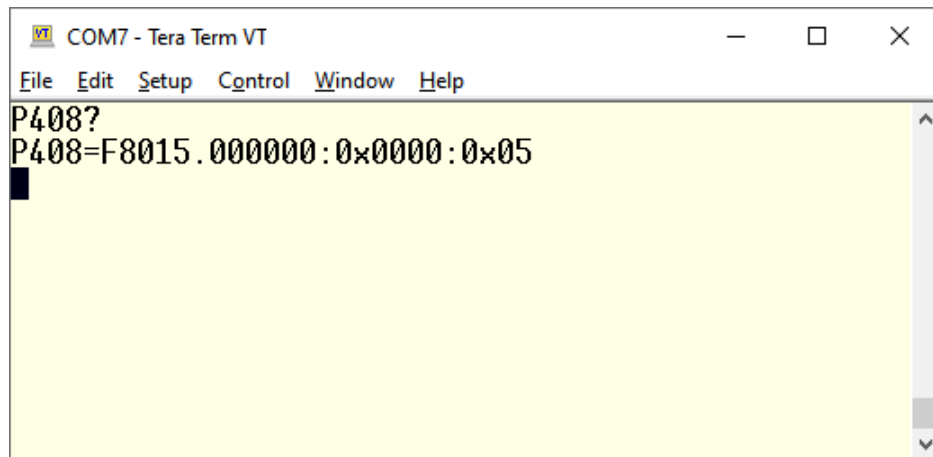


Applies to FTC320 and FTC400

Remote Control via Serial Communication



The image shows a screenshot of a terminal window titled "COM7 - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". The terminal content displays two lines of text: "P408?" followed by "P408=F8015.000000:0x0000:0x05". A cursor is visible on the line containing the data.

```
COM7 - Tera Term VT
File Edit Setup Control Window Help
P408?
P408=F8015.000000:0x0000:0x05
```

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1. Introduction

The configuration of the device is defined by about 400 parameters. Using programs for serial communication like e.g. Tera Term the user has access to these values.

For basic configuration of the device or triggering of a calibration it is strongly recommended to use menu controlled procedures via the control panel of the FTC320/400. Controlled procedures prevent handling errors. Of course this is not possible for OEM-devices.

Not sure if you are connected to the device?

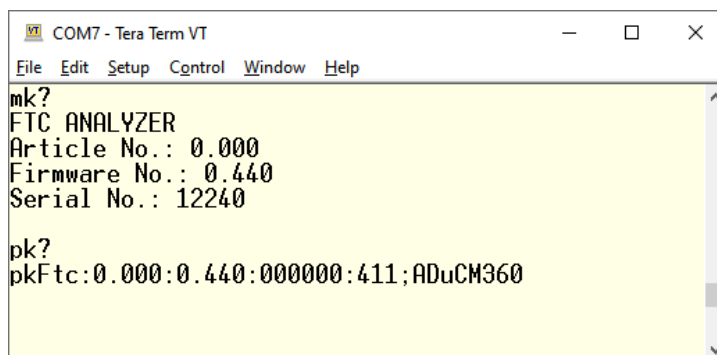
Send one of the following commands to receive an Identification message from the device:

- mk?

or

- pk?

The device should greet you back with a short message as shown in Figure 1.



```
COM7 - Tera Term VT
File Edit Setup Control Window Help
mk?
FTC ANALYZER
Article No.: 0.000
Firmware No.: 0.440
Serial No.: 12240
pk?
pkFtc:0.000:0.440:000000:411;ADuCM360
```

Figure 1 - Functional test using Identification messages

Note: Commands need to end with a Carriage Return (Hex: 0x0D), in Tera Term this can be set up in "Setup→Terminal...→Transmit: CR".



Read this manual and the manual of the device carefully before performing any action described in this manual.



Information on the installation of the RS232 interface and the necessary PC settings are given in the manual of the device.



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 **software versions between version 0.400 to 0.458**. Parameter numbers may be offset for your software. Please refer to the parameter list of your specific device.*

1.1. Cheat sheet

Small collection of useful commands:

Get Parameter name (here: "Block_Temp")

- P48N

Get Parameter value (here: Gas concentration measured by thermal conductivity)

- P408?

