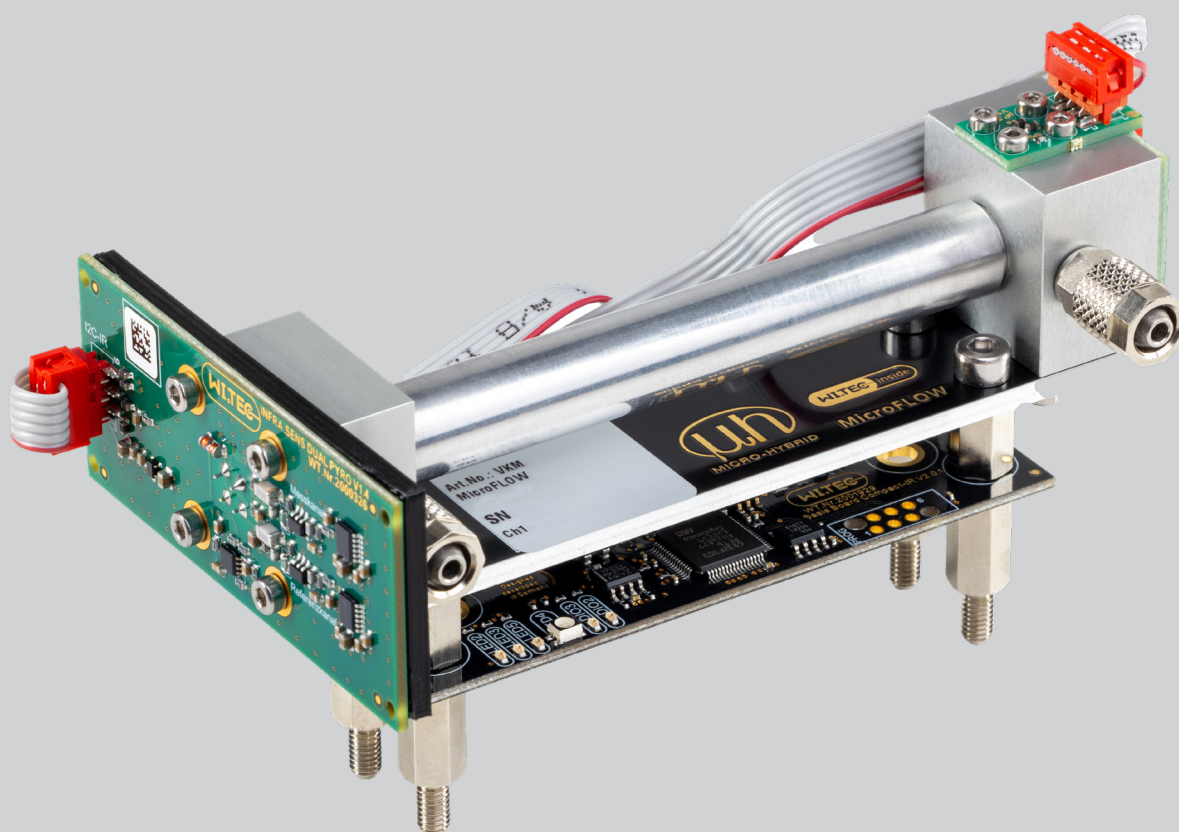![MICRO-HYBRID logo]

MicroFLOW Manual
Operating instructions

MicroFLOW is available at Micro-Hybrid-Shop

WI.TEC inside

🛒 **microhybrid.com/shop**

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Table of contents

1. Instruction of use

- Dry sample gas with less than 5 °C dew point – via electric cooler, Naf on™ hose or similar.

- Reliable particle f ltration < 1 µm, with membrane f lter or similar – must be checked and maintained regularly.

