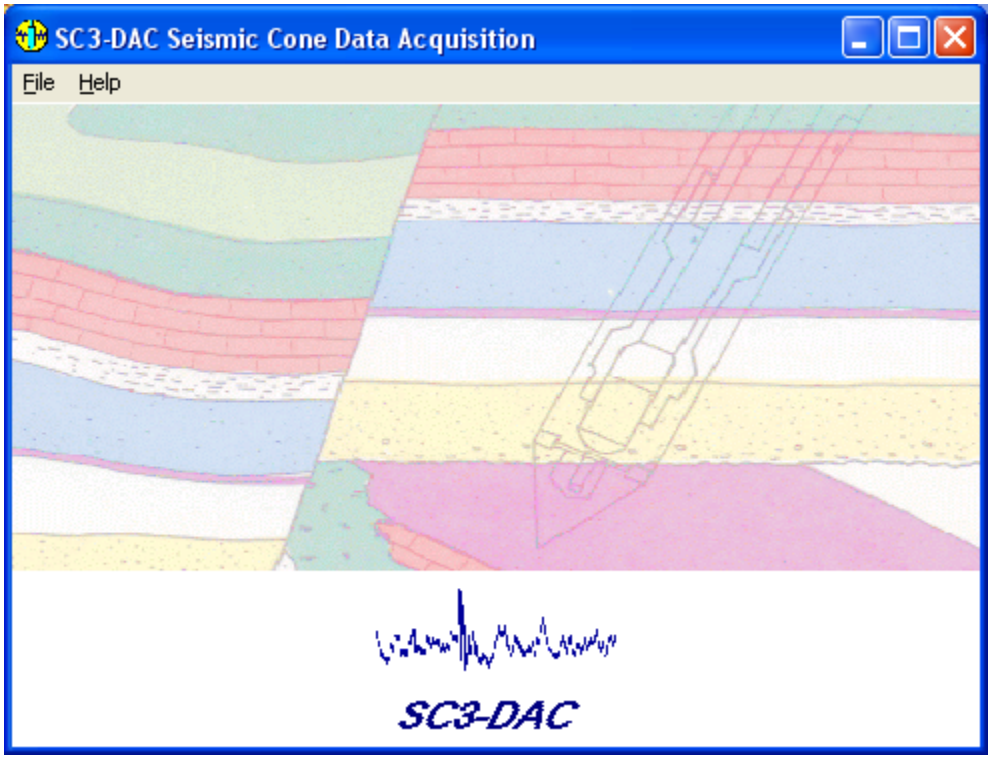
SC3-DAC™ 2011

User's Reference Manual

BCE
SUB-SURFACE
DIAGNOSTICS



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BCE's mission is to provide our clients around the world with state-of-the-art seismic data acquisition and analysis systems, which allow for better and faster diagnostics of the sub-surface.

The company provides state-of-the-art hardware and software solutions for a wide variety of seismic engineering applications. If necessary, we will customize our products to suit the requirements of our clients even better.

BCE's products and services consist of

- Seismic Data Acquisition and Signal Conditioning Hardware
- Seismic Data Processing Software
- Applied Seismology Consulting Services
- Seismic Data Processing
- Professional Seminars

By publishing this manual we will hopefully provide a better understanding of downhole seismic testing and the role it can play in geotechnical investigations.

Baziw Consulting Engineers Ltd
3943 West 32nd Avenue Vancouver B.C. Canada V6S 1Z4
url: www.bcengineers.com
email: info@bcengineers.com

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Chapter 1 Introduction

1.1 What is SC3-DAC™?

SC3-DAC™ is a Windows® program that facilitates the data acquisition of triaxial Seismic Cone (SC) time series data.

SC3-DAC™ includes the following features:

- Configurable for either geophones or accelerometers.
- Configurable for either contact Switch or Sensor Triggers.
- Suitable for P-Wave and S-wave.
- Option for a time delay in collecting data.
- Maximized data sampling rate.
- Option for Data Stacking.

1.2 Organization of users manual

The purpose of this manual is to instruct users of ***SC3-DAC™*** in the use of the product by explaining its structure, taking the user step by step through the program menus, and specifying the use of interactive graphics and I/O routines.

WARNING:
To ensure that the program will function properly it is important that it is installed correctly as outlined in Appendix 1.

