

CN0357 Shield Evaluation Board User Guide

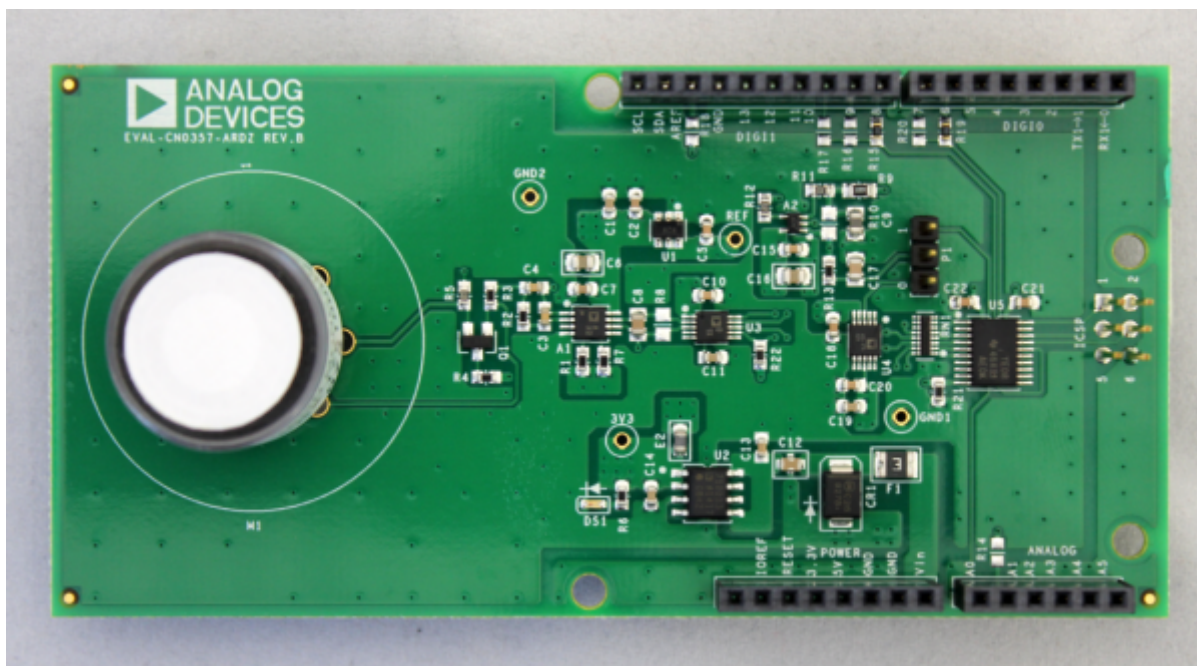
Overview

[CN0357](#) single-supply, low noise, portable gas detector circuit using an electrochemical sensor. The Alphasense CO-AX carbon monoxide sensor is used in this example. Electrochemical sensors offer several advantages for instruments that detect or measure the concentration of many toxic gases. Most sensors are gas specific and have usable resolutions under one part per million (ppm) of gas concentration.

The circuit shown in below uses the [ADA4528-2](#), dual auto zero amplifier, which has a maximum offset voltage of 2.5 μV at room temperature and an industry leading 5.6 $\mu\text{V}/\sqrt{\text{Hz}}$ of voltage noise density. In addition, the [AD5270-20](#) programmable rheostat is used rather than a fixed transimpedance resistor, allowing for rapid prototyping of different gas sensor systems, without changing the bill of materials. The [ADR3412](#) precision, low noise, micropower reference establishes the 1.2 V common-mode, pseudo ground reference voltage with 0.1% accuracy and 8 ppm/ $^{\circ}\text{C}$ drift. For applications where measuring fractions of ppm gas concentration is important, using the [ADA4528-2](#) and the [ADR3412](#) makes the circuit performance suitable for interfacing with a 16-bit ADC, such as the [AD7790](#).

The [EVAL-CN0357-ARDZ](#) evaluation board is compatible with the Arduino Shield form factor. This user guide will discuss how to use the evaluation software to collect data from the EVAL-CN0357-ARDZ Evaluation Board (**CN-0367 Board**).

