

FXX

Visualization software and User Interface for K+K Measurement Devices

Release Notes

Version	Date	Author	Description
1.0	2018-10-11	Martin	Initial version
1.1	2019-02-15	Martin	Digital inputs, linear combinations
1.2	2019-05-09	Martin	Sensor support, double graphic window
1.3	2019-09-20	Martin	Multi source log files
1.4	2019-03-11	Martin	Frequency and sensor warnings, email notifications, popup messages, NSZ device support
1.5	2020-10-15	Martin	Multi type log files, NSZ calibration, graphic window: improved Center function
1.6	2020-11-03	Martin	TCP server, multiple USB users
2.0	2021-11-19	Martin	Allan Deviation, High Resolution Channels
3.3	2024-07-10	Martin	Virtual Channels, Phase residuals, Config Device

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Introduction

FXX is a user interface for high-precision phase and frequency measuring devices from K + K Messtechnik GmbH. It has the following basic functions:

- Setting the operating options (e.g. mode, rate) of the K + K measuring instruments
- Visualization of measured data in real time as numerical values or as graphics
- Generation of log files on the PC for later analysis of the measured values.
- Client / server function for transmitting measured data to other PCs

The K + K measuring devices can be connected to the PC via several interfaces as USB, Ethernet, RS232 and CAN.

FXX is a multi-window interface. This means that any number of resizable and freely locatable windows can be used. For each graphics or text window, measurement data from one or more channels may be selected and stored in different forms, e.g. presented as a phase difference or as a frequency.

In addition, FXX is also a multi-source interface. This means that measured values from multiple sources can be processed and displayed simultaneously. A source is a connection to a K+K device, i.e. several devices can be connected at the same time. In addition, up to 4 different connections (users) with different measurement modes can be set up per device, in order to achieve e.g. to display different measuring rates or average values in different windows.

In addition to FXE or NSZ devices, measuring devices with sensors (for example for temperature, humidity or voltage) can be defined as additional sources.

Each source can be individually assigned a colour and a name, so that windows can be recognized quickly. This also applies to the individual channels of each device, whereby a coloured square with the channel number is always displayed in the individual windows.

For all input channels, log files can be generated in several formats (e.g. phase, frequency etc.) and also in combination of several sources. Different file directories can be defined to ensure clarity even at high data rates and many simultaneous measurements. The names of source and channels are also found in the log files.

Typically, the FXX software receives measurement data from a K+K device via an interface, such as USB. It can also work as a server for other computers connected via Ethernet. The FXX software that works on these client computers defines as "Source" not a device or an interface, but the server with its IP address and port number. But it has the same functionality as if it were connected directly to the K+K device.

Requirements

A successful use of the FXX software depends on a correct connection of the K+K device. Thus, at least one interface connection, a reference signal (typically 10 MHz) and at least one signal on an NSZ device on channel 1 must be present so that data can be received at all. Random measurement values can be reported if input channels remain open (see also the hardware manual for the used K + K device).

User Interface and Windows

The FXX graphical user interface consists of the following elements:

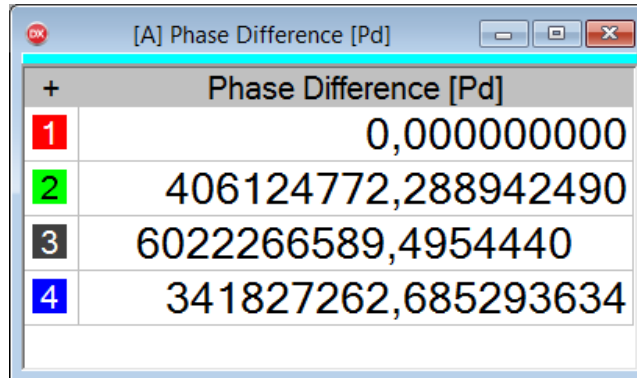
- A menu bar to access all functions
- An info window for each source, i.e. every connection to a device / user
- Any number of text windows (numerical display of the measured values)
- Any number of graphics windows (curve display of the measured values)
- A status window for digital inputs if available
- A message window for status outputs and error messages

In text and graphics windows you can choose freely which channels of a source are to be displayed.

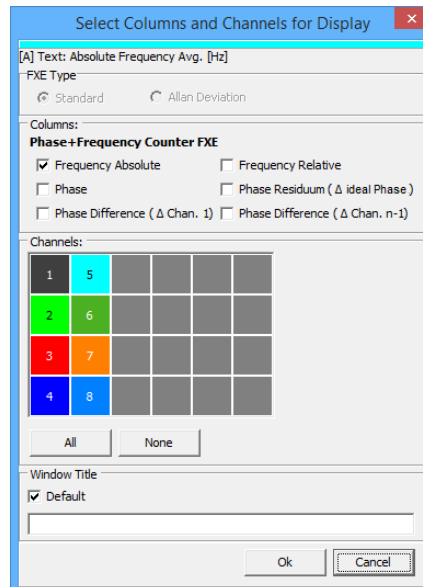
In combination devices that contain both a FXE and a NSZ device, two measuring devices are assigned to one source because technically they are two data streams with independent time behaviour. In this case, when defining windows or log files, a distinction must be made between the two device types, even though the source is the same.

Text Window

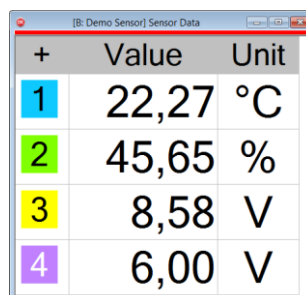
In a text window, one or more measured values are displayed in numerical form. By clicking on the coloured square showing the channel number, the display of the channel is switched off. If you hover over a square without clicking it, the name of the channel (that is also used in log files) will be displayed.



By clicking on the + symbol, a dialogue is opened enabling the selection of displayed channels and the use of several columns, e.g. for the parallel representation of frequency and phase in a window.