Chapter 2 Main Menu

SC3-DAC™ is a Windows® program that facilitates the data acquisition of triaxial seismic cone (SC) time series data. The main menu of ***SC3-DAC™***, as illustrated in Figure 1, has two options:

- *File (to carry out the SC data acquisition).*
- *Help.*

The desired submenu is chosen either by moving the mouse over the desired option and pressing the left hand mouse button, by pressing function <F10> on the keyboard and selecting the desired highlighted option, or by pressing the corresponding menu item letter on the keyboard.

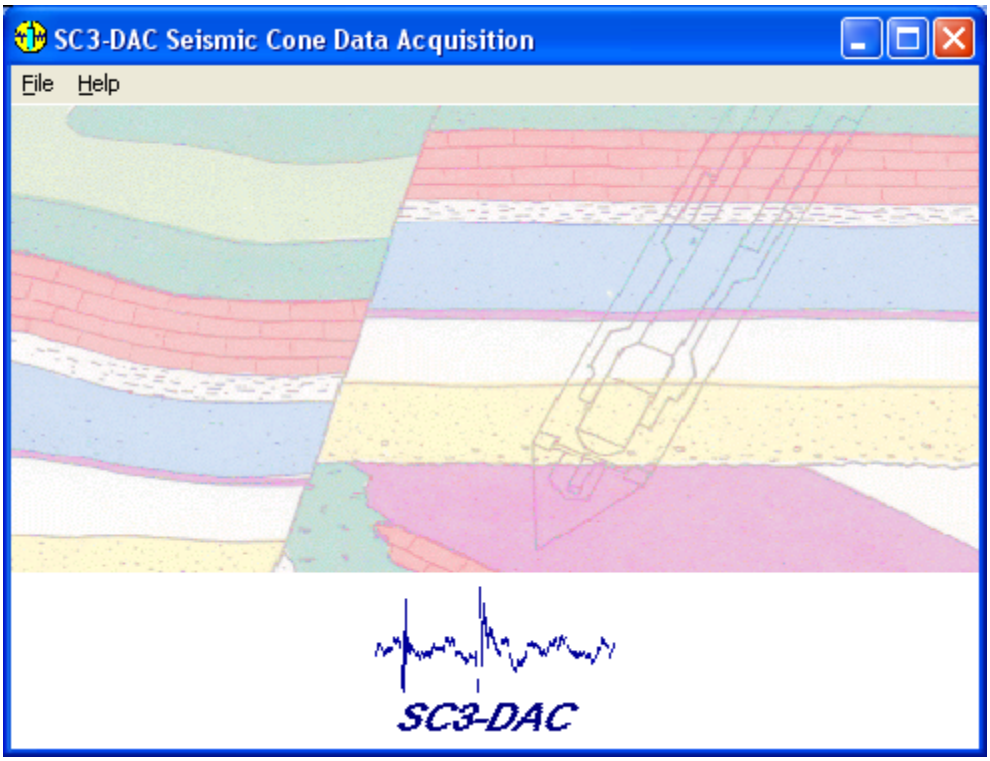


Figure 1: Main Menu in SC3-DAC™

Chapter 3 Seismic Cone Data Acquisition

The *File* menu option is used to carry out the data acquisition and allows the user to communicate with the BCE signal conditioning board and the analog/digital (A/D) conversion board. As shown in Figure 2, this menu has three tabs for data input:

- *Source Parameters and Data File Specification.*
- *A/D Parameters.*
- *Trigger Parameters.*

Once the data has been entered, the tool bar at the top of the screen is used to control the actual data acquisition.

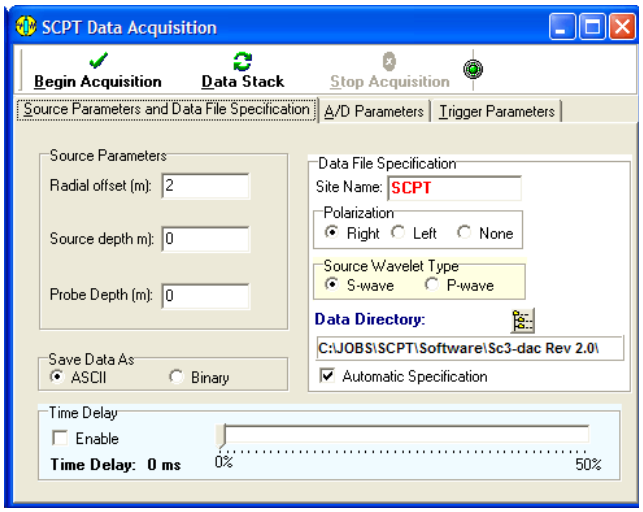


Figure 2: File Menu

3.1 Source Parameters and Data File Specification

The *Source Parameters and Data File Specification* tab is illustrated in Figure 2 and the six input parameters required on this tab are as follows:

- **Radial Offset** - radial offset (m) of the source from the penetration cone.
- **Source Depth** - depth (m) of the source into the ground.
- **Probe Depth** - cone depth (m) from ground level.
- **Save Data As** - the user has the option to store seismic data in either ascii or binary file formats by selecting the appropriate radio button. The default filenames are *.aci for ASCII file formats and *.bin for binary file formats. Binary file formats are desirable because they typically require less memory storage, while ASCII data files can easily be read into other programs.
- **Data File Specification** - the user can automate the seismic data file naming and saving process. A typical file name for a seismic file saved with the *Automatic Specification* check box enabled is outlined and defined as follows:

SCPTS0_0R05_07_00 10-12-52 PM.aci

SCPT	- specified by the user in the *Site Name* edit box
S	- S-wave (S) or P-wave (P) - dominant source wavelet type
0_0	-probe depth specification
R	-right (R), left (L), or no (N) source polarization radio buttons
05_07_00	-day data acquired (i.e., day_month_year)
10-12-52 PM	-time data acquired (i.e., hour-minute-second)
.aci	-user specified data type

The default data file storage directory is selected by pressing the directory list icon. Figure 3 illustrates the dialogue box which appears when the directory list icon is selected. The user browses the available drives and directories and selects the one most appropriate for seismic data file storage.

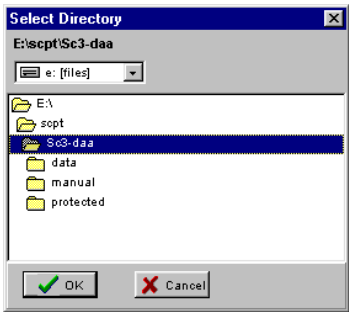


Figure 3: Default Directory Data Dialog Box

- **Time Delay** - the user may not want to store early information within the seismic time series when conducting deep SC investigations. This is due to the fact that the source wave arrives much later in the time series and the early portion of the data contains no useful information. In this situation, the investigator should check the box entitled *Enable* and select the appropriate *Time Delay* with the accompanying slide bar. The *Time Delay* is specified as a percentage of the *Sampling Time* (see Section 3.2). If the *Time Delay* is Enabled, ***SC3-DAC™*** will display the full seismic time series, but only store data which exceeds the user specified *Time Delay*. This saves significant data storage space on the computer hard drive. However, the implementation of a *Time Delay* is not all that important and is typically not implemented as most computer hard drives provide adequate storage space.

3.2 A/D Parameters

The *A/D Parameters* tab is shown in Figure 4 and the four input parameters required on this tab are as follows:

- **Data Gain** - the data gain corresponds to the amplitude gain on the recorded data. The Data Gain can be set from 0 to 84 dB in increments of 6 dB.
- **Sampling Rate** - the sampling rate is specified in KHz and it ranges in values from 1 KHz to 80 KHz, although for high signal resolution a sampling rate of at least 30 KHz is recommended.

  Once the user has specified the Sampling Rate, the program will determine the Actual Sampling Rate, which is a multiple of the specified Sampling Rate, to take optimal advantage of the fact that a digital trigger is used.

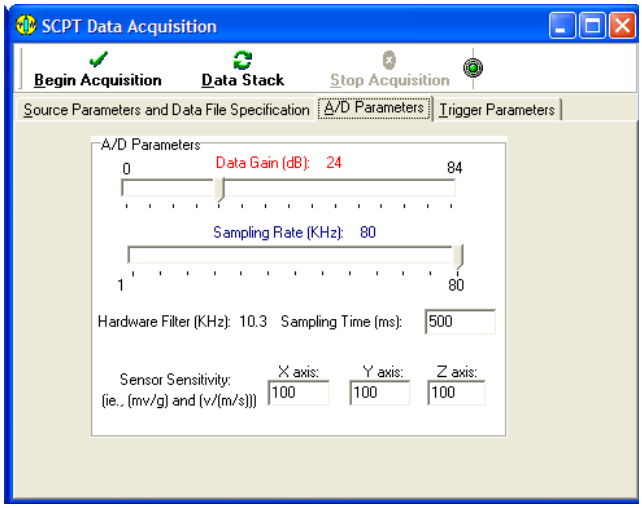


Figure 4: A/D Parameters Input Screen

Listed below are the options for the specified Sampling Rate with the associated Actual Sampling Rates:

