USER MANUAL

ProDAQ Signal Conditioning Cards

ProDAQ 5821 16-Channel RTD Signal Conditioning Card

PUBLICATION NUMBER: 5820-XX-UM-1000

bustec

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Reference Documents

Title	Number
ProDAQ 3416 User Manual	3416-XX-UM
ProDAQ 6100 User Manual	6100-XX-UM
ProDAQ 3180 Hardware Manual	3180-XX-HM

Glossary

Safety

This equipment contains voltage hazardous to human life and safety and is able to inflict personal injury. Disconnect the device from the AC line (mains) before opening the covers as described in chapter 3.4.

To operate this device, use a three-conductor power cord and an power outlet providing protective earth. Do not use a two-conductor extension cord or a three-prong/two-prong adapter.

If you replace the power cord provided, make sure that the replacement is rated for the power consumption stated in the specifications.

Do not position the device so that it is difficult to operate the disconnecting device.

If the equipment is used in a manner not specified by the manufacturer, its safety may be impaired.

Waste Electrical and Electronic Equipment (WEEE)

This product complies with the WEEE Directive 2002/96/EC marking requirement. The affixed product label indicates that you must not discard this electrical product in domestic household waste.

Product Category: Monitoring and Control Instrumentation

To return unwanted products, contact Bustec Ltd.

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1. Introduction

1.1. Overview

The ProDAQ 5821 series of Signal Conditioning Cards is designed to interface with a variety of sensors such as RTDs, Thermistors and Cryogenic Diodes. Different versions support modes like 2-wire, 3-wire (with compensation) and 4-wire sensor attachment and different excitation currents. In order to achieve the highest accuracy the excitation current may be automatically calibrated 'on-the-fly' using the ProDAQ 3416 24-bit Sigma-Delta ADC card and an on-board precision resistor.

Figure 1 - ProDAQ 5720 Signal Conditioning Carrier with
ProDAQ 5821 RTD Signal Conditioning Card

The ProDAQ 5821 card is designed to work with the ProDAQ 3416 16-ch, 24-bit Sigma-Delta ADC function card installed in one of the ProDAQ function card carriers for VXI or LXI systems. The connection between the ADC function card and the signal conditioning card is done via a standard ProDAQ 8010 SCSI-style data I/O cable. It carries the analog signals as well as the control signal for the conditioning card.

The control of the signal conditioning card is done via an additional VXIplug&play driver, which links to the standard ProDAQ 3416 driver dynamically. In this way, drivers for different signal conditioning cards can be used at the same time with the ProDAQ 3416 driver.

1.1.1. ProDAQ 5720 Signal Conditioning Carrier

The ProDAQ 5720 can host up to two signal conditioning cards of the 5820 Series. It provides power and cooling to the cards but provides no functionality of its own. It is designed to be mounted in a standard 19" rack.

1.2. Features

The ProDAQ 5821 RTD Signal Conditioning Card provides excitation current, compensation modes, gain etc for resistive type sensors such as:

Resistance Temperature Detectors (RTD)

A RTD sensing element consists of a wire coil or deposited film of pure metal. The element's resistance increases with temperature in a known and repeatable manner. RTD's exhibit excellent accuracy over a wide temperature range and represent the fastest growing segment among industrial temperature sensors. Their advantages include a large

temperature range (typically -260 to 850°C), a low drift per year (ordinary RTD's typically drift less than 0.1°C/year), a good linearity (better than thermocouples) and an industrial standardization.

Thermistors

Thermistors are thermally sensitive resistors whose prime function is to exhibit a large, predictable and precise change in electrical resistance when subjected to a corresponding change in body temperature. Negative Temperature Coefficient (NTC) thermistors exhibit a decrease in electrical resistance when subjected to an increase in body temperature and Positive Temperature Coefficient (PTC) thermistors exhibit an increase in electrical resistance when subjected to an increase in body temperature. Because of their very predictable characteristics and their excellent long term stability, thermistors are generally accepted to be the most advantageous sensor for many applications including temperature measurement and control. Thermistors typically achieve a high precision within a limited temperature range, typically −90 °C to 130 °C.

Cryogenic Diodes

Diode temperature sensors are based on the fact that the voltage drop across a forward biased PN junction is a function of temperature. This voltage drop is determined by the nature of the semiconductor. Diodes are usable from 1.4 Kelvin to 325 Kelvin, but are more frequently used at 4.2 Kelvin and above. This temperature range can be covered by a single device. Because diodes follow a standard calibration curve with reasonable accuracy, and because a single device can cover this broad temperature range, diodes are widely used in instrumentation and control systems for helium liquefiers, cryogenic distribution systems and similar equipment. (Cryogenic diodes are supported only by the -BB version of the ProDAQ 5821)

With resistive devices, the lead wire resistance directly affects its accuracy. The error can be quite large, depending on the lead wire resistance. The ProDAQ 5821 supports different types of connection schemes for the sensors to compensate for the lead wire resistance.

2-wire

One lead wire is connected to each lead of the sensor. This arrangement is suitable for uses where the lead wire resistance may be considered as a constant in the circuit; where changes in the lead wire resistance due to ambient temperature changes can be ignored or where the lead resistance is a fraction of the sensor resistance.

3-wire

This is the most common of RTD configurations. One lead wire is connected to one lead of the element and two lead wires are connected to the other lead. A special built-in compensation circuit “adds” the fourth wire (ProDAQ 5821-Bx only), providing a precision comparable to the 4-wire compensation mode while allowing for less expensive cabling.

4-wire

The most accurate of the RTD configurations, this element uses two wires for each lead of the sensor. By measuring the voltage directly at the sensor, compensation is made for the resistance in each lead wire, allowing for a highly-accurate temperature measurement.

2. Getting Started

The ProDAQ 5820 series signal conditioning cards are factory mounted into the ProDAQ 5720 carrier. There are no customer serviceable parts inside the ProDAQ 5720.

2.1. Mounting the ProDAQ 5720 into a 19” rack

The ProDAQ 5720 comes with two mounting brackets for standard 19” racks. To support different cabling options, these mounting brackets can be attached to the ProDAQ 5720 in four different ways:

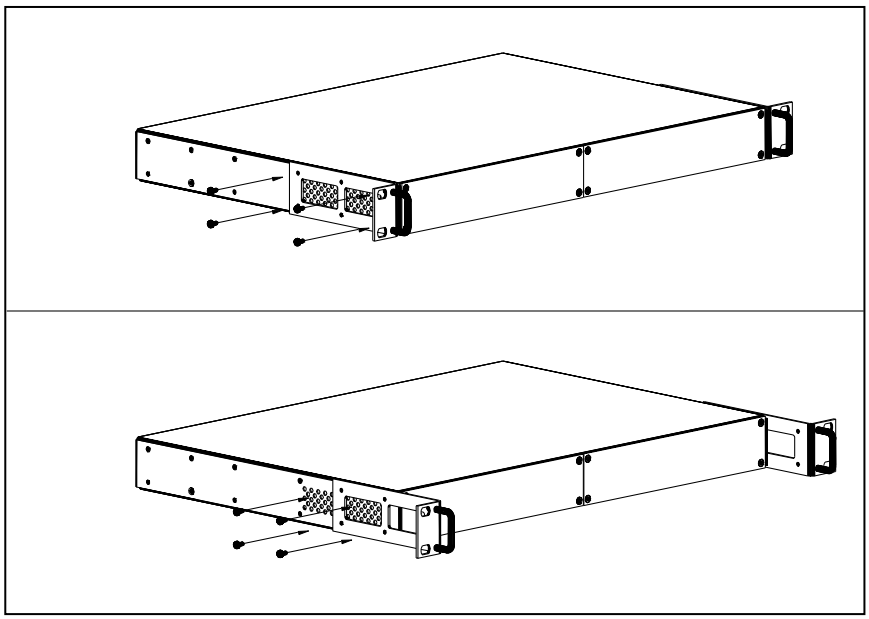


Figure 2 - ProDAQ 5720 Front Rack-mount Options

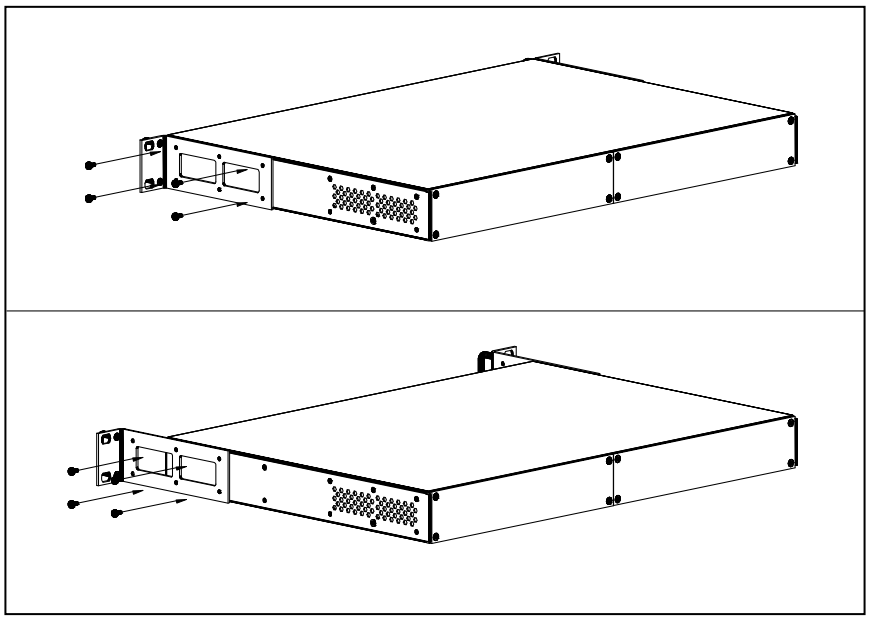


Figure 3 - ProDAQ 5720 Rear Rack-mount Options

The ProDAQ 5720 carrier power supply accepts 115V/230V AC at 47-63Hz via a standard IEC inlet on the rear.

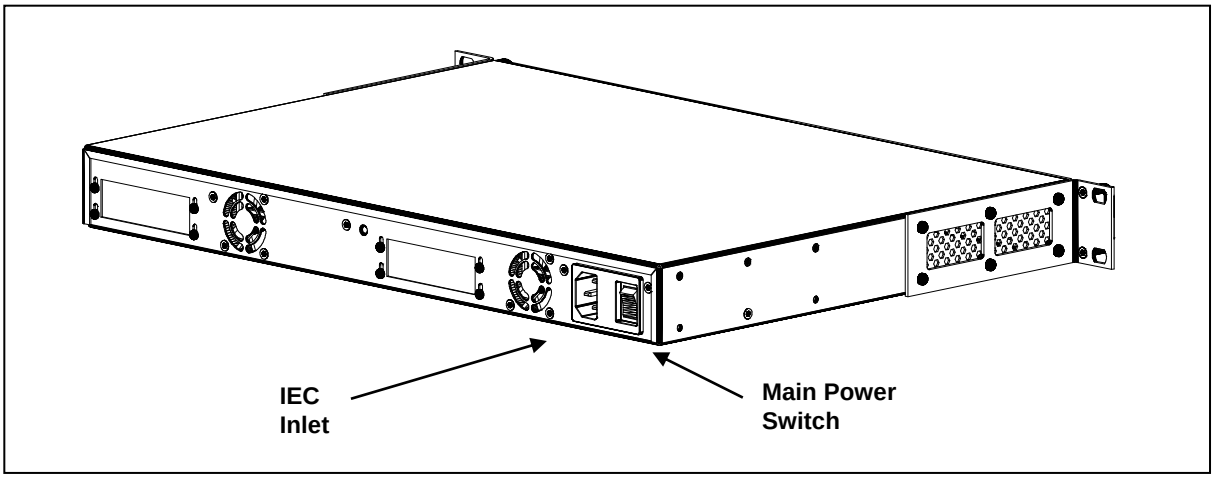
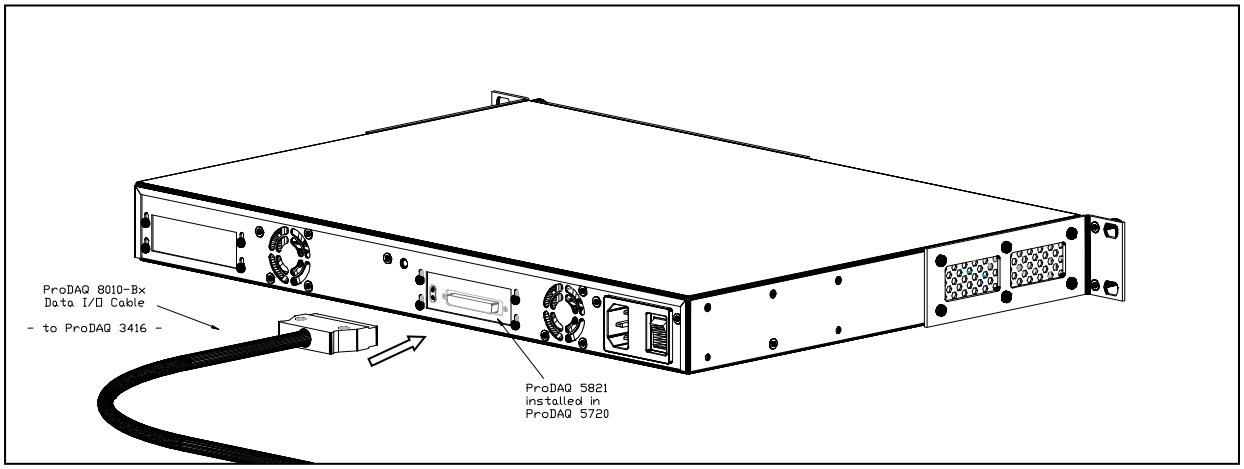


Figure 4 - ProDAQ 5720 Rear View

2.2. Connecting to a ProDAQ 3416 ADC Function Card

For the connection between the ProDAQ 5821 Signal Conditioning Card and a ProDAQ 3416 ADC Function Card a standard ProDAQ 8010-Bx series data I/O cable is used. The ProDAQ 5821 is equipped with a standard 50-pin SCSI connector on its rear panel to attach the cable to.



2.3. Connecting your Sensors

The ProDAQ 5821 uses 4-pole, 3.5mm pitch pluggable terminal block style connectors for the sensor connection (Weidmüller BL 3.5/04/180F SN BK, P/N 1615800000). Lead wires of sizes between 28 AWG and 14 AWG (0.2 mm^2 to 1.5 mm^2) can be directly inserted into the plug and are secured by a clamping yoke screw system.

Figure 5 - Sensor Connector

Once plugged in, the connector can be secured by two screws to the socket.

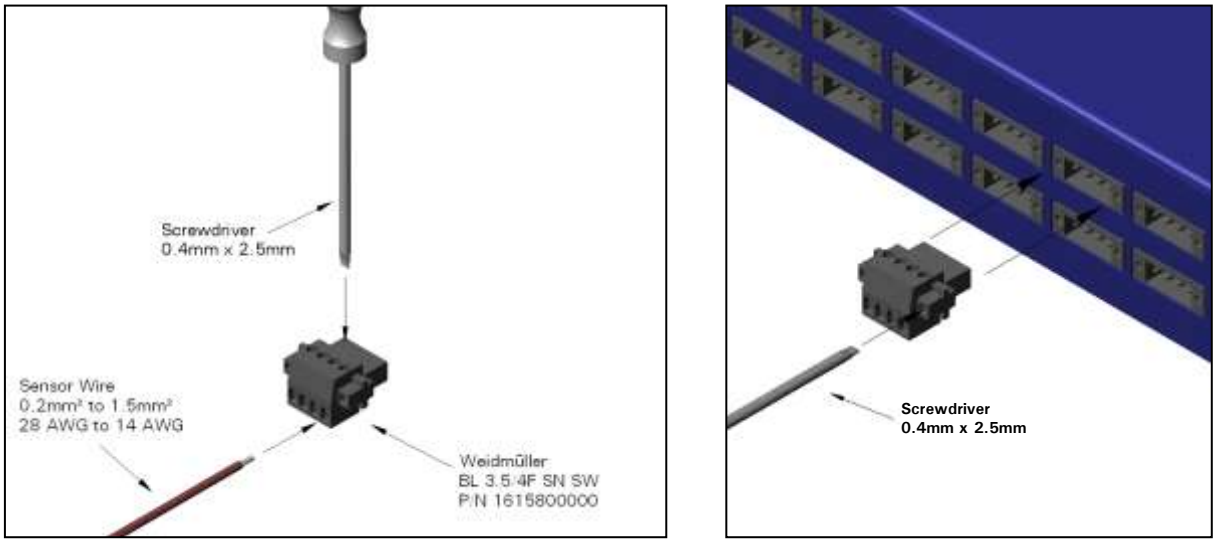


Figure 6 - Wire and Plug Assembly

Each connector has four positions for connecting excitation and sensing leads dependent on the chosen configuration.

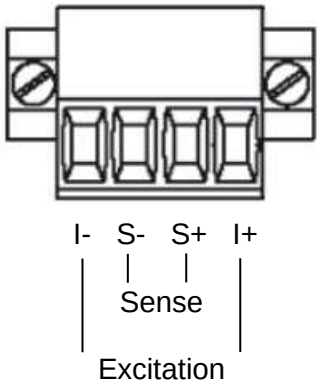


Figure 7 Connector Pin-out

The ProDAQ 5821 comes in different versions. Only the -Bx versions are equipped internally with relays to make necessary connections, for example between I+ and S+ in 2-wire mode; the -Ax versions do not support the configuration of the channels for different connection modes by software.

2.3.1. 2-Wire Configuration

ProDAQ 5821-Ax versions

The ProDAQ 5821-Ax versions do not support the channel configuration for different sensor connections. It is required instead that the wiring of the input connector is made accordingly. For a 2-wire configuration, this requires to add shorting links on the input connector between I+/S+ and S-/I- as shown in Figure 8 .

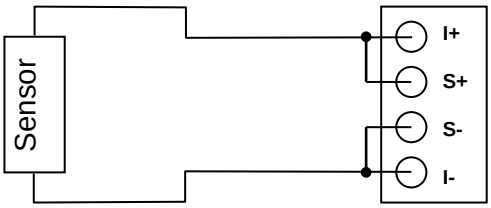


Figure 8 - ProDAQ 5821-Ax 2-wire sensor connection

ProDAQ 5821-Bx versions

The ProDAQ 5821-Bx versions support the channel configuration for the different sensor connections internally. To connect to your sensor in a 2-wire configuration, simply attach the lead wires to the excitation signal contacts of the plug (I+/I-). The connection to the sensing inputs is made internally in the ProDAQ 5821 when configuring the particular channel for 2-wire mode via the driver functions. No external shortening links are necessary between I+/S+ and S-/I-.

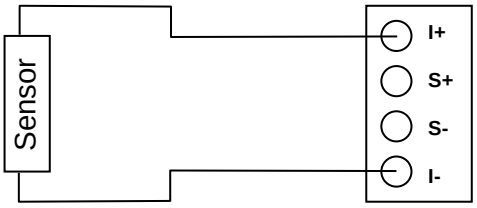


Figure 9 - ProDAQ 5821-Bx 2-wire sensor connection

2.3.2. 3-Wire Configuration

ProDAQ 5821-Bx versions only

To connect a sensor using 3 wires, connect the lead wires to the excitation contacts and additionally the negative sense contact (S-) of the plug. The compensation for the missing fourth wire is automatically activated when configuring the particular channel for 3-wire mode via the driver functions.

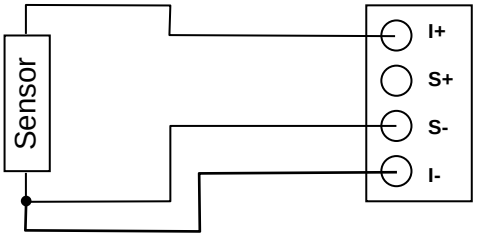


Figure 10 - ProDAQ 5821-Bx 3-wire sensor connection

2.3.3. 4-Wire Configuration

For the 4-wire configuration separate sense and excitation wires need to be connected to the sensor. This configuration yields the highest measurement accuracy.

