MC6-T

Multifunction Temperature Calibrator and Communicator

Applies to firmware version 5.30

Dear user,

We have made every effort to ensure the accuracy of the contents of this manual. Should any errors be detected, we would greatly appreciate to receive suggestions to improve the quality of the contents of this manual.

For more information on the Beamex MC6-T Multifunction Temperature Calibrator and Communicator, please visit the MC6-T product page on Beamex website.

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Prologue

Thank you for buying Beamex MC6-T Multifunction Temperature Calibrator and Communicator.

The Beamex MC6-T is a reliable and stable, high-accuracy temperature dry block with built-in multifunction process calibrator and communicator. It provides versatility that no other temperature calibrator can match. The main features of MC6-T are its advanced functionality, enhanced usability and fully digitalized calibration process. It uses advanced, patented methods for following stability and ensuring safety.

MC6-T offers calibration capabilities for temperature, pressure, and various electrical signals. It also contains a multi-bus field communicator for HART, FOUNDATION Fieldbus H1, and Profibus PA protocols, allowing you to calibrate, configure, and trim your smart instruments.

It includes several intuitive user interface modes, optimized for different use cases and available in multiple languages. The calibrator guides you step by step through your calibration work and can even perform fully automatic calibrations.

Additionally, the MC6-T is a documenting calibrator that communicates with Beamex Calibration Management Software, enabling a fully digitalized calibration process.

There are two models available for the MC6-T. Models MC6-T150 and MC6-T660 provide a temperature range from -30 to 660 ºC:

- MC6-T150 can generate temperatures between -30 and 150 °C, at ambient temperature of 23 °C.
- MC6-T660 can generate temperatures between 50 and 660 °C.

Most measurement functions can be used with the rechargeable battery, without mains voltage connected.

This manual applies to both models.

Unpacking and Inspection

At the factory, each new MC6-T passes a careful inspection. It should be free of scrapes and scratches and in proper working order upon receipt. The receiver should, however, inspect the unit for any damage that may have occurred during transportation. If there are signs of obvious mechanical damage, package contents are incomplete, or it does not operate according to specifications, contact your Beamex representative as soon as possible.

A leaflet listing all standard accessories is included in the package. To verify the contents of your delivery, please check the leaflet.

About This Manual

The MC6-T User Manual is divided into several parts as follows:

- Safety - explains how to ensure safe use of the calibrator. Read the warnings carefully before using the calibrator.
- Specifications - includes information about the operating conditions and specifications of the calibrator.
- About MC6-T - provides an overview of the calibrator's hardware and software. It also explains how calibration capabilities can be expanded by utilizing other Beamex products and services, as well as battery, charger, and power management information.
- Calibration Capabilities and Connections - describes all the measurement, simulation and generation functions the calibrator supports. It also explains how to make the necessary connections to the calibrator’s terminals.
- Temperature Calibrator - covers the user interface mode optimized for temperature calibrations. Up to three instruments can be calibrated simultaneously.
- Calibrator - presents the user interface mode for calibrating various process instruments. It allows you to measure, simulate, or generate two signals at a time.
- Documenting Calibrator - explains the user interface mode for documented and automated calibration of various types of process instruments. Use the Documenting Calibrator together with Beamex LOGiCAL or CMX Calibration Management Software to fully benefit from the digitalized calibration process.
- Data Logger - describes the optional user interface mode designed for logging various measurement results over shorter or long periods of time.
- Communicator - outlines the user interface mode for viewing and editing the configuration of HART, FOUNDATION Fieldbus H1, or Profibus PA smart instruments.
- Working With Smart Instruments - explains how to use your smart instruments in various user interface modes of the MC6-T.
- Advanced Features - introduces various functionalities of the MC6-T that support your calibration process.
- Settings - presents how to edit different settings of the calibrator.
- Maintenance - provides a description of maintenance actions that can be performed by the user.

Typographical Conventions

The following typographical conventions apply to the MC6-T User Manual:

Bold text is typically used in cases like:

- keywords, such as terms and User Interface buttons
- other keywords, for example, fieldbus parameters

Note: This is a note. Notes typically provide important information to consider and remember.

Tip: This is a tip. Tips offer useful advice or practical information related to the current topic.

Caution: This is a caution. Cautions highlight situations that could result in damage to the calibrator if not observed. Always read cautions carefully and follow the instructions.

Warning: This is a warning. Warnings indicate situations that could cause serious injury or damage if not followed. Always read warnings carefully and comply with them to ensure safety.

Safety

MC6-T calibrator is a precision tool intended for use by skilled personnel who have read and understood this manual. Working with MC6-T involves the usage of temperature, pressure and/or electrical instruments. Make sure to know how to handle these instruments safely, including how to connect and disconnect temperature sensors, electrical test leads clips, and other accessories.

Use the MC6-T calibrator only if you are confident that it can be operated safely. Safe use of the MC6-T is no longer possible if any of the following cases are true:

- The enclosure of the MC6-T is visibly damaged.
- The MC6-T is not functioning as expected.
- There is an unusual smell coming from the unit's battery.
- The calibrator has been stored for a prolonged period under unfavorable conditions.
- The calibrator has suffered serious damage during transportation.

Certifications

The MC6-T complies with the EMC Directive and Low Voltage Directive. The EU Declaration of Conformity and the UK Declaration of Conformity contain approvals, certificates, and detailed standard references. The declarations are available under the Resources tab on the MC6-T page on the Beamex website.

Safety Symbols

The following safety-related symbols are used on the MC6-T.

	Caution! See manual for further information
	Caution! Hot surface

Safety Precautions and Warnings

Caution: Read and fully understand this manual and all other safety instructions before operating the Beamex MC6-T Multifunction Temperature Calibrator and Communicator.

Warning: Do not use the MC6-T in any way other than as described in this user manual. Using the calibrator in a manner not specified by the manufacturer may impair the protection it provides against hazards.

Caution: Working with the MC6-T involves the use of temperature, electrical, and pressure instruments. Only qualified and trained personnel with good experience and knowledge of high-temperature media, instruments, and connections are allowed to work with the Temperature Block. Incorrect use may result in damage to the device and/or personal injury.

Warning: Only use the calibrator for purposes and in environments specified in the user manual.

- Do not use in wet conditions.
- Do not use in pollutive environments.
- Do not use in potentially explosive environments.

Note: If the calibrator has been stored in different environment, allow it to stabilize to new environment before use.

Caution: Using the calibrator in highly pollutive environment, such as coal mines or steel factories, is not allowed unless the calibrator is stored and used in a non-pollutive area, for example, a dedicated calibration room with suitable air filters. Contamination by conductive dust can cause electrical hazard.

Warning: Do not tap the touch screen with sharp or hard objects or press hard on the display, especially with fingernails. Instead, tap lightly using your fingertips.

Warning: To ensure safe use of the MC6-T follow these rules:

- Use the correct type and rating Mains cord. The Mains cord of the calibrator is equipped with a grounding plug for your protection against electrical shock hazards. Plug it directly into a properly grounded socket.
- Always make sure the Mains inlet socket is easy to reach in case the Mains cord needs to be unplugged. It is located at the front of the device for maximum safety.
- Use the calibrator always in an upright standing position.
- Ensure that there is enough free space around the calibrator. To allow the correct ventilation, 25 cm is required on all sides and 1 m above the calibrator.
- Avoid touching sensors or inserts while they are hot. Greasy or dirty hands can leave marks and contaminate the surfaces.
- Avoid handling flammable objects near the calibrator.

Note: When transporting the unit in the field, set the handle to the Carrying position (see section MC6-T Handle) and treat the unit with extra care.

Note: For all measurement ports except IN and OUT, use cables not longer than 3 m.

Note: Sometimes it is necessary to use a portable radio transceiver while working with the calibrator. To prevent calibration errors caused by radio frequency interference, keep the radio at least 1 m away from the calibrator and the circuit under calibration while transmitting.

Warnings Concerning Temperature

Warning: The MC6-T is a temperature calibrator designed for calibrating instruments using typical industrial calibration procedures. It has not been designed for prolonged use at a fixed temperature setpoint. Very low and very high temperatures may cause injuries if touched. Temperatures below the dew point may cause condensation on cold surfaces in high-humidity environments. If water gathers on top of the calibrator, wipe the excess liquid away with a clean cloth. Do not leave the calibrator unattended. Always power off the calibrator when not in use.

Warning: Do not touch areas marked with the hot surface warning symbol (). These areas may become hot during use. Never leave the calibrator unattended while it is hot.

The hot warning symbol next to the screen will light up to indicate when the Temperature Block is hot.

Warning: Do not remove or insert the removable insert from or into the Temperature Block when the block's temperature is above 50 °C. Do not touch the insert when it is hot. Note that the instruments being calibrated may also become hot and must not be touched during calibration.

Note: MC6-T150: Always use an insert insulation for all temperature points.

Note: Use the sensor heat shield when calibrating sensors at temperatures above 150 °C to protect the sensor's handle and internal structures.

Warning: Do not use any heat-transfer media, such as oil or paste. Ensure that the Temperature Block boring is clean. If necessary, use a soft wipe or compressed air to clean it.

Warning: Avoid handling flammable objects or liquids near the calibrator, as they might catch fire.

Warning: The handle of the MC6-T must be in Down position during calibration to prevent it from becoming too hot.

Warnings Concerning Inserts

Warning: For reliable and safe performance of the calibrator, always use original Beamex MC6-T inserts.

Warning: Remove the insert when the calibrator is not in use. Use the insert removal tool for removing the insert.

Warning: Never place a hot insert in the accessory holder or transport case (optional accessories). The insert must not be removed from or inserted into the Temperature Block when block temperature is above 50 °C.

Note: Before first use, heat the inserts to the maximum block temperature and keep them there for 30 minutes.

Note: Use an insert with suitably sized holes for the temperature sensors, instruments to be calibrated, and the external reference sensor. The diameter of the boring may be at most 0.5 mm larger than the outer diameter of the instrument being calibrated.

Note: Avoid scratching or denting the inserts. Always use clean and undamaged inserts.

Warnings Concerning the Temperature Block

Warning: If the Temperature Block has been heated to temperatures above 50 °C, allow it to cool below this temperature before switching off the device.

Warning: If the Temperature Block has been cooled below the dew point, heat it up until all moisture has evaporated from both the Temperature Block and the insert. Cool the Temperature Block below 50 °C before switching it off.

Warning: Always remove the insert from the Temperature Block when the calibrator is not in use. Use the insert removal tool for this purpose.

Note: If the calibrator is not in use, it is recommended to keep the **Transport tap** inserted into the Temperature Block boring to minimize the risk of contamination.

Warning: Always switch off the Mains switch when the calibrator is not in use.

Warning: Never place the MC6-T inside a transport case if the Temperature Block temperature is above 50 °C or below the dew point.

Warnings Concerning Electrical Measurement and Generation

Warning: All MC6-T terminals are protected against overvoltage and overcurrent as far as possible without affecting accuracy. Do not connect signals that exceed the measurement range of the selected function.

The maximum output voltage from MC6-T terminals is below 30 V. However, if you connect voltages from both the IN and TC-R-OUT sections together, or connect external voltages to the MC6-T, the resulting voltage may be high enough to be hazardous.

There is no galvanic isolation between the USB and the external pressure module connectors.

Although there is a galvanic isolation between the MC6-T IN and TC-R-OUT sections, it is intended for functional purposes only. The R3 connector is also galvanically isolated from the other connectors. Do not exceed 60 V DC / 30 V AC / 100 mA between any terminals.

Functional insulation is not intended for protection against transient overvoltages. Do not connect measuring terminals to circuits where transient overvoltages may occur.

Warnings Concerning Pressure

Warning: Never exceed the maximum pressure of a pressure module. The maximum pressure is indicated on the module's sticker or in the user manual. Never exceed the maximum allowable pressures of optional pressure hoses.

Applying pressure above these limits can be hazardous.

We recommend using Beamex pressure hoses, fittings and optional pressure hose sets. If using other hoses or fittings, ensure they are of high quality and withstand the applied pressure.

Warning: Always depressurize the system before opening or connecting any pressure fittings or connectors. Use appropriate venting valves and ensure all connections are correct, with hoses and connectors in good condition.

Warning: For external pressure modules, always use the pressure media specified on the module:

- up to 20 bar (300 psi): dry, clean, inert, non-toxic, non-corrosive gases.
- higher than 20 bar (300 psi): clean, inert, non-toxic, non-corrosive gases or liquids.

Use of the wrong type of pressure media may destroy the pressure module or calibrator.

Warning: Never plug a hose with your hands or place your hands in front of a gas spray coming from a leak. A gas bubble in the bloodstream can be fatal.

Warnings Concerning High Pressure

Warning: High pressure is always dangerous. Only personnel with sufficient experience and knowledge of high-pressure liquid, air, and nitrogen operations are permitted to work with the pressure module. **Carefully** read these instructions and familiarize yourself with local safety regulations for high-pressure operations before starting use.

Warning: When using gas, ensure that the system does not contain any liquid, especially if you do not know how it may react under pressure. Use of clean air or nitrogen is recommended as the gaseous pressure media. Liquid pressure media should be preferred when using modules with a pressure range of 60 bar (30,000 psi) and higher.

Warning: If you use nitrogen, minimize the leakage to the atmosphere and ensure sufficient ventilation. Close the valve of the nitrogen cylinder, when the system is not in use. An increase in the percentage of nitrogen in the ambient air may cause unconsciousness and death without warning. **Carefully** read the safety instructions for nitrogen and make sure that other people in the same space are aware of the danger.

Use of liquid pressure medium is recommended with pressure measurement modules at higher pressure ranges. Use water or suitable hydraulic oil. Check that the liquid used is not aggressive against the materials of the transducer or tubing. When using liquid, minimize the amount of air in the system. This way you can minimize the amount of spilled liquid in case of leakage.

Warning: Do not use the same hoses with different liquids or gases.

Check the local regulations regarding the construction and use of pressurized vessels. The regulations usually apply to systems where the product of the pressure and volume exceeds a certain limit. The volume of the system depends on the instrument connected to it.

High-pressure gas is dangerous because it can break the container, and the flying splinters may cause injury. Also, small leaks of gas may be dangerous because the high velocity of the leaking gas jet enables penetration through skin. If a gas bubble gets into the bloodstream, it can cause death. The leak jet is particularly dangerous if some liquid is coming with the gas.

Warnings Concerning Smart Instruments

Warning: Configuring or calibrating an instrument while it is a part of a live segment is possible only with HART and FOUNDATION Fieldbus H1. When working on a live segment, first ensure that the control loop the instrument belongs to is set to manual. Always follow the instructions provided in the instrument's own manual.

Beamex is not responsible for any damage caused by connecting an MC6-T to a live factory fieldbus segment.

Warning: When working in PROFIBUS PA, never connect two master devices (e.g. MC6-T, a Field Communicator, or a control system) to the same segment at the same time. This will cause conflicts and make the fieldbus segment unstable. Always remove the instrument to be calibrated from the live segment before calibration.

Warning: Using an MC6-T to change instrument parameters may cause discrepancies, as a fieldbus host control system may mirror all instrument parameters in its permanent database. In such cases, when returning an instrument with changed parameters to a live segment, make sure the updated parameters are also entered into the control system's permanent database. Additionally, confirm that the new parameters do not lead to an unstable control loop.

Specifications

Each MC6-T is delivered with a traceable, accredited calibration certificate as standard, providing proof of its accuracy.

Note: Accuracy specifications for all measurement, generation, and simulation functions can be found under the Specifications tab on the MC6-T page on the Beamex website.

The temperature specifications are valid for ambient temperatures between 13 and 33 °C (55.4 … 91.4 °F). Outside of this range, temperature coefficients must be applied. For more information, refer to chapter User Sensors.

Table 1: General Specifications

FEATURE	VALUE
Temperature range at 23 °C (73 °F)	MC6-T150: -30 … 150 °C (-22 … 302 °F) MC6-T660: 50 … 660 °C (122 … 1220 °F)
Display	5.7" Diagonal 640 x 480 TFT LCD module
Touch panel	5-wire resistive touch screen
Weight	MC6-T150: 9.4 kg (20.7 lbs) MC6-T660: 8.6 kg (18.96 lbs)
Dimensions	322 mm x 180 mm x 298 mm (12.68" x 7.09" x 11.73")
Power requirements	230 V ±10%, 50/60 Hz, 380 W (MC6-T150), 1560 W (MC6-T660) 115 V ±10%, 50/60 Hz, 380 W (MC6-T150), 1560 W (MC6-T660)
Fuse size	MC6-T150: 230 V: T 3.15 A 250 V / 115 V: T 3.15A 250V MC6-T660: 230 V: T 8 A 250 V / 115 V: T 16 A 250 V
Operating temperature	0 … 45 °C (32 … 113 °F)
Operating humidity	0 … 90 % R.H. non condensing
Storage temperature	-20 … 60 °C (−4 … 140 °F)

FEATURE	VALUE
Storage Humidity	10 ... 60 % R.H. non condensing
Max. altitude	5000 m (approx. 16,404 ft)
Max. input voltage	30 V AC, 60 V DC
Pollution Degree	2 (only non-conductive POLLUTION is present, except for occasional temporary conductivity caused by condensation is expected)
Indoor use only	

Note: MC6-T150 heating and cooling modules experience a normal aging process during use, which can lead to an increase in the minimum reachable calibration temperature over time.

Table 2: Battery Pack Specifications

FEATURE	VALUE
Battery pack type	Rechargeable lithium-ion battery, 4300 mAh, 11.1 V
Charging time	Approximately 4 hours
Battery pack operation	10 … 16 hours
Battery pack storage temperature (charged 30%)	≤ 1 month: -20 … 45 °C (-4 … 113 °F) > 3 months: -20 … 30 °C (-4 … 86 °F)

Note: If MC6-T is not in use for an extended period, it is recommended to recharge it every 3 months.

Specifications are subject to change without prior notice. For the latest technical information, visit the MC6-T page on the Beamex website.

About MC6-T

Hardware Overview

MC6-T - Main View

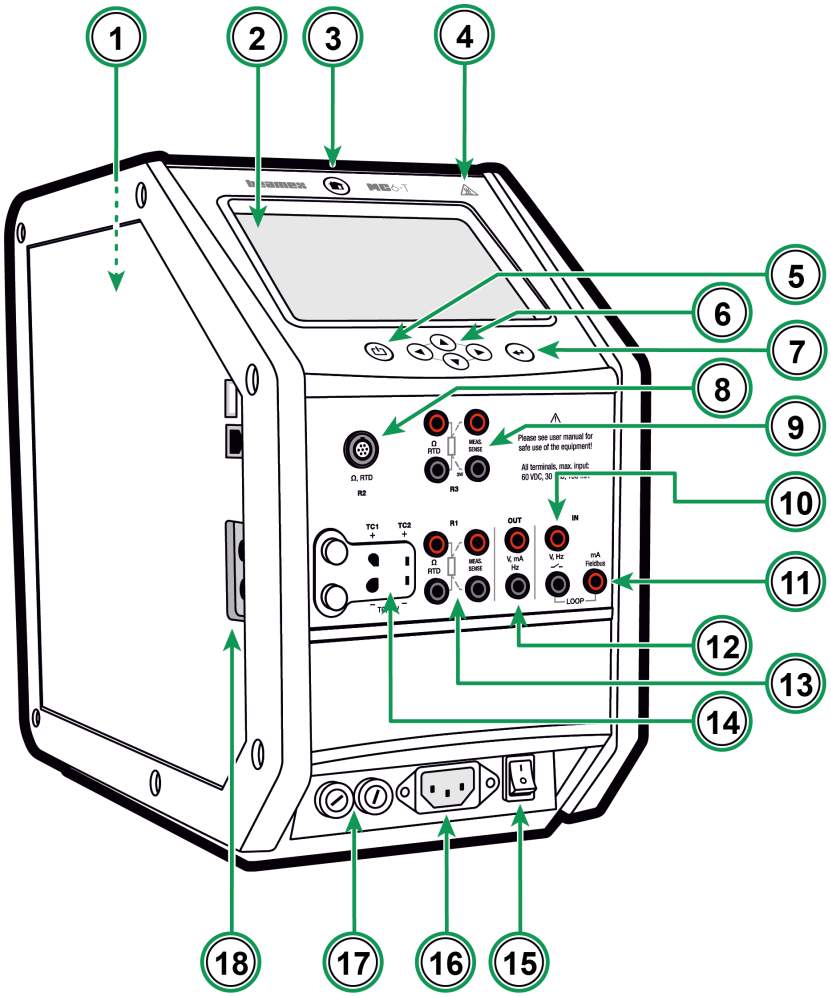


Figure 1: MC6-T, overview

Legend:

1. **Temperature Block**.
2. **Display** and **Touch Panel**.
3. **Home** button — press to return to Home View.
4. **Hot surface** warning indicator that **lights up** when the Temperature Block is hot.
5. **Calibrator Power** button. See more in chapter Power Management.

6. **Arrow** buttons — press once to display the hardware focus indicator.
7. **Enter** button — selects the item surrounded by the hardware focus indicator.
8. **RTD** and **Resistor** connector (**R2**).
9. **RTD** and **Resistor** terminals (**R3**).
10. **Voltage**, **Frequency**, and **Switch** input (**IN**).
11. **Current Measurement**, **Loop Supply**, and **Smart instrument** (HART and fieldbus) terminal (**IN**).
12. **Voltage**, **Current**, and **Frequency** output (**OUT**).
13. **RTD** and **Resistor** terminals (**R1**).
14. **Thermocouple** and **Millivolt** ports (**TC1** and **TC2**): TC1 supports cables and standard TC plugs, while TC2 is designed for TC plugs with flat contacts.
15. **Mains switch** (115 V/230 V). Refer to chapter Power Management for more details.
16. **Mains Inlet socket** (115 V/230 V) used to connect the the Mains cord.
17. **Fuse** holders.
18. **Connectors** on the left side of MC6-T.

MC6-T - Top View

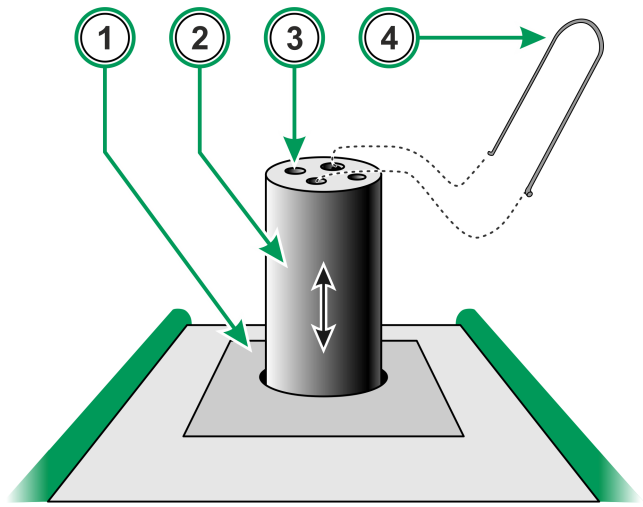


Figure 2: MC6-T, top view

Legend:

1. **Temperature Block boring** for inserts
2. **Replaceable insert** (sold separately)
3. **Insert boring**
4. **Insert removal tool**

Note: To calibrate temperature sensors and instruments of various diameters, use replaceable inserts with different sized borings in the Temperature Block. For more details, refer to chapter Inserts. You can find available insert types at the Beamex Webshop.

MC6-T - Side View

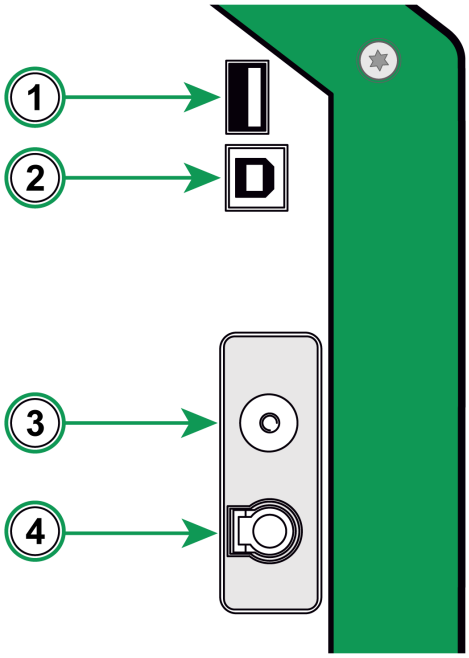


Figure 3: Connectors on the left side of MC6-T

Legend:

1. **USB-A** port for connecting various USB devices, such as external controllers and a Bluetooth adapter, to MC6-T.
2. **USB-B** port used for communication with a PC.
3. The optional **Internal Barometric Pressure Module** with a measurement opening.
4. **PX** connector (4-pin LEMO). Provides the possibility to connect Beamex external pressure modules to MC6-T.

Pressure Modules

Beamex offers a wide range of external pressure modules for MC6-T, covering pressure ranges from barometric up to 1000 bar. The MC6-T can only accommodate a barometric pressure module internally.

Only one external module can be connected to the calibrator at a time using the PX connector and a communication cable.

Barometric Pressure Module

The optional internal barometric pressure module is located inside MC6-T, with a measurement opening on the side of the calibrator. For accurate barometric pressure readings, do not plug the measurement opening.

Table 3: Available internal pressure measurement module type and its measurement range

Internal modules	Range		Pressure connection
PB	70 … 120 700 … 1200 10.15 … 17.4	kPa a mbar a psi a	10/32" (M5) female

Table 4: Available external pressure measurement module types and their measurement ranges

External modules	Range		Pressure connection
EXTB	70 … 120 700 … 1200 10.15 … 17.4	kPa a mbar a psi a	10/32" (M5) female
EXT10mD	±1 ±10 ±4	kPa diff mbar diff iwc diff	2 x adapters for 1/8” ID hose (3,2 mm)
EXT100m	0 … 10 0 … 100 0 … 40	kPa mbar iwc	Bx G1/8” male compatible with Beamex 40 bar hoses
EXT400mC	±40 ±400 ±160	kPa mbar iwc	Bx G1/8” male compatible with Beamex 40 bar hoses
EXT1C	±100 ±1 -14.5 … 15	kPa bar psi	Bx G1/8” male compatible with Beamex 40 bar hoses

EXT2C	-100 … 200 -1 … 2 -14.5 … 30	kPa bar psi	Bx G1/8” male compatible with Beamex 40 bar hoses
EXT6C	-100 … 600 -1 … 6 -14.5 … 90	kPa bar psi	Bx G1/8” male compatible with Beamex 40 bar hoses
EXT20C	-100 … 2000 -1 … 20 -14.5 … 300	kPa bar psi	Bx G1/8” male compatible with Beamex 40 bar hoses
EXT60	0 … 6000 0 … 60 0 … 900	kPa bar psi	Bx 1215 male compatible with Beamex 630 bar hoses EXT60: G1/4" B male
EXT100	0 … 10 0 … 100 0 … 1500	MPa bar psi	Bx 1215 male compatible with Beamex 630 bar hoses EXT100: G1/4" B male
EXT160	0 … 16 0 … 160 0 … 2400	MPa bar psi	Bx 1215 male compatible with Beamex 630 bar hoses EXT160: G1/4" B male
EXT250	0 … 25 0 … 250 0 … 3700	MPa bar psi	G1/4" B male
EXT600	0 … 60 0 … 600 0 … 9000	MPa bar psi	G1/4" B male
EXT1000	0 … 100 0 … 1000 0 … 15,000	MPa bar psi	G1/4" B male

Note: Use caution when working with pressure and pressure modules. For more information, see chapter Warnings Concerning Pressure.

MC6-T Handle

The MC6-T handle has three positions:

- **Carrying** – when gripped and used to carry the calibrator, the handle sits close to the center of mass, making it comfortable to carry.
- **Resting** – when released, the handle automatically falls to a resting position, making it easy to grip again when needed.
- **Down** – when pushed fully down, the top surface of the handle aligns with the calibrator's top surface. This position should be used during calibration and transportation.