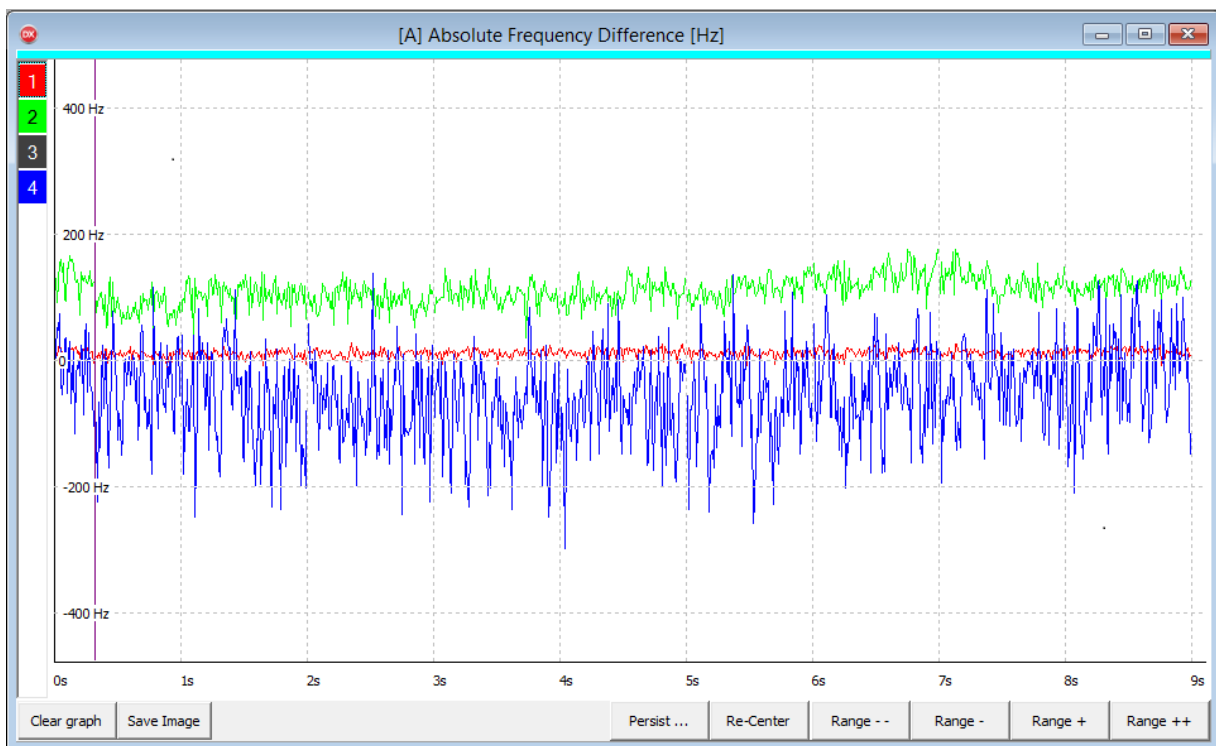


Text windows can also be defined for sensors and other measuring devices.



Graphic Window

In the graphic window, actively displayed channels are indicated by a coloured square with the channel number and channels not shown by a grey square. By clicking on the square, the representation of a channel can be switched on and off.



If a graphic window is selected, further operating options are displayed as buttons at the bottom of the window. These are:

Clear Graph: Clears the entire graphic and starts with a new rendering

Save Image: Generates a screenshot

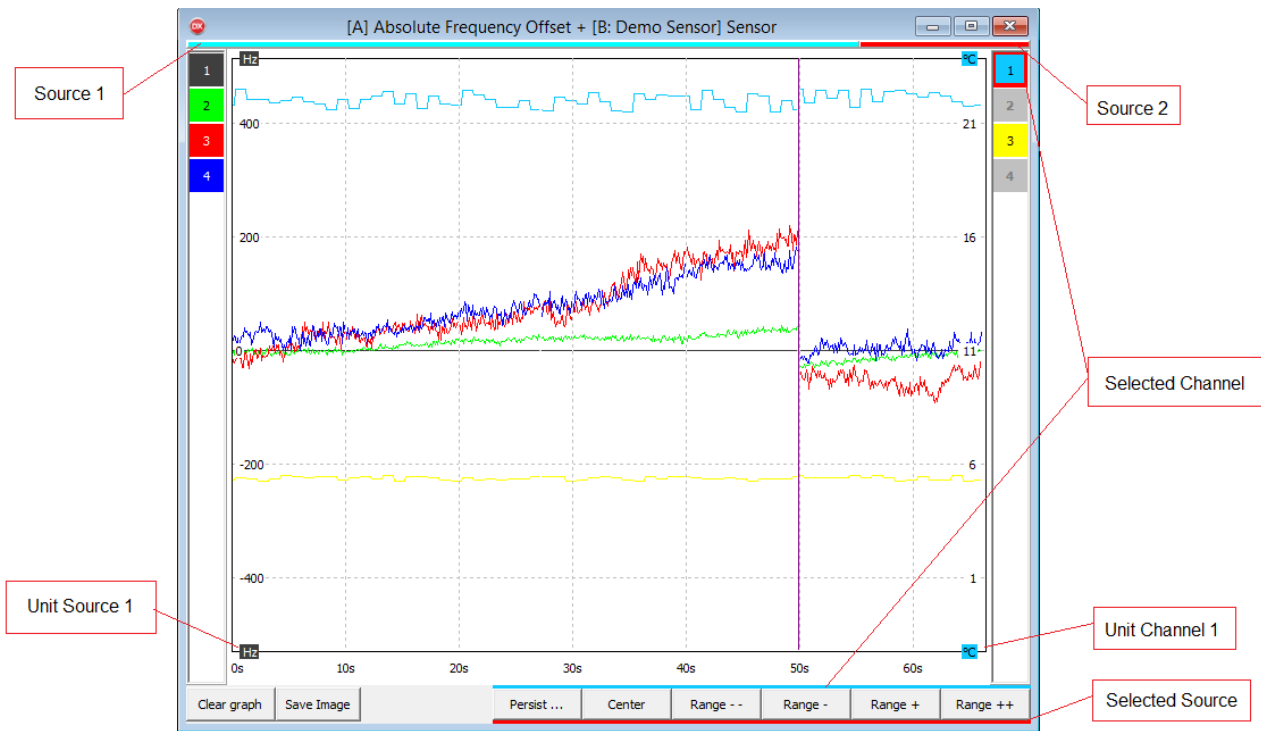
Persist: Turn Persist mode on / off for individual channels. Persist mode does not overwrite old metrics in the graph, but preserves them. Over time, it becomes clear in which range the measured values fluctuate. As a result, noise and individual outliers can be detected very well.

Re-Center: Resets all displayed curves to the zero line, if e.g. drift out of the visible range

Range: Enlarge / reduce the display area in 1-2-5 or 10-step increments.

Double Graphic

A double graphic can represent the data from two sources in a graphic window. The second source may be a sensor (e.g., for temperature or humidity), but also another FXE/NSZ.



For the second source, the channel selection and scaling of this source is also shown on the right. Since there are devices that can provide different measures (such as temperature and humidity sensors), the scaling for each channel can also be set separately.