Sampling Rate (KHz)	
Specified	**Actual**
1, 2, 5, 10, 50	250
3, 9	243
4, 8, 20, 30, 40, 60, 80	240
7, 70	210

It should be noted that the analog anti-aliasing filter is set automatically based on the specified sampling rate (at 1/3 of the sampling frequency).

- **Sampling time** - the sampling time is specified in ms and it corresponds to the total data acquisition time. For optimal data storage and processing, the sampling time should not be much longer than what is required to capture the P-wave and S-wave.
  For a first estimate of the required Sampling Time, the user should determine the maximum travel distance of the seismic wave and assume a wave velocity of 100 m/s to calculate the travel time. To determine the recommended Sampling Time the user should add to the travel time at least 60 ms to cover three periods of a 60Hz SH source wave. However, since data storage is not really limited in most cases, it is more important that the Sampling Time is set large enough to capture all required data within a vertical seismic profile than to optimize this parameter.
- **Sensor Sensitivity** - the user inputs the seismic sensor's sensitivity allowing for the recording of the particle accelerations or velocities (in the true units of m/s^2 or m/s respectively). This value is provided by your SC system supplier.

3.3 Trigger Parameters

The *Trigger Parameters* tab is illustrated in Figure 5 and the four input parameters required for this tab are as follows:

- **Trigger Type** - there are two types of triggers: Contact Switch or Sensor. The *Contact* switch is triggered when contact (i.e., ground) is made between source and receiver (e.g., when the source hammer strikes the truck pads). The *Sensor* option reflects a transducer type triggering mechanism (e.g., Accelerometer or Geophone).

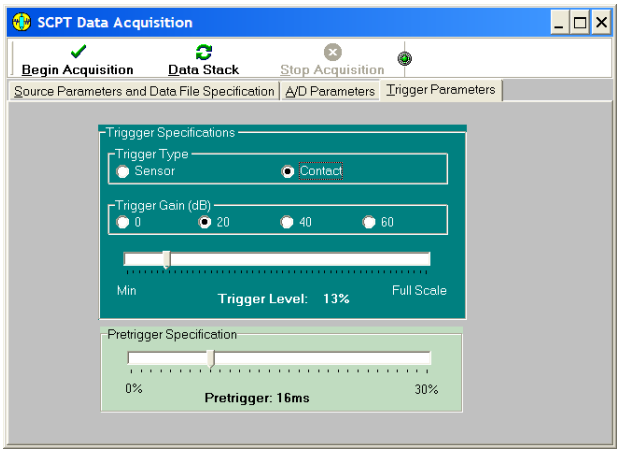


Figure 5: Trigger Parameters Input Screen

- **Trigger Gain** - the gain on the trigger channel has the four possible settings 0 dB (1x), 20 dB (10x), 40 dB (100x) and 60 dB (1000x). The trigger gain settings are only applicable to the *Sensor* trigger. The *Contact* trigger has zero gain applied.
- **Trigger level (or sensitivity)** - this value specifies the percentage of full scale trigger amplitude that signifies a trigger event. This parameter is only applicable to the *Sensor* trigger. The *Contact* trigger is an on-off trigger.
- **Pretrigger** - the *Pretrigger* slide bar allows the user to specify the amount of information to be stored prior to triggering. The pretrigger is specified as a percentage of the total *Sampling Time*. For example, if the total sampling time is 500 ms and the *Pretrigger* slide bar is set to 5% then the pretrigger is (500 x 0.05) = 25ms. The maximum allowable pretrigger is 30% of the total sampling time specified. Similar to the *Time Delay*, *Pretrigger* seismic data is not stored when saving the captured time series data.

