Instruction Manual
AK Protocol
Communication Option for
MLT 1, MLT 2, MLT 3, MLT 4, MLT 5 and CAT 200

ESSENTIAL INSTRUCTIONS
READ THIS PAGE BEFORE PROCEEDING!

Emerson Process Management (Rosemount Analytical) designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you MUST properly install, use, and maintain them to ensure they continue to operate within their normal specifications. The following instructions MUST be adhered to and integrated into your safety program when installing, using and maintaining Emerson Process Management (Rosemount Analytical) products. Failure to follow the proper instructions may cause any one of the following situations to occur: Loss of life; personal injury; property damage; damage to this instrument; and warranty invalidation.

- **Read all instructions** prior to installing, operating, and servicing the product.

- If you do not understand any of the instructions, contact your Emerson Process Management (Rosemount Analytical) representative for clarification.

- **Follow all warnings, cautions, and instructions** marked on and supplied with the product.

- Inform and educate your personnel in the proper installation, operation, and maintenance of the product.

- **Install your equipment as specified in the Installation Instructions of the appropriate Instruction Manual and per applicable local and national codes.** Connect all products to the proper electrical and pressure sources.

- To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product.

- When replacement parts are required, ensure that qualified people use replacement parts specified by Emerson Process Management (Rosemount Analytical). Unauthorized parts and procedures can affect the product’s performance, place the safe operation of your process at risk, and VOID YOUR WARRANTY. Look-alike substitutions may result in fire, electrical hazards, or improper operation.

- **Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.**

The information contained in this document is subject to change without notice. Misprints reserved.

# Contents

## I) V24/RS232/485 Interface - Basics

1. Introduction ........................................................................................................... 1 - 1  
2. Hardware .............................................................................................................. 1 - 2  
3. Protocol settings ................................................................................................... 1 - 3  
   3.1 Command telegram ........................................................................................ 1 - 3  
   3.2 Response telegram ......................................................................................... 1 - 4  
   3.3 Command telegram for RS485 BUS operating .............................................. 1 - 5  
   3.4 Response telegram for RS485 BUS operating .............................................. 1 - 6  
4. Specifications of data settings ............................................................................ 1 - 7  
   4.1 Head telegram (Header) ............................................................................... 1 - 7  
   4.2 Data block and error status byte .................................................................. 1 - 8  
   4.3 End of telegram ............................................................................................. 1 - 9  
   4.4 Command and response telegram timing ..................................................... 1 - 10  
   4.5 Handling of malfunctions ............................................................................ 1 - 10  
5. Examples for potential responses to control or write commands resp. to command telegrams with data (format) errors .............................................. 1 - 11  
6. Function sequence and error status after the receipt of the "SRES" or "STBY" commands ................................................................. 1 - 19  

## II) V24/RS232/485 Interface - Single Analyzers and Systems

1. Basic Informations ............................................................................................... 2 - 2  
2. List of all Codes [Commands - Overview including page numbers] ............... 2 - 5  
   2.1 Control commands ....................................................................................... 2 - 5  
   2.2 Read commands ......................................................................................... 2 - 6  
   2.3 Write commands ....................................................................................... 2 - 7  
3. Description of all Control Commands ............................................................... 2 - 8  
4. Description of all Read Commands .................................................................. 2 - 39  
5. Description of all Write Commands .................................................................. 2 - 85  

**Supplement**

1. Overview about working AK commands in NGA devices ......................... Supplement - 1  
2. AK Service Commands .................................................................................. Supplement - 3
Protocol settings of a serial interface between a test bench control computer and peripheral analyzers on exhaust test benches

1. Introduction

The serial interface is made for slow point to point connections ($f \leq 10$ Hz). The communication between the test bench control computer (TBCC) and the peripheral analyzers works according to the master slave principle. That means that the peripheral analyzers will only answer with a response telegram to the command telegram of the TBCC. They will not send an own message.

You can distinguish two cases:

(1) Analyzers in a function unit (system)

Some analyzers are combined to a logical unit. They are connected to the TBCC via an front-end computer. In that case the communication will not take place directly between the TBCC and the analyzers, but between the TBCC and the front-end computer. Each analyzer or the whole system unit will be identified by a defined channel number:
- K0 is the channel number for the whole defined system.
- ("Assembling command resp. assembling report")
- Kn ($n=1$, nmax) is the channel number for each analyzer.
- KV is the channel number for the front-end computer.

(2) Single analyzers

Each analyzer is connected directly to the TBCC. In that case the identification of each analyzer will be done by the hardware connections and not by a software control. That is why the two channel number bytes (Kn) could be deleted. But in spite of that the channel number is generally 0 (K0) to get a uniform protocol.

The data transfer will only be done by ASCII code to get an easy handling of the protocol with a terminal for simulation of the TBCC, the system unit and the analyzers. Therefore, no parity check will be done as data saving.
2. **Hardware**

1. **Baud rate:** 1200, 2400, 4800, 9600, 19200

2. **Length of signs:**
   - 1 start bit
   - 7 or 8 data bits
   - 1 or 2 stop bits

3. **Parity:** even/odd/none

4. **Operating:** full duplex, no echo

5. **Handshake:** Xon/Xoff

6. **Plug:** 9 pin sub d, socket

7. **Pin assignment:** RS 232 module

---

![RS 232 Pin Assignment](image1)

- **GND**
- **RxD**
- **TxD**
- **NC**
- **GND**

6. Relay 1 contact NC/NO
7. Relay 2 contact NC/NO
8. Relay 3 contact NC/NO
9. Relay common node

---

![RS 485 Pin Assignment](image2)

- **GND**
- **RxD-**
- **RxD+**
- **TxD+**
- **TxD-**

6. Relay 1 contact NC/NO
7. Relay 2 contact NC/NO
8. Relay 3 contact NC/NO
9. Relay common node
3. Protocol settings

The data and command transfer protocol has the following structure:

3.1. Command telegram

1. Byte
   
2. Byte
   
3. Byte
   
4. Byte
   
5. Byte
   
6. Byte
   
7. Byte
   
8. Byte
   
9. Byte
   
D
A
T
A

n. Byte

ETX

END

STX
DON'T CARE
FUNCT. CODE 1
FUNCT. CODE 2
HEAD
FUNCT. CODE 3
FUNCT. CODE 4
BLANK
"K"
VARIABLE DATA

(number with several digits possible)

(other data can also disappear, depending on the function code)
### 3.2. Response telegram

<table>
<thead>
<tr>
<th>Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STX</td>
</tr>
<tr>
<td>2</td>
<td>DON'T CARE</td>
</tr>
<tr>
<td>3</td>
<td>FUNCT. CODE 1</td>
</tr>
<tr>
<td>4</td>
<td>FUNCT. CODE 2 (HEAD)</td>
</tr>
<tr>
<td>5</td>
<td>FUNCT. CODE 3</td>
</tr>
<tr>
<td>6</td>
<td>FUNCT. CODE 4</td>
</tr>
<tr>
<td>7</td>
<td>BLANK</td>
</tr>
<tr>
<td>8</td>
<td>ERROR STATUS (FIXED DATA)</td>
</tr>
</tbody>
</table>

**VARIABLE DATA**
- D
- A
- T
- A

(can also disappear, depending on the function code)

<table>
<thead>
<tr>
<th>Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>ETX</td>
</tr>
</tbody>
</table>

END
3.3. **Command telegram for RS485 BUS operating**

<table>
<thead>
<tr>
<th>1. Byte</th>
<th>STX</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Byte</td>
<td>BUS ADDRESS</td>
</tr>
<tr>
<td>3. Byte</td>
<td>FUNCT. CODE 1</td>
</tr>
<tr>
<td>4. Byte</td>
<td>FUNCT. CODE 2</td>
</tr>
<tr>
<td>5. Byte</td>
<td>FUNCT. CODE 3</td>
</tr>
<tr>
<td>6. Byte</td>
<td>FUNCT. CODE 4</td>
</tr>
<tr>
<td>7. Byte</td>
<td>BLANK</td>
</tr>
<tr>
<td>8. Byte</td>
<td>&quot;K&quot;</td>
</tr>
<tr>
<td>9. Byte</td>
<td>NUMBER</td>
</tr>
<tr>
<td></td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>T</td>
</tr>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>n. Byte</td>
<td>ETX</td>
</tr>
</tbody>
</table>

(Other data can also disappear, depending on the function code)
### 3.4. Response telegram for RS485 BUS operating

<table>
<thead>
<tr>
<th>No.</th>
<th>Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Byte</td>
<td>STX</td>
</tr>
<tr>
<td>2.</td>
<td>Byte</td>
<td>BUS ADDRESS</td>
</tr>
<tr>
<td>3.</td>
<td>Byte</td>
<td>FUNCT. CODE 1</td>
</tr>
<tr>
<td>4.</td>
<td>Byte</td>
<td>FUNCT. CODE 2</td>
</tr>
<tr>
<td>5.</td>
<td>Byte</td>
<td>FUNCT. CODE 3</td>
</tr>
<tr>
<td>6.</td>
<td>Byte</td>
<td>FUNCT. CODE 4</td>
</tr>
<tr>
<td>7.</td>
<td>Byte</td>
<td>BLANK</td>
</tr>
<tr>
<td>8.</td>
<td>Byte</td>
<td>ERROR STATUS FIXED DATA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VARIABLE DATA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(can also disappear, depending on the function code)</td>
</tr>
<tr>
<td>n.</td>
<td>Byte</td>
<td>ETX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>END</td>
</tr>
</tbody>
</table>
4. Specifications of data settings

4.1. Head telegram (Header)

The begin of each transfer is a "STX" in the first byte. Each "STX" will start a new transfer. Previous transfers will be deleted, if they are not finished by "ETX". That means, only completed telegrams may be interpreted and answered.

You can take any content for the "DON'T CARE" byte, excluding control signs or signs reserved by the AK commands.

For the RS485 BUS operating an address byte will be used instead of the "DON'T CARE" byte. The analyzers will only answer to this command if the bus address setup will concur with this byte.

In the command telegram a function code will be sent to the system unit or the analyzer with the four function bytes.

In the response telegram this function code will be sent back as an echo if the transfer is successful. The echo will be four question marks (????), if

- the command telegram has not minimum the number of bytes of the head telegram, the channel number in the data part and the end telegram (number of bytes = 10; using a channel number with two digits = 11 bytes) or
- the function code has errors or is unknown.

The function code may not contain blanks.

There are three groups of function codes:

(1) Control commands
(2) Read commands
(3) Write commands
4.2. **Data block and error status byte**

The data presentation is variable. A fixed format will not be used. A blank or a `<CR>` with `<LF>` will be used as separating characters of data. The separation with `<CR>`:<LF> will only be done, if the following complete date will have more than 60 digits. Each data set will begin normally with a blank.

The data block of the command telegram has only variable data. These data depend on the function code. They can disappear for some function codes excluding the channel number. The channel number can have more than two bytes.

The data block of the response telegram is divided in fixed and variable data. The first digit of the fixed data is a blank followed by an error status byte. The error status number will be zero for an error free running analyzer or system unit. The error status number will be counted up from 1 to 9 with each change in the error status. The error status number will be zero again after the errors will be removed. Changing the status of the system will not change the error status number. The variable data depend on the function code. They can disappear for some function codes.

The long and variable floating point format or the E-Format are allowed to display the digits of numbers. You can find in each analyzer protocol which of these formats may be used. The decimal point can disappear for integers. The "+/-" sign may only be used for negative numbers. Digits without physical meaning have to be vanished.

You can distinguish the following cases if a date with an error exists for a reading:

1. The transfer of the date is not possible, e.g. an analyzer in a system is missing or it cannot send a signal.
   → The date will be replaced by a "]#".
2. The date is only valid with restrictions, e.g. FID temperature too low.
   → The date will begin with a "]#".
   Range overflow and range underflow will be displayed in the same way. "Valid" means that no criterions of plausibility will be considered.

Example:
You ask for a concentration value and the analyzer is in the "stand-by" mode. The date must not be marked with "#" as "valid with restrictions", if the analyzer would work normally in the operation mode.
If an analyzer or a system is not in the "REMOTE" status, the control and write commands have to report "OF" ("Offline") in the data set to the. In system units the channel number has to be reported, too.

If one analyzer is missing, a system unit has to send the channel number and "NA" ("Not Available") to the test bench control computer with control and write commands.

A response telegram is not possible, if the test bench control computer has a direct contact to the analyzers and one analyzer is missing or the whole system is missing. So the test bench control computer has to realize the missing of devices by "Time Out".

If the system or the analyzer is occupied by executing a function, the new start of a control command will lead to the response "BS" (Busy) in the data block of the response telegram. The running function will not be disturbed. Exception: The order was a software reset.

If the data or parameters transfer is not complete (i.e. not expected format) in the command telegram to the system or the analyzer, the test bench control computer will get a "SE" (Syntax Error) in the data block of the following response telegram.

If the system or the analyzers cannot work with the data or the parameters of the command telegram (data error, parameter error), the test bench control computer will get a "DF" (data error) in the data block of the following response telegram.

4.3. **End of telegram**

Each transfer will end with "ETX" in the last byte.
4.4. **Command and response telegram timing**

For each command telegram of the TBCC the peripheral analyzer sends a response telegram. It is not allowed for the TBCC to send new command telegrams before this response telegram is received.

For most of the command telegrams this response might be sent after some milliseconds. But for some commands the response telegram might be started to sent 2-3 seconds after receiving the command telegram. The time starts the moment the peripheral analyzer receives the ETX character of the command telegram. It is not assured that the response telegram is sent without any delay between the single characters but it might be that there are up to 2-3 seconds in between.

4.5. **Handling of malfunctions**

For the case of a malfunction it might be that the ETX-character of the command telegram is not received by the peripheral analyzer. Then it will not evaluate the command telegram and so will not send a response telegram.

In this case it is in the responsibility of the TBCC not to run into an endless loop. It has to have a timeout of 4-5 seconds to react on this communication failure. The TBCC may repeat the last command telegram or doing some other exception handling.
5. **Examples for potential responses to control or write commands resp. to command telegrams with data (format) errors:**

1. **Analyzer and/or system unit with several analyzers "Online" and called analyzers are existing.**

<table>
<thead>
<tr>
<th>1. Byte</th>
<th>STX</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Byte</td>
<td>DON'T CARE</td>
</tr>
<tr>
<td>3. Byte</td>
<td>C</td>
</tr>
<tr>
<td>4. Byte</td>
<td>O</td>
</tr>
<tr>
<td>5. Byte</td>
<td>D</td>
</tr>
<tr>
<td>6. Byte</td>
<td>E</td>
</tr>
<tr>
<td>7. Byte</td>
<td>BLANK</td>
</tr>
<tr>
<td>8. Byte</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>n. Byte</td>
<td>ETX</td>
</tr>
</tbody>
</table>

Error status byte:  
Value is zero: Device without error.  
Value is not zero: Device with one or more errors.
2. Analyzer and/or system unit with several analyzers "Offline" and called analyzers are existing.

| 1. Byte | STX              |
| 2. Byte | DON'T CARE       |
| 3. Byte | C                |
| 4. Byte | O                |
| 5. Byte | D                |
| 6. Byte | E                |
| 7. Byte | BLANK            |
| 8. Byte | x                |
| 9. Byte | BLANK            |
| 10. Byte | K              |
| 11. Byte | n                |
| 12. Byte | BLANK            |
| 13. Byte | O                |
| 14. Byte | F                |
|        | evtl. variable   |
|        |                  |
|        |                  |
|        |                  |
|        |                  |
| n. Byte | ETX              |

Error status byte: Value is zero: Device without error. Value is not zero: Device with one or more errors.

