Data Logger Meteo-42L

Warranty and License Information

```
Ammonit Measurement GmbH
Wrangelstraße 100
10997
Berlin
Germany
```

Linux is a registered trademark of Linus Torvalds. Mozilla Firefox is a registered trademark of the Mozilla Foundation. Windows and Internet Explorer are registered trademarks of Microsoft Corp.

Meteo-42 includes free software developed by third parties, including software code subject to the GNU General Public License (GPL). See Chapter 16.7 to view the terms of this license.

To access the source code distributed under the terms of the GPL or the LGPL used in Meteo-42, contact Ammonit.

Caution

In order to ensure that Meteo-42 data loggers work properly, some requirements should be met.

The data logger can be affected by extreme temperature and humidity conditions. Meteo-42 is designed to operate properly at temperatures between -40 °C and +65 °C in non-condensing environments. The display is readable between -20 °C and +70 °C.

On site the data logger has to be installed in a robust and weatherproof cabinet (see also at www.ammonit.com (`http://www.ammonit.com/`)). The cabinet protects Meteo-42 against weather and condensation damage, theft and vandalism. If humidity tolerance is exceeded and moisture penetrates, the electronics of Meteo-42 can be damaged. Users are responsible for effective humidity control.

Handle Meteo-42 with care, do not drop the device, and avoid mechanical shocks and vibrations to prevent the electronics from being damaged. Do not try to open or break the Meteo-42 housing or any of the slots. Avoid permanent pressure on the data logger.

To ensure that Meteo-42 operates properly, install only equipment, e.g. sensors, adapters and cables, which is undamaged and approved by Ammonit. Contact Ammonit with any questions.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1   Opening Remarks

Meteo-42 data loggers by Ammonit Measurement GmbH are professional measuring devices which record meteorological details in order to calculate the wind energy potential of a site. The data loggers can be used flexibly and are well-suited for a wide range of applications. The implemented standards of measurement evaluation and data security meet the requirements of professional specialists. However, you conveniently configure sensors, statistics and the communication via the user-friendly web interface.

Before installation read this manual carefully. Remember that time spent now setting up the data logger properly might save you from losing valuable data!

We recommend to configure and to test sensors and communication before the measuring equipment is installed on the mast.

We hope you find this manual clear and easy to understand. If you have any comments or suggestions, please let us know.

1.2   Overview of Meteo-42

Depending on the model, Meteo-42 offers up to 48 measuring channels, i.e. up to 14 analog differential voltage inputs, up to 12 counters, up to 12 pulse width inputs and up to 7 digital channels. In addition, Meteo-42 can support up to 24 intelligent sensors via up to 3 physically separated RS485 interfaces.

In general, Meteo-42 is divided into two main units: A communication unit and a measuring unit. The communication unit offers 3 USB slots to connect a PC, modem, web camera, or flash drive, and 1 Ethernet slot to connect a camera or router. Additionally, the Meteo-42 can be connected to the network via Ethernet.

The basic concept is shown in detail in Figure 1.1.

Picture of Meteo-42L with Caption

Figure 1.1: Overview of Meteo-42L

1.3   Meteo-42 Series

The Meteo-42 series differs mainly in the number of input and output channels and in the measurement data storage capacity. Some basic information about the different models (Meteo-42M, Meteo-42L, and Meteo-42A) are shown in Table 1.1.

Feature		Meteo-42M	Meteo-42L	Meteo-42A
Input channels	Counters	8	12	2
	Digital	4	7	4
	Analog Voltage	8	14	14
	Pulse Width	8	12	2
	RS485 Ports	2	3	2
Output channels	Switches	4	8	4
	200uA Current Source	1	1	1
	5V Voltage Source	1	1	1
SCADA		1 dedicated RS485 SCADA port		
Memory Size	Source Data	2 GiB		
	CSV Data	approx. 1.8 GiB		
Connectivity	USB	2 USB host, 1 USB device		
	Ethernet	1 for router, LAN		
Display and keys		LC display with backlight (4 lines each with 20 characters), five keys		
Power supply		9 - 36 V (DC)		

Table 1.1: Meteo-42 feature overview

Find below an overview of the terminals. The white areas indicate available connectors.
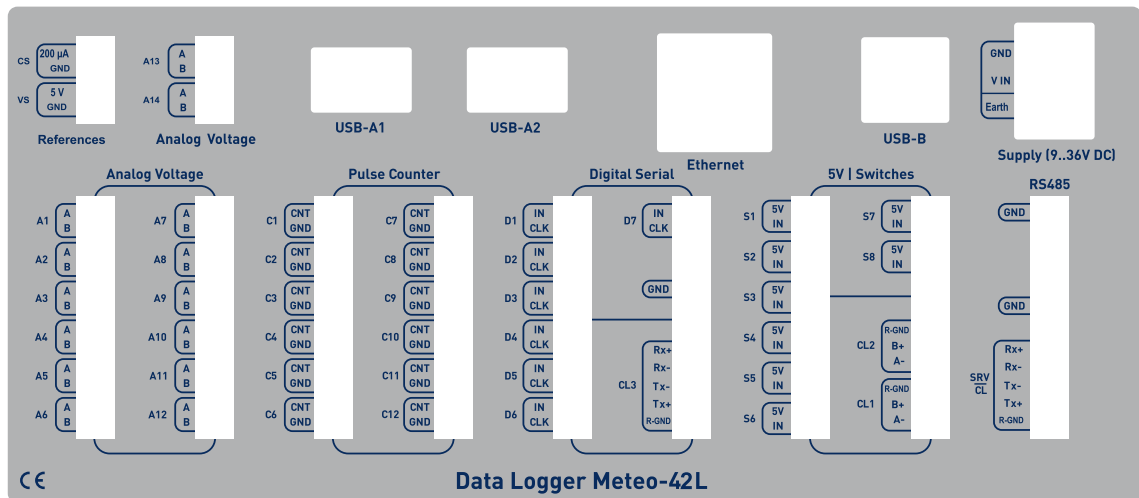
Figure 1.2: Meteo-42L Terminal
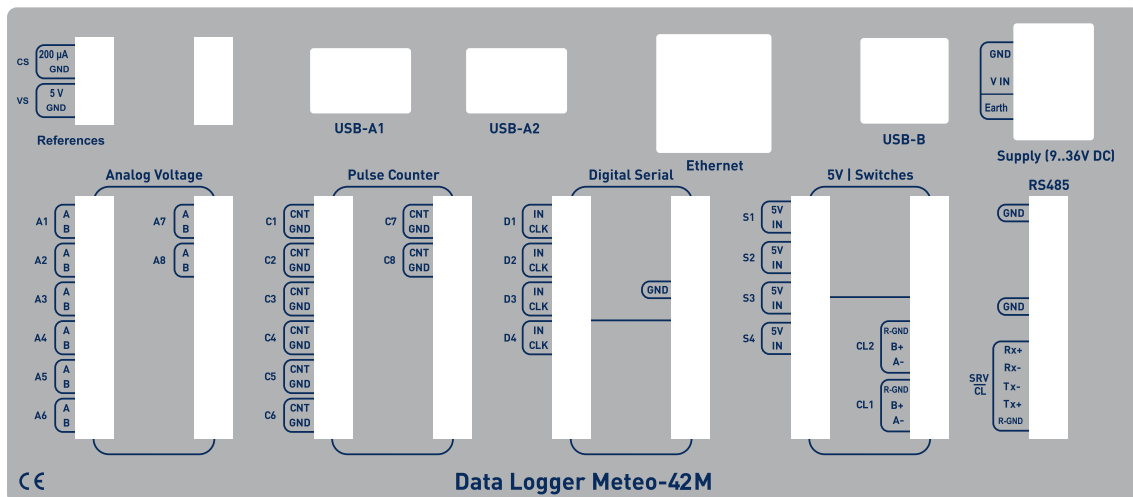
Figure 1.3: Meteo-42M Terminal
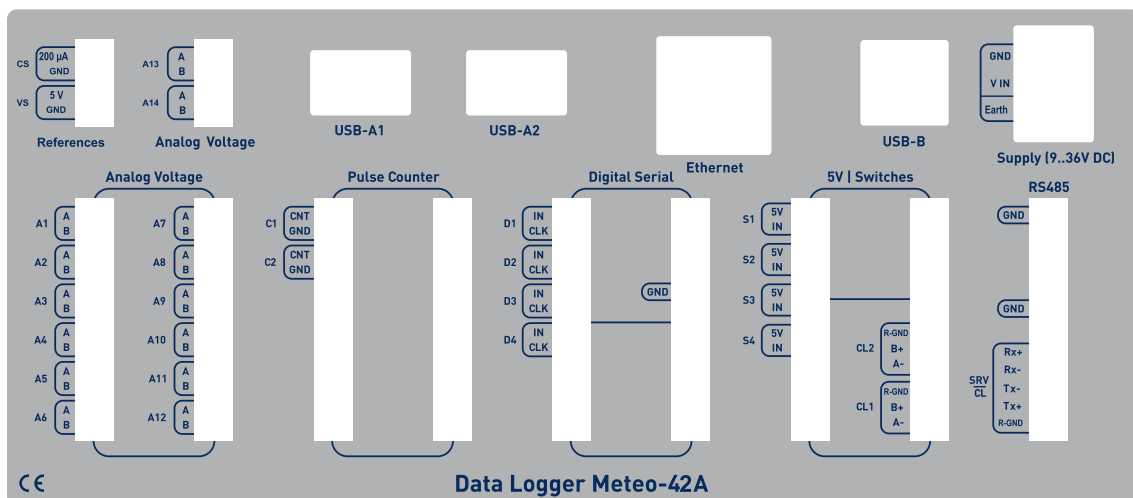
Figure 1.4: Meteo-42A Terminal

1.4   The Two Systems of Meteo-42

Meteo-42 consists of two basic systems: the *Measurement And Recording System* (MARS) and the *Configuration, Evaluation and Communication System* (CECS).

For measuring and recording data, only MARS is needed. MARS is a Cortex™-M3 microcontoller designed to work with minimal power consumption. It controls the analog data logger hardware, measurement channels and data storage. It has no access to the display or to the devices that could be connected via USB or Ethernet.

In order to use connected devices and to operate the display or the web interface, CECS has to be started. CECS is a fully operational embedded Linux™ computer with a 32-bit microcontroller. Starting it activates all Meteo-42's features, but increases power consumption.

To save power during a measurement campaign, CECS is usually powered down and only MARS is running. MARS starts, when the power connector is plugged in.

The booting process of the MARS software is indicated by the illumination of the two lower LEDs (red and yellow). Both LEDs will turn off, when the MARS is started successfully.

CECS can be started either manually or automatically. To manually start CECS, press the middle button of the keyboard and hold it until the display turns on. A manual start of CECS is necessary for the initial configuration of Meteo-42.

Later on, during a measurement campaign, CECS will be started by MARS according to the configured time schedule, e.g. to upload measurement data. After the scheduled actions have been executed, CECS turns off automatically to reduce power consumption.
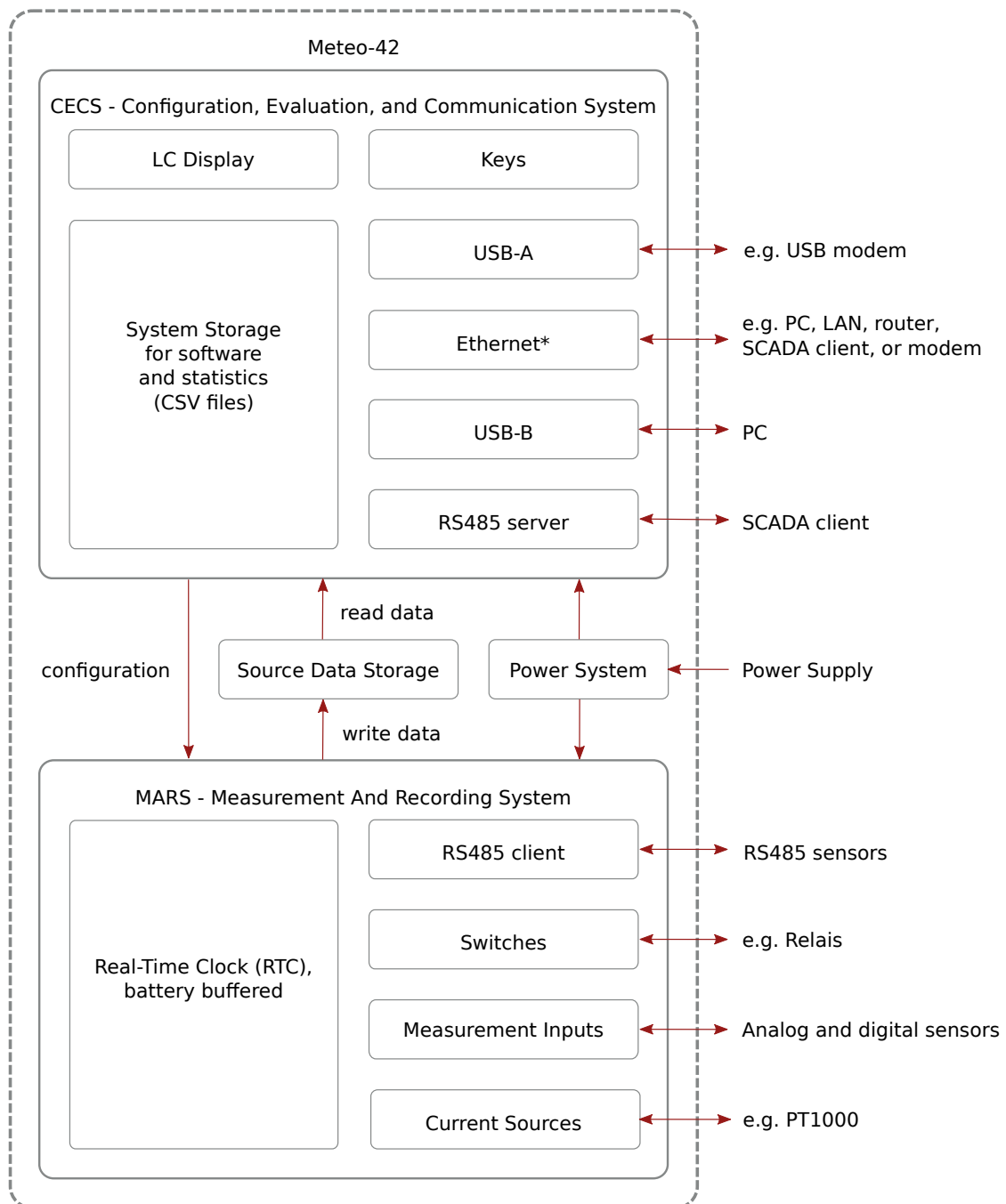
Figure 1.5: Block diagram of Meteo-42

1.4.1   CECS: Switch on / off behavior

CECS is configured to run for 20 minutes, before it automatically turns off. When the time is expired and an action is still running, e.g. sending an email, the system will wait until the action is finished and will switch off afterwards. The remaining time is displayed in the status box (see Section 3.2) of the Meteo-42 web interface.

> **Note**
> With every user action, e.g. navigating the web interface or pressing a button on the keyboard, the remaining time will be reset to 20 minutes.

For SCADA operation, CECS has to run permanently. This is possible by means of the *CECS always active* mode. If *CECS always active* mode is selected, it will be displayed in the status box (see Section 3.2) in the web interface with the infinity symbol (∞) as well as on the Meteo-42 display with the word `Always`.

> **Note**
> The *CECS always active* mode is not selected by default. If the SCADA server is activated, the CECS `always active` mode is automatically set.

If power supply is disconnected and the data logger shuts down while CECS was running in the *CECS always active* mode, it will start automatically as soon as power is available again.

> **Important**
> When CECS is configured to be permanently on, you cannot manually shut down the system by pressing the middle button on the data logger.

1.5   Data Storage

CECS and MARS both have access to the measurement data storage, referred to as the shared source data memory. It is possible to view or download the source data via the web interface, see Section 6.7.

> **Note**
> For optimal data recording, it is recommended to format the data storage before starting a new measurement campaign. Formatting is a very fast process, which only takes a few seconds and can be performed via the web interface under the System → Administration menu. For further details see Section 4.2.

1.6   User Interfaces

There are two ways to control and configure the data logger: via web interface or by using the buttons of Meteo-42. The second method is only intended for checking and testing, since this control menu provides only a limited number of configuration options. However, the web interface offers all available setup options and is recommended for the configuration of the device. To use the web interface a TCP/IP or USB connection is required.

Thanks to its web interface, Meteo-42 can also be operated via Internet with mobile devices, e.g. smartphone or tablet PC.

> **Important**
> The Meteo-42 web interface is accessed via HTTPS connection, which uses high-grade encryption (AES-256, 256 bit). This connection cannot be decrypted using today's technologies.

1.7 Communication Methods and Required Devices

Depending on the project, Meteo-42 offers various methods for communication and data retrieval. All available methods are commonly used as well as easy to handle and to configure. In order to set up the connection to Meteo-42, devices like Ethernet cable or modem are necessary as shown in the following table.

Method / Action	Configuration	Software Update	Data Download	Required Devices	Comment
Meteo-42 (stand-alone)	no (only a few settings can be changed)	no	no	-	Using the display (see Section 4.4.1 and Chapter 9).
USB flash drive (connected to data logger)	no	no	yes	USB flash drive	Manual data download on pre-configured USB flash drive (see Section 4.2).
LAN (data logger connected to LAN)	yes	yes (Internet access required)	yes (Data transfer via email, SCP/FTP/S-FTP/FTPS, AmmonitOR or manual data download via web interface)	Ethernet cable	Recommended for initial configuration and software updates (see Section 2.3).
WLAN (PC, laptop etc. connected to data logger's WLAN)	yes	no	yes (Download via web interface)	USB WLAN dongle	Recommended on site for maintenance (see Section 7.8).
Point-to-Point Ethernet (data logger connected to PC)	yes	no	yes (Download via web interface)	Ethernet cable	PC has to be configured (see Section 2.4).
USB (data logger connected to PC)	yes	no	yes (Download via web interface)	USB (A/B) cable	Backup access. Driver file might be required (see Section 2.5).
USB (data logger connected to smartphone)	yes	yes, tethering function of the smartphone needs to be activated	yes (Download via web interface)	USB cable of the smartphone (accessory)	Convenient for remote servicing or software upgrades, when no modem is installed.
Modem access (data logger connected to modem, e.g. GPRS/GSM, directional radio, satellite)	yes	yes (Internet access required)	yes (Data transfer via email, SCP/FTP/S-FTP/FTPS, AmmonitOR or manual data download via web interface)	Modem and accessory cable	Thanks to AmmonitConnect a standard SIM card can be used in a GSM modem. A SIM card with a static IP address is not necessary. (see Section 7.9).

Method / Action	Configuration	Software Update	Data Download	Required Devices	Comment
SCADA over RS485 (Modbus RTU)	no	no	yes (Modbus protocol)	-	Modbus register map has to be configured for data retrieval (see Section 8.1).
SCADA over Ethernet (Modbus TCP/IP)	no	no	yes (Modbus protocol)	-	Modbus register map has to be configured for data retrieval (see Section 8.1).

Chapter 2

Getting Started with Meteo-42

2.1 Introduction

Before you start working with Meteo-42, connect the data logger to the power supply. The moment Meteo-42 is connected to the power supply, the lower LED lights turn on and indicate that the Measurement And Recording System (MARS) is booting. Both LEDs turn off, when MARS has successfully started and is running. To access the web interface, the second system Configuration, Evaluation and Communication System (CECS) has to be started. Press the middle button of Meteo-42 and hold it until the display turns on (see Section 1.4).

In order to access the web interface, it is necessary to establish a TCP/IP connection between the host PC and Meteo-42. There are multiple ways to create this connection:

1. Ethernet with DHCP: If you connect the data logger to your LAN using an Ethernet cable (see Section 2.3) and DHCP (Dynamic Host Configuration Protocol), any other device in the LAN (e.g. your PC) will have access to the web interface of the data logger, as long as the CECS is running.

LAN connection between Data Logger and PC
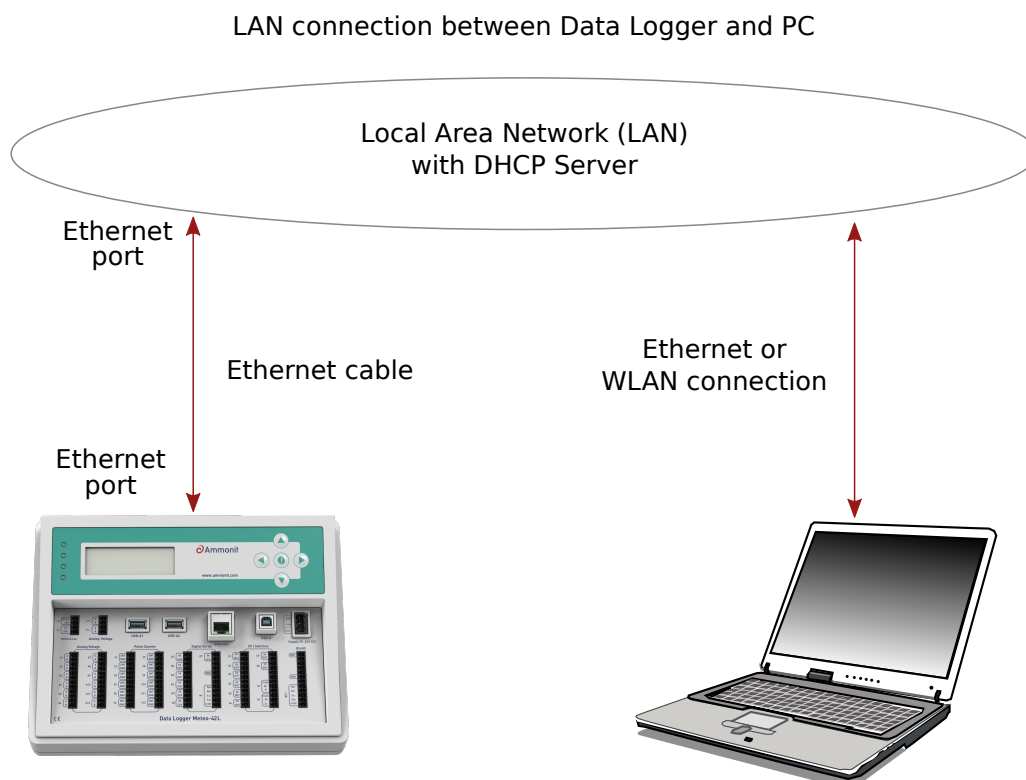
Figure 2.1: Accessing Meteo-42 via LAN (see Section 2.3)

2. Ethernet with `link-local` or `static IP`: Here, only a point-to-point connection between the data logger and the PC is established (see Section 2.4). The `link-local` method is recommended.

Point-to-point Ethernet connection between Data Logger and PC
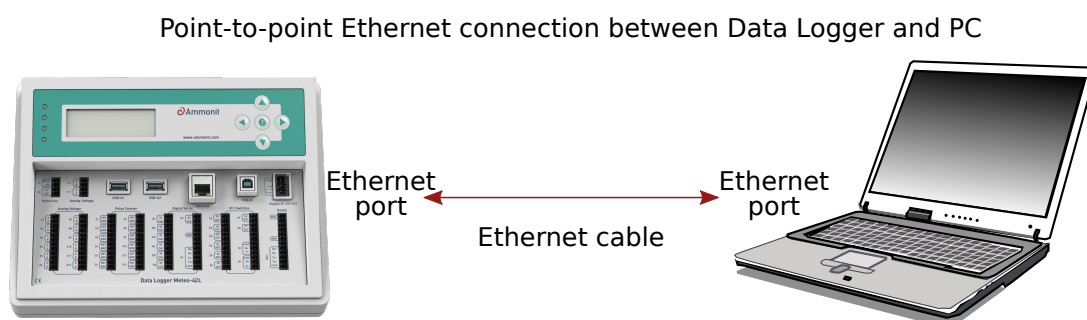
Figure 2.2: Accessing Meteo-42 via Point-to-Point Ethernet Connection (see Section 2.4)

3. USB: There are two options, either with a USB 2.0 A to B cable (The same type of cable is typically used to connect a USB printer to a PC) or with a micro-USB cable and activated USB tethering (see Section 2.5).

USB Connection between Data Logger and PC or Mobile Phone

USB A
port

USB B
port

USB A/B cable

USB A
port

Micro
USB B
port

Micro USB cable
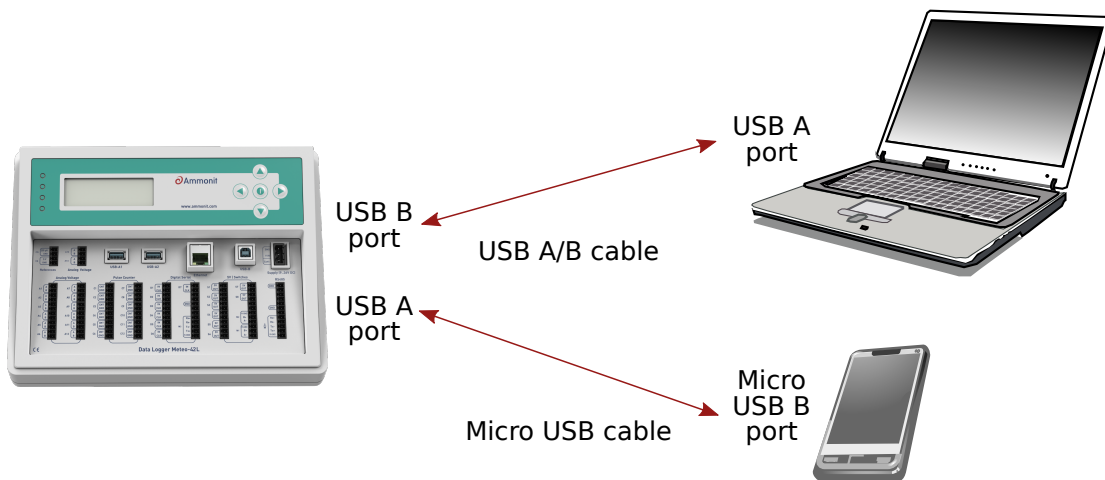
Figure 2.3: Accessing Meteo-42 via USB-B (see Section 2.5)

Important

If you establish a connection via USB, a driver file might be needed for Windows PCs. The driver file can be downloaded from download.windowsupdate.com (`http://download.windowsupda te.com/msdownload/update/driver/drvs/2012/12/20342322_4b9970e3174b23b5cb 2371af0837f939a71271ea.cab`). For further details refer to Section 2.5.

Note

After having configured Meteo-42 for WLAN, the data logger web interface can also be accessed by using a WLAN USB dongle (see Section 7.8).

Picture of Ethernet / USB ports of Meteo-42L

Figure 2.4: Ethernet / USB ports of Meteo-42L

Tip

We recommend connecting Meteo-42 via Ethernet to your LAN. It is the easiest method, no additional driver file is needed and updates can be performed immediately.

2.2   Using Bonjour™ on Windows™

For Windows Vista™ and later versions, this procedure can be simplified by installing the software Bonjour Print Services for Windows from Apple (`http://support.apple.com/kb/DL999`). It provides automatic resolution of computer host names and the data logger can be accessed via its serial number. Unfortunately, our tests have revealed that this software can cause problems when installed on Windows XP.

After the installation of Bonjour Print Services just type the serial number as follows in your web browser `https://Dnnnnnn.local` with *Dnnnnnn* as your data loggers serial number. The untrusted connection alert page will appear and should be accepted as described in Section 2.5.1.

Ammonit

Meteo-42 G001234

Username:

Password:

☐ Show password

☐ Low traffic mode

Login

中文(简) English Español Português Français Deutsch 日本

© 2011-2023 Ammonit Measurement GmbH
www.ammonit.com

Figure 2.5: Meteo-42 web interface initial screen

2.3 Connecting Meteo-42 via Ethernet to your LAN

In order to connect Meteo-42 with your PC via Ethernet, both devices have to be connected to your local network. Your PC should be connected via LAN or WLAN to your network. To connect Meteo-42 to the network, a standard Ethernet cable is needed. If you have only one Ethernet port in your office, use a switch or a hub to multiply the available Ethernet ports. See Figure 2.1.

To see that Meteo-42 has been connected successfully, use the buttons on the data logger to navigate through the menu. In the Communication → Devices → LAN menu you can find a list of connections, which displays all available connections. If `eth Activated` is displayed, the connection has been successfully established.

By opening this menu item (click on the right button of the data logger keyboard), you can browse for the connection properties such as IP address, which was automatically assigned to the data logger by DHCP server. To access the web interface, start your web browser. Enter `https://` and the IP address shown in the data logger display, e.g. https://192.168.12.30.

Tip
We recommend using Mozilla Firefox (`http://www.mozilla.com/`) as your web browser to access Meteo-42. Other modern web browsers, including mobile web browsers, should work as well, but are not systematically tested by Ammonit.

After entering the address in your web browser, a confirmation prompt may appear. Click *I understand the risks* and press *Add Exception*.

© 2011 — 2023 Ammonit Measurement GmbH
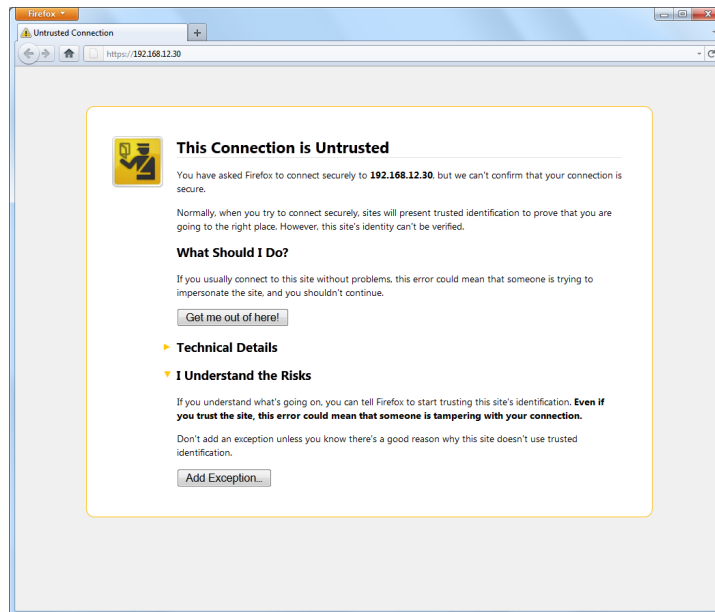
Figure 2.6: Firefox Connection Untrusted alert page

In the next step download the certificate by clicking on *Get Certificate* and *Confirm Security Exception* to access the Meteo-42 web interface. In order to save the exception *Permanently store this exception* should be checked.
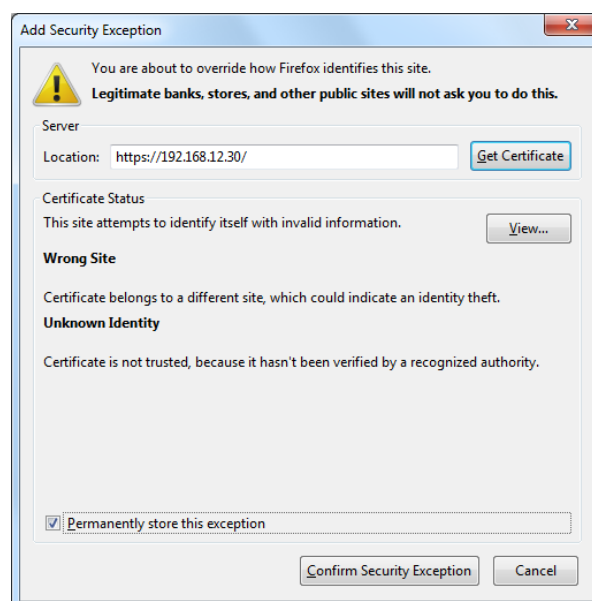
Figure 2.7: Add Security Exception

⚠️ **Important**
In order to prevent misuse of the certificate, Ammonit deliberately did not store the security certificate on each data logger. After downloading the certificate, its validity can be verified.

URL: https://192.168.43.21/

⟳ Ammonit

Meteo-42 G001234

Username:

Password:

☐ Show password

☐ Low traffic mode

Login

中文(简) English Español Português Français Deutsch 日本   © 2011-2023 Ammonit Measurement GmbH
                                                                        www.ammonit.com

Figure 2.8: Meteo-42 web interface initial screen

Important

In order to use all functions of the web interface, activate JavaScript and Cookies in your web browser!

Go to Chapter 3 to proceed with the configuration.

2.4 Connecting Meteo-42 to your Windows 10™ PC via point-to-point Ethernet connection

In order to connect Meteo-42 with your Windows 7™ PC, an Ethernet cable is required. No additional driver file is needed for a direct point-to-point connection via Ethernet. See Figure 2.2.

Before you connect the devices, Meteo-42 has to be configured to use either a *link-local* connection or a *static IP address*. The former is much easier to use, because it does not involve any manual configuration of the PC, if it has the standard configuration of obtaining an IP address automatically.

2.4.1 Using link-local connection

To use a link-local address, you have to make sure your PC is configured to obtain an IP address automatically. In most cases, this is already be the case.

In the next step Meteo-42 has to be configured for the link-local Ethernet connection. Open the Communication → Devices → LAN menu and select *eth0*. Move to *Method* and press the right button on the Meteo-42 keyboard. The > symbol should now change to >>. Now, you can select `Link-local` by pressing the up or down button. When you are done, press the left button. Figure 2.9. Note that *DHCP* is configured by default to support standard LAN (see Section 2.3) connection via Ethernet.

```
  IP / Netmask
  DNS Servers
  Routes
> Method: Link-local
```

Figure 2.9: Meteo-42 display with activated link-local connection

Open your browser, e.g. Mozilla Firefox. When you are using a Mac or a Linux computer, or when you have installed `Bonjour` on a Windows PC, you can just enter `https://Dnnnnnn.local` in the URL field of your web browser.

Otherwise, look up the IP number in the menu and enter the number as follows `https://169.254.nnn.nnn` as URL. For *link-local* connection, IP addresses start always with `169.254.`, while the remaining numbers are random and change every time.

2.4.2   Using static IP address

To use a static IP address, you need to configure both, your PC and the Meteo-42. To configure the PC, open the *Network and Sharing Center* in the *Control Panel* of your computer and click on *LAN Connection* (see Figure 2.10). In most cases, the link-local connection Section 2.4.1 is preferable.
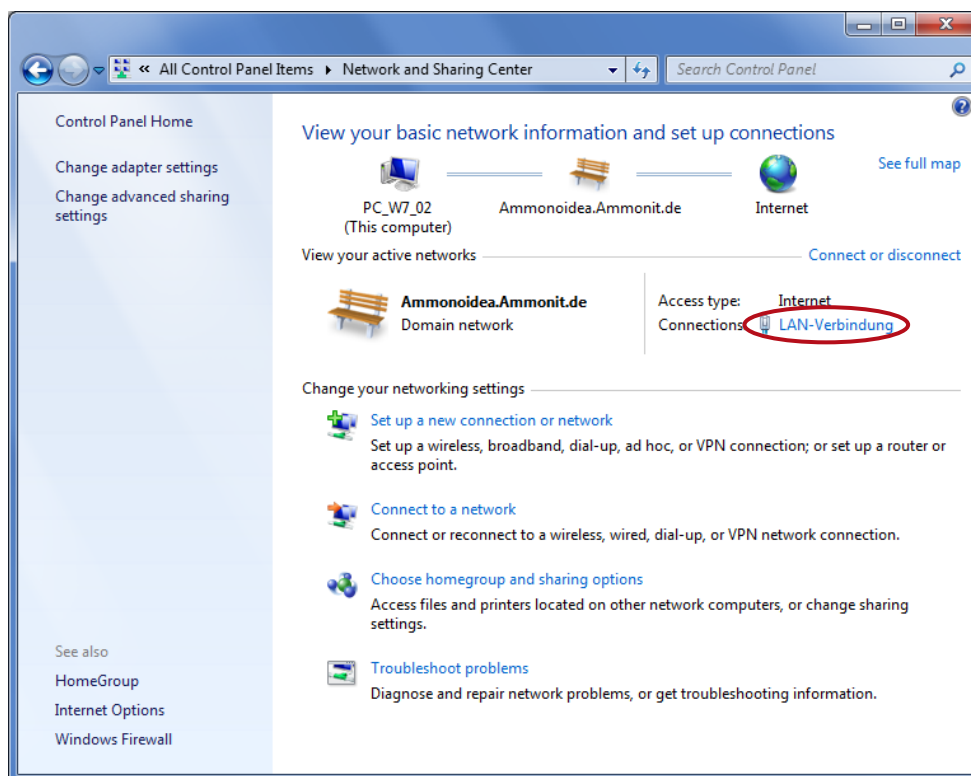
Figure 2.10: Network and Sharing Center of Windows 7™

To configure the LAN connection, click on *Properties* (Figure 2.11) in the LAN Connection Status window.
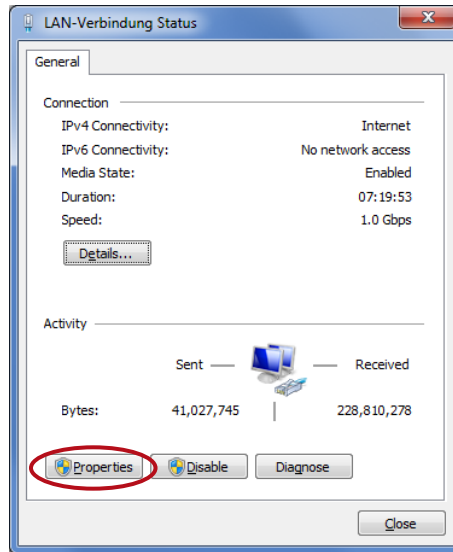
Figure 2.11: LAN Connection Status

Select *Internet Protocol Version 4 (TCP/IPv4)* and open the *Properties* of the Internet protocol as shown in Figure 2.12
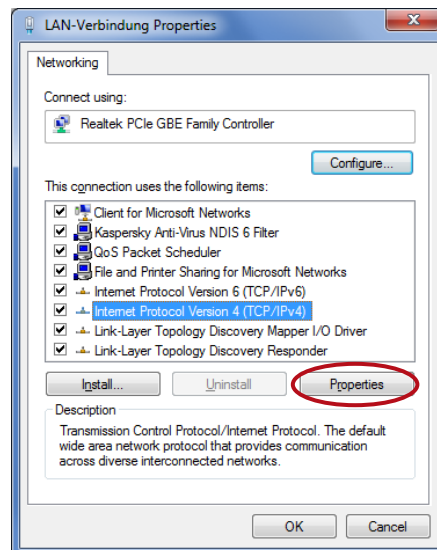
Figure 2.12: Properties of LAN Connection

Choose *Use the following IP address* and enter the following IP address 192.168.40.1 as shown in Figure 2.13. By pressing the TAB button the Subnet mask will be filled automatically. Save the configuration with *OK*.

> **Important**
> If you do not have the rights to configure the settings, contact your system administrator.
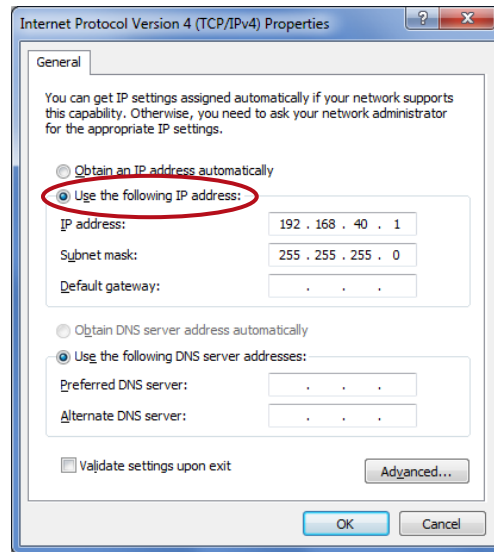
Figure 2.13: Properties of Internet Protocol

After having configured the LAN connection, connect your PC with your Meteo-42 using a standard Ethernet cable and switch on your Meteo-42 by pressing the middle button of the keyboard.

In the next step the Meteo-42 has to be configured for the static IP point-to-point Ethernet connection. Open the Communication → Devices → LAN → Ethernet menu and select *Ethernet (Offline)*. Move to *Method* and press the right button and afterwards the up and down buttons on the Meteo-42 keyboard until `Static IP` is displayed.

```
  IP / Netmask
  DNS Servers
  Routes
> Method: Link-local
```

Figure 2.14: Meteo-42 display with activated link-local connection

Open your browser, e.g. Mozilla Firefox. When you are using a Mac or a Linux computer, or when you have installed `Bonjour` on a Windows PC, you can just enter `https://Dnnnnnn.local` in the URL field of your web browser.

Otherwise, just enter `https://192.168.40.40`, where 192.168.40.40 is the preconfigured IP address of each Meteo-42 data logger.

Afterwards a confirmation prompt appears. Click *I understand the risks* and press *Add Exception* as shown in Figure 2.15.
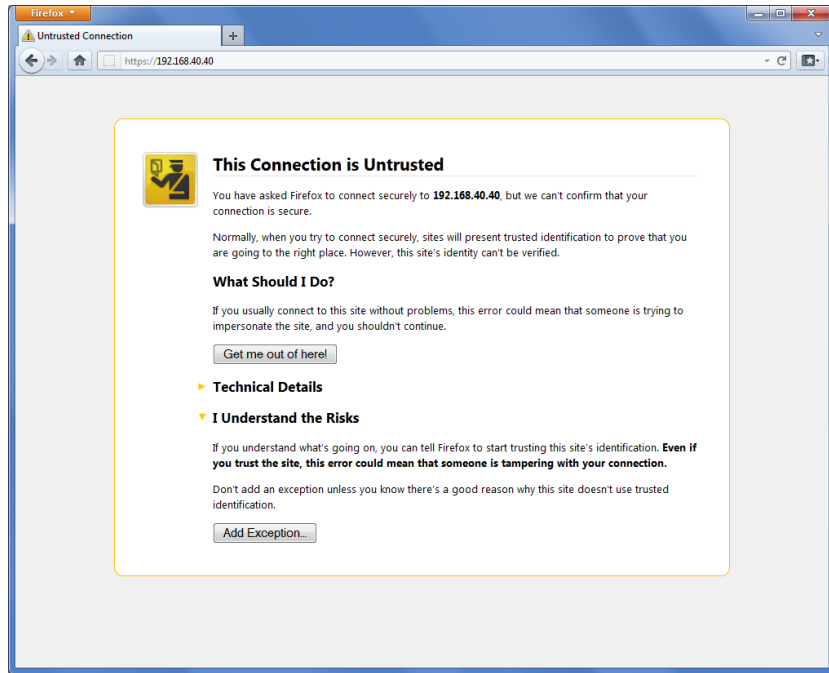
Figure 2.15: Mozilla Firefox Connection Untrusted Alert Page

In the next step download the certificate by clicking on *Get Certificate* and *Confirm Security Exception* to access the Meteo-42 web interface. In order to save the exception, *Permanently store this exception* should be checked.

Figure 2.16: Add Security Exception

After confirming the certificate, the Meteo-42 login page is shown. Use your login details (Meteo-42 certificate) to enter the web interface. To proceed with the configuration, go to Chapter 3.

URL: https://192.168.40.40/

ᗧAmmonit

| Meteo-42 G001234 |

Username:

Password:

☐ Show password

☐ Low traffic mode

Login

中文(简) English Español Português Français Deutsch 日本   © 2011-2023 Ammonit Measurement GmbH
www.ammonit.com

Figure 2.17: Meteo-42 web interface initial screen

Tip
By using this point-to-point connection (without Internet access), the modem connection can be tested, e.g. sending emails via modem.

Note
Do not forget resetting the LAN configuration on your PC (Internet protocol properties) and enabling DHCP on Meteo-42 (if needed).

2.5   Connecting Meteo-42 with your Windows 10™ PC via USB

Meteo-42 requires a standard RNDIS USB driver. You can download it from download.windowsupdate.com (`http://download.windowsupdate.com/msdownload/update/driver/drvs/2012/12/20342322_4b9970e3174b23b5cb2371af0837f939a71271ea.cab`).

Tip
You can also connect Meteo-42 to your tablet PC or smartphone by using a micro USB cable as shown in Figure 2.3. In doing so, you can easily connect to the data logger for maintenance reasons in the field or for performing updates using the tethering function of your mobile device (see also Section 4.3.1).

2.5.1   Standard RNDIS USB Driver

Unpack the file `20342322_4b9970e3174b23b5cb2371af0837f939a71271ea.cab`, downloaded from download.windowsupdate.com (`http://download.windowsupdate.com/msdownload/update/driver/drvs/2012/12/20342322_4b9970e3174b23b5cb2371af0837f939a71271ea.cab`) by double-clicking on the file icon, then mark both contents, right-click and select then Extract....
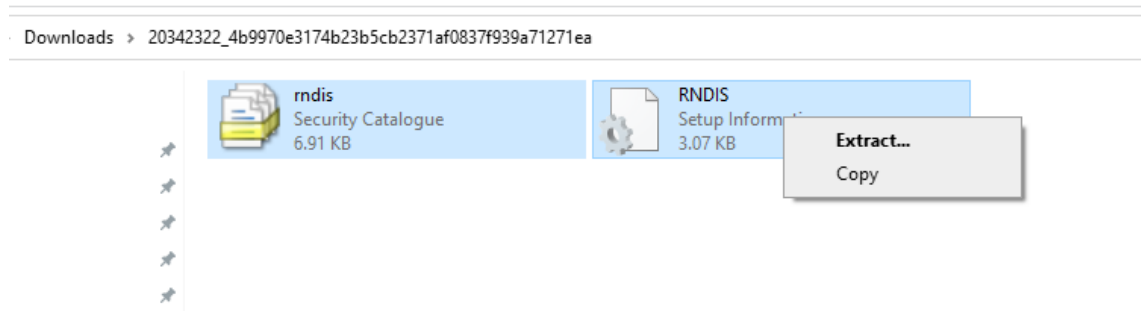
Figure 2.18: Unpack Windows Driver Software

Now you have two files, `rndis.cat` (*Security Catalogue*) and `RNDIS.inf` (*Setup Information*). The former is the digital signature by Microsoft, the latter is the actual device driver file.
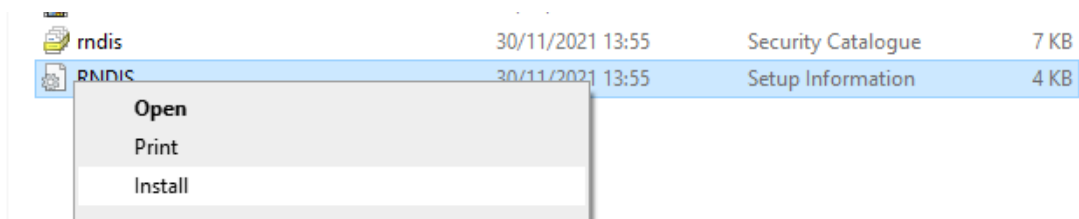
Figure 2.19: Select Installation of RNDIS Driver

You probably get the following security warning, which you need to confirm by clicking on Open:
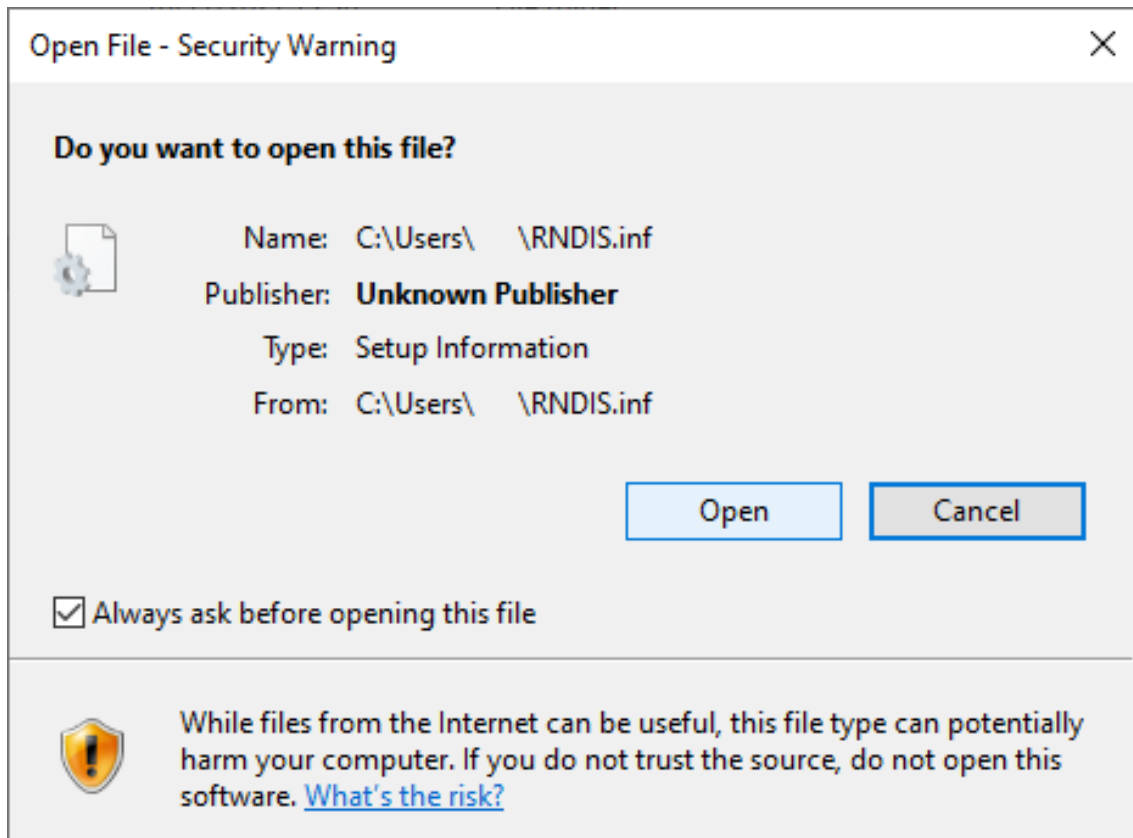
Figure 2.20: Confirm Security Warning

Finally, confirm the success dialog, by clicking on OK:
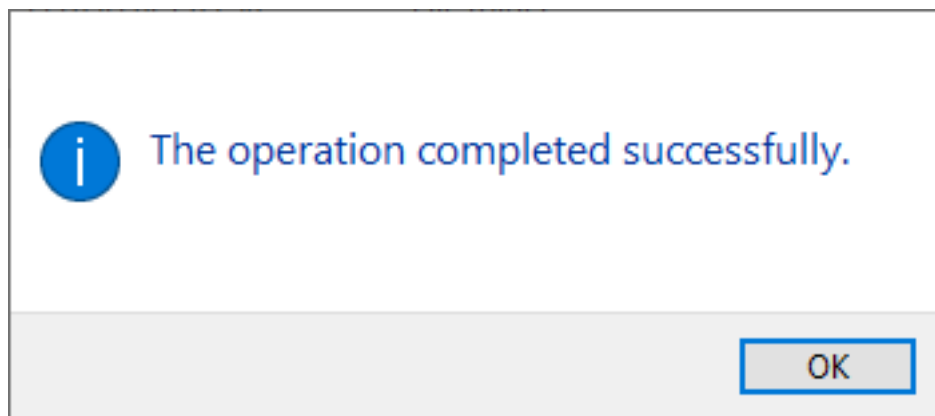
Figure 2.21: Confirm Operation Successful

The local connection can be established now by pluging in the USB cable. An IP address is automatically assigned to the data logger, which can be found on its display in the menu Communication → Devices → LAN → USB under IP/Netmask. To start using Meteo-42, type the address in your web browser, e.g. `https://169.254.12.25/`. The address always starts with `169.254`, the remaining part is random.

> **Tip**
>
> We recommend using Mozilla Firefox (`http://www.mozilla.com/`) as your web browser to access Meteo-42. Other modern web browsers, including mobile web browsers, should work as well, but are not systematically tested by Ammonit.

> **Important**
>
> In order to use all functions of the web interface, activate JavaScript and Cookies in your web browser!

After entering the address in your web browser, a confirmation prompt may appear. Click *I understand the risks* and press *Add Exception*.
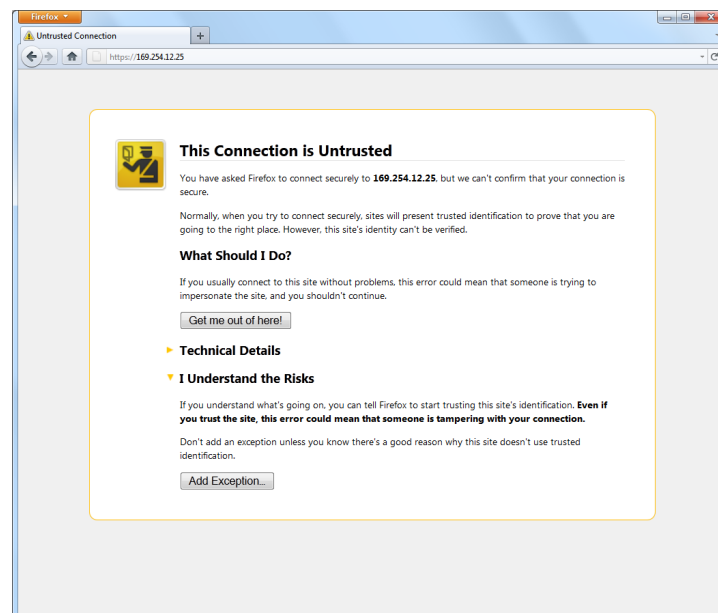
Figure 2.22: Firefox Connection Untrusted alert page

In the next step download the certificate by clicking on *Get Certificate* and *Confirm Security Exception* to access the Meteo-42 web interface. In order to save the exception, *Permanently store this exception* should be checked.
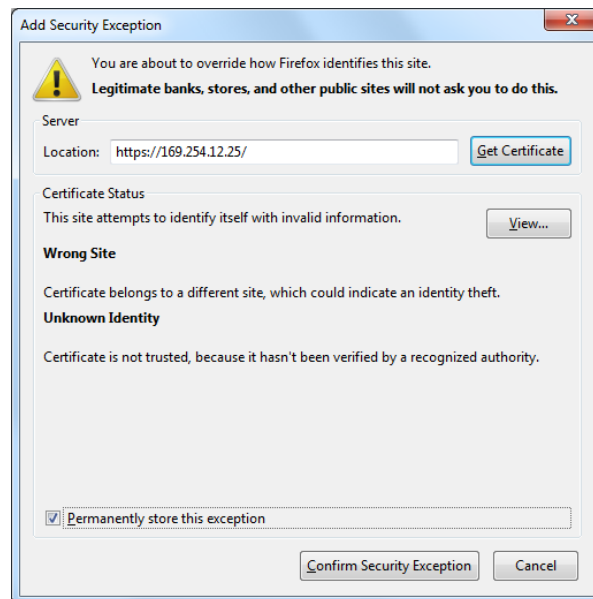
Figure 2.23: Add Security Exception

⚠ **Important**

In order to prevent misuse of the certificate, Ammonit deliberately did not store the security certificate on each data logger. After downloading the certificate, its validity can be verified.

Figure 2.24: Meteo-42 web interface initial screen

2.6   Using Meteo-42 with Linux

Recommended is any up-to-date Linux distribution with installed Network Manager (`http://projects.gnome.org/NetworkManager/`). Configure the RNDIS/Ethernet Gadget to use link-local and connect the Meteo-42 with the PC. You should be able to access the Meteo-42 with your web browser now.

Chapter 3

Login at Meteo-42

3.1   Login Options

Once you access the login page of the data logger over the web interface, you may log into one of four accounts, which have different access rights: `Guest`, `Viewer`, `User` or `Admin`.

URL: https://g001234.local/

Ammonit

Meteo-42 G001234

Username:

Password:

☐ Show password

☐ Low traffic mode

Login

中文(简) English Español Português Français Deutsch 日本   © 2011-2023 Ammonit Measurement GmbH
                                                                          www.ammonit.com

Figure 3.1: Login Screen

The original access password for each account is enclosed in the data logger's delivery. The passwords are unique for each Meteo-42. All passwords can be changed by an Admin user. Admin users can also create, edit and delete other accounts. (see User Management: in Section 4.2).

⚠ **Warning**
Be careful if you change the password for the Admin account. A forgotten Admin password cannot be recovered. The data logger must be returned to Ammonit to restore the original password.

Account	Permissions
Guest	• Look at all configuration pages • Look at live data
Viewer	• All of the above • Download measurement data
User	• All of the above • Configure the data logger • See and change communication and encryption passwords
Admin	• All of the above • Change the name of the data logger • Upgrade the data logger software • Change all users access passwords

Table 3.1: Accounts and permissions

The Meteo-42 web interface is available in seven languages: Chinese, English, French, German, Portuguese, Spanish and Japanese.

There is a "Low traffic mode" checkbox which will prevent parts of the page from being updated asynchronously. It is particularly recommended when using BGAN satellite modems.

! **Important**
In order to use all functions of the web interface, activate JavaScript and Cookies in our web browser!

After login, two links are shown in the upper right corner:

Help Access online help.

Logout Close the session, when access to the data logger is no longer needed.

Under these links the account you are logged into (`Guest`, `Viewer`, `User` or `Admin`) is shown, followed by the serial number of the data logger.

⚠ **Warning**
Be aware that due to security reasons it is not possible to reset the access passwords. Furthermore, if you change the `Admin` password and forget it, there is no way to recover it, not even for Ammonit. In this case, you have to send the data logger to Ammonit, so that we can restore the original passwords.

3.2   Global Control Elements

A Status Box is shown in the upper left corner of the Meteo-42 web interface. It always shows the most important information and control options.

Recording:	**On**	Switch off
Configuration:	**Saved**	Save
Connection:	**MODEM, Ethernet, AmmonitConnect⁺**	
Remaining:	**∞ (3)**	
Date/time:	**2023-08-11 16:01:01 UTC**	
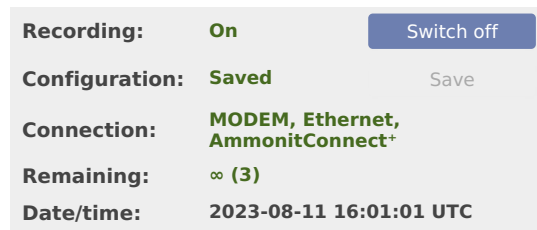
Figure 3.2: Meteo-42 Status Box with Recording Enabled

Recording:	⚠ **Off**	Switch on
Configuration:	⚠ **Unsaved**	Save
Connection:	**USB**	
Remaining:	**12:34**	
Date/time:	**2023-08-11 16:01:05 UTC**	

Figure 3.3: Meteo-42 Status Box with Recording Disabled

The Status Box displays whether Meteo-42 is recording data and whether the current configuration is saved. You can switch on or off recording here and save the configuration after having made any changes.

Note

If you switch `Recording` on, the `Configuration` will be saved automatically.

Important

If you switch `Recording` off, no measurement data will be saved to memory and no live data will be shown. If `Configuration` is not saved, you have changed the configuration and the old configuration is active. You must save the configuration to use the new configuration permanently. If you do not save the configuration, your settings will be lost after disconnecting the power supply!

The Meteo-42 Status Box displays the current established connections (`Connection`), e.g. AmmonitConnect via modem or using Ethernet directly in a LAN. The available connection modes are USB, Ethernet and Modem. If the data logger is available through the tunnel, it will be shown as `AmmonitConnect` in the connections list. If maintenance access is enabled, there will be a superscript plus (□) after `AmmonitConnect`. The current preferred connection for the Internet access is written in capital letters.

Additionally, the web interface informs about the remaining time until shut down or whether CECS is configured to run permanently (`Remaining`). In brackets the number of running actions are displayed, e.g. online access or upload of CSV file.

Figure 3.2 shows a Meteo-42 with recording on and configuration saved which has a primary modem connection and a secondary ethernet connection (e.g. for SCADA via Modbus TCP). CECS is always on and three actions are running.

Figure 3.3 shows a Meteo-42 with recording off and configuration unsaved which is connected by USB-B. CECS will remain on for 12 minutes and 34 seconds without further interaction and no actions are running.

3.3   Menu of the Web Interface

The menu of the Meteo-42 web interface consists of four main menu items: *System*, *Measurement*, *Evaluation* and *Communication*. Each menu item is explained in the following chapters (See Chapter 4 to Chapter 7).

Menu	Submenu Item
System	Information
	Administration
	Upgrade
	Device
	Camera
	Switches
	Logbook
Measurement	Sensors
	Channels
	Evaluation
Data	Live
	Statistics
	Gusts
	Source
Communication	Schedule
	Online
	AmmonitOR
	Email
	Remote Copy
	SCADA
	LAN
	WLAN
	Modem

Table 3.2: Menu of the Web Interface

Chapter 4

System Configuration

4.1   System Information

This page gives an overview of important system properties, such as data logger type, serial number, available memory, software versions and number of channels.

⊘ Ammonit

Recording:	⚠ **Off**	Switch on
Configuration:	**Saved**	Save
Connection:	**Ethernet**	
Remaining:	**∞**	
Date/time:	**2023-08-11 15:56:15 UTC**	

System Information

Meteo-42

System
Information
Administration
Upgrade
Device
Camera
Switches
Logbook

Measurement
Sensors
Channels
Evaluation

Data
Live
Statistics
Gusts
Source

Communication
Schedule
Online
AmmonitOR
Email
Remote Copy
SCADA
LAN
WLAN
Modem

Data logger type	**Meteo-42L**
Serial number	**G001234**
Number of channels	**14 analog voltage, 12 counters, 1 current sources, 1 voltage sources, 7 digital, 8 switches, 24 RS485, 12 period measurement**
Active input channels	**none**
Installed sensors	**none**
Data logger location	**13.43479, 52.50176 @ 36.5 m**
RAM	**Total: 7522 MiB, Used: 3695 MiB, Available: 3121 MiB**
Source data storage	**0.49 MiB (0.00% used, current page-id: 0) ---**
System storage	**Total: 237791.37 MiB, Used: 218186.79 MiB, Free: 19604.58 MiB**
Number of statistics files	**3**
Uptime	**CECS: 6:53:14, MARS: 0:00:09**
Software version	**2.1.14 (2023-08-01)**
Production date	**2023-08-02 15:17:50**
AmmonitOR	**ABCD**
Signing/encryption	**signing**
SCADA	**Modbus TCP**
Current connections	**none**
Metering	**unknown**

⬇ Download current configuration

Choose File No file selected

Upload configuration file

中文(简) English Español Português Français Deutsch 日本

Figure 4.1: System Information Page

RAM shows the total Random-access memory available to the CECS, how much of it is used and how much is free for system processes. If the free RAM is low (indicated in red), the CECS should be restarted.

