ENGINEERING
TOMORROW

Operating Guide

SonoCollect 112

Data Concentrator for Smart Metering

www.heating.danfoss.com

Table of Contents

1 Notes and conventions

1.1 About this document

This manual provides guidance and procedures for a fast and efficient installation and start-up of the units described in this manual. It is imperative to read and carefully follow the safety guidelines.

1.2 Legal basis

1.2.1 Copyright protection

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1.2.2 Personnel qualification

The product use described in this documentation is intended exclusively for electronics specialists or persons instructed by electronics specialists. They must all have good knowledge in the following areas:

- Applicable standards
- Use of electronic devices

The solidus GmbH accepts no liability for faulty actions and damage to the described devices and third-party products caused by disregarding the information in this manual.

1.2.3 Intended use

If necessary, the components or assemblies are delivered ex works with a fixed hardware and software configuration for the respective application. Modifications are only permitted within the scope of the possibilities shown in the documentation. All other changes to the hardware or software as well as the non-intended use of the components result in the exclusion of liability on the part of Danfoss A/S.

Please send any requests for a modified or new hardware or software configuration to Danfoss A/S.

1.3 Symbols

- Caution: It is essential to observe this information in order to prevent damage to the device.
- Notice: Boundary conditions that must always be observed to ensure smooth and efficient operation.
- ESD (Electrostatic Discharge): Warning of danger to components due to electrostatic discharge. Observe precautionary measures when handling components at risk of electrostatic discharge.
- Note: Routines or advice for efficient equipment use.
- Further information: References to additional literature, manuals, data sheets and internet pages.

1.4 Font conventions

Names of paths and files are marked in italics. According to the system the notation is done by slash or backslash.

e. g.: *D:\Data*

Menu items or tabs are marked in bold italics.

e. g.: *Save*

An arrow between two menu items or tabs indicates the selection of a sub-menu item from a menu or a navigation history in the web browser.

- e. g.: *File → New*

Buttons and input fields are shown in bold letters.

e. g.: **Input**

Key labels are enclosed in angle brackets and shown in bold with capital letters.

e. g.: <**F5**>

Program codes are printed in Courier font.

e. g.: ENDVAR

Variable names, identifiers and parameter entries are marked in italics in the text.

e. g.: *Measured value*

1.5 Number notation

Numbers a noted according to this table:

Number system	Example	Comments
Decimal	100	Normal notation
Hexadecimal	0x64	C notation
Binary	'100' '0110.0100'	in quotation marks nibbles separated by dot

Table 1: Number systems

1.6 Safety guidelines

- The power supply must be switched off before replacing components and modules.

If the contacts are deformed, the affected module or connector must be replaced, as the function is not guaranteed in the long term. The components are not resistant to substances that have creeping and insulating properties. These include e.g. aerosols, silicones, triglycerides (ingredient of some hand creams). If the presence of these substances in the vicinity of the components cannot be excluded, additional measures must be taken. Install the components in an appropriate casing. Handle components with clean tools and materials only.

- Only use a soft, wet cloth for cleaning. Soapy water is allowed. Pay attention to ESD.
- Do not use solvents like alcohol, acetone etc. for cleaning.
- Do not use a contact spray, because in an extreme case the function of the contact point is impaired and may lead to short circuits.
- Assemblies, especially OEM modules, are designed for installation in electronic housings. Do not touch the assembly when it is live. In each case, the valid standards and directives applicable to the construction of control cabinets must be observed.
- The components are populated with electronic elements which can be destroyed by an electrostatic discharge. When handling the components, ensure that everything in the vicinity is well earthed (personnel, workplace and packaging). Do not touch electrically conductive components, e.g. data contacts.

1.7 Scope

This documentation describes the devices made by Danfoss A/S, Nordborg stated in the title.

1.8 Abbreviations

Abbreviation	Meaning
2G	Mobile radio standard, synonym for GSM or GPRS

Abbreviation	Meaning
3G	Mobile radio standard, synonym for UMTS
4G	Mobile radio standard, synonym for LTE
BACnet	Building Automation and Control networks
BBMD	BACnet Broadcast Management Device
CA	Certification Authority
CHAP	Challenge Handshake Authentication Protocol
COSEM	COmpanion Specification for Energy Metering
CSV	Character-Separated Values
DNS	Domain Name System
DE, DI	Digital Input, Digital Input Terminal
DA, DO	Digital Output, Digital Output Terminal
DIN	German Institute for Standardization
DLDE	Direct Local Data Exchange (EN 62056-21, IEC 1107)
DLDERS	DLDE communication via RS-232 or RS-485
DLMS	Device Language Message Specification
I/O	Input / output
ESD	ElectroStatic Discharge
FNN	Forum Network Technology/Network Operation
FTP	File Transfer Protocol
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
HTTP	Hypertext Transfer Protocol
I/O	Input/Output
ICMP	Internet Control Message Protocol
ID	Identification, identifier, unique marking
IoT	Internet of Things
IP	Internet Protocol or IP address
JSON	JavaScript Object Notation
LED	Light-Emitting Diode
LSB	Least significant byte
LSW	Least significant word
LTE	Long Term Evolution
M-Bus	Meter bus (EN 13757, part 2 - 3)
MAC	Medium Access Control or MAC address
MEI	Modbus Encapsulated Interface
MQTT	Message Queuing Telemetry Transport
MSB	Most Significant Byte
MSW	Most Significant Word
MUC	Multi Utility Communication, MUC-Controller
NBIoT	Narrow Band Internet of Things
OEM	Original Equipment Manufacturer
OMS	Open Metering System
PAP	Password Authentication Protocol
PEM	Privacy Enhanced Mail
PPP	Point-to-Point Protocol
PPPoE	Point-to-Point Protocol over Ethernet
RFC	Requests For Comments
RSSI	Received Signal Strength Indicator
RTC	Real Time Clock
RTOS	Real-Time Operating System
S0	S0 interface (pulse interface, EN 62053-31)
SIM	Subscriber Identity Module
SML	Smart Message Language
SMTP	Simple Mail Transfer Protocol
SNTP	Simple Network Time Protocol
SSL	Secure Socket Layer
TCP	Transmission Control Protocol
TLS	Transport Layer Security
UDP	User Datagram Protocol
UMTS	Universal Mobile Telecommunications System
UTC	Universal Time Coordinated
VDE	Association of Electrical, Electronic & Information Technologies e.V.
WAN	Wide Area Network
wM-Bus	Wireless Meter Bus (EN 13757, part 3 - 4)
XML	eXtensible Markup Language
XSLT	eXtensible Stylesheet Language Transformation

Table 2: Abbreviations

2 Presentation of the device

SonoCollect stands for a communication module, which automatically records customer's consumption data within the scope of Smart Metering. This is sent via a wide area network (WAN) to the measuring service provider or measuring point provider and, via a local interface, it can also be displayed on a customer PC.

The so-called SonoCollect 112 is a variant of such a communication module. This is separate from the meter, and acts as the data transport interface. The SonoCollect is the central device for the implementation of Smart Metering. Its advantage is that the measuring equipment and short-lived wide area communication are installed in separate devices, and so can be installed or exchanged independently of each other.

The SonoCollect 112 is a modular controller. The device comes in a 4U enclosure (modules) and is intended for DIN rail mounting (DIN rail 35 mm).

2.1 Delivery variants

The SonoCollect 112 is offered in a range of versions, and so can easily be adapted to the requirements of the particular property.

Variant	Order number	Meter interfaces			Communication interfaces			Outputs
		M-Bus	wM-Bus	S0	Ethernet	WAN	RS-485	Digital 24 V
SonoCollect 112 E-WM-80	014U1603	X	X	3	X	-	X	1
SonoCollect 112 G-WM-80	014U1605	X	X	3	X	X (LTE)	X	1
SonoCollect 112 EB-WM-80*	014U1609	X	X	3	X	-	X	1
SonoCollect 112 GB-WM-80*	014U1612	X	X	3	X	X (LTE)	X	1

Table 3: Abbreviations

*The Variants “EB-WM-80” and “GB-WM-80” includes the BACnet IP communication protocol.

The RS485 interface can be used both for communication (e.g. with a display (optional) and for reading meters.

2.2 Connectors

The various interfaces of the SonoCollect 112 are on different sides of the device.

The following figure shows the device variants:

Figure 1 SonoCollect 112 E-WM-80 SonoCollect 112 G-WM-80

The following connectors are available at SonoCollect 112:

Connector	Designation	Pinning	Comments
Power supply	N, L	N: neutral conductor L: Phase conductor	230 VAC (90-260 VAC), 50 Hz Screw clamp Connection cable 2.5 mm²
Ethernet connection	Ethernet	1: TX+ 2: TX- 3: RX+ 4: 5: 6: RX- 7:	according to EIA/TIA 568A/B

		8:	
RS-485	RS+, RS-	RS+: positive bus line RS-: negative bus line	Screw clamp Connection cable 2.5 mm²
WAN antenna	WAN	Inner: RF Outer: Reference ground	SMA with 4G variant only
wireless M-Bus antenna	OMS	Inner: RF Outer: Reference ground	SMA
M-Bus connection	MB+, MB-	MB+: positive bus line MB-: negative bus line	Screw clamp Connection cable 2.5 mm²
S0 inputs	Sx+, Sx (x = 1..3)	Sx+: Pulse input Sx-: Reference ground	Screw clamp Connection cable 2.5 mm² Voltage range 24 VDC No galvanic isolation
Digital output	DO+, DO-	DO+: Output DO-: Reference ground	Screw clamp Connection cable 2.5 mm² 24 VDC, 100 mA No galvanic isolation

Table 4: Pin assignments

2.3 Status LEDs

Depending on the version, the SonoCollect 112 has up to 5 status LEDs. These indicate the following states:

LED	Colour	Meaning
Power	green	Power supply active
Active (ACT)	Off green	inactive, waiting state Meter reading
State (STA)	Off green orange (flashing) orange red	Software is not started Main program is running Scanning meters Initialization is running Error
Mode*	off red (flashing) red yellow green	No connection Data connection setup Low received field strength Average received field strength Good received field strength
Link*	Off green yellow white	WAN module switched off WAN module switched on (no data connection) WAN module switched on + data connection (no data traffic) WAN module switched on + data connection (active data traffic)

*only available in variant with WAN

Table 5: Status LEDs (all models)

In the operating state, the *State* LED is green and the active LED flashes green briefly during the readout. The *Mode* LED indicates the reception field strength when the WAN connection is active at and the *Link* LED lights up yellow or white when the WAN connection is active.

2.4 First steps

2.4.1 Power supply

The SonoCollect 112 has an integrated power supply unit and is supplied with 230 VAC (wide input voltage range). Therefore, initially only the supply of the device must be ensured. The SonoCollect 112 starts automatically after connection to the supply voltage.

By default, following calls are made on system startup:

- Configuration of the network interface (Ethernet) via DHCP or static configuration
- Initial generation of SSL device keys (needs some time at first startup)
- Obtaining the system time via SNTP
- Starting the system services
- Start of the main program

The main program then provides the entire functionality, including the web interface of the SonoCollect 112.

2.4.2 Network configuration and first access

The SonoCollect 112 can be completely configured via the network interface. This must therefore be configured according to your network. If necessary, ask your administrator.

- ✔ SonoCollect 112 is set by default to the static IP address 192.168.1.101 (subnet mask: 255.255.255.0, gateway: 192.168.1.254).

For intuitive operation, a configuration website is available on the device, which can be accessed via

- ➔ website on the SonoCollect 112, e.g.: http://192.168.1.101
- ℹ when handling multiple devices under one IP (e.g. commissioning) or different software versions (e.g. update), you should always empty the cache of the browser (e.g. Ctrl+F5) to prevent an inconsistent display of the website.

The following site opens in the browser:

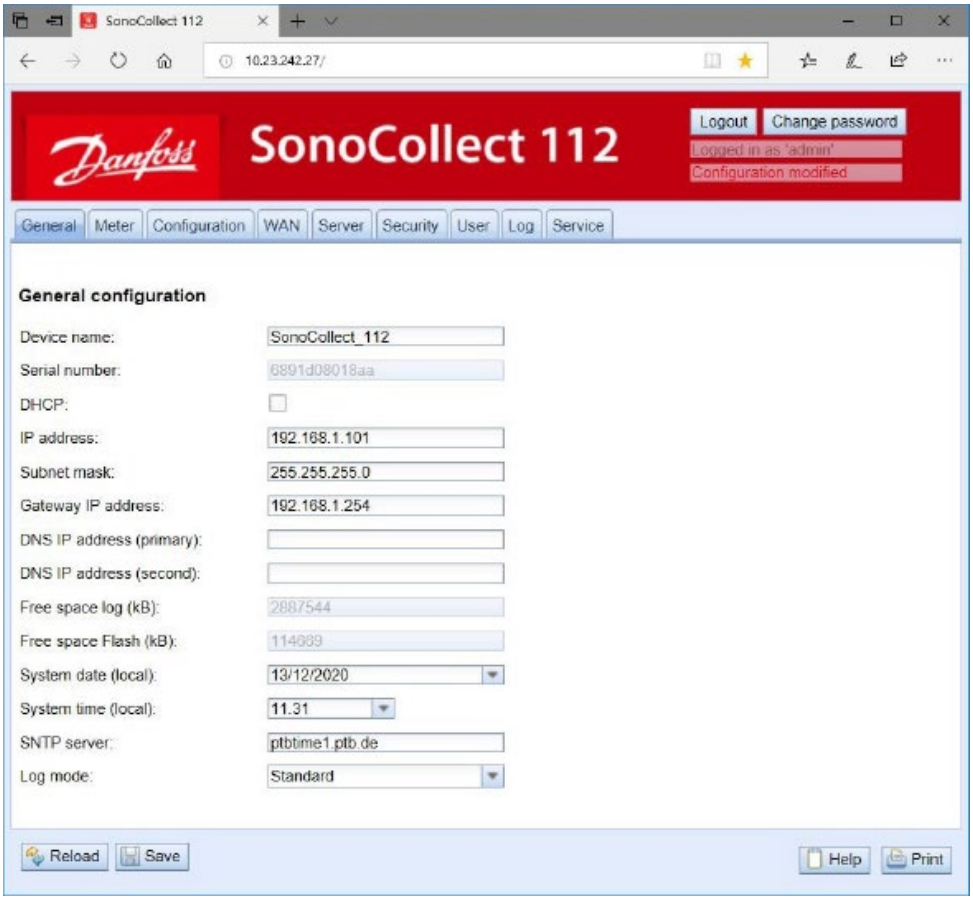


Figure 2 Website of the SonoCollect 112

The web frontend is described separately in chapter 4. There you will find a detailed overview of the functionalities of the web-based frontend.

In addition, access via SFTP, SCP, FTPS (file transfer) or via SSH (console) is also possible by default:

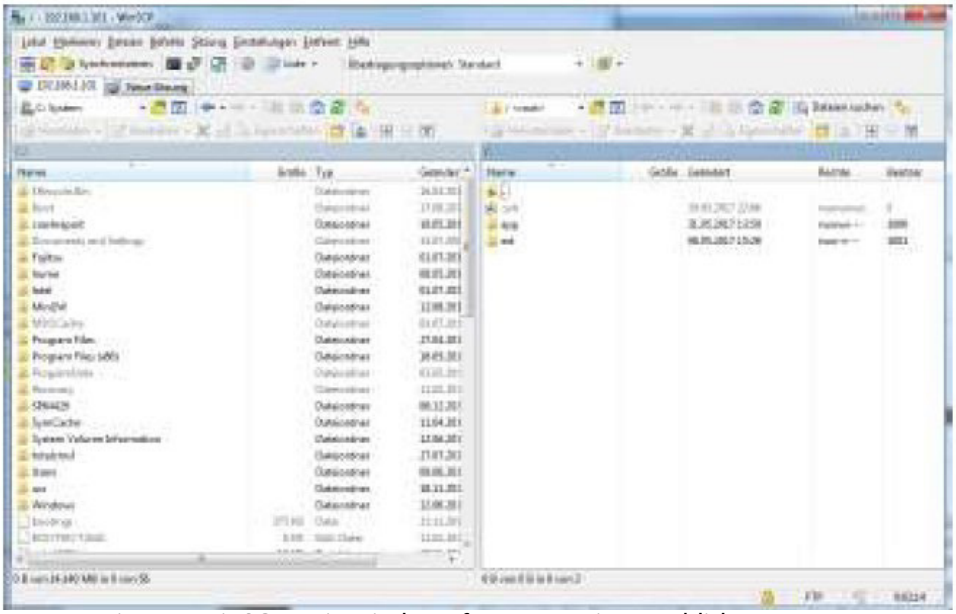


Figure 3 WinSCP main window after connection establishment

2.5 Specific troubleshooting SonoCollect 112

2.5.1 All LEDs remain dark, the device does not respond.

- CAUTION LIFE HAZARD: The testing of the power supply may only be carried out by trained personnel.

Switch off the power supply. Remove all cables and antennas except the power supply. Now switch on the power supply and check the voltage level from 90 to 260 VAC.

Ensure that no faults are caused by the infrastructure, circuit breakers or circuit breakers of the power supply. Test the SonoCollect 112 under laboratory conditions if necessary.

If errors could not be rectified, please contact your local Danfoss customer support.

2.5.2 The Power LED flashes green.

Switch off the power supply. Remove all cables and antennas except the power supply. Now switch on the power supply and check whether the power LED is now permanently lit.

Now reconnect all cables and antennas one by one and check after each step whether the power LED remains permanently lit.

If the fault actually occurs on the connection of a specific cable, check it more thoroughly. There may be a fault in the external circuitry, e.g. short-circuit or overload. If necessary, replace faulty cables.

If errors could not be rectified, please contact your local Danfoss customer support.

2.6 Typical application scenarios

The following are examples of how the SonoCollect 112 can be used.

To use the SonoCollect 112, the network and meter interfaces must be parameterized according to your application and your plant (see chapter 4).

2.6.1 Local application without control system

The SonoCollect 112 can be used for local meter reading.

No control system is required to collect and store meter data. Server services can therefore be deactivated (Server tab). Only the local storage of CSV files has to be set up.

The SonoCollect 112 is accessed in this application via a PC that is located in the same network. The current meter values can thus be monitored via the website in the Meters tab. The CSV files can be accessed via FTP access, provided logging is active. To do this, connect to the SonoCollect 112 with an FTP client (see chapter: 6.2.2).

Users can be configured in the user management with the corresponding access rights to allow read access to the meter list (see chapter 4.7).

2.6.2 Remote monitoring without control system

This application case is largely equivalent to the example in section 2.6.1. The only difference is the network infrastructure that is set up between a PC and the SonoCollect 112 (Internet). The PC and the SonoCollect 112 are not located in a physical but in a logical network.

- ✔ As a rule, routers and firewalls must be parameterized here to allow access from an external network (PC in the Internet) to the SonoCollect 112 in the internal system network. Please ask your administrator about setting up routings, port forwarding, packet filters and firewalls for the individual services of the product, such as FTP, HTTP and SSH.

If the network is parameterized correctly, you can access the SonoCollect 112 in the same way as in the local application.

2.6.3 Remote monitoring with email dispatch

The SonoCollect 112 can send the meter data as e-mails to any e-mail address. The meter data is stored in XML format and can be processed as required (see section 9.7).

- ✔ In order to send emails, the internal system network has to be set up correspondingly (e.g. firewall, router). Ask your administrator about this.

2.6.4 Remote monitoring with FTP upload

The SonoCollect 112 can also actively upload this data to an FTP server instead of manually downloading the CSV data. This makes it possible to access and process the files automatically.

- ✔ For the FTP Upload, on the one hand the internal system network (e.g. firewall, router) and on the other hand the receiving FTP server must be correctly configured. Ask your administrator about this.

2.6.5 Remote monitoring with SFTP upload

The transfer of files to a server can also be secured via encrypted communication. For example, it is possible to encrypt the data using Secure Shell (SSH).

The following configuration must be made in the device to use the so-called SFTP.

The SSH and thus the SFTP use the asymmetric encryption and are secured by certificates. Both remote stations have both a private and a public key. A PKI (Public Key Infrastructure) is used to check the authenticity. This is usually associated with administrative work. Therefore, the authenticity can also be confirmed by the user.

For this purpose, a finger print is exchanged during the initial connection, which uniquely identifies the remote station. The finger print is the public key of the remote station. Now the user can manually check and trust this. If this remote station is a trusted host, its fingerprint must be entered in the file *app/ssh/known_hosts*. This is done by adding such a line to the file:

- 192.168.2.34 ecdsa-sha2-nistp256 AAAAE2VjZHNhLXNoYTItbmlzdHAyNTYAAAAIbmlzdHAy[...]

Therefore, the corresponding finger print of the server must first be called in order to be entered into this file. There are two possibilities:

- The finger print is called directly from the server and manually entered into the file *app/ssh/known_hosts*.
- The server is accessed via SSH from the device and its finger print is accepted. Then the finger print is automatically written to the file *app/ssh/known_hosts*.

It can be done directly from the device via the SSH console:

> ssh admin@192.168.2.34 <ENTER>

The authenticity of host '192.168.2.34 (192.168.2.34)' can't be established. ECDSA key fingerprint is SHA256:HtAa1pkvafJSmAiMJmi1ZvJi6spgf5i0yt/A2rJ/OnY. Are you sure you want to continue connecting (yes/no/[fingerprint])?

yes <ENTER>

Warning: Permanently added '192.168.2.13' (ECDSA) to the list of known hosts.

Subsequently, an encrypted cyclic upload of meter data can be performed via SFTP.

2.6.6 Remote monitoring with TCP/HTTP transmission

The transmission of XML data per TCP or HTTP is suitable for the direct connection of database systems. The database servers can thus receive the data directly (XML format see chapter: 6.3.3).

- ✔ For TCP/HTTP dispatch, on the one hand the internal system network (e.g. firewall, router) and on the other hand the database server must be correctly configured. Ask your administrator about this.

2.7 Technical data

2.7.1 General properties

Dimensions/Weight

The casing has the following dimensions (without antenna):

- Width: 72 mm
- Height: 91 mm
- Depth: 62 mm (without antenna sockets)
- Weight: approx. 210 or 220 g

Assembly

The device is intended for control cabinet mounting:

- Temperature range: -20-70 °C
- Air humidity: 0-95 \% relH
- Type of protection: IP20
- Top hat rail mounting (DIN rail 35 mm)

2.7.2 Electrical properties

Power supply

The device has an internal power supply unit (for pin assignment, see section 2.2):

- Voltage: 90-260 V(AC), 50-60 Hz, screw clamps (2.5 mm²)
- Power consumption: 2 W (idle), max. 10 W
- Safety: Overvoltage category 3, protection class 1

- Peak inrush-current: <40 A
- Galvanic isolation between interfaces and mains: >3 kV

Meter interfaces

The device has various meter interfaces (for pin assignment, see section 2.2):

- M-Bus: compliant with to EN 13757-2, max. 80 standard loads (UL), Uspace = 36 V, Umark = 24 V, screw clamps (2.5 mm²).
- wM-Bus: compliant with EN 13757-4, 169/433/868 MHz, S, T or C mode, SMA antenna connector for external antenna
- S0: compliant with EN 62053-31, U = 24 V, screw terminals (2.5 mm²)
- DLDERS: compliant with EN 62056-21, mode and UART settings, see section: 4.4, EIA-485, screw clamps (2.5 mm²)

The meter interfaces are not galvanically isolated from each other.

Communication interfaces

The device has an Ethernet communication interface (for pin assignment, see section 2.2):

- Ethernet: compliant with IEEE 802.3, 10/100 base-TX, RJ45 connector incl. status LEDs, no Auto-MDIX
- Mobile communication: 4G modem, LTE Cat1, Band 2,8,9, SMA antenna connector for external antenna

2.7.3 Further characteristics

Galvanic isolation

The Ethernet communication interface is separated from the meter interface and supply:

- Galvanic isolation: 1000 V

Processing unit

The central unit is a microprocessor system:

- CPU: ARM9™ architecture, 454 MHz clock frequency
- Memory: 128 MB RAM, 4 GB internal eMMC flash memory
- Operating System : Linux
- Integrated RTC: Power reserve for up to 7 days

3 Netdiscover tool

Danfoss provides its customers with the Netdiscover tool for easier management of products in the customer network. This tool allows you to find SonoCollect devices in the local network and to manage them.

The installation integrates two additional programs. The *Putty* and *WinSCP* programs are installed utilities for SSH and (S) FTP access. The integration into the Netdiscover tool enables the easy access to the devices from a central location.

3.1 Locating and accessing devices

When the tool started, it uses UDP broadcast via UDP port 8001 to determine all SonoCollect devices accessible in the local network and displays them in the main window.

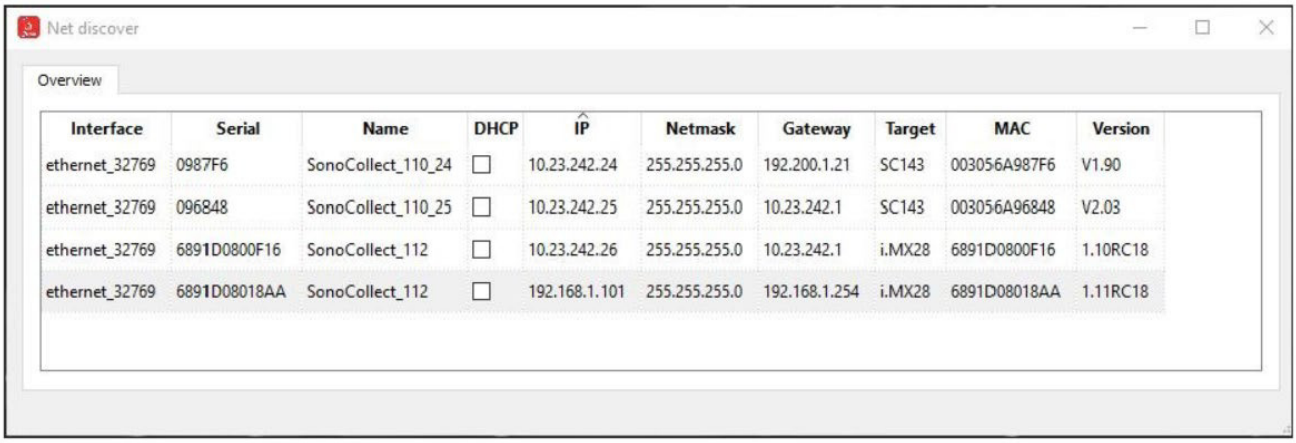


Figure 4 Main window of the Netdiscover tool

- ✔ The UDP broadcast finds all devices on the local network, regardless of IP settings and subnet masks. Therefore, this function is initially recommended.
- ℹ The UDP broadcast is usually not forwarded by routers. Therefore, this tool will only find all devices on the local network in front of the router.

In addition to the MAC address of the devices and their network configuration, the names of the devices and also the version of the operating system can be viewed. Thus, all devices to be managed can be clearly identified and assigned.

- ✔ The name of the devices corresponds to the **Device name** entry in the General tab (see section 4.2).

Various functions can be called up in the context menu that appears by right-clicking on one of the devices:

- ***Ping:*** Starts the ping via ICMP to the device in a separate tab. So testing of connectivity via TCP is possible.
- ***Web:*** Opens the default browser with the IP of the device. The web-based frontend should open (see chapter 4).
- ***FTP:*** Starts *WinSCP* with the IP of the device or in general. The login data or also its IP must be entered before connecting to the FTP/SFTP server of the device.
- ***FTP (default):*** Starts *WinSCP* with the IP of the device and connects an SFTP with default access data of the *admin*-user.
- ***SSH:*** Starts *Putty* with the IP of the device. The login data must be entered to connect to the SSH console.
- ***Deploy:*** Starts the mass management of the devices in a separate tab.
- ***Import device list:*** Imports a device list into the main window.
- ***Net configuration:*** Starts in a separate tab for changing the network configuration of the devices via UDP broadcast.

- ***Version:*** Version information about the Netdiscover tool.

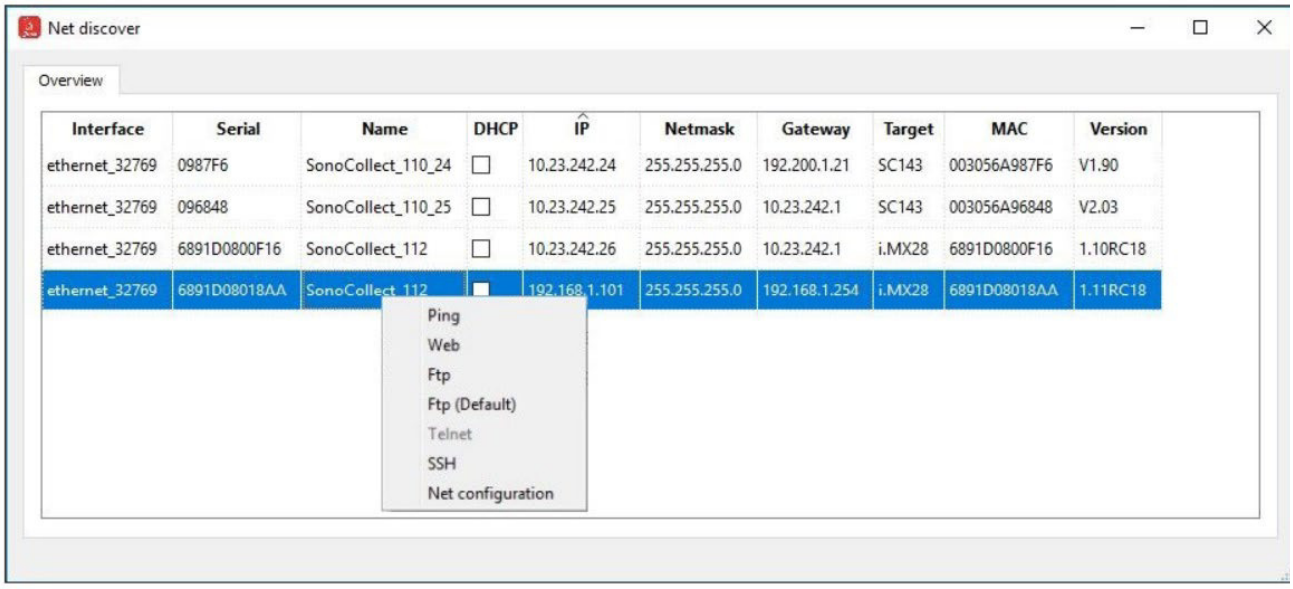


Figure 5 Context menu in the Netdiscover tool

- Depending on the network settings of your PC or your general network infrastructure, the UDP port 8001 may be blocked. Then calls of the tool are blocked and the main window remains empty.
- When a firewall in your network (also directly on the PC) is used, it is to create an appropriate firewall rule. It releases this port to be able to list the devices.
- Ask your administrator about the firewall and network configuration.
- If access via UDP broadcast is not possible, a list can be imported with the Import device list function in order to still be able to use all other functions via TCP.

Some important functions are described in more detail in the following subsections.

3.2 Network configuration

It is often necessary to adjust the network settings of the device for further work with the devices, especially when commissioning devices.

The command *Net configuration* from the context menu in the Netdiscover tool opens another tab for the network configuration. Thus, IP address, subnet mask or gateway address can be changed statically or DHCP can be activated to obtain these settings automatically from a DHCP server.

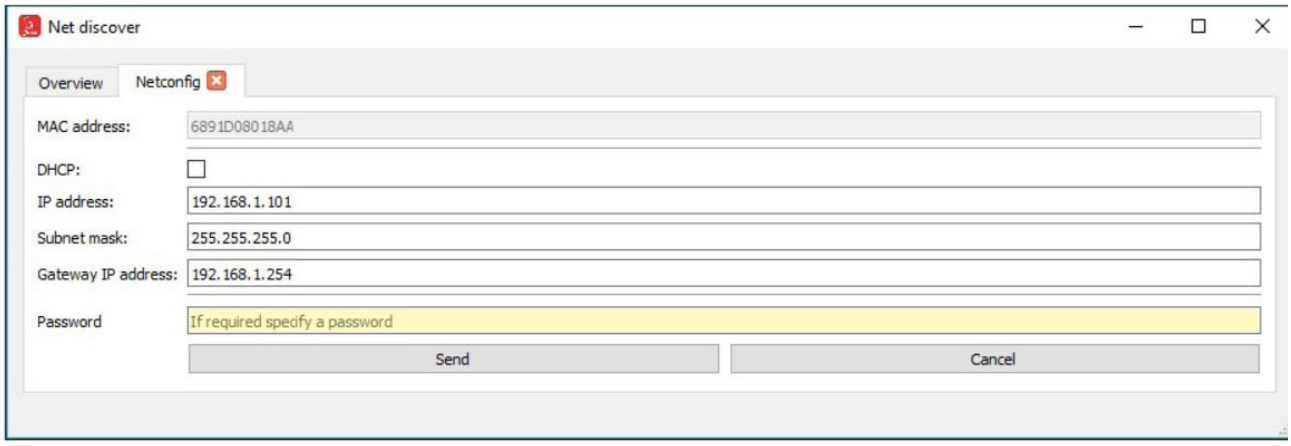


Figure 6 Network configuration via the Netdiscover tool

Modifications are only accepted with the password of the *admin* user.

3.3 Access to the web-based front end via HTTP

A web server is integrated on the SonoCollect devices. This enables the configuration of the devices via an integrated, web-based front end (see chapter 4).

Use the command ***Web*** from the context menu in the Netdiscover tool to quickly and easily call it from the default browser.

- If the web-based front end does not open, please follow the instructions in section 4.13.

3.4 Access to the file system via FTP

The SonoCollect devices can be accessed via FTP to work directly on the file system level. Updates, special configurations and function extensions can be carried out (see chapter 10). The integrated FTP server of the devices supports both FTP and SFTP.

- If access via FTP or SFTP is not possible, check especially the IP settings and the port release of port 21 for FTP and 22 for SFTP.
- In case of access problems, ask your administrator.

The commands ***FTP*** and ***FTP (default)*** from the context menu in the Netdiscover tool start the WinSCP program and use the IP address of the selected device. Always use the selected device to have access via FTP. To use a secure SFTP, the context menu must be called without a selected device, then only the command ***FTP*** is available. Now select in the WinSCP window whether FTP, SFTP or SCP should be used.

The mode ***FTP (default)*** tries to log in with the default access data of the *admin* user, while in the mode ***FTP*** any access data can be entered.

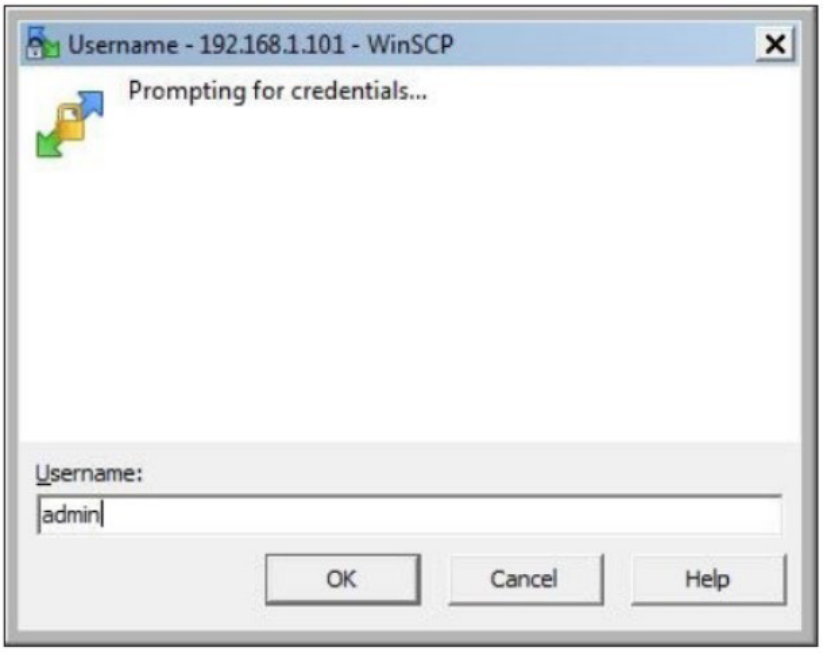


Figure 7 Entering user data when logging in via SFTP

- If the access data of the admin user is modified, the use of **FTP (default)** is not possible.

