EMPA water quality analysis sensor communication protocol

A host MODBUS protocol framework

MODBUS first address		Description
0x0000	64	host setup parameter space
0x0040	32	Data space for water quality parameters
0x0060	32	raw signal data space
0x0080	32	temperature signal data space
0x00A0	32	parameter space for the calibration operation
0x00C0	64	space associated with storage operations
0x0140	48	sensor compensation settings

- **Host setup parameters (first address of parameter data area 0x0000)**

The address of the message	data type	Reading and writing	Length	Description	
First address + 0x0000	Unsigned int	R	1	host alarm code	
First address + 0x0001	String	R	3	Current time	First address + 0x0000
First address + 0x0004	Unsigned int	R	1	from the time of the next measurement	Unit S
First address + 0x0005	Unsigned int	R	1	the mainframe's operating status	In standby (0x00), Initialization in progress (0x01), Working (0x02), Cleaning in progress (0x03),
First address + 0x0006	Unsigned int	R	1	host operating mode selection	Continuous operation mode (0x00), Trigger operating mode (0x01), Cyclic operating mode (0x02),
First address + 0x0007	Unsigned int	R	1	operating the startup register (Operation required only in trigger mode)	Single acquisition start (0xAAAA) Continuous acquisition start (0xBBBB) Enter standby mode (0xCCCC)
First address + 0x0008	Unsigned int	R/W	1	Measurement interval (timed operation mode)	10 minutes - 24 hours
First address + 0x0009	Unsigned int	R/W	1	store the enable flag	
first address + 0x000A	Unsigned int	R/W	1	Sweeping mode	0x00:Auto 0x01:Manual 0x02: Starts a sweep
first address + 0x000B	Unsigned int	R/W	1	Number of sweeps (1-100)	
first address + 0x000C	Unsigned int	R/W	1	Minutes between sweeps	10 minutes - 24 hours
first address + 0x000D	Unsigned int	R/W	1	Sweep offset	
First address + 0x00010	Unsigned int	R/W	1	channel 1 sensor type	
First address + 0x00011	Unsigned int	R/W	1	channel 2 sensor type	
First address + 0x00012	Unsigned int	R/W	1	channel 3 sensor type	
First address + 0x00013	Unsigned int	R/W	1	channel 4 sensor type	
First address + 0x00014	Unsigned int	R/W	1	channel 5 sensor type	
First address + 0x00014	Unsigned int	R/W	1	channel 5 sensor type	
First address + 0x00015	Unsigned int	R/W	1	channel 6 sensor type	
First address + 0x00016	Unsigned int	R/W	1	channel 7 sensor type	
First address + 0x00017	Unsigned int	R/W	1	channel 8 sensor type	
First address + 0x0018	String	R	8	Serial Number	

				(16Byte)	
First address + 0x0020	String	R	1	Hardware version (1Byte)	
First address + 0x0021	String	R	2	Software Version (4 Byte)	
First address + 0x0023	Unsigned int	R/W	1	mailing address	
First address + 0x0024	Unsigned int	R/W	1	baud rate	
First address + 0x0025	Unsigned int	R	1	type of equipment	
First address + 0x0032		R/W	2	atmospheric pressure values	for dissolved oxygen calculations
First address + 0x0034		R/W	2	dissolved oxygen to calculate salinity compensation values	for dissolved oxygen calculations
First address + 0x0036		R/W	1	Dissolved Oxygen Salinity Compensation Options (current calculated value, set value)	0x00 : Using setup value compensation 0x01 : Using calculated numerical compensation
First address + 0x0037		R/W	1	conductivity units	0x00：uS/cm 0x01：mS/Cm 0x02：mS/m
First address + 0x0038		R/W	1	salinity units	0x00 : PPT 0x01 : PSU
First address + 0x0039		R/W	1	Turbidity range	
first address + 0x003A		R/W	1	Chlorophyll range	
first address + 0x003B		R/W	1	Blue-green algae range	
first address + 0x003C		R/W	1	The number of times the optical parameters were averaged	

Higher 8 bits	8 bits lower	Type
0x19:empa host	0x01	EMPA-4S
	0x02	EMPA-6S
	0x03	EMPA-8S

