SIMEAS P

Power Meter

Operating Instructions PROFIBUS

Edition: 30.08.2004

Information for Your Own Safety

This manual does not contain a full list of the safety measures for operation of the equipment (module, device) because special operating conditions may necessitate further measures. However, it does contain information which must be adhered to in the interests of your own personal safety and to avoid material damages. This information is highlighted by a warning triangle and are represented as follows, depending on the degree of potential danger:

_____

Warning

means that failure to take the necessary safety precautions can result in death, serious injury or considerable material damage

Caution

means that failure to take the necessary safety precautions will result in death, serious injury or considerable material damage

_____

Qualified personnel
Commissioning and operation of the equipment (module, device) described in this manual may only be performed by qualified personnel. Qualified personnel in the sense of the safety information contained in this manual are persons who are authorized to commission, start up, ground and label devices, systems and circuits according to safety standards.

Use for the intended purpose
The equipment (device, module) may only be used for the application cases specified in the catalog and the technical manual and only in connection with OEM devices and components recommended and approved by Siemens.
The prerequisites for perfect, reliable operation of the product are proper transport, proper storage, installation and assembly, as well as proper operation and maintenance.
When operating electrical equipment, certain parts of this equipment automatically carry dangerous voltages. Improper handling can therefore result in serious injury or material damage:

- The equipment must be grounded at the PE terminal before making any connections whatsoever.

- Dangerous voltages may occur in all circuit components connected to the power supply.

- Dangerous voltages may still exist in the equipment even after it has been disconnected from the power supply (capacitor memory)

- Equipment with current transformer circuits may not be operated in an open state.

- The limit values specified in the manual and in the operating instructions must not be exceeded; this must also be taken into account during inspection and commissioning

Foreword

Purpose of this manual

This manual describes the interfacing of the power meter SIMEAS P (7KG7xxx) to the PROFIBUS.

Validity

This manual is valid only for SIMEAS P (7KG7xxx) using firmware version 1.xx or 2.xx. Before using this manual, please make sure it is suited for the device to be interfaced to the PROFIBUS.

Target group

This manual is targeted to users of the power meter SIMEAS P.

Standards

SIMEAS P was developed according to the principles of ISO 9000.

Additional support

If you have questions concerning SIMEAS P please contact:
- Your local Siemens distributor
- The Siemens hotline (workdays from 7.30 to 17.00 h): +0049(0)180-5247000
- Fax: 0180-5242471
- E-Mail: support@ptd.siemens.de

More information under:

- www.powerquality.de

SIMEAS P on PROFIBUS DP

1 Introduction

This manual describes connection of the power meter SIMEAS P (7KG70xx) to the PROFIBUS.

A brief general introduction on the topics communication and PROFIBUS is followed by chapters providing all relevant information concerning the PROFIBUS connection of SIMEAS P. In chapter 6 you will find the PROFIBUS data records in detail

Selected examples will show you how to integrate SIMEAS P into a SIMATIC S7 PLC. Further literature you may find for example in [1].

1.1 General introduction

PROFIBUS DP is an open, standardized and manufacturer-independ field bus system.

PROFIBUS DP is standardized according to DIN (E) 19424 Part 3 / EN 50170 and thus provides the ideal basis required for the high demands posed to data exchange in the domain of distributed peripherals and field devices.

For this purpose, PROFIBUS relies on a hybrid control system for bus access consisting of a central token-passing procedure between the active bus nodes (masters) and a central master-slave procedure for data exchange between active and passive bus nodes.

This control system for bus access enables the following system configurations to be implemented:

- Pure master-slave system
- Pure master-master system with token passing
- A system consisting of a combination of both procedures
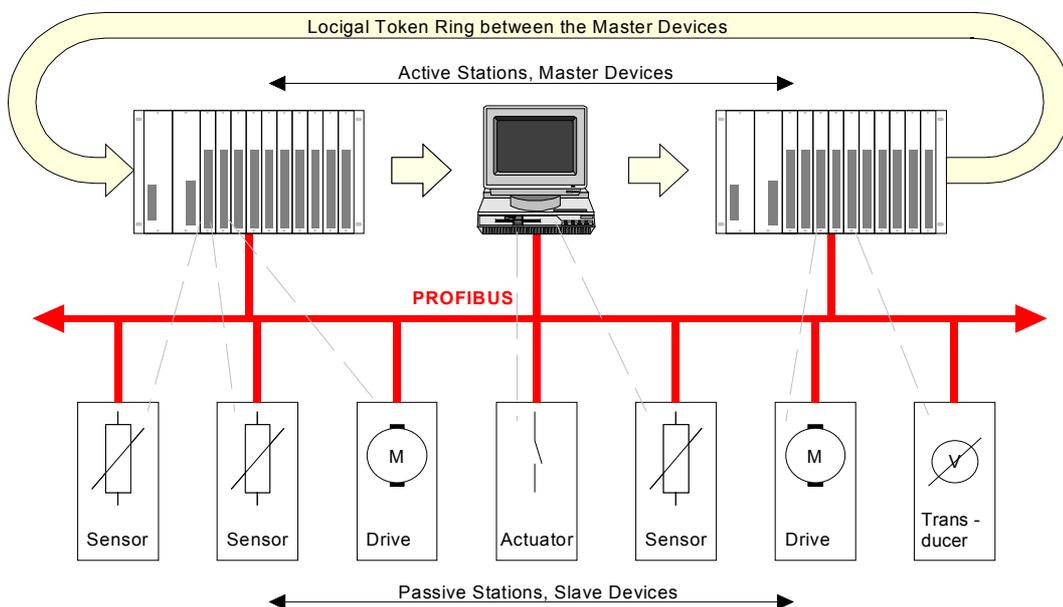
Figure 1-1 Example of a PROFIBUS system

Figure 1-1 depicts an example with 3 master modules and 7 slaves. The 3 master devices constitute a logic circle. Control of the token is accomplished by the bus access control (MAC). In the start-up phase it generates the token and supervises that only one token is passed within the logic circle.

Each slave communicating cyclically via the PROFIBUS is assigned one class-1 master. The cyclic data exchange is accomplished according to the DP standard profile (DPV0). A class-1 master primarily fulfils automation tasks. In addition to the cyclic data exchange a class-1 master can also establish an acyclic communication connection to its slaves and thus utilize the expanded functions of a slave.

A class-2 master is especially appropriate to accomplish commissioning tasks, diagnostics and visualization tasks. It is connected to the PROFIBUS in addition to a class-1 master and can address slaves and exchange data via acyclic services, provided this is permitted by the slaves.

The acyclic data transmission is accomplished via DPV1. DPV 1 supplements the existing PROFIBUS standard by several functions. Among others this enables the slave configuration to be modified during running operation and to establish an acyclic data exchange. DPV1 also enables data to be read directly from the slave by a class-2 master although the slave still entertains a connection to a class-1 master.