Warning: Always ensure the handle is in the Down position when calibrating. The Resting position is designed to prevent the handle from being accidentally left in the Carrying position, which could cause it to overheat during high-temperature calibrations.

Memory and Data Management

The MC6-T can safely store a large amounts of data, such as instruments, calibration results, and data logs. The data is stored on solid-state memory that preserves information without requiring power. This shockproof memory ensures that no data is lost even if the calibrator is damaged.

All data is stored locally on the MC6-T. The calibrator does not transmit any user-entered or generated data to Beamex.

You can erase all data with a factory reset. For more information, see chapter Resetting the Calibrator.

Caution: Deleted data cannot be recovered.

Display

The MC6-T features a backlit 5.7" TFT LCD display with a resolution of 640×480 pixels and a responsive touch panel. You can operate the touch screen with your fingers, whether wearing gloves or not. Optionally, use a stylus designed for touch screens.

Tip: For brightness adjustments, see chapter Settings.

Warning: Do not tap the touch screen with sharp or hard objects, and avoid pressing hard on the display, especially with fingernails. Always tap gently with your fingertips. Using sharp tools like screwdrivers can damage the screen.

Battery and Charging

MC6-T is equipped with internal rechargeable Lithium-ion (Li-ion) battery pack, which can be charged at any time as it does not experience memory effect.

The MC6-T uses a built-in intelligent charger that maintains and charges the internal battery whenever mains voltage is connected and the Mains Switch is on. No separate charger is required.

Checking Battery Level and Charging Status

An icon indicating battery level is visible in several user interface views.

Figure 4: Battery level icons

Battery operating time without recharging varies based on the use of the display backlight and transmitter supply voltage. Under constant full load, the standard rechargeable batteries should provide approximately 10 hours of use. In typical conditions, an average operating time of 16 hours can be expected.

Note: An approximate time (hh:mm) appears on the battery icon:

- **Charging time remaining** — while charging
- **Operating time remaining** — while running on battery

For detailed battery and charging status, tap the battery icon.

Caution: The MC6-T internal clock and calendar consume a small amount of power even when the calibrator is switched off. Check the battery capacity periodically, even if the MC6-T is not being used. Turn it on to recharge when necessary.

Power Management

The startup procedure ends in the **Home View**.

MC6-T has two power buttons:

- **Mains switch** — powers all functions of MC6-T, both the Temperature Block and Process Calibrator.

- **Calibrator Power** button — powers only the Process Calibrator, even when not connected to mains voltage.

Note: In Process Calibrator mode, electrical and pressure functions are active, but the Temperature Block is disabled. The Temperature Block, including the R3 terminals, is only operational when MC6-T is connected to mains voltage.

Use the same power button you used to switch on the unit to power it off. Turning off the Mains switch disables all functions except a few.

Warning: If the Temperature Block has been heated above 50 °C, allow it to cool below this temperature before switching off the MC6-T.

Warning: Always switch off the Mains switch when the unit is not in use.

The Temperature Block must be cooled below 50 °C before turning off the Mains switch. When the Mains switch is switched off, MC6-T enters Standby mode, allowing faster startup when the Calibrator Power button is pressed again.

If the Temperature Block is not cooled down before switching off the Mains switch, MC6-T enters Temperature Warning mode and will prevent powering off. You will be prompted to switch the Mains switch back on to accelerate cooling. When turned on, cooling starts automatically in silent mode. Set the temperature setpoint close to ambient to minimize cooling time. If the Mains switch is not turned back on, MC6-T will enter Standby mode only when it is safe to do so.

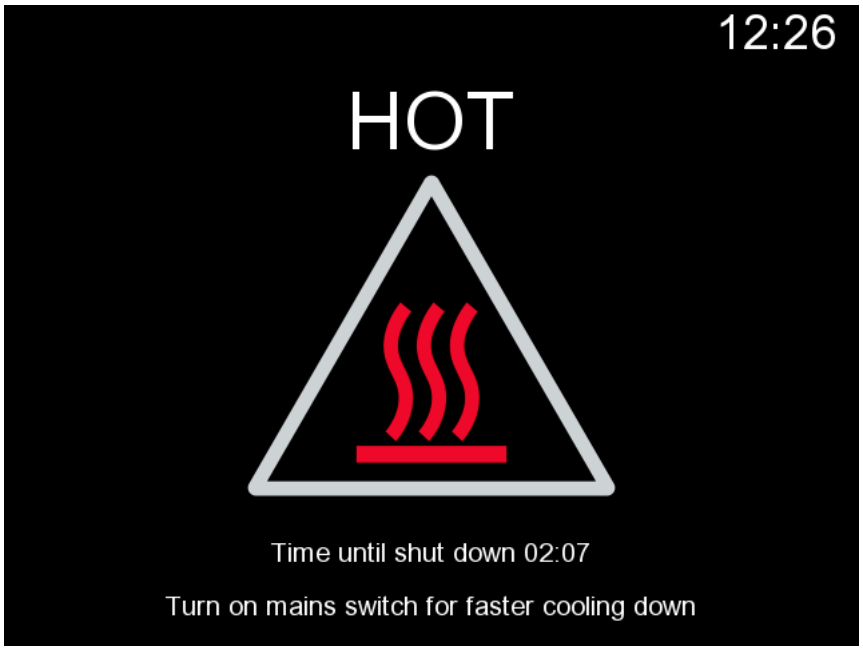


Figure 5: Temperature warning mode prompt

If the calibrator is in use when the Mains switch is turned off, the Process Calibrator will remain on and, if possible, continue its current operation. The Process Calibrator must be powered off using the Calibrator Power button once it is no longer needed.

Note: The calibrator is considered in use in the following cases:

- when adjusting MC6-T own measurement, generation, or simulation ranges
- when a data log is in progress
- when an instrument calibration is in progress in Documenting Calibrator.

Pressing the **Calibrator Power** button while the MC6-T is running opens the Power Menu dialog with the following options:

- **Calibrator Power Off** — shuts down the Process Calibrator, using minimum battery power and requiring full startup on next power-on.
- **Standby** — puts the Process Calibrator into Standby Mode, allowing faster startup when the Calibrator Power button is pressed again.
- **Backlight Off** — temporarily turns off the display backlight

Note: When the Mains switch is on, the Calibrator Power Off and Standby options are disabled for safety reasons. To fully power off MC6-T, use the Mains switch.

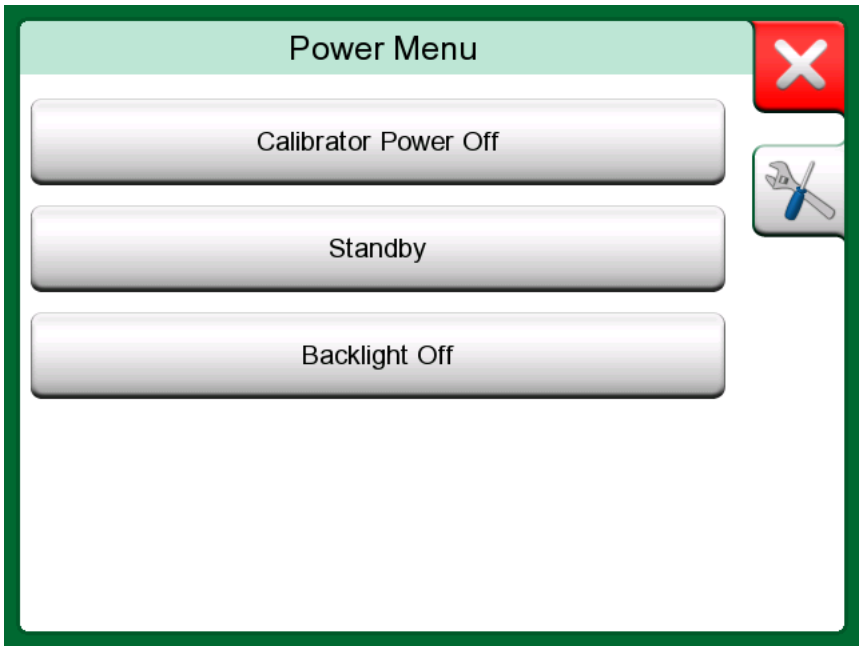


Figure 6: Power Menu dialog

Pressing the **Tools** button ( ) in the Power Menu window opens **Power Management** window, where you can adjust the Backlight Brightness and set auto-off delays for the backlight, display, and calibrator to save battery power.

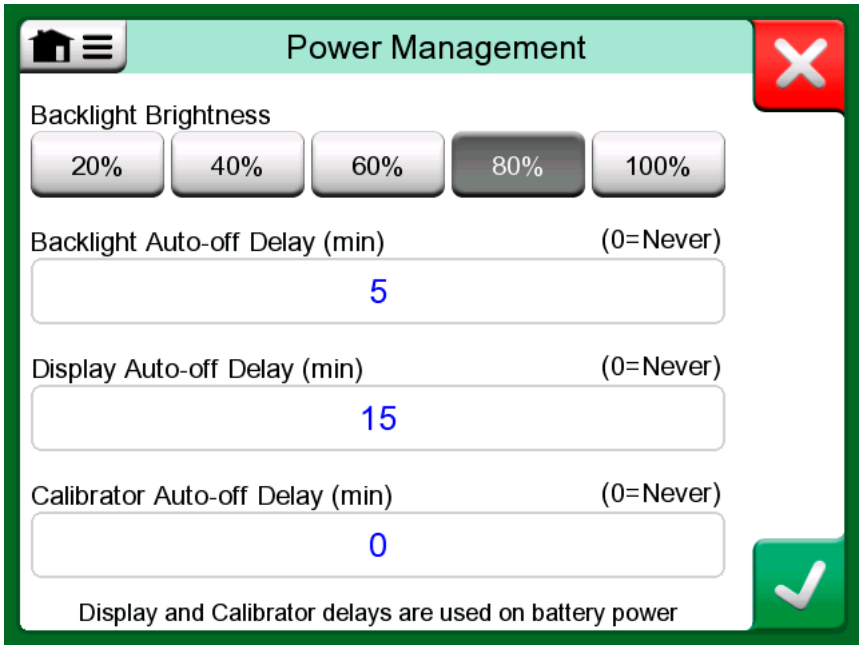


Figure 7: Power Management window

Note: Auto-off is disabled when the calibrator is in use.

Note: Auto-off feature is disabled in the following cases:

- Mains voltage is connected
- Adjusting MC6-T own measurement, generation, or simulation ranges
- A data log is in progress
- An instrument calibration is in progress

User Interface

The MC6-T offers several user interface modes optimized for different use cases.

Note: Some modes are optional and become available after enabling the software option.

Home View and User Interface Modes

Starting from the MC6-T **Home View**, you can access any available user interface mode. This manual provides detailed information on the main user interface modes as follows:

- Temperature Calibrator
- Calibrator
- Documenting Calibrator
- Data Logger
- Communicator
- Settings

Figure 8: Home view

Tip: Use the **Home** button to quickly return to the Home View from anywhere.

Figure 9: Home button

Interacting with MC6-T

You can interact with MC6-T by tapping the available buttons and controls displayed on the touch screen. Alternatively, use the hardware **Arrow** buttons to navigate between buttons and controls. The first time you press a hardware **Arrow** button, the hardware focus indicator appears as a blue border around the active button or control. When navigating with the hardware Arrow buttons, press the hardware **Enter** button to confirm a selected button or control.

Figure 10: Button with and without hardware focus indicator

Buttons often open pop-up windows for entering data—for example, tapping a unit button labeled mmH_2O opens a pop-up window with available units. Some buttons have special functions, such as **Accept** and **Close** buttons, which close pop-up windows and either confirm or cancel changes. Other buttons allow you to move to the next or previous page or scroll through wide tables. **Back** button () can, for example, delete a number in a numeric field or clear a numeric field.

Figure 11: Accept button (left) and Close button (right)

The **Menu** button, located in the upper left corner of nearly every window, opens a context-sensitive menu.

Figure 12: Menu button

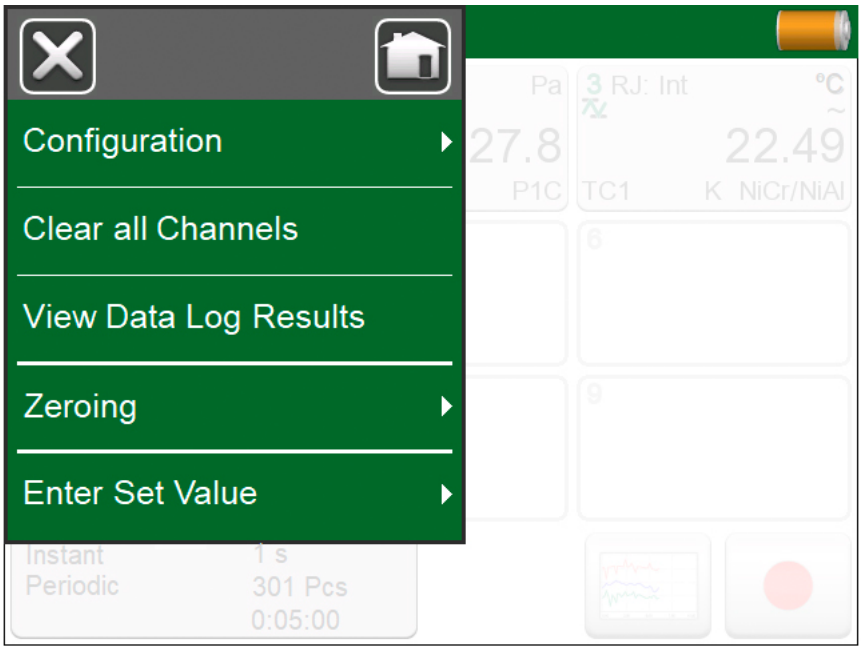


Figure 13: Open menu example

Check Boxes are a special type of button that can be either checked or unchecked.

Figure 14: Check boxes – checked (top) and unchecked (bottom)

MC6-T also includes flat buttons, commonly used in lists. Their color may vary depending on the context. For example, to visually group calibration events, combined results belonging to the same event share the same shade of gray background. If an instrument's settings have changed, the related field displays a blue background.

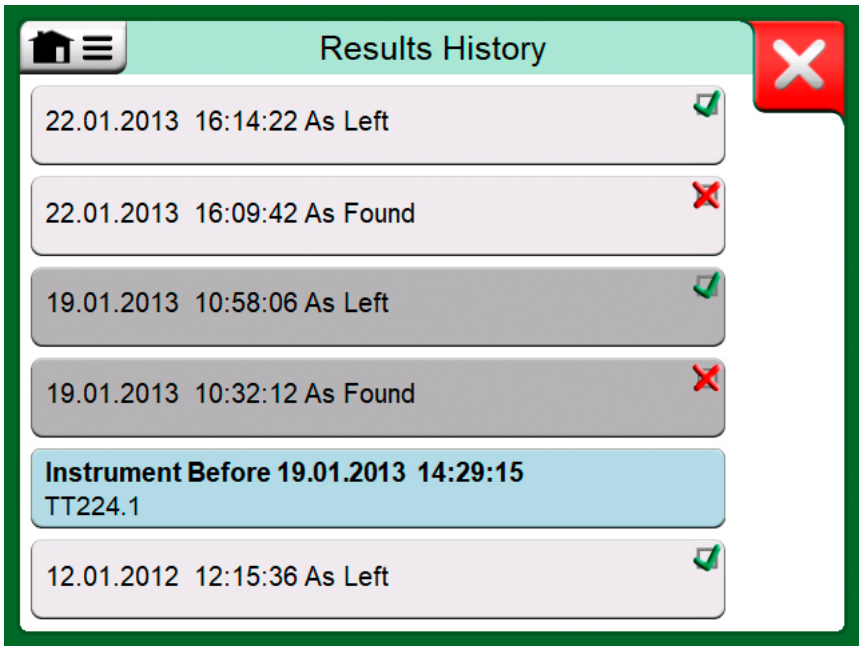


Figure 15: Flat button list example

Editable Fields

The following editable fields are available:

- **Text fields**,
- **Numeric fields** (in certain cases including Spinning)
- **Date/Time fields**.

Text Fields

Letters and numbers in editable fields are shown in **blue** to indicate that they can be modified. **Black** text represents descriptive user interface labels that are not editable. An example of a text field and its edit window is shown in the images below.

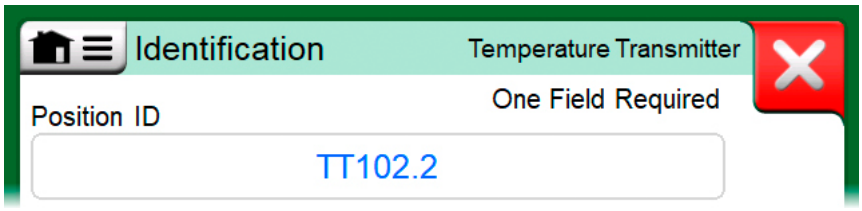


Figure 16: Text field

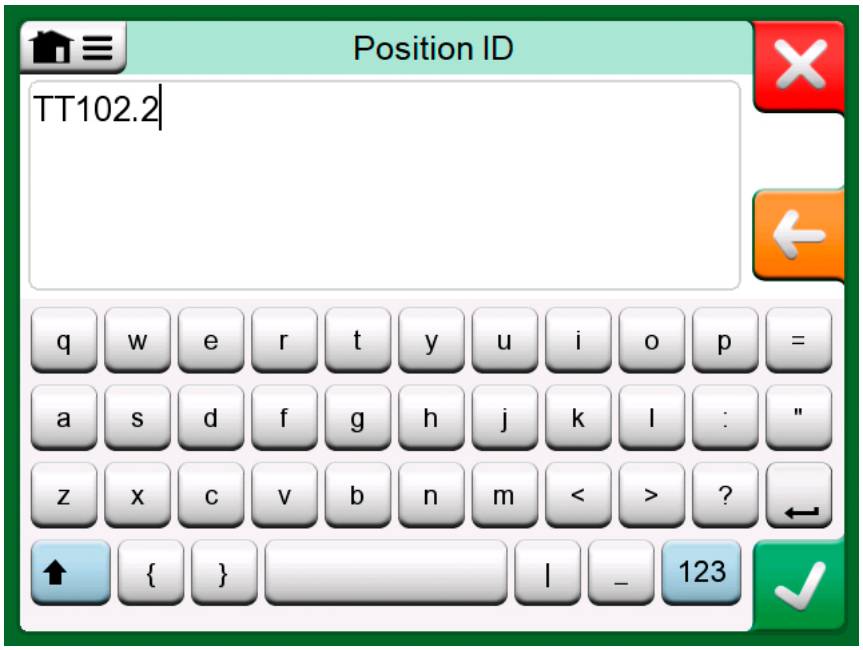


Figure 17: Text edit window

Numeric Fields

Numeric fields are used when a generated, simulated, or other numerical value is either empty (displaying dashes) or when a new value is needed. To enter a value:

1. Tap the field to open the **soft numeric keypad**.

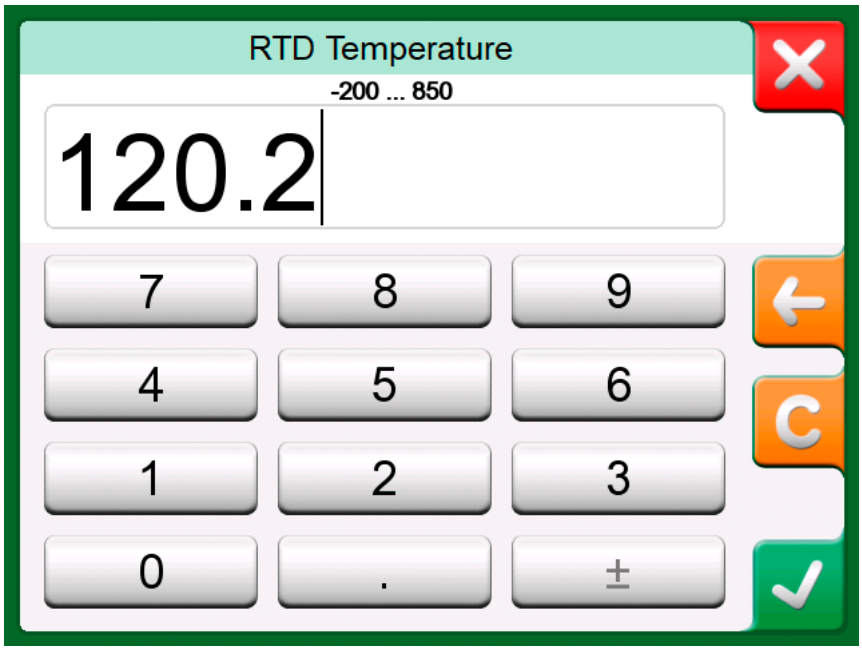


Figure 18: Soft numeric keypad

2. Use the keypad to enter the desired value.

Tip: Use the **Clear** button () to clear the entered value. The **Back** button () will delete the number to the left of the cursor.

3. Close the keypad by tapping **Accept** button — the entered value will then be applied.

Note: MC6-T may use the entered value as a source for determining resolution. To ensure useful resolution, include trailing zeros where appropriate.

When applicable, **minimum and maximum limits** for the value are displayed above the numeric entry. If you enter a value outside these limits and attempt to accept it, MC6-T will stay in the keypad window and replace your entry with the nearest acceptable limit, highlighting the replaced value.

Note: Because the MC6-T uses floating-point numbers with six significant digits, rounding errors may occur in the seventh digit. When converting between binary and decimal values, exact matches may not always be found.

Tip: To input very small or large numbers into the **Factor** field, use the context-sensitive menu in the **Soft Numeric Keypad**. When available, this menu lets you insert an exponent and enter values in scientific notation, like 5.775E-07.

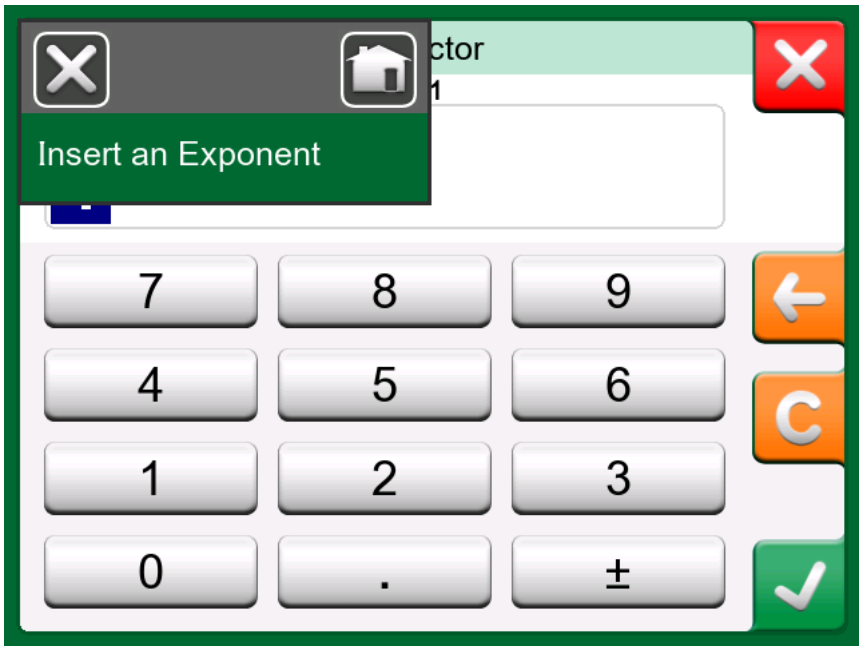


Figure 19: Context-sensitive menu in Factor window — Insert an Exponent

Spinning

Spinning is a tool available in **Calibrator** and **Documenting Calibrator** modes. It allows small, digit-by-digit adjustments to an existing numeric value.

Non-empty numeric fields in generation and simulation windows have a **Spinner** button ( ) to the left of the value. Tap the **Spinner** button to activate spinning.

Figure 20: Active spinner

When spinning is active, one digit will be highlighted. Use the **Up** and **Down** arrow buttons to increase or decrease its value. **Left** and **Right** arrow buttons will move the highlight to another digit.

Figure 21: Inactive spinner

To stop spinning, tap the **Spinner** button again.

Note: Changes made with the Spinner are applied immediately to the generated or simulated signal.

You cannot exceed the function's defined minimum and maximum limits.

The spun value follows the resolution rules of the function.

If the numeric field is empty (showing dashes), you must first enter a value using the soft numeric keypad before you can use the Spinning tool.

Date/Time Fields

Date and time fields work as a specific case of numeric fields. Entering a date is done in the same way as entering a numeric value using the soft numeric keypad.

Setting the time for MC6-T is a special case of the Spinning functionality.

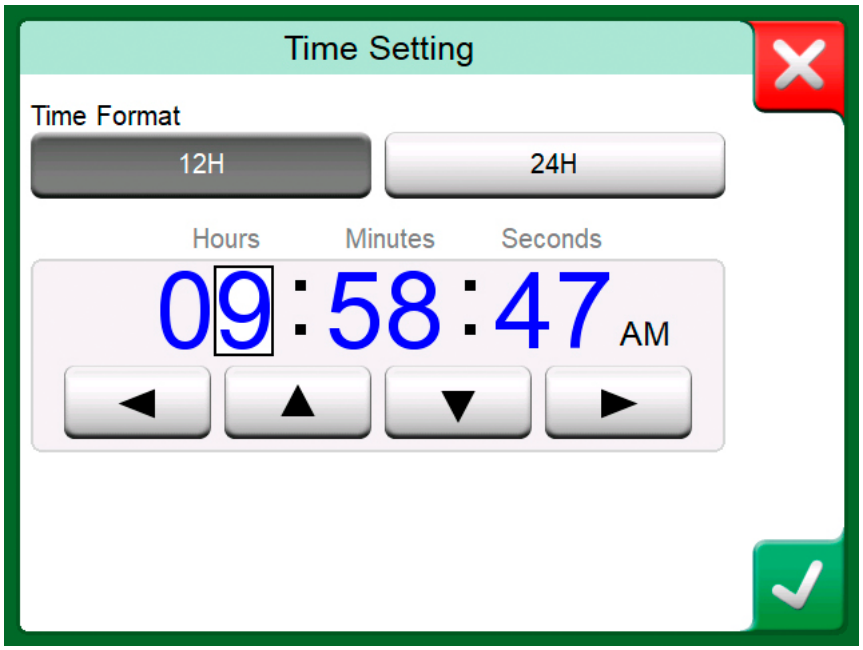


Figure 22: Time Setting window

Calibration Management Software

The MC6-T communicates with Beamex CMX and LOGiCAL Calibration Management Software, supporting a fully digitalized calibration process.

The MC6-T must be connected to a PC to communicate with the software. It operates with Microsoft's generic USB driver (WinUSB) and supports Windows® 11 operating system.

Communicating with LOGiCAL

MC6-T communicates with LOGiCAL via the Beamex Sync application installed on a PC. Communication options include USB cable or wireless communication.

For wireless communication, a **Wireless Communication** option and Bluetooth adapter are required. More details are provided in chapter Wireless Communication.

For instructions on syncing data between MC6-T and LOGiCAL using Beamex Sync, refer to the *LOGiCAL Help*.

Communicating with CMX

MC6-T150 is compatible with CMX version 2.12.2 and later, while MC6-T660 works with CMX version 2.12.1 and later.

The MC6-T can establish direct communication with a PC with CMX installed, using either a USB connection or Bluetooth.

For Bluetooth communication, a wireless option and Bluetooth adapter are required. More details are provided in chapter Wireless Communication.

In addition to local connections, MC6-T can communicate with CMX over Wide Area Networks via the Calibration Web Service Interface (CWSI).

Customers may either implement a local CWSI environment or use Connect.beamex.com, a secure web service hosted by Beamex.

For more details about transferring data between MC6-T and CMX, refer to the *CMX User Manual*.

Options, Accessories and Services

To support your changing needs, Beamex regularly releases firmware updates that add features and enhance performance. You can also upgrade your

calibrator with additional hardware modules or software options. Accessories are available in the Beamex Webshop. For further details, contact Beamex.