Set Parameter value (here: set Offset Reference Gas to 100 Vol%)

- P398=F1000000.0

Calibrate the offset of Thermal Conductivity measurement Channel (**Careful!** Read manual first!)

- P12=F250

You cannot change a parameter/perform an action? You probably need to log in as Expert. **Proceed with caution!** Access Level remains for max. 1hour, then reverts to User

- E@222

Note: Concentration 5 is the concentration of the gas measured by Thermal Conductivity (e.g. Hydrogen)! Channels 1-4 are relevant for devices with additional gas sensors: (Infrared on channels 2-4, Humidity sensor or Oxygen sensor via channel 1).

Table 1 - List of important parameters

P.No.	Name	Description	Access Expert / User
8	Access_Level	Current Access Level, can be User(0x001), Expert (0x010) or Messkonzept (0x100)	Read / Read
48	Block_Temp	Temperature of the device body. Should show a stable value during operation (63 °C for most devices).	Read / Read
116	Pressure	Currently measured gas pressure (not available in all devices)	Read / Read
133	TCS_Rm_V	Raw signal of the Thermal Conductivity sensor, typically between 1500 mV and 7000 mV	Read / Read
212	Offset_Gas1	Ref. gas concentration (in ppm) for offset calibration of channel 1 (AUX)	Write/ Write
213	Gain_Gas1	Ref. gas concentration (in ppm) for gain calibration of channel 1 (AUX)	Write/ Write
222	Concentration1	Calibrated gas concentration (in ppm) of channel 1 (AUX)	Read / Read
258	Offset_Gas2	Ref. gas concentration (in ppm) for offset calibration of channel 2 (IR2)	Write/ Write
259	Gain_Gas2	Ref. gas concentration (in ppm) for gain calibration of channel 2 (IR2)	Write/ Write
268	Concentration2	Calibrated gas concentration (in ppm) of channel 2 (IR2)	Read / Read
304	Offset_Gas3	Ref. gas concentration (in ppm) for offset calibration of channel 3 (IR3)	Write/ Write
305	Gain_Gas3	Ref. gas concentration (in ppm) for gain calibration of channel 3 (IR3)	Write/ Write
314	Concentration3	Calibrated gas concentration (in ppm) of channel 3 (IR3)	Read / Read
350	Offset_Gas4	Ref. gas concentration (in ppm) for offset calibration of channel 4 (IR4)	Write/ Write
351	Gain_Gas4	Ref. gas concentration (in ppm) for gain calibration of channel 4 (IR4)	Write/ Write
360	Concentration4	Calibrated gas concentration (in ppm) of channel 4 (IR4)	Read / Read
362	MultGas_Select	Selection of the gaspair to be measured by channel 5 (Thermal Conductivity measurement)	Read / Write
398	Offset_Gas5	Ref. gas concentration (in ppm) for offset calibration of channel 5 (Thermal Conductivity measurement)	Write/ Write
399	Gain_Gas5	Ref. gas concentration (in ppm) for gain calibration of channel 5 (Thermal Conductivity measurement)	Write/ Write
408	Concentration5	Calibrated gas concentration (in ppm) of channel 5 (Thermal Conductivity measurement)	Read / Read

2. Command Syntax

2.1. Read and Write Commands

The setting of the device is defined by a set of parameters. The list of parameters is enclosed in the delivery. Each parameter is addressed by its number written in first column.

2.2. Read Command

A simple example is the query of the value of a parameter: Parameter 408 “Concentration5” contains the gas concentration measured by thermal conductivity in ppm.

