CALIBRATION PROCEDURE

NI USB-443*x*

Français	Deutsch	日本語	한국어	简体中文
ni.com/manuals				

This document contains information about calibrating the National Instruments USB-4431 and USB-4432. These devices are referred to in this document as NI USB-443x. For more information about calibration, visit `ni.com/calibration`.

Contents

Software Requirements

Calibrating the NI USB-443*x* device requires installing NI-DAQmx 9.3 or later on the calibration system. You can download the NI-DAQmx driver from `ni.com/downloads`. NI-DAQmx supports conducting a calibration in several programming language application development environments (ADEs). When you install NI-DAQmx, you only need to install support for the ADE that you intend to use.

Documentation Requirements

For information about NI-DAQmx and the NI USB-443*x*, you can consult the following documents:

- *DAQ Getting Started* guides—provides instructions for installing and configuring NI USB-443*x* devices.
- *NI-DAQmx C Reference Help*—contains the C reference and general information about measurement concepts.
- *NI USB-443x Specifications*—provides the published specification values for the NI USB-443*x*. Refer to the most recent *NI USB-443x Specifications* online at `ni.com/manuals`.
- *NI-DAQmx Help*—includes information about creating applications that use NI-DAQmx.

These documents are installed with NI-DAQmx. You can also download the latest versions from the NI Web site at `ni.com/manuals`.

Calibration Interval

National Instruments recommends a calibration interval of one year for the NI USB-443*x*. Adjust the recommended calibration interval based on the measurement accuracy demands of your application.

Test Equipment

Table 1 lists the equipment National Instruments recommends for calibrating the NI USB-443*x*.

Table 1. Recommended Equipment

Equipment	Recommended Model	Parameter Measured/ Adjusted	Minimum Requirements
Calibrator	Fluke 5700A	AI AC Coupled Gain AI DC Coupled Gain AI Offset	Frequency Range: 1 kHz Voltage Range: up to 9 V_{pk} AC Voltage Accuracy: ± 0.03% at 1 kHz* DC Voltage Accuracy: ±150 ppm at 9 V ±100 μV with 1 mA load current
Function Generator	HP/Agilent 33250A	Timebase Frequency Accuracy	Frequency Range: up to 10 kHz Frequency Accuracy: ±5 ppm† Voltage Range: up to 9 V_{pk}
Digital Multimeter	NI 4071	AO Gain AO Offset	DC Voltage Resolution: 1 μV DC Voltage Accuracy at 3.15 V: ±150 ppm
BNC Shorting Cap NI USB-4431: quantity 4 NI USB-4432: quantity 5	Pomona Electronics 5085	AI Offset	Resistance: <1 Ω
BNC Cables: quantity 6	Pomona Electronics 5697	All	Characteristic Impedance: 50 Ω
BNC (Female) to Banana Adapter	Pomona Electronics 1269	All	
BNC T-Connectors: quantity 4	Pomona Electronics 4896	AI Gain AI Offset	Characteristic Impedance: 50 Ω

* AC accuracy is the sum of all errors, including percent of reading error and temperature error, but excluding percent of range error.

† Frequency accuracy is the sum of all errors, including initial accuracy and stability errors.

If the recommended equipment is not available, select a substitute calibration standard that meets the given specifications.

Test Conditions

The following setup and environmental conditions are required to ensure the NI USB-443x meets published specifications:

- Keep connections to the NI USB-443*x* as short as possible. Long cables and wires act as antennae, picking up extra noise that can affect measurements.
- Use 50 Ω BNC coaxial cables for all connections to the device.
- Keep relative humidity between 10% and 80%, noncondensing, or consult the device documentation for the optimum relative humidity.
- Maintain the ambient temperature between 18 °C and 28 °C, or refer to the device specifications for the optimum temperature range.
- Allow a warm-up time of at least 30 minutes to ensure that the measurement circuitry of the NI USB-443*x* is at a stable operating temperature.
- Allow a warm-up time for all of the instruments and equipment according to the manufacturer instructions.

