

# ibaClock

Time synchronization module for ibaPDA systems

Manual

Issue 2.0

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The content of this publication has been checked for compliance with the described hardware and software. Nevertheless, deviations cannot be excluded completely so that the full compliance is not guaranteed. However, the information in this publication is updated regularly. Required corrections are contained in the following regulations or can be downloaded on the Internet.

The current version is available for download on our web site <http://www.iba-ag.com>.

**Protection note**

Windows® is a label and registered trademark of the Microsoft Corporation. Other product and company names mentioned in this manual can be labels or registered trademarks of the corresponding owners.

**Certification**

The device is certified according to the European standards and directives. This device corresponds to the general safety and health requirements. Further international customary standards and directives have been observed.



Issue	Date	Revision	Chapter	Author	Version HW / FW
2.0	09-2023	Scope of delivery, ibaPDA GUI			

## Table of contents

<b>1</b>	<b>About this manual</b> .....	<b>5</b>
1.1	Target group .....	5
1.2	Notations .....	5
1.3	Used symbols .....	6
<b>2</b>	<b>Introduction</b> .....	<b>7</b>
<b>3</b>	<b>Scope of delivery</b> .....	<b>8</b>
<b>4</b>	<b>Safety instructions</b> .....	<b>9</b>
<b>5</b>	<b>System requirements</b> .....	<b>10</b>
5.1	Hardware .....	10
5.2	Software .....	10
<b>6</b>	<b>Mounting and Dismounting</b> .....	<b>11</b>
6.1	Mounting and Connecting .....	11
6.2	Dismounting .....	11
<b>7</b>	<b>Device description</b> .....	<b>12</b>
7.1	Device views .....	12
7.1.1	Front view .....	12
7.1.2	Bottom view .....	12
7.2	Display elements .....	13
7.3	Connections .....	13
7.3.1	FO connections X10 and X11 .....	13
7.3.2	Power supply X14 .....	14
7.3.3	Digital outputs .....	14
7.3.4	GPS input X44 .....	14
7.3.5	IRIG-B input X45 .....	14
7.3.6	Ethernet interface .....	15
<b>8</b>	<b>System integration</b> .....	<b>16</b>
8.1	Time source via FO .....	16
8.2	Time server via network .....	17
8.2.1	TIME Protocol .....	17
8.2.2	DAYTIME Protocol .....	17
8.2.3	NTP .....	17
8.2.4	PTP .....	22
<b>9</b>	<b>Initial start-up</b> .....	<b>23</b>
9.1	Basis .....	23
9.2	Setup of communication connections .....	23
9.2.1	Ethernet interface .....	23
9.3	Web interface .....	26
9.3.1	Open the web interface .....	26
9.3.2	Information - start page .....	28
9.3.3	Network .....	29
9.3.4	Settings .....	30

9.3.5	GPS .....	33
9.3.6	PTP.....	34
9.3.7	Administration .....	36
9.3.8	Help .....	37
<b>10</b>	<b>Configuration with ibaPDA.....</b>	<b>38</b>
10.1	First steps .....	38
10.2	ibaClock - "General" tab.....	40
10.3	ibaClock – “Analog” tab.....	41
10.4	ibaClock - "Digital" tab.....	42
10.5	ibaClock - "Diagnostics" tab .....	42
<b>11</b>	<b>Technical data .....</b>	<b>45</b>
11.1	Main data .....	45
11.2	Dimension sheet .....	48
11.3	Pin assignment antenna cable .....	49
11.4	Example for FO budget calculation .....	51
<b>12</b>	<b>Accessories.....</b>	<b>53</b>
12.1	Antenna mounting .....	53
12.1.1	Mounting socket.....	54
12.1.2	Wall bracket .....	54
<b>13</b>	<b>Trouble shooting.....</b>	<b>55</b>
13.1	Antenna configuration .....	56
<b>14</b>	<b>Security.....</b>	<b>58</b>
14.1	List of ports used.....	59
14.2	Other types of access .....	59
<b>15</b>	<b>PTP.....</b>	<b>60</b>
15.1	Functional principle .....	60
15.2	Network requirements .....	61
<b>16</b>	<b>NTP.....</b>	<b>63</b>
16.1	Functional principle .....	63
<b>17</b>	<b>GPS .....</b>	<b>65</b>
17.1	Functional principle .....	65
<b>18</b>	<b>Timescales.....</b>	<b>67</b>
18.1	Leap second .....	67
18.2	GPS .....	67
18.3	Temps Atomique International (TAI).....	67
18.4	Coordinated Universal Time UTC.....	67
18.5	Local .....	67
18.6	Links .....	68
<b>19</b>	<b>Support and Contact .....</b>	<b>69</b>

# 1 About this manual

This manual describes the construction, the use and the operation of the device ibaClock.

## 1.1 Target group

This manual addresses in particular the qualified professionals who are familiar with handling electrical and electronic modules as well as communication and measurement technology. A person is regarded to as professional if he/she is capable of assessing safety and recognizing possible consequences and risks on the basis of his/her specialist training, knowledge and experience and knowledge of the standard regulations.

## 1.2 Notations

The following designations are used in this manual:

Action	Notations
Menu command	Menu „Logic diagram“
Call of menu command	„Step 1 – Step 2 – Step 3 – Step x“ Example: Select menu „Logic diagram – Add – New logic diagram“
Keys	<Key name> Example: <Alt>; <F1>
Press keys simultaneously	<Key name> + <Key name> Example: <Alt> + <Ctrl>
Buttons	<Button name> Example: <OK>; <Cancel>
File names, Paths	„File name“, „Path“ Example: „Test.doc“

## 1.3 Used symbols

If safety instructions or other notes are used in this manual, they mean:

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### **DANGER**

The non-observance of this safety information may result in an imminent risk of death or severe injury:

- By an electric shock!
- Due to the improper handling of software products which are coupled to input and output procedures with control function!

If you do not observe the safety instructions regarding the process and the system or machine to be controlled, there is a risk of death or severe injury!

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### **WARNING**

The non-observance of this safety information may result in a potential risk of death or severe injury!

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### **CAUTION**

The non-observance of this safety information may result in a potential risk of injury or material damage!

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#### **Note**

A note specifies special requirements or actions to be observed.

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#### **Tip**

Tip or example as a helpful note or insider tip to make the work a little bit easier.

---



#### **Other documentation**

Reference to additional documentation or further reading.

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## 2 Introduction

ibaClock is a compact device for the time synchronization of several connected ibaPDA systems.

The time base of every ibaPDA system is the time of the respective ibaPDA computer. In case of requirements such as real time measurements or correlation of decentralized data, distributed systems may require a synchronization of all computers.

ibaClock indicates the time base for all connected ibaPDA systems as central master clock and ensures an exact and timely synchronized acquisition of the data. Thereby, a precision of better than 150 ns can be reached.

For a high-precision synchronization, ibaClock receives the time signal of the GPS satellites. The functions of ibaClock are adjusted to the “Trimble® Acutime™ GG” and “Trimble® Acutime™ 360” smart antennas, therefore the use of the device is exclusively provided for one of these antennas. The antennas, the suitable antenna cables and mounting accessories are also available at iba, see chapter 12. The length of the antenna cable has to be indicated when placing the order.

Alternatively, ibaClock can use the time code IRIG-B as external time source. The following telegrams are supported, e.g. IEEE C37.118, AFNOR NF S87-500, IEEE 1344 or B004 + B124, B005 + B125, B006 + B126, B007 + B127, see chapter 7.3.5.

The distribution of the time signal to the ibaPDA systems is made via fiber-optic cables. For this purpose, the ibaPDA computers need a card of the ibaFOB-D-family with FO input and output for the connection of an ibaClock device.

Beginning with firmware version v01.02.001, time synchronization with ibaClock is possible via network. The following protocols are supported: TIME protocol, DAYTIME protocol and NTP.

Furthermore, the firmware version v01.04.001 provides the possibility to use PTPv2 (IEEE 1588) for synchronization. This functionality is available both as master and as slave.

ibaClock has an internal clock that will continue to set the time in case of a failure of the GPS signal. Here, ibaClock provides a stability of < 0.150 ppm for temporary signal failures.

ibaClock can be configured comfortably via ibaPDA or the web interface.

### 3 Scope of delivery

After unpacking, please check the completeness and integrity of the delivery.

The scope of delivery comprises:

- ibaClock device
- 2-pin connector for power supply
- 4-pin connector for digital outputs

#### **Required accessories:**

##### GPS:

- “Trimble® Acutime™ GG” or “Trimble® Acutime™ 360” smart antenna
- Pre-assembled cable
  - The cable length has to be indicated when placing the order.
- Antenna base, optional
- Mounting bar, optional

##### IRIG-B:

- IRIG-B time source
- Coaxial cable, e.g. RG58 with BNC connector

## 4 Safety instructions

The device is only to be used as shown in the chapter 11 “Technical Data”.

---

**⚠ WARNING**

This is a Class A device. This equipment may cause radio interference in residential areas. In this case, the operator will be required to take appropriate measures.

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**⚠ WARNING****Strictly observe the operating voltage range**

The device is supplied with a voltage of 24 V DC  $\pm 10\%$ . When connecting to the voltage, please ensure compliance with the correct power level and polarity.

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**Important note**

A possibly necessary lightning protection for the GPS antenna, that might be needed, must be foreseen and built by an electrician.

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**Important note**

Do not open the device! Opening the device results in a loss of warranty!

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**Note**

Clean the device only on the outside with a dry or slightly damp and statically discharged cloth.

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## 5 System requirements

### 5.1 Hardware

- External time source:
  - “Trimble® Acutime™ GG” or “Trimble® Acutime™ 360” GPS smart antenna
  - Time code IRIG-B
  - PTP (IEEE 1588), E2E and P2P
- Pre-assembled antenna cable for a point-to-point-connection from the antenna to the device
- Connection to an ibaPDA system: 2 fiber optic patch cable for a bidirectional fiber optic connection to one of the following ibaFOB cards in the ibaPDA computer (suitable FO patch cables are available at iba):
  - ibaFOB-io-D
  - ibaFOB-2io-D
  - ibaFOB-2i-D, optionally with extension module ibaFOB-4o-D
  - ibaFOB-4i-D, optionally with extension module ibaFOB-4o-D
  - ibaFOB-io-ExpressCard
  - ibaFOB-io-USB adapter

The firmware of the ibaFOB-D-card must eventually be upgraded to a state D3 or higher for the use of ibaClock. Please contact the iba support in case of a required firmware update.

- Connection to a standard computer: standard Ethernet cable

### 5.2 Software

- ibaPDA version 6.34.0 and higher
- Web browser for configuration and diagnosis via the web interface of the device

## 6 Mounting and Dismounting

### 6.1 Mounting and Connecting

1. Insert the DIN rail clip at the backside of the device into the upper part of the DIN rail, then press the device downwards-backwards and let it snap into the DIN rail.
2. Then, connect the DC 24 V power supply with the correct polarity and create the following connections:
  - FO connection to the ibaPDA computer
  - Or Ethernet connection to a standard computer
3. Connection of the GPS smart antenna to the "GPS X44" connection via the supplied antenna cable. The device must be connected with the antenna via a point-to-point connection only.

#### Note for the mounting of the antenna

The antenna must be installed in the outdoor area with "sight contact" to the satellites. For the calculation of the exact time at least 4 satellites must be detected. At free sight to the horizon, averagely 7-9 satellites are visible.

The antenna should be installed with greatest possible opening angle towards the sky. A mounting rob for the mounting on buildings is available at iba.



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#### Other documentation

Please find information for positioning and mounting of the antenna in the antenna manual.

As a registered user you can find the manual at [www.iba-aq.com](http://www.iba-aq.com) in the download area.

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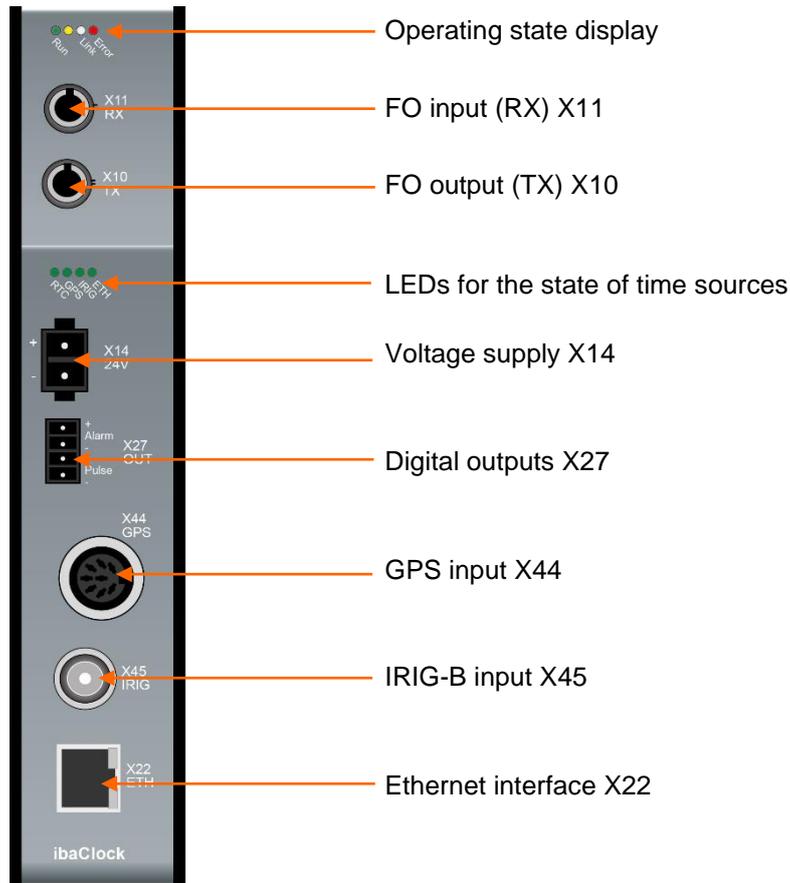
### 6.2 Dismounting

1. First, remove all connections of the device.
2. Grasp the upper part of the device with one hand. Press the device slightly downwards in order to hold it safely in both hands later to prevent the device from falling down.
3. Grasp the bottom part of the device with the other hand and pull it forwards-upwards. Thereby, the device will get detached from the DIN rail.

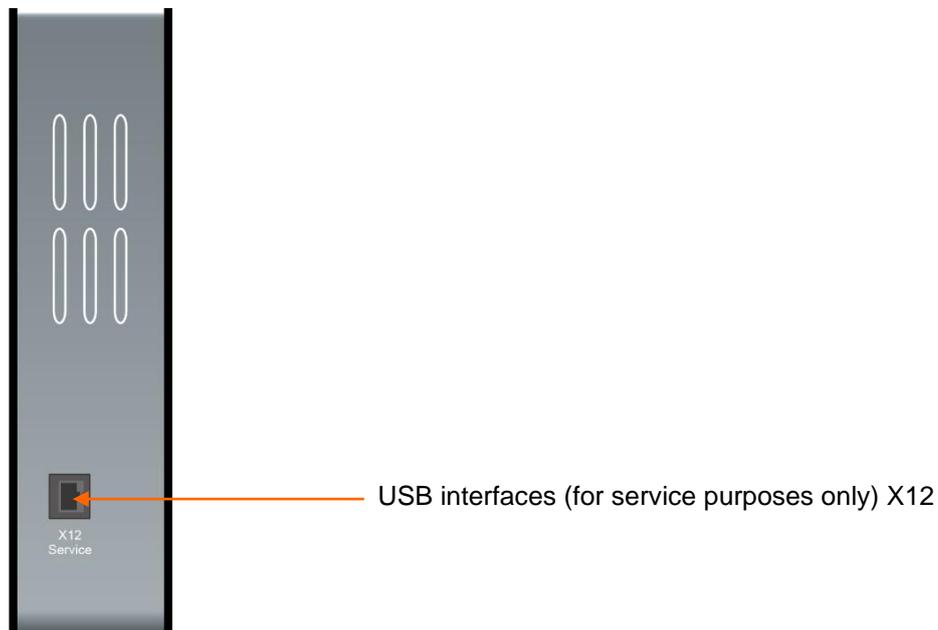
## 7 Device description

### 7.1 Device views

#### 7.1.1 Front view



#### 7.1.2 Bottom view



## 7.2 Display elements

The operating status of the device is shown by colored status LEDs.

### Operating state

LED	Color	State	Description
Run	Green	Flashes slowly	Ready for use, power supply is applied to
		Flashes quickly	Programming mode, e.g. at a firmware update
		Off	Out of service, no voltage supply
-	Yellow	-	Without function
Link	White	On	Valid signal at RX
		Flashes	Signal at RX, but configuration deviates from the detected signal
		Off	No signal at RX
Error	Red	Flashes	Error message
		Off	Error-free operation

### Status of time sources

The LED of the activated time source is always the only one activated (currently GPS). Every LED can accept the following statuses:

Status	Description
Off	Time source not selected
Green	Time source OK
Flashes green	Synchronization to time source or time source disrupted
Red	Time source defective

## 7.3 Connections

### 7.3.1 FO connections X10 and X11

- X11 (RX): FO receive interface
- X10 (TX): FO send interface

A bidirectional FO connection is required for the connection to an ibaPDA system. A FO card type ibaFOB-D or ibaFOB-Dexp has to be installed in the ibaPDA computer so that data can be received and sent.

#### Maximum distance of fiber optic connections

The maximum distance of fiber optic connections between 2 subscribers depends on various influencing factors. This includes, for example, the specification of the fiber (e.g. 62.5/125 µm, 50/125 µm or other), or the attenuation of other components in the fiber optic cable such as couplers or patch panels.

However, the maximum distance can be estimated on the basis of the sender output power of the transmitting interface (TX) or the receiving responsivity of the receiving interface (RX). An example calculation can be found in chapter 11.4.