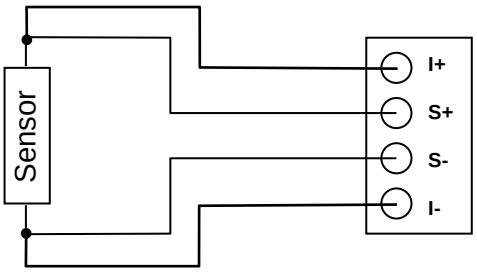


Figure 11 - 4-wire sensor connection

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3. The ProDAQ 5821 Soft Front Panel

The purpose of soft front panel application is to demonstrate the instrument's abilities. The 5821 SFP connects to a 5821 via its control 3416. After the start of the soft front panel application, the user has the choice to either enter the address information (VISA resource specification and function card number) of the function card the soft front panel application shall connect to or else to use the built-in "Auto Find" functionality in order to discover accessible ProDAQ 3416/5821 cards.

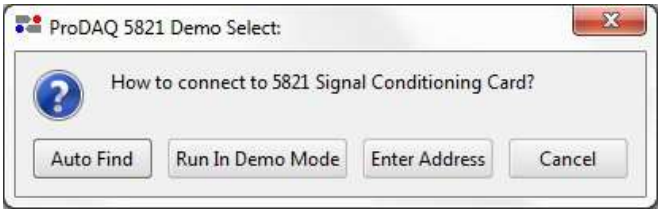

Figure 12 – Function Card Selection

Please note that the "Auto Find" find functionality will only inspect network resources that are known to the VISA library to avoid unwanted accesses of network resources that might be unintentionally reachable via the local network. For VXIbus resources, running the VISA resource manager prior to running the soft front panel application is necessary for both the "Auto Find" functionality to work and in general the access to the function card to be possible.

If "Auto Find" is selected and there are multiple ProDAQ 3416/5821 cards, the user will be presented with a dialog box showing all available ProDAQ 3416 cards, allowing the selection of one function card to connect to. It is important that the user choose a 3416 card that has a 5821 connected to it, otherwise an initialization error will occur. The soft front panel is not designed to handle more than one function card and signal conditioning card at a time. If there is only one function card / signal conditioning card available, the dialog box will not appear and the soft front panel application will automatically establish communication to this instrument. If no ProDAQ 3416/5821 is available in your system, the soft front panel application can be run in demo mode, allowing operation of all controls, as if connected to an instrument.

If "Enter Address" is selected, the user is presented with a dialog box that allows entering the VISA resource string and the 3416 function card number directly, as shown in Figure 13.

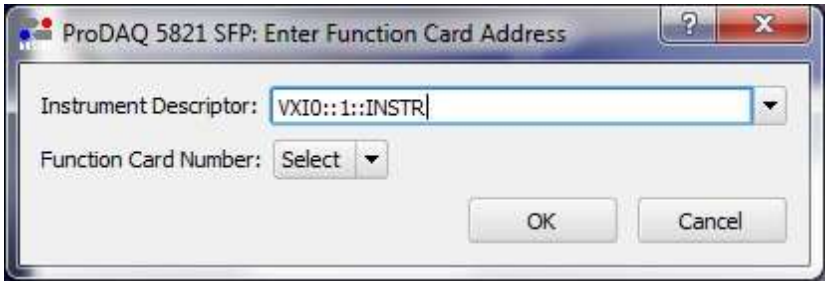

Figure 13 – Entering Function Card Address

The resource string and range of function card numbers differ depending on the ProDAQ Motherboard or Carrier that the ProDAQ 3416 is installed on. Please refer to the motherboard/carrier user manual for more information.

After initializing the ProDAQ 3416 function card and ProDAQ 5821 signal conditioning card, during which a splash screen is displayed, the soft front panel window shown in Figure 14 will appear.

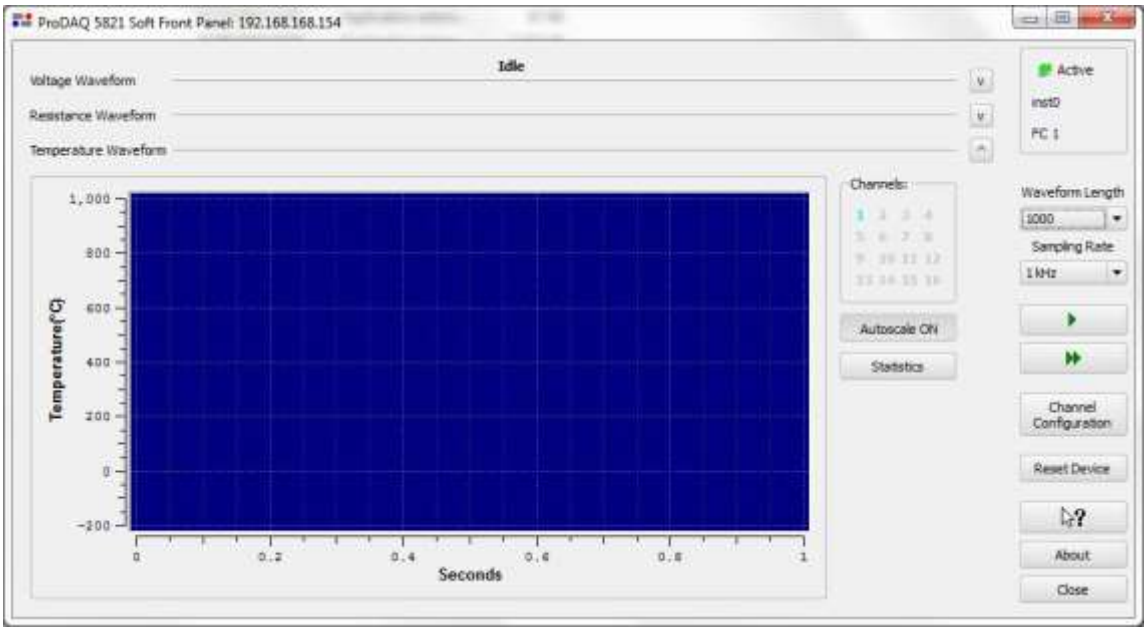

Figure 14 – 5821 SFP Initial Start Up Screen

The soft front panel has separate graphical displays for the three different types of measurement possible using the ProDAQ 5821, namely Voltage, Resistance and Temperature. Depending on the channel configuration, the graph for the channel will be shown in the related graphical display. Thus, all channels set to Voltage will be grouped together in the Voltage Waveform graphical display and similarly for Resistance and Temperature. Only channels that are 'Enabled' will be displayed.

After startup, only the graphical display for the temperature display is visible, as by default only channel one, which is set for PT-100 measurement, is enabled. Using the buttons to the right of the dividers, you can hide/unhide each of the displays. Clicking a down arrow will open a display and the arrow will change to an up arrow. Clicking an up arrow will close a display and the arrow will change to a down arrow.

Figure 15 – 5821 SFP Start Up Screen Drop Down Arrows

3.1. Channel Configuration

To configure the channels, select the "Channel Configuration" button on the right of the soft front panel. This will open up a dialog box, allowing the operator to set the configuration for each channel as shown in Figure 16. By default, channel 1 is enabled and the sensor type set to PT-100.

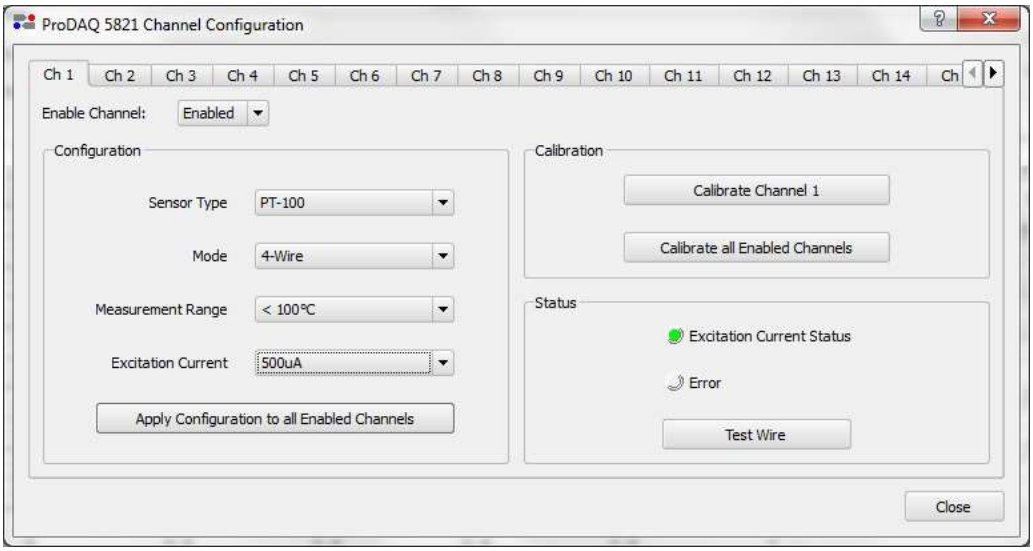

Figure 16 – 5821 Channel Configuration Dialog

All other channels are disabled. To enable or disable a channel use the drop-down box located on the top left of the configuration channel dialog box, as shown in Figure 17.

Figure 17 – 5821 SFP Enable and Disable Channels

The control of each channel is separated using tabs. To control channel 10, for example, it is necessary to click the 'Ch 10' tab. Each tab is functionally identical. The controls in each tab are grouped in three group boxes, a 'Configuration' group, a 'Calibration' group and a 'Status' group.

The controls in the 'Configuration' group, shown in Figure 18, allow the operator to choose the sensor type, the sensor configuration mode, the measurement range and, for RTD and Resistance measurements, the ability to turn the excitation current on and off. Settings take place immediately after a change has been selected. It is also possible to apply the channel configuration settings to all other channels that have been enabled.

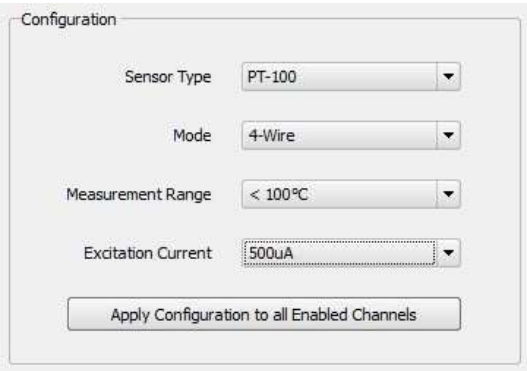

Figure 18 – 5821 SFP Configuration Group

The possible sensor types available are Temperature (PT-100, PT-500 and PT-1000 RTDs), Resistive and Voltage type sensors. A drop-down box, shown in Figure 19, allows the operator to select the type of sensor being used.

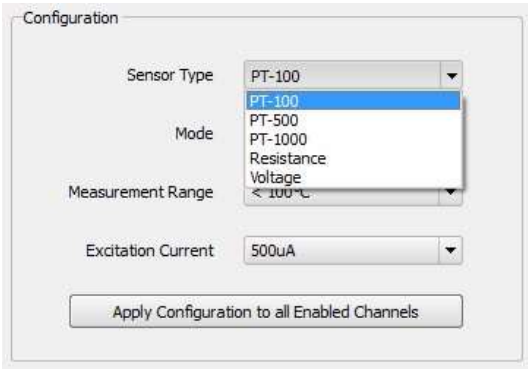

Figure 19 – 5821 SFP Sensor Selection

Depending upon the version of the 5821, both the temperature and resistive sensors may be operated in three different modes, namely 2-wire, 3-wire and 4-wire mode. These modes are described in section **Error! Reference source not found.**. Note that the 5821-Ax only has 4-wire mode available.

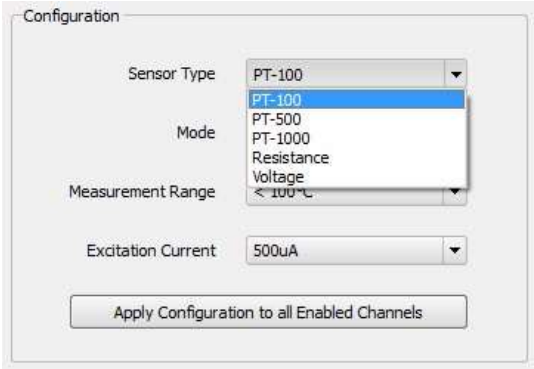

Figure 20 – 5821 SFP Mode Selection, RTD or Resistor

Both the temperature and resistive sensors generally require an excitation current. This current may be switched on or off. For the 5821-xA the current is nominally 500µA. For the 5821-BB a second current level of nominally 10µA is also available. During calibration the set current is calibrated and used during Data Acquisition (DA). The current is also adjusted in order to be as close as possible to the nominal value. This feature is useful for cryogenic diodes, for example, where the diode output voltage over temperature is normally specified for a given current level, generally 10µA.

If the selected sensor type is ‘Voltage’ then two modes of operation are possible, namely Differential Voltage and Single Ended Voltage, as shown in Figure 21. A differential voltage signal has three outputs, namely a ground reference and two signal lines that are in opposite polarity (balanced) around the ground reference. In this case the I- pin of the connector should be used as the ground reference and S+/S- use as the signal inputs. A single-ended voltage signal has two outputs, namely a ground reference and a signal line. In this case S+ should be used as the signal input and S- as the ground reference input. Note how excitation current is switched off for voltage sensors.

Each sensor type has a number of Measurement Ranges associated with it. In order to ensure the highest measurement accuracy it is important that the operator selects the appropriate range. For the PT-100, PT-500 and PT-1000 the measurement units are °C and all associated waveforms will display on the Temperature graph.

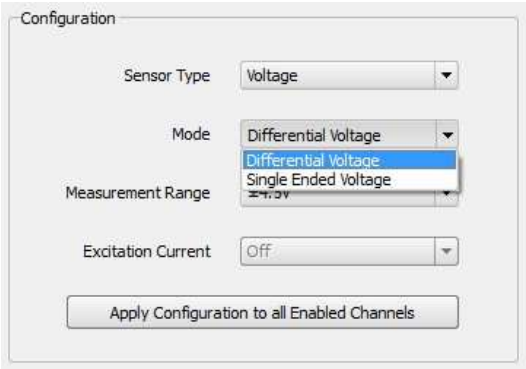

Figure 21 – 5821 SFP Mode Selection, Voltage

As shown in Figure 22, for the PT-100 there are four available measurement ranges, < -80°C, < 100°C, < 500°C and < 850°C. The PT-500 and PT-1000 sensors have different ranges, namely < -100°C, < 0°C, < 300°C and < 850°C.

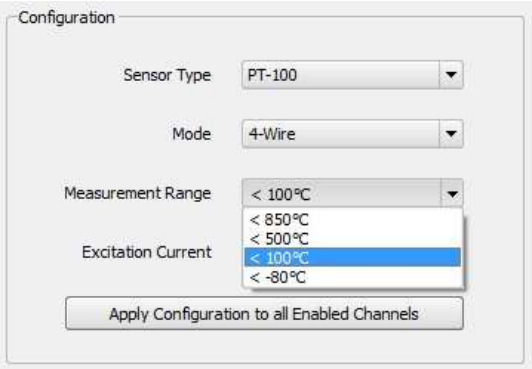

Figure 22 – 5821 SFP Measurement Range Selection, Temperature Sensors

If the measured temperature is greater than the chosen measurement range then the red Error LED will light. In Figure 23 a 100Ω resistor is connected to channel 1, simulating a PT-100 operating at 0°C. The maximum temperature of the selected measurement range is -80°C and thus the temperature is outside the range. Hence the Error LED lights.

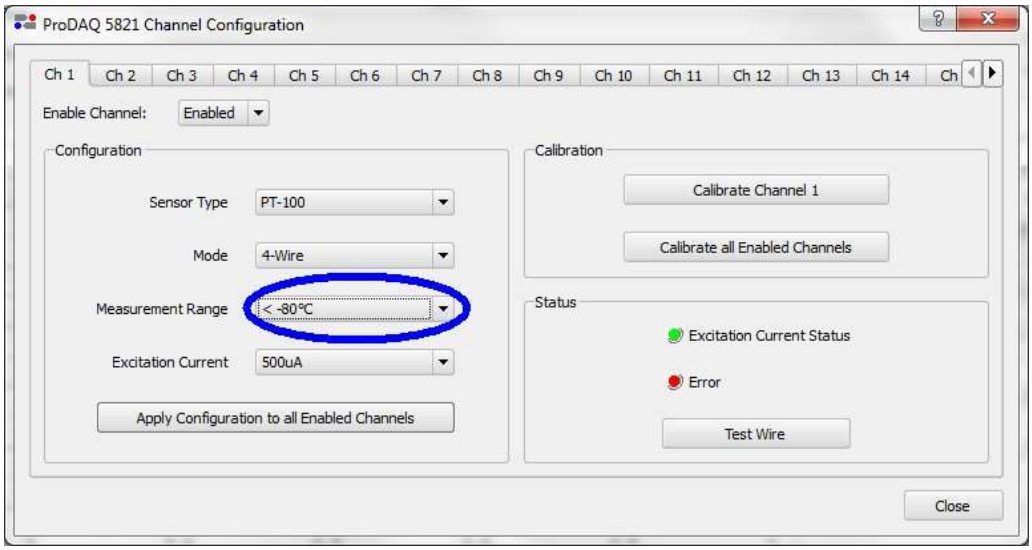

Figure 23 – 5821 SFP Measurement Range Selection too Low, PT-100

If the ‘Resistance’ sensor type with 500µA of current is chosen then nine resistance ranges are available, varying from < 70Ω up to < 20kΩ. Again, as with Temperature Sensors, if the measured resistance is greater than the chosen measurement range then the red Error LED will light.

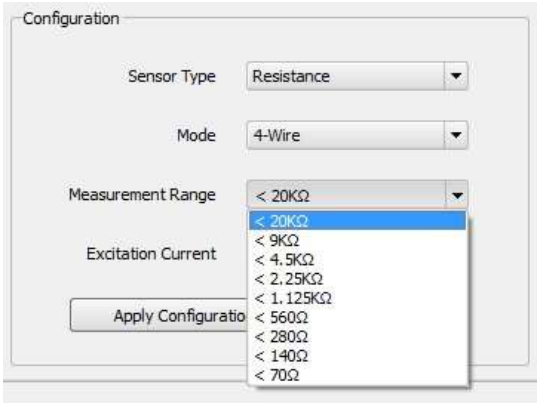

Figure 24 – 5821 SFP Measurement Range Selection, Resistive Sensors, 500µA current

If the current setting is 10µA (-BB only) then the resistive ranges vary from < 4kΩ to < 1MΩ, as shown in Figure 25.

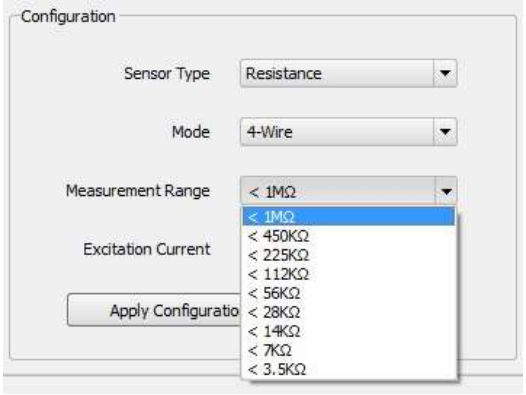

Figure 25 – 5821 SFP Measurement Range Selection, Resistive Sensors, 10µA current

For Voltage sensors the measurement ranges vary from ±35mV to ±10V.

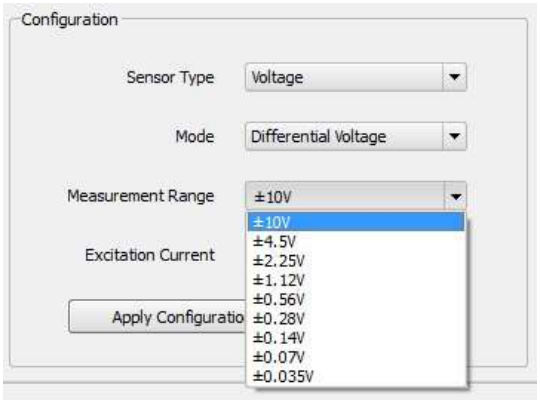

Figure 26 – 5821 SFP Measurement Range Selection, Voltage Sensors

3.2. Channel Calibration

The 3416/5821 system has factory default calibration values which allow an operator to make extremely accurate measurements without performing further calibration. However, for the highest accuracy, it is recommended that an 'online' calibration be made after the system has warmed-up sufficiently (30 minutes minimum). To make an online calibration the operator simply has to click the button 'Calibrate Channel' as shown in Figure 27. Alternatively all enabled channels may be calibrated sequentially using the 'Calibrate All Enabled Channels' button. Note that this might take some time if a lot of channels are enabled.

