CALIBRATION PROCEDURE

NI PXIe-4463

DSA Analog Output

This document contains the verification and adjustment procedures for the National Instruments PXIe-4463 with either BNC or mini-XLR connectors. For more information about calibration solutions, visit ni.com/calibration.

Contents

NATIONAL INSTRUMENTS

Software

Calibrating the NI PXIe-4463 requires the installation of NI-DAQmx on the calibration system. NI-DAQmx 14.5 added driver support for the NI PXIe-4463. For the list of devices supported by a specific release, refer to the *NI-DAQmx Readme*, available on the version-specific download page or installation media.

You can download NI-DAQmx from ni.com/downloads. NI-DAQmx supports LabVIEW, LabWindows™/CVI™, C/C++, C#, and Visual Basic .NET. When you install NI-DAQmx, you only need to install support for the application software that you intend to use.

Note For LabVIEW applications, all functions used in verification and adjustment procedures can be found in the LabVIEW Functions palette; C/C++ equivalents are referenced in parentheses.

Documentation

Consult the following documents for information about the NI PXIe-4463, NI-DAQmx, and your application software. All documents are available on ni.com and help files install with the software.

NI PXIe-4463 Getting Started Guide

NI PXIe-4463 software installation, hardware setup, and configuration

NI PXIe-4463 Specifications

NI PXIe-4463 specifications and calibration interval

NI-DAQmx Readme

Operating system and application software support in NI-DAQmx

NI-DAQmx Help

Information about creating applications that use the NI-DAQmx driver

LabVIEW Help

LabVIEW programming concepts and reference information about NI-DAQmx VIs and functions

NI-DAQmx C Reference Help

Reference information for NI-DAQmx C functions and NI-DAQmx C properties

NI-DAQmx .NET Help Support for Visual Studio

Reference information for NI-DAQmx .NET methods and NI-DAQmx .NET properties, key concepts, and a C enum to .NET enum mapping table

Test Equipment

Table 1 lists the equipment required for the verification and adjustment procedures. If the recommended model is not available, use equipment that meets the requirements listed in Table 1.

Table 1. Required Equipment

Equipment	Recommended Model	Where Used	Requirements
Digital Multimeter (DMM)	Keysight Technologies 3458A	AO Offset Verification AO Offset and Gain Adjustment	DC Voltage Input Range: 1 V, 10 V Accuracy: 2 ppm of range, 15 ppm of reading
		AO Gain Verification AO Flatness Verification AO Interchannel Gain Mismatch Verification	AC Voltage Input Range: 0.1 $V_{rms,}$ 1 $V_{rms,}$ 10 V_{rms} Frequency Range: 20 Hz to 22.4 kHz Accuracy: 45 ppm of range, 370 ppm of reading, 160 ppm of reading @ 1 kHz

Table 1. Required Equipment (Continued)

Equipment	Recommended Model	Where Used	Requirements
Digital Multimeter (DMM)	Keysight Technologies 3458A	AO Current Drive Verification	AC Current Input Range: 0.1 A_{rms} Accuracy: 200 ppm of range, 750 ppm of reading Burden Voltage: < 250 mV
Frequency Counter	Keysight Technologies 53220A-010	Timebase Frequency Verification and Adjustment	Resolution: > 10 digits Timebase Accuracy: ±0.2 ppm
Analog Input DSA	NI PXIe-4464, BNC connectors	AO Noise Verification	Noise: ≤ 0.7 μV_{rms}
PXI Express Chassis	NI PXIe-1082	All Tests	One of the following chassis: NI PXIe-1082 NI PXIe-1085 NI PXIe-1075 NI PXIe-1065 NI PXIe-1062Q
System Controller	NI PXIe-8135	All Tests	A PXI Express controller or MXI Express card
mXLR (F) to BNC (M) Cable (quantity 1)	NI 156789-0R46 or NI 140150-0R46	All Tests (mXLR Variant)	Length: ≤ 0.5 m
BNC (M) to BNC (M) Cable (quantity 1)	Pomona Electronics 5697	All Tests (BNC Variant)	Length: ≤ 0.5 m
BNC (M) to BNC (M) Cable (quantity 3)	Pomona Electronics 5697	AO Noise Verification	Length: ≤ 0.5 m

Table 1. Required Equipment (Continued)

Equipment	Recommended Model	Where Used	Requirements
BNC (F) to Banana Adapter (quantity 1)	Pomona Electronics 1269	AO Offset Verification AO Gain Verification AO Flatness Verification AO Interchannel Gain Mismatch Verification AO Current Drive Verification AO Offset and Gain Adjustment	—
BNC F-M-F Tee Connector (quantity 3)	Pomona Electronics 3285	AO Noise Verification	Characteristic Impedance: 50 Ω

Note The settings listed in this calibration procedure apply to the recommended equipment only. If different equipment is used, ensure that it is properly configured so that requirements listed in Table 1 are met.

