SonarWiz SB 24 Analog Server

Revision 7.0, 1/29/2019
<mark>*(Includes CTI Key Buffer Box (CTI-KBB) design information)*</mark>

Chesapeake Technology, Inc.

eMail: support@chesapeaketech.com
Main Web site: http://www.chesapeaketech.com
Support Web site: http://www.chestech-support.com

1605 W. El Camino Real, Suite 100
Mountain View, CA 94040

Tel: 650-967-2045
Fax: 650-450-9300

Table of Contents

# 1   SonarWiz 24-bit Analog Sub-Bottom Interface (SBP24)

The SonarWiz 24-bit analog sub-bottom server (SBP24) is a small interface program that controls the National Instruments (NI) USB-4431 dynamic signal analysis (DSA) device. The combination of the USB-4431 and this dedicated

software interface provides extremely high resolution sampling of analog sub-bottom signals for transmission to the SonarWiz data acquisition software for recording into the SEG-Y floating point data format. This interface is capable of digitizing each channel from 10kHz to 100kHz per channel. Each channel has its own dedicated delta signal A/D converter providing samples at 24-bit resolution. SBP24 can be configured to generate its own trigger signal at user specified rates or it can accept an external 1ms wide positive going TTL pulse as the trigger source.

1.1   SB24Server GUI Controls

The various controls on the SBP24 application are described below.
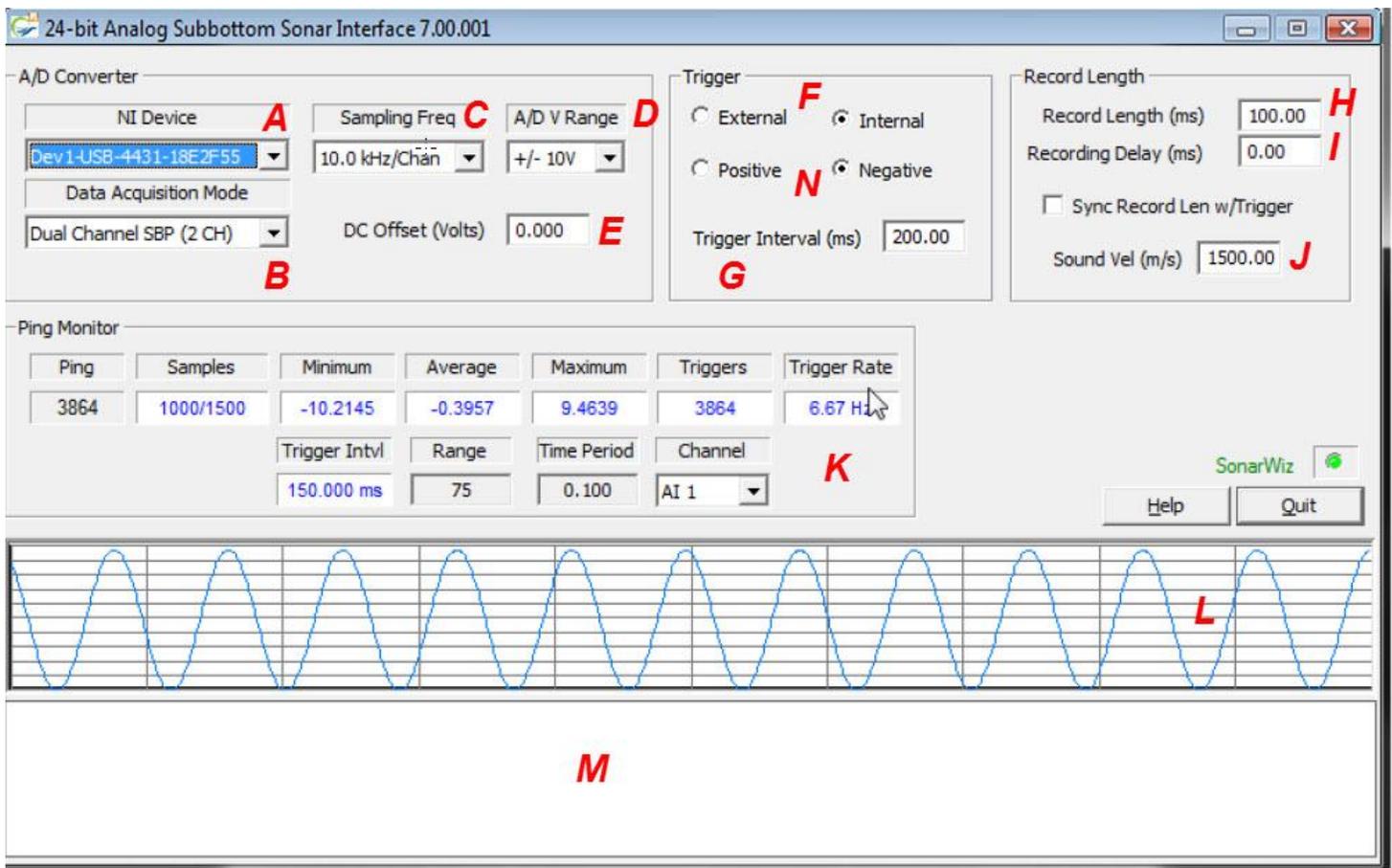
A) NI Device: Used to select the active NI Device when more than one are installed.

B) Data Acquisition Mode: Use this to select either single or dual channel acquisition mode.

C) Sampling Frequency: Use this to control how many samples will be acquired of the selected recording interval. Higher sampling rates

produce more samples which equates to higher resolution, but at the expense of larger data files.

D) A/D Voltage Range: Set the Voltage range to expected range of your input signal. The SBP24 system can accept inputs from +/- 10VDC.

E) DC Offset: If your input signal contains a bias voltage you may use the DC Offset control to add a positive or negative voltage to the digitized signal to center that signal about the 0 VDC level.