A question mark is used to indicate a query, the string:

- P408?

followed by CR command queries the measured gas concentration. The answer is a string containing the questioned parameter, its value and a system status byte, for example:

- P408=F585646.875000:0x0000:0x05

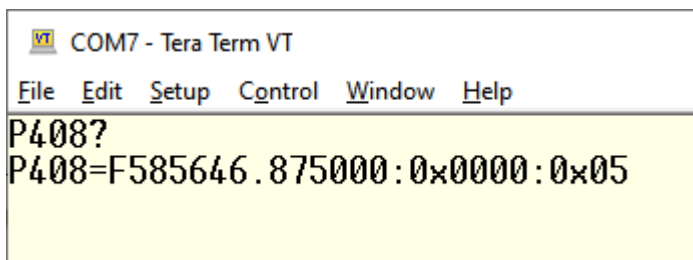


Figure 2 - Reading the gas concentration (in unit ppm)

Table 2 - Syntax of a returned value

Queried parameter	Float - type of following value	Value, here 58.56 Vol. %		Device status-bitmask	Command status, here „success!“
P408=	F	585646.875000	:	0x0000	: 0x05

2.3. Parameter Name request

A modified read command, with “N” replacing “?” returns the name of the parameter instead of its value. The query

- P408N

returns

- P408=Concentration5:0x0000:0x05

A query following the examples above can be applied to all parameters. Some of the parameters are “read-only”. Those parameters contain values that are measured by the device and are not suited for modification.

2.4. Write Command

As a protection mechanism, most parameters of the FTC320 are write-protected in the Access Level "User"! Many more parameters may be changed in the Access Level "Expert", see Section 2.5.

The write command is explained in the example of setting the offset reference gas concentration in the FTC320 before performing a calibration:

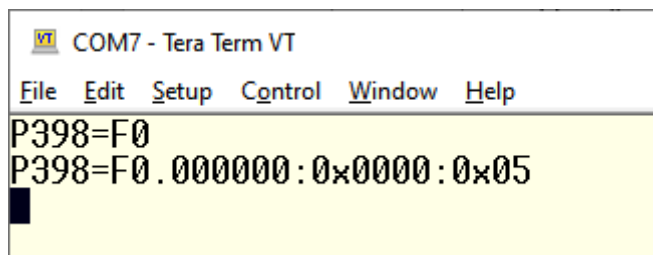
Assume we want to calibrate a device measuring in a range of 0-100 Vol. % H₂ in N₂. Typically a simple offset calibration using Nitrogen as a reference will suffice. Before triggering the calibration routine, we need to tell the analyzer at which reference gas it will be calibrated: Hence we will need to set the offset reference of 0 Vol. % = 0 ppm H₂ in N₂.

The command

- `P398=F0`

sets the offset reference to 0 ppm = 0.00 Vol%.

Note that the value is preceded by a capital "F", which indicates the data type float. Alternatively we could write: "`P398=F0.0`"



```

VT COM7 - Tera Term VT
File Edit Setup Control Window Help
P398=F0
P398=F0.000000:0x0000:0x05

```

Figure 3 - Setting the offset calibration's reference gas concentration of channel 5

After execution of the command the device returns

"`P398=F0.000000:0x0000:0x05`", the syntax is the same as the response to a query of that parameter.



Please note that parameter numbers might be different in your software version. Please check the parameter name before writing (e.g. send: "`P398N`", or query all parameters for a complete list before changing settings, see Section 3.1)



The parameters have only two different types: float (F) and hexadecimal (X). Floats are also used for numbers of integer values.



The internal update cycle of the device demands for polling frequencies below 5Hz.



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

2.5. Login / Change of Access Level (before FW Version 0.458)

NOTE: As the Login-Feature caused much confusion for many customers, it was removed from the Firmware in versions 0.458 and later. Please proceed with caution, as there will be no access protection against accidental misconfiguration.

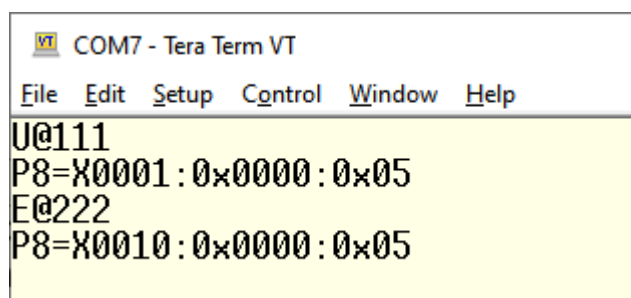
To protect common device users from operating errors, many actions may be performed only by an "Expert" after entering a password. Please proceed with caution! With the Access Level "Expert" you might misconfigure important device features such as the Analogue Outputs or Relay Settings etc. Some settings may only be made by Messkonzept - these will not be changeable even with the Access Level "Expert".

