

# USS Compact

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The USS protocol (Universal Serial Interface Protocol) defines an access technique according to the master-slave principle for communications via a serial bus. This includes, as a sub-quantity, also a point-to-point connection.

## Telegram traffic

The master selects all slaves with an address character in the telegram and expects a reply from each addressed slave within 20ms. A slave is not allowed to transmit data without first being initiated by the master. All tasks must be sent in a complete telegram. Splitting task telegrams is not allowed!

## Cyclic and acyclic mode

USS generally distinguishes between cyclic and acyclic telegram transfer. In cyclic mode (drive automation tasks) the master addresses all slaves one after the other in identical time intervals and with predefined identical telegram length. Whereas in acyclic operation the master sends telegrams to the slaves at irregular times. The telegram size can vary.

## Telegram structure

Each telegram starts with a STX, followed by a telegram length field LGE, a combined address/type field, the data payload and ends with a checksum BCC. The STX itself is not sufficient to identify the beginning of a telegram because it can also occur in the data payload. Therefore an additional start delay of at least 2 character run times between every telegram is specified. The start interval or delay is part of the telegram.

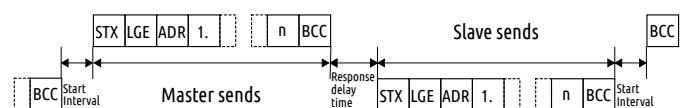
Table 1: USS telegram structure

Header			Net data block				
STX	LGE	ADR	1.	2.	...	n	BCC
← Telegram length $LGE = n + 2$ →							

- **STX** Start of text, 1 byte, always 02 hexadecimal
- **LGE** Telegram length, 1 byte, contains the telegram length in binary code which is the net data block plus ADR and BCC (2 bytes).
- **ADR** Address byte, combination of the slave address and telegram type, see accord. section.
- **Net data block** Contains a fixed or variable length of data subdivided into the two areas PKW and PZD.
- **BCC** Block check character, calculated as the exclusive OR link of all previous bytes including STX.

## Sending sequence

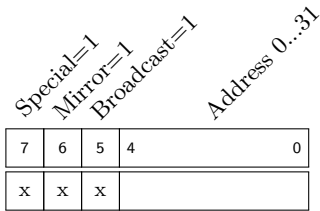
The data transfer always has to happen as shown in the schematic below whereas both - start interval or response delay - is specified as at least the mentioned sending run time of two characters.



## ADR

The bits in the address byte are assigned as following:

### Address byte



Bit no.

The priority of the type bits is from the highest:

1. Bit 7 (special diagram)
2. Bit 5 (Broadcast)
3. Bit 6 (Mirror)

### Special telegram

Special telegram types can be used in case the application has a need for different net data structures as specified in the converter profile. Mostly it is set to 0.

### Mirror telegram

A telegram with a set mirror bit will be simply sent back (mirrored) by the given slave without evaluating the telegram content. Mirror telegrams can be used to test the data transfer between the master and a slave.

### Broadcast telegram

Broadcast telegrams are handled by all slaves regardless of the address field and the slaves only evaluate the PZD area.

### Checksum

The checksum is calculated by XOR all bytes of the telegram (except for the BBC of course). Here coded in Lua:

```

1 function chksum( data )
2     local cks = 0
3     for i=1,#data do
4         cks = bit.bxor( data:byte(i), cks )
5     end
6     return cks
7 end

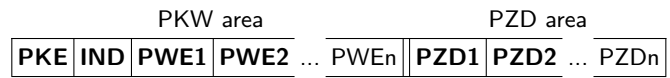
```

### Structure of the net data block

This block is used to transfer the data payload and is divided in a 'Parameter Kennwerte' field PKW and a 'Prozeßdaten' field PZD. The length of both depends from application and has to be specified in the according PKW\_ANZ (P2012) and PZD\_ANZ

(P2013) parameters.

In case of a variable length of the PKW field, PKW\_ANZ has to be set to 127 independent of the PZD\_ANZ value. The bus participants then have to evaluate the right length of the PKW field with the help of the PZD\_ANZ parameter.



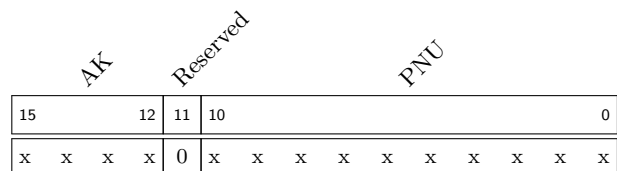
### PKW (Parameter channel field)

The PKW field is used to read/write individual device parameters. It consists of:

- **PKE:** Parameter ID (Kennung)
- **IND:** Parameter index
- **PWE:** Parameter value(s) (Werte)

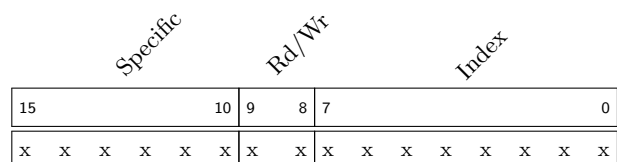
The size of PKE and IND is always one word. The PWE is an array of words which can vary in size depending on the requested/responded data (word, double word, float or variable data). If only PZD data are to be transferred, the whole PKW field can be set to 0. Thus the allowed PKW word count is 0, 3, 4 or 127 (variable). The length of PWE has to be set via P2012 for controller (master) and slave.

#### Description of the PKE field



The AK field contains the task or response ID and is listed below. The meaning of the bits in the PNU field depends on the device and must be taken from the according device instruction manual.

#### Description of the IND field



The IND field is used for the following task/response ID:

- Read/write parameter description

- Read/write array values
- Read/write text

In all other cases the bits are set to 0.

## AK - Task and reply ID

The task are issued, coded from the master to a slave in the task ID (AK).

Task ID	Meaning
0	No task
1	Request parameter value
2	Change parameter value (word) [RAM only]
3	Change parameter value (dword) [RAM only]
4	Request description element
5	Change description element
6	Request parameter value (array), indexed param.
7	Change parameter value (array, word) [RAM only]
8	Change parameter value (array, dword) [RAM only]
9	Request the number of array elements
10	Reserved
11	Save paramter value (array, dword) [RAM, EEPROM]
12	Save parameter value (array, word) [RAM, EEPROM]
13	Save parameter value (dword) [RAM, EEPROM]
14	Save parameter value (word) [RAM, EEPROM]
15	Read or change text

When in cycle mode no information is required from the PKW area, the task ID has to be set to 'No task' and the slave has to response with 'No Reply'.

The slave processes the task and answers with the appropriate response which is coded in the response ID.

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

If the task cannot be executed, the slave response with the reply ID 7 (see above) and put the error number or index in the first PWE field.

Error ID	Meaning
0	Illegal parameter number
1	Parameter cannot changed, read-only
2	Lower or upper limit exceeded
3	Erroneous index
4	No array
5	Incorrect data type
6	Setting not permitted
7	Descriptive element not be changed
...	
100	Reserved
> 100	Device dependent

## PZD (Process data field)

The PZD area transfers control commands and set-points to the slave. The slave responses with actual status information and values. Usually the first PZD word contains the control or status word. The second word contains the main set-point or actual value. Totally up to 16 words can be used if required. The number of PZD words can also be set to 0 if only PKW data is used. This gives an allowed range of 0...16. The setting via P2013 has to be the same for master and slave.