8.1 Universal Serial Interface (USS)

Introduction

This documentation describes the application of the Universal Serial Interface Protocol (USS) for SIMOVERT MASTERDRIVES MC and VC.

NOTE

The USS protocol is a simple serial data transfer protocol, defined by Siemens AG, which is fully tailored to the requirements of drive technology. A detailed description of the protocol specifications, the physical interface, the bus structure as well as a definition of the transferred net data for drive applications are documented in the specification "Universal serial interface protocol USS® protocol" (Order No. E20125-D0001-S302-A1).

Using the USS protocol, a user can establish a serial bus link between a higher-level master system and several slave systems. Master systems can be, for example, PLCs or PCs. SIMOVERT MASTERDRIVES drive converters are always the slaves on the bus system. Furthermore, SIMOVERT MicroMaster, SIMOVERT P 6SE21 and 6RA23 and 6RA24 drive converters can be operated as slaves on the USS bus.

The USS protocol allows the user to implement both automation tasks with cyclical telegram traffic (⇒ a fixed telegram length is necessary) as well as visualization tasks. In this case, the protocol with variable telegram length is advantageous, as texts and parameter descriptions can be transferred in one telegram without chopping up the information.

8.1.1 Protocol specification and bus structure

Features

The USS protocol has the following significant features:

- Supports a multi-point-capable link, e.g. EIA RS 485 hardware or a point-to-point link, e.g. EIA RS 232.
- Master-slave access technique
- Single-master system
- Maximum 32 nodes (max. 31 slaves)
- Operation with variable or fixed telegram length
- Simple, reliable telegram frames
- The same bus mode of operation as with the PROFIBUS (DIN 19245 Part 1)
- Data interface to the basic unit according to PROFILE variable-speed drives. This means that, when the USS is being used, information is transferred to the drive in the same way as with the PROFIBUS-DP.
- Can be used for start-up, service and automation
- PC-based service tools (e.g. SIMOVIS) for SIMOREG and SIMOVERT
- Can be easily implemented in customized systems

8.1.1.1 Protocol specification

Introduction

The USS protocol defines an access technique according to the master-slave principle for communications via a serial bus. The point-to-point link is included as a sub-quantity.

One master and a maximum of 31 slaves can be connected to the bus. The individual slaves are selected by the master using an address character in the telegram. A slave can never transmit without first being initiated by the master so that direct information transfer between individual slaves is not possible. Communication takes place in the half-duplex mode.

The master function cannot be transferred (single-master system).

The following illustration shows a bus configuration using drive technology as an example.

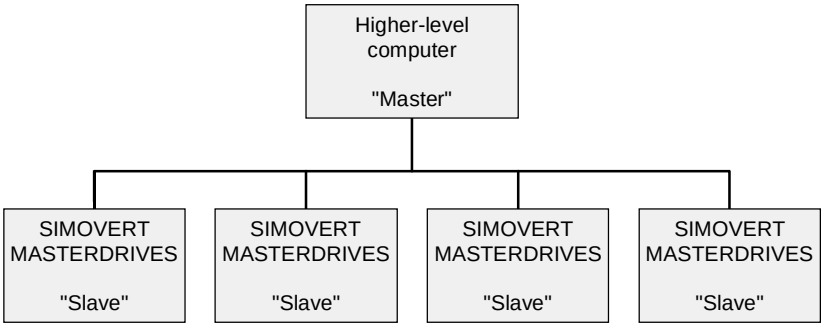


Fig. 8.1-1 Serial linking of SIMOREG/SIMOVERT drive converter (slaves) with a higher-level computer as the master

Telegram structure

Each telegram begins with the start character STX (= 02 hex), followed by the length information (LGE) and the address byte (ADR). The net characters then follow. The telegram is terminated by the BCC (Block Check Character).

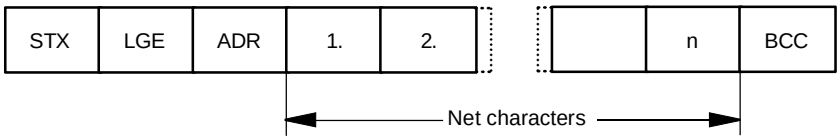


Fig. 8.1-2 Telegram structure

For single-word data (16 bit) in the net data block (= net character block), the high byte (first character) is always sent and then the low byte (second character). The same applies to double-word data: the high word is sent first followed by the low word.

The protocol does not identify tasks in the net characters. The contents of the net data for SIMOVERT MASTERDRIVES drive converters is dealt with in Section 8.1.3.

Data coding

Information is coded as follows:

- STX (start of text)
  ASCII characters: 02 hexadecimal
- LGE (telegram length)
  1 byte, contains the telegram length
- ADR (address byte)
  1 byte, contains the slave address and the telegram type (binary coded)
- Net characters
  Each one byte, contents are task-dependent
- BCC
  1 byte, Block Check Character

Assigning the address byte (ADR)

In the address byte, information other than the node number is coded: The individual bits in the address byte are assigned as follows:

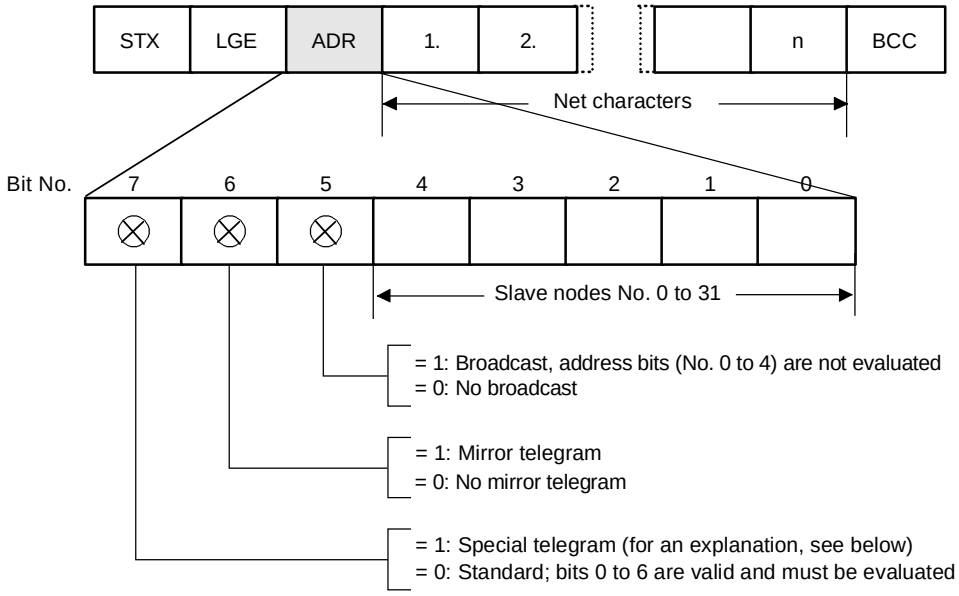


Fig. 8.1-3 Assignment of the address byte (ADR)

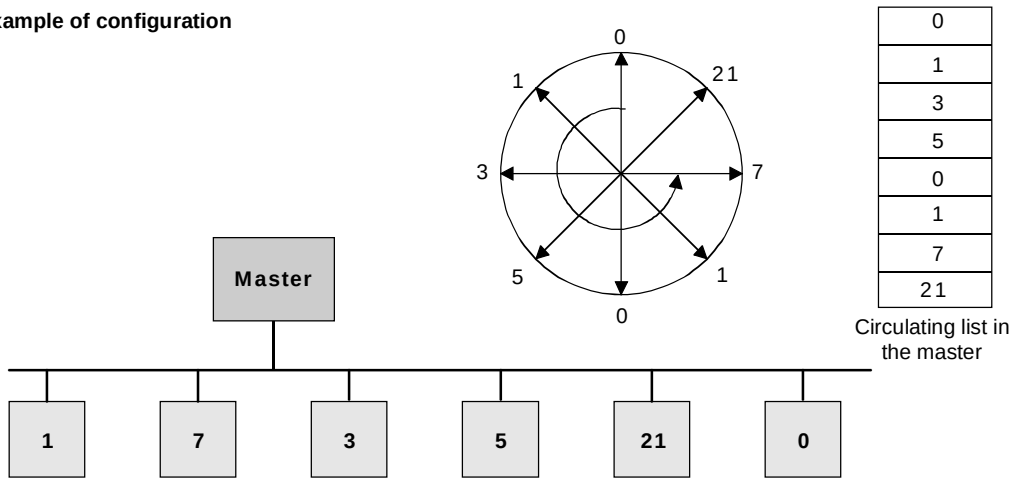
Data transfer procedure

The master ensures cyclical telegram data transfer. The master addresses all of the slave nodes one after the other with a task telegram. The addressed nodes respond with a reply telegram. In accordance with the master-slave procedure, the slave, after receiving the task telegram, must send the reply telegram to the master before the master can address the next slave node.

Handling data transfer

The sequence of the addressed slave nodes can be specified, for example, by entering the node numbers (ADR) in a circulating list (polling list) in the master. If it is necessary to address several slaves in a faster cycle than the other slaves, their node number can occur several times in the circulating list. A point-to-point link can be implemented by means of the circulating list, in which case only one node is entered into the circulating list.

Example of configuration



SIMOVERT MASTERDRIVES with the addresses 0, 1, 3, 5, 7 and 21
Nodes 0 and 1 are signalled twice as often as others

Fig. 8.1-4 Circulating list

Cycle time

The length of a cycle time is determined by the time needed for the sequential occurrence of data exchange with the individual nodes.