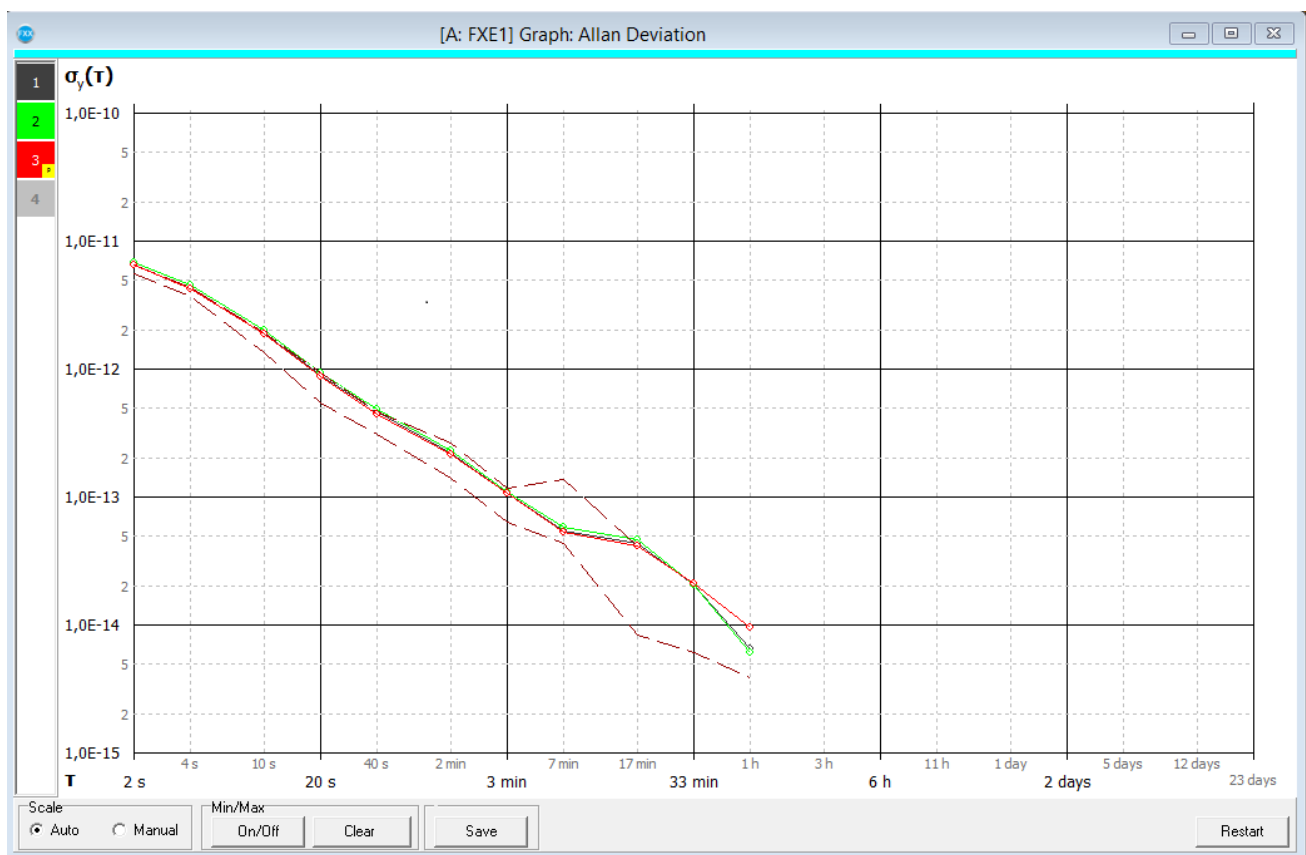
By clicking on a square with the channel number one of the channels of a source is selected; the Re-Center and Range buttons of the window and the right or left scaling then refer to this channel. Another click on the square switches the display of the channel off or on again.

The speed at which the graphic is drawn always corresponds to the rate of the first source (left). If the second source is slower, readings are repeated (horizontal bars); if it is faster, measured values are skipped. If both sources are FXE or NSZ devices, the measurement rates of both sources must be the same.

Allan Deviation

The Allan deviation shows the frequency stability over different time intervals. The time intervals range from a few seconds to hours or days. The key figure Tau indicates the number of measured values and thus corresponds to the measuring rate, i.e. at a measuring rate of 1 s, Tau = 1 corresponding to one second.

The more measured values are available, i.e. the longer the measurement runs, the longer intervals can be viewed and their stability displayed. This is why the curve "grows" further and further towards large Tau values while the measurement is running. For small Tau values, the calculation becomes more and more precise during the measurement, because averaging can be carried out over more and more intervals.



The scaling can be done automatically or manually.

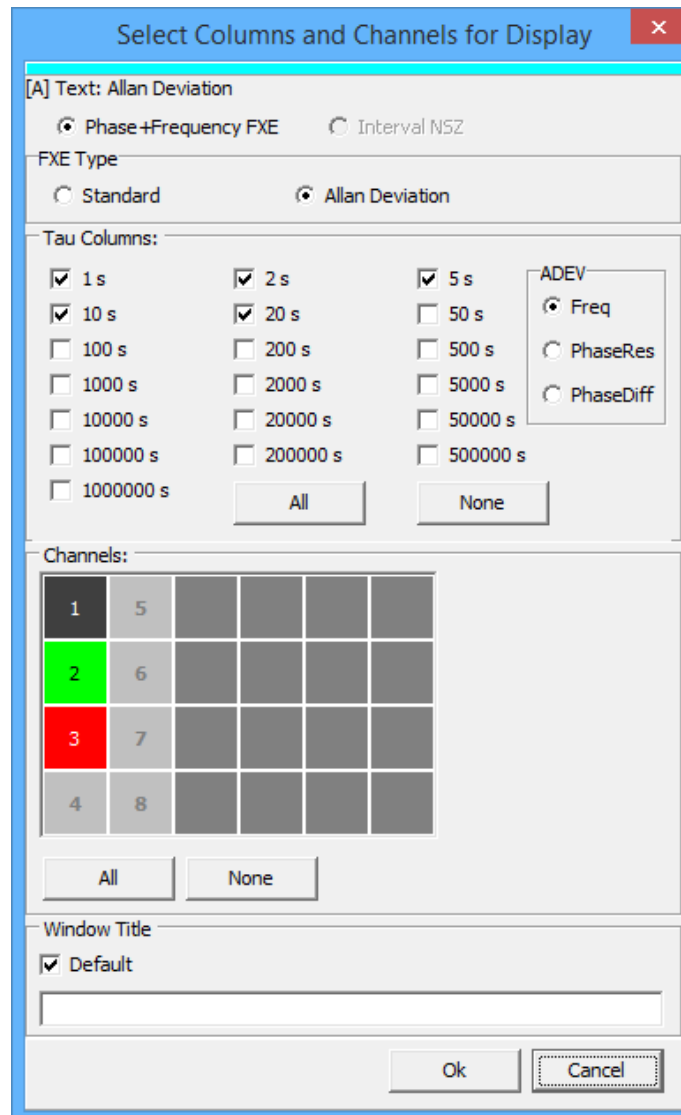
By clicking on the channel numbers, channels can be switched on and off, and the minimum and maximum values that have occurred so far for each channel can be displayed as a dashed line. In addition, all minimum and maximum lines of all channels can be switched on / off and reset together. With "Save" a screenshot can be generated.

Be careful when pressing the "Restart" button! Then a new Allan deviation is calculated, i.e. values can be deleted that have been accumulated over many hours.

The Allan deviation values can also be displayed in a text window:

	1	2	5	10	20	50	100
1	1,911E-11	1,208E-11	4,756E-12	2,949E-12	1,216E-12	5,806E-13	2,031E-13
2	1,935E-11	1,230E-11	4,815E-12	2,989E-12	1,222E-12	5,804E-13	1,981E-13
3	1,888E-11	1,196E-11	4,687E-12	2,899E-12	1,198E-12	5,658E-13	1,981E-13

The channels (rows) and Tau values (columns) to be displayed can be freely selected. As input data frequencies, phase residuals or phase differences are possible.



Nominal Frequencies and Phase Residuals

An ideal frequency (nominal frequency) can be defined for each channel under "Source/Nominal frequencies". From this, the phase residual, i.e. the deviation of the phase progression or the relative frequency in relation to the ideal value, can be calculated and displayed.

