

CALIBRATION PROCEDURE

PXIe-1092

PXI Chassis

This document contains the verification and adjustment procedures for the National Instruments PXIe-1092 chassis. Refer to ni.com/calibration for more information about calibration solutions.

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Software

Calibrating the PXIe-1092 requires installing the following software on the calibration system:

- PXI Platform Services 18.1 or later

You can download PXI Platform Services from ni.com/downloads.

PXI Platform Services supports programming the calibration procedures using several application development environments (ADEs), including LabVIEW, LabWindows™/CVI™, and Microsoft Visual C++. When you install PXI Platform Services, you need to install support for only the ADE that you intend to use.

Documentation

You might find the following documents helpful as you perform the calibration procedure:

- *PXIe-1092 User Manual*
- *PXIe-1092 Specifications*

The latest versions of these documents are available on ni.com/manuals.

Test Equipment

The following table lists the equipment NI recommends for the performance verification and adjustment procedures. If the recommended equipment is not available, select a substitute using the minimum requirements listed in the table.

Table 1. Recommended Test Equipment

| Equipment | Recommended Models | Minimum Requirements |
|---------------------|--------------------|---|
| Frequency Reference | Symmetricom 8040C | Output Frequency: 10 MHz Accuracy: $\leq 1 \times 10^{-10}$ |
| Frequency Counter | Keysight 53220A | Frequency Range: >10 MHz Frequency Resolution: ≤ 0.001 Hz at 10 MHz |
| BNC-BNC Cable | — | — |
| BNC-SMA Cable | — | — |

Test Conditions

Review and become familiar with the entire procedure before beginning the calibration process.

The following setup and environmental conditions are required to ensure the PXIe-1092 chassis meets published specifications.

- Keep cabling as short as possible. Long cables and wires act as antennae, picking up extra noise that can affect measurements.
- Verify that all connections, including front panel connections and screws, are secure.
- Maintain an ambient temperature of $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.
- Keep relative humidity below 80%.
- Ensure that the PXIe-1092 chassis has been continuously powered for at least 24 hours prior to calibration to allow the 10 MHz oscillator frequency to stabilize.
- Ensure that the Frequency Reference has been continuously powered as specified by its manual for its accuracy to meet the minimum requirements specified in Table 1.

Initial Setup

Refer to the *PXIe-1092 User Manual* for information about how to install the software and hardware and how to configure the device in Measurement & Automation Explorer (MAX).

Verification

The performance verification procedure assumes that adequate traceable uncertainties are available for the calibration references.

Complete the following procedure to determine the PXIe-1092 chassis as-found status.

Verifying OCXO Frequency Accuracy

1. Connect the 10 MHz Ref Out SMA on the rear of the PXIe-1092 chassis to Channel 1 of the Frequency Counter.
2. Configure the Frequency Reference to output a 10 MHz sine wave on one of its output channels. Connect this channel to the Ext Ref In port of the Frequency Counter.
3. Configure the Frequency Counter to use the Ext Ref In port as the reference oscillator source and to use Channel 1 as its input source. Set the Frequency Counter gate time to 3 seconds.
4. Measure the OCXO frequency using the Frequency Counter.
5. Compare the measured frequency to the device specifications.

To determine whether the device under test meets its specifications, you must compare the measured frequency with the published specifications. Table 2 shows the frequency range that is acceptable according to the PXIe-1092 chassis published specifications.

Table 2. One Year Test Limits

| Device | Specified Accuracy Within 1 Year of Calibration | Acceptable Frequency Range — As Found | |
|-----------|--|---------------------------------------|------------------|
| | | Low Limit | High Limit |
| PXIe-1092 | $\pm 80 \times 10^{-9}$ | 9,999,999.20 Hz | 10,000,000.80 Hz |

If the measured value is within the low-limit and high-limit range listed in Table 2, the chassis is operating in specification but requires adjustment to be considered calibrated. If the measured value is outside the range listed in Table 2, the chassis is operating out of specification.

To determine if the device under test is already calibrated, you must compare the measured frequency with the ranges listed in Table 3.

Table 3. Adjustment Target Frequency Ranges (As-Left Limits)

| Device | Calibration Measurement Accuracy | Acceptable Frequency Range — As Left | |
|-----------|----------------------------------|--------------------------------------|------------------|
| | | Low Limit | High Limit |
| PXIe-1092 | $\pm 1 \times 10^{-9}$ | 9,999,999.99 Hz | 10,000,000.01 Hz |

If the measured value is within the low-limit and high-limit range listed in Table 3, no adjustment is needed.



