

ELAN Interface

| Description | 11/08 |
|-------------|-------|
| | |

C79000-B5276-C176-04

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1 General

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

- ULTRAMAT 6 / 23
- OXYMAT 6 / 61 / 64
- CALOMAT 6 / 6 TG / 62
- FIDAMAT 6

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

Series 6 consists of all mentioned analyzers except ULTRAMAT 23.

The following definitions are used in this description:

- Analyzer: independent analyzer device with electronics, sample chamber(s) and tubing in a housing
- Channel: analyzer device with electronics (1 motherboard), connected component(s) and tubing
- Component: device 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 6 TG, CALOMAT 62, FIDAMAT 6, ULTRAMAT 23 | XMT + | 3 |
| | XMT - | 8 |
| | switchable termination by shorting | <p>Diagram illustrating the switchable termination by shorting configuration. The setup shows a 5V source connected to pin 7 through a 1kΩ resistor. A 221Ω resistor is connected between pins 7 and 9. A 1kΩ resistor is connected between pins 9 and 5. A 0V source is connected to pin 5. Pins 8 and 3 are labeled XMT. A dashed line connects pins 7, 9, and 5, with an arrow pointing to it labeled 'shorted'.</p> |

2 ELAN Network

2.1 Principle Connection

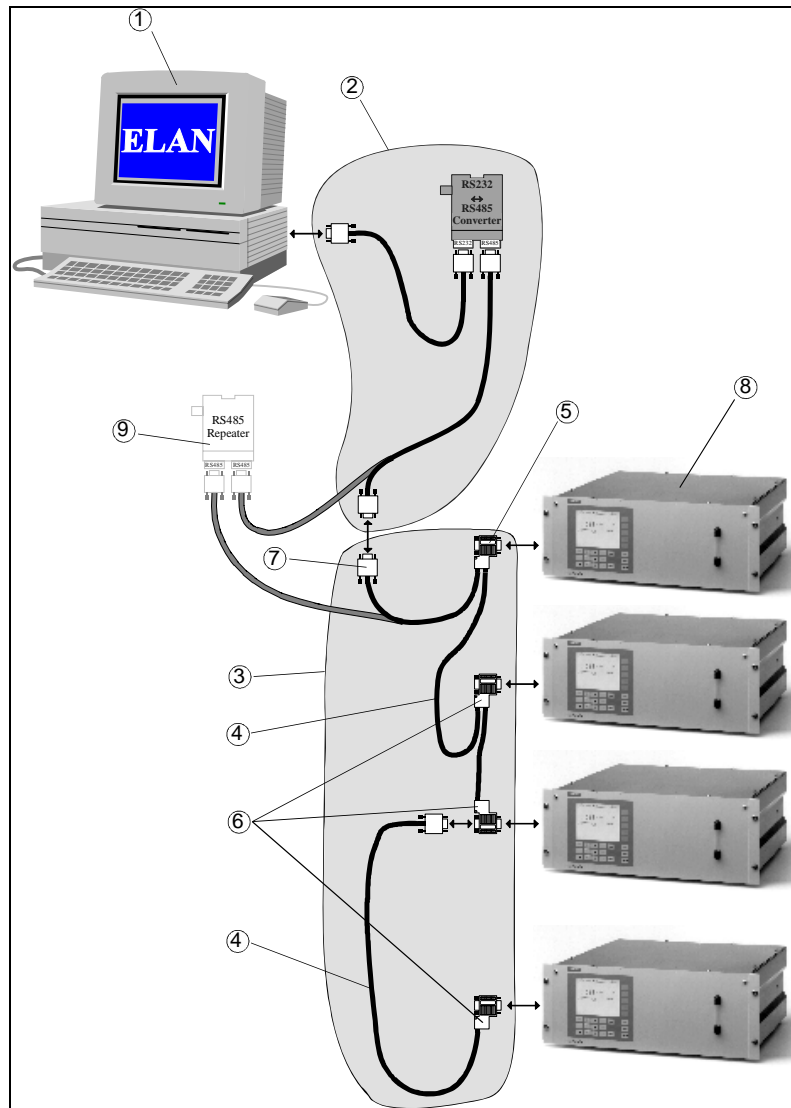


Fig. 22-1 Principle connection

2.2 Elements of ELAN Network

| Item | Name |
|------|---|
| 1 | Computer |
| 2 | RS485 ↔ RS232 converter with connection cable RS232 and ELAN [1]; RS485 ↔ USB converter with connection cable USB and ELAN [1]; RS485 ↔ Ethernet converter with connection cable Ethernet and ELAN [1]; |
| 3 | ELAN network (RS485) |
| 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] |

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 | | converter : RS485 ↔ RS232 RS485 ↔ USB RS485 ↔ Ethernet | C79451-Z1589-U1 A5E00852382 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.

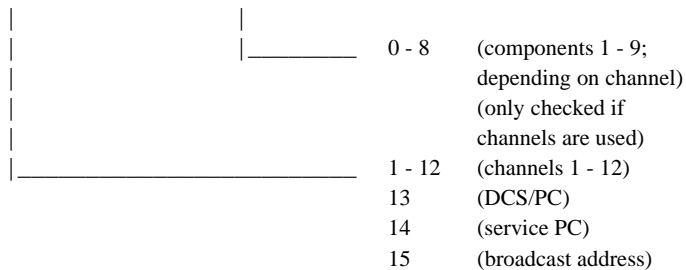
General

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.

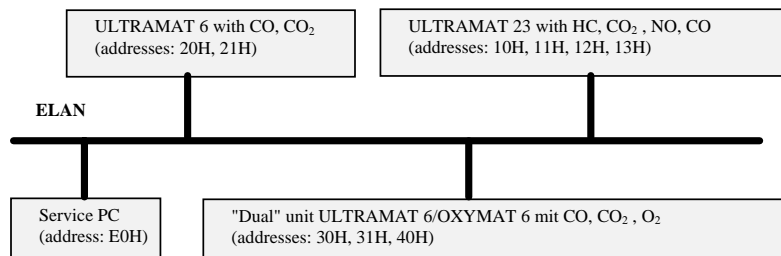
Addressing

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

channel address * 16 + component address = address (1 byte)



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 remainder 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 | O64 | C62 |
|--|----|----|----|-------|----|-----|-----|-----|
| 'Z', 1 Reset | b | b | b | b | b | b | b | b |
| 2 Pause | b | b | b | b | b | b | b | b |
| 3 Standby | b | b | b | b | b | b | b | b |
| 4 Measure | b | b | b | b | b | b | b | b |
| 5 Zero calibration | k | k | k | k | k | k | k | k |
| 6 Adjust component slope | k | k | k | k | k | k | k | k |
| 7 Not yet defined | - | - | - | - | - | - | - | - |
| 8 Adjust curve dip | k | - | k | k | k | k | k | k |
| 9 Adjust linearization sensitivity | k | - | k | k | k | k | k | k |
| 10 Adjust temperature compensation | b | b | - | - | - | b | - | - |
| 11 Adjust pressure compensation | b | - | b | b | b | - | - | b |
| 12 Adjust linearization zero | k | - | k | k | k | - | k | k |
| 13 Not yet defined | - | - | - | - | - | - | - | - |
| 14 Autocal (once) | b | b | b | b | k | b | b | 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 | k | k |
| 20 Adjust analog input | b | b | b | b | b | - | b | b |
| 21 Autocal check | b | b | b | b | b | - | b | b |
| 22 Calibration of sensor | - | - | - | - | - | - | k | - |
| 23 Calibration of sensor % range | - | - | - | - | - | - | k | - |

