VIBRATION ANALYSIS HARDWARE



SC320 Series Signal Conditioner Product Manual

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Introduction

This document contains information on the operation, installation, and maintenance of the SC320 Series Signal Conditioner. The signal conditioner is a device that converts a sensor input to 0-20 mA, 4-20 mA, 0-5 VDC, or 0-10 VDC 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 outputs 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.

SC320 Series Overview

The SC320 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
- Two independent selectable channels offering 0-5 VDC, 0-10 VDC, 4-20 mA, or 0-20 mA output signals proportional to vibration
- Built-in selectable 24 VDC, 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 for each channel
- Input selectable between acceleration, velocity, and displacement
- Ultrasound compatible up to 40 kHz
- Independent and selectable digital bandpass filters for each channel
- Outputs scalable for Metric and English

- Outputs independently selectable between acceleration, velocity, or displacement (varies by configuration)
- Ten available full-scale ranges from 0.5 to 500 for each channel (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

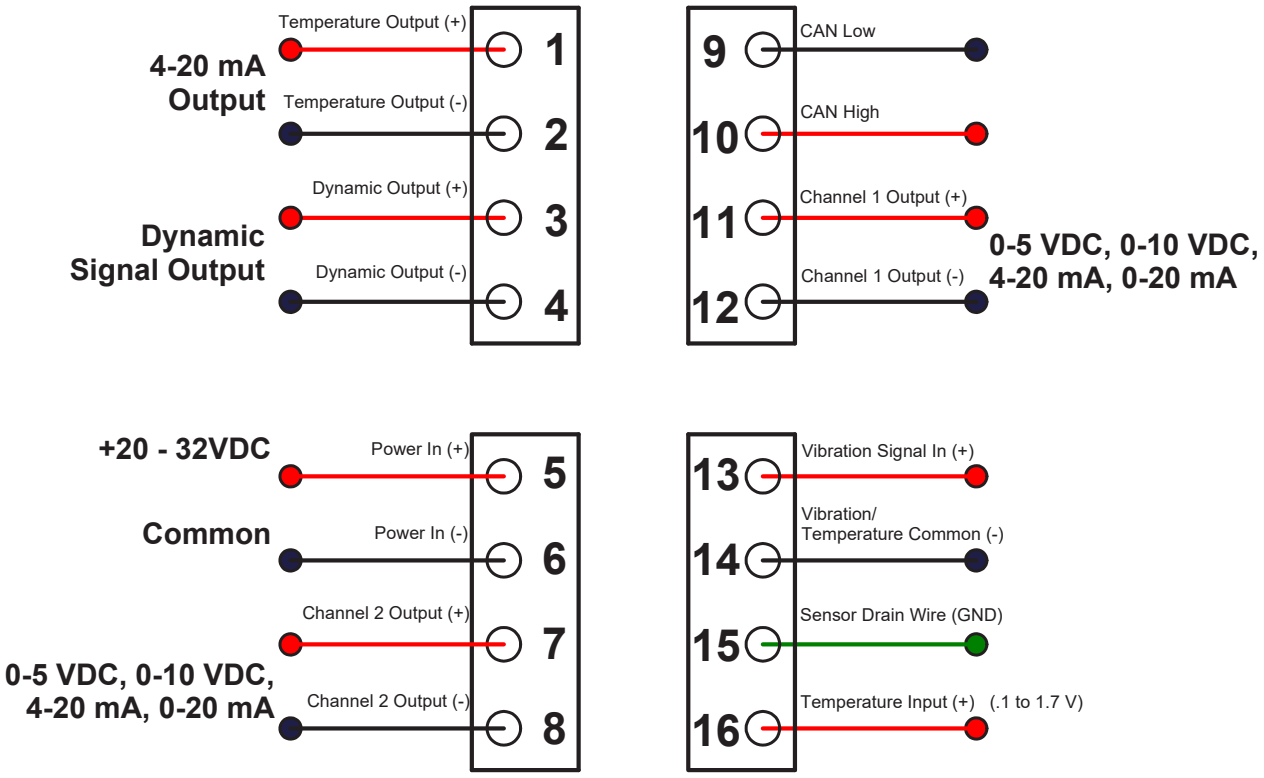


Figure 1. Signal Conditioner Electrical Wiring Diagram for Two Channel IEPE Accelerometer Input, with Temperature

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 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.