Calibration Procedures

The calibration process includes the following steps:

1. *Initial Setup*—Install the device and configure it in Measurement & Automation Explorer (MAX).
2. *Verification*—Verify the existing operation of the device. This step confirms whether the device is operating within the published specifications prior to adjustment.
3. *Adjustment*—Adjust the calibration constants of the device. The adjustment procedure automatically stores the calibration date on the EEPROM.
4. *Reverification*—Repeat the verification procedure to ensure that the device is operating within the published specifications after adjustment.

Note Skip the AC coupled portion of the *AI Offset Verification* procedure if both of the following apply:

- Your device is hardware revision C or earlier.
- You have never performed an analog input calibration adjustment according to this document.

Initial Setup

Refer to the *DAQ Getting Started* guides for information about how to install the software and hardware and how to configure the device in MAX.

Note When a device is configured in MAX, it is assigned a device name. Each function call uses this device name to determine which device to calibrate. This document uses `Dev_name` to refer to the device name. In the following procedures, use the device name as it appears in MAX.

Changing Coupling on NI USB-443x Devices

NI USB-443*x* devices support both AC and DC coupling. After changing the coupling on a device from DC to AC, wait 30 seconds for the inputs to settle. If samples are acquired before the 30 seconds has elapsed, the acquired data may be distorted. This section illustrates a deterministic method for setting the delay.

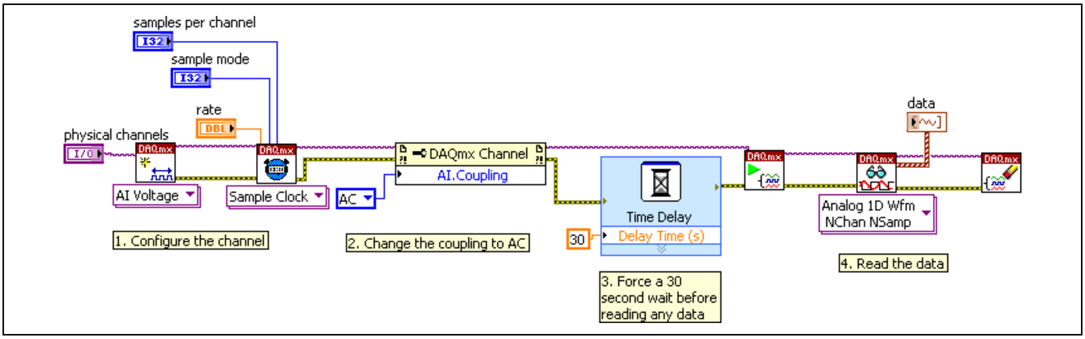


Figure 1. Implicitly Setting Configuration Settings with the DAQmx Start Task VI

When channel configuration settings are set in software, NI-DAQmx keeps track of the desired settings and downloads them to hardware simultaneously when the DAQmx Start Task VI is called. This means that in Figure 1, the settings on the hardware change when the DAQmx Start Task VI is called, and not when they are set earlier. Therefore, there is no 30 seconds wait between setting the coupling on the device and starting the acquisition.

For flexibility, NI-DAQmx gives you the ability to download channel configuration settings to hardware at any point by calling the DAQmx Control Task VI with the `commit` option as shown in Figure 2. When programmed this way, the DAQmx Control Task VI ensures that the wait occurs after the coupling setting has changed on the device.

