

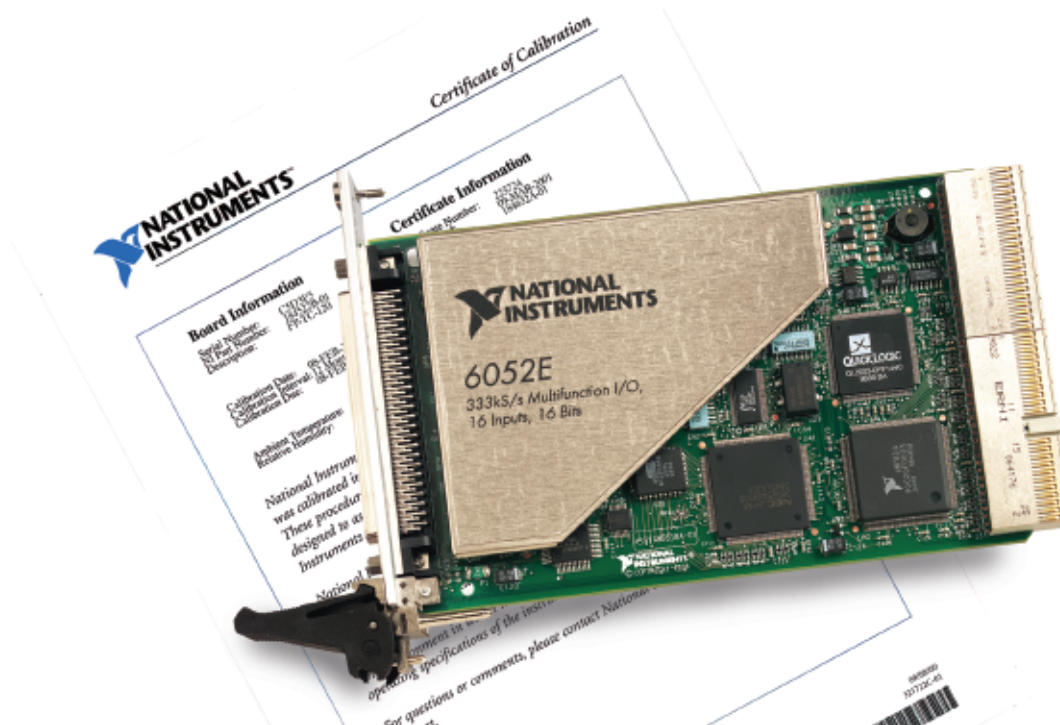


# Calibration

**Maintaining Accurate Measurements  
with NI Products**

- Calibration Services
- Calibration Software  
for Metrology Laboratories

# Calibration Overview



Calibration is the comparison of an instrument's actual measurement performance to a standard of known accuracy. Calibration performed on an instrument can document the deviation of a measurement from the known standard, or it can include adjusting the instrument's measurement capability to improve measurement accuracy. International committees define standards for calibration such as ISO Guide 17025.

The most basic requirement of a calibration is proof of traceability. Traceability is defined as an unbroken chain of comparisons, all having stated uncertainties, between your measurement and some national or internationally accepted standard.

The benefits of purchasing calibrated, computer-based data acquisition and instrumentation hardware and maintaining it by performing periodic external recalibration include:

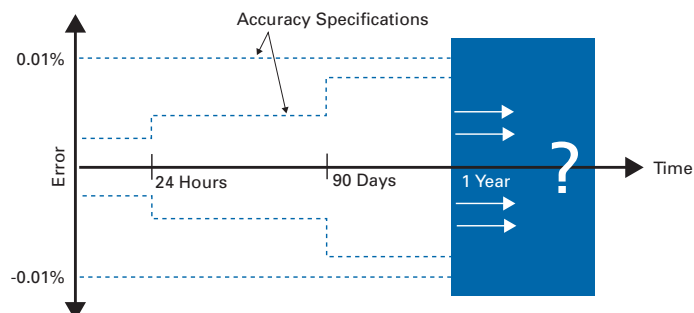
- Assurance of accurate measurements
- Ability to trace your measurements back to a known and accepted standard
- Acceptance of your measurements among countries
- Increases in production yields
- The meeting of requirements of quality programs such as ISO-9001

## Improving Measurement Accuracy Recommended Calibration Intervals

The accuracy of the electronic components used in all instruments drifts over time. The effects of time in service as well as environmental conditions add to this drift. At some point, the drift causes the instrument's uncertainty to become undefined, meaning the manufacturer no longer can predict the uncertainty and guarantee measurement results. When this happens, you should return the instrument for calibration.

