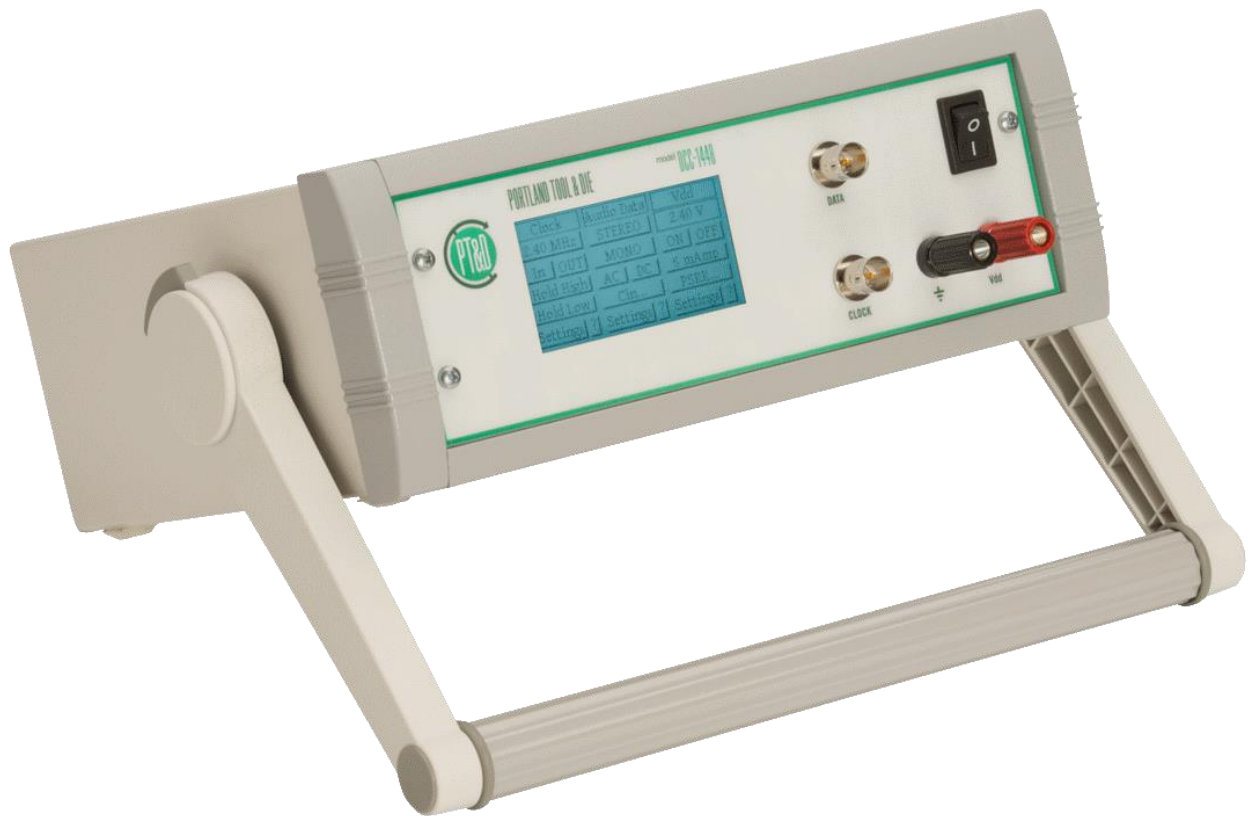




# PORTLAND TOOL & DIE

DCC-1448 & PQC-3048

MEMS Digital Microphone Measurement Interfaces



User's Guide, v5

## Summary

The DCC-1448 and PQC-3048 instruments provide a complete interface for measuring and characterizing digital microphones with a Pulse Density Modulated outputs. Both instruments accept a 1-bit signal in the range of 500 kHz to 4 MHz and output a 24-bit, 44.1 or 48 kHz PCM signal. The DCC-1448 provides an AES3/SPDIF output and a USB output while the PQC-3048 provides only a USB output.

The laboratory oriented DCC-1448 provides touchscreen interface for instrument control and can also be remotely configured via the USB interface. The clock interface is programmable and can be set as master or slave and can even be stopped in order to test the sleep state of a microphone. The data interface provides variable input capacitance and a selectable AC coupling filter can be applied to the demodulated audio data.

The quality control application oriented PQC-3048 provides only a USB interface for both instrument control and audio data. In addition it does not provide the PSR impairment function or selective input capacitance functions of the DCC-1448. An AC coupling filter is not provided, audio data is always DC coupled, and the instrument can only operate as the clock master.