Software Options

The following software options are available:

- **Communicator options for HART, FOUNDATION Fieldbus H1, or Profibus PA** allow the calibrator to function as a fieldbus communicator. All three options can be installed in the same unit. The Communicator user interface mode is activated when any of these protocols are installed.

> **Note:** Fieldbus hardware capability must be installed with FOUNDATION Fieldbus and Profibus PA Communicator options. You can verify if the communication hardware required for fieldbus communication is installed on the first page of the **Settings** > **About** window.

- **Data Logger** allows logging of various measurement results. The Data Logger user interface mode is activated only if this option is installed.
- **Communication drivers** are available for external pressure controllers and temperature dryblocks, enabling fully automatic calibration of various pressure and temperature instruments.
- **Wireless Communication** functionality supports wireless transfer of instrument and calibration data between MC6-T and Beamex Calibration Management Software.

> **Note:** Bluetooth is an alternative data transfer method between the calibrator and PC. USB cable connection is also supported.

- **Mobile Security Plus** technology ensures calibration data integrity during calibrations. This option works only with CMX Calibration Management Software, version 2.11 or later, and when the Mobile Security Plus option is installed in CMX and the MC6 family calibrator.

> **Note:** The software options installed in your MC6-T can be viewed on the third page of the **Settings** > **About** window.

> **Note:** You can purchase additional software options for your existing calibrator. After purchase, Beamex provides you with an option file (.opt). The option file is installed on the calibrator using the **MC6 Option Installer** PC tool. To purchase options, please contact Beamex Sales.

Inserts

To calibrate temperature sensors of different diameters, replaceable inserts with appropriately sized holes must be used. The hole diameter should be 0.2...0.3 mm (0.0079...0.012") larger than the sensor's outer diameter, but no more than 0.5 mm (0.02"). For safe and reliable operation, always use original Beamex MC6-T inserts.

Each MC6-T150 insert includes two insulation rubber shields—either solid or with holes matching the insert. These shields help prevent condensation when operating at temperatures below ambient.

Inserts are not included with the standard delivery. Standard options are available in the Beamex Webshop, and custom inserts can be designed upon request.

Accessory Holder

An optional **Accessory holder** is available for both MC6-T models, making it easier to:

- carry accessories when working in the field,
- store additional accessories, and
- secure the Mains cord safely out of the way.

Note: The **Accessory holder** for the MC6-T660 model also includes a heat shield, designed to protect the instrument to be calibrated from excess heat during high-temperature applications. Always use the heat shield when calibrating at temperatures above 150 °C to prevent damage to the handle and internal structure of the instrument to be calibrated.

Figure 23: Accessory holder, fully equipped shows the **Accessory holder**'s components — common parts for both MC6-T models and those specific to each (MC6-T150 on the left, MC6-T660 on the right).

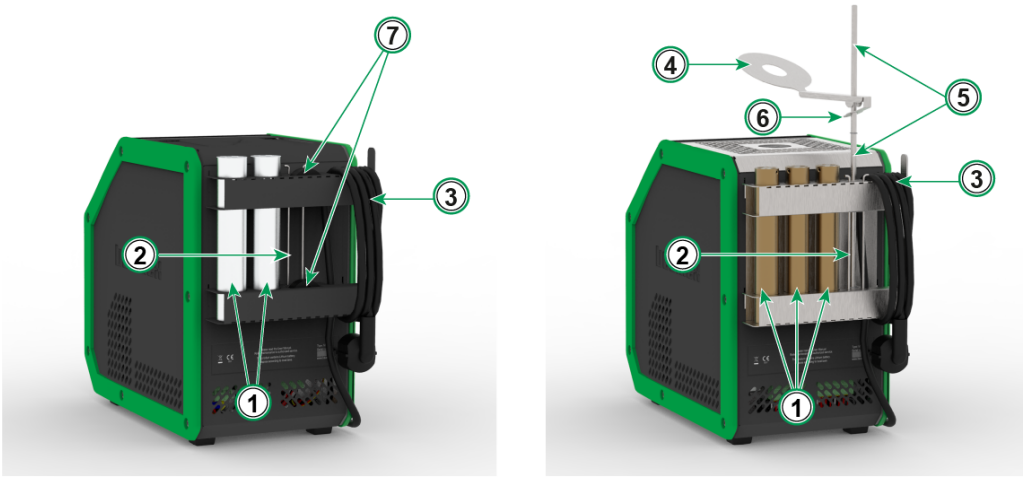


Figure 23: Accessory holder, fully equipped

Legend:

1. **Cut-outs** designed to store inserts.
2. **Insert removal tool**.
3. Holder for the **Mains cord**.
4. **Heat shield**.
5. Mounting support for the **Heat shield**.
6. **Heat shield tongue**.
7. **Cut-outs** for storing insert insulation.

Assembly

If the **Accessory holder** is ordered together with the MC6-T unit, it's attached at Beamex before delivery. If purchased separately, a Torx T20 tool is included for assembly. Follow these steps to attach the **Accessory holder**:

1. Loosen the two screws holding the side panels in place (**A** in Figure 24: MC6-T660 transportation position).
2. Slide the **Accessory holder** into position and tighten the screws back in place.
3. To detach the **Accessory holder**, carry out the assembly steps in reverse order.

Figure 24: MC6-T660 transportation position

To install the heat shield (MC6-T660 model only):

1. Connect the two parts of the heat shield mounting support by twisting them together.
2. Screw the assembled heat shield mounting support into the threaded hole on the right side at the bottom of the **Accessory holder**.
3. Slide the heat shield onto the mounting support, pressing gently on the **Heat shield tongue** (6 in Figure 23: Accessory holder, fully equipped).
4. Adjust the shield's position to provide effective protection for your sensor during calibration.

Note: When moving within the factory, it's recommended to place the accessories in their designated transportation positions, as illustrated in Figure 24: MC6-T660 transportation position.

Accessories and Related Products

You can use the MC6-T together with a wide selection of complementary products, including Beamex ePG Electric Pressure Pump and Controller, RPRT, IPRT, and SIRT temperature sensors, EXT External Pressure Modules, and calibration pumps for different pressure ranges. Visit the Beamex website for more details.

Accessories are available in the Beamex Webshop.

Services

Like any precision instrument, calibrators require regular calibration to maintain accuracy and meet compliance requirements. Keeping your calibrator up to date with scheduled recalibrations ensures reliable performance and extends its service life.

Beamex provides calibration services, repairs, and service plans to support the long-term performance of your equipment.

For details, visit the Beamex website.

Available PC Tools

A selection of PC tools is available under the Resources tab on the MC6-T page on the Beamex website. Available tools include:

- **Data Log Viewer** – transfer and view logged data from the calibrator on your PC. See chapter Data Log Viewer for details.
- **Option Installer** – install optional features on your calibrator. After purchasing a software option for an existing calibrator, Beamex creates and delivers an option file (.opt) to you.
- **Remote Controller** – control the calibrator from a PC, which is particularly useful for training purposes and capturing user interface screenshots.
- **Device Description Installer** – transfer updated Device Descriptions from your PC to the calibrator. More details can be found in chapter Device Description Files.
- **Fieldbus Configuration Viewer**– view and manage smart instrument configurations. Additional information is available in chapter Managing Smart Instrument Configurations in MC6-T.

Calibration Capabilities and Connections

The MC6-T is a high-accuracy, multifunction calibrator designed for calibrating temperature, pressure, and a variety of electrical signals. This section of the user manual describes all the measurement, generation, and simulation functions the MC6-T can perform.

Each diagram shows which connectors and terminals to use for each function, along with the required connection cables and any optional connections.

Tip: The connection diagrams are also available in the Documenting Calibrator user interface mode to help make the required connections for the selected measurement, generation, or simulation function.

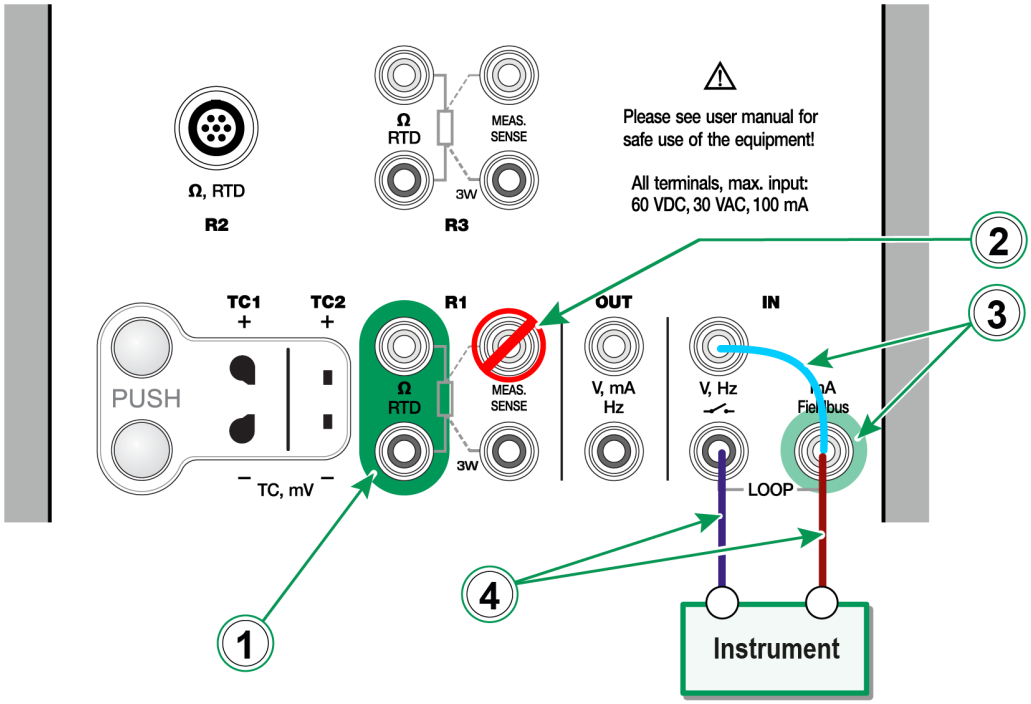


Figure 25: Connection diagram example

Legend:

1. Active terminals
2. Terminal not to be used
3. Possible optional connections
4. Connection cables

Note: When the Mains switch is turned off, the Temperature Block and R3 settings are disabled.

Note: Keep in mind that starting a measurement, generation, or simulation in one subwindow reserves the necessary terminals on the MC6-T, which may affect the availability of certain functions in the other subwindow. To release the terminals, tap the quantity button and then select **Stop** button.

For information about using external controllers like pressure controllers and temperature dry blocks in Calibrator and Documenting Calibrator modes, see chapter Controller Communication.

Temperature Generation

Two models available for the MC6-T:

- MC6-T150 — generates temperatures between -30 … 150 °C (-22 … 302 °F), at ambient temperature of 23 °C
- MC6-T660 — generates temperatures between 50 … 660 °C (122 … 1220 °F).

When you generate temperature using the **Temperature Block**, you have to decide whether to use the **internal reference sensor** or an **external reference sensor**. Using a high-accuracy external reference sensor typically results in better calibration accuracy and lower uncertainty. The internal reference sensor is permanently built into the Temperature Block and doesn't directly measure the temperature of the insert. The external sensor, on the other hand, is placed inside the insert, much closer to the temperature sensor or the instrument to be calibrated.

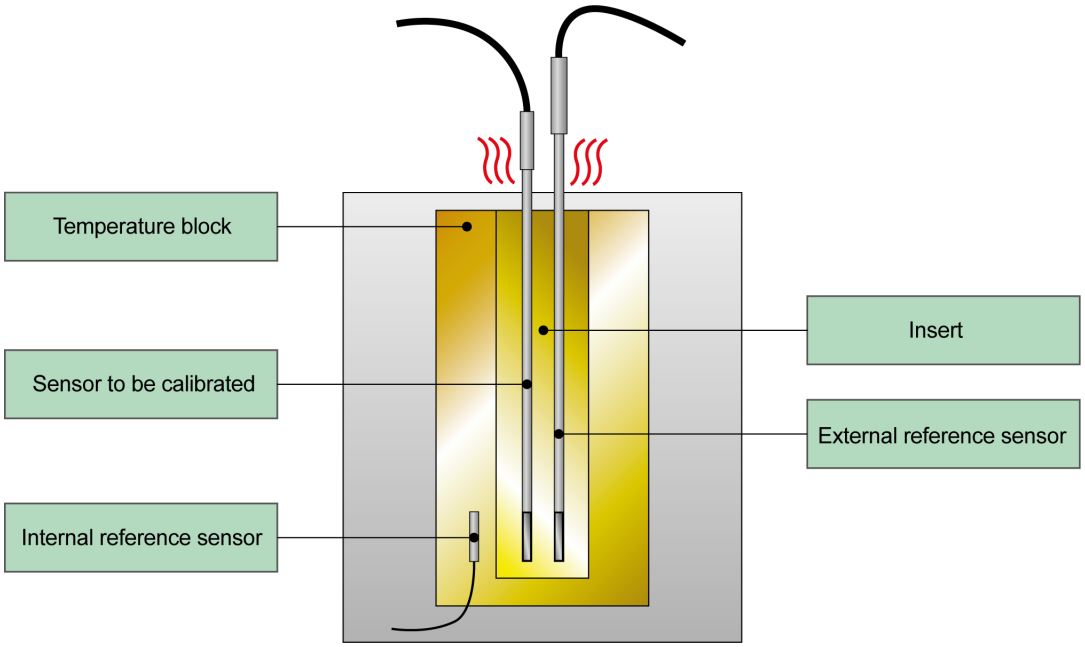


Figure 26: Internal vs external reference sensor

For internal reference use, no connections are needed. Select the Internal Reference in the Temperature Calibrator mode or use **Temperature Instrument – Wizard** in Documenting Calibrator.

To use an external reference, connect it to one of the temperature measurement ports and place it in an insert boring with suitable size. See connection diagrams in sections Temperature Measurement (RTD) or Temperature Measurement (Thermocouple).

Note: Temperature changes happen slowly and it takes time for the temperatures to stabilize before recording the measurement results. For additional information about stability, refer to section Additional Stability Check.

Note: Make sure your reference sensor has accuracy appropriate for the instrument being calibrated. Generally, RTDs offer better accuracy than thermocouples.

Note: When calibrating an instrument with **automatic acceptance**, make sure the wait time is sufficient for the temperature to stabilize. The required time depends on several factors, such as how well the sensor fits into the insert and the thermal conductivity between the insert and sensor, as well as within the sensor itself. Allow enough time for proper stabilization.

Measurements

Temperature Measurement (RTD)

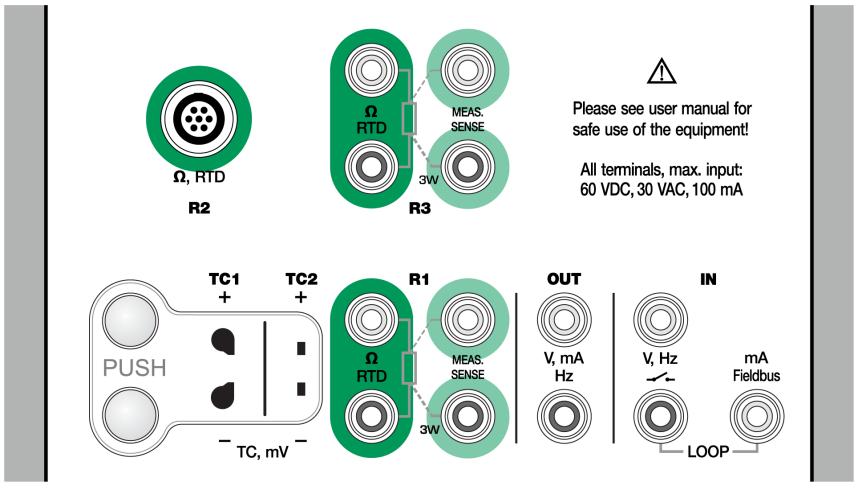


Figure 27: RTD temperature measurement terminals

MC6-T supports a range of standard Platinum Resistance Temperature (PRT) RTD sensors, available when RTD Temperature is selected as the Quantity. Always confirm the sensor type on your connected device and set the same type in your MC6-T unit. Incorrect settings will lead to inaccurate measurements. The available measurement range depends on the selected sensor type.

For R1 and R3 terminals:

For 2-wire measurements, use the two leftmost terminals. MC6-T automatically detects and displays the wiring configuration (2-wire, 3-wire, or 4-wire) when a connection is made.

Note: For 3-wire systems, use the terminal marked "3W".

For R2 connector: All Beamex temperature sensors use a 6-pin LEMO connector compatible with the R2 connector. If you need to connect a non-Beamex Pt-sensor, suitable adapter cables can be found in the Beamex Webshop.

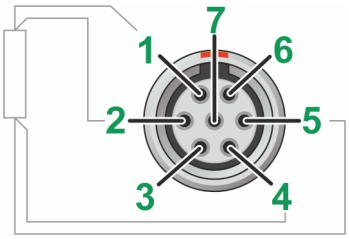


Figure 28: Female connector (R2) in MC6-T

R2 connector pin layout:

1. Excitation current +
2. Sense +
3. 1-Wire Ground
4. Sense -
5. Excitation current -
6. 1-Wire IO
7. Not used

See also chapters:

- RTD Simulation
- Resistance Measurement
- Resistance Simulation

Tip: To ensure proper contact between the test leads and the device under test, we recommend using the supplied alligator clips.

Note: If you encounter a “+OVER” or “-OVER” error, check your connections. You can also use the 2-wire resistance measurement function to verify the wiring.

Temperature Measurement (Thermocouple)

MC6-T has two thermocouple ports: **TC1** for standard thermocouple plugs and cables, and **TC2** for plugs with flat contacts.

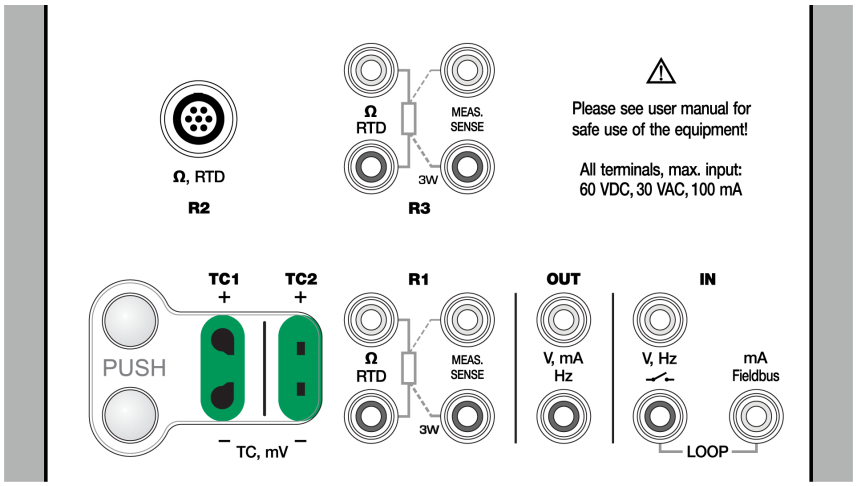


Figure 29: Thermocouple temperature measurement terminals

Before starting measurements, confirm the sensor type of your connected device and select the corresponding thermocouple type in your MC6-T. Choosing the wrong type will result in unreliable data. The available measurement range depends on the sensor type. Make sure to also select an appropriate **Reference Junction** compensation method. Incorrect settings will result in invalid measurement results.

See also chapters:

- Thermocouple Simulation
- Voltage Measurement

Warning: When using another thermocouple or an RTD connected to MC6-T to measure the external reference junction temperature, remember that there is no galvanic isolation between the connected devices.

Note: Thermocouple measurements can be sensitive to errors caused by poor connections, incorrect extension cables, or wrong settings in MC6-T. If you're uncertain about your setup, see chapter Thermocouple Connections and consult thermocouple reference materials.

Resistance Measurement

Measurement range: **-1 … 4040 Ω**

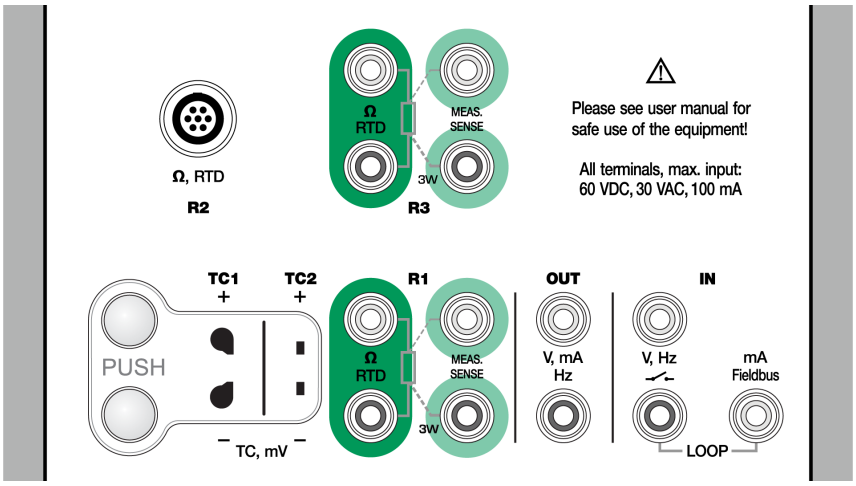


Figure 30: Resistance measurement terminals

For R1 terminals:

For 2-wire measurements, use the two leftmost terminals. MC6-T automatically detects and displays the wiring configuration (2-wire, 3-wire, or 4-wire) when a connection is made.

Note: For 3-wire systems, use the terminal marked "3W".

For R2 connector: All Beamex temperature sensors use a 6-pin LEMO connector compatible with the R2 terminal. If you need to connect a non-Beamex Pt-sensor, suitable adapter cables can be found in the Beamex Webshop.

See also chapters:

- Resistance Simulation
- Temperature Measurement (RTD)

Note: To ensure proper contact between the test leads and the device under test, we recommend using the supplied alligator clips.

Note: If you encounter a “+OVER” or “-OVER” error, check your connections. You can also use the 2-wire resistance measurement function to verify the wiring.

Current Measurement

Measurement range (internal supply): **-101 … 101 mA DC**

When measuring electric current, you need to decide whether MC6-T will supply the 24 V **loop supply voltage**. If it does not, an external device must be used to provide the loop supply voltage.

The connection depends on the selected loop supply setting.

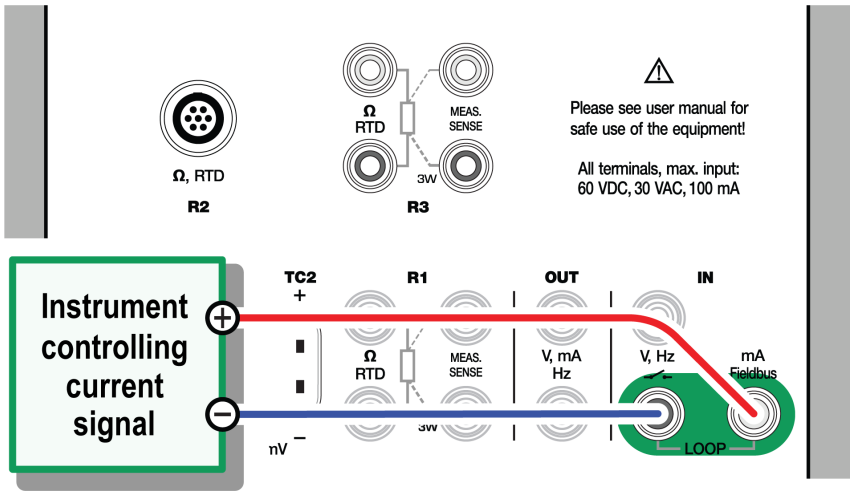


Figure 31: Current measurement terminals, internal supply

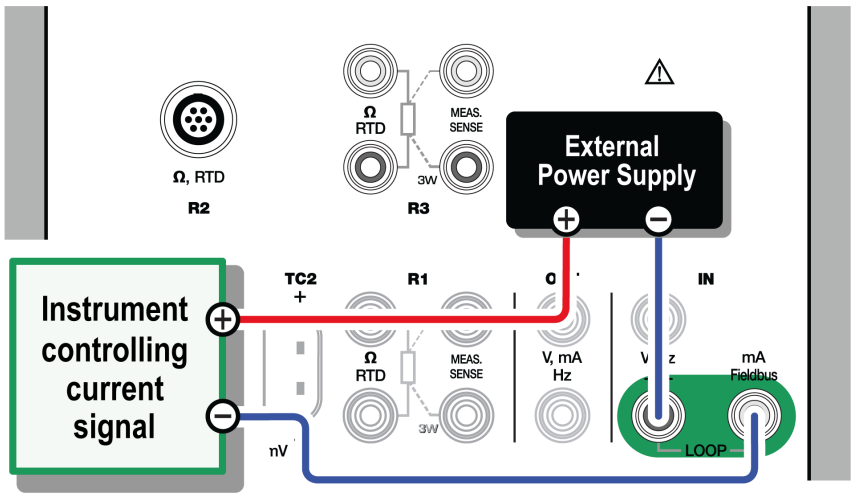


Figure 32: Current measurement terminals, external supply

See also chapter:

- Current Generation (Source or Sink)

Voltage Measurement

The voltage measurement ports available on MC6-T, along with their ranges, are listed below:

- **TC1** Measurement range: -1.01 … 1.01 V DC
- **TC2** Measurement range: -1.01 … 1.01 V DC
- **IN** Measurement range: -1.01 … 60.6 V DC

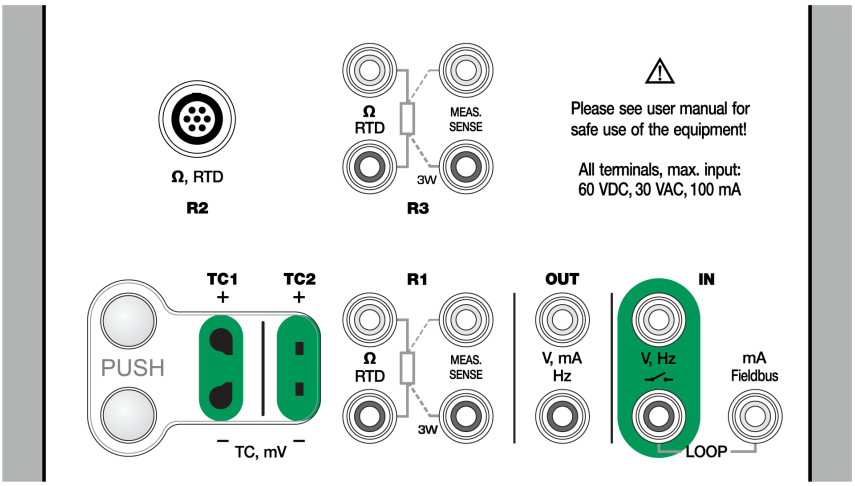


Figure 33: Voltage measurement terminals

Note: Non-supported thermocouple signals can be measured with MC6-T using the TC1 or TC2 ports. The result will be shown in millivolts (mV), and you'll need a reference table to convert those values into temperatures.

Tip: The **Scaling** function, available in Calibrator user interface mode, makes it possible to convert millivolt readings into temperatures.

Warning: Never apply hazardous voltages (over 30 V AC or 60 V DC) to the MC6-T terminals.

