

GenTwo®

Modbus Protocol Description with Applications

Software description for GenTwo® Multigas Analyzers

Version 1.00.00

Modbus protocol software version 2.00.100





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Quick support

If you have any questions about this product regarding commissioning, handling or technical service - feel free to contact us. We will support you directly, quickly and of course free of charge with our experience and product knowledge.

**Please contact our service center in Ratingen, Germany,
for US Service Ventura, California**

Please help us by providing this information about the device, if possible:

- Product model
- Product serial number
- M&C order or invoice number

- Germany service center:
+49 2102 935 - 888
service@mc-techgroup.com
- US service:
+1 805-654-6970
info-usa@mc-techgroup.com

In addition, we are continuously working on providing further assistance for many of our products online on our webpage:

- www.mc-techgroup.com

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1 About this document

This documentation only applies to GenTwo® analyzers starting with software version 1.00. The document is therefore also explicitly non-transferable.

If you have any questions about this document, please contact M&C or one of our official distributors.

Document:	Software description in EN for Modbus Protocol
Version:	1.00.00
Software Version:	2.00.100
Release date:	01.2023
Copyright:	© 2023 M&C TechGroup
Published by:	M&C TechGroup Germany GmbH, Rehhecke 79 40885 Ratingen, Deutschland

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The German software description is the original document.

With the release of this version all older versions will no longer be valid.



Registered trademarks

GenTwo®	GenTwo® is a registered trademark of M&C Techgroup Germany GmbH.
MODBUS	Modbus is a registered trademark of SCHNEIDER ELECTRIC USA, INC.
CAS Modbus Scanner	This Product is published by Chipkin - A company registered in the province of British Columbia, Canada.
ModScan64	This product is published by WinTECH Software Design is a Registered Trade Name of WINPASO INC., a West Virginia Corporation with headquarters at 209 Highland Circle, Lewisburg, WV 24901.
Modbus Poll	Modbus Poll („The Software“) is copyright 2002-2022 by Witte Software, all rights reserved.
CPU1510SP-1 PN	This is a product by Siemens, Munich, Germany
TIA Portal V15.1 MB_CLIENT V5.1	These are software products by Siemens, Munich, Germany



2 Important safety information

Please follow the general safety precautions when mounting, commissioning and operating M&C components.

The Modbus protocol description with applications is a software description for GenTwo® multigas analyzers for implementing the Modbus protocol.

Implementation may only be carried out by personnel specially trained for this purpose. Missing or incorrect data may cause damage to the instrument or to the plant where the instrument has been used.

2.1 Signs and definitions in this document



Qualified personnel

“Qualified personnel” are experts who are familiar with the installation, mounting, commissioning and operation of these types of products.



Note

“Note” indicates important information relating to the product or highlights parts of the documentation for special attention.

3 Modbus-TCP

The O2 analyzer is a TCP server. The TCP client has to set up a connection to the device on its IP address and port. Currently, only one connection is possible at a time.

IP adresse: 172.20.30.2 (is always active)

Port: 5000 or 502

3.1 Modbus protocol implementation



Qualified personnel

Implementation should only be carried out by personnel specially trained for this purpose.

The MODBUS protocol was implemented in line with the following specifications:

MODBUS Protocol Specification, December 28, 2006

(Modbus_application_Protocol_V1_1b.pdf)

MODBUS Messaging in TCP/IP Implementation Guide, October 24, 2006

(Modbus_Messaging_Implementation_Guide_V1_0b.pdf)

The specifications are available at:

<http://www.modbus.org>

<http://www.modbus.org/specs.php>

3.2 User data format

The data transmission is carried out in the Big Endian format (High Byte/Low Byte, High Word/Low Word).

Floating point data are transmitted in the IEEE 754 format.

