HBK HOTTINGER BRÜEL & KJÆR

# USER MANUAL

## Brüel & Kjær®
## Production Test USB DAQ
## Type 3670

BN 2510 – 11
English

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# Production Test USB DAQ
# Type 3670

## User Manual

BN 2510 – 11
December 2020

www.bksv.com

## Health and Safety Considerations

This apparatus has been designed and tested in accordance with IEC/EN 61010 – 1 and ANSI/UL 61010 – 1 *Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use*. This manual contains information and warnings which must be followed to ensure safe operation and to retain the apparatus in safe condition.

### *Safety Symbols and Signal Words Used*

The apparatus will be marked with this symbol when it is important that you refer to the associated danger or warning statement given in this manual

The manual uses this symbol when a danger or warning statement is applicable

Hazardous Voltage/Electricity. Both the apparatus and manual use this symbol when there is a risk for shock or electrocution

Hot Surface. This manual will use this symbol when there is a risk for burning or scolding

Earth (Ground) Terminal. The apparatus will be marked with this symbol when applicable

Protective Conductor Terminal. The apparatus will be marked with this symbol when applicable

Alternating Current. The apparatus will be marked with this symbol when applicable

**Danger** Signals an imminent hazardous situation, which, if not avoided, will result in death or serious injury

**Warning** Signals a possibly hazardous situation, which, if not avoided, will result in death or serious injury

**Caution** Signals a hazardous situation, which, if not avoided, could result in minor or moderate injury or damage to the apparatus

**Notice** Signals a situation or practice that requires attention, but does not directly result in personal injury if ignored

### *Risks and Hazards*

#### Explosion Hazards

**Danger:** The apparatus is not designed to be used in potentially explosive environments. It should not be operated in the presence of flammable liquids or gases

#### Electrical Hazards

**Warning:** Any adjustment, maintenance and repair of the open apparatus under voltage must be avoided as far as possible and, if unavoidable, must be carried out only by trained service

**Caution:** Switch off all power to equipment before connecting or disconnecting their digital interface. Failure to do so could damage the equipment

#### Mechanical Hazards

**Caution:** Whenever it is likely that the correct function or operating safety of the apparatus has been impaired, it must be made inoperative and be secured against unintended operation

## Waste Handling

HBK complies with the EU's Waste Electrical and Electronic Equipment (WEEE) Directive, which issues the following waste handling instructions:

- Do not dispose of electronic equipment or batteries as unsorted municipal waste
- It is your responsibility to contribute to a clean and healthy environment by using the appropriate local return and collection systems
- Hazardous substances in electronic equipment or batteries may have detrimental effects on the environment and human health
- The symbol shown to the left indicates that separate collection systems must be used for any discarded equipment or batteries marked with that symbol
- Waste electrical and electronic equipment or batteries may be returned to your local HBK representative or to Hottinger Brüel & Kjær A/S for disposal

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# Contents

# Chapter 1

# Introduction

## 1.1 About Production Test USB DAQ Type 3670

Type 3670 is a data acquisition system, specifically designed to be used with CCLD* measurement transducers, that digitizes and streams data through a USB interface to computers running either macOS® or Windows® operating systems.

Uses:

- Real-time, multichannel sound and vibration data acquisition
- CCLD power supply for transducers
- Audio and vibration quality control (QC) of components or sub-assemblies
- Final assembly, test and pack (FATP) stations for finished products

Type 3670 is available in two variants:

- **Type 3670-A-082**– 8 input channels, 2 output channel
- **Type 3670-A-088** – 8 input channels, 8 output channels

This user manual covers both variants.

### 1.1.1 Features

The design of Type 3670 provides exceptional accuracy and fidelity for all acquired or generated signals. The 110 dB dynamic range allows resolution of signals that differ in amplitude by a ratio of one million to one.

Design features:

- Instrumentation-grade acquisition system
- Analogue input and output channels
- 24-bit analogue-to-digital converter (ADC) and digital-to-analogue converter (DAC)
- 150 mW output channels
- Streaming via Core Audio for macOS or audio stream input/output (ASIO®) for Windows
- Wide frequency bandwidth
- Single input voltage range covering full dynamic range
- Information-only front panel; no controls on rear panel
- Internal CCLD switch (on/off) on each input channel
- Rugged and light
- IP 50 – dust protected
- Silent operation (convective cooling)


* Constant current line drive, also known as DeltaTron® (ICP® and IEPE compatible).

Type 3670 is delivered with a USB key (item no. BZ-5089) that contains: installation instructions, audio drivers, a USB audio tool that allows use of Type 3670 without programming, factory calibration information, a readme file with links to GitHub® for programming examples, and a product datasheet for specification references.

## The Input Channels

The input channels provide conditioning for the transducers, are synchronized and support sampling frequencies up to 96 kHz. This provides a usable analogue input frequency range of 5 Hz to 40 kHz.

All input channels have both analogue and digital filters, providing alias protection for the 96kHz sampling frequency and ensuring data integrity. They have a single voltage range from 5 µV to 5 V peak that, when combined with the 24-bit resolution, provides the extremely low noise floor often required for acoustic measurements. Moreover, the range supports the full portfolio of Brüel & Kjær CCLD transducers making multiple input ranges unnecessary. This simplifies setup and avoids overload and underrange errors when measuring.

## The Output Channels

Output channels are synchronized in pairs (1-2, 3-4, etc.). The output channel amplifiers are DC-coupled to 40 kHz and have a very low output impedance, allowing them to directly drive up to 150 mW into low-impedance loads like small speakers and headphones.