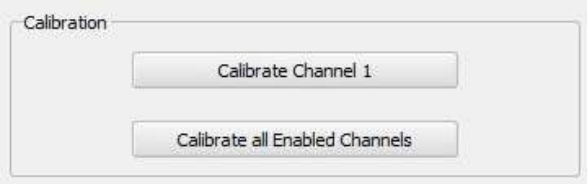

Figure 27 – 5821 SFP Calibration Frame

An online calibration makes a calibration at the configuration settings chosen by the operator. Furthermore, in the case of temperature and resistive sensors it automatically calibrates current by using the 3416 to measure the voltage across the internal precision resistor used for setting the excitation current. This high precision resistor has a tolerance of 0.01% and a temperature drift of just 1ppm/°C.

Calibration may be made with or without a sensor connected. If no sensor is connected the software detects this fact and automatically grounds the output of the current source in order to allow current calibration to be made. If a sensor is detected then the current flowing through that sensor is calibrated and adjusted to the set value (500µA or 10µA).

The calibration process involves three steps, all of which are invisible to the user. First a voltage calibration of the signal path is made, then a voltage calibration of the current path is made and finally a calibration of the excitation current is made. In this way the highest possible accuracy is achieved.

3.3. Channel Status

Figure 28 shows a screenshot of the Channel Status group box. It contains two LED controls and a Test Wire button. The Excitation Current Status LED indicates the status of the excitation current. If the excitation current is off then the Excitation Current Status LED will be off (grey, as shown in Figure 28).

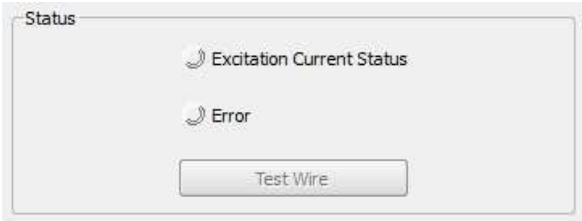

Figure 28 – 5821 SFP Channel Status

If the excitation current is turned on and is flowing correctly then the Excitation Current Status LED will be green, as shown in Figure 29.

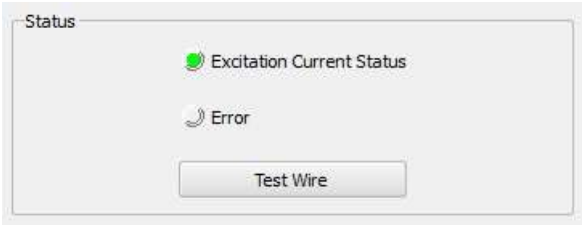

Figure 29 – 5821 SFP Excitation Current Status LED green

If the excitation current is turned on but is not flowing correctly then the Excitation Current Status LED will be red, as shown in Figure 30. Note that the error LED has not indicated an error. Thus, the operator needs to check that the status of both LEDs is as expected.

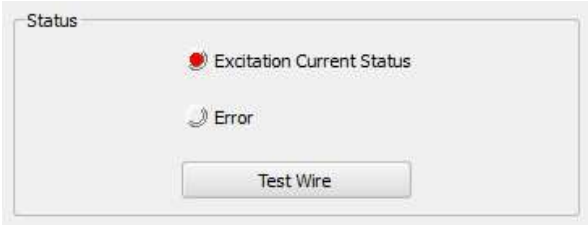

Figure 30 – 5821 SFP Excitation Current Status LED red

The Error LED is normally grey but will go red if a fault is detected. An example of a fault is signal over-range detection. If this LED is red it is recommended firstly to check channel configuration and secondly to test for broken wires using the Test Wire button. Note that the error LED operates using polling and thus it might several seconds before the LED reacts.

The Test Wire button will check whether any wires from the sensor that are connected to the channel are broken. It is disabled if excitation current is off and is not available for Voltage sensors. The number of wires checked depends on the chosen mode, 4-wire, 3-wire or 2-wire. In 4-wire mode all four wires are checked, in 3-wire mode the S+ input is not checked and in 2-wire mode only I+ and I- are checked.

Testing for broken wires involves a two step process. The first step involves checking the I+ and I- wires. If these are determined to be ok then S+ and S- are checked and it can be determined whether S+, S- or both are broken. If a wire is ok a green message indicates this while a broken wire has a red message.

If I+ or I- are broken it is not possible to determine which and thus a yellow message is displayed, indicating that one of the wires or possibly both are broken and thus they should be checked. The signal wires are shown in blue with status unknown. After fixing these wires the operator should run Test Wires again to confirm that all wires are now ok.

Figure 31 to Figure 35 show various simulated broken wire conditions.

Figure 31 – 5821 4-Wire Mode All Wires OK

Figure 32 – 5821 4-Wire Mode Broken I- Wire

Figure 33 – 5821 4-Wire Mode Broken S+ Wire

Figure 34 – 5821 3-Wire Mode No S+ Wire so all wires OK

Figure 35 – 5821 2-Wire Mode No S+, S- Wires so all wires OK

3.4. Making a Measurement

This section describes the process of making a measurement, in order to guide the operator more clearly. Several sensor types will be considered, a PT-100 in 4-wire and 3-wire mode, a PT-1000, a PT-500, a precision high resistance sensor and a voltage sensor.

During these tests a 3416-AA, mounted in a 6100-AA, was connected to a 5821-BA via a 2m SCSI cable. The whole system was suitably warmed up.

3.4.1. PT-100 operating at 0°C

A 100Ω 0.005% 1ppm resistor was connected to channel 14 via a 30m 24AWG multi-core cable and connected in 4-wire mode. Using an 8.5digit DMM operating in 4-wire mode the resistance of the load was previously confirmed to be 100.007Ω, slightly outside the ±5mΩ specification quoted by the manufacturer. A resistance of 100.007Ω equates to a temperature of 0.018°C for the PT-100 sensor.

Channel 14 was enabled and the sensor type set to PT-100, with 4-wire mode. The current was set to 500µA. As the expected temperature was 0.018°C, the temperature range was set to < 100°C (the maximum recommended operating temperature for this range) in order to maximize the measurement accuracy. Figure 36 shows the configuration of channel 14. Note how the Excitation Current Status LED is green, indicating that current is on and flowing.

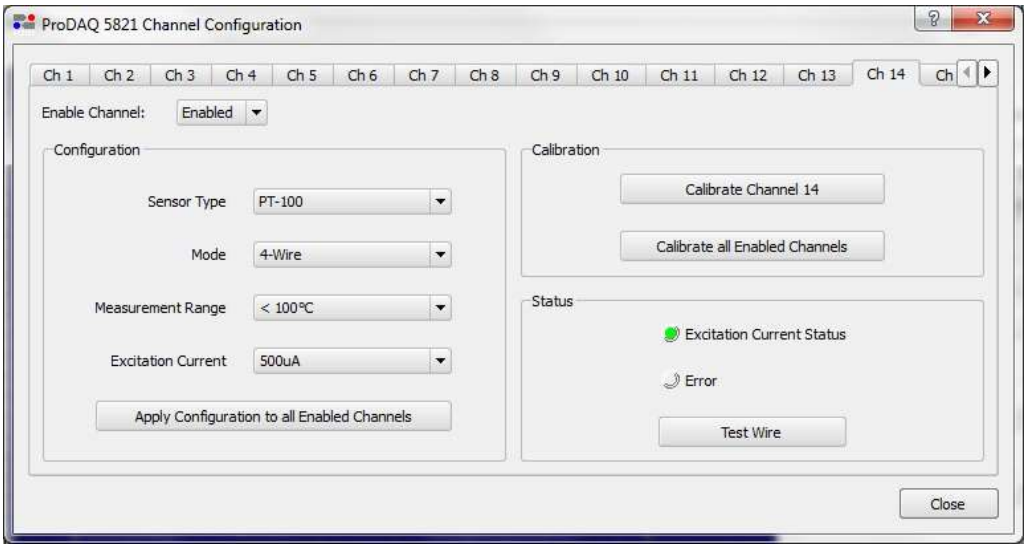

Figure 36 – Configuration of Channel 14

An online calibration of channel 14 was made and the channel configuration dialog closed. In the main panel the sample rate was set to 1ksps with 1000 samples. The test duration in this case is thus 1s. It is of course possible to sample at different sample rates and varying numbers of samples.

The green single DA button was clicked and the 1000 measurement values shown in Figure 37 captured.

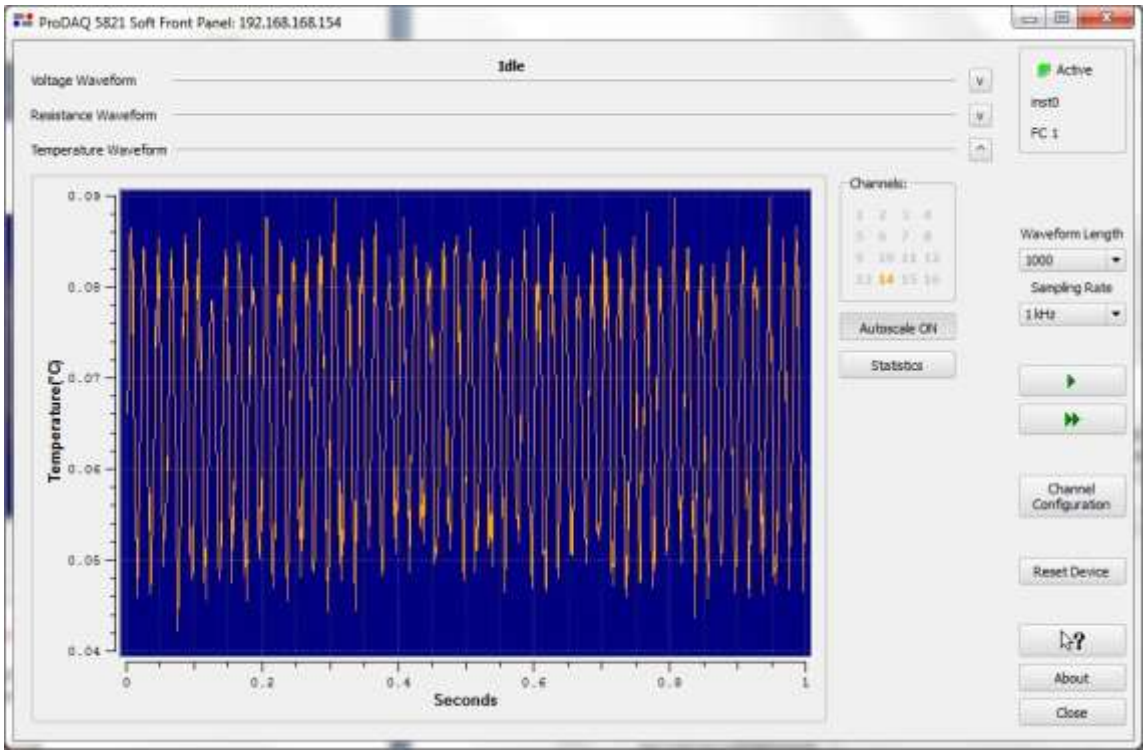

Figure 37 –Channel 14 Temperature Waveform

Clicking on the 'Statistics' button shows that the mean value of this waveform is 0.066°C, compared to the ideal value of 0.018°C for a 100.007Ω resistor, a typical error of 0.048°C. The peak to peak range of the measured values is about 0.04°C.

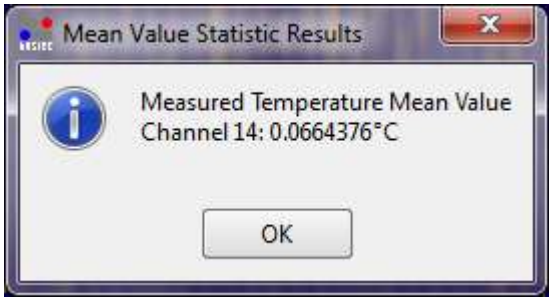

Figure 38 –Channel 14 Mean Measured Temperature

3.4.2. PT-100 operating at 0°C in 3-Wire Mode

A 100Ω 0.005% 1ppm resistor was connected to channel 1 via a 30m 24AWG multi-core cable and connected in 3-wire mode (the S+ wire was disconnected). Using an 8.5digit DMM operating in 4-wire mode the resistance of the load was previously confirmed to be 100.007Ω, slightly outside the ±5mΩ specification quoted by the manufacturer. A resistance of 100.007Ω equates to a temperature of 0.018°C for the PT-100 sensor.

Figure 39 shows the initial screen after the 'Channel Configuration' button is clicked. The Status LEDs show that the excitation current is off and also that there is an error detected.

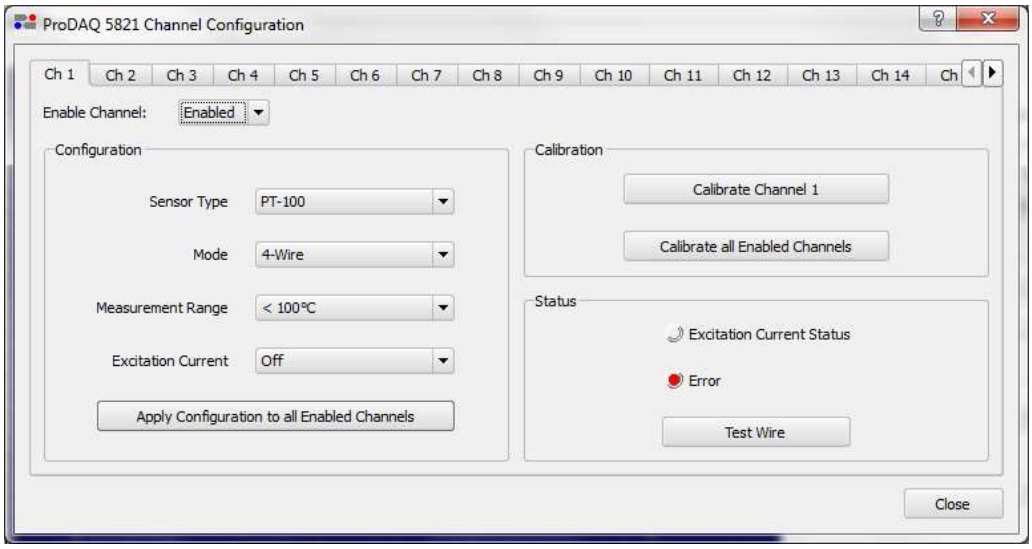

Figure 39 – Configuration of Channel 1 Initial Screen

Figure 40 shows the LED status after turning on the 500µA excitation current. The current is flowing correctly but the error flag is still red. The measurement range is set correctly to < 100°C. Note however that the chosen Mode is 4-Wire while the sensor is connected up as 3-Wire.

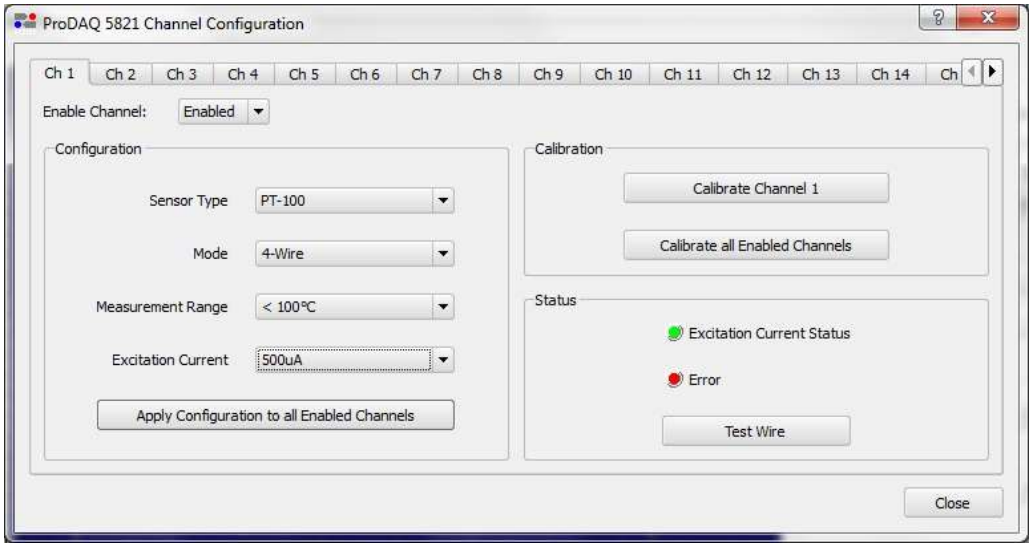

Figure 40 – Configuration of Channel 1 Excitation Current On

Changing the mode to 3-Wire eliminates the error, as shown in Figure 41.

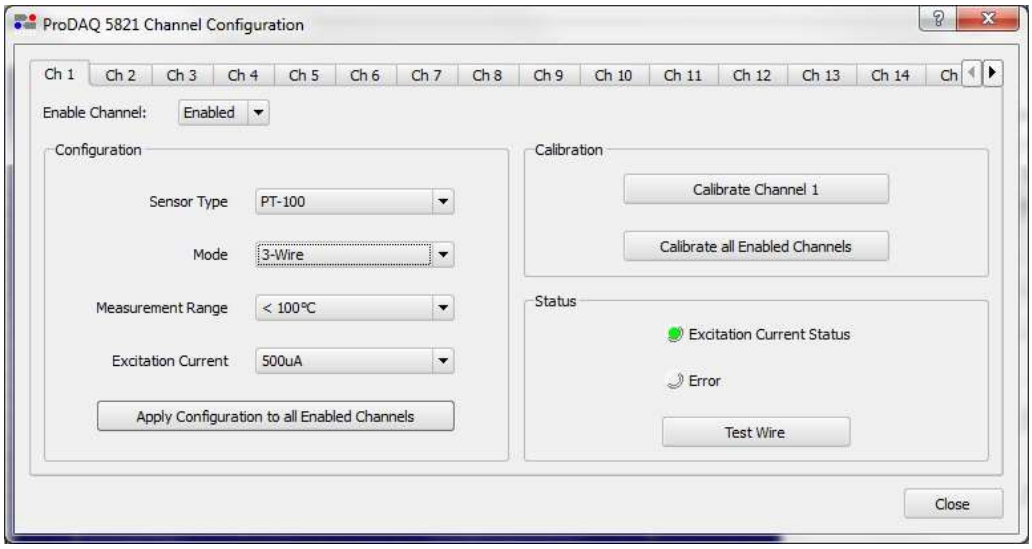

Figure 41 – Configuration of Channel 1 3-Wire Mode Selected

After calibration a measurement was made with 1000 samples at 1ksps. This is shown in Figure 42. The mean value, given in Figure 43, is -0.12°C compared to the theoretical value of 0.018°C, a difference of 0.138°C.