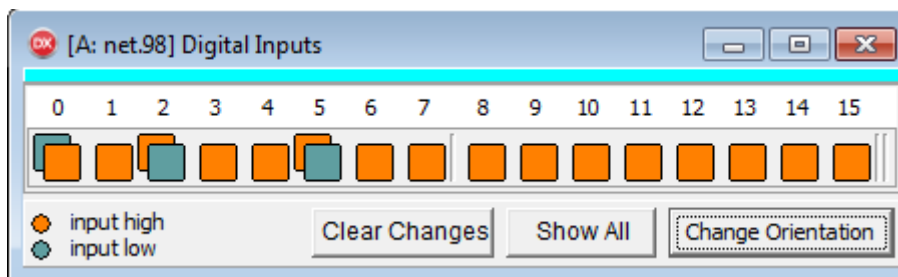
Virtual Channels

In addition to the measured values, linear combinations of these values can also be presented as virtual channels. A linear combination is the sum of all measured values each multiplied by a linear factor. This function is available for phase differences, phase residuals and frequency values.

The factors are defined in the menu under "Source/Virtual Channels". Virtual channels can be displayed in text and graphic windows and saved in protocols.

Digital Inputs

The Digital Inputs window displays the status of the digital inputs (FDI inputs). Each square represents a digital input, its color indicates the currently read state, i. high or low. If the input level changes, the original status is displayed in a second square behind it. This makes it easy to see which input level has changed (two squares) and which ones have remained unchanged (one square).



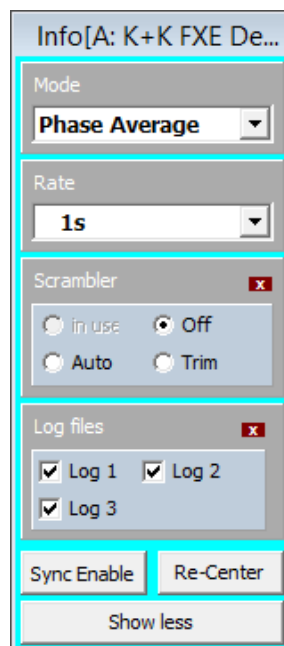
Clicking on a double square clears this change indicator, i.e. returns to a single square with the current status. Another click clears the appearance of this input from the list; this can be undone using the function "Show All".

With the function "Clear Changes" all double squares are deleted. In addition, with "Change Orientation" you can choose between a horizontal and a vertical display.

In the menu under "Source / Digital Input Names" an individual name can be defined for each input, which will then be used in the list.

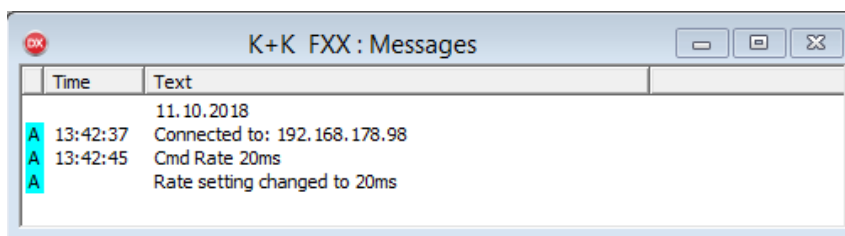
Info Window

The info window displays the status of a source (connection or device). The most important settings (e.g. measuring rate and mode) can be changed directly in the info window. In addition, there are optional scrambler, log file and debug settings that may not always be visible. They are activated with "Show All" and removed with the close cross. In addition, "Sync enable" activates the sync function of a device.



Message Window

The message window displays all status and error messages. Each source is marked with its colour. If the message window is activated, the messages can be saved with "Save-Messages" and the window can be cleared with "Clear-Messages".



Errors, warnings and information are handled separately: by default, only errors are also output in a large window (popup message window). This function can be enabled or disabled under "Options / Popup Message Notifications ..".

Menue

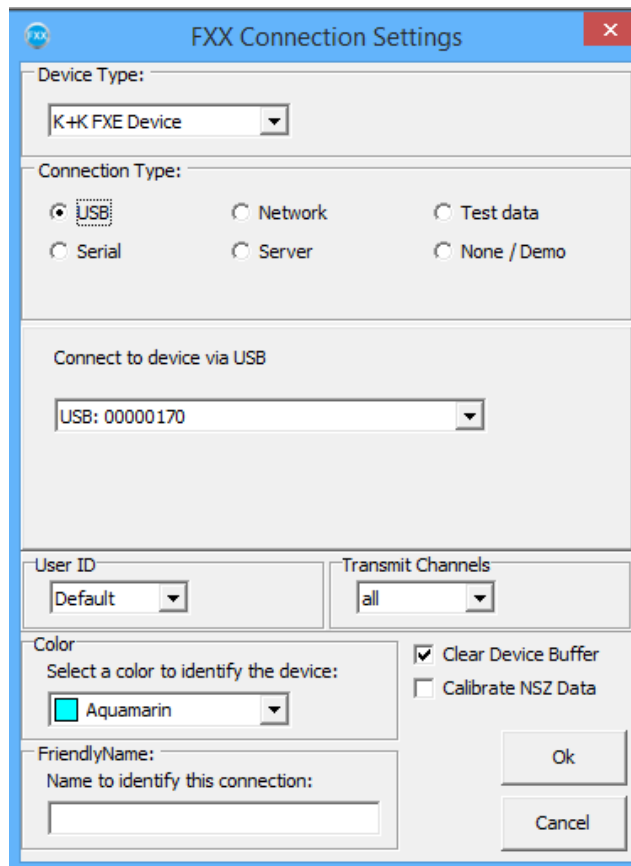
All controls and options can be accessed via the menu - even those that are available directly in the windows. The following description of the menu items refers to the case where only one source is used. If more than one source has been defined, an additional menu level is used to select the source. The following menu items are available in detail:

Source

Source / New Source..

Define a new source. The device is selected under „Device Type“, it can be

- another FXE or NSZ device,
- another user of an already connected FXE or NSZ device, i.e. multiple users for USB and network connections are possible
- a sensor device for measuring temperature, voltage or similar.



The properties of the selected source have to be defined, i.e.

- Interface (USB, Network, Serial, Server)
- User ID (1..4)
- Transmit channels (1 .. maximum number of channels of a device)
- Colour (colour used to mark this source in the windows of the user interface)
- Name (name of the source, used in the window title and protocol)
- Start condition (clear device buffer, NSZ calibration)
- Baud rate serial interface: FXE2: as defined at „Config Device“ (typ. 576000), FXE1: 115200

A source can also be another PC to which a K+K device is connected. In this case the other PC works as a server and the FXX software as a client, and the IP address and port number of the server must be defined (see also „Source/Run Local Server..“ and “Description of the KK Multisource Library”).

Source / Mode

Sets the measurement mode of the Source: Phase, Phase Average, Frequency, Frequency Average, Phase Difference, Phase Difference Average

Source / Interval

Defines the measuring rate: with FXE devices 1 ms .. 20 s, otherwise dependent on the device type

Source / Scrambler

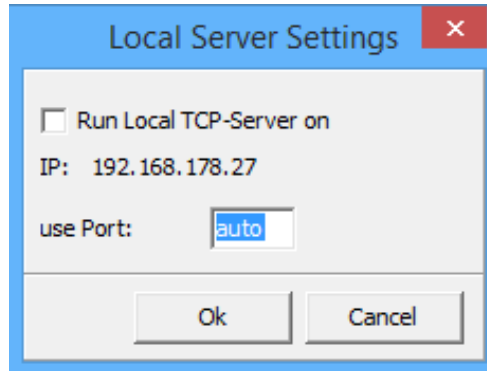
Sets the scrambler mode: Off, Auto, Trim. When set to "in use", the scrambler is operated by another user and can't be changed.

