



ibaPDA-Multistation

Measure and record synchronously with multiple ibaPDA systems

Manual
Issue 2.0

Measurement Systems for Industry and Energy

www.iba-ag.com

Manufacturer

iba AG
Koenigswarterstrasse 44
90762 Fuerth
Germany

Contacts

Main office	+49 911 97282-0
Fax	+49 911 97282-33
Support	+49 911 97282-14
Engineering	+49 911 97282-13
E-mail	iba@iba-ag.com
Web	www.iba-ag.com

Unless explicitly stated to the contrary, it is not permitted to pass on or copy this document, nor to make use of its contents or disclose its contents. Infringements are liable for compensation.

© iba AG 2022, All rights reserved.

The content of this publication has been checked for compliance with the described hardware and software. Nevertheless, discrepancies cannot be ruled out, and we do not provide guarantee for complete conformity. However, the information furnished 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 www.iba-ag.com.

Version	Date	Revision	Author	Version SW
2.0	10-2022	Slave without master, Unsynchronized stations, RM new version ibaPDA v8		8.0.0

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

Content

1	About this documentation	4
1.1	Target group and previous knowledge	4
1.2	Notations	4
1.3	Used symbols.....	5
2	System requirements	6
2.1	Hardware	6
2.2	Software	6
3	Introduction.....	7
4	Functional principle.....	8
4.1	Connections in detail	10
4.2	Timing and synchronization	12
5	Configuration and engineering ibaPDA	15
5.1	Configuration as multistation master	16
5.2	Configuration as multistation slave	18
5.3	Trigger configuration	19
6	Operation.....	23
6.1	Start of the acquisition	23
6.2	Dealing with connection problems.....	24
7	Unsynchronized stations	25
7.1	Configure multistation master for unsynchronized stations.....	26
7.2	Configuration as Slave without Master.....	27
7.3	Settings for unsynchronized stations	27
7.4	Diagnostics tab	28
7.5	Trigger pool.....	29
8	Diagnostics.....	30
8.1	Diagnostics tab	30
8.2	Data storage status	31
8.3	MultiStationStatus() function	31
9	Support and contact.....	32

1 About this documentation

This documentation describes the function and application of the software *ibaPDA-Multistation*.

1.1 Target group and previous knowledge

This manual is aimed at qualified professionals who are familiar with handling electrical and electronic modules as well as communication and measurement technology. A person is regarded 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

In this manual, the following notations are used:

Action	Notation
Menu command	Menu <i>Logic diagram</i>
Calling the menu command	<i>Step 1 – Step 2 – Step 3 – Step x</i> Example: Select the menu <i>Logic diagram – Add – New function block</i> .
Keys	<Key name> Example: <Alt>; <F1>
Press the keys simultaneously	<Key name> + <Key name> Example: <Alt> + <Ctrl>
Buttons	<Key name> Example: <OK>; <Cancel>
Filenames, paths	<i>Filename, Path</i> Example: <i>Test.docx</i>

1.3 Used symbols

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

Danger!



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

- Observe the specified measures.
-

Warning!



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

- Observe the specified measures.
-

Caution!



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

- Observe the specified measures
-

Note



A note specifies special requirements or actions to be observed.

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.

2 System requirements

2.1 Hardware

- *ibaPDA* computer as per the currently valid minimum requirements (see *ibaPDA* manual)
- *ibaFOB-D* input card for the measuring signals in every participating computer, firmware version D3
- For the so-called multistation master computer:

1 *ibaFOB-4i-D* (or - *Dexp*) + *ibaFOB-4o-D*

The module *ibaFOB-4o-D* must be connected to the socket for the mirror mode (white socket on the card board).

The *ibaFOB-io-D/Dexp* and *ibaFOB-2io-D/Dexp* cards are also suitable. The *ibaFOB-4o-D* module can also be attached to these cards.

- For the so-called multistation slave computer:

At least 1 free *ibaFOB-D* input channel for synchronization (not required for "unsynchronized slaves")

- 2 separate network interfaces on all participating computers

2.2 Software

- *ibaPDA* V7.1.0 or higher
- Multistation license required

License information

Order no.	Product name	Description
30.001930	ibaPDA-Multistation	Extension license for <i>ibaPDA</i> to enable multistation operation This license is required for each computer in a multistation network.

3 Introduction

Multistation operation is an extension of the *ibaPDA* function, which offers highly accurate, synchronized data acquisition on multiple *ibaPDA* computers.

Multistation operation is used in cases where the number of the necessary measuring signals exceeds the total capacity of the input cards in a computer or if a spatially separated yet synchronized acquisition will be carried out.

This situation frequently occurs when the acquisition of many signals with a high sampling rate via *ibaFOB* cards is required; for example, in the field of energy measurement technology.

If there is an insufficient number of slots for input cards in a computer to accommodate all measuring channels from a plant, then the only option is to install additional *ibaPDA* computers and distribute the inputs to the respective systems.

In principle, the systems can be time-synchronized via NTP, PTP, DCF77 or similar methods. However, sample-accurate synchronous measurement on all systems is not possible in this way. Furthermore, these are independent *ibaPDA* systems that can start and stop their measurements at different times.

The start times of the data files from the different systems may also differ. When viewing the data files in *ibaAnalyzer* it is difficult to align the files accurately.

Multistation operation ensures that all participating *ibaPDA* systems can acquire and store the signals absolutely synchronously with a synchronization accuracy of less than one sample.

A comprehensive trigger management system ensures that the systems in a multistation network can exchange trigger events with each other and thus synchronously control each other's data storage.

The trigger signals are transmitted with high accuracy. Therefore, the actuation of a trigger on one *ibaPDA* system can simultaneously start or stop the recording on any other *ibaPDA* system. This also makes it possible to configure individual pre- or post-trigger times for the data storage.

This function is especially useful if the participating *ibaPDA* systems are widely separated and the connected plants are technically related, e.g., as is often the case with energy transmission systems. Interactions or subsequent events in connected plants can thus be proven.

If, during the subsequent analysis, the measurement files from the different *ibaPDA* systems are opened with *ibaAnalyzer*, it is as if the signals had been recorded with one single system.

A pleasant side effect is the minimal wiring effort, as signals that may be useful for multiple *ibaPDA* systems must only be wired once.

4 Functional principle

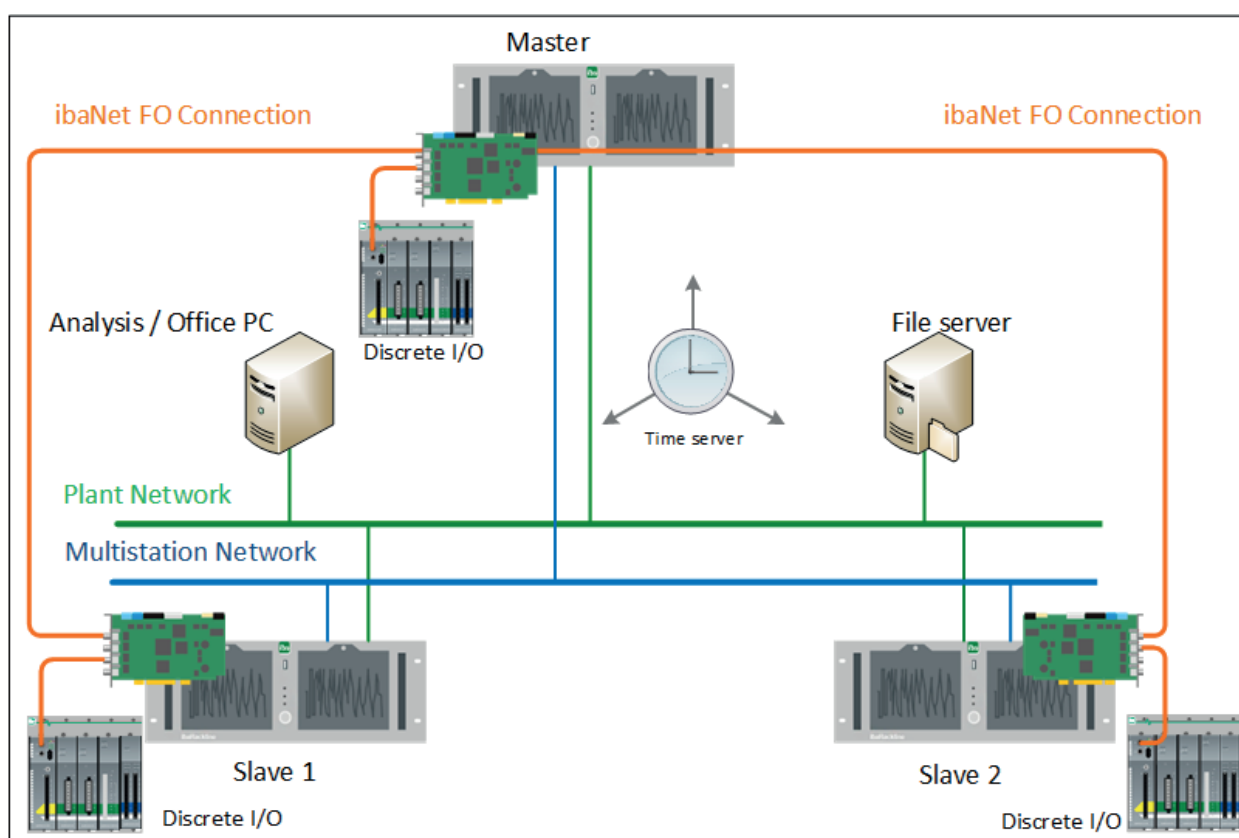
Multistation operation enables synchronized data acquisition by multiple *ibaPDA* systems and mutual control of the data recording.