11. Byte: Channel number is zero: "The whole system unit offline". Channel number is one to n: "Single analyzer offline".
### 3. Called system unit "online", called single analyzer not available.

If the test bench control computer will call the devices directly and the system unit or the analyzer are not available, you will not get any response telegram. So, the test bench control computer will have to realize the missing of the system or of the analyzer by "Time Out".

<table>
<thead>
<tr>
<th>Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>STX</td>
</tr>
<tr>
<td>2.</td>
<td>DON'T CARE</td>
</tr>
<tr>
<td>3.</td>
<td>C</td>
</tr>
<tr>
<td>4.</td>
<td>O</td>
</tr>
<tr>
<td>5.</td>
<td>D</td>
</tr>
<tr>
<td>6.</td>
<td>E</td>
</tr>
<tr>
<td>7.</td>
<td>BLANK</td>
</tr>
<tr>
<td>8.</td>
<td>Error status byte</td>
</tr>
<tr>
<td>9.</td>
<td>BLANK</td>
</tr>
<tr>
<td>10.</td>
<td>K</td>
</tr>
<tr>
<td>11.</td>
<td>n</td>
</tr>
<tr>
<td>12.</td>
<td>BLANK</td>
</tr>
<tr>
<td>13.</td>
<td>N</td>
</tr>
<tr>
<td>14.</td>
<td>A</td>
</tr>
<tr>
<td>15.</td>
<td>ETX</td>
</tr>
</tbody>
</table>

Error status byte:
- Value is zero: Device without error
- Value is not zero: Device with one or more errors

11. Byte: Channel number one to n: "Called device not available".
4. Called system unit "offline", called single analyzer not available.

If the test bench control computer will call the devices directly and the system unit or the analyzer are not available, you will not get any response telegram. So, the test bench control computer will have to realize the missing of the system or of the analyzer by "Time Out".

<table>
<thead>
<tr>
<th>Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STX</td>
</tr>
<tr>
<td>2</td>
<td>DON'T CARE</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
</tr>
<tr>
<td>4</td>
<td>O</td>
</tr>
<tr>
<td>5</td>
<td>D</td>
</tr>
<tr>
<td>6</td>
<td>E</td>
</tr>
<tr>
<td>7</td>
<td>BLANK</td>
</tr>
<tr>
<td>8</td>
<td>x Error status byte</td>
</tr>
<tr>
<td>9</td>
<td>BLANK</td>
</tr>
<tr>
<td>10</td>
<td>K</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>BLANK</td>
</tr>
<tr>
<td>13</td>
<td>O</td>
</tr>
<tr>
<td>14</td>
<td>F</td>
</tr>
<tr>
<td>15</td>
<td>BLANK</td>
</tr>
<tr>
<td>16</td>
<td>K</td>
</tr>
<tr>
<td>17</td>
<td>n</td>
</tr>
<tr>
<td>18</td>
<td>BLANK</td>
</tr>
<tr>
<td>19</td>
<td>N</td>
</tr>
<tr>
<td>20</td>
<td>A</td>
</tr>
<tr>
<td>21</td>
<td>ETX</td>
</tr>
<tr>
<td>Error status byte</td>
<td>Value is zero:</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td></td>
<td>Value is not zero:</td>
</tr>
</tbody>
</table>

11. Byte: Channel number zero: "System unit offline"

17. Byte: Channel number one to n: "Called device not available."
### 5. Called unit or channel is busy with a running function.

<table>
<thead>
<tr>
<th>1. Byte</th>
<th>STX</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Byte</td>
<td>DON'T CARE</td>
</tr>
<tr>
<td>3. Byte</td>
<td>C</td>
</tr>
<tr>
<td>4. Byte</td>
<td>O</td>
</tr>
<tr>
<td>5. Byte</td>
<td>D</td>
</tr>
<tr>
<td>6. Byte</td>
<td>E</td>
</tr>
<tr>
<td>7. Byte</td>
<td>BLANK</td>
</tr>
<tr>
<td>8. Byte</td>
<td>x</td>
</tr>
<tr>
<td>9. Byte</td>
<td>BLANK</td>
</tr>
<tr>
<td>10. Byte</td>
<td>K</td>
</tr>
<tr>
<td>11. Byte</td>
<td>n</td>
</tr>
<tr>
<td>12. Byte</td>
<td>BLANK</td>
</tr>
<tr>
<td>13. Byte</td>
<td>B</td>
</tr>
<tr>
<td>14. Byte</td>
<td>S</td>
</tr>
<tr>
<td>15. Byte</td>
<td>ETX</td>
</tr>
</tbody>
</table>

**Error status byte:**
- Value is zero: Device without error.
- Value is not zero: Device with one or more errors.

**11. Byte:**
- Channel number is zero: "The whole unit is busy".
- Channel number is one to n: "Single analyzer is busy".
6. The data are incomplete or the data do not have the expected format.

<table>
<thead>
<tr>
<th>1. Byte</th>
<th>STX</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Byte</td>
<td>DON'T CARE</td>
</tr>
<tr>
<td>3. Byte</td>
<td>C</td>
</tr>
<tr>
<td>4. Byte</td>
<td>O</td>
</tr>
<tr>
<td>5. Byte</td>
<td>D</td>
</tr>
<tr>
<td>6. Byte</td>
<td>E</td>
</tr>
<tr>
<td>7. Byte</td>
<td>BLANK</td>
</tr>
<tr>
<td>8. Byte</td>
<td>x</td>
</tr>
<tr>
<td>9. Byte</td>
<td>BLANK</td>
</tr>
<tr>
<td>10. Byte</td>
<td>K</td>
</tr>
<tr>
<td>11. Byte</td>
<td>n</td>
</tr>
<tr>
<td>12. Byte</td>
<td>BLANK</td>
</tr>
<tr>
<td>13. Byte</td>
<td>S</td>
</tr>
<tr>
<td>14. Byte</td>
<td>E</td>
</tr>
<tr>
<td>15. Byte</td>
<td>ETX</td>
</tr>
</tbody>
</table>

Error status byte:  
Value is zero: Device without error.  
Value is not zero: Device with one or more errors.
7. The data or the parameters do not have the expected size.

<table>
<thead>
<tr>
<th>1. Byte</th>
<th>STX</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Byte</td>
<td>DON'T CARE</td>
</tr>
<tr>
<td>3. Byte</td>
<td>C</td>
</tr>
<tr>
<td>4. Byte</td>
<td>O</td>
</tr>
<tr>
<td>5. Byte</td>
<td>D</td>
</tr>
<tr>
<td>6. Byte</td>
<td>E</td>
</tr>
<tr>
<td>7. Byte</td>
<td>BLANK</td>
</tr>
<tr>
<td>8. Byte</td>
<td>x</td>
</tr>
<tr>
<td>9. Byte</td>
<td>BLANK</td>
</tr>
<tr>
<td>10. Byte</td>
<td>K</td>
</tr>
<tr>
<td>11. Byte</td>
<td>n</td>
</tr>
<tr>
<td>12. Byte</td>
<td>BLANK</td>
</tr>
<tr>
<td>13. Byte</td>
<td>D</td>
</tr>
<tr>
<td>14. Byte</td>
<td>F</td>
</tr>
<tr>
<td>15. Byte</td>
<td>ETX</td>
</tr>
</tbody>
</table>

Error status byte:

- Value is zero: Device without error.
- Value is not zero: Device with one or more errors.
6. Function sequence and error status after the receipt of the 'SRES' or 'STBY' commands

1. The test bench control computer is sending the control command SRES (Reset) to the system unit or any single analyzer.

All running functions or procedures will be canceled. An initializing will start, that is analogous to the switching on of the system unit or the analyzer: CPU and memory check, regulating or controlling of required temperatures, igniting of the flame in a FID and so on. The operation mode of the system or analyzer is "stand-by" during the initializing, even if the device is not ready and error free. That means, the status STBY will be reported to the read command ASTZ. The test bench control computer can only realize with the read command ASTF (error status), if the device is ready for measurements. The device will be ready to measure, if the essential functions of the current measuring instruction will be error free.

Example:
The status of the system unit or analyzer is SXYZ. The test bench control computer sends SRES:

Test bench control computer sends SRES Kn
→ System or analyzer will response SRES x

The system unit or the analyzer will cancel the status SXYZ. It will run a CPU and memory check and it will control the temperatures. If the temperatures are out of the allowed setpoint range, the device will regulate it. The FID will control the flame and will try to ignite it, if necessary, and so on. The test bench control computer will read the operation mode and the error status:

Test bench control computer sends ASTZ Kn
→ System or analyzer will response ASTZ 0 SMAN STBY

or

Test bench control computer sends ASTZ Kn
System or analyzer will response ASTZ x SMAN STBY

Test bench control computer sends ASTF Kn
System or analyzer will response ASTF x n

The error status byte will be zero and the system or the analyzer will be ready to measure, if all temperatures are in the allowed setpoint range, if the FID flame is burning etc.
If these parameters are not correct, the error status byte will be different from zero. The test bench control computer will read the operation mode and the error status as long as the system or the analyzer will be ready to measure. The test bench control computer will control the maximum time for this reading.
There are two different cases:

- If the system or the analyzer is resting, this mode will be finished. Then, it will be tried to get the stand-by mode ready for an error free measurement. The system or the analyzer will regulate all temperatures to the required setpoints, that were down during the resting. The FID will control the flame burning and if necessary it will try to ignite the flame etc. The operation mode of the system or analyzer is "stand-by" during these checkups, even if the device is not ready and error free. That means, the status STBY will be reported to the read command ASTZ. The test bench control computer can only realize with the read command ASTF (error status), if the device is ready for measurements. The device will be ready to measure, if the essential functions of the current measuring instruction will be error free.

Example:
The system or the analyzer is resting. No error is existing. The test bench control computer will ask for the operation mode:

**Test bench control computer sends ASTZ Kn**
→ **System or analyzer will response ASTZ 0 SREM SPAU**

Test bench control computer sends STBY. System or analyzer shall accept the stand-by mode:

**Test bench control computer sends STBY Kn**
→ **System or analyzer will response STBY 0**

The system or analyzer is finishing the resting. Then, it will try to get the stand-by mode for an error free measurement. The system or analyzer will check the conditions: Are all temperatures in the setpoint range ? Is the FID flame burning ? etc. The test bench control computer will read the operation mode:

Status is error free:

**Test bench control computer sends ASTZ Kn**
→ **System or analyzer will response ASTZ 0 SREM STBY**

or status has still some errors:

**Test bench control computer sends ASTZ Kn**
→ **System or analyzer will response ASTZ x SREM STBY**

**Test bench control computer sends ASTF Kn**
→ **System or analyzer will response ASTF x n**

The error status byte will be zero and the system or the analyzer will be ready to measure, if all temperatures are in the allowed setpoint range, if the FID flame is burning etc.

If these parameters are not correct, the error status byte will be different from zero. The test bench control computer will read the operation mode and the error status as long as the system or the analyzer will be ready to measure. The test bench control computer will control the maximum time for this reading.
The system or the analyzer is in the operation mode SXYZ. This mode will be finished. Then, it will be tried to get the stand-by mode ready for an error free measurement. If there will be an error in the function SXYZ, the system or the analyzer will try to remove this error to get the stand-by mode ready for an error free measurement (i.e. FID flame is not burning, the FID will try to ignite). The operation mode of the system or analyzer is "stand-by" during these check-ups, even if the device is not ready and error free. That means, the status STBY will be reported to the read command ASTZ. The test bench control computer can only realize with the read command ASTF (error status), if the device is ready for measurements. The device will be ready to measure, if the essential functions of the current measuring instruction will be error free.

Example:
The system or the analyzer is in the operation mode SXYZ. An error is existing with the error number n, i.e. FID flame is not burning. The test bench control computer will ask for the error status:

Test bench control computer sends ASTF Kn
→ System or analyzer will response ASTF x n

Test bench control computer sends STBY. System or analyzer shall accept the stand-by mode and get ready for an error free measurement:

Test bench control computer sends STBY Kn
→ System or analyzer will response STBY x

The system or analyzer is finishing the operation mode SXYZ. Then, it will try to get the stand-by mode for an error free measurement. The system or analyzer will check the conditions and will try to remove the error, i.e. ignition of the FID flame. The test bench control computer will read the operation mode:

Error is removed (e.g. Flame was ignited):

Test bench control computer sends ASTZ Kn
→ System or analyzer will response ASTZ 0 SREM STBY

or

Error is still existing (e.g. Flame has not been ignited):

Test bench control computer sends ASTZ Kn
→ System or analyzer will response ASTZ x SREM STBY

Test bench control computer sends ASTF Kn
→ System or analyzer will response ASTF x n

The error status byte will be zero and the system or the analyzer will be ready to measure, if the error is removed i.e. the FID flame is still burning. If these parameters are not correct, the error status byte will be different from zero. The test bench control computer will read the operation mode and the error status as long as the system or the analyzer will be ready to measure. The test bench control computer will control the maximum time for this reading.
Specifications of the criterions and codes for the communication between

- the front-end computer (system computer) of an exhaust analyzer system and the test bench control computer.
- each analyzer of an exhaust analyzer system and the test bench control computer.
- the front-end computer (system computer) of an exhaust analyzer system and their single devices. The following measurement systems and equipments can also be such single devices.
- the front-end computer (system computer) of a fuel consumption analyzer and a test bench control computer.
- the front-end computer (system computer) of an SHED measurement equipment and the test bench control computer. (SHED: Sealed Housing for Evaporative Determination)
- the front-end computer (system computer) of a sampling system and the test bench control computer.

The computer of an analyzer or of a system will be named as FU (Function Unit) and the test bench control computer will be abbreviated with TBCC.
1. **Basic Informations**

You can distinguish three cases:

(1) Exhaust analyzer system:

Some analyzers are combined logically. That means, these analyzers are connected with the TBCC via an front-end computer (system computer). The communication does not take place directly between the TBCC and the analyzers, but it will take place via the front-end computer. The identification of each device resp. of the whole system will be done by a channel number. K0 means the whole configured analyzer system ("assembling command resp. assembling report"). Kn (n=1, nmax) means each physical available analyzer. KV means the corresponding front-end computer.