WinSCP now establishes a secure SFTP or unsecure FTP connection. When a connection is established to a specific device with SFTP, its authenticity is checked using stored certificates. Normally, the SonoCollect devices receive an individual, self-signed certificate upon delivery. This certificate is usually classified as untrusted by your PC. Therefore, a security prompt with information about the device's certificate is

displayed. The user must actively trust this certificate for the connection to be established. The confirmed certificate is stored in the PC for future connections.

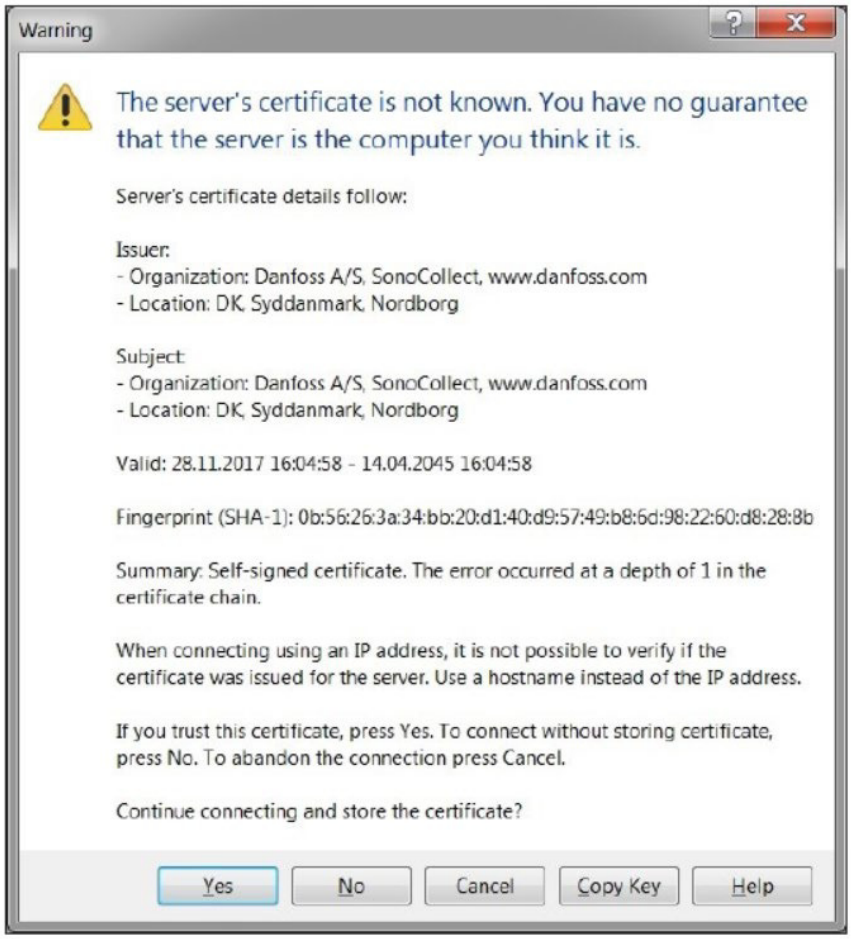


Figure 8 Safety query for the certificate of the device

WinSCP presents a two-part file browser view after successful login. This allows files to be uploaded to or downloaded from the device. File commands can be executed via a context menu (e.g. copying, renaming or editing. Drag&Drop for uploading and downloading is also supported.

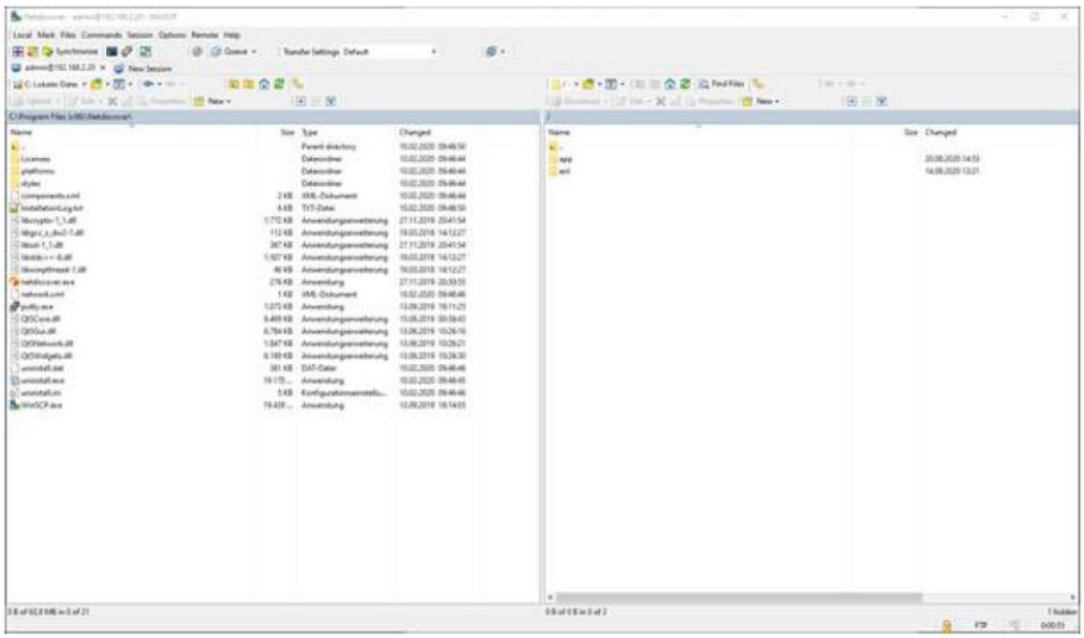


Figure 9 File Browser View in WinSCP

- Changes to the files or the file system can limit the functionality of the system.
- The standard access data in the delivery state are contained in the section 4.8.

3.5 Access to the command line via SSH

Access to the command line interface (CLI) of the device is suitable for maintenance purposes.

The command *SSH* from the context menu in the Netdiscover tool opens the integrated *Putty* client and establishes a connection to the device.

When a connection is established to a specific device with SSH, its authenticity is checked using stored certificates. Normally, the SonoCollect devices receive an individual, self-signed certificate upon delivery. This certificate is usually classified as untrusted by your PC. Therefore, a security prompt with information about the device's certificate is displayed. The user must actively trust this certificate for the connection to be established. The confirmed certificate is stored in the PC for future connections.

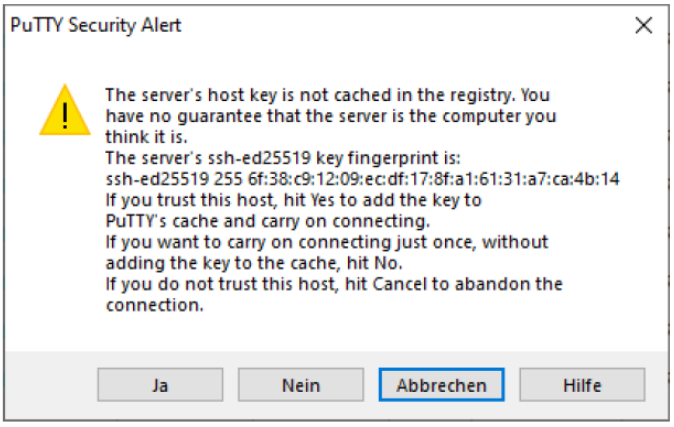


Figure 10 Safety query for the certificate of the device

Now the *Putty* client opens where the SSH access data of the *admin* user must first be entered. Then. the command line is ready for input via SSH.

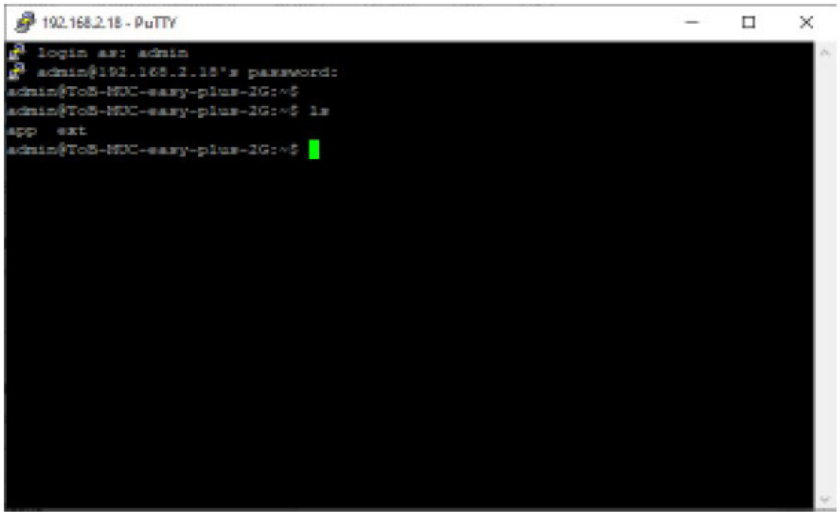


Figure 11 Command line in the Putty client

- Inputs on the command line can restrict the functionality of the system.
- The standard access data in the delivery state are contained in the section 4.8.

3.6 Mass management

Using this function it is possible to perform certain device configurations or firmware updates in parallel for all devices displayed in Netdiscover. This makes it possible, for example, to import an exported device configuration to other devices at the same time. Another example would be importing certificate files needed

on multiple devices to export meter data. A third and final example would be updating the application software on multiple devices in parallel.

The configuration or update should only be carried out explicitly for similar devices.

In this case mark the devices in Netdiscover on which you want to perform a parallel configuration or firmware update.

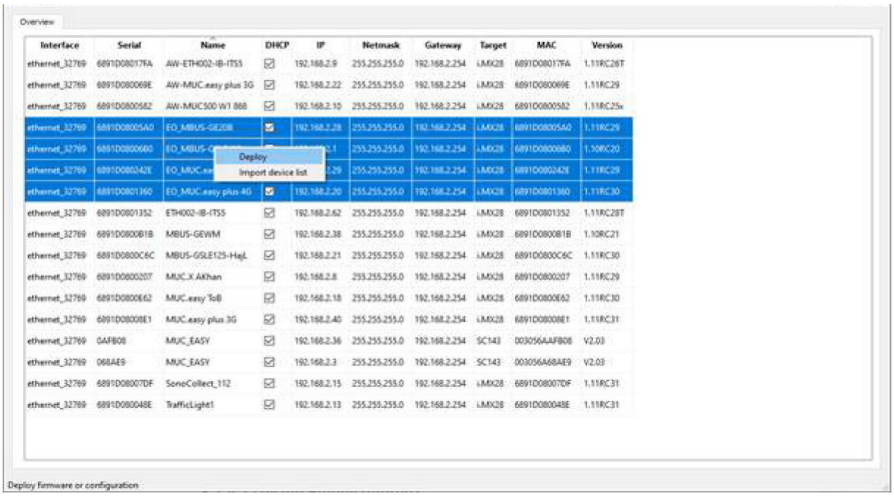


Figure 12 Selection and call of the mass management

The *Deploy* command from the context menu in the Netdiscover tool opens another tab for mass management.

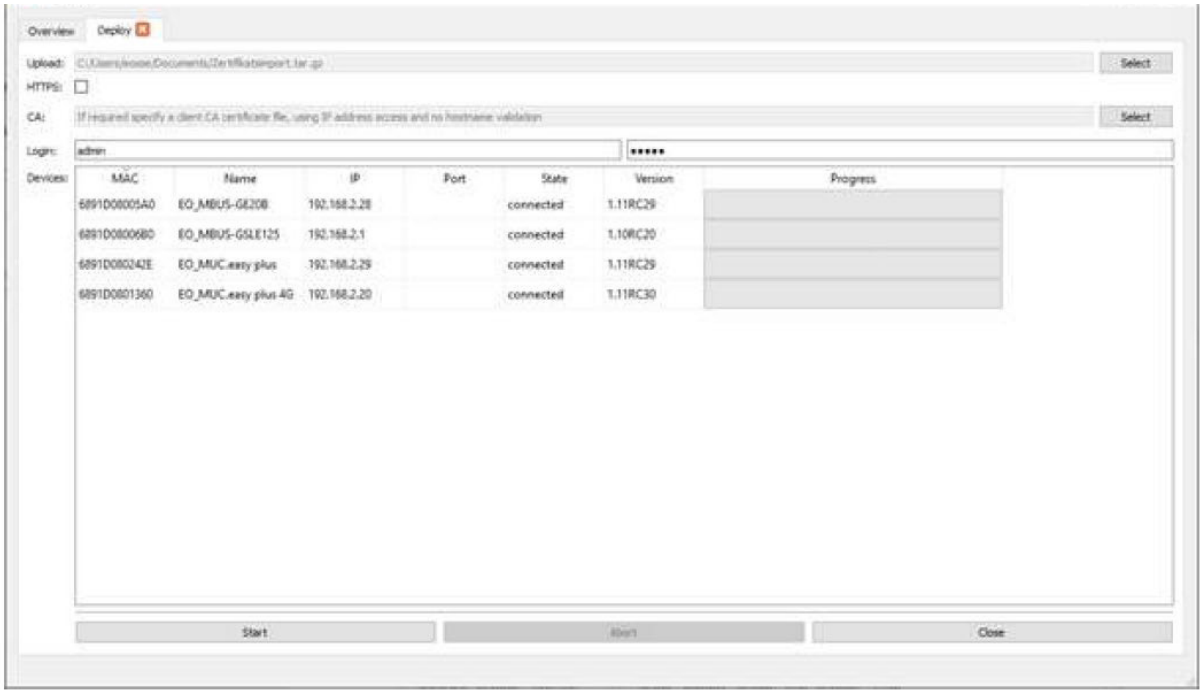


Figure 13 Mass management via the Netdiscover tool

The following input fields and buttons are available here:

- **Upload:** The configuration or update to be uploaded.
- **HTTPS:** Selection field whether HTTP or HTTPS should be used.
- **CA:** The CA certificate to verify the client certificate of the devices for HTTPS-based work.
- **Login:** User name and password for the admin user.
- **Start:** Starts the process.
- **Abort:** Cancels the process.
- **Close:** Closes the mass management tab.

In the central part, there is a list view with information about the devices and the status/progress of the operation.

- Only *.tar.gz archives are intended for uploading to the device.

The file is unpacked on the device after the upload, and processed, the device is then restarted.

3.7 Import of a device list

Devices cannot always be found automatically. Firewalls, routing settings or also the deactivation of the function **Network discovery active** in the ***Security*** tab (see section 4.7) are possible causes.

A device list can be imported in order to still be able to manage devices via the Netdiscover tool.

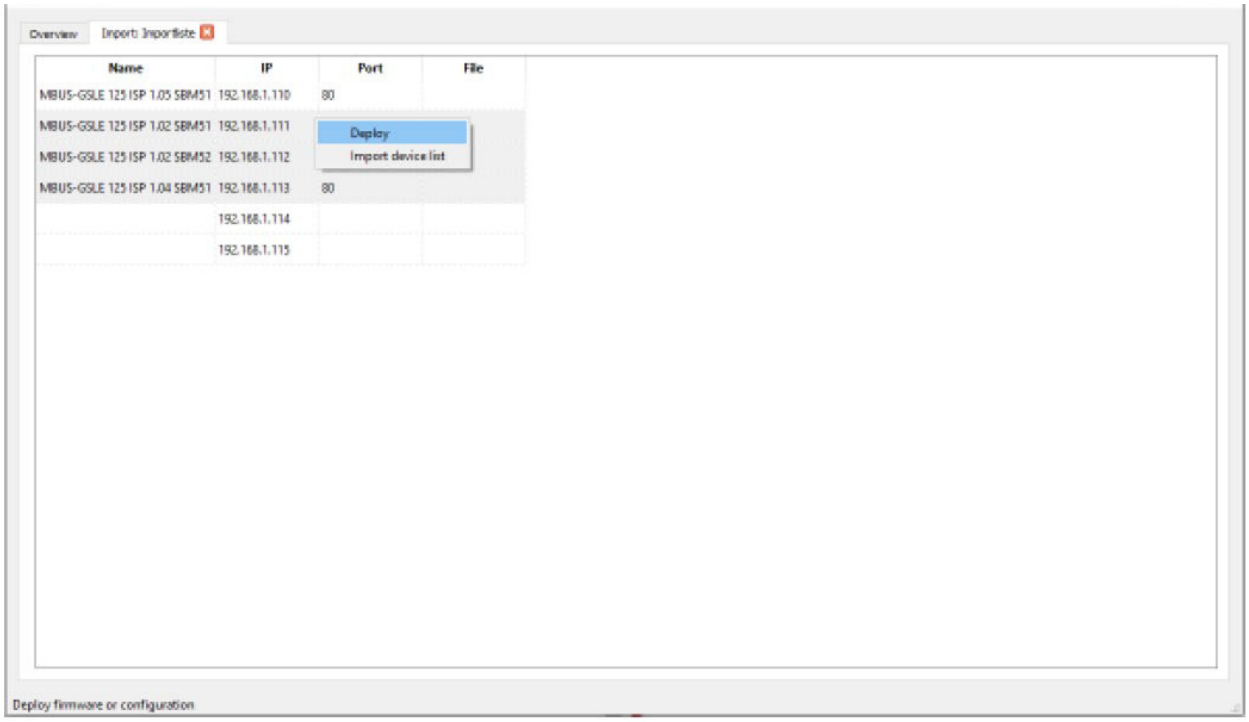


Figure 14 Viewing and using an imported list in the Netdiscover tool

A suitable CSV file must first be created before the actual import. A comma or semicolon can be used as a separator in the CSV file. The device data is entered here according to the following example to obtain the above list in the Netdiscover tool:

Port;Name;Password;Username;IP;File

80;MBUS-GSLE 125 ISP 1.05 SBM51;admin;admin;192.168.1.110;

80;MBUS-GSLE 125 ISP 1.02 SBM51;admin;admin;192.168.1.111;

80;MBUS-GSLE 125 ISP 1.02 SBM52;admin;admin;192.168.1.112;

80;MBUS-GSLE 125 ISP 1.04 SBM51;admin;admin;192.168.1.113;

;;admin;;192.168.1.114;

;;;;192.168.1.115;

- The header of the CSV file must be identical to the one above.
- Only the IP column is mandatory. The other columns can be left empty and are set to default for special functions (port: 80, password: admin, user name: admin).

4 Web-based front end

Many products of Danfoss A/S, especially data concentrators and gateways for smart metering, have an integrated web server and provide a website for the configuration. The devices can be configured easily and in a user-friendly manner via this website. Device parameters, meter configuration as well as service services can be displayed or changed on this website.

This chapter contains an overview of the operating options via the web front end.

- The use of some functions listed below depends on the product. A gateway for example does not have a report interface for data push or a cellular modem. This is indicated at the relevant point.

The web front end can be easily opened in the browser by entering the device IP address. Alternatively, right-click on the device in our Netdiscover tool (see chapter 3) and select the ***Web*** command in the context menu to call the browser.

- We test the web front end in different browsers. We recommend the use of the Chrome and Firefox browsers for optimal viewing.

In the delivery state, the browser automatically logs the user into the website using the standard access data. The user "`web"' with the password "`web"' is stored ex works for this purpose. This user has full access to the website. This facilitates the initial commissioning.

If the default user "`web"' has been changed in the configuration via the tab ***User***, for example by changing the password, the correct access data must be entered in order to log in. Then, the automatic login will not take place. A login window will then always appear:

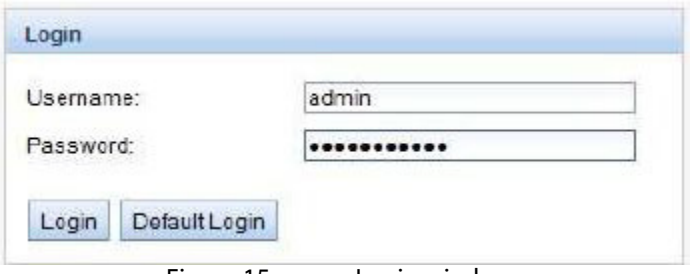


Figure 15 Login window

- To change an already logged-in user (or default user), the Logout button in the top right can be selected.
- The standard access data in the delivery state are contained in the chapter 4.7.

If the logged-in user has write access, the user must be logged out after the configuration has finished. If the connection remains active, no other work computers have write access to the web front end. Only one session with write access is possible at a time.

- If a session is terminated without prior logout, e.g. by closing the browser window, it remains active for approx. 1 min. Afterwards it is automatically closed and write access is possible again.

The functions are subdivided into different tabs on the website of the device. So the clarity can be maintained despite the large number of parameters. All modifications in one of the tabs must be saved before changing tabs, otherwise the modifications will be lost. The functions and parameters of the individual tabs are described below.

4.1 Access via HTTPS

Normally the web front end is accessible via HTTP (port 80) as well as via HTTPS (port 443). Depending on the requirements, one of the services can be deactivated (see section 4.10).

Compared to HTTP, HTTPS offers both encryption and authentication methods and thus enables secure access to the devices in insecure networks.

The SonoCollect devices are delivered with certificates and keys in preparation for HTTPS access:

- app/keys/http_host_cert. : Self-generated certificate of the device to verify the identity of the device, server-side authentication
- app/keys/http_host_key. : Private key of the device

The user can upload another certificate to the device to fully secure the communication and for mutual authentication.

- app/keys/http_host_ca. : Root certificate to check the client certificate of the browser and thus the identity of the client, client-side authentication

Based on these files, a protected identification and authentication of the communication partners takes place and a symmetric session key is negotiated.

- Access to the web front end via HTTPS can be blocked by installing incorrect or invalid certificates.
- Deactivating HTTPS or HTTP is only possible via the other access to the web front end.
- Optionally, customer-specific certificates can be uploaded before delivery.

4.2 General tab

The General tab displays general properties of the device and its network configuration.

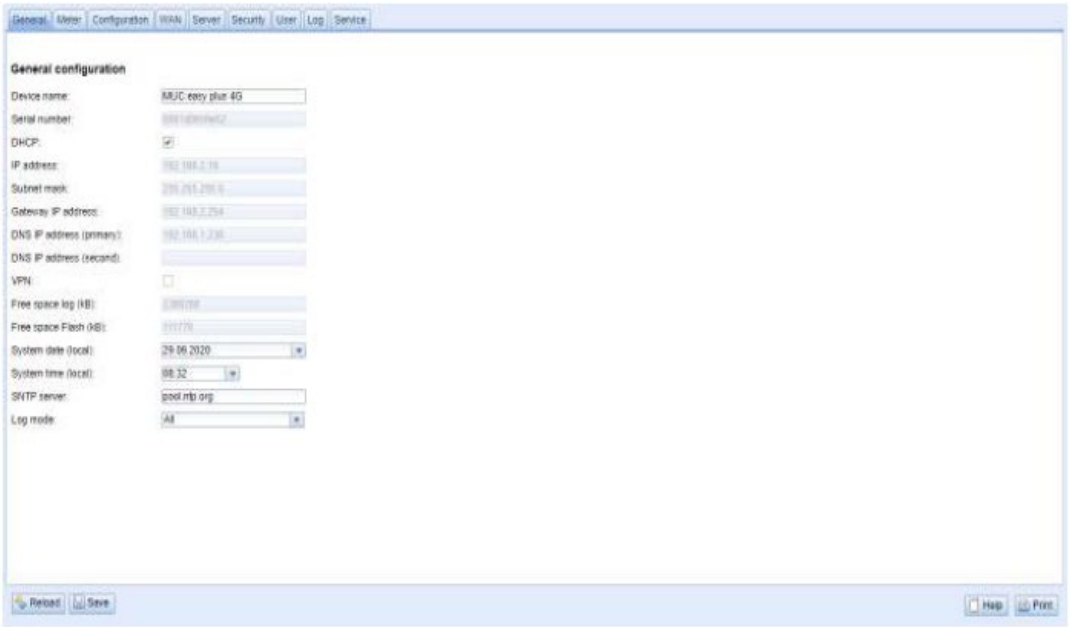


Figure 16 General tab

The following values can be viewed or changed here:

Field name	Description
Device name	Name of the device (assignment in Netdiscover)
Serial number	Serial number of the device (MAC address), not editable
DHCP	Enable automatic network configuration
IP address	IP address of the device, not editable with DHCP
Subnet mask	Subnet mask of the device, not editable with DHCP
Gateway IP address	IP address of the default gateway, not editable with DHCP
DNS IP address (primary)	IP address of the primary DNS server, not editable with DHCP
DNS IP address (secondary)	IP address of the secondary DNS server, not editable with DHCP
VPN	Activates the OpenVPN client functionality
Free space log (kB)	Free space on the log area, not editable
Free space Flash (kB)	Free space on the application area, not editable
System date (local)	Current, local system date
System time (local)	Current, local system time
SNTP server	Address of the time server
Log mode	Detail depth of the log entries of the application ▪ None: The application does not generate log entries ▪ Standard: The application generates log entries for errors and warnings. ▪ All: The application generates log entries for all events

Table 6: Fields in the General tab

The **Save** button is used to save the configuration. The **Reload** command loads the last saved values and resets the current changes.

If the network configuration is changed, the device is available under the new IP after the save process. All existing connections will be disconnected or logged in users will be logged out automatically.

- Changing the network parameters of the device can restrict the accessibility. If the network parameters have already been set correctly by an administrator, they should not be changed.
- The device is automatically reinitialized by setting the parameters via the **SAVE** button.
- Date and time are always processed as UTC time (without time zone shift). When displayed on the website, the browser converts it according to the locally set time zone of the computer. In Central Europe, for example, this is Central European Time or Central European Summer Time. If a different time zone is set here, the time on the website will also be displayed accordingly.

→ The use of OpenVPN is described in the section 10.5.

4.3 Meter tab

The Meter tab displays an overview of the connected meters, and gives the user the possibilities of automatically searching for meters, adding meters manually, and configuring meters that are already present. The meter list can additionally be exported in this way.

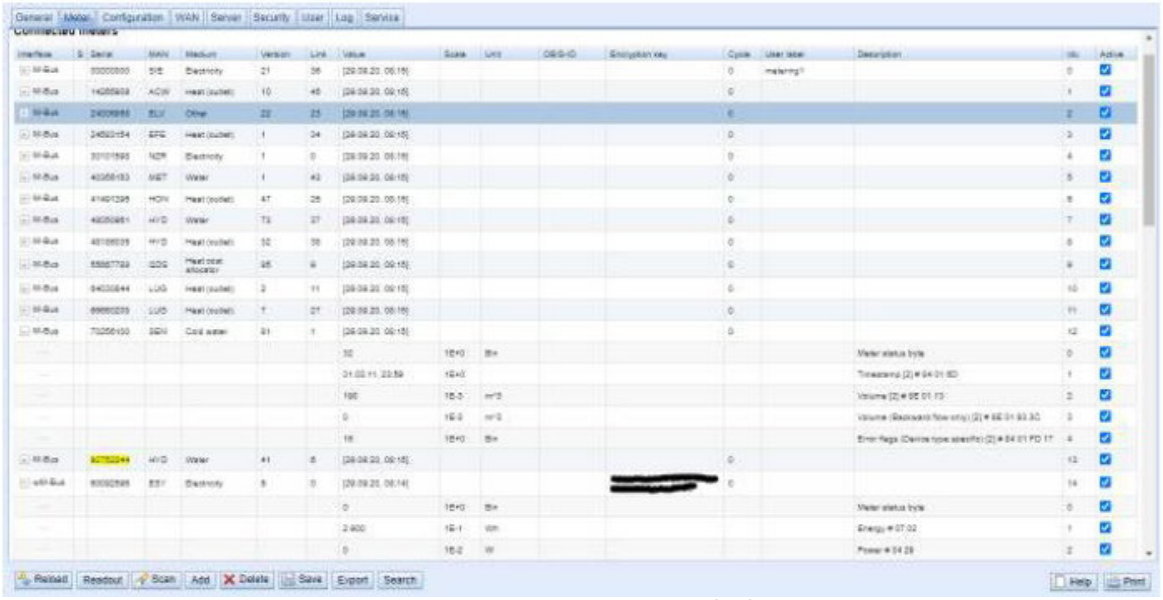


Figure 17 General tab

The meter list is displayed in tabular form. Meter entries and the corresponding meter value entries are displayed one below the other. The individual columns have the following meaning:

Field name	Description
Interface	Interface to the meter ▪ M-Bus: wired M-Bus according to EN 13757-2/-3/-7 and OMS ▪ wM-Bus: wireless M-Bus according to EN 13757-4/-3/-7 and OMS ▪ DLDE: wired serial interface according to IEC 62056-21 or IEC 1107/61107 ▪ S0: wired meter/pulse interface according to IEC 62053-31 or for simple contactors ▪ System: Monitoring of internal measured values of the device
S (Status)	Shows the status of the meter or the meter value ▪ !: Meter or not all meter values can be read, meter value not current ▪ E: Meter/meter value edited ▪ A: Meter/meter value added ▪ *: Meter value list limited (see Maximum value parameter count in Configuration tab)
Serial	Serial number of the meter (meter number, secondary ID)
MAN	Manufacturer of the meter (abbreviation), DLMS Flag-ID
Medium	Meter medium, see second column in Table 25
Version	Version number of the meter
Link	Primary address of a meter (M-Bus) or reception field strength (RSSI) for wM-Bus
Value	Meter reading or measured value (unscaled)
Scale	Scaling factor (scientific notation)
Unit	Unit, see second column in Table 27
OBIS-ID	OBIS code in the format X-X:X.X*X (X=0..255)

Encryption key	Key for encrypted wM-Bus meters
Cycle	Readout interval in seconds (at 0 the general readout cycle is used, see *Configuration* tab)
User label	User defined description of the meter value, this allows an application specific assignment. Allowed characters are: A-Z, a-z, 0-9, !,§,\$,\%,\ ,/,(,),=,?,+ and *. A comma is also allowed. Inadmissible are: $\langle$, $\rangle$ and ". When using the CSV format, the semicolon (or the corresponding separator) should not be used.
Description	Description of the meter value according to the second column in Table 26. The display of memory number, tariff, value type and raw data can be configured via the *Description mode* parameter in the *Configuration* tab.
Idx	Index/position of meter/meter value in the meter list
Register	Offset of the register set to the value when using the Modbus server
BACnet	Object number of the value when using the BACnet server
Active	Activates a meter or meter value for transmission to the server or logging.

Table 7: Columns in the Meter tab

The meter configuration can be changed with the buttons in the lower area or through the context menu. Individual meters or meter values can be automatically searched for, created, deleted or changed according to the limitation of the interface used (M-Bus, wM-Bus etc.).

The meters or meter values in the list can be selected by a simple mouse click. A range can be selected with the <**SHIFT**> key held down, or multiple meters can be selected with the <**STRG**> key held down.

Duplicates of the serial number are marked in yellow for easier checking of the meters created. With the **Search** button the complete meter list can be searched for a search text. Hidden entries are also searched (meter values of closed maters).

Reload loads the last saved values, resets current changes, and correspondingly updates the meter values.

In the delivery state, the device has an empty meter list. If meters are connected via the external interfaces of the device, the **Scan** button can start an M-Bus scan. The scan mode "M-Bus mode" is configured in the ***Configuration*** tab. More information on this can be found in chapter 6.1.1.

- ✔ Depending on the mode and the number of connected meters, this may take a very long time.

The process can be interrupted with the **Cancel** button, whereby the meters already found are saved in the meter configuration. After the scan, the meter configuration is immediately accepted, and only has to be saved again after further changes. The scan can add meters to the existing meter list but no already configured meters are deleted or changed. Newly found M-Bus meters and their values are automatically activated after the scan or are assigned a Modbus address or BACnet number. The scan also permanently adds newly received wM-Bus meters to the configuration, provided that the parameter *wM-Bus listen* in the ***Configuration*** tab is activated. Since wM-Bus meters are not necessarily your own, they are not automatically activated, unlike the M-Bus. The list mode initially only lists all received meters without permanently saving their configuration.

- ✔ The meter values of M-Bus and wM-Bus meters are arranged in the same order as the data in the M-Bus or wM-Bus protocol. This means that the meanings of the values can be directly compared with the data sheet of the relevant meter. Alternatively, the arrangement can be via the raw data of the meter values (see *Description mode* parameter in the ***Configuration*** tab in chapter 4.3).
- ✔ The time stamps transmitted in the M-Bus or wM-Bus protocol are automatically assigned to the individual measured values, and therefore not listed in the meter list by default. The explicit representation of all time stamps can be manually activated via the configuration parameter MUC_SHOWTIMESTAMPENTRIES (chip.ini) (see chapter 8.4.1).
- ℹ Newly received wM-Bus meters are deactivated by default, and have to be manually activated and saved in order to be transmitted in the server communication and log data. Non-saved wM-Bus meters are deleted after a restart.

Meters not found and meters not connected via interfaces which do not allow an automated search, can be added manually with the **Add** button or with ***Add meter*** in the context menu. More information on this can be found in chapter 6.1.3.

To configure individual meters or meter values, double click an entry or call the Editing window with the context menu item ***Edit***. The field descriptions correspond to the columns of the meter list (see Table 7). Individual fields are activated or deactivated according to the interface.

Among other things, *User label* can be assigned to all entries here, so the meter or meter value can be assigned to a specific application. The (specific) read out interval of the meters can also be set via the parameter *Cycle*. The key required for decoding can also be set for wM-Bus meters in the Meter editing window.

- S0 meters are internally processed with the number of pulses. The representation on the website in the value column is nevertheless scaled to provide better readability. The *Scale* column contains the pulse value and, in contrast to other meter interfaces, does not have to be additionally multiplied. If a value of 280.09 and a scaling of 1e-4 is displayed in the Meter tab, 2800900 pulses are recorded internally. However, this unscaled meter value appears analogously to those of other meters in the report data, such as the CSV of the XML.
- With S0 meter values, the meter value itself can only be set in the Add or Edit window if the *Set Value* checkbox set is activated. The *Set Value* checkbox must be deactivated if a configuration does not change or overwrite the current meter value (e.g.: change of the user label). The input of a meter value is scaled.
- Before an S0 meter value is saved, the input value is calculated back to the pulse value and rounded to whole pulses. Inaccuracies can result from the floating point data types.

The configuration can be finished with the **Ok** button or cancelled with the **Cancel** button.

For transmission and logging, individual meters and meter values can be directly activated or deactivated with the checkbox in the *Active* column. The meter values are automatically activated or deactivated by the configuration of a meter corresponding to the hierarchy. In the same way, an inactive meter is automatically activated if one of its meter values is activated. Multiple selected meters or meter values can be set with the context menu items ***Activate*** and ***Deactivate***.

All selected meters and meter values can be deleted with the **Delete** button or the context menu item with the same name. Deleted wM-Bus meters are then created again if the *wM-Bus lists* parameter in the *Configuration* tab is activated.

- Individual meter values of an M-Bus or wM-Bus meter cannot be deleted.

The meter list is saved with the **Save** button.

- Saving causes all the meter log data on the clipboard which have not yet been transmitted via the WAN interface to be lost. This also deletes the CSV log data of the current day because the column assignment it contains may have changed.

The ***Export*** button can be used to export the meter list as a CSV file or, if available, to download the data set of an active report at a certain point in time as a CSV or XML file.

- Logged meter data can only be exported if data was recorded for the specified period, i.e. a report was active during this period (see section 4.6).

