



VIBRATION ANALYSIS HARDWARE



SC150 Series Signal Conditioner Product Manual

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INTRODUCTION

This document contains information on the operation, installation, and maintenance of the SC150 Series Signal Conditioner. The signal conditioner is a device that converts a sensor input to a 4-20 mA output signal and provides a buffered dynamic output of the vibration waveform. The signal conditioner accepts input from a 100 mV/g accelerometer.

SC150 Series Overview

The SC150 signal conditioner is a DIN rail mountable component used in continuous machinery monitoring applications. It provides signal conditioning, signal conversion, and re-transmission. Limited settings are configured using downloadable and easy to use software (requires PC and a micro USB cable). User-programmable settings include:

- 0-5 V or 0-10 V output
- IEPE Power enabled or disabled
- Output scalable for Metric and English

General features include:

- Two buffered dynamic outputs, one via BNC and one via terminal blocks
- 35 mm DIN rail mountable
- Removable terminal blocks facilitate easy wiring
- Full scale range from 2 Hz to 1000 Hz on SC150-XX-XX-00
- Full scale range from 10 Hz to 1000 Hz on SC150-XX-XX-01
- LED indicator for unit operation and basic troubleshooting



INSTALLATION

Electrical Connections

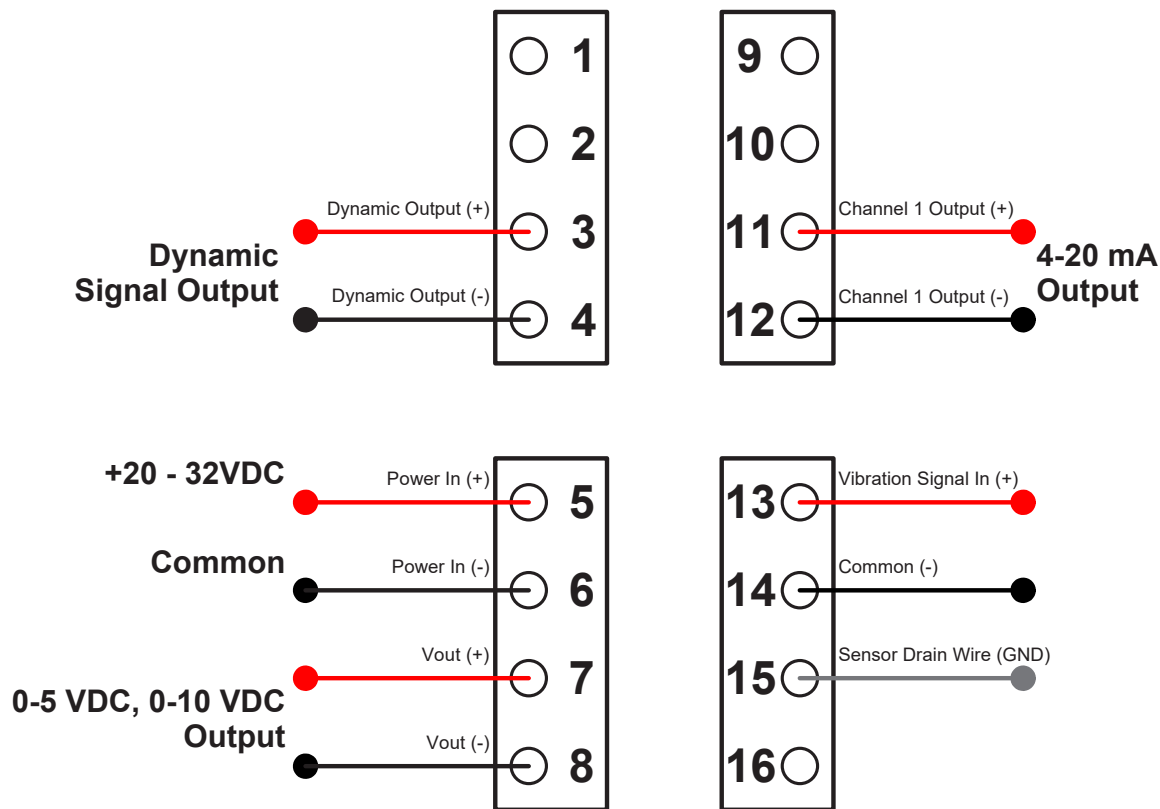


Figure 1. Signal Conditioner Electrical Wiring Diagram for Single Channel IEPE Accelerometer Input

SIGNAL CONDITIONERS ARE SHARED COMMON DEVICES, MEANING ALL INPUTS AND OUTPUTS REFERENCE THE SAME INTERNAL COMMON. TERMINALS 4, 8, 12, AND 14 ARE ALL INTERNALLY TIED TOGETHER.

1. Connect the +20 - 32 VDC power lead to the terminal marked 5 and the negative or common to the terminal marked 6.
2. For single-axis accelerometer input connection, wire the sensor leads to 13(+), 14(-), and 15(shield drain wire) as shown in Figure 1.
3. Connect the output device to terminals 11(+) and 12(-) for channel one's 4-20 mA signal proportional to the vibration level. If measuring from a voltage signal rather than a 4-20 mA loop, connect to terminals 7(+) and 8(-) instead.
4. Terminals 1, 2, 9, 10 and 16 are inactive.
5. The dynamic signal output can be obtained from the BNC connector at the top of the signal conditioner or from terminals 3(+) and 4(+).