Term	Number Bits	Description	
S	1	Sign	
E	8	Exponent	
M	23	Mantissa	
SEEEEEEE	EMMMMMMM	MMMMMMMMM	MMMMMMMMM

3.3 Modbus frame

Example Request: Read Input Register

Byte	Description	Value	Description
MBAP Header			
0	Transaction identifier (high)	0x00	0x0005: Consecutive number of request
1	Transaction identifier (low)	0x05	
2	Protocol identifier (high)	0x00	0x0000 = Modbus protocol
3	Protocol identifier (low)	0x00	
4	Length (high)	0x00	0x0006 bytes follow this byte.
5	Length (low)	0x06	The value includes the last byte of the MBAP header
6	Unit identifier	0xFF	Can be any value.
General Modbus Frame			
7	Function code	0x04	0x04 = read input register
8	Start address (high)	0x75	0x7531: start address 30001
9	Start address (low)	0x31	
10	Number of 16 bit register (high)	0x00	Number of 16 bit register = 0x0004
11	Number of 16 bit register (low)	0x04	

Example Response: Read Input Register

Byte	Description	Value	Description
MBAP Header			
0	Transaction identifier (high)	0x00	0x0005: Same identifier as in the request for clear assignment.
1	Transaction identifier (low)	0x05	
2	Protocol identifier (high)	0x00	0x0000 = Modbus protocol
3	Protocol identifier (low)	0x00	
4	Length (high)	0x00	11 bytes follow this byte.
5	Length (low)	0x06	The value includes the last byte of the MBAP header
6	Unit identifier	0xFF	Same identifier as in the request

Byte	Description	Value	Description
General Modbus Frame			
7	Function code	0x04	0x04 = read input register
8	Byte count	0x08	0x08 bytes follow
9	Byte 1	0x41	0x411E3282 IEEE = 9.887331
10	Byte 2	0x1E	
11	Byte 3	0x32	
12	Byte 4	0x82	
13	Byte 5	0x80	Status bits
14	Byte 6	0x00	
15	Byte 7	0x00	
16	Byte 8	0x0F	

3.4 Modbus functions implemented

Function Code	Function
0x01	Read Coils
0x02	Read Discrete Inputs
0x03	Read Holding Registers
0x04	Read Input Registers
0x05	Write Single Coil
0x06	Write Single Register
0x0F	Write Multiple Coils
0x10	Write Multiple Registers
0x14	Read File Record
0x15	Write File Record



Note

MODBUS Protocol V 1.00 ... V 1.20 only includes: **0x04**

3.5 Input register: general structure

The GenTwo® Multigas-Analyzer can process up to 10 channels: K1...K10. Per channel all input registers are identical.

An offset of 100 is specified per channel, resulting in the following address ranges:

Channel	Address	Offset
K1	30001...30099	0
K2	30101...30199	100
K3	30201...30299	200
K4	30301...30399	300
K5 ...	30401...30499	400



Note The polling frequency should not exceed 1 Hz.

3.6 Input register (description only applicable for K1. K2-K10)

Input Register			
Address	6-Digit Register Number	Type	Description
30001	330002	FLOAT	Measuring value 1: Concentration gas [vol%] or [ppm]
30002	330003		
30003	330004	FLOAT	Measuring value 2: Temperature in [°C]
30004	330005		
30005	330006	FLOAT	Measuring value 3: Pressure PIN in [mbar]
30006	330007		
30007	330008	FLOAT	Measuring value 4: Flow / Flow in [l/h]
30008	330009		
30009	330010	FLOAT	Measuring value 5: Pressure POUT in [mbar]
30010	330011		
30011	330012	FLOAT	Analog output (I/O module). Current in [mA]
30012	330013		
30013	330014	FLOAT	Measuring value 6: pressure delta P (PIN – POUT) in [mbar]
30014	330015		
30015	330016	FLOAT	Calculation: relative deviation of calibration-gradient mx in [%]
30016	330017		
30017	330018	FLOAT	Calculation: relative deviation from calibration-offset +b in [%]
30018	330019		



