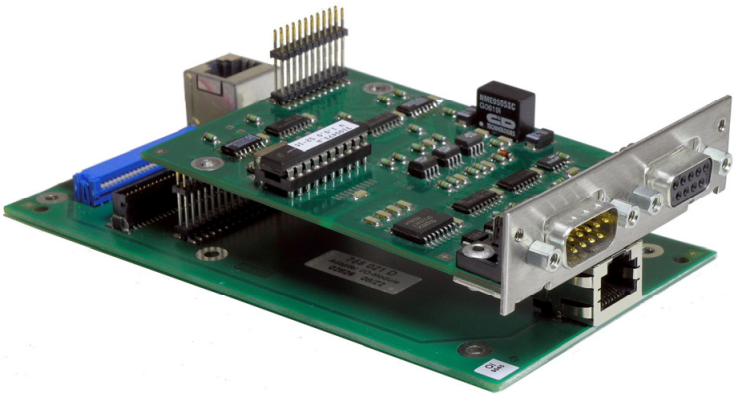
EasyLine Continuous gas analyzers

EL3000, EL3010-C, EL3060
Modbus

Technical information

30/24-416 EN Rev. 4



Contents

Description

Application

Information from the gas analyzer can be transferred to a PC or DCS via the Modbus. Measurement values, status signals and also signals of analog and digital inputs and outputs are thus available for further usage.

Basic documents

- Modbus Application Protocol Specification V1.1b, December 28, 2006
- Modbus Over Serial Line Specification and Implementation Guide V1.02, December 20, 2006
- Modbus Messaging on TCP/IP Implementation Guide V1.0b, October 24, 2006

These documents are available at http://www.Modbus.org/specs.php.

Interfaces

EL3000, EL3060

The RS232 and the RS485 interfaces (see page 6) located on the optional RS232/RS485 module in the gas analyzer are supported, where only one can be operated at a time.

As an alternative, the Ethernet 10/100BASE-T interface can be used for data transmission via Modbus TCP/IP protocol (see page 11) (from software version 3.3.2).

EL3010-C

The Ethernet 10/100BASE-T interface is used for data transmission via Modbus TCP/IP protocol (see page 11).

Modbus via RS232/RS485

NOTE
The RS232 and RS485 interfaces are supported only in the EL3000 series and EL3060 series gas analyzers.

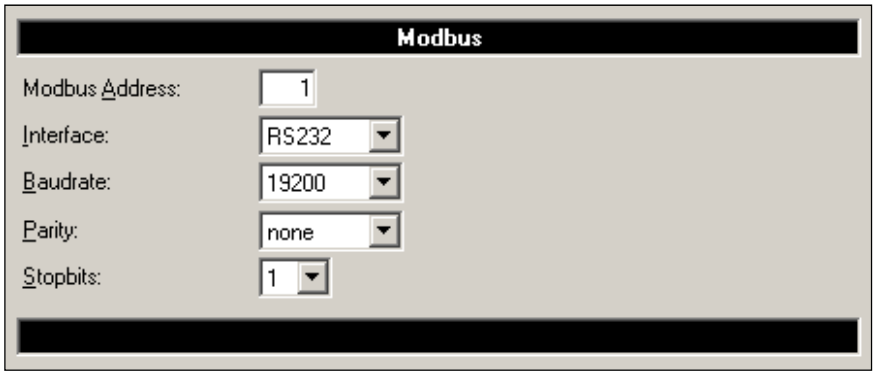
Parameters

Function

The gas analyzer can be connected e.g. to a PC or a process control system via the RS232 or RS485 interface when it is equipped with the Modbus module (option). The gas analyzer supports the Modbus slave protocol with RTU (Remote Terminal Unit) mode. The access interval of the Modbus master should be > 100 ms.

Configuration

The Modbus parameters can only be set in the configurator and not in the gas analyzer.



Modbus parameters

Parameter	Value range
Modbus address	1...255
Interface	RS232, RS485
Baud rate	9600, 19200, 38400
Parity bit	none, odd, even
Stop bits	1, 2

The default settings are underlined.

Connection and cabling

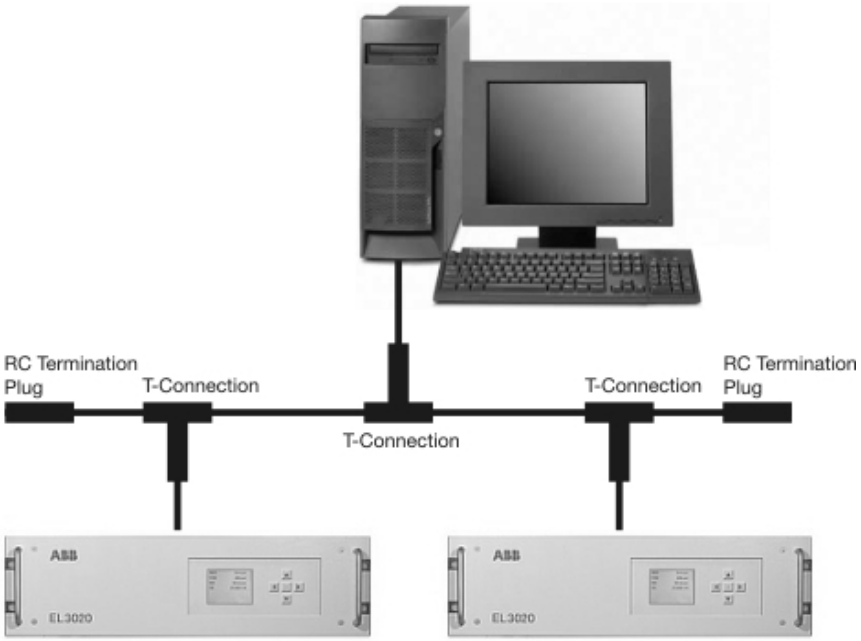
Connection via the RS232 interface

Connect the Modbus master to the RS232 interface of the gas analyzer. This connection only provides a point to point access (e.g. EL3000 and a PC).

A cable with two 9-pin female Sub-D connectors, pins 2 and 3 twisted pair, is needed for connecting.

Connection via the RS485 interface

Several gas analyzers (max. 32) can be connected to the PC in a network via the RS485 interface. A linear topology as shown in the following illustration must be complied with for the cabling. In this connection, the exposed cable ends must be terminated with RC terminating connectors. This also applies for point-to-point connections.



Cable type

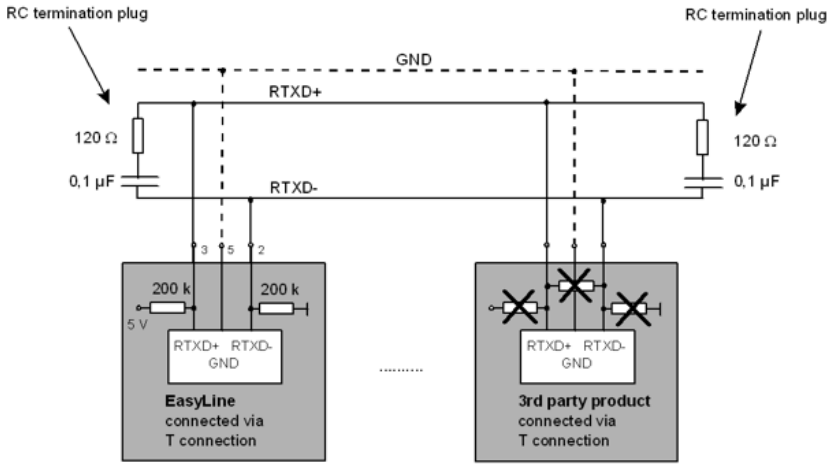
A 3-core twisted-pair cable with cable cross-section of 0.25 mm^2 (e.g. Thomas & Betts, Type LiYCY) is used. The maximum line length is 1200 m.

Level converter

If the PC does not have an RS485 interface, an RS232/RS485 level converter must be connected between the PC and the Modbus cabling.

Cabling with RC terminating connectors

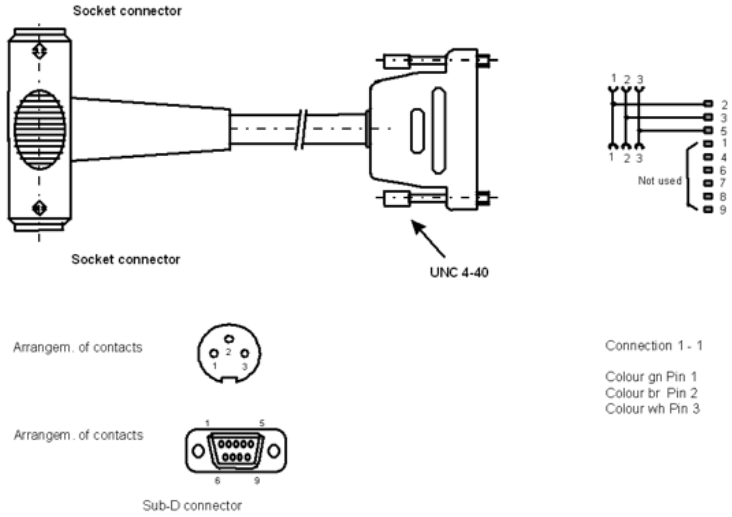
Refer to the illustration below for technical details. Please note the illustrated slave input circuit. Any existing DC or AC terminations on the terminal units must be removed. AC terminations may only be implemented at the cable ends by means of the provided RC terminating connectors. Alternative cabling elements can be used as long as they comply with the specifications in the illustration below.



