SIEMENS

ELAN Interface

Description 08/06

C79000-B5276-C176-03

Contents

1 General

This ELAN interface description (Economical Local Area Network) is valid for the SIEMENS analyzers:

- ULTRAMAT 6
- OXYMAT 6 / OXYMAT 61
- CALOMAT 6
- ULTRAMAT 23

OXYMAT 61 behaves like OXYMAT 6. For information see OXYMAT 6.

The following definitions are used in this description:

- Analyzer: independent analyzer unit with electronics, sample chamber(s) and tubing in a housing
- Channel: analyzer unit with electronics (1 motherboard), connected component(s) and tubing
- Component: unit comprising sample chamber or sensor and associated electronics

The characters used in this description have the following formats:

- xxH: hex format
- 'x': ASCII format
- Other characters are decimal
- Commas are used to separate characters

Example: 54H = 'T' = 84

1.1 Features

ELAN is designed as an economic serial interface for transmitting measured values between analyzers (for correction of cross-interference) and for simple PC communication for test and service purposes.
A small network can be implemented if the requirements for speed (data refresh rate 500 ms) and number of analyzers (max. 12) are not too high.
Communication is based on the following specifications:

- Serial data communication (RS 485) with protocol (see Chapter 3)
- Bus capability: connection to up to 2 control systems/PCs and up to 12 analyzers (the number of analyzers and components may differ because one analyzer may measure several components)
- All analyzers connected to the ELAN have equal rights
- To avoid bus conflicts, each analyzer must check the state of the bus and stop the transmission immediately if necessary (CSMA/CD)
- A new command may only be sent if the previous command has been answered completely (except 'broadcast', see Section 1.2).

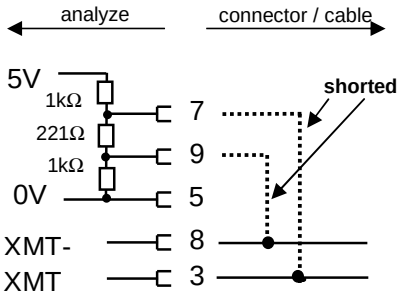
1.2 Broadcast Operation

Analyzers are mainly restricted to answering requests. An exception is the automatic cyclic transmission of all measured values present in a channel (every 500 ms, identical to the answer to command 'k', 2) (see Section 4.9).
The broadcast address is used as the target address (see Sections 3.2 and 4.9). All received messages with this address are neither confirmed nor answered.
This procedure allows correction of cross-interference between analyzers. Another feature is the reduced load of the bus as no request telegrams are needed.
The number of components in broadcast mode is limited to 12.
The broadcast function can be switched off remotely by a command or directly on the analyzer panel. This master/slave operation requires that the control system/PC must take over the correction of cross-interference.

1.3 Interface Parameters

Level	RS485
Baud rate	9600
Data bits	8
Stop bit	1
Start bit	1
Parity	none
no ECHO	

Pin assignments

ULTRAMAT 6, OXYMAT 6, OXYMAT 61, OXYMAT 64, CALOMAT 6, CALOMAT TG, CALOMAT 62, FIDAMAT 6, ULTRAMAT 23	XMT +	3
	XMT -	8
	switchable Termination	

2 ELAN Network

2.1 Principle Connection

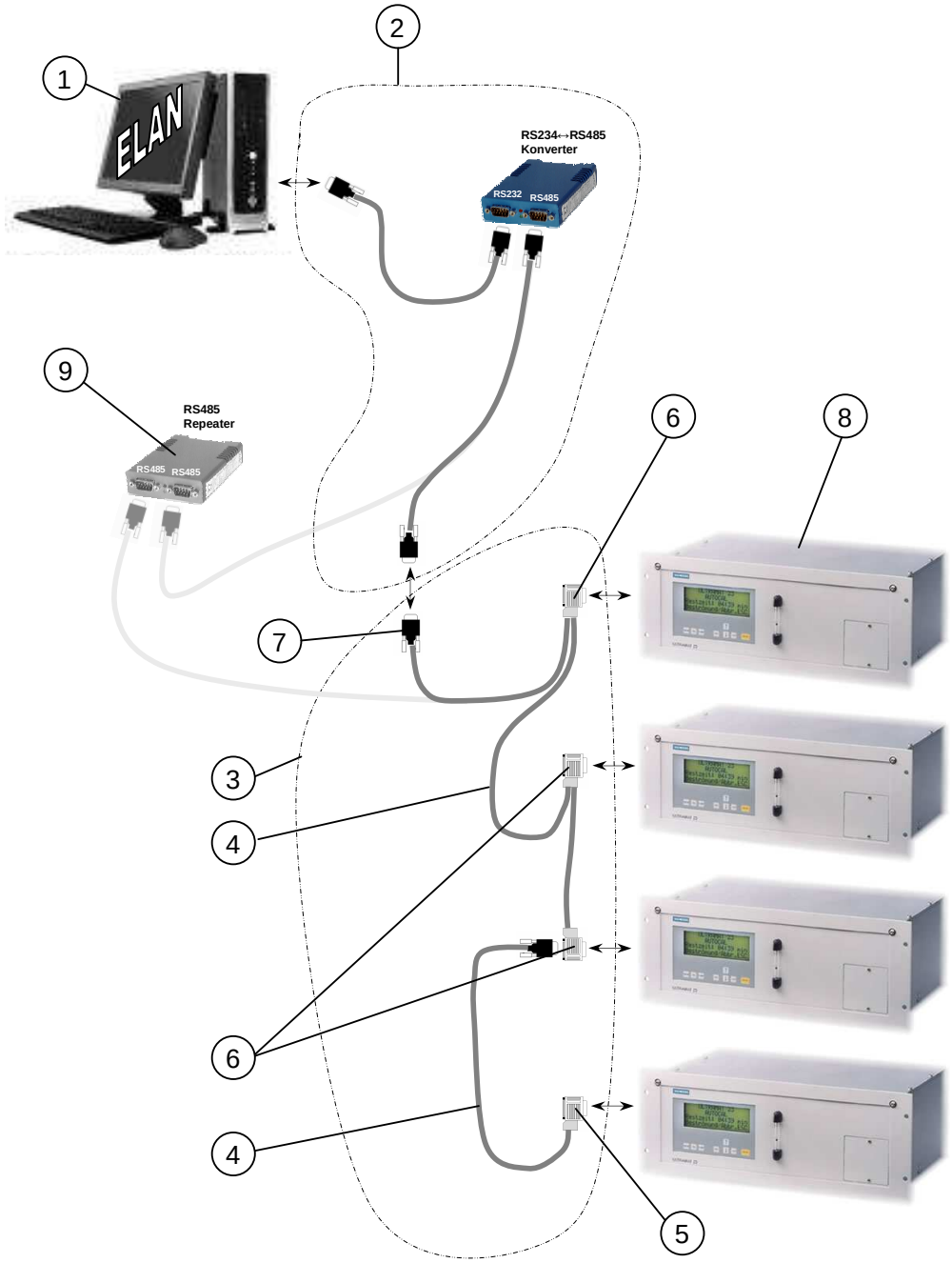


Figure 2-1 Principle schematic

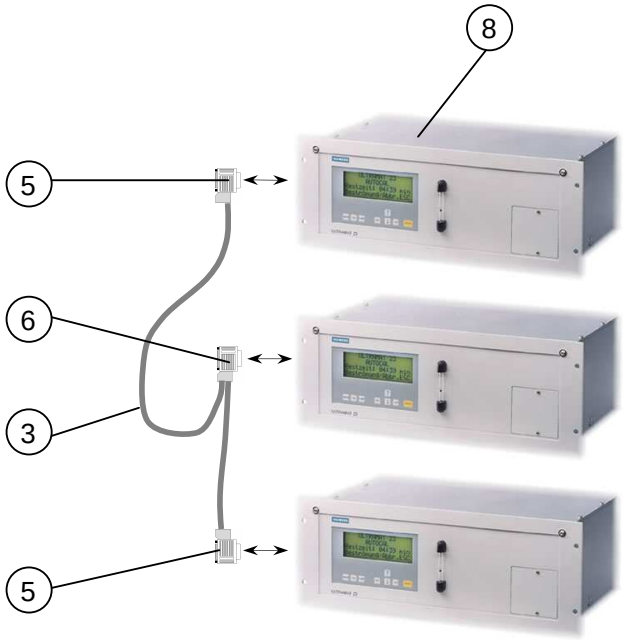


Figure 2-2 Principle scematic by operating in the transverse compensation mode[1]

2.2 Elements of ELAN Network

Item	Name
1	Computer
2	RS485 ↔ RS232 converter with connection cable between RS232 and ELAN [1]
3	ELAN network
4	ELAN cable [2]
5	RS485 bus plug [3] with bridge
6	RS485 bus plug[3]
7	9-contact DSUB socket[4]
8	Analyzers
9	Option: RS485 repeater [5]

[1] Operating in the transverse compensation mode one to four analyc devices are broadcasting their measured value while one analyc device is listening and process the measurements internal. In the broadcasting mode is no need for a master. Because of this there is no PC via a converter connected to the ELAN network.

2.3 Structure of ELAN Network

- Specifications of ELAN cable (item 4)

Cable impedance	100 to 300 Ohm, at frequency > 100 kHz
Cable capacitance	Typ. < 60 pF per meter
Wire diameter	> 0.22 mm^2, corresponding to AWG 23
Type of cable	Twisted pair, 2 wires
Attenuation	Max. 9 dB along the whole cable
Shield	Copper braiding or braided shield and foil

- The cable is easy to install and is highly resistant to noise due to its double shield. It can be used for distances up to 500 m without repeaters.
- The double shield means that the bus cable is particularly suitable for routing in electromagnetically loaded industrial environments.
  Further information:
  - EIA-485
  - ISO 8482: 1997 (Twisted Pair Multipoint Interconnections)
  - DIN 66259
- The first plug on an analyzer (item 5) needs a bus termination. The termination is made using the bridges described in Section 1.3.
- The switches on the plugs (items 5 and 6) have to be OFF. The internal resistances on the plugs are not needed.

Note
A repeater (item 9) should be used at the analyzer end with a cable length of more than 500 m or high interferences.

2.4 Order Numbers

Item	Purveyor	Brief description	Type	Order No.
[1] Converter (item 2)	SIEMENS AG		RS232↔RS485 converter	C79451-Z1589-U1
[1] Converter (item 2)	SIEMENS AG		USB↔RS485 converter	A5E00852382
[1] Converter (item 2)	SIEMENS AG		Ethernet↔RS485 converter	A5E00852383
[2] Cable (item 4)	SIEMENS AG	Bus cable for PROFIBUS	Bus cable	6XV1 830-0AH10
[3] Plug (items 5, 6)	SIEMENS AG		SIMATIC bus connector	6ES7972-0BB20-0XA0
[4] 9 pin DSUB socket (item 7)	Commercially available			
[5] Repeater (item 9)	Wieseman & Theis GmbH Wittener Str. 312 D-42279 Wuppertal (Germany)		RS422 isolator/ RS485 repeater 1 kV isolated Type 66201	#40 10344 66201 3

3 Protocol

3.1 Protocol Steps

Source	Target	Comments
DLE (10H), SOH (01H)		Start
USED DATA (target address, source address, collective state, channel state, command, data)		Max. characters: 68; 10H is doubled every time (only when channel answers) (only when channel answers)
DLE (10H), ETX (03H)		End of transmission
BCC, BCC		CRC-16 checksum of all transmitted characters from DLE + SOH onwards
	DLE (10H), ACK (06H) or NAK (15H)	Confirms communication NAK with checksum error

The confirmation of the communication does not occur if the broadcast address is used as the target address.

3.2 Features

Timeout

The block timeout is 500 ms. The block timeout is the time in which the answer must have been started.
The confirm timeout is 50 ms. The confirm timeout is the time in which the confirm communication (DLE, ACK/NAK) must have been started.
The character timeout is 5 ms. The character timeout is the maximum time from character to character within the string from start (DLE, SOH) to checksum (BCC, BCC).

Block length

The maximum useful data length is 68 characters, exceeding data will be ignored.

Control character

Each control character is started with DLE (10H). A 10H within the useful data will be doubled (10H, 10H). The transmission is code-transparent as a result of this.

General

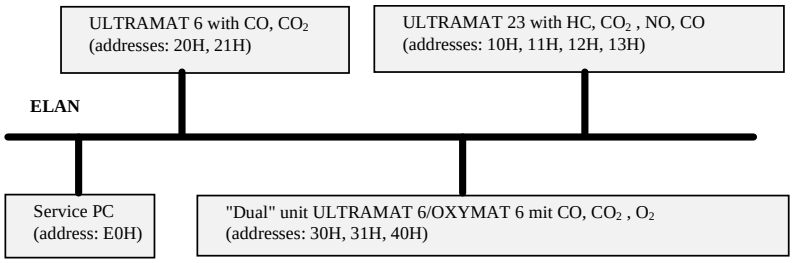
Every character outside of the defined string from start (DLE, SOH) to checksum (BCC, BCC) and outside of the confirm communication (DLE, ACK/NAK) are ignored.

Addressing

The address consists of a channel address (device address with controllers) and a component address:

channel address	* 16 + component address	= address (1 byte)	
|	|		
|	|_____	0 - 8	(components 1 - 9; depending on channel) (only checked if channels are used)
|_____		1 - 12	(channels 1 - 12)
		13	(DCS/PC)
		14	(service PC)
		15	(broadcast address)

Example



To find the addresses of the components from a channel, use command 'k', 2 (= *read all measured values of this channel*).
The channels only react if their target address is received correctly. If 'broadcast' is received as the target address there will be neither confirmation nor answer.

Collective state of the channel

When the channel answers, the collective state (1 byte) is transmitted after the addresses.
If the collective state is 0, the transmitted measured values are valid.

Table 33-1 Collective state of a channel

Bit 0: 1 =>	Error
Bit 1: 1 =>	Maintenance request
Bit 2: 1 =>	Not ready (not measure)
Bit 3: 1 =>	Maintenance switch on
Bit 4: 1 =>	Function check on
Bit 5: 1 =>	Command not accepted
Bit 6: 1 = >	Limit alarm
Bit 7: 1 = >	0

Channel state

When the channel answers, the channel state (1 byte) is transmitted after the collective state.

Table 3-2 Channel state

1	Warm-up
2	Pause
3	Standby
4	Measure
5	Zero calibration
6	Adjust component slope
7	Not yet defined
8	Adjust curve dip
9	Adjust linearization sensitivity
10	Adjust temperature compensation
11	Adjust pressure compensation
12	Adjust linearization zero
13	Not yet defined
14	Autocal
15	Adjust phase
16	Zero calibration of O_2 sensor
17	Synchronous zero calibration
18	Purging for synchronous zero calibration
19	Adjust analog output
20	Adjust analog input
21	Autocal check

3.3 CRC-16 Checksum (Cyclic Redundancy Check)

The CRC-16 is used for the checksum.
The block check is carried out for all transmitted characters including control characters and DLE doubling.

The CRC-16 is performed as follows:

- The characters to be transmitted are treated as a binary number X.
- X is multiplied by 2^{16} (shifted to the left sixteen times) and then divided by the polynomial $2^{16} + 2^{15} + 2^2 + 1$. The 16-bit remainder of this operation is the CRC-16 value.
- This reminder is preset to FFFFH to prevent a telegram from only consisting of zeros.

