HAMILTON

MODBUS ARC CONVERTERS

Programmer's Manual

Modbus: PROFIBUS® DP / PROFINET®

Product REF 10116586

Product REF 243555

Hamilton Warranty

Please refer to the General Terms of Sales (GTS).

Important Note

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Content

1 Wiring and General Information

1.1 Introduction

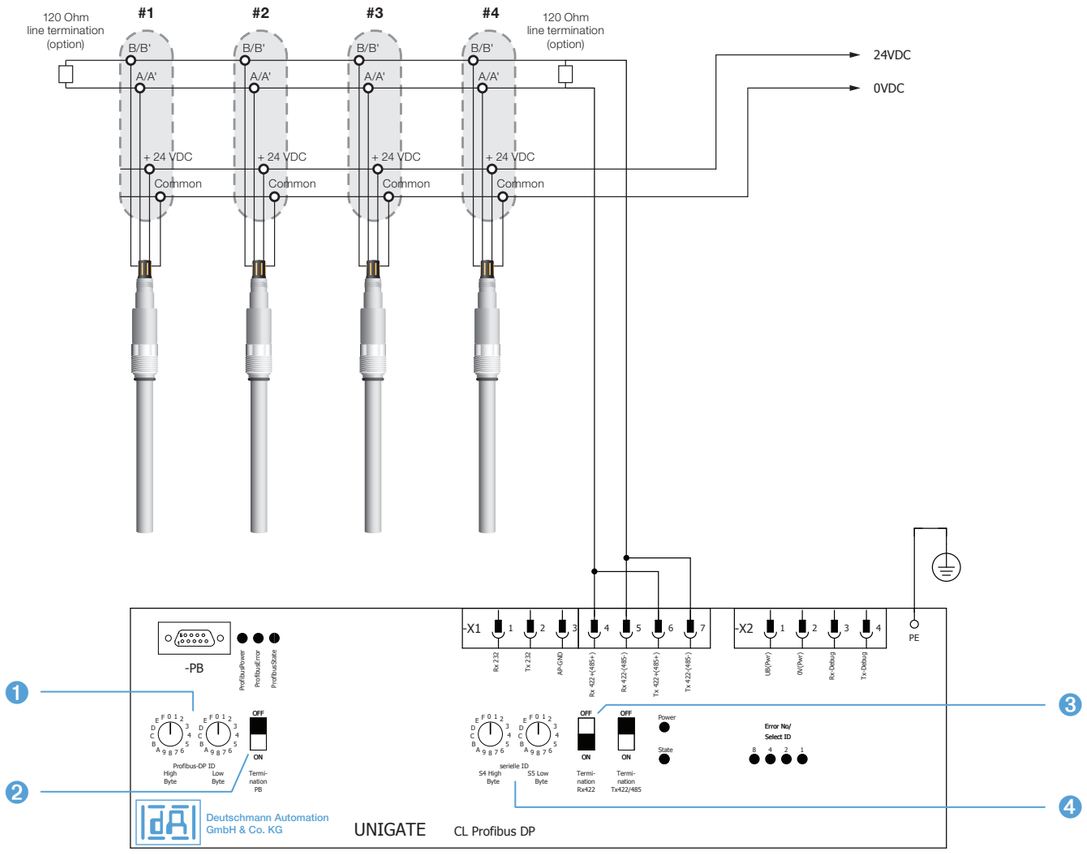
This is a programmers manual for how to use the Script developed by HAMILTON that is loaded onto the respective converter. For all other technical details such as Intended use, please consult the respective operating instructions on www.deutschmann.de

1.2 PROFIBUS DP

To use the Deutschmann Unigate® CL Module, the script must be programmed on the module. Additionally, the ID for the Profibus slave must be set correctly. The GSD file provided must be filed to the process control system for it to recognize the Module.

Please download the relevant files from :

https://www.hamiltoncompany.com/process-analytics/arc-knowledge/firmware-for-arc-products



❶ Blue marked rotary switches are used to set the PB ID in Hexadecimal representation.
The setting depends on the programming on the PCS with which PB ID the module has been integrated.

❷ Termination switch can normally be left to off

❸ Termination switches for RS 422 operation can be left to default settings Rx = off / Tx = on

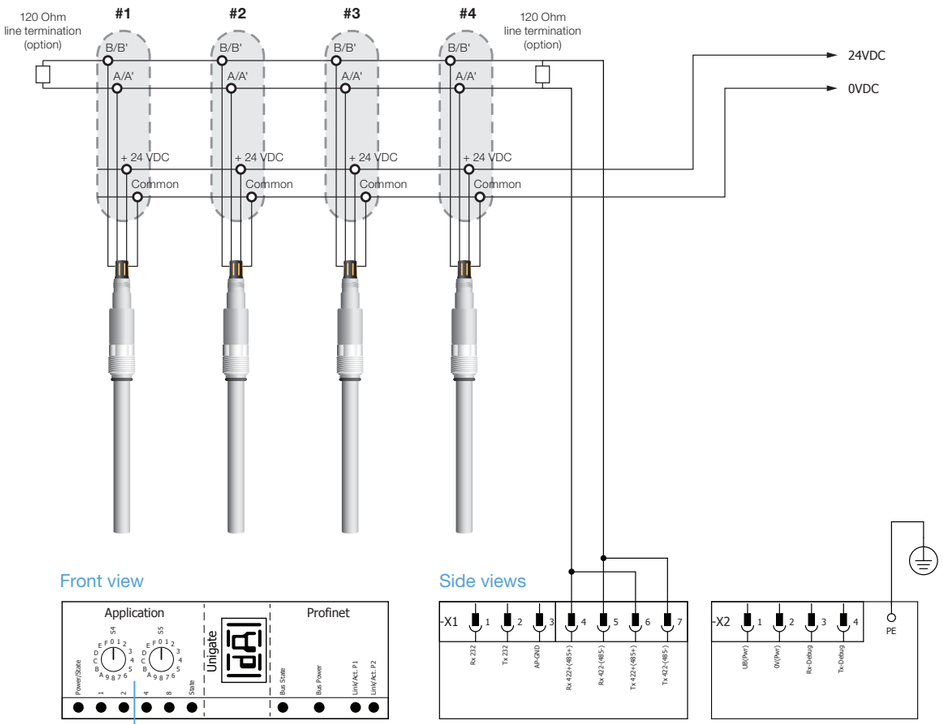
❹ Green marked rotary switches should be left to “0” for normal operation

1.3 PROFINET

The Deutschmann Unigate® CL GT Module is supplied with an already programmed script on the Module. The required GSDML file is provided and must be filed to the process control system for it to recognize the Module.