Alarm code

flag bit	Type
Bit[0]	Optical sensor failure
Bit[1]	Dissolved oxygen sensor failure
Bit[2]	conductivity sensor failure
Bit[3]	
Bit[4]	
Bit[5]	
Bit[6]	
Bit[7]	
Bit[8]	
Bit[9]	
Bit[10]	
Bit[11]	
Bit[12]	
Bit[13]	
Bit[14]	Cleaning brush malfunction
Bit[15]	Depth sensor failure

- **Water quality parameter data area (parameter data area first address 0x0040)**

The address of the message	data type	Reading and writing	Length	Description	Unit
First address + 0x0000	float	R	2	Temperature	℃
First address + 0x0002	float	R	2	PH	--
First address + 0x0004	float	R	2	ORP	mV
First address + 0x0006	float	R	2	Dissolved oxygen	mg/L
First address + 0x0008	float	R	2	Dissolved oxygen	%
first address + 0x000A	float	R	2	Turbidity	NTU
first address + 0x000C	float	R	2	conductivity	Optional
first address + 0x000E	float	R	2	Salinity	Optional
First address + 0x0010	float	R	2	COD	mg/L
First address + 0x0012	float	R	2	chromaticity/transparency	°/cm
First address + 0x0014	float	R	2	Depth	m
First address + 0x0016	float	R	2	Chlorophyll	ug/L
First address + 0x0018	float	R	2	blue-green algae	Cell/mL
first address + 0x001A	float	R	2	ammonia nitrogen	mg/L
first address + 0x001C	float	R	2	Nitrogen	mg/L
first address + 0x001E	float	R	2	chloride/potassium/fluoride ions	mg/L

- **Raw signal data area (first address of raw signal data area 0x0060)**

The address of the message	data type	Reading and writing	Length	Description
First address + 0x0000	float	R	2	PH raw signals
First address + 0x0002	float	R	2	ORP raw signal
First address + 0x0004	float	R	2	Dissolved oxygen raw signal
First address + 0x0006	float	R	2	Turbidity raw signal
First address + 0x0008	float	R	2	conductivity raw signal
first address + 0x000A	float	R	2	The raw chlorophyll signal
first address + 0x000C	float	R	2	raw blue-green algae signals
first address + 0x000E	float	R	2	deep raw signals
First address + 0x0010	float	R	2	COD raw signal
First address + 0x0012	float	R	2	chroma/transparency raw signal
First address + 0x0014	float	R	2	raw ammonia signal
First address + 0x0016	float	R	2	Nitrate-nitrogen raw signals
First address + 0x0018	float	R	2	chloride/potassium/fluoride signals

- **Temperature raw signal data area (Temperature raw signal data area first address 0x0080)**

The address of the message	data type	Reading and writing	Length	Description
First address + 0x0000	float	R	2	Optical sensor temperature measurement values
First address + 0x0002	float	R	2	Dissolved Oxygen Sensor Temperature Measurement Values
First address + 0x0004	float	R	2	conductivity sensor temperature measurement values

First address + 0x0006	float	R	2	
First address + 0x0008	float	R	2	
first address + 0x000A	float	R	2	
first address + 0x000C	float	R	2	
first address + 0x000E	float	R	2	
First address + 0x0010	float	R	2	Optical sensor temperature raw signal
First address + 0x0012	float	R	2	Dissolved Oxygen Sensor Temperature Raw Signal
First address + 0x0014	float	R	2	Conductivity sensor temperature raw signal
First address + 0x0016	float	R	2	
First address + 0x0018	float	R	2	
first address + 0x001A	float	R	2	
first address + 0x001C	float	R	2	
first address + 0x001E	float	R	2	