This could look as follows:

1. Preset remainder (K0) to FFFFH
2. XOR K0 with the first byte of the message, result to K0
3. Shift K0 by 1 bit to the right
4. If step 3 shifted a bit '1' to the right:

   K0 XOR 0A001H

   otherwise: K0 remains unchanged
5. Repeat steps 3 and 4 eight times
6. XOR next byte with K0
7. Repeat steps 3 to 6 until all bytes of the message have been processed
8. The CRC-16 is now stored in K0

Example program using language 'C':

```
static word k0;
void CrcCheck (byte bb) {
byte bitanzahl;
word flag;
        k0 ^= bb;
        for (bitanzahl = 8; bitanzahl > 0; bitanzahl--) {
                flag = k0 & 1;
                k0 = k0 >> 1;
                if(flag) {
                        k0 ^= 0xA001;
                }
        }
}
```

4 Commands

4.1 General

Commands

- All commands consist of two characters.
  - 1st character: ASCII letter

    2nd character: a number between 1 and 255 (01H to FFH).
  - Commands for setting/writing states or values start with an upper-case letter ('A' to 'Z').
  - Commands for reading start with a lower-case letter ('a' to 'z').
- Commands for setting states or values are only executed in remote operation. Commands for reading are always allowed.
- Executed commands are answered with the same command. Answer in case of command not accepted (bit 5 in collective state is set):
  - '??' unknown command
  - 'CE' unknown component
  - 'OF' data input or state selection is not possible because

    channel is not set to remote
  - 'BS' data input or state selection is not currently possible

    (function being executed, or wrong mode of operation)
  - 'SE' wrong number of data
  - 'DE' wrong data value
- There are component-related and channel-related commands.
  - Channel-related commands are accepted with any valid component address.
- Only reading commands are valid while the analyzer is in calibration mode. Exceptions are the commands to control the calibration, the abort commands *Standby* ('Z', 3) and *Measure* ('Z', 4), as well as *Reset* ('Z', 1).

Data

- Transmitted data are values (ASCII format, possibly with added dimension) and control characters (1 byte between 1 and 255). All data are separated by a separation sign (1 byte: 0).
- Excess data are ignored.
- If data are requested within a known command which do not belong to this channel, the answer is finished, or a blank (' ') is inserted if other data follow.

4.2 List of all Commands

Set channel state	U6	O6	C6	C6 TG	F6	U23
'Z', 1 Reset	b	b	b	b	b	b
2 Pause	b	b	b	b	b	b
3 Standby	b	b	b	b	b	b
4 Measure	b	b	b	b	b	b
5 Zero calibration	k	k	k	k	k	b
6 Adjust component slope	k	k	k	k	k	k
7 Not yet defined	-	-	-	-	-	-
8 Adjust curve dip	k	-	k	k	k	k
9 Adjust linearization sensitivity	k	-	k	k	k	k
10 Adjust temperature compensation	b	b	-	-	-	b
11 Adjust pressure compensation	b	-	b	b	b	-
12 Adjust linearization zero	k	-	k	k	k	-
13 Not yet defined	-	-	-	-	-	-
14 Autocal (once)	b	b	b	b	k	b
15 Adjust phase	k	k	-	-	-	-
16 Zero calibration of O_2 sensor	-	-	-	-	-	k
17 Not yet defined	-	-	-	-	-	-
18 Not yet defined	-	-	-	-	-	-
19 Adjust analog output	k	k	k	k	k	k
20 Adjust analog input	b	b	b	b	b	-
21 Autocal check	b	b	b	b	b	-

U6 = ULTRAMAT 6
O6 = OXYMAT 6, OXYMAT 61
C6 = CALOMAT 6
C6 TG = CALOMAT 6 Turbo
F6 = FIDAMAT 6
U23 = ULTRAMAT 23

b = channel-related command
k = component-related command
# = read-only command
- = command not implemented

Set switching function		U6	O6	C6	C6 TG	F6	U23
'F', 1	*Remote* on/ off	b	b	b	b	b	b
2	Pressure switch for sample gas on/ off	b	b	-	-	-	b
3	Pressure switch for reference gas on/ off	b	b	-	-	-	-
4	Total/ single calibration	k	k	k	-	k	k
5	Maintenance switch on/ off	b	b	b	b	b	b
6	Solenoid valve for zero gas on/ off	-	-	-	-	-	b
7	Not yet defined	-	-	-	-	-	-
8	Magnetic field on/ off	-	b	-	-	-	-
9	Solenoid valve for calibration gas on/ off	-	-	-	-	-	b
10	Broadcast on/ off	b	b	b	b	b	b
11	Pump on/ off	-	-	-	-	b	b
12	Radiator voltage on/ off	b	-	-	-	-	-
13	Lock logbook on/ off	b	b	b	b	b	-
14	Sample point switching on/ off	b	b	b	b	b	-
15	Suppress negative measured values on the analog output on/ off	k	k	k	k	k	-
16	Signal violation of calibration tolerance	k	k	k	k	k	-
17	Not yet defined	-	-	-	-	-	-
18	Zero calibration before slope calibration	-	-	-	-	-	k
19	Synchronous zero calibration with ELAN on/ off	-	-	-	-	-	k
20	Linearization on/ off	k	k	k	k	k	-
21	Temperaturcompensation on/ off	k	k	k	k	k	-
22	Pressurecompensation on/ off	k	k	k	k	k	-
23	Heating on/ off	b	b	-	-	b	-
24	Precompensation on/ off	k	-	-	-	-	-
25	Aftercompensation of the zero point on/ off	k	k	k	k	k	-
26	Aftercompensation of the span on/ off	k	k	k	k	k	-
27	Fault/ Maint. request/function control according to NAMUR on/ off	k	k	k	k	k	-
28	Zero calibration concerted on/ off	b	-	-	-	-	-
29	Suppress negative measured values on the display on/ off	b	b	b	b	b	-
30	Ignition on/ off	-	-	-	-	b	-
31	Heating of catalyzer on/ off	-	-	-	-	b	-
32	Fan on/ off	-	-	-	-	b	-
33	Relay by PROFIBUS on/ off	b	b	b	b	b	b

Read/ set control function		U6	O6	C6	C6 TG	F6	U23
's'/'S', 1	Limit 1	k	k	k	k	k	k
2	Limit 2	k	k	k	k	k	k
3	Analog output range	b	b	b	b	b	b
4	Relay outputs (standard)	b	b	b	b	b	b
5	Relay outputs (with optional board)	b	b	b	b	b	b
6	Binary inputs (standard)	b	b	b	b	b	b#
7	Binary inputs (with optional board)	b	b	b	b	b	b
8	Current measuring range	k	k	k	k#	k	k
9	Not yet defined	-	-	-	-	-	-
10	Measuring head heating	-	b#	-	-	-	-
11	*Autocal* mode	b	b	b	-	b	-
12	*Autocal* steps	b	b	b	-	b	b#
13	Compensation/ calibration step	k	k	k	-	k	k
14	Not yet defined	-	-	-	-	-	-
15	Pressure compensation	b	b	b	b	-	-
16	Correction 1 of cross-interference	k	k	b	b	b	k
17	Not yet defined	-	-	-	-	-	-
18	Not yet defined	-	-	-	-	-	-
19	Save measured value	b	b	b	b	b	b
20	Valves	b	b	b	b	b	b
21	AK parameters	b	b	-	-	b	-
22	Sync input/ pump	-	-	-	-	-	b
23	External interference component 1,2	k	k	b	b	b	k
24	Dimension of measured value	k	k#	k#	-	k	k
25	Internal interference component	-	-	-	-	-	k
26	Relay outputs/ binary inputs	b#	b#	b#	b#	b#	-
27	Language selection	b	b	b	b	b	b
28	Automatic temperature compensation	b	b	-	-	-	-
29	Heating parameters	b	b	-	-	-	-
30	Limit 3	k	k	k	k	k	-
31	Limit 4	k	k	k	k	k	-
32	PROFIBUS parameters	b	b	b	b	b	b
33	Integrated optional board	b#	b#	b#	b#	b#	b#-
34	Relais outputs/ binary inputs general	b#	b#	b#	b#	b#	b#
35	Correction 2 of cross-interference	-	-	b	b	b	-
36	Correction 3 of cross-interference	-	-	b	b	b	-
37	Correction 4 of cross-interference	-	-	b	b	b	-
38	External interference component 3,4	-	-	b	b	b	-
39	External channel of pressure compensation	b	b	b	b	-	-
40	PROFIBUS profile	b	b	b	b	b	b
41	Internal valves	-	-	-	-	b	-
42	Relay by PROFIBUS	b	b	b	b	b	b

Read/ write values		U6	O6	C6	C6 TG	F6	U23
'w'/'W', 1	Start-of-scale values	k	k	k	k#	k	k#
2	Full-scale values	k	k	k	k#	k	k
3	Slope gas concentrations	k	k	k	k#	k	k
4	Linearization gas concentrations	k	-	k	k	k	k
5	Zero gas concentration	k	k	k	k	k	k#
6	*Autocal* cycle parameters	b	b	b	-	b	b
7	Purge times for *Autocal* steps 1 to 6	b	b	b	-	b	b
8	Purge times for *Autocal* steps 7 to 12	b	b	b	-	b	-
9	Limit 1	k	k	k	k	k	k
10	Limit 2	k	k	k	k	k	k
11	Integration times	k	k	k	k	k	k
12	Autorange hysteresis (% measuring range)	k	k	k	-	k	k
13	Pump capacity	-	-	-	-	-	b
14	Date of O_2 sensor installation	-	-	-	-	-	b
15	Not yet defined	-	-	-	-	-	-
16	Time	b	b	b	b	b	-
17	Not yet defined	-	-	-	-	-	-
18	Barometric pressure	b	b	b#	b#	b#	b
19	Analog output	k	k	k	k	k	k
20	LCD contrast	b	b	b	b	b	b
21	Frequency	b	b	-	-	-	b
22	Reduction value	k	k	-	-	-	-
23	Phase	k#	k	-	-	-	-
24	Noise signal suppression duration	k	k	k	k	k	-
25	Calibration tolerances	k	k	k	-	k	b
26	Shock compensation	-	b	-	-	-	-
27	Parameters of external pressure sensor	b	b	b	b	-	-
28	Parameters of external interfering gas 1	k	k	b	b	b	k
29	Sample point times	b	b	b	-	b	-
40	Autorange lower limits (absolute value)	k	k	k	-	k	-
41	Autorange upper limits (absolute value)	k	k	k	-	k	-
42	Full-scale value of linearization curve	k	k#	k	k	k	k
43	Deviation in zero and slope calibration	k#	k#	k#	k#	k#	k#
44	Parameters of external interfering gas 2	-	-	b	b	b	k
45	Parameters of internal interfering gas 1	-	-	-	-	-	k
46	Parameters of internal interfering gas 2	-	-	-	-	-	k
47	Temperature values of temperature comp.	k	k	k	k	k	k
48	Zero point values of temperature comp.	k	k	k	k	k	k
49	End point values of temperature comp.	k	-	k	k	k	-
50	Zero point koefficients of temperature comp.	k	k	k	k	k	k
51	End point koefficients of temperature comp.	k	k	k	k	k	k
52	Switching temperatur of temperature comp.	k	-	k	k	k	k
53	Koefficients of linearization	k	k	k	k	k	k
54	Pressure values of pressure compensation	k	-	k	k	k	-
55	Zero point values of pressure compensation	k	-	k	k	k	-
56	End point values of pressure compensation	k	-	k	k	k	-
57	Koefficients of pressure compensation	k	-	k	k	k	k
58	Reference of pressure compensation	k	-	k	k	k	-
59	Aftercompensation of the zero point	k	k	k	k	k	-
60	Aftercompensation of the measured value	k	k	k	k	k	-
61	Precompensation	k	-	-	-	-	-

Read/ write values	U6	O6	C6	C6 TG	F6	U23
2 Parameters of calibration	k	-	k	k	k	-
63 Limit 3	k	k	k	k	k	-
64 Limit 4	k	k	k	k	k	-
65 Autocal check calibration tolerances	b	b	b	-	b	-
66 Parameters of external interfering gas 3	-	-	b	b	b	-
67 Parameters of external interfering gas 4	-	-	b	b	b	-
68 Value of interfering gas 1	k	k#	b	b	b	-
69 Value of interfering gas 2	-	-	b	b	b	-
70 Value of interfering gas 3	-	-	b	b	b	-
71 Value of interfering gas 4	-	-	b	b	b	-
72 Koefficients of external interfering gas 1	-	-	b	b	b	-
73 Koefficients of external interfering gas 2	-	-	b	b	b	-
74 Koefficients of external interfering gas 3	-	-	b	b	b	-
75 Koefficients of external interfering gas 4	-	-	b	b	b	-
76 Zero-scale value of linearization curve	k	k#	k	k	k	k
77 Noise signal suppression level	k	k	k	k	k	-
78 Offset of pressure sensors	-	-	-	-	b	-
79 Parameters of preamplifier	-	-	-	-	b	-
80 Heating parameters of FIDAMAT	-	-	-	-	b	-
81 Set values of pressures	-	-	-	-	b#	-
82 Tolerances of pressures	-	-	-	-	b	-
83 Drift values	k	k	k	k	k	k

Read diagnostic values (see chapter 4.8)	U6	O6	C6	C6 TG	F6	U23
'h', 1 - n						

Other commands	U6	O6	C6	C6 TG	F6	U23
'k', 1 Read measured value of one component	k	k	k	k	k	k
'k', 2 Read all measured values of the channel	b	b	b	b	b	b
'k', 3 Read channel functions	b	b	b	b	b	b
'k', 4 Read component functions	k	k	k	k	k	k
'k', 5 Read error state	b	b	b	b	b	b
'k', 6 Read channel version	b	b	b	b	b	b
'K', 7 Reset linearization coefficients	-	-	-	-	-	k
'k', 8 Read remaining time	-	-	-	-	-	b
'k', 9 Read time to next zero calibration	-	-	-	-	-	b
'k', 10 Read logbook entry	b	b	b	b	b	b
'K', 10 Acknowledge logbook entry	b	b	b	b	b	b
'k', 11 occupied	-	-	-	-	-	-
'k', 12 Read maintenance request state	b	b	b	b	b	b
'K', 13 Acknowledge logbook error	b	b	b	b	b	b
'K', 14 Transfer data sectors	b	b	b	b	b	b
'k', 15 occupied	-	-	-	-	-	-
'k'/'K', 16 Channel name	b	b	b	b	b	b
'k'/'K', 17 Not yet defined	-	-	-	-	-	-
'k', 18 Read message state	b	b	b	b	b	-
'k', 19 Read current *Autocal* step	b	b	b	b	b	-
'k', 20 Scan boot program errors	b	b	b	b	b	b
'K', 20 Start boot program	b	b	b	b	b	b
'K', 21 Run firmware update	b	b	b	b	b	b
'K', 22 Clear logbook	b	b	b	b	b	-
'k', 23 Read state of the external connections	b	b	b	b	b	-
'k'/'K',24 Download mode	b	b	b	b	b	b
‚K‘, 25 Data transfer for download	b	b	b	b	b	b
‚k‘, 26 Set of parameters read/ write	b	b	b	b	b	b
‚k‘, 27 Transfers a part of a set of parameters	b	b	b	b	b	b
‚k‘, 28 Read firmware versions	b	b	b	b	b	b
‚k‘, 29 Read warm-up state	-	-	-	-	b	-
'k'/'K', 30 Startup state	-	-	-	-	b	-
‚k‘, 31 Read channel variant	b	b	b	b	b	b

4.3 Data Formats

Transmitted data are values and control characters which are separated by 0H.