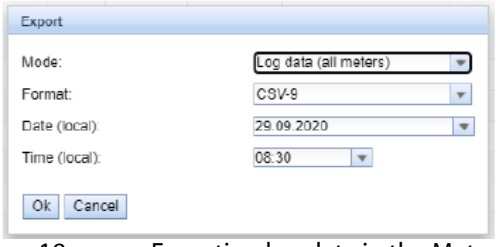


Figure 18 Exporting log data in the Meter tab

4.3.1 System meter

The system meter is a special function for providing device-specific operating parameters. These parameters are displayed via the system meter like normal meter values and can thus be monitored and evaluated.

These default values are available depending on the device:

Field name	Description
Digital Input <x>	State of the digital input, channel x

Digital output <y>	State of the digital output, channel y
Operating time	Operating seconds meter
Reset meter	Meter of power supply interruptions
Temperature	Board temperature, not calibrated
Ampere	Bus load at M-Bus
On time	Time since last power supply interruption
CPU	Processor load
Memory	Free working memory
Memory <1>	Free memory of the application partition
Memory <2>	Free memory of the database partition
RSSI	Field strength of the mobile radio signal in dBm (-113 to -51 dBm, -114 corresponds to not connected)

Table 8: Values of the system meter

Figure 19 System meter in the Meter tab

➔ The system meter can be extended by further meter values via scripts. More about this is described in the section 10.7.3.

4.4 Configuration tab

The *Configuration* tab enables parametrization of the meter interfaces of the device.

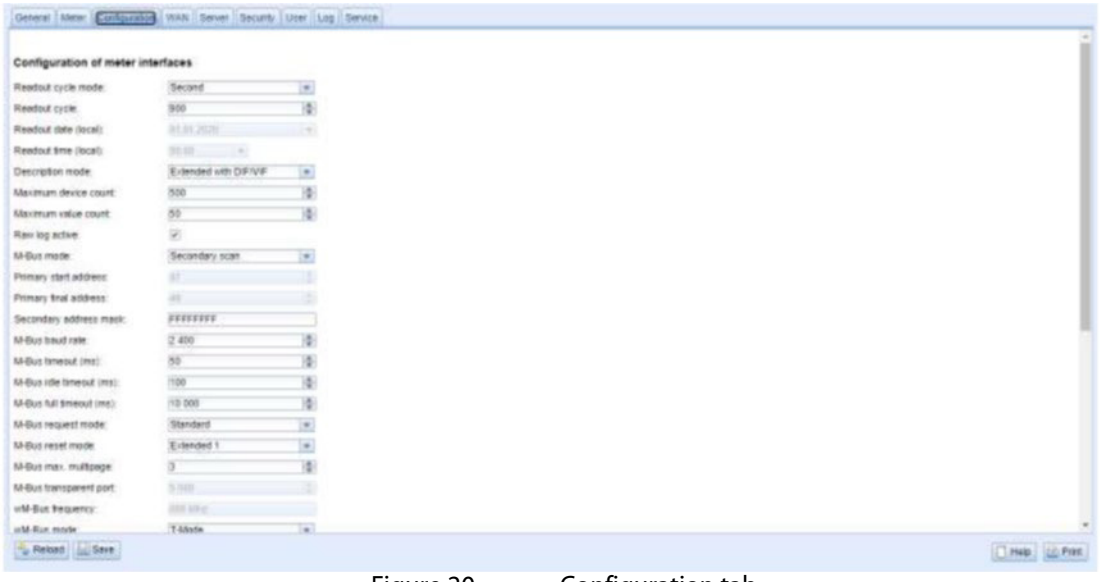


Figure 20 Configuration tab

The following parameters are available:

Field name	Description
General readout and display parameters	

Field name	Description
Readout cycle mode	Format of the specification of the standard readout cycle (for all meters, unless otherwise specified for individual meters in the *Meter* tab via the parameter *Cycle*). ▪ *Second*: Cycle of the readout is specified in seconds ▪ *Minute*: Cycle of the readout is specified in minutes ▪ *Hour*: Cycle of the readout is specified in hours ▪ *Daily*: Readout takes place daily at the specified time ▪ *Weekly*: Readout takes place daily on the specified weekday and at the specified time ▪ *Monthly*: Readout takes place monthly on the specified day of the month and at the specified time ▪ *Quarterly*: Readout takes place quarterly on the specified day and month of the quarter and at the specified time (month 1..3 per quarter) ▪ *Yearly*: Readout takes place annually on the specified day and month and at the specified time
Readout cycle	Standard readout cycle of the meters (unit according to *Readout interval mode* in seconds, minutes or hours)
Readout date (local)	Day of readout for weekly to yearly specification of the standard readout cycle, depending on the interval format the month specification is used, the year specification is not used
Readout time (local)	Time of readout for daily to annual specification of the standard readout cycle
Description mode	Mode for displaying the meter value description on the website: ▪ *None*: No display of the meter value description ▪ *Standard*: Display of the general meter value description ▪ *Extended*: Expanded display (individual parameters are only displayed if they are not 0): Notation: Description [memory no.] <Tariff> Value type Example: Energy [2] <1> max ▪ *Extended with DIF/VIF*: Extended display additionally with DIF/VIF raw data: Notation: Description [memory no.] <Tarif> Value type # XX XX XX … Example: Energy [2] <1> # 8C 11 04 ▪ *Extended with raw data*: Expanded display also including the raw data of the complete meter value entry. Notation corresponds to Extended with DIF/VIF: Example: Energy [2] <1> # 8C 11 04 96 47 06 00 ▪ *DIF/VIF*: Representation of the DIF/VIF raw data ▪ *Raw data*: Display of the raw data of the complete meter value entry
Maximum device count	Limit for the number of meters during a scan (0: no limit). Already configured meters are not limited by this parameter.
Maximum value count	Limit for the number of meter values of a meter during a readout process (0: no limit). Already configured meter values are not limited by this parameter.
Raw log active	Activation oft he raw data loggings
Specific parameters to the M-Bus*	
M-Bus mode	Sets the first address for the primary search
Primary start address	Sets the last address for the primary search
Primary final address	Sets the search mask for the secondary search, 8 digits; wildcards are indicated by the letter "F"; missing characters are replaced by 0 from the left
Secondary address mask	Baud rate for M-Bus communication (300 - 19200 baud)
M-Bus baud rate	M-Bus timeout until first data is received (in ms)
M-Bus timeout	M-Bus timeout for detecting the end of communication (in ms)
M-Bus idle timeout	M-Bus timeout (total) for the reception of a data packet (in ms)
M-Bus full timeout	Limit for the number of meters during a scan (0: no limit). Already configured meters are not limited by this parameter.
M-Bus request mode	Mode of the M-Bus readout (REQ_UD2): ▪ Standard: Readout process with REQ_UD2 ▪ Extended 1: Readout process with Get-All-Data (DIF/VIF 7F 7E) and REQ_UD2 ▪ Extended 2: Readout process with Get-All-Data (DIF 7F) and REQ_UD2
M-Bus reset mode	Mode of the M-Bus-Reset (before scan and readout operations): ▪ *None*: No reset ▪ *Standard*: SND_NKE to the primary address of the meter or broadcast for secondary addressing. ▪ *Extended 1*: SND_NKE to the primary address FD and a SND_NKE to the primary address of the meter or broadcast in case of secondary addressing. ▪ *Extended 2*: SND_NKE and an application reset to the primary address FD and a SND_NKE to the primary address of the meter or broadcast for secondary addressing.
M-Bus max. multipage	Limits the number of multipage requests
M-Bus transparent port	Network port for transparent M-Bus mode
Specific parameters to the M-Bus slave*	
M-Bus slave mode	Configuration of the M-Bus-Salve-Mode (M-Bus, TCP or UDP) or deactivation of the interface
M-Bus slave port	Network port for the M-Bus slave in case of TCP or UDP
M-Bus slave mode (2nd)	Configuration of the M-Bus-Salve-Mode (Instance 2, only TCP or UDP) or deactivation of the interface
M-Bus slave port (2nd)	Network port for the M-Bus slave (instance 2)
Specific parameters to the wM bus*	
wM-Bus frequency	Frequency band for communication with the wM-Bus meters

Field name	Description
wM-Bus mode	Configuration of the wM-Bus communication mode for the OMS interface (T, S, C or C/T-Mode) or deactivation of the interface.
wM-Bus transparent mode	Configuration of the transparent wM-Bus communication mode (Transparent/TCP, Transparent/UDP)
wM-Bus transparent port	Network port for transparent wM-Bus mode
wM-Bus listen	Activates the detection and display of newly received wM-Bus subscribers.
Show encryption keys	Displays the keys in plain text after the save operation
Specific parameters to the wM bus (channel 2)*	
wM-Bus2 frequency	Frequency band for communication with the wM-Bus meters (channel 2)
wM-Bus2 mode	Configuration of the wM-Bus communication mode for the OMS interface (T, S, C or C/T mode) or deactivation of the interface (channel 2).
wM-Bus2 transparent mode	Configuration of the transparent wM-Bus communication mode (Transparent/TCP, Transparent/UDP) (channel 2)
wM-Bus2 transparent port	Network port for transparent wM-Bus mode (channel 2)
Specific parameters for pulse inputs*	
S0 mode	Selection for absolute or relative pulse counting or deactivation of the interface
Specific parameters for the serial interface*	
Serial mode	Operating mode of the serial interface (DLDE, Transparent/TCP or Transparent/UDP) or deactivation of the interface
DLDE baud rate	Baud rate for serial DLDE communication
DLDE data bits	Data bits for serial DLDE communication
DLDE stop bits	Stop bits for serial DLDE communication
DLDE parity	Parity for serial DLDE communication
DLDE mode	Flow chart for serial DLDE communication: ▪ *Request*: Request according to mode A or B according to IEC 62056-21 (constant baud rate) ▪ *Request (C-Mode)*: Request and handshake according to mode C of IEC 62056-21 (constant baud rate) ▪ *Push*: Receiving spontaneous data sent by the meter
DLDE first timeout	Timeout until reception of first data (in ms) for serial DLDE communication
DLDE idle timeout	DLDE idle time out for receiving the first data of the meter (in seconds). In push mode, no data may be sent from the meter within this configured time (corresponds to the idle time).
DLDE full timeout	Maximum DLDE waiting time for reading a meter (in seconds)
DLDE transparent port	Network port for transparent DLDE mode

*if device has this interface/function

Table 9: Fields in the Configuration tab

The configuration is saved with the **Save** button. The **Reload** command loads the last saved values and resets the current changes.

The device is automatically reinitialized by setting the parameters via the **Save** button.

4.5 WAN tab

The ***WAN*** tab enables the configuration of the WAN connection for devices with integrated cellular modem. This is permanently set up when the device is restarted and is kept permanently active.

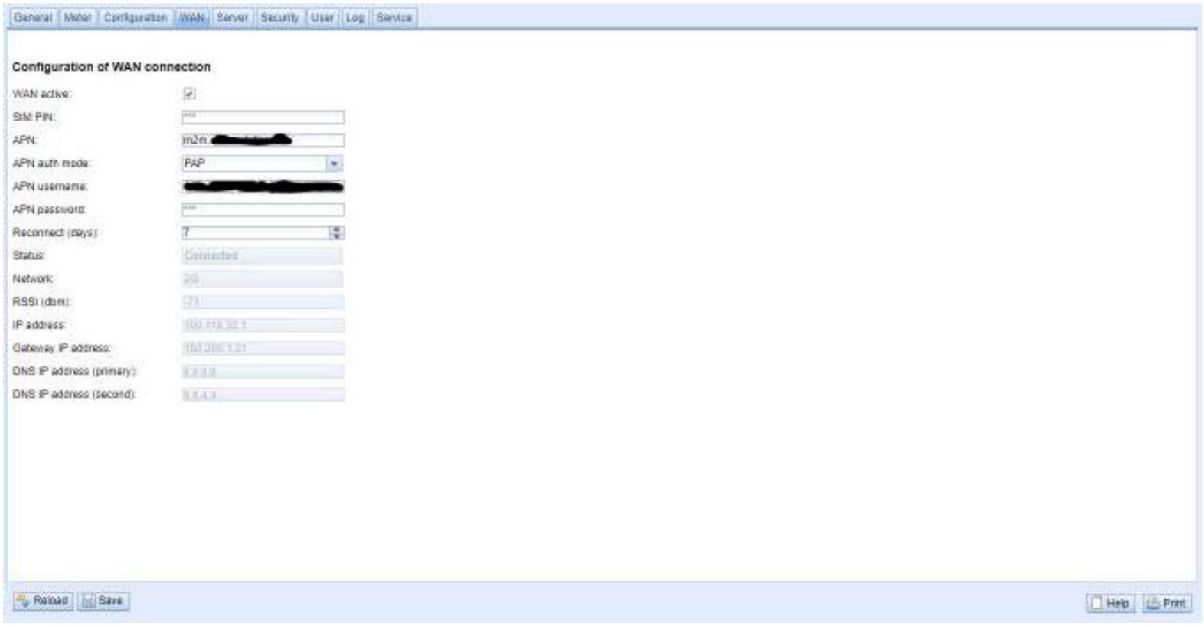


Figure 21 WAN tab

The following parameters are available:

Field name	Description
WAN active	Activation of the WAN module
SIM PIN	PIN of the SIM card
APN	Name of the access point (APN)
APN auth mode	Authentication mode at the APN
APN username	User name for authentication at the APN
APN password	Password for authentication at the APN
Reconnect (days)	Interval in days after which a forced disconnection and re-establishment of the mobile radio connection is carried out (if no data is exchanged). Rationale numbers are also valid here, e.g.: *0.25*.
Status	Status of the WAN connection (connected / not connected)
Network	Information about the mobile network
RSSI (dbm)	Display of the reception field strength in dBm (-113 to -51 dBm, -114 corresponds to not connected)
IP address	IP address in the WAN
Gateway IP address	Remote station in the WAN
DNS IP address (primary)	IP address of the primary DNS server, not editable with DHCP
DNS IP address (second)	IP address of the secondary DNS server, not editable with DHCP

Table 10: Fields in the WAN tab

The necessary parameters for WAN connection should be provided by the mobile service provider of your SIM card.

- Please check whether the mobile radio contract includes the expected quantity of data, otherwise increased costs or a blocking of the SIM card may follow.
- Please check that the parameters are correct. The entry of incorrect parameters can lead to increased mobile radio costs or blocking of the SIM card.
- If an invalid PIN is entered, it will be used only once per software startup. Thus, the remaining attempts for entering the PIN are not depleted and a new PIN can be entered via the website.
- Changing the WAN configuration via an active mobile radio connection is not recommended, as the device may no longer be accessible after a changed or invalid configuration.

The configuration is saved with the **Save** button. The **Reload** command loads the last saved values and resets the current changes.

- The device is automatically reinitialized by setting the parameters via the SAVE button. An existing WAN connection is terminated and re-established.

4.6 Server tab

The *Server* tab enables the parameterization of data provision to third-party systems. Ten independent instances can be defined here.

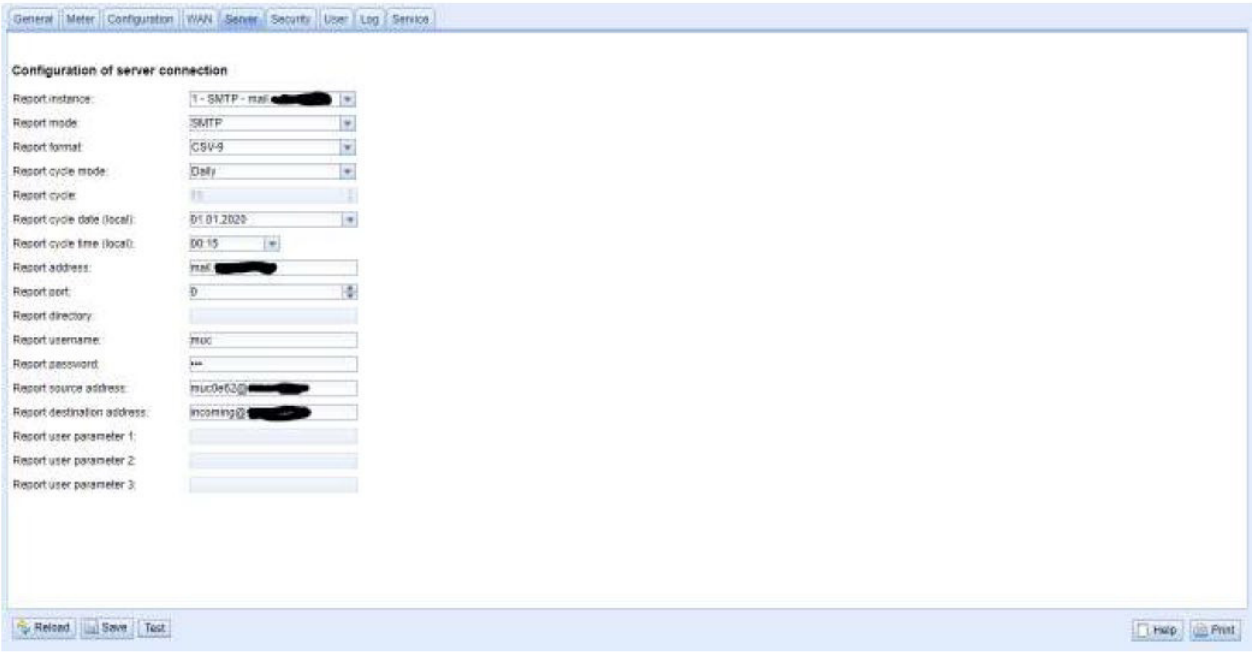


Figure 22 Server tab

The following parameters are available:

Field name	Description
Parameters for data collectors with push functionality	
Report instance	Selection of the respective instance
Report mode	Operating mode or deactivation of the respective instance. There are these modes to choose from: *TLS:* Transmission via active data push over secured TCP channel to specified server *TCP:* Transmission via active data push over unsecured TCP channel to specified server *SMTP:* Transmission via active data push by e-mail to the specified address *FTP (client active):* Transmission by active file transfer via FTP to the specified server (encrypted or unencrypted), in case of unencrypted FTP data connection is established from the server *FTP (client passive):* Transmission by active file transfer via FTP to the specified server (encrypted or unencrypted), in case of unencrypted FTP data connection is established from the device *MQTT:* Transmission via active data push via MQTT client to the specified server/broker (encrypted or unencrypted) *File:* Generation of local files for later retrieval (data pull) by third party system *User:* User-specific connection procedure based on a Bash script (see section 10.7.210.7.2)
Report format	Data format for the transmission of the respective instance. Several CSV and XML formats are available. The User format uses a stored XSLT script to format the data (see 10.7.1).
Report cycle mode	Format of the indication of the transmission cycle of the respective instance *Second:* Cycle of the transmission is specified in seconds. *Minute:* Cycle of the transmission is indicated in minutes. *Hour:* Cycle of transmission is specified in hours. *Daily:* Transmission takes place daily at the specified time *Weekly:* Transmission takes place daily on the specified day of the week and at the specified time. *Monthly:* Transmission takes place monthly on the specified day of the month and at the specified time. *Quarterly:* Transmission takes place quarterly on the specified day and month of the quarter and at the specified time (month 1..3 per quarter) *Yearly:* Transmission takes place annually on the specified day and month and at the specified time.
Report cycle	Transmission cycle of the respective instance
Report cycle date (local)	Day of transmission of the respective instance for weekly to yearly indication of the transmission cycle, depending on the interval format, the month indication is used, the year indication is not used.
Report cycle time (local)	Time of transmission for daily to annual Transmission cycle indication
Report address	Host address of the remote station or mail server (outgoing mail server)
Report port	Port number of the remote station to be connected
Report directory	Directory on the server
Report username	User name for server access
Report password	Password for server access
Report source address	Address of the transmitter (e-mail)
Report destination address	Destination address (e-mail)
Report user parameter 1	User-specific parameters 1 (use of format or user mode)
Report user parameter 2	User-specific parameters 2 (use of format or user mode)
Report user parameter 3	User-specific parameters 3 (use of format or user mode)
Parameters for Modbus server	
Modbus mode	Operating mode: Modbus TCP or Modbus UDP In the operating mode "Modbus TCP" up to 5 parallel connections by different Modbus TCP masters are possible.
Modbus port	Network port to which the remote station (the Modbus TCP client) must connect.
Modbus test	Dummy mode, where the test process image shown in Table 34 is activated, see section 11.4.2
Modbus swap	Changes the Word order from MSW first (default) to LSW first (option checked), see section 11.4.3
Modbus float only	Reduces the Modbus register layout from 10 registers/value to 2 registers/value and represents only the serial number of the meter and the floating point value of the corresponding meter value, see section 11.3 and section 11.4.4
Modbus multi slave	Activates the multi-slave feature, where the data of a meter can be accessed as its own virtual Modbus slave under its own Modbus address, see section 11.4.5
Parameters for BACnet server	
BACnet active	Activates the BACnet functionality globally
BACnet config network	Activates a second virtual network interface for the BACnet service
BACnet IP	IP address of the second virtual network interface for BACnet
BACnet netmask	Subnet mask of the second virtual network interface for BACnet
BACnet broadcast	Broadcast address of the second virtual network interface for BACnet
BACnet BBMD	IP address of a BACnet Broadcast Management Device (BBMD) for routing across local network boundaries
BACnet port	UDP port number of the BACnet service (default port: 47808)
BACnet device ID	ID number of the BACnet device
BACnet device name	Device name of the BACnet device
BACnet location	Location information of the BACnet device

Table 11: Fields in the Server tab

Individual parameters that are required for the configuration are enabled corresponding to the operating mode of the server interface.

The configuration is saved with the **Save** button. The **Reload** command loads the last saved values and resets the current changes. The **Test** button allows die immediate transmission of the previously read-out data.

- The device is automatically reinitialized by setting the parameters via the **SAVE** button.
- Make sure that the system time is correct before you activate the report. If the system time is synchronized later, e.g. by NTP service, gaps may occur in the log. These gaps are then transferred to the target system in the form of empty files.

4.7 Security tab

The **Security** tab enables the parameterization of the network services of the device.

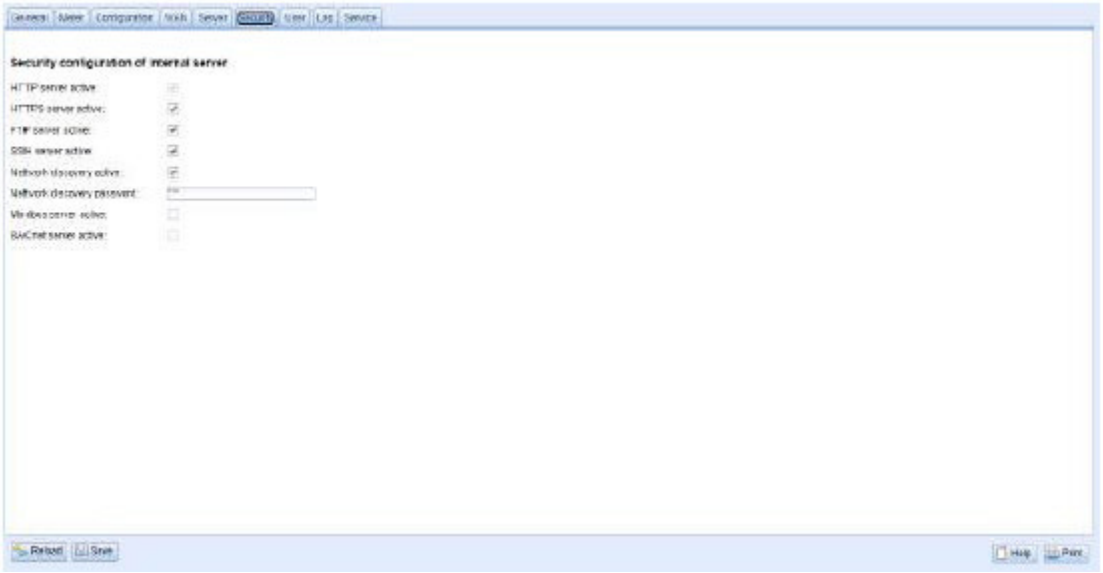


Figure 23 Security tab

The following parameters are available:

Field name	Description
HTTP server active	Activates the internal HTTP server of the device, activation and deactivation only possible via HTTPS to be able to use the website.
HTTPS server active	Activates the internal HTTPS server of the device, activation and deactivation only possible via HTTP to be able to use the website.
FTP server active	Activates the internal FTP server of the device, if deactivated, no FTP access to the device is possible.
SSH server active	Activates the internal SSH server of the device (administrative access)
Network discovery active	Activates the internal discovery server of the device; if deactivated, the device is no longer displayed in the Netdiscover tool (see chapter 3).
Network discovery password	Password for setting the network parameters via the Netdiscover tool
Modbus server active	Modbus server active, read-only, depending on the *Server* tab
BACnet server active	BACnet server active, read-only, depending on *Server* tab

Table 12: Fields in the Security tab

The configuration is saved with the **Save** button. The **Reload** command loads the last saved values and resets the current changes.

- The device is automatically reinitialized by setting the parameters via the SAVE button. An existing WAN connection is terminated and re-established.

4.8 User tab

In the *User* tab different users with specific access rights to the website can be created.

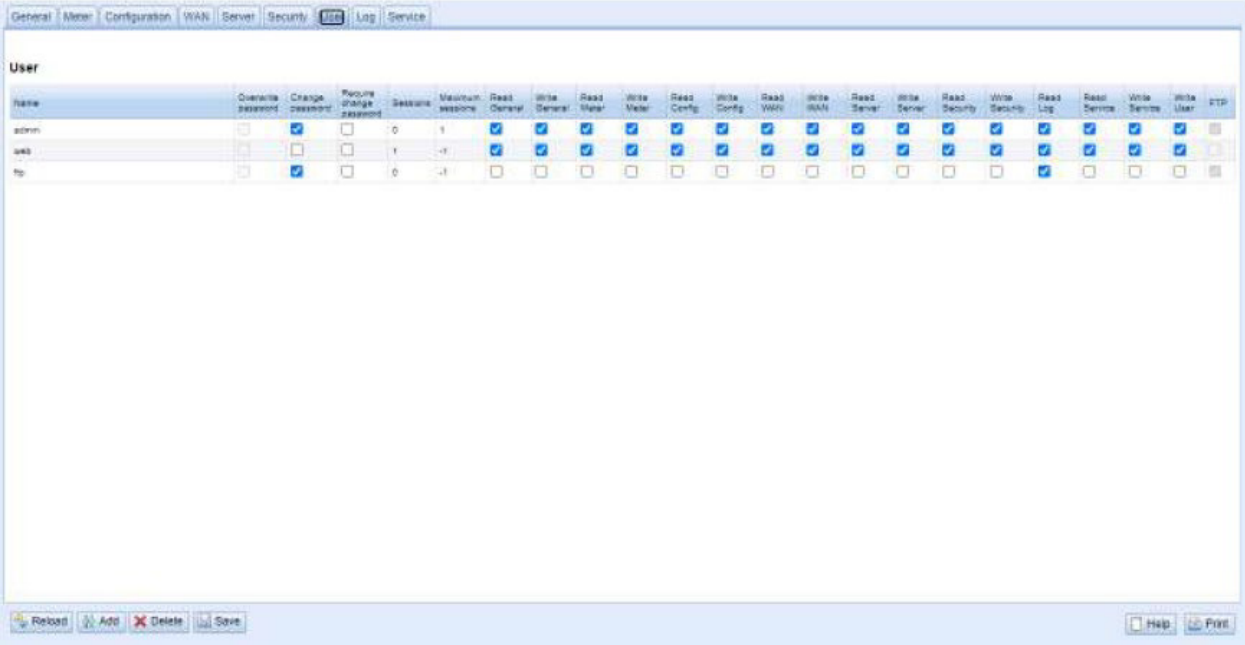


Figure 24 User tab

The following users are preconfigured in the delivery state:

User name	Password	Comments
admin	admin	Administrative user that allows full access to all services of the device (HTTP, FTP, SSH, IP configuration).
web	web	Default user for the web interface. If a user with this name and password exists, the web interface automatically logs in with these access data. Otherwise, the user is prompted to enter the access data. When delivered, this user has full access to the website of the device.
ftp	ftp	User for unencrypted FTP access to the log directory *ext/Log*

Table 13: User accounts on delivery

The existing configuration in the user table can be changed on the website:

Field name	Description
Name	User name
Overwrite password	It is set if a (new) password has been set for the user in the editing window.
Change Password	Setting whether the user is allowed to change his password
Require change Password	Setting whether the user must change his password at the next login
Sessions	Display how often the user is logged in at the same time
Maximum sessions	Setting, how often the user may be logged in at the same time (-1=unlimited)
Read General	Read authorization for the General tab
Write General	Write authorization for the General tab
Read Meter	Read authorization for the Meter tab
Write Meter	Write authorization for the Meter tab
Read Config	Read authorization for the Configuration tab
Write Config	Write authorization for the Configuration tab
Read WAN	Read authorization for the WAN tab
Write WAN	Write authorization for the WAN tab
Read Server	Read authorization for the Server tab
Write Server	Write authorization for the Server tab
Read Security	Read authorization for the Security tab
Write Security	Write authorization for the Security tab
Read Service	Read authorization for the Service tab
Write Service	Write authorization for the Service tab
Write User	Read and write authorization for the User tab
FTP	Authorization of the user to log in via FTP (maximum 2 users)

Table 14: Fields in the User tab

The user configuration can be changed with the buttons in the lower area or through the context menu. With the exception of the *admin* user, individual users can be created, deleted or changed.

The users in the list can be selected with a simple mouse click. A range can be selected with the <**SHIFT**> key pressed, or multiple users can be selected with the <**CTRL**> key pressed.

The **Reload** command loads the last saved values and resets the current changes.

When write access is activated on a tab, read access is also activated.

- The *admin* user cannot be changed or deleted in the general user configuration. The administrator password can only be changed with the ***Change password*** button if the *admin* user is logged in.
- Encrypted/secured FTP is usually SFTP not FTPS.When resetting, all configuration data and meter data are lost.
- Only the *admin* user has full access to the file system of the device via encrypted FTP. The second FTP user can also access */ext/Log* without encryption.

New users can be added via the button **Add** or via the context menu entry of the same name. The following window will open:

Figure 25 Input mask for adding a user

In addition to the user name and password, you can specify how often a user may log in at the same time (-1 no restriction). Besides the user *admin* another user can get FTP access to the device. The unencrypted FTP access only allows access to the log data of the device (directory: */ext/Log*). This property can only be enabled at the time the user is created.

- A separate FTP user (e.g.: ftp) allows a remote client to call the stored log data (manually or automatically), whereby it is not given access to other services or data of the SonoCollect 112.

To configure an already existing user, the Editing window can be called by double clicking its entry or via the context menu item **Edit**. This window has the same structure as the input window for creating a user. To reset the password of an existing user, the **Set Password** checkbox must be set. If the **Set Password** checkbox is not set, the user password is not changed or reset during this configuration process. A user password cannot be read.

The configuration can be finished with the **Ok** button or cancelled with the **Cancel** button.

The rights of an individual user are set directly in the user list. If a user has write access in a tab, he/she automatically also receives the right to display the tab (read access).

All selected users (with the exception of the admin user) can be deleted with the **Delete** button or the Context menu item with the same name.

The user configuration is saved with the **Save** button.

4.9 Log tab

The *Log* tab provides access to log information and status outputs. that facilitates the analysis of the behaviour and troubleshooting.

- The scope of the log entries depends largely on the settings in the **Log mode** field in the *General* tab (see section 4.2).
- For raw data logs on the meter interfaces, the **Raw data log** field in the ***Configuration*** tab must be activated (see section 4.4).

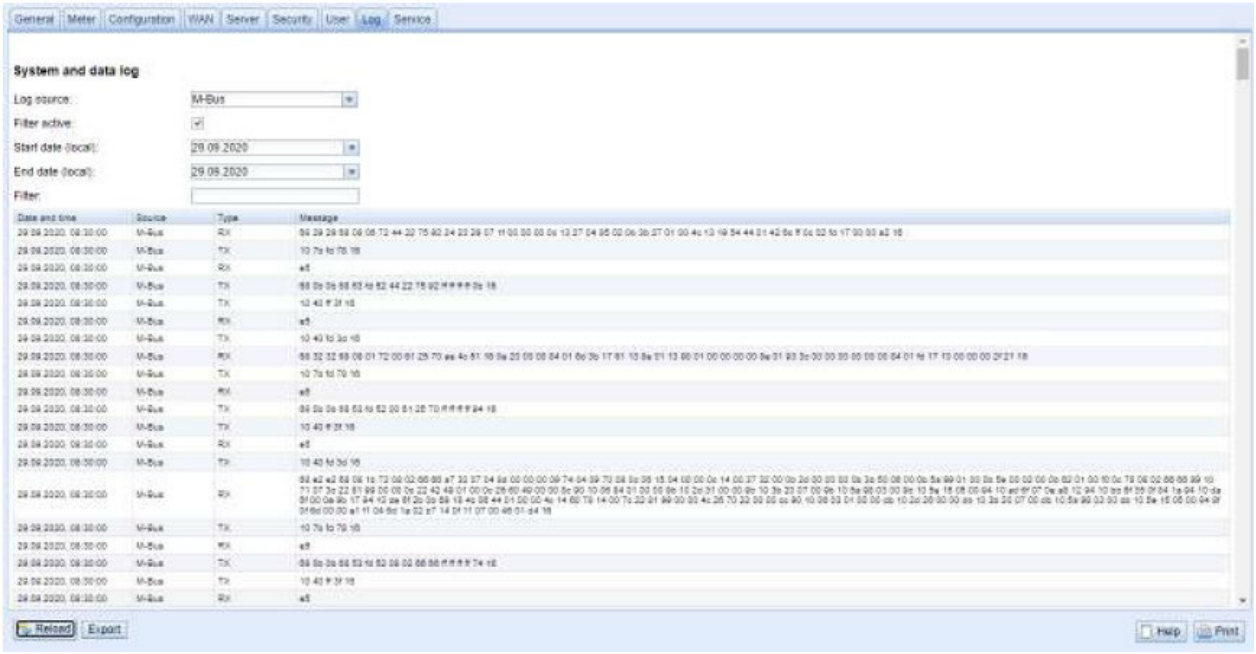


Figure 26 Log tab

The following options are available on the website:

Field name	Description
Log source	Selection of the source of the log entries *System log*: Display of the log entries of the system (Linux) and the application *Application*: Display of the log entries of the application *M-Bus*: Display of the raw data of the M-Bus interface (if Raw data log is active in the *Configuration* tab) *wM-Bus*: Display of the raw data of the wM-Bus interface (if Raw data log is active in the *Configuration* tab) *DLDE*: Display of the raw data of the DLDE interface (if Raw data log is active in the *Configuration* tab)
Start date (local)	Start date for the time range of the log entries
End date (local)	End date for the time range of the log entries
Filter	Character string according to which the log is to be filtered (search for keyword or regular expression in Message column)

Table 15: Fields in the Log tab

The **Reload** button updates the entries. The **Filter** button activates the search filter and the time range from the input fields and thus offers the possibility of targeted searches.

- The raw data log can be searched for meter numbers with the special filter input *serial=*, e.g.: *serial=12345678*. All packages will then appear at the named meter.
- If no log entries are displayed, please check the entries. If necessary, extend the specified time range or reset the filter.
- The number of log entries displayed is limited to 500. Use the filter or the time range to reduce the entries.

The **Export** button downloads a compilation of all entries matching the filter as a CSV file from the device. This download may take some time depending on the size of the log.