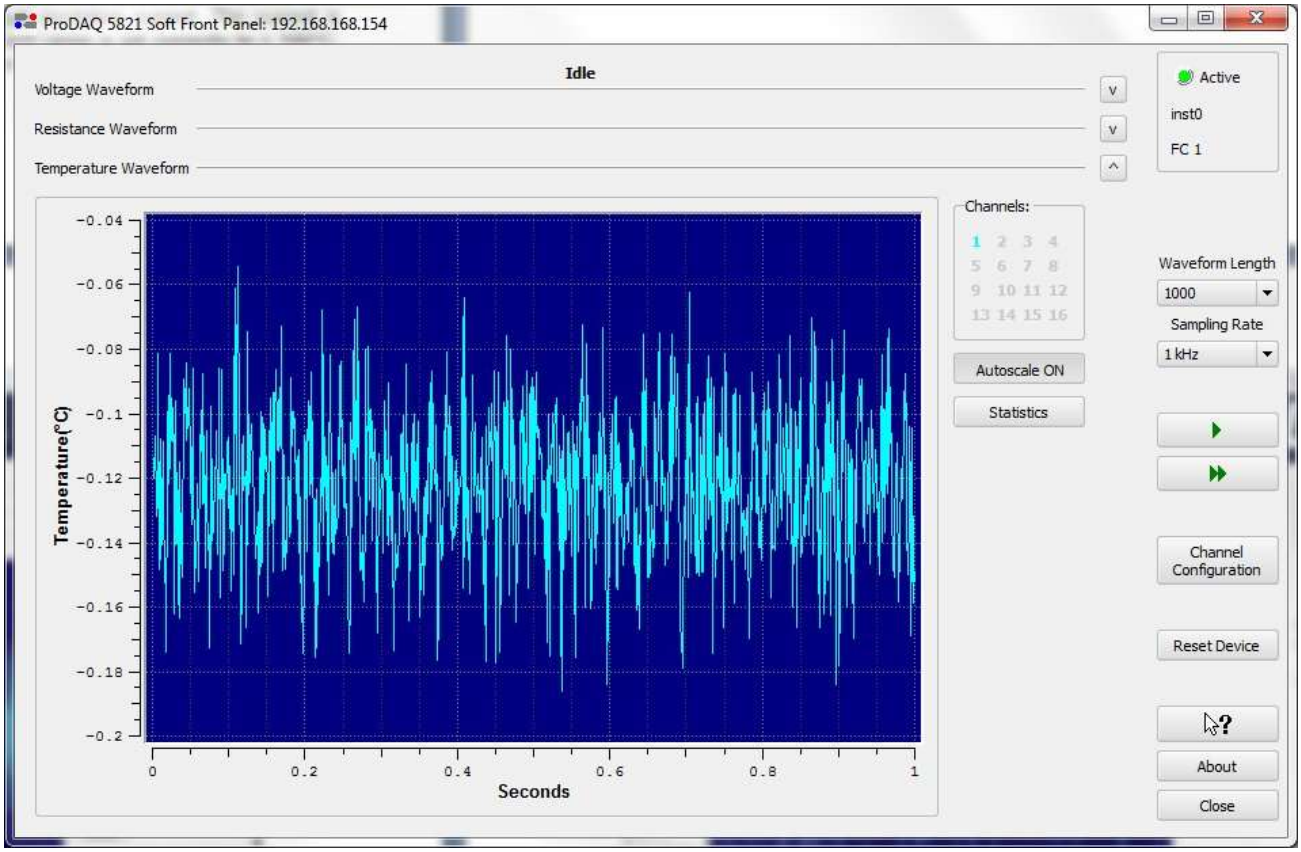

Figure 42 – Measurement of Channel 1 PT100 sensor 3-Wire Mode

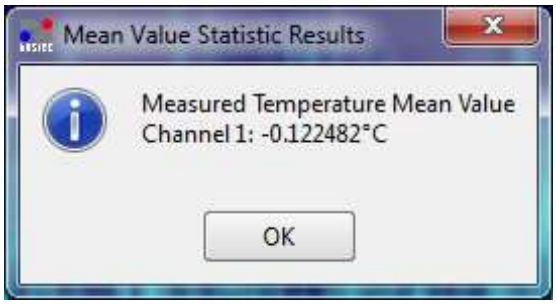

Figure 43 – Statistics Mean of Measurement of Channel 1 PT100 sensor 3-Wire Mode

In order to demonstrate how effective the 3-Wire compensation circuit is channel 1 was configured for 4-Wire mode but only 3 wires were connected to the 100Ω resistor. In order for the channel to function correctly S+ and I+ were shorted at the connector. A measurement was then made using the same measurement range.

Figure 44 shows the result. The error without using 3-Wire compensation is now about 6.5°C, about 50 times worse than using the compensation. Obviously this figure would vary with sensor resistance, cable length and size.

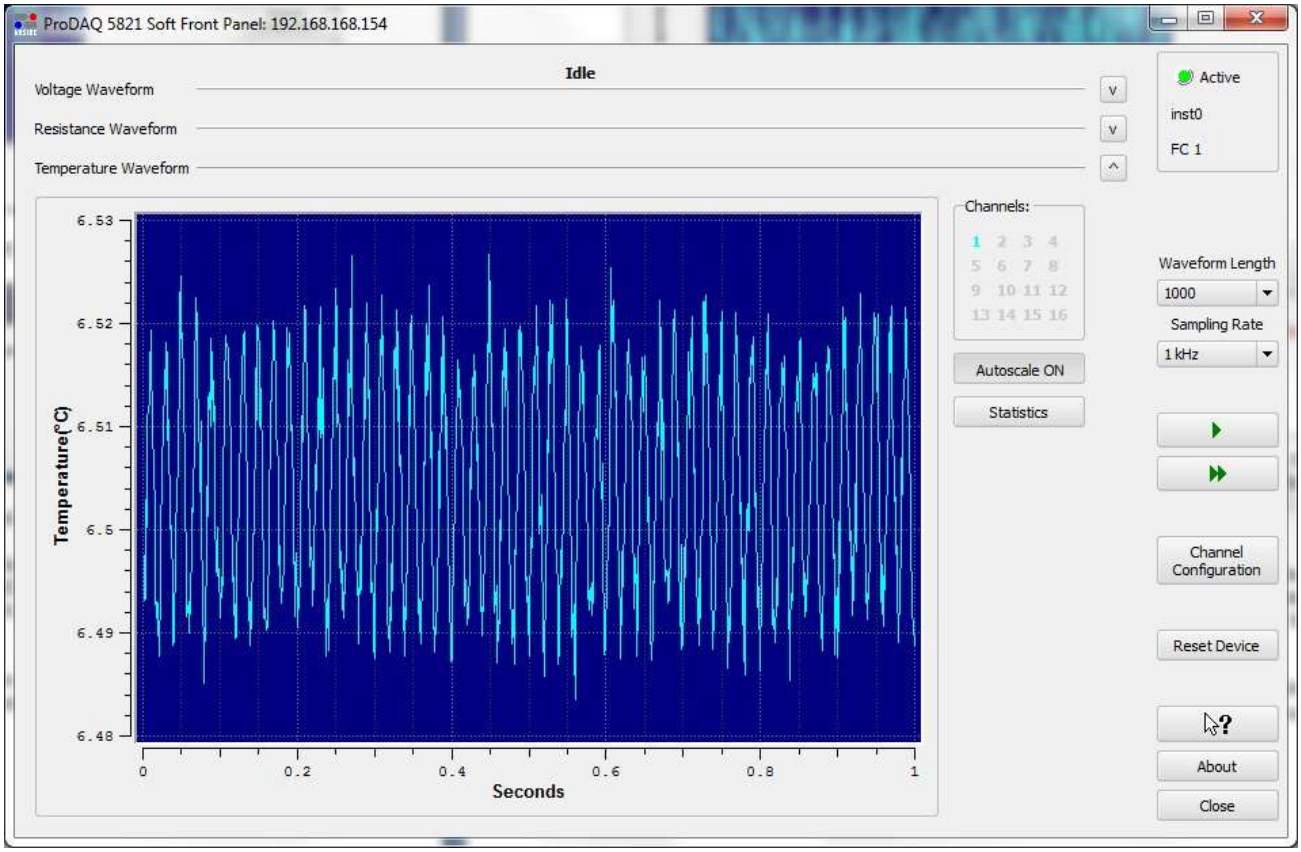

Figure 44 – Measurement of Channel 1 PT100 4-Wire Mode, S+ and I+ Shorted Externally

3.4.3. Measuring a 1.25kΩ Resistor as a PT-1000 and PT-500

A 1.25kΩ 0.01% 1ppm resistor was connected to channel 9 via a 30m 24AWG multi-core cable and connected in 4-wire mode. Using an 8.5digit DMM operating in 4-wire mode the resistance of the load was previously confirmed to be 1249.95Ω, well within the ±125mΩ specification quoted by the manufacturer. A resistance of 1249.95Ω equates to a temperature of 64.57°C for the PT-1000 sensor and 408.42°C for a PT-500.

Channel 9 was enabled and the sensor type set to PT-1000, with 4-wire mode. The current was set to 500µA. As the expected temperature was 64.57°C, the temperature range was set to < 300°C (the maximum recommended operating temperature for this range) in order to maximize the measurement accuracy. A calibration was then made and results taken.

Figure 45 shows the measured waveform and Figure 46 gives a mean value of 64.58°C, a difference of just 0.01°C from the theoretical value. It can be seen that the peak-peak variation around this mean is less than ±0.01°C.

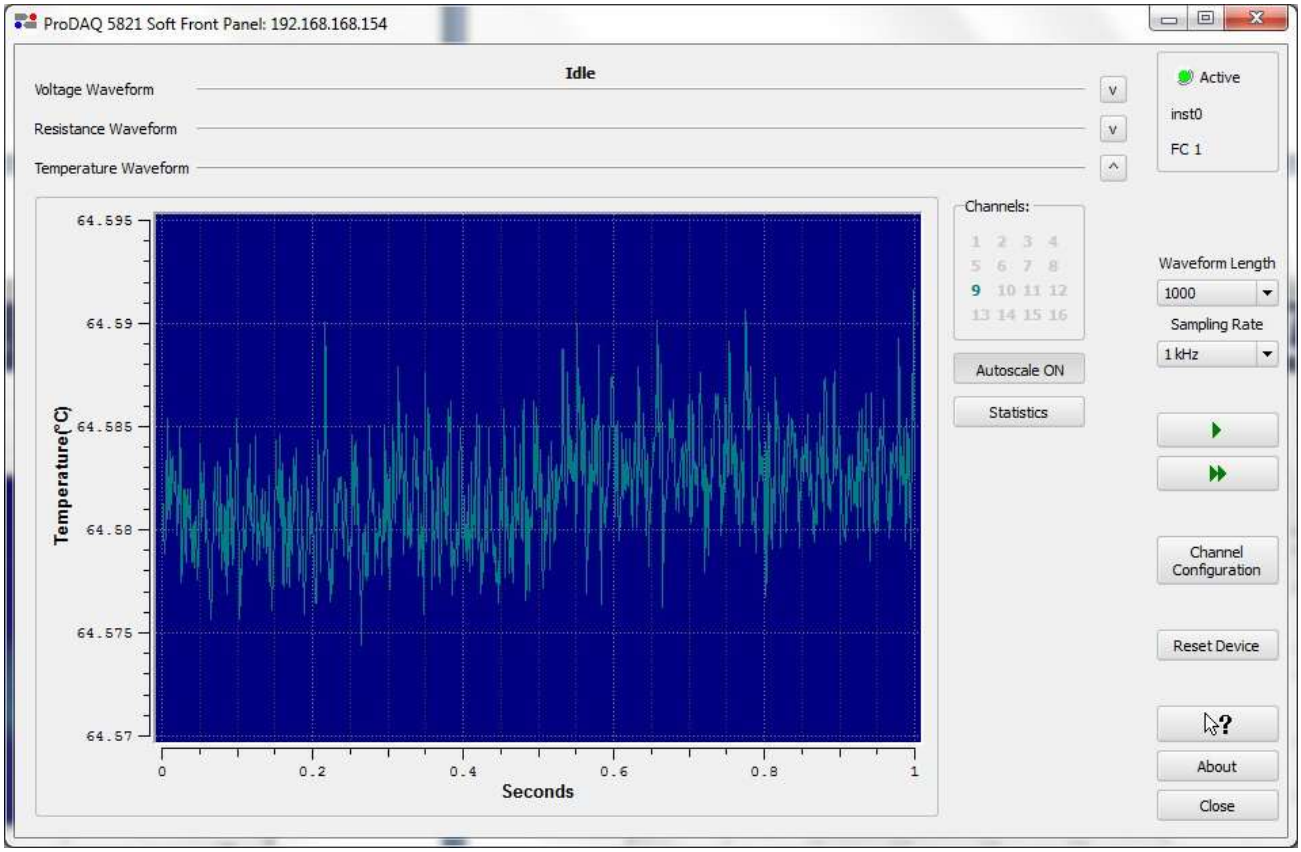

Figure 45 – Measurement of Channel 9 sensor PT-1000

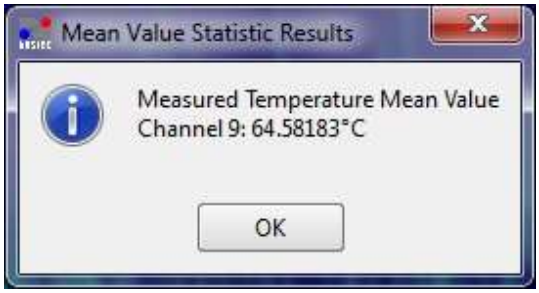

Figure 46 – Statistics Mean of Measurement of Channel 9 sensor, PT-1000

Channel 9 was then set to PT-500, with 4-wire mode. As the expected temperature was 408.42°C, the temperature range was changed to < 850°C (the maximum recommended operating temperature for this range) in order to maximize the measurement accuracy. A calibration was then made and results taken. Note that a calibration was made because the measurement range was changed.

Figure 47 shows the measured waveform and Figure 48 gives a mean value of 408.48°C, compared to the theoretical value of 408.42°C. The difference is just 0.06°C. It may be seen that the peak-peak variation around this mean is about ±0.015°C.

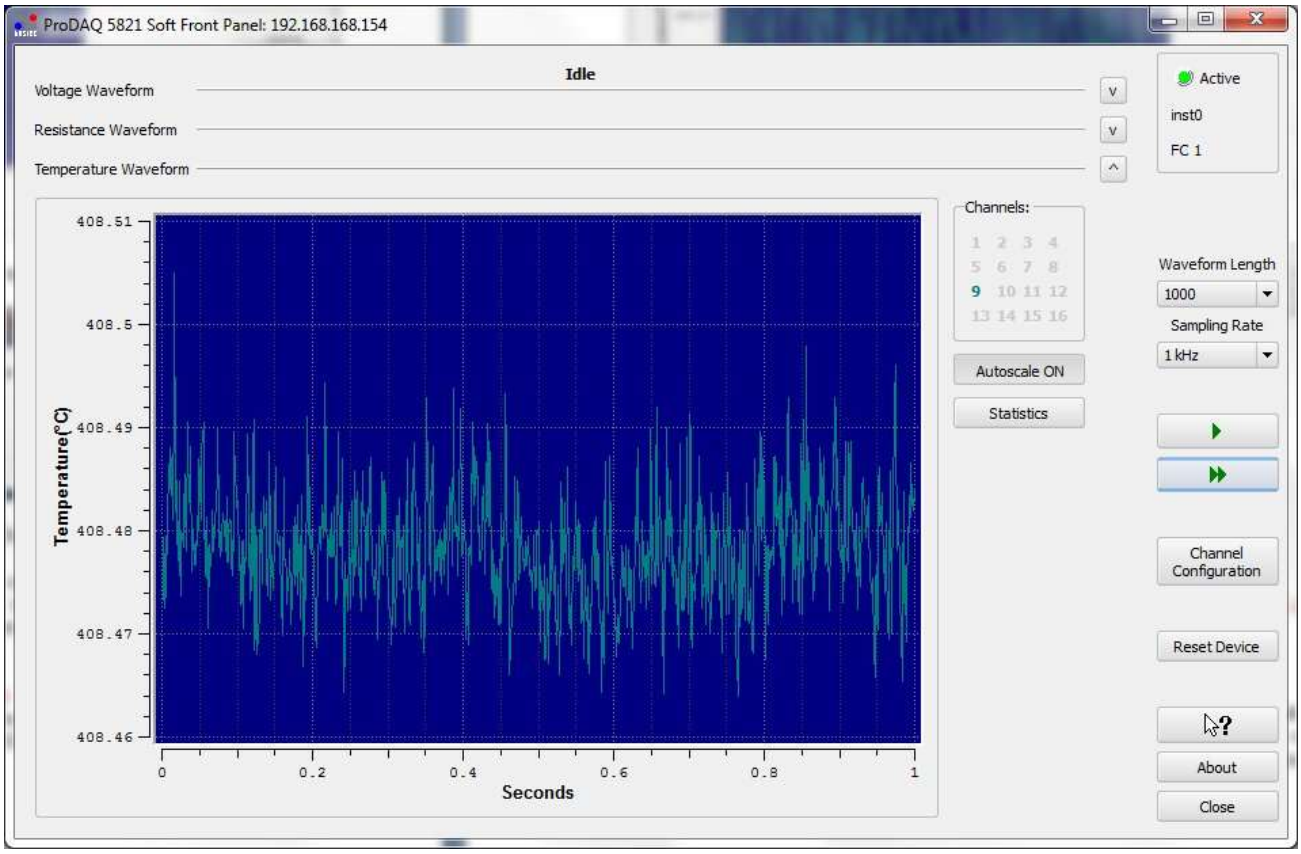

Figure 47 – Measurement of Channel 9 sensor PT-500

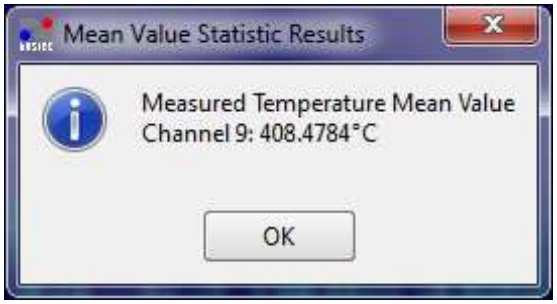

Figure 48 – Statistics Mean of Measurement of Channel 9 sensor, PT-500

3.4.4. Measuring a 5kΩ Resistor

A 5kΩ 0.01% 1ppm resistor was connected to channel 8 via a 50m 24AWG multi-core cable and connected in 4-wire mode. Using an 8.5digit DMM operating in 4-wire mode the resistance of the load was previously confirmed to be 4999.61Ω, just inside the ±0.5Ω specification quoted by the manufacturer. Figure 49 shows the final set-up.

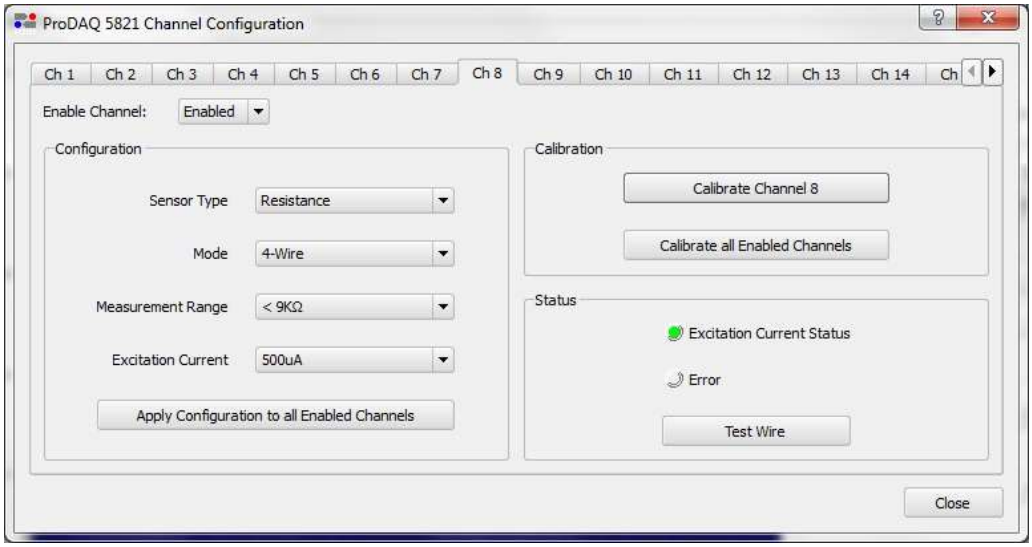

Figure 49 – Configuration of Channel 8 Resistance 4-Wire Mode Selected

Channel 8 was calibrated and the configuration dialog box closed. A test was made using 50 samples at 100Hz sampling rate. Figure 50 shows the result. The 50 measurements vary from 4999.64Ω to 4999.73Ω. Figure 51 shows that the mean resistance value is 4999.69Ω, a difference of just 80mΩ or just 0.0016% from the value calibrated using an 8.5 digit DMM. The peak-peak variation around the mean is about ±40mΩ or ±0.0008%.