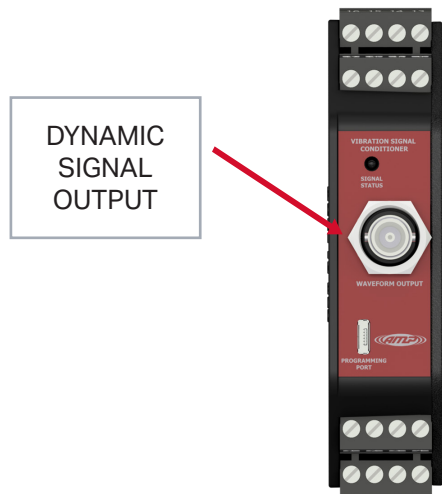


Figure 2. Signal Conditioner — Dynamic Signal Output BNC

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

Wiring for Biaxial/Triaxial Accelerometers

The SC150 Series signal conditioners are compatible with 100 mV/g biaxial and triaxial sensors. Each vibration input will require a unique signal conditioner, so a triaxial sensor will require three SC150 units, and each biaxial sensor will require two SC150 units. Each axis of vibration will have its own signal conductor wire, which will then be run to a separate SC150 on terminal 13. The black common conductor will be run to one of the signal conditioners at terminal 14, **then must be daisy chained** to terminal 14 of the remaining signal conditioners. For more information or questions, please contact CTC.

Note: The signal conditioner is not capable of receiving power from an acquisition system (SCADA/DCS/PLC) through its 4-20mA output loops, and must receive power solely from a 24V-30V DC source through pins 5 & 6. Any Loop Power Source from the acquisition system connected to the signal conditioner output channels **MUST** be turned off to avoid improper device operation and potential damage.

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 flathead screwdriver as a lever on the spring-loaded mounting clip. With the clip disengaged, slide the signal conditioner from the mounting rail.

Note: Cooling is required when enclosure temperatures exceed 115 °F (46 °C) in CTC SCD Series, SCE Series, or user-installed enclosures. If cooling or venting is not used above these temperatures, signal conditioner functionality issues will occur.

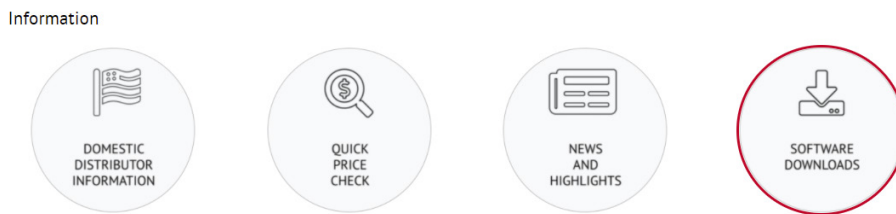
SIGNAL CONDITIONER CONFIGURATION

Requirements

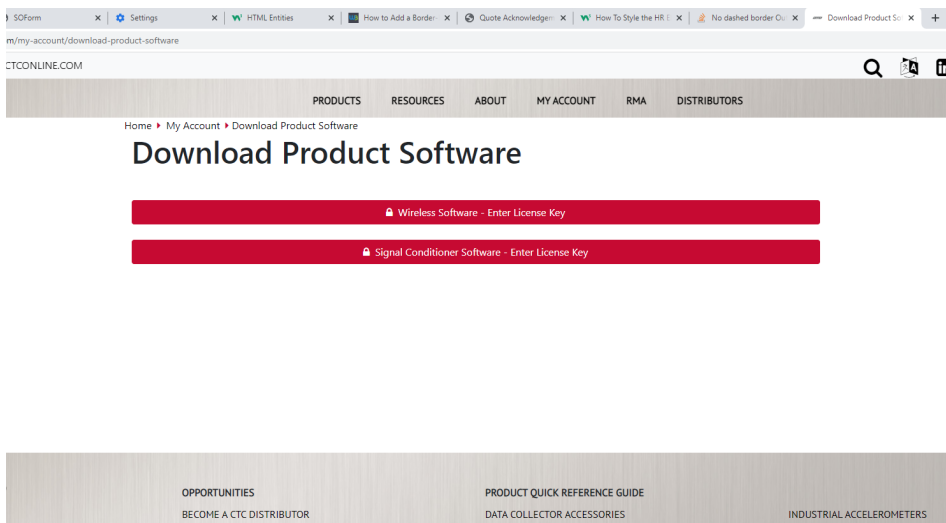
- Windows 10 minimum build version: 1703 **or** .NET Framework 4.7.2 (<https://dotnet.microsoft.com/download/dotnet-framework/thank-you/net472-web-installer>)
- Approximately 1 GB of free storage (5 GB recommended) to create application files, log files, and database records.

Installing the Configuration Software

1. Log into your account on the CTC website.
 - a. On the resulting page, scroll down to the information panel, and click the "Software Downloads" button.

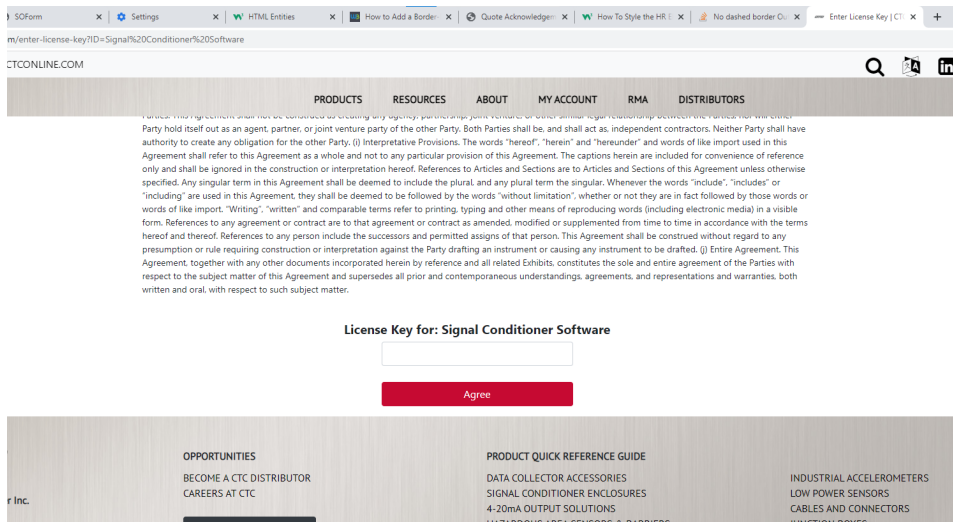


2. Click the Signal Conditioner Software button.

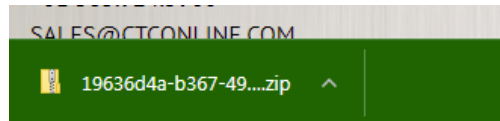


- a. If you have not downloaded the signal conditioner software previously, you will be prompted to insert a license key. This is the serial number of your signal conditioner.