The specification of the sender output power and the receiving responsivity of the fiber optic components installed in the device can be found in chapter "Technical data" 11.1 under "ibaNet interface".

### 7.3.2 Power supply X14

The 2-pin input serves for the supply of the device with DC 24 V  $\pm$ 10% (non regulated). The operating voltage should be put in via the supplied Phoenix threaded coupling connector. If requested, you can also order DIN rails or plug-in power supply units at iba.

### 7.3.3 Digital outputs

#### Alarm

Semiconductor relay output, switching current up to 200 mA, open in de-energized state. If GPS is configured as time source and the connection to the GPS antenna is interrupted for > 3 minutes, the alarm output will be closed.

#### Pulse

Reserved for future functions.

### 7.3.4 GPS input X44

The GPS interface serves to connect the "Trimble® Acutime™ GG" or "Trimble® Acutime™ 360" smart antenna with the pre-assembled cable. ibaClock only supports this antenna type. The antenna must be connected with a point-to-point connection to the device.

It is recommended to only use the cable which is assembled by iba. When placing the order the required cable length must be indicated (max. 400 m). Due to the technical specification, the use of standard antenna cables is not possible.

No separate power supply is needed for the antenna. The power supply is made via ibaClock.

The GPS antenna receives the time signal and position data of the GPS satellites which are in their viewing range. The GPS universal time (GPS-UTC, Universal Time Coordinated) is calculated from the time signal and the runtimes. The world time UTC is calculated from the GPS-UTC by subtraction of the switching seconds.

A configuration of the GPS input is not required.

### 7.3.5 IRIG-B input X45

Time sources using IRIG-B time code formats can be connected via the IRIG interface X45.

The following IRIG-B telegrams are supported by ibaClock:

- IEEE C37.118
- AFNOR NF S87-500
- IEEE 1344
- B004 + B124, B005 + B125
- B006 + B126, B007 + B127

**Note**

If the IRIG-B time code format sent by your time source is not listed above, please contact our support team. Usually all IRIG-B time code formats transmitting the date in years are supported.

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### 7.3.6 Ethernet interface

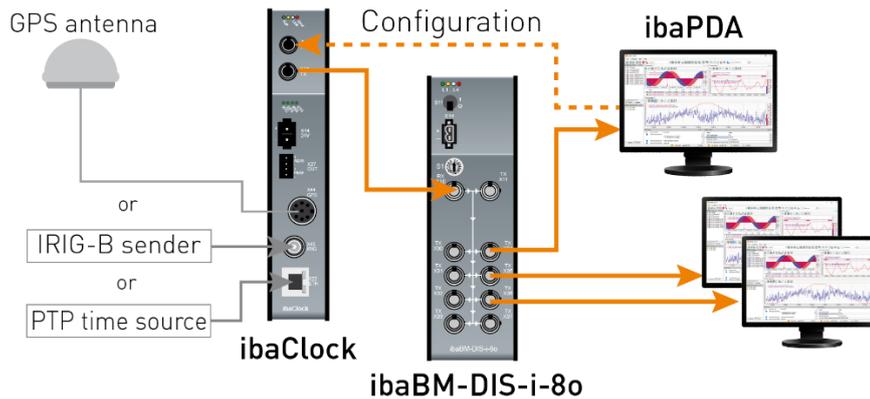
The device can be connected to a computer or to a network via the Ethernet interface X22. The web interface of the device can be accessed via the Ethernet connection.

➤ For more information, please refer to chapter 9.2.1.

The NTP and PTP protocols for time synchronization are also available via the Ethernet interface.

## 8 System integration

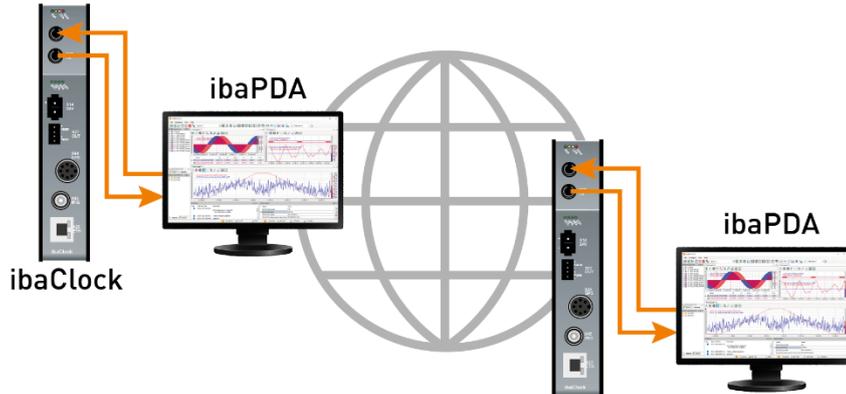
### 8.1 Time source via FO



#### Synchronization via FO

As shown in the figure above, several distributed **ibaPDA** systems can be synchronized exactly in time with **ibaClock** by means of a data distributor or an optical signal multiplier like **ibaBM-DIS-i-80** or **ibaBM-FOX-i-3o/-D**. **ibaClock** receives the time signal of the GPS satellites; alternatively a **IRIG-B** or **PTP** time source can be used. Subsequently the time information is transferred via **FO** to connected **ibaPDA** systems.

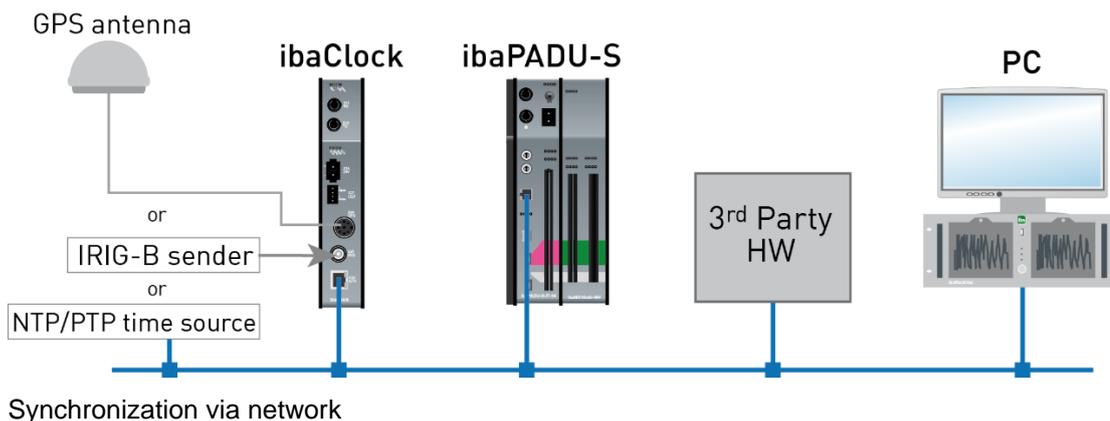
With the first **ibaPDA** system, the configuration is made by **ibaPDA** or the web interface. The configuration system must be connected with **ibaClock** via a bidirectional **FO** connection. An additional **Ethernet** cabling is hereby not necessary.



#### Synchronization of remote systems

Measuring systems which are located very far apart can also be synchronized. Therefore, each measuring point needs an **ibaClock** module which synchronizes the recording of the corresponding **ibaPDA** system to the global **GPS** time. The local time zone is taken into consideration. Thus, the local time is used in the measuring data. To compare the measuring data, the offset against the **GPS** time has to be taken into account. The offset will be saved as an information field in the measuring data.

## 8.2 Time server via network



The following protocols are available for time synchronization via network:

### 8.2.1 TIME Protocol

Using this protocol, the time is sent as an unsigned 32-bit integer to the connected device, representing the number of seconds since January 1, 1900, 00:00 GMT.

The protocol requires port 37 (TCP/UDP). This port has to be released in the firewall, if a firewall is used.

### 8.2.2 DAYTIME Protocol

When a host is connected to the server, the host will receive the current date and time as ASCII character string. The used format may vary from system to system.

Possible format:

Weekday, month, day, year time zone

#### Example:

Tuesday, December 14, 1982 13:37:42-GMT

The protocol requires port 13 (TCP/UDP), which has to be released in the firewall.

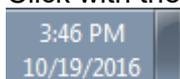
### 8.2.3 NTP

Many controls and PCs can be synchronized with NTP (Network Time Protocol). When using the NTP client integrated in Windows (from Windows 2000), a precision of 1 – 2 s can be reached. If a higher precision is required, then third party programs have to be used, since the Windows built-in client does not provide higher accuracy. Since Windows 10 1607 (Anniversary Update) and its counterpart Windows Server 2016, the client integrated in Windows also offers an accuracy of up to 1 ms.

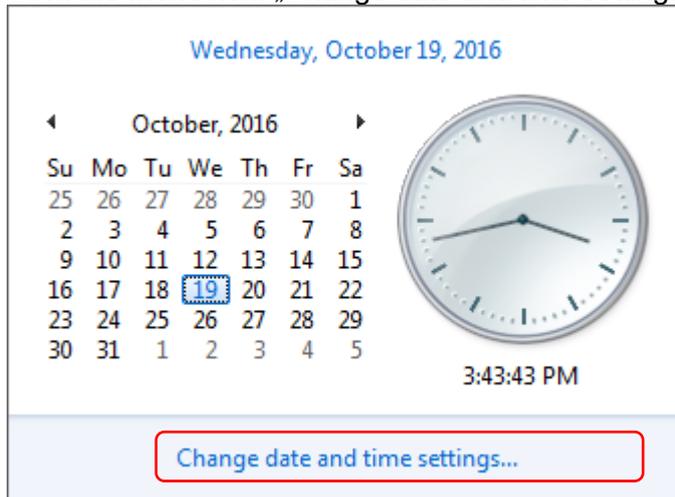
The protocol uses port 123 UDP. This port has to be released in the firewall to ensure a proper function.

#### Setup under Windows 7 (as example):

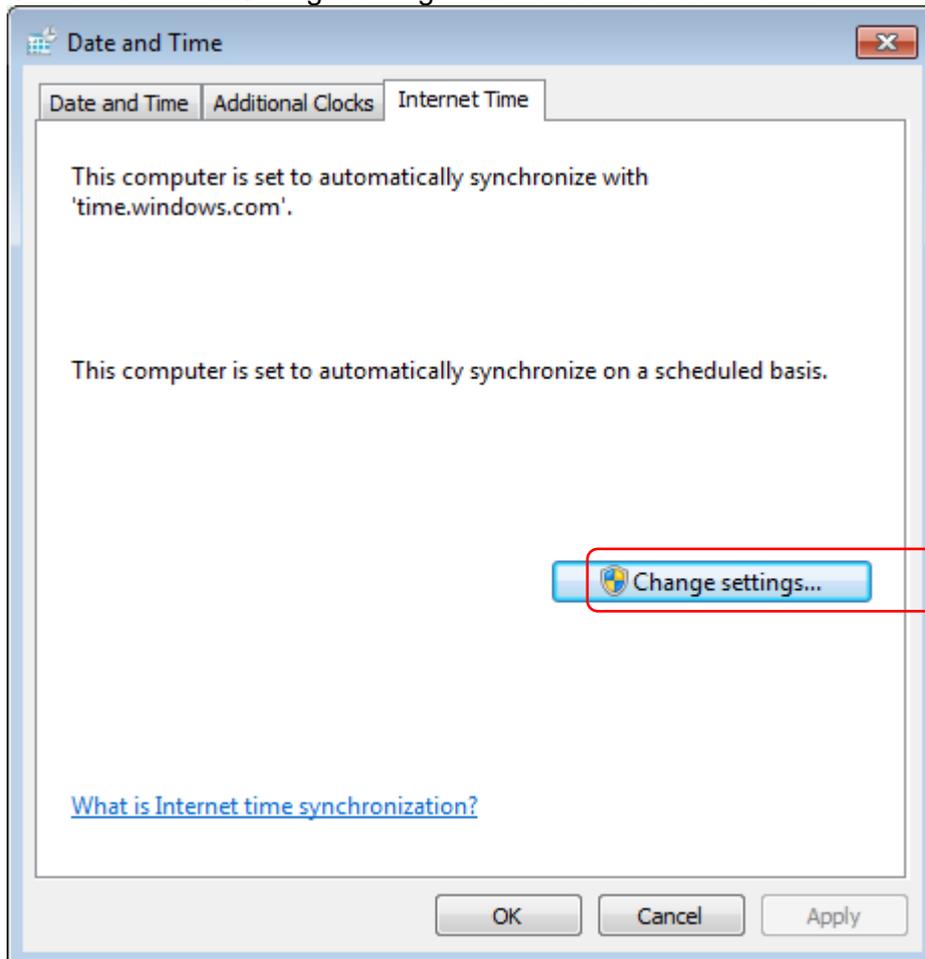
1. Click with the left mouse button on the time display in the taskbar.



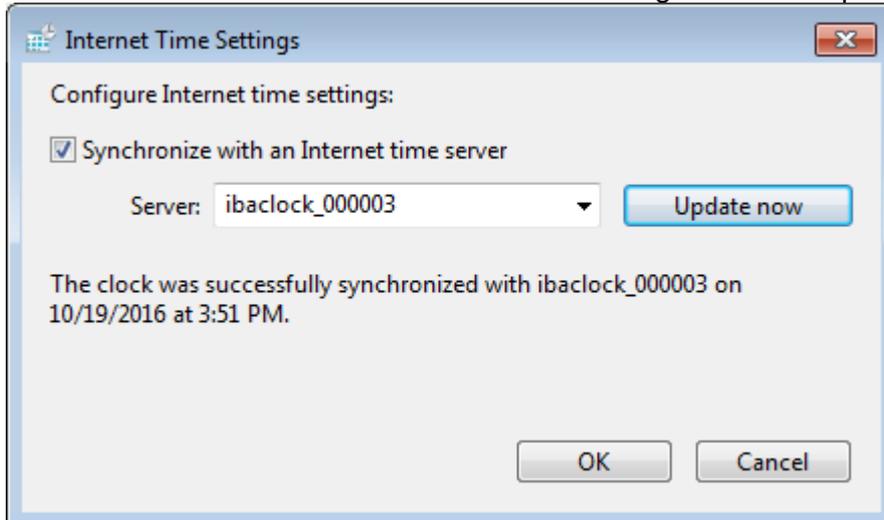
2. Click the menu item „Change date and time settings...”



3. Click the button <Change settings...> on the Internet time tab.



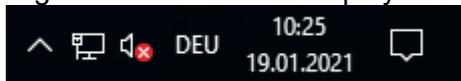
4. Enter the IP address or the host name in the dialog and click <Update now>.



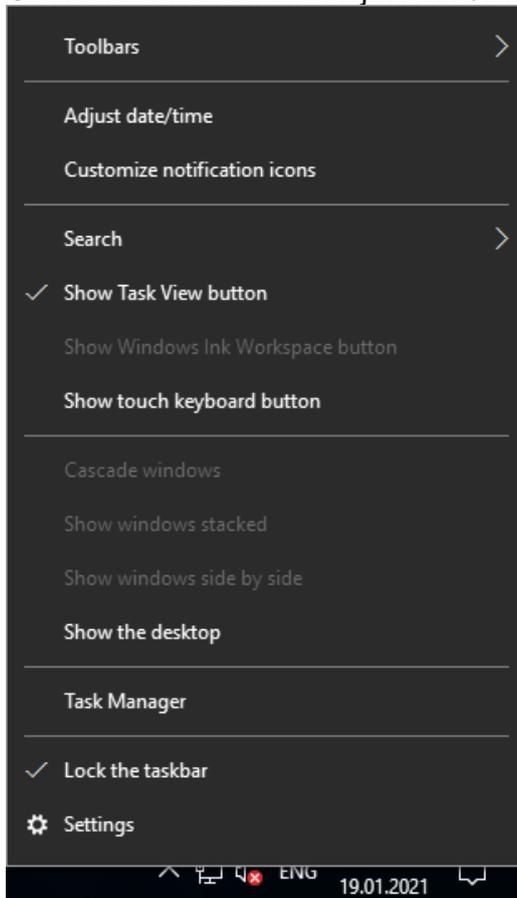
Confirm with <OK>.

### Setup under Windows 10

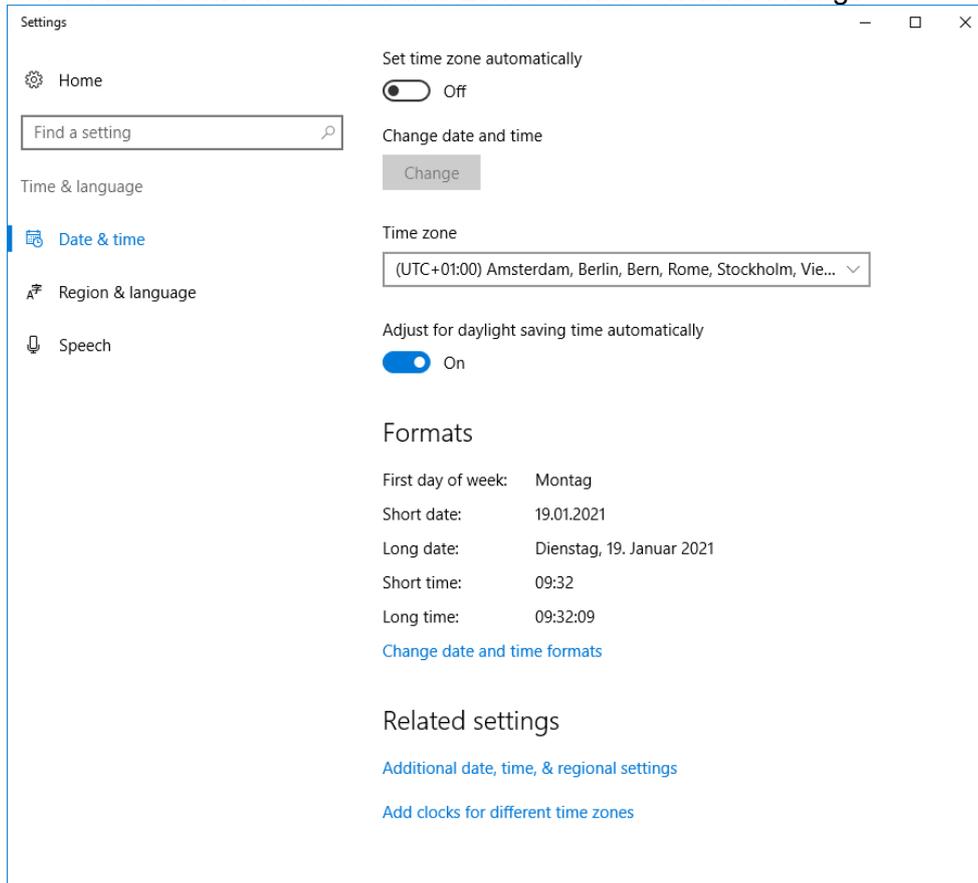
1. Right-click on the time display in the taskbar.