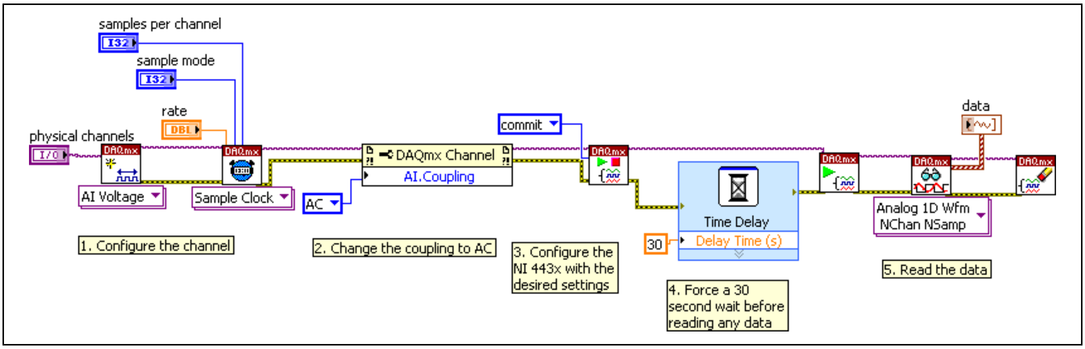


Figure 2. Explicitly Setting Configuration Settings with the DAQmx Control Task VI

Be sure to perform an explicit commit and wait 30 seconds whenever you change the coupling on an NI USB-443*x* from DC to AC.

Note NI-DAQmx may initialize the coupling on an NI USB-443*x* to DC when the device first powers on. Similarly, NI-DAQmx may set the coupling to DC at the end of the execution of one of the calibration adjustment VIs. Perform the 30 seconds wait procedure described in this section when performing an AC-coupled acquisition after the device is powered on, and after calling any of the calibration adjustment VIs.

Verification

This section provides instructions for verifying the *NI USB-443x Specifications* for gain, offset, and frequency accuracy. By completing this procedure, you can see how device accuracy has drifted over time, which helps you determine the appropriate calibration interval for your application.

Note Limits in Tables 3, 4, 6, 8, 9, 11, 13, and 15 are for the specified calibration sample rates and temperatures, and are based on the March 2011 edition of the *NI USB-443x Specifications*. For more general specifications, refer to the most recent *NI USB-443x Specifications* online at `ni.com/manuals`. If a more recent edition of the specifications is available, recalculate the limits based upon the latest specifications.

Analog Input Performance Verification

This section verifies the analog input (AI) performance of NI USB-443*x* devices. Refer to the *NI USB-443x Specifications* for the number of channels and performance specifications.

AI Offset Verification

Note Skip the AC coupled portion of this procedure if both of the following apply:

- Your device is hardware revision C or earlier.
- You have never performed an analog input calibration adjustment according to this document.

Complete the following steps to verify the AI offset:

1. Connect a BNC shorting cap to the channel you want to verify on the device.
2. Using Figure 2 as a guide, create and configure an AI voltage task on the NI USB-443*x* as shown in Table 2.

Table 2. AI Offset Verification Configuration for NI USB-443*x*

Configuration	Value
Minimum value	–10.0
Maximum value	10.0
Terminal configuration	Pseudodifferential
Acquisition mode	Finite number of samples
Rate	102400.0
Samples per channel	65,536
Coupling	DC
Physical channel	Dev_name/ai*x*[*]

[*] Dev_name is the name shown for the NI USB-443*x* in MAX. *x* refers to the channel number.

3. Acquire readings with the NI USB-443*x*.
4. Average all of the acquired samples.

5. If verifying an NI USB-4431, compare the averaged value to the limits in Table 3. If verifying an NI USB-4432, compare the averaged value to the limits in Table 4.

Table 3. AI Offset Limits for NI USB-4431

Coupling	Device Input Offset (One Year Limits)	
	Min (mV)	**Max (mV)**
AC and DC	–1.3	1.3

Table 4. AI Offset Limits for NI USB-4432

Coupling	Device Input Offset (One Year Limits)	
	Min (mV)	**Max (mV)**
AC and DC	–3.2	3.2

6. Repeat steps 1 through 5 for each analog input channel that you want to verify. Connect the BNC shorting cap to the channel being verified in step 1. In step 2, replace `aix` in the physical channel parameter with the channel being verified.

   NI recommends that you verify each channel, but you can save time by verifying only the channels used in your application.
7. Repeat steps 1 through 6. In step 2, set the coupling parameter to AC.

Note Skip the AC coupled portion of this procedure if both of the following apply:

- Your device is hardware revision C or earlier.
- You have never performed an analog input calibration adjustment according to this document.

