T-Calibro Software Manual

This user guide is designed to provide documentation for T-Calibro Software, . Read these instructions carefully

Description: Software Manual for T-Calibro:

Issued by: T.I.E.R.A Pvt. Ltd.

Edition: 1.5/2025

Contents

General Instructions

Installing the Software

System Requirements

Processor	Pentium 4M/Celeron 866 MHz (or equivalent) or later (32-bit) Pentium 4 G1 (or equivalent) or later (64-bit)
RAM	4 GB
Screen Resolution	1024 x 768 pixels
Operating System	Windows 10 or higher
Disk Space (Min)	2 GB

For installing the software in Windows 10/ higher versions is recommended, follow the steps below.

Installing the Software

1. Download T-Calibro Installer.& Driver.
2. Run the Install.exe file and complete the installation.

Installing the Driver file

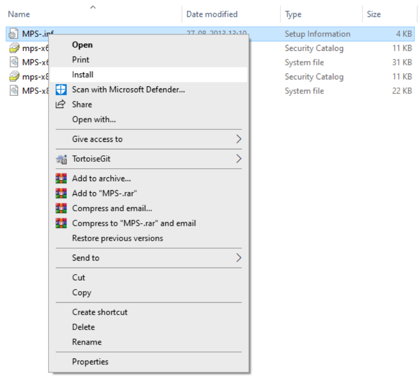
Note:

Only for Phonovibe Q/O/HD

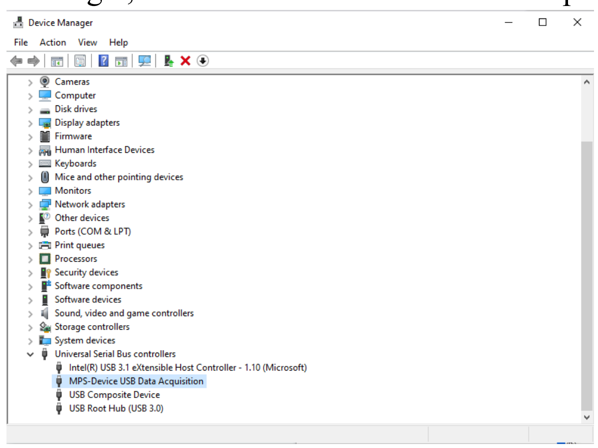
Phonovibe D *does not require any additional driver file installation.*

Step 1: Download & Extract the driver, and install the **.inf** file.

Note: Make sure the device is not connected to the PC while the driver is installed.



Step 2: After the installation is complete, connect the DAQ.
Step 3: Check in the Device Manager, make sure the device is detected properly.



Introduction

Calibration Workstation Overview

The **T-Calibro Accelerometer Calibration** System is a complete and integrated **hardware and software system** developed to **automate vibration calibration procedures**. Its purpose is to ensure accurate, reliable, and traceable calibration of a wide range of vibration sensors used in laboratories or field environments.

System Description

The **TCalibro** combines several essential functions into a single platform:

- **Hardware Components:**
  This includes precision vibration generation and measurement equipment designed for **maximum accuracy and reliability**. This makes it suitable for both **permanent calibration laboratories** and **mobile calibration units**.

- **Computer Integration:**
  A **Windows®-based PC** is included as part of the workstation. This PC serves multiple roles:

  - Controls the vibration shaker system.
  - Performs **real-time measurement calculations**.
  - Handles **data storage and archiving** for future retrieval.
  - Generates **calibration reports** automatically.

All these processes are managed through the **T Calibro Software**, which is the main control and analysis application of the Calibration system.

Software Functionality (T Calibro)

The **T Calibro Software** is engineered to deliver **high automation and efficiency**, particularly suited for laboratories with **high-volume sensor calibration** requirements.
Key roles of the software include:

- **Automated calibration control** across a wide frequency range.
- **Data processing** using algorithms for precise deviations and phase calculations.

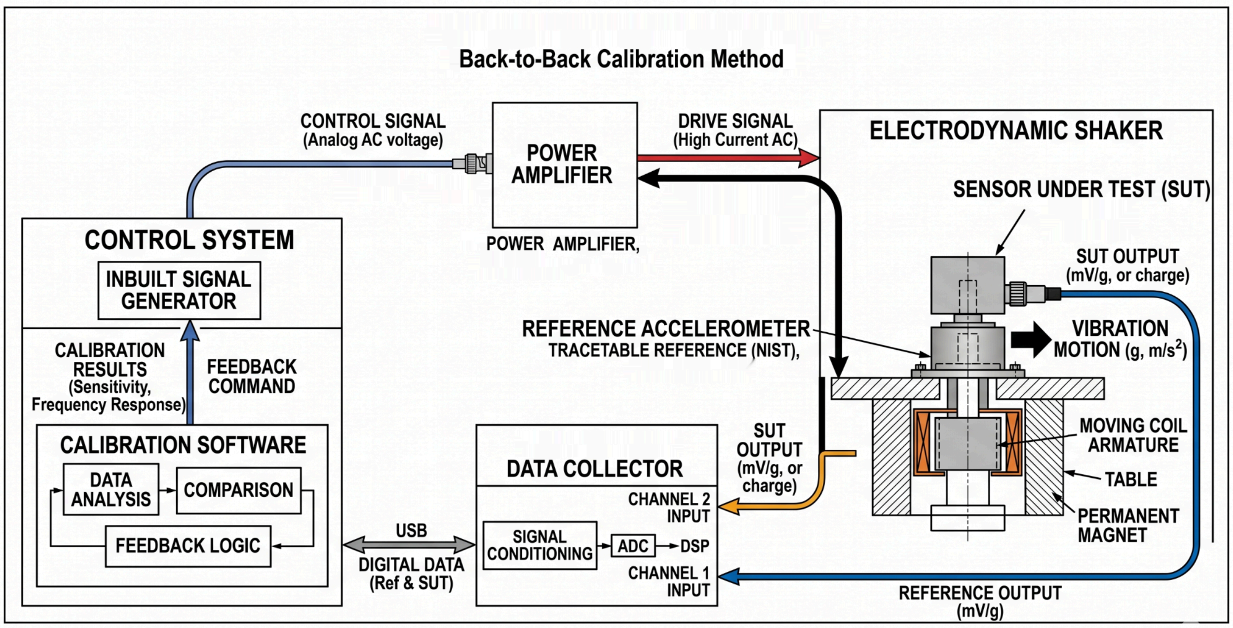
- **Archiving and retrieval of calibration records** using a **Structured Query Language (SQL)** database, ensuring compatibility with external systems.

- **Report generation** with Microsoft word to meet documentation standards.

Understanding System Setup

Before using the calibration system, users are expected to have:

- A **basic understanding of vibration sensors** (accelerometers, velocity sensors, etc.)
- Familiarity with **vibration test setups and procedures**.



Schematic of a typical Calibration System

Key Features of the T-Calibro Calibration System

The **system** includes the following major features:

1. **Automated Calibration Range:**
    - Fully automated testing over **10 Hz to 10,000 Hz**
    - Enables precise, repeatable calibrations over a wide frequency spectrum.
2. **Customizable Reporting:**
    - User-configurable reports
3. **Magnitude and Phase Measurement:**
    - Utilizes **DFT-based signal processing** for high-accuracy measurement of both **amplitude (magnitude)** and **phase response**.
4. **Broadband Excitation:**
    - Provides **broadband vibration excitation**, reducing the overall **test cycle time** and increasing throughput.
5. **Acceleration and Velocity Calibration:**
    - Capable of calibrating both **acceleration-type** and **velocity-type** vibration transducers.
6. **Data Management and Archiving:**
    - Uses a **structured query language** .

Setting Up the T-Calibro Software

The **T-Calibro software** is the core application that controls the calibration process, performs measurement calculations, and manages calibration data in the **Accelerometer Calibration Workstation**. Occasionally, you may need to **reinstall** this software — for example, after a system upgrade, hardware replacement, or software malfunction.