- Value => ASCII value ('0' - '9', possibly sign, decimal point).
  Any scanned value (read value) additionally contains the dimension (1 byte).
  Values to be set (write value) are always without a dimension since the dimensions cannot be changed.
- Control character (crc.) => 1-byte value (1 - 255; no 0 to avoid separator)

Table 4-1 Dimensions

1	No dimension (only number)	21	S/ cm	41	Hz
2	ppm	22	mS/ m	42	pH
3	ppb	23	mS/ cm	43	µg/ l
4	vpm	24	µS/ m	44	mg/ l
5	ppm C_1	25	µS/ cm	45	l/ min
6	ppm C_3	26	S	46	µA
7	ppm C_6	27	min	47	mg/ dm^3
8	mg C/ m^3	28	H	48	kPa
9	mg/ m^3	29	Pa	49	kΩ * cm
10	%	30	MA	50	MΩ * cm
11	% vol	31	µV	51	°
12	% of measuring range	32	MV	52	1/ min
13	% saturation	33	V	53	1/ m
14	%/ °C	34	mbar	54	g/ m^3
15	%/ K	35	hPa	55	g/ l
16	% weight	36	Ml/ min	56	% Vol C
17	mV/ pH	37	kΩ		
18	mV/ mbar	38	MΩ		
19	nA/ mbar	39	S		
20	S/ m	40	°C		

Examples

Write values:
-3000 V => '-3000', 0
2.84 ppm, 39.0 °C, 1.8 => '2.84', 0, '39.0', 0, '1. 8', 0

Read values:
-3000 V => '-3000', 0, 33, 0
2.84 ppm, 39.0 °C, 1.8 => '2.84', 0, 2, 0, '39.0', 0, 40, 0, '1.8', 0, 1, 0

4.4 Set Channel State

Command structure

Control command:	'Z', number, control character (if required)
Answer:	'Z', number

Example: start *Measure*

Control command:	'Z', 4	
Answer:	'Z', 4	Command has been or is being executed
	or:	
Answer:	'OF'	Command cannot be executed (e.g. channel is not in *Remote* mode)

Reset **'Z', 1**

The channel executes a *Reset* (as if switched off/ on).
Starting the boot program is possible within 1 s after *Rese*t.
This command is always accepted.

Pause **'Z', 2**

The channel starts the *Pause* state (pump off; gas flow off, ...),
Only valid in S*tandby* state.

Standby **'Z', 3**

The channel starts the *Standby* state (pump off, ...)
This command also aborts running functions (*adjust component slope, adjust temperature compensation etc*.).
This command is not valid on FIDAMAT 6 versions without pump.

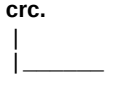
Measure **'Z', 4**

The channel starts the *Measure* state.
This command also aborts running functions (*adjust component slope, adjust temperature compensation etc*.).

Zero calibration **'Z', 5**

Zero calibration of selected component (slope calibration of O_2 sensor). Calibration starts by opening the zero gas valve (relay). The command 'Set compensation/ calibration step' ('S', 13) imports the new zero point.
Only valid in *Standby* or *Measure* state. On FIDAMAT 6 only valid in *Measure* state.

Adjust component slope **'Z', 6, crc.**



Slope calibration of the selected measuring range of the addressed component (except O_2 sensor). Calibration starts by opening the calibration gas valve (relay).
The command 'Set compensation/ calibration step' ('S', 13) imports the new slope.
With a total calibration, the calculated slope is also assigned to the other measuring ranges.
Only valid in *Standby* or *Measure* state. On FIDAMAT 6 only valid in *Measure* state.
On C6TG is only measuring range (1 to 3).

Adjust curve dip **'Z', 8**

The channel calibrates the dip for linearization of the addressed component (except O_2 sensor). The calibration gas must be connected to the sample gas inlet.
The command 'Set compensation/ calibration step' ('S', 13) imports the new curve dip value.
Only valid in *Standby* or *Measure* state. On FIDAMAT 6 only valid in *Measure* state.

Adjust linearization sensitivity **'Z', 9**

The channel calibrates the sensitivity for linearization of the addressed component (except O_2 sensor). The calibration gas must be connected to the sample gas inlet.
The command 'Set compensation/ calibration step' ('S', 13) imports the new sensitivity.
Only valid in *Standby* or *Measure* state. On FIDAMAT 6 only valid in *Measure* state.

Adjust temperature compensation

'Z', 10

The channel carries out a temperature measuring cycle to determine the temperature coefficients.
The command 'Set compensation step' ('S', 13) controls this procedure. Any temperature step must be set for at least 5 hours.
Only valid in *Standby* or *Measure* state.

Adjust pressure compensation

'Z', 11

The channel carries out a pressure measuring cycle to determine the pressure coefficient.
The command 'Set compensation step' ('S', 13) controls this procedure.
Only valid in *Standby* or *Measure* state.

Adjust linearization zero

'Z', 12

The channel carries out a sensitivity calibration for linearization of the addressed component (except O_2 sensor). The zero gas must be connected to the sample gas inlet.
The command 'Set compensation/ calibration step' ('S', 13) imports the new zero point.
Only valid in *Standby* or *Measure* state. On FIDAMAT 6 only valid in *Measure* state.

Autocal

'Z', 14

The channel starts a single *Autocal.*
Only valid in *Standby* or *Measure* state and with *channel function Autocal on*. On FIDAMAT 6 only valid in *Measure* state.
Commands for *Autocal* are only permissible for an ULTRAMAT 6, CALOMAT 6, FIDAMAT 6 or OXYMAT 6 if the optional board is fitted.

Adjust phase

'Z', 15

The component carries out an adjustment to determine the phase.

Zero calibration of O_2 sensor **'Z', 16**

The channel carries out a zero calibration for the O_2 sensor. Zero gas must be connected via the sample gas inlet.
The command 'Set compensation/ calibration step' ('S', 13) imports the new zero point.
Only valid in *Standby* or *Measure* state.

Adjust analog output **'Z', 19**

The component starts the calibration of the analog current output.
The command 'Set analog output' ('W', 19) controls this procedure.
Only valid in *Standby* or *Measure* state.

Adjust analog input **'Z', 20**

The channel starts the calibration of the analog current inputs. The analog current output 1 must be adjusted beforehand.
Calibration steps :

1. Connect analog current output 1 to analog current input 1. Send command 'Z', 20.
2. Send command 'Set compensation/ calibration step' ('S', 13) (analog current input 1 is adjusted to 20 mA).
3. Send command 'Set compensation/ calibration step' ('S', 13) (analog current input 1 is adjusted to 0 mA).
4. Connect analog current output 1 to analog current input 2.
5. Send command 'Set compensation/ calibration step' ('S', 13) (analog current input 2 is adjusted to 20 mA).
6. Send command 'Set compensation/ calibration step' ('S', 13) (analog current input 2 is adjusted to 0 mA).

Only valid in *Standby* or *Measure* state.

Autocal check **'Z', 21**

The channel starts a single *Autocal check.*
Only valid in *Standby* or *Measure* state and with channel function *Autocal* on. On FIDAMAT 6 only valid in *Measure* state.
Commands for *Autocal check* are only permissible if the optional board is fitted.

4.5 Set Switching Function

Command structure

Control command:	'F', number, function ('0' => off; '1' => on)
Answer:	'F', number

Example: Remote on

Control command:	'F', 1, '1', 0
Answer:	'F', 1

***Remote* on/ off**

'F', 1, function

'0' => off; '1' => on

The channel starts or finishes *Remote* mode *(*remote control via the interface).
Without *Remote*, only read commands are accepted.
Only valid if the channel is coded (all codes switched off).

Pressure switch for sample gas on/ off

'F', 2, function

'0' => off; '1' => on

The channel starts or finishes monitoring the sample gas pressure.

Pressure switch for reference gas on/ off

'F', 3, function

'0' => off; '1' => on

The channel starts or finishes monitoring the reference gas pressure.

Total/ single calibration

'F', 4, function

'0' => single calibration;
'1' => total calibration

The component performs with total calibration (calibration valid for all ranges) or single calibration (each range is calibrated independent of the others).
The function is not available at C6TG.
The function is not available at O2-component of ULTRAMAT 23.

Maintenance switch on/ off

'F', 5, function

'0' => off; '1' => on

The channel is being serviced (a code has been entered).

Solenoid valve for zero gas on/ off (ULTRAMAT 23)

'F', 6, function

'0' => off; '1' => on

The channel switches the internal solenoid valve and the relay contact for the external solenoid valve on or off.

Magnetic field on/ off (OXYMAT 6)

'F', 8, function

'0' => off; '1' => on

The channel switches the magnetic field on or off.
If the magnetic field is switched off, the heating of the measuring head is also off.

Solenoid valve for calibration gas on/ off

'F', 9, function

'0' => off; '1' => on

The channel switches the relay contact for the external solenoid valve on or off.

Broadcast on/ off

'F', 10, function

'0' => off; '1' => on

The channel starts or finishes the automatic transmission (broadcasting) of measured values (identical to answer to command 'k', 2).

Pump on/ off

'F', 11, function

'0' => off; '1' => on

The channel switches the internal pump on or off.

Radiator voltage on/ off (ULTRAMAT 6)

'F', 12, function

'0' => off; '1' => on

The channel switches the radiator voltage on or off.

Lock logbook on/ off

'F', 13, function
|
|_____ '0' => off; '1' => on

The channel stops or allows the input of further messages into the logbook.

Sample point switching on/ off

'F', 14, function
|
|_____ '0' => off; '1' => on

The channel stops or allows sample point switching.

Suppress negative measured values on the analog output on/ off

'F', 15, function
|
|_____ '0' => off; '1' => on

Signal violation of calibration tolerance on/off

'F', 16, function
|
|_____ '0' => off; '1' => on

Zero calibration before slope calibration on/ off

'F', 18, function
|
|_____ '0' => off; '1' => on

The zero is automatically calibrated before the component slope.

Synchronous zero calibration with ELAN on/ off

'F', 19, funktion
|
|_____ '0' => off; '1' => on

Broacast has to be switched on before.

Linearization on/ off

'F', 20, funktion
|
|_____ **'**0**'** => off; **'**1**'** => on

Temperature compensation on/ off

'F', 21, funktion
|
|_____ '0' => off; '1' => on

Pressure compensation on/ off

'F', 22, funktion
|
|_____ '0' => off; '1' => on

Heating on/ off

'F', 23, funktion
|
|_____ '0' => off; '1' => on

Only valid if heating is integrated.

Precompensation on/ off

'F', 24, funktion
|
|_____ '0' => off; '1' => on

Aftercompensation of the zero point on/ off

'F', 25, funktion
|
|_____ '0' => off; '1' => on

Aftercompensation of the span on/ off

'F', 26, funktion
|
|_____ '0' => off; '1' => on

Fault/ Maint. request/ Function control according to NAMUR on/ off

'F', 27, funktion
|
|_____ '0' => off; '1' => on

Zero calibration concerted on/ off

'F', 28, funktion
|
|_____ '0' => off; '1' => on

A zero calibration performs a calibration of both components. This command applies only to ULTRAMAT 6 with two components.

Suppress negative measured values on the display on/ off

'F', 29, function
|
|_____ '0' => off; '1' => on

Ignition on/ off

'F', 30, function

'0' => off; '1' => on

If flame is burning the ignition is switched off.

Heating of catalyzer on/ off

'F', 31, funktion

'0' => off; '1' => on

Only valid for FIDAMAT with integrated catalyzer.

Fan on/ off

'F', 32, funktion

'0' => off; '1' => on

Relay by PROFIBUS on/ off

'F', 33, funktion

'0' => off; '1' => on

This command is only permissible with the PROFIBUS optional board fitted and unused relay outputs of optional board.

4.6 Read/ Set Control Function

Command structure

Read control:

Control command:	's', number
Answer:	's', number, crc.

Example: analog output range

Control command: 's', 3

Answer: 's', 3, 81H, 0

```
   |   |   |
   |   |   |_  Separator
   |   |_____  Range: 2 - 20 mA, not inverted
   |_________  Analog output current range
```

Set control:

Control command:	'S', number, crc.
Answer:	'S', number

Example: limit 1

Control command: 'S', 1, A3H, 0

Answer: 's', 1

Read/ set limit 1

's'/'S', 1, crc.

```
   |
   |_  Bit 7: 1
       Bit 6: 0
       Bit 5: 1 => limit active                (0 => passive)
       Bit 4: 1 => active upward violation  (0 => downward
       violation)
       Bit 3: 1 => active in meas. range 4  (0 => passive)
       Bit 2: 1 => "                        "" 3    "
       Bit 1: 1 => "                        "" 2    "
       Bit 0: 1 => "                        "" 1    "
```

The range information is ignored for the ULTRAMAT 23 (always measuring ranges 1 and 2).
The data for upward/ downward violation for the ULTRAMAT 23 are only observed if "Limit active" is also present.
There has to be at least one active range for the ULTRAMAT 6, CALOMAT 6 and OXYMAT 6.
There are only meassure range (1 to 3) available for the C6TG.

Read/ set limit 2 **'s'/'S', 2, crc.** (as for alarm 1)

Read/ set analog output range **'s'/'S', 3, crc.**

Bit 7: 1
Bit 6, 5, 4, 3 : 0
Bit 2: 1 => inverted (0 => not inverted)

Bit 1	Bit 0
1	1 => 4 - 20 mA Namur
1	0 => 4 - 20 mA
0	1 => 2 - 20 mA
0	0 => 0 - 20 mA

The ranges are never inverted with the ULTRAMAT 23.
With ULTRAMAT 23, the output range Namur can only be set with Softwareversion 2.9.2 or later.

Read/ set relay outputs (standard) **'s'/'S', 4, crc. 1, crc. .2, crc. 3, crc. 4, crc. 5, crc. 6, crc. 7, crc. 8**

Relay 8
Relay 7
Relay 6
Relay 5
Relay 4
Relay 3
Relay 2
Relay 1

Control character (crc.)	Function of the relay output	Comment
1	Free	
2	Error	
3	Maintenance request	
4	Calibration	Only U6/ O6/ C6/ F6
5	Component 1 measuring range 1 selected	Only U6/ O6/ C6/ F6
6	Component 1 measuring range 2 selected	
7	Component 1 measuring range 3 selected	Only U6/ O6/ C6/ F6
8	Component 1 measuring range 4 selected	Only U6/ O6/ C6/ F6
9	Component 1 alarm 1 triggered	
10	Component 1 alarm 2 triggered	
11	Function check	
12	Valve for sample gas is open	Only U6/ O6/ C6/ F6
13	Valve for zero gas is open	
14	Valve for calibration gas 1 is open	
15	Valve for calibration gas 2 is open	Only U6/ O6/ C6/ F6
16	Valve for calibration gas 3 is open	Only U6/ O6/ C6/ F6
17	Valve for calibration gas 4 is open	Only U6/ O6/ C6/ F6
18	Measuring point 1	Only U6/ O6/ C6/ F6

Control character (crc.)	Function of the relay output	Comment
19	Measuring point 2	Only U6/ O6/ C6/ F6
20	Measuring point 3	Only U6/ O6/ C6/ F6
21	Measuring point 4	Only U6/ O6/ C6/ F6
22	Measuring point 5	Only U6/ O6/ C6/ F6
23	Measuring point 6	Only U6/ O6/ C6/ F6
24	Signal from measuring point 1	Only U6/ O6/ C6/ F6
25	Signal from measuring point 2	Only U6/ O6/ C6/ F6
26	Signal from measuring point 3	Only U6/ O6/ C6/ F6
27	Signal from measuring point 4	Only U6/ O6/ C6/ F6
28	Signal from measuring point 5	Only U6/ O6/ C6/ F6
29	Signal from measuring point 6	Only U6/ O6/ C6/ F6
30	Signal contact (for synchronization with *Autocal*)/sync signal	
31	Flow of reference gas	Only U6/ O6
32	Flow of sample gas	Only U6/ O6
33	Valve for zero gas 2 is open	Only U6/ O6/ C6/ F6
34	Component 2 measuring range 1 selected	Only U6
35	Component 2 measuring range 2 selected	Only U6/ U23
36	Component 2 measuring range 3 selected	Only U6
37	Component 2 measuring range 4 selected	Only U6
38	Component 2 limit 1 triggered	Only U6/ U23
39	Component 2 limit 2 triggered	Only U6/ U23
40	Component 3 measuring range 2 selected	Only U23
41	Component 3 limit 1 triggered	Only U23
42	Component 3 limit 2 triggered	Only U23
43	Component 4 measuring range 2 selected	Only U23
44	Component 4 limit 1 triggered	Only U23
45	Component 4 limit 2 triggered	Only U23
46	CAL/MEAS	Only U23
47	Component 1 limit 3 triggered	Only U6/ O6/ C6/ F6
48	Component 1 limit 4 triggered	Only U6/ O6/ C6/ F6
49	Component 2 limit 3 triggered	Only U6
50	Component 2 limit 4 triggered	Only U6
51	Heating	Only U6/ O6
52	Autocal check difference	Only U6/ O6/ C6/ F6
53	Comp. 2 Valve for zero gas is open	Only U6
54	Comp. 2 Valve for calibration gas 1 is open	Only U6
55	Comp. 2 Valve for calibration gas 2 is open	Only U6
56	Comp. 2 Valve for calibration gas 3 is open	Only U6
57	Comp. 2 Valve for calibration gas 4 is open	Only U6
58	Valve for hydrogen is open	Only F6
59	Valve for combustion air is open	Only F6
60	Internal valve 5 is open	Only F6
61	Internal valve 6 is open	Only F6

ULTRAMAT 6, CALOMAT 6, OXYMAT 6 and FIDAMAT 6 have only 6 relay outputs. Each function can be set for only one relay.