4.10 Service tab

The *Service* tab enables maintenance work and provides related information or functions:

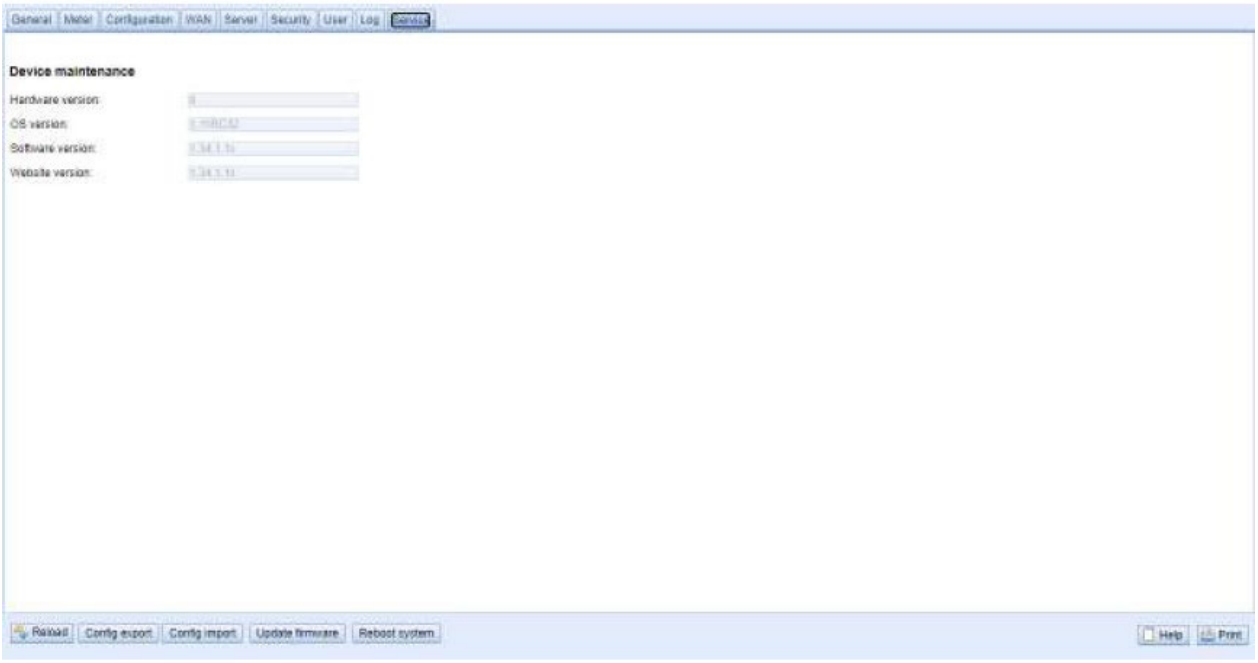


Figure 27 Service tab

Field name	Description
Hardware version	Version of the hardware
OS version	Version of the operating system
Software version	Version of the software
Website version	Version of the website

Table 16: Fields in the Service tab

The values are updated with the **Reload** button.

The buttons **Config export** and **Config import** are available to download the configuration of the device or to upload a configuration to the device.

When exporting the configuration, a selection box can be used to specify which data is downloaded from the device:

- Certificates
- Device configuration
- Network configuration
- Device name
- Meter configuration

✔ The Network configuration and the device name are part of the device configuration. If the device configuration is to be transferred to another device, it is recommended not to export the network configuration and the device name as well, since these settings are usually not to be transferred as well.

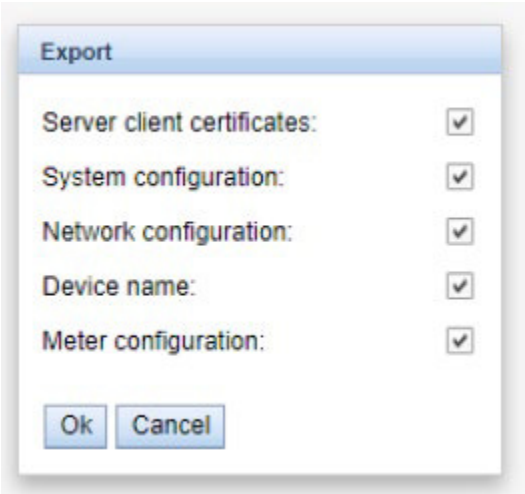


Figure 28 Configuration export options

The configuration is downloaded as **.tar.gz* file. This archive is an extract from the file system of the device. It can be stored and modified for later use on another device. It can be used when transferring a valid configuration to a replacement device or when commissioning many similar devices.

When importing the configuration, a file selection window opens in which you can select a corresponding **.tar.gz* file.

Pressing the buttons **Update firmware** also opens a file selection window. An update file can be selected in this window. Danfoss provides update files as **.enc* files at regular intervals. These files can then be uploaded to the device. After a successful upload, the update process is carried out automatically and the device is then restarted.

The device can be restarted with the **Reboot system** button, All internal processes are shut down and reinitialized after the restart. Meter data (WAN interface) stored on the clipboard may be transferred after a restart. Use this button to adapt the configuration manually per FTP(S) adjustment or make an update.

4.11 Print page

A print version of the web page can be called up via the **Print** button (bottom right) to print view of the configuration or to export the device configuration via the clipboard. The website generates an additional print preview containing all available configured parameters according to the access rights. The print preview is automatically closed after a user has logged out (if not already closed).

- The meter list displayed is also suitable for insertion into a table calculation.

SonoCollect 112

Configuration

General configuration

Device name:	SonoCollect_112
Serial number:	6891d08018aa
DHCP:	off
IP address:	10.23.242.27
Subnet mask:	255.255.255.0
Gateway IP address:	10.23.242.1
DNS IP address (primary):	
DNS IP address (second):	
Free space log (kB):	2887268
Free space Flash (kB):	114667
System date (local):	Mon Jan 13 2020 15:47:00 GMT+0100 (Romance Standard Time)
SNTP server:	ptbtime1.ptb.de
Log mode:	DEFAULT

Configuration of meter interfaces

Readout interval mode:	SECOND
Readout interval:	900
Readout date (local):	Wed Jan 01 2020 00:00:00 GMT+0100 (Romance Standard Time)
Description mode:	3
Maximum device count:	500
Maximum value count:	25
Raw log active:	off
CSV log active:	on
Protocol version:	8
M-Bus mode:	SECONDARYSCANREVERSE
Primary start address:	0
Primary final address:	250
Secondary address mask:	FFFFFFFF
M-Bus baud rate:	2400
M-Bus timeout (ms):	2000
M-Bus idle timeout (ms):	100
M-Bus full timeout (ms):	10000
M-Bus request mode:	2
M-Bus reset mode:	0
M-Bus max. multipage:	3
M-Bus transparent port:	5000
M-Bus slave mode:	DISABLED
M-Bus slave port:	0
wM-Bus frequency:	868 MHz
wM-Bus mode:	C2_T2_OTHER_REQ

Figure 29 Print page of the device, here the example SonoCollect 112

4.12 Supplied manual

Danfoss provides a manual as a PDF file on the devices. Use the **Help** button (on the right bottom) to access this manual.

4.13 Front-end troubleshooting

Access to the web server of the device via a standard web browser provides an easy and intuitive way to operate the device. Nevertheless, impairments or unwanted behaviour may occur.

- ✔ A possible source of error is the browser cache, especially if several devices are operated under the same IP or an update has been applied. First terminate the web session with the **Logout** button and then completely reload the website to eliminate this source of error. Depending on the browser, this is done using a key combination, e.g. <**CTRL+F5**> or <**CTRL+R**>.

4.13.1 Website or front end cannot be accessed

The website cannot be loaded or the error message "webservice not available" appears.

Check the IP settings of the device and your computer. The IP addresses should be in the same subnet or a route must be set up. If possible, change the IP addresses accordingly. Ask your administrator. Alternatively, you can use DHCP to give the device a valid IP address (see the Netdiscover tool in chapter 3). Two examples of a valid configuration:

- Device: 192.168.1.101 (default IP), subnet mask: 255.255.255.0 → PC: 192.168.1.xxx (xxx = 0-254, except 101 and other already used IP addresses), recommended for direct connection 1:1 device and PC
- PC: 192.168.178.21, subnet mask: 255.255.255.0 → Device: 192.168.178.xxx (xxx = 0-254, except 1, 101 and 254 and other already used IP addresses), typical for connection to a router in the home network

Check whether the device is listed in the Netdiscover tool (see chapter 3). Check the general connectivity via ping test also from the Netdiscover tool.

Check whether a firewall blocks the data exchange or the routing is configured accordingly. Ask your administrator in this case.

In the case of an HTTPS connection, the browser may block the connection under certain circumstances. Confirm the stored certificate in the browser or "trust" the website and the certificate if you are sure to access the device.

If errors could not be rectified, please contact your local Danfoss support:

4.13.2 Login on website not possible

Check the user settings and rights for the website and the access data.

There may be another user already logged in and the number of active sessions may be limited. Then the login is also denied. In the *User* tab check the access data and the number of active sessions.

If errors could not be rectified, please contact your local Danfoss support:

4.13.3 All input fields or buttons are greyed out.

Greyed out buttons indicate a denied write access. A maximum of one user has write access.

Check whether another session is already active. This can also occur if a window in the browser is simply closed without logging out first. The session is then active for a short time. Log out again and wait about one minute. In the ***User*** tab check the user rights and the number of active sessions.

Check whether the user has write access.

If errors could not be rectified, please contact your local Danfoss support:

4.13.4 Not all tabs are visible

Check the user's read access. Only the tabs for which the read access is active can be viewed. Check the user rights in the *User* tab.

If errors could not be rectified, please contact your local Danfoss support:

4.13.5 Export of the log data of one/several meters is empty

Log data is only generated when a report is active in order to optimize the memory. Check in the *Server* tab whether a report is active.

Check the time range for the export. The time of the report must start before a valid readout. For example, to export the readout from 09/29/2020 13:15, the time for export should be set to 09/29/2020 13:10. The report then contains all readouts from 13:10 onwards until the end of the **Report cycle** in the *Server* tab of instance 1 or 15 minutes.

If errors could not be rectified, please contact your local Danfoss support:

4.13.6 The log is empty

Check the filter settings. If no filter is active, entries should always be available for the **Log source** *System log*. If not, this indicates a system-level misconfiguration. This can be remedied by the command *solcmd config-partitions* via the SSH console (see section 10.1.2).

Check whether the raw data log is active for the interfaces (see *Configuration* tab). Only then the raw data for the **Log source** e.g. *M-Bus* will be generated.

If errors could not be rectified, please contact your local Danfoss support:

5 Reading meters via M-Bus

A widely used interface for the automated acquisition of meter data is the wired M-Bus (Meter-Bus). This was originally specified in EN 1434-3. It received its own series of standards with EN 13757:

- EN 13757-2 Communication systems for meters - Part 2: Wired M-Bus communication
- EN 13757-3 Communication systems for meters - Part 3: Application logs
- EN 13757-7 Communication systems for meters - Part 7: Transport and security services

Originally developed for heat meters, the M-Bus is now available for all types of consumption meters as well as sensors and actuators. Thus, it has a high value with regard to the collection of consumption data.

Essential features and advantages of the M-Bus are:

- The M-Bus is a digital interface for the electronic reading of meter data.
- All consumption meters in a building/property can be operated and read on a single cable.
- All consumption meters are addressable.
- The readout is protected against transmission errors and is very robust.
- The data is machine-readable and therefore easy to process.
- The data are self-describing.
- High readout rates are possible.
- The M-Bus is manufacturer independent, there is a wide range of devices.

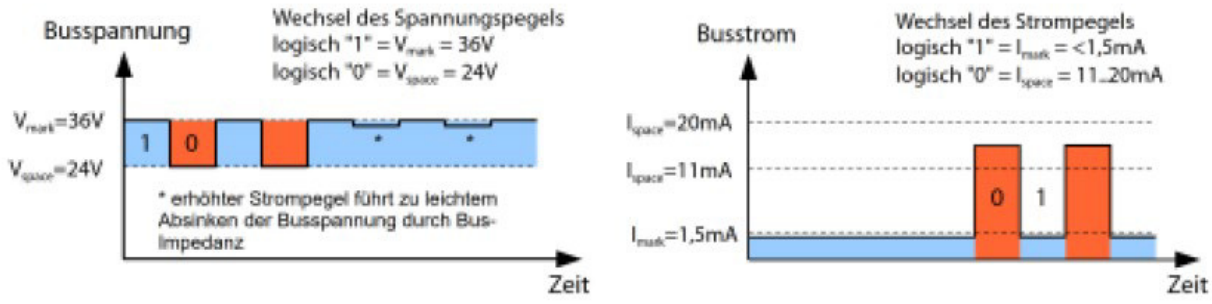
5.1 Signalling on the M-Bus

The M-Bus is a single master multiple slave bus. Therefore, a single bus master controls the bus and the data traffic on the bus, to which several slaves, i.e. meters, can be connected.

A second physical master is not allowed on the M-Bus.

The M-Bus uses voltage and current modulation on a physical level to transmit data. The master transmits telegrams by voltage modulation, the slave transmits telegrams by current modulation.

This is shown schematically in the following figure:



Legend

Busspannung	Bus voltage	Busstrom	Bus current
Wechsel des Spannungspegels	Change of the voltage level	Wechsel des Strompegels	Change of the current level
logisch	logical	logisch	logical
* erhöhter Strompegel führt zu leichtem Absinken der Busspannung durch Bus-Impedenz	* increased current level leads to a slight drop in bus voltage due to bus impedance		
Zeit	Time	Zeit	Time

Figure 30 Signalling with M-Bus

The M-Bus works according to the request-response principle, i.e. the master initiates the communication by a request/command which is then answered/confirmed by the slave. Spontaneous data transmission on the part of the slaves is not allowed.

Certain terms are used in the M-Bus standard. The basics of communication are taken from IEC 60870-5-101. Key examples are explained in the table below:

Term	Description
ACK	Acknowledge, confirmation of a command, transmitted on the M-Bus as a single character telegram with content 0xE5.
Application reset	Reset of the application layer, command to reset the meter to the default state and to reset the meter for successive telegrams (multipaging).
Broadcast	Broadcast, command or request is sent to all slaves, special addresses 0xFE and 0xFF are used.
C field	Command field, code that describes the direction in which a telegram is exchanged and the meaning of the telegram.
Checksum	Check number for checking transmission errors, with the M-Bus the checksum results from the addition of the transmitted data (without telegram header, up to checksum).
Single character	One of the three telegram forms at the M-Bus with length of exactly 1 byte, telegram header and end from checksum and 0x16 are not present, used at the M-Bus for ACK.
FCB	Frame Count Bit, bit in the C-field, which is alternately set to 1 or 0 for successive telegrams, or for which successive telegrams can be retrieved when the bit changes.
I_{mark}	Transmit current of the slave at logical 1, usually 1 UL.
I_{space}	Transmit current of the slave at logic 0, usually 12.5-21.5 mA.
Short frame	One of the three telegram forms on the M-Bus with a length of exactly 5 bytes, are only sent from the master to the slave (e.g. commands and instructions), the telegram header is 0x10 and the telegram ends with checksum and 0x16.
Long frame	One of the three telegram forms on the M-Bus with variable length, the telegram header consists of 0x68 LL LL 0x68 (LL is the length of the telegram in each case), the telegram ends with checksum and 0x16.
Multipaging	M-Bus method of distributing large amounts of data over several logically consecutive telegrams, use of the FCB for sequence control.
Primary address	Link layer Address at the M-Bus, this is used to address the requests/commands, address range 0-250, special addresses 253 (0xFD), 254 (0xFE) and 255 (0xFF).
REQ-UD2	REQuest User Data type 2, request for consumption data, transmitted on the M-Bus by the master as a short frame telegram.
RSP-UD	ReSPonse User Data, response to request for data at the meter, transmitted on the M-Bus by the slave as a long frame telegram.
Secondary address	Worldwide unique identification number of the meter, consisting of manufacturer code, 8-digit serial number, medium ID and version number.
Slave select	Procedure for extending the address space to the secondary address of the meter, use of the SND-UD for selecting the meter via the application layer, then selected meter can be addressed via special address 0xFD.
Standard load	Defined quiescent current that a meter may draw from the M-Bus, according to the standard 1 UL=1.5 mA.
SND-NKE	SeND Normalization request, initialization command to the slave (reset FCB bit and selection), transmitted by the master as a short frame telegram on the M-Bus.
SND-UD	SeND User data, sending data or commands to the meter, transmitted by the master as a long frame telegram on the M-Bus.
U_{mark}	Mark voltage, upper voltage of the M-Bus signals at the master, representation of the logicalEN 1, idle state, usually 24-42 V.
U_{space}	Space voltage, lower voltage of the M-Bus signals at the master, representation of the logical 0, usually 12-30 V.
UL	Unit of standard load (see above)

Table 17: M-Bus specific terms

5.2 Setup of the interface in the web front end

5.2.1 M-Bus mode

The parameter **M-Bus mode** in the *Configuration* tab activates the M-Bus interface and defines the basic range of functions:

- *Disabled*
- *Secondary scan*
- *Secondary scan reverse*
- *Primary scan*
- *Transparent/TCP*
- *Transparent/UDP*

The *Transparent* modes allow the physics of the M-Bus interface to be used via a TCP or UDP port. The data stream is thus forwarded from the M-Bus interface to an IP interface (network (LAN) or mobile radio (WAN)). The device then works in a similar way to an Ethernet M-Bus converter or even a mobile radio router with an M-Bus interface. The network port to be used is defined in the parameter **M-Bus transparent port**.

- ✔ The transparent mode makes it possible to directly address meters via M-Bus interface. This requires appropriate M-Bus software on the host system. The device provides the physical connection. The transparent mode makes it possible to directly address meters via M-Bus interface.

5.2.2 Addressing, search and search range

A distinction is made between primary addressing and secondary addressing with the M-Bus.

The primary address is used for access control on the link layer. It is the basis of communication between master and slaves on the M-Bus and is used for communication in every telegram except the short frame. The secondary address is an extension of the addressing and additionally controls the access to the application layer.

The valid address range for the primary addresses is 0-250, whereby the address *0* is given a special position. According to the standard, this is only permissible for unconfigured meters (ex works). The address *253* is a special address for the use of secondary addressing, the addresses *254* and *255* are used for the broadcast with and without response. The addresses *251* and *252* are reserved.

The secondary address consists of 4 parts. These are the *secondary ID* (an 8-digit decimal number), the *manufacturer ID* (value of 0-65535), the *medium ID* (value of 0-255), and the *version number* (value of 0-255). Thus the address space is theoretically $115.19*10^{15}$ unique values.

- The *vendor ID* can be converted to a *vendor identifier* , which is maintained by the DLMS *User Association*. An overview can be found here: *https://www.dlms.com/flag-id/flag-id-list*

The slave whose primary address matches the address in the request responds in case of primary addressing. This makes it possible to implement simple and short communication.

- If the primary address is not unique during primary addressing, collisions and thus disturbed communication may occur, since several slaves are responding.

Secondary addressing, on the other hand, uses a so-called selection (slave select) on the basis of the secondary address in order to be able to address the meter with a matching secondary address via the primary address *253*.

The non-matching meters deselect in the same step. Therefore, the process will be somewhat more complex, since an additional selection with confirmation is required. Communication takes a longer time. However, the address space is much larger, collisions do not occur, and more than 250 meters are possible on one bus system. In addition, commissioning is faster because not every meter has to be configured to a unique primary address.

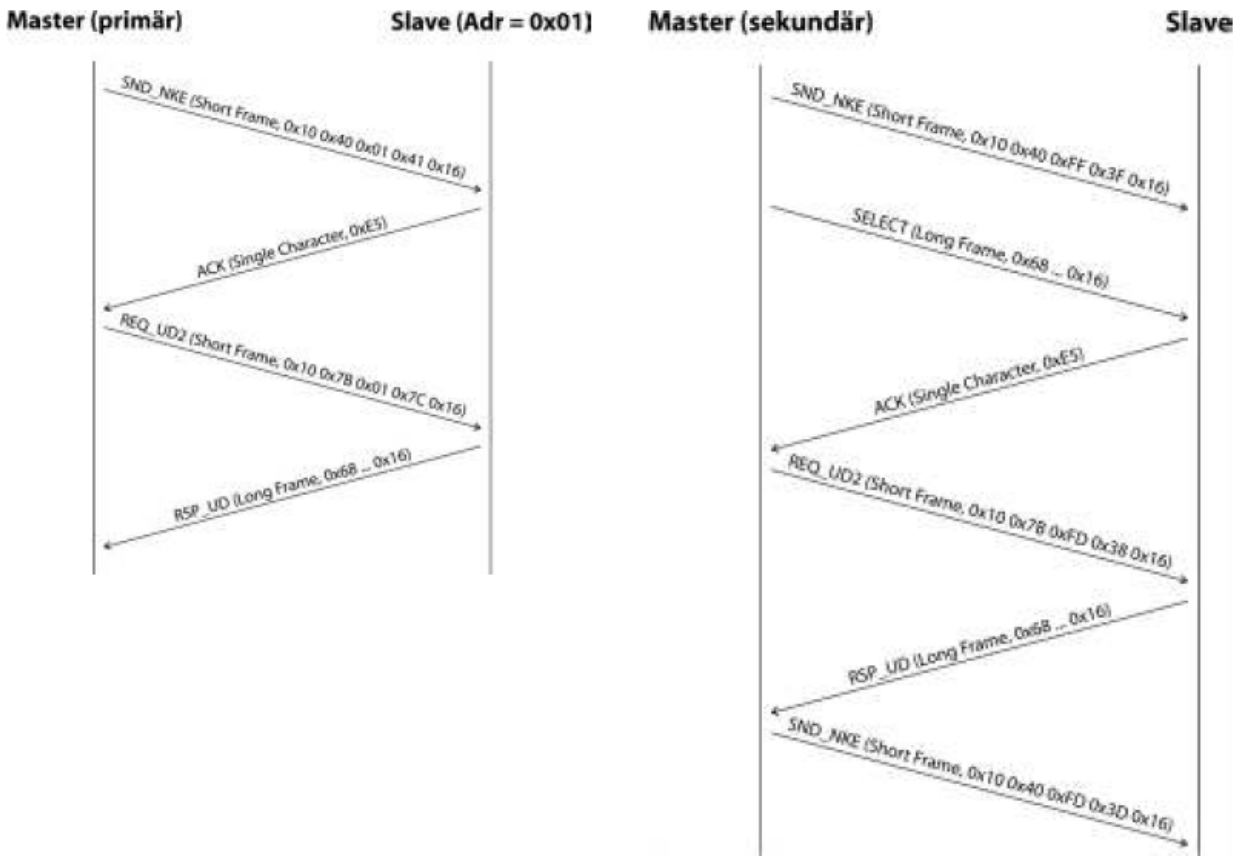


Figure 31 Example of primary and secondary addressing in comparison

Wildcards are also supported for secondary addressing. This allows, for example, the sole use of the 8-digit *secondary ID* for selection. The other parts are masked with the placeholder 0xFF (255) or 0xFFFF (65535). Individual digits of the secondary address can also be masked with 0xF (16).

- ✔ The M-Bus uses the BCD display for the *Secondary ID*, therefore the 8-digit decimal number is encoded by an 8-digit hexadecimal number. Special functions can be represented by the characters A-F per digit, but only the *F* is used, as a placeholder at the respective digit.

The placeholders are also the basis of the secondary search. This divides the secondary address space piece by piece by means of the placeholders and checks whether there are meters in the respective part. If so, this part is further subdivided until there is only at most one meter per part or further subdivision is not possible. The classic procedure here is to mask the *manufacturer ID*, *medium ID* and *version number* and search the 8-digit number range of the *secondary ID*.

The range 000000-999999 is divided by sending the selection to 0FFFFFFF, i.e. selecting all meters with a *0* at the top of the *Secondary ID*. A query is then sent to the selected meters using the primary address *253*. If no response is received, no meter is in this range the lowest unmasked digit can then be incremented and it continues with 1FFFFFFF. If you get an undisturbed response, there is only one meter in this range and you can save this meter as found and count up the lowest unmasked digit and continue searching. If one receives a disturbed response or collision, one moves to the next still masked location and traverses it from *0* to *9*. Due to the variability of the process depending on the meters and the distribution of the *secondary ID* in the address space, it is difficult to estimate in advance what time a search will take.

Primary search, in contrast, is very direct and determinate. Every primary address is requested and depending on a valid answer a meter is then stored as found or not. Thus, 250 queries are always necessary for a complete search.

The parameters **Primary start address** and **Primary final address** in the ***Configuration*** tab limit the primary search by specifying the start and end. The parameter **Secondary address mask** is used to mask the *secondary ID*, so that the search can be limited to certain areas. For example, a mask *33FFFFFF* limits the search to all meters whose *secondary ID* begins with *33*.

5.2.3 M-Bus baud rate

The parameter **M-Bus baud rate** in the *Configuration* tab is used to configure the bit display on the M-Bus interface. The baud rate essentially determines the speed of the data transmission.

- ✔ M-Bus usually uses 2400 baud. 300 baud and 9600 baud are other common baud rates. Many meters detect the baud rate automatically.
- ✔ The other parameters for the bit display of the M-Bus interface are fixed to 8 data bits, even parity and 1 stop bit (8-E-1).

5.2.4 M-Bus timeouts

The M-Bus interface uses with **M-Bus timeout**, **M-Bus idle timeout** and **M-Bus full timeout** three different timeouts (in transparent mode only the **M-Bus idle timeout**), which can be parameterized in the *Configuration* tab.

The **M-Bus idle timeout** specifies what time the M-Bus interface must be "idle", i.e. no data is sent/received, in order to detect the end of a telegram (end of communication). It is mainly used for package formation of the M-Bus data stream, i.e. the assignment of incoming data to a logical unit (data packet).

The **M-Bus timeout** specifies what time it takes to wait for a response from the meter. If no data is received within this time from the request, the readout attempt is aborted.

The **M-Bus full timeout** indicates the latest time at which reception is interrupted in order to process the received meter data. This parameter also terminates reception if the **M-Bus idle timeout** is not reached because data is continuously received (without idle, e.g. in the event of faults).

5.2.5 M-Bus request mode

By default the readout is done via the command REQ_UD2 which the master sends to the meter. This is answered by the meter with the RSP_UD, which contains the usual meter data (consumption data).

In addition, the parameter **M-Bus request mode** in the *Configuration* tab can be used to explicitly select the data to be read out before the actual readout. In case of the SonoCollect devices there is the possibility to send a so-called global readout request to the meter before the actual query. For this purpose a SND_UD is sent to the meter. The user data then consists of only one or two characters. There are two implementations with the same function, depending on the manufacturer one or the other is supported:

- User data consisting of 2 bytes: DIF=0x7F, VIF=0x7E → **M-Bus request mode** *Extended 1*
- User data consisting of 1 byte: from DIF=0x7F → **M-Bus request mode** *Extended 2*

- ✔ This command is usually not necessary, because all meter values are transmitted by default with the normal query.
- ℹ The use may result in a change of the data record of the meter

5.2.6 M-Bus reset mode

With the M-Bus there are several variants and applications of a reset. A distinction is made between:

- Link layer reset → SND_NKE
- Application layer reset → Application reset mittels SND_UD

The link layer reset is only responsible for initializing the communication flow of the link layer according to EN 13757. Therefore, it resets the selection based on the secondary address, deselects the meter, and also resets the FCB mechanism (see section 5.2.7).

The application layer reset, on the other hand, resets the application in the meter (or the communication application).

The parameter **M-Bus reset mode** in the *Configuration* tab can be used to set which of the resets and to which address it is sent. The resets are then sent at the beginning of a search run and before each readout of a meter:

- *None*: Neither a link layer reset nor an application layer reset is sent.
- *Standard*: A link layer reset is sent to the broadcast address 0xFF and, in the case of primary addressing, also to the respective primary address.
- *Extended 1*: A link layer reset is explicitly sent to the selection address 0xFD and then the link layer resets of the *standard* mode.
- *Extended 2*: After the link layer reset to the selection address 0xFD an application layer reset is sent to the broadcast address 0xFF and then the link layer resets of the *Standard* mode.

5.2.7 M-Bus multipaging

If the data of a meter do not fit into a single telegram (maximum 255 bytes user data), there is the possibility to split these data into several logically connected, consecutive telegrams. The FCB mechanism according to IEC 60870-5-2 is used for the readout sequence. Danfoss calls this process "multipaging".

In order to call possibly existing telegrams of the meter, the master must switch the FCB with each new request REQ_UD2 to inform the meter to send the following telegram. If the master does not switch the FCB, the meter always responds with the same telegram again. The REQ_UD2 then alternately have a C field of 0x5B or 0x7B.

The parameter **M-Bus max. multipage** in the *Configuration* tab restricts the maximum number of interrelated telegrams to a number. Especially in the case of meters with a lot of data (e.g. load profiles, reference date series), the readout time can be shortened and less relevant values are not read out at all.

- ✔ It is sufficient to use the first telegram of the telegram sequence for most applications.
- ℹ The M-Bus does not provide a mandatory mechanism to directly access certain telegrams of the sequence. As a rule, the procedure always starts from the first telegram. At least all relevant telegrams must be called.
- ℹ An "Application reset" to the meter leads to a reset to the first telegram of the sequence.

5.3 M-Bus troubleshooting

5.3.1 Physical troubleshooting

In order to determine why meters on the M-Bus do not respond or are not found during the search, a physical check of the M-Bus network is usually suitable. It can be relatively easy to basically determine whether the M-Bus is at least correctly wired.

A standard multimeter is sufficient for simple measurement. The most important measurement is the voltage measurement between both M-Bus lines. The voltage measurement shows that:

- the M-Bus master correctly supplies the bus: approx. 30-40 V are present
- the meter is correctly connected to the M-Bus: approx. 30-40 V are present
- the voltage drop is not too high: the voltage at the master is only slightly higher than at the meter
- the telegrams of the master arrive at the meter: when sending, the value in the display of the multimeter 'wobbles'.

Another important measurement is the current measurement on the two M-Bus lines. The current measurement shows that:

- the load on the M-Bus is in a valid range: approx. (number of meters)*1.5 mA flows
- no external currents are present: current through both lines is identical
- the telegrams of the meter arrive at the master: the value in the display of the multimeter 'wobbles' in case of the response

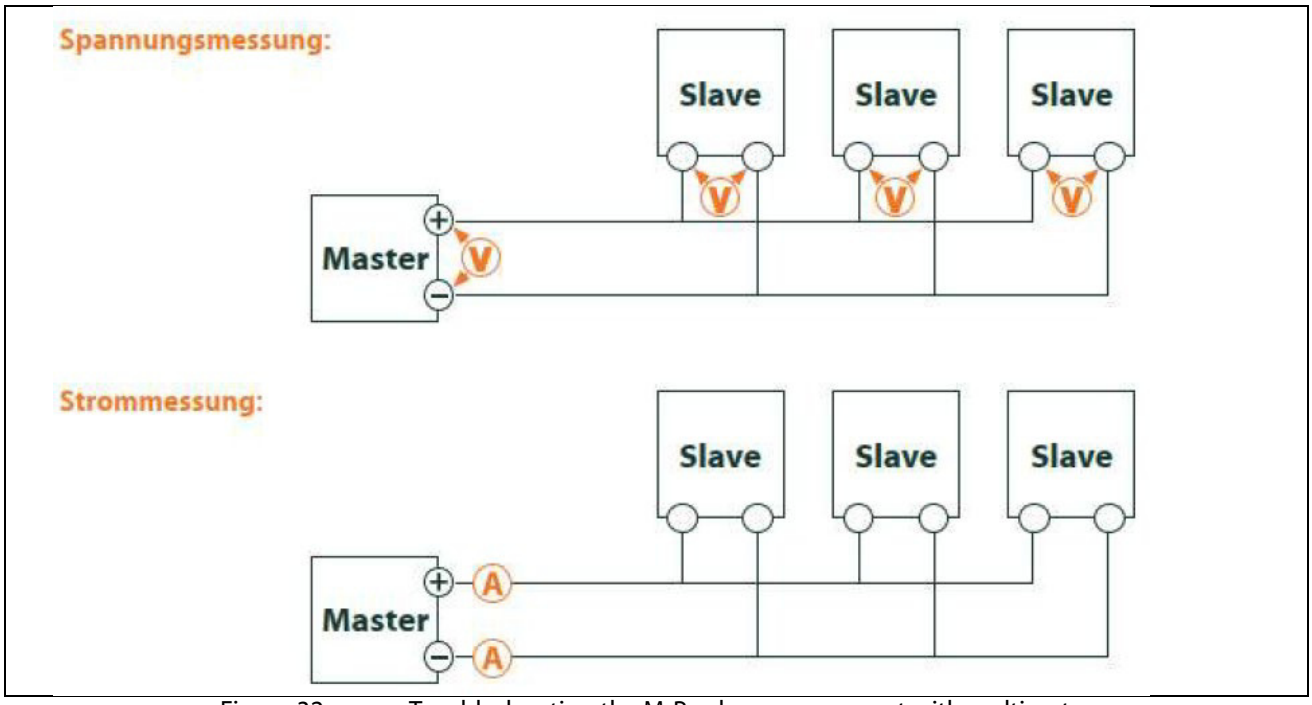


Figure 32 Troubleshooting the M-Bus by measurement with multimeter

5.3.2 M-Bus meters are not found

Check the cables between the device and the meter, and replace faulty cables if necessary. While the device is switched on, measure the M-Bus voltage (approx. 30 to 40 V) between the two M-Bus connections on the device and also on the meter.

Ensure that the M-Bus interface is activated via the parameter **M-Bus mode** on the web page in the *Configuration* tab and that the search mode configured therein (secondary or primary) is supported by the meter(s).

Work with search masks or a restriction of the search range to search the M-Bus step by step (e.g.: **Primary start address**, **Secondary search mask**).

The M-Bus query can also be adapted with the following parameters:

- **M-Bus request mode**
- **M-Bus reset mode**

Scan again with a different M-Bus baud rate (300, 2400 or 9600) or lengthen the timeout.

Remove other meters (if any) to eliminate a possible source of error.

If another M-Bus meter (possibly the same type) is available, you can perform another communication test with the other meter to localize the source of error.

The number of attempts for an M-Bus request can be increased via the parameter **MBUS_MAXRETRY** in the extended configuration of the device by the use of file *app/chip.ini* (see section 10.3) This makes it easier to find meters that do not answer every query. The default value here is 3. Start the search again.

Collisions can occur if the same primary or secondary addresses occur more than once during the search procedures. An address duplication is common with primary addressing. Therefore we recommend secondary addressing. In such cases collisions can also occur, since due to the default value of the parameter **MBUS_SELECTMASK**=*14* (see section 10.3), only the 8-digit serial number is searched during the search.

Activate the raw data log with **Raw data log** in the *Configuration* tab (see section 4.4). The communication process can be analyzed very well using this raw data log.

If errors could not be rectified, please contact your local Danfoss support.

M-Bus meters are found, but do not show any data

Some meters contain incorrect secondary address or encryption information in the data packet. As a result, they may not be addressable for readout or may be processed incorrectly. Parts of the secondary address can be masked and thus meters can be read after all using the parameter MBUS_SELECTMASK (see section 10.3) The parameter **MBUS_DISABLEDECRYPTION**=*1* (see section 10.3) can also be used to disable the unusual decryption of M-Bus packets if they pretend to be encrypted.

Restart the search or perform a readout.

If errors could not be rectified, please contact your local Danfoss support.

5.3.3 The search takes a long time

The search for M-Bus meters can take a long time under certain circumstances, quite longer than 1 h, especially with secondary search and ascending meter serial numbers.

Work with search masks or a restriction of the search area to search the M-Bus step by step.

Decrease the value of the parameter **MBUS_MAXRETRY** in the file *app/chip.ini* (see section 10.3) or reduce the timeouts.

Use a different search mode in the ***Configuration*** tab (see section 4.4). In particular, the reverse secondary search *Secondary scan reverse* may help in this case. Then start the search again.

In the event of faults on the M-Bus, long search runs may also occur, since faults are processed as receive packets and a meter is thus assumed in each search step.

If errors could not be rectified, please contact your local Danfoss support.

