Operating Echo Test + Measurement AIO with QC Stand-alone Software

Technical Note for KLIPPEL QC Stand-alone Software (Document Revision 1.0)

1   Introduction

The KLIPPEL QC Stand-alone Software is dedicated for performing electro-acoustical measurements for quality control applications with 3rd party sound cards and audio interfaces, instead of KLIPPEL Analyzer devices.

In contrast to most commercially available audio interfaces that are mainly designed for music and speech recording, the modular Echo Test + Measurement AIO system is a specialized, professional audio test interface for cost-efficient end-of-line testing applications of both low-power passive and active audio devices. Since the AIO provides a USB 2.0 audio class compliant interface, a dedicated ASIO driver, suitable inputs and outputs and a control panel, it is highly suitable for operation with KLIPPEL QC Software.

This document provides guidelines for putting the Echo AIO into operation with KLIPPEL QC Stand-alone for a typical passive transducer test scenario.

2   Requirements

2.1   Hardware

The following components are required to operate the test scenario introduced in this tech note.

Echo AIO

- Echo Test + Measurement AIO Frame
    - AIO-S Speaker Test Module or (alternatives: AIO-A, AIO-H, AIO-L)
    - Opt. second module: AIO-C module (GPIO, battery simulator for the device under test)
    - Power and USB cable (included)
- 4-wire speaker cable (not provided)
    - Separate force and voltage sensing lines (positive and negative)
    - Euroblock to custom clamping

Note: The listed components are not distributed by KLIPPEL. Please contact Echo T+M sales.

Accessories

Here is a list of further required components that may be provided by KLIPPEL

- Pre-polarized measurement microphone (e.g., GRAS 40PP-10 Item No. 2400-350)
    - CCP/IEPE operated
    - BNC connector
    - TEDS compliant (opt.)
    - BNC cable
- Ambient noise microphone (opt.)
- KLIPPEL USB License Dongle
- USB Temperature & Humidity Sensor (opt., Item No. 2800-011)
- Manual Sweep Controller (opt., Item No. 2800-005)
- PC or Laptop with Windows 7 or higher (not provided by KLIPPEL)

2.2   Software

The following mandatory and optional software components are recommended:

- Echo AIO Software (device driver, control panel, CLI/API)
- KLIPPEL QC Stand-alone Software (Item No. 4006-001)
- Measurement tasks licenses
  - SPL – Sound Pressure (Item No. 4006-263)
  - IMP – Impedance (Item No. 4006-262)
- Add-on licenses (opt.)
  - SYN – External Synchronization (Item No. 1001-107)
  - PNI – Production Noise Immunity (Item No. 4000-250)
  - STAT – Statistics (Item no. 4000-225)

3   Preparation

This section will guide you through the initial software and hardware setup including device and sensor calibration.

3.1   Hardware Connection

The following scheme shows how the recommended hardware compensates are connected in a typical passive transducer test scenario.
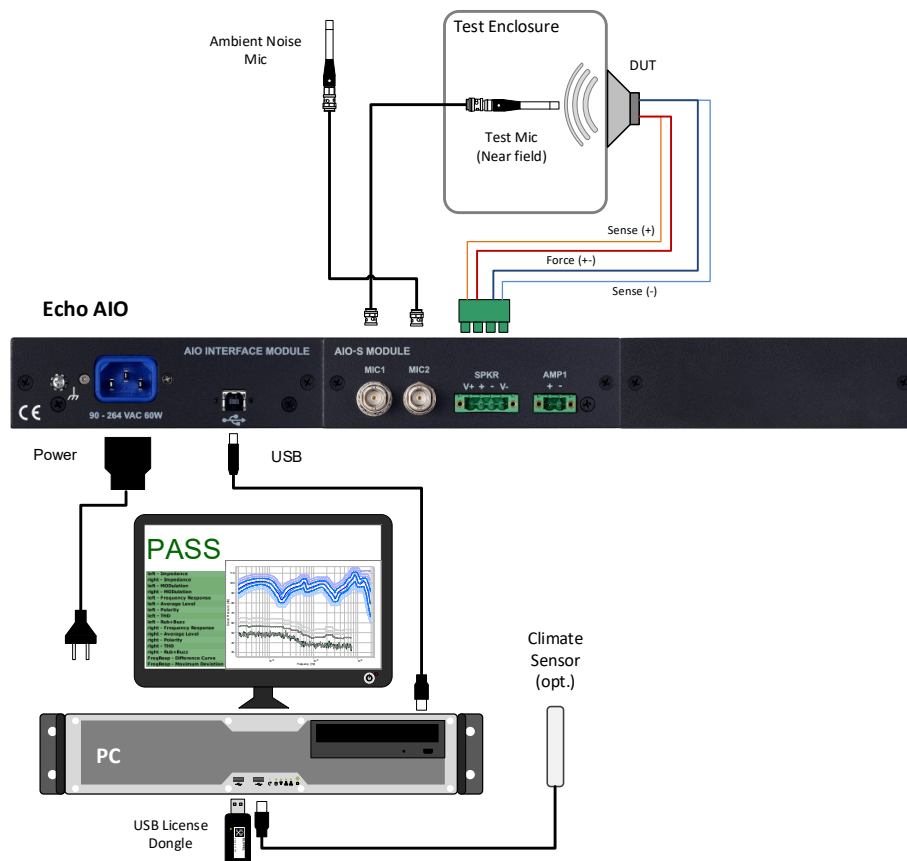
- Follow the Echo AIO Quickstart Guide to put the AIO into operation
  - Connect the AIO to the PC
  - Plug the supplied locking power cable into the AIO and connect to a properly grounded outlet
- Connect the microphone(s) to the input(s) MIC1 (and MIC2) of the AIO-S Module
- Connect the DUT (device under test) to the SPKR output using a 4-wire connection
- Connect the KLIPPEL USB License Dongle to the PC