F) Trigger Source: There are two modes for triggering the SBP24 External or Internal.
   a. External Triggering: When this mode is selected, the SBP24 is expecting a 1 millisecond wide, positive going square-wave pulse to be applied to the BNC connector labeled AI 0 on the front panel of the USB-4431 device.
   b. Internal Triggering: When internal triggering is selected, the SBP24 software will generate a square-wave trigger signal on the BNC output connector labeled **AO 0** on the front panel of the USB-4431 device. This signal must be physically connected to both the BNC connector **AI 0** as shown below:

Nota bene: Please be sure to test trigger use with your actual equipment before a survey, as it may not be a TTL-compatible voltage range, though it is a square-wave signal output. If you will need an intermediate pre-amp stage to make this perfectly TTL-compatible, better to find this out in a lab test, before discovery at the boat.

G) Trigger Interval (ms): When using an internally generated trigger, this control specifies the "nominal" inter-ping time interval of the square-wave trigger signal. Note that the trigger interval must always have a longer duration than the sum of the delay and the record length. Trigger intervals and ping rates tested at the CTI headquarters include these:
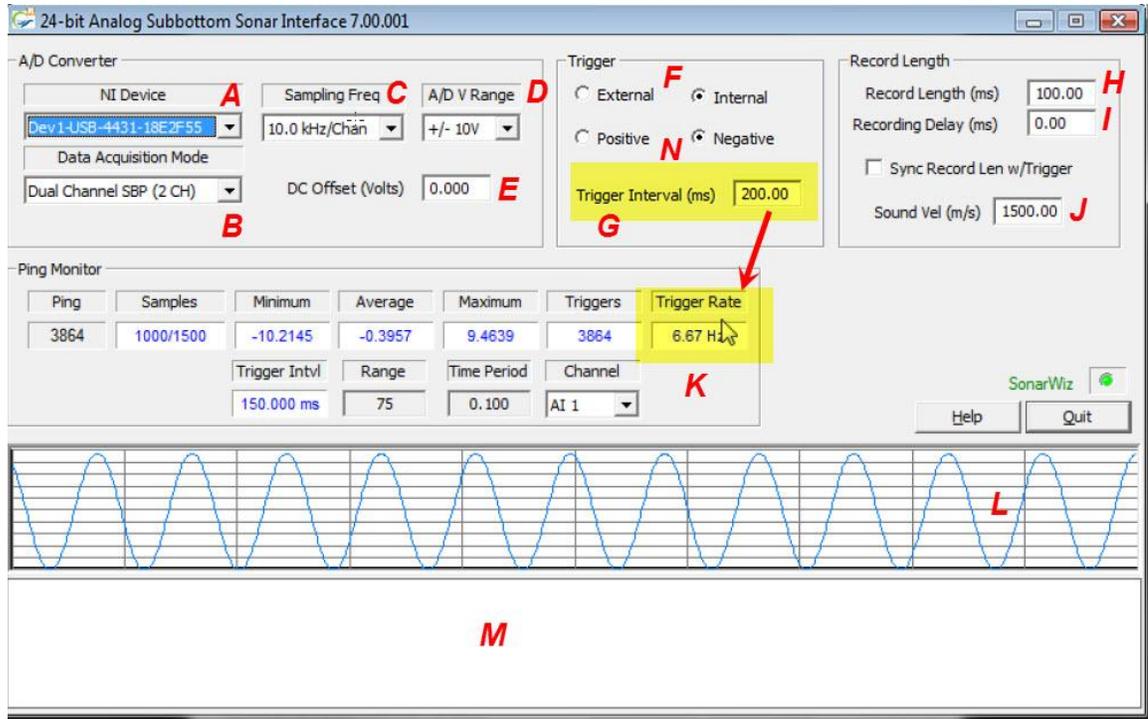
Internal Trigger Interval (msec)	Empirical Ping Rate (Hz)
2000.00	0.5
1000.00	1
500.00	2
333.33	3
250.00	4
200.00	5
166.66	6
142.85	7
125.00	8
111.11	9
100.00	10

If you are unable to achieve these ping rates with equipment connected, chances are that your external load and capacitance is pulling down the Aout0 line, which you will have Tee-ed to Ain0 and the external equipment. Try using an opto-isolator between your external equipment, and the NI USB-4431 output trigger signal, or using an external trigger instead, or try a slower ping rate.

H) Record Length (ms): This is the duration in milliseconds of the digitized data that will be sent to SonarWiz for recording.

I)   Recording Delay (ms): This is the amount of time in milliseconds after the trigger detection to delay the recording. For example, if the internal triggering is enabled and set at an interval of 2000ms, the record length is set at 500ms and the delay is set at 1400ms then SonarWiz will record a shot every 2000ms that will contain the data samples from 1400-1900ms. The recording delay is typically used in deep water application, to avoid digitizing large areas of the water column.

J)   Sync Record Len w/Trigger: This checkbox forces the record length in milliseconds to match the actual observed trigger interval. For example, if the trigger interval is 100 ms then if the user enables the Sync Record Len w/Trigger checkbox then the record length will be forced to be 100ms also.

K)   Ping Monitor: This section of the display monitors the values from the selected channel **AI 1** or **AI 2** which represents the SBP data signals applied to the BNC connectors labeled **AI 1** and **AI 2**, respectively.

L)   Signal Plot: This simple graph displays an auto-scaled graphical representation of the input signal selected in the channel selection drop down. The choices for channels to monitor are channel **AI 1** or **AI 2** which represents the SBP data signals applied to the BNC connectors labeled **AI 1** and **AI 2**, respectively.

M)   Notification Area: This area is reserved for various status and error messages to alert the user to problems in the system.