Input Register			
Address	6-Digit Register Number	Type	Description
30019	330020	FLOAT	free
30020	330021		
30021	330022	UINT32	System settings in bits ¹⁾
30022	330023		
30023	330024	UINT32	Status information in bits ²⁾
30024	330025		
30025	330026		free
30026	330027		
30027	330028		
30028	330029		
30029	330030		
30030	330031		
30031	330032	FLOAT	Operational limit: Lim1: in [vol%] or [ppm]
30032	330033		
30033	330034	FLOAT	Operational limit: Lim2: in [vol%] or [ppm]
30034	330035		
30035	330036		free
30036	330037		
30037	330038		
30038	330039		
30039	330040		
30040	330041		
30041	330042	FLOAT	Measuring range 1: Lower limit "from" in [vol%] or [ppm]
30042	330043		
30043	330044	FLOAT	Measuring range 1: Upper limit "up to" in [vol%] or [ppm]
30044	330045		
30045	330046	FLOAT	Measuring range 2: Lower limit "from" in [vol%] or [ppm]
30046	330047		
30047	330048	FLOAT	Measuring range 2: Upper limit "up to" in [vol%] or [ppm]
30048	330049		
30049	330050	FLOAT	Measuring range 3: Lower limit "from" in [vol%] or [ppm]
30050	330051		



Input Register			
Address	6-Digit Register Number	Type	Description
30051	330052	FLOAT	Upper limit "up to" in [vol%] or [ppm]
30052	330053		
30053	330054	FLOAT	Measuring range 4: Lower limit "from" in [vol%] or [ppm]
30054	330055		
30055	330056	FLOAT	Measuring range 4: Upper limit "up to" in [vol%] or [ppm]
30056	330057		

3.6.1 System settings in bits

Input Register			
Address	6-Digit Register Number	Type	Description
30021	330022	UINT32	System settings in bits ¹⁾
30022	330023		

Foot note 1):

Bit	Channel	
0	Kx Sensor active	(0 = no, 1 = active)
1	Kx concentration: unit in vol%/ppm	(0 = vol%, 1 = ppm)

3.6.2 Status Information in bits

Input Register			
Address	6-Digit Register Number	Type	Description
30023	330024	UINT32	Status information in bits ²⁾
30024	330025		

Foot note 2):

Bit	Channel	
0	Kx Ready for measuring	(0 = not ready [false], 1 = ready [true])
1	Kx Collective status	(0 = ok, no error 1 = any error)
2	I/O-Relais R1	(0 = off, 1 = on) for safety first
3	I/O-Relais R2	(0 = off, 1 = on) for calibration
4	I/O-HighSideSwitch 1	(0 = off, 1 = on) for measuring range 2
5	I/O-HighSideSwitch 2	(0 = off, 1 = on) for measuring range 3
6	I/O-HighSideSwitch 3	(0 = off, 1 = on) for operational limit Lim1
7	I/O-HighSideSwitch 4	(0 = off, 1 = on) for operational limit Lim2
8	Error: Temperature	(0 = no, 1 = yes)
9	Error: Pressure	(0 = no, 1 = yes)
10	Error: Flow	(0 = no, 1 = yes)
11	Error: IRbench error 1	(0 = no, 1 = yes) emitter faulty
12	Error: IRbench error 2	(0 = no, 1 = yes) signal measuring channel 1 not working properly
13	Error: IRbench error 3	(0 = no, 1 = yes) signal measuring channel 2 not working properly
14	Error: IRbench error 4	(0 = no, 1 = yes) signal measuring channel 3 not working properly
15	Not used	
16	Measuring range 1	(0 = no, 1 = yes) selected measuring range 1
17	Measuring range 2	(0 = no, 1 = yes) selected measuring range 2
18	Measuring range 3	(0 = no, 1 = yes) selected measuring range 3
19	Measuring range 4	(0 = no, 1 = yes) selected measuring range 4
20	Not used	
21	Error: RA gradient mx	(0 = no, 1 = yes)
22	Error: RA offset +b	(0 = no, 1 = yes)



Note

The IR bench (if a circuit board is available) can have up to 4 errors. Further information can also be obtained in the event list at the HMI.



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3.7 Holding Register

The holding register is currently not in use.

3.8 Coils

The coils are currently not in use.

3.9 File Records

The file records are currently not in use.



4 Appendix I: Modbus communication GenTwo®-Siemens PLC

The GenTwo® measuring data can be accessed by using a Siemens programmable logic controller (PLC).

For a Modbus server request to the GenTwo®, the MB_CLIENT module can be used with the parameter combination shown below.