A complete design support package for the [EVAL-CN0357-ARDZ](#) evaluation board containing schematics, layouts (native and Gerber), and bill-of-materials can be found at: [CN0357-Shield-DesignSupport](#).



Required Equipment

- [EVAL-CN0357-ARDZ Evaluation Board](#)
- Arduino Processor Board (Uno/Mega 2560/Leonardo or Similar)
- [LINX](#) Firmware loaded on the Arduino (only if using the software GUI)
- [CN0357 Shield Evaluation Software](#)
- PC with the following *Minimum Requirements*
 - Windows Vista/7 (32-bit)
 - USB type A Port
 - Processor rated at 1GHz or faster
 - 1GB RAM and 500 MB available hard disk space
- Electrochemical Gas Sensor

NOTE - Three electrode electrochemical toxic gas sensors can be used with the **CN-0357 Board**. The footprint can accommodate 3 different sizes of sensor. This guide was written with the Alphasense CO-AX in mind.

General Setup

- The [EVAL-CN0357-ARDZ](#) (CN-0357 Shield Board) connects to a Shield form factor Arduino Board
- Power the system through the Arduino using an external wall wart (7V-12V recommended) for best performance
- Connect the system to the PC using a USB cable
- The sensor may be connected to the M1 footprint using the appropriate pin sockets

Jumper P1 Settings



- “0” position - Sensor output connected to ADC(default)
- “1” position - Sensor output connected to A1 pin of ANALOG header, for connection to external ADCs

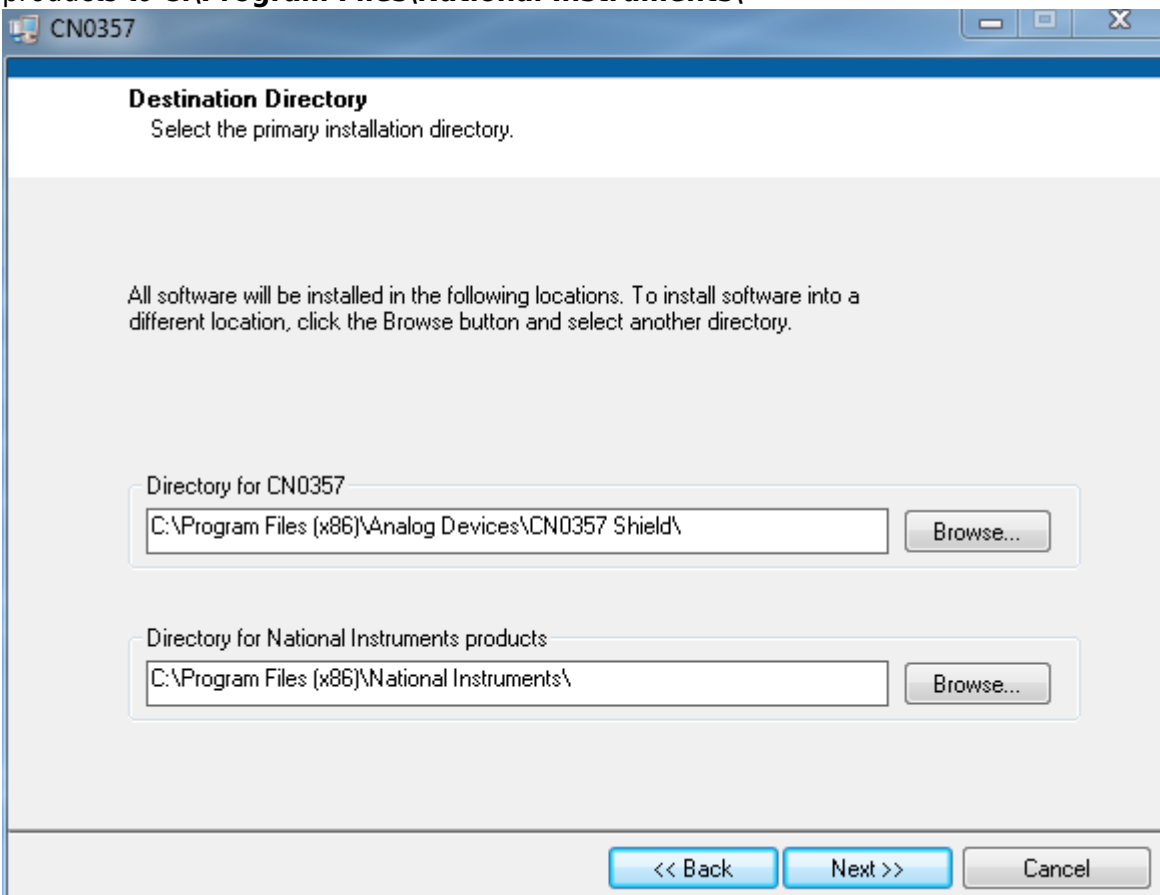
Recommended PCB Sockets(for Alphasense Sensors)