Both instruments share the same digital filtering algorithm and will provide identical results. The conversion from a 1-bit signal to a 24-bit PCM signal occurs entirely in the digital domain. Ideal for use directly inside an anechoic chambers or isolation enclosures, the instruments are completely acoustically silent. The simultaneous USB digital audio outputs are compatible with both Apple Mac and PC compatible computers.

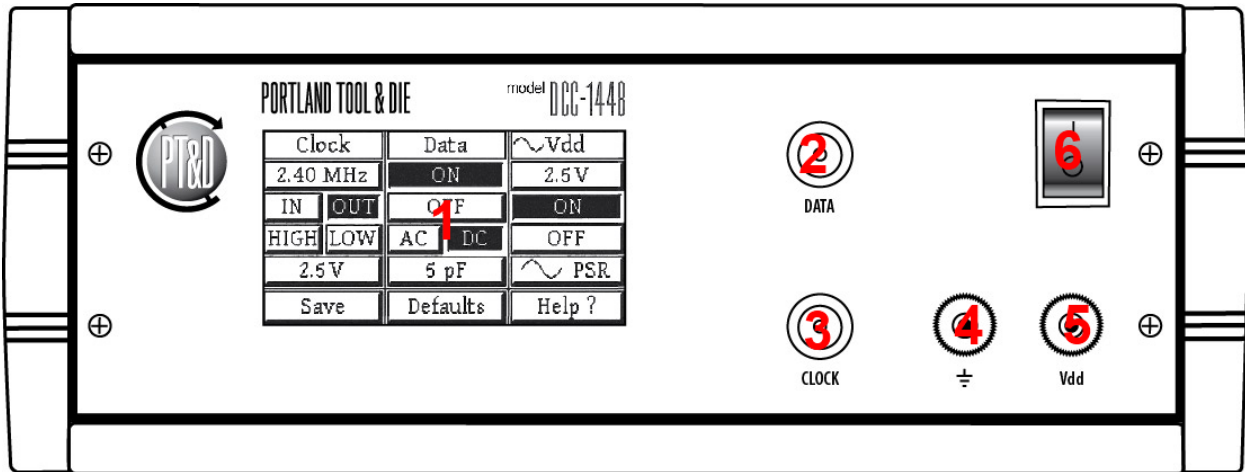
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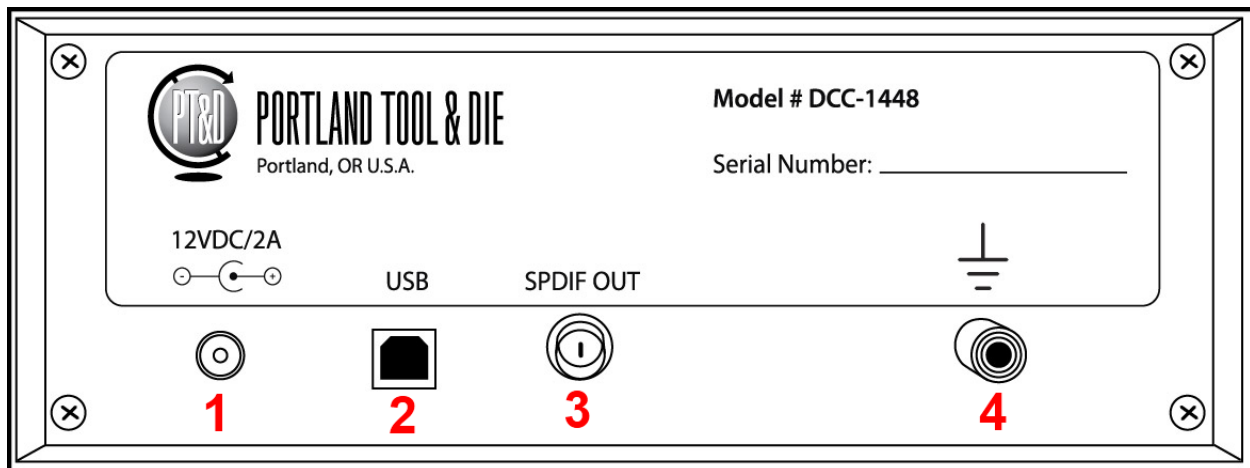
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# Hardware

## DCC-1448



1. Touchscreen display
2. Audio data input connector
3. Clock input or output connector
4. Chassis ground
5. Vdd microphone DC power supply connector
6. Instrument On/Off switch