See also chapters:

- Voltage Generation
- Temperature Measurement (Thermocouple)

Frequency Measurement

Measurement range: **0.0027 … 51 000 Hz**

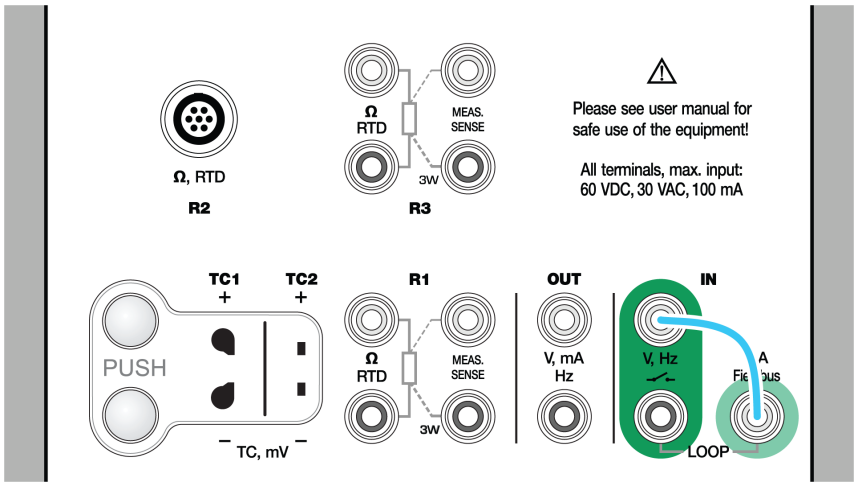


Figure 34: Frequency measurement terminals

When measuring frequency, be sure to select an appropriate **Trigger Level** setting. You can access the settings by pressing the Trigger Level button.

Figure 35: Trigger Level button

There are separate trigger level options for dry and wet contacts:

- **Dry Contact, Supply 3V** — typically, the signal comes from a mechanical switch. MC6-T supplies 3 V and sets the trigger level to 1 V, allowing it to detect the state of the contact.
- **Wet Contact** — the signal has its own internal voltage supply. You only need to set the trigger level voltage in the calibrator to detect the signal state. The value can also be manually adjusted using the **Custom 1.0V** flat button.

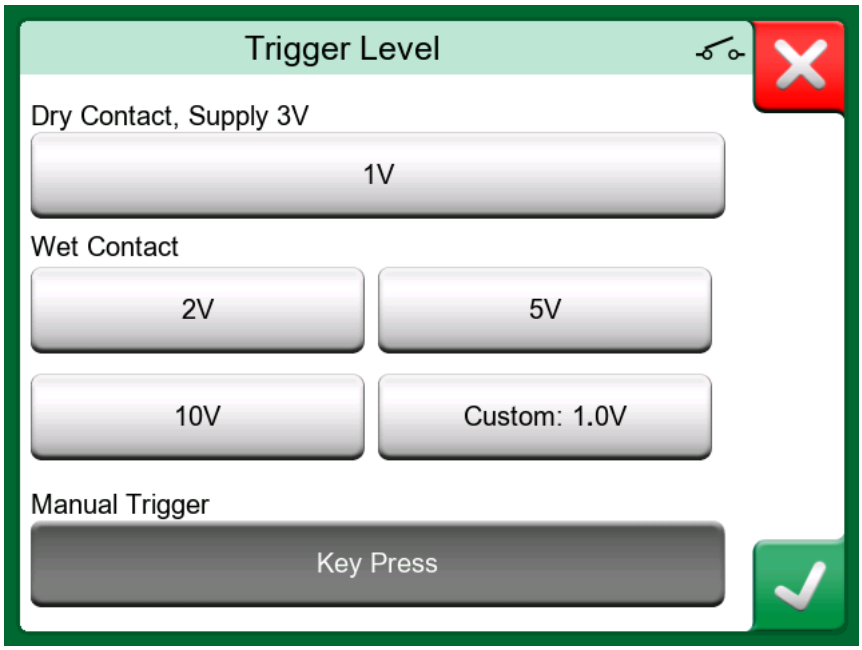


Figure 36: Trigger Level window

See also chapters:

- Frequency Generation
- Pulse Counting
- Switch Sensing

Pulse Counting

Measurement range: **0 … 9,999,999 pulses**

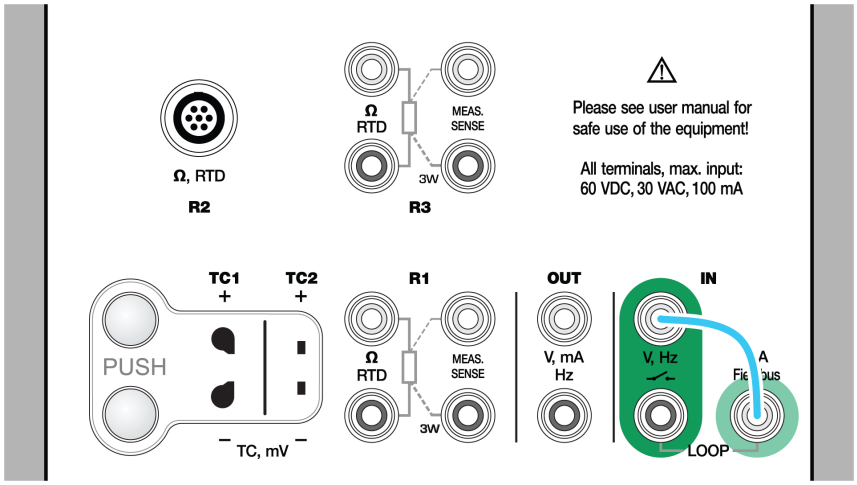


Figure 37: Pulse counting terminals

Before you start or restart a pulse count, make sure to check the following settings:

- **Trigger Level** — choose a level appropriate for your signal. For details, see chapter Frequency Measurement.
- **Trigger Edge** — set to either rising or falling edge, depending on your needs.
- **Zeroing** — use this to reset the pulse count to zero if needed.

Figure 38: Trigger Level, Trigger Edge, and Zeroing buttons

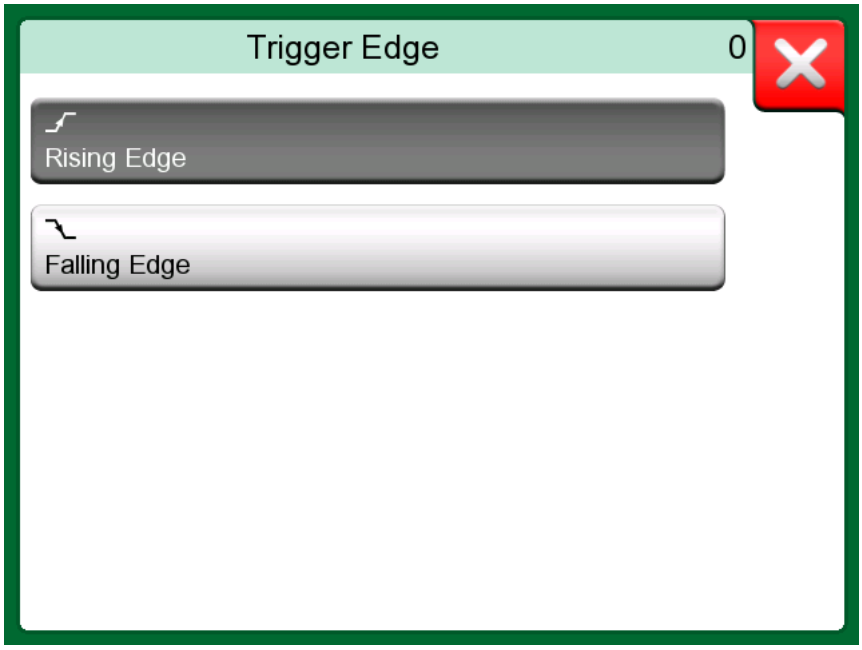


Figure 39: Trigger Edge window

See also chapters:

- Pulse Generation
- Frequency Generation
- Frequency Measurement

Switch Sensing

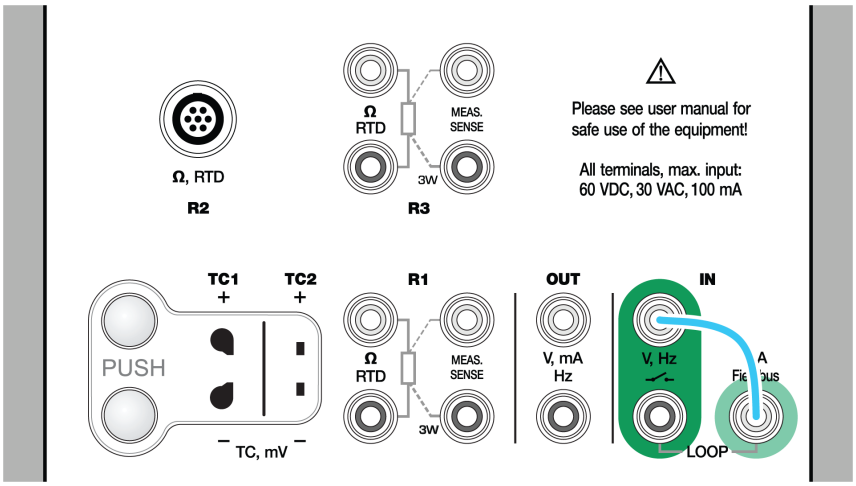


Figure 40: Switch sensing terminals

Make sure to check the following switch sensing settings:

- **IN: Normal** — allows you to reverse the open/close indication of the switch.
- **Trigger Level** — choose a trigger level suitable for your switch.
- **Switch Sound** — decide whether MC6-T plays a sound when the switch changes state, and define which event triggers it.

Figure 41: Trigger Level and Switch Sound buttons

Note: As an alternative, you can select the Manual Trigger, which enables calibrating non-electrical switches.

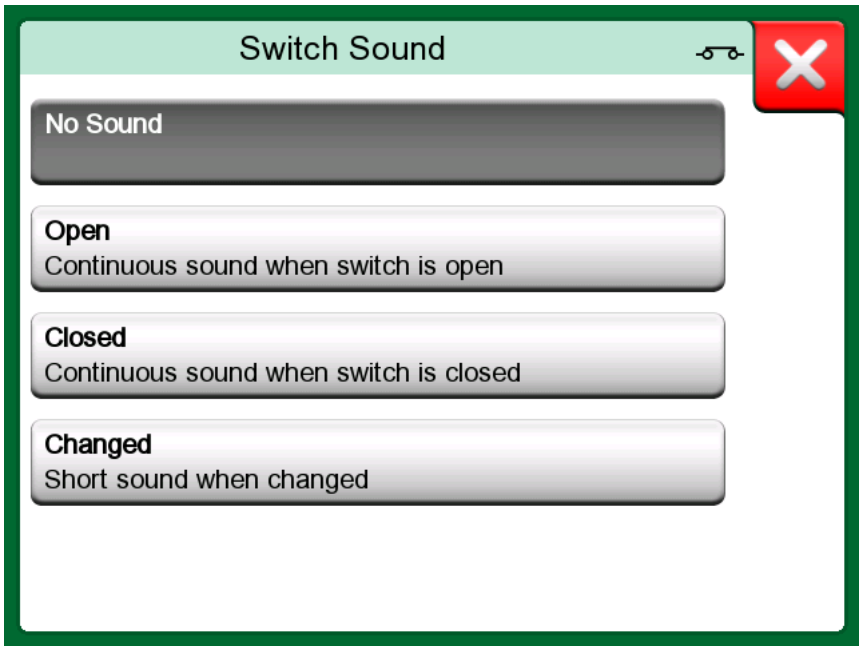


Figure 42: Switch Sound window

See also chapters:

- Pulse Counting
- Pulse Generation

Tip: Switch sensing can also detect binary signals.

By default, an open switch equals **1 / True** — and a closed switch equals **0 / False**.

Tip: For switches without an electrical contact, use the Manual Trigger by pressing the **Switch** button ( ) during calibration.

Pressure Measurement

MC6-T supports external pressure modules **EXT**, when connected to **PX** connector. Additionally, MC6-T offers an optional internal Barometric Module for measuring atmospheric pressure. When combined with a gauge EXT module, MC6-T can display the absolute pressure for any range supported by the connected EXT module.

You can find the available pressure module types and their measurement ranges in chapter Pressure Modules.

Warning: Always choose a pressure module with a measurement range appropriate for your pressure signal. Using a module outside its intended range can cause inaccurate results, damage to the module, or safety risks.

Caution: Accurate pressure measurement requires understanding the different **pressure types**: absolute, gauge, and differential. Measuring pressure without adequate knowledge of these types or the hazards of pressure devices can lead to incorrect measurement results and potentially serious accidents.

Please refer to the warnings in chapter Warnings Concerning Pressure.

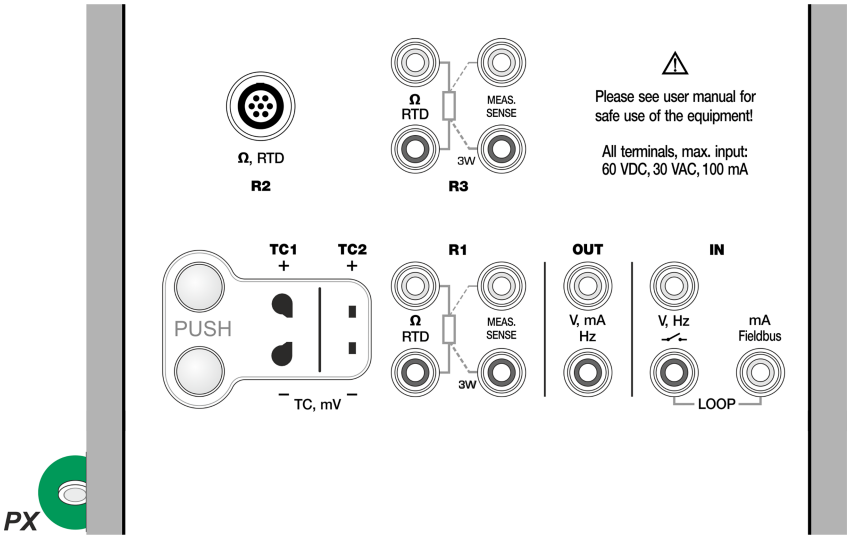


Figure 43: PX connector for external pressure measurement module connection

Before starting pressure measurements, check these settings:

- **Pressure Type** — lets you select the appropriate type based on your measurement setup.
- **Zeroing** — allows you to set the pressure module reading to zero.

Figure 44: Pressure measurement buttons

Note: If a selected pressure module does not display zero when no pressure is applied, it must be zeroed. To zero a pressure module, ensure zero gauge pressure is applied, then press the **Zero** button (▸0◂).

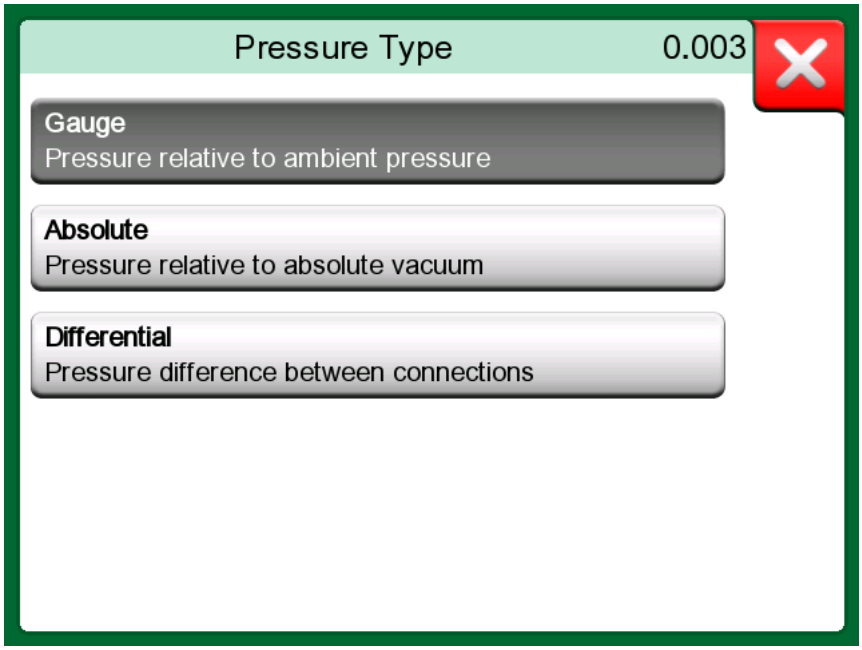


Figure 45: Pressure Type window

User-Defined Pressure Units

When pressure is selected as the **Quantity**, you can choose from a wide range of pressure units organized across multiple pages. Additionally, you can add your own custom pressure units to the following page(s)

To create a new custom unit, go to the **Configuration** page, press **Create New** button (), and give the unit a clear, descriptive name.

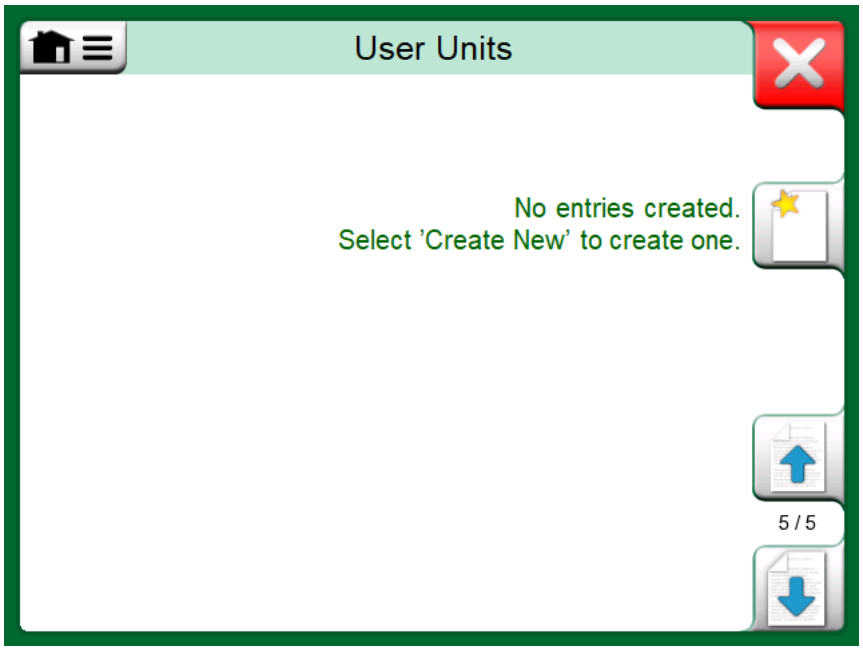


Figure 46: User Units window — Create New button for user-defined pressure units

Next, select a **Reference Unit** and enter the **Factor**, which defines the relationship between your new unit and the reference unit. The **Reference Unit** can be any of the predefined pressure units available in MC6-T.

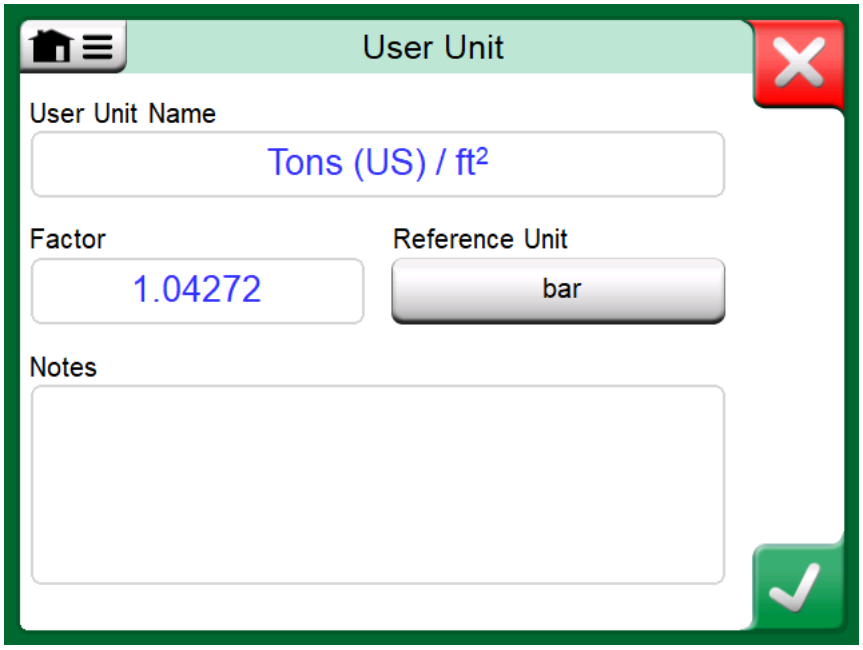


Figure 47: User-defined pressure unit configuration window

Whenever a custom unit is in use, a warning symbol (⚠) appears next to the unit's name, as shown in the example below. together with the name of the user defined pressure unit, as shown in the example below.

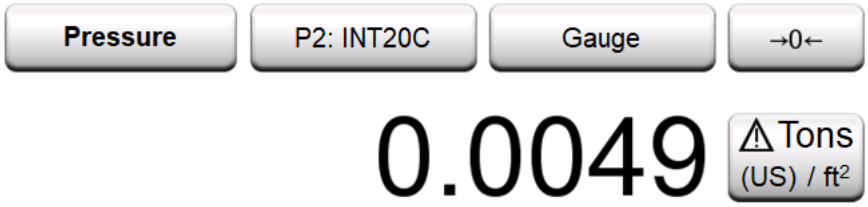


Figure 48: User-defined pressure unit example in Calibrator

Other user interface modes display the custom unit in a similar way.

Note: To select **pressure** as a **Quantity**, make sure you have either an internal barometric module or an external pressure module connected to MC6-T.

Connecting and Disconnecting External Pressure Modules

All Beamex EXT external pressure modules use a 4-pin LEMO connector compatible with the PX connector.

When you connect an external pressure measurement module, MC6-T opens a dialog where you can review information and select where to use the connected module.

You can disconnect an external pressure module whenever needed. MC6-T will notify you when a module has been removed, and if it was active in a measurement, that measurement will stop.

Note: When using MC6-T with an EXT module together with CMX or LOGiCAL, keep the module connected to the calibrator while communicating with the software. This ensures that, if the module has been recalibrated, its calibration date is automatically updated in the CMX/LOGiCAL reference database.

Electrical Generations and Simulations

Generations and simulations are supported in all user interface modes.

RTD Simulation

RTD simulation is available only from the R1 terminals.

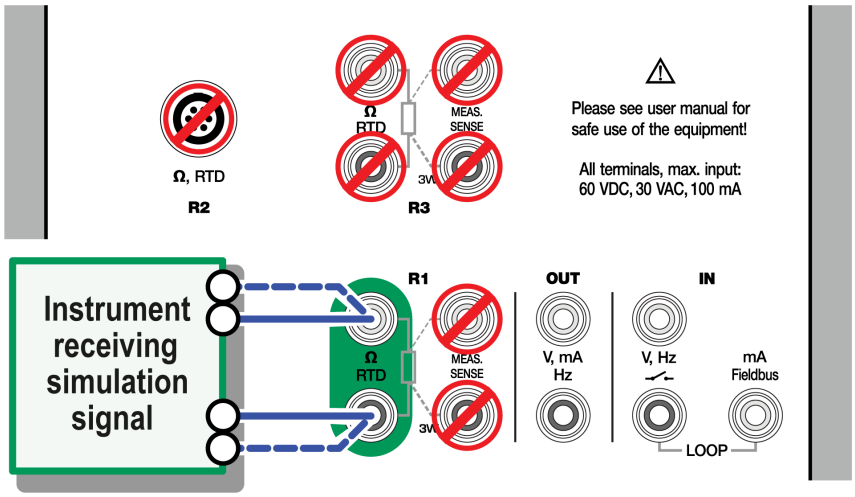


Figure 49: RTD simulation terminals

The receiving instrument determines whether a 2-, 3-, or 4-wire connection is used. Connect any additional third and fourth wires as required but always **use only the two leftmost R1 terminals** in MC6-T.

Always confirm the sensor type on your connected device and set the same type in your MC6-T unit. Incorrect settings will lead to inaccurate measurements. The available measurement range depends on the selected sensor type.

See also chapters:

- Temperature Measurement (RTD)
- Resistance Simulation

Warning: Keep in mind that RTD simulation accuracy can be affected if the connected transmitter uses a test pulse function that cannot be disabled.

Tip: To ensure proper contact between the test leads and the device under test, we recommend using the supplied alligator clips.

Note: AC measurement current from the device under test is not supported. If the device under test uses pulsed measurement current, include a delay of a few milliseconds before measuring resistance.

Thermocouple Simulation

Thermocouple simulation is available only from the TC1 terminals.

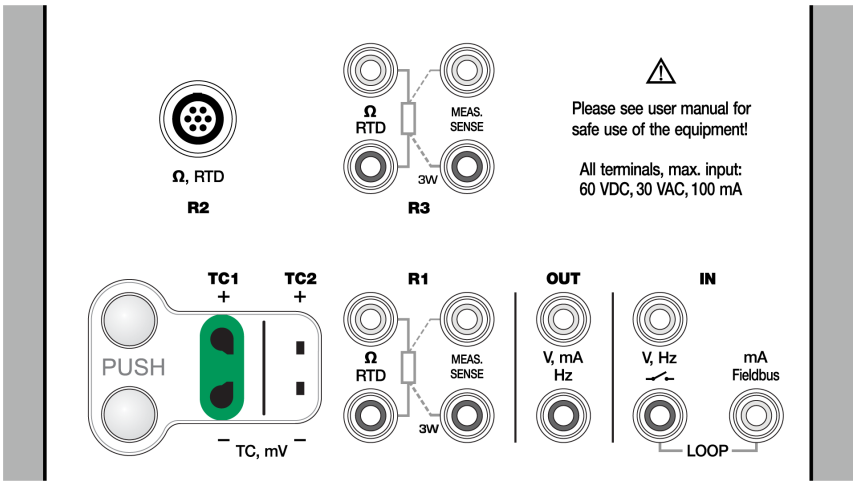


Figure 50: Thermocouple simulation terminals

Always confirm the sensor type on your connected device and set the same type in your MC6-T unit. Incorrect settings will lead to inaccurate measurements. The available measurement range depends on the selected sensor type. Make sure to also select an appropriate **Reference Junction** compensation method. Incorrect settings will result in invalid measurement results.

For more information on thermocouple connections and reference junction setting, see chapter Thermocouple Connections.

See also chapter:

- Temperature Measurement (Thermocouple)

Warning: Keep in mind that thermocouple simulation accuracy can be affected if the connected transmitter uses a test pulse function that cannot be disabled.

Warning: When using another thermocouple or an RTD connected to MC6-T to measure the external reference junction temperature, remember that there is no galvanic isolation between the connected devices.

Note: Thermocouple measurements can be sensitive to errors caused by poor connections, incorrect extension cables, or wrong settings in MC6-T. If you're uncertain about your setup, see chapter Thermocouple Connections and consult thermocouple reference materials.

Resistance Simulation

Resistance simulation is available only from R1 terminals.

Simulation range: **0 … 4000 Ω**

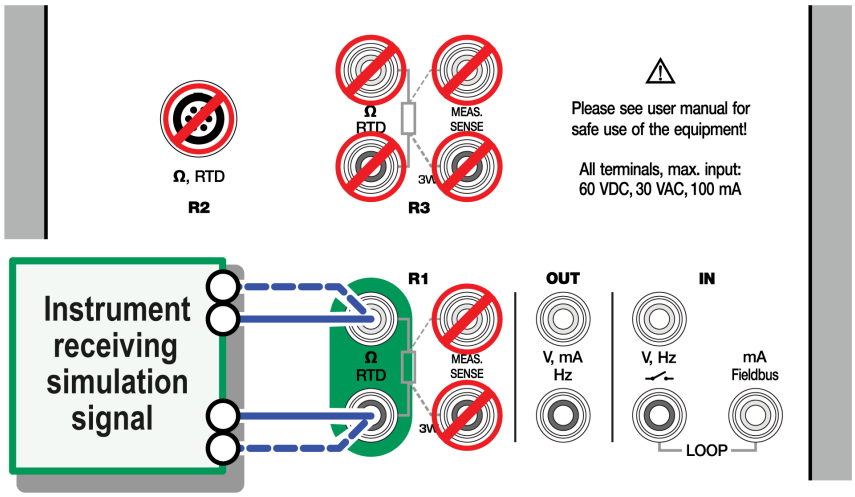


Figure 51: Resistance simulation terminals

The receiving instrument determines whether a 2-, 3-, or 4-wire connection is used. Connect any additional third and fourth wires as required but always **use only the two leftmost R1 terminals** in MC6-T.

MC6-T monitors the resistance measurement current. If the current rises too high, MC6-T cannot simulate the desired resistance value and will display an error message.