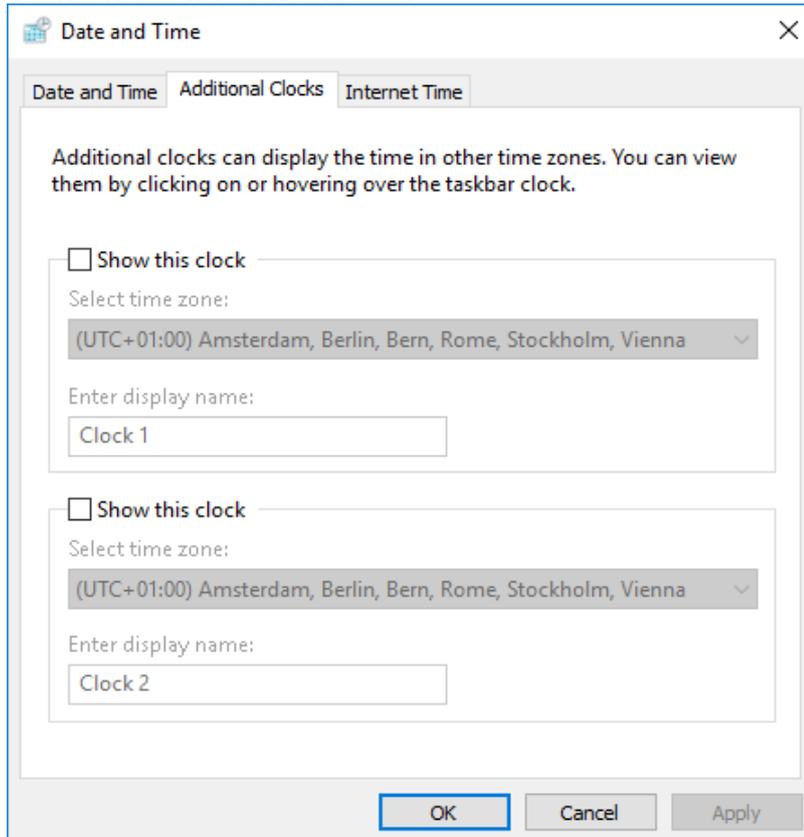
2. Click on the menu item "Adjust date/time"



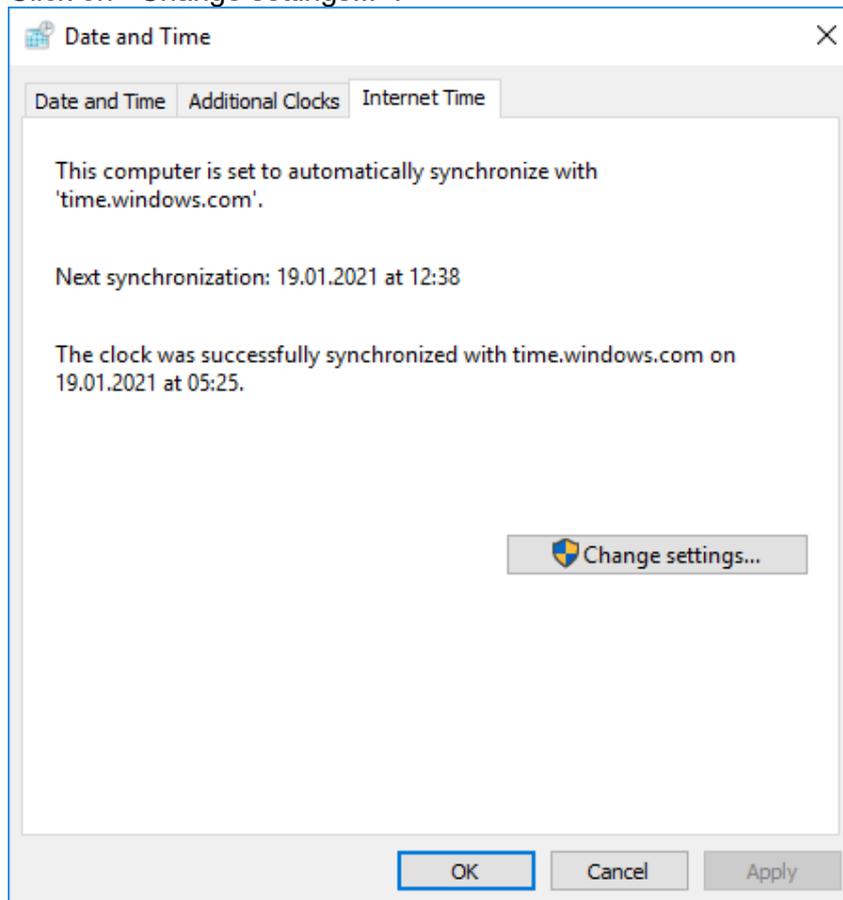
### 3. Click "Add clocks for different time zones" under "Related settings"



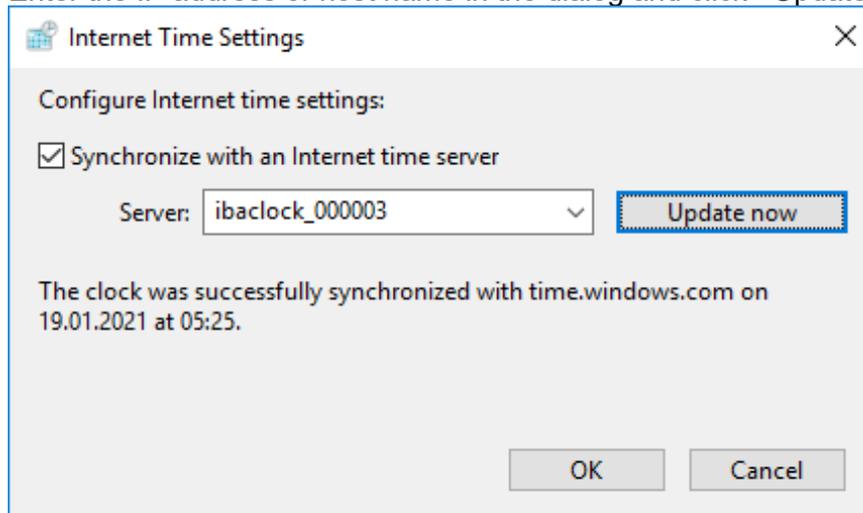
### 4. Switch to the tab "Internet Time"



5. Click on <Change settings...>.



6. Enter the IP address or host name in the dialog and click <Update now>.



#### Note

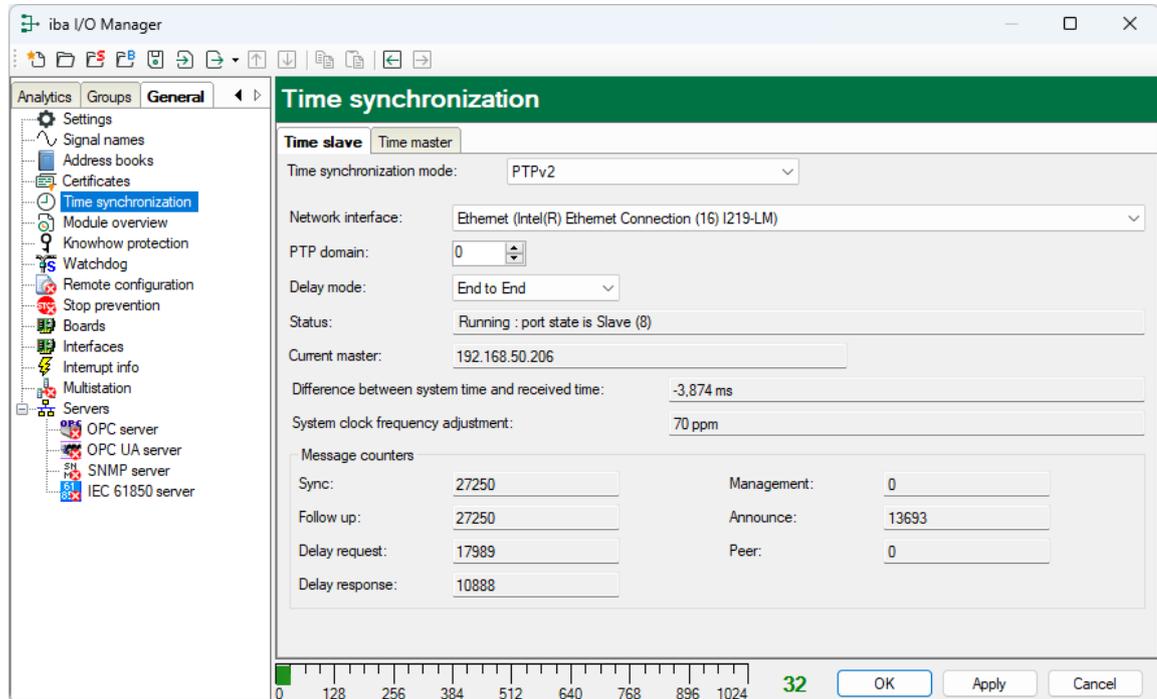
If the PC is operated within a domain, it may be necessary that these settings have to be carried out by the IT department using group policies.

## 8.2.4 PTP

Since version 6.31.0 ibaPDA offers the possibility to carry out the time synchronization via PTP.

To do this, simply set the synchronization mode for the time to PTP in the I/O manager, in the node *General – Time synchronization*.

Furthermore, the network interface and the PTP domain on which the PTP timer provides the data must be selected.



No further settings have to be made in ibaPDA.

As soon as ibaPDA receives PTP telegrams, the BMCA (Best Master Clock Algorithm) determines the best timer in the network and synchronization is carried out.



### Important note

When using PTP, please observe the requirements for the network and the built-in components.

Refer to chapter 15.2

## 9 Initial start-up

### 9.1 Basis

After switching on, ibaClock boots and the internal PLL synchronizes the system time of the device to the GPS signal. Thereby, a precision of better than 150 ns is reached. During the synchronization to the time source, the green LED of the particular time display is on. The LED is statically on when the synchronization has been finished and the source is ok. This process usually takes approx. 3 minutes.

If the device is ready for operation and the GPS is stable, it sends the time signal to the connected ibaPDA system via the FO output. ibaClock always sends the UTC time.

If the GPS signal fails, the internal clock of the device continues to set the time signal. In this process ibaClock provides a stability of < 0.150 ppm for temporary signal failures. If the GPS signal fails for a longer time (days), deviations of approx. 30 ms are possible per day between two systems which are synchronized with ibaClock.

The device can be configured via a web interface.

The following functions are available:

- Diagnosis of device status and GPS signal reception
- Network settings
- Creating passwords
- Firmware update

For the access to the device by ibaPDA, a bidirectional FO connection from the ibaPDA computer to the device is required.

The access to the web interface of the device can also be carried out via the bidirectional FO connection or via an Ethernet or USB connection.

## 9.2 Setup of communication connections

### 9.2.1 Ethernet interface

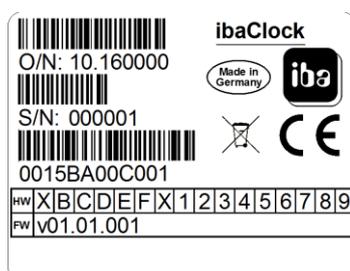
The access to the web interface of the device can be carried out via the Ethernet connection.

Each ibaClock device has a unique MAC address for the network identification.



#### Tip

You can find the MAC address on the type label on the backside of the device.



Type label on the backside of the device.

Above that, the device can be addressed by its name within the network.

Host name: **ibaclock\_XXXXXX**

XXXXXX stands for the six-digit serial number of the device (see type label), example: ibaclock\_000001.

Set an IP address that matches the present network at the first configuration of the device. The IP address can be set via the web interface (see chapter 9.3). Here, you can also choose if DHCP (dynamic IP address allocation) or the fixed IP address shall be used.



---

**Important note**

The Ethernet interface of ibaClock is set as default to the fixed IP address **192.168.1.1**. This IP address will be restored to the default setting during the reset.

---

To establish a network connection via the Ethernet interface (X22), please proceed as follows:

1. Connect the PC and the device using a network cable, either directly or via a switch or hub. PC and device must belong to the same network.
2. Set the network interface of the computer to the same subnet address 255.255.255.0 as the device via "Control Panel - Network and Sharing Center - Change adapter settings" (Windows 7) and assign a suitable IP address, e.g. 192.168.1.2.



---

**Note**

The IP address of your computer must not be 192.168.1.1, as this is the address of ibaClock. Set another IP address in the 192.168.1.x format.

---

3. Start a web browser on the computer and insert the IP address of the device as URL: <http://192.168.1.1>



---

**Note**

To be able to use DHCP, a DHCP sever must be available in the network, which automatically assigns the IP addresses. Experience shows that fixed IP addresses are mostly used in the automation area, which means that no DHCP server exists.

---

If DHCP is activated in the network settings of ibaClock, please proceed as follows for establishing a network connection:

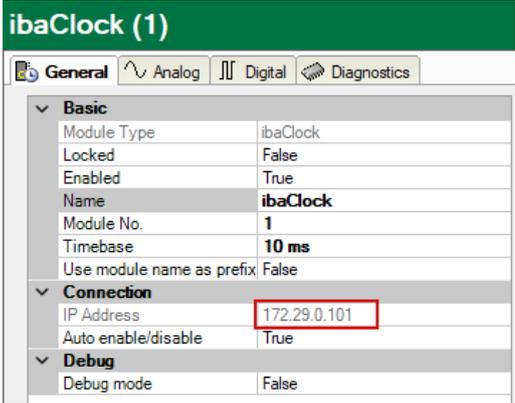
1. Connect the PC and the device using a network cable to a hub, switch or router. The DHCP server has to be in the same network.
2. Switch on the device.  
When the LED "Run" is consistently on, the device is ready for operation.
3. The DHCP server automatically assigns an IP address to the device.
4. Set the network interface of the computer also to DHCP via "Control Panel - Network and Sharing Center - Change adapter settings".
5. The DHCP server automatically assigns an IP address to the computer.

6. Start a web browser on the PC and enter the host name of the device into the URL:  
e.g. [http://ibaclock\\_000001](http://ibaclock_000001).
- For more information, see chapter 9.3.3.

## 9.3 Web interface

### 9.3.1 Open the web interface

1. Start your web browser if your computer is connected to ibaClock via a bidirectional FO connection, Ethernet or USB.
2. Enter the internet address (URL) of the device into the address line.

If connection via...	Then URL...
FO bidirectional	<p>IP address, that appears in the I/O Manager of ibaPDA in the "General" tab in the field "IP address" if the device has been configured or automatically detected, in the example below <a href="http://172.29.0.101">http://172.29.0.101</a>.*</p>  <p>The resolution of the device name is not supported.</p>
Ethernet TCP/IP interface	<p>IP address of the device, e.g. <a href="http://192.168.1.1">http://192.168.1.1</a> or device name <a href="http://ibaclock_xxxxxx">http://ibaclock_xxxxxx</a></p>
USB interfaces	<p>IP address of the device: <a href="http://192.168.0.1">http://192.168.0.1</a>. The resolution of the device name is not supported.</p>

\*IP address in Flex mode



#### IP address in Flex mode

The automatically assigned IP address in Flex mode consists of 4 sections, e.g. 172.29.0.101.

The first two sections (172.29) correspond to the IP address of the ibaFOB-D network adapter, the third section (0) corresponds to the number displayed in the ibaFOB-D card in the computer \*10 + link number, to which the device is connected, the fourth section (101) is the device address + 100.



#### Tip

If you use the Internet Explorer as browser, it might be necessary, depending on the security level of the Internet Explorer, to enter the address [http://ibaclock\\_xxxxxx](http://ibaclock_xxxxxx) or, depending on the access path, the IP based URL into the trusted pages.

The pages Network, Settings and Administration are only accessible by the administrators and are password protected.



Default setting for the user credentials:

**User name:** admin

**Password:** 1234

The access should only be available for experienced users to avoid an accidental change of the settings. An accidental change of the network parameters can e.g. cause that the access to the device via Ethernet is no longer possible and that the device parameters have to be reset to the default settings.



---

### Important note

Change the default password directly after commissioning to prevent unauthorized access to the configuration.

Permitted signs are numbers and letters in capitalization and lower case.

If you have forgotten the password, you can only change it by a reset to the default settings. Thereby all settings made on the device will get lost.

