
178	Property for Byte 76	-	Metering	-	EB	8	-
179	Property for Byte 78	-	Metering	-	EB	8	-
180	Property for Byte 80	-	Metering	-	EB	8	-
181	Property for Byte 82	-	Metering	-	EB	8	-
182	Property for Byte 86	-	Metering	-	EB	8	-
183	Property for Byte 90	-	Metering	-	EB	8	-
184	Property for Byte 94	-	Metering	-	EB	8	-
185	Property for Byte 98	-	Metering	-	EB	8	-
186	Property for Byte 100	-	Metering	-	EB	8	-
187	Property for Byte 102	-	Metering	-	EB	8	-
188	Property for Byte 104	-	Metering	-	EB	8	-
189	Property for Byte 106	-	Metering	COM10	EB	8	-
190	Property for Byte 108	-	Metering	-	EB	8	-
191	Property for Byte 109	-	Metering	-	EB	8	-
192	Property for Byte 110	-	Metering	-	EB	8	-
193	Property for Byte 111	-	Metering	-	EB	8	-
194	Reserved	-	-	-	-	8	-
195	Property for Byte 114	-	COM15	-	EB	8	-
196	Property for Byte 115	-	BSS	-	EB	8	-

Table 7-35 *The data set 94 contains all current measured values. The additional property bytes provides the properties of each data point in this data set. Part 3*

DS97: Identification detail (Length 223 Byte, read only) part 1							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Order No. of the trip unit	407	ETU	ETU	16 x char	144	-
18	Manufactoring date of trip unit	408	ETU	-	Time	64	-
26	Ident number of the trip unit	409	ETU	ETU	17 x char	136	-
43	Reserved	-	-	-	-	8	-
44	Determination of earth fault current	410	ETU	ETU	Format (410)	2	-
45	N-Sensor activated/deactivated	411	ETU	ETU	Format (411)	1	-
46	Reserved	-	-	-	-	8	-
47	Market of the circuit breaker	95	ETU	-	Format (95)	2	-
48	Ident number of the circuit breaker	96	ETU	-	20 x char	160	-
68	Reserved	-	-	-	-	48	-
74	Last test date breaker	98	ETU	-	Time	64	-
82	Switching capacity	99	ETU	-	Format (99)	4	-
83	Frame size	100	ETU	-	Format (100)	2	-
84	Rated voltage of the circuit br. (Phase2Phase)	101	ETU	-	unsigned int	16	0
86	Rated current groand fault transformer	102	ETU	-	unsigned int	16	0
88	Order No. of the circuit breaker (..ETU@SENTRON VL)	103	ETU	ETU	Format (103)	160	-
108	Reserved	-	-	-	-	144	-
126	Order No. of the trip unit	371	ETU	-	18 x char	144	-
144	# of poles	108	ETU	ETU	Format (108)	3	-
145	Reserved	-	-	-	-	8	-
146	Rating Plug	377	ETU	ETU	unsigned int	16	0
148	Sensor Rating	378	ETU	ETU	unsigned int	16	0
150	Reserved	-	-	-	-	32	-
154	Order No. COM10	424	-	COM10	16 x char	128	-
170	Serial No. COM10	425	-	COM10	16 x char	128	-
186	Reserved	-	-	-	-	112	-
200	Property for Byte 0	-	ETU	ETU	EB	8	-
201	Property for Byte 16	-	ETU	-	EB	8	-
202	Property for Byte 28	-	ETU	ETU	EB	8	-
203	Property for Byte 44	-	ETU	ETU	EB	8	-
204	Property for Byte 45	-	ETU	ETU	EB	8	-
205	Reserved	-	-	-	-	8	-
206	Property for Byte 47	-	ETU	-	EB	8	-
207	Property for Byte 48	-	ETU	-	EB	8	-
208	Reserved	-	-	-	-	8	-
209	Property for Byte 74	-	ETU	-	EB	8	-
210	Property for Byte 82	-	ETU	-	EB	8	-
211	Property for Byte 83	-	ETU	-	EB	8	-
212	Property for Byte 84	-	ETU	-	EB	8	-

Table 7-36 *It is very important for a remote access to know which breaker is connected to. This data set 97 provide all data to identify the SENTRON circuit breaker. Part 1*

DS97: Identification detail (Length 223 Byte, read only) part 2							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
213	Property for Byte 86	-	ETU	-	EB	8	-
214	Property for Byte 88	-	ETU	ETU	EB	8	-
215	Reserved	-	-	-	-	8	-
216	Property for Byte 126	-	ETU	-	EB	8	-
217	Property for Byte 144	-	ETU	ETU	EB	8	-
218	Property for Byte 146	-	ETU	ETU	EB	8	-
219	Property for Byte 148	-	ETU	ETU	EB	8	-
220	Reserved	-	-	-	-	8	-
221	Property for Byte 154	-	-	COM10	EB	8	-
222	Property for Byte 170	-	-	COM10	EB	8	-

Table 7-37 *It is very important for a remote access to know which breaker is connected to. This data set 97 provide all data to identify the SENTRON circuit breaker. Part 2*

DS100: Identification overview (Length 100 Byte, read only)							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Header; Fixed to 0x00 00 00 00	-	COM15	COM10	-	32	-
4	Last test date breaker	98	ETU	-	PROFIBUS Time	64	-
12	Manufactorer (SIEMENS oder SE&A)	-	COM15	COM10	20 x char	160	-
32	Device name (SENTRON WL oder SENTRON VL)	-	COM15	COM10	24 x char	192	-
56	Device family (fixed to 0x03)	-	COM15	COM10	hex	8	-
57	Device sub family (fixed to 0x01)	-	COM15	COM10	hex	8	-
58	Device class (1 = power circuit breaker; 2 = moulded case circuit breaker)	-	COM15	COM10	hex	8	-
59	System (fixed to 0x06)	-	COM15	COM10	hex	8	-
60	Function group (Bit .0 for COM15; Bit .4 for COM10)	-	COM15	COM10	hex	8	-
61	Reserved	-	-	-	-	8	-
62	Short name (PCB or MCCB)	-	COM15	COM10	16 x char	128	-
78	HW version	-	COM15	-	4 x char	32	-
82	PROFIBUS Ident number (0x00 00 80 C0)	-	COM15	COM10	hex	32	-
86	Reserved	-	-	-	-	16	-
88	Service number (lower part of the breaker identification number)	-	COM15	COM10	8 x char	64	-
96	FW version of the PROFIBUS module	-	COM15	COM10	4 x char	32	-