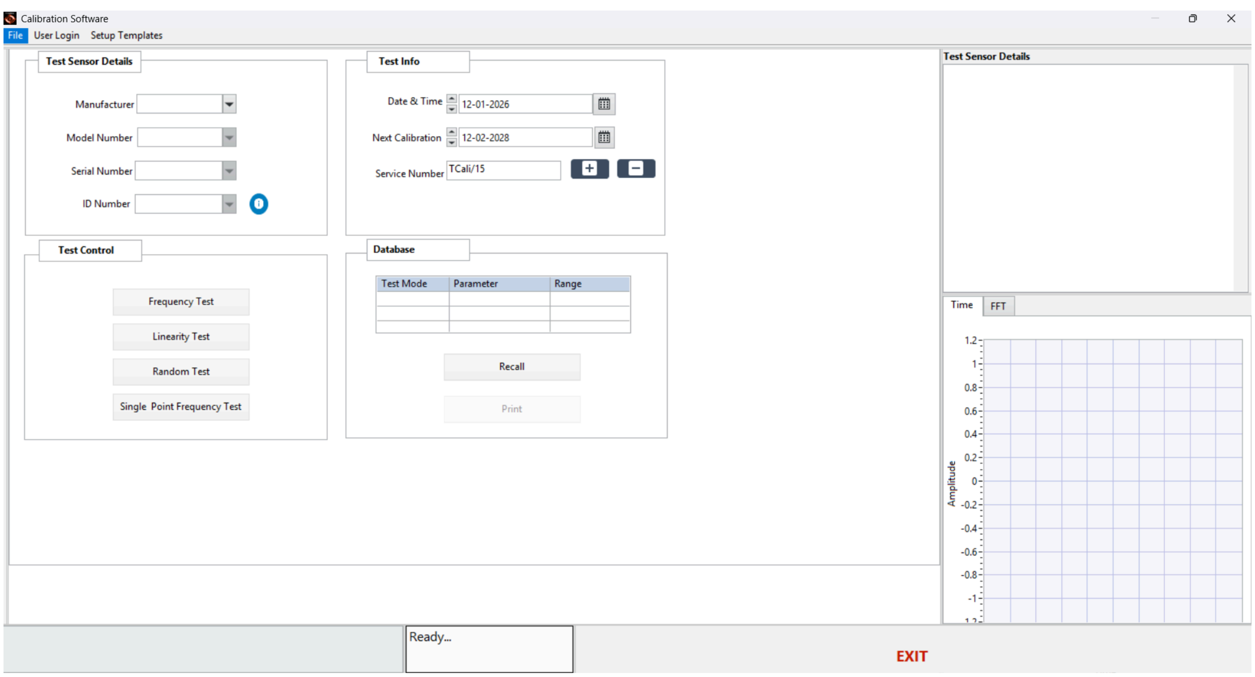
However, this process should be handled carefully to prevent data loss or configuration errors.

Overview of T-Calibro Software

When you open the **T-Calibro software**, the **main front panel** serves as the central control interface for the entire accelerometer calibration process.
It is designed to give the operator a clear, organized view of all key information and controls needed for setup, execution, and documentation of a calibration test.

The main panel typically contains **four main sections**:

1. **Test Sensor Details**
2. **Test Information (Test Info)**
3. **Test Control**
4. **Database**



Test Sensor

The details of the Sensor under test is selected in the **Test Sensor Details** area on the T-Calibro front panel - that is, the accelerometer or vibration transducer currently being calibrated.

Accurate entry of these details is critical because the information becomes part of the **calibration record** and the **final calibration certificate**.

Fields Included

1. **Manufacturer**
    - **Purpose:** Identifies the company or brand that produced the sensor
    - **Use:** Selecting or entering the correct manufacturer ensures traceability and helps organize data within the database.
    - **Displayed In Reports:** Appears automatically on the printed calibration certificate under the "Sensor Information" section.
2. **Model Number**
    - **Purpose:** Specifies the exact sensor model as defined by the manufacturer
    - **Use:** The model number determines the **type of sensor**, its **sensitivity range**, **connector type**, and other technical specifications that affect calibration parameters.
    - **Benefit:** Allows the software to retrieve standard configuration data or reference files for that model, if available.
3. **Serial Number**
    - **Purpose:** Provides a **unique identifier** for each individual sensor unit.
    - **Use:** The serial number is the key reference for tracking each sensor’s **calibration history**, including dates, results, and stability trends.
    - **Importance:** Ensures that calibration results are specific to one sensor and cannot be confused with another of the same model.
    - **Database Function:** Used as the primary search key when retrieving past calibration data.
4. **ID Number (or Internal ID)**
    - **Purpose:** Represents a **lab-assigned identification number** or **customer-specific reference code**.
    - **Use:** Often used for internal tracking, asset management, or linking the sensor to a customer’s inventory system.
    - **Example:** A lab may assign "CAL-0235" or "ClientA-Sensor07" as an internal ID even if the manufacturer’s serial number is different.
    - **Benefit:** Enables flexible tracking when multiple organizations or systems are involved.

Test Information (Test Info) Section

The **Test Information** area records all essential metadata about the calibration test — including **when** the test is performed and **when the next calibration is due**.
This information ensures that every calibration is fully traceable and compliant with laboratory quality standards (such as ISO 17025).

---

1. Date & Time

- **Purpose:**
  Displays the **exact date and time** when the calibration is performed or initiated.

- **Function:**

  - Automatically filled in by the T-Calibro software when a new test session begins.

  - Used to time-stamp the calibration data file and the final calibration certificate.

- **Importance:**
  Provides traceability for the measurement record.
  It ensures that the calibration can be matched precisely with environmental conditions, equipment versions, and operator activity on that specific date.

- **Example:**
  Date: 31-Oct-2025 *Time:* 14:32:15

---

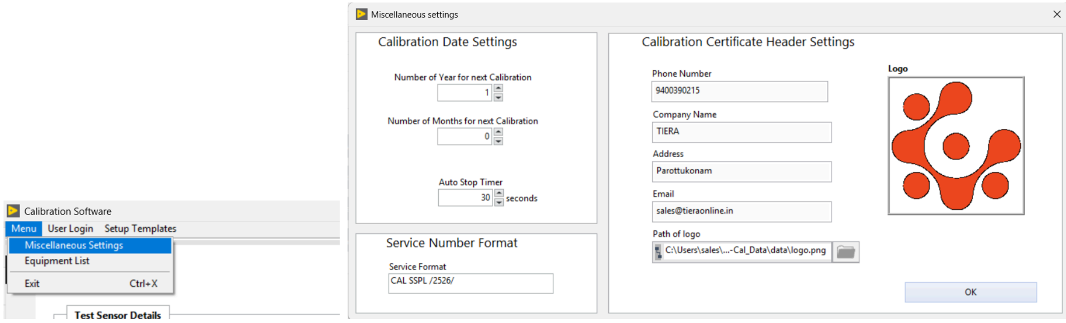
2. Next Calibration

- **Purpose:**
  Indicates the **recommended date for the next calibration** of the same sensor.

- **Function:**

  - This value is usually determined based on the **organization's calibration schedule** (e.g., every 6 months or 1 year).

  - It is automatically displayed based on the years and the months specified in the **Miscellaneous Settings**. The user can specify the years and months in the **Menu** >> **Miscellaneous Settings.**



- **Importance:**
  Helps maintain sensor accuracy over time and ensures compliance with internal or external quality-assurance policies.
  The date also appears on the printed calibration certificate as a reminder for the next due calibration.

- **Example:**
  Next Calibration: 31-Oct-2026 (one-year interval)

---

3. Service Number

- **Purpose:**
  Provides a **unique job or service identifier** for the specific calibration performed.

- **Function:**
  - Assigned by the calibration laboratory or customer service department.
  - May correspond to a **work order**, **job ticket**, or **service request number**.
  - Used internally for file organization, billing, and traceability.
  - The format for the service number can be specified in the **Miscellaneous Settings**. **.**

- **Importance:**
  Ensures that each calibration session can be linked to administrative records, such as customer requests, service reports, or invoices.

- **Example:**
  Service Number: SRV-2025-0421

Test Control Section

The **Test Control** area of the T-Calibro software provides the operator with options to **execute different vibration test modes**.
Each mode applies a specific type of excitation to the sensor under test (SUT) and measures its response compared to a reference standard accelerometer.
The goal is to determine the sensor's **sensitivity, frequency response, and performance stability**.