Components for the RS485 cabling

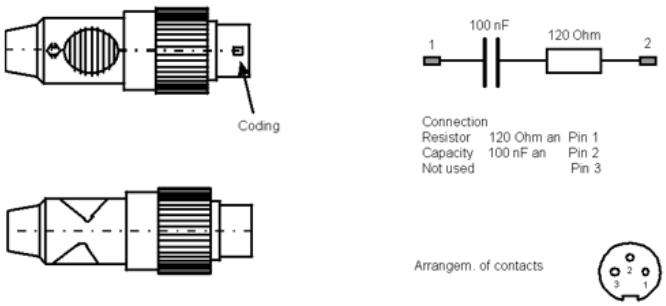
T-joint

Order no. 24009-4-0746617



RC terminating connector

Order no. 24009-4-0746616

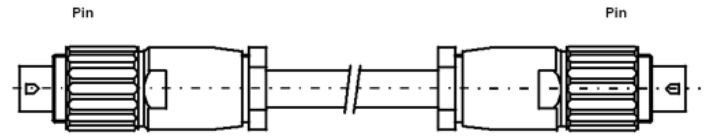


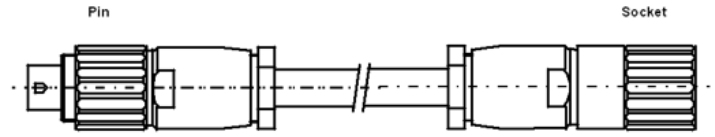
Variable connection

The desired cable lengths must be specified in the order in the case of this connection variant. The connectors and sockets must be attached to the cable on-site. There are two executions:

- Direct connection of two T-joints. Pin contacts must be provided on both sides.
- Extension with a pin contact on one side and a socket on the other side.

	Order no.
Cable with a variable length	24009-4-0746622
Pin plug	24009-4-0746318
Socket connector	24009-4-0746471

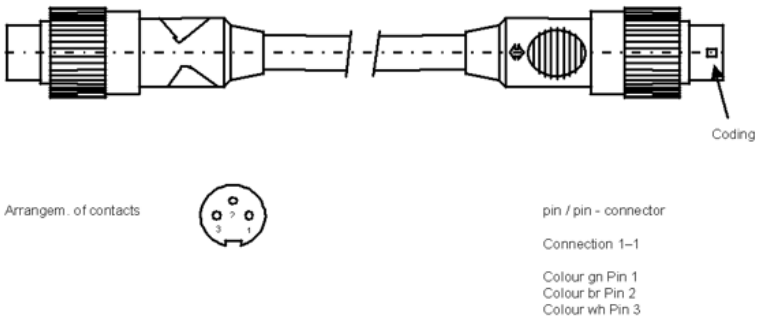




Preassembled connection

The cable is used for the direct connection of two T-joints. There is a choice of three preassembled lengths for this connection variant.

Length	Order no.
1.0 m	24009-4-0746619
2.0 m	24009-4-0746620
5.0 m	24009-4-0746621



Modbus via TCP/IP

Modbus/TCP client

Integration

The EL3000 Modbus/TCP server expects requests from the current IP addresses via the communication port. A maximum of 4 clients can be connected to the Modbus/TCP server of an EL3000 at the same time.

As soon as the starting process of the gas analyzer has ended (after approx. 3 minutes), Modbus requests can be sent.

The data refresh interval is max. 25 ms. The sensor signal is refreshed at intervals of 100 ms.

If the connection to a client breaks down, the connection status in the Modbus/TCP server is enabled again after a max. 60 seconds.

Reading out data from the EL3000 Modbus/TCP server

The following procedure must be executed on the Modbus client, in order to receive data from the EL3000 Modbus/TCP server:

1 Establish a TCP connection to port 502 on the server.

2 Create a Modbus request.

3 Send the Modbus request incl. the Modbus/TCP MBAP Header.

4 Wait for a response to the same TCP connection.

5 Read the first 6 bytes of the response; these state the length of the response.

6 Read the remaining bytes of the response.

Functions, addresses and registers

The supported functions and the addresses and registers of Modbus over TCP/IP are equivalent to those of Modbus over RS232/RS485.

Example: Scanning of a measured value via Modbus TCP/IP

The example shows how the measured value of sample component 1 is scanned in the IEEE-754 32 bit floating-point format (see page 66) via Modbus TCP/IP.

Addresses for scanning floating point measured values

Modicon Modbus address	Type	Register number	Description
30001	Input Register	0	Measured value of Component 1
30002	Input Register	1	
30003	Input Register	2	Status of Component 1

Scan

Byte	Description	Value	Explanation
	MBAP Header		
0	Transaction identifier	0x00	Transaction identifier: 0x0005 = We send the 5th scan
1	Transaction identifier	0x05	
2	Protocol identifier	0x00	Protocol identifier: 0x0000 = Modbus protocol
3	Protocol identifier	0x00	
4	Length	0x00	Length: 0x0006 bytes follow this byte, this includes the last byte of the MBAP header
5	Length	0x06	
6	Unit identifier	0xFF	Unit: Any value
	General Modbus Frame		
7	Function code	0x04	Function code: 0x04 = Read out input register
8	Starting address	0x00	Starting address = 0x0000
9	Starting address	0x00	
10	Quantity of registers	0x00	Quantity of registers = 0x0003
11	Quantity of registers	0x03	

Answer

Byte	Description	Value	Explanation
	MBAP Header		
0	Transaction identifier	0x00	Transaction identifier: 0x0005 is returned as sent by the client
1	Transaction identifier	0x05	
2	Protocol identifier	0x00	Protocol identifier: 0x0000 = Modbus Protocol
3	Protocol identifier	0x00	
4	Length	0x00	Length: 0x0009 bytes follow this byte, this includes the last byte of the MBAP header
5	Length	0x09	
6	Unit identifier	0xFF	Unit: is returned as sent by the client
	General Modbus Frame		
7	Function code	0x04	Function code: 0x04 = Read out input register
8	Byte count	0x06	Number of bytes: 0x06 bytes with data follow
9	Byte 1	0x41	0x411E3282 = 9.887331
10	Byte 2	0x1E	
11	Byte 3	0x32	
12	Byte 4	0x82	
13	Byte 5	0x00	0x000 = Status "No error"
14	Byte 6	0x00	

Modbus according to VDI 4201 Part 3

Function code

Function code 43 with MEI 14 (MEI = Modbus Encapsulated Interface) is used to read the device parameters in order to

- read measured values,
- transfer simulation data,
- apply reference material.

Address assignment of the device parameters for the function code 43

There is read access to the device parameters.

Measurement components are mapped with the following structure:

- Name
- Measurement range start
- Measurement range end
- Unit

The number of the first measured values register is listed under BasisM in the device parameters list.

The measured value status is implemented as NAMUR status:

Bit	Assignment
0	Error
1	Maintenance
2	Maintenance request
3	Beyond specification
4	Test operation, simulation measured value transmitted
5…15	Reserved for extensions
16…31	Vendor-specific

The number of the first simulation data register is listed under BasisS in the device parameters list.

The number of the register to apply reference material is listed under BasisR in the device parameters list. Maximum 32 Bus DIs are reserved for transferring reference material.

The register "status of application" is used for feedback of the DIs for which a hardware digital output is connected. When reference material is applied, the status "maintenance" is set and a message is displayed on the gas analyzer's screen.

Device parameters list

Name	Object ID	Encoding	Table	Attribute	Description
VendorName	0x00	String	System_control	Fabrication_number	Manufacturer name
ProductCode	0x01	String	System_control	Product_Code	Manufacturer-specific device identifier
MajorMinorRevision	0x02	String	System_control	Version	Software version of measuring system
ProductName	0x04	String	System_control	Product_Name	Device name
SerialNumber	0x80	String	System_control	SerialNumber	Serial number of measuring system
ComponentNumber	0x81	Word	Detector_para	Classification = 0	Number of measurands
BasisM	0x82	Word	Modbus_conf	Registernumber	First register of the measurands block
BasisS	0x83	Word	Modbus_conf	Registernumber	First register of the simulation data
BasisR	0x84	Word	Modbus_conf	Registernumber	First register of the reference material data
Component1_Name	0x85	String	Component_para	Name	Name of measured component 1
Component1_ Range_Start	0x86	Float	Meas_range_para	Lower_meas_range	Lower limit of output range of measured component 1
Component1_ Range_End	0x87	Float	Meas_range_para	Upper_meas_range	Upper limit of output range of measured component 1
Component1_Unit	0x88	String	Component_para	Unit_name	Unit of measured component 1
Component2_Name	0x89	String	Component_para	Name	Name of measured component 2
Component2_ Range_Start	0x8A	Float	Meas_range_para	Lower_meas_range	Lower limit of output range of measured component 2
Component2_ Range_End	0x8B	Float	Meas_range_para	Upper_meas_range	Upper limit of output range of measured component 2
Component2_Unit	0x8C	String	Component_para	Unit_name	Unit of measured component 2
…	…	…	…	…	…

Reference material application

Reference material application is done according the table below.

Reference material for zero point is automatically applied when the calibration cell is inserted.