---

### 9.3.2 Information - start page

The screenshot shows the ibaClock web interface. At the top right is the 'ibaClock' logo. Below it is a navigation bar with tabs: 'Info', 'Network', 'Settings', 'GPS', 'PTP', 'Administration', 'Help', and a red '(1)' next to 'Help'. Below the navigation bar is a banner with a green grid background and the text 'Bringing Transparency to the World of Automation.' Below the banner is a status bar showing 'Time Source: GPS' and 'Status: OK' with a red '(2)' next to 'OK'. Below the status bar is a table of information:

<b>Product Information</b>	Device type	ibaClock
	Serial number	000026
	Firmware version	v01.04.001
	Hardware version	A0
<b>Network Information</b>	Device name	ibaClock_000026
	IP address	192.168.50.206
	Subnet mask	255.255.255.0
	MAC address	00:15:BA:00:19:DE
<b>Time Status</b>	Time Source	GPS <b>OK</b>
	Time Distribution by Alarm	FO, NTP, Time, Daytime, PTP OFF
<b>Current Time</b>	UTC	Thu, 08 Mar 2018 12:25:58 GMT

At the bottom of the page, there is a footer with 'Measurement and Automation Systems' on the left, a logo on the right, and 'www.iba-ag.com' and 'Thu, 08 Mar 2018 12:25:58 GMT' in the center.

The basic structure of the websites is identical:

- (1) Navigation field to select the separate websites. The currently displayed website is shown in green.
- (2) The actually set time source and its status are displayed in the status bar. The update of the status bar is made automatically.
- (3) Display area for detail data, depending on the page selected in the navigation field.



#### Important note

To have an automatic update of the status bar display, the web browser must allow the execution of JavaScript.

### 9.3.3 Network

This page is only accessible after the login over the user “admin”.

Time Source: GPS      Status: OK

Network interface: Ethernet

Obtain IP address via DHCP (1)  
 Use static IP address (2)

IP address: 192.168.50.206  
 Subnet mask: 255.255.255.0 (3)  
 Default gateway: 192.168.50.1 (4)

Submit (5)    Refresh (6)

Service interface: TCP/IP over USB

IP address: 192.168.0.1 (7)

FO interface: TCP/IP over LWL

UDP Port: 62012 (8)

Submit    Refresh

Measurement and Automation Systems

www.iba-ag.com      Thu, 08 Mar 2018 12:27:08 GMT

This page shows both network adapters the device has. The upper interface „Network interface: Ethernet“ describes the settings of the LAN interface X22, the lower interface „TCP/IP over USB“ describes the settings of the USB connection X12.

- (1) Here you can select whether a DHCP server, that is available in the network, or
- (2) a fixed IP address should be used.
- (3) “Subnet Mask” suitable for the network
- (4) “Default Gateway”, if no gateway is used enter 0.0.0.0 here.
- (5) By pressing the <Submit> button the entries for the network interface “Ethernet” are saved in the device.
- (6) By pressing the <Refresh> button the display of the entries is updated (e.g. useful for DHCP).
- (7) Fixed set and non-changeable IP address of the USB connection



### Note

Ask the network administrator for a suitable IP address for your network.

The following IP addresses are not admitted:

0.0.0.0, broadcast: 255.255.255.255 and localhost addresses (also known as loopback addresses): 127.0.0.0 to 127.255.255.255 as well as the multicast addresses 224.0.0.0 to 239.255.255.255 (224.0.0.0/4).

For the IP address, the "standard IPv4 dotted-decimal format" without leading zeros is used. Eventually inserted leading zeros will be eliminated automatically at the takeover of the IP addresses.

## 9.3.4 Settings

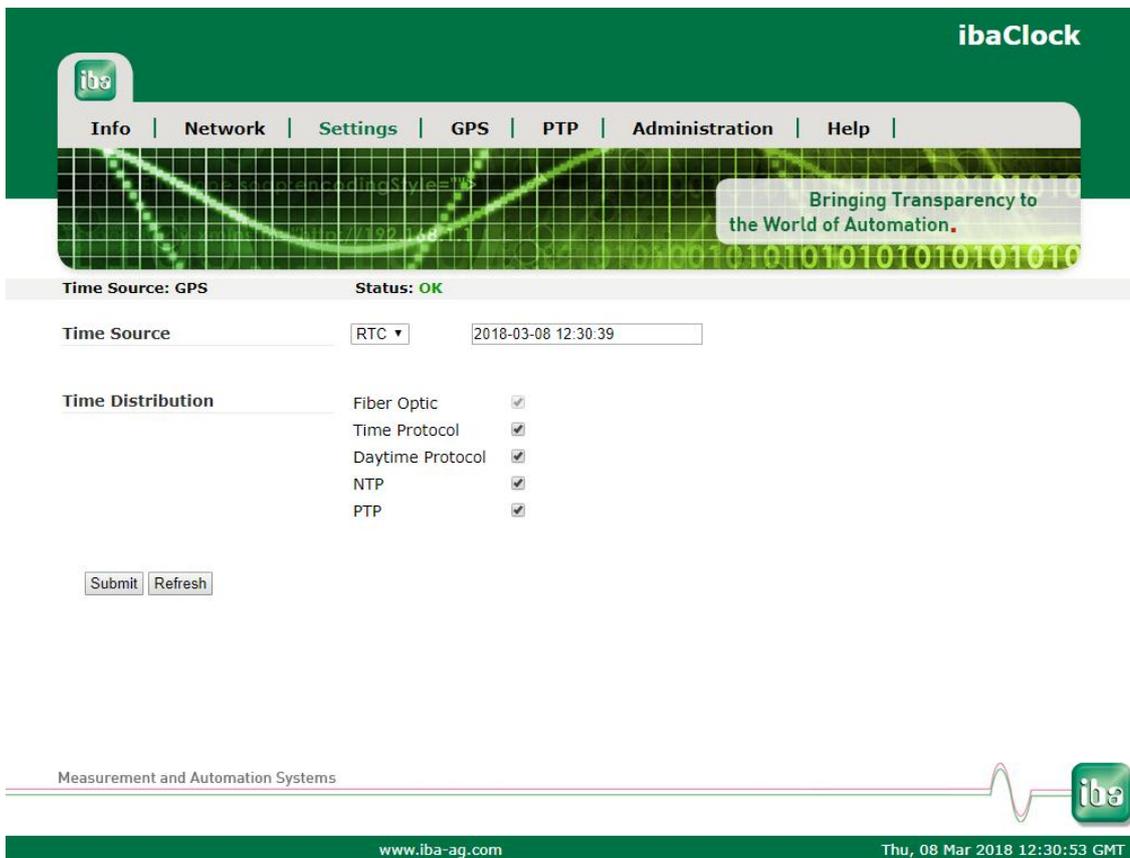
This page is only accessible after the login over the user "admin".

(1) The "Time Source" can be determined here.

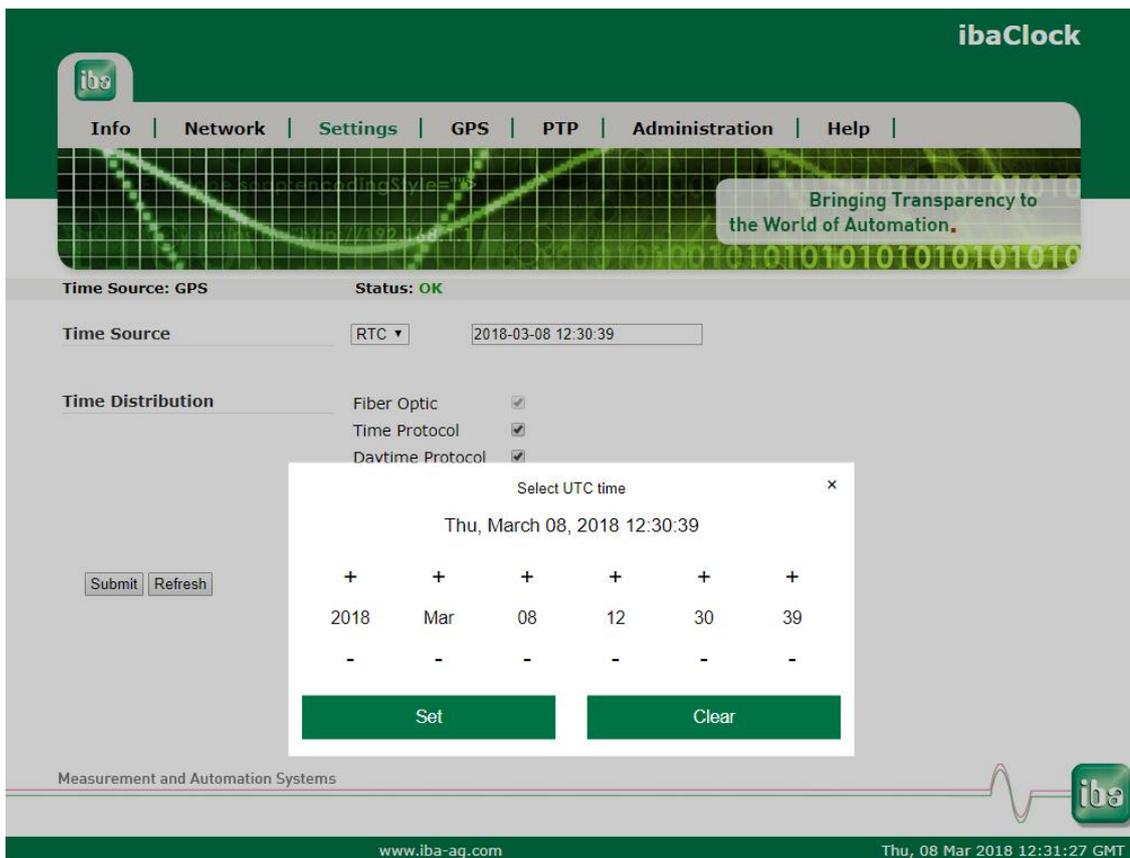
<GPS>, <RTC>, <IRIG> and <PTP> are available.

If a GPS antenna has not yet been installed during commissioning, the time can be specified by RTC in order to synchronize the connected devices.

(2) The item „Time Distribution“ provides the distribution services, which can be individually enabled or disabled. However, the distribution via fiber optic is always enabled. If <PTP> is activated as time source, the "Time Distribution" for PTP is deactivated.



Web interface time source, RTC



Select UTC time

### PTP settings:

The screenshot shows the PTP settings page in the ibaClock web interface. The page has a green header with the 'ibaClock' logo and a navigation menu with links for 'Info', 'Network', 'Settings', 'GPS', 'PTP', 'Administration', and 'Help'. Below the header is a decorative banner with a grid and binary code, featuring the slogan 'Bringing Transparency to the World of Automation.' The main content area displays the current 'Time Source' as 'GPS' and 'Status' as 'OK'. A dropdown menu for 'Time Source' is currently set to 'PTP'. Under the 'Time Distribution' section, there are five checkboxes: 'Fiber Optic' (checked), 'Time Protocol' (checked), 'Daytime Protocol' (checked), 'NTP' (checked), and 'PTP' (unchecked). At the bottom of the settings area are 'Submit' and 'Refresh' buttons. The footer of the page includes the text 'Measurement and Automation Systems', the website 'www.iba-ag.com', and the timestamp 'Thu, 08 Mar 2018 12:32:52 GMT'.

### 9.3.5 GPS

**Time Source:** GPS      **Status:** OK

**Status**

GPS Time	1520512092
GPS Antenna	connected
GPS Signal	OK
Fix	3D
Latitude	49.282
Longitude	10.5974
Satellites in view	9
Satellites in use	9

**Satellites**

ID	USED	ELV	AZM	SIG
24	1	43	282	51
17	1	35	106	52
28	1	32	50	47
15	1	70	233	50
20	1	19	236	36
10	1	13	326	41
12	1	14	220	38
19	1	26	131	46
13	1	56	151	50
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

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www.iba-ag.com      Thu, 08 Mar 2018 12:28:13 GMT

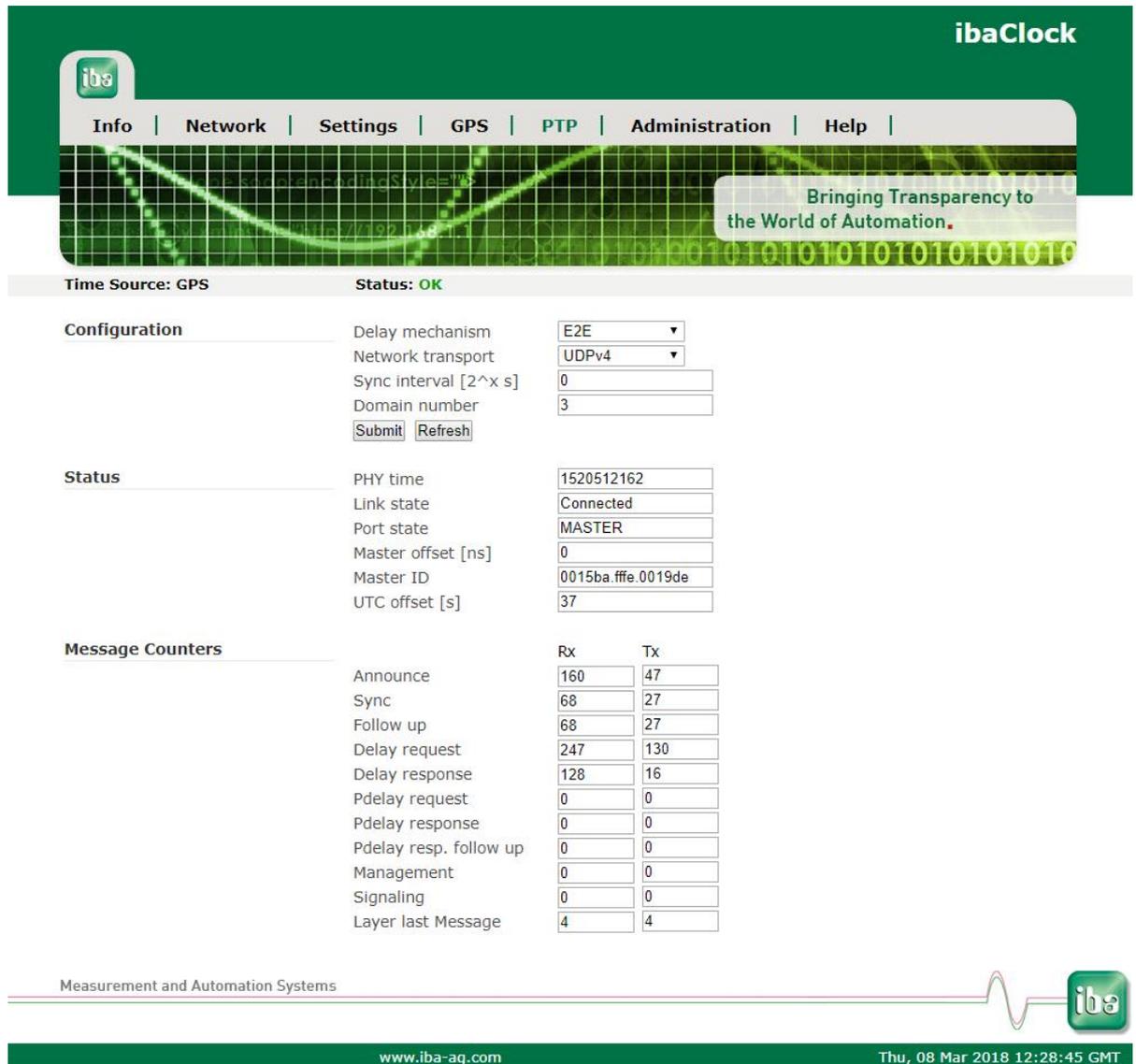
**Status:**

- GPS Time:**  
Time in seconds since 1 January 1970 00:00 UTC
- GPS Antenna:**  
Indicates whether the GPS antenna is connected.
- GPS Signal:**  
Indicates the status of the GPS signal.
- Fix:**  
2D: Three satellites are used for the time synchronization.  
3D: At least four satellites are used for the time synchronization.
- Latitude:**  
Geographical latitude in decimal degrees.
- Longitude:**  
Geographical longitude in decimal degrees.
- Satellites in view:**  
Number of satellites that are currently in the field of view of the antenna.
- Satellites in use:**  
Number of satellites that are used for time determination.

### Satellites:

The list of satellites with their ID, elevation and azimuth angle as well as the signal strength in dB and whether they are being used at this moment.

## 9.3.6 PTP



**Time Source:** GPS      **Status:** OK

**Configuration**

Delay mechanism	E2E
Network transport	UDPv4
Sync interval [2 <sup>x</sup> s]	0
Domain number	3

**Status**

PHY time	1520512162
Link state	Connected
Port state	MASTER
Master offset [ns]	0
Master ID	0015ba.ffe.0019de
UTC offset [s]	37

**Message Counters**

	Rx	Tx
Announce	160	47
Sync	68	27
Follow up	68	27
Delay request	247	130
Delay response	128	16
Pdelay request	0	0
Pdelay response	0	0
Pdelay resp. follow up	0	0
Management	0	0
Signaling	0	0
Layer last Message	4	4

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www.iba-ag.com      Thu, 08 Mar 2018 12:28:45 GMT

### Configuration:

#### Delay mechanism:

- Auto  
Automatic detection of the delay mechanism.
- E2E (End-to-End) mechanism  
If network components are installed between the end points that are not PTP-capable, this mechanism should be used to detect the propagation delay.
- P2P (Peer-to-Peer) mechanism  
If only PTP-capable components are installed in the network and they are configured so that they can use the same mechanism, this setting can then be used to detect the propagation delay.

Network Transport:

This setting is used to determine the communication layer in the network on which the PTP synchronization occurs.

- L2  
The PTP synchronization occurs directly on the data link layer (OSI model layer 2).
- UDPv4  
The network layer (OSI model layer 3) is used for the synchronization. The communication occurs via the ports 319 and 320.

Sync interval:

The time interval in which a synchronization telegram is to be sent. The specification occurs in  $2^x s$ ; i.e. a value of 0 results in a time interval of 1s, since  $2^0 s = 1s$ .

Domain number:

In order to operate several independent PTP clocks in one network, these can be split up onto several domains. Only “slaves” that belong to the same domain refer to the time of the PTP master clock available in the domain.