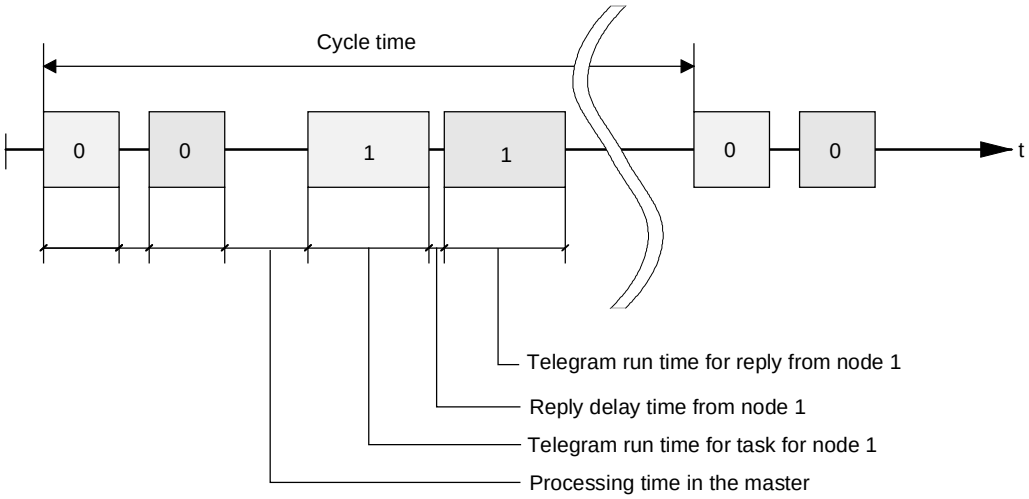


Fig. 8.1-5 Cycle time

Due to inconstant reply delay and processing times, the cycle time is not fixed.

Start interval

The STX start character (= 02 hexadecimal) by itself is not sufficient for the slaves to clearly identify the start of a telegram because the bit combination 02/hexadecimal can also occur in the net characters. For this reason, a no-character start interval of at least 2 character run-times before the STX is specified for the master. The start interval is part of the task telegram.

Baud rate in bit/s	Start interval in ms
9600	2,30 ms
19200	1,15 ms
38400	0,58 ms
76800	0,29 ms
93750	0,23 ms
187500	0,12 ms

Table 8.1-1 Minimum start intervals for various baud rates

Only an STX with a preceding start interval identifies the valid start of a telegram.

Data is always transferred in accordance with the diagram illustrated below (half-duplex mode):

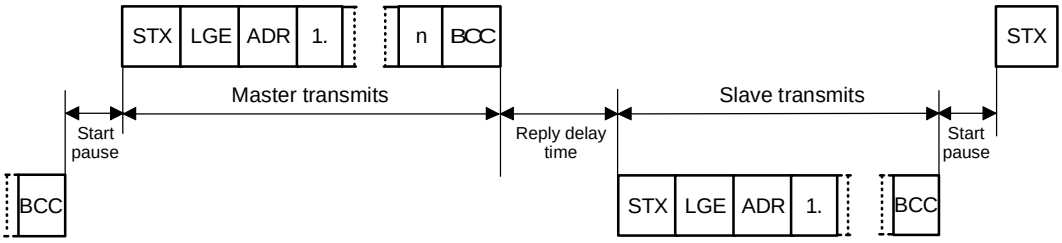


Fig. 8.1-6 Transmit sequence

Reply delay time

The time interval between the last character of the task telegram (BCC) and the start of the reply telegram (STX) is known as the **reply delay time**. The maximum permissible reply delay time is **20 ms, but it must not be less than the start interval**. If node x does not respond within the maximum permissible reply delay time, an error message is deposited in the master.
The master than sends the telegram for the next slave node.

8.1.1.2 Bus structure

The data transfer medium and the physical bus interface are essentially determined by what the bus system is used for.

The physical interface of the USS protocol is based on the "Recommended Standard RS-485". For point-to-point links, a sub-quantity of EIA RS-232 (CCITT V.24), TTY (20 mA current loop) or fiber-optic cables can be used as the physical interface.

The interfaces for SIMOVERT MASTERDRIVES are always RS 485 with 2-wire cable.

Exception: Either RS 485 or RS 232 can be connected at the 9-pin SUB D socket connector on the PMU (operator control and parameterizing unit) of the basic units.

NOTICE

This section describes how a USS field bus has to be structured in order to ensure reliable data transfer via the transfer medium in standard applications. Under special conditions of use, additional factors must be taken into account which require further measures or restrictions that are not described in this document.

Topology

The USS bus is based on a linear topology without branches.

Both ends of the line terminate at a node.

The maximum cable length and therefore the maximum distance between the master and the last slave is limited by the characteristics of the cable, the ambient conditions and the data transfer rate. With a data transfer rate of < 100 kbit/s, a maximum length of 1200 m is possible.

The number of nodes is limited to a maximum of 33 (1 master, 32 slaves).

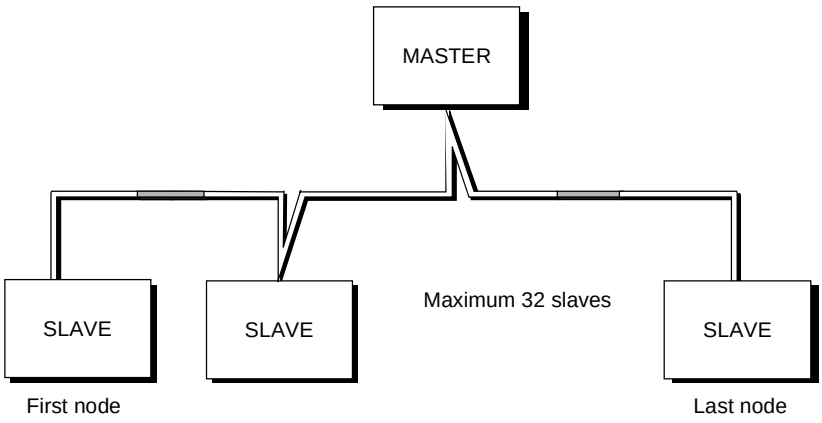


Fig. 8.1-7 USS bus topology

The two ends of a bus line (first node and last node) must be terminated with bus terminating networks.
Point-to-point connections are handled just like bus connections. One node has the master function and the other has the slave function.

Data transfer technology

Data is transferred in accordance with Standard EIA 485. RS 232 can be used for point-to-point links. Data transfer is always half-duplex – i.e. alternating between transmitting and receiving – and it must be controlled by the software. The half-duplex technique allows the same cables to be used for both data-transfer directions. This permits simple and inexpensive bus cabling, operation in environments subject to interference and a high data transfer rate.

Cable characteristics

A shielded, twisted two-wire cable is used as the bus cable.

Conductor diameter ∅	$2 \times \approx 0{,}5\ mm^2$
Conductor	≥ 16 x ≤ 0,2 mm
Lay ratio	≥ 20 twists / m
Overall shield	Braided, tin-plated copper wire, diameter ∅ ≥ $1{,}1\ mm^2$ 85 % optical coverage
Overall diameter∅	≥ 5 mm
External sheath	Depending on the requirements regarding flame retardation, deposits after burning etc.

Table 8.1-2 Structural data

NOTE

All information should only be considered as a recommendation. Deviations or different measures may be required depending on the particular requirements, the specific application and the conditions on site.

Thermal and electrical characteristics

Cable resistance (20°C)	≤ 40 Ω/km
Insulation resistance (20°C)	≥ 200 MΩ/km
Operating voltage (20°C)	≥ 300 V
Test voltage (20°C)	≥ 1500 V
Temperature range	-40 °C ≤ T ≥ 80 °C
Load capability	≥ 5 A
Capacitance	≤ 120 pF/m

Table 8.1-3 Thermal and electrical characteristics

Mechanical characteristics

Single bending: ≤ 5 x outer diameter

Repeated bending: ≤ 20 x outer diameter

Recommendations

1. Standard, without any special requirements:
Two-core, flexible, shielded conductor in accordance with VDE 0812, with colored PVC sheath.
PVC insulation resistant to oil and petroleum products.

- Type: LIYCY 2 x 0,5 mm^2
  e.g. Metrofunk Kabel-Union GmbH
  Postfach 41 01 09, 12111 Berlin
  Tel 030-831 40 52, Fax: 030-792 53 43

2. Halogen-free cable (no hydrochloric acid is generated when the cable burns):
Halogen-free, highly flexible, resistant to extreme heat and cold.
Sheath manufactured from a special ASS silicon-based composite.

- Type: ASS 1 x 2 x 0,5 mm^2
  e.g. Metrofunk Kabel-Union GmbH
  Postfach 41 01 09, 12111 Berlin
  Tel 030-831 40 52, Fax: 030-792 53 43

3. Recommended if halogen-free and silicon-free cables are required:

- Type: BETAflam G-M/G-G-B1 flex. 2 x 0,5 mm^2
  e.g. Studer-Kabel-AG, CH 4658 Däniken

Cable lengths

The cable length is dependent on the data transfer rate and the number of connected nodes. The following cable lengths are possible given the specified cable characteristics:

Data transfer rate	Max. number of nodes	Max. cable length
9.6 kbit/s	32	1200 m
19.2 kbit/s	32	1200 m
93.75 kbit/s	32	1200 m
187.5 kbit/s	30	1000 m

Table 8.1-4 Cable lengths

8.1.2 The structure of net data

Information which, for example, a SIMATIC S5 control unit (= master) sends to a drive (= slave) or the drive sends to the control unit is placed in the net-data area of each telegram.

8.1.2.1 General structure of the net-data block

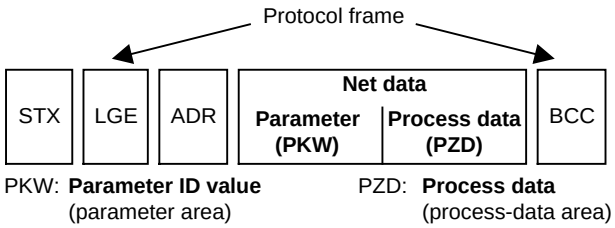
Introduction

The net-data block is divided into two areas:

- the PKW (parameter ID value) range
- the PZD (process data) range

Telegram structure

The structure of the net data in the USS-protocol telegram is shown below.