Source data storage shows the amount of memory which is already in use for storing source data. Please note that more than 100% is possible. A value beyond 100% means that the data logger is overwriting the oldest source data by storing new data. e.g. 110% means that the oldest 10% has been overwritten.

Metering shows the amount of traffic used by each network interface since the last reset (see Section 4.2).

Under *Current connections* all current logins are displayed with IP address, e.g. via LAN, link-local USB or W-LAN (WiFi). Connections estabilshed via AmmonitConnect are indicated as such (see Section 7.3).

Use *Download Current Configuration* to download the configuration file. The configuration file is an INI file (`http://en.wikipedia.org/wiki/INI_file`), which is a widely-used file format. This file contains configuration settings related to modem, Ethernet, server upload, email, data evaluation, SCADA as well as activated channels and sensors. By saving a configuration file, the configuration can quickly be uploaded and effectively applied to other data

loggers. The file name is `config-Gnnnnnn.txt` with Gnnnnnn as the serial number of the data logger. Configuration files are both forwards and backwards compatible.

> **Warning**
>
> If the configuration file is from a larger model, e.g. downloading from Meteo-42L and uploading to Meteo-42M, the sensors and evaluations which use channels which the smaller model does not have will be ignored.
>
> Be careful with uploading a changed INI file to the data logger. Inconsistencies can lead to malfunctions of the data logger.
>
> We strongly advice not to change any entry in the configuration file manually.

4.2   System Administration

This page contains different administration aspects of the data logger. Only users logged in as `Admin` can access the complete functionality of this section. If you are logged in as `User`, `Viewer` or `Guest`, changes in the System → Administration menu are not possible.

Data Logger Name: By giving each Meteo-42 a name, the data loggers can be identified easier. The name appears in the statistics file footer, on AmmonitOR (`http://or.ammonit.com/`) and in the `config.txt` file.

Documentation

Data logger name

[   ]

Power Supply

☐ Battery

☐ Solar

☐ Wind turbine

☐ Electrical grid

☐ Generator

☐ Fuel cell

☐ Other

Minimum supply voltage

[11.5   ⬚]

[Save documentation]

Figure 4.2: Assigning a Data Logger Name

> 📎 **Note**
>
> The data logger serial number is the most important ID to identify the data logger. Use the *Data Logger Name* to give the data logger a custom name, e.g. `Meteo-42 Site 1`.

CECS Power Mode   The standard operation mode keeps CECS running for 20 minutes. Each user interaction resets the remaining time to 20 min.

In order to keep CECS permanently running, e.g. for SCADA wind farm monitoring, Meteo-42 offers the *CECS always active* mode. This mode prevents the automatic shutdown of CECS. It can be configured via web interface (System → Administration) or by using the display (Status → CECS) of the data logger. To do any changes of the CECS mode via display, permissions have to be defined in the web interface (System → Display, see Section 4.4.1). If the *CECS always active* mode is selected, it will be displayed in the status box of the web interface with the infinity symbol (∞) as well as on Meteo-42 display with the word `Always`. The *CECS always active* mode is not selected by default.

<div style="text-align:center;">

CECS Power Mode

Restart CECS

Shutdown CECS

☒ CECS is always active (only recommended for SCADA and Switch Manager)

Automatic CECS reboot ('Never' only recommended for SCADA)
Weekly ▼

Power CECS on digital status signal
None ▼

Save CECS power mode

</div>

Figure 4.3: Configuring the *CECS always active* Power Mode

Note
When the *CECS always active* mode is set, you cannot manually shut down the system by pressing the middle button on the data logger.
If the power supply for Meteo-42 is disconnected while CECS is running in the *CECS always active* mode, CECS will restart automatically as soon as Meteo-42 is powered again.

To ensure reliable Meteo-42 functionality it is highly recommended to reboot CECS regularly. In cases where CECS is always on, e.g. for SCADA, Meteo-42 has an automatic reboot function. The default behavior of Meteo-42 is to reboot once a week, every Sunday five minutes before midnight. Alternatively, you can choose to reboot every day five minutes before midnight, or never.

To restart the CECS, click on *Restart CECS*.

To shutdown the CECS, e.g. during remote access, click on *Shutdown CECS*.

! **Important**
When CECS is configured to be permanently active, you cannot shut down the system, neither by pressing the middle button on the data logger nor using the *Shutdown CECS* button at the web interface. You can still restart the CECS with the *Restart CECS* button.

! **Important**
MARS (for measuring and recording) continues without stopping during the restart. You will not loose any measurement data unless the recording is switched off or the power supply has been disconnected. For further details about the systems refer to Section 1.4.

With the *Power CECS on digital status signal* option you can start the CECS by applying a voltage peak to the selected digital channel. The voltage peak can be triggered over a cable / switch reachable from the ground to start the CECS on site, in orther to prevent further climbing up the met mast during maintenance work.

The voltage peak must last at least one second (see also Section 12.2.3). The digital channel has to be selected from the list of available digital channels in the *Power CECS on digital status signal* dropdown list. This change

on data logger's configuration will stop the measurement for some seconds, until it is automatically or manually restarted (see Section 3.2).

Once the CECS is on, the communication can be established remotely via Modem, a previously connected Ethernet cable or WLAN. The CECS will automatically turn off after 20 min if no action on the data logger is performed.

Date and Time, Location: Time synchronization of the data logger is a primary concern. Four synchronisation methods are available: GPS, NTP, SCADA and Manually.

In order to synchronize date and time automatically to NTP servers, select *NTP (Internet), set date and time*.

NTP is a networking protocol that allows clock synchronization between the computer systems. The NTP servers need to be trusted, as they will impose the time on your data logger.

We provide a default set of the NTP servers from the NTP Pool. The NTP Pool is generally very high quality, but it is a service run by volunteers in their spare time. If you wish to change an NTP server, feel free to do so.

We recommend putting at least three trusted NTP servers on the NTP server list. Having less than three can potentially cause problems. If they start to show different times, which one is to be trusted? With at least three servers, it is easy for the device to decide which one shows the current time incorrectly.

The first NTP synchronisation happens two minutes after every CECS boot. If it fails, it tries again again 10 minutes later, otherwise it synchronises every six hours to ensure the clock remains accurate.

You can instead choose *GPS, set date, time, and location*. The GPS device must provide a sentence following the GPRMC NMEA standard (e.g. PHS8-P modem).

The CECS will attempt to get the date, time and location from the satellite according to the same logic as NTP.

The *Time zone* field may be used to define a fixed UTC offset for the system. The measurement data is stored as a local time without this information. Therefore, changing the *Time zone* during a measurement campaign may result in data loss and is strongly discouraged.

The *Minimal offset for automatic time adjustments (seconds)* field can be used to only adjust the time when the difference is sufficiently large, so that there are less discontinuities in the measurement data.

If date and time should be set manually, enter date (date format `YYYY-MM-DD`) and time (time format `hh:mm:ss`) in the appropriate fields. Date and time format are validated after typing the values.

Every date, time and/or location adjustment is logged in the Logbook. Moreover, the current latitude and longitude as well as the time of the GPS adjustment are included in each CSV file's footer.

Date and Time, Location

Time zone

UTC (United Kingdom, Mc ▼

Method to set Date, Time and Location

Manually, set date, time ▼

NTP servers

0.pool.ntp.org 1.pool.ntp.or

Minimal offset for automatic time adjustments (seconds)

0.4

Date (YYYY-MM-DD)

Time (hh:mm:ss)

Latitude (decimal)

13.43479

Longitude (decimal)

52.50176

Altitude (meters)

36.5

Save

⬇ Download KML file

Figure 4.4: Configuring Date, Time and Location of the Data Logger

In order to view the data logger location in GIS programs or Google Earth™, you can set the data logger location (not altitude) either automatically via a GPS device, or manually by entering latitude, longitude, and altitude in the appropriate fields. Enter latitude and longitude in the decimal format (`dd.dddddd°`), not in degrees and minutes (`dd°mm.mmmm'`, like GPS) nor in degrees, minutes, and seconds (`dd°mm'ss.ss"`).

After downloading the KML file, you can open the file in Google Earth™.
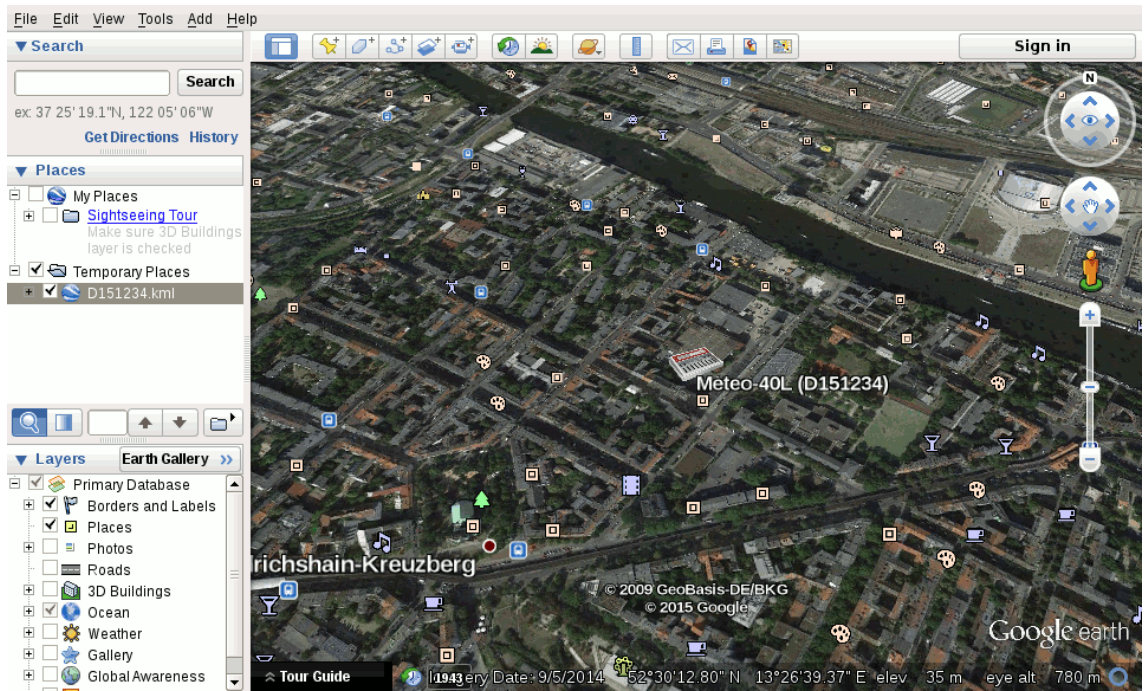
Figure 4.5: Data Logger Location displayed in Google Earth™

User Management: By default there are four user accounts: `Admin`, `User`, `Viewer` and `Guest`. Each account has its own level of permissions and access rights, described in Table 3.1. Here you can change their passwords, delete any that you do not need, and create new ones.

Figure 4.6: User List

To change a password, click "Edit". To remove an account, click "Delete".

To create new accounts click "Add a New User". You need to set the Username and Password that they will use to log in, and what level of permissions they will have when they do. The rights offered by each level of permissions are described in Table 3.1.

Username

joebloggs

Permissions

Admin

Password

•••••••• ☐ Show password

Save

Figure 4.7: Add a New User

Users created this way will be visible in the list alongside the default users. They can also be changed just like the built-in ones.

Name	Permissions		
Admin	Admin	Edit	Delete
User	User	Edit	Delete
Viewer	Viewer	Edit	Delete
Guest	Guest	Edit	Delete
joebloggs	Admin	Edit	Delete

Add a New User

Figure 4.8: User List with Custom User

Once created, a user's name cannot be changed. You can achieve the same thing by deleting the user whose name you'd like to change and re-creating it with the correct name.

An Admin cannot delete their own account. To remove the built-in Admin account, you must first create another account with Admin permissions. You can then use that account to remove the built-in Admin.

A deleted account is not logged out immediately. However, all accounts (including deleted ones) are logged out when CECS restarts.

Warning
Be aware that due to security reasons it is not possible to reset passwords. If you lose a modified `Admin` password, there is no way to recover it, not even for Ammonit. In this case, return the data logger to Ammonit. Only Ammonit is able to restore the original passwords.

Signing and Encryption Files sent by Meteo-42, such as CSV data or logbook files, can optionally be digitally signed or encrypted using the OpenPGP standard. The signature guarantees that the files have been really produced by a specific data logger and have not been altered. The encryption ensures that nobody can see the contents of the files without the correct password.

Figure 4.9: Signing and Encryption

For additional security, an `Admin` user can set the option Force Encryption. If this option is set, users without `Admin` permissions have only restricted access to measurement data:

- CSV files can only be downloaded in encrypted form.
- CSV files can only be copied to USB flash drive in encrypted form.
- Live data can be seen only for 2 minutes on the web interface, but still unlimited on the LC display.
- Source data cannot be downloaded nor copied to USB flash drive.
- Data transfer settings (AmmonitOR, Email, Remote Copy, SCADA) cannot be changed.

> **Note**
> The signature for a CSV file refers to the canonical, uncompressed CSV file.

Allow Manufacturer Administration In some cases it is necessary that Ammonit developers have access to your data logger to check configurations or to modify any settings. This mode is only used for maintenance purposes. Activate the manufacturer administration mode to allow Ammonit developers accessing your data logger.
By default the manufacturer administration mode is inactive.

Figure 4.10: Allow Manufacturer Administration

> **Important**
> Without your permission, Ammonit cannot and will never access any of your data loggers!

Reset Data: The *Disable recording* button will cause the MARS to stop recording and prevents it starting automatically as long as the browser keeps the page open. This is useful when the CECS needs to process a lot of source data at once, e.g. generating many statistics files or USB source data copy.

The *Reset metering* button will reset the network traffic metering counters which are shown on the information page and in the statistics file footer.

In order to delete all measurement data in one step, click on *Delete all measurement data*. The user will be asked to approve a confirmation prompt. Deleting the measurement data usually takes less than half a minute.

URL: https://g001234.local/confirm/format

Figure 4.11: Deleting All Measurement Data

> **Important**
> Recording stops after deleting measurement data. Start recording by clicking *Switch on* in the status box of the web interface.

In order to delete all configurations, passwords and measurement data, click on *Factory reset, delete all data*. The data logger will be set back to the condition at delivery. The user will be asked to approve a confirmation prompt before the reset is performed.

URL: https://g001234.local/confirm/factory_reset

Figure 4.12: Factory Reset

> **Note**
> After performing a factory reset, recording stops. Recording can be started after at least one sensor has been configured.
> The data reset is logged in the Meteo-42 logbook.

4.3   Upgrade Data Logger Software

The development of Meteo-42 is an ongoing process. Ammonit is constantly adding new features to the data logger to better meet the needs of the user.

> **Important**
> In order to perform a software upgrade, the data logger has to be connected to the Internet, e.g. via modem or LAN or using the tethering function of a mobile phone (Section 4.3.1). It is not sufficient to connect Meteo-42 to a PC over USB, because a PC is not necessarily configured to work as a router.
> You have to be logged in as `Admin` to perform an upgrade.
> Make sure, that the date and time of the data logger is set correctly. If the data logger date and time is too far in the past or in the future, the upgrade will not work.
> If you do not have an Internet connection, you may upgrade the data logger offline, using a USB flash drive. See Section 4.3.3 for details.

Update software list: In this step the data logger browses for updates and displays the number of available software packages. Below the progress bar the currently installed version is displayed; the latest version describes the available upgrade.

> **Note**
> The new software itself will not be downloaded and installed after clicking on *Update software list*. The software version is not changed in this step!

<div align="center">

Update software list

Update software list
100%

Installed: 2.0.0. Latest: 2.0.1.

Required download
5 Packages, 1.060 MiB

Upgrade data logger software

Download software
0%

Install software
0%

</div>
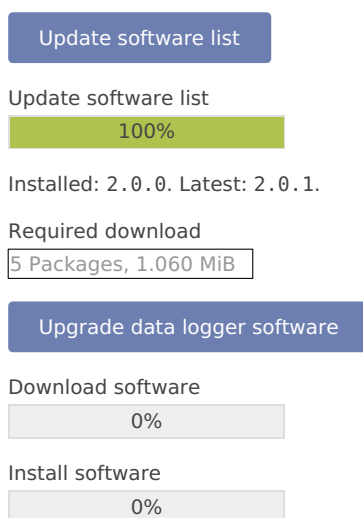
Figure 4.13: System Upgrade

Upgrade data logger software: The software upgrade can easily be performed by pressing the *Upgrade data logger software* button. The software packages will be downloaded and installed.
After the installation is completed, CECS is restarted.

> **Important**
> Before upgrading the data logger via modem, make sure that the corresponding switch is configured correctly in the Communication → Modem menu of the data logger web interface.
> Depending on the installed firmware version, the software packages needed for the upgrade can be large. So the download and installation process can take some time depending on the speed of your Internet connection.
> In rare cases the progress bar in the Meteo-42 web interface may stop Reload the page and wait. If the progress bar does not move several minutes, we recommend restarting the upgrade process.
> Do not disconnect the power supply or reboot the system during the whole upgrade process.

Update software list

Update software list

100%

Installed: `2.0.0`. Latest: `2.0.1`.

Required download

5 Packages, 1.060 MiB

Upgrade data logger software

Download software

100%

Install software

50%
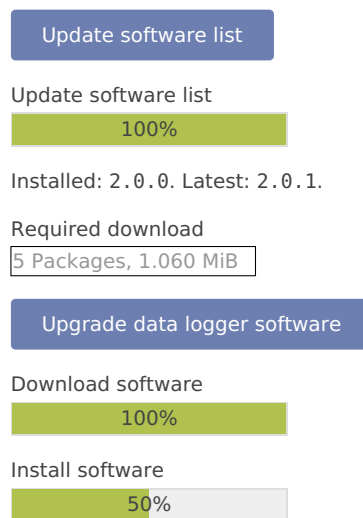
Figure 4.14: System Upgrade

4.3.1 Upgrade using a Smartphone

The Meteo-42 data logger can only be upgraded when it is connected to the Internet.

By connecting your smartphone to the data logger, you can set up an Internet connection via the tethering function of the smartphone.

Connect your smartphone to the USB-A slot of the Meteo-42. Make sure that the data logger has no Ethernet LAN connection during the procedure. If in doubt just unplug the Ethernet cable from the data logger. Open the settings for *Tethering and portable hotspot* of the smartphone operating system (see Figure 4.15) and activate USB tethering.

> **Important**
> Before starting the upgrade via tethering, make sure that *Use DHCP for wired network* is selected in the Communication → LAN menu of the Meteo-42 web interface. Additionally, make sure *Connect to Internet via modem only* is not selected in the Communication → LAN menu of the Meteo-42 web interface. See Figure 7.26 for an example.

Browse at Meteo-42 display for the IP address using the keys (Communication → Devices → LAN → USB (Activated) → IP settings). Enter the data logger's IP address in your smartphone browser, login and perform the upgrade.
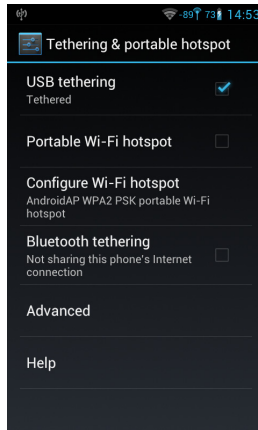
Figure 4.15: Tethering Settings of an Android™ smartphone

Tip
The tethering function can also be very useful for remote servicing. You might need to start an online action over the display in order to stablish the connection via AmmonitConnect for remote access (see Section 4.4.1).

4.3.2 Software Upgrade Behind a Firewall

For most firewalls that allow outgoing HTTPS and HTTP traffic, no special configuration is needed. Only in some very restrictive environments, you may need to configure your firewall for the Meteo-42 software upgrade or ask your network administrator to do so. If Meteo-42 is in a separated subnet, you may also need to specify a `Gateway` in the LAN settings of the data logger.

Meteo-42 needs to connect the server `archive.ammonit.com` via HTTPS (port 443) as outbound connection to perform a software upgrade. Make sure, that these connections are allowed. There is no need for Meteo-42 to connect any other servers, use any other protocols or use any kind of inbound connections.

4.3.3 Offline Upgrade using USB Flash Drive

Warning
Note, that this method is *not* the preferred software upgrade method. If possible, please use the online upgrade method.
Make sure, you have saved all your data and your configuration before performing an offline upgrade.
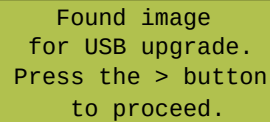
4.3.3.1 Prepare the Offline Upgrade

1. Make sure that all relevant data from data logger is saved: Configuration file, CSV files, and, if necessary, source data.

2. Make sure the software version you will upgrade to is actually newer than the software version already installed on the data logger. Downgrades are not supported. Always use the latest offline update image from Ammonit, because errors of older versions might be fixed!

3. Download the latest version from here (`https://archive.ammonit.com/archive/usb-images/appr oved/Meteo-42.zip`) and unpack the zip archive. You will need the meteo-42.bin image file.

4. You need a prepared USB flash drive of at least 2 `GiB` capacity. The flash drive must formatted as `FAT32`. The image file must be placed in the top-level of the flash drive, not in a directory. Further information is in the `README.txt` file.

4.3.3.2 Performing the Offline Upgrade

1. Switch off the CECS of the data logger. In doubt, remove the power supply.

2. Plug the prepared USB flash drive into one of the two USB-A slots of the Meteo-42.

3. If necessary, reconnect the power supply of the data logger. Switch on the CECS.

4. You will see the following text on the LC display:
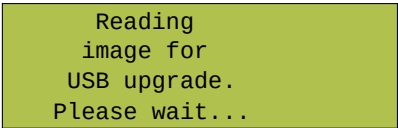
```
    Found image
  for USB upgrade.
 Press the > button
     to proceed.
```

Figure 4.16: Press the right arrow button

You have to press the right arrow button within ten seconds, otherwise the boot process continues normally and no upgrade will be performed.

5. For around half a minute, the following message appears:

```
      Reading
     image for
   USB upgrade.
  Please wait...
```
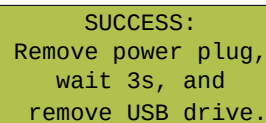
Figure 4.17: Reading the image

> ⚠ **Warning**
> After that step interrupting the process, unplugging the USB flash drive, or a power failure can lead to an non-functional data logger!

6. The complete process takes about ten to fifteen minutes, until the following message appears:

```
     SUCCESS:
  Remove power plug,
     wait 3s, and
   remove USB drive.
```

Figure 4.18: Successful upgrade

which should be performed accordingly: Remove the power supply of the data logger, remove the USB flash drive, wait at least three seconds, and plug-in again the power supply of the data logger.

4.4 The Device Page

4.4.1 Display Access

The display page shows, what can be seen on the LCD.

Remote Display

> System
  Status
  Channels
  Communication
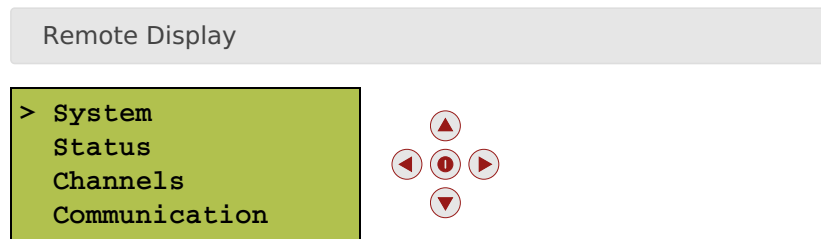
Figure 4.19: Remote Display

In order to give users without access to the web interface the chance of configuring the data logger, some permissions for display users can be selected, e.g. switch on recording or (de-)activate WLAN.

If the corresponding permission *Run an action* is set, you can also start the execution of an action over the display menu Communication → Schedule. Select one of the actions and press the right button to start it.

Display Settings

Permissions of Display User

☐ Change CECS mode

☒ Switch between DHCP, static IP, and link-local

☐ Switch off recording

☒ Switch on recording

☒ Change the state of switches

☒ (De-) Activate WLAN

☒ Run an action, e.g. go online

Other Settings

☒ Activate display backlight

Save
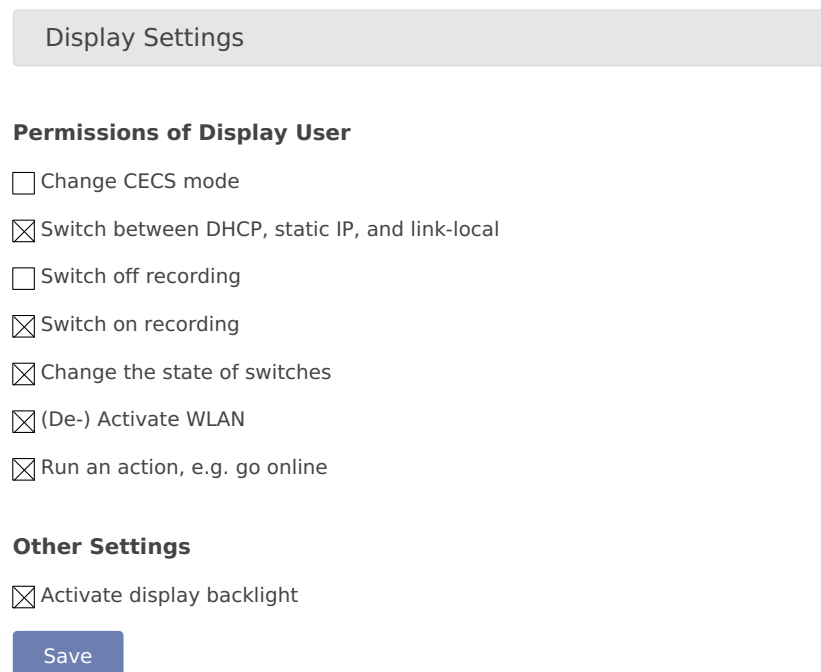
Figure 4.20: Display Settings

📎 **Note**
To view the display in the web interface, it is advised to enable JavaScript in your web browser.

4.4.2 Connected USB Devices

Also on the device page, you can find a list of the USB devices, that are currently connected to the data logger and recognized by it, e.g. a modem, a flash drive, or a camera.

4.4.3   USB Flash Drive Copy

Meteo-42 offers the possibility to download created CSV statistics files with measurement data (statistics see Section 6.3), the source data in CSV format, and/or the logbook in CSV format on an USB flash drive, which is connected to the data logger. Before you use this function, data logger and USB flash drive have to be configured.

Figure 4.21: Configuring the USB Flash Drive Copy

> ⚠️ **Important**
>
> A file system like FAT32, NTFS, ext4, ext3, or ext2 is required on USB flash drive.

In order to format the USB flash drive with FAT32 on your Windows™ PC, connect the USB flash drive to the PC. Open the Windows™ Explorer. Right-click on the USB flash drive shown under *Computer*. Click on *Format...* and select FAT32 as *File system*. *Start* the formating process.
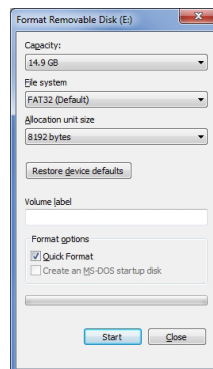
Figure 4.22: Formatting the USB flash drive (Windows™ PC)

Create a INI file named `keyfile.txt`, which has to be saved on the USB flash drive used to download CSV files (statistics and/or source data). This INI file must include the data logger serial number and a password in a the INI file format. The INI file is necessary to prevent unauthorized access to data. Example:

```
[D123456]
password = yoursecretpassword
statistics = all
```

📎   **Note**
    The passphrase for the USB flash drive must have at least 8 characters!

The passphrase has to be entered in the field shown in Figure 4.21.

It is possible to use one USB flash drive for several data loggers. To do so, in the `keyfile.txt` the details of the data loggers have to be entered section by section, e.g.

```
[D123456]
password = passwordone
statistics = since 2016-01-01
gustdata = since 2016-01-01
config = save
logbook = all

[D234567]
password = passwordtwo
statistics = newest 10
config = save
sourcedata = all

[D345678]
password = passwordthree
statistics = month 2016-01
config = save
sourcedata = day 2016-01-07
```

The following entries are possible:

password Mandatory, must have at least eight characters

statistics One of the time period values, see below. Copies the primary statistics files.

secondary One of the time period values, see below. Copies the secondary statistics files.

tertiary One of the time period values, see below. Copies the tertiary statistics files.

config Value `save` to copy the configuration file. Other values are not yet implemented.

logbook One of the time period values, see below.

gustdata One of the time period values, see below.

sourcedata One of the time period values, see below.

⚠️   **Warning**
    Copying source data may take a very long time, even some hours.

---

stop_recording Value `yes` to stop recording while copying source data. By default, Meteo-42 keeps recording while copying source data. With this entry, it is much faster since the hardware does not need to read and write at the same time. It is intended for back-ups after the measurement campaign is finished.

The time period values are:

all Copy all files of this type.

since DATE Copy files of this type since and including DATE in format YYYY-MM-DD.

until DATE Copy files of this type until and including DATE in format YYYY-MM-DD.

month DATE Copy files of this type in the month of DATE in format YYYY-MM.

day DATE Copy files of this type at the day of DATE in format YYYY-MM-DD.

---

newest NUMBER Copy newest files of this type, max. NUMBER.

oldest NUMBER Copy oldest files of this type, max. NUMBER.

Meteo-42 has to be switched on for download. If the USB flash drive is configured correctly, it will be recognized by the data logger. If the passphrase entered in the web interface and in the `keyfile.txt` does not match data download is not possible.

Meteo-42 shows in its display the number of downloaded files. When the download is finished, the data logger menu is shown and the USB flash drive can be disconnected.

All data files are compressed to keep them as small as possible.

Note
If encryption and/or digital signature is switched on for the data logger, copying to the USB flash drive behaves accordingly, i.e. data will be encrypted and/or signed.
If the Force Encryption option is enabled, copying source data to USB flash drive is prohibited.

4.4.4   Show USB Files

This page shows the files corresponding to the data logger on the attached USB stick and allows them to be downloaded and deleted.

4.5   Using a Camera

You can take pictures with Meteo-42 and send the image to AmmonitOR, as an email attachment, copy it to an SCP/FTP/SFTP file server or copy it to a permanently connected USB flash drive. Each of these options must be individually configured. See the corresponding checkboxes in the Communication → AmmonitOR, Communication → Email, and Communication → Remote Copy submenus.

You can either use a USB webcam plugged into one of the two USB-A slots or an Ethernet connected camera by HTTP/HTTPS.

URL: https://g001234.local/system/camera/

Ammonit   Help   Logout
                                                                         Admin on G001234

			Camera
Recording:	⚠ Off	Switch on	
Configuration:	Saved	Save	
Connection:	Ethernet		
Remaining:	∞		
Date/time:	2023-08-11 15:57:00 UTC		

Meteo-42

System
Information
Administration
Upgrade
Device
Camera
Switches
Logbook

Measurement
Sensors
Channels
Evaluation

Data
Live
Statistics
Gusts
Source

Communication
Schedule
Online
AmmonitOR
Email
Remote Copy
SCADA
LAN
WLAN
Modem

Current Camera Image

Refresh image

Camera Image Settings

Camera Image URL:

☐ Copy Camera Image to USB Drive

Save camera settings

中文(简) English Español Português Français Deutsch 日本   © 2011-2023 Ammonit Measurement GmbH
                                                                         www.ammonit.com

Figure 4.23: Camera Image

📎 **Note**
   If the camera should be used for monitoring purposes, a steady power supply has to be connected.

4.5.1 Camera Configuration

To take one or more photos with an outdoor camera, just enter the URL of the photo in the web interface. The URL depends on the installed camera, e.g. `http:// nn.nn.nn.nn/` or `https:// nn.nn.nn.nn/`. Mobotix M25M

---

camera image URL typically is `http://10.13.0.197/record/current.jpg`.
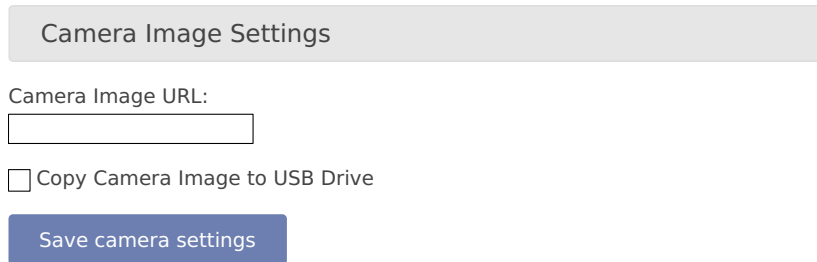
Figure 4.24: Attaching Camera Images

If the option `Copy Camera Image to USB Drive` is selected and a USB drive is connected to the data logger, the image will be copied to the USB device whenever any of the scheduled actions run (see also Section 7.2). The files can be downloaded or deleted (see also Section 4.4.4).

If you connect the cammera via Ethernet, it is recommended to use static IP addresses. You must configure both the camera and Meteo-42, each with a different address in the same network. E.g. `10.13.0.197` for the camera and `10.13.0.200` for the data logger. In this case, the netmask would be `255.0.0.0`. DNS server and gateway are not relevant here.

The static IP address of Meteo-42 can be configured in the Communication → LAN menu (see Section 7.7). In order to configure the IP address of the camera use the software delivered with it.

If *LAN online, whenever CECS is on* has been disabled, the Ethernet port may be inactive. This means you might not see an image on accessing the System → Camera menu (see Section 4.5) menu. You will know if the Ethernet interface is active because it will appear at the connections list in the status box of the web interface.

If you want the Ethernet port to be always active despite the higher power consumption, you can configure it in Communication → LAN menu (see Section 7.7).

> **!** **Important**
> If a USB modem is connected to Meteo-42 and Ethernet is used for the camera, it is necessary to select `Connect to Internet via modem only` in the Communication → LAN menu.

4.6 Configuring Switches

Switches can be used to control and optimize the power consumption of the measurement system. External devices connected to Meteo-42, such as modem, camera or heating can be controlled via the data logger. Meteo-42 will close (turn on) the configured switch when the correspondig device is needed, e.g. to send data via the modem connection, and open it again (turn off) when not needed.

In a solar power plant, a switch can be used to orient the solar trackers for protection of the payloads in case of high wind.

Meteo-42L data logger provides eight switches intended for the following tasks:

- Control the modem power supply (recommended). See Section 7.9 for GSM and Section 7.7 for satelite.
- Control camera power supply. See Section 7.7.
- Control of the selected switch according to the configured measurements and thresholds Section 4.6.1.

A switch can only fulfill one of the duties. It can either be used to control the modem's power supply or at the `Switch Manager`.

To manually toggle one or more of the switches individually, go to the System → Switches menu.

Figure 4.25: Switch Configuration

Warning
We highly recommend configuring a switch for the modem in the Communication → Modem menu. If the modem is switched manually via the System → Switches menu, you risk the shutdown of the modem after rebooting the data logger or after problems with the power supply.
Switch S1 is assigned to the modem by default. In case the switch is not used for the modem, it can be deselected.

Note
Refer to Chapter 13 for more information about physically connecting the supply using a switch.

4.6.1 Switch manager

The `Switch manager` is designed to automatically toggle one of the switches deppending on the configured conditions. It is commonly used for sensor's heating control. Only one switch can be selected.

In order to use this function, select a switch as well as one or more switching conditions. The available switching conditions are temperature range, minimum humidity, minimum voltage, minimum windspeed and two time frames. If more than one condition is configured, the switch will only be closed (i.e. on) when all conditions are fulfilled. If only one time frame is needed, the duration of the second time frame duration must be set to 00:00. If the inverted logic is selected, the switch will remain closed as long as the conditions are not fulfilled. Only configured sensors and free switches are listed.

The state of the selected switch is reviewed according to the values calculated at the end of the configured statistics interval for SCADA, Switch manager and snapshots in the Data → Statistics menu. The default statistics interval is 10 min. The average value is used for temperature, humidity and voltage whereas the maximum is used for wind speed.

Important
It is necessary to keep the *CECS always on* if the switch manager is deployed. The state of the switch can only be closed (i.e. on) when CECS is running, i.e. to perform an action (see Section 7.2) or if CECS is configured to be always on (see Section 4.2). On CECS shut down, the selected switch is opened (turned off).

Switch Manager

Managed switch

S2

☐ Invert switch behaviour

Label

Heating

Switching Conditions

Temperature

Int. Temperature (Temperature)

Minimum temperature (°C)

-30

Maximum temperature (°C)

30

Humidity

None

Minimum humidity (%)

70

Voltage

Supply voltage measurement (Analog Voltage)

Minimum voltage (V)

0

Wind speed

Anemometer (Wind Speed)

Minimum wind speed (m/s)

20

Time Frames

☒ Use timer

First time frame start (hh:mm)

09:00

Duration (hh:mm)

0:45

Second time frame start (hh:mm)

09:50

Duration (hh:mm)

00:00

Save

Figure 4.26: Switch Manager
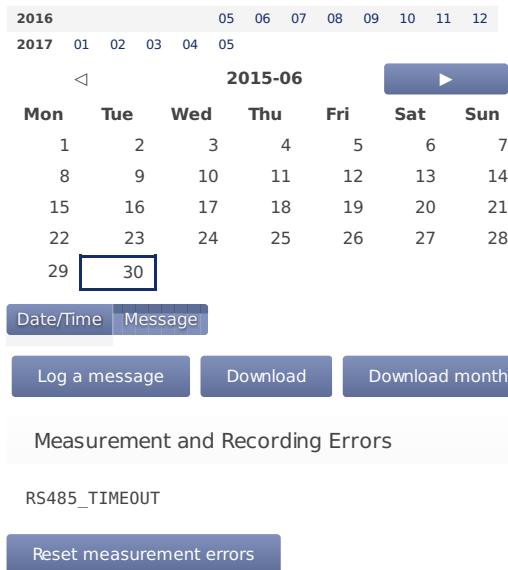
If the sensor heating should be supplied by an external power supply via relay, check the connection plan Figure 13.14.

4.7   Using the Logbook

Events which are not related to measurement data are listed in the logbook. The logbook displays for example all user logins and the user's IP address. A calendar is shown with a monthly overview. Blue highlighted boxes indicate days with logbook entries. By clicking on the day, the entries are displayed. Click on the arrows shown above the calender to go to the previous or next month.

It is also possible to add entries to the logbook, e.g. to record replacements of sensors or any maintenance work that is important for data interpretation. Add messages by clicking on *Log a message*. A short text message can be entered.

Logbook entries of a day can be downloaded by clicking on the *Download* buttons.

2016				05	06	07	08	09	10	11	12
2017	01	02	03	04	05						

◁		**2015-06**			▶	
Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Date/Time   Message

Log a message   Download   Download month   Download year   Download all

Measurement and Recording Errors

RS485_TIMEOUT

Reset measurement errors

Figure 4.27: Logbook

MARS errors are indicated by the red LED (second from bottom). A detailed list containing error codes is reported below *Measurement and Recording Errors*. By clicking on *Reset Measurement Errors* the list of errors can be deleted.

Note
The MARS error codes can be important for Ammonit engineers to identify errors in the data logger.

4.7.1   Logbook Events

The following actions or events are logged to the logbook:

- User note to logbook
- Log in of a user and failed login attempt
- Factory reset
- Memory format
- Configuration file upload
- Setting date and time via GPS, NTP, EKO sun tracker, SCADA or Admin (manually)
- Setting location via GPS or EKO sun tracker
- Copying CSV files in any of the following ways: to USB flash drive, via Email, Remote Copy or AmmonitOR upload
- Software upgrade
- Password reset by manufacturer
- CECS start/stop

- Actions execution
- Actions initiated by a short message (SMS)
- RS485 Serial Interface

Chapter 5

Measurement

5.1   Sensor Configuration

In the Measurement → Sensors menu, sensors can be added and basic parameters can be configured by using the *Sensor Helper* (see Section 5.1.2). After having configured the sensors, two buttons are available for each sensor: *Delete* and *Change*. These allow a user to delete or change an existing sensor with help of the *Sensor Helper*.

Label	Type	Model	Order No.	Height	Serial No.	Period	Channels	Change	Delete
Top Anemometer	Anemometer	Thies Anemometer First Class Advanced		120		1 s	C1	Change	Delete
Backup Anemometer	Anemometer	Thies Anemometer First Class Advanced		118		1 s	C2	Change	Delete
Middle Anemometer	Anemometer	Thies Anemometer First Class Advanced		60		1 s	C3	Change	Delete
Low Anemometer	Anemometer	Thies Anemometer First Class Advanced		10		1 s	C4	Change	Delete
Top Wind Vane	Wind Vane	Thies Wind Vane 10 Bits Serial Synchron		120		1 s	D1	Change	Delete
Backup Wind Vane	Wind Vane	Thies Wind Vane 10 Bits Serial Synchron		118		1 s	D2	Change	Delete
Low Wind Vane	Wind Vane	Thies Wind Vane 10 Bits Serial Synchron		60		1 s	D3	Change	Delete
Hygro/Thermo @10.0m	Hygro/Thermo	Galltec Hygro-Thermo Active KP		10		1 s	A1, A2	Change	Delete
Barometer @10.0m	Barometer	Barometric Pressure Sensor AB60		10		1 s	A3	Change	Delete

Add sensor

Delete all sensors

RS485 client configuration

Figure 5.1: Sensor Definitions

Below the sensor definitions overview you can find four buttons: *Add sensor*, *Delete all sensors*, *RS485 serial interface* and *Download sensor database*.

Add sensor: Opens the *Sensor Helper* to configure a new sensor.

Delete all sensors If all sensors should be deleted, e.g. after a completed measurement campaign, you can click on *Delete all sensors* to remove all sensors from the configuration in one step.

RS485 serial interface Occasionally it can be necessary to send a command to a sensor connected to an RS485 client port, e.g. in order to detect communication problems or to change a sensor configuration (see Section 5.1.4).

Download sensor database Download a CSV file which describes all the sensors available in Sensor Helper.

Note

By clicking on a column headline in the sensor definitions overview, you can sort the selected column in ascending or descending order.

Note

When adding a new sensor or changing the electrical channel of a sensor, recording is stopped automatically. That way, it is clear which measurements use the old configuration and which measurements use the new one. Also, if no sensors at all are configured, recording is switched off. Afterwards, one can switch on recording. Also, recording will be switched on automatically after 20 minutes of no further configuration changes.

Important

For some estimations related to solar sensors, the location of the measurement station has to be added in the System → Administration menu (see also Section 4.2).

Warning

Adding or deleting a sensor switches the recording off. The new configuration is unsaved! By clicking on *Switch on*, the configuration will be automatically saved and recording will resume.

5.1.1 Difference between Sensors, Channels, and Evaluations

To have a better understanding of the sensor management, it is important to know the difference between sensors, channels, and evaluations.

In general, a sensor is an electro-mechanical device, which records physical values. The physical values are transformed into an electrical value by the sensor. For example, wind speed can be transformed into a frequency. To map these electrical values on the corresponding physical values, an evaluation process has to be performed.

A sensor may be connected to more than one electrical channel of Meteo-42. The number of used electrical channels depends on the kind of sensor and also on the kind of electrical wiring of the sensor. For example, wind vane POT (potentiometer) may use the two analog channels A1 and A2. Another example is the pyranometer Delta-T SN1 that emits two analog voltage signals and one digital status signal. The two analog output signals have to be connected to two analog voltage channels and the digital status signal has to be connected to one digital input.

The evaluation process of the measured values is done by the software of the Meteo-42 data logger. Both pieces of data are saved: the measured physical value at every channel and the evaluated value. Some typical formulas are displayed below.

Most anemometers deliver a rectangle pulse output signal with a frequency proportional to the instant speed. Connecting it to a counter input (i.e. `C1` to `C12`), its frequency will be measured. For the evaluation of wind speed a linear

formula will be applied using slope and offset values given in the configuration of the Measurement $\rightarrow$ Sensors menu.

$$v_{\text{wind}} = \left\{ \begin{array}{ll} \text{slope} \cdot Cx + \text{offset} & : Cx > 0 \\ minimal\_value & : Cx = 0 \end{array} \right.$$

Equation 5.1: Linear Equation for Wind Speed

A counter value of `0` results in an output equal to the `minimal_value` instead of the `offset`. The offset is ignored in that case. Leaving the `minimal_value` field blank is equivalent to setting it equal to the `offset`.

The output signal of many pyranometers is an analog voltage. To measure and record this signal, the output of the pyranometer should be connected to an analog voltage input (i.e. `A1` to `A12`). To interpret the value of the apparent solar radiation, the measured value is internally divided by the specific sensitivity of this sensor. In this case sensitivity has to be configured.

5.1.2   Sensor Helper

In order to simplify the configuration of sensors, Meteo-42 provides a *Sensor Helper* in the Measurement $\rightarrow$ Sensors menu. The *Sensor Helper* guides you through the sensor configuration. It will appear when you attempt to *Add sensor* or *Change* a sensor, a channel or an evaluation.

You must select one of the available sensor types (e.g. anemometer, wind vane, barometric pressure sensor, solar sensor, etc.) and the supported models. If the sensor appears in the list, the appropriate channel settings will be automatically selected as shown in Figure 5.2. Depending on the sensor, further settings can be configured by the user, e.g. `Slope`, `Offset`, `Sensitivity`, measurement rate, channel, etc..

> **Important**
> If the sensor doesn't appear in the list of preconfigured sensor, you can always use a generic sensor from the *Other Sensor* list.

> **Note**
> Only channels and switches which are not already used by other sensors are available.

Sensor type

Anemometer ▼

Sensor

Thies Anemometer First ▼

Installation height (m)

120 ▲▼

Label

Top Anemometer

Serial number

Wind Speed Slope (m/s/l)

0.0462 ▲▼

Wind Speed Offset (m/s)

0.21 ▲▼

Measurement rate

1 s ▼

Counter Channel

C1 ▼

Add more

Finish

Figure 5.2: Sensor Helper with Sensor Settings

> **Important**
> For many sensors, slope and offset values are pre-configured according to the manufacturer's information. Carefully check the values. If calibrated sensors are installed, use the slope and offset or sensitivity values indicated in the calibration protocol of the sensor.

5.1.3 Order of Sensors and Evaluations

The order of sensors and evaluations in the web interface and the LC display is always consistent.

Sensors are ordered by

1. sensor type (anemometers, wind vanes, thermo/hygro sensors, barometers, precipitation sensors, solar sensors, ultrasonics, power meters, other sensors),

2. height (from highest to lowest),

3. and finally the textual label (alphabetically).

Evaluations are ordered by

1. evaluation type (wind speed, wind direction, humidity, temperature, differential temperature, air pressure, air density, etc.),

2. height of the corresponding sensor (from highest to lowest),

3. and finally the textual label (alphabetically).

5.1.4 RS485 Serial Interface

During the installation process or when changing any sensor settings during deployment, it can be useful to send a special command to a connected RS485 sensor.

Send request over CL1 (R1)

Protocol:

ASCII

Modbus address

1

Modbus start register (0..65535)

0

Modbus register quantity (1..20)

1

Modbus function code

3

Command:

Latest response:

Not available

Send request

CL1 serial settings

RS485 speed

38400

RS485 data format

8N1

☐ Enable biasing

Save

Figure 5.3: RS485 Serial Interface

First of all, the general serial settings of the RS485 client have to be configured according to the configuration of the sensor. All sensors in an RS485 bus will share the configured settings.

If Modbus protocol is selected, the telegram will be internally composed according to the selected parameters and shown in the `command` box. The available parameters for the request are: `Sensor ID` for the unique sensor identificator in the bus (0..247), Modbus `Function code` (01 to 06 supported), `Start address` (PDU addressing, first reference is 0) and `Quantity or value` (quantity of registers/inputs for read only function codes (01 to 04) and value for writing function codes (05 and 06)).

If ASCII protocol is selected, the custom command must be typed by the user in the command box. The following escape sequences representations are recognized for the ASCII commands:

Escape Sequence	Symbol
<CR>	U+000D Carriage Return
<LF>	U+000A End of Line
<STX>	U+0002 Start of Text
<ETX>	U+0003 End of Text

Table 5.1: ASCII escape sequences for RS485 Serial Interface

The communication will be reflected in the logbook including a timestamp. Example of ASCII communication: "RS485 Request: '01TR00003<CR>', Response: '<STX>000.1 096 +24.6 M 0E*1D<CR><ETX>'". Example of Modbus communication: "RS485 Request: '0104277400063aa6', Response: '01040c41375c2942c0000041e800006d3d'".

📎 **Note**

The RS485 serial interface is only available for Admin.

5.2 Measurement Channels

In the Measurement → Channels menu a table is shown, which displays all connected channels with details such as label, value, rate, range, protocol and selected switch. To modify sensor settings, click on *Change* to open the *Sensor Helper* (see also Section 5.1.2).

Id	Label	Value	Unit	Period	Range	Protocol	Addr.	Switch	Sw. Pretime	Change
A1	Hygro/Thermo @10.0m	---	V	1 s	-10 V..+10 V					Change
A2	Hygro/Thermo @10.0m	---	V	1 s	-1 V..+1 V					Change
A3	Barometer @10.0m	---	V	1 s	-10 V..+10 V					Change
C1	Top Anemometer	---	I	1 s						Change
C2	Backup Anemometer	---	I	1 s						Change
C3	Middle Anemometer	---	I	1 s						Change
C4	Low Anemometer	---	I	1 s						Change
D1	Top Wind Vane	---		1 s		Thies 10-Bit				Change
D2	Backup Wind Vane	---		1 s		Thies 10-Bit				Change
D3	Low Wind Vane	---		1 s		Thies 10-Bit				Change

Digital test

Figure 5.4: Measurement Channels Overview

📎 **Note**

Click on a column headline in the measurement channels overview to sort the selected column in ascending or descending order.

5.3 Configuring the Evaluation

In the Measurement → Evaluation menu the settings for data evaluation are shown. A table displays the configured sensors with their measured and estimated values. The order of evaluations is explained in Section 5.1.3. If the settings should be modified, click on *Change* to open the *Sensor Helper* (see also Section 5.1.2).

Label	Evaluation	Origin	Height	Value	Unit	Minimal Value	Slope	Offset	Installation Offset	Clip	Change
Top Anemometer	Wind Speed	C1		---	m/s	0.21	0.0462	0.21			Change
Backup Anemometer	Wind Speed	C2		---	m/s	0.21	0.0462	0.21			Change
Middle Anemometer	Wind Speed	C3		---	m/s	0.21	0.0462	0.21			Change
Low Anemometer	Wind Speed	C4		---	m/s	0.21	0.0462	0.21			Change
Top Wind Vane	Wind Direction	D1		---	°		0.3515625	0	0		Change
Backup Wind Vane	Wind Direction	D2		---	°		0.3515625	0	0		Change
Low Wind Vane	Wind Direction	D3		---	°		0.3515625	0	0		Change
Hygro/Thermo @10.0m	Humidity	A1		---	%		100	0		100	Change
Hygro/Thermo @10.0m	Temperature	A2		---	°C		100	-30			Change
Barometer @10.0m	Air Pressure	A3		---	hPa		60	800			Change

Add evaluation

Figure 5.5: Screenshot of the Configuration for the Evaluation

In addition to the automatically generated evaluations, it is possible to apply formulas to the measured values or even combine evaluations. The new evaluations can be added in the *Evaluation Helper* by clicking on *Add evaluation*. See Section 5.3.1.

> **Note**
> Click on a column headline in the evaluation configuration overview to sort the selected column in ascending or descending order.

5.3.1 Evaluation Helper

The *Evaluation Helper* introduces a higher flexibility to Meteo-42 sensors configuration. Apart from the automatically configured evaluations which appear when you add a sensor, this tool allows you to generate new evaluations, combining the existing ones by means of a formula. The standard statistics are available for the new evaluation and will be included in the CSV statistics file. The *Evaluation Helper* also provides some special statistics like the covariance, kurtosis, turbulence intensity or Obukhov length. To use this feature, click *Add evaluation* in the Measurement → Evaluation menu. The *Evaluation Helper* will guide you through the configuration process. After choosing a formula from the list, the corresponding parameters will be shown for selection.

> **Important**
> Only the measured values are saved by default to the CSV statistics file. Estimated values are for information purposes. In order to include estimated values in the CSV statistics file, select the values over the statistics selection interface in the Data → Statistics menu under *Select statistics* (see also Section 6.3.1).

5.3.1.1 Addition

Addition of two or three previously configured evaluations.

$$A = B + C$$

Equation 5.2: Addition of two elements

$$A = B + C + D$$

Equation 5.3: Addition of three elements

5.3.1.2   Density of moist air

According to IEC 61400-12-1 it is required to measure air density, which is calculated from air temperature and air pressure. Air density has a significant influence on the wind energy calculation. See calculation of wind energy in Section 10.1.

At high temperatures measuring relative air humidity is recommended according to IEC 61400-12-1. In order to calculated density of moist air, Meteo-42 offers two options: with or without relative humidity.

If air density should be calculated without humidity, choose only a temperature and a barometric pressure sensor from the list in the *Evaluation Helper* (see Section 5.3.1). Meteo-42 calculates air density for evaluation with original 1-sec measurement data according to the following formula:

$$\rho = \frac{p}{R_0 \cdot T}$$

Equation 5.4: Calculation of Density [ρ] of Dry Air

where p is the air pressure, T the air temperature and R_O the gas constant of dry air 287.05[J/kgK].

If relative humidity should be considered for air density calculation, choose also a humidity sensor from the list in the *Evaluation Helper* (see Section 5.3.1). With selected humidity sensor, Meteo-42 calculates density of moist air for evaluation with original 1-sec measurement data according to the following formula:

$$\rho = \frac{1}{T} \left(\frac{p}{R_0} - RH \cdot p_{H_2O} \left(\frac{1}{R_0} - \frac{1}{R_{H_2 0}} \right) \right)$$

Equation 5.5: Calculation of Density [ρ] of Moist Air

where T is the air temperature, p the air pressure, R_0 the gas constant of dry air 287.05[J/kgK], R_{H_2O} the gas constant of water vapour 461.5[J/kgK], p_{H_2O} the vapor pressure, RH the relative humidity.

Formula

Density of moist air (IEC 61400 2005) ▾

Unit: kg/m³

Temperature

Hygro/Thermo @20.0 m ▾

Air Pressure

Barometer ▾

Label

Installation height (m)

20.0

Save

Delete

Figure 5.6: Evaluation for Air Density

5.3.1.3 Albedo

Surface albedo is defined as the ratio of irradiance reflected to the irradiance received by a surface. It is dimensionless and measured on a scale from 0 (corresponding to a black body that absorbs all incident radiation) to 1 (corresponding to a body that reflects all incident radiation). If an upper pyranometer reading, a lower pyranometer reading, or both is/are less than 2 W/m², the albedo value is invalid.

$$\text{Albedo} = \frac{\text{IrradianceReflected}}{\text{IrradianceGlobal}}$$

Equation 5.6: Albedo

5.3.1.4 Ampere meter

Based on Ohm's law, you can use the Ampere meter formula to transform the measured voltage to the corresponding current, after introducing the value of the shunt resistor used. This formula can be used with any existing voltage evaluation (e.g. if you previously configured a Gantner A3.1 module).

$$I = \frac{V}{R}$$

Equation 5.7: Ohm's law

where I is the current through the conductor in units of amperes, V is the voltage measured across the conductor in units of volts, and R is the resistance of the conductor in units of ohms.

5.3.1.5 Differential temperature

By selecting *Differential temperature* in the *Evaluation Helper*, the difference between two temperature measurements can be recorded every second. Choose two temperature sensors from the list for theta 1 and theta 2. According to the following equation the difference is calculated.

$$\Delta\vartheta_{[\text{K}]} = \vartheta1_{[°\text{C}]} - \vartheta2_{[°\text{C}]}$$

Equation 5.8: Calculation of the Temperature Difference [Δtheta]

5.3.1.6 Division

Division of two previously configured evaluations.

$$A = \frac{B}{C}$$

Equation 5.9: Division

5.3.1.7 Effective irradiance

Effective irradiance (E_{eff}) is total plane of array (POA) irradiance adjusted for angle of incidence losses, soiling, and spectral mismatch. In a general sense it can be thought of as the irradiance that is "available" to the PV array for power conversion.

$$E_{eff} = G_0 \cdot \frac{I_{SC}}{I_{SC_0} \cdot (1 + TK_{I_{sc}} \cdot (T - T_0))}$$

Equation 5.10: Calculation of effective irradiance

where G_0 : reference condition irradiance (W/m²), I_{SC} : measured short circuit current (A), I_{SC0} : short circuit current at reference condition (A), T : measured surface temperature (°C), T_0 : surface temperature at reference condition (°C), TK I_{SC} : temperature coefficient of short circuit current (%).

5.3.1.8 Soiling ratio I_{SC} index

The soiling ratio I_{SC} index (SR I_{SC}) is a standard metric for the effects of soiling on energy production. This dimensionless factor is in range 1.0 to 0 and equals 1 when both modules are clean.

For identic soiled an clean devices, SR I_{SC} can be calculated as follows (legacy systems).

$$SR_{I_{SC}} = \frac{I_{SC\,Soiled} \cdot (1 - TK_{I_{sc}} \cdot (T_{Soiled} - T_0))}{I_{SC\,Clean} \cdot (1 - TK_{I_{sc}} \cdot (T_{Clean} - T_0))}$$

Equation 5.11: Calculation of SR ISC for identic soiled and clean devices

where I_{SC} is the measured short-circuit current of the soiled and clean modules and T is the measured temperature of the soiled and clean modules respectively.

5.3.1.9 Soiling loss index

The soiling loss index (SLI) is a standard metric for the effects of soiling on energy production. It is calculated from the effective irradiances of a clean reference panel and a dirty test panel.

$$SLI = (1 - \frac{E_{eff\,Clean}}{E_{eff\,Soiled}}) \cdot 100$$

Equation 5.12: Calculation of SLI

where $E_{eff_{Clean}}$: efective irradiance of the clean PV module and $E_{eff_{Soiled}}$: effective irradiance of the reference PV module.

5.3.1.10 Pyrgeometer incoming long wave irradiance Ein

Incoming long wave irradiance received from the atmosphere. Pyrgeometer equation by Albrecht and Cox.

$$E_{in} = E_{net} + \sigma \cdot T$$

Equation 5.13: Pyrgeometer incoming long wave irradiance

where E_{in} is the long-wave irradiance received from the atmosphere [W/m²], E_{net} is the net irradiance at sensor surface [W/m²], σ is the Stefan–Boltzmann constant 5.670374419 x 10^{-8} [W/(m²·K⁴)] and T is the Absolute temperature of pyrgeometer detector [K].

5.3.1.11 Net radiation total NR

Calculation of the total net radiation for net radiometers.

$$NR = E_{up_{short-wave}} + E_{up_{long-wave}} - E_{low_{short-wave}} - E_{low_{long-wave}}$$

Equation 5.14: Net radiation total

where long-wave radiation must be calculated with the Section 5.3.1.10 formula.

5.3.1.12 Inflow angle

Angle off the horizontal plane at which the wind flow comes into the sensor.

$$\varphi = \arctan(\frac{V_z}{V_h})$$

Equation 5.15: Calculation of the inflow angle

where V_z is the vertical wind speed and V_h is the horizontal wind speed.

5.3.1.13 Linear equation

The linear equation can be used with any existing evaluation in order to apply an slope and offset. It can also be used to provide a dimensionless measurement (e.g. from a previously configured *Other sensor*) with a unit, an evaluation type, a height and a label for better interpretation.

$$A = Slope \cdot B + Offset$$

Equation 5.16: Linear equation

Formula

| Linear equation | ⏷ |

Slope * Evaluation + Offset

Any Evaluation

| Other Sensor Other Evaluation R1C1_1 | ⏷ |

Offset

| 0.3 | ⬍ |

Slope

| 1 | ⬍ |

Evaluation type

| Temperature | ⏷ |

Unit

| °C |

Label

| |

Installation height (m)

| 0.0 | ⬍ |

Save

Delete

Figure 5.7: Evaluation for linear equation

5.3.1.14 Multiplication

Multiplication of two previously configured evaluations.

$$A = B \cdot C$$

Equation 5.17: Multiplication

5.3.1.15 Turbulence intensity

Turbulence intensity (TI) is defined as the ratio of standard deviation of fluctuating wind velocity to the mean wind speed, and it represents the intensity of wind velocity fluctuation. It is calculated at the end of the averaging period (normally 10 minutes) and included in the measurement data CSV files.

$TI = \sigma(U) / avg(U)$

Equation 5.18: Turbulence intensity

where $\sigma(U)$ is the standard deviation of the wind speed and $avg(U)$ is the mean wind speed.

A commonly used procedure when analyzing turbulence data is to transform the horizontal wind vector in the geographical coordinate system into a rotated coordinate system that aligns with the mean wind direction during every averaging period. The longitudinal TI is defined as the standard deviation of longitudinal wind speed, normalized with the mean wind speed.

TI Long = σ(U) / avg(U)

<div align="center">Equation 5.19: Longitudinal turbulence intensity</div>

where $\sigma(U)$ is the standard deviation of the longitudinal wind speed and avg(U) is the mean wind speed.

5.3.1.16 Obukhov length

The Obukhov Length can be useful for turbulences analysis and is typically associated with a 3D ultrasonic sensor. To add this evaluation, the measurement of wind speed, wind direction, vertical wind speed and virtual temperature at one height are needed.

$$L = u_*^3 / (K \times g / avg(T) \times \sigma(V_Z, T))$$

<div align="center">Equation 5.20: Calculation of the Obukhov Length</div>

$$u_* = (\sigma(V_X, V_Z)^2 + \sigma(V_Y, V_Z)^2)^{1/4}$$

<div align="center">Equation 5.21: Calculation of the friction velocity</div>

where u_* is the friction velocity [m/s], g the graviatitonal acceleration 9.81[m/s²], $\sigma(V_Z, T)$ the covariance of vertical wind speed and virtual temperature and K the von Kármán constant 0.41.

5.3.1.17 Obukhov stability parameter

Dimensionless stability parameter given by the normalized measuring height above ground z with the Obukhov length L. Can be useful for turbulences analysis and is typically associated with a 3D ultrasonic sensor. To add this evaluation, the measurement of wind speed, wind direction, vertical wind speed and virtual temperature at one height are needed.

$$\zeta = z / L$$

<div align="center">Equation 5.22: Calculation of the Obukhov stability parameter</div>

where z is the height above ground and L is te Obukhov length as in Section 5.3.1.16.