N)   Trigger polarity control - using internal or external trigger, please tell the SB24Server which polarity trigger pulse to generate (outgoing INTERNAL trigger), or expect as input (incoming EXTERNAL trigger).
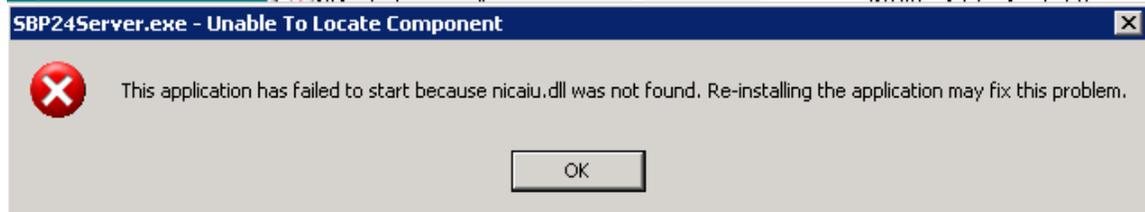
1.2   SB24Server - 3 Setup and Installation Steps

Software installation of the SB24Server requires three software items, which can be installed in any order:

(1) SonarWiz full installation - from www.chestech-support.com "SonarWiz " downloads section, or your installation CD.

(2) SonarWiz SB24Server - from www.chestech-support.com "SonarWiz Servers" downloads section ("Analog 24-bit SB Server" item), or your installation CD.

(3) National Instruments NI DAQMux Driver - full installation of the NI USB-4431 driver software is available either from www.ni.com, or from the NI CD, if you purchased the USB-4431 unit from Chesapeake Technology, and received such a CD.

Once all 3 of these software items have been installed, SonarWiz may be started, and the SB24Server item may be selected from the sub-bottom real-time servers dialog, and started.

If you see a message about nicaiu.dll missing:

SBP24Server.exe - Unable To Locate Component

This application has failed to start because nicaiu.dll was not found. Re-installing the application may fix this problem.

OK

it just means that you did not complete installation step (3) above.

1.3   GROUNDING NOTES - 2 Recommendations

(1) The NI USB-4431 User Manual says this on p. 2-1:

" The inputs and outputs of these products are not connected to chassis ground for functional reasons. Therefore, the outer conductor of any connected coaxial cable is not connected to chassis ground and the outer conductor will not act as a shield for unwanted noise. The shield can act as an antenna to transmit noise into the environment or receive noise from the environment that could affect measurement accuracy. To ensure proper shielding effectiveness of connected coaxial cables, the outer conductor must be directly connected to chassis or earth ground at the load end of the cable."

So for best SIGNAL quality, ground your co-axial cables shield properly.

(2) For proper unit performance, boat use has shown that good continuous performance of the NI USB-4431 may require a good CHASSIS GROUND, such as a conductive wire connected to the rear panel GROUNDING SCREW, to a seawater mop:
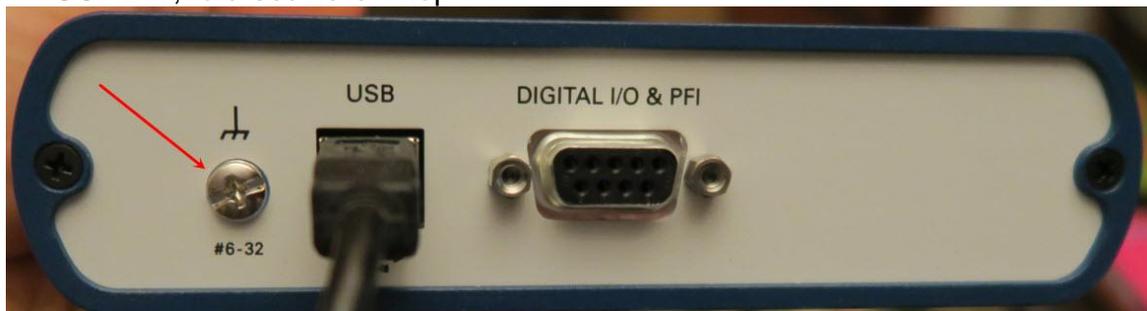
We have had some users, rarely, see unit performance interruptions occur periodically, sort of random, unless they properly grounded the chassis:

The NI USB-4431 User Manual says this on p. 2-2:

"For USB-443x devices, connect the ground terminal on the back of the USB case to the chassis of the host PC."

Our SB24 user experience has shown that connecting the CHASSIS GROUND screw to a seawater mop ground, instead of the LAPTOP/PC chassis, when on a boat, does the job well.

2   Test It Before You Survey

Go ahead and connect a sonar, or even just a function generator, to your USB-4431 unit, collect some data, and get a feel for the hardware and software, before trying a real sonar survey. Save a SEG file and import it, so you trust that it is all working as you need it to do.

Setting it all up in the lab is a good idea, so that you have Internet access, and access to all the installation CDs that you need, and will not find yourself missing any set-up item when you get to the boat.

3   INTERNAL Trigger - Susceptible to external load

This section describes a vulnerability to external load in the NI USB-4431 unit, which manifests as a lack of trigger, when isolation-from-ground requirements are not met on the trigger signal line. Because this has happened to some surveyors, it seems worth testing in your own survey plans, at the dock BEFORE leaving port, and discovering the issue during the actual survey.

There are two components to this issue:

(1) the AO0 output voltage for trigger is nominally a 0 - 3.75v 1 msec trigger square wave, not meeting 5v TTL level expectations, and this is sometimes a surprise to surveyors. With a second unit connected, the voltage may even be as low as a 0-3.64 v transition:
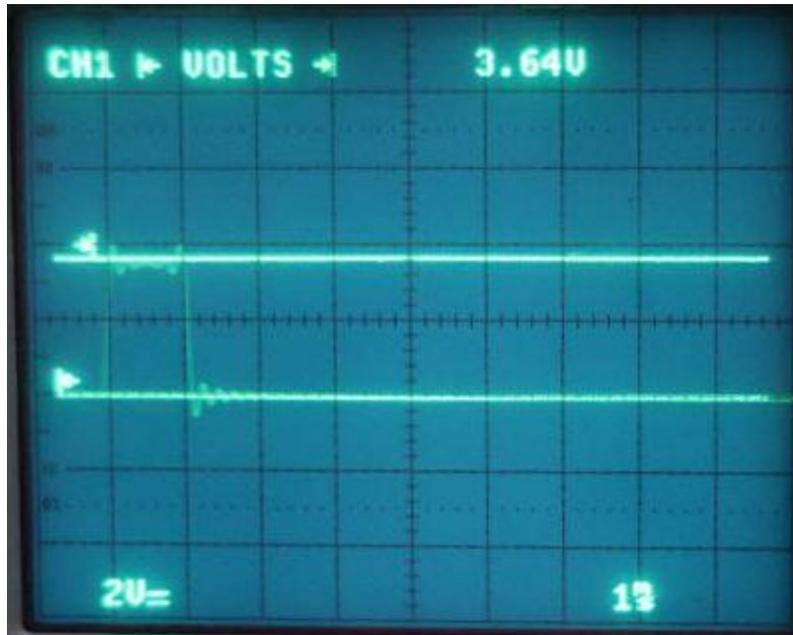
(2) Secondly, the ground isolation at AO0 is nominally 50 ohms, which is surprisingly low, and can lead to an impedance mis-match with your sonar top-side unit, reducing the output current (power) of the trigger signal, if your top-side unit ground isolation is MORE than 50 ohms.

Here's an example. The trigger signal current going to your top-side unit will be inversely proportional to the impedance there, versus the 50 ohms at AO0. So say you have 1000 ohms ground isolation at the trigger I/O input BNC on your top-side unit. If that's the case, AI0 will receive 950/1000 of the trigger current, and your top-side unit will receive 50/1000 of the trigger current sent out of AO0.

The voltage being low, and the possible impedance mismatch, are both handled well by using a CTI product called a KDD box (key divide delay) in series with the 4431 trigger output. The KDD delivers a 100 usec 5.10v trigger, strong enough for any top-side unit. An advantage too is that it has a pair of outputs, so that you can drive AI0 as well as the top-side unit, with identical power and voltage.

Overall there seem to be 4 good solutions for this, so we'll describe them here in order of preference.

3.1   Solution 1: Use the CTI - KEY BUFFER BOX (yellow)

In July, 2018 we are providing a new hardware option to enhance INTERNAL TRIGGER capability with the SB24Server / NI USB-4431 combination. We have

shown the CTI KEY BUFFER BOX (CTI-KBB) (yellow box in the photograph below), and how to cable it. The benefits are that an independent power source to the CTI-KBB provides a substantially stronger, cleaner trigger output than the NI USB-4431, and this has a better chance of working well with your sonar equipment.

KBB Cabling Instructions:
Connections description:
(1) Connect the SonarWiz PC USB cable to the NI USB-4431 USB port as usual
(2) Connect the 4431 AO0 to KEY IN on the CTI-KBB
(3) Connect KEY OUT on the CTI-KBB to the 4431 AI0
(4) Connect the second KEY OUT on the CTI-KBB to your sonar TRIGGER IN