2 Integration

2.1 Integration of SIMEAS P into an automation system
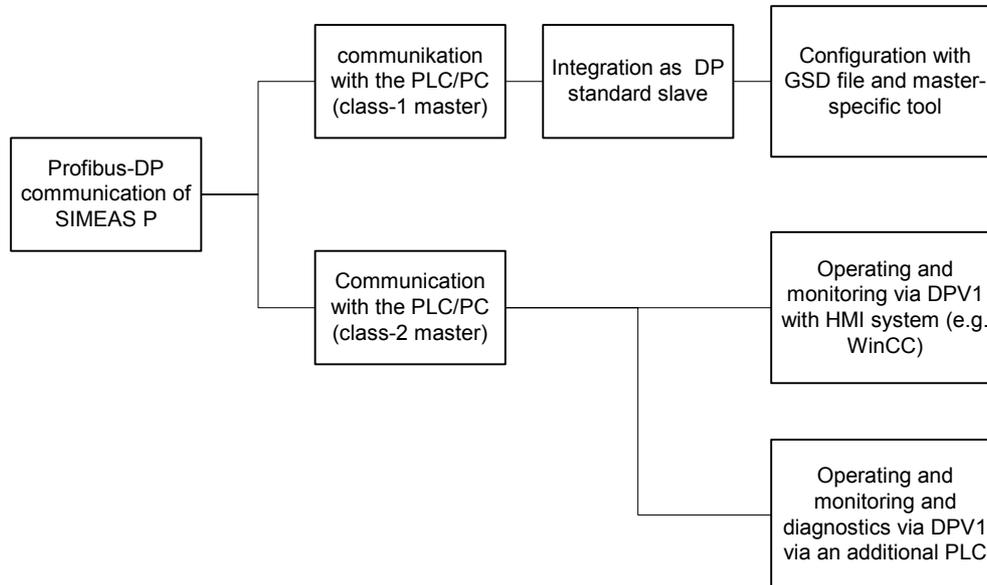
Figure 2-1 Integration of SIMEAS P into an automation system

2.2 Basic setting of SIMEAS P

Call the input window "interface" in the parameterization menu of SIMEAS P.

Settings:

Bus address:	1, 2, 4 to 126[1]
Baudrate:	see below
Protocol:	PROFIBUS

Specifying the baudrate has no function for the protocol PROFIBUS DP. Baudrate is selected via the master station. (max. 12 Mbit/s)

```
*   Bus address:      1
*   Baudrate:         9600 Bd
*   Protocol:         PROFIBUS


<   OK
<   Cancel
```

2.3 1.2.3 Integration via the GSD file

The configuration of the device parameters is accomplished via a configuration tool which is part of each DP standard master. If a SIMATC S7 is applied as master, this is the HW Config of the SIMATIC STEP7 package. If it is not a SIMATIC S7, the configuration can be performed depending on the master e.g. via COM PROFIBUS.

If the GSD file containing the device master data of the power meter has not yet been installed, this file must first be integrated into the configuration tool. For this purpose, you can, e.g., copy the GSD file to the subdirectory in which all GSD files of the configuration tool are stored and update the device library via the corresponding menu item. All parameters which have to be sent by the master during start-up of the slave are stored within the GSD file.

Example: When using a SIMATIC S7 the GSD file is installed via the hardware configuration (HW Config) of STEP 7 in the menu „Options" → „Install new GSD".

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[1] Bus address 3 is reserved for special functions in future versions of SIMEAS P and therefore should not be used.
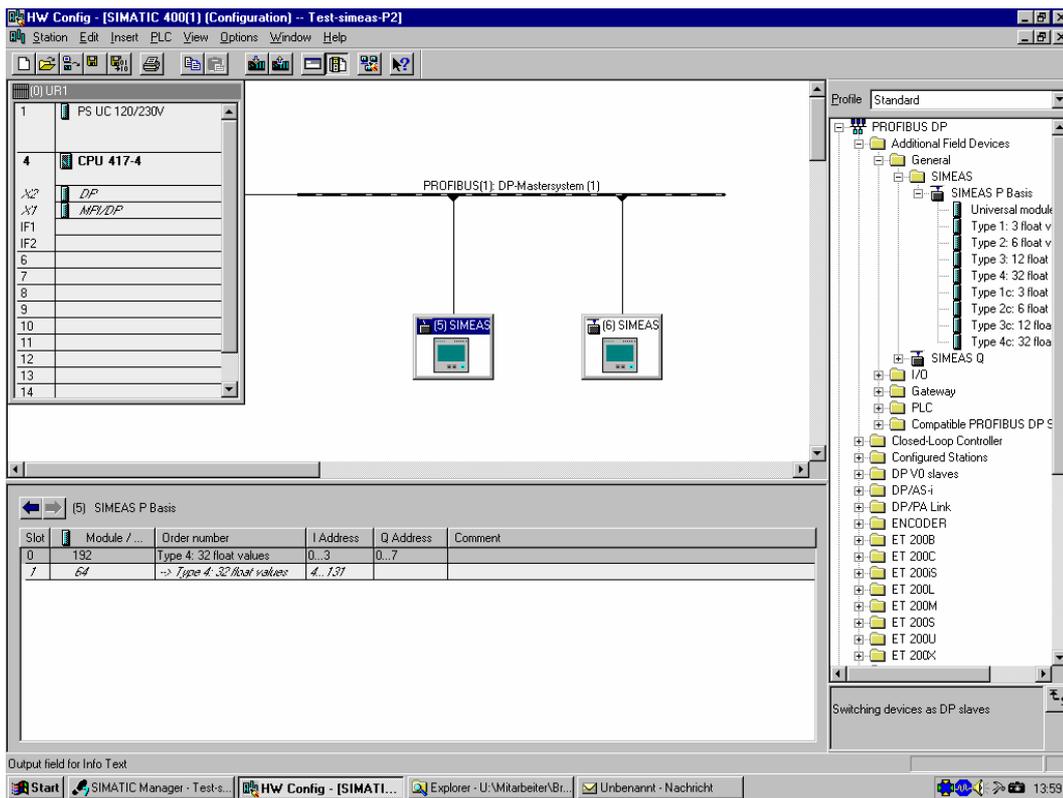
Figure 2-2 Integration of SIMEAS P via GSD file in HW Config of STEP 7

Via the GSD file the SIMEAS P power Meter is always integrated as DP standard slave. Optionally, additional data can easily be transmitted also via DPV1 and e.g. parameters can be modified, see chapter 6.

2.4 Selection of a basic type

After integrating SIMEAS P into your DP master first select the desired basic type from the device catalog. In the following steps chose the remaining parameters such as e.g. I/O-addresses (see lower left of Figure 2-2) or measured values (chapter 2.5)

Example:	For a SIMATIC S7 you will find this in STEP 7 under „device catalog" → „PROFIBUS DP" → „Additional Field Devices" → „General" → „SIMEAS" → „SIMEAS P Basis", see Figure 2-2 and Figure 2-3.

SIMEAS P offers 8 basic types for the transfer of measured values (Table 2-1).

Table 2-1 Basic types of SIMEAS P

Basic type	measured values transferred(floating point format)
type 1	max. 3 measured values
type 2	max. 6 measured values
type 3	max. 12 measured values
type 4	max. 32 measured values [*]
type 1c	max. 3 measured values as consistent data block
type 2c	max. 6 measured values as consistent data block
type 3c	max. 12 measured values as consistent data block
type 4c	max. 32 measured values as consistent data block [*]

[*] Choosing basic type 4 or 4c requires that the DP master allows the parameterization of an I/O-address range of 132 Bytes for DP slaves.