Read/ set relay outputs (with optional board)

's'/'S', 5, crc. 1, crc. 2, crc. 3, crc. 4, crc. 5, crc. 6, crc. 7, crc. 8

|	|	|	|	|	|	|	|	
|	|	|	|	|	|	|	|__	Relay 8
|	|	|	|	|	|	|_____	Relay 7
|	|	|	|	|	|_____		Relay 6
|	|	|	|	|_____			Relay 5
|	|	|	|_____				Relay 4
|	|	|_____					Relay 3
|	|_____						Relay 2
|_____								Relay 1

See "Relay outputs (standard)" for explanation of control characters.

Read/ set binary inputs (standard)

's'/'S', 6, crc. 1, crc. 2, crc. 3, crc. 4, crc. 5, crc. 6

|	|	|	|	|	|_	Binary input 6
|	|	|	|	|_____		Binary input 5
|	|	|	|_____			Binary input 4
|	|	|_____				Binary input 3
|	|_____					Binary input 2
|_____						Binary input 1

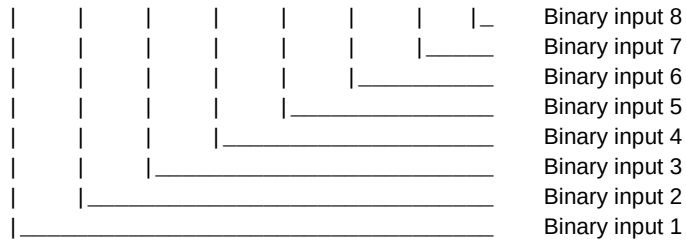
Control character	Function of the binary input	Comment
1	Vacant	
2	Other fault	
3	Fault probe heating	
4	Fault sample gas filter	
5	Fault gas cooler	
6	Other maintenance request	
7	Maintenance request probe heating	
8	Maintenance request sample gas filter	
9	Maintenance request gas cooler	
10	Acknowledge (logbook reset)	
11	Function control 1	
12	Function control 2	
13	Function control 3	
14	Function control 4	
15	Autocalibration	U23 only read
16	Component 1 Range 1	
17	Component 1 Range 2	
18	Component 1 Range 3	Only U6/ O6/ C6 / F6
19	Component 1 Range 4	Only U6/ O6/ C6 / F6
20	Component 1 Autorange	
21	Zero gas	Only U6/ O6/ C6 / F6
22	Span gas	Only U6/ O6/ C6 / F6
23	Sample gas	Only U6/ O6/ C6 / F6

Control character	Function of the binary input	Comment
24	Zero calibration	Only U6/ O6/ C6 / F6
25	Component 1 Span calibration	Only U6/ O6/ C6 / F6
26	Fault condensate vessel	
27	Fault sample pump/ flow	Only U23
28	Fault sample line	Only U23
29	Maintenance request condensate vessel	
30	Maintenance request sample pump/ flow	
31	Maintenance request sample line	
32	Pump on/ off	Only U23; only read
33	Synchron zero adjustment	Only U23; only read
34	Component 2 range 1	Only U6/ U23
35	Component 2 range 2	Only U6/ U23
36	Component 2 range 3	Only U6
37	Component 2 range 4	Only U6
38	Component 2 autorange	Only U6/ U23
39	Component 3 range 1	Only U23
40	Component 3 range 2	Only U23
41	Component 3 autorange	Only U23
42	Component 4 range 1	Only U23
43	Component 4 range 2	Only U23
44	Component 4 autorange	Only U23
45	Component 2 span calibration	Only U6
46	Autocal check	Only U6/ O6/ C6 / F6
47	*Measure* state locked	Only U6/ O6/ C6 / F6
48	Component 2 zero gas	Only U6
49	Component 2 span gas	Only U6
50	Component 2 zero calibration	Only U6

Each function can be set for only one binary input.

Read/ set binary inputs (with optional board)

's'/'S', 7, cr. 1, cr. 2, cr. 3, cr. 4, cr. 5, cr. 6, cr. 7, cr. 8



See "Binary inputs (standard)" for explanation of control characters.

Read/ set current measuring range

's'/'S', 8, crc.

Bit 7: 1
Bit 6, 5, 4, 3: 0
Bit 2: 1 => autorange on

Bit 1	Bit 0
1	1 => measuring range 4
1	0 => " 3
0	1 => " 2
0	0 => " 1

The autorange function is switched off if a measuring range is set.
Ranges 3 and 4 cannot be selected for the ULTRAMAT 23.
There are only measuring rang (1-4) in readonly mode available, for the C6TG

Read measuring head heating

's', 10, crc.

Bit 7: 1
Bit 6, 5, 4: 0
Bit 3: 1 => measuring head heating on (0 => off)
Bit 2: 0

Bit 1	Bit 0
1	1 => 100 °C setpoint temperature
1	0 => 90 °C "
0	1 => 80 °C "
0	0 => 75 °C "

Read/ set *Autocal* mode

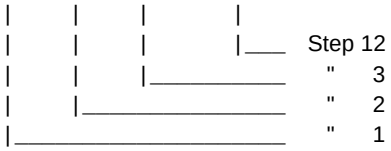
's'/'S', 11, crc.

Bit 7: 1
Bit 6, 5, 4 : 0
Bit 3: 1 => *Autocal* check on (0 => off)
Bit 2: 1 => *Autocal* on (0 => off)
Bit 1: 1 => start by binary input
Bit 0: 1 => start by cyclic parameter

Commands for *Autocal* mode are only valid if the optional board is fitted.
The function is not available for the C6TG

Read/ set *Autocal* steps

's'/'S', 12, crc. 1, crc. 2, crc. 3, ... crc. 12



Control character	Step	Comment
1	Not used	
2	Zero gas 1	
3	Zero gas 2	
4	Calibration gas 1	
5	Calibration gas 2	
6	Calibration gas 3	
7	Calibration gas 4	
8	Sample gas purging	
9	Intermediate sample gas mode	
10	Signalling contact	

Commands for *Autocal* are only valid for the ULTRAMAT 6, CALOMAT 6 and OXYMAT 6 if the optional board is fitted.
The function is not available for the C6TG

Read/ set compensation/ calibration step

's'/'S', 13, crc.

1 – 255

With multi-step compensation/ calibration procedures, a "Set step" command sets the current values for calculation of the compensation and starts the next step. The transmitted control character is ignored.
With "Read step", the control character defines the current step.
The function is not available for the C6TG.

Read/ set pressure compensation

's'/'S', 15, crc. 1, crc. 2

Bit 7: 1
Bit 6, 5, 4, 3, 2: 0

Bit 1	Bit 0	Analog input of ext. pressure
1	0 =>	4 - 20 mA/ NAMUR
0	1 =>	2 - 20 mA
0	0 =>	0 - 20 mA

Bit 7: 1
Bit 6, 5, 4, 3, 2: 0

Bit 1	Bit 0
1	1 => pressure comp. with ELAN
1	0 => pressure comp. with analog current 2
0	1 => pressure comp. with int. pressure
0	0 => no pressure compensation

The settings for pressure compensation are channel-related. However with the setting 'no pressure compensation' it is possible to switch the single components off from compensation.

's'/'S', 16, crc. 1, crc. 2

Read/ set correction 1 of cross-interference

Bit 7: 1
Bit 6: 0
Bit 5: 1 => corr. of cross-interference valid for range 4
Bit 4: 1 => corr. of cross-interference valid for range 3
Bit 3: 1 => corr. of cross-interference valid for range 2
Bit 2: 1 => corr. of cross-interference valid for range 1

Bit 1	Bit 0	Analog input of ext. interfering gas
1	0 =>	4 – 20 mA / NAMUR
0	1 =>	2 – 20 mA
0	0 =>	0 – 20 mA

Bit 7: 1
Bit 6, 5, 4, 3, 2: 0

Bit 2	Bit 1	Bit 0
1	0	1 => residual gas influence with analog current (analog input 2)
1	0	0 => residual gas influence with internal component
0	1	1 => residual gas influence via ELAN
0	1	0 => residual gas influence with analog current (analog input 1)
0	0	1 => constant residual gas interference
0	0	0 => no residual gas influence

With ULTRAMAT 23, the correction of cross-interference is always valid for
range 1 and 2, and residual gas influence is possible only via ELAN.
There has to be at least one range for cross-interference with ULTRAMAT 6, CALOMAT 6, FIDAMAT 6 and OXYMAT 6.
The residual gas influence with internal component is only valid with ULTRAMAT 6 with 2 components.
The residual gas influence with analog input 2 is only valid with CALOMAT 6 and FIDAMAT 6.
With CALOMAT 6 and FIDAMAT 6, the current range of the analog input can only be set when residual gas influence with analog current 1 or 2 is selected.

Read/ set measured-value saving

's'/'S', 19, crc.

Bit 7: 1
Bit 6, 3, 2: 0

Bit 5	Bit 4	with error:
1	1 =>	highest value (20 mA)
1	0 =>	lowest value (0/ 2/ 4 mA)
0	1 =>	save measured value
0	0 =>	save function off (update)
Bit 1	**Bit 0**	**with function check:**
1	1 =>	highest value (20 mA)
1	0 =>	lowest value (0/ 2/ 4 mA)
0	1 =>	save measured value
0	0 =>	save function off (update)

With the ULTRAMAT 6, CALOMAT 6, FIDAMAT 6 and OXYMAT 6 there is no difference between an error and a function check. The input for a function check thus also applies to an error.

Read/ set valves

's'/'S', 20, crc.

Bit 7: 1
Bit 6: 0
Bit 5: 1 => valve for calibration gas 4 open (0 => close)
Bit 4: 1 => " calibration gas 3 " "
Bit 3: 1 => " calibration gas 2 " "
Bit 2: 1 => " calibration gas 1 " "
Bit 1: 1 => " zero gas " "
Bit 0: 1 => " sample gas " "

Only one valve can be open.
With ULTRAMAT 23 only bit 0 - 2 are used.

Read/ set AK parameters

's'/'S', 21, crc. 1, crc. 2, crc. 3, crc. 4, crc. 5

|_	'Don't care' character
|_____	End character
|_____	Start character
|_____	AK[2] format (see table)
|_____	Baud rate (see table)

This command is only permissible with the AK optional board fitted.
The start character, end character and 'Don't care' character must not be 0.

Control character 1	Baud rate
1	300
2	600
3	1200
4	2400
5	4800
6	9600

	AK format			
Control character 2	No. of data bits	Parity	No. of stop bits	No. of bits per sign
1	7	None	2	10
2	7	Even	1	10
3	7	Odd	1	10
4	8	None	1	10
5	7	Even	2	11
6	7	Odd	2	11
7	8	Even	1	11
8	8	Odd	1	11
9	8	None	2	11

Sync input/ pump (ULTRAMAT 23)

's'/'S', 22, crc.

|_ Bit 7: 1
Bit 6, 5, 4, 3: 0
Bit 2: 1 => pump on with *Zero calibration* (0 => off)
Bit 1: 1 => pump on with *Measure* (0 => off)
Bit 0: 1 => Sync input starts *Zero calibration*
(0 => no *Zero calibration;* only set Cal contact)

[2] AK: Arbeitskreis der deutschen Automobilindustrie (Working Party of the German Automotive Industry)

Read/ set external interference component 1,2

's'/'S', 23, crc. 1, crc. 2

|	|__	Component address for correction of cross-interference 2
|		Bit 7, 6, 5, 4: channel address (1 - 12)
|		Bit 3, 2, 1, 0: component address (0 - 3)
|_____		Component address for correction of cross-interference 1
		Bit 7, 6, 5, 4: channel address (1 - 12)
		Bit 3, 2, 1, 0: component address (0 - 3)

The address for correction may not be the address of the device. With the ULTRAMAT 6 and OXYMAT 6, only the component address for correction of cross-interference 1 is valid.

Note

The component addresses in device menu are 1 – 4 !

Read/ set dimension of measured value

's'/'S', 24, crc.

Control character	Dimension U23	Dimension U6	Dimension F6
1	Not used	% Vol	ppm C1
2	vpm	vpm	ppm C3
3	% (only for read)	mg/ m^3	ppm C6
4	mg/ m^3	ppm	mg/ m^3
5	ppm	mg/ l	% Vol C (only for read)
6		g/ m^3 (since V4.4.0)	
7		g/ l (since V4.4.0)	

This command is not valid for the O_2 sensor of the U23. No change allowed if full-scale value of linearization curve in new dimension exeeds 99999 or for U23 component with dimension % (percent).

Read/ set internal interference component

's'/'S', 25, crc. 1, crc. 2

```
|     |
|     |__   Component address for correction of internal
|           cross-interference 2
|           Bit 7: 1
|           Bit 6, 5, 4: 0
|           Bit 3, 2, 1, 0: component address    (0 - 3)
|
|_____      Component address for correction of internal
            cross-interference 1
            Bit 7: 1
            Bit 6, 5, 4: 0
            Bit 3, 2, 1, 0: component address    (0 - 3)
```

Read relay inputs/ binary outputs

's'/, 26, crc. 1, crc. 2, crc. 3, crc. 4

```
|     |     |     |
|     |     |     |__   binary inputs 8 - 14
|     |     |           Bit 7 : 1
|     |     |           Bit 0 – 6 : state of binary inputs 8 -
                        14
|     |     |
|     |     |_____      binary inputs 1 - 7
|     |                 Bit 7 : 1
|     |                 Bit 0 – 6 : state of binary inputs 1 - 7
|     |
|     |_____________    relay outputs 8 - 14
|                       Bit 7 : 1
|                       Bit 0 – 6 : state of relay outputs 8 -
                        14
|
|_____________________  relay outputs 1 - 7
                        Bit 7 : 1
                        Bit 0 – 6 : state of relay outputs 1 - 7
```

Relay outputs 7 – 14 and binary inputs 7 – 14 are on the optional board.

Read/ set language selection

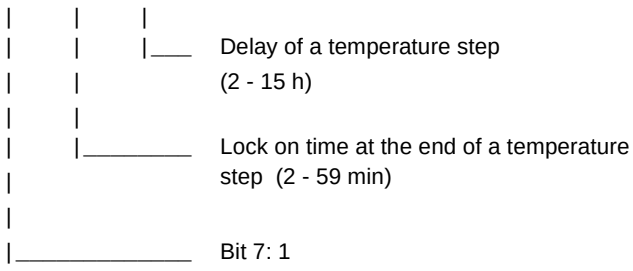
's'/'S', 27, crc.

crc.:
1 => German / Second language
2 => English
3 => Spanish
4 => French
5 => Italian

Only english and the ordered language (crc. = 1) can be set.