- Stable sample gas f ow between 0.1 … 1.5 l/min – pump without pressure f uctuation and no variable back pressure

- Regular zero check and adjustment – we recommend the use of a standard N2 cylinder (or other inert gas) and a solenoid valve for SW controlled automatic zero adjustment. For this purpose, our AZF module can be used as an accessory. (See chapter autozero function)

- Regular end point adjustment requires appropriate test gas

- Before each calibration, let the sensor run for at least 30 minutes under stable ambient conditions in operation

- Stable sensor temperature without contact to attachments or other materials – in the best case the environment or the sensor itself is tempered to ~ 40 – 50 °C, here also our optionally available heating controller can be used

2. Loss of warranty / liability / legal information

⚠ **CAUTION!**

Opening the sensor as well as tampering with or damaging the device will void the warranty!

Loss of warranty is also threatened using aggressive chemicals, contamination and liquids that have penetrated the device and by non-observance of the instructions in this module and communication description!

Micro-Hybrid Electronic GmbH accepts no liability for consequential damage or damage to property or personal injury caused by failure to observe the module and communication description.

3. General description MicroFlow

The MicroFlow is based on the selective absorption of infrared radiation in the range from 2 µm to 12 µm. In this spectral range it is possible to measure a lot of important gases like carbon dioxide (CO_2), carbon monoxide (CO), carbon hydrogens (CH_4, C_2H_6, C_3H_8, C_4H_{10} ...) and sulphur hexafluoride (SF_6). We use broadband radiation sources (thermal emitters). This radiation immediately reaches the sample cell in which specific spectral ranges are absorbed from the broadband spectrum of the radiation source.

The measuring detector which contains at least 2 separate channels is located at the end of the sample cell. In the simplest case the measuring channel has an interference filter placed in front of the detector. Afterwards a detector measures the specific radiation absorption. The reference detector has an interference filter in front of the detector, too but with a spectral transmission range (approx. 4 µm) where no absorption takes place.

The evaluation electronics use the two signals to calculate the gas concentration in the sample cell. Alternatively, a detector with several measuring channels can be placed at the end of the sample cell, so that 3 components can be detected simultaneously.

3.1 General technical data

MicroFlow	
Power supply	24 (9 – 30) VDC
Supply current	< 50 mA
Power consumption	< 1 W
Warm up time	< 15 min
PC requirements	Windows 7 – 10, RS232, CAN bus adapter (PEAK etc.)
Ambient conditions	Temperature: 5 – 45 ° C, rel. humidity: < 95 % not condensing
Gas connection / house	Viton or teflon flexible tube (4 mm / 6 mm)

Table 1: General technical data of the MicroFlow

The technical data are general, please refer for the right setting to the data sheet of your module.

3.2 Device description

In Figure 1 the entire assembly of the MicroFlow is shown. The gas input is designated at the left side (source unit) and the gas output at the right side (detector unit). The f ttings are suitable for 4 mm (inner diameter) and 6 mm (outer diameter) f exible tubes (viton or tef on). The optical bench and the basisboard are assembled on a support plate (Aluminium). The dimensions of the support mounting brackets are shown in the f gures below. The 4 threaded pins are suitable for M4 nuts.
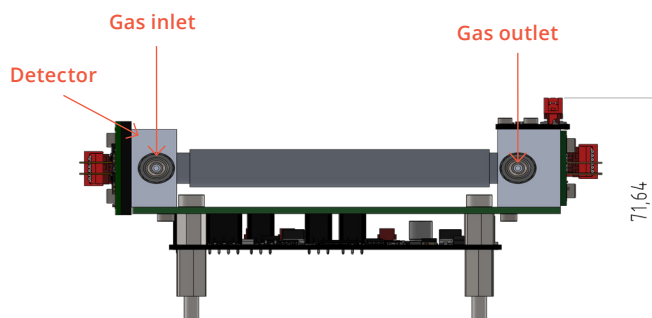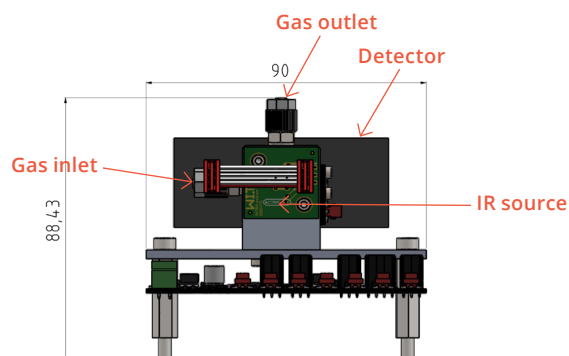