Table 7-38 *Data set 100 can be used to identify the connected device.*

DS128: Parameter for the metering function and the ext. protective function (Length 103 Byte, read- and writeable) part 1							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Header; fixed to 0x00 00 00 00	-	COM15	COM10	-	32	-
4	Primary connection of the voltage transformer Ypsilon or Delta	162	Metering	-	Format (162)	1	-
5	Reserved	-	-	-	-	8	-
6	Rated operational voltage (Phase2Phase)	164	Metering	-	unsigned int	16	0
8	Secondary voltage of the voltage transformer	165	Metering	-	unsigned char	8	0
9	Length der Periode für die Demandberechnung	166	Metering	-	unsigned char	8	0
10	No. of sub periods for calculating demands	167	Metering	-	unsigned char	8	0
11	Reserved	-	-	-	-	8	-
12	Current transmission limit; below this all currents will be set to 0	372	ETU	-	unsigned int	16	0
14	Real power in normal direction	141	Metering	-	unsigned int	16	0
16	Real power in reverse direction	143	Metering	-	unsigned int	16	0
18	Delay time for Real power in normal direction	142	Metering	-	unsigned char	8	0
19	Delay time for Real power in reverse direction	144	Metering	-	unsigned char	8	0
20	Defintion of the normal energy direction	145	Metering	-	Format (145)	1	-
21	Phase rotation	146	Metering	-	Format (146)	1	-
22	Under frequency	147	Metering	-	unsigned int	16	0
24	Delay time for Over frequency	150	Metering	-	unsigned char	8	0
25	Delay time for Under frequency	148	Metering	-	unsigned char	8	0
26	Over frequency	149	Metering	-	unsigned int	16	0
28	THD of the current	158	Metering	-	unsigned char	8	0
29	Delay time for THD of the current	159	Metering	-	unsigned char	8	0
30	THD of the voltages	160	Metering	-	unsigned char	8	0
31	Delay time for THD of the voltages	161	Metering	-	unsigned char	8	0
32	Phase unbalance voltage	151	Metering	-	unsigned char	8	0
33	Delay time for Phase unbalance voltage	152	Metering	-	unsigned char	8	0
34	Under voltage	153	Metering	-	unsigned int	16	0
36	Over voltage	155	Metering	-	unsigned int	16	0
38	Delay time for Under voltage	154	Metering	-	unsigned char	8	0
39	Delay time for Over voltage	156	Metering	-	unsigned char	8	0
40	Reserved	-	-	-	-	8	-
41	Phase unbalance current	139	Metering	ETU	unsigned char	8	0
42	Delay time for Phase unbalance current	140	Metering	ETU	unsigned char	8	0
43	Reserved	-	-	-	-	8	-
44	Pre alarm for overcurrent (VL only)	369	-	ETU	unsigned int	16	0
46	Events for the configurable dig. output module	129	konf. DO	-	Format (129)	168	-
67	Reserved	-	-	-	-	24	-

Table 7-39 *The settings of the metering function and the parameter for the extended protective function are contained in data set 128. Part 1.*

DS128: Parameter for the metering function and the ext. protective function (Length 103 Byte, read- and writeable) part 2							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
70	Property for Byte 4	-	Metering	-	EB	8	-
71	Reserved	-	-	-	-	8	-
72	Property for Byte 6	-	Metering	-	EB	8	-
73	Property for Byte 8	-	Metering	-	EB	8	-
74	Property for Byte 9	-	Metering	-	EB	8	-
75	Property for Byte 10	-	Metering	-	EB	8	-
76	Reserved	-	-	-	-	8	-
77	Property for Byte 12	-	ETU	-	EB	8	-
78	Property for Byte 14	-	Metering	-	EB	8	-
79	Property for Byte 16	-	Metering	-	EB	8	-
80	Property for Byte 18	-	Metering	-	EB	8	-
81	Property for Byte 19	-	Metering	-	EB	8	-
82	Property for Byte 20	-	Metering	-	EB	8	-
83	Property for Byte 21	-	Metering	-	EB	8	-
84	Property for Byte 22	-	Metering	-	EB	8	-
85	Property for Byte 24	-	Metering	-	EB	8	-
86	Property for Byte 25	-	Metering	-	EB	8	-
87	Property for Byte 26	-	Metering	-	EB	8	-
88	Property for Byte 28	-	Metering	-	EB	8	-
89	Property for Byte 29	-	Metering	-	EB	8	-
90	Property for Byte 30	-	Metering	-	EB	8	-
91	Property for Byte 31	-	Metering	-	EB	8	-
92	Property for Byte 32	-	Metering	-	EB	8	-
93	Property for Byte 33	-	Metering	-	EB	8	-
94	Property for Byte 34	-	Metering	-	EB	8	-
95	Property for Byte 36	-	Metering	-	EB	8	-
96	Property for Byte 38	-	Metering	-	EB	8	-
97	Property for Byte 39	-	Metering	-	EB	8	-
98	Property for Byte 40	-	Metering	-	EB	8	-
99	Property for Byte 41	-	Metering	ETU	EB	8	-
100	Property for Byte 42	-	Metering	ETU	EB	8	-
101	Property for Byte 44	-	-	ETU	EB	8	-
102	Property for Byte 46	-	conf. DO	-	EB	8	-

Table 7-40 *The settings of the metering function and the parameter for the extended protective function are contained in data set 128. Part 2.*

DS129: Parameter for the protective function (Length 139 Byte, read- and writeable) part 1							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Header; fixed to 0x00 00 00 00	-	COM15	COM10	-	32	-
4	Overload parameter I_R parameter set A (PS A)	333	ETU	ETU	unsigned int	16	0
6	Overload N-Phase I_N PS A (WL)	334	ETU	-	unsigned int	16	0
8	Time lag class t_R PS A	335	ETU	ETU	unsigned int	16	–1
10	Instantaneous protection parameter I_i PS A	336	ETU	ETU	unsigned int	16	1/ 0(VL)
12	Short time delayed prot. parameter I_{sd} PS A	337	ETU	ETU	unsigned int	16	1/ 0(VL)
14	Delay time for S-trip t_{sd} PS A	338	ETU	ETU	unsigned int	16	–3
16	Earth fault protection parameter I_{g1} PS A	339	ETU	ETU	unsigned int	16	0
18	Delay time earth fault protection t_{g1} PS A	340	ETU	ETU	unsigned int	16	–3
20	Earth fault protection parameter I_{g2} PS A	341	ETU	ETU	unsigned int	16	0
22	Delay time earth fault protection t_{g2} PS A	342	ETU	ETU	unsigned int	16	–3
24	I^2t curve for delayed S-trip PS A	343	ETU	ETU	Format (343)	1	-
25	I^2t curve for earth fault protection PS A	344	ETU	ETU	Format (344)	1	-
26	I^4t curve for overload protection PS A	345	ETU	-	Format (345)	1	-
27	Thermal memory PS A	346	ETU	ETU	Format (346)	1	-
28	Phase loss sensitivity PS A	347	ETU	-	Format (347)	1	-
29	Reserved	-	-	-	-	8	-
30	Thermal time constant PS A	348	ETU	-	unsigned int	16	0
32	Overload parameter I_R parameter set B (PS B)	349	ETU	-	unsigned int	16	0
34	Overload N-Phase I_N PS B (WL)	350	ETU	-	unsigned int	16	0
36	Time lag class t_R PS B	351	ETU	-	unsigned int	16	–1
38	Instantaneous protection parameter I_i PS B	352	ETU	-	unsigned int	16	1
40	Short time delayed prot. parameter I_{sd} PS B	353	ETU	-	unsigned int	16	1
42	Delay time for S-trip t_{sd} PS B	354	ETU	-	unsigned int	16	–3
44	Earth fault protection parameter I_{g1} PS B	355	ETU	-	unsigned int	16	0
46	Delay time earth fault protection t_{g1} PS B	356	ETU	-	unsigned int	16	–3
48	Earth fault protection parameter I_{g2} PS B	357	ETU	-	unsigned int	16	0
50	Delay time earth fault protection t_{g2} PS B	358	ETU	-	unsigned int	16	–3
52	I^2t curve for delayed S-trip PS B	359	ETU	-	Format (343)	1	-
53	I^2t curve for earth fault protection PS B	360	ETU	-	Format (344)	1	-
54	I^4t curve for overload protection PS B	361	ETU	-	Format (345)	1	-
55	Thermal memory PS B	362	ETU	-	Format (346)	1	-
56	Phase loss sensitivity PS B	363	ETU	-	Format (347)	1	-
57	Reserved	-	-	-	-	8	-
58	Thermal time constant PS B	364	ETU	-	unsigned int	16	0
60	Load shedding	367	ETU	-	unsigned int	16	0
62	Load restorage	368	ETU	-	unsigned int	16	0

Table 7-41 *The parameter for the protective function are transmitted in the data set 129 as well as the settings for load shedding and load restorage. Part 1.*

