Remote Control
via Serial Communication

Applies to FTC150, FTC320 and FTC400
with Firmware Versions later than 2.000

Messkonzept GmbH
Gas Analytical Technology
https://messkonzept.de/
Niedwiesenstrasse 33
60431 Frankfurt am Main
Germany
T +49 5305 6444

Version 12, 03/2024

Table of Contents

1 Connecting and Setup

1.1 Modbus Setup over RS485

1.1.1 Bus Parameters

The default settings of the RS485 Modbus communication are:

- Baudrate: 19.2 kBaud
- Parity: none
- Stop bits: 1
- Address: 1

These parameters may be configured according to your requirements via the following holding registers:

- Modbus_Address: Holding Registers 0x0020 & 0x0021 (UINT32)
  - Allowed values: 1-255

- RS485_Baudrate: Holding Registers 0x0022 & 0x0023 (UINT32)
  - Allowed values: 9600, 19200, 38400, 57600, 115200

- RS485_Parity: Holding Registers 0x0024 & 0x0025 (UINT32)
  - Combine bits according to the following table

Bit	Property
0	parity check enable: 0: OFF 1: ON
1	parity: 0: odd 1: even
2	number of stop bits: 0: 1 stop bit 1: 2 stop bits

1.1.2 Data Types and Endianness

The device uses both 16-bit and 32-bit variables internally, which can be accessed through the Modbus registers. **All registers are to be read and written in big-endian notation with quantity 2.**

The following data types may be used:

- UINT16: unsigned integer, 16 bits
- INT16: signed integer, 16 bits (using two's complement)
- float32: IEEE 754 floating point number (big-endian: ABCD)
- UINT32: unsigned integer, 32 bits (big-endian: ABCD)

1.1.3 Address Table

1.1.3.1 Function Code 03 (0x03) Read Holding Registers

Through Function Code 3 all internal device parameters can be accessed, also such parameters which will not be needed by the typical device users.

A complete list of all holding registers can be found in Appendix B: List of Modbus Holding Registers (page 24).

1.1.3.2 Function Code 04 (0x04) Read Input Registers

To allow for flexible adaptation to various systems, the most needed device parameters can be read out either as:

- float32 for highest precision (see addresses 0-31)
- UINT16 / INT16 with conversion factor for easy readability (addresses 100-131)

float32 / real values:

address		name	data type	physical unit
decimal	**hexadecimal**			
0	0x0000	Concentration5	float32	ppm
2	0x0002	Concentration1	float32	ppm
4	0x0004	Concentration2	float32	ppm
6	0x0006	Concentration3	float32	ppm
8	0x0008	Concentration4	float32	ppm
10	0x000A	Residual	float32	ppm
12	0x000C	BlockTemp	float32	°C
14	0x000E	TCS RmV	float32	mV
16	0x0010	Serial Number	float32	-
18	0x0012	Firmware Version	float32	-
20	0x0014	*Status_Matrix*	*float32**	-
22	0x0016	*Errors Status*	*float32**	-
24	0x0018	*MaintR Status*	*float32**	-
26	0x001A	*Limits_Status*	*float32**	-

*): unsigned integer values in float32 format. Convert to 16 bit unsigned integer value and then read out bitwise.

Integer registers:

address		name	data type	decimal shift**	physical unit
decimal	**hexadecimal**				
100	0x0064	Concentration5	INT16	+2	ppm
102	0x0066	Concentration1	INT16	+2	ppm
104	0x0068	Concentration2	INT16	+2	ppm
106	0x006A	Concentration3	INT16	+2	ppm
108	0x006C	Concentration4	INT16	+2	ppm
110	0x006E	Residual	INT16	+2	ppm
112	0x0070	BlockTemp	INT16	−2	°C
114	0x0072	TCS RmV	UINT16	−1	mV
116	0x0074	Serial Number	UINT16	0	-
118	0x0076	Firmware Version	UINT16	−3	-
120	0x0078	Status_Matrix	UINT16	0	-
122	0x007A	Errors Status	UINT16	0	-
124	0x007C	MaintR Status	UINT16	0	-
126	0x007E	Limits_Status	UINT16	0	-

**): register values must be multiplied with $10^{(\text{decimal shift})}$ to arrive at the correct value matching the physical unit indicated here. The shift-value may also be read from register at address+1 (e.g. address 101 contains the decimal shift for the contents of register 100) in INT16 notation.

1.1.3.3 Function Code 08 (0x08) Diagnostics

Sub function code	Function	Request	Response
0	Return Query	any	Echo of Request
1	Restart Comm.	0x0000 or 0xFF00	Echo of Request
4	Force Listen Only Mode	0x0000	No Response
10	Clear all Counters	0x0000	Echo Request
11	Bus Message Count	0x0000	Total Message Count
12	Bus Comm. Error Count	0x0000	CRC Error Count
13	Exception Error Count	0x0000	Except. Error Count
15	Server no Response Count	0x0000	Broadcast & listen only count

1.1.3.4 Function Code 16 (0x10) Write Multiple Registers

Through Function Code 16 all internal device parameters, also such parameters, which should not be accessed by inexperienced users, may be changed. Please proceed with caution before making changes to these registers!

1.1.4 Example: Read parameters with “Modbus Poll”

Figure 1 shows an example with the software “Modbus Poll” to read out the Serial Number (here shown with a value of 12345) and the Firmware Version (here: 2.004) from the Holding Registers, using function code 3.

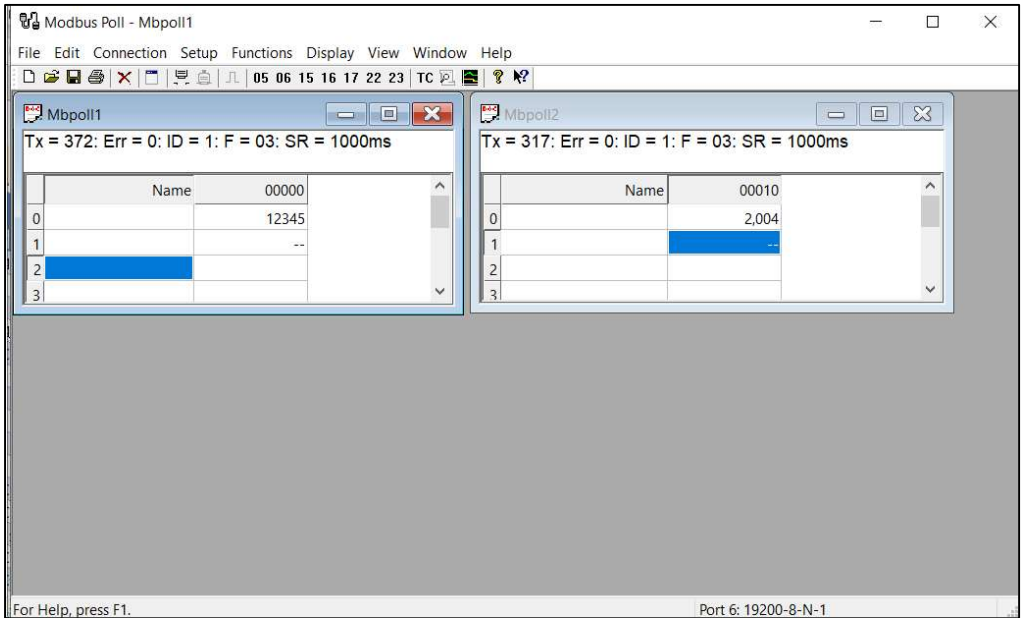

Figure 1: Window of software "Modbus Poll" reading out the Serial number "12345" and the Firmware Version "2.004" of the device.

Please follow these steps to attain Figure 1 (page 5) via “Modbus Poll”:

1) Find out the Holding Register Addresses and datatypes of Serial Number and Firmware Version from Appendix B: List of Modbus Holding Registers (page 24).

Serial Number: 0x0000 (dec: 0) with quantity 2, Datatype: UINT_32

Firmware Version: 0x000A (dec: 10) with quantity 2, Datatype: float32

2) Read out one of these register pairs using function code 3 (see Figure 2), and format into the adequate datatype in Big Endian Notation. Figure 3 shows how to do this for the serial number (formatted as UINT_32) in the software “Modbus Poll”.