Some analyzers and the sampling devices or systems (e.g. CVS equipment, particle sampler, sampling system, etc.) are combined logically. That means, these analyzers are connected with the TBCC via an front-end computer (system computer). The communication does not take place directly between the TBCC and the devices or systems, but it will take place via the front-end computer. The identification of each device and system will be done by a channel number. The handling of the analyzers will be like described above. All the other devices or systems can only be called directly by the corresponding channel number. The front-end computer must know the mnemonics of these devices and systems. Furthermore, the front-end computer has to be able to send orders and read commands to the channels resp. to send responses to the TBCC.

(2) Single exhaust analyzers (single channel analyzers):

All analyzers are connected to the TBCC individually. So, an identification of the analyzers by the software would not be necessary, because the analyzers are identified by their hardware connections. But to get a homogeneous protocol, the channel number will be indicated with K0.

(3) Single exhaust analyzers (multi channel analyzers):

All analyzers are connected to the TBCC individually, but they measure more than a single component (e.g. CO and C02). The identification by the software is necessary, because it will call the single channels resp. components. That is why such a single analyzer will be treated like a system.
The codes determined in this manual are valid for the communication between

- the TBCC and the front-end computer of an exhaust analyzer system.
- the front-end computer of an exhaust analyzer system and the corresponding single devices.
- the TBCC and the single exhaust analyzers connected directly to the TBCC.
- the TBCC and other exhaust measuring or analyzing devices or equipments connected directly to the TBCC.

The floating point format is valid for the signal transfer.

The physical units are determined as follows:

- Exhaust values: ppm
- Temperatures: K
- Pressures: Pa
- Flow: l/min

The analyzer system or each analyzer can be set to the operation mode "MANUAL" selecting "REMOTE DISABLE" for the parameter "REMOTE EN-/DISABLE". This setup does not depend on the previous status of the system or analyzer.

If you select "REMOTE ENABLE", the mode "MANUAL" will retain for the moment, but the TBCC can call this operation mode with a control command. If the TBCC will setup the system/the analyzer to "REMOTE", the system/the analyzer will execute control commands from the TBCC. Precondition: The system/the analyzer is able to start the function selected.

In the mode "REMOTE DISABLE", the TBCC can only send read commands. It is only possible to read signals and status informations. If then the system or the analyzer is in the mode "MANUAL", it will ignore the control command from the TBCC. No change of the error status will be done in the response to the TBCC. Instead of that the response will display "MANUAL" as first date.

The same will be valid, if the parameter is "REMOTE ENABLE", but the TBCC did switch the system/the analyzer to the mode "MANUAL".

Otherwise, the operation mode can only be recognized by reading the status. This is also valid during a test is running.
If it is possible in a system to put single channels together to lines, so the following definition will be valid:

A line is the summary of "1-x" analyzers to a logical group "y", that can be switched physically to a gas channel "z". Each device can only be assigned to one line at the same time. If you will try to assign a channel to another line and this channel is already assigned, the front-end computer will send as response "DF" (data error). The organization of each defined line will be done in the front-end computer (CODE KV Ln ...). The order must be sent to the front-end computer "KV".

A line will be dissolved by the configuration without assignment of channels (CODE KV Ln) or by the reset order (SRES).

All available gas inputs can be assigned to a defined line. So it is possible to assign different lines to different gas sampling points, e.g. in front of a catalyst, behind a catalyst. If the gas running time will change in such cases, you have to regard for it.
2. List of all Codes

2.1. Control commands

<table>
<thead>
<tr>
<th>CODE</th>
<th>Kn</th>
<th>Mm</th>
<th>Function</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SALI</td>
<td>Kn</td>
<td>Mm</td>
<td>Linearization check with spangas</td>
<td>2 - 8</td>
</tr>
<tr>
<td>SARA</td>
<td>Kn</td>
<td>Autoranging &quot;OFF&quot; (located range will remain)</td>
<td>2 - 9</td>
<td></td>
</tr>
<tr>
<td>SARE</td>
<td>Kn</td>
<td>Autoranging &quot;ON&quot;</td>
<td>2 - 9</td>
<td></td>
</tr>
<tr>
<td>SATK</td>
<td>Kn</td>
<td>Autom. calibration</td>
<td>2 - 10</td>
<td></td>
</tr>
<tr>
<td>(zero and span calibration + zerogas + stand-by)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEGA</td>
<td>Kn</td>
<td>Spangas (spangas will flow with time limit)</td>
<td>2 - 15</td>
<td></td>
</tr>
<tr>
<td>SEMB</td>
<td>Kn</td>
<td>Mm</td>
<td>Set range (1, 2, 3, 4)</td>
<td>2 - 16</td>
</tr>
<tr>
<td>SFRZ</td>
<td>Kn</td>
<td>Decimal point setup for floating point format</td>
<td>2 - 18</td>
<td></td>
</tr>
<tr>
<td>SGTS</td>
<td>Kn</td>
<td>Device test</td>
<td>2 - 19</td>
<td></td>
</tr>
<tr>
<td>SHDA</td>
<td>Kn</td>
<td>K0</td>
<td>Hold mode &quot;OFF&quot;</td>
<td>2 - 20</td>
</tr>
<tr>
<td>SHDE</td>
<td>Kn</td>
<td>K0</td>
<td>Hold mode &quot;ON&quot;</td>
<td>2 - 20</td>
</tr>
<tr>
<td>SINT</td>
<td>Kn</td>
<td>Start integration (integral average)</td>
<td>2 - 21</td>
<td></td>
</tr>
<tr>
<td>SLCH</td>
<td>Kn</td>
<td>Mm</td>
<td>Linearization check (with gas distribution)</td>
<td>2 - 22</td>
</tr>
<tr>
<td>SLIN</td>
<td>Kn</td>
<td>Mm</td>
<td>Linearization</td>
<td>2 - 23</td>
</tr>
<tr>
<td>(with determination of corrections and saving)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLST</td>
<td>Kn</td>
<td>Set linearization step and get values</td>
<td>2 - 24</td>
<td></td>
</tr>
<tr>
<td>SMAN</td>
<td>Kn</td>
<td>Operation mode &quot;Manual&quot;</td>
<td>2 - 25</td>
<td></td>
</tr>
<tr>
<td>SMGA</td>
<td>Kn</td>
<td>Samplegas (will be sucked or will be on)</td>
<td>2 - 26</td>
<td></td>
</tr>
<tr>
<td>SNAB</td>
<td>Kn</td>
<td>Zerogas calibration</td>
<td>2 - 27</td>
<td></td>
</tr>
<tr>
<td>SNGA</td>
<td>Kn</td>
<td>Zerogas (zerogas will flow with time limit)</td>
<td>2 - 28</td>
<td></td>
</tr>
<tr>
<td>SPAB</td>
<td>Kn</td>
<td>Spangas calibration</td>
<td>2 - 29</td>
<td></td>
</tr>
<tr>
<td>SPAU</td>
<td>Kn</td>
<td>Pause (resting status, e.g. pumps, ozonator, deozonator, high voltage off, gas input closed within the device)</td>
<td>2 - 30</td>
<td></td>
</tr>
<tr>
<td>SQEF</td>
<td>Kn</td>
<td>Mm</td>
<td>Cross interference (only for CO analyzers)</td>
<td>2 - 31</td>
</tr>
<tr>
<td>SREM</td>
<td>Kn</td>
<td>Operation mode &quot;Remote&quot;</td>
<td>2 - 32</td>
<td></td>
</tr>
<tr>
<td>SRES</td>
<td>Kn</td>
<td>Reset (analyzer will change via initializing mode to stand-by)</td>
<td>2 - 33</td>
<td></td>
</tr>
<tr>
<td>SROF</td>
<td>Kn</td>
<td>Delay modus &quot;OFF&quot; (operation mode: signal output with/without delay time, involved are SINT, AKON, AIKO, AIKG, analog signal)</td>
<td>2 - 34</td>
<td></td>
</tr>
<tr>
<td>SRON</td>
<td>Kn</td>
<td>Delay modus &quot;ON&quot; (analog to &quot;SROF&quot;)</td>
<td>2 - 34</td>
<td></td>
</tr>
<tr>
<td>SSPL</td>
<td>Kn</td>
<td>Purging (purge air will be sucked or will be on)</td>
<td>2 - 35</td>
<td></td>
</tr>
<tr>
<td>ST9O</td>
<td>Kn</td>
<td>Set t&lt;sub&gt;90&lt;/sub&gt; time step (S = fast, M = medium, L = slowly)</td>
<td>2 - 36</td>
<td></td>
</tr>
<tr>
<td>STBY</td>
<td>Kn</td>
<td>Stand-by (get ready for measurement no matter of the previous history)</td>
<td>2 - 37</td>
<td></td>
</tr>
</tbody>
</table>

Optional:

| CODE | Kn | Start system calibration (only for platform) | 2 - 13 |
| SENO | Kn | NO measurement (operation mode CLD) | 2 - 17 |
| SNOX | Kn | NO<sub>x</sub> measurement (operation mode CLD) | 2 - 17 |

**Kn:** Channel n

**Mm:** Range m

**Response**

The response to the control commands will contain the CODE of the control command and the error status byte (0-9).
2.2. Read commands

<table>
<thead>
<tr>
<th>CODE</th>
<th>Function</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAEG</td>
<td>Kn Spangas deviation</td>
<td>2 - 39</td>
</tr>
<tr>
<td>AALI</td>
<td>Kn Mm Deviations of the last linearization checks with spangas</td>
<td>2 - 40</td>
</tr>
<tr>
<td>AANG</td>
<td>Kn Zerogas deviation</td>
<td>2 - 41</td>
</tr>
<tr>
<td>AEMB</td>
<td>Kn CODE Selected range (R1, R2, R3, R4)</td>
<td>2 - 45</td>
</tr>
<tr>
<td>AFDA</td>
<td>Kn CODE Zero- /spangas time (function length of calibration)</td>
<td>2 - 46</td>
</tr>
<tr>
<td>AFDA</td>
<td>Kn CODE Purge time</td>
<td>2 - 46</td>
</tr>
<tr>
<td>AGID</td>
<td>Kn Device identification</td>
<td>2 - 47</td>
</tr>
<tr>
<td>AGRW</td>
<td>Kn m Limit</td>
<td>2 - 48</td>
</tr>
<tr>
<td>AIKG</td>
<td>Kn Concentration integral average; all (in ppm)</td>
<td>2 - 49</td>
</tr>
<tr>
<td>AIKO</td>
<td>Kn Concentration integral average (in ppm)</td>
<td>2 - 51</td>
</tr>
<tr>
<td>AKAK</td>
<td>Kn Mm Calibration gas concentration (in ppm)</td>
<td>2 - 53</td>
</tr>
<tr>
<td>AKAL</td>
<td>Kn Stored calibration corrections</td>
<td>2 - 54</td>
</tr>
<tr>
<td>AKFG</td>
<td>Kn Configuration of the system</td>
<td>2 - 57</td>
</tr>
<tr>
<td>AKON</td>
<td>Kn Concentration (current value in ppm)</td>
<td>2 - 58</td>
</tr>
<tr>
<td>ALCH</td>
<td>Kn Mm Deviations of the last linearization checks</td>
<td>2 - 61</td>
</tr>
<tr>
<td>ALIK</td>
<td>Kn Calculation of linearization curve</td>
<td>2 - 62</td>
</tr>
<tr>
<td>ALIN</td>
<td>Kn Mm Linearization values in the device (X/Y = Setpoint-/raw value)</td>
<td>2 - 63</td>
</tr>
<tr>
<td>ALEKO</td>
<td>Kn Mm Polynomial coefficients of the linearization curve</td>
<td>2 - 64</td>
</tr>
<tr>
<td>ALST</td>
<td>Kn Linearization steps</td>
<td>2 - 65</td>
</tr>
<tr>
<td>AM90</td>
<td>Kn Actual response time (t90 time)</td>
<td>2 - 66</td>
</tr>
<tr>
<td>AMBA</td>
<td>Kn Mm Begin of range (in ppm)</td>
<td>2 - 67</td>
</tr>
<tr>
<td>AMBE</td>
<td>Kn Mm End of range (in ppm)</td>
<td>2 - 68</td>
</tr>
<tr>
<td>AMBU</td>
<td>Kn Switch levels for autoranging</td>
<td>2 - 69</td>
</tr>
<tr>
<td>AMDR</td>
<td>Kn Manual adjusted pressure</td>
<td>2 - 70</td>
</tr>
<tr>
<td>AQEF</td>
<td>Kn Cross interference check result (in ppm) (only for CO analyzers)</td>
<td>2 - 71</td>
</tr>
<tr>
<td>ASOL</td>
<td>Kn Setpoint value with limits</td>
<td>2 - 72</td>
</tr>
<tr>
<td>ASTA</td>
<td>Kn General status of the system</td>
<td>2 - 73</td>
</tr>
<tr>
<td>ASTF</td>
<td>Kn Internal error status</td>
<td>2 - 74</td>
</tr>
<tr>
<td>ASTZ</td>
<td>Kn Device status</td>
<td>2 - 76</td>
</tr>
<tr>
<td>ASYZ</td>
<td>Kn System time (year, month, day, hour, min., sec.)</td>
<td>2 - 78</td>
</tr>
<tr>
<td>AT9O</td>
<td>Kn T90 time (response time)</td>
<td>2 - 79</td>
</tr>
<tr>
<td>ATEM</td>
<td>Kn m Temperature</td>
<td>2 - 80</td>
</tr>
<tr>
<td>ATOL</td>
<td>Kn Mm Stability tolerances</td>
<td>2 - 81</td>
</tr>
<tr>
<td>AVEZ</td>
<td>Kn Delay and synchronization time</td>
<td>2 - 83</td>
</tr>
<tr>
<td>AZEI</td>
<td>Kn CODE Times (for procedures)</td>
<td>2 - 84</td>
</tr>
</tbody>
</table>

Optional:

| ABST   | Kn Counter of operating hours                                                                 | 2 - 42|
| ADRU   | Kn m Pressure (for service)                                                                    | 2 - 43|
| ADUF   | Kn m Flow (for service)                                                                         | 2 - 44|
| AKEN   | Kn Device tag                                                                                  | 2 - 56|
| AKOW   | Kn Mm Correction (zerogas calibration and gradient)                                             | 2 - 60|
| AUKA   | Kn Uncorrected analog value                                                                     | 2 - 82|

Kn: Channel n  
Mm: Range m

Response
The response to the read command will contain the CODE of the read command, the error status byte (0-9) and the data.
2.3. **Write commands**