With the selection of a basic type you define the number of measured values to be transferred from SIMEAS P to the PROFIBUS master. You also define whether the measured values are defined as a consistent data block. The transfer of consistent data block is possible with cyclic data transfer only. For further information please see chapter 3.2. In addition to the selected measured values status bytes and control bytes are available, see chapter 3.3.

At this point only the number of measured values is defined, not which measured values are to be transferred. This requires further parameterization, see chapter 2.5.

Example:	In STEP 7 HW Config for SIMATIC S7 the basic types are listed a shown in Figure 2-3. Drag the selected basic type over the respective slot in HW Config, see lower left in Figure 2-2. You may need to manually correct the I/O-addresses which have been assigned automatically.
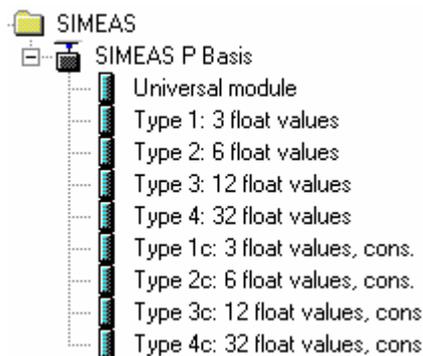
Figure 2-3 basic types of SIMEAS P in STEP 7 HW Config

Notice:	The „Universal module" shown in Figure 2-4 is not described by the GSD file. It is a module specific to SIMATIC S7 which should not be used.

2.5 Parameterization of device properties

After integrating the power meter SIMEAS P into the DP master you will now parameterize the device. In this step you define which measured values are transferred with the variables available according to the selected basic type.

Example:	In STEP 7 HW Config you set these parameters in the properties dialog of the slave (here: SIMEAS P). Figure 2-4 gives an example for the basic type 2. There are three lines for each variable: line 1: value to be measured (voltage, current etc.) line 2: phase of the measured value. You may select a single phase or summed values. line 3: Which harmonics are to be taken into account. This field is relevant only if the measuring function selected in line 1 is "harmonics". In that case you will receive a measured value of 0 if no harmonics are selected.
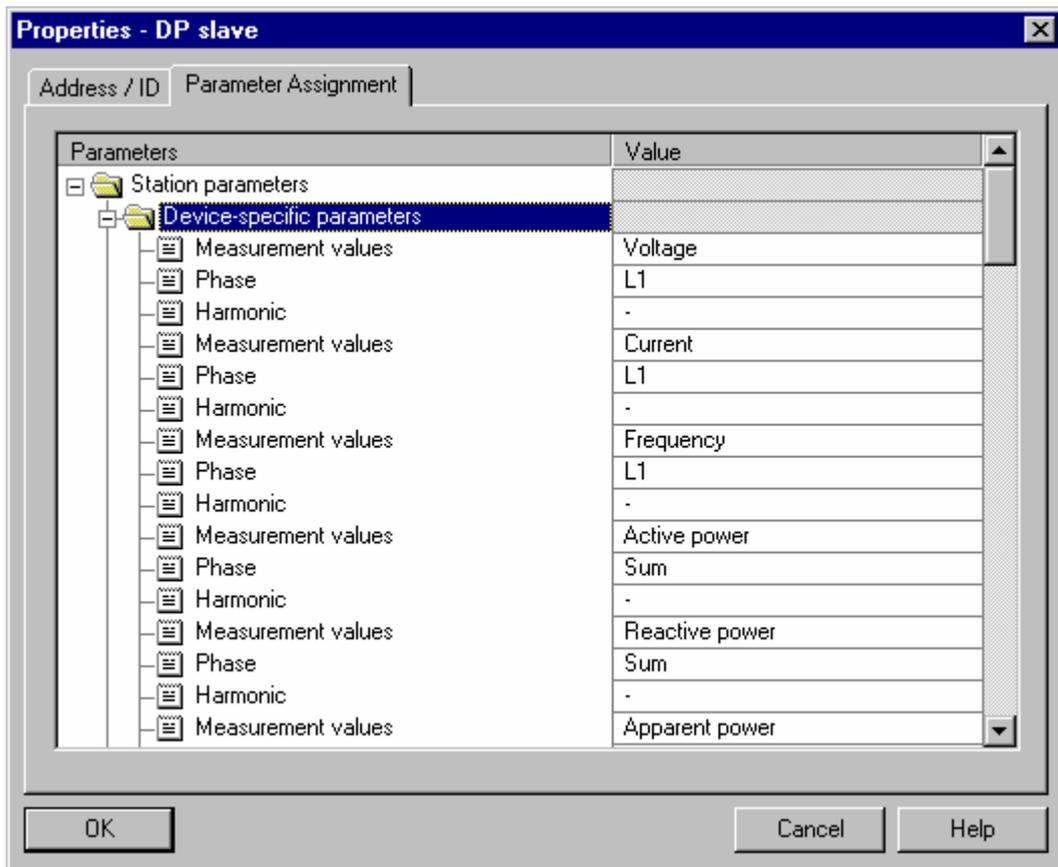
Figure 2-4 Selection of measured values in STEP 7 HW Config

Notice:	Please observe the additional hints for error handling in chapter 5.

For the devices with optional I/O modules (7KG7610/7KG7660) the I/O channels may be used as additional measurement values via the GSD file V03.xx. It is possible to visualize the values of the optional analog in- and outputs and of the binary inputs. Primary values will be derived from the measurement values according to the parameterization.
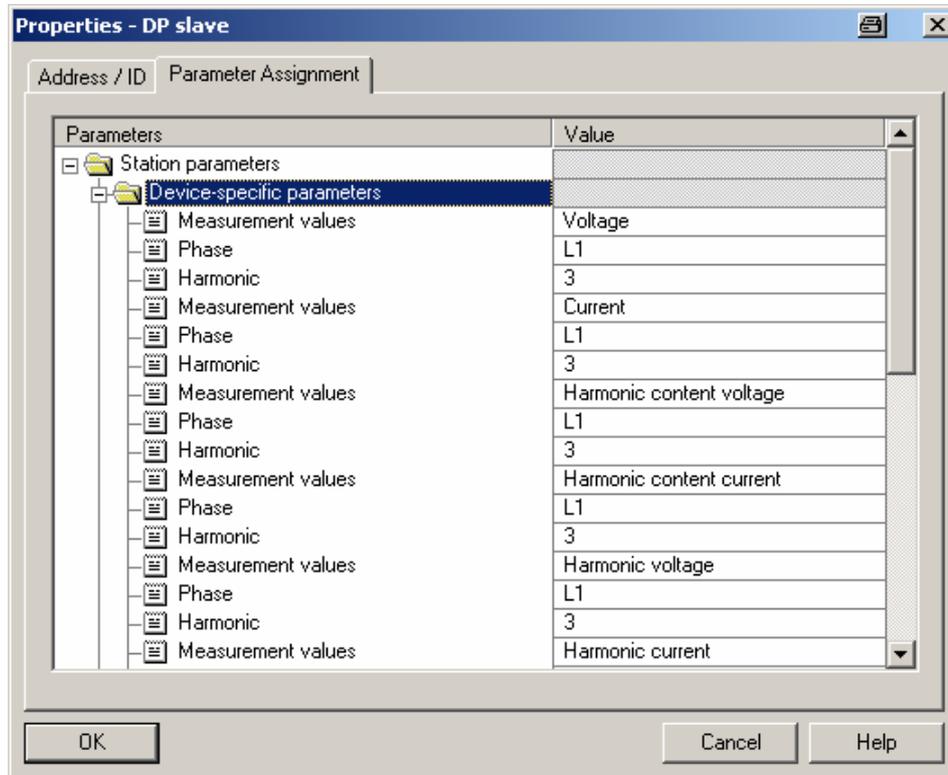