Test Conditions

The following setup and environmental conditions are required to ensure the NI PXIe-4463 meets published specifications.

- Keep connections to the NI PXIe-4463 as short as possible. Long cables and wires act as antennas, picking up extra noise that can affect measurements.
- Verify that all connections to the NI PXIe-4463 are secure.
- Maintain an ambient temperature of 23 °C ± 5 °C. The NI PXIe-4463 temperature will be greater than the ambient temperature.
- As Found Test Limits are valid for a device temperature within ±5 °C of the last self-calibration.
- Keep relative humidity below 80%.
- Allow a warm-up time of at least 15 minutes to ensure that the NI PXIe-4463 circuitry is at a stable operating temperature.
- Allow adequate warm-up time for all of the instruments and equipment according to the manufacturer instructions.

Initial Setup

Refer to the *NI PXIe-4463 Getting Started Guide* for information about how to install the software and hardware and how to configure the device in NI Measurement & Automation Explorer (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.

Note If the NI PXIe-4464 is used for the AO noise verification, install it in the rightmost PXI Express slot.

Self-Calibration

The NI PXIe-4463 includes precise internal circuits and calibration references used during self-calibration to adjust for drift over time and temperature.

Note No signal connections are needed for self-calibration.

Complete the following steps to self-calibrate the device.

1. Wait 15 minutes for the device to warm up.
2. Launch MAX.
3. Select **My System»Devices and Interfaces**, and then select the NI PXIe-4463 device to self calibrate.
4. Click **Self-Calibrate** in the upper right corner of the window.

Verification

The following procedures describe the sequence of operation and provide test points required to verify the NI PXIe-4463. The verification procedures assume that adequate traceable uncertainties are available for the calibration references.

Note The verification procedure requires performing a self-calibration as a first step unless it is done immediately after an adjustment. Refer to the *Self-Calibration* section for instructions on performing a self-calibration.

Characteristics have As Found limits for verification *before adjustment* and As Left limits for reverification *after adjustment*. Characteristics unaffected by adjustment have test limits with no additional qualification.

Note If any test fails verification or reverification, confirm that you have met the *Test Conditions* before returning your device to NI. Refer to *Worldwide Support and Services* for assistance in returning the device to NI.

Analog Output Performance Verification

This section verifies the analog output (AO) performance of the NI PXIe-4463.

AO Offset Accuracy Verification

Complete the following procedure to verify the AO offset accuracy.

1. Connect channel AO 0 of the NI PXIe-4463 to the DMM using the cables recommended in Table 1.
2. Configure the DMM using the information in Table 2.

Table 2. DMM Configuration

Configuration	Value
Function	DC Volts (DCV)
Range	1 V
Number of Power Line Cycles (NPLC)	100

3. Generate a voltage with the NI PXIe-4463:
   a. Configure an AO voltage channel task using the values in Table 3.

Table 3. AO Setup

Configuration	Value
Physical Channels	*Dev_name*/ao0
AO Gain	0 dB
Output Terminal Configuration	Differential
Rate	51200 S/s
Sample Mode	Continuous Sample
Samples Per Channel	512

   b. Create an array of 512 points, and fill every element with value 0.
   c. Write the array to AO, and start the task.
4. Measure the output voltage with the DMM.
5. Stop the task.

6. Repeat steps 3 to 5 for AO Attenuation of 17 dB and 37 dB, setting the AO Gain parameter with the values from Table 4.

Table 4. AO Attenuation

AO Attenuation (dB)	AO Gain (dB)
0	0
17	-17
37	-37

7. Repeat steps 3 to 6 for pseudodifferential output terminal configuration.
8. Repeat steps 1 to 7 for AO 1.
9. Compare each measured value with the Min and Max limits in Table 5.

Table 5. AO Offset Verification Limits

AO Attenuation (dB)	As Found Test Limits		As Left Test Limits	
	Min (mV)	Max (mV)	Min (mV)	Max (mV)
0	-0.5	0.5	-0.22	0.22
17	-0.3	0.3	-0.13	0.13
37	-0.2	0.2	-0.10	0.10

Note Test limits are the same for differential and pseudodifferential output configurations.