**Status:**

PHY time

Time in seconds since 01.01.1970.

The time scale used is TAI.



**Note**

This time scale is ahead of UTC by the number of leap seconds. Further information can be found in chapter 18.

Link state

Indicates whether a connection exists.

Port state

MASTER: ibaClock is the timer and distributes the time via PTP

SLAVE: ibaClock receives time from another PTP master and is synchronized

Master offset [ns]

Time difference to the PTP master in nanoseconds

Master ID

ID of the time master from which the time is received or distributed.

UTC Offset [s]

Current time offset, in leap seconds, between the TAI time scale used by PTP and UTC.

Further information can be found in chapter 18.

**Message Counters:**

- Number of synchronization messages received or sent sorted by their type.

### 9.3.7 Administration

This page is only accessible after the login over the user “admin”.

On the “Administration” page you can change the administrator password and load new firmware.

#### Change password

1. If you want to change a password, please enter it into the fields. For safety purposes, please enter the existing password once and the new password twice.
2. Then, please click on <Change password>. The changes are now applied.



#### Important note

As soon as you have put the device into operation, please change the password immediately. This makes it difficult for unauthorized persons to access administrative properties.

#### Firmware update

1. Click on the <Browse...> button and select the update file <clock\_v[xx.yy.zzz].iba>.
2. By clicking on <Start Update>, you start the update. The update progress is displayed in the status bar.



#### Note

If a firmware update should be necessary, please contact the iba support. You will then receive the corresponding data and further information about the update.

**Important note**

The firmware update takes a few minutes. The device must certainly not be turned off during the running update!

**Reset to factory defaults**

By pressing this button, the device is reset to its factory defaults.

**Important note**

After a factory reset, all customized settings will be lost.

**9.3.8 Help**

**ibaClock**

Info | Network | Settings | GPS | PTP | Administration | Help

Bringing Transparency to the World of Automation.

Time Source: GPS      Status: OK

**Support**

Phone +49 911 97282-14  
 Fax +49 911 97282-33  
 Email support@iba-ag.com  
 Note If you require support, please specify the serial number and firmware version of the product.

**Shipping address**

iba AG  
 Gebhardtstrasse 10  
 90762 Fuerth  
 Germany  
 Phone +49 911 97282-0  
 Fax +49 911 97282-33  
 Email iba@iba-ag.com

**iba Regional Offices**

For contact data of your regional iba office or representative, please refer to our website [www.iba-ag.com](http://www.iba-ag.com).

Measurement and Automation Systems

[www.iba-ag.com](http://www.iba-ag.com) Thu, 08 Mar 2018 12:30:10 GMT

This page contains important contact data to maintain the support for the device.

## 10 Configuration with ibaPDA

To be able to use ibaClock together with ibaPDA, the device must be configured in the I/O Manager of ibaPDA.

### Requirements:

- ibaPDA, version 6.34.0 or higher
- Firmware of the ibaFOB-D card: D3 or higher

If ibaClock is connected to an ibaPDA system, the device sends the UTC time to ibaPDA. If ibaPDA saves measuring data (\*.dat), the time stamp of the local time and the offset at the UTC time is saved with every file.

Using this time stamp, measuring data of different systems/locations can be assigned and compared to each other.

The time axis in the signal display of ibaPDA displays the local system time of the ibaPDA computer at which the data was recorded.

To compare measuring data that was recorded by different ibaPDA systems at different locations, the time difference in the signal display in ibaAnalyzer can be compensated.

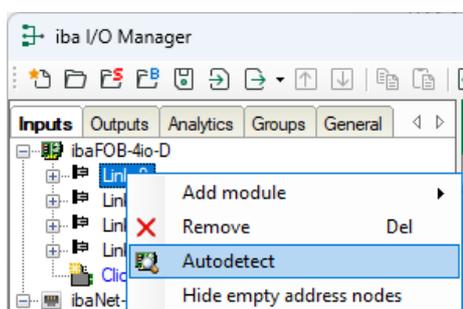


### Note

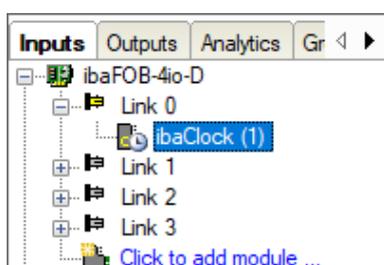
The acquisition time basis must be identically configured in the ibaPDA I/O Manager on the ibaPDA systems to avoid a potential asynchrony.

### 10.1 First steps

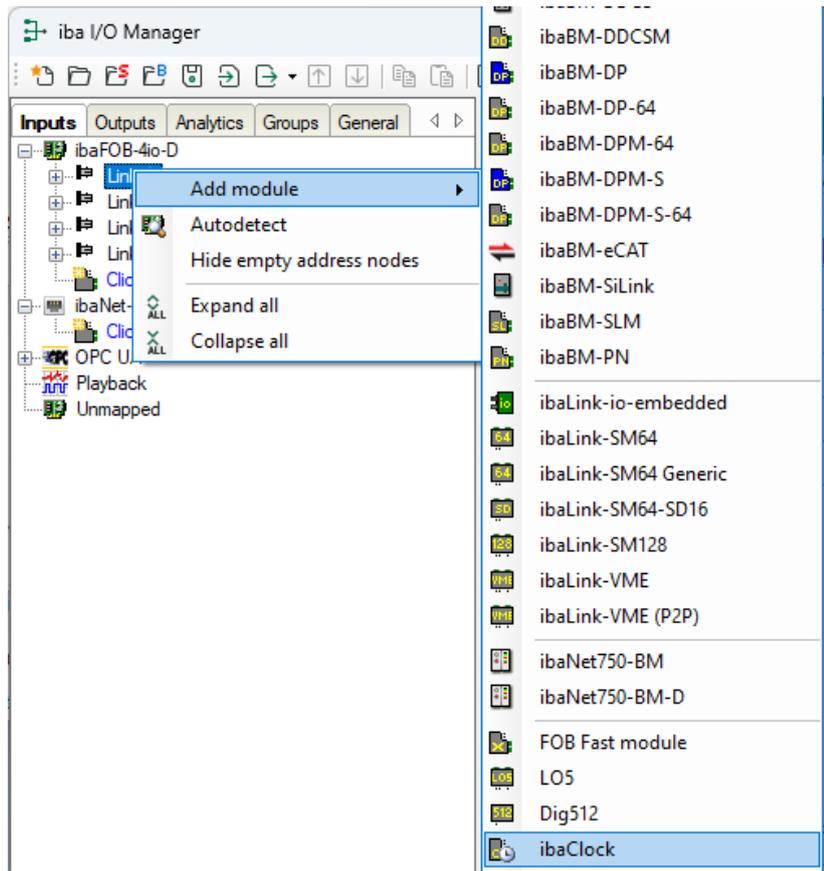
1. Start ibaPDA and open the I/O Manager.
2. In the signal tree (to the left), mark the link of the ibaFOB card the device is connected to. Click on the link using the right mouse button and a submenu will be opened. Select "Autodetect"



ibaPDA automatically detects the device and displays it in the signal tree.



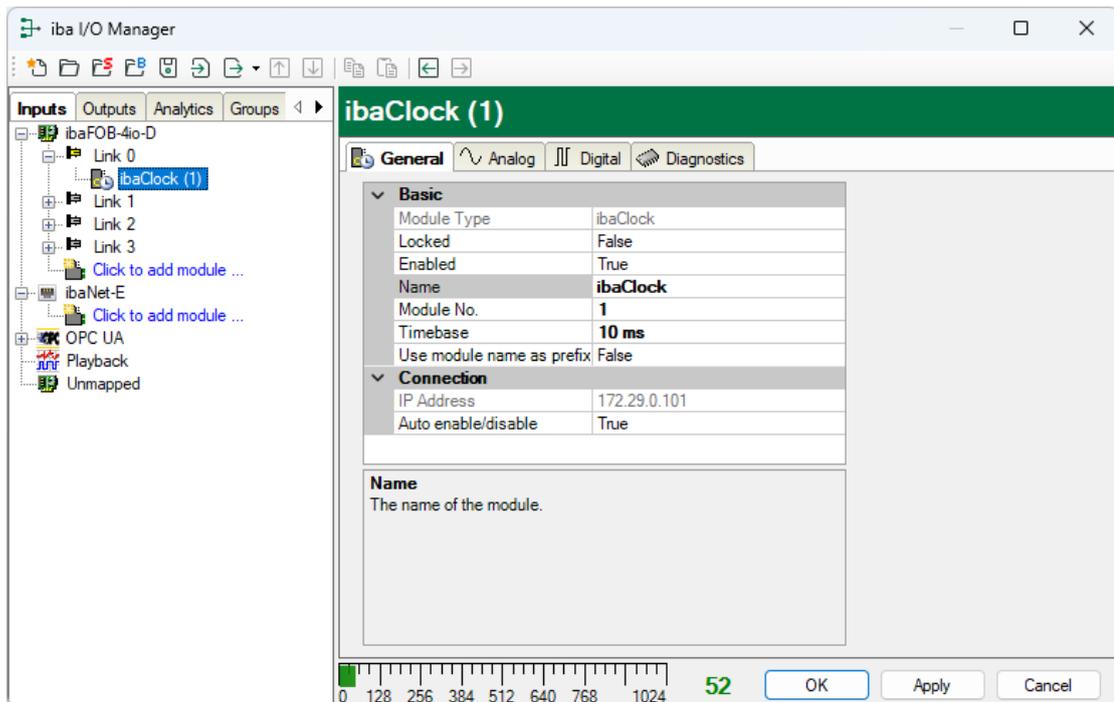
3. You can also manually add the device. Click the right mouse button on the link of the ibaFOB card the device shall be connected to and select “Add module” and “ibaClock” from the displayed list.



The device will be displayed in the signal tree.

4. Configure the “ibaClock” module in the I/O Manager.

## 10.2 ibaClock - "General" tab



### Basic settings

#### Module Type

Display of the module type, cannot be changed.

#### Locked

True: the module can be changed by authorized users only.

False: the module can be changed by all users.

#### Enabled

The data acquisition for this module is either enabled or disabled.

#### Name

Here you can assign a name for the module.

#### Time base

Time base for the data acquisition that is used for this module.

#### Use name as prefix

IF TRUE is selected, the module name is put as prefix in front of the signal name of this module.

### Connection

#### IP address

The IP address is determined by the slot, the link number of the FOB card and the device number which is set on the device. ibaPDA sends configuration data and reads diagnosis data over the TCP/IP connection which is realized in the FO protocol. This IP address cannot be changed.

#### Auto enable/disable

If the value is TRUE, the data acquisition is started even though the device is missing. The missing device is temporarily disabled in the configuration. During the measurement process, ibaPDA tries to re-establish the connection to the missing device. If this is successful, the measurement is restarted automatically including the device that has been missing.

If the value is FALSE, the measurement is not started, if ibaPDA cannot establish a connection to the device.

### 10.3 ibaClock – “Analog” tab

	Name	Unit	Active	Actual
0	Device temperature	°C	<input checked="" type="checkbox"/>	31,5 °C
1	GPS UTC year		<input checked="" type="checkbox"/>	2020
2	GPS UTC month		<input checked="" type="checkbox"/>	5
3	GPS UTC day		<input checked="" type="checkbox"/>	18
4	GPS UTC hour		<input checked="" type="checkbox"/>	14
5	GPS UTC minute		<input checked="" type="checkbox"/>	52
6	GPS UTC second	s	<input checked="" type="checkbox"/>	44 s
7	GPS Latitude	°	<input checked="" type="checkbox"/>	49,47 °
8	GPS Longitude	°	<input checked="" type="checkbox"/>	10,9957 °
9	GPS satellites in use		<input checked="" type="checkbox"/>	8
10	GPS satellites in view		<input checked="" type="checkbox"/>	9

In addition to the device temperature, the GPS data are also listed in the "Analog" tab. If ibaClock is mounted on a vehicle, the position data, in decimal degrees, can also be recorded directly here.

#### Name

The signal name is already given. You can insert two additional comments if you click the  symbol in the signal name field.

#### Unit

The SI unit of the signal

#### Active

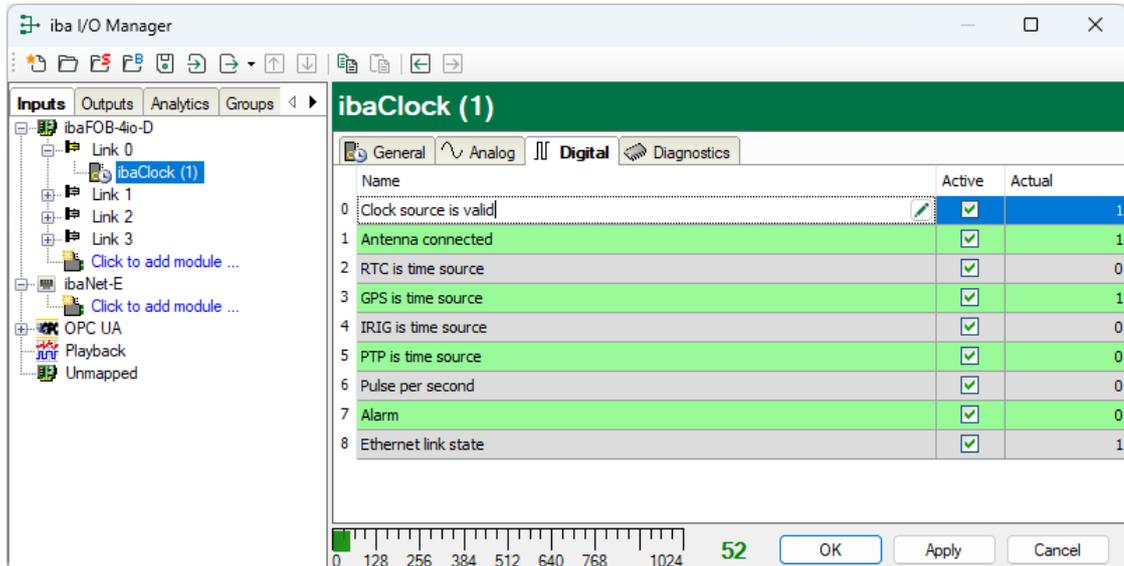
Status signal activated / deactivated

#### Actual

Display of the currently recorded value (only available if the measurement is running).

You can display or hide further columns via the context menu (right mouse click in the headline).

## 10.4 ibaClock - "Digital" tab



Various status signals are listed in the "Digital" tab. The signals listed here indicate which time source is currently set and used and whether the time source is valid. Furthermore, the connection status of the antenna and the network as well as the status of the alarm contact can also be identified.

### □ Name

The signal name is already given. You can insert two additional comments if you click the  symbol in the signal name field.

### □ Active

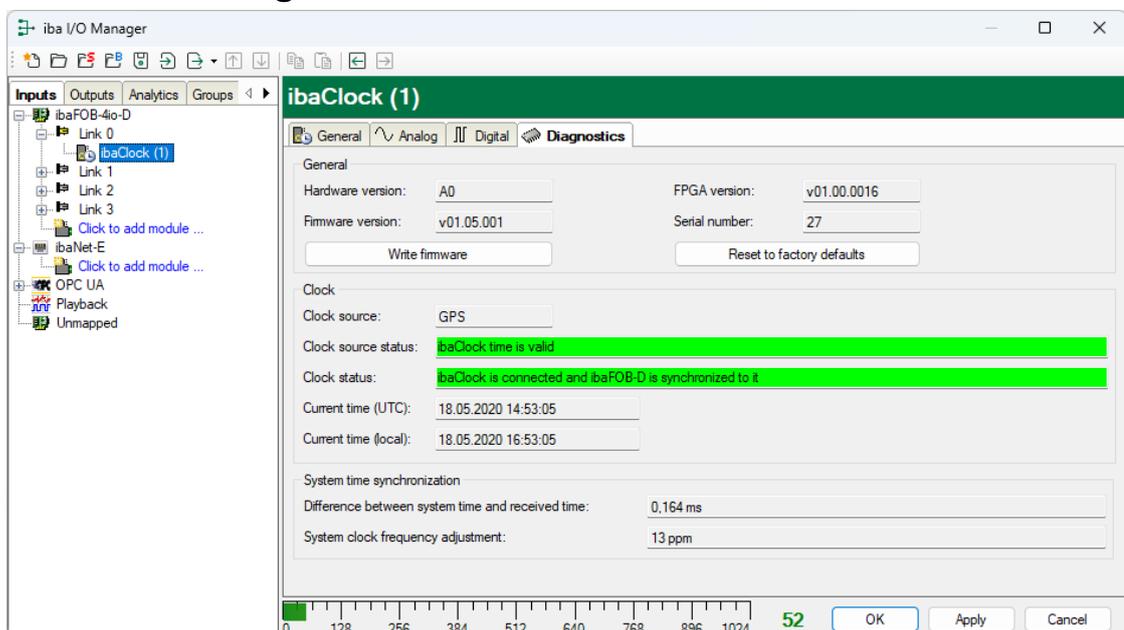
Status signal activated / deactivated

### □ Actual

Display of the currently recorded value (only available if the measurement is running).

You can display or hide further columns via the context menu (right mouse click in the headline).

## 10.5 ibaClock - "Diagnostics" tab



## General

In the “General” section the version of hardware, firmware and FPGA is displayed as well as the serial number of the device.

### Write firmware

Using the <Write firmware> button, it is possible to run firmware updates. Select the update file „clock\_v[xx.yy.zzz].iba“ in the browser and start the update with <OK>.