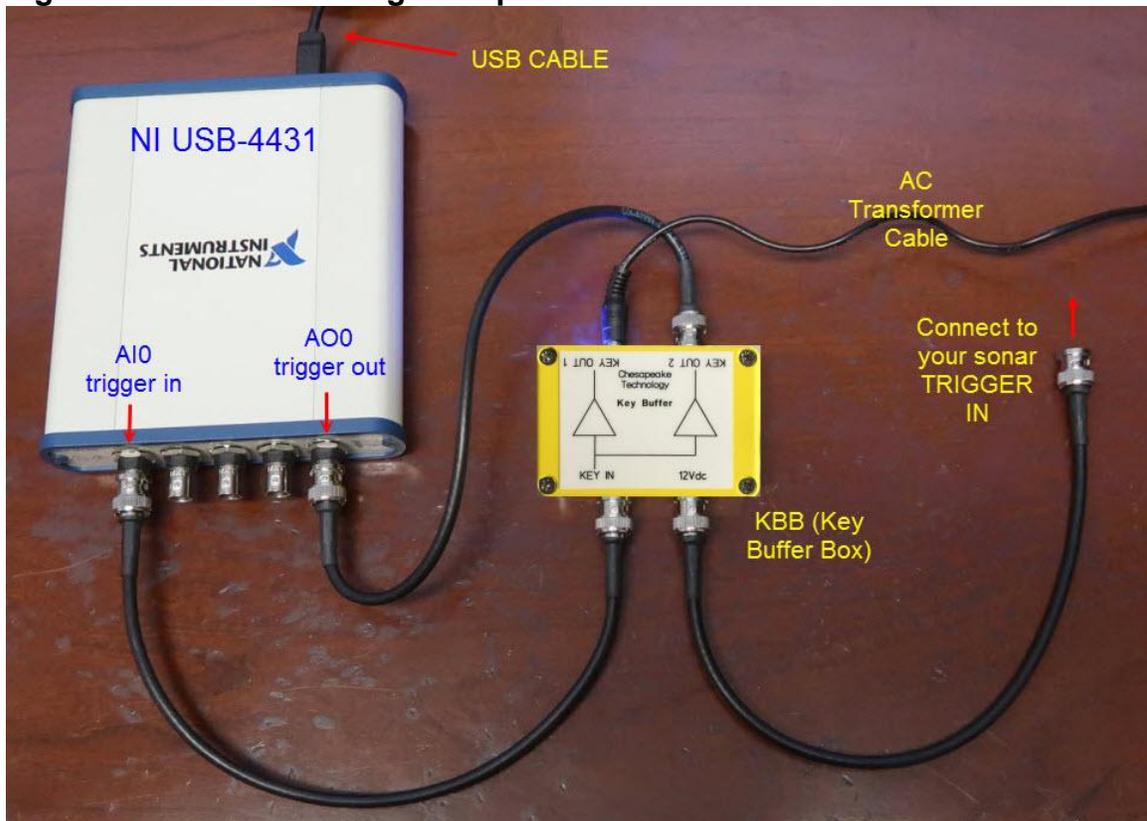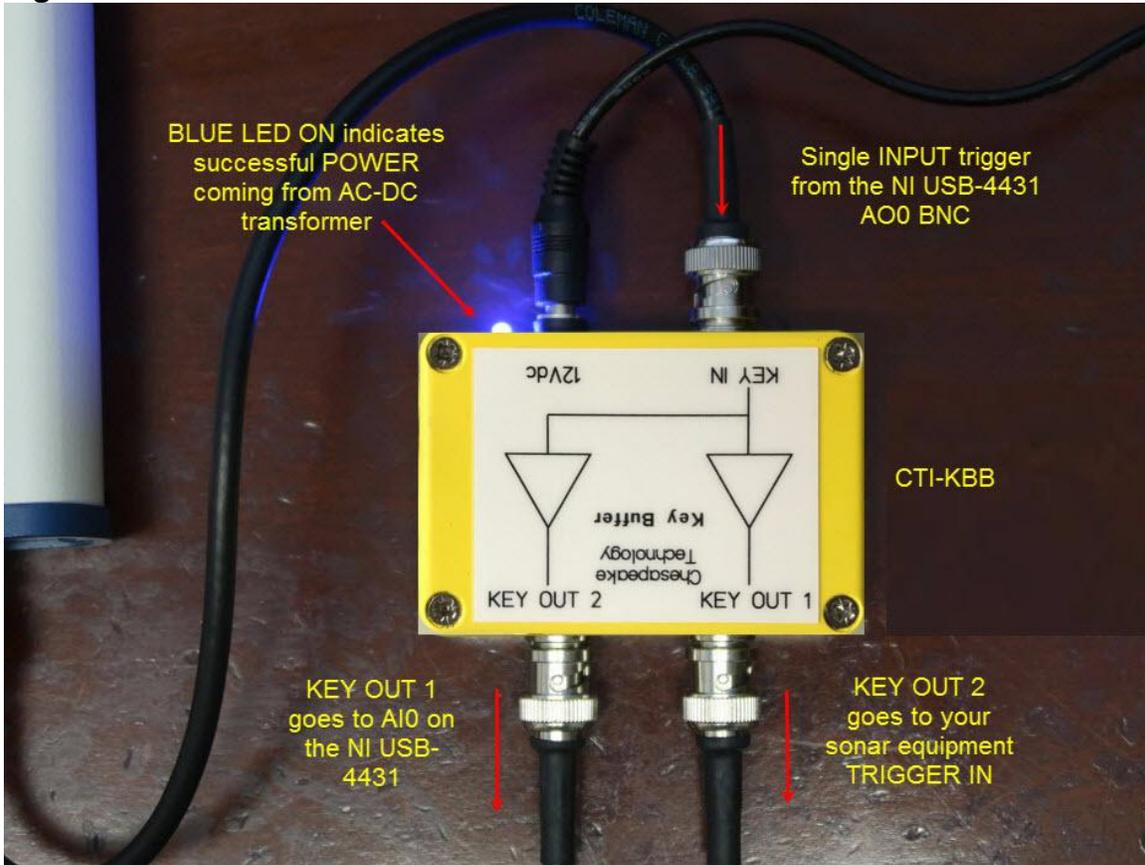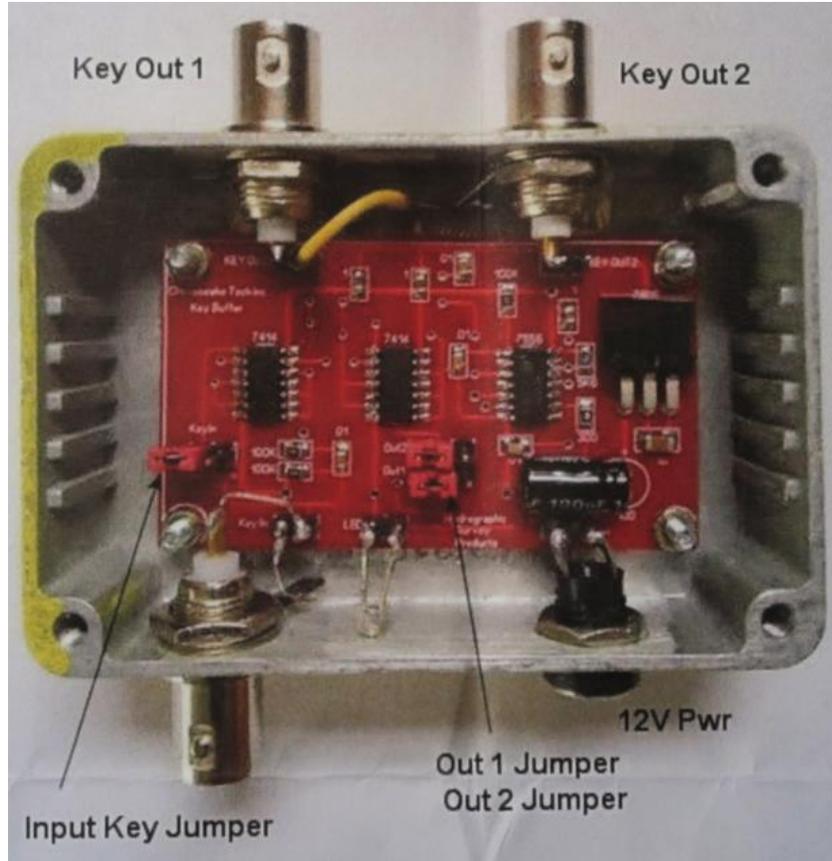**Figure 1: CTI-KBB Cabling example**

Figure 2: Closer view of the CTI-KBB

3.2   Solution 1B: November 2018 - CTI Key Buffer Box (CTI-KBB) option

In case you have a CTI Key Buffer Box, top view of the CTI-KBB internal hardware and control switches looks like this:

The CTI-KBB has a pulse-filtering option to transform say a 10 Hz square-wave input wave-form on INPUT to a 10 Hz PULSE waveform on OUT2 and OUT1, with the pulse being a 2-msec square pulse. This means that a 10 Hz square wave timing signal from a third-party vendor could be used to trigger the NI USB-4431 unit, which needs a PULSE format trigger input.

