

Model 5970-003 Calibration Package

Version 1.2

The Diagram Defined

The diagram at right illustrates the capabilities of the Calibration Package, and is an example of the chain of devices associated with a particular channel.

The diagram is an individual example; the system as a whole (including the calibration software) is very flexible in the number and type of devices that appear on the logical channel.

Devices that have been defined for the logical channel chain can be calibrated either individually or end-to-end. Devices in the diagram are the A/D Converter (ADC), an amplifier (CSC), one or more External Signal Conditioners (XSCs) and a Transducer (XDR). Signal injection points (A, B, C, D and E in the diagram) are used when performing device calibration; a signal injection point "E" is used when performing an end-to-end calibration.

Ordering Information

Model 5970-003



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Sophisticated, Simplified Device Calibration

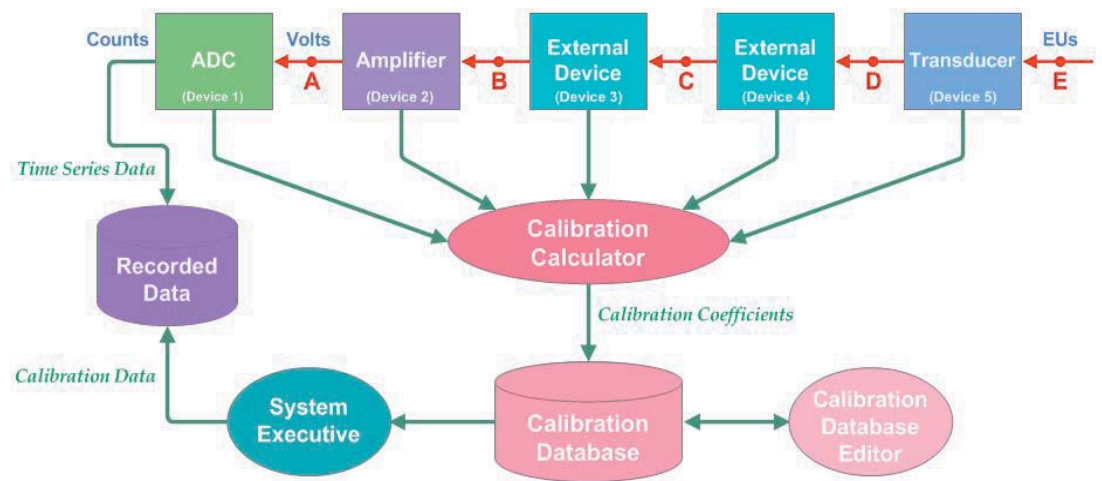
The Calibration Package, a fundamental component of the Piranha III™ Data Acquisition System, is a powerful set of software tools that provides a great deal of flexibility and functionality for calibrating the system.

System Calibration

A key concept of the Piranha system is that calibration information associated with a test is recorded to data file headers. Calibration data is retrieved from the Calibration Database during actual run-time, and is recorded in recording file headers. Once made, a recording stands alone and can be ported without reliance on external files.

Device and/or End-End Calibration

The Calibration Package provides true versatility. It can calibrate the data acquisition system and any attached signal conditioner and transducer devices as separate components, or perform an end-to-end channel calibration.



Persistent Storage of Calibration Data

The *Calibration Database* component provides persistent storage of calibration data, including calibration values and such auxiliary information as calibration dates and device conditions. For example, when performing a device calibration, the Calibration Calculator computes calibration coefficients and stores the values to the Database.

Calibration Calculation

The *Calibration Calculator* component automates in-situ calibration of devices or end-to-end calibration of channels. An intuitive GUI sets the calibration parameters and accepts or rejects calibration values before they're written to the Database. Channels can be calibrated individually or in groups. The software computes various sanity checks based on the nominal characteristics of devices, and displays error warnings when it detects common mistakes.

The Calibration Package provides for wideband "time-domain" calibration of devices and/or channels, and frequency-dependent calibration of devices and/or end-to-end of the channel.

Wideband Calibration

Wideband calibration defines frequency-invariant conversion factors associated with the device. The Calibration Calculator supports AC and DC calibration of devices. Performing a device calibration does not preclude also performing an end-to-end calibration. This minimizes any accumulation of calibration errors associated with combining device calibrations when a channel consists of a large number of individual, independently-calibrated devices.