---

1. Frequency Test

Purpose:
To measure the **sensitivity and phase response** of the sensor over a **range of frequencies**.

Description:

- The shaker system generates a **sine wave vibration** that sweeps through a defined frequency range (for example, 10 Hz to 10,000 Hz).
- The software compares the output of the sensor under test to the reference accelerometer's output at each frequency point.
- Results are plotted as **magnitude (amplitude ratio)** and **phase difference** versus frequency.

Typical Parameters:

- Start Frequency (e.g., 10 Hz)
- Stop Frequency (e.g., 10 kHz)
- Step Size or Sweep Rate
- Vibration Amplitude (e.g., 10 m/s^2)

Outcome:
Generates the **frequency response curve**, showing how sensor sensitivity changes with frequency.
Used to verify compliance with manufacturer specifications.

---

2. Linearity Test

Purpose:
To verify the **linearity of sensor response** — i.e., whether the sensor's output is directly proportional to the applied vibration level.

Description:

- The test applies vibration at a **fixed frequency** (commonly 100 Hz or 160 Hz).
- The amplitude of vibration is varied in several steps (for example, from 1 m/s^2 up to 50 m/s^2).
- The sensor output is recorded at each level.
- A plot of **output voltage (or charge)** vs. **input acceleration** is generated.

Typical Parameters:

- Fixed Frequency (e.g., 100 Hz)
- Amplitude Steps (e.g., 1, 5, 10, 20, 50 m/s^2)

Outcome:

- Produces a **linearity graph** showing output vs. input.
- A straight line indicates ideal linear behavior.
- Deviations reveal non-linearity or mechanical issues in the sensor.

---

3. Random Test

Purpose:
To simulate **real-world vibration conditions** and evaluate the sensor's **broadband response** under random excitation.

Description:

- The shaker generates a **broadband random vibration signal** covering a wide frequency band simultaneously (e.g., 20 Hz to 10 kHz).
- The sensor's output is analyzed using **frequency-domain signal processing (FFT/DFT)**.

- The software calculates the **Power Spectral Density (PSD)** and compares it to the reference sensor's PSD.

Typical Parameters:

- Frequency Band (e.g., 20 Hz – 10 kHz)
- RMS Level (e.g., 1 g RMS)
- Test Duration (e.g., 30 seconds)

Outcome:

- Provides an overall picture of the sensor's **dynamic performance** under broadband excitation.
- Useful for quick verification tests and for reducing total calibration time.

---

4. Single Point Frequency Test

Purpose:
To determine the **sensitivity** of the sensor at a **specific frequency** — typically the reference frequency used in calibration certificates.

Description:

- The shaker operates at one fixed frequency (commonly 159.2 Hz, which corresponds to a 1 rad/s² conversion).
- The vibration level is held constant (for example, 10 m/s² RMS).
- The sensor output is measured and compared to the reference standard.

Typical Parameters:

- Fixed Frequency (e.g., 159.2 Hz)
- Constant Amplitude (e.g., 10 m/s²)

Outcome:

- Calculates and displays the **sensitivity value (mV/g or pC/g)**.

- This value is stored in the database and printed on the calibration certificate as the **primary sensitivity** result.

Database Section

The **Database** section in the T-Calibro software is designed to **store, organize, and retrieve calibration data** for every sensor tested using the system.
It ensures that all calibration results are traceable, easily accessible, and ready for report generation or certificate printing.

This section typically includes controls such as **Recall**, **Print**, **Save**, and **Search**, which interact directly with the internal **ODBC (Open Database Connectivity)** data structure.

---

1. Recall Function

Purpose:
To **retrieve previously stored calibration data** for a specific sensor or test from the database.

Description:

- The **Recall** feature allows the user to **search and load historical calibration records** based on sensor identifiers such as:
  - Manufacturer
  - Model number
  - Serial number
  - ID number
  - Service number or date range
- Once recalled, the previously stored details — such as **sensitivity, frequency response curves, operator name, and calibration date** — are displayed on the main screen.
- This enables comparison with new results or review of past performance trends.

Typical Use Cases:

- Checking a sensor's **previous calibration results** before performing a new test.
- Reviewing **long-term stability** or drift in sensitivity.

- Reprinting old calibration certificates.

Benefit:
Ensures quick access to complete calibration history for **traceability, audit, and quality management**.

---

2. Print Function

Purpose:
To **generate and print calibration certificates or reports** from stored or newly acquired test data.

Description:

- After a calibration test or after recalling previous data, the **Print** function formats all relevant information into a **calibration certificate template**.
- Templates are **customizable** and may include:
  - Laboratory name and logo
  - Sensor details (Manufacturer, Model, Serial No., ID No.)
  - Calibration conditions (Date, Operator, Reference standard)
  - Test results (Sensitivity, Frequency response, Linearity plots)
  - Next calibration due date and service number
- The system supports printing directly to a physical printer or exporting as a **PDF or digital report file** for electronic recordkeeping.

Typical Use Cases:

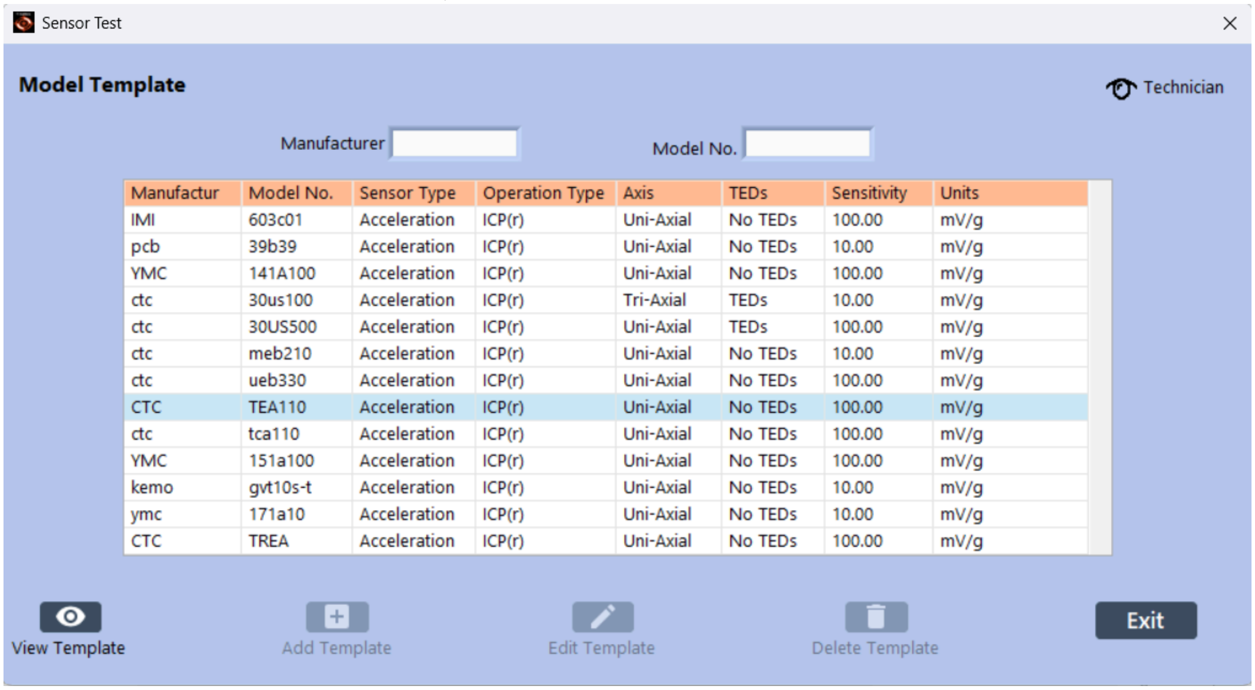
- Producing official calibration certificates for customers.
- Printing internal verification reports for quality documentation.
- Generating summary reports for multiple sensors in batch mode.

Benefit:
Simplifies **documentation and certification**, ensuring consistent and professional presentation of calibration data.

