



## VIBRATION ANALYSIS HARDWARE



## SC310 Series Signal Conditioner Product Manual

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## INTRODUCTION

This document contains information on the operation, installation, and maintenance of the SC310 Series Signal Conditioner. The signal conditioner is a device that converts a sensor input to 0-20 mA, 4-20 mA, 0-5 V<sub>DC</sub>, or 0-10 V<sub>DC</sub> output signals and provides a buffered dynamic output of the vibration waveform. The signal conditioner accepts input from an accelerometer, velocity transducer, or proximity probe. The signal conditioner's output can be configured proportional to acceleration, velocity, or displacement depending on the input transducer type. Additionally, the signal conditioner also contains dedicated pins for input from a temperature sensor and a 4-20 mA signal proportional to the temperature sensor input voltage.

### SC310 Series Overview

The SC310 signal conditioner is a DIN rail mountable component used in continuous machinery monitoring applications. It provides signal conditioning, signal conversion, and re-transmission. All settings are configured using downloadable and easy to use software (requires PC and a micro USB cable). A general list of features includes:

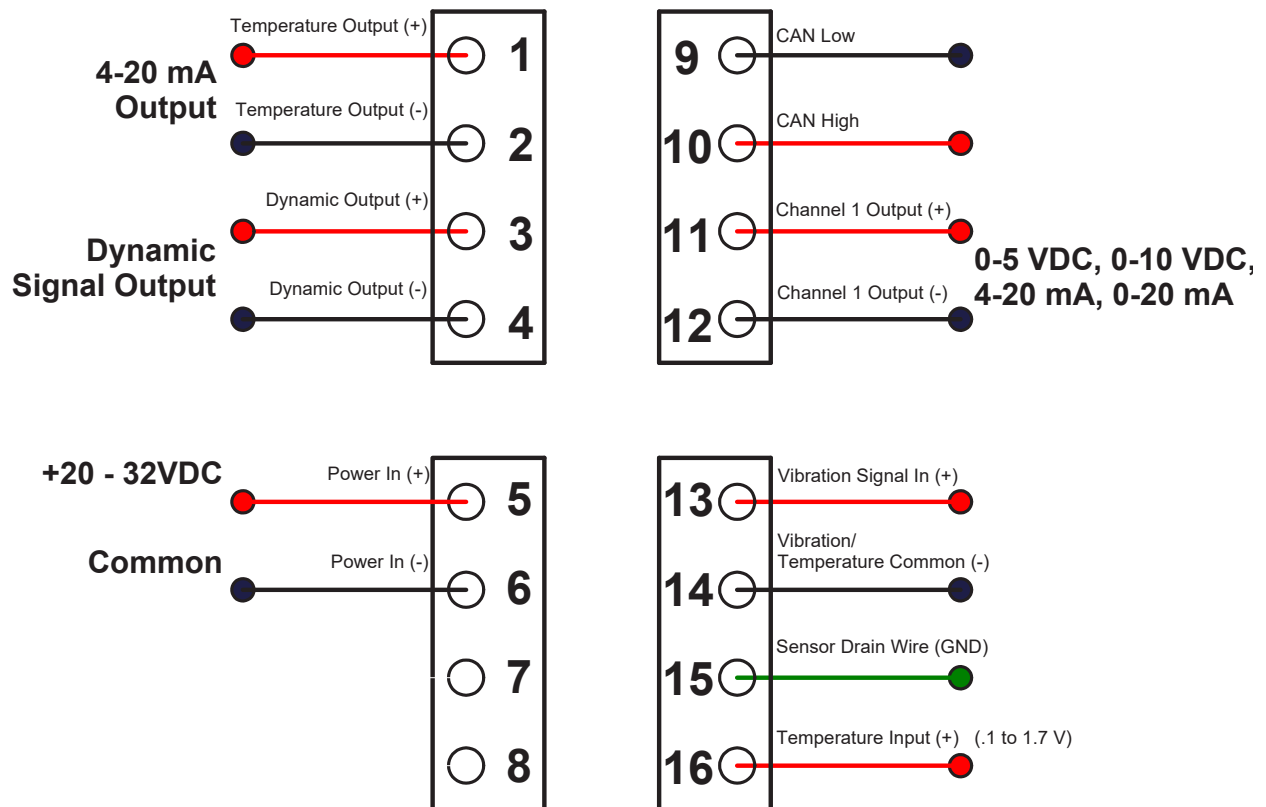
- 4-20 mA output signal for temperature
- One selectable channels offering 0-5 V<sub>DC</sub>, 0-10 V<sub>DC</sub>, 4-20 mA, or 0-20 mA output signals proportional to vibration
- Built-in selectable 24 V<sub>DC</sub>, 4 mA IEPE Sensor Excitation
- LED indicator for unit operation and basic troubleshooting
- Selectable configurations for 0-Pk, Pk-Pk, RMS, as well as peak and hold
- Input selectable between acceleration, velocity, and displacement
- Ultrasound compatible up to 40 kHz
- Independent and selectable digital bandpass filters
- Output scaleable for Metric and English



- Output selectable between acceleration, velocity, or displacement (varies by configuration)
- Ten available full-scale ranges from 0.5 to 500 (g's, IPS, mm/sec, mils; the maximum full-scale range varies based on input sensor activity)
- Two buffered dynamic outputs, one via BNC and one via terminal blocks
- 35 mm DIN Rail mountable
- Removable Terminal Blocks facilitates easy wiring

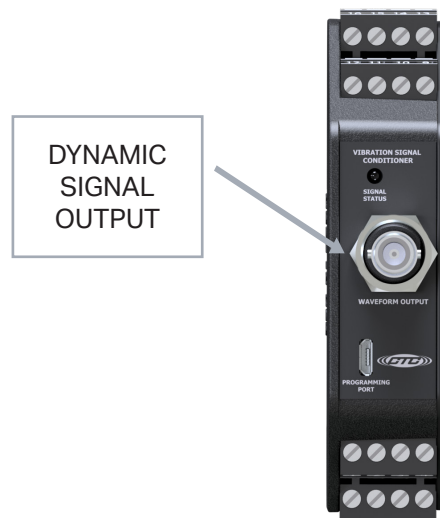
## INSTALLATION

### Electrical Connections



**Figure 1. Signal Conditioner Electrical Wiring Diagram for Single Channel IEPE Accelerometer Input, with Temperature**

1. Connect the +20 - 32 V<sub>DC</sub> Power Lead to the terminal marked 5 and the negative or common to the terminal marked 6.
2. For single channel accelerometer input connection, wire the sensor leads to 13(+), 14(-), and 15(shield drain wire) as shown in Figure 1. If using a TA series sensor, the temperature out lead is attached to terminal 16.
3. Connect the output device to terminals 11(+) and 12(-) for channel one's 4-20 mA signal proportional to the vibration level.
4. Connect output device to terminals 1(+), and 2(-) to obtain the 4-20 mA signal representative of temperature level.
5. Connect the output device to terminals 7(+) and 8(-) to obtain channel two's 4-20 mA signal proportional to the vibration level.
6. The Dynamic Signal output can be obtained from the BNC connector at the top of the signal conditioner or from terminals 3(+) and 4(+).



**Figure 2. Signal Conditioner — Dynamic Signal Output BNC**

Terminal connections are also listed on the side of the signal conditioner.

## Mounting

The signal conditioner is designed to be mounted on a 35 mm DIN rail. The mounting clip is spring-loaded to facilitate simple permanent locating. To remove the signal conditioner, use a small flat-head screwdriver as a lever on the spring-loaded mounting clip. With the clip disengaged, slide the signal conditioner from the mounting rail.

# SIGNAL CONDITIONER CONFIGURATION

## Requirements

- Windows 10 minimum build version: 1703
- Administrator Privileges
- Microsoft SQL Server 2012 or above (See Below)
- Approximately 1Gb of free storage (5Gb recommended) to create application files, log files, and database records

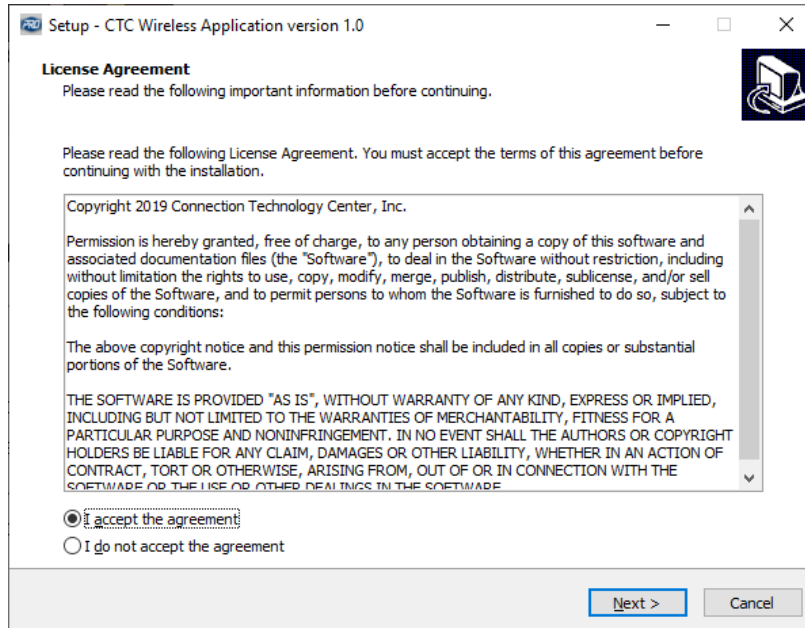
## Embedded Server Mode Requires SQL Server

This software has several different configurations. The default configuration is to run an embedded API server, which requires Microsoft SQL Server. If you need a free version of Microsoft SQL Server, copy and paste this link into your browser (<https://www.microsoft.com/en-us/sql-server/sql-server-downloads>) to download and install the free/specialized version "Microsoft SQL Server Express." If you already have a Microsoft SQL Server, after you install the software, please make corrections to the "Connection String" in the settings to connect to your desired server.