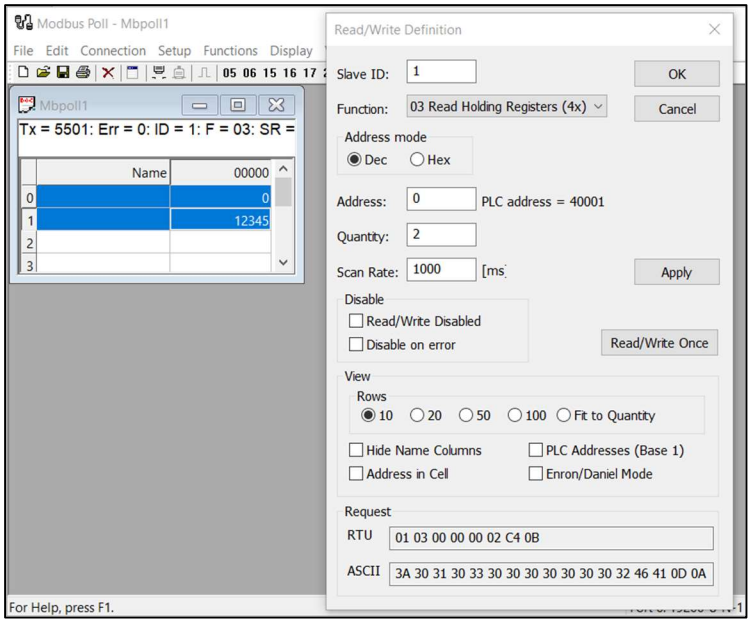

Figure 2: Reading out register pair for Serial Number by reading address 0 (Hex: 0x0000) with quantity 2.

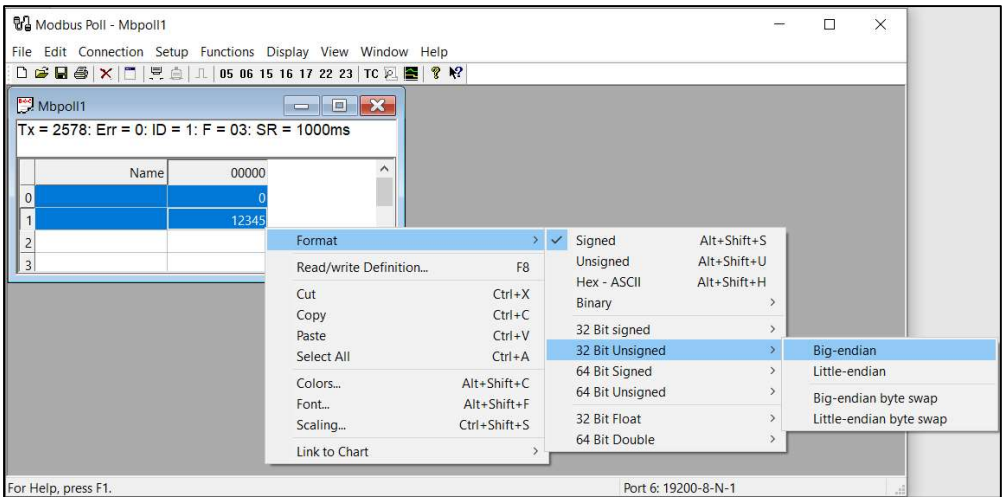

Figure 3: Screenshot of software "Modbus Poll". Addresses 0x0000 and 0x0001 are read out via function code 0x03. Both registers are selected and formatted to UINT32.

3) Repeat step 1 and 2 for the Firmware Version. Make sure to format to “32 Bit Float” in Big Endian Notation.

1.2 RS232 Setup

To connect your device via RS232 set up a COM-port connection to your device with a serial communication program like e.g. Tera Term.
The default settings for the RS232 communication are:

- Baudrate: 19.2 kBaud
- Parity: none
- Stop bits: 1

To check your connection, you can send one of the following commands to receive an identification message from the device:

- `mk?`

or

- `pk?`

The device should greet you back with a short message as shown in Figure 4.

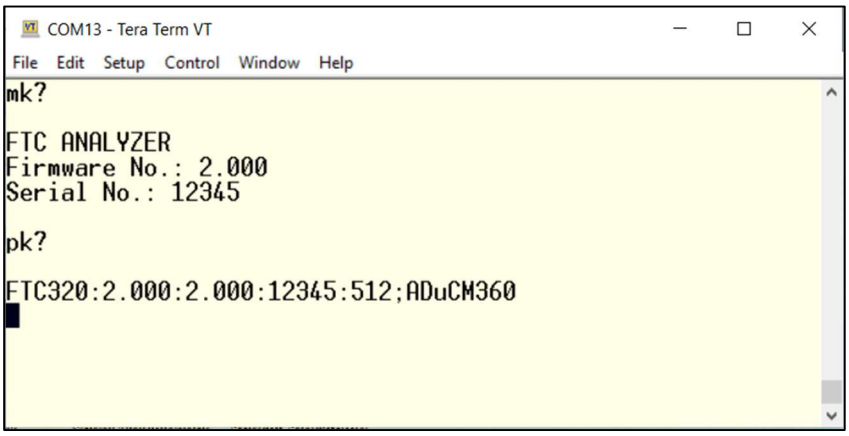

Figure 4 - Functional test using Identification messages

Recommended terminal settings: new line/send: CR+LF, local echo.

Caution!
Any inexpert change of the parameters might cause a fatal failure or damage the instrument. Messkonzept will deny any warranty claims due to improper settings of the parameters.

Caution!
*Parameter numbers listed in this manual refer to **firmware versions after 2.000**. Parameter numbers may be offset for your software. Please refer to the parameter list of your specific device.*

1.2.1 Command reference

Commands are formatted in bold and black (**example**) while the parameter numbers are indicated in red and italic (*example*). Additionally passed values are indicated in blue and italic (*example*). In the following *Pn* is a shortcut for "Parameter-number".

Action	Command	Example
Get parameter name	***PPnN***	***P2N*** *(get name of parameter 2)*
Get parameter value	***PPn?***	***P1?*** *(get value of parameter 1)*
Set parameter value	***PPn=F****set_value*	***P496=F****0* *(set parameter 496 to value 0)*

A list of important parameters is given in Table 1 - List of important parameters (page 9).
A complete parameter list can be found in Appendix B: List of Modbus Holding Registers (page 24).
For more information, please contact Messkonzept GmbH.

An often-requested application is the offset calibration of the **T**hermal **C**onductivity (**TC**) measurement channel 5. This can be done by the following command:

- `P12=F250`

For further information see "Offset and Gain calibration of the measurement channels" (page 12).

Table 1 - List of important parameters

P.No.	Name	Description
0	***Serial Number***	***Serial Number as unique identifier for each device by Messkonzept [-]***
1	***Concentration5***	***Calibrated gas concentration (in ppm) of channel 5 (Thermal Conductivity measurement)***
2	***Block_Temp***	***Temperature of the device body. Should show a stable value during operation (63 °C for most devices).***
3	***TCS_Rm_V***	***Raw signal of the Thermal Conductivity sensor, typically between 1500 mV and 7000 mV***
97	***Pressure***	***Currently measured gas pressure (not available in all devices)***
237	Offset_Gas1	Test gas concentration (in ppm) for offset calibration of channel 1 (AUX)
238	Gain_Gas1	Test gas concentration (in ppm) for gain calibration of channel 1 (AUX)
252	Concentration1	Calibrated gas concentration (in ppm) of channel 1 (AUX)
301	Offset_Gas2	Test gas concentration (in ppm) for offset calibration of channel 2 (IR2)
302	Gain_Gas2	Test gas concentration (in ppm) for gain calibration of channel 2 (IR2)
316	Concentration2	Calibrated gas concentration (in ppm) of channel 2 (IR2)
365	Offset_Gas3	Test gas concentration (in ppm) for offset calibration of channel 3 (IR3)
366	Gain_Gas3	Test gas concentration (in ppm) for gain calibration of channel 3 (IR3)
380	Concentration3	Calibrated gas concentration (in ppm) of channel 3 (IR3)
429	Offset_Gas4	Test gas concentration (in ppm) for offset calibration of channel 4 (IR4)
430	Gain_Gas4	Test gas concentration (in ppm) for gain calibration of channel 4 (IR4)
444	Concentration4	Calibrated gas concentration (in ppm) of channel 4 (IR4)
446	MGM_Select	Selection of the gaspair to be measured by channel 5 (Thermal Conductivity measurement)
496	Offset_Gas5	Test gas concentration (in ppm) for offset calibration of channel 5 (Thermal Conductivity measurement)
497	Gain_Gas5	Test gas concentration (in ppm) for gain calibration of channel 5 (Thermal Conductivity measurement)

1.2.2 Response reference

The response to most commands on the device is a data frame, individualized by Messkonzept. Here are some examples of responses to typical commands.

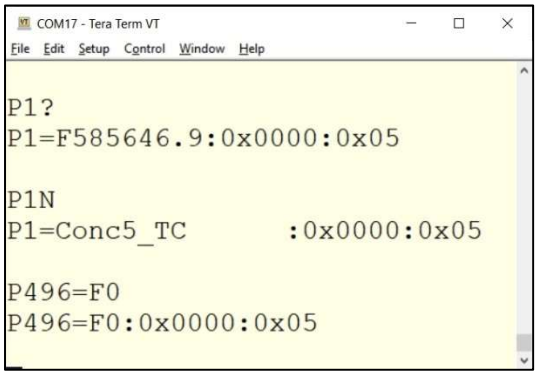

Figure 5: Example of commands and responses of FTC device displayed via “Tera Term”.