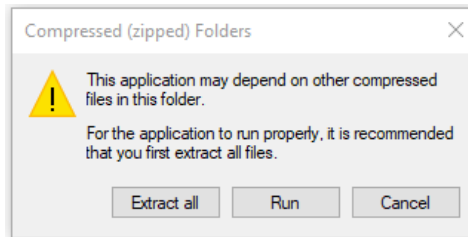




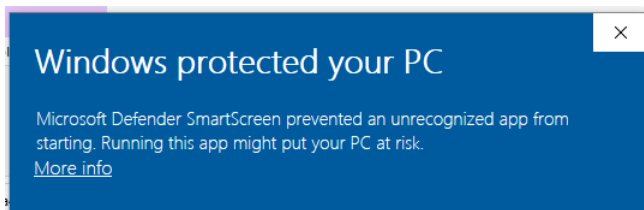
3. A compressed .zip folder will download. Find this in your browser's download manager and open the file.



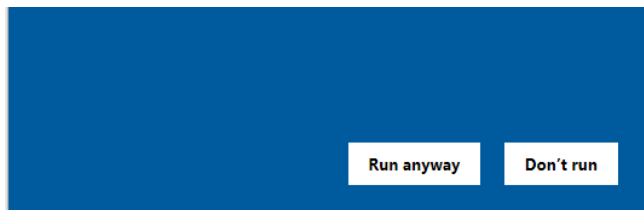
- a. A window may pop up asking about compressed folders. Click Extract all.



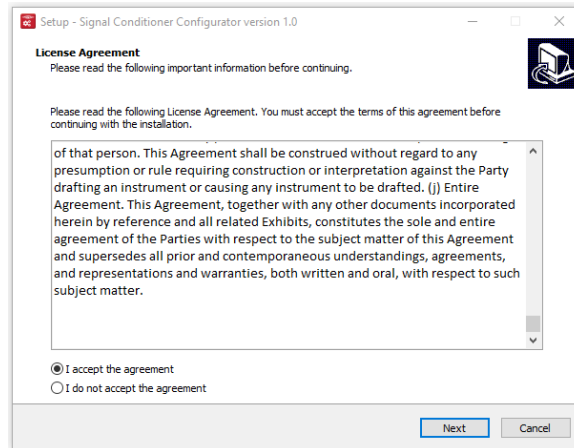
4. Double click the .exe file located in the folder to launch the installer.
 - a. Windows security might attempt to block the installer on launch. If this is the case, click the "More info" line.



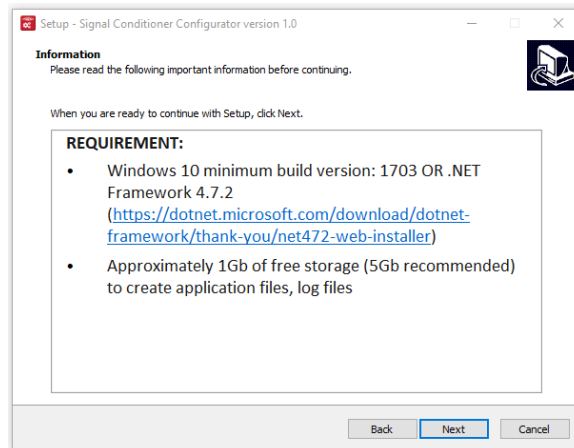
- b. Click the Run Anyway button. This will launch the software installer.



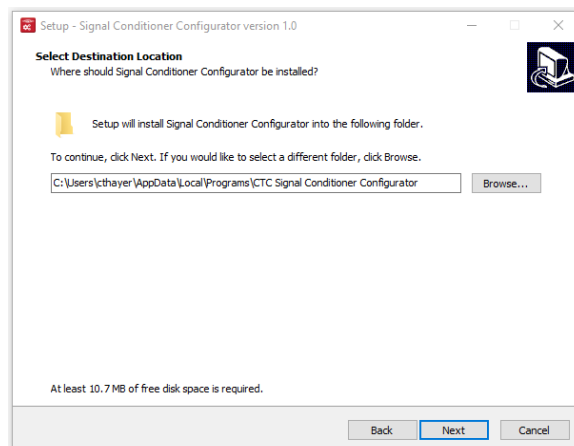
5. Read and accept the license. Click Next.



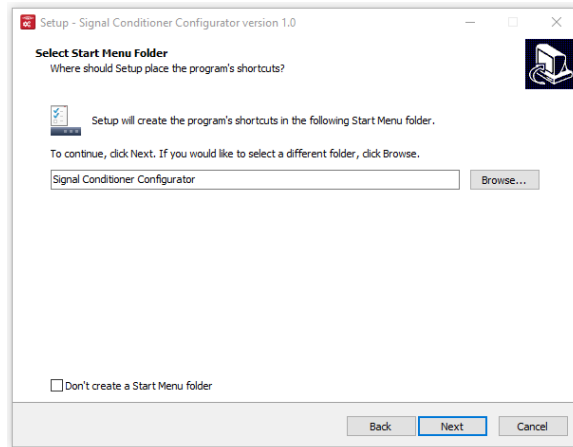
6. Review the system requirements. Click Next.