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 | O64 | C62 |
|--|----|----|----|----------|----|-----|-----|-----|
| 'F', 1 Remote on/ off | b | b | b | b | b | b | b | b |
| 2 Pressure switch for sample gas on/ off | b | b | - | - | - | b | b | - |
| 3 Pressure switch for reference / purge gas on/ off | b | b | - | - | - | - | b | - |
| 4 Total/ single calibration | k | k | k | - | k | k | k | k |
| 5 Maintenance switch on/ off | b | b | 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 | b | b |
| 11 Pump on/ off | - | - | - | - | b | b | b | - |
| 12 Radiator voltage on/ off | b | - | - | - | - | b | - | - |
| 13 Lock logbook on/ off | b | b | b | b | b | - | b | b |
| 14 Sample point switching on/ off | b | b | b | b | b | - | b | b |
| 15 Suppress negative measured values on the analog output on/ off | k | k | k | k | k | b | k | k |
| 16 Signal violation of calibration tolerance | k | k | k | k | k | - | k | k |
| 17 CTRL at change | - | - | - | - | - | - | b | - |
| 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 | - | k | k |
| 21 Temperaturecompensation on/ off | k | k | k | k | k | k | k | k |
| 22 Pressurecompensation on/ off | k | k | k | k | k | - | k | k |
| 23 Heating on/ off | b | b | - | - | b | - | - | b |
| 24 Precompensation on/ off | k | - | - | - | - | - | - | - |
| 25 Aftercompensation of the zero point on/ off | k | k | k | k | k | - | k | k |
| 26 Aftercompensation of the span on/ off | k | k | k | k | k | - | k | k |
| 27 Fault/ Maint. request/function control according to NAMUR on/ off | k | k | 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 | - | 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 | b | b |
| 34 Constant cross-interference | - | - | - | - | - | k | - | - |
| 35 Temperaturecompensation module on/ off | - | - | - | - | - | - | - | b |
| 36 Not yet defined | - | - | - | - | - | - | - | - |
| 37 Linearization module on/ off | - | - | - | - | - | - | - | b |
| 38 internal cross-interference 1 on/ off | - | - | - | - | - | k | - | - |
| 39 internal cross-interference 2 on/ off | - | - | - | - | - | k | - | - |

| Read/ set control function | U6 | O6 | C6 | C6 TG | F6 | U23 | O64 | C62 |
|--|----|----|----|----------|----|-----|-----|-----|
| 's'/S', 1 Limit 1 | k | k | k | k | k | k | k | k |
| 2 Limit 2 | k | k | k | k | k | k | k | k |
| 3 Analog output range | b | b | b | b | b | b | b | b |
| 4 Relay outputs (standard) | b | b | b | b | b | b | b | b |
| 5 Relay outputs (with optional board) | b | b | b | b | b | b | b | b |
| 6 Binary inputs (standard) | b | b | b | b | b | b# | b | b |
| 7 Binary inputs (with optional board) | b | b | b | b | b | b | b | b |
| 8 Current measuring range | k | k | k | k# | k | k | k | k |
| 9 Not yet defined | - | - | - | - | - | - | - | - |
| 10 Measuring head heating | - | b# | - | - | - | - | - | - |
| 11 Autocal mode | b | b | b | - | b | - | b | b |
| 12 Autocal steps | b | b | b | - | b | b# | b | b |
| 13 Compensation/ calibration step | k | k | k | - | k | k | k | k |
| 14 Not yet defined | - | - | - | - | - | - | - | - |
| 15 Pressure compensation | b | b | b | b | - | - | - | b |
| 16 Correction 1 of cross-interference | k | k | b | b | b | k | b | b |
| 17 Not yet defined | - | - | - | - | - | - | - | - |
| 18 Not yet defined | - | - | - | - | - | - | - | - |
| 19 Save measured value | b | b | b | b | b | b | b | b |
| 20 Valves | b | b | 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 | b | b |
| 24 Dimension of measured value | k | k# | k# | - | k | k | k | k# |
| 25 Internal interference component | - | - | - | - | - | k | - | - |
| 26 Relay outputs/ binary inputs | b# | b# | b# | b# | b# | - | b# | b# |
| 27 Language selection | b | b | b | b | b | b | b | b |
| 28 Automatic temperature compensation | b | b | - | - | - | - | - | - |
| 29 Heating parameters | b | b | - | - | - | - | - | b |
| 30 Limit 3 | k | k | k | k | k | - | k | k |
| 31 Limit 4 | k | k | k | k | k | - | k | k |
| 32 PROFIBUS parameters | b | b | b | b | b | b | b | b |
| 33 Integrated optional board | b# | b# | b# | b# | b# | b# | b# | b# |
| 34 Relais outputs/ binary inputs general | b# | b# | b# | b# | b# | b# | b# | b# |
| 35 Correction 2 of cross-interference | - | - | b | b | b | - | b | b |
| 36 Correction 3 of cross-interference | - | - | b | b | b | - | b | b |
| 37 Correction 4 of cross-interference | - | - | b | b | b | - | b | b |
| 38 External interference component 3,4 | - | - | b | b | b | - | b | b |
| 39 External channel of pressure compensation | b | b | b | b | - | - | - | b |
| 40 PROFIBUS profile | b | b | b | b | b | b | b | b |
| 41 Internal valves | - | - | - | - | b | - | - | - |
| 42 Relay by PROFIBUS | b# | b# | b# | b# | b# | b# | b# | b# |

| Read/ write values | U6 | O6 | C6 | C6 TG | F6 | U23 | O64 | C62 |
|---|----|----|----|----------|----|-----|-----|-----|
| 'w'/'W', 1 Start-of-scale values | k | k | k | k# | k | k# | k | k |
| 2 Full-scale values | k | k | k | k# | k | k | k | k |
| 3 Slope gas concentrations | k | k | k | k# | k | k | k | k |
| 4 Linearization gas concentrations | k | - | k | k | k | k | k | k |
| 5 Zero gas concentration | k | k | k | k | k | k# | k | k |
| 6 Autocal cycle parameters | b | b | b | - | b | b | b | b |
| 7 Purge times for Autocal steps 1 to 6 | b | b | b | - | b | b | b | b |
| 8 Purge times for Autocal steps 7 to 12 | b | b | b | - | b | - | b | b |
| 9 Limit 1 | k | k | k | k | k | k | k | k |
| 10 Limit 2 | k | k | k | k | k | k | k | k |
| 11 Integration times | k | k | k | k | k | k | k | k |
| 12 Autorange hysteresis (% measuring range) | k | k | 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 | - | b | b |
| 17 Not yet defined | - | - | - | - | - | - | - | - |
| 18 Barometric pressure | b | b | b# | b# | b# | b | b# | b# |
| 19 Analog output | k | k | k | k | k | k | k | k |
| 20 LCD contrast | b | b | b | b | b | b | b | b |
| 21 Frequency | b | b | - | - | - | b | - | - |
| 22 Reduction value | k | k | - | - | - | k | - | - |
| 23 Phase | k# | k | - | - | - | - | - | - |
| 24 Noise signal suppression duration | k | k | k | k | k | - | k | k |
| 25 Calibration tolerances | k | k | k | - | k | b | k | k |
| 26 Shock compensation | - | b | - | - | - | - | - | - |
| 27 Parameters of external pressure sensor | b | b | b | b | - | - | - | b |
| 28 Parameters of external interfering gas 1 | k | k | b | b | b | k | b | b |
| 29 Sample point times | b | b | b | - | b | - | b | b |
| 40 Autorange lower limits (absolute value) | k | k | k | - | k | - | k | k |
| 41 Autorange upper limits (absolute value) | k | k | k | - | k | - | k | k |
| 42 Full-scale value of linearization curve | k | k# | k | k | k | k | k | k |
| 43 Deviation in zero and slope calibration | k# | k# | k# | k# | k# | k# | k# | k# |
| 44 Parameters of external interfering gas 2 | - | - | b | b | b | k | b | b |
| 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 | k | k |
| 48 Zero point values of temperature comp. | k | k | k | k | k | k | k | k |
| 49 End point values of temperature comp. | k | - | k | k | k | - | k | k |
| 50 Zero point coefficients of temperature comp. | k | k | k | k | k | k | k | k |
| 51 End point coefficients of temperature comp. | k | k | k | k | k | k | k | k |
| 52 Switching temperatur of temperature comp. | k | - | k | k | k | k | k | k |
| 53 Coefficients of linearization | k | k | k | k | k | k | k | k |
| 54 Pressure values of pressure compensation | k | - | k | k | k | - | - | k |
| 55 Zero point values of pressure compensation | k | - | k | k | k | - | - | k |