Bit	Assignment	
0	Reference material 1	Zero point
1	Reference material 2	End point 1
2	Reference material 3	End point 2
3	Reference material 4	End point 3
4	Reference material 5	End point 4
5	Reference material 6	End point 5
6…7	Reserved	
8	Reference material 9	Calibration cell 1
9	Reference material 10	Calibration cell 2
10	Reference material 11	Calibration cell 3
11	Reference material 12	Calibration cell 4
12	Reference material 13	Calibration cell 5
13…31	Reserved	

Overview of the functions

Function	Description
Measured values as floating-point numbers with measured value status (see page 20)	Measured value, in each case followed by the associated measured value status (as a 16-bit integer). The active component (see page 25) is shown for detectors with several components (max. 5).
Measured values as fixed-point numbers with measured value status (see page 20)	Measured value in % span, in each case followed by the associated measured value status (both values as 16-bit integers). The active component (see page 25) is shown for detectors with several components (max. 5).
Range Limits (see page 21)	Lower value and end-point of measuring range 2 as floating-point numbers. The active component (see page 25) is shown for detectors with several components (max. 5).
Drift, delta drift (see page 22)	Drift values and delta drift values as a floating-point number The active component (see page 25) is shown for detectors with several components (max. 5).
Status signals (see page 23)	Status signals Error, Function Check and Maintenance Required as a 1 bit value in each case.
Status of the alarm values (see page 23)	Status of the alarm values as a 1-bit value. Up to 10 alarm values.
Bus digital inputs (see page 27)	Eight digital inputs as 1-bit values, writable.
Autocalibration control (see page 29)	Starting, aborting and disabling the autocalibration.
Autocalibration status (see page 29)	Autocalibration running.
Autocalibration mode (see page 28)	Mode of the autocalibration: zero point and end-point calibration alone or together.
Autocalibration of calibration setpoints (see page 28)	Setpoints of the zero point and span gases for the autocalibration. Format: floating-point numbers, alterable, for up to 5 components.
Active component (see page 25)	Selection of the active component with up to 5 detectors. A 16 bit register in each case.
Low pass time constants (see page 24)	Time constant, time constant for non-linear filter and threshold for non-linear filter as a floating-point number. The active component (see page 25) is shown for detectors with several components (max. 5).
Status of the digital inputs (see page 26)	Status of the digital inputs as a 1-bit value, 16 objects for 4 IO modules with 4 inputs each.
Status of the digital outputs (see page 27)	Status of the digital outputs as a 1-bit value, 16 objects for 4 IO modules with 4 outputs each.
Externally controlled calibration (see page 30)	Control signals for initiation of the calibration, control signals for initiation of the calibration reset, control signals for insertion of the calibration cells, control signals for control of the Fidas24 NMHC, transmission of the calibration setpoints, parameterization of the calibration method, feedback signal of the externally controlled calibration
Control of the Fidas24 (see page 41)	Fidas24 Standby, Fidas24 Standby/Purge, Fidas24 Restart
User memory (see page 42)	User Memory Record, User Memory Store

Measured values of the auxiliary variables (see page 43)	Temperature detectors, temperature controllers, pressure detectors, pressure regulators, flow detectors, flow regulators, flame monitoring Fidas24
Instrument information (see page 48)	Production number, serial number, software version, software version date
Administration of system events (see page 51)	Location of the event files, reading the sender ID, reading the event texts

Overview of the addresses and register numbers

Modicon Modbus address	Type	Register number	Description/name
30001	Input Register	0	Measured values (see page 20)
30101	Input Register	100	Integer measured values (see page 20)
30201	Input Register	200	Measuring range (see page 21)
30301	Input Register	300	Drift values (see page 22)
30401	Input Register	400	Temperature detectors (see page 43)
30451	Input Register	450	Temperature controller (see page 44)
30501	Input Register	500	Pressure detectors (see page 45)
30551	Input Register	550	Pressure regulator (see page 46)
30601	Input Register	600	Flow detectors (see page 47)
30651	Input Register	650	Flow regulator (see page 47)
30701	Input Register	700	Flame monitoring Fidas24 (see page 47)
31001	Input Register	1000	Production number (see page 49)
31021	Input Register	1020	Serial number (see page 49)
31041	Input Register	1040	Software version (see page 50)
31061	Input Register	1060	Software version date (see page 50)
10001	Input Status	0	Status (see page 23)
11001	Input Status	1000	Alarm values (see page 23)
11101	Input Status	1100	IO module digital inputs (see page 26)
11201	Input Status	1200	IO module digital outputs (see page 27)
11301	Input Status	1300	Autocalibration status (see page 29)
11301	Input Status	1300	Externally controlled calibr. status (see page 37)
1001	Coil Status	1000	Bus digital inputs (see page 27)
1101	Coil Status	1100	Autocalibration control (see page 29)
1111	Coil Status	1110	Start the calibration (see page 31)
1131	Coil Status	1130	Initiation of the calibration reset (see page 32)
1151	Coil Status	1150	Inserting the calibration cells Uras26 (see page 32)
1161	Coil Status	1160	Control of the Fidas24 NMHC (see page 33)
1171	Coil Status	1170	Control of the Fidas24 (see page 41)
1181	Coil Status	1180	User memory (see page 42)
40001	Holding Register	0	Component switch-over (see page 25)
40101	Holding Register	100	Autocalibration setpoints (see page 28)
40151	Holding Register	150	Calibration setpoints transmission (see page 34)
40201	Holding Register	200	Autocalibration mode (see page 28)
40211	Holding Register	210	Setting the calibration method (see page 35)
40301	Holding Register	300	Low pass (see page 24)

Measured value functions

Measured values

Modicon Modbus address	Type	Register number	Description/name
30001	Input Register	0	Component 1
30002		1	
30003	Input Register	2	Measured value status comp. 1
30004	Input Register	3	Component 2
30005		4	
30006	Input Register	5	Measured value status comp. 2
30007	Input Register	6	Component 3
30008		7	
30009	Input Register	8	Measured value status comp. 3
30010	Input Register	9	Component 4
30011		10	
30012	Input Register	11	Measured value status comp. 4
30013	Input Register	12	Component 5
30014		13	
30015	Input Register	14	Measured value status comp. 5

The measured values are transmitted in the IEEE 754 32 bit floating-point format (see page 66). Two Word registers are used to represent a floating-point value. The measured value of the active component of a detector is transmitted in each case.

Integer measured values

Modicon Modbus address	Type	Register number	Description/name
30101	Input Register	100	Component 1
30102	Input Register	101	Measured value status comp. 1
30103	Input Register	102	Component 2
30104	Input Register	103	Measured value status comp. 2
30105	Input Register	104	Component 3
30106	Input Register	105	Measured value status comp. 3
30107	Input Register	106	Component 4
30108	Input Register	107	Measured value status comp. 4
30109	Input Register	108	Component 5
30110	Input Register	109	Measured value status comp. 5

The measured value is transmitted in % span $\times$ 100 is transferred as an integer value. The measured value of the active component of a detector is transmitted in each case.

Measuring range

Modicon Modbus address	Type	Register number	Description/name
30201	Input Register	200	Component 1 Lower value of measuring range
30202		201	
30203	Input Register	202	Component 1 Measuring range end point
30204		203	
30205	Input Register	204	Component 2 Lower value of measuring range
30206		205	
30207	Input Register	206	Component 2 Measuring range end point
30208		207	
30209	Input Register	208	Component 3 Lower value of measuring range
30210		209	
30211	Input Register	210	Component 3 Measuring range end point
30212		211	
30213	Input Register	212	Component 4 Lower value of measuring range
30214		213	
30215	Input Register	214	Component 4 Measuring range end point
30216		215	
30217	Input Register	216	Component 5 Lower value of measuring range
30218		217	
30219	Input Register	218	Component 5 Measuring range end point
30220		219	

The measuring range is transmitted in the IEEE 754 32 bit floating-point format (see page 66). Two Word registers are used to represent a floating-point value. The measuring range of the active component of a detector is transmitted in each case.

Drift values

Modicon Modbus address	Type	Register number	Description/name
30301	Input Register	300	Offset Drift Component 1
30302		301	
30303	Input Register	302	Ampl. Drift Component 1
30304		303	
30305	Input Register	304	Delta Offset Drift Component 1
30306		305	
30307	Input Register	306	Delta Ampl. Drift Component 1
30308		307	
30309	Input Register	308	Offset Drift Component 2
30310		309	
30311	Input Register	310	Ampl. Drift Component 2
30312		311	
30313	Input Register	312	Delta Offset Drift Component 2
30314		313	
30315	Input Register	314	Delta Ampl. Drift Component 2
30316		315	
30317	Input Register	316	Offset Drift Component 3
30318		317	
30319	Input Register	318	Ampl. Drift Component 3
30320		319	
30321	Input Register	320	Delta Offset Drift Component 3
30322		321	
30323	Input Register	322	Delta Ampl. Drift Component 3
30324		323	
30325	Input Register	324	Offset Drift Component 4
30326		325	
30327	Input Register	326	Ampl. Drift Component 4
30328		327	
30329	Input Register	328	Delta Offset Drift Component 4
30330		329	
30331	Input Register	330	Delta Ampl. Drift Component 4
30332		331	
30333	Input Register	332	Offset Drift Component 5
30334		333	
30335	Input Register	334	Ampl. Drift Component 5
30336		335	
30337	Input Register	336	Delta Offset Drift Component 5
30338		337	
30339	Input Register	338	Delta Ampl. Drift Component 5
30340		339	

The drift values are transmitted in the IEEE 754 32 bit floating-point format (see page 66). Two Word registers are used to represent a floating-point value. The drift values of the active component of a detector are transmitted in each case.

Status

Modicon Modbus address	Type	Input number	Description/name
10001	Input Status	0	Error
10002	Input Status	1	Function Check
10003	Input Status	2	Maintenance Required

The Modbus has read access to the instrument status.
0 = inactive, 1 = active.

Alarm values

Modicon Modbus address	Type	Input number	Description/name
11001	Input Status	1000	Status Limit 1
11002	Input Status	1001	Status Limit 2
11003	Input Status	1002	Status Limit 3
11004	Input Status	1003	Status Limit 4
11005	Input Status	1004	Status Limit 5
11006	Input Status	1005	Status Limit 6
11007	Input Status	1006	Status Limit 7
11008	Input Status	1007	Status Limit 8
11009	Input Status	1008	Status Limit 9
11010	Input Status	1009	Status Limit 10

The Modbus has read access to the status of the alarm values (limit).
0 = normal, 1 = Alarm.