5.3.4 Device restarts during search

For safety reasons, the device operates with an internal watchdog, which is intended to prevent the device from becoming unreachable. If the search takes a long time, this watchdog may cause the device to restart. If the search takes a long time, it is recommended to increase the value of the parameter **WATCHDOG_SCAN** in the file *app/chip.ini* (see section 10.3). Then start the search again.

There may also be severe collisions on the bus under certain circumstances, e.g. if all meters respond at the same time. In exceptional cases, these severe collisions and the associated large increase in current can lead to the device restarting. Work with search masks or a restriction of the search range to search the M-Bus step by step (e.g.: **Primary start address**, **Secondary search mask**). If necessary, divide the bus for the search, and search the bus sections one after another.

If errors could not be rectified, please contact your local Danfoss support.

6 Reading meters via wM bus

A widely used interface for the automated acquisition of meter data is the wireless M-Bus (wM-Bus, wireless M-Bus, wireless Meter-Bus). Like the wired M-Bus, it is specified in the series of standards EN 13757:

- EN 13757-4 Communication systems for meters - Part 4: Wireless M-Bus communication
- EN 13757-3 Communication systems for meters - Part 3: Application logs
- EN 13757-7 Communication systems for meters - Part 7: Transport and security services

The wM-Bus is the extension of the M-Bus for use via a radio system. Protocol and mechanisms are therefore very similar, deviations are due to the speciality of radio. Thus, it has a high value with regard to the collection of consumption data.

Essential features and advantages of the wM-Bus are:

- The wM-Bus is a digital interface for the electronic reading of meter data.
- All consumption meters have a unique identifier.
- The readout is protected against transmission errors and is very robust.
- The data is machine-readable and therefore easy to process.
- The data are self-describing.
- High readout rates are possible.
- The M-Bus is manufacturer independent, there is a wide range of devices.
- The data can be encrypted and is protected against replay attacks.
- The used frequency of 868 MHz offers sufficient penetration in the building at low transmission power.
- Repeaters can be used to extend the radio network.

6.1 Signalling via wM bus

The wM-Bus is a radio system that operates mainly in the SRD band at 868 MHz. Other frequencies, such as 433 MHz or 169 MHz are also defined. The used and allowed frequency differs between continents and countries.

Technically, the wM bus uses frequency modulation (FSK). The physical parameters and the modulation type depend on the mode of the wM bus. There are different modes:

- *S-Mode*: Stationary mode: Mode originally intended for fixed installations, declining importance
- *T-Mode*: Frequent transmit mode: Mode originally intended for walk-by application, frequently used
- *R-Mode*: Frequent receive mode: Special mode for reception on multiple radio channels simultaneously
- *C-Mode*: Compact mode: Energy-optimized variant similar to T-mode, growing importance
- *N-Mode*: Narrow band VHF: Special mode for the use of 169 MHz
- *F-Mode*: Frequent receive and transmit mode: Special mode for the use of 433 MHz

The modes S, T, C and N are defined as unidirectional (e.g. S1 or T1) as well as bidirectional (e.g. S2 or T2). The R and F modes are always bidirectional. In the context of the meter interface, unidirectional means that the meter only transmits and does not receive. Therefore, no data can be sent to the meter. The reception time window in the meter is open for only a very short time after a telegram has been sent due to the battery in case of bidirectional communication. The other side must then respond within this very short time to keep the receiver active, otherwise it will be switched off again.

- The SonoCollect devices are intended for unidirectional operation and are therefore only used to receive meter data.

6.2 Troubleshooting the wM bus

6.2.1 wM-Bus meters are not found

Ensure that the wM-Bus interface is configured for T-, C-, C/T- or S-Mode via the parameter **wM-Bus mode** on the web page in the *Configuration* tab (see section 4.4) according to the configuration of the meter.

Test the communication connection over a short distance. To do this, position the meter at a distance of about 1 m from the device.

Check the internal configuration of the meter (e.g.: transmission mode, transmission interval). Check the antenna connection and the position of the antenna.

Check whether the parameter **wM-Bus lists** in the *Configuration* tab is active. If not, no new meters are added to the list.

If another wM-Bus meter is available, you can run the communication test again with this meter to localize the source of error, possibly with a different communication mode.

Activate the raw data log with **Raw data log** in the *Configuration* tab. The communication process can be analyzed very well using this raw data log.

If errors could not be rectified, please contact your local Danfoss support.

6.2.2 wM-Bus mounters are found but show no data

In most cases, this occurs when the transmitted meter data are encrypted. Check whether encryption is active in the meter and whether the entered key is correct. For this purpose go to the *Meter* tab and enter the correct key there (column *Encryption key*, see section 4.3).

If errors could not be rectified, please contact your local Danfoss support.

7 Reading meters via pulse interface

A simple way to digitize consumption is the pulse interface.

The method of digitization consists of outputting a certain number of pulses per unit of consumption. This way gives a pulse a weighting. It is therefore possible to infer the consumption value and thus the meter reading by counting the pulses. The weighting of the pulses is meter-specific and usually noted on the meter. Example: Inscription "1000 Imp/kWh" → 1 pulse = 1 Wh, so with each pulse the energy register can be increased by 1 Wh.

Generally, this pulse interface is referred to as the S0 interface. However, this designation is to be understood only as a synonym. There are essentially 3 different realizations:

- S0 Type A according to EN 62053-31
- S0 Type B according to EN 62053-31
- Potential free contact

Physically, the types differ from each other. The real S0 interfaces according to EN 62054-31 are digital current interfaces. A pulse is represented by a current of more than 10 mA. In the idle state, the current is less than 2 mA. Type A and type B differ only in the maximum permitted voltage. Type A uses a maximum of 27 V, type B a maximum of 15 V. The specified maximum current of results in a minimum internal resistance of 1 kOhm. A minimum voltage is required depending on the implementation.

The potential-free contact is easier to implement on the encoder side (meter). This usually simply uses the transistor output of an optocoupler which is directly controlled. The internal resistance is the same as the optocoupler and no minimum voltages are required.

✔ This device has a pulse interface which is compatible with S0 interfaces according to type A and with potential-free contact. Therefore all common meters with pulse interface can be connected.

7.1 Setup of a meter in the web front end

The setup of a meter with pulse interface is only possible manually.

First, the pulse interface must be activated. This is done in the *Configuration* tab via the parameter **S0 mode** (see section 4.4). Three modes can be set here:

- Disabled
- Absolute
- Relative

The most commonly used mode is *Absolute*. Here, the meter value is continuously incremented by its value for each pulse. Thus, the recorded measured value should always correspond to the display of the meter.

In the *Relative* mode, the value is also incremented, but is reset to 0 at the end of the readout period to increment again. This can be used to record the consumption per period.

After activating and setting the mode of the pulse interface, the meter can be added in the *Meter* tab.

The meter is first created via the **Add** button or the context menu. In the dialog, the **Interface** must be set to *S0-n* (n = channel number). Further data such as manufacturer code, serial number, **medium** or **user label** are optional and can be assigned. The user may refer to Table 25 for the **Medium** field. This ensures a uniform display across all meters. Use the **Ok** button to accept the entries and the meter is created in the meter list in the *Meter* tab.

Figure 33 Creating a pulse meter (sample data)

A meter value must now be added to the newly created meter. This is done by right-clicking on the newly added pulse meter and selecting the **Add value** command from the context menu. This command opens a dialogue box for entering the parameters of the meter value.

Figure 34 Creating the meter a pulse meter (sample data)

The parameters **Value** and **Unit** should be set to the values in the meter display. The unit may differ, we recommend using basic units such as *Wh* as opposed to the standard unit often used for energy meters *kWh*.

The parameter **Scale** indicates the pulse value. The value entered in **Value** is incremented by this value during a meter pulse. The calculation of the pulse value results from the indication on the meter, here are a few examples:

- 1000 Imp/kWh → 0.001 = 1e-3 with unit kWh or 1 = 1e+0 with unit Wh
- 5000 Imp/kWh → 0.0002 = 2e-4 for unit kWh or 0.2 = 2e-1 for unit Wh
- 200 Imp/m³ → 0.5 = 5e-1 with unit m³

The parameters **Value** and **Scale** must be set to ensure correct metering, the other parameters are used for an easily readable data display. The user can refer to Table 26 and Table 27 for the fields **Description** and **Unit**. This ensures a uniform display across all meters.

The measured value set up in this way is now updated by incrementing, depending on the number of pulses acquired, with each readout. For S0 meters, only one meter value can be assigned.

7.2 Troubleshooting the pulse interface

7.2.1 The meter does not increment

Check the technical specification of the pulse generator, especially its internal resistance or its current consumption in active/inactive state. The detection threshold is approx. 8-10 mA.

Check the polarity.

If errors could not be rectified, please contact your local Danfoss support.

8 Reading meters via serial interface

One way to read meters is via serial communication. Physically, these can be found in the form of RS-485, RS-232, optical interface (D0) or current loop interface (C0).

Some SonoCollect devices offer an RS-485 interface or an RS-232 interface. Coupling of other physics requires appropriate converters (e.g. optical read head for RS-485).

In addition to the physics, the meter's protocol is crucial. Here you can find several variants:

- EN 62056-21, also IEC 61107 or IEC 1107 (*ASCII*protocol, called DLDE by us), part of DLMS
- "Real" DLMS according to series of standards EN 62056
- SML
- Modbus RTU

The SonoCollect devices support both SML and EN 62056-21 (Mode A and Mode C). While SML is only processed as a receive stream (data push of the meter), EN 62056-21 allows both the data push to be processed and data to be actively requested from the meter (data request).

8.1 Setup of the interface in the web front end

The setup of a meter with serial interface is only possible manually.

First the serial interface must be activated and parameterized. This is done in the ***Configuration*** tab via the parameter set **DLDE....** (see section 4.4).

8.1.1 Serial mode

The parameter **Serial mode** activates the serial interface and defines the basic range of functions:

- *Disabled*
- *DLDE*
- *Transparent/TCP*
- *Transparent/UDP*

The *Transparent* modes allow the use of the physics of the serial interface via a TCP or UDP port. The data stream is thus forwarded from the serial interface to an IP interface (network (LAN) or mobile radio (WAN)). The device then operates in a similar way to an Ethernet-to-serial converter or even a mobile radio router with a serial interface. The network port to be used is defined in the parameter **DLDE transparent port**.

✔ The transparent mode makes it possible to read meters via serial interface even if their protocol is not directly supported by the device. The protocol can then be processed in the host system while the device provides physical connectivity.

The mode *DLDE* activates the reading of meters by the device itself. This means that the protocol is handled directly in the device and the meter must be created accordingly (see section 8.2).

✔ Regardless of the mode, the parameters for baud rate, bit representation and timeouts must be set to match the serial (see section 8.1.2).

8.1.2 DLDE baud rate, data bits, stop bits and parity

The parameters **DLDE baud rate**, **DLDE data bits**, **DLDE stop bits** and **DLDE parity** are used to configure the bit display on the serial interface.

The baud rate essentially determines the speed of the data transmission. The other parameters describe the byte display:

- The number of data bits is either 7 bits or 8 bits.
- The parity activates an additional bit to enable error detection. While parity *None* (no parity, N) renounced this additional bit, the modes *Even* (even parity, E) or *Odd* (odd parity, O) add a corresponding bit which supplements the data bits in such a way as to obtain an even or odd number of ones (1) in the data stream. The modes *Mark* (character, M) and *Space* (space, S) complement either a 1 or a 0, but are practically not used.
- The number of stop bits is either 1 bit or 2 bits.

Usual settings are exemplary:

- 2400-8-E-1 (e.g. for M-Bus)
- 300-7-E-1 (e.g. for meters according to EN 62056-21)
- 9600-8-N-1 (e.g. for meters with SML push or according to DLMS)

8.1.3 DLDE mode

The protocol implementation of EN 62056-21 takes place in three variants. This is set by the parameter **DLDE mode**.

The mode Push is provided for meters that send their data cyclically, unsolicited. The meters according to EN 62056-21 and SML protocol can be processed.

Meters which have to be requested according to EN 62056-21 can be requested either via the modes *Request* or *Request (C-Mode)*. *Request* is the mode A described in the standard. When the meter is queried, it gives its meter values in response. The mode C described in the standard allows a baud rate change before the response with meter data. For this purpose an additional telegram exchange is mandatory (baud rate negotiation). The exchange is supported in the *Request (C-Mode)* mode, but the set baud rate is requested.

8.1.4 DLDE timeouts

The serial interface uses three different timeouts with **DLDE first timeout**, **DLDE idle timeout** and **DLDE full timeout** (in transparent mode only the **DLDE idle timeout**).

The **DLDE idle timeout** specifies what time the serial interface must be "idle", i.e. no data is sent/received, in order to detect the end of a telegram (end of communication). It is mainly used for package formation of the serial data stream, i.e. the assignment of incoming data to a logical unit (data packet). In the *Push* mode this time is used to detect the start of the telegram, therefore no data may be sent from the meter for this time.

The **DLDE first timeout** specifies what time it takes to wait for a response from the meter. If no data is received within this time from the request, the readout attempt is aborted.

The **DLDE full timeout** indicates the latest time at which reception is interrupted in order to process the received meter data. This parameter also terminates reception if the **DLDE idle timeout** is not reached because data is continuously received (without idle time, e.g. in the event of faults).

8.2 Setup of the meter in the web front end

After activating and parameterizing the serial interface, the meter can be added in the ***Meter*** tab.

The meter is first created via the **Add** button or the context menu. To do this, the **Interface** must be set to *DLDE* in the dialog. The parameters **Serial** and **Manufacturer** are used to assign the meter data to the meter; their input is therefore mandatory. Further data **Medium** or **User label** are optional and can be assigned. The user may refer to Table 25 for the **Medium** field. This ensures a uniform display across all meters. Use the **Ok** button to accept the entries and the meter is created in the meter list in the ***Meter*** tab.

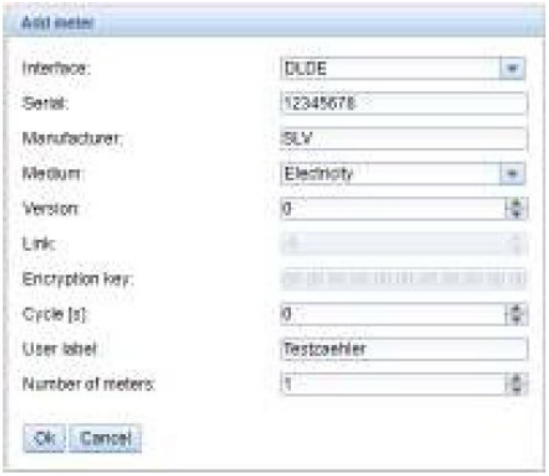


Figure 35 Creating a DLDE meter (sample data)

A meter value must now be added to the newly created meter. This is done by right-clicking on the newly added DLDE meter and selecting the **Add value** command from the context menu. This command opens a dialogue box for entering the parameters of the meter value.

Figure Creating the meter a DLDE meter (sample data)

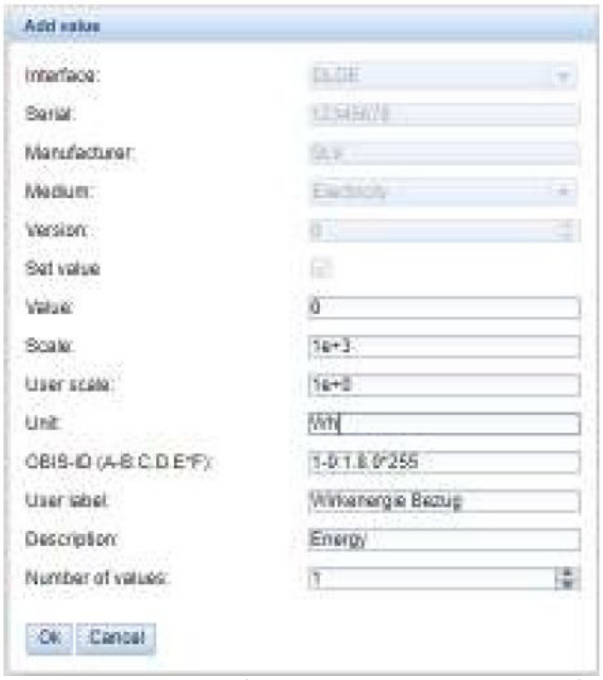


Figure 36 Creating the meter a DLDE meter (sample data)

The assignment of meter values for EN 62056-21 (DLDE) is based on *OBIS* codes. This 6-digit code is standardized worldwide and clearly describes the measured value. Therefore, it is mandatory to assign the correct value in the parameter **OBIS-ID (A-B:C.D.E*F)**. The parameters **Unit** and **Scale** should also be set according to the meter.

- ✔ We recommend the use of base units like *Wh* and a scaling factor **Scale** of *1e+3* compared to the oten used standard unit for energy meters *kWh* with factor *1e+0*.

The user can refer to Table 26 and Table 27 for the fields **Description** and **Unit**. This ensures a uniform display across all meters.

The measured value set up in this way is now read out and recorded cyclically by the meter. The DLDE meters often transmit multiple values for various OBIS codes, so additional meter values can be added to the meter. Here are a few examples of commonly used OBIS codes, especially for energy meters:

- 1-0:1.8.0*255 → Total value of active energy import
- 1-0:1.8.1*255 → Total value of active energy import (tariff 1)
- 1-0:1.8.2*255 → Total value of active energy import (tariff 2)
- 1-0:2.8.0*255 → Total value of active energy export
- 1-0:3.8.0*255 → Total value of apparent energy import
- 1-0:4.8.0*255 → Total value of apparent energy export
- 1-0:1.7.0*255 → Instantaneous value of active power import
- 1-0:31.7.0*255 → Instantaneous current phase 1
- 1-0:51.7.0*255 → Instantaneous current phase 2
- 1-0:71.7.0*255 → Instantaneous current phase 3
- 1-0:32.7.0*255 → Instantaneous voltage phase 1
- 1-0:52.7.0*255 → Instantaneous voltage phase 2
- 1-0:72.7.0*255 → Instantaneous voltage phase 3

8.3 Troubleshooting the serial interface

8.3.1 Meters are not read out

Check whether the parameters of the serial interface are set correctly in the *Configuration* tab.

Check whether the meter supports the protocol according to IEC 62056-21 (**DLDE mode** *Request*) or spontaneously transmits data according to IEC 62056-21 or SML format (**DLDE mode** *Push*).

Check the timeout parameters of the serial interface in the *Configuration* tab.

Activate the raw data log with **Raw data log** in the *Configuration* tab. The communication process can be analyzed using this raw data log.

If errors could not be rectified, please contact your local Danfoss support.

9 Transmission of meter data

A basic distinction is made between actively sending data, the data push, and collecting data, the data pull when transmitting meter data to third-party systems such as meter data management, energy management or monitoring systems.

The SonoCollect device is the client and the third-party system is the server in the client-server model. In the case of the data pull, the SonoCollect device is the server and the third-party system is the client. The client establishes the connection and monitors the data exchange. The server answers the requests and executes the commands of the client.

This chapter describes the data push, which can be configured in the data concentrators in the ***Report*** tab. The data pull is described separately, e.g. in the chapter 11 or in the section 2.6.

9.1 Instances and database

In the SonoCollect devices of 10 independent report instances can be parameterized. The settings such as cycle time, data format, transport mechanism and other parameters can be set for each of these reports in the ***Server*** tab (see section 2.6).

The data sent in the reports is stored in a database. The database is file-based and uses *SQLITE*. The report instances therefore have the same data.

- The database is not active until at least one report instance is active. If not, no data is stored in the database and is therefore not available later.
- Only active values (column *Active* in the ***Meter***) tab are written to the database. Other values are not available later.

9.2 General settings

Each instance has a parameter set. This can be configured via the web interface in the ***Report*** tab. Some parameters are always to be configured, others depend on the set mode.

The following parameters are available and to be configured for each instance:

- **Report mode**: Operating mode or deactivation of the respective instance (see also section 4.6)
- **Report format**: Data format for the transmission of the respective instance (see also section 4.6)
- **Report cycle mode**: Format specifying the transmission cycle of the respective instance (see also section 4.6).
- **Report cycle**: Transmission cycle of the respective instance (see also section 4.6)
- **Report cycle date (local)**: Day of transmission of the respective instance, for weekly to annual format (see also section 4.6)
- **Report cycle time (local)**: Time of transmission of the respective instance, with daily to annual format specification (see also section 4.6)

9.3 Preset data or file formats

The SonoCollect devices have some predefined data formats.

9.3.1 XML format

Several XML formats are available for transmission. XML is a data stream distinguished by so-called tags (entries and attributes) for the display of hierarchically structured data. These data are usually in plain text and therefore readable by both humans and machines.

The XML format is specified as follows:

Entry	Attribute	Description
interface		Contains a complete package with one or more muc entries.
	MESSAGE_TYPE	Specifies the type/version of the package: e. g. 1
muc		Contains the data for one device at a time with corresponding meter entries.
	MUC_ID	Hexadecimal notation of the serial number of the device (corresponds to the serial number/MAC address on the website in the General tab).
	VERSION	Protocol version

Entry	Attribute	Description
	TIMESTAMP	UNIX time (UTC) at time of transmission
meter		Includes one or more data entries for a meter
	INTERFACE	Interface of the meter, as number or as text
		1: S0
		2: M-Bus
		5: wM-Bus
		6: DLDERS
		10: System
	METER_ID	Serial number of the meter
	USER	Application-specific description of the meter (configured in the Meter tab)
	MAN	Manufacturer code of the meter
	VER	Version number of the meter
	MED	Medium of the meter, see second column in Table 25
	MED_ID	Medium ID of the meter, see first column in Table 25
data		Contains one or more measured values of a type in the respective entry entries, which are specified via the attributes.
	OBIS_ID	OBIS code according to OBIS specification is configured via the web page, in version XML-8 the DIF/DIFE/VIF/VIFE fields from the M-Bus/wM meter value are transmitted in this code.
	DESCRIPTION	See second column in Table 26
	MEDIUM	Medium of the meter, see second column in Table 25
	UNIT	See second column in Table 27, energy values in Wh are converted to kWh
	SCALE	Signed scaling factor (scientific notation)
	DIF	DIF/DIFE fields from the M-Bus/wM-Bus raw data, the display is in hexadecimal byte notation.
	VIF	VIF/VIFE fields from the M-Bus/wM-Bus raw data, the representation is in hexadecimal byte notation.
	USER	Application-specific description of the meter value (configured in the Meter tab)
entry		Data entry consisting of a time stamp (T) and a measured value (VAL)
parameter		Contains a parameter value
	NAME= “T”	The associated parameter value represents the UNIX time (UTC) at the time of the measurement, if transmitted by the meter with the measured value.
	NAME= “T_MUC”	The associated parameter value represents the UNIX time (UTC) of the device at the time of receipt of the measurement data
	NAME= “VAL”	The associated parameter value represents the measured value specified in data.

Table 18: Format of the XML data

The following table illustrates the different protocol versions:

Entry	Attribute	XML-3	XML-6	XML-7	XML-8	XML-9
interface		x	x	x	x	x
	MESSAGE_TYPE	x	x	x	x	x
muc		x	x	x	x	x
	MUC_ID	x	x	x	x	x
	VERSION	1F4	1F7	1F8	1F9	9
	TIMESTAMP	x	x	x	x	x
meter		x	x	x	x	x
	INTERFACE	Numeric	Numeric	Numeric	Numeric	Text
	METER_ID	x	x	x	x	x
	USER		x	x	x	x
	MAN			x	x	x
	VER			x	x	x
	MED			x	x	x
	MED_ID					x
data		x	x	x	x	x
	OBIS_ID	x	x	x	Raw data	x
	DESCRIPTION	x	x	x	x	x
	MEDIUM	x	x	x	x	
	UNIT	x	x	x	x	x
	SCALE	x	x	x	x	x
	VIF					x
	DIF					x
	USER		x	x	x	x
entry		x	x	x	x	x
parameter		x	x	x	x	x
	NAME= „T“	x	x	x	x	x
	NAME= „T_MUC“	x	x	x	x	x
	NAME= “VAL“	x	x	x	x	x

Table 19: Data in different XML versions

A sample XML package after version 3 looks like this:

```
<?xml version="1.0" encoding="utf-8"?>
<interface MESSAGE_TYPE="1">
 <muc MUC_ID="13fd0" VERSION="1F4" TIMESTAMP="1252004322">
 <meter METER_ID="92752244" INTERFACE="5">
 <data DESCRIPTION="VOLUME" UNIT="m^3" SCALE="0.001" MEDIUM="WATER"
 OBIS_ID="8-0:1.0.0*255">
 <entry>
  <parameter NAME="T">1253000282</parameter>
  <parameter NAME="T_MUC">1253000282</parameter>
  <parameter NAME="VAL">2850427</parameter>
 </entry>
 <entry>
  <parameter NAME="T">1253000482</parameter>
  <parameter NAME="T_MUC">1253000482</parameter>
  <parameter NAME="VAL">2850428</parameter>
 </entry>
 </data>
 <data ...>
 ...
 </data>
 </meter>
 <meter ...>
 ...
 </meter>
 </muc>
</interface>
```

9.3.2 CSV format

Several CSV formats are available. CSV is a table-like file format which uses a character, at Danfoss a semicolon ";" to separate numerical values and texts (columns) from each other. This makes processing or viewing e.g. with Excel very easy.

The header line in the file specifies the column heading; the following lines contain data on the meter and the meter values at a particular readout time.

The CSV data have the following format:

Column name in header	Description
Information about the meter	
Index	Indexes the different devices within a CSV file
Timestamp	Unix time stamp (UTC) or readable time information of the device at the time of readout
DeviceId	ID of the meter, composed of manufacturer ID, serial number, version number and media type
Link	Primary address of the meter or RSSI for wM-Bus meters
User	Application-specific description of the meter (column User label in Meter tab)
IndexX	Indexes the different meter values of a meter
ValueX	Meter value (transmitted by the meter)
ScaleX	Scaling factor in scientific notation (transmitted by the meter)
UnitX	Unit, see second column in Table 27 (transmitted by the meter)
DescriptionX	Description, see second column in Table 27 (transmitted by the meter)
UserX	Application-specific description of the meter value (column User label in Meter tab)

Column name in header	Description
TimestampX	The timestamp transmitted by the meter (Unix timestamp or readable time), or 0 if not available.
ObisidX	OBIS-ID (column OBIS-ID in Meter tab)

Table 20: CSV format

The first columns of a line entry contain data of the meter, including the meter identification (address) and the time the data was read out. The other columns are inserted dynamically according to the configured meters and number of meter values, whereby the meter values are inserted starting from 0 (e.g.: Value0).

The following table illustrates the different protocol versions:

Column	CSV-0	CSV-1	CSV-3	CSV-4	CSV-5	CSV-6	CSV-9
Index						x	x
Timestamp	Unix	Unix	Unix	Unix	Unix	Unix	Plain text
DeviceId	x	x	x	x	x	x	x
Link				x	x	x	x
User					x	x	x
IndexX						x	x
ValueX	x	x	x	x	x	x	x*
ScaleX	x	x	x	x	x	x	
UnitX	x	x	x	x	x	x	x
DescriptionX	x	x	x	x	x	x	x
UserX		x	x	x	x	x	x
TimestampX		Unix	Unix	Unix	Unix	Unix	Plain text
ObisIdX	x	x	x	x	x	x	x

*scaled value

Table 21: Data in different CSV versions

An example record of the CSV data in version 3 is shown in the following figure:

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Timestamp	DeviceId	Value0	Scale0	Unit0	Description0	User0	Timestamp0	ObisId0	Value1	Scale1	Unit1	Description1 U
2	1370135021	EMU-000238	987	1,00E+00	Wh	Energy		0					
3	1370135025	EMH-003898	18354	1,00E+00	h	On Time		1339357800		24214	1,00E+01	Wh	Energy
4	1370135028	ZRM-314040	90	1,00E-03	m^3	Volume	label5	1369836720		1943	1,00E-02	Grad C	Flow Tempe k
5	1370135030	LUG-6666020	436	1,00E+03	Wh	Energy	label 1	1370141940	1-0:0.0.0*0	650	1,00E-03	m^3/h	Volume Flow k
6	1370135031		245	1,00E-03	m³			0	0-2:2.0.0*0				
7	1370200016	EMU-000238	987	1,00E+00	Wh	Energy		0					
8	1370200020	EMH-003898	18373	1,00E+00	h	On Time		1339422780		24228	1,00E+01	Wh	Energy
9	1370200022	ZRM-314040	90	1,00E-03	m^3	Volume	label5	1369901700		1945	1,00E-02	Grad C	Flow Tempe k
10	1370200025	LUG-6666020	436	1,00E+03	Wh	Energy	label 1	1370206920	1-0:0.0.0*0	650	1,00E-03	m^3/h	Volume Flow k
11	1370200026		245	1,00E-03	m³			0	0-2:2.0.0*0				
12													
13													

Figure 37 Section of a CSV log file

9.3.3 JSON format

A JSON format is available for transmission. JSON is a compact, serialized data stream for representing structured data. These data are usually readable by both humans and machines and separated by separators.

Object	Property	Data type	Description
muc		Object	Contains the data for one device at a time with corresponding meter entries.
	MUC_ID	String	Hexadecimal notation of the serial number of the device (corresponds to the serial number/MAC address on the website in the General tab).
	VERSION	String	Protocol version
	TIMESTAMP	Integer	UNIX time (UTC) at time of transmission
	meter	Array	Array of meter objects
meter		Object	Contains the data for one meter at a time with corresponding data entries.
	METER_ID	String	Serial number of the meter
	INTERFACE	String	Interface of the meter
			S0
			MBus
			wMBus
			DLDERS
			System

Object	Property	Data type	Description
	MAN	String	Manufacturer code of the meter
	VER	String	Version number of the meter
	MED	String	Medium of the meter, see second column in Table 25
	MED_ID	String	Medium ID of the meter, see first column in Table 25
	USER	String	Application-specific description of the meter (configured in the Meter tab)
	data	Array	Array of data objects
data		Object	Contains the data for one meter value each with corresponding entry entries.
	DESCRIPTION	String	See second column in Table 26
	UNIT	String	See second column in Table 27; Energy values in Wh are converted to kWh
	SCALE	String	Signed scaling factor (scientific notation)
	OBIS_ID	String	OBIS code according to OBIS specification is configured via the web page, in version XML-8 the DIF/DIFE/VIF/VIFE fields from the M-Bus/wM-Bus raw data are transmitted to the meter value in this code.
	USER	String	Application-specific description of the meter value (configured in the Meter tab)
	DIF	String	DIF/DIFE fields from the M-Bus/wM-Bus raw data, the display is in hexadecimal byte notation.
	VIF	String	VIF/VIFE fields from the M-Bus/wM-Bus raw data, the representation is in hexadecimal byte notation.
	entry	Array	Array of data objects
entry		Object	Data entry consisting of a time stamp (T) and a measured value (VAL)
	T_MUC	Integer	UNIX time (UTC) of the device at the time of receipt of the measurement data
	T	Integer	UNIX time (UTC) at the time of the measurement, if transmitted by the meter with the measured value
	VAL	String	Measured value specified in data

Table 22: Format of the JSON data

A sample JSON packet looks like this (breaks inserted due to display):

{"muc":{ "MUC_ID":"6891d0800e62","VERSION":"1","TIMESTAMP":1601297784,"meter":[
{"METER_ID":"00000001","INTERFACE":"MBus","MAN":"SIE","VER":21,"MED":"Electricity",
"MED_ID":2,"USER":"metering1","data":[
{"DESCRIPTION":"Energy","UNIT":"kWh","SCALE":0.001,"OBIS_ID":"1-0:1.8.0*255",
"USER":"energy3","DIF":"04","VIF":"03","entry":[
{"T_MUC":1601297679,"VAL":"537980",{"T_MUC":1601297761,"VAL":"537980",
{"T_MUC":1601297765,"VAL":"537980",{"T_MUC":1601297770,"VAL":"537980"]],
{"METER_ID":"00094824","INTERFACE":"MBus","MAN":"BEC","VER":32,"MED":"Electricity",
"MED_ID":2,"data":[
{"DESCRIPTION":"Energy","UNIT":"kWh","SCALE":0.01,"DIF":"0E","VIF":"84 00","entry":[
{"T_MUC":1601297679,"VAL":"2887897",{"T_MUC":1601297761,"VAL":"2887897",
{"T_MUC":1601297765,"VAL":"2887897",{"T_MUC":1601297770,"VAL":"2887897"],
{"DESCRIPTION":"Power","UNIT":"W","SCALE":0.01,"DIF":"04","VIF":"A9 00","entry":[
{"T_MUC":1601297679,"VAL":"382207",{"T_MUC":1601297761,"VAL":"382207",
{"T_MUC":1601297765,"VAL":"382207",{"T_MUC":1601297770,"VAL":"382207"]]]

9.3.4 User format

If the above options do not fit or are not sufficient, the report can be switched to scripting with **Report** format *User*.

This provides the user with an XSLT parser to generate specific data formats. An overview of this can be found in section 10.7 and specifically in section 10.7.1.

Only one user format is available for the standard operating modes (e.g. TCP or FTP). For different, user-specific formats, the script-based report (see section 9.10) must be used.

9.4 Data transmission via TCP

A common communication method for transmitting data is to use the data content of TCP packets. The data is thus sent as a data stream to the remote station, where it is collected and processed.

The data is transmitted unencrypted using TCP. If encryption is necessary, the data should be sent via TLS (see section 9.5).

Since the data processing systems are usually databases or similar, an automated processable data format such as XML or JSON is preferred here. But any data format can be transferred.

According to the destination the parameters **Report address**, **Report port** and **Report directory** have to be set. An empty path specification in **Report directory** generates a TCP data stream, a set path specification generates an HTTP data stream (e.g. "/", "/upload").

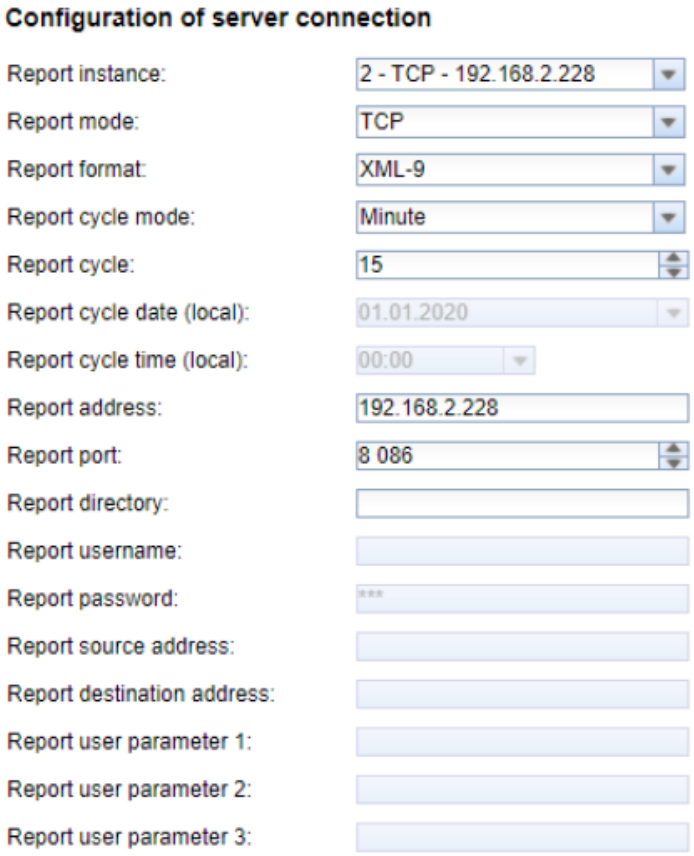


Figure 38 Example configuration for 15-minute transmission of XML data via TCP

9.5 Data transmission via TLS

As a rule, an unencrypted TCP connection for the transmission of data (see section 9.4) is not recommended in productive use. Encryption is common here.