3.2   Software Setup

This section will quickly guide you through the software installation.

Echo AIO Software

First, download and install the Echo AIO software and follow the AIO Quickstart Guide.

The setup installs the following components

- ASIO & WASAPI drivers
- Control panel application
- CLI application & API library
- Documentation

Open the *Echo AIO Control Panel* and activate *CCP* supply for the microphone input(s) *MIC1*(*2*). You may adjust input gain (1x, 10x or 100x) now or later depending on your expected peak SPL. A gain factor of 10 should be suitable for most scenarios.
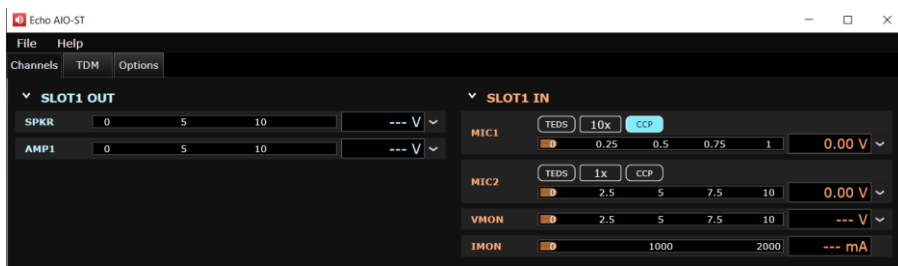
Note*: the ASIO input/output channels are assigned in the order of appearance in the control panel.*

Switch to the *Options* tab. It is recommended to deactivate the *Windows system audio* option during test operation to avoid any interference. Adjust other options as desired.
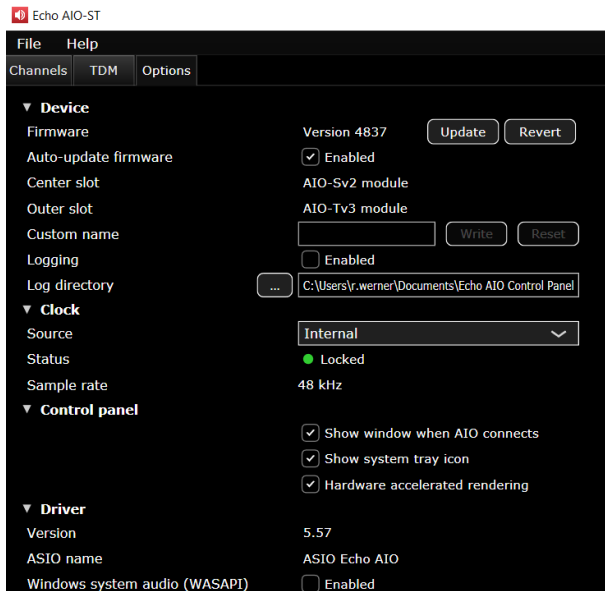
KLIPPEL QC

Download the KLIPPEL QC Software and start the setup using the *QC Install Guide* in the root folder. Please make sure to select *Setup without analyzer hardware* before you continue.

Follow the step-by-step instructions that will guide you through the initial software and hardware setup. The hardware and sensor calibration are also addressed during the process. Please follow the given instructions and also consider the information given in the next section.