AO Gain Accuracy Verification

Complete the following procedure to verify the AO gain accuracy.

1. Connect channel AO 0 of the NI PXIe-4463 to the DMM using the cables recommended in Table 1.
2. Use the values in Table 6 to configure the DMM.

Table 6. DMM Configuration

Configuration	Value
Function	AC Volts (ACV)
Range*	10 V
RMS Mode (SETACV)	3 (SYNC)
AC Bandwidth (ACBAND)	20,100000 (20 Hz to 100 kHz)
Level Filter (LFILTER)	1 (ON)
* Refer to Table 9 for details about the correlation between AO Gain, DMM Range, and Signal Amplitude.	

3. Generate a waveform with the NI PXIe-4463.
   a. Configure an AO voltage channel task using the values in Table 7.

Table 7. AO Setup

Configuration	Value
Physical Channels	*Dev_name*/ao0
AO Gain*	0 dB
Output Terminal Configuration	Differential
Rate	51200 S/s
Sample Mode	Continuous Samples
Samples Per Channel	512
* Refer to Table 9 for details about the correlation between AO Gain, DMM Range, and Signal Amplitude.	

b. Call `Basic Function Generator` using the parameters in Table 8.

Table 8. Basic Function Generator Parameters

Parameter	Value
Signal Type	Sine Wave
Frequency	1000 Hz
Amplitude*	10 V
Sampling Info»Sampling Rate	51200 S/s
Sampling Info»Number of Samples	512

* Refer to Table 9 for details about the correlation between AO Gain, DMM Range, and Signal Amplitude.

c. Write the resulting waveform to AO, and start the task.

4. Measure the output voltage with the DMM.
5. Stop the task.
6. Repeat steps 2 to 5 for AO Attenuation of 17 dB and 37 dB. Refer to Table 9 for AO Gain, DMM Range, and Signal Amplitude settings.

Table 9. Settings for AO Gain Verification

AO Attenuation (dB)	AO Gain (dB)	DMM Range (V)	Signal Amplitude (V)
0	0	10	10
17	-17	1	1.41421
37	-37	0.1	0.141421

7. Repeat steps 2 to 6 for pseudodifferential output terminal configuration.
8. Repeat steps 1 to 7 for AO 1.
9. Compare the DMM readings with the Max and Min limits in Table 10.

Table 10. AO Gain Verification Limits

AO Attenuation (dB)	As Found Test Limits		As Left Test Limits	
	Min (V_{rms})	Max (V_{rms})	Min (V_{rms})	Max (V_{rms})
0	7.0548	7.0874	7.06635	7.07578
17	0.9977	1.0023	0.99929	1.00070
37	0.09977	0.10023	0.099928	0.100071

AO Flatness Verification

Complete the following procedure to verify the AO flatness.

1. Connect channel AO 0 of the NI PXIe-4463 to the DMM using the cables recommended in Table 1.
2. Use the information in Table 6 to configure the DMM.
3. Generate a waveform with the NI PXIe-4463.
   a. Configure an AO voltage channel task using the values in Table 11.

Table 11. AO Setup

Configuration	Value
Physical Channels	*Dev_name*/ao0
AO Gain*	0 dB
Output Terminal Configuration	Differential
Rate	51200 S/s
Sample Mode	Continuous Sample
Samples Per Channel	2560

* Refer to Table 9 for details about the correlation between AO Gain, DMM Range, and Signal Amplitude.

   b. Call `DAQmx Channel Property Node`, and set the AO Idle Output Behavior property (**Analog Output»General Properties»Output Configuration»Idle Output Behavior**) to `Zero Volts`.
   c. Call `Basic Function Generator` using the parameters in Table 12.

Table 12. Basic Function Generator Parameters

Parameter	Value
Signal Type	Sine Wave
Frequency	1000 Hz
Amplitude*	10 V
Sampling Info»Sampling Rate	51200 S/s
Sampling Info»Number of Samples	2560

* Refer to Table 9 for details about the correlation between AO Gain, DMM Range, and Signal Amplitude.

   d. Write the resulting waveform to AO, and start the task.
4. Measure the output voltage with the DMM and record for future calculations.

5. Stop the task.
6. Repeat steps 3 to 5 with signal frequencies of 20 Hz, 20 kHz, and 22.4 kHz.
7. Repeat steps 3 to 6 for pseudodifferential output terminal configuration.
8. Repeat steps 2 to 7 for AO Attenuation of 17 dB and 37 dB. Refer to Table 9 for AO Gain, DMM Range, and Signal Amplitude settings.
9. Repeat steps 1 to 8 for AO 1.
10. Compare the DMM readings with the Max and Min limits in Table 13.