Low pass

Modicon Modbus address	Type	Register number	Description/name
40301	Holding Register	300	Low pass time 1 component 1
40302		301	
40303	Holding Register	302	Low pass time 2 component 1
40304		303	
40305	Holding Register	304	Threshold component 1
40306		305	
40307	Holding Register	306	Low pass time 1 component 2
40308		307	
40309	Holding Register	308	Low pass time 2 component 2
40310		309	
40311	Holding Register	310	Threshold component 2
40312		311	
40313	Holding Register	312	Low pass time 1 component 3
40314		313	
40315	Holding Register	314	Low pass time 2 component 3
40316		315	
40317	Holding Register	316	Threshold component 3
40318		317	
40319	Holding Register	318	Low pass time 1 component 4
40320		319	
40321	Holding Register	320	Low pass time 2 component 4
40322		321	
40323	Holding Register	322	Threshold component 4
40324		323	
40325	Holding Register	324	Low pass time 1 component 5
40326		325	
40327	Holding Register	326	Low pass time 2 component 5
40328		327	
40329	Holding Register	328	Threshold component 5
40330		329	

The low-pass values are transmitted in the IEEE 754 32 bit floating-point format (see page 66). The filter values of the active component of a detector are transmitted in each case.
Time 1 = low pass time constant
Time 2 = low pass time constant non-linear filtering
Threshold = threshold for non-linear filtering

Component switch-over

Modicon Modbus address	Type	Register number	Description/name
40001	Holding Register	0	Active component Detector 1
40002	Holding Register	1	Active component Detector 2
40003	Holding Register	2	Active component Detector 3
40004	Holding Register	3	Active component Detector 4
40005	Holding Register	4	Active component Detector 5

The component switch-over has an effect on the measured values, measuring ranges, drift values and low-pass values. The values of the active component are output. When writing a value, e.g. low pass, only the active component is written to.

Component 1 = 1, component 2 = 2, …

Inputs and outputs

IO module digital inputs

Modicon Modbus address	Type	Input number	Description/name
11101	Input Status	1100	IO module 1 DI1
11102	Input Status	1101	IO module 1 DI2
11103	Input Status	1102	IO module 1 DI3
11104	Input Status	1103	IO module 1 DI4
11105	Input Status	1104	IO module 2 DI1
11106	Input Status	1105	IO module 2 DI2
11107	Input Status	1106	IO module 2 DI3
11108	Input Status	1107	IO module 2 DI4
11109	Input Status	1108	IO module 3 DI1
11110	Input Status	1109	IO module 3 DI2
11111	Input Status	1110	IO module 3 DI3
11112	Input Status	1111	IO module 3 DI4
11113	Input Status	1112	IO module 4 DI1
11114	Input Status	1113	IO module 4 DI2
11115	Input Status	1114	IO module 4 DI3
11116	Input Status	1115	IO module 4 DI4

The Modbus has read access to the digital inputs.

IO module digital outputs

Modicon Modbus address	Type	Input number	Description/name
11201	Input Status	1200	IO module 1 DO1
11202	Input Status	1201	IO module 1 DO2
11203	Input Status	1202	IO module 1 DO3
11204	Input Status	1203	IO module 1 DO4
11205	Input Status	1204	IO module 2 DO1
11206	Input Status	1205	IO module 2 DO2
11207	Input Status	1206	IO module 2 DO3
11208	Input Status	1207	IO module 2 DO4
11209	Input Status	1208	IO module 3 DO1
11210	Input Status	1209	IO module 3 DO2
11211	Input Status	1210	IO module 3 DO3
11212	Input Status	1211	IO module 3 DO4
11213	Input Status	1212	IO module 4 DO1
11214	Input Status	1213	IO module 4 DO2
11215	Input Status	1214	IO module 4 DO3
11216	Input Status	1215	IO module 4 DO4

The Modbus has read access to the digital outputs.

Bus digital inputs

Modicon Modbus address	Type	Coil number	Description/name
1001	Coil Status	1000	Bus DI1
1002	Coil Status	1001	Bus DI2
1003	Coil Status	1002	Bus DI3
1004	Coil Status	1003	Bus DI4
1005	Coil Status	1004	Bus DI5
1006	Coil Status	1005	Bus DI6
1007	Coil Status	1006	Bus DI7
1008	Coil Status	1007	Bus DI8

The Modbus has read/write access to the bus digital inputs.

Automatic calibration

Autocalibration mode

Modicon Modbus address	Type	Register number	Description/name
40201	Holding Register	200	Autocalibration mode
40202	Holding Register	201	Number of nth zero point

Autocalibration mode:
1 = only zero point calibration (ZP)
2 = only end-point calibration (EP)
3 = End-point calibration at every nth zero-point calibration

Number of nth zero point:
Example: Value = 3 ⇒ ZP, ZP, ZP+EP

Autocalibration setpoints

Modicon Modbus address	Type	Register number	Description/name
40101	Holding Register	100	Setpoint of zero point component 1
40102		101	
40103	Holding Register	102	Setpoint of end point component 1
40104		103	
40105	Holding Register	104	Setpoint of zero point component 2
40106		105	
40107	Holding Register	106	Setpoint of end point component 2
40108		107	
40109	Holding Register	108	Setpoint of zero point component 3
40110		109	
40111	Holding Register	110	Setpoint of end point component 3
40112		111	
40113	Holding Register	112	Setpoint of zero point component 4
40114		113	
40115	Holding Register	114	Setpoint of end point component 4
40116		115	
40117	Holding Register	116	Setpoint of zero point component 5
40118		117	
40119	Holding Register	118	Setpoint of end point component 5
40120		119	

The calibration setpoints are transmitted in the IEEE 754 32-bit floating-point format (see page 66). Two Word registers are used to represent a floating-point value.

Autocalibration control

Modicon Modbus address	Type	Input number	Description/name
1101	Coil Status	1100	Start autocalibration
1102	Coil Status	1101	Abort autocalibration
1103	Coil Status	1102	Disable autocalibration

The Modbus has read/write access.

Starting the autocalibration on the value changing from 0 to 1.
Aborting an autocalibration in progress on the value changing from 0 to 1.
Preventing an autocalibration from starting and aborting an autocalibration in progress when the value is set to 1.

Autocalibration status

Modicon Modbus address	Type	Input number	Description/name
11301	Input Status	1300	Autocalibration status

Status = 1: Autocalibration in progress

Externally controlled calibration

Externally controlled calibration

The user has full control over the sequence of the calibration and the feed-in of the calibration gases in this type of calibration. The instrument carries out a calibration immediately after transmission of the calibration command. The only exception here is the check of the raw values during an end-point calibration: an end-point calibration with zero gas is not carried out.

The following input and control signals are required for the externally controlled calibration:

- Control signals (see page 31) for initiation of the zero point or end-point calibration in one or more detectors
- Control signals (see page 32) for initiation of the calibration reset
- Control signals (see page 32) for insertion of the calibration cells of the Uras26 for the end-point calibration
- Control signals (see page 33) for control of the Fidas24 NMHC
- Specification (see page 34) of the setpoints for zero points and end-points
- Setting the calibration method
- Feedback signal (see page 37) of the calibration process

Control signals to start the calibration

Modicon Modbus address	Type	Coil number	Description/name
1111	Coil Status	1110	Ext. calibration of zero point detector 1
1112	Coil Status	1111	Ext. calibration of zero point detector 2
1113	Coil Status	1112	Ext. calibration of zero point detector 3
1114	Coil Status	1113	Ext. calibration of zero point detector 4
1115	Coil Status	1114	Ext. calibration of zero point detector 5
1121	Coil Status	1120	Ext. calibration of end point detector 1
1122	Coil Status	1121	Ext. calibration of end point detector 2
1123	Coil Status	1122	Ext. calibration of end point detector 3
1124	Coil Status	1123	Ext. calibration of end point detector 4
1125	Coil Status	1124	Ext. calibration of end point detector 5

The externally controlled calibration can be activated separately for each detector for zero and end-point adjustment. The change of a control signal from "0" to "1" initiates the calibration process. Control signals for more than one detector can be sent consecutively. The calibration processes are performed only 2 seconds after transmission of the first control signal. All detectors whose start signal has been set to "1" are calibrated together.

The active component is always adjusted for a detector with several components. The desired component of the detector must therefore be activated before the adjustment.

Control signals for initiation of the calibration reset

Modicon Modbus address	Type	Coil number	Description/name
1131	Coil Status	1130	Ext. calibration reset detector 1
1132	Coil Status	1131	Ext. calibration reset detector 2
1133	Coil Status	1132	Ext. calibration reset detector 3
1134	Coil Status	1133	Ext. calibration reset detector 4
1135	Coil Status	1134	Ext. calibration reset detector 5

A calibration reset resets the calibration parameters to the status of the last initial calibration. A calibration reset can be activated separately for each detector. The change of a signal from "0" to "1" initiates the calibration reset. In order to compensate for transmission delays, a calibration reset started by the first signal waits 2 seconds and then re-reads the start signals. After the calibration reset has been completed, the processed control inputs are automatically reset to "0".

All components are reset for a detector with several components.

The status signal function check is set during the calibration reset. The output "External calibration / Calibration Reset running" is set as a feedback signal (see page 37) that a calibration reset is running.

Control signals for inserting the calibration cells of the Uras26 and the Limas23

Modicon Modbus address	Type	Coil number	Description/name
1151	Coil Status	1150	Calibration cell 1
1152	Coil Status	1151	Calibration cell 2
1153	Coil Status	1152	Calibration cell 3
1154	Coil Status	1153	Calibration cell 4
1155	Coil Status	1154	Calibration cell 5

In the **Uras26**, one calibration cell per sample cell can be installed. All calibration cells can be inserted together.