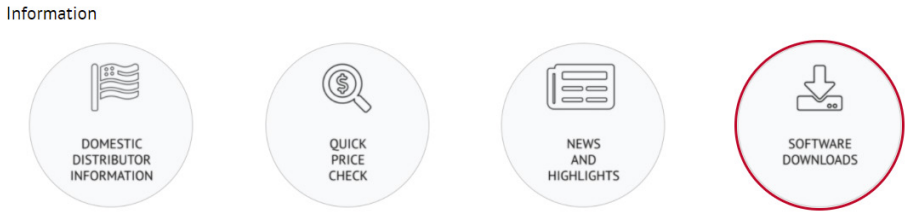
Signal Conditioner Configuration

Requirements

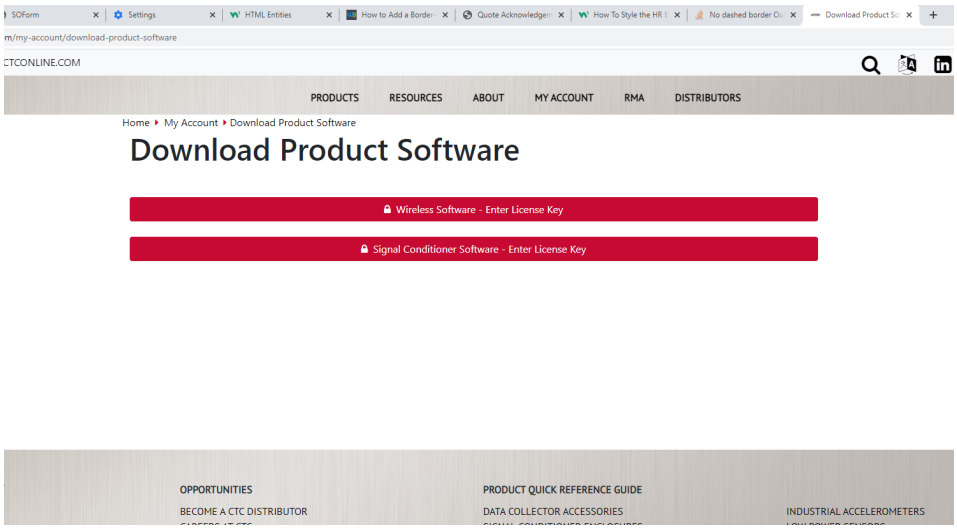
- Windows 10 minimum build version: 1703 ***or*** .NET Framework 4.7.2 (*https://dotnet.microsoft.com/download/dotnet-framework/thank-you/net472-web-installer*)
- Approximately 1Gb of free storage (5Gb recommended) to create application files, log files, and database records

Installing the Configuration Software

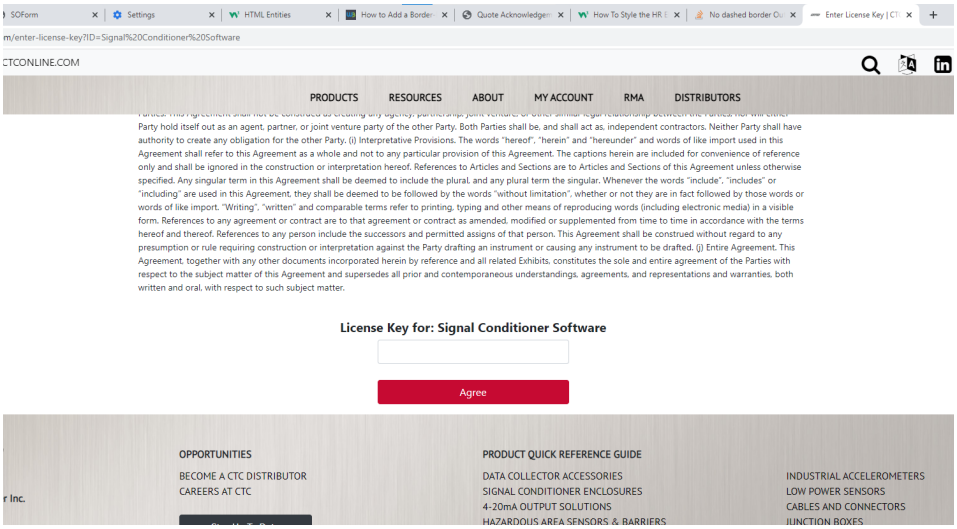
1. Log into your account on the CTC website.
   a. On the resulting page, scroll down to the information panel, and click the "Software Downloads" button.



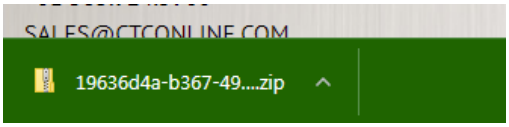
2. Click the Signal Conditioner Software button.



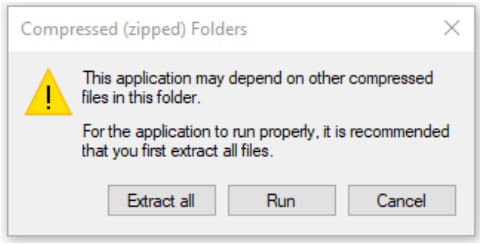
   a. If you have not downloaded the signal conditioner software previously, you will be prompted to insert a liscence key. This is the serial number of your signal conditioner.



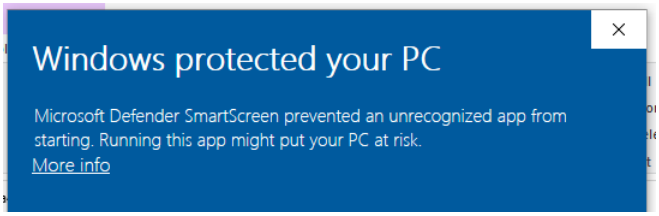
3. A compressed .zip folder will download. Find this in your browser's download manager and open the file.



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



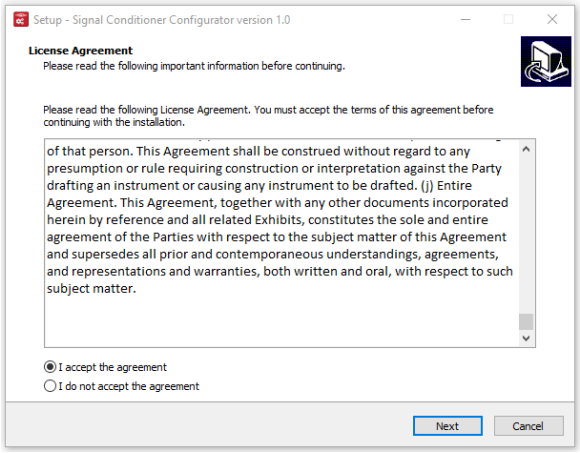
4. Double click the .exe file located in the folder to launch the installer.
   a. Windows security might attempt to block the installer on launch. If this is the case, click the "More info" line.