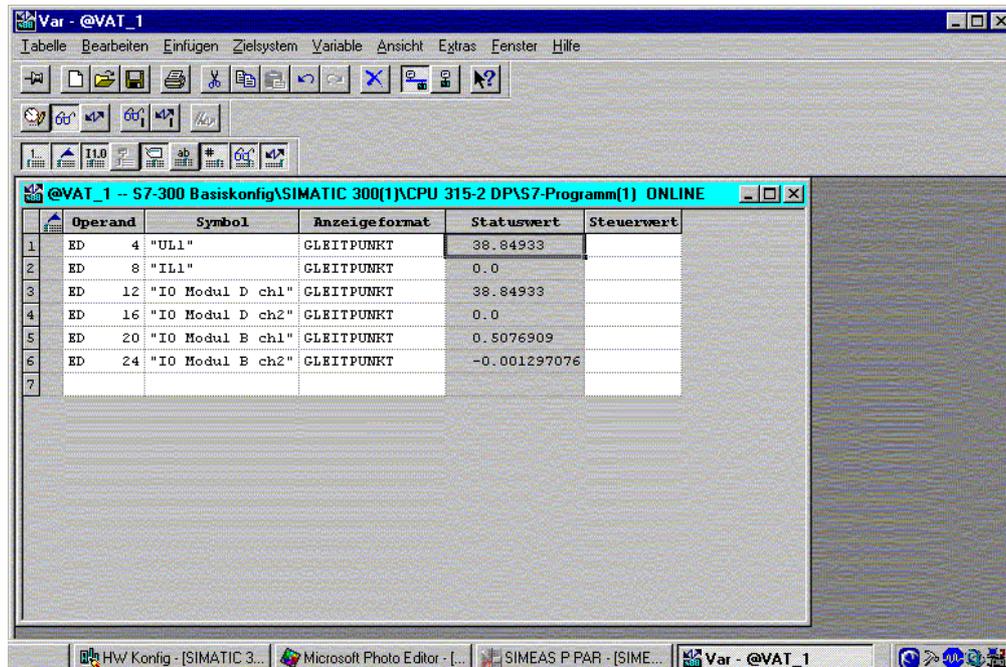**Figure 2-5: Selecting I/O channels in STEP 7 HW Config**

Figure 2-6: Measurement values from I/O channels

Notice:	Please note the additional hints on error handling (see chapter 5).

3 Cyclic data exchange

During cyclic data transfer each telegram transfers a specified number of user data. For this purpose, it must be determined during the configuration of the slave (here SIMEAS P) how many data and what data are to be exchanged cyclically between the power meter and the PLC. Cyclic data exchange therefore represents the best option for transferring information which is required continuously and rapidly. The time interval between two values depends on the number of nodes, the data volume and the baudrate.

Subsequent modifications of the data volume during operation are not possible.

3.1 Basic types for cyclic data transfer

Due to the large volume of data provided by the SIMEAS P power meter, a compromise between the data volume and the performance on the bus has to be found. If the information volume transmitted during data exchange is too large and only a small amount of the data can be used, the performance of the PROFIBUS is impaired.

Therefore, four basic types for non-consistent data (types 1 to 4) or for consistent data (types 1c to 4c, see chapter 3.2) are available for efficient and flexible transmission. During configuration this enables the best-suited basic type and the corresponding bus configuration to be selected for the specific application. Configuration is accomplished by means of a PROFIBUS configuration tool such as e.g. COM PROFIBUS or HW Config of SIMATIC S7. The basic types are already pre-assigned and enable a fast commissioning without additional configuration / parameterization.

Please see chapter 2.4 for more information on the selection of basic types. You may also to define a user-defined configuration within a basic type. See chapter 3.3 for more information.

Data that is not required permanently can additionally be transmitted via DPV1.

3.2 Exchange of consistent data via cyclic data transfer

Basic types 1c to 4c (chapter 2.4) provide measured values as consistent data structures.[2]

The SIMEAS P uses consistent data structures in order to ensure the same reference frame for measured values at the time of evaluation within the DP master, i.e. the same time stamp [3]. Use one of these basic types whenever consistent data are relevant in your application. Please consult the manual of your DP master for information on how to read and process consistent data.

Example:	For SIMATIC S7 use SFC14 DPRD_DAT for reading consistent data from a SIMEAS P.

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[2] Consistent data structures are closed structures that can not be transferred as byte, word or longword. Consistent data structures may be as long as 64 bytes.

[3] Contrary to this the reference may vary slightly for basic types 1 to 4. This may depend e.g. on the computing load of the PROFIBUS master.

3.3 Overview of the basic types

Table 3-1 gives an overview of the 4 possible basic types including size and partitioning of the information which can be called cyclically by SIMEAS P.

Table 3-1 Input Packet Layouts of the different basic types

Byte	Basic type 1	Basic type 2	Basic type 3	Basic type 4
0-3	status SIMEAS P	status SIMEAS P	status SIMEAS P	status SIMEAS P
4-7	data block 1	data block 1	data block 1	data block 1
8-11	data block 2	data block 2	data block 2	data block 2
12-15	data block 3	data block 3	data block 3	data block 3
16-19		data block 4	data block 4	data block 4
20-23		data block 5	data block 5	data block 5
24-27		data block 6	data block 6	data block 6
28-31			data block 7	data block 7
32-35			data block 8	data block 8
36-39			data block 9	data block 9
40-43			data block 10	data block 10
44-47			data block 11	data block 11
48-51			data block 12	data block 12
:				:
:				:
:				:
128-131				data block 32

If the configuration is modified, the desired data block numbers can be determined to transmit any information within a basic type.

In chapter 6.3 you will find a comprehensive description of the data blocks as well as examples. At this point a short overview is given for a quick start.