See also chapters:

- Resistance Measurement
- RTD Simulation

Warning: Keep in mind that resistance simulation accuracy can be affected if the connected transmitter uses a test pulse function that cannot be disabled.

Note: When you simulate the resistance or an RTD sensor using R1 terminals, MC6-T does not support measuring the simulated signal using R2 terminals.

Tip: To ensure proper contact between the test leads and the device under test, we recommend using the supplied alligator clips.

Warning: AC measurement current from the device under test is not supported. If the device under test uses pulsed measurement current, include a delay of a few milliseconds before measuring resistance.

Current Generation (Source or Sink)

Generation range (internal supply): **0 … 55 mA DC**

You can generate current with MC6-T using one of two methods:

- MC6-T provides a loop supply voltage (source mode).

  Setting: **Supply: On**.
- An external device provides the loop supply voltage (sink mode)

  Setting: **Supply: Off**.

Connection depends on the loop supply setting.

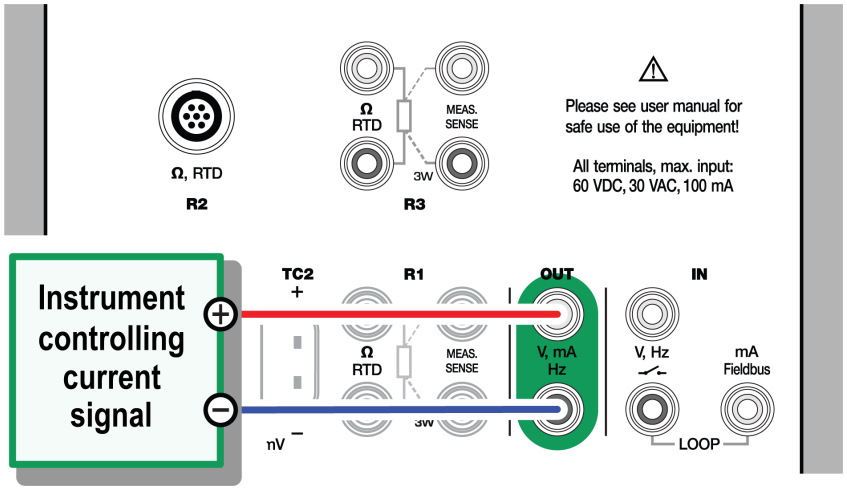


Figure 52: Current generation terminals, internal supply

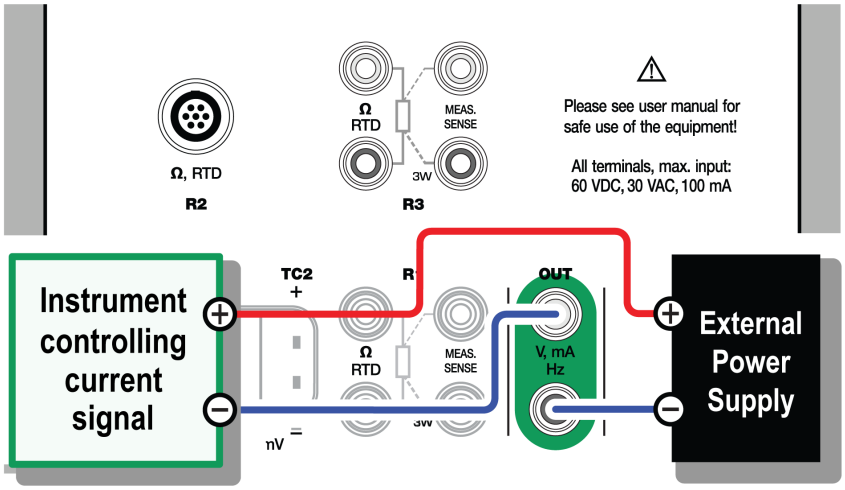


Figure 53: Current generation terminals, external supply

See also chapter:

- Current Measurement

Warning: Do not exceed the maximum current allowed by the device under test.

If the loop is opened during current generation, MC6-T attempts to maintain the current by increasing its output voltage. When the loop is closed again, a short current peak may occur before stabilizing. To avoid potential damage from this peak, ensure the loop cannot open during operation, or use overcurrent protection. Always set the output to 0 mA before connecting the loop.

Note: If MC6-T is supplying 24 V and you connect a smart instrument, the battery symbol (+ –) appears in the Temperature Calibrator, Calibrator, Documenting Calibrator, and Data Logger user interface modes.

Voltage Generation

The voltage generation terminals of MC6-T and their corresponding generation ranges are shown below:

- **TC1** Generation range: -1 … 1 V DC
- **OUT** Generation range: -3 … 24 V DC

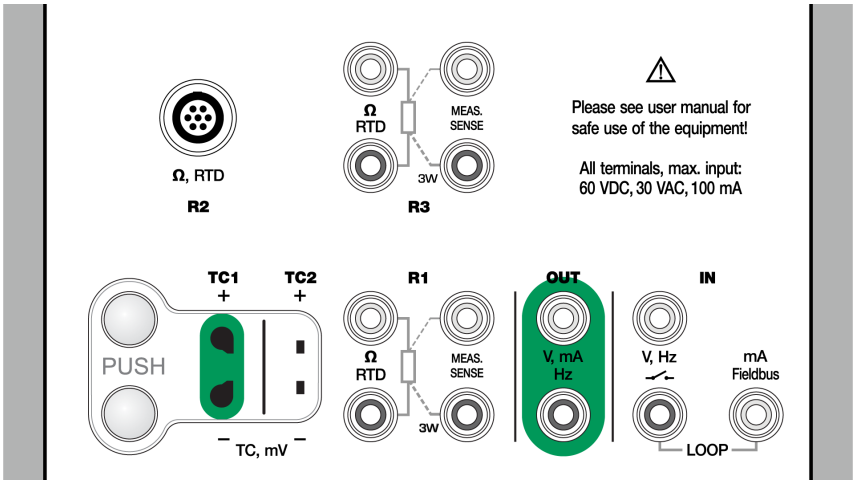


Figure 54: Voltage generation terminals

See also chapters:

- Voltage Measurement
- Thermocouple Simulation

Warning: Starting the voltage generation mode causes a short 24 V voltage peak. To prevent damage, connect the terminals only after entering voltage generation mode.

Always set the output to 0 V before making the connection.

Warning: If the voltage output is short-circuited, it can damage both the calibrator and the connected instrument.

Frequency Generation

Generation range: **0.0005 … 50 000 Hz**

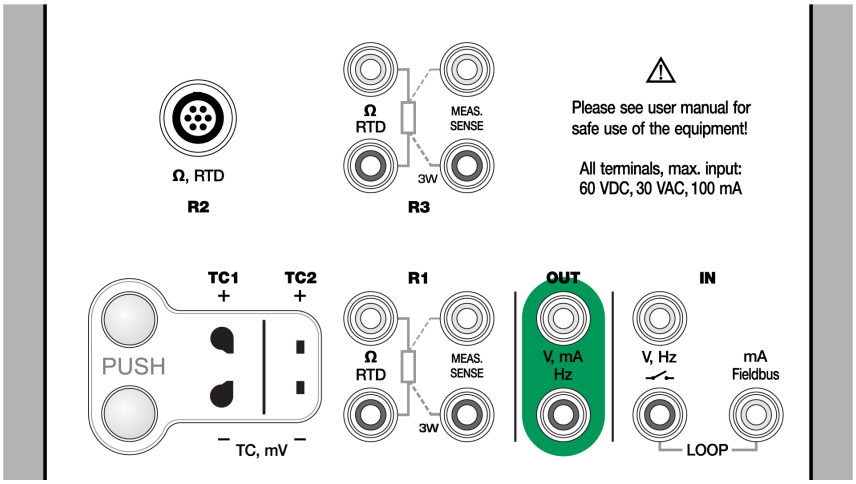


Figure 55: Frequency generation terminals

Before generating a frequency signal, check the following settings:

- **Amplitude** — define the desired voltage using the **'value' V** flat button.
- **Waveform & Duty Cycle** — choose either a Positive or Symmetric waveform and set the Duty Cycle.

Figure 56: Amplitude and Waveform & Duty Cycle buttons

The Duty Cycle defines the proportion of high output time relative to the total cycle. At higher frequencies, technical limitations may prevent the calibrator from achieving the exact Duty Cycle you set. In such cases, an asterisk (*) appears before the displayed Duty Cycle to indicate the difference.

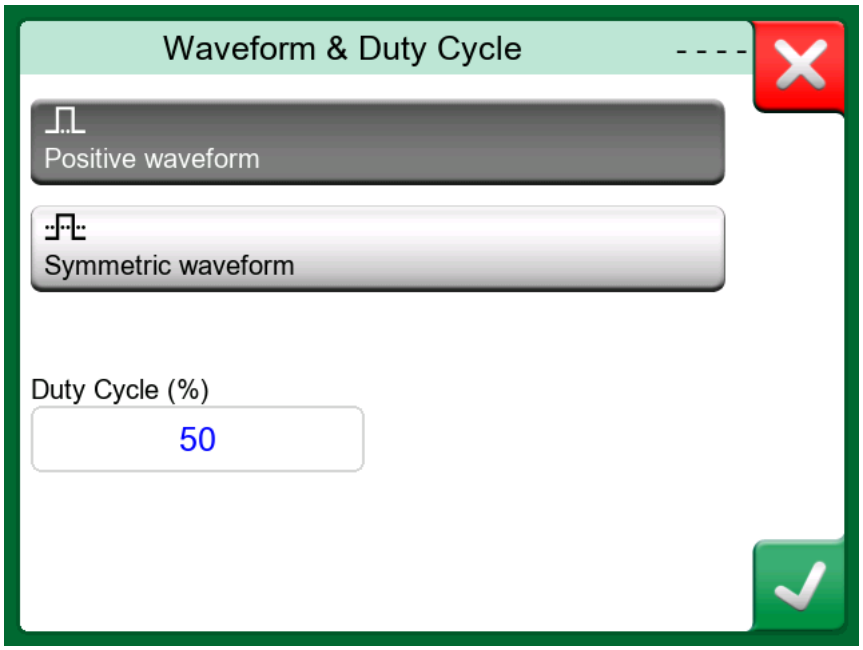


Figure 57: Waveform & Duty Cycle window

See also chapters:

- Frequency Measurement
- Pulse Generation

Pulse Generation

Generation range: **0 … 9,999,999 pulses**

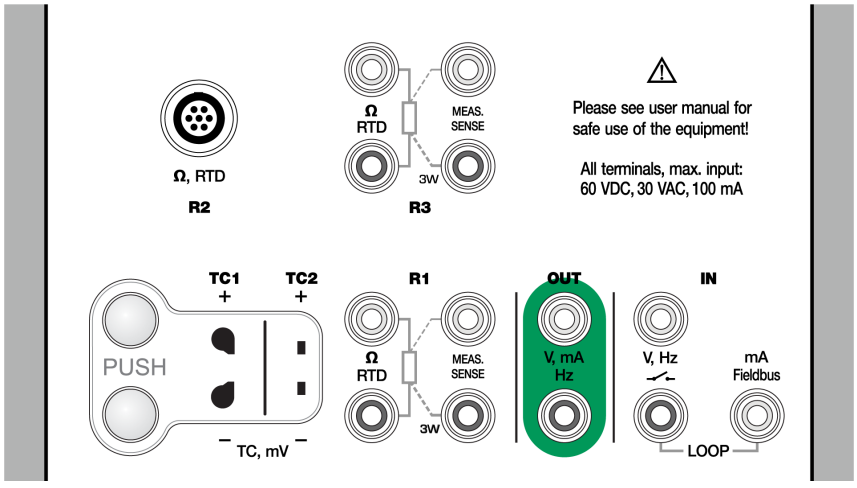


Figure 58: Pulse generation terminals

Before starting pulse generation, check the following settings:

- **Frequency** – specify the frequency by pressing the **'value' Hz** flat button.
- **Amplitude** — define the desired voltage using the **'value' V** flat button.

- **Waveform & Duty Cycle** — choose either a Positive or Symmetric waveform and set the Duty Cycle.

Figure 59: Frequency, Amplitude, and Waveform & Duty Cycle buttons

The Duty Cycle defines the proportion of high output time relative to the total cycle. At higher frequencies, technical limitations may prevent the calibrator from achieving the exact Duty Cycle you set. In such cases, an asterisk (*) appears before the displayed Duty Cycle to indicate the difference.

See also chapters:

- Pulse Counting
- Frequency Generation

Smart Instrument Connections

When working with smart instruments, it is important to choose the suitable power supply and ensure proper connections. Incorrect settings can lead to invalid measurement results. Choose the power supply source from the following options:

- **Internal power supply**

  The MC6-T internal power supply can safely power a single instrument. If your HART or fieldbus segment includes multiple instruments, consider using an external power supply.

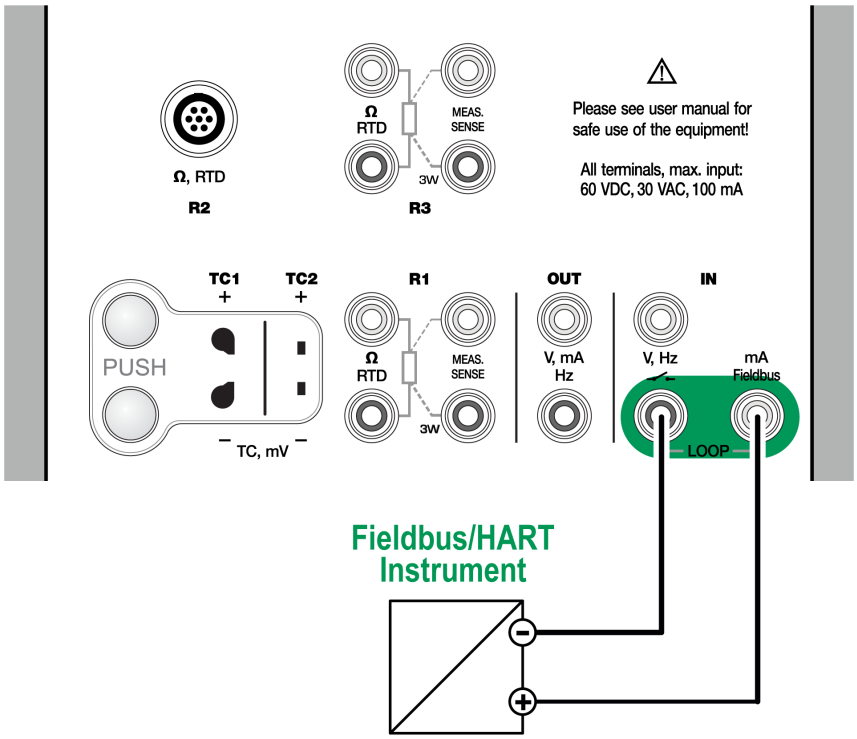


Figure 60: Smart instrument terminals, internal supply

- **External power supply**

  To maintain communication, you might need an external resistor—250 Ω for HART or 50 Ω for fieldbus. If you use a fieldbus-compliant power supply, an external resistor is not necessary.

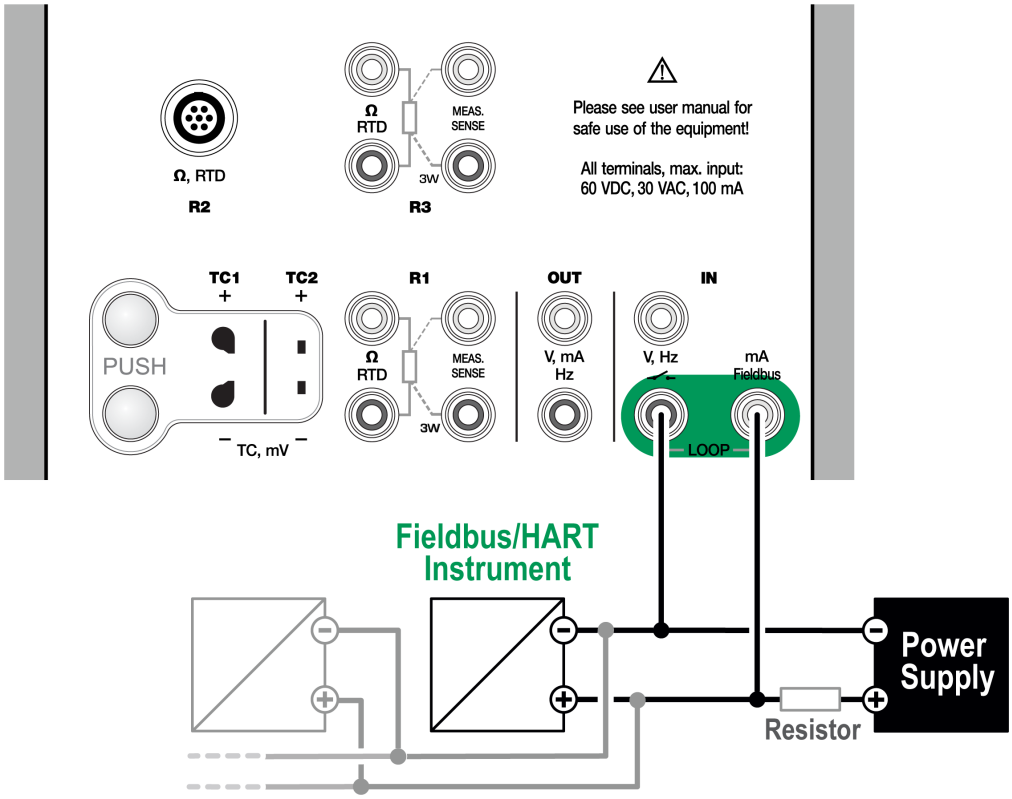


Figure 61: Smart instrument terminals, external supply

Note: You can connect MC6-T to the instrument or fieldbus using standard measurement cables. For longer cable runs, fieldbus terminators might be required.

Warning: PROFIBUS PA segment: Never connect two master devices (such as MC6-T, a field communicator, or a control system) simultaneously to the same segment. Doing so can cause conflicts and make the segment unstable. Always remove the instrument to be calibrated from the live segment before calibration.

See also chapter Warnings Concerning Smart Instruments.

Further details about smart instruments are available in chapter Working With Smart Instruments.

Thermocouple Connections

When working with thermocouples, it is important to choose the suitable **Reference Junction** compensation method and ensure proper connections. Incorrect settings can lead to invalid measurement results. Choose the Reference Junction mode from the following options:

- **Internal**

  Connect the MC6-T using appropriate thermocouple, extension, or compensation wires. The calibrator automatically manages the reference junction compensation. If needed, you can also use the TC2 terminal.

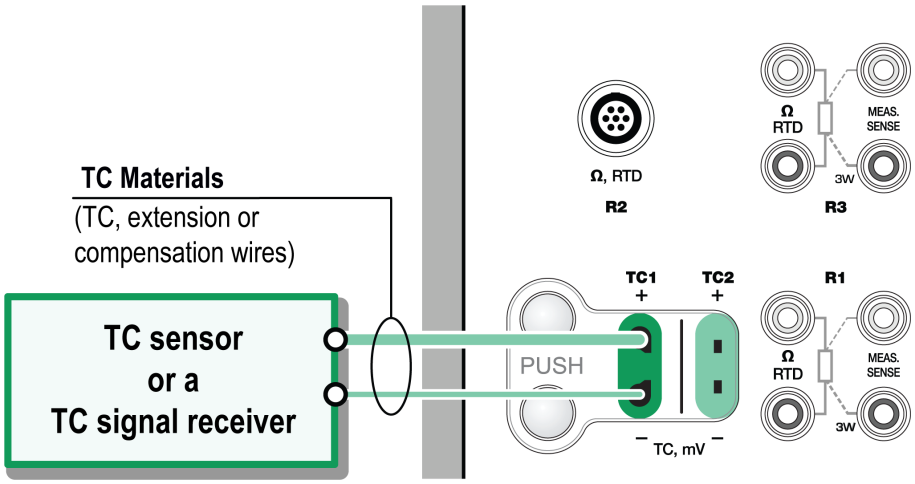


Figure 62: Internal Reference Junction

- **External R1** and **External R2**

  Connect an external RTD sensor to the selected terminal to measure the Reference Junction temperature. You may optionally also use the TC2 terminal.

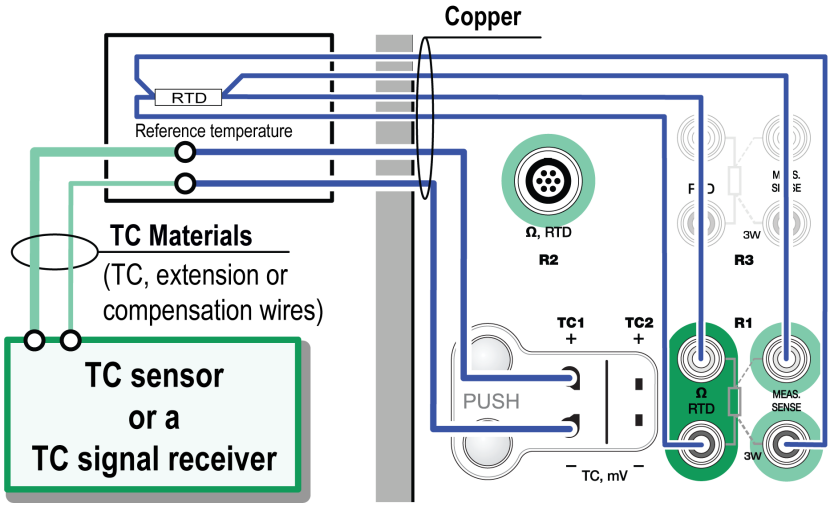


Figure 63: RTD connected to R1 terminals measuring the Reference Junction temperature

- **Fixed (0°C)** and **Manual**

  Use this option when the reference junction temperature is controlled by a compensation box, temperature controller, or other similar method. **Manual** mode lets you enter any temperature, while **Fixed (0 °C)** mode provides a shortcut for setting 0 °C. You may optionally also use the TC2 terminal.

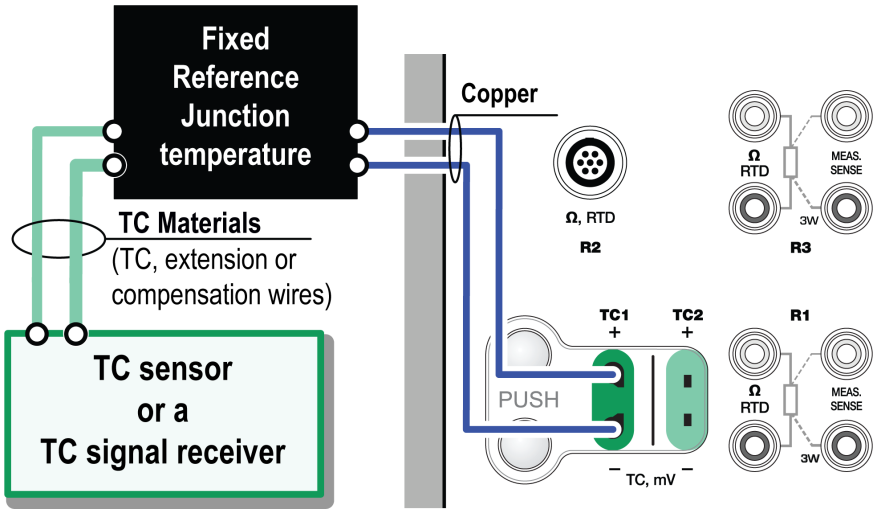


Figure 64: Fixed/Manual Reference Junction temperature

Warning: Before starting the measurement, ensure that MC6-T has reached temperature stability. Differences between MC6-T and ambient temperature can reduce thermocouple accuracy. In extreme cases, stabilization may take up to 90 minutes.

Temperature Calibrator

The **Temperature Calibrator** user interface mode is optimized for temperature calibrations. You can calibrate any supported RTD or thermocouple sensor—and any other temperature instrument, as long as MC6-T can read its output signal. Up to three instruments can be calibrated at the same time.

To start the Temperature Calibrator mode, tap the **Temperature Calibrator** button in the Home view.

Figure 65: Home view, Temperature Calibrator user interface mode

Note: This mode does not support keyed output and requires the Mains switch to be on.

Note: To document calibration data automatically, use the Documenting Calibrator mode.

Main View

The main view window in Temperature Calibrator mode has three sections:

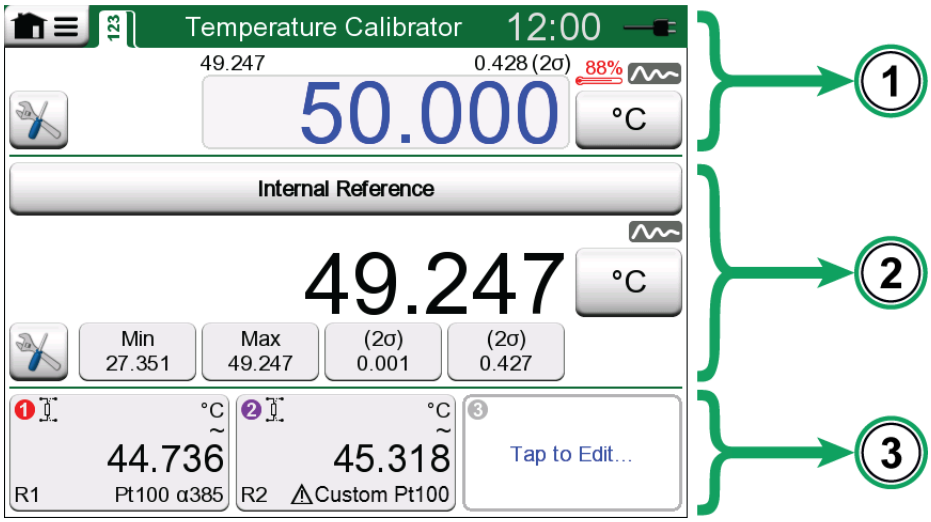
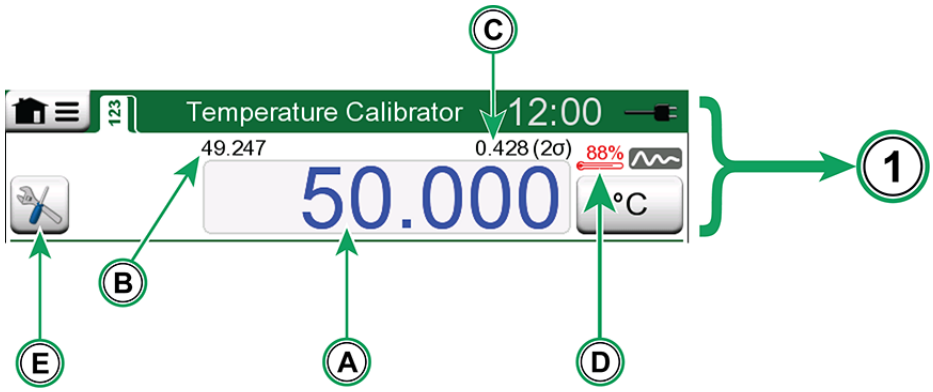


Figure 66: Temperature Calibrator, main view

Legend:

1. Temperature Block Setpoint Section



A. Temperature Block setpoint.

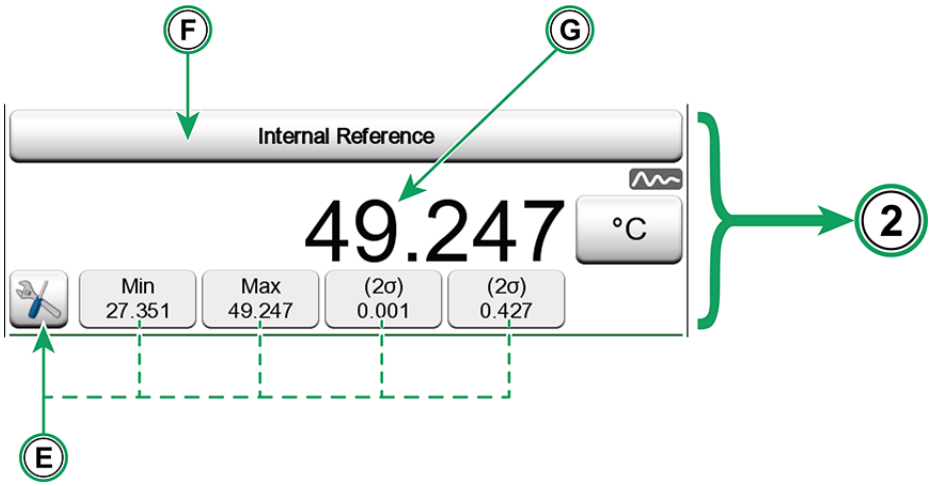
B. Internal reference sensor temperature.