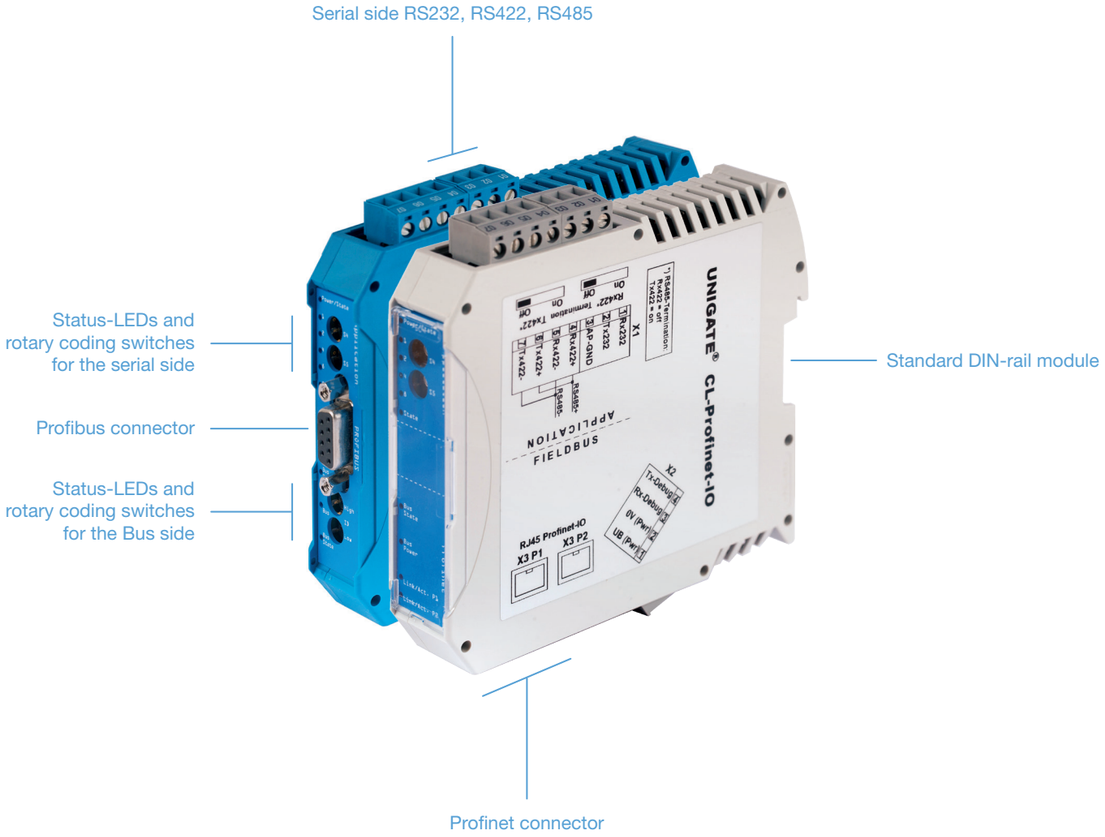
Please download the relevant files from :

https://www.hamiltoncompany.com/process-analytics/arc-knowledge/firmware-for-arc-products



Rotary switches S4 and S5 can be left on “0” for normal operation.

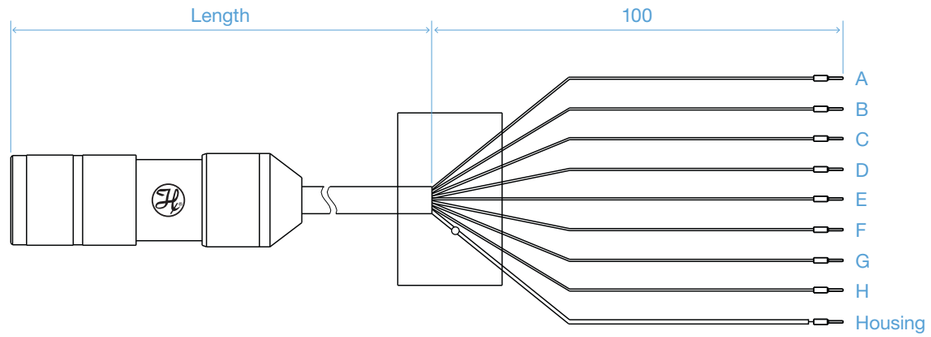
1.4 Converter Description



2 Cables

2.1 Data Cable VP8 / Open End (4-20 mA and/or Modbus)

Our standard data cable enables 4-20 mA communication as well as Modbus communication.



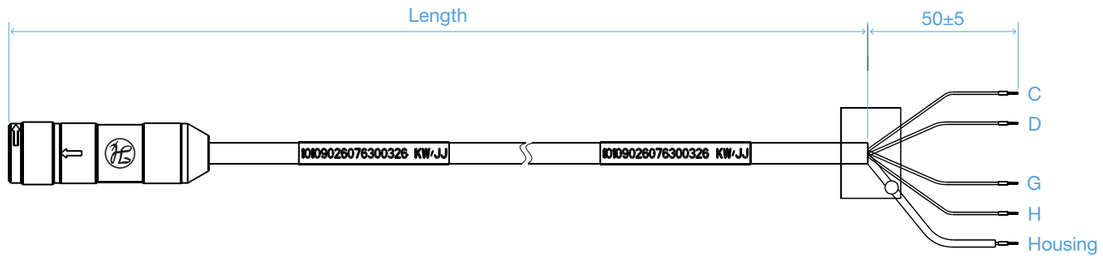
Wire color	VP Pin	Description
Yellow	A	4-20 mA interface #2
Green	B	4-20 mA interface #1
Red	C	Power: +24VDC
Blue	D	Power: Ground
Brown	E	–
White	F	–
Grey	G	RS485 (A)
Pink	H	RS485 (B)
Green/yellow	Housing	Shield

The Data Cable is available in the following lengths:

REF	Length
355263	1 m
355264	3 m
355265	5 m
355266	10 m
355267	15 m
355268	20 m

2.2 Data Cable VP8 / Open End 4 wires (Modbus only)

A thinner cable purely for digital communication with our probes.



VP 8 socket pins have the following Designation to the Sensor Data Cable VP 8:

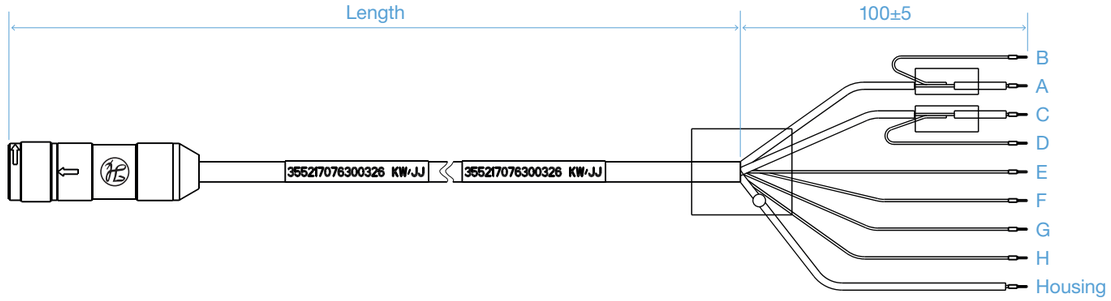
Wire color	VP Pin	Description
Brown	C	Power supply
White	D	Power: Ground
Blue	G	RS485 (A)
Black	H	RS485 (B)
Green/yellow	Housing	Shield

The Data Cable is available in the following lengths:

REF	Length
10109026	1 m
10109251	2 m
10109250	3 m

2.3 Double Coaxial VP8 / Open End

Our standard shielded cable for sensitive Electro Chemical Signals that can also be used for digital communication.