DS129: Parameter for the protective function (Length 139 Byte, read- and writeable) part 2							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
64	Delay time load shedd./restorage	366	ETU	-	unsigned char	8	0
65	Active parameter set	370	ETU	-	Format (370)	1	-
66	Overload N-Phase I_N (VL)	365	-	ETU	unsigned char	8	0
67	Reserved	-	-	-	-	8	-
68	Trip class (only SENTRON VL LCD ETU40M)	331	-	ETU	Format (331)	8	0
69	Determination of earth fault current	410	ETU	ETU	Format (410)	2	-
70	Rated current groand fault transformer	102	ETU	-	unsigned int	16	0
72	Reserved	-	-	-	-	208	-
98	Property for Byte 70	-	ETU	-	EB	8	-
99	Property for Byte 68	-	ETU	ETU	EB	8	-
100	Property for Byte 4	-	ETU	ETU	EB	8	-
101	Property for Byte 6	-	ETU	-	EB	8	-
102	Property for Byte 8	-	ETU	ETU	EB	8	-
103	Property for Byte 10	-	ETU	ETU	EB	8	-
104	Property for Byte 12	-	ETU	ETU	EB	8	-
105	Property for Byte 14	-	ETU	ETU	EB	8	-
106	Property for Byte 16	-	ETU	ETU	EB	8	-
107	Property for Byte 18	-	ETU	ETU	EB	8	-
108	Property for Byte 20	-	ETU	ETU	EB	8	-
109	Property for Byte 22	-	ETU	ETU	EB	8	-
110	Property for Byte 24	-	ETU	ETU	EB	8	-
111	Property for Byte 25	-	ETU	ETU	EB	8	-
112	Property for Byte 26	-	ETU	-	EB	8	-
113	Property for Byte 27	-	ETU	ETU	EB	8	-
114	Property for Byte 28	-	ETU	-	EB	8	-
115	Property for Byte 30	-	ETU	-	EB	8	-
116	Property for Byte 32	-	ETU	-	EB	8	-
117	Property for Byte 34	-	ETU	-	EB	8	-
118	Property for Byte 36	-	ETU	-	EB	8	-
119	Property for Byte 38	-	ETU	-	EB	8	-
120	Property for Byte 40	-	ETU	-	EB	8	-
121	Property for Byte 42	-	ETU	-	EB	8	-
122	Property for Byte 44	-	ETU	-	EB	8	-
123	Property for Byte 46	-	ETU	-	EB	8	-
124	Property for Byte 48	-	ETU	-	EB	8	-
125	Property for Byte 50	-	ETU	-	EB	8	-
126	Property for Byte 52	-	ETU	-	EB	8	-
127	Property for Byte 53	-	ETU	-	EB	8	-
128	Property for Byte 54	-	ETU	-	EB	8	-

Table 7-42 *The parameter for the protective function are transmitted in the data set 129 as well as the settings for load shedding and load restorage. Part 2.*

DS129: Parameter for the protective function (Length 139 Byte, read- and writeable) part 3							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
129	Property for Byte 55	-	ETU	-	EB	8	-
130	Property for Byte 56	-	ETU	-	EB	8	-
131	Property for Byte 58	-	ETU	-	EB	8	-
132	Property for Byte 60	-	ETU	-	EB	8	-
133	Property for Byte 62	-	ETU	-	EB	8	-
134	Property for Byte 64	-	ETU	-	EB	8	-
135	Property for Byte 65	-	ETU	-	EB	8	-
136	Property for Byte 66	-	-	ETU	EB	8	-
137	Reserved	-	-	-	-	8	-
138	Property for Byte 68	-	-	ETU	EB	8	-

Table 7-43 *The parameter for the protective function are transmitted in the data set 129 as well as the settings for load shedding and load restorage. Part 3.*

DS130: Parameter for the setpoints (Length 148 Byte, read- and writeable) part 1							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Header; fixed to 0x00 00 00 00	-	COM15	COM10	-	32	-
4	Real power in normal direction	283	Metering	-	unsigned int	16	0
6	Real power in reverse direction	285	Metering	-	unsigned int	16	0
8	Power factor capacitive	287	Metering	-	signed int	16	–3
10	Power factor inductive	289	Metering	-	signed int	16	–3
12	Delay time for Real power in normal direction	284	Metering	-	unsigned char	8	0
13	Delay time for Real power in reverse direction	286	Metering	-	unsigned char	8	0
14	Delay time for Power factor capacitive	288	Metering	-	unsigned char	8	0
15	Delay time for Power factor inductive	290	Metering	-	unsigned char	8	0
16	Over frequency	303	Metering	-	unsigned char	8	0
17	Delay time for Over frequency	304	Metering	-	unsigned char	8	0
18	Under frequency	305	Metering	-	unsigned char	8	0
19	Delay time for Under frequency	306	Metering	-	unsigned char	8	0
20	THD current	319	Metering	-	unsigned char	8	0
21	Delay time for THD current	320	Metering	-	unsigned char	8	0
22	THD voltage	321	Metering	-	unsigned char	8	0
23	Delay time for THD voltage	322	Metering	-	unsigned char	8	0
24	Crest factor	323	Metering	-	unsigned int	16	–2
26	Form factor	325	Metering	-	unsigned int	16	–2
28	Delay time for Crest factor	324	Metering	-	unsigned char	8	0
29	Delay time for Form factor	326	Metering	-	unsigned char	8	0
30	Demand Real power	291	Metering	-	unsigned int	16	0
32	Demand Apparent power	293	Metering	-	unsigned int	16	0
34	Delay time Demand of the real power	292	Metering	-	unsigned char	8	0
35	Delay time Demand of the apparent power	294	Metering	-	unsigned char	8	0
36	Demand Reactive power	295	Metering	-	unsigned int	16	0
38	Reactive power in normal direction	297	Metering	-	unsigned int	16	0
40	Delay time Demand of the reactive power	296	Metering	-	unsigned char	8	0
41	Delay time for Reactive power in normal direction	298	Metering	-	unsigned char	8	0
42	Reactive power in reverse direction	299	Metering	-	unsigned int	16	0
44	Apparent power	301	Metering	-	unsigned int	16	0
46	Delay time for Reactive power in reverse direction	300	Metering	-	unsigned char	8	0
47	Delay time for Apparent power	302	Metering	-	unsigned char	8	0
48	Over current	267	Metering	ETU	unsigned int	16	0

Table 7-44 *The parameter to set setpoints can be read and changed using data set 130. Part 1.*

DS130: Parameter for the setpoints (Length 148 Byte, read- and writeable) part 2							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
50	Earth fault current	269	Metering	ETU	unsigned int	16	0
52	Over current N-phase	271	Metering	ETU	unsigned int	16	0
54	Demand of the current	275	Metering	ETU	unsigned int	16	0
56	Delay time for Over current	268	Metering	ETU	unsigned char	8	0
57	erzögerungsTime of the current, fault current	270	Metering	ETU	unsigned char	8	0
58	Delay time for Over current N-phase	272	Metering	ETU	unsigned char	8	0
59	Phase unbalance current	273	Metering	ETU	unsigned char	8	0
60	Delay time for Phase unbalance current	274	Metering	ETU	unsigned char	8	0
61	Delay time for demand of the current	276	Metering	ETU	unsigned char	8	0
62	Under voltage	277	Metering	-	unsigned int	16	0
64	Delay time for Under voltage	278	Metering	-	unsigned char	8	0
65	Phase unbalance voltage	279	Metering	-	unsigned char	8	0
66	Delay time for Phase unbalance voltage	280	Metering	-	unsigned char	8	0
67	Reserved	-	-	-	-	8	-
68	Over voltage	281	Metering	-	unsigned int	16	0
70	Delay time for Over voltage	282	Metering	-	unsigned char	8	0
71	Reserved	-	-	-	-	232	-
100	Property for Byte 4	-	Metering	-	EB	8	-
101	Property for Byte 6	-	Metering	-	EB	8	-
102	Property for Byte 8	-	Metering	-	EB	8	-
103	Property for Byte 10	-	Metering	-	EB	8	-
104	Property for Byte 12	-	Metering	-	EB	8	-
105	Property for Byte 13	-	Metering	-	EB	8	-
106	Property for Byte 14	-	Metering	-	EB	8	-
107	Property for Byte 15	-	Metering	-	EB	8	-
108	Property for Byte 16	-	Metering	-	EB	8	-
109	Property for Byte 17	-	Metering	-	EB	8	-
110	Property for Byte 18	-	Metering	-	EB	8	-
111	Property for Byte 19	-	Metering	-	EB	8	-
112	Property for Byte 20	-	Metering	-	EB	8	-
113	Property for Byte 21	-	Metering	-	EB	8	-
114	Property for Byte 22	-	Metering	-	EB	8	-
115	Property for Byte 23	-	Metering	-	EB	8	-
116	Property for Byte 24	-	Metering	-	EB	8	-
117	Property for Byte 26	-	Metering	-	EB	8	-
118	Property for Byte 28	-	Metering	-	EB	8	-
119	Property for Byte 29	-	Metering	-	EB	8	-
120	Property for Byte 30	-	Metering	-	EB	8	-