Table 13. AO Flatness Verification Limits

Output Terminal Configuration	Frequency	Test Limits	
		Min (V_{rms})	Max (V_{rms})
Differential	1 kHz	V_{1kHz}	
	20 Hz	0.999194 * V_{1kHz}	1.000806 * V_{1kHz}
	20 kHz	0.999194 * V_{1kHz}	1.000806 * V_{1kHz}
	22.4 kHz	0.998964 * V_{1kHz}	1.001037 * V_{1kHz}
Pseudodifferential	1 kHz	V_{1kHz}	
	20 Hz	0.999079 * V_{1kHz}	1.000921 * V_{1kHz}
	20 kHz	0.999079 * V_{1kHz}	1.000921 * V_{1kHz}
	22.4 kHz	0.998849 * V_{1kHz}	1.001152 * V_{1kHz}

Note Test limits are the same for all AO Attenuation settings.

AO Interchannel Gain Mismatch Verification

Complete the following procedure to verify AO interchannel gain mismatch. Use the voltages recorded during *AO Flatness Verification* for calculations.

1. Compute the ratio between AO 0 and AO 1 output voltages (AO 0/AO 1) for each test frequency, AO Attenuation, and Output Terminal Configuration.
2. Compare the results with the Min and Max limits in Table 14.

Table 14. AO Interchannel Gain Mismatch Limits

Min Test Limit (V_{rms}/V_{rms})	Max Test Limit (V_{rms}/V_{rms})
0.996552	1.00346

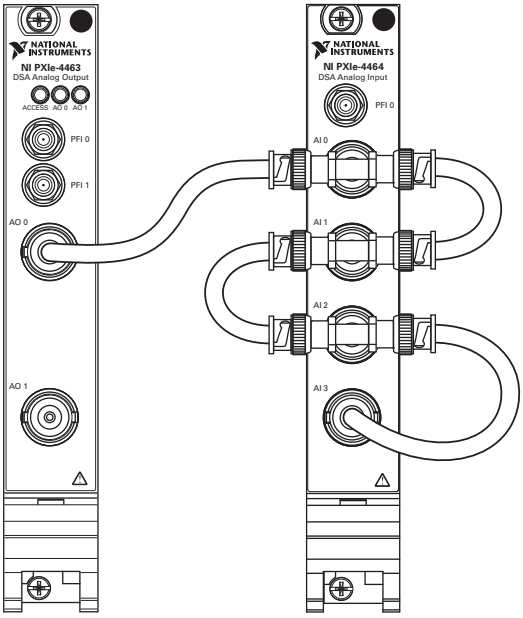
Note Test limits are the same for all frequencies and AO configurations.

AO Noise Verification

Complete the following procedure to verify AO noise.

1. Connect channel AO 0 to all four NI PXIe-4464 inputs using the cables recommended in Table 1. Use tee connectors to split the signal as shown in Figure 1.

Figure 1. AO Noise Verification Setup



2. Generate a voltage with the NI PXIe-4463:
   a. Configure an AO voltage channel task using the values in Table 15.

Table 15. AO Setup

Configuration	Value
Physical Channels	*Dev_name*/ao0
AO Gain	0 dB
Output Terminal Configuration	Differential
Rate	51200 S/s
Sample Mode	Continuous Sample
Samples Per Channel	512

b. Create an array of 512 points, and fill every element with value 0.

c. Write the array to AO, and start the task.

3. Measure the noise with the NI PXIe-4464:

a. Configure an AI voltage channel task for the NI PXIe-4464 using the values in Table 16.

Table 16. AI Setup

Configuration	Value
Physical Channels	*Dev_name*/ai0:3
AI Gain	30 dB
Terminal Configuration	Differential
Excitation (IEPE)	0 A
Rate	49340 S/s
Sample Mode	Finite Number of Samples
Samples Per Channel	2467

b. Start acquisition, and read data arrays for each input channel.

c. Average the four input channels (add the arrays element by element, and divide by 4).

d. Call `Standard Deviation and Variance`, and enter the previously computed array. Obtain the noise as standard deviation output.