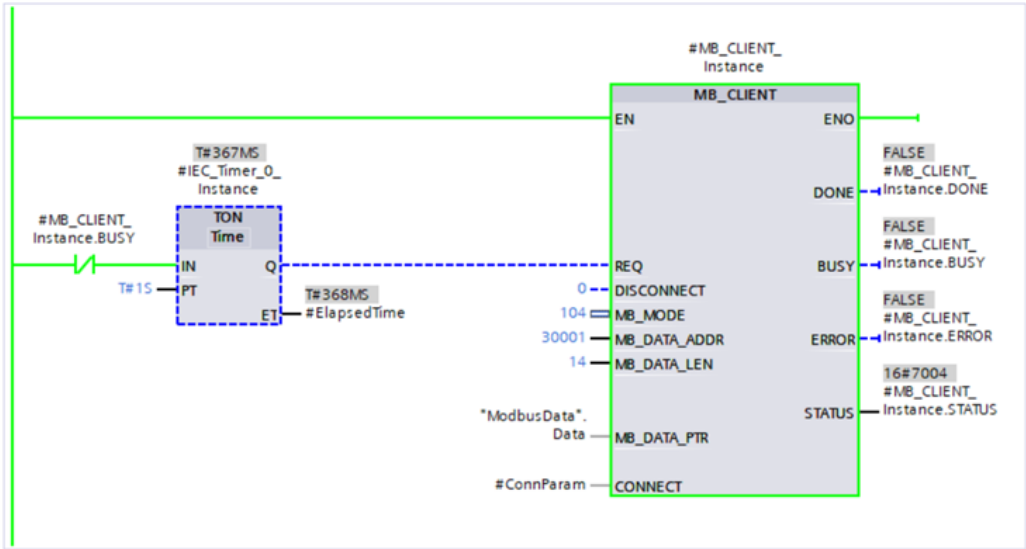


Fig. 1: MB_CLIENT module

8	▼	ConnParam	TCON_IP_v4	...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
9	■	InterfaceId	HW_ANY	64	...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	HW-identifier of IE-interface submodule
10	■	ID	CONN_OUC	1	...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	connection reference / identifier
11	■	ConnectionType	Byte	11	...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	type of connection: 11=TCP/IP, 19=UDP (17=TCP/IP)
12	■	ActiveEstablished	Bool	true	...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	active/passive connection establishment
13	▶	RemoteAddress	IP_V4		...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	remote IP address (IPv4)
14	■	RemotePort	UInt	502	...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	remote UDP/TCP port number
15	■	LocalPort	UInt	502	...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	local UDP/TCP port number

Fig. 2: Connection parameters of the CONNECT parameter

Please regard that Siemens allows the readout of the input registers via function code 04 in two different variants (see following table).

The determining factor for the selection of the variant is the definition of the parameters MB_MODE, MB_DATA_ADDR and MB_DATA_LEN.

	Variant 1	Variant 2
MB_MODE	0	104
MB_DATA_ADDR	30.001 to 39.999	0 to 65.535
MB_DATA_LEN	1 to 125	1 to 125
Function code	04 (Read Input Register)	04 (Read Input Register)
Address requested	0 to 9.998	0 to 65.535

In variant 1 the function code to be used is determined independently via the three parameters by the MB_CLIENT block. In variant 2, the function code to be used is determined directly via the MB_MODE parameter.

Only variant 2 is suitable for reading out the measurement data of the GenTwo® from address 30001 due to the limited addressing of the first variant.



Note

Read out GenTwo® measurement data starting from address 30001 with MB_MODE=104.

The response from the GenTwo® server is stored in the memory area of the PLC referred to by the MB_DATA_PTR parameter on the MB_CLIENT block. The screenshot shows the values of the „ModbusData“ data block, which in this example serves as the location of the received data.

ModbusData		Name	Datentyp	Startwert	Beobachtungswert	Übe...	Kommentar
1	▼	Static								
2	▼	Data	Array[0..6] o...			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
3	▶	Data[0]	Real	0.0	24.42	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		concentration
4	▶	Data[1]	Real	0.0	54.9	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		temperature
5	▶	Data[2]	Real	0.0	972.5314	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		inlet pressure
6	▶	Data[3]	Real	0.0	0.0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		flow
7	▶	Data[4]	Real	0.0	987.7189	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		outlet pressure
8	▶	Data[5]	Real	0.0	17.03	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		analog out
9	▶	Data[6]	Real	0.0	0.0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		pressure differential

Fig. 3: Data block specified by MB_DATA_PTR with GenTwo® server response



Fig. 4: Screenshot of the GenTwo® display to compare with Fig. 3

The measured values of the GenTwo® are transmitted as IEEE754 32-bit floating point number in two 16-bit registers, therefore two registers must be queried per measured value ($MB_DATA_LEN = 2 * \text{number of measured values}$).