Table 7-45 *The parameter to set setpoints can be read and changed using data set 130. Part 2.*

DS130: Parameter for the setpoints (Length 148 Byte, read- and writeable) part 3							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
121	Property for Byte 32	-	Metering	-	EB	8	-
122	Property for Byte 34	-	Metering	-	EB	8	-
123	Property for Byte 35	-	Metering	-	EB	8	-
124	Property for Byte 36	-	Metering	-	EB	8	-
125	Property for Byte 38	-	Metering	-	EB	8	-
126	Property for Byte 40	-	Metering	-	EB	8	-
127	Property for Byte 41	-	Metering	-	EB	8	-
128	Property for Byte 42	-	Metering	-	EB	8	-
129	Property for Byte 44	-	Metering	-	EB	8	-
130	Property for Byte 46	-	Metering	-	EB	8	-
131	Property for Byte 47	-	Metering	-	EB	8	-
132	Property for Byte 48	-	Metering	ETU	EB	8	-
133	Property for Byte 50	-	Metering	ETU	EB	8	-
134	Property for Byte 52	-	Metering	ETU	EB	8	-
135	Property for Byte 54	-	Metering	ETU	EB	8	-
136	Property for Byte 56	-	Metering	ETU	EB	8	-
137	Property for Byte 57	-	Metering	ETU	EB	8	-
138	Property for Byte 58	-	Metering	ETU	EB	8	-
139	Property for Byte 59	-	Metering	ETU	EB	8	-
140	Property for Byte 60	-	Metering	ETU	EB	8	-
141	Property for Byte 61	-	Metering	ETU	EB	8	-
142	Property for Byte 62	-	Metering	-	EB	8	-
143	Property for Byte 64	-	Metering	-	EB	8	-
144	Property for Byte 65	-	Metering	-	EB	8	-
145	Property for Byte 66	-	Metering	-	EB	8	-
146	Property for Byte 68	-	-	-	EB	8	-
147	Property for Byte 70	-	Metering	-	EB	8	-

Table 7-46 *The parameter to set setpoints can be read and changed using data set 130. Part 3.*

DS131: Parameter to activate/deactivate parameters for the ext. protective function and setpoints (Length 70 Byte, read- and writeable) part 1							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Header; fixed to 0x00 00 00 00	-	COM15	COM10	-	32	-
4	Property for DS129.4	-	ETU	ETU	EB	8	-
5	Property for DS129.6	-	ETU	-	EB	8	-
6	Property for DS129.10	-	ETU	ETU	EB	8	-
7	Property for DS129.12	-	ETU	ETU	EB	8	-
8	Property for DS129.16	-	ETU	ETU	EB	8	-
9	Property for DS129.20	-	ETU	ETU	EB	8	-
10	Property for DS129.32	-	ETU	-	EB	8	-
11	Property for DS129.34	-	ETU	-	EB	8	-
12	Property for DS129.38	-	ETU	-	EB	8	-
13	Property for DS129.40	-	ETU	-	EB	8	-
14	Property for DS129.44	-	ETU	-	EB	8	-
15	Property for DS129.48	-	ETU	-	EB	8	-
16	Property for DS128.14	-	Metering	-	EB	8	-
17	Property for DS128.16	-	Metering	-	EB	8	-
18	Property for DS128.21	-	Metering	-	EB	8	-
19	Property for DS128.22	-	Metering	-	EB	8	-
20	Property for DS128.26	-	Metering	-	EB	8	-
21	Property for DS128.28	-	Metering	-	EB	8	-
22	Property for DS128.30	-	Metering	-	EB	8	-
23	Property for DS128.32	-	Metering	-	EB	8	-
24	Property for DS128.34	-	Metering	-	EB	8	-
25	Property for DS128.36	-	Metering	-	EB	8	-
26	Property for DS128.41	-	Metering	-	EB	8	-
27	Property for DS130.4	-	Metering	-	EB	8	-
28	Property for DS130.6	-	Metering	-	EB	8	-
29	Property for DS130.8	-	Metering	-	EB	8	-
30	Property for DS130.10	-	Metering	-	EB	8	-
31	Property for DS130.16	-	Metering	-	EB	8	-
32	Property for DS130.18	-	Metering	-	EB	8	-
33	Property for DS130.20	-	Metering	-	EB	8	-
34	Property for DS130.22	-	Metering	-	EB	8	-
35	Property for DS130.24	-	Metering	-	EB	8	-
36	Property for DS130.26	-	Metering	-	EB	8	-
37	Property for DS130.30	-	Metering	-	EB	8	-
38	Property for DS130.32	-	Metering	-	EB	8	-
39	Property for DS130.36	-	Metering	-	EB	8	-
40	Property for DS130.38	-	Metering	-	EB	8	-

Table 7-47 *The parameter for protective function, for the extended protective function and for the setpoints can be activated and deactivated in data set 131. Part 1.*

DS131: Parameter to activate/deactivate parameters for the ext. protective function and setpoints (Length 70 Byte, read- and writeable) part 2

Byte	Description	Data point	Source WL	Source VL	Format	Length (Bit)	Scale
41	Property for DS130.42	-	Metering	-	EB	8	-
42	Property for DS130.44	-	Metering	-	EB	8	-
43	Property for DS130.48	-	Metering	-	EB	8	-
44	Property for DS130.50	-	Metering	-	EB	8	-
45	Property for DS130.52	-	Metering	-	EB	8	-
46	Property for DS130.54	-	Metering	-	EB	8	-
47	Property for DS130.59	-	Metering	-	EB	8	-
48	Property for DS130.62	-	Metering	-	EB	8	-
49	Property for DS130.65	-	Metering	-	EB	8	-
50	Property for DS130.68	-	Metering	-	EB	8	-
51	Property for DS128.44	-	-	ETU	EB	8	-
52	Property for DS129.27	-	ETU	ETU	EB	8	-
53	Reserved	-	-	-	-	8	-
54	Property for DS97.45	-	ETU	ETU	EB	8	-
55	Reserved	-	-	-	-	120	-

Table 7-48 *The parameter for protective function, for the extended protective function and for the setpoints can be activated and deactivated in data set 131. Part 2.*

DS160: Parameter for the communication (Length 77 Byte, read- and writeable)							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Header; fixed to 0x00 00 00 00	-	COM15	COM10	-	32	-
4	Reserved	-	-	-	-	8	-
5	PROFIBUS address	5	COM15	COM10	unsigned char	8	0
6	Basic type for the cyclic data transmission	6	COM15	COM10	Hex	2	-
7	Reserved	-	-	-	-	8	-
8	Changeable data points in the cyclic telegram	7	COM15	COM10	Format (7)	224	-
36	Reserved	-	-	-	-	48	-
42	IP address of the BDA/BDA *Plus*	10	BDA	-	Format (10)	40	-
48	Reserved	-	-	-	-	176	-
70	Reserved	-	-	-	-	8	-
71	Property for Byte 5	-	COM15	COM10	EB	8	-
72	Property for Byte 6	-	COM15	COM10	EB	8	-
73	Reserved	-	-	-	EB	8	-
74	Property for Byte 8	-	COM15	COM10	EB	8	-
75	Reserved	-	-	-	EB	8	-
76	Property for Byte 42	-	BDA	-	EB	8	-