- The **PKW area** relates to the handling of the parameter ID value (PKW) interface. The PKW interface is not a physical interface but a mechanism which handles parameter transfer between two communication partners (e.g. control unit and drive). This involves, for example, reading and writing parameter values and reading parameter descriptions and associated texts.
  All tasks which are performed via the PKW interface essentially involve operator control and visualization, service and diagnosis.
- The **PZD area** contains the signals required for the **automation** system:
  - Control word(s) and setpoint(s) from the master to the slave
  - Status word(s) and actual value(s) from the slave to the master.

Structure of the PKW and PZD areas

PKW area			PZD area		
PKE	IND	PKW elements	PZD1	• • •	PZD16
Variable length			Variable length		

The two areas together make up the net data block. This structure applies to telegrams from the master to the slave and vice versa.

8.1.2.2 PKW area

With the help of the PKW mechanism, the following tasks can be performed via any serial interface with the USS protocol:

- Reading and writing parameters in the basic unit and, if available, parameters on a technology board, e.g. T100
- Reading the description of a parameter (applies to parameters of the basic unit and of technology boards)
- Reading of texts assigned to the indices of an indexed parameter. (Applies to parameters of the basic unit and of the technology modules.)
- Reading of texts assigned to the values of a parameter. (Applies to parameters of the basic unit and of the technology modules.)

Settings in the PKW area

The PKW area can be varied. Depending on the particular requirement, **3-word, 4-word or variable word lengths** can be parameterized.

PKW area parameterized for 3 words

The following is an example of a structure when access (write/read) is made to **single-word** (16 bit) parameter values:

1st word	2nd word	3rd word
PKE	IND	PWE1
Parameter ID	**Index**	**Parameter value 1**

The PKW area must be permanently set to 3 words at the master and the slave. This setting is made during start-up and should not be altered any more during bus operation.

PKW area parameterized to 4 words

The following is an example of a structure when access (write/read) is made to **double-word** (32 bit) parameter values:

1st word	2nd word	3rd word	4th word
PKE	IND	PWE1	PWE2
		High-Word	Low Word
Parameter ID	**Index**	**Parameter value (double word)**	

Parameterization to a fixed length of 4 words applies to telegrams from the master to the slave and from the slave to the master. The setting must be made both at the master and at the slave and can no longer be altered during bus operation.

PKW area parameterized with variable word length

1st word	2nd word	3rd word	4th word		(m+2) word
PKE	IND	PWE1	PWE2	• • •	PWEm

With:

- 1 word ≤ m ≤ 110 words (maximum) when 16 PZD words (maximum) are contained in the net data block.
- 1 word ≤ m ≤ 126 words (maximum) when there is no PZD.

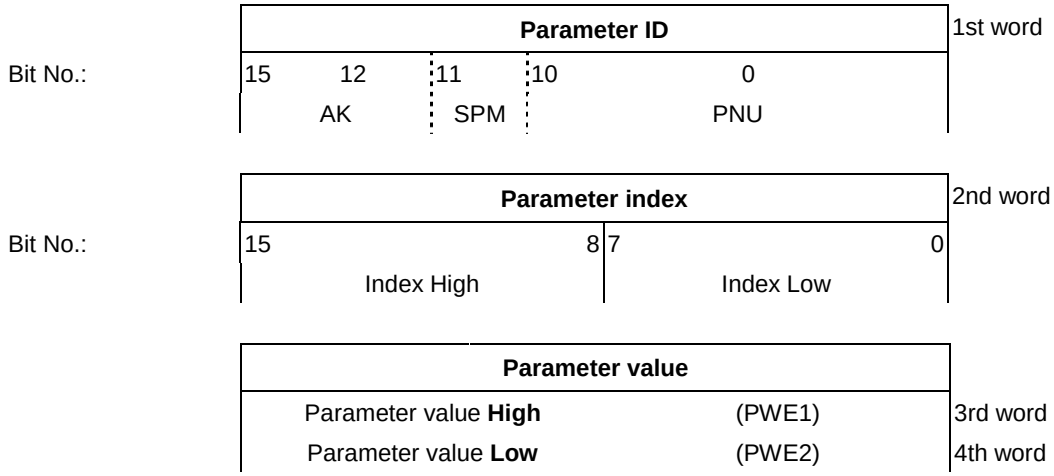
Telegram data transfer with variable telegram length means that the slave responds to a telegram from the master with a telegram whose length does not have to be the same length as the telegram from the master to the slave. The length of elements PEW 1 to PWE m in the reply telegram and what is contained in them depends on the task issued by the master. Variable length means that only the number of words necessary to pass on the appropriate information is transferred. The minimum length, however. is always 3 words.

If a slave, for example, transfers a parameter value which is a 16-bit quantity (e.g. the output voltage in parameter r003), then only 3 words of the PKW area are sent in the telegram from the slave to the master. With regard to the MASTERDRIVES MC/VC for example, if the current speed (parameter r002) is to be read, the PKW area in the telegram from the slave to the master is 4 words long since the speed is stored as a 32-bit quantity in parameter r002. Variable word-length parameterization is mandatory if, for example, all values are to be read at once from an "indexed" parameter or if the parameter description of a parameter is to be partially or completely read. This setting to variable word-length is made during start-up.

NOTICE

Do not use a variable word length if a SIMATIC S5 or SIMATIC S7 is the master.

Structure of the parameter area (PKW)



AK: Task or reply ID

SPM: Toggle bit for processing of parameter-change reports

PNU: Parameter number

NOTE

The PKW area is transferred in increasing order, always starting with the 1st word.

Parameter ID (PKE), 1st word

The parameter ID (PKE) is always one word (16-bit quantity).

Bits 0 to 10 (PNU), together with bit 15 of the parameter index, make up the number of the desired parameter (see parameter list).

Number	PKE: Bits 0 to 10 (PNU)	Index: Bit 15	
1 - 999	1 - 999	0	Basic unit
2000 - 2999	0 - 999	1	Basic unit
1000 - 1999	1000 - 1999	0	Technology module
3000 - 3999	1000 - 1999	1	Technology module

Bit 11 (SPM) is the toggle for parameter-change reports.
MASTERDRIVES do not support parameter change reports.

Bits 12 to 15 (AK) contain the task or reply ID.

The **task IDs** are sent in the telegram from the master to the slave. The meaning of the IDs is given in Table 8.1-5. Correspondingly, the **reply IDs** are transferred at this position in the telegram from the slave to the master (see Table 8.1-6). Depending on the task ID, only certain reply IDs are possible. If the reply ID is 7 (task cannot be executed), then an error number is entered in parameter value 2 (PWE2). The error numbers are shown in Table 8.1-7.

Task ID	Meaning	Reply ID	
		positive	negative
0	No task	0	7 or 8
1	Request parameter value	1 or 2	↑
2	Change parameter value (word)	1	|
3	Change parameter value (double word)	2	|
4	Request descriptive element [1]	3	|
6	Request parameter value (array)[1]	4 or 5	|
7	Change parameter value (array, word)[2]	4	|
8	Change parameter value (array, double word)[2]	5	|
9	Request the number of array elements	6	|
10	Reserved	-	|
11	Change parameter value (array, double word) and save in EEPROM [2]	5	|
12	Change parameter value (array, word) and save in EEPROM [2]	4	|
13	Change parameter value (double word) and save in EEPROM	2	|
14	Change parameter value (word) and save in EEPROM	1	↓
15	Read or change text (only supported via OP or SIMOVIS)	15	7 or 8

[1] The required element of the parameter description is specified in IND (2nd word)
[2] The required element of the indexed parameter is specified in IND (2nd word)

Table 8.1-5 Task IDs (master -> drive converter)

Reply ID	Meaning
0	No reply
1	Transfer parameter value (word)
2	Transfer parameter value (double word)
3	Transfer descriptive element [1]
4	Transfer parameter value (array, word) [2]
5	Transfer parameter value (array, double word) [2]
6	Transfer the number of array elements
7	Task cannot be executed (with error number)
8	No control/change rights for the PKW interface
9	Parameter change report (word)
10	Parameter change report (double word)
11	Parameter change report (array, word) [2]
12	Parameter change report (array, double word) [2]
13	Reserved
14	Reserved
15	Transfer text

* For table footnotes [1] and [2], see Table 8.1-5

Table 8.1-6 Reply IDs (drive converter -> master)

Example

Source for the ON/OFF1 command (control word1, bit 0):
P554 (=22A hex) Change parameter value (array, word) and save in the EEPROM.

	Parameter ID (PKE)				1st word
Bit No.:	15 12	11	10 0		
	AK	SPM	PNU		
	1 1 0 0	0	0 1 0	0 0 1 0	1 0 1 0	Binary value
	C	2	2	A	HEX value

- Bits 12 to 15: Value = 12 (= "C" hex); change parameter value (array, word) and save in the EEPROM
- Bits 0 to 11: Value = 554 (= "22A" hex); parameter number with a set change-report bit

Error numbers for reply "Task cannot be executed"

No.	Meaning
0	Inadmissible legal parameter number (PNU); if PNU is not available
1	Parameter value cannot be changed; if the parameter is a visualization parameter
2	Lower or upper limit exceeded
3	Erroneous sub-index
4	No array
5	Incorrect type of data
6	Setting not permitted (can only be reset)
7	Descriptive element cannot be changed; not possible
11	No operator control rights
12	Key word missing; Drive converter parameter: 'Access Key' and/or 'Parameter Special Access' not correctly set
15	No text array available
17	Task cannot be executed due to operating status; drive converter status does not permit the set task at the moment
101	Parameter number deactivated at the moment; Parameter has no function in the present state of the drive converter (e.g. type of closed-loop control)
102	Channel width too small; only for short channels The parameterized length of the PKW area is too large due to internal limitations of the drive converter. This error message can occur with the USS protocol on the T100 technology board only if access is made to parameters of the basic unit from this interface.
103	Number of PKWs incorrect; only for G-SCom 1/2 and SCB interface (USS); The error number is transferred in the following two cases: • if the task concerns all the indices of an indexed parameter (task index equal to 255) or the whole parameter description is requested and a variable telegram length has not been parameterized. • if the parameterized number of PKWs (process-data items) in the telegram is too small for the set task (e.g. alteration from the double word and the number of PKWs is 3 (words).
104	Parameter value not permissible; This error number is transferred if the parameter value which is to be transferred does not have an assigned function in the drive converter or cannot be accepted at the instant of the change for internal reasons (although it lies within the limits).
105	The parameter has been indexed e.g. task 'PWE change word' for indexed parameter
106	Task not implemented

Table 8.1-7 Error numbers for the reply ID "Task cannot be executed"

Example Error message 104

The parameter 'SCom/SCB PKW #" P702:

- Minimum value: 0 (0 words)
- Maximum value: 127 (corresponds to: variable length)
- Permissible values for USS: 0, 3, 4 and 127.