Wire color & Description	VP Pin	VisiFerm ECS (ECS mode)	VisiFerm ECS (mA mode)	OxyFerm VP / OxyGold	pH / Redox
Black transparent coax core	A	Cathode (ECS Mode)	–	Cathode	pH / Redox
Black coax shield	B	Anode (ECS Mode)	4-20 mA	Anode	Reference
Red transparent coax core	C	Power: +24VDC	Power: +24VDC	Guard	–
Red coax shield	D	Power: Ground	Power: Ground	Ground	Liquid Earth
White	E	NTC 22 kOhm	–	NTC 22 kOhm	Pt 100 / Pt 1000
Green	F	NTC 22 kOhm	–	NTC 22 kOhm	
Yellow	G	RS485 (A)	–	–	–
Brown	H	RS485 (B)	–	–	–
Green/yellow	Housing	Shaft	–	Shield	Shield

The Data Cable is available in the following lengths:

REF	Length
355263	1 m
355264	3 m
355265	5 m
355266	10 m
355267	15 m
355268	20 m

3 Interfaces

Input Buffer
1-Sensor Modbus Address
1-Function Code
2-Sensor Modbus Address
2-Function Code
3-Sensor Modbus Address
3-Function Code
4-Sensor Modbus Address
4-Function Code
Calibration Modbus Address
Calibration Point
User Data1
User Data2
User Data3
User Data4

Converter

Output Buffer
1-PMC 1 and PMC 6
1-Sensor Status
1-Function Return Values
1-Error
1-Function Echo
2-PMC 1 and PMC 6
2-Sensor Status
2-Function Return Values
2-Error
2-Function Echo
3-PMC 1 and PMC 6
3-Sensor Status
3-Function Return Values
3-Error
3-Function Echo
4-PMC 1 and PMC 6
4-Sensor Status
4-Function Return Values
4-Error
4-Function Echo

3.1 Input Buffer

Byte	Type	Content
0	uint	Modbus Address Sensor 1
1	uint	Function Code Sensor 1
2	uint	Modbus Address Sensor 2
3	uint	Function Code Sensor 2
4	uint	Modbus Address Sensor 3
5	uint	Function Code Sensor 3
6	uint	Modbus Address Sensor 4
7	uint	Function Code Sensor 4
8	uint	Calibration Modbus Address
9	uint	Calibration Point
10…13	byte	User Data 1
14…17	byte	User Data 2
18…21	byte	User Data 3
22…25	byte	User Data 4

Technology Standard for calibration	Sensor Type	Calibration Point1 in input buffer	Calibration Point2 in input buffer
TS1	pH	**1**	**2**
	ORP		
	oDO		
	eDO		
	COND		
	UPW		
TS2	oDO*	**21**	**22**
	VCD		
	TCD		
	DCO_2		

*The TS2 is available with VisiFerm RS485 ECS and VisiTrace RS485 family only

This is a fixed-sized memory area of the gateway, which must be written to by the user. The user must specify the used Modbus addresses and the requested function codes etc. The gateway is reading the input buffer cyclically roughly every second. This means that the information in the output will be updated according to the input buffer.

- **Modbus Address:** This must match the address set in the sensor.
- **Function Code:** This code represents the function which will return with the required information.
- **Calibration Modbus Address:** This address must be set before the user performs the calibration, one sensor at a time.
- **Calibration Point:** By specifying the calibration point, the calibration procedure will begin.
- **User Data:** These fields can contain the information to write to the sensor. E.g. calibration value or text.

3.2 Output Buffer

Byte	Type	Content	
0…3	float	Primary Measurement Channel 1 (unit must be known)	Sensor 1
4…7	float	Primary Measurement Channel 6 (unit must be known)	
8…11	byte	Sensor Status (see following table)	
12…27	byte	Function Return Values	
28	byte	Error	
29	uint	Function Echo	
30…33	float	Primary Measurement Channel 1 (unit must be known)	Sensor 2
34…37	float	Primary Measurement Channel 6 (unit must be known)	
38…41	byte	Sensor Status (see following table)	
42…57	byte	Function Return Values	
58	byte	Error	
59	uint	Function Echo	
60…63	float	Primary Measurement Channel 1 (unit must be known)	Sensor 3
64…67	float	Primary Measurement Channel 6 (unit must be known)	
68…71	byte	Sensor Status (see following table)	
72…87	byte	Function Return Values	
88	byte	Error	
89	uint	Function Echo	
90…93	float	Primary Measurement Channel 1 (unit must be known)	Sensor 4
94…97	float	Primary Measurement Channel 6 (unit must be known)	
98…101	byte	Sensor Status (see following table)	
102…117	byte	Function Return Values	
118	byte	Error	
119	uint	Function Echo	

Table 1: Output buffer

This memory area will be written to by the converter and updated every second, according to the input buffer. The requested information can be found in the Function Return Values of the corresponding sensor in the Output buffer table above.

The following information is always available in the output buffer:

- Primary measurement channel 1 (sensor dependent, e.g. pH value)
- Primary measurement channel 6 (temperature)
- Sensor status
- Interface warnings
- **PMC1 and PMC6:** These are the primary measurement channel values (PMC1-main measurement and PMC6-temperature) of the sensor at the corresponding Modbus address.
- **Sensor Status:** This information will reflect the status of the sensor or measurement at the corresponding Modbus address

Sensor Status	Bit number	HEX
Sensor O.K.	–	0x00
Temperature out of the measurement range	0 (LSB)	0x01
Temperature out of the operating range	1	0x02
Calibration status not zero	2	0x04
Warning not zero	3	0x08
Error not zero	4	0x10

Table 2: Sensor Status description

- **Function Return Values:** This field contains the return value of the requested function if the sensor replies without any error. The 16 bytes long field is separated into 4 pieces of 4 bytes long fields if multiple return data is expected. In the case of long strings (e.g. Measuring point) the entire section is used.

Function Return Values (16 bytes in total)			
Byte 1st… 4th	Byte 5th… 8th	Byte 9th… 12th	Byte 13th… 16th
1. Return value	2. Return value	3. Return value	4. Return value

Table 3: Function return values

- **Error:** When an interface error to the sensor occurs, the module makes a retry. If this retry fails, the module puts an error on the error byte defined in *Table 1: Output buffer*. The PMC1 value will be -1.5, the PMC6 value -35, and the sensor status will be set to 0xFFFFFFFF.

Byte 28	Error description	PMC1	PMC6	Sensor Status
0x00	Everything OK	Measured values		0x00000000
0x01	Sensor replies with an error (The sensor replies correctly, but the answer contains an error code)	-1.5	-35	0xFFFFFFFF
0x02	Wrong answer (No sensor available, sensor sends an invalid message or no message)			
0x03	Requested parameter or function code is not available with the sensor			
0x04	Operator level S (specialist) is required for the requested action			

Table 4: Error description

- **Function echo:** This part of the output is feedback. If a function request is arrived at the sensor and is processed correctly, the function code should appear in the function echo field of the output buffer in *Table 1: Output buffer*.

⚠ **CAUTION! In your programming, the error values when combined with a sensor status of 0xFFFFFFFF should be ignored as process values and interpreted as communication errors and not actual values for control. E.g. PMC1 value of -1.5 should be ignored as a process value if 0xFFFFFFFF is present.**

Available Modules in GSD/GSDML file

Table 1 Output Buffer defines the output buffer when four Arc sensors are connected to the Arc Converters (forming a Modbus network). In case when only one sensor is connected to a Converter, the output buffer can be reduced in size to save communication bandwidth. For this purpose, select the appropriate module as shown in the table 5 below.

Module Name	No. of sensors
ARC 30 Byte In 26 Byte out	1
ARC 60 Byte In 26 Byte out	2
ARC 90 Byte In 26 Byte out	3
ARC 120 Byte In 26 Byte out	4

Table 5: Available modules

3.3 Decoding the Return Values

Characters, Strings

According to the Modbus convention, the characters are interchanged byte-wise. The char «01234567» will be transmitted as «10325476».

Float, Integers

According to the Modbus convention, the 4-byte values are interchanged word/2-byte-wise.

For example:

The float value 2.54 has the hex representation of **0x40228f5c.**

The sensor puts this value as **8f5c 4022** on the line.

Name	Data Type	Address	Monitor value
Sensor1_PMC1_0	Word	%IW0	16#79C0
Sensor1_PMC1_1	Word	%IW2	16#4365

Incoming data in the output buffer

Name	Monitor value
#value	16#4365_79C0
#sensor1_PMC1	229.4756

Hexadecimal and decimal value of the properly swapped floating point number

3.4 Modbus Interface Configuration

The sensors need the following configuration for the Modbus (RS-485) interface to communicate with the Unigate® CL and the corresponding script:

- Parity: none
- 1 start bit
- 8 data bits
- 2 stop bits
- Baud rate: 19,200 bps
- Modbus address: 1-32

4 Function Codes

The following chapter details the function codes available to configure and use our sensors. *Figure 1: Integration level overview* shows different colors associated with the desired level of programming/integration. There are 3 levels of integration detailed below.