3.3 Hardware Calibration

By default, non-KLIPPEL devices can be operated as purely digital devices without further actions. In this case, all output and input levels will be expressed in dBFS (digital level relative to full scale). However, in order to specify test stimulus voltage or measure SPL in absolute units it is necessary to calibrate the AIO outputs and inputs or the complete input signal chain including the microphone using a microphone calibrator (recommended).

Although the QC Install Guide provides instructions for device and sensor calibration, some particular information is provided to consider when using the Echo AIO. More detailed information is given in the QC Manual.

Output/Input Calibration

This step is considered to be optional.

Note: *The input/output calibration of the QC software currently supports only two channels. It is recommended to calibrate the output only and the inputs indirectly using sensor calibration.*
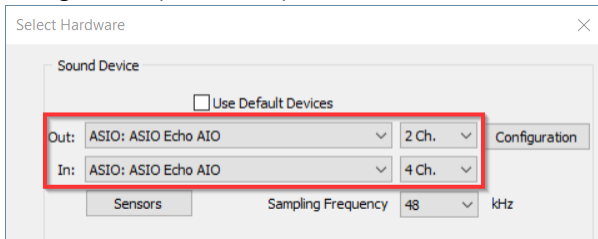
- Open *Calibration for Device and Sensors* during the *QC Install Guide* or from the *QC Start Engineer* as shown below
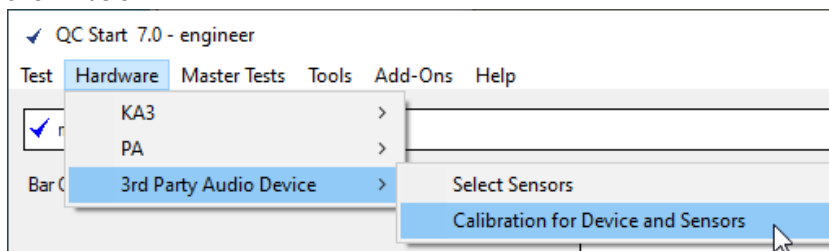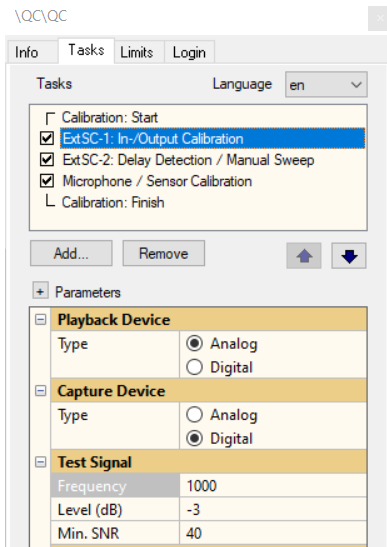

- Open hardware configuration via the property page
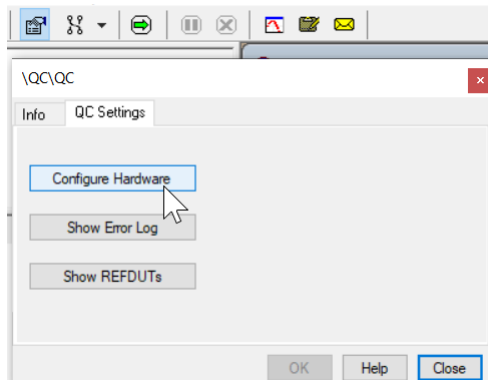
- and select *ASIO Echo AIO* for both input and output and set the input number according to your card configuration (4 for AIO-S)


- Click the green arrow icon in the task bar ⇨ to log in
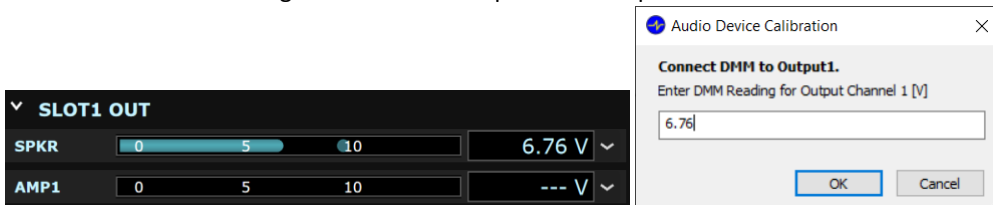- Select step *ExtSC-1* and set the parameter as follows