Frequency-dependent Calibration

Frequency response functions are stored in the Calibration Database as breakpoint tables that allow for variable granularity of the frequency points—depending on device properties. The software is very flexible, and each device can have a completely independent frequency response function at frequency points that are independent of all other devices. The Calibration Calculator combines frequency response functions among devices and wideband calibration coefficients.

Calibration Database Editor

An easy-to-use GUI adds or updates devices and manufacturer calibration information for devices. The Editor provides persistent storage and a relational database for accessing calibration and other device information, and is used to view and print calibration reports.

The Calibration Database

Features

Centralized location for all device calibration data

High-performance, SQL-based transaction system

Calibration data held for all device conditions (Gain, Coupling, AC Cal & DC Cal)

Calibration history is retained

The Piranha III Calibration Database provides a persistent storage and relational database for accessing calibration and other device information. The database server provides this information to users and client applications in the Piranha III software suite.

Piranha application software interfaces with the Database to store and retrieve calibration information. For example, the **Calibration Calculator** provides automatic calibration of devices and stores this information to the Database automatically. Similarly, the real-time display and recording applications retrieve calibration information in order to provide calibrated results to the system operators and end users of the data.

The Database provides for storing calibration data for transducers, wiring, controllable and static signal conditioning, and analog-to-digital conversion. It provides for both broadband and frequency-dependent calibration coefficients as well as device conditions like amplifier gains.

The **Database Editor** software is included with the database to allow device information to be entered and viewed.

Key Concepts of the Calibration Database and the Calibration Package

Device Types

The Database is pre-populated with four device types. All devices fall into one of these categories:

- **ADC** – Analog-to-Digital Converter
- **CSC** – Controllable Signal Conditioner (*e.g., an amplifier with controllable properties like gain, coupling, excitation, etc.*)
- **XSC** – External Signal Conditioner. Any non-controllable device (other than a transducer) falls into this category (*e.g., wiring and amplifiers with fixed gain*).
- **XDR** – Transducer

Models

A Model is defined by a Manufacturer, Model Number, Device Type, and number of channels. The Database is pre-populated with known Models.

Devices

A Device is either a specific serial-numbered device of a Model or a generic device of a Model. Devices are assigned a Tag ID. However, when a device is to be used on multiple channels, or when it is calibrated once and that calibration information is used for all channels that contain the device, it is labeled “generic”. This prevents the device from being calibrated automatically. A Generic device (one with no specific serial number assigned to it) cannot be calibrated, since it is a non-specific (generic), rather than a specific instance of a device. Nominal coefficients are always used for generic devices.

Nominal Conversion Coefficients

All Devices inherit Nominal conversion factor information for the nominal input/output from the Model with which they are associated. For example, a transducer that measures pressure might have a nominal conversion coefficient of 10kPSI/volt. All Devices have a nominal conversion factor when they are entered into the Database. Devices can also contain conversion coefficients that are Non-Nominal (*i.e., actual*). Such coefficients may come from automatic calibration (the *Calibration Calculator*) or can be entered manually (the *Database Editor*) from calibration certificates obtained from the manufacturer or other calibration facility. Non-nominal conversion coefficients are optional.

Official Conversion Coefficients

As new calibration coefficients are entered into the Database, the old values are not deleted; they are simply marked as non-official. These values are maintained for historical purposes (calibration trend analysis). Calibration values in the database that are designated for use by the Piranha software are marked in the Database as Official. Official is independent of Nominal; that is, a device may have both Nominal and Non-Nominal coefficients that are Official. The Piranha III software determines which value to use depending on the scenario (typically, a Non-Nominal value takes precedence over a Nominal value).

The Calibration Calculator Component

The Calibration Calculator is an efficient and easy-to-use calibration verification tool. It provides calibration services and calibration verification using a simple, structured method by which a NIST-traceable instrument can be used to calibrate a Piranha system.

Saves Time and Effort

Traditional manual calibration is time-consuming and tedious. The Calibration Calculator automates this task using remotely-operated, NIST-traceable calibration instruments to completely eliminate any need for lengthy manual tasks like setting function generators and entering data from digital multi-meters (DMMs).