Example 1: *Query value* of parameter 1. (Concentration measured by TC measurement (channel 5))
Command **“P*1*?”** returns:

P1	=	F	585646.9	:	0x0001	:	0x05
Queried parameter, here 1		Datatype, here float (F)	Value, here 58.56 Vol. %		Device status-bitmask		Command status

Example 2: *Query name* of parameter 1. (Concentration measured by TC measurement (channel 5))
Command **“P*1*N”** returns:

P1	=	Conc5_TC	:	0x0001	:	0x05
Queried parameter, here 1		Parameter name		Device status-bitmask		Command status

Example 3: *Set parameter* 496 to value 0.
Command **“P*496*=F*0*”** returns:

P496	=	F	0	:	0x0001	:	0x05
Set parameter, here 496		Datatype, here float (F)	Value, here 0 Vol%		Device status-bitmask		Command status

For further information on the device status-bitmask and the command status please see Appendix A: Device status bitmask and command status (page 22).

2 Specific Applications

2.1 Triggering of Internal Routines/ ”Special Action” Command

Setting parameter P12 to certain values triggers internal routines (special actions). Table 2 is a list of important special actions with the according command. After processing a routine, P12 is automatically set back to 0.

Table 2 - Actions triggered by P12

Command	Executed Procedure
Standard	
`P12=F0`	Do nothing
`P12=F100`	Restart system
`P12=F101`	Reset to Factory Settings
`P12=F201`	Overwrite Factory Settings
`P12=F98`	Query device protocol
Calibration specific	
`P12=F210`	Calibrate Offset extern Channel 01
`P12=F211`	Calibrate Gain extern Channel 01
`P12=F220`	Calibrate Offset extern Channel 02
`P12=F221`	Calibrate Gain extern Channel 02
`P12=F230`	Calibrate Offset extern Channel 03
`P12=F231`	Calibrate Gain extern Channel 03
`P12=F240`	Calibrate Offset extern Channel 04
`P12=F241`	Calibrate Gain extern Channel 04
`P12=F250`	Calibrate Offset extern Channel 05
`P12=F251`	Calibrate Gain extern Channel 05

2.2 Offset and Gain calibration of the measurement channels

A gain and an offset calibration can be performed for each measurement channel (1-5). Please see Table 2 - Actions triggered by P12 (page 11) to look up the commands.

Caution!
Channel 5 is the main measurement channel (of the gas measured by **T**hermal **C**onductivity).

In the majority of cases, gain calibration is not needed!
*An offset calibration **must** be performed before a gain calibration.*

The concentration of the offset test gases should be close to the start-point and the concentration of the span test gas should be close to end-point of the measuring range.

Normally the test gas concentration values can be found on the imprint of your test gas bottle or on the associated datasheet (see Figure 6, page 13).

Always follow these steps to calibrate your device:

1) Set your offset and gain test gas concentrations.

2) Apply your offset test gas.

3) Start task “Calibrate Offset”.

If two-point calibration is necessary (usually not needed):

4) Apply your gain test gas.

5) Start task “Calibrate Gain”.

Specific commands for performing these actions are given in the following.

2.2.1 Calibration via RS232

Follow these steps to calibrate your device via RS232. Here is an example calibrating a device with a measuring range 0-40 Vol% Ar in CO2 using the following test gases:

- Start point: 100 Vol% CO2 (0 Vol% Ar in CO2)
- End point: 39.93 Vol% Ar in CO2 (see Figure 6, page 13)

1) Set gain- and offset- test gas concentration values. Parameter numbers for other channels can be found in Table 1 (page 9).

- P496=F0

P	496	=	F	0
	Parameter “Offset test gas (channel 5)”			0 ppm

- P497=F399300

P	497	=	F	399300
	Parameter “Gain test gas (channel 5)”			*399300* ppm

2) Apply your offset-gas concentration to your device and wait for signal to stabilize (5-10 mins).

3) “Calibrate Offset”.
   - P12=F250

P	12	=	F	250
	Parameter “Special Command”			Task “Calibrate Offset”

Calibration sampling takes 10s. The device will answer with “P12=F0” when task is finished. Please verify if calibration was successful by reading out the measurement value.

4) Apply your gain-gas concentration to your device and wait for signal to stabilize (5-10 mins).

If measurement value satisfies precision requirement, there is no need for a gain calibration.

5) “Calibrate Gain”.
   - P12=F251

P	12	=	F	251
	Parameter “Special Command”			Task “Calibrate Gain”

Calibration sampling takes 10s. The device will answer with “P12=F0” when task is finished.

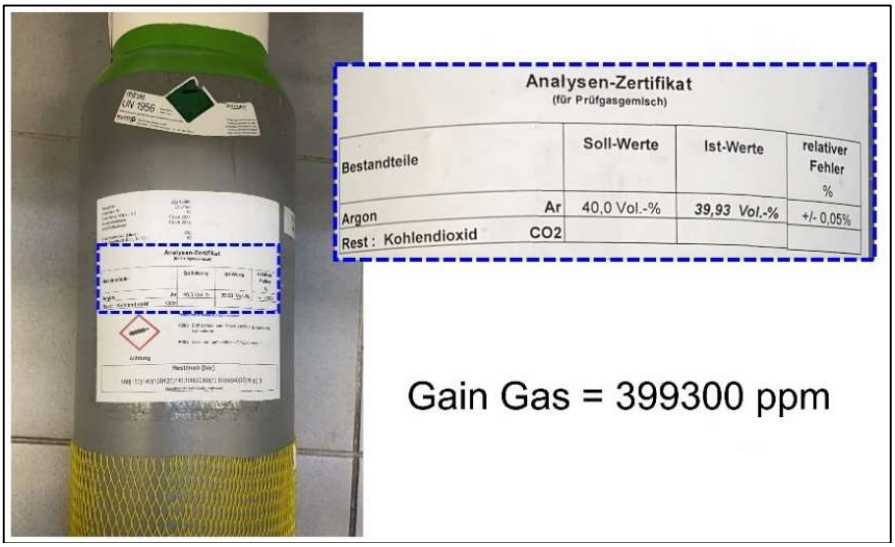

Figure 6: Test gas bottle from Messkonzept. The imprint is highlighted in the blue box. The imprint shows the effective concentration value 39,93 Vol% = 399300 ppm.

2.2.2 Calibration via Modbus over RS485

Follow these steps to calibrate your device via Modbus. Here is an example calibrating a device with a measuring range 0-40 Vol% Ar in CO2 using the following test gases:

- Start point: 100 Vol% CO2 (0 Vol% Ar in CO2)
- End point: 39.93 Vol% Ar in CO2 (see Figure 6, page 13)

1) Look up necessary parameter addresses in Appendix B: List of Modbus Holding Registers. For channel 5 these are:

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
24	0x0018	12	Perform_Task	UINT32	r/w
992	0x03E0	496	Offset_Gas5	float32	r/w
994	0x03E2	497	Gain_Gas5	float32	r/w

Note that two addresses have to be set for the 32 bit datatypes. Use Big Endian Notation.

2) Use “Function Code 16 (0x10) Write Multiple Registers” to set test gas concentrations in ppm:
   - Offset_Gas5 = 0 (Tx: 01 10 03 E0 00 02 04 00 00 00 00 E9 17)
   - Gain_Gas5 = 399300 (Tx: 01 10 03 E2 00 02 04 48 A5 AC 80 13 ED)

3) Apply your offset-gas concentration to your device and wait for signal to stabilize (5-10 mins).

4) Use “Function Code 16 (0x10) Write Multiple Registers” to start task “Calibrate Offset Channel 5”:
   - Perform_Task = 250 (Tx: 01 10 00 18 00 02 04 00 00 00 FA 73 46)

   Calibration sampling takes 10s. Please verify if calibration was successful by reading out the measurement value.

5) Apply your gain-gas concentration to your device and wait for signal to stabilize (5-10 mins).

   If measurement value satisfies precision requirement, there is no need for a gain calibration.

6) Use “Function Code 16 (0x10) Write Multiple Registers” to start task “Calibrate Gain Channel 5”:
   - Perform_Task = 251 (Tx: 01 10 00 18 00 02 04 00 00 00 FB B2 86)

Caution!
While sampling during calibration (for 10s) the device will answer to requests with error code 0x06 (Slave Device Busy).

Caution!
It is recommended to execute Function Code 16 only once per writing.

2.3 Data Logging

There are two possible solutions for logging continuously with the FTC320/400:

- **Polling**
  - You need to write a script or application that continuously sends parameter requests to the device and evaluates the responses. Please contact Messkonzept for some example code written in Python.
  - Make sure to limit the polling speed to max. 5 Hz.
- **Push-Mode**
  - After setting up the Push-Mode, your device will continuously send parameter values via RS232.
  - You simply need to save the terminal output to a file (e.g. with Tera Term).

2.3.1 Push-Mode

To configure the Push-Mode, please follow these steps:

1) Write the parameter numbers to be pushed into the **PushSource**-parameters (P81 to P96). 16 parameters can be pushed in total.

2) Activate the Push-Mode by setting a **Push-Rate** in multiples of 100 ms.
   A **Push-Rate** (P80) of *10* translates to 1 datapoint every *10* * 100 ms (1 Hz).

Example: Push TC measurement (channel 5) and block temperature with 1 Hz.