| Read/ write values | U6 | O6 | C6 | C6 TG | F6 | U23 | O64 | C62 |
|---|----|----|----|----------|----|-----|-----|-----|
| 56 End point values of pressure compensation | k | - | k | k | k | - | - | k |
| 57 Coefficients of pressure compensation | k | - | k | k | k | k | - | k |
| 58 Reference of pressure compensation | k | - | k | k | k | - | - | k |
| 59 Aftercompensation of the zero point | k | k | k | k | k | - | k | k |
| 60 Aftercompensation of the measured value | k | k | k | k | k | - | k | k |
| 61 Precompensation | k | - | - | - | - | - | - | - |
| 62 Parameters of calibration | k | - | k | k | k | - | k | k |
| 63 Limit 3 | k | k | k | k | k | - | k | k |
| 64 Limit 4 | k | k | k | k | k | - | k | k |
| 65 Autocal check calibration tolerances | b | b | b | - | b | - | b | b |
| 66 Parameters of external interfering gas 3 | - | - | b | b | b | - | b | b |
| 67 Parameters of external interfering gas 4 | - | - | b | b | b | - | b | b |
| 68 Value of interfering gas 1 | k | k# | b | b | b | - | b | b |
| 69 Value of interfering gas 2 | - | - | b | b | b | - | b | b |
| 70 Value of interfering gas 3 | - | - | b | b | b | - | b | b |
| 71 Value of interfering gas 4 | - | - | b | b | b | - | b | b |
| 72 Coefficients of external interfering gas 1 | - | - | b | b | b | - | b | b |
| 73 Coefficients of external interfering gas 2 | - | - | b | b | b | - | b | b |
| 74 Coefficients of external interfering gas 3 | - | - | b | b | b | - | b | b |
| 75 Coefficients of external interfering gas 4 | - | - | b | b | b | - | b | b |
| 76 Zero-scale value of linearization curve | k | k# | k | k | k | k | k | k |
| 77 Noise signal suppression level | k | k | 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 | k | k |
| 84 Heating of sensor | - | - | - | - | - | - | b | b |
| 85 Offset / span of sensor | - | - | - | - | - | - | b | b |
| 86 Parameter of constant cross-interference | - | - | - | - | - | k | - | - |
| 87 Parameters of internal interfering gas 1; new | - | - | - | - | - | k | - | - |
| 88 Parameters of internal interfering gas 2; new | - | - | - | - | - | k | - | - |

| Read diagnostic values (see chapter 4.8) | U6 | O6 | C6 | C6 TG | F6 | U23 | O64 | C62 |
|--|----|----|----|----------|----|-----|-----|-----|
| 'h', 1 - n | | | | | | | | |

| Other commands | U6 | O6 | C6 | C6 TG | F6 | U23 | O64 | C62 |
|--|----|----|----|----------|----|-----|-----|-----|
| 'k', 1 Read measured value of one component | k | k | k | k | k | k | k | k |
| 'k', 2 Read all measured values of the channel | b | b | b | b | b | b | b | b |
| 'k', 3 Read channel functions | b | b | b | b | b | b | b | b |
| 'k', 4 Read component functions | k | k | k | k | k | k | k | k |
| 'k', 5 Read error state | b | b | b | b | b | b | b | b |
| 'k', 6 Read channel version | b | b | 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 | b | b |
| 'K', 10 Acknowledge logbook entry | b | b | b | b | b | b | b | b |
| 'k', 11 occupied | - | - | - | - | - | - | - | - |
| 'k', 12 Read maintenance request state | b | b | b | b | b | b | b | b |
| 'K', 13 Acknowledge logbook error | b | b | b | b | b | b | b | b |
| 'K', 14 Transfer data sectors | b | b | b | b | b | b | b | b |
| 'k', 15 occupied | - | - | - | - | - | - | - | - |
| 'k'/'K', 16 Channel name | b | b | b | b | b | b | b | b |
| 'k'/'K', 17 Not yet defined | - | - | - | - | - | - | - | - |
| 'k', 18 Read message state | b | b | b | b | b | - | b | b |
| 'k', 19 Read current <i>Autocal</i> step | b | b | b | b | b | - | b | b |
| 'k', 20 Scan boot program errors | b | b | b | b | b | b | b | b |
| 'K', 20 Start boot program | b | b | b | b | b | b | b | b |
| 'K', 21 Run firmware update | b | b | b | b | b | b | b | b |
| 'K', 22 Clear logbook | b | b | b | b | b | - | b | b |
| 'k', 23 Read state of the external connections | b | b | b | b | b | - | b | b |
| 'k'/'K', 24 Download mode | b | b | b | b | b | b | b | b |
| 'K', 25 Data transfer for download | b | b | b | b | b | b | b | b |
| 'k', 26 Set of data read/ write | b | b | b | b | b | b | b | b |
| 'k', 27 Transfers a part of a set of data | b | b | b | b | b | b | b | b |
| 'k', 28 Read firmware versions | b | b | 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 | b | b |
| 'k', 32 Read module identification | - | - | - | - | - | - | b | b |
| 'k'/'K', 33 Module user data | - | - | - | - | - | - | 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 | l/ min |
| 13 | % saturation | 33 | V | 53 | l/ 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 *Reset*.

This command is always accepted.

Pause

'Z', 2

The channel starts the *Pause* state (pump off; gas flow off, ...),
Only valid in *Standby* 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 O₂ 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, 

Slope calibration of the selected measuring range of the addressed component (except O₂ 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 O₂ 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 O₂ 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 | <p>'Z', 10</p> <p>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 <i>Standby</i> or <i>Measure</i> state.</p> |
| Adjust pressure compensation | <p>'Z', 11</p> <p>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 <i>Standby</i> or <i>Measure</i> state.</p> |
| Adjust linearization zero | <p>'Z', 12</p> <p>The channel carries out a sensitivity calibration for linearization of the addressed component (except O₂ 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 <i>Standby</i> or <i>Measure</i> state. On FIDAMAT 6 only valid in <i>Measure</i> state.</p> |
| Autocal | <p>'Z', 14</p> <p>The channel starts a single <i>Autocal</i>. Only valid in <i>Standby</i> or <i>Measure</i> state and with <i>channel function Autocal on</i>. On FIDAMAT 6 only valid in <i>Measure</i> state. Commands for <i>Autocal</i> are only permissible for a series 6 analyzer if the optional board is fitted.</p> |
| Adjust phase | <p>'Z', 15</p> <p>The component carries out an adjustment to determine the phase.</p> |

**Zero calibration
of O₂ sensor**

'Z', 16

The channel carries out a zero calibration for the O₂ 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.

Calibration of sensor

'Z', 22, crc.

The component starts the calibration of the sensor.

Air and the selected calibration gas are needed.

The measured value of sensor can be read by command 'h',6.

Calibration steps :

1. Connect air. The command 'Set compensation/ calibration step' ('S', 13) imports the new zero point of sensor.
2. Connect selected calibration gas for the vpm range. The command 'Set compensation/ calibration step' ('S', 13) imports the new span of sensor for the vpm range and finishes the calibration.

Only valid with total calibration and in *Standby* or *Measure* state.

Calibration of sensor % range

'Z', 23, crc.

The component starts the calibration of the sensor %Vol range.

The selected calibration gas are needed.

The measured value of sensor can be read by command 'h',6.

Connect selected calibration gas for the %Vol range. The command 'Set compensation/ calibration step' ('S', 13) imports the new span of sensor for the %Vol range and finishes the calibration.

Only valid with total calibration and in *Standby* or *Measure* state.

4.5 Set Switching Function

Command structure

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

Example: Remote on

Control 'F', 1, '1', 0
command:
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 / purge gas on/ off

'F', 3, **function**
 |
 |_____ '0' => off; '1' => on

The channel starts or finishes monitoring the reference / purge 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 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**

'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**

'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**

'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

**CTRL at
change
on/ off**

'F', 17, **function**
 |
 |_____ '0' => off; '1' => on

'Function check' is set while dimension of measured value is changed.

**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

Broadcast 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

With ULTRAMAT 23, the function is available only at O2-component.

**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.

**Precompensa-
tion on/ off**

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

**Aftercompensa-
tion of the zero
point on/ off**

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

**Aftercompensa-
tion 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, funktion
 |
 |_____ '0' => off; '1' => on

**Ignition
on/ off**

'F', 30, funktion
 |
 |_____ '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.

'F', 34, funktion
|
|_____ '0' => off; '1' => on

'F', 35, funktion
|
|_____ '0' => off; '1' => on

'F', 37, funktion
|
|_____ '0' => off; '1' => on

'F', 38, funktion
|
|_____ '0' => off; '1' => on

'F', 39, funktion
|
|_____ '0' => off; '1' => on

4.6 Read/ Set Control Function

Command structure

Read control:

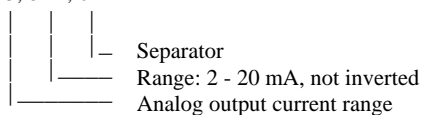
| | |
|----------|-------------------|
| Control | 's', number |
| command: | |
| Answer: | 's', number, crc. |

Example: analog output range

Control 's', 3

command:

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



Set control:

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

Example: limit 1

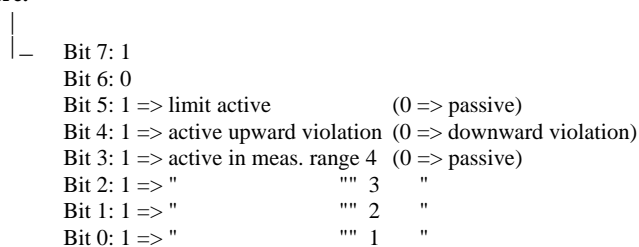
Control 'S', 1, A3H, 0

command:

Answer: 'S', 1

Read/ set limit 1

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



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 analyzers of Series 6.

