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Mapping variables to an address space MODBUS - basic

Electromagnetic flow meters **FLONET FH30xx a FLONEX FXx11x**



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1. INTRODUCTION

Electromagnetic flow meters of type FLONET FH30xx (for normal environment) and FLONEX FXx11x for hazardous environment make possibility to measure flow and volume of conductive liquids in both directions in fully flooded pipes. The range of measurement velocity is 0,025 to 10 m/s and min conductivity of measured medium is 10 $\mu\text{S/cm}$ (for demineralized water from 20 $\mu\text{S/cm}$).

The flow meters are equipped for communication with a control room with digital interfaces:

- RS-485 MODBUS RTU

This manual is intended for explanation, how to connect flow meters of types **FLONET FH30xx** and **FLONEX FXx11x** to a parent computer by serial communication line RS-485 MODBUS RTU.

2. MAPPING

2.1. Address space MODBUS

MODBUS is divided to 5 blocks acc to specification of application protocol:

Function	Address space	Type of variable	Access	Type	Size	Length
01 05 15	0-9999	1 bit	r/w	coils	1 bit	
02	10000-29999	1 bit	r	discrete inputs	1 bit	
	30000-31999	word 0-65535	r	input registers	2 bytes	1 reg
	32000-33999	float	r		4 bytes	2 reg
	34000-35999	Long 0-4294967296	r		4 bytes	2 reg
	36000-37999	string	r		10 bytes	5 reg
	38000-39999	double	r		8 bytes	4 reg
	40000-41999	word 0-65535	r/w	holding registers	2 bytes	1 reg
	42000-43999	float	r/w		4 bytes	2 reg
	43500-44000	word 0-65535	r/w		2 bytes	1 reg
	46000-47999	string	r/w		6 bytes	3 reg
	50000-51999	string	r	data structure	see 2.14 Data structures	see 2.14 Data structures

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2.2. Address space 0–9999

It is reserved for single-bit variables that can be read and written (coils). **For the billing meter, the coils are 1500 and above read-only.**

Variables	Address MODBUS	Note
E1 - Over or under voltage on A/D converter	112	0 – turns off notifications 1 – turns on notifications
E2 - Very fast different of measured data	113	0 – turns off notifications 1 – turns on notifications
E3 - Error on write/read data to eeprom, FRAM, comm error.... Appears even in the event of a CRC error (ie the calculated value does not match the stored one)	114	0 – turns off notifications 1 – turns on notifications
E4 - Other error - timer, watchdog and other	115	0 – turns off notifications 1 – turns on notifications
E5 - Error calibrate	116	0 – turns off notifications 1 – turns on notifications
E6 - No coil, low current	117	0 – turns off notifications 1 – turns on notifications
E7 - Short circuit, overcurrent	118	0 – turns off notifications 1 – turns on notifications
E8 - Calibration in progress	119	0 – turns off notifications 1 – turns on notifications
E9 - Too high resistance	120	0 – turns off notifications 1 – turns on notifications
E10 - Multifunction output OUT1 err	121	0 – turns off notifications 1 – turns on notifications
E11 - Multifunction output OUT2 err	122	0 – turns off notifications 1 – turns on notifications
E12 - Current output is out of range	123	0 – turns off notifications 1 – turns on notifications
E13 - Date/Time not set	124	0 – turns off notifications 1 – turns on notifications
E14 - Overflow (110% of max float)	125	0 – turns off notifications 1 – turns on notifications
Reserve	126	
Reserve	127	

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2.3. Address space 10000–29999

This space is intended to single bit variables, by which can be only to read discrete inputs

Variables	Address MODBUS	Note
E1 over or under voltage on A/D converter	10016	This is actual error 0 – status OK 1 – error
E2 very fast different of measured data	10017	This is actual error 0 – status OK 1 – error
E3 error on write/read data to eeprom, FRAM, comm error....	10018	This is actual error 0 – status OK 1 – error
E4 other error - timer, watchdog and other	10019	This is actual error 0 – status OK 1 – error
E5 error calibrate, cannot calibrate if ADC running or other ADC comm err	10020	This is actual error 0 – status OK 1 – error
E6 No coil, low current	10021	This is actual error 0 – status OK 1 – error
E7 Short circuit, overcurrent	10022	This is actual error 0 – status OK 1 – error
E8 Calibration in progress	10023	This is actual error 0 – status OK 1 – error
E9 Too high resistance	10024	This is actual error 0 – status OK 1 – error
E10 Multifunction output OUT1 err	10025	This is actual error 0 – status OK 1 – error
E11 Multifunction output OUT2 err	10026	This is actual error 0 – status OK 1 – error
E12 Current output is out of range	10027	This is actual error 0 – status OK 1 – error
E13 Date/Time not set	10028	This is actual error 0 – status OK 1 – error
E14 Overflow (110% of max float)	10029	This is actual error 0 – status OK