AI AC Coupled Gain Accuracy Verification

Complete the following steps to verify AC coupled gain accuracy:

1. Connect the output of the calibrator to the channel you want to verify on the device.
2. Output a 1 kHz, 6.36 V_{rms} AC signal from the calibrator.

3. Using Figure 2 as a guide, create and configure an AI voltage task on the NI USB-443*x* as shown in Table 5.

Table 5. AI AC Coupled Gain Accuracy Verification Configuration for NI USB-443*x*

Configuration	Value
Minimum value	–10.0
Maximum value	10.0
Terminal configuration	Pseudodifferential
Acquisition mode	Finite number of samples
Rate	102400.0
Samples per channel	65,536
Coupling	AC
Physical channel	Dev_name/ai*x**
* Dev_name is the name shown for the NI USB-443*x* in MAX. *x* refers to the channel number.	

4. Acquire readings with the NI USB-443*x*.
5. Calculate the amplitude of the acquired 1 kHz fundamental tone in V_{rms}, and compare the amplitude to the limits in Table 6.

Table 6. AI AC Coupled Gain Accuracy Limits for NI USB-443*x*

	Device Input Amplitude (One Year Limits)	
Calibrator Output Amplitude (V_{rms})	Min (V_{rms})	Max (V_{rms})
6.36	6.350	6.370

6. Repeat steps 1 through 5 for each analog input channel that you want to verify. Connect the output of the calibrator to the channel being verified in step 1. In step 3, replace `aix` in the physical channel parameter with the channel being verified.

   NI recommends that you verify each channel, but you can save time by verifying only the channels used in your application.

AI DC Coupled Gain Accuracy Verification

Complete the following steps to verify DC coupled gain accuracy:

1. Connect the output of the calibrator to the channel you want to verify on the device.
2. Output 0 VDC from the calibrator.

3. Create and configure an AI voltage task on the NI USB-443*x* as shown in Table 7.

Table 7. AI DC Coupled Gain Accuracy Verification Configuration for NI USB-443*x*

Configuration	Value
Minimum value	–10.0
Maximum value	10.0
Terminal configuration	Pseudodifferential
Acquisition mode	Finite number of samples
Rate	102400.0
Samples per channel	65,536
Coupling	DC
Physical channel	Dev_name/ai*x*[*]
[*] Dev_name is the name shown for the NI USB-443*x* in MAX. *x* refers to the channel number.	

4. Acquire readings with the NI USB-443*x*.
5. Average all of the acquired samples. Record this value.
6. Repeat steps 1 through 5. In step 2, output 9 VDC instead of 0 VDC. Subtract the averaged value measured for 0 VDC from the 9 VDC measurement.
7. Compare the calculated value to the DC coupled gain accuracy limits.

   If verifying an NI USB-4431, compare the calculated value to the appropriate limits in Table 8. If verifying an NI USB-4432, compare the calculated value to the appropriate limits in Table 9.

Table 8. AI DC Coupled Gain Accuracy Limits for NI USB-4431

Calibrator Output Amplitude (VDC)	Device Input Amplitude (One Year Limits)	
	Min (V)	Max (V)
9	8.9856	9.0144
–9	–9.0144	–8.9856

Table 9. AI DC Coupled Gain Accuracy Limits for NI USB-4432

Calibrator Output Amplitude (VDC)	Device Input Amplitude (One Year Limits)	
	Min (V)	Max (V)
9	8.982	9.018
–9	–9.018	–8.982

8. Repeat steps 1 through 5. In step 2, output –9 VDC instead of 9 VDC. Subtract the averaged value measured for 0 VDC from the –9 VDC measurement.

9. Compare the calculated value to the DC coupled gain accuracy limits.

   If verifying an NI USB-4431, compare the calculated value to the appropriate limits in Table 8. If verifying an NI USB-4432, compare the calculated value to the appropriate limits in Table 9.

10. Repeat steps 1 through 9 for each analog input channel that you want to verify. Connect the output of the calibrator to the channel being verified in step 1. In step 3, replace ai*x* in the physical channel parameter with the channel being verified.

    NI recommends that you verify each channel, but you can save time by verifying only the channels used in your application.