- Minimum, the absolute minimum recured codes to get only the most important sensor data
- Recommended, our recommended function codes allow you to integrate the necessary features (Calibration etc.)
- Full, all other function codes may not be necessary for every application.

- Measurement values
- Basic sensor status
- Cell density basic features

- Quality
- Vital information
- Standard calibration
- Product calibration
- Errors & warnings
- User and password management

- Register parameters
- Calibration parameters
- Cell density specific parameters

Figure 1: Integration level overview

Function Codes

4.1 Minimum integration : Measurement values

The following Table 6 Minimum integration function codes gives you the description of the value returned by the corresponding sensor (e.g. pH) for the given function code.

Code	Read/Write	Register	Return data types	Access	Group	pH	ORP	oDO	eDO	COND	UPW	VCD	TCD	dCO_2	Comment
13	Read	2472	float (4 bytes)	S	SMC1	R Glass*	–	–	R Cathode*	Resistance 2-El	Resistance 2	Alpha*	–	–	*minimum required user level is U
46	Read	2504	float (4 bytes)	U,S	SMC2	–	R reference	–	–	Resistance 4-El	Resistance	fc	–	–	
47	Read	2536	float (4 bytes)	U,S	SMC3	–	R ORP	–	I cathode	–	–	Delta E	–	–	
48	Read	2568	float (4 bytes)	U,S	SMC4	E pH vs ref	E pH vs ref	–	Measure Parameter	–	–	Cole fit R2	–	–	
49	Read	2600	float (4 bytes)	S	SMC5	–	E SG vs ref*	–	E ref vs. anode	–	–	Cole fit RMSE*	–	–	*minimum required user level is U
50	Read	2632	float (4 bytes)	U,S	SMC6	–	E ORP vs ref	–	–	–	–	Permittivity	–	–	
52	Read	2696	float (4 bytes)	S	SMC8	pH act	ORP act	–	DO act	–	–	–	–	–	
53	Read	2728	float (4 bytes)	S	SMC9	T act	T act	–	T act	–	–	–	–	–	
57	Read	2856	float (4 bytes)	S	SMC13	–	–	–	–	–	–	–	Transmission	–	
58	Read	2888	float (4 bytes)	S	SMC14	–	–	–	–	–	–	–	Reflection	–	
64	Read	2154	float (4 bytes)	U,S	PMC2	–	–	–	–	–	–	Cond	–	–	
91	Read	41246	integer (4 bytes)	U,S	Cell Density	–	–	–	–	–	–	Mark Zero VCD	Mark Zero TCD	–	1 = set, 0 = remove
92	Write	41246	integer (4 bytes)	S	Cell Density	–	–	–	–	–	–	Mark Zero VCD	Mark Zero TCD	–	1 = set, 0 = remove
94	Read	41300	integer (4 bytes)	U,S	Cell Density	–	–	–	–	–	–	Inoculate	Inoculate	–	1 = set, 0 = remove
95	Write	41300	integer (4 bytes)	S	Cell Density	–	–	–	–	–	–	Inoculate	Inoculate	–	1 = set, 0 = remove

Table 6: Minimum integration function codes

4.2 Recommended integration : Sensor quality & Vital information

Code	Read/Write	Register	Return data types	Access	Group	pH	ORP	oDO	eDO	COND	UPW	VCD	TCD	dCO_2	Comment
1	Read	1288	string (16 bytes)	U,S	Sensor Details	Sensor Name	Sensor Name	Sensor Name	Sensor Name	Sensor Name	Sensor Name	Sensor Name	Sensor Name	Sensor Name	
113	Write	1288	string (16 bytes)	S	Sensor Details	Sensor Name	–	–	–	Sensor Name	–	Sensor Name	–	–	Only SU sensors
2	Read	1296	string (16 bytes)	U,S	Sensor Details	Lot Number	Lot Number	Lot Number	Lot Number	Lot Number	Lot Number	Lot Number	Lot Number	Lot Number	
114	Write	1296	string (16 bytes)	S	Sensor Details	Lot Number	–	–	–	Lot Number	–	Lot Number	–	–	Only SU sensors
3	Read	1304	string (16 bytes)	U,S	Sensor Details	Lot Date	Lot Date	Lot Date	Lot Date	Lot Date	Lot Date	Lot Date	Lot Date	Lot Date	
115	Write	1304	string (16 bytes)	S	Sensor Details	Lot Date	–	Lot Date	–	Lot Date	–	Lot Date	–	–	Only SU sensors
4	Read	1360	string (16 bytes)	U,S	Sensor Details	Sensor ID	Sensor ID	Sensor ID	Sensor ID	Sensor ID	Sensor ID	Sensor ID	Sensor ID	Sensor ID	
116	Write	1360	string (16 bytes)	S	Sensor Details	Sensor ID	–	Sensor ID	–	Sensor ID	–	Sensor ID	–	–	Only SU sensors
5	Read	1600	string (16 bytes)	U,S	Sensor Details	Measuring Point	Measuring Point	Measuring Point	Measuring Point	Measuring Point	Measuring Point	Measuring Point	Measuring Point	Measuring Point	
117	Write	1600	string (16 bytes)	S	Sensor Details	Measuring Point	Measuring Point	Measuring Point	Measuring Point	Measuring Point	Measuring Point	Measuring Point	Measuring Point	Measuring Point	
6	Read	4872	float (4 bytes)	U,S	Sensor Details	Quality Indicator	Quality Indicator	Quality Indicator	Quality Indicator	Quality Indicator	Quality Indicator	Quality Indicator	Quality Indicator	Quality Indicator	
7	Read	4676	float (4 bytes)	U,S	Sensor Details	Operating Hours	Operating Hours	Operating Hours	Operating Hours	Operating Hours	Operating Hours	Operating Hours	Operating Hours	Operating Hours	
118	Read	4688	2 x integer (4 bytes)	U,S	Sensor Details	SIP,CIP counter	SIP,CIP counter	SIP,CIP counter	SIP,CIP counter	SIP,CIP counter	SIP,CIP counter	SIP,CIP counter	SIP,CIP counter	SIP,CIP counter	1. Return value = SIP 2. Return value = CIP
119	Read	4692	integer (4 bytes)	U,S	Sensor Details	Number of Autoclavings	Number of Autoclavings	Number of Autoclavings	Number of Autoclavings	Number of Autoclavings	Number of Autoclavings	Number of Autoclavings	Number of Autoclavings	Number of Autoclavings	
120	Write	4692	integer (4 bytes)	S	Sensor Details	Number of Autoclavings	Number of Autoclavings	Number of Autoclavings	Number of Autoclavings	Number of Autoclavings	Number of Autoclavings	Number of Autoclavings	Number of Autoclavings	Number of Autoclavings	Only RU sensors