In the **Limas23**, one calibration cell per sample component can be installed. Only one calibration cell can be inserted. The previous calibration cell must be removed before another calibration cell can be inserted.

An inserted calibration cell is automatically considered during an end-point calibration. The setpoint for the calibration is then specified by the calibration cell.

A maximum of 5 control signals are available. The change of a control signal from "0" to "1" initiates the calibration cell insertion. The calibration cell status can be interrogated by means of a read access.

Control signals for control of the Fidas24 NMHC

Modicon Modbus address	Type	Coil number	Description/name
1161	Coil Status	1160	NMHC 1
1162	Coil Status	1161	NMHC 2

A Fidas24 with the NMHC application has two internal sample gas feed paths for CH_4 measurement via converter (cutter) or for direct THC measurement. Two special solenoid valves NMHC 1 and NMHC 2 are set up in the configuration of the data record. They define the operating status of the switching valve installed in the instrument.

The following are set up in the data record of the Fidas24 NMHC:

- Detector 1: CH_4 (measurement via converter),
- Detector 2: THC,
- Detector 3: NMHC (is only calculated if the measuring mode is to be switched over to automatically).

Control is executed as follows:

NMHC 1	NMHC 2	Function
0	0	Automatic switchover is activated
1	0	Measurement of detector 1, CH_4 (cutter) (automatic switchover off)
0	1	Measurement of detector 2, THC (bypass) (automatic switchover off)
1	1	Measurement of detector 1, CH_4 (bypass) (automatic switchover off) for checking the converter effectiveness

Any activated automatic switchover of the detectors must be deactivated and one detector permanently set before starting a calibration.

Transmission of the calibration setpoints

Modicon Modbus address	Type	Register number	Description/name
40151 40152	Holding Register	150 151	Setpoint of zero point detector 1
40153 40154	Holding Register	152 153	Setpoint of end point detector 1
40155 40156	Holding Register	154 155	Setpoint of zero point detector 2
40157 40158	Holding Register	156 157	Setpoint of end point detector 2
40159 40160	Holding Register	158 159	Setpoint of zero point detector 3
40161 40162	Holding Register	160 161	Setpoint of end point detector 3
40163 40164	Holding Register	162 163	Setpoint of zero point detector 4
40165 40166	Holding Register	164 165	Setpoint of end point detector 4
40167 40168	Holding Register	166 167	Setpoint of zero point detector 5
40169 40170	Holding Register	168 169	Setpoint of end point detector 5

The setpoints of the manual calibration are used as the setpoints for the externally controlled calibration.

Setpoint pairs for five detectors are available via the Modbus interface. If a detector has more than one component, the setpoints for the active component and activated calibration method apply. A component must be activated before its setpoints can be written.

The calibration setpoints are transmitted in the IEEE 754 32bit floating-point format (see page 66). Two Word registers are used to represent a floating-point value.

Setting the calibration method

Calibration method

Information on the "calibration method" is included in the operator's manual of the gas analyzer.

The calibration method can be set for each detector via the following register:

Modicon Modbus address	Type	Register number	Description/name
40211	Holding Register	210	Extcal. mode detector 1
40212	Holding Register	211	Extcal. mode detector 2
40213	Holding Register	212	Extcal. mode detector 3
40214	Holding Register	213	Extcal. mode detector 3
40215	Holding Register	214	Extcal. mode detector 4

The following applies here:

Calibration method	Value
Common calibration	0
Substitute gas calibration	1
Standard gas calibration	2
Single-point gas calibration	3

Permissible calibration methods for the analyzers:

Calibration method	Uras26	Limas23	Magnos206	Magnos27	Caldos25	Caldos27	Fidas24
Common calibration	X	X	X	X	X	X	X
Substitute gas calibr.			X	X	X	(X)	
Standard gas calibr.						X	
Single-point calibr.			X				

If a non-permissible calibration method is set, the common calibration is automatically activated as the method. Since only the common calibration is permissible for Uras26 and Limas23, there is no write access for the calibration method.

Example of a calibration sequence

Fidas24 with a detector and 3 components THC, CH_4 und C_3H_8.

A **substitute gas calibration** with the component C_3H_8 is set at the zero and end-point for the detector.

1 The calibration method of the detector is set to 1 (substitute gas calibration).

2 The active component of the detector is set to C_3H_8 (C_3H_8 is now measured and displayed).

3 The setpoints for the substitute gas calibration can now be set.

4 If a calibration is now initiated, a substitute gas calibration is executed for this detector.

If the setting **common calibration** is selected as a calibration method for this detector, the above sequence results in the following:

1 The calibration method of the detector is set to 0 (common calibration).

2 The active component of the detector is set to Propane (C_3H_8 is now measured and displayed).

3 The setpoints for the common calibration can now be set.

4 If a calibration is now initiated, a common calibration is executed for this component.

Feedback signal of the externally controlled calibration

The feedback signals of the externally controlled calibration and the calibration reset can be output at digital outputs. "External calibration / calibration reset running" and a status bit are available as feedback functions. The status signals are associated with the automatic calibration.

Modicon Modbus address	Type	Input number	Description/name
11301	Input Status	1300	Autocal. status
11302	Input Status	1301	Extcal. / calibration reset running
11303	Input Status	1302	Extcal. status detector 1
11304	Input Status	1303	Extcal. status detector 2
11305	Input Status	1304	Extcal. status detector 3
11306	Input Status	1305	Extcal. status detector 4
11307	Input Status	1306	Extcal. status detector 5

Extcal. running:	"1"	Externally controlled calibration / calibration reset currently running
	"0"	No externally controlled calibration
Extcal. status:	"0"	Calibration OK
	"1"	Calibration error (The calibration was aborted; does not occur for drift events.)

The status signals are deleted at the beginning of a calibration and set at the end. The status is then active until the next calibration or until a cold restart of the instrument.

Example: Performing an externally controlled calibration

Preliminary remarks

The following example is based upon the procedures described in the document "Modbus Application Protocol Specification V1.1b, December 28, 2006".

The example describes the procedure of a zero point and end point calibration in detector 1 of a gas analyzer.

Step 1: Writing the setpoints

Addresses and registers

Modicon Modbus address	Type	Register number	Description/name
40151 40152	Holding Register	150 151	Setpoint zero point detector 1
40153 40154	Holding Register	152 153	Setpoint end point detector 1

Use Modbus function No. 16 to write multiple registers (see section 6.12 in document "Modbus Application Protocol Specification V1.1b").

Write setpoint for zero-point calibration

Setpoint "0" in format 4 byte real is converted to [0;0] in format U16.
Send "0" to register No. 150 and subsequent:

Request		Response	
Field Name	**Hex**	**Field Name**	**Hex**
Function	10	Function	10
Starting Address Hi	00	Starting Address Hi	00
Starting Address Lo	96	Starting Address Lo	96
Quantity of Registers Hi	00	Quantity of Registers Hi	00
Quantity of Registers Lo	02	Quantity of Registers Lo	02
Byte Count (4 byte following)	04		
Registers Value Hi	00		
Registers Value Lo	00		
Registers Value Hi	00		
Registers Value Lo	00		

Write setpoint for end-point calibration

Setpoint "1000" in Format 4 byte real is converted to [17530;0] in format U16.
Send "17530" to register No. 152 and subsequent:

Request		Response	
Field Name	**Hex**	**Field Name**	**Hex**
Function	10	Function	10
Starting Address Hi	00	Starting Address Hi	00
Starting Address Lo	98	Starting Address Lo	98
Quantity of Registers Hi	00	Quantity of Registers Hi	00
Quantity of Registers Lo	02	Quantity of Registers Lo	02
Byte Count (4 byte following)	04		
Registers Value Hi	44		
Registers Value Lo	7A		
Registers Value Hi	00		
Registers Value Lo	00		

Step 2: Performing the calibration

Zero-point calibration

Modicon Modbus address	Type	Coil number	Description/name
1111	Coil Status	1110	Ext. calibration zero point detector 1

Procedure

1. Use Modbus function No. 05 to write coils (see section 6.5 in document "Modbus Application Protocol Specification V1.1b").
Send "On" to coil No. 1110:

Request		Response	
Field Name	**Hex**	**Field Name**	**Hex**
Function	05	Function	05
Output Address Hi	04	Output Address Hi	04
Output Address Lo	56	Output Address Lo	56
Output Value Hi	FF	Output Value Hi	FF
Output Value Lo	00	Output Value Lo	00

2. Wait for two seconds.

3. Use Modbus function No. 01 to read coils until hex 00 is sent (see section 6.1 in document "Modbus Application Protocol Specification V1.1b").
Read coil No. 1110:

Request		Response	
Field Name	**Hex**	**Field Name**	**Hex**
Function	01	Function	01
Starting Address Hi	04	Byte Count	01
Starting Address Lo	56	Output Status	01
Quantity of Outputs Hi	00		
Quantity of Outputs Lo	01		

End-point calibration

Modicon Modbus address	Type	Coil number	Description/name
1121	Coil Status	1120	Ext. calibration end point detector 1

Procedure

(like zero-point calibration)

1. Use Modbus function No. 05 to write coils.

2. Wait for two seconds.

3. Use Modbus function No. 01 to read coils until hex 00 is sent.

Control of the Fidas24

Fidas24 Standby

In this mode, the detector flame is out, and there is no sample gas flow. The detector is kept at setpoint temperature:

- The fuel gas valve is switched off.
- The injector air is switched off.
- All pressure regulators have the output variable 0.
- The detector temperature remains at its setpoint.

For safe standby operation, it is recommended that the detector is purged with zero gas before execution of the standby function (Purge; only in EL3000 if calibration gas valves are present).

Fidas24 Standby/Purge

This function requires a zero gas valve and can therefore not be used in the EL3010-C.