Note



Typical and previously realized configurations comprise 3 to 5 *ibaPDA* systems. A multistation network cannot comprise more than 5 systems (1 master + 4 slaves) due to device limitations.

One system is designated multistation master, the other systems are multistation slaves.



There are 2 connections between master and slave:

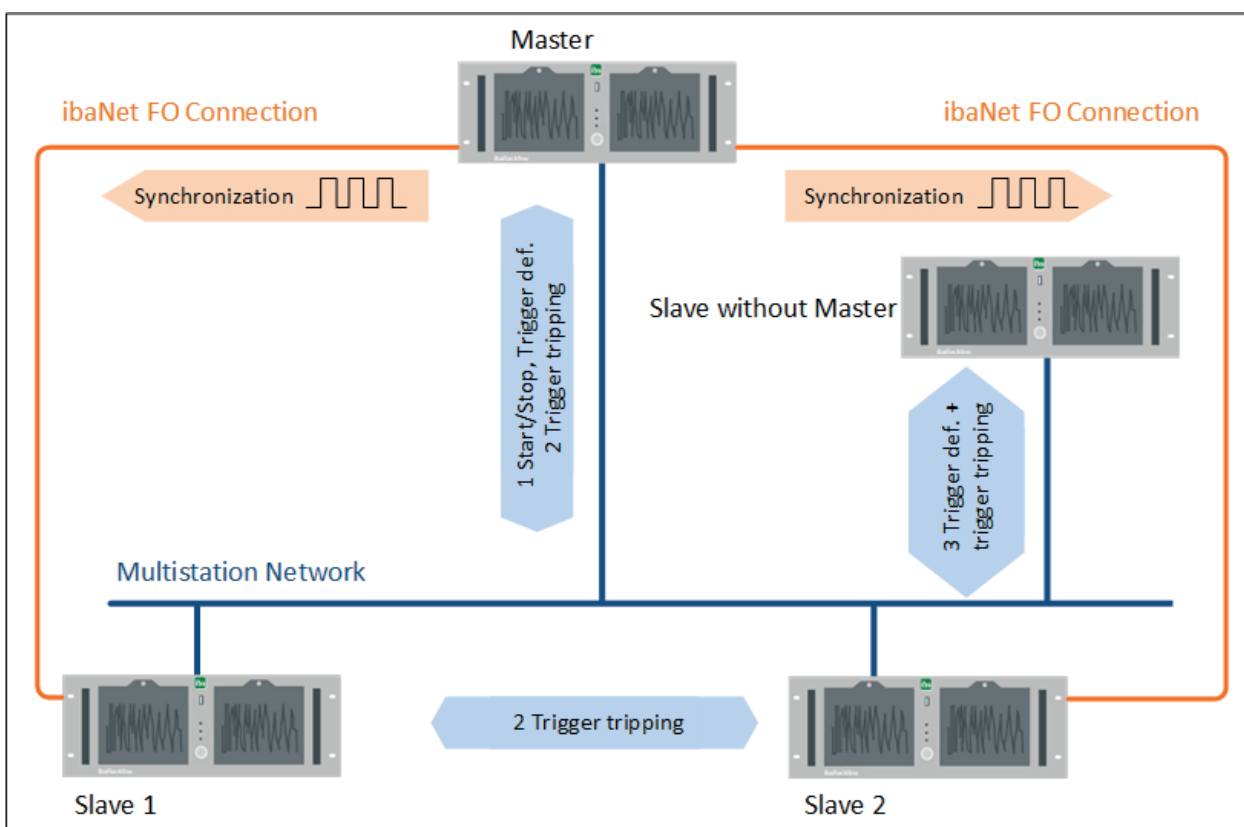
- Network connection for the transmission of control signals between master and slave (start, stop acquisition, watchdog, trigger, etc.)
- ibaNets fiber optic cable connection between *ibaFOB-D* cards for transmission of the synchronization clock (in case of multiple slaves, they are connected in a star configuration from the master to the slaves)

In the overall system, 2 separate networks must be installed, to which the participating *ibaPDA* computers are connected:

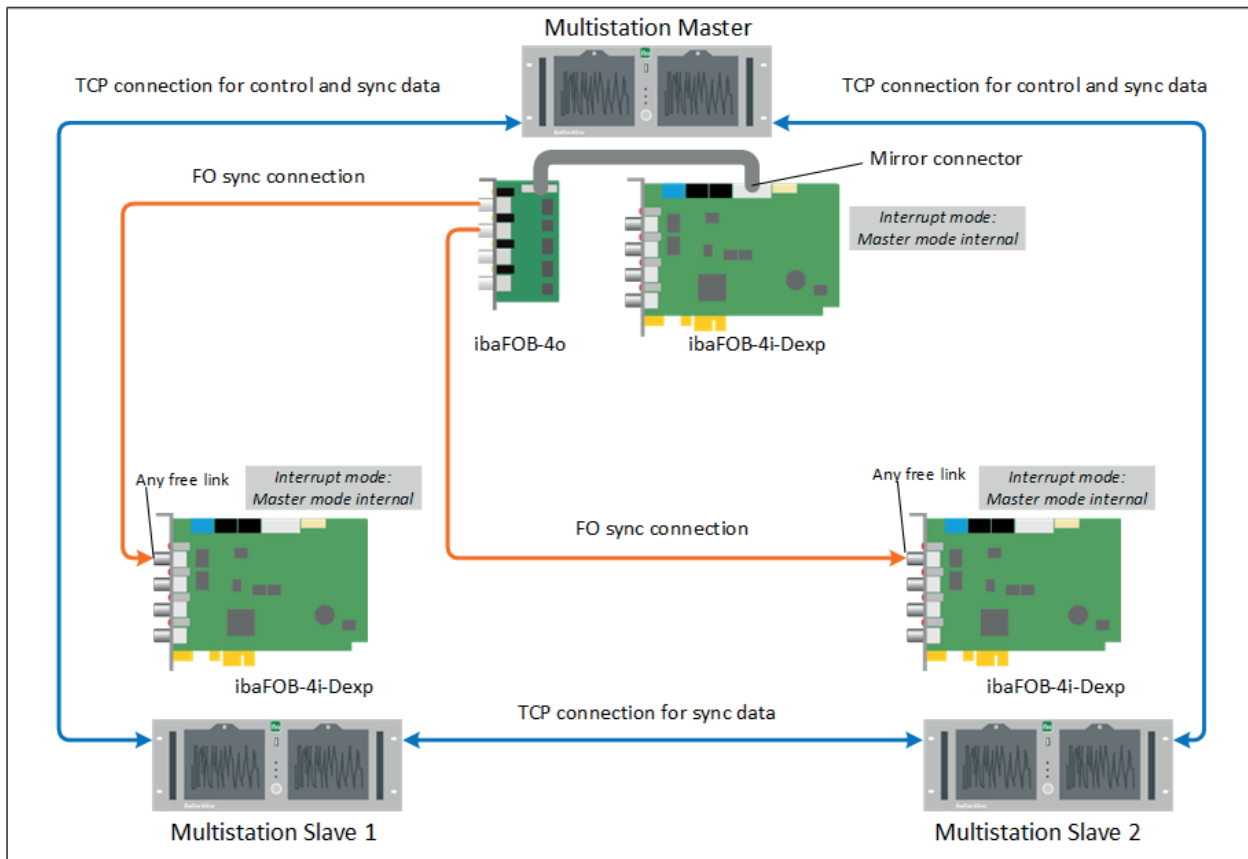
- Multistation network which only connects the *ibaPDA* computers and serves to transfer the multistation communication
- Network for general access to the *ibaPDA* computers, also externally, e.g., to open or copy data files ("plant network" in the figure above)

The connections established via the multistation network are differentiated according to three categories:

1. Connection between the master and synchronized slaves for synchronized start and stop of acquisition and exchange of trigger definitions
2. Connection between synchronized computers (master-slaves and slave-slave) for triggering with trigger name and parameters; these connections only exist when the acquisition is running
3. Connection to unsynchronized computers for exchange of trigger definitions and trigger actuation. Unsynchronized computers are either "slaves without master" or masters of different multistation stations, which are connected to each other.