Note Test limits in Table 2 are based on the PXIe-1092 specifications. Refer to the most recent PXIe-1092 specifications online at ni.com/manuals.

Adjustment

Adjusting OCXO Frequency Accuracy

If the OCXO frequency accuracy is outside the specified range for the product, the device is out of calibration.

A programmable voltage controls the OCXO frequency. By using the NI System Configuration API to vary this voltage and precisely measure the frequency, you can find a voltage that gives a frequency as close as possible to 10 MHz.



Note You can use a binary search algorithm to find the optimal oscillator control voltage. The PXIe-1092 uses a 16-bit digital-to-analog convertor (DAC) to create the oscillator control voltage; therefore, you need 16 (at most) iterations of adjustment and measurement to calibrate the 10 MHz oscillator.

Complete the following procedure to adjust the PXIe-1092 chassis OCXO frequency accuracy:

1. Get a resource handle for the PXIe-1092 to calibrate using the System Configuration API.
 - a. Call `Initialize Session` to set up a new session.
 - b. Call `Create Filter` to create a new filter for searching for devices. Set the **IsChassis** and **IsNI** attributes of the filter to `TRUE`.
 - c. Find the chassis resource name of the PXIe-1092 to calibrate using `Measurement & Automation Explorer (MAX)` and set the **Alias** attribute of the filter to match the chassis resource name.
 - d. Call `Find Hardware` using the filter created in the previous steps. Set the **Experts** parameter of this function to `ni-pxi`. This function returns an array with exactly

one element: the resource handle to the chassis. Check your filter settings if the resource handle only is not returned.

2. Initialize the calibration process.
 - a. Using the resource handle obtained with Find Hardware, set the **CalPasswd** property to the current calibration password for the chassis.



Note NI is the default calibration password.

- b. Using the same resource handle, set the **CalExtAction** property to OCXO Start.
 - c. Also using the same resource handle, call Save Changes to commit these changes to hardware.



Note To complete this step, LabVIEW must be running as an elevated process with administrator rights. Otherwise, you will encounter error -2147220611: The current user does not have permission for the requested operation.

3. Write a new value for the oscillator DAC value. The range of oscillator control voltage values is 0 to 65535, with frequency increasing as the value increases. Use a DAC value of 32768, which is in the middle of the valid range, as a starting point.
 - a. Using the same resource handle, set the **DacValue** property to the new DAC value.
 - b. Call Save Changes to commit these changes to hardware.
 - c. Allow a wait time of 5 seconds after changing the DAC value.
 4. Measure the OCXO frequency following the steps in [Verifying the OCXO Frequency Accuracy](#).
 5. Compare the measured frequency to the target frequency and repeat steps 3 and 4, adjusting the oscillator DAC value up to increase the frequency and down to decrease the frequency.



Note NI recommends that you implement a binary search to determine the optimal DAC value. This requires going through 16 iterations, with confirmation that the final DAC value measured crosses over the target frequency when the DAC value is changed by 1 bit.

6. Compare the final measured frequency to the specified limits in Table 3 to confirm adjustment completed successfully.

7. If adjustment was successful, commit the calibration values to device memory. If adjustment was unsuccessful, cancel the external adjustment action; the chassis may be in need of repair.
 - a. Using the resource handle obtained in step 1d, set the **CalExtAction** property to Commit (or Cancel if adjustment was unsuccessful).
 - b. Call Save Changes to commit these changes to hardware.
8. Update the External Calibration Date and External Calibration Due Dates by calling the System Configuration function **Update Calibration**. This VI uses the hardware resource handle opened in step 1d.



Note Calling the **CalExtAction** property with **Commit** updates the External Calibration Date, but not the External Calibration Due Date. Calling the **CalExtAction** property with **Cancel** updates neither.

Reverification

Repeat the *Verification* section to determine the device as-left status. If the measured value is within the low-limit and high-limit range listed in Table 3, the chassis is considered to be calibrated, and no further adjustment is needed.



Note If any test fails reverification after performing an adjustment, verify that you have met the *Test Conditions* before returning your device to NI. Refer to *Where to Go for Support* for information about support resources or service requests.

Where to Go for Support

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.

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 websites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

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