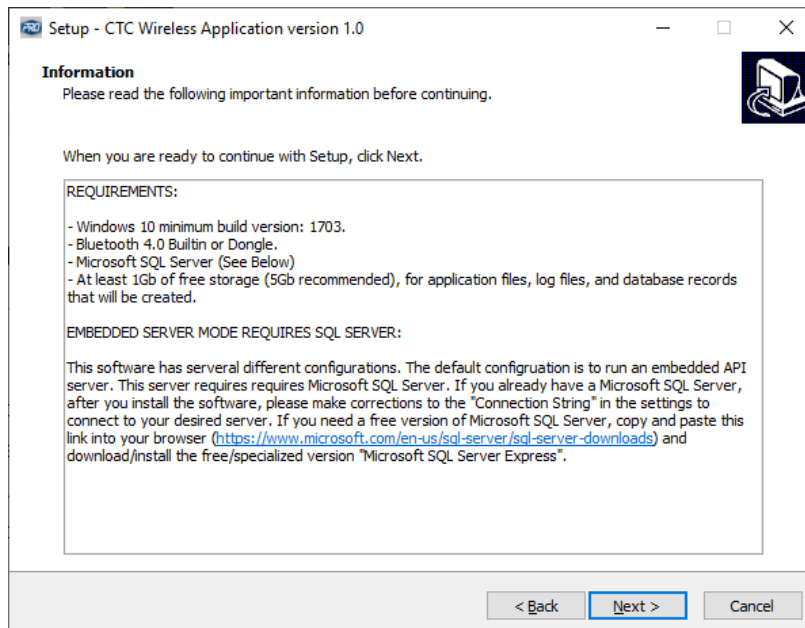


## Installing the Configuration Software

1. Run the program labeled "CTC Signal Conditioner Installer"
  - a. Please note that this installer must be run under an administrator account
  - b. Read and Accept the license -> Click Next



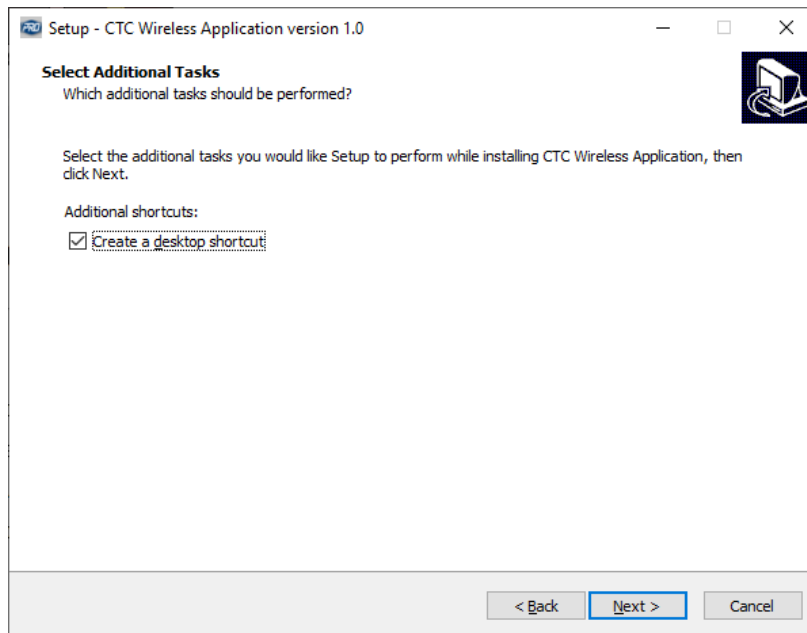
2. Review the requirements



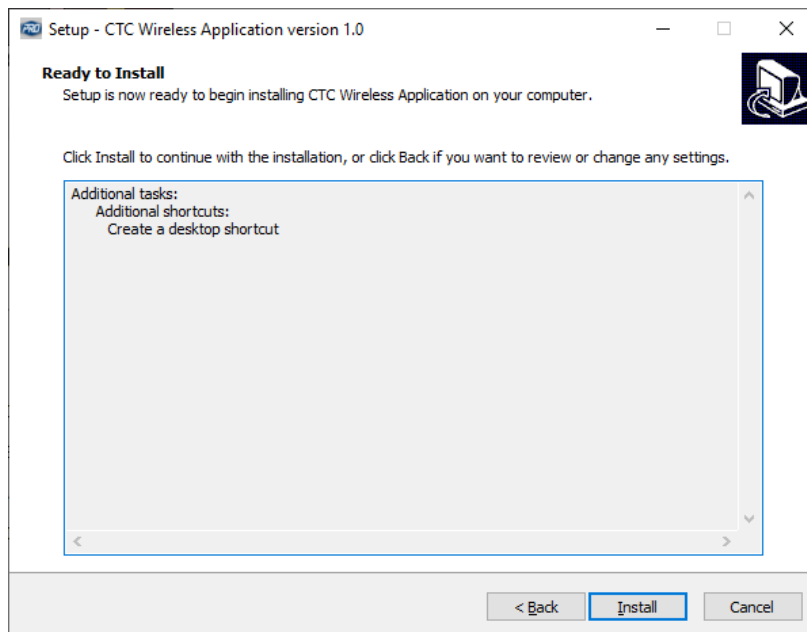
- a. A Microsoft MSSQL Server 2012 or later is required to run the software; make sure there is reserved space on an existing MSSQL database within your organization, or install the free latest MSSQL Express from

the Microsoft website <https://www.microsoft.com/en-us/sql-server/sql-server-editions-express>

- b. Click Next
- 3. Make sure the "Create a desktop shortcut" option is selected



- a. This will allow the user to easily enable admin privileges later
- b. Click Next
- 4. Install the application
  - a. Click Install

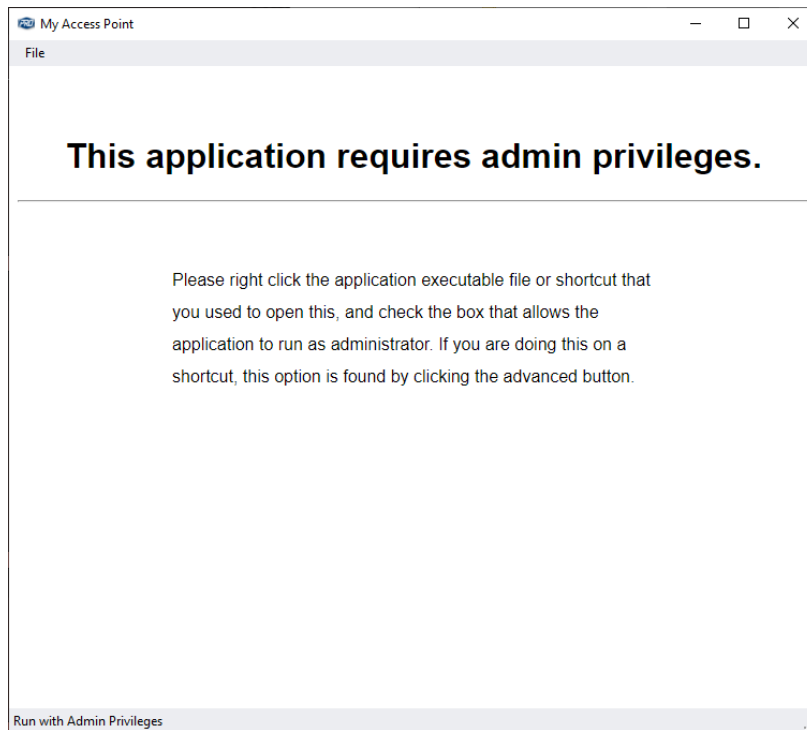




## Starting the Application for the First Time

The first time the application is started the Windows Firewall notification may pop up, asking the user to grant the application access to the public and private networks. It is best to allow the application access to both the private and public networks. If running the embedded server, the application may only need access to the private network, but if there is a need to change the configuration later, it would be best to give it access to both networks.

