CALIBRATION PROCEDURE

PXI-6683 Calibration Procedure

This document contains the verification and adjustment procedures for the PXI-6683 Series.
Refer to *ni.com/calibration* for more information about calibration solutions.

Required Software

Calibrating the PXI-6683 Series requires you to install the following software on the
calibration system:

• NI-Sync 17.0 or later.

You can download all required software from *ni.com/downloads*.

Related Documentation

For additional information, refer to the following documents as you perform the calibration
procedure:

• PXI-6683 Series Installation Guide
• PXI-6683 Series User Manual

Visit *ni.com/manuals* for the latest versions of these documents.

Test Equipment

The following is required equipment for the external calibration verification or adjustment of
PXI-6683 Series boards:

Equipment	Recommended Model(s)	Where Used	Minimum Requirements
Reference Clock	• Symmetricon 8040C Rubidium Frequency Standard • PXIe-6674T	Verification Adjustment	• Accuracy: 100 ppb or better • Frequency: 10 MHz

PXI or PXI Express Chassis	• PXI-6683
	  – PXIe-1065
	  – PXI-1045
	  – Any chassis with an available PXI slot.
	• PXI-6683H
	  – PXIe-1065
	  – PXIe-1085
	  – Any chassis with an available PXI slot or PXI Express hybrid slot.
		Verification
		
		Adjustment
			• An available slot for a PXI-6683 Series board.
			  – PXI-6683H boards can be installed in a full PXI slot or a PXI Express hybrid slot.
			  – PXI-6683 Series boards require a full PXI slot.
			• The chassis must be able to lock its PXI_CLK10 to the 10 MHz calibration reference clock. Refer to the PXI chassis user manual for more information.

Test Conditions

The following setup and environmental conditions are required to ensure the PXI-6683 Series board meets published specifications.

- The 10 MHz reference clock for calibration must be present at PXI_CLK10 in the chassis being used. You can do this with one of the following methods:
    - Connect the 10 MHz reference signal directly to the 10 MHz Reference IN connector of the chassis.
    - Configure the timing and synchronization board in the timing slot of the chassis to route its CLKIN input to PXI_CLK10_IN.
    - Use the timing and synchronization board being calibrated to route the 10 MHz reference clock to PXI_CLK10_IN.
- Externally connect the ClkOut terminal of the PXI-6683 Series board to the PFI0 terminal.
- 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 ambient temperature of 23 °C ± 3 °C.

> **Note** Do not use the device and calibration temperature reported by MAX. The device and calibration temperature reported by MAX are the internal temperature readings of the FPGA, not the ambient temperature.

- Keep relative humidity between 10% and 90% non-condensing.

- Allow at least 15 minutes of warm-up time for the PXI-6683 Series board being calibrated.
- Allow the device providing the 10 MHz reference clock the appropriate amount of warm-up time.
  – Refer to the user manual for the device to determine the warm-up time necessary to achieve required accuracy.

Password

The default password for password-protected operations is `NI`.

Calibration Interval

National Instruments recommends a calibration interval of one year for the PXI-6683 Series boards. Adjust the recommended calibration interval based on the measurement accuracy demands of your application.

PXI-6683 Series Calibration Overview

Install the device and configure it in Measurement & Automation Explorer (MAX).

The calibration process for PXI-6683 Series boards includes the following steps:

1. Verification—Verify the existing operation of the device. This step confirms whether the device is operating within the published specifications prior to adjustment.
2. Adjustment—Adjust the calibration constants of the device. The adjustment procedure automatically stores the calibration date on the EEPROM.
3. Reverification—Repeat the verification procedure to ensure that the device is operating within the published specifications after adjustment.

Verification

The performance verification procedures assume that adequate traceable uncertainties are available for the calibration references.

Verification and Measuring the Frequency

1. Initialize the PXI-6683 Series board. Set **reset device** to `True`.

   Note If the PXI-6683 Series board to be calibrated is being used to route the 10 MHz reference signal to PXI_CLK10_IN, connect CLKIN to PXI_CLK10_IN.

2. Set the time reference to Free Running.
3. Using Connect Clock Terminals, route PXI_Clk10 to BoardClk and Oscillator to ClkOut.
4. Use Measure Frequency and set the parameters in Table 1:

Table 1. Measure Frequency Parameters

Parameter	Value
decimation count	1,000,000
duration	10 seconds
source terminal	PFI0

5. Close the connection to the PXI-6683 Series board.

Comparing the Frequency

To determine if the device under test meets its specifications, you must compare the measured frequency with the specified accuracy. The following tables show the frequency range that is acceptable according to the published specifications for PXI-6683 Series boards.

Table 2. One Year Test Limits

Device	Specified Accuracy Within 1 Year of Calibration	Acceptable Frequency Range—As Found	
		Low Limit	**High Limit**
PXI-6683 Series	± 3.5 ppm	9,999,965 Hz	10,000,035 Hz

Table 3. Adjustment Target Frequency Range

Device	Calibration Measurement Accuracy	Calibration Measurement Target Frequency Range—As Left	
		Low Limit	**High Limit**
PXI-6683 Series	100 ppb	9,999,999 Hz	10,000,001 Hz

Note
- If the measured frequency is within the range in Table 3, you do not need to search for a new oscillator voltage. Read the current oscillator voltage from the Calibration EEPROM using Get Oscillator Voltage. Use this voltage value and skip to Step 4 of *Adjustment*. This will keep the same value for the oscillator voltage, but update the calibration date.
- If the accuracy of the 10 MHz oscillator is outside the specified range for the product, the device is out of calibration. A programmable voltage controls the oscillator frequency. By varying this voltage and precisely measuring the frequency, you can find a voltage that gives a frequency as close as possible to 10 MHz.

Adjustment

This section describes the steps needed to adjust the PXI-6683 Series to meet published specifications.

PXI-6683 Series Adjustment Procedure

A binary search algorithm may be used to find the optimal oscillator control voltage. PXI-6683 Series boards use a 21-bit digital to analog converter (DAC) to create the oscillator control voltage, therefore at most 21 iterations of adjusting and measuring would be needed to calibrate the 10 MHz oscillator.

1. Set the oscillator control voltage. The acceptable voltage range is 0.6 V to 3 V with frequency increasing as voltage increases. Use a control voltage of 1.8 V, which is in the middle of the valid range, as a starting point.
   a) Initialize the device.
   b) Use the **Oscillator Voltage** property to set the oscillator voltage to 1.8 V.
   c) Close the connection to the PXI-6683 Series board.
2. After setting the control voltage, measure the frequency again as described in *Verification and Measuring the Frequency*.
3. If the measured frequency falls within the frequency range specified in Table 3, go to Step 4. Otherwise, repeat the first two steps of this section until the measured value falls within this range. Adjust the oscillator control voltage up to increase the frequency or down to decrease the frequency. If (measured frequency - 10 MHz) is greater than 0, the voltage needs to decrease; if (measured frequency - 10 MHz) is less than 0, the voltage needs to increase.
4. Commit the calibration values to the Calibration EEPROM.

Reverification

Repeat the *Verification* section to determine the as-left status of the PXI-6683 Series.

📝 **Note** If any test fails reverification after performing an adjustment, verify that you have met the test conditions before returning your PXI-6683 Series to NI. Refer to the *Worldwide Support and Services* section for information about support resources or service requests.

Worldwide Support and Services

The NI 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 NI 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*.

NI corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. NI 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.

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit *ni.com/certification*, search by model number or product line, and click the appropriate link in the Certification column.