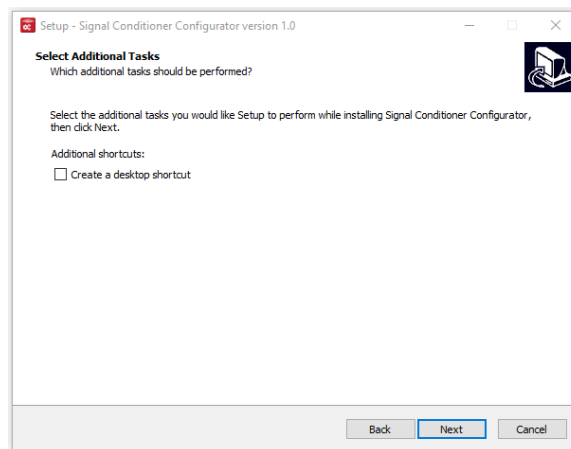
7. Review the location for the program files to be installed. If a different location is preferred, click Browse, and set the new destination. Click Next.



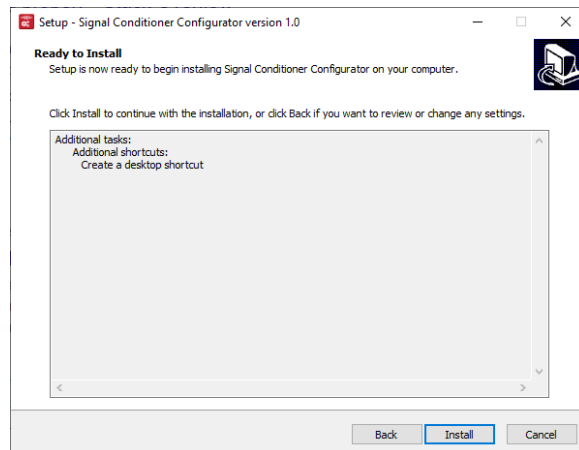
8. By default, the program will add a launch button to the Windows Start Menu. If this is not desired, click the "Don't create a Start Menu folder" checkbox. Click Next to proceed.



9. If a desktop icon is desired, click the "Create a desktop shortcut" checkbox. Click Next.

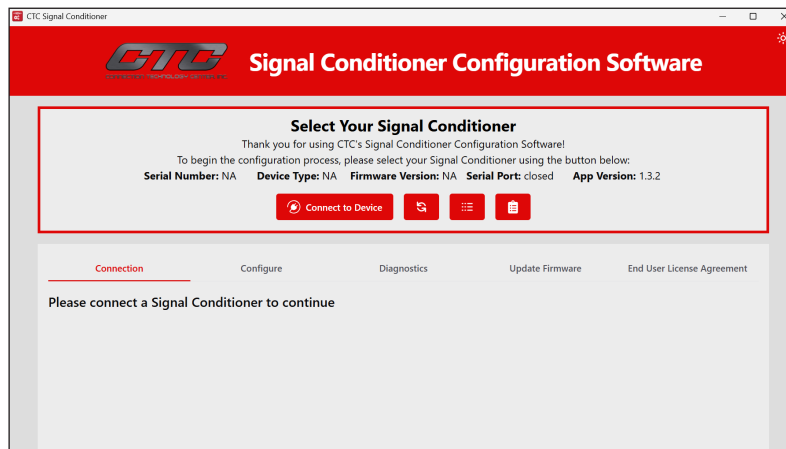


- a. For ease of access, it is highly recommended to include either a desktop icon or a Windows Start Menu launcher. If neither of these options were included during installation, it is still possible to launch the software by typing "Signal Conditioner Configurator" in the Windows search bar.
10. Click Install to finalize installation preferences and install the program to the computer.



Running the application

When you run the CTC Signal Conditioner Application, the first thing that will appear is a device select screen. This is where all units currently plugged into the computer will appear. If no signal conditioners are plugged in to the computer, a pop up window will display requesting that one be connected. **Note:** It is currently discouraged to plug multiple devices in at the same time due to a limitation of the USB serial drivers that cause the devices to lock up if any two USB COM ports read or write at the same time. If this occurs, unplugging the devices should resolve the issue. From this window, if a signal conditioner is connected to the computer, it will appear automatically in the list and will be selected as soon as it's detected.



Clicking the Configure Your Signal Conditioner button on the left of the screen will take you to the page in Figure 3.

Configuration Software

There are several different controls for changing the configuration of the selected device. The Part Number text box will display the part number for the currently selected configuration values. The Part Number text box will also change the selected configuration values if a part number is typed or pasted into the box.