- **Calibration operation space (first address of raw signal data area 0x00A0)**

The address of the message	data type	Reading and writing	Length	Description
First address + 0x0000	Unsigned int	R/W	1	calibration parameters
First address + 0x0001	Float	R/W	2	The first point of raw data
First address + 0x0003	Float	R/W	2	First point calibration data
First address + 0x0005	Float	R/W	2	The second point of raw data
First address + 0x0007	Float	R/W	2	Second point of calibration data
First address + 0x0009	Float	R/W	2	The third point of raw data
first address + 0x000B	Float	R/W	2	Third-point calibration data
first address + 0x000D	Unsigned int	R/W	1	The calibration start sign (0x0001: start 1-point calibration 0x0002: start 2-point calibration, 0x0003: start 3-point calibration)
First address + 0x0010	String	R	3	New time
First address + 0x0013	Unsigned int	R	1	time to set the startup flag

parameter identification	calibration parameters	The method of finalization of bids
0x0001	Temperature	One-point calibration
0x0002	PH	One-point calibration, two-point calibration
0x0003	ORP	One-point calibration, two-point calibration
0x0004	Dissolved oxygen	One-point calibration, two-point calibration
0x0005	Turbidity	one-point calibration, two-point calibration, three-point calibration
0x0006	conductivity	One-point calibration
0x0007	NC	NC
0x0008	Salinity	One-point calibration
0x0009	Depth	One-point calibration
0x000A	Chlorophyll	One-point calibration, two-point calibration
0x000B	blue-green algae	One-point calibration, two-point calibration
0x000C	ammonia nitrogen	One-point calibration, two-point calibration
0x000D	Nitrogen	One-point calibration, two-point calibration
0x000E	Potassium ions	One-point calibration, two-point calibration
0x000F	Chloride ions	One-point calibration, two-point calibration
0x0010	NC	NC
0x0011	Fluoride ions	One-point calibration, two-point calibration
0x0012	NC	NC
0x0013	NC	NC
0x0014	NC	NC

- **Storage related (first address of storage related area 0x00C0)**

The address of the message	data type	Reading and writing	Length	Description
First address + 0x0000	ULONG	W	2	the current operation record ID
First address + 0x0002	USHORT	W	1	operation command (0x11: read operation 0x22:write operation 0x33: write record 0x66:Delete a BLOCK (total 1024 BLOCKS 64KB each) 0x77:Delete the entire FLASH 0x88:initiate a store operation
First address + 0x0003	String	R	43	86 BYTE string
first address + 0x003E	ULONG	R	2	total number of record IDs

data type	Reading and writing	Length	BYTE
String	Storage time	3	6
Unsigned int	host alarm code	1	2
Float	20 parameters	40	80

Serial number	data type	Description	Unit
1	float	Temperature	℃
2	float	PH	--
3	float	ORP	mV
4	float	Dissolved oxygen	mg/L
5	float	Dissolved oxygen	%
6	float	Turbidity	NTU
7	float	Conductivity (25 degrees compensation)	uS/cm
8	float	Salinity	ppt
9	float	COD	mg/L
10	float	chromaticity/transparency	° /cm
11	float	Depth	m
12	float	Chlorophyll	ug/L
13	float	blue-green algae	Cell/mL
14	float	ammonia nitrogen	mg/L
15	float	Nitrogen	mg/L
16	float	chloride/potassium/fluoride ions	mg/L

- **Ion selection sensor compensation setup space (first address 0x0140)**

The address of the message	data type	Reading and writing	Length	Description	
First address + 0x0000		R/W	1	Potassium ions compensate for ammonia ions to enable	
First address + 0x0001		R/W	1	Ammonia ions compensate for potassium ions to enable	
First address + 0x0002		R/W	1	Chloride ion to nitrate ion compensation enable	
First address + 0x0003		R/W	1	Nitrate ions compensate for chloride ions to enable	
First address + 0x0004	float	R/W	2	Potassium ion to ammonia ion compensation factor	
First address + 0x0006	float	R/W	2	ammonia ion to potassium ion compensation factor	
First address + 0x0008	float	R/W	2	Chloride ion to nitrate ion compensation factor	
first address + 0x000A	float	R/W	2	Nitrate ion to chloride ion compensation factor	
first address + 0x000C	float	R/W	2	Parameters for manual compensation of potassium ions to ammonia ions	
first address + 0x000E	float	R/W	2	parameters for manual compensation of ammonia ions to potassium ions	
First address + 0x0010	float	R/W	2	Parameters for manual compensation of chloride ions to nitrate ions	
First address + 0x0012	float	R/W	2	Parameters for manual compensation of chloride ions by nitrate ions	
First address + 0x0020	float	R/W	2	Turbidity compensation factor for chlorophyll	
First address + 0x0022	float	R/W	2	Turbidity compensation factor for blue-green algae	