Table 7-49 *The parameter for communication are stored in data set 160. This data set is read- and writeable so that the parameter can also be changed using DS160.*

DS162: Device configuration (Length 75 Byte, read only)							
Byte	**Description**	**Data point**	**Source WL**	**Source VL**	**Format**	**Length (Bit)**	**Scale**
0	Header; fixed to 0x00 00 00 00	-	COM15	COM10	-	32	-
4	Ident number of the COM15/COM10	91	COM15	COM10	16 x char	128	-
20	Order No. of the circuit breaker (... of the trip unit in case of SENTRON VL)	103	ETU	ETU	Format (103)	160	-
40	Type (Metering, Metering *Plus*)	138	Metering	-	Format (138)	8	-
41	Type of trip unit	412	ETU	ETU	Format (412)	5	-
42	Reserved	-	-	-	-	224	-
70	Property for Byte 4	-	COM15	COM10	EB	8	-
71	Property for Byte 20	-	ETU	ETU	EB	8	-
72	Reserved	-	-	-	EB	8	-
73	Property for Byte 41	-	ETU	ETU	EB	8	-
74	Reserved	-	-	-	EB	8	-

Table 7-50 *The device configuration is important to know which kind of breaker is connected to the PROFIBUS communication module.*

DS165: Identification comment (Length 194 Byte, read- and writeable)							
Byte	Description	Data point	Source WL	Source VL	Format	Length (Bit)	Scale
0	Header; fixed to 0x00 00 00 00	-	COM15	COM10	-	32	-
4	User comment	20	COM15	-	64 x char	512	-
68	Equipment identifier	21	COM15	-	64 x char	512	-
132	Date (free for user edit)	22	COM15	-	Time	64	-
140	Author (free for user edit)	23	COM15	-	30 x char	240	-
170	Reserved	-	-	-	-	160	-
190	Property for Byte 4	-	COM15	-	EB	8	-
191	Property for Byte 68	-	COM15	-	EB	8	-
192	Property for Byte 132	-	COM15	-	EB	8	-
193	Property for Byte 140	-	COM15	-	EB	8	-

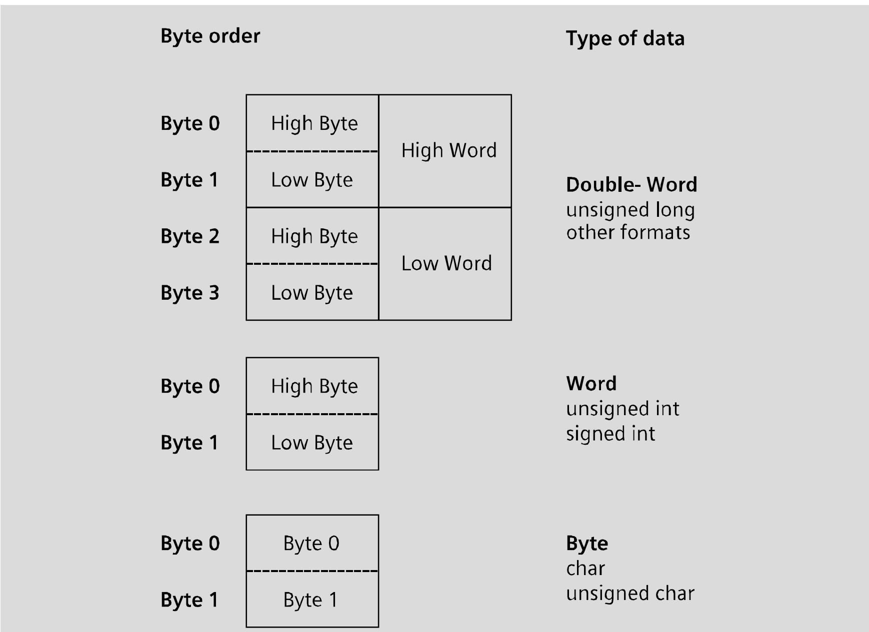
Table 7-51 *Data set 165 can be used to add user specific comments into the PROFIBUS communication modules.*

Data Dictionary
Common and special data formats

The pages ahead explained the available data points and how they are being communicated via the PROFIBUS DPV1 data sets. In the column „Format" the format for the correct interpretion of the data points are listed. Most of the data points are stored in a common known format (like unsigned int), but some of them do have their own special data format. All these formats are explained in this part of the chapter.

Format	Length in Byte	Sign	Value range without scale	Used for...
unsigned int	2		0...65535	Metering values, parameter
signed int	2	✓	–32678...32767	signed metering values
unsigned char	1		0...255	Metering values with smaller range
char	1		0...255	ASCII code
unsigned long	4		0...4294967295	Metering values and maintenance information with a huge range

Table 7-52 *The used standard formats together with the range of the values and the usage are explained here..*



Grafik 7-1 *Data points huger than two bytes are stored in the Motorola Format (Big-Endian).*

Common data formats

The size of many data points is longer as two byte. In this case data can be stored depending on the processor type in the format called Little-Indian (for intel processors) or in Big-Endian (for motorola processors).

In the Big-Endian-Format the most significant byte will be transmitted first which makes it easier for the user to read the data. The Intel-Format changes the order of most and least significant byte.

In general all data transmitted from the SENTRON circuit breaker via the PROFIBUS (cyclic channal and DPV1 data sets) must be read in Motorola-(Big-Endian) Format.

First of all the format **unsigned int** will be used to communicate parameters and metering values as well as statistic informations. If the range of this data type is insufficient enough the data will be scaled.

To transmit metering values which can also be negative (e.g. power factor) the format **signed int** is used.

If the range of parameters or metering values is not huge enough to justify the need for two bytes (e.g. phase unbalance from 0 up to 50%) the date typ **unsigned char** is used.

For data points with text elements consiting of ASCII sign the data type **char** is used.

If the range is insufficiant enough to cover all possible values the data type **unsigned long** is used. One example for this data type is the counter of the operating hours which would return to zero after seven years at the format int.

The format **hex** is used to string binary informations together, for example the status of the inputs of the digital input module. It is also used if digits in the

hexa decimal format must be transmitted.

The format Property Byte (**PB**) is already described in chapter 4.

To transmit time stamps the S7 compatible format **Time** (DATE_AND_TIME) is used. One exception of this is the time stamp in DS100, which is build following the PROFIBUS standard.

Format Time

Byte	Bit	Description
0	-	Year
1	-	Month
2	-	Day
3	-	Hour
4	-	Minute
5	-	Seconds
6	-	Low byte of milliseconds
7	4-7	High digits of milliseconds (4MSB)
7	0-3	Day of week (1 = Sunday...7 = Saturday)

Table 7-53 *All time stamps (except DS100) will be communicated in this format.*

Format PROFIBUS Time (DS100.4)

Byte	Bit	Description
0	-	High digits of milliseconds
1	-	Low digits of milliseconds
2	-	Minute
3	0-4	Hour
3	7	1 = daylight saving time; 0 = wintertime
4	0-4	Day in month(1–31)
4	5-7	Day of week (1 = Monday...7 = Sunday)
5	-	Month
6	-	Year (02 = 2002)
7	-	Reserved

Table 7-54 *This format is conform to the PROFIBUS time standards.*

Special data formats

If the standard formats are not flexible enough to cover the certain data points it is necessary to define special formats. Examples for special data formats are binary coded data or combined data points (trip log).

If a data point is stored using a special data format it is mentioned in the column „format" as **Format (X)** in the first and second part of this chapter. The x is a substitution for a consecutive number describing the special format in the following pages. In most cases the number x is identical to the data point number to alleviate the search for the explanation of the corresponding special format.