If a change task with a PWE which is not 0, 3, 4 or 127 is issued to the drive converter, the reply is "Task cannot be executed" with error value 104.

Parameter index (IND) 2nd word

The low-part of the index (bit 0 to 7), depending on the task, describes a definite element:

- desired array element in the case of indexed parameters,
- desired element of the parameter description,
- for indexed parameters with "index text": desired index text,
- for non-indexed parameters with "selection text": desired selection text.

Bits 8 to 14 must as a general rule all be equal to 0. The only exceptions are those parameters that are indexed and possess "selection texts". In this case bit 9 must be set to 1 to clearly identify the desired text type. The low-part then defines the desires "selection text".

Bit 15, together with bits 0 to 10 in the PKE, serves to constitute the number of a parameters (see Parameter coding).

Special significance of index value 255 (low-part)

With regard to the task "Request (parameter element) descriptive element" (= AK 4) or tasks relating to the reading/writing of indexed parameters (= arrays), index value 255 has a special significance:

Task ID	Meaning
4	The complete (parameter) description is requested
6	Request all values of the indexed parameter This task can generate error message 102.
7, 8, 11 or 12	All values of the indexed parameter are to be changed. These tasks can generate error message 102.

Table 8.1-8 Tasks with index value 255

Example
Parameter index

Source for ON/OFF1 command (control word 1, bit 0): P554 (= 22A hex)
Change parameter value of index 1.

	Parameter index				2nd word
Bit No.:	15 8		7 0		
	0	0	0	1	HEX value

Bit 0 to 7: Index or number of the descriptive element
Bit 8 to 14: 0
Bit 15: 0

Parameter value (PWE) 3rd and 4th words

Depending on the word length parameterization of the PKW area, the parameter value (PWE) is transferred as word or double word (32 bit). Only one parameter value can be transferred in a telegram.

If the word length of the PKW area is parameterized with 3 words, then only 16 bit parameters can be transferred. Parameter description elements larger than 16 bit and texts cannot be transferred.

If the word length of the PKW area is parameterized with 4 words, then 16 and 32 bit parameters can be transferred. Parameter description elements larger than 32 bit and texts cannot be transferred.

If the word length of the PKW area is parameterized with "Variable length" (127), then 16 and 32 bit parameters can be transferred. Parameter description elements and texts can also be transferred. Furthermore, all elements of an indexed parameter can be read or changed as a single task and the whole parameter description can be called (index value: low-part = 255).

Transfer of a 16-bit parameter value:

1. PKW area, fixed, 3 words:
   PWE1 contains the value
2. PKW area, fixed, 4 words:
   PWE2 (least significant word, 4th word) contains the value; PWE1 is set to 0.
3. PKW area, variable:
   PWE1 contains the value. There is no PWE2 or higher!

Transfer of one 32-bit parameter value:

1. PKW area, fixed, 3 words:
   Task is rejected with error message 103.
2. PKW area, fixed, 4 words:
   PWE1 (most significant word; 3rd word) contains the high-word of the double word
   PWE2 (least significant word; 4th word) contains the low-word of the double word.
3. PKW area, variable:
   As 2.; There is no PWE3 or higher!

Example
Parameter value

Source for the ON/OFF1 command (control word 1, bit 0): P554 (= 22A hex)
Change parameter value of index 1 to the value 2100 (hex).

	Parameter value				
Bit No.:	31 24		23 16		3rd word, PWE1 (hex)
	0	0	0	0	
Bit No.:	15 8		7 0		4th word, PWE2 (hex)
	2	1	0	0	

Bit 0 to 15: Parameter value for 16-bit parameter or low component for 32-bit parameter
Bit 16 to 31: Value = 0 for 16-bit parameter or high component for 32-bit parameter

8.1.2.3 Process-data area (PZD)

In this area, process data are **continually** exchanged between the master and slaves. The process data to be exchanged with a slave is configured at the start of communications. The setpoint for the current is to be transferred to slave x in the second PZD (= PZD2), for example. This setting is fixed for the whole procedure of data transfer.

PZD1-PZD16 = Process data
(= control / status word(s) and setpoint(s) / actual value(s))

The control/status word(s), setpoint(s) and actual value(s) required for the automation system are transferred in this area.

The length of the PZD area is determined by the number of PZD elements and their size (e.g. word, double word). In contrast to the PKW area, which can be variable, the length of this area (master and slaves) must always be agreed on between the communication partners. The maximum number of PZD words per telegram is limited to 16 words. If only PKW data is to be transferred in the net data block, the number of PZDs may even be 0!

In PZD1, control word 1 or status word 1 is always transferred, depending on the direction of data transfer and, in PZD2, the main setpoint or the main actual value is always transferred, again depending on the direction of data transfer. In the subsequent process data areas PZD3 to PZDn, additional setpoints and actual values are sent. For SIMOVERT MASTERDRIVES, control word 2 or status word 2, if necessary, is transferred in PZD4.

Structure of the PZD area

1 word	1 word	1 word		1 word
PZD1	PZD2	PZD3	• • •	PZD16

Maximum 16 words
Minimum 0 words, i.e. no PZD area in the net data block

NOTE

PZDn is always transferred before PZDn+1 on the USS bus.

Task telegram (master ⇒ slave)

PZD1	PZD2 / PZD3	PZD4	PZD5 ... PZD16
Control word 1	Setpoint (32 Bit) / Setpoints (16 Bit)	Setpoint / Control word 2	Setpoints

Reply telegram (slave ⇒ master)

PZD1	PZD2 / PZD3	PZD4	PZD5 ... PZD16
Status word 1	Main actual value 1)	Actual values 1) / Status word 2	Actual values

1) Setpoint/actual value assignments are freely selectable, which means, for example, that the speed setpoint can be given in the task telegram in the PZD2, while the actual speed value can be returned in the reply telegram in the PZD2 (technologically useful). Or another actual value can be returned, such as actual torque value, actual position value or actual current value.

8.1.3 Interface overview

The following section describes all of the presently available SIMOVERT MASTERDRIVES MC/VC interfaces which use the USS protocol.

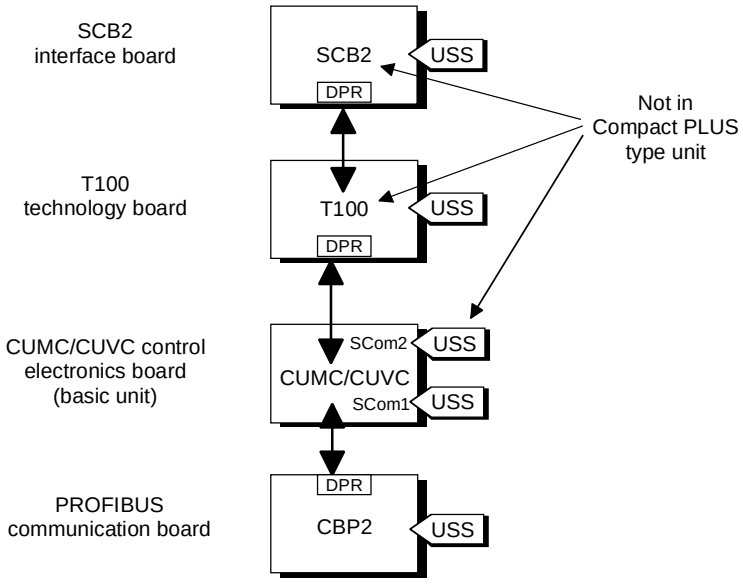


Fig. 8.1-8 Interface overview

Basic unit with CUMC/CUVC/CUVP

In the SIMOVERT MASTERDRIVES MC series, the control electronics board, CUMC (Control Unit Motion Control) or CUVC (Control Unit Vector Control), is used. Depending on the type of basic unit, it has at least one serial interface with the USS protocol. The following table shows the available interfaces:

Board	Number of interfaces	Physical interface	Baud rate [kBit/s]
CUMC in Compact PLUS unit	1 interface with USS protocol Designation: SCom1	RS485 / 2-wire at terminal strip X100 or RS232 or RS485 / 2-wire at 9-pole SUB-D socket X103	max. 38.4
CUMC in Compact and chassis type unit	2 interfaces with USS protocol Designation: SCom1 and SCom2	RS485 / 2-wire on terminal strip X103 (SCom1 and SCom2) or RS232 or RS485 / 2-wire at 9-pole SUB-D socket X300 (SCom1)	max. 38.4
CUVC in Compact and chassis type unit	2 interfaces with USS protocol Designation: SCom1 and SCom2	RS485 / 2-wire on terminal strip X101 (SCom2) and RS232 or RS485 / 2-wire at 9-pole SUB-D socket X300 (SCom1)	max. 38.4
CUVP in Compact PLUS unit	2 interfaces with USS protocol Designation: SCom1 and SCom2	RS485 / 2-wire on terminal strip X100 (SCom2) and RS232 or RS485 / 2-wire at 9-pole SUB-D socket X103	max. 38.4

Table 8.1-9 Interfaces on the CU board

NOTICE

All the interfaces on the CU boards are non floating (not electrically isolated).

SCB 2 supplementary board

The SCB2 (Serial Communications Board) is an expansion board of the SIMOVERT MASTERDRIVES. The board has a floating RS485 interface. Either the peer-to-peer protocol or the USS protocol can be used at this interface.

NOTE

The supplementary SCB2 board cannot be built into the Compact PLUS type of unit.