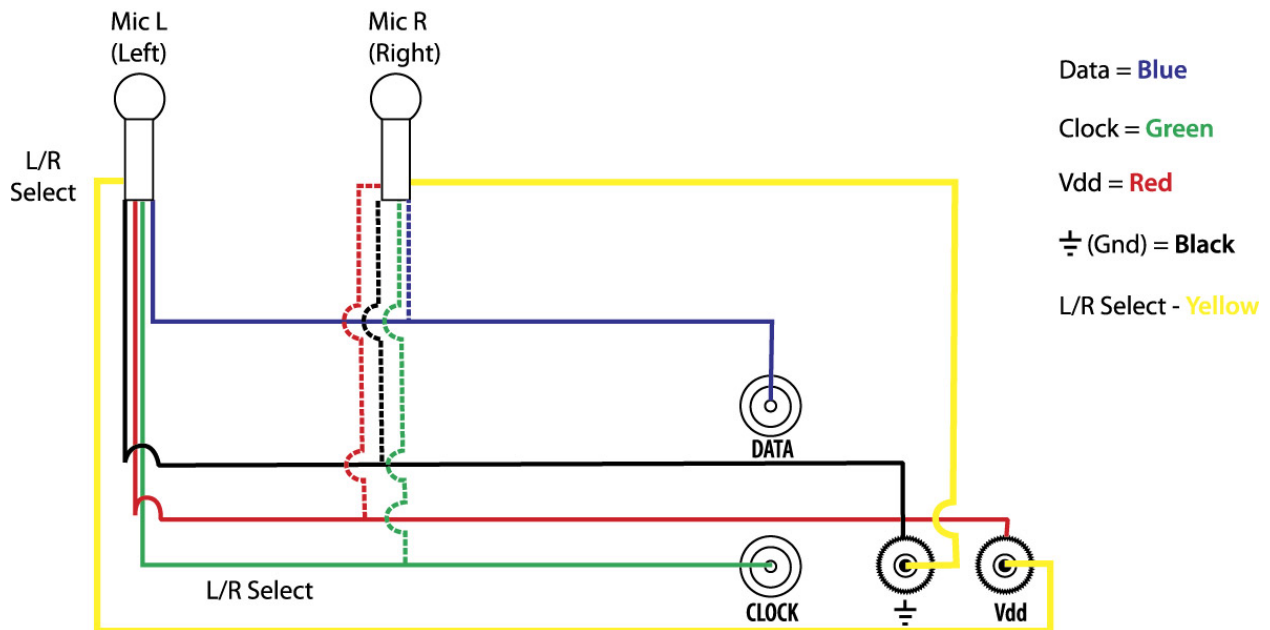


1. Instrument power input
2. USB audio and control interface port
3. SPDIF/AES3 digital audio output port
4. Chassis ground

PQC-3048



## Microphone Connection Diagram



### Notes on connecting a typical MEMS microphone with a PDM output

1. When connecting a single microphone it is recommended that the left/right select pin be connected to ground or Vdd in order to configure the microphone to transmit data on the rising edge (Left) of the clock.
2. When two microphones are connected, the microphone which transmits data on the rising edge of the clock is automatically mapped to the left output channel of the instrument. The microphone which transmits data on the falling edge of the clock is mapped to the right output channel.

## Configuring the DCC-1488 instrument via the touchscreen display

Clock		Data	Vdd
--- MHz		ON	2.5V
IN	OUT	OFF	ON
HIGH	LOW	AC	DC
---		5 pF	PSR
Save	Defaults	Help ?	

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

### Clock Settings

Clock
---1 MHz
IN
HIGH
---
Save

1. Press to set clock rate or when clock is set to "IN" to view the clock rate at full measured resolution.
2. Press to set mode: **IN** selects an external clock generator. **OUT** selects the instruments internal clock generator. **HIGH** stalls the clock at the programmed high voltage level. **LOW** stalls the clock by pinning it to ground.
3. Press to set clock logic voltage level. **Note** - Clock voltage is independent of Vdd supply level.

### Data Settings

Data
ON
OFF
AC
5 pF



1. Select data on or off. When data is off the data input connector is disconnected via relay and the connector becomes High-Z.
2. Select between AC or DC coupling of demodulated audio data.
3. Press to toggle between data input connector capacitance values of 5, 50, 100, 200, or 400 pF.

### Vdd Settings

Vdd
2.5V
ON
OFF
PSR

1. Press to set Vdd DC supply level. **Note** - Vdd supply level is independent of clock logic level.
2. Turn the Vdd DC supply on or off
3. Press to access settings to enable or disable the summing of an AC waveform with the DC supply.