Function Codes

Code	Read/Write	Register	Return data types	Access	Group	pH	ORP	oDO	eDO	COND	UPW	VCD	TCD	dCO_2	Comment
121	Read	1280	string (16 bytes)	U,S	Sensor Details	Part Number	Part Number	Part Number	Part Number	Part Number	Part Number	Part Number	Part Number	Part Number	
122	Write	1280	string (16 bytes)	S	Sensor Details	Part Number	–	–	–	Part Number	–	Part Number	–	–	Only SU sensors
123	Read	1184	string (16 bytes)	U,S	Sensor Details	Modul Serial Number	Modul Serial Number	Modul Serial Number	Modul Serial Number	Modul Serial Number	Modul Serial Number	Modul Serial Number	–	–	Only SU sensors
124	Read	1312	string (16 bytes)	U,S	Sensor Details	Sensor Serial Number	Sensor Serial Number	Sensor Serial Number	Sensor Serial Number	Sensor Serial Number	Sensor Serial Number	Sensor Serial Number	Sensor Serial Number	Sensor Serial Number	
125	Write	1312	string (16 bytes)	S	Sensor Details	Sensor Serial Number	–	Sensor Serial Number	–	Sensor Serial Number	–	Sensor Serial Number	–	–	Only SU sensors
126	Read	2080	string (16 bytes)	U,S	Sensor Details	Sensor Type	Sensor Type	Sensor Type	Sensor Type	Sensor Type	Sensor Type	Sensor Type	Sensor Type	Sensor Type	

Table 7: Recommended integration function codes 1

4.3 Basic integration : Standard calibration & Product calibration

Code	Read/Write	Register	Return data types	Access	Group	pH	ORP	oDO	eDO	COND	UPW	VCD	TCD	dCO_2	Comment
–	Write	5162	float (4 bytes)	S	TS1 Calibration	Make Calibration CP1	Make Calibration CP1	Make Calibration CP1	Make Calibration CP1	Make Calibration CP1	Make Calibration CP1	–	–	–	Input buffer byte 8 = address Input buffer byte 9 = 1 User Data 1 = value
–	Write	5194	float (4 bytes)	S	TS1 Calibration	Make Calibration CP2	–	Make Calibration CP2	Make Calibration CP2	Make Calibration CP2	–	–	–	–	Input buffer byte 8 = address Input buffer byte 9 = 2 User Data 1 = value
30	Write	–	float (4 bytes)	S	TS1 Calibration	Perform Product Calibration	Perform Product Calibration	Perform Product Calibration	Perform Product Calibration	Perform Product Calibration	Perform Product Calibration	–	–	–	User Data 1 = calibration value
31	Read	5340	–	S	TS1 Calibration	Delete Product Calibration	Delete Product Calibration	Delete Product Calibration	Delete Product Calibration	Delete Product Calibration	Delete Product Calibration	–	–	–	
32	Read	5318	hexa (4 bytes) integer (4 bytes) float (4 bytes)	U,S	TS1 Calibration	Read Product Calibration information	Read Product Calibration information	Read Product Calibration information	Read Product Calibration information	Read Product Calibration information	Read Product Calibration information	–	–	–	1. Return value = status 2. Return value = unit 3. Return value = buffer value
33	Write	5448	float (4 bytes) float (4 bytes)	S	TS1 Calibration	Write Single Use Calibration Parameters (Offset, Slope)	–	Write Single Use Calibration Parameters (Phi0, CSV)	–	Write Single Use Calibration Parameters (Offset resistance, Cell constant)	–	–	–	–	User Data 1 = offset value User Data 2 = slope value
12	Read	9504	string (16 bytes)	U,S	TS1 Calibration	Buffer Manufacturer	Buffer Manufacturer	–	DO Standards	Standard Manufacturer	Standard Manufacturer	–	–	–	
127	Write	9504	string (16 bytes)	S	TS1 Calibration	Buffer Manufacturer	Buffer Manufacturer	–	DO Standards	Standard Manufacturer	Standard Manufacturer	–	–	–	
39	Write	19336	float (4 bytes)	S	TS2 Calibration	–	–	–	–	–	–	Write Single Use Calibration Parameters	–	–	User Data 1 = parameter value
40	Read	19336	float (4 bytes)	U,S	TS2 Calibration	–	–	–	–	–	–	Read Single Use Calibration Parameters	–	–	1.Return value = parameter value
–	Write	10314	float (4 bytes)	S	TS2 Calibration	–	–	Make Calibration CP1*	–	–	–	–	–	Make Calibration CP1	*Only RU sensors Input buffer byte 8 = address Input buffer byte 9 = 21 User Data 1 = value
–	Write	11034	float (4 bytes)	S	TS2 Calibration	–	–	Make Calibration CP2*	–	–	–	–	–	Make Calibration CP2	*Only RU sensors Input buffer byte 8 = address Input buffer byte 9 = 22 User Data 1 = value

Function Codes

Code	Read/Write	Register	Return data types	Access	Group	pH	ORP	oDO	eDO	COND	UPW	VCD	TCD	dCO_2	Comment
43	Read	10560 10592	2 x float (4 bytes)	U,S	TS2 Calibration	–	–	Pressure & Humidity CP1*	–	–	–	–	–	Pressure & Humidity CP1*	*Only RU sensors and Visiferm RS485 ECS family 1. Return value = Pressure 2. Return value = Humidity
44	Write	10560 10592	2 x float (4 bytes)	S	TS2 Calibration	–	–	Pressure & Humidity CP1*	–	–	–	–	–	Pressure & Humidity CP1*	*Only RU sensors; User Data 1 = Pressure User Data 2 = Humidity
139	Read	11280 11312	2 x float (4 bytes)	U,S	TS2 Calibration	–	–	Pressure & Humidity CP2*	–	–	–	–	–	Pressure & Humidity CP2*	*Only RU sensors and Visiferm RS485 ECS family 1. Return value = Pressure 2. Return value = Humidity
140	Write	11280 11312	2 x float (4 bytes)	S	TS2 Calibration	–	–	Pressure & Humidity CP2*	–	–	–	–	–	Pressure & Humidity CP2*	*Only RU sensors; User Data 1 = Pressure User Data 2 = Humidity
34	Write	13914	float (4 bytes)	S	TS2 Calibration	–	–	Perform Product Calibration	–	–	–	–	–	Perform Product Calibration	User Data 1 = calibration value
35	Read	13914	–	S	TS2 Calibration	–	–	Delete Product Calibration	–	–	–	–	–	Delete Product Calibration	
138	Read	13912 13968	hexa (4 bytes) hexa (4 bytes) float (4 bytes)	U,S	TS2 Calibration	–	–	Read Product Calibration Info	–	–	–	–	–	Read Product Calibration Info	1. Return value = status 2. Return value = unit 3. Return value = buffer value
136	Read	10270	integer (4 bytes)	U,S	TS2 Calibration	–	–	Selected Standard*	–	–	–	Selected Standard	Selected Standard	Selected Standard	*Only RU sensors and Visiferm RS485 ECS family
137	Write	10270	integer (4 bytes)	S	TS2 Calibration	–	–	Selected Standard*	–	–	–	Selected Standard	Selected Standard	Selected Standard	*OnlyRU sensorsand VisifermRS485 ECS family

