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1 abbreviations

2 Version

0.1	Initial draft
0.2	set to official
0.3	corrected REQ_UD2 Protocol IE1-3

3 M-Bus Protocol

3.1 Preamble

Before you can send a telegram to the SENSOSTAR over the optical interface, you have to wake it up. You have to send a preamble (504 Bytes of 0x55) with the following settings:

Start bits: 1
 Data bits: 8
 Parity: none
 Stop bits: 1

You have to do this before every telegram.

After the Preamble the Device is for 4 Seconds Active to receive the Telegram.
 After a Successfully Communication the Device is active for 4 additional seconds.

3.2 M-Bus Protocol

All bytes transmitted over the M-Bus and the optical interface, have the format 8E1:

1	8	1	1
Start bit	Data bits	Parity bit (even)	Stop bit

For communication three different telegram types are used. These are:

1. Single character 0xE5 (only used by slave=meter)
2. Short frame (only used by master)
3. Long frame (used by master and slave=meter)

3.3 Single character

The single character 0xE5 (CON_ACK) is only used by the meter. It serves as an acknowledgement of the reception of a valid frame (it does not say anything about whether the command was accepted and executed or not!)

3.4 Short frame

0x10	C	A	csum	0x16
------	---	---	------	------

Short frames always consist of 5 bytes.

They are initiated by the master.

There are two different frames: SND_NKE and REQ_UD2

- „C“ Command
- „A“ Address
- „csum“ Low byte of the sum of „C“ and „A“

3.4.1 SND_NKE

Deselection of a meter after selection by its secondary address.

Short frame identifier	0x10
C	0x40
A	adrs
Checksum	csum
Stop byte	0x16

Acknowledged by 0xE5.

3.4.2 REQ_UD2

Request for a data frame

Short frame identifier	0x10
C	0x5B or 0x7B
A	adrs
Checksum	csum
Stop byte	0x16

Acknowledged by a long frame.

3.4.2.1 Long frame master to slave

0x68	len	len	0x68	C	A	CI	userdata	csum	0x16
------	-----	-----	------	---	---	----	----------	------	------

- „C“ Command
- „A“ Address
- „CI“ Control information
- „len“ Total amount of bytes in userdata + 3 („C“, „A“, „CI“)
- Maximum length is 0xFF (max. 252 data bytes)
- „csum“ Low byte of the sum of „userdata“, „C“, „A“ and „CI“

Response to a REQ_UD2 command:

Long frame identifier	0x68
Length bytes	len, len
Long frame identifier	0x68
„C“ byte	0x08
„A“ byte	adrs
„Cl“ byte	0x72
4-byte type A identification number	$i_{low} \dots i_{high}$
2-byte manufacturer code	$Man_{low} \dots Man_{high}$
Meter version number	Ver
Medium code	Med
Access number	Acc
Status	Sta
Signature	0x00, 0x00
Data bytes read	$b_1 \dots b_n$
Checksum	csum
Stop byte	0x16

The „access number“ is the amount of data frames sent by the meter (M-bus and opto-coupler). It is incremented before being sent.

The „status“ is generally “0x00”. In case of an error in the meter the current error code will be sent.

Definition of the data bytes:

Length	Function	DIF(+E)	VIF(+E)	Data type
6	Device ID	0x04	0x78	32-bit type A
6 or 7	Total heat energy (current value, heat meter: heat; cooling meter: cooling; heat/cooling meter: heat)	0x04	0x06 (0.001 MWh) 0x0E (0.001 GJ) 0x86,0x3D (0.001 MMBTU) 0xFB,0x0D (0.001 Gcal)	32-bit type B
6 or 7	Total volume	0x04	0x13 (0.001 m³)	32-bit type B

6	Power (current value)	0x04	0x2B (0.001 kW)	32-bit type B
6	Power (maximum value)	0x14	0x2B (0.001 kW)	32-bit type B
6	Flow (current value)	0x04	0x3B (1 l/h)	32-bit type B
6	Flow (maximum value)	0x14	0x3B (1 l/h)	32-bit type B
4	Forward flow temperature	0x02	0x5B (1 °C)	16-bit type B
4	Return flow temperature	0x02	0x5F (1 °C)	16-bit type B
6	Temperature difference	0x02	0x61 (0.01 °C)	16-bit type B
4	Days in operation	0x02	0x23	16-bit type B
6	Current date and time	0x04	0x6D	32-bit type F
6 or 7	Total heat energy (last billing date; heat meter: heat; cooling meter: cooling; heat/cooling meter: heat)	0x44	0x06 (0.001 MWh) 0x0E (0.001 GJ) 0x86,0x3D (0.001 MMBTU) 0xFB,0x0D (0.001 Gcal)	32-bit type B
6 or 7	Total volume (last billing date)	0x44	0x13 (0.001 m³)	32-bit type B
4	Last billing date	0x42	0x6C	16-bit type G
4	Error code	0x01	0xFD, 0x17	8-bit type D
6	Device type / version	0x03	0xFD, 0x0C	24-bit type B
7 or 8	Total cooling energy (current value) (only heat/cooling meter)	0x84, 0x10	0x06 (0.001 MWh) 0x0E (0.001 GJ) 0x86,0x3D (0.001 MMBTU) 0xFB,0x0D (0.001 Gcal)	32-bit type B
7 or 8	Total cooling energy (last billing date; only heat/cooling meter)	0xC4, 0x10	0x06 (0.001 MWh) 0x0E (0.001 GJ) 0x86,0x3D (0.001 MMBTU) 0xFB,0x0D (0.001 Gcal)	32-bit type B