C. Internal reference sensor stability.

D. Heating (red) or cooling (blue) power percentage.

E. Tools button () — see chapter Tools for details.

2. Reference Sensor Selection Section



E. Tools button () — allows you to select what additional data to display, such as the 2σ stability reading and instability indicator. These help you determine when the temperature is stable enough to manually document the results.

F. Reference sensor - lets you choose the reference sensor: either the internal sensor or an external one connected to an RTD or thermocouple input. If using an external sensor, place it in the Temperature Block's insert.

G. Temperature of the reference sensor.

3. Instrument Configuration Section (three channels)

Tap any of the three channels to configure its quantity, port, and function.

Note: You can choose any available function to add as a channel and have it displayed.

Graph View

The **graph** view displays a visual representation of the measurements from the three defined channels.

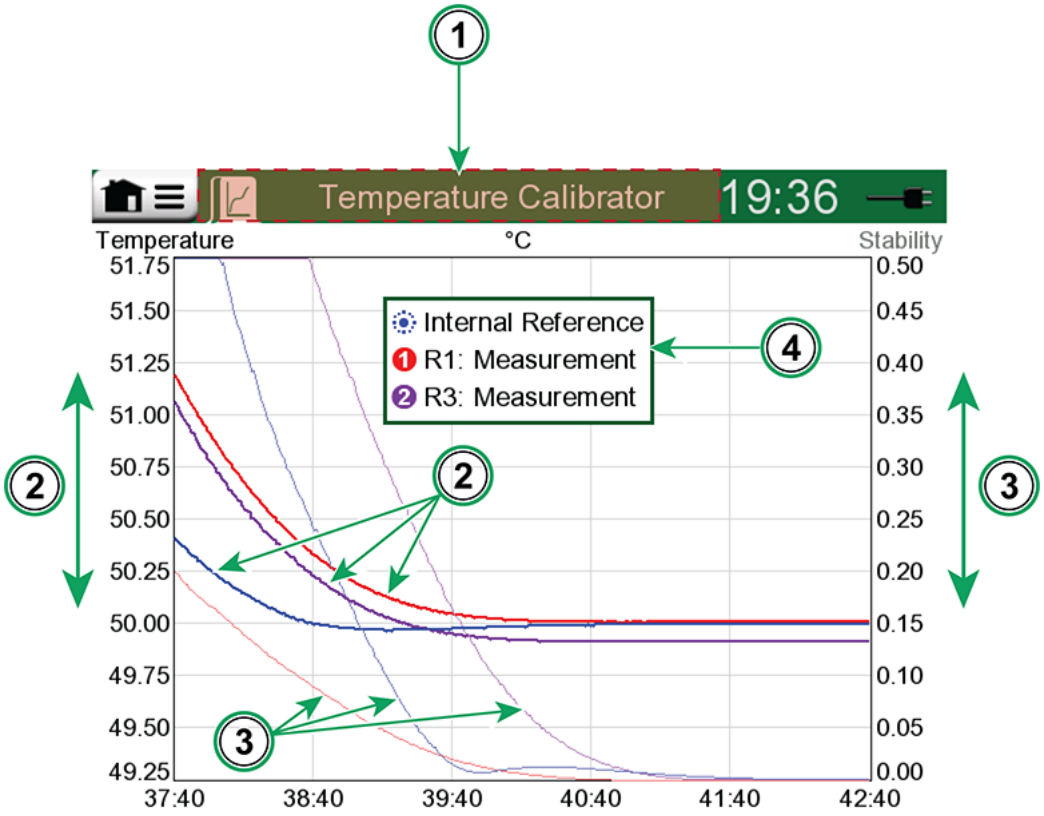


Figure 67: Temperature Calibrator, graph view

Legend:

1. Toggle area of the title bar – tap to switch between the main and graph views.
2. Temperature readings for the selected channels.
3. Stability of the corresponding temperature measurements.
4. Graph legend button – tap to display the legend.

The Menu

The Temperature Calibrator menu includes the following options:

- **Toggle View** – Switch between the main and graph views. This works the same as tapping the active area in the title bar.
- **Reset Graph** – Clear trend lines and have MC6-T recalculate minimum and maximum values based on current measurement and calculations.
- **Settings** – Configure heating and cooling parameters. By default, both operate at full speed. In cases involving delicate sensors, you can set custom limits to reduce the risk of damage.

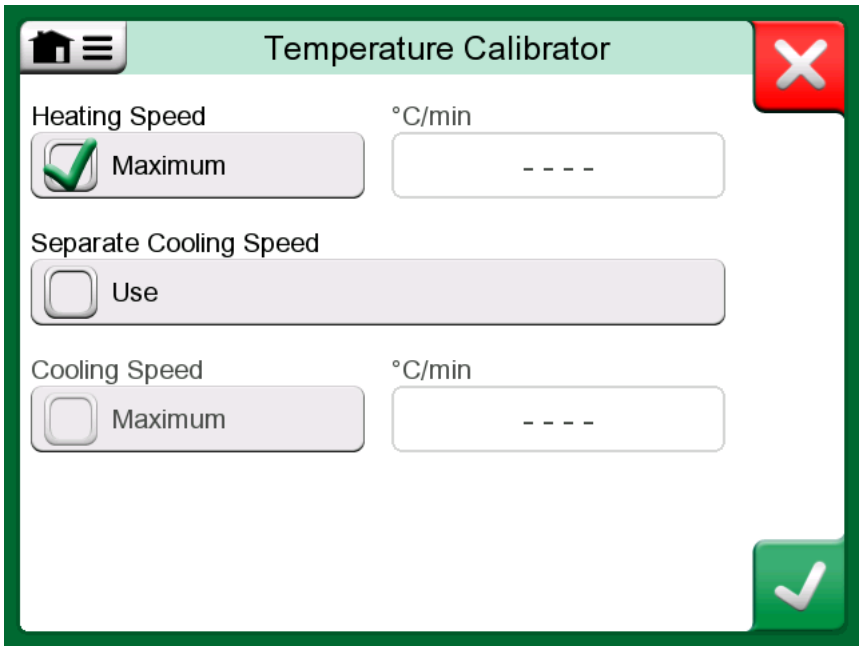


Figure 68: Temperature Calibrator settings window

Note: You can adjust the heating and cooling speed settings even while the Temperature Block is actively heating or cooling. However, with sensitive temperature sensors, it's best to set the required speed first—before changing the temperature setpoint—to avoid undesired fluctuations in the temperature change rate.

Calibrator

The **Calibrator** user interface mode is designed for calibrating instruments. It allows you to independently configure two signals—for example, one as the instrument's input and the other as its output—to be measured, generated, or simulated.

To start the Calibrator mode, tap the **Calibrator** button in the Home view.

Figure 69: Home view, Calibrator user interface mode

To configure the signal:

1. Choose the **Quantity** of the signal for both input and output.
2. Use Port/Function to select whether to **measure**, **generate**, or **simulate** the signal, and follow the connection diagrams to make the necessary connections.
3. Configure the quantity-specific settings.

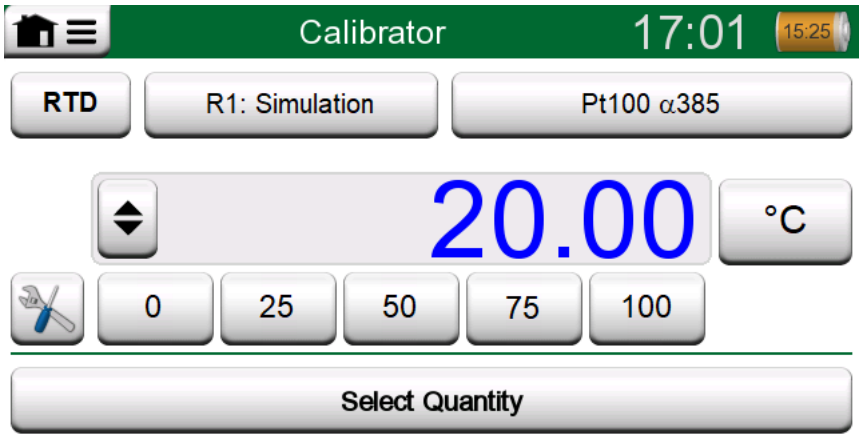


Figure 70: Calibrator configuration window

Tip: Tapping the **Tools** button ( ) opens a menu showing the available tools. Certain tools are limited to use with measurements or generations. A complete list can be found in the Tools section.

For details on connections and quantity-specific settings, see chapter Calibration Capabilities and Connections.

Note: If one signal is set to generate and the other to switch sensing, the switch captures the generated value when it actuates. This enables manual calibration of switches. However, for temperature switches, always use **Documenting Calibrator** mode for accurate calibration.

Note: To document calibration data automatically, use the Documenting Calibrator mode.

Note: For information about using external controllers like pressure controllers and temperature dry blocks in Calibrator mode, refer to chapter Controller Communication.

Documenting Calibrator

The **Documenting Calibrator** mode is designed for documented and automated calibration of process instruments. In this mode, the calibration process is guided, and the calibrator can automatically set the calibration points and record the results. The Documenting Calibrator mode works with Beamex Calibration Management Software.

Note: The calibrator automatically synchronizes its date and time with the computer during communication with the calibration management software, ensuring correct time settings.

To start the Documenting Calibrator mode, tap the **Documenting Calibrator** button in the Home view.

Figure 71: Home view, Documenting Calibrator user interface mode

When starting Documenting Calibrator mode, you must select an existing user or create a new one. The user can originate from the calibrator or the Calibration Management Software database (CMX/LOGiCAL), and this is displayed to the right of the user name.

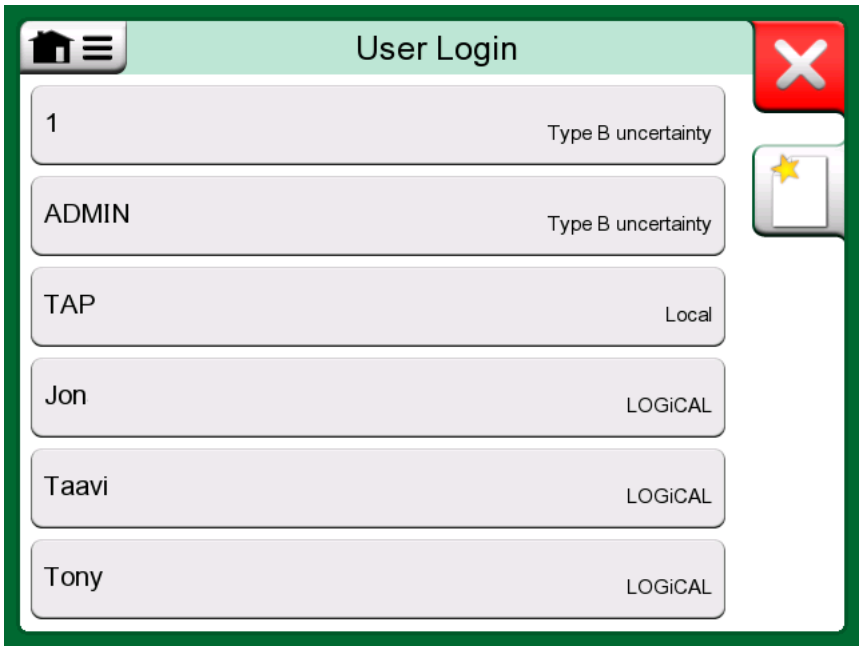


Figure 72: User selection in Documenting Calibrator

Calibration Process with MC6-T

Calibration is a documented comparison of a measurement device to be calibrated against a traceable reference.

When calibrating instruments, a calibration reference with a known value must be compared to the instrument's measurement value. The calibration process must be documented, and comparison calculations performed.

A documenting multifunction calibrator performs all these tasks and can even carry out fully automatic calibrations.

The MC6-T is a documenting calibrator that communicates with Beamex LOGiCAL or CMX Calibration Management Software, enabling a fully digitalized calibration process.

Instrument Data

The **Instrument data** in MC6-T includes all the necessary components to define how a calibration process should be carried out. It is recommended to use calibration management software to determine what to calibrate, how, and when. When the instrument is due for calibration, its data can be transferred from the Calibration Management Software to the calibrator. You can also create and save instrument data directly in the Documenting Calibrator. With

smart instruments, some data elements can also be populated directly from the instrument.

The **Identification** data describes the instrument to be calibrated. **Device** can be defined as the physical product (asset) performing the process measurement. **Position** specifies the functional location in the process the device is installed (commonly called the Tag). Defining the position is optional, but allows you to define a hierarchical Plant Structure where the position can be placed. The Plant Structure is typically maintained in the Calibration Management Software.

In calibration, **Input** (the calibration reference with a known value) is compared to the instrument's **Output**. MC6-T can provide the input signal and measure the output signal for pressure, temperature and various electrical signals. You can also manually enter the input or output signal into the calibrator (Keyed) if necessary.

The **Function** describes the measurement capability of the instrument to be calibrated. Function is described by its quantity, unit, range, and sensor type.

Note: Measurement devices like sensors and switches usually handle one quantity and range.

Industrial transmitters measure a physical quantity (such as pressure or temperature) and convert it into an electrical or digital signal using a transfer function. In these cases, the input and output quantities and ranges are different.

Note: Be sure to define the quantity, unit, and range for both input and output—even when the values are the same.

Tip: When the input signal is pressure or temperature, the Automatic Control feature can assign a supported internal or external controller to generate the reference pressure or temperature automatically. The calibrator can also simulate temperature if needed.

Calibration is performed according to the **calibration procedure**. By default, calibration point values are distributed evenly across the instrument range. You can set the calibration direction as up, down, down-up, or up-down. If the standard configurations are not suitable, you can also define fully customized calibration points. You can enable Automatic Acceptance of calibration points if certain conditions are met (see chapter Calibration Point Acceptance for details).

The **Error Limit** defines the maximum acceptable calibration error. Error is calculated as the difference between the input and output signals—i.e., the reference value and the measured value of the instrument to be calibrated.

Note: For transmitters, the error is the difference between the expected (ideal) output signal—calculated using the transfer function—and the actual measured output signal.

Calibration passes only if measured error in all calibration points are within the defined limit. Otherwise the calibration fails.

Calibration Execution and Calibration Results

After the instrument data has been created in the Documenting Calibrator or received from the Calibration Management Software, the instrument is ready for calibration.

The Documenting Calibrator walks you through the calibration process step by step, progressing through the defined calibration points. Depending on the defined procedure, points can be accepted manually or automatically.

Documenting Calibrator captures the data digitally and automatically documents the calibration. Once completed, a result preview is displayed, with both numerical and graphical views available. The calibrator calculates the measurement error and performs a pass/fail check based on the measured input/output values and the defined error limits. The pass/fail result is the key outcome of the calibration. The first calibration repeat can be saved as the **As Found** calibration.

If the calibration fails or the error is too close to the defined limit, you can adjust the instrument.

Tip: MC6-T can perform adjustments for smart instruments. For more information, see chapter Trimming Smart Instruments.

After adjustment, you can perform a new calibration repeat—called **As Left**—to document the instrument's post-adjustment condition. If the instrument cannot be adjusted to meet the calibration requirements, consider replacing it with a more accurate one.

Once the calibration is complete, it is recommended to transfer the results to Calibration Management Software to maintain a complete calibration history. The calibration data stored in the Calibration Management Software is easily available for analysis, reporting, and creating calibration certificates.

Note: Calibration results can be temporarily stored in the calibrator’s memory, but for permanent storage, it is strongly recommended to use Calibration Management Software.

Instrument List

When you start the Documenting Calibrator, the Instrument List window opens if there are instruments saved in the calibrator.

Tap an instrument to select it for calibration. This opens the Instrument Overview window, which shows general information about the selected instrument. For more details on the Instrument Overview window, refer to chapter Instrument Overview Window.

It is recommended to use calibration management software to manage instruments and transfer the data to the calibrator when the instrument is due for calibration. You can also create and save instruments directly in the Documenting Calibrator. For instructions, see chapter Creating Instruments in MC6-T.

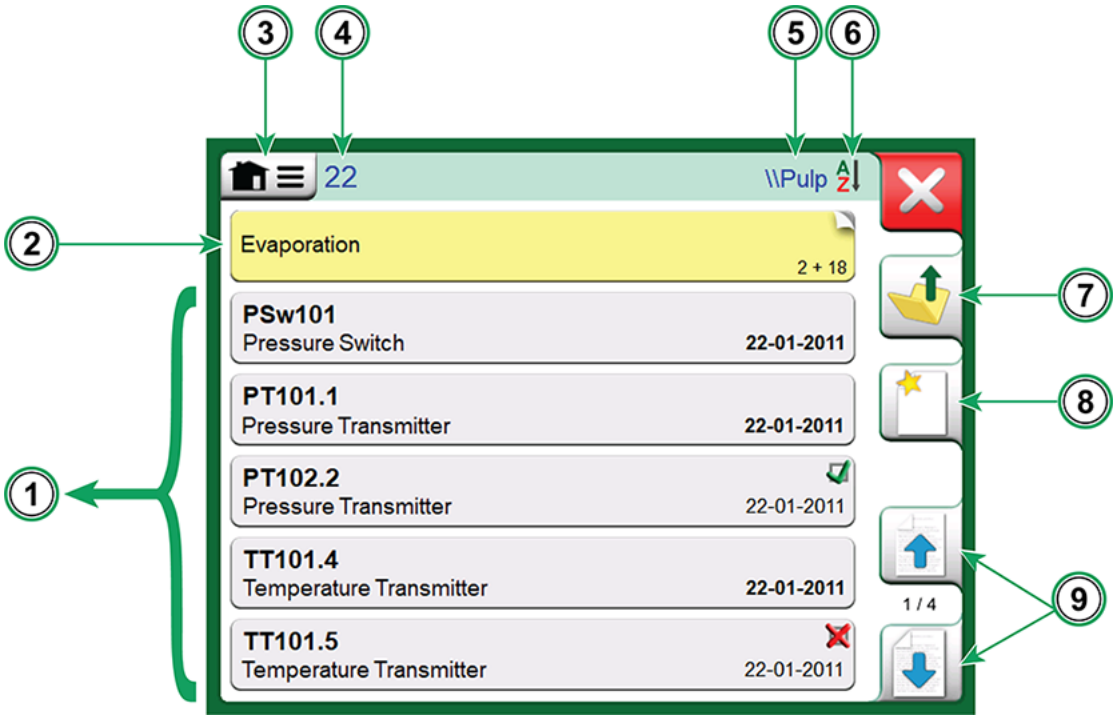


Figure 73: Instrument List example

Legend:

1. Instruments listed at the current Plant Structure Level.
2. Sublevel within the Plant Structure. A detailed description is available in chapter Plant Structure Levels.
3. Menu for managing the Instrument List. More information in chapter Instrument List Menu.
4. Total number of instruments at this level and all sublevels.
5. Name of the current Plant Structure Level.
6. Sorting order icon. Refer to chapter Instrument List Menu.

7. **Return** button ( ) to move one level up in the Plant Structure.
8. **Create New** instrument button ( ). Detailed instructions for creating instruments are provided in the chapter Creating Instruments in MC6-T.
9. Page navigation buttons for browsing a multi-page Instrument List.

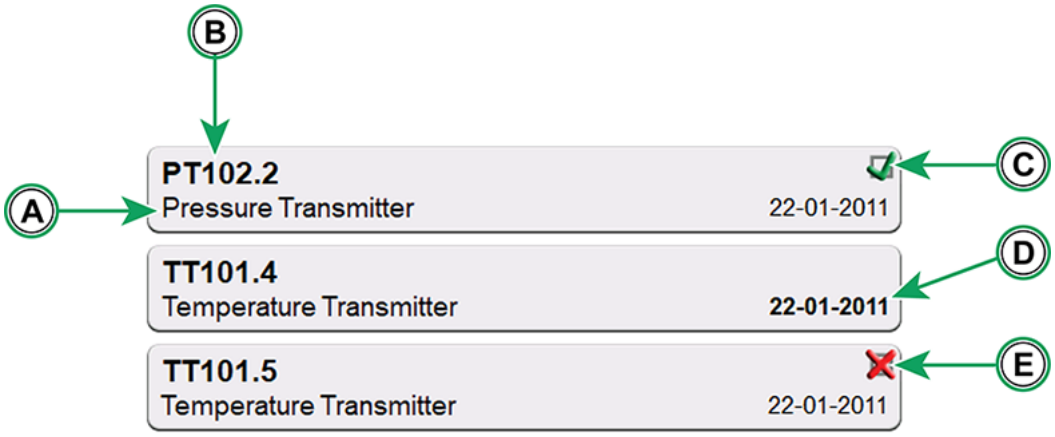


Figure 74: Instruments in the Instrument List

Legend:

A. Function Name.

B. Position ID.

> **Note:** When Position information is not available, the Device ID is displayed instead.

C. Most recent calibration result: "Passed" (visible only if the instrument has been calibrated).

D. Calibration Due Date.

E. Most recent calibration result: "Failed" (visible only if the instrument has been calibrated).

> **Note:** You can also view instruments in Work Order View Mode. More information in chapter Work Order View Mode.

Plant Structure Levels

Tap a Plant Structure Level to display its sublevels and the instruments it contains. To move one level up in the hierarchy, tap the **Return** button ( ).

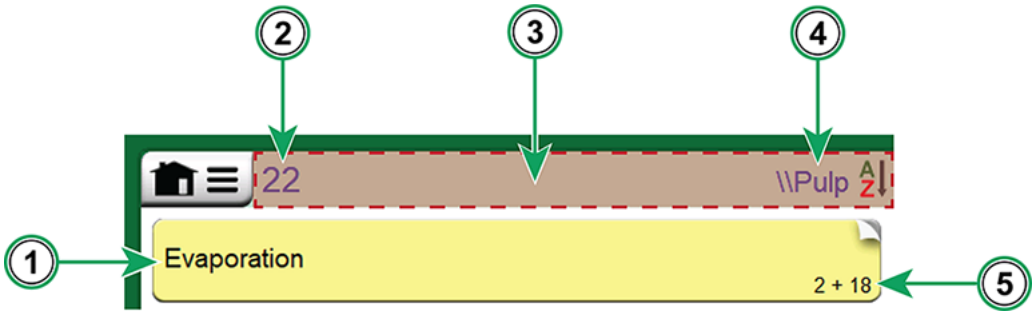


Figure 75: Plant Structure Level in the Instrument List

Legend:

1. Sublevel within the Plant Structure.
2. Total number of instruments at this level and all sublevels.
3. Title bar active area – tap to display the full Plant Structure path.
4. Name of the current Plant Structure Level.
5. Number of sublevels and instruments within them.

Note: For details on how to create and manage Plant Structure Levels, see chapter Instrument List Menu.

Instrument List Menu

Tap the Instrument List context-sensitive menu (3 in Figure 73: Instrument List example) to access additional tools for managing the Plant Structure and Instrument List.

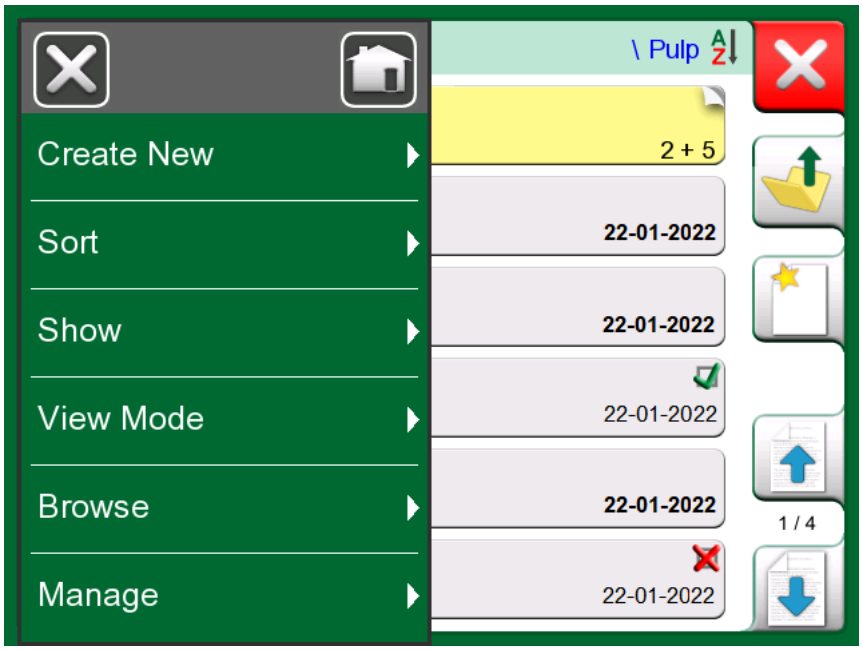


Figure 76: Instrument List menu

Create New – allows you to create new items:

- Instrument – creates a new instrument (see chapter Creating Instruments in MC6-T for instructions).
- Plant Structure Level – adds a new sublevel to the current level.
- Group – creates a new calibration group (see chapter Group Calibration for more details).

Sort – let you organize list content by:

- Instrument Identification – alphabetically, Ascending ( ) or Descending ( ).
- Due Date – Ascending ( ) or Descending ( ).
- Creation – Ascending ( ) or Descending ( ).

Show – filter ( ) the list view to show:

- All – all instruments and levels.
- Calibrated – only calibrated instruments.
- Not Calibrated – only not calibrated instruments.
- Not Calibrated and Failed – instruments that are either not calibrated or have failed calibration.

View Mode – control how the Plant Structure is displayed:

- Obey Structure
- Ignore & Hide Structure
- Show All from Here/Below
- Show Instruments from Here/Below

- Work Order (see chapter Work Order View Mode)

Browse – allows you to search () for instruments or jump to the beginning or end of the list.

Manage – delete instruments or results, or manage the Plant Structure.

Caution: Deleting a Plant Structure Level will also delete all instruments and calibrations on that level and below. The root level cannot be deleted.

Warning: Deleted items cannot be recovered.

Instrument Overview Window

Selecting an instrument for calibration opens the Instrument Overview window. This window presents general details of the instrument configuration data and provides connection diagrams for the selected input and output functions. The diagrams show which connectors and terminals to use for attaching the test leads, helping you make the correct connections. For further details on connections and required communication cables, see Calibration Capabilities and Connections.

Note: If available, a Before Calibration Note will be displayed.

Tip: Before beginning calibration in the Documenting Calibrator, you can use Calibrator mode to verify that the test leads are connected properly and that input and output signals can be provided.