## The Microcontroller

Type 3670 has an embedded microcontroller controlling 24-bit analogue-to-digital converters (ADC) for the input channels and 24-bit digital-to-analogue converters (DAC) for the output channels. The microcontroller performs all the necessary housekeeping of the ADC, DAC and industry-standard USB 2.0 interface, freeing the host PC to give maximum responsiveness for your application.

## CCLD/ICP Power

Type 3670 is delivered with CCLD power ON for all input channels per default.

## USB Audio Tool

**Please note:**

- The USB Audio Tool included on the memory stick, is provided as is and is not covered by any warranty.
- The USB Audio Tool is NOT to be considered as a measurement tool.

The USB Audio Tool provides a simple manual interface that can be used for a quick check of the functionality of both input and output of Type 3670.

The tool includes limited generator functionality, a time signal and FFT signal window, all described briefly below.

## 1.2 Hardware Overview

### 1.2.1 Hardware Interface

*Front Panel*

**Fig. 1.1** *Front view of Type 3670-A-082*


*Rear Panel*

**Fig. 1.2** *Rear view of Type 3670-A-082*


*Mounting*

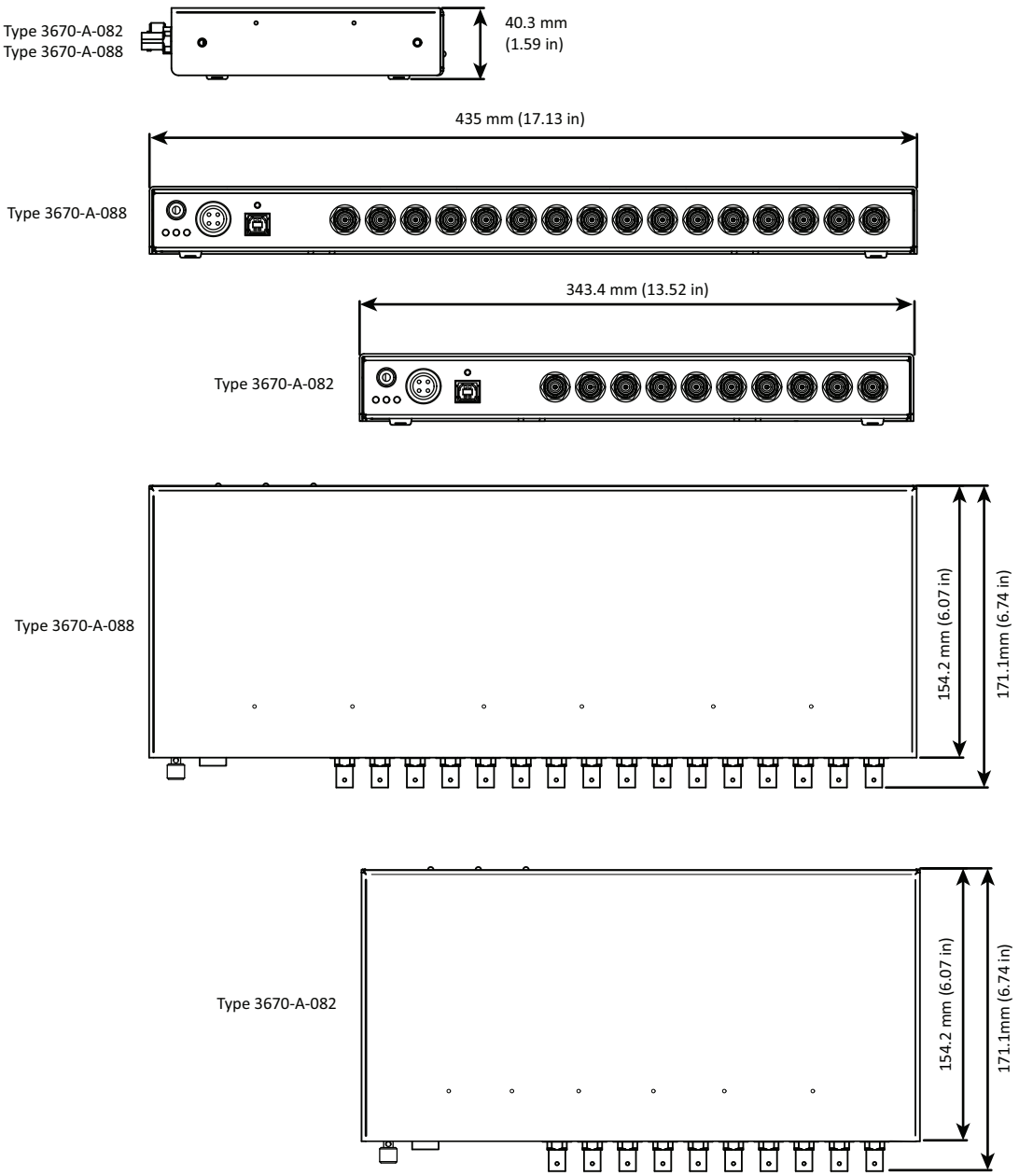
Type 3670 is delivered with a rack mounting kit as an included accessory:

- UA-1764 with the two-channel output variant, Type 3670-A-082
- UA-1767 with the eight-channel output variant, Type 3670-A-088

Both UA-1764 and UA-1767 include two brackets (item nos. GV-0041 and GV-0042) for 19" rack mounting and four M4 × 10 mm screw (item no. YS-0413) for mounting the bracket at the side of the instrument.