7 or 8	Tariff register 1 (current)	0x84, 0x20	0x06 (0.001 MWh) 0x0E (0.001 GJ) 0x86,0x3D (0.001 MMBTU) 0xFB,0x0D (0.001 Gcal) 0x20 (1 s)	32-bit type B
7 or 8	Tariff register 1 (billing date)	0xC4, 0x20	0x06 (0.001 MWh) 0x0E (0.001 GJ) 0x86,0x3D (0.001 MMBTU) 0xFB,0x0D (0.001 Gcal) 0x20 (1 s)	32-bit type B
7 or 8	Tariff register 2 (current)	0x84, 0x30	0x06 (0.001 MWh) 0x0E (0.001 GJ) 0x86,0x3D (0.001 MMBTU) 0xFB,0x0D (0.001 Gcal) 0x20 (1 s)	32-bit type B
7 or 8	Tariff register 2 (billing date)	0xC4, 0x30	0x06 (0.001 MWh) 0x0E (0.001 GJ) 0x86,0x3D (0.001 MMBTU) 0xFB,0x0D (0.001 Gcal) 0x20 (1 s)	32-bit type B
<i>7 or 8</i>	<i>Pulse counter 1 (current)</i>	<i>0x84, 0x40</i>	<i>0x13 (0.001 m³) 0x14 (0.01 m³) 0x15 (0.1 m³) 0x06 (0.001 MWh) 0x07 (0.01 MWh) 0xFB,0x00 (0.1 MWh) 0xFD,0x3A (dimensionless)</i>	<i>32-bit type B</i>
<i>7 or 8</i>	<i>Pulse counter 1 (billing date)</i>	<i>0xC4, 0x40</i>	<i>0x13 (0.001 m³) 0x14 (0.01 m³) 0x15 (0.1 m³)</i>	<i>32-bit type B</i>

			<p>0x06 (0.001 MWh) 0x07 (0.01 MWh) 0xFB,0x00 (0.1 MWh) 0xFD,0x3A (dimensionless)</p>	
8 or 9	Pulse counter 2 (current)	0x84, 0x80, 0x40	<p>0x13 (0.001 m³) 0x14 (0.01 m³) 0x15 (0.1 m³) 0x06 (0.001 MWh) 0x07 (0.01 MWh) 0xFB,0x00 (0.1 MWh) 0xFD,0x3A (dimensionless)</p>	32-bit type B
8 or 9	Pulse counter 2 (billing date)	0xC4, 0x80, 0x40	<p>0x13 (0.001 m³) 0x14 (0.01 m³) 0x15 (0.1 m³) 0x06 (0.001 MWh) 0x07 (0.01 MWh) 0xFB,0x00 (0.1 MWh) 0xFD,0x3A (dimensionless)</p>	32-bit type B
8 or 9	Pulse counter 3 (current)	0x84, 0xC0, 0x40	<p>0x13 (0.001 m³) 0x14 (0.01 m³) 0x15 (0.1 m³) 0x06 (0.001 MWh) 0x07 (0.01 MWh) 0xFB,0x00 (0.1 MWh) 0xFD,0x3A (dimensionless)</p>	32-bit type B
8 or 9	Pulse counter 3 (billing date)	0xC4, 0xC0, 0x40	<p>0x13 (0.001 m³) 0x14 (0.01 m³) 0x15 (0.1 m³) 0x06 (0.001 MWh) 0x07 (0.01 MWh) 0xFB,0x00 (0.1 MWh)</p>	32-bit type B

			0xFD, 0x3A (dimensionless)	
Note: The data marked in red is only transmitted when the option is present!				