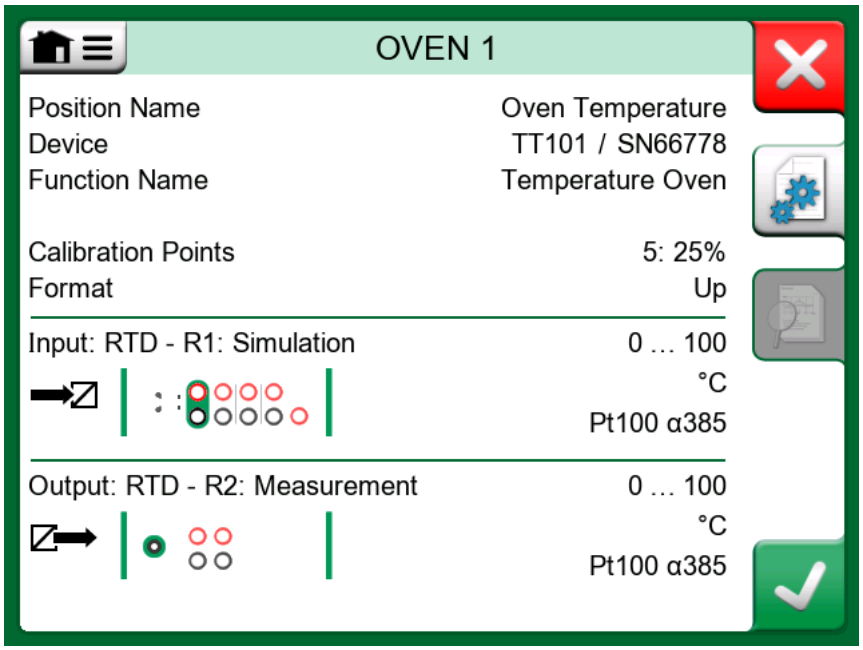


Figure 77: Instrument Overview window

From the Instrument Overview window, you can:

- Return to the Instrument List by tapping **Close** button ( ).
- Edit or review instrument configuration data by pressing **Configure** button ( ). For a detailed description of all instrument data pages, see Creating Instruments in MC6-T.
- View existing calibration results by tapping the **View Results** button ( ).
- Start calibrating the selected instrument and open the Calibration window by pressing the **Accept** button ( ).

The context-sensitive menu provides options to Copy, Move, or Delete the selected instrument, check Database Information, as well as view the Plant Structure. For more details on the Database Information window, see chapter Enabling Uncertainty.

Calibrating an Instrument

After selecting the instrument to be calibrated, check the displayed connection diagram to see where to connect the leads.

Note: Use the **Info** button ( ) to view connection diagrams.

Once connected, tap the **Accept** button ( ) in the Instrument Overview window (see Figure 77: Instrument Overview window). The **Calibration** window

opens, displaying the nominal input and output values for the first calibration point.

Note: To perform smart instrument calibration, check the instructions in chapter Calibrating Smart Instruments.

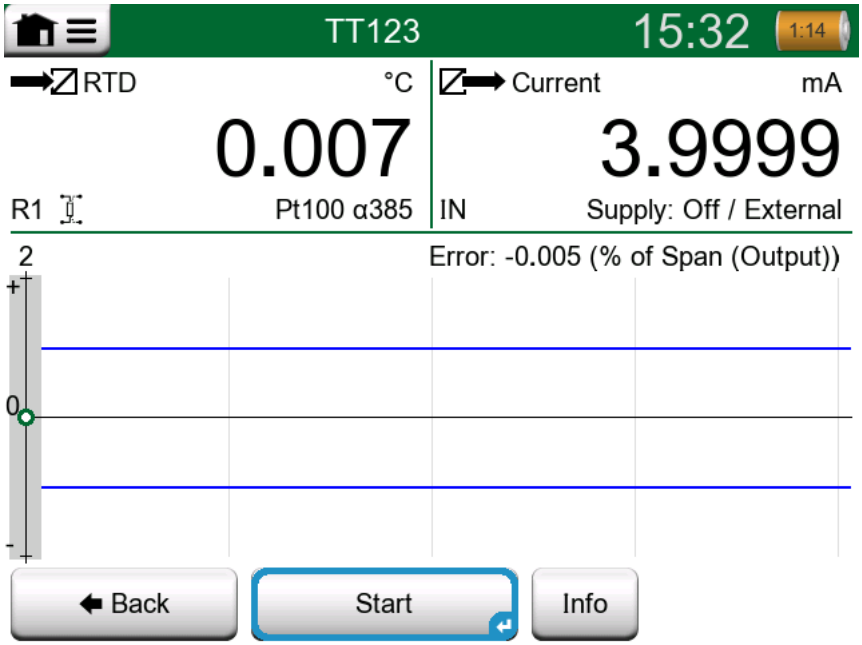


Figure 78: Calibration window

Tip: With temperature calibrations, you can click the toggle area in the window's title bar (see callout **#1** in Figure 67: Temperature Calibrator, graph view) to switch the view to the temperature graph.

Note: If gauge pressure modules are used, zero them before beginning calibration.

Tap the **Start** button to begin the calibration.

Note: Generations are started in the Instrument Overview window before the **Start** button is pressed.

If **Automatic Acceptance** is enabled, calibration points will be accepted automatically. Otherwise, you must manually accept each point. See section Calibration Point Acceptance for more on accepting calibration points.

Note: Tap the **Back** button to return to the Instrument Overview window.

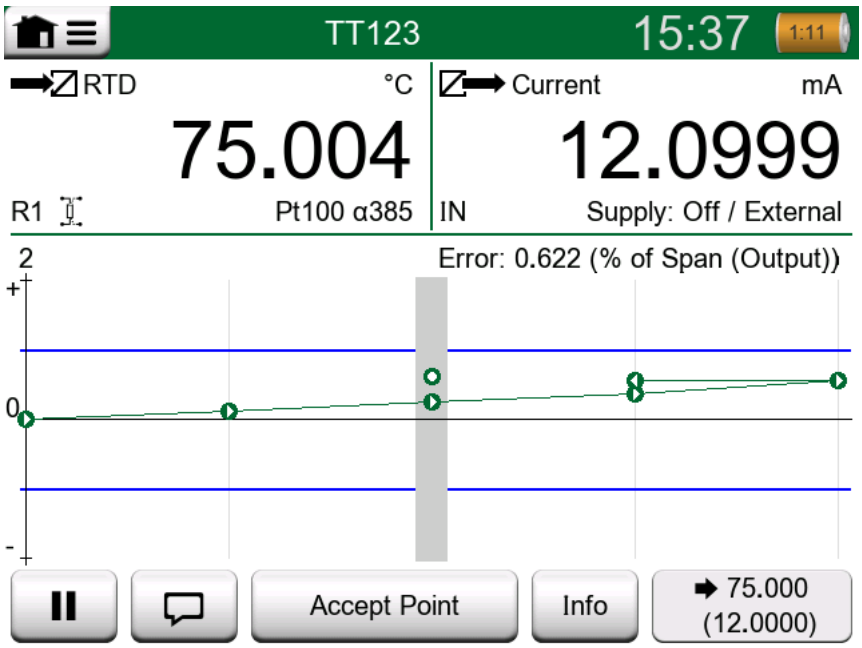


Figure 79: Calibration with manual acceptance

As calibration progresses, each accepted point appears on the graph—passed points in green, failed points in red. Points are linked with a thin line to indicate the point sequence. A grey column marks the next target point, and its width is determined by the **Max. Point Deviation** setting. The numeric value of the next target point is shown in the lower-right corner. If any point exceeds the defined error limits (blue dotted lines), the line turns red.

Use the **Pause** button ( ) to reject a calibration or undo a point. The **Notes** button ( ) lets you add notes to individual calibration points. Additional settings are available in the context-sensitive menu.

Various tools are available under the **Instrument Input/Instrument Output** menu items in the Calibration window. Tap the **Tools** button ( ) to view the available tools. The tool selection depends on the selected Quantity and Port. These tools are also available during instrument configuration. For details, see chapter Tools.

Note: Certain tools are not compatible with the Calibration Management Software.

Calibration Point Acceptance

Calibration points can be accepted either manually or using Automatic Acceptance feature. When **Automatic Acceptance** is not in use, you must manually accept each calibration point using the **Accept Point** button when signals are stable. The MC6-T then proceeds to the next calibration point.

Note: Use the **Force Accept** button to manually accept points when, e.g. the calibration does not advance because of an unstable input and/or output signal or the input point is not within the maximum deviation window.

The following instrument data should be defined when using the **Automatic Acceptance** feature:

- Max. Point Deviation (% of span) – the acceptable deviation of the input signal from the nominal value.
- Stability – of both input and output signals.
- Point Delay – the time (in seconds) the calibrator waits before accepting the values.

When **Automatic Acceptance** is enabled (checked), MC6-T accepts calibration points automatically, following this process:

1. MC6-T checks whether the input signal falls within the Max. Point Deviation value of the next calibration point.
2. When the input signal is close enough, MC6-T checks the signal stability to decide whether the readings can be saved.
3. When signal stability is reached, a timer ( ) counts down the **Point Delay** amount of seconds. After that, the readings are saved only if the signal is still stable. If the signal becomes unstable, MC6-T returns to step two.

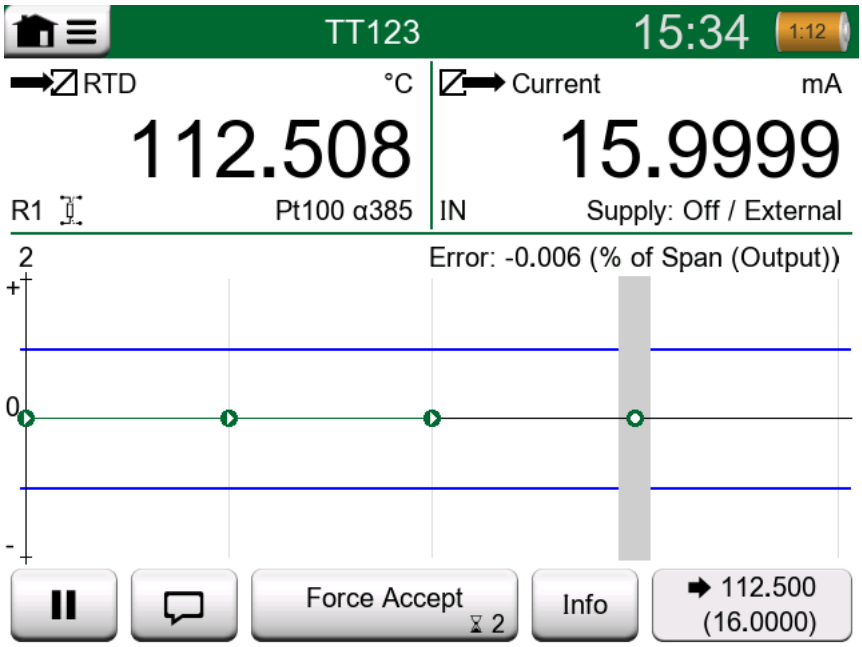


Figure 80: Calibration with Automatic Acceptance in use

Note: Opening the menu during calibration pauses the process until the menu is closed.

Calibration Results Window

After the calibration is completed, the Calibration Results window opens and indicates whether the calibration **Passed** or **Failed**. The results are shown on multiple pages, offering different views of the calibration data, such as numerical values, graphical representation, and general information.

Note: The number of result pages shown in the Calibration Results window can be adjusted through the menu. To view only the basic result pages, select **Show, Basic Pages**. To include all available pages, choose **Show, All Pages**.

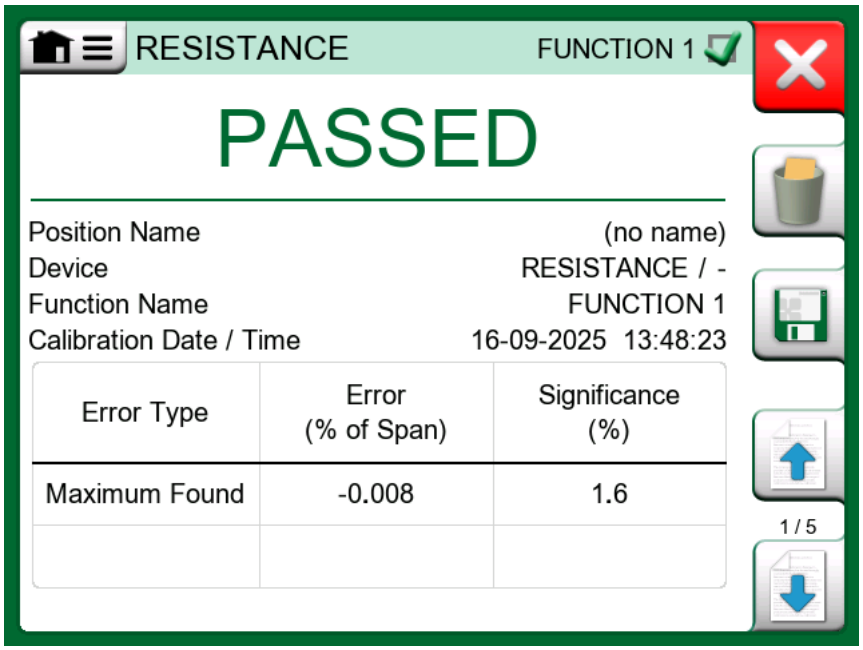


Figure 81: Calibration Results window – first page

On the second page of the Calibration Results window, the user (Calibrated by) must be selected. If a calibration management software is used, the user list is transferred to the calibrator and the correct user can be selected. A new user can also be created by tapping the **Calibrated by** button and then pressing Create New button ( ).

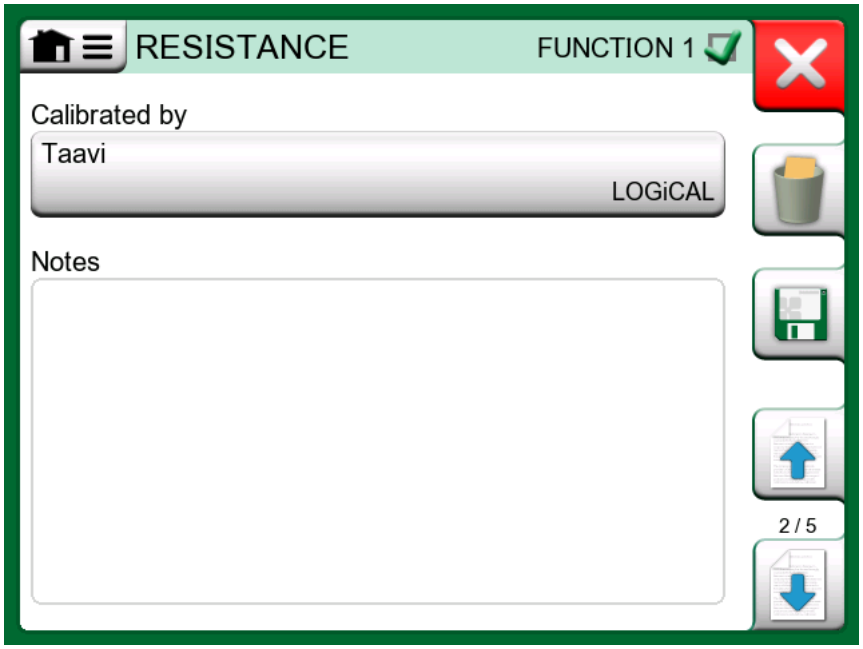


Figure 82: Calibration Results window – second page

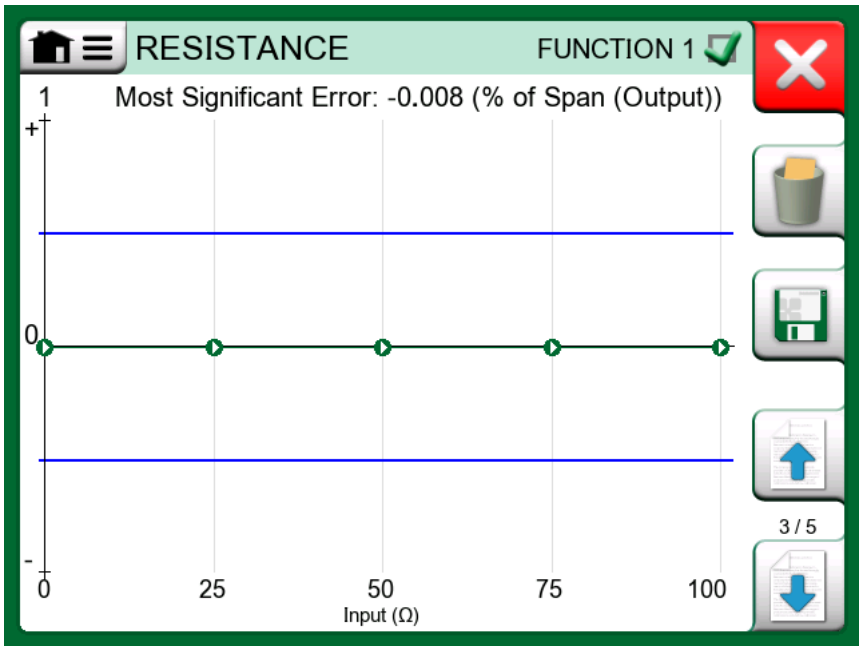


Figure 83: Calibration Results window – third page

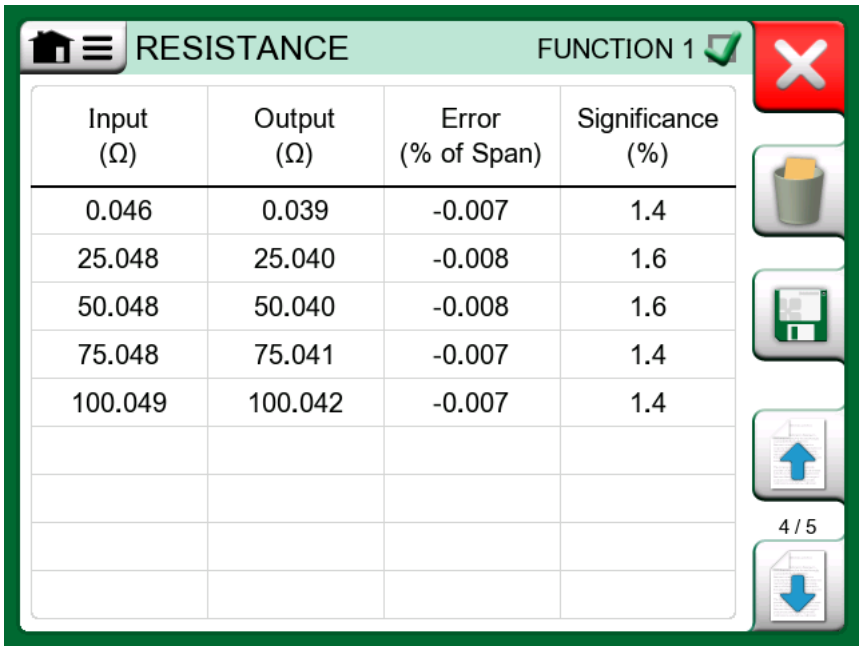


Figure 84: Calibration Results window – fourth page

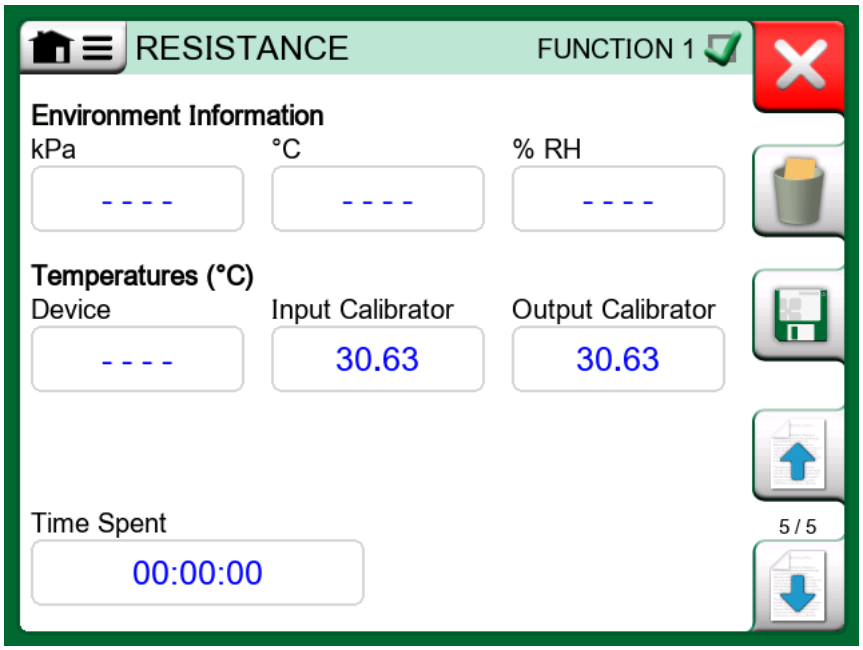


Figure 85: Calibration Results window – fifth page

You can save the results using the **Save** button (). Select whether the calibration is *As Found* or *As Left*. *As Left* result can be also combined with previous result by checking the **Combine with Previous Result** box. When enabled, the Calibration Management Software considers all combined results as a single calibration event with multiple repeats.

You can reject the result by pressing the **Delete** () button if you do not want to save it.

After saving or rejecting the results, the Calibration window opens (see Figure 78: Calibration window). You can either start another calibration repeat by tapping the **Start** button or finish calibration for this instrument by tapping the **Back** button.

Viewing Saved Calibration Results

After calibrating an instrument, you can view the saved calibration results, one instrument at a time. You can find the most recent result in the Instrument Overview window using the **View Results** button (). To browse all previously saved results, open the context-sensitive menu in the **Calibration Results** window and select **Results History**.

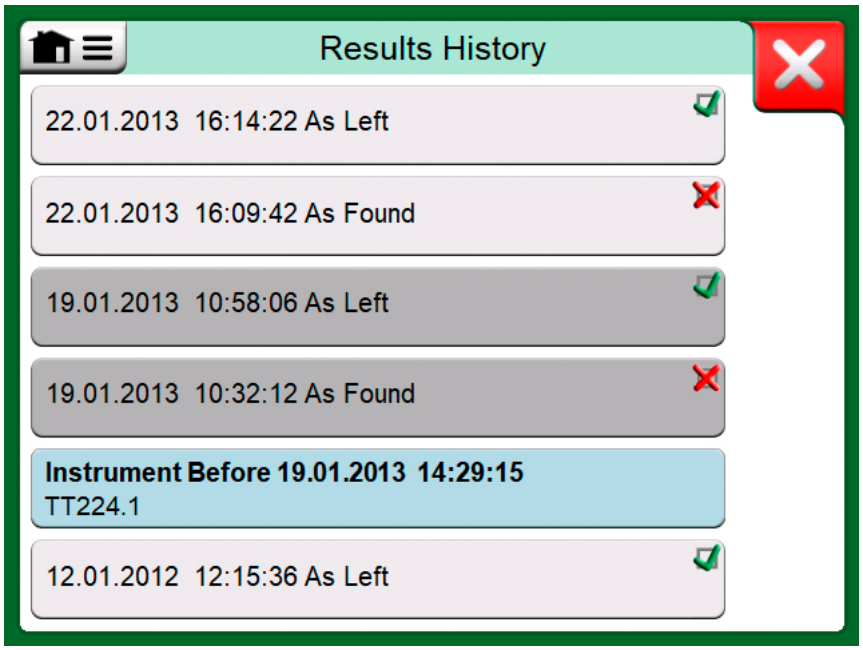


Figure 86: Calibration Results History window

Different shades of gray help distinguish separate calibration events. If the instrument's settings were changed, the background turns blue. Tap the entry to view the settings as they were at that date and time.

Note: Saved calibration results are read-only and cannot be edited.

Note: Changing the user sensor coefficients will also affect previously saved calibration results. We recommend using a calibration management software to store the results.

Deleting Calibration Results

To delete calibration results, open the context-sensitive menu and choose **Manage**. Choose **Delete This Result** to remove the currently displayed result, or select **Delete All Results** to erase all results associated with the current instrument.

Alternatively, you can delete all results for the current instrument in the **Results History** window by choosing **Delete All Results** from the menu.

After the results have been successfully transferred to CMX or LOGiCAL, you can also delete them in the Calibration Management Software or Sync Client.

Note: To remove all calibration results for all instruments across all Plant Structure Levels, go to the Instrument List window, open the menu, and select **Manage** > **Delete All Results**.

Warning: Deleted results cannot be recovered.

Creating Instruments in MC6-T

You can create a new instrument in Documenting Calibrator mode in one of two ways:

- Tap **Create New** instrument button ( ).
- Go to the Instrument List menu and select **Create New** > **Instrument**.

Note: For temperature instruments, you can use the **Temperature Instrument -Wizard**, available in the context-sensitive menu.

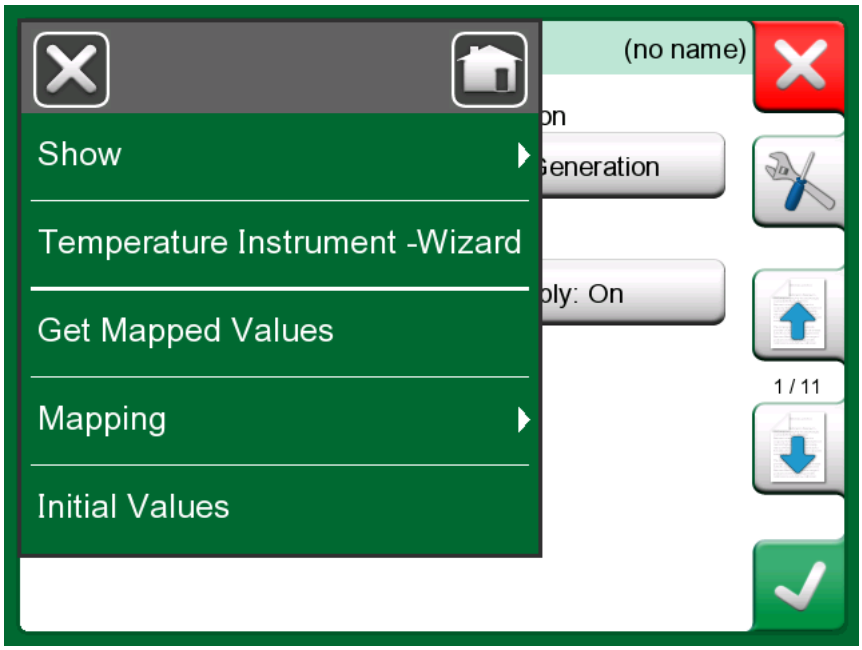


Figure 87: Temperature Instrument -Wizard

Temperature Instrument Specifics and Temperature Instrument -Wizard

When the instrument's input is temperature-related, keep the following in mind:

- If the input quantity is **Temperature**, (e.g., using the Temperature Block to generate temperature), the internal reference sensor is used as the reference.
- If the input quantity is **RTD Temperature** or **TC Temperature**, the input sensor acts as the reference. For these two input types, you can define how temperature is controlled via the **Automatic Control** button. The calibrator will handle setting the calibration points. If external controllers are connected, they will be listed under Controllers.
- For temperature-related input and output quantities, enabling the **Additional Stability Check** is highly recommended (see chapter Additional Stability Check for details).

The **Temperature Instrument -Wizard** is designed to help you select the correct calibration reference for your temperature instrument.

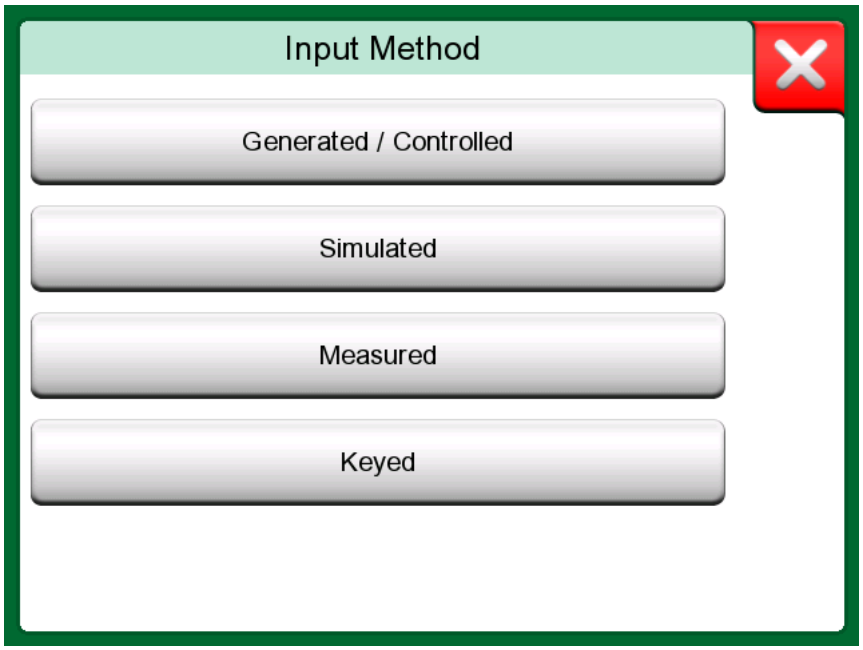


Figure 88: Temperature Instrument -Wizard, Input Method

You can choose from the following calibration methods:

- **Generated/Controlled** – Available when the Temperature Block is enabled or an external controller is used. The calibrator either uses its internal Temperature Block or controls an external controller to generate temperature. Works with both internal and external reference sensors.
- **Simulated** – The calibrator simulates temperature.
- **Measured** – The calibrator measures temperature without controlling it.
- **Keyed** – Temperature values are entered manually.