4.1 Connections in detail



FO sync connection

The master station is connected with every slave station via a fiber optic cable, which leads from an output of an *ibaFOB-4o-D* card in the master to an input of an *ibaFOB-4i-D* card in the slave.

The *ibaFOB-4o-D* module must be connected to the mirror socket of an *ibaFOB-4i-D* card (white connector on the card).

The *ibaFOB* card in the slave must be configured as interrupt master (internal), as it clocks possible other cards in the slave computer.

The master sends a clock signal via the fiber optic cable, which allows the other stations to sample the measuring data at the exactly same time. Furthermore, this clock signal is transmitted to the connected signal sources of the slaves (e.g. *ibaPADU-M*, *ibaPADU-S-CM*, *ibaPADU-S-IT*, *iba-Link-VME*, etc.), so that these devices can measure in the exact same clock.

ibaPDA knows and compensates the protocol-related time delays during the transmission and such enables a perfect synchronization of the signals, which are sent with different fiber optic protocols from different devices.

For unsynchronized stations or Slaves without Master that are participants in a multistation network, no FO synchronization connection is required.

TCP/IP connection

Besides the fiber optic synchronization connection, an Ethernet network is used between all stations. This way, two different kinds of network connections are created:

- Control connections, with the functions...
 - Transmission of start and stop commands
 - Monitoring (Watchdog)
 - Negotiation of the timing between the stations in the starting phase
 - Check for validation errors
 - Control of the exactly synchronous start of the acquisition
 - Ensuring synchronized data processing on all stations
 - Trigger configuration
- Data connections, with the functions...
 - Transmission of trigger events

The control and data connections are established during the starting phase between master and slave(s). If more than 1 slave is in the network, data connections are established between the slaves, so that every station has a data connection to all other stations. Via the control connection, specific telegrams are exchanged between the stations, which contain the system time of the master and furthermore information regarding the defined trigger events, which have been calculated based on the data volume to be processed.

The acquisition does not start before every station has received a data telegram by all of the other stations.

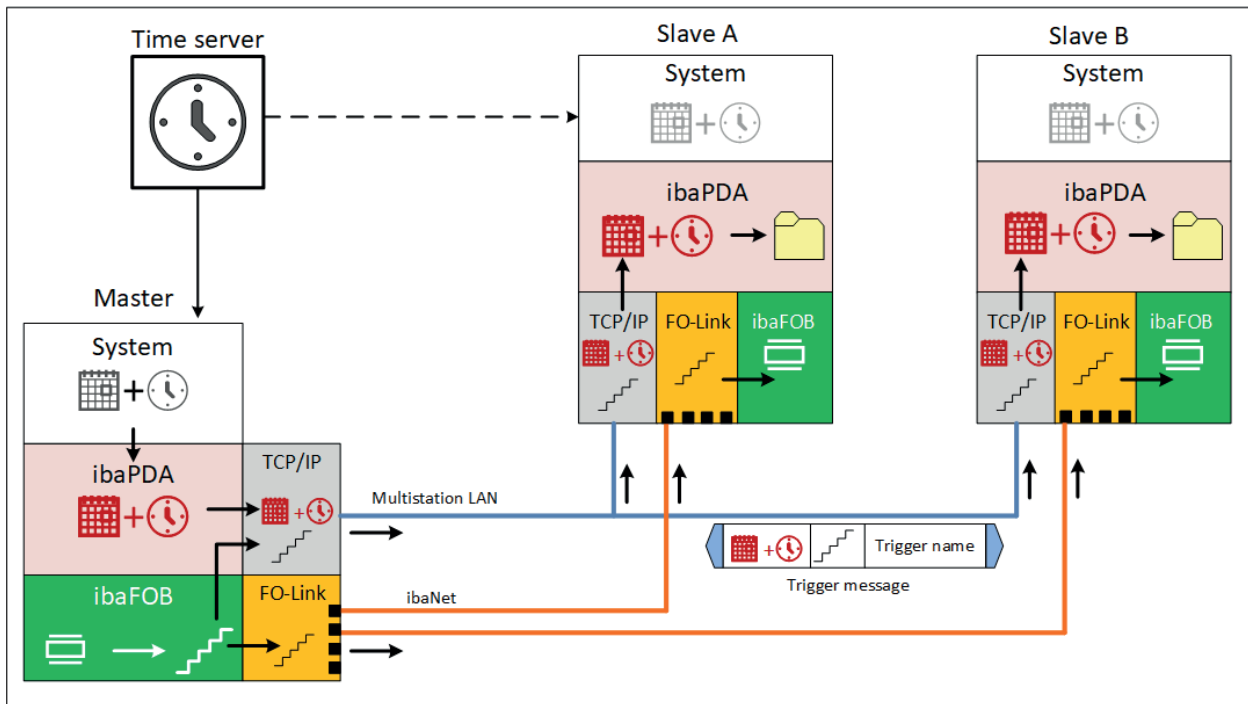
An exact synchronization of the system times of the particular stations is not necessary, because all stations use the system time of the master for the data files.

4.2 Timing and synchronization

In multistation operation, a basic distinction is made between synchronized and non-synchronized operation.

Synchronized multistation operation

In a multistation network, starting from the multistation master, all connected stations are synchronized via the ibaNet fiber optic link with regard to the acquisition. The following figure represents the processes in synchronized operation as a diagram.



The multistation master specifies the date, time, and the highly accurate clock for all participants. Ideally, the system times of all participants are based on an accurate time source, e.g., a GPS clock via PTP protocol. However, the respective system times are irrelevant with regard to synchronization of the acquisition on the individual stations.

Only the date and time of the master are used for the acquisition and to date the data files!

With the ibaFOB card in the multistation master, a highly accurate clock in the nanosecond range is generated, which is used as a counter value. This clock or running counter value is transmitted via the fiber optic link to the ibaFOB cards of the stations in order to synchronize them.

At the same time, the counter value, together with the date and time from the master, is sent to the stations via the network connection (multistation LAN). All stations thus have the same time with regard to the acquisition, even if the system times are different.