Provides NIST Traceability

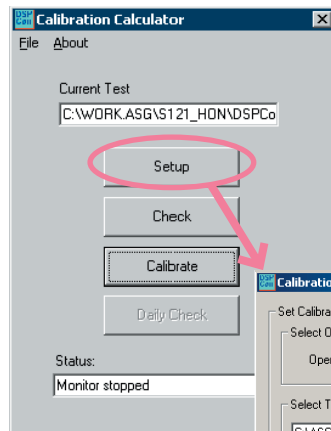
Piranha system architecture calls for the tight integration of data capture hardware to signal conditioning equipment and transducers, microphones, strain gauges, etc. When the Piranha system is coupled to a signal conditioning system as a unified instrument, it, like any measurement equipment, is subject to a calibration interval—the Calibration Calculator is used to generate calibration coefficients that provide the correction factor that links the values the Piranha system measures with actual NIST-accepted measurements.

The Calibration Calculator provides efficient and easy-to-use calibration verification. The Reporting feature provides detailed hard copy and soft copy reports of calibration results for the traceability requirements that many facilities require.

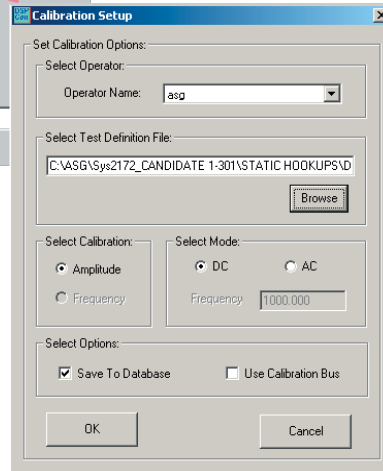
Versatile Calibration

The Calculator can calibrate a component in the amplitude or frequency domains automatically using known input voltages or engineering unit quantities. **Amplitude Calibration** creates system correction factors to accurately reconstruct digital data to input units. **Frequency Calibration** creates compensation factors to normalize a frequency-dependent signal. Calibration is performed for the calibration method (amplitude or frequency), the calibration mode (AC or DC), and the user-selected component.

The Main Window



Calibration setup is simple. Enter your ID, browse to a file, set the calibration method and calibration mode (here we've made them "Amplitude" and "DC"), and then choose the performance option (here we've decided to "Save to Database"). Click "OK" and you're done!



The Setup Window

Features

Piece-by-piece or end-to-end calibration

Amplitude-only (DC signal-based) or Frequency-dependent (amplitude & phase) calibration

AC and DC calibration

Calibrates individual channels or large blocks of channels

Provides rapid, automated "end-to-end" calibration verification

Performs full end-to-end calibration verification in minutes, even for large-channel-count systems

Menu-selectable automatic calibration mode or user-friendly manual calibration mode

Manual or automated calibration verification

Uses Ethernet-controlled devices for automatic calibration (optional)

Graphical breakdown of all calibratable system devices

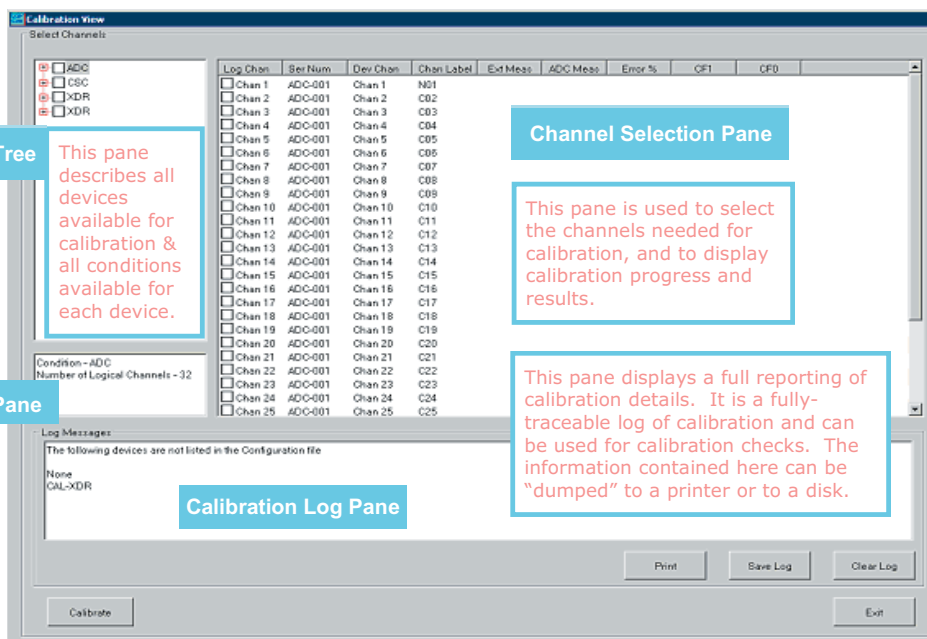
Easy navigation through full system calibration