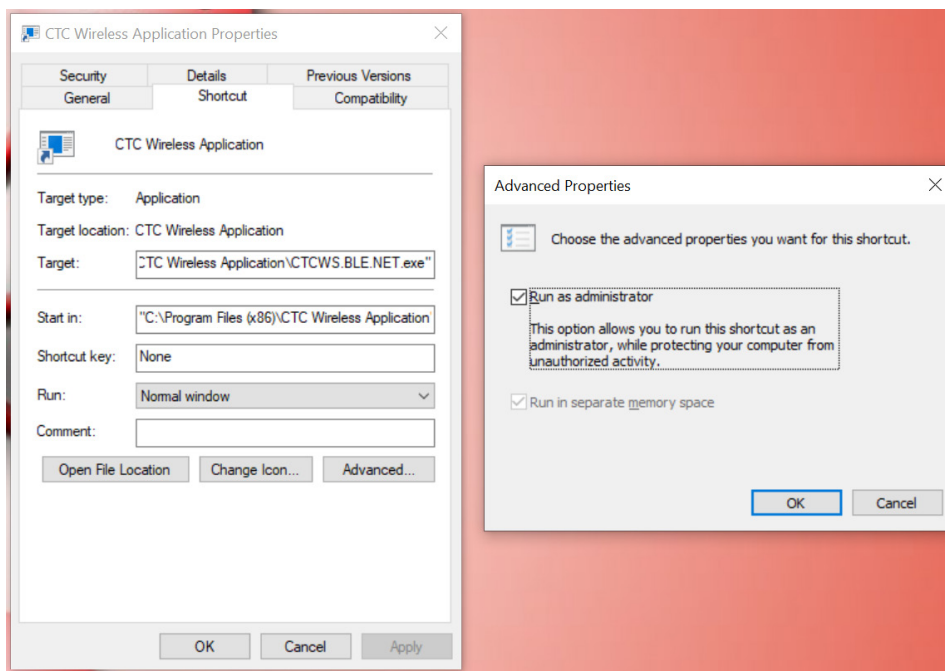
Additionally, the user may encounter a window stating that the CTC Signal Conditioner App will need to be run with administrative privileges.



The application requires administrative privileges in order to write the configuration files for the embedded server, as well as write log files for sensor readings and cached settings files for offline use.

To assign the application administrative privileges, find the desktop shortcut that the installation created, right-click it, and select properties.

In the window that pops up, click the advanced button. When the "Advanced" window pops up, check the box that says run as administrator, and click OK. Finally, click "Apply" in the original "Properties" window.



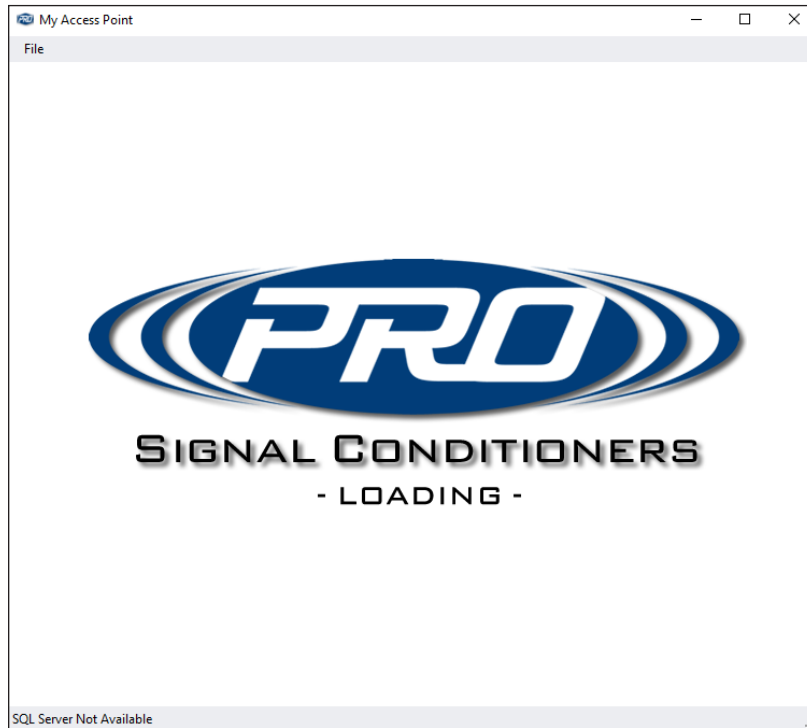
A confirmation dialog may appear that requires the user to provide administrative credentials. Click continue, and if the Windows Smart Screen pops up, type the computer's administrative credentials into the appropriate fields.

**Please note:** some organizations do not allow non-administrators to install or run unsigned programs. In this event, the application will need to be installed and run under the Administrator account. Please see your system administrator or IT department if you are unable to get the program to run correctly.

The application is now ready to take readings.

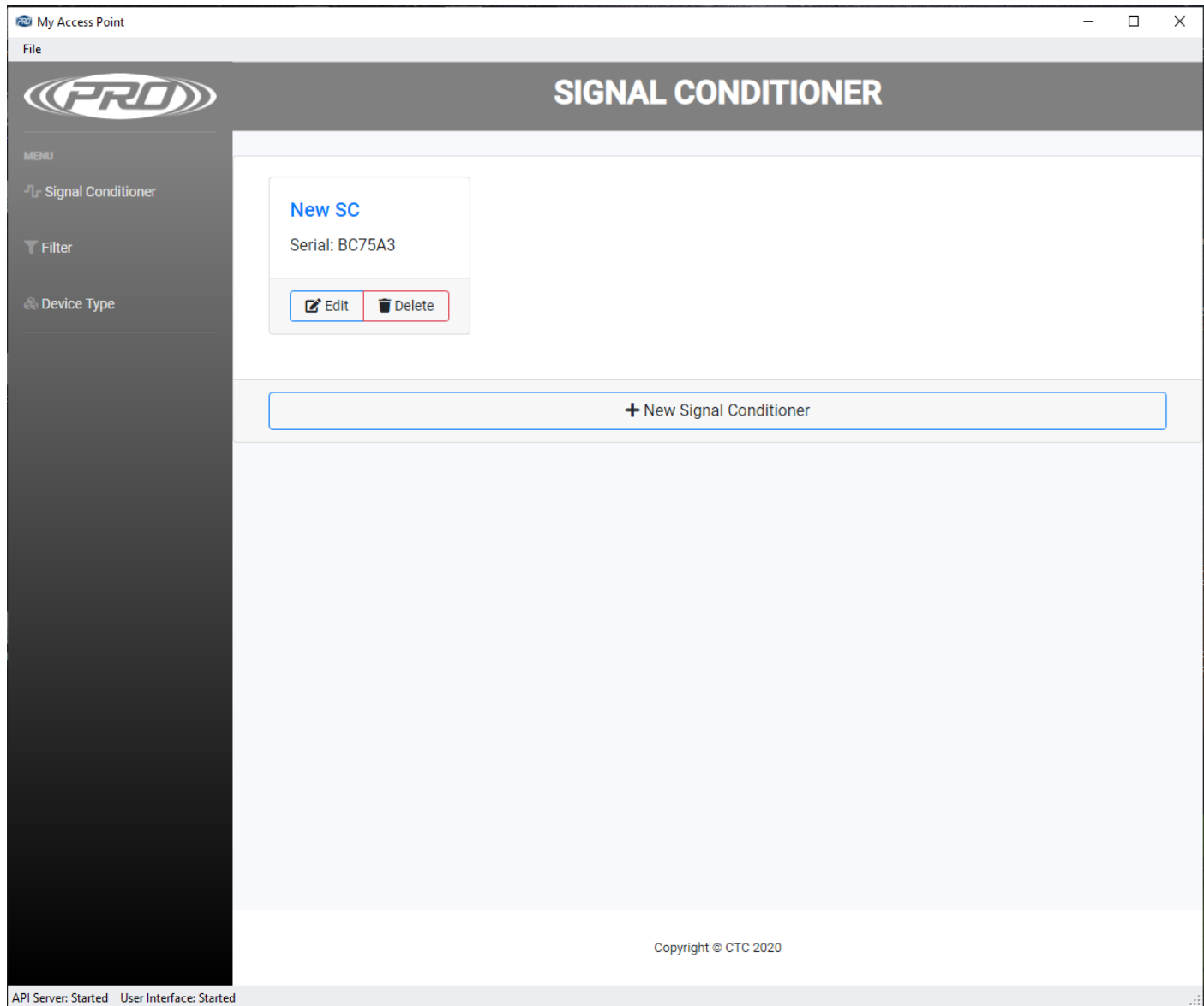
## Running the application

When you run the CTC Signal Conditioner Application, the first thing that will appear is a loading screen. This screen may take up to 30 seconds on the first run, as it creates necessary directories, configures the server, starts the embedded server, and synchronizes its own configuration.