Table 8: Recommended integration function codes 2

4.4 Basic integration : Errors & warnings and user & password management

Code	Read/Write	Register	Return data types	Access	Group	pH	ORP	oDO	eDO	COND	UPW	VCD	TCD	dCO_2	Comment
20	Read	4736	4 x hexa (4 bytes)	U,S	Warnings & Errors	Warnings	Warnings	Warnings	Warnings	Warnings	Warnings	Warnings	Warnings	Warnings	1. Return value = measurement 2. Return value = calibration 3. Return value = interface 4. Return value = hardware
21	Read	4800	4 x hexa (4 bytes)	U,S	Warnings & Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	
93	Read	4288	hexa (1 byte)	U,S	User Management	Read Current Operator Level	Read Current Operator Level	Read Current Operator Level	Read Current Operator Level	Read Current Operator Level	Read Current Operator Level	Read Current Operator Level	Read Current Operator Level	Read Current Operator Level	0x00000030 = S level 0x00000003 = U level
22	Write	4288	–	U,S	User Management	Set Operator Level U	Set Operator Level U	Set Operator Level U	Set Operator Level U	Set Operator Level U	Set Operator Level U	Set Operator Level U	Set Operator Level U	Set Operator Level U	first byte of the function return values will show the actual user level
24	Write	4288	integer (4 byte)	U,S	User Management	Set Operator Level S	Set Operator Level S	Set Operator Level S	Set Operator Level S	Set Operator Level S	Set Operator Level S	Set Operator Level S	Set Operator Level S	Set Operator Level S	firs byte of the function return values will show the actual user level User Data 1 = password
41	Write	4292	integer (4 bytes)	S	User Management	Change S level Password	Change S level Password	Change S level Password	Change S level Password	Change S level Password	Change S level Password	Change S level Password	Change S level Password	Change S level Password	User Data 1 = new password
45	Read	–	string (3 bytes)	U,S	Script version	Read Converter Script version	Read Converter Script version	Read Converter Script version	Read Converter Script version	Read Converter Script version	Read Converter Script version	Read Converter Script version	Read Converter Script version	Read Converter Script version	first3 bytesoffunctionreturnvalues

Table 9: Recommended integration function codes 3

Function Codes

4.5 Full Integration : Register parameters

Code	Read/Write	Register	Return data types	Access	Group	pH	ORP	oDO	eDO	COND	UPW	VCD	TCD	dCO_2	Comment
68	Read	3114	3 x float (4 bytes)	U,S	Register Parameter (PA01)	–	–	Salinity	Salinity	–	–	Cell factor VCD	–	Salinity	1. Return value = value 2. Return value = min value 3. Return value = max value
69	Write	3114	float (4 bytes)	S	Register Parameter (PA01)	–	–	Salinity	Salinity	–	–	Cell factor VCD	–	Salinity	User Data 1 = value 1. Return value = actual written value
70	Read	3146	3 x float (4 bytes)	U,S	Register Parameter (PA02)	–	–	Air Pressure	Air Pressure	–	–	Offset VCD	Offset TCD	Air Pressure	1. Return value = value 2. Return value = min value 3. Return value = max value
71	Write	3146	float (4 bytes)	S	Register Parameter (PA02)	–	–	Air Pressure	Air Pressure	–	–	Offset VCD	Offset TCD	Air Pressure	User Data 1 = value 1. Return value = actual written value
72	Read	3178	3 x float (4 bytes)	U,S	Register Parameter (PA03)	–	–	Humidity*	–	T comp. Temp	T comp. Temp	–	–	Humidity	*VisiFerm RS485 ECS and VisiTrace RS485 family only 1. Return value = value 2. Return value = min value 3. Return value = max value
73	Write	3178	float (4 bytes)	S	Register Parameter (PA03)	–	–	Humidity*	–	T comp. Temp	T comp. Temp	–	–	Humidity	*VisiFerm RS485 ECS and VisiTrace RS485 family only User Data 1 = value 1. Return value = actual written value
74	Read	3210	3 x float (4 bytes)	U,S	Register Parameter (PA04)	–	–	–	I offset	T comp. Factor	T comp. Factor	–	–	–	1. Return value = value 2. Return value = min value 3. Return value = max value
75	Write	3210	float (4 bytes)	S	Register Parameter (PA04)	–	–	–	I offset	T comp. Factor	T comp. Factor*	–	–	–	User Data 1 = value 1. Return value = actual written value *If the USP function value is not 0 the temperature compensation factor is automatically set to zero
78	Read	3370	3 x integer (4 bytes)	U,S	Register Parameter (PA09)	Moving average	Moving average	Moving average	Moving average	Moving average	Moving average	–	Moving average	Moving average	1. Return value = value 2. Return value = min value 3. Return value = max value
79	Write	3370	integer (4 bytes)	S	Register Parameter (PA09)	Moving average	Moving average	Moving average	Moving average	Moving average	Moving average	–	Moving average	Moving average	User Data 1 = value 1. Return value = actual written value
80	Read	3402	3 x integer (4 bytes)	U,S	Register Parameter (PA10)	–	–	Resolution	–	Cali. Points	USP function	–	–	–	1. Return value = value 2. Return value = min value 3. Return value = max value
81	Write	3402	integer (4 bytes)	S	Register Parameter (PA10)	–	–	Resolution	–	Cali. Points	USP function	–	–	–	User Data 1 = value 1. Return value = actual written value
82	Read	3434	3 x integer (4 bytes)	U,S	Register Parameter (PA11)	–	–	Min auto resol	–	–	–	–	–	–	Not supported by the Visiferm RS485 ECS and VisiTrace RS485 family 1. Return value = value 2. Return value = min value 3. Return value = max value
83	Write	3434	integer (4 bytes)	S	Register Parameter (PA11)	–	–	Min auto resol	–	–	–	–	–	–	Not supported by the Visiferm RS485 ECS and VisiTrace RS485 family User Data 1 = value 1. Return value = actual written value
84	Read	3466	3 x integer (4 bytes)	U,S	Register Parameter (PA12)	Moving average R	Moving average R	–	Moving average R	–	–	–	–	–	1. Return value = value 2. Return value = min value 3. Return value = max value
85	Write	3466	integer (4 bytes)	S	Register Parameter (PA12)	Moving average R	Moving average R	–	Moving average R	–	–	–	–	–	User Data 1 = value 1. Return value = actual written value
86	Read	3498	3 x integer (4 bytes)	U,S	Register Parameter (PA13)	–	–	Meas. Interval	–	–	–	–	Meas. Interval	–	1. Return value = value 2. Return value = min value 3. Return value = max value

Function Codes

Code	Read/Write	Register	Return data types	Access	Group	pH	ORP	oDO	eDO	COND	UPW	VCD	TCD	dCO_2	Comment
87	Write	3498	integer (4 bytes)	S	Register Parameter (PA13)	–	–	Meas. Interval	–	–	–	–	Meas. Interval	–	User Data 1 = value 1. Return value = actual written value
88	Read	3530	3 x integer (4 bytes)	U,S	Register Parameter (PA14)	–	–	SensorCap PartNr	–	–	–	–	–	–	1. Return value = value 2. Return value = min value 3. Return value = max value
89	Write	3530	integer (4 bytes)	S	Register Parameter (PA14)	–	–	SensorCap PartNr	–	–	–	–	–	–	User Data 1 = value 1. Return value = actual written value