**Fig. 1.3**
*Mounting holes on the instrument for 19" rack mounting brackets*

### 1.2.2 Dimensions



## 1.3 Software Overview

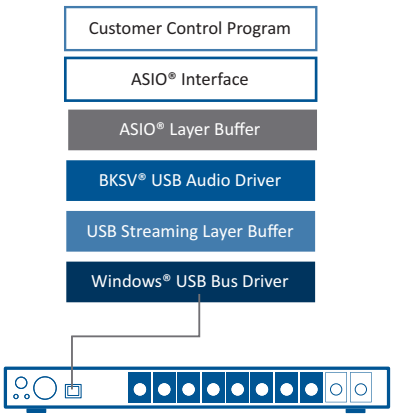
Type 3670 is an audio streaming device that supports the standard USB Audio 2.0 interface protocol.

The software control of Type 3670 is depending on the operating system:

- For macOS®, it can be accessed directly using the built-in Core Audio
- For Windows®, it can be accessed through an ASIO® driver (included)

The included USB Audio Driver implements standard ASIO interface.

**Fig. 1.4**
*Block Diagram of Type 3670 in a Windows environment*




The functionality provided by Type 3670 can be evaluated using commercially available professional audio software, such as Audacity® or Audacity for Windows (compiled with ASIO support).

Standard available ASIO API or Core Audio tools can be used for the programming interface.

**Please note:** ASIO API and SDK (Software Development Kit) are not included with this product nor supplied by HBK.

## 1.4 System Requirements

**Operating System:** Microsoft® Windows® 7 or later; macOS® Panther (v10.3) or later

**USB:** USB 2.0 High-speed, Type A (F)

**Driver:**

- **macOS:** Native driver
- **Windows:** Driver included with instrument or downloaded at bksv.com (go to **Support** > **Downloads** > **3670 USB Audio Demo Tool**)

No additional files or software are required for macOS systems.

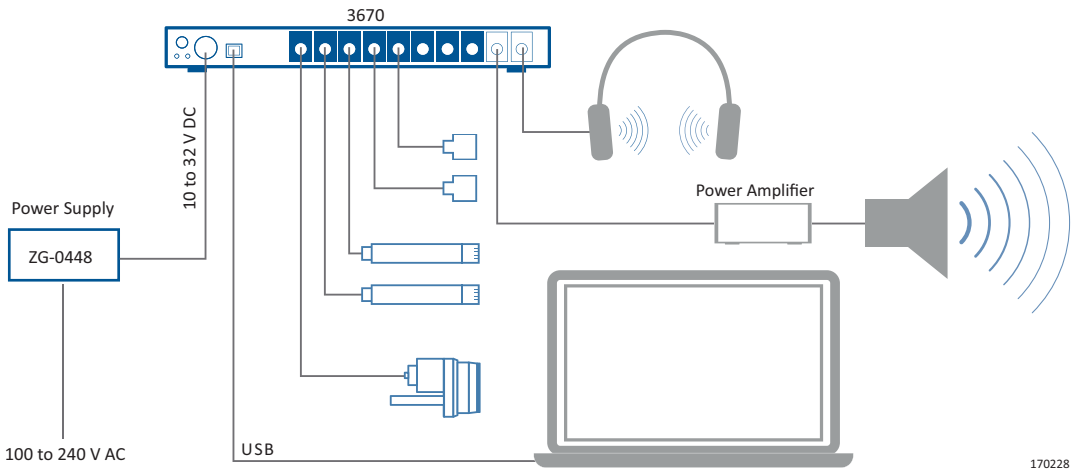
# Chapter 2

# Connect and Install

## 2.1 Connecting the Instrument

Type 3670 supports CCLD accelerometers, microphones and ear simulators; drives devices such as headphones or loudspeakers (with amplification); and streams data via USB.

***Fig. 2.1*** *Connection examples*




1) Connect the included USB Cable (item no. AO-0728-D-020) to the instrument's USB connector and your PC.
2) Connect the included **Power Supply** (item no. ZG-0448) to the instrument's **DC Power** input and the mains power* (100 to 240 VAC).

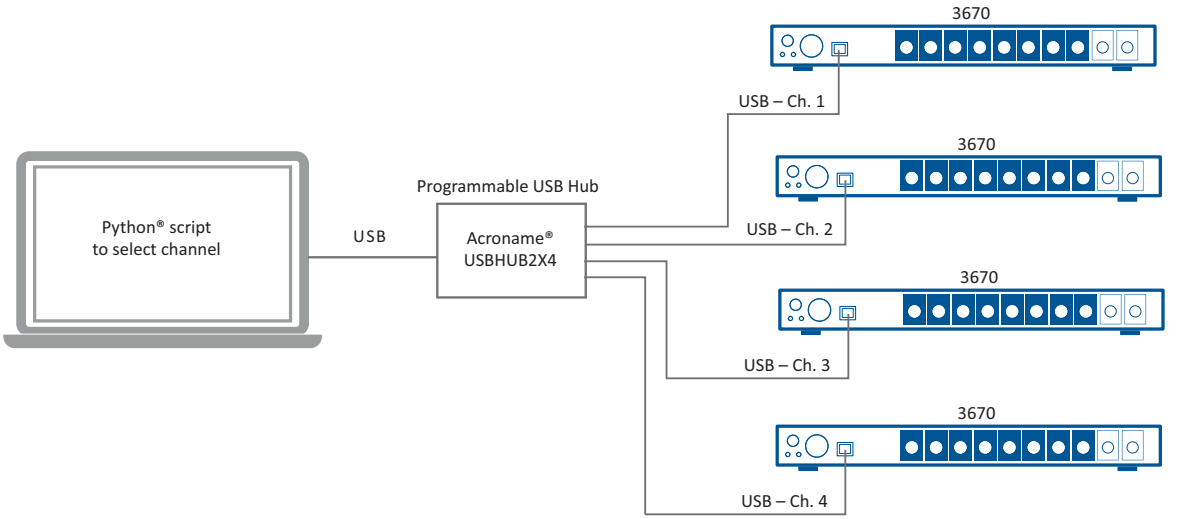
When connected, the instrument's Power LEDs (both front and rear) will light green. When the PC is connected via USB, the instrument's Status LEDs (both front and rear) will light green. If you lose connection to the PC, the Status LEDs will light red.