3.4 Begin Acquisition, Stack Data, and Stop Acquisition Tool Bar

Once the user has specified the necessary data acquisition parameters, seismic cone data acquisition can commence. The ***SC3-DAC™*** tool bar options are as follows:

- **Begin Acquisition** - the *Begin Acquisition* option is chosen once the data acquisition parameters have been specified. ***SC3-DAC™*** stores the current data acquisition parameters in the SC3dac.ini file and these values become the default parameters.
  As soon as the trigger has been set off, the *Data Acquisition* window as shown in Figure 6 opens to display the captured seismic data.
  The top chart of the screen contains the acquired seismic time. The vertical light blue line shown in Figure 6 on the left of the screen signifies the trigger time. The red, green, blue are the Crosshair and the coordinates of the intersection in the active area are shown at the top of the screen.

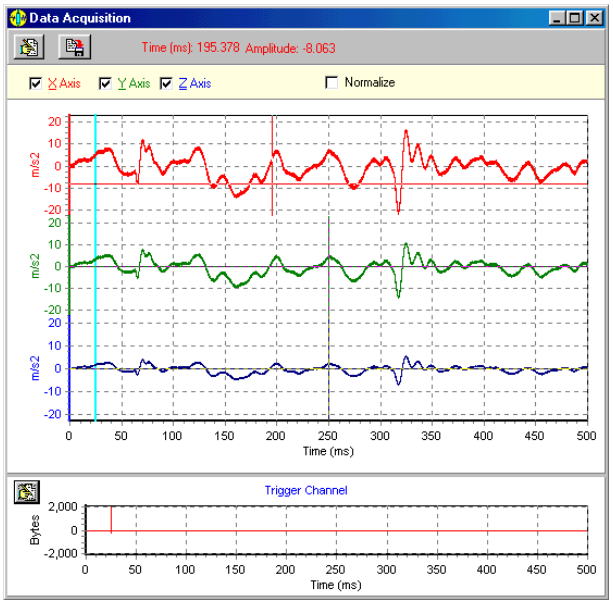


Figure 6: Seismic Data Display Screen

  The trigger channel is displayed in the bottom chart of the screen, and it contains both pre trigger and post trigger information. The vertical red line shown in Figure 6 on the left of the screen signifies the trigger time.
- **Stop Acquisition** - the user may abort the operation by pressing the *Stop Acquisition* push button.

- **Stack** - the stack data option allows the user to stack multiple seismic traces at a specific depth by implementing repeated sources. Since the program automatically displays the average seismic data graph, this option generally results in a higher signal-to-noise ratio. The user may abort the *Stack* operation by pressing the *Stop Acquisition* push button.

On the top right hand corner of the screen a graphical LED shows at all times the status:

Green - ready to commence data acquisition
Yellow - waiting for trigger
Red trigger occurred

Once the data acquisition has been completed, the user may then either format, export or print the captured seismic data by selecting the E*dit* button at the top left hand corner of the screen (see Section 4.0) and/or save the recorded trace by selecting the *Save* button to the right of the *Edit* button. If the user has selected the *Automatic Specification* check box (as shown in Figure 2) then the seismic data file is automatically saved; otherwise the dialogue box for saving the captured seismic traces as shown in Figure 7 appears.

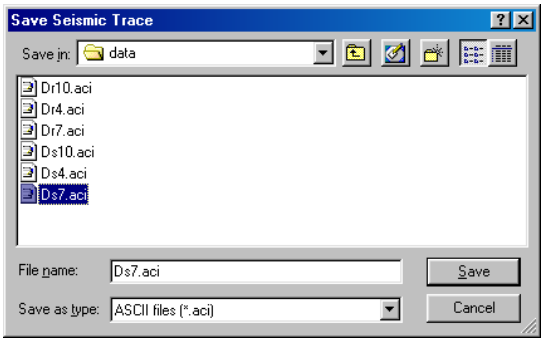


Figure 7: File Save Dialog Box

It should be noted that the data file includes the following header information:

sample rate (ms), time delay (ms), probe depth, source radial offset, and source depth.

Chapter 4 Chart Formatting, Exporting, and Printing

The graphical edit button  displayed at the top left hand corner of the *Seismic Data Display Screen* shown in figure 6 allows for chart formatting, printing, and exporting. Figure 8 illustrates the graphical interface that appears when this button is selected, which allows for extensive modification of the displayed data and chart attributes. In addition the data can be printed by selecting the *Print* tab, which brings up the *Chart Printing Dialogue Box* as shown in Figure 9. Finally, this utility has an extensive electronic Help function, which is accessed though the H*elp* button at the bottom left of the screen.