Model Template Database

Purpose

The **Model Template Database** in T-Calibro serves as a **central repository of reference specifications** for each model of sensor used in the system.



Manufactur	Model No.	Sensor Type	Operation Type	Axis	TEDs	Sensitivity	Units
IMI	603c01	Acceleration	ICP(r)	Uni-Axial	No TEDs	100.00	mV/g
pcb	39b39	Acceleration	ICP(r)	Uni-Axial	No TEDs	10.00	mV/g
YMC	141A100	Acceleration	ICP(r)	Uni-Axial	No TEDs	100.00	mV/g
ctc	30us100	Acceleration	ICP(r)	Tri-Axial	TEDs	10.00	mV/g
ctc	30US500	Acceleration	ICP(r)	Uni-Axial	TEDs	100.00	mV/g
ctc	meb210	Acceleration	ICP(r)	Uni-Axial	No TEDs	10.00	mV/g
ctc	ueb330	Acceleration	ICP(r)	Uni-Axial	No TEDs	100.00	mV/g
CTC	TEA110	Acceleration	ICP(r)	Uni-Axial	No TEDs	100.00	mV/g
ctc	tca110	Acceleration	ICP(r)	Uni-Axial	No TEDs	100.00	mV/g
YMC	151a100	Acceleration	ICP(r)	Uni-Axial	No TEDs	100.00	mV/g
kemo	gvt10s-t	Acceleration	ICP(r)	Uni-Axial	No TEDs	10.00	mV/g
ymc	171a10	Acceleration	ICP(r)	Uni-Axial	No TEDs	10.00	mV/g
CTC	TREA	Acceleration	ICP(r)	Uni-Axial	No TEDs	100.00	mV/g

Each entry (or template) in this database represents a **default configuration** for a specific sensor model, including its **electrical, mechanical, and calibration characteristics**.

These stored templates are used to automatically populate the **SUT (Sensor Under Test) Specification Record**, ensuring consistency and reducing the need to manually re-enter sensor parameters each time a calibration is performed.

Accessing the Database

To open the **Model Template** database panel:

1. From the main menu, select **System Setup → Model Template**.
2. The **Model Template Table** window will appear.

Searching and Filtering Records

Because this database can hold a **large number of templates**, it does not automatically display all records to prevent slow performance.

- Use the **filter fields** at the top of the panel (e.g., Manufacturer, Model Number, or Sensor Type) to **narrow down the search**.
- After entering search criteria, click **Search** to display matching records.
- To view **all stored templates**, leave all search fields blank and click **Search** — this will list every record currently in the database.

Record Management

The lower section of the panel includes several control buttons that allow you to **manage sensor templates**.
These include:

Button / Function	Description
Add Template	Creates a new Model Number Template entry. Used to define a new sensor model based on manufacturer specifications.
Delete Record	Permanently removes the selected template from the database.
Update Record	Opens the selected record for modification. Allows editing of specifications or tolerances.
View Record	Displays the selected record in read-only mode for review.

Note:
All functions except **View Record** require **Advanced User Mode** access (refer to Section 6.5 for enabling advanced mode).
This restriction helps maintain database integrity by limiting modifications to authorized personnel only.

Adding a New Model Template

To add a new sensor model:

1. Click **Add Template**.
2. A blank form will appear where you can enter all relevant parameters, such as:
   - Manufacturer name
   - Model number
   - Sensor type (Uni-axial / Tri-axial)
   - Sensitivity, output type, excitation voltage
   - Mass
   - Frequency ranges and tolerances

Mass is a critical specification that the user needs to enter the **T-Cal Software**

   -
3. Most of these details can be copied directly from the **manufacturer's data sheet**.
4. Once complete, click **Save** to store the template in the database.

Frequency Range Tolerances

Each Model Number Template contains tables to input the frequency range tolerances.These define the **allowable deviations** in amplitude and phase across different frequency bands.

Parameter	Description
Amplitude Deviation Tolerance	Maximum allowed variation in output amplitude within a specific frequency band.
Phase Deviation Tolerance	Acceptable phase shift variation within that frequency range.

Rules for Frequency Range Configuration:

- If a value of **0** is entered for a range, that range is **ignored** by the software.
- If the sensor is **Uni-axial**, only the **X-axis** ranges are used; Y and Z ranges are ignored.

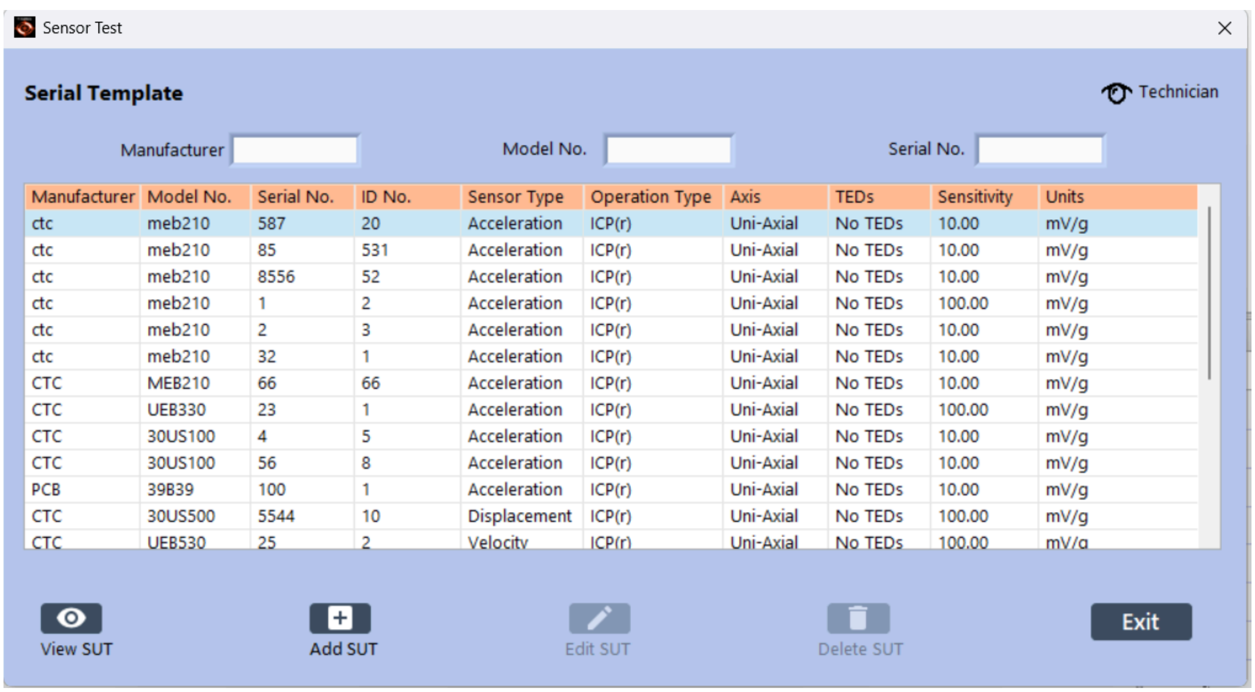
- If **two frequency ranges overlap**, the system automatically uses the **range with the smallest tolerance** (tightest specification) within the overlap.

Use in Calibration Process

When a new calibration test is initiated:

- The software automatically pulls the **default specifications** for the sensor model from the **Model Number Template Database**.
- These parameters populate the **Running SUT Specification Record**, which is used during testing and result comparison.
- This ensures every calibration follows the correct model-specific limits and tolerances.