* Type 3670 can also be powered via a car cigarette lighter using the optional DC Power Cable AO-0546-W-002, available via HBK.

### 2.1.1 Connecting Multiple Instruments to a PC

Even though it is only possible to run one Type 3670 at a time on a PC, it is possible to connect more than one Type 3670 to one PC by using a programmable USB hub to switch between the instruments.

*Fig. 2.2* *Possible setup for multiple Type 3670 instruments connected to one PC*




This setup has been tested and verified using a Windows®-based PC running the included USB Audio driver, an Acroname® Programmable USB HUB and two Type 3670.

**Please note:** There is a pause of approximately three seconds when switching between instruments. That is because the audio driver can only handle one Type 3670 at a time, and will need time to settle.

## 2.2 Installing the USB Audio Driver (for Windows users)

Type 3670 is delivered with all the necessary software (driver and audio tool) and documentation on a USB memory stick (Item no. BZ-5089).

Alternatively, you can download the software* and manual at bksv.com (go to **Support** > **Downloads** > **3670 USB Audio Demo Tool**).

To install the USB Audio Driver:

1) Copy the content of the included memory stick or the downloaded files to your local drive and unpack the zipped file.
2) Run the setup program:
   - If installing from the memory stick, the setup program, **bksv_vX.XX.X_year-mm-dd_setup.exe**, is developed for the latest version of Windows. For older versions, see the drivers in the **Archive** folder
   - If installing from the Downloads page, select the driver best suited for your setup under **USB Audio Driver Wizard**

* The latest version of the software is always available for download.

**Please note:** It is recommended to close all other applications before running in order to avoid the need to restart your PC.

*Fig. 2.3*
*BKSV USB Audio Driver installer*


3) Click **Next** and follow the instructions in the installation tool. When complete, click **Finish**.
4) If not already done, connect Type 3670 to the PC via USB and switch it on.

**Please note:** If Type 3670 is not connected before you install the audio driver, you will get a warning that your device will need to be disconnected and reconnected. Click **Yes** to continue, then connect Type 3670.

5) Click in the PC Taskbar to open the BKSV USB Audio Control Panel.
6) Ensure *BKSV USB Audio 2.0* (the instrument's firmware) is detected and listed. If not, check the connection to Type 3670.

## 2.3 (Optional) Installing the USB Audio Tool

The USB Audio Tool provides a simple interface that can be used for a quick check of the input and output functionality of Type 3670 and includes limited generator functionality, a time signal and an FFT signal window.

The USB Audio Tool is included on the USB memory stick (Item no. BZ-5089) that is delivered with Type 3670.

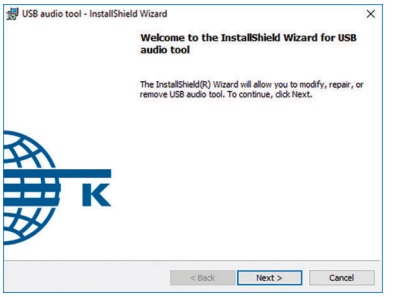
Alternatively, you can download the software* and manual at bksv.com (go to **Support** > **Downloads** > **3670 USB Audio Demo Tool**).

To install the USB Audio Tool:

1) Copy the content of the included memory stick or the downloaded files to your local drive and unpack the zipped file.
2) Run the setup program, setup.exe.
3) Run the setup program:
   - If installing from the memory stick select **setup.exe**
   - If installing from the Downloads page, select **USB Audio tool setup wizard**

* The latest version of the software is always available for download.

*Fig. 2.4*
*BKSV USB Audio Tool installer*



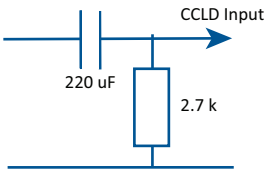

4) Click **Next** and follow the instructions in the installation tool. When complete, click **Finish**.
5) If not already done, connect Type 3670 to the PC via USB and switch it on.

## 2.4 Direct Input with CCLD Power On

The default CCLD power setting is ON for Type 3670. If you want to connect a direct signal from, for instance, a signal generator, to a Type 3670 input channel, there is a risk of distorting the signal as some generators cannot accept (sink) the 4 mA CCLD current.

To avoid this distortion without having to switch off the CCLD power, you can use a DC current blocker made of a capacitor and a resistor with a value of 2.7 to 3 kΩ.

*Fig. 2.5*
*CCLD current blocker diagram*




Inserting the DC current blocker, as shown in Fig. 2.5, between your generator and the input of Type 3670 will load the generator with the 2.7 kΩ.