<table>
<thead>
<tr>
<th>CODE</th>
<th>Kn</th>
<th>Function</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFDA</td>
<td>Kn</td>
<td>CODE Zero-/spangas time (function length of calibration)</td>
<td>2 - 85</td>
</tr>
<tr>
<td>EGRA</td>
<td>Kn</td>
<td>DATA Purge time</td>
<td>2 - 85</td>
</tr>
<tr>
<td>EKAK</td>
<td>Kn</td>
<td>Mm Calibration gas concentration (in ppm)</td>
<td>2 - 88</td>
</tr>
<tr>
<td>EKFG</td>
<td>Kn</td>
<td>DATA Configuration of the system</td>
<td>2 - 90</td>
</tr>
<tr>
<td>ELIN</td>
<td>Kn</td>
<td>Mm Linearization values in the device (X/Y = Setpoint-/raw value)</td>
<td>2 - 91</td>
</tr>
<tr>
<td>ELKO</td>
<td>Kn</td>
<td>DATA Polynomial coefficients of the linearization curve</td>
<td>2 - 92</td>
</tr>
<tr>
<td>ELST</td>
<td>Kn</td>
<td>DATA Linearization steps</td>
<td>2 - 93</td>
</tr>
<tr>
<td>EMBN</td>
<td>Kn</td>
<td>Mm Begin of range (in ppm)</td>
<td>2 - 94</td>
</tr>
<tr>
<td>EMBE</td>
<td>Kn</td>
<td>Mm End of range (in ppm)</td>
<td>2 - 95</td>
</tr>
<tr>
<td>EMBU</td>
<td>Kn</td>
<td>DATA Switch levels for autoranging</td>
<td>2 - 96</td>
</tr>
<tr>
<td>EMDR</td>
<td>Kn</td>
<td>DATA Manual adjusted pressure</td>
<td>2 - 97</td>
</tr>
<tr>
<td>ESOL</td>
<td>Kn</td>
<td>Mm Setpoint value with limits</td>
<td>2 - 98</td>
</tr>
<tr>
<td>ESYZ</td>
<td>Kn</td>
<td>DATA System time (year, month, day, hour, min., sec.)</td>
<td>2 - 99</td>
</tr>
<tr>
<td>ET9O</td>
<td>Kn</td>
<td>DATA T90 time (response time)</td>
<td>2 -100</td>
</tr>
<tr>
<td>ETOL</td>
<td>Kn</td>
<td>Mm Stability tolerances</td>
<td>2 -101</td>
</tr>
<tr>
<td>EVEZ</td>
<td>Kn</td>
<td>DATA Delay and synchronization time</td>
<td>2 -102</td>
</tr>
<tr>
<td>EZEI</td>
<td>Kn</td>
<td>CODE Times (for procedures)</td>
<td>2 -103</td>
</tr>
</tbody>
</table>

**Optional:**

| EKEN | Kn | DATA Device tag | 2 - 89 |

**Kn:** Channel n  
**Mm:** Range m

**Response**

The response to the write commands will contain the CODE of the write command and the error status byte (0 - 9).
3. **Description of all Control Commands**

- **SALI – Control command \"Linearization check with span gases\"**

Starting this command the analyzer in a system or the single analyzer will start the span gases flow with all available span gases one after another. It will check the setpoint values automatically. The device will record the determined values and store the raw/setpoint deviations. These deviations can be read with the command "AALI".

**Control command**

SALI Kn Mx

Function associated to channel n, range x

Code

**Response**

SALI 0

Error status

Code
SARA – Control command "Autoranging OFF"
SARE – Control command "Autoranging ON"

Starting the command "Autoranging ON" the analyzers in a system or the single analyzer will select the best range for the current concentration automatically. With the control command "SEMB" the autoranging will be stopped and the range sent with the "SEMB" command will be selected. The command "Autoranging OFF" will stop this function, but the found range will remain.

Control command

SARE K0
SARA K0

Function associated to the whole system unit

Code

SARE Kn
SARA Kn

Function associated to a single analyzer

Code
SATK – Control command "Automatic calibration"

Starting this command the analyzers in a system or the single analyzer will start a calibration procedure to determine the correction values. The required calibration gases and the pumps will be switched on automatically. Then, the calibration procedure will start automatically. Such a procedure has to run until the end. It may not be canceled or interrupted by other functions. Otherwise it is not sure that the correction values will be valid to calculate the exhaust values of analysis. Exceptions are the commands "Reset" or "Stand-by". After the procedure will be over the system, the analyzers in a system or the single analyzer will have to change to the operation mode "Stand-by".

Control command

\[
\text{SATK } K0
\]
Function associated to the whole system unit

\[
\text{SATK } K1 \text{ Kn}
\]
Function associated to channel n
Function associated to channel 1

\[
\text{SATK } Kn \text{ M3}
\]
Function associated to channel n and range 3

Response

\[
\text{SATK } 0
\]
Error status

\[
\text{Code}
\]
Stability control procedure

- Wait dead time $T_t$, if gases were switched
- Start timer for time-out $T_o$
- Calculate concentration mean value $K_1$ over time $T_i$
- Set and start timer for stability time
- Calculate concentration mean value $K_{new}$ over time $T_i$
- Deviation $= |K_1 - K_{new}|$
- Time out ?
  - Yes: Signal not stable
  - No:
    - Dev. $\geq$ Tol.:
      - Yes: $K_1 = K_{new}$
      - No:
        - Stability time over ?
          - Yes: Signal stable
          - No: Signal $= K_{new}$

Parameters:
- $T_o$: Time-out [xx s] (max. time for stability control)
- $T_t$: Dead time [xx s] (Wait after gas switching)
- $T_i$: Integration time [xx, x s] (for $K_1$, $K_{new}$)
- $T_s$: Stability time [xx s]
- Tol.: Tolerance [x, x % range]
**Stability control**

- Begin of gas flow
- Begin of stability control
- New begin of stability control
- Signal = Knew
- K1
- Knew
- 2 * Deviation
- Dead time Tt
- Stability time Ts
- Time-out

**Stability controlled procedure of the zero/span calibration**

- Begin of the function SATK
- Average over Ti, Read with AANG
- Average over Ti, Read with AAEG
- Dead time
- Stability time

Calibration

Average over Ti, Read with AAEG
Only for platform: SCAL – Control command "Start system calibration"

To control the system calibration procedures the commands "SCAL", "STBY" and "ASTZ" have to be used. With "SCAL" the procedures will be started. For more exact description of procedures see also the "documentation of system calibration".

Starting condition: All attached analyzer module are in the stand-by mode ("AK STBY") and the variable "CALSTAT" is "0". Otherwise the response is "BUSY" (BS).

Control command

SCAL  Kx  m  (n)

Optional parameters
Type of system calibration
Function associated to channel x
Code

<table>
<thead>
<tr>
<th>m</th>
<th>Kx</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = ZERO-CAL</td>
<td>K0</td>
<td>n = 1: switch into test mode</td>
</tr>
<tr>
<td>1 = ZERO/SPAN-CAL</td>
<td>K0</td>
<td>else: switch into normal mode</td>
</tr>
<tr>
<td>2 = PROGRAM</td>
<td>K0</td>
<td></td>
</tr>
<tr>
<td>3 = TEST ZERO-GAS</td>
<td>K1...999</td>
<td>time-out in sec</td>
</tr>
<tr>
<td>4 = TEST SPAN-GAS1</td>
<td>K1...999</td>
<td>time-out in sec</td>
</tr>
<tr>
<td>5 = TEST SPAN-GAS2</td>
<td>K1...999</td>
<td>time-out in sec</td>
</tr>
<tr>
<td>6 = TEST SPAN-GAS3</td>
<td>K1...999</td>
<td>time-out in sec</td>
</tr>
<tr>
<td>7 = TEST SPAN-GAS4</td>
<td>K1...999</td>
<td>time-out in sec</td>
</tr>
<tr>
<td>8 = TEST CLOSE GASES</td>
<td>K1...999</td>
<td>time-out in sec</td>
</tr>
</tbody>
</table>

If optional parameter "n" is not in the command string the appropriate variable will not be changed.

Stop command
STBY K0

- Function associated to the whole system unit
- Code

Only using the channel number 0 (K0) will stop running "SYSCAL" procedure. Besides, all procedures of the other analyzer modules will be stopped.

Response

SCAL 0

- Error status
- Code

Read command

ASTZ K0

- Read of the whole FU
- Code

With the command "ASTZ K0" it will be checked, if a system calibration is running or not. "SCAL" will be sent back for a running system calibration. If no system calibration is running this string will be missed.
SEGA – Control command "Spangas"

Starting this command the analyzers in a system or the single analyzer will switch on the calibration valve to spangas and switch on the required pumps. This function will only check the end point. It will not correct the calibration. If continuous line recorders will be available, the paper transport will also be switched on.

Control command

SEGA K0
- Function associated to the whole system unit
- Code

SEGA K1 Kn
- Function associated to channel n
- Function associated to channel 1
- Code

Response

SEGA 0
- Error status
- Code
SEMB – Control command "Set range"

Starting this command the analyzers in a system or the single analyzer will set the range that is named in the data. If the function "Autoranging" is running at that moment, it will be stopped and the named range will be selected.

Control command

SEMB  K1  M4  Kn  M2
       Function associated to channel n range 2
       Function associated to channel 1 range 4
       Code

Response

SEMB  0
      Error status
      Code
Only for CLD module: SENO/SNOX – Control command "Operation mode CLD"

Starting the command "SENO" the CLD analyzers in a system or the single CLD analyzer will start the NO measurement. The command "SNOX" will start the NO\textsubscript{x} measurement.

Control command

SENO  Kn

\begin{itemize}
  \item Function associated to channel n
  \item Code for NO measurement
\end{itemize}

SNOX  Kn

\begin{itemize}
  \item Function associated to channel n
  \item Code for NO\textsubscript{x} measurement
\end{itemize}

Response

SENO  0

\begin{itemize}
  \item Error status
  \item Code for NO measurement
\end{itemize}

SNOX  0

\begin{itemize}
  \item Error status
  \item Code for NO\textsubscript{x} measurement
\end{itemize}
SFRZ – Control command "Decimal point setup for floating point format"

With this command the format of real numbers will be setup.

This command will have an effect to the output of all real numbers. It is not possible to vary it for different channels.

Control command

SFRZ K0 n

Parameter
Function associated to the whole system unit
Code

Description of parameter “n”

n = 1..9:  n  = number of digits after decimal point in normal floating point format.
           (f-notation of C-language’s printf)

n = 11..19: (n-10) = is the maximum number of significant digits of either normal floating point format or E-format, whichever is shorter.
            (g-notation of C-language’s printf).

Factory setting: n = 16 (= default).

Default is used if no other value for n is specified by a SFRZ command.

n = 10 will set n = default

Response

SFRZ 0

Error status
Code

Example:
Number:  1234567.821
n = 2  →  1234567.82
n = 13 →  1.23E06
n = 15 →  1234600
**SGTS – Control command "Device test"**

Starting this command the analyzers in a system or the single analyzer will switch off the calibration gas and the samplegas. That means, all gas tubes to the analyzer device will be closed and the pumps will be switched off. Then, the device can be checked via a gas input that is located directly in front of the device.

**Control command**

SGTS K0

- Function associated to the whole system unit
- Code

SGTS K1 Kn

- Function associated to channel n
- Function associated to channel 1
- Code

**Response**

SGTS 0

- Error status
- Code
We have the possibility to activate the "Hold"-feature not only per calibration. We can do this also by AK-Command "SHDE". With the command "SHDA" we have the possibility to deactivate an activated "Hold" again. Starting the command "SHDE" will switch on the "hold status". So it is possible to start the "Hold"-feature directly by AK command and not only per calibration. With the "SHDA" command the "Hold status" will be deactivated.

**Control command**

<table>
<thead>
<tr>
<th>Command</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHDE K0</td>
<td></td>
</tr>
<tr>
<td>SHDA K0</td>
<td></td>
</tr>
</tbody>
</table>

Function associated to the whole system unit

**Response**

<table>
<thead>
<tr>
<th>Command</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHDE 0</td>
<td></td>
</tr>
<tr>
<td>SHDA 0</td>
<td></td>
</tr>
</tbody>
</table>

Error status

**Code**
SINT – Control command "Integrator"

Starting this command the FU will activate the internal integrators. The previous calculated and stored integral averages will be set to zero. The integrator will calculate new integral averages as long as the control command "SINT" will be received again. The result of the integrator can be read with the command "AIKG".

Control command

SINT  K0

Function associated to the whole system unit

Code

SINT  K1  Kn

Function associated to channel n

Function associated to channel 1

Code

Response

SINT  0

Error status

Code
**SLCH – Control command "Linearization check"**

Starting this command the analyzers in a system or the single analyzer will switch on the gas tubing to a gas distribution and a linearization procedure will run. The device will record the correction values to the receiver specific raw curve. The deviations to the correction values of the last determined linearization will be stored. Look at the command "SLIN" for informations about the logic of the device control and of the gas distribution control.

**Control command**

```
SLCH Kn Mn
```

- Range n
- Function associated to channel n
- Code

**Response**

```
SLCH 0
```

- Error status
- Code
SLIN – Control command "Linearization"

Starting this command the analyzers in a system or the single analyzer will switch on the gas tubing to a gas distribution. A linearization procedure for the selected range will run. The device will record the determined correction values to the receiver specific raw curve. The values will be stored in the device to calculate the gas concentration. This procedure will be controlled by several commands of the TBCC or the system. The device or the gas distribution will only accept those commands, if they have already received the "SLIN" command. The "SLIN" command prepares the device or the gas distribution to receive and execute further commands being necessary for the linearization procedure. The spangas concentration has to be set up before by the "EKAK" command.

Control command

SLIN  Kn  Mn

Range n

Function associated to channel n

Code

Response

SLIN  0

Error status

Code
SLST – Control command "Set linearization step"

Starting this command the gas distribution will switch on the named distribution step. The device will work like described for the commands "SLIN" or "SLCH" depending on the current procedure. The device will only accept the "SLST" command, if the commands "SLIN" or "SLCH" were received before followed by the command "ELST".

Control command

SLST  K1   n

Distribution step

Function associated to channel 1

Code

Response

SLST  0

Error status

Code
SMAN – Control command "Operation mode MANUAL"

With this command the FU will change to the operation mode "Manual". Then it will only be possible to start functions from an operating unit integrated in the FU. The same operation mode will be enabled, if the service switch of the FU will be in the position "Remote Disable". In that mode it will only be possible to answer to read commands of the TBCC.

Control command

- **SMAN K0**
  - Function associated to the whole system unit
  - Code

- **SMAN K1 Kn**
  - Function associated to channel n
  - Function associated to channel 1
  - Code

Response

- **SMAN 0**
  - Error status
  - Code
SMGA – Control command "Samplegas"

Starting this command the analyzers in a system or the single analyzer will switch on the sample gas valve and the pumps necessary for the samplegas transport. If continuous line recorders will be available, the paper transport will also be switched on.