- A Series Sensors - Mill-Max 0364-0-15-15-13-27-10-0
- B Series Sensors - Mill-Max 0294-0-15-15-06-27-10-0
- D Series Sensors - Mill-Max 0667-0-15-15-30-27-10-0

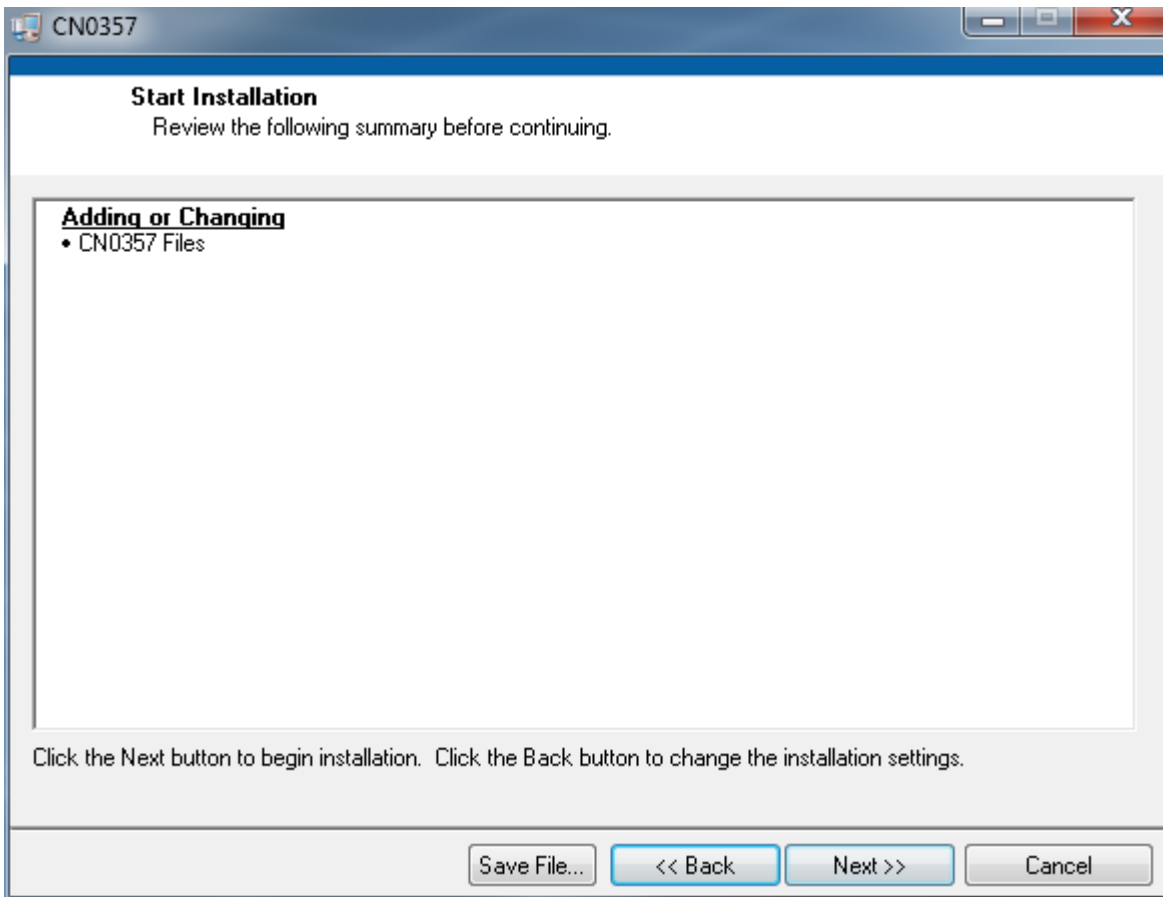
Installing the Software

1. Extract the file **CN0357 Eval Software.zip** and open the file **setup.exe**.