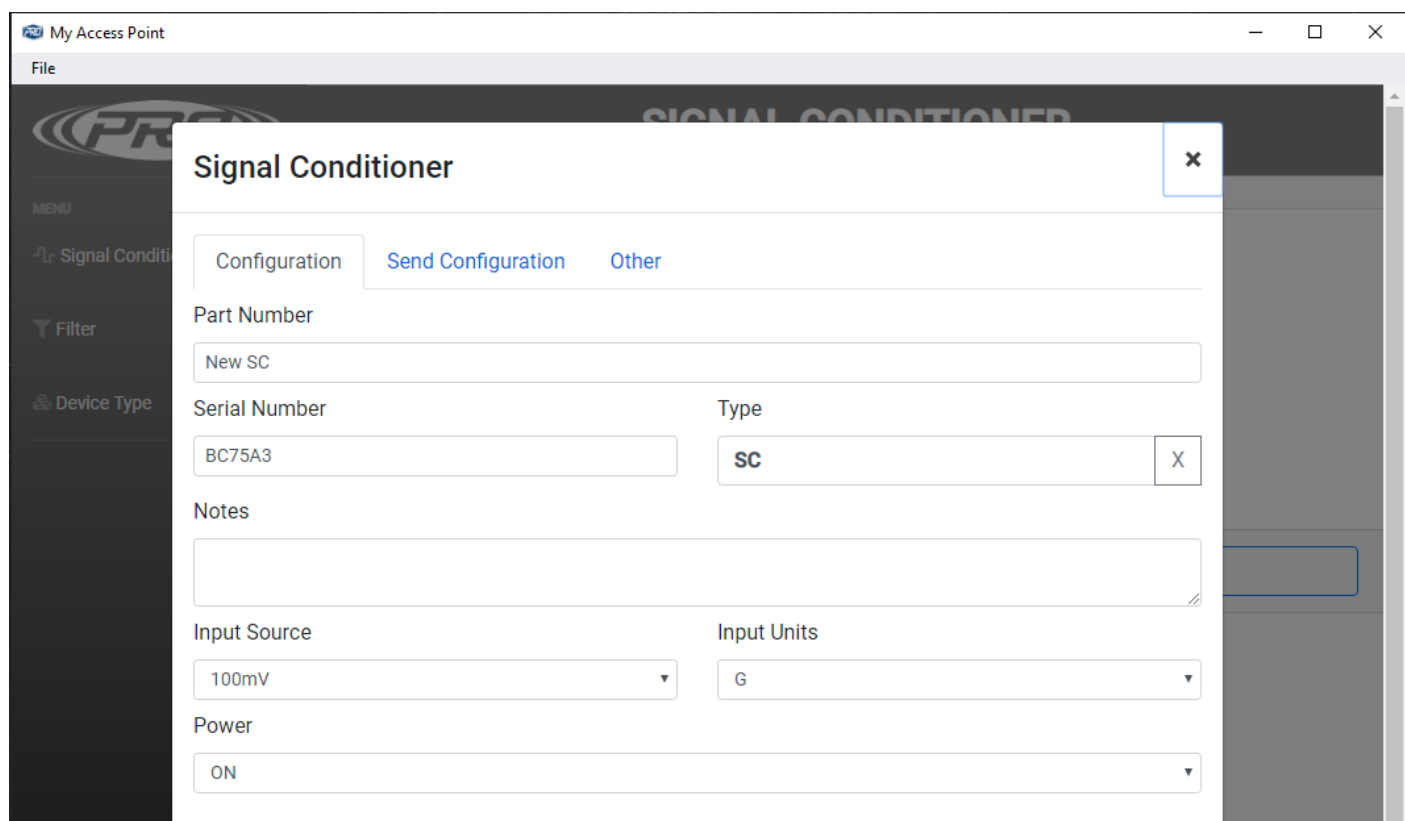
## Configuration Software

The configurator will open to the window shown in Figure 3. This is where all units known to the software will appear. From this window, if a signal conditioner is connected to the computer, it will appear automatically. If you are preparing to configure later, you can also add it manually using the “New Signal Conditioner” button.



**Figure 3. Configurator Home Window**

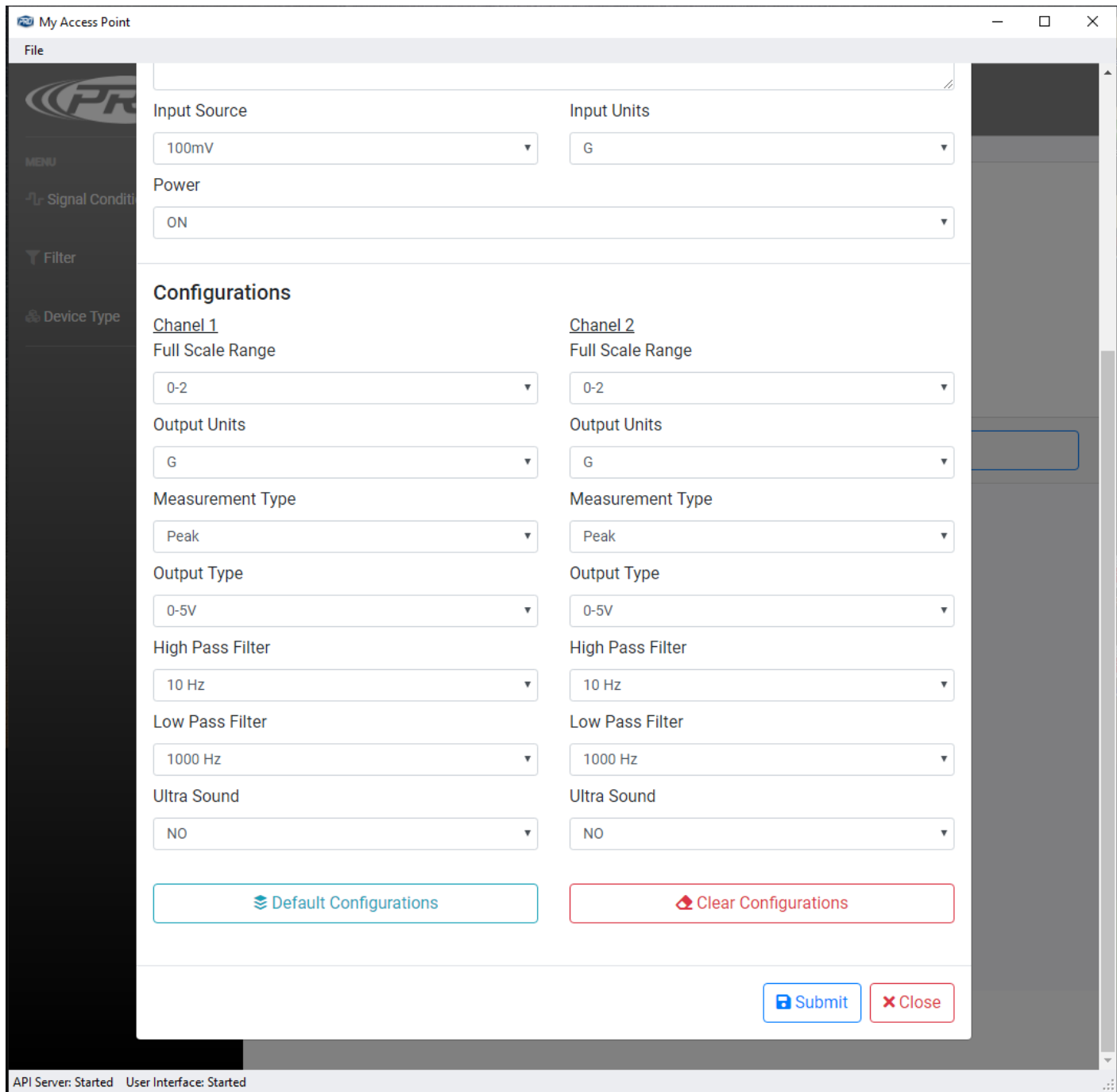
If you click "Edit" on a signal conditioner or click to add a new signal conditioner manually, the Signal Conditioner Configuration window shown in Figure 4a will be opened. If you are manually adding a signal conditioner, the "Serial Number" and "Type" fields will be blank. Make sure to correctly type in the device's serial number and select "SC" under "Type." If the signal conditioner was discovered automatically by the software, these fields will automatically be filled. **Ensure that the serial number field correctly matches the serial number of the device you want to configure.** The "Part Number" text field can be set to whatever is desired (designated for the CTC part number of the device) and acts as a name for the signal conditioner in the software. It will read "New SC" by default. Details about the signal conditioner (e.g., the device's location in the field) can be added in the text box titled "Notes."



**Figure 4a. Signal Conditioner Configuration Window**

Under this configuration tab is also where the configuration settings for the unit are set. The "Input Source" and "Input Units" dropdown menus define the sensor connected to the signal conditioner. Input source refers to the sensor's sensitivity, and input unit refers to the sensor's measurement type (g's for acceleration, IPS and mm/s for velocity, and mils for displacement). In Figure 4a, the signal conditioner is configured to accept input from a 100 mV/g accelerometer.