**Hint:** It is possible to loop back a Type 3670 output channel to an input channel using a a BNC cable modified to include a DC current blocker as shown in Fig. 2.5. The output will be able to accept the load, even if you are running several inputs in parallel.

## 2.5 Switching CCLD Power On/Off

⚠ **WARNING:** This should ONLY be performed by a qualified technician and with proper protection against electrical discharge to avoid electrical or mechanical damage to the product.

Please watch out for any electrical discharges. Do not touch any electronic components on the instrument internal board with your fingers!

To switch the CCLD power OFF or ON for one or more channels, please follow this procedure:

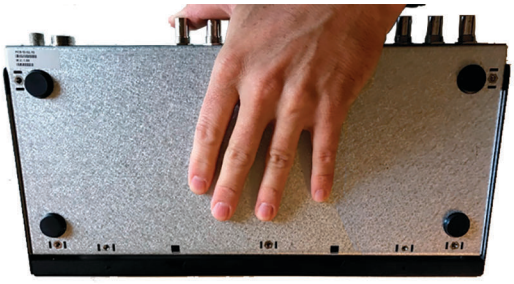
**NOTICE:** Bruel & Kjaer CCLD transducers will require CCLD power ON.

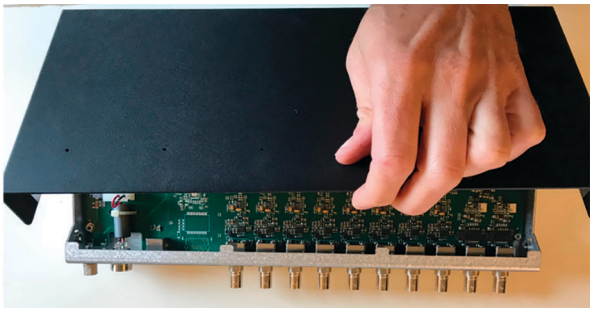
1) Switch the instrument power off.
2) Remove the two security screws on the bottom of the instrument using a star-shaped flathead screwdriver (Torx T10).

*Fig. 2.6* *Remove screws, insert the screwdriver and twist to loosen the bottom panel from the enclosure*

3) Gently flip the instrument over.
4) Slide the enclosure forward and remove.

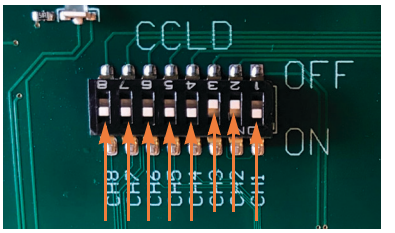
*Fig. 2.7* *Removing the top enclosure*





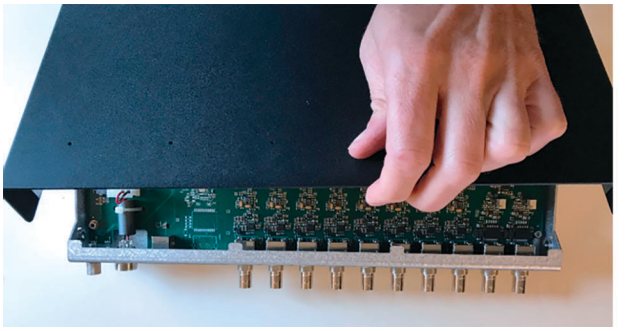
5) Locate the CCLD dual in-line package (DIP) switch on the circuit board.
6) Switch the CCLD power **OFF**/**ON** for one or more channels using their individual selectors. The example in Fig. 2.8 shows that all channels have the CCLD power **ON**, except for channels 2 and 3.

***Fig. 2.8***
*The CCLD switch with all channel power selectors*




7) Re-install the enclosure.
8) Gently flip the instrument over and re-insert the two screws.

***Fig. 2.9*** *Re-installing the enclosure and inserting the two security screws*



## 2.6 Firmware Updates

You can see the version of the Type 3670s firmware in the Info tab of the USB Audio Driver's BKSV USB Audio Control Panel.

From firmware version 8.F4, you can update the firmware via a USB port.

Check bksv.com/Service/downloads under 3670 for Firmware version later than v8.F4

A Type 3670 with an older firmware version than 8.F4 can be upgraded by contacting your local HBK sales representative or Global Customer Care.

# Chapter 3

# Set Up the Instrument's Audio Device

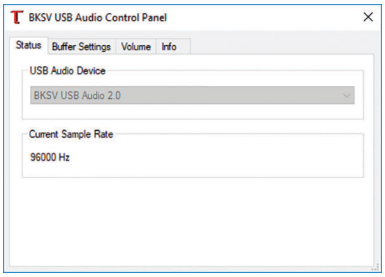
## 3.1 Set Up the USB Audio Driver

The audio driver's BKSV USB Audio Control Panel provides the interface to set the parameters for Type 3670. The four tabs are:

- Status
- Buffer Settings
- Volume
- Info

### 3.1.1 Status

*Fig. 3.1*
*Status tab*

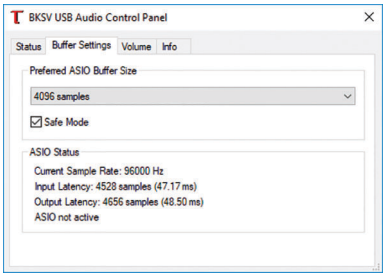



On the Status tab, you can check connection with the *USB Audio Device*. If ***BKSV USB Audio 2.0*** is displayed, you are connected to Type 3670 (BKSV USB Audio is the instrument's firmware).