5.3.1.18 Sensible heat flux

Sensible heat flux is measured with the eddy covariance method. In meteorology, it represents the heat exchanged between the Earth's surface and the atmosphere which resulted in a temperature change.

$$Q_H = \rho \times C_p \times \sigma(V_Z, T)$$

<div align="center">Equation 5.23: Calculation of the sensible heat flux</div>

where ρ is the air density 1.2[kg/m³], C_p the specific heat with constant pressure 1004.67[J/K/kg] and $\sigma(V_Z, T)$ the covariance between the vertical wind speed and the temperature.

5.3.1.19 Solar zenith angle

The solar zenith angle is the angle between the zenith and the centre of the Sun's disc. It is calculated from the configured latitude and longitude and the time in the moment of the calculation.

> **Important**
> In order to use any formula based on the solar zenith angle, latitude and longitude of the measurement station have to be entered or acquired with a GPS device in the System → Administration menu (see also Section 4.2).

5.3.1.20 Diffuse solar irradiance (DHI)

$$\text{DHI}_{[W/m^2]} = \text{GHI}_{[W/m^2]} - \text{DNI}_{[W/m^2]} \cdot \cos(\theta)$$

Equation 5.24: Calculation of Diffuse Solar Irradiance

where θ is the solar zenith angle.

> **Note**
> If the DNI pyranometer was tilted or not alligned to north, tilt angle and cardinal direction must be introduced.
>
> **Tilt angle (°):** (X axis) inclination angle with the Y axis aligned to north [-90°, 90°]
>
> **Cardinal direction (°):** Clockwise rotation from north around the Z axis [0°, 360°]

5.3.1.21 Total apparent power

Apparent power is the product of the rms (root mean square) values of voltage and current. It is taken into account when designing and operating power systems.

$$S_{[VA]} = U_{1[V]} \cdot I_{1[A]} + U_{2[V]} \cdot I_{2[A]} + U_{3[V]} \cdot I_{3[K]}$$

Equation 5.25: Calculation of total apparent power [S].

Chapter 6

Data Evaluation

6.1 Introduction

As soon as *Recording* in the status box (see Section 3.2) is switched on, Meteo-42 records and stores measurement data. In order to check current data, the web interface offers the possibility to have see the live data (see Section 6.2). In the Data menu, measurement data can be downloaded (see Section 6.7 and Section 4.2) and statistics can be configured, which will be saved into CSV files.

6.2 Live Data Page

This page displays the currently measured data. The data are presented in a table and in a line chart.

Click on *Start* to display currently measured values. *Stop* pauses displaying data. The table shows all available data. In comparison, the line chart can be customized by choosing sensors and connected channels.

📎   **Note**
    Enable JavaScript in your web browser to display live data in a chart.

6.2.1 Publishing live data

The Meteo-42 can be configured to publish live data every second to an XMPP server using the publish-subscribe extension. The data are published using SSL/TLS encryption in JSON format.

The Meteo-42 authenticates itself with the server using the serial number as the local part of the JID, e.g. "d123456@xmpp.test".

Multiple clients can efficiently subscribe to and process the data. The Ammonit Live Data Aggregator is a tool to generate and send statistics files using the published data which is configured on AmmonitOR (`https://or.ammonit.com/`). Ammonit Live Dashboard (`https://live.ammonit.com/`) is an interactive program which visualises live data in the browser.

Livedata server Select to which server you want to publish your data to. You can choose between *Ammonit livedata server* and *Custom server*.

Publish live data to server Enable this checkbox to start publishing the live data.

Publish average data to server Enable this checkbox to start publishing average data.

Server name The name of the XMPP server to which the data should be published, e.g. "xmpp.test". If you selected *Ammonit Livedata server* as your *Livedata server* above, you will not be able to change this parameter.

Server port The TCP port for incoming XMPP connections, e.g. 443 or 5223. If you selected *Ammonit Livedata server* as your *Livedata server* above, you will not be able to change this parameter.

Password Password to your custom live data server. If you selected *Ammonit Livedata server* as your *Livedata server* above, you will not be able to change this parameter.

Allowed subscribers The Ammonit Live Data Aggregator can be enabled using the checkbox. Allow more JIDs by entering them into the text box. Use a semicolon (;) between each JID. This is useful for Ammonit Live Dashboard.

Allow unrestricted data access If you allow the unrestricted data acces using this checkbox, live and average data along with the configuration will be published to the public nodes, where the data will be publicly avaliable to anyone who subscribes to this node. It overrides the JIDs specified above in the *Allowed Subscribers* field.

6.3 Statistics Data Files

In the Data → Statistics menu CSV files with statistics are listed and can be downloaded. Meteo-42 shows a calendar with available statistics. Click on a month to highlight days with available CSV files. To navigate through the calendar, click on a month or use the arrows to move one month ahead or back. Click on a highlighted day to list all CSV files which have been generated for this day.

To view the available CSV files for a whole month, click on *Show month*; for a complete year, click on *Show year*. You can jump between the years and months by clicking on a month or year in the calendar.

All CSV files for the selected period are listed in a table and the file name refers to the time interval covered. For each file, a link to download the corresponding signature, its size in bytes, the methods through which the file has been shared and a link to visualize the matching source data are available. To display the source data corresponding to a file, click on the arrow in the *Source* column.

Below the list of CSV files it is indicated how many statistics CSV files are currently visible, from the available files in the data logger, e.g. 1 of 53 files.

If CSV files have been uploaded to an AmmonitOR project, sent per Email, copied to a configured SCP/FTP/SFTP/FTPS server, or copied onto a USB stick, they will be tagged by a checkmark in the corresponding box.

To manually download or delete one or more files, select them and click *Download selected* or *Delete selected* respectively. For the download, the CSV files will be compressed into one ZIP archive. If you want a certain file to be sent or copied again, you can also mark the selected files as not sent with the option *Mark as not sent*.

! **Important**
Deleting CSV statistics files does not delete the corresponding source data, statistics files can be generated again as long as the matching source data are still in the *Source data storage*.

To immediately generate statistics files form the available source data, click on *Generate now*. Meteo-42 will generate new files for the configured *file interval*, containing a line with the calculated statistics for each *statistics interval*. For the standard configuration of daily file interval and ten minutes statistics interval, there will be 144 lines.

If *Generate partial files* is selected, not only the files for a complete *file interval* will be generated but also a file with the residual data until the moment of the generation. This setting is only recommended for testing purposes.

Whenever statistics files are generated they are checked for a variety of known issues. If any checks fail, the files will be marked as possibly inconsistent with a description in the *Check* column. Sometimes new software releases perform new checks.

If many files are generated at once, the new ones will have a question mark in the *Check* column until they have all been generated and checked.

Once the files pass the checks, the days will be shown in blue on the calendar with a tick in the *Check* column. Until then, they are brown.

If some files have been marked as possibly inconsistent, and the issue cannot be fixed, you can manually mark them as ok with the *Ignore errors* button.

Under *Maintenance* we provide some options for trouble-shooting in case of CSV files generation problems. *Clear all sent files* will replace all existing CSV files which have already been shared by any means (AmmonitOR, Email or Remote Copy) with the text "CSV file removed via web interface" to free up memory. *Fix checked files* will inspect all existing files, search for known issues and regenerate the files if needed. This option is only available if the data logger detects any suspicious files. Files which have been replaced with an empty file as described in *Clear all sent files* will be marked as suspicious. The *Behaviour if file limit is reached* option controls what happens when the system is low on storage. When there are more than 10,000 statistics files or less than 30MiB free storage remaining, the data logger stops creating new files. Changing the behaviour to automatically delete the oldest sent files will ensure that these limits are not exceeded, and files continue to be generated.

Figure 6.1: Downloading Statistics

6.3.1   Configuring Statistics and CSV files

In order to configure statistics and CSV files, go to the Data → Statistics menu. You can define the interval over which statistics will be calculated, and which statistics are needed.

Meteo-42 automatically suggests the standard statistics for each evaluation and channel. These can be removed and additional statistics can be selected manually.

Click on *Select statistics* in the *Configure statistics* section to create the statistics, e.g. average, maximum, minimum, standard deviation, count, sum and median. Activate checkboxes to include evaluators and channels in the statistics.

Remove checkboxes to exclude evaluators and channels. Additionally, Meteo-42 displays internal current and internal voltage in the CSV files.

Figure 6.2: Configuring the Statistics

The options are:

Select statistics Select individual statistics for every evaluator and channel. See Figure 6.4.

Statistics interval for files Defines over which time interval statistics are calculated, generating a new line in the CSV file. Several intervals are available from 1/4 s to 1 h. The same statistics interval may appear in multiple files if the recording is switched off and on again.

File interval Determines, how often a new aggregate data file in CSV format has to be created. Selecting *Hourly*, produces one file per hour that includes data from the last hour. *Daily* generates only one file per day, etc. Several intervals are available from every 5 minutes to weekly. The file interval is also applied to Gust data files.

Generate partial files Generate CSV files up to the current moment, even if the file interval has not yet finished. This means that the latest file will be incomplete and regenerated later, so it is only recommended for testing purposes.

Statistics interval for SCADA, Switch manager and snapshots Defines over which time interval statistics are calculated from the live data. The calculation occurs at the end of the interval and the data are available over SCADA, applied to switch manager, sent/copied as a snapshot and uploaded to an XMPP server if configured. All current data from that period is considered to generate new aggregate data. Several intervals are available from 2 s to 1 h.

SCADA Summary interval Applied only to the Summary statistic of the SCADA Modbus server. Typically used to obtain a daily summary of sun status or precipitation measurements.

Secondary Files Suplementary statistics files can be generated with a different interval for the statistics calculation. Secondary statistics can be configured here. See Section 6.4.

Tertiary Files A further suplementary statistics interval can be configured here. See Section 6.4.

⚠ **Warning**
Be careful with setting the *statistics interval* and the *file interval*! Low values for the *statistics interval* lead to huge statistics files, which you might need to remove manually once in a while. Low values for the *file interval* lead to many small CSV files, which might be hard to handle.

📎 **Note**
Low data file time intervals like 1, 2, 5 and 10 minutes are always delayed in generation by one or two intervals. It means that 5 minute file will always be generated with the delay of 5 or 10 minutes. I.e. 5 minute interval file that should be generated at 12:00 (containing data from 11:55 to 12:00) will be first generated at 12:05 or 12:10.

For solar-related evaluations Meteo-42 estimates certain values in addition to the measured values, i.e. estimated sun status and estimated direct normal irradiation. In order to create the estimated values, the location of the measurement station has to be entered in the System → Administration menu. By default the estimated values are not included in the CSV file. If required, select the values for the statistics.

Meteo-42 uses vectorial calculations for wind direction, i.e. vectorial average, direction maximum, direction minimum, and vectorial standard deviation (Yamartino method). Hence, the calculated minimum value for the wind direction can be higher than the maximum in case of wind from northern directions.

$$d = atan2 \left(\sum_{i=1}^{n} \sin(\vartheta_i), \sum_{i=1}^{n} \cos(\vartheta_i) \right)$$

Equation 6.1: Calculation of wind direction average

The equation for the average wind direction d is given by Equation 6.1 and converted to a value between 0 and 360°.
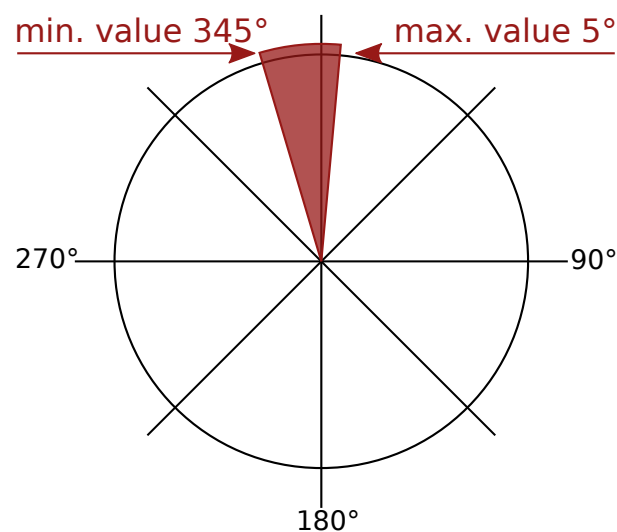
Figure 6.3: Vectorial Calculation for the Wind Direction

Evaluator/Channel	Avg	Max	Min	SDv	Cnt	Sum	Med	Val
Wind Speed (Top Anemometer)	☒	☒	☒	☒	☒		☐	
Wind Speed (Backup Anemometer)	☒	☒	☒	☒	☒		☐	
Wind Speed (Middle Anemometer)	☒	☒	☒	☒	☒		☐	
Wind Speed (Low Anemometer)	☒	☒	☒	☒	☒		☐	
Wind Direction (Top Wind Vane)	☒	☐	☐	☒	☒		☐	
Wind Direction (Backup Wind Vane)	☒	☐	☐	☒	☒		☐	
Wind Direction (Low Wind Vane)	☒	☐	☐	☒	☒		☐	
Humidity (Hygro/Thermo @10.0m)	☒	☒	☒	☒	☒		☐	
Temperature (Hygro/Thermo @10.0m)	☒	☒	☒	☒	☒		☐	
Air Pressure (Barometer @10.0m)	☒	☒	☒	☒	☒		☐	
A1 (Hygro/Thermo @10.0m)	☒	☒	☒	☒	☒		☐	
A2 (Hygro/Thermo @10.0m)	☒	☒	☒	☒	☐		☐	
A3 (Barometer @10.0m)	☒	☒	☒	☒	☐		☐	
C1 (Top Anemometer)	☒	☒	☒	☒	☒	☐	☐	
C2 (Backup Anemometer)	☒	☒	☒	☒	☒	☐	☐	
C3 (Middle Anemometer)	☒	☒	☒	☒	☒	☐	☐	
C4 (Low Anemometer)	☒	☒	☒	☒	☒	☐	☐	
D1 (Top Wind Vane)	☒	☒	☒	☒	☐	☐	☐	
D2 (Backup Wind Vane)	☒	☒	☒	☒	☒	☐	☐	
D3 (Low Wind Vane)	☒	☒	☒	☒	☒	☐	☐	
Analog Voltage (Int. Voltage)	☒	☒	☒					
Analog Current (Int. Current)	☒	☒	☒					
Temperature (Int. Temperature)	☒	☐	☐					

Save

Back

Figure 6.4: Statistics Configuration Page

Press *Save* to finish the configuration of statistical values.

6.4 Secondary and Tertiary Statistics Files

Sometimes it is necessary, to have additional statistics on top of the standard, e.g. with a different statistics interval or a different selection of values. You can activate the supplementary generation of statistics files with two different configurations. The files will be listed in a similar table as the main statistics files (see Figure 6.5 and Figure 6.6). If the files are generated, they will be automatically sent per Email or AmmonitOR alongside the main statistics files.

Warning
Beware that having more CSV files

1. is more work for the data logger, so more time and energy is consumed

2. fills the memory of the data logger faster

3. needs more bandwidth for data transmission

6.4.1   Secondary Statistics Files

Select *Generate additional files with secondary interval* to activate the generation of the secondary files. You can configure a *statistics interval* different from the main statistics interval. To select the statistics which will be calculated and included in the secondary files, click on *Select statistics*.

Secondary statistics files calendar

Show month   Show year

◀   **2023-08**   ▶

Mon	Tue	Wed	Thu	Fri	Sat	Sun
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

☐ Select | File | Sig | Size | AmmonitOR | Email | Copy | USB | Source

0 of 0 files

Generate now   ⬇ Download selected   Delete selected

Mark as not sent   Ignore errors

☐ Generate additional files with secondary interval

Select statistics

Secondary statistics interval

10 min ▼

Save

Back

Figure 6.5: Secondary Statistics Page

6.4.2   Tertiary Statistics Files

Select *Generate additional files with tertiary interval* to activate the generation of the tertiary files. You can configure an *statistics interval* different from the main and the secondary statistics interval. To select the statistics which will be calculated and included in the secondary files, click on *Select statistics*.

Figure 6.6: Tertiary Statistics Page

6.5 Gust Data Files

Detecting extreme wind events or gusts can be interesting to compare different geographical terrains or to estimate wind turbines load. Meteo-42 offers the possiblity to generate extra CSV files including the measurements at the maximum rate. To generate gusts data files you must activate this option in menu Data → Gusts.

One gusts CSV file will be generated per day (or the configured *file interval* in Data → Statistics menu) including all wind gusts of that period. If no gust was registered during the period, an empty file is generated. Empty files will not be visible in the *Gust data files calendar* but will be listed beneath.

To be considered a gust, the selected *trigger evaluation* must exceed the configured threshold value a minimum number of consecutive repetitons (*minimum repetitions* parameter) and not more than the selected *maximum repetitions*. The gust as well as the previous and posterior number of seconds specified by *time overhang* parameter are included in the gusts CSV file.

Gust data files calendar

Show month   Show year

◄   **2023-08**   ►

Mon	Tue	Wed	Thu	Fri	Sat	Sun
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

☐ Select | File | Sig | Size | AmmonitOR | Email | Copy | USB | Source

0 of 0 files

Generate now   ↓ Download selected   Delete selected

Mark as not sent   Ignore errors

Figure 6.7: Gust Data Calendar

Not every existing measurement is related to gusts analysis. The relevant evaluations must be selected. Press the *Select evaluations* button to access the evaluations selection site and select which evaluations will be included in gusts CSV files.

Evaluator	Include
Anemometer (Wind Speed)	☐
Wind Vane (Wind Direction)	☐
Hygro/Thermo (Humidity)	☐
Hygro/Thermo (Temperature)	☐

Save

Back to gust data

Figure 6.8: Gust Evaluations Selection

! Important
If the gusts data generation is activated in a running project, all existing source data will be analyzed and gusts CSV files will be generated. This process could take several hours.

6.6 The CSV File Format

Meteo-42 stores measurement data in standard Comma-Separated Value (CSV) format with configuration information in ini file format. The CSV format is documented in RFC 4180 (http://tools.ietf.org/html/rfc4180) and well explained, e.g. in Wikipedia (http://en.wikipedia.org/wiki/Comma-separated_values). Ini files

are described, e.g. in Wikipedia (`http://en.wikipedia.org/wiki/INI_file`) as well. CSV files can easily be read by many programs and software tools, as can the ini file format. The CSV section and configuration footer are separated by a blank line.

📎 **Note**

In almost all cases, the CSV files created by Meteo-42 are compressed using GNU gzip (`http://www.gzip.org/`) with the typical file extension `.gz`. gzip compressed files can be decompressed on all operating systems, see, e.g. Wikipedia (`http://en.wikipedia.org/wiki/Gzip`) for further details.

6.6.1 Ammonit Meteo-42 specific details

The measurement data files of the Meteo-42 use the `,` (comma) as field separator, `"` (double quote) for embedding commas in textual strings and UTF-8 as character set.

The CSV and ini parts are separated by one empty line.

6.6.1.1 Data part (CSV format)

The CSV part starts with a header line. This line is a comma-separated list of the statistics for each active channel and evaluator. The first item of the list is the date/time entry.

⚠️ **Important**

The date and time value shows the start time of the statistics interval.

Date and time format are similar to ISO-8601, e.g. `2014-07-17 15:50:00`. The date and time values are always the local time of the data logger. The timezone is stated in the second part of the file.

The evaluator statistics have the form `Sensor;Evaluation;Statistic` (e.g. `Anemometer;wind_speed;Avg` or `WindVane10bit;wind_direction;Count`). Thereafter, the channel statistics are displayed in the form `Channel;Statistic` (e.g. `A2;Avg` or `C1;StdDev`).

The statistics can individually be selected per sensor in the Data → Statistics menu (see Figure 6.4).

According to the configured statistics interval, Meteo-42 calculates the statistics. Each time period is represented in a line of the CSV file. The values are generally decimal numbers, using a point (`.`) as decimal mark. The number of digits displayed after the decimal point is automatically calculated based on the measurement precision. For example, an anemometer with a slope of 0.0462 m/sI uses two digits after the decimal point. The average and standard deviation statistics include two additional digits to reflect the additional information from repeated sampling.

Language settings of the data logger do not have an influence on the CSV file.

The following evaluation types are available:

```
wind_speed: Wind Speed,
wind_direction: Wind Direction,
humidity: Humidity,
temperature: Temperature,
temperature_differential: Differential Temperature,
air_pressure: Air Pressure,
air_density: Air Density,
solar_irradiance: Global Horizontal Irradiance,
solar_irradiance_diffuse: Diffuse Horizontal Irradiance,
solar_irradiance_direct: DNI·cosθ,
solar_DNI: Direct Normal Irradiance (DNI),
solar_irradiance_direct_sw: Estimated DNI,
solar_DNIcos_sw: Estimated DNI·cosθ,
sun_status: Sun Status,
sun_status_sw: Estimated Sun Status,
precipitation: Precipitation,
precipitation_intensity: Precipitation Intensity,
precipitation_status: Precipitation Status,
precipitation_sum: Precipitation Sum,
wind_speed_vert: Vertical Wind Speed,
counter: Counter,
voltage: Analog Voltage,
current: Analog Current,
status: Status,
active_power: Active Power,
power_factor: Power Factor,
reactive_power: Reactive Power,
apparent_power: Apparent Power,
obukhov_length: Obukhov Length,
dir_max_speed: Direction at max. Speed,
brightness_max: Brightness max. Value,
brightness_direction: Direction of Brightness,
frequency: Frequency,
inclination_angle: Angle of Inclination,
vibration_frequency: Vibration Frequency,
vibration_amplitude: Vibration Amplitude,
other: Other Evaluation,
any: Any Evaluation
```

The following statistics are available:

```
Avg: Average,
Max: Maximum,
Min: Minimum,
StdDev: Standard deviation,
Count: Count of valid values,
Sum: Sum,
Med: Median,
Val: First valid value
```

The last column of the CSV file is `addr`. This is the memory address in the source data storage for the start of the interval.

6.6.1.2   Information part (Ini file format)

The information part contains data logger information as well as sensor details like installation height, slope and offset values, as well as unit and sensor name.

The information part is included in every file. It can be found below the statistical data. The overall format of the configuration is the following:

```
[Section 1]
key1=value
```

```
key2=value
[Section 2]
key1=value
```

All section names, keys and values are case-sensitive and may contain unicode characters in UTF-8 encoding. While sections and values may contain spaces; keys will not. Each section is unique; each key is unique within its section. Neither the order of sections nor the order of entries within the sections are significant or guaranteed.

- `[System]`: Serial number in the format `serial=G123456` and type of the data logger in the format `type=Meteo-42L` the assigned name; timezone in the format `timezone=UTC+01:00` (the offset can be positive or negative or be missing, which indicates UTC); the location in decimal degrees and altitude in meters: `latitude=0.0 longitude=0.0 altitude=0.0` as well as the software version and important system settings, e.g. `cecs_power_permanent=true`. The `gps_fix` field indicates the timestamp of the most recent synchronisation with the satellite if GPS is used.
- `[Summary]` contains the date and time when the CSV file was created, the used source data storage, the summary over the file time interval for configured precipitation, precipitation intensity, status and sun status evaluations and total traffic for each network interface.
- `[Evaluation]` indicates `file_interval` and `stat_interval` (see also Section 6.3).
  The `file_interval`, usually `daily`, can have the following values:
    fiveminutes
    tenminutes
    fifteenminutes
    twentyminutes
    thirtyminutes
    hourly
    twohours
    threehours
    fourhours
    sixhours
    twelvehours
    daily
    weekly
  The `stat_interval`, usually `10 min`, can have the following values:
    1 s
    2 s
    3 s
    5 s
    10 s
    20 s
    30 s
    1 min
    2 min
    5 min
    10 min
    15 min
    20 min
    30 min
    1 h
- `[Adjustment]`: CS1 and CS2 are the calibration values for the current source of Meteo-42. The values are for informational purpose only.
- `[RX]`: The `rate` of RS485 client number X is given in s, min or h; `serial_setting` for RS485 includes speed without unit, as well as data format in conventional notation (e.g. 9600 8N1).
- `[Sensor;Evaluator]`
  - `statistic`: List of statistics, which are calculated for the sensor, e.g. average, min, max.
  - `unit`: Unit for the data, e.g. m/s.
  - `sensor_label`: Name, which has been entered by the user in the sensor configuration.
  - `sensor_height`: Installation height in meters, which has been entered by the user in the sensor configuration.
  - `sensor_type`: Indicates the type of the sensor, e.g. `anemometer`. The following values are possible:

> anemometer: Anemometer,
> wind_vane: Wind Vane,
> hygro_thermo: Humidity / Temperature Sensor,
> barometer: Barometric Pressure Sensor,
> precipitation: Precipitation Sensor,
> pyranometer: Solar Sensor,
> ultrasonic: Ultrasonic Anemometer,
> power_meter: Power Meter,
> other: Other Sensor

- – sensor_model: The model of the sensor, e.g. Thies First Class Advanced.
- – formula: The type of formula used to convert the electrical values, e.g. linear.
- – formula_params: Parameters, which are referenced to in the formula, including related channels and evaluator parameters, e.g. A5 A6 var_offset var_slope. Values of the parameters are displayed in the lines below the formula parameters, e.g. var_offset, var_slope, var_period, var_sensitivity.

- [Channel]

- – statistic: List of statistics, which are calculated for the channel/sensor. For each statistic a column is displayed in the upper part of the CSV file.
- – unit: Unit of the calculated data. This is the SI unit for the type of quantity, however the unit for barometric pressure might be either hPa or mbar, and the temperature unit is °C or K for differential temperature.
- – rate: Configured rate for the channel with unit (not applicable for client channels).
- – range: Configured range for analog voltage channels (Ax) with unit.
- – protocol: Protocol, which is used for digital channels (Dx).

6.6.2   CSV import in LibreOffice or OpenOffice

Tip

Use LibreOffice (http://www.libreoffice.org/) Calc or OpenOffice.org (http://www.openoffice.org) Calc. These are free, professional spreadsheet programs to process your CSV files.

The recommended settings to import the CSV file are shown in Figure 6.9.
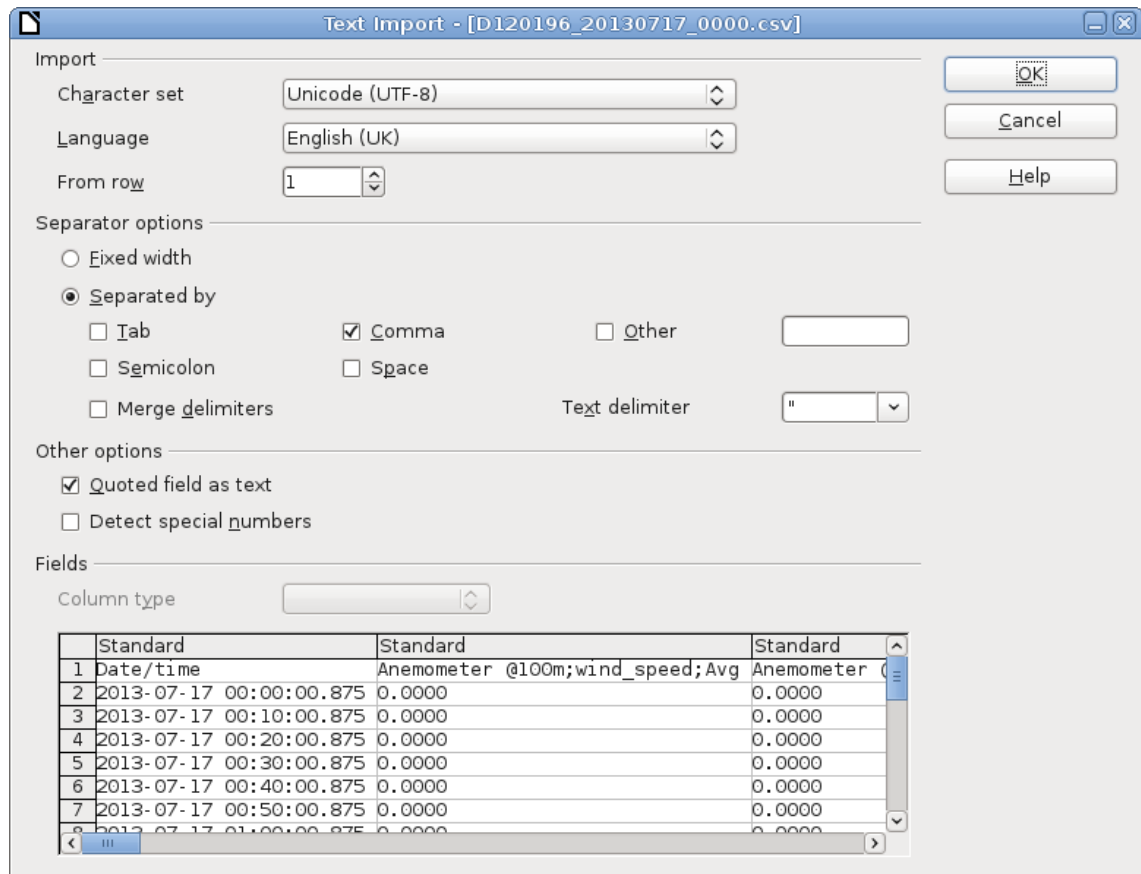
Figure 6.9: LibreOffice CSV-file import settings

6.6.3 CSV Import in Microsoft Excel 2010™

Depending on the version of Microsoft Excel™ the procedure can be slightly different. In general, we recommend using the import assistant of Microsoft Excel™.

> **Note**
> Save CSV files always in a directory. The described process in Microsoft Excel™ does not work, when files are opened via your email program.

1. Launch Microsoft Excel™ and open the *Options* window, which can be found in the *File* menu. Open the *Advanced* menu. In the *Editing options* section deselect *Use system separators* and use `.` (dot) as decimal separator and `,` (comma) as Thousands separator. See figure Figure 6.10.
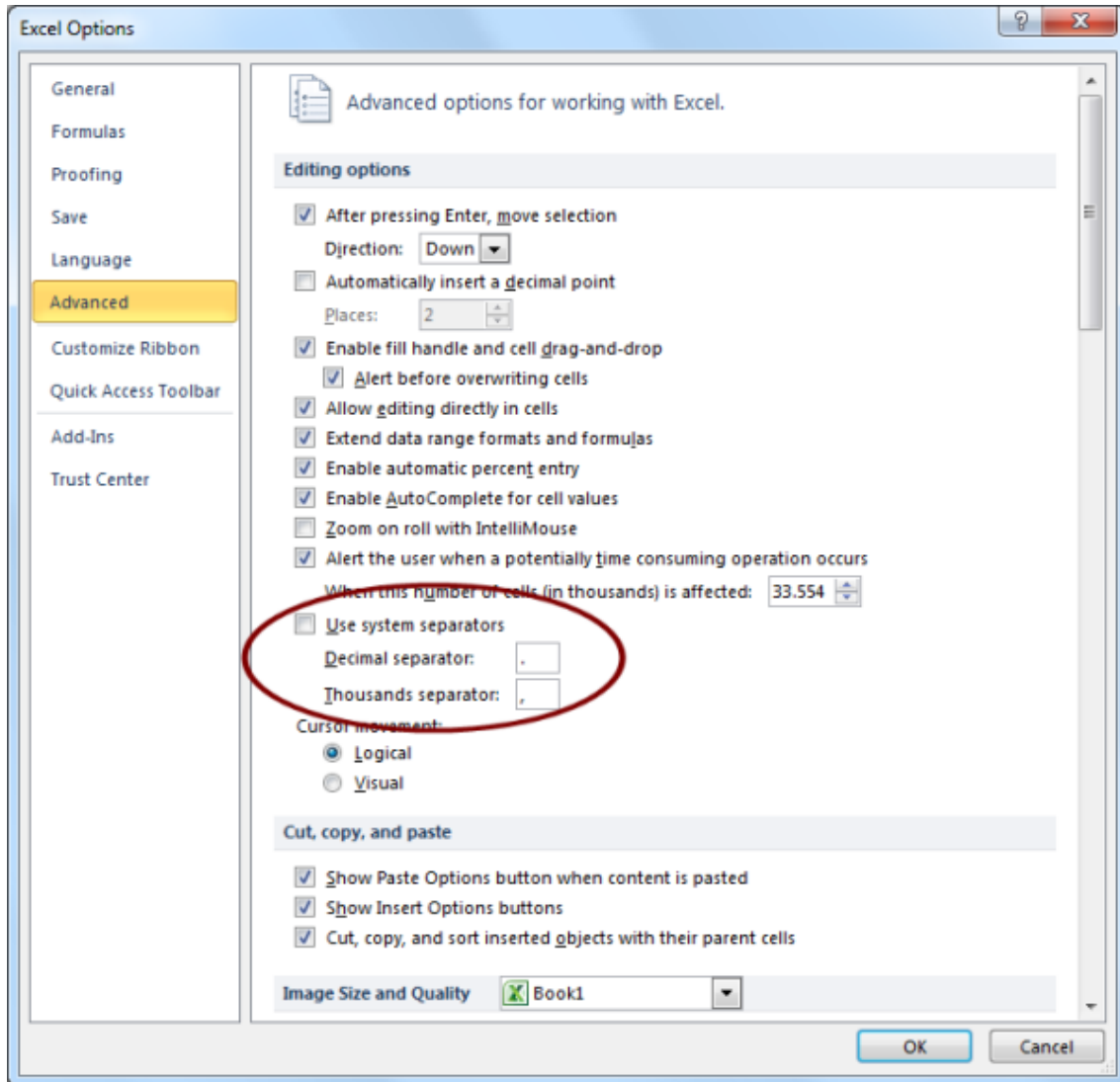
Figure 6.10: Microsoft Excel 2010™ CSV Import (1)

2. After setting the options, click on the *Data* tab as shown in Figure 6.11. In order to import the CSV file, click on *From Text* in the group *Get External Data*, locate and double-click the file you want to import. Follow the instructions in the *Text Import Wizard*.
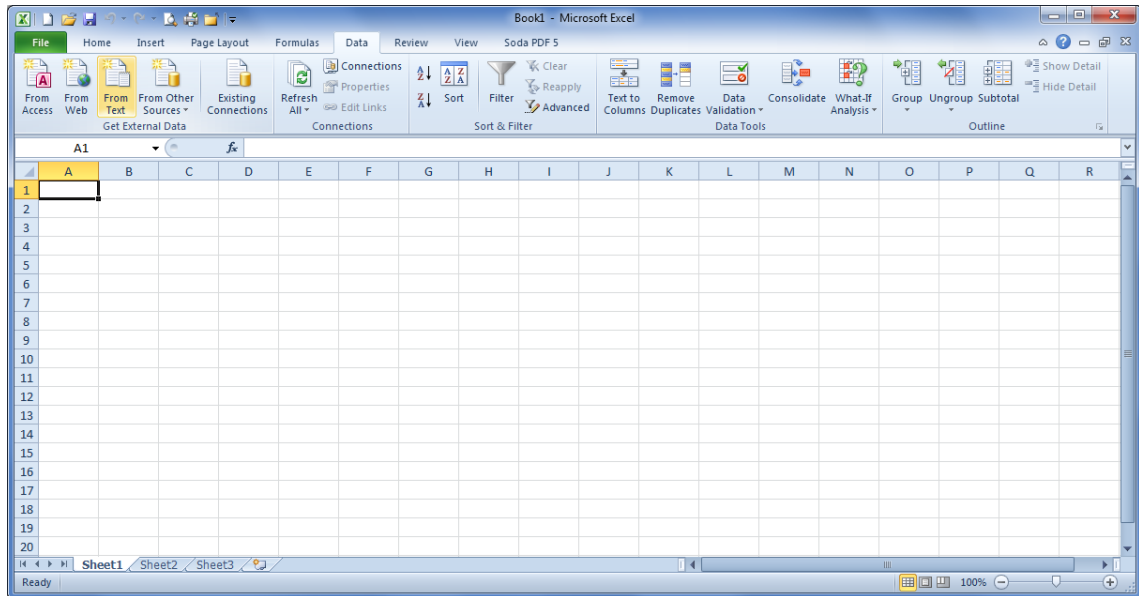
Figure 6.11: Microsoft Excel 2010™ CSV Import (2)

3. In the first step of the wizard choose *Delimited* as *Original data type* and select *Unicode (UTF-8)* for the file origin. See Figure 6.12.
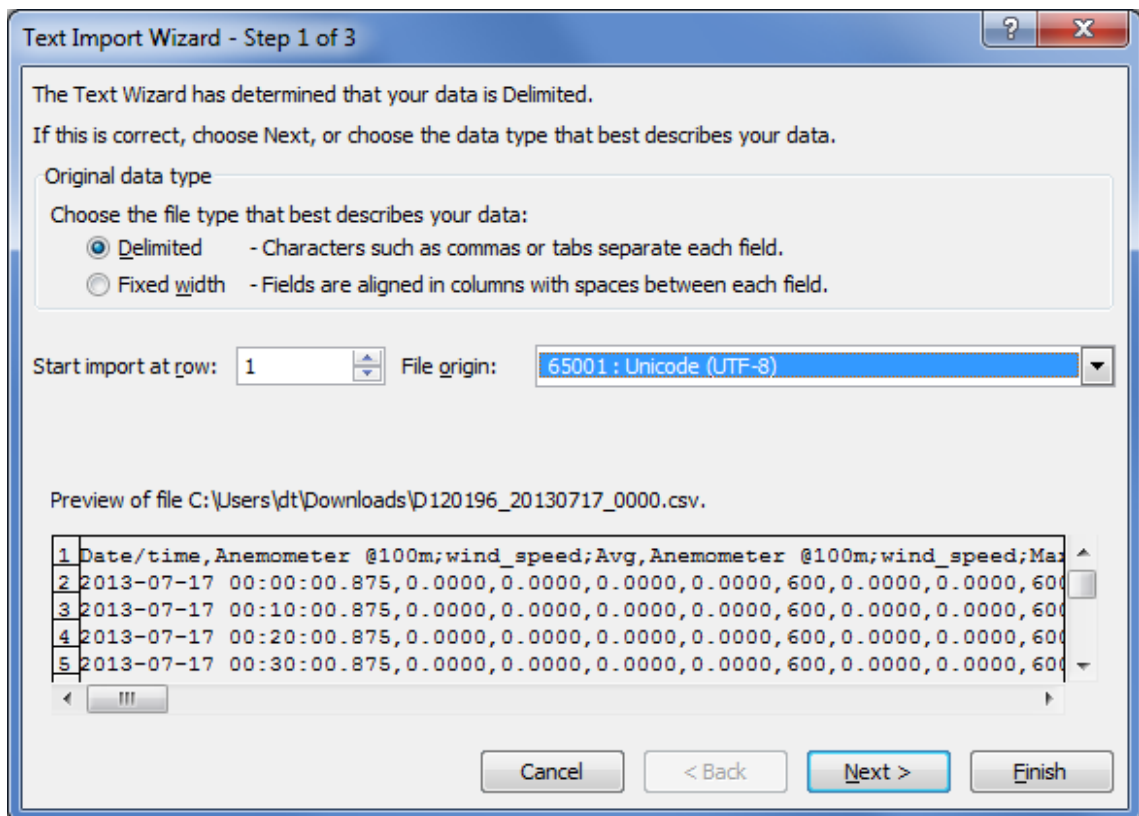
Figure 6.12: Microsoft Excel 2010™ CSV Import (3)

4. In next step define *Comma* as delimiter and *"* as text qualifier as shown in Figure 6.13.
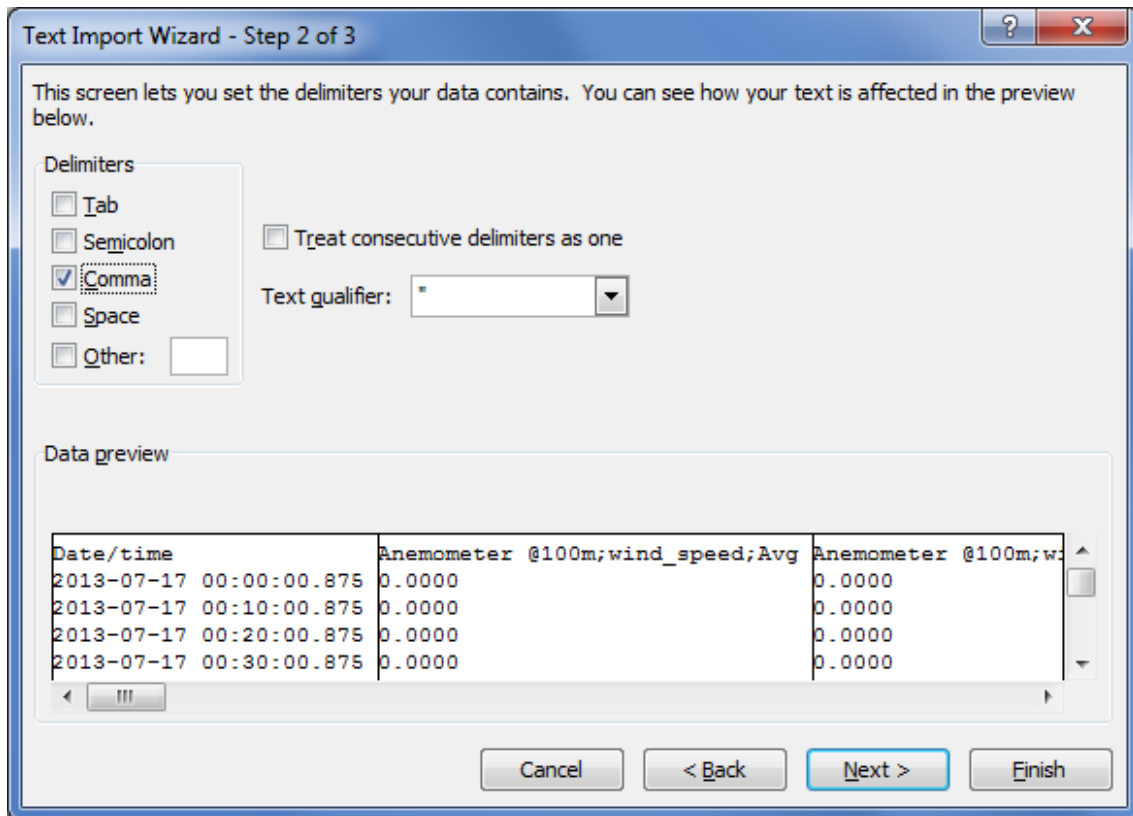
Figure 6.13: Microsoft Excel 2010™ CSV Import (4)

5. In the last step of the wizard, select *Text* for the data format columns. See Figure 6.14.
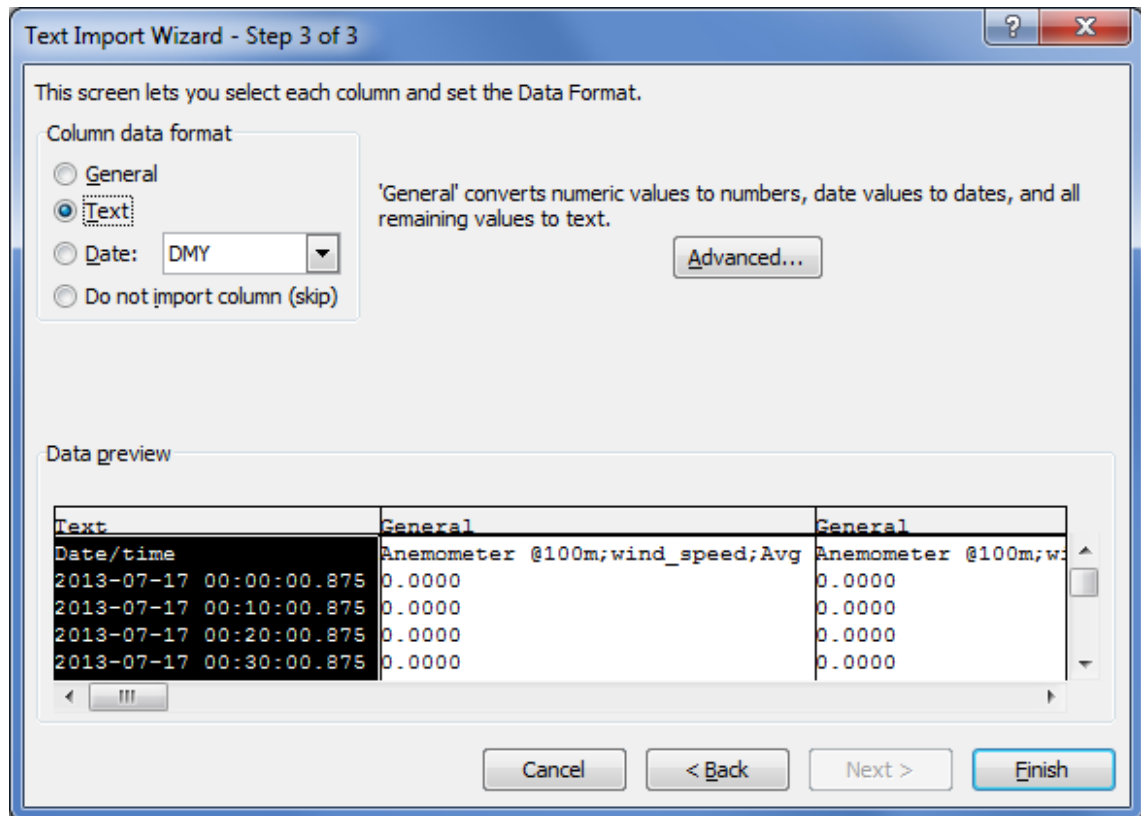
Figure 6.14:   Microsoft Excel 2010™ CSV Import (5)

6. By clicking on *Finish* the file opens in your selected sheet. See Figure 6.15.
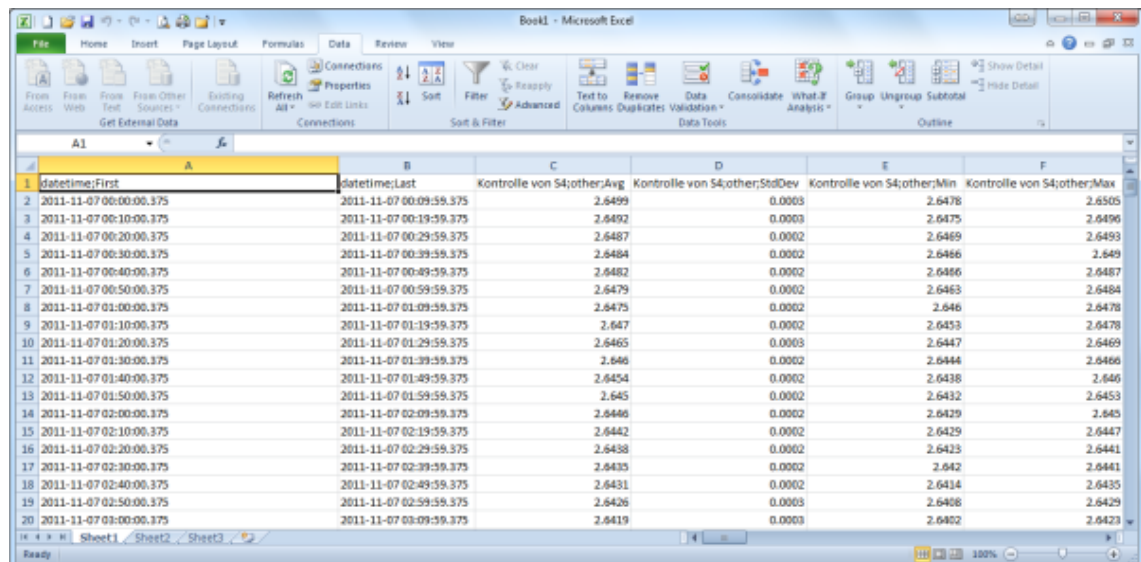
Figure 6.15:   Microsoft Excel 2010™ CSV Import (6)

7. In order to change the cell format of the date and time columns from text to date time format, highlight the column(s) and open *Format Cells* in the *Numbers* group on the *Home* tab. Select *Custom* and enter YYYY-MM-DD hh:mm:ss.000 as shown in Figure 6.16.

© 2011 — 2023 Ammonit Measurement GmbH
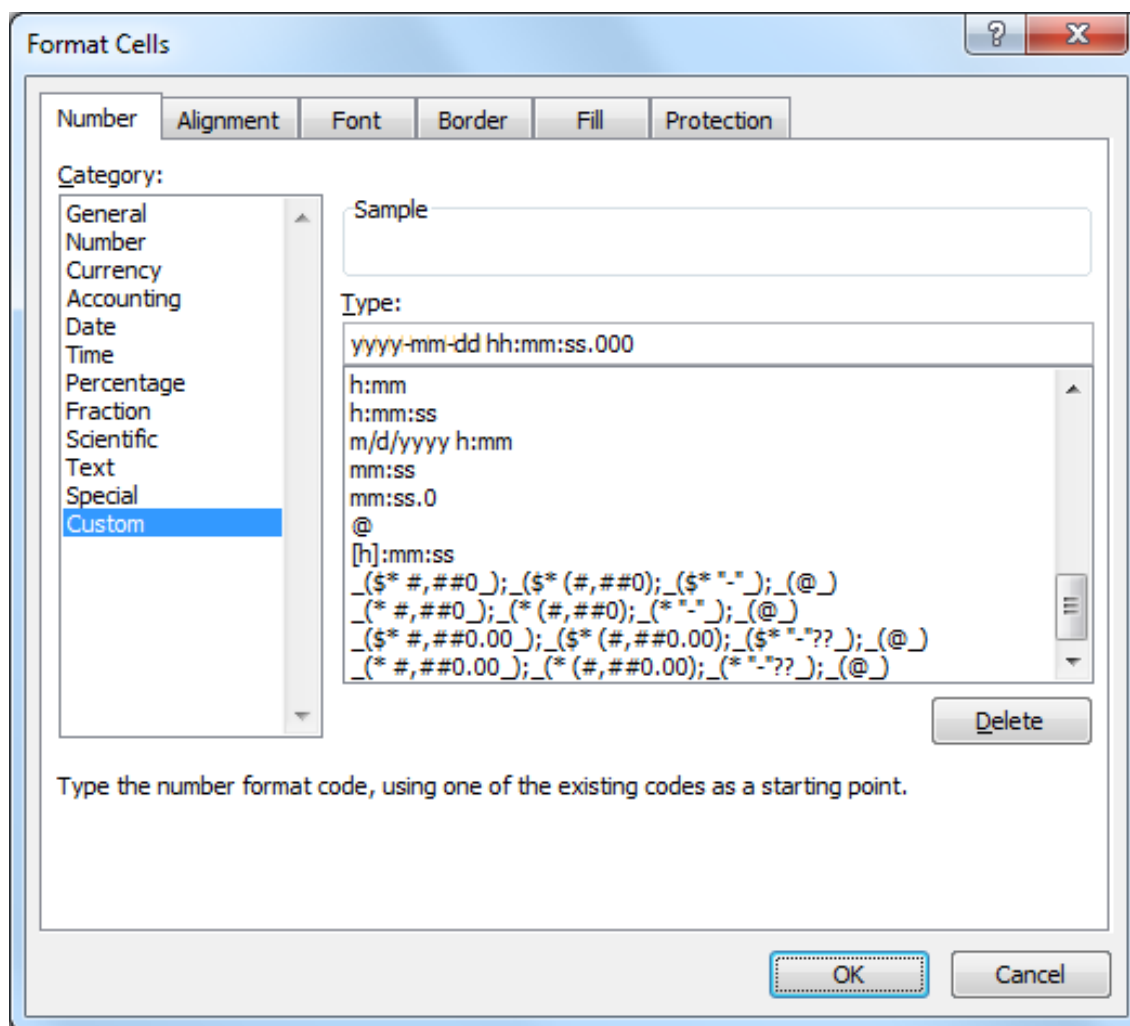
Figure 6.16: Microsoft Excel 2010™ Format Cells

6.7   Access to Source Data

Source data contains all electrically measured values neither interpreted nor aggregated statistically. If source data are available and the used sensors are known, it is possible to re-evaluate a complete measurement campaign.

> **! Important**
> Source data is only recorded, when recording is switched on!
> See the note about recording in Section 5.1 for details.

The source data storage is organized as a ring buffer, which means that the oldest data will be overwritten when the storage is filled entirely. For compactness reasons data is saved in a binary format and cannot be read directly. However, you can view or download data.

To view or download source data, go to the Data → Source menu. Meteo-42 displays all months and related days, on which source data is available. As shown in Figure 6.17, select month, day and time period to display related source data in the table below.

HH:MM	HH:MM	HH:MM	HH:MM	HH:MM	HH:MM
00:00	00:10	00:20	00:30	00:40	00:50
01:00	01:10	01:20	01:30	01:40	01:50
02:00	02:10	02:20	02:30	02:40	02:50
03:00	03:10	03:20	03:30	03:40	03:50
04:00	04:10	04:20	04:30	04:40	04:50
05:00	05:10	05:20	05:30	05:40	05:50
06:00	06:10	06:20	06:30	06:40	06:50
07:00	07:10	07:20	07:30	07:40	07:50
08:00	08:10	08:20	08:30	08:40	08:50
09:00	09:10	09:20	09:30	09:40	09:50
10:00	10:10	10:20	10:30	10:40	10:50
11:00	11:10	11:20	11:30	11:40	11:50
12:00	12:10	12:20	12:30	12:40	12:50
13:00	13:10	13:20	13:30	13:40	13:50
14:00	14:10	14:20	14:30	14:40	14:50
15:00	15:10	15:20	15:30	15:40	15:50

```
    Date and Time      A1 A2 A3 A4 C1 sw  V  I  T     addr
2023-08-11 15:35:00.000                              0000001051x0
2023-08-11 15:40:00.000 4  2  2  3  1  1  1  2  3    0000001052x0
2023-08-11 15:45:00.000                              0000001053x0
2023-08-11 15:50:00.000 3  4  5  0  3  1  2  2  4    0000001054x0
2023-08-11 15:55:00.000                              0000001055x0
```
5 lines

Figure 6.17: Screenshot of the Source Data Page

The displayed source data can be downloaded as CSV file by clicking on the buttons below the table.

Download ten minutes Click to download a CSV file with source data of the selected 10min-period.

Download hour Click to download source data of the selected hour, i.e. source data of one table row. The source data in the downloaded CSV file starts with 00:00 and ends with 59:59.

Download day Click to download source data of the selected day, i.e. the source data of the whole day from 00:00:00 to 23:59:59. If source data of the current day is downloaded, the CSV file includes all data up to the download moment.

Download week Click to download source data of the week containing selected day, i.e. Monday 00:00:00 to Sunday 23:59:59.

Show all weeks Open a table of every week of source data for a complete overview and easier downloading.

⚠️ **Warning**
The volume of downloaded source data can be huge, e.g. a filled 2 GB memory can lead to a 10 GB CSV file.

Chapter 7

Communication

7.1   Introduction

Depending on the usage of Meteo-42, several communication methods are available:
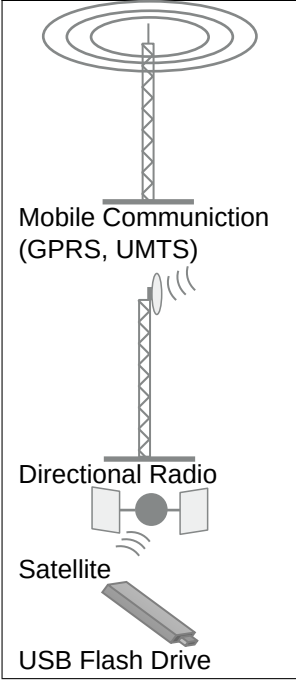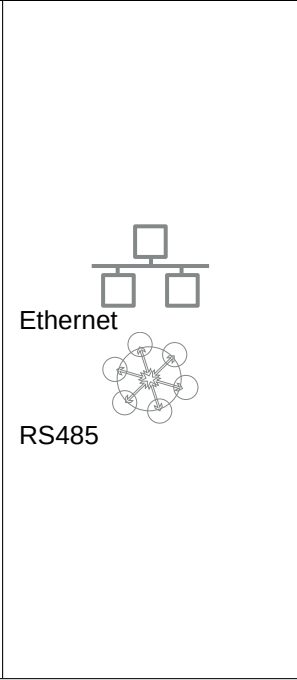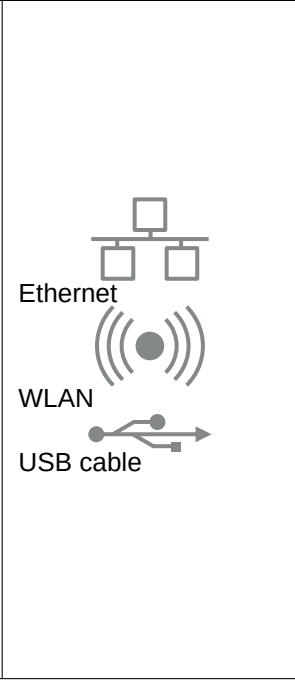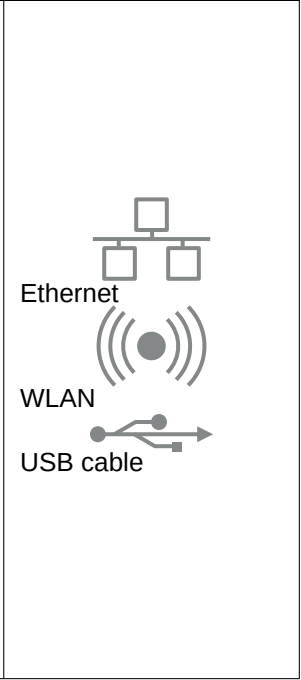
Measurement Campaign	Power Plant Monitoring	Maintenance (Site)	Configuration (Office)
Mobile Communiction (GPRS, UMTS) Directional Radio Satellite USB Flash Drive	Ethernet RS485	Ethernet WLAN USB cable	Ethernet WLAN USB cable

Table 7.1: Data Transmission with Meteo-42

The Meteo-42 web interface can be accessed via:

- LAN
- WLAN(WiFi) using a USB WiFi stick
- Modem for GSM/ GPRS, directional radio or satellite connection
- USB

If Meteo-42 has been connected successfully to one of the above mentioned devices or networks, it is shown on the data logger display under the menu Communication. USB and Ethernet connections are displayed in menu Communication → Devices → LAN; a connected modem in menu Communication → Devices → Modem. WLAN (WiFi) parameters are displayed in menu Communication → Devices → WLAN.

Once the connection has been established, further settings can be configured via the web interface. There are different ways to collect data from Meteo-42:

- Email
- Remote Copy
- AmmonitOR upload (also AmmonitOR installation on customer's server) (AmmonitOR account is required)
- Direct download via web interface
- Direct download from data logger on USB flash drive

Data transmission between Meteo-42 and PC can be automatic (one-way) or interactive (two-way). Automatic communication means that Meteo-42 sends CSV files by email or uploads data via SCP/FTP/SFTP/FTPS. Once the actions have been configured, no further interaction is needed. Active communication implies an action by the user, e.g. accessing the web interface while Meteo-42 is online. If a modem is used, you can access Meteo-42 via Ammonit-Connect.
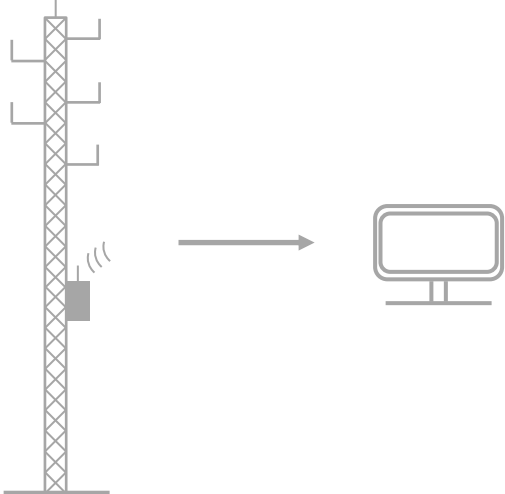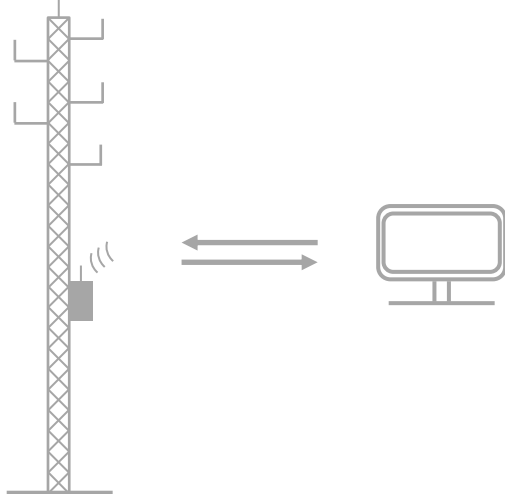
Automatic Communication	Interactive Communication
• Data Upload to AmmonitOR • Email CSV and other files • Data Upload via SCP, FTP, SFTP or FTPS	• Online Access via AmmonitConnect • Meteo-42 Configuration • Data Download via Web Interface

Table 7.2: Automatic vs. Interactive Communication with Meteo-42

The settings for data transmission or online access can easily be configured via the Meteo-42 web interface in the Communication → Schedule menu (see also Section 7.2). CSV files, which include measurement data, are stored on

the data logger and can be downloaded directly from the data logger, sent automatically via email to an address of your choice or uploaded automatically to an SCP/FTP/SFTP/FTPS server of your choice.

In order to configure the settings for each communication method, use the menu items: *Online*, *AmmonitOR*, *Email*, *Remote Copy*, *LAN*, *WLAN* and *Modem*.

Tip
We recommend using our online platform *AmmonitOR* to manage and monitor measurement data. To register and start using *AmmonitOR*, go to the AmmonitOR login page (`https://or.ammonit.com/access/login/`).