There is only measure 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

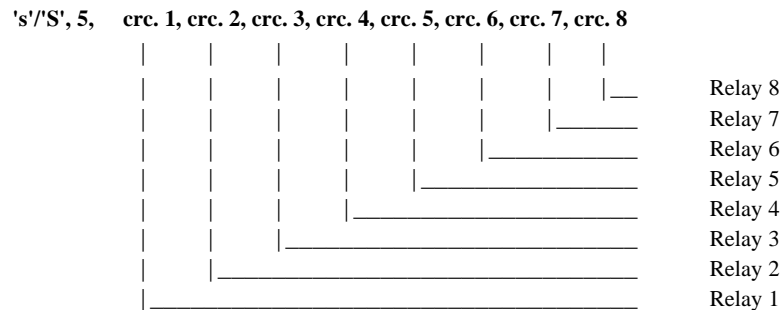
| Control character (crc.) | Function of the relay output | Comment |
|--------------------------|--|---------------|
| 1 | Free | |
| 2 | Fault | |
| 3 | Maintenance request | |
| 4 | Calibration | Only series 6 |
| 5 | Component 1 measuring range 1 selected | Only series 6 |
| 6 | Component 1 measuring range 2 selected | |
| 7 | Component 1 measuring range 3 selected | Only series 6 |
| 8 | Component 1 measuring range 4 selected | Only series 6 |
| 9 | Component 1 alarm 1 triggered | |
| 10 | Component 1 alarm 2 triggered | |
| 11 | Function check | |
| 12 | Valve for sample gas is open | Only series 6 |
| 13 | Valve for zero gas is open | |
| 14 | Valve for calibration gas 1 is open | |
| 15 | Valve for calibration gas 2 is open | Only series 6 |
| 16 | Valve for calibration gas 3 is open | Only series 6 |

| Control character (crc.) | Function of the relay output | Comment |
|--------------------------|---|-------------------|
| 17 | Valve for calibration gas 4 is open | Only series 6 |
| 18 | Measuring point 1 | Only series 6 |
| 19 | Measuring point 2 | Only series 6 |
| 20 | Measuring point 3 | Only series 6 |
| 21 | Measuring point 4 | Only series 6 |
| 22 | Measuring point 5 | Only series 6 |
| 23 | Measuring point 6 | Only series 6 |
| 24 | Signal from measuring point 1 | Only series 6 |
| 25 | Signal from measuring point 2 | Only series 6 |
| 26 | Signal from measuring point 3 | Only series 6 |
| 27 | Signal from measuring point 4 | Only series 6 |
| 28 | Signal from measuring point 5 | Only series 6 |
| 29 | Signal from measuring point 6 | Only series 6 |
| 30 | Signal contact (for synchronization with Autocal)/sync signal | |
| 31 | Flow of reference / purge gas | Only U6/ O6 / O64 |
| 32 | Flow of sample gas | Only U6/ O6 / O64 |
| 33 | Valve for zero gas 2 is open | Only series 6 |
| 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 series 6 |
| 48 | Component 1 limit 4 triggered | Only series 6 |
| 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 series 6 |
| 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 |

| Control character (crc.) | Function of the relay output | Comment |
|--------------------------|------------------------------|-------------------------|
| 62 | Operation request | Only F6 |
| 63 | Device with dimension % Vol | Only O64 (since V0.1.6) |

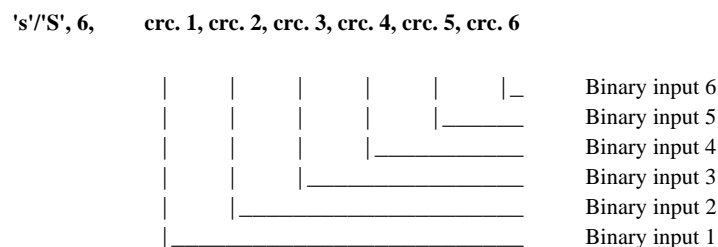
Series 6 analyzers have only 6 relay outputs. Each function can be set for only one relay.

Read/ set relay outputs (with optional board)



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

Read/ set binary inputs (standard)



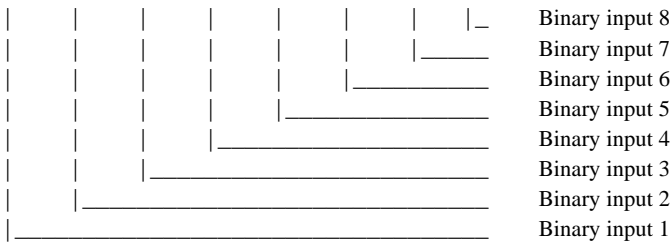
| Control character | Function of the binary input | Comment |
|-------------------|--|---------|
| 1 | Vacant | |
| 2 | Other fault (external fault) | |
| 3 | Fault probe heating (external fault) | |
| 4 | Fault sample gas filter (external fault) | |
| 5 | Fault gas cooler (external fault) | |
| 6 | Other maintenance request (external maintenance request) | |
| 7 | Maintenance request probe heating (external maintenance request) | |
| 8 | Maintenance request sample gas filter (external maintenance request) | |

| Control character | Function of the binary input | Comment |
|-------------------|--|---------------------|
| 9 | Maintenance request gas cooler (external maintenance request) | |
| 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 series 6 |
| 19 | Component 1 Range 4 | Only series 6 |
| 20 | Component 1 Autorange | |
| 21 | Zero gas | Only series 6 |
| 22 | Span gas | Only series 6 |
| 23 | Sample gas | Only series 6 |
| 24 | Zero calibration | Only series 6 |
| 25 | Component 1 Span calibration | Only series 6 |
| 26 | Fault condensate vessel (external fault) | |
| 27 | Fault sample pump/ flow (external fault) | |
| 28 | Fault sample line (external fault) | |
| 29 | Maintenance request condensate vessel (external maintenance request) | |
| 30 | Maintenance request sample pump/ flow (external maintenance request) | |
| 31 | Maintenance request sample line (external maintenance request) | |
| 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 series 6 |
| 47 | Measure state locked | Only series 6 |
| 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 range 1-3 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 " |

'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

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

| | | | | |
|--|-------|-------|-------|---------|
| | | | | Step 12 |
| | | | _____ | " 3 |
| | | _____ | _____ | " 2 |
| | _____ | _____ | _____ | " 1 |

's'/'S', 13, crc.
|
— 1-255

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. With CALOMAT 6 and CALOMAT 62, there is no pressure compensation with internal pressure.

Read/ set correction 1 of cross- interference

's'/'S', 16, 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 |

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 Series 6 analyzers.

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 Series 6 analyzers there is no difference between an error and a function check. The input for a function check thus also applies to an error.

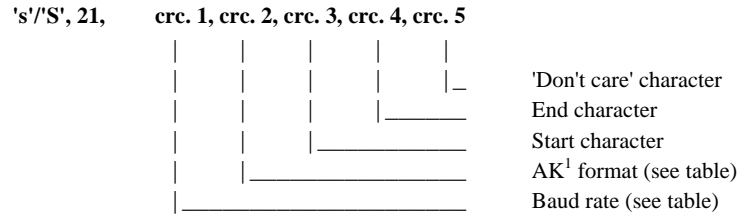
Read/ set valves

'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



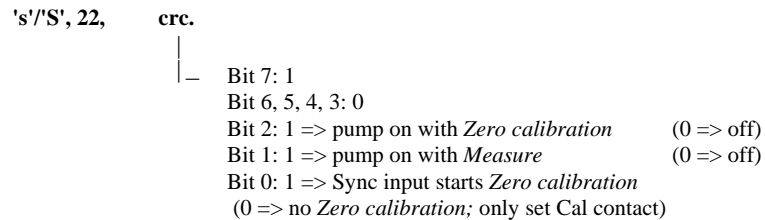
This command is only permissible with the AK optional board fitted.

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 |

| Control character 2 | No. of data bits | AK format | | |
|---------------------|------------------|-----------|------------------|----------------------|
| | | 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)



¹ 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,O6,C6,C62 | Dimension F6 | Dimension O64 |
|-------------------|--------------------|----------------------------------|-------------------------|-----------------------------------|
| 1 | Not used | % Vol | ppm C1 | % Vol (since V0.1.6) |
| 2 | vpm | vpm | ppm C3 | vpm |
| 3 | % (only for read) | mg/ m ³ | ppm C6 | automatical change (since V0.1.6) |
| 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 O₂ sensor of the U23.
With the ULTRAMAT 6 and FIDAMAT 6, no change allowed if full-scale value of linearization curve in new dimension exceeds 99999.
No change allowed with ULTRAMAT 23 components with dimension %.