Table 3-2 Status bytes of SIMEAS P (read only)

Byte	Bit[4]	SIMEAS P
0	7-0	not used
1	7-0	not used
2	7-0	not used
3	7	Binary output 1
	6	Binary output 2
	5-0	7KG7100/7200/7500/7550/7600/7650: not used 7KG7610/7660 (optional) a) Module slot A relay module - Bit 5: binary output 3 - Bit 4: binary output 4 - Bit 3: binary output 5 b) Module slot A binary output - Bit 5: binary output 3 - Bit 4: binary output 4 c) Module slot A+B binary output - Bit 5: binary output 3 - Bit 4: binary output 4 - Bit 3: binary output 5 - Bit 2: binary output 6 d) Module slot B binary output - Bit 5: binary output 3 - Bit 4: binary output 4

Table 3-3 Control bytes of SIMEAS P (write access)

Byte	Bit	SIMEAS P
0	7-0	command ID, see Table 3-4
1-7	7-0	parameters

---

[4] bit 7 = MSB, bit 0 = LSB

Table 3-4 Overview of the commands

command	ID	parameter	type / format
null command	**0x00**	---	---
Reset	**0x10**	Min-Avg-Max = 0x01 Energy values = 0x02 Alarm counter = 0x04 **Records in the memory: [5]** Power[5] = 0x08 Mean values[5] = 0x10 Limit violations[5] = 0x20 Binary states[5] = 0x40	bit field 8 bit, simultaneous reset of different values is possible by OR-ing the bit values.
set clock	**0x20**	Date and time	DD MM YY HH MM SS 00 as Hex values
Controlling binary and relay outputs	**0x30**	Bit 0: internal binary output 1 Bit 1: internal binary output 2 **IO modules: [6]** **a) 1 relay module in slot A** Bit 2: relay output A-1 Bit 3: relay output A-2 Bit 4: relay output A-3 **b) 1 BO module in slot A** Bit 2: external binary output A-1 Bit 3: external binary output A-2 **c) 2 BO modules in slot A and B** Bit 2: external binary output B-1 Bit 3: external binary output B-2 Bit 2: external binary output A-1 Bit 3: external binary output A-2 **d) 1 BO module in slot B** Bit 2: external binary output B-1 Bit 3: external binary output B-2	bit field 8 bit, simultaneous reset of different values is possible by OR-ing the bit values.

Measured values are transferred as 4 byte floating point numbers (FLOAT, see chapter 6.3) within a data block.

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[5] For devices 7KG72*/7KG76* only

[6] For devices 7KG7610/7KG7660 with BO- or relay module(s)

4 Acyclic data exchange

PROFIBUS DPV1 is an expansion of the PROFIBUS DP protocol. Devices for PROFIBUS DP and also for PROFIBUS DPV1 can be connected to one line. It is downward compatible; therefore the PROFIBUS DP protocol and the PROFIBUS DPV1 protocol can run over the same line. Additional data blocks can thus be transmitted acyclically with up to 240 bytes of user data by means of application programs such as STEP7 or WinCC.

The PROFIBUS DPV1 protocol thus constitutes the basis for a comfortable data exchange of e.g. parameter data, diagnostic data, control data and test data.

The prerequisite is a DPV1-compatible class-1 master or class-2 master. They enable the above mentioned data to be transmitted via an additional established channel.

The class-2 master can even establish communication to slaves that are not configured and parameterized by this master and which still entertain a connection to a class-1 master. A class-2 master is especially suitable for commissioning, diagnostics, and visualization tasks e.g. by using the program WinCC.

5 Error handling

In case of problems during data exchange between SIMEAS P and the DP master (distorted line, loss of communication) alarm messages will possibly occur within the PROFIBUS master. It is necessary to catch these alarms and to evaluate them if required by the application running on the PROFIBUS master.

Example:	Within a SIMATIC S7 loss of communication to the SIMEAS P will raise an alarm. This alarm will in turn trigger the object blocks in charge of program errors or device failures (OB85 and OB86). It is imperative to program these object blocks in order to avoid the S7 to enter the STOP mode in case of an alarm. When these object blocks are programmed the alarm can be evaluated and subsequent actions and error messages can be controlled.

6 Protocol description

6.1 Introduction

In the following a protocol for SIMEAS P power meter via PROFIBUS DP V1 will be defined. Among others, this protocol supports the parameterization as required by the end user, the calibration, the collection of measured values and the final testing of the device.

The individual layers required for providing the communication services will be explained according to the ISO-OSI reference model.

- Layer 1:   according to PROFIBUS
- Layer 2:   according to PROFIBUS
- Layer 3-7:   not relevant
- Layer +:   DP profile: device functionality of SIMEAS P
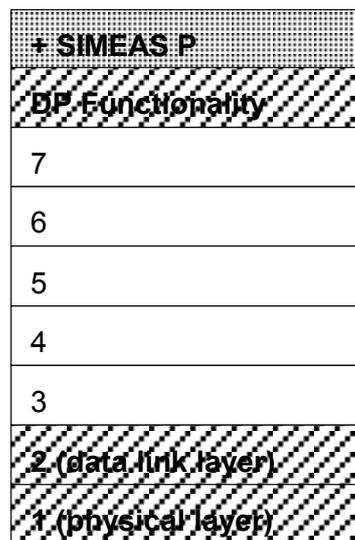
Figure 6-1 Subdivision of the communication services by layers

6.1.1 Physical layer

The physical layer is designed according to PROFIBUS DP (RS485).

6.1.2 Data link layer

The link layer is designed according to PROFIBUS DP.

6.2 Standard services

Standardized services for the application layer are described which are currently limited to the file transfer as the sole service. The definition is in accordance with IEC 870-5-5 file transfer. The file transfer is defined in two directions of data transfer:

- From master (controlling station) to slave (controlled station)
- From slave to master

6.2.1 File transfer: from master to slave
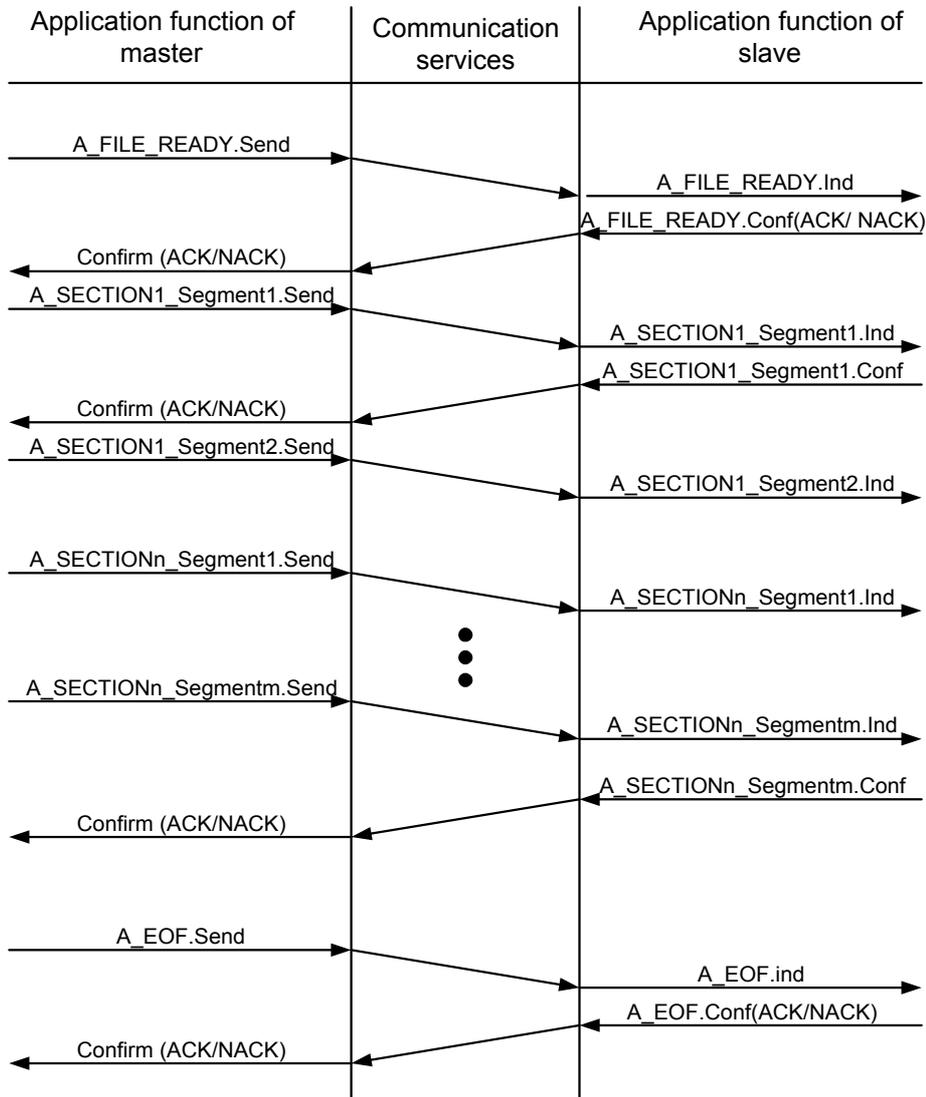
Figure 6-2 File transfer master → slave