Board	Number of interfaces	Physical interface
SCB2	1 interface with USS protocol	RS485 / 2-wire at terminal strip X128

Table 8.1-10 Interface on the SCB 2 board

NOTE

For a more detailed description of the SCB 2, refer to the instruction manual, "Serial Communication Board 2" (Order No.: 6SE7087-6CX84-0BD0).

T100 technology board

The T100 technology board is an expansion board of the SIMOVERT MASTERDRIVES. The board has two, non-floating RS485 interfaces. One interface is permanently provided for the peer-to-peer protocol, the other is for the USS protocol.

NOTE

The T100 technology board cannot be built into the Compact PLUS type of unit.

Board	Number of interfaces	Physical interface
T100	1 interface with USS protocol and 1 interface for peer-to-peer linking	RS485 / 2-wire at terminal strip X132

Table 8.1-11 Interfaces on the T100 board

NOTE

For a more detailed description of the T100, refer to the instruction manual "Technology Board T100" [Order No. 6SE7080-0CX87-0BB0, (hardware) and 6SE7080-0CX84-0BB0 (software)].

CBP2 supplementary board

The CBP2 interface board (Communication Board PROFIBUS 2) is an extension board of the SIMOVERT MASTERDRIVES. The board has a floating RS485 interface. For this interface, either the PROFIBUS protocol or the USS protocol can be used.

Board	Number of interfaces	Physical interface
CBP2	1 interface with USS protocol	RS485 / 2-wire at terminal strip X448

Table 8.1-12 Interface on the CBP2 board

NOTE

A more detailed description of the CBP2 can be found in the operating instructions "CBP/CBP2 - Communication Board PROFIBUS" (Order No.: 6SE7087-6NX84-0FF0).

8.1.4 Connecting-up

DANGER

- The equipment is operated at high voltages. They must be in a no-voltage condition (off load) during all connecting work!
- When work is being done on the unit, it must be in a no-load condition, i.e. it must be disconnected and locked-out from the line supply.
- Only appropriately qualified personnel may work on or with the equipment.
- Death, severe bodily injury or considerable material damage may result if this warning is not complied with.
- Due to the DC link capacitors, there are still hazardous voltage levels in the equipment for at least 5 minutes after it has been disconnected from supply. There must therefore be a delay of at least 5 minutes before the unit is opened.
- The power terminals and the control terminals can still carry hazardous voltage even when the motor has been shut down.

8.1.4.1 Bus cable connection

On SIMOVERT MASTERDRIVES, connection of the USS bus cable depends on the control version and, in the case of MC units, it is dependent on the respective type of construction.

MC, VC, "Compact PLUS" type

With the "Compact PLUS" type of unit, either terminal strip X100 or connector X103 can be used to connect up the USS bus cable. The exact pin assignment is given in the relevant operating instructions for the basic unit.

MC, "Compact type" and "chassis type"

With "Compact type" and "chassis type" units, the SCom1 and SCom2 interfaces can be operated at the same time on terminal strip X103 with the USS protocol. Alternatively, connector X300 can be used as SCom1. The exact pin assignment of terminal strip X103 or connector X300 is given in the relevant operating instructions of the basic unit.

VC, "Compact type" and "chassis type"

In the case of the "Compact type" and "chassis type" units, either the connection of terminal strip X101 (SCom2) or X300 (SCom1) can be used to connect up the USS bus cable. The exact pin assignment of terminal strip X101 or connector X300 is given in the relevant operating instructions of the basic unit.

SCB 2 board

In the case of the SCB2 board, the bus cable is terminated at terminal strip X128. The exact pin assignment and other notes on termination are given in the operating instructions for the SCB2.

Technology board T100

In the case of the T100 technology board, the USS protocol is implemented at interface 1. The bus cable is terminated at terminal strip X132. The exact pin assignment and other notes on termination are given in the hardware operating instructions for the T100.

8.1.4.2 Fitting the bus cable

At all interfaces to the CUMC, CUVC control electronics, the SCB2 board and the T100, except for connectors X103 and X300 or X448 (9-pin SUB-D connectors), the USS bus cable is connected by means of screw/plug-in terminals. The correct method of connecting the bus cable at the connector is shown in the following diagram.

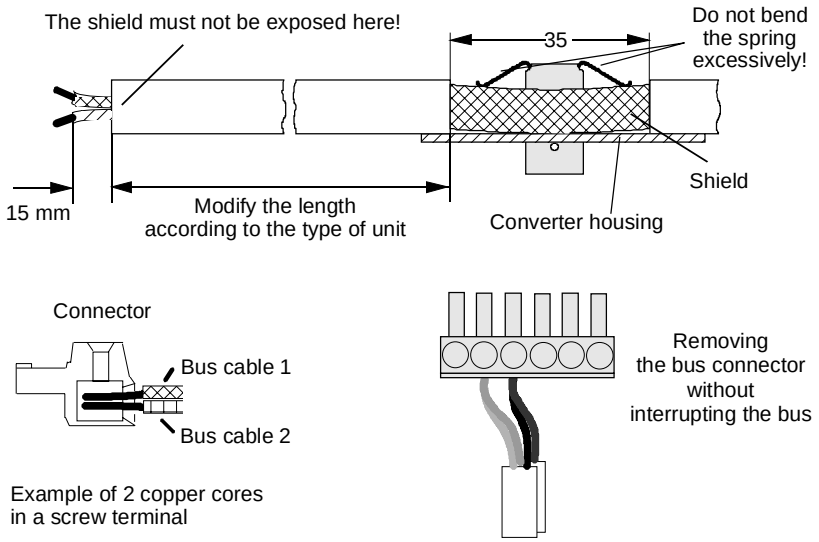


Fig. 8.1-9 Connecting up the bus cables

NOTE It must be ensured that both copper cores are securely held inside the screw terminal.

8.1.4.3 EMC measures

For interference-free operation of the USS, it is absolutely necessary that the following measures are carried out:

Shielding

Shielding is necessary for damping magnetic, electrical and electromagnetic interference fields. Interference currents are discharged to earth by the shield braiding via the housing earth.

NOTE

The bus cables must be twisted and shielded and are to be routed separately from power cables, the minimum clearance being 20 cm. The shield must be connected through the largest possible surface area on both sides, i.e. the shield of the bus cable between 2 converters must be connected to the converter housing at **both** ends. The same applies to the shield of the bus cable between master and converter.

If bus and power cables intersect, they must do so at an angle of 90 °.

- With regard to the bus cable, the shield must not be exposed in the bus connector. Shielding is provided by the shield clamps (Compact type units) or shield clamps and cable ties (chassis type units) at the converter housing. How to use the shield clamps is shown in the following illustration. It must be ensured that the solid copper core is not damaged when the insulation is removed from the ends of the conductors.
- It must also be ensured that the shield of every bus cable is connected where the cable enters the cabinet as well as at the converter housing!