To obtain the "Expert" level, send: "E@[password]" followed by a carriage return (CR) to the device. The default Expert password is 222.

If you wish to reset to the "User" state, send: "E@[password]" followed by a carriage return (CR) to the device. The default user password is 111.

In response to this login you will get a different Access_Level (coded in parameter 8). In the following screenshot you can see the different responds to the Access Levels User (default after startup) and Expert in parameter 8.

The Access Level remains set for one hour, then is automatically reset to "User". If you are unsure which Access Level you currently have, you can query this using the command "P8?".



```
COM7 - Tera Term VT
File Edit Setup Control Window Help
U@111
P8=X0001:0x0000:0x05
E@222
P8=X0010:0x0000:0x05
```

Figure 4 - Login as User and Expert

The access level has an effect on actions (parameter 12, Section 3.1) but also to writing of parameters. Some parameters (such as the measured gas concentration) will be read-only (RRR) for all access levels.

3. Specific Applications

3.1. Triggering of Internal Routines/"Special Action" Command

P12 ("Perform Task") is able to trigger the execution of internal routines, which gives it an exceptional position among the RW parameters. Setting parameter P12 to a certain value leads to the execution of one of the routines in the table below. After processing a routine P12 is automatically set back to "0".

Note that for some actions the Access Level "Expert" is required, see section 2.5.

Table 3 - Actions triggered by P12

Command	Executed Procedure
Access Level: EXPERT	
P12 = F99	Print parameter list
P12 = F0	Do nothing
P12 = F100	Restart system
P12 = F154	Scan Bridge Balance
P12 = F98	Query device protocol
Access Level: USER	
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

3.2. 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 evaluated 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 (Requires Expert 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).

Push-Mode

Please make sure that the parameter numbers given here correspond with your device.

To work with push-mode we need the Access Level “Expert”:

- E@222

First, write the parameter numbers that should be pushed into the “PushSource”-parameters PushSource00 to PushSource15 (P100 to P115):

Assume we want to push the gas concentration measured by thermal conductivity (P408) and the Block Temperature of the device (P48). For that we need to set the PushSource-parameters PushSource00 (P100) and PushSource01 (P101):

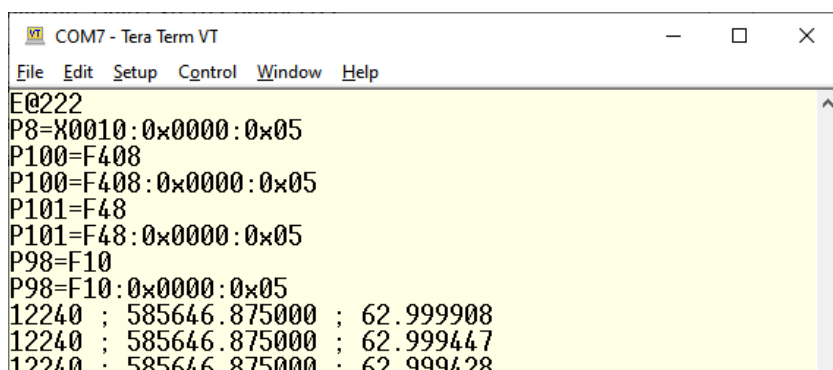
- P100=F408
- P101=F48

Push-Mode is activated using parameter 98 “Push_Rate”:

- P98=F10

A value of 10 will push every 10 cycles of the device’s measure loop, one cycle is ~100ms.

The device will now output the measured gas concentration and the temperature of the device continuously at a rate of about 1Hz. The first number in each output line (here “12240”) is the device’s serial number.



```

COM7 - Tera Term VT
File Edit Setup Control Window Help
E@222
P8=X0010:0x0000:0x05
P100=F408
P100=F408:0x0000:0x05
P101=F48
P101=F48:0x0000:0x05
P98=F10
P98=F10:0x0000:0x05
12240 ; 585646.875000 ; 62.999908
12240 ; 585646.875000 ; 62.999447
12240 ; 585646.875000 ; 62.999447
  
```

Figure 5 - Configuration of a device for push-mode

To stop the Push-Mode, set

- P98=F0

Note: Setting this parameter requires Expert Mode, which is automatically set back to User after some time.