**Note**

Two registers must be queried per measured value for readout ($MB_DATA_LEN = 2 * \text{number of measured values}$).

Components used:

- **Hardware:**
SIMATIC ET 200SP - CPU1510SP-1 PN Siemens PLC (Siemens part No. 6ES7510-1DJ01-0AB0)
- **Software:**
TIA Portal V15.1
MB_CLIENT V5.1

5 Appendix II: application examples for troubleshooting

Note

The Windows PC programs listed here are only application examples. It is completely up to you which program you want to use in your specific case. If you have any questions, please feel free to contact M&C TechGroup.

Various free or shareware Windows PC programs can be used for troubleshooting when commissioning the Modbus TCP function of the GenTwo® analyzer. These Windows PC programs can be used for many different Modbus protocols and hardware interfaces.

Due to the universal use of these Windows PC programs, it is possible that the address settings of the individual programs differ. This can lead to transmission problems and interfere with successful communication with the GenTwo®.

In these application examples, we describe the address settings of three different Windows PC programs as examples.

**Note**

For checking TCP communication, it is recommended to use a network sniffer.

**Note**

The reaction of these programs is according to the protocol description. MODBUS Protocol V 1.00 ... V 1.20 only includes: **0x04**

Application examples in the form of screenshots are available for the following programs:

- CAS Modbus Scanner by Chipkin
- ModScan64
- Modbus Poll

5.1 Sample data

Queried for measuring channel 1:

- Gas concentration (30001+30002)
- Temperature of the sensor (30003+30004)

Values at the time of recording:

- Gas concentration: 0.07 or 0.09 vol%
- Temperature of the sensor: 41.6 or 42.4 °C

5.2 CAS Modbus Scanner by Chipkin

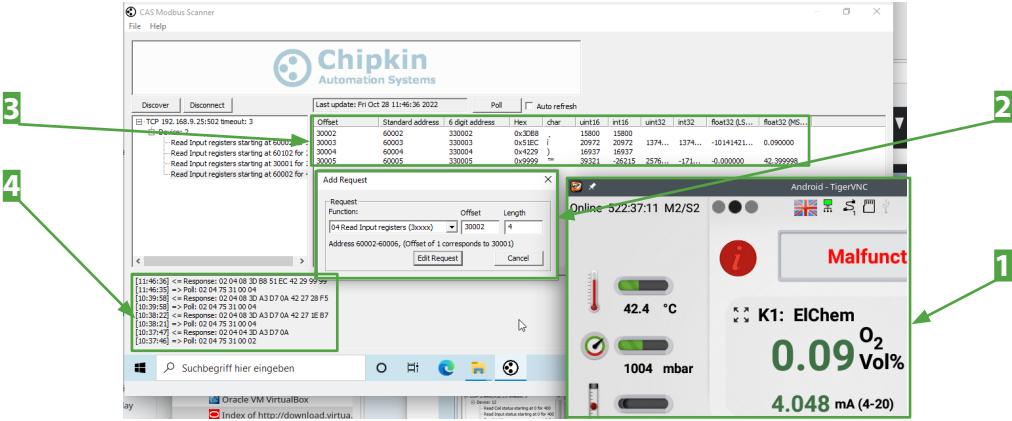


Fig. 5: Overview: screenshots for CAS Modbus Scanner by Chipkin

- 1 GenTwo® display with measuring values
- 2 CAS Modbus Scanner input window
- 3 Reaction from the CAS Modbus Scanner with retrieved measuring data
- 4 Log: query and response telegram of the CAS Modbus Scanner