Sensor Serial Template Records



Manufacturer	Model No.	Serial No.	ID No.	Sensor Type	Operation Type	Axis	TEDs	Sensitivity	Units
ctc	meb210	587	20	Acceleration	ICP(r)	Uni-Axial	No TEDs	10.00	mV/g
ctc	meb210	85	531	Acceleration	ICP(r)	Uni-Axial	No TEDs	10.00	mV/g
ctc	meb210	8556	52	Acceleration	ICP(r)	Uni-Axial	No TEDs	10.00	mV/g
ctc	meb210	1	2	Acceleration	ICP(r)	Uni-Axial	No TEDs	100.00	mV/g
ctc	meb210	2	3	Acceleration	ICP(r)	Uni-Axial	No TEDs	10.00	mV/g
ctc	meb210	32	1	Acceleration	ICP(r)	Uni-Axial	No TEDs	10.00	mV/g
CTC	MEB210	66	66	Acceleration	ICP(r)	Uni-Axial	No TEDs	10.00	mV/g
CTC	UEB330	23	1	Acceleration	ICP(r)	Uni-Axial	No TEDs	100.00	mV/g
CTC	30US100	4	5	Acceleration	ICP(r)	Uni-Axial	No TEDs	10.00	mV/g
CTC	30US100	56	8	Acceleration	ICP(r)	Uni-Axial	No TEDs	10.00	mV/g
PCB	39B39	100	1	Acceleration	ICP(r)	Uni-Axial	No TEDs	10.00	mV/g
CTC	30US500	5544	10	Displacement	ICP(r)	Uni-Axial	No TEDs	100.00	mV/g
CTC	UEB530	25	2	Velocity	ICP(r)	Uni-Axial	No TEDs	100.00	mV/g

Purpose

The **Sensor Serial Template Records** store information for **individual sensors**, identified by their **unique serial numbers**.

Unlike the **Model Number Template**, which defines default specifications for a sensor model, the **Serial Template** applies these specifications to **specific physical sensor units**.

The data contained in these records is used to:

- Control the **behavior of the T-Calibro software** during calibration,
- Define **pass/fail acceptance criteria** for test results,
- Determine how **calibration data is evaluated and reported**, and
- Specify the **frequencies at which each sensor is tested**.

By using serial-specific records, the system ensures **accurate traceability** and **consistent reporting** for every sensor.

Source of Default Data

When a new Sensor Serial Template is created:

- All default values are automatically copied from the corresponding **Model Number Template**.
- These include sensor type, operating mode, axis configuration, sensitivity, and tolerance limits.
- The user only needs to enter **serial-specific information** unless changes are required.

This approach minimizes data entry errors and ensures uniformity across sensors of the same model.

Accessing the Sensor Serial Template Panel

To open the Sensor Serial Template data panel:

1. Select **Setup Template → Sensor Serial Template** from the main menu.
2. The **Sensor Serial Template** record list will be displayed.

This panel shows all existing sensor serial records and provides access to record management functions.

Record Management Functions

The buttons located at the **bottom of the panel** allow the user to manage sensor records:

Function	Description
View SUT	Opens the selected sensor record in read-only mode
Add SUT	Creates a new sensor serial template
Edit SUT	Modifies an existing sensor record
Delete SUT	Removes a sensor record from the database

User Access Levels

Access to record functions depends on the user mode:

- **Technician Mode**
  - Allowed:
    - **View SUT**
    - **Add SUT** (only if default values are not changed)
  - Restrictions:
    - Only serial-specific fields such as **Serial Number**, **ID Number**, and **customer information** may be entered.
    - No changes to default specifications inherited from the Model Template are permitted.
- **Advanced User Mode**
  - Full access to:
    - Add

        - Edit
        - Delete
        - View sensor records
    - Required when modifying:
        - Sensitivity
        - Frequency ranges
        - Pass/fail tolerances
        - Axis or operation type

This access control protects critical specification data from unintended changes.

Adding a New Sensor Serial Record

To add a new sensor:

1. Click **Add SUT**.
2. Enter the **Manufacturer** and **Model Number** of the sensor.
3. The software automatically loads default values from the **Model Number Template**.
4. Enter serial-specific information such as:
    - Serial Number
    - ID Number
    - Customer details (if applicable)
5. Review the inherited specifications.

Saving the Record

After entering all required information, save the record using one of the following options:

- **Add / New**

    - Saves the current sensor record.
    - Clears the **Serial Number** and **ID Number** fields.
    - Allows quick entry of another sensor with the **same model number**.
- **Add / Done**
    - Saves the current sensor record.
    - Returns the user to the **Sensor Serial Template list**.

This dual-save option improves efficiency when adding multiple sensors of the same model.

Sensor Serial Template – Add Sensor Panel

When a **new sensor** is added using the **Sensor Serial Template**, the data entry panel is divided into **three main sections**. Each section controls a specific aspect of how the sensor is calibrated, evaluated, and reported.

Panel Sections

1. **Sensor Specifications** – Defines sensor identity, configuration, and pass/fail criteria
2. **Calibration Frequencies** – Specifies frequencies used to measure amplitude and phase response
3. **Amplitude Control** – Defines vibration levels for the linearity test

---

1. Sensor Specifications

Purpose

The **Sensor Specifications** section contains detailed information about the **Sensor Under Test (SUT)**.
This information is used by the software to:

- Configure the calibration process
- Control reporting and data evaluation

Default Behavior

- By default, all values in this section are **automatically populated** from the associated **Model Number Template**.
- If no changes are required, the user only needs to enter:
  - **Serial Number**
  - **ID Number**
  - **Default Label**
  - **Customer Information**

User Access Rules

- **Technician Mode**
  - Allowed to edit:
    - Serial Number
    - ID Number
    - Default Label
    - Customer information
- **Advanced User Mode**
  - Required to modify:
    - Sensitivity
    - Frequency tolerances
    - Pass/fail limits
    - Axis configuration
    - Operation type

This access control prevents accidental modification of critical calibration parameters.

Frequency Range Tolerances (Important Note)

- Up to **six frequency ranges per axis** (X, Y, Z) may be defined.
- Each range includes:
    - **Amplitude deviation tolerance**
    - **Phase deviation tolerance**

Rules Applied by the Software

- If a frequency range contains a value of **“0”**, that range is **ignored**.
- For **Uni-axial sensors**:
    - Only **X-axis ranges** are used.
    - Y and Z ranges are ignored.
- If **two frequency ranges overlap**:
    - The range with the **smallest (tightest) tolerance** is applied within the overlap region.

---

2. Calibration Frequencies

Purpose

This section defines the **frequencies and amplitudes** used to calibrate the sensor’s:

- **Amplitude response**
- **Phase response**

Key Characteristics

- Up to **200 frequency–amplitude combinations** can be entered.
- The table is **automatically sorted**, so frequency order does not matter.
- To remove a frequency:
    - Replace the frequency value with **“0”**

Displayed in Table Column

- Determines whether a frequency point appears in the **calibration certificate table**.
- Even if a frequency is not displayed, it may still be used in the calibration.
- Certificate templates can be modified to include additional frequency points if required.

Frequency List Buttons

The panel includes buttons to automatically populate frequency lists:

User Input Frequencies

- Pulled from the **Frequencies_User** table in the system database.
- These frequencies can be customized by:
    1. Opening the database
    2. Selecting the **Tables** tab
    3. Editing the **Frequencies_User** table
- (The **Shift key** must be held while opening the database.)

Traceable Frequencies

- Uses the exact frequencies at which the **currently selected reference accelerometer** was calibrated.
- **No interpolation** is performed between frequency points.
- **Not recommended** if multiple reference accelerometers are used in the system.

Mandatory Requirement

- The **reference frequency** defined in the **Sensor Specifications** section **must appear** in the Calibration Frequencies table.

Performance Note

- The number and selection of frequencies directly affect **total calibration time**.
- More frequency points = longer calibration duration.

Amplitude Units Control

- The **Units** selector determines which amplitude units are used (e.g., m/s^2, g).
- Changing units:
  - Automatically converts all existing amplitude values to the new unit.
- These values represent **target amplitudes**.
- During calibration, the system will excite at:
  - The **lesser** of the target amplitude or
  - The **maximum achievable amplitude** based on shaker and hardware limits.

---

3. Amplitude Control (Linearity Test)

Purpose

The **Amplitude Control** section defines vibration levels used during the **linearity test**, which evaluates whether the sensor output remains proportional to input acceleration.

Amplitudes Button

- Clicking **Amplitudes** opens the **Linearity Amplitude Setup** window.
- Up to **20 amplitude levels** may be specified.

Linearity Amplitude Setup

Amplitude Limits

The achievable amplitude range depends on:

- Shaker distortion limits
- Shaker stroke limitations
- Power limits of the shaker and amplifier
- Mechanical amplifier bar resonance behavior

(Refer to individual product manuals for exact limits.)