Note: *The displayed absolute voltage and current values in the AIO Control Panel are based on the device's factory calibration. You can use the values displayed in the panel instead of an external multi-meter during calibration. Note that the factory output calibration of the AIO-S card is performed with an 8 Ohm load.*
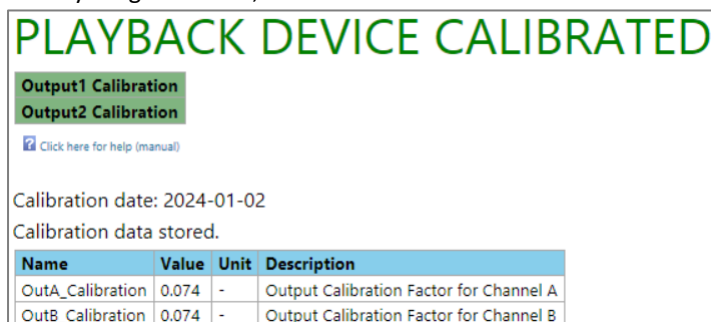
- Connect a multimeter to the SPKR + & - terminals for open loop output voltage calibration or an 8 Ohm load if you want to follow the AIO factory calibration applied in the *AIO Control Panel*
- Press Calibrate Playback and follow the instructions (replace "multimeter" with *AIO Control Panel* meter, if used)
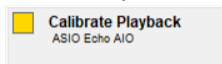
- Enter the measured voltage in the text box input field and press OK

- If everything went well, the calibration is stored

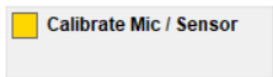| Name	Value	Unit	Description
OutA_Calibration	0.074	-	Output Calibration Factor for Channel A
OutB_Calibration	0.074	-	Output Calibration Factor for Channel B

Microphone Calibration

This section will address the calibration for the microphones and inputs as well as the integrated voltage and current sensors of the AIO-S module. It is assumed that the plain MIC inputs have not been calibrated in the device calibration (previous step) and that a sound calibrator is available. If you want to use TEDS data or the microphone datasheet instead, it is required to calibrate the voltage input of *MIC1/2*, first.

- Open the *Calibration for Device and Sensors* as described in the previous section
- Select Microphone / Sensor Calibration and fill in the marked information according to your setup
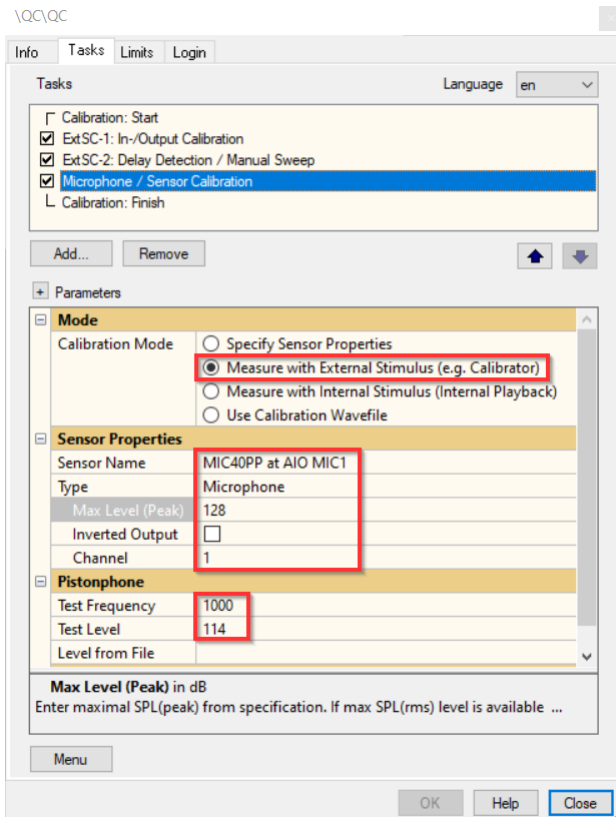
- Connect the calibrator to the microphone and activate
- Check the signal level in the AIO Control Panel, check the signal and adjust input gain, optionally (attention: do not modify after sensor calibration)
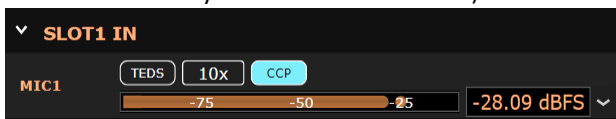

- Click

to start the calibration measurement
- If successful, store the sensor using the pop-up window

- Repeat this for the second input, if used (set *Channel* to 2 and select a different *Sensor Name*)