Show in Info Box: shows the scrambler settings in the info box

Source / Run Local Server..

Turns on the server function of the FXX software for this source. This makes it possible to continuously transfer the read-in measurement data to one or more other PCs (clients). Applications processing the measurement data can run on several PCs, even if only one PC is directly connected to the K + K device.

The server port number can be specified or assigned automatically.



The client application can be the FXX software, but also a customer-specific software (see manual “KK DLL multisource library”).

If a customer-specific client software is connected to the FXX server on LOG level, the following log items are available:

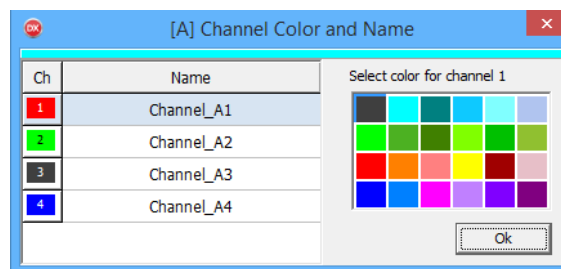
Source delivers FXE reports:

- PHASELOG: Report modes “Phase”, “Phase Average”: Phase values in periods
- FREQLOG: Report modes “Phase”, “Phase Average”, “Frequency”, “Frequency Average”: Frequency values in Hertz
- PHASEDIFFLOG: Report modes “Phase”, “Phase Average”, “Phase diff”, “Phase diff Average”: Phase difference to channel 1 in periods
- PHASEPREDECESSORLOG: Report modes “Phase”, “Phase-Average”, “PhaseDiff”, “PhaseAverageDiff”: Phase difference CH_n – CH_{n-1} in periods

Source delivers NSZ reports:

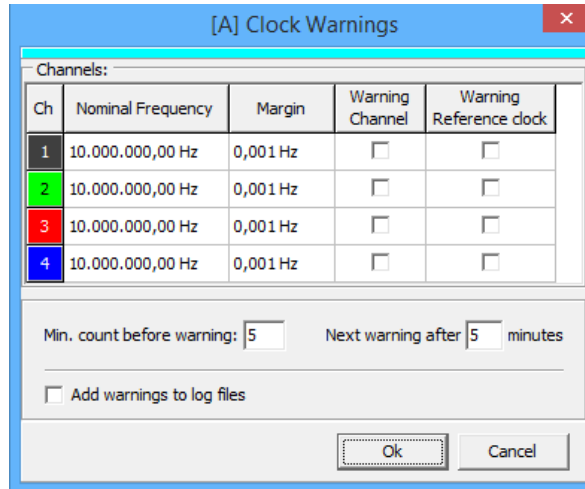
- NSZLOG: Time interval in nano seconds
- NSZDIFFLOG: time difference to channel 1 in nano seconds (if more than one channel is reported)

Source / Channel Colors/Names..



Definition of colour and name for all channels of a source

Source / Clock Warnings..



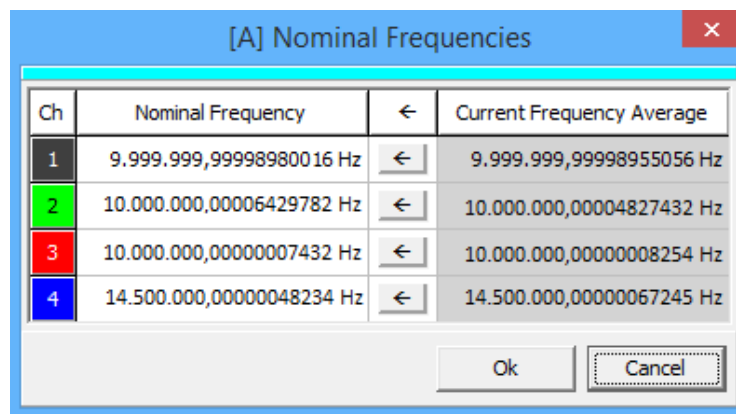
Generate warnings when the measured frequencies or the reference clock leave a predetermined range. Since a reference clock deviation can't be measured directly, at least 2 input frequencies are monitored. If these show deviations at the same time, a reference clock warning is generated.

The sensitivity and frequency of a warning can be defined. The warnings can be written to the log file or sent as an email (see "Email Notification").

Source / Digital Input Names..

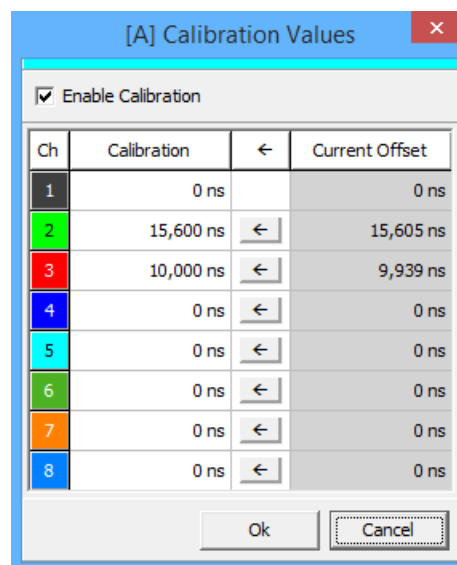
Definition of the names of the digital inputs (FDI inputs).

Source / Nominal Frequencies..



For each channel, an ideal frequency (nominal frequency) can be defined, which is used for the phase residual (deviation of the phase from the ideal value) or the relative frequency in relation to the ideal value. The value can be entered or an estimated value can be adopted.

Source / NSZ Calibration..



NSZ devices only:

An offset can be defined for each channel in columns "Calibration". The offset is added to the measured values, e.g. to compensate for cable lengths.

In the "Current Offset" column, the average deviation from channel 1 is suggested as the value. The suggestion can be accepted by using the arrow buttons

The calibration can be switched on and off with "Enable Calibration".

Source / FXE High Resolution Channels..

Ch	Nominal Frequency [Hz]	LO Frequency [Hz]	Factor
1	10.000.000,000000000000	9.500.000,000000000000	20,000000000000
2	10.000.000,000000000000	9.499.999,999999886310	19,999999999995
3			
4			
5			
6			
7			
8			

For channels that use a "High Resolution" extension, the necessary parameters can be specified here. High resolution channels can only measure a very limited frequency range around a nominal frequency, but with significantly higher accuracy. They also use a "Local Oscillator LO". The nominal frequency and LO frequency must be specified precisely in order to determine a factor that is required for the measurement (see hardware manual for the FHR measurement card).

High-resolution channels are color-coded in text windows.

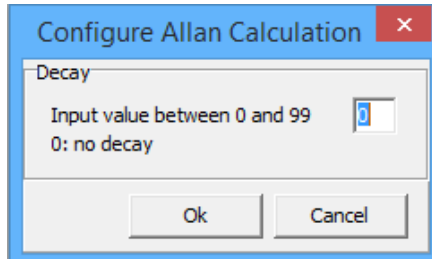
Source / Allan Deviation / Restart Calculation

Restart of the Allan deviation calculation for all open Allan deviation windows for the selected source. Same effect as the "Restart" button in the graphics window. Caution: the previous values are discarded, i.e. values can be reset that have been accumulated over many hours.