Description:

File transfer is used here to transmit data from the master to the slave. The master sub-divides the file into sections. Each section can be further divided into segments. If no data is available for sending, the master does not send a SectionN_SegmentM telegram and the A_EOF telegram follows directly after the confirmation A_File_Ready.

Corrupted data:

If the master detects an error in the data received it responds by sending NACK. The slave then repeats the telegram. If the slave does not send a response, the master repeats the sending of the telegram after a certain period of time (timeout).

6.2.2 File transfer: from slave to master
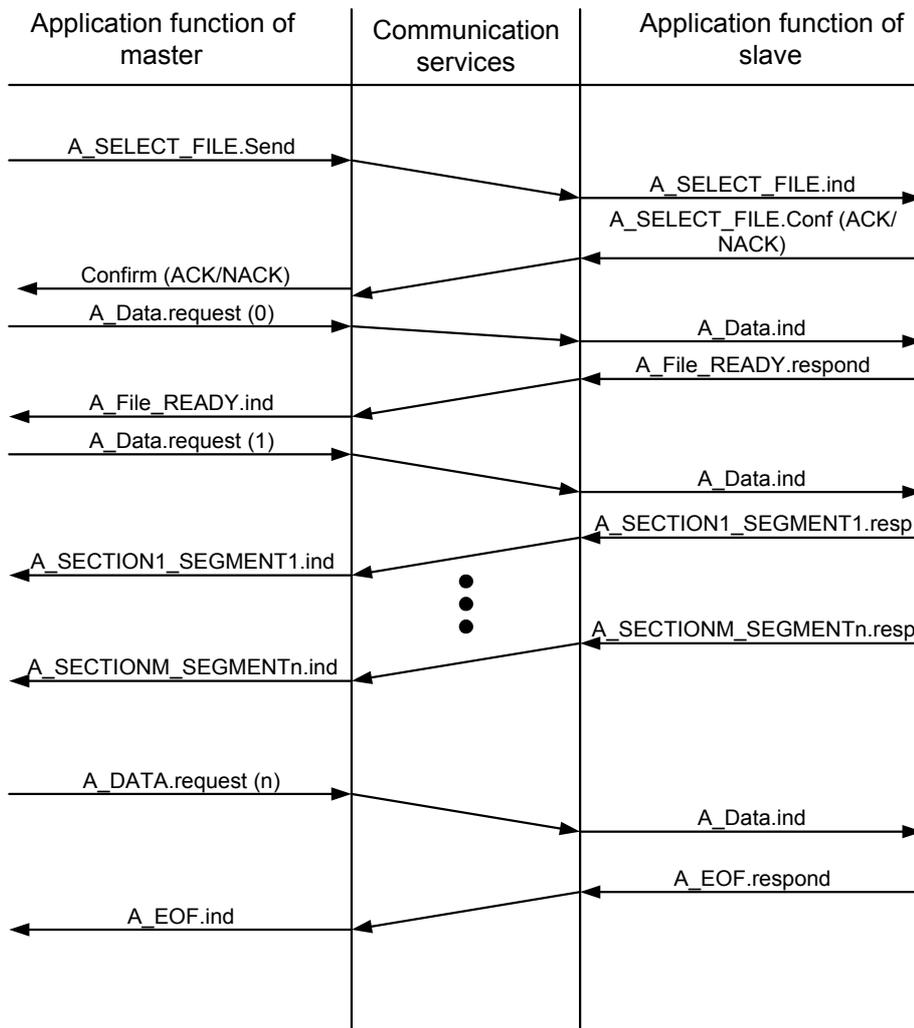
Figure 6-3 File transfer slave → master

Description:

This file transfer is used to receive data from the slave. The master subdivides the file into sections. Each section can be further divided into segments. If the slave has no data to send, no SectionN_SegmentM telegram is sent and the A_EOF telegram follows immediately after the confirmation A_File_Ready. The data request contains a counter which is incremented by 1 for each transmission step. Counting starts at 0. When the maximum value has been reached, the counter is reset to 0, see Table 6-1.

Table 6-1 Maximum counters for section and segment

Counter	Maximum
Section	999
Segment	999

Corrupted data:

If the slave detects an error in the telegrams received, it responds by sending NACK. The master then repeats the telegram. If the slave does not send a response, the master repeats the request after a certain period of time (timeout). Timeouts are defined independently of each other for each telegram.

6.2.3 Mapping to PROFIBUS DP

The standard for PROFIBUS DP does not provide a service that is directly comparable to file transfer. The nature of file transfer is the piecewise transmission of larger data volumes upon request. This contradicts the operating principle of PROFIBUS to a great deal. Originally, PROFIBUS DP performed only cyclic data transmission of a specified length. The expansions (DPV1) at least enable acyclic data transmission upon request. These are, however, restricted to a permanently assigned address space of 64kB. For this reason a file transfer is established by means of the available services. However, it cannot be assumed that this file transfer is supported by standards-compatible application software on the master as a standard feature. File transfer under PROFIBUS is thus only suitable for application services which are optional (they can also be renounced) or redundant (standards-compatible support is also available).

The file transfer on PROFIBUS DP relies on acyclic data transmission (MSAC1 or MSAC2 , API=0). Responsibility for this service is assumed by slot 0, index 240 whose assignment corresponds to the telegram structure "Maintenance protocol ASCII".

The communication procedures SEND/CONFIRM or REQUEST/RESPOND of the ASCII protocol are mapped to the services DDLM_Rd_Outp/ DDLM_Rd_Inp of the PROFIBUS protocol. All requests to a slave are thus mapped by writing a data block (0,240) and the responses from the device by reading a data record (0,240).