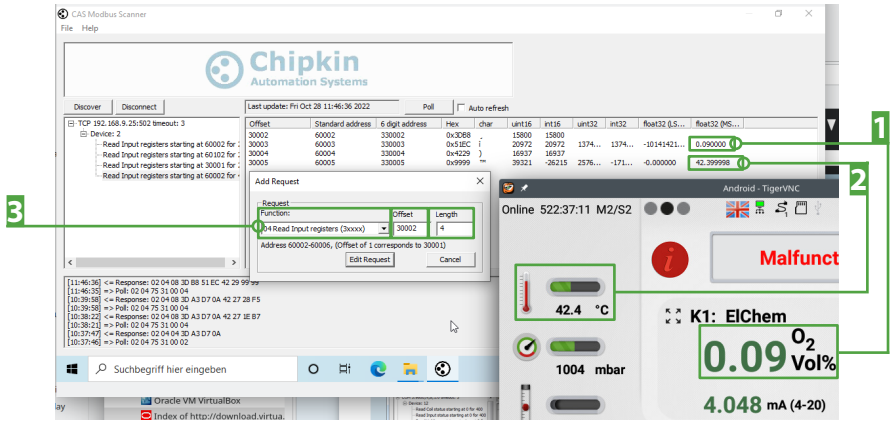


Fig. 6: Sample values: CAS Modbus Scanner by Chipkin

- 1 Retrieved measured value concentration: 0.09 Vol.-% shown here in CAS Modbus Scanner, displayed as Float32
- 2 Retrieved measured value temperature: 42.4 °C shown here in CAS Modbus Scanner, displayed as Float32
- 3 Settings for query starting from address 3001, length = 4

5.3 ModScan64

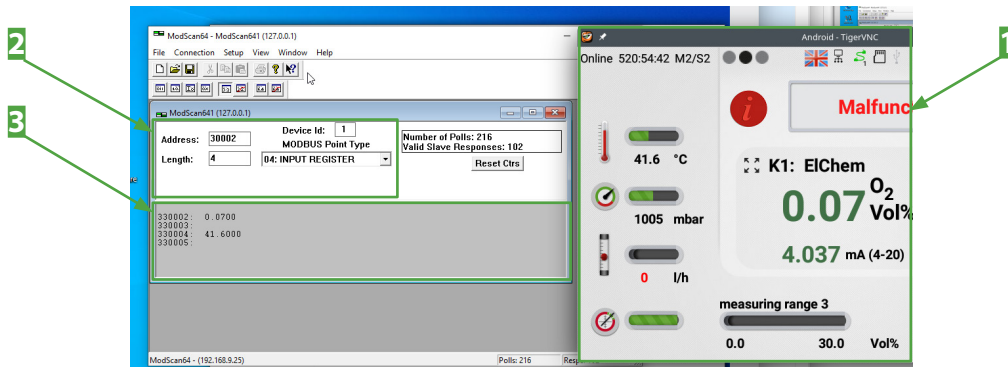


Fig. 7: Overview: Screenshots for ModScan64

- 1 GenTwo® display with measuring values
- 2 ModScan64 input window
- 3 Reaction from the ModScan64 with retrieved measuring data

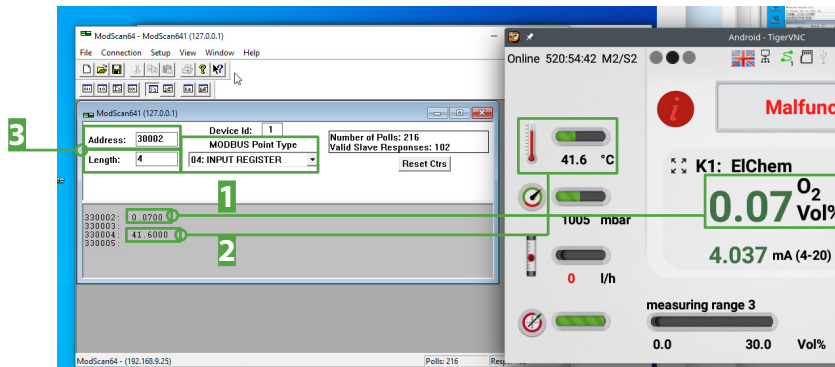


Fig. 8: Sample values: ModScan64

- 1 Retrieved measured value concentration: 0.07 vol% shown here in ModScan64, displayed as Float32
- 2 Retrieved measured value temperature: 41.6 °C shown here in ModScan64, displayed as Float32
- 3 Settings for query starting from address 30001, length = 4