This works well whether you are using INTERNAL or EXTERNAL trigger. For INTERNAL trigger, configure like in section 3.1 for the CTI-KBB:

**CTI Key Buffer Box Cabling Instructions:**
Connections description:
(1) Connect the SonarWiz PC USB cable to the NI USB-4431 USB port as usual
(2) Connect the 4431 AO0 to INPUT on the CTI-KBB
(3) Connect KEY OUT1 or KEY OUT2 on the CTI-KBB to the 4431 AI0
(4) Connect the second KEY OUT on the CTI-KBB to your sonar TRIGGER IN

The **INPUT KEY jumper** shown below, in the
(1) LEFT position - SHORTENS the input 2 msec PULSE, in case it had been a
    long pulse like the positive portion (50 msec) of a 10 Hz waveform.
(2) RIGHT position - If you want to PASS-THROUGH the input trigger signal
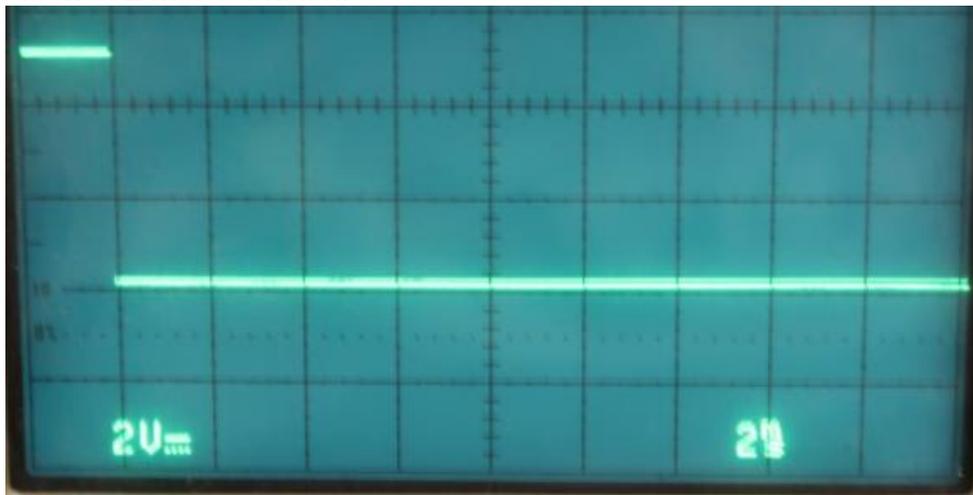   UNCHANGED, shift the jumper to the RIGHT position.
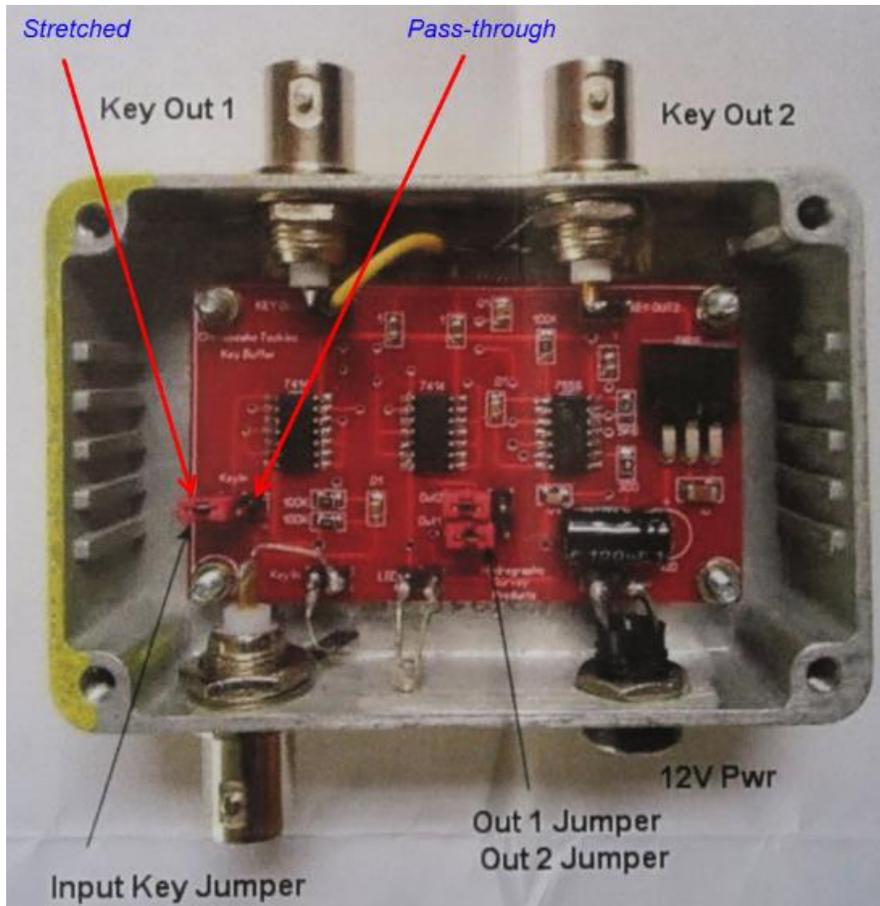
Example 10 Hz SQUARE WAVE external trigger input:
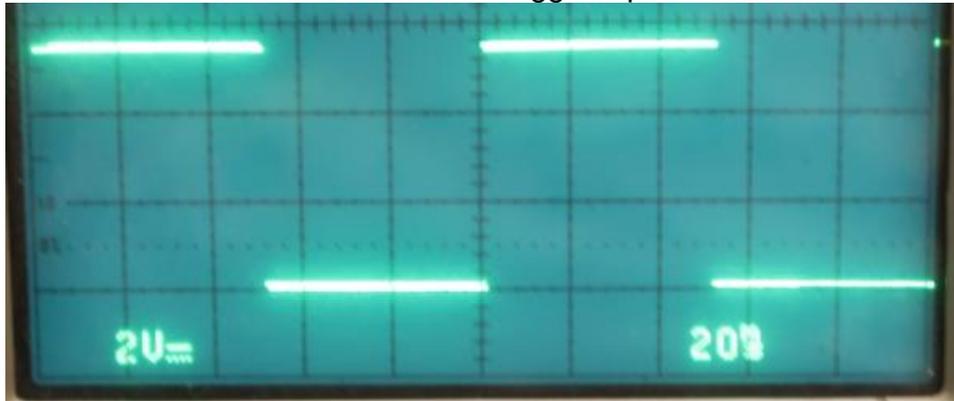
Example SHORTENED result - 2 msec PULSE at 10 Hz, shown at 20 msec/division:
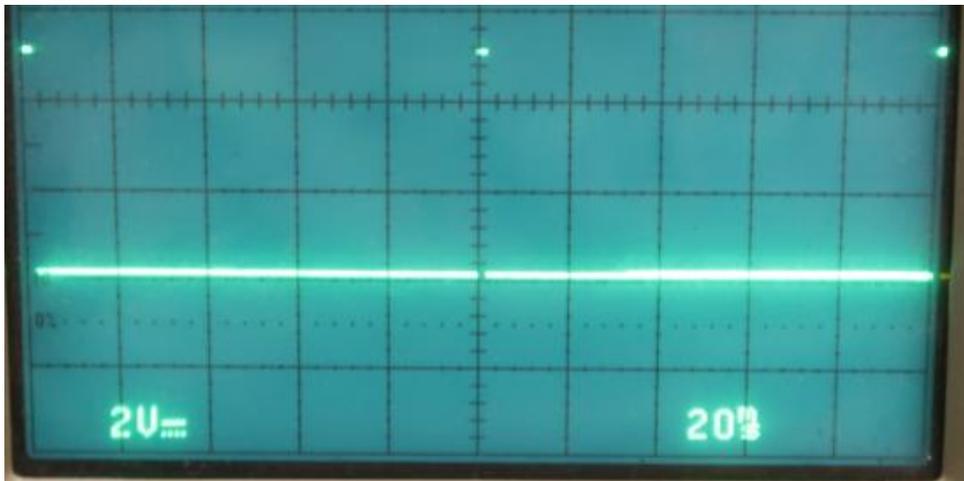