Setting Amplitude Levels

To configure linearity test levels:

1. Enter the **number of amplitude levels** required.
2. Either:
    - Manually enter each amplitude value, **or**
    - Enter the **Maximum Linearity Amplitude** and click **Set Amplitudes** to auto-generate evenly spaced levels.

Performance Note

- Best performance is achieved when operating **at or near mechanical amplifier bar resonance frequencies**.
- Actual achievable levels may vary depending on system configuration.

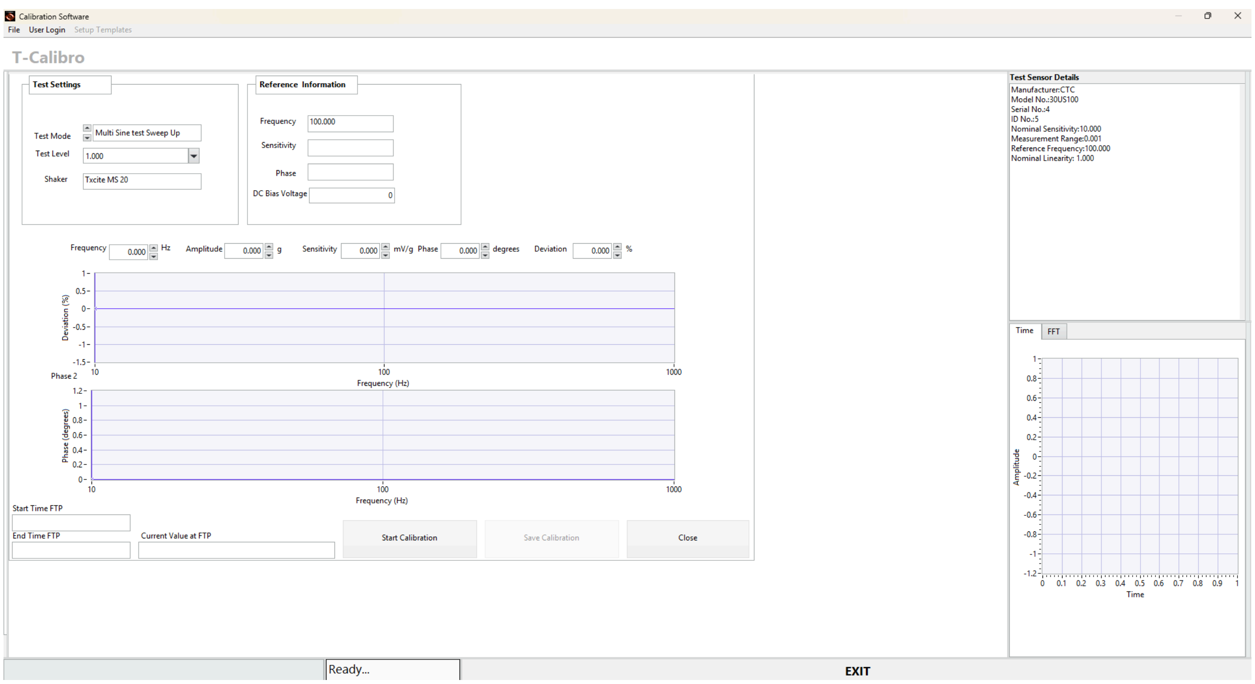
Running a Calibration

Frequency Response Panel

After selecting the sensor to be calibrated, initiate a frequency response calibration by clicking the **"Frequency Test"** button. This opens the **Frequency Response Calibration** panel, where both **magnitude and phase response** measurements are performed.

Frequency Sweep (Magnitude and Phase) – Test Setup

In the **Frequency Response Calibration** panel, configure the following parameters using the available drop-down menus:



- **Start Frequency**
- **Stop Frequency**
- **Test Level**
- **Test Mode**
- **Calibration Shaker** currently connected to the system

Tips and Best Practices

- **Test Mode Selection**
  Test Mode is a valuable time-saving feature. Common setup issues typically occur:
    - At **high frequencies** (often due to improper mounting)
    - At **low frequencies** (often due to cable routing or inadequate strain relief)
- By starting the frequency sweep at suspected problem frequencies, setup issues can be identified immediately. If a problem is observed, the test can be stopped, the sensor remounted, and the test restarted.
- **Multiple Shaker Systems**
  When both high-frequency and low-frequency shakers are used:
    - Ensure that the tested frequency ranges **do not overlap**.
    - If overlapping ranges are selected, the results from the most recent test will overwrite previous data for those frequencies.
- **Reference Frequency Considerations**
  It is possible that the reference frequency is not included in the frequency sweep. If calibration results are saved or printed in this condition, the system automatically assigns the reference frequency to the nearest available frequency in the **Running SUT Database**.

  Refer to the **Hardware Manual** for additional guidance when using a low-frequency reference standard.

IMPORTANT

If the system is equipped with multiple shakers, always verify that the **correct shaker is selected and physically connected** before starting the calibration. Selecting the wrong shaker may result in incorrect measurements or potential hardware damage.

If the message **“Unexpected Sensor Output”** appears:

- **Immediately stop the test**
- Verify the physical shaker connection
- Confirm the correct shaker selection in the software before proceeding

---

Running the Calibration

Once the software confirms the correct Sensor Under Test (SUT) selection, the calibration begins automatically. The system calibrates the SUT at all frequencies defined in the **Sensor Serial Template Data** table for the selected sensor.

During the test:

- The status bar displays **“Test In Progress”**
- Live signals from the **SUT** and **Reference Sensor** are shown
- **Harmonic Distortion**, **Signal Level**, and **RMS values** are continuously monitored

Upon completion:

- The status bar changes to **“Ready”**
- A completion message is displayed to confirm the test has ended

---

Test Results and Signal Monitoring

During and after the calibration:

- **Magnitude and Phase Response Plots**
  Calibration data is plotted against the sensor’s specified tolerance limits. Any points exceeding tolerance are highlighted and listed in the **“Test Results”** section.
- **Virtual Scope Displays**
  Two virtual scope panels display the real-time signals from:
  - The Reference Sensor
  - The Sensor Under Test
- These displays include harmonic distortion and signal-to-noise ratio indicators. Monitoring these signals ensures proper sinusoidal excitation and measurement integrity.
- **Time and Frequency Domain Views**
  Users may switch between:
  - **Time-domain plots** (voltage vs. time)
  - **Frequency-domain plots** (power spectrum shown in red)

- The frequency-domain plot can be exported using the **"Export"** button.

Sensitivity and Tolerance Indications

- If the measured reference sensitivity falls outside the specified nominal range, the **Sensitivity Results** window (top-center of the panel) is highlighted
- Clicking any point on the magnitude or phase plots displays detailed information, including:
  - Frequency
  - Sensitivity
  - Phase
  - Deviation from reference sensitivity

If any out-of-tolerance conditions occur, verify the test setup, calibration procedure, and equipment, then repeat the test if necessary.

Warnings and Monitoring

Throughout the calibration process, the system continuously monitors for:

- Sensor overload conditions
- Poor signal-to-noise ratio

If detected:

- The **"Warnings"** tab turns **red**
- All identified conditions are listed

Note: A poor signal-to-noise ratio does not necessarily indicate a system fault and may be expected when testing low-sensitivity sensors. Always evaluate warnings before proceeding.

Saving and Combining Calibration Results

- Click **"Save Calibration"** to store the test results.
  Refer to the **Saving the Calibration Data** section for additional details.

- **Two-Shaker Calibration**
  When using two shakers:

  1. Save the results from the first shaker

  2. Repeat the calibration using the second shaker

- The software automatically merges results from both tests when generating the calibration certificate.

Shaker Amplitude Limitations (Important Note)

Shaker acceleration at low frequencies is limited by physical armature displacement and amplifier output. For example:

- Achieving **10 g peak at 5 Hz** requires approximately **5.5 inches of armature displacement**

- If the shaker cannot provide this displacement, the software automatically limits the acceleration level

Amplitude limits are pre-configured to protect the system. To modify these limits, refer to the **"Change the Maximum Shaker Amplitude Level"** section of the manual.