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Variables	Address MODBUS	Note
		1 – error
E15 – Power failure indication	10030	This is actual error 0 – status OK 1 – error
Reserve	10031	

2.4. Address space 30000-31999

It is reserved for an integer double-byte variable of type word (range 0-65535), which can only be read by input registers

The length of each variable is 1 register.

Variables	Address MODBUS	Note
Error archive capacity (number of records)	30019	Archiving
Length of the record in the error archive (B)	30020	Archiving
Number of records stored in the error archive - index	30021	Archiving
Access archive capacity	30022	Archiving
Record length in access archive (B)	30023	Archiving
Number of records stored in the access archive - index	30024	Archiving
Hourly log archive capacity	30025	Archiving
Daily log archive capacity	30026	Archiving
Monthly log archive capacity	30027	Archiving
Length of the recorded archive of measured values	30028	Archiving
Number of records stored in the hourly archive - index	30029	Archiving
Number of records stored in the daily archive - index	30030	Archiving
Number of records stored in the monthly archive - index	30031	Archiving

2.5. Address space 32000-33999

It is intended to read 4-byte variables of type float, by which it is possible to read input registers only.

The length of each variable is 2 registers.

Variables	Address MODBUS	Note
Volume flow rate [l/s]	32000	
Current flow in user units	32002	Actual data
Current output 1 - voltage on the loop [V]	32004	Current output

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2.6. Address space 34000-35999

It is reserved for an integer four-byte variable of type long (range 0-4294967296), which can only be read by input registers. **The length of each variable is 2 registers.**

Variables	Address MODBUS	Note
Time of operation [s]	34000	Data
Time of power failure [s]	34002	Data
Time of measurement failure [s]	34004	Data

2.7. Address space 36000-37999

It is reserved for variables of type string, which can only read input registers.

The length of each variable is 5 registers. The length of the string is shorter by the last character \0! UTF8 encoding.

Variables	Address MODBUS	Note
Hardware identifier	36000	Production data
Type of device	36005	Production data
System series number	36015	Production data
Production number of a transmitter	36025	Production data
Production number of a sensor	36035	Production data
Nominal diameter of a sensor	36045	Production data
Nominal pressure	36050	Production data
Date of calibration, production	36055	Production data
Number of sw-version of control processor	36060	Production data
Number of sw-version of processor of measuring module	36070	Production data

2.8. Address space 38000-39999

It is intended to real 8-byte variables of type double, by which it is possible to read input registers.

The length of each variable is 4 registers.

Variables	Address MODBUS	Note
Total volume in + direction	38000	[m3]
Total volume in - direction	38004	[m3]
Volume Q+ in user units	38008	
Volume Q- in user units	38012	

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2.9. Address space 40000-41999

It is reserved for an integer double-byte variable of type word (range 0-65535), which can be read and written to the edit register (holding registers). For the billing meter, registers 41500 and above are read-only. **The length of each variable is 1 register.**

Variables	Address MODBUS	Note
Language of device	40000	Basic setting
Date and time	40001	Basic setting
MODBUS address of a client	40013	MODBUS
MODBUS Speed Bd	40014	MODBUS
Display backlight time [s]	40016	Production data
Type of output	41510	Current output
Display	41513	Basic setting
Type of output	41515	Multifunction outputs
Inversion of output	41517	Multifunction outputs
Length of pulse [ms]	41520	Multifunction outputs
Type of output	41523	Multifunction outputs
Inversion of output	41525	Multifunction outputs
Length of pulse [ms]	41528	Multifunction outputs
Code of flow unit	41537	Production data
Code of volume unit	41538	Production data

2.10. Address space 42000-43999

It is reserved for real four-byte float variables that can be read and written to (some) editing registers (holding registers). **For a billing meter, these registers are read-only.** The length of each variable is 2 registers.