Source / Allan Deviation / Clear Min-/Max-Values

Resetting of all min / max values of the Allan deviation calculation for the selected source. Same effect as the "Clear" button in the graphics window.

Source / Allan Deviation / Configuration..



Determination of whether older measured values should be included in the Allan deviation calculation in the same way as new measured values (decay = 0) or whether they should weaken over time, i.e. "decay".

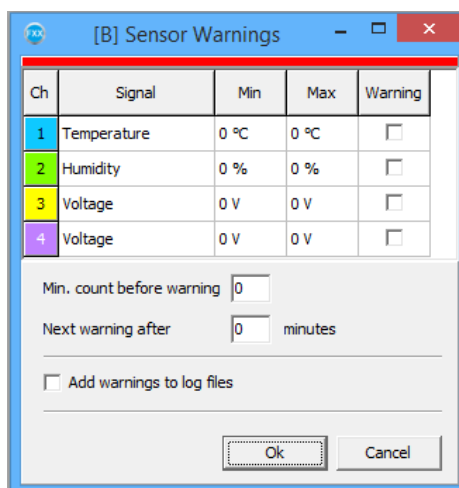
With Decay = 0, all previous measured values and the new measured value are weighted equally, i.e. in the case of long-term measurements with many measured values, the current measured values are hardly included in the overall result. The impression arises that the measurement result no longer changes. This can be prevented by using other decay values.

For example:

Decay = 10: old values 10 percent and the new measured value 90 percent (more dynamic)

Decay = 95: Old values 95 percent and the new measured value 5 percent (less dynamic).

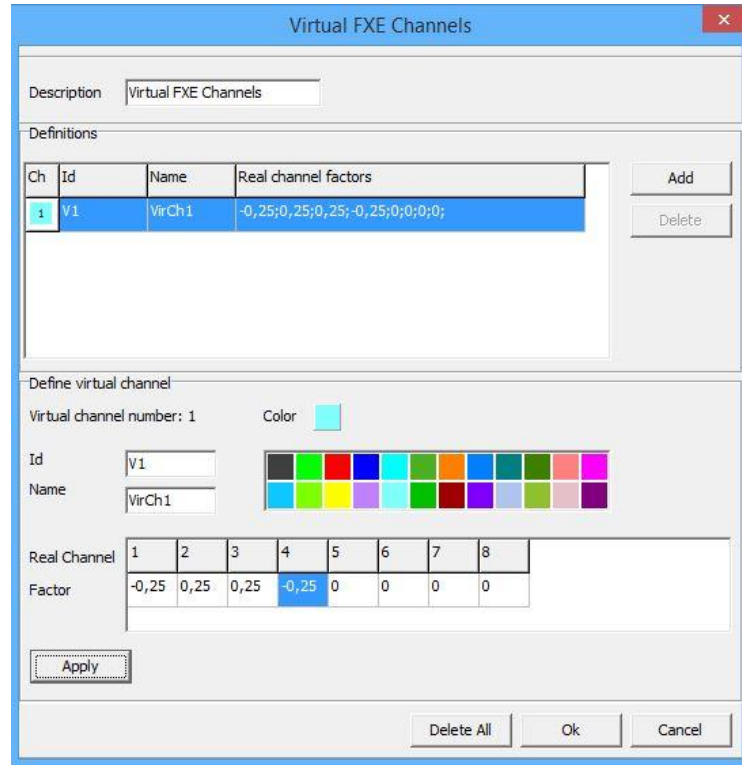
Source / Sensor Warnings..



Generate warnings when a sensor falls below or exceeds a minimum or maximum value.

The sensitivity and frequency of a warning can be defined. The warnings can be written to the log file or sent as an email (see "Email Notification").

Source / Virtual FXE Channels..



Definition of "virtual channels", i.e. linear combinations of the input data. The virtual channels can be displayed in text and graphic windows and output in log files. In the example a virtual channel $VirCh1 = 0.25 * (-Ch1+Ch2+Ch3-Ch4)$ is defined.

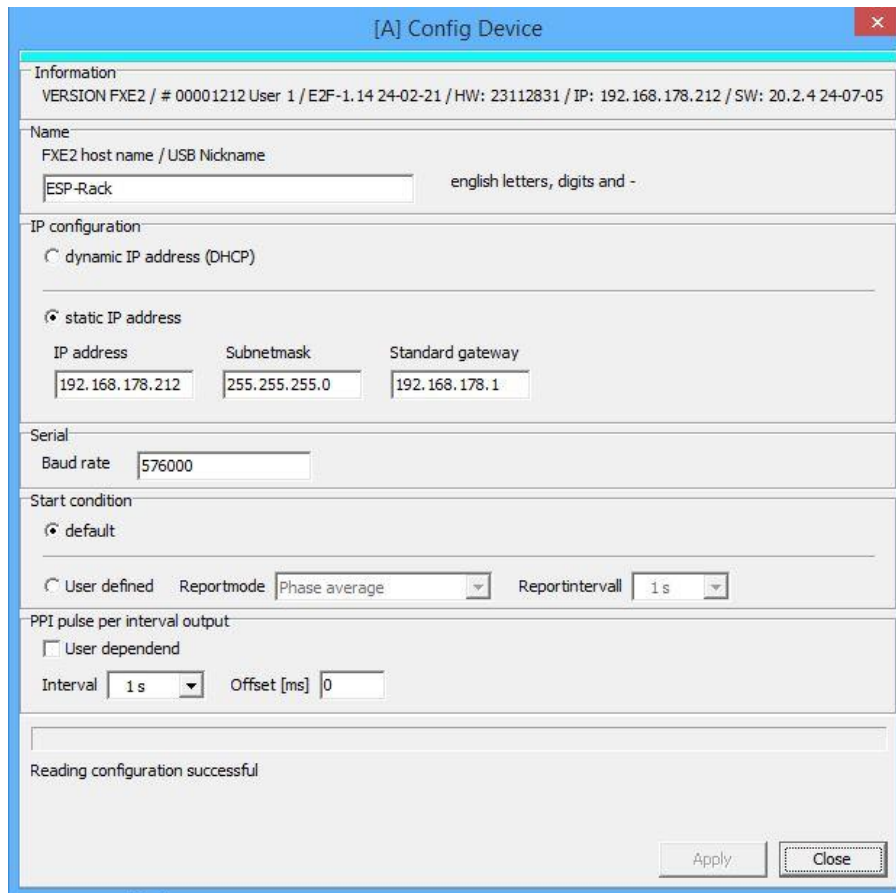
Source / Config Device..

Definition of device-specific settings, especially for the interfaces used. These are saved in the device and are retained even during a power cycle.

Even if the device cannot be reached via LAN or serial, the USB interface can be used to set all interface parameters.

In addition to the interface parameters, mode and interval at startup as well as a PPI output can be defined.

Changing the settings with "Apply" always resets the device. If you change the USB nickname, the USB driver will also be reinstalled. Not all options are available on older devices.



Source / Change Source..

Change properties of the selected source, same menu contents as "New Source", see also "Description KK-DLL".

Source / Re-Open Source

The recently used sources are typically opened automatically when the FXX user interface is started. However, if a device is switched on after the FXX start, "Re-Open" can be used to open it with the settings last used, without having to define a new source.