1) Assign pushed parameters to Push-Sources
   - P81=F1

P	81	=	F	1
	PushSource00			Parameter 1 (Conc5_TC)

   - P82=F2

P	82	=	F	2
	PushSource01			Parameter 2 (Block temperature)

2) Set Push-Rate to 1 Hz.
   - P80=F10

P	80	=	F	10
	Push-Rate			10 * 100 ms (1Hz)

3) Eventually stop the Push-Mode.
   - P80=F0

P	80	=	F	0
	Push-Rate			0 * 100ms

A visual example of the Push-Mode is shown in Figure 7 (page 16). The first column (here “12345”) displays the serial number of the device. The following columns show the parameters P1 and P2, chosen by user in this example.

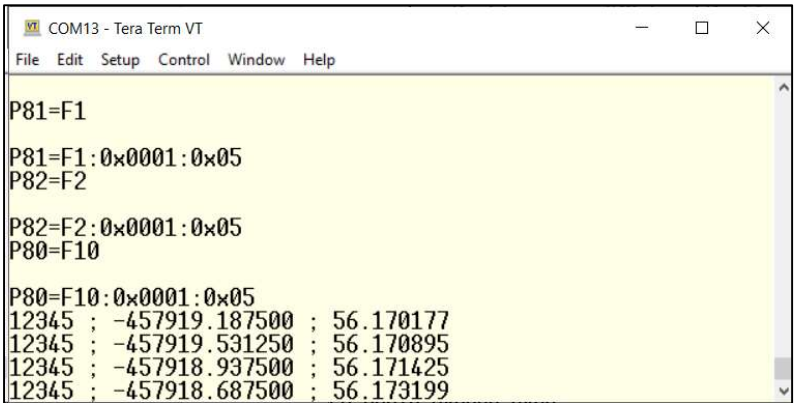

Figure 7 - Configuration of a device for push-mode

2.4 Analogue Output Configuration (RS232)

There are three analogue outputs: one current loop and two voltage signals (except the FTC320 OEM, which has no current loop) which may be configured according to your requirements. Every analogue output can be set to either of four modes, which are described in the following Table:

Table 3 - Description of analogue output modes.

Mode name	Description
Voltage output modes	
U_OUT_CONST	Return a constant analogue voltage signal.
U_OUT_0_10	Voltage output range from 0 to 10V. Voltage is limited to 10.5 V.
U_OUT_0_5	Set voltage range from 0 to 5 V. Voltage is limited to 5.5 V.
U_OUT_2_10_ERR_1_5	Set voltage range from 2 to 10 V. Voltage is limited to minimum value 1.9 V and maximum value of 10.25 V. 1.5 V displayed in case of error indication.
Current output modes	
I_OUT_CONST	Return analogue current signal without limits.
I_OUT_4_20_FLEX_ERR	Set current range from 4 to 20 mA. Current is limited to minimum value of 3.8 mA and maximum value of 20.5 mA. Flexible choice of current value in case of an error indication.
I_OUT_0_20_ERR_21	Set current range from 0 to 20 mA. Current is limited to maximum value of 20.5 mA. 21 mA displayed in case of error indication.
I_OUT_0_20	Set current range from 0 to 20 mA. Current is limited to maximum value of 20.5 mA.

To configure the analogue outputs, follow these steps:

1) Set a mode. Look up the required mode in Table 3 (page 17).

2) In case of a **CONST** or **FLEX** mode set additional values. The parameter numbers are given in Table 4 (page 18).

3) Assign a measurement signal to an analogue output.

Caution!
The following examples are explained based on looking up parameter numbers in Table 4 (page 18). Please pay attention to the datatype prefix.
Explanation of modes are listed in Table 3.

The following table should be used as a guide to setup the analogue output. Pay attention to the steps, which are numbered in the table. For examples, using this table, check the following pages.

Table 4 - List of commands for analogue output configuration

Parameter name	Parameter Number		Datatype Prefix	Set Value	Output Mode
1) Choose mode					
UOut1_Mode	P52	=	X	1 2 3 4	U_OUT_CONST U_OUT_0_10 U_OUT_0_5 U_OUT_2_10_ERR_1_5
UOut2_Mode	P59	=	X		
IOut1_Mode	P66	=	X	1 2 3 4	I_OUT_CONST I_OUT_4_20_FLEX_ERR I_OUT_0_20_ERR_21 I_OUT_0_20
IOut2_Mode	P73	=	X		
2) Assign signal source					
Uout1_Source	P54	=	F	1 2 3 4 5	Concentration of Channel: 1 (“AUX”) 2 (“IR2”) 3 (“IR3”) 4 (“IR4”) 5 (“TC”)
UOut2_Source	P61	=	F		
IOut1_Source	P68	=	F		
IOut2_Source	P75	=	F		
3) Set voltage or current value (only available for “CONST”-Modes)					
Uout1_Const_V	P55	=	F	Value in range 0…12 [V] (driver circuit limited at ~10.7 V)	
Uout2_Const_V	P62	=	F		
IOut1_Const_mA	P69	=	F	Value in range 0…24 [mA]	
IOut2_Const_mA	P76	=	F		
4) Set error values (only available for “FLEX”-Modes)					
Iout1_Err_mA	P70	=	F	Value in range 0…24 [mA]	
Iout2_Err_mA	P77	=	F		

The FTC320 OEM has two voltage-, but no current analogue output to be set.

Example 1: Set up a current analogue output 0-20 mA for TC measurement (channel 5).

1) For current output 1 set mode “0-20 mA”.
   - P66=X4

P	66	=	X	4
	Mode of current output 1		Datatype “Hex”	Mode “I_OUT_0_20”

2) To current output 1 assign TC measurement signal (channel 5).
   - P68=F5

P	68	=	F	5
	Signal source of current output 1		Datatype “Float”	TC measurement (channel 5)

Example 2: Set up a voltage analogue output 2-10V with error voltage 1.5 V for TC measurement (channel 5).

1) For voltage output 1 set mode “2-10 V with error voltage 1.5V”.
   - P52=X4

P	52	=	X	4
	Mode of voltage output 1		Datatype “Hex”	Mode “U_OUT_2_10_Err_1_5”

2) To voltage output 1 assign TC measurement signal (channel 5).
   - P54=F5

P	54	=	F	5
	Signal source of voltage output 1		Datatype “Float”	TC measurement (channel 5)

Example 3: Set up a constant current 10 mA.

1) For current output 1 set mode with constant current.
   - P66=X1

P	66	=	X	1
	Mode of current output 1		Datatype “Hex”	Mode “I_OUT_CONST”

2) For current output 1 set constant current to 10 mA.
   - P69=F10

P	69	=	F	10
	Constant current parameter for current output 1		Datatype “Float”	Current 10 mA

Example 4: Set up a current analogue output 4-20 mA with flexible error current (here 2 mA) for TC measurement (channel 5).

1) For current output 1 set mode “4-20 mA with Flex”.
   - P66=X2

P	66	=	X	2
	Mode of current output 1		Datatype “Hex”	Mode “I_OUT_4_20_FLEX_ERR”

2) To current output 1 assign TC measurement (channel 5).

- P68=F5

P	68	=	F	5
	Signal source of current output 1		Datatype “Float”	TC measurement (channel 5)

3) For current output 1 set error current to 2 mA.

- P70=F2

P	70	=	F	2
	Error current parameter for current output 1		Datatype “Float”	Error current 2 mA

2.5 Multi Gas Mode (MGM)

In devices configured for Multi Gas Mode (MGM), the active linearization curve and calibration values of the thermal conductivity measurement (channel 5) may be switched by the user to be adapted to varying measuring tasks.

Caution!
The gas pairs of the Multi Gas Mode are specifically set up and calibrated upon customer request by Messkonzept. Only the gas pairs which have been part of the order from Messkonzept will work correctly!

	Gases	Standard/Vol.%	Different/Vol.%	
Gases/ Ranges:	00. H2 in N2	0-100		☑
	01. O2 in N2	0-100		☑
	02. He in N2	0-100		☑
	03. CO2 in N2	0-100		☑
	04. N2 in Ar	0-100		☑
	05. O2 in Ar	0-100		☑
	06. H2 in Ar	0-100		☑
	07. He in Ar	0-100		☑
	08. CO2 in Ar	0-60		☑
	09. Ar in CO2	40-100		☑
	10. CH4 in N2	0-100		☑
	11. CH4 in Ar	0-100		☑
	12. Ar in O2	0-100		☑
	13. N2 in H2	0-100		☑
	14. O2 in CO2	0-100		☑
	15. H2 in O2	0-100		☐
	16. O2 in H2			☐

Figure 8 - List of preconfigured gas pairs (found in the device protocol)

The currently selected gas pair, e.g. H2 in N2, is indicated by parameter **P446**. In the manufacturing protocol, shipped with the device, you find a list of preconfigured gas pairs for your specific device, see for example the figure above. In this example the gas pairs 0-14 may be selected by the user.