Variables	Address MODBUS	Note
User flow conversion factor	42000	Production data
User volume conversion factor	42002	Production data
Insensitivity of flow measurement, suppressed flow [l/s]	42018	Production data (for reading only)
Calibration constant K1	42024	Production data (for reading only)
Simulated flow value	42028	Service
Value representing 100% of the volume flow	42030	Actual data
Constant current 4...20mA	42060	Current output
Qmax [l/s]	42068	Multifunction outputs
Insensitivity band [l/s]	42070	Multifunction outputs

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Insensitivity band [liter]	42076	Multifunction outputs
Qmax [liter]	42080	Multifunction outputs
Q for 1kHz [l/s]	42102	Multifunction outputs
Q for 1kHz [liter]	42106	Multifunction outputs
Pulse number - [l/pulse]	42126	Multifunction outputs
Pulse number - [l/pulse]	42128	Multifunction outputs
Flow for 20mA [l/s]	42176	Current output
Flow for 4mA [l/s]	42178	Current output

2.11. Address space 50000-51999

It is reserved for real eight-byte variables of type double, which **can only read** input registers. The length of each variable is according to the length of the structures of individual records. See. 2.14 Data structures:

Variables	Address MODBUS	Note
Date	50000	Error log
Error	50003	Error log
Operation time [sec]	50004	Error log
CRC16	50007	Error log
Date	50512	Audit log
Password	50515	Audit log
Operation time [sec]	50518	Audit log
CRC16	50521	Audit log
Date and time	50832	Hourly log
Flow [l/s]	50836	Hourly log
Q+ [m3]	50840	Hourly log
Q- [m3]	50844	Hourly log
Operation time [s]	50848	Hourly log
CRC16	50851	Hourly log
Date and time	51312	Daily log
Flow [l/s]	51316	Daily log
Q+ [m3]	51320	Daily log
Q- [m3]	51324	Daily log
Operation time [s]	51328	Daily log
CRC16	51331	Daily log
Date and time	51344	Monthly log
Flow [l/s]	51956	Monthly log
Q+ [m3]	51960	Monthly log
Q- [m3]	51964	Monthly log
Operation time [s]	51968	Monthly log
CRC16	51971	Monthly log

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Date structure:

```
#define Len_Of_Pswd 6
```

```
struct PassRec{
    char Password[Len_Of_Pswd] = "00000";
};
```

This data structure is used to define passwords. Its copy is used to record accesses.

```
struct XchgRec{
    char s;           // second, 0 - 59
    char n;           // minute, 0 - 59
    char h;           // hour, 0 - 23
    char d;           // day, 1 - 32
    char m;           // month, 1 - 12
    char y;           // year, year - 2000
    char sign[6];     // signature - login password, 5 characters + \0
};
```

This data structure is used to record access via the meter "keyboard".

```
struct ErrRec{
    char s;
    char n;
    char h;
    char d;
    char m;
    char y;
    uint16_t SysState; // code of error, as in address 10016 - 10031
};
```

This data structure is used to record errors and warnings. Recording is performed only when an error occurs.

```
struct LogRec{
    char s;
    char n;
    char h;
    char d;
    char m;
    char y;
    // 2byte dummy
    float ActQ;           // Actual flow
    // 4byte dummy
    double dTotalVolumePlus; // Total volume in positive direction [m³]
    double dTotalVolumeMinus; // Total volume in negative direction [m³]
};
```

This data structure is used to record the current flow and flow volumes in both directions every hour, day, month.

The default compiler setting for the processor is `pack(4)`, so the `LogRec` structure contains empty bytes.

All record counters are automatically reset after filling and start counting from the beginning - index 0.

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3. DOCUMENTATION AND STANDARDS

Standards

EN/IEC 61158-2

Manuals

Es 90686K Control instruction
 FLONEX FXx11x a FLONET FH30xx

Es 90684K Communication interface RS-485 MODBUS RTU
 FLONEX FXx11x a FLONET FH30xx

Ronešová, A Přehled protokolu MODBUS (Overview of protocol MODBUS)

<http://www.modbus.org>.

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