



PORTLAND TOOL & DIE

BTC-4149

Bluetooth Audio Measurement Interface

User's Guide v1.1



Summary

The Portland Tool & Die BTC-4149 is a complete interface for measuring and characterizing Bluetooth audio devices including handsets, headsets, speakers, car kits and other devices with Bluetooth audio input or output.

Accurately measuring Bluetooth devices is challenging. The Bluetooth protocol is a dynamic and adaptive system that provides devices with many options and parameters that are normally negotiated and set in an invisible manner. Using typical PC Bluetooth interface devices as an audio bridge in test applications is not ideal as the compression codec, sample rate and other parameters cannot be directly controlled, and the engineer is left guessing as to which values are actually used by the Bluetooth link.

The BTC-4149 overcomes this by offering full control over all Bluetooth protocol settings and explicit control over the CODEC choice and display of the sample rate. This enables devices to be specifically tested under the conditions that they need to operate. For example, when testing a device that supports apt-X compression, you can be certain that apt-X is in fact being used. It also enables comparison of characteristics such as frequency response using different compression algorithms or sample rates.

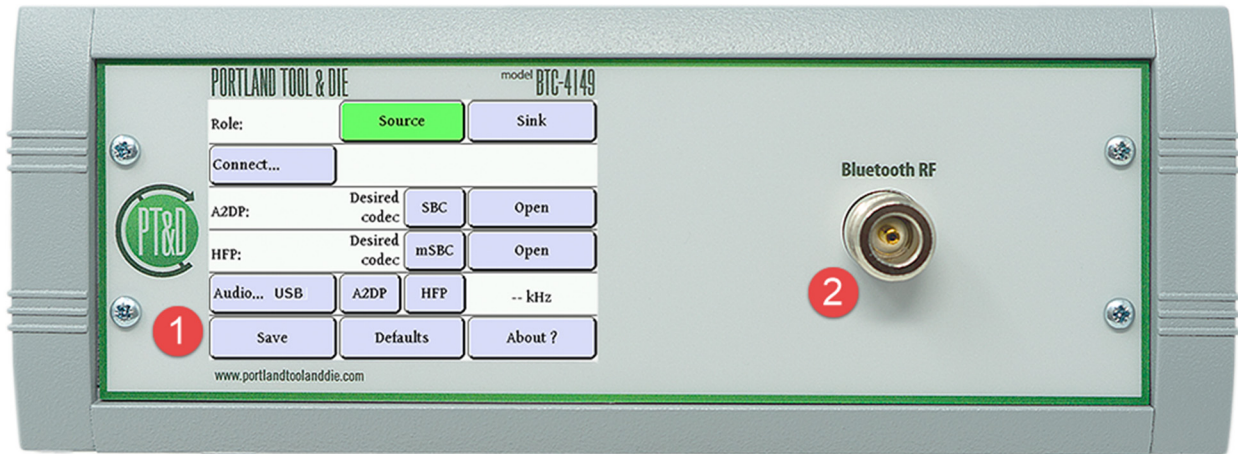
The instrument is controlled via touchscreen or Microsoft Windows command line interface. It provides a Bluetooth 3.0 compliant RF interface and supports A2DP, HFP and HSP. It also provides an interface for device inquiry/discovery, pairing, and control of SCO and A2DP audio streaming states.

To speed up manufacturing and quality control test scenarios, the instrument provides for pairing directly by device address rather than requiring a lengthy inquiry step first. The USB host interface is used for both audio data and instrument control. Audio data is simultaneously available via both USB and SPDIF. Audio is always transported in the digital domain maximizing measurement fidelity.