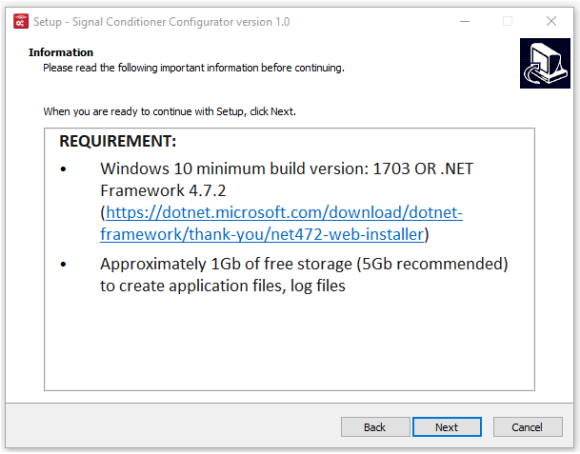
   b. Click the Run Anyway button. This will launch the software installer.



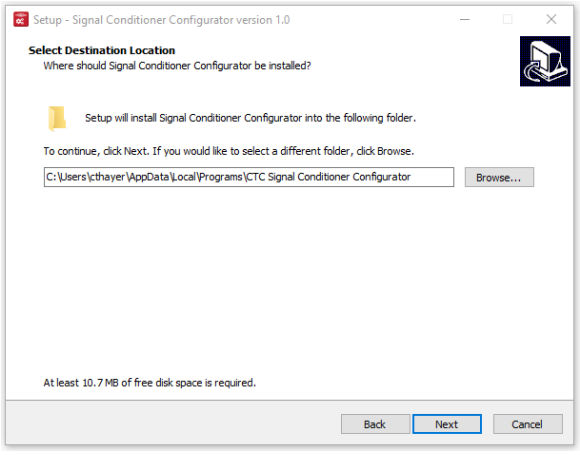
5. Read and accept the licence. Click next.



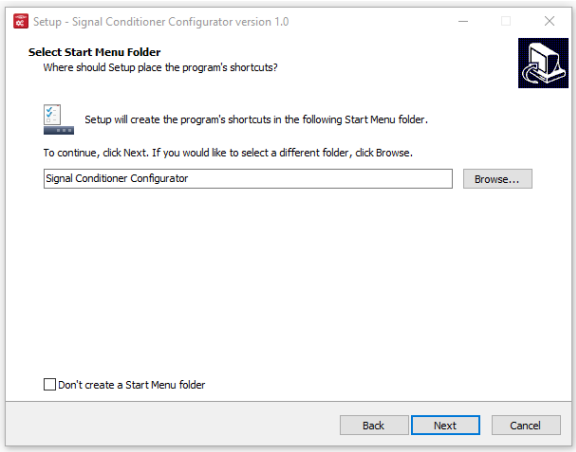
6. Review the system requirements. Click next.



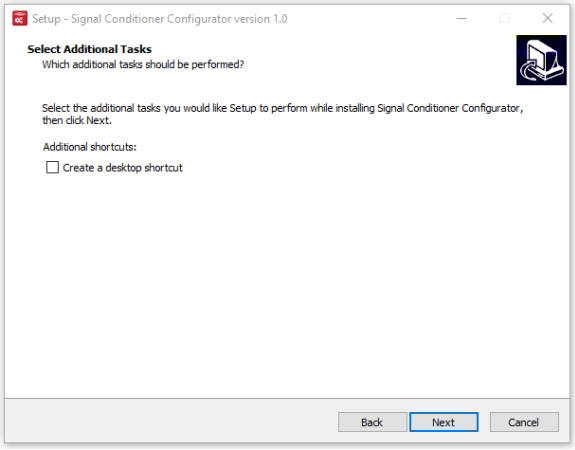
7. Review the location for the program files to be installed. If a different location is preferred, click Browse, and set the new destination. Click Next.



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.