3.3. Analogue Output Configuration (FW Version 0.454 to 0.458)

NOTE: The analogue outputs of devices with firmware versions before version 0.454 are configured differently, see Section 0.

There are three analogue outputs: one current loop and two voltage signals which may be configured according to your requirements. Depending on the requirements, there are four different modes to be set for each analogue output. The modes are described in the following Table:

Table 4 - 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 output, it is necessary to set parameter values on the device. In order to do that, send the following command via RS232 to your device.

- "P[P.No]=F[ParameterValue]" for float values
- "P[P.No]=X[ParameterValue]" for integer values

The syntax above is the format to set the parameter number "P.No" to the required value "ParameterValue". The datatype prefixes are also listed in Table 4.

To configure the analogue output, follow these steps:

- 1) Check Table 4 for parameter numbers and possible set values.
- 2) Set required mode.

Example:

Set first **voltage output (UOut1)** to mode "U_OUT_CONST" with command:

- P66 = X1

- 3) Assign output mode to requested measuring channel.

Example:

Assign first **voltage output (UOut1)** to channel 5 (TC) with command:

- P68=X363
- 4) **Optional:** If “FLEX”-mode chosen for current output, then set error current.
Example:
 Set error current for IOut1 to 1.5 mA with command:
- P87 = F1.5
- 5) **Optional:** If “CONST”-mode chosen, then set a constant analogue output.
Example:
 Set constant voltage output for Uout1 to 10V with command:
- P69 = F10

Table 5 - List of commands for analogue output configuration

Parameter name	P. No	Datatype Prefix	Set_Value	Mode
Activation				
UOut1_Mode	66	X	1	U_OUT_CONST
UOut2_Mode	74	X	2	U_OUT_0_10
			3	U_OUT_0_5
IOut1_Mode	82	X	4	U_OUT_2_10_ERR_1_5
			1	I_OUT_CONST
IOut2Mode	90	X	2	I_OUT_4_20_FLEX_ERR
			3	I_OUT_0_20_ERR_21
			4	I_OUT_0_20
Set source				
Uout1_Source	68	F	223 269 315 363	Concentration of Channel: 2 (“IR2”) 3 (“IR3”) 4 (“IR4”) 5 (“TC”)
UOut2_Source	76	F		
IOut1_Source	84	F		
IOut2_Source	92	F		
Set voltage or current value (only available for “CONST”-Modes)				
Uout1_Const_V	69	F	Value in range 0...12 [V] (driver circuit limited at ~10.7 V)	
Uout2_Const_V	77	F		
IOut1_Const_mA	85	F	Value in range 0...24 [mA]	
IOut2_Const_mA	93	F		
Set error values (only available for “FLEX”-Modes)				
Iout1_Err_mA	87	F	Value in range 0...24 [mA]	
Iout2_Err_mA	95	F		



Caution!

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

Offset and Gain for analogue output

The analogue output has the option for gain and offset calibration like the calibration of the measurement signals. The offset and gain value can be set manually by sending commands like shown above via RS232.

For detailed information about the gain und offset calibration read further in the manual.

Setting offset or gain value by setting **parameter** (read Table 6) to **value**:

Example:

Set offset for first analogue output (UOut1) to 2 V.

- **P72 = F2**

Table 6 - List of gain and offset parameters for analogue output

Parameter name	P.No	Datatype Prefix
UOut1_Offset UOut2_Offset	72 80	F
UOut1_Gain UOut2_Gain	73 81	F
IOut1_Offset IOut2_Offset	88 96	F
IOut1_Gain IOut2_Gain	89 97	F

3.4. Analogue Output Configuration (up to FW Version 0.453)

NOTE: The analogue outputs of devices with firmware versions 0.454 to version 0.458 are configured differently, see Section 3.3.

There are three analogue outputs: one current loop (4 – 20 mA) and two voltage signals (0 – 10 V) which may be configured according to your requirements.

The configuration is done in three steps:

- 1) Activate analogue output.
- 2) Set source signal of analogue output.
- 3) Adjust the output range by setting min and max value.

In practise these steps are performed by sending commands via RS232 to the device. The command follows the scheme "**P [P.No] =F [Set_Value]**" for float values and "**P [P.No] =X [Set_Value]**" for integer values, which are send by appending a carriage return (CR).

An overview of the commands is given in Table 7. "UOut1"-Parameters refer to the first voltage analogue output, "UOut2" to the second voltage output and "IOut1" to the current output.

Table 7 - List of commands for analogue output configuration

Parameter name	P.No	Datatype Prefix	Set_Value	Function
Activation				
UOut1_Mode	66	X	0	Deactivate
UOut2_Mode	74	X	1	Activate
IOut1_Mode	82	X		
Set source				
Uout1_Source	68	F	177	Concentration of Channel: 1 ("AUX") 2 ("IR4") 3 ("IR4") 4 ("IR4") 5 ("TC")
UOut2_Source	74	F	223	
IOut1_Source	84	F	269	
			315	
			363	
Adjust the range of analogue outputs				
Uout1_Min_Volt	69	F	0....10 V	Set lower and upper voltage values
Uout1_Max_Volt	70			
Uout2_Min_Volt	77	F	4....20 mA	Set lower and upper current values
Uout2_Max_Volt	78			
Iout1_Min_mA	85	F		
Iout1_Max_mA	86			

**Caution!**

The FTC320 OEM only has two voltage and no current analogue output to be set.

Example:

Assume we have a FTC320 device, which measures H₂ in N₂ in the range 0-10% by thermal conductivity (TC) measurement.

We want to configure **voltage output 1** such that:

- beginning of range (0%) is indicated with 0 V and
- End of range (10%) is indicated with 8 V.

Step 1) Activate analogue output

Activate the first voltage analogue output. For voltage output 1, set "UOut1_Mode" to **value 1**.

- P66=X1

Step 2) Set source signal of analogue output

The TC-measurement is monitored on channel 5.

Set "UOut1_Source" to **channel 5**. The parameter number can be looked up in Table 7.

- P68=X363

Step 3) Adjust the output range by setting min and max value

As the last step we define, which voltages should be output for the beginning/end of range (0 Vol.% / 10 Vol.%). As stated above, for the example we assume 0V at 0 Vol. % and 8 V at 10 Vol. %:

Set "Uout1_Min_Volt" to 0 V.

- P69=F0

Set "Uout1_Max_Volt" on 8 V.

- P70=F8

As a result, we have configured an analogue output reacting to H2 in N2 responding with 0V to 0 Vol.% and 8V to 10 Vol.% H2 in N2.

3.5. 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		<input checked="" type="checkbox"/>
	01. O2 in N2	0-100		<input checked="" type="checkbox"/>
	02. He in N2	0-100		<input checked="" type="checkbox"/>
	03. CO2 in N2	0-100		<input checked="" type="checkbox"/>
	04. N2 in Ar	0-100		<input checked="" type="checkbox"/>
	05. O2 in Ar	0-100		<input checked="" type="checkbox"/>
	06. H2 in Ar	0-100		<input checked="" type="checkbox"/>
	07. He in Ar	0-100		<input checked="" type="checkbox"/>
	08. CO2 in Ar	0-60		<input checked="" type="checkbox"/>
	09. Ar in CO2	40-100		<input checked="" type="checkbox"/>
	10. CH4 in N2	0-100		<input checked="" type="checkbox"/>
	11. CH4 in Ar	0-100		<input checked="" type="checkbox"/>
	12. Ar in O2	0-100		<input checked="" type="checkbox"/>
	13. N2 in H2	0-100		<input checked="" type="checkbox"/>
	14. O2 in CO2	0-100		<input checked="" type="checkbox"/>
	15. H2 in O2	0-100		<input type="checkbox"/>
16. O2 in H2			<input type="checkbox"/>	

Figure 6 - List of preconfigured gas pairs (found in the device protocol)

The currently selected gas pair, e.g. H2 in N2, is indicated by parameter **P362**. 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:

- P362=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.