Port	Direction	Configurable	Usage
21/tcp (FTP)	outgoing	yes	file transfer from Meteo-42 to file server
25/tcp (SMTP)	outgoing	yes	email transfer from Meteo-42 to mail server
53/tcp+udp (DNS)	outgoing	no	domain name system
123/tcp+udp (NTP)	outgoing	no	network time protocol to set time and date
443/tcp (HTTPS)	incoming	no	secure Meteo-42 web interface
443/tcp (HTTPS, XMPP)	outgoing	no	software update and live data
465/tcp (SMTPS)	outgoing	yes	secure email transfer from Meteo-42 to mail server
502/tcp (Modbus)	incoming	no	Meteo-42 SCADA service
587/tcp (SMTP with STARTTLS)	outgoing	yes	secure email transfer from Meteo-42 to mail server
4040/tcp	outgoing	no	secure tunnel for Meteo-42 web interface
4041/tcp	outgoing	no	secure file transfer from Meteo-42 to file server, e.g. AmmonitOR

Table 7.3: Ports used by Meteo-42

7.2   Configuring the Communication Schedule

Actions are processes, which the data logger performs according to the settings in the Communication → Schedule menu. You select which action should be performed at which time and how often or how long during a day.

Meteo-42 turns on one minute before an action takes place and stays switched on as long as the action is running. The status box in the web interface informs about the number of running actions.

Note
If *CECS is always active* has been selected in the CECS power mode section of the System → Administration menu, Meteo-42 does not switch off automatically. Refer to Section 1.4.1 for further details.

Configuring the schedule includes defining the communication behavior during a day and selecting on which weekdays an action should be performed. Each action starts performing at its `Start Time` and will be repeated according to the defined *Interval* until the number of actions (*Quantity*) is achieved or a new day begins (`00:00`).

Online Indicates the periods, at which the Meteo-42 web interface can be accessed over the Internet. If configured, a tunnel connection is established.

> 📎 **Note**
> Be carefully selecting the online intervals of the data logger. Connection costs can be very high depending on the communication method. In most cases up to three online intervals of 20 minutes are sufficient.

AmmonitOR Indicates, when and how often CSV files should be uploaded to an AmmonitOR account.

Email Indicates, when and how often emails with attached CSV file(s) should be sent. If necessary, CSV files are generated automatically before emails are sent.

Remote Copy Indicates, when and how often CSV file(s) should be uploaded to a configured server using SCP, FTP, SFTP or FTPS. If necessary, CSV files are generated automatically before upload.

Only generate CSV Indicates, when and how often CSV files should be generated without sending or uploading them. Select this option to generate CSV files for the manual download via web interface or on USB flash drive. According to the configured statistics (see Section 6.3), Meteo-42 generates CSV files on the selected days at the scheduled times.

Action	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Start time	Quantity	Interval	Next	Progress	Status
Online	☒	☒	☒	☒	☒	☒	☒	12:00	1	0:00	2023-08-12 12:00	Run now	Waiting
AmmonitOR	☒	☒	☒	☒	☒	☒	☒	12:00	1	0:00	2023-08-12 12:00	Run now	Waiting
Email	☒	☒	☒	☒	☒	☒	☒	12:00	1	0:00	2023-08-12 12:00	Run now	Waiting
Remote Copy	☐	☐	☐	☐	☐	☐	☐	12:00	1	0:00	—	Run now	Waiting
Only generate CSV	☐	☐	☐	☐	☐	☐	☐	12:00	1	0:00	—	Run now	Waiting

Online duration
| 00:20 |

| Save |

Figure 7.1: Configuring the Schedule

Weekdays Select the weekdays on which the action should be performed.

Start time Enter the time of the first occurence on the given weekdays in 24-hour `hh:mm` format. For example, enter `14:00` when the action should start at 2 PM.

Quantity Enter the number of occurences which should be performed during a day. After raising the *Quantity* above 1, an *Interval* can be entered. The last action will be performed at the latest at midnight, even if the user's defined number of actions has not been achieved.

Enter the *Quantity* as integer, e.g. 2, 3 or 4.

Interval Enter the time between successive occurences of the action. The *Interval* can be entered once the *Quantity* of an action is raised above 1. Entering 01:00 means that the action will be performed hourly; entering 24:00 means that there is only one action per day possible.

Enter the *Interval* in the time format `hh:mm`.

Next Displays the date and time of the next occurence.

Status If the action has not run since the CECS booted, the status will be "Waiting". If the action is running, it will describe what it is doing. Once completed, the status will be "Finished".

Online duration Enter the length of time (hh:mm), which the data logger should be connected to the Internet.

>   Example: start time `11:00`, duration `00:20`, quantity 2 and interval `03:00` means that the data logger will be online at 11:00 and 14:00 for 20 minutes. Note that the duration should be shorter than the interval if the quantity is greater than 1, but this is not enforced.

> 📎 **Note**
> Actions running just before midnight may be interrupted by the automatic CECS reboot. See Section 4.2 for details. The action will not be resumed in this case.

For immediate action, click *Run now*. You can also start an action over the display menu (see Section 4.4.1).

While Meteo-42 is online, the time elapsed is shown in the last column as percentage value. Otherwise, the *Run now* button can be clicked to connect Meteo-42 immediately to the Internet.

> 📎 **Note**
> Consider the time settings for sending emails and uploading CSV files via SCP/FTP/SFTP. During night hours the battery's energy might be too low to send or upload large files.

Do not forget saving your modifications. Without saving the previous changes will be reset.

> 💡 **Tip**
> In order to save or reduce connection costs, we recommend carefully setting the online periods of the data logger in the schedule. In most cases it is sufficient to configure not more than three time slots of 20 minutes for Internet activity.

7.3   Configuring Online Access

The Meteo-42 web interface can only be accessed remotely, when the data logger is powered-on and an Internet connection has been established. Periods for online access can be configured in the Communication → Schedule menu.

> ⚠️ **Important**
> Meteo-42 can be connected to AmmonitConnect (see Figure 7.2) to obtain a unique subdomain. Thus the GSM modem can be equipped with a standard SIM card with dynamic IP address. AmmonitConnect manages the subdomains. Users access the Meteo-42 web interface (when online) by entering its subdomain, e.g. `https://`*subdomain*`.connect.ammonit.com`. Additionally, the connection between data logger and server is encrypted and therefore cannot be accessed by unauthorized users.

AmmonitConnect can be configured in the Communication → Online menu. You can choose between `AmmonitConnect`, your own `AmmonitConnect` or no `AmmonitConnect`.
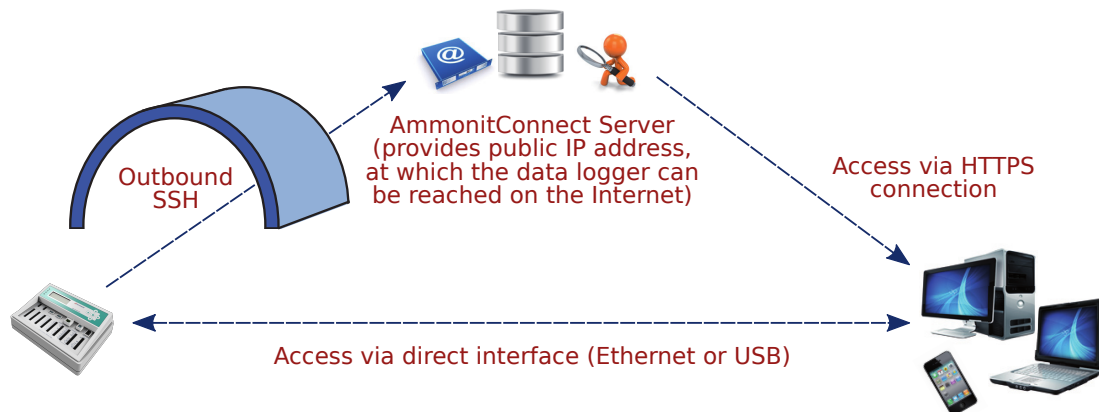
Figure 7.2: Communication between Meteo-42 and PC via AmmonitConnect

---

> 📎 **Note**
>
> If you use a SIM card with static IP address, an AmmonitConnect connection is not necessarily needed. AmmonitConnect is still useful because it caches static files such as images.

AmmonitConnect

AmmonitConnect server
Official AmmonitConnect ▼

AmmonitConnect login
_ac-login@connect.amm

AmmonitConnect port
4040

AmmonitConnect access code (highly recommended)

☐ Prevent implicit AmmonitConnect activation (only recommended for satellite communication)

AmmonitConnect notify address (optional, use semicolon (;) for more than one address)

Save

⬇ Download SSH key

↗ Link to AmmonitConnect

Remove AmmonitConnect identification

Figure 7.3: Configuring the Online Access

Meteo-42 offers three AmmonitConnect options (see Figure 7.3) in the Communication → Online menu:

No AmmonitConnect Select this option, when you use a SIM card with static IP address or when you are connected directly to the data logger via LAN (Ethernet) or USB.

AmmonitConnect Select AmmonitConnect (see Figure 7.2) to access the data logger's web interface via an AmmonitConnect domain link `https://Gnnnnnn.connect.ammonit.com`).

Custom AmmonitConnect Enter *AmmonitConnect login* and *AmmonitConnect port* of your own AmmonitConnect server. Your server has to authenticate the Meteo-42 data logger. Download the SSH key of the data logger for authentication. Contact your system administrator for further details.

Download SSH Key *Download SSH Key* is only necessary, if you use your own AmmonitConnect server or an AmmonitOR installation. The SSH public key is used to authenticate the data logger at your server.

Link to AmmonitConnect In order to get the URL to access your Meteo-42 data logger via AmmonitConnect, click on *Link to AmmonitConnect*.

AmmonitConnect access code By using a *AmmonitConnect access code*, you prevent unauthorized Internet traffic from reaching the data logger. This traffic might slow down your connection and increase Internet costs. For the AmmonitConnect access code, you can use upper and lower case letters, number, and the underscore. Other symbols are not allowed.

Tip
By entering an AmmonitConnect access code, connection costs can be saved. The login page of the data logger is not visible for unauthorized users. Thus the URL of the data logger cannot easily be spammed or attacked.

Once the *AmmonitConnect access code* has been entered in your browser, it is saved as cookie on your PC. The *AmmonitConnect access code* only needs to be entered again on your PC after the cookie has been deleted.

Tip
By using AmmonitConnect with an *AmmonitConnect Access Code*, you can boost your connection to your data logger. The AmmonitConnect server recognizes the IP address of your data logger in the field. In some cases the IP address is accessible from outside (routable IP address of the installed SIM card). However, in this case you can directly access your data logger via its IP address. There is no need to use the detour via the AmmonitConnect server in Germany. AmmonitConnect still manages the connection. In this case you can access the web interface of the data logger via the URL: `https://gnnnnnn-direct.connect.ammonit.com`.
This feature works with all Ammonit Meteo-42 data loggers, no matter which firmware version is installed.

In order to access the data logger via AmmonitConnect, the URL of the data logger has to be entered in your browser, i.e. `https://gnnnnnn.connect.ammonit.com/` . On your first access via AmmonitConnect you have to enter the *AmmonitConnect access code*, see Figure 7.4.

URL: https://loggerserial.connect.ammonit.com/

Figure 7.4: Entering the AmmonitConnect Access Code

Prevent implicit AmmonitConnect activation The data traffic can be reduced by selecting this checkbox. The feature is especially designed for satellite communication. By activating the checkbox, the connection is only established according to the configured schedule (see Section 7.2). Other AmmonitConnect activations are prevented.

AmmonitConnect notify address Any semicolon (;) separated XMPP addresses (JIDs) entered here will be contacted when the data logger connects to or disconnects from AmmonitConnect. Those accounts will receive a message from `connect@ammonit.com` which includes the timestamp of the connection, the installed software version and links to the relevant online services.

> ⚠️ **Important**
> Meteo-42 can only be accessed via AmmonitConnect server, when the data logger is online! The online periods are configured in the Communication → Schedule menu.

If Meteo-42 is configured for AmmonitConnect and your data logger is currently not online, the following page (see fig Figure 7.5) will be displayed.

URL: https://loggerserial.connect.ammonit.com/

⟁ Ammonit

AmmonitConnect

Your device is currently not connected to
AmmonitConnect.

If you believe it should be, please check that:

- Your device is configured to be online at this
  time
- Your device is configured to use
  AmmonitConnect

You can view your device's connection at
AmmonitOR.

© 2011-2023 Ammonit Measurement GmbH
www.ammonit.com

Figure 7.5: Communication via AmmonitConnect (closed tunnel)

Remove AmmonitConnect identification Public key cryptography is used at Meteo-42 to identify the AmmonitConnect server in order to prevent man-in-the-middle attacks. During the installation, Ammonit includes the ssh host fingerprint of the official AmmonitConnect server in the known hosts list of every data logger, to make it possible to use the AmmonitConnect service. If you are using a custom AmmonitConnect server, the new fingerprint will be added to the data logger known hosts list on the first access to your AmmonitConnect server. If the AmmonitConnect server ssh host key changes due to a server relaunch you must delete the old AmmonitConnect host identification in order to allow the connection.

7.4   Configuration for using AmmonitOR

In the Communication → AmmonitOR the AmmonitOR server can be selected, and one can configure which kind of data is send to AmmonitOR.

If an `Admin` user set the option Force Encryption, the parameters cannot be changed with `User` permissions.

📎 **Note**
If you do not have an AmmonitOR account yet, go to the AmmonitOR login page (`https://or.ammonit.com/access/login/`) or click on *Link to AmmonitOR* to register. Further details about AmmonitOR and a user manual can be found on www.ammonit.com (`http://www.ammonit.com`).
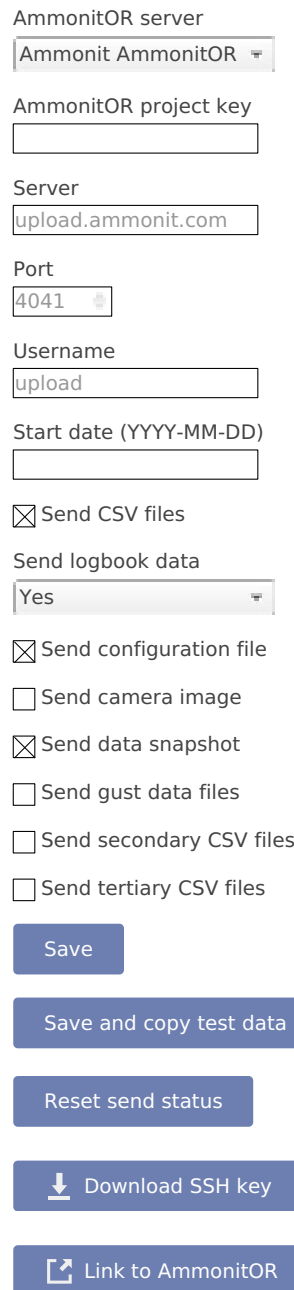
AmmonitOR server Select your preferred AmmonitOR server: Ammonit-hosted installation or your own AmmonitOR server.
If you use the Ammonit-hosted installation, server details are filled automatically. If you use your own installation, enter the necessary server details. Your local AmmonitOR server has to authenticate each data logger. To do so, see Section 7.4.1.

AmmonitOR project key Enter the *Project key* of your related AmmonitOR project. The *Project key* is displayed in the project overview of your AmmonitOR project. It consists of four to six uppercase letters. You can connect more than one data logger to an AmmonitOR project. To do so, use the same *Project key* for all project-related data loggers.

Server, Port, Username Name or IP address of your AmmonitOR server, TCP port, and username for upload. These values are automatically set correctly for the Ammonit hosted server.

Start date Files older than this date will not be transmitted to AmmonitOR.

AmmonitOR server

Ammonit AmmonitOR

AmmonitOR project key

Server

upload.ammonit.com

Port

4041

Username

upload

Start date (YYYY-MM-DD)

☒ Send CSV files

Send logbook data

Yes

☒ Send configuration file

☐ Send camera image

☒ Send data snapshot

☐ Send gust data files

☐ Send secondary CSV files

☐ Send tertiary CSV files

Save

Save and copy test data

Reset send status

⬇ Download SSH key

↗ Link to AmmonitOR

Figure 7.6: AmmonitOR Settings

Decide, which data should be monitored in AmmonitOR:

AmmonitOR send options

© 2011 — 2023 Ammonit Measurement GmbH

CSV files Select this, if you want to send all measurement data to AmmonitOR.

> If you do not want your measurement data sent to AmmonitOR, deselect this switch.

Logbook data Whether to send logbook entries. Select `No` to never send them, `Yes` to send them always on the next day, or `Immediately` to send them with every scheduled email.

Configuration file Select this option, to send the data logger configuration file to AmmonitOR. Passwords and the modem PIN will be stripped of the configuration file for security reasons.

Camera image Select this option, to send camera images to AmmonitOR. The camera image is taken at the moment of the sending to AmmonitOR. See Section 4.5.1 to save the image to a USB stick instead of sending it.

Data snapshot Select this option, to send data snapshots to AmmonitOR. The data snapshot consists of the measurements just in the moment of sending to AmmonitOR.

Gust data, secondary, and tertiary CSV files Select this option, to send gust data, secondary, or tertiary CSV files to AmmonitOR.

🔖 **Note**

This files are only stored on AmmonitOR, but not yet interpreted in any way.
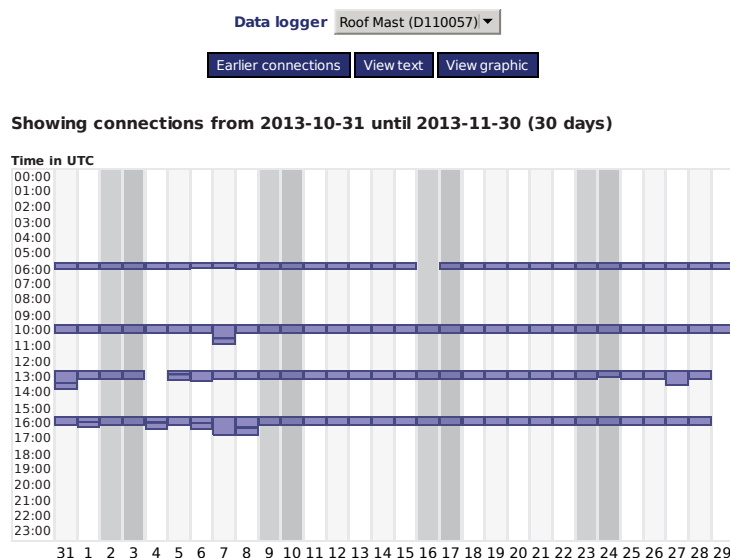
Figure 7.7: Connection Log in AmmonitOR

Reset send status With this function, Meteo-42 forgets about ever sending files to AmmonitOR. Any files will be sent again.

Save and copy test data This function sends a test file to AmmonitOR. This is useful to check the connection and settings, such as the project key.

Save Save the current settings.

Link to AmmonitOR Click on *Link to AmmonitOR* to set up a new AmmonitOR account.

Download SSH Key Applies only, when you use a local AmmonitOR installation (not the Ammonit-hosted installation). Your AmmonitOR server has to authenticate each Meteo-42 data logger. To do so, download the SSH key and see Section 7.4.1 and AmmonitOR user manual on the Ammonit website (`http://www.ammonit.com/en/a mmonit-customer-login`).

7.4.1   Authenticating Meteo-42 at your local AmmonitOR installation

If data files should be uploaded to a local AmmonitOR installation, the local AmmonitOR server has to authenticate each Meteo-42 data logger. To do so, download the *SSH key* from each Meteo-42 data logger. The *SSH key* can be downloaded in the Communication → AmmonitOR menu. Copy the *SSH key* on your local AmmonitOR server.

Open the AmmonitOR administration web interface (admin rights are necessary) and enter the *SSH key* in the Base → SSH keys menu of AmmonitOR. For further details see AmmonitOR manual, which can be downloaded from the Ammonit website (`http://www.ammonit.com/en/ammonit-customer-login`). After adding the key, the file upload can be configured.

7.5   Configuring Email Parameters

In order to receive data via email from the data logger, Meteo-42 has to be connected to the Internet (e.g. via modem) and an email account has to be configured in the Communication → Email menu.

Important

Do not use your personal email account for data logger emails. We recommend setting up a separate account. Anyone logged in as either `Admin` or `User` on the data logger can access username and password, and consequently the related email account.
The mechanism for sending emails with username and password is called SMTP AUTH, which is being gradually phased out by some email service providers.
AmmonitOR can be configured to automatically export emails which doesn't require an external email service provider and avoids uploading the same files multiple times from the data logger.

Enter server and account details:

SMTP method Select the method used to secure outgoing SMTP transfers. SMTP (Simple Mail Transfer Protocol) is a standard protocol used to send emails. Choose either SMTP over SSL/TLS (also known as SMTPS), STARTTLS (establish an initially-insecure connection which is upgraded to a secure one before data transfer) or unencrypted. Check with your email service provider for the supported methods.

SMTP server Enter SMTP server address, e.g. smpt.mail.provider.com. SMTP server details can be obtained from your email service provider.

SMTP port Enter the SMTP port, or 0 for the default. The default is 465 for "SMTP over SSL/TLS", otherwise 25. The port number can be found in the SMTP server details or from your email service provider. Some newer servers use 587 for STARTTLS.

Verify server SSL/TLS certificates When using SMTP over SSL/TLS or STARTTLS, the server identifies itself by sending a certificate. When this option is enabled, the data logger verifies that the configured server was issued that certificate by a trusted authority. Disabling this option risks man-in-the-middle attacks.

SMTP username Enter the username, which is used to access your email account. Often the username is the same as the email address.

SMTP password Enter the password, which is used to access your email account.

From Enter the sender's email address, which is often also the username of the email account.

To Enter the email address of the recipient. If more than one email address should be entered, use a semicolon (;) to separate the email addresses.

Cc If required, enter the recipient(s), who should receive the email in copy. If more than one email address should be entered, use a semicolon (;) to separate the email addresses.

POP server (for POP-before-SMTP authorization) Only required for SMTP servers using POP-before-SMTP or SMTP-after-POP authentication.

Start date (YYYY-MM-DD) Indicates which data files should be sent via email. No files older than the *Start date* will be sent.
Enter the start date in ISO-8601 format: YYYY-MM-DD (e.g. 2016-01-31).

Maximal number of attachments Each email will contain at most this many attachments. If there are more than this amount of attachments to send, then multiple emails will be sent.

All other send options are explained in the AmmonitOR section, AmmonitOR send options.

According to the settings in the Communication → Schedule menu (see Section 7.2), an email is sent to the specified account including one or more CSV files. An email includes all CSV files generated since the last email was sent.

SMTP method

SMTP over SSL/TLS

SMTP server

SMTP port (e.g. 0 (default), 25, 465, or 587)

0

☐ Verify server SSL/TLS certificates

SMTP username

SMTP password

☐ Show password

From

To (use semicolon (;) for more than one address)

Cc (use semicolon (;) for more than one address)

POP server (for POP-before-SMTP authorisation)

Maximal number of attachments

10

Start date (YYYY-MM-DD)

☒ Send CSV files

Send logbook data

Yes

☒ Send configuration file

☐ Send camera image

☐ Send data snapshot

☐ Send gust data files

☐ Send secondary CSV files

☐ Send tertiary CSV files

Save

Save and send test email

Reset send status

Figure 7.8: Configuring Email Parameters

In certain cases it might be necessary to reset the status of the data files sent via email. The data files can be resent e.g. to another email address or if old files have been lost. Press *Reset send status* to set the send status of CSV files listed in the Data → Statistics menu to zero. The entered *Start date* indicates the data files, which should be reset for email transfer.

! **Important**
Do not forget saving the settings. By clicking the button `Save and send test email`, the configuration can be checked.

Note
In order to test the email function, the data logger has to be connected to the Internet via modem, LAN or WLAN (WiFi). It is not sufficient to connect Meteo-42 to a PC via USB, because a PC is not necessarily configured as router. If your smartphone supports tethering, you can connect your smartphone and configure it as router to test the email function of the data logger (see Section 4.3.1).

On the *Statistics Data Download* page in the Data → Statistics menu all CSV files which have been sent via email have a checkmark. See also Section 6.3.

7.5.1 Signing and Encrypting Emails and Attachments

Digital signature and encryption are very complex topics. By digitally signing an email or a file, its authenticity can be verified. A valid digital signature indicates that the email or file was created by a known sender, e.g. your Meteo-42 data logger (authentication), and the email has not been manipulated on its way to the receiver (integrity). By using encryption, you can encode emails and attachments in a way that third parties cannot read the file, only authorized parties are allowed to open and read the files. A password is required to decrypt emails and files.

Read this section carefully and follow our description step by step to avoid any misunderstandings. For further details about digital signature and encryption, refer to Chapter 14.

Meteo-42 supports the international standard OpenPGP (https://en.wikipedia.org/wiki/Pretty_Good_Privacy#OpenPGP) for signing and encryption. Specifically, the free software GnuPG is used. Refer to the GnuPG website (http://gnupg.org/) for further details.

In the Communication → Email menu emails and attachments can be signed or signed and encrypted using OpenPGP.

Unsigned and unencrypted If emails should be sent neither with digital signature nor password protected, select this option.

Sign data (OpenPGP) Select this option to digitally sign CSV and logbook files sent via email. The CSV and logbook files sent by Meteo-42 are signed with a unique digital key. A certificate, indicating the digital signature, is attached to the email for each CSV and logbook file. The attachments can, however, be opened and saved without restriction.

As soon as a signed file is modified, the certificate is invalid.

In order to verify the certificate, download the `Public key`, displayed in the Meteo-42 web interface and import the key into your local verification software, e.g. Gpg4win (see Section 7.5.1.1).

Sign and encrypt data (OpenPGP) Select this option to sign (as above) and encrypt CSV and logbook files sent via email. Enter an *Encryption password*, which is required to decrypt the file on the recipient's side.

In addition to the digital signature Meteo-42 can encrypt CSV and logbook attachments with a `Private key`. The encrypted files can only be opened by authorized persons with the *Encryption password*. To do so, additional software is required. See e.g. Section 7.5.1.1.

To decrypt the data, download the `Public key` by clicking on the button in the Meteo-42 web interface. Import the `Public key` into your encryption software (see below). The displayed `Fingerprint` is used to authenticate the `Public key`.

7.5.1.1 Working with Gpg4win to Decrypt and Verify Files on Windows™ PCs

In order to open and read files, which have been encrypted by Meteo-42, additional software is necessary. We recommend installing GPG4win (GNU Privacy Guard for Windows). Ggp4win enables users to encrypt, decrypt, sign and verify emails and attachments as well as files in a directory. The software includes the following components:

- GnuPG: encryption tool
- Kleopatra: certificate manager for OpenPGP
- GpgOL: add-in for Microsoft Outlook 2003/2007/2010/2013™ for email encryption
- GpgEx: plug-in for Microsoft Explorer™ for file encryption
- Gpg4win Compendium: documentation for beginners and advanced users

Go to the GPG4WiN website (`http://gpg4win.de/download`) and download the current software version. Install the software with the above mentioned components.

> **Note**
>
> If you work with Microsoft Outlook™, the program has to be restarted to implement the GpgOL add-in as separate ribbon. For decryption via the GpgOL add-in, go to Section 7.5.1.5.

Before working with Gpg4win, the software has to be configured. Download the `Public key` from the Meteo-42 web interface, as shown in Figure 4.9.

> **Important**
>
> Each Meteo-42 data logger has its own unique public key. If you work with different Meteo-42 data loggers, you have to import the public key of each Meteo-42. One user's private key is sufficient to certify the public keys (as shown in Figure 7.11).

Import the `Public key` in Gpg4win via right-mouse click in the Windows Explorer™. A message is displayed after successfully importing the key.
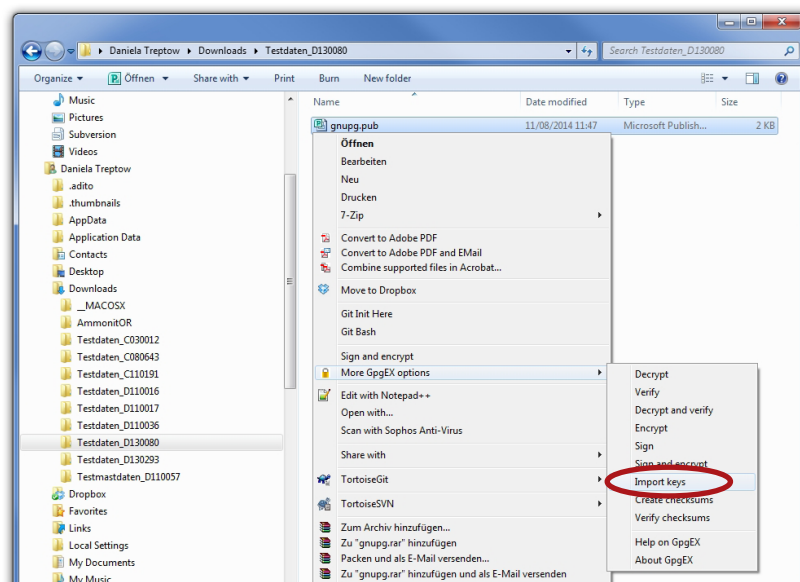
Figure 7.9: Importing the Public key into Gpg4win

Open the Kleopatra software. The `Public key` is listed under *Other Certificates*.

The `Public key` of the Meteo-42 data logger has to be certified by your own key. If a user's private key has already been generated, skip the following task and go on with Figure 7.11.

If no user's private key exists, create a new certificate via the File → New Certificate menu. Select *Create a personal OpenPGP key pair* and enter the required details. Click *Create key* and enter a high quality password. Your key should have been successfully created.
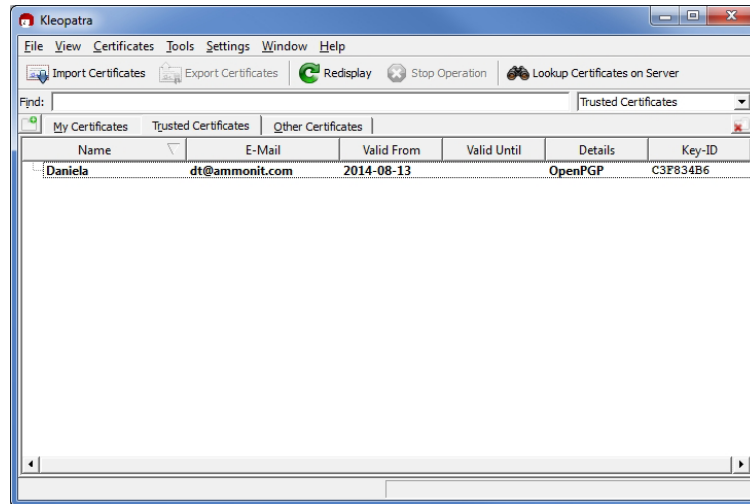
Figure 7.10: Creating the private key

The `Public key` of Meteo-42 has to be certified. Go to *Other Certificates* and select Meteo-42's key. Open the context menu via right-mouse click and select *Certify Certificate*.
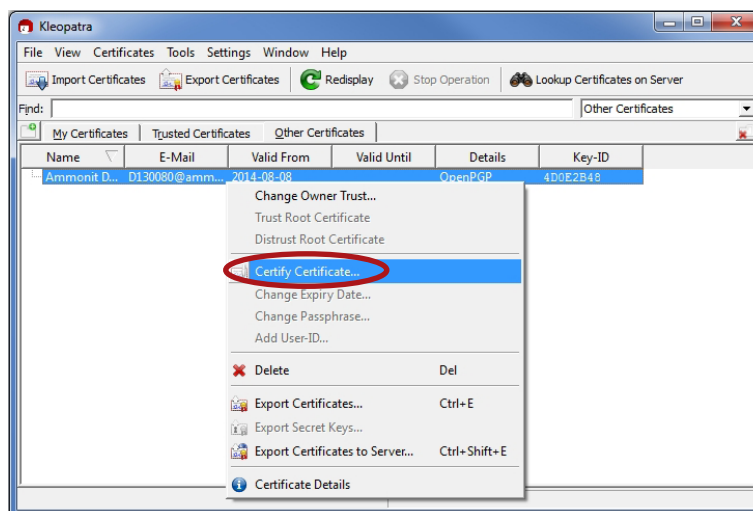
Figure 7.11: Certifying the Public key

Before trusting the certificate, check the displayed `Fingerprint` with the `Fingerprint` shown in the Meteo-42 web interface (see Figure 4.9).
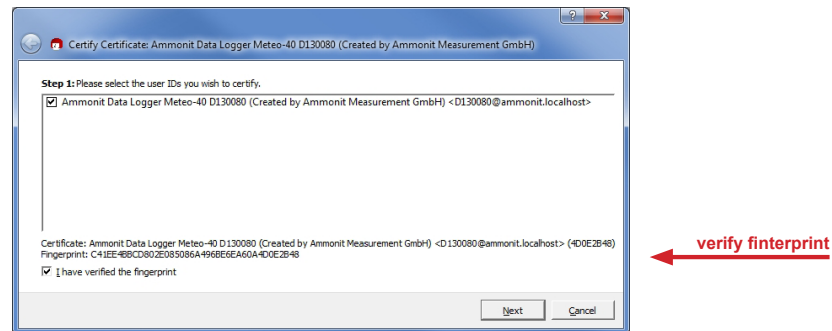
Figure 7.12: Verifying the Fingerprint

Verify the certificate and enter the password for the `Private key`. The password is used to unlock the `Private key` for the OpenPGP certificate. Finally both certificates are displayed under *Trusted Certificates*.
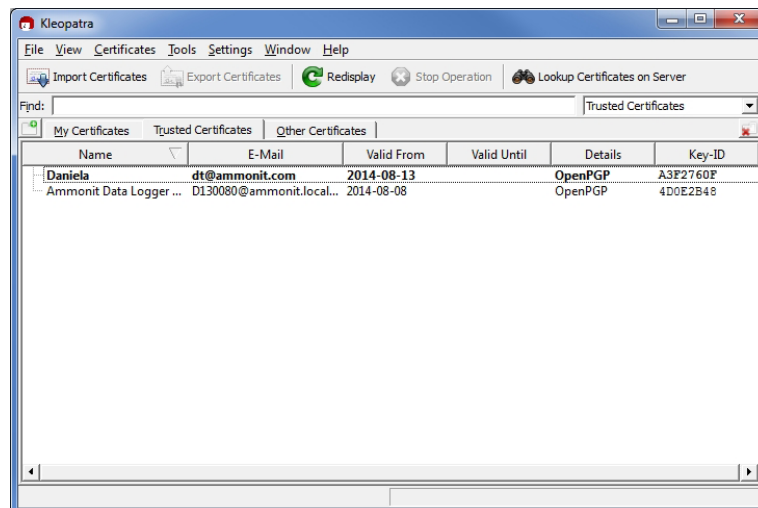
Figure 7.13: Trusted Certificates

7.5.1.2 Verifying digital signatures in the Windows Explorer™

If *Sign data (OpenPGP)* has been selected, each CSV and logbook file sent by Meteo-42 comes with a detached signature file, i.e. a separate signature file (.sig) is attached to the email. The signature file has the same name as the CSV or logbook file - ending on `.sig`.

Download and certify the `Public key` of Meteo-42 as described in Section

Download both related files to your directory. Choose the data or logbook file, which should be verified. Open the context menu with a right-mouse click on the `.csv.gz`, `.log` or `.sig` file and select *Verify*.
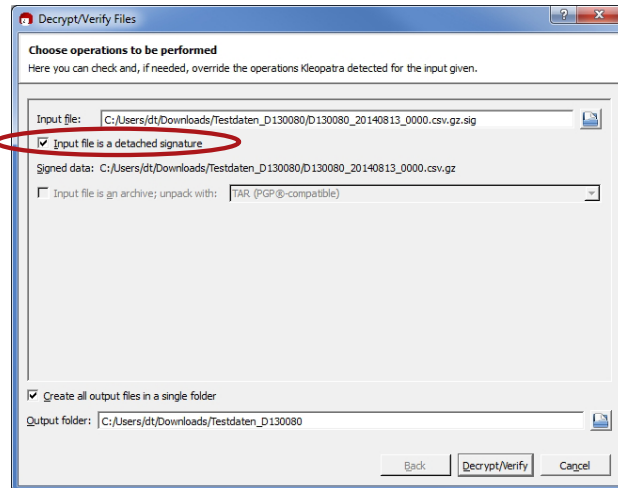
Figure 7.14: Verifying signed files

Make sure that *Input file is a detached signature* is selected. Both related files should be listed, with the signature ending on `.sig` in the *Input file* field. Select *Decrypt/Verify*. After verification the Kleopatra software indicates the validity of the signature.
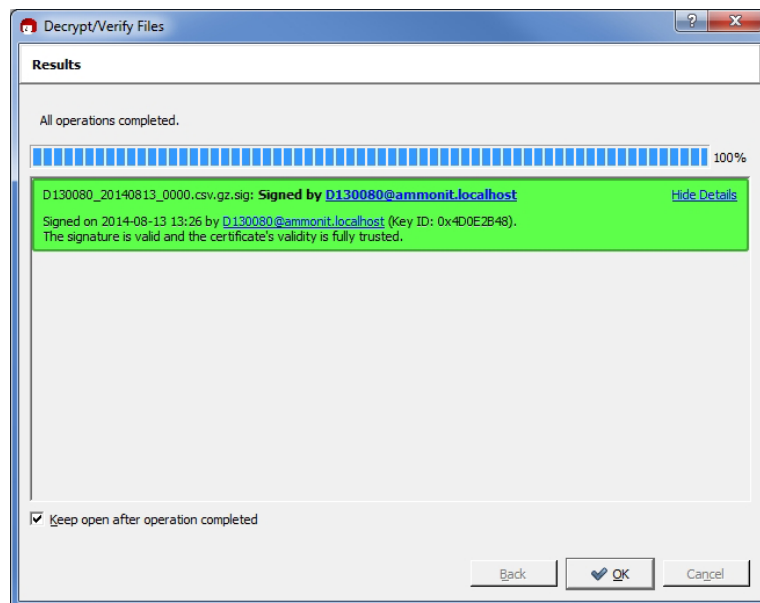
Figure 7.15: Successfully verified signature

7.5.1.3 Verifying digital signatures in Microsoft Outlook™

If *Sign data (OpenPGP)* has been selected, each CSV and logbook file sent by Meteo-42 comes with a detached signature file, i.e. a separate signature file (.sig) is attached to the email. The signature file has the same name as the CSV or logbook file - ending on `.sig`.

Download and certify the `Public key` of Meteo-42 as described in Section 7.5.1.1.

Open the email and select the file, which should be verified (ending on `.csv.gz` or `.log`). Click on *Save and decrypt* in the *Attachments* ribbon of Microsoft Outlook™.

© 2011 — 2023 Ammonit Measurement GmbH
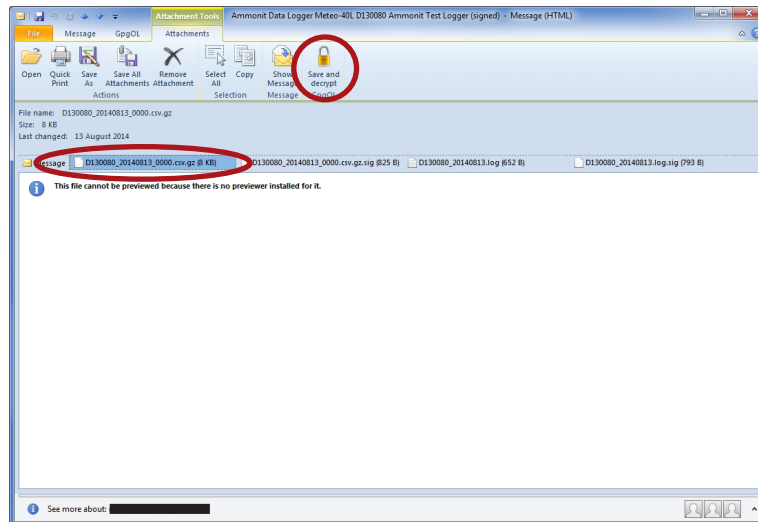
Figure 7.16: Verifying files in Microsoft Outlook™

Make sure that *Input file is a detached signature* is selected. Both related files should be listed, with the signature ending on `.sig` in the *Input file* field. Select *Decrypt/Verify*.
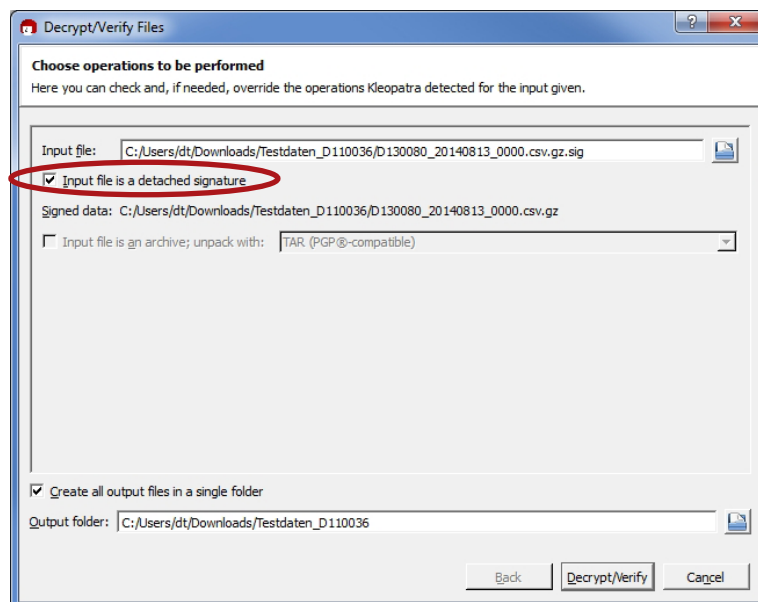
Figure 7.17: Verifying signatures in Microsoft Outlook™

After verification the Kleopatra software indicates the validity of the signature.
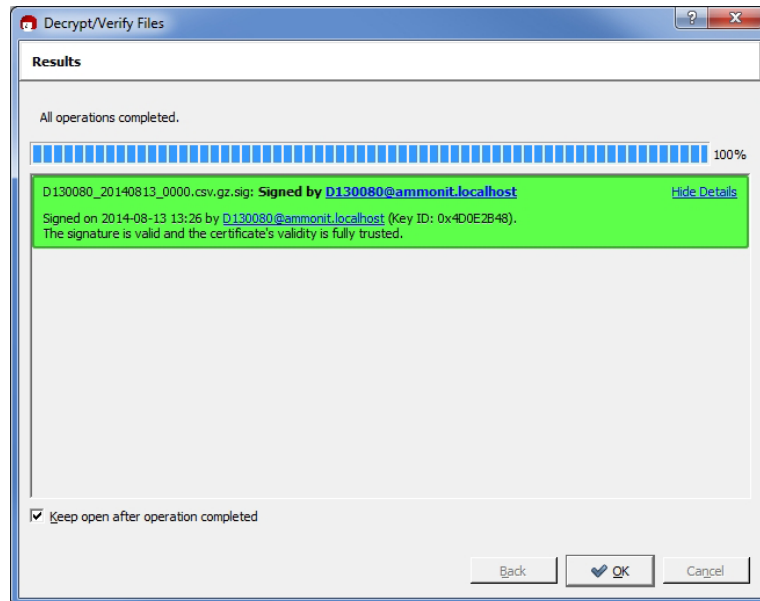
Figure 7.18: Successful validation of the signature

Note

If test emails sent by Meteo-42 have been signed, a separate signature file is attached, e.g. Meteo-42.txt.sig. To verify the signature, open the email and select both related attachments, e.g. Meteo-42.txt and Meteo-42.txt.sig. Choose *Save and decrypt* in the *Attachments* ribbon of Microsoft Outlook™.
Both files are listed in the Kleopatra software: Input file and Signed data (see Figure 7.19). Select *Decrypt/Verify* to validate the signature.
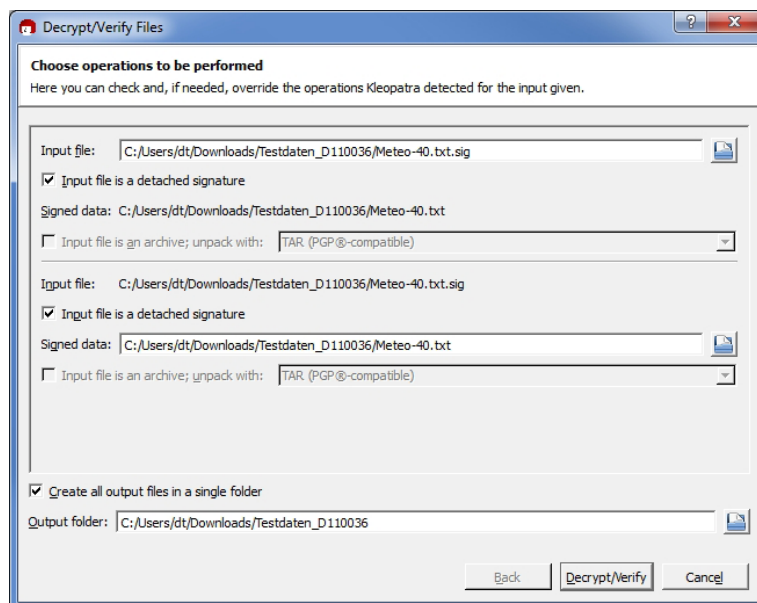
Figure 7.19: Verifying signed test mails

7.5.1.4 Decrypting files in the Windows Explorer™

Download and certify the `Public key` of Meteo-42 as described in Section 7.5.1.1.

Encrypted files can be decrypted in the Windows Explorer™. Right click on the file and select *Decrypt and verify*.
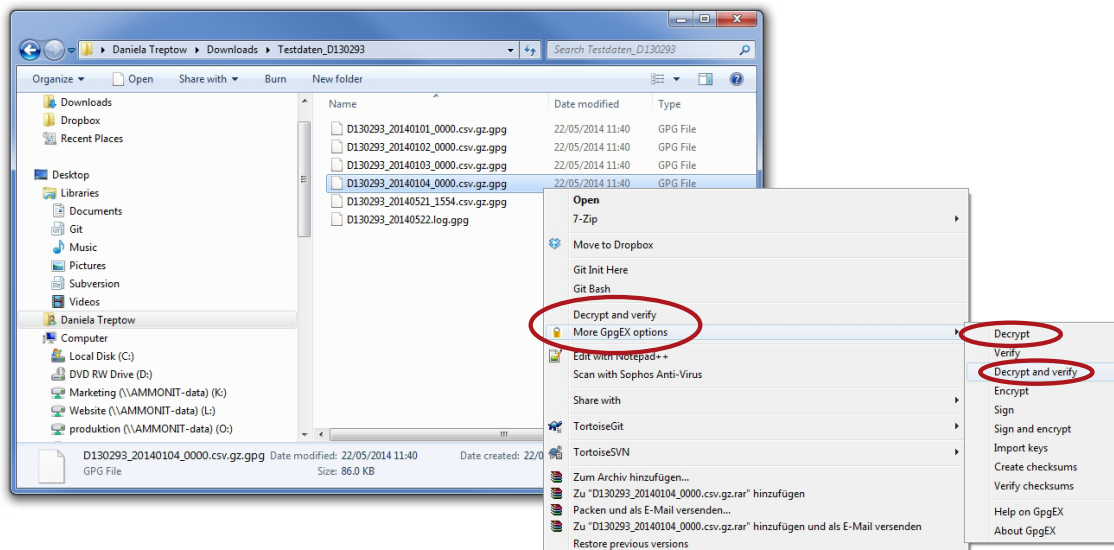
Figure 7.20: Decrypting files via the GpgEx plug-in for Windows Explorer™

Start the decryption process by clicking *Decrypt and verify*.
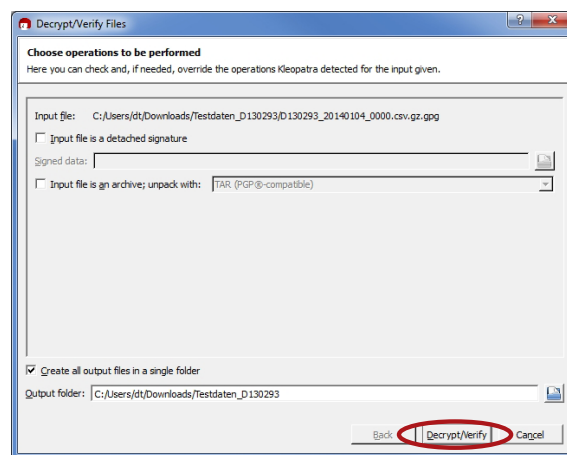
Figure 7.21: Decryption via Kleopatra Software

For decryption enter the password, which you entered for encryption in the Meteo-42 web interface in the System → Administration menu.
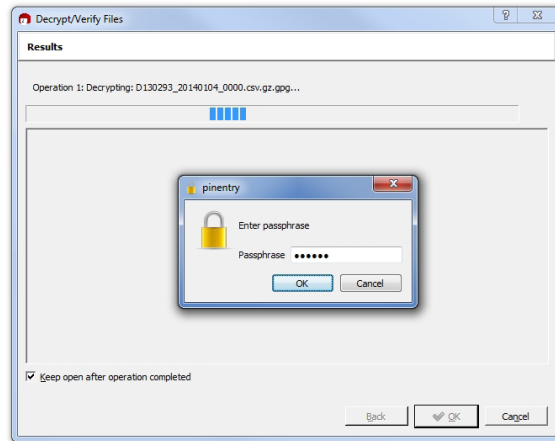
Figure 7.22: Password Prompt for Decryption

After successful decryption the file is displayed in the initial folder or the one selected in the decryption process.
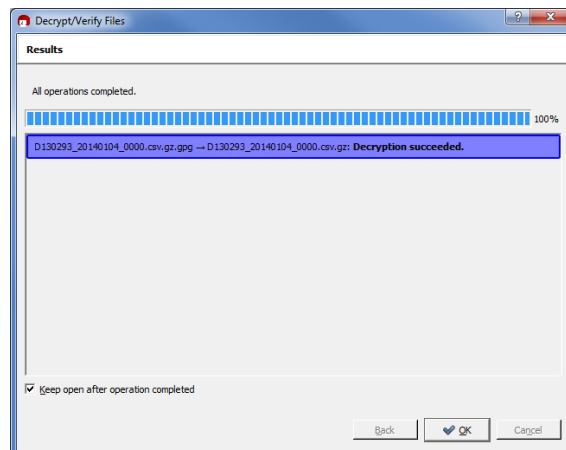
Figure 7.23: Successful File Decryption

7.5.1.5 Decrypting files in Microsoft Outlook™

After installing Gpg4win a new ribbon *GpgOL* should be shown in your Outlook™ application. Follow our step by step guide to decrypt encoded data files sent by your Meteo-42 data logger.

Download and certify the `Public key` of Meteo-42 as described in Section 7.5.1.1.

Open the email item and go to the *Attachments* ribbon (Click on one of the attached files). Click on *Save and decrypt* in the *Attachments* ribbon.

© 2011 — 2023 Ammonit Measurement GmbH
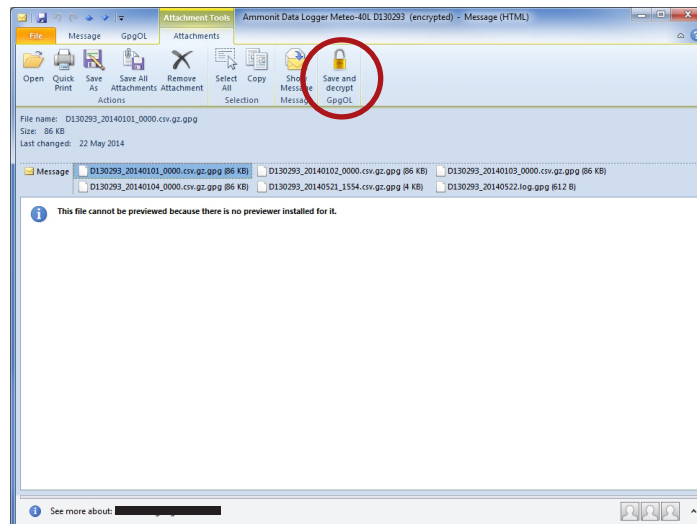
Figure 7.24: GgpOL add-in in Microsoft Outlook™

Select the folder, in which the files should be saved and start the decryption process by clicking on *Decrypt/Verify* in the Kleopatra software. For decryption, enter the passphrase that you configured for encryption in the Communication → Email menu of the Meteo-42 web interface. See also Section 7.5.1.4.

Both encoded and decrypted data files should be successfully saved in the selected folder.

> **Note**
> In order to verify signed and encrypted test emails sent by Meteo-42, open the email and select *Decrypt* in the *GpgOL* ribbon of Microsoft Outlook™. Enter the password, which has been set for *Encryption* in the Meteo-42 web interface at the System → Administration menu.

7.6 Configuring SCP, FTP, SFTP and FTPS Parameters

By using *Remote copy* you can upload CSV files to a server of your choice. To do so, Meteo-42 has to be connected to the Internet, e.g. via modem.

The CSV file upload can be configured in the Communication → Remote copy menu. Meteo-42 offers six methods to upload data:

If an `Admin` user set the option Force Encryption, the parameters cannot be changed with `User` permissions.

SCP with SSH key Select this option to upload files via SCP to your server. The connection is encrypted with RSA 2048 bit. Enter server address, port, username and directory to enable the file upload. Contact your system administrator for the server details.

To set this up, copy the data logger's public SSH key to the `authorized_keys` file on the server. If in doubt, ask your server administrator.

> **Note**
> The `Directory` can be either *absolute*, i.e. starting with a forward slash (`/`), or *relative* to the remote users home directory, i.e. starting with a tilde and a forward slash (`~/`).

SCP with password This option is the same, but authenticates using the provided password instead of the SSH key.

FTP Select this option to upload files to your FTP server. Enter server address, username, password and directory to enable the file upload. Contact your system administrator for the server details.

SFTP with SSH key or password SFTP is similar to FTP but encrypted using SSH. In principle, the same facts apply as with SCP.

FTPS FTPS is similar to FTP but encrypted using TLS (also known as SSL).

All files uploaded via Remote Copy have a checkmark in the Copy column in the Data → Statistics menu. See also Section 6.3.

Method

SCP with SSH key

☒ Verify server SSL/TLS certificates

Server

Port
0

Username

Password
☐ Show password

Directory

Start date (YYYY-MM-DD)

☒ Send CSV files

Send logbook data

Yes

☒ Send configuration file

☐ Send camera image

☐ Send data snapshot

☐ Send gust data files

☐ Send secondary CSV files

☐ Send tertiary CSV files

Save

Save and copy test data

Reset send status

⬇ Download SSH key

Figure 7.25: Configuring the Remote Copy Parameters

By entering a *Start date*, you can configure which files should be uploaded. No files older than the *Start date* will be uploaded.

All other send options are explained in the AmmonitOR section, AmmonitOR send options.

⚠ **Important**
Save your configuration. The entered values are reset after moving to another page.

Each upload includes all collected CSV files, which have been generated since the last file upload. If it is the first

upload, Meteo-42 uploads all CSV files - no matter, how many CSV files have been generated. The sequence of actions can be configured in the Communication → Schedule menu. For further details refer to Section 7.2

> **Tip**
> If you are using Windows™, you might try the FileZilla (`http://filezilla-project.org`) FTP server. After downloading and installing the software, you have to add a new user. Enter the appropriate fields and select the folder, which should be shared. It is also important to configure Windows™ Firewall by adding an exception for the corresponding port (21 for FTP) and the FileZilla server interface.

> **Warning**
> Make sure to download FileZilla only from its official website or other trusted sources. Malicious versions have been released, that might copy private information to unauthorized parties.

7.7   Configuring LAN Parameters

> **Important**
> Restart the data logger or disconnect the Ethernet cable for some seconds to apply new network settings.

Meteo-42 data loggers can be connected to your LAN using a standard Ethernet cable. The network connection will be automatically recognized. In order to access the Meteo-42 web interface, enter the assigned IP address `https://nn.nn.nn.nn/` in your web browser. The IP address can be found on the data logger display by selecting the corresponding device at the Communication → Devices → LAN → eth0 menu. Refer to Section 2.3 and Chapter 3 for more information about the login.

A table in the Communication → LAN menu displays, which devices are connected, e.g. USB and / or Ethernet with its state, IP address and product (if available).

Interface	State	IP Addresses
eth0	activated	172.17.0.2

☒ LAN online, whenever CECS is on

IP address allocation method

DHCP ▾

☐ Connect to internet via USB modem only (recommended e.g. for SCADA and Ethernet camera)

LAN switch (typically S1)

None ▾

IP address

192.168.40.40

DNS server

192.168.40.1

Gateway

192.168.40.1

Subnet mask

255.255.255.0

Additional subnets

Save

Check optimal BGAN settings

Figure 7.26: Configuring LAN parameters

LAN online, whenever CECS is on The checkbox is selected by default. Thus after connecting Meteo-42 to LAN via Ethernet, the data logger goes online as soon as the CECS subsystem is switched on.

Use DHCP, static IP, or link-local By default, Meteo-42 automatically obtains an IP address from a DHCP server. DHCP is available in most networks. If DHCP is selected, the fields below are disabled. DHCP can be used to connect a Meteo-42 to the internet through a local network without any further configuration.

For most SCADA applications, the data logger has to be configured with a fixed IP address by selecting `Static IP`. Thus the use of DHCP server has to be deactivated. See Section 7.7.1 for more information.

> **Note**
> For upgrading the Meteo-42 firmware via the tethering function of your smartphone, the method has to be set to DHCP. See also Section 4.3.1.

The `Link-local` method is useful for connecting a PC with Meteo-42 directly using an Ethernet cable. A link-local connection cannot be used for internet access. This connection will not have an influence over a USB modem communication and can be used for testing the modem.

Setting the method to `Disabled` will power off the Ethernet port which considerably reduces power consumption while the CECS is on and Ethernet is not needed (e.g. when using a USB modem).

Connect to Internet via USB modem only (recommended e.g. for SCADA) Select this checkbox to set the USB modem connection as preferred Internet connection. This checkbox is not selected by default.

This function is only recommended, when the Ethernet port is used and the USB-modem is preferred for the Internet connection, e.g. in SCADA applications or connecting a camera to the Ethernet port.

By choosing a *LAN switch* you can supply your router or modem, e.g. BGAN satellite modem. For further details about BGAN modems refer to Section 7.9.7.

7.7.1 Configuring a Static IP address in a LAN

In order to configure a static IP address in a LAN, go to the Communication → LAN menu and select *Static IP*. Enter the details for *IP address*, *DNS server*, *Gateway* and *Subnet mask*.

If the data logger has to be available from other subnets, e.g. if the SCADA client is located in another network segment, it is possible to add additional subnets. The previously configured gateway will also be used for this subnets. A list of IP numbers and subnet prefixes can be entered in *Additional subnets* field. Use a semicolon (;) to separate the IP addresses, e.g. 192.168.13.0/24;192.168.14.0/24

Interface	State	IP Addresses
eth0	activated	172.17.0.2

☒ LAN online, whenever CECS is on

IP address allocation method

Static IP ▼

☐ Connect to internet via USB modem only (recommended e.g. for SCADA and Ethernet camera)

LAN switch (typically S1)

None ▼

IP address

192.168.1.170

DNS server

0.0.0.0

Gateway

0.0.0.0

Subnet mask

255.255.255.0

Additional subnets

Save

Check optimal BGAN settings

Figure 7.27: Configuring a Static IP Address in a LAN

Note
If you are working with a SIM card with static IP address, it is not necessary to change the LAN settings. Refer to Section 7.9.3.

7.8 Configuring WLAN

For local wireless access to the data logger, you can connect a WLAN (WiFi) USB stick to Meteo-42. Meteo-42 will create a wireless access point (hotspot) and you can connect to this network and access the data logger web interface.

Before using the WLAN function, Meteo-42 has to be configured. Go to the Communication → WLAN menu and select the checkbox *Activate WLAN*. According to the configured *IP address* and *Netmask*, the available IP addresses range is shown.

> ⚠ **Important**
> Note down or copy the assigned IP address, as you need this IP address to access the Meteo-42 web interface via WLAN!

Each Meteo-42 is delivered with a unique default WLAN passphrase. If you would like to change it, you may enter a *Passphrase* consisting of at least eight characters. Click on *Save* to finish the configuration.

☒ Activate W-LAN

IP address
192.168.42.1

Netmask
255.255.255.0

Network
192.168.42.0

First address
192.168.42.2

Last address
192.168.42.254

Passphrase (at least eight characters)
☐ Show password

Save

Figure 7.28: Configuring WLAN Parameters

After successfully configuring the Meteo-42, the new wireless access point must appear among the available wireless networks at your computer. The new WLAN name is the serial number of the data logger (Gnnnnnn). Select the WLAN and enter the *Passphrase*.

Open your browser and enter the configured IP address (see Figure 7.28).

> 📎 **Note**
> If you are already connected to a WLAN, a second WLAN connection could cause problems.

7.9 Configuring the Modem

Meteo-42 can be connected to the Internet via modem to perform scheduled actions. UMTS/GSM/GPRS modems, or BGAN satellite modems can be configured. UMTS/GSM/GPRS modems are configured via the Meteo-42 web interface in the Communication → Modem menu.

> 📎 **Note**
> Depending on the SIM card used in the modem, a different APN (Access Point Name) has to be entered for proper communication. If you use a SIM card with dynamic IP address, you can easily configure the modem via our provider helper, see Section 7.9.1. If you use a SIM card with static IP address, an individual APN might be necessary. Ask your provider for the correct APN. See also Section 7.9.3.

In order to configure a BGAN satellite modem, refer to Section 7.9.7.

> ⚠ **Important**
> We recommend configuring the modem in the web interface before connecting the modem to the data logger.

> 💡 **Tip**
> If your SIM card gets locked, e.g. by entering the wrong PIN code, enter the PUK code to reset the PIN code. See also Section 7.9.5.

On the upper part of the configuration page, the properties of the connected modem are displayed, e.g. signal strength, operator, IP address and supported bands. If there is no modem connected, the fields are empty.

<div align="center">

Use provider helper

Telephone number
`*99#`

APN
`[                    ]`

Username
`[                    ]`

Password
`[                    ]`

☒ Modem online, whenever CECS is on (recommended)

Modem switch (typically S1)
`S1 ▼`

PIN
`[                    ]`

Save

New PIN
`[                    ]`

PUK (for changing the PIN)
`[                    ]`

Save new PIN

Short Message Service

SMS configuration

Received SMS messages

</div>

Figure 7.29: Modem Configuration

In the upper part of the screen, the current modem and connection properties are displayed:

State Connection status

Reason Reason of connection failure

Signal Signal strength

Operator Mobile network operator

IP Address IP address of modem

Product Product details

RX/TX Received/transmitted bytes

Bands Radio bands supported by the modem

Use the *Provider Helper* (see Section 7.9.1) to complete the required information or enter the details manually:

Number Depending on your provider, the phone number of the GPRS/ UMTS or satellite service has to be entered, e.g. `*99#`.