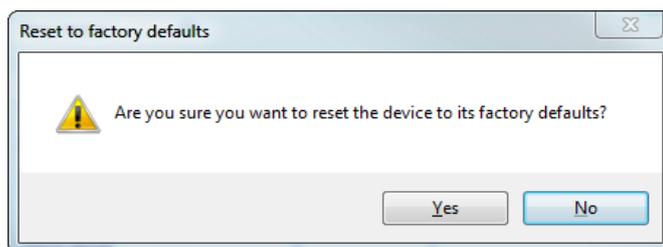


### Important note

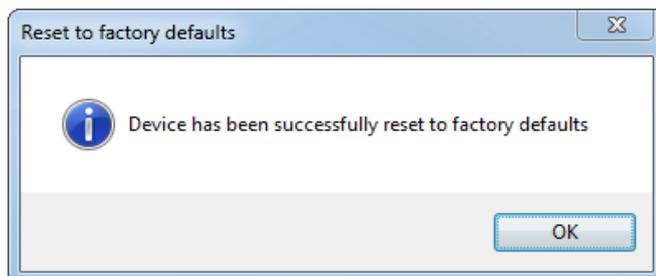
This procedure can take a few minutes and must not be interrupted.

### Reset to factory defaults

With the button <Reset to factory defaults>, any settings are reset to the default settings having confirmed the following query with <Yes>.



Then you will receive the following notification:



## Clock

In the “Clock” section, time source information and the current time are displayed.

### Clock source: selected time source

### Clock source status: Display if ibaClock sends a valid time

Clock status: ibaClock will not synchronize with the ibaFOB-D card before the configuration has not been applied from ibaClock to ibaPDA. When the synchronization is done, the bar changes its color to green and displays a corresponding status message.

### Current time (UTC): Display of date and UTC time [hh:mm:ss]

Current time (local): Display of date and local time [hh:mm:ss]. The local time is based on the time zone that has been set at Windows.

## System time synchronization

Information on the synchronization status is displayed in the section “System time synchronization”.

- ❑ Difference between system time and received time  
Indicates how much the current system time leads or lags.
- ❑ System clock frequency adjustment  
Indicates the current adjustment value used for compensation.

## 11 Technical data

### 11.1 Main data

Manufacturer	iba AG, Germany
Order number	10.160000
Description	Universal time server
<b>Time sources</b>	
GPS	Supported GPS antenna: Smart antenna Trimble Acutime GG / Acutime 360; power supply via ibaClock Antenna precision: 15 ns (static) Cable length: up to 400 m Control accuracy of the internal PLL: (typ.) < $\pm 150$ ns of the absolute GPS PPS signal Time stability in case of GPS signal loss: < 0.15 ppm after min. 10 minutes of receiving GPS
IRIG-B	Plug connector: BNC, 50 $\Omega$ Supported telegrams: B004, B124, B005, B125, B006, B126, B007, B127 IEEE1344 / IEEE C37.118 AFNOR NF S87-500 (Firmware: v01.03.001 and higher)
IEEE 1588	PTP (Precision Time Protocol), hardware based
<b>Time server function</b>	
ibaNet	Time synchronization of ibaPDA systems via fiber optics
IEEE 1588	PTP (Precision Time Protocol), hardware based
NTP Time & Daytime	Synchronization over network via NTP According to RFC 868 and RFC 867
DCF77 <sup>1</sup>	Optional output of the DCF77 time code via semiconductor relay output
<b>Alarm</b>	
Alarm	Semiconductor relay output, switching current up to 200 mA, open in de-energized state
<b>ibaNet interface</b>	
Number	1
Design	Fiber optic cable
ibaNet protocol	SYNC (bidirectional), with TCP/IP channel Can be used simultaneously for data, settings and service (e. g. updates)
Connector type	2 ST connectors for RX and TX; iba recommends the use of FO with multimode fibers of type 50/125 $\mu\text{m}$ or 62.5/125 $\mu\text{m}$ ; For information on cable length, see chap. 11.4.

<sup>1</sup> For future firmware versions

Transmitting interface (TX)		
Sender output power	50/125 µm FO fiber:	-19.8 dBm to -12.8 dBm
	62.5/125 µm FO fiber:	-16 dBm to -9 dBm
	100/140 µm FO fiber:	-12.5 dBm to -5.5 dBm
	200 µm FO fiber:	-8.5 dBm to -1.5 dBm
Temperature range	-40 °F to 185 °F (-40 °C to 85 °C)	
Light wavelength	850 nm	
Receiving interface (RX)		
Receiver responsivity <sup>2</sup>	62.5/125 µm FO fiber:	-30 dBm
	Temperature	77 °F (25 °C)
<b>Interfaces / features</b>		
Fiber optics	Time synchronization, configuration and diagnostics	
Ethernet	RJ45 socket (Ethernet 10/100 Mbit/s) for configuration and diagnostics	
Simulation	Time server function without active time source (e.g. commissioning, etc.)	
Freewheel accuracy	High-precision with PLL-controlled internal quartz generator	
RTC	Buffered RTC (Real Time Clock) for approx. 10 days	
<b>Supply and indicator elements</b>		
Power supply	DC 24 V, ± 10 % unstabilized	
Power consumption	Up to 2 W (without antenna), approx. 2.5 W (with antenna)	
Indicators	4 LEDs for device status 4 LEDs for status of the time sources	
<b>Operating and environmental conditions</b>		
Cooling	Passive	
Operating temperature	0°C to +50 °C	
Storage temperature	-25°C to +65 °C	
Transport temperature	-25°C to +65 °C	
Humidity class acc. to DIN 40040	F, no condensation	
Protection class	IP20	
CE conformity	EMC: EN 55011:2009+A1:2010, EN 61326-1:2013, FCC part 15 class A	
RoHS	EN 50581:2012	
Mounting	DIN rail, vertical	
Dimensions (Width x Height x Depth)	37 mm x 188 mm x 145 mm (with DIN rail clip)	
Weight (incl. packaging and documentation)	approx. 1.1 kg	

<sup>2</sup> Data for other FO fiber diameters not specified

**Supplier's Declaration of Conformity  
47 CFR § 2.1077 Compliance Information**

**Unique Identifier:**      10.160000      ibaClock

**Responsible Party - U.S. Contact Information**

iba America, LLC  
370 Winkler Drive, Suite C  
Alpharetta, Georgia  
30004

(770) 886-2318-102  
[www.iba-america.com](http://www.iba-america.com)

**FCC Compliance Statement**

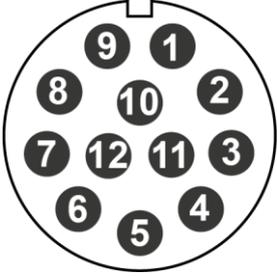
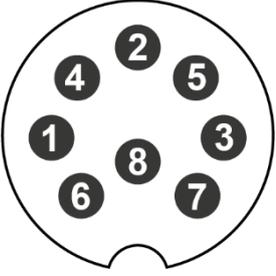
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.



### 11.3 Pin assignment antenna cable

Assignment of the connector at antenna side - connector ibaClock side



Antenna connector*  Manufacturer description: IMC26-2212X (12 size 22)		⇒	Connector for ibaClock (X44)*  (DIN 45326)	
Antenna	Function	Protocol	ibaClock	Function
Pin 1	DC Power	5 - +36VDC	Pin 7	+24V
Pin 2	Port B: Receive -	TSIP RS-422	Pin 6	UART TXn
Pin 3	Port B: Receive +	TSIP RS-422	Pin 1	UART TXp
Pin 4	Port B: Transmit -	TSIP RS-422	Pin 4	UART RXn
Pin 5	Port B: Transmit +	TSIP RS-422	Pin 2	UART RXp
Pin 6	-		-	
Pin 7	-		-	
Pin 8	-		-	
Pin 9	DC Ground	Ground	Pin 8	GND
Pin 10	-		-	
Pin 11	PPS Transmit +	TSIP RS-422	Pin 3	PPS RXp
Pin 12	PPS Transmit -	TSIP RS-422	Pin 5	PPS RXn

\*View soldering or crimp side.

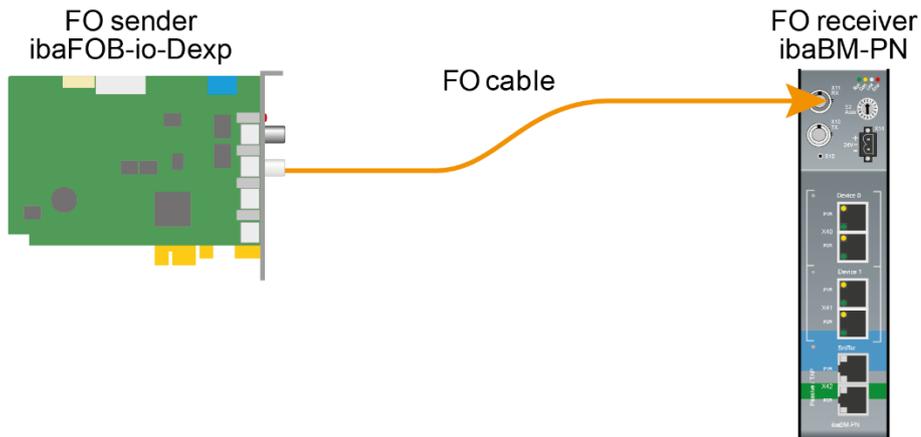
### Accessories and connectors for the cable assembly

If you want to assemble the cable by yourself, some special accessories are necessary. You can order the accessories or connectors at Farnell via [de.farnell.com](http://de.farnell.com), for example.

Manufacturer no.	Description
6862-201-22278	Crimp socket, IMC, AWG22 to 26 750VAC/5A
IMC26-2212X	Connector cable assembly 12-pin
681020012250961D	Bend relief sleeves PVC cable entry 6.35
AMSC22/1	Crimp tools, GR. 22,IMC/QC Contacts
6757-201-2201	Disassembly tools IMC connection 22
C091 31H008 1002	Amphenol C091 connector, cable 8-pin. 4-6 mm
C091 31H008 1012	Amphenol C091 connector, cable 8-pin. 6-8mm

## 11.4 Example for FO budget calculation

As an example, an FO connection from an ibaFOB-io-Dexp card (FO transmitter) to an ibaBM-PN device (FO receiver) is used.



The example refers to a point-to-point connection. The light wavelength used is 850 nm. The range of the minimum and maximum values of the sender output power or receiver responsivity depends on the component and, among other things, on temperature and aging.

For the calculation, the specified sender output power of the transmitting device and on the other side the specified receiver responsivity of the receiving device must be used in each case. You will find the corresponding values in the respective device manual in the chapter "Technical data" under "ibaNet interface".

### Specification ibaFOB-io-Dexp:

Sender output power of FO transmitting interface		
FO cable in $\mu\text{m}$	Min.	Max.
62.5/125	-16 dBm	-9 dBm

### Specification ibaBM-PN:

Receiver responsivity of FO receiving interface		
FO cable in $\mu\text{m}$	Min.	Max.
62.5/125	-30 dBm	

### Specification FO cable

To be found in the data sheet of the fiber optic cable used:

FO cable	62.5/125 $\mu\text{m}$
Connector loss	0.5 dB connector
Cable attenuation at 850 nm wavelength	3.5 dB / km

**Equation for calculating the FO budget ( $A_{Budget}$ ):**

$$A_{Budget} = |(P_{Receiver} - P_{Sender})|$$

$P_{Receiver}$  = Receiver responsivity of FO receiving interface

$P_{Sender}$  = Sender output power of FO transmitting interface

**Equation for calculating the fiber optic cable length ( $l_{Max}$ ):**

$$l_{Max} = \frac{A_{Budget} - (2 \cdot A_{Connector})}{A_{Fiberoptic}}$$

$A_{Connector}$  = connector loss

$A_{Fiberoptic}$  = Cable attenuation

**Calculation for the example ibaFOB-io-Dexp -> ibaBM-PN in the best case:**

$$A_{Budget} = |(-30 \text{ dBm} - (-9 \text{ dBm}))| = 21 \text{ dB}$$

$$l_{Max} = \frac{21 \text{ dB} - (2 \cdot 0.5 \text{ dB})}{3.5 \frac{\text{dB}}{\text{km}}} = 5.71 \text{ km}$$

**Calculation for the example ibaFOB-io-Dexp -> ibaBM-PN in the worst case:**

$$A_{Budget} = |-30 \text{ dBm} - (-16 \text{ dBm})| = 14 \text{ dB}$$

$$l_{Max} = \frac{14 \text{ dB} - (2 \cdot 0.5 \text{ dB})}{3.5 \frac{\text{dB}}{\text{km}}} = 3.71 \text{ km}$$

**Note**

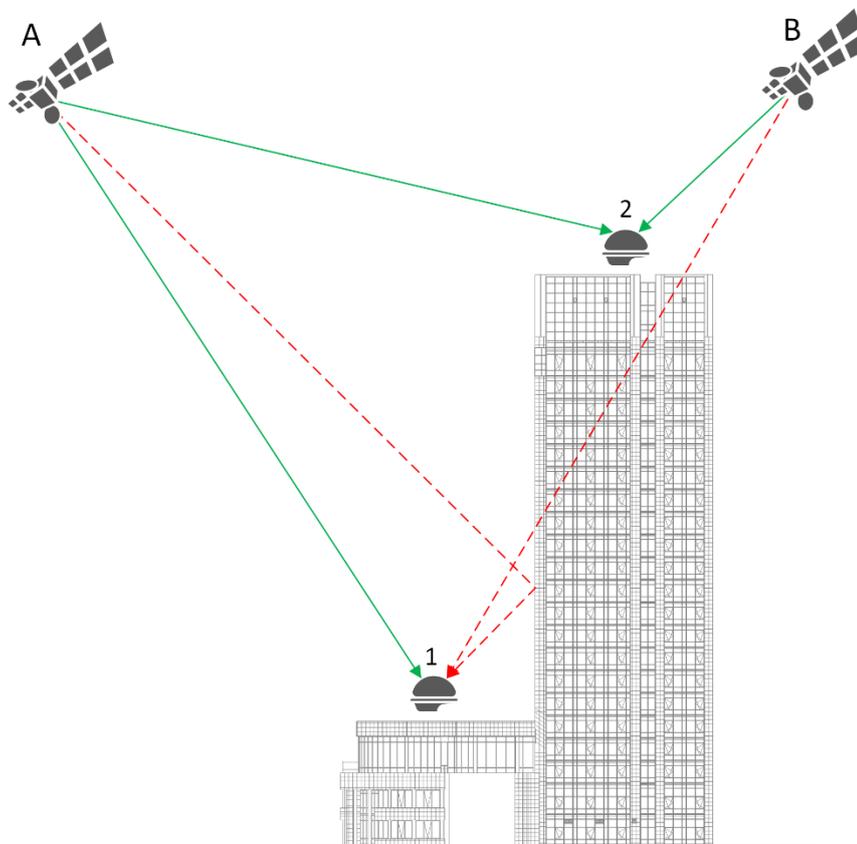
When connecting several devices as daisy chain (e.g. ibaPADU-8x with 3Mbit) or as ring (e.g. ibaPADU-S-CM with 32Mbit Flex), the maximum distance applies to the section between two devices. The FO signals are re-amplified in each device.

## 12 Accessories

Order No.	Description
10.160010	GPS smart antenna
10.160011	Mounting socket for antenna
10.160012	Mounting bar
10.160016	Antenna Masthead L bracket
10.160017	Antenna Masthead bracket
10.160013	Antenna cable 30 m
10.160014	Antenna cable 60 m
10.160015	Antenna cable 120 m

### 12.1 Antenna mounting

The antenna must be mounted with a sufficiently clear view to the sky. Mounting directly next to high buildings should also be avoided to prevent reflections.

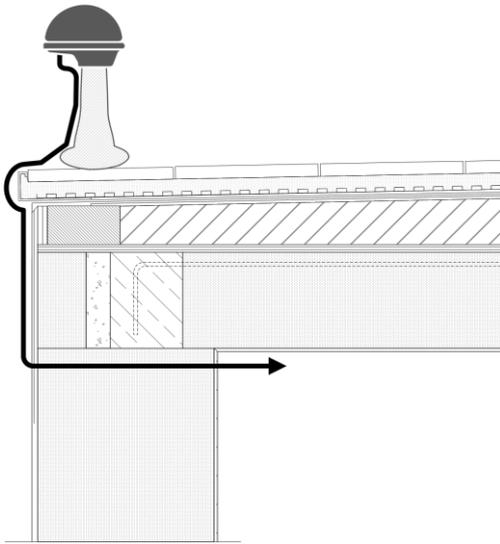


Reflection

The figure shows that the antenna at position 1 can detect satellite A twice (reflection), but satellite B is not detected. In the worst case, this leads to an incorrect determination of position and time. If the antenna is mounted at position 2, no reflections occur and the satellites can be detected without interference.

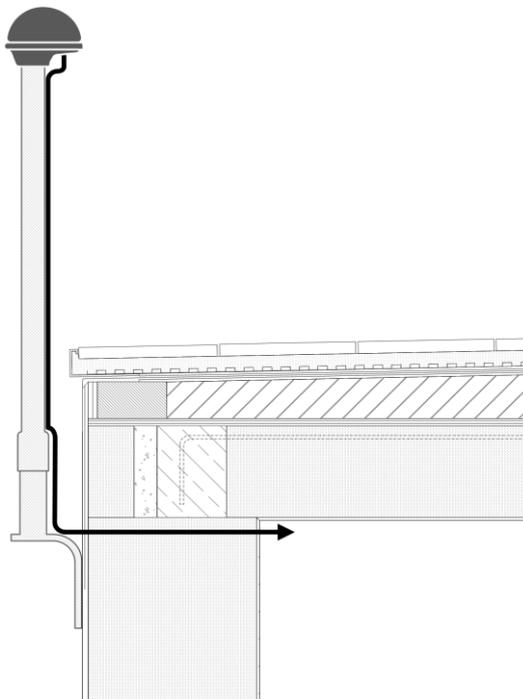
### 12.1.1 Mounting socket

The mounting socket is suitable for mounting the antenna on flat roofs.