## PSR Settings

PSR Gen	Waveform	1. Turn the AC waveform generator on or off.
ON		2. Select between a sine or square waveform
OFF		3. Set the level of the AC waveform
	1.0Vpp	4. Set the frequency of the AC waveform
	60Hz	

## Save, Defaults and Help ? options

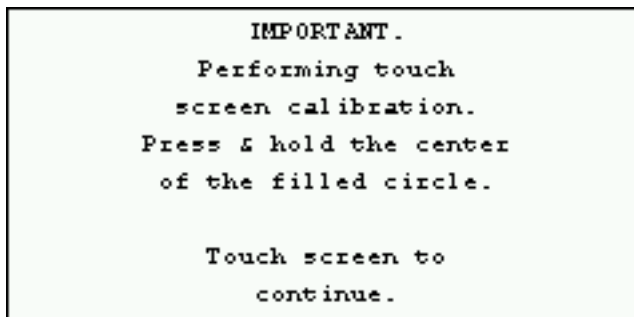
Save	Defaults	Help ?
------	----------	--------

1. Saves all the current instrument settings to non-volatile memory. If the instrument is power cycled, all settings will be restored.
2. Restores factory default settings for all parameters.
3. Displays context sensitive help for the current screen.

## Calibrating the touchscreen display

If you find that the touchscreen is not responding correctly to inputs it may be necessary to recalibrate it. To recalibrate the touchscreen simply:

1. Turn the instrument off
2. Touch the screen while turning the unit on
3. Follow the onscreen directions



## Configuring the DCC-1488 or PQC-3048 via the USB interface

### I. Installing the virtual com port driver (Microsoft Windows)

When connected to a host computer via USB the DCC-1448 appears as two distinct USB devices. The first is a digital microphone. Both Microsoft Windows and Apple OSX operating systems automatically enable this device. The second device is a USB emulation of an RS-232 com port. PT&D supports the use of the com port for firmware updates and remote control of the instrument only under Microsoft Windows XP and 7. However, several steps are required to enable this communication channel. To enable the com port, do the following:

1. Download the latest windows setup program for the DCC or PQC from:

<http://portlandtoolanddie.com/support>

2. Run the setup utility. Please make sure that the “Drivers” option is enabled on the first page of the setup utility.
3. When the setup utility attempts to install the driver for the instrument, you should see a windows dialog that asks if you want to install the ComPort driver. You must select “Install” to allow the setup utility to configure the USB com port driver.

### II. Installing USB command line control utility

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.

After running the windows setup program, the command line utility should be available under the windows “Start->PTD” menu.

Each instrument has a dedicated control utility. For the DCC-1448 the utility is named dccutil.exe and for the PQC-3048 it is named pqcutil.exe.

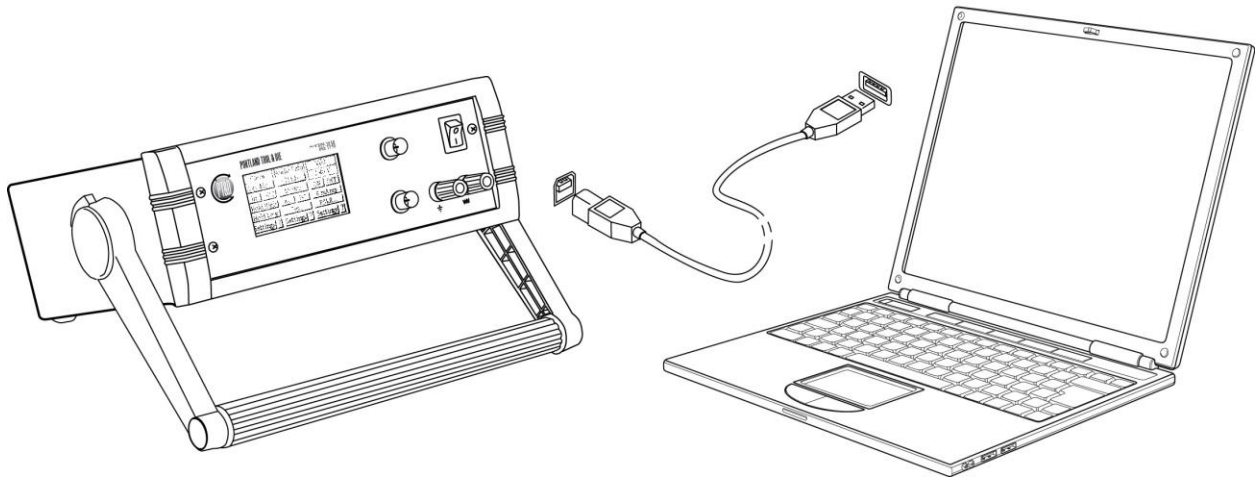
To use the command line utility, either select the “Run CommandLineUtility” option from the windows “Start->PTD” menu or open a command prompt. At the command line prompt, you can view the supported options by typing “dccutil.exe /?” or “pqcutil.exe /?” depending on which kind of instrument is connected.