> If you are using point-to-point protocol (PPP, TCP/IP connection without GPRS or UMTS), enter the phone number in the relevant field. In this case, the APN is not important, but username and password probably are, depending on your provider.

> In case of doubt contact your provider.

APN (Access Point Name) Enter the APN of the GPRS/ UMTS network, which can be requested from the provider or can be found in the Internet. CDMA does not require an APN.

> Use the Provider helper to set APN and provider details automatically. Check the details with your provider. See Section 7.9.1.

> ⚠ **Important**
> If you are using a SIM card with static IP address, the APN is different from the one offered in the *Provider helper*. Ask your provider for the exact APN. See also Section 7.9.3.

Username Enter the username for the APN, if applicable.

> The username will automatically be set by selecting the APN via the Provider helper.

Password Enter the password for the chosen APN.

> Password is automatically set after selecting the APN via Provider helper.

Modem online, whenever CECS is on The checkbox is selected by default. Thus the modem establishes an online connection as soon as CECS is switched on (automatically or manually). See also Section 7.9.4.

> If the checkbox is deselected, the modem only turns on according to the defined actions in the schedule (see Section 7.2).

> 📎 **Note**
> The default setting with activated checkbox *Modem online, whenever CECS is on* can increase power consumption - depending on modem type and location of the next transmitting mast.

> 💡 **Tip**
> By deactivating the checkbox *Modem online, whenever CECS is on*, connection costs can be saved. The modem will only be switched on according to the scheduled actions, and not if the CECS is just switched on for maintenance purposes.

Modem switch A switch can be selected for automatic control of modem power supply at the *Modem switch* combo box (see Section 4.6). An external relay will be controlled by the switch (see also Figure 13.1 for electrical connection plans). The modem will be power cycled as needed to prevent possible modem hangups.

> **Important**
>
> If the modem is connected via relay to the data logger, a switch must be configured. Without selecting a switch for the modem, it will not be power cycled on data logger restart, e.g. after installing an upgrade or at the end of an action requiring communication. The assigned switch has to be saved to the data logger configuration. We highly recommend the usage of a modem switch, the modem may otherwise misbehave.
>
> Switch S1 is set by default for the modem. If a different switch is used to control the modem relay, it must be accordingly selected. If the switch is not used for the modem, it can be deselected.

> **Note**
>
> The switch configured for the modem supply is not available for sensor configuration.

> **Important**
>
> If you use a BGAN satellite modem, a switch for the LAN connection has to be assigned in the Communication → LAN menu (see also Section 7.9.7).

PIN Enter the PIN code of the used SIM card.

Band restrictions By default, the modem decides which band to use to connect to the network. Some modems can restrict which bands are allowed, and which one is preferred. The modem does not automatically reconnect after changing this setting. Changing this setting is only recommended when certain bands do not work or are unwanted.

New PIN This field is used, if you like or have to change the PIN. To use it, you need also to enter the PUK below.

PUK The PUK PIN Unlock Key (or Personal Unblocking Code, PUC) is used to activate the new PIN above.

SMS Click here to configure short message functions. See Section 7.9.2.

After connecting a modem, Meteo-42 shows certain modem properties in its display in the Communication → Devices → Modem menu. Use the right keyboard button to navigate to the modem properties. Additionally, you can see the properties such as state, signal strength and bands in the table (see Figure 7.29) displayed in the web interface in the Communication → Modem menu.

Apply the configuration by clicking on *Save*. We recommend testing the modem connection. Therefore, activate the checkbox *Modem online, whenever CECS is on*. The state of the modem should change to `Active`, when the modem has been configured successfully.

Close the modem connection by deactivating the *Modem online, whenever CECS is on* mode. If no action is running, the modem connection is closed after 20 minutes from the last user interaction.

The connection will instantly be closed, when CECS is shut down in the System → Administration menu or when the modem is manually disconnected from Meteo-42.

> **Important**
>
> If you close the modem connection while accessing the data logger over the modem, you will instantly lose the communication with the data logger and you will not be able to access it until the next scheduled online action (Communication → Schedule).

7.9.1   Using the Provider Helper

In order to support users configuring modem settings, Meteo-42 offers a provider form, which can be started by clicking on *Use provider helper*. After choosing continent and country, the form shows available providers and APNs. Select the relevant APN and click on *Finish* to set APN, username and password in the modem configuration.

> 📎 **Note**
> The *Provider helper* is designed for SIM cards with dynamic IP address. For SIM cards with static IP address, refer to your provider to get the details for the modem configuration. See also Section 7.9.3.

The *Provider helper* does not fill in the number field. Enter number and PIN code manually to finish the modem configuration.

Continent
Europe

Country
Germany

Provider
O2

Access point name/CDMA access
internet (o2 MMS)

Finish

Figure 7.30: Meteo-42 Provider Helper

7.9.2 Short Message Service

In order to configure the Short Message Service (SMS), go to the Communication → Modem menu and select SMS.

☐ Enable short message service

Receiver number

SMSC

SMS password
☐ Show password

Save and send test message

Save

Figure 7.31: Settings for Short Message Service

The parameters are:

Enable short message service Tick the checkbox to enable the SMS function of Meteo-42.

Receiver number This number is currently only used for sending test messages, i.e. one should enter the telephone number of a mobile phone. The number is not used for other SMS functions of Meteo-42.

SMSC The SMSC (Short message service center) has to be configured for some mobile telephony providers and SIMs, for others it is not necessary. In case of doubt, ask your mobile telephony provider.

SMS password Enter a password to use the SMS function. Without password the service is not possible. Use at least eight characters for the password (numbers and letters are allowed).

7.9.2.1 Sending a Short Message

If the SMS feature is activated and a password has been entered, a message can be sent to the telephone number linked with the SIM in the modem. The content must be *password command* where *password* is the configured SMS password and *command* is an SMS command. Be careful typing the password respecting upper and lower cases.

Command	Description
`info` or just `i`, like *information*	Meteo-42 replies to the short message with its serial number, software version, internal voltage, internal current, and internal temperature in that moment, and the current recording pointer, as well as state of switches, modem, and Ethernet.
`online` or just `o`, like *online*	Meteo-42 tries to get online immediately and replies the same details as *information*.
`s` *N* `+` or `s` *N* `-`, like *switch N on/off* (*N* corresponds to the switch number)	Meteo-42 turns on or off the specified switch and replies the same details as *information*. E.g.: `s1+` to switch on S1 `s2-` to switch off S2.

Table 7.4: Short Message Commands

Note

If you are unsure about the telephone number of the SIM or whether SMS sending works, try the Save and send test message function.

7.9.3 Working with Static IP SIM cards

If a SIM card with static IP address is used, refer to the configuration details given by your provider to complete the fields in the Communication → Modem menu. The APN for SIM cards with static IP address is different than for SIM cards with dynamic IP address. The *Provider helper* is designed for SIM cards with dynamic IP address.

7.9.4 Two Ways to Establish an Online Connection via Modem

Note

For testing the USB modem communication you can use a link-local connection over USB or LAN simultaneously. This connection will not have an influence over the usb modem communication.

According to the actions scheduled in the Communication → Schedule menu, Meteo-42 has to establish an online connection. To do so, CECS of Meteo-42 has to be switched on (see also Section 1.4). Meteo-42 offers two possibilities to set up or control the online connection via modem using the checkbox *Modem online, whenever CECS is on*:

Modem is online to perform a scheduled action (checkbox inactive) An online connection is established, when it is needed for an action, i.e. sending emails, uploading files or remote access according to the schedule (see also Section 7.2).

Modem is online, when CECS is running - independent of scheduled actions (checkbox is active; default) An online connection via modem is established as soon as CECS (see also Section 1.4) of Meteo-42 is activated, either manually or according to the schedule in the Communication → Schedule menu. The connection is closed, when CECS is switched off.

By default the *Modem online, whenever CECS is on* checkbox is activated and the modem always goes online, when CECS is running.

> **!** **Important**
> The default setting with activated checkbox can increase power consumption - depending on modem type and location of next transmitting mast.

We recommended deactivating this option, if the *CECS always active* mode (see Section 4.2) is selected. With activated *CECS always active* mode, the modem will stay permanently online, despite the scheduled online actions.

The mode is independent from the LAN online mode.

7.9.5   Reset PIN Code of Locked SIM Card

If a wrong PIN code has been entered and the SIM card has been locked, use its PUK code to create a new PIN code. On the bottom of the modem configuration page you can find the appropriate fields (see Figure 7.29). Click on *Save* to apply the new PIN code, which will automatically be copied in the PIN code field for the modem configuration.

> **📎** **Note**
> Sometimes, the modem will report that the SIM card is locked but the actual issue is connectivity. When testing indoors, it can help to attach an antenna and place it outside or near a window.

7.9.6   Connecting a GSM/GPRS Modem to Meteo-42

We recommend testing the modem connection before final installation in the field.

> **!** **Important**
> In order to avoid PIN conflicts, we recommend configuring the modem before the modem is connected to Meteo-42.

Before connecting the modem to Meteo-42 insert the SIM card into the modem. Afterwards the modem can be provided with power and connected to the data logger. If the modem has been successfully recognized, Meteo-42 shows the connection in its display Communication → Devices → Modem.

7.9.6.1   Information on Modem Sierra Wireless Airline Fastback Extend EDGE FXT009

If you are using the modem Sierra Wireless AirLine Fastback Extend EDGE FXT009, slide the SIM card into the modem as shown in Figure 7.32.

> **!** **Important**
> It is very important to lock the SIM card slot after inserting the SIM card into the modem. If the SIM card is not properly placed, connection problems may occur.
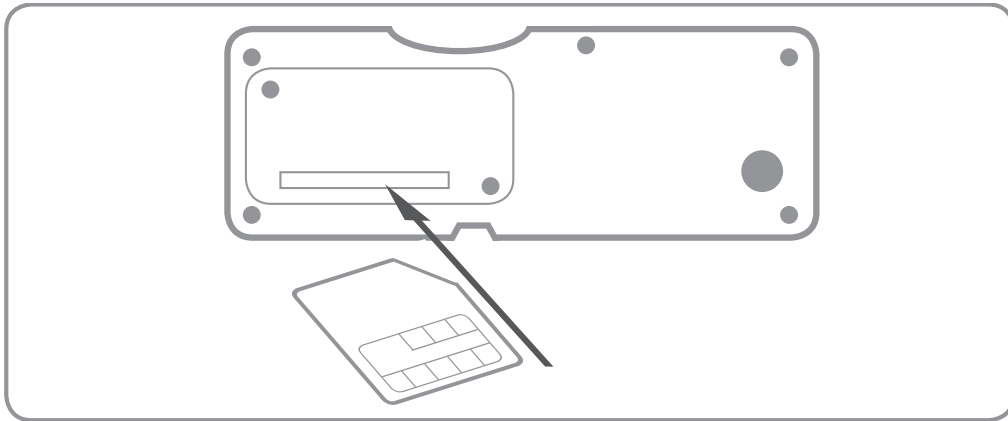
Figure 7.32: Inserting SIM Card into modem Fastback Extend EDGE FXT009

To customize the frequency bands of the modem, connect the modem directly to your computer via USB. If you are using a Windows™ PC and the modem is not displayed in the *Device Manager* under *Modem*, you require a driver file, which can be downloaded from the Sierra Wireless (`http://www.sierrawireless.com/`) website. On Linux™ PCs, in general no driver file needs to be installed.

After connecting the modem to your PC, go to the *Device Manager* (see Figure 7.33) and open the properties of the modem by double-clicking on the modem.
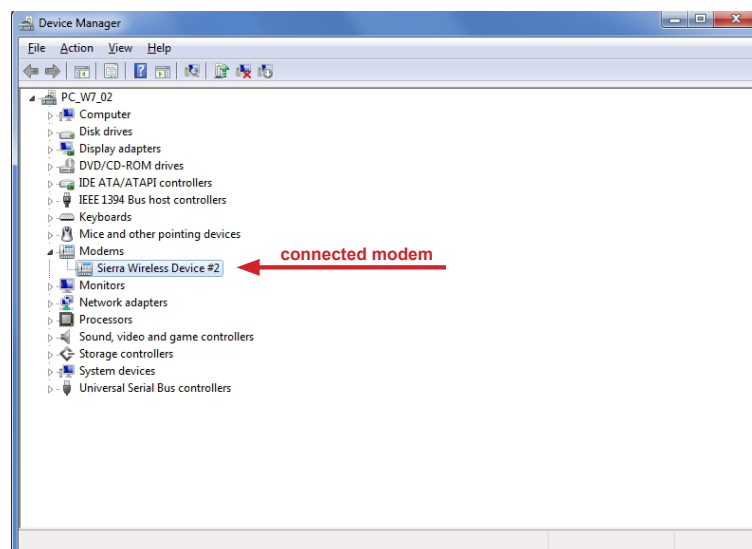
Figure 7.33: Device Manager

Go to the *Modem* tab (see Figure 7.34) to get the name of the *COM Port*, to which the modem is connected, e.g. COM5. Change the *Maximum Port Speed* to `57600 baud rate`. Save the changes.
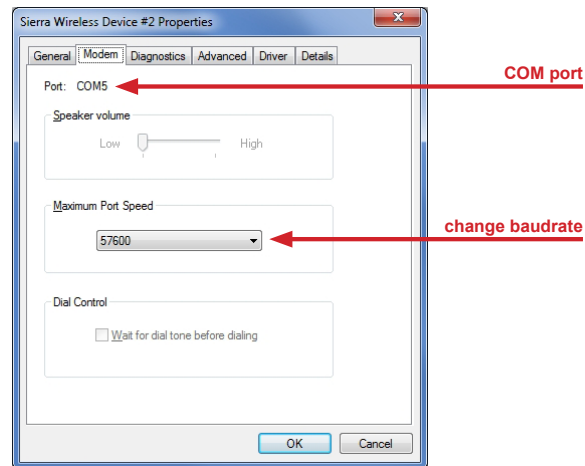
Figure 7.34: Modem Properties

To switch from one supported band to another, you can configure your modem with the help of AT commands.

AT+WMBS=5 *(to switch to 850/1900 MHz)*
AT+WMBS=4 *(to switch to 900/1800 MHz)*
AT+WMBS=7 *(to switch to 850/900/1800/1900 MHz)*

In order to customize the frequency bands, a standard terminal program like PuTTY (http://www.putty.org/) can be used. Open the program and enter the port number as *Serial line* and 57600 for the *Speed* as shown in Figure 7.35. *Open* the command window (see Figure 7.36) of the terminal program. In order to test the connection, enter ″at″ and press Enter. If OK is shown, the connection is fine and you can change the frequency bands with the above mentioned AT commands.

⚠ **Warning**
Make sure to download PuTTY only from its official website or other trusted sources. Malicious versions have been released, that might copy private information to unauthorized parties.
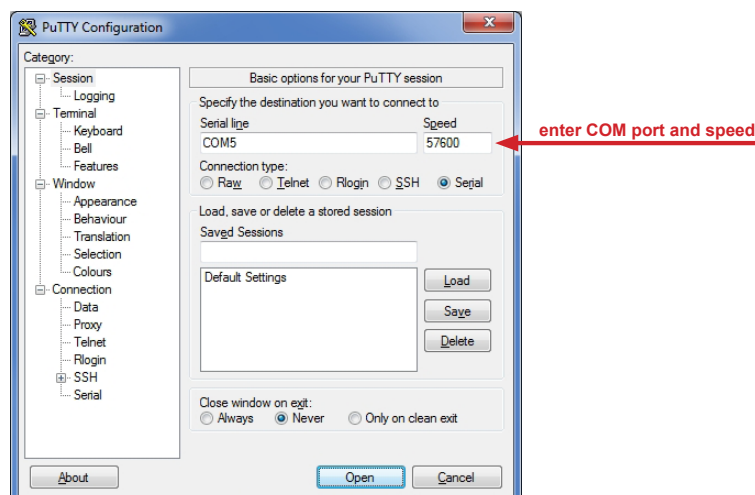
Figure 7.35: PuTTY Configuration
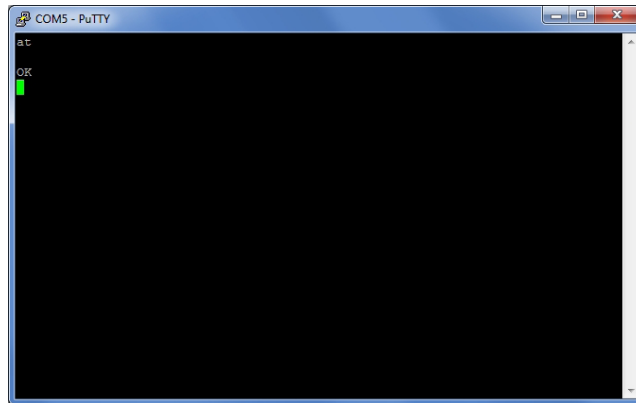
Figure 7.36: PuTTY Command Window

! **Important**
Restart the modem after modification.

7.9.7 Connecting a BGAN Satellite Modem to Meteo-42

7.9.7.1 Pointing the terminal to the satelite

It is recommended to test the conectivity outdoors because pointing through a window introduces a slight drop in signal strength. Most units have audible and visual pointing indicators. The terminal first needs to acquire GPS, which may take a long time. Some units will then diplay pointing information to help with the orientation of the antena. Line-of-sight to the satellite is required for connectivity.

7.9.7.2 Configuring Meteo-42 with BGAN Satellite Modem

! **Important**
BGAN modems are not configured using the modem page, but in the LAN page, as shown in Figure 7.26.

BGAN satellite modems are connected via Ethernet to Meteo-42.

Configure DHCP to automatically assign an IP address to data logger Ethernet port and modem. Both Meteo-42 and modem must be configured to use DHCP.

Use the software provided by its manufacturer to configure the BGAN satellite modem.

In order to supply the modem, select a *LAN switch* from the dropdown list in the Communication → LAN menu. Hence prior to the scheduled actions, the modem can be supplied via the Meteo-42 switch (see Section 7.7). For testing, the checkbox *LAN online, whenever CECS is on* may be switched on. So the modem goes online as soon as CECS has been switched on. After testing, this setting should be switched off to prevent excessive traffic.

For testing the satellite modem, go to the Communication → Schedule menu and press *Run now* for the online action. Go to the Communication → Online menu and copy the AmmonitConnect address of the data logger, e.g. `https://gnnnnnn.connect.ammonit.com` . Disconnect the data logger from your PC and / or LAN. After entering the copied address in your browser, you should be able to log into the Meteo-42 web interface.

7.9.7.3 Recommended Settings for Satellite Connections

URL: https://g001234.local/communication/lan/?screenshot=yes

Ammonit

Help Logout
Admin on G001234

Recording:	⚠ Off	Switch on
Configuration:	⚠ Unsaved	Save
Connection:	Ethernet	
Remaining:	∞	
Date/time:	2023-08-11 16:00:08 UTC	

LAN

Please turn off 'CECS is always active'

Please activate AmmonitOR with a valid project key

Please use AmmonitOR for data transfer

Please configure a AmmonitConnect access code

Please prevent implicit AmmonitConnect activation

Please configure no more than three online times of max. one hour combined

Please turn off LAN online, whenever CECS is on

Please do not use EMail for data transfer

Please use daily CSV files with 10 minute statistics interval

Interface	State	IP Addresses
eth0	activated	172.17.0.2

☒ LAN online, whenever CECS is on

IP address allocation method

DHCP ▼

☐ Connect to internet via USB modem only (recommended e.g. for SCADA and Ethernet camera)

LAN switch (typically S1)

None ▼

IP address

192.168.40.40

DNS server

192.168.40.1

Gateway

192.168.40.1

Subnet mask

255.255.255.0

Additional subnets

Save

Check optimal BGAN settings

Figure 7.37: Check BGAN optimal settings

Use the `Check optimal BGAN settings` button to verify if all recommended settings are properly configured.

1. We strongly recommend sending data *only to AmmonitOR*, but not by email. The data transfer to AmmonitOR consumes less bandwidth than email (see Section 7.2 and Section 7.4).

2. Use only few tunnel connections, e.g. twice or thrice a week for twenty minutes (see Section 7.2).

3. Use a tunnel access code to prevent unauthorized access to the data loggers login page (see Figure 7.3) which can generate data traffic.

4. Prevent implicit tunnel activation, only recommended for satellite communication (see Figure 7.3).

5. Do not set the check on *LAN online, whenever CECS is on* (see Section 7.7).

6. Be sure to generate not too huge or too many CSV files by keeping the default of one file per day with 10 minutes statistics interval (see Section 6.3). Avoid gust data files, which may get large, depending on configuration and wind conditions.
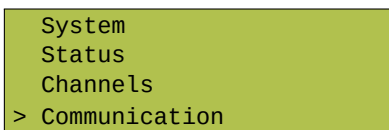
7.10 Troubleshooting

Some mobile service providers and also firewalls in corporate networks restrict the communication of mobile devices to certain ports. The communication of the Meteo-42 data logger might also be affected. There are different incidents, e.g. the tunnel connection does not work, but Rx/Tx traffic is possible or the tunnel is accessible, but sending emails does not work. Reasons for this are often blocked ports by the communication service provider or the firewall or broken DNS.

7.10.1 How to perform the test for tunnel and AmmonitOR
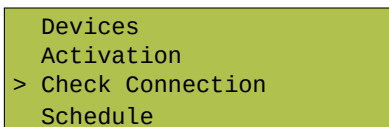
In the web user interface, just save the online/tunnel parameters or AmmonitOR settings. In this moment the data logger checks the connection and presents the result.

Alternatively, you can do the check from the LC display. Go to `Communication` (Figure 7.38). Then select `Communication Check` (Figure 7.39). This will take some time. After some seconds, you can see the results (Figure 7.40).
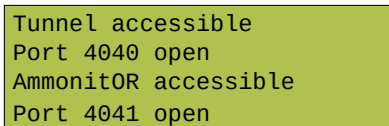
```
   System
   Status
   Channels
 > Communication
```

Figure 7.38: Select "Communication"

```
   Devices
   Activation
 > Check Connection
   Schedule
```

Figure 7.39: Select "Check Connection"

```
Tunnel accessible
Port 4040 open
AmmonitOR accessible
Port 4041 open
```

Figure 7.40: View results of check

If one of the servers is not accessible or a port is blocked, please contact your network administrator or mobile service provider.

Chapter 8

SCADA

8.1   Configuring Meteo-42 for SCADA

Meteo-42 SCADA Server can be used to monitor performance and production of wind farms by providing reliable meteorological data. Meteo-42 data loggers support the standard protocols `Modbus TCP/IP` over Ethernet as well as `Modbus RTU` over RS485 (server).

SCADA parameters can be configured in the Communication → SCADA menu. In order to activate SCADA for Meteo-42, select the checkbox *Activate SCADA server*.

☒ Activate SCADA server

SCADA protocol

| Modbus RTU ▼ |

TCP port

| 502 ▲▼ |

☐ Allow global access

Allowed client IP address(es)

| |

Modbus unit id

| 3 ▲▼ |

RS485 server speed

| 38400 ▼ |

RS485 server data format

| 8N1 ▼ |

[Save]

[Edit Modbus register map]

Figure 8.1: Configuring SCADA Parameters

Depending on the SCADA system in which Meteo-42 is integrated, a protocol for data retrieval has to be chosen:

Modbus TCP over Ethernet   If you use Modbus TCP, a *TCP port* has to be entered. The default value is 502. If *Allow global access* is selected, the SCADA server will be accessible over every available TCP connection (e.g.

Ethernet, Modem, USB-B), otherwise it will only be available over the Ethernet connection. By entering an IP address in field *Allowed client IP address*, the access to the data can be restricted to a single IP. Only the client with the specified IP address can request data from Meteo-42. If the field is left empty or filled with value 0.0.0.0, any client is allowed to access the data. You can also introduce a list of IP addresses separated by a semicolon (;), e.g. 192.168.13.5;192.168.14.6

> **Note**
> In most SCADA systems, the Ethernet interface should be configured properly with a static IP address. Refer to Section 7.7 for further details.

> **Important**
> If a USB modem is connected to Meteo-42 and Ethernet is used for SCADA, it is necessary to select `Connect to Internet via USB modem only` in the Communication → LAN menu.

In order to connect Meteo-42 to a fiber optic, an industrial media converter 10/100BaseT to 100BaseFX (-40–75 °C) can be used.

Make sure that your Modbus TCP client is addressing the *Meteo-42 SCADA server* with the proper *Modbus unit ID* configured here. The default value is 1.

Modbus TCP uses the unit identificator for routing purposes in case of addressing a device on a MODBUS or MODBUS+ serial line subnetwork. The Modbus TCP server is still sensitive for this parameter. For further details see *MODBUS Messaging on TCP/IP Implementation Guide V1.0b* recommendations at The Modbus Organization (`http://www.modbus.org/`).

Modbus RTU over RS485 S (server) If you are using the Modbus RTU protocol, *Modbus Unit ID* and *RS485 serial settings* (speed and data format) have to be selected.

Available baud rates: 115200, 57600, 38400, 19200 and 9600 bits per second.

Available serial settings (data/parity/stop): 8N1, 8N2, 8E1.

If you are using more than one Meteo-42 data logger in your SCADA system, each data logger requires a unique Modbus Unit ID and all data loggers have to use the same RS485 serial settings (speed and data format).

Save your settings. Otherwise, the configuration is reset to the previous values after moving to another page.

8.1.1 CECS power mode

To use Meteo-42 SCADA server, the CECS must remain permanently on (see also Section 4.2). This mode is automatically set when the SCADA server is activated in the Communication → SCADA. You can only switch it off again after deactivating the SCADA server.

> **Important**
> CECS is a fully embedded Linux™ computer (see also Section 1.4). Be aware that the power consumption of Meteo-42 is higher, when CECS is switched on.

8.1.2 Statistics selection

It is possible to request both live data and statistics over SCADA (see available statistics). The *time interval* over which the SCADA statistics are calcuated defaults to 10 minutes and can be modified in menu Data → Statistics menu (see also Section 6.3.1).

> **Important**
> The same statistics interval is used for SCADA, the *Switch manager* and the *data snapshots*.

Summary statistics are normally used to calculate the summary over a complete day. It is available for precipitation, precipitation intensity, status, sun status, bat passes and bat pulses evaluations. The SCADA summary interval can also be changed in Data → Statistics menu.

The Modbus register map in the Meteo-42 web interface only shows the selected statistics from the Data → Statistics menu. Go to the Data → Statistics menu and select the required data. See also Section 6.3.1.

8.2 Meteo-42 and Modbus

The configurable Modbus Register Map allows Meteo-42 to operate in most existing SCADA systems. The user must determine which measurement values should be available for the SCADA client and configure a unique address for each measurement (first reference is 0, available range is 0 to 65535). For more information about the supported function codes see the public function code definition from the Modbus application protocol specification The Modbus Organization (`http://www.modbus.org/`).

> **Important**
> Meteo-40 uses Protocol Data Unit (PDU) addressing, i.e. the start address is 0. Typically, reference numbers are one-indexed, meaning that the start value of a given range is one. Thus if your Modbus client expects the value at register 400001, you must introduce addess 0 in Meteo-40 Modbus Holding Register Map. No prefixing for the data blocks is used (e.g. 3 for input and 4 for holding registers).

All registers in range 0 to 65535 not selected to hold a measurement will contain the hexadecimal value FFFFh. If the register is selected but no valid measurement is present, the invalid value corresponding to the configured data type is written (see Table 8.1).

Data Type	Invalid Value
short (16-bit integer)	7FFFh
ushort (16-bit unsigned integer)	FFFFh
long (32-bit integer)	7FFFFFFFh
ulong (32-bit unsigned integer)	FFFFFFFFh
IEEE 754 (32-bit single precision binary floating point)	7FC00000h
Unix Time	00000000h

Table 8.1: Modbus Invalid values

Figure 8.2: SCADA Modbus Register Table

Column `Measurements` Name of the evaluation, channel, or measurand. For every measurand either two or four registers are used, depending on the data type selected (see Table 8.2).

Name of date, time, and switches fields. Every single value needs one register, with the exception of the UNIX time (seconds since `1970-01-01 00:00:00 GMT`), which needs two registers.

Columns statistics (`Live, Avg, ... Med`) In these fields, the modbus register number where each measurement value will be contained must be introduced.

Type For each evaluation or channel, a data type can be selected, e.g. `float`, (see Table 8.2).

Factor For each evaluation or channel, a scale factor can be selected, e.g. `float`, (see Table 8.2).

Live data Describes instantly measured data of the active channels (A *n*, AC *n*, C *n*, D *n*, R *n* C *m*, P *n*) and switches (S *n*) as well as instantly evaluated data (Top Anemometer Wind Speed (m/s), Precipitation (mm), etc.).

Live data are updated in the Modbus store once per second. If a higher measurement rate is configured for a sensor, only the last value of every second will be available over SCADA.

All live data values, including Live Date/Time and Live Unix Time, are written in the Modbus store with an atomic operation. This guarantees that the time-stamps, in case configured, match the measurement values.

Aggregated / statistical data Statistics can be applied to channels and to evaluated data. All statistics data values, including Statistics Date/Time and Start-End Unix Time, are written in the Modbus store with an atomic operation. This guarantees that the time-stamps, in case configured, match the measurement values

The SCADA interval for statistics calculation (*Statistics interval for SCADA, Switch manager and snapshots*) defaults to 10 minutes and can be configured in the Data → Statistics menu. This interval is applied for standard statistics: average (Avg), maximum (Max), minimum (Min), standard deviation (SDv), sum (Sum, only for status signals), median (Med) and value (Val). For the Summary statistics, *SCADA summary interval* is applied, which defaults to daily. The summary statistics are calculated as a simple moving statistic at the end of every SCADA interval for statistics calculation (i.e. 10 minutes with the default configuration).

⚠ **Warning**
If the CECS reboots, aggregated data are only available after the corresponding statistics interval or summary interval is elapsed.

❗ **Important**
Only statistics selected in menu Data → Statistics(see Figure 6.4) are available here for retrieval.

In order to configure the Modbus server address of the data logger for serial subnetworks, go to the Communication → SCADA menu. For further details about Modbus see: www.modbus.org (`http://www.modbus.org`).

Option	Description
Measurements Data Type and Scale Factor	Date/time values, i.e. year, month, day, hour, minute, and second, as well as state of the switches are represented as unsigned short values, stored in one 16-bit Modbus register each. Data type and scale factor do not apply to these values. For the measurement value representation, data type and scale factor have to be selected. Data types short, ushort, long and ulong represent a measurement value as an integer and store it in one or respectively two subsequent 16-bit registers. To achieve higher resolution on the representation or a wider range of values represented with a lower resolution, the original measured value can be divided by a scale factor before storing it into the registers as an integer. The default data type is IEEE 754 standard in binary32 format (32-bit single precision binary floating point), being values stored in two subsequent 16-bit Modbus registers. In this last case, scale factor 1 is recommended. See also Equation 8.1.
Modbus Endianness for SCADA Server	According to the Modbus Application Protocol Specification V1.1.b, Modbus is a 'big-Endian' protocol: "Modbus uses a 'big-Endian' representation for addresses and data items. If a numerical quantity larger than a single byte is transmitted, the most significant byte will be sent first." Meteo-42 endianness can be configured by the user via web interface and is set by default to 'big-endian' byte order and 'big-endian' registers order representation (high byte first, high word first). For example for value -4.395978e-11, the representation is shown in table Table 8.3.
Modbus register address interpretation	For historical reasons, some devices use a starting offset to refer to Modbus register addresses, depending on the function code used to read the data. That means, a Modbus client may represent for example Modbus input register 100 with address 30101 and Modbus holding register 100 with address 40101. Meteo-42 does not use this representation. Only the register address, unique for each measurement that will be retrieved and in range 0 to 65535, must be introduced at the Modbus register table. For the previous example, only 100 should be introduced at the corresponding text box of the register table.
Modbus Device Identification	Some additional information relative to the physical and functional descripton of the device is available with function code 43 (see Table 8.4).

Table 8.2: Optional Available Information and configuration

$$\text{Value}_{SCADA} = \frac{\text{Value}_{Original}}{\text{Scalefactor}}$$

Equation 8.1: Scale Factor

Representation	Byte Endianness	Word Endianness
AE41 5650	Big (high byte first)	Big (high word first)
5650 AE41	Big (high byte first)	Little (low word first)
41AE 5056	Little (low byte first)	Big (high word first)
5056 41AE	Little (low byte first)	Little (low word first)

Table 8.3: Modbus Endianness for SCADA Server

Object Id	Description	Type
0x00	VendorName: 'Ammonit Measurement GmbH'	ASCII String
0x01	ProductCode: Data logger serial number (e.g. 'D151234')	ASCII String
0x03	VendorURL: 'http://ammonit.com/'	ASCII String
0x04	ProductName: Data logger name (see Section 4.2)	ASCII String
0x05	ModelName: Data logger type (e.g. 'Meteo-42L')	ASCII String

Table 8.4: Modbus Device Identification

8.2.1 Input Registers

Input registers contain the measurement values configured by the user. Meteo-42 SCADA server instantly writes measured values in the `Live` registers and the calculated statistics after each interval in the aggregated data registers. These data can be read with modbus function code 04. Register addresses must be between 0 and 65535. The following values can be accessed in modbus registers, if so configured in the table:

Live and statistical data of all active channels
Data logger internal values (`Int. Voltage (V)`, `Int. Current (mA)` and `Int. Temperature (°C)`)
Switches state
Unix Time (for live data and start/end of current statistics and summary intervals)
Live data time stamp (`Date/Time Live`)
Last second of the evaluated interval for statistical data (`Date/Time Statistics`)
Last second of the evaluated interval for summary data (`Date/Time Summary`)

> **Important**
> Only measurements selected in menu Data → Statistics (see Figure 6.4) are available here for retrieval.

8.2.2 Holding Registers

Holding registers can be both read or written. If `Write measurements to holding registers` is selected, the measurement values from the Input registers table will be also written in the same register numbers from the Holding registers table. They can be read with function code 03.

Holding registers can be written by the SCADA client in order to achieve any of the following implemented functionalities.

Date/Time synchronization To synchronise data logger date and time over Modbus, configure the start holding register number for the date/time value in the Modbus Register Map (*Set Date/Time*). By means of a single modbus frame and function code 16 (write multiple registers), year, month, day, hour, minute and second must be written in six subsequent registers, starting at the previously configured register number (16-bit unsigned short values).

A successful synchronization will be logged in the logbook.

> **Important**
> It is necessary to allow date and time synchronization over SCADA in Section 4.2.

Set switches state If a register number is configured in *Set switches state*, it is possible to set the current state of the switches. You can use modbus function code 6 (write single register) to control the state of all 8 switches with one telegram or function code 5 (write single coil) to set the state of only one switch.

In the first case, you must write into the configured register the integer representing the state of all switches. Each bit determines the state of one switch: "0" for open, "1" for closed switch.

In the second case the configured register is the first address and corresponds to S1. To change the state of switch 'n' (Sn) you must write the coil address.

Switch number	S8	S7	S6	S5	S4	S3	S2	S1
Bit Position	7	6	5	4	3	2	1	0

Table 8.5: Set switches state

8.3   Cascading two Meteo-42 Data Loggers using RS485

An easy way to cascade two or more Meteo-42 data loggers to get more measurement channels, is to use one Meteo-42 as RS485 SCADA client, and up to four Meteo-42 as RS485 servers. All data loggers have to be connected as an RS485 bus.

Please be aware of the following characteristics of RS485 cascading:

- Due to the additional communication involved, there is a delay on the cascaded channels, between 1 and 2 seconds. For most applications, where only 10 minute average data are relevant, this should not be a problem.
- The CECS of the servers must be always active, leading to a higher energy consumption.
- The servers do not necessarily have a connection to the Internet. If there is no additional modem or a router, the data loggers cannot be accessed from remote nor can receive software updates easily.
- The client can only read up to 20 Modbus registers per server in one read instruction. Instead of using four Meteo-42 servers, one can also configure the same Meteo-42 up to four times to read different register sets. This allows reading up to 80 Modbus registers from one server.
- Care has to be taken, that client and server configurations fit exactly.

8.3.1   Configuration of the servers

The Meteo-42 server or servers need to be configured as a SCADA device with Modbus RTU protocol and a unique Modbus unit identifier. Note, that if you need to share more than 20 registers with the client, Meteo-42 will need more than one read requests. Meteo-42 can perform until 8 read requests per second, of 20 registers each. The CECS must be always active.

8.3.2   Configuration of the client

At the client side, every server has to be added as an RS485 sensor (Other Sensor/ Modbus RTU), introducing server's unit identifier as RS485 address. If you need to request more than 20 registers from one server, you must do this configuring two different sensors with the same server unit identifier. After selecting the corresponding data type, the resulting evaluations must show the same measurement value as at the server. For each of the measurement values you should configure a custom evaluation using a linear equation in order to confer it the known unit and data type (see Evaluation Helper).

Chapter 9

Using the Display

The LC display of Meteo-42 with background light is able to show 4 lines, each with 20 characters. In order to navigate through the menu or to perform an action, use the buttons next to the display.

Figure 9.1: Use of the Meteo-42 buttons

1. Press this button for a few seconds to switch Meteo-42 (CECS) on or off.

2. Navigate into a submenu or perform an action.

3. Scroll down in the menu list.

4. Leave the submenu, return to the previous menu.

5. Scroll up in the menu list.

📎 **Note**
After connecting Meteo-42 to the power supply, the two lower LED lights (red and yellow) turn on for a few seconds. When the LED lights turn off, Meteo-42 is ready and can be switched on.

9.1   Assigning Permissions to Display Users

In order to avoid that settings are accidentally modified by a display user, e.g. when measurement data is downloaded on a USB flash drive, you can assign permissions to display users. The configuration can be changed in the System → Display menu (see also Section 4.4.1).

9.2   LED Lights

Meteo-42 has four LED lights next to its display. The two upper LED lights have not yet been assigned a function. The two lower LED lights (red and yellow) turn on, when Meteo-42 is connected to a power supply and turn off as soon as Meteo-42 is ready to be switched on. However, the lower LED lights show:

Red (third from the top) Indicates errors in measuring operation. For details see the error list in the display System → Errors → Error List.

Yellow (lower LED light) Indicates that RS485 sensors are connected. According to the Modbus protocol the LED light blinks, when a measurement is made.

9.3 Navigating through the Display Menu

The display menu of Meteo-42 includes four main menu items and several submenu items. The main menu items are *System*, *Status*, *Channel* and *Communication*.

In order to jump into a submenu or to perform an action, press the right button. To return to the previous menu, use the left button. By pressing the upper or the lower button, you can navigate up and down the menu list. For further details see Figure 9.1.

Some menu items allow you to reconfigure the system, e.g. Communication → Devices → LAN → eth0 → Method, which lets you change the connection method of the Ethernet port. Pressing right changes the ">" symbol to ">>". You can press up and down to change the value, and left to confirm the change. The changes will only be saved if the display has the relevant permissions (see Section 9.1).

9.4 Menu: System

Submenu	Submenu Item	Description
Information	Data Logger	• Type • Serial Number (Dnnnnnn) • Channels
	Version	• Software version • Bootloader version
	Memory	• RAM including % of memory used • Source Memory including % of memory used. Note, that the value can go beyond 100%, because the memory is organized as ring buffer.
Time and Date	Clock	Displays date and time, incl. time zone
	Set Clock	Sets date and time on Meteo-42 according to NTP server time and *Time Zone* defined in the web interface in menu System → Administration
Errors	Error List	Displays the error list
	Clear List	Clears the error list

Table 9.1: Menu: System

9.5 Menu: Status

The `Status` menu includes the information shown in the status box of the Meteo-42 web interface (see Section 3.2 also). In order to switch recording on / off or to save the configuration, press the right navigation button next to the display.

Submenu Item	Description
Rem. Time	• Infty = Infinity (if `CECS always active` is selected) • Remaining time in mm:ss
Recording	• On • Off (no recording, e.g. after changing the configuration)
Configuration	• Saved • Unsaved (changes have been made)
CECS	• When needed • Always (if `CECS always active` is selected)
Ethernet	• Online • Offline
Modem	• Online • Offline
Tunnel	• Active • Inactive
Jobs	Number of currently running actions

Table 9.2: Menu: Status

9.6 Menu: Channels

The menu channels contains seven submenus: `Evaluations`, `Analog Voltage`, `Analog Current`, `Counter`, `Digital Lines`, `Switches` and `Internal`. In order to set or display the values, press the right button until the required value appears in the display.

Submenu	Property
Evaluations	Displays current values of the evaluation, e.g. wind speed, wind direction, temperature etc. The order of evaluations is explained in Section 5.1.3.

Table 9.3: Menu: Channels/Evaluations

Submenu	Submenu Item	Property	Range of Values
Analog A1 (Depending on the data logger type, Meteo-42 offers 8 or 14 analog voltage channels)	Measurement	State	On or Off
		Value	Displays the current value
	Settings	Range	0.1 V, 0.1–0.3 V, 1 V, 10 V
		Rate	• 1/8 s–30 s • 1 min–30 min • 1 h
	Switch	State	On or Off
		ID	Select the appropriate switch. Depending on the data logger type, Meteo-42 offers 2, 4 or 8 switches.
		Time	• 1/8 s–30 s • 1 min–30 min • 1 h

Table 9.4: Menu: Channels/Analog Voltage

Submenu	Submenu Item	Property	Range of Values
Counter C1 (Depending on the data logger type, Meteo-42 offers 2, 8 or 12 counters)	Measurement	State	On or Off
		Value	Displays the current value
	Settings	Rate	• 1 s–30 s • 1 min–30 min • 1 h
	Switch	State	On or Off
		ID	Select the appropriate switch. Depending on the data logger type, Meteo-42 offers 4 or 8 switches.
		Time	• 1/8 s–30 s • 1 min–30 min • 1 h

Table 9.5: Menu: Channels/Counter

Submenu	Submenu Item	Property	Range of Values
Digital D1 (Depending on the data logger type, Meteo-42 offers 4 or 7 digital channels)	Measurement	State	On or Off
		Value	Displays the current value
	Settings	Rate	• 1/8 s–30 s • 1 min–30 min • 1 h
		Type	• None • Thies10bit • Thies8bit • Status
	Switch	State	On or Off
		ID	Select the appropriate switch. Depending on the data logger type, Meteo-42 offers 4 or 8 switches.
		Time	• 1/8 s–30 s • 1 min–30 min • 1 h
	ClockPin	CLK 5 V	Press the right button to force the clock pin to 5 V for 10 seconds.
		CLK 0 V	Press the right button to force the clock pin to 0 V for 10 seconds.

Table 9.6: Menu: Channels/Digital Lines

Submenu	Range of Values
Displays a list of switches. Depending on the data logger type, Meteo-42 offers 2, 4 or 8 switches.	On or Off

Table 9.7: Menu: Channels/Switches

Submenu	Property
Voltage	Displays the current value
Current	Displays the current value
Temperature	Displays the current value

Table 9.8: Menu: Channels/Internal

9.7   Menu: Communication

Submenu	Submenu Item	Property	Description
Devices	Modem	Product Name (only when a modem is connected)	Quality: displays signal strength
			Status: • `Offline` • `Active`
			Type: indicates connection mode, i.e. GSM
			RX Bytes: displays sum of bytes received
			TX Bytes: displays sum of bytes transferred
	LAN	USB	State / Interface • State: `Active` • or `Unavailable` • Interface: `usb`
			IP / Netmask: displays IP address and subnet mask
			Routes: displays router or gateway address
			MAC / Speed: displays MAC address of the data logger and the transmission rate
		Ethernet (network connection)	State / Interface • State: `Active` • Interface: `eth`
			IP / Netmask: displays IP address and subnet mask
			DNS Servers: displays DNS server addresses
			Routes: displays router or gateway address
			MAC / Speed: displays MAC address of the data logger and transmission rate
			Method: DHCP/ `Static IP`/ `Link-local` (can be selected using the keyboard)
	WLAN	• `Restart` • `Active`/`Inactive` • IP Address	The WLAN connection can be restarted using the display.
Activation	Modem: `When needed` or `Permanent` (can be selected using the keyboard)		
	LAN: `When needed` or `Permanent` (can be selected using the keyboard)		

Submenu	Submenu Item	Property	Description
	WLAN: `Active` or `Not active`		
Check Connection			Checks the connection to Tunnel and AmmonitOR servers, see Section 7.10.1.
Schedule	Online	• `Online`	Perform the respective actions immediately, by pressing the right button. The configuration for the actions has to be done beforehand. The dash (-) is visible, if the action is not active at the moment, otherwise it show `runs` or done.
	AmmonitOR	• `AmmonitOR` • `AmmonitOR Test`	
	Email	• `Email` • `Email Test`	
	Copy	• `Copy` • `Copy Test`	
	Generate CSV	• `Gen. CSV`	
	SMS	• `SMS Test`	

Chapter 10

Sensors

Meteo-42 data loggers are designed for installation in wind and solar measurement campaigns. Thus the data logger is compatible with all relevant sensor types. Depending on the data logger type a different number of sensors can be connected to analog voltage, pulse or counter, digital, serial or status as well as analog current, current source and RS485 channels. See also Chapter 11 and Section 1.3.

Depending on the measurement campaign different sensors are required. Find below a list of measurement instruments for wind measurement and solar measurement purposes as well as a list of other meteorological sensors and different measurement devices.

> **Note**
> If the sensor you want to connect is not listed in this manual, refer for technical details and connection plans to the data sheets on the Ammonit website (`http://www.ammonit.com`) or contact our sales team (+49-30-6003188-0 or info@ammonit.com).

10.1   Sensors for Wind Resource Assessment and Wind Farm Monitoring

In order to evaluate the wind conditions at a specific location, various measurements for wind resource assessment are required. According to IEC 61400-12-1 horizontal wind speed, wind direction as well as air density have to be measured. Wind energy is calculated as follows:

$$P = 1/2\rho \cdot A \cdot v^3$$

Equation 10.1: Calculation of Wind Energy [P]

where A is the area; ρ is the air density, $\rho = p / (R \cdot T)$, where p is the air pressure, T the air temperature and R the gas constant; v is the wind speed.

Therefore, wind speed (v) is the most important parameter, as wind energy (P) is proportional to the cube of wind speed. $\Delta 1\%$ wind speed $\approx \Delta 3\%$ wind energy.

The following sensors are crucial for wind site assessment:

Sensor	Description	Link
Anemometer (wind speed)	• Most important parameter for wind measurement • Wind energy is proportional to the cube of wind speed • Install calibrated cup anemometers or calibrated ultrasonic anemometers • Heated sensors are recommended for measurements in cold climates **Note** Vertical wind speed measurement for turbulence and wind turbine load analysis with 3D ultrasonic or propeller anemometer.	Section 10.6 Section 10.8 Section 10.6.2
Wind vane (wind direction)	• Important parameter for wind farm micrositing • Ultrasonic anemometers also determine the wind direction	Section 10.7 Section 10.8
Temperature / Humidity sensor	• Important parameters for air density calculation • Wind energy is linearly proportional to the inverse of air temperature in K • Measurement of relative humidity recommended at high temperatures according to IEC • Combined air temperature and relative humidity sensors available	Section 10.10
Barometric pressure sensor	• Important parameter for air density calculation • Wind energy is linearly proportional to air pressure	Section 10.11
Ultrasonic anemometer	• Evaluate horizontal wind speed and direction; 3D ultrasonics measure vertical wind speed for turbulence analysis • Recommended for measurements in cold climates, as ultrasonic anemometers do not have moving parts and can be fully heated	Section 10.8

Table 10.1: Sensors for Wind Measurement

10.2   Sensors for Solar Resource Assessment

Certain solar measurements are necessary to design profitable solar power plants. Refer to the Ammonit website (`http://www.ammonit.com`) to learn more about solar measurement systems. Depending on application (e.g. PV, CSP, CPV) and size of the solar power plant different measurements are crucial.

Insolation combines Direct Normal Irradiation (DNI) and Diffuse Horizontal Irradiance (DHI). Both are linked according to the formula for Global Horizontal Irradiation (GHI):

$$\text{GHI}_{[W/m^2]} = \text{DHI}_{[W/m^2]} + \text{DNI}_{[W/m^2]} \cdot \cos(\theta)$$

Equation 10.2: Calculation of Global Horizontal Irradiation

where θ is the solar zenith angle.

On a sunny day the insolation is 100 % GHI, 20 % DNI and 80 % DNI·cos(θ).

Sensor	Description	Link
Pyranometer	• Measures GHI (Global Horizontal Irradiation), if installed horizontally • Measures GTI (Global Tilted Irradiation), if installed tilted as PV panel • Measures DHI (Diffuse Horizontal Irradiation), if shaded by a shadow ball or shadow ring (installation on sun tracker)	Section 10.12.1
Pyrheliometer	• Measures DNI (Direct Normal Irradiation) and has to be installed on a sun tracker to follow the position of the sun on the sky	Section 10.12.3
Sunshine Duration sensor	• Indicates the sunshine status as defined by WMO (sunshine = direct irradiation exceeds the level of 120 W/m²)	Section 10.12.4
Solar Tracker	• Capable to orient a payload towards the sun Can be combined with different solar sensors to measure solar radiation global, direct and diffuse components	Section 10.12.5
Soiling Measurement	• Soiling and Irradiance Measurement Systems collect critical data for evaluating PV array performance	Section 10.19

Table 10.2: Sensors for Solar Measurement

Besides measuring the solar conditions at the site of the planned solar power plant, some additional measurements might be necessary to design the solar power plant, e.g. wind speed, wind direction, air temperature, relative humidity as well as air pressure (see Table 10.1). In some cases soiling detectors and precipitation sensors are required.

10.3   Other Sensors for Meteorological Purposes

There are several sensors, which are not mandatory for wind and solar resource assessment, but provide important parameters for ground construction and other influential conditions, e.g. precipitation sensors.

Sensor	Description	Link
Precipitation Rain Gauge	• Measures the amount of precipitation (rain gauge)	Section 10.13
Laser Precipitation Monitor	• Calculates SYNOP code (Surface Synoptic Observations) • Measures intensity of total precipitation • Measures intensity of liquid precipitation • Measures intensity of solid precipitation • Calculates the amount of precipitation	Section 10.13.2

Table 10.3: Sensors for Meteorological Purposes

10.4   Devices for Electrical Measurements

Meteo-42 can be used to connect power meters, multifunction transducers or other electrical measurement devices, e.g. for power curve measurement.

Device	Description	Link
Multifunction Transducer	• Also power meters or measuring transducers • Measure average phase voltage, current, real and reactive power	Section 10.14

Table 10.4: Electrical Measurement Devices

10.5   Research Applications

Meteo-42 is also used for research applications. A large and always growing list of formulas, developed and tested in collaboration with specialists, is included in the *Evaluation Helper*. For a complete list of the available formulas see Section 5.3.1. Thanks to the *Evaluation Helper*, it is possible to apply a linear formula to live measured data for later calculation of the standard statistics on this value. Most formulas combine different measurements and constants, like the air density, the covariance or a plain additon. Some special statistics related to turbulences analysis like Obukhov length or turbulence intensity can also be configured. The resulting value will be included in the statistics files.

In some research projects, a higher measurement rate can be needed. Over an RS485 client (RS485) port, Meteo-42 offers the possibility to record data from one RS485 sensor with a maximum polling rate of 8 Hz. If more than one RS485 sensor is connected to the RS485 client, a maximum polling rate of 1 Hz is available. For the analog voltage channels Ax, analog current ACx and digital channels Dx, the highest measurement rate is 8 Hz. However, for counter channels Cx and period measurement Px the maximum is 1 Hz.

10.6   Anemometers

Anemometers measure the horizontal wind speed (velocity). This parameter is crucial for any wind site assessment. Cup anemometers are the general standard type of anemometers. They are robust and resistant to turbulence and skew winds caused by masts and traverses. Each anemometer should be individually calibrated and equipped with a certified calibration report according to international standards (e.g. MEASNET). At least two anemometers have to be installed on a met mast. Most anemometers can be equipped with electronically regulated heating.

Refer to the Ammonit website (`http://www.ammonit.com/`) to learn more about anemometer behavior and accuracy.

The wind speed (v) is determined by the linear function of the frequency (impulse) output (I):

$$v_{[m/s]} = \begin{cases} \text{slope}_{[m]} \cdot I_{[1/s]} + \text{offset}_{[m/s]} & : I > 0 \\ 0 & : I = 0 \end{cases}$$

Equation 10.3: Calculation of Wind Speed (v)

A counter value of 0 produces the minimal value, which matches the offset by default (see Equation 5.1).

For wind assessment campaigns it is required to perform an individual MEASNET calibration of each anemometer in a wind tunnel to achieve optimal accuracy. After calibration, use the values for slope and offset according to the calibration protocol.

Anemometers are connected to counter channels (Cx). Refer to Figure 13.9 for the connection diagram. Further details about counter channels can be found in Section 11.2 and Section 12.2.

Anemometers can easily be configured in the Meteo-42 web interface via the *Sensor Helper* (see Section 5.1.2).

Sensor	Order-No	Description
Thies Anemometer FCA X vibration extended - Modbus	S11200 / S11200H	See Section 10.6.1
Thies Anemometer FCA X inclination extended - Modbus	S11200 / S11200H	See Section 10.6.1
Thies Anemometer FCA X - Modbus	S11200 / S11200H	See Section 10.6.1
Thies Anemometer FCA X - ASCII	S11200 / S11200H	See Section 10.6.1
Thies Anemometer First Class Advanced	S11100/S11100H	
Thies Anemometer First Class	P6100H/P6100	
Thies Anemometer Compact	S12100H	
Thies Anemometer Classic	P6121H	
Anemometer Vento First Class		
Vector L100 First Class	S14100/S14100H	
Risø P2546A	S16100	
Vaisala Anemometer WAA 252	S15100H	
Young Propeller Anemometer Model 27106T	S17100	See Section 10.6.2
NRG #40 Anemometer	S18200C	
NRG #40 Anemometer linear	S18200C	Pure linear formula
Second Wind C3		
Lambrecht Wind Professional 14522		
Young Wind Monitor	S17200	
Met One 014 mini		
Generic Anemometer		
Generic Anemometer linear		Pure linear formula for NRG anemometers
Generic Anemometer PM		

Table 10.5: Overview Anemometers

Important

If you plan to install anemometer NRG #40H (Hall Effect), anemometer Risø P2546A (Reed switch) or anemometer Thies (if open drain is used), an external circuitry is needed. This can be solved by an external resistor or using an external module supplied by Ammonit. The external modules allow adaption for many different types of sensors and provide stabilized and ripple-free voltage supply for the sensors. Refer to the data sheet and contact Ammonit for further details.

Note

For technical details and electrical characteristics of sensors, refer to the data sheets, which can be downloaded from the Ammonit website (`http://www.ammonit.com/`).

Meteo-42 saves all electrically measured values to the source data (see Section 6.7). The calculated wind speed in m/s is saved to the CSV file (see Section 6.6.1).

Note

The CSV file contains for all active channels the electrical values according to the chosen statistical interval.

10.6.1 Thies First Class Advanced X

The anemometer Thies First Class Advanced X is a cup anemometer that can be connected to an RS485 client port and offers a list of aggregated information like vibration frequency, inclination, corrected an uncorrected wind speed. Thanks to the digital communication over an RS485 bus, this suplementary information can synchronously be requested by Meteo-42.

The corrected wind speed (EC 61400-12-1 Edition 2.0 compliant) is the result of correcting the influence of the atmospheric pressure on the measured wind speed. Meteo-42 will acquire the measurement values of the lower table every second, including measured frequency, corrected and uncorrected wind speed and 3-axis vibration frequencies.

If a Modbus RTU implementation is used ('Thies FCA X - Modbus', 'Thies Anemometer FCA X vibration extended - Modbus' or 'Thies Anemometer FCA X inclination extended - Modbus') and the option RS485 sensors check is active, the sensor will be uniquely identified during configuration by requesting its hardware ID, which will be written in the configuration file. The calibration table, which is applied to the measured frequency resulting from the uncorrected wind speed at the second position of the table, is also requested and saved in the configuration file. If any changes are detected in either the hardware ID or the calibration table, it is reflected in the logbook, including the time stamp when the calibration was performed and the number of the calibration certificate.

Important

Due to the inherent time required in client/server protocols like Modbus or Thies ASCII protocol, if you want to connect more than four RS485 sensors to the RS485 bus and request the measurement value every second, it is not possible to request a long list of measurement data. Modbus protocol optimizes the amount of data transmitted and you must use the plain version ('Thies FCA X - Modbus') in this case.

Model	Channel (Protocol)	Description	Measurement Data
Thies FCA X vibration extended - Modbus	RS485 (Modbus RTU)	Registers 35013-35014, 35021-35022, 35025-35026, 35037-35050	Wind speed corrected (m/s)[1] Wind speed uncorrected (m/s)[2] Frequency (Hz)[3] Absolute atmospheric pressure (hPa) Status word[4] Vibration frequency X (Hz) Vibration amplitude X (mg) Vibration frequency Y (Hz) Vibration amplitude Y (mg) Vibration frequency Z (Hz) Vibration amplitude Z (mg)
Thies FCA X inclination extended - Modbus	RS485 (Modbus RTU)	Registers 35013-35014, 35019-35022, 35025-35026, 35031-35035, 35049-35050	Wind speed corrected (m/s)[1] Wind speed uncorrected (m/s)[2] Frequency (Hz)[3] Housing interior temperature (°C) Absolute atmospheric pressure (hPa) Status word[4] Inclination angle θ (°) Inclination angle ρ (°) Inclination angle φ (°)
Thies FCA X one-step calibration - Modbus[5]	RS485 (Modbus RTU)	Registers 35019-35022, 35025-35026, 35037-35050	Wind speed with configurable slope and offset (m/s)[6] Temperature (°C) Absolute atmospheric pressure (hPa) Status word[4] Vibration frequency X (Hz) Vibration amplitude X (mg)[7] Vibration frequency Y (Hz) Vibration amplitude Y (mg)[7] Vibration frequency Z (Hz) Vibration amplitude Z (mg)[7]
Thies FCA X - Modbus	RS485 (Modbus RTU)	Registers 35013-35014, 35019-35022, 35025-35026	Wind speed corrected (m/s)[1] Housing interior temperature (°C) Absolute atmospheric pressure (hPa) Status word[4]
Thies FCA X - ASCII	RS485 (Thies)	Telegram 2	Wind speed calculated with current calibration table (m/s) Wind speed calculated with standard curve (m/s) Wind speed corrected (m/s)[1]
Thies FCA X - Counter	Counter		Wind speed corrected/calculated (m/s)

Table 10.6: Connecting Thies FCA X to Meteo-42

10.6.2   Propeller Anemometer Young

The Propeller Anemometer measures horizontal and vertical wind speed. However, it is not classified according to MEASNET and IEC. The anemometer is widely used to measure vertical wind speed to analyse turbulences and the wind load of a turbine.

The anemometer uses a transducer which converts linearly the rotational speed into DC voltage levels. Connect the sensor to the analog voltage channels (Ax) of your Meteo-42 data logger.

The anemometer can easily be configured in the Meteo-42 web interface via the *Sensor Helper* (see Section 5.1.2).

Sensor	Order-No
Propeller Anemometer Young 27106T	S17100

Table 10.7: Overview Propeller Anemometer

> **Note**
> For technical details and electrical characteristics of sensors, refer to the data sheets, which can be downloaded from the Ammonit website (`http://www.ammonit.com/`).

Meteo-42 stores all electrically measured values to the source data (see Section 6.7). The calculated wind speed in m/s is saved to the CSV file (see Section 6.6.1).

> **Note**
> The CSV file contains for all active channels the electrical values according to the chosen statistical interval.

10.7   Wind Vanes

Wind vanes indicate the horizontal wind direction. The evaluation of the wind direction enables the best possible positioning of wind turbines. It is essential that a wind vane covers an entire 360° degree radius - without north gap.

Meteo-42 data loggers are capable of using different types of wind vanes: Digital Wind Vanes and Analog (potentiometric) Wind Vanes. The Meteo-42 data logger comprises digital interfaces to connect several Digital Wind Vanes.

In addition to Digital Wind Vanes Meteo-42 data loggers can make use of classical Analog Wind Vanes using a potentiometer. Ammonit suggests using a five wire setup with two analog voltage channels to eliminate measurement errors caused by cable length and voltage drops in the supply voltage of the wind vane.

Furthermore, wind direction can also be recorded using wind vanes with data transmission via RS485 bus.

---

[1]The air pressure compensated wind speed, based on the measured values recorded by means of the calibration curve (register 35013).

[2]Wind speed calculated at data logger from Frequency and current calibration table.

[3]Info: It is the directly measured, uncorrected frequency. Independent of the command FO (register 35049).

[4]Provides information about the condition of the transmitter.

[5]For the case that the calibration values are not saved in the sensor (not recommended).

[6]Calibration slope and offset can be applied to the directly measured, uncorrected frequency. Independent of the command FO (register 35049).

[7]Amplitude vibration unit is mg, where 1g = 9.81m/s².

> **Note**
> It is possible to introduce an installation offset and a calibration offset for a wind vane in the *Sensor Helper*
> (see Section 5.1.2) of the Meteo-42 web interface. These values are internally added, but for documentation
> reasons there are two separate fields for them. The `Installation Offset[°]` must be filled when the
> wind vane has not been precisely aligned to the north, e.g. when the wind vane has been aligned to the
> mast. It specifies the angle between the North and the point the wind vane has been aligned to. The second
> `Offset` field is meant to be used for the calibration offset.

$$D_{[°]} = D_{[°]} + \text{offset}_{[°]} + \text{installationoffset}_{[°]}$$

Equation 10.4: Wind Direction Offset

10.7.1   Digital Wind Vanes Tunnel Magnetoresistance (TMR)

Ammonit recommends installing digital wind vanes TMR to determine the wind direction. Wind vanes TMR deliver
higher precision and are less susceptible to mechanical wear because of their solid state design. Ammonit offers wind
vane Thies First Class TMR 10-bit serial-synchron and wind vane Thies Compact TMR 10-bit serial-synchron.

Wind Vane	Accuracy
Thies Compact TMR	± 1°
Thies Compact POT	± 2°
Thies First Class TMR	± 0.5°
Thies First Class POT	± 1°

Table 10.8: Comparison of Wind Vane Accuracy

Each wind vane TMR requires one digital channel, whereas potentiometer wind vanes require two analog voltage
channels each. By installing wind vanes TMR instead of wind vanes POT, analog voltage channels are available for
other analog sensors, e.g. barometric pressure sensor, temperature or humidity sensors.