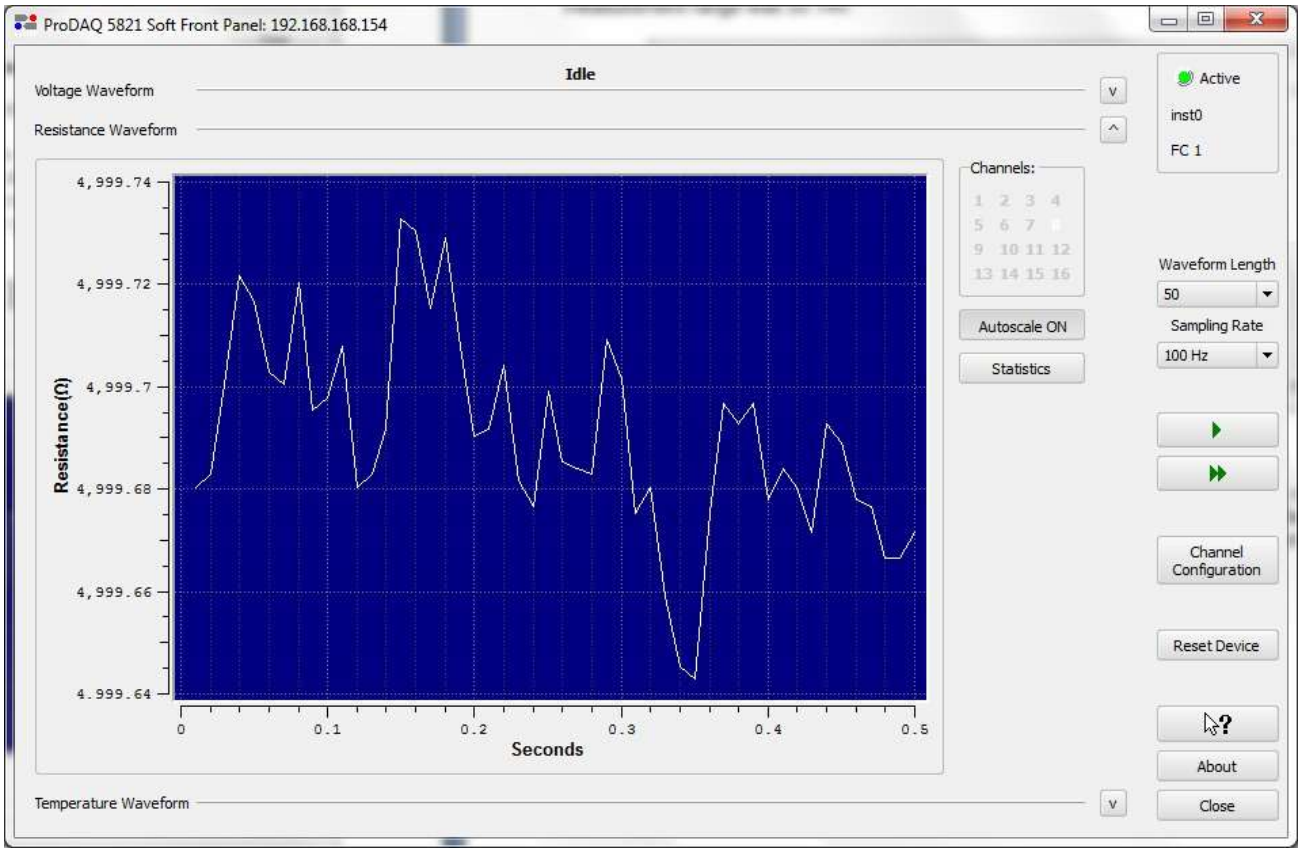

Figure 50 – Measurement of Channel 8 sensor 5kΩ Resistance

Figure 51 – Statistics Mean of Measurement of Channel 8 sensor, 5kΩ Resistance

3.4.5. Measuring a Voltage Signal

A 100mV DC voltage was set-up and measured using a calibrated 8.5 digit DMM. The measured value was 100.771mV. Chanel 7 was set-up for voltage as shown in Figure 52 and calibrated online. The measurement range was ±0.14V.

Figure 52 – Configuration of Channel 8 Voltage Input

Figure 53 shows the result of the measurement while Figure 54 shows that the mean measured voltage was 100.766mV, a difference of 5µV from the mean value measured by the 8.5 digit DMM. The peak-peak variation around the mean was about 45µV or 7µVRMS. An error of 5µV on a ±100mV range is 0.005% Full-Scale.

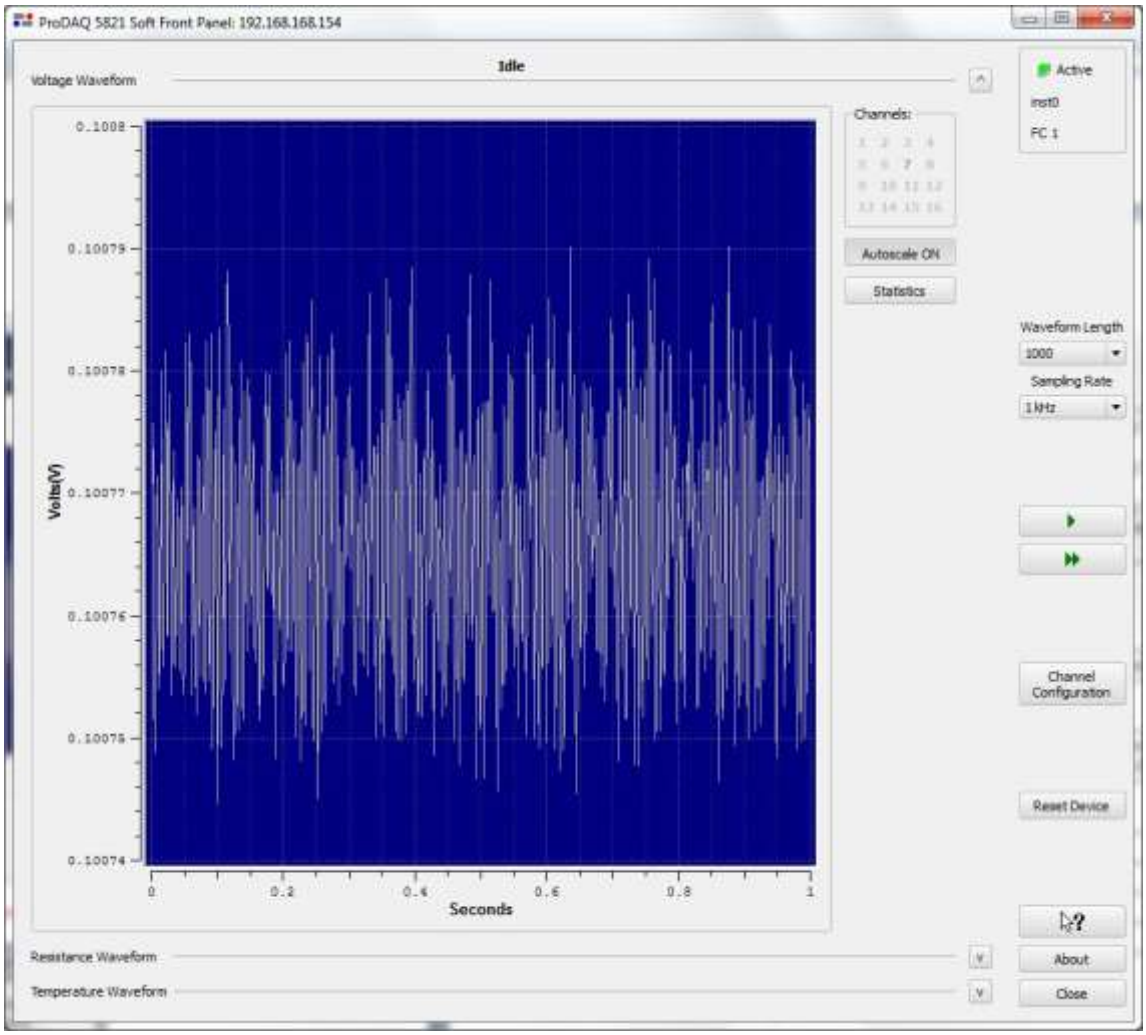

Figure 53 – Measurement of Channel 8 Voltage Input

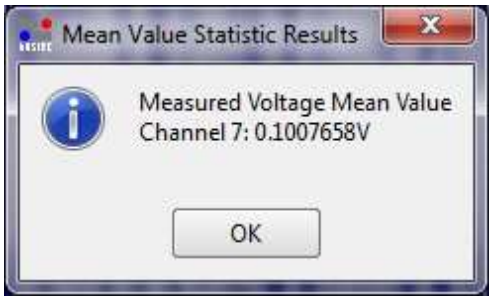

Figure 54 – Statistics Mean of Measurement of Channel 8 Voltage Input

4. Programming the ProDAQ 5821

This chapter shows how to program the ProDAQ 5821 signal conditioning card using the VXI*plug&play* driver. Complete examples can be found in the “Examples” subdirectory of the driver. All functions are explained in detail in the help file coming with the driver.

4.1. VXI*plug&play* Driver Organization

The VXI*plug&play* driver is organized in a hierarchical manner to allow the user to quickly choose the function calls to solve the task at hand without being confronted with unnecessary details. Besides the standard connection/disconnection and utility functions it contains different levels of functionality which provide single functions or sets of functions to solve a particular data acquisition task:

Function Tree Layout:
ProDAQ 5821 RTD Signal Conditioning Card

Initialization	bu5821_init
Hardware Configuration	
Set Channel Configuration	bu5821_setChanConfig
Get Channel Configuration	bu5821_getChanConfig
Calibration Functions	
Signal Path Calibration	bu5821_pgaCalibration
Excitation Current Calibration	bu5821_excCalibration
Low-level Access	
…	
Utility Functions	
Read Temperature	bu5821_readTemperature
Reset	bu5821_reset
Error Message	bu5821_error_message
Device Serial Number	bu5821_serialNumber
Revision Query	bu5821_revision_query
Get Function Card Last Error	bu5821_getFCLastError
Check Broken Wire	bu5821_brokenWireDetect
Set Conversion	bu5821_bu5821_setConversion
Close	bu5821_close

Figure 55 – VXI*plug&play* Driver Organization

The section **Hardware Configuration** contains high-level functions to configure the card. The section **Calibration Functions** contains high-level functions that can be used to calibrate the ProDAQ 3416 and ProDAQ 5821. The section **Utility Functions** contains utility functions that can be used together with the high-level functions.

The section **Low-level Access** contains functions that directly change settings on a register level and are used by the higher level functions to implement their functionality. Using them directly in combination with the higher level functions might interfere with the functionality implemented and should be avoided. In general the usage of the low-level functions will require an intimate knowledge of the ProDAQ 5821 hardware as well as the hardware of the ProDAQ 3416 and the respective function card carrier. Before you attempt to implement your data acquisition or test application using them, it is recommended to study their usage in the higher level functions in the driver sources and/or contact Bustec for support.

The following paragraphs will explain the usage of the high level functions.

4.2. Connecting to the Function Card and Signal Conditioning Card

The ProDAQ 5821 driver utilizes the ProDAQ 3416 driver to access the signal conditioning card. Therefore first the ProDAQ 3416 driver need to be initialized and connected to the correct function card (the one connect via cable to the ProDAQ 5821) before the ProDAQ 5821 driver can be initialized.

To initialize the ProDAQ 3416 driver and connect to the ProDAQ motherboard or function card carrier, the standard VXI*plug&play* initialization function **`bu3416_init()`** is used (see Figure 56,①). (Please refer to the VXI*plug&play* standard VPP-4.3, section 4.3 for a detailed description of the address string.) After initializing the driver and connecting to the motherboard or carrier, the driver must be told which one of the function cards to work with. This is done by the function **`bu3416_fcSelect()`**. It takes as an argument the session established via the function **`bu3416_init()`**, the function card number and a boolean value specifying whether to reset the selected function card (see Figure 56, ②).

```
#include <visa.h>
#include <bu3416.h>
#include <bu5821.h>

main (int argc, char **argv)
{
    ViStatus status;
    ViSession session_3416;
    ViSession session_5821;
    ViChar descr[256];

#ifndef USE_PARAMINIT
①   /* connect to a ProDAQ motherboard in a VXIbus system */
    if ((status = bu3416_init("VXI0::2::INSTR", VI_TRUE, VI_TRUE, &session_3416)) != VI_SUCCESS)
    {
        viStatusDesc (session_3416, status, descr);
        printf ("Error: bu3416_init() failed due to %s\n", descr);


        return -1;
    }
②   /* use function card in position/slot 1 */
    if ((status = bu3416_fcSelect(session_3416, 1, VI_TRUE)) != VI_SUCCESS)
    {
        viStatusDesc (session_3416, status, descr);
        printf ("Error: bu3416_fcSelect failed due to %s\n", descr);

        return -1;
    }
#else
    /* OR: connect to a 3416 in position 1 in a LXI function card carrier */
③   if ((status = bu3416_paramInit("TCPIP::192.168.168.63::INSTR",
                                    1, VI_TRUE, VI_TRUE, &session_3416)) != VI_SUCCESS)
    {
        viStatusDesc (rm_session, status, descr);
        printf ("Error: bu3416_paramInit() failed due to %s\n", descr);


        return -1;
    }
#endif
④   /* connect to the 5821 controled by the 3416 */
    if ((status = bu5821_init(session_3416, VI_TRUE, VI_TRUE, &session_5821)) != VI_SUCCESS)
    {
        viStatusDesc (session_5821, status, descr);
        printf ("Error: bu5821_init() failed due to %s\n", descr);


        return -1;
    }
    /* ... */
```

Figure 56 - Connecting to The ProDAQ 3416 and ProDAQ 5821

For your convenience, the driver contains a new function called **`bu3416_paramInit()`**, which combines the functionality of the **`bu3416_init()`** and **`bu3416_fcSelect()`** functions by extending

the argument list of the standard initialization function with a parameter specifying the function card number (see Figure 56,③).

For the driver functions to work properly, you will either have to use the function **bu3416_paramInit()** to open a session with the device, or you will have to call the function **bu3416_fcSelect()** after calling the function **bu3416_init()** and before any other driver function is called.

Now you can connect to the ProDAQ 5821 as well by using the function **bu5821_init()** with the session handle to the ProDAQ 3416 returned by the functions **bu3416_init()** or **bu3416_paramInit()**. As with the ProDAQ 3416 init function you have the choice whether to check the ID of the signal conditioning card to connect to as well as to reset the card (see Figure 56, ④). The function returns a new session handle, which must be used with all ProDAQ 5821 driver functions

To close the driver sessions with the ProDAQ 5821 and the ProDAQ 3416, the standard VXIplug&play functions **bu5821_close() and bu3416_close()** must be used, preferably in this sequence.

NOTE

Please note that only code snippets are shown here in the manual. For the complete example, refer to the 'Examples' folder in the drivers installation directory.

4.3. Hardware Configuration

To measure correctly, an application need to configure both cards, the ProDAQ 3416 as well as the ProDAQ 5821.

4.3.1. ProDAQ 3416 Channel Configuration

The input multiplexer and gain stages on the ProDAQ 3416 function card are configured using the function **bu3416_setChanConfig()**. It takes as arguments the session to the instrument, a channel number, a selection for the input multiplexer and a value for the gain setting. The channel number has to be an integer number in the range of 1...16 to select one of the channels or 0 for applying the configuration to all channels. Predefined macros from the include file *bu3416.h* can be used (**bu3416_CHAN_1** to **bu3416_CHAN_16** or **bu3416_CHAN_ALL**). The input multiplexer can be set to either connect the channel's input to the front panel connector or to the internal voltage reference bus. The selection can be made by using an integer value of 0 (front panel connector) or 1 (voltage reference bus) or again by using a macro predefined in *bu3416.h* (**bu3416_CH_FP** or **bu3416_CH_VREF**). The gain can be set in steps of 1, 2, 5 between 1 and 2000 by either using valid integer numbers (1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000) or by using the predefined macros **bu3416_GAIN_1** to **bu3416_GAIN_2000** (for more information, refer to the ProDAQ 3416 User Manual).

4.3.2. ProDAQ 5821 Channel Configuration

The ProDAQ 5821 allows to configure the channel for a connection mode (5821-Bx only) as well as to configure its gain stage and excitation current via the driver function **bu5821_setChanConfig()**. It takes as an input the instrument session, a channel number, the selection of a mode (ignored for 5821-Ax versions), the gain and the selection of the excitation current. As for the ProDAQ 3416's **bu3416_setChanConfig()** function, the channel number has to be an integer number in the range of 1...16 to select one of the channels or 0 for applying the configuration to all channels. Predefined

macros from the include file *bu5821.h* can be used for all the settings. The mode can be set for 2-wire (**bu5821_MODE_2_WIRE**), 3-wire (**bu5821_MODE_3_WIRE**), 4-wire (**bu5821_MODE_4_WIRE**), single-ended and differential voltage (**bu5821_MODE_SE_VOLT, bu5821_MODE_DIFF_VOLT**) and other modes which can be used for calibration or test purposes (see chapter 5.1.24). The gain can be set to values of 1/8th to 128 (1/8, 1/4, 1/2, 1, 2, 4, 8, 16, 32, 64, 128) by using the macros **bu5821_GAIN_1_8** to **bu5821_GAIN_128**. The excitation current can be switched off (**bu5821_CURRENT_OFF**) or can be enables and set to 10 µA (**bu5821_CURRENT_10**, 5821-BB only) or 500 µA (**bu5821_CURRENT_500**).

4.4. Calibration

The calibration of the ProDAQ 3416 and ProDAQ 5821 requires several steps, mainly because the calibration of the excitation current requires first the complete signal path being calibrated for accurate voltage measurements. Once the excitation current is calibrated, the ProDAQ 5821 can be configured and calibrated for the desired mode of operation and measurement.

4.4.1. Excitation Current Calibration

To calibrate the excitation current, three steps are necessary. The first step is to calibrate the ProDAQ 3416. The second step is to calibrate the signal path of the ProDAQ 5821 and the last step then is to calibrate the excitation current.

For the best precision, the ProDAQ 3416 normally has to be calibrated for each gain separately. But due to the design of the gain stage in the ProDAQ 5821, the optimal gain setting for the ProDAQ 3416 when used together with the ProDAQ 5821 is a gain of 2 for all measurements. Therefore the calibration of the ProDAQ 3416 only needs to be done once for this particular gain setting.

The calibration is done by using the function **bu3416_calibrateChannels()** (see **Error! Reference source not found.**, ②). This function takes as input a channel bit mask, the setting for the gain the channel(s) shall be calibrated at and returns after a successful calibration the different coefficients which will be applied by the driver. As these coefficients are not used here, VI_NULL is passed in the example for those parameters, in which case the function ignores them.

Next the signal path of the ProDAQ 5821 needs to be configured and calibrated for a gain of 1 (see **Error! Reference source not found.**, ③ & ④).. This ensures the accurate measurements of voltages within the correct range for the current calibration throughout the complete signal path from the ProDAQ 5821 front-end to the ProDAQ 3416 ADC. This is done by the function **bu5821_pgaCalibration()**. The function takes as parameters again a channel number (**bu5821_CHAN_1** to **bu5821_CHAN_16**) and a selection of the reference source and returns the coefficients the driver will use.

To perform voltage calibration on the ProDAQ 5821, there are several options. If no voltage reference is present in the system, the ProDAQ 5821 can only perform an offset calibration. In this case you need to use the reference source selection **bu5821_VREF_NO_VREF**. If the controlling ProDAQ 3416 is installed on a VXIbus motherboard or LXI function card carrier with a voltage reference installed, so that this reference voltage is forwarded to the ProDAQ 5821, the source selections **bu5821_VREF_0V**, **bu5821_VREF_FROM_MASTER** or **bu5821_VREF_MASTER_POS** can be used. In case of **bu5821_VREF_0V**, again only an offset calibration is performed, but the ground reference of the master is used. **bu5821_VREF_FROM_MASTER** performs a full calibration, while **bu5821_VREF_MASTER_POS** only performs an offset calibration.
Another option to perform calibration is to use an external calibrator connected to the voltage reference monitor connector on the ProDAQ 5821. In this case bu5821_VREF_CUSTOM must be used and the exact voltage need to be specified as the fourth parameter for the function

bu5821_pgaCalibration(). In the example (see **Error! Reference source not found.**, ②) **bu5821_VREF_MASTER_POS** is used to save time as the current calibration does not require to measure negative values.