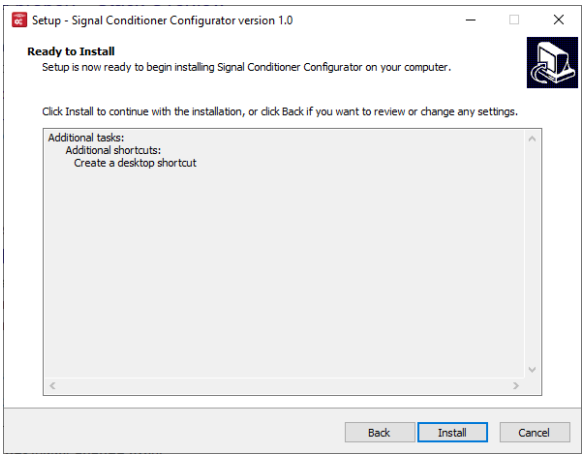


9. If a desktop icon is desired, click the "Create a desktop shortcut" checkbox. Click next.



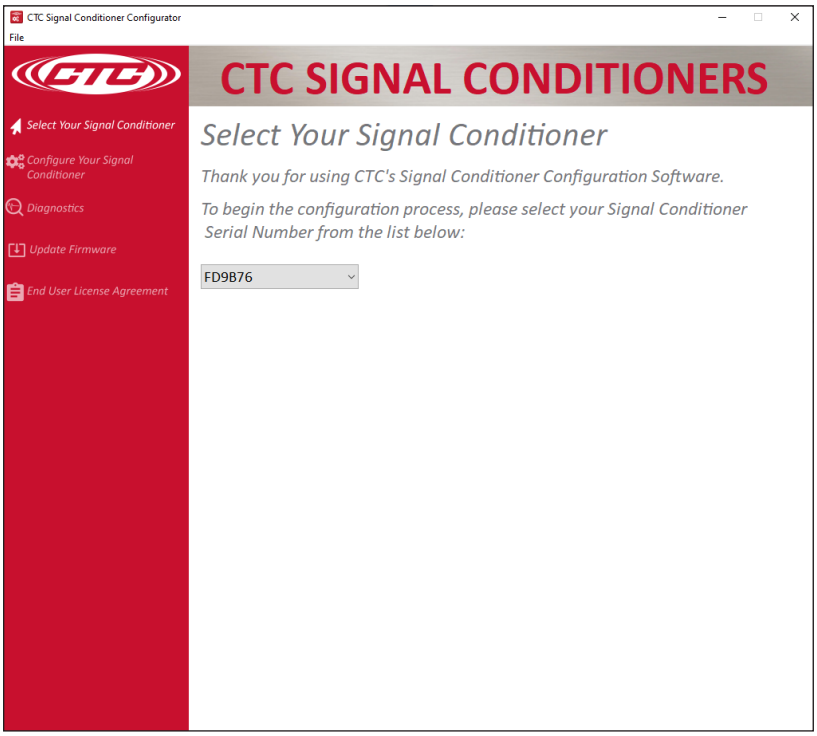
   a. For ease of access, it is highly recommended to include either a desktop icon or a Windows Start Menu launcher. If neither of these options were included during installation, it is still possible to launch the software by typing "Signal Conditioner Configurator" in the Windows search bar.

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.

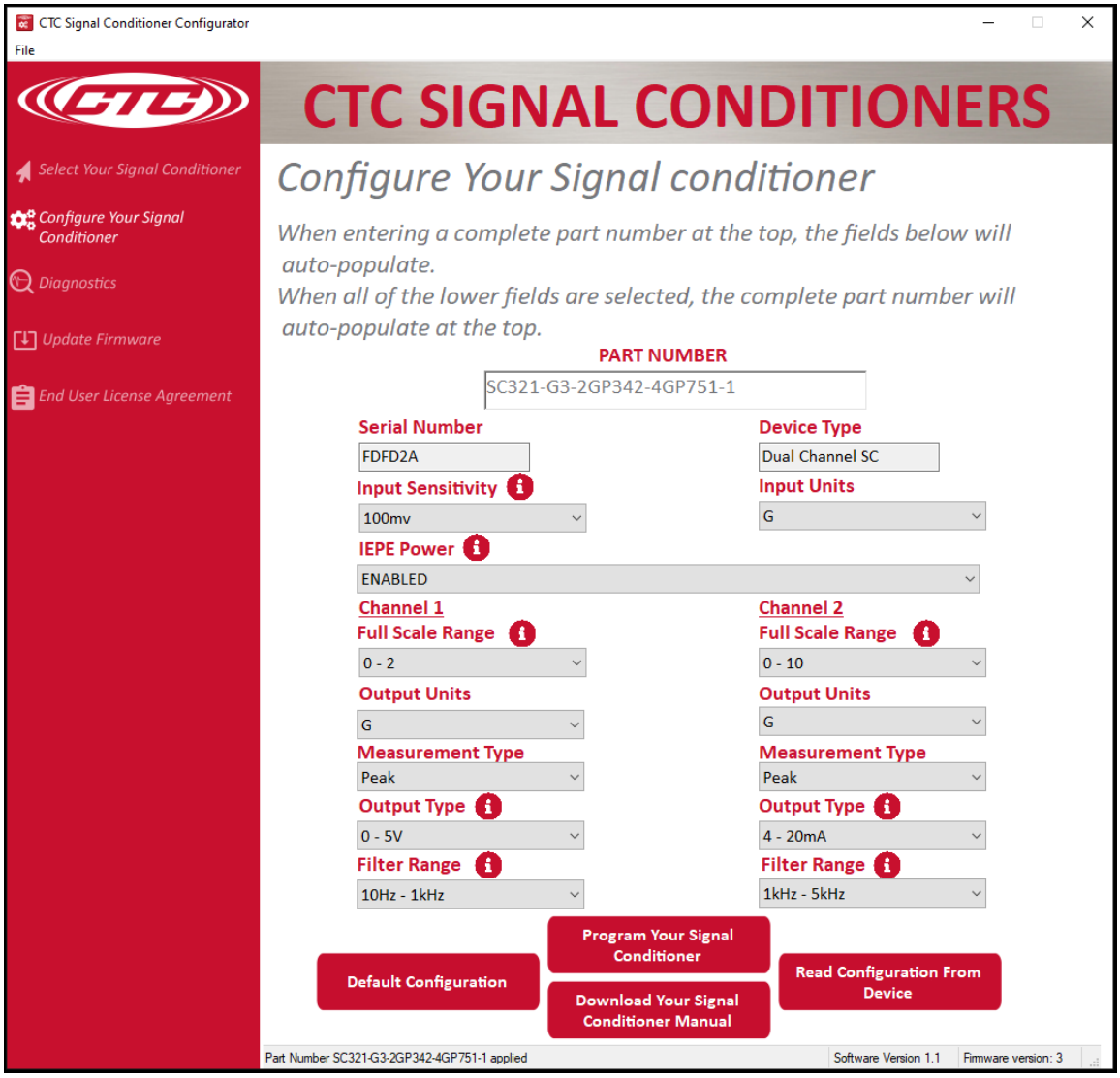


Figure 3. Signal Conditioner Configuration Window

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.