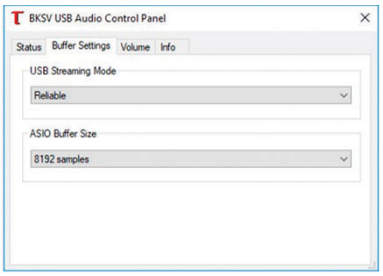
The *Current Sample Rate* is determined by the application software like the USB Audio Tool (see section 3.2). You may find that some application software may only work with certain sample rates.

### 3.1.2 Buffer Settings

*Fig. 3.2*
*Buffer Settings tab*




USB Audio Driver version 4.47




USB Audio Driver version 4.11

The Buffer Settings tab is used to control the USB streaming mode (USB Streaming Layer) and/or the ASIO® buffer size, depending on the version of the driver.

#### USB Audio Driver Version 4.47

The selectable buffer size: ***16***, ***36***, ***64***, ***128***, ***256***, ***512***, ***1024***, ***2048*** or ***4096***.

Set the *Preferred ASIO Buffer Size* to ***4096*** samples and enable ***Safe Mode***.

##### *Latency*

The *Input Latency* and *Output Latency* depends on the selected buffer size. The latency will remain constant for the given buffer size.

#### USB Audio Driver Version 4.11 and Older

The USB Streaming Layer buffer size is specified in time length where the buffer size is specified in samples. Please note that some application software may not allow all combinations of buffer setting and sample rates.

1) Set the *USB Streaming Mode* to:
   - ***Minimum Latency*** = 1 millisecond
   - ***Low Latency*** = 2 milliseconds
   - ***Standard*** = 4 milliseconds
   - ***Relaxed*** = 8 milliseconds
   - ***Reliable*** = 12 milliseconds
   - ***Safe*** = 16 milliseconds
   - ***Extra Safe*** = 32 milliseconds

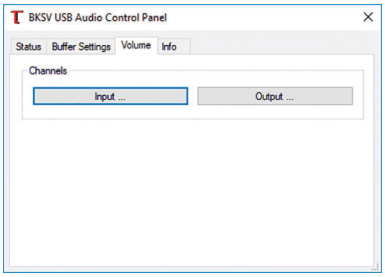
   It is recommended to select either ***Reliable*** or ***Standard***.
2) For the *ASIO Buffer Size*, the smaller the buffer size, the greater the responsibility the PC has to pass the samples to your application program. Using a small buffer will give you low latency but you risk missing some samples if the CPU cannot follow the pace. Using a bigger buffer will give you a greater latency but you will have more data security.

   Selecting ***Auto*** lets the driver decide the buffer size, which means you cannot control the latency yourself. The driver will set the ASIO buffer size (in milliseconds) so that it is bigger than or equal to the streaming buffer depth (also in milliseconds).

   It is recommended to set the *ASIO Buffer Size* to ***8192*** samples.

### 3.1.3 Volume

*Fig. 3.3*
*The Volume tab*



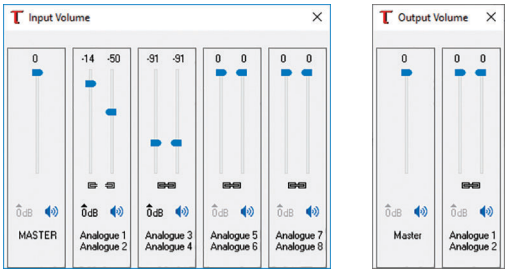

The Volume tab allows you to digitally scale the input and output volume in the audio driver. For the output channels, the Volume control acts like an attenuator, reducing the output signal. For the input channels, the Volume control only affects the digital scaling of the signal and does not attenuate the analogue input signal.

Scaling can be done in steps of 1 dB from 0 to –127 dB.

#### The Controls

Click either ***Input*** or ***Output*** to edit the volume setting for those specific channels.

*Fig. 3.4*
*Example using Type 3670-A-082. Note that for the input channels, channels 1 and 2 have individual settings while all other channel settings are paired*



For both Input and Output volumes:

- The channels are laid out in pairs. You can scale the volume individually per channel or per pair by clicking the link symbol open (individual) or closed (paired)

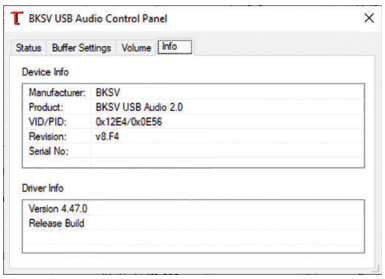

- Use the *Master* control to adjust all input or all output channels


- Click the speaker icon ( ) on either the Master volume control or the channel volume control to mute and unmute all or the pair of channels, respectively.

**Please note:** To ensure the same scaling of all channels, it is recommended to have all Volume controls set to ***0***.

### 3.1.4 Info

*Fig. 3.5*
*The Info tab*




The Info tab shows information about Type 3670, including firmware and driver.

## 3.2 Set Up the USB Audio Tool

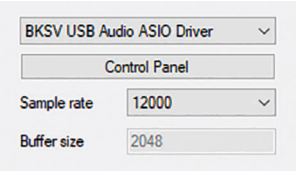
The included USB Audio Tool provides a simple interface that can be used for quick checks of the input and output functionality of Type 3670. The USB Audio Tool is NOT to be considered as a measurement tool.

The USB Audio tool includes limited generator functionality, a time signal window and an FFT signal window.