**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 3<sup>rd</sup> party test equipment

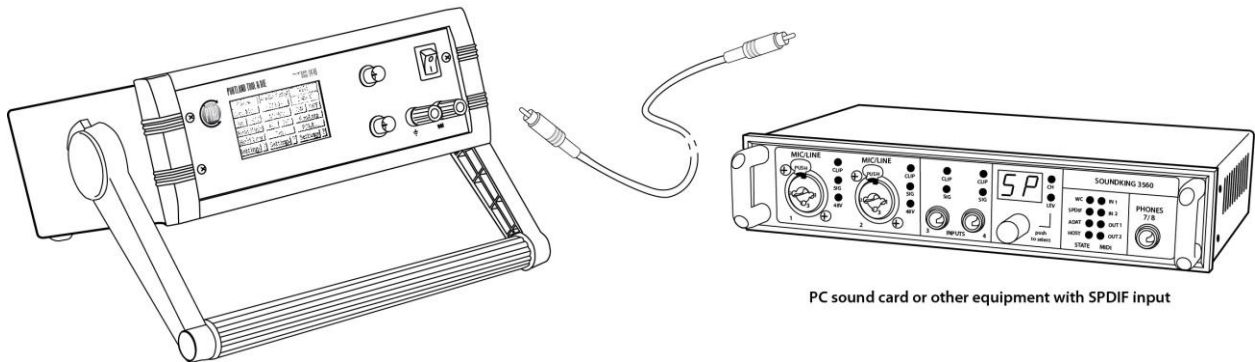
### Via USB



Simply 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 standard digital audio microphone 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 – DCC-1448 Only



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

### A note on sample rate and bit depth

The DCC-1448 outputs 24-bit, 44.1 kHz or 48 kHz PCM digital audio. For best results insure that your test system accepts audio at this sample rate and bit depth.

## Use with Listen, Inc. SoundCheck

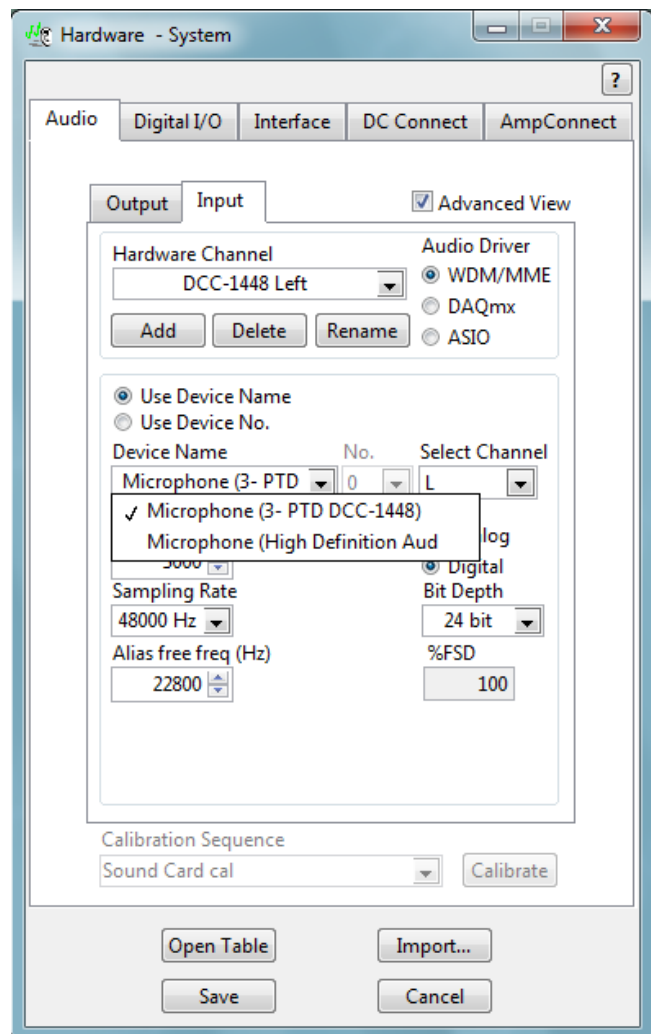
The DCC-1448 integrates directly with Listen, Inc.'s SoundCheck audio measurement system via USB or the SPDIF input of a professional audio interface. Instructions for both are provided below:

### Directly via USB

#### First, create a hardware channel

Since the DCC-1448 appears as a normal Windows audio device when connected via USB to use it with SoundCheck you simply configure it as any other WDM audio device. Simply follow these steps:

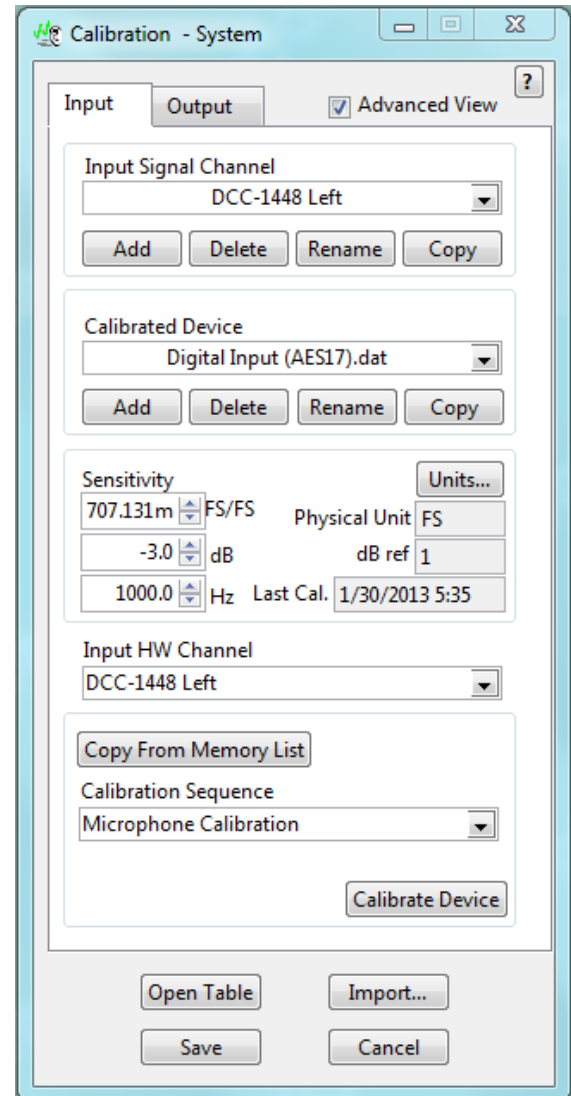
1. With your DCC-1448 connected and powered on start SoundCheck.
2. From the main menu open Setup and then Hardware...
3. Add a hardware channel. You can call it what you want but for this exercise I will call it a DCC-1448 Left
4. Insure that the Audio Driver is set to WDM/MME
5. You can address the device by name or number it will appear as a PTD DCC-1448
6. Set the channel to L
7. Set the sample rate to 48 kHz, the type to Digital, and the bit depth to 24-bits if using Windows 7. **NOTE** - If using Windows XP set the bit depth to 16-bits.
8. Because it is using a WDM driver the latency is variable but 3048 samples is typical.
9. Repeat if you wish to also address the right channel of data.
10. 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, simply follow these steps:

1. From the main menu open Setup and then Calibration...
2. Add a new input signal channel. You can call it what you want but for this exercise DCC-1448 Left will be used.
3. Add a new calibrated device. The name is arbitrary, but I chose Digital Input (AES17) to make it clear that it is a sine RMS referenced value. The physical unit will be FS. It is advised to then add a sensitivity of -3.01 dB. This will adjust the FS reference so that measurements plotted in dB re 1 FS or dBFS will correspond with results that reference FS as defined by the Audio Engineering Society standard AES-17-1998-r2009-f.
4. Select the DCC-1448 Left hardware input channel that was previously created.
5. Save your changes.