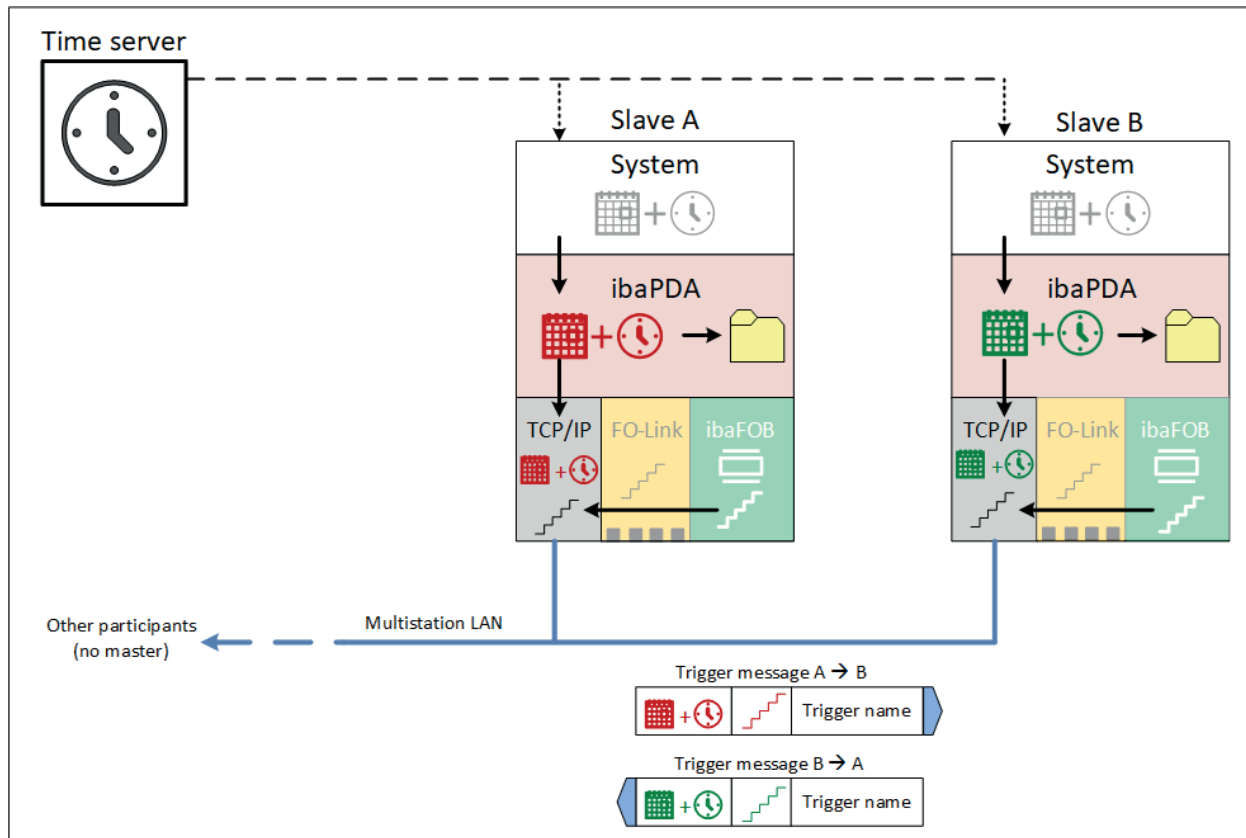
When a trigger event occurs at one of the stations, it sends a telegram that contains the trigger name as well as the date, time, and counter reading from the clock source. Since all stations have the same time information and counter readings, the trigger event can also be correctly and accurately classified on the other computers. This even works if there is latency between sending and receiving the telegram, e.g., due to long distances.

The receiving stations take the time stamp from the telegram to start the corresponding data file and select the samples according to the counter reading. The start time of the data file is the time of the trigger event minus a trigger lead time, if configured. Nevertheless, the time stamp of the trigger event is applied to the file name.

Non-synchronized multistation operation (operation without master)

In non-synchronized operation, there is no synchronization via the ibaNet fiber optic link. This may be the case, for example, if a multistation master fails or is not available. Any computers operating in the multistation network as a "slave without master" also use this operating mode.

The following diagram illustrates the processes for non-synchronized operation.



In non-synchronized operation, the ibaNet fiber optic link between the stations is either absent or cannot be used because the master has failed. In this case, the stations work autonomously, i.e., they start and stop the acquisition independently, use their own clock counter, and date their data files with their own system time.

Only the multistation network (multistation LAN) is available for communication. When a trigger event occurs at one of the stations, it sends a telegram that contains the trigger name, its own clock count, and its own date and time.

The receiving stations take the time stamp from the telegram and file it on the basis of their own time in order to date the data file and select the appropriate samples. The start time of the data file is the time of the trigger event minus a trigger lead time, if configured. Nevertheless, the time stamp of the trigger event is applied to the file name.

Due to this approach, it is very important that the system times of all stations are as close to identical as possible. Since the system time on a computer is relatively inaccurate unless it is set

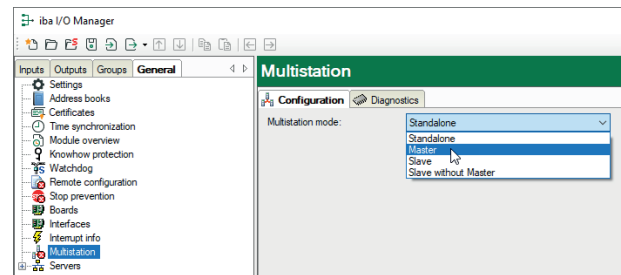
regularly, e.g., at least by the Windows service, the times on the different stations would begin to diverge relatively quickly.


All computers in the multistation network should therefore be fed the date and time via a time server. For this purpose, ibaPDA offers various options such as NTP, PTP, DCF77 or ibaClock (GPS).

The best fallback strategy in the event that the connection to the master is lost is to ensure that the time on all computers is as accurate as possible.

5 Configuration and engineering ibaPDA

The configuration of the multistation operation is made in the I/O manager of *ibaPDA*. You can find the setup dialog in the I/O manager on the node *General*, sub-node: *Multistation*.

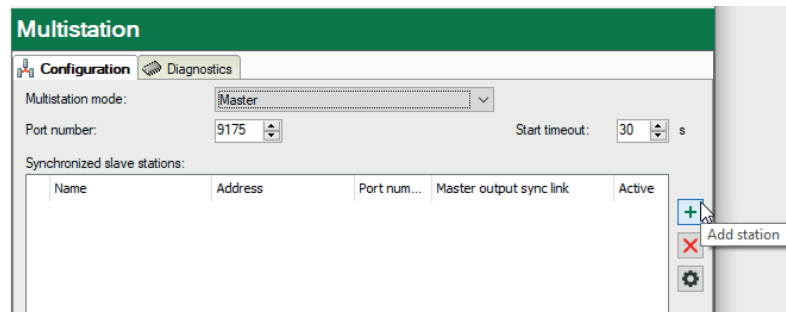


Multistation mode	Note
Standalone (default)	Multistation operation is disabled, the <i>ibaPDA</i> system operates autonomously. In the interface tree this is indicated by the  symbol.
Master	Select this mode on the <i>ibaPDA</i> system that will operate as the multistation master. The fiber optic hardware for the distribution of the synchronization clock (ibaFOB card with an ibaFOB-4o-D module at the mirror port) must be available in this computer. In addition, the computer must be connected to the multistation network.
Slave	Select this mode on all <i>ibaPDA</i> systems that will be synchronized by the master in the multistation network. Each slave computer requires an ibaNet FO connection to the master. In addition, the computer must be connected to the multistation network.
Slave without Master	Select this mode on an <i>ibaPDA</i> system that will be connected to the multistation network to exchange global triggers, but otherwise collects its data independently. This system is not synchronized by the master and therefore does not require an ibaNet FO connection. A connection to the multistation network is still required. See ↗ Unsynchronized stations , page 25.

5.1 Configuration as multistation master

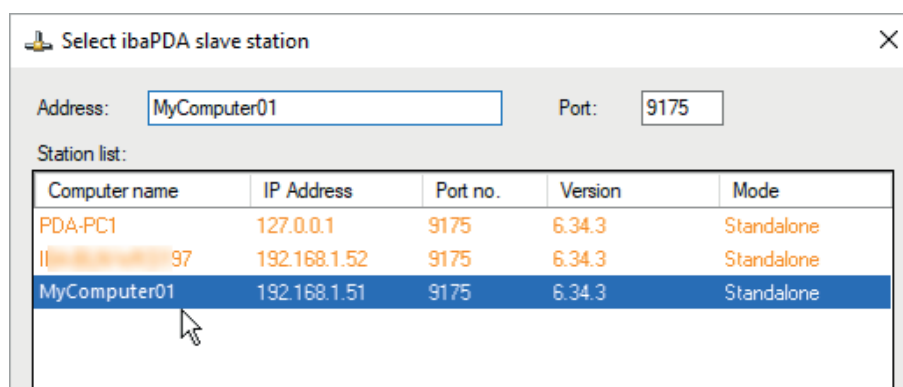
1. To configure a system as the multistation master, select "Master" in the multistation mode field.

Further elements will appear in the dialog.



2. At first, all of the involved slave systems must be entered into the table. For this purpose, click on the button with the plus-symbol.