It is essential that this correctly matches the sensor type used to ensure proper scaling and accurate calculations. The "IEPE Power" dropdown menu controls whether or not the built-in IEPE supply on the device is turned on or off. In Figure 4a, the IEPE power supply is configured to "ON," so once configured and plugged in, the signal conditioner will supply a constant 4 mA to the sensor connected to the sensor terminals. The sensor input and thus settings described above are shared by both channels. Below the "IEPE Power" dropdown menu is where each channel's scaling settings are configured, as shown in Figure 4b.



**Figure 4b. Signal Conditioner Configuration Window Continued**



“Full-Scale Range” corresponds to the dynamic range of the measurement, and combined with “Output Units,” make up the scaling for the output control signal. The maximum selectable full-scale range is dependent on the sensor sensitivity and corresponds to a maximum dynamic input range of 10 V<sub>PP</sub>. The output unit selections are the same as the input unit selections and depend on the sensor type. The output unit can either be straight through or integrated. In a straight through configuration, the output unit matches the sensor input unit (e.g., g’s in and g’s out). In an integrated configuration, the output is integrated and then measured (e.g., an accelerometer signal in g’s can be integrated to measure velocity in either IPS or mm/s). Conversion can also take place between mm/s and IPS. The “Measurement Type” describes how the signal conditioner measures the sensor signal for scaling calculations. This can be either peak, peak to peak, or RMS. For example, the input sensor in Figure 4b is 100 mV/g, the full-scale range is 0-2 with a unit of g’s, and the measurement type is peak. Therefore, a mid-scale condition will occur when the sensor is outputting a signal corresponding to 1 g peak (halfway between 0 g and 2 g). If the measurement type were RMS instead, a mid-scale condition would occur if the RMS of the sensor signal was equal to 1 g (a peak value of 1.414 g). If the signal was integrated and the output unit was IPS, a mid-scale condition would occur if the sensor were outputting a signal corresponding to 1 IPS after integration.

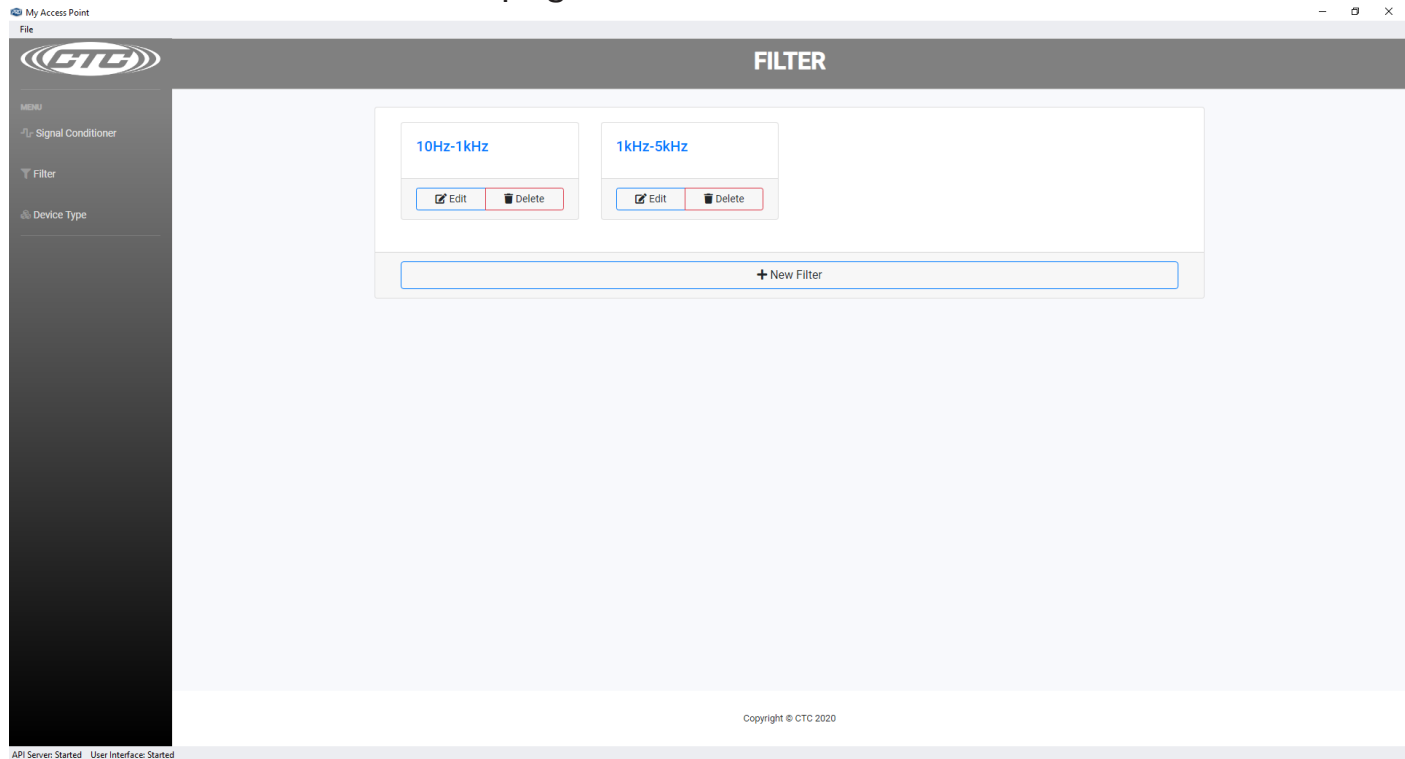
The “Output Type” dropdown determines what kind of process signal each channel will output. Selectable options are 0-20 mA, 4-20 mA, 0-5 V<sub>DC</sub>, and 0-10 V<sub>DC</sub>. The level of the output signal corresponds to where it falls in the full-scale range. So, continuing the example from Figure 5b, if the signal is at mid-scale vibration (1g peak for this configuration), and the output type is 0-5 V<sub>DC</sub>, then the output signal will read 2.5 V.

The “High Pass Filter” and “Low Pass Filter” selections combine to describe the cutoff frequencies of a digital bandpass filter used to filter the sensor signal on each channel. In the configuration in Figure 5b, each channel’s frequency range is 10 Hz - 1 kHz. Frequencies below 10 Hz and above 1 kHz will be attenuated. To maximize precision, it is beneficial to keep the primary frequencies of interest in the middle of the passband. There are also computational limitations that put a limit on bandwidth for filtering. If it is necessary to observe frequencies from 10 Hz to 20 kHz, this will not work on a single channel. Having both channels be configurable is advantageous in these kinds of scenarios. Channel one could be set to measure frequencies from 10 Hz to 1 kHz, and channel two could handle frequencies from 1 kHz to 20 kHz. This is also useful to split up the output units, such as integrating for velocity on channel one and monitoring channel two for acceleration. If ultrasound frequencies are to be measured (above 20 kHz), the



“Ultrasound” dropdown should be set to “YES.” In such a case, the high pass filter value will be locked at 20 kHz.

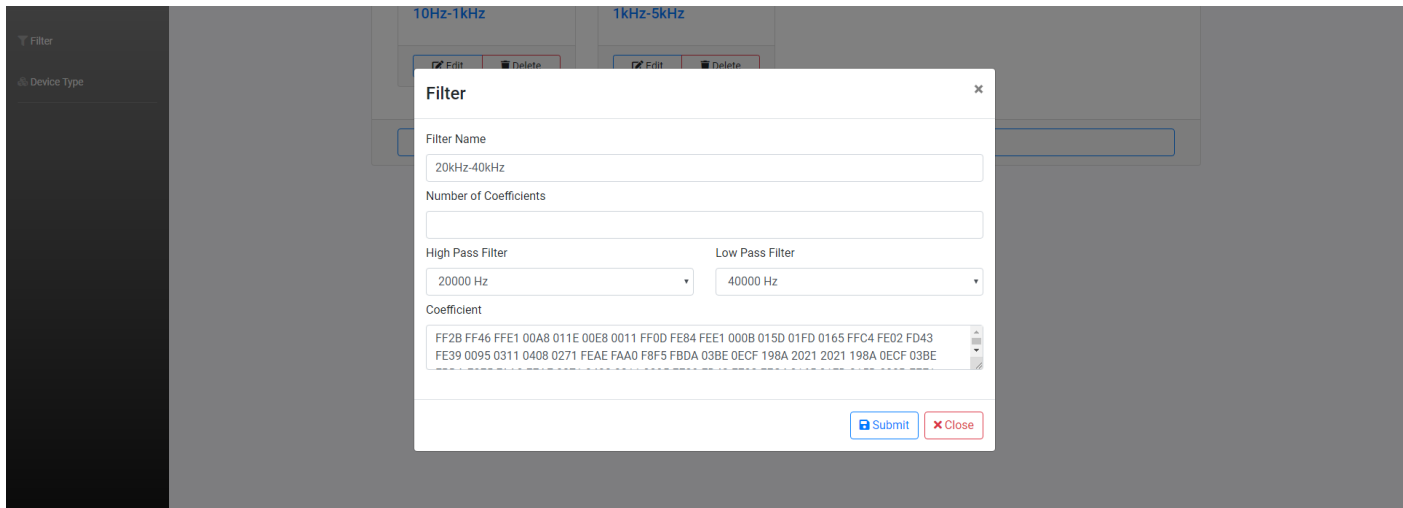
When configuring the filter options for a signal conditioner, the selection must correspond to an existing filter on the filter page. The default channel filter options (10 Hz-1 kHz and 1 kHz-5 kHz) will automatically exist on the page, as shown in Figure 6. To configure a signal conditioner with a different filter, that filter must have already been created. If the signal conditioner is being set to an ultrasound configuration from 20 kHz to 40 kHz, a corresponding 20 kHz - 40 kHz filter must exist on the filter page.