In the configuration tab are the configuration settings for the unit. The "Input Sensitivity" and "Input Units" dropdown menus define the sensor connected to the signal conditioner. Input Sensitivity refers to the sensor's sensitivity, and the 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 3, 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 software will allow you to use combinations of input sensitivity and input units that do not currently exist as sensors. If you do this, the software will alert you that the "Part number is invalid or the software is out of date. Config can still be applied" and produce a part number with a space in it.

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. Below, the "IEPE Power" dropdown menu is where each channel's scaling settings are configured.

"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. For more information, please visit *https://documents.ctconline.com/archive/full-scale-range-limitations*. 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, peak hold.

For example, the input sensor in Figure 3 is 100 mV/g, the full-scale range of Channel 1 is 0-2 with a unit of g's, and the measurement type is peak. Therefore, a midscale condition will occur when the sensor outputs 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 VDC, and 0-10 VDC. The level of the output signal corresponds to where it falls in the full-scale range. So, continuing the example from Figure 3, if the signal from Channel 1 is at midscale vibration (1g peak for this configuration), and the output type is 0-5 VDC, then the output signal will read 2.5 V.

The “Filter Range” describes the cutoff frequencies of a digital bandpass filter used to filter the sensor signal on each channel. In the configuration in Figure 3, Channel 1’s frequency range is 10 Hz - 1 kHz. Channel 1 will attenuate frequencies below 10 Hz and above 1 kHz. 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 5 kHz, this will not work on a single channel. Having multiple configurable channels is advantageous in these situations. Channel 1 could be set to measure frequencies from 10 Hz to 1 kHz, and Channel 2 could handle frequencies from 1 kHz to 5 kHz. This is also useful to split up the output units, such as integrating for velocity on Channel 1 and monitoring Channel 2 for acceleration.

The “Default Configuration” button will load all dropdown menus with the standard ISO configuration, corresponding to a 100 mV/g sensor in and IEPE Power on. Channel 1 will display a 0-2 full-scale range, IPS output units, RMS, and a frequency range of 10 Hz - 1 kHz. Channel 2 will display a 0-10 full-scale range, output units of G, Peak, and a frequency range of 1 kHz - 5 kHz. Both channels will show 4-20 mA.

The “Read Configuration From Device” button will clear whatever configuration is currently selected and replace it with the last one saved on the device (Only on devices above firmware version 2). This happens every time a device over firmware version 2 is connected, and this button is meant to allow you to see what was previously configured without unplugging the device. The feature will falsely claim that the filters are 10Hz-1kHz and 1kHz-5kHz after updating past firmware version 2 until the device is programmed again. This error is because the device will not know what the previous filters were before firmware version 2.

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.”

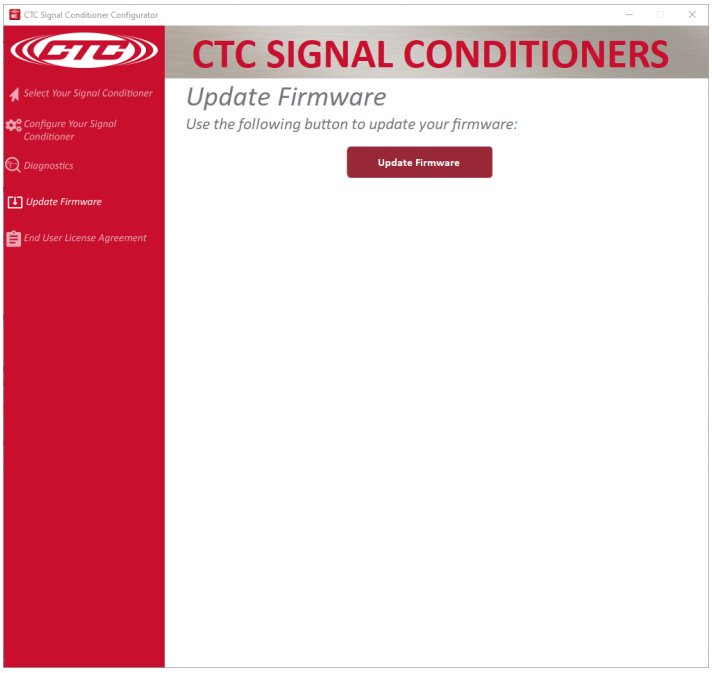


Figure 4. Update Firmware

The Diagnostics tab shown 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 the "Clear Errors." Both operations are done via the USB port, like when programming the device.