Table of Contents

Summary	2
Table of Contents	3
BTC-4149 Hardware	4
Configuring the BTC-4149 instrument via the touchscreen display	5
Main Menu	5
Role	5
Connect	5
<i>Connect To:</i>	6
<i>Inquire</i>	6
<i>Paired</i>	6
<i>Close all</i>	7
A2DP:	7
HFP:	7
A Note On Opening & Closing A2DP and HFP Connections	8
Audio:	8
Save, Defaults and About	9
Configuring the BTC-4149 via the USB interface	9
Installing the Microsoft Windows support software	9
Using the btc4149.exe command line interface	9
Connection to 3rd party test equipment	12
Via USB	12
Via SPDIF	12
A note on sample rate and bit depth	12
Use with Listen, Inc. SoundCheck	12
Directly via USB	12
<i>First, create a hardware channel</i>	12
<i>Second, setup an input signal channel</i>	13
Via an existing audio interface using SPDIF	14
<i>Advantages of using an existing audio interface with a SPDIF input</i>	14
BTC-4149 Specifications	16
Bluetooth RF	16
Bluetooth Protocol	16
HFP/HSP Audio Gateway or Hands Free	16
A2DP Source or Sink	16
Host Interface	16
Physical	16
Support and Contact Information	16

BTC-4149 Hardware



1. Touchscreen display
2. Bluetooth RF interface, N-type connector



1. Power switch
2. Instrument DC power input
3. USB interface
4. SPDIF/AES3 input
5. SPDIF/AES3 output
6. Chassis ground connector

Configuring the BTC-4149 instrument via the touchscreen display

The instrument's touchscreen display allows all instrument parameters to be controlled and displays the value for all parameters. To configure:

Main Menu

Role:	Source	Sink
Connect...		
A2DP:	Desired codec	SBC
		Open
HFP:	Desired codec	mSBC
		Open
Audio... USB	A2DP	HFP
		-- kHz
Save	Defaults	About ?

From the main menu you can set the operational role of the instrument, the Bluetooth address the instrument will connect to, configure the audio profiles, and start and stop the audio streaming.

When operating the instrument via the touchscreen the best practice is to start at the top of the menu and proceed down. That is, first set the role of the instrument then select the device to connect to, then configure your audio profiles and connect them. Finally, you can start and stop streaming via the Audio menu.

Role

Role:	Source	Sink
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The top row of the touchscreen UI allows you to configure whether the operational role of the instrument is as a source or a sink.

When configured as a **Source** the instrument is an A2DP (Advanced Audio Distribution Profile) Source and an HFP (Hands Free Profile) / HSP (Headset Profile) Gateway. This is the appropriate mode for testing speakers, headphones, headsets and car kits.

When configured as a **Sink** the instrument is an A2DP Sink and an HFP/HSP hands-free device. This is the appropriate mode for testing telephones, tables, and computers.

Connect...

Connect...

The Connect... button provides access to functions for selecting the device to connect to. Selecting it takes you to the Connect To: sub-menu. From the Connect To: sub-menu you can

directly enter the address of a Bluetooth device, perform a Bluetooth inquiry to identify available devices, and view and/or clear the devices the instrument is already paired with.

Connect To:

Connect To:

E 0 : D 1 : E 6 : 0 A : 1 6 : 3 C

0 1 2 3 4 5 6 7

8 9 A B C D E F

Inquire Paired

In the Connect To: sub-menu you can directly enter the address of a device you want to pair with. You can also access the Inquire and Paired sub-menus from this location.

Inquire

Inquire 15 s 30 s

MINIJAMBOX by Jawbone E0:D1:E6:0A:16:3C

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In the Inquire sub-menu you can run a Bluetooth Inquiry. There are two options, to inquire for 15 seconds or 30 seconds. Please note that the total time to perform the inquiry will take slightly longer than the requested time because after the remote devices return their BT address, the instrument attempts to decode their friendly name. If many devices respond, the friendly name query may take a significant amount of time.

You can select the device to connect to by selecting the button that contains its friendly name.

Paired

Paired devices Clear

MINIJAMBOX by Jawbone E0:D1:E6:0A:16:3C

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The Paired devices sub-menu allows you to view devices are already paired with the instrument. With this sub-menu you can directly connect with a device you have previously connected to without manually entering its Bluetooth address or performing an inquiry. To use one of the previously paired devices, select the button that contains the friendly name of the device you want to connect to.

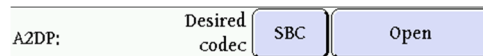
Additionally, you can clear the paired device list by selecting the Clear button. It may be desirable to un-pair with a device you have previously connected to, if for example, you want to change the Bluetooth connection profiles under which you connect. That can be accomplished in this sub-menu.