For most computer-based data acquisition and instrumentation hardware, NI supplies graduated accuracy tables, so you gain a better uncertainty profile for the life of your measurement device. NI recommends regular calibration of your hardware<sup>1</sup> to ensure the best measurement accuracy.

<sup>1</sup>Check the documentation of your product for recommended calibration intervals.



# Calibration Overview

## External Calibration

When an instrument's time in service reaches its specified calibration interval, you should return it to the manufacturer or a suitable metrology laboratory for calibration service. Metrologists compare the instrument's measurements to external standards of known accuracy. If the results of the measurements do not fall within certain specifications, metrologists make adjustments to the measurement circuitry. In general, the act of external calibration includes:

1. Evaluation of the instrument's capabilities to determine if it operates within specifications
2. Adjustments to measurement circuitry and onboard signal references if the instrument does not operate within specifications
3. Reverification of the instrument to ensure that it operates within specifications
4. Issuance of a calibration certificate, stating that the instrument measures within specifications when compared to a traceable standard

Routine performance of external calibration ensures your measurement accuracy.

## Self-Calibration

Self-calibration, also known as internal calibration, is a method whereby an instrument uses onboard signal references instead of external references to adjust measurement accuracy. During self-calibration, the instrument measures the onboard references and adjusts its measurement capabilities to account for changes in accuracy due to environmental effects such as temperature.

Self-calibration does not replace external calibration. You must perform external calibration to quantify the references so you can use them during self-calibration. Self-calibration and external calibration tools work together to ensure the measurement accuracy of your instruments.

NI measurement products contain highly stable signal references to maintain traceability and facilitate self-calibration. Through simple software function calls, you can self-calibrate your instruments to ensure top measurement performance.

## System Calibration

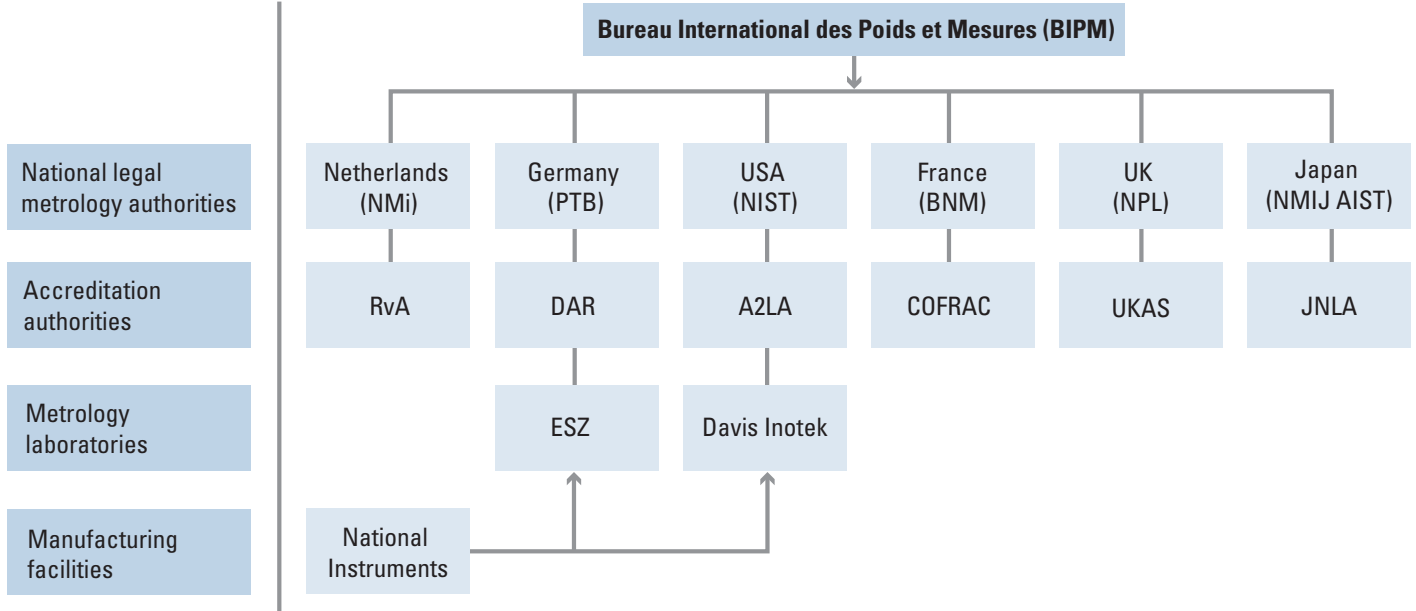
The goal of system calibration is to quantify and compensate for the total measurement error in your system. Cable losses, conditioning, and sensor errors may induce measurement error. By applying known inputs to your system and reviewing the resulting measurement, you develop a model that represents the error in your system.