6.3 Device protocol SIMEAS P (Layer +)

6.3.1 Continuous transmission of measured data

The cyclic transmission of measured data to the master is accomplished via the PROFIBUS service MSCY1. To balance performance, bus load and information needs, different sizes can be selected for data transmission packets. These so-called basic types define the size and the contents of request packet and response packet. 3 different basic types are available. They can be selected within the PROFIBUS configuration tool.

For each basic type specific information elements are defined which can constitute a part of the request packet or the response packet.

<Control>

Commands can be sent to SIMEAS P. A command consists of 1 byte for the command ID and up to 7 bytes for parameters, see Table 6-3.

Table 6-2 Command bytes of the SIMEAS P (write only)

byte	bit	content
0	7-0	command ID, see Table 6-3
1-7	7-0	parameter

The command ID defines the command to be executed according to Table 6-3. The following 7 bytes contain the parameters.

Table 6-3 Command overview of the SIMEAS P

command	ID	parameter	type / format
null command	**0x00**	---	---
Reset	**0x10**	Min-Avg-Max = 0x01 energy values = 0x02 alarm counter = 0x04 **Records in the memory: [5]** Power[7] = 0x08 Mean values[5] = 0x10 Limit violations[5] = 0x20 Binary states[5] = 0x40	bit field 8 bit, simultaneous reset of different values is possible by OR-ing the bit values.
set clock	**0x20**	Date and time	DD MM YY HH MM SS 00 as Hex values
Controlling binary and relay outputs	**0x30**	Bit 0: internal binary output 1 Bit 1: internal binary output 2 **IO modules: [8]** **a) 1 relay module in slot A** Bit 2: relay output A-1 Bit 3: relay output A-2 Bit 4: relay output A-3 **b) 1 BO module in slot A** Bit 2: external binary output A-1 Bit 3: external binary output A-2 **c) 2 BO modules in slot A and B** Bit 2: external binary output B-1 Bit 3: external binary output B-2 Bit 2: external binary output A-1 Bit 3: external binary output A-2 **d) 1 BO module in slot B** Bit 2: external binary output B-1 Bit 3: external binary output B-2	bit field 8 bit, simultaneous reset of different values is possible by OR-ing the bit values.

Some examples are given in the following Table 6-4:

Table 6-4 Examples for commands to the SIMEAS P

command	byte							
	0	1	2	3	4	5	6	7
null command	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00
reset Min-Avg-Max	0x10	0x01	0x00	0x00	0x00	0x00	0x00	0x00
reset energy values	0x10	0x02	0x00	0x00	0x00	0x00	0x00	0x00
reset Min-Avg-Max and energy values	0x10	0x03	0x00	0x00	0x00	0x00	0x00	0x00
Reset power (Memory)	0x10	0x08	0x00	0x00	0x00	0x00	0x00	0x00
Reset mean values (Memory)	0x10	0x10	0x00	0x00	0x00	0x00	0x00	0x00
Reset limit violations (Memory)	0x10	0x20	0x00	0x00	0x00	0x00	0x00	0x00

---

[7] For devices 7KG72*/7KG76* only

[8] For devices 7KG7610/7KG7660 with BO- or relay module(s)

Reset binary states (Memory)	0x10	0x40	0x00	0x00	0x00	0x00	0x00	0x00
Date and time = 12.09.02, 14:52:00	0x20	0x0C	0x09	0x02	0x0E	0x34	0x00	0x00

Notice:	When writing commands including parameters from a PLC which as a rule supports maximally DWORD[9] accesses to the DP master please observe the following: Write the most significant DWORD (bytes 4-7) first, the least significant DWORD (bytes 0-3) last. Thus you ensure that the correct parameters are used upon execution of the command.
Important:	When using these commands during cyclic transfers a null command has to be sent after each command in order to enable the corresponding function of the SIMEAS P. Otherwise the command last sent will remain active which means that e.g. the counters will be permanently reset.

<Status>

Status information from the device. Currently the status of the binary outputs (BA1 and BA2) is reported. The status consists of 4 bytes with the following format:

Table 6-5 Status bytes of SIMEAS P (read only)

Byte	Bit[10]	SIMEAS P
0	7-0	not used
1	7-0	not used
2	7-0	not used
3	7	Binary output 1, (BO1), 1 = active, 0 = inactive
	6	Binary output 2, (BO2), 1 = active, 0 = inactive
	2-5	7KG7100/7200/7500/7550/7600/7650: not used 7KG7610/7660 (optional) a) Module slot A relay module - Bit 2: binary output A-1 (BO3), 1 = active, 0 = inactive - Bit 3: binary output A-2 (BO4), 1 = active, 0 = inactive - Bit 4: binary output A-3 (BO5), 1 = active, 0 = inactive b) Module slot A binary output - Bit 2: binary output A-1 (BO3), 1 = active, 0 = inactive - Bit 3: binary output A-2 (BO4), 1 = active, 0 = inactive c) Module slot A+B binary output - Bit 2: binary output B-1 (BO3), 1 = active, 0 = inactive - Bit 3: binary output B-2 (BO4), 1 = active, 0 = inactive - Bit 4: binary output A-1 (BO5), 1 = active, 0 = inactive - Bit 5: binary output A-2 (BO6), 1 = active, 0 = inactive d) Module slot B binary output - Bit 2: binary output B-1 (BO3), 1 = active, 0 = inactive - Bit 3: binary output B-2 (BO4), 1 = active, 0 = inactive

---

[9] 1 DWORD = 4 byte.
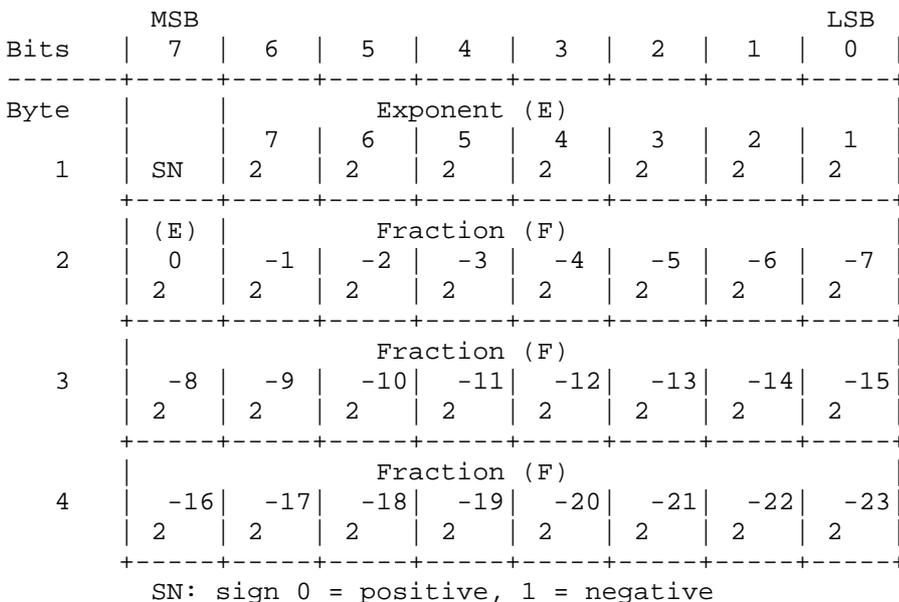
[10] bit 7 = MSB, bit 0 = LSB