The data stream is asymmetrically encrypted via TCP by using TLS. Each participant has both a private key known only to him and a public key known to everyone. Data that is exchanged is encrypted with the public key of the other participant. The decryption is then performed using the secret private key on the recipient side.

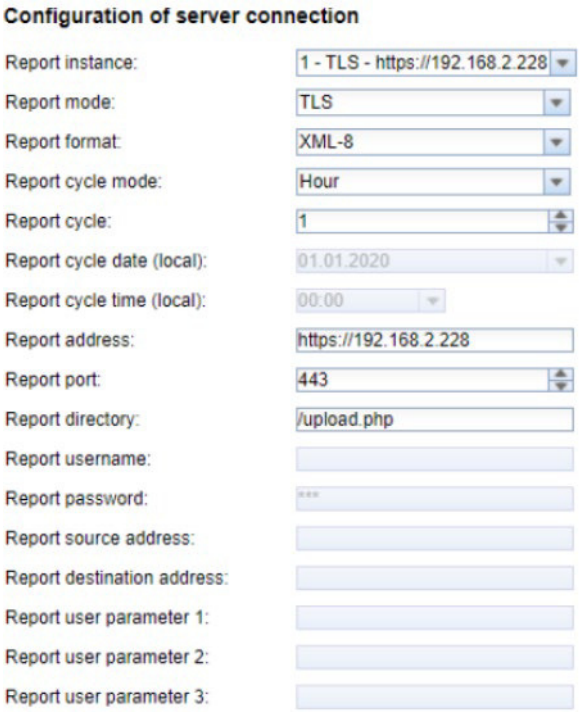


Figure 39Example configuration for hourly transmission of XML data via TCP

TLS also offers mutual authenticity checks of client and server by means of signed certificates, which provides a very high level of security. A distinction is made between server-side authentication and client-side authentication, depending on which side is authenticating. Both variants are supported, also in combination, by the products of Danfoss.

- ✔ The SonoCollect devices use certificates in the *PEM*format (RFC 7468).

In the case of server-side authentication, the server, and in the case of data collectors and gateways therefore the remote terminal, must authenticate itself. In order to check its certificate, a certificate from a certification authority (its public key) must be installed on the SonoCollect device against which the server certificate can be checked.

- ✔ Unless otherwise specified and available, the file *app/cacert.pem* is used to check the authenticity of the server on the SonoCollect devices (RFC 4945).

The client, and therefore the device in the case of data collectors and gateways, must authenticate itself with client-side authentication. It requires an issued certificate and a secret private key in this case.

- ✔ Unless otherwise specified and available, the file *app/clicert.pem* is used as the certificate of the device for the SonoCollect devices (RFC 5280).
- ✔ Unless otherwise specified and available, the file *app/clikey.pem* is used as the private key of the device for the SonoCollect devices (RFC 5958).

The certificates can be uploaded manually via SFTP (see also section 3.4). However, it is also possible to import via the ***Service*** tab (see section 4.10). The file(s) must be packed as a **.tar.gz* file in this case.

- ➔ To create a **.tar.gz*archive, the free, open source software *7zip* can be used. The file *meter_conf_import.csv* can be packed herewith without subdirectory first into a **.tar* ball and afterwards into a **.gz* archive.
- ⚠ If the files are to be named differently or different certificates are possibly required per configured server instance, the use of other file names and paths must be entered manually in the file *app/chip.ini* (see also section 10.3).

The following parameters are entered for the assignment to the respective report in the file *app/chip.ini* in the area [*REPORT_x*]:

CA_FILE: the public key of the certification authority matching the server certificate, e.g.: CA_FILE=app/srv_instance1.pem

CERT_FILE: the certificate of the device for the respective report, e.g.: CERT_FILE=app/dcu.pem

KEY_FILE: the private key matching the certificate of the device, e.g.: KEY_FILE=app/key.pem

9.6 Sending files via FTP

Another common communication method for transferring data is the use of the FTP protocol, especially when it comes to file-based transfer.

The data is transmitted unencrypted using FTP. If encryption is required, data should be sent via SFTP or FTPS (see section 9.6.1).

Since files are transferred, the CSV format is preferred here. It enables easy import into Excel or databases among other things. However, other data formats can also be transferred.

According to the destination, the parameters **Report address**, **Report port**, **Report directory**, **Report username** and **Report password** must be set.

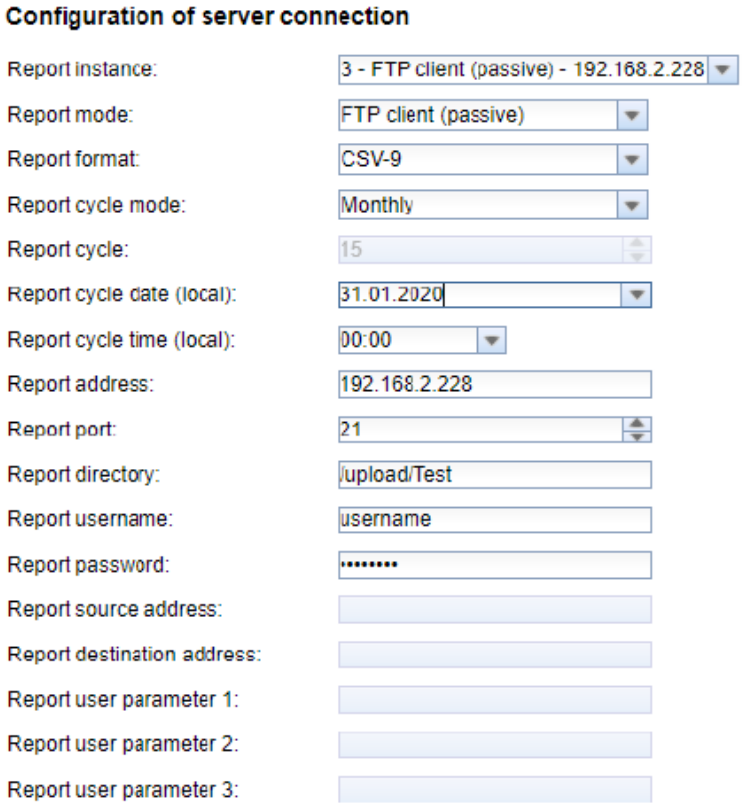


Figure 40Example configuration for automatic transfer of CSV data via FTP

The **Report mode** is either *FTP (active)* or *FTP (passive)*. Both differ in the procedure by the definition of the port to be used for the data connection. FTP uses one TCP port for the control connection, e.g. for transmitting control commands, and a second TCP port for the data connection. The client specifies the second port; in the *passive*mode, the server specifies the second port in the *active* mode. Therefore, *FTP (passive)* is usually used, because firewalls on the server side often only allow outgoing communication on an "arbitrary" port.

- ✔ If no **Report port** is specified, the default port *21* is used.

9.6.1 Sending files via SFTP or FTPS

As a rule, an unencrypted FTP connection for transferring files (see section 9.6) is not recommended for productive use. Encryption is common here.

By using TLS, secure transmission is also possible for FTP (see also section 9.5). A distinction is made here between SFTP, an FTP imitated via SSH, and FTPS, FTP via a channel secured by TLS. Since SSH also uses

SSL, both are very similar from a security standpoint. SFTP has the advantage that SSH and therefore only one port is used (usually port *22*) while FTPS uses the two ports as with FTP, only the data content is encrypted.

- ✔ Encrypted/secured FTP is usually SFTP not FTPS.

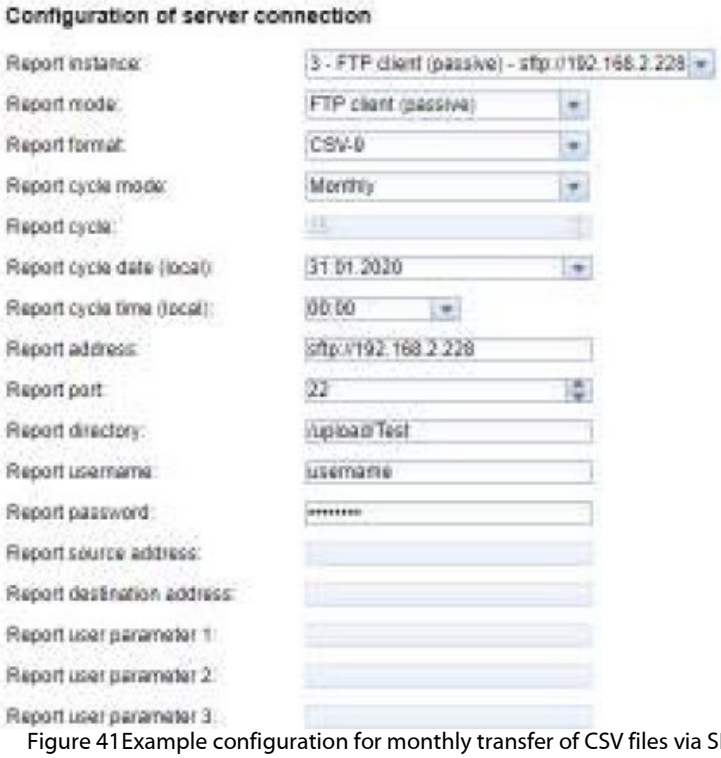


Figure 41Example configuration for monthly transfer of CSV files via SFTP

Since both variants involve a connection secured by TLS, appropriate certificates must be stored and configured. Background information and the procedure are described in section 9.5.

9.7 Sending e-mails via SMTP

Data can also be sent by e-mail. SMTP is used for this purpose.

It is necessary to send this data in the text of the e-mail or as an attachment depending on the requirement.

SMTP itself is not encrypted. The STARTTLS extension provides a certain level of security based on TLS, but the connection is also established unencrypted. For complete encryption of the communication, the use of SMTPS is recommended.

Todo.

9.7.1 Report as content of the e-mail

Todo.

9.7.2 Report as attachment to an e-mail

Todo.

9.7.3 SMTP with STARTLS

Todo.

9.8 Data transmission via MQTT

MQTT is a widely used standard in cloud communications, specifically for sending data to a cloud system. It is an open network protocol which can be used in the area of M2M communication despite potentially high delays and networks which are not continuously available. TCP ports 1883 and 8883 reserved for MQTT, the latter for encrypted communication using the TLS protocol.

MQTT distinguishes between:

- Publischer: Device or service that sends the data, e.g. a sensor or a data concentrator.
- Subscriber: Device or service that processes the data, e.g. a visualization or a billing software.
- Broker: Central data hub for MQTT, this also manages the network and ensures robustness

MQTT uses so-called topics to classify messages hierarchically. This is comparable to a path specification. The publisher sends data of these Topics to the Broker. This then distributes the data to the subscribers.

Certificates must be provided on the device for the encrypted connection via port 8883. Ask your administrator in this case.

9.8.1 Example Azure Cloud

Set the parameters as follows to connect to an Azure cloud:

- **Report address**: Internet address of the Azure cloud server
- **Report directory**: Device ID and Topic for the Azure Cloud
- **Report user name**: User name for the Azure cloud, usually consisting of internet address, device name and API version.
- **Report password**: Password for the Azure cloud, usually a composition of access key, signature and expiration date.

The following example should clarify the parameters:

Report address: ExampleHub.azure-devices.net

Report directory: devices/MUC063C/messages/events

Report user name: ExampleHub.azure-devices.net/MUC063C/?api-version=2018-06-30

Report password: SharedAccessSignature sr=ExampleHub.azure-devices.net%2fdevices%2f MUC063C&sig=rQXaVuN%2bjWqh0vVr9E6ybo7VbMBQ4QQNOidzMtoqI2g%3d&se=1639260907

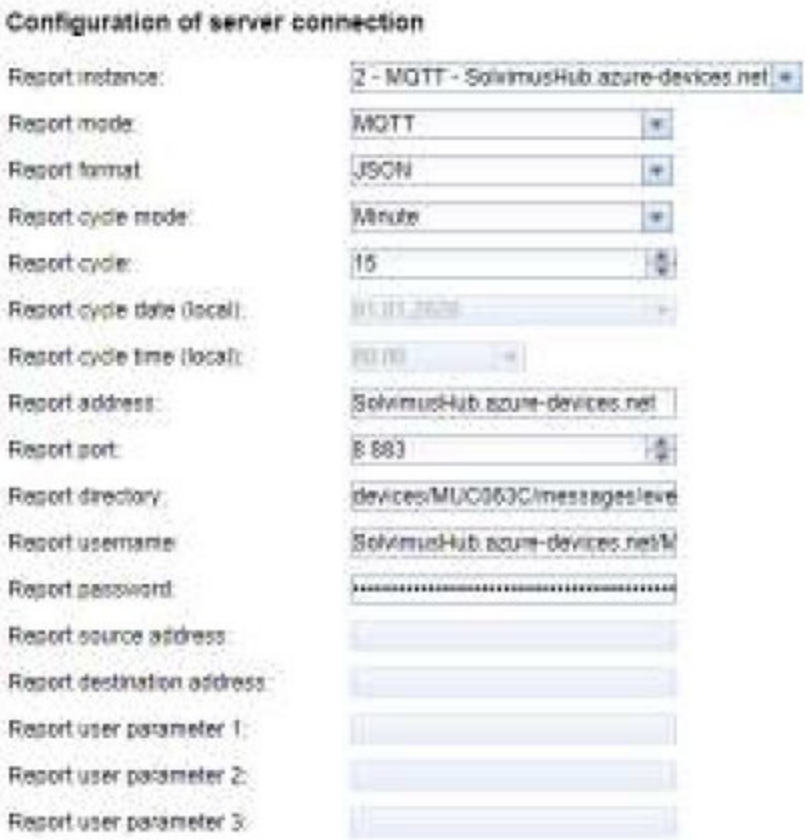


Figure 42Example configuration for Azure Cloud

9.8.2 Example AWS Cloud

Set the parameters as follows to connect to an AWS cloud:

- **Report address**: Internet address of the AWS cloud server
- **Report directory**: User name and Topic for the AWS Cloud
- **Report user name**: User name for the AWS Cloud
- **Report password**: Password for the AWS Cloud

The following example should clarify the parameters:

- **Report address**: b-fbf31b71-1234-5678-a052-3b5a4fafabcd-1.mq.eu-central-1.amazonaws.com
- **Report directory**: demo201909/testing
- **Report user name**: demo201909
- **Report password**: YXcajMTbZ7WUBzrsst

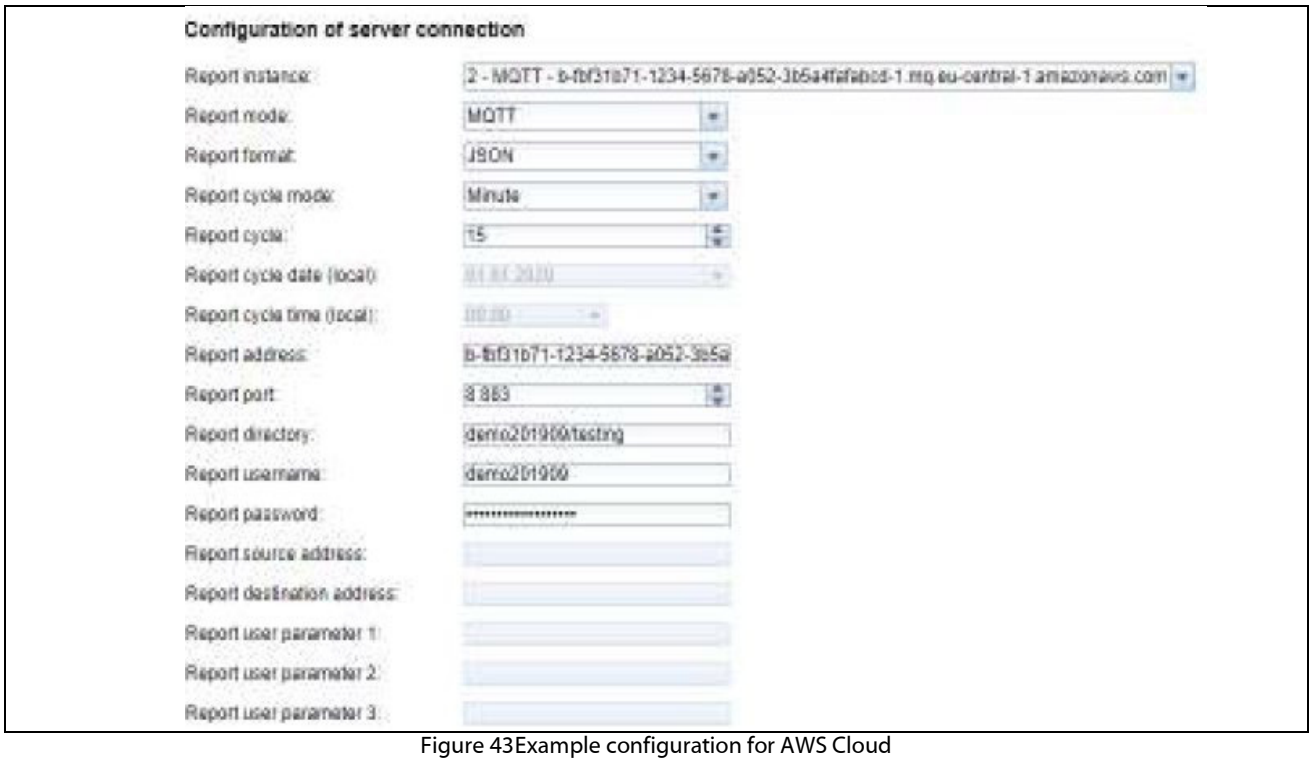


Figure 43Example configuration for AWS Cloud

9.9 Local file storage

The meter data can also be stored directly on the device as a file. This can be used if the data is to be called via FTP, for example. This is called a data pull.

As with all other reports, the predefined formats and the user-specific format are available for selection.

The files are stored according to the set parameters in the folder *ext/Log/YYYY/MM*, where YYYY is the associated year and MM is the associated month for the report (according to the system time of the device).

The following settings, for example, cause a CSV file containing all readings from the previous report period to be created and stored on the system every day at 01:00 local time:

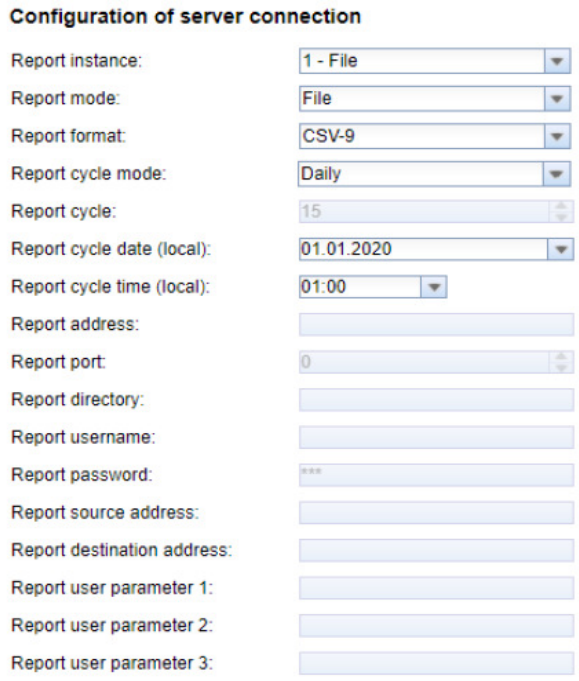


Figure 44Example of a report via local file storage

9.10 Script-based report

If the above options do not fit or are not sufficient, the report can be switched to scripting using **Report port** *User*.

This way, the user has free access to the powerful Linux tools supplied with the device. Each instance is assigned its own script. An overview of this can be found in section 10.7 and specifically with examples in section 10.7.2.

Since the script-based report offers a lot of freedom, additional parameters **Report user parameter 1**, **Report user parameter 2** and **Report user parameter 3** are available to the instance, in which any texts can be entered. This information is then available to the script. The parameters of the report instance can be used in the script, but do not have to be.

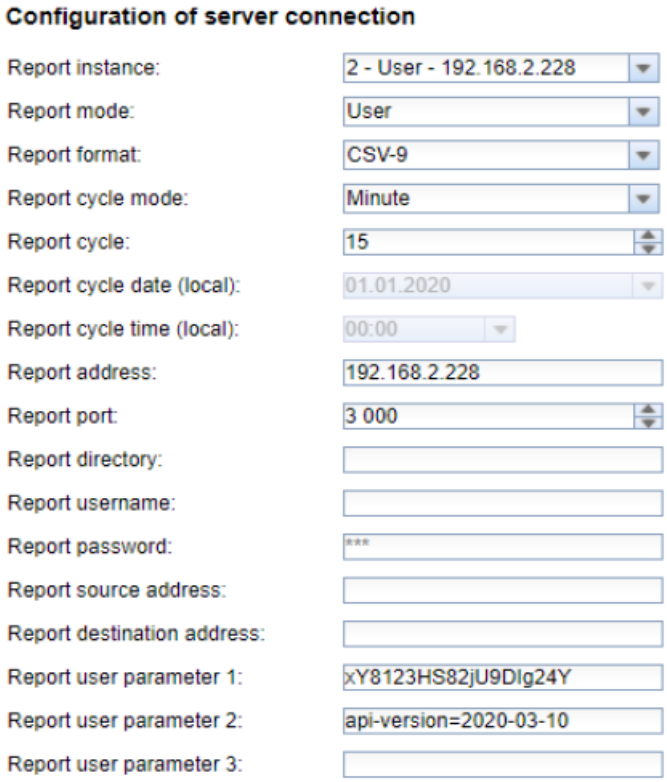


Figure 45Example configuration for 15-minute transfer of CSV data via a user script

9.11 Specific troubleshooting

Troubleshooting the transmission of meter data is very complex. Typically it is due to connectivity or authentication/encryption. Indications of the cause of the error can be found in the *Log* tab.

Check whether the remote terminal can be reached. Use the *ping* command from the SSH console of the device for this purpose (see also section 10.1.2). This will also check the name resolution (DNS). A hostname should be converted to an IP address when pinging.

Check whether a firewall blocks the data exchange or the routing is configured accordingly. Ask your administrator in this case.

In the case of TLS encryption, check whether all necessary certificates are available, especially the CA certificate for the remote terminal.

Check the correct entry of **Report username** and **Report password** as well as **Report address**, **Report port** and **Report directory** of the respective instance.

If errors could not be rectified, please contact your local Danfoss support.

10 Advanced configuration options

10.1 Linux operating system

The SonoCollect devices are based on the Linux operating system. This ensures that the devices continuously follow the state of the art and that errors in the software are quickly found and corrected due to a large community. It also ensures a certain basic functionality and security for the user.

The Linux operating system is built through the Yocto/openembedded build environment, with all components included according to the latest version and security patches. The Linux itself is unchanged except for a few specific tools and customizations (e.g. solcmd). Corresponding Linux documentation can thus be used directly. For custom projects, additional components provided on the Yocto/openembedded platform can be made available on the target system.

10.1.1 User rights

Linux supports and has in principle user roles. There is operating system internally the user *root* with full access to all operating system functions. In addition, further users with restricted access can be created. Their permissions can be set by groups and names, mostly file access permissions (read, write or execute).

In case of the SonoCollect devices, in addition to the user *root*, the user *admin* has also been created. It has read and write access to the partitions */app* and */ext* and can execute files there. For the user, *admin* is the user who can completely configure the device.

- The user *web* is created as the default user for the web interface, but has no access rights to the file system.
- For reasons of downward compatibility, the user *ftp* is created as the default user for FTP access to the directory */ext*.
- The user *root* has no external access to the device. It protects the safety of the user. Only the user *admin* can grant the user *root* the release.
- The password of the user *root* is generated randomly and device-specific during production and stored access-protected in a database.

10.1.2 Command line

The Linux operating system on the SonoCollect devices has a command line based on *BASH*. It allows the user and also other applications to execute commands via the command line.

The user can access the command line via an SSH console. The Netdiscover tool (see chapter 3) opens an SSH console with a Putty client.

10.1.3 Standard commands

The Linux operating system and the command line *BASH* provide certain built-in standard commands. Examples include:

- *help*: Display list of all integrated commands
- *cd*: Navigation in the directory tree
- *ls*: List directory contents
- *cat*: View file contents
- *cp*: Copying files/directories
- *mv*: Move/rename files/directories
- *rm*: Delete files/directories
- *sync*: Write the data from the RAM buffer to the data carrier
- *chmod*: Adjust access rights
- *grep*: Search for text content
- *echo*: Output text
- *date*: Display system time
- *ps*: Show list of all running processes

- *tail*: Output last lines of a file
- *netstat*: Query the status of the network interfaces
- *ping*: Network connectivity test
- *nslookup*: Display of the DNS configuration
- */sbin/ifconfig*: Overview of the network interfaces

Further commands are provided by programs:

- *tcpdump*: Recording network traffic
- *openssl*: Use of encryption, certificates and PKI
- *curl*: Calling a server connection
- *esmtp*: Sending e-mails
- *socat*: Connecting two interfaces
- *vi*: Editing files
- *xsltproc*: Execution of XSL transformations

Solcmd command interpreter

For special application functions of Danfoss there is a command interpreter *solcmd*due to the system access rights. The interpreter can be called with various parameters and thus provides access to the application and its control.

The following parameters are supported:

- *format-partition-app*: Formatting the configuration partition */app*
- *format-partition-ext:* Format the logging partition */ext*
- *config-partitions*: Resetting the access rights to the partitions
- *config-users*: Transfer of the changed user settings
- *config-hostname*: Acceptance of the changed device name
- *config-timezone*: Adopting the time zone setting
- *restart-eth0:* Restart of the Ethernet interface
- *restart-wifi*: Restarting the WLAN interface (only if WLAN is available)
- *filter-vlan*: VLAN filter for network interface (only if switch integrated)
- *start-ppp0*: Establishing the PPP dial-up connection (mobile network)
- *stop-ppp0*: Disconnection of the PPP dial-up connection (mobile network)
- *start-vpn*: Establishing a VPN connection (OpenVPN)
- *stop-vpn*: Terminating a VPN connection (OpenVPN)
- *manual-vpn*: Establishment of a VPN connection (OpenVPN) in the foreground with manual password entry
- *restart-server*: Restarting the server services
- *regenerate-server-keys*: Re-creating the keys for secured server services
- *start-solapp*: Starting the main application
- *stop-solapp*: Exit the main application
- *start-transparent-tty*: Activate transparent data forwarding of a serial interface to Ethernet port
- *stop-transparent-tty*: Stop transparent data forwarding of a serial interface to Ethernet port
- *start-virtual-tty*: Activating a virtual interface via an Ethernet port
- *stop-virtual-tty*: Terminating a virtual interface via an Ethernet port
- *update-rtc*: Writing the system time to the buffered real-time clock
- *factory-reset*: Resetting the device to factory settings
- *update-system*: Performing a System Update
- *reboot-system*: Restarting the system
- *help*: Command overview with explanation and examples

10.2 Update

The firmware can be updated manually or conveniently via the web interface (see section 4.10).

Access via SSH is necessary for a manual update, and the easiest way to download the update file is via SFTP. The tools for this are provided by the Netdiscover tool (see chapter 3).

First, the appropriate and signed update file **.enc* must be loaded via SFTP into the directory *ext/Upd* (see section 3.4). It requires the *admin* access.

After uploading the file, the user must log in as *admin via SSH* (see section 3.5). In the command line (see section 10.1.2), the command *solcmd update-system* must then be executed. After completion, a reboot is necessary, which is triggered with the command *solcmd reboot-system*.

10.3 Configuration file chip.ini

The file */app/chip.ini* contains the general system parameters and is therefore the central configuration file. The parameters are grouped into different sections. If the parameters are not configured in *chip.ini*, the default values are used.

- In order for manual changes to the file *chip.ini* to be adopted by the device, it must be restarted via the web front end using the button **Reboot system** in the ***Service*** tab or the command line.
- Manually changed data will only be permanently stored on the flash after a few minutes. As a result, such changes may not be applied after a power supply reset.
- The file *chip.ini* can be transferred to another device via FTPS, taking into account the network configuration (e.g. different IP address).

Parameter	Description	Value range	Standard
Group [IP]			
ADDRESS	IP address of the device	0.0.0.0-255.255.255.255	192.168.1.101 (explicit)
NETMASK	Subnet mask of the device	0.0.0.0-255.255.255.255	255.255.255.0 (explicit)
GATEWAY	IP address of the gateway	0.0.0.0-255.255.255.255	192.168.1.254 (explicit)
DHCP	Activation of the DHCP client	0.1	0 (explicit)
DHCP_HOSTNAME	Host name for logging on to the DHCP server	Text, max. 255 characters, \%SERIAL\%: MAC address of the device	Device name from group [DEVICE]
Group [DEVICE]			
NAME	Name of the device in the Tool Netdiscover	Text, max. 50 characters	***Product name*** (explicit)
TIMEZONE	Time zone of the device	Text, max. 255 characters	Universal, corresponds to GMT
Group [DNS]			
NAME_SERVER1	IP address of the primary DNS server, IP or host name	Text, max. 255 characters	Not set
NAME_SERVER2	IP address of the secondary DNS server, IP or host name	Text, max. 255 characters	Not set
Group [VPN]			
ENABLE	Activation of the OpenVPN client	0.1	0
Group [WEB]			
HTTP_ENABLE	Activation of the HTTP server	0.1	1
HTTPS_ENABLE	Activation of the HTTPS server	0.1	1
Group [FTP]			
ENABLE	Activation of the FTP server	0.1	1
Group [SSH]			
ENABLE	Activation of the SSH server	0.1	1
Group [UDPCFG]			
ENABLE	Activation of the UDP-based search and configuration protocol	0.1	1
IPCFG_PASSWORD	Password for changing the IP address via the UDP configuration protocol	Text, max. 255 characters	Not set
Group [Danfoss]			
BACNET_BBMD	IP of the BACnet BBMD (BACnet Broadcast Management Device)	Text, max. 255 characters	Not set
BACNET_BROADCAST	BACnet broadcast IP address (system configuration is used if not set)	Text, max. 255 characters	Not set

Parameter	Description	Value range	Standard
BACNET_CONFIGURE\NETWORK	Activation of a BACnet-specific network configuration (additional IP address)	0, 1	0
BACNET_DEVICEID	BACnet device ID	1-4294967295	1
BACNET_DEVICENAME	BACnet device name	Text, max. 255 characters	Not set
BACNET_ENABLE	Activation of BACnet communication	0, 1	0
BACNET_IP	BACnet IP (system configuration is used if not set)	Text, max. 255 characters	Not set
BACNET_LOCATION	BACnet site information	Text, max. 255 characters	metering
BACNET_NETMASK	BACnet network mask (system configuration is used if not set)	Text, max. 255 characters	Not set
BACNET_PORT	BACnet network port	0-65535	47808
DLDERS_ADDRESS\DISABLE	DLDE request with meter serial number (=0) or by means of wildcard request (=1), in this case only 1 meter may be connected.	0, 1	0
DLDERS_BAUDRATE	Baud rate for serial DLDE communication	300, 600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800	9600
DLDERS_DATABITS	Data bits for serial DLDE communication	7, 8	7
DLDERS_DEVPATH	Linux path for the serial DLDE interface	Text, max. 255 characters	Not set
DLDERS_ENABLE	Activation of the serial DLDE interface	0, 1	0
DLDERS_FIRST\TIMEOUT	Waiting time until first data is received from the meter. Push mode: Time without data reception (Wait idle, in ms)	0-65535	3000
DLDERS_FLOWCONTROL	Flow control for serial DLDE communication: 0: none, 1: XON/XOFF during transmission, 2: RTS/CTS, 8: XON/XOFF when receiving, 9: XON/XOFF during transmission and reception	0, 1, 2, 8, 9	0
DLDERS_FULL\TIMEOUT	Maximum waiting time for reading out the meter (in ms)	0-65535	30000
DLDERS_IDLE\TIMEOUT	Time out to detect the end of communication (in ms)	0-65535	100
DLDERS_MODE	Communication mode for the serial DLDE interface	REQUEST, REQUEST_ECHO, PUSH	REQUEST_ECHO
DLDERS_PARITY	DLDE parity 0: none 1: odd, 2: even, 3: mark, 4: space	0-4	2
DLDERS_RAWLOG\ENABLE	Activation of raw data logging to the directory *ext/*	0, 1	0
DLDERS_RS485\ENABLE	Activation of the RS-485 interface for DLDE communication	0, 1	1
DLDERS_SMLENABLE	Activation of the processing of SML log data	0, 1	0
DLDERS_STOPBITS	Stop bits for the serial DLDE interface	1, 2	1
DLDERS_TRANSPARENT	Activation of the transparent forwarding of the serial DLDE interface to a network port: NONE: Forwarding disabled, TCP: Forwarding to a TCP port, UDP: Forwarding to a UDP port	NONE, TCP, UDP	NONE
DLDERS_TRANSPARENT\PORT	Network port for transparent forwarding via TCP or UDP	0-65535	0
FASTRESCAN_TIME	Cycle time for updating the temporary meter list for received wM-Bus meters (in s)	1-4294967295	60
I2C_DEBUGOUT	Activation of raw data output for internal I2C communication in the system log	0, 1	0
MBUS_ALLOW\INSECURE	Disables the authenticity check during decryption	0, 1	0
MBUS_BAUDRATE	Baud rate for M-Bus communication	300, 600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800	2400
MBUS_DATABITS	Data bits for M-Bus communication	7, 8	8
MBUS_DEVPATH	Linux path for the M-Bus interface	Text, max. 255 characters	Not set
MBUS_DISABLE\DECRYPTION	Deactivating the decryption of M-Bus packets (status field)	0, 1	0
MBUS_ENABLE	Activation of the M-Bus interface	0, 1	1
MBUS_FIRST\FCBBIT_NEG	If the M-Bus meter reading starts with a specific FCB bit value (0: first FCB bit set, 1: first FCB bit not set)	0, 1	0

Parameter	Description	Value range	Standard
MBUS_FLOWCONTROL	Flow control for M-Bus communication: 0: none, 1: XON/XOFF during transmission, 2: RTS/CTS, 8: XON/XOFF when receiving, 9: XON/XOFF during transmission and reception	0, 1, 2, 8, 9	0
MBUS_FORCE	Compatibility mode for reading faulty M-Bus meters, emulates correct ACK	0-2	0
MBUS_FREEZE\STORAGENUM	Memory number for freeze meter data	0-4294967295	0
MBUS_FULL\TIMEOUT	Maximum waiting time for reading out the meter (in ms)	0-65535	10000
MBUS_IDLE\TIMEOUT	Time out to detect the end of communication (in ms)	0-65535	100
MBUS_IGNORE\CRCFIELD	Compatibility mode for reading faulty M-Bus meters, ignores CRC field	0, 1	0
MBUS_IGNORE\LENGTH\FIELD	Compatibility mode for reading faulty M-Bus meters, ignores length field	0, 1	0
MBUS_LOAD\PROFILE\MANUFACTURER	Manufacturer code for identification of the load profile meter, according to M-Bus standard: "`EMH"=(0xA8 0x15) → 0x15A8=5544	0-65535	5544
MBUS_LOAD\PROFILE\MAXCOUNT	Number of load profile entries that are initially called from the meter.	1-65535	65535
MBUS_LOAD\PROFILE\MODE	Activation of load profile reading for electricity meters via M-Bus	DISABLED, DIZH, DIZG	DISABLED
MBUS_LOADPROFILE START	Start index for the load profile call	0-65535	1
MBUS_MAX\MULTIPAGE	Limits the number of multipage requests	0-255	3
MBUS_MAX\PRIMARY\ADDRESS	Upper address for M-Bus primary search	0-250	250
MBUS_MAX\RETRY	Retries for a M-Bus or multipage request	0-255	3
MBUS_MIN\PRIMARY\ADDRESS	Lower address for M-Bus primary search	0-250	0
MBUS_NOADDRESS\VERIFY	Deactivates the address check for primary addressing	0, 1	0
MBUS_PARITY	Parity for the M-Bus communication: 0: none, 1: odd, 2: even, 3: mark, 4: space	0-4	2
MBUS_RAWLOG\ENABLE	Activation of raw data logging to the directory ***ext/***	0, 1	0
MBUS_REQUEST\MODE	Inquiry mode	ALL, EXT, ONLY, FREEZE	ONLY
MBUS_RESET\MODE	Reset Modes: 0: NKE after Select, 1: NKE before Select 2: No NKE 3: NKE at 0xFD and NKE at 0xFF before communication 4: NKE at 0xFD, Application Reset at 0xFF and NKE at 0xFF before communication	0-4	0
MBUS_RS485\ENABLE	Activation of the RS-485 interface for M-Bus communication	0, 1	0
MBUS_SCAN\MODE	Search algorithm for the M-bus	PRIMARYSCAN, SECONDARYSCAN, SECONDARYSCANALLOC, SECONDARYSCAN REVERSE, SECONDARYSCANALLOC REVERSE	SECONDARYSCAN
MBUS_SEC\MASK\MANUFACTURER	Predefined manufacturer ID for secondary search	Exactly 4 characters each 0-9 or 0xFFFF	0xFFFF
MBUS_SEC\MASK\MEDIUM	Predefined medium ID for secondary search	Exactly 2 characters each 0-9 or 0xFF	0xFF
MBUS_SEC\MASK\SERIAL	Secondary search mask for the meter serial number	Exactly 8 characters each 0-9 or 0xF	0xFFFFFFFF
MBUS_SEC\MASK\VERSION	Predefined version number for secondary search	Exactly 2 characters each 0-9 or 0xFF	0xFF
MBUS_SELECT\MASK	Hiding of selection areas, placeholders are used for these areas (setting via bit mask): 1: Serial number 2: Manufacturer	0-15,	14