Close all



When an A2DP or HFP link is active the Connect... button will instead display Close All. When selected this action will disconnect all active audio channels. Please note that if the device to which the instrument was connected shuts down or otherwise becomes inaccessible without first closing all open connections, it can take the instrument up to 60 seconds to respond.

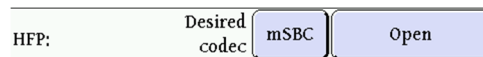
A2DP:



The A2DP control allows you to select the CODEC that will be prioritized when connecting to a device via the A2DP profile. You can select SBC, the default and mandatory CODEC that all devices should support or aptX, an enhanced optional CODEC. Please note that when aptX is selected if the remote device does not support it, the instrument will fall back to SBC.

Selecting the Open button will open the A2DP L2CAP (Logical Link Control and Adaptation Protocol) connection but will not start audio streaming. When a connection is open the button label will change to Close. Selecting Close will close the A2DP connection.

HFP:



The HFP control allows you to control whether the CVSD (narrow band) or mSBC (wide band) CODEC is prioritized when connecting via the HFP or HSP profile. As with the A2DP control, selecting the Open button opens a SCO (Synchronous Connection) channel to the Bluetooth device but it does not open a call or stream audio. When a connection is open the button will instead display Close. Selecting close will disconnect the SCO.

CVSD is a mandatory CODEC and even when a device supports mSBC for wide band voice service, the initial connection will be via CVSD. In this case the instrument may not indicate that mSBC is being used until a call is opened and audio data is streaming.

A Note On Opening & Closing A2DP and HFP Connections

When opening and closing connections several operation will happen in the background if the instrument and the device under test are not paired and have not previously connected.

First, the instrument and the device will assess each other's capabilities via SDP (Service Discovery Protocol).

Second, the instrument will try and pair using SSP (Simple Secure Pairing) *Just Works*.

The above steps will take some time depending on the device under test and therefore the very first time a connection is opened with a device it will take longer than subsequent connections.

When disconnecting a device after testing, it is recommended to deliberately close all open links rather than just powering the device off. If an instrument simply disappears without first closing the Bluetooth links, then the instrument may appear unresponsive for up to 60 seconds.

Finally, many devices remember the properties of the devices they pair with and do not update unless they are paired with again. For this reason, if you change the instrument's A2DP or HFP/HSP configuration, for example if you change from SBC to aptX, you may need to re-pair with the device for the change to be effective.

Audio:



The audio control line provides three functions:

Audio Source:

⏪Back	Rear Panel Audio	
Source:	USB	SPDIF
Sample Rate:	44.1 kHz	48 kHz
Save	Defaults	

First, access to the audio source sub-menu. By selecting the Audio: button you will access this sub-menu which allows you to select whether audio transmitted to the Bluetooth device is sourced from the USB connection or the SPDIF input.

Please note, audio received from the Bluetooth device is simultaneously provided to both the USB connection and the SPDIF output.

Second, you can selectively enable or disable A2DP audio streaming or HFP/HSP call activity by selecting the appropriate button.

Finally, when connected to a device and streaming audio the instrument will display the sample rate of the Bluetooth audio stream in kHz.

Save, Defaults and About

Save	Defaults	About ?
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The Save button will save the current instrument settings to non-volatile memory. The Defaults button restores the factory default settings. The About button displays the instruments own Bluetooth address, firmware version and other information.

Configuring the BTC-4149 via the USB interface

Installing the Microsoft Windows support software

Please run BTC-4149-Setup-vX-XX.exe, supplied with your instrument to automatically install the device driver required to control your instrument via USB.

Using the btc4149.exe command line interface

A Windows command shell program is also provided as an alternate to the touchscreen interface. This program allows all variable parameters of the instrument to be set.

BTC-4149-Setup automatically installs, creates a program group and shortcut icon. Once installed the program can be called from the command line as follows.

Portland Tool & Die, Inc. BTC-4149 Control Utility
Version 4.2
Usage: btc4149 [<option> <value>] [<option> <value>] ...