Figure 1: MicroFlow with 100 mm cell

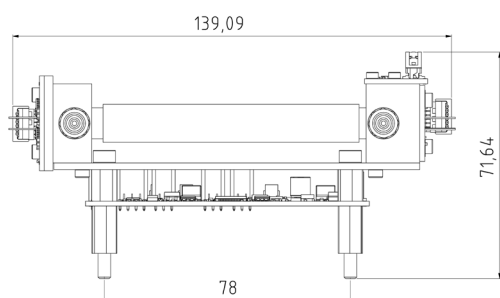Figure 2: MicroFLOW with 2 mm cell

Figure 3: Dimensions front view of MicroFLOW with 100 mm cell
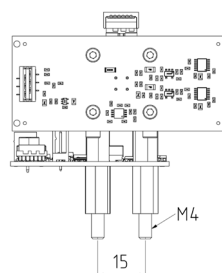

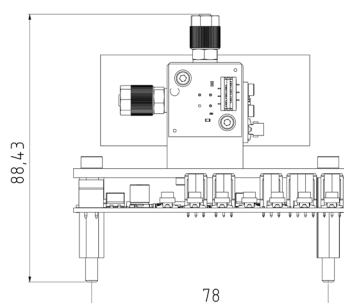Figure 4: Dimensions side view of MicroFLOW with 100 mm cell

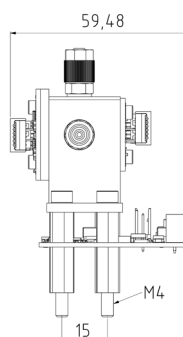Figure 5: Dimensions front view of MicroFLOW with 2 mm cell

Figure 6: Dimensions side view of MicroFLOW with 2 mm cell

4. Electrical connections

In this chapter you will f nd an overview of all main electronics.

4.1 Connectors and their configurations

In the following subchapter you will f nd all connectors for supply and communication with our modules.
Please take the shortcuts of the connectors for repeated listings.
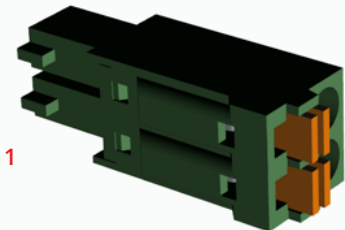
Power Basisboard IR-compact V2.0.X			Pin configuration (C2)	
			Pin	**Signal**
			1	VCC+
			2	GND-
Shortcut	**Connector**	**Manufacturer**	**Article no.**	**Specification**
C2	V2.0.X.	Würth electronic	691304100002	3,5 mm; 2 pol

Table 2: Power supply conf guration Basisboard IR-compact V2.0.x.

RS232 Basisboard IR-compact V2.0.X.			Pin configuration (C5)	
			Pin	**Signal**
			1	R x D (Receive data output)
			2	T x D (Transmit data input)
			3	GND (Device ground supply)
Shortcut	**Connector**	**Manufacturer**	**Article no.**	**Specification**
C5	RS232	Würth electronic	661003152222	3,54 mm; 3 pol

Table 3: RS232 conf guration on Basisboard IR-compact V2.0.x.

CAN-Bus Basisboard IR-compact V2.0.X.			Pin configuration (C5)	
			Pin	**Signal**
			1	CAN-L
			2	CAN-H
			3	GND (Device ground supply)

Table 4: CAN-bus conf guration on Basisboard IR-compact V2.0.X.