**Figure 5. Filter Window**

To create the filter, click “New Filter” from the filter page. This will bring up the new filter window, which will be filled with the 10 Hz-1 kHz filter settings by default. The new filter can be named anything; in this case, it was named after the filter’s frequency range. We want a 20 kHz-40 kHz filter. Under the “High Pass Filter” dropdown, the 20000 Hz option is selected, and under the “Low Pass Filter” dropdown, 40000 Hz is selected as shown. Once the selections are made, the coefficients for that filter will be auto-populated in the “Coefficient” field. The “Number of Coefficients” field is currently unimplemented and does not need to be filled in. Once the selections are made, click submit to save the filter, and it will appear in the filter page window. It is now ready to be used for configuring the signal conditioner.





**Figure 6. Creating A New Filter**

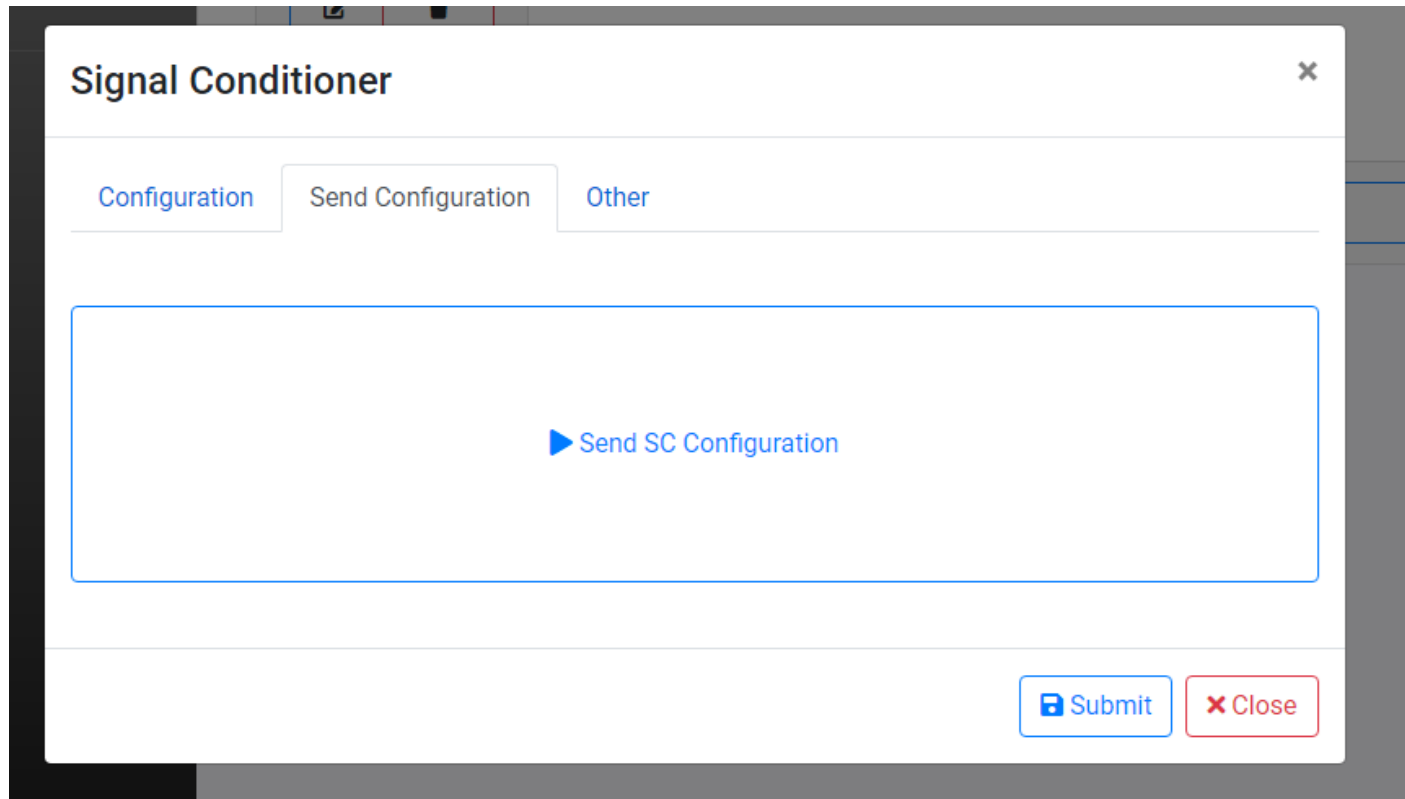
There are currently 37 valid filter options with coefficients defined, as shown in the table below. If, when creating a new filter, the selections don't match one of these 37, an error will be shown. Likewise, when configuring the signal conditioner, if filter options are chosen that do not correspond to an existing filter in the filter page, an error will be shown when attempting to program.

High Pass Filter	Low Pass Filter	High Pass Filter	Low Pass Filter	High Pass Filter	Low Pass Filter
1 Hz	10 Hz	50 Hz	500 Hz	1 kHz	20 kHz
1 Hz	50 Hz	50 Hz	1 kHz	5 kHz	10 kHz
2 Hz	10 Hz	50 Hz	5 kHz	5 kHz	15 kHz
2 Hz	50 Hz	100 Hz	500 Hz	5 kHz	20 kHz
2 Hz	100 Hz	100 Hz	1 kHz	10 kHz	15 kHz
5 Hz	10 Hz	100 Hz	5 kHz	10 kHz	20 kHz
5 Hz	50 Hz	500 Hz	1 kHz	15 kHz	20 kHz
5 Hz	100 Hz	500 Hz	5 kHz	20 kHz	25 kHz
10 Hz	50 Hz	500 Hz	10 kHz	20 kHz	30 kHz
10 Hz	100 Hz	500 Hz	15 kHz	20 kHz	35 kHz
10 Hz	500 Hz	1 kHz	5 kHz	20 kHz	40 kHz
10 Hz	1 kHz	1 kHz	10 kHz		
50 Hz	100 Hz	1 kHz	15 kHz		

**Table 1. Possible Filter Options**

The “Default Configurations” button will load all dropdown menus with the standard ISO configuration, corresponding to a 100 mV/g sensor in, IEPE Power on, 0-2 IP RMS on both channels, 4-20 mA on channel one, 0-5 V<sub>DC</sub> on channel two, and a frequency range of 10 Hz-1 kHz. “Clear Configurations” will empty all dropdown menus. Clicking on “Submit” will save the current configuration and close the Signal Conditioner Configuration window. Clicking on “Close” will close the window without saving changes to the structure.