Voltage/Current Sensor Calibration

- Now connect a load resistor (8 Ohm recommended) or a DUT to the SPKR terminal and make sure that all 4 wires are connected according to the hardware connection scheme
- Set the Microphone / Sensor Calibration options as follows and click *Calibrate*
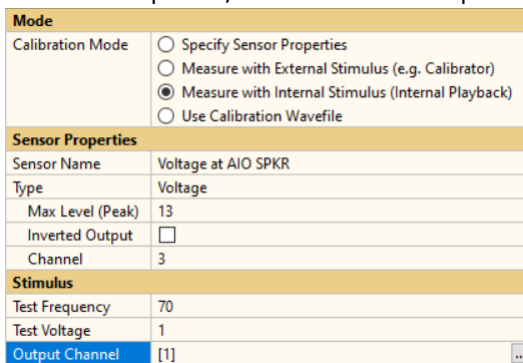
- Enter the value displayed in the *AIO Control Panel (VMON)* or use an external multimeter for more accurate readings
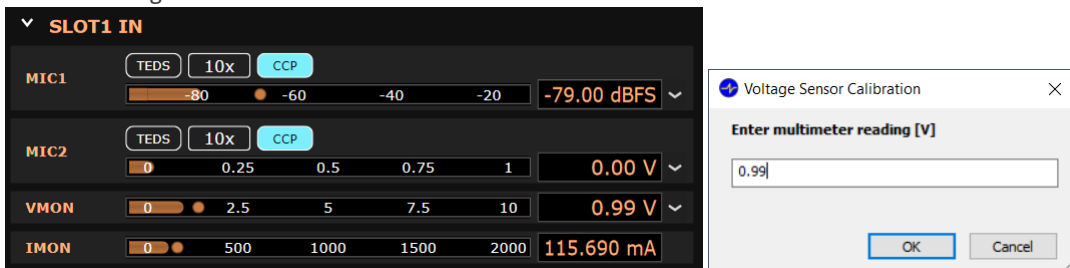
- Store the sensor file
- Repeat the same for the current sensor (*IMON*)
- Exit the calibration operation

Note: *The default voltage and current sensor calibration for the AIO-S module is provided with this tech note.*

Sensor Assignment

The created sensors that result from the calibration need to be assigned to the particular ASIO capture channels of the AIO device in order to be applied.

- Open the sensor configuration dialog for 3rd party audio devices in *dB-Lab* as shown below or via the *Hardware* menu
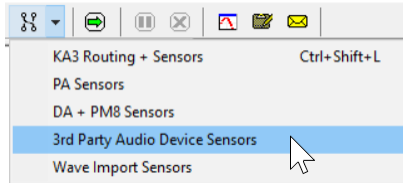
- Select *Device: ASIO Echo AIO* and assign the stored sensors via *Select…* button to the 4 input channels as shown below
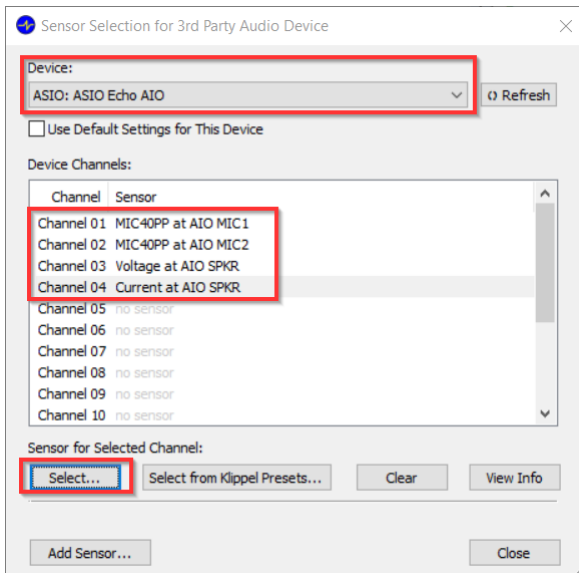
Ater finishing this step, everything is set for testing.
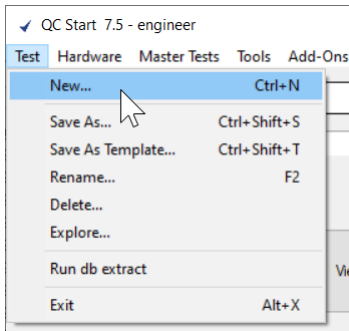
4   Test Operation