If not mentioned different all bit signals are high active.

Format (7) Data in cyclic telegram

Byte	Bit	Description
0	-	Assignment (Data point number) of the 1. data block in the cyclic telegram
2	-	accordingly
4	-	accordingly
6	-	accordingly
8	-	accordingly
10	-	accordingly
12	-	accordingly
14	-	accordingly
16	-	accordingly
18	-	accordingly
20	-	accordingly
22	-	accordingly
24	-	accordingly
26	-	Assignment (Data point number) of the 14. data block in the cyclic telegram

Table 7-55 *Format (7) declares the content of the data in the cyclic channel*

Format (10) IP-Address BDA

Byte	Bit	Description
0	-	unsigned int: 1. part IP-address **X**.x.x.x
1	-	unsigned int: 2. part IP-address x.**X**.x.x
2	-	unsigned int: 3. part IP-address x.x.**X**.x
3	-	unsigned int: 4. part IP-address x.x.x.**X**
4	-	Reserved

Table 7-56 *The IP-address consists of four numbers frmo 0 to 255 devided by "."*

Format (14) PROFIBUS Write Enable

Byte	Bit	Description
0	0	0 = Write portection active 1 = No write protection

Table 7-57 *At COM10 and COM15 an hardware input defines the write access from the PROFIBUS.*

Format (15) Trip log		
Byte	**Bit**	**Description**
0	-	Time stamp of the 1. trip
8	-	Reserved 0x00
9	-	Reason for 1. trip *1 = Overload* *2 = Instantaneous* *3 = Short time delay* *4 = Earth fault* *5 = Ext. prot. function* *6 = Overload N-phase* *20 = Unbalance current* *21 = Unbalance voltage* *22 = Real power in normal direction* *23 = Real power in reverse direction* *24 = Over voltage* *25 = Under voltage* *26 = Over frequency* *27 = Under frequency* *28 = THD current* *29 = THD voltage* *30 = Change of phase rot.*
10	-	Source of the 1. trip *14 = Metering/Metering Plus* *25 = Trip Unit*
11	-	Reserved 0x00
12	-	Time stamp of the 2. trip
20	-	Reserved 0x00
21	-	Reason for 2. trip
22	-	Source of the 2. trip
23	-	Reserved 0x00
24	-	Time stamp of the 3. trip
32	-	Reserved 0x00
33	-	Reason for 3. trip
34	-	Source of the 3. trip
35	-	Reserved 0x00
36	-	Time stamp of the 4. trip
44	-	Reserved 0x00
45	-	Reason for 4. trip
46	-	Source of the 4. trip
47	-	Reserved 0x00
48	-	Time stamp of the 5. trip
56	-	Reserved 0x00
57	-	Reason for 5. trip
58	-	Source of the 5. trip
59	-	Reserved 0x00

Table 7-58 *The trip log contains the reason of the last five trips and their corresponding time stamps.*

Format (16) Event log		
Byte	**Bit**	**Description**
0	-	Timest. of the 1. event
8	-	Reserved 0x00
9	-	1. event (first event = coming +; second event = going -), refer to 1 u. 2! *1 = + Overload warning* *2 = – Overload warning etc...* *3 = Overload warning N-ph.* *5 = Load shedding* *7 = Load restorage* *9 = Phase unbalance warn.* *11 = ETU error* *13 = Earth fault warning* *15 = Over temperature* *20 = Breaker on* *21 = Breaker off* *40 = Setpoint SP over current* *42 = SP earth fault warning* *44 = SP over current N-ph.* *46 = SP Phase unbalance current* *48 = SP demand current* *50 = SP under voltage* *52 = SP phase unbalance voltage* *54 = SP over voltage* *56 = SP demand real power* *58 = SP demand apparent power* *60 = SP demand reactive power* *62 = SP reactive power in normal direction* *64 = SP reactive power in reverse direction* *66 = SP apparent power* *68 = SP over frequency* *70 = SP under frequency* *72 = SP power factor cap.* *74 = SP power factor ind.* *76 = SP THD current* *78 = SP THD Spann.* *80 = SP crest factor* *82 = SP form factor* *84 = SP real power in normal direction* *86 = SP real power in reverse direction*
10	-	Source of the 1. event *14 = Metering/Metering Plus* *25 = Trip unit*
11	-	Reserved 0x00
12	-	Timest. of the 2. event
20	-	Reserved 0x00
21	-	2. event
22	-	Source of the 2. event
23	-	Reserved 0x00
24	-	Timest. of the 3. event
32	-	Reserved 0x00
33	-	3. event
34	-	Source of the 3. event
35	-	Reserved 0x00
36	-	Timest. of the 4. event
44	-	Reserved 0x00
45	-	4. event
46	-	Source of the 4. event
47	-	Reserved 0x00
48	-	Timest. of the 5. event
56	-	Reserved 0x00
57	-	5. event
58	-	Source of the 5. event
59	-	Reserved 0x00
60	-	Timest. of the 6. event
68	-	Reserved 0x00
69	-	6. event
70	-	Source of the 6. event
71	-	Reserved 0x00
72	-	Timest. of the 7. event
80	-	Reserved 0x00
81	-	7. event
82	-	Source of the 7. event
83	-	Reserved 0x00
84	-	Timest. of the 8. event
92	-	Reserved 0x00
93	-	8. event
94	-	Source of the 8. event
95	-	Reserved 0x00
96	-	Timest. of the 9. event
104	-	Reserved 0x00
105	-	9. event
106	-	Source of the 9. event
107	-	Reserved 0x00
108	-	Timest. of the 10. event
116	-	Reserved 0x00
117	-	10. event
118	-	Source of the 10. event
119	-	Reserved 0x00

Table 7-59 *The last ten events and the time stamps are included in the data point event log.*

Format (17) Status PROFIBUS-DP		
Byte	**Bit**	**Description**
0	0	No communication to class 1 master
0	1	COM1x does not have a valid address
0	2	PROFIBUS address is locked

Table 7-60 *The status informs the user whether a cyclic communication is running.*

Format (18) Control COM1x		
Byte	**Bit**	**Description**
0	2	Clears the maintenance counter
0	3	Clears the min./max. temperature values
0	4	Clears all min./max. values excepting temp.
0	5	Synchronises the clock to xx:30:00,000
0	6	Deletes the content of trip and event log
0	7	Unlocks the DP-address and set it to default 126

Table 7-61 *Some informations can be deleted using the data point 18.*

Format (19) Ctrl. Outputs COM1x		
Byte	**Bit**	**Description**
0	0	Set user output
0	1	Reset user ouput
0	2	Switch breaker off
0	3	Switch breaker on
0	6	Read status of user output
0	7	Read status of user input (only COM15)

Table 7-62 *The breaker can be contolled via the data point 19.*

Format (24) Position in the frame		
Byte	**Val.**	**Description**
0	0	Disconnected position
0	1	Operating position
0	2	Test position
0	3	Breaker not available

Table 7-63 *Data point 24 contains the position of the breaker in the frame.*

Format (88) CubicleBUS Modules		
Byte	**Bit**	**Description**
0	0	COM15
0	1	Trip unit ETU
0	2	ZSI Module
1	0	config. dig. output module
1	2	Dig. output module #2
1	3	Dig. input module #2
1	4	Breaker Status Sensor BSS
1	5	Dig. output module #1
1	6	Dig. input module #1
2	1	BDA or BDA *Plus*
2	3	Grafic display ETU76B
2	4	Analog output module #2
2	5	Analog output module #1
2	6	*Metering or Metering Plus*

Table 7-64 *Includes the connected* **CubicleBUS** *modules.*

Format (95) Market		
Byte	**Val.**	**Description**
0	1	IEC
0	2	UL
0	3	ANSI

Table 7-65 *Informs about the market for which the breaker was build.*

Format (99) Switching capacity		
Byte	**Val.**	**Description**
0	2	ECO switching capacity N
0	3	Standard switching cap. S
0	4	High switching capacity H