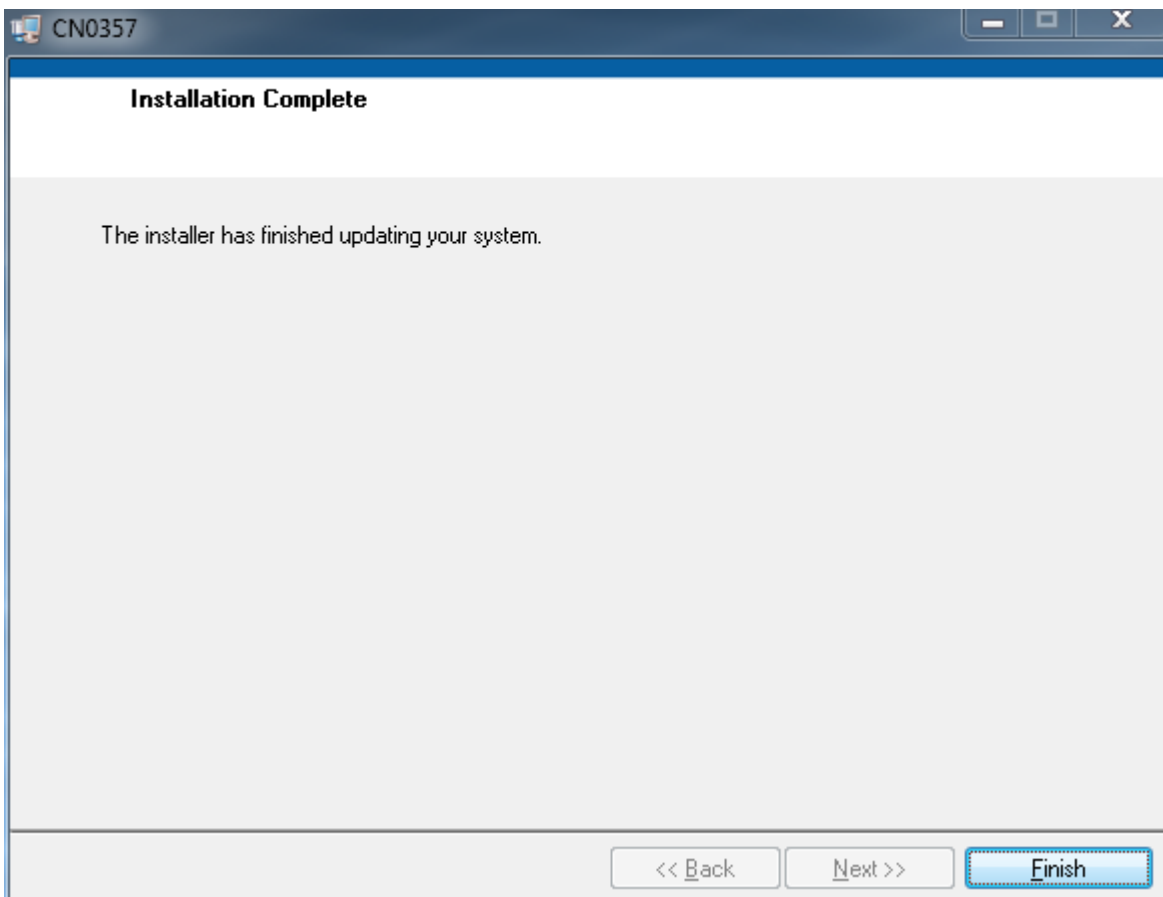
NOTE: It is recommended that you install the [CN0357 Shield Evaluation Software](#) to the default directory path **C:\Program Files\Analog Devices\CN0357 Shield** and all National Instruments products to **C:\Program Files\National Instruments**