<table>
<thead>
<tr>
<th>Control command</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMGA K0</td>
</tr>
<tr>
<td>Function associated to the whole system unit</td>
</tr>
<tr>
<td>Code</td>
</tr>
<tr>
<td>SMGA K1 Kn</td>
</tr>
<tr>
<td>Function associated to channel n</td>
</tr>
<tr>
<td>Function associated to channel 1</td>
</tr>
<tr>
<td>Code</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMGA 0</td>
</tr>
<tr>
<td>Error status</td>
</tr>
<tr>
<td>Code</td>
</tr>
</tbody>
</table>
SNAB – Control command "Zerogas calibration"

Starting this command the analyzers in a system or the single analyzer will start a zerogas calibration. The calibration gas flow will start automatically and the calibration procedure will run. After this procedure will be over the system, the analyzer in a system or the single analyzer will change to the stand-by mode. The running calibration procedure can be canceled with the "STBY" command.

Control command

SNAB K0

Function associated to the whole system unit

Code

SNAB K1 Kn

Function associated to channel n

Function associated to channel 1

Code

Response

SNAB 0

Error status

Code
**SNGA – Control command "Zerogas"

Starting this command the analyzers in a system or the single analyzer will switch on the zerogas valve and the pumps necessary for the zerogas transport. This function will only check the zero point. It will not correct the calibration. If continuous line recorders will be available, the paper transport will also be switched on.

**Control command**

SNGA K0

<table>
<thead>
<tr>
<th>Function associated to the whole system unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
</tr>
</tbody>
</table>

SNGA K1 Kn

<table>
<thead>
<tr>
<th>Function associated to channel n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function associated to channel 1</td>
</tr>
<tr>
<td>Code</td>
</tr>
</tbody>
</table>

**Response**

SNGA 0

<table>
<thead>
<tr>
<th>Error status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
</tr>
</tbody>
</table>
SPAB – Control command "Spangas calibration"

Starting this command the analyzers in a system or the single analyzer will start a spangas calibration. The calibration gas flow will start automatically and the calibration procedure will run. After this procedure will be over the system, the analyzer in a system or the single analyzer will change to the stand-by mode. The running calibration procedure can be canceled with the "STBY" command.

Control command

SPAB K0
Function associated to the whole system unit
Code

SPAB K1 Kn
Function associated to channel n
Function associated to channel 1
Code

Response

SPAB 0
Error status
Code
**SPAU – Control command "Pause"**

With this command the FU will be set to a defined status of interruption. This command will only be accepted, if the FU is already in the stand-by mode. The "SPAU" command will switch off the operation modes (e.g. FID flame, pump of an NO device) or the corresponding setpoints (e.g. temperature of the hot pipe). With the control command „Reset“ or „Stand-by“ the FU will change to the stand-by mode to get ready for operation. The real functionality of the "SPAU" command will depend on the used FU. It is part of each device or system specification.

**Control command**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAU K0</td>
<td>Function associated to the whole system unit</td>
<td></td>
</tr>
<tr>
<td>SPAU Kn</td>
<td>Function associated to channel n</td>
<td></td>
</tr>
</tbody>
</table>

**Response**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAU 0</td>
<td>Error status</td>
<td></td>
</tr>
</tbody>
</table>
**SQEF – Control command "Cross interference"**

Starting this command the CO analyzer will measure wet CO$_2$. It will be produced by streaming three percent CO$_2$ through water bottles at 20 degrees Celsius. The CO analyzer will measure this gas mixture. The signal will be stored in the analyzer. It can be read by the TBCC with the "AQEF" command. The measured concentration has to be maximum 3 ppm for ranges smaller than 300 ppm. For bigger ranges it has to be maximum 1 % of the end of range value. These limits will be controlled by the TBCC.

**Control command**

\[
\text{SQEF } Kn
\]

\begin{itemize}
  \item Function associated to channel n
  \item Code
\end{itemize}

**Response**

\[
\text{SQEF } 0
\]

\begin{itemize}
  \item Error status
  \item Code
\end{itemize}
**SREM – Control command "Remote"**

With this command the FU will change to the computing operation mode. Then, the function start will only be possible by the TBCC. This operation mode may only be set, if the service switch of the FU is in the position "Remote Enable".

**Control command**

- **SREM K0**
  - Function associated to the whole system unit
  - Code

- **SREM K1 Kn**
  - Function associated to channel n
  - Function associated to channel 1
  - Code

**Response**

- **SREM 0**
  - Error status
  - Code
**SRES – Control command "Reset"**

With this command the FU will get a software reset. This command has the same effect to the FU like the switching off and on of the power supply. All running procedures will be canceled. An initializing will be started, e.g. check and control of temperature setpoints. After that the operation modes "Manual" and "Stand-by" will be enabled.

**Control command**

SRES K0

| Function associated to the whole system unit | Code |

SRES Kn

| Function associated to channel n | Code |

**Response**

SRES 0

| Error status | Code |
SRON  – Control command "Delay modus ON"
SROF  – Control command "Delay modus OFF"

Starting this command the analyzers in a system or the single analyzer will determine measurement and integral values (averages), that will be delayed according to the delay time of the write command "EVEZ". The read commands "AKON", "AIKO" and "AIKG" will get an old value according to the synchronization time of the command "EVEZ". The analog output will get the same delay. With the command "Delay modus OFF" the integrators will start immediately and the measurement and integral values will be determined and sent out without delay.

Control command

SRON  K0
SROF  K0

Function associated to the whole system unit

Code

SRON  Kn
SROF  Kn

Function associated to channel n

Code

Response

SRON  0
SROF  0

Error status

Code
SSPL – Control command "Purging"

Starting this command the analyzers in a system or the single analyzer will switch on the purge gas valve and the pumps necessary for the purge gas transport. This function can be finished either by a new command or by a defined time interval. After the purging will be over the system, the analyzer in a system or the single analyzer will change to the stand-by mode.

Control command

SSPL K0
  Function associated to the whole system unit
  Code

SSPL Kn
  Function associated to channel n
  Code

Response

SSPL 0
  Error status
  Code
ST9O – Control command "Set $t_{90}$ time step"

With this command the analyzer will use the $t_{90}$ time according to the current step. The abbreviation "S" means fast time, "M" means medium time and "L" means slow time. After the switching on of the device or after a "Reset" the fastest time will be set.

Control command

ST9O K1 S

Function associated to channel 1, fast time

Code

Response

ST9O 0

Error status

Code
**STBY – Control command "Stand-by"**

With the command "Stand-by" the FU will be set to a defined status of interruption. Running functions like measuring or purging will be canceled. Then, the stand-by mode will be enabled. The ranges will keep selected. The FU will get ready for measurement and operating, no matter which mode was the previous.

**Control command**

STBY  Kn

Function associated to the whole system unit

Code

**Response**

STBY  0

Error status

Code
4. Description of all Read Commands

AAEG - Read command "Deviation to spangas"

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device):

* The measured and stored signal of the last spangas measurement.
* The deviation from the setpoint value of the linearized curve in ppm and percent, referred to the end of range value.

Spangas measurement: Signal after the end of the functions "Automatic calibration" or "Spangas", stability controlled or time controlled depending on the setup in "EFDA".

Read command

```
AAEG K0
AAEG Kn
```

Read of the whole system unit

```
Code
```

Response

```
AAEG 0 M1 XXX YYY ZZ ... Mn XXX YYY ZZ
```

```
Deviation [%]
Deviation [ppm]
Signal [ppm]
Range n
Deviation [%]
Deviation [ppm]
Signal [ppm]
Range 1
Error status
Code
```

The values will get the same format for the read of single channels.
AALI - Read command "Deviations of the last linearization check with spangas"

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device) and subchannel (range):

* The determined and stored deviations in ppm of the last linearization check with spangas.

Read command

AALI  Kn  Mx

Read of channel n and range x

Code

Response

AALI  0  AAA  BBB ...... XXX

xth difference

2nd difference

1st difference

Error status

Code
AANG - Read command "Deviation to zerogas"

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device):
* The determined and stored signal of the last zerogas measurement with its range.
* The deviation from the setpoint value of the linearized curve in ppm and percent, referred to the end of range value.

Zerogas measurement: Signal after the end of the functions "Automatic calibration" or "Zerogas", stability controlled or time controlled depending on the setup in "EFDA".

**Read command**

AANG K0
AANG Kn

Read of the whole system unit

**Response**

AANG 0 M1 XXX YYY ZZ ... Mn XXX YYY ZZ

|------|---------------|-----------------|--------------|---------|---------------|-----------------|--------------|---------|--------------|------|

The values will get the same format for the read of single channels.
ABST - Read command "Counter of operating hours"

To this read command the FU will send to the TBCC the following data:
* The operating hours until now for the roots fan, the turbo compressor, the sampling pumps etc. The operating hours will only be sent as integers.

Read command

ABST  K0
    Read of the whole system unit
    Code

Response

ABST  0  T1  T2 ... Tn
    Value of each hour of operation
    Error status
    Code
ADRU - Read command "Pressure"

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device) and if need be for the subchannel (pressure measurement):

* The signal in Pascal.

**Note:** At the moment no subchannels will be used.

Read command

ADRU  K0
ADRU  Kn  (m)

Read of channel n (and subchannel m)

Code

Response

ADRU  0  XXX

Pressure value

Error status

Code
**ADUF - Read command "Flow"**

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device) and subchannel (flow measurement):

* The signal in liter per time unit.

**Read command**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADUF K0</td>
<td>Read of channel n (and subchannel m)</td>
</tr>
<tr>
<td>ADUF Kn</td>
<td>Code</td>
</tr>
</tbody>
</table>

**Response**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADUF 0</td>
<td>Flow value</td>
</tr>
<tr>
<td>XXX</td>
<td>Error status</td>
</tr>
<tr>
<td></td>
<td>Code</td>
</tr>
</tbody>
</table>
AEMB - Read command "Selected range"

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device):

* The selected and used range at this moment.

**Read command**

AEMB K0
AEMB Kn

Read of channel n Code

**Response**

AEMB 0 Mn

Range with setup
Error status
Code
AFDA - Read command "Function length"

To this read command the FU will send to the TBCC the following data for the called channel (device):

- The function or procedure times of the function determined in "CODE". Functions like "SATK", "SLIN", "SLCH", "SALI", "SQEF", "SNGA" or "SEGA" will run time controlled according to the times T1 to T4 or stability controlled.

**Time control:** If only T1 is set or if T2 = 0, time control will run with step time T1 (total function time).

**Stability control:** Times T1 to T4 have to be set.

**Read command**

AFDA K0 CODE  
AFDA Kn CODE  

- Code for the function
- Read of channel n

**Response**

AFDA 0 T1 (T2 T3 T4)  

- "Time out"; after this time is over, the procedure will be canceled and you will get an error message; this time will start after the wait.
- Integration time to get the mean value of one signal.
- Stability time: All signals have to be in a certain tolerance during this time.
- Time to wait for: after the switching on resp. changing of gases or the stepping time of time control.

Error status

Code
AGID - Read command "Device identification"

To this read command the gas analyzer will send to the TBCC a text string consisting of several data. These data will be separated by a slash (/).

Read command

AGID K0

Read of the whole system unit

Code

Response

AGID 0 a/b/c

Device identification

a = Name and serial number
b = Program version

Error status

c = Date

Code
**AGRW - Read command "Limits"**

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device):

* The corresponding limits, e.g. maximum deviations of calibration.

**Read command**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGRW K0 m</td>
<td>Read of channel n and subchannel m</td>
</tr>
<tr>
<td>AGRW Kn m</td>
<td></td>
</tr>
<tr>
<td></td>
<td>m = 0: Zerogas calibration</td>
</tr>
<tr>
<td></td>
<td>m = 1: Spangas calibration</td>
</tr>
</tbody>
</table>

**Response**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGRW 0 XXX</td>
<td>Limit</td>
</tr>
<tr>
<td></td>
<td>Error status</td>
</tr>
<tr>
<td></td>
<td>Code</td>
</tr>
</tbody>
</table>
**AIKG - Read command "Concentration integral value; all"**

To this read command the FU will send to the TBCC the following data:

* The corrected average signal valid at that moment (e.g. analyzed value), that has been calculated since the last "SINT" command. The physical parameter is described in the section about FU. The value will be limited to six relevant digits, because it is useless to send gas concentrations in an accuracy less than pars pro mille. Look at the example of the "AKON" command!

Cf. the "SFRZ" command!

---

**Read command**

AIKG  K0

- Read of the whole system unit
- Code

AIKG  K1 ... Kn

- Read of channel n
- Read of channel 1
- Code
Response

AIKG 0 123400 12340 1234 123.4 12.34 -1.23 #

Channel 7 no signal, invalid or range overflow/underflow

Channel 6 negative value 1 digit before/2 digits after decimal point.

Channel 5 positive value 2 digit before/2 digits after decimal point.

Channel 4 positive value 3 digits before/1 digit after decimal point.

Channel 3 positive value 4 digits

Channel 2 positive value 5 digits

Channel 1 positive value 6 digits

Error status

Code

The values will get the same format for the read of single channels.
**AIKO - Read command "Concentration integral value"**

To this read command the FU will send to the TBCC the following data:

* The corrected average signal valid at that moment (e.g. analyzed value), that has been calculated since the last "SINT" command resp. the last "AIKO" command. The physical parameter is described in the section about FU. The value will be limited to six relevant digits, because it is useless to send gas concentrations in an accuracy less than parts pro mille. Look at the example of the "AKON" command!

**Read command**

```plaintext
AIKO  K0
      Read of the whole system unit
      Code

AIKO K1 ... Kn
      Read of channel n
      Read of channel 1
      Code
```
Response

AIKO 0 123400 12340 1234 123.4 12.34 -1.23 #

Channel 7 no signal, invalid or range overflow/underflow

Channel 6 negative value 1 digit before / 2 digits after decimal point.

Channel 5 positive value 2 digit before / 2 digits after decimal point.

Channel 4 positive value 3 digits before / 1 digit after decimal point.

Channel 3 positive value 4 digits

Channel 2 positive value 5 digits

Channel 1 positive value 6 digits

Error status

Code

The values will get the same format for the read of single channels.
AKAK - Read command "Calibration gas concentration"

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device) and range:

* The calibration gas concentration in ppm.

Read command

```
AKAK Kn [Mx]
```

- Range number (optional); \( x = 1, 2, 3, 4 \)
- Output of all ranges, if no range is named.
- Read of channel n
- Code

Response

```
AKAK 0 M1 XXX M2 XXX ... Mn ZZZ
```

- Concentration of calibration gas
- Range n
- Concentration of calibration gas
- Range 2
- Concentration of calibration gas
- Range 1
- Error status
- Code

The values will get the same format for the read of single ranges.
**AKAL - Read command "Stored calibration corrections"**

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device):

* The corrections in ppm determined and stored during the last calibration. These corrections are also necessary to calculate the analyzer values (deviations from the linearized curve).
* The sum of deviations (total correction) to the calibration before the last linearization check for the last range calibrated with zero and spangas.

Read command

```
AKAL  K0  [Mx]
AKAL  Kn  [Mx]
```

Range number (optional); \( x = 1, 2, 3, 4 \)

Output of all ranges, if no range is named.