Figure 57 - Excitation Current Calibration

```
    {
        ViStatus status;
        ViSession session_3416;
        ViSession session_5821;
        ViChar descr[256];
        ViReal64 excitCurrent;

        /* ..initialization as per Figure 56 */

        /* configure channel one of the 3416 for gain 2, front panel connector input */
①       if ((status = bu3416_setChanConfig (session_3416, bu3416_CHAN_1,
                                            bu3416_CH_FP, bu3416_GAIN_2, VI_FALSE)) < VI_SUCCESS)
        {
            bu3416_error_message (session_3416, status, descr);
            printf ("Error: bu3416_setChanConfig() failed due to %s\n", descr);

            return -1;
        }

        /* Excitation Current Calibration */
        /* Step 1: Calibrate the 3416 for GAIN 2 */
②       if ((status = bu3416_calibrateChannels (session_3416, 0x0001, bu3416_GAIN_2,
                                                VI_NULL, VI_NULL, VI_NULL)) < VI_SUCCESS)
        {
            bu3416_error_message (session_3416, status, descr);
            printf ("Error: bu3416_calibrateChannels() failed due to %s\n", descr);

            return -1;
        }

        /* configure 5821 channel 1 for gain 1 */
③       if ((status = bu5821_setChanConfig (session_5821, bu5821_CHAN_1,
                                                bu5821_MODE_4_WIRE, bu5821_GAIN_1,
                                                     bu5821_CURRENT_500)) < VI_SUCCESS)
        {
            bu5821_error_message (session_5821, status, descr);
            printf ("Error: bu5821_setChanConfig() failed due to %s\n", descr);

            return -1;
        }

        /* Excitation Current Calibration */
        /* Step 2: Calibrate the signal path of the 5821 */
④       if ((status = bu5821_pgaCalibration (session_5821, bu5821_CHAN_1,
                                  bu5821_VREF_MASTER_POS, 0.0, VI_NULL, VI_NULL)) < VI_SUCCESS)
        {
            bu5821_error_message (session_5821, status, descr);
            printf ("Error: bu5821_pgaCalibration () failed due to %s\n", descr);

            return -1;
        }

        /* Excitation Current Calibration */
        /* Step 3: Calibrate the 5821 current excitation */
        if ((status = bu5821_excCalibration (session_5821, bu5821_CHAN_1, bu5821_CURRENT_500,
⑤                                                         &excitCurrent, VI_NULL)) != VI_SUCCESS)
        {
            bu5821_error_message (session_5821, status, descr);
            printf ("Error: bu5821_excCalibration() failed due to %s\n", descr);

            return -1;
        }

        /* ... */
    }
```


Now the excitation current can be calibrated using the function bu5821_excCalibration(). This function calibrates a particular channel for one of possible currents and returns the exact value of the current measured (see Figure 57, ⑤).

Note

The calibration coefficients or absolute current values the excitation functions return are also stored in the driver and automatically applied.

4.4.2. Final Calibration

Once the excitation current is calibrated, the ProDAQ 5821 can be configured for the planned measurement. If this measurement requires a different gain setting then the gain setting used during the excitation current calibration, then, to reach the highest possible accuracy, the signal path needs to be calibrated again for the new gain. In the example the ProDAQ 5821 is configured for 3-wire mode and a gain of 64 to use a PT100 sensor and then the signal path is again calibrated using the function **`bu5821_pgaCalibration()`** (see Figure 58, ① & ②).

```
{
    ViReal64 dblBuf[128];

    /* initialization and excitation current calibration */

    /* … */

    /* configure the ProDAQ 5821 for 3-wire mode, gain 64, exc. current 500 uA */
    if ((status = bu5821_setChanConfig (session_5821, bu5821_CHAN_1,
①                                       bu5821_MODE_3_WIRE, bu5821_GAIN_64,
                                            bu5821_CURRENT_500)) < VI_SUCCESS)
    {
        bu5821_error_message (session_5821, status, descr);
        printf ("Error: bu5821_setChanConfig() failed due to %s\n", descr);

        return -1;
    }

    /* Final Signal Path Calibration */
    if ((status = bu5821_pgaCalibration (session_5821, bu5821_CHAN_1,
②                                 bu5821_VREF_MASTER_POS, 0.0, VI_NULL, VI_NULL)) < VI_SUCCESS)
    {
        bu5821_error_message (session_5821, status, descr);
        printf ("Error: bu5821_pgaCalibration () failed due to %s\n", descr);

        return -1;
    }

    /* acquire 128 Samples at 1000 Samples/sec */
    if((status = bu3416_acquireWaveform (session_3416, bu3416_CHAN_1, bu3416_CH_FP,
③                                            bu3416_GAIN_2, VI_FALSE, 1000.0, 128,
                                             dblBuf, VI_NULL)) < VI_SUCCESS)
    {
        bu3416_error_message (session_3416, status, descr);
        printf ("Error: bu3416_ acquireWaveform() failed due to %s\n", descr);

        return -1;
    }

    /* ... */
}
```

Figure 58 - Final Configuration, Calibration and Measurement

4.5. Performing a Measurement

To perform measurements, the appropriate ProDAQ 3416 driver function must be used. In the example the function **`bu3416_acquireWaveform()`** is used to acquire 128 Samples at speed of 1000 Samples/sec from channel 1 (see Figure 58, ③). To do the same on multiple channels, the function **`bu3416_acquireWaveforms()`** can be used. For continuous acquisition, functions like **`bu3416_startAcquisition()`**, **`bu3416_stopAcquisition()`** etc must be used (for more information, refer to the ProDAQ 3416 user manual and driver documentation).

The following table shows the ProDAQ 5821 configuration parameter to be used for the different types of sensors and measurements calculated to reach the highest accuracy.

Sensor	Range	Mode	Current	3416 Gain	5821 Gain
PT100	< 850 °C	2-wire 3-wire 4-wire	500 µA	2	16
	< 500 °C			2	32
	< 100 °C			2	64
	< -80 °C			2	128
PT500	< 850 °C	2-wire 3-wire 4-wire	500 µA	2	4
	< 300 °C			2	8
	< 0 °C			2	16
	< -110 °C			2	32
PT1000	< 850 °C	2-wire 3-wire 4-wire	500 µA	2	2
	< 300 °C			2	4
	< 0 °C			2	8
	< -110 °C			2	16
Resistance	20 kΩ	2-wire 3-wire 4-wire	500 µA	2	¼
	9 kΩ			2	1
	4.5 kΩ			2	2
	2.25 kΩ			2	4
	1.12 kΩ			2	8
	560 Ω			2	16
	280 Ω			2	32
	140 Ω			2	64
	70 Ω			2	128
	1 MΩ		10 µA (5821-BB)	2	¼
	450 kΩ			2	1
	225 kΩ			2	2
	112 kΩ			2	4
	56 kΩ			2	8
	28 kΩ			2	16
	14 kΩ			2	32
	7 kΩ			2	64
	3.5 kΩ			2	128
Voltage	±10 V	Differential Single-ended	off	2	¼
	±4.5 V			2	1
	±2.25 V			2	2
	±1.12 V			2	4
	±0.56 V			2	8
	±0.28 V			2	16
	±0.14 V			2	32
	±0.07 V			2	64
	±0.035V			2	128

Table 1 - Channel Configuration Parameter

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5. VXI*plug&play* Driver Functions

Introduction

This instrument driver provides programming support for the ProDAQ 5821 16 channel RTD Signal Conditioning Card. It contains functions for opening, configuring, calibrating and closing the instrument.

Assumptions

To successfully use this function card, it must be installed onto a ProDAQ VXIbus motherboard or a ProDAQ LXI function card carrier. The ProDAQ motherboard must in turn be installed in a VXIbus system which is connected via a suitable slot-0 controller to your computer. The LXI function card carrier must be connected via network to your computer. A suitable VISA library must be installed on your computer.

Error and Status Information

Each function in this instrument driver returns a status code that either indicates success or describes an error or warning condition. Your program should examine the status code from each call to an instrument driver function to determine if an error occurred.

The general meaning of the status code is as follows:

Value	Meaning
0	Success
Positive Values	Warnings
Negative Values	Errors

The description of each instrument driver function lists possible error codes and their meanings.

Function Tree Layout

Class/Panel Name:	**Function Name:**
Initialization	bu5821_init
Hardware Configuration	
Set Channel Configuration	bu5821_setChanConfig
Get Channel Configuration	bu5821_getChanConfig
Calibration Functions	
Signal Path Calibration	bu5821_pgaCalibration
Excitation Current Calibration	bu5821_excCalibration
Low-level Access	
Set Mode	bu5821_setMode
Get Mode	bu5821_getMode
Set Gain	bu5821_setGain
Get Gain	bu5821_getGain
Set Excitation Current	bu5821_setExcitCurrent
Get Excitation Current	bu5821_getExcitCurrent
Voltage Reference Access	
Set Voltage Reference Output	bu5821_setVoltRefOutput
Get Voltage Reference Output	bu5821_getVoltRefOutput
Get Voltage Reference Info	bu5821_getVoltRefInfo
Low-Level Calibration	
Reset Calibration Coeff	bu5821_resetCalibCoeff
Get Signal Path Calib Coeff.	bu5821_getPgaCalibCoeff
Get Excit. Calibration Coeff	bu5821_getExcCalibCoeff
Store Calibration Coeff	bu5821_storeCalibCoeff
Status Functions	
Check EC Current Status	bu5821_checkECStatus
Check EC Error	bu5821_checkECError
Utility Functions	
Read Temperature	bu5821_readTemperature
Reset	bu5821_reset
Error Message	bu5821_error_message
Device Serial Number	bu5821_serialNumber
Revision Query	bu5821_revision_query
Get Function Card Last Error	bu5821_getFCLastError
Check Broken Wire	bu5821_brokenWireDetect
Set Conversion	bu5821_bu5821_setConversion
Close	bu5821_close

5.1. VXI*plug&play* Driver Function Details

The following functions are in alphabetical order.

5.1.1. bu5821_brokenWireDetect

```
    ViStatus bu5821_brokenWireDetect (ViSession instrumentHandle, ViInt16 channel,
                                      ViInt16 *currentPosWireStatus,
                                      ViInt16 *currentNegWireStatus,
                                      ViInt16 *signalPosWireStatus,
                                      ViInt16 *signalNegWireStatus);

Purpose

    This function checks the broken wire status of the specified channel.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    channel

        Variable Type       ViInt16

        This parameter specifies which channel will be checked.

        Possible values are:

        bu5821_CHAN_1        1   Channel 1
        bu5821_CHAN_2        2   Channel 2
        ...
        bu5821_CHAN_15       15  Channel 15
        bu5821_CHAN_16       16  Channel 16

        OR

        bu5821_CHAN_ALL      0   All 16 channels will be configured
                                    with the same parameters.

    currentPosWireStatus

        Variable Type       ViInt16 (passed by reference)

        This parameter holds the Current + Wire status to be returned

        Possible values:

        bu5821_WIRE_BROKEN  -1   Wire broken detected
        bu5821_WIRE_OK      0    Wire broken undetected

        NOTE: If only one channel is selected, the parameter should be
        allocated as a one-element array, however if all channels are
        selected, the array should be allocated as a 16-element array

    currentNegWireStatus

        Variable Type       ViInt16 (passed by reference)

        This parameter holds the Current - Wire status to be returned

        Possible values:

        bu5821_WIRE_BROKEN  -1   Wire broken detected
        bu5821_WIRE_OK      0    Wire broken undetected

        NOTE: If only one channel is selected, the parameter should be
        allocated as a one-element array, however if all channels are
```



```
        selected, the array should be allocated as a 16-element array

    signalPosWireStatus

        Variable Type       ViInt16 (passed by reference)

        This parameter holds the Signal + Wire status to be returned

        Possible values:

        bu5821_WIRE_BROKEN  -1   Wire broken detected
        bu5821_WIRE_OK      0    Wire broken undetected

        NOTE: If only one channel is selected, the parameter should be
        allocated as a one-element array, however if all channels are
        selected, the array should be allocated as a 16-element array

    signalNegWireStatus

        Variable Type       ViInt16 (passed by reference)

        This parameter holds the Signal - Wire status to be returned

        Possible values:

        bu5821_WIRE_BROKEN  -1   Wire broken detected
        bu5821_WIRE_OK      0    Wire broken undetected

        NOTE: If only one channel is selected, the parameter should be
        allocated as a one-element array, however if all channels are
        selected, the array should be allocated as a 16-element array

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
        interface library, which are used by the 5821 driver to access a
        ProDAQ motherboard. Warnings returned by the library will be in the
        range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
        0xBFFC0900. They are defined in the include file bu3100.h.

        BU5821 Warnings/Errors:
        Warning codes returned by the 5821 driver functions will be in the
        range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
        0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
        bu5821.h.
```

5.1.2. bu5821_bu5821_setConversion

```
    ViStatus bu5821_bu5821_setConversion (ViSession instrument_Handle,
                                          ViInt32 channelMask);

Purpose

    This function specifies if the conversion from voltage to resistance will
    be applied to the acquired data for specific channel(s).

Parameter List

    instrument_Handle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    channelMask

        Variable Type       ViInt32

        Decide which channel's acquired data will be converted from voltage
        to resistance.

        The value is a bit mask:

        Bit 0 corresponds to channel 1
        ...
        Bit 15 corresponds to channel 16

        To set N-th bit as "1", channel N-1's output data conversion from
        voltage to resistance will be applied. Otherwise the data will not be
        converted.

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu3416_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
        interface library, which are used by the 5821 driver to access a
        ProDAQ motherboard. Warnings returned by the library will be in the
        range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
        0xBFFC0900. They are defined in the include file bu3100.h.

        BU5821 Warnings/Errors:
        Warning codes returned by the 5821 driver functions will be in the
        range 0x3FFC0A00 to 0x3FFC0AFF and error codes in the range
        0xBFFC0A00 to 0xBFFC0AFF. They are defined in the include file
        bu5821.h.
```


5.1.3. bu5821_checkECError

```
    ViStatus bu5821_checkECError (ViSession instrumentHandle, ViUInt16 *ecErrFlag);

Purpose

    This function returns the all 16 channels' excitation error status.
    Excitation current error means that the current was applied but it
    doesn't flow through with specified value because of broken wire or too
    high resistance of the sensor.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    ecErrFlag

        Variable Type       ViUInt16 (passed by reference)

        This parameter holds the bitmask of all 16 channels' Excitation
        Current Error to be returned

        Each bit represents the following channel:

           Bit0  - channel 1
           Bit1  - channel 2
           ...
           Bit15 - channel 15

        Possible values:

           0 - No Excitation Current Error Detected
           1 - Excitation Current Error Detected

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
        interface library, which are used by the 5821 driver to access a
        ProDAQ motherboard. Warnings returned by the library will be in the
        range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
        0xBFFC0900. They are defined in the include file bu3100.h.

        BU5821 Warnings/Errors:
        Warning codes returned by the 5821 driver functions will be in the
        range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
        0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
        bu5821.h.
```

5.1.4. bu5821_checkECStatus

```
    ViStatus bu5821_checkECStatus (ViSession instrumentHandle, ViUInt16 *statusFlag);

Purpose

    This function returns the excitation current status of all 16 channels.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    statusFlag

        Variable Type       ViUInt16 (passed by reference)

        This parameter holds the bitmask of all 16 channels' Excitation
        Current Status

        Each bit represents the following channel:

           Bit0  - channel 1
           Bit1  - channel 2
           ...
           Bit15 - channel 15

        Possible values:

           0 - No Excitation Current Detected
           1 - Excitation Current Detected

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
        interface library, which are used by the 5821 driver to access a
        ProDAQ motherboard. Warnings returned by the library will be in the
        range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
        0xBFFC0900. They are defined in the include file bu3100.h.

        BU5821 Warnings/Errors:
        Warning codes returned by the 5821 driver functions will be in the
        range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
        0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
        bu5821.h.
```


5.1.5. bu5821_close

```
    ViStatus bu5821_close (ViSession instrumentHandle);

Purpose

    This function closes the instrument and frees the resources allocated by
    the call to the initialization function bu5821_init().

    This function must be called once for every instrument handle returned by
    the initialize function, prior to terminating the application program.


Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
        interface library, which are used by the 5821 driver to access a
        ProDAQ motherboard. Warnings returned by the library will be in the
        range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
        0xBFFC0900. They are defined in the include file bu3100.h.

        BU5821 Warnings/Errors:
        Warning codes returned by the 5821 driver functions will be in the
        range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
        0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
        bu5821.h.
```

5.1.6. bu5821_error_message

```
    ViStatus bu5821_error_message (ViSession instrumentHandle,
                                   ViStatus errorReturnValue, ViChar errorMessage[]);

Purpose

    Converts a numeric error code, returned by one of the functions of this
    driver into a descriptive error message string.


Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    errorReturnValue

        Variable Type       ViStatus

        Accepts the error code, returned by one of the functions in this
        instrument driver. See bu5821.h for error codes.


    errorMessage

        Variable Type       ViChar[]

        Upon return from the function, this parameter holds a text error
        message which corresponds to the error code.

        The VISA Warnings and VISA Errors are described in section 3.3 of the
        VPP 4.3.2 document and Appendix B of VPP 4.3.


Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
        interface library, which are used by the 5821 driver to access a
        ProDAQ motherboard. Warnings returned by the library will be in the
        range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
        0xBFFC0900. They are defined in the include file bu3100.h.

        BU5821 Warnings/Errors:
        Warning codes returned by the 5821 driver functions will be in the
        range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
        0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
        bu5821.h.
```


5.1.7. bu5821_excCalibration

```
ViStatus bu5821_excCalibration (ViSession instrumentHandle, ViInt16 channel,
                                ViInt16 excitationCurrent,
                                ViReal64 *finalCurrentValue,
                                ViInt16 *digipotWiperTrimValue);
```

Purpose

This function performs the excitation calibration of the specified channel. If the operating 5821 Signal Conditioning Card is BA or BB version (they can be configured with different gains), it is recommended to run Signal Path Calibration for Gain of 1 before running this function.

Parameter List

instrumentHandle

Variable Type ViSession

The Instrument Handle is used to identify the unique session or communication channel between the driver and the instrument.

If more than one instrument of the same model type is used, this handle will be used to differentiate between them.

channel

Variable Type ViInt16

This parameter specifies which channel will be calibrated.

Possible values are:

bu5821_CHAN_1	1	Channel 1
bu5821_CHAN_2	2	Channel 2
...		
bu5821_CHAN_15	15	Channel 15
bu5821_CHAN_16	16	Channel 16

excitationCurrent

Variable Type ViInt16

This parameter specifies which current source will be used for the current calibration.

Available values are:

bu5821_CURRENT_500	1	Exitation current of 500uA will be trimmed
bu5821_CURRENT_10	2	Exitation current of 10uA will be trimmed

finalCurrentValue

Variable Type ViReal64 (passed by reference)

This parameter returns the final measured value of the Excitation Current after the calibration is finished.

digipotWiperTrimValue

Variable Type ViInt16 (passed by reference)

This parameter returns the trimed digipot wiper value.
The trimmed value will be applied automatically after calibration is done.
This value is given to the user only for information.

Return Value

If the function was successful, it will return a status of VI_SUCCESS, otherwise it will return a warning or error code. Passing the status code to the function "bu5821_error_message" will return a string describing the warning or error.

A driver function can return three different types of warnings or errors. The function "bu5821_error_message" will handle all three types of warning/error codes by passing them to the appropriate function if necessary ("bu3100_error_message" or "viStatusDesc"), to return the correct warning/error message.

VISA Warnings/Errors:
See section 3.3 of the VPP 4.3.2 document for a complete list of VISA status codes and their values. The VPP 4.3 document contains detailed descriptions of all VISA functions and the status codes returned by each of them.

BU3100 Warnings/Errors:
These are warning or error codes returned by the common motherboard interface library, which are used by the 5821 driver to access a ProDAQ motherboard. Warnings returned by the library will be in the range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to 0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range 0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file bu5821.h.