Amplitude Linearity Option

MS20 Systems

The **Amplitude Linearity option** is an optional add-on available for MS20 systems. When installed, this option enables verification of a sensor's amplitude linearity over a defined acceleration range. Using the **TX8 version of the MS20 air-bearing shaker**, linearity measurements of up to **40 g at 100 Hz** can be achieved, subject to system limitations.

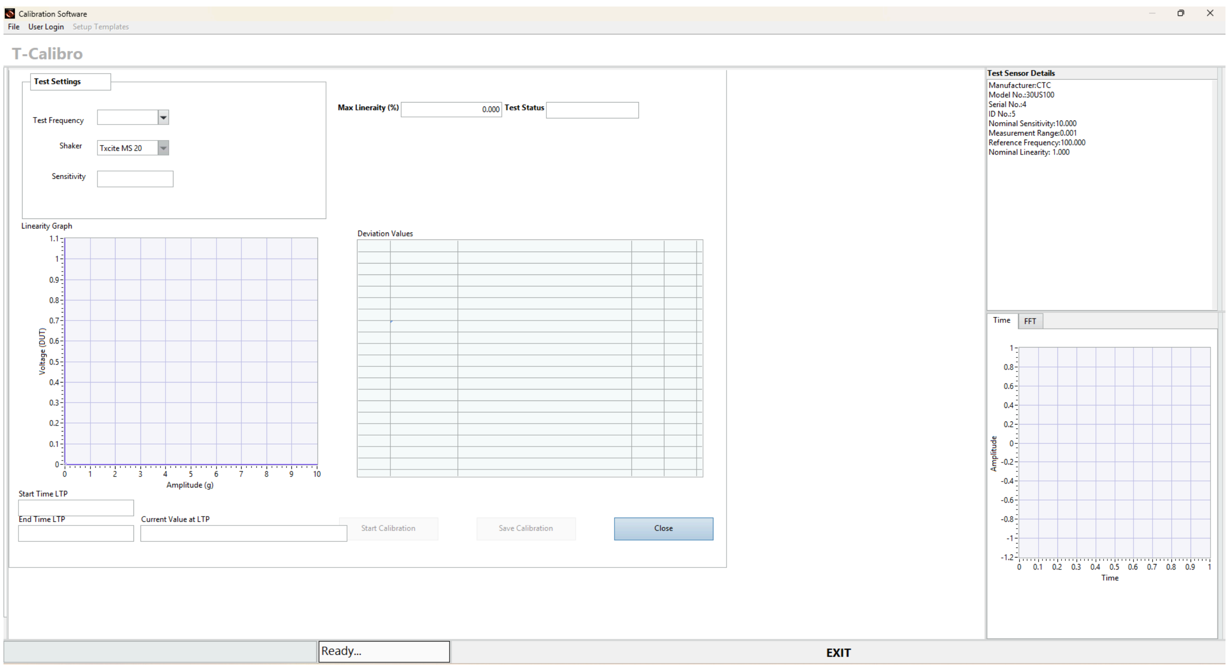
If the Amplitude Linearity option is installed, the associated menu items become active and open the **Linearity Test** panel.

Linearity Test Overview

Amplitude linearity testing is performed with the **Sensor Under Test (SUT)** mounted directly to either:

- The shaker table, or
- The reference sensor

This configuration allows the user to select the test frequency freely, but the achievable acceleration levels are limited by the performance characteristics of the selected shaker and amplifier.



Test Frequency and Amplitude Selection

- The test frequency may be set anywhere from **10 Hz up to the maximum operating frequency of the shaker**.
- By default, the linearity test frequency is set to the **reference frequency** defined in the **Sensor Serial Template SUT Database**.
- Physical limitations—such as shaker stroke, payload mass, and amplifier output—may restrict the maximum achievable amplitude.

Refer to the **shaker payload curve** in the shaker manual for detailed limitations applicable to your specific shaker model.

Linearity Test Parameters

- Target acceleration levels are displayed in the table on the right side of the Linearity Test panel.
- These amplitude levels and the corresponding **pass/fail criteria** are defined in the **SUT Specification** record.
- Both the amplitude levels and acceptance criteria can be modified within this specification record, subject to user access permissions.

Running the Linearity Test

When the **“Run Calibration”** button is pressed:

- The software sequentially excites the SUT at each specified acceleration level.
- The status bar displays **“Test In Progress”** while the test is running.
- Upon completion, the status bar changes to **“Ready”**.

Linearity Results

- The **Max Linearity** value represents the **maximum deviation** of any measured test point from the **Best-Fit Straight Line (BFSL)** derived from all tested points.
- The results table displays the measured response and deviation at each acceleration level.
- Any out-of-tolerance conditions are clearly indicated in the results display.

⚠ WARNING – Mechanical Amplifier Bars

Never perform a linearity test with a mechanical amplifier bar attached using the procedure described above.

Mechanical Amplifier Bars must **only** be operated at their **resonance frequency**. Operating them outside of resonance—such as during amplitude linearity testing—can result in **serious shaker damage**.

Refer to the dedicated procedure for **linearity testing with mechanical amplification** when applicable.

Random Test

Purpose

The **Random Test** is used to simulate real-world vibration environments and evaluate the **broadband dynamic response** of the Sensor Under Test (SUT) under random excitation. Unlike sine sweep testing, this method excites **multiple frequencies simultaneously**, making it well suited for fast verification and overall health assessment of vibration sensors.

Random Test Panel Description (Based on Image)

The Random Test is configured and executed from the **Frequency Response Calibration** panel when the **Test Mode** is set to **Random Broad Band**, as shown in the Test Settings section of the panel.

---

1. Test Settings Section

This section defines how the random excitation is generated and controlled:

- **Test Mode**
    - Set to **Random Broad Band**.
    - Enables broadband random vibration instead of single-frequency sine excitation.
- **Test Level**
    - Specifies the target **RMS acceleration level** (e.g., **1.000 g RMS**).
    - This value represents the overall energy level of the random vibration applied by the shaker.
- **Shaker Selection**
    - Displays the currently connected shaker (e.g., **TXcite MS20**).

    - It is critical that the selected shaker matches the physically connected hardware to avoid incorrect excitation levels or hardware damage.

---

2. Reference Information Section

This section displays measured parameters from the **reference sensor** during the random test:

- **Frequency**
    - Displays the nominal reference frequency used for sensitivity normalization (commonly **100 Hz**).
- **Sensitivity**
    - Calculated reference sensitivity during the test.
- **Phase**
    - Phase relationship between the reference sensor and the SUT.
- **DC Bias Voltage**
    - Displays the measured DC bias (important for ICP®/IEPE sensors).
    - Abnormal values may indicate cabling or power issues.

---

3. Test Sensor Details Panel (Right Side)

This panel summarizes the **SUT identification and specification data**, including:

- Manufacturer
- Model Number
- Serial Number
- ID Number
- Nominal Sensitivity
- Measurement Range
- Reference Frequency

- Nominal Linearity

This information is pulled directly from the **Running SUT Specification Database** and ensures traceability of the calibration results.

---

4. Frequency Response Plots

During and after the Random Test, multiple graphical displays are updated:

a) Deviation vs Frequency Plot

- Displays the **percentage deviation** of the SUT sensitivity relative to the reference sensor across the frequency band.
- The horizontal axis represents **frequency (Hz)**.
- The vertical axis represents **deviation (%)**.
- Deviations outside the allowable tolerance indicate potential sensor performance issues.

b) Phase vs Frequency Plot

- Displays the **phase difference** (in degrees) between the SUT and reference sensor.
- Used to evaluate phase consistency across the broadband frequency range.

---

5. FRF and Coherence Displays

On the right side of the panel:

- **FRF Magnitude**
  - Shows the Frequency Response Function magnitude derived from random excitation.
  - Indicates how uniformly the sensor responds across the frequency band.
- **FRF Phase**
  - Displays phase response across frequencies.
- **Coherence Plot**

- ○ Indicates the quality of the measurement.
- ○ High coherence (close to 1) confirms a reliable relationship between the shaker input and sensor output.
- ○ Low coherence may indicate noise, mounting issues, or insufficient excitation energy.