Example: To configure the device for measurement of CO2 in Ar, select gas pair 8:

- P446=F8

Please note that the change of gas pair takes approximately 3 seconds to take effect, while the parameters related to channel 5 are interchanged with a different set of parameters (stored in a hidden section of the device memory). During the change of gas pair parameters, the device will not respond to external requests.

Appendix A: Device status bitmask and command status

The device status bitmask is a 8-bit hex code, which gives information about the device status.

Bit	Name	Description
8	Performing task	Device is currently busy working on a task triggered by the user
7	System in warmup	Set if during the first 20 minutes of device operation if the block temperature is not within the operational tolerance
6	Performing calibration	A calibration routine is running (relevant for “frozen during calibration” of analog outputs & relays)
5	Digital in	Not used.
4	Relay 3 closed	Set to 1 if the relay 1 contact is closed
3	Relay 2 closed	Set to 1 if the relay 2 contact is closed
2	Relay 1 closed	Set to 1 if the relay 3 contact is closed
1	Maintenance Request	The maintenance request bit indicates detected problems during calibration, see user manual or contact Messkonzept.
0	System Error	System Error! The device may not measure according to specifications! Note, that during warmup the error bit is set because the block temperature is not within operational tolerance yet.

Example: A device, which responds with device status bitmask 0x85. The prefix “0x” indicates that this is a hexadecimal value. For a better understanding the four hexadecimal figures are converted to binary numbers. Every hexadecimal figure is represented by 4 binary figures, see table below. Every binary figure is assigned to one status attribute, altering between “0” for attribute not set and “1” for attribute set.

0x85 = 0 1000 0101 b

- bit 7: device is warming up
- bit 2: relay 1 is closed
- bit 0: system error (device still heating up)

0x	0				0				8				5			
Binary	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1
Description								Performing task	System in warmup	Performing calibration	Digital in	Relay 3 closed	Relay 2 closed	Relay 1 closed	Maintenance Request	System Error
0x status	0x8000	0x4000	0x2000	0x1000	0x0800	0x0400	0x0200	0x1000	0x0080	0x0040	0x0020	0x0010	0x0008	0x0004	0x0002	0x0001

The command status is a hex code giving a response on the success of the execution of your command.

Command status code	Name	Description
0x00	COMMAND_ERROR	Command syntax is incorrect.
0x01	PARAMETER_NOT_EXISTING	Parameter number does not exist.
0x02	REQUEST_DENIED	No access rights for setting this parameter.
0x03	EEPROM_SET	Relevant for setting values in hidden memory (EEPROM). Setting the value was successful.
0x05	COMMAND_OK	Command was successful.
0x06	COMMAND_FORMAT_ERROR	Wrong syntax in command to set parameter, e.g. non-existing data type or data type not matching data.
0x07	PARAMETER_FORMAT_ERROR	Datatype of set value and parameter do not match (*Float* (F) or *Hex (X)*).
0x08	PARAMETER_RANGE_ERROR	Set value out of allowed parameter range.
0x09	PARAMETER_READ_ONLY	Read-only parameter. Error in case of parameter setting.

Appendix B: List of Modbus Holding Registers

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
0	0x0000	0	Serial_No	UINT32	r/w
2	0x0002	1	Conc5_TC	float32	r/-
4	0x0004	2	Block_Temp	float32	r/-
6	0x0006	3	TCS_Rm_mV	float32	r/-
8	0x0008	4	Status_Matrix	UINT32	r/-
10	0x000A	5	Firmw_Vers	float32	r/-
12	0x000C	6	ArticleNo_A	UINT32	r/w
14	0x000E	7	ArticleNo_B	UINT32	r/w
16	0x0010	8	ArticleNo_V	UINT32	r/w
18	0x0012	9	Operation_Hrs	UINT32	r/w
20	0x0014	10	Access_Level	UINT32	r/w
22	0x0016	11	T90_Response	float32	r/w
24	0x0018	12	Perform_Task	UINT32	r/w
26	0x001A	13	Expert_Passw	UINT32	r/w
28	0x001C	14	User_Passw	UINT32	r/w
30	0x001E	15	Setup_Matrix	UINT32	r/w
32	0x0020	16	Modbus_Address	UINT32	r/w
34	0x0022	17	RS485_Baudrate	UINT32	r/w
36	0x0024	18	RS485_Parity	UINT32	r/w
38	0x0026	19	Errors_Status	UINT32	r/-
40	0x0028	20	Ignore_Errors	UINT32	r/w
42	0x002A	21	MaintR_Status	UINT32	r/-
44	0x002C	22	Limits_Status	UINT32	r/-
46	0x002E	23	Relay1_Setup	UINT32	r/w
48	0x0030	24	Relay1_Trigger	UINT32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
50	0x0032	25	Relay2_Setup	UINT32	r/w
52	0x0034	26	Relay2_Trigger	UINT32	r/w
54	0x0036	27	Relay3_Setup	UINT32	r/w
56	0x0038	28	Relay3_Trigger	UINT32	r/w
58	0x003A	29	Relays_Status	UINT32	r/-
60	0x003C	30	BT_Set	float32	r/w
62	0x003E	31	BT_Err_Toler	float32	r/w
64	0x0040	32	BT_Sens_Addr	UINT32	r/w
66	0x0042	33	BT_Contr_ON	UINT32	r/w
68	0x0044	34	BT_Contr_Out	UINT32	r/w
70	0x0046	35	BT_Contr_P	float32	r/w
72	0x0048	36	BT_Contr_I	float32	r/w
74	0x004A	37	BT_Contr_D	float32	r/w
76	0x004C	38	Decimal_Digits	UINT32	r/w
78	0x004E	39	Disp_Lines	UINT32	r/w
80	0x0050	40	Disp_Comp_1	UINT32	r/w
82	0x0052	41	Disp_Comp_2	UINT32	r/w
84	0x0054	42	Disp_Comp_3	UINT32	r/w
86	0x0056	43	Disp_Comp_4	UINT32	r/w
88	0x0058	44	Disp_Comp_5	UINT32	r/w
90	0x005A	45	Disp_Comp_6	UINT32	r/w
92	0x005C	46	Disp_Comp_7	UINT32	r/w
94	0x005E	47	Disp_Comp_8	UINT32	r/w
96	0x0060	48	Ext_Str12	UINT32	r/w
98	0x0062	49	Ext_Str34	UINT32	r/w
100	0x0064	50	Ext_Str56	UINT32	r/w
102	0x0066	51	Ext_Str78	UINT32	r/w
104	0x0068	52	Uout1_Mode	UINT32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
106	0x006A	53	Uout1_Volt	float32	r/-
108	0x006C	54	Uout1_Source	UINT32	r/w
110	0x006E	55	Uout1_Const_V	float32	r/w
112	0x0070	56	Uout1_Err_V	float32	r/w
114	0x0072	57	Uout1_Offset	float32	r/w
116	0x0074	58	Uout1_Gain	float32	r/w
118	0x0076	59	Uout2_Mode	UINT32	r/w
120	0x0078	60	Uout2_Volt	float32	r/-
122	0x007A	61	Uout2_Source	UINT32	r/w
124	0x007C	62	Uout2_Const_V	float32	r/w
126	0x007E	63	Uout2_Err_V	float32	r/w
128	0x0080	64	Uout2_Offset	float32	r/w
130	0x0082	65	Uout2_Gain	float32	r/w
132	0x0084	66	Iout1_Mode	UINT32	r/w
134	0x0086	67	Iout1_mA	float32	r/-
136	0x0088	68	Iout1_Source	UINT32	r/w
138	0x008A	69	Iout1_Const_mA	float32	r/w
140	0x008C	70	Iout1_Err_mA	float32	r/w
142	0x008E	71	Iout1_Offset	float32	r/w
144	0x0090	72	Iout1_Gain	float32	r/w
146	0x0092	73	Iout2_Mode	UINT32	r/w
148	0x0094	74	Iout2_mA	float32	r/-
150	0x0096	75	Iout2_Source	UINT32	r/w
152	0x0098	76	Iout2_Const_mA	float32	r/w
154	0x009A	77	Iout2_Err_mA	float32	r/w
156	0x009C	78	Iout2_Offset	float32	r/w
158	0x009E	79	Iout2_Gain	float32	r/w
160	0x00A0	80	Push_Rate	UINT32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
162	0x00A2	81	PushSource00	UINT32	r/w
164	0x00A4	82	PushSource01	UINT32	r/w
166	0x00A6	83	PushSource02	UINT32	r/w
168	0x00A8	84	PushSource03	UINT32	r/w
170	0x00AA	85	PushSource04	UINT32	r/w
172	0x00AC	86	PushSource05	UINT32	r/w
174	0x00AE	87	PushSource06	UINT32	r/w
176	0x00B0	88	PushSource07	UINT32	r/w
178	0x00B2	89	PushSource08	UINT32	r/w
180	0x00B4	90	PushSource09	UINT32	r/w
182	0x00B6	91	PushSource10	UINT32	r/w
184	0x00B8	92	PushSource11	UINT32	r/w
186	0x00BA	93	PushSource12	UINT32	r/w
188	0x00BC	94	PushSource13	UINT32	r/w
190	0x00BE	95	PushSource14	UINT32	r/w
192	0x00C0	96	PushSource15	UINT32	r/w
194	0x00C2	97	Pressure	float32	r/-
196	0x00C4	98	Press_Ser_No	float32	r/w
198	0x00C6	99	P_Maint_Req	UINT32	r/w
200	0x00C8	100	P_Low_Lim	float32	r/w
202	0x00CA	101	P_High_Lim	float32	r/w
204	0x00CC	102	P_Temp	float32	r/-
206	0x00CE	103	P_Offset	float32	r/w
208	0x00D0	104	P_Gain	float32	r/w
210	0x00D2	105	TCS_Ser_No	UINT32	r/w
212	0x00D4	106	TCS_Maint_Req	float32	r/w
214	0x00D6	107	TCS_Low_Lim	float32	r/w
216	0x00D8	108	TCS_High_Lim	float32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
218	0x00DA	109	TCS_Rt1_0	float32	r/w
220	0x00DC	110	TCS_Rt2_0	float32	r/w
222	0x00DE	111	TCS_Rm_0	float32	r/w
224	0x00E0	112	TCS_Rt1_mV	float32	r/-
226	0x00E2	113	TCS_Rt2_mV	float32	r/-
228	0x00E4	114	TCS_Bridge_mV	float32	r/-
230	0x00E6	115	TCS_Poti	UINT32	r/w
232	0x00E8	116	TCS_TC_Factor	float32	r/w
234	0x00EA	117	TCS_R_Ref	float32	r/w
236	0x00EC	118	TCS_Membr_Temp	float32	r/-
238	0x00EE	119	TCS_Rt2_Temp	float32	r/-
240	0x00F0	120	TCS_Filter_Lim	float32	r/w
242	0x00F2	121	Uin1_mV	float32	r/-
244	0x00F4	122	Uin2_mV	float32	r/-
246	0x00F6	123	Pt_Raw_mV	float32	r/-
248	0x00F8	124	Pt_R0_Ohm	float32	r/w
250	0x00FA	125	Pt_Temperature	float32	r/-
252	0x00FC	126	Test_Signal1	float32	r/w
254	0x00FE	127	Test_Signal2	float32	r/w
256	0x0100	128	Test_Signal3	float32	r/w
258	0x0102	129	Flow_Ser_No	UINT32	r/w
260	0x0104	130	Flow_Maint_Req	UINT32	r/w
262	0x0106	131	F_Low_Lim	float32	r/w
264	0x0108	132	F_High_Lim	float32	r/w
266	0x010A	133	Flow_dP	float32	r/-
268	0x010C	134	Flow_Temp	float32	r/-
270	0x010E	135	Flow_N2_gain	float32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
272	0x0110	136	Flow_H2_gain	float32	r/w
274	0x0112	137	Flow_CO2_gain	float32	r/w
276	0x0114	138	Flow_O2_gain	float32	r/w
278	0x0116	139	Flow_He_gain	float32	r/w
280	0x0118	140	Flow_Ar_gain	float32	r/w
282	0x011A	141	Flow_CH4_gain	float32	r/w
284	0x011C	142	RESERVED_001	float32	r/w
286	0x011E	143	RESERVED_002	float32	r/w
288	0x0120	144	RESERVED_003	float32	r/w
290	0x0122	145	RESERVED_004	float32	r/w
292	0x0124	146	Flow	float32	r/-
294	0x0126	147	IR_Ser_No	UINT32	r/w
296	0x0128	148	IR_Maint_Req	UINT32	r/w
298	0x012A	149	IR_Low_Lim	float32	r/w
300	0x012C	150	IR_High_Lim	float32	r/w
302	0x012E	151	Lamp_Power_Lim	UINT32	r/w
304	0x0130	152	Lamp_Rm	float32	r/-
306	0x0132	153	IR_DFT_Periods	UINT32	r/w
308	0x0134	154	IR1_mV	float32	r/-
310	0x0136	155	IR2_mV	float32	r/-
312	0x0138	156	IR3_mV	float32	r/-
314	0x013A	157	IR4_mV	float32	r/-
316	0x013C	158	IR_FilterCoeff	float32	r/w
318	0x013E	159	IR2_kPlanck	float32	r/w
320	0x0140	160	IR3_kPlanck	float32	r/w
322	0x0142	161	IR4_kPlanck	float32	r/w
324	0x0144	162	IR2_Signal	float32	r/-
326	0x0146	163	IR3_Signal	float32	r/-