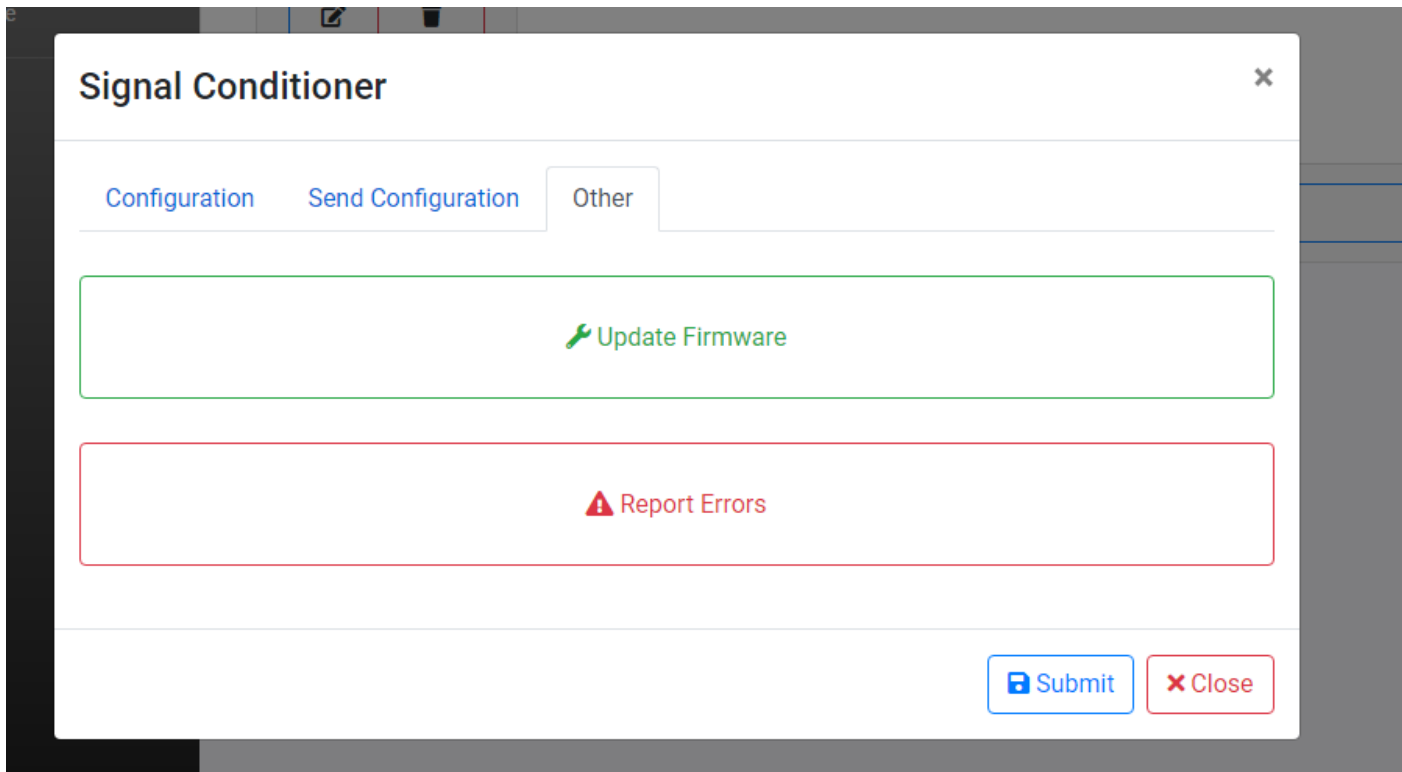
Once the desired configuration is set, the device will need to be programmed in the “Send Configuration” tab, as shown in Figure 7. Plug the signal conditioner into the PC using the provided USB cable (if not already), and click the button to send the configuration to the device. Any errors that occur during this process will be reported directly back. In the case of an error, make sure the USB is securely attached and the status LED is orange. If the configurator reports “Device Not Found,” ensure that the serial number in the configuration tab matches the connected signal conditioner.



**Figure 7. Send Configuration Window**

The “Other” tab shown in Figure 8 is where the signal conditioner’s firmware can be updated by clicking “Update Firmware.” This is also where device errors and warnings can be read off the signal conditioner (see Indicators in the Operation

section) by clicking "Report Errors." If errors are present on the device, report errors will read them and display information about the error(s) for corrective action. Both Operations are done via the USB port like when programming the device.



**Figure 8. Other Window**

## **OPERATION**

Once all wires are connected, apply power to begin operating the signal conditioner. Make sure the status light settles to normal mode.

### **Calibration**

The signal conditioner is calibrated internally during startup. The digital calibration eliminates the need for any adjustments to the Analog Output.

### **Indicators**

The LED on the front of the signal conditioner will indicate the status of the signal conditioner.

#### **State 1 - Normal Operation**

- LED is solid green

## **State 2** - Input Short Detected

- LED is rapidly flashing red

A short circuit is indicative of a lack of electrical resistance, removing the ability to measure the impact from a change in voltage. This instance is largely driven by an incorrect wiring setup. Verify that all wiring connections are attached in the correct polarity, and that no signal and common wires are touching. Lastly, ensure that the system is free of water and other contaminants.

## **State 3** - Input Open Detected

- LED is solid red

An open circuit implies a physical disconnect somewhere on the electrical path of the circuit. When receiving this error, verify that there is no physical separation within the system, such as unattached or broken cabling. Be sure that the connector is firmly secured to the accelerometer, and that the accelerometer is in good working order.

## **State 4** - Device Warning Detected

- LED is flashing green in 1-second intervals

A detected warning can be due to several things, such as incorrect output wiring (e.g., an open circuit detected on a current output or a short circuit detected on a voltage output) or corrupted configuration memory. The device will still be processing input data. However, it may be running in a reduced state or return unexpected results (e.g., if memory is corrupted, the unit will default to the standard ISO configuration until reprogrammed). If this state is detected, carefully inspect all wiring for secure connections and cycle power to the device. If the warning persists, the configurator can be used to determine the root cause and corrective action.

## **State 5** - Fatal Error

- LED is flashing red in 1-second intervals

In the case of a fatal error, the device has detected some non-recoverable hardware issue which could have been caused due to physical damage or misuse. Processing will be disabled in this case. Communication with the configurator may or may not work depending on the root cause but should be attempted as it may state the error that occurred. In some cases, cycling power to the device can remedy the issue.



## State 6 - Programming & Startup

- LED is solid orange

This state occurs when the signal conditioner starts up, confirms there is an available configuration, and sets up its peripherals and outputs. If the USB cable is connected and plugged into a PC, this state will persist. Plugging in the USB cable at any point will also cause the device to enter this state. Regular operation will not occur while the USB cable is plugged in.

## State 7 - Bootloader

- LED is flashing between red and green

This state occurs during device startup and indicates the bootloader is running. This state will persist if new firmware is being written for the duration of the update. If no firmware update handshake is received from the configurator within 5 seconds, the device leaves this state and continues with the startup.

## Portable Data Collector Interfacing

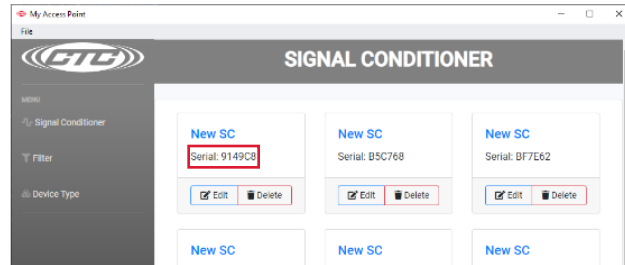
When using a portable data collector that supplies constant power to collect waveform data via the BNC jack on the signal conditioner, **the data collector must be set so that power to the sensor is turned off.** Failure to do so might result in a damaged or non-functional signal conditioner.



**Figure 9. Signal Conditioner, BNC**

# VERIFYING DRIVER SUPPORT FOR CONFIGURATION

If the SC300 is correctly connected via USB and the software properly installed, a box will appear with the title "New SC" in the main app page. The screen will show a serial number for each signal conditioner below the title.



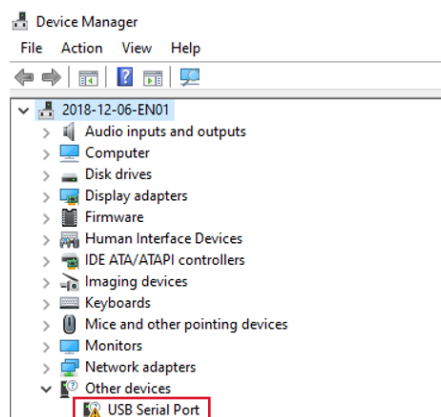
If a box doesn't appear, follow the troubleshooting steps below.

- Check the USB connection to make sure it is secure.
- Confirm that the LED indicator on the SC300 unit is lit up with a solid orange light (LED will blink when first plugged in and should then turn solid orange).

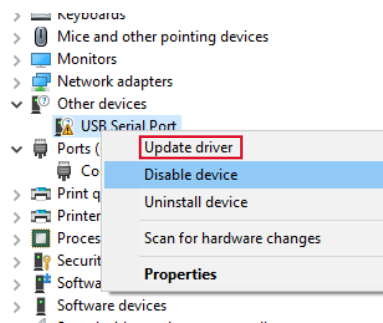


If both steps above are confirmed, then the device might be missing critical PC drivers needed to read the USB.

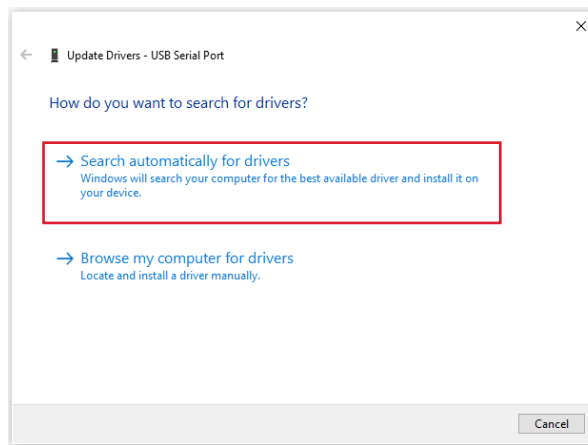
In this case, navigate to the Device Manager program (through the Start menu on Windows Devices) and look for the drop-down menu on the left side of the page.



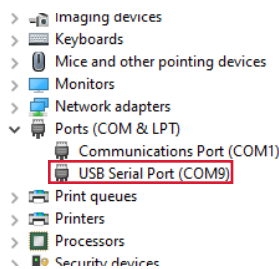
Look for and select the "Other Devices" option, then right-click on "USB Serial Port." Select the "Update Driver" option.