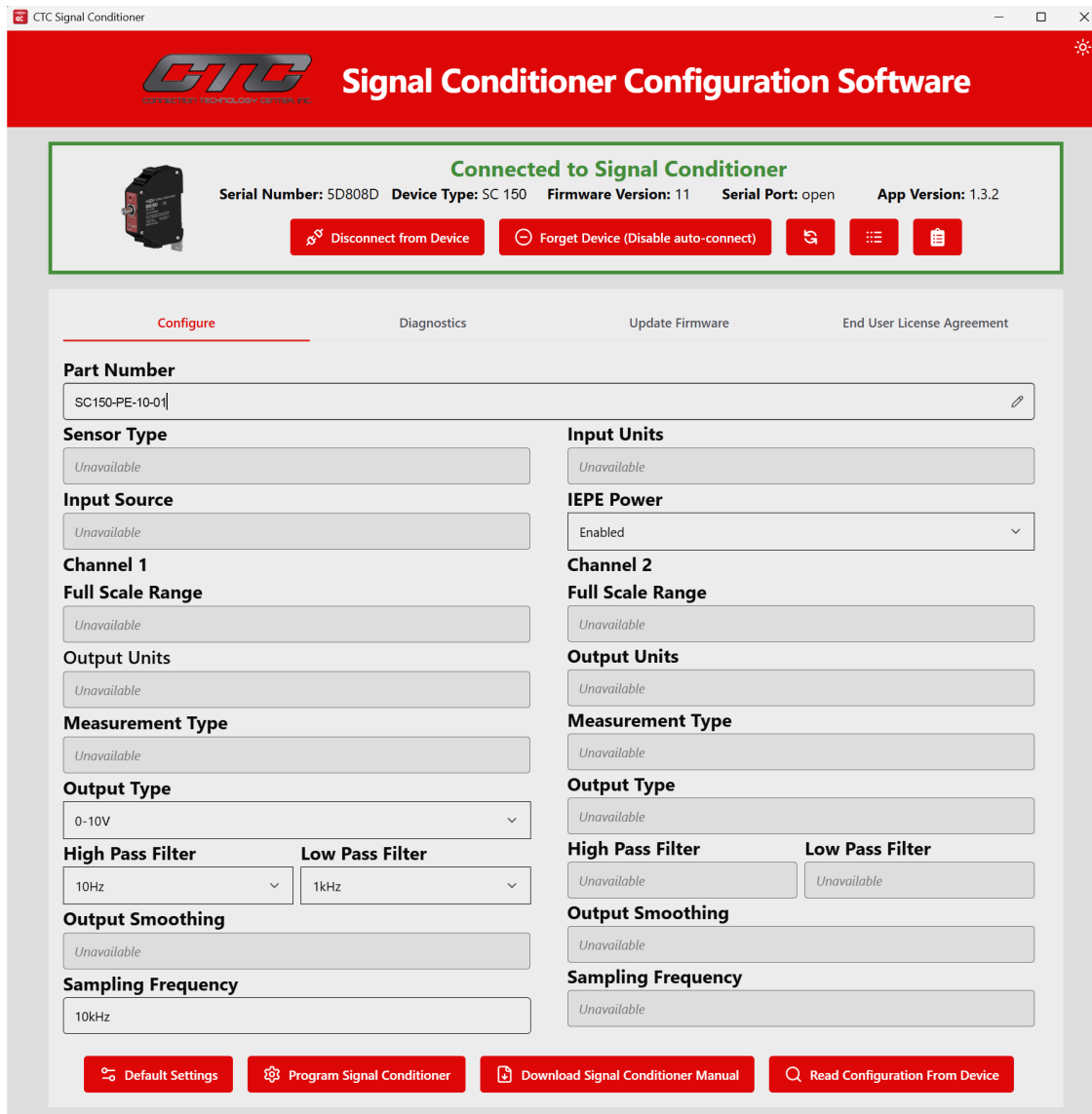


Figure 3. Signal Conditioner Configuration Window

The Serial Number box will display the serial number of the currently selected device.

The Device Type box will show whether the currently selected signal conditioner is Single Channel or Dual Channel.

The "IEPE Power" dropdown menu controls whether or not the built-in IEPE supply on the device is enabled or disabled. In Figure 3, the IEPE power supply is configured to "ENABLED," so once configured and plugged in, the signal conditioner will supply a constant 4 mA to the sensor. The sensor input and thus settings described above are shared by both channels.

Once the desired configuration is set, the device will need to be programmed by pressing the "Program Your Signal Conditioner" button. A new window will pop up and show the current progress. If this process fails, be sure to read the troubleshooting guide. The "Update Firmware" tab shown in Figure 4 is where the user can update the signal conditioner's firmware by clicking "Update Firmware."

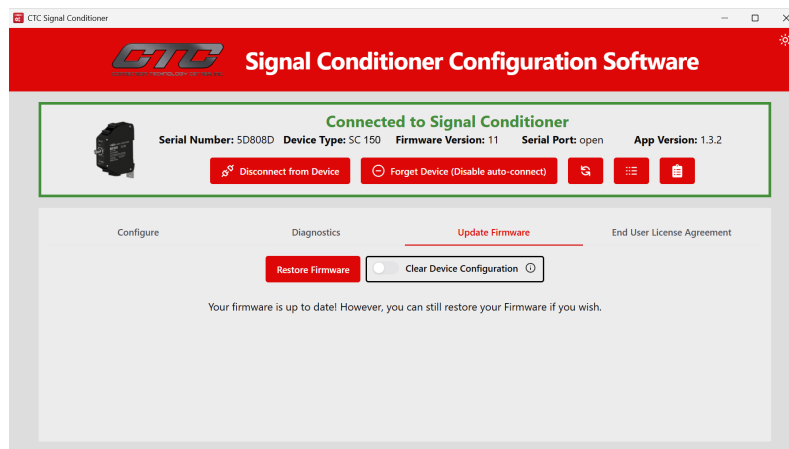


Figure 4. Update Firmware

The Diagnostics tab, shown on the following page in Figure 5, is where device errors and warnings can be read off the signal conditioner (see Indicators in the Operation section) by clicking "View Errors." If errors are present on the device, View Errors will read them and display information about the error(s) for corrective action. Any errors that appear may be cleared from the device by clicking "Clear Errors." Both operations are done via the USB port, like when programming the device.