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
328	0x0148	164	IR4_Signal	float32	r/-
330	0x014A	165	O2_Ser_No	UINT32	r/w
332	0x014C	166	O2_Maint_Req	UINT32	r/w
334	0x014E	167	O2_Low_Lim	float32	r/w
336	0x0150	168	O2_High_Lim	float32	r/w
338	0x0152	169	O2_Raw	UINT32	r/-
340	0x0154	170	O2_P_Comp	float32	r/-
342	0x0156	171	RH_Ser_No	float32	r/w
344	0x0158	172	RH_Maint_Req	float32	r/w
346	0x015A	173	RH_Low_Lim	float32	r/w
348	0x015C	174	RH_High_Lim	float32	r/w
350	0x015E	175	Rel_Humidity	float32	r/-
352	0x0160	176	RH_Temp	float32	r/-
354	0x0162	177	Residual	float32	r/-
356	0x0164	178	Residual_Name	UINT32	r/w
358	0x0166	179	Buttons_OFF	UINT32	r/w
360	0x0168	180	RESERVED_006	float32	r/w
362	0x016A	181	RESERVED_007	float32	r/w
364	0x016C	182	RESERVED_008	float32	r/w
366	0x016E	183	RESERVED_009	float32	r/w
368	0x0170	184	RESERVED_010	float32	r/w
370	0x0172	185	RESERVED_011	float32	r/w
372	0x0174	186	RESERVED_012	float32	r/w
374	0x0176	187	RESERVED_013	float32	r/w
376	0x0178	188	RESERVED_014	float32	r/w
378	0x017A	189	SignalAdr1	UINT32	r/w
380	0x017C	190	MeasurandName 1	UINT32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
382	0x017E	191	CarrGasName1	UINT32	r/w
384	0x0180	192	MeasurandNorm1	float32	r/w
386	0x0182	193	CarrGasNorm1	float32	r/w
388	0x0184	194	Lin1_Function	UINT32	r/w
390	0x0186	195	Lin1_Coeff_0	float32	r/w
392	0x0188	196	Lin1_Coeff_1	float32	r/w
394	0x018A	197	Lin1_Coeff_2	float32	r/w
396	0x018C	198	Lin1_Coeff_3	float32	r/w
398	0x018E	199	Lin1_Coeff_4	float32	r/w
400	0x0190	200	Lin1_Coeff_5	float32	r/w
402	0x0192	201	Lin1_Coeff_6	float32	r/w
404	0x0194	202	CS1_Press_C0	float32	r/w
406	0x0196	203	CS1_Press_C1	float32	r/w
408	0x0198	204	CS1_DisturbInp	UINT32	r/w
410	0x019A	205	CS1_Function	UINT32	r/w
412	0x019C	206	CS1_Coeff_10	float32	r/w
414	0x019E	207	CS1_Coeff_11	float32	r/w
416	0x01A0	208	CS1_Coeff_12	float32	r/w
418	0x01A2	209	CS1_Coeff_13	float32	r/w
420	0x01A4	210	CS1_Coeff_14	float32	r/w
422	0x01A6	211	CS1_Coeff_15	float32	r/w
424	0x01A8	212	CS1_Coeff_16	float32	r/w
426	0x01AA	213	CS1_Coeff_17	float32	r/w
428	0x01AC	214	CS1_Coeff_18	float32	r/w
430	0x01AE	215	CS1_Coeff_19	float32	r/w
432	0x01B0	216	CS1_Coeff_20	float32	r/w
434	0x01B2	217	CS1_Coeff_21	float32	r/w
436	0x01B4	218	CS1_Coeff_22	float32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
438	0x01B6	219	CS1_Coeff_23	float32	r/w
440	0x01B8	220	CS1_Coeff_24	float32	r/w
442	0x01BA	221	CS1_Coeff_25	float32	r/w
444	0x01BC	222	RESERVED_015	float32	r/w
446	0x01BE	223	RESERVED_016	float32	r/w
448	0x01C0	224	RESERVED_017	float32	r/w
450	0x01C2	225	RESERVED_018	float32	r/w
452	0x01C4	226	RESERVED_019	float32	r/w
454	0x01C6	227	RESERVED_020	float32	r/w
456	0x01C8	228	RESERVED_021	float32	r/w
458	0x01CA	229	RESERVED_022	float32	r/w
460	0x01CC	230	RESERVED_023	float32	r/w
462	0x01CE	231	RESERVED_024	float32	r/w
464	0x01D0	232	Unit1	UINT32	r/w
466	0x01D2	233	Low_Cutoff1	float32	r/w
468	0x01D4	234	High_Cutoff1	float32	r/w
470	0x01D6	235	MR1_Begin	float32	r/w
472	0x01D8	236	MR1_End	float32	r/w
474	0x01DA	237	Offset_Gas1	float32	r/w
476	0x01DC	238	Gain_Gas1	float32	r/w
478	0x01DE	239	Offset1	float32	r/w
480	0x01E0	240	Gain1	float32	r/w
482	0x01E2	241	Limit1_Thrsh_1	float32	r/w
484	0x01E4	242	Limit1_Type_1	UINT32	r/w
486	0x01E6	243	Limit1_Hyst_1	float32	r/w
488	0x01E8	244	Limit1_Thrsh_2	float32	r/w
490	0x01EA	245	Limit1_Type_2	UINT32	r/w
492	0x01EC	246	Limit1_Hyst_2	float32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
494	0x01EE	247	Conc1_Norm	float32	r/-
496	0x01F0	248	Conc1_Lin	float32	r/-
498	0x01F2	249	Conc1_PressCS	float32	r/-
500	0x01F4	250	Conc1_Calib	float32	r/-
502	0x01F6	251	Conc1_CS	float32	r/-
504	0x01F8	252	Concentration1	float32	r/-
506	0x01FA	253	SignalAdr2	UINT32	r/w
508	0x01FC	254	MeasurandName 2	UINT32	r/w
510	0x01FE	255	CarrGasName2	UINT32	r/w
512	0x0200	256	MeasurandNorm2	float32	r/w
514	0x0202	257	CarrGasNorm2	float32	r/w
516	0x0204	258	Lin2_Function	UINT32	r/w
518	0x0206	259	Lin2_Coeff_0	float32	r/w
520	0x0208	260	Lin2_Coeff_1	float32	r/w
522	0x020A	261	Lin2_Coeff_2	float32	r/w
524	0x020C	262	Lin2_Coeff_3	float32	r/w
526	0x020E	263	Lin2_Coeff_4	float32	r/w
528	0x0210	264	Lin2_Coeff_5	float32	r/w
530	0x0212	265	Lin2_Coeff_6	float32	r/w
532	0x0214	266	CS2_Press_C0	float32	r/w
534	0x0216	267	CS2_Press_C1	float32	r/w
536	0x0218	268	CS2_DisturbInp	UINT32	r/w
538	0x021A	269	CS2_Function	UINT32	r/w
540	0x021C	270	CS2_Coeff_10	float32	r/w
542	0x021E	271	CS2_Coeff_11	float32	r/w
544	0x0220	272	CS2_Coeff_12	float32	r/w
546	0x0222	273	CS2_Coeff_13	float32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
548	0x0224	274	CS2_Coeff_14	float32	r/w
550	0x0226	275	CS2_Coeff_15	float32	r/w
552	0x0228	276	CS2_Coeff_16	float32	r/w
554	0x022A	277	CS2_Coeff_17	float32	r/w
556	0x022C	278	CS2_Coeff_18	float32	r/w
558	0x022E	279	CS2_Coeff_19	float32	r/w
560	0x0230	280	CS2_Coeff_20	float32	r/w
562	0x0232	281	CS2_Coeff_21	float32	r/w
564	0x0234	282	CS2_Coeff_22	float32	r/w
566	0x0236	283	CS2_Coeff_23	float32	r/w
568	0x0238	284	CS2_Coeff_24	float32	r/w
570	0x023A	285	CS2_Coeff_25	float32	r/w
572	0x023C	286	RESERVED_025	float32	r/w
574	0x023E	287	RESERVED_026	float32	r/w
576	0x0240	288	RESERVED_027	float32	r/w
578	0x0242	289	RESERVED_028	float32	r/w
580	0x0244	290	RESERVED_029	float32	r/w
582	0x0246	291	RESERVED_030	float32	r/w
584	0x0248	292	RESERVED_031	float32	r/w
586	0x024A	293	RESERVED_032	float32	r/w
588	0x024C	294	RESERVED_033	float32	r/w
590	0x024E	295	RESERVED_034	float32	r/w
592	0x0250	296	Unit2	UINT32	r/w
594	0x0252	297	Low_Cutoff2	float32	r/w
596	0x0254	298	High_Cutoff2	float32	r/w
598	0x0256	299	MR2_Begin	float32	r/w
600	0x0258	300	MR2_End	float32	r/w