Source / Remove Source..

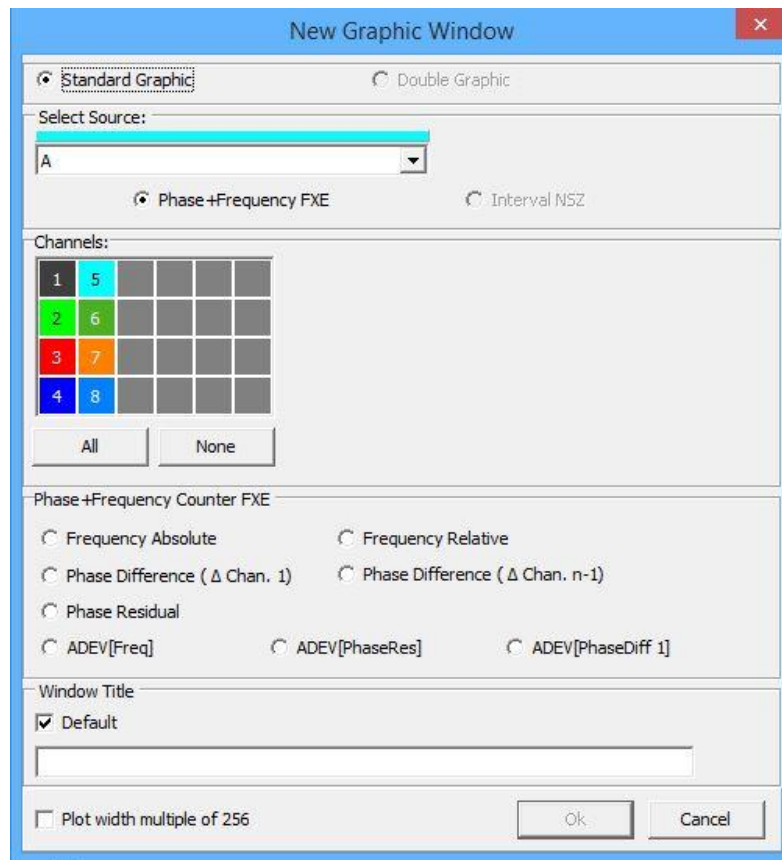
Deleting a source, closes all associated windows.

Window

The functions in the "Window" menu always refer to the actual selected window of the FXX interface. As a result not all functions are always available (e.g. "Clear Graph" with active text window)

Window / New Graph Window

Creates a new window for displaying measurement data



You can display data from just one source (Standard Graphic, scale labels left) or from two sources (Double Graphic, scale labels left and right).

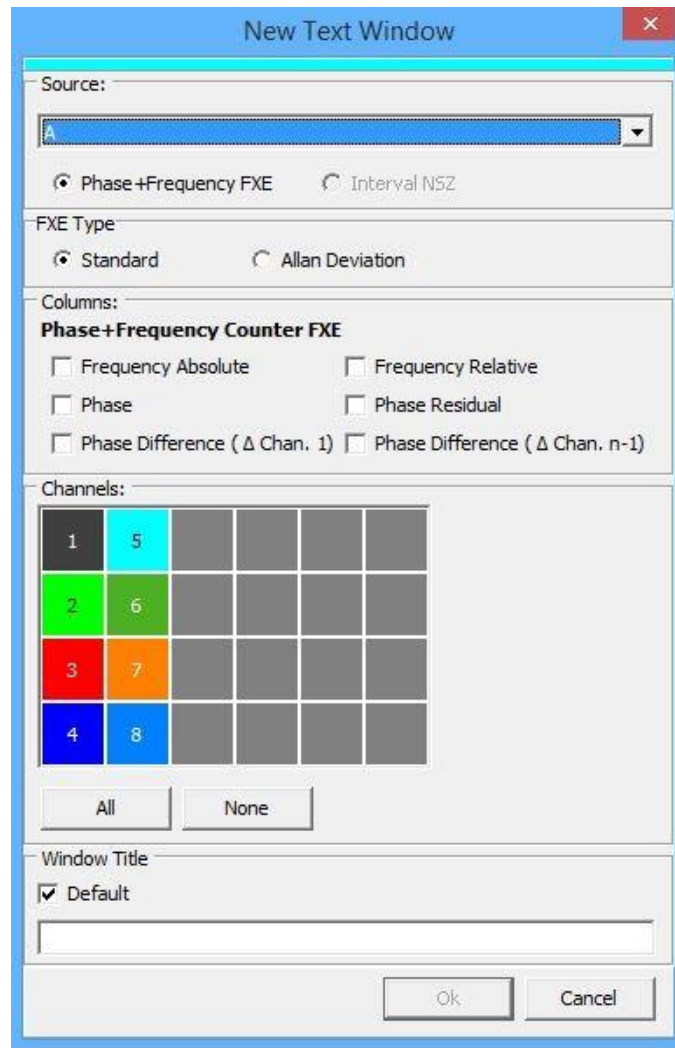
The displayed channels are selected under "Channels". If virtual channels have been defined, these can also be selected. The selection can also be made in the window itself.

FXE and NSZ devices can choose between different forms of presentation (e.g., FXE: phase or frequency, NSZ: time interval or difference). An individual title for the new window can be defined.

The width of the graphic is always a multiple of 20 pixels. This value can be changed to multiples of 256 using the "multiple of 256" option.

Window / New Text Window

Creates a new window for displaying measurement data in text form with one or more columns.



The displayed channels are selected under "Channels". If virtual channels have been defined, these can also be selected. The selection can also be made in the window itself.

Window / New Digital Inputs Window

Creates a new window for displaying the digital inputs of a K+K device.

Window / Change Window Settings..

Changes the settings of an open graphics or text window.

Window / Center Values..

With the "Center" function of a graphics window, the drawn graphs can be centered on the zero line.

The offset values used for this can be changed here, but they can also be set back to 0.

Window / Messages

Opens the message window

Action

Action / Sync Enable

Unlocks the device's sync function so that it can be synchronized with other devices through an external signal

Action / Diff Reset

Sets the measured phase difference (FXE) or the time interval difference (NSZ) to 0.