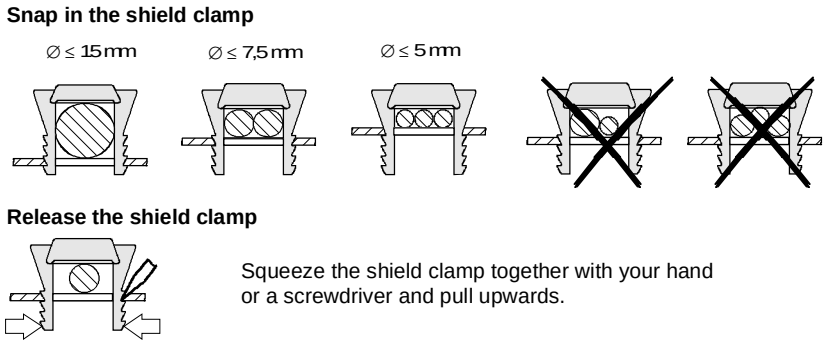


Fig. 8.1-10 Using the shield clamps

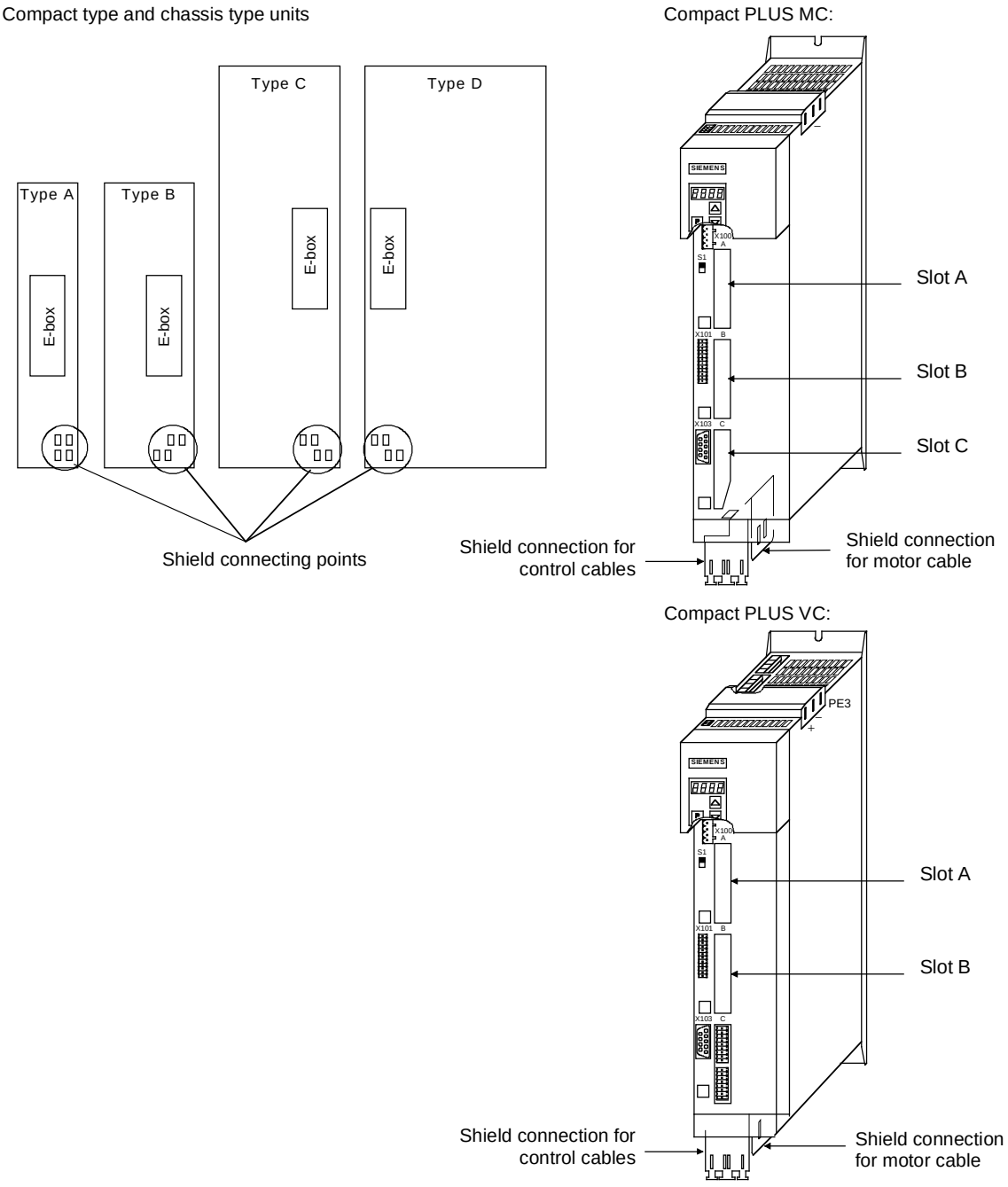


Fig. 8.1-11 Position of the shield connecting points

Equipotential bonding

Equipotential bonding is necessary in order to prevent differences in potential (e.g. due to different supply voltages) between the individual bus nodes (converters and master system).

- This is achieved with the help of equipotential-bonding conductors:
  - 16 mm^2 Cu for equipotential-bonding conductors up to 200 m in length
  - 25 mm^2 Cu for equipotential-bonding conductors more then 200 m in length
- The equipotential-bonding conductors are to be laid so that there is the smallest possible surface area between a conductor and any signal cables.
- The equipotential-bonding conductor must be connected to the earth electrode/protective conductor through the largest possible surface area.

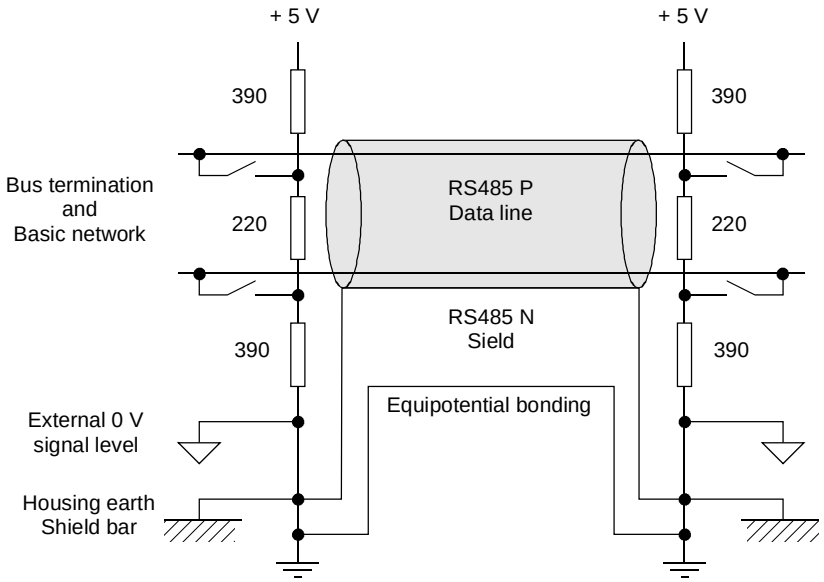


Fig. 8.1-12 Shielding and equipotential bonding

Laying cables

Instructions for laying cables:

- Bus cables (signal cables) must not be laid close to and parallel to power cables.
- Signal cables and the associated equipotential-bonding cables must be laid as closely together as possible and kept as short as possible.
- Power cables and signal cables must be laid in separate cable ducts.
- Shields must be connected through the largest possible surface area.

For more information on electromagnetically compatible installation of systems, see for example Chapter 3 of the Compendium or the description "Instructions for Design of Drives in Conformance with EMC Regulations" (Order No. 6SE7087-6CX87-8CE0).

8.1.4.4 Bus termination, USS protocol

In order to ensure interference-free USS operation, the bus cable must be terminated with bus terminating resistors at both ends. The bus cable from the first USS node to the last USS node is to be regarded as **one** bus cable. The USS bus therefore must be terminated twice. The bus terminating resistors must be switched in at the **first** bus node (e.g. master) and **last** bus node (e.g. converter).

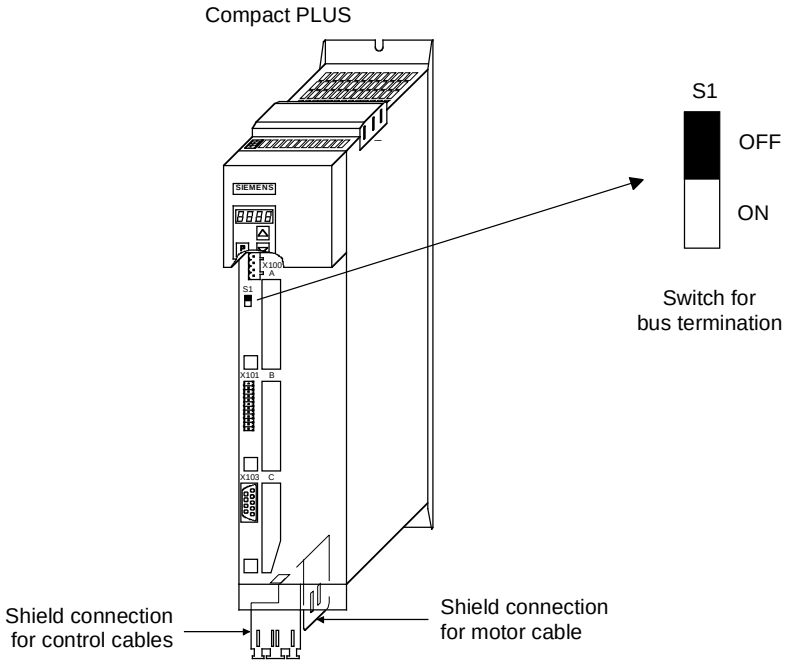


Fig. 8.1-13 S1 bus-terminating switches in the Compact PLUS type of unit

NOTE

In the Compact and chassis type units, two mutually independent USS interfaces (SCom1 and SCom2) are available. Switch S1 or S2 is provided for switching in the terminating resistor.

If the bus-terminating node is a T100 board, the bus terminating resistors are switched in through the two plug-in jumpers, X8 and X9.

NOTE

- When the unit is supplied, the terminating resistors are not switched in!
- Please note that the bus termination is switched in only at the first bus node (e.g. SIMATIC S 5/CP524) and last bus node (e.g. CUMC)! When the matching resistors are being set, the electronics box must be **isolated from supply**!
- **Data transmission faults possible on the bus!**
  During active bus operation, the units with a **switched-in** terminating resistor must not be disconnected from supply. The matching resistor when disconnected from supply (off-load) is no longer effective because the terminating resistor obtains its voltage from the connected unit.

Bus connection via terminal strip

The following illustration shows an example of the bus connection at terminal strip X100 (Compact PLUS). If the connector at terminal strip X100 of one node is removed, data transfer via bus is **not** interrupted. The other nodes on the bus continue to be supplied with data via the bus.

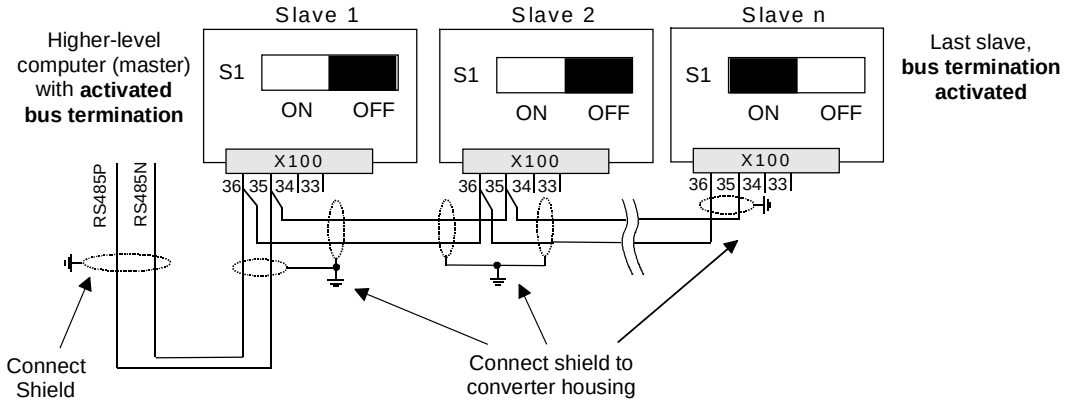


Fig. 8.1-14 Connection of the 2-wire bus cable at terminal strip X100 (Compact PLUS)

Bus connection via connector X103

The following illustration shows the structure of a bus connection via the 9-pin connector, X103 (Compact PLUS).