Analog Output Performance Verification

This section verifies the analog output (AO) performance of the NI USB-4431 device. Refer to the *NI USB-443x Specifications* for the performance specifications.

AO Offset Verification for the NI USB-4431 Device

Complete the following steps to verify the AO offset:

1. Connect channel AO 0 on the device to the input of the multimeter.
2. Create and configure an AO voltage task on the NI USB-4431 as shown in Table 10.

Table 10. AO Offset Verification Configuration for NI USB-4431

Configuration	Value
Minimum value	–3.5
Maximum value	3.5
Terminal configuration	Pseudodifferential
Acquisition mode	Continuous samples
Rate	96000.0
Samples per channel	96,000
Regeneration mode	Allow regeneration
Physical channel	Dev_name/ao0*
* Dev_name is the name shown for the NI USB-4431 in MAX.	

3. Create an array of length 96,000. Set every element in the array to a value of 0.0. Write the array to the AO task.
4. Start the AO task. The AO channel will output 0 V as long as the task is running because regeneration mode is enabled and the task is configured to generate samples continuously.
5. Wait 100 ms. This compensates for the filter delay of the analog output channel.
6. Measure the DC voltage of channel AO 0 on the device using the lowest voltage range of the multimeter that can measure approximately 100 mV. Record the measured offset, as it will be used in the *AO Gain Verification for the NI USB-4431 Device* procedure.

7. Compare the measured voltage value to the AO offset limits in Table 11.

Table 11. AO Offset Limits for NI USB-4431

Device Output Offset (One Year Limits)	
Min (mV)	**Max (mV)**
–1.3	1.3

8. Stop and clear the AO task.

AO Gain Verification for the NI USB-4431 Device

Complete the following steps to verify AO gain accuracy:

1. Connect channel AO 0 on the device to the input of the multimeter.
2. Create and configure an AO voltage task on the NI USB-4431 as shown in Table 12.

Table 12. AO Gain Verification Configuration for NI USB-4431

Configuration	Value
Minimum value	–3.5
Maximum value	3.5
Terminal configuration	Pseudodifferential
Acquisition mode	Continuous samples
Rate	96000.0
Samples per channel	96,000
Regeneration mode	Allow regeneration
Physical channel	Dev_name/ao0*
* Dev_name is the name shown for the NI USB-4431 in MAX.	

3. Create an array of length 96,000. Set every element in the array to a value of 3.15. Write the array to the AO task.
4. Start the AO task. The AO channel will output 3.15 V as long as the task is running, because regeneration mode is enabled and the task is configured to generate samples continuously.
5. Wait 100 ms. This compensates for the filter delay of the analog output channel.
6. Measure the DC voltage of the analog output channel using the multimeter in the appropriate range for a 3.5 V amplitude. Subtract the value measured in step 6 of the *AO Offset Verification for the NI USB-4431 Device* procedure, and compare this value to the limits in Table 13.
7. Stop and clear the AO task.

8. Repeat steps 1 through 7. In step 3, set every element in the array to a value of –3.15 instead of 3.15. Compare the result to the limits in Table 13.

Table 13. AO Gain Limits for NI USB-4431

Device Output Amplitude (VDC)	Device Input Amplitude (One Year Limits)	
	Min (V)	Max (V)
3.15	3.1437	3.1563
–3.15	–3.1563	–3.1437

Timebase Frequency Accuracy Verification

This section describes the process used to verify the frequency accuracy of the timebase on NI USB-443*x* devices. All analog input and output channels on a single device use the same timebase circuitry. Therefore, you only need to verify the timebase accuracy on one channel.

Complete the following steps to verify the timebase accuracy:

1. Connect the function generator to the channel being verified on the device.
2. Configure the function generator to generate a 10 kHz sine wave with an amplitude of 9 V_{pk} and no DC offset.
3. Create and configure an AI voltage task on the NI USB-443*x* as shown in Table 14.