Action / Clear Buffer

Clears the data buffer in the K+K device

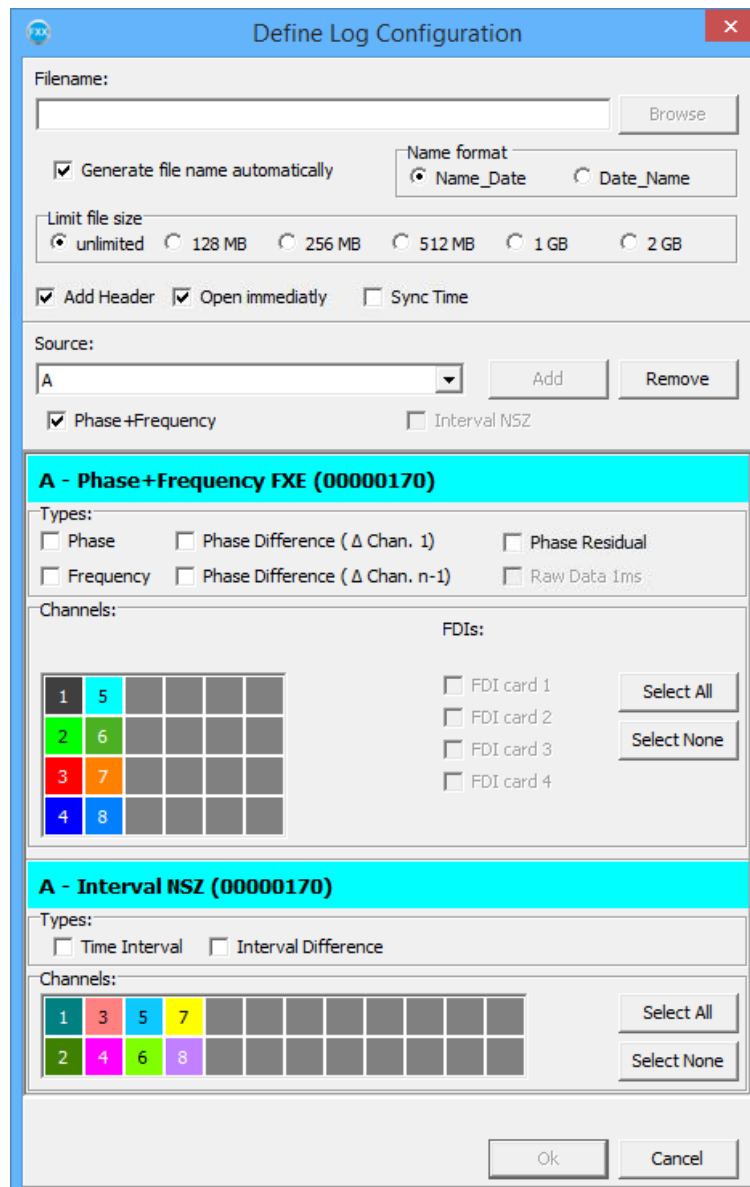
Action / Version

Output of software, firmware, FPGA version etc. in the message window

Logging

Logging / New Log Configuration..

Definition of the configuration of a new measurement data log file. Measured values from one or more sources can be recorded. All defined log configurations are listed in the logging menu. A new log file can be opened and a running log file can be closed. The defined configurations can be changed or removed.



The file name can be generated automatically and is then made up of source, type and date; the date can be set before or after the name. In addition, the file size can be limited; i.e. a new log file is started when the maximum size is reached.

If a source is added to the log file with "Add", one or more modes for logging can be selected under "Types", i.e. it is e.g. possible to log phase and frequency values of a source in a common log file.

The selection of channels is possible separately for each source.

Option "Add Header Lines": Insert additional headers in the log file

Option "Open immediately": Switch logging of this log file on/off

Option „Sync Time“: FXE time stamp (every 100ms), if not selected: „1“ mark

Logging / Show in Info Box

Shows the settings for measuring data log files in the info box. There the logs can be switched on/off directly. The number of the log file in the info box corresponds to the number in the file list in the "Logging" menu.

Logging / Root Folder..

Defines the folder in which the measurement data log files are stored

Logging / Time Settings..

Defines the time stamp format. Can be based on the PC time or the reference clock of the FXE device

Logging / Debug Files ..

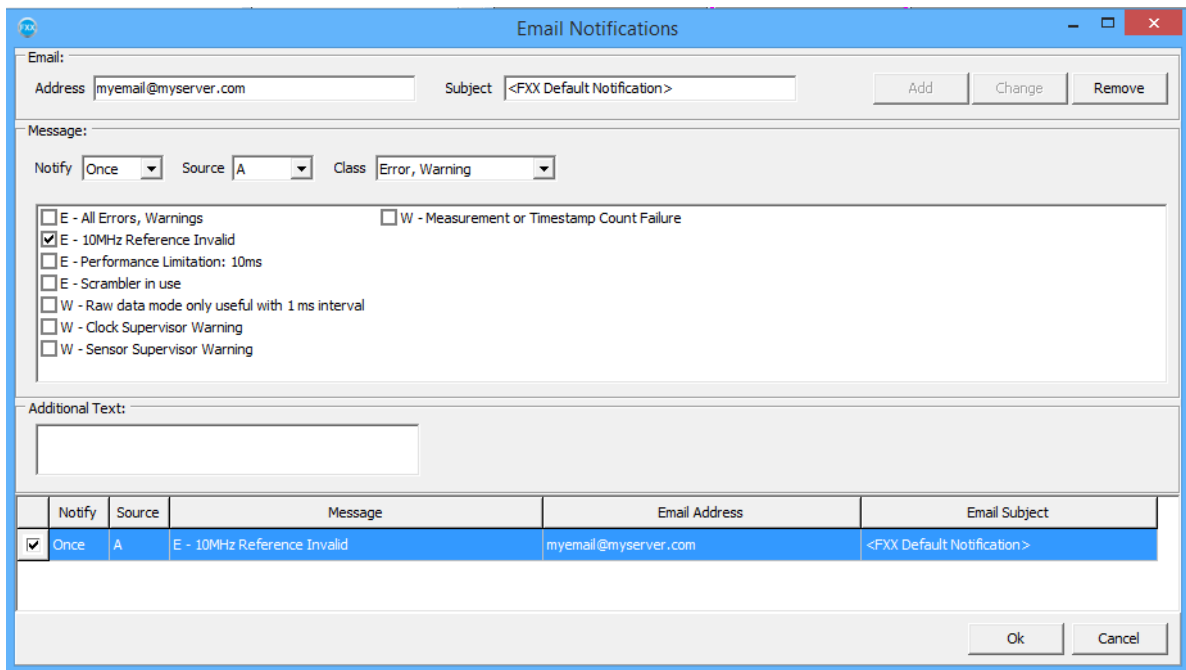
The FXX software always creates debug log files for the software and for connected sources. If an error occurs, these files are retained, otherwise they are overwritten with new debug information. Further options (reports, lowlevel) are available.

A "Test Data" file can also be generated. A new source can be defined for this file (see "New / Change Source") in order to read it into the FXX user interface again later.

Options

Selection of decimal separator, units, start conditions etc.

Options / Email Notification..



Definition of warnings or error messages to be sent by email. For this purpose, several messages can be defined and entered with "Add" in a list. The message definitions contain:

Address: destination address

Subject: Subject of the email, automatically generated (with host, source and message) or individually specified

Notify: Sending the message on each occurrence or once

Source: Source that reports the warning or error

Class: Error/Warning, Info or Internal Error. For a class, all messages or any selection of possible messages can be defined. Internal errors indicate a hardware or software problem and should be reported to K+K.

Additional Text: Individual additional text that is inserted in the message.

Options / Config Email Server..

Definition of the email server from which the emails defined under "Email Notifications" will be sent.

The default is the K + K server, i.e. the sender of the emails is "info@kplusk-messtechnik.de".

However, another server can be defined. This will require host name, port number, authentication and password.

Options / Popup Message Notifications..

Enable or disable messages for output in the "popup message" window. Enabled messages are not only output in the message window, but also in a large font in a central window (popup message). Error messages are enabled by default, warnings and info messages are disabled.

These settings can be changed here. The message list contains all messages that have occurred, as well as all messages that deviate from the default setting.

Help

[Help / Info](#)

[Help / Manual..](#)