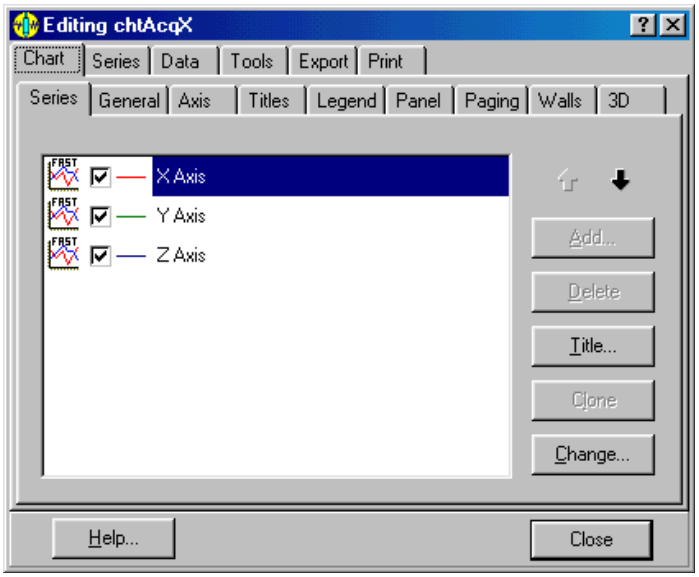


Figure 8: Chart Editing Dialog Box

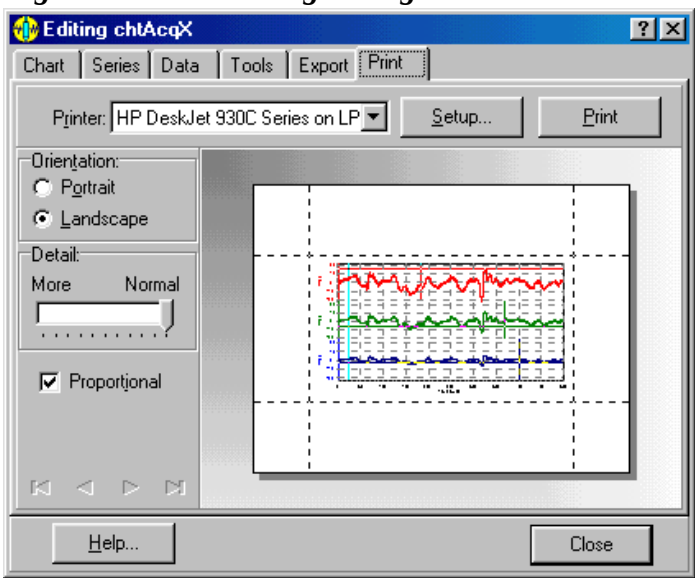


Figure 9: Chart Printing Dialog Box

Chapter 5 Help Menu

The main menu shown in Figure 1 includes a *Help* option that includes the following:

- **About** - provides software version information on *SC3-DAC™*.
- **User's Manual** - will output the *SC3-DAC™* user's manual in a default pdf browser.
- **Link to BCE** - makes a link to *Baziw Consulting Engineers'* web page.

Appendix 1 SC3-DAC™ Installation Procedure

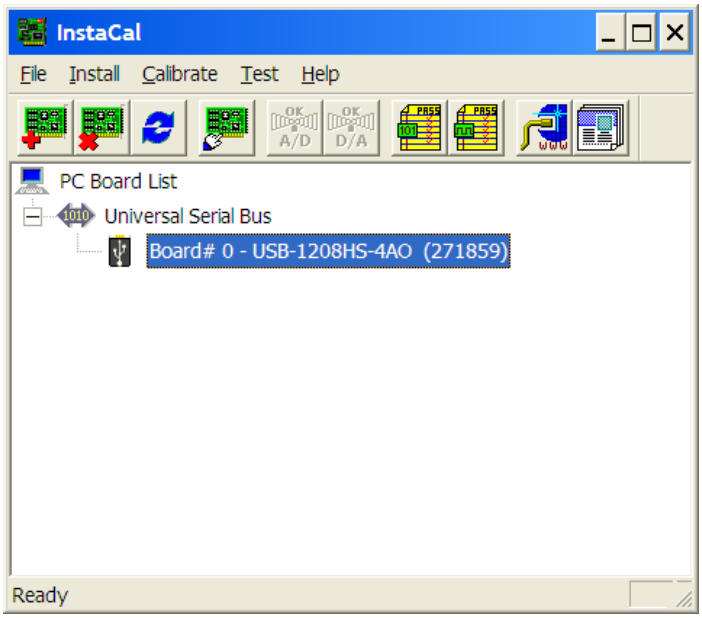
In order for *SC3-DAC™* to function properly it is important that the all software (incl. the *InstaCal* software) is installed in the right sequence. Therefore do not connect the USB-1208HS A/D device until step 3.