Table 14. Timebase Frequency Accuracy Verification Configuration for NI USB-443*x*

Configuration	Value
Minimum value	–10.0
Maximum value	10.0
Terminal configuration	Pseudodifferential
Acquisition mode	Finite number of samples
Rate	40000.0
Samples per channel*	2,560,000
Coupling	DC
Physical channel	Dev_name/ai*x*†

* The read timeout must be greater than 64 seconds.

† Dev_name is the name shown for the NI USB-443*x* in MAX. *x* refers to the channel number.

4. Acquire readings with the NI USB-443*x*.

5. Measure the exact frequency of the acquired signal. Compare the detected frequency to the timebase frequency accuracy limits in Table 15.

Table 15. Timebase Frequency Accuracy Limits for NI USB-443*x*

Function Generator Output		Device Input Frequency	
Amplitude (V_{pk})	**Frequency (Hz)**	**Min (Hz)**	**Max (Hz)**
9	10000	9999.25	10000.75

Adjustment

Performing the calibration adjustment procedure automatically updates the calibration constants and date in the EEPROM on the NI USB-443*x* device.

Analog Input Adjustment

Complete the following steps to adjust the analog input of an NI USB-443*x* device.

1. Connect the output of the calibrator to all input channels on the device. Use the BNC T-connectors to route the signal to all of the inputs.
2. Configure the calibrator to output a 1 kHz signal with a 6.3 V_{rms} (8.91 V_{pk}) amplitude.
3. Enable the calibrator output.
4. Using Figure 3 as a guide, commit an AI voltage task on the NI USB-443*x* with the settings shown in Table 16. After the task is committed, clear the task and wait for 30 seconds.

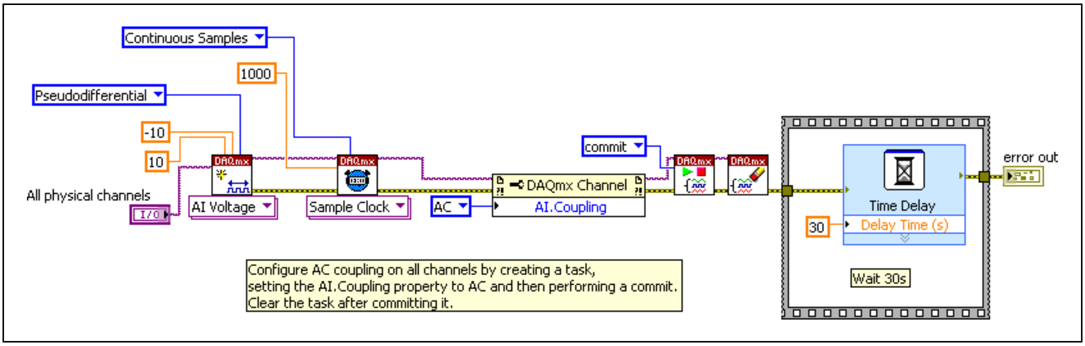


Figure 3. VI Showing How to Prepare a NI USB-443*x* for Analog Input Adjustment

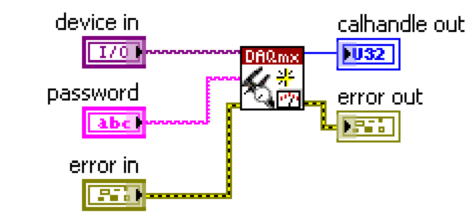
Table 16. AI Adjustment Configuration for NI USB-443*x*

Configuration	Value
Minimum value	–10.0
Maximum value	10.0
Terminal configuration	Pseudodifferential
Acquisition mode	Continuous
Rate	1000.0
Coupling	AC
Physical channel	Dev_name/ai*x**

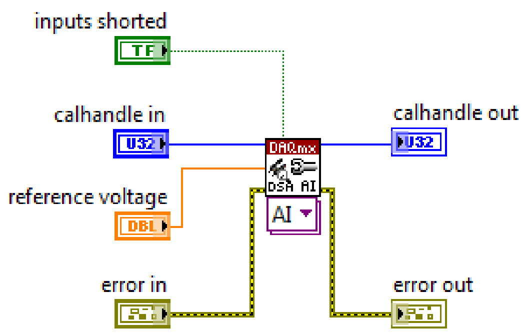
* Dev_name is the name shown for the NI USB-443*x* in MAX. *x* refers to the channel number: 0:3 for the NI USB-4431, and 0:4 for the NI USB-4432.