4.1   Create a Test

You may start with any test template provided along with the QC Software or you may start from the example test sequence provided with this Tech Note (based on the standard Woofer template).
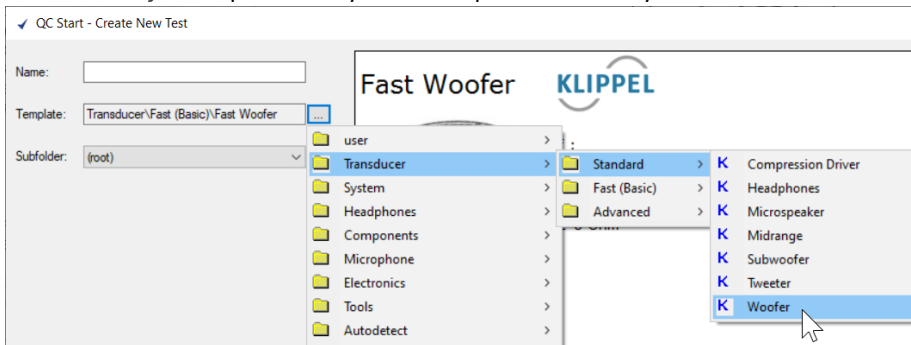
Note: *If you want to use the provided template, just copy the template to this folder: %ProgramData%\Klippel\QC\QC\TemplatesQC4.*

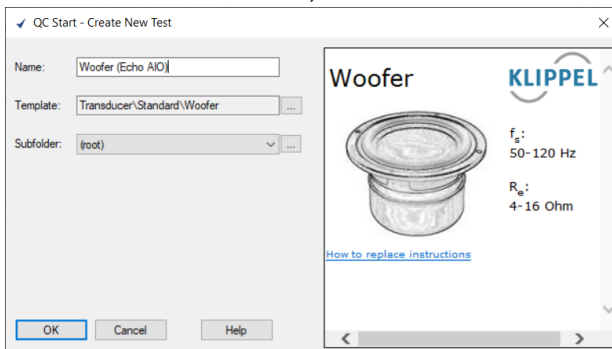Starting from a standard template, follow these steps

- Open QC Start – Engineer
- Select *Test – New…*

- Find the *Woofer* template or any other template that suits your DUT
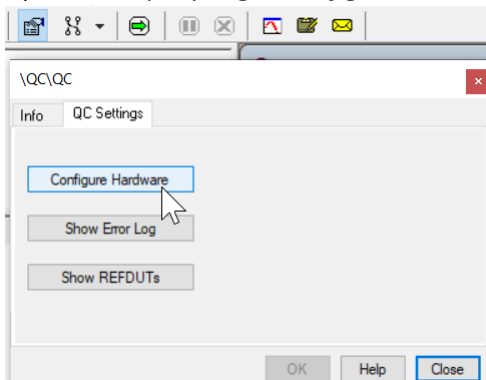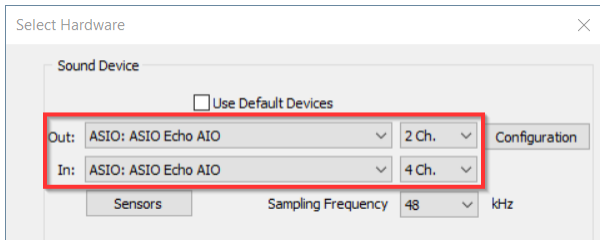

- Choose a suitable test name, click *OK*


4.2 Test Operation Setup

- Select your test and click the *View* button to access the test
- Open the *Property Page – Configure Hardware*

- Set the playback and capture device in the same way as the calibration operation