Parameter	Description	Value range	Standard
	4: Version field 8: Medium		
MBUS_SML\ENEABLE	Activation of the processing of SML log data	0, 1	0
MBUS_SPXMETER\CONVERT	Activation of manufacturer-specific decoding (manufacturer code SPX)	0, 1	0
MBUS_STOPBITS	Stop bits for M-Bus communication	1, 2	1
MBUS_TIMEOUT	Waiting time until first data are received from the meter (in ms)	0-65535	2000
MBUS_TRANSPARENT	Activation of transparent forwarding of the M-Bus interface to a network port or an M-Bus slave interface: NONE: Forwarding disabled, TCP: Forwarding to a TCP port, UDP: Forwarding to a UDP port	NONE, MBUS, TCP, UDP	NONE
MBUS_TRANSPARENT\PORT	Network port for transparent forwarding via TCP or UDP	0-65535	0
MBUS_WAKEUP\ENABLE	Activation of the specific wakeup request	0, 1	0
MBUSSLV_BAUDRATE	Baud rate for M-Bus slave communication	300, 600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800	2400
MBUSSLV_DATABITS	Data bits for M-Bus slave communication	7, 8	8
MBUSSLV_DEBUGOUT	Activation of raw data output for M-Bus slave communication in the system log	0, 1	0
MBUSSLV_DEVPATH	Linux path for the M-Bus slave interface	Text, max. 255 characters	Not set
MBUSSLV_FLOWCONTROL	Flow control for M-Bus slave communication: 0: none, 1: XON/XOFF during transmission, 2: RTS/CTS, 8: XON/XOFF when receiving, 9: XON/XOFF during transmission and reception	0, 1, 2, 8, 9	0
MBUSSLV_FULLTIMEOUT	Maximum waiting time for the request for a meter (in ms)	0-65535	10000
MBUSSLV_IDLETIMEOUT	Time out to detect the end of communication (in ms)	0-65535	100
MBUSSLV_PARITY	Parity for M-Bus slave communication: 0: none, 1: odd, 2: even, 3: mark, 4: space	0-4	2
MBUSSLV_RS485\ENABLE	Activation of the RS-485 interface for M-Bus slave communication	0, 1	0
MBUSSLV_STOPBITS	Stop bits for M-Bus slave communication	1, 2	1
MBUSSLVMETER_ECHO	Echo suppression	0, 1	Depending on product
MBUSSLVMETER_MODE	Activation of the M-Bus slave interface: DEFAULT: Activated depending on the product, NONE: Disabled, TCP: Activation via a TCP port, UDP: Activation via a UDP port, MBUS: Activation via the physical M-Bus slave interface	DEFAULT, NONE, TCP, UDP, MBUS	DEFAULT
MBUSSLVMETER_PORT	Network port for access to the M-Bus slave interface via TCP or UDP	0-65535	5040
MBUSSLVMETER_WMBUSALLOW\ENCRYPTED	Activates the forwarding of encrypted wM-Bus meters via the M-Bus slave interface	0, 1	0
MBUSSLVMETER_WMBUSALLOW\EXTENDEDHEADER	Activates the forwarding of specific wM-Bus header data (e.g. AFL/ELL) via the M-Bus slave interface.	0, 1	0
MBUSSLVMETER_WMBUSALLOW\OTHER	Activates forwarding despite unknown wM-Bus header data via M-Bus slave interface	0, 1	0
MBUSSLV2METER_MODE	Activation of the second M-Bus slave interface: NONE: Disabled, TCP: Activation via a TCP port, UDP: Activation via a UDP port	NONE, TCP, UDP	NONE
MBUSSLV2METER_PORT	Network port for access to the second M-Bus slave interface via TCP or UDP	0-65535	5050
MBUSSLV2METER_WMBUSALLOW\ENCRYPTED	Activates the forwarding of encrypted wM-Bus meters via the second M-Bus slave interface	0, 1	0

Parameter	Description	Value range	Standard
MBUSSLV2METER_WMBUSALLOW\EXTENDEDHEADER	Activates the forwarding of specific wM-Bus header data (e.g. AFL/ELL) via the second M-Bus slave interface.	0, 1	0
MBUSSLV2METER_WMBUSALLOW OTHER	Activates forwarding via the second M-Bus slave interface despite unknown wM-Bus header data.	0, 1	0
METER_ADJUST TIMESTAMPS			0
METER_CYCLEMODE			SECOND
METER_CYCLE TIMESTAMP			Not set
METER_DELAY	Delay for reading out the meter data according to the configured readout cycle (in s)	0-4294967295	0
METER_PRESENT VALUESONLY			0
METER_MAXALLVALUE COUNT	Limitation of the total meter values (0: no limit)	0-65535	0
METER_MAXDEVICE COUNT	Limitation of the number of meters (0: no limit)	0-65535	500
METER_MAXVALUECOUNT	Limitation of the meter values (0: no limit)	0-65535	25
METER_RETRYDIVIDER	Sets the divider for the retry timeout (according to the readout interval).	0-65535	0
METER_STAT_CONFIG	Path to the meter configuration file	Text, max. 255 characters	app/device_handle.cfg
METER_TIME	Cycle time for meter reading (in s), Caution: with small cycle times and larger meter populations, considerable log data may be generated.	1-4294967295	900
METERSYSTEM_ENABLE	Activation of the system meter functionality	0, 1	1
METERSYSTEM_SCRIPT\TIMEOUT	Waiting time after which the system meter scripts are terminated (in seconds)	0-65535	0
MODBUS_ADDRESS	Primary Modbus address or unit identifier	0-255	0
MODBUS_APPLICATION	Application information within the device identification	Text, max. 255 characters	Modbus TCP Gateway
MODBUS_BAUDRATE	Baud rate for serial Modbus communication (RTU)	300, 600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800	19200
MODBUS_CONNECTION TIMEOUT	Connection timeout of the Modbus TCP connection (in seconds)	0-65535	60
MODBUS_DATABITS	Data bits for serial Modbus communication (RTU)	7, 8	8
MODBUS_DEBUGOUT	Activation of raw data output for Modbus communication in the system log	0, 1	0
MODBUS_DEVPATH	Linux path for the serial Modbus interface	Text, max. 255 characters	Not set
MODBUS_DISCONNECT\TIMEOUT	Waiting time after which inactive Modbus TCP connections are disconnected (in seconds)	0-1000	60
MODBUS_ENABLE	Activation of the Modbus slave	0, 1	0
MODBUS_FLOWCONTROL	Flow control for Modbus serial communication (RTU): 0: none, 1: XON/XOFF during transmission, 2: RTS/CTS, 8: XON/XOFF when receiving, 9: XON/XOFF during transmission and reception	0, 1, 2, 8, 9	0
MODBUS_IP			Not set
MODBUS_MAXCONNECTIONS	Maximum number of parallel Modbus TCP connections	0-80	5
MODBUS_MODE		Serial, TCP, UDP	TCP
MODBUS_MODEL	Device information within the device identification	Text, max. 255 characters	Standard
MODBUS_NWPORT	Network port of the Modbus TCP slave	0-65535	502
MODBUS_PARITY	Parity for Modbus serial communication (RTU): 0: none, 1: odd, 2: even, 3: mark, 4: space	0-4	0
MODBUS_PRODUCT\CODE	Device information within the device identification	0-65535	-1

Parameter	Description	Value range	Standard
MODBUS_RS485\ENABLE	Activation of the RS-485 interface for serial Modbus communication (RTU)	0, 1	0
MODBUS_SPAN			1
MODBUS_STOPBITS	Stop bits for Modbus serial communication (RTU)	1, 2	1
MODBUS_VENDOR	Manufacturer information within the device identification	Text, max. 255 characters	
MODBUS_VENDORURL	Website information about the manufacturer within the device identification	Text, max. 255 characters	
MODBUS_VERSION	Version information within the device identification	Text, max. 255 characters	1.34.1001.1
MODBUS_WRITE ACCESS			READONLY
MODBUSMETER_PROTOCOL VERSION	Protocol version of the Modbus meter data: Bit 0: 2 registers per value (floating point value only), Bit 1: Multislave activated, Bit 2: Word swapping of 32-bit floating point values, Bit 3: Dummy mode activated	0-16	0
MUC_CONFIG_VER	Version of the configuration, compatibility with older firmware versions.	1-21	-
MUC_LOG	Sets the level of the system output via system log	DEFAULT, NONE, ERRORONLY, ALL	DEFAULT
MUC_LOGCYCLE DIVIDER			1
MUC_METER DESCRIPTION_ENABLEFLAGS	Enable flags for the display of the description on the web page: Bit 0: Description Bit 1: Storage-Number, Tariff, Value Type Bit 2: DIF/VIF raw data Bit 3: Total raw data of the data value entry	0 - 16	1
MUC_REPORT FATALREBOOTTIMEOUT			0
MUC_REPORT SCRIPTABORTTIMEOUT			30
MUC_SCALEVALUES	Scaled numerical values within the CSV and XML log data	0, 1	0
MUC_SETDEVICES	Activation of the setting of meter values	S0, ALL, NONE	S0
MUC_SETDEVICETIME			0
MUC_SHOWDATAFRAME	Explicit listing of the raw data frame as meter value, for multipage meter one entry is inserted per frame	0, 1	0
MUC_SHOW METERSTATUSBYTE	Explicit listing of the status byte of the meter (M-Bus and wM-Bus) as meter value	0, 1	0
MUC_SHOW TIMESTAMPENTRIES	Explicit display of the timestamps of a meter	0, 1	0
MUC_SHOW VENDORRAWDATA	Explicit listing of the manufacturer-specific data as a meter value	0, 1	0
MUC_SHOW VENDORRAWDATAWEB	Display of binary data on the web page (manufacturer-specific or data container)	0, 1	0
MUC_SHOW WMBUSRSSIVALUE			0
MUC_TRIMVALUES			0
MUC_USE_FREEZE	Activation of the freeze command for meter reading	0, 1	0
SHOW_KEYS	Display decryption data on the web page.	0, 1	1
SNTP_ENABLE	Activation of the time reference via SNTP server	0, 1	1
SNTP_REQTIMEOUT	Waiting time for an SNTP request (in ms)	1-65535	15000
SNTP_RETRY	Number of retries for an SNTP request	0-255	2
SNTP_TIMEOUT	Waiting time for a new SNTP time poll (explicit, in s)	1-4294967295	86400

Parameter	Description	Value range	Standard
SNTPIP	Address of the time server (SNTP)	Text, max. 255 characters	pool.ntp.org
SNULL_ENABLE	Activation of the S0 interface	0, 1	0
SNULL_MODE	Metering mode for S0	RELATIVE, ABSOLUTE	RELATIVE
WAN_APN	Access point for dialling into the WAN	Text, max. 255 characters	Not set
WAN_AUTH	Authentication procedure for dialling into the WAN	NONE, PAP, CHAP	CHAP
WAN_BAUDRATE	Baud rate for WAN communication	300, 600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800	115200
WAN_DATABITS	Data bits for WAN communication	7, 8	8
WAN_DEBUGOUT	Activation of raw data output for WAN communication in the system log	0, 1	0
WAN_DEVPATH	Linux path for the WAN interface	Text, max. 255 characters	Not set
WAN_ENABLE	Activation of WAN communication (mobile radio)	0, 1	0
WAN_FLOWCONTROL	Flow control for WAN communication: 0: none, 1: XON/XOFF during transmission, 2: RTS/CTS, 8: XON/XOFF when receiving, 9: XON/XOFF during transmission and reception	0, 1, 2, 8, 9	0
WAN_FULLTIMEOUT			0
WAN_IDLETIMEOUT			0
WAN_MAXRETRY	Number of retries for the WAN connection setup (0: endless)	0-255	0
WAN_OLDBAUDRATE	Baud rate for WAN communication, only affects older devices	300, 600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800	0
WAN_PARITY	Parity for WAN communication: 0: none, 1: odd, 2: even, 3: mark, 4: space	0-4	0
WAN_PASSWORD	Password for dialling into the WAN	Text, max. 255 characters	Not set
WAN_PIN	PIN of the SIM card	Text, max. 255 characters	Not set
WAN_PUK	PUK of the SIM card	Text, max. 255 characters	Not set
WAN_RADIOACCESS TECHNOLOGY	Selection of radio access technology: 0: Default, 1: GPRS only (HL85XX, HL76XX), 2: UMTS only (HL85XX, HL76XX), 3: First search GPRS then UMTS (HL85XX), 4: First search UMTS then GPRS (HL85XX), 5: LTE only (HL76XX), 6: First search UMTS then LTE (HL76XX), 7: First search LTE then UMTS (HL76XX), 8: First search GPRS then LTE (HL76XX), 9: First search LTE then GPRS (HL76XX)		0
WAN_RECONNECT MAXTIMEOUT	Seconds	1800-4294967295	604800
WAN_RS485ENABLE	Activation of the RS-485 interface for WAN communication	0, 1	0
WAN_RSSITEST			0
WAN_STOPBITS	Stop bits for WAN communication	1, 2	1
WAN_USER	User name for dialling into the WAN	Text, max. 255 characters	Not set
WATCHDOG_IDLE	Watchdog timeout for the idle state (in s)	1-4294967295	120
WATCHDOG_PROCESS	Watchdog timeout in busy state (in s)	1-4294967295	900
WATCHDOG_READOUT	Watchdog timeout during readout (in s)	1-4294967295	4-fold readout cycle, minimum: WATCHDOG_PROCESS
WATCHDOG_SCAN	Watchdog timeout during the scan process (in s)	1-4294967295	43200000

Parameter	Description	Value range	Standard
WEBCOM_PASSWORD PATTERN			Not set
WEBCOM_ADMINLOGIN_ SWITCHREQ		0, 1	1
WEBCOM_USESWITCH			Not set
WEBCOM_TIMEOUT	Waiting time for a web session after a user is automatically logged out (in ms)	1-4294967295	60000
WMBUS_ALLOW INSECURE			0
WMBUS_BAUDRATE	Baud rate for wM-Bus communication	300, 600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800	19200
WMBUS_CACHE SIZE	wM-Bus cache size, for buffering of received meter packets	1-500	500
WMBUS_CACHE TIMEOUT	Retention time for received wM-Bus packets in the cache list (in s, 0: endless)	0-4294967295	0
WMBUS_DATABITS	Data bits for wM-Bus communication	7, 8	8
WMBUS_DECRYPT USE LINKLAYERID			0
WMBUS_DEVPATH	Linux path for the wM-Bus interface	Text, max. 255 characters	Not set
WMBUS_ENABLE	Activation of the wM-Bus interface	0, 1	1
WMBUS_FLOWCONTROL	Flow control for wM-Bus communication: 0: none, 1: XON/XOFF during transmission, 2: RTS/CTS, 8: XON/XOFF when receiving, 9: XON/XOFF during transmission and reception	0, 1, 2, 8, 9	0
WMBUS_IDLETIMEOUT			0
WMBUS_MODE	Mode of the wM-Bus module	R2_OTHER_REQ, S2_REQ, T1_OTHER_REQ, T2_OTHER_REQ, C/T, C	T1_OTHER_REQ
WMBUS_PARITY	Parity for wM-Bus communication: 0: none, 1: odd, 2: even, 3: mark, 4: space	0-4	0
WMBUS_ RAWDATAINCLUDERSSI		0, 1	0
WMBUS_RAWLOG ENABLE	Activation of raw data logging to the directory ***ext/***	0, 1	0
WMBUS_RS485ENABLE	Activation of the RS-485 interface for wM-Bus communication	0, 1	0
WMBUS_SMLENABLE	Activation of the processing of SML log data	0, 1	0
WMBUS_STOPBITS	Stop bits for wM-Bus communication	1, 2	1
WMBUS_TRANSPARENT	Activation of transparent forwarding of the wM-Bus interface to a network port: NONE: Forwarding disabled, TCP: Forwarding to a TCP port, UDP: Forwarding to a UDP port	NONE, TCP, UDP	NONE
WMBUS_TRANSPARENT PORT	Network port for transparent forwarding via TCP or UDP	0-65535	0
WMBUS_TRANSPARENT RSSI	Activation of the integration of the RSSI value in transparent mode	0, 1	0
WMBUS_TRANSPARENT \STARTSTOP	Activation of the integration of a start and stop byte in transparent mode	0, 1	0
WMBUS_USE LINKLAYERID	Compatibility mode for reading faulty wM-Bus meters, uses link layer address instead of extended link layer address	0, 1	0
WMBUS2_BAUDRATE	Baud rate for wM-Bus communication (channel 2)	300, 600, 1200, 1800, 2400, 4800, 9600, 19200,	19200

Parameter	Description	Value range	Standard
		38400, 57600, 115200, 230400, 460800	
WMBUS2_DATABITS	Data bits for wM-Bus communication (channel 2)	7, 8	8
WMBUS2_DEVPATH	Linux path for the M-Bus interface	Text, max. 255 characters	Not set
WMBUS2_FLOW CONTROL	Flow control for M-Bus communication (channel 2): 0: none, 1: XON/XOFF during transmission, 2: RTS/CTS, 8: XON/XOFF when receiving, 9: XON/XOFF during transmission and reception	0, 1, 2, 8, 9	0
WMBUS2_MODE	Mode of the wM-Bus module (channel 2)	DISABLED, R2_OTHER_REQ, S2_REQ, T1_OTHER_REQ, T2_OTHER_REQ, C/T, C	DISABLED
WMBUS2_PARITY	Parity for wM-Bus communication (channel 2): 0: none, 1: odd, 2: even, 3: mark, 4: space	0-4	0
WMBUS2_RS485ENABLE	Activation of the RS-485 interface for wM-Bus communication (channel 2)	0, 1	0
WMBUS2_STOPBITS	Stop bits for wM-Bus communication (channel 2)	1, 2	1
WMBUS2_TRANSPARENT	Activation of transparent forwarding of the wM-Bus interface (channel 2) to a network port: NONE: Forwarding disabled, TCP: Forwarding to a TCP port, UDP: Forwarding to a UDP port	NONE, TCP, UDP	NONE
WMBUS2_TRANSPARENT PORT	Network port for transparent forwarding via TCP or UDP	0-65535	0
WMBUS2_TRANSPARENTRSSI	Activation of the integration of the RSSI value in transparent mode (channel 2)	0, 1	0
WMBUS2_TRANSPARENT STARTSTOP	Activation of the integration of a start and stop byte in transparent mode (channel 2)	0, 1	0
Group [REPORT_x]*			
MODE	Mode of the report instance or deactivation		DISABLED
FORMAT	Used format of the report instance		Not set
HOST	Remote station of the report instance		Not set
PORT	Network port of the remote station of the report instance		
PATH	Path specification for the remote station of the report instance		Not set
USER	User name for the remote station of the report instance		Not set
PASSWORD	Password for the remote station of the report instance		Not set
TOADDRESS	Recipient address for the report instance, especially SMTP		Not set
FROMADDRESS	Sender address for the report instance, especially SMTP		Not set
PARAM1	User-specific parameter (1) for the report instance, especially user format or user mode		Not set
PARAM2	User-specific parameter (2) for the report instance, especially user format or user mode		Not set
PARAM3	User-specific parameter (3) for the report instance, especially user format or user mode		Not set
BASENAME	Base file name for the files to be transmitted (XML or CSV)		
CONTENTTYPE			
EXTENSION			
INSECURE			0
CA_FILE	Path to the CA certificate for the report instance		
CERT_FILE	Path to the device certificate for the report instance		
KEY_FILE	Path specification to the device key for the report instance		
CYCLEMODE			MINUTE
CYCLE			15
CYCLEDELAY			0

Parameter	Description	Value range	Standard
CYCLETIMESTAMP			Not set
RANDOMDELAY			

*x denotes the report instance 1-10

Table 23: Parameters of chip.ini

10.4 Configuration file Device_Handle.cfg

The file */app/device_handle.cfg* stores the meter configuration. If this file is not present, it can be created via the website in the Meter tab. wM-Bus meters detected during operation are accepted after a scan process or by manually saving the configuration. Only the entries that deviate from the defined default value must be saved (version entry excluded).

- When changing the meter configuration, all files in the folder *ext/Tmp* must be deleted manually (if present).
- The file must be saved as UTF8-encoded XML file.
- The meter data (report) that have not yet been transmitted are discarded when the meter configuration has been changed.
- In order for manual changes to the file to be accepted by the device, it must be restarted. The device must be restarted via the website, not by a power reset (as this will not complete any memory accesses that are still open).
- The file can be transferred to another device via FTP, taking into account the connected meters.

The file is an XML file and has the following structure:

Parental element	Element	Description	Standard	Example
	root	Root element	-	-
root	version	Version number of the XML specification	-	0x06
root	meter	Parent element for each meter	-	-
meter	interface	Interface of the meter: M-Bus, wM-Bus, DLDERS, S0	-	M-Bus
meter	serial	Meter number (serial number), BCD notation, "0x" leading	0xFFFFFFFF	0x30101198
meter	manufacturer	Manufacturer code of the meter (wildcard 0xFFFF, if not set)	Not set	NZR
meter	version	Version number of the meter	0xFF	0x01
meter	medium	Medium of the meter, see second column in table 25 (wildcard 0xFF, if not set).	Not set	Electricity
meter	primaryaddress	Primary address of the meter (M-Bus or S0)	0	0x03
meter	addressmode	Addressing mode 0: Secondary, 1: Primary	0	0
meter	readoutcycle	Specific readout cycle (in s)	0	900
meter	maxvaluecount	Limitation of the number of meter values	0	12
meter	encryptionkey	Key for secure communication, e.g.: AES for wM-Bus	Not set, 0	0x82 0xB0 0x55 0x11 0x91 0xF5 0x1D 0x66 0xEF 0xCD 0xAB 0x89 0x67 0x45 0x23 0x01
meter	active	Activates the meter for logging or for WAN transmission.	1	1
meter	rssi	RSSI value of the last transmission (wM-Bus)	0	123
meter	register	Register assignment (e.g. Modbus)	0	250
meter	user	Application-specific text (see User label column in the Meter tab)	Not set	OG-1-right
meter	dbid	unique database key of the meter, if the meter is activated for WAN transmission	-	1
meter	value	Parent element for each register value in the meter	-	-
value	description	Description of the meter value, see second column in table 26	None	Energy
value	unit	Unit of the meter value, see second column in table 27	None	Wh
value	encodetype	Coding of the meter value	NODATA	INT32
value	scale	Scaling factor of the meter value (scientific notation)	1e0	1e-3
value	valuetype	Type of meter value: INSTANTANEOUS, MAXIMUM,	instantaneous	instantaneous

Parental element	Element	Description	Standard	Example
		MINIMUM, ERRORSTATE		
value	storagenum	Memory number of the register value	0	2
value	tariff	Tariff information on the register value	0	3
value	confdata	Generic data, OBIS code of the register value (X-X:X.X*X; X=0-255; see column OBIS-ID in *Meter* tab)	Not set	0x01 0x00 0x01 0x08 0x00 0xFF
value	rawdata	Raw data to the meter value with M-Bus and wM-Bus	-	07 FB 0D 00 00 00 00 00 00 00 00
value	dif	Data information boxes for the meter value with M-Bus and wM-Bus	-	07
value	vif	Value information boxes for the meter value with M-Bus and wM-Bus	-	FB 0D
value	active	Activates the meter value for logging or for WAN transmission.	1	1
value	register	Register assignment (e.g. Modbus)	0	250
value	user	Application-specific text (see User label column in the *Meter* tab)	Not set	Room 2

Table 24: Structure device_handle.cfg

10.5 OpenVPN Client

In order to enable an encrypted remote access to the SonoCollect devices and thus create a comfortable way of configuring and operating the devices remotely, an OpenVPN client has been implemented. The configuration on the devices themselves, is very simple and intuitive.

10.5.1 Configuration of the device

Only a created client configuration file *config.ovpn* must be stored in the path *app/vpn* to use an OpenVPN.

Activation takes place via the selection field **VPN** in the ***General*** tab (see section 4.2).

Note the correct file name *config.ovpn*.

When saving the configuration via the website, the OpenVPN client is started and the VPN connection is established.

OpenVPN usually uses the UDP port 1194. This port must be enabled in a firewall.

Please contact your administrator to deploy a client configuration file.

10.6 Preconfiguration of the meter list

Manual editing of the meter list for large installations with many meters is time-consuming.

Using the file *app/meter-conf-import.csv* this can also be automated. This file is used when scanning/listing a meter to add meta information such as the **Encryption key** or the **User label**.

If the meter is already listed or configured in the ***Meter*** tab, the data from the file will not be taken over. The meter must then first be removed from the list.

The file can be manually uploaded to the device via SFTP (see also section 3.4). However, it is also possible to import via the ***Service*** tab (see section 4.10). The file must be packed as **.tar.gz* file.

To create a **.tar.gz*archive, the free, open source software *7zip* can be used. The file *meter-conf-import.csv* can be packed herewith without subdirectory first into a **.tar* ball and afterwards into a **.gz* archive.

The following columns can be used in the CSV file:

Interface: Interface via which the meter is read out (MBUS, WMBUS).

- Serial: 8-digit meter number
- Encryptionkey: Meter key in hexadecimal byte notation (optional)
- user label: User-specific text for the meter (optional)
- Cycle: Readout interval to the meter (optional)

Here is an example:

Interface;Serial;Encryptionkey;user label;

WMBUS;12345670;00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F;Apartment 01
WMBUS;12345671;01 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F;Apartment 02
WMBUS;12345672;02 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F;Apartment 03
WMBUS;12345673;03 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F;Apartment 04
WMBUS;12345674;04 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F;Apartment 05
WMBUS;12345675;05 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F;Apartment 06
WMBUS;12345676;06 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F;Apartment 07
WMBUS;12345677;07 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F;Apartment 08
WMBUS;12345678;08 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F;Apartment 09
WMBUS;12345679;09 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F;Apartment 10

10.7 Scripting

By scripting we mean the extension of the functional scope of the standard device by customer-specific functionalities on the basis of source codes which are executed or interpreted on the target system, i.e. the device.

Compiled standard environments such as *XSLTPROC* or *BASH* are available as interpreters of the SonoCollect devices. Scripts can run in these environments and perform various functions.

10.7.1 XSLT parser

XSLTPROC is an interpreter for applying XSLT stylesheets to XML documents.

- More information can be found at: http://xmlsoft.org/XSLT/xsltproc.html

Extensible Stylesheet Language Transformation XSLT is a description language for transforming an XML document into another document. This can be an XML document, a text document (e.g. CSV file or JSON file) or even a binary file.

Source and target files are considered as logical trees in XSLT. The transformation rule describes which nodes of the tree are processed and how the new content is derived from them. Conditional statements and loops can also be used.

The use of XSLT on the SonoCollect devices is intended for the generation of user-specific data formats. The device internally uses a proprietary XML format to provide the meter data. In order to generate the format that the user uses or prefers, an XSLT conversion rule is used. In this way, the standard available formats can be generated (see section 4.6) and additional user formats can be stored.

- Only one user format is available for the standard operating modes (e.g. TCP or FTP) of the report instance. If several different user-specific formats are required, other instances must be set to *User* mode.

Possible applications are exemplary:

- CSV file per meter
- JSON data stream for IoT communication
- Time display as readable ASCII string instead of UNIX timestamp
- Fixed point notation in CSV file
- Changed column arrangement in CSV file
- Summary of several identical meter value types at one point in time in one line

The XSL files should be stored in *app/report*. The file *app/report/report.xsl* is used for a ***Report format*** *User* which can be selected via the web front end.

10.7.2 Report script

In addition to the user, the application can also issue commands via the command line (see section 10.1.2). It can be used on the SonoCollect devices to implement user-specific processes.

If the mode of a report instance is set to *User*, this function comes into play. Instead of the fixed programmed processes like TCP or FTP, the stored BASH script is now called. The command sequence contained therein is run through and then the script is terminated. In this way, third-party tools available for Linux can also be used to transfer data or to implement functions that are independent of it.

Possible applications are exemplary:

- MQTT for IoT communication
- Connection to an InfluxDB
- Request to server before sending data (conditional data sending)
- Sending to different file servers, depending on the set user label
- Threshold testing and alarming

The script files are stored as sh files in the *app/report* folder. The file name is composed of *report_* and a consecutive number from *1* upwards. Thus, up to 10 user-specific file names can be realized: *report_1.sh*, *report_2.sh*, ...

The following example sends user-specific data via MQTT, therefore *XSLTPROC* is called before the actual MQTT call is made via *mosquitto_pub* (long lines are wrapped):

```
#!/bin/bash
exec 1> >(logger -t report) 2>&1
set -e
set -o pipefail

shopt -s nullglob
rm -rf /tmp/reportfiles || true
mkdir /tmp/reportfiles
mcsvtoxml -m -c | xsltproc --stringparam serial "$SOLAPP_SERIAL"
  --stringparam timestamp "$(date +%s)" /mnt/app/report/report.xsl -

for file in /tmp/reportfiles/*/*; do
  subpath=$(echo ${file#/tmp/reportfiles/ | cut -d "." -f 1)
  mosquitto_pub -u "$SOLAPP_REPORT_USER" -P "$SOLAPP_REPORT_PASSWORD"
    -h "$SOLAPP_REPORT_HOST" -p "$SOLAPP_REPORT_PORT"
    --cafile "/var/conf/app/cacert.pem" --cert "/var/conf/app/clicert.pem"
    --key "/var/conf/app/clikey.pem" -t "$SOLAPP_REPORT_PATH/$subpath"
    -f "$file" --id "$HOSTNAME" --insecure
done
```

10.7.3 System meter script

Like the data dispatch with the report scripts (see section 10.7.2), the system meter can also be extended user-specifically with system meter scripts.

Here a BASH script is called at the readout time, which returns a meter value after completion. The return must contain the following values separated by *newline* in this order:

- Designation of the measured value, description column
- Unit of the measured value, unit column
- Value of the measured value, value column

Possible applications are exemplary:

- Measure ping times for network quality monitoring
- Display outdoor temperature via Web API access

- Request data via Modbus TCP

The script files are stored as sh-file in the *app/metersystem* folder. The file name is composed of *"value"* and a consecutive number from *1* upwards. Thus, additional 1-n measured values can be realized: *value1.sh*, *value2.sh, ...*

The following example adds the ping time to the system meter at www.example.de:

```
#!/bin/bash
echo -ne "Ping\nms\n"
ping=$(ping -n -c 3 www.example.de 2> /dev/null)
if [ $? -eq 0 ]; then
  echo $ping | awk -F '/' 'END {print $4'
else
  echo -1
fi
```

10.8 Media types, measurement types and units

In the EN 13757-3 standard, media types, measurement types (measurement value descriptions) and units and are predefined. This procedure is used in the SonoCollect devices to enable uniform data display.

The following table contains the predefined values of the medium:

Index	English designation	German designation
0	Other	Sonstiges
1	Oil	Öl
2	Electricity	Elektrizität
3	Gas	Gas
4	Heat (outlet)	Wärme
5	Steam	Dampf
6	Warm water	Warmwasser
7	Water	Wasser
8	Heat cost allocator	Heizkostenverteiler
9	Compressed air	Druckluft
10	Cooling (outlet)	Kältezähler (Rücklauf)
11	Cooling (inlet)	Kältezähler (Vorlauf)
12	Heat (inlet)	Wärme (Vorlauf)
13	Combined heat / cooling	Wärme-/Kältezähler
14	Bus / System component	Bus-/Systemkomponente
15	Unknown medium	Unbekanntes Medium
16-19	Reserved	Reserved
20	Calorific value	Heiz-/Brennwert
21	Hot water	Heißwasser
22	Cold water	Kaltwasser
23	Dual register (hot/cold) water	Doppelregister-Wasserzähler
24	Pressure	Druck
25	A/D Converter	A/D-Umsetzer
26	Smoke detector	Rauchmelder
27	Room sensor	Raumsensor
28	Gas detector	Gasdetektor
29-31	Reserved	Reserviert
32	Breaker (electricity)	Unterbrecher (Elektrizität)
33	Valve (gas or water)	Ventil (Gas oder Wasser)
34-36	Reserved	Reserviert
37	Customer unit	Kundeneinheit (Anzeigegerät)
38-39	Reserved	Reserviert
40	Waste water	Abwasser
41	Waste	Abfall
42	Carbon dioxide	Kohlendioxid
43-48	Reserved	Reserviert
49	Communication controller	Kommunikationssteuergeräte
50	Unidirectional repeater	Unidirektionalen Repeater
51	Bidirectional repeater	Bidirektionalen Repeater
52-53	Reserved	Reserviert
54	Radio converter (system side)	Funkumsetzer (systemseitig)

Index	English designation	German designation
55	Radio converter (meter side)	Funkumsetzer (zählerseitig)
56-255	Reserved	Reserviert

Table 25: Media types

The following table contains the predefined measurement types (descriptions for the measured value). One's own text-based measurement types (indication by index 31) can also be configured according to the meter interface.