5.4 Modbus Poll

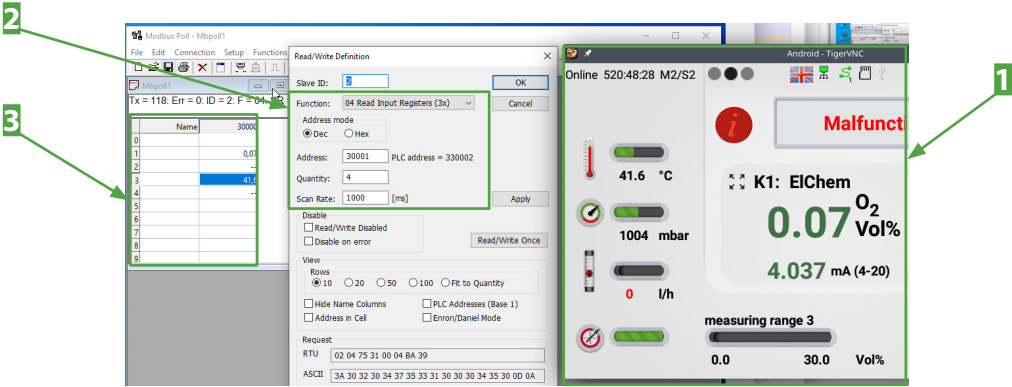


Fig. 9: Overview: Screenshots for Modbus Poll

- 1 GenTwo® display with measuring values
- 2 Modbus Poll input window
- 3 Reaction from the Modbus Poll with retrieved measuring data

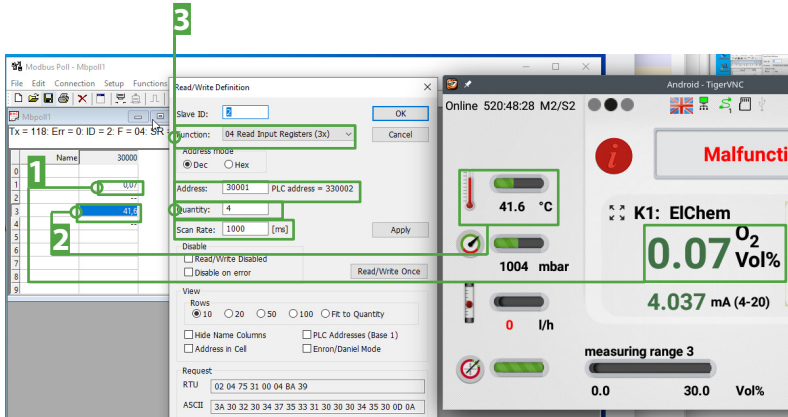


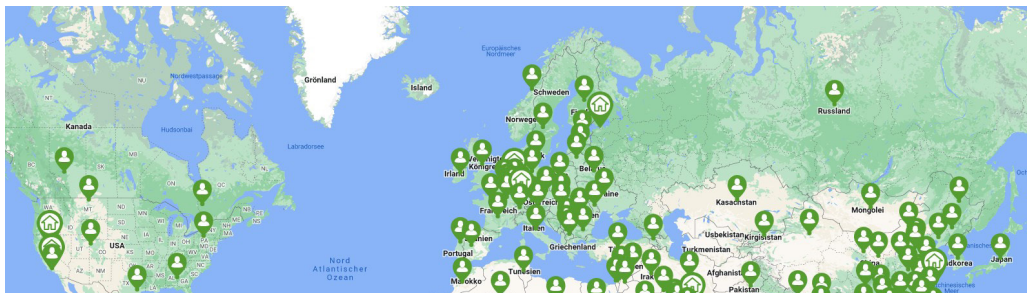
Fig. 10: Sample values: Modbus Poll

- 1 Retrieved measured value concentration: 0.07 vol% shown here in Modbus Poll, displayed as Float32
- 2 Retrieved measured value temperature: 41.6 °C shown here in Modbus Poll, displayed as Float32
- 3 Settings for query starting from address 30001, length = 4 and for choosing the polling frequency



Note The polling frequency should not exceed 1 Hz.

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