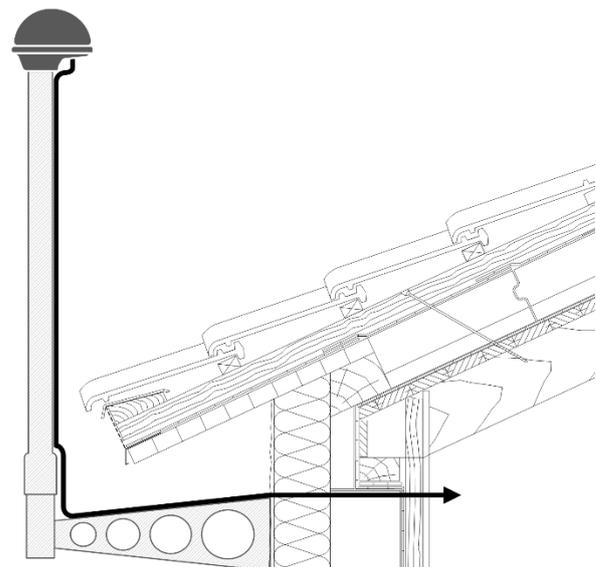


### 12.1.2 Wall bracket

The wall bracket is available in two versions, which must be used in combination with the mounting bar to mount the antenna.



L shape



Extension

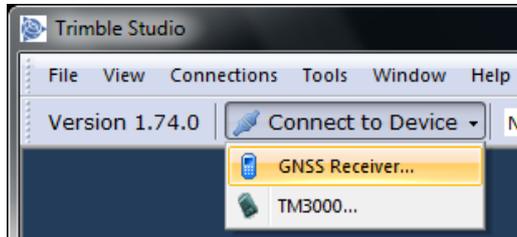
## 13 Trouble shooting

Error	Possible grounds
GPS: Time source is invalid after several synchronization attempts LED: Red	<ul style="list-style-type: none"> <li>- The antenna cable is defect</li> <li>- The antenna cable not correctly connected</li> <li>- The antenna is defect</li> <li>- There is no sufficient visual contact to at least 4 satellites. An opening angle of min. 45° to the sky is typically necessary.</li> <li>- The antenna is not correctly configured, refer to chapter 13.1</li> </ul>
GPS: ibaClock resynchronizes in irregular periods LED: Flashes	<ul style="list-style-type: none"> <li>- The antenna cable is defect</li> <li>- The antenna is defect</li> <li>- Voltage supply is overloaded</li> <li>- There is no sufficient visual contact to at least 4 satellites. An opening angle of min. 45° to the sky is typically necessary.</li> </ul>
GPS: ibaClock synchronizes very long after a GPS signal break LED: Flashes	<ul style="list-style-type: none"> <li>- A synchronization can take longer if the GPS signal has failed for a very long time, e. g. 2 days. In the test, the synchronization has been carried out after approx. 30 minutes, subsequent to a 3-days signal failure.</li> <li>- The GPS antenna downloads an almanac and does not supply a signal</li> </ul>
Distribution of the ibaClock FO via ibaBM-FOX-i-3o-D or ibaBM-DIS-i-8o does not work	<ul style="list-style-type: none"> <li>- The firmware of the data distributor must be upgraded.</li> </ul>
ibaClock is not detected	<ul style="list-style-type: none"> <li>- Check FO connection</li> <li>- FO defect</li> <li>- Voltage supply is overloaded</li> <li>- Firmware of the ibaFOB-D card is not up-to-date, D3 is required at least</li> <li>- ibaPDA version is not up-to-date, v6.34.0 is at least required</li> </ul>
ibaClock is not detected in the Flex ring	<ul style="list-style-type: none"> <li>- ibaClock can not be run in a Flex ring. The device needs its own link on the ibaFOB-D card.</li> </ul>

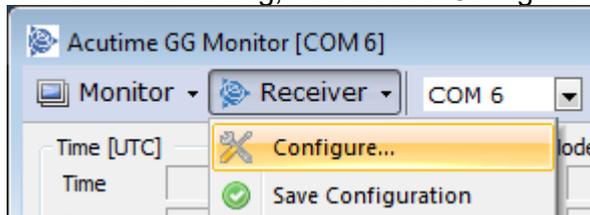
## 13.1 Antenna configuration

If you have not purchased the antenna from iba, it will still be provided with the manufacturer's delivery configuration.

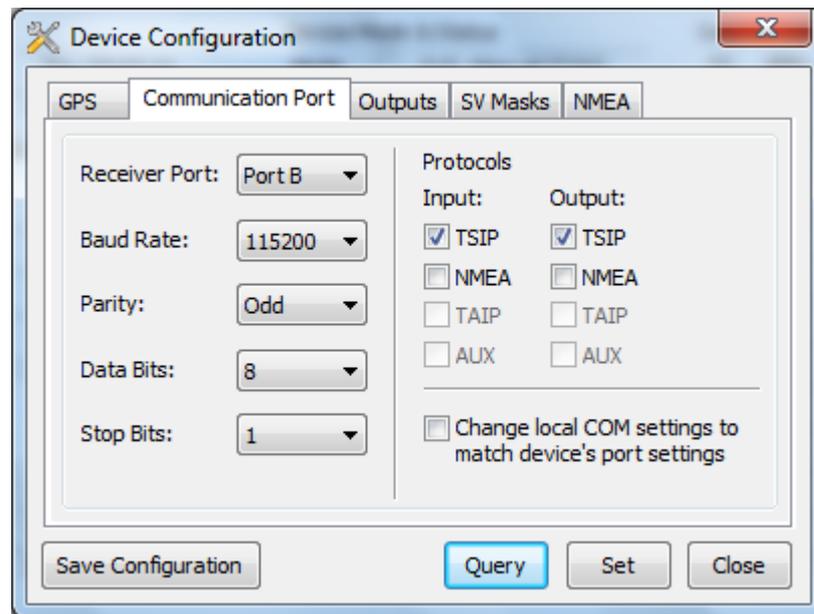
1. Connect the antenna with the Trimble RS-422 to USB converter (included in the starter kit) and connect these to the PC.
2. Open the Trimble Studio or the Trimble Visual Timing Studio.
3. Select "New Connection..." in the Connections menu or "GNSS Receiver" in the drop-down field "Connect to Device".



4. In the following dialog, select the device as well as the COM port for the connection of the antenna. Also set a check mark for "Auto-detect settings" in order to automatically identify the communication settings.
5. In the monitor dialog, now select "Configure" in the drop-down field "Receiver".



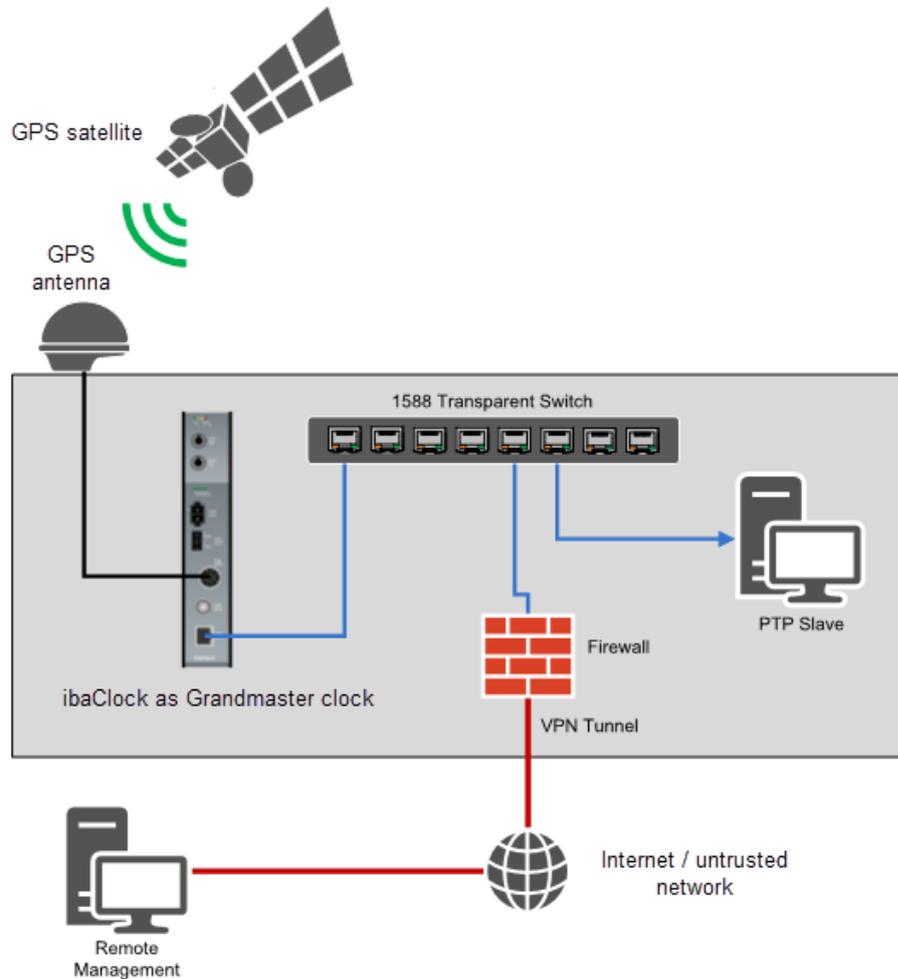
6. In the device configuration dialog, switch to the tab "Communication Port".
  - a. Select the receiver port "Port B" in the first drop-down field.
  - b. Now set the following parameters.
    - Baud rate: 115200
    - Parity: Odd
    - Data Bits: 8
    - Stop Bits: 1
    - Protocols:
    - Input and Output: TSIP
  - c. Click "Set" to accept the changes.
  - d. Click on "Save Configuration" to make the changes permanent.



7. The configuration is complete.

## 14 Security

Continuously advanced attack techniques in the field of IT as well as ever-new security gaps in proprietary as well as open-source software or hardware make unauthorized network accesses easier. It is therefore recommended to connect network-capable iba devices to untrusted networks only with sufficient protection, such as a firewall.



Example of a network configuration with remote access

## 14.1 List of ports used

- 13 TCP/UDP: DAYTIME – Time service
- 37 TCP/UDP: TIME - Time service
- 80 TCP: Web interface of the device
- 123 UDP: NTP - Time service
- 21: FTP (only on fiber optic/service interface)
- 23: Telnet (only on fiber optic/service interface)
- 319 – 320 UDP: PTP time service
- 62000 TCP: Device identification (auto detect)
- 62001 TCP: Configuration
- 62002 TCP: Configuration
- 62012 TCP: Transmission of diagnostic data of the time source to ibaPDA  
This port can be changed.
- 62101 – 62104 TCP: Configuration
- 63000 TCP: Service
- 63002 TCP: Service
- 63101 TCP: Configuration

## 14.2 Other types of access

In addition to the web interface, the device also has the following accesses.

### Telnet

A telnet service runs on the service and fiber optic interface. In support cases, this can be used by the iba support to get more accurate information about the error situation.

### FTP

An FTP server for transmitting update files is active on the service and fiber optic interface.

### Diagnostics

In addition, a diagnostic interface runs on the device that can be used in the event of service.

## 15 PTP



### Note

PTP uses its own time scale, TAI, which precedes the normal time scale by a number of leap seconds. Further information can be found in chapter 18.

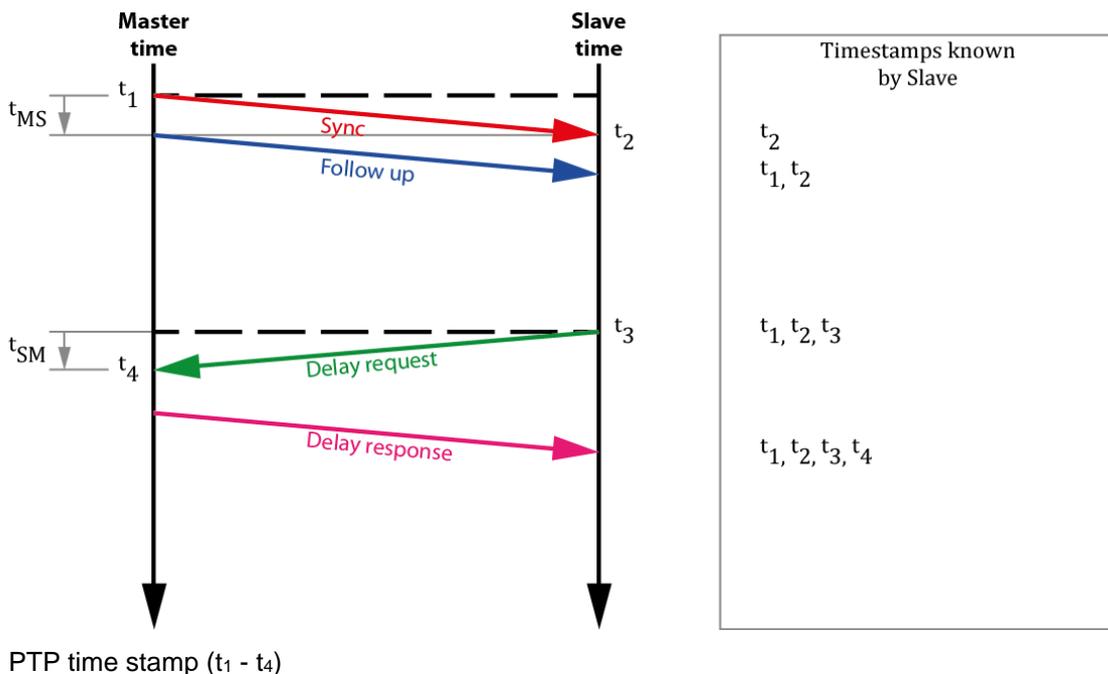
### 15.1 Functional principle

Similar to NTP, PTP synchronization messages can also be exchanged between the nodes involved. PTP defines the nodes involved as masters or slaves. NTP, on the other hand, defines the nodes as servers and clients.

These messages consist of master sync, master follow-up, master delay response and slave delay request. In addition, an algorithm is used to determine the best master in the network, the so-called “Best Master Clock Algorithm” (BMCA). The clock determined by the BMCA is also called a grandmaster clock and serves as a reference clock.

Several slaves can synchronize with a master in the network. For this purpose, the master sends synchronization messages that the slaves use to correct their local clock. The master and slave generate exact time stamps in order to determine the network latency, which is required for the synchronization.

To calculate the slave offset, four time stamps are recorded between the master and slave. These are usually called  $t_1$  to  $t_4$ ; see figure below.



Two run-times are then calculated with these four time stamps. From the master to the slave and from the slave to the master.

$$\begin{aligned} \text{MasterSlave difference} &= t_2 - t_1 \\ \text{SlaveMaster difference} &= t_4 - t_3 \\ \text{run - time} &= \frac{\text{MasterSlave difference} + \text{SlaveMaster difference}}{2} \end{aligned}$$

The offset that is used to correct the slave clock is calculated as follows.

$$\text{Offset} = \text{MasterSlave difference} - \text{run - time}$$

or

$$\text{Offset} = (t_2 - t_1) - \frac{(t_2 - t_1 + t_4 - t_3)}{2}$$

However, this calculation of the offset is only correct on the assumption that a constant propagation speed prevails in the network. No accurate synchronization can occur if devices are installed in the infrastructure that cause different run-times between the master and slave.

Different run-times can be caused, for example, by switches that are not designed to operate PTP applications.

## 15.2 Network requirements

With an optimally developed network architecture, PTP allows for a synchronization of under 100 nanoseconds. To be able to achieve this, however, the network architecture must be fully IEEE 1588 compliant.

The three main components of grandmaster clock (best with GPS receiver), network switch (transparent or boundary clock) and PTP slave must support the time stamping on the hardware side.

### Network switch

Switches can be categorized as “standard” and “IEEE1588-supporting.” A standard switch temporarily stores the network packets before sending them on again. The time of the caching may vary depending on the utilization of the switch. This in turn affects the calculation of the delay and the offset.

### High-Speed, Low-Latency Switch

Like the standard switch, this switch caches the packets. In the event of a slightly higher network load, it also allows for an accurate and stable synchronization. However, since the cache time also varies with this switch, it has a negative impact on the calculation of the delay and the subsequent synchronization.

### Transparent Clock

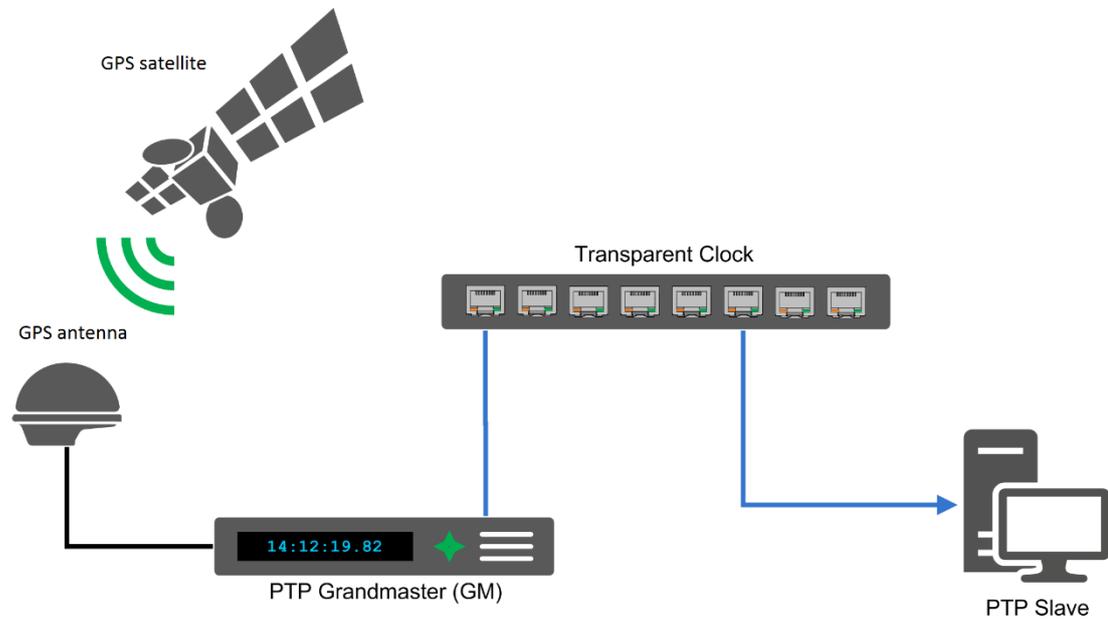
A transparent clock (TC) is a network switch that handles the IEEE1588 packets differently than the standard switch. The transparent clock measures the cache time of the packets and enters this in a field of the packet. The slave then uses the original time stamp and the time in the additional field to correctly calculate the delay.