**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 Relay by PROFIBUS

'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.

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 series 6, commands for *Autocal* are only valid with the optional board fitted.

With the ULTRAMAT 23, value 3 cannot be written.

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

| 'w'/'W', 7, | val. 1, | val. 2, | val. 3, ... val. 6 | |
|-------------|---------|---------|--------------------|----------------------------|
| | | | | Purge time step 6 (in min) |
| | | | | " 3 " |
| | | | | " 2 " |
| | | | | " 1 " |

Purge time inputs for step 'Signalling contact' are ignored.
With the Series 6 analyzers, 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 O₂ probe is connected, times less than 1 min can not be entered for the ULTRAMAT 23.

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

| 'w'/'W', 8, | val. 7, | val. 8, | val. 9... val. 12 | |
|-------------|---------|---------|-------------------|-----------------------------|
| | | | | Purge time step 12 (in min) |
| | | | | " 9 " |
| | | | | " 8 " |
| | | | | " 7 " |

Purge time inputs for step 'Signalling contact' are ignored.
With the series 6 analyzers, commands for *Autocal* are only valid with the optional board fitted.

**Read/ write
limit 1**

| 'w'/'W', 9, | val. 1, | val. 2 | |
|-------------|---------|--------|------------|
| | | | Hysteresis |
| | | | Limit |

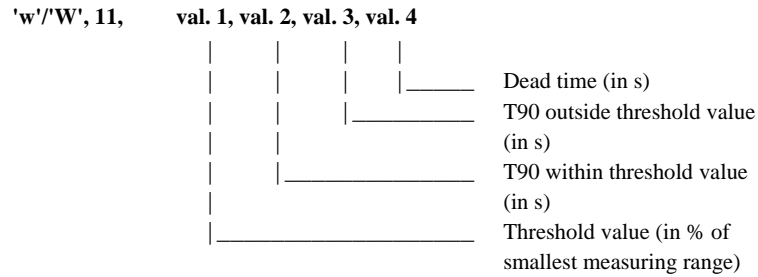
The hysteresis is always 0.

**Read/ write
limit 2**

| 'w'/'W', 10, | val. 1, | val. 2 | |
|--------------|---------|--------|------------|
| | | | Hysteresis |
| | | | Limit |

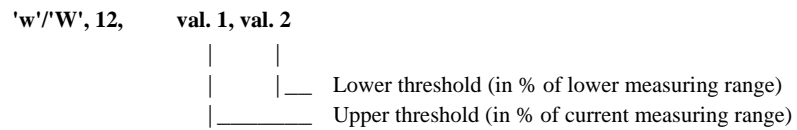
The hysteresis is always 0.

Read/ write integration times



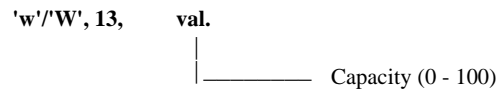
The dead time is always 0.

Read/ write autorange hysteresis thresholds

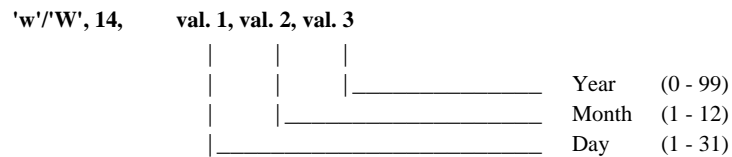


The upper threshold must be higher than the lower threshold.
The function is not available for the C6TG.

Read/ write pump capacity

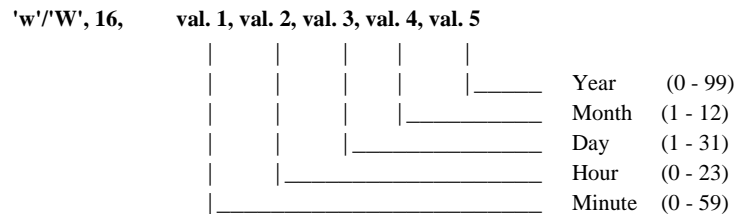


Read/ write date of O₂ sensor installation

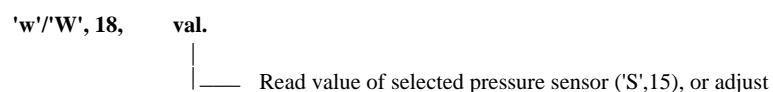


This command is only permissible with an O₂ sensor connected.
A zero calibration ("Z", 5) must have been executed prior to input of date.

Read/ write time



Read/ write barometric pressure



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 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 series 6 analyzers. 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**

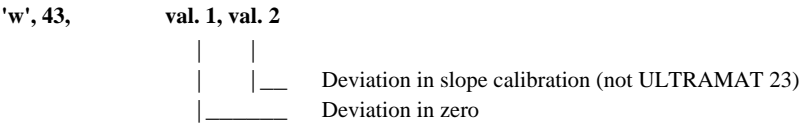
| | | |
|--------------|------------------------|-----------------------------------|
| 'w'/'W', 41, | val. 1, val. 2, val. 3 | |
| | | Upper limit for measuring range 3 |
| | | " " " 2 |
| | | " " " 1 |

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**

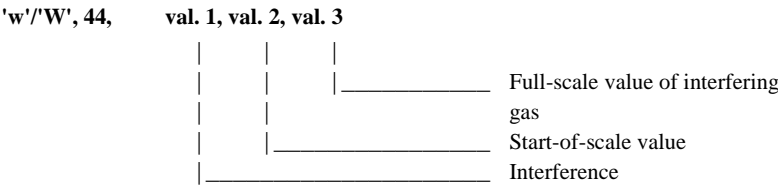
| | | |
|--------------|------|---|
| 'w'/'W', 42, | val. | |
| | | Full-scale value of linearization curve |

**Read deviation
in zero and slope
calibration**



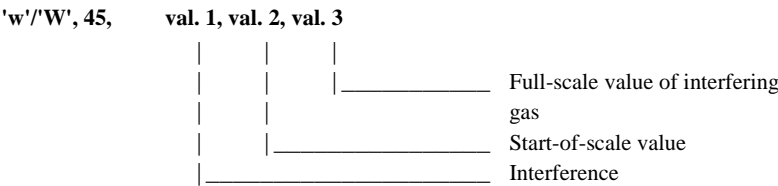
Read deviations for last *Zero calibration* ('Z', 5), *Adjust component slope* ('Z', 6) or *Autocal* ('Z', 14).

**Read/ write
parameters of
external
interfering gas 2**



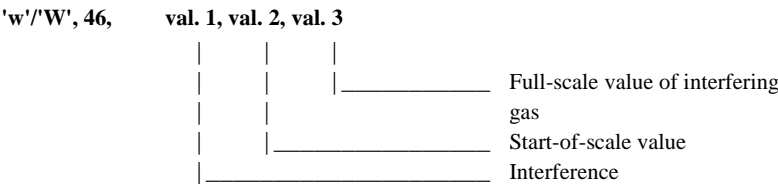
With the ULTRAMAT 23, only the interference applies.
The scale-values can only be set when correction of residual gas influence with analog current 1 or 2 is selected.

**Read/ write
parameters of
internal
interfering gas 1**



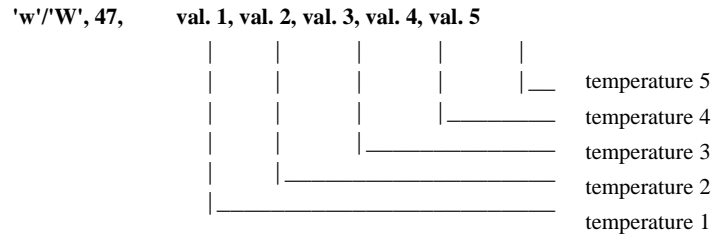
With the ULTRAMAT 23, only the interference applies.

**Read/ write
parameters of
internal
interfering gas 2**



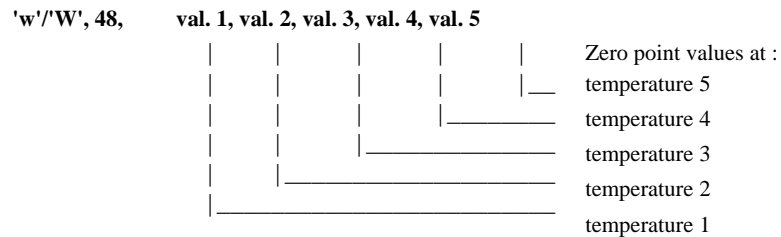
With the ULTRAMAT 23, only the interference applies.