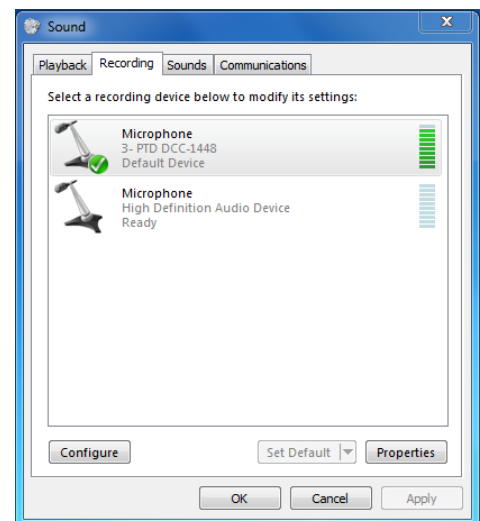


## Finally, set the recording device gain in the Windows mixer

In Windows XP no changes are required to the Windows audio mixer. The default setting provides unity gain.

In Windows 7 setting the record level for the PTD-1448 to 3 provides unity gain. To set the record level in Windows 7:

1. Go to the Control Panel -> Hardware and Sound and select Manage Audio Devices.
2. Select the Recording tab and double-click in the PTD DCC-1448 device.



3. Select the Levels tab and move the slider till the value is 3.

**Optional, verify Windows mixer gain**

You can verify that the system is set to unity gain with the following steps:

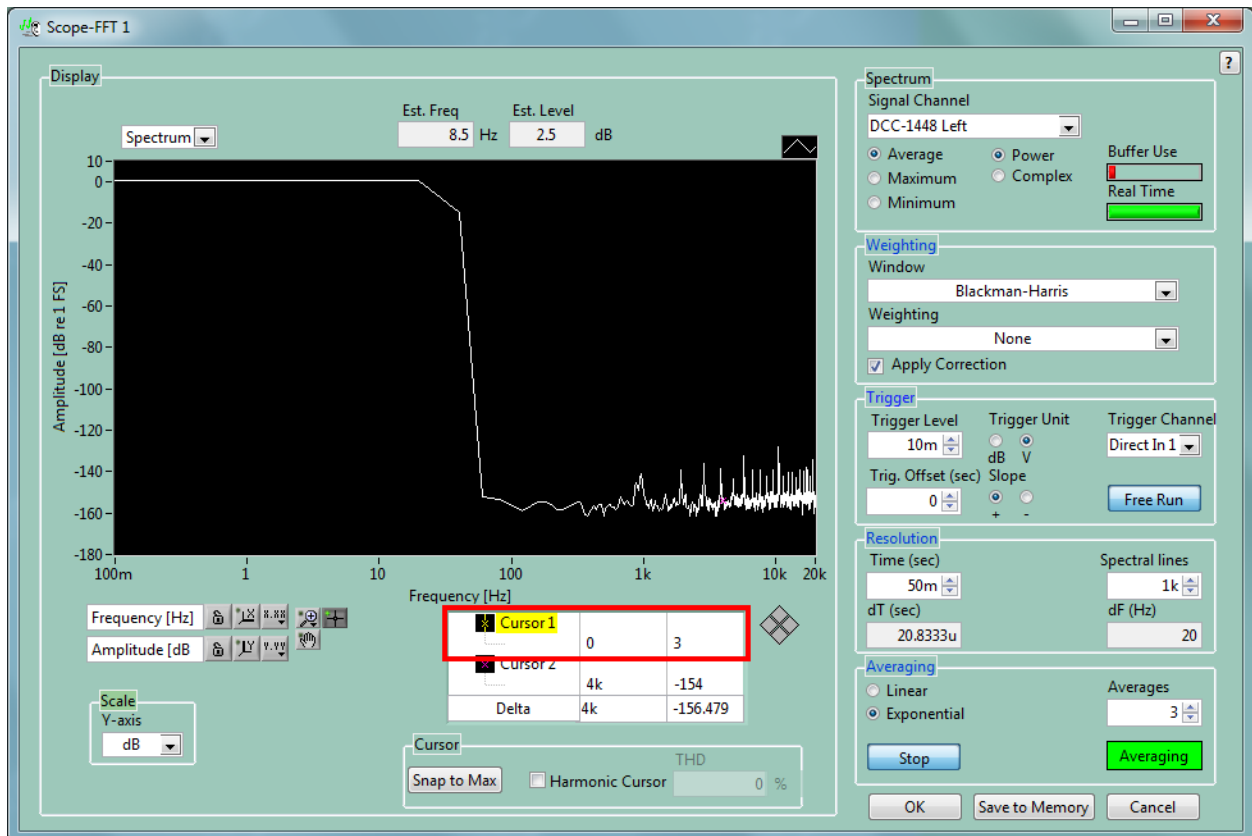
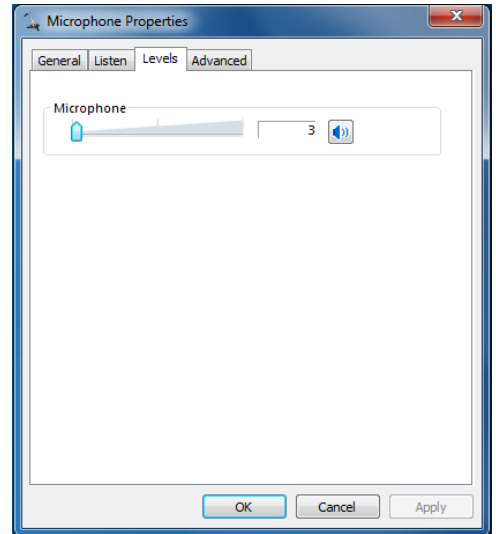
1. On the DCC-1448 set the following parameters:

```

Clock = Out
Data = OFF
AC/DC = DC Selected
Vdd = OFF