The software should be installed as follows:

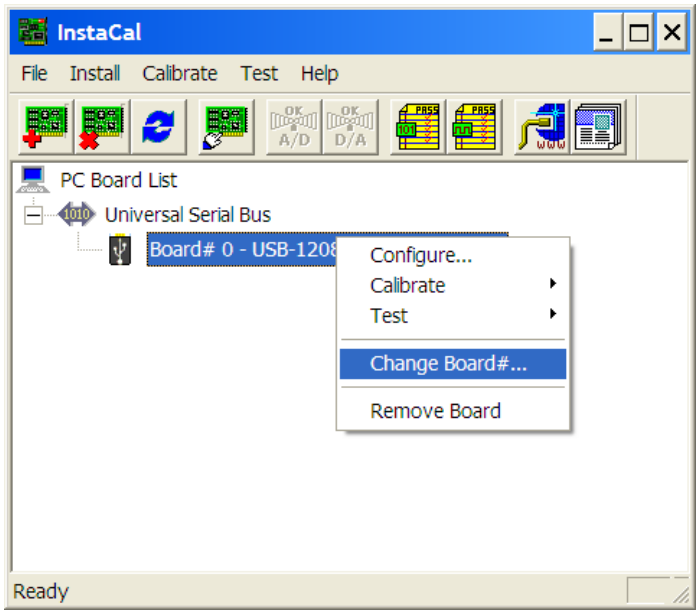
1. Put ***SC3-DAC™*** CD into CD reader; navigate to sub-directory *InstaCal 6.01* and install *InstaCal* (select file *icalsetup.exe*).

2. After installation, reboot the computer.

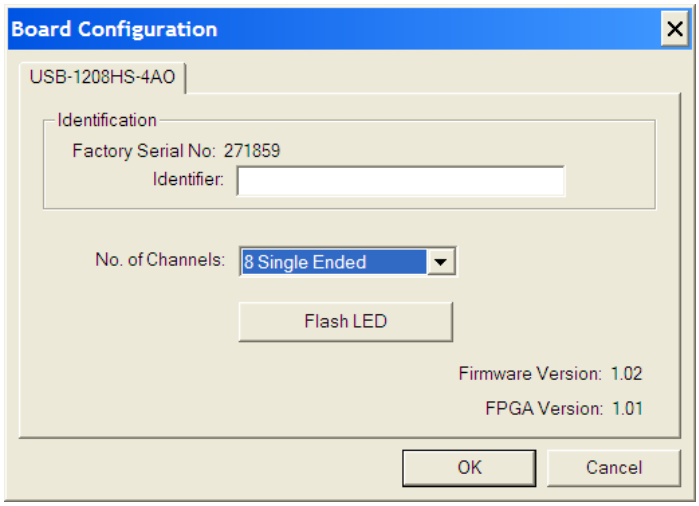
3. Plug USB-1208HS A/D into USB port and execute program *InstaCal*. *InstaCal* insures that the USB A/D device is recognized by the Windows® operating system and allows for configuration and calibration. Verify that the USB-1208HS device is configured as Board #0 as illustrated below.



If not, select the USB-1208HS A/D device and right mouse click and select the *Change Board #* as shown below.



4. Configure the USB-1208HS A/D device as *Single Ended* by selecting the *Configure* option shown above and selecting *8 Single Ended* as illustrated below.



5. Put ***SC3-DAC™*** CD into CD reader; navigate to sub-directory *SC3-DAC*. Execute program *setup.exe*.

6. ***SC3-DAC™*** default directory is c:\SC3-DAC unless otherwise specified.

7. Execute program c:\SC3-DAC\SC3DAC.exe.