Temperature values of temperature compensation



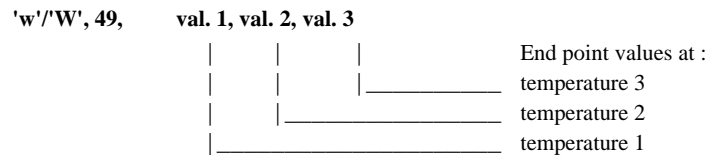
temperature 1 < temperature 2 < temperature 3 < temperature 4 < temperature 5. Value 4 and value 5 are only used with ULTRAMAT 23.

Zero point values of temperature compensation



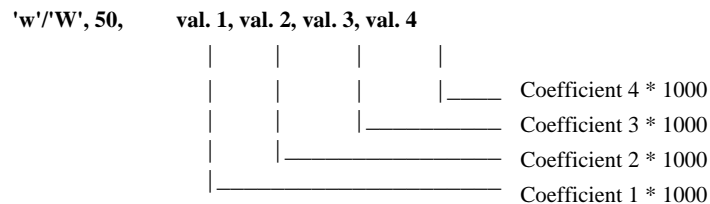
Value 4 and value 5 are only used with ULTRAMAT 23. If values are written, the new zero point coefficients will be calculated automatically. Therefore it is necessary that the temperature values ('W',47) are written before.

End point values of temperature compensation



If values are written, the new end point coefficients 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 coefficients of temperature compensation



Value 4 is only used with ULTRAMAT 23.

End point coefficients of temperature compensation

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

| | | | | |
|-------|-------|-------|-------|----------------------|
| | | | _____ | Coefficient 3 * 1000 |
| | | _____ | _____ | Coefficient 2 * 1000 |
| _____ | _____ | _____ | _____ | Coefficient 1 * 1000 |

Value 3 is only used with OXYMAT 6.

Switching temperature of temperature compensation

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

| | | |
|--|-------|--|
| | _____ | Temperature to select the coefficients |
|--|-------|--|

Coefficients of linearization

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

| | | | | | | |
|-------|-------|-------|-------|-------|-------|----------------------|
| | | | | | _____ | Coefficient 5 * 1000 |
| | | | _____ | _____ | _____ | Coefficient 4 * 1000 |
| | | _____ | _____ | _____ | _____ | Coefficient 3 * 1000 |
| | _____ | _____ | _____ | _____ | _____ | Coefficient 2 * 1000 |
| _____ | _____ | _____ | _____ | _____ | _____ | Coefficient 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 coefficients 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 coefficients will be calculated automatically. Therefore it is necessary that the pressure values ('W',54) and the zero point values ('W',55) are written before.

Coefficients of pressure compensation

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

| | | | | |
|--|--|--|--|----------------------|
| | | | | Coefficient 4 * 1000 |
| | | | | Coefficient 3 * 1000 |
| | | | | Coefficient 2 * 1000 |
| | | | | Coefficient 1 * 1000 |

Value 3 and 4 are not used with ULTRAMAT 23.

Reference of pressure compensation

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

| | |
|--|-------------------------------------|
| | Pressure to select the coefficients |
|--|-------------------------------------|

Aftercompensation of the zero point

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

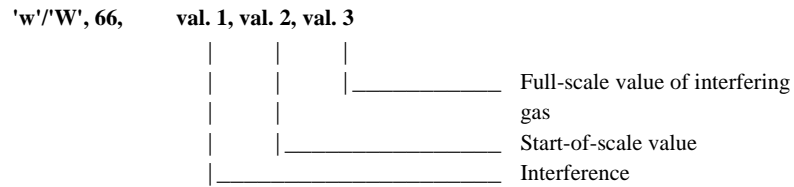
| | | | |
|--|--|--|---|
| | | | Compensation above the reference temperature (%/10°C) |
| | | | Compensation below the reference temperature (%/10°C) |
| | | | reference temperature |

Aftercompensation of the measured value

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

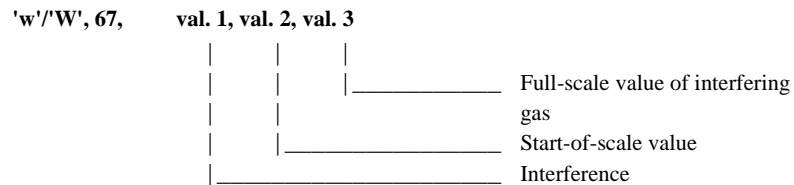
| | | | |
|--|--|--|---|
| | | | Compensation above the reference temperature (%/10°C) |
| | | | Compensation below the reference temperature (%/10°C) |
| | | | reference temperature |

**Read/ write
parameters of
external
interfering gas 3**



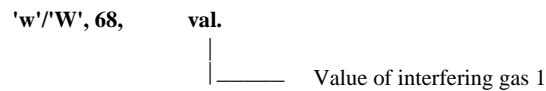
The scale-values can only be set when correction of residual gas influence with analog current 1 or 2 is selected

**Read/ write
parameters of
external
interfering gas 4**

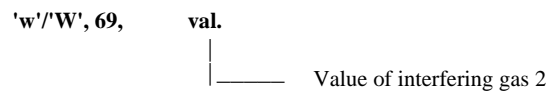


The scale-values can only be set when correction of residual gas influence with analog current 1 or 2 is selected.

**Read/ write
value of
interfering gas 1**



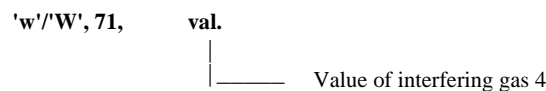
**Read/ write
value of
interfering gas 2**



**Read/ write
value of
interfering gas 3**



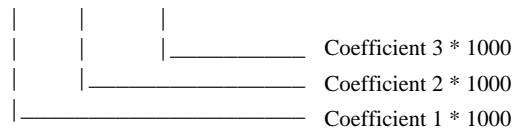
**Read/ write
value of
interfering gas 4**



**Read/ write
Coefficients of
external
interfering gas 1**

'w'/'W', 72,

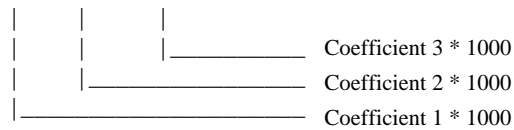
val. 1, val. 2, val. 3



**Read/ write
Coefficients of
external
interfering gas 2**

'w'/'W', 73,

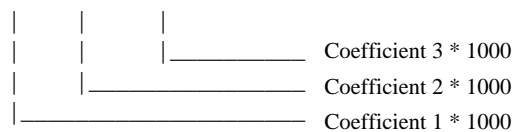
val. 1, val. 2, val. 3



**Read/ write
Coefficients of
external
interfering gas 3**

'w'/'W', 74,

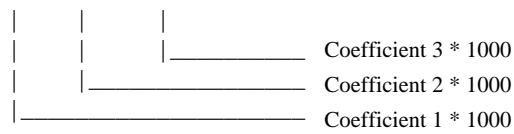
val. 1, val. 2, val. 3



**Read/ write
Coefficients of
external
interfering gas 4**

'w'/'W', 75,

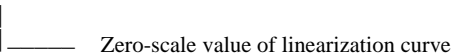
val. 1, val. 2, val. 3



**Read/ write zero-
scale value of
linearization
curve**

'w'/'W', 76,

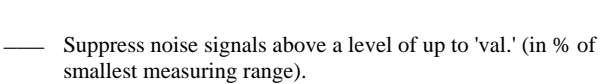
val.



**Read/ write noise
signal
suppression
level**

'w'/'W', 77,

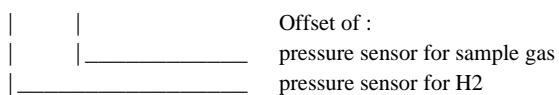
val.



**Read/ write
offset of
pressure
sensors**

'w'/'W', 78,

val. 1, val. 2



Read/ write parameters of preamplifier

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

parameter 2
parameter 1

Heating parameters of FIDAMAT

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

max. deviation of oven-/
catalyzer- heating
set value of 'flame on'
set value of catalyzer heating
set value of oven heating

Read set values of pressures

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

combustion air
hydrogen

Read/ write tolerances of pressures

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

difference at start of pump /
change to standby
Tolerance of combustion air
Tolerance of hydrogen

Read/ write Drift values

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

measuring range 4
measuring range 3
measuring range 2
measuring range 1
zero point

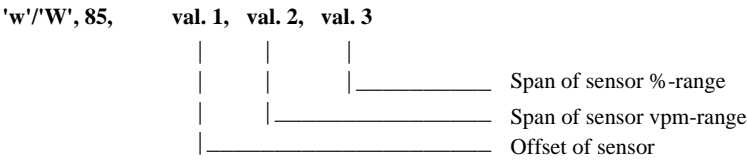
Drift values are the sum of calibration deviations.
With the ULTRAMAT 23, the measuring ranges 3 and 4 are not used. The O₂-component of ULTRAMAT 23 uses only measuring range 1.
Writing drift values sets all values to 0.0. The send values will be ignored.