> **Tip**
> Considering a measurement system with wind vanes TMR a smaller Meteo-42 model with less channels
> can be sufficient.

Wind vanes TMR are connected to digital channels (Dx). Refer to Figure 13.11 for the connection diagram. Further
details about digital channels can be found in Section 11.3 and Section 12.2.

Wind vanes can easily be configured in the Meteo-42 web interface via the *Sensor Helper* (see Section 5.1.2). The
offset and installation offset are entered in degrees. The slope is also shown, but changing it is strongly discouraged.
The 10-bit gray code measured by the digital channel is multiplied by the slope to produce an angle. The 10-bit gray
code is between 0 and 2^{10}, so any slope besides 360 / 1024 = 0.3515625 will produce incorrect results. If the wind
vane calibration indicates a slope close to 1, the product of the two slopes could be configured instead, but doing so
is not recommended.

Sensor	Order-No
Thies First Class	S21100H
Thies Compact	S22100 / S22100H

Table 10.9: Overview Wind vanes TMR

$D_{[°]}$ = 10-bit gray code × slope + offset + installation offset

Equation 10.5: 10-bit digital wind vane formula

10.7.2 Wind Vanes with Potentiometer

To determine the wind direction with a potentiometer wind vane, e.g. Thies First Class and Thies Compact, Ammonit recommends using a five wire connetion between data logger and wind vane. This five wire connection eliminates voltage drops across the connection cables and also eliminates the negative impact of voltage drops in the sensor's supply. Select the `Generic Analog Wind Vane` sensor type to connect any wind vane using this equation with the voltage range -10 V–+10 V.

The five wire connection method makes use of two consecutive analog voltage channels of the Meteo-42 data logger: A_n, A_{n+1}. A_n records the total voltage of the potentiometer (voltage between vane supply and Ground), A_{n+1} measures the voltage between wiper and Ground. The following equation shows the calculation of the wind direction (D).

$$D_{[°]} = \frac{U_{An+1[V]}}{U_{An[V]}} \cdot 360° + \text{offset}_{[°]}$$

Equation 10.6: Calculation of the Wind Direction (D)

Refer to Figure 13.7 for the connection diagram. Further details about analog voltage channels can be found in Section 11.1 and Section 12.2

Sensor	Order-No	Offset
Thies First Class	S21200H	0° (if aligned to the North)
Thies Compact	S22200 / S22200H	0° (if aligned to the North)

Table 10.10: Parameters for the configuration of potentiometric wind vanes

> **Important**
> If potentiometric wind vanes, e.g. Thies First Class, Thies Compact, Vector W200P, Vector W200P/L, NRG
> #200P additional resistors for current limitation have to be used in the wiring setup. Contact Ammonit
> regarding further details about the accessory module!

Meteo-42 stores all electrically measured values to the source data (Section 6.7). The calculated wind direction in ° (degree) is saved to the CSV file (see Section 6.6.1).

> **Note**
> The CSV file contains the electrical values according to the chosen statistical interval for all active mea-
> surement channels.

10.7.3   Wind Vanes connected to RS485 client

Certain wind vanes have an RS485 interface. Meteo-42 data loggers can address up to 24 smart sensors on the RS485 buses.

⚠ Important

If you intend to connect more than one sensor to an RS485 client port, all connected sensors must use the same protocol and serial settings. Additionally, each sensor needs a unique ID (*RS485 address*), which has to be configured for the sensor. The transmission mode for all RS485-connected sensors has to be configured as half duplex. See Section 11.6.

Wind vanes can easily be configured in the Meteo-42 web interface via the *Sensor Helper* (see Section 5.1.2). See Table 10.11 for the configuration of RS485 wind vanes.

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
Thies Wind Vane TMR RS485	Thies	Telegram 3	RxCy_1: Wind direction	Serial settings, address, half duplex mode
Thies Wind Vane First Class RS485	Thies	Telegram 3	RxCy_1: Wind speed RxCy_2: Wind direction	Serial settings, address, half duplex mode
Thies Wind Vane 8-bit parallel via ICP DAS I7051	DCON	RS485 module to connect two Thies 8-bit parallel wind vanes	RxCy_1: Wind direction vane DI: 0–7 RxCy_2: Wind direction vane DI: 8–15	Serial settings: 38400 8N1, address: 6, checksum: disabled

Table 10.11: Configuration of RS485 Wind Vanes

Meteo-42 stores all measured values to the source data (Section 6.7). The wind direction in ° (degree) is saved to the CSV file (see Section 6.6.1).

10.7.4   Kintech Geovane™

Connecting the Kintech Geovane™ to Meteo-42 is possible on two different ways: via RS485 or three analog channels (two analog voltage channels A and one counter C).

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
Kintech Geovane™ Analog			Cx: Direction True-North Ax: Angle of inclination X Ay: Angle of inclination Y	Analog output must be activated
Kintech Geovane™ ORN	NMEA [8]	ORN message	RxCy_1: Direction True-North RxCy_2: Angle of inclination X RxCy_3: Angle of inclination Y RxCy_4: Status byte	baud rate must be higher than 9600 bps to connect more than 4 RS485 devices

Table 10.12: Kintech Geovane™

10.8   Ultrasonic Anemometers

Ultrasonic anemometers must be connected to an RS485 client port (see Section 11.6). 2D ultrasonic anemometers measure horizontal wind speed, wind direction and acoustic virtual temperature. 3D ultrasonic anemometers also measure the vertical wind velocity, which is important for turbulence and wind load calculations.

> **Important**
> If you intend to connect more than one sensor to an RS485 client port, all connected sensors must use the same protocol and serial settings. Additionally, each sensor needs a unique ID (*RS485 address*), which has to be configured for the sensor. The transmission mode for all RS485-connected sensors has to be configured as half duplex. See Section 11.6.

The following ultrasonic anemometers are included in the Meteo-42 sensor helper for easy configuration. More Modbus sensors can be configured as Other sensor.

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
Thies 2D Anemometer	Thies	Telegram 3	RxCy_1: Wind speed RxCy_2: Wind direction RxCy_3: Acoustic virtual temperature RxCy_4: Thies Status Byte[9]	serial settings, address, half duplex mode, scalar averaging over 1 s
Thies 3D Anemometer	Thies	Telegram 3	RxCy_1: Wind speed azimuth RxCy_2: Wind direction azimuth RxCy_3: Wind speed elevation RxCy_4: Acoustic virtual temperature RxCy_5: Thies Status Byte[9]	serial settings, address, half duplex mode, scalar averaging over 1 s
NMEA - Thies Compact Anemometer	NMEA	Telegram 3	RxCy_1: Wind direction RxCy_2: Wind speed	serial settings, address, NMEA protocol, half duplex mode, scalar averaging over 1 s
Lufft 2D VENTUS-V200A-UMB	Modbus RTU	input registers 14 and 25	RxCy_1: Wind direction RxCy_2: Wind speed	serial settings, address, Modbus RTU protocol, parity none
Gill Wind Master Pro 3D	Gill	Mode 4	RxCy_1: Wind direction azimuth RxCy_2: Wind speed azimuth RxCy_3: Wind speed elevation RxCy_4: Sonic temperature (if activated)	serial settings (B5: 38400 bps, 8N1), address (default Q), averaging inactive (G0), sampling rate 20 Hz (P8), polar polled (M4), output format CSV (O1), Sonic temperature activated (A3)
Gill Wind Master Pro 3D - M3	Gill	Mode 3	RxCy_1: Wind speed X RxCy_2: Wind speed Y RxCy_3: Wind speed Z RxCy_4: Sonic temperature (if activated)	serial settings (B5: 38400 bps, 8N1), address (default Q), averaging inactive (G0), sampling rate 20 Hz (P8), UVW polled (M3), output format CSV (O1), Sonic temperature activated (A3)

---

[8]Compatible with Thies ASCII protocoll.

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
Gill Wind Master Pro 3D - XYZT	Gill	Mode 4	RxCy_1: Wind speed X RxCy_2: Wind speed Y RxCy_3: Wind speed Z RxCy_4: Sonic temperature (if activated)	serial settings (B5: 38400 bps, 8N1), address (default Q), averaging inactive (G0), sampling rate 20 Hz (P8), polar polled (M4), output format CSV (O1), Sonic temperature activated (A3)
Gill Wind Observer / WindSonic 2D Anemometer	Gill	Mode 4	RxCy_1: Wind direction azimuth RxCy_2: Wind speed azimuth RxCy_3: Sonic temperature (if activated)	serial settings (B5: 38400 bps, F1: default 8N1), address (default A), averaging inactive (G0), sampling rate 20 Hz (P8), polar polled (M4), output format CSV (O1), Sonic temperature optionally activated (A2)
Vaisala WMT700 NMEA MWV	NMEA	WMT700 NMEA MWV Data Message	RxCy_1: Wind direction RxCy_2: Wind speed	autoSend = 0 (automatic messages disabled), com2_protocol = 11 (WMT700 NMEA profile for serial port COM2 MWV protocol), com2_interf = 0 (RS485 interface for serial port COM2), com2_delay = 10, wndUnit = 0 (m/s wind speed unit), address = WI (Weather Instruments), device identifier = II

10.8.1   NMEA MWV V 2.0

Supported NMEA telegram: $WIMWV,<dir>,<ref>,<spd>,<uni>,<sta>*<chk><CR> <LF>

- <dir>: Wind direction xxx.x
- <ref>: Reference R = relative
- <spd>: wind speed xxx.x
- <uni>: Wind speed unit M = m/s
- <sta>: Status A = valid
- <chk>: Checksum (8-bit XOR, excluding $ and *)
- <CR>: Carriage return code, ASCII 0DH
- <LF>: Line feed code, ASCII 0AH

10.8.2   Thies Ultrasonic Configuration Options

Before connecting any Thies sensor to an RS485 client port, it has to be configured. Three Thies ultrasonic types are available: 2D compact, 2D and 3D. You can use the Thies Device Utility software to configure your sensors (Thies Device Utility software (https://www.thiesclima.com/en/Products/Accessories-Software/?art=2 16)).

Ammonit recommends configuring Thies ultrasonic sensors as follows:

Required settings

- Half duplex for transmission mode

---

[9]Last value of the Thies status byte for the interval. Typical values for the Thies status byte are: 14 (0x0E) and 206 (0xCE) for a correct behaviour; 225 (0xE1) and 97 (0x61) for malfunction. For more information see sensor's manual.

- Unique ID for each sensor connected to the bus
- Heating ON/OFF

Further Thies-specific settings

- Voltage threshold for heating suppression: 17 V (HC=17)
- Serial settings: 38400 bps, 8N1 (data format)
- Average mode: scalar-averaged velocity and vectorial-averaged angle (AM=2)

Tip

For more information about Thies acoustic virtual temperature, see sensor's manual.

10.8.3 Lufft UMB Configuration Tool

Before connecting any Lufft sensor to Meteo-42, it has to be configured. Download and install the software UMB-Config-Tool (`https://www.lufft.com/de-de/produkte/download-de/software-umb-config-tool`) and follow the next steps:

1. Power on the sensor.

2. Connect sensor's A-, B+ to your computer using RS485 to USB or RS232 adapter.

3. Start *Config-Software-UMB* and setup the connection in the Edit → Connection settings menu.

4. In order to configure the sensor, switch all sensors temporarily to UMB protocol in the *Options* menu (follow instructions).

5. Add the new sensor in the Edit → Sensor menu. Select the appropriate type from the list and ID (default 1). Do not exit this menu, press *Configure* to access the sensor configuration.

6. Load the profile from the sensor (press the button again, if it does not respond). Select the tab with sensor type name and configure as described in the table above (see Section 10.8).

7. Store profile on sensor to apply the configuration changes to the sensor. Save the profile also to your disk to keep a copy of the sensor configuration.

8. Close the configuration program, disconnect and power off the sensor. Connect the sensor to the data logger and power on the sensor.

9. Add the sensor to the sensor list of the data logger in the Measurement → Sensors menu, applying the same configuration.

10.8.4 Gill Wind Configuration Tool

Before connecting any Gill sensor to Meteo-42, it must be configured accordingly.

1. Download and install Gill Wind Com (`http://www.gill.co.uk/main/software.html`).

2. Use the Wizard tool to change from the default configuration all parameters specified in the upper table (see Section 10.8).

3. Use a different address for each unit connected to an RS485 client port. It is recommended that letters A to F, K, M, N, and P are not used since they can appear in a data string and might result in erroneous poll responses.

4. Do not forget to save the configuration report in the *Tools* menu.

5. Close the configuration program, disconnect and power off the sensor. Connect the sensor to the data logger and power on the sensor.

6. Add the sensor to Meteo-42 sensors list in the Measurement → Sensors menu, applying the same configuration.

Note

Any wind magnitude lower than defined by sensor's parameter K (default 0.050 m/s) will omit the wind direction.

⚠️ **Important**

Gill Wind Master sensors with firmware v7.01 can be networked with other Wind Master units on a 2-wire RS485 bus. Units with older versions cannot be networked.

10.9   Weather and Environmental Integrated Monitoring Stations

Weather and environmental stations are capable of measuring a large amount of athmospheric conditions in only one device. To acquire this data the preferred connection is RS485. These sensors can be connected to an RS485 client port (see Section 11.6).

⚠️ **Important**

If you intend to connect more than one sensor to an RS485 client port, all connected sensors must use the same protocol and serial settings. Additionally, each sensor needs a unique ID (*RS485 address*), which has to be configured for the sensor. The transmission mode for all RS485-connected sensors has to be configured as half duplex. See Section 11.6.

The following weather and environmental stations are included in the Meteo-42 sensor helper for easy configuration. More Modbus sensors can be configured as Other sensor.

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
Weather Station Thies Clima US MODBUS	Modbus RTU	input registers 35001-35006, 35013, 35014, 35017, 35018, 35029, 35030, 35033-35040	RxCy_1: Wind speed RxCy_2: Wind direction RxCy_3: Temperature RxCy_4: Humidity RxCy_5: Air pressure RxCy_6: Direction of brightness RxCy_7: Precipitation status RxCy_8: Precipitation intensity RxCy_9: Precipitation sum RxCy_10: SYNOP	BR=384, DM=0
Weather Station Thies Clima US	Thies	Telegram 6	RxCy_1: Wind speed RxCy_2: Wind direction RxCy_3: Temperature RxCy_4: Humidity RxCy_5: Air pressure RxCy_6: Brightness max. value RxCy_7: Direction of brightness RxCy_8: Precipitation status RxCy_9: Precipitation intensity RxCy_10: Precipitation sum RxCy_11: SYNOP	BR=384, DM=0, DT=0, TT=0, RD=5
Weather Station Thies Clima US VDTHP	Thies	Telegram 2	RxCy_1: Wind speed RxCy_2: Wind direction RxCy_3: Temperature RxCy_4: Humidity RxCy_5: Air pressure	BR=384, DM=0, DT=0, TT=0, RD=5

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
Lufft Weather station WS	Modbus RTU	input registers 10, 14, 22, 31 and 47	RxCy_1: Relative humidity (act.) RxCy_2: Rel. air pressure (act.) RxCy_3: Wind direction fast RxCy_4: Air temperature (act.) RxCy_5: Wind speed fast	serial settings (38400 bps), address, Modbus RTU protocol, parity none
Lufft Weather station WS 300	Modbus RTU	input registers 10, 14 and 31	RxCy_1: Relative humidity (act.) RxCy_2: Rel. air pressure (act.) RxCy_3: Air temperature (act.)	serial settings (38400 bps), address, Modbus RTU protocol, parity none
Lufft Weather station WS 502	Modbus RTU	input registers 10, 14, 22, 27, 31 and 47	RxCy_1: Relative humidity (act.) RxCy_2: Rel. air pressure (act.) RxCy_3: Wind direction fast RxCy_4: Global radiation (act.) RxCy_5: Air temperature (act.) RxCy_6: Wind speed fast	serial settings (38400 bps), address, Modbus RTU protocol, parity none
Lufft Weather station WS 600	Modbus RTU	input registers 10, 14, 22, 24, 25, 31, 47, 48, 49 and 50	RxCy_1: Relative humidity (act.) RxCy_2: Rel. air pressure (act.) RxCy_3: Wind direction fast RxCy_4: Compass direction RxCy_5: Precipitation type RxCy_6: Air temperature (act.) RxCy_7: Wind speed fast RxCy_8: Precipitation Quantity Absolute RxCy_9: Precipitation Quantity Difference RxCy_10: Precipitation Intensity	serial settings (38400 bps), address, Modbus RTU protocol, parity none
Lufft Weather station WS 601	Modbus RTU	input registers 10, 14, 22, 24, 25, 31, 47, 48, 49 and 50	RxCy_1: Relative humidity (act.) RxCy_2: Rel. air pressure (act.) RxCy_3: Wind direction fast RxCy_4: Compass direction RxCy_5: Precipitation type RxCy_6: Air temperature (act.) RxCy_7: Wind speed fast RxCy_8: Precipitation Quantity Absolute RxCy_9: Precipitation Quantity Difference RxCy_10: Precipitation Intensity	serial settings (38400 bps), address, Modbus RTU protocol, parity none

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
Gill MaxiMet GMX600	Modbus RTU	registers 2 to 20	RxCy_1: Wind direction RxCy_2: Wind speed RxCy_3: Wind direction corrected RxCy_4: Air pressure RxCy_5: Humidity RxCy_6: Temperature RxCy_7: Dew point RxCy_8: Precipitation sum RxCy_9: Precipitation intensity	serial settings, address
WDS308 integrated dust monitoring sensor	Modbus RTU	registers 1 to 14	RxCy_1: Wind direction RxCy_2: Wind speed RxCy_3: Temperature RxCy_4: Humidity RxCy_5: Air pressure RxCy_6: Precipitation sum RxCy_7: Global irradiance RxCy_8: UV Index RxCy_9: Noise RxCy_10: Particulate Matter PM2.5 RxCy_11: Particulate Matter PM10	averaging interval 1s, serial settings, address
LSI Lastem DNB201	Modbus RTU	registers 0 to 18	RxCy_1: Wind speed RxCy_2: Wind direction RxCy_3: Temperature RxCy_4: Humidity RxCy_5: Air pressure RxCy_6: Minute precipitation RxCy_7: Hour precipitation RxCy_8: Day precipitation RxCy_9: Total precipitation	serial settings, address

10.10   Temperature Humidity Sensors

Temperature sensors measure the air temperature, while humidity sensors measure the air humidity. Both sensors are often applied in combination to reduce cost.

Temperature humidity sensors, e.g. Galltec Active KP, Galltec Active TP, have to be connected to analog voltage channels (Ax). Refer to Figure 13.4 for the connection diagram.

The output signal (U) from the temperature sensor is proportional to the temperature (T) in °C.

$$T_{[°C]} = \text{slope}_{[°C/V]} \cdot U_{[V]} + \text{offset}_{[°C]}$$

Equation 10.7: Calculation of Temperature (T)

The output signal (U) from the humidity sensor is proportional to the humidity (RH) in %.

$$RH_{[\%]} = \text{slope}_{[\%/V]} \cdot U_{[V]}$$

Equation 10.8: Calculation of Humidity (RH)

`Slope` and `Offset` are internal parameters of the sensor, which are important to calculate temperature (T) in °C and humidity (RH) in %. Both values are pre-configured in the *Sensor Helper* (see Section 5.1.2).

> **Note**
> For more flexibility, when connecting the combined Galltec temperature and humidity sensor to Meteo-42, two different Galltec Active KP sensors are listed in the *Sensor Helper* (see Section 5.1.2). Two analog channels are needed and thus the order of the signals to be connected is selectable. "Galltec Thermo-Hygro Active KP" assigns the first analog channel to temperature and the second to humidity. As opposite, "Galltec Hygro-Thermo Active KP" assigns the first channel to humidity and the second to temperature.

Sensor	Order-No	Slope	Offset
Galltec Active KP (Temperature + Humidity)	S52100	100 %/V (Humidity) 100 °C/V (Temperature)	0 % (Humidity) -30 °C(Temperature)
Galltec Active TP (Temperature)	S42100	100 °C/V	-30 °C

Table 10.13: Parameters for the configuration of temperature humidity sensors

> **Important**
> If you install calibrated sensors, enter the values given in the calibration protocol.

Meteo-42 saves all electrically measured values in V to the source data (Section 6.7). The calculated values for temperature (°C) and humidity (%) are saved to the CSV file (see Section 6.6.1).

> **Note**
> The CSV file also contains for all active channels the electrical values according to the chosen statistical interval.

> **Note**
> For technical details and electrical characteristics of sensors, refer to the data sheets, which can be downloaded from the Ammonit website (`http://www.ammonit.com/`).

10.10.1 Resistance Temperature Detectors (RTD) / Pt100 / Pt1000

RTDs measure the temperature by correlating the resistance of the RTD element with temperature. Those sensors provide high accuracy and repeatability; the sensors are suitable for precision applications. RTDs use electrical resistance and require a power source to operate.

Platinum Resistance Thermometers (Pt100 / Pt1000) are classified according to DIN EN 60751 - see tolerance classes below.

Tolerance Class	Tolerance in K
Class B1/3 DIN	±(0.10 K + 0.0017 × [t])
Class A	±(0.15 K + 0.002 × [t])
Class B	±(0.30 K + 0.005 × [t])
Class 0.5	±(0.50 K + 0.006 × [t])

Table 10.14: Tolerance Classes - Platinum Resistance Thermometers (Pt100)

Pt100 / Pt1000 sensors have to be connected to the analog voltage channel and the current source of Meteo-42 data loggers. The sensors can easily be configured via the *Sensor Helper* (see Section 5.1.2) in the Meteo-42 web interface.

Meteo-42 saves all electrically measured values in V to the source data (Section 6.7). The calculated value for temperature (°C) is saved to the CSV file (see Section 6.6.1).

📎 **Note**
The CSV file also contains for all active channels the electrical values according to the chosen statistical interval.

10.10.2   Temperature Humidity Sensors connected to RS485 client

Some available temperature humidity sensors have to be connected to a Meteo-42 RS485 client bus. The sensors can easily be configured in the Meteo-42 web interface via the *Sensor Helper* (see Section 5.1.2).

⚠️ **Important**
If you intend to connect more than one sensor to an RS485 client port, all connected sensors must use the same protocol and serial settings. Additionally, each sensor needs a unique ID (*RS485 address*), which has to be configured for the sensor. The transmission mode for all RS485-connected sensors has to be configured as half duplex. See Section 11.6.

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
Galltec Thermo/Hygro KPC.MS	Modbus RTU	registers 0, 1, 3, 4	RxCy_1: Temperature RxCy_2: Humidity	Fixed serial settings (19200 8N1)
Campbell Hygro/Thermo CS215	SDI-12	D0	RxCy_1: Temperature RxCy_2: Humidity	External module needed (address, 19200 8N1, 120Ω termination). See SDI-12
Thies Hygro-Thermo-Baro - RS485	Modbus RTU	registers 35001 - 35013	RxCy_1: Absolute air pressure RxCy_2: Reduced air pressure RxCy_3: Relative humidity RxCy_4: Air temperature RxCy_5: Dew point temperature RxCy_6: Sensor Status	serial settings, address

Table 10.15: Data request for RS485 Temperature Humidity Sensors

Meteo-42 saves all measured values to the source data (Section 6.7). The values for temperature (°C) and humidity (%) are saved to the CSV file (see Section 6.6.1).

10.11 Barometric Pressure Sensors

Barometric pressure sensors measure the air pressure. Air pressure and air temperature should be evaluated for an accurate wind site assessment. It is recommended including an air pressure sensor as part of a measuring system.

Barometric pressure sensors, e.g. AB60, AB100 and Vaisala PTB110, have to be connected to analog voltage channels (Ax). Refer to Figure 13.3 for the connection diagram.

The output signal (U) from the barometric pressure sensor is proportional to the air pressure (P).

$$P_{[mbar]} = slope_{[mbar/V]} \cdot U_{[V]} + offset_{[mbar]}$$

Equation 10.9: Calculation of Air Pressure (P)

`Slope` and `Offset` are internal parameters of the sensor, which are important to calculate the air pressure in hPa. Both values are pre-configured for sensors listed in the library of the *Sensor Helper* (see Section 5.1.2).

Sensor	Order-No	Slope	Offset
Ammonit AB60	S31100	60 mbar/V	800 mbar
Ammonit AB100	S31200	100 mbar/V	600 mbar
Vaisala PTB110	S32100 for PTB 110.3 S32200 for PTB 110.2 S32300 for PTB 110.1	60 mbar/V	800 mbar

Table 10.16: Parameters for the configuration of barometric pressure sensors

> **!** **Important**
> If you install calibrated sensors, enter the values given in the calibration protocol.

Meteo-42 saves all electrically measured values in V to the source data (Section 6.7). The calculated air pressure value in mbar is saved to the CSV file (see Section 6.6.1).

> **Note**
> The CSV file contains for all active channels the electrical values according to the chosen statistical interval.

> **Note**
> For technical details and electrical characteristics of sensors, refer to the data sheets, which can be downloaded from the Ammonit website (`http://www.ammonit.com/`).

10.11.1 Barometric Pressure Sensors connected to RS485 client

Certain barometric pressure sensors have to be connected to a Meteo-42 RS485 client bus The sensors can easily be configured in the Meteo-42 web interface via the *Sensor Helper* (see Section 5.1.2).

> **Important**
>
> If you intend to connect more than one sensor to an RS485 client port, all connected sensors must use the same protocol and serial settings. Additionally, each sensor needs a unique ID (*RS485 address*), which has to be configured for the sensor. The transmission mode for all RS485-connected sensors has to be configured as half duplex. See Section 11.6.

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
Thies Baro Transmitter	Thies	Telegramm 1	RxCy_1: Air pressure RxCy_2: Temperature	serial settings, address

Table 10.17: Data request for RS485 Barometric Pressure Sensors

Meteo-42 saves all measured values to the source data (Section 6.7). The air pressure value in hPa is saved to the CSV file (see Section 6.6.1).

10.12   Solar Sensors

10.12.1   Pyranometers

Pyranometers measure the global horizontal radiation. They are also used as reference instruments thanks to their measurement precision. The use of this sensor is crucial for measurements with solar-powered applications.

Meteo-42 indicates for pyranometers the global horizontal irradiation (GHI).

Pyranometers, e.g. MS series of EKO Instruments or CMP series of Kipp & Zonen, have to be connected to analog voltage channels (Ax). Refer to Figure 13.2 for the connection diagram.

The output signal (U) from the pyranometer is proportional to the solar irradiance (E) in W/m².

$$E_{[W/m^2]} = \frac{U_{[\mu V]}}{Sensitivity_{[\mu V/[W/m^2]]}}$$

Equation 10.10: Calculation of Solar Irradiance (E)

`Sensitivity` is an internal parameter of the sensor, which is important to calculate the radiation in W/m². The value is given in the calibration certificate of the sensor.

Sensor	Order-No
CMP 3	S61100
CMP 6	S61110
CMP 10	S61130
CMP 11	S61120
EKO ML-01	S64350
EKO MS-40	S64111
EKO MS-410	S64130
EKO MS-60	S64131
EKO MS-602	S64110
EKO MS-60M (RS485)	S64160
EKO MS-60S (RS485)	S64137
EKO MS-80A	S64150
EKO MS-80M (RS485)	S64160
EKO MS-80S (RS485)	S64185
EKO MS-802	S64120
EKO MS-90+ (RS485)	
Kipp & Zonen CMP11	S61120
Kipp & Zonen CMP6	S61110
Kipp & Zonen CMP3	S61100
Kipp & Zonen SMP10 (RS485)	S61430 / S61420
Hukseflux Pyranometer LP 02	S63100
Hukseflux Pyranometer SR 11	S63120
Hukseflux Pyranometer SR30 (RS485)	
Hukseflux Pyranometer SR20-T1	
SP Lite2	S61180
Silicon Irradiance Sensor MT 0-1V	S68310 / S68320 / S68330
Silicon Irradiance Sensor MT 0-10V	S68100
Silicon Irradiance Sensor MT 4-20mA	S68110 / S68210
Silicon Irradiance Sensor SiS-13TC-T	S68250
Li-Cor LI-200SZ	
ISET Solar Radiation Sensor	
Datasol MET Reference Cell (RS485)	

Table 10.18: Pyranometers

Meteo-42 saves all electrically measured values in `V` to the source data (Section 6.7). The calculated values for solar radiation are saved in `W/m²` to the CSV file (see Section 6.6.1).

> **Note**
> The CSV file also contains for all active channels the electrical values according to the chosen statistical interval.

> **Note**
> For technical details and electrical characteristics of sensors, refer to the data sheets, which can be downloaded from the Ammonit website (`http://www.ammonit.com/`).

Some pyranometers can or must be connected to an RS485 client port. For EKO pyranometers, it is also possible to use the M-Box RS485 Modbus RTU adapter and connect analog pyranometers to an RS485 client bus. If more than one sensor is connected to an RS485 client bus, they must be configured with a unique Modbus ID and they must all share the same protocol and serial settings (see Section 11.6).

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
Hukseflux Pyranometer SR30	Modbus RTU	registers 2 to 7	R1C1_1: Global Irradiance Compensated (W/m²) R1C1_2: Global Irradiance Uncompensated (W/m²) R1C1_3: Internal Temperature (°C)	serial settings (default 9600, 8N2)
EKO MS-60M	Modbus RTU	registers 19 to 24	R1C1_1: Measuring Voltage (mv) R1C1_2: Global Irradiance (W/m²) R1C1_3: Internal Temperature (°C)	serial settings (default 9600, 8N2)
EKO MS-80M	Modbus RTU	registers 19 to 24	R1C1_1: Measuring Voltage (mv) R1C1_2: Global Irradiance (W/m²) R1C1_3: Internal Temperature (°C)	serial settings (default 9600, 8N2)
EKO MS-80S	Modbus RTU	registers 2, 3, 8, 9, 14-17 and 20-25	R1C1_1: GHI (W/m²) R1C1_2: Temperature Pt100 (°C) R1C1_3: Angle of Inclination X R1C1_4: Angle of Inclination Y R1C1_5: Analog Voltage (mV) R1C1_6: Temperature (°C) R1C1_7: Humidity (%)	serial settings
EKO MS-90+	Modbus RTU	registers 4-7, 12-13, 22-23 and 28-29	R1C1_1: GHI MS-80S (W/m²) R1C1_2: DNI MS-90 (W/m²) R1C1_3: DHI calculated (W/m²) R1C1_4: Humidity MS-80S (%) R1C1_5: Temperature MS-80S (°C) R1C1_6: Elevation (°) R1C1_7: Azimuth (°)	serial settings, MS-90 sensitivity configured in C-Box
EKO M-Box	Modbus RTU	registers 19 to 24	R1C1_1: Measuring Voltage (mv) R1C1_2: Global Irradiance (W/m²) R1C1_3: Internal Temperature (°C)	serial settings (default 9600, 8N2)
EKO SMP10	Modbus RTU	registers 5 to 10	R1C1_1: Solar Irradiance (W/m²) R1C1_2: Solar Irradiance Long (W/m²) R1C1_3: Temperature (°C)	serial settings (default 19200, 8E1)[10]

Table 10.19: Data request for RS485 pyranometer

10.12.2   Delta-T Sunshine SPN 1

The pyranometer Delta-T Sunshine SPN 1 measures global horizontal and diffuse irradiation in W/m². It provides 2 analog voltage outputs (Ax) for global and diffuse irradiation, and 1 digital output (Dx) for sunshine duration.

Additionally, Meteo-42 estimates the direct normal irradiation based on the values of global horizontal and diffuse irradiation according to the general formula: Global Horizontal Irradiation = Diffuse Horizontal Irradiation + Direct Normal Irradiation * cos(θ), where θ is the solar zenith angle

The order number for Delta-T Sunshine SPN 1 is S65100.

> **Important**
>
> In order to estimate direct normal irradiation (DNI) and sun status, latitude and longitude of the measurement station have to be entered in the System → Administration menu (see also Section 4.2).
> If any estimated values should be included in the CSV statistics file, the values have to be selected in the Data → Statistics menu under *Select statistics* (see also Section 6.3.1).

> **Note**
>
> For technical details and electrical characteristics of sensors, refer to the data sheets, which can be downloaded from the Ammonit website (`http://www.ammonit.com/`).

10.12.3   Pyrheliometers

Pyrheliometers are used to measure the direct irradiance emitted by the sun in a 5 degree angle. The sensors have to be connected to the analog voltage channels (Ax) of Meteo-42.

The output signal (U) from the pyrheliometer is proportional to the solar irradiance (E) in W/m².

$$E_{[W/m²]} = \frac{U_{[\mu V]}}{Sensitivity_{[\mu V/[W/m²]]}}$$

Equation 10.11: Calculation of Direct Solar Irradiation (E)

`Sensitivity` is an internal parameter of the sensor, which is important to calculate the irradiation in W/m². The value is given in the calibration certificate of the sensor.

Meteo-42 indicates for pyrheliometers direct normal irradiation. Additionally, the data logger estimates DNI * cos(θ) and sun status based on the recorded values for direct normal irradiation. In order to estimate sun status and DNI * cos(θ), latitude and longitude of the measurement station have to be entered in the System → Administration menu (see also Section 4.2)

The sensor often comes with built-in Pt100 sensor and thermistor. The Pt100 sensor can be connected to the current source (see Section 11.4) of Meteo-42.

If the built-in Pt100 sensor should be connected to Meteo-42, pyrheliometer and Pt100 sensor have to be configured separately in the *Sensor Helper*: Pyrheliometer via sensor type *Solar Sensors* and Pt100 via sensor type *Hygro/Thermo*.

---

[10]SmartExplorer software - Kipp & Zonen (`https://www.kippzonen.com/Download-Center/Downloads-per-category`).

> **!** **Important**
> Do not connect the thermistor to Meteo-42!

Sensor	Order-No
EKO MS-56	S64210
Kipp & Zonen CPH1	S62210

Table 10.20: Pyrheliometers

> **!** **Important**
> In order to estimate sun status and direct normal irradiation [DNI * cos(θ)], latitude and longitude of the measurement station have to be entered or acquired with a GPS device in the System → Administration menu (see also Section 4.2).
> If any estimated values should be included in the CSV statistics file, the values have to be selected in the Data → Statistics menu under *Select statistics* (see also Section 6.3.1).

> **Note**
> For technical details and electrical characteristics of sensors, refer to the data sheets, which can be downloaded from the Ammonit website (`http://www.ammonit.com/`).

10.12.4   Sunshine Duration Sensors

Sunshine duration sensors indicate the sunshine status as defined by the WMO (sunshine = irradiation exceeds the level of 120 W/m²). The sensor measures the irradiation and switches the output voltage high or low to indicate sunny or not sunny conditions.

Sunshine duration sensors, e.g. Kipp & Zonen CSD 3, have to be connected to analog voltage channels (Ax). If direct irradiation should be measured, connect this output also to another analog voltage channel (Ax). Refer to Figure 13.2 for the connection diagram.

The output signal (V) indicates sunshine or no sunshine. Additionally, the calculated direct irradiation can be measured. The output signal (mV) for direct irradiation is proportional to the direct irradiation (W/m²).

$$E_{[W/m^2]} = \frac{U_{[\mu V]}}{Sensitivity_{[\mu V/[W/m^2]]}}$$

Equation 10.12: Calculation of Solar Irradiation (E)

`Sensitivity` is an internal parameter of the sensor, which is important to calculate the radiation in W/m². The value is given in the calibration certificate of the sensor.

Meteo-42 saves all electrically measured values in V to the source data (Section 6.7). The calculated values for direct irradiation are saved in `W/m²` to the CSV file (see Section 6.6.1).

Sensor	Order-No
Kipp & Zonen CSD 3	S61910

Table 10.21: Sunshine Duration Sensors

Meteo-42 saves all electrically measured values to the source data (Section 6.7). The calculated direct irradiation in W/m² and the current sun status are saved to the CSV file (see Section 6.6.1).

> 📎 **Note**
> The CSV file contains for all active channels the electrical values according to the chosen statistical interval.

10.12.5 Solar Trackers

EKO Instruments high precision STR Sun Tracker provide high tracking reliability, enhanced functionality with fully automated set up procedure through a built in GPS receiver. The compact sun trackers are suited to support all kinds of measurement sensors to measure Global, Diffuse and Direct Radiation.

EKO Sun Trackers must be connected to an RS485 client port by means of an RS232 to RS485 adapter.

Date, time and location are acquired from the sensor by means of commands TM and LO. If the data logger values are significantly different, Meteo-42 will get automatically synchronized and the changes will be logged in the logbook. This synchronization happens in two cases: when configuring the sensor and, if RS485 sensors check is active, on every CECS reboot. If you want to trigger the synchronisation routine, you can access the configured EKO Sun Tracker for editing and save it again without changing the configuration.

According to the configured polling rate, which is 1 s per default, the calculated angle according to the GPS information and the current angle are requested and recorded.

> ⚠️ **Important**
> Make sure that no other method to synchronize date and time is active (Section 4.2).

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
EKO Sun Tracker	EKO	Commands MR and CR	R1C1_1: Azimuth calculated (CR) R1C1_2: Altitude calculated (CR) R1C2_1: Azimuth (MR) R1C2_2: Altitude (MR)	serial settings

Table 10.22: Data request for RS485 Sun Tracker

10.12.6 Rotating Shadowband Irradiometer

Measure Global, Diffuse and Direct Radiation from two LiCor sensors as well as the temperature. The average values from both sensors are also calculated.

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
CSPS RSI	Modbus RTU	Registers 0 to 20	R1C1_1: Global Horizontal Irradiance (GHI) R1C1_2: Difuse Horizontal Irradiance (DHI) R1C1_3: Direct Normal Irradiance (DNI) R1C1_4: Temperature R1C1_5: GHI LiCor 1 R1C1_6: DHI LiCor 1 R1C1_7: DNI LiCor 1 R1C1_8: GHI LiCor 2 R1C1_9: DHI LiCor 2 R1C1_10: DNI LiCor 2	serial settings

Table 10.23: Configuration of RS485 CSPS RSI

10.12.7 Reference Cell

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration	
Datasol MET Reference Cell	Modbus RTU	registers 96 to 108	RxCy_1: Solar irradiance Avg. (W/m²) RxCy_2: Solar irradiance 1 (W/m²) RxCy_3: Solar irradiance 2 (W/m²) RxCy_4: Wind Speed (m/s) RxCy_5: Temperature Air (°C) RxCy_6: Temperature Panel (°C)	serial settings, address	

Table 10.24: Configuration details for RS485 Reference Cell

10.13 Precipitation Sensors

10.13.1 Rain Gauge

Precipitation sensors are designed to measure the quantity and intensity of precipitation striking the earth's surface. Precipitation is best measured with a tipping bucket device. Precipitation, collected over a surface of 200 cm², is moved through an inflow sieve into a tipping bucket. When the bucket has collected 2 cm³ = 0.1 mm of precipitation, it tips over. This measurement principle is based on the "Guide to Meteorological Instruments No 8, WMO". Precipitation sensors are typically applied for meteorological assessments.

Precipitation sensors, e.g. Young precipitation sensor, have to connected to counter channels (Cx). Refer to Figure 13.10 for the connection diagram.

The output signal (I) from the sensor is proportional to the precipitation quantity (N).

$$N_{\mu m} = slope_{[\mu m/pulse]} \cdot I_{[pulse]}$$

Equation 10.13: Calculation of Precipitation Quantity (N)

$Slope$ is an internal parameter of the sensor, which is important to calculate the precipitation quantity according to the measurement rate set in the sensor configuration. The value is pre-configured in the *Sensor Helper* (see Section 5.1.2).

Sensor	Order-No	Slope	Offset
Thies Precipitation Sensor	S71100H	0.1 mm/I	0 mm
Young Precipitation Sensor	S73100 / S73100H	0.1 mm/I	0 mm

Table 10.25: Parameters for the configuration of precipitation sensors

---

! **Important**

If you install calibrated sensors, enter the values given in the calibration protocol.

Meteo-42 saves all electrically measured values in `Pulse [I]` to the source data (Section 6.7). The calculated values are saved to the CSV file (see Section 6.6.1).

Note

The CSV file also contains for all active channels the electrical values according to the chosen statistical interval.

! **Important**

If you plan to install precipitation sensor Thies or Young, you have to implement an accessory module! Refer to the data sheet and contact Ammonit for further details.

Note

For technical details and electrical characteristics of sensors, refer to the data sheets, which can be downloaded from the Ammonit website (`http://www.ammonit.com/`).

10.13.2 Laser Precipitation Monitors

Laser precipitation monitors measure various precipitation details, i.e. intensity of total, liquid and solid precipitation as well as the precipitation amount and the SYNOP parameter.

Thies Laser Precipitation Monitor (LPM) sensor performs a new calculation every minute, after the first 5 minutes of operation. Meteo-42 requests data with a 1 s rate in order to guarantee a valid measurement per minute with a working sensor.

Thies LPM has to be connected to RS485 client port.

Model	Protocol	Description	Channels / Evaluated Data	Required Configura-tion
Precipitation Monitor Thies Laser	Thies	Telegram 8	RxCy_1: SYNOP RxCy_2: Intensity total precipitation RxCy_3: Intensity liquid precipitation RxCy_4: Intensity solid precipitation RxCy_5: Precipitation amount	Serial settings, address, half duplex mode, no automatic telegram sending

Table 10.26: Configuration of RS485 Laser Precipitation Monitor Sensors

---

Note
SYNOP (surface synoptic observations) is a numerical code used for reporting weather observations, also called FM-12 by the World Meteorological Organization. Refer to Thies LPM sensor's manual for more information.

10.14 Multifunction Transducer, Power Meters and other Electrical Measurement Devices

Meteo-42 can be used to connect power meters, multifunction transducers or other electrical measurement devices, e.g. for power curve measurement. The devices are connected to a Meteo-42 RS485 client port (see Section 11.6).

Model	Protocol	Description	Channels and Evaluated data	Sensor's previous configura-tion needed	
Sineax CAM (see Section 10.14.1)	Modbus RTU	Actual values (registers 40100, 40118 to 40122, 40134 to 40142)	RxCy_1: Average phase Voltage U RxCy_2: Current I1 RxCy_3: Current I2 RxCy_4: Current I3 RxCy_5: Real Power P1 RxCy_6: Real Power P2 RxCy_7: Real Power P3 RxCy_8: Total Real Power P RxCy_9: Total Reactive Power Q	Serial settings, address	
Iskra MT540 (see Iskra manuals download (http://www.iskrasistemi.si/download/manuals/))	Modbus RTU	Normalized actual values (registers 804, 809 to 811, 816 to 819, 823)	RxCy_1: Average phase Voltage U RxCy_2: Current I1 RxCy_3: Current I2 RxCy_4: Current I3 RxCy_5: Real Power P1 RxCy_6: Real Power P2 RxCy_7: Real Power P3 RxCy_8: Total Real Power P RxCy_9: Total Reactive Power Q	Serial settings, address	

Model	Protocol	Description	Channels and Evaluated data	Sensor's previous configuration needed	
GD2000 Multi-function Power Analyzer	Modbus RTU	registers 56 to 63	RxCy_1: Active power RxCy_2: Power factor RxCy_3: Reactive power RxCy_4: Apparent power	Serial settings (19200 bps), address	

10.14.1   Sineax CAM Measuring Unit

Sineax CAM is a universal measuring unit for heavy current variables. Actual measurements for average phase voltage, current, real and reactive power are requested from this sensor. For more information refer to Gossen Metrawatt Sineax CAM documentation (`http://www.gossenmetrawatt.com/english/produkte/sineaxcam.htm#`).

10.15   Remote Sensing

10.15.1   ZephIR 300 Lidar

Meteo-42 can acquire ZephIR 300 live and averaged wind data measurements and include them in the measurement CSV files or share them over SCADA. You can select 'ZephIR 300' for averaged data or 'ZephIR 300 Live' for live data from the sensors list under 'Other Sensor'.

Before adding a ZephIR 300 to the list, it must be powered and connected to an RS485 client port. The configured heights will be automatically requested and for each height, an RS485 channel (RxCy) will be configured. If both live and averaged data are requested, a maximum of 4 heights can be configured at ZephIR 300.

Note

For more information about how to electrically connect ZephIR 300 and Meteo-42 please contact us.

Important

Measurement polling interval for averaged data is 1 minute per default. To ensure a valid measurement per interval it must always be lower than the statistics time interval (see Section 6.3).

Model	Protocol	Description	Channels / Evaluated Data	Required Configura-tion
ZephIR 300	Modbus RTU	Averaged wind data per height (registers 4096-4103, 4116-4121 and 4150-4153)	RxCy_1: Reference RxCy_2: Wind Speed RxCy_3: Vertical Wind Speed RxCy_4: Wind Direction RxCy_5: Temperature RxCy_6: Air Pressure RxCy_7: Humidity RxCy_8: Wind Speed Max RxCy_9: TI	Serial settings, address
ZephIR 300 Live	Modbus RTU	Live wind data per height (registers 1-7 and 21-26)	RxCy_1: Reference RxCy_2: Wind Speed RxCy_3: Vertical Wind Speed RxCy_4: Wind Direction RxCy_5: Temperature RxCy_6: Air Pressure RxCy_7: Humidity	Serial settings, address

Table 10.27: Requested values

10.16   Bats Detection

10.16.1   Song Meter SM3BAT/SM4BAT

It is possible to connect the Wildlife Acustics Song Meter SM3BAT or SM4BAT FS to an RS485 client interface. This allows a real time monitoring of bat passes and pulses, as well as of the status of the SM3BAT/SM4BAT flash memory card and power supply.

Note

An external RS232 to RS485 adapter is required.

Model	Protocol	Description	Channels / Evaluated Data
SM3BAT	ASCII[8]	Protocol compatible with Thies	RxCy_1: Internal Voltage (V) RxCy_2: Internal Temperature (°C) RxCy_3: Flash memory level (%) RxCy_4: Bat passes Mic0 RxCy_5: Bat pulses Mic0 RxCy_6: Bat passes Mic1 RxCy_7: Bat pulses Mic1
SM4BAT FS	ASCII[8]	Protocol compatible with Thies	RxCy_1: Internal Voltage (V) RxCy_2: Internal Temperature (°C) RxCy_3: Flash memory level (%) RxCy_4: Bat passes RxCy_5: Bat pulses

Table 10.28: Requested values

Scheduling: The SM3BAT can be programmed to monitor during specific periods of the day, and "sleep" during other parts of the day to conserve power. When the SM3BAT is sleeping, it will not respond to Meteo-42 messages. Thus, the SM3BAT needs to be programmed when to be monitoring for bats e.g. 24 hours or just at night, etc..

Recording: The SM3BAT normally records the ultrasonic echolocation audio data on up to 4 SDHC or SDXC flash cards. Full spectrum recordings can typically consume 1-2GB of card space per night depending on bat activity. The flash cards will eventually fill up. Normally, the SM3BAT would shut down if it is no longer able to make recordings. However, for this application, it is desirable to continue monitoring, updating bat counters, and responding to requests. If the interface to Meteo-42 is detected, then the SM3BAT will continue monitoring for bats even if the flash cards are full, but no new bat activity data will be recorded. This condition is indicated by the flash card 100% full indication in the response messages.

Bat Activity: Echolocating bats typically produce individual ultrasonic "pulses" continuously while they fly for navigation, avoiding obstacles, and hunting for food. The frequencies, bandwidth and duration of pulses vary from species to species and with the functional needs of the bat at the time (e.g. many bats will increase bandwidth and decrease duration as they close in on prey). The SM3BAT can be configured to recognize pulses that may be tuned to specific bats in a given area. This includes specifying the minimum and maximum frequencies and minimum and maximum durations of a pulse. These parameters can be tuned to recognize echolocating bats while avoiding false positives from other ultrasonic noise sources such as wind, rain, and insects. The optimum parameters will depend on the specific bats and insects likely occurring in a given area. A "bat pass" refers to a series of pulses recorded as a bat flies by the microphone. Additional parameters in SM3BAT help define what a bat pass is including the maximum trigger duration and the maximum time between pulses (the trigger window). A bat pass begins with the first detected pulse, and ends when either no pulses have been detected after the maximum time between pulses has occurred, or when the maximum trigger duration has been reached. SM3BAT will not count a bat pass unless it contains at least two pulses. In this way, the SM3BAT can count passes and pulses detected on an ongoing basis and report these counts to the customer equipment.

10.17   Lightning Detector

10.17.1   SG1000 Lightning Detector

The SkyScan SG1000 lightning detector can detect the presence of lightning or thunderstorm activity occurring within 64 km of your location. It detects the characteristic electromagnetic emissions from individual lightning strokes and uses patented technology to determine the distance to the detected stroke. The distances are indicated in four ranges: 0-5 km; 5-13 km; 13-32 km; and 32-64 km. This allows you to track the approach of dangerous storm activity.

Note
More than one range can be detected simultaneously.

SG1000 may also identify certain types of especially strong storms. These storms can produce dangerous winds, heavy rains or tornadoes. When SG1000 detects lightning patterns indicating the presence of these storms, it activates the Severe thunderstorm alarm.

Four digital signals with complementary information are supplied by this lightning detector: Alarm, Error, Battery power and Baseline (see Table 10.29).

Signal	Description
0-5km	Distance range 0-5 km
5-13km	Distance range 5-13 km
13-32km	Distance range 13-32 km
32-64km	Distance range 32-64 km
Severe	Severe thunderstrom alarm
Alarm	Lightning activity has moved within range
Error	There is a system error that needs to be addressed (error code is indicated by the status LED on the unit)
Battery power	Mains power has been interrupted and system is operating on battery backup
Baseline	Ensures that there is activity on the digital output (i.e. can be used as a heartbeat to confirm system is up-and-running)

Table 10.29: SG1000 status signals

! **Important**

If the period of the digital output signal of the sensor is changed, it is necessary to configure the measurement rate at Meteo-42 accordingly. The period of the digital output signal can be set to a value between 2.0 and 4.8 seconds, being the default value 2.0. The measurement rate configured at the data logger for this sensor must be at least twice as long as the period duration of the digital output, in order to guarantee that a complete period is catched. The default measurement rate is 5 seconds.

10.18   Soil Water Content

Measuring the water content, electrical conductivity (EC), and temperature of soil is a main topic for any agricultural project. Meteo-42 supports several volumetric water content (VWC) sensors, connected to an analog channel or to an RS485 client interface.

Sensor
Decagon EC-20, EC-10, EC-5 Soil Moisture Sensors

Table 10.30: Soil Moisture Sensors

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
Campbell Reflectometer CS650	SDI-12	D0	RxCy_1: Volumetric water content RxCy_2: Electrical conductivity	External module needed (address, 19200 8N1, 120Ω termination). See SDI-12.

Table 10.31: RS485 Soil Water Content Sensors

10.19   Soiling Measurement

Soiling is the accumulation of dust, dirt and other contaminants on the surfaces of photovoltaic (PV) modules. The amount of dust is extremely dependent on the location of the PV power plant, e.g. in a desert valley with sand storms. In the absence of significant rain events or regular cleaning, production losses due to soiling effects increase. Measuring soiling effects provides important details about the PV power plant production, e.g. how much dust can be on the modules before any problem occurs and how the dust affects transparency and efficiency of the modules.

10.19.1   Atonometrics RDE300

Soiling and Irradiance Measurement Systems with the Atonometrics RDE300 Series measurement and control unit collect critical data for evaluating PV array performance. The systems can be used at operating PV power plants and pre-construction site survey locations.

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
Atonometrics RDE300	Modbus RTU		R1C1_1: Global Irradiance PV1 R1C1_2: Analog Current PV1 R1C1_3: Temperature PV1 R1C1_4: Active Power PV1 R1C2_1: Global Irradiance PV2 R1C2_2: Analog Current PV2 R1C2_3: Temperature PV2 R1C2_4: Active Power PV2 R1C2_5: Soiling Ratio R1C2_6: Soiling Ratio Isc R1C2_7: Soiling Ratio Pmax R1C3_1: Event Code R1C4_1: Status Fluid R1C5_1: Status Pump	Serial settings, address

Table 10.32: Data request for RS485 Soiling Measurement

10.19.2   Ammonit Soiling Measurement Kit SD2100

The temperature-corrected short-circuit current of a clean PV module is proportional to the irradiance. After measuring short-circuit current and temperature of the PV module, the effective solar irradiance (E_{eff}) can be determined (see also Section 5.3.1.7).

The Ammonit soiling measurement kit compares the estimated effective irradiance of a naturally-soiled PV module with a clean reference PV module. The measurement station determines the short-circuit current output as well as the module surface temperature from the backside of both soiled and clean PV modules. Based on these measurements the effective irradiance can be determined for each module.

Formula

Effective irradiance   ▼

Effective irradiance

Analog Current Isc

SD2100 Analog Current Isc-soiled   ▼

Temperature

SD2100 Temperature soiled   ▼

Short Circuit Current Reference (A)

3.07

Reference Condition Irradiance (W/m²)

1000

Surface Temperature Reference (°C)

25

Temperature Coeficient at Isc (%)

0.081

Label

Effective Irradiance soiled

Installation height (m)

0.0

Save

Delete

Figure 10.1: Ammonit Soiling Measurement Kit Effective Irradiance Soiled PV

Two standard metrics for the effects of soiling on energy production are available at the Evaluation Helper. The Soiling Ratio Isc index (see also Section 5.3.1.8), which equals 1 when both modules are clean, and the Soiling Loss Index (see also Section 5.3.1.9), expressed as a percentage.

The Ammonit soiling measurement kit includes the following components: Ammonit I-U Conversion Box, Surface Temperature Sensor and a 30 W Photovoltaic (PV) Module. The reference constants for the PV-module must be introduced for the effective irradiance and soiling ratio Isc formulas:

- Isc0: Short Circuit Current (A)
- G0: Reference Condition Irradiance (W/m²)
- T0: Surface Temperature (°C)
- TK Isc: Temperature Coeficient at Isc (%)

Configure an Ampere meter from the sensors list for each of the I-U Conversion Boxes. In order to achieve best match to the output voltage, the appropriate voltage range must be selected. If you are using CM8281, with a shunt resistor of 50 mΩ, you must select the ±1.0 V range.

For the surface temperature measurement, a PT100 is used.

10.19.3   Kipp & Zonen DustIQ

The Kipp & Zonen DustIQ is an instrument meant to measure and report the transmission loss (TL) and soiling ratio (SR) caused by light being blocked and reflected and subsequently not getting through the glass of the panel due to soiling of the panel.

> **Important**
> A local dust calibration of the device is required. The DustIQ leaves the factory calibrated for Arizona Test Dust (ATD) but it is very unlikely that the local dust composition matches this ATD and it is therefore advised to train each DustIQ for the local dust composition (see `https://www.kippzonen.com/` for more information).

Before and after the calibration process, Ammonit recommends to read some relevant Modbus registers to record this values in the data logger logbook. The RS485 Serial Interface must be used: register 2 (software version), register 34 (device status flags), register 35 (calibration flags), register 36 (current sensitivity value).

Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
DustIQ	Modbus RTU	registers 20, 21, 24, 25	R1C1_1: Soiling Ratio 1 (%) R1C1_2: Transmission Loss 1 (%) R1C1_3: Soiling Ratio 2 (%) R1C1_4: Transmission Loss 2 (%)	Serial settings, address
DustIQ & temperature	Modbus RTU	registers 20, 21, 24, 25, 31	R1C1_1: Soiling Ratio 1 (%) R1C1_2: Transmission Loss 1 (%) R1C1_3: Soiling Ratio 2 (%) R1C1_4: Transmission Loss 2 (%) R1C1_5: Temperature (°C)	Serial settings, address

Table 10.33: Data request for DustIQ RS485 Soiling Measurement

10.20   Other RS485 Sensors

In addition to meteorological sensors, further RS485-compatible sensors or devices can be connected to an RS485 client bus (see Section 11.6). The following list includes some sensors and their configuration.

10.20.1   RS485 Multiplexer

Sensor type	Model	Protocol	Description	Channels / Evaluated Data	Required Configuration
Multi Channel Voltage Module	Gantner e.bloxx A1	Modbus RTU	registers 17 to 32	RxCy_1: Analog Voltage AI1 RxCy_2: Analog Voltage AI2 RxCy_3: Analog Voltage AI3 RxCy_4: Analog Voltage AI4 RxCy_5: Analog Voltage AI5 RxCy_6: Analog Voltage AI6 RxCy_7: Analog Voltage AI7 RxCy_8: Analog Voltage AI8	Serial settings, address, protocol, channels definition
Multi Channel Voltage Module	Gantner e.bloxx A3-1	Modbus RTU	registers 17 to 26	RxCy_1: Analog Voltage 1 RxCy_2: Analog Voltage 2 RxCy_3: Analog Voltage 3 RxCy_4: Analog Voltage 4 RxCy_5: Digital status	Serial settings, address, protocol, channels definition
Multi Channel Digital Module	Gantner e.bloxx D1-1	Modbus RTU	registers 0 to 7	RxCy_1: Digital status 1 RxCy_2: Digital status 2 RxCy_3: Digital status 3 RxCy_4: Digital status 4 RxCy_5: Digital status 5 RxCy_6: Digital status 6 RxCy_7: Digital status 7 RxCy_8: Digital status 8	Serial settings, address, protocol, channels definition
Power system monitor	SYCBA Monitor	Modbus RTU	registers 0 to 6	RxCy_1: Analog Voltage Load RxCy_2: Analog Current Load1 RxCy_3: Analog Current Load2 RxCy_4: Analog Current Load3 RxCy_5: Analog Current Load4 RxCy_6: Analog Voltage Charge	Serial settings (default 9600 8N1), address (default 1)

Table 10.34: Configuration details for other RS485 Sensors / Devices

10.20.2   Configuring generic Modbus RTU sensors

It is possible to connect up to 8 Modbus RTU sensors to RS485 client port (see Section 11.6). They can be combined with other Modbus RTU sensors implemented in Meteo-42 like Lufft sensors, but not with other protocols like Thies or Gill.

Sensor type

Other Sensor   ▼

Sensor

Modbus RTU   ▼

Installation height (m)

0.0   ⬍

Label

Serial number

Evaluation type

Other Evaluation   ▼

Unit

Serial port

R1   ▼

RS485 Channel

R1C1   ▼

Sensor ID (1..247)

1   ⬍

Data Type:

ushort (16-bit)   ▼

Word Endianness:

Big (most significant first)   ▼

Modbus start register (0..65535)

0   ⬍

Modbus register quantity (1..20)

1   ⬍

Modbus function code (3..4)

4   ⬍

Serial settings

RS485 speed

38400   ▼

RS485 data format

8N1   ▼

☐ Enable biasing

Measurement period

1 s   ▼

[Add more]

[Finish]

Figure 10.2: Generic Modbus RTU sensor configuration

The maximum quantity of consecutive registers that can be read from each sensor is 20. It is necessary to specify the first register (PDU addressing, first reference is 0) and the amount of registers. The function code is selectable between '03' (read holding registers) and '04' (read input registers).

Read registers will be evaluated according to the selected data type (see Table 10.35). If a 32-bit data type is selected, each pair of registers will be merged. For each register pair (if 32-bit data type selected) or each individual register (if 16-bit data type selected), an evaluation is generated. E.g. reading 10 registers on RS485 channel R1C1 will generate 10 evaluations if a 16-bit data type is selected (R1C1_1 to R1C1_10) and 5 evaluations if a 32-bit data type is selected (R1C1_1 to R1C1_5).

The resulting evaluations have no unit or evaluation type. You can create a new evaluation on top of each original evaluation by means of the linear equation from the Evaluation Helper (see Section 5.3.1). Finally, it is necessary to properly select the evaluations to be included in the CSV statistics files in the Data → Statistics(see Figure 6.4).

Data Type	Description
short (16-bit)	16-bit integer
ushort (16-bit)	16-bit unsigned integer
long (32-bit)	32-bit integer
ulong (32-bit)	32-bit unsigned integer
float (IEEE754 32-bit)	32-bit single precision binary floating point
32-bit unsigned (8-bit exp)	8-bit signed decade exponent, 24-bit uint
32-bit signed (8-bit exp)	8-bit signed decade exponent, 24-bit signed int

Table 10.35: Data types available

Chapter 11

Channels

The previous chapter described various sensors which can be connected to Meteo-42. The sensors have to be connected to the corresponding channel. Depending on the data logger type, Meteo-42 offers up to 45 channels. Meteo-42 provides connectors for the following measurands and signals:

• Analog Voltage (DC)
• Pulse Counter / Period
• Digital / Serial / Status
• RS485 (client)

Furthermore, the data logger Meteo-42 provides a precision 5V voltage reference and a high precision Current Source to supply passive sensors.

See also Section 1.3.

11.1   Connecting Sensors to Analog Voltage Channels

Meteo-42 is equipped with up to 14 differential voltage inputs, depending on the logger's type. Generally, there are two benefits from differential inputs:

1. Reduced impact of perturbances and interferences on the signal lines,

2. Helps to avoid ground loops.

You can find the analog voltage channels (Ax, Bx) on the lower left side of the measuring unit (see Section 1.2). For example, analog wind vanes, barometric pressure sensors or pyranometers with analog voltage output can be connected to analog voltage channels of Meteo-42.

The analog voltage ranges comprise the following voltage ranges:

• ±0.1 V,
• ±1 V,
• ±10 V,
• 0.1 V to 0.3 V.

Note: The voltage range 0.1 V to 0.3 V is a high resolution range, especially designed for use with passive Pt1000 temperature sensors in conjunction with the current source of Meteo-42.

Input voltages which are below the configured range will be stored as "UF" (underflow) in the source data, and above as "OF" (overflow). These out of bounds measurements will be excluded from statistics.

For further electrical details refer to Section 12.2.

Channel	Meteo-42M	Meteo-42L	Meteo-42A
Analog Voltage Channels	8	14	14

Table 11.1: Analog Channels of Meteo-42

11.2   Connecting Sensors to Counter / Period Channels

The counter channels (C) are located next to the analog voltage channels (see Section 1.2). For example, anemometers and precipitation sensors can be connected to counter channels. For electrical details refer to Section 12.2.

All counter channels can also be used as period measurement channels (P). This is useful for low frequency signals. The channel names are P1 to P12 respectively.