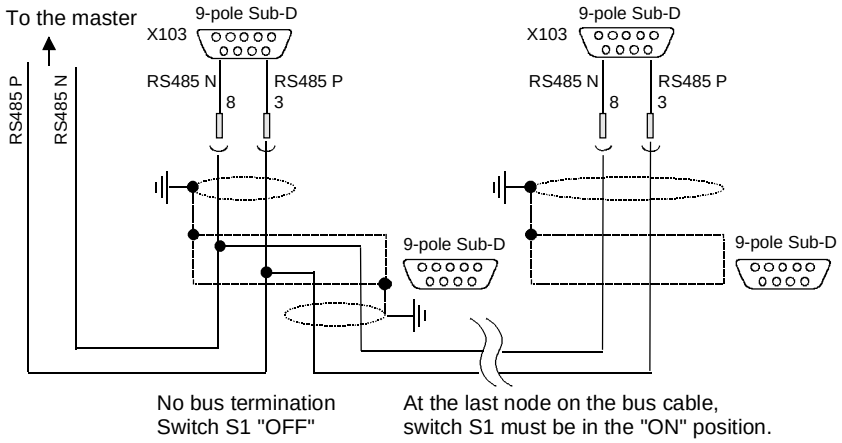


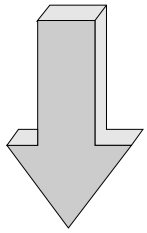
Fig. 8.1-15 Connection of the 2-wire bus cable at terminal strip X103 (Compact PLUS)

8.1.5 Start-up

The USS protocol can be started up in two steps:

1. Parameterization of the USS protocol at the "selected" interface
2. Parameterization of process-data interconnections and the "parameterizing enable" for the selected interface.

Parameterizing the USS protocol
Create the right conditions: • Set P060 = 1 (menu selection)
Parameterize the interface: Settings to be made: • P682 (SCB protocol) only applies to the SCB2, • P700 (SCom/SCB BusAddr), P701 (SCom/SCB baud rate), • P702 (SCom/SCB PKW #), P703 (SCom/SCB PcD # and P704 (SCom/SCB TlgOFF)



Parameterizing the parameterizing enable and process-data interconnections
Set the **parameterizing enable** via USS at the selected interface: • Set P053 (parameter access)
Set process-data interconnections: • For status words and actual values: P707 (Src SCom 1 TrnsDat) and P708 (Src SCom 2 TrnsDat) for CUMC P690 (SCB actual value) for SCB 2 board • For control words and setpoints: e.g. P554 (control word, bit 0) to P591 (control word, bit 32), P443 (Src Main Setp), P433 (Src Add Setp1), etc.

8.1.5.1 Parameterization of the USS protocol (1st step)

The USS protocol is parameterized at serial interfaces SCom 1 and SCom 2 on the CU board of the basic units or at the serial interface on the SCB 2 board by means of the following parameters: **P682, P700, P701, P702, P703** and **P704**.

NOTE

The USS protocol is parameterized at the serial interface of the T100 technology board by means of the "technology parameters" H290, H291, H292, H293, H294 and H295. These parameters are part of the T100 (see software instruction manual of the T100).

Example 1 **USS protocol at the SCom1 on MASTERDRIVES MC**

As already described in Section 8.1.3, the bus cable for the SIMOVERT MASTERDRIVES MC can be connected either at terminal strip X100/X103 ("Compact PLUS" type) or at connector X103/X300 ("Compact" and "chassis" types).

- Settings:
  USS protocol with 19.2 kbit/s and 3-word PKW area and 2-word PZD area
  - 3-word PKW area:
    With this setting, all parameters whose values are 16-bit quantities (1 word) can be read and written via the USS protocol.
  - 2-word PZD area:
    Transfers control word 1 and a setpoint (each of them 16 bit) from the master to the converter and status word 1 and an actual value (each of them 16 bit) from the converter to the master.
- Preconditions:
  P060 = 1 or 7 (default setting)
- Parameterizing the SCom 1 interface (applies to X100 or X103 ("Compact PLUS" type) and X103 or X300 ("Compact" and "chassis" types) at the same time):

Parameter number	Parameter	Index and value (index i001 for SCom 1)	Comments
P700	SCom/SCB BusAddr	i001 = 0	Bus address SCom1 = 0
P701	SCom/SCB Baud	i001 = 7	19.2 kbit/s
P702	SCom/SCB PKW #	i001 = 3	3-word PKW (SCom 1)
P703	SCom/SCB PcD #	i001 = 2	2-word PZD (SCom 1)
P704	SCom/SCB TlgOFF	i001 = 0 to 6500	0: No monitoring >0: Monitoring time in ms

Example 2 **USS protocol at the SCom2 (only in Compact type and chassis type units)**

- Setting:
  USS protocol with 38.4 kbit/s and 4-word PKW area and 6-word PZD area
  - 4-word PKW area:
    With this setting, all parameters whose values are 16-bit (= 1 word) or 32-bit (double word) quantities can be read or written via the USS protocol.
  - 6-word PZD area:
    Transfers control words 1 and 2 and a maximum of four setpoints (each of them 16 bits) from the master to the converter or control words 1 and 2 (each one of them 16 bits) and a maximum of four actual values (each one of them 16 bits) from the converter to the master.
- Preconditions:
  P060 = 1 or 7
- Parameterizing the SCom2 interface (CUMC: X103, CUVC: X101):

Parameter number	Parameter	Index and value (index i002 for SCom 2)	Comments
P700	SCom/SCB BusAddr	i002 = 15	Bus address, SCom 2 = 15
P701	SCom/SCB Baud	i002 = 8	38.4 kbit/s
P702	SCom/SCB PKW #	i002 = 4	4-word PKW (SCom 2)
P703	SCom/SCB PcD #	i002 = 6	6-word PZD (SCom 2)
P704	SCom/SCB TlgOFF	i002 = 0 to 6500	0: No monitoring >0: Monitoring time in ms

Example 3 **USS protocol at the SCB2 board**

- Settings:
  USS protocol with 19.2 kbit/s and 4-word PKW area and 2-word PZD area
  - 4-word PKW area:
    With this setting, all parameters whose values are 16-bit (= 1 word) or 32-bit (double word) quantities can be read or written via the USS protocol.
  - 2-word PZD area:
    Transfers control word 1 and a setpoint (each of them 16 bit) from the master to the converter and control word 1 and an actual value (each of them 16 bit) from the converter to the master.
- Preconditions:
  P060 = 1 or 7
- Parameterization of the interface on the SCB2 board:

Parameter number	Parameter	Value	Comments
P682	SCB protocol	2	Physical bus cable, 2-wire USS protocol (according to /1/, only USS operation with 2 wires is defined.

Parameter number	Parameter	Index and value (index i003 for SCB2)	Comments
P700	SCom/SCB BusAddr	i003 = 21	Bus address SCom2 = 21
P701	SCom/SCB Baud rate	i003 = 7	19.2 kbit/s
P702	SCom/SCB PKW #	i003 = 4	4-word PKW
P703	SCom/SCB PcD #	i003 = 2	2-word PZD
P704	SCom/SCB TlgOFF	i003 = 0 to 6500	0: No monitoring >0: Monitoring time in ms

Example 4 **USS protocol on the CBP2 board**

- Settings:
  USS protocol with 19.2 kbit/s and 4-word PKW area and 2-word PZD area
  - 4-word PKW area:
    With this setting, all parameters whose values are 16 bit- (= 1 word) or 32-bit variables (double word) can be read or written by means of the USS protocol.
  - 2-word PZD area:
    Transmission of control word 1 and a setpoint (each 16 bits) from the master to the converter and of status word 1 and an actual value (each 16 bits) from the converter to the master.
- Requirements:
  P060 = 1 or 7
- Parameterization of the interface on the CBP2 board:

Parameter number	Parameter	Value	Comments
P713.x	CBP2 protocol	2	A change from PROFIBUS to USS protocol and vice versa only comes into effect when the voltage of the drive is turned off and then on again.

Parameter number	Parameter	Value	Comments
P918.x	CBP2 BusAddr	21	Bus address CBP2 = 21
P718.x	CBP2 Baud	7	19.2 kbit/s
P719.x	CBP2 PKW #.	4	4-word PKW
P720.x	CBP2 PcD #.	2	2-word PZD
P722.x	CBP2 TlgOFF.	0...6500	0: No monitoring >0: Monitoring time in ms

8.1.5.2 Parameterizing the parameterizing enable and process-data interconnections (2nd step)

Parameterization of the parameterizing enable

During start-up, an interface with the USS protocol must be explicitly enabled for parameterization in order to be able to change (= write) the parameters of a SIMOVERT MASTERDRIVES via this interface – this applies to the parameters of the basic unit (P/U parameters) and to the technology-board parameters (H/L parameters).

NOTE

Access to the SIMOVERT MASTERDRIVES via USS protocol is only possible if, during start-up, the PKW area is appropriately defined to contain 3, 4 words (fixed length) or a variable PKW length (= value 127) in the useful (net) data area.

The following rules apply to this:

- All parameters (P, r, U and n parameters of the basic units, or H, d, L and c parameters of the technology board) can be read out via any interface. **For reading purposes**, it is **not** necessary that the interface has been enabled for parameterization.

  P, U, H and L parameters: Can be read and written
  r, n, d and c parameters: Can only be read

- Parameterizing enable is specified in **parameter P053** (parameter access). This parameter **can always be written** from any interface.
- Several interfaces can be in possession of a parameterizing enable simultaneously.

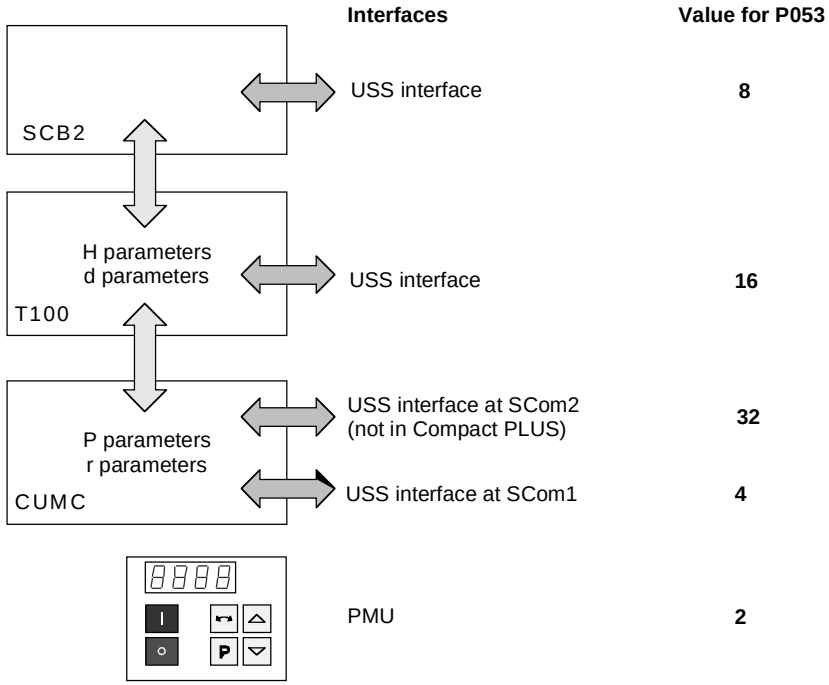


Fig. 8.1-16 Parameterizing enable for the USS interfaces

The rules for generating the value which is entered in parameter P053 for specifying parameter access is explained with the following example.