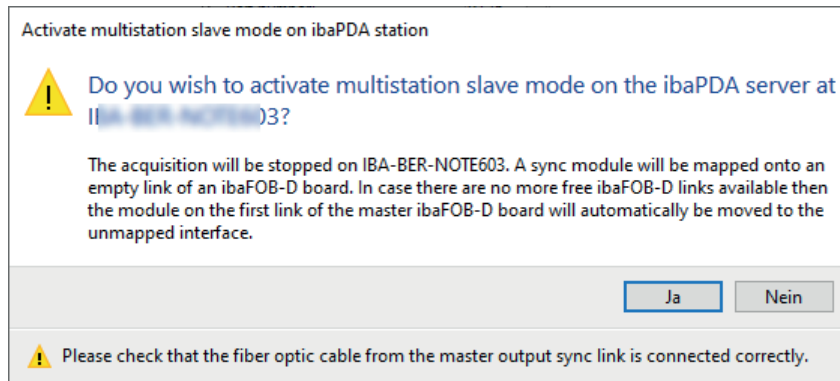
A station browser is opened in which all *ibaPDA* servers that are active in the network are listed.



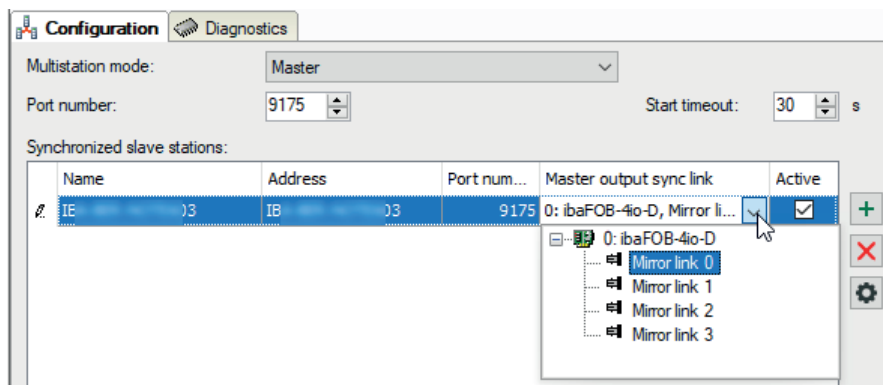
The mode of the *ibaPDA* systems is displayed along with the computer name, IP address, port number and *ibaPDA* version.

The color of the lines has the following meaning:

- Green: This station supports multistation operation and the computer is already in the slave mode.
 - Orange: This station supports multistation operation and the computer is not in the right mode (Standalone or Slave without Master).
 - Red: This station does not support multistation operation. (Software upgrade necessary).
3. Select a computer that should be run as multistation slave.
If the computer in question is in *Standalone* or *Slave without Master* mode, a note will appear with the question if the mode should be switched.



4. Confirm with <Yes>. The acquisition on the slave system is then stopped, the system is set into the multistation slave mode and is then ready to be started together with the master system.
5. If requested, you can name the slave computer ("Name" column). When using the station browser, the name of the computer is applied by default.
6. In the "Address" column, enter the IP address or the computer name if it has not been entered by the station browser yet.
7. The same applies to the port number. Please note, that all involved computers in the multistation network use the same port number.
8. Select finally the link of an *ibaFOB-4io-D* output card (mirror module) of the master, which is connected to the according slave computer with an input of the *ibaFOB-D* input card (interrupt master). The slave is synchronized via this link.



9. Repeat steps 2 to 8 until all slave stations are connected.

The "Start timeout" parameter defines the waiting time of the system, until it has established a connection with the other stations for the start of the acquisition. If the acquisition must be started on a slave system, e.g., after a change of the I/O configuration, the system will wait for a response from the master for this amount of time. If the connection to the master is not achieved in this time, the systems starts in the standalone mode. The default port is 9175. The master and all slaves in a multistation network must use the same port number.

Under the table containing the slaves you can configure the support for "Unsynchronized stations", see also ↗ *Unsynchronized stations*, page 25.

5.2 Configuration as multistation slave

Usually, every system can be configured as multistation slave when configuring the multistation master (see above, step 3 and 4).

If you want to configure a system as a multistation slave via its own I/O manager, click on *Slave* in the *Multistation mode* drop-down menu.

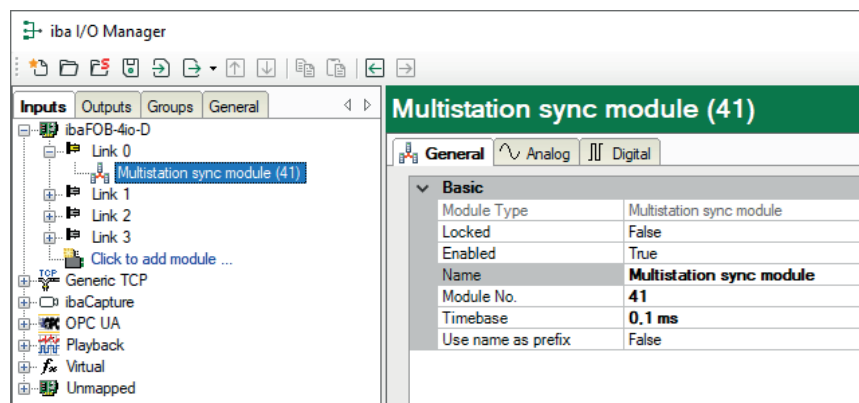
Further elements appear in the dialog.

The port number and the value for the start timeout can be set for a slave. The port number must be identical to the port number of the master (default 9175).

You can also configure support for "Unsynchronized Stations", see ↗ *Unsynchronized stations*, page 25.

The connection setup is always carried out from master to slave, so the slave does not need to know the name or the address of the master.

As soon as a station has been switched to slave mode, a "Multistation sync module" is added on the first free link of the *ibaFOB-D* card (interrupt master) in the I/O manager of the station concerned.



This module has – like other modules – the tabs *General*, *Analog* and *Digital*. However, these settings and values are intended for internal management and debugging. They have no practical use for the user.

Do not change the timebase setting, as this is already preset properly.

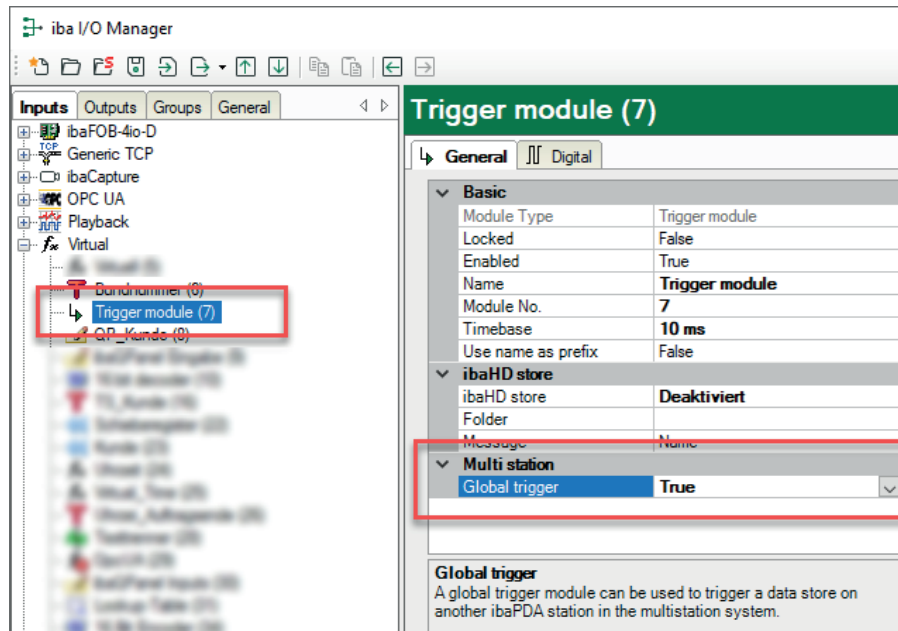
The module supplies two signals:

- Analog value "Sync counter", a 24 bit sync-message counter
- Digital signal "Clock", a digital pulse signal running in 1 ms clock (interrupt)

These signals are also available in the signal tree for display and in the signal selection of the data stores.