4. Stop all previously started tasks.

5. Repeat steps 2 to 4 for AO Attenuation of 17 dB and 37 dB.

6. Repeat steps 2 to 5 for pseudodifferential output terminal configuration.

7. Repeat steps 1 to 6 for AO 1.

8. Compare the results with the limits in Table 17.

Table 17. AO Noise Verification Limits

Output Terminal Configuration	AO Attenuation (dB)	Noise Limits (Max) (μV_{rms})
Differential	0	11.22
	17	2.79
	37	1.93
Pseudodifferential	0	11.42
	17	3.18
	37	2.60

Note AO Noise Verification limits were obtained by root sum-of-squares (RSS), adding the NI PXIe-4463 output noise with the input noise of four averaged inputs from the NI PXIe-4464. The noise of four averaged identical analog inputs is half the noise of one analog input (1.4 $\mu V_{rms}/2 = 0.7\ \mu V_{rms}$).

AO Current Drive Verification

Complete the following procedure to verify the AO current drive.

1. Connect channel AO 0 of the NI PXIe-4463 to the DMM current measurement ports using the cables recommended in Table 1.
2. Configure the DMM using the information in Table 18.

Table 18. DMM Configuration

Configuration	Value
Function	AC Current (ACI)
Range	0.1 A
Number of Power Line Cycles (NPLC)	100

3. Generate a waveform with NI PXIe-4463:
   a. Configure an AO voltage channel task using the values in Table 19.

Table 19. AO Setup

Configuration	Value
Physical Channels	*Dev_name*/ao0
AO Gain	0 dB
Output Terminal Configuration	Pseudodifferential
Rate	51200 S/s
Sample Mode	Continuous Sample
Samples Per Channel	512

b. Call `Basic Function Generator` using the parameters in Table 20.

Table 20. Basic Function Generator Parameters

Parameter	Value
Signal Type	Sine Wave
Frequency	100 Hz
Amplitude	4.5 V
Sampling Info»Sampling Rate	51200 S/s
Sampling Info»Number of Samples	512

c. Write the resulting waveform to AO, and start the task.

4. Measure the output current with the DMM.
5. Stop the task.
6. Repeat steps 1 to 5 for AO 1.
7. Compare the results with the following test limit (min):

   output current ≥ 70.71 mA_{rms}

Timebase Frequency Accuracy Verification

Note Both analog outputs on a single device use the same timebase circuitry. Therefore, the measurements made on one channel are valid for both channels.

Complete the following procedure to verify the timebase frequency accuracy.

1. Connect channel AO 0 of the NI PXIe-4463 to the frequency counter using the cables recommended in Table 1.
2. Configure the frequency counter using the values in Table 21.

Table 21. Frequency Counter Setup

Configuration	Value
Function	Frequency
Impedance	1 MΩ
Range	50 V
Coupling	AC
Bandwidth Limit	100 kHz
Trigger Source	Internal
Gate Time	0.5 s

3. Generate a waveform with NI PXIe-4463:
   a. Configure an AO voltage channel task using the values in Table 22.

Table 22. AO Setup

Configuration	Value
Physical Channels	*Dev_name*/ao0
AO Gain	0 dB
Output Terminal Configuration	Differential
Rate	51200 S/s
Sample Mode	Continuous Sample
Samples Per Channel	500

   b. Call `Basic Function Generator` using the parameters in Table 23.

Table 23. Basic Function Generator Parameters

Parameter	Value
Signal Type	Sine Wave
Frequency	20480 Hz
Amplitude	10 V
Sampling Info»Sampling Rate	51200 S/s
Sampling Info»Number of Samples	500

   c. Write the resulting waveform to AO, and start the task.
4. Measure the signal with the frequency counter, and compare the results with the limits in Table 24.

Table 24. Timebase Frequency Verification Test Limits

Programmed Frequency (Hz)	As Found Test Limit		As Left Test Limit	
	Min (Hz)	Max (Hz)	Min (Hz)	Max (Hz)
20480	20479.556	20480.444	20479.662	20480.338

5. Stop the task.

Adjustment

An adjustment is required at least once every two years to warrant the published specifications for the next calibration interval. An adjustment is recommended even if the NI PXIe-4463 successfully passed each of the verification procedures within the As Left test limits *without adjustment*. Performing an adjustment procedure improves the device accuracy and resets the calibration interval.

Upon successful completion of an adjustment procedure, the calibration constants, date, and temperature in the device EEPROM are automatically updated.

To update the calibration date without performing adjustment, refer to the instructions in the *EEPROM Update* section.

The following procedures describe the sequence of operation required to adjust the NI PXIe-4463.

AO Offset and Gain Adjustment

Complete the following procedure to adjust the offset and gain performance of the NI PXIe-4463.