Sensor heating

'w'/'W', 84, val.

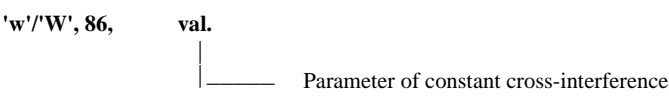
Set value of sensor heating

**Read/ write
offset / span of
sensor**

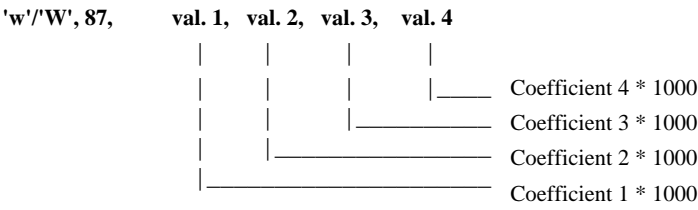


Value 3 is only valid for OXYMAT 64.

**Parameter of
constant cross-
interference**

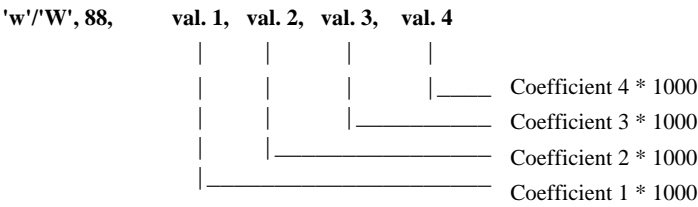


**Read/ write
parameters of
internal
interfering gas 1;
new**



The command is only valid on ULTRAMAT 23 with firmware V2.14.02 or later. Coefficient 2, 3 and 4 are only valid for component 2 or 3 and are ignored for the other.

**Read/ write
parameters of
internal
interfering gas 2;
new**



The command is only valid on ULTRAMAT 23 with firmware V2.14.02 or later. Coefficient 2, 3 and 4 are only valid for component 2 or 3 and are ignored for the other.

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

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

| 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 / TG | | Command type * |
|----------------|------------------------------|----------------|
| "h", 1 | Temperature of TCD | k |
| 2 | Not yet defined | |
| 3 | Normalized 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 | Sensor voltage | b |
| 5 | Temperature of display | b |
| 6 | Measured value of sensor | b |
| 7 | Analog input | k |
| 8 | Temperature of electronic | b |

| OXYMAT 64 | | Command type * |
|-----------|-----------------------------|----------------|
| "h", 1 | Temperature of sensor | b |
| 2 | Not yet defined | |
| 3 | Raw signal of sensor | b |
| 4 | Sensor voltage | 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 ₆ H ₆ (Benzol) |
| 2. CO | 27. SF ₆ |
| 3. CO ₂ | 28. CH ₃ OH (Methanol) |
| 4. CH ₄ (Methan) | 29. C ₂ H ₅ OH (Ethanol) |
| 5. C ₆ H ₁₄ (Hexan) | 30. CH ₂ Cl ₂ |
| 6. SO ₂ | 31. C ₂ H ₄ Cl ₂ |
| 7. NO | 32. CH ₃ Cl |
| 8. NO ₂ | 33. C ₂ H ₄ O |
| 9. CHClF ₂ (R22) | 34. H ₂ O (water vapor) |
| 10. C ₃ H ₈ (Propan) | 35. G/l (conductivity) |
| 11. C ₄ H ₁₀ (Butan) | 36. C |
| 12. O ₂ | 37. S |
| 13. C ₅ H ₁₂ (Pentan) | 38. N |
| 14. CnHm (THC) | 39. CF ₄ |
| 15. P (process pressure) | 40. COCl ₂ (phosgene) |
| 16. pH | 41. CHF ₃ (R23) |
| 17. T (temperature) | 42. C ₂ F ₆ (R116) |
| 18. C ₂ H ₄ (Ethen) | 43. ----- (self defined component) |
| 19. C ₂ H ₂ (Ethin) | 44. C ₂ H ₃ Cl |
| 20. C ₃ H ₆ (Propen) | 45. H ₂ (Hydrogen) |
| 21. C ₄ H ₆ | 46. Ar |
| 22. C ₄ H ₈ | 47. He |
| 23. C ₂ H ₆ (Ethan) | 48. Cl ₂ |
| 24. NH ₃ (Ammoniak) | 49. N ₂ |
| 25. N ₂ O | 100. Help variable process pressure (only used at command 'k', 2) |

Read measured value(s) of the channel

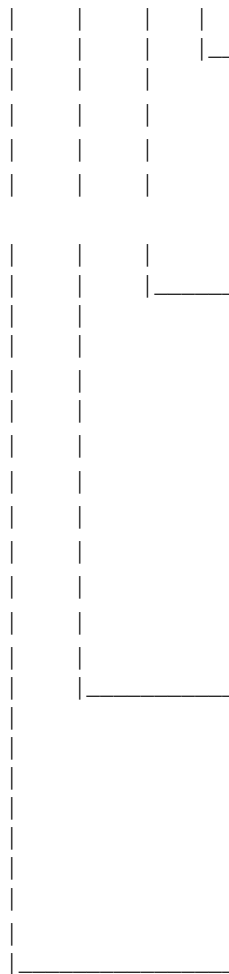
'k', 2, val. 1, crc. 1, ...
val. x, crc. x

| |
| | _____ 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.

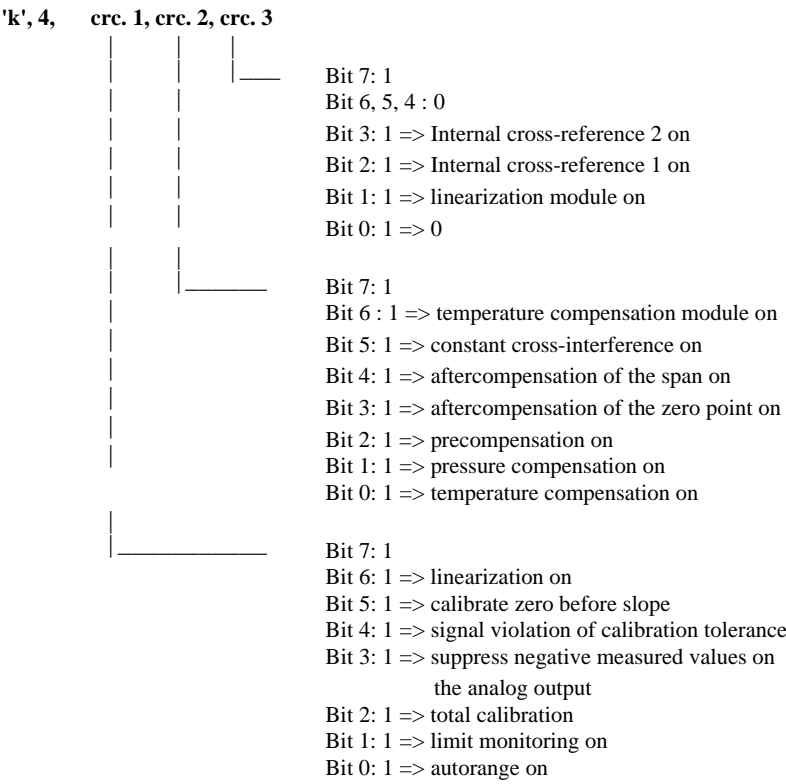
Read channel functions

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



- Bit 7: 1
 - Bit 6, 5, 4 : 0
 - Bit 3: 1 => CTRL at change on
 - 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 / purge 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