Closer look at 2 msec/division:

Sending KEY OUT 1 or 2 into AI1 on the NI USB-4431 triggers well with a perfect PULSE shape like this, 2 msec duration.

The **OUTPUT KEY jumpers** on the right side are opposite in function - they can actually LENGTHEN the pulse, if it was too short.

(1) LEFT position for the OUTPUT jumpers mean LENGTHEN the pulse to 1 msec (in practice, we are seeing a 2 msec pulse, but it works ok with the NI USB-4431).

(2) RIGHT position for the OUTPUT jumpers mean PASS-TRHOUGH UNCHANGED.
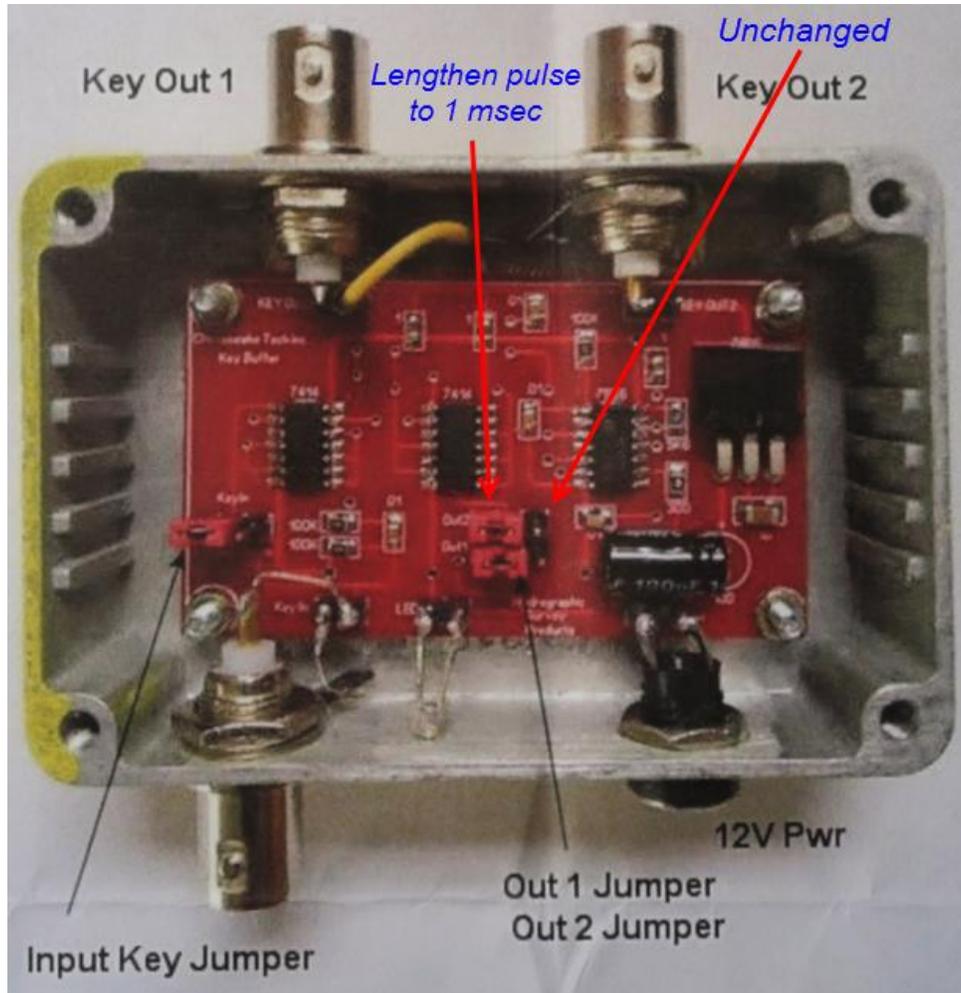
The OUT1 and OUT2 jumpers can be set independently and differently, to have one lengthened, the other pass-through.