602	0x025A	301	Offset_Gas2	float32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
604	0x025C	302	Gain_Gas2	float32	r/w
606	0x025E	303	Offset2	float32	r/w
608	0x0260	304	Gain2	float32	r/w
610	0x0262	305	Limit2_Thrsh_1	float32	r/w
612	0x0264	306	Limit2_Type_1	UINT32	r/w
614	0x0266	307	Limit2_Hyst_1	float32	r/w
616	0x0268	308	Limit2_Thrsh_2	float32	r/w
618	0x026A	309	Limit2_Type_2	UINT32	r/w
620	0x026C	310	Limit2_Hyst_2	float32	r/w
622	0x026E	311	Conc2_Norm	float32	r/-
624	0x0270	312	Conc2_Lin	float32	r/-
626	0x0272	313	Conc2_PressCS	float32	r/-
628	0x0274	314	Conc2_Calib	float32	r/-
630	0x0276	315	Conc2_CS	float32	r/-
632	0x0278	316	Concentration2	float32	r/-
634	0x027A	317	SignalAdr3	UINT32	r/w
636	0x027C	318	MeasurandName 3	UINT32	r/w
638	0x027E	319	CarrGasName3	UINT32	r/w
640	0x0280	320	MeasurandNorm3	float32	r/w
642	0x0282	321	CarrGasNorm3	float32	r/w
644	0x0284	322	Lin3_Function	UINT32	r/w
646	0x0286	323	Lin3_Coeff_0	float32	r/w
648	0x0288	324	Lin3_Coeff_1	float32	r/w
650	0x028A	325	Lin3_Coeff_2	float32	r/w
652	0x028C	326	Lin3_Coeff_3	float32	r/w
654	0x028E	327	Lin3_Coeff_4	float32	r/w
656	0x0290	328	Lin3_Coeff_5	float32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
658	0x0292	329	Lin3_Coeff_6	float32	r/w
660	0x0294	330	CS3_Press_C0	float32	r/w
662	0x0296	331	CS3_Press_C1	float32	r/w
664	0x0298	332	CS3_DisturbInp	UINT32	r/w
666	0x029A	333	CS3_Function	UINT32	r/w
668	0x029C	334	CS3_Coeff_10	float32	r/w
670	0x029E	335	CS3_Coeff_11	float32	r/w
672	0x02A0	336	CS3_Coeff_12	float32	r/w
674	0x02A2	337	CS3_Coeff_13	float32	r/w
676	0x02A4	338	CS3_Coeff_14	float32	r/w
678	0x02A6	339	CS3_Coeff_15	float32	r/w
680	0x02A8	340	CS3_Coeff_16	float32	r/w
682	0x02AA	341	CS3_Coeff_17	float32	r/w
684	0x02AC	342	CS3_Coeff_18	float32	r/w
686	0x02AE	343	CS3_Coeff_19	float32	r/w
688	0x02B0	344	CS3_Coeff_20	float32	r/w
690	0x02B2	345	CS3_Coeff_21	float32	r/w
692	0x02B4	346	CS3_Coeff_22	float32	r/w
694	0x02B6	347	CS3_Coeff_23	float32	r/w
696	0x02B8	348	CS3_Coeff_24	float32	r/w
698	0x02BA	349	CS3_Coeff_25	float32	r/w
700	0x02BC	350	RESERVED_035	float32	r/w
702	0x02BE	351	RESERVED_036	float32	r/w
704	0x02C0	352	RESERVED_037	float32	r/w
706	0x02C2	353	RESERVED_038	float32	r/w
708	0x02C4	354	RESERVED_039	float32	r/w
710	0x02C6	355	RESERVED_040	float32	r/w
712	0x02C8	356	RESERVED_041	float32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
714	0x02CA	357	RESERVED_042	float32	r/w
716	0x02CC	358	RESERVED_043	float32	r/w
718	0x02CE	359	RESERVED_044	float32	r/w
720	0x02D0	360	Unit3	UINT32	r/w
722	0x02D2	361	Low_Cutoff3	float32	r/w
724	0x02D4	362	High_Cutoff3	float32	r/w
726	0x02D6	363	MR3_Begin	float32	r/w
728	0x02D8	364	MR3_End	float32	r/w
730	0x02DA	365	Offset_Gas3	float32	r/w
732	0x02DC	366	Gain_Gas3	float32	r/w
734	0x02DE	367	Offset3	float32	r/w
736	0x02E0	368	Gain3	float32	r/w
738	0x02E2	369	Limit3_Thrsh_1	float32	r/w
740	0x02E4	370	Limit3_Type_1	UINT32	r/w
742	0x02E6	371	Limit3_Hyst_1	float32	r/w
744	0x02E8	372	Limit3_Thrsh_2	float32	r/w
746	0x02EA	373	Limit3_Type_2	UINT32	r/w
748	0x02EC	374	Limit3_Hyst_2	float32	r/w
750	0x02EE	375	Conc3_Norm	float32	r/-
752	0x02F0	376	Conc3_Lin	float32	r/-
754	0x02F2	377	Conc3_PressCS	float32	r/-
756	0x02F4	378	Conc3_Calib	float32	r/-
758	0x02F6	379	Conc3_CS	float32	r/-
760	0x02F8	380	Concentration3	float32	r/-
762	0x02FA	381	SignalAdr4	UINT32	r/w
764	0x02FC	382	MeasurandName 4	UINT32	r/w
766	0x02FE	383	CarrGasName4	UINT32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
768	0x0300	384	MeasurandNorm4	float32	r/w
770	0x0302	385	CarrGasNorm4	float32	r/w
772	0x0304	386	Lin4_Function	UINT32	r/w
774	0x0306	387	Lin4_Coeff_0	float32	r/w
776	0x0308	388	Lin4_Coeff_1	float32	r/w
778	0x030A	389	Lin4_Coeff_2	float32	r/w
780	0x030C	390	Lin4_Coeff_3	float32	r/w
782	0x030E	391	Lin4_Coeff_4	float32	r/w
784	0x0310	392	Lin4_Coeff_5	float32	r/w
786	0x0312	393	Lin4_Coeff_6	float32	r/w
788	0x0314	394	CS4_Press_C0	float32	r/w
790	0x0316	395	CS4_Press_C1	float32	r/w
792	0x0318	396	CS4_DisturbInp	UINT32	r/w
794	0x031A	397	CS4_Function	UINT32	r/w
796	0x031C	398	CS4_Coeff_10	float32	r/w
798	0x031E	399	CS4_Coeff_11	float32	r/w
800	0x0320	400	CS4_Coeff_12	float32	r/w
802	0x0322	401	CS4_Coeff_13	float32	r/w
804	0x0324	402	CS4_Coeff_14	float32	r/w
806	0x0326	403	CS4_Coeff_15	float32	r/w
808	0x0328	404	CS4_Coeff_16	float32	r/w
810	0x032A	405	CS4_Coeff_17	float32	r/w
812	0x032C	406	CS4_Coeff_18	float32	r/w
814	0x032E	407	CS4_Coeff_19	float32	r/w
816	0x0330	408	CS4_Coeff_20	float32	r/w
818	0x0332	409	CS4_Coeff_21	float32	r/w
820	0x0334	410	CS4_Coeff_22	float32	r/w
822	0x0336	411	CS4_Coeff_23	float32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
824	0x0338	412	CS4_Coeff_24	float32	r/w
826	0x033A	413	CS4_Coeff_25	float32	r/w
828	0x033C	414	RESERVED_045	float32	r/w
830	0x033E	415	RESERVED_046	float32	r/w
832	0x0340	416	RESERVED_047	float32	r/w
834	0x0342	417	RESERVED_048	float32	r/w
836	0x0344	418	RESERVED_049	float32	r/w
838	0x0346	419	RESERVED_050	float32	r/w
840	0x0348	420	RESERVED_051	float32	r/w
842	0x034A	421	RESERVED_052	float32	r/w
844	0x034C	422	RESERVED_053	float32	r/w
846	0x034E	423	RESERVED_054	float32	r/w
848	0x0350	424	Unit4	UINT32	r/w
850	0x0352	425	Low_Cutoff4	float32	r/w
852	0x0354	426	High_Cutoff4	float32	r/w
854	0x0356	427	MR4_Begin	float32	r/w
856	0x0358	428	MR4_End	float32	r/w
858	0x035A	429	Offset_Gas4	float32	r/w
860	0x035C	430	Gain_Gas4	float32	r/w
862	0x035E	431	Offset4	float32	r/w
864	0x0360	432	Gain4	float32	r/w
866	0x0362	433	Limit4_Thrsh_1	float32	r/w
868	0x0364	434	Limit4_Type_1	UINT32	r/w
870	0x0366	435	Limit4_Hyst_1	float32	r/w
872	0x0368	436	Limit4_Thrsh_2	float32	r/w
874	0x036A	437	Limit4_Type_2	UINT32	r/w
876	0x036C	438	Limit4_Hyst_2	float32	r/w
878	0x036E	439	Conc4_Norm	float32	r/-