Fidas24 Restart

The automatic ignition procedure of the Fidas24 is started. The Fidas24 varies the combustion air quantity and the fuel gas quantity during the ignition procedure. Successful ignition of the flame is indicated by the temperature display of the flame monitoring increasing to approx. 30 °C above the current detector temperature. In the case of a restart from standby operation, the detector temperature is 191 °C.

Addresses and registers

The respective function is initiated by setting a coil. Only one of the three coil statuses may be set in each case.

Modicon Modbus address	Type	Coil number	Description/name
1171	Coil Status	1170	Fidas24 standby
1172	Coil Status	1171	Fidas24 standby/purge[1]
1173	Coil Status	1172	Fidas24 restart

1 not in EL3010-C

User memory

The User Memory area enables user data or parameters, e.g. external calculation quantities for the calibration or measured value correction, to be stored in the instrument.

"Read File Record" and "Write File Record" are required as functions in the Modbus stack for reading and writing to the User Memory area. Four file records with 4 kBytes (2 kWord Register) are available.

The data is initially stored in the RAM after it is written to the file record. It is permanently stored in the database of the instrument by setting an additional coil register.

The User Memory segments are stored in the database and the database backed up on the flash disk by setting the coil status. The coil status can be read at this time thereby enabling the storage event to be monitored. At the earliest, a read request may be sent 1 second after the coil status has been set. The conclusion of the storage event is indicated by the reset status.

User memory record

Modicon Modbus address	Type	Record number	Description/name
	File Record	1	User memory segment 1
	File Record	2	User memory segment 2
	File Record	3	User memory segment 3
	File Record	4	User memory segment 4

User memory store

Modicon Modbus address	Type	Coil number	Description/name
1181	Coil Status	1180	Store user memory segments

Measured values of the auxiliary variables

The measured values of the auxiliary variables are transmitted in the IEEE 754 32 bit floating-point format (see page 66). Two Word registers are used to represent a floating-point value..

Auxiliary variables: Temperature detectors

Modicon Modbus address	Type	Register number	Description/name
30401 30402	Input Register	400 401	Temperature detector 1 Uras26 , Magnos206, Limas23
30403	Input Register	402	Measured value status temperature detector 1
30404 30405	Input Register	403 404	Temperature detector 2
30406	Input Register	405	Measured value status temperature detector 2
30407 30408	Input Register	406 407	Temperature detector 3
30409	Input Register	408	Measured value status temperature detector 3
30410 30411	Input Register	409 410	Temperature detector 4
30412	Input Register	411	Measured value status temperature detector 4
30413 30414	Input Register	412 413	Temperature detector 5
30415	Input Register	414	Measured value status temperature detector 5

Auxiliary variables: Temperature controllers

Modicon Modbus address	Type	Register number	Description/name
30451 30452	Input Register	450 451	Temperature controller 1 Thermostat temperature Uras26, Limas23[1], Fidas24, Magnos206
30453 30454	Input Register	452 453	Output variable temperature controller 1
30455	Input Register	454	Measured value status temperature controller 1
30456 30457	Input Register	455 456	Temperature controller 2 Fidas24 heated sample gas inlet
30458 30459	Input Register	457 458	Output variable temperature controller 2
30460	Input Register	459	Measured value status temperature controller 2
30461 30462	Input Register	460 461	Temperature controller 3 Fidas24 NMHC Block (optional)
30463 30464	Input Register	462 463	Output variable temperature controller 3
30465	Input Register	464	Measured value status temperature controller 3
30466 30467	Input Register	465 466	Temperature controller 4 Fidas24 preamplifier
30468 30469	Input Register	467 468	Output variable temperature controller 4
30470	Input Register	469	Measured value status temperature controller 4
30471 30472	Input Register	470 471	Temperature controller 5
30473 30474	Input Register	472 473	Output variable temperature controller 5
30475	Input Register	474	Measured value status temperature controller 5

1 For Limas23:

No.	Component
1	Sample cell
2	Lamp (EDL)
3	Beam splitter
4	Reference amplifier
5	Measurement amplifier

Auxiliary variables: Pressure detectors

Modicon Modbus address	Type	Register number	Description/name
30501 30502	Input Register	500 501	Pressure detector 1 Atmospheric pressure Uras26, Limas23, Magnos206
30503	Input Register	502	Measured value status pressure detector 1
30504 30505	Input Register	503 504	Pressure detector 2
30506	Input Register	505	Measured value status pressure detector 2
30507 30508	Input Register	506 507	Pressure detector 3
30509	Input Register	508	Measured value status pressure detector 3
30510 30511	Input Register	509 510	Pressure detector 4
30512	Input Register	511	Measured value status pressure detector 4
30513 30514	Input Register	512 513	Pressure detector 5
30515	Input Register	514	Measured value status pressure detector 5

Auxiliary variables: Pressure regulators

Modicon Modbus address	Type	Register number	Description/name
30551 30552	Input Register	550 551	Pressure regulator 1 combustion air Fidas24
30553 30554	Input Register	552 553	Output variable Pressure regulator 1
30555	Input Register	554	Measured value status Pressure regulator 1
30556 30557	Input Register	555 556	Pressure regulator 2 combustion gas Fidas24
30558 30559	Input Register	557 558	Output variable Pressure regulator 2
30560	Input Register	559	Measured value status Pressure regulator 2
30561 30562	Input Register	560 561	Pressure regulator 3 sample gas inlet Fidas24
30563 30564	Input Register	562 563	Output variable Pressure regulator 3
30565	Input Register	564	Measured value status Pressure regulator 3
30566 30567	Input Register	565 566	Pressure regulator 4 sample gas outlet Fidas24
30568 30569	Input Register	567 568	Output variable Pressure regulator 4
30570	Input Register	569	Measured value status pressure regulator 4
30571 30572	Input Register	570 571	Pressure regulator 5
30573 30574	Input Register	572 573	Output variable Pressure regulator 5
30575	Input Register	574	Measured value status pressure regulator 5

Auxiliary variables: Flow detectors

Modicon Modbus address	Type	Register number	Description/name
30601 30602	Input Register	600 601	Flow detector 1 Sample gas flow Uras26, Limas23, Magnos206, Fidas24
30603	Input Register	602	Measured value status flow detector 1
30604 30605	Input Register	603 604	Flow detector 2
30606	Input Register	605	Measured value status flow detector 2

Auxiliary variables: Flow regulators

Modicon Modbus address	Type	Register number	Description/name
30651 30652	Input Register	650 651	Flow regulator 1
30653 30654	Input Register	652 653	Output variable flow regulator 1
30655	Input Register	654	Measured value status flow regulator 1
30656 30657	Input Register	655 656	Flow regulator 2
30658 30659	Input Register	657 658	Output variable flow regulator 2
30660	Input Register	659	Measured value status flow regulator 2

Auxiliary variables: Flame monitoring Fidas24

Modicon Modbus address	Type	Register number	Description/name
30701 30702	Input Register	700 701	Flame combustion chamber 1
30703	Input Register	702	Measured value status flame 1
30704 30705	Input Register	703 704	Flame combustion chamber 2 (extension double chamber FID)
30706	Input Register	705	Measured value status flame 2

Instrument information

Preliminary remarks

The following device information is available:

- Production number
- Serial number
- Software version
- Software version date

Device information data is stored as ASCII code. Up to 16 register numbers are reserved for each information. Data can be extracted by reading the content of the subsequent register numbers. A "Hex 00" content is used as terminator and readout may be stopped.

The serial number is the ID of the built in PCB. The last digits of the serial number correspond to the MAC address.

Instrument information: Production number

Modicon Modbus address	Type	Register number	Description/name
31001	Input Register	1000	Production number
31002		1001	
31003		1002	
31004		1003	
31005		1004	
31006		1005	
31007		1006	
31008		1007	
31009		1008	
31010		1009	
31011		1010	
31012		1011	
31013		1012	
31014		1013	
31015		1014	
31016		1015	

Instrument information: Serial number

Modicon Modbus address	Type	Register number	Description/name
31021	Input Register	1020	Serial number (MAC address)
31022		1021	
31023		1022	
31024		1023	
31025		1024	
31026		1025	
31027		1026	
31028		1027	
31029		1028	
31030		1029	
31031		1030	
31032		1031	
31033		1032	
31034		1033	
31035		1034	

Instrument information: Software version

Modicon Modbus address	Type	Register number	Description/name
31041	Input Register	1040	Software version
31042		1041	
31043		1042	
31044		1043	
31045		1044	
31046		1045	
31047		1046	
31048		1047	
31049		1048	
31050		1049	
31051		1050	
31052		1051	
31053		1052	
31054		1053	
31055		1054	
31056		1055	

Instrument information: Software version date

Modicon Modbus address	Type	Register number	Description/name
31061	Input Register	1060	Date of the software version
31062		1061	
31063		1062	
31064		1063	
31065		1064	
31066		1065	
31067		1066	
31068		1067	
31069		1068	
31070		1069	
31071		1070	
31072		1071	
31073		1072	
31074		1073	
31075		1074	
31076		1075	

Administration of system events

Accessing the system events

The system events in the instrument are administered in a system memory area. All events can be read and registered. A series of events requires acknowledgement and has to be noted and acknowledged by the user before the active status messages are reset.

The system events of the instrument are accessed via Modbus function 20 (read file record). The data is updated and the system events which require acknowledgement are acknowledged via the Modbus function 21 (write file record).

The system events are stored in the instrument as a sender address with the event number as an ID. A detailed breakdown according to detector / component, etc. in plain language is not possible until it appears in the display of the instrument.

Only the event number and a sender ID are entered in the list of system events. If an event is to be completely decoded, the sender text and the event text can also be read out.