<Data Block>

Within a data block a measured value is transferred as FLOAT. A measured value consists of 4 bytes with the following format:

Floating point number (FLOAT)
Notation: Floating-Point (4 Byte)
Range of values: see IEEE Std 754 Short Real Number (32 Bits)
Coding: see IEEE Std 754 Short Real Number (32 Bits)

```
         MSB                                              LSB
Bits  |  7  |  6  |  5  |  4  |  3  |  2  |  1  |  0  |
------+-----+-----+-----+-----+-----+-----+-----+-----+
Byte  |     |            Exponent (E)                  |
      |     |  7  |  6  |  5  |  4  |  3  |  2  |  1  |
  1   | SN  |  2  |  2  |  2  |  2  |  2  |  2  |  2  |
      +-----+-----+-----+-----+-----+-----+-----+-----+
      | (E) |            Fraction (F)                  |
  2   |  0  | -1  | -2  | -3  | -4  | -5  | -6  | -7  |
      |  2  |  2  |  2  |  2  |  2  |  2  |  2  |  2  |
      +-----+-----+-----+-----+-----+-----+-----+-----+
      |                 Fraction (F)                   |
  3   | -8  | -9  | -10 | -11 | -12 | -13 | -14 | -15 |
      |  2  |  2  |  2  |  2  |  2  |  2  |  2  |  2  |
      +-----+-----+-----+-----+-----+-----+-----+-----+
      |                 Fraction (F)                   |
  4   | -16 | -17 | -18 | -19 | -20 | -21 | -22 | -23 |
      |  2  |  2  |  2  |  2  |  2  |  2  |  2  |  2  |
      +-----+-----+-----+-----+-----+-----+-----+-----+
         SN: sign 0 = positive, 1 = negative
```

Figure 6-4 Coding of Data of Data Type Floating Point according to IEEE Std 754

Depending on the basic type a data block contains either 3, 6, 12 or 32 measured values. From that these telegrams follow:

Basic type 1   Request = { <Control> }, Respond = { <Status>, {<Data Block>}^{3}}

Basic type 2   Request = { <Control> }, Respond = { <Status>, {<Data Block>}^{6}}

Basic type 3   Request = { <Control> }, Respond = { <Status>, {<Data Block>}^{12}}

Basic type 4   Request = { <Control> }, Respond = { <Status>, {<Data Block>}^{32}}

6.4 Transmission of measured data upon request

Acyclic data transmission via addressing to slot and index.
Via the slot the individual modules of modular devices are addressed. Slot 0 identifies the device as a whole. SIMEAS P is a compact device and therefore it is addressed exclusively via slot 0.

The meaning of the data records which are distinguished via the index is stated in the following tables.

Table 6-6 DS93: Commands

group	byte	type	meaning
command	0	8 byte	see chapter 6.3.1

Table 6-7 DS94: measured values (main group)

group	byte	type	measuring points
voltage	0	FLOAT	L1, L2, L3, NE
current	16	FLOAT	L1, L2, L3, N
voltage	32	FLOAT	L12, L23, L31, SUM
current	48	FLOAT	SUM
effective power	52	FLOAT	L1, L2, L3, SUM
reactive power	68	FLOAT	L1, L2, L3, SUM
apparent power	84	FLOAT	L1, L2, L3, SUM
power factor	100	FLOAT	L1, L2, L3, SUM
active factor	116	FLOAT	L1, L2, L3, SUM
phase angle	132	FLOAT	L1, L2, L3, SUM
mains frequency	148	FLOAT	

Note: Measured values are transferred subsequently — in the order of the listing of the measuring points — as floating point numbers. With this data set 38 measured values are transferred.

Table 6-8 DS160: Measured values (1. subgroup)

group	byte	type	measuring points
voltage symmetry	0	FLOAT	---
current symmetry	4	FLOAT	---
harmonic distortion voltage	8	FLOAT	L1, L2, L3
harmonic distortion current	20	FLOAT	L1, L2, L3
harmonic voltage	32	FLOAT	L1, L2, L3 5. harm. L1, L2, L3 7. harm. L1, L2, L3 11. harm. L1, L2, L3 13. harm. L1, L2, L3 17. harm. L1, L2, L3 19. harm. L1, L2, L3 3. harm.
harmonic current	104	FLOAT	L1, L2, L3 5. harm. L1, L2, L3 7. harm. L1, L2, L3 11. harm. L1, L2, L3 13. harm. L1, L2, L3 17. harm. L1, L2, L3 19. harm. L1, L2, L3 3. harm.

Note: Measured values are transferred subsequently — in the order of the listing of the measuring points — as floating point numbers. With this data set 50 measured values are transferred.

Table 6-9 DS161: Measured values (2. subgroup)

group	byte	type	measuring points		
energy	0	FLOAT	EPP	L1, L2, L3, SUM	
			EPS	L1, L2, L3, SUM	
			EPT	L1, L2, L3, SUM	
			EQT	L1, L2, L3, SUM	
			EQI	L1, L2, L3, SUM	
			EQC	L1, L2, L3, SUM	
			ES	L1, L2, L3, SUM	
			EPN	SUM	
counter limit violations	116		1,2,3,4		

Note: Measured values are transferred subsequently — in the order of the listing of the measuring points — as floating point numbers. With this data set 33 measured values are transferred.

EPT = Energy absolute based on power P (delivery/procurement)
EPN = Energy balance based on power P
EPP = Energy based on power P received
EPS = Energy based on power P supplied
EQI = Energy based on power Q inductive
EQC = Energy based on power Q capacitive
EQT = Energy absolute based on power Q (inductive/capacitive)
ES = Energy based on power S

Table 6-10 DS94: Device identification (overview)

group	byte	type	meaning
	0…239	byte	

Table 6-11 DS100: Device identification (detail)

group	byte	type	meaning
	0	char	MLFB (machine readable product identifier)
	25	char	serial number
	45	long	FW-Version
date of calibration	49	char	Date ddmmyyyy

7 Appendix

7.1 References

1. „Decentralization with PROFIBUS DP: Architecture and Fundamentals, Configuration and Use with SIMATIC S7", J. Weigmann and G. Kilian, John Wiley & sons, 2nd edition, May 2000, ISBN 3-89578-144-4

7.2 Table of abbreviations

ASCII	American Standard Code for Information Interchange
AVG	Average
EPN	Energy balance based on power P
EPP	Energy based on power P received
EPS	Energy based on power P supplied
EPT	Energy absolute based on power P (delivery/procurement)
EQI	Energy based on power Q inductive
EQC	Energy based on power Q capacitive
EQT	Energy absolute based on power Q (inductive/capacitive)
EQC	Energy based on power Q capacitive
ES	Energy based on power S
GSD file	Device master data file
ID	Identification
Max	Maximum value
Min	Minimum value
NE	Index neutral to earth
OB	Object block
PLC	Programmable logic control