```

2. In SoundCheck open the Spectrum Analyzer and select the DCC-1448 Left input signal channel.
3. Set the cursor to 0 Hz.
4. If everything is correct the value will be 3 dBFS (AES17) as highlighted in red below.



## Via an existing audio interface using SPDIF

The SPDIF output of the DCC-1448 can also be connected to the SPDIF input 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. From there follow the second step described for “Adding a USB input” to add the input signal channel and verify the mixer gain as previously described.

### **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 DCC-1448. These include:

1. ASIO Driver - By using, for example, 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 to the signal under Windows 7.
2. Reference microphone measurement - If you wish to measure one microphone by comparing it to another, the simplest solution is to connect the DCC-1448 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 DCC-1448 then both the MEMS digital microphone and the reference microphone will be sampled synchronously, the 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.

## DCC-1448 Specifications

### PDM Data Input

500 kHz to 4 MHz sample rate  
Mono or Stereo multiplex  
1.5 to 5.5 V logic level  
Selectable 5, 50, 100, 200, or 400 pF input capacitance  
Selectable open or closed circuit  
BNC Connector

### PCM Data Output

24 bit, 44.1 or 48 kHz sample rate  
SPDIF/AES3 BNC  
USB Audio – Windows and Mac compatible

### Control Interface

Touchscreen LCD panel  
USB - Windows command line

### Clock

Selectable clock master or slave  
500 kHz to 4 Mhz  
Selectable 1.4 to 5.5 V logic level  
Clock modes: In, Out, Hold High, Hold Low  
BNC Connector

### Vdd DC Power Supply

0 – 5.5 V DC  
10 mAmp current limit  
Selectable power supply rejection impairment  
waveform generator  
    Sine or Square waveform  
    20 – 20 kHz frequency  
    0 – 1 Vpp AC waveform amplitude  
Banana / binding post style connector

### 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)

## PQC-3048 Specifications

### PDM Data Input

500 kHz to 4 MHz sample rate  
 Mono or Stereo multiplex  
 1.5 to 5.5 V logic level  
 Phoenix connector

### Clock

Clock master  
 500 kHz to 4 Mhz  
 Selectable 1.4 to 3.3 V logic level  
 Phoenix connector

### PCM Data Output

24 bit, 44.1 or 48 kHz sample rate  
 USB Audio – Windows and Mac compatible

### Vdd DC Power Supply

0 – 3.3 V DC  
 10 mA current limit  
 Phoenix connector

### Control Interface

Touchscreen LCD panel  
 USB - Windows command line

### Physical

30 x 64 x 135 mm H x W x D  
 0.18 kg  
 USB power input

## Differences between DCC-1448 and PQC-3048

	<b>DCC-1448</b>	<b>PQC-3048</b>
<b>User Interface</b>	Touchscreen and USB	USB Only
<b>Input</b>	500 kHz to 4 MHz	500 kHz to 4 MHz
<b>Output</b>	SPDIF and USB	USB Only
<b>Clock</b>	In, Out, Hold High, Hold Low	Out / Master Only
<b>Vdd</b>	0 – 5.5 V	0 – 3.3 V
<b>PSR Function</b>	Yes – Sine, Square to 1 Vp	No
<b>Selectable Input F</b>	5, 50, 100, 200 or 400 pF	5 pF Fixed
<b>Data Input</b>	On / Off	Always On
<b>Audio data AC/DC Coupling</b>	Selectable	DC Only

## Support and Contact Information

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