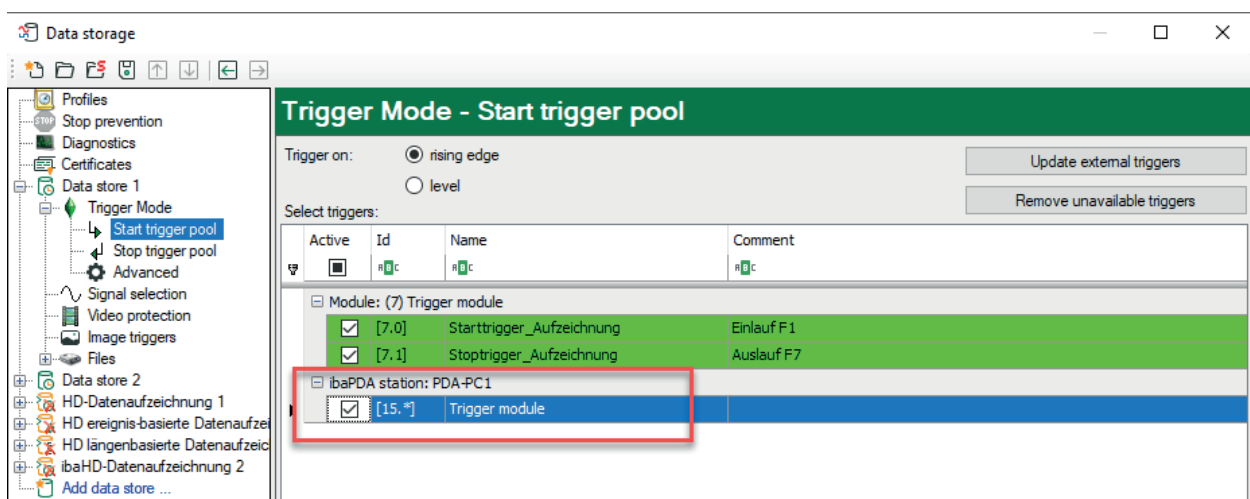
5.3 Trigger configuration

In a multistation network, a trigger can be used by one station to start or stop the data storage on another station. For this purpose there are so-called "global triggers". Global trigger is a property of the trigger modules, which can be enabled or disabled in the general module settings. If this property is set to *True*, all trigger signals on this module are treated as global triggers and can be used to control data storage on other stations.



The global trigger module is then available in the data storage configuration of all of the other stations in the multistation network and can only be enabled in the start or stop trigger pool.

The global trigger module is listed in the trigger pool with one line and a reference to the original station. It can only be enabled entirely, the access to particular global trigger signals is not possible. In terms of a logical OR operation a trigger is fired, if one of the global trigger signals (on the source station) trips.



If a global trigger occurs, a telegram is sent from the concerned station to all other stations over the data connections (network). This telegram contains, amongst others, the following information:

- Sample number
- Name of the trigger event

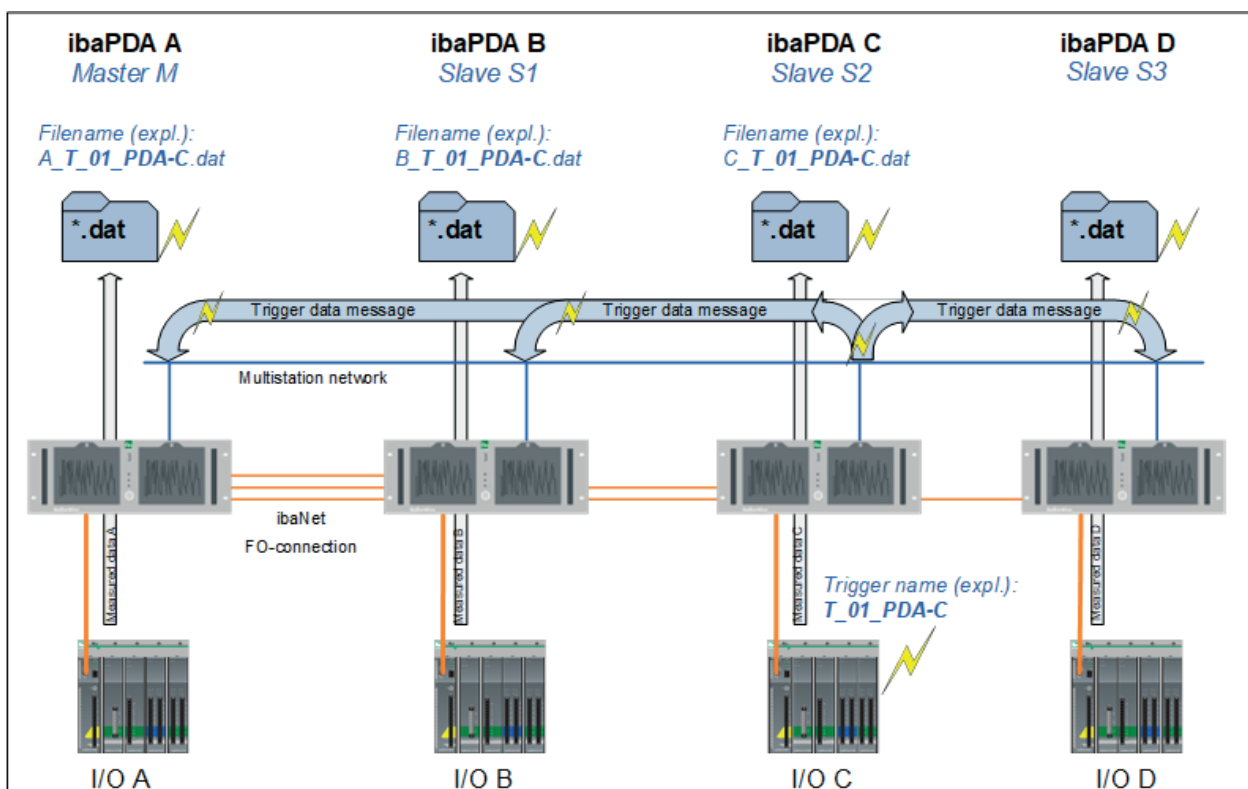
The transmission of the sample number ensures, that the trigger event is inserted in any data file at the same sample number. As all systems count completely synchronously, a clear assignment is on hand. Only by different pre- and post-trigger times at the storage configuration, different intervals, e.g., from the starting point of the data file to the trigger event, can be present in the data files.

The transmission of the trigger name provides for the information which event tripped the trigger. As the trigger name can be used for the generation of a data file name, data files are created that can be clearly assigned to a trigger event.

To include the trigger name into the file name you must enable the option “Add start trigger name” in the configuration dialog of the data storage, file node.

This option is only available, if the trigger settings of the storage “Use the start trigger pool” or “Use the stop trigger pool” was selected as trigger type.

Example:



The figure shows a configuration consisting of 4 ibaPDA systems.

In the “ibaPDA C” system, a trigger named T_01_PDA-C is defined, that belongs to the group of global triggers. When the trigger in the “ibaPDA C” system occurs, a telegram comprising the trigger event is sent to all of the other stations via the data connection.

If data stores are configured in other stations with the global trigger e.g., in the start trigger pool, recordings are started there at the same time. If recordings are stopped or started by a trigger pool, the triggering events are written as info fields into the data files. The following info fields for a start trigger can be found in the info node of the data file:

- "start_event", followed by the signal and/or trigger name
- "start_event_expression", followed by an expression which evaluates the signal.

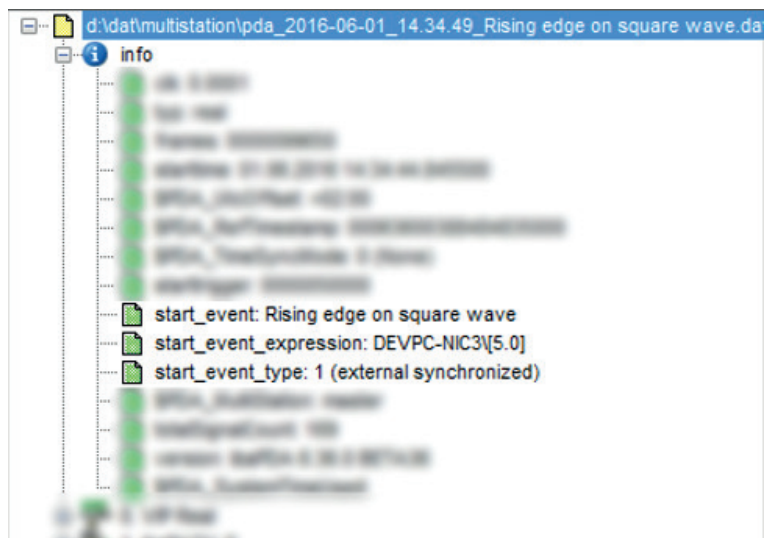
Accordingly, the info fields “stop_event” and “stop_event_expression” exist for the stop trigger. To easily associate the created data files with the trigger event, the option “add trigger name” was selected in the data storage configuration on all systems. The data files of the respective systems then carry the trigger name T_01_PDA-C in the file name.