### Boundary Clock

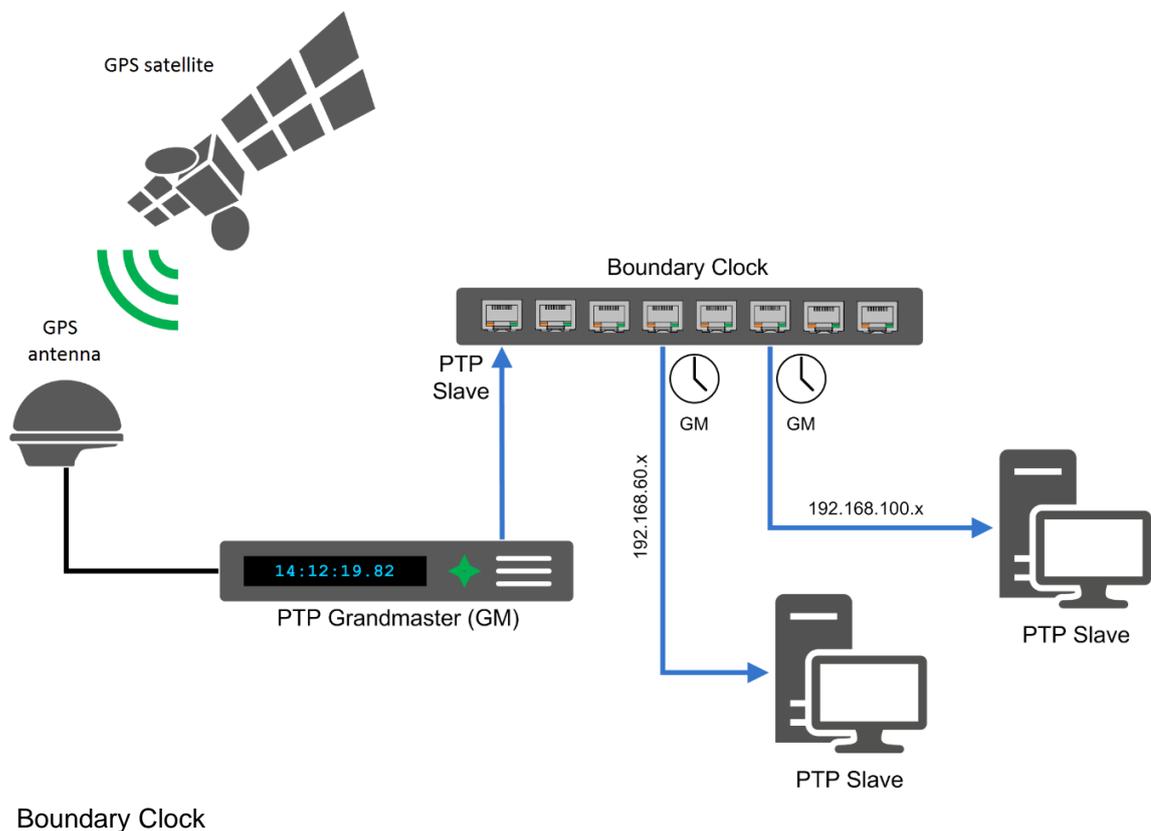
The boundary clock (BC) is another switch where the handling of the IEEE1588 packets is again different from that of a transparent clock or a standard switch.

The boundary clock can transport the PTP time information across network boundaries. For this purpose, it receives the time information as a slave and passes this on as a master.

Slaves connected to the boundary clock see this as a grandmaster clock and synchronize themselves, even if they are in a different subnetwork.



Exemplary PTP environment with a transparent clock



Boundary Clock

## 16 NTP

Since NTP was developed for synchronization over long distances (wide area networks = WANs), it does not place any particular requirements on the network infrastructure.

In the event of a synchronization via WANs, such as the Internet, NTP can be used to achieve an accuracy of about 0.01 seconds. This can be increased to < 1 ms in local networks (LANs).

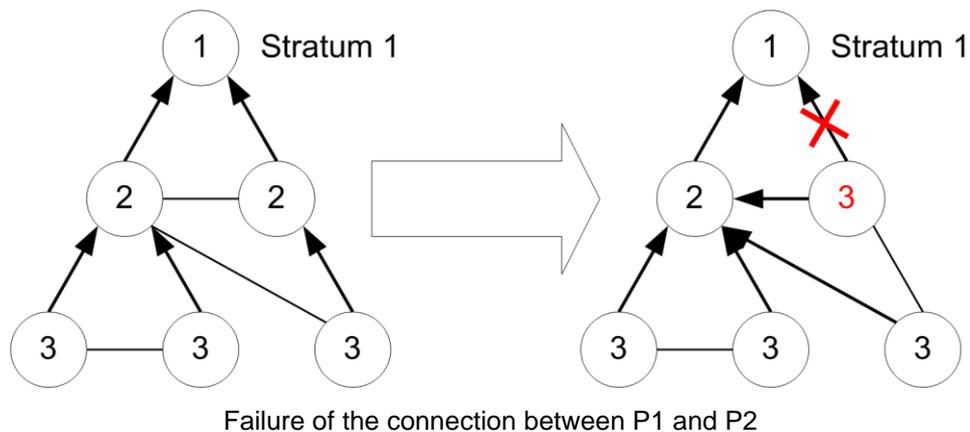
Prior to Windows 10 1607 (anniversary update) and the Pendant Windows Server 2016, however, only an accuracy of about 1-2 seconds could be achieved with the client integrated in Windows. If a greater accuracy was required, third party clients had to be resorted to.

With the above-mentioned Windows versions, the integrated client offers an accuracy of up to 1 ms.

### 16.1 Functional principle

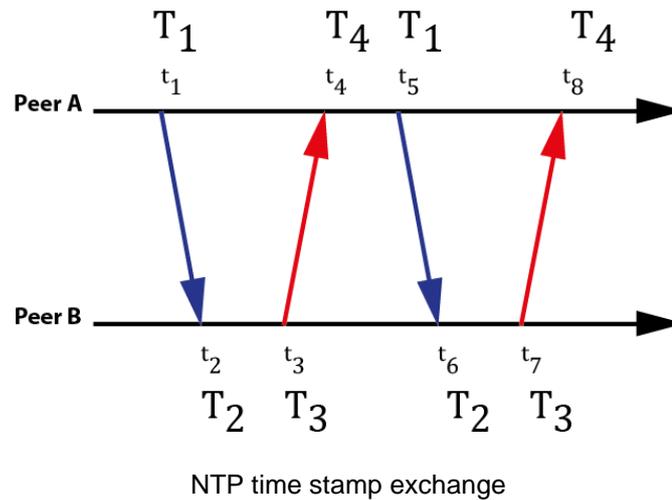
With NTP, there are primary servers (stratum 1) that are synchronized with a GPS receiver, for example. For the following, secondary, tertiary and other NTP servers, the stratum value is always increased by one the lower they are in the synchronization structure.

NTP also offers a high level of reliability through redundant servers and network paths as well as a self-organizing hierarchical network structure.



As can be seen in the figure above, if a connection between P1 and P2 fails, then the structure reorganizes itself and automatically assigns new strata.

The round-trip delay as well as the offset are determined similarly to with PTP, as the following example shows.



The client (peer A) sends the time stamp  $T_1$  to the server (peer B). Then the server sends the client a message containing the time stamp  $T_1$  (sending time from the client),  $T_2$  (receiving time at the server) and  $T_3$  (sending time from the server). As soon as the client has received this message, the time stamp  $T_4$  (receiving time at the client's location) is also set and the offset as well as the round-trip delay can be calculated as follows.

$$\text{Round - trip delay} = (T_4 - T_1) - (T_3 - T_2)$$

$$\text{Offset} = \frac{1}{2} \cdot [(T_2 + T_3) - (T_1 + T_4)]$$

However, this offset calculation only provides an exact value if the run-times in both directions are identical.

To keep the error in the time synchronization as small as possible, the time stamp exchange  $T_1$  to  $T_4$  takes place a total of 4 times.

The network components involved do not make any additional corrections to the NTP packets, as is the case with PTP for example.

## 17 GPS

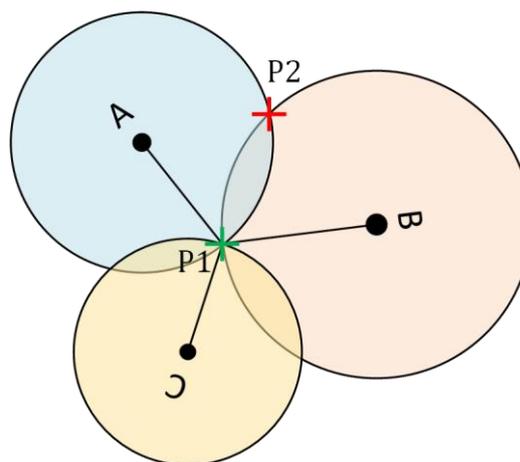
### 17.1 Functional principle

The normal configuration of the GPS network consists of 24 satellites orbiting the earth at about 14000 km/h on an orbit of about 20000 km. Thus, each satellite orbits the earth about two times per day.

From any point on earth and at any time, at least four of these GPS satellites are visible and can be used to determine position.

However, due to the constellation of satellites, a maximum of 12 are available at one time.

Only three satellites are used for 2D position determination (2D fix). In order to determine the 3D position (3D fix), another satellite is required. With this satellite it is possible to determine the height above sea level and to determine the exact position.



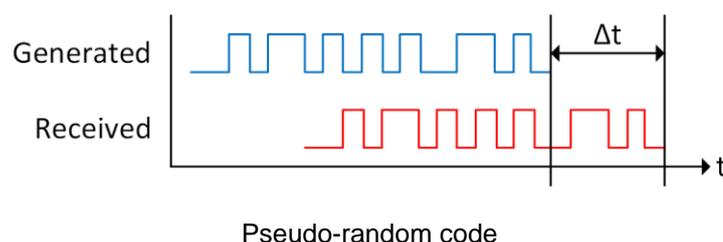
Trilateration

The trilateration method is used to determine position in the plane. In this method, the position is determined by measuring distances. As can be seen in the figure above, it is only possible to determine the position in the plane by satellite C. Before that, an object could be located at two points P1 and P2 respectively.

For the determination of the altitude above sea level, the measurement of the fourth satellite is then used.

The fourth satellite is also required to determine deviations between the clocks of the satellites and the clock of the receiver as well as to calculate these deviations out of the measured transit times.

To determine the travel time, the transmitter (satellite) and receiver generate the same pseudo-random codes. The receiver then measures the time between the code generated on its end and the received code.



Pseudo-random code

$$v * \Delta t = s$$

$$v = 299\,792\,458 \frac{m}{s}$$

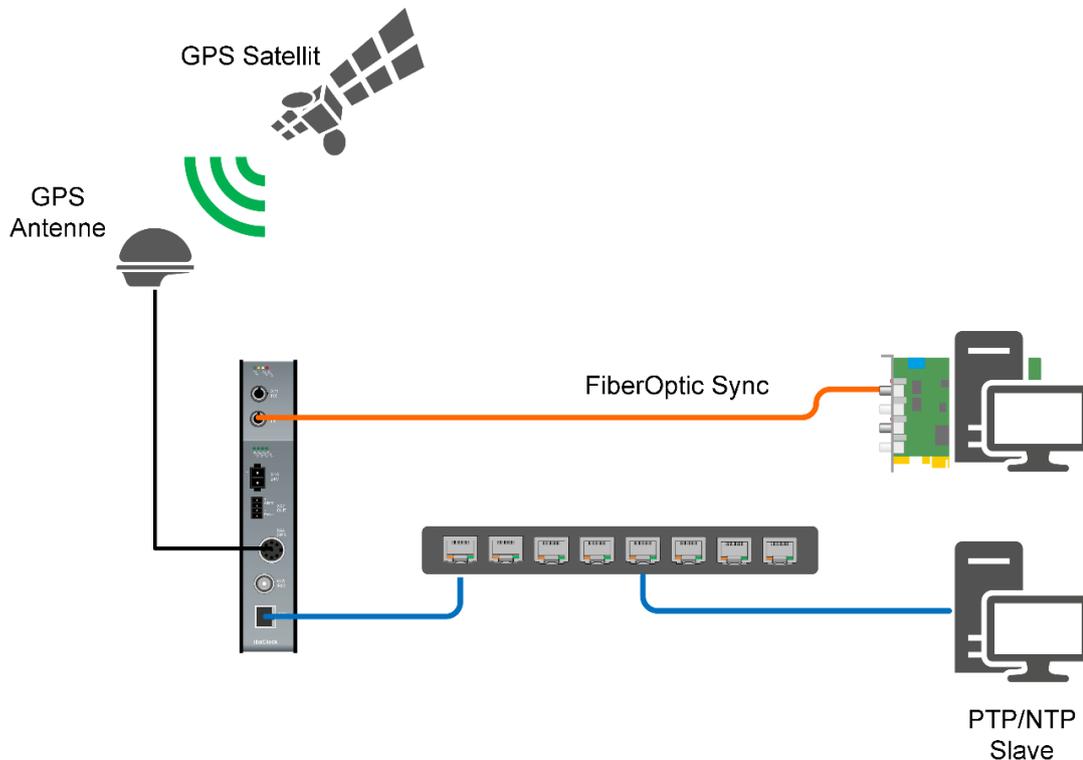
$$\Delta t = \text{measured time}$$

$$s = \text{distance in m}$$

After the deviations have been eliminated, the travel time is used to determine the distance to the satellite. For this purpose, it is simply multiplied by the speed of light.

The distances determined in this way are then used in the tri- or multilateration process for position determination.

### Use with ibaClock



Example application with ibaClock

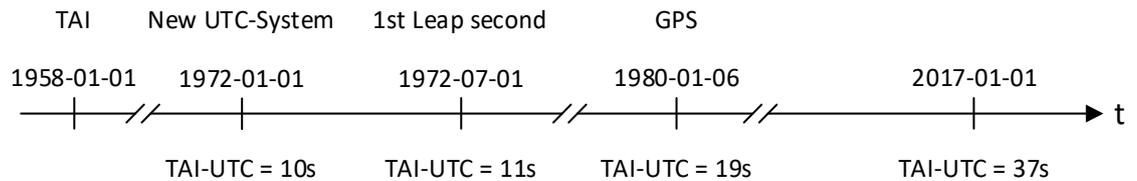
As shown in the figure above, it is possible to synchronize other systems with the help of ibaClock via different ways and media. In the upper system, the synchronization is carried out directly via an ibaFOB card using optical fibers.

The lower system is synchronized via network. This is done here via PTP or NTP. For synchronization via PTP, chapter 15 must be observed.

## 18 Timescales

### 18.1 Leap second

The first leap seconds was introduced in July of 1972.



To keep UTC in sync with the astronomical time scale UT1, leap seconds are inserted at irregular intervals. These leap seconds are determined from observations of the Earth's rotation. These observations are collected and evaluated by the IERS (International Earth Rotation and Reference Systems Service). The insertion of leap seconds usually happens in the middle or end of a year, exactly in the last minute of June 30 or December 31.

### 18.2 GPS

Global Positioning System time is the atomic time scale implemented by the atomic clocks in the GPS ground control stations and the GPS satellites themselves.

The GPS satellites adopted a time scale which was synchronized with UTC on 1980-01-06, and it has been steered in close synchrony with TAI since then. Therefore, the difference TAI - GPS has been 19 s to within a microsecond. The 19 s are the leap seconds that were introduced at that point in time.

### 18.3 Temps Atomique International (TAI)

Is the international atomic time scale based on a continuous counting of the SI second (BIPM, 2019).

Since the SI second is based on the resonance of cesium, the atomic time has no relation to the rotation of the earth, which in the long run means it has no relation to a calendar.

TAI is always ahead of GPS by 19 seconds. The 19 seconds come from the fact that on January 6, 1980, there were only 19 leap seconds between the TAI and the GPS time. Since then, GPS time has tracked TAI to within microseconds.

At the time of writing, TAI is 37 seconds ahead of UTC.

### 18.4 Coordinated Universal Time UTC

Coordinated Universal Time UTC is created by the cooperation of more than 70-time institutes worldwide, which have a total of about 400 atomic clocks (PTB).

### 18.5 Local

By adding the hours of the current time zone to the coordinated universal time, the local time is formed.

## 18.6 Links

BIPM. 2019. Le Système international d'unités / The International System of Units ('The {SI} Brochure'). Ninth. Online : Bureau international des poids et mesures, 2019. ISBN 978-92-822-2272-0.

PTB. Physikalisch-Technische Bundesanstalt. [Online] [Cited: 02 28, 2022.] <https://www.ptb.de/cms/en/ptb/fachabteilungen/abt4/fb-44/ag-441/realisation-of-legal-time-in-germany/leap-seconds.html>

## 19 Support and Contact

### Support

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Fax: +49 911 97282-33

E-Mail: [support@iba-ag.com](mailto:support@iba-ag.com)



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### Note

If you require support, specify the serial number (iba-S/N) of the product.

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