Channel	Meteo-42M	Meteo-42L	Meteo-42A
Counter Channels	8	12	2
Period measurements	8	12	2

Table 11.2: Counter / Period Channels of Meteo-42

11.2.1   Period measurement

Meteo-42 can detect rising and falling edges of a signal connected to P channels. Three different measurement options are implemented: period, pulse width and duty cycle. These can be configured as `Other Sensor` in the `Sensor Helper` (see Section 5.1.2). If you want to use the period measurement to connect an anemometer, you must select the `Generic Anemometer PM` form the list of sensors.

For the period-related measurements, the first two or three edges in the measurement interval are registered. No averaging is applied for a measurement interval.

! Important
The measurement rate must be at least twice as long as the period of the measured signal. If the measurement rate is too short, there might not be enough edges per measurement interval.

Period: The Period is the duration of time of one cycle in a repeating event, so the Period is the reciprocal of the frequency. For the Period measurement, a total of three edges is needed.

Pulse Width: The Pulse Width or pulse duration is the time between a rising and a falling edge. At least one rising and one falling edge are needed for this measurement.

Duty Cycle: The Duty Cycle is the percentage of the ratio of the pulse width to the total period of the waveform. In this case, at least three edges are needed for the measurement.

Period, Pulse Width and Duty Cycle are illustraded in Figure 11.1.
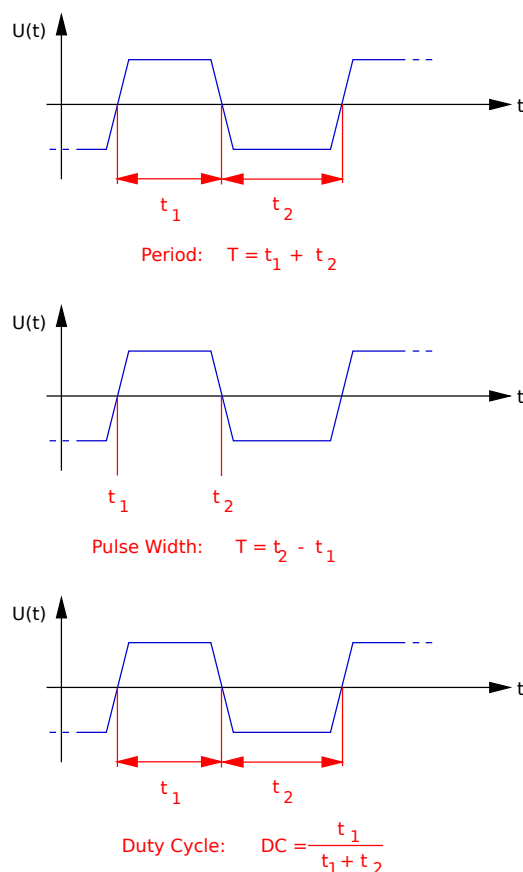
Figure 11.1: Illustration of Period, Pulse Width and Duty Cycle.

11.3   Connecting Sensors to Digital Channels

To use digital serial wind vanes Meteo-42 includes up to seven Digital Channels (D). These Digital Channels are located in the middle of the connection panel of the data logger. For further electrical details refer to Section 12.2.

Channel	Meteo-42M	Meteo-42L	Meteo-42A
Digital Channels	4	7	4

Table 11.3: Digital Channels of Meteo-42

11.3.1   Functionality Check of Clock Output

To set up a proper digital connection between the sensor and Meteo-42 it is sometimes necessary to verify the functionality of the Digital Clock Output. The Digital Clock Output sends a short data sequence to the sensor, the sensor should respond with a data sequence on the IN line of the serial interface.

To request data from the sensor the Digital Clock Output must provide voltage levels that can be detected (understood) by the sensor. To simply test the functionality of the Digital Clock Output with a Multimeter, Meteo-42 provides a software driven test procedure. To perform the CLK-Line Output Test do the following:

- Disconnect the sensor from the data logger.
- Connect the data logger to the PC to configure it via web interface.

- Login into the data logger and follow the links Measurement → Channels
- Press the "Digital test" button below the sensor list.
- A tabular showing the Digital Channels available on this logger appears. The right columns of the table contain two buttons: "5 V" and "0 V" corresponding to each channel.

Channel	CLK 5 V	CLK 0 V
D1	5 V	0 V
D2	5 V	0 V
D3	5 V	0 V
D4	5 V	0 V
D5	5 V	0 V
D6	5 V	0 V
D7	5 V	0 V

Figure 11.2: Configuration Menu for CLK-Line Test in Meteo-42.

- Connect the multi meter between CLK output and GND of the Digital Channel you intend to check.
- **First step:** Press the button "5 V" to switch on the DC voltage of the Clock Output. There must be a voltage between 4 V and 5.6 V present at the Clock Output.
- **Second Step:** Add a resistor of 1 kΩ–1.2 kΩ in parallel to the multi meter (see figure Figure 11.3). Press the button "5 V" to switch on the DC voltage of the Clock Output. The voltage at the Clock Output *must not drop below 3 volts*.

Notes:

- The DC voltage output can be toggled between High- and Low-level via the two buttons "5 V" and "0 V"
- The test has limited timespan: After pressing the "Digital test" button and choosing the DC voltage level, the voltage level will remain only 10 seconds. To repeat the test, the button "5 V" has to be pressed again.

Test Result: If the voltage level drops below 3 volts, the CLK output of the data logger could be defective.
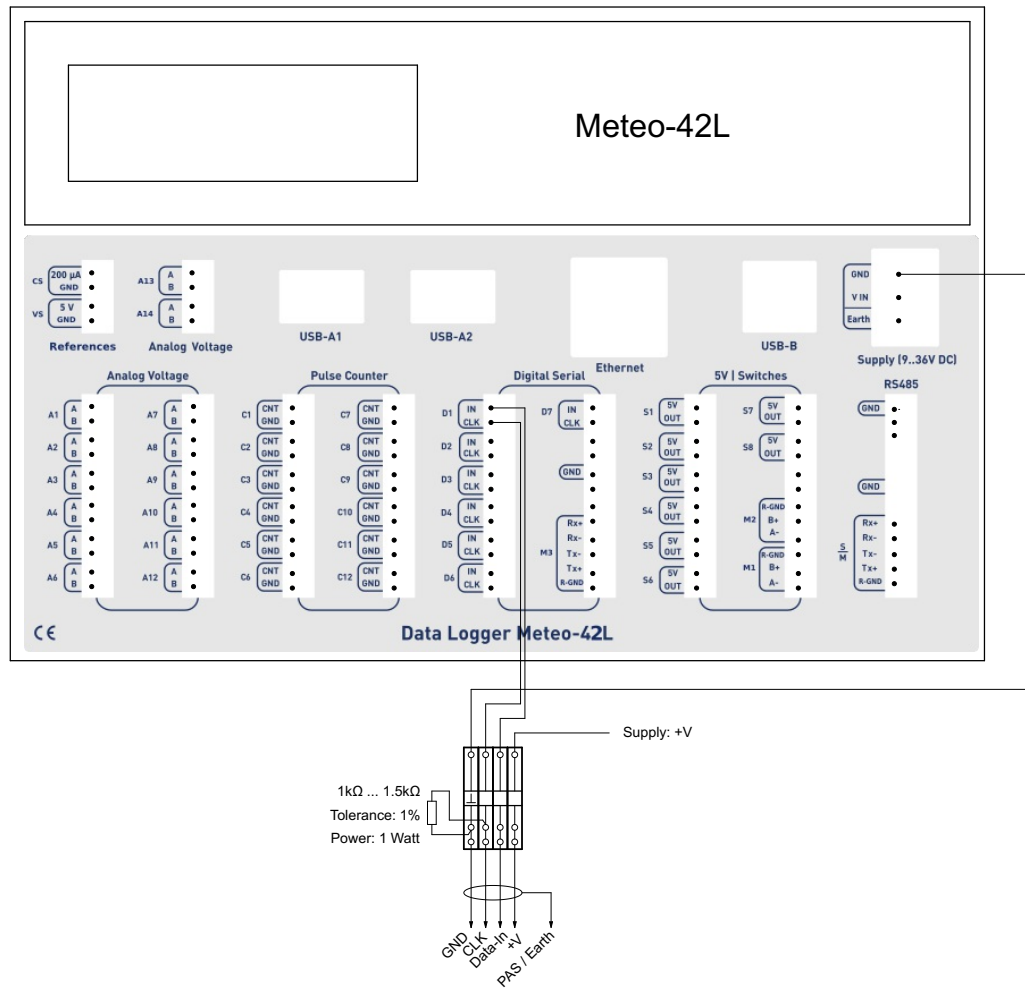
Figure 11.3: Setup for CLK-Line test of Serial Interface.

11.4 Connecting Sensors to Current Source

The current source (CS) is located in the upper left corner next to the analog current channels (see Section 1.2). All Meteo-42 data loggers are equipped with one current source. The purpose of this current source is to supply passive temperature sensors (PT100 or PT1000). The connected resistor should not exceed 10kΩ.

Single Pt100 and Pt1000 sensors as well as Pt100 sensors, which are for example implemented inside pyrheliometers can be connected to the current source of Meteo-42. For electrical details refer to Section 12.2.

Channel	Meteo-42M	Meteo-42L	Meteo-42A
Current Source Channels	1	1	1

Table 11.4: Current Source Channels of Meteo-42

📎 **Note**
For technical details and electrical characteristics of sensors, refer to the data sheets, which can be downloaded from the Ammonit website (http://www.ammonit.com/).

11.5 Connecting Sensors to Voltage Source

The voltage source (VS) is located in the upper left corner next to the analog current channels (see Section 1.2). All Meteo-42 data loggers are equipped with one voltage source. The purpose of the voltage source is to provide a 5V voltage for the potentiometer resistor in analog wind vanes. The maximum output current is 50mA.

Channel	Meteo-42M	Meteo-42L	Meteo-42A
Voltage Source Channels	1	1	1

Table 11.5: Voltage Source Channels of Meteo-42

11.6 Connecting Sensors to RS485 Client

Meteo-42 data loggers offer either two or three RS485 client terminals for bus connection of up to eight sensors with RS485 interface each. All RS485 interfaces of Meteo-42 provide galvanic separation for overvoltage protection of the data logger. This makes the optical repeater unneeded, which was necessary for Meteo-40. Furthermore, the RS485 CL1 and CL2 interfaces comprise an internal switchable biasing hardware, which can be activated via web interface. This makes an external resistor network or biasing module unnecessary.

The galvanic separation of the RS485 interfaces comprise a separate ground for all RS485 interfaces. This RS485-GND must be connected either with the signal ground of the sensor or with the Supply GND of the measurement system. Otherwise the data-signal are floating, which can lead to data loss. The figure below depicts the general concept for connecting the sensors to the half-duplex interfaces CL1 and CL2 of the Meteo-42.
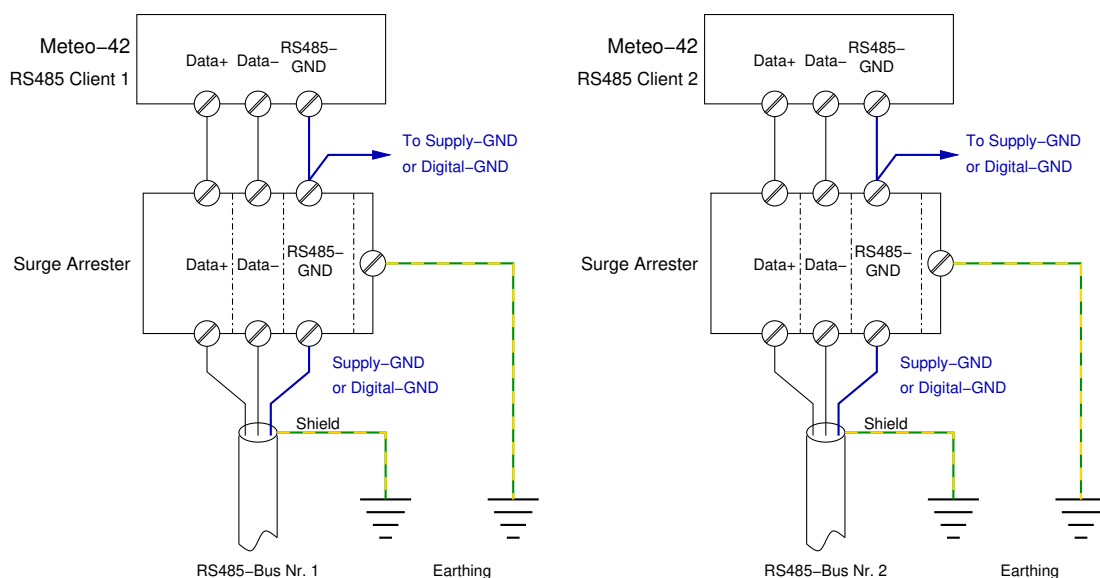

Figure 11.4: Electrical Connection Plan: RS485 client terminals of Meteo-42

For further electrical details of the RS485 interfaces of Meteo-42 refer to Section 12.2.

11.6.1   RS485-Bus: Notes on Termination and Biasing

11.6.1.1   RS485-Bus: Termination

The RS485 interfaces CL1, CL2 and CL3 are intended to connect the sensors to a data logger via a bus system. CL1 and CL2 are Half Duplex while CL3 provides a flexible RS485 interface that can either be used as Full Duplex or Half duplex.

The interfaces for RS485 Half Duplex consists of a cable with twisted pair lines for Data-Plus and Data-Minus (transmission line) and a signal ground. The signal ground can either be the supply ground of the sensor or a separate signal ground for digital interfaces of the sensor.

While the data logger is connected to the lower end of this transmission line the sensors are to be connected via stubs to the transmission line. Transmission line effects often present two problems in data communication networks: reflections and signal attenuation. To eliminate reflections from the end of the cable, it must be terminated at both ends with a resistor across the line (between Data-Plus and Data-Minus). Both ends must be terminated since the direction of propagation of the signals is bidirectional. In case of an RS485 twisted pair cable this termination is typically set to 120 Ohms.

11.6.1.2   RS485-Bus: Biasing networks

In RS485 networks, there are periods of time in which none of the drivers actively control the bus. In an RS485 bus system (master-slave network), this would correspond to times when the master is not transmitting and the slaves are no longer responding to a command. This state is also referred to as "tri-state mode".

During this time the terminating resistors collapse the differential bus voltage between Data+ and Data- to 0 V, which represents an undefined input level for many RS485 receivers. Given this undefined input, a receiver could output the wrong logic state. Bus biasing is one easy way to solve this problem.

The aim of biasing is to ensure that the RS485 line remains in a defined state when no devices are transmitting. Only a single pair of resistors is required to bias the entire network: a pull-up resistor to +5 V connected to the Data-Plus line and a pull-down resistor to ground connected to the Data-Minus line.

Meteo-42 provides on both Half-Duplex RS485 interfaces CL1 and CL2 an internal termination resistor of 120 Ohms. Furthermore, internal biasing is made with pull up and pull down resistors for these two RS485 interfaces. Biasing can be switched on and off in graphical user interface of the Meteo-42. It is recommended to switch biasing on when interfaces CL1 and/or CL2 are used.

The figure below depicts an example setup of a RS485 transmission line with stubs, termination on both ends and biasing network inside the Meteo-42. Up to eight sensors can be handled by each RS485-Bus interface of the Meteo-42.
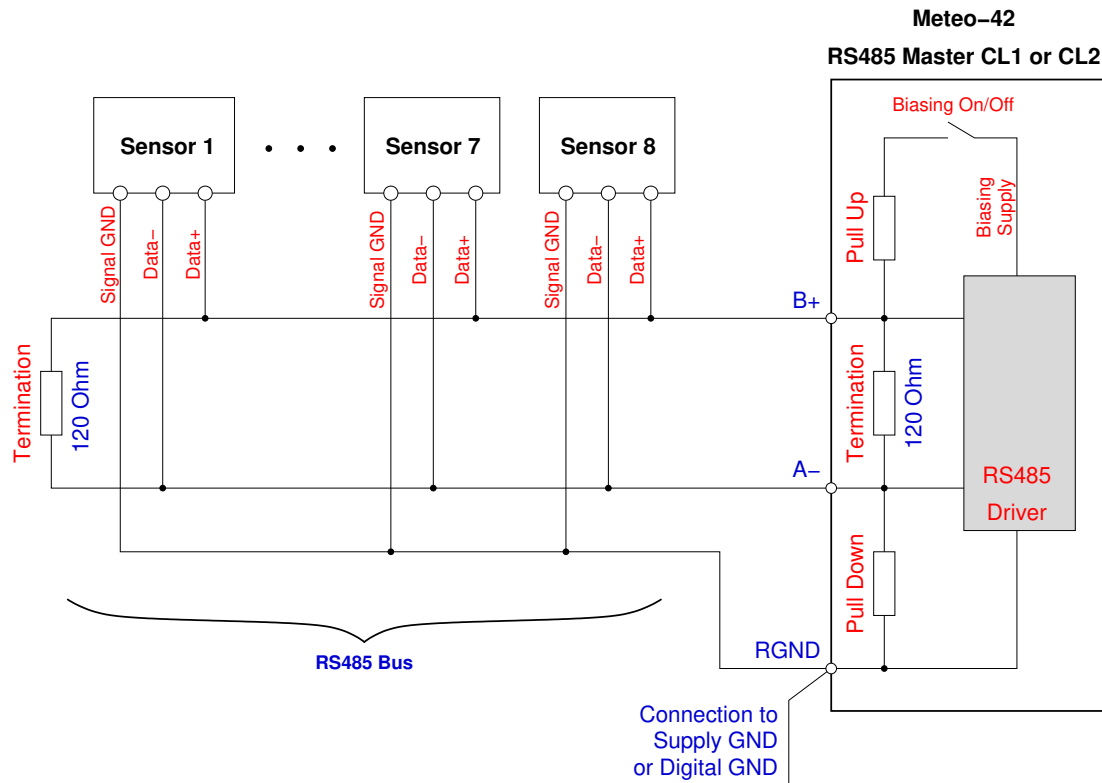
Figure 11.5: RS485-Bus (CL1, CL2) setup with termination and biasing using Meteo-42

11.6.1.3 Third RS485 interface

Only Meteo-42 L comprises a third RS485 interface, named CL3, to connect the sensors to a data logger via a bus system.

The hardware of the CL3 interface is designed so that it can be configured as freely as possible. Therefore there are a few important things to note, which are explained below.

In contrast to the CL1 and CL2 interfaces, the CL3 interface offers the option of using full duplex. All four data lines TX+, TX-, RX+, RX-, as well as the galvanically isolated RS485-Ground are accessible here. For this reason, the CL3 interface has no internal biasing. Furthermore the interface CL3 does not provide an internal termination.

If you want to use the CL3 interface for half-duplex, wire jumpers must be set. The following connections are to be made: TX+ and RX+, TX- and RX-. So the rule is: plus with plus, minus with minus.

To use the CL3 interface as a half-duplex interface, the following is required. For biasing the data lines the Ammonit module M83570 is recommended, as the wiring is particularly simple. Both, bus-termination and data line biasing can be done in an elegant way. Please note that that the negative pole of the M83570 supply must be connected to the negative pole of the Meteo-42 supply (common ground). It is also important that the negative pole of the M83570 is connected to the RS485 GND (RGND) of the CL3 interface to avoid floating lines.

The following diagram shows the wiring of the CL3 interface as a half-duplex interface with the necessary wire jumpers and the necessary connections for the biasing of the data lines using the M83570.
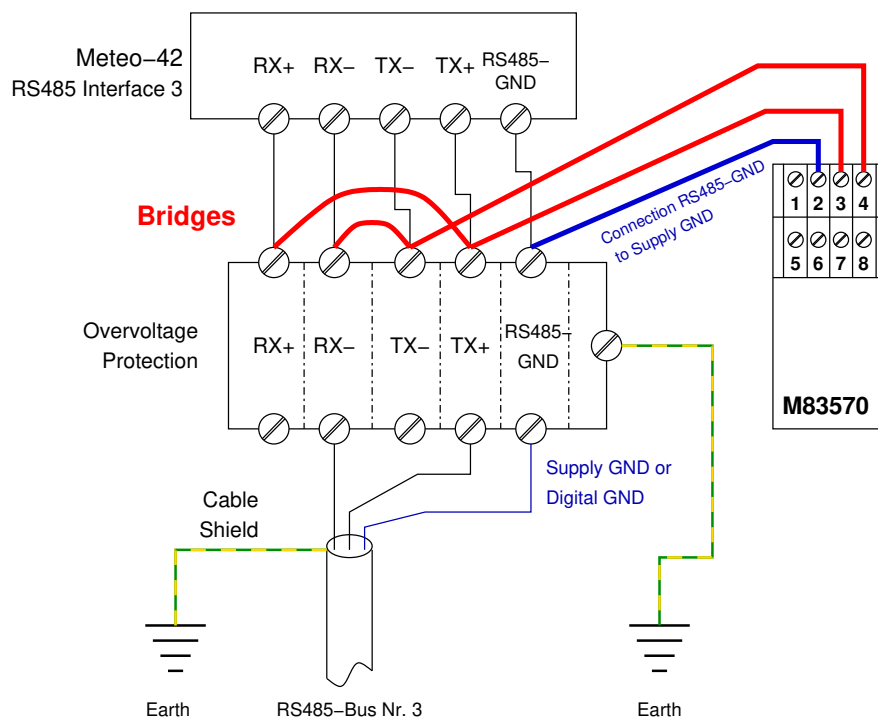
Figure 11.6: RS485-Bus CL3 in Half-Duplex with external Biasing

If the CL3 interface is to be used as a full-duplex interface, the wiring is considerably more complex more complex, as the two TX lines and the two RX lines require their own biasing. There are two termination resistors and four biasing resistors are required.

The following diagram shows the wiring of the CL3 interface with two biasing chains for RX and TX. The biasing is supplied from the 5 volt voltage output of the switch connections. Important is the bridge between the RS485 ground and the supply ground of the logger (shown in red).

Figure 11.7: RS485-Bus CL3 in Full-Duplex with external Biasing

11.6.2 Configuring Sensors for RS485 client in the User Interface

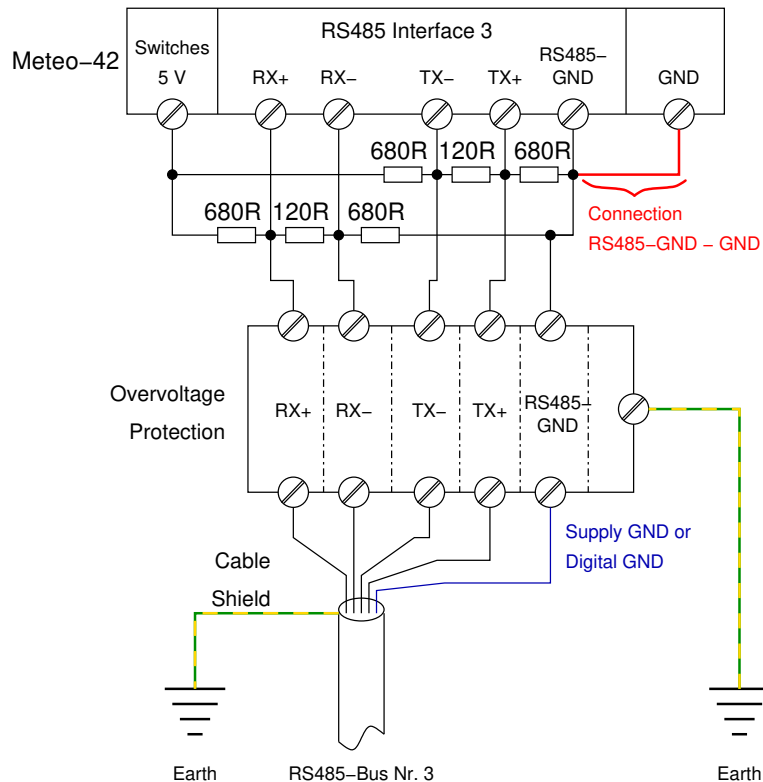When adding an RS485 sensor in the Measurement → Sensors menu, a (selectable) channel name between RxC1 and RxC8 is assigned to the sensor. Subindexes, e.g. R1C1_1, R1C1_2, are created for measured data and evaluations. In the Measurement → Evaluation menu the evaluations are displayed. Both measured values and evaluated data are included in the CSV files and can be seen in the Data → Live menu.

Most RS485 sensors have to be configured before use. The same configuration must be applied, when adding the sensors to Meteo-42 in the Measurement → Sensors menu.

> **Important**
> Only sensors using the same protocol and serial settings can share the same RS485 bus. It is necessary to configure each sensor with a unique RS485 address in the bus.

The time allocated to a sensor depends on the number of sensors configured and the measurement period. The sensor request, the response delay and the response transmission itself should happen within this interval. Otherwise the response telegram will not be fully read and an RS485_TELEGRAM_ERROR will appear in the *Measurement and Recording Errors* (see Section 4.7).

The response telegram will be recorded at the end of this interval, this implies a delay between sensor response and recording. The maximum delay is 1 s.

If more than one sensor is configured and the measurement period is 1 s, the time must be shared between the sensors. The minimum dedicated time per sensor is 125 ms.

Measurement intervals between 1 s and 1 h can be selected. If only one RS485 sensor is configured, shorter measurement intervals are available: 1/2 s, 1/4 s, 1/4 s and 1/8 s.

Available baud rates: 115200, 57600, 38400, 19200 and 9600 bits per second.

Available serial settings (data/parity/stop): 8N1, 8N2, 8E1.

11.6.3   SDI-12 sensors

SDI-12 is a standard communications protocol which provides a means to transfer measurements taken by an intelligent sensor to a data recorder. A subset of the SDI-12 protocol is implemented on Meteo-42. By means of an external hardware, an RS485 client interface can be used to connect SDI-12 sensors. If more than one SDI-12 is connected, the external adapters must be configured with different RS485 addresses. The supported SDI-12 sensors can be found in section Sensors.

11.7   Using the Switches

Each Meteo-42 data logger provides solid state switches to switch different kinds of loads on and off. The number of switches depends on the type of the logger (M, L, or A). The switches are internally realized as low-side switches, which connect the terminals with the label IN to the supply ground (GND). When switching loads with a supply that is not equal to the supply of the Meteo-42 it is essential that both supplies share the same ground (GND). Inside the Meteo-42 the switches are realised by a field effect transistor (FET) that shorts the input IN to GND. Additionally above each switch input terminal IN there is a terminal which provides a 5 V DC voltage. Make sure that the load connected to the 5 volt terminal does not exceed the specified maximum current.

Input terminal: This is the input of the voltage to be switched. Note: Input voltage must be positive with respect to ground (GND).

5 V Output terminal: The 5 V output can be used as a control voltage for external devices. Load current must be below 50 mA. The 5 V output is always available, it is not toggled with the switch.

The following two figures show example circuits to make clear the use of the 5 V and the switches terminals.
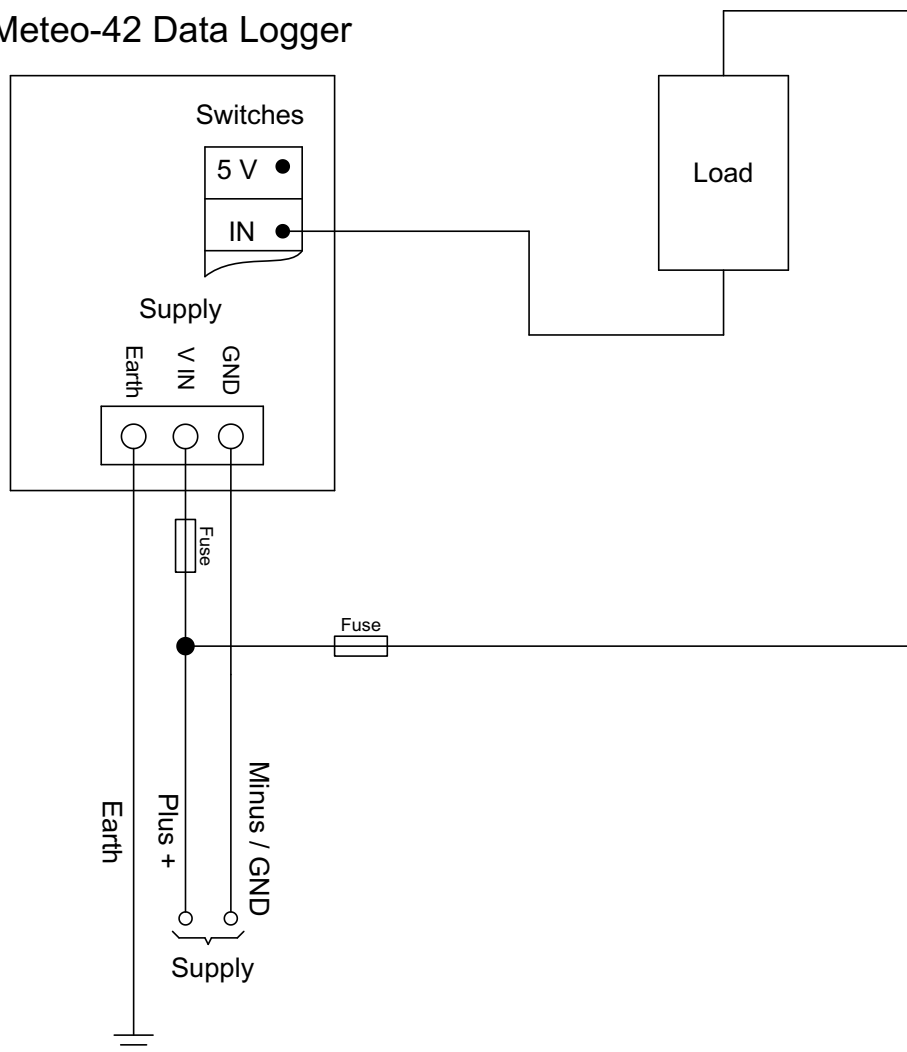
Meteo-42 Data Logger

Switches

5 V

IN

Supply

Earth

V IN

GND

Fuse

Fuse

Load

Earth

Plus +

Minus / GND
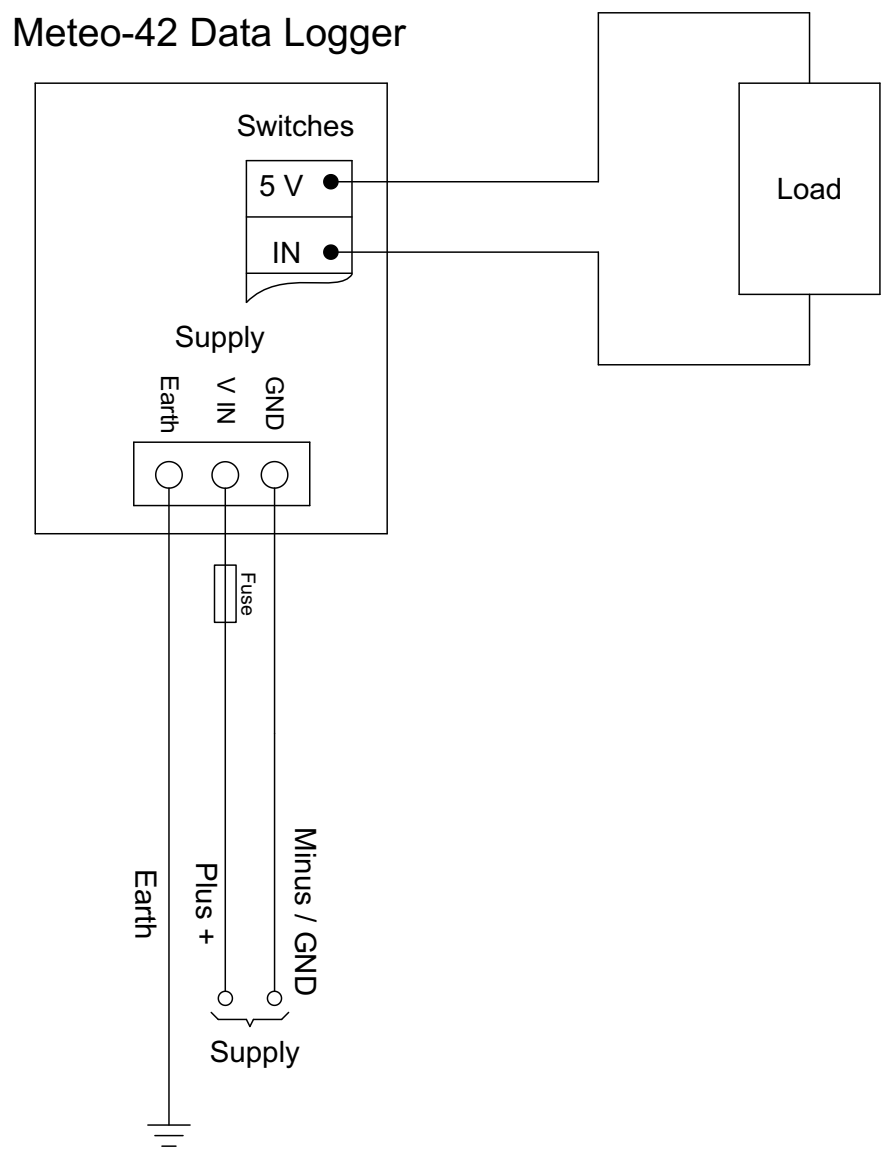
Supply

Earth

Figure 11.8: Use switches to supply sensors.

Figure 11.9: Use switches and 5 V to control external loads.

Chapter 12

Technical Data

12.1 Specification

Property	Specification
Housing Dimensions	260 × 194 × 65 [mm]
Weight	1.15 kg
Protection	IP65
Temperature	-40–+65 °C (operation) -20–+65 °C (display readable)
Memory	Meteo-42M: 2 GB Meteo-42L: 2 GB Meteo-42A: 2 GB
Date Format	YYYY-MM-DD
Time Format	hh:mm:ss
Clock	Buffered real time clock Accuracy: -40–+85 °C (±10 ppm); 3 V Lithium Button Cell CR2032; approx. 180 mAh; operating time >3 years
Power Supply	No internal supply! (see Section 12.2.12)

> **Important**
> Meteo-42 has no internal supply battery! External power supply is essential for proper operation. Section 12.2.12 contains the characteristics of the voltage supply and the current consumption of the data logger.
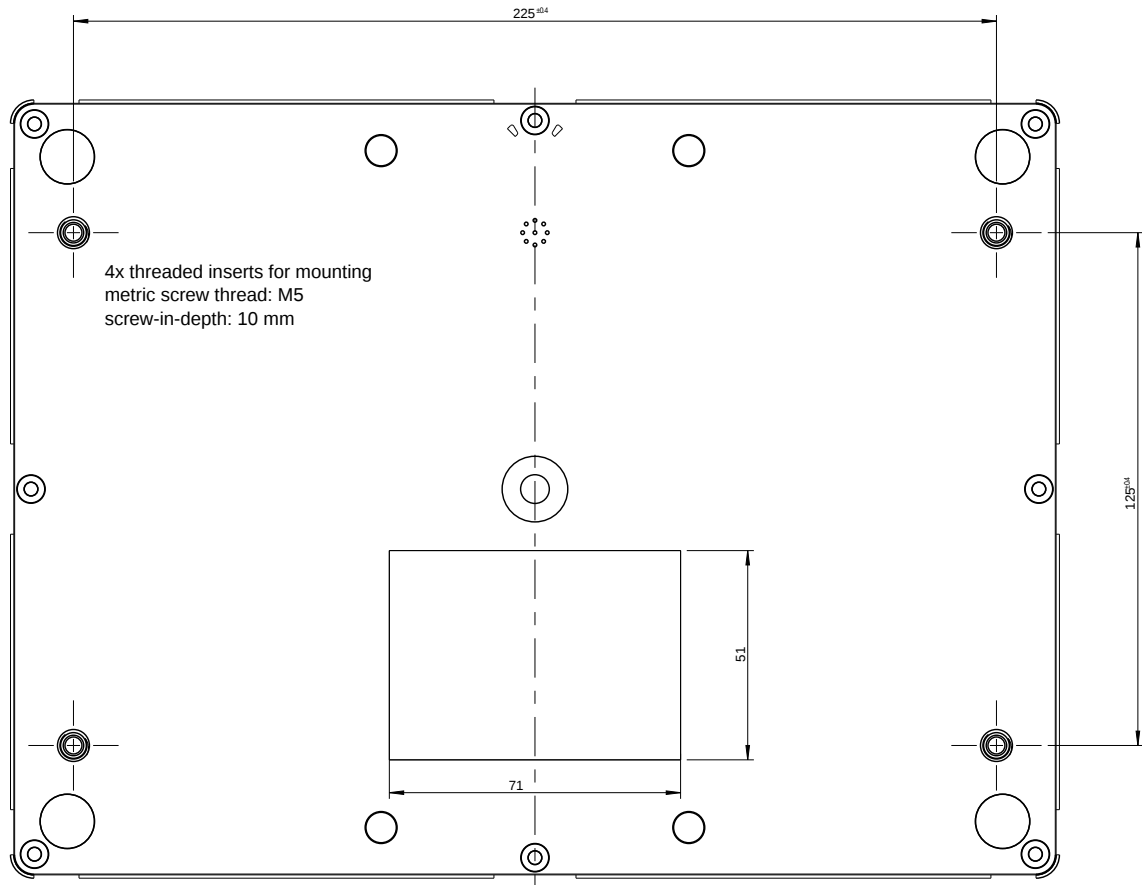
Figure 12.1: Mounting threads dimensions.

12.2 Electrical Characteristics

The values given in the following tables Table 12.1 to Table 12.11 contain the specifications of the digital and analog inputs and outputs. The given values are specified for a temperature range of $-40 - +65$ °C.

> **Note**
> All inputs and outputs are protected against overvoltage and electrostatic discharge using suppressor diodes. All voltage outputs of the data logger are fused by an self-resetting electronic fuse. Additionally, the power supply includes a reverse-polarity protection diode.

12.2.1   Electrical Specifications of Analog Voltage Channels / Differential Inputs

Property	Specification
Number of Channels per Data Logger Type	8 @ Meteo-42M (A1–A8) 14 @ Meteo-42L (A1–A14) 14 @ Meteo-42A (A1–A14)
Available Voltage Ranges (DC)	±0.1 V ±1 V ±10 V 0.1 V–0.3 V
Internal Resolution (Bit)	15 bit (Range: ±0.1 V) 16 bit (Range: ±1 V) 16 bit (Range: ±10 V) 16 bit (Range: 0.1 V–0.3 V)
Internal Resolution (Voltage)	6.1 µV (Range: ±0.1 V) 30 µV (Range: ±1 V) 300 µV (Range: ±10 V) 3.1 µV (Range: 0.1 V–0.3 V)
Measurement Accuracy (Voltage)	≤ 50 µV (Range: ±0.1 V) ≤ 150 µV (Range: ±1 V) ≤ 1 mV (Range: ±10 V) ≤ 50 µV (Range: 0.1 V–0.3 V)
Input Impedance	1 MΩ
Input Voltage	min. -12 V max. +12 V
Maximum Measurement Frequency	4 Hz

Table 12.1: Electrical Specifications of Analog Voltage Channels / Differential Inputs

12.2.2   Electrical Specifications of Counter Channels / Non-Differential Inputs

The counter counts impulses within a defined measurement timespan. This measurement timespan is derived from a precise timer signal with a precision of ± 5 ppm in the temperature range -40–+65 °C.

In case of a measurement timespan of one second the count of impulses is equal to frequency (Unit: Hz).

Property	Specification
Number of Channels per Data Logger Type	8 @ Meteo-42M (C1–C8) 12 @ Meteo-42L (C1–C12) 2 @ Meteo-42A (C1–C2)
Maximum measurable frequency	65535/period in Hz
Frequency Resolution [1]	1/period in Hz
Voltage Threshold (f > 1 Hz)	0.22 V
Input Voltage	min. -12 V max. +12 V
Period Measurement (Non-Differential Inputs)	8 @ Meteo-42M (P1–P8) 12 @ Meteo-42L (P1–P12) 2 @ Meteo-42A (P1–P2)

Table 12.2: Electrical Specifications of Counter Channels / Non-Differential Inputs

---

[1]The frequency resolution depends on the measurement period setting. Longer period time setting results in higher resolution. Measurement period defines how often the signal frequency is measured per second.

12.2.3 Electrical Specifications of Digital Channels (Serial Input / Output)

Property	Specification
Number of Channels per Data Logger Type	4 @ Meteo-42M (D1–D4) 7 @ Meteo-42L (D1–D7) 4 @ Meteo-42A (D1–D4)
Input Voltage Range (High State)	2 V–25 V
Input Voltage Range (Low State)	-0.5 V–0.6 V
Input Resistance	≥ 10 kΩ

Table 12.3: Electrical Specifications of Digital Channels (Serial Input / Output)

12.2.4 Electrical Specifications for Digital Clock Output

Property	Specification
Number of Channels per Data Logger Type	4 @ Meteo-42M (D1–D4) 7 @ Meteo-42L (D1–D7) 4 @ Meteo-42A (D1–D4)
High State	5 V
Low State	0 V
Output Resistance	100 Ω
Minimal Load Resistance	500 Ω

Table 12.4: Electrical Specifications for Digital Clock Output

12.2.5 Electrical Specifications for Analog Current Source

Property	Specification
Number of Channels per Data Logger Type	1 @ Meteo-42M (CS) 1 @ Meteo-42L (CS) 1 @ Meteo-42A (CS)
Nominal Current	200 µA
Tolerances	< 0.5 %
Max. Resistance	10 kΩ

Table 12.5: Electrical Specifications for Anlog Current Source

12.2.6 Electrical Specifications for Precision 5V Voltage Source

Property	Specification
Number of Channels per Data Logger Type	1 @ Meteo-42M (VS) 1 @ Meteo-42L (VS) 1 @ Meteo-42A (VS)
Max. Tolerance	0.04 %
Max. Output Current	50 mA

Table 12.6: Electrical Specifications for Precision 5V Voltage Source

12.2.7   Electrical Specifications for Switches

Property	Specification
Number of Channels per Data Logger Type	4 @ Meteo-42M (S1–S4) 8 @ Meteo-42L (S1–S8) 4 @ Meteo-42A (S1–S4)
Switch Voltage	> 0 V
Max. Current Continuous Switch	120 mA
Peak Switch Current (2 s)	400 mA
Switch On Resistance	< 83 mΩ
Switch Off Resistance	> 10 MΩ
Max. Output Voltage of 5 V Output Terminal	5.5 V
Min. Output voltage of 5 V Output Terminal	4.7 V
Max. Output Current per 5 V Output Terminal	15 mA

Table 12.7: Electrical Specifications for Switches

> **！ Important**
> The Meteo-42 switches deliver 5 V output to supply peripheral devices inside the steel cabinet of the measurement setup. The 5 V supply is not intended to supply sensors connected with long cables due to the risk of damage caused by lightning strike.
> The 5 V outputs provide an electronic current limiter and an overvoltage protection.

12.2.8   Electrical Specifications of the RS485 Interface

Property	Specification
Number of busses per data logger type	3 @ Meteo-42M (CL1, CL2, SRV/CL) 4 @ Meteo-42L (CL1, CL2, CL3, SRV/CL) 3 @ Meteo-42A (CL1, CL2, SRV/CL)
Supply voltage	5 V
Half-duplex bus (master)	CL1, CL2 (internal, software switchable termination resistor 120 Ω)
Full-duplex bus (master)	CL3
Full-duplex bus (slave)	SRV/CL
Galvanic isolation	CL1, CL2, CL3, SRV/CL

Table 12.8: Electrical Specification of the RS485 Interface

> **📎 Note**
> Full-duplex busses can also be used as half-duplex busses. For this purpose, a corresponding external wiring is required.

12.2.9 Electrical Specification of the Ethernet Interface

Property	Specification
Ethernet port	100 Mbit/s (100BASE-TX)

Table 12.9: Electrical Specification of the Ethernet Interface

12.2.10 Electrical Specification of the USB Interfaces

Property	Specification
USB-A1 and USB-A2 (host)	USB V2.0 Full-speed: 480 Mbps or 12 Mbps
USB-B (device)	Enhanced HCI (EHCI): 480 Mbps or 12 Mbps

Table 12.10: Electrical Specification of the USB Interfaces

12.2.11 Electrical Specifications of Internal Measurements

Meteo-42 measures the *Internal Supply Voltage* and *Internal Current* of the data logger. These measurement values can be used for remote verification of the functionality of the data logger and are written to the source data and the CSV data files respectively.

Important Notes:

- Internal Supply Voltage and Internal Current are recorded with 12 bit resolution only,
- Internal Supply Voltage is measured directly behind a reverse polarity protection diode. This means the measured value is approximately 0.35 volt lower than the supply voltage at the logger's supply terminals.

12.2.12 Electrical Specification of the Power Supply

Important
Meteo-42 has no internal supply battery! External power supply is essential for proper operation.

Property	Specification
Supply Voltage Range	9 V (DC)–36 V (DC)
Peak Supply Voltage (10 s)	55 V (DC)

Table 12.11: Electrical Specification of the Power Supply

Note
Meteo-42 has a reverse voltage protection.

Use case	Typical Power Consumption
CECS on, no sensors defined/connected, no Ethernet connected	0.85 W
CECS on, different sensors, one RS485 Interface with Biasing, Ethernet connected	1.5 W
CECS off, no RS485	less than 0.35 W
CECS off, one RS485-Interface, without Biasing, 12 V Supply	less than 0.310 W
CECS off, one RS485-Interface, without Biasing, 24 V Supply	less than 0.370 W
CECS off, RS485-Interfaces CL1, CL2, without Biasing, 12 V Supply	less than 0.385 W
CECS off, RS485-Interfaces CL1, CL2, without Biasing, 24 V Supply	less than 0.450 W
CECS off, all three RS485-Interfaces, without Biasing, 12 V Supply	less than 0.405 W
CECS off, all three RS485-Interfaces, without Biasing, 24 V Supply	less than 0.460 W
CECS off, one RS485-Interface with Biasing, 12 V Supply	less than 0.365 W
CECS off, one RS485-Interface with Biasing, 24 V Supply	less than 0.425 W
CECS off, RS485-Interfaces CL1, CL2, with Biasing, 12 V Supply	less than 0.460 W
CECS off, RS485-Interfaces CL1, CL2, with Biasing, 24 V Supply	less than 0.525 W
CECS off, all three RS485-Interfaces, with Biasing, 12 V Supply	less than 0.520 W
CECS off, all three RS485-Interfaces, with Biasing, 24 V Supply	less than 0.570 W

Table 12.12: Typical Power Consumption for different use cases

Note

When the display backlight turns on, the power consumption increases by approximately 2 W.

In general: CECS adds at least 0.5 W to the power consumption.

When the CECS is switched off, no power can be drawn from the USB or Ethernet ports.

When 5 V output ports (Switches) are used the load at these ports must also be taken in account when calculating the power consumption of the data logger.
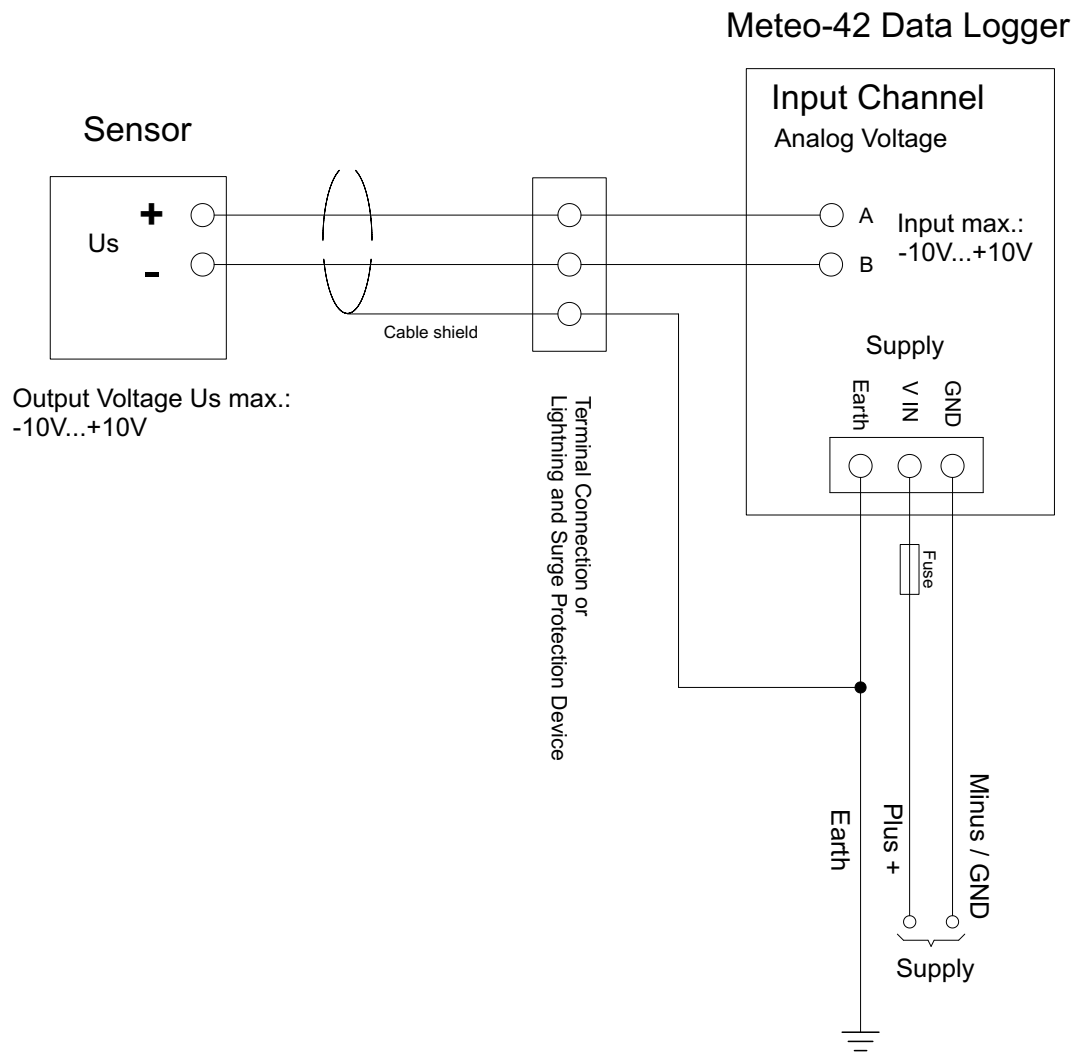
Chapter 13

Electrical Connection Plans

The following connection plans explain how Meteo-42 is connected with power supply, sensors and other peripherals.

Note
Since Meteo-42 is designed to be very flexible, various sensors can be connected to the data logger. If the sensor you intend to connect is not listed in this manual, refer for technical details and connection plans shown on the data sheets on our website (www.ammonit.com (http://www.ammonit.com)) or contact our sales team (+49-30-6003188-0 or sales@ammonit.com).

Figure 13.1: Meteo-42 Supply incl. Modem

Meteo-42 Data Logger

Sensor

Input Channel
Analog Voltage

Us

+

−

A   Input max.:
     -10V...+10V
B

Cable shield

Supply

Earth   V IN   GND

Output Voltage Us max.:
-10V...+10V

Terminal Connection or
Lightning and Surge Protection Device

Fuse

Earth

Plus +

Minus / GND

Supply

Figure 13.2: Electrical Connection Plan: Analog Voltage (Pyranometer)

Floating voltage source (pyranometer) is connected via terminal or OVP to the differential analog voltage channels.
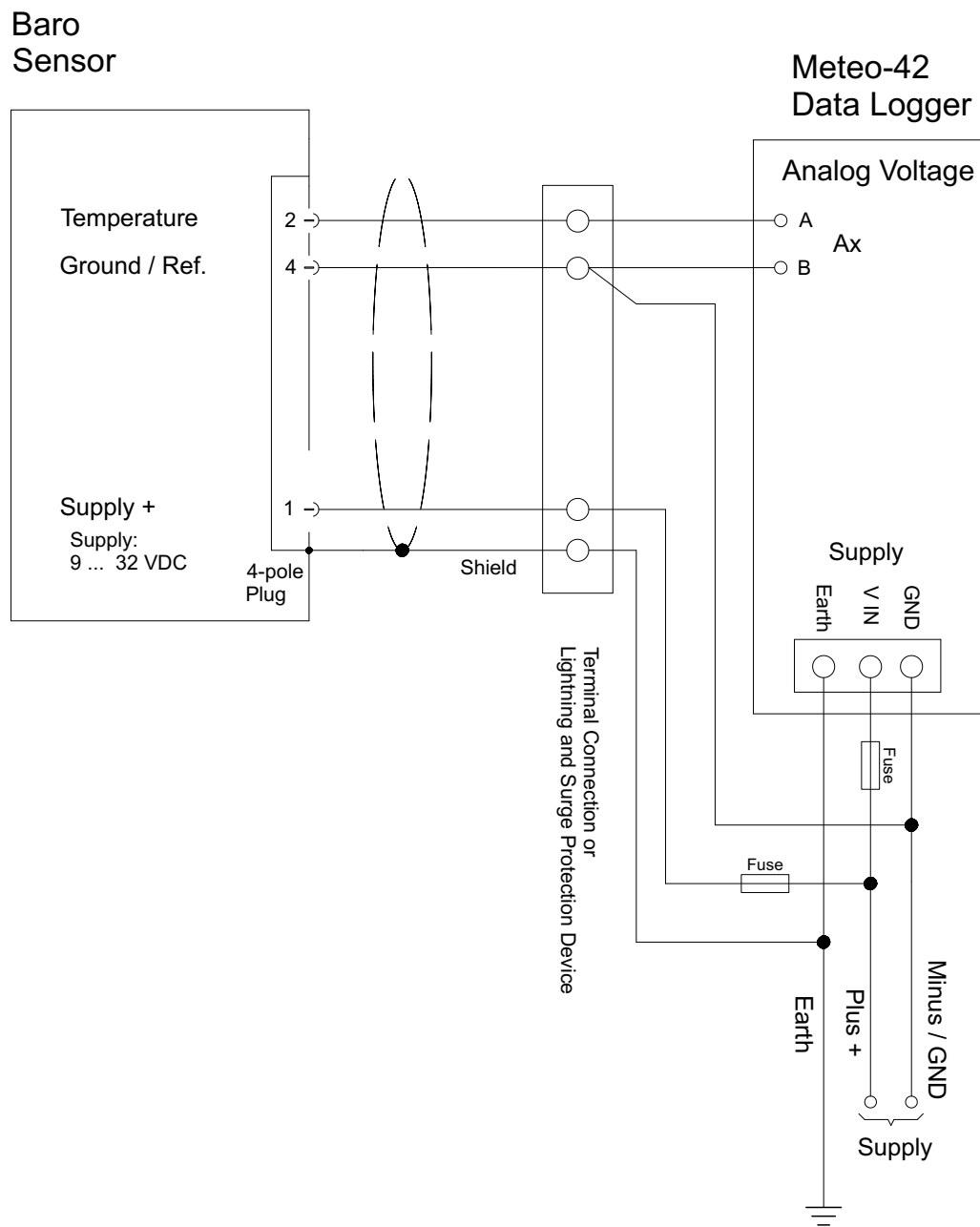
Figure 13.3: Electrical Connection Plan: Analog Voltage (Temperature / Barometric Pressure Sensor)

The temperature and/or barometric pressure sensor is connected via terminal or OVP to the differential analog voltage channels. To avoid ground loops, it is not recommended connecting the B terminal of the analog voltage input directly to common ground.