---

6. Running the Random Test

To start the test:

1. Verify the correct **sensor**, **shaker**, and **test level**.
2. Click **Start Calibration**.

During execution:

- The status bar indicates **"Test In Progress"**.
- The shaker excites the system with broadband random vibration.
- The software continuously acquires data from both the reference sensor and the SUT.

Upon completion:

- The status changes to **"Ready"**.
- Results are displayed on the plots and numerical fields.
- Any out-of-tolerance conditions are clearly visible.

---

7. Signal Processing and Analysis

- The sensor output is analyzed using **FFT/DFT-based frequency-domain processing**.
- The software computes the **Power Spectral Density (PSD)** of both the reference sensor and the SUT.
- The SUT PSD is compared against the reference PSD to assess broadband response accuracy.

Typical Test Parameters

- **Frequency Band:** 20 Hz – 10 kHz (system dependent)
- **RMS Level:** 1 g RMS (typical)
- **Test Duration:** 20–30 seconds

Outcome and Benefits

- Provides a fast assessment of **overall sensor health and dynamic behavior**.
- Useful for **quick verification**, troubleshooting, and reducing total calibration time.
- Especially effective for detecting broadband issues such as mounting problems, cabling faults, or sensor degradation.

Single Point Frequency Test

Purpose

The **Single Point Frequency Test** is used to determine the **sensitivity of the Sensor Under Test (SUT)** at one specific frequency.
This frequency is typically the **reference frequency** specified by the sensor manufacturer and is the value reported on the **calibration certificate**.

Test Panel Description (As Shown in the Image)

1. Test Input Parameters

Located at the top of the panel:

- **Frequency (Hz)**

  - Defines the fixed excitation frequency for the test.
  - Common reference values include **100 Hz** or **159.2 Hz**.
  - The frequency remains constant throughout the test.
- **Amplitude (g)**
  - Specifies the vibration level applied by the shaker.
  - This value is held constant during the test (e.g., 0.5 g, 1 g, or equivalent m/s^2).
- **Sensitivity (mV/g)**
  - Displays the calculated sensitivity of the SUT after the test is completed.
  - This field is automatically updated based on the measured sensor output.

---

2. Test Control Buttons

- **Start**
  - Initiates the single point frequency calibration.
  - The shaker excites the sensor at the defined frequency and amplitude.
- **Close**
  - Exits the Single Point Frequency Test panel.

---

3. Test Sensor Details Panel

Displayed on the right side of the screen:

- Manufacturer
- Model Number
- Serial Number
- ID Number
- Nominal Sensitivity

- Measurement Range
- Reference Frequency
- Nominal Linearity

These details are automatically loaded from the **Running SUT Database** and ensure proper identification and traceability of the sensor being calibrated.

---

4. Time and FFT Monitoring Panels

Located in the lower-right section:

- **Time Domain View**
  - Displays the real-time vibration signal amplitude versus time.
  - Used to verify stable sinusoidal excitation.
- **FFT View**
  - Displays the frequency spectrum of the sensor output.
  - Confirms that the excitation energy is concentrated at the selected test frequency and free from distortion or harmonics.

Test Description

During the **Single Point Frequency Test**:

1. The shaker operates at **one fixed frequency**.
2. The vibration **amplitude is held constant**.
3. The sensor output is measured and compared with the reference standard.
4. The software calculates the sensor sensitivity using the ratio of output signal to applied acceleration.

Typical Test Parameters

- **Fixed Frequency:**
    - 100 Hz or 159.2 Hz (commonly used reference frequencies)
- **Constant Amplitude:**
    - Example: 10 m/s² RMS or equivalent g-level

Test Outcome

- The calculated **sensitivity value** (mV/g or pC/g) is displayed in the Sensitivity field.
- This value is:
    - Stored in the system database
    - Used as the **primary sensitivity result**
    - Printed on the **calibration certificate**

Importance of the Test

- Establishes the **reference sensitivity** of the sensor.
- Ensures compliance with calibration standards.
- Provides a repeatable and traceable measurement point for comparison with future calibrations.

Saving the Calibration Results

(Applicable to All Tests)

When a calibration test is completed, the results can be saved either by selecting **Save** from the by clicking the **Save** button on the active test panel.

Saving a test opens the **Calibration Certificate Setup** panel. All information entered in this panel is stored in the database and is identical to the data printed on the **calibration certificate**. This ensures that calibration results can be **recalled, reviewed, and reprinted** at a later date with all original details preserved.

Calibration Certificate Setup – Field Descriptions

The following table describes the controls available in the **Calibration Certificate Setup** panel and their purpose on the printed report.

Table 1 – Certificate Controls Printed on the Hardcopy Report

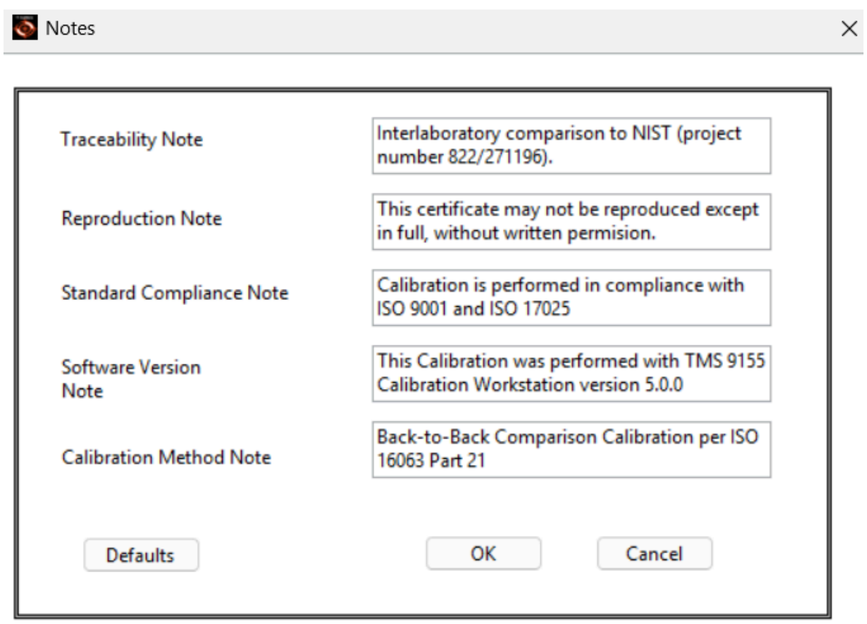
Control Name	Description
Certificate Title	Title printed at the top of every calibration report
Operator's Name	Name of the person performing the calibration
User Notes	Miscellaneous test notes to be included in the report
As Found / As Left Condition	Notes describing the condition of the SUT before and after calibration
Orientation	Direction of sensor travel relative to the opposite direction of Earth's gravity
Temperature	Ambient temperature at the time of test. Values may be entered in °C or °F; the alternate unit updates automatically
Humidity	Relative humidity at the time of test

Pressure	Ambient atmospheric pressure at the time of test
Digits of Precision	Number of decimal places printed on the report. This applies to significant digits for sensitivity and decimal places for tabular and phase data
Cal Sheet	Selects the calibration certificate template that will be previewed when the **Save/Preview** button is pressed

Advanced Certification Setup

In addition to the standard fields listed above, the hardcopy calibration report may contain **advanced notes and settings** that are modified less frequently.

These settings can be viewed or edited by clicking the **Advanced** button in the **Calibration Certificate**



Setup panel

Note:
If a customized calibration certificate is being used, some or all advanced fields may not be applicable or visible.

Saving and Previewing the Certificate

After completing all required fields:

- Click **Save/Preview**
    - Saves the calibration data and opens a preview of the calibration certificate for review or printing.

Once saved, the calibration results can be **recalled and printed at any time** with full traceability and original test information intact.

CONTACT US

Tyrannus Innovative Engineering and Research Academy Pvt. Ltd.
TrEST Research Park, TC- 4/2322, GEM building, (Opp) CET Thiruvananthapuram, Kerala
695016
GSTIN: 32AAFCT7371M1ZY
sales@tieraonline.in
www.tieraonline.in