Example

Setting the parameterizing enable for SIMOVERT MASTERDRIVES with SCB2

Setting:
Write access to the parameters of the basic units (P parameters) via the PMU as well as via the USS protocol at both SCom1 interfaces and on SCB2

Parameter number	Value	Comments
P053	14	2 = PMU, 4 = SCom1, 8 = SCB2 ⇒ value = 2 + 4 + 8 = 14

Parameterizing process-data interconnections

As already described in Section 8.1.2.3 (PZD area), the PZD area consists of a maximum of 16 words. During start-up, the length of this area is defined in words using parameter P703 (SST/SCB PZD #). This definition applies to the telegram from the master to the converter and, vice versa, to the telegram from the converter back to the master. In the telegram from the master to the converter, the PZD area contains control word 1 or control word 2 and the setpoints. In the telegram from the converter to the master, status word 1 or status word 2 and the actual values are transferred.

1 word	1 word	1 word		1 word
PZD1	PZD2	PZD3	• • •	PZD16

Maximum 16 words
Minimum 0 words, i.e. no PZD area in the net data block

NOTE

Here, process-data interconnection is only described for the basic units. Process-data interconnection for the technology boards is described in their instruction manual.

"Interconnecting" control word 1 and control word 2

The two control words (bits 0 to 15) and 2 (bits 16 to 31) give commands and external information to the converter. A select parameter is assigned to each control-word bit, e.g. bit 0 of parameter P554. The select parameter specifies from which source(s) this control bit can be influenced (= changed).

USS interface, from which control word bits 0 to 15 (= control word 1) are to be changed (source)	Values to which select parameters P554 to P575 are to be set
SCom1	**2**1xy
SCom2	**6**1xy
SCB2	**4**5xy

Note:

- e.g. **2**1xy:
  The first digit (here 2) identifies the interface SST1 as source.
  The second digit (here 1) indicates that it is the 1st word in the PZD area of the telegram. "xy" (= 00 to 15) identifies the bit position.

NOTE

Control word 1 is always transferred in the 1st word of the PZD area in the USS protocol.

Example 1

- The control word command "ON/OFF1" should be taken from bit 0 in the 1st PZD word of SST1.
- The control word command "OFF2" should be taken from bit 1 in the 1st PZD word of SST1.
- The control word command "ACK" should be taken from bit 7 in the 1st PZD word of SST1.

Parameter number	Parameter	Index and value (index i001 for BICO data set 1) (index i002 for BICO data set 2)	Comments
P554	Source ON/OFF1	i001 = 2001	ON/OFF from SCom1
P555	Source 1 OFF2	i001 = 2001	Operating condition/OFF2 from SCom1
P565	Source 1 ACK	i001 = 2107	Edge 0 ⇒ 1

etc.

Values of select parameters P576 to P591

The following values of select parameters P576 to P591 are to be set for the USS interfaces:

USS interface from which control-word bits 16 to 31 (= control word 2) are to be changed (source)	Values to which select parameters P576 to P591 are to be set
SCom1	**2**4xy
SCom2 (not with the Compact PLUS)	**6**4xy
SCB2	**4**8xy

Note:

- e.g. **4**8xy:
  The first position (in this case, 4) identifies the interface on SCB 2 as the source.
  The second digit (here 8) indicates that it is the 4th word in the PZD area of the telegram (5 signifies the 1st word). "xy" (= 00 to 15) identifies the bit position.

NOTE

If necessary, control word 2 is always transferred in the 4th word of the PZD area in the USS protocol.
⇒ Set PZD area to a length of at least 4 words (P703).

Example 2

- Bit 0 for switching over the function data set should be taken from bit 0 in the 4th PZD word of SCB2.
- Bit1 for switching over the function data set should be taken from bit 1 in the 4th PZD word of SCB2.

Parameter number	Parameter	Index and value (index i001 for BICO data set 1) (index i002 for BICO data set 2)
P576	Source FDS Bit 0	i001 = 4800
P577	Source FDS Bit 1	i001 = 4801

etc.

"Interconnection" of setpoints

The user can select the source from which the setpoints for the converter are to be taken. This is done in the same way in which control-word bits are "interconnected". This is now illustrated with two examples.

Example 1

The "wiring" of the setpoints is done via parameters P443 (source main setpoint) and P433 (source supplementary setpoint 1).

Source for setpoints	Value for parameters P443 and P428
Interface allocation: SCom1 SCB2	 20xx 45xx
Position of the setpoints (16 bit quantify) in the PZD area: In the 2nd word ⇒ 02 In the 3rd word ⇒ 03 etc.	xx = 02, 03, 04 (only if control word 2 is not transferred), 05, up to 16

The main setpoint comes from SCom 1 and is located in the 2nd word of the PZD area. The supplementary setpoint comes from the USS interface on SCB 2 and is also located in the 2nd word of the PZD area (for BICO data set 1).

Parameter number	Parameter	Index and value (index i001 for BICO data set 1) (index i002 for BICO data set 2)
P443	Source of main setpoint	i001 = 2002
P433	Source of supplementary setpoint 1	i001 = 4502

Example 2

The "wiring" of the setpoints is done via parameters **P443** (source main setpoint), **P433** (source supplementary setpoint 1), **P438** (source supplementary setpoint 2), and so on. For a detailed description, see the instruction manual.

Source for the setpoints	**Values for parameters P443, P433, P438 and so on**
Interface allocation: **SCom1** **SCom2** **SCB2**	 **2**0xx **6**0xx **4**5xx
Position of the setpoints (16-bit quantity) in the PZD area: In the **2**nd word ⇒ 0**2** In the **3**rd word ⇒ 0**3** and so on	xx = 02,03, 04 (only if control word 2 is not transferred), 05, up to 16
Position of the setpoints (32-bit quantity) in the PZD area: In the 2nd word + 3rd word ⇒ 3**2** Rules for generating: xx = 30 (indicates 32-bits) + position in the PZD area at which the 32-bit setpoint begins. In the **3**rd word and 4th word ⇒ 3**3** and so on	x x = 32,33 (only if control word 2 is not transferred), 34 (only if control word 2 is not transferred), 35, up to 45

NOTE

When 32-bit quantities are being transferred, the high word is located in PZD n and the low word in PZD n+1
⇒ For example, 32-bit setpoint in PZD2 and PZD3; the high-word is then transferred in PZD2 and the low word in PZD3 via the USS bus.

The main setpoint (32-bit quantity) comes from SCom1 and is located in the 2nd word and 3rd word of the PZD area. Control word 2 is in the 4th word. In the 5th and 6th words, supplementary setpoint 1 (32-bit quantity) is transmitted (for BICO data set 1).

Parameter number	**Parameter**	**Index and value** (index i001 for BICO data set 1) (index i002 for BICO data set 2)
P443	Source of main setpoint	i001 = 2032
P433	Source of supplementary setpoint 1	i001 = 2035

"Interconnection" of status words 1 and 2 and the actual values

The two status words 1 (bits 0 to 15) and 2 (bits 16 to 31) send messages from the converter to a higher-level converter system.

An indexed parameter is assigned to each interface. Each index is assigned to a net-data word in the PZD area. For example, index i001 to the 1st word, index i002 to the 2nd word and so on up to i016.

Parameter number	Parameter	Index and value (index i001 for BICO data set 1) (index i002 for BICO data set 2)
SCom1	707 (SCom1 actual values)	i001 to 016
SCom2 (not with the Compact PLUS)	708 (SCom2 actual values)	i001 to 016
SCB2	706 (SCB actual values)	i001 to 016

NOTE

Status word 1 is always transferred in the 1st word of the PZD area in the USS protocol.

Example 1

"Interconnection" of status word 1 and the actual speed/frequency (KK0091) at interface SCom1.

- Precondition:
  PZD area at least 2 words in length; P703, i001 ≥ 2 is set.

Parameter No.	Parameter	Index and value	Comments
P707	SCom1 actual values	i00**1** = 0032	1st word in the PZD area: status word (K0032)
		i00**2** = 0091	2nd word in the PZD area: actual speed/frequency (KK0091, only H-Word)
		i003 to i016 = 0	3rd to 16th word in the PZD area (if parameterized): "Not interconnected"

Example 2

"Interconnection" of status word 1, status word 2, actual speed (KK0091) and the actual DC link voltage (K0240) at the interface on SCB2.

- Precondition:
  PZD area at least 5 words in length; P703, i003 ≥ 5 is set.

Parameter number	Parameter	Index and value	Comments
P706	SCB actual values	i00**1** = 0032	1st word in the PZD area: status word (K0032)
		i00**2** = 0091	2nd word in the PZD area: high word of the actual speed (KK0091)
		i00**3** = 0091	3rd word in the PZD area: low word of the actual speed (KK0091)
		i00**4** = 0033	4th word in the PZD area: status word 2 (K0033)
		i00**5** = 0240	5th word in the PZD area: Vd(act) (K0240)

NOTE

When 32-bit quantities are being transferred, the high word is located in PZD n, the low word in PZD n+1.
⇒ For example, 32-bit actual value of KK0091 in PZD2 and PZD3.