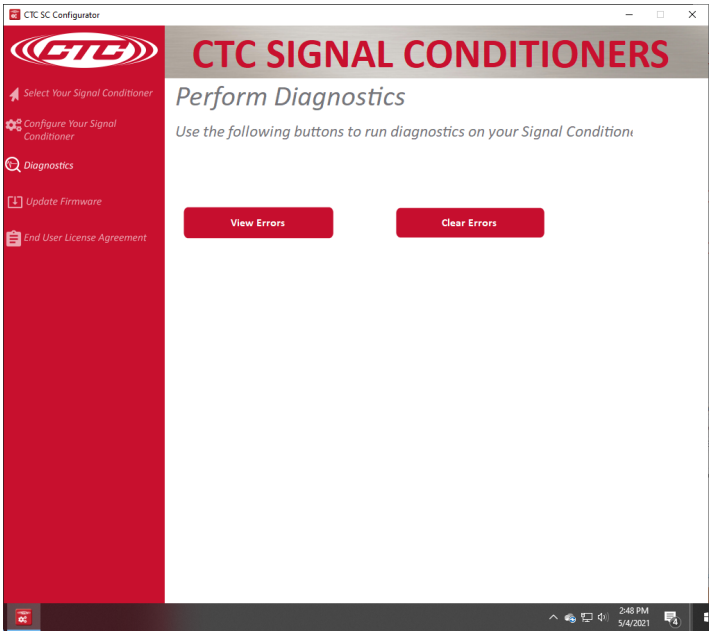
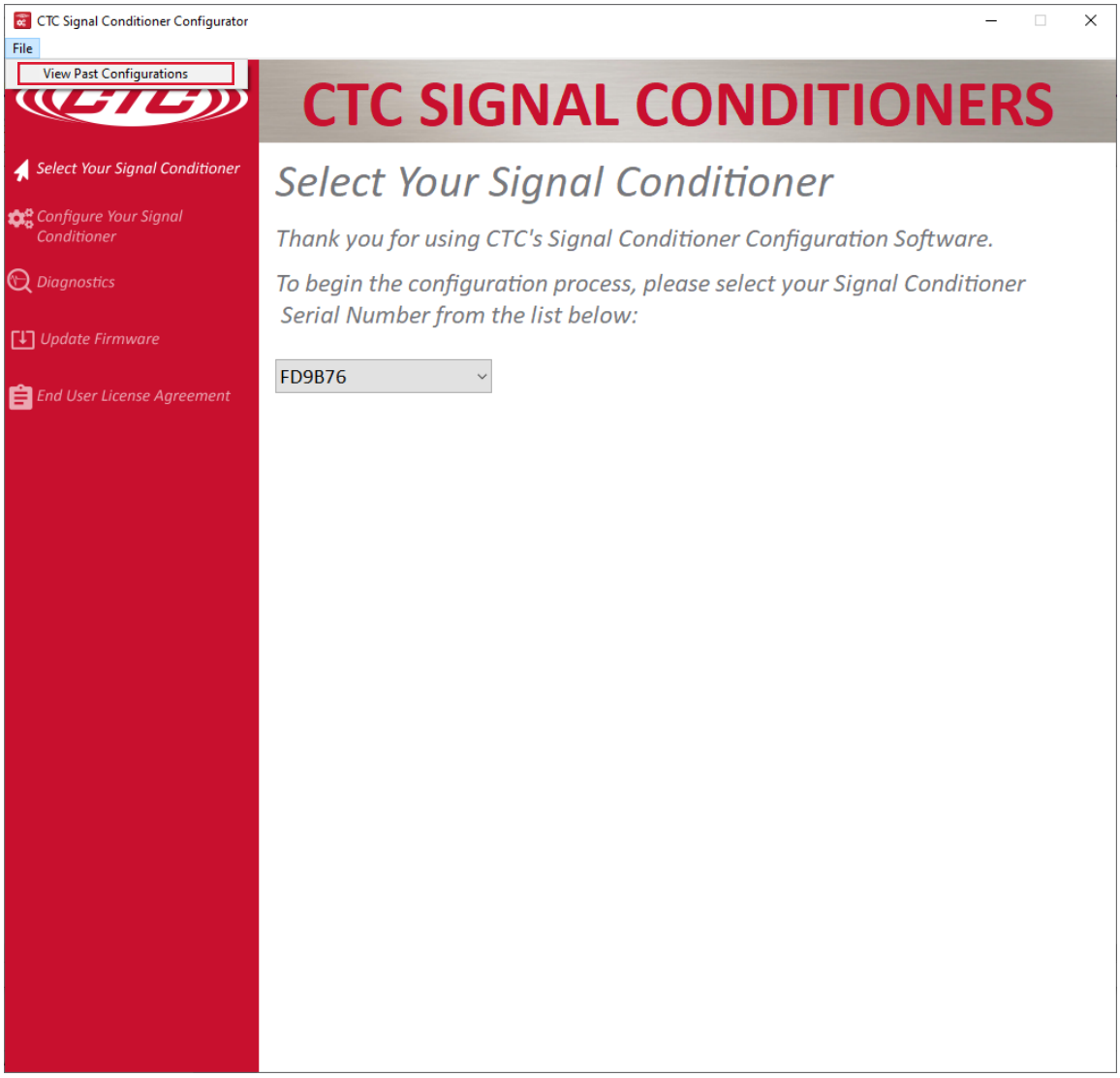


Figure 5. Diagnostics

Accessing Configuration History

Clicking “File” in the top menu will allow the user to select an option to view previous configurations. Selecting this option will open the computer’s default text file viewer with a log containing the date, time, serial number, part number, and full configuration.