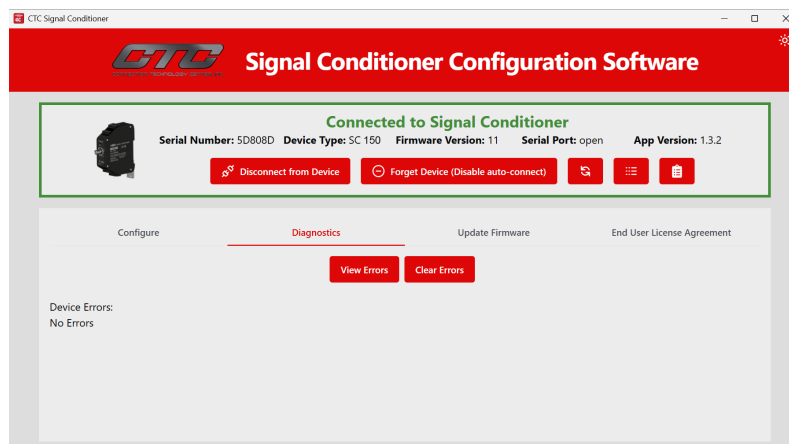
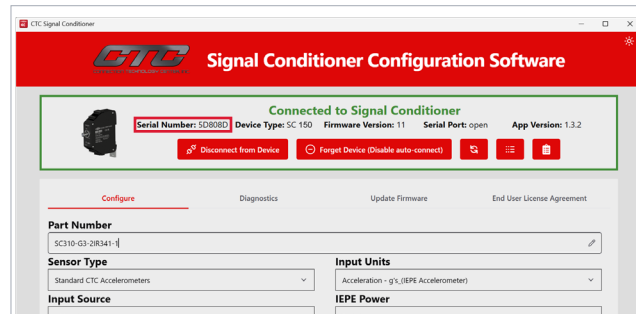


Figure 5. Diagnostics

VERIFYING DRIVER SUPPORT FOR CONFIGURATION

If the SC150 is correctly connected via USB and the software properly installed, the serial number of the device will appear in the dropdown menu.



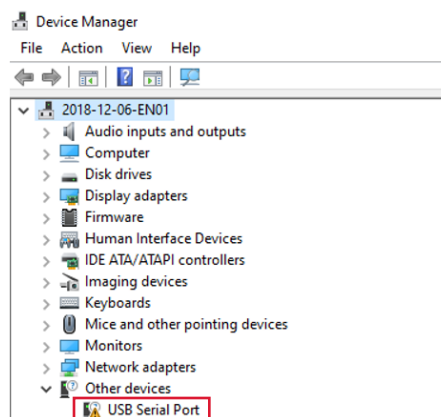
If a serial number doesn't appear, follow the troubleshooting steps below.

- Check the USB connection to make sure it is secure.
- Confirm that the LED indicator on the SC150 unit is lit up with a solid orange light (LED will blink when first plugged in and should then turn solid orange).

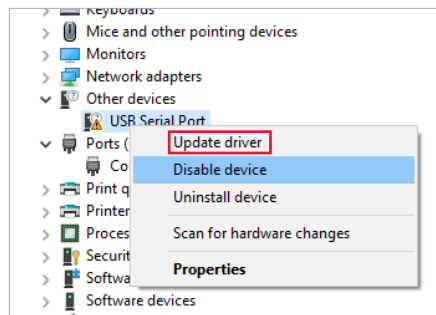


If both steps above are confirmed, then the device might be missing critical PC drivers needed to read the USB.

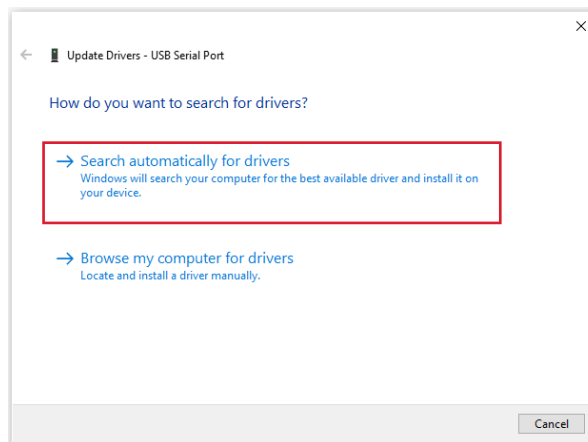
In this case, navigate to the Device Manager program (through the Start menu on Windows Devices) and look for the drop-down menu on the left side of the page.



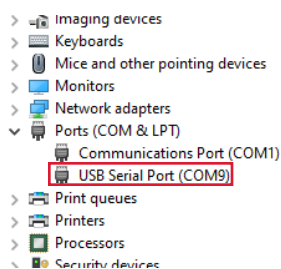
Look for and select the "Other Devices" option, then right-click on "USB Serial Port." Select the "Update Driver" option.



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 SC150 will appear with a serial number, and all functions will perform correctly.

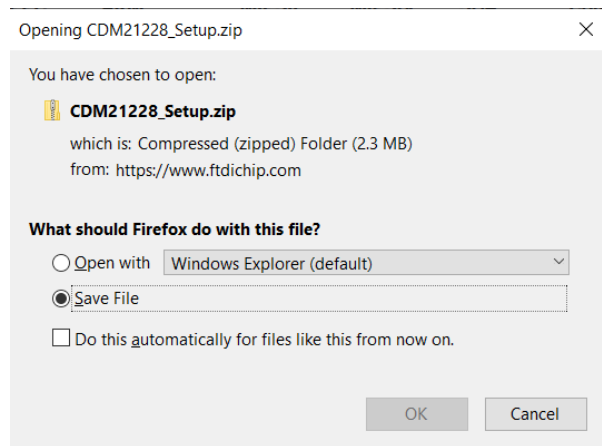
If a notification appears that there is no available upgrade, the driver will have to be installed manually.

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

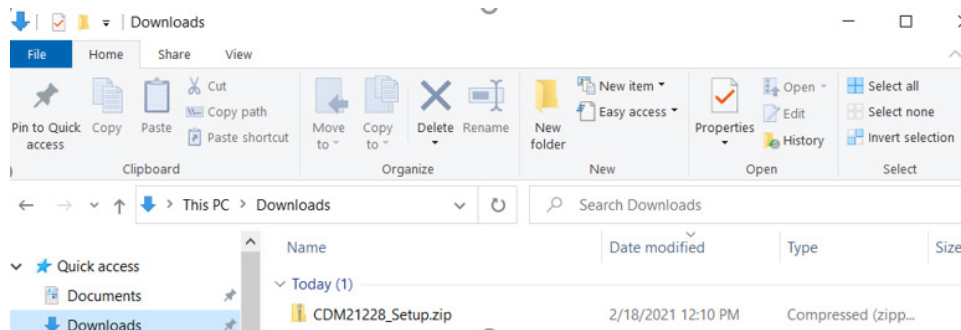
Scroll down to the download link section and select the setup executable option on the left side.