The event texts are available in the two installed languages of the instrument. These texts depend only on the software version of the instrument, but are always the same within the instrument family. Once the text of an event number is known, it no longer has to be read.

The sender ID depends on the configuration. If the configuration in the instrument has changed (data record input with ECT/TCT), the sender IDs could also change. The event sender must also be read in after a cold restart of the instrument. This sender ID is valid unless the configuration in the instrument has been changed.

Location of the event files in the instrument

Modicon Modbus address	Type	File number	Description/name
	File	256	Reading / acknowledging system events
	File	257	Read the event address data ID
	File	258	Read event texts via number

System events

All events of the instrument are stored in the event store. This event store is volatile, i.e. it is empty after a cold restart of the system. However, if a system defect or similar is present, the resulting event is detected again during the run-up phase of the instrument and entered in the event store.

Structure of the Modbus event file

The events are stored in Modbus file 256. Since the events in the instrument event store are dynamically generated and deleted, the Modbus event file is always a static copy of the instrument event store. The user can check whether there are any changes by reading out the header section of the file and initiate updating if necessary. Conclusion of the updating is also reported in the header. The events can subsequently be read out non-time critically.

Contents of the records in the event file

Record no.	Meaning read file record	Meaning write file record
Header		
0	File status Bit. 0: Copying 0 = completed 1 = Copying in progress Bit1: Freshness of the file 0 = Current events 1 = Changes in the event store	Updating Bit. 0: 1 = Re-read data This starts the job request to update the events in the file.
1	Number of events in the file	not allowed
Events		
2–9	Event 1 (see Format of an event (see page 53))	Acknowledgement (see Event acknowledgement (see page 55))
10–17	Event 2	Acknowledgement
18–25	Event 3	Acknowledgement
…		
2722–2729	Event 340	Acknowledgement

Updating the event file

Record 0 must be written to the event file (file 256) to update the message file.

Record	Meaning (write record)
0	Bit 0: 1 = Data re-read

Updating is started internally after this bit has been written to Record 0. The updating is shown in Record 0 in the event file (file 256).

Record	Meaning (read record)
0	Bit. 0: Copying 0 = completed 1 = Copying in progress

The current event data is available after Bit 0 has been reset to "0".

The current number of events in the file can be read in Record 1 of the event file (file 256).

Record	Meaning (read record)
1	Number of events in the file

Format of an event

An event comprises 8 Records. The first event begins with Record #2 of the file.

Structure of an event in the event file

Record offset	Meaning of the record (read)	
0	Sender ID	
1	Event number	
2	Status identifier	Event type
3	Event behavior	NAMUR status signals
4	Incoming time stamp Low Word	
5	Incoming time stamp High Word	
6	Outgoing / Acknowledgement time stamp Low Word	
7	Outgoing / Acknowledgement time stamp High Word	

Sender ID: (16 bit) Unique sender ID of the events for this instrument.

Event number: (16 bit) Unique event number of the instrument family.

Status identifier: (8 bit High Byte) Describes the current status of the respective event.
0 = Event gone. Wait for acknowledgement.
1 = Event is active.
2 = Event is active and has been acknowledged.

Event type: (8 bit Low Byte) Information on the classification of an event. The classification has no effects on the NAMUR status management.
1 = Event type System error
2 = Event type Runtime error (e.g. during calibrations)
3 = Event type Maintenance request
7 = Event type Log book (currently not supported).

Event behavior: (8 bit High Byte) Describes the processing instruction for the event.

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Meaning
X	X	X	X	0	0	0	0	No acknowledgment requirement Status signals follow the event.
X	X	X	X	0	0	0	1	Acknowledgment requirement 1 Status signals go when the event becomes inactive. The event itself must be acknowledged.
X	X	X	X	0	0	1	0	Acknowledgment requirement 2 Status signals and event do not go until the event is inactive and has been acknowledged.
X	X	X	X	0	1	0	0	Inactive (no storage)
X	X	X	X	0	1	0	1	Inactive acknowledgment requirement 1 No status signals are output, but the event is registered and is deleted after acknowledgement.

"X": Bit has no meaning and must be ignored.

NAMUR status signals: (8 bit Low Byte) describes the current NAMUR status behavior of the event, i.e. which status outputs have been set. The "overall status" bit can be combined with the bits of the other status outputs. The content is changed for the runtime, e.g. if an event requiring acknowledgement (according to acknowledgement requirement 1) goes but has not yet been acknowledged. This event no longer initiates a status, the register is "0".

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Meaning
X	X	X	X	0	0	0	1	Error
X	X	X	X	0	0	1	0	Maintenance request
X	X	X	X	0	1	0	0	Maintenance mode
X	X	X	X	1	0	0	0	Overall status

"X": Bit has no meaning and must be ignored.

Incoming time stamp: (32 bit) Point of time in the instrument at which the event was generated. Time in seconds since 00:00:00 UTC 01.01.1970.

Outgoing / Acknowledgement time stamp: (32 bit) Point of time in the instrument at which the event was canceled by the system or acknowledged by the user. Time in seconds since 00:00:00 UTC 01.01.1970.

Event acknowledgement

If an event in the instrument requires acknowledgement, the event must be confirmed, before it is removed from the event system of the instrument. Confirmation can take place on the HMI of the instrument (see Format of an event (see page 53), "Event behavior")

The events can be acknowledged via the Modbus event file (file 256) by a write access to the relative Record 0 of the event.

Record offset	Meaning (write record)
0	Sender ID Writing the sender ID acknowledges the event.

Write file

Example

Event 1 of the event list is acknowledged by writing the sender ID of Event 1 in Record 2 of file 256. Event 2 of the event list is acknowledged by writing the sender ID of Event 2 in Record 12 of file 256. After acknowledgement, a change in the event list is shown in Bit 1 of Record 0. All the events in the file can be acknowledged before the file is updated. The acknowledgement of an event which does not require acknowledgement or the transmission of an invalid sender ID does not cause a system reaction.

Read-out of the sender ID

The sender of an event is transmitted in the event file encoded in the sender ID (relative Record 0, see Format of an event (see page 53)).

The sender ID is unique for an instrument but depends on the configuration. If the configuration has changed in an instrument (data record input with ECT/TCT), the sender IDs may also change. The event sender can be identified via Modbus file 257.

Location of the event sender file in the instrument

Modicon Modbus address	Type	File number	Description/name
	File	257	Read the event address data ID

Starting the read-out of a sender ID

Record 1 must be written to the event sender file (file 257), in order to read out a sender ID.

Record	Meaning (write record)
1	Sender ID

Write file

After writing the ID in Record 1, read-out of the event sender in plain language is initiated. The updating is shown in the event sender file (file 257) in Record 0.

Record	Meaning (read record)
0	Bit. 0: Read-out 0 = completed 1 = Evaluation in progress

Read file

Once the content of Record 0 of the event sender file (file 257) returns to "0", the requested sender ID is ready for read-out in plain language.

Format of the sender ID file

Once a sender ID has been determined (see Starting the read-out of a sender ID (see page 56)), the sender of the event can be read out in plain language.

The transmission takes place in the form of a UTF8 encoded character string with a "0x00" (zero byte) as termination. 2 bytes of the character string in a record of the Modbus file (257) are transmitted.

Record	Meaning (read record)
Header	
0	Bit 0: Read-out 0 = completed 1 = Evaluation in progress
1	Sender ID
2	Quantity of the records for this identifier (excluding header)
Identifier data	
3	Sender ID in plain language (Byte 1 and 2)
…	Sender ID in plain language (2 bytes per record)
n	Sender ID in plain language (0x00 termination or 1 byte and 0x00 termination)

Read file

Format of a sender ID

The sender ID can be transmitted multilingually. The individual language texts are transmitted in succession in a character string separated by an identifier. The transmission takes place in the form of a UTF8 encoded character string. If there is no language identifier, the text is directly applicable.

Structure of a language text

Character	Meaning
Language encoding	
"|"	ASCII character 124;0x7C as one byte (not UTF8-encoded) precedes a language identifier and therefore separates the individual language texts.
001	Three-digit identifier of the language of the subsequent text. The following are currently available: 001 English (language as delivered, default identifier) 049 German (language as delivered) 086 Chinese 351 Portuguese 033 French 081 Japanese 034 Espanol 039 Italian 055 Brasilian 007 Russian 090 Turkish 358 Finnish
Text	
UTF8	Text of the sender ID

Ranking for the applicability of the language texts:

- If the desired language identifier exists, this text applies.
- If not: If the language identifier |001 exists, this text applies.
- If not: If a language identifier exists, this text applies.
- If not: The complete text applies.

Examples

Multilingual text

Sender ID: "|001Fidas24:A.Pres.|049Fidas24:Luftd."

Identifier	Language	Text
001	English	Fidas24:A.Pres.
049	German	Fidas24:Luftd.

Unilingual text with language identifier

Sender ID: "|001Fidas24:TOC"

Identifier	Language	Text
001	English	Fidas24:TOC

Unilingual text without language identifier

Sender ID: "System"

Identifier	Language	Text
- - -	Universal	System

Reading event texts

The meaning of an event is transmitted in the event file encoded in the event number (relative Record 1, see Format of an event (see page 53)).

The event number is unique for all instruments of a software version. The meaning of an event can be determined in plain language via Modbus file 258.

Location of the event files in the instrument

Modicon Modbus address	Type	File number	Description/name
	File	258	Read event texts via number

Starting the read-out of an event text

To read out an event text, Record 1 must be written to the event text file (file 258).

Record	Meaning (write Record)
1	Event number

Write file

After writing the event number in Record 1, read-out of the event text in plain language is initiated. The updating is shown in the event text file (file 258) in Record 0.