2. Click **Next** to view the installation review page



3. Click **Next** to start the installation



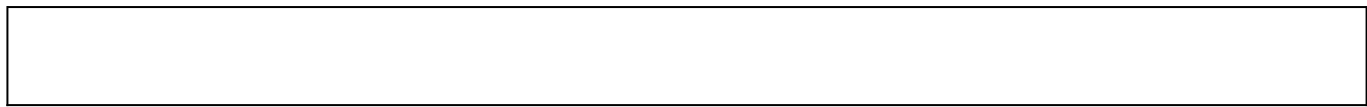
4. Click **Finish** to complete the installation.

Please make sure Arduino USB drivers are installed and your Arduino processor board is flashed with the latest LINX Firmware

Using the Evaluation Software

NOTE - The Arduino processor/controller board must use LINX firmware to be able to connect to the Evaluation Board. For more information, see the links found on the next portion of this guide.

Software Control and Indicator Descriptions



CN0357 Evaluation Software

File Edit Help

CN0357 Evaluation Software

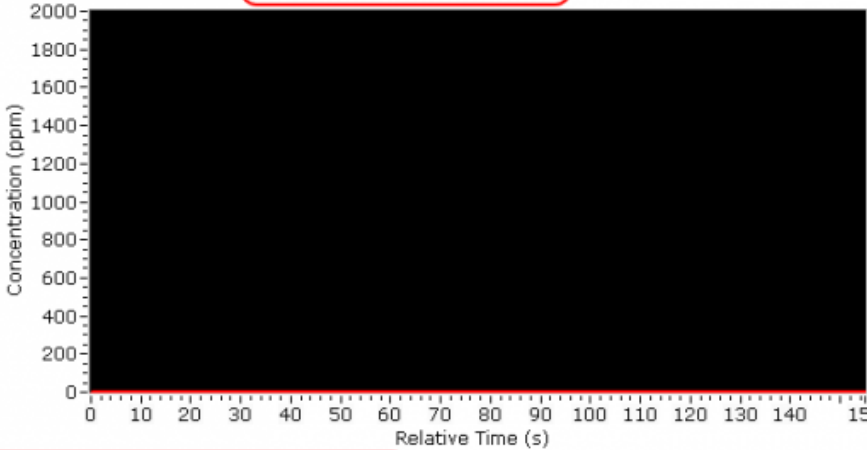
Universal Electrochemical Gas Detector

ANALOG DEVICES

1 Run 2 Stop 3 Save Data 4 Clear Data

Measure Concentration Configure System 5

Concentration (ppm) 0.00ppm 6



7 Max Sensor Sensitivity 100 nA/ppm

8 Typ Sensor Sensitivity 65 nA/ppm

9 Sensor Range 2000 ppm

10 Feedback Resistance 5996.09 ohms

11 ppm/mV 2.56577

12 mV/ppm 0.389746

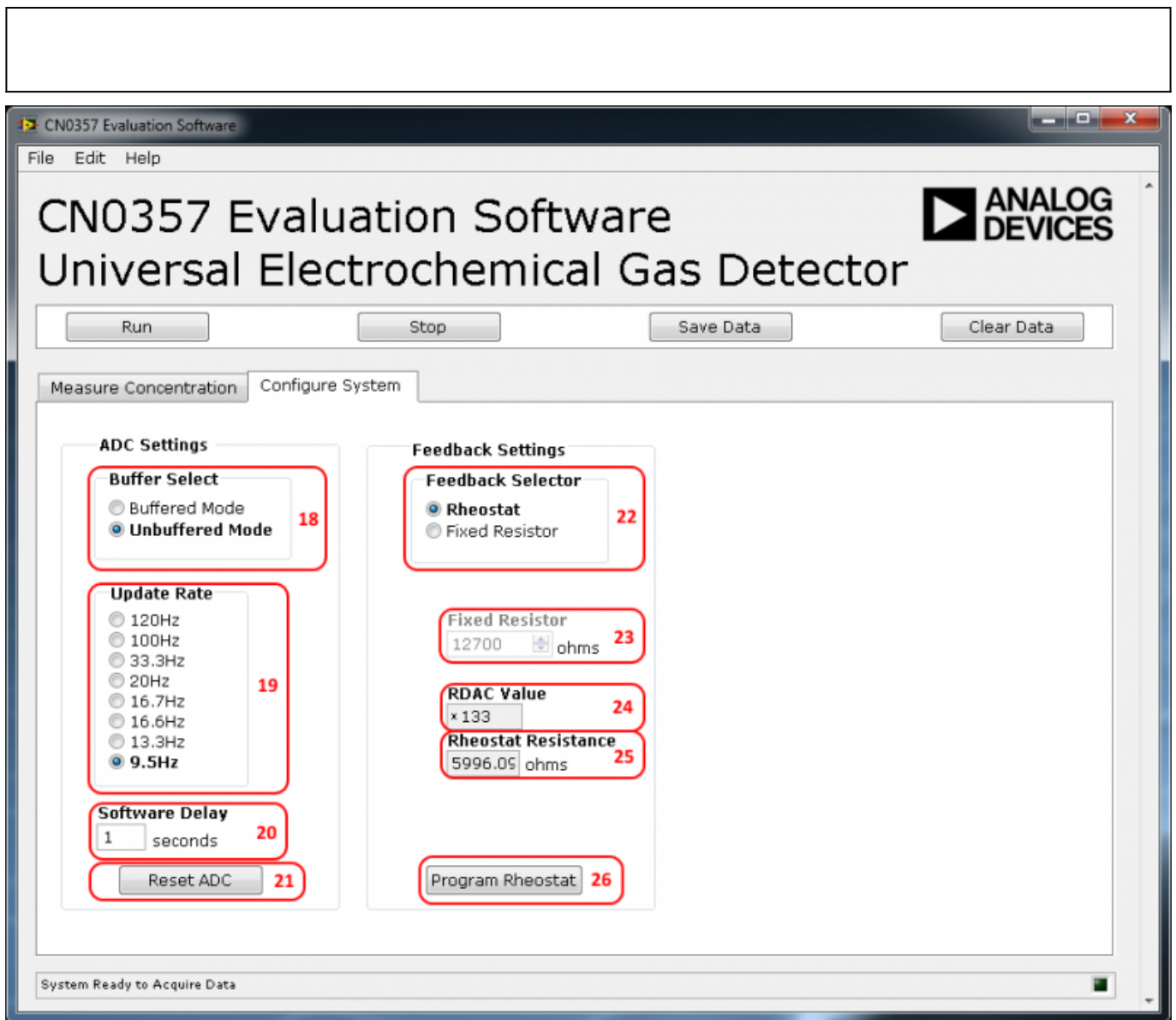
13 ADC Conversion (V) 0

15 Graph Units
 ADC Codes
 PPM

Relative Time (s)

Concentration 14

System Ready to Acquire Data 16 17



1. Run Button

- When this button is pressed, the system will collect concentration data and present the acquisitions in the chart.

2. Stop Button

- When this button is pressed, the software stop collecting data from the CN0357 Board

3. Save Data Button

- When this button is pressed, the software will save the data collected to a tab delimited ASCII spreadsheet file.

4. Clear Data Button

- When this button is pressed, the software will clear all data collected from the chart history.

5. Control Tabs

- Measure Concentration - Clicking this tab brings the data collection chart to the front.
- Configure System - Clicking this tab brings the system configuration settings to the front.
- SDP Board Information - Clicking this tab brings the SDP Board Information to the front.

6. Concentration Numerical Indicator

- This indicator displays the current concentration measured by the system.

7. Max Sensor Sensitivity Numerical Control

- The maximum amount of current in nanoamps (nA) the sensor will sink/source per part per million (ppm).
- This control influences the feedback resistance set by the Rheostat ([AD5270](#)).