This model could be as simple as a lookup table of input versus output values, or as detailed as a polynomial. Once you develop your error model, you can apply it to all measurements made by your system.

Computer-based data acquisition and instrumentation hardware is ideal for this type of compensation because, unlike traditional box instruments, with computer-based hardware, you create the software application that defines your measurement functionality. In this way, you can easily add error compensation and automate system calibration in your application software.



# Traceability



The most basic requirement of a calibration is proof of traceability. Traceability is defined as an unbroken chain of comparisons, all having stated uncertainties, between your measurement and some national or international standard. Because standards maintained by national and international bodies are well quantified and maintained, the ability to demonstrate an unbroken chain of comparisons between your measurements and these standards provides advantages such as:

- Ability to trace your measurement uncertainty back to a known and accepted standard
- Acceptance of your instrument's measurement capabilities between countries
- Ability to determine the maximum uncertainty associated with your measurements

Traceability is defined at a number of levels. At the top level, the BIPM ensures worldwide uniformity of measurements and their traceability to the International System of Units (SI). It does this with the authority of the Convention of the Metre, a diplomatic treaty among 51 nations. The BIPM also takes part in, and organizes, international comparisons of national measurement standards, and carries out calibrations for member states.

At the national level, different legal metrology authorities exist for each country. These bodies follow the guidelines defined by the BIPM and its associated committees to provide quality measurement standards for their associated country. The National Metrology Institutes (NMI) of each member state of the Convention of the Metre also participates in the Mutual Recognition Agreement (MRA). This document provides, among other things, a mutual recognition of calibration and measurement certificates issued by NMI.

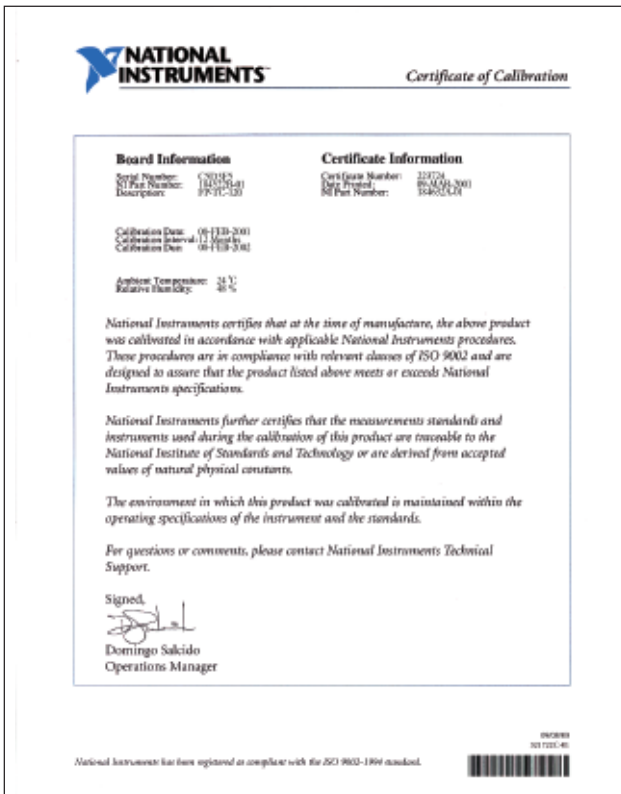
Finally, each country maintains accreditation institutes whose job is to audit and accredit local metrology. In Europe, many of these accreditation institutes participate in the EA Multilateral Agreement (MLA) to ensure that accreditations in one country are acceptable in others.