To be able to identify the data files in ibaAnalyzer later, the file names start with the name of the respective ibaPDA system, as in this example B_T-01_PDA-C.dat for the system "B".

Additionally, the info fields *start_event_type* for start triggers and *stop_event_type* for stop triggers are inserted into the data files. These info fields indicate which trigger type has triggered the respective data file. The info fields can have the following values:

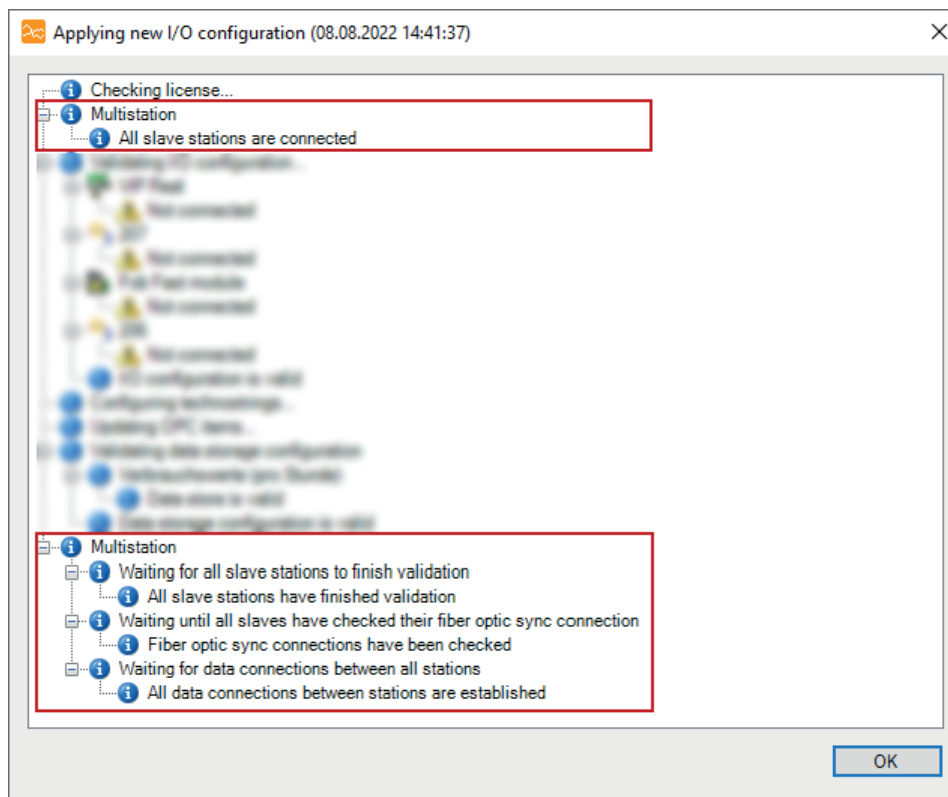
0 (local)	This is a local trigger.
1 (external synchronized)	This is a synchronized external trigger.
2 (external unsynchronized)	This is an unsynchronized external trigger whose time stamp was successfully synchronized with the local data.
3 (external unsynchronized invalid time)	This is an unsynchronized external trigger whose time stamp deviated from the current UTC time by more than 5 seconds when received. A measurement file was created, but the trigger time stamp was changed to the current UTC system time.

The following image shows an opened data file with info fields for the start trigger with name, expression, and type.



6 Operation

6.1 Start of the acquisition



In a multistation system, the acquisition is started and stopped on all stations at the same time. If the acquisition is started on a station – no matter if it is a master or a slave – then the acquisition will also start on any other station in the network. This applies accordingly for stopping the acquisition. Thereby, the following cases are differentiated:

Start of the acquisition on the multistation master

If the acquisition is started on the master, it will initially establish the connections to the slaves. If a slave cannot be connected within the preset start timeout, then this slave will be disabled and the acquisition starts on the master and all connected slaves. If no slave can be connected, the master will start in the standalone mode.

Start of the acquisition on a multistation slave

If the acquisition is started on a slave, it will wait until a connection to the master is established. If this does not work within the preset start timeout, the slave will start in the standalone mode.

Start of the acquisition in case of a configuration error

If it turns out during the validation after the start of the acquisition, that the configuration of a station is invalid, then this station will be excluded from the multistation network. If the station in question is the master, all slaves will start in the standalone mode. If the station in question is a slave, it is excluded from the network until the next start of the acquisition.

6.2 Dealing with connection problems

Multiple scenarios are possible during operation of a multistation network. There follows a description of the system behavior in some typical situations:

- If a master station has started the acquisition despite one or more missing slaves, then it will restart the acquisition automatically as soon as a missing slave reconnects.
- If the network connection between two random stations is interrupted during the acquisition, then the acquisition will be restarted after a timeout of 5 s. The same applies to the FO synchronization connection between the master and the slave.
- If a slave was unable to start in multistation mode because the FO connection was interrupted at the start of the acquisition, then it monitors the FO connection constantly. If the FO connection has been re-established and is active for more than 2 s, the slave station will automatically restart the acquisition and is included into the multistation network again. If support for "Unsynchronized stations" is activated on the slave in the multistation configuration, then the slave automatically switches to "Slave without master" mode if there is no connection to the master. In this mode, the slave starts its acquisition and tries to exchange trigger events with the other stations.
- If the *ibaPDA* service will be stopped on a station during an ongoing acquisition, e.g., because the computer shuts down, then the acquisition is stopped on every station and is restarted without the station in question. If the station in question is a slave, then the master and the remaining slaves will restart together. If this concerns the master, the slaves will restart independently. The exchange of the trigger signals among each other is nevertheless performed for the slaves.
- If the master fails, the central time synchronization of the systems is missing. Because the slaves restart the acquisition in case of a master failure and work individually, the system time of the slaves is used for the data files. As the clocks of the computers normally do not spread too quickly, deviations are first very low.
To ensure a high-precision synchronization of the systems in such a case, the time synchronization via a radio and/or GPS clock (e.g. *ibaClock*) of every involved computer is recommended.

7 Unsynchronized stations

Computers without a fiber optic link for synchronization can also be integrated into a multistation network. As so-called *unsynchronized stations*, these computers communicate with the other stations exclusively via the (multistation) network. This means that they each acquire their data asynchronously to the other stations and also do not start or stop together. Only the exchange of global triggers is also supported for unsynchronized stations.

Communication with unsynchronized stations can be configured for both a master and a slave. This means that the master or slave in question is enabled to communicate or exchange trigger signals with unsynchronized stations in addition to synchronized stations.

In this way, you can build up a multistation network even without ibaNet FO synchronization and benefit from the exchange of global triggers between several *ibaPDA* servers.

A station configured as a *Slave without Master* can only participate in the multistation network as an *unsynchronized station*.

The following matrix shows the possible connections between stations with different and the same multistation modes.

Multistation mode	Stand-alone	Master	Slave	Slave without Master
Standalone	-	-	-	-
Master	-	*1	**	*
Slave	-	**	*	*
Slave without Master	-	*	*	*

** classic multistation network with fiber optic synchronization and network, unsynchronized connections optional

* connection only via network, only unsynchronized connections

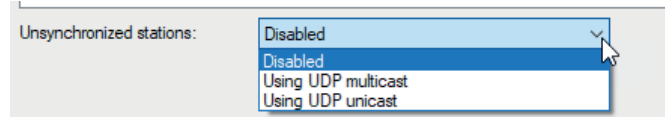
*1 Master-Master only connection between two multistation networks, only unsynchronized connections

7.1 Configure multistation master for unsynchronized stations

In order for unsynchronized *Slaves without Master* to also participate in the multistation network, support for these connections must be enabled on the multistation master.

Another case where communication with unsynchronized stations must be enabled is when two multistation masters are interconnected in order to exchange trigger signals over the network ("interstation triggering").