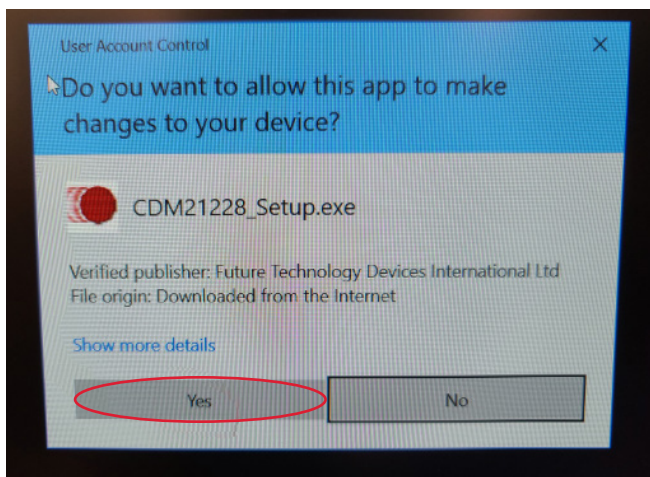
Operating System	Release Date	X86 (32-bit)	X64 (64-bit)	PPC	ARM	MIPSII	MIPSIV	SH4	Comments
Windows*	2017-08-30	2.12.28	2.12.28	-	-	-	-	-	WHQL Certified. Includes VCP and D2XX. Available as a setup executable . Please read the Release Notes and Installation Guides .

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.

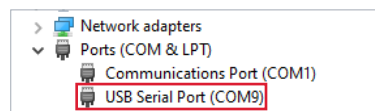




A standard installation wizard will open. Follow it to completion.



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.

OPERATION

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

Note: When the software reports an error, it does not necessarily mean that the error is currently present on the signal conditioner. It just means that the error has been encountered at some time and recorded for reporting. For example, if the signal conditioner was powered before any output wiring was complete, the device will record an output error. If wiring is then completed, the output error will go away if the wiring is correct but would show up in an error report if not cleared. Always reference the LED indicator for live device status, and remove any erroneous/out-of-date errors.

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. Ensure that the signal conditioner is configured with IEPE power ON if the sensor is not being powered from any separate source. 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 and 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 collecting waveform data from the BNC jack on the signal conditioner using a portable data collector that supplies constant current power, it is recommended that the data collector is configured so that power to the sensor is turned off. Although the BNC connector circuitry offers short circuit protection and can safely sink the current, long-term degradation may occur due to increased power dissipation depending on the magnitude of the IEPE current. There is no need for the data collector sensor power to be turned on for the data collection to be made, and it is the safest way to make measurements if possible.



Figure 6. Signal Conditioner, BNC

TROUBLESHOOTING

Troubleshooting the Software

Problem Description	Recommended Actions
Application does not open	<p>Verify that the minimum requirements for the software are met.</p> <p>Reinstall the software.</p> <p>Read the log file located in the install directory.</p>
USB device not recognized	<p>Make sure the drivers for the device are installed. A new COM port should be displayed in Device Manager a few seconds after the device is plugged in and the LED has turned Amber. If the drivers are not installed see the Verifying Driver Support for Configuration page.</p> <p>The device may take as long 40 seconds for the software to recognize the signal conditioner. This will be especially true with signal conditioners older than firmware version 2.</p> <p>Try unplugging the signal conditioner and closing the software.</p> <p>Only have one signal conditioner plugged in at a time.</p> <p>Try using a different USB cable.</p> <p>Try using a different USB port.</p> <p>Check wiring for correctness/robustness; ensure signal conditioner is not tied to earth/chassis ground.</p>
View Errors/Clear Errors/Program Device failed	<p>Try unplugging the signal conditioner and closing the software.</p> <p>Only have one signal conditioner plugged in at a time.</p> <p>Update to latest firmware version.</p>



Troubleshooting the Hardware

Problem Description	Recommended Actions
4-20 mA or 0-5/10 VDC output is non-functional	Check status LED, if the LED is NOT solid green there is a device fault present, and when there is a device fault both outputs will be set to their 0 condition and frozen. 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 VDC 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 Ω .
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.

Problem Description	Recommended Actions
Open circuit detected on CH1	<p>Check output wiring, ensure all connections are present and secure, there are no breaks in the wires, and there is no exposed conductors that can cause short circuits.</p> <p>Ensure that the end measurement device (DCS, DAQ, PLC, multimeter, etc.) is correctly configured to read the signal conditioner's output signal (current for 0-20/4-20 mA, voltage for 0-5/0-10 VDC).</p>
Short circuit detected on CH1	<p>If a resistive load is being used for measurement, ensure it is properly valued.</p> <p>Load should be 1k Ω minimum for voltage configurations.</p> <p>For current configurations, load must be configured so that compliance voltage (voltage powering the device) is not exceeded (1k Ω maximum recommended for a compliance voltage of 24 VDC).</p>
CH1 overheat detected	<p>The signal conditioner detected a temperature outside of its operating range while running. Ensure operating environment/enclosure does not exceed 80 °C.</p>
Hardware configuration error	<p>Power cycle the device.</p> <p>Check wiring for correctness/robustness; ensure signal conditioner common is NOT tied to earth/chassis ground.</p>
Internal communication bus fault	<p>Try re-programming.</p> <p>Try setting to ISO.</p>