Find detailed information on these agreements and accreditations at [www.bipm.org](http://www.bipm.org).

NI products calibrated at the time of manufacture are traceable to international standards such as the National Institute of Standards and Technologies (NIST). This ensures that calibrations performed in one country are accepted in all countries.

# Calibration of NI Hardware

National Instruments computer-based data acquisition and instrumentation hardware is calibrated at the factory to ensure measurement accuracy and to verify that the devices meet their published specifications. During factory calibration, internationally accepted standards ensure proper traceability. NI also provides a certificate of calibration recognized in all countries as documented proof that the hardware meets published specifications. You can recalibrate NI measurement products to factory specifications.



NI provides a Basic Calibration certificate with all NI measurement hardware. NI offers Detailed Calibration certificates at the time you purchase your measurement hardware. You also can take advantage of Detailed and Basic Calibration certificates by returning your product to NI for recalibration. Maintaining up-to-date calibration certificates provides documentation that gives:

- Proof of calibration for quality audits
- Traceability of your measurements to internationally accepted standards
- Detailed measurement data proving your product meets its measurement specifications
- Proof that calibration was performed in accordance with quality standards

## Calibration Certificates

Calibration certificates are documented proof that your specific measurement hardware meets its published specifications. A calibration certificate must at a minimum identify the measurement device calibrated, provide proof of traceability, cover environmental conditions (temperature and humidity) and date of calibration, and show that the calibration conforms to a quality standard. Calibration certificates also can list detailed information such as the actual measurement data or uncertainty calculations and can conform to internationally accepted standards.

| Features   | Basic Calibration Certificate | Detailed Calibration Certificate |
|--|-------------------------------|----------------------------------|
| Identity of device including   | ✓                             | ✓                                |
| – Date of calibration  |                               |                                  |
| – Proof of traceability to a national standard                                       |                               |                                  |
| – Environmental conditions   |                               |                                  |
| Detailed measurement data  | –                             | ✓                                |
| FREE with product purchase   | ✓                             | –                                |
| Available in soft copy at <a href="http://ni.com/calibration">ni.com/calibration</a> | ✓                             | –                                |
| Available at time of order of measurement device                                     | –                             | ✓                                |
| Available as service by returning product to NI for recalibration                    | ✓                             | ✓                                |

# Calibration Services



As a manufacturer of high-accuracy measurement products, National Instruments understands the need to maintain properly calibrated equipment.

NI recommends that you calibrate your measurement hardware according to the device's published calibration interval.

To help meet your calibration needs, NI provides calibration support and services. These services include manual calibration procedures, services to recalibrate your products, and automated calibration software specifically designed for use by metrology laboratories.

## Basic Calibration Service

NI provides a FREE Basic Calibration certificate with all new measurement products. This certificate states that the product is calibrated, meets NI ISO 9001 quality requirements, and is traceable to internationally accepted standards. Should you require your calibration certificate, simply visit [ni.com/calibration](http://ni.com/calibration).

## Detailed Calibration Service

If your quality requirements state that you need more than a Basic Calibration certificate, NI meets your needs with Detailed Calibration service. Through partnerships with Davis Inotek in the Americas and ESZ in Europe, NI provides certificates that contain detailed measurement data and can meet the requirements of internationally accepted quality standards (such as ISO Guide 17025). You can order Detailed Calibration service at the time of purchase.

## Recalibration of Existing Products

You can return your products to NI for either Basic or Detailed recalibration.