Table 10: Full integration function codes 1

4.6 Full Integration : Calibration parameters TS1

Code	Read/Write	Register	Return data types	Access	Group	pH	ORP	oDO	eDO	COND	UPW	VCD	TCD	dCO_2	Comment
8	Read	5164	float (4 bytes)	U,S	TS1 Calibration	Operating Hours CP1*	Operating Hours CP1	Operating Hours CP1*	Operating Hours CP1	Operating Hours CP1*	Operating Hours CP1	–	–	–	*Only RU sensors
9	Read	5196	float (4 bytes)	U,S	TS1 Calibration	Operating Hours CP2*	–	Operating Hours CP2*	Operating Hours CP2	–	–	–	–	–	*Only RU sensors
10	Read	5448	float (4 bytes)	U,S	TS1 Calibration	Offset	Offset	Phi 0	Zero current	Offset resistance	Offset resistance	–	–	–	
11	Read	5448	float (4 bytes)	U,S	TS1 Calibration	Slope	–	CSV	Slope	Cell Constant	Cell Constant	–	–	–	
14	Read	5158	hexa (4 bytes) integer (4 bytes) float (4 bytes)	U,S	TS1 Calibration	Status CP1*	Status CP1	Status CP1*	Status CP1	Status CP1*	Status CP1	–	–	–	*Only RU sensors 1. Return value = status 2. Return value = unit 3. Return value = buffer value
15	Read	5164	float (4 bytes)	U,S	TS1 Calibration	Temp. Value CP1*	Temp. Value CP1	Temp. Value CP1*	Temp. Value CP1	Temp. Value CP1*	Temp. Value CP1	–	–	–	*Only RU sensors
16	Read	5520	3 x float (4 bytes)	S	TS1 Calibration	Effective(assigned) Value CP1*	Effective Value CP1	Effective Value CP1*	Effective Value CP1	Effective Value CP1*	Effective Value CP1	–	–	–	*Only RU sensors 1. Return value = effective calibration value 2. Return value = calibration voltage 3. Return value = calibration temperature
17	Read	5190	hexa (4 bytes) integer (4 bytes) float (4 bytes)	U,S	TS1 Calibration	Status CP2*	–	Status CP2*	Status CP2	Status CP2*	–	–	–	–	*Only RU sensors 1. Return value = status 2. Return value = unit 3. Return value = buffer value
18	Read	5196	float (4 bytes)	U,S	TS1 Calibration	Temp. Value CP2*	–	Temp. Value CP2*	Temp. Value CP2	Temp. Value CP2*	–	–	–	–	*Only RU sensors
19	Read	5528	3 x float (4 bytes)	S	TS1 Calibration	Effective(assigned) Value CP2*	–	Effective Value CP2*	Effective Value CP2	Effective Value CP2*	–	–	–	–	*Only RU sensors 1. Return value = effective calibration value 2. Return value = calibration voltage 3. Return value = calibration temperature

Table 11: Full integration function codes 2

4.7 Full Integration : Calibration parameters TS2

Code	Read/Write	Register	Return data types	Access	Group	pH	ORP	oDO	eDO	COND	UPW	VCD	TCD	dCO_2	Comment
111	Read	10464	float (4 bytes)	U,S	TS2 Calibration	–	–	Operating hours CP1*	–	–	–	–	Oper. Hours init CP1	Operating Hours CP1	*Only RU sensors and RU Visiferm RS485 ECS family
112	Read	11184	float (4 bytes)	U,S	TS2 Calibration	–	–	Operating hours CP2*	–	–	–	–	Oper. Hours init CP2	Operating Hours CP2	*Only RU sensors and RU Visiferm RS485 ECS family
36	Read	14640 14672 14704 14736	float (4 bytes) float (4 bytes) float (4 bytes) float (4 bytes)	U,S	TS2 Calibration	–	–	Group 1* 1. Return value: Phase 0 2. Return value: Stern Volmer 3. Return value: Ref. Temp 4. Return value: -	–	–	–	–	Group1 1. Return value: I0f 2. Return value: Rho 3. Return value: Xi 4. Return value: I0b	Group1 1. Return value: Zero Point SR 2. Return value: CO_2 Point SR 3. Return value: 4. Return value:	*Visiferm RS485 ECS family only Every return value consists of 4 bytes

Function Codes

Code	Read/Write	Register	Return data types	Access	Group	pH	ORP	oDO	eDO	COND	UPW	VCD	TCD	dCO_2	Comment
37	Read	14768 – – –	float (4 bytes) – – –	U,S	TS2 Calibration	–	–	–	–	–	–	–	Group2 1. Return value: Ibl 2. Return value: 3. Return value: 4. Return value:	–	
128	Read	10312	hexa (4 bytes)	U,S	TS2 Calibration	–	–	Status CP1*	–	–	–	–	Status CP1	Status CP1	*Only RU sensors and RU VisiFerm RS485 ECS family
129	Read	10400	float (4 bytes)	U,S	TS2 Calibration	–	–	Temp. Value CP1*	–	–	–	–	Temp. Value CP1	Temp. Value CP1	*Only RU sensors and RU VisiFerm RS485 ECS family
130	Read	10336	float (4 bytes)	U,S	TS2 Calibration	–	–	Calibrate(measured) Value CP1*	–	–	–	–	–	Calibrate(measured) Value CP1	*Only RU sensors and RU VisiFerm RS485 ECS family
131	Read	10368	float (4 bytes)	U,S	TS2 Calibration	–	–	Effective(assigned) Value CP1*	–	–	–	–	–	Effective(assigned) Value CP1	*Only RU sensors and RU VisiFerm RS485 ECS family
132	Read	11032	hexa (4 bytes)	U,S	TS2 Calibration	–	–	Status CP2*	–	–	–	–	Status CP2	Status CP2	*Only RU sensors and RU VisiFerm RS485 ECS family
133	Read	11120	float (4 bytes)	U,S	TS2 Calibration	–	–	Temp. Value CP2*	–	–	–	–	Temp. Value CP2	Temp. Value CP2	*Only RU sensors and RU VisiFerm RS485 ECS family
134	Read	11056	float (4 bytes)	U,S	TS2 Calibration	–	–	Calibrate(measured) Value CP2*	–	–	–	–	–	Calibrate(measured) Value CP2	*Only RU sensors and RU VisiFerm RS485 ECS family
135	Read	11088	float (4 bytes)	U,S	TS2 Calibration	–	–	Effective(assigned) Value CP2*	–	–	–	–	–	Effective(assigned) Value CP2	*Only RU sensors and RU VisiFerm RS485 ECS family

Table 12: Full integration function codes 3

4.8 Full Integration : Cell density specific parameters

Code	Read/Write	Register	Unit	Access	Group	pH	ORP	oDO	eDO	COND	UPW	VCD	TCD	dCO_2	Comment
42	Write	41968 41972	3 x integer (4 bytes)	S	Cell Density	–	–	–	–	–	–	Start/Stop data logging	–	–	1. User data = record rate (min 6 sec) 2. User data = start condition (default 0 -automatic recording after sensor power up) 3. User data = start/stop (1: start recording, 0: stop recording)
109	Read	41968	2 x integer (4 bytes)	S	Cell Density	–	–	–	–	–	–	Read Record Configuration	–	–	1. Return value = record rate (minimum 6 seconds) 2. Return value = start condition (default 0 -automatic recording after sensor power up)
110	Read	41972	integer (4 bytes)	U,S	Cell Density	–	–	–	–	–	–	Read Recording Status	–	–	0 = Recording off, 1 = Recording on
96	Read	41318	integer (4 bytes)	U,S	Cell Density	–	–	–	–	–	–	Culture time	Culture time	–	
97	Read	41228	integer (4 bytes)	U,S	Cell Density	–	–	–	–	–	–	Cell Type Mode	Cell Type Mode	–	
98	Write	41228	integer (4 bytes)	S	Cell Density	–	–	–	–	–	–	Cell Type Mode	Cell Type Mode	–	
99	Read	42006	string (16 bytes)	U,S	Cell Density	–	–	–	–	–	–	Correlation Identifier	–	–	
100	Write	42006	string (16 bytes)	S	Cell Density	–	–	–	–	–	–	Correlation Identifier	–	–	
101	Read	42102	hexa (16 byte)	U,S	Cell Density	–	–	–	–	–	–	Checksum of correlation model	–	–	
102	Write	42102	hexa (16 byte)	S	Cell Density	–	–	–	–	–	–	Checksum of correlation model	–	–	
103	Read	42086	string (16 bytes)	U,S	Cell Density	–	–	–	–	–	–	Creation date of correlation model	–	–	
104	Write	42086	string (16 bytes)	S	Cell Density	–	–	–	–	–	–	Creation date of correlation model	–	–	
105	Read	42094	string (16 bytes)	U,S	Cell Density	–	–	–	–	–	–	Creation time of correlation model	–	–	
106	Write	42094	string (16 bytes)	S	Cell Density	–	–	–	–	–	–	Creation time of correlation model	–	–	
107	Read	42014	integer (4 bytes)	U,S	Cell Density	–	–	–	–	–	–	Status of correlation model	–	–	0 = MVDA stopped / not running, 1 = MVDA start / running
108	Write	42014	integer (4 bytes)	S	Cell Density	–	–	–	–	–	–	Activate/Deactivate correlation model	–	–	0 = MVDA stopped / not running, 1 = MVDA start / running