3.4.2.2 Error code

Error Bit	Error Description
Bit 0	temperature sensor 1: cable broken
Bit 1	temperature sensor 1: short circuit
Bit 2	temperature sensor 2: cable broken
Bit 3	temperature sensor 2: short circuit
Bit 4	error in flow measurement system (eg no water) / coil error
Bit 5	electronics defective
Bit 6	reset
Bit 7	low battery

3.4.2.3 Device type/variant

device type	number	device variant	number
SENSOSTAR	5	Engelmann Retrofittable	0
		Engelmann Radio	1

3.4.3 Application reset

Long frame identifier	0x68
Length bytes	0x03, 0x03
Long frame identifier	0x68
„C“ byte	0x53 or 0x73
„A“ byte	adrs
„Cl“ byte	0x50
Checksum	csum
Stop byte	0x16

This deselects the device (secondary addressing).

Frame length: 9 bytes

Acknowledged by 0xE5.

3.4.4 Set primary M-Bus address

Long frame identifier	0x68
Length bytes	0x06, 0x06
Long frame identifier	0x68
„C“ byte	0x53 or 0x73
„A“ byte	adrs
„CI“ byte	0x51
Set primary M-bus address command	0x01, 0x7A
New primary address	new_adrs
Checksum	csum
Stop byte	0x16

„new_adrs“ for setting a new M-Bus address

Frame length: 12 bytes

Acknowledged by 0xE5.

3.4.5 Set identification number (M-Bus secondary address)

Long frame identifier	0x68
Length bytes	0x09, 0x09
Long frame identifier	0x68
„C“ byte	0x53 or 0x73
„A“ byte	adrs
„CI“ byte	0x51
Set identification number command	0x0C, 0x79
4-byte type A identification number	ID _{low} ... ID _{high}
Checksum	csum
Stop byte	0x16

ID_{low}... ID_{high} for setting a new identification number

Frame length: 15 bytes

Acknowledged by 0xE5.

Generally, the identification number and the serial number have the same value.

3.4.6 Select meter by secondary address

Long frame identifier	0x68
Length bytes	0x0B, 0x0B
Long frame identifier	0x68
„C“ byte	0x53 or 0x73
„A“ byte	0xFD
„CI“ byte	0x52
4-byte type A serial number	$S_{low} \dots S_{high}$
2-byte manufacturer code	$Man_{low} \dots Man_{high}$
Meter version number	Ver
Medium code	Med
Checksum	csum
Stop byte	0x16

The placeholder „0xF“ can be used at any decimal place of the serial number.

The placeholder „0xFF“ can be used for „medium code“, „meter version number“ and „manufacturer code“.

Frame length: 17 bytes

Acknowledged by 0xE5, if the secondary address is correct.

3.4.7 Set billing date

Long frame identifier	0x68
Length bytes	0x08, 0x08
Long frame identifier	0x68
„C“ byte	0x53 or 0x73
„A“ byte	adrs
„CI“ byte	0x51
Set billing date command	0x02, 0xEC, 0x00
2-byte „type G“ billing date	$d_{low} \dots d_{high}$

Checksum	csum
Stop byte	0x16

Frame length: 14 bytes

The validity of the date is not checked.

In order to set a monthly billing date, the month has to be set to "15".

Acknowledged by 0xE5.

3.4.8 Set date and time

Long frame identifier	0x68
Length bytes	0x0A, 0x0A
Long frame identifier	0x68
„C“ byte	0x53 or 0x73
„A“ byte	adrs
„Cl“ byte	0x51
DIF	0x04
VIF	0xED
VIFE	0x00
4-byte „type F“ date and time	d _{low} ... d _{high}
Checksum	csum
Stop byte	0x16

Frame length: 16 bytes

Acknowledged by 0xE5.

The validity of the date and time is not checked.

Years <=80 corresponds to 2000 – 2080

Note: Changing the date may influence the billing period and monthly values.

4 Summary of M-bus data types

4.1 32-bit Type A

LS word

15		12	11		8	7		4	3	0	
3	(nibble 3)	0	3	(nibble 2)	0	3	(nibble 1)	0	3	(nibble 0)	0

MS word

15		12	11		8	7		4	3	0	
3	(nibble 7)	0	3	(nibble 6)	0	3	(nibble 5)	0	3	(nibble 4)	0

Used for the serial number of the heat meter.

4.2 Type B

Represents a two's binary integer with sign.

4.3 Type C

Represents an binary integer without sign.

4.4 Type D

Represents a bit field.

4.5 Type F

LS word

15		12	11		8	7		4	3	0
SU	not used	4	hours	0	IV	n.u.	5	minutes	0	

MS word

15		12	11		8	7		4	3	0	
6	year (part)	3	3	month	0	2	year (part)	0	4	day	0

Application: date / time

4.6 Type G

15		12	11		8	7		4	3	0	
6	year (part)	3	3	month	0	2	year (part)	0	4	day	0

Application: date / time