## Ordering Information

Contact National Instruments to obtain a calibration Returned Merchandise Authorization (RMA) number. Please specify the type of calibration service when you order. For calibration service pricing and part numbers, visit [ni.com/calibration](http://ni.com/calibration).

## Calibration Services Partners

Through independent calibration services partners, NI can provide you with additional calibration services such as express calibration services, on-site calibration services, and calibration services for non-NI instrumentation products. For information in addition to the calibration services partners listed below, visit [ni.com/calibration](http://ni.com/calibration).

### Americas and Asia

#### Davis Inotek

8107 Springdale Rd.

Suite 106

Austin, TX 78724

USA

Tel: (800) 365-0147, (512) 926-7625

e-mail: [vpena@davisinotek.com](mailto:vpena@davisinotek.com)

<http://www.daviscalibrationlab.com>



### Europe

#### esz Elektronik-Service GmbH

Max-Planck-str. 16

D-82223 Eichenau

Germany

Tel: +49-8141-88887-0

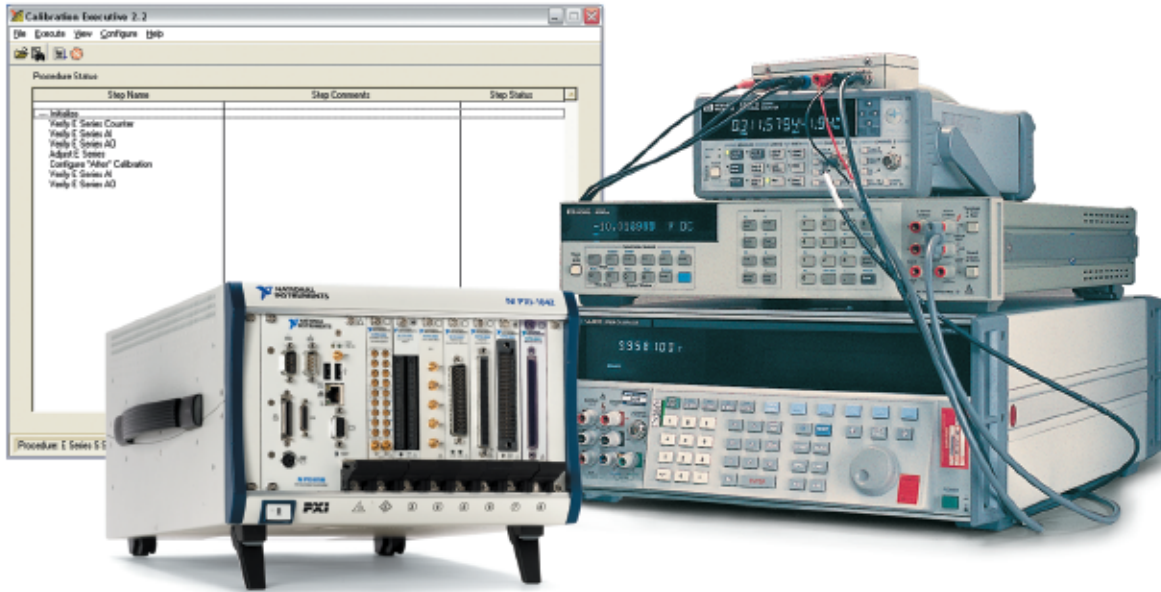
Fax: +49-8141-88887-77

e-mail: [info@esz-gmbh.de](mailto:info@esz-gmbh.de)

<http://www.esz-gmbh.de>



# Calibration Software Support for Metrology Laboratories



To support the more advanced user and metrology laboratories, NI provides access to manual calibration procedures at [ni.com/calibration](http://ni.com/calibration). Manual calibration procedures offer detailed step-by-step instruction on how to verify and adjust NI products during a calibration. These documents also define calibration standards, software functions, and test specifications used during the calibration.

For users and laboratories that do not have the time or expertise to develop their own calibration software, NI provides a turnkey calibration application – National Instruments Calibration Executive.

## NI Calibration Executive

Manual calibration can prove to be time-consuming and costly. The National Instruments Calibration Executive, developed primarily for metrology laboratories, automates the verification and adjustment of your NI products. By using Calibration Executive, you easily can automate your calibration operations and benefit from NI technology such as NI-VISA, Interchangeable Virtual Instruments (IVI), and NI TestStand.