Go ahead and **power off** the CTI-KBB, open it up, and change the jumpers if you need to do so to get the combination of triggering you need on the NI USB-4431 (e.g. KEY OUT 1) and your sonar equipment (KEY OUT 2). Then **power on** the CTI-KBB after closing the lid again.

3.3   Solution 2: Achieve matched isolation from ground

If you are not using the KBB, and have an electrical technician in the survey, and they can diagnose a failure to trigger and rearrange the wiring, go for it! If you can, set up an identical 50 ohm isolation from ground on your top-side unit trigger input line. If you can do that, then you would get half the trigger power (since the line is Tee'ed into AI0 as well), and it may be enough to get triggers and pings happening at your top-side unit.

3.4   Solution 3: Use external trigger

The issue only is a problem if the NI USB-4431 is trying to generate INTERNAL trigger output into an external load. If instead, you configure your sparker/boomer/echo-sounder top-side unit to generate trigger, and set up the SB24Server to use EXTERNAL TRIGGER, you won't have the INTERNAL trigger problem at all.

3.5   Solution 4: Use an opto-isolator or KDD buffer

A second approach is to insert an opto-isolator or buffer (e.g. the Key Divide & Delay box (KDD) is a buffer) in-line between the trigger output of the NI USB-4431 unit A0 line, and the top-side unit. You would want to purchase and install and test this solution before survey, for sure, but it guarantees that the AO0 output trigger would be adequate. You may still have to achieve adequate isolation from ground then on the opto-isolator output line, connected to the sparker/boomer/echo-sounder trigger input.

Example KDD output trigger, 100 usec 0-5.10 v transition:
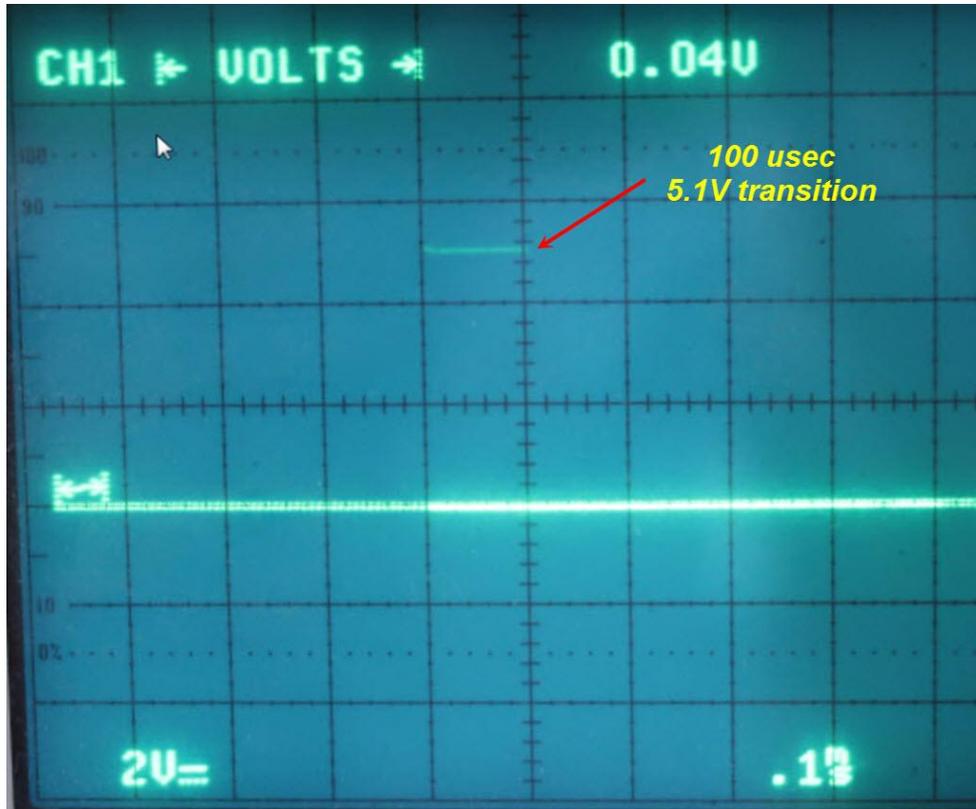
3.6   Solution 5: Switch to the CTI 5-BNC 16-bit Analog Interface Box

A fourth solution option is to switch to the more ruggedized hardware of the CTI 5-BNC 16-bit analog interface box. The units we sell have defensive electronics built into a separate PCB card, inside the box, in-line between the NI USB-6210 card and the sparker/boomer/echo-sounder trigger line. These electronics have in practice never failed to achieve adequate trigger, in spite of external loads on the trigger line. As a more robust solution, you may want to use this even though the data resolution is only 16-bits per sample.

4   Document Versions

Rev 7, 1/28/2019 - New sections added describing the CTI Key Buffer Box (CTI-KBB) as a new trigger-out buffering solution, to help the fan-out issue of using AO0 for triggering both the NI USB-4431 and customer equipment.

Rev 6, 5/22/2018 - Section 5.1.2 added describing the SB24Server issue when INTERNAL trigger is selected.

Rev 5, 3/29/2018 - New section describing trigger vulnerability and solution options added; Section N) for trigger polarity documented

Rev 5, 3/29/2018 - New section describing trigger vulnerability and solution
    options added; Section N) for trigger polarity documented

Rev 4, 2/4/2016 - Previous version - section 1.3 on chassis grounding options
    described.