4.2 Basisboard Compact-IR V2.0.X.
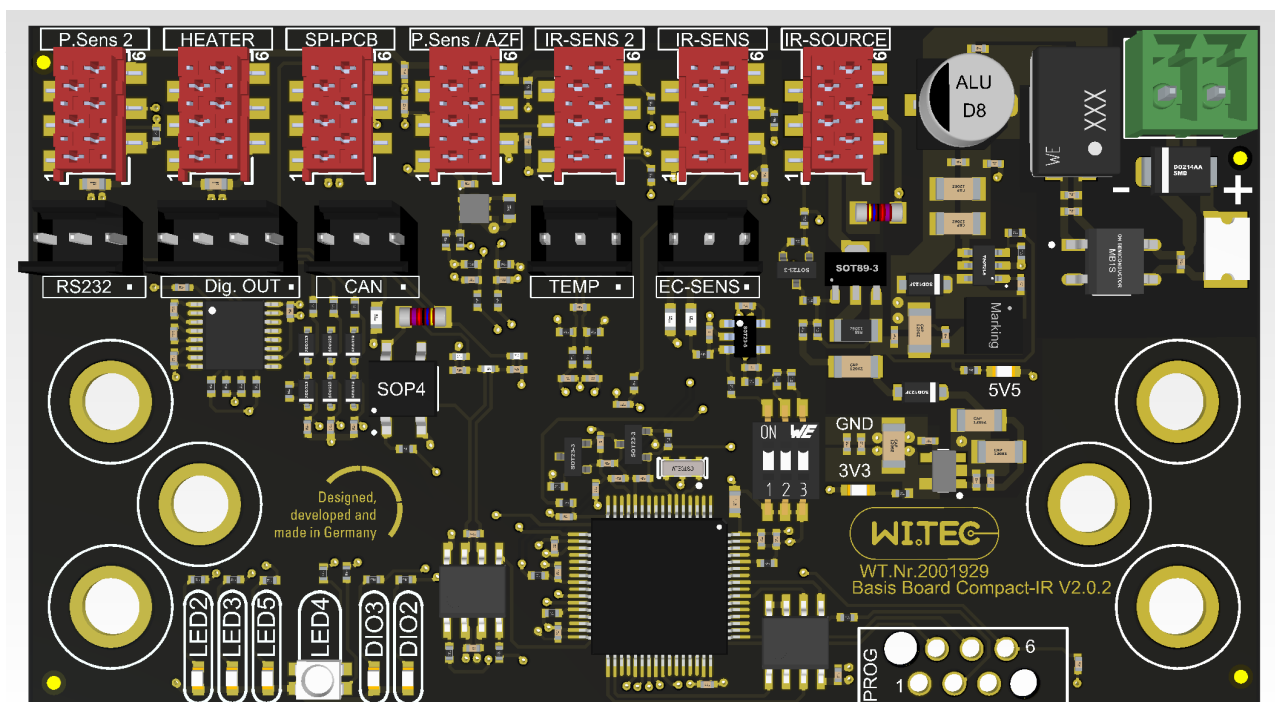
The labels of the connectors are directly on the Basisboard IR-compact V2.0.X. In the table you can f nd the function of each connector.

Connector	Signal	Function	
RS232	Communication RS232	RX (1), TX (2), GND (3) – 2.54 mm, 3 pol	
		Pin	**Signal**
		1	DIO1 (digital input for zero trigger) Pull the pin to GND (Pin 4) for min. 4 sec to set the Zero value for each gas channel
Dig. OUT	Digital input/output	2	DIO2 (digital output/input)
		3	DIO3 (digital output for autozero module or external trigger output)
		4	GND 2.54 mm, 4 pol
CAN	Communication CAN-bus	CAN-L (1), CAN-H (2), GND (3) – 2.54 mm, 3pol	
TEMP	Input external pt1000 2wire	Pt1000_1 (1) , GND (2), Pt1000_2 (3)	
EC-SENS	Input electrochemical sensor	Vsignal (1), GND (2), GND_f lter (3)	
PROG	Progr. interface (f rmware-update)		
P.sens2	2. pressure sensor	Optional second input pressure-sensor	
Heater	Heater control	Not implemented	
SPI-PCB	Analog voltage PCB	Opt. analog voltage 0 – 10 V (0 – 2 V / 0 – 5 V)	