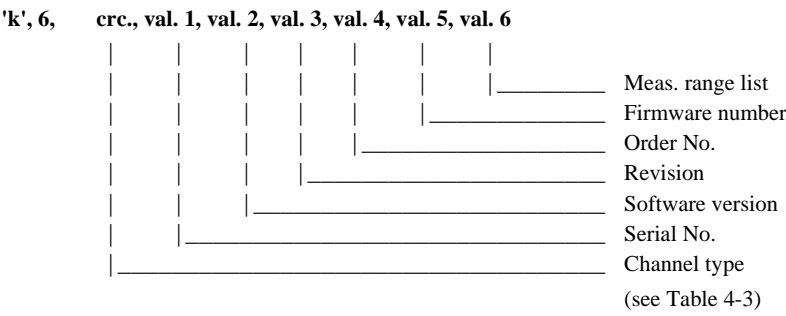
Read component functions



Read error state



Read channel version



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 / OXYMAT 61 |
| 3 | CALOMAT 6 |
| 4 | ULTRAMAT 23 |

| | |
|---|-------------|
| 5 | FIDAMAT 6 E |
| 6 | occupied |
| 7 | OXYMAT 64 |
| 8 | CALOMAT 62 |

**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 7.1 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 |

Read current *Autocal* step

'k', 19, crc.

| Control character | Step | Comment |
|-------------------|------------------------------|---------|
| 1 | No <i>Autocal</i> | |
| 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 <i>Reset</i> using a <i>Reset</i> 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 |
| | | | | | |
| | | | | | <u>External function controls :</u> |
| | | | | | 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 |
| | | | | | |
| | | | | | <u>External maintenance requests :</u> |
| | | | | | 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 |
| | | | | | |
| | | | | | <u>External faults :</u> |
| | | | | | 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 Physikmodul OXYMAT 64 / CALOMAT 62'

**Read channel
variant**

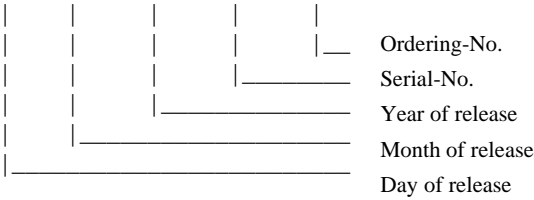
'k', 31, crc.

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

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

**Read module
identification**

'k', 32, crc. 1, crc. 2, crc. 3, val. 1, val. 2



**Module
user data**

'k'/'K', 33, val.

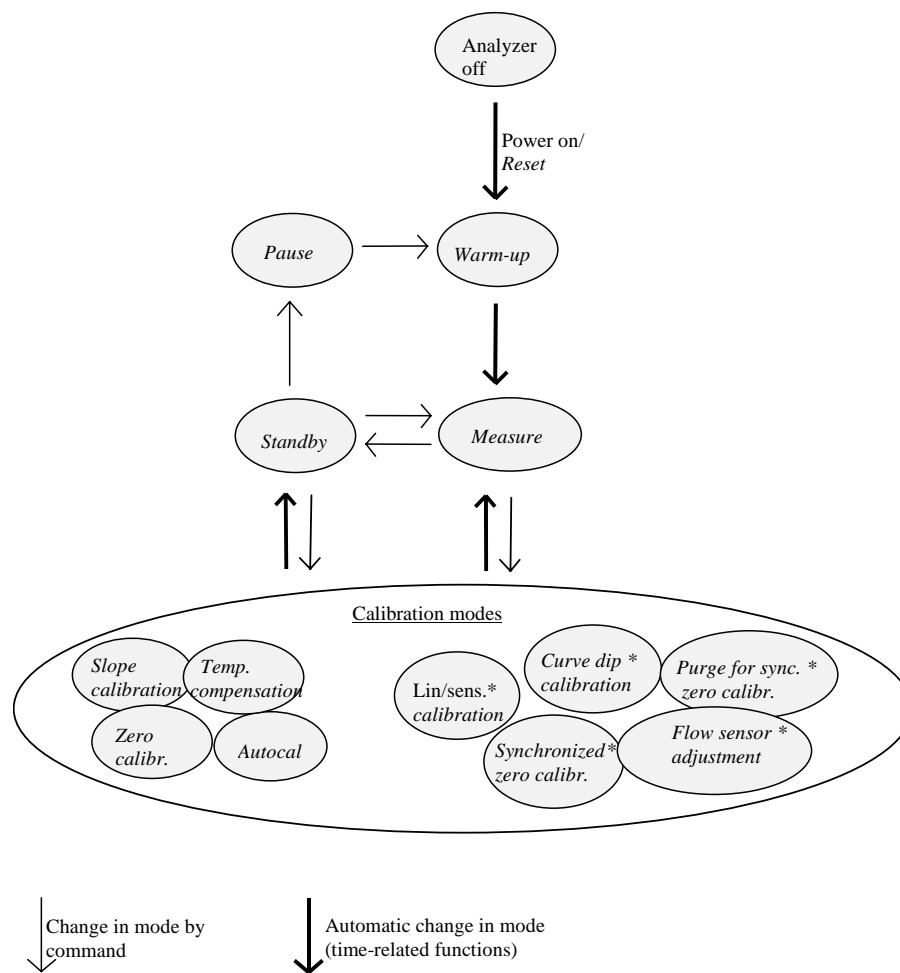
A name can be assigned to the sensor module to permit easy identification.
The value may contain ASCII letters and characters (+, -, ., /, etc.) in addition to ASCII numbers. The maximum length of the value is 16 characters.

5 Channel Modes

5.1 General

Following power-up the channels are in *Warm-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: <i>Measure</i> (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, 05H, 01H, 6BH, 05H, 07H, 00H, 1BH, 00H, 10H, 03H, XXH, YYH | DLE, SOH, addresses Collective state: not ready to measure, error (Table 33-1) Mode: <i>Warm-up</i> (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: <i>Measuring</i> (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, 24H, 03H, 3FH, 3FH, 10H, 03H, XXH, YYH | DLE, SOH, addresses Collective state, not ready to measure, command not accepted (Table 33-1) Mode: <i>Standby</i> (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. |
|--|--|

Channel starts automatic transmission of measured values every 500 ms.

| Control system/PC | Analyzer | Comment |
|-------------------|--|---|
| | 10H, 01H, F0H, 30H, 00H, 04H, 6BH, 02H, 34H, 2EH, 31H, 00H, 0BH, 00H, 02H, 00H, 33H, 2EH, 35H, 00H, 0AH, 00H, 03H, 00H, 31H, 30H, 31H, 33H, 00H, 23H, 00H, 64H, 00H, 10H, 03H, XXH, YYH | DLE, SOH Broadcast, channel address Collective state: ready to measure (Table 33-1) Mode: <i>Measuring</i> (Table 3-2) Command ('k', 2) Component 1: 4.1 % v/v CO Component 2: 3.5 % CO ₂ Pressure: 1013 hPa process pressure DLE, ETX 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 too 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 too 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 (valid until V4.2.2) | Microflow sensor (valid until V4.2.2) |
| 22 | W6 | Temp. sensor LCD display | Temp. sensor LCD display |
| 23 | W7 | Temp. analyzer sec. > 70°C | Temp. analyzer sec. > 70°C |
| 24 | W8 | | Temp. meas. head > +-3°C |
| 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 | | 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. too 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 | | 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 | CALOMAT 62 (valid from V0.1.5) | OXYMAT 64 (valid from V0.1.5) |
|--------------|------------|--|-------------------------------------|
| 1 | S1 | Parameter memory | Parameter memory |
| 2 | S2 | | |
| 3 | S3 | | |
| 4 | S4 | External fault | External fault |
| 5 | S5 | Temp. analyzer | Temp. analyzer |
| 6 | S6 | Heating defective (only heated versions) | |
| 7 | S7 | | |
| 8 | S8 | | Signal pressure sensor |
| 9 | S9 | Signal too high | |
| 10 | S10 | 24h RAM/ Flash-Check | 24h RAM/ Flash-Check |
| 11 | S11 | | Purge gas pressure too low (Option) |
| 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 | | Gas flow too small |
| 17 | W1 | Calib. diff. too large | Calib. diff. too large |
| 18 | W2 | | |
| 19 | W3 | | |
| 20 | W4 | Set clock Fkt.58 | Set clock Fkt.58 |
| 21 | W5 | | |
| 22 | W6 | Temp. sensor LCD display | Temp. sensor LCD display |
| 23 | W7 | Heating tolerance exceeded (only heated versions) | |
| 24 | W8 | | |
| 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. air beyond 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 addresses 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 too 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 device 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.

Bootting 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.

1. After transmission of all records the analyzer pauses for about 15 s to determine the checksum.
2. With ELAN command "k", 20 it must be checked for an error-free boot process.
3. 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 <i>Reset</i> 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 <i>Reset</i> 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 <i>Reset</i> |
| 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 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 <i>Reset</i> Start, addresses, command ('Z', 1), end, CRC Analyzer Reset |

| | | |
|--|--|-----------------------------------|
| | | Analyzer starts with new firmware |
|--|--|-----------------------------------|