Calibration traceability via calibration reports generated to a file or to a printer

Calibrates all devices of a certain type in a single cycle

Fully supports calibration for specific parameters when more frequent, rapid calibration is needed, including:

- AC coupling
- DC coupling
- Charge type device
- Specific gain ranges



The Calibration View Window Defined

The Device Calibration Database Editor Component

Features

Persistent storage of calibration data

Ability to view past calibration history

Ability to view and audit calibration coefficients

Ability to add new devices and transducers

Ability to generate lists and reports

Controls database access via user authentication

Handles information on pre-populated calibration database types:

ADC

Analog to Digital Converters

CSC

Controllable Signal Conditioners

XSC

External Signal Conditioners

XDR

Transducers

Put simply, the Piranha III Database Editor provides a user-friendly means of entering and accessing device and device calibration information.

The Database Editor edits the Calibration Database using a simple Graphical User Interface (GUI) to access an editable catalog of products, specific units, and the calibration factors of those units. The GUI can be used to:

- Add or update user information
- Update the device/manufacturers catalog
- Add or modify device models
- Add or modify manufacturers information
- Add or modify device types and their calibration coefficients
- Generate device type Unit Reports
- Generate sorted lists of device types contained in the database
- Export data and produce Calibration Reports
- Restrict non-administrator access to the database

Device Types

General information for device types is catalogued in the form of records listings. Existing records of devices are catalogued by Model Name, Manufacturer, Device Type, Channel Count, and Full Scale and Engineering Unit inputs and outputs. Records are populated with current information, and can be updated at any time.

Each individual device type listing—ADC, CSC, XSC, XDR—contains information on model number, tag number and serial number.

Calibration Coefficients

Calibration Coefficients for each device type and their associated values are also maintained using the Database Editor tool. These values include Calibration Method, Coefficient, Calibration Frequency and Calibration Due Date. Coefficients can be filtered and sorted by their Official, Nominal, or Non-nominal values.

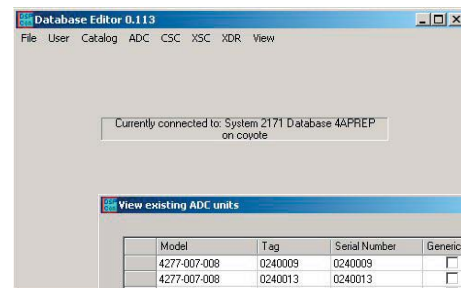
Unit Reports

The GUI can create a report on specific device type models. This report can be printed or exported as a file to a variety of formats.

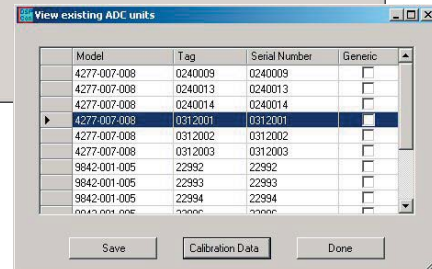
Calibration Reports

By selecting a specific device type, a Calibration Report that contains all calibration information for the selected device can be generated. Calibration reports contain information for all dimensions of the device's calibration; they are not effected by sort or filter functions.

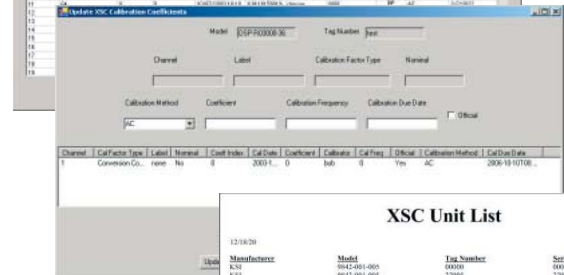
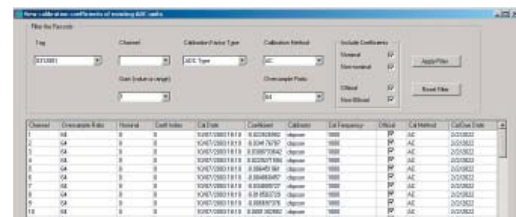
Main Window



Device Selection Window



Calibration Coefficients



Calibration Report

Unit Report

Model	Manufacturer	Tag Number	Serial Number
121870			
K51	1942-001-005	00000	00000
K51	1942-001-005	22995	22995
K51	1942-001-005	23000	23000
K51	1942-001-005	23010	23010
K51	1942-001-005	23417	23417

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