5. Initialize the AI calibration using the DAQmx Initialize External Calibration VI as shown below.

Note Refer to the NI-DAQmx function parameters for the LabVIEW input values.

LabVIEW Block Diagram	NI-DAQmx Function Call
	Call `DAQmxInitExtCal` with the following parameters: **deviceName**: `Dev_name` **password**: `NI` **calHandle**: `&myCalHandle`

6. Perform the AI calibration adjustment by selecting the DAQmx Adjust DSA AI Calibration VI from the DAQmx Adjust DSA AI Calibration Polymorphic VI as shown below.

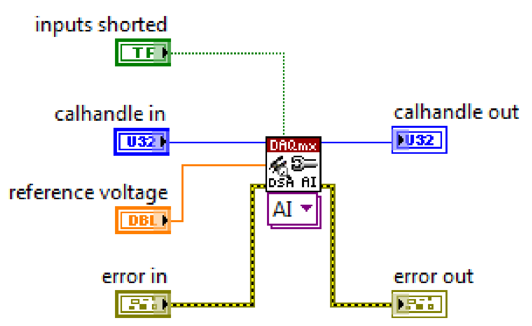
LabVIEW Block Diagram	NI-DAQmx Function Call
	Call `DAQmxAdjustDSAAICal` with the following parameters: **calHandle**: `myCalHandle` **referenceVoltage**: `6.3` **inputsShorted**: `False`

7. Disable the calibrator output.

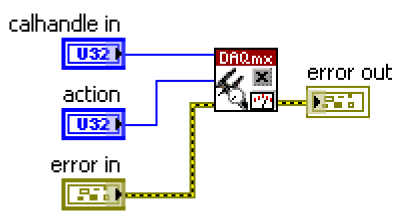
8. Configure the calibrator to output 0 V.

Note The Fluke 5700A calibrator must be locked on the 2.2 V range when the output is set to 0 V. Alternately, you can use a shorting cap instead of the calibrator in step 8 and step 9.

9. Enable the calibrator output.
10. Set the reference voltage to 0 VDC, and call the DAQmx Adjust DSA AI Calibration Polymorphic VI as shown below.

LabVIEW Block Diagram	NI-DAQmx Function Call
	Call `DAQmxAdjustDSAAICal` with the following parameters: **calHandle**: `myCalHandle` **referenceVoltage**: `0` **inputsShorted**: `True`

11. Disable the calibrator output.
12. Finish the AI calibration with the DAQmx Close External Calibration VI as shown below. Use the action `cancel` if there has been any error during the AI calibration or if you do not want to save the new AI calibration constants in the device EEPROM. Use the action `commit` to save the new AI calibration constants in the device EEPROM.

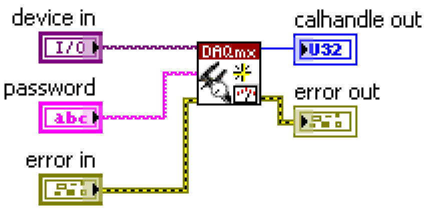
LabVIEW Block Diagram	NI-DAQmx Function Call
	Call `DAQmxCloseExtCal` with the following parameters: **calHandle**: `myCalHandle` **action**: `DAQmx_Val_Action_Commit` or `DAQmx_Val_Action_Cancel`

The analog input of the device is now calibrated with respect to your external equipment. After calibrating the device, verify the analog input operation by repeating the *Analog Input Performance Verification* section.

Analog Output Adjustment for the NI USB-4431 Device

Complete the following steps to adjust the analog output of the NI USB-4431 device.

1. Connect channel AO 0 on the device to the multimeter.
2. Initialize the AO calibration using the DAQmx Initialize External Calibration VI as shown below.