Select "Search Automatically for Drivers," and the computer should search for and install the necessary driver.



If the driver updates correctly, there will no longer be a "USB Serial Port" option in the "Other Devices" section, and a new option will appear in the "Ports" section of the drop-down tree.



Once this is completed, open the CTC Signal Conditioner program. The SC300 will appear with a serial number, and all functions will perform correctly.

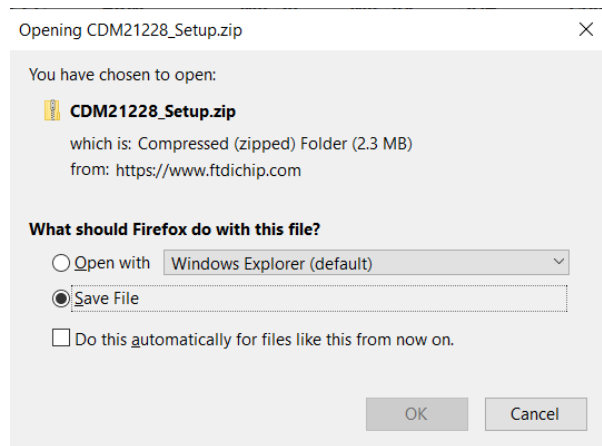
If a notification appears that there is no available upgrade, the driver will have to be installed manually.

The first step is to go to the link below –  
<https://ftdichip.com/drivers/vcp-drivers/>

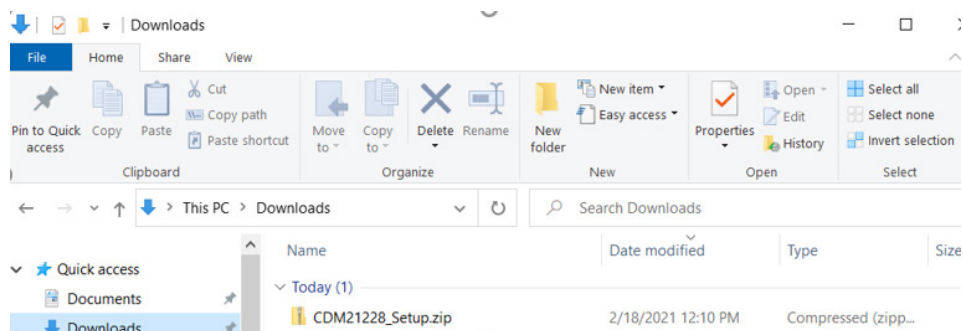
Scroll down to the download link section and select the setup executable option on the left side.

Operating System	Release Date	X86 (32-bit)	X64 (64-bit)	PPC	ARM	MIPSII	MIPSIV	SH4	Comments
Windows*	2017-08-30	<a href="#">2.12.28</a>	<a href="#">2.12.28</a>	-	-	-	-	-	WHQL Certified. Includes VCP and D2XX. Available as a <b>setup executable</b> . Please read the <a href="#">Release Notes</a> and <a href="#">Installation Guides</a> .

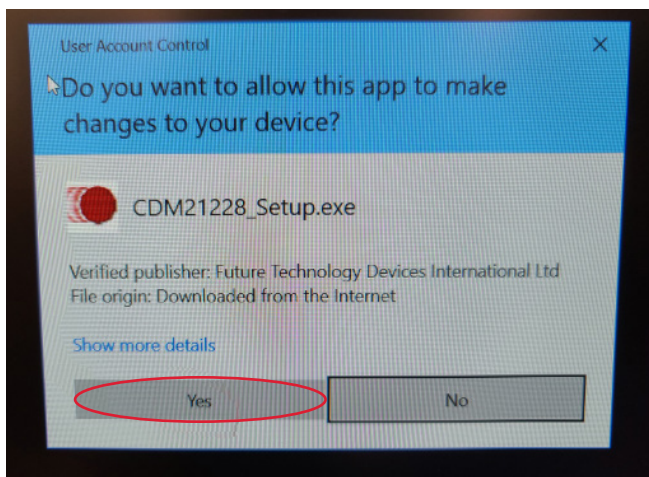
Save the file – it will be saved as CDMXXXX\_Setup.



Retrieve the file from the Downloads section of your File Manager, and run the program.



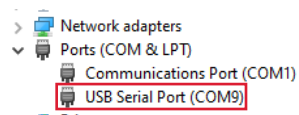




A standard installation wizard will open. Follow it to completion.



When this is complete, return to the Device Manager. If all is correct, USB Serial Port (ComX) will be displayed in the Ports section of the drop-down menu.



When this appears, open the CTC Signal Conditioner program. The SC300 will appear with a serial number, and all functions will perform correctly. Please feel free to contact CTC for any technical assistance.

Problem Description	Recommended Actions
4-20 mA or 0-5/10 V <sub>DC</sub> output is non-functional	Check status LED; ensure Signal conditioner is in Normal mode. Ensure it was correctly programmed and make sure all wiring is correct. Refer to Figure 1 for wiring diagram. Use the configurator's error reporter to read potential hardware issues.
No waveform data from BNC jack	Check status LED; ensure signal conditioner is in Normal mode. Make sure sensor is properly wired. Refer to Figure 1 for wiring diagram. Ensure the sensor power option is correctly programmed.
4-20 mA or 0-5/10 V <sub>DC</sub> output is lower than expected	Check filter settings. Make sure low pass and high pass filters have been set to range capable of capturing the expected frequencies. Ensure the rest of the configuration is correct.
4-20 mA signal is less than 2 mA	Check output cabling for damage. Ensure load resistance is no more than 1 k $\Omega$ .
Filter data or configuration profile did not send correctly	Ensure that the connection to the PC is secure and did not come loose during programming. Also make sure that the signal conditioner does not lose power during programming. LED status light should remain solid orange while plugged in. Check that the configuration is correct and try programming again.
No response from signal conditioner when programming	Ensure that the connection to the PC is secure and did not come loose during programming. Also make sure that the signal conditioner does not lose power during programming. LED status light should remain solid orange while plugged in. Check that the configuration is correct and try programming again.



# SOFTWARE END USER LICENSE AGREEMENT

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- (d) **Governing Law.** This Agreement is governed by and construed in accordance with the internal laws of the State of New York without giving effect to any choice or conflict of law provision or rule that would require or permit the application of the laws of any jurisdiction other than those of the State of New York. Any legal suit, action, or proceeding arising out of or related to this Agreement or the licenses granted hereunder will be instituted exclusively in the federal courts of the United States or the courts of the State of New York in each case located in the city of Rochester and County of Monroe, and each Party irrevocably submits to the exclusive jurisdiction of such courts in any such suit, action, or proceeding.
- (e) **Severability.** If any provision or provisions of this Agreement shall, for any reason, be deemed unenforceable or in violation of law, such unenforceability or violation shall not affect the remaining provisions of this License, which shall continue in full force and effect and be binding upon the parties hereto.
- (f) **Section Headings.** The headings of the sections, paragraphs, and appendices herein are for the Parties' convenient reference only and shall not define or limit any of the terms or provisions hereof.
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- (h) **Status of Parties.** This Agreement shall not be construed as creating any agency, partnership, joint venture, or other similar legal relationship between the Parties; nor will either Party hold itself out as an agent, partner, or joint venture party of the other Party. Both Parties shall be, and shall act as, independent contractors. Neither Party shall have authority to create any obligation for the other Party.



- (i) Interpretative Provisions. The words "hereof", "herein" and "hereunder" and words of like import used in this Agreement shall refer to this Agreement as a whole and not to any particular provision of this Agreement. The captions herein are included for convenience of reference only and shall be ignored in the construction or interpretation hereof. References to Articles and Sections are to Articles and Sections of this Agreement unless otherwise specified. Any singular term in this Agreement shall be deemed to include the plural, and any plural term the singular. Whenever the words "include", "includes" or "including" are used in this Agreement, they shall be deemed to be followed by the words "without limitation", whether or not they are in fact followed by those words or words of like import. "Writing", "written" and comparable terms refer to printing, typing and other means of reproducing words (including electronic media) in a visible form. References to any agreement or contract are to that agreement or contract as amended, modified or supplemented from time to time in accordance with the terms hereof and thereof. References to any person include the successors and permitted assigns of that person. This Agreement shall be construed without regard to any presumption or rule requiring construction or interpretation against the Party drafting an instrument or causing any instrument to be drafted.
- (j) Entire Agreement. This Agreement, together with any other documents incorporated herein by reference and all related Exhibits, constitutes the sole and entire agreement of the Parties with respect to the subject matter of this Agreement and supersedes all prior and contemporaneous understandings, agreements, and representations and warranties, both written and oral, with respect to such subject matter.



## **MAINTENANCE**

There are no customer replaceable parts on the signal conditioner. The device has been designed to self calibrate and monitor its own operational status. It is designed to provide trouble-free continuous service under normal operating conditions. Should the instrument require repair, visit [ctconline.com](http://ctconline.com) for a return material authorization.

## **WARRANTY & REFUND**

### **Warranty**

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