Record	Meaning (read record)
0	Bit. 0: Read-out 0 = completed 1 = Evaluation in progress

Read file

Once the content of Record 0 of the event text file (file 258) returns to "0", the requested event number is ready for read-out in plain language.

Format of the event text file

Once an event number has been obtained (see Starting the read-out of an event text (see page 59)), the event text can be read out in plain language.

The transmission takes place in the form of a UTF8 encoded character string with a "0x00" (zero byte) as termination. 2 bytes of the character string in a record of the Modbus file (258) are transmitted.

Record	Meaning (read record)
Header	
0	Bit. 0: Read-out 0 = completed 1 = Evaluation in progress
1	Event number
2	Quantity of the records for this identifier (excluding header)
Identifier data	
3	Event text in plain language (Byte 1 and 2)
…	Event text in plain language (2 bytes per record)
n	Event text in plain language (0x00 termination or 1 Byte and 0x00 termination)

Read file

Format of an event text

The event text can be transmitted multilingually. The individual language texts are transmitted in succession in a character string separated by an identifier. The transmission takes place in the form of a UTF8 encoded character string. If there is no language identifier, the text is directly applicable.

Structure of an event language text

Character	Meaning
Language encoding	
"|"	ASCII character 124;0x7C as one byte (not UTF8-encoded) precedes a language identifier and therefore separates the individual language texts.
001	Three-digit identifier of the language of the subsequent text. The following are currently available: 001 English (language as delivered, default identifier) 049 German (language as delivered) 086 Chinese 351 Portuguese 033 French 081 Japanese 034 Spanish 039 Italian 055 Brazilian 007 Russian 090 Turkish 358 Finnish
Text	
UTF8	Text of the event (see below for format)

The event texts are stored in several lines. The character "§" is used as a line separator. The first line is a short description of the event which is used in the display of overview lists. The detailed description of the event begins from line 2; the detailed description can comprise a maximum of 20 lines.

Structure of an event text

Character	Meaning
UTF8	Line 1 of the event (event short text)
"§"	ASCII character 167;0xA7 as one byte (not UTF8-encoded) line separator
UTF8	Line 2 of the event (beginning [Line 1] of the detailed description)
"§"	ASCII character 167;0xA7 as one byte (not UTF8-encoded) line separator
UTF8	Line 3 of the event (line 2 of the detailed description)
	…
"§"	ASCII character 167;0xA7 as one byte (not UTF8-encoded) line separator
UTF8	Line 21 of the event (Line 20 of the detailed description)

Example

Multilingual text

Event text: "|001Offset >>§The offset Drift§exceeds the§permissible range.|049Offset >>§Die Offsetdrift§überschreitet den§zulaessigen Bereich."

Identifier	Language	Event text	
001	English	Event short text:	Line 1: Offset >>
		Details of the event:	Line 2: The offset drift Line 3: exceeds the Line 4: permissible range.
049	German	Event short text:	Line 1: Offset >>
		Details of the event:	Line 2: Die Offsetdrift Line 3: überschreitet den Line 4: zulaessigen Bereich.

Status messages

Status messages: Uras26

Error code	Status message	Brief description
0x0001	Detector error	No interrupt inside the time window
0x0002	Overrange	Measuring range of the ADC over/underranged
0x0004	Half	Half the drift range (offset or ampl.) overranged
0x0008	Over	Drift range (offset or ampl.) overranged
0x0010	Delta Over	Calibration drift (offset or ampl.) overranged
0x0020	Floating-point error	An error has occurred in the measured value calculation
0x0040	Temperature controller error	Control deviation 1, 2 or measured temperature value incorrect
0x0080	Temperature comp. error	Measured value for the temperature compensation incorrect
0x0200	Pressure comp. error	Measured value for the pressure compensation incorrect
0x0400	CS correction error	Measured value of the disturbance variable not OK
0x0800	Carrier gas correction error	Measured value of the disturbance variable not OK
0x1000	ADC read error	Incorrect or no data transmission from the ADC

Status messages: Limas23

Error code	Status message	Brief description
0x0001	Detector error	No interrupt inside the time window
0x0002	Overrange	Measuring range of the ADC over/underranged
0x0004	Half	Half the drift range (offset or ampl.) overranged
0x0008	Over	Drift range (offset or ampl.) overranged
0x0010	Delta Over	Calibration drift (offset or ampl.) overranged
0x0020	Floating-point error	An error has occurred in the measured value calculation
0x0040	Temperature controller error	Control deviation 1, 2 or measured temperature value incorrect
0x0080	Temperature comp. error	Measured value for the temperature compensation incorrect
0x0200	Pressure comp. error	Measured value for the pressure compensation incorrect
0x0400	CS correction error	Measured value of the disturbance variable not OK
0x0800	Carrier gas correction error	Measured value of the disturbance variable not OK
0x1000	Measurement preamplifier error	Measurement amplifier defective
0x2000	Ref. preamplifier error	Reference preamplifier defective
0x4000	Intensity Half error	Half of lamp intensity limit underranged
0x8000	Intensity Over error	Lamp intensity limit underranged

Status messages: Magnos206

Error code	Status message	Brief description
0x0001	Detector error	No interrupt inside the time window
0x0002	Overrange	Measuring range of the ADC over/underranged
0x0004	Half	Half the drift range (offset or ampl.) overranged
0x0008	Over	Drift range (offset or ampl.) overranged
0x0010	Delta Over	Calibration drift (offset or ampl.) overranged
0x0020	Floating-point error	An error has occurred in the measured value calculation
0x0040	Temperature controller error	Control deviation 1, 2 or measured temperature value incorrect
0x0080	Temperature comp. error	Measured value for the temperature compensation incorrect
0x0200	Pressure comp. error	Measured value for the pressure compensation incorrect

Status messages: Magnos27

Error code	Status message	Brief description
0x0001	Detector error	No interrupt inside the time window
0x0002	Overrange	Measuring range of the ADC over/underranged
0x0004	Half	Half the drift range (offset or ampl.) overranged
0x0008	Over	Drift range (offset or ampl.) overranged
0x0010	Delta Over	Calibration drift (offset or ampl.) overranged
0x0020	Floating-point error	An error has occurred in the measured value calculation
0x0040	Temperature controller error	Control deviation 1, 2 or measured temperature value incorrect

Status messages: Caldos25

Error code	Status message	Brief description
0x0001	Detector error	No interrupt inside the time window
0x0002	Overrange	Measuring range of the ADC over/underranged
0x0004	Half	Half the drift range (offset or ampl.) overranged
0x0008	Over	Drift range (offset or ampl.) overranged
0x0010	Delta Over	Calibration drift (offset or ampl.) overranged
0x0020	Floating-point error	An error has occurred in the measured value calculation
0x0040	Temperature controller error	Control deviation 1, 2 or measured temperature value incorrect

Status messages: Caldos27

Error code	Status message	Brief description
0x0001	Detector error	No interrupt inside the time window
0x0002	Overrange	Measuring range of the ADC over/underranged
0x0004	Half	Half the drift range (offset or ampl.) overranged
0x0008	Over	Drift range (offset or ampl.) overranged
0x0010	Delta Over	Calibration drift (offset or ampl.) overranged
0x0020	Floating-point error	An error has occurred in the measured value calculation
0x0040	Temperature controller error	Control deviation 1, 2 or measured temperature value incorrect
0x0200	Pressure comp. error	Measured value for the pressure compensation incorrect

Status messages: Fidas24

Error code	Status message	Brief description
0x0001	Detector error	No interrupt inside the time window
0x0002	Overrange	Measuring range of the ADC over/underranged
0x0004	Half	Half the drift range (offset or ampl.) overranged
0x0008	Over	Drift range (offset or ampl.) overranged
0x0010	Delta Over	Calibration drift (offset or ampl.) overranged
0x0020	Floating-point error	An error has occurred in the measured value calculation
0x0040	Temperature controller error	Control deviation 1, 2 or measured temperature value incorrect
0x0100	Pressure regulator error	Control deviation 1, 2 or measured pressure value incorrect
0x1000	Steam error	The operating temperature has not (yet) been reached
0x2000	Flame error	Flame(s) not lit (always the case except in the MEAS_MODE)
0x4000	Fail Safe	Fail Safe Mode

Annex

Modbus protocol and IEEE-754 format

Processing the format

The Modbus protocol provides 16 bit registers as transmission values. However, some of the gas analyzer data is stored in the IEEE-754 format (32 bit). For this reason, the format must be processed on the application side.

Structure of the IEEE-754 format

Description	Quantity of bits	Meaning
S	1	Sign bit; states the sign (0 = positive, 1 = negative)
E	8	Exponent in two's-complement representation. The true value is therefore the exponent minus 127.
M	23	Mantissa. The "Most Significant Bit" of the standardized mantissa in front of the decimal point is implicitly 1, but is not stored. The value range is therefore between 1.0 (inclusive) and 2.0.

Example

The number –12.5 is stored as a hexadecimal value `0xC1480000`. The following table describes the memory assignment:

Address	+0	+1	+2	+3
Format	SEEEEEEE	EMMMMMMM	MMMMMMMM	MMMMMMMM
Binary	11000001	01001000	00000000	00000000
Hexadecimal	C1	48	00	00

Explanation

The sign bit S is 1, i.e. the value is negative.

The exponent E is `10000010` binary, which corresponds to a decimal value of 130. If 127 is subtracted from 130, the result is 3. This is the exponent value.

The stored mantissa value M is `10010000000000000000000`. The value `1.10010000000000000000000` is obtained by adding the un-stored leading 1 in front of the decimal point.
`1100.10000000000000000000` is obtained after adjusting the mantissa to the exponent (shift of three places). This binary number corresponds to the decimal number 12.5.

This decimal number still has to be provided with the negative sign. The number –12.5 is obtained from this.

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