Read of channel \( n \)

Code
Response

AKAL 0 M1 aaa kk AAA KK ..... Mn xxx ff XXX FF

- Deviation of the final point value
- Correction for the final point
- Deviation of the zero value
- Correction for the zero point
- nth range
- Deviation of the final point value
- Correction for the final point
- Deviation of the zero value
- Correction for the zero point
- 1st range
- Error status
- Code
# AKEN - Read command "Device tag"

To this read command the FU will send to the TBCC the tag for the called channel (device).

## Read command

<table>
<thead>
<tr>
<th>AKEN K0</th>
<th>Read of channel n</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>AKEN Kn</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Response

<table>
<thead>
<tr>
<th>AKEN 0 XXX.X</th>
<th>Device tag</th>
<th>Error status</th>
<th>Code</th>
</tr>
</thead>
</table>

---
AKFG - Read command "Configuration of the system"

To this read command the system will send to the TBCC the following data:

* The adjustment about the channels (analyzers or virtual channels) that are expected to send the current signals and the corresponding sequence.
* The channels that can be called with the total channel command "K0". That means: Which devices can be included with "K0" or "KV Ln" to operation modes like measuring, zerogas and spangas.
* Which channel will analyze which chemical component.
* The sequence in which the signals of analyzers or calculated values from virtual channels will be sent to the total channel read command "K0" or "KV Ln". This information will be done by the string "XYZ" standing for each component, e.g. C0, N0, NOx, BRETT (Lambda according to Brettschneider) etc.

Read command

AKFG K0
AKFG KV Ln

Read of the whole system unit resp. some defined lines

Code

Response

AKFG 0 XYZ Kn XYZ Km XYZ Kx

Selected channel x, component XYZ
Selected channel m, component XYZ
Selected channel n, component XYZ
Error status
Code
**AKON - Read command "Signal" (measured concentration value)**

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data:

* The corrected signal (concentration value) valid at that moment. Normally the physical unit is ppm. The value will be limited to six relevant digits, because it is useless to send gas concentrations in an accuracy less than pars pro mille.

**Example for four relevant digits (default: six digits):**

<table>
<thead>
<tr>
<th>measured conc. [ppm]</th>
<th>sent conc. [ppm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>123456</td>
<td>123500</td>
</tr>
<tr>
<td>12356</td>
<td>12360</td>
</tr>
<tr>
<td>1234.4</td>
<td>1234</td>
</tr>
<tr>
<td>123.45</td>
<td>123.5</td>
</tr>
<tr>
<td>12.56</td>
<td>12.56</td>
</tr>
<tr>
<td>1.23</td>
<td>1.23</td>
</tr>
</tbody>
</table>

Cf. the "SFRZ" command!

**Read command**

AKON K0

Read of the whole system unit

---

AKON K1 .... Kn

Read of channel n

Read of channel 1

---

Code
Response

AKON 0 123400 12340 1234 123.4 12.34 -1.23 #

Channel 7 no signal, invalid or range overflow/underflow

Channel 6 negative value 1 digit before/ 2 digits after decimal point.

Channel 5 positive value 2 digit before / 2 digits after decimal point.

Channel 4 positive value 3 digits before / 1 digit after decimal point.

Channel 3 positive value 4 digits

Channel 2 positive value 5 digits

Channel 1 positive value 6 digits

Error status

Code

The values will get the same format for the read of single channels.
**AKOW - Read command "Correction for zerogas calibration and gradient"**

To this read command each analyzer in a system or the single analyzer will send to the TBCC the following data:

* The correction of the last zero calibration and the gradient of the calibration curve.

**Read command**

AKOW K0 Mx
AKOW Kn Mx

Read of channel \( n \) range \( x \)

**Response**

AKOW 0 XXX YYY

Steepness of the calibration curve
Correction of the zero calibration
Error status

Code
ALCH - Read command "Deviations of the last linearization check"

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device) and subchannel (range):

- The determined and stored deviations of the last linearization check in ppm.
- The information if these deviations will be in the lawful tolerances. That means: Is the check o.k. or not?

Read command

ALCH  Kn  Mx

Read of channel n and range x

Code

Response

ALCH  0  IO AAA BBB ... XXX

xth difference

2nd difference

1st difference

Checked result is o.k. (otherwise NO)

Error status

Code
Only for MLT analyzers: ALIK - Read command "Output of the linearization curve"

To this read command the x/y values of the linearization curve will be sent. With this values can be determined the desired segment of the linearization curve and the interval between the function values.

**Read command**

\[
\text{ALIK Kn a b c} \\
\text{Interval between the function values [ppm]} \\
\text{End concentration of the segment [ppm]} \\
\text{Beginning concentration of the segment [ppm]} \\
\text{Read of channel n} \\
\text{Only one channel can be checked (no K0).} \\
\text{Code}
\]

**Response**

\[
\text{ALIK s y1 x1 y2 x2 y3 x3...} \\
\text{Raw value No. 3} \\
\text{Setpoint value No. 3} \\
\text{Raw value No. 2} \\
\text{Setpoint value No. 2} \\
\text{Raw value No. 1} \\
\text{Setpoint value No. 1} \\
\text{Error status} \\
\text{Code}
\]
ALIN - Read command "Linearization values" (X/Y = Setpoint / Raw value)

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device) and subchannel (range):
 * The determined and stored setpoint/raw values of the last linearization.

Read command

ALIN  Kn  [Mx]

- This information is optional. It will not be evaluated, because the values are valid for all ranges.
- Read of channel n and range x
- Code

Response

ALIN  0  aaa  AAA  bbb  BBB ...... xxx  XXX

- nth pair of values
- 2nd pair of values
- 1st pair of values
- Error status
- Code
ALKO - Read command "Polynomial coefficients of the linearization curve"

The coefficients of the linearization polynomial calculated by the analyzer linearization will be transferred. These coefficients will be enabled using the polynomial method to linearize.

Read command

ALKO  Kn  Mm

Read of channel n and range m

Code

Response

ALKO  0  Mm  a0  a1  a2  a3...

Coefficients of the polynomial

Range m

Error status

Code
ALST - Read command "Linearization steps"

To this read command the gas distribution will send to the TBCC or to the system the following data:

* The numbers and the division in percent of the distribution steps (maximum two digits after decimal point).
This command will only be accepted by the gas distribution, if the commands "SLIN" or "SLCH" have been received before.

Read command

ALST  Kn

Read of the gas distribution

Code

Response

ALST  0  1  XY  2  XY ... n  XY

Last distribution step n, division XY %

2nd distribution step, division XY %

1st distribution step, division XY %

Error status

Code
AM90 - Read command "Actual response time (t_{90})"

To this read command the analyzer will send the t_{90} time in seconds that is enabled to calculate the concentration for the called channel at the moment.

Cf. "AT90", "ET90", "ST90" and "EM90"

Read command

AM90 Kn

Read of channel n

Code

Response

AM90 0 a

t_{90} time (response time) [s]

Error status

Code


**AMBA - Read command "Begin of range"**

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device):

* The begin of range values in ppm.

**Read command**

\[
\begin{align*}
\text{AMBA} \ K_0 & \ [Mx] \\
\text{AMBA} \ K_n & \ [Mx]
\end{align*}
\]

- Range number (optional)
- Read of channel n
- Code

**Response**

\[
\begin{align*}
\text{AMBA} \ 0 & \ Mx \ XXX \\
\end{align*}
\]

- Begin of range x
- Range No. x
- Error status
- Code

The values will get the same format for the read of single channels.
**AMBE - Read command "End of range"**

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device):

* The end of range values in ppm.

**Read command**

AMBE K0 [Mx]  
AMBE Kn [Mx]  

Range number (optional)  
Read of channel n  
Code

**Response**

AMBE 0 Mx XXX  

End of range x  
Range No. x  
Error status  
Code

The values will get the same format for the read of single channels.
AMBU - Read command "Switching values for autoranging"

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device):
* The adjusted switching values in ppm for a changing of ranges with autoranging.

Read command

AMBU K0
AMBU Kn

Read of channel n
Code

Response

AMBU 0 M1 xxx XXX M2 yyy YYY Mn zzz ZZZ

Switch on value of range n
Switch off value of range n
Range No. n
Switch on value of range 2
Switch off value of range 2
Range No. 2
Switch on value of range 1
Switch off value of range 1
Range No. 1
Error status
Code

The values will get the same format for the read of single channels.
**AMDR - Read command "Manual adjusted pressure"**

To this read command the gas analyzer will send the value adjusted for the parameter. This value will be useful, if no pressure measurement will be installed in the analyzer.

**Read command**

AMDR  Kn

- Read of channel n
- Code

**Response**

AMDR  0  a

- Pressure [Pa]
- Error status
- Code

The values will get the same format for the read of single channels.
### AQEF - Read command "Cross interference"

To this read command the CO analyzer or the system will send to the TBCC:

* The concentration value in ppm determined and stored in the analyzer. This value will be stored in the device until a new cross interference will be determined by the "SQEF" command. The TBCC will control, if limits will be exceeded. The TBCC will also start actions if necessary.

#### Read command

<table>
<thead>
<tr>
<th>AQEF Kn</th>
<th>Read of channel n</th>
<th>Code</th>
</tr>
</thead>
</table>

#### Response

<table>
<thead>
<tr>
<th>AQEF 0 XXX</th>
<th>Interference [ppm]</th>
<th>Error status</th>
<th>Code</th>
</tr>
</thead>
</table>
**ASOL - Read command "Setpoint value with limits"**

To this read command the FU will send to the TBCC the following data for the called channel (FU) and subchannel (e.g. heating):

* The adjusted setpoints with deviation limits for error reports.

For the actual used devices subchannel "m" will be:

- \( m = 0 \) Concentration
- \( m = 1 \) Temperature
- \( m = 2 \) Pressure
- \( m = 3 \) Flow
- \( m = 4 \) Pocket calculator No. 1
- \( m = 5 \) Pocket calculator No. 2
- \( m = 6 \) Pocket calculator No. 3
- \( m = 7 \) Pocket calculator No. 4

These assignments may be changed for devices used in the future!

**Read command**

\[
\text{ASOL } K0 \ m \\
\text{ASOL } Kn \ m \\
\overset{\text{Read of channel } n \text{ and subchannel } m}{\text{Code}}
\]

**Response**

\[
\text{ASOL } 0 \ \text{WWW} \ xxx \ XXX \\
\overset{\text{Upper limit}}{\text{Lower limit}} \\
\overset{\text{Setpoint value}}{\text{Error status}} \\
\overset{\text{Code}}{} 
\]
### ASTA - Read command "General status of the system"

To this read command the FU will send to the TBCC:
* All channels of the FU with any error in their status at that moment. A detailed description of the errors will not be sent to this read command. It is only possible to read channel No. 0.

#### Read command

**ASTA K0**

- Read of channel zero
- Code

#### Response

**ASTA 7 K1 K4 Kn**

- Channel n with error status
- Channel 4 with error status
- Channel 1 with error status
- Error status
- Code
**ASTF - Read command "Error status"**

To this read command the FU will send to the TBCC:

* All error existing at that moment in the called channel (FU). The description of the error characterization is specific for each device. It will be symbolized with a number. A reading to "K0" will get the errors of devices that are not assigned to single channels (e.g. samplegas cooler).

### Read command

```
ASTF Kn
```

- `Kn` Read of channel n
- `Code`

### Response

```
ASTF 7 XXX YYY ... NNN
```

- `7` nth error number
- `XXX` 2nd error number
- `YYY` 1st error number
- `...` Error status
- `NNN` Code
Typical meanings of errors for certain devices:

**NDIR/NDUV Analyzers**

No. 1 = Flow error  
No. 2 = Chopper failure  
No. 3 = Thermostat failure  
No. 4 = RAM error  
No. 5 = Calibration error zerogas  
No. 6 = Calibration error spangas  
No. 7 = Range overflow  
No. 8 = External error (digital input)  
No. 9 = Error of pressure measurement  
No.10 = Error of temperature measurement

**TFID Analyzers**

No. 1 = Flow error  
No. 2 = Flame out  
No. 3 = Thermostat failure  
No. 4 = RAM error  
No. 5 = Calibration error zerogas  
No. 6 = Calibration error spangas  
No. 7 = Range overflow  
No. 8 = Fuel gas error  
No. 9 = Fuel air error  
No.10 = H₂ generator failure (optional H₂ generators, if available)  
No.11 = Temperature of the heated wires  
No.12 = Temperature of the heated filters  
No.13 = Response of ethane too high (optional for methane free measurement)
ASTZ - Read command "Status"

To this read command the FU will send to the TBCC the following data for the called channel (FU):
* The device status at that moment
* Running procedures.
The status will be described by the code used for the activation of the function. The operation modes "REMOTE" or "MANUAL" will also be sent. These modes will always be the first codes in the data string. To the read of channel 0 the statuses of all channels (FU) defined with "EKFG" will be sent. If a defined FU will be defect or not available and it cannot send its status, the statuses of these channels (FU) will be replaced by "#", analogous to the values like described for "AKON".

Read command

ASTZ K0
ASTZ Kn

Read of channel n

Code
### Response

<table>
<thead>
<tr>
<th>ASTZ 0</th>
<th>KV</th>
<th>SREM</th>
<th>CODEn</th>
<th>K1</th>
<th>SREM</th>
<th>CODEn</th>
<th>K2</th>
<th>#</th>
<th>Kn</th>
<th>SREM</th>
<th>CODEn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Status code**
- **Channel n and its status**
- **Device is not available**
- **Channel 2 and its status**
- **Status code**
- **Channel 1 and its status**
- **Status code**
- **Channel 0 and its status**
- **Error status**
- **Code**

---

<table>
<thead>
<tr>
<th>ASTZ 0</th>
<th>Kn</th>
<th>SREM</th>
<th>CODEn</th>
<th>SMAN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Status code**
- **Channel n and its status**
- **Error status**
- **Code**
ASYZ - Read command "System time"

To this read command the FU will send to the TBCC the following data for the called channel (device):
* The current system time (calendar time).

Read command

ASYZ Kn

Read of channel n

Code

Response

ASYZ 0 JJMMTT hhmmss

Time of the system

Error status

Code
AT9O - Read command "T₉₀ time" (response time)

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device):
* The t₉₀ time steps.

Read command

AT9O  K0
AT9O  Kn
Read of channel n
Code

Response

AT9O  0  XXX  YYY  ZZZ
T₉₀ time (fast)
T₉₀ time (medium)
T₉₀ time (slowly)
Error status
Code
ATEM Read command "Temperature"

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device) and subchannel (temperature measurement):

* The signal in Kelvin.

Read command

ATEM K0 (m)
ATEM Kn (m)

Read of channel n (and subchannel m).

Note: Subchannel m is not in use at the moment.

Code

Response

ATEM 0 XXX

Temperature

Error status

Code
**ATOL - Read command "Stability tolerances"**

To this read command the analyzers in a system, the single analyzer or the front-end computer will send to the TBCC the following data:

* The necessary tolerances for functions running stability controlled.