## Features

- Externally calibrates most NI measurement devices
- Operates in automatic or manual mode through an intuitive user interface
- Automatically configures and controls calibration instruments
- Stores calibration reports in ODBC-compliant database
- Provides convenient connections through hardware calibration fixtures

## Engine and Procedures

The Calibration Executive engine provides the core execution, control, and reporting functionality. Each procedure includes the calibration routines and automation for a specific measurement family. Visit [ni.com/calibration](http://ni.com/calibration) for the list of available calibration procedures and supported standards.

## System Requirements

- Pentium 600 MHz processor or better
- 256 MB RAM; 1 GB hard drive space
- VGA monitor capable of 800x600 resolution, 256 colors
- Windows 2000/XP

## Ordering Information

### Calibration Executive Software

NI Calibration Executive .....777608-02

### Calibration-Specific Hardware<sup>1</sup>

Calibration Executive hardware adapter

for E Series, S Series devices .....778056-03

Calibration Executive hardware adapter

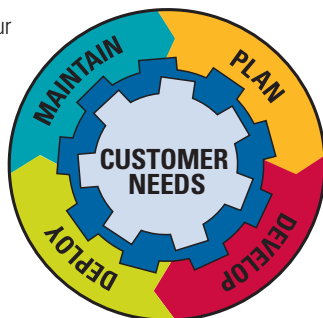
for NI 435x devices .....778031-03

FieldPoint FP-TB-CAL calibration base .....777519-90

<sup>1</sup>Visit [ni.com/calibration](http://ni.com/calibration) for a current list of applicable products, calibration services part numbers, and pricing.

# Services and Support

NI has the services and support to meet your needs around the globe and through the application life cycle – from planning and development through deployment and ongoing maintenance. We offer services and service levels to meet customer requirements in research, design, validation, and manufacturing. Visit [ni.com/services](http://ni.com/services).



## Training and Certification

NI training is the fastest, most certain route to productivity with our products. NI training can shorten your learning curve, save development time, and reduce maintenance costs over the application life cycle. We schedule instructor-led courses in cities worldwide, or we can hold a course at your facility. We also offer a professional certification program that identifies individuals who have high levels of skill and knowledge on using NI products. Visit [ni.com/training](http://ni.com/training).

## Professional Services

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 600 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit [ni.com/alliance](http://ni.com/alliance).



## OEM Support

We offer design-in consulting and product integration assistance if you want to use our products for OEM applications. For information about special pricing and services for OEM customers, visit [ni.com/oem](http://ni.com/oem).

## Local Sales and Technical Support

In offices worldwide, our staff is local to the country, giving you access to engineers who speak your language. NI delivers industry-leading technical support through online knowledge bases, our applications engineers, and access to 14,000 measurement and automation professionals within NI Developer Exchange forums. Find immediate answers to your questions at [ni.com/support](http://ni.com/support).

We also offer service programs that provide automatic upgrades to your application development environment and higher levels of technical support. Visit [ni.com/ssp](http://ni.com/ssp).

## Hardware Services

### NI Factory Installation Services

NI Factory Installation Services (FIS) is the fastest and easiest way to use your PXI or PXI/SCXI combination systems right out of the box. Trained NI technicians install the software and hardware and configure the system to your specifications. NI extends the standard warranty by one year on hardware components (controllers, chassis, modules) purchased with FIS. To use FIS, simply configure your system online with [ni.com/pxiadvisor](http://ni.com/pxiadvisor).

### Calibration Services

NI recognizes the need to maintain properly calibrated devices for high-accuracy measurements. We provide manual calibration procedures, services to recalibrate your products, and automated calibration software specifically designed for use by metrology laboratories. Visit [ni.com/calibration](http://ni.com/calibration).

### Repair and Extended Warranty

NI provides complete repair services for our products. Express repair and advance replacement services are also available. We offer extended warranties to help you meet project life-cycle requirements. [ni.com/services](http://ni.com/services).

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