<table>
<tr><th>LabVIEW Block Diagram</th><th>NI-DAQmx Function Call</th></tr>
<tr><td>
</td><td>Call <code>DAQmxInitExtCal</code> with the following parameters:
deviceName: <code>Dev_name</code>
password: <code>NI</code>
calHandle: <code>&myCalHandle</code></td></tr>
</table>

3. Create and configure an AO voltage task on the NI USB-4431 as shown in Table 17.

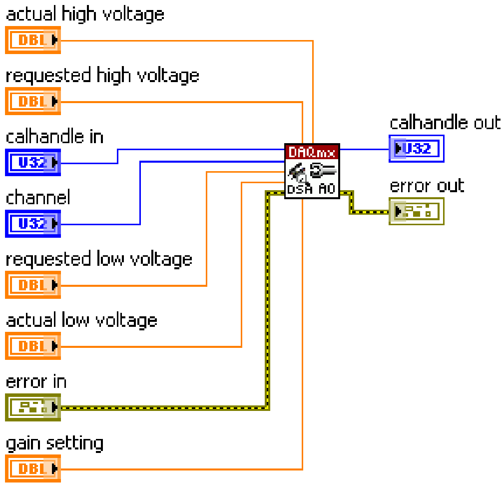
Table 17. Analog Output Adjustment Configuration for NI USB-4431

Configuration	Value
Minimum value	–3.5
Maximum value	3.5
Terminal configuration	Pseudodifferential
Acquisition mode	Continuous samples
Rate	96000.0
Samples per channel	96,000
Regeneration mode	Allow regeneration
Physical channel	Dev_name/ao0*

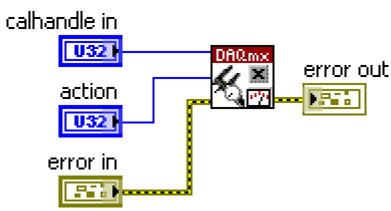
* Dev_name is the name shown for the NI USB-4431 in MAX.

4. Create an array of length 96,000. Set every element in the array to a value of 2.0. Write the array to the AO task.
5. Start the AO task. The AO channel will output 2.0 V as long as the task is running because regeneration mode is enabled and the task is configured to generate samples continuously.
6. Wait 100 ms. This compensates for the filter delay of the analog output channel.
7. Measure the DC voltage of channel AO 0 on the device using the multimeter. Record this value as `actualHighVoltage`.
8. Stop and clear the AO task.
9. Repeat steps 3 through 8. In step 4, set every element in the array to a value of –2.0 instead of 2.0. In step 7, record the measured value as `actualLowVoltage`.

10. Perform AO calibration using the DAQmx Adjust DSA AO Calibration VI as shown below.

LabVIEW Block Diagram	NI-DAQmx Function Call
	Call `DAQmxAdjustDSAAOCal` with the following parameters: **calhandle**: `myCalHandle` **channel**: 0 **requestedHighVoltage**: 2.0 **actualHighVoltage**: (value from step 7) **requestedLowVoltage**: –2.0 **actualLowVoltage**: (value from step 9) **gainSetting**: 0.0

11. Finish the AO calibration with the DAQmx Close External Calibration VI as shown below. Use the action `cancel` if there has been any error during the AO calibration or if you do not want to save the new AO calibration constants in the device EEPROM. Use the action `commit` to save the new AO calibration constants in the device EEPROM.

LabVIEW Block Diagram	NI-DAQmx Function Call
	Call `DAQmxCloseExtCal` with the following parameters: **calHandle**: `myCalHandle` **action**: `DAQmx_Val_Action_Commit` or `DAQmx_Val_Action_Cancel`

The analog output of the device is now calibrated with respect to your external equipment. After calibrating the device, verify the analog output operation by repeating the *Analog Output Performance Verification* section.

Where to Go for Support

The National Instruments Web site is your complete resource for technical support. At `ni.com/support` you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers. National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world to help address your support needs. For telephone support in the United States, create your service request at `ni.com/support` and follow the calling instructions or dial 512 795 8248. For telephone support outside the United States, visit the Worldwide Offices section of `ni.com/niglobal` to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

373489A-01 Oct11