### Read command

**ATOL Kn [Mx]**
- Range number (optional)
- Read of channel n
- Code

### Response

**ATOL 0 Mm Tnm**
- Tolerance of channel n
- Range m as percent of end of range
- Error status
- Code
AUKA - Read command "Uncorrected analog value"

To this read command the called analyzer in a system or the single analyzer will send to the TBCC the following data:
* The uncorrected analog output value in Volt and the corresponding range.

**Read command**

AUKA K0
AUKA Kn
    Read of channel n
    Code

**Response**

AUKA 0 Mn XXX
    Uncorrected analog value
    Range n
    Error status
    Code
**AVEZ - Read command "Delay and synchronization time"**

To this read command the analyzers in a system or the single analyzer will send to the TBCC the following data for the called channel (device):

- The delay time used for the record of valid signals or used to start the integrators by "SINT".
- The synchronization time used for the output of values from an internal buffer that were read by "AKON", "AIKO" and "AIKG". This synchronization time is also the delay time for the output signal of those values.

This procedure will be started with the control command "SRON" and will be finished with the control command "SROF".

### Read command

<table>
<thead>
<tr>
<th>Code</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVEZ K0</td>
<td>AVEZ Kn</td>
</tr>
<tr>
<td></td>
<td>Read of channel n</td>
</tr>
<tr>
<td></td>
<td>Code</td>
</tr>
</tbody>
</table>

### Response

<table>
<thead>
<tr>
<th>Code</th>
<th>Time of synchronization</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVEZ 0 XXX YYY</td>
<td>Delay time</td>
</tr>
<tr>
<td></td>
<td>Error status</td>
</tr>
<tr>
<td></td>
<td>Code</td>
</tr>
</tbody>
</table>
**AZEI - Read command "Times"**

To this read command the FU will send to the TBCC the following data for the called channel (FU):

* The times used to start a function or procedure, e.g. times for the automatic start of a calibration.

**Read command**

```
AZEI Kn CODE
```

- **Code of the function**
- **Read of channel n**
- **Code**

The following codes will be supported:
SNAB, SPAB, SATK, SNGA, SEGA, SQEF, SSPL, SALI, SMGA

**Response**

```
AZEI 0 JJMMTT hhmms T-0
```

- **Function length**
- **Start time**
- **Start date**
- **Error status**
- **Code**
## 5. Description of all Write Commands

**EFDA – Write command "Function length"**

With this write command the FU will get the function length of the function "SXXX" in seconds for the called channel (device), e.g. "Time Out" for purging or for switching on the calibration gases. If the function "SXXX" will be a procedure with several internal steps, the times will be valid for each step and not for the whole procedure. If the function will be for instance "Automatic calibration", the times will be valid for each spangas resp. each range and not for the whole procedure. During this time of flow the analyzer will test, if the setpoint value will be reached and stable. If this test will not succeed during the function time, it will produce a function error. The same effect will exist for other procedures like linearization, converter test etc. If the function length will be set to zero, the function will run without any time limit.

Functions like "SATK", "SLIN", "SLCH", "SALI", "SQEF", "SNGA" or "SEGA" will run time controlled according to the times T1 to T4 or stability controlled.

**Time control:** If only T1 is set or if T2 = 0, time control will run with step time T1 (total function time).

**Stability control:** Times T1 to T4 have to be set.

### Write command

```
EFDA Kn SXXX T1 (T2 T3 T4)
```

### Response

"Time out"; after this time is over, the procedure will be canceled and you will get an error message; this time will start after the wait.

Integration time to get the mean value of one signal.

Stability time: All signals have to be in a certain tolerance during this time.

Time to wait for: after the switching on / changing of gases or the stepping time of time control.

Function

Addressed channel

Code
EFDA 0

Error status

Code
EGRW – Write command "Limit"

With this write command the analyzers in a system or the single analyzer will get the required limits for the called channel (device), e.g. maximum deviation for calibration. If these limits will be exceeded during the operation, it will cause a changing of the error status byte. – The unit of limits is percent. The deviation value is referred to the setpoint. For zero calibration the deviation value will be referred to the smallest spangas value.

Write command

EGRW Kn m XXX

Limit
Addressed subchannel m
m = 0: zero calibration; m = 1: spangas calibration
Addressed channel n
Code

Response

EGRW 0

Error status
Code
EKAK – Write command "Calibration gas concentration"

With this write command the analyzers in a system or the single analyzer will get the spangas values for each range.

Write command

EKAK K0 M1 YYYY ... Mx ZZZZ
EKAK Kn M1 YYYY ... Mx ZZZZ

Spangas value
Addressed range x
Spangas value
Addressed range 1
Addressed channel n
Code

Response

EKAK 0
Error status
Code
**EKEN – Write command "Device tag"**

With this write command the FU will get a tag to store in the FU memory. Then it will have to be unchangeable. That means, if this part of memory will be written, the device processor will have to save it against an overwriting automatically. The setup of a new tag will only be possible by changing the processor. The memory size for the tag is 30 ASCII characters.

**Write command**

```
EKEN  Kn  TAG
      Data of the device tag
      Read of channel n
      Code
```

**Response**

```
EKEN  0
      Error status
      Code
```
With this write command the FU will get the channels (analyzers) sending the current signals and their sequence. Furthermore the FU will get the channels that should be called with the total channel command "K0" or "KV Ln", i.e. the channels that shall be included to operation modes like measurement, zerogas and spangas. With the string XYZ the FU will be told which chemical component or virtual device (e.g. Lambda) shall be combined with which channel. The string XYZ will be for instance C0, N0, Nox or BRETT (Lambda according to Brettschneider) etc. The other physical or virtual channels can only be called directly with their channel number.

If no component and no channel number will be specified, the FU will get its default configuration of the system. That means, that all physical and virtual available components will be included to the read and control commands with the total channel command "K0" or "KV Ln". Besides, the TBCC can get the real physical composition of the FU with the read command "AKFG".

### Write command

EKFG K0 XYZ Kn XYZ Km XYZ Kx

- Adjusted channel x, component XYZ
- Adjusted channel m, component XYZ
- Adjusted channel n, component XYZ
- Addressed channel 0

Code

EKFG KV Ln Kn ... Kx

- Adjusted channel n to x
- Lines getting assigned with adjusted channels
- Addressed channel; front-end computer

Code

### Response

EKFG 0

Error status

Code
**ELIN – Write command "Linearization values (X/Y)"**

With this write command the analyzers in a system or the single analyzer will get the linearization values for the calculation of gas concentration for the called channel (device) and subchannel (range). A new linearization curve will be calculated with these x/y-pairs.

**Write command**

```
ELIN  Kn  Mx  aaa  AAA  bbb  BBB ... xxx  XXX
```

- **nth pair of values**
- **2nd pair of values**
- **1st pair of values**
- **Addressed channel n and range x**
- **Code**

**Response**

```
ELIN  0
```

- **Error status**
- **Code**
The coefficients of a linearization polynomial will be transferred to the analyzer. These values will then be enabled to calculate the gas concentration using the polynomial method for linearization.

**Write command**

```
ELKO  Kn  a0  a1  a2  a3...
```

**Response**

```
ELKO  0
```

Error status

Code
**ELST – Write command "Linearization steps"

With this write command the device will get the numbers of the distribution steps and each division in percent of the gas distribution used for linearization. But this command will only be accepted, if the commands "SLIN" or "SLCH" were received before.

**Write command**

```
ELST Kn 1 XY 2 XY ... n XY
```

- Last distribution step, division XY %
- 2nd distribution step, division XY %
- 1st distribution step, division XY %
- Addressed channel n
- Code

**Response**

```
ELST 0
```

- Error status
- Code
**EMBA – Write command "Begin of range"**

With this write command the analyzers in a system or the single analyzer will get each begin of range of the total range in ppm. The analog output signal will be referred to these values for instance.

**Write command**

```
EMBA  Kn  M1  YYYY [... Mx  ZZZZ]
```

- Begin of range x (optional)
- Addressed range x (optional)
- Begin of range 1
- Addressed range 1
- Addressed channel n
- Code

**Response**

```
EMBA  0
  Error status
  Code
```
EMBE – Write command "End of range"

With this write command the analyzers in a system or the single analyzer will get each end of range of the total range in ppm. The analog output signal will be referred to these values for instance.

Write command

EMBE K\textsubscript{n} M1 YYYY [... Mx ZZZZ]

- End of range x (optional)
- Addressed range x (optional)
- End of range 1
- Addressed range 1
- Addressed channel n
- Code

Response

EMBE 0

- Error status
- Code
EMBU – Write command "Switch levels for autoranging"

With this write command the analyzers in a system or the single analyzer will get for the called channel (device):

* The required values in ppm to switch from one range to another with autoranging.

**Write command**

EMBU Kn Mn XXX YYY [Mm XXX YYY ...] (optional)

- Switching value to change to the bigger range
- Switching value to change to the smaller range
- Range n
- Addressed channel n
- Code

**Response**

EMBU 0

- Error status
- Code
EMDR – Write command "Manual adjusted pressure"

With this write command the analyzer will get a pressure value for the called channel. This value will be used as pressure correction, if no pressure measurement is installed in the device.

Cf. "AMDR", "ADRU" !

Write command

EMDR  Kn  a

| Pressure in Pa |
| Read of channel n |
| Code |

Response

EMDR  0

| Error status |
| Code |
ESOL – Write command "Setpoint value with limits"

With this write command the FU will get the required setpoint values with acceptable deviations for the called channel (device) and subchannel (e.g. heating). If these limits will be exceeded during the operation, it will cause a changing of the error status byte.

For the actual used devices subchannel "m" will be:

- m = 0  Concentration
- m = 1  Temperature
- m = 2  Pressure
- m = 3  Flow
- m = 4  Pocket calculator No. 1
- m = 5  Pocket calculator No. 2
- m = 6  Pocket calculator No. 3
- m = 7  Pocket calculator No. 4

These assignations may be changed for devices used in the future!

Write command

<table>
<thead>
<tr>
<th>ESOL</th>
<th>Kn</th>
<th>m</th>
<th>XXX</th>
<th>yyy</th>
<th>YYY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Upper limit</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lower limit</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Addressed setpoint value</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Addressed subchannel m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Addressed channel n</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Code</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Response

<table>
<thead>
<tr>
<th>ESOL</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Error status</td>
</tr>
</tbody>
</table>

2 - 98
**ESYZ – Write command "System time"**

With this write command the FU will get the system time (calendar time) that has to be adjusted for the called channel (device).

**Write command**

```
ESYZ  Kn  JJMMTT  hhmmss
```

- **Value for the adjustment of the system time**
- **Addressed channel n**
- **Code**

**Response**

```
ESYZ  0
```

- **Error status**
- **Code**
**ET9O – Write command "T\textsubscript{90} time" (response time)**

With this write command the analyzers in a system or the single analyzer will get the $t_{90}$ time steps in seconds that have to be adjusted for the called channel (device).

**Write command**

ET9O  Kn  XXX  YYY  ZZZ

- Value for the adjustment of the $t_{90}$ time (fast)
- Value for the adjustment of the $t_{90}$ time (medium)
- Value for the adjustment of the $t_{90}$ time (slowly)
- Addressed channel n
- Code

**Response**

ET9O  0

- Error status
- Code
ETOL – Write command "Stability tolerances"

With this write command the analyzers in a system, the single analyzer or the front-end computer will get the required tolerances for functions running stability controlled. The tolerance will be specified in percent of the end of range value. The tolerance can be adjusted for each range separately. No tolerance check will be done, if the tolerance value will be set to $T = 100\%$.

**Write command**

ETOL  Kn  M1  Tn1  [...Mm  Tnm]

- Tolerance channel n, range m in percent of the end of range value;
- tolerance deviation = 2 * tolerance (optional)

- Tolerance channel n, range 1

- Range 1

- Addressed channel n

- Code

**Response**

ETOL  0

- Error status

- Code
EVEZ – Write command "Delay and synchronization time"

With this write command the analyzers in a system or the single analyzer will get the delay time and the synchronization time for the called channel (device). The delay time will be used for integrators started by "SINT" or for the delayed record of valid signals. The synchronization time will be used for the output of values that were read by "AKON", "AIKO" and "AIKG" from an internal buffer. The same synchronization time will also delay the analog signal of these values. This procedure will be started by the control command "SRON" or will be finished by the control command "SROF".

Write command

```
EVEZ  K0  XXX  YYY  
EVEZ  Kn  XXX  YYY  
```

Synchronization time

Delay time

Read of channel n

Code

Response

```
EVEZ  0  
```

Error status

Code
**EZEI – Write command "Times"**

With this write command the FU will get the times that have to be adjusted in the called channel (device) for the automatic start of functions or procedures (e.g. "Automatic calibration"). Furthermore, the FU will get the function length in seconds.

The following controls will be possible:

- If the calendar day will be mentioned, the function will start only once at one date. If the calendar day will be missing, the function will start each day.
- The clock time as starting time and the function length have always to be mentioned.
- If the function length will be zero, the function will run without any time limit. Then it can only be finished by another control command. A function length of the write command "EFDA" will not be used here.
- Unused data will be replaced by "#".

If the functions shall start several times automatically at the same day, the times can be set up in blocks one after another (maximum 4 digits).

Functions with day information will be deleted automatically after they will be ready. Otherwise, the set-ups of functions will be deleted by resetting all values to zero.