Table 7-66 *Defines the switching capacity of the connected breaker.*

Format (100) Frame size		
Byte	**Val.**	**Description**
0	1	Frame size 1
0	2	Frame size 2
0	3	Frame size 3

Table 7-67 *The frame size influences also the physical dimensions.*

Format (103) Order # CB		
Byte	**Bit**	**Description**
0	-	3
1	-	W
2	-	L
3	-	Market
4	-	Frame size
5/6	-	Rated current
7	-	Dash
8	-	Switching capacity
9	-	Trip unit *E = ETU45B without Display* *F = ETU45B with Display* *J = ETU55B* *N = ETU76B*
10	-	Addons trip unit *B = without earth fault module* *G = with earth fault module*
11	-	Number of poles
12	-	Kind of main connections
13	-	Dash
14	-	Operating mechanism
15	-	1. auxilary release
16	-	2. auxilary release
17	-	Auxilary switches
18	0	Option F02
18	2	Option F04
18	3	Option F05
18	6	Option F01
18	7	Option F20 to F22
19	0	Option K01
19	1	Option K10 to K13

Table 7-68 *The breaker can be identified with the order number.*

Format (107) Sum. of . I^2t Values

Byte	Bit	Description
0	-	Phase L1 (unsigned long)
4	-	Phase L2 (unsigned long)
8	-	Phase L3 (unsigned long)
12	-	Phase N (unsigned long)

Table 7-69 *The summary of the I^2 values are stored in the unsigned long format*

Format (108) # of poles

Byte	Val.	Description
0	1	3 pole
0	2	4 pole (with N-phase)

Table 7-70 *# of poles which are interrupted in case of a trip.*

Format (111) Rotary switch pos. DI

Byte	Val.	Description
0	1	Parameter switch (Modul #1)
0	2	6 x dig. Inputs (Modul #2)

Table 7-71 *The position of the rotary coding switch defines the function of the input module.*

Format (119) Rotary switch pos. DO

Byte	Val.	Description
0	0x01	Mod. #1 Trips not delayed
0	0x02	Mod. #1 Trips del. 200ms
0	0x03	Mod. #1 Trips del. 500 ms
0	0x04	Mod. #1 Trips del. 1s
0	0x05	Mod. #1 Trips del. 2s
0	0x06	Mod. #2 Alarm not delayed
0	0x07	Mod. #2 Alarm delayed 200ms
0	0x08	Mod. #2 Alarm delayed 500ms
0	0x09	Mod. #2 Alarm delayed 1s
0	0x0A	Mod. #2 Alarm delayed 2s

Table 7-72 *This data point informs about the position of the rotary coding switch.*

Format (121) DO control Outputs

Byte	Val.	Description
0	0	No action
0	1	Set output 1 ("1")
0	2	Reset output 1 ("0")
0	3	Set output 2 ("1")
0	4	Reset output 2 ("0")
0	5	Set output 3 ("1")
0	6	Reset output 3 ("0")
0	7	Set output 4 set ("1")
0	8	Reset output 4 ("0")
0	9	Set output 5 ("1")
0	10	Reset output 5 ("0")
0	11	Set output 6 ("1")
0	12	Reset output 6 ("0")
0	13	Force mode off

Table 7-73 *Controls the outputs of the dig. output module with rotary coding switch.*

Format (129) Conf. Output module

Byte	Val.	Description
0	-	1. Event for the 1. output
0	0x00	not used
0	0x01	Breaker on
0	0x02	Breaker off
0	0x03	Spring charged
0	0x04	Ready to switch on
0	0x05	Common warning
0	0x06	Common trip message
0	0x07	Write protection active
0	0x08	DP communication active
0	0x09	Warn: Overload
0	0x0A	Warn: Overload N-phase
0	0x0B	Warn: Load shedding
0	0x0C	Warn: Earth fault
0	0x0D	Warn: Over temperature
0	0x0E	Warn: µP error
0	0x0F	Warn: Phase unbalance current
0	0x10	Warn: Load restorage
0	0x11	Trip: Overload
0	0x12	Trip: Instantaneous I
0	0x13	Trip: Short time delayed S
0	0x15	Trip: Earth fault G
0	0x16	Trip: Overload N-phase N
0	0x17	Trip: Phase unb. current
0	0x18	Trip: Phase unb. voltage
0	0x19	Trip: Under frequency
0	0x1A	Trip: Over frequency
0	0x1B	Trip: Under voltage
0	0x1C	Trip: Over voltage
0	0x1D	Trip: Real power in normal direction
0	0x1E	Trip: Real power in reverse direction
0	0x1F	Trip: THD current
0	0x20	Trip: THD voltage
0	0x21	Trip: Change of phase rotation
0	0x22	Setpoint SP: Over current
0	0x23	SP: Over current N-Leiter
0	0x24	SP: Over current earth fault
0	0x25	SP: Phase unbalance current
0	0x26	SP: Phase unbalance voltage
0	0x27	SP: Current demand
0	0x28	SP: Under voltage
0	0x29	SP: Over voltage
0	0x2A	SP: THD current
0	0x2B	SP: THD voltage
0	0x2C	SP: Crest factor
0	0x2D	SP: Form factor
0	0x2E	SP: Under frequency
0	0x2F	SP: Over frequency
0	0x30	SP: Real power in normal direction
0	0x31	SP: Real power in reverse direction
0	0x32	SP: Apparent power
0	0x33	SP: Reactive power in normal direction
0	0x34	SP: Reactive power in reverse direction
0	0x35	SP: power factor capacitive
0	0x36	SP: Power factor inductive
0	0x37	SP: Demand Real power
0	0x38	SP: Demand Reactive power
0	0x39	SP: Demand Apparent power
0	0x3A	Triggerevent A occured

0	0x3B	Triggerevent B occured
0	0x3C	Parameter set A active
0	0x3D	Parameter set B active
0	0x3E	PROFIBUS Bit 1(#426)
0	0x3F	PROFIBUS Bit 2 (#426)
0	0x40	PROFIBUS Bit 3 (#426)
0	0x41	PROFIBUS Bit 4 (#426)
0	0x42	PROFIBUS Bit 5 (#426)
0	0x43	PROFIBUS Bit 6 (#426)
1	-	2. event for the 1. output
2	-	3. event for the 1. output
3	-	4. event for the 1. output
4	-	5. event for the 1. output
5	-	6. event for the 1. output
6	-	1. event for the 2. output
7	-	2. event for the 2. output
8	-	3. event for the 2. output
9	-	4. event for the 2. output
10	-	5. event for the 2. output
11	-	6. event for the 2. output
12	-	1. event for the 3. output
13	-	2. event for the 3. output
14	-	3. event for the 3. output
15	-	4. event for the 3. output
16	-	5. event for the 3. output
17	-	6. event for the 3. output
18	-	Event for the 4. output
19	-	Event for the 5. output
20	-	Event for the 6. output

Table 7-74 *The first event for the first output explains the coding of the events for all others.*

Format (138) Type of metering funct.		
Byte	Val.	Description
0	0x00	No metering function
0	0x02	Metering function
0	0x03	Metering function *Plus*

Table 7-75 *Informs about the kind of metering function.*

Format (145) Incoming direction		
Byte	Val.	Description
0	0	Top down
0	1	Bottum up

Table 7-76 *The sign of real and reactive power shows the energy flow in relation to the normal direction.*

Format (146) Phase rotation		
Byte	Val.	Description
0	0	L1 – L2 – L3
0	1	L1 – L3 – L2 equivalent

Table 7-77 *Setting of the "normal" phase rotation of the energy net.*

Format (162) Voltage transformer		
Byte	Val.	Description
0	0	Primary connection of the voltage transformer is Delta
0	1	Primary connection of the voltage transformer is Star

Table 7-78 *This setting also influence the calculation of the voltages inside the WL system.*