8. Typical Sensor Sensitivity Drop-down Menu



- The typical amount of current in nanoamps (nA) the sensor will sink/source per part per million (ppm).
 - This control influences the size of the LSB in terms of ppm/mV and mV/ppm.
9. **Sensor Range Numerical Control**
 - The maximum concentration the sensor can measure in parts per million.
 10. **Feedback Resistance Numerical Indicator**
 - The feedback resistance of the transimpedance amplifier on the **CN0357 Board** ([ADA4528-2](#)).
 - This can be set by the Rheostat ([AD5270](#)) or by populating a fixed resistor in the available footprint.
 11. **ppm/mV Numerical Indicator**
 - Parts per million concentration per millivolt
 12. **mV/ppm Numerical Indicator**
 - millivolts per parts per million concentration
 13. **ADC Conversion Numerical Indicator**
 - The converted voltage seen by the ADC ([AD7790](#)).
 14. **Chart Controls**
 - These controls allow the user to zoom-in, zoom-out, and pan through the data collected.
 15. **Graph Units**
 - This changes the units in the graph between concentration and equivalent ADC code.
 16. **System Status String Indicator**
 - This indicator displays a message to the user detailing the current state of the software.
 17. **System Status LED Indicator**
 - This indicator displays the current state of the software in the form of an LED. There are three status LED colors.
 - Inactive
 - Busy
 - Error
 18. **Buffer Select Radio Buttons**
 - Buffered Mode - This allows the user to place source impedance on the front end without contributing to gain errors to the system.
 - Unbuffered Mode - This disables the buffers, lowering the power consumption of the device.

Enabling the buffers also reduces the **Analog Input Range** of the ADC

19. **Update Rate Radio Buttons**
 - This control allows you to select the desired output data rate of the ADC.
20. **Software Delay**
 - This control allows for a user configurable delay between each conversion
21. **Reset ADC Button**
 - Resets the ADC back to the power-on state and configures it for operation
 - Sets ADC back to Unbuffered mode and 9.5 Hz data rate
 - ADC in standby mode when not in use
22. **Feedback Selector Radio Buttons**
 - Rheostat - Selecting this option uses the Rheostat for the feedback resistance of the transimpedance amplifier and disables the **Fixed Resistor Numerical Control**.
 - Fixed Resistor - Selecting this option uses a fixed-resistor for the feedback resistance of the transimpedance amplifier and disables the **RDAC Value Numerical Indicator, Rheostat Resistance Numerical Indicator** and **Program Rheostat Button**.
23. **Fixed Resistor Numerical Control**

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- Input the value of the resistor populated at **R8** if not using the Rheostat
 - 24. **RDAC Value Numerical Indicator**
 - The value transmitted to the RDAC register of the Rheostat in hexadecimal format.
 - 25. **Rheostat Resistance Numerical Indicator**
 - The equivalent resistance of the Rheostat.
 - 26. **Program Rheostat Button**
 - Load the current RDAC value to the 50-TP Memory Block of the Digital Rheostat.

Programming the current RDAC value to 50-TP can only occur 50 times.

Programming with Arduino

The Arduino IDE is used for programming Arduino processor boards. The IDE may be downloaded from the [Official Arduino Downloads Page](#). Download and install the Arduino IDE to get started. Helpful guides may also be found on the [Getting Started with Arduino](#) webpage.

Example code and library is available for the CN0357 and may be downloaded [here](#).

To learn more about libraries and how to install them to your Arduino IDE, please visit this [page](#).

More Information & Downloads

- [CN-0357 Webpage](#)
- [CN-0357 Design Support Package Download](#) - Includes Arduino Example Code
- [CN0357 Shield Evaluation Software](#)
- [AD7790 Product Page](#)
- [ADA4528-2 Product Page](#)
- [ADR3412 Product Page](#)
- [AD5270-20 Product Page](#)
- [AD8500 Product Page](#)
- [Arduino Official Website](#)
- [LINX Firmware Download](#)

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