**Examples:**

- CODE 871113 171200 0: The adjusted function will be started for one time at 13/11/87, 5 o'clock p.m. (17 o'clock), 12 minutes and 0 seconds. The function length will be unlimited.
- CODE 871113 171200 33: The adjusted function will be started for one time at 13/11/87, 5 o'clock p.m. (17 o'clock), 12 minutes and 0 seconds. The function length will be limited to 33 sec.
- CODE # 051208 0: The adjusted function will be started each day at 5 o'clock a.m., 12 minutes and 8 seconds. The function length will be unlimited.
- CODE # 051200 1850: The adjusted function will be started each day at 5 o'clock a.m., 12 minutes and 0 seconds. The function length will be limited to 1850 seconds.
- CODE # 060000 100 # 120000 0 # 180000 0 # 240000 150: The adjusted function will be started each day at 6, 12, 18 (6 p.m.) and 24 (12 p.m.) o'clock.
Write command

EZEI Kn CODE JJMMTT hhmmss T-0

- Function length
- Start time of the function
- Start day of the function
- Function that shall be started
- Addressed channel
- Code

Response

EZEI 0

- Error status
- Code
1. **Overview about working AK commands in NGA devices**

<table>
<thead>
<tr>
<th>Code</th>
<th>Function</th>
<th>MLT local V3.2</th>
<th>MLT/CU V3.2</th>
<th>Other AM V3.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAEG</td>
<td>Deviation to span gas</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>AALI</td>
<td>Linearization check results</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AANG</td>
<td>Deviation to zero gas</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABST</td>
<td>Hours of operation</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADRU</td>
<td>Pressure</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADUF</td>
<td>Flow</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AEMB</td>
<td>Actual range number</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AFDA</td>
<td>Function length</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGID</td>
<td>Device identification</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGRW</td>
<td>Limits</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AIKG</td>
<td>PV average (Concentration integral value); all</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AIKO</td>
<td>PV average (Concentration integral value); partial</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AKAK</td>
<td>Span gases</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AKAL</td>
<td>Calibration results</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AKEN</td>
<td>Tag</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AKFG</td>
<td>System configuration</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AKON</td>
<td>Concentration</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AKOW</td>
<td>Calibration values (Correction for zero and gradient)</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALCH</td>
<td>Linearization check results</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALIK</td>
<td>Calculation of linearization curve</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALIN</td>
<td>Linearization x/y-values</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALKO</td>
<td>Linearization polynomial coefficients</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALST</td>
<td>Linearization steps</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AM90</td>
<td>Actual t90 time</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMBA</td>
<td>Begin of ranges</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMBE</td>
<td>End of ranges</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMBU</td>
<td>Switch levels for autorange</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMDR</td>
<td>Manual pressure value</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APAR</td>
<td>Parameters general</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AQEF</td>
<td>Cross interference check result</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASOL</td>
<td>Setpoints with limits</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASTA</td>
<td>Internal status</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASTF</td>
<td>Internal error status</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASTZ</td>
<td>Action status (running procedure)</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASYZ</td>
<td>Time and date of the system</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AT90</td>
<td>t90-times</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATEM</td>
<td>Temperature</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATOL</td>
<td>Tolerances for stability controlled procedures</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUKA</td>
<td>Uncorrected, analog PV value</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVEZ</td>
<td>Delay and synchronization time</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AZEI</td>
<td>Times for procedures</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EFDA</td>
<td>Function length</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EGRW</td>
<td>Limits</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EKAK</td>
<td>Span gases</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EKEN</td>
<td>Tag</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EKFG</td>
<td>System configuration</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELIN</td>
<td>Linearization x/y-values</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Function</td>
<td>MLT local V3.2</td>
<td>MLT/CU V3.2</td>
<td>Other AM V3.2</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------------</td>
<td>----------------</td>
<td>--------------</td>
<td>---------------</td>
</tr>
<tr>
<td>ELKO</td>
<td>Linearization polynomial coefficients</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>ELST</td>
<td>Linearization steps</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>EMBA</td>
<td>Begin of ranges</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>EMBE</td>
<td>End of ranges</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>EMBU</td>
<td>Switch levels for autorange</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>EMDR</td>
<td>Manual pressure value</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>EPAR</td>
<td>Parameters general</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESOL</td>
<td>Setpoints with limits</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>ESYZ</td>
<td>Time and date of the system</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>ET90</td>
<td>190 times</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>ETOL</td>
<td>Tolerances for stability controlled procedures</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>EVEZ</td>
<td>Delay and synchronization time</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>EZEI</td>
<td>Times for procedures</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SALI</td>
<td>Linearization check with span gases</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SARA</td>
<td>Autoranging OFF</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SARE</td>
<td>Autoranging ON</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SATK</td>
<td>Zero and span calibration</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SCAL</td>
<td>Start system calibration</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SEGA</td>
<td>Open spangas valve</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SEMB</td>
<td>Set range</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SENO</td>
<td>Switch to NO mode for CLD module</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SFRZ</td>
<td>Floating point format of real numbers</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SGTS</td>
<td>Switch to device test status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHDA</td>
<td>Hold mode OFF</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SHDE</td>
<td>Hold mode ON</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SINT</td>
<td>Start integration</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SLCH</td>
<td>Start linearization check</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SLIN</td>
<td>Start linearization</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SLST</td>
<td>Switch linearization step</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SMAN</td>
<td>Communication: Manual</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SMGA</td>
<td>Open sample gas valve</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SNAB</td>
<td>Zero calibration</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SNGA</td>
<td>Open zero gas valve</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SNOX</td>
<td>Switch to NOx mode for CLD module</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SPAB</td>
<td>Span calibration</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SPAU</td>
<td>Set to pause mode</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SQEF</td>
<td>Start cross interference measurement</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SREM</td>
<td>Communication: Remote</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SRES</td>
<td>µP-Reset</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SROF</td>
<td>Delay mode OFF</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SRON</td>
<td>Delay mode ON</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SRUC</td>
<td>Purge backwards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSPL</td>
<td>Open purge gas valve</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>ST90</td>
<td>Set t90 time</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>STBY</td>
<td>Set to stand-by</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

**Implemented additional Fisher-Rosemount specific commands (not official AK):**
- ALIK, AMBA, AMDR
- EMDR, SCAL, SFRZ, SHDA, SHDE, SNAB, SPAB
- ASVC, ESVC, SSVC, (additional service commands)
2. **AK Service Commands**

### ASVC K0 S599 ExactNode Name

**Reading of LON variables of a network node**

**Description:** This command is an enlarged alternative to the S600 command. It may use the variables of all network nodes, even if they will not be analyzer modules. You only have to know the right node address (cf. S632).

**Syntax:**

\[
\text{ExactNode} = \text{Right network node address} \\
\text{Name} = \text{Name of the variable}
\]

**Response:**

\[
\text{ASVC} \ 0 \ a \\
\ \ a: \text{Value of the desired variable}
\]

**Notes:** Only texts without an AK separating sign will be valid as variable names. The "ExactNode" is an address composed from a node address and its subnode address.

- The formula is: \( \text{ExactNode} = \text{Subnode} \times 256 + \text{Node} \);
- Example: Node = 2 Subnode = 1 ExactNode = 1*256 + 2 = 258

**Cf.:** S600, S630, S632

### ESVC K0 S599 ExactNode Name a

**Writing from a LON variable of a network node**

**Description:** This command is an enlarged alternative to the S600 command. It may use the variables of all network nodes, even if they will not be analyzer modules. You only have to know the right node address (cf. S632).

**Syntax:**

\[
\text{ExactNode} = \text{Right network node address} \\
\text{Name} = \text{Name of the variables} \\
\text{a} = \text{Value of the variable}
\]

**Notes:** Only texts without an AK separating sign will be valid as variable names. The "ExactNode" is an address composed from a node address and its subnode address.

- The formula is: \( \text{ExactNode} = \text{Subnode} \times 256 + \text{Node} \);
- Example: Node = 2 Subnode = 1 ExactNode = 1*256 + 2 = 258

**Cf.:** S600, S630, S632

### SSVC K0 S599 ExactNode Name a

**Writing from a LON variable of a network node without checking the range of values**

**Description:** This command corresponds to "ESVC K0 S599...", only without checking the range of values.
S600: Access to LON network variables

Access to network variables of an analyzer module.

Notes:

☞ If a variable will contain several values (array), you can access to these values by adding the corresponding number directly to the name of the variable.

Example:

\[
\text{LINYA} = [31, 44, 54]
\]

\[
\text{LINYA}_1 = 31 \\
\text{LINYA}_2 = 44 \\
\text{LINYA}_3 = 54
\]

☞ The network variable knows its data type. The AK command will try to convert the text of value inputs to the required type. Only if this will not be possible a syntax error will be reported.

☞ If the data will be of the so-called "enum" type, the value will have to be inputted as integer. The text on the display cannot be used, because this text information is only existing in the control unit.
To find out the integer value corresponding to a certain "enum" text, you have to look into the EXCEL-File. In the EXCEL-File the first column of the "enum" text will correspond to the value "0", the next column to the value "1" etc.

<table>
<thead>
<tr>
<th>ASVC Kn S600 Name</th>
<th>Reading of the variable value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax:</td>
<td>Name = Name of the variable</td>
</tr>
<tr>
<td>Response:</td>
<td>ASVC 0 a</td>
</tr>
<tr>
<td></td>
<td>a: Value of the desired variable</td>
</tr>
<tr>
<td>Note:</td>
<td>Only texts without an AK separating sign will be valid as variable names.</td>
</tr>
<tr>
<td>Cf.:</td>
<td>S630 (which variables are existing ?)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ESVC Kn S600 Name a</th>
<th>Writing of the variable value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax:</td>
<td>Name = Name of the variable</td>
</tr>
<tr>
<td></td>
<td>a = Value of the variable</td>
</tr>
<tr>
<td>Cf.:</td>
<td>S630 (which variables are existing ?)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SSVC Kn S600 Name a</th>
<th>Writing of the variable value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>This command corresponds to &quot;$\text{ESVC Kn S600...}$&quot;, only without checking the range of values.</td>
</tr>
</tbody>
</table>
### ASVC Kn S615 b

**Reading of the current data of a DIO board**

**Description:** The current status of the named DIO board will be read.

**Syntax:**
- `b`: Board number (1, 2, 3, 4; not SLOT-ID);
- for `b = 0` the data of all available DIO’s will be sent

**Response:**
- `ASVC 0 IIIIIIII OOOOOOOO OOOOOOOO OOOOOOOO RLLL`
- `I1...8` Status of the digital input pins 1...8
- `O1...24` Status of the digital output pins 1...24
- `R` Retrigger error
- `L1...3` Overload group 1...3

### SSVC Kx S617 n s [n s]

**Setup of the external switch variable DIGEXTSWITCH**

**Description:** The outputs of a DIO board can be assigned to the single bits of the variable DIGEXTSWITCH. For the platform the lowest 8 bits of this variable are available. With the command "SSVC" each switch can be set. This on the other hand may cause a direct switch of an assigned digital output.

**Syntax:**
- `n`: Switch number
- `s`: Status (`0` = OFF; `1` = ON)
- `x`: If the channel number will be K0, the variable DIGEXTSWITCH will be called of the module containing the local SIO
  - (platform SIO → control module, MLT SIO → analyzer module).
  - The parameters "n s" can be repeated up to seven times for the platform.

**Examples:**
- `SSVC K0 S617 1 1 2 0 3 1` Set external switch 1 to HIGH
- `SSVC K0 S617 1 1 2 0 3 1` Set external switch 2 to LOW
- `SSVC K0 S617 1 1 2 0 3 1` Set external switch 3 to HIGH
**SSVC Kn S621 a**

<table>
<thead>
<tr>
<th>Description:</th>
<th>With this command you can load/save the device specific parameters. This will be possible via the serial interface and from/to the internal FLASH memory (if on ACU available!).</th>
</tr>
</thead>
</table>
| Syntax:     | a =  
1:  loading new configuration via the serial interface.  
2:  sending out the current configuration via the serial interface  
3:  saving the current configuration in the FLASH memory  
4:  loading the configuration saved in the FLASH memory |
| Notes:      | The data format for the loading via the serial interface (a = 1) corresponds to the data format of the serial sending out (a = 2). |
|             | Some peculiarities will have to be heeded, because the serial interface will be used parallel for AK and for in-/output of the data stream:  
For a = 1 you will have to wait for the AK response, before you will start the sending of the data stream.  
For a = 2 the AK response ("<STX><don't care>SSVC 0<ETX>") will be sent at first. It will not be necessary to treat these response signs in a certain way, because this line will be deleted as invalid stream! |
|             | Saving the configuration in the FLASH memory (a = 3) will overwrite the factory settings of the device !! |
|             | With a = 4 the factory settings will be reloaded to the RAM memory and so to the actual working memory. |
| Cf.:        | Instruction manual |

Some peculiarities will have to be heeded, because the serial interface will be used parallel for AK and for in-/output of the data stream:
For a = 1 you will have to wait for the AK response, before you will start the sending of the data stream.
For a = 2 the AK response ("<STX><don't care>SSVC 0<ETX>") will be sent at first. It will not be necessary to treat these response signs in a certain way, because this line will be deleted as invalid stream!
Saving the configuration in the FLASH memory (a = 3) will overwrite the factory settings of the device !!
With a = 4 the factory settings will be reloaded to the RAM memory and so to the actual working memory.
ASVC Kn S630  Output of the LON variable names

Description: All LON variables that are available in an analyzer module will be sent out with their names. If a variable will contain several values (array), it will be marked by an appendix in brackets. In these brackets you will find the numbers to access to the array values of the variable.

Example: LINYA[1-7] contains 7 values. You can access to these values with the names LINYA1, LINYA2, ... LINYA7.

Notes: K0 is not possible.

At the moment the command is implemented in a way that it will send out for each channel all variables available in the certain module. That means that variable names may exist multiplex. These multiplex available variables will be separated internal and each will be assigned to another channel (subnode). If variables will not exist multiplex, these variables will only exist once. That means that a changing within a channel will have an effect as changing of the other channels.

Cf.: S600 (Access to network variables)

ASVC Kn S631  Output of the LON node informations

Syntax: ASVC Kn S631

Response: ASVC 0 <name> <version> <node-number> <subnode-number>

ASVC Kn S632  Output of the LON node informations of all nodes

Syntax: ASVC K0 S632

Response: ASVC 0 <ExactNode> <NodeTag>

ExactNode = Exact node address in the network
NodeTag = Tag string of this node

Notes: The "ExactNode" is an address composed from the node address and its subnode address.

The formula is: ExactNode = Subnode * 256 + Node;

Example: ExactNode = 258
Subnode = ExactNode mod 256 = 1
Node = ExactNode - ((ExactNode mod 256)*256) = 2

Cf.: S599, S600, S630
Concentration formula:

\[ \text{Conce} = \text{FacP} \times \text{FacT} \times \text{FacSpan} \times \text{Lin}\{(\text{RawAvg} - \text{OffP} - \text{OffT} - \text{OffX}) \times \text{RGain} \times \text{Gain}\} \]

Meaning of the variables:

- **RawAvg**: Raw value average (including t_90 time)
- **OffP**: Offset correction of physics
- **OffT**: Offset correction of temperature
- **OffX**: Offset correction of interferences from other channels
- **RGain**: Analog pre amplifying factor (BIS)
- **Gain**: Factor standardizing to the desired setpoint value (span)
- **Lin**: Linearization procedure
- **FacSpan**: Span factor standardizing the product "FacP*FacT*FacSpan" to 1.0 during the span cal.
- **FacT**: Temperature correction in the sensitivity
- **FacP**: Pressure correction in the sensitivity
- **Conce**: Concentration value

Syntax:  ASVC Kn S640 a

Response:

- **a = 0**: value1 = RawCount = uncorrected signal
  value2 = RawAvg
  value3 = OffT
  value4 = OffX
  value5 = OffP
  value6 = Gain
  value7 = RGain
- **a = 1**: value1 = LinInput = (\(\text{RawAvg} - \text{OffP} - \text{OffT} - \text{OffX}\)) \times \text{RGain} \times \text{Gain}
  value2 = LinOutput = \text{Lin}\{(\text{RawAvg} - \text{OffP} - \text{OffT} - \text{OffX}) \times \text{RGain} \times \text{Gain}\}
  value3 = FacSpan
  value4 = FacT
  value5 = FacP
  value6 = Conce
- **a = 2**: value1 = Temperature for OffT
  value2 = Temperature for FacT
  value3 = Atmospheric pressure for FacP