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. 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

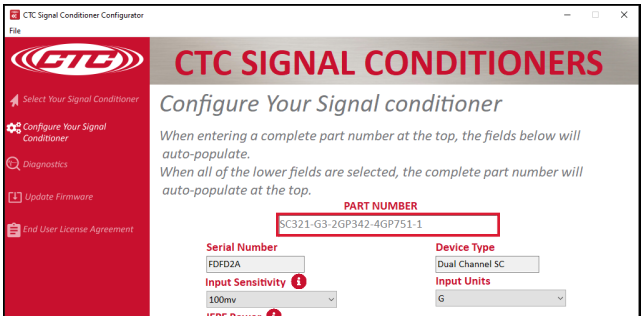
When collecting waveform data from the BNC jack on the signal conditioner using a portable data collector that supplies constant current power, it is recommended that the data collector is configured so that power to the sensor is turned off. Although the BNC connector circuitry offers short circuit 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 9. Signal Conditioner, BNC

Verifying Driver Support for Configuration

If the SC300 is correctly connected via USB and the software properly installed, the serial number of the device will appear in the dropdown menu.



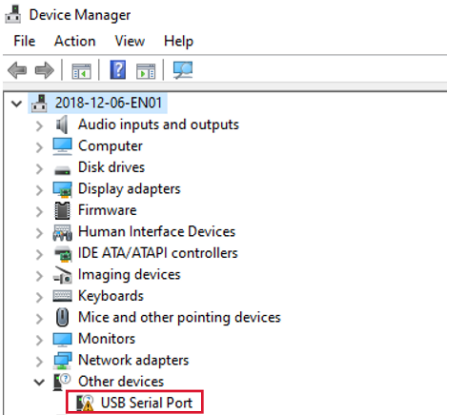
If a serial number doesn't appear, follow the troubleshooting steps below.

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

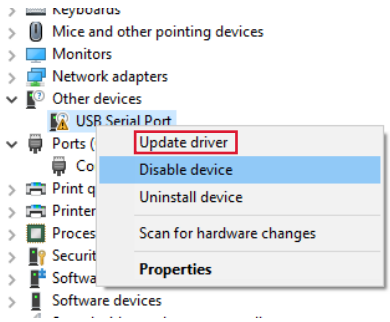


If both steps above are confirmed, then the device might be missing critical PC drivers needed to read the USB.

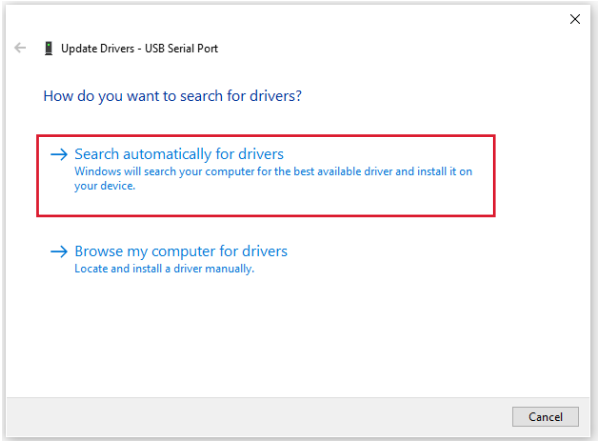
In this case, navigate to the Device Manager program (through the Start menu on Windows Devices) and look for the drop-down menu on the left side of the page.



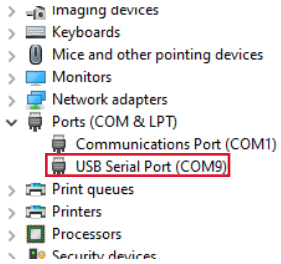
Look for and select the “Other Devices” option, then right-click on “USB Serial Port.” Select the “Update Driver” option.



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.

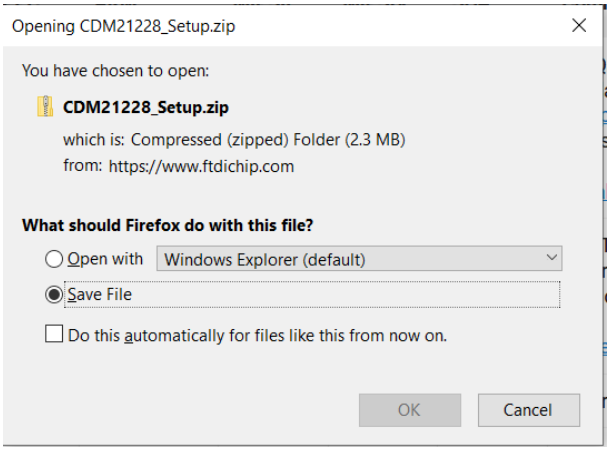
If a notification appears that there is no available upgrade, the driver will have to be installed manually.

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

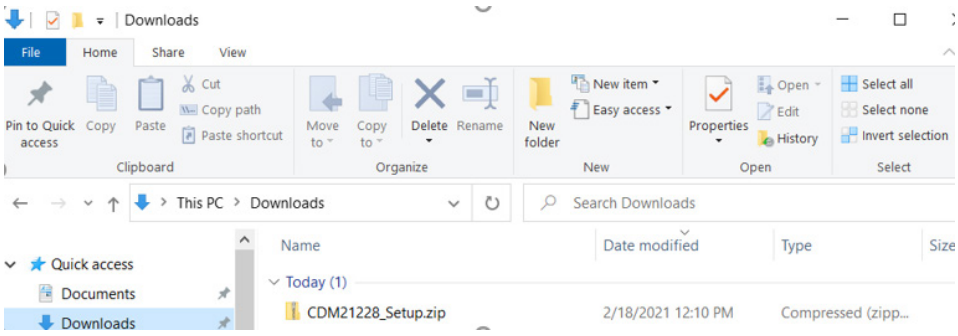
Scroll down to the download link section and select the setup executable option on the left side.