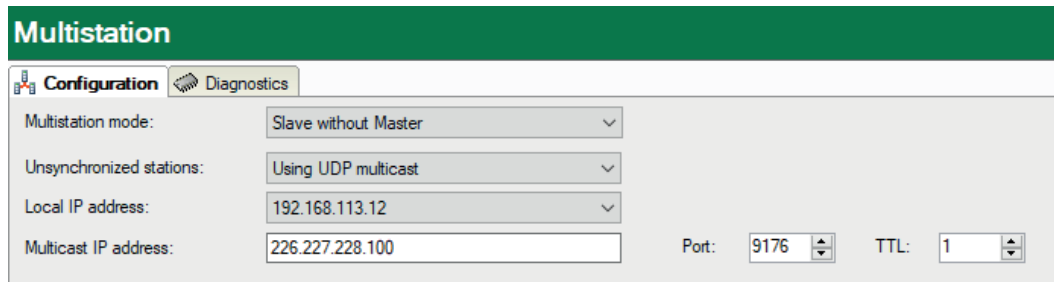
You can enable this function by selecting one of the two possible communication protocols (UDP multicast or UDP unicast) in the *Configuration* tab of the master (see ↗ *Configuration as multistation master*, page 16) under the table for the synchronized stations.



Information on these protocols can be found at ↗ *Settings for unsynchronized stations*, page 27

7.2 Configuration as Slave without Master

Stations configured as *Slave without Master* can only be included in a multistation network if other stations support communication with unsynchronized stations. This is because a *Slave without Master* has no fiber optic link for synchronization. In this case, you can only configure communication as an unsynchronized station and can choose between UDP multicast or UDP unicast communication.



Multistation

Configuration **Diagnostics**

Multistation mode: Slave without Master

Unsynchronized stations: Using UDP multicast

Local IP address: 192.168.113.12

Multicast IP address: 226.227.228.100

Port: 9176 TTL: 1

Deactivation of *Unsynchronized stations* is not possible.

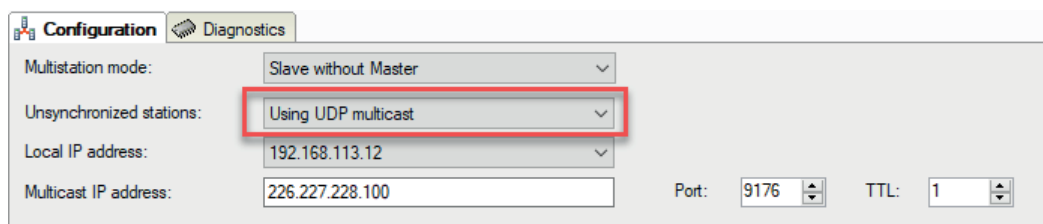
7.3 Settings for unsynchronized stations

Unsynchronized stations communicate with each other via UDP multicast or UDP unicast.

Select UDP multicast if you want to include all stations on the network.

Select UDP unicast if you want to target only specific stations.

UDP multicast



Configuration **Diagnostics**

Multistation mode: Slave without Master

Unsynchronized stations: Using UDP multicast

Local IP address: 192.168.113.12

Multicast IP address: 226.227.228.100

Port: 9176 TTL: 1

First, select the network adapter in the local *ibaPDA* server that will be used for the communication with unsynchronized stations in the *Local IP address field*. To do this, use the IP address in the drop-down list, which contains all configured IP addresses of the *ibaPDA* server.

Then, if necessary, set the multicast address and port number that the stations should use to exchange multicast messages.

Via the parameter *TTL* (Time To Live) you can set the number of routers via which a multicast message can run. Ideally, *TTL* = 1, i.e., even the unsynchronized stations are directly connected to the multistation network.

UDP unicast

Configuration | Diagnostics

Multistation mode: Slave without Master

Unsynchronized stations: Using UDP unicast

Port number: 9177

Unsynchronized slave stations:

Name	Address	Port number	Active
------	---------	-------------	--------

+

-

The port number is preset to 9177 for UDP unicast and can be changed if required.

In the *Unsynchronized slave stations* table window, you can add the desired slave stations with which the local system should communicate.

These can be slaves without a master or slaves for which communication with unsynchronized stations via UDP unicast has been enabled.

7.4 Diagnostics tab

In the *Diagnostics* tab, connections with unsynchronized stations are listed in a separate *Unsynchronized connections* group if they are configured. The background color of the lines with unsynchronized connections has the following meaning:

Color	Meaning
Green	Trigger events are actively exchanged via this connection.
Orange	No trigger events are exchanged over this connection because, for example, there is already a data connection to the same station or because the trigger pools in the other stations' data storage are not configured to respond to triggers from the local station.

7.5 Trigger pool

Global triggers on unsynchronized stations are recognizable in the start- and stop-trigger pool of the data storage configuration for the other stations via the addendum "Unsynchronized station..." in the group heading.

Unlike synchronized stations, trigger configurations on unsynchronized stations are not automatically updated when acquisition is started. You have to manually click on the <Update external triggers> button in the data storage configuration to make *ibaPDA* search for unsynchronized stations and update the trigger definitions.

If a trigger fires on a station on which support for unsynchronized stations is enabled, then the trigger event is sent via the multicast address so that all other stations can receive the event. If the UDP unicast transmission type is set, the trigger event is sent to the configured stations accordingly.

The event message contains the trigger name, the ID (module and signal number) and the absolute UTC time at which the trigger event occurred.

Unsynchronized stations receiving such an event will compare the received absolute UTC time with their own UTC system time in order to synchronize the trigger event with their own acquired data. For this reason, it is very important that the system time of all unsynchronized stations is accurate. The more accurate the system time, the more precisely the trigger event can be synchronized with the local data.

8 Diagnostics

8.1 Diagnostics tab

In the *Diagnostics* tab of the multistation node in the I/O manager you will find information about the connections between particular stations.

Diagnostics on a multistation master:

The screenshot shows the 'iba I/O Manager' window with the 'Multistation' node selected. The 'Diagnostics' tab is active. The 'Current multistation mode' is set to 'Slave' and 'Unsynchronized stations' is 'Disabled'. The table below shows the connections:

Name	Address	Messages receive	Messages sent
Control connections			
PDA-PC1	192.168.1.54:1545	424	395
Data connections			
IBA-BLN-WKS 197	IBA-BLN-WKS 197:9175	1	2
PDA-PC1	192.168.1.54:1965	2	2

Diagnostics on a multistation slave:

The screenshot shows the 'iba I/O Manager' window with the 'Multistation' node selected. The 'Diagnostics' tab is active. The 'Current multistation mode' is set to 'Master' and 'Unsynchronized stations' is 'Disabled'. The table below shows the connections:

Name	Address	Messages received	Messages sent
Control connections			
IB ... IE ...	45:9175	63	69
IB ... 97 IE	97:9175	59	65
Data connections			
IB ... IE ...	45:9175	1	1
IE ... IB ...	97:9175	1	1

Current multistation mode

Here, the mode of the station is indicated. Master, Slave, Slave without Master or Standalone are possible.

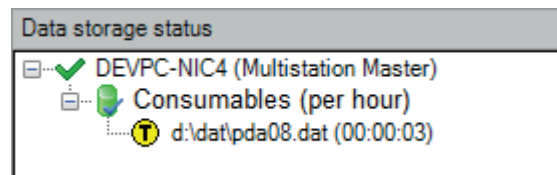
Table

In the table, the network connections between the stations (control and data connections) are displayed.

The example in both figures above shows a system, consisting of 3 stations. The master station has a control and data connection each to both slaves. The slave station has a control connection to the Master as well as a data connection to the master and to the other slave.

8.2 Data storage status

The current multistation mode of a station is also displayed in the "Data storage status" window.



8.3 MultiStationStatus() function

In the expression builder there is a MultiStationStatus() function which detects and returns the current multistation mode.

The possible return values are:

0	Standalone
1	Slave
2	Master
3	Slave without Master

This lets you (for example) create a virtual signal to visualize the status in *ibaQPanel* or to make it available to other systems as an output signal.

9 Support and contact

Support

Phone: +49 911 97282-14
Fax: +49 911 97282-33
Email: support@iba-ag.com

Note



If you need support for software products, please state the license number or the CodeMeter container number (WIBU dongle). For hardware products, please have the serial number of the device ready.

Contact

Headquarters

iba AG
Koenigswarterstrasse 44
90762 Fuerth
Germany

Phone: +49 911 97282-0
Fax: +49 911 97282-33
Email: iba@iba-ag.com

Mailing address

iba AG
Postbox 1828
D-90708 Fuerth, Germany

Delivery address

iba AG
Gebhardtstrasse 10
90762 Fuerth, Germany

Regional and Worldwide

For contact data of your regional iba office or representative please refer to our web site

www.iba-ag.com.