Note Set the polymorphic selector to `4463` for all polymorphic VIs used in the Offset and Gain Adjustment procedure.

1. Connect channel AO 0 of the NI PXIe-4463 to the DMM using the cables recommended in Table 1.
2. Configure the DMM using the parameters in Table 25.

Table 25. DMM Configuration

Parameter	Value
Function	DC volts (DCV)
Autorange	ON
Number of Power Line Cycles (NPLC)	100

3. Call `DAQmx Initialize External Calibration` (DAQmxInitExtCal) with the following parameters:

   deviceName: *`Dev_name`*

   password: `NI` (default)

   Use the *calhandle out* from this function to reference the current session.

4. Generate and measure each adjustment point for AO.
   a. Call `DAQmx Get DSA Calibration Adjustment Points Polymorphic` (DAQmxGet4463CalAdjustPoints) with gain set to 0 dB and differential terminal configuration. This will return an array of three calibration points.
   b. Call `DAQmx Setup DSA Calibration Polymorphic` (DAQmxSetup4463Cal) with the same parameters as before, and use the first adjustment point as output voltage.
   c. Measure the output voltage with the DMM.
   d. Enter the measured value into the `DAQmx Adjust DSA Calibration Polymorphic` (DAQmxAdjust4463Cal).
   e. Repeat steps b to d for the remaining adjustment points.
   f. Repeat steps a to e for AO Gain of -17 dB and -37 dB.
   g. Repeat steps a to f for pseudodifferential terminal configuration.
5. Repeat step 4 for channel AO 1.
6. Call `DAQmx Close External Calibration` (DAQmxCloseExtCal) to close the session.

   Use the action `cancel` if there has been any error during the calibration or if you do not want to save the new calibration constants in the device EEPROM.

   Use the action `commit` if you want to save the new calibration constants in the device EEPROM.

Timebase Adjustment

Complete the following procedure to adjust the timebase frequency of the NI PXIe-4463.

Note Set the polymorphic selector to `4463` for all polymorphic VIs used in the Timebase Adjustment procedure.

1. Connect channel AO 0 of the NI PXIe-4463 to the frequency counter using the cables recommended in Table 1.
2. Configure the frequency counter using the values in Table 21.
3. Call `DAQmx Initialize External Calibration` (DAQmxInitExtCal) with the following parameters:

   deviceName: *`Dev_name`*

   password: `NI` (default)

   Use the *calhandle out* from this function to reference the current calibration session.
4. Perform the following iterative timebase adjustment procedure:
   a. Call `DAQmx Setup DSA Calibration Polymorphic` (DAQmxSetupDSAAOTimebaseCal) to generate the test frequency.
   b. Measure the output frequency with the frequency counter.

c. Enter the measured frequency into the `DAQmx Adjust DSA Calibration Polymorphic` (DAQmxAdjustDSAAOTimebaseCal).

d. Repeat steps a to c until the calibration complete indicator returns TRUE.

5. Call `DAQmx Close External Calibration` (DAQmxCloseExtCal) to close the session.

   Use the action `cancel` if there has been any error during the calibration or if you do not want to save the new calibration constants in the device EEPROM.

   Use the action `commit` if you want to save the new calibration constants in the device EEPROM.

EEPROM Update

Upon successful completion of an adjustment procedure, the calibration constants, date, and temperature in the device EEPROM are automatically updated.

You can update the calibration date and onboard calibration temperature without making any adjustments by initializing an external calibration and closing the external calibration.

Reverification

After completing the adjustment procedure, repeat the *Verification* section for performance characteristics that are affected by adjustment. Characteristics affected by adjustment have As Found limits for verification *before adjustment* and As Left limits for verification *after adjustment*.

Note If any test fails reverification, confirm that you have met the *Test Conditions* before returning your device to NI. Refer to *Worldwide Support and Services* for assistance in returning the device to NI.

Worldwide Support and Services

The National Instruments website 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.

Visit `ni.com/services` for NI Factory Installation Services, repairs, extended warranty, and other services.

Visit `ni.com/register` to register your National Instruments product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

A Declaration of Conformity (DoC) is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting `ni.com/certification`. If your product supports calibration, you can obtain the calibration certificate for your product at `ni.com/calibration`.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world. For telephone support in the United States, create your service request at ni.com/support or dial 1 866 ASK MYNI (275 6964). For telephone support outside the United States, visit the Worldwide Offices section of ni.com/niglobal to access the branch office websites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

375095B-01 Feb16