Generally, you can edit parameters as needed. Some parameters like *Sample rate* and *FFT Lines* require that you restart (click ***Start***) after editing for the changes to be applied.

### 3.2.1 The Control Panel

*Fig. 3.6*
*Control panel settings*



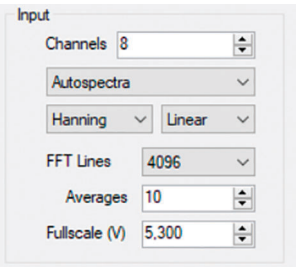

At the top of the display, the active device can be selected. The default is ***BKSV USB Audio ASIO Driver***, which is the USB Audio Driver you have installed.

Set the *Sample rate*: ***96000***, ***48000***, ***24000*** or ***12000***. The anti-aliasing filter in Type 3670 is only valid with ***96000***. If you edit this setting, you will need to restart (click ***Start***) to apply the change.

The *Buffer size* is displayed but cannot be changed from the USB Audio Tool (edit in the USB Audio Driver).

### 3.2.2 Input

*Fig. 3.7*
*Input settings*




In the Input section, you can select:

- *Channels:* ***1*** to ***8***
  Total number of input channels included in the analysis
- ***Autospectra*** or ***Freq. Resp.***
  The type of input
- ***Hanning***, ***Flat Top*** or ***None***
  The weighting function
- ***Linear***, ***Exponential*** or ***Peak***
  The type of averaging
- *FFT Lines*: ***64***, ***128***, ***256***, ***512***, ***1024***, ***2048*** or ***4096***
  The number of FFT lines/samples in the time record. If you edit this setting, you will need to restart (click ***Start***) to apply the change
- *Averages*: ***1*** to ***100***
  The number of averages in steps of 1
- *Fullscale (V)*: ***0.100*** to ***10000***
  Only visible when ***Gain Adjust*** is enabled in the View menu at top

Generally, you can edit the parameters at any time.

### 3.2.3 Output

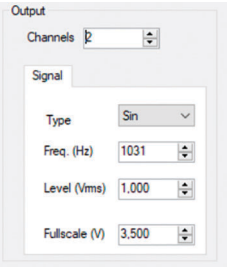



***Fig. 3.8***
*Output settings*

The USB Audio Tool includes a signal generator that streams a signal to the output. The output parameters are:

- *Channels*: ***1*** to *n*

  Total number of output channels, where *n* is the maximum available for the instrument (Type 3670-A-082 has 2 output channels, Type 3670-A-088 has 8 output channels)
- *Type*: ***Pink*** (pink noise), ***White*** (white noise), ***Sweep*** (swept sine) ***Sin*** (sine), ***Square***, ***Triangle*** or ***SawTooth*** (sawtooth)

  The type of output signal
- *Freq. in Hz*: ***0*** to ***100000***

  The signal frequency
- *Level (Vrms)*: ***0.000*** to ***4000***

  The signal level
- *Fullscale (V)*: ***0.010*** to ***10000***

  Only visible when ***Gain Adjust*** is enabled in the View menu at top

Generally, you can edit the parameters at any time.

### 3.2.4 Time and FFT Signal Windows

The USB Audio Tool includes a time signal display, FFT display window, channel legend and cursor readout displays.

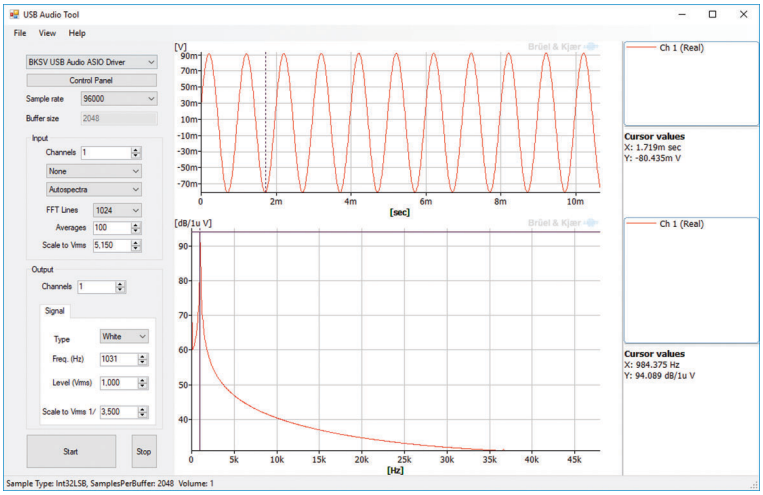



*Fig. 3.9*
*The USB Audio Tool user interface, showing the display area*
***Left:** Parameters*
***Top centre:** Time signal display*
***Bottom centre:** FFT signal display*
***Right:** Channel legend and cursor readouts*

1) Select the number of input channels.
2) Define the parameter values.
3) Click ***Start*** to view time and FFT data.

When multiple channels are selected, you can view individual cursor values by clicking on the channel in the legend on the right-hand side. Each display has its own legend and cursor readout.

Right-click in a display area to edit graph property settings, including type of cursor and placement of the legend and readout in the interface.