Automatic temperature compensation

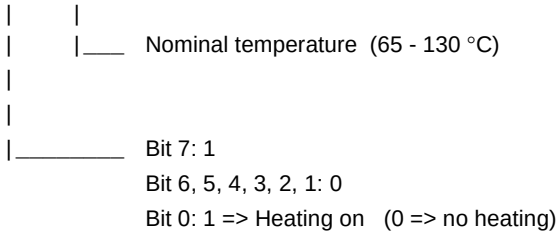
's'/'S', 28, crc. 1, crc. 2, crc. 3



The parameters of the automatic temperature compensation are lost when device is reset.

Heating parameters

's'/'S', 29, crc. 1, crc. 2



With ULTRAMAT 6 the nominal temperature can be read only.

Limit 3

's'/'S', 30, crc. (see limit 1)

Limit 4

's'/'S', 31, crc. (see limit 1)

PROFIBUS parameter

's'/'S', 32, crc.

Bit 7: 1

Bit 6,5,4,3,2,1,0 => PROFIBUS address (0 - 126)

This command is only permissible with the PROFIBUS optional board fitted.
The address can only be set when there is no cyclical communication.

integrated optional board

's', 33, crc.

1 => no option board fitted
2 => Autocal optional board
3 => AK optional board
4 => PROFIBUS PA optional board
5 => PROFIBUS DP optional board

Relay outputs/ binary inputs general

's'/, 34, crc. 1, crc. 2, crc. 3, crc. 4 , crc. 5

|	|	|	|	|	
|	|	|	|	|_	Binary inputs 8 - 14 :
|	|	|	|		Bit 7 : 1
|	|	|	|		Bit 0 - 6: state of binary inp. 8 – 14
|	|	|	|		
|	|	|	|_____		Binary inputs 1 - 7 :
|	|	|			Bit 7 : 1
|	|	|			Bit 0 - 6: state of binary inp. 1 – 7
|	|	|			
|	|	|_____			Relay outputs 15 - 16 :
|	|				Bit 7 : 1
|	|				Bit 0 - 1 : state of relay 15 - 16
|	|				
|	|_____				Relay outputs 8 - 14 :
|						Bit 7 : 1
|						Bit 0 - 6 : state of relay 8 - 14
|						
|_____						Relay outputs 1 - 7 :
						Bit 7 : 1
						Bit 0 - 6 : state of relay 1 - 7

The relay outputs 1 - 8 and the binary inputs 1 - 6 are on the main board.
All further relay outputs and binary inputs are on the optional board.
ULTRAMAT 23 has no binary inputs 4 – 6.
ULTRAMAT 6, CALOMAT 6, FIDAMAT 6 and OXYMAT 6 have no relay output 7 - 8.

Read/ set correction 2 of cross-interference

's'/'S', 35, crc. 1, crc. 2

Bit 7: 1
Bit 6: 0
Bit 5: 1 => corr. of cross-interference valid for range 4
Bit 4: 1 => corr. of cross-interference valid for range 3
Bit 3: 1 => corr. of cross-interference valid for range 2
Bit 2: 1 => corr. of cross-interference valid for range 1

Bit 1	Bit 0	Analog input of ext. interfering gas
1	0 =>	4 – 20 mA / NAMUR
0	1 =>	2 – 20 mA
0	0 =>	0 – 20 mA

Bit 7: 1
Bit 6, 5, 4, 3, 2: 0

Bit 2	Bit 1	Bit 0
1	0	1 => residual gas influence with analog current (analog input 2)
1	0	0 => residual gas influence with internal component
0	1	1 => residual gas influence via ELAN
0	1	0 => residual gas influence with analog current (analog input 1)
0	0	1 => constant residual gas interference
0	0	0 => no residual gas influence

There has to be at least one range for cross-interference.
The residual gas influence with internal component is not valid.
The current range of the analog input can only be set when residual gas influence with analog current 1 or 2 is selected.

Read/ set correction 3 of cross-interference

's'/'S', 36, crc. 1, crc. 2 (see correction 2)

Read/ set correction 4 of cross-interference

's'/'S', 37, crc. 1, crc. 2 (see correction 2)

Read/ set external interference component 3,4

's'/'S', 38, crc. 1, crc. 2

| | |__ Component address for correction of cross-interference 4
| | Bit 7, 6, 5, 4: channel address (1 - 12)
| | Bit 3, 2, 1, 0: component address (0 - 3)
| |_____ Component address for correction of cross-interference 3
Bit 7, 6, 5, 4: channel address (1 - 12)
Bit 3, 2, 1, 0: component address (0 - 3)

The address for correction may not be the address of the device.

Note

The component addresses in device menu are 1 – 4!

Read/ set external channel for pressure compensation

's'/'S', 39, crc.

| |_ Channel address for pressure compensation
Bit 7, 6, 5, 4: channel address (1 - 12)
Bit 3, 2, 1, 0 => 0

The address for compensation may not be the address of the device.

PROFIBUS profile

's'/'S', 40, crc.

| |_____ Bit 7: 1
Bit 6,5,4,3,2,1,0 => PROFIBUS profile (0, 1, 3)

This command is only permissible with the PROFIBUS optional board fitted.
The profile can only be set when there is no cyclical communication.

Read/ set internal valves

's'/'S', 41, crc.

|_ Bit 7: 1
Bit 6: 0
Bit 5: 1 => valve 6 (shed ...) open (0 => close)
Bit 4: 1 => " 5 (control air/sample gas..)" "
Bit 3: 1 => " for span gas " "
Bit 2: 1 => " " zero gas " "
Bit 1: 1 => " " combustion ai r " "
Bit 0: 1 => " " hydrogen " "

Only one valve for zero gas, span gas and 5 can be opened at the same time. Valve 6 can be opened only in *Measure* state.
Switching the valves by application flow is still active.
Valve 5 and 6 are not included for every version of FIDAMAT.

There is no valve 5 and 6 at FIDAMAT E
There is no valve 6 at FIDAMAT G.

Read / Set Relay by PROFIBUS

's'/'S', 42, crc. 1, crc. 2

| |	
| |___	Bit 7: 1
|	Bit 6, 5, 4, 3, 2, 1: 0
	Bit 0: 1 => Relay output 8
|	
|_____	Bit 7: 1
	Bit 0 - 6: Relay output 1 - 7

Relay output 1 – 8 are on the PROFIBUS optional board.
This command is only permissible with the PROFIBUS optional board fitted and ‘Relay by PROFIBUS’ (F,33) is on.

4.7 Read/ Write Values

Command structure

Read values:

Control command:	'w', number
Answer:	'w', number, val. 1 ... val. n

Example: read integration times

Control command: 'w', 11

Answer: 'w', 11, '10.0', 0, 9, 0,
'1.0', 0, 25, 0,
'3.0', 0, 25, 0,
'5.0', 0, 25, 0

- Separator
- Units (Table 4-1)
- Separator
- Values
- Integration times

Write values:

Control command:	'W', number, val. 1 ... val. n
Answer:	'W', number,

Example: write slope gas concentrations

Control command: 'W', 3, '10.0', 0, '50', 0, '100.0', 0, '3000', 0

Answer: 'W', 3

Read/ write start-of-scale values

'w'/'W', 1, val. 1, val. 2, val. n

- Start-of-scale value of highest range
- " measuring range 2
- " measuring range 1

Condition: value 1 ≤ value 2 ≤... ≤ value n
With the ULTRAMAT 6 until Software version V4.2.4, value 1 is valid for all measuring ranges.
There are only value 1 to value 3 in the readonly mode available for the C6TG.

Note

If new start-of-scale values are written, it is necessary to write the full-scale values (”W”,2) afterwards.

Read/ write full-scale values

'w'/'W', 2, val. 1, val. 2... val. n

|	|	|_____	Full-scale value of highest range
|	|_____		" measuring range 2
|_____			" measuring range 1

Condition: value 1 < value 2 <... < value n
There are only value 1 to value 3 in the readonly mode available for the C6TG.

Read/ write slope gas concentrations

'w'/'W', 3, val. 1, val. 2... val. n

|	|	|	
|	|	|	Calibration gas concentration:
|	|	|_____	Highest measuring range
|	|_____		Measuring range 2
|_____			Measuring range 1

The slope gas concentrations must be smaller than the full-scale value of the associated measuring range.
There are only value 1 to value 3 in the readonly mode available for the C6TG.

Read/ write linearization gas concentrations

'w'/'W', 4, val. 1, val. 2

|	|	
|	|_____	Concentration of sensitivity gas
|_____		" of curve dip gas

This command is only valid for IR components.
The concentration of the curve dip gas must be between 30% and 70% of the full-scale value, and the concentration of the sensitivity gas between 70% and 105% of the full-scale value.

Read/ write zero gas concentration

'w'/'W', 5, value

Read/ write *Autocal* cycle parameters

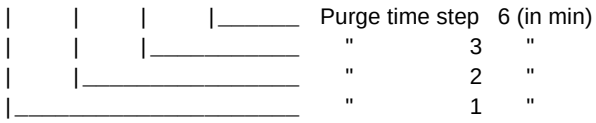
'w'/'W', 6, val. 1, val. 2, val. 3

|	|	|	
|	|	|____	Carry out slope calibration following
|	|		each 'Value 3' cycle
|	|_____		Cycle time (in hours)
|_____			Time up to next *Autocal* (in minutes)

With the ULTRAMAT 6, CALOMAT 6, FIDAMAT 6 and OXYMAT 6, commands for *Autocal* are only valid with the optional board fitted.
With the ULTRAMAT 23, value 3 cannot be written.
The function is not available for the C6TG.

Read/ write purge times for *Autocal* steps 1 to 6

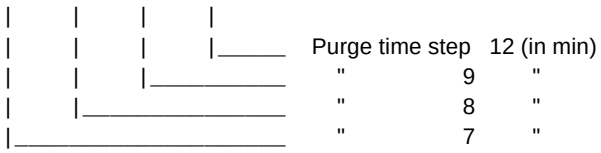
'w'/'W', 7, val. 1, val. 2, val. 3, ... val. 6



Purge time inputs for step 'Signalling contact' are ignored.
With the ULTRAMAT 6, CALOMAT 6, FIDAMAT 6 and OXYMAT 6, commands for *Autocal* are only valid with the optional board fitted.
ULTRAMAT 23 only has the *Autocal* steps for zero gas and sample gas purging with the same purge time. This purge time is entered using value 1. Further values are ignored.
If an O_2 probe is connected, times less than 1 min can not be entered for the ULTRAMAT 23.
The function is not available for the C6TG.

Read/ write purge times for *Autocal* steps 7 to 12

'w'/'W', 8, val. 7, val. 8, val. 9... val. 12



Purge time inputs for step 'Signalling contact' are ignored.
With the ULTRAMAT 6, CALOMAT 6, FIDAMAT 6 and OXYMAT 6, commands for *Autocal* are only valid with the optional board fitted.
The function is not available for the C6TG.

Read/ write limit 1

'w'/'W', 9, val. 1, val. 2

The hysteresis is always 0.

Read/ write limit 2

'w'/'W', 10, val. 1, val. 2

The hysteresis is always 0.

Read/ write integration times

'w'/'W', 11, val. 1, val. 2, val. 3, val. 4

- val. 1: Dead time (in s)
- val. 2: T90 outside threshold value (in s)
- val. 3: T90 within threshold value (in s)
- val. 4: Threshold value (in % of smallest measuring range)

The dead time is always 0.

Read/ write autorange hysteresis thresholds

'w'/'W', 12, val. 1, val. 2

- val. 1: Lower threshold (in % of lower measuring range)
- val. 2: Upper threshold (in % of current measuring range)

The upper threshold must be higher than the lower threshold. The function is not available for the C6TG.

Read/ write pump capacity

'w'/'W', 13, val.

- val.: Capacity (0 - 100)

Read/ write date of O_2 sensor installation

'w'/'W', 14, val. 1, val. 2, val. 3

- val. 1: Year (0 - 99)
- val. 2: Month (1 - 12)
- val. 3: Day (1 - 31)

This command is only permissible with an O_2 sensor connected. A zero calibration (”Z”, 5) must have been executed prior to input of date.

Read/ write time

'w'/'W', 16, val. 1, val. 2, val. 3, val. 4, val. 5

- val. 1: Year (0 - 99)
- val. 2: Month (1 - 12)
- val. 3: Day (1 - 31)
- val. 4: Hour (0 - 23)
- val. 5: Minute (0 - 59)

Read/ write barometric pressure

'w'/'W', 18, val.

Read value of selected pressure sensor ('S',15), or adjust integrated pressure sensor to entered value (in hPa).

Read/ write analog output

'w'/'W', 19, val.

By writing the measured value (in µA) at the analog output in mode *Adjust analog output*, the current output is set to the defined setpoint, and the next current value is output.
'Read analog output' shows the actual analog output current.

Read/ write LCD contrast

'w'/'W', 20, val.

Contrast (0 - 100)

Read/ write frequency

'w'/'W', 21, val.

Read or set the chopper frequency for the ULTRAMAT 6 and ULTRAMAT 23 or the magnetic field frequency for the OXYMAT 6.

A *Reset* is executed automatically following the write command with ULTRAMAT 23. With the ULTRAMAT 23 from Software version V2.10.0, value is not possible to be changed.

Read/ write reduction value

'w'/'W', 22, val.

Read reduction value for gain or set reduction value to entered value.

Read/ write phase

'w'/'W', 23, val.

Read phase value or set phase to entered value.

Read/ write noise signal suppression duration

'w'/'W', 24, val.

Suppress noise signals with a duration of up to 'val.' (in s).

Read/ write calibration tolerances

'w'/'W', 25, val. 1, val. 2, val. 3

		Number of calibrations for determination of tolerance
		Calibration tolerance at zero (in % of smallest measuring range)
		Calibration tolerance of sensitivity (in % of current measuring range)

The calibration tolerance of the sensitivity is not used with the ULTRAMAT 23. The number of calibrations is not used with the ULTRAMAT 6, CALOMAT 6, FIDAMAT 6 and OXYMAT 6. The values have no meaning at O2-component of ULTRAMAT 23.

Read/ write shock compensation

'w'/'W', 26, val.

Attenuation coefficient in the compensation circuit (in % of the measuring circuit attenuation).

Read/ write parameters of external pressure sensor

'w'/'W', 27, val. 1, val. 2

	Full-scale value of external pressure sensor (in hPa)
	Start-of-scale value

Read/ write parameters of external interfering gas 1

'w'/'W', 28, val. 1, val. 2, val. 3

		Full-scale value of interfering gas
		Start-of-scale value
		Interference

With the ULTRAMAT 23, only the interference applies.
With CALOMAT 6 and FIDAMAT 6, the scale-values can only be set when correction of residual gas influence with analog current 1 or 2 is selected.

Read/ write sample point times

'w'/'W', 29, val. 1, val. 2, val. 3, ... val. 6

|	|	|	|___ 6th sample point time (in min)
|	|	|_____ 3rd " " "
|	|_____ 2nd " " "
|_____ 1st " " '

Inputs for sample points which are not enabled (relay set) are ignored.

Note

The assignment of the sample point number to the sample point time results from the number of the relay which is assigned to the sample point. The sample point with the lowest relay number is assigned the first sample point time, etc.

Read/ write autorange lower limits

'w'/'W', 40, val. 1, val. 2, val. 3

|	|	|_____ Lower limit for measuring range 4
|	|_____ " " " 3
|_____ " " " 2

If the measured value falls below the lower limit for measuring range x, measuring range x-1 will be selected if autorange is on. The limit for measuring range x must be greater than or equal to the limit of measuring range x-1.

Read/ write autorange upper limits

'w'/'W', 41, val. 1, val. 2, val. 3

|	|	|_____ Upper limit for measuring range 3
|	|_____ " " " 2
|_____ " " " 1

If the measured value exceeds the upper limit for measuring range x, measuring range x+1 will be selected if autorange is on. The limit for measuring range x must be greater than or equal to the limit of measuring range x-1. The upper limit must be greater than the lower limit of the same measuring range.