- Use the yellow arrow button and login as *QC Engineer* or exit *dB-Lab* and use the *Measure* button to achieve the same
- Open the property page and set the global routing as follows (output 1 globally; inputs controlled by task)
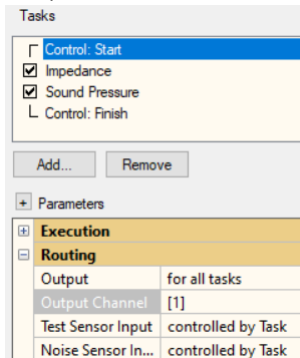
- Now set the input channels in the Impedance and Sound Pressure task (remember that the ASIO channel number corresponds to the order of hardware input channels as shown in the *AIO Control Panel*)
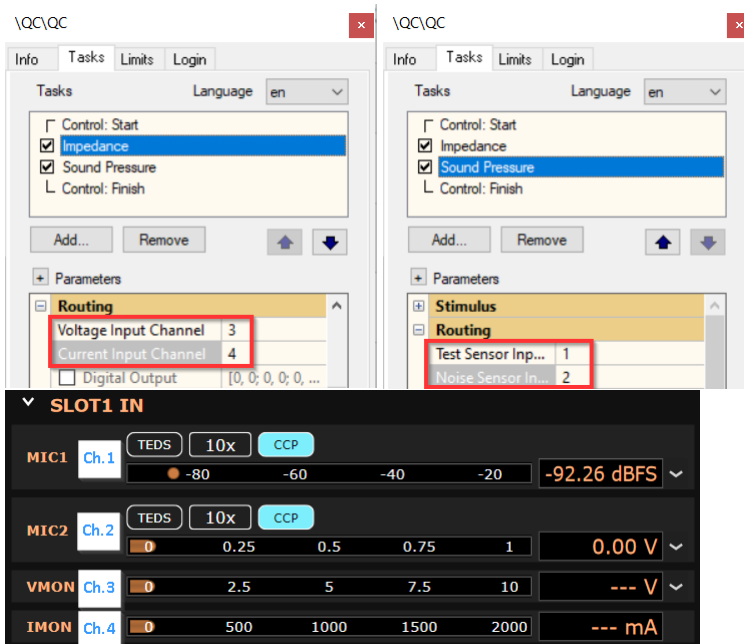
- Now adjust all other test settings according to your preferences (make sure to activate/deactivate/adjust Ambient Noise detection in the Sound Pressure task depending on your microphone and test setup)

- Perform a test run using the *Start* button in the *Control Panel* and check that the stimulus is played back all response signals are valid (see QC Manual for more information)
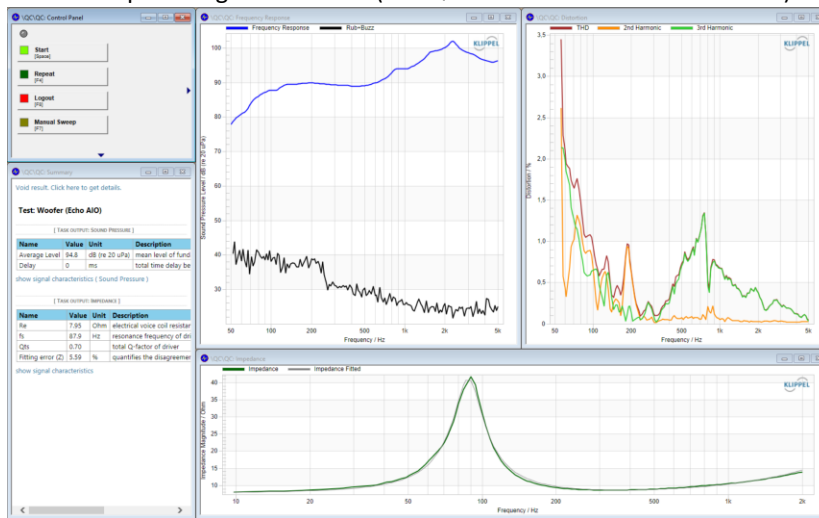
Note: *Before creating test limits, please read and consider the information about latency given in the following section.*

4.3 Handling Latency

In contrast to operation with a KLIPPEL analyzer device, the latency caused by the DAC, ASIO buffers and USB streaming is not compensated automatically when using 3rd party audio devices. This can lead to artifacts as shown below in the frequency response where the analysis window loses a part of the response due to the additional delay.
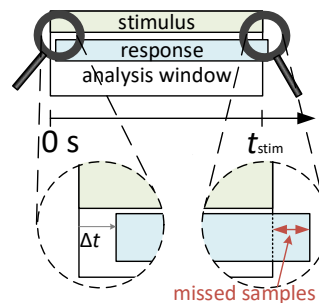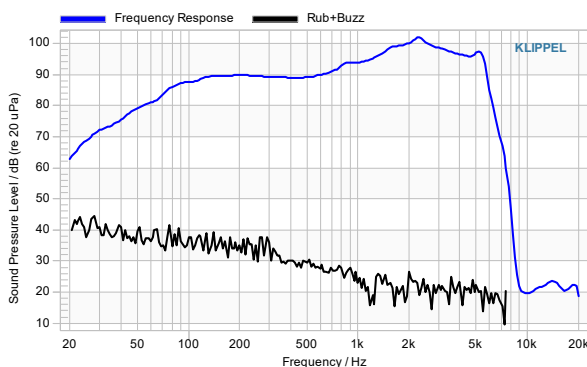
To manually compensate for the latency, you may check the detected delay in *Summary* window

[TASK OUTPUT: SOUND PRESSURE]