Problem Description	Recommended Actions
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.
Error writing configuration to memory	Close the application and reconnect the signal conditioner and attempt to reprogram the device. If communication errors persist, follow the USB device not recognized section in the Troubleshooting the software section of the user manual.
Configuration memory corrupted	
Error configuring CH1	
Error configuring CH1 (CRC)	
Once installed and connected to an online system (PLC, DCS, SCADA), the values that the system receives do not match what is expected (too high, too low, etc.)	<p>Ensure that the PLC/DCS input settings (unit, scaling, filtering) match the chosen configuration of the signal conditioner exactly.</p> <p>Confirm wiring from the signal conditioner to the system is correct according to manual instructions and diagram, with consideration for noise, along with radio frequency and electromagnetic interference.</p> <p>Note: the SC300 Series signal conditioner features shared commons between each channel and between multiple units if wired into one of our SCE or SCD enclosures. The SC300 does not require an isolated analog input card for the monitoring system.</p> <p>Ensure that there is a strong earth ground connection to avoid noise and loop interference.</p>

SOFTWARE END USER LICENSE AGREEMENT

This END USER LICENSE AGREEMENT ("Agreement"), is a binding agreement between Connection Technology Center, Inc., a New York corporation, with offices at 7939 Rae Boulevard, Victor, NY 14564 ("CTC") and the entity registered with CTC ("Licensee") as the purchaser of the SC300 Series signal conditioner (the "Signal Conditioner"). Licensee and CTC are individually hereinafter referred to as a "Party" and collectively as the "Parties".

THE SIGNAL CONDITIONER IS A PROPRIETARY PRODUCT MANUFACTURED AND MARKETING BY CTC THAT IS DESIGNED TO MONITOR THE INTERNAL BEARINGS OF INDUSTRIAL EQUIPMENT FOR FAILURE AND REPLACEMENT. CTC HAS DEVELOPED SOFTWARE ("Software") TO, AMONG OTHER THINGS, INTERFACE WITH THE SIGNAL CONDITIONER TO TRACK INPUT READINGS AND PROVIDE ALERTS BASED ON USER DEFINED LIMITS AND VARIANCES. CTC PROVIDES THE SOFTWARE SOLELY ON THE TERMS AND CONDITIONS SET FORTH IN THIS AGREEMENT AND ON THE CONDITION THAT LICENSEE ACCEPTS AND COMPLIES WITH THEM. BY ENTERING THE SERIAL NUMBER FROM THE SIGNAL CONDITIONER IN THE BOX AND CLICKING "ACCEPT" YOU (A) ACCEPT THIS AGREEMENT AND AGREE THAT LICENSEE IS LEGALLY BOUND BY ITS TERMS; AND (B) REPRESENT AND WARRANT THAT YOU HAVE THE RIGHT, POWER, AND AUTHORITY TO ENTER INTO THIS AGREEMENT ON BEHALF OF LICENSEE AND BIND LICENSEE TO ITS TERMS. IF LICENSEE DOES NOT AGREE TO THE TERMS OF THIS AGREEMENT, CTC WILL NOT AND DOES NOT LICENSE THE SOFTWARE TO LICENSEE AND THE SOFTWARE AND DOCUMENTATION MUST NOT BE DOWNLOADED.

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Licensee. Licensee will employ at least the same methods and degree of care, but no less than a reasonable degree of care, to prevent disclosure of the Confidential Information as Licensee employs with respect to its own confidential information.

- (c) Upon CTC's written request, Licensee shall destroy or return to CTC all Confidential Information in its custody or control. This provision will survive any termination of this Agreement.

12. Miscellaneous.

- (a) Notices. All notices required or permitted under this Agreement will be in writing and will be deemed received when (i) delivered personally; (ii) three (3) days after having been sent by registered or certified mail; or (iii) one day after deposit with a recognized commercial express courier specifying next day delivery. All communications will be sent to CTC at the address in the preamble to this Agreement and to Licensee at the address on file with CTC for purchase of the Sensor, or any other address subsequently identified by a Party giving notice pursuant to this paragraph.
- (b) Injunctive Relief. Licensee acknowledges and agrees that a breach or threatened breach by Licensee of any of its obligations under Section 9 or, in the case of Licensee, Sections 2, 4, 7(b), 11 or 12, would cause the other Party irreparable harm for which monetary damages would not be an adequate remedy and agrees that, in the event of such breach or threatened breach, the other Party will be entitled to equitable relief, including a restraining order, an injunction, specific performance, and any other relief that may be available from any court, without any requirement to post a bond or other security, or to prove actual damages or that monetary damages are not an adequate remedy. Such remedies are not exclusive and are in addition to all other remedies that may be available at law, in equity, or otherwise.
- (c) Assignment. Licensee may not assign or transfer any of its rights or delegate any of its obligations hereunder, in each case whether voluntarily, involuntarily, by operation of law or otherwise, without the prior written consent of CTC. Any purported assignment, transfer, or delegation in violation of this Section is null and void. No assignment, transfer, or delegation will relieve the assigning or delegating Party of any of its obligations hereunder. For purposes of this provision, a sale of controlling equity to, or all or substantially all of the assets of Licensee, to a third party, or the merger of Licensee with a third party, shall also



constitute an impermissible assignment. This Agreement is binding upon and inures to the benefit of the Parties hereto and their respective permitted successors and assigns.

- (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.
- (g) **Amendment & Waiver.** No amendment to or modification of this Agreement is effective unless it is in writing and signed by an authorized representative of each Party. No waiver by any Party of any of the provisions hereof will be effective unless explicitly set forth in writing and signed by the Party so waiving. Except as otherwise set forth in this Agreement, (i) no failure to exercise, or delay in exercising, any rights, remedy, power, or privilege arising from this Agreement will operate or be construed as a waiver thereof and (ii) no single or partial exercise of any right, remedy, power, or privilege hereunder will preclude any other or further exercise thereof or the exercise of any other right, remedy, power, or privilege.
- (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.



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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 for a return material authorization.

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