Read/ write full-scale value of linearization curve

'w'/'W', 42, val.

|_____ Full-scale value of linearization curve

Read deviation in zero and slope calibration

'w', 43, val. 1, val. 2

|	
|__	Deviation in slope calibration (not ULTRAMAT 23)
|_____	Deviation in zero

Read deviations for last *Zero calibration* ('Z', 5), *Adjust component slope* ('Z', 6) or *Autocal* ('Z', 14).

Read/ write parameters of external interfering gas 2

'w'/'W', 44, val. 1, val. 2, val. 3

| | |	
| | |_____	Full-scale value of interfering gas
| |_____	Start-of-scale value
|_____	Interference

With the ULTRAMAT 23, only the interference applies.
The scale-values can only be set when correction of residual gas influence with analog current 1 or 2 is selected.

Read/ write parameters of internal interfering gas 1

'w'/'W', 45, val. 1, val. 2, val. 3

| | |	
| | |_____	Full-scale value of interfering gas
| |_____	Start-of-scale value
|_____	Interference

With the ULTRAMAT 23, only the interference applies.

Read/ write parameters of internal interfering gas 2

'w'/'W', 46, val. 1, val. 2, val. 3

| | |	
| | |_____	Full-scale value of interfering gas
| |_____	Start-of-scale value
|_____	Interference

With the ULTRAMAT 23, only the interference applies.

Temperature values of temperature compensation

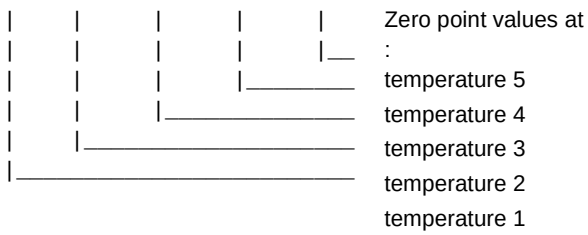
'w'/'W', 47, val. 1, val. 2, val. 3, val. 4, val. 5

| | | | |	
| | | | |__	temperature 5
| | | |_____	temperature 4
| | |_____	temperature 3
| |_____	temperature 2
|_____	temperature 1

temperature 1 < temperature 2 < temperature 3 < temperature 4 < temperature 5. Value 4 and value 5 are only used with ULTRAMAT 23.

Zero point values of temperature compensation

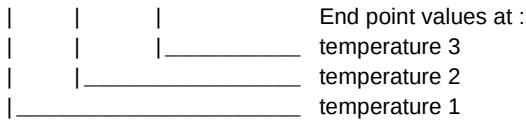
'w'/'W', 48, val. 1, val. 2, val. 3, val. 4, val. 5



Value 4 and value 5 are only used with ULTRAMAT 23.
If values are written, the new zero point koefficients will be calculated automatically. Therefore it is necessary that the temperature values ('W',47) are written before.

End point values of temperature compensation

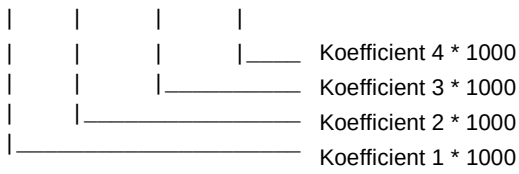
'w'/'W', 49, val. 1, val. 2, val. 3



If values are written, the new end point koefficients will be calculated automatically. Therefore it is necessary that the temperature values ('W',47) and the zero point values ('W',48) are written before.

Zero point koefficients of temperature compensation

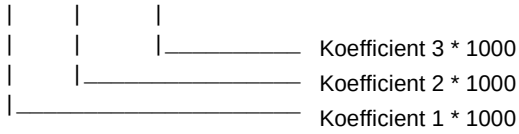
'w'/'W', 50, val. 1, val. 2, val. 3, val. 4



Value 4 is only used with ULTRAMAT 23.

End point koefficients of temperature compensation

'w'/'W', 51, val. 1, val. 2, val. 3



Value 3 is only used with OXYMAT 6.

Switching temperature of temperature compensation

'w'/'W', 52, val.

Temperature to select the koefficients

Koefficients of linearization

'w'/'W', 53, val. 1, val. 2, val. 3, val. 4, val. 5

Koefficient 5 * 1000
Koefficient 4 * 1000
Koefficient 3 * 1000
Koefficient 2 * 1000
Koefficient 1 * 1000

Pressure values of pressure compensation

'w'/'W', 54, val. 1, val. 2, val. 3

high pressure
medium pressure
low pressure

Zero point values of pressure compensation

'w'/'W', 55, val. 1, val. 2, val. 3

Zero point values at :
high pressure
medium pressure
low pressure

If values are written, the new zero point koefficients will be calculated automatically. Therefore it is necessary that the pressure values ('W',54) are written before.

End point values of pressure compensation

'w'/'W', 56, val. 1, val. 2, val. 3

End point values at :
high pressure
medium pressure
low pressure

If values are written, the new end point koefficients will be calculated automatically. Therefore it is necessary that the pressure values ('W',54) and the zero point values ('W',55) are written before.

Koefficients of pressure compensation

'w'/'W', 57, val. 1, val. 2, val. 3, val. 4

- val. 4 → Koefficient 4 * 1000
- val. 3 → Koefficient 3 * 1000
- val. 2 → Koefficient 2 * 1000
- val. 1 → Koefficient 1 * 1000

Value 3 and 4 are only used with ULTRAMAT 6, FIDAMAT 6 and CALOMAT 6.

Reference of pressure compensation

'w'/'W', 58, val.

- val. → Pressure to select the koefficients

Aftercompensation of the zero point

'w'/'W', 59, val. 1, val. 2, val. 3

- val. 3 → Compensation above the reference temperature (%/10℃)
- val. 2 → Compensation below the reference temperature (%/10℃)
- val. 1 → reference temperature

Aftercompensation of the measured value

'w'/'W', 60, val. 1, val. 2, val. 3

- val. 3 → Compensation above the reference temperature (%/10℃)
- val. 2 → Compensation below the reference temperature (%/10℃)
- val. 1 → reference temperature

Precompensation

'w'/'W', 61, val.

- val. → Value of precompensation

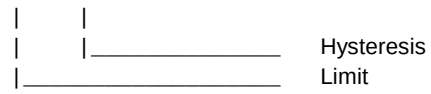
Parameters of calibration

'w'/'W', 62, val. 1, val. 2, val. 3

- val. 3 → Maximum value
- val. 2 → Hang down value
- val. 1 → Zero value

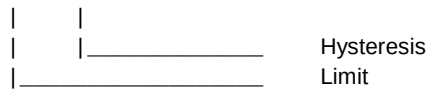
Results of the calibration of hang-down and maximum linearization.

Read/ write limit 3 **'w'/'W', 63, val. 1, val. 2**



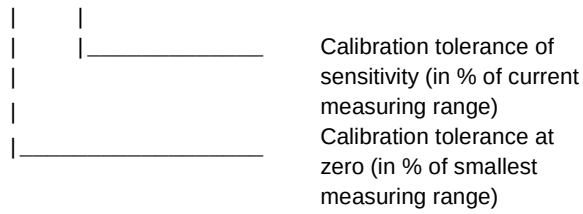
The Hysteresis can not be entered.

Read/ write limit 4 **'w'/'W', 64, val. 1, val. 2**



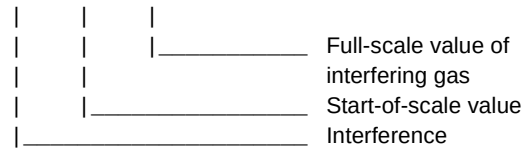
The Hysteresis can not be entered.

Read/ write Autocal check calibration tolerances **'w'/'W', 65, val. 1, val. 2**



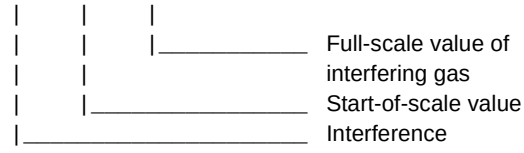
The function is not available for the C6TG.

Read/ write parameters of external interfering gas 3 **'w'/'W', 66, val. 1, val. 2, val. 3**



The scale-values can only be set when correction of residual gas influence with analog current 1 or 2 is selected
The function is not available for the C6TG.

Read/ write parameters of external interfering gas 4 **'w'/'W', 67, val. 1, val. 2, val. 3**



The scale-values can only be set when correction of residual gas influence with analog current 1 or 2 is selected.
The function is not available for the C6TG.

Read/ write value of interfering gas 1

'w'/'W', 68, val.

- **val.** — Value of interfering gas 1

Read/ write value of interfering gas 2

'w'/'W', 69, val.

- **val.** — Value of interfering gas 2

Read/ write value of interfering gas 3

'w'/'W', 70, val.

- **val.** — Value of interfering gas 3

Read/ write value of interfering gas 4

'w'/'W', 71, val.

- **val.** — Value of interfering gas 4

Read/ write Koefficients of external interfering gas 1

'w'/'W', 72, val. 1, val. 2, val. 3

- **val. 3** — Koefficient 3 * 1000
- **val. 2** — Koefficient 2 * 1000
- **val. 1** — Koefficient 1 * 1000

Read/ write Koefficients of external interfering gas 2

'w'/'W', 73, val. 1, val. 2, val. 3

- **val. 3** — Koefficient 3 * 1000
- **val. 2** — Koefficient 2 * 1000
- **val. 1** — Koefficient 1 * 1000

Read/ write Koefficients of external interfering gas 3

'w'/'W', 74, val. 1, val. 2, val. 3

- **val. 3** — Koefficient 3 * 1000
- **val. 2** — Koefficient 2 * 1000
- **val. 1** — Koefficient 1 * 1000

Read/ write Koefficients of external interfering gas 4

'w'/'W', 75, val. 1, val. 2, val. 3

- val. 3 → Koefficient 3 * 1000
- val. 2 → Koefficient 2 * 1000
- val. 1 → Koefficient 1 * 1000

Read/ write zero-scale value of linearization curve

'w'/'W', 76, val.

- val. → Zero-scale value of linearization curve

Read/ write noise signal suppression level

'w'/'W', 77, val.

- val. → Suppress noise signals above a level of up to 'val.' (in % of smallest measuring range).

Read/ write offset of pressure sensors

'w'/'W', 78, val. 1, val. 2

- val. 2 → Offset of :
- val. 1 → pressure sensor for sample gas
- val. 2 → pressure sensor for H2

Read/ write parameters of preamplifier

'w'/'W', 79, val. 1, val. 2

- val. 2 → parameter 2
- val. 1 → parameter 1

Heating parameters of FIDAMAT

'w'/'W', 80, val. 1, val. 2, val. 3, val. 4

- val. 4 → max. deviation of oven-/ catalyzer- heating
- val. 3 → set value of ‘flame on’
- val. 2 → set value of catalyzer heating
- val. 1 → set value of oven heating

Read set values of pressures

'w', 81, val. 1, val. 2

- val. 2 → combustion air
- val. 1 → hydrogen

Read/ write tolerances of pressures

'w'/'W', 82, val. 1, val. 2, val. 3

- val. 3 → difference at start of pump / change to standby
- val. 2 → Tolerance of combustion air
- val. 1 → Tolerance of hydrogen

Read/ write Drift values

'w'/'W', 83, val. 1, val. 2, val. 3, val. 4, val. 5

- val. 5 → measuring range 4
- val. 4 → measuring range 3
- val. 3 → measuring range 2
- val. 2 → measuring range 1
- val. 1 → zero point

Drift values are the sum of calibration deviations.
With the ULTRAMAT 23, the measuring ranges 3 and 4 are not used. The O2-component of ULTRAMAT 23 uses only measuring range 1.
Writing drift values sets all values to 0.0. The sended values will be ignored.

4.8 Read Diagnostic Values

Command structure

Read values:

Control command:	'h', number
Answer:	'h', number, value

Example: read temperature of measuring head (OXYMAT 6)

Control command: 'h', 2

Answer: 'h', 2, '75.8', 0, 40, 0

|	Diagnostic number
|	Value
|	Separator
|	Unit (Table 4-1)
|	Separator
|	Separator

OXYMAT 6			Command type *
"h",	1	Temperature of physical section	b
	2	Temperature of measuring head	b
	3	Detector raw signal	k
	4	Magnetic field	b
	5	Temperature of display	b
	6	Calibration reserve	k
	7	Analog input	k
	8	Signal vector	k
	9	Disturbance vector	k

ULTRAMAT 6			Command type *
"h",	1	Temperature of heating	b
	2	Temperature of receiver chamber	b
	3	Detector raw signal	k
	4	Chopper deviation	b
	5	Temperature of display	b
	6	Calibration reserve	k
	7	Analog input	k
	8	Signal vector	k
	9	Disturbance vector	k

CALOMAT 6			Command type *
"h",	1	Temperature of TCD	k
	2	Not yet defined	
	3	Normed raw signal of TCD	k
	4	Raw signal of TCD	k
	5	Temperature of display	b
	6	Not yet defined	
	7	Analog input	k

ULTRAMAT 23			Command type *
"h",	1	Temperature of detectors	k
	2	Temperature of radiator	b
	3	Detector raw value	k
	4	Supply raw voltage	b
	5	Temperature of display	b
	6	Calibration reserve	k
	7	O_2 sensor voltage	b
	8	Installation voltage of the O_2 sensor	b
	9	Not yet defined	
	10	signed measured value	k

FIDAMAT 6			Command type *
"h",	1	Temperature of physic	b
	2	Temperature of oven	b
	3	Raw current	k
	4	Temperature of catalyzer (only at ANM-version)	b
	5	Temperature of display	b
	6	Temperature of flame	b
	7	Analog input	k
	8	Temperature of electronic	b
	9	Pressure of hydrogen	b
	10	Pressure of combustion air	b
	11	Adapterboard reference voltage	b
	12	Adapterboard negative supply	b
	13	Adapterboard positive supply	b
	14	Adapterboard high voltage	b

CALOMAT 62			Command type *
"h",	1	Temperature of Sensor	b
	2	Temperature of gas pipe (Option)	b
	3	Raw signal of Sensor	b
	4	Sensorvoltage	b
	5	Temperature of display	b
	6	Measured value of Sensor	b
	7	Analog input	k

OXYMAT 62			Command type *
"h",	1	Temperature of Sensor	b
	2	Not yet defined	b
	3	Raw signal of Sensor	b
	4	Sensorvoltage	b
	5	Temperature of display	b
	6	Measured value of Sensor	b
	7	Analog input	k
	8	Pressure of sample gas	b
	9	Flow of sample gas (Option)	b

*: b = channel-related command
k = component-related command

4.9 Other Commands

Read measured value of one component

'k', 1, val., crc.

| |
| |_____ Measured variable (see Tabelle 4-2)
|_____ Measured value of component

Tabelle 4-2 Measured variable

1. no component (only used with command "k", 2)	26. C_6H_6 (Benzol)
	27. SF_6
2. CO	28. CH_3OH (Methanol)
3. CO_2	29. C_2H_5OH (Ethanol)
4. CH_4 (Methan)	30. CH_2Cl_2
5. C_6H_{14} (Hexan)	31. $C_2H_4Cl_2$
6. SO_2	32. CH_3Cl
7. NO	33. C_2H_4O
8. NO_2	34. H_2O (water vapor)
9. $CHClF_2$ (R22)	35. G/l (conductivity)
10. C_3H_8 (Propan)	36. C
11. C_4H_{10} (Butan)	37. S
12. O_2	38. N
13. C_5H_{12} (Pentan)	39. CF_4
14. CnHm (THC)	40. $COCl_2$ (phosgene)
15. P (process pressure)	41. CHF_3 (R23)
16. pH	42. C_2F_6 (R116)
17. T (temperature)	43. ------ (self defined component)
18. C_2H_4 (Ethen)	44. C_2H_3Cl
19. C_2H_2 (Ethin)	45. H_2 (Hydrogen)
20. C_3H_6 (Propen)	46. Ar
21. C_4H_6	47. He
22. C_4H_8	48. Cl_2
23. C_2H_6 (Ethan)	49. N_2
24. NH_3 (Ammoniak)	100. Help variable process pressure (only used at command 'k',2)
25. N_2O	

Read measured value(s) of the channel

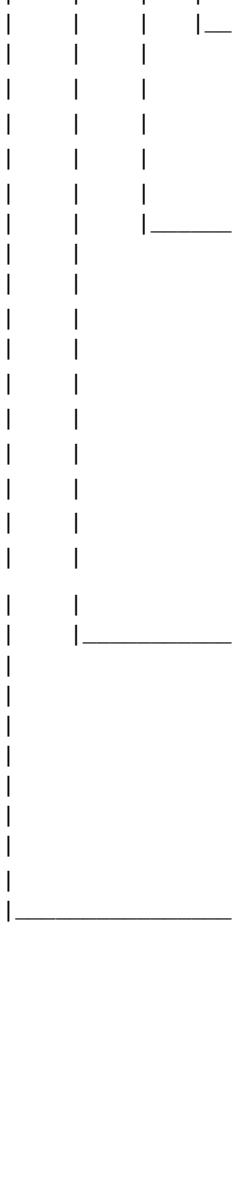
'k', 2, val. 1, crc. 1, ...
val. x, crc. x

| |
| |_____ Measured variable (see Tabelle 4-2)
|_____ Measured value of component

This command can be used to determine the assignment between component and measured variable. After the components the help variables (see Tabelle 4-2) are transmitted.