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
880	0x0370	440	Conc4_Lin	float32	r/-
882	0x0372	441	Conc4_PressCS	float32	r/-
884	0x0374	442	Conc4_Calib	float32	r/-
886	0x0376	443	Conc4_CS	float32	r/-
888	0x0378	444	Concentration4	float32	r/-
890	0x037A	445	MGM_List	UINT32	r/w
892	0x037C	446	MGM_Select	UINT32	r/w
894	0x037E	447	RESERVED_055	UINT32	r/w
896	0x0380	448	SignalAdr5	UINT32	r/w
898	0x0382	449	MeasurandName 5	UINT32	r/w
900	0x0384	450	CarrGasName5	UINT32	r/w
902	0x0386	451	MeasurandNorm5	float32	r/w
904	0x0388	452	CarrGasNorm5	float32	r/w
906	0x038A	453	Lin5_Function	UINT32	r/w
908	0x038C	454	Lin5_Coeff_0	float32	r/w
910	0x038E	455	Lin5_Coeff_1	float32	r/w
912	0x0390	456	Lin5_Coeff_2	float32	r/w
914	0x0392	457	Lin5_Coeff_3	float32	r/w
916	0x0394	458	Lin5_Coeff_4	float32	r/w
918	0x0396	459	Lin5_Coeff_5	float32	r/w
920	0x0398	460	Lin5_Coeff_6	float32	r/w
922	0x039A	461	CS5_Press_C0	float32	r/w
924	0x039C	462	CS5_Press_C1	float32	r/w
926	0x039E	463	CS5_DisturbInp	UINT32	r/w
928	0x03A0	464	CS5_Function	UINT32	r/w
930	0x03A2	465	CS5_Coeff_10	float32	r/w
932	0x03A4	466	CS5_Coeff_11	float32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
934	0x03A6	467	CS5_Coeff_12	float32	r/w
936	0x03A8	468	CS5_Coeff_13	float32	r/w
938	0x03AA	469	CS5_Coeff_14	float32	r/w
940	0x03AC	470	CS5_Coeff_15	float32	r/w
942	0x03AE	471	CS5_Coeff_16	float32	r/w
944	0x03B0	472	CS5_Coeff_17	float32	r/w
946	0x03B2	473	CS5_Coeff_18	float32	r/w
948	0x03B4	474	CS5_Coeff_19	float32	r/w
950	0x03B6	475	CS5_Coeff_20	float32	r/w
952	0x03B8	476	CS5_Coeff_21	float32	r/w
954	0x03BA	477	CS5_Coeff_22	float32	r/w
956	0x03BC	478	CS5_Coeff_23	float32	r/w
958	0x03BE	479	CS5_Coeff_24	float32	r/w
960	0x03C0	480	CS5_Coeff_25	float32	r/w
962	0x03C2	481	RESERVED_056	float32	r/w
964	0x03C4	482	RESERVED_057	float32	r/w
966	0x03C6	483	RESERVED_058	float32	r/w
968	0x03C8	484	RESERVED_059	float32	r/w
970	0x03CA	485	RESERVED_060	float32	r/w
972	0x03CC	486	RESERVED_061	float32	r/w
974	0x03CE	487	RESERVED_062	float32	r/w
976	0x03D0	488	RESERVED_063	float32	r/w
978	0x03D2	489	RESERVED_064	float32	r/w
980	0x03D4	490	RESERVED_065	float32	r/w
982	0x03D6	491	Unit5	UINT32	r/w
984	0x03D8	492	Low_Cutoff5	float32	r/w
986	0x03DA	493	High_Cutoff5	float32	r/w
988	0x03DC	494	MR5_Begin	float32	r/w

Address (dec)	Address (hex)	Parameter number	Parameter Name	Data type	read/write
990	0x03DE	495	MR5_End	float32	r/w
992	0x03E0	496	Offset_Gas5	float32	r/w
994	0x03E2	497	Gain_Gas5	float32	r/w
996	0x03E4	498	Offset5	float32	r/w
998	0x03E6	499	Gain5	float32	r/w
1000	0x03E8	500	Limit5_Thrsh_1	float32	r/w
1002	0x03EA	501	Limit5_Type_1	UINT32	r/w
1004	0x03EC	502	Limit5_Hyst_1	float32	r/w
1006	0x03EE	503	Limit5_Thrsh_2	float32	r/w
1008	0x03F0	504	Limit5_Type_2	UINT32	r/w
1010	0x03F2	505	Limit5_Hyst_2	float32	r/w
1012	0x03F4	506	Conc5_Norm	float32	r/-
1014	0x03F6	507	Conc5_Lin	float32	r/-
1016	0x03F8	508	Conc5_PressCS	float32	r/-
1018	0x03FA	509	Conc5_Calib	float32	r/-
1020	0x03FC	510	Conc5_CS	float32	r/-
1022	0x03FE	511	Concentration5	float32	r/-