5.1.8. bu5821_getChanConfig

```
    ViStatus bu5821_getChanConfig (ViSession instrumentHandle, ViInt16 channel,
                                   ViInt16 *mode, ViInt16 *gain,
                                   ViInt16 *excitationCurrent);

Purpose

    This function returns the configuration of the specified channel.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    channel

        Variable Type       ViInt16

        This parameter specifies for which channel's configuration will be
        returned.

        Possible values are:

        bu5821_CHAN_1        1   Channel 1
        bu5821_CHAN_2        2   Channel 2
        ...
        bu5821_CHAN_15       15  Channel 15
        bu5821_CHAN_16       16  Channel 16

    mode

        Variable Type       ViInt16 (passed by reference)

        This parameter returns the channel mode.

        Possible values are:

        bu5821_MODE_4_WIRE     1 4-wire Cable
        bu5821_MODE_3_WIRE     2 3-wire Cable
        bu5821_MODE_2_WIRE     3 2-wire Cable
        bu5821_MODE_DIFF_VOLT  4 Differential Voltage
        bu5821_MODE_SE_VOLT    5 Single Ended Voltage
        bu5821_MODE_GND        6 Input is grounded
        bu5821_MODE_VREF       7 Input is connected to Voltage Reference
        bu5821_MODE_IREF       8 Input is connected to Excitation
                                 Current Reference
        bu5821_MODE_IREF_GND   9 Input is connected to Excitation
                                 Current Reference but I+ path is
                                 grounded (can be used to measure the
                                 current without external load)


    gain

        Variable Type       ViInt16 (passed by reference)

        This parameter returns the channel gain.

        Possible values are:

        bu5821_GAIN_1_8        0         Gain 1/8
        bu5821_GAIN_1_4        1         Gain 1/4
        bu5821_GAIN_1_2        2         Gain 1/2
        bu5821_GAIN_1          3         Gain 1
        bu5821_GAIN_2          4         Gain 2
        bu5821_GAIN_4          5         Gain 4
        bu5821_GAIN_8          6         Gain 8
        bu5821_GAIN_16         7         Gain 16
```

```
        bu5821_GAIN_32         8         Gain 32
        bu5821_GAIN_64         9         Gain 64
        bu5821_GAIN_128        10        Gain 128


    excitationCurrent

        Variable Type       ViInt16 (passed by reference)

        This parameter return the channel current source.

        Available values are:

        bu5821_CURRENT_OFF 0   Exitation current is not applied
        bu5821_CURRENT_500 1   Exitation current of 500uA is applied
        bu5821_CURRENT_10  2   Exitation current of 10uA is applied


Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
        interface library, which are used by the 5821 driver to access a
        ProDAQ motherboard. Warnings returned by the library will be in the
        range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
        0xBFFC0900. They are defined in the include file bu3100.h.

        BU5821 Warnings/Errors:
        Warning codes returned by the 5821 driver functions will be in the
        range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
        0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
        bu5821.h.
```


5.1.9. bu5821_getExcCalibCoeff

```
    ViStatus bu5821_getExcCalibCoeff (ViSession instrumentHandle, ViInt16 channel,
                                      ViInt16 *trimmerValue);

Purpose

    This function retrieves the values for the Excitation Current Trimmer.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    channel

        Variable Type       ViInt16

        This parameter specifies for which channel the calibration
        coefficients will be returned.

        Possible values are:

        bu5821_CHAN_1        1   Channel 1
        bu5821_CHAN_2        2   Channel 2
        ...
        bu5821_CHAN_15       15  Channel 15
        bu5821_CHAN_16       16  Channel 16

    trimmerValue

        Variable Type       ViInt16 (passed by reference)

        Returns the calibration Excitation Current Trimmer value.

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
        interface library, which are used by the 5821 driver to access a
        ProDAQ motherboard. Warnings returned by the library will be in the
        range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
        0xBFFC0900. They are defined in the include file bu3100.h.

        BU5821 Warnings/Errors:
        Warning codes returned by the 5821 driver functions will be in the
        range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
        0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
        bu5821.h.
```

5.1.10. bu5821_getExcitCurrent

```
    ViStatus bu5821_getExcitCurrent (ViSession instrumentHandle, ViInt16 channel,
                                     ViInt16 *excitationCurrent);

Purpose

    This function returns the Excitation Current for the selected channel.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    channel

        Variable Type       ViInt16

        This parameter specifies for which channel's gain setting to be
        returned.

        Possible values are:

        bu5821_CHAN_1        1   Channel 1
        bu5821_CHAN_2        2   Channel 2
        ...
        bu5821_CHAN_15       15  Channel 15
        bu5821_CHAN_16       16  Channel 16

    excitationCurrent

        Variable Type       ViInt16 (passed by reference)

        This parameter return the Excitation Current for the selected
        channel.

        Available values are:

        bu5821_CURRENT_OFF 0   Exitation current is not applied
        bu5821_CURRENT_500 1   Exitation current of 500uA is applied
        bu5821_CURRENT_10  2   Exitation current of 10uA is applied

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
        interface library, which are used by the 5821 driver to access a
        ProDAQ motherboard. Warnings returned by the library will be in the
        range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
        0xBFFC0900. They are defined in the include file bu3100.h.
```



```
BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the
range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
bu5821.h.
```

5.1.11. bu5821_getFCLastError

```
ViStatus bu5821_getFCLastError (ViSession instrumentHandle,
                                ViStatus *fcErrorCode);
```

Purpose

The last error code returned by the function card driver which controls the ProDAQ 5821. Useful in the event of the error bu5821_MASTER_ERR in response to the ProDAQ 5821 driver function call.

Parameter List

instrumentHandle

Variable Type ViSession

The Instrument Handle is used to identify the unique session or communication channel between the driver and the instrument.

If more than one instrument of the same model type is used, this handle will be used to differentiate between them.

fcErrorCode

Variable Type ViStatus (passed by reference)

Last error code returned by the function card driver which controls the ProDAQ 5821. This code is related to the function card driver and should be passed only to bu3416_error_message() when using the ProDAQ 3416 as the master card.

Return Value

If the function was successful, it will return a status of VI_SUCCESS, otherwise it will return a warning or error code. Passing the status code to the function "bu5821_error_message" will return a string describing the warning or error.

A driver function can return three different types of warnings or errors. The function "bu5821_error_message" will handle all three types of warning/error codes by passing them to the appropriate function if necessary ("bu3100_error_message" or "viStatusDesc"), to return the correct warning/error message.

VISA Warnings/Errors:
See section 3.3 of the VPP 4.3.2 document for a complete list of VISA status codes and their values. The VPP 4.3 document contains detailed descriptions of all VISA functions and the status codes returned by each of them.

BU3100 Warnings/Errors:
These are warning or error codes returned by the common motherboard interface library, which are used by the 5821 driver to access a ProDAQ motherboard. Warnings returned by the library will be in the range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to 0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range 0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file bu5821.h.

5.1.12. bu5821_getGain

```
    ViStatus bu5821_getGain (ViSession instrumentHandle, ViInt16 channel,
                             ViInt16 *gain);

Purpose

    This function returns the PGA gain setting of the specified channel.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    channel

        Variable Type       ViInt16

        This parameter specifies for which channel's gain setting to be
        returned.

        Possible values are:

        bu5821_CHAN_1        1   Channel 1
        bu5821_CHAN_2        2   Channel 2
        ...
        bu5821_CHAN_15       15  Channel 15
        bu5821_CHAN_16       16  Channel 16


    gain

        Variable Type       ViInt16 (passed by reference)

        This parameter returns the gain of the specified channel.

        Possible values are:

        bu5821_GAIN_1_8        0         Gain 1/8
        bu5821_GAIN_1_4        1         Gain 1/4
        bu5821_GAIN_1_2        2         Gain 1/2
        bu5821_GAIN_1          3         Gain 1
        bu5821_GAIN_2          4         Gain 2
        bu5821_GAIN_4          5         Gain 4
        bu5821_GAIN_8          6         Gain 8
        bu5821_GAIN_16         7         Gain 16
        bu5821_GAIN_32         8         Gain 32
        bu5821_GAIN_64         9         Gain 64
        bu5821_GAIN_128        10        Gain 128


Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.
```

BU3100 Warnings/Errors:
These are warning or error codes returned by the common motherboard interface library, which are used by the 5821 driver to access a ProDAQ motherboard. Warnings returned by the library will be in the range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to 0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range 0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file bu5821.h.

5.1.13. bu5821_getMode

```
    ViStatus bu5821_getMode (ViSession instrumentHandle, ViInt16 channel,
                             ViInt16 *mode);

Purpose

    This function returns the mode of the specified channel.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    channel

        Variable Type       ViInt16

        This parameter specifies for which channel the mode will be returned.

        Possible values are:

        bu5821_CHAN_1        1   Channel 1
        bu5821_CHAN_2        2   Channel 2
        ...
        bu5821_CHAN_15       15  Channel 15
        bu5821_CHAN_16       16  Channel 16


    mode

        Variable Type       ViInt16 (passed by reference)

        This parameter returns the channel mode.

        Possible values are:

        bu5821_MODE_4_WIRE     1 4-wire Cable
        bu5821_MODE_3_WIRE     2 3-wire Cable
        bu5821_MODE_2_WIRE     3 2-wire Cable
        bu5821_MODE_DIFF_VOLT  4 Differential Voltage
        bu5821_MODE_SE_VOLT    5 Single Ended Voltage
        bu5821_MODE_GND        6 Input is grounded
        bu5821_MODE_VREF       7 Input is connected to Voltage Reference
        bu5821_MODE_IREF       8 Input is connected to Excitation
                                 Current Reference
        bu5821_MODE_IREF_GND   9 Input is connected to Excitation
                                 Current Reference but I+ path is
                                 grounded (can be used to measure the
                                 current without external load)

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.
```

BU3100 Warnings/Errors:
These are warning or error codes returned by the common motherboard interface library, which are used by the 5821 driver to access a ProDAQ motherboard. Warnings returned by the library will be in the range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to 0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range 0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file bu5821.h.

5.1.14. bu5821_getPgaCalibCoeff

```
ViStatus bu5821_getPgaCalibCoeff (ViSession instrumentHandle, ViInt16 channel,
                                  ViInt16 gain, ViInt16 gainMultiplier,
                                  ViReal64 *calibOffset, ViReal64 *calibGain);
```

Purpose

This function retrieves the signal path calibration coefficients currently being used for the specified channel and gain setting.

Parameter List

instrumentHandle

Variable Type ViSession

The Instrument Handle is used to identify the unique session or communication channel between the driver and the instrument.

If more than one instrument of the same model type is used, this handle will be used to differentiate between them.

channel

Variable Type ViInt16

This parameter specifies for which channel's configuration will be returned.

Possible values are:

bu5821_CHAN_1	1	Channel 1
bu5821_CHAN_2	2	Channel 2
...		
bu5821_CHAN_15	15	Channel 15
bu5821_CHAN_16	16	Channel 16

gain

Variable Type ViInt16

This parameter specifies the gain for which the calibration coefficients will be retrieved.

Possible values are:

bu5821_GAIN_1_8	0	Gain 1/8
bu5821_GAIN_1_4	1	Gain 1/4
bu5821_GAIN_1_2	2	Gain 1/2
bu5821_GAIN_1	3	Gain 1
bu5821_GAIN_2	4	Gain 2
bu5821_GAIN_4	5	Gain 4
bu5821_GAIN_8	6	Gain 8
bu5821_GAIN_16	7	Gain 16
bu5821_GAIN_32	8	Gain 32
bu5821_GAIN_64	9	Gain 64
bu5821_GAIN_128	10	Gain 128

gainMultiplier

Variable Type ViInt16

This parameter specifies the gain for which the calibration coefficients will be retrieved.

Possible values are:

bu5821_GAIN_MULT_1	0	Gain Multiplier of 1
bu5821_GAIN_MULT_1_375	1	Gain Multiplier of 1.375

calibOffset

Variable Type ViReal64 (passed by reference)

This parameter returns the calibrated offset value.

calibGain

Variable Type ViReal64 (passed by reference)

This parameter returns the calibrated gain value.

Return Value

If the function was successful, it will return a status of VI_SUCCESS, otherwise it will return a warning or error code. Passing the status code to the function "bu5821_error_message" will return a string describing the warning or error.

A driver function can return three different types of warnings or errors. The function "bu5821_error_message" will handle all three types of warning/error codes by passing them to the appropriate function if necessary ("bu3100_error_message" or "viStatusDesc"), to return the correct warning/error message.

VISA Warnings/Errors:
See section 3.3 of the VPP 4.3.2 document for a complete list of VISA status codes and their values. The VPP 4.3 document contains detailed descriptions of all VISA functions and the status codes returned by each of them.

BU3100 Warnings/Errors:
These are warning or error codes returned by the common motherboard interface library, which are used by the 5821 driver to access a ProDAQ motherboard. Warnings returned by the library will be in the range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to 0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range 0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file bu5821.h.

5.1.15. bu5821_getVoltRefInfo

```
ViStatus bu5821_getVoltRefInfo (ViSession instrumentHandle, ViInt16 *nVolts,
                                ViReal64 voltages[]);
```

Purpose

This function returns the voltages available on the master function card carrier.

Parameter List

instrumentHandle

Variable Type ViSession

The Instrument Handle is used to identify the unique session or communication channel between the driver and the instrument.

If more than one instrument of the same model type is used, this handle will be used to differentiate between them.

nVolts

Variable Type ViInt16 (passed by reference)

Returns the number of voltages available on the selected voltage reference module.

voltages

Variable Type ViReal64[]

This array contains the list of all possible voltages generated by the voltage reference module. It should be allocated with size 20 prior to the function call.

Return Value

If the function was successful, it will return a status of VI_SUCCESS, otherwise it will return a warning or error code. Passing the status code to the function "bu5821_error_message" will return a string describing the warning or error.

A driver function can return three different types of warnings or errors. The function "bu5821_error_message" will handle all three types of warning/error codes by passing them to the appropriate function if necessary ("bu3100_error_message" or "viStatusDesc"), to return the correct warning/error message.

VISA Warnings/Errors:
See section 3.3 of the VPP 4.3.2 document for a complete list of VISA status codes and their values. The VPP 4.3 document contains detailed descriptions of all VISA functions and the status codes returned by each of them.

BU3100 Warnings/Errors:
These are warning or error codes returned by the common motherboard interface library, which are used by the 5821 driver to access a ProDAQ motherboard. Warnings returned by the library will be in the range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to 0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range 0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file bu5821.h.

5.1.16. bu5821_getVoltRefOutput

```
ViStatus bu5821_getVoltRefOutput (ViSession instrumentHandle,
                                  ViInt32 *voltRefModule, ViReal64 *voltage,
                                  ViBoolean *monitor);
```

Purpose

This function returns the current output voltage of the voltage reference module.

Parameter List

instrumentHandle

Variable Type ViSession

The Instrument Handle is used to identify the unique session or communication channel between the driver and the instrument.

If more than one instrument of the same model type is used, this handle will be used to differentiate between them.

voltRefModule

Variable Type ViInt32 (passed by reference)

This parameter returns which voltage reference module is currently used to generate the voltage reference.

Possible values are:

bu5821_VREF_NO_VREF	0	No VREF used
bu5821_VREF_0V	1	0V to all channels
bu5821_VREF_FROM_MASTER	2	VREF from master function card to all channels
bu5821_VREF_CUSTOM	4	Custom VREF from external VREF connector) to all channels

voltage

Variable Type ViReal64 (passed by reference)

This parameter returns the current output voltage of the voltage reference module.

monitor

Variable Type ViBoolean (passed by reference)

This parameter returns whether the voltage reference output is routed to the ProDAQ 5821 rear panel connector (for monitoring purposes).

Possible values are:

VI_FALSE	Voltage reference output is disconnected from the ProDAQ 5821 rear panel connector.
VI_TRUE	Voltage reference output is connected to the ProDAQ 5821 rear panel connector.

Return Value

If the function was successful, it will return a status of VI_SUCCESS, otherwise it will return a warning or error code. Passing the status code to the function "bu5821_error_message" will return a string describing the warning or error.

A driver function can return three different types of warnings or errors. The function "bu5821_error_message" will handle all three types of warning/error codes by passing them to the appropriate function if necessary ("bu3100_error_message" or "viStatusDesc"), to return the correct warning/error message.


```
VISA Warnings/Errors:
See section 3.3 of the VPP 4.3.2 document for a complete list of
VISA status codes and their values. The VPP 4.3 document contains
detailed descriptions of all VISA functions and the status codes
returned by each of them.

BU3100 Warnings/Errors:
These are warning or error codes returned by the common motherboard
interface library, which are used by the 5821 driver to access a
ProDAQ motherboard. Warnings returned by the library will be in the
range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the
range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
bu5821.h.
```

5.1.17. bu5821_init

```
    ViStatus bu5821_init (ViSession masterHandle, ViBoolean IDQuery,
                          ViBoolean resetDevice, ViSession *instrumentHandle);

Purpose

    Initializes the instrument and returns an "Instrument Handle".  The
    instrument handle must be used with all of the other functions of this
    driver.

    The initialize call allows the instrument to be queried to ensure that it
    is a Bustec data acquisition system. It also resets the module to the
    power-up state if the "Reset" parameter is True (ON).

    This function interrogates the motherboard registers to ascertain in
    which locations there are function cards fitted and then checks those
    locations to identify the type of function card fitted.

    Note that for each "bu5821_init()" call, a new unique instrument handle
    is returned. Thus, if four calls are made to the initialize call in
    succession, four unique instrument handles will be returned.

    For each instrument handle returned by the "bu5821_init()" function, the
    "bu5821_close()" function should be called to free up the resources
    allocated by "bu5821_init()". The call(s) to "bu5821_close()" should be
    made before the application program terminates.

Parameter List

    masterHandle

        Variable Type       ViSession

        This control specifies the instrument handle of the master function
        card (For instance, ProDAQ 3416 function card).
        The VXI Plug&Play driver of the master function card should be
        initialized prior to this function call.

    IDQuery

        Variable Type       ViBoolean

        Specifies whether to send an ID Query to the instrument during the
        initialization procedure.

         Valid Range:   1 = Yes
                        0 = No

         Default Value: 1 - Yes

        NOTE: Under normal circumstances the ID Query ensures that the
        instrument initialized over the bus is the type supported by this
        driver. However, circumstances may arise where it is undesirable to
        send an ID Query to the instrument. In those cases, set this control
        to Skip Query and this function will initialize the bus and the
        command arrays in the driver, without doing an ID Query.

    resetDevice

        Variable Type       ViBoolean

        Specifies whether the instrument is to be reset to its power-on
        settings during the initialization procedure.

         Valid Range:   1 = Yes
                        0 = No

         Default Value: 1 - Yes

        NOTE: If you do not want the instrument reset, set this control to No
        while initializing the instrument.

    instrumentHandle

        Variable Type       ViSession (passed by reference)
```



```
The Instrument Handle is used to identify the unique session or
communication channel between the driver and the instrument.

If more than one instrument of the same model type is used, this
handle will be used to differentiate between them.

NOTE: A new (unique) handle will be returned EACH time the initialize
function is called. The bu5821_close() call should be used for EVERY
handle returned by the bu5821_init() function.


Return Value

If the function was successful, it will return a status of
VI_SUCCESS, otherwise it will return a warning or error code.
Passing the status code to the function "bu5821_error_message" will
return a string describing the warning or error.

A driver function can return three different types of warnings or
errors. The function "bu5821_error_message" will handle all three
types of warning/error codes by passing them to the appropriate
function if necessary ("bu3100_error_message" or "viStatusDesc"), to
return the correct warning/error message.

VISA Warnings/Errors:
See section 3.3 of the VPP 4.3.2 document for a complete list of
VISA status codes and their values. The VPP 4.3 document contains
detailed descriptions of all VISA functions and the status codes
returned by each of them.

BU3100 Warnings/Errors:
These are warning or error codes returned by the common motherboard
interface library, which are used by the 5821 driver to access a
ProDAQ motherboard. Warnings returned by the library will be in the
range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the
range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
bu5821.h.
```

5.1.18. bu5821_pgaCalibration

```
ViStatus bu5821_pgaCalibration (ViSession instrumentHandle, ViInt16 channel,
                                ViInt16 voltRefSource, ViReal64 voltRefValue,
                                ViReal64 *offset, ViReal64 *gain);
```

Purpose

This function performs the signal path calibration of the specified channel. The calibration is performed for the current setting of the gain. The obtained calibration coefficients are applied automatically after calibration is done. The function gives to user obtained offset and gain only for information.

Parameter List

instrumentHandle

Variable Type ViSession

The Instrument Handle is used to identify the unique session or communication channel between the driver and the instrument.

If more than one instrument of the same model type is used, this handle will be used to differentiate between them.

channel

Variable Type ViInt16

This parameter specifies which channel will be calibrated.

Possible values are:

```
bu5821_CHAN_1        1   Channel 1
bu5821_CHAN_2        2   Channel 2
...
bu5821_CHAN_15       15  Channel 15
bu5821_CHAN_16       16  Channel 16
```

voltRefSource

Variable Type ViInt16

This parameter specifies which voltage reference source will be used for calibration.

Possible values are:

```
bu5821_VREF_NO_VREF     0 No Volatge Reference module will be
                          used. Only offset will be calibarted;
bu5821_VREF_0V          1 The same as bu5821_VREF_NO_VREF;

bu5821_VREF_FROM_MASTER 2 Voltage reference module located
                          on the motherboard module of the
                          master function card. Calibration for
                          negative and positive voltages will be
                          done;
bu5821_VREF_MASTER_POS  3 Voltage reference module located
                          on the motherboard module of the
                          master function card. Calibration
                          only for positive voltages will be
                          done. It gives better precision if
                          input signal supposed to have only
                          positive values (like PT100)

bu5821_VREF_CUSTOM      4 User voltage reference is used
                          which is connected to monitor
                          input. User must know exactly,
                          the value of voltage and enter
                          this value to the Voltage
                          parameter.
```


voltRefValue

Variable Type ViReal64

This parameter is used only if external voltage reference module is used (VoltRefSource = bu5821_VREF_CUSTOM). In this case it should contain the value of the voltage reference applied to the Voltage Reference Monitor input. For othe types of calibration this parameter is ignored.

offset

Variable Type ViReal64 (passed by reference)

This parameter returns the calibrated offset value of the channel.

gain

Variable Type ViReal64 (passed by reference)

This parameter returns the calibrated gain value of the channel.