Read channel functions

'k', 3, crc. 1, crc. 2, crc. 3, crc. 4



Bit 7: 1
Bit 6, 5, 4, 3 : 0
Bit 2: 1 => Relay by PROFIBUS on
Bit 1: 1 => Fan on
Bit 0: 1 => Heating of catalyzer on

Bit 7: 1
Bit 6: 1 => suppress negative measured values on the display
Bit 5: 1 => Zero calibration concerted on
Bit 4: 1 => Fault/ Maint. request/ function control according to NAMUR
Bit 3: 1 => Heating on
Bit 2: 1 => synchronous zero calibration on
Bit 1: 1 => solenoid valve for calibration gas on
Bit 0: 1 => ignition on

Bit 7: 1
Bit 6: 1 => measured-value store on
Bit 5: 1 => sample point switching on
Bit 4: 1 => logbook locked
Bit 3: 1 => *Autocal* calibration cycles on
Bit 2: 1 => radiator voltage on
Bit 1: 1 => pump on
Bit 0: 1 => solenoid valve for zero gas on

Bit 7: 1
Bit 6: 1 => measuring head heating on
Bit 5: 1 => magnetic field on
Bit 4: 1 => pressure monitor for reference gas on
Bit 3: 1 => pressure monitor for sample gas on
Bit 2: 1 => broadcast on
Bit 1: 1 => remote on
Bit 0: 1 => maintenance switch on

Read component functions

'k', 4, crc. 1, crc. 2, crc. 3

- Bit 7: 1
  Bit 6, 5, 4, 3, 2, 1, 0: 0
- Bit 7: 1
  Bit 6,5: 0
  Bit 4: 1 => Aftercompensation of the span on
  Bit 3: 1 => Aftercompensation of the zero point on
  Bit 2: 1 => Precompensation on
  Bit 1: 1 => Pressure compensation on
  Bit 0: 1 => Temperature compensation on
- Bit 7: 1
  Bit 6: 1 => linearization on
  Bit 5: 1 => calibrate zero before slope
  Bit 4: 1 => signal violation of calibration tolerance
  Bit 3: 1 => suppress negative measured values on the analog output
  Bit 2: 1 => total calibration
  Bit 1: 1 => limit monitoring on
  Bit 0: 1 => autorange on

Read error state

'k', 5, crc. 1, ... crc. x

- Current errors (see Instruction Manual)

Read channel version

'k', 6, crc., val. 1, val. 2, val. 3, val. 4, val. 5, val. 6

- Meas. range list
- Firmware number
- Order No.
- Revision
- Software version
- Serial No.
- Channel type (see Table 4-3)

Values 1 to 6 may contain ASCII letters and characters (+, -, ., /, etc.) in addition to ASCII numbers.

Table 4-3 Channel type

1	ULTRAMAT 6
2	OXYMAT 6
3	CALOMAT 6
4	ULTRAMAT 23
5	FIDAMAT 6 E
6	FIDAMAT 6 G

Reset linearization coefficients **'K', 7**

Read remaining time **'k', 8, val.**

Remaining time for states with automatic change upon expiry (e.g. *Warm-up phase, Temperature compensation, Zero calibration, Slope calibration...).*

Read time to next *zero calibration* **'k', 9, val.**

Read logbook entry

Control command:

'k', 10, crc.

Entry number (last entry => number 1; last but one entry => number 2; etc.)

Answer:

'k', 10, crc. 1, crc. 2, crc. 3, val. 1, val. 2, val. 3, val. 4, val. 5

- Year
- Month
- Day
- Hour
- Minute
- State (Table 4-4)
- Error No.
- Entry No.

An logbook entry without error gets error number 255.
See chapter 1.1 for error numbers.

Table 4-4 State of logbook entries

Bit 0:	1 => error appeared 0 => error disappeared
Bit 1:	1 => entry acknowledged 0 => entry not acknowledged
Bit 2, 3, 4, 5, 6:	0
Bit 7:	1

Acknowledge logbook entry

'K', 10, crc.

| Entry number (last entry => number 1; last but one entry => number 2; etc.)

Read maintenance request state

'k', 12, crc. 1... crc. x

| Current maintenance requests (see Instruction Manual)

Acknowledge logbook error

'K', 13, crc.

| Error number

Acknowledge a logbook entry with the stated error number.
See chapter 1.1 for error numbers.
If there is no logbook entry with the stated error number the logbook remains unchanged.

Transfer data sectors

'K', 14, crc.

Control character	Function
1	Load user data into current working data
2	Save current working data in user data
3	Load factory settings into current working data
4	Save current working data in factory settings
5	Load basic factory data into current working data

No communication is possible while these commands are being executed.
A *Reset* is executed automatically following the load commands.
With ULTRAMAT 23 the commands for the user data (control characters 1, 2) are not possible.

Read/ enter channel name

'k'/'K', 16, val.

A name can be assigned to the channel to permit easy identification.
The value may contain ASCII letters and characters (+, -, ., /, etc.) in addition to ASCII numbers. The maximum length of the value is 10 characters.

Read message state

'k', 18, crc. 1... crc. x

| Current messages (see Instruction Manual)

Read current *Autocal* step

'k', 19, crc.

Control character	Step	Comment
1	No *Autocal*	
2	Zero gas 1	
3	Zero gas 2	
4	Calibration gas 1	
5	Calibration gas 2	
6	Calibration gas 3	
7	Calibration gas 4	
8	Sample gas purging	
9	Intermediate sample gas mode	
10	Signalling contact	

Commands for *Autocal* are only permissible with the optional board fitted.

Scan boot program errors

"k", 20, Stz.

| Bit 7: 1
Bit 6, 5, 4 : 0
Bit 3: 1 => boot program error
Bit 2: 1 => transmission error
Bit 1: 1 => data error
Bit 0: 1 => flashprom-error

Error scan only possible after termination of boot program.

Start boot program

'K', 20, crc. (without separator 00H)

Control character	Step	Comment
1	Start boot program without checking of target address	Only meaningful with single analyzer.
2	Start boot program with checking of target addresses (bus mode).	The channel must first be set to *Reset* using a *Reset* command.

This command is only accepted within one second of the *Reset.*

Run firmware update

'K', 21, crc. 1, ... crc. x (without separator 00H)

This command is only accepted within the boot program. Refer to Appendix for description of control characters and sequence.

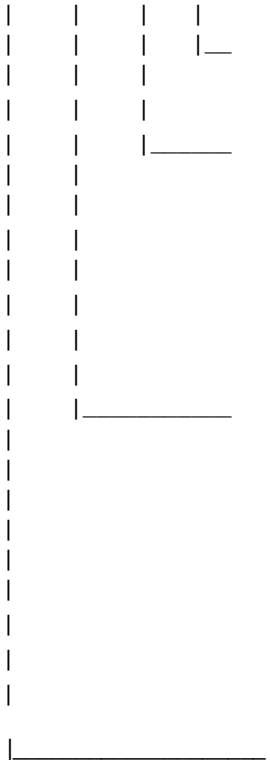
Clear logbook

'K', 22

All current logbook entries are cleared.

State of the external connections

'k',23 crc. 1, crc. 2, crc. 3, crc. 4



Bit 7: 1
Bit 6, 5, 4, 3, 2, 1, 0 : 0

External function controls :
Bit 7: 1
Bit 6, 5, 4: 0
Bit 3: 1 => general 4
Bit 2: 1 => general 3
Bit 1: 1 => general 2
Bit 0: 1 => general 1

External maintenance requests :
Bit 7: 1
Bit 6: 1 => probe heating
Bit 5: 1 => sample gas filter
Bit 4: 1 => gas cooler
Bit 3: 1 => condensate vessel
Bit 2: 1 => sample pump / flow
Bit 1: 1 => sample line
Bit 0: 1 => other maintenance request

External faults :
Bit 7: 1
Bit 6: 1 => probe heating
Bit 5: 1 => sample gas filter
Bit 4: 1 => gas cooler
Bit 3: 1 => condensate vessel
Bit 2: 1 => sample pump / flow
Bit 1: 1 => sample line
Bit 0: 1 => other fault

Download mode

'K'/'k', 24, crc.

see description 'Download bei Optionskarte PROFIBUS PA/DP, Adapterplatte FIDAMAT 6 und Henze Physikmodul OXYMAT64/ CALOMAT62'

Data transfer for download

'K', 25, crc. 1... crc. x

|_____ Record data

see description 'Download bei Optionskarte PROFIBUS PA/DP, Adapterplatte FIDAMAT 6 und Henze Physikmodul OXYMAT64/ CALOMAT62'

Read firmware versions

'k', 28, val. 1, val. 2, val. 3, val. 4, val. 5, val. 6

						Firmware version of :
|	|	|	|	|	|_____	Adapterboard Boot
|	|	|	|	|_____	Adapterboard
|	|	|	|_____		Optional Board Boot
|	|	|_____			Optional Board
|	|_____				Mainboard Boot
|_____						Mainboard

Not used firmware is shown with space.

Read warm-up state

'k', 29, crc.

Control character	Step
1	no *warm-up*
2	test of hydrogen
3	hydrogen not ok
4	test of combustion air
5	combustion air not ok
6	heating of oven
7	heating of chamber
8	ignition
9	start of pump

Startup state **'k'/'K', 30, crc.**

Control character	Startup state
1	Measure
2	Standby
3	Pause

Standby can not be selected with FIDAMAT 6 G.

Read channel variant **'k', 31, crc.**

Channel	Variant	crc.
FIDAMAT 6	Variant E	1
"	Variant G	2

Value of crc. is 1 if channel has no variants.

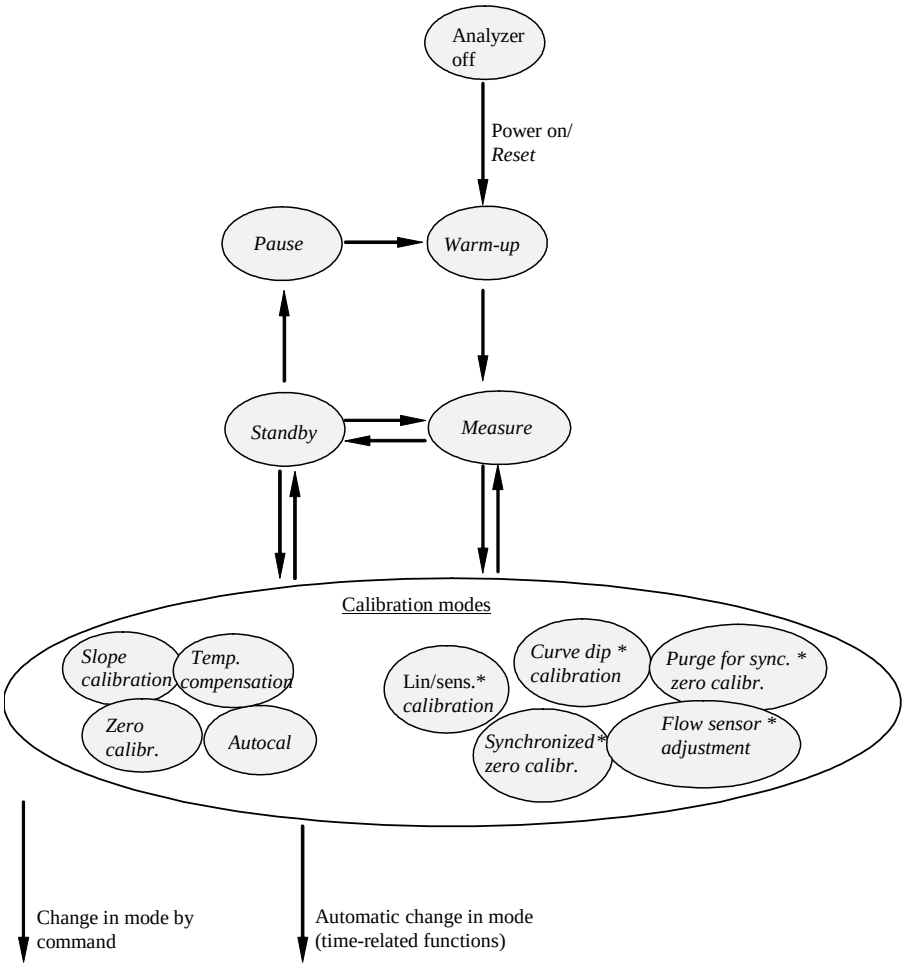
5 Channel Modes

5.1 General

Following power-up the channels are in W*arm-up* mode.
When this is finished, the channels are automatically switched to *Measure* mode.