Format (307) Trips of the met. fun.		
Byte	Val.	Description
0/1	0x0000	No trip
0/1	0x0001	Phase unbalance current
0/1	0x0002	Phase unbalance voltage
0/1	0x0004	Real power in normal direction
0/1	0x0008	Real power in reverse direction
0/1	0x0040	Over voltage
0/1	0x0080	Under voltage
0/1	0x0100	Over frequency
0/1	0x0200	Under frequency
0/1	0x0400	THD current
0/1	0x0800	THD voltage
0/1	0x1000	Change of phase rotation

Table 7-79 *Contents the reason for the last trip initiated by the metering function*

Format (308) Setpoint warnings		
Byte	Bit	Description
1	0	Power factor capacitive
1	1	Power factor inductive
1	2	THD current
1	3	THD voltage
1	4	Crest factor
1	5	Form factor
1	6	Real power in normal direction
1	7	Real power in reverse direction
2	0	Demand real power
2	1	Demand apparent power
2	2	Demand reactive power
2	3	Reactive power in normal direction
2	4	Reactive power in reverse direction
2	5	Apparent power
2	6	Over frequency
2	7	Under frequency
3	0	Over current
3	1	Over current earth fault
3	2	Over current N-phase
3	3	Phase unbalance current
3	4	Demand current
3	5	Under voltage
3	6	Phase unbalance voltage
3	7	Over voltage

Table 7-80 *Includes the current active setpoint warnings.*

Format (309) Harmonics

Byte	Bit	Description
0	-	1. harmonic current: Exponent (signed char)
1	-	1. harmonic current: Val. (unsigned char)
2	-	1. harmonic voltage: Exponent (signed char)
3	-	1. harmonic voltage: Val. (unsigned char)
4	-	2. harmonic current: Exponent (signed char)
5	-	2. harmonic current: Val. (unsigned char)
6	-	2. harmonic voltage: Exponent (signed char)
7	-	2. harmonic voltage: Val. (unsigned char)
...	...	...
112	-	29. harmonic current: Exponent (signed char)
113	-	29. harmonic current: Val. (unsigned char)
114	-	29. harmonic voltage: Exponent (signed char)
115	-	29. harmonic voltage: Val. (unsigned char)

Table 7-81 *For calculation the value must be mulitplied with the signed exponent.*

Format (328) Status of the breaker

Byte	Bit	Description
0	0	Breaker is off
0	1	Breaker is on
0	2	Breaker has tripped (mechanical trip indication)
0	3	Breaker is ready to switch on
0	4	Storage spring is charged
0	5	1st auxilary release is operated
0	6	2nd auxilary release is operated

Table 7-82 *Communicates the informations collected by the BSS.*

Format (331) Trip Class (VL only)

Byte	Val.	Description
0	5	3 seconds delay @ 7,2 x rated current
0	10	6 seconds delay @ 7,2 x rated current
0	15	9 seconds delay @ 7,2 x rated current
0	20	12 seconds delay @ 7,2 x rated current
0	30	18 seconds delay @ 7,2 x rated current

Table 7-83 *The trip class is to adjust the overload settings according to the connected motor.*

Format (343) I^2t for S

Byte	Val.	Description
0	0	I^2t curve for S-trip is deactivated
0	1	I^2t curve for S-trip is activated

Table 7-84 *The I^2t curve can be activated/deactivaed via this data point.*

Format (344) I^2t for G

Byte	Val.	Description
0	0	I^2t curve for G-trip is deactivated
0	1	I^2t curve for G-trip is activated

Table 7-85 *The I^2t curve can be activated/deactivaed via this data point.*

Format (345) I^4t for L

Byte	Val.	Description
0	0	I^4t curve for L-trip is deactivated
0	1	I^4t curve for L-trip is activated

Table 7-86 *The I^4t curve can be activated/deactivaed via this data point.*

Format (346) Therm. memory

Byte	Val.	Description
0	0	Thermal memory is switched off
0	1	Thermal memory is switched on

Table 7-87 *The thermal memory can be activated/deactivaed via this data point.*

Format (347) Phase sentitivity

Byte	Val.	Description
0	0	Phase sensitivity is deactivated
0	1	Phase sensitivity is activated

Table 7-88 *The phase sensitivity can be activated/deactivaed via this data point.*

Format (370) Active parameter set

Byte	Val.	Description
0	0	Parameter set A is active
0	1	Parameter set B is active

Table 7-89 *Defines the active parameter set of the SENTRON WL.*

Format (373) Phase number

Byte	Val.	Description
0	0	Phase L1
0	1	Phase L2
0	2	Phase L3
0	3	N-phase
0	4	Earth

Table 7-90 *The definition of the phase number for example of the phase number of the last trip.*

Format (401) Current Trip of the ETU

Byte	Val.	Description
0	0x00	No active trip
0	0x01	Overload (L)
0	0x02	Instantaneous (I)
0	0x04	Short time delayed short circuit (S)
0	0x08	Earth fault(G)
0	0x10	Trip from the extended protective function (metering)
0	0x20	Overload N-phase (N)

Table 7-91 *Contains the last active, not yet cleared trip.*

Format (402) Active warnings ETU

Byte	Val.	Description
0	0	Pretrip for L
1	0	Overload
1	1	Overload N-phase
1	2	Load shedding
1	3	Load restorage
1	4	Phase unbalance current
1	5	µP error
1	6	Earth fault warning
1	7	Over temperature

Table 7-92 *Data point #402 includes the active warnigns of the trip unit.*

Format (405) Status main contacts

Byte	Val.	Description
0	0	No maintenance is necessary (Note: Please check the main contacts after each trip!)
0	1	Maintain the main contacts immediately
0	2	Maintain the main contacts

Table 7-93 *A maintenance recommendation is given based on the calculated main contact status.*

Format (406) Control the trip unit

Byte	Val.	Description
0/1	0x0002	Clear last trip in the trip unit
0/1	0x0022	Reset maintenance informations and counters

Table 7-94 *Via this data point maintenance information can be cleared.*

Format (410) Earth fault settings

Byte	Val.	Description
0	0	Detection of the earth fault current using external transformer
0	1	Calculation of the earth fault current
0	2	Calculation of the earth fault current (warning) and over the external transformer (trip)

Table 7-95 *The kind of getting the earth fault current can be set using #410.*

Format (411) N-transformer

Byte	Val.	Description
0	0	No N-transformer is available
0	1	N-transformer is connected

Table 7-96 *Informs whether a N-transformer is connected to the trip unit.*

Format (412) Type of trip unit

Byte	Val.	Description
0	4	ETU45B
0	5	ETU45B with display
0	6	ETU45B with earth fault protection
0	7	ETU45B with display and earth fault protection
0	8	ETU55B
0	9	ETU55B with earth fault protection
0	13	ETU76B
0	14	ETU76B with earth fault protection

Table 7-97 *Contains the kind of trip unit and the add ons.*

Format (426) PROFIBUS Bit

Byte	Bit	Description
0	0	PROFIBUS Bit 1
0	1	PROFIBUS Bit 2
0	2	PROFIBUS Bit 3
0	3	PROFIBUS Bit 4
0	4	PROFIBUS Bit 5
0	5	PROFIBUS Bit 6

Table 7-98 *These bits can be used to output informations from the plc to the conf. output module.*

The information provided in [this brochure/product catalog, etc.] containsmerely general descriptions or characteristics of performance which in case of actual use do not always apply as described or which may change as a result of further development of the products. An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of contract.

Siemens AG

Automation and Drives
Low voltages switch gear for energy distribution
P.O. Box 3240, 91050 Erlangen, Germany

www.siemens.com/lowvoltage

Subject to change without prior 10/03 | Bestell-Nr. E20001-A210-P307-X-7600 | Dispostelle 27604 | 10815596 PDSS.52.3.01 KG10031.0 | © Siemens 2003 | Printed in Germany