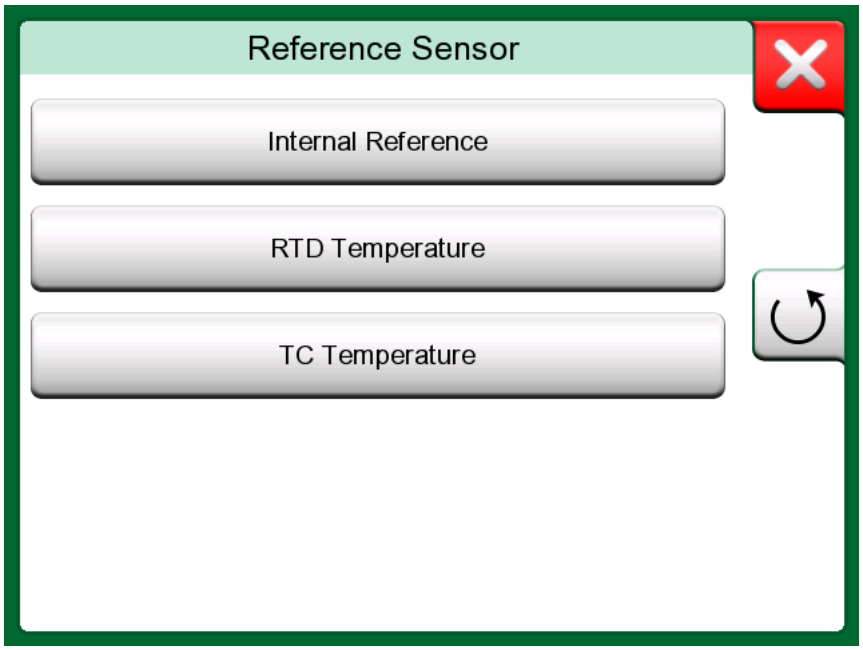


Figure 89: Temperature Instrument -Wizard, Reference Sensor

Continue setting up the instrument by editing several pages of the instrument configuration data.

The MC6-T calibrator includes these configuration pages:

- Identification – Defines the identification information of position and device.
- Input, Output and Function – Describe the instrument's measurement capability and define how input and output signals are captured.
- Procedure – Specifies calibration points and point acceptance method. Advanced settings allow for calibration notes and scheduling.
- Error Limit – Lets you select the error calculation method and define advanced error limits.

Table 5: Data location in Beamex Calibration Management Software

MC6-T configuration pages	Corresponding entity in CMX	Corresponding tab in LOGiCAL
Identification	Position, Device	Position tab, Device tab
Input	Function	Function tab, partly in Calibration Methods related to instrument type
Output		
Function		
Procedure	Calibration Procedure	Procedure tab
Error Limit		Error Limit tab

Note: Although several devices can be linked to one position in the Calibration Management Software, the calibrator only shows the data of the measurement device currently being calibrated.

By default, only the basic configuration pages are shown. To view all pages, select **Show** > **All Pages** from the context-sensitive menu when creating or editing an instrument. Note that page numbering will change accordingly.

Start creating an instrument and fill in the instrument data in all the fields.

Tip: You can automatically populate some of the smart instrument data when creating a new instrument in MC6-T with the Get Mapped Values feature. For more information, see chapter Get Mapped Values feature.

Note: MC6-T allows instruments with identical identification, but this may cause issues when transferring the results to calibration management software, where instrument identifications must be unique (with exception of multi-function instruments).

Identification Related Data

The **Identification** configuration page allows you to define the Position ID, Position Name, Device ID, and Device Serial Number.

Note: The Device ID field is mandatory.

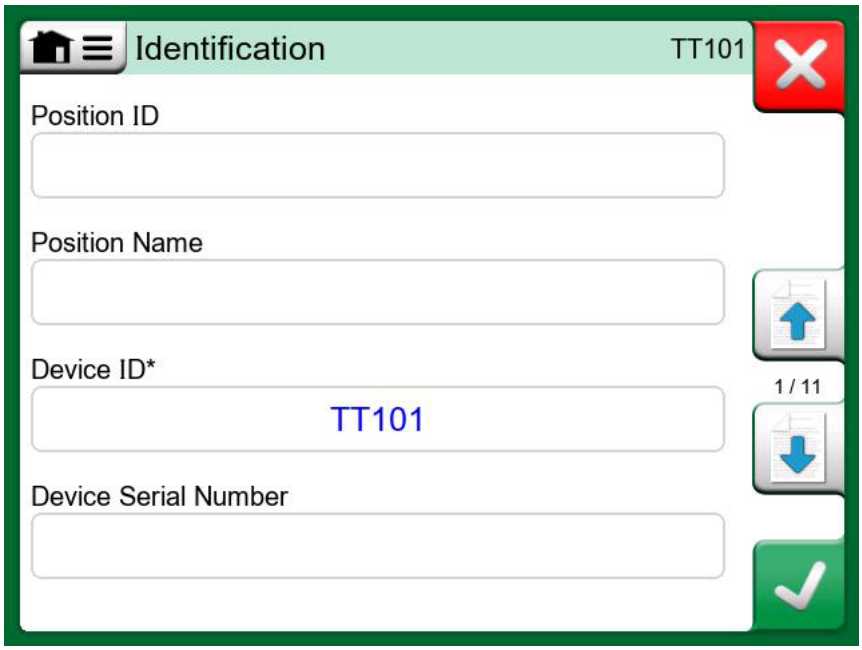


Figure 90: Identification configuration page

Instrument Function Related Data

The **Input** configuration page defines the input Quantity and related parameters.

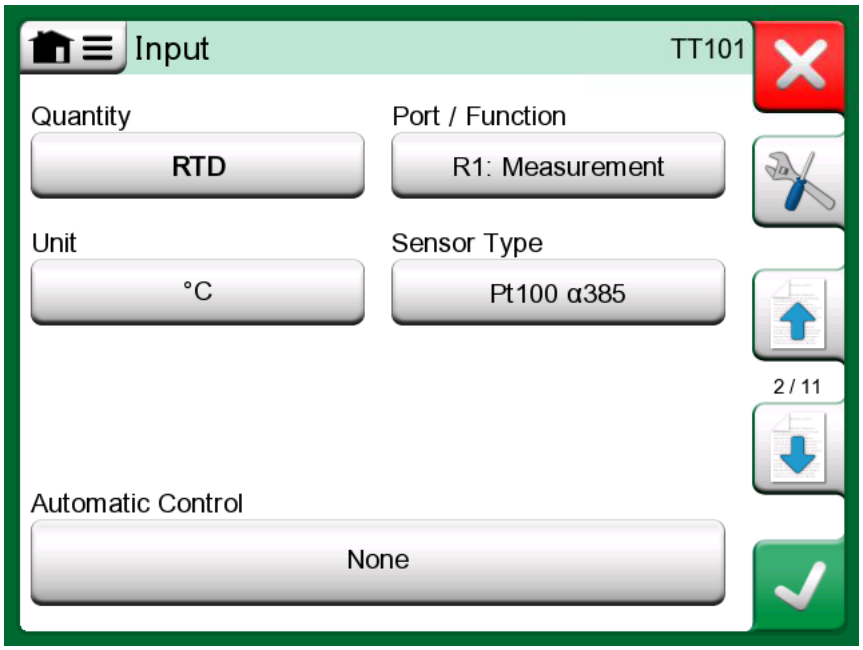


Figure 91: Input configuration page

Port/Function (excluding Keyed) and **Unit** settings are available for all input quantities. Additional configuration fields may appear depending on the selected Quantity and Port/Function (see table below).

Table 6: Input parameters depending on the selected Quantity

Quantity	Additional settings available
RTD Temperature	Sensor Type, Automatic Control
TC Temperature	Sensor Type, RJ Mode, Automatic Control
Pressure	Pressure Type
Current	Loop Supply
Frequency	Amplitude, Waveform & Duty Cycle, Trigger Level
Pulse	Amplitude, Waveform & Duty Cycle, Frequency, Trigger Level, Trigger Edge
Keyed	Keyed Quantity, Resolution, Resolution from Entry

Note: When using MC6-T calibrator with an external controller, select the controller on the Input page. For a pressure controller, select *Pressure* as the quantity and the controller in Port/Function.

By default, all generations begin when the calibration starts. If necessary, you can start the generation earlier by selecting **Initial Values** from the context-sensitive menu on any instrument configuration page.

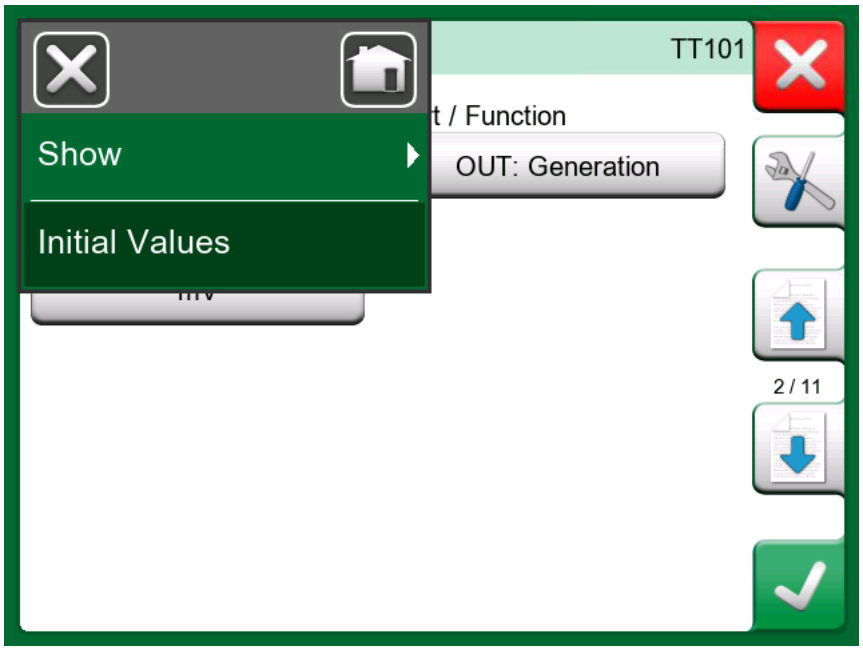


Figure 92: Initial Values functionality

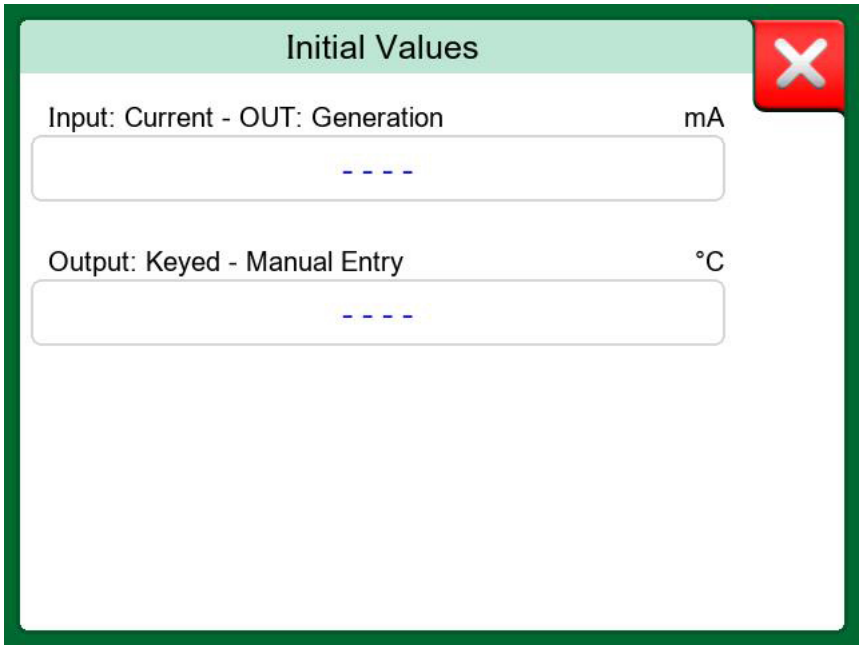


Figure 93: Initial Values window

The **Additional Supplies** (advanced configuration) page lets you choose an additional supply source (for Loop and/or Sensor).

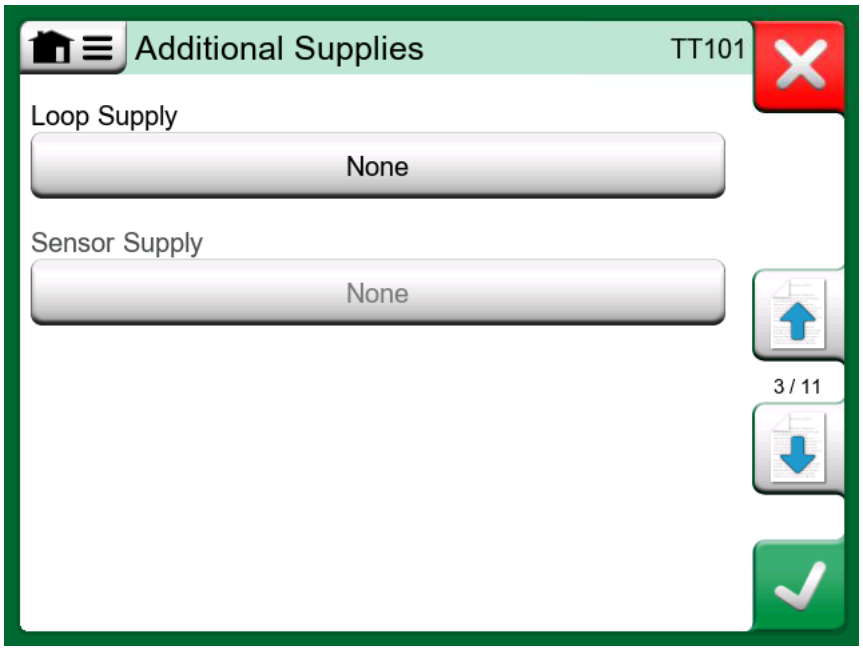


Figure 94: Additional Supplies advanced configuration page

Use the **Output** configuration page to define the output signal Quantity and its parameters.

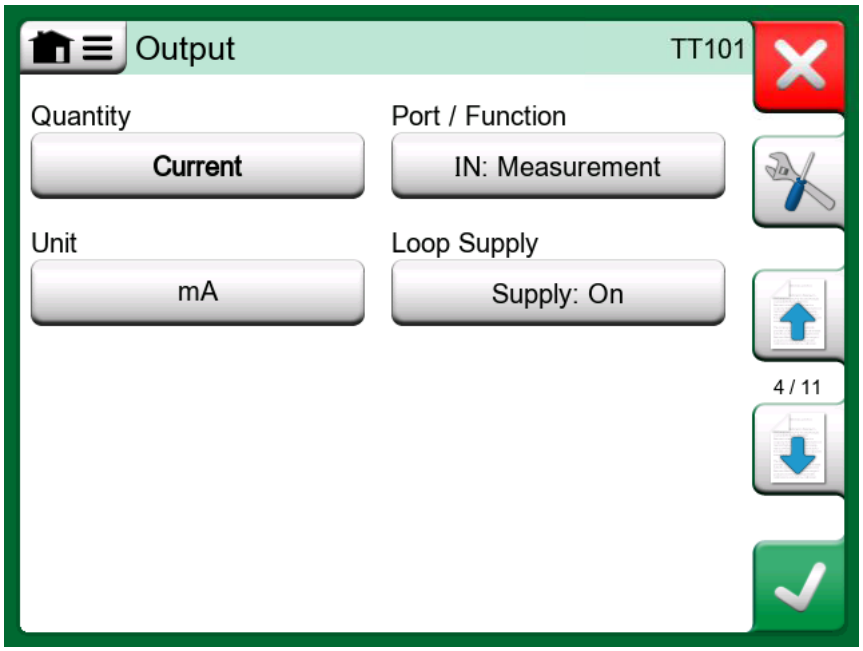


Figure 95: Output configuration page

For most Quantities, the same parameters as for Input are available, with a few additional settings (see table below).

Table 7: Additional Output parameters

Quantity	Additional available settings
Pulse	Zero
Switch	Switch Type, Switch Sound, Trigger Level
Keyed	Display Type

The **Function** configuration page allows you to configure the following:

- Input Range - lower and upper limits for the calibration reference signal.
- Transfer Function - defines the relationship between instrument's input and output (e.g. Linear, Square Root, etc.).
- Output Range - the lower and upper limits for the output signal.

Note: For measurement devices, the output range is the same as the input range.

- Function name.

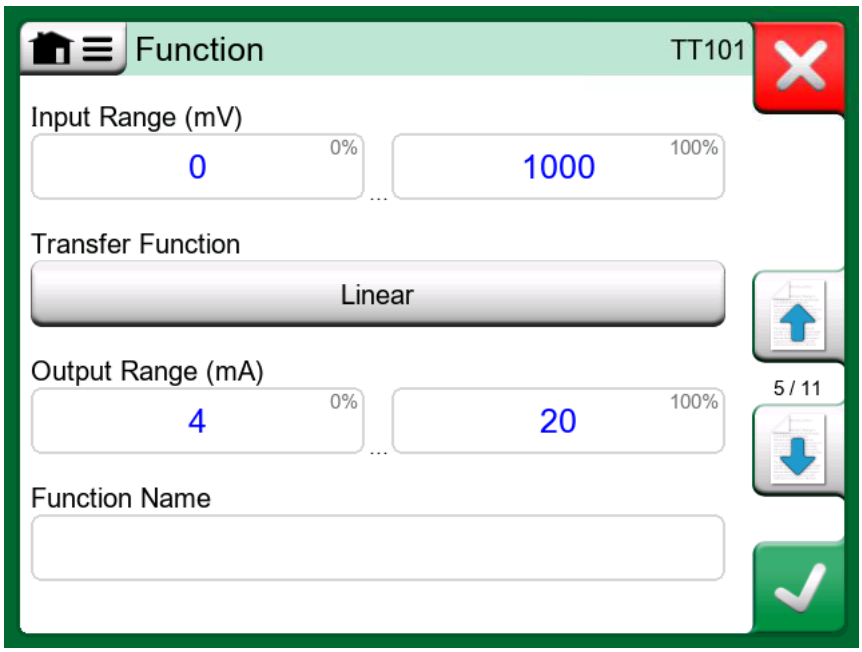


Figure 96: Function configuration page

Calibration Procedure Related Data

Procedure configuration page allows you to define the following parameters:

- Calibration Points (Predefined) – specifies calibration points (number of steps, step size, and percentage) or select one of the predefined sets.
- Repeat Format – defines the way the calibration points are advanced.

> **Tip:** The combination of Calibration Points and Repeat Format determines how many points are used and the order in which they are executed.

- Points are Input / Output – by default, calibration points are based on input. Tick this box to calculate them from output instead.
- Max Point Deviation (%) – allows deviation from the nominal calibration point value and works together with automatic point acceptance. If the input value stays within the defined tolerance, the point is accepted automatically and calibration continues. Otherwise, it requires manual acceptance.
- Stability Check – calibrator checks input signal stability before saving the reading. Tick this box to also check output stability.
- Point Delay (s) – sets the delay before a point is accepted, provided Automatic Acceptance is enabled.
- Automatic Acceptance – automatically accepts points after considering settings such as point delay, stability, etc.

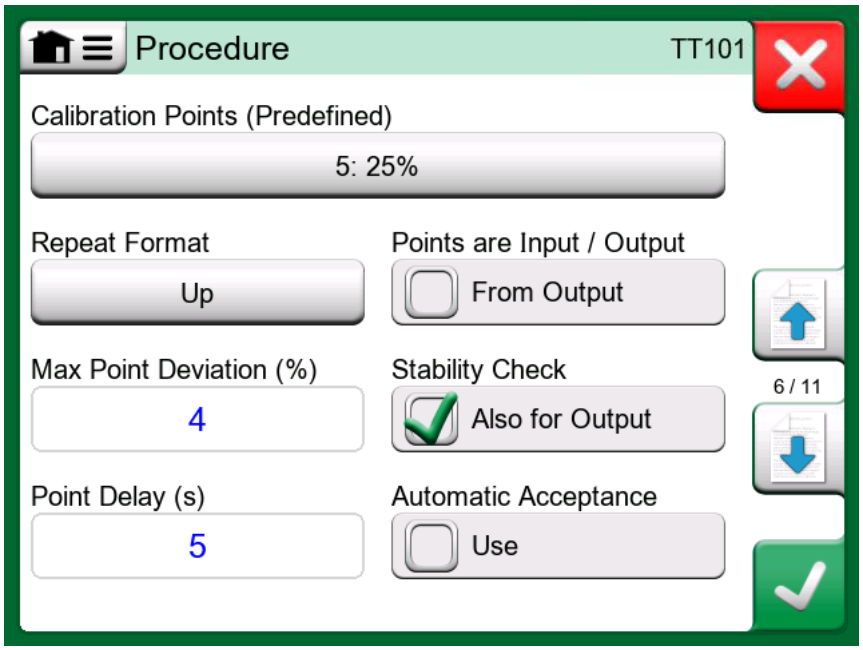


Figure 97: Procedure configuration page

The **Notes** (advanced configuration) page can be used to enter calibration and adjustment notes.

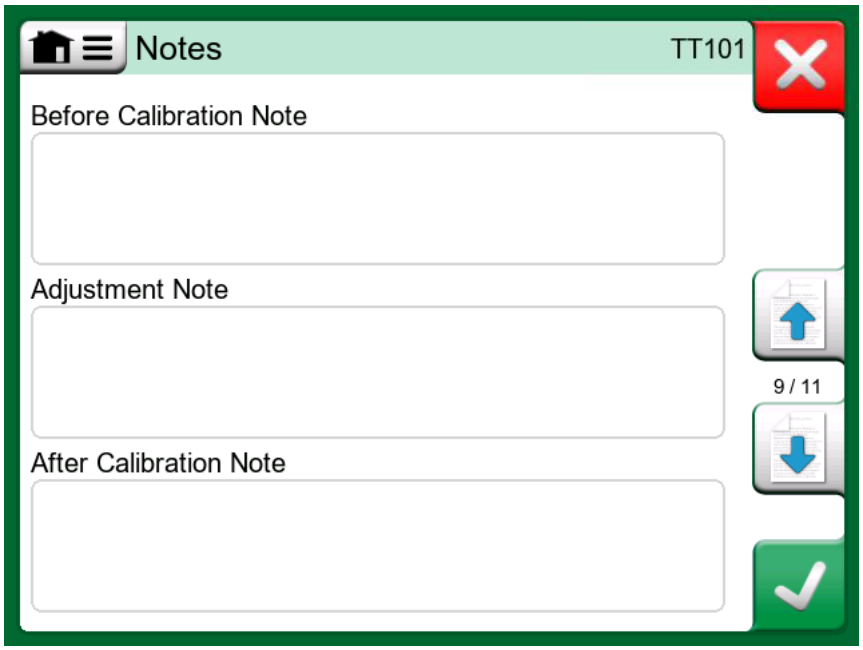


Figure 98: Notes advanced configuration page

The **Scheduling** (advanced configuration) page includes options to set the calibration due date and configure the calibration interval. You can also define the interval unit and calibration repeat count.

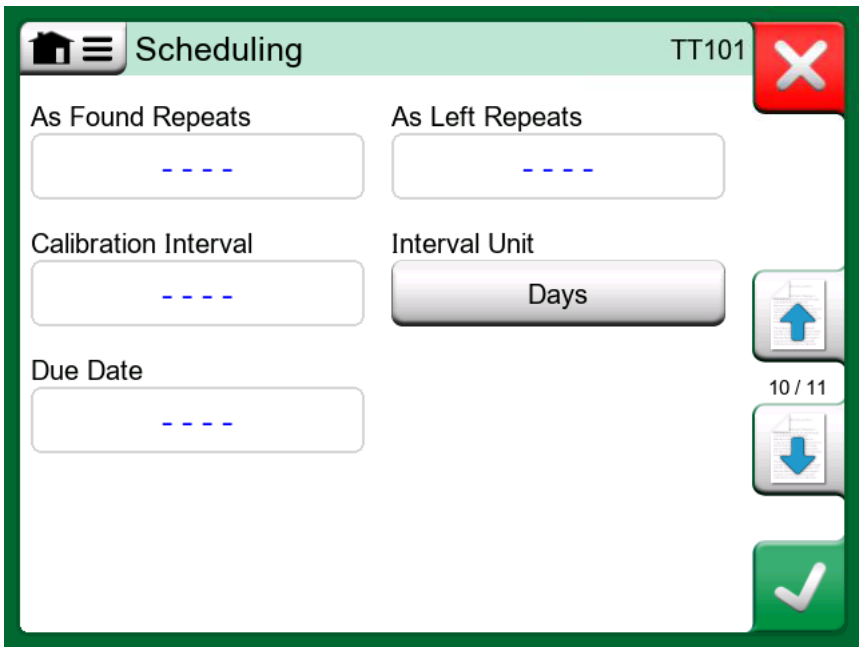


Figure 99: Scheduling advanced configuration page

Error Limit Related Data

The **Error Limit** configuration page lets you choose the **Error Calculation Method** (unit and reference), and set measurement error limits. It also provides

a place to set up multiple error limits for the instrument (the instrument range can be divided up to 10 subranges, each having their own constant and relative error values).

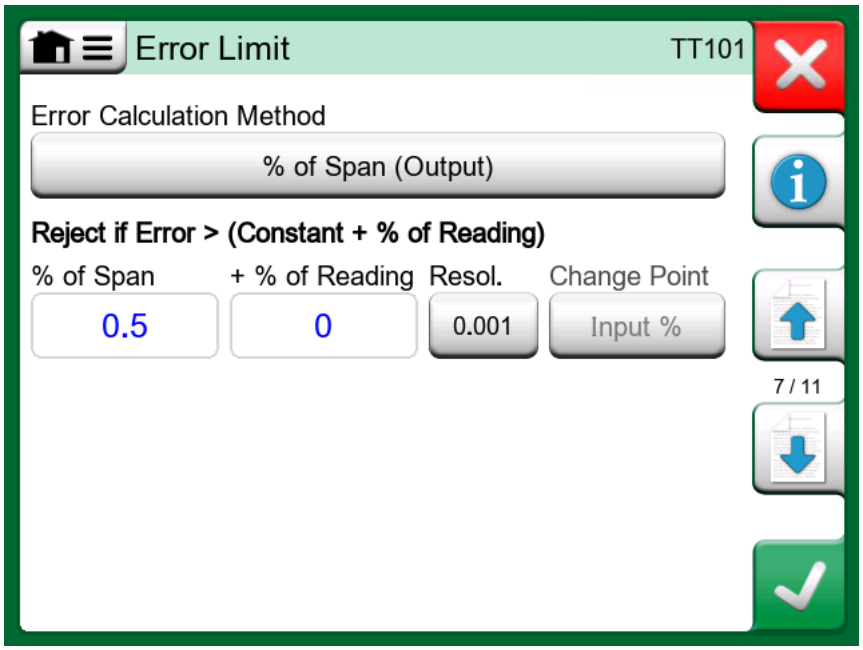


Figure 100: Error Limit configuration page

The **Other Error Limits** (advanced configuration) page helps you define additional error limits and possible instrument adjustment settings.