Name	Value	Unit	Description
Average Level	93.2	dB (re 20 uPa)	mean level of fundamental frequency response in specified bands
Delay	29.3	ms	total time delay between stimulus and microphone signal
Distance	1004.7	cm	distance corresponding to delay

show signal characteristics (Sound Pressure)

and use this value given in ms to shift the analysis window using the *Recording Delay* property of each measurement task (category *Processing*).
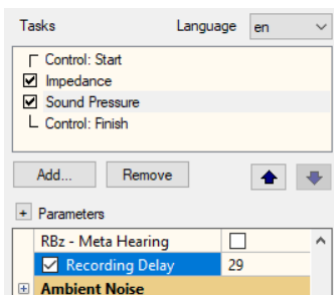
Note: *Apply this delay to all measurement tasks and make sure that you do not overcompensate.*

A more comfortable and fail-safe way to do this is using the *External Synchronization* (*SYN*) add-on which uses a synchronization signal to detect and compensate the delay accurately. Please follow the SYN Manual for setting up the SYN.

4.4   Automatic Device Configuration (Command Line Interface)

In some cases, it might be desirable to verify or change the settings such as input gain of the ECHO AIO depending on the test application or test sequence automatically (e.g., via a script). There are several ways to achieve that. The most straight-forward way is to setup the *AIO Control Panel* manually and store the configuration(s) to multiple a session files.
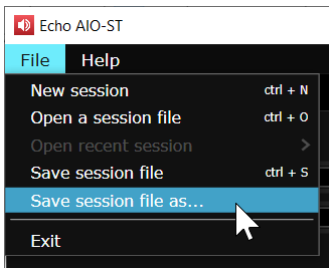
Those files can be loaded via the AIO Command Line Interface (CLI):

```
C:\Program Files\Echo AIO\CLI + API>echoaio config --load-file="c:\temp\settings.aiosession"

Echo AIO Command-Line Interface 4.3

Set SLOT1:MIC1 gain to 10x
Enabled constant current power for SLOT1:MIC1
Set SLOT1:MIC1 gain to 10x
Enabled constant current power for SLOT1:MIC1
```

Alternatively, you may change settings directly via the CLI. The tool provides a command reference, directly in the command line.

```
C:\Program Files\Echo AIO\CLI + API>echoaio

Echo AIO Command-Line Interface 4.3

echoaio <command> [option....]

Command     Description
-------     -----------
 help       Show more information about a command
 mic        Configure a single MIC input
 headphone  Configure an AIO-H module
 config     Load or save the AIO configuration
 tdm        Configure an AIO-T module
 combo      Configure an AIO-C module
 device     Device-level configuration

'echoaio help <command>' will show the options for that command. For example:

    echoaio help mic
```

Commands can be wrapped in a Batch file (.bat) so it can be called by the QC Software. For example, use the *klbefore.bat* file to configure AIO in accordance with the test sequence before starting a new test session. An example is provided together with this document. Please find mor information in the QC Manual. Use the IO Task if you want to change settings during the test sequence.

5   Limitations

Compared to KLIPPEL QC Standard with KLIPPEL Analyzer 3, the following limitations apply when using Echo AIO (selection):

- No traceable device calibration
- Minimum load: 4 Ohm (AIO-S)
- Max. power: 10 W (AIO-S, 8 Ohm)
- Max. voltage: 9.475 V (AIO-S, 8 Ohm, RMS)

- No external amplifier supported (AIO-S)
- No amplifier gain check
- Min. output impedance 0.290 Ohm (AIO-S SPKR)
- Only AC coupling
- No laser supported
- No automatic compensation of latency
- No native TEDS software integration in KLIPPEL QC Software

For further details refer to the specifications of the KLIPPEL Analyzer System and Echo AIO module specifications

6   References

QC Software Specification	KLIPPEL QC Stand-alone Software
	QC Feature Overview
QC Tasks and Add-Ons	Sound Pressure Task (SPL)
	Impedance Task (IMP)
	External Synchronization (SYN)
QC Manual	Online Manual
QC Accessories	Accessories Overview
KLIPPEL Analyzer	KLIPPEL Analyzer 3
KLIPPEL Price List	KLIPPEL QC System Price Lists
AIO Datasheet	https://echotm.com/echo-aio-test-system/
AIO-S Datasheet	https://echotm.com/echo-aio-test-system/aio-s-module/
AIO Quick Start Guide	https://echotm.com/library/category/aio-product-documentation/startup-guides/
AIO Software	https://echotm.com/library/
Echo Distribution	https://echotm.com/distributors/

Find explanations for symbols at:

http://www.klippel.de/know-how/literature.html

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