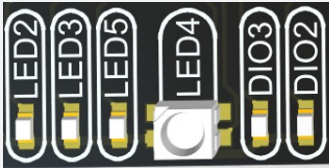| Connector	Signal	Function
P.sens/AZF	Pressure-/humidity sensor/AZF	Input pressure/humidity sensor and control of Autozero function (AZF_VV / VP via DIO 3)
IR-SENS 2	Input 2nd DUAL detector or QUAD (UV)	I2C Input (I2C1)
IR-SENS	Input DUAL detector or QUAD (IR)	I2C Input (I2C2)
IR-SOURCE	Output for IR Lamp	V_{lamp}+ (3 / 5) , V_{lamp}- (4 / 6), control (1), GND (2)
Green	Power 24 V	9 – 30 Vdc Input - 3,5 mm; 2 pol
Status LEDs		LED 2: signal for system tick (1 Hz) LED 3: signal for I2C sensor communication LED 5: signal for RS232 communication LED 4: Status LED (red/green) DIO 3: AZF on/of DIO 2: not in use

Table 5: Description of pin assignment of Basisboard IR-compact V2.0.X.

4.3 Description of status byte

IR detected	NA	NA	NA	IR level error	NA	NA	NA	Satus code		Status LED
Bit 0	Bit 1	Bit2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	bin	hex	dez
0	1	1	1	1	1	1	1	1111111	7F	127	red
1	1	1	1	1	1	1	1	11111111	7F	255	red
1	1	1	1	0	1	1	1	11110111	7F	247	green

Table 6: Description status byte IR

For example:

CO 2 sensor

- IR lamp is detected, and signal level are in normal range > 50 % intensity › Status byte code: **0xF7**

- IR lamp is detected, and signal level are under signal threshold 50% intensity › Status byte code: **0xFF**

- IR lamp is not detected, and signal level are under signal threshold 50% intensity › Status byte code: **0x7F**

4.4 Description of device ID

Device ID (0xCH1MT, CH2MT, CH3MT, CH4MT, CH1GT, CH2GT, CH3GT, CH4GT)		
Index	Gas type (GT)	Measurement type (MT)
0	none	none
1	CO2	IR
2	CO	
3	CH4	
4	CnHm	
5	SF6	

Table 7: Description device ID

For example:

Device ID: 0 x 20002000

Gas channel 1: IR sensor with CO2 detector

Gas channel 1: IR sensor with CO2 detector

Device ID: 0 x 20008000

Gas channel 1: IR sensor with CH4 detector

5. External zero input signal

It is possible to set the zero point of each gas channel without any digital interface or software efforts.
The basic PCB up version 1.8.2 is capable for external zero input trigger.
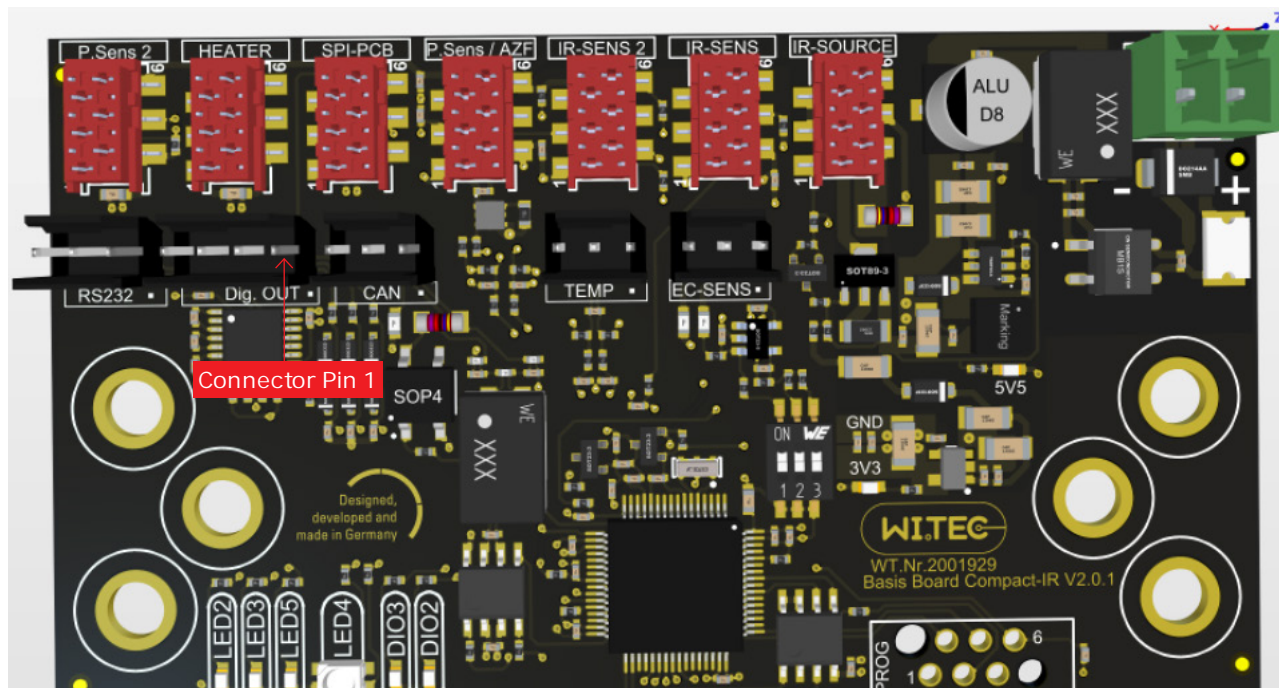
Figure 7: Basisboard IR-compact V2.0.X.

Pin	Signal
1	**Pull the pin to GND (pin 4) for min. 4 sec to set the zero value for each gas channel**
2	DIO2 (digital output)
3	DIO3 (digital output AZF control)
4	GND

Table 8: external I/O Pin configuration

6. Digital communication protocol via RS232 (ASCII mode)

Settings

Baudrate	115200 Baud
Databits	8
Stopbit	1
Parity	None
Data format (inout)	UINTx – LSB f rst Float – IEE754 Data format: little endian
Data format (output)	ASCII string with max. 15 bytes incl. CR/LF

Protocol basic (to detector)

Control frame								
	Com- mand	Frame index	Data 0	Data 1	Data 2	Data 3	Read / write	Selector
	0 x 25	0 x 00	0 x 00	0 x 00	0 x 00	0 x 00	0 x 55	0 x 30

Dummy

Read command: **0 x 55**
Write command: **0 x 7A**
Receiving data from detector:
Status detector: 0 x 03 (normal)

Data format type:
Float IEE754 (data 0 – 3) little endian
UINT32   (data 0 – 3) LSB
UINT16   (data 0 – 1) LSB
UINT8   (data 0) LSB

The frame index is used for more than 1 data beyond main.

Main command identif er. The dif erent commands are listed in the table below. This byte is for control of the detector and is also implemented in the receive frame to verify the detector answer.

Protocoll basic

The detector answer with an ASCII String followed by a CR and LF code for separation. For example, please note the diagram below. The incoming data from the detector can be displayed with a simple terminal program (Hterm ect.) or with the more comfortable MARS light. Download software on our website: www.microhybrid.com/downloads

	to detector	0 x 17	0 x 00	0 x 00	0 x 00	0 x 00	0 x 00	0 x 55	0 x 00
Read concentration CH1	from detector	ASCII data (ppm [Vol.-%]) + (CR + LF)							

	to detector	0 x 17	0 x 00	0 x 00	0 x 00	0 x 00	0 x 00	0 x 55	0 x 00
Read temperature CH1	from detector	ASCII data (°C) + (CR + LF)							

CR – carriage return (0 x 0D)
LF – line feed (0 x 0A)

Command list

Normal operating mode
These commands are important for the main function of the detector.