Table 13: Full integration function codes 4

5 Examples of Calibration Programming

5.1 Standard Auto Calibration

No.	Action	Minimum required User Level
1	The System and Operator Type settings for the chosen calibration standard should support Auto calibration. This can be set in ArcAir if necessary. Not appropriate settings can lead to unsuccessful calibration. System Type for Calibration Standard 1 [Manual and Auto] Operator Type for Calibration Standard 1 [Manual and Auto] Put the sensor into the appropriate buffer solution. Check the PMC1, if the measured value is stabilized, go forward.	U
2	For the automated calibration all the User Data fields of the input buffer must be 0.	U
3	Enter the address of the sensor in the Calibration Modbus Address field.	U
4	Change the User Level to S with FC24 if the current level is lower.	S
5	Enter the appropriate value in the Calibration Point field. Note: While the value is present in the input field the appropriate calibration will be executed cyclically. To stop repeated calibrations remove the value from the input field before you move on to other calibration points. Point: TS1-CP1 | TS1-CP2 | TS2-CP1 | TS2-CP2 Value: 1 | 2 | 21 | 22	S
6	Wait a few seconds and the calibration status can be checked with the appropriate function code. The calibration was successful if the status is 16#0000_0000 and the stored buffer value is matching with the applied one. *Note: When both CP1 and CP2 calibrations are required to have a successful calibration, the status can be different from 16#0000_0000 until both points are calibrated.* Point: TS1-CP1 | TS1-CP2 | TS2-CP1 | TS2-CP2 Function: FC14 | FC17 | FC128 | FC132	U

Example of standard auto calibration of the CP1 on pH (TS1) sensor with Modbus address 5:

Byte	0	1	2	3	4	5	6	7	8	9	10…13	14…17	18…21	22…25
HEX data	–	–	–	–	–	–	–	–	5	1	0	0	0	0

5.2 Standard Manual Calibration

No.	Action	Minimum required User Level
1	The System and Operator Type settings for the chosen calibration standard should support Manual calibration. This can be set in ArcAir if necessary. Not appropriate settings can lead to unsuccessful calibration. System Type for Calibration Standard 1 [Manual and Auto] Operator Type for Calibration Standard 1 [Manual and Auto] Put the sensor into the appropriate buffer solution. Check the PMC1, if the measured value is stabilized, go forward.	U
2	For the manual calibration the User Data1 field of the input buffer must contain the chosen buffer value in the appropriately swapped format. The not used User Data field's content should remain 0.	U
3	Enter the address of the sensor in the Calibration Modbus Address field.	U
4	Change the User Level to S with FC24 if the current level is lower.	S
5	Enter the appropriate value in the Calibration Point field. Note: While the value is present in the input field the appropriate calibration will be executed cyclically. To stop repeated calibrations remove the value from the input field before you move on to other calibration points. Point: TS1-CP1 | TS1-CP2 | TS2-CP1 | TS2-CP2 Value: 1 | 2 | 21 | 22	S
6	Wait a few seconds and the calibration status can be checked with the appropriate function code. The calibration was successful if the status is 16#0000_0000 and the stored buffer value is matching with the applied one. *Note: When both CP1 and CP2 calibrations are required to have a successful calibration, the status can be different from 16#0000_0000 until both points are calibrated.* Point: TS1-CP1 | TS1-CP2 | TS2-CP1 | TS2-CP2 Function: FC14 | FC17 | FC128 | FC132	U

Example of standard manual calibration of the CP2 on pH(TS1)sensor with Modbus address 5 and buffer value 8.0 (0x41000000):

Byte	0	1	2	3	4	5	6	7	8	9	10…13	14…17	18…21	22…25
HEX data	–	–	–	–	–	–	–	–	5	2	0x0000_4100	0	0	0

5.3 Perform Product Calibration

No.	Action	Minimum required User Level
1	Enter the desired calibration value in the User Data1 field of the input buffer in the appropriately swapped format. The not used User Data field`s content should remain 0.	U
2	Execute the appropriate from the below listed function codes. Technology standard: TS1 / TS2 Function: FC30 / FC34	S
3	The current product calibration can be read with the below listed function codes. The product calibration is Active and Assigned if the status bit is 16#1400_0000. Technology standard: TS1 / TS2 Function: FC32 / FC138	U

Example of performing product calibration of pH sensor with Modbus address 5 and calibration value 3.3 (0x40533333):

Byte	0	1	2	3	4	5	6	7	8	9	10…13	14…17	18…21	22…25
HEX data	5	1E	–	–	–	–	–	–	–	–	0x3333_4053	0	0	0

5.4 Delete Product Calibration

No.	Action	Minimum required User Level
1	Execute the appropriate from the below listed function codes. Technology standard: TS1 / TS2 Function: FC31 / FC34	S
2	The current product calibration can be read with the below listed function codes. The product calibration is Inactive if the status bit is 16#0000_0000. Technology standard: TS1 / TS2 Function: FC32 / FC138	U

Example of deleting product calibration of pH sensor with Modbus address 5:

Byte	0	1	2	3	4	5	6	7	8	9	10…13	14…17	18…21	22…25
HEX data	5	1F	X	X	X	X	X	X	X	X	0	0	0	0

5.5 Perform Single Use Calibration

No.	Action	Minimum required User Level
1	Enter the desired single use calibration values in the User Data1 (e.g. Offset) and User Data2 (e.g. Slope) fields of the input buffer in the appropriately swapped format. [link to the swapping must be placed]. The not used User Data field's content should remain 0. *Note: Not every sensor supports two calibration*	U
2	Execute the appropriate from the below listed function codes. Technology standard: TS1 / TS2 (only CDC) Function: FC33 / FC39	S
3	The current single use calibration can be read with the below listed function codes. Note : Not every sensor supports two calibration Technology standard: TS1 / TS2 (only CDC) Function: FC10/FC11 / FC40	U

Example of single use calibration of pH sensor with Modbus address 5 and calibration values 4.01 (0x408051EC) and 7 (0x40E00000):

Byte	0	1	2	3	4	5	6	7	8	9	10…13	14…17	18…21	22…25
HEX data	5	21	X	X	X	X	X	X	X	X	0x51EC_4080	0x0000_40E0	0	0

6 Converter Update

To update the script version, the Converter must be connected to a PC and the following steps must be taken:

1. Download the newest version of the script from www.hamiltoncompany.com
2. Download Wingate configuration software directly from Deutschmann website (www.deutschmann.de/en/support/downloads) and install it.
3. Establish a cable connection from a RS-232 COM port of the PC (can also be provided via USB RS-232 converter) to the Deutschmann module. The following RS-232 signals have to be connected to connector X1 of the module:
   - Pin1: Rx232
   - Pin2: Tx232
   - Pin3: Ground
4. At the Converter the switches S4 and S5 must be in position F.
5. Start Wingate, set COM port correctly (Options > Port).
6. Supply (Or Restart) the Converter with power (via X2, Pin1 and Pin2). In Wingate, the module information should be displayed in the script in the grey log area.
7. The new script can be loaded onto the Converter via «File > Write script». A success message is displayed at the end.
8. Set switches S4 and S5 back to position 0.
9. Restart Converter.

NOTE: For technical assistance, please contact Hamilton Technical Support at the following address:
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