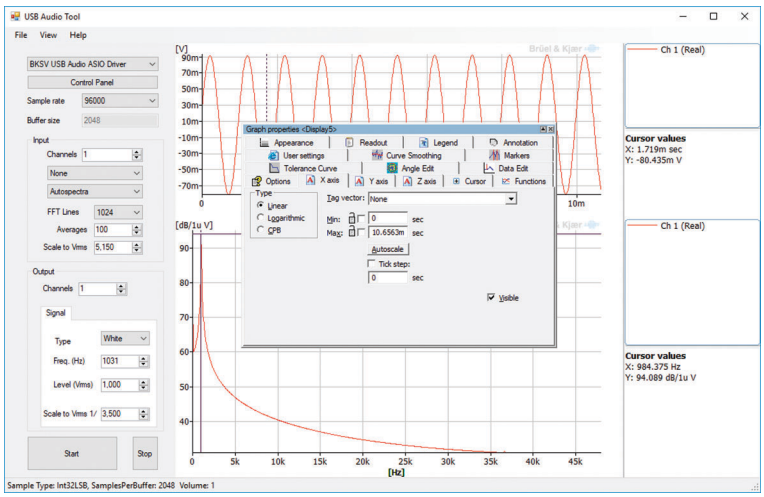



*Fig. 3.10*
*Graph properties dialog box*

Graph properties can be edited at any time.

# Chapter 4

# Calibration

## 4.1 Factory Calibration

Every Type 3670 is delivered with a Factory Standard Calibration Certificate. The certificate can be found on the USB memory stick delivered with the instrument.

Factory standard calibration provides detailed calibration information and measured results on the individual instrument for all input and output channels.

Input channel calibration information:

- Frequency response
- Harmonic distortion
- Noise
- Gain correction
- DC offset

Output channel calibration information includes:

- Frequency response
- Harmonic distortion
- Noise

## 4.2 Using the Input Gain Correction and DC Offset Information

The information provided in the calibration certificate can be used to calculate the corrected measured level

*Corrected Measured (V) = (sample / DIG_FS) * ANA_FS * Gain_corr + DC_Offset*

where:

*DIG_FS* is digital full-scale

*ANA_FS* is analogue full-scale

*Gain_corr* is the gain correction for the selected channel

*DC_Offset* is the DC offset for the selected channel

Example:

Assume that our measurement software receives a level corresponding to a maximum digital level from Type 3670 Input Channel 1 and we want to know the actual input level in volts. In the Calibration Certificate we find:

*Gain_Corr for Ch. 1 = 0.994375*

*DC_Offset for Ch. 1 = 5.7 µV*

*ANA_FS = 5.3 V*

Now we can calculate the input level using the equation above:

*Input level (V) = 1 * 5.3 V * 0.994375 + 0.0000057 V = 5.2701932 V*

# Chapter 5

## Verify Type 3670 Functionality

For a quick check of Type 3670's functionality before using the instrument, the following procedure can be used.

1) Install the USB Audio Driver and the optional USB Audio Tool on the PC.
2) Connect the instrument to the PC using USB Cable AO-0728.
3) Connect the mains power to the instrument using Power Supply ZG-0448.
   a) Both the Power and Status LEDs on the instrument should light green.
   b) Open the USB Audio Driver by clicking in the PC Toolbar and check on the Status page that *USB Audio Driver 2.0* is displayed.
4) Start the USB Audio Tool – it will be listed under ***Start*** > ***Programs***.
5) Set the Input parameters in the USB Audio Tool:
   - *Channels*: ***8***
   - (input): ***Autospectra***
   - (weighting function): ***Flat Top***, which is best suited for sine waves
   - (averaging): ***Exponential***
   - *Averages*: ***10***
6) Set the Output parameters in the USB Audio Tool:
   - *Channels*: ***2***
   - *Type*: ***Sin*** (sine)
   - *Freq. (Hz)*: ***1000***
   - *Level (Vrms)*: ***1.000***
7) On the instrument, connect an output channel to an input channel using a BNC-to-BNC cable.
8) Click ***Start*** in the USB Audio Tool.
9) Check that the signal levels in the time and FFT signal displays correspond to the Level set on the generator, adjusted for the sensitivity of the selected channel (can be found in the included Factory Standard Calibration Certificate).
10) Repeat steps 6 – 8 for all input channel and output channels.
11) Attach a CCLD microphone to an input channel and click ***Start*** in the USB Audio Tool.
12) Connect a calibrator to the microphone.
13) Check that the levels in the time and FFT signal displays correspond to the combined level of the calibrator, adjusted for the microphone sensitivity and the input sensitivity of the selected channel (can be found in the Factory Standard Calibration Certificate).
14) Repeat steps 10 – 12 for all input channels.

# Chapter 6

# Supported Interfaces

## 6.1 Program Development in C++

OS X (macOS) applications can be written in, for example, Objective-C using Core Audio. Windows® C++ applications can be written on top of the ASIO.SDK. The latest C++ documentation and code for this is available at: https://www.steinberg.net/en/company/developers.html.

## 6.2 Program Development in .NET

To make applications in C#, the recommended software is NAudio. Source code and documentation is available at: https://github.com/naudio/NAudio/wiki. A complete package for a simple build is available at: https://www.nuget.org/packages/NAudio/1.8.4.

## 6.3 MATLAB Support

MATLAB® users can find more information and ready-made code here: https://se.mathworks.com/help/audio/ref/audioplayerrecorder-system-object.html.

## 6.4 Listen SoundCheck Support

When using USB Audio Driver version 4.11 or older with SoundCheck®, it is recommended to NOT set the *ASIO Buffer Size* to Auto as this can result in buffer sizes that are not supported.

Use of an *ASIO Buffer Size* that is not in the $2^n$ range when analysing signals with SoundCheck, may cause wrapping issues (discontinuities in the signal) in SoundCheck which will appear as increased distortion.

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