Index	English designation	German designation
0	Other	Sonstiges
0	None	Keine
1	Error flags (Device type specific)	Fehler-Flags (Gerätetypspezifisch)
2	Digital output	Digitaler Ausgang
3	Special supplier information	Besondere Lieferanteninformationen
4	Credit	Guthaben (örtliche Währungseinheit)
5	Debit	Soll (örtliche Währungseinheit)
6	Volts	Spannung (V)
7	Ampere	Strom (A)
8	Reserved	Reserviert
9	Energy	Energie
10	Volume	Volumen
11	Mass	Masse
12	Operating time	Laufzeit
13	On time	Betriebsdauer
14	Power	Leistung
15	Volume flow	Durchflussmenge
16	Volume flow ext	Erweiterung Durchflussmenge
17	Mass flow	Massestrom
18	Return temperature	Rücklauftemperatur
19	Flow temperature	Vorlauftemperatur
20	Temperature difference	Temperaturdifferenz
21	External temperature	Außentemperatur
22	Pressure	Druck
23	Timestamp	Zeitstempel
24	Time	Zeit
25	Units for H. C. A.	Einheiten für HKV
26	Averaging duration	Mittelungsdauer
27	Actuality duration	Aktualitätsdauer
28	Identification	Erweiterte Identifikation
29	Fabrication	Fabrikationsnummer
30	Address	Adresse
31	Meter specific description (text based)	Zählerspezifische Beschreibung (textbasiert)
32	Digital input	Digitaler Eingang
33	Software version	Softwareversion
34	Access number	Telegrammidentifikation
35	Device type	Gerätetyp
36	Manufacturer	Hersteller
37	Parameter set identification	Identifikation des Parametersatzes
38	Model / Version	Modell/Version
39	Hardware version	Hardware-Versionsnummer
40	Metrology (firmware) version	Versionsnummer der Messtechnik (Firmware)
41	Customer location	Standort des Kunden
42	Customer	Kunde
43	Access code user	Zugangscode Nutzer
44	Access code operator	Zugangscode Betreiber
45	Access code system operator	Zugangscode Systembetreiber
46	Access code developer	Zugangscode Entwickler
47	Password	Passwort
48	Error mask	Fehlermaske
49	Baud rate	Baudrate
50	Response delay time	Ansprechverzögerungszeit
51	Retry	Wiederholung
52	Remote control (device specific)	Fernsteuerung (gerätespezifisch)
53	First storagenum. for cyclic storage	Erste Speichernummer für zyklische Speicherung
54	Last storagenum. for cyclic storage	Letzte Speichernummer für zyklische Speicherung
55	Size of storage block	Größe des Speicherblocks
56	Storage interval	Speicherintervall
57	Vendor specific data	Betreiberspezifische Daten

Index	English designation	German designation
58	Time point	Zeitpunkt
59	Duration since last readout	Zeit seit letztem Auslesen
60	Start of tariff	Beginn des Tarifs
61	Duration of tariff	Dauer des Tarifs
62	Period of tariff	Tarifzeitraum
63	No VIF	Kein VIF
64	wM-Bus data container	Datencontainer für wireless M"' Bus-Protokoll
65	Data transmit interval	Nennintervall der Datenübertragungen
66	Reset meter	Resetzähler
67	Cumulation meter	Kumulationszähler
68	Control signal	Steuersignal
69	Day of week	Wochentag
70	Week number	Wochennummer
71	Time point of day change	Zeitpunkt des Tageswechsels
72	State of parameter activation	Zustand der Parameteraktivierung
73	Duration since last cumulation	Dauer seit letzter Kumulierung
74	Operating time battery	Betriebszeit Batterie
75	Battery change	Batteriewechsel (Datum und Uhrzeit)
76	RSSI	RSSI (Empfangspegel)
77	Day light saving	Sommerzeit
78	Listening window management	Verwaltung des Empfangsfensters
79	Remaining battery life time	Verbleibende Lebensdauer der Batterie
80	Stop meter	Anzahl der Male, die der Zähler angehalten wurde
81	Vendor specific data container	Datencontainer für herstellerspezifisches Protokoll
82	Reactive energy	Blindenergie
83	Reactive power	Blindleistung
84	Relative humidity	Relative Feuchte
85	Phase voltage to voltage	Phase U/U (Spannung-Spannung)
86	Phase voltage to current	Phase U/I (Spannung-Strom)
87	Frequency	Frequenz
88	Cold/Warm Temperature limit	Kalt-Warm-Temperaturgrenze
89	Cumulative count max. power	Kumulationszahl max. Leistung
90	Remaining readout requests	Verbleibende Zählerauslesungen
91	Meter status byte	Zähler Statusbyte
92	Apparent energy	Scheinenergie
93	Apparent power	Scheinleistung
94	Security key	Sicherheitsschlüssel
95	Data frame	Datenrahmen bzw. –paket
96-255	Reserved	Reserviert

Table 26: Media types

The following table contains the predefined units. Own unit fields can be additionally configured depending on the meter interface.

Index	Unit	Characters	English designation	German designation
0	None		None	Keine
1	Bin		Binary	Binär
2	Cur		Local currency units	Örtliche Währungseinheit
3	V	V	Volt	Volt
4	A	A	Ampere	Ampere
5	Wh	Wh	Watt hour	Wattstunden
6	J	J	Joule	Joule
7	m³	m³	Cubic meter	Kubikmeter
8	kg	kg	Kilogram	Kilogramm
9	s	s	Second	Sekunde
10	min	min	Minute	Minute
11	h	h	Hour	Stunde
12	d	d	Day	Tag
13	W	W	Watt	Watt
14	J/h	J/h	Joule per Hour	Joule pro Stunde
15	m³/h	m³h	Cubic meter per hour	Kubikmeter pro Stunde
16	m³/min	m³/min	Cubic meter per minute	Kubikmeter pro Minute
17	m³/s	m³/s	Cubic meter per second	Kubikmeter pro Sekunde
18	kg/h	kg/h	Kilogram per hour	Kilogramm pro Stunde
19	Degree C	°C	Degree celsius	Grad Celsius
20	K	K	Kelvin	Kelvin
21	Bar	Bar	Bar	Bar
22			Dimensionless	Dimensionslos

Index	Unit	Characters	English designation	German designation
23-24		Res	Reserved	Reserviert
25	UTC		UTC	UTC
26	bd	bd	Baud	Baudrate
27	bt	bt	Bit time	Bitzeit
28	mon	mon	Month	Monat
29	y	y	Year	Jahr
30			Day of week	Wochentag
31	dBm	dBm	Decibel (1 mW)	Dezibel (1 mW)
32	Bin		Bin	Binär (Sommerzeit)
33	Bin		Bin	Binär (Verwaltung des Empfangsfensters)
34	kVARh	kVARh	Kilo voltampere reactive hour	Kilo Voltampere Reaktiv Stunden
35	kVAR	kVAR	Kilo voltampere reactive	Kilo Voltampere Reaktiv
36	cal	cal	Calorie	Kalorie
37	%	%	Percent	Prozent
38	ft³	ft³	Cubic feet	Kubikfuß
39	Degree	°	Degree	Grad
40	Hz	Hz	Hertz	Hertz
41	kBTU	kBTU	Kilo british thermal unit	Kilo Britische Wärmeeinheit
42	mBTU/s	mBTU/s	Milli british thermal unit per second	Milli Britische Wärmeeinheit pro Sekunde
43	US gal	US gal	US gallon	US Gallonen
44	US gal/s	US gal/s	US gallon per second	US Gallonen pro Sekunde
45	US gal/min	US gal/min	US gallon per minute	US Gallonen pro Minute
46	US gal/h	US gal/h	US gallon per hour	US Gallonen pro Stunde
47	Degree F	°F	Degree Fahrenheit	Grad Fahrenheit
48-255	Res		Reserved	Reserviert

Table 27: Units

11 Access to meter data via Modbus TCP

11.1 General information

The Modbus protocol was originally developed by the Modicon company (now Schneider Electric) for data traffic with their controllers. Data were transmitted in the form of 16 bit registers (integer format) or as status information in the form of data bytes. Over the course of time, the protocol has been continually expanded. Modbus TCP is such a type.

- Modbus TCP is part of the standard IEC 61158
- A specification can be found at: http://www.modbus.org

The Modbus protocol is a single-master protocol. This master controls the entire transmission and monitors any timeouts that may occur (no response from the addressed device). The connected devices may only send telegrams upon request by the master.

The SonoCollect devices are if, option available, a Modbus TCP server and therefore a Modbus TCP slave.

The Modbus communication requires the establishment of a TCP connection between a client (e.g.: PC or controller) and the server (this device). The TCP port reserved for Modbus from the ***Server*** tab is used for communication. This is configured to 502 by default (see section 4.6).

- ✔ If there is a firewall between server and client, it must be ensured that the configured TCP port is enabled.

The SonoCollect devices allow up to 5 simultaneous Modbus TCP connections in the standard configuration. This means, for example, that in addition to a classic PLC, you can also connect a building control system and a Modbus-capable display to the device without the queries of these Modbus clients influencing each other.

The configuration parameter *MODBUS_MAXCONNECTIONS* (*app/chip.ini*, see chapter 8.4.1) determines the maximum number of simultaneous Modbus queries. If this limit is exceeded, the oldest existing Modbus TCP connection is disconnected by the gateway and the newly requested connection is allowed.

- ✔ The device supports up to five simultaneous Modbus TCP connections in the standard configuration.

11.2 Function codes and addressing

The following function codes are supported by the SonoCollect devices:

Code	Name	Description
0x01	Read Coil	Currently without function
0x03	Read Holding Register	Request of meter data, register layout, see tables in section 11.3
0x05	Write Single Coil	Currently without function
0x06	Write Single Register	Currently without function
0x10	Write Multiple Register	Currently without function
0x0F	Force Multiple Coil	Currently without function
0x2B	Read Device Identification	Request of device information with MEI = 0x0E

Table 28: Function codes for Modbus TCP or Modbus UDP

The function codes marked "without function" are answered with *ILLEGAL DATA ADDRESS* (0x02), all others not listed with the error message *ILLEGAL FUNCTION* (0x01).

If the function code 0x2B with MEI = 0x03 is used, the device returns an identification packet. The values 0x01 and 0x02 are supported as *Device ID* code, which allows the simple (*basic device identification*) and the standard (*regular device identification*) data to be called. The following data can be called via the device identification:

Object ID	Name	Data type	Example	Type
0x00	VendorName	String	Danfoss A/S	Basic
0x01	ProductCode	String	1036	Basic
0x02	MajorMinorRevision	String	001	Basic
0x03	VendorUrl	String	www.danfoss.com	Regular
0x04	ProductName	String	MBUS-GE80M*	Regular
0x05	ModelName	String	Standard	Regular
0x06	UserApplicationName	String	Modbus TCP Gateway	Regular

*Corresponds to the configured *Device name* in the **General** tab

Table 29: Device identification

Different stations on the bus can be addressed in the Modbus via a slave address. Addressing is done directly in the Modbus TCP via the IP address of the device. Therefore, the slave address remains usually unused. It is therefore recommended to use 0xFF (255) for Modbus TCP.

- ✔ The SonoCollect devices do not check the slave address in the standard configuration, but always respond if the IP address matches.
- ✔ The meter data of the connected meters are not logically separated In the standard implementation of the Modbus server from each other and can be called across the board using a Modbus query.

11.3 Data display

The data arrangement in the Modbus registers corresponds to the usual structure at Danfoss A/S. Addressing starts with *0* and uses the *big endian* display, therefore in the 16-bit registers the higher byte is sent first, the lower then afterwards (this is also called *most significant byte first* or *MSB*).

Example: Value: 0x1234 → is sent: first 0x12, then 0x34

Numbers and data ranges that exceed 16 bits are represented in a similar manner. Again, the most significant 16-bit register is sent first, so it is at the lowest register address (this is also referred to as *most significant word first* or *MSW*).

Example: Value: 0x12345678 → is sent: first 0x12, then 0x34, 0x56 and 0x78

The devices use 10 Modbus registers for each entry in the meter list to display meta information such as readout time, unit and readout status. This results in the following Modbus register specification with a fixed grid of 10 Modbus registers each.

- ℹ The register addresses are counted starting from the value 0.
- ℹ For data types that span more than one register, the higher order data word is encoded at the lower address.
- ℹ The Modbus registers are read out via the function code *0x03 (Read holding register)* (see section 11.2).
- ✔ In the Modbus protocol, the data are transmitted as integers or floating values. Other data formats, which are specified for the M-Bus (e.g.: BCD), are already converted internally into integer values before transmission.

The 10 Modbus registers starting at address 0 are status registers of the device itself and are defined according to the following table:

Address	Designation	Data width	Description / Comment
0-1	Serial number	32 bits	The serial number is encoded in hexadecimal.
2	Protocol version	16 bits	Protocol version of the Modbus data (value=1)
3	Version	16 bits	Software version of the device (integer value)
4-5	Time stamp	32 bits	Current Unix timestamp of the system time of the device. For this purpose, the clock time in the device must be set correctly (manually or via SNTP).
6	Reserved		Reserved
7	Type field / Reserved	16 bits	The type field (value=1 for device entry) is transmitted in the high-order byte. The least significant byte is reserved.
8-9	Reserved		Reserved

Table 30: Modbus register for the data set of the device

These first 10 Modbus registers are now followed by entries for meters and entries for meter values in accordance with the hierarchy in the meter list. An entry for meters is followed by associated entries for meter values, before a new entry for the next meter follows, and so on.

The 10 Modbus registers of a meter entry are defined according to the following table, where the offset must be added to the configured Modbus address in the ***Meter*** tab.

Offset	Designation	Data width	Description / Comment
0-1	Serial number	32 bits	The serial number is encoded in hexadecimal. Unlike M-Bus or wM-Bus, this is an integer and not BCD.
2	Manufacturer identification	16 bits	The encoding of the manufacturer identification as three ASCII characters is done via individual bit areas: Bits 10-14: First character, bits 5-9: Second character and bits 0-4: Third character. The particular character results from the individual meter values (significant bit at the highest position), counted starting with the letter "A" with the value 1.
3	Version / Medium	16 bits	The meter version is encoded in the high-order byte and the medium ID in the low-order byte of the register. The medium is assigned using Table 25. The transferred value corresponds to the index.
4-5	Time stamp	32 bits	Unix time stamp at the time of the last meter reading. For this purpose, the clock time in the device must be set correctly (manually or via SNTP).
6	Reserved		Reserved
7	Type field / Reserved	16 bits	The type field (value=2 for meter entry) is transmitted in the high-order byte. The least significant byte is reserved.
8	Flags	16 bits	Bit 0: Value 1: Meter not read, value 0: Meter correctly read Bit 1: Value 1: Not all meter values current, value 0: All meter values up to date Bit 2-7: Reserved
9	Reserved		Reserved

Table 31: Modbus register for the data set of a meter

The 10 Modbus registers of a meter value entry are defined according to the following table, where the offset must be added to the configured Modbus address in the ***Meter*** tab:

Offset	Designation	Data width	Description / Comment
0-3	Meter value	64 bits	Signed, integer meter value (unscaled)
4-5	Meter value	32 bits	Floating point meter value (scaled to the unit in register 7), IEEE 754
6	Scaling factor	16 bits	Signed scaling factor to base 10
7	Type field / Unit	16 bits	The type field (value=0 for meter value entry) is transmitted in the high-order byte. The unit is transmitted in the least significant byte. This is assigned using Table 27. The transferred value corresponds to the index.
8-9	Time stamp	32 bits	Unix time stamp provided by the meter. If the meter does not transmit any time values, this time stamp is 0.

Table 32: Modbus register for the data set of a meter value

Floating point formats have a limited resolution. It may result in slight deviations between the represented value and the exact number.

0x449a522b = 1234.5677490234375 instead of 1234.5678

The following figure shows an example configuration of the Modbus addresses via the web interface:

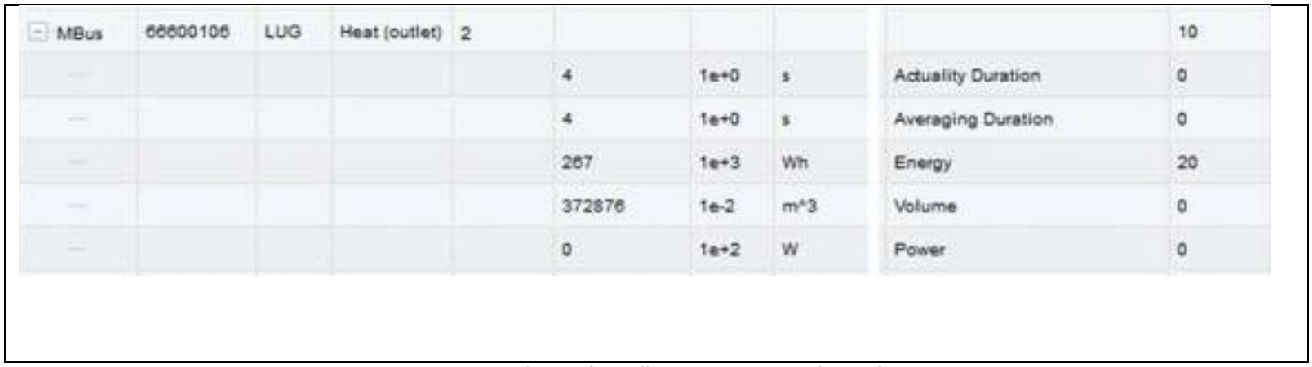


Figure 46Configured Modbus registers on the website

The following data is transmitted to the Modbus master in this example:

Address	Value	Designation	Decoded value
Device entry			
0	0x0002	Serial number	0x0002993A
1	0x993A		
2	0x0001	Protocol version	1
3	0x006F	Version	Version = 0x006F = 111 ? v1.11
4	0x519C	Time stamp	0x519CC16D = 1369227629:
5	0xC16D		Wed, 22 May 2013 15:00:29 GMT+2
6	0x0000	Reserved	
7	0x0100	Type field / Reserved	Type = 1 → Device entry
8	0x0000	Reserved	

Address	Value	Designation	Decoded value
9	0x0000	Reserved	
Meter entry			
10	0x03F8	Serial number	0x03F83CAA = 66600106
11	0x3CAA		
12	0x32A7	Manufacturer identification	0x32A7 = '0011.0010.1010.0111' 1st character: _011.00__.____.____' → 0x0C = 12 → L 2nd character: '____.__10.101_.____' → 0x15 = 21 → U 3rd character: '____.____.___0.0111' → 0x07 = 7 → G
13	0x0204	Version / Medium	Version = 2 Medium = 4 = Heat (outlet)
14	0x519C	Time stamp	0x519CC16D = 1369227629:
15	0xC16D		Wed, 22 May 2013 15:00:29 GMT+2
16	0x0000	Reserved	
17	0x0200	Type field / Reserved	Type = 2 → meter entry
18	0x0000	Reserved	
19	0x0000	Reserved	
Meter value entry			
20	0x0000	Meter value (integer)	0x000000000000010B = 267
21	0x0000		Resulting meter value: 267 * 10^3 Wh
22	0x0000		
23	0x010B		
24	0x4882	Meter value (floating point)	0x48825F00 = 267000.000000 Wh
25	0x5F00		
26	0x0003	Scaling factor	Factor = 10^3
27	0x0005	Type field / Unit	Type = 0 → Meter value entry Unit = 5 → Wh
28	0x519C	Time stamp	0x519CBBB3 = 1369226163:
29	0xBBB3		Wed, 22 May 2013 14:36:03 GMT+2

Table 33: Example data for Modbus

11.4 Configuration via web front end

The Modbus function is activated and configured via the ***Server*** tab. The parameters are described in the section 4.6. The settings are explained in detail below.

11.4.1 Modbus mode and Modbus port

The Modbus function can be activated with the aid of the parameter *Modbus mode* and set to *Modbus TCP* or *Modbus UDP*.

Modbus TCP is the most widespread and common Modbus variant based on IP and uses TCP for communication. The use of UDP at *Modbus UDP* is uncommon, but is available as an option.

The port specified in the parameter *Modbus port* is used for both IP-based protocols. This is 502 by default.

- If the parameter *Modbus port* is set to a value that is used by other services (e.g.: HTTP: port 80), these services may block each other and access to the device is restricted.

11.4.2 Modbus test

Depending on the Modbus implementation, data arrangement and addressing may differ between the Modbus nodes. The transmission of static test data can be activated with the parameter *Modbus test* in the tab ***Server*** tab to check the correct data transmission parameters, (see chapter: 4.5). The following data is then provided via Modbus according to the register assignment from chapter 6.3.4:

Address	Value	Description	Decoded value
0	0xD080	Serial number of the device, upper word	0xD0800DC1: last digits of the MAC address: 68:91:D0:80:0D:C1
1	0x0DC1	Serial number of the device, lower word	
2	0x0002	Version of the communication protocol of the device	2
3	0x0084	Version of the software of the device	0x84 = 132: Version 1.32
4	0x5CE5	Time stamp of the device, upper word	0x5CE55EAC = 1559054252: Wed, 22 May 2019 16:37:32 GMT+2
5	0x5EAC	Time stamp of the device, lower word	
6	0x0000	Empty field	
7	0x0100	Type field of the register set in the upper byte	0x01: Entry of the device type
8	0x0000	Empty field	
9	0x0000	Empty field	
10	0x00BC	Serial number of the meter, upper word	0xBC614E = 12345678

11	0x614E	Serial number of the meter, lower word	
12	0x0443	Manufacturer identification of the meter (see chapter 6.3.4)	0x0443: ABC
13	0x0102	Version (upper byte) and medium (lower byte) of the meter	0x01: Version = 1, 0x02: Medium = 2 (electricity)
14	0x5CE5	Time stamp of the meter, upper word	0x5CE55EAC = 1559054252: Wed, 22 May 2019 16:37:32 GMT+2
15	0x5EAC	Time stamp of the meter, lower word	
16	0x0000	Empty field	
17	0x0200	Type field of the register set in the upper byte	0x02: Entry of the meter type
18	0x0000	Flags in the lower byte	0x00: Meter correctly read and all values up to date
19	0x0000	Empty field	
20	0x0000	Meter value (integer), highest word	0xBC614E = 12345678: Resulting meter value: 12345678 * 10-4 = 1234.5678 Wh
21	0x0000	Meter value (integer)	
22	0x00BC	Meter value (integer)	
23	0x614E	Meter value (integer), lowest word	
24	0x449A	Meter value (floating point), upper word	0x449A522B = 1234.5677490234375 (Rounding error at FLOAT32)
25	0x522B	Meter value (floating point), lower word	
26	0xFFFC	Scaling factor (exponent to base 10)	0xFFFC = -4: Factor = 10-4
27	0x0005	Type field of the register set in the upper byte and unit in the lower byte (see Table 27)	0x00: Entry of the type meter value 0x05: Unit = Wh
28	0x5CE5	Time stamp of the meter value, upper word	0x5CE55EAC = 1559054252: Wed, 22 May 2019 16:37:32 GMT+2
29	0x5EAC	Time stamp of the meter value, lower word	

Table 34: Test data for Modbus TCP or Modbus UDP

So, the above values should be reproduced exactly(!) in the target system. If not, the addressing type and byte order probably do not match.

11.4.3 Modbus swap

The Modbus uses the data display *big endian* for bytes and words (individual registers) and addressing is started at *0*. Depending on the manufacturer and implementation, the address count and the arrangement of data may differ between nodes for data types larger than 16 bits.

While the two types of addressing from *0* or from *1* can be corrected relatively easily by an additive offset, the byte order is somewhat more complex.

Since the meter values are transmitted as floating point values (*FLOAT32*), the possible arrangements are shown as examples. The *FLOAT32* value is displayed in 32 bits and thus 4 bytes. These 4 bytes are stored in two Modbus registers. Each of the bytes follows the *big endian* notation, but the byte order is not always consistent.

For the example, a meter value from the test data of 12345678 * 10^{-4} = 1234.5678 Wh is used (see Table 34). This value is represented by the *FLOAT32* number 0x449A522B.

	Order of							
Mode	**Bits in the byte**	**Bytes in word**	**Words**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4**	**Abbreviated form**
Standard	big endian	big endian	MSW	0x44	0x9A	0x52	0x2B	ABCD
	big endian	little endian	MSW	0x9A	0x44	0x2B	0x52	BADC
Modbus swap	big endian	big endian	LSW	0x52	0x2B	0x44	0x9A	CDAB
	big endian	little endian	LSW	0x2B	0x52	0x9A	0x44	DCBA

Table 35: Data sequence with Modbus in the example

The bits and bytes in the register are always displayed in the format *big endian* according to the Modbus standard for SonoCollect devices. The registers themselves are displayed either as most significant word first (MSW) when Modbus swap is not active (default mode) or as least significant word first (LSW) when *Modbus swap* is active.

11.4.4 Modbus float only

In most applications, only the pure measured value is used for further processing. Here, the floating point representation of the measured values via Modbus is particularly suitable.

By omitting the meta information, the data display via Modbus can be more compact in order to save storage space or communication effort. By setting the parameter *Modbus float only* in the ***Server*** tab the Modbus address space is consolidated and only the serial number of the meter as integer and the floating point

values of the meter value entries are transmitted. This reduces the grid to 2 Modbus registers. The device entry is then not available.

The meter entry only contains the serial number of the meter and is formatted as follows:

Offset	Designation	Data width	Description / Comment
0-1	Serial number	32 bits	The serial number is encoded in hexadecimal. Unlike M-Bus or wM-Bus, this is an integer and not BCD.

Table 36: Meter entry with reduced Modbus register layout

The meter value entry only includes the scaled floating point value, which is calculated from the integer values of the meter, if the meter does not provide a floating point value. The meter value is formatted as follows:

Offset	Designation	Data width	Description / Comment
0-1	Meter value	32 bits	Floating point meter value (scaled), IEEE 754

Table 37: Meter value entry with reduced Modbus register layout

11.4.5 Modbus multi slave

Depending on the use and further processing of the data, it may be useful to logically separate meter data from different meters.

When setting the parameter *Modbus multi slave* in the ***Server*** tab, each of the meters gets its own address range in the Modbus. Each M-Bus slave in the meter list is thus managed as a separate virtual Modbus slave with its own Modbus address. The slave address of the respective meter is then displayed in the column *Register* in the ***Meter*** tab at the meter entry and can be adjusted there (see section 4.3). The meter value entries show the corresponding Modbus register addresses within this virtual Modbus slave.

- If there are meters in the meter list, the addresses must be re-assigned after activating or deactivating the Multi-Slave functionality.
- Multiple selection by holding down **SHIFT** or **CTRL** is possible within the meter list.

The reset or reallocation of the slave addresses and Modbus register addresses are possible, while marking all meters with the help of the functions **Allocate** and **Deallocate** from the context menu.

This allows the dedicated call of only one meter at a time. The register meter then starts anew at each meter. This enables the creation of macros and other automation approaches when programming the Modbus client if the same meter type is used several times.

- Since the slave address can only accept values 1-247, no more than 247 meters can be addressed logically.
- The slave address 0 is a broadcast address.
- The slave address 255 addresses the device itself.
- Per slave address the register layout follows the conventions according to section 11.3 or section 11.4.4.

11.5 Instructions for use

11.5.1 How often is the data updated?

The meter data is read out independently of the Modbus requests. The meter data is updated with each automatic or manual reading of a meter and is then currently available via Modbus. You can set the required cycle time in the ***Configuration*** tab for all meters or also provide individual meters with an individual cycle in the ***Meter*** tab in the column *Cycle* .

11.5.2 How can you detect if the meter is read or the value is current?

For monitoring applications such as in automation technology (e.g.: SCADA system, PLC), it is often decisive which quality a value has. It is therefore recommended to check whether a meter could be read at all and whether the meter value is also current.

The register set of the meter entry also contains, among other things, the readout time stamp and a flag register that provides information about the readout status.

If the flag register has the value *0* the last readout was complete and therefore the values of this meter are current. An explanation of the values can be found in Table 31. The time stamp can also be used to assess the timeliness and provides information on how old the meter values are (also in the event of an error).

11.5.3 Which data type must be used?

The register set of the meter value entry contains both the unscaled meter value as *INT64* value in connection with a scaling factor and the scaled value as *FLOAT32* value.

When it comes to exact billing/settlement, the *INT64* value is to be preferred, since this can be processed further without loss of accuracy. However, not all Modbus clients are capable of processing 64-bit data. It should also be noted that the scaling factor must still be multiplied. The *INT64* value is therefore to be regarded as a fixed point value.

- It cannot be excluded that the scaling changes during the runtime, because it is determined and transmitted by the meter.

For monitoring applications such as in automation technology (e.g. SCADA system, PLC), the *FLOAT32* value is more suitable. Subsequent scaling is thus not necessary and the accuracy of about 7 digits is sufficiently good in most cases.

11.5.4 What is the unit of value?

The register set of the meter value entry contains, among other things, the unit and the scaling of the value. An explanation can be found in Table 32.

11.5.5 How many Modbus masters can call data simultaneously?

The SonoCollect devices allow up to 5 simultaneous Modbus TCP connections in the standard configuration.

11.5.6 How can the data be automatically assigned?

Each register set, i.e. device entry, meter entry and meter value entry, contains a type field (see Table 30, Table 31 and Table 32). This type field can be used to automatically identify which entry this is.

If the register addresses in the ***Meter*** tab are assigned automatically (see section 4.3), then the values are arranged logically one after the other in the Modbus data area:

- Device entry
- Meter entry 1
  - Meter value entry 1
  - Meter value entry 2
  - Meter value entry x
- Meter entry 2
  - Meter value entry x+1
  - Meter value entry x+2
  - .
  - Meter value entry x+y

.

- Meter entry n
  - Meter value entry x+y+..+1
  - Meter value entry x+y+..+2

  .

  .

  - Meter value entry x+y+..+z

This allows the complete Modbus data set to be run through iteratively in a 10 register grid and the hierarchy and assignment to be recorded automatically. When using the contents of the respective entry, you thus obtain an image of the meter list from the ***Meter*** tab.

11.6 Specific troubleshooting

11.6.1 Why does the value in the Modbus differ from the value on the website?

Value deviations can have various causes. A list is provided to explain the most common causes of errors.

- If the web page or the ***Meter*** tab has been open for some time, it may no longer display the most current values. In this case reload the ***Meter*** tab using the **Reload** button.
- If you compare the information on the web page with a *FLOAT32*display, there may be small deviations from the 7th digit. These are accuracy errors due to the format.
- Check the use of the correct data type, the meter values are available as *INT64* plus scaling and *FLOAT32*.
- Check the data arrangement, specifically the Word order on *MSW* or *LSW* (see section 11.4.3).
- Check the register address. Pay special attention to the count based on *0* or *0*. Also note the additive offsets in the respective register set (e.g. to use the *FLOAT32*value).
- In case of integer display, check whether your Modbus master also supports 64 bit wide data types.
- In case of floating point display, check whether your Modbus master also supports *FLOAT32*values. Fixed point numbers are not supported.
- Use the test data to check various settings (see section 11.4.2).
- If errors could not be rectified, please contact your local Danfoss support.

11.6.2 Why does the device/the Modbus server not respond?

Connection problems with Modbus TCP or Modbus UDP can have various causes. A list is provided to explain the most common causes of errors.

- Check your IP settings. Are Modbus client and Modbus server in the same IP address range or subnet? If not, is the gateway and route set correctly? A ping test
- Check whether Modbus is activated on the device in the ***Server*** tab.
- Check that the port on the master and client match (usually 502). Also check if another service on the device is mistakenly blocking the port.
- Check whether a firewall is blocking the communication.
- Check if the correct slave address for Modbus is used.

If errors could not be rectified, please contact your local Danfoss support.

12 Access to meter data via BACnet IP

12.1 General information

BACnet (Building Automation and Control Networks) is a network protocol for building automation. It is standardized by ASHRAE, ANSI and as ISO 16484-5.

- This device is a BACnet server.
- A specification can be found at: http://de.wikipedia.org/wiki/BACnet

BACnet communication requires the establishment of a UDP connection between a client (e.g.: PC, controller or BMS) and the server (this device). The UDP port reserved for BACnet from the ***Server*** tab is used for communication. This is configured to 47808 by default (see section 4.6).

- If there is a firewall between the server and the client, ensure that the configured UDP port and the broadcast transmission are enabled.

12.1.1 Implemented services

The following BACnet services are supported by the device:

Service	Implemented
BACnet Operator Workstation (B-OWS)	No
BACnet Advanced Operator Workstation (B-AWS)	No
BACnet Operator Display (B-OD)	No
BACnet Building Controller (B-BC)	No
BACnet Advanced Application Controller (B-AAC)	No
BACnet Application Specific Controller (B-ASC)	Yes
BACnet Smart Sensor (B-SS)	No
BACnet Smart Actuator (B-SA)	No

Table 38: Implemented BACnet services

12.1.2 Supported BACnet Interoperability Building Blocks (Annex K)

12.2 Configuration via web front end

The BACnet function is activated and configured via the ***Server*** tab. The parameters are described in the section 4.6. The settings are explained in detail below.

12.2.1 BACnet active

The BACnet IP function can be activated via the parameter *BACnet active*. *BACnet IP* is a widely used and common BACnet variant based on IP and uses UDP for communication.

12.2.2 BACnet config network, BACnet IP, BACnet netmask und BACnet broadcast

The device supports the activation of a second, virtual network interface for the BACnet service. Thus, the device can be integrated into two logical networks via one physical network connection.

This function is activated via the parameter *BACnet config network*.

The second, virtual network interface is set up via the parameters *BACnet IP*, *BACnet netmask* and *BACnet broadcast*.

- The parameters *BACnet IP* and *BACnet netmask* are independent of the default settings in ***General*** tab.

12.2.3 BACnet BBMD

Various messages are sent to the broadcast MAC address (FF:FF:FF:FF:FF:FF) on the local network with the aid of BACnet IP. All BACnet devices in the local network receive the message and respond accordingly. However, routers that switch to other subnets do not forward these messages. The BACnet Broadcast Management Device (BBMD) was introduced to solve this problem. The BBMD forwards IP broadcast messages to other subnets using a Broadcast Distribution Table (BDT).

The parameter *BACnet BBMD* can be used to set the IP address of the BBMD in the network.

12.2.4 BACnet port

The port specified in the parameter *BACnet port* is used for both IP-based protocols. This is 47808 (0xBAC0) by default.

If the parameter *BACnet port* is set to a value that is used by other services (e.g.: HTTP: port 80), these services may block each other and access to the device is restricted.

12.2.5 BACnet device ID, BACnet device name and BACnet location

The parameters *BACnet device ID*, *BACnet device name* and *BACnet location* can be used to identify the device in the BACnet network.

The following values are assigned by default:

Identifier	Default value
BACnet device ID	1
BACnet device name	*Name of the device*
BACnet location	metering

Table 39: Default values for the identification parameters

12.2.6 Change of Value

Todo.

Configuration

12.2.7 Export of an EDE file

Todo.

Tab meter, export, BACnet must be active, units table

12.3 Data display

12.3.1 Meter values

All meter values are displayed as "Analog Value" at the BACnet interface. The data is structured as follows:

Analog Value [1..n]

{

object-identifier: (analog-value,1)

object-name: "Name Meter 1"

object-type: analog-value

present-value: ?

description: "Beschreibung Meter 1"

status-flags: ?

event-state: ?

out-of-service: ?

priority-array: {NULL, NULL, NULL, NULL, NULL, NULL, NULL,
NULL, NULL, NULL, NULL, NULL, NULL, NULL, NULL, NULL

units: 95

relinquish-default: ?

cov-increment: 0.2

12.3.2 BACnet Device object

The device object of the device is structured as follows:

```
object-identifier: (device,2)
{
 object-name: "ctrl_cb_buero1"
 object-type: device
 system-status: ?
 vendor-name: www.bektasic.de
 vendor-identifier: 725
 model-name: "www-ctrl"
 firmware-revision: "1.3.2"
 application-software-version: "14"
 location: "Buero CB"
 description: "www-controller for Automation"
 protocol-version: 1
 protocol-revision: 12
 protocol-services-supported:
 (
  +-- readProperty
  +-- readPropertyMultiple
  +-- deviceCommunicationControl
  +-- i-Have
  +-- i-Am

 object-list:
 {
  (device,2),
  (analog-output,1),(analog-output,2),(analog-output,3),
  (analog-output,4),(analog-value,1),(analog-value,2),
  (analog-value,3),(analog-value,4),(analog-value,5),
  (analog-value,6),(analog-value,7),(analog-value,8),
  (analog-value,9),(analog-value,10),(analog-value,11),
  (analog-value,12),(analog-value,13)..(analog-value,n))

 max-apdu-length-accepted: 1476
 segmentation-supported: 1 // only transmit
 max-segments-accepted: 4
 local-date: ?
 local-time: ?
 utc-offset: -60
 daylight-savings-status: ?
 apdu-segment-timeout: 3000
 apdu-timeout: 3000
```

number-of-apdu-retries: 3
device-address-binding: ?
database-revision: 1

12.4 Specific troubleshooting

Todo.
If errors could not be rectified, please contact your local Danfoss support.