Return Value

If the function was successful, it will return a status of VI_SUCCESS, otherwise it will return a warning or error code. Passing the status code to the function "bu5821_error_message" will return a string describing the warning or error.

A driver function can return three different types of warnings or errors. The function "bu5821_error_message" will handle all three types of warning/error codes by passing them to the appropriate function if necessary ("bu3100_error_message" or "viStatusDesc"), to return the correct warning/error message.

VISA Warnings/Errors:
See section 3.3 of the VPP 4.3.2 document for a complete list of VISA status codes and their values. The VPP 4.3 document contains detailed descriptions of all VISA functions and the status codes returned by each of them.

BU3100 Warnings/Errors:
These are warning or error codes returned by the common motherboard interface library, which are used by the 5821 driver to access a ProDAQ motherboard. Warnings returned by the library will be in the range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to 0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range 0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file bu5821.h.

5.1.19. bu5821_readTemperature

```
    ViStatus bu5821_readTemperature (ViSession instrumentHandle,
                                     ViReal64 *temperature);

Purpose

    This function reads the temperature from the onboard ProDAQ 5821
    temperature sensors.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    temperature

        Variable Type       ViReal64 (passed by reference)

        This control returns the temperature from onboard temperature sensor
        in degrees Celsius.

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
        interface library, which are used by the 5821 driver to access a
        ProDAQ motherboard. Warnings returned by the library will be in the
        range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
        0xBFFC0900. They are defined in the include file bu3100.h.

        BU5821 Warnings/Errors:
        Warning codes returned by the 5821 driver functions will be in the
        range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
        0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
        bu5821.h.
```


5.1.20. bu5821_reset

```
    ViStatus bu5821_reset (ViSession instrumentHandle);

Purpose

    This function resets the function card to its power-on state.


Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
        interface library, which are used by the 5821 driver to access a
        ProDAQ motherboard. Warnings returned by the library will be in the
        range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
        0xBFFC0900. They are defined in the include file bu3100.h.

        BU5821 Warnings/Errors:
        Warning codes returned by the 5821 driver functions will be in the
        range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
        0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
        bu5821.h.
```

5.1.21. bu5821_resetCalibCoeff

```
    ViStatus bu5821_resetCalibCoeff (ViSession instrumentHandle, ViInt16 type);

Purpose

    Resets the calibration coefficients with default values or with values
    taken from the onboard EEPROM memory.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    type

        Variable Type       ViInt16

        Specifies which type of calibration coefficient will be set.

        Possible values are:

        bu5821_CALIB_TYPE_PGA    1  Signal path calibration
        bu5821_CALIB_TYPE_EXC    2  Excitation calibration
        bu5821_CALIB_TYPE_ALL    3  Both Signal path and Excitation

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
        interface library, which are used by the 5821 driver to access a
        ProDAQ motherboard. Warnings returned by the library will be in the
        range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
        0xBFFC0900. They are defined in the include file bu3100.h.

        BU5821 Warnings/Errors:
        Warning codes returned by the 5821 driver functions will be in the
        range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
        0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
        bu5821.h.
```


5.1.22. bu5821_revision_query

```
ViStatus bu5821_revision_query (ViSession instrumentHandle,
                                ViChar driverRevision[],
                                ViChar instrumentFirmwareRevision[]);
```

Purpose

Returns information about the hardware and software revisions.

Parameter List

instrumentHandle

Variable Type ViSession

The Instrument Handle is used to identify the unique session or communication channel between the driver and the instrument.

If more than one instrument of the same model type is used, this handle will be used to differentiate between them.

driverRevision

Variable Type ViChar[]

Returns the instrument driver revision.

instrumentFirmwareRevision

Variable Type ViChar[]

Returns firmware revision string.

Return Value

If the function was successful, it will return a status of VI_SUCCESS, otherwise it will return a warning or error code. Passing the status code to the function "bu5821_error_message" will return a string describing the warning or error.

A driver function can return three different types of warnings or errors. The function "bu5821_error_message" will handle all three types of warning/error codes by passing them to the appropriate function if necessary ("bu3100_error_message" or "viStatusDesc"), to return the correct warning/error message.

VISA Warnings/Errors:
See section 3.3 of the VPP 4.3.2 document for a complete list of VISA status codes and their values. The VPP 4.3 document contains detailed descriptions of all VISA functions and the status codes returned by each of them.

BU3100 Warnings/Errors:
These are warning or error codes returned by the common motherboard interface library, which are used by the 5821 driver to access a ProDAQ motherboard. Warnings returned by the library will be in the range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to 0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range 0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file bu5821.h.

5.1.23. bu5821_serialNumber

```
ViStatus bu5821_serialNumber (ViSession instrumentHandle, ViChar subversion[],
                              ViInt32 *serialNumber);
```

Purpose

This function returns the ProDAQ 5821 device subversion and serial number.

Parameter List

instrumentHandle

Variable Type ViSession

The Instrument Handle is used to identify the unique session or communication channel between the driver and the instrument.

If more than one instrument of the same model type is used, this handle will be used to differentiate between them.

subversion

Variable Type ViChar[]

This parameter returns the ProDAQ 5821 subversion in the form of a string, i.e., "AA", "AB", or "AC".

serialNumber

Variable Type ViInt32 (passed by reference)

This parameter returns the serial number of the ProDAQ 5821.

Return Value

If the function was successful, it will return a status of VI_SUCCESS, otherwise it will return a warning or error code. Passing the status code to the function "bu5821_error_message" will return a string describing the warning or error.

A driver function can return three different types of warnings or errors. The function "bu5821_error_message" will handle all three types of warning/error codes by passing them to the appropriate function if necessary ("bu3100_error_message" or "viStatusDesc"), to return the correct warning/error message.

VISA Warnings/Errors:
See section 3.3 of the VPP 4.3.2 document for a complete list of VISA status codes and their values. The VPP 4.3 document contains detailed descriptions of all VISA functions and the status codes returned by each of them.

BU3100 Warnings/Errors:
These are warning or error codes returned by the common motherboard interface library, which are used by the 5821 driver to access a ProDAQ motherboard. Warnings returned by the library will be in the range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to 0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range 0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file bu5821.h.

5.1.24. bu5821_setChanConfig

```
    ViStatus bu5821_setChanConfig (ViSession instrumentHandle, ViInt16 channel,
                                   ViInt16 mode, ViInt16 gain,
                                   ViInt16 excitationCurrent);

Purpose

    This function configures the specified channel or all 16 channels.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    channel

        Variable Type       ViInt16

        This parameter specifies which channel will be configured.

        Possible values are:

        bu5821_CHAN_1        1   Channel 1
        bu5821_CHAN_2        2   Channel 2
        ...
        bu5821_CHAN_15       15  Channel 15
        bu5821_CHAN_16       16  Channel 16

        OR

        bu5821_CHAN_ALL      0   All 16 channels will be configured
                                    with the same parameters.

    mode

        Variable Type       ViInt16

        This parameter specifies the channel mode.

        Possible values are:

        bu5821_MODE_4_WIRE     1 4-wire Cable
        bu5821_MODE_3_WIRE     2 3-wire Cable
        bu5821_MODE_2_WIRE     3 2-wire Cable
        bu5821_MODE_DIFF_VOLT  4 Differential Voltage
        bu5821_MODE_SE_VOLT    5 Single Ended Voltage
        bu5821_MODE_GND        6 Input is grounded
        bu5821_MODE_VREF       7 Input is connected to Voltage Reference
        bu5821_MODE_IREF       8 Input is connected to Excitation
                                 Current Reference
        bu5821_MODE_IREF_GND   9 Input is connected to Excitation
                                 Current Reference but I+ path is
                                 grounded (can be used to measure the
                                 current without external load)

        Default value: 1 - bu5821_MODE_4_WIRE.

    gain

        Variable Type       ViInt16

        This parameter specifies the channel gain.

        Possible values are:

        bu5821_GAIN_1_8        0         Gain 1/8
        bu5821_GAIN_1_4        1         Gain 1/4
        bu5821_GAIN_1_2        2         Gain 1/2
```

```
        bu5821_GAIN_1          3         Gain 1
        bu5821_GAIN_2          4         Gain 2
        bu5821_GAIN_4          5         Gain 4
        bu5821_GAIN_8          6         Gain 8
        bu5821_GAIN_16         7         Gain 16
        bu5821_GAIN_32         8         Gain 32
        bu5821_GAIN_64         9         Gain 64
        bu5821_GAIN_128        10        Gain 128

        Default value: 3 - bu5821_GAIN_1

    excitationCurrent

        Variable Type       ViInt16

        This parameter specifies the Excitaion Current.

        Available values are:

        bu5821_CURRENT_OFF 0   Exitation current is not applied
        bu5821_CURRENT_500 1   Exitation current of 500uA is applied
        bu5821_CURRENT_10  2   Exitation current of 10uA is applied

        Default value: 0 - bu5821_CURRENT_OFF

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
        interface library, which are used by the 5821 driver to access a
        ProDAQ motherboard. Warnings returned by the library will be in the
        range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
        0xBFFC0900. They are defined in the include file bu3100.h.

        BU5821 Warnings/Errors:
        Warning codes returned by the 5821 driver functions will be in the
        range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
        0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
        bu5821.h.
```


5.1.25. bu5821_setExcitCurrent

```
    ViStatus bu5821_setExcitCurrent (ViSession instrumentHandle, ViInt16 channel,
                                     ViInt16 excitationCurrent);

Purpose

    This function sets the excitation current for the selected channel or all
    16 channels.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    channel

        Variable Type       ViInt16

        This parameter specifies which channel will be configured.

        Possible values are:

        bu5821_CHAN_1        1   Channel 1
        bu5821_CHAN_2        2   Channel 2
        ...
        bu5821_CHAN_15       15  Channel 15
        bu5821_CHAN_16       16  Channel 16

        OR

        bu5821_CHAN_ALL      0   All 16 channels will be configured
                                    with the same parameters.

    excitationCurrent

        Variable Type       ViInt16

        This parameter specifies the Excitaion Current.

        Available values are:

        bu5821_CURRENT_OFF 0   Exitation current is not applied
        bu5821_CURRENT_500 1   Exitation current of 500uA is applied
        bu5821_CURRENT_10  2   Exitation current of 10uA is applied

        Default value: 0 - bu5821_CURRENT_OFF

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
```

```
interface library, which are used by the 5821 driver to access a
ProDAQ motherboard. Warnings returned by the library will be in the
range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the
range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
bu5821.h.
```


5.1.26. bu5821_setGain

```
    ViStatus bu5821_setGain (ViSession instrumentHandle, ViInt16 channel,
                             ViInt16 gain);

Purpose

    This function sets the gain of PGA for the specified channel or all 16
    channels.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    channel

        Variable Type       ViInt16

        This parameter specifies which channel will be configured.

        Possible values are:

        bu5821_CHAN_1        1   Channel 1
        bu5821_CHAN_2        2   Channel 2
        ...
        bu5821_CHAN_15       15  Channel 15
        bu5821_CHAN_16       16  Channel 16

        OR

        bu5821_CHAN_ALL      0   All 16 channels will be configured
                                    with the same parameters.

    gain

        Variable Type       ViInt16

        This parameter specifies the gain for the input channel.

        Possible values are:

        bu5821_GAIN_1_8        0         Gain 1/8
        bu5821_GAIN_1_4        1         Gain 1/4
        bu5821_GAIN_1_2        2         Gain 1/2
        bu5821_GAIN_1          3         Gain 1
        bu5821_GAIN_2          4         Gain 2
        bu5821_GAIN_4          5         Gain 4
        bu5821_GAIN_8          6         Gain 8
        bu5821_GAIN_16         7         Gain 16
        bu5821_GAIN_32         8         Gain 32
        bu5821_GAIN_64         9         Gain 64
        bu5821_GAIN_128        10        Gain 128

        Default value: 3 - bu5821_GAIN_1.

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.
```

```
VISA Warnings/Errors:
See section 3.3 of the VPP 4.3.2 document for a complete list of
VISA status codes and their values. The VPP 4.3 document contains
detailed descriptions of all VISA functions and the status codes
returned by each of them.

BU3100 Warnings/Errors:
These are warning or error codes returned by the common motherboard
interface library, which are used by the 5821 driver to access a
ProDAQ motherboard. Warnings returned by the library will be in the
range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the
range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
bu5821.h.
```


5.1.27. bu5821_setMode

```
    ViStatus bu5821_setMode (ViSession instrumentHandle, ViInt16 channel,
                             ViInt16 mode);

Purpose

    This function sets the mode of the specified channel or all 16 channels.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    channel

        Variable Type       ViInt16

        This parameter specifies which channel will be configured.

        Possible values are:

        bu5821_CHAN_1        1   Channel 1
        bu5821_CHAN_2        2   Channel 2
        ...
        bu5821_CHAN_15       15  Channel 15
        bu5821_CHAN_16       16  Channel 16

        OR

        bu5821_CHAN_ALL      0   All 16 channels will be configured
                                    with the same parameters.

    mode

        Variable Type       ViInt16

        This parameter specifies the channel mode.

        Possible values are:

        bu5821_MODE_4_WIRE     1 4-wire Cable
        bu5821_MODE_3_WIRE     2 3-wire Cable
        bu5821_MODE_2_WIRE     3 2-wire Cable
        bu5821_MODE_DIFF_VOLT  4 Differential Voltage
        bu5821_MODE_SE_VOLT    5 Single Ended Voltage
        bu5821_MODE_GND        6 Input is grounded
        bu5821_MODE_VREF       7 Input is connected to Voltage Reference
        bu5821_MODE_IREF       8 Input is connected to Excitation
                                 Current Reference
        bu5821_MODE_IREF_GND   9 Input is connected to Excitation
                                 Current Reference but I+ path is
                                 grounded (can be used to measure the
                                 current without external load)

        Default value: 1 - bu5821_MODE_4_WIRE.


Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
```

```
return the correct warning/error message.

VISA Warnings/Errors:
See section 3.3 of the VPP 4.3.2 document for a complete list of
VISA status codes and their values. The VPP 4.3 document contains
detailed descriptions of all VISA functions and the status codes
returned by each of them.

BU3100 Warnings/Errors:
These are warning or error codes returned by the common motherboard
interface library, which are used by the 5821 driver to access a
ProDAQ motherboard. Warnings returned by the library will be in the
range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the
range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
bu5821.h.
```


5.1.28. bu5821_setVoltRefOutput

```
    ViStatus bu5821_setVoltRefOutput (ViSession instrumentHandle,
                                      ViInt32 voltRefModule, ViReal64 voltage,
                                      ViBoolean monitor);

Purpose

    This function sets the specified voltage reference module output voltage.

Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    voltRefModule

        Variable Type       ViInt32

        This parameter specifies which voltage reference module will be used
        to generate the voltage reference.

        Possible values are:

        bu5821_VREF_NO_VREF      0    No VREF used
        bu5821_VREF_0V           1    0V to all channels
        bu5821_VREF_FROM_MASTER  2    VREF from master function card to
                                      all channels
        bu5821_VREF_CUSTOM       4    Custom VREF from external VREF
                                      connector) to all channels

        WARNING:

        Please always make sure that if you use external voltage reference,
        to disconnect it or set Monitor parameter to VI_FALSE when changing
        the voltage reference source.


    voltage

        Variable Type       ViReal64

        This parameter specifies the output voltage of the voltage reference
        module. The available set of voltages depend on the type of the
        selected voltage reference module.
        If the voltage reference module is unable to generate the requested
        message, the function will return an error status. If the external
        voltage reference module is used, this parameter will contain the
        actual voltage provided by the external voltage reference source.

    monitor

        Variable Type       ViBoolean

        This parameter specifies whether the voltage reference output will be
        routed to the ProDAQ 5821 rear panel connector (for monitoring
        purposes). This parameter will be ignored if the external voltage
        reference is selected as a source.

        Possible values are:

        VI_FALSE   Voltage reference output is disconnected from the
                   ProDAQ 5821 rear panel connector.

        VI_TRUE    Voltage reference output is connected to the ProDAQ
                   5821 rear panel connector.

        WARNING:
```

Please always make sure when using monitor, that the power source or voltage reference is NOT connected to the rear panel connector.

Return Value

If the function was successful, it will return a status of VI_SUCCESS, otherwise it will return a warning or error code. Passing the status code to the function "bu5821_error_message" will return a string describing the warning or error.

A driver function can return three different types of warnings or errors. The function "bu5821_error_message" will handle all three types of warning/error codes by passing them to the appropriate function if necessary ("bu3100_error_message" or "viStatusDesc"), to return the correct warning/error message.

VISA Warnings/Errors:
See section 3.3 of the VPP 4.3.2 document for a complete list of VISA status codes and their values. The VPP 4.3 document contains detailed descriptions of all VISA functions and the status codes returned by each of them.

BU3100 Warnings/Errors:
These are warning or error codes returned by the common motherboard interface library, which are used by the 5821 driver to access a ProDAQ motherboard. Warnings returned by the library will be in the range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to 0xBFFC0900. They are defined in the include file bu3100.h.

BU5821 Warnings/Errors:
Warning codes returned by the 5821 driver functions will be in the range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range 0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file bu5821.h.

5.1.29. bu5821_storeCalibCoeff

```
    ViStatus bu5821_storeCalibCoeff (ViSession instrumentHandle, ViInt16 type);

Purpose

    This function stores the calibration coefficients into the onboard EEPROM
    memory.

    CAUTION: The factory calibration coefficients will be
             overwritten.


Parameter List

    instrumentHandle

        Variable Type       ViSession

        The Instrument Handle is used to identify the unique session or
        communication channel between the driver and the instrument.

        If more than one instrument of the same model type is used, this
        handle will be used to differentiate between them.

    type

        Variable Type       ViInt16

        Specifies which type of calibration coefficient will be stored into
        EEPROM.

        Possible values are:

        bu5821_CALIB_TYPE_PGA    1  PGA calibration type
        bu5821_CALIB_TYPE_EXC    2  EXECITATION calibration type
        bu5821_CALIB_TYPE_ALL    3  PGA & EXECITATION calibration type

Return Value

        If the function was successful, it will return a status of
        VI_SUCCESS, otherwise it will return a warning or error code.
        Passing the status code to the function "bu5821_error_message" will
        return a string describing the warning or error.

        A driver function can return three different types of warnings or
        errors. The function "bu5821_error_message" will handle all three
        types of warning/error codes by passing them to the appropriate
        function if necessary ("bu3100_error_message" or "viStatusDesc"), to
        return the correct warning/error message.

        VISA Warnings/Errors:
        See section 3.3 of the VPP 4.3.2 document for a complete list of
        VISA status codes and their values. The VPP 4.3 document contains
        detailed descriptions of all VISA functions and the status codes
        returned by each of them.

        BU3100 Warnings/Errors:
        These are warning or error codes returned by the common motherboard
        interface library, which are used by the 5821 driver to access a
        ProDAQ motherboard. Warnings returned by the library will be in the
        range 0x3FFC0800 to 0x3FFC0900 and errors in the range 0xBFFC0800 to
        0xBFFC0900. They are defined in the include file bu3100.h.

        BU5821 Warnings/Errors:
        Warning codes returned by the 5821 driver functions will be in the
        range 0x3FFC0B00 to 0x3FFC0FFF and error codes in the range
        0xBFFC0B00 to 0xBFFC0FFF. They are defined in the include file
        bu5821.h.
```

6. Specifications

6.1. Available Versions

Versions	5821-AA	RTD Signal Conditioning Card
	5821-BA	RTD Signal Conditioning Card with 3-wire compensation
	5821-BB	RTD Signal Conditioning Card with 3-wire compensation and support for cryogenic diodes

6.2. Signal Conditioning

Sensor Types	Resistive: RTD, Thermistors, Cryogenic Diodes
Sensor Modes (internally configurable)	2, 3 & 4-wire (5821-Bx) 4-wire (5821-Ax)
Output Current	500 µA (RTD, Thermistors; all versions) 10 µA (Cryogenic Diodes; 5821-BB only)
Current Accuracy	500 µA: ±0.01% typical 10 µA: ±0.02% typical
Compliance Voltage	5 Volt
Current Monitoring	Yes
Broken Wire Detection	Yes (5821-Bx only)
Volt. Reference Monitoring	Yes (5821-Bx only)

6.3. Environmental Specifications

Temperature	0 °C to +50 °C (operational) -40 °C to +70 °C (storage only)
Humidity	5% - 95% (non-condensing)
Warm-up Time	30 min minimum.

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