5.2 Graphic Overview

* Only if channel includes this mode



6 Examples

Read measured value of channel 3, component 1

Control system/PC	Analyzer	Comment
10H, 01H, 30H, D0H, 6BH, 01H, 10H, 03H, 95H, C0H		DLE, SOH Component address Control system address Command ('k', 1) DLE, ETX Checksum
	10H, 06H	DLE, ACK
	10H, 01H, D0H, 30H, 00H, 04H, 6BH, 01H, 33H, 2EH, 35H, 00H, 0BH, 00H, 02H, 00H, 10H, 03H, XXH, YYH	DLE, SOH Control system address, component address Collective state: ready to measure (Table 33-1) Mode: *Measure* (Table 3-2) Command ('k', 1) 3.5 % v/ v CO DLE, ETX Checksum
10H, 06H		DLE, ACK

Read error state

Control system/PC	Analyzer	Comment
10H, 01H, 12H, D0H, 6BH, 05H, 10H, 03H, D2H, 83H		DLE, SOH, addresses Command ('k', 5) DLE, ETX, checksum
	10H, 06H	DLE, ACK
	10H, 01H, D0H, 12H,	DLE, SOH, addresses
	05H, 01H, 6BH, 05H, 07H, 00H, 1BH, 00H, 10H, 03H, XXH, YYH	Collective state: not ready to measure, error (Table 33-1) Mode: *Warm-up* (Table 3-2) Command ('k', 5) Error 7 and error 27 are set DLE, ETX, checksum
10H, 06H		DLE, ACK

Write slope concentration for channel 1, component 4

Control system/PC	Analyzer	Comment
10H, 01H, 13H, D0H, 57H, 03H, 32H, 30H, 30H, 2EH, 30H, 00H 10H, 03H, 6EH, FAH		DLE, SOH, addresses Command ('W', 3) 200.0 DLE, ETX, checksum
	10H, 06H	DLE, ACK
	10H, 01H, D0H, 14H, 00H, 04H, 57H, 03H, 10H, 03H, XXH, YYH	DLE, SOH, addresses Collective state: ready to measure (Table 33-1) Mode: *Measuring* (Table 3-2) Command ('W', 3) DLE, ETX, checksum
10H, 06H		DLE, ACK

Send unknown command

Control system/PC	Analyzer	Comment
10H, 01H, 13H, D0H, 57H, 51H, 01H, 30H, 48H, 68H, 10H, 03H, 53H, 29H		DLE, SOH, addresses Unknown command ('W', 81) Any data DLE, ETX, checksum
	10H, 06H	DLE, ACK
	10H, 01H, D0H, 13H,	DLE, SOH, addresses
	24H, 03H, 3FH, 3FH, 10H, 03H, XXH, YYH	Collective state, not ready to measure, command not accepted (Table 33-1) Mode: *Standby* (Table 3-2) '??' DLE, ETX, checksum
10H, 06H		DLE, ACK

Send wrong checksum

Control system/PC	Analyzer	Comment
10H, 01H, 13H, D0H, 5AH, 04H, 10H, 03H, XXH, YYH		DLE, SOH, addresses Command ('Z', 4) DLE, ETX, checksum (wrong)
	10H, 15H	DLE, NAK

Broadcasting of measured values

Channel starts automatic transmission of measured values every 500 ms.

Control system/PC	Analyzer	Comment
	10H, 01H,	DLE, SOH
	F0H, 30H,	Broadcast, channel address
	00H,	Collective state: ready to measure (Table 33-1)
	04H,	Mode: *Measuring* (Table 3-2)
	6BH, 02H,	Command ('k', 2)
	34H, 2EH, 31H, 00H, 0BH, 00H, 02H, 00H,	Component 1: 4.1 % v/v CO
	33H, 2EH, 35H, 00H, 0AH, 00H, 03H, 00H,	Component 2: 3.5 % CO_2
	31H, 30H, 31H, 33H, 00H, 23H, 00H, 64H, 00H,	Pressure: 1013 hPa process pressure
	10H, 03H,	DLE, ETX
	XXH, YYH	Checksum

There will be neither a confirmation nor an answer.

7 Appendix

7.1 Error numbers for the command 'read logbook entry' ('k',10)

error number	short-name	ULTRAMAT 6 (valid from V3.0.0)	OXYMAT 6 / OXYMAT 61 (valid from V3.0.0)
1	S1	Parameter memory	Parameter memory
2	S2	Choppermotor faulty	Magnetic field supply
3	S3	Microflow sensor	Microflow sensor
4	S4	External fault	External fault
5	S5	Temp. analyzer	Temp. analyzer
6	S6	Heating defective	Heating defective
7	S7		Temperature measuring head
8	S8	Signal pressure sensor	Signal pressure sensor
9	S9		Signal too high
10	S10	24h RAM/ Flash-Check	24h RAM/ Flash-Check
11	S11	Ref. gas pressure too low	Ref. gas pressure to low
12	S12	Power supply	Power supply
13	S13	Hardware / Powerfrequency	Hardware / Powerfrequency
14	S14	Measure value > full-scale value	Measure value > full-scale value
15	S15	Calibration aborted	Calibration aborted
16	S16	Sample gas flow too small	Sample gas flow to small
17	W1	Calib. diff. too large	Calib. diff. to large
18	W2	Zero calib. reserve < 20%	Sig. volt. zero to large
19	W3	Sig. volt. adj. too small	Sig. volt. adj. to small
20	W4	Set clock Fkt.58	Set clock Fkt.58
21	W5	Microflow sensor	Microflow sensor
22	W6	Temp. sensor LCD display	Temp. sensor LCD display
23	W7	Temp. analyzer sec. > 70℃	Temp. analyzer se c. > 70℃
24	W8		Temp. meas. head > +-3℃
25	W9	External maint. request	External maint. request
26	LIM	LIM (Limit 1/ 2/ 3/ 4, channel 1)	LIM (Limit 1/ 2/ 3/ 4)
27	W10	Autocal check diff.	Autocal check diff.
28	CTRL	CTRL (Functional check)	CTRL (Functional check)
29	LIM	LIM (Limit 1/ 2/ 3/ 4, channel 2)	
30			
31			
32			

error number	short-name	CALOMAT 6 (valid from V1.1.0)	FIDAMAT 6 (valid from V1.0.0)
1	S1	Parameter memory	Parameter memory
2	S2		Pump does not start
3	S3		Flame does not ignite
4	S4	External fault	External fault
5	S5	Temp. analyzer	Temperature oven
6	S6	Heating defective (only heated versions)	Temperature catalyst
7	S7		Temperature flame
8	S8		Sample gas / H2 pressure
9	S9		Heating is switched off
10	S10	24h RAM/ Flash-Check	24h RAM/ Flash-Check
11	S11		
12	S12	Power supply	Power supply
13	S13	Hardware / Powerfrequency	Hardware / Powerfrequency
14	S14	Measure value > full-scale value	Measure value > full-scale value
15	S15	Calibration aborted	Calibration aborted
16	S16		
17	W1	Calib. diff. to large	Calib. diff. too large
18	W2		
19	W3		
20	W4	Set clock Fkt.58	Set clock Fkt.58
21	W5		Sample gas / H2 pressure
22	W6	Temp. sensor LCD display	Temp. sensor LCD display
23	W7	Heating tolerance exeeded (only heated versions)	Electronics/Physics temperature
24	W8		Flame is expired
25	W9	External maint. request	External maint. request
26	LIM	LIM (Limit 1/ 2/ 3/ 4)	LIM (Limit 1/ 2/ 3/ 4)
27	W10	Autocal check diff.	Autocal check diff.
28	CTRL	CTRL (Functional check)	CTRL (Functional check)
29			
30			
31			
32			

error number	short name	ULTRAMAT 23 (valid from V2.5.0)
1	S	Meas. value comp. 1 beyond tolerance
2	S	Meas. value comp. 2 beyond tolerance
3	S	Meas. value comp. 3 beyond tolerance
4	S	Meas. value O2 beyond tolerance
5	S	Mains voltage beyond tolerance
6	S	Temp. of analyzer beyond tolerance
7	S	Pressure of amb. airbeyond tolerance
8	S	Flow too low during measuring
9	S	No data for temperature compensation
10	S	Flow too low during AUTOCAL
11	S	Conc. of O2 too low during AUTOCAL
12	S	Fault at analog output
13	S	General fault of all IR-channels
14	S	Fault of adresses for IR-channels
15	S	AUTOCAL-drift beyond tolerance
16	S	Fault at EEPROM
17	S	Phase not found
18	S	
19	S	
20	S	IR-channel 1 not calibrated
21	S	IR-channel 2 not calibrated
22	S	IR-channel 3 not calibrated
23	S	Volt. for IR-source beyond tolerance
24	S	Supply of bridge beyond tolerance
25	S	half bridge voltage beyond tolerance
26	S	Lockin fault
27	S	External fault
28	S	
29	S	
30	S	
31	S	Sensitivity of O2-Sensor to low
32	S	Overflow of AD-converter
33		
34		
35	W	AUTOCAL-drift beyond tolerance
36	W	Sensor capacity low
37	W	LCD-temperature beyond tolerance
38	W	External maint. request
39	W	
40	W	

The actual errorlists are in the instruction manuals.

7.2 Boot Program

The channel's program memory contains a non-erasable boot program. Using this program it is possible to download new channel firmware by means of ELAN commands.
The boot program can be started with the boot command when sent within one second after switching on the unit or resetting the channel.
In order to allow booting even with faulty firmware there are two versions of the command "Start boot program" ('K', 20, 1 or 2)

1. **Boot without checking of channel address:**
   The boot command is accepted by all channels.

   This mode is not possible in bus operation since command answers are necessary to control the transmission.

   This command version is specifically made for firmware updates of a channel when the firmware is missing or faulty.
2. **Boot with checking of channel address:**

   The boot program is only accepted by the addressed channel. In order to avoid loss of the channel address during the reset which is required prior to booting, the reset must be executed using the ELAN *Reset* command.

   Booting with this command is possible during bus operation. However, it is advisable to reduce other bus communication (e.g. broadcast, scanning of other channels) at this time for faster, more reliable downloading.

The command "Run firmware update" ('K', 21) is used for downloading. The channel address is checked or not depending on the boot command (see above).
After execution of the boot program it should be checked for an error-free download using command ”Scan boot program errors (”k”, 20). In case of errors restart boot program.
The firmware is stored in the PC as a file in Intel hex format (extended). To speed up the transmission, the individual strings (records) of this file are shortened of the start character, checksum and end character, and converted from ASCII to binary format.
The characters thus obtained are the data in the command.

Example of data transformation (write bytes 12H, A0H, 5CH, BFH starting at address 4A80H)

	Intel hex format	Binary format	ELAN command ('K', 21)
Start character:	3AH,	-	10H, 01H,
ELAN addresses:	-	-	20H, D0H,
ELAN command:	-	-	4BH, 15H,
Data number:	30H, 34H,	04H,	04H,
Address:	34H, 41H, 38H, 30H,	4AH, 80H,	4AH, 80H,
Record type:	30H, 30H,	00H,	00H,
Data:	31H, 32H, 41H, 30H, 35H, 43H, 42H, 46H,	12H, A0H, 5CH, BFH	12H, A0H, 5CH, BFH,
Checksum:	xxH, yyH,	-	-
End character:	0DH, 0AH	-	10H, 03H,
ELAN-CRC:	-	-	XXH, YYH

Boot procedure without checking of channel address

1. Switch off the analyzer, disconnect it from the bus system and connect it to the controller (PC).
2. Switch on the analyzer and send the command 'K', 20, 1 from the PC to the analyzer within the first second.

Note

The target address used is insignificant but should be within the acceptable range (1-12) and must be retained throughout the boot process.

3. The analyzer is now in boot mode. The old firmware is deleted first (takes about 20 s) and then the analyzer expects the data transmission. While deleting no commands are accepted.
4. Each individual firmware record must be converted in the PC (as shown in the example) and sent to the analyzer with the ELAN command 'K', 21. The successful transmission and the correct programming of the record is acknowledged with DLE (10H), ACK (06H).
   If the analyzer answers with DLE (10H), NAK (15H), the record must be transmitted again.

Note

Because duration of deleting (step 3) is undefined, it is advisable to send the first firmware record shortly after step 3 until this command is answered.

5. After transmission of all records the analyzer pauses for about 15 s to determine the checksum.
6. With ELAN command ”k”, 20 it must be checked for an error-free boot process.
7. The new firmware can be started by switching the analyzer off and on again or alternatively by using the ELAN *Reset* command ('Z', 1).

Note

To speed up the transmission during the download and the subsequent *Reset* command, there are no answering telegrams.

Boot procedure with checking of channel address

1. Restart analyzer using the ELAN *Reset* command ('Z', 1) (takes about 20 s). No commands are answered while *Reset* is executed.
2. Send the command 'K', 20, 2 from the PC to the analyzer within the first second after restart.

Note

Because duration of Reset (step 1) is undefined, it is advisable to send the command 'K',20,2 (step 2) until this command is answered.

3. The analyzer is now in boot mode. The old firmware is deleted first (takes about 20 s) and then the analyzer expects the data transmission. While deleting no commands are accepted.
4. Each individual firmware record must be converted in the PC (as shown in the example) and sent to the analyzer with the ELAN command 'K', 21. The successful transmission and the correct programming of the record is acknowledged with DLE (10H), ACK (06H).
   If the analyzer answers with DLE (10H), NAK (15H), the record must be transmitted again.

Note

Because duration of deleting (step 3) is undefined, it is advisable to send the first firmware record shortly after step 3 until this command is answered.

5. After transmission of all records the analyzer pauses for about 15 s to determine the checksum.

6. With ELAN command ”k”, 20 it must be checked for an error-free boot process.
7. The new firmware can be started by switching the analyzer off and on again or alternatively by using the ELAN *Reset* command ('Z', 1).

Note

To speed up the transmission during the download and the subsequent *Reset* command, there are no answering telegrams.

Example of boot program without checking of channel address

Control system/PC	Analyzer	Comment
		1. Switch off the analyzer
10H, 01H, 20H, D0H, 4BH, 14H, 01H, 10H, 03H, 89H, 51H		2. Switch on the analyzer and send boot request Start, addresses, command ('K', 20, 1), end, CRC
	10H, 06H	3. Analyzer accepts the request and enters boot mode (wait about 20 s)
10H, 01H, 20H, D0H, 4BH, 15H, 04H, 4AH, 80H, 00H, 12H, A0H, 5CH, BFH, 10H, 03H, 26H, 6DH	10H, 06H 10H, 15H	4. Send data strings Start, addresses, command ('K', 21), data (example of data conversion), end, CRC Analyzer has received data string correctly and stored it => send next string or Error occurred => send string again
		5. After transmission of all records wait approx. 10 s
10H, 01H, 20H, D0H, 6BH, 14H, 10H, 03H, 86H, 94H	10H, 06H 10H, 01H, D0H, 20H, 04H, 01H, 6BH, 14H, 80H, 00H, 10H, 03H, 71H, 83H	6. Send error scan after transmission of all data strings Start, addresses, command (‘k’, 20), end, CRC Analyzer has received command correctly Start, addresses, State : not ready, State : warm-up, command (‘k’, 20), error state : no errors, end, CRC
10H, 01H, 20H, D0H, 5AH, 01H, 10H, 03H, 99H, ACH	10H, 06H	7. switch on and off or send command *Reset* Start, addresses, command (‘Z’, 1), end, CRC Analyzer Reset
		Analyzer starts with new firmware

Example of boot program with checking of channel address

Control system/PC	Analyzer	Comment
10H, 01H, 60H, D0H, 5AH, 01H, 10H, 03H, 97H, 6CH	10H, 06H	1. Restart analyzer using *Reset* command Start, addresses, command ('Z', 1), end, CRC Command received
	10H, 01H, D0H, 60H, 5AH, 01H, 10H, 03H, XXH, YYH	Command answer Analyzer carrying out a *Reset*
10H, 01H, 60H, D0H, 4BH, 14H, 02H, 10H, 03H, 38H, 95H		2. Send boot request Start, addresses, command ('K', 20, 2), end, CRC
	10H, 06H	3. Analyzer accepts the request and enters boot mode (wait about 20 s)
10H, 01H, 60H, D0H, 4BH, 15H, 04H, 4AH, 80H, 00H, 12H, A0H, 5CH, BFH, 10H, 03H, 67H, EDH	10H, 06H 10H, 15H	4. Send data strings Start, addresses, command ('K', 21), data (example of data conversion), end, CRC Analyzer has received the data string correctly and stored it ➔ send next string or Error occurred => send string again
		5. After transmission of all records wait approx. 10 s

10H, 01H, 20H, D0H, 6BH, 14H, 10H, 03H, 86H, 94H	10H, 06H	6. Send error scan after transmission of all data strings Start, addresses, command ('k', 20), end, CRC Analyzer has received command correctly
	10H, 01H, D0H, 20H, 04H, 01H, 6BH, 14H, 80H, 00H, 10H, 03H, 71H, 83H	Start, addresses, State : not ready, State : warm-up, command ('k', 20), error state : no errors, end, CRC
10H, 01H, 20H, D0H, 5AH, 01H, 10H, 03H, 99H, ACH	10H, 06H	7. switch on and off or send command *Reset* Start, addresses, command ('Z', 1), end, CRC Analyzer Reset
		Analyzer starts with new firmware