Meteo-42 Data Logger

Input Channel
Analog Voltage

A _
A Input max.:
B -10V...+10V

A _
A Input max.:
B -10V...+10V

Supply

Earth   V IN   GND

Sensor

U$_{S1}$ + -

U$_{S2}$ + -

GND
+V

Output Voltage Us max.:
-10V...+10V

Cable shield

Fuse

Fuse

Terminal Connection or
Lightning and Surge Protection Device

Earth

Plus +

Minus / GND

Supply
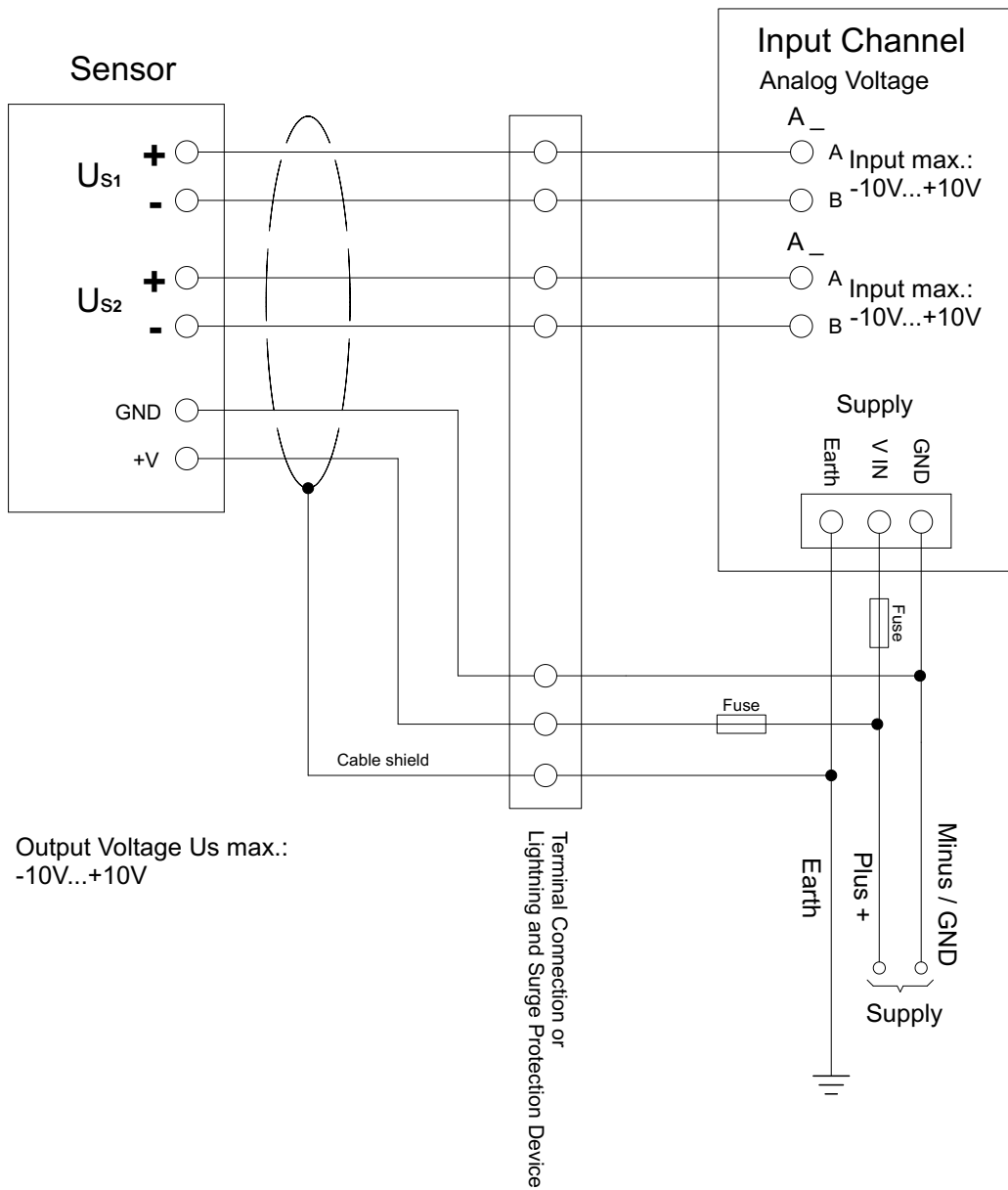
Figure 13.4: Electrical Connection Plan: Analog Voltage (Temperature + Humidity Sensor)

Voltage sources (temperature and humidity sensor) are connected via terminal or OVP to the differential analog voltage channels. To avoid ground loops, it is not recommended connecting the B terminal of the analog voltage input directly to common ground.
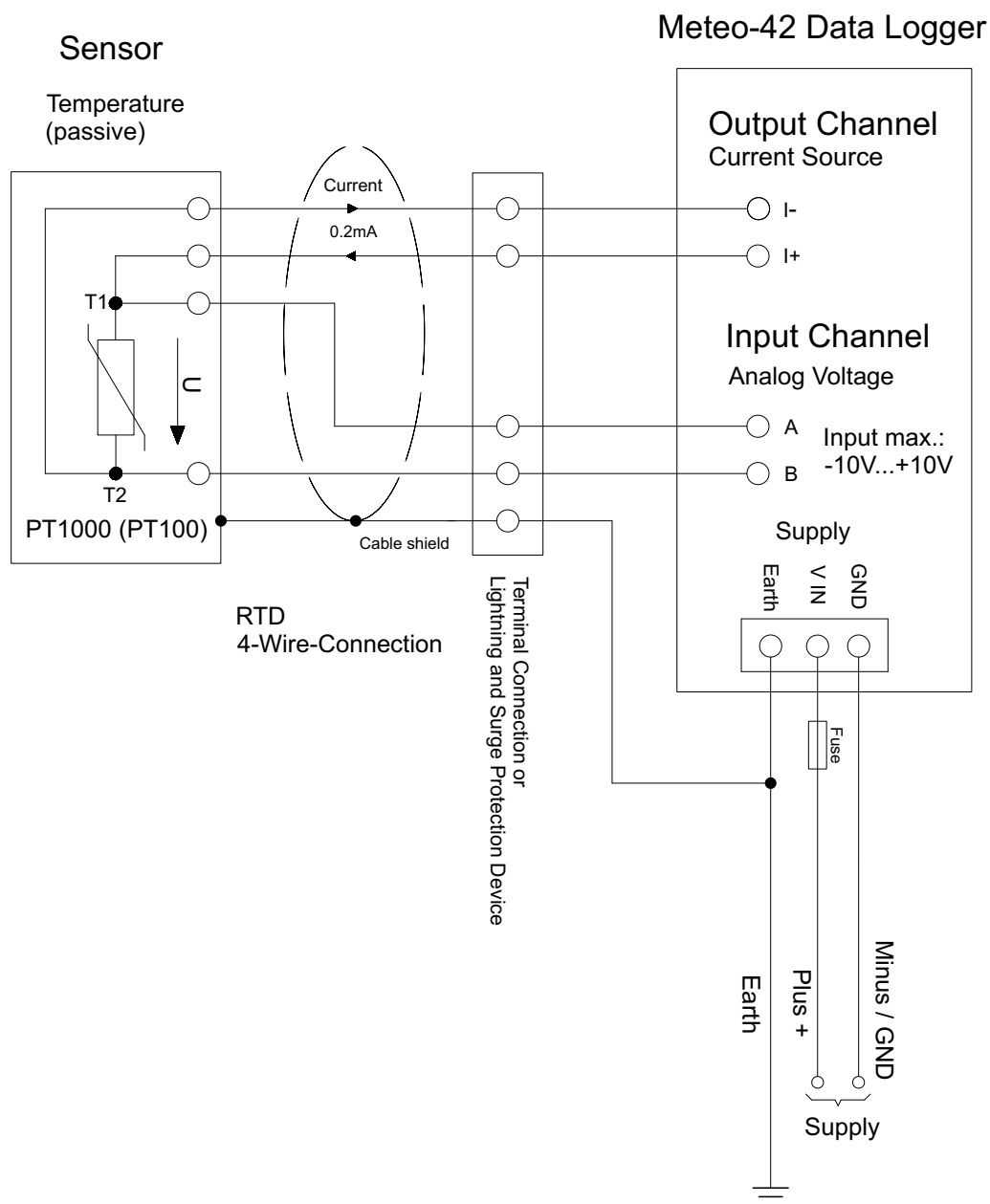
Figure 13.5: Electrical Connection Plan: Analog Voltage / Current Source (4-wire-connection; Pt1000)

Analog Current Source (CS) of Meteo-42 is applied to feed a Pt100/Pt1000 temperature sensor. The sensor is connected via terminal or OVP to the differential analog voltage channel. 4-wire measurement is recommended to avoid voltage errors due to the resistance of feed line.
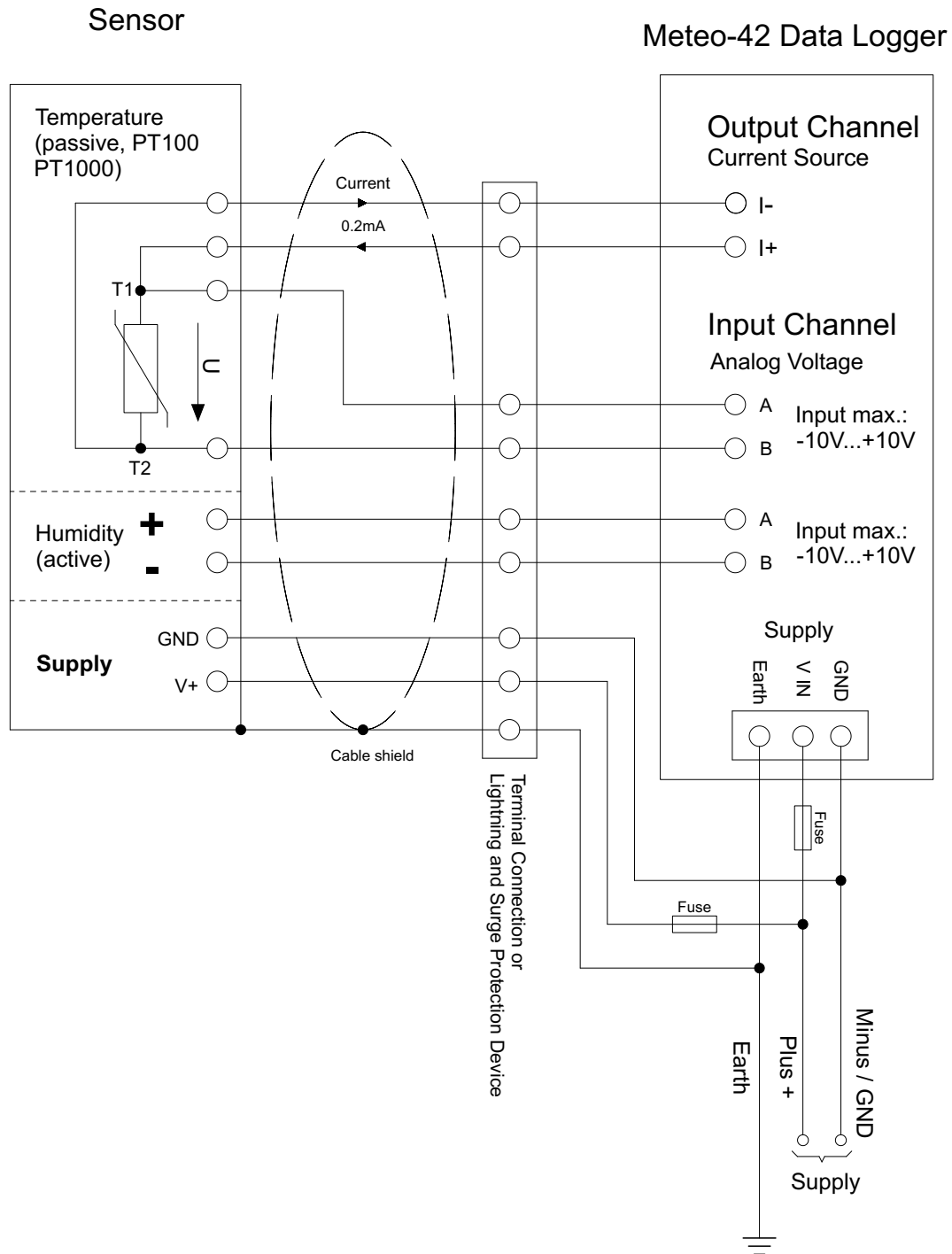
Figure 13.6: Electrical Connection Plan: Analog Voltage / Current Source (4-wire-connection; Pt1000 + Humidity)

Analog Current Source (CS) of Meteo-42 supplies the Pt100/Pt1000 temperature sensor. The active humidity sensor may be fed by the same supply as the data logger. Both sensor outputs are connected via terminal or OVP to individual differential analog voltage channels.
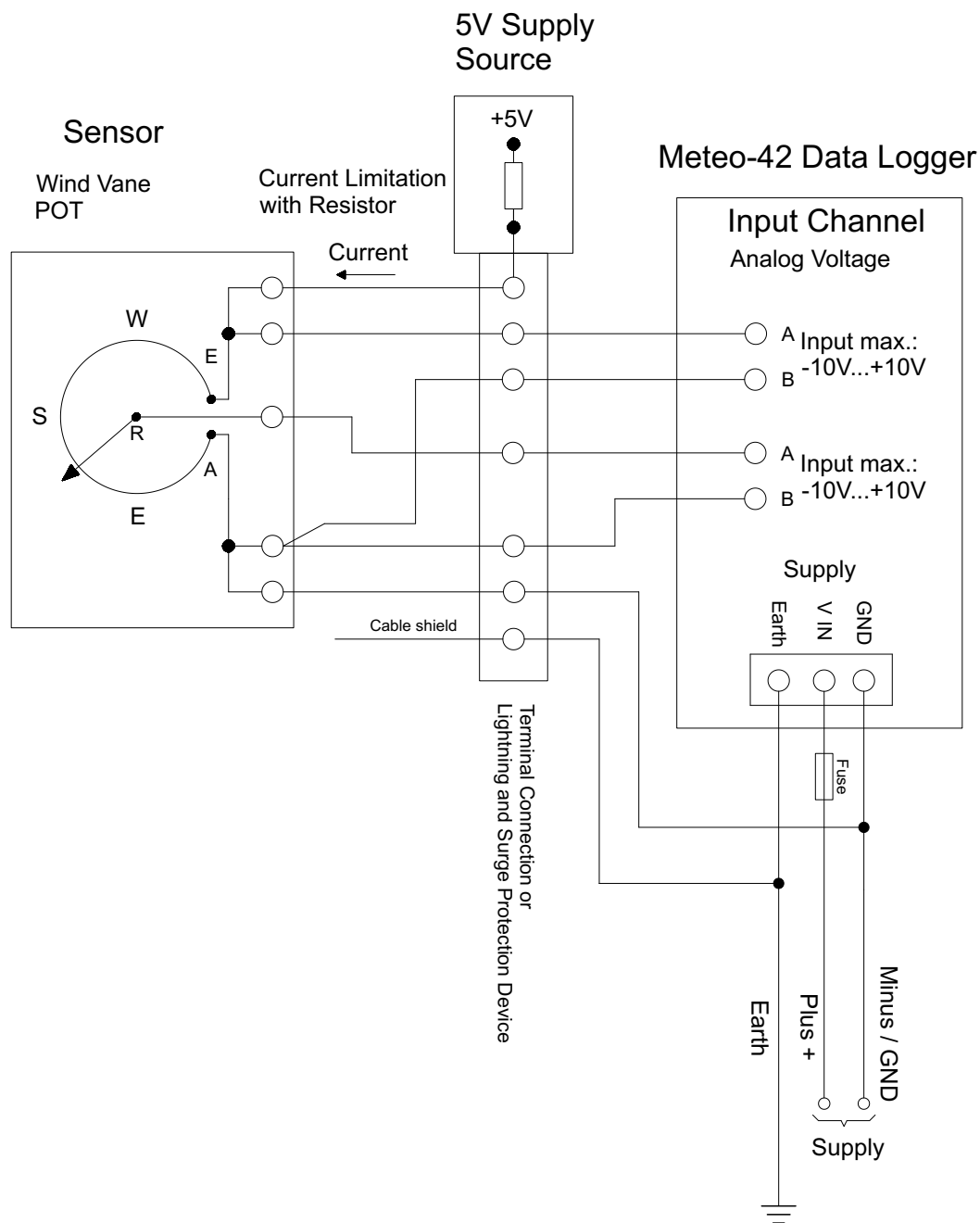
Figure 13.7: Electrical Connection Plan: Analog Voltage (Potentiometric Wind Vane)

The figure above shows the 5-wire connection of a potentiometric wind vane. The intention of this configuration is to avoid voltage drops on the measurement lines caused by wire resistance. The first analog voltage channel measures the voltage across the whole potentiometer while the second channel measures the voltage between wiper and ground. The configuration is supplied via current limiting resistor by a 5 V supply. All lines to the wind vane are connected via terminal or OVP.
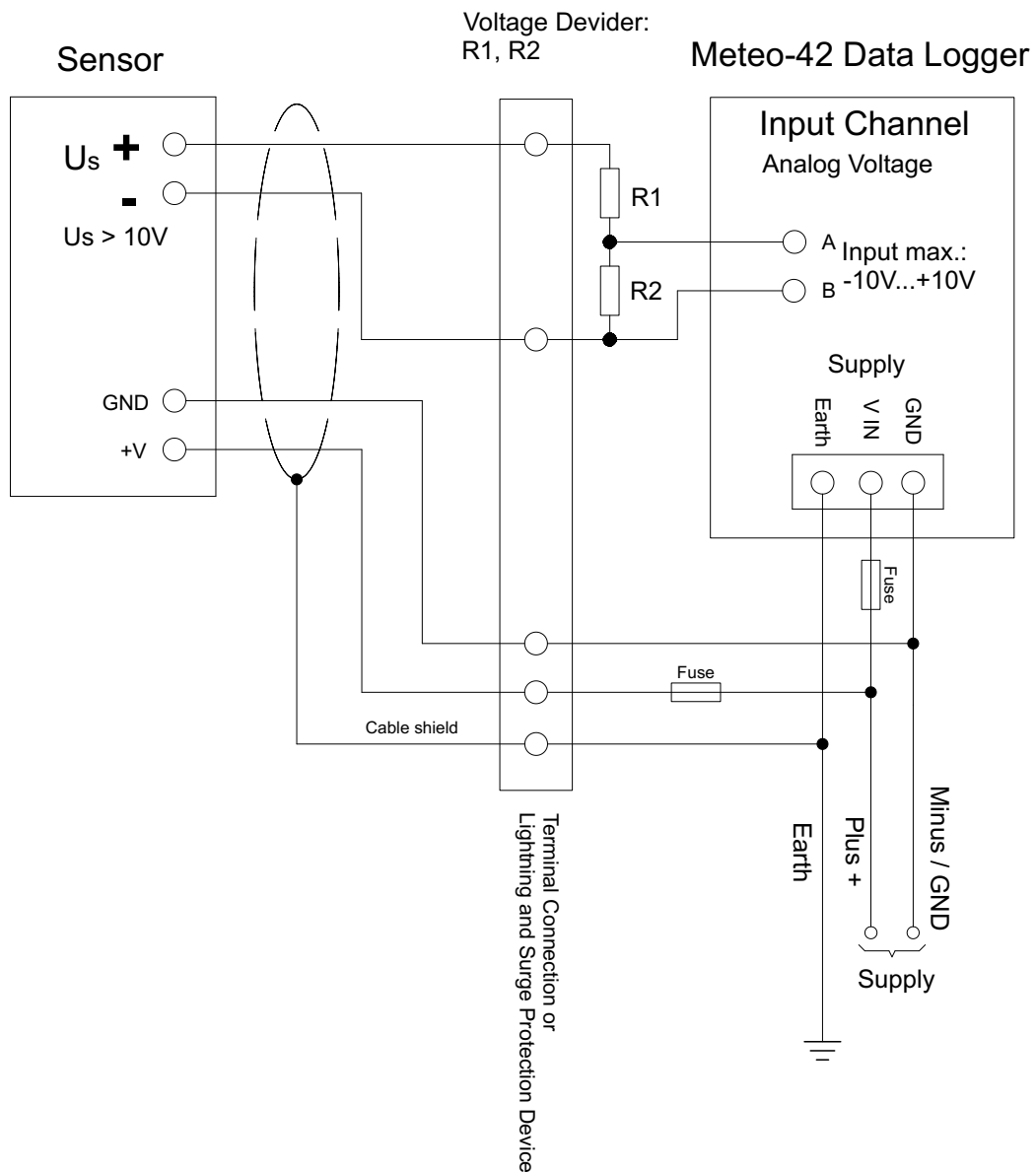
Figure 13.8: Electrical Connection Plan: Analog Voltage with Voltage Divider (R1, R2)

The Meteo-42 data logger is designed to measure analog DC voltages from -10 V–10 V. This is sufficient for most meteorological sensors. If voltages higher than +10 V occur, the voltage at the analog voltage inputs must be shared by a voltage divider. Note that R2 is in parallel to the input impedance of the analog voltage channel (1 MΩ).

Meteo-42 Data Logger

Sensor

Input Channel
Pulse Counter

Output:
Pulse /
Frequency

CNT

Input max.:
-15V...+15V

Supply

Earth   V IN   GND

GND

+V

Fuse

Fuse

Cable shield

Terminal Connection or
Lightning and Surge Protection Device

Earth

Plus +

Minus / GND

Supply
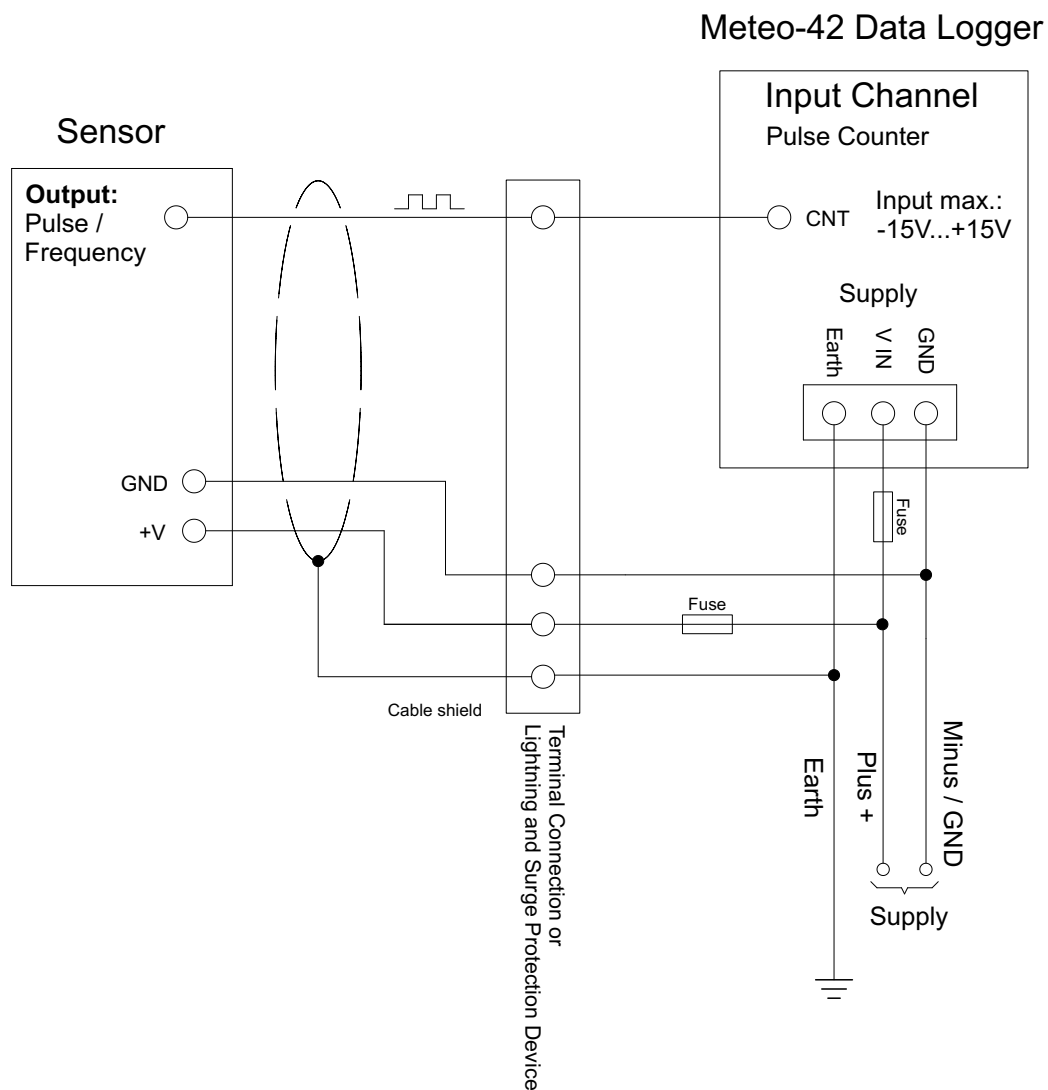
Figure 13.9: Electrical Connection Plan: Pulse Counter (Anemometer)

Meteo-42 includes several impulse counter inputs (CNT). In most cases they are used for anemometer setup. The signal output of the sensor has to be connected to the CNT input of the data logger. To avoid floating signals common ground is used for the negative line of counter connection. The figure above depicts the recommended setup using connections via terminal or OVP to the data logger.
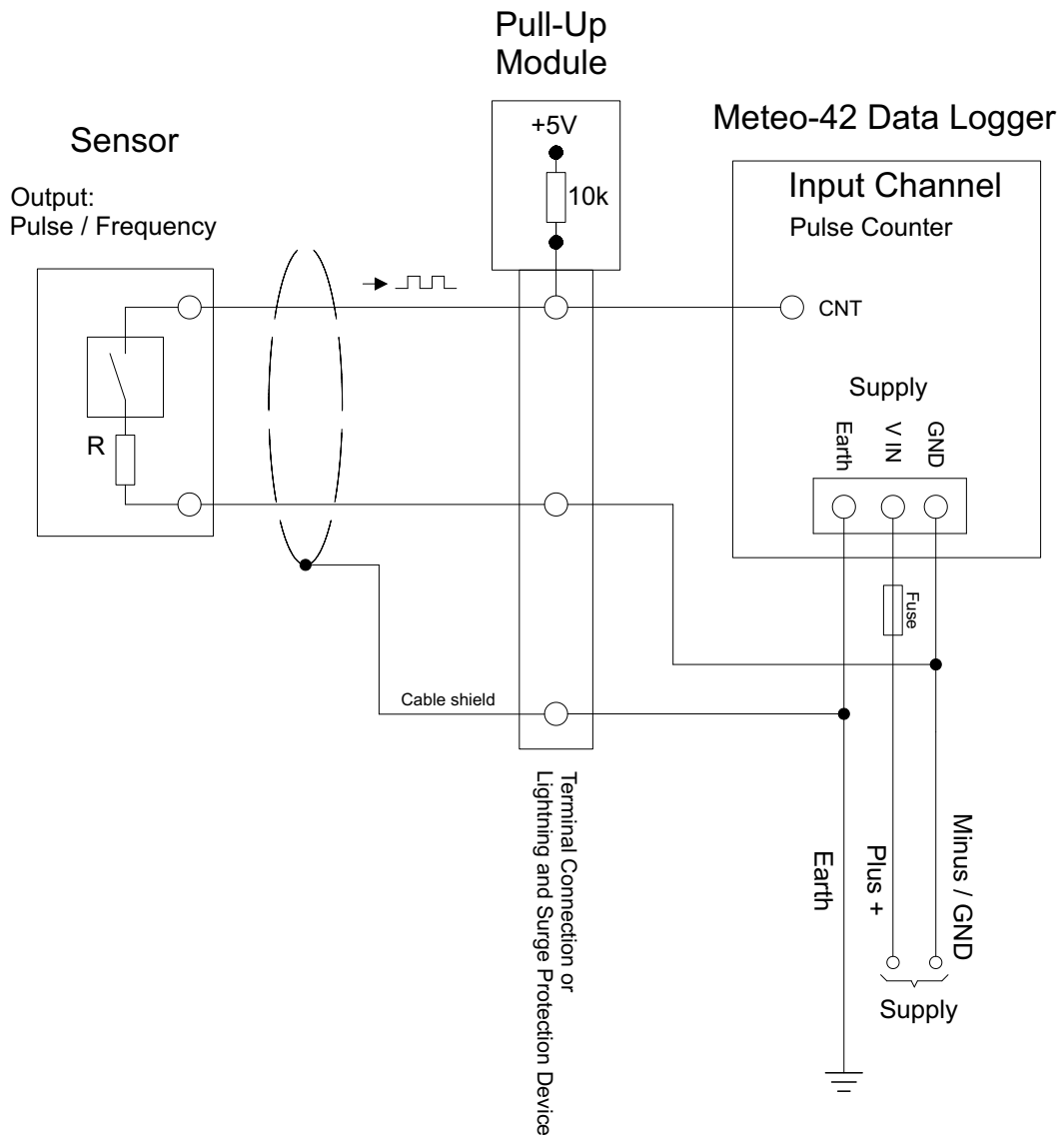
Figure 13.10: Electrical Connection Plan: Pulse Counter with Pull-up Module for Precipitation Measurement

The counter inputs of the Meteo-42 data logger can be used for precipitation sensors. Most precipitation sensors have open collector outputs or use a switching reed contact. In both cases an additional pull-up resistor has to be applied. This pull-up resistor is tied to a 5 V supply to feed the sensor's output. The module M83570 by Ammonit has several configurable pull-up resistors and an internal 5 V supply. M83570 can easily be integrated in the setup of a steel cabinet. The figure above shows the recommended setup using connections via terminal or OVP to the data logger.

Meteo-42 Data Logger

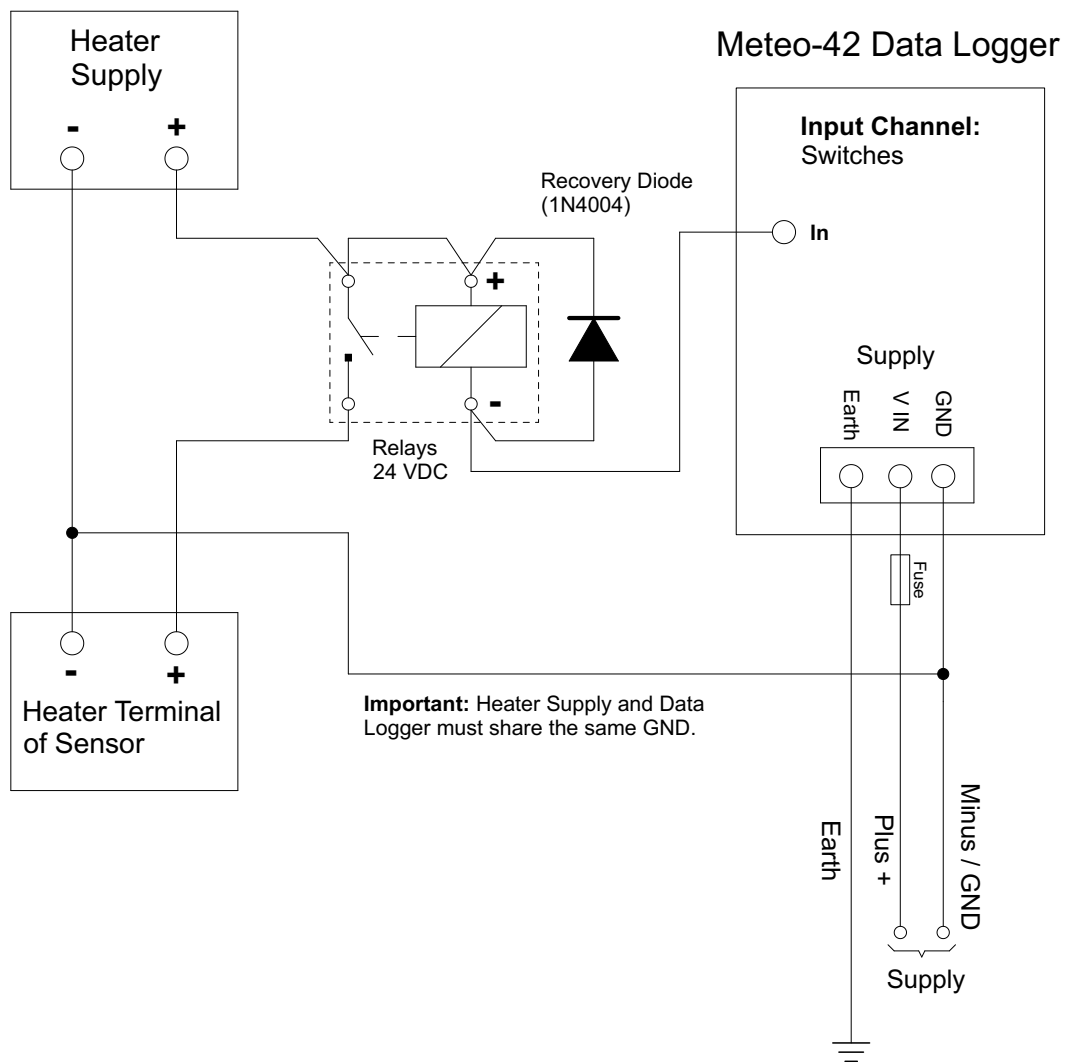### Sensor

Input Channel
Digital Serial

Data

Clock

GND

+V

IN

CLK

Supply

Earth   V IN   GND

max. Sensor Voltage:
Data: 2V...25V
Clock: 5V

Cable shield

Terminal Connection or
Lightning and Surge Protection Device

Fuse

Fuse

Earth

Plus +

Minus / GND

Supply
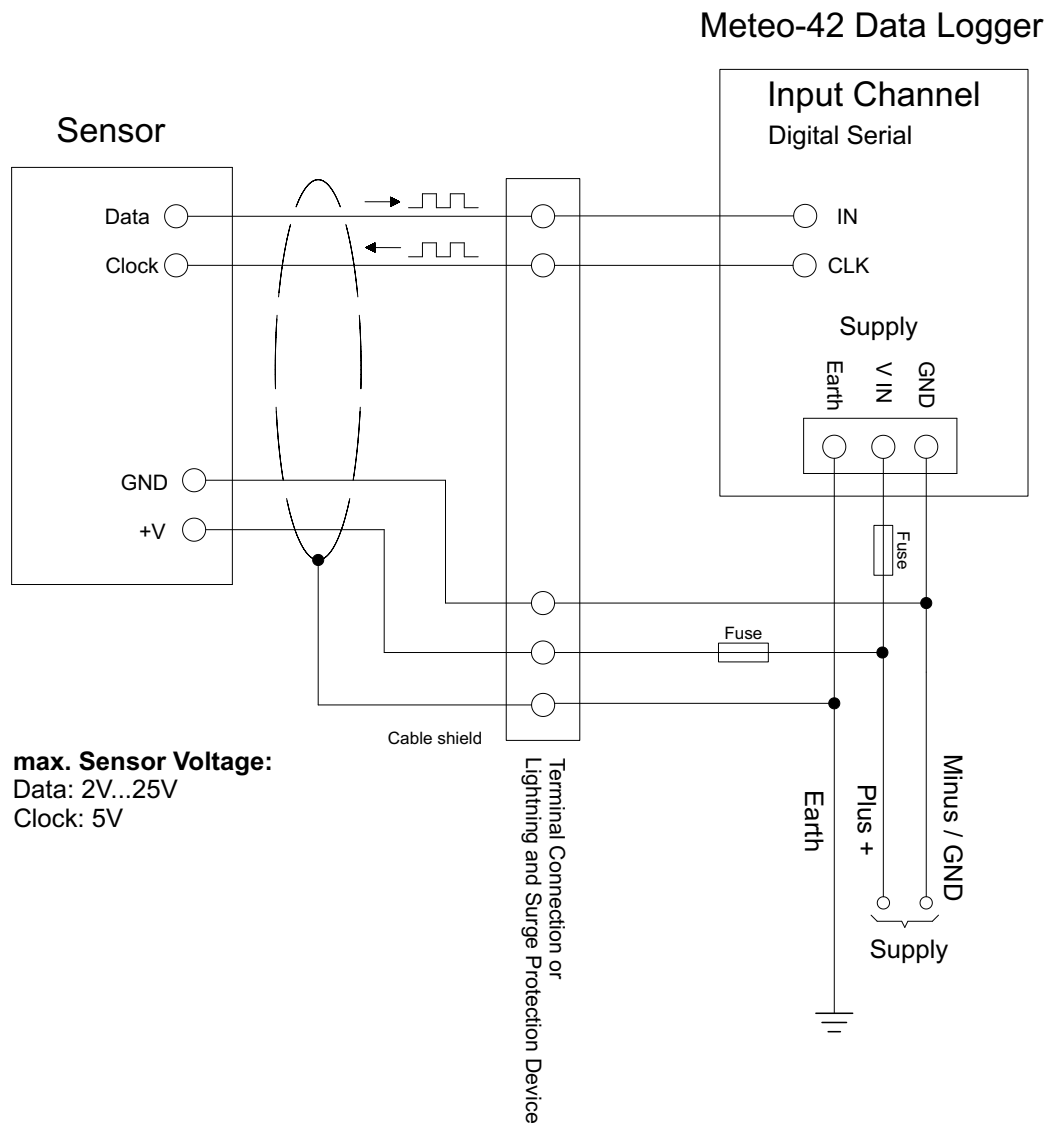
Figure 13.11: Electrical Connection Plan: Digital Serial for Serial Wind Vane (Thies TMR)

The Digital Serial inputs of Meteo-42 data loggers are designed to connect sensors using serial communication. The data logger sends a clock burst to the sensor via the CLK line. The response of the sensor is sent back to the data input line (IN) of the Digital Serial panel. It is essential that sensor and data logger use the same common ground. The figure above shows the recommended setup using connections via terminal or OVP to the data logger.

Pull-Down
Resistor (to GND)

Sensor / Push-Button

Output:
Status 0 / 1

GND

10k

Meteo-42 Data Logger

Input Channel
Digital Serial

IN

Supply

Earth   V IN   GND

Status:
1: Data 2V...25V

0: Data <2V

Cable shield

Fuse

Terminal Connection or
Lightning and Surge Protection Device

Earth

Plus +

Minus / GND

Supply

Figure 13.12: Electrical Connection Plan: Status with Pull-down Module

In some cases an additional pull-down resistor may be required to equalise the electrical potential on the status signal lines. This may be necessary to reduce perturbance caused by floating lines. The potential equalization can be realized by an external resistor to GND or an external module M83570 provided by Ammonit. This external module has pull down resistors for several signal lines.

Obstacle Light

Output:
Status 0 / 1

Meteo-42 Data Logger

Input Channel
Digital Serial

IN

Supply

Earth   V IN   GND

+V

Status

T

Cable shield

Terminal Connection or
Lightning and Surge Protection Device

Status:
Data 2V...25V   Light OK
Data <2V   Light Failure

Fuse

Fuse

Earth

Plus +

Minus / GND

Supply

Figure 13.13: Electrical Connection Plan: Status for Obstacle Light

Many obstacle lights provide a diagnosis port to indicate malfunction. This diagnosis port can be connected to the IN port of the Serial Digital panel. For a detailed description of the electrical characteristics of the interfaces see table in Section 12.2.3. The figure above shows the recommended setup using connections via terminal or OVP to the data logger.

Figure 13.14: Electrical Connection Plan: Switch external Sensor Heating via Meteo-42 Switch Manager

The configuration above displays the connection of an external sensor heating switched by the Meteo-42 heating control.

Chapter 14

Cryptographic Software

Ammonit uses certain standard cryptographic software to protect sensitive measurement data. None of the algorithms are developed by Ammonit. All cryptographic software used on Meteo-42 is free software. Its source code is available for everybody to study and check for security problems.

Currently the following is encrypted:

- Access to Meteo-42 via web interface over HTTPS with high-grade encryption using the RSA 2048 bit or Elliptic Curve Cryptography (ECC) 256 bit key.
- All data sent and received via the Meteo-42 web interface, e.g. data download
- Data upload via SCP to AmmonitOR or your own server, using an Elliptic Curve Digital Signature Algorithm (ECDSA) 256 bit key.
- Emails and attached CSV files sent by Meteo-42 (optional)
- Live data publishing to our or your own server, using the XMPP protocol with ECC 384 bit certificate
- Complete system hard disk of the CECS (AES-256)

📎 **Note**
There is no encryption, when data is uploaded via FTP to a server. Moreover, the data stored on Meteo-42 is not encrypted. But only computer specialists with inside knowledge could be able to access the data.

Software or Protocol	Description	Used Algorithms
HTTPS	All access to the user interface of the data logger is done via HTTPS, a combination of HTTP with SSL/ TLS, as implemented in OpenSSL.	RSA (2048 bits), ECC NIST Curve P-256 (256 bits)
SSH	The connection to the AmmonitConnect server (the Ammonit one or any AmmonitConnect server of your choice) is performed with an SSH reverse tunnel.	RSA (2048 bits), ECDSA NIST Curve P-256 (256 bits)
OpenPGP (GnuPG)	The international standard OpenPGP, specifically the GnuPG implementation, is used to digitally sign and encrypt measurement data.	RSA (2048 bits), ECC NIST Curve P-256 (256 bits)
XMPP	Meteo-42 live data can be published to our server using the XMPP, which is an open communication protocol designed for instant messaging. The communication is encrypted using the TLS certificate.	ECC NIST Curve P-384 (384 bits)

Table 14.1: Cryptographic Software

Chapter 15

Maintenance and Care

In order to ensure that Meteo-42 data loggers work properly, it is important that you maintain and handle the device with care.

⚠ Important

If an error occurs and the Ammonit support team needs to be contacted, download the configuration file (`config-Dnnnnnn.txt` in menu System → Information) and send it with the error description to the Ammonit Support support@ammonit.com.

15.1 Operation and Storage

The data logger can be affected by extreme temperature and humidity conditions. Meteo-42 is designed to operate properly at temperatures between -40 and +65 °C in non-condensing environments. The display is readable between -20 and +70 °C.

On site the data logger has to be installed in a robust and weatherproof cabinet (see also at www.ammonit.com (`http://www.ammonit.com/`)). The cabinet protects the data logger against weather and condensation damage, theft and vandalism. If humidity tolerance is exceeded and moisture penetrates, the electronics of Meteo-42 can be damaged. Users are responsible for effective humidity control.

Handle Meteo-42 with care, do not drop it, and avoid mechanical shocks and vibrations to prevent the electronics from being damaged. Do not open or break the Meteo-42 housing or any of the slots. Avoid permanent pressure on the data logger.

To ensure that Meteo-42 operates properly, install only equipment, e.g. sensors, adapters and cables, which is undamaged and approved by Ammonit. Contact Ammonit, if any questions occur.

15.2 Overvoltage / Lightning Protection

Ammonit offers lightning and overvoltage protection devices for DC and AC low-voltage supplies of components and measuring systems, ensuring protection of data and signal lines and power cables. The surge protection cable clamp is installed in the steel cabinet instead of a regular unprotected cable clamp. We offer several types of surge protection devices, differing in number of pins and voltage levels. Although the installation of overvoltage protection devices is not mandatory, we highly recommend installing them, as unprotected lightning can lead to a total breakdown of the entire measuring system. Overvoltage protection is strongly advised at freestanding measuring stations or when aircraft obstacle lights are applied.

Chapter 16

Frequently Asked Questions

Find in this chapter a summary of frequently asked questions.

If you do not find the answer to your specific question in this chapter, contact the Ammonit support team.

16.1   Local Communication

Question	Answer
The Meteo-42 display does not show anything.	The display is switched off. Press the middle button of your data logger and hold it until the display turns on. The display of Meteo-42 is only illuminated, when CECS is running. During MARS operation, the display is switched off. Refer to Chapter 9. If the ambient temperature is below -20 °C, the crystals of the LCD may be stuck.
I cannot configure Meteo-42 using the buttons.	You do not have permission to configure the data logger with the buttons on the Meteo-42 housing. See Section 9.1.
The red LED light is turned on. What does it indicate?	It indicates that an error in the measuring operation occured. For details see System $\rightarrow$ Logbook in the web interface or System $\rightarrow$ Errors $\rightarrow$ Error List in the display menu.
The yellow LED light blinks. What does it indicate?	It indicates that at least one RS485 sensor is connected. According to the Modbus protocol, the yellow LED light blinks, when a measurement is taken.
Meteo-42 is connected to the LAN. After entering the IP address of Meteo-42 in my browser, I receive an error message.	Check the following possibilities: • The browser does not trust the TLS certificate supplied by the Meteo-42. See Section 2.3. • The CECS is switched off. The web interface can only be accessed when the CECS is on. See Section 1.4. • Make sure the Meteo-42 and your PC are within the same LAN. • A static IP address is configured, which does not exist in your current LAN. If you have the permission, you can activate DHCP in the display of Meteo-42. Go to the Communication $\rightarrow$ Devices $\rightarrow$ LAN $\rightarrow$ eth menu and set *Use DHCP* to Yes (see Section 9.1. Or connect the data logger via USB and change the LAN settings. See Section 7.7.
Meteo-42 is connected via USB to a Windows PC but is not recognized.	Download and install the required driver file. See Section 2.5.

Question	Answer
Which cable I have to use to connect Meteo-42 to my PC?	Use a standard USB-A+B cable, the same cable used to connect printers or other devices. Note that you might require a driver file for Meteo-42 (see above). Ethernet also works if both ends are configured for link-local connections.

16.2 Remote Communication

16.2.1 Modem

Question	Answer
Modem USB connected but internet (e.g. AmmonitConnect, email, remote copy) is not working.	It is a common mistake to try to test the modem communication while accessing the user interface locally via ethernet. With the default configuration, the preferred connection in this case is the ethernet and, if there is no internet access via ethernet, the data logger will not have internet access. You can see in the status box: *Connection: ETHERNET, Modem* (See Figure 3.2). The recommended way to test the USB GSM modem is to disconnect the ethernet cable and check the connection at the display menu Communication (see Section 7.10) or via AmmonitConnect (see Section 7.3). You can always access the data logger user interface using the USB-B cable, which doesn't interfere with the modem communication. If both the ethernet communication (for local access) and the modem communication (for remote access) are needed, you must activate the option *Connect to Internet via modem only* in Communication → LAN menu (see Section 7.7). This is usually the case with SCADA (Modbus TCP).
After configuring and connecting the Sierra Wireless FXT009 modem, the connection cannot be established.	• Make sure the SIM card is not broken. The SIM card should be inserted properly and the SIM card slot of the modem has to be locked (see Section 7.9.6.1). • Check the power supply of the modem. A small red light indicates that the modem is running. • Make sure that you configured the SIM card's provider details in the provider settings. Use the *Provider helper* (see Section 7.9.1), if you are unsure. If your provider is not given in the list, ask your provider for the details, i.e. APN, username and password. We recommend double checking the provider details. • Make sure that the used SIM card has not been locked by entering a wrong PIN code. You can create a new PIN code via the Meteo-42 web interface; the PUK code is required. • Make sure that you use a SIM card and contract which support mobile Internet.
An Internet connection is always established, when I switch on the CECS of Meteo-42. The modem should only be online, when data has to be sent.	Deselect the checkbox *Modem online, when CECS is on* in the Communication → Modem menu. Thus the modem only establishes an online connection when an action (e.g. upload data, email data or online availability) is scheduled.

Question	Answer
I cannot connect to the data logger via modem?	• Make sure the modem is switched on and running to perform the scheduled actions. Did you configure a switch to toggle the modem? If the modem is connected via relay to the data logger, a switch has to be configured in the Communication → Modem menu of the data logger. S1 is set by default in the modem configuration. It is not sufficient to toggle the switch manually, as it is not saved to the data logger configuration. After rebooting the data logger or after power supply interruptions, the modem will not start again. It remains switched off. See also Section 7.9. • If the modem is configured properly and you do not receive any measurement data, it could be a problem with the modem. Are the frequency bands configured correctly? Refer to Section 7.9.6.1. We also recommend upgrading the data logger firmware regularly as we continuously improve the software. • If you receive measurement data, the signal might be too weak to set up the Internet connection to access the data logger. In this case refer to Section 16.2.2. **Tip** We recommend testing the modem functions before installation in the field, e.g. sending emails, uploading files and accessing the web interface via modem connection.
How do I connect a BGAN satellite modem?	BGAN satellite modems are connected via Ethernet cable to Meteo-42. In order to supply the satellite modem, a *LAN switch* has to be assigned in the Communication → LAN menu. Make sure that the checkbox *LAN online, whenever CECS is on* is not selected. Hence, the modem goes online only when needed. The modem itself has to be configured using the software provided by its manufacturer. For further details refer to Section 7.9.7 and especially to Section 7.9.7.3.

16.2.2   AmmonitConnect

Question	Answer
I see the error "Your data logger is currently not connected to AmmonitConnect.".	• Your data logger is (currently) not connected to the Internet. Maybe the data logger has not been configured to be online for this time. Meteo-42 establishes an Internet connection for the periods configured in the schedule (see Section 7.2). **Tip** If you use AmmonitOR to monitor your data logger, you can check, when the data logger is scheduled to be online. • The data logger is busy, e.g. performing an upgrade, uploading files. Try again after a few minutes. • Another user is logged in and is downloading data files. Try again after a few minutes.
The entered URL seems to be wrong.	Make sure that the URL has the form `https://Dnnnnnn.connect.ammonit.com/`, where `Dnnnnnn` must be replaced with the serial number of the data logger without spaces or hyphens.

Question	Answer
I do not know the access code.	Contact the Ammonit support team. The default access code is "Ammonit".
The data logger is sending / uploading data, but I cannot connect via AmmonitConnect.	The connection seems to be unstable. The issue can be solved as follows: • The GPRS connection might be very weak. Switch to GSM. Ask your provider for the dial-in number (P-to-P). The dial-in *Number* has to be configured in the Meteo-42 web interface in the Communication → Modem menu. An *APN* does not have to be entered. See also Section 7.9. • The signal might be very weak. Replace the installed antenna with a *Yagi* directional antenna. The *Yagi* antenna can be aligned to a near transmitting station to receive a better signal. For further details see Wikipedia (`http://en.wikipedia.org/wiki/Yagi-Uda_antenna`). • Instead of using a standard SIM card with dynamic IP address, insert a SIM card with public IP address into the modem. The data logger can be accessed via its public IP address as well as AmmonitConnect, if configured. See also Section 7.3. If your data logger is registered in AmmonitOR, you can find its public IP address in the Data Loggers → Connections menu. Go with the mouse pointer on a displayed connection in the *graphic view* or look up the IP address in the *text view*.

16.3   Firmware Upgrade

Question	Answer
Do I have to be on site to perform an upgrade?	No, you can start the upgrade via remote access (tunnel connection), e.g. when the data logger is scheduled to be online. Nevertheless we recommend upgrading the data logger in the office to avoid any unexpected difficulties.
The upgrade does not work, despite of having an internet connection.	Check date and time of the data logger. If the data logger date and time is too far in the past or in the future, the upgrade will not work.
My data logger is not connected to the Internet; how can I perform an upgrade?	In order to perform an upgrade, the data logger has to be connected to the Internet. By connecting your smartphone to the data logger, you can set up an Internet connection via the tethering function of the smartphone. Connect your smartphone to your Meteo-42 data logger via USB (USB-A slot of the data logger and micro USB slot of the smartphone). Open the settings for *Tethering and portable hotspot* of the smartphone operating system (see Figure 4.15). Activate USB tethering. Browse for the IP address of your Meteo-42 data logger using the keys (Communication → Devices → LAN → USB (Activated) → IP settings). Enter the data logger's IP address in your smartphone browser, login and perform the upgrade. See also Section 4.3.3.
Do I have to install all upgrades?	We recommend installing all available upgrades to benefit from new features and to fix recent problems. Ammonit regularly informs Meteo-42 users about available upgrades by email.
During the download process the connection was interrupted? Do I have to restart the download process?	The downloaded software packages are stored on the data logger. Start the upgrade process again to continue the download and installation process. Once downloaded packages do not have to be downloaded again.

© 2011 — 2023 Ammonit Measurement GmbH

Question	Answer
How does the installation process affect the recording of the MARS?	If the MARS is not affected by the upgrade, the recording continues without any interruption. If the MARS will be upgraded, the recording stops for approx. 30s and continues afterwards.

16.4 Data: Format, Transfer and Download

Question	Answer
Which methods are available to transfer data files?	• Upload data files via SCP/FTP/SFTP/FTPS connection to a server of your choice or the AmmonitOR installation on your server (see Section 7.6). • Upload data files to your AmmonitOR account on the Ammonit server (AmmonitOR project key is required, see Section 7.6). • Sent data files to an email account (see Section 7.5). • Manual download of CSV files via the Meteo-42 web interface. • Manual download of CSV files on pre-configured USB flash drive on site (see Section 4.4.3).
If no Internet connection is available on site, can I download data files?	Yes, you can download the statistics and/or the source data using a pre-configured USB flash drive. Switch on the data logger (CECS) and plug in the prepared USB flash drive. All generated CSV files will automatically be saved on the USB flash drive. See also Section 4.2. You can also connect to the data logger via USB or W-LAN on site and download the CSV files on your PC.
What happens to data files which could not be sent or uploaded according to the schedule time, e.g. because of connection problems?	Files which have not been sent according to the scheduled time will be sent or uploaded at the next scheduled action.
I receive data files with the file type csv.gz? How do I handle these files?	The file is compressed using GNU gzip (See Section 6.6) and has to be decompressed before you can use it. If you work with Microsoft Excel™, open the file as decribed in Section 6.6.3. If you work with LibreOffice or OpenOffice, use the settings decribed in Section 6.6.2.
How can I open CSV files generated by Meteo-42 with Microsoft Excel?	In order to open CSV files with Microsoft Excel, the settings have to be adapted. Launch Microsoft Excel and open the *Options* in menu *File*. Under *Advanced* the decimal and thousands separators are defined. Adapt the settings for Meteo-42 CSV files as follows, if necessary. Decimal separator has to be a dot (.); thousands separator has to be a comma (,). If necessary, deselect the function Use system separators. CSV files generated by Meteo-42 data loggers use the comma (,) as field separator, double quote (") for embedding commas in textual strings and UTF-8 as character set. These details have to be considered, when data files are imported. In order to import CSV files, click on *From Text* on the *Data* tab and browse for the CSV file. Follow the instructions of the import wizard. For further details refer to Section 6.6.3.
I have an AmmonitOR installation on my own server. How can I upload the data files to it?	Select in the Communication → AmmonitOR menu of your Meteo-42 data logger for *AmmonitOR server* the value `Custom AmmonitOR` and below under *server* the name or IP address of your server.
What does the date/time at the beginning of each row of the CSV file show?	The date and time value shows the start time of the statistics interval of this row. Date and time format are similar to ISO-8601, e.g. 2014-07-17 15:50:00. The date and time values are always the local time of the data logger. See also Section 6.6.

16.5   Sensor: Configuration and Connection

16.5.1   Sensor Configuration

Question	Answer
The sensor which I have to install is not given in the sensor list. How do I configure the sensor?	If the sensor is not given in the list, you can select *Other Sensor* in the *Sensor Helper* and configure channels, slope and offset values, measurement rate etc. manually. If the anemometer you want to install is not listed in the *Sensor Helper*, select *Anemometer* for the sensor type and *Generic Anemometer* for the sensor. The other values have to be configured manually. If the analog wind vane you want to install is not listed in the *Sensor Helper*, select *Wind Vane* for the sensor type and *Generic Analog Wind Vane* for the sensor. The other values have to be configured manually. ⚠️ **Important** Only for the sensors listed in the *Sensor Helper*, Ammonit assures the correct calculation of the statistics! If you are unsure how to configure an unlisted sensor, contact the Ammonit support team.
I have a calibrated sensor. Where do I enter the calibration values?	For each configured sensor you can modify the slope and offset values in the *Sensor Helper*.
My configured pyranometer SPN1 does not display any estimated value?	In order to estimate DNI and sun status, you have to enter the geographic coordinates of the measurement station, i.e. latitude and longitude. Both coordinates are important to get the zenith angle of the sun at the site. Enter latitude and longitude in the System → Administration menu of your Meteo-42 data logger.
Why is the slope of a 10-bits digital wind vane `0.3515625`?	The slope of a 10-bits wind vane is always $360°/2^{10}$. Since version 2.1.7, you *can* change the value, but we recommend *not* to change it, even if the calibration certificate shows a slightly different value.
Some statistics files have been generated with incorrect configuration, e.g. because a sensor was replaced but the slope and offset were not updated. How do I regenerate the statistics?	In the Data → Statistics menu, click "Show month" and select the files to be recreated. Click "Download selected" first to make a backup. Then click "Delete selected" to remove the incorrect files. You may now click "Generate now" or wait for the next scheduled transfer action which will automatically regenerate the statistics.

16.5.2   Sensor Connection

Question	Answer
Where can I find a plan to connect a sensor?	• If you ordered the measurement system including steel cabinet and cables from Ammonit, connection plans can be found in the steel cabinet. Additionally, the sensor connection with Ammonit cables is described in the data sheet, which you received for each sensor bought from Ammonit. • If you ordered only the sensors without cables from Ammonit, refer to the data sheet by the sensor's manufacturer. In Chapter 13 you can find the electrical connection plans for Meteo-42.

Question	Answer
I have to install two potentiometric wind vanes, a barometric pressure sensor and a temperature humidity sensor - all connected to analog voltage channels. Which data logger model is suitable?	The Meteo-42M model offers 8 analog voltage channels to connect two potentiometric wind vanes, a barometric pressure sensor and a temperature humidity sensor. If digital wind vanes TMR would be installed, which require only one digital channel each, the Meteo-40S model would be suitable, as well. **Note** Digital wind vanes TMR are more precise than potentiometric wind vanes. Additionally, digital wind vanes TMR are subject to less mechanical wear than potentiometer wind vanes thanks to their solid state design. Wind vanes TMR do not have moving parts, except the bearings. Thus digital wind vanes TMR are more reliable and less susceptible to failure.

16.6   Measurement

Question	Answer
Sensors are configured and connected, but the measurement is not recorded?	Check the following options: • It seems that the power supply during measurement was not sufficient or has stopped. Thus MARS is turned off. Connect Meteo-42 to a reliable power supply to turn MARS on. • In the status box *Recording* is swiched off. Click *Switch on* in the Meteo-42 web interface. • The configuration has not been saved after the last modification. Save the configuration and click *Switch on* for recording.
Where can I find the meteorological data in m/s or °C?	The current value of each evaluation is displayed in the Measurement → Evaluation menu in the Meteo-42 web interface. Additionally, you can display live data in the Data → Live menu of the data logger. In the CSV files you can find the evaluated meteorological data according the the settings you made in the Data → Statistics menu. Furthermore, if you work with AmmonitOR, you can monitor the meteorological data in your AmmonitOR project, e.g. in various plots for selectable periods.
Where can I find the original electrical measurement data?	The current electrical value of each channel is displayed in the Measurement → Channels menu of the Meteo-42 web interface. Additionally, you can see the electrical values of all channels in the Data → Source menu. In the source file, which can be downloaded in the Data → Statistics menu of the data logger, you can see all electrical values of all channels for a selected period.

16.7   Errors and Messages

Question	Answer
After saving a configuration or starting an action, an *Internal error* occured and is displayed in the web interface?	Internal errors could have various reasons. Not always a serious error occured, e.g. due to a short connection time out, an operation could have been interrupted. Try the following actions to solve the problem: • Go to another page and perform the action again. • Restart the data logger and perform the action again.

Question	Answer
The red LED light is turned on. What does it indicate?	It indicates that an error in the measuring operation occured. For details see System → Logbook in the web interface or System → Errors → Error List in the display menu.

Important

If you should notice any error on your data logger or in the web interface, we kindly ask you to inform us as soon as possible. The Meteo-42 data logger is a very complex system, so unfortunately it can happen that errors occur. In order to avoid any disruption of the data logger operation, we need on your assistance.

In case of an error, please note down what have been done on the data logger before the error occured, which system components are used, e.g. GSM modem or satellite modem, and which system configuration is active.

Release Notes

Version 2.2.4 (2024-02-08)

- Display analogue voltage channel overflow as "OF" and underflow as "UF" in the source data instead of "nan".
- Run actions which are scheduled only once per week (previously these actions were erroneously skipped).
- Allow source data which begins with repeated config changes to be indexed correctly.
- Generate statistics files during sending actions even if the configuration is invalid.
- Show incoming live data access requests in the web interface.
- Rename POA irradiance to Effective irradiance evaluations, correct name for the formula applied.

Version 2.2.3 (2023-12-13)

- Allow measurement data with invalid timestamps to be indexed again (not working since 2.2.2).

Version 2.2.2 (2023-12-06)

- Output statistics with an appropriate number of decimal places for the measurement precision (in most cases 1 or 2 fewer).
- Allow the time zone to be changed without duplicating timestamps or creating artifical gaps.

📎 **Note**
After the upgrade, manually restart the recording once, generate statistics and wait 24 hours before changing the time zone.

- Add Effective Irradiance calculation in Evaluation Helper.
- Fix configuring 'Wind Vane Lambrecht wind Professional 14521'.
- Show progress on the display when copying statistics files to a USB flash drive (missing since 2.2.0).
- Fix wind direction calculation for upside down ultrasonic sensors.
- Add "Disabled" Ethernet mode for reduced power consumption.
- Include more measurements in statistics files either side of configuration changes.
- Improved compatibility with GLONASS and Galileo GPS-like devices.

Version 2.2.1 (2023-10-27)

- Fix system instability when configuring ultrasonic anemometers.
- Preserve user-submitted inputs when the Sensor Helper form is reloaded.
- Fix 'Silicon Irradiance Sensor M&T 2 x 0-10V' implementation.
- Migrate average and standard deviation statistics for secondary and tertiary files.

Version 2.2.0 (2023-10-18)

- This is the first public release of Meteo-42.

Known Problems

Although Meteo-42 plus has been released for measurement campaigns, errors can occur. Please find below a list of known problems. We will fix the problems as soon as possible.

- Wi-Fi stick TL-WN321G does not work
- Chinese translation is still incomplete

GNU General Public License

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change free software - to make sure the software is free for all its users. This General Public License applies to most of the Free Software Foundation's software and to any other program whose authors commit to using it. (Some other Free Software Foundation software is covered by the GNU Library General Public License instead.) You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs; and that you know you can do these things.

To protect your rights, we need to make restrictions that forbid anyone to deny you these rights or to ask you to surrender the rights. These restrictions translate to certain responsibilities for you if you distribute copies of the software, or if you modify it.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must give the recipients all the rights that you have. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

We protect your rights with two steps:

1. copyright the software, and
2. offer you this license which gives you legal permission to copy, distribute and/or modify the software.

Also, for each author's protection and ours, we want to make certain that everyone understands that there is no warranty for this free software. If the software is modified by someone else and passed on, we want its recipients to know that what they have is not the original, so that any problems introduced by others will not reflect on the original authors' reputations.

Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that redistributors of a free program will individually obtain patent licenses, in effect making the program proprietary. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

The precise terms and conditions for copying, distribution and modification follow.

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

Section 0

This License applies to any program or other work which contains a notice placed by the copyright holder saying it may be distributed under the terms of this General Public License. The "Program", below, refers to any such program or work, and a "work based on the Program" means either the Program or any derivative work under copyright law: that is to say, a work containing the Program or a portion of it, either verbatim or with modifications and/or translated

into another language. (Hereinafter, translation is included without limitation in the term "modification".) Each licensee is addressed as "you".

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running the Program is not restricted, and the output from the Program is covered only if its contents constitute a work based on the Program (independent of having been made by running the Program). Whether that is true depends on what the Program does.

Section 1

You may copy and distribute verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and give any other recipients of the Program a copy of this License along with the Program.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

Section 2

You may modify your copy or copies of the Program or any portion of it, thus forming a work based on the Program, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a. You must cause the modified files to carry prominent notices stating that you changed the files and the date of any change.

b. You must cause any work that you distribute or publish, that in whole or in part contains or is derived from the Program or any part thereof, to be licensed as a whole at no charge to all third parties under the terms of this License.

c. If the modified program normally reads commands interactively when run, you must cause it, when started running for such interactive use in the most ordinary way, to print or display an announcement including an appropriate copyright notice and a notice that there is no warranty (or else, saying that you provide a warranty) and that users may redistribute the program under these conditions, and telling the user how to view a copy of this License. (Exception: If the Program itself is interactive but does not normally print such an announcement, your work based on the Program is not required to print an announcement.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Program, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Program, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Program.

In addition, mere aggregation of another work not based on the Program with the Program (or with a work based on the Program) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

Section 3

You may copy and distribute the Program (or a work based on it, under Section 2 in object code or executable form under the terms of Sections 1 and 2 above provided that you also do one of the following:

a. Accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,

    b. Accompany it with a written offer, valid for at least three years, to give any third party, for a charge no more than your cost of physically performing source distribution, a complete machine-readable copy of the corresponding source code, to be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,

    c. Accompany it with the information you received as to the offer to distribute corresponding source code. (This alternative is allowed only for noncommercial distribution and only if you received the program in object code or executable form with such an offer, in accord with Subsection b above.)

The source code for a work means the preferred form of the work for making modifications to it. For an executable work, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the executable. However, as a special exception, the source code distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

If distribution of executable or object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place counts as distribution of the source code, even though third parties are not compelled to copy the source along with the object code.

Section 4

You may not copy, modify, sublicense, or distribute the Program except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense or distribute the Program is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

Section 5

You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Program or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Program (or any work based on the Program), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Program or works based on it.

Section 6

Each time you redistribute the Program (or any work based on the Program), the recipient automatically receives a license from the original licensor to copy, distribute or modify the Program subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties to this License.

Section 7

If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Program at all. For example, if a patent license would not permit royalty-free redistribution of the Program by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Program.

If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system, which is implemented by public license practices. Many people have made generous contributions to the wide

range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

Section 8

If the distribution and/or use of the Program is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Program under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

Section 9

The Free Software Foundation may publish revised and/or new versions of the General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of this License, you may choose any version ever published by the Free Software Foundation.

Section 10

If you wish to incorporate parts of the Program into other free programs whose distribution conditions are different, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY Section 11

BECAUSE THE PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

Section 12

IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSE-QUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

<one line to give the program's name and a brief idea of what it does.> Copyright (C) <year> <name of author>

This program is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation; either version 2 of the License, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with this program; if not, write to the Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA

Also add information on how to contact you by electronic and paper mail.

If the program is interactive, make it output a short notice like this when it starts in an interactive mode:

Gnomovision version 69, Copyright (C) year name of author Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type "show w". This is free software, and you are welcome to redistribute it under certain conditions; type "show c" for details.

The hypothetical commands "show w" and "show c" should show the appropriate parts of the General Public License. Of course, the commands you use may be called something other than "show w" and "show c"; they could even be mouse-clicks or menu items--whatever suits your program.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the program, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in the program "Gnomovision" (which makes passes at compilers) written by James Hacker.

<signature of Ty Coon>, 1 April 1989 Ty Coon, President of Vice

This General Public License does not permit incorporating your program into proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the library. If this is what you want to do, use the GNU Library General Public License instead of this License.

Chapter 17

Glossary

APN
Access Point Name
CDMA
Code Division Multiple Access
CECS
Configuration, Evaluation, and Communication System
CPV
Concentrated Photovoltaics
CSP
Concentrated Solar Power
CSV
Comma Separated Values
DHCP
Dynamic Host Configuration Protocol
DHI
Diffuse Horizontal Irradiation
DNI
Direct Normal Irradiation
DNS
Domain Name System
FTP
File Transfer Protocol
FTPS
FTP Secure (using TLS/SSL)
GHI
Global Horizontal Irradiation
GIS
Geographic Information System
GNU
GNU's Not Unix
GnuPG
GNU Privacy Guard
GPL
General Public License

GPRS

General Packet Radio Service

GPS

Global Positioning System

GSM

Global System for Mobile communications

GTI

Global Tilted Irradiation

HTTP

HyperText Transfer Protocol

HTTPS

HTTP Secure

IEEE

Institute of Electrical and Electronics Engineers

IP

Internet Protocol

JID

Jabber Id, an XMPP address

LAN

Local Area Network

LCD

Liquid Crystal Display

LED

Light-emitting diode

LGPL

Lesser General Public License

MARS

Measurement And Recording System

NTP

Network Time Protocol

OVP

Overvoltage Protection

PIN

Personal Identification Number

POA

Plane of Array

POT

Potentiometer - Measurement principle, e.g. Wind vane POT

PPP

Point-to-point protocol

PUK

PIN Unlock Key (or Personal Unblocking Code, PUC)

PV

Photovoltaic

RNDIS

Remote Network Driver Interface Specification

SCADA

Supervisory Control and Data Acquisition

SCP

Secure Copy Protocol/Program (using SSH)

SFTP

Secure FTP (using SSH)

SIM

Subscriber Identity Module

SMS

Short Message Service

SMSC

Short Message Service Center

SSH

Secure Shell

SSL

Secure Sockets Layer

TCP/IP

Transmission Control Protocol/Internet Protocol

TLS

Transport Layer Security

TMR

Tunnel Magnetoresistance - Measurement principle, e.g. Wind vane TMR

UMTS

Universal Mobile Telecommunications System

USB

Universal Serial Bus

W-LAN

Wireless Local Area Network

WMO

World Meteorological Organization

XMPP

Extensible Messaging and Presence Protocol (originally named Jabber)

Chapter 18

Index