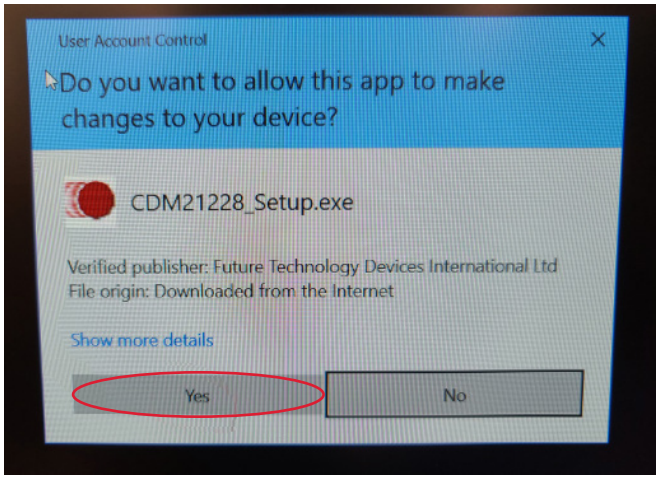
Operating System	Release Date	X86 (32-bit)	X64 (64-bit)	PPC	ARM	MIPSII	MIPSIV	SH4	Comments
Windows*	2017–08–30	2.12.28	2.12.28	–	–	–	–	–	WHQL Certified. Includes VCP and D2XX. Available as a setup executable Please read the Release Notes and Installation Guides.

Save the file – it will be saved as CDMXXXX_Setup.

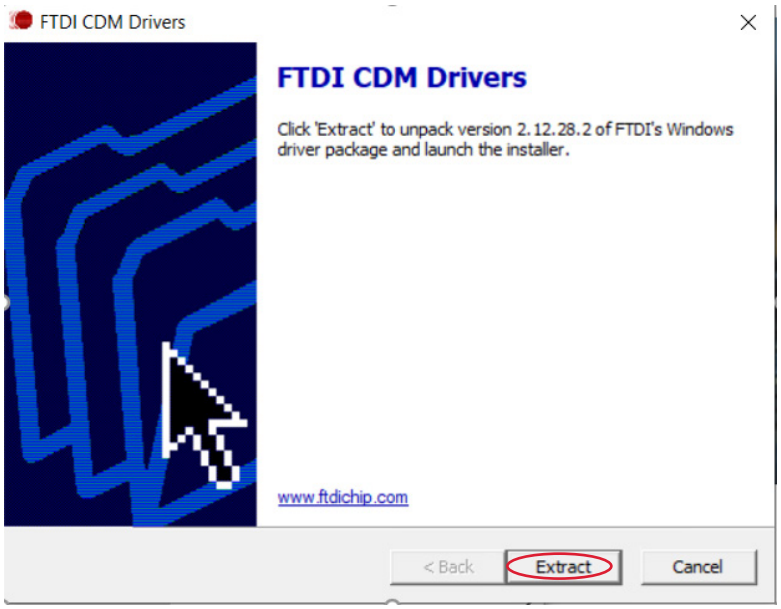


Retrieve the file from the Downloads section of your File Manager, and run the program.

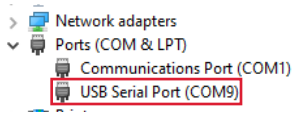




A standard installation wizard will open. Follow it to completion.



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.

Troubleshooting

Troubleshooting the Software

Problem Description	Recommended Actions
Application does not open	Verify that the minimum requirements for the software are met. Reinstall the software Read the log file located in the install directory.
USB device not recognized	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. 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. Try unplugging the Signal Conditioner and closing the software. Only have one Signal Conditioner plugged in at a time. Try using a different USB cable. Try using a different USB port Check wiring for correctness/ robustness; ensure signal conditioner is not tied to earth/chassis ground
View Errors/Clear Errors/Program Device failed	Try unplugging the Signal Conditioner and closing the software. Only have one Signal Conditioner plugged in at a time. Update to latest firmware version

Troubleshooting

Troubleshooting the Hardware

Problem Description	Recommended Actions
4-20 mA or 0-5/10 V_{DC} 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_{DC} 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 kΩ.
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	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. 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 V_{DC}). If a resistive load is being used for measurement, ensure it is properly valued. Load should be 1k Ω minimum for voltage configurations. 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 V_{DC}).
Short circuit detected on CH1	
Open circuit detected on CH2	
Short circuit detected on CH2	
CH1 overheat detected	The signal conditioner detected a temperature outside of its operating range while running. Ensure operating environment/enclosure does not exceed 80 deg °C.
CH2 overheat detected	
Hardware configuration error	Power cycle the device Check wiring for correctness/ robustness; ensure signal conditioner common is NOT tied to earth/chassis ground Try re-programming Try setting to ISO
Internal communication bus fault	

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 CH2	
Error configuring CH1 (CRC)	
Error configuring CH2 (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.)	Ensure that the PLC/DCS input settings (unit, scaling, filtering) match the chosen configuration of the signal conditioner exactly. 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. **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. Ensure that there is a strong earth ground connection to avoid noise and loop interference.

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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 for a return material authorization.

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