Options:

/?	--help	Prints this information
/#	--instrument	Specific instrument # or serial number
/s	--save	Save settings into [filename]
/o	--open	Load settings from [filename]
/i	--identify	Identifies connected instruments
/l	--list	List current instrument settings
/r	--restore	Restore factory default settings
/sd	--save-defaults	Save current settings as power on defaults
/sc	--screen-capture	[filename] to save screen bitmap into
/as	--audio-source	Audio source [USB SPDIF]
/ba	--bluetooth-address	Bluetooth address of selected instrument
/c	--call	Call [<friendly name> or <bt address>];[A2DP HFP]. The friendly name must be surrounded with quotes if the name contains spaces. The bt address must be formatted as xx:xx:xx:xx:xx:xx.
/lc	--list-connections	List open Bluetooth connections
/d	--disconnect	Closes all connections and makes instrument discoverable
/ro	--role	[SOURCE SINK] Set the role of the instrument. SOURCE=(A2DP source, HFP-AG), SINK=(A2DP sink, HFP-HF)
/pc	--profile-codec	[A2DP;SBC APTX APTXHD] or [HFP;NARROW_BAND WIDE_BAND]
/q	--query	Search for Bluetooth devices for [1-48] seconds
/bn	--bluetooth-name	Bluetooth friendly name
/lp	--list-paired	Lists the currently paired devices
/cp	--clear-paired	Clears the paired devices list
/aa	--a2dp-audio	[ON OFF] Set the a2dp audio state
/ha	--hfp-audio	[ON OFF] Set the hfp audio state
/br	--bluetooth-reset	Reset Bluetooth radio
/rs	--rear-panel-fs	Rear panel sample rate [44100, 48000] Hz
/to	--bluetooth-timeout	Bluetooth command timeout [0-120] Seconds
/av	--avrcp-volume	Avrcp absolute volume value [0-15]
/hv	--hfp-volume	Hfp volume value [0-15]
/mm	--man-in-the-middle	ManInTheMiddle security required [ON OFF]
/pp	--pair-pin	Pin to be used for pairing [nnnn]. Must be 4 decimal digits.
/lk	--link-key	Get the link key for <bt address>.
/rl	--rssi-level	Get the current RSSI level for the current connection. RSSI values range from 20(max) to -127(disconnected).

Note - The command line utility does require the Microsoft .NET runtime installed. It can be downloaded from here: <http://www.microsoft.com/net/>

Connection to 3rd party test equipment

Via USB

Connect the USB interface on the instrument to an Apple Mac or Microsoft Windows PC. The audio portion of the instrument will appear as a line level input device and requires no driver installation.

Note - The instrument appears as two distinct USB devices. An audio device and a virtual com port. The audio device requires no drivers and will function immediately. The virtual com port requires a device driver to be installed but is only required if you wish to control the instrument remotely over USB. For command port installation instructions see the following page.

Via SPDIF

The SPDIF output is simultaneously active with the USB audio output. To use, connect to equipment with a SPDIF or AES3 input.

The SPDIF input must be selected as the audio source via the touchscreen or command line interface.

A note on sample rate and bit depth

The BTC-4149 outputs 24-bit, 48 kHz PCM digital audio regardless of the sample rate of the Bluetooth link. For best results insure that your test system accepts audio at this sample rate and bit depth.

Use with Listen, Inc. SoundCheck

The BTC-4149 integrates directly with Listen, Inc.'s SoundCheck audio measurement system via USB or the SPDIF input of a professional audio interface. Instructions for both are provided below:

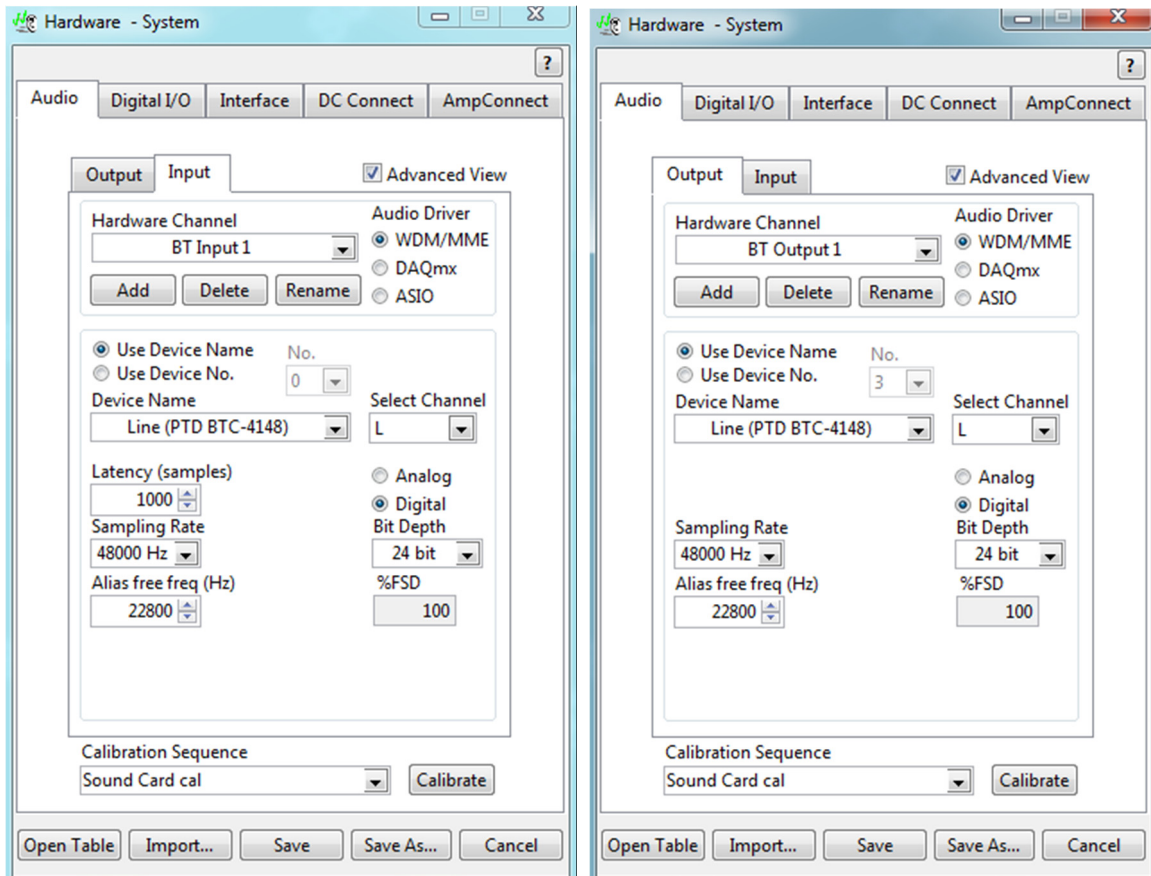
Directly via USB

First, create a hardware channel

Since the BTC-4149 appears as a normal Windows audio device when connected via USB to use it with SoundCheck you configure it as you would any other WDM audio device. Follow these steps:

1. With your BTC-4149 connected and powered on start SoundCheck.
2. From the main menu open Setup and then Hardware...

3. Add input and output hardware channels.
4. The BTC-4149 uses the WDM driver, operates at 48 kHz sample rate and supports 24-bit audio. Typical input and output channel configurations are:

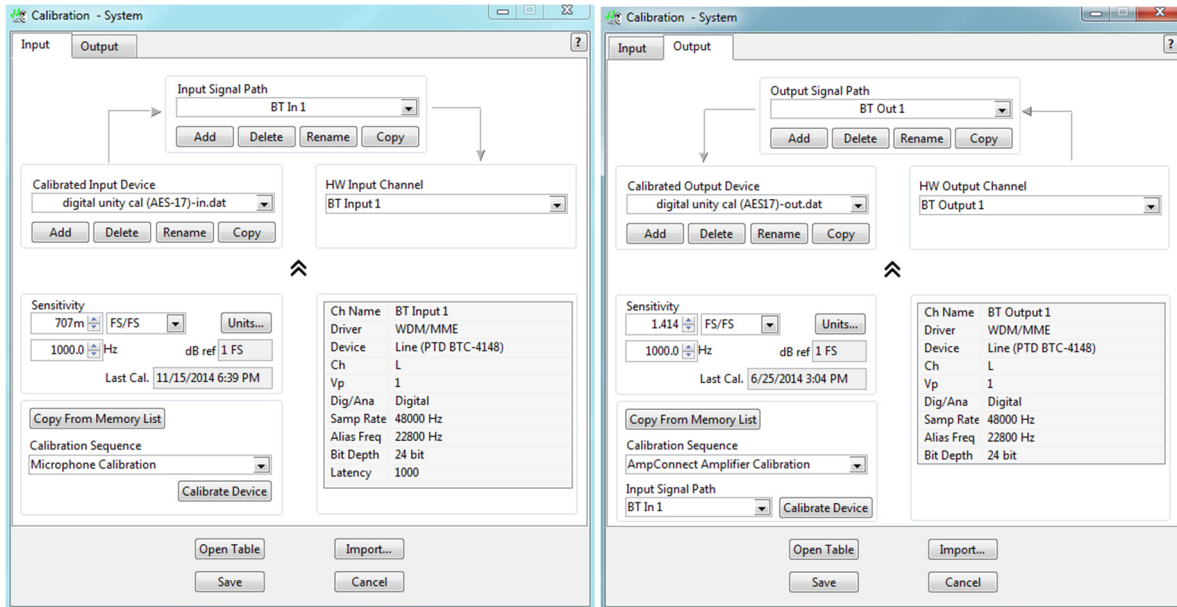


5. Save your changes.

Second, setup an input signal channel

Once the hardware channel is setup we need to add an input signal channel to the calibration table. To do so, follow these steps:

1. From the main menu open Setup and then Calibration...
2. Add input and output signal paths.



Note: If you wish your input and output units to be scaled according to AES17 then add new input and output calibrated devices with sensitivities of 0.707 (-3.01 dB) FS/FS for the input and 1.414 (+3.01 dB) FS/FS for the output.

3. Save your changes.

Via an existing audio interface using SPDIF

The SPDIF input and output of the BTC-4149 can also be connected to the SPDIF I/O of an audio interface such as an RME Multiface or Fireface, Digital Audio Labs Card Deluxe, Lynx Studio Lynx Two or Aurora that is already supported by and interfaced to SoundCheck.

In this case the actual input would appear to originate from the audio interface and you would follow the steps specific for that device to add the hardware channel.

Advantages of using an existing audio interface with a SPDIF input

There are two configuration scenarios where it is useful to use the SPDIF input of a professional audio interface rather than the USB output of the BTC-4149. These include:

1. ASIO Driver - By using the digital input of an RME Fireface UC or UCX, the audio signal is delivered to SoundCheck via an ASIO driver with the practical benefit of deterministic and consistent delay. In addition, ASIO bypasses the Windows mixer, which allows full 24-bit audio under Windows XP and eliminates the concern that gain may be applied by the Windows audio sub-system.

2. Reference microphone measurement - If you wish to measure one microphone by comparing it to another, the simplest solution is to connect the BTC-4149 to the same input device as the reference microphone. Further, if you then slave the sample clock of the audio interface to the SPDIF output of the BTC-4149 then both the MEMS digital microphone and the reference microphone will be sampled synchronously, this is useful for the Log Time Selective Response measurement.

Using a reference microphone or mic substitution measurement is the simplest way to measure a digital microphone's sensitivity and frequency response in a non-anechoic environment and without special test fixtures or couplers.

BTC-4149 Specifications

Bluetooth RF

Transmit Power: +4 dBm
Receive Sensitivity: -88 dBm
Connector: Female N-type

HFP/HSP Audio Gateway or Hands Free

- Voice: CVSD
- Wide-Band Voice: mSBC

Host Interface

Capacitive touch TFT panel
USB - Windows command line

Bluetooth Protocol

Bluetooth 3.0 Compliant

A2DP Source or Sink

- SBC
- aptX
- aptX-HD

Physical

86 x 271 x 211 mm H x W x D
1.6 kg
12VDC, 24W power input
(Universal 100-240 VAC / 50 – 60 Hz
power supply included)

Support and Contact Information

Sold and distributed world-wide by:

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