Option	Description	Cmd	Frame index	Format type	Unit	Access
	Concentration CH1– CH2	0 x 17	0 – 1	FLOAT	ppm (Vol.-%)	Read
	Temperature CH1 (IR detector)	0 x 18	0	FLOAT	°C	Read
	Temperature CH2 (ext. pt 1000)	0 x 1F	0	FLOAT	°C	Read
	Temperature CH4 (µController board)	0 x 20	0	FLOAT	°C	Read
	Set zero calibration (**all** channel) zeropoint stored*	0 x 11 or (0 x 08)	0	BOOL		
	Set zero calibration channel 1 zeropoint stored*	0 x 11	1	BOOL		Write
	Set zero calibration channel 2 zeropoint stored*	0 x 11	2	BOOL		Write
	Set span calibration CH1– CH2	0 x 60	0 – 1	FLOAT	ppm (Vol.-%)	Write
	Read / write span calibration factor CH1– CH2	0 x 63	0 – 1	FLOAT	1,00 Factory setting	RW
	Pressure sensor out	0 x 19	0	FLOAT	mbar	Read
	Set IR source on	0 x 29	0	BOOL		Write
	Set IR source of	0 x 30	0	BOOL		Write

Sensor raw signals

Description	Cmd	Frame index	Format type	Unit	Access	Range
ADC raw CH1 reference	0 x 14	0	FLOAT	V	Read	0 – 1,25 V
ADC raw CH1 sensor	0 x 15	0	FLOAT	V	Read	0 – 1,25 V
ADC raw CH2 reference	0 x 10	0	FLOAT	V	Read	0 – 1,25 V
ADC raw CH2 sensor	0 x 13	0	FLOAT	V	Read	0 – 1,25 V
Modulation CH1	0 x 16	0	FLOAT		Read	0 – 1
Modulation CH2	0 x 16	1	FLOAT		Read	0 – 1

Setup and sensor information

	Cmd	Frame index	Format type	Unit	Access	Range
IR lamp frequency	0 x 23	0	UINT16	Hz	RW	0 – 10
Filter depth of modulation CH1, CH2	0 x 35	2	UINT8		RW	0 – 255
Filter depth of concentration CH1, CH2	0 x 35	3	UINT8		RW	0 – 255
Serial number	0 x 40	0	UINT16		Read	
Device ID	0 x 62	0	UINT32		Read	**See table** p. 10
Hardware revision	0 x 41	0	UINT16		Read	
Software revision	0 x 0b	0	UINT16		Read	
Operating hours	0 x 43	0	UINT16		Read	
Measurement range CH1	0 x 47	2	FLOAT	ppm (Vol.-%)	Read	
Measurement range CH2	0 x 47	3	FLOAT	ppm (Vol.-%)	Read	
Measurement unit CH1	0 x 61	2	UINT16		Read	0 – ppm
Measurement unit CH2	0 x 61	3	UINT16		Read	1 – Vol-%
Source power IR LAMP	0 x 49	2	UINT8	%	Read	0 – 100 %
Status byte	0 x 50	0	UINT8			**See table** p. 9
Software system reset	0 x 04	0	BOOL		Write	

Example for transmitting the endpoint calibration for channel 1 – CO2

Concentration test gas = 6050.00 ppm (certified gas bottle)
Measured concentration with sensor = 6021.00 ppm

Set span calibration CH31	to detector	0 x 17	0 x 00	0 x 00	0 x 00	0 x 00	0 x 00	0 x 55	0 x 00
	from detector	ASCII string: 1.00482 + (CR + LF)							

The detector sends the calculated compensation factor back. The compensation factor in this example is 1.00482. This factor is stored in the internal EEprom.

Now the sensor is calibrated with the new span factor.

Calculation of the direct absorption for a dual beam process:

$$\text{Modulation} = \frac{\dfrac{\text{ADC Raw CH1ref}}{\text{ADC Raw CH1ref@zero}} - \dfrac{\text{ADC Raw CH1mess}}{\text{ADC Raw CH1mess@zero}}}{\dfrac{\text{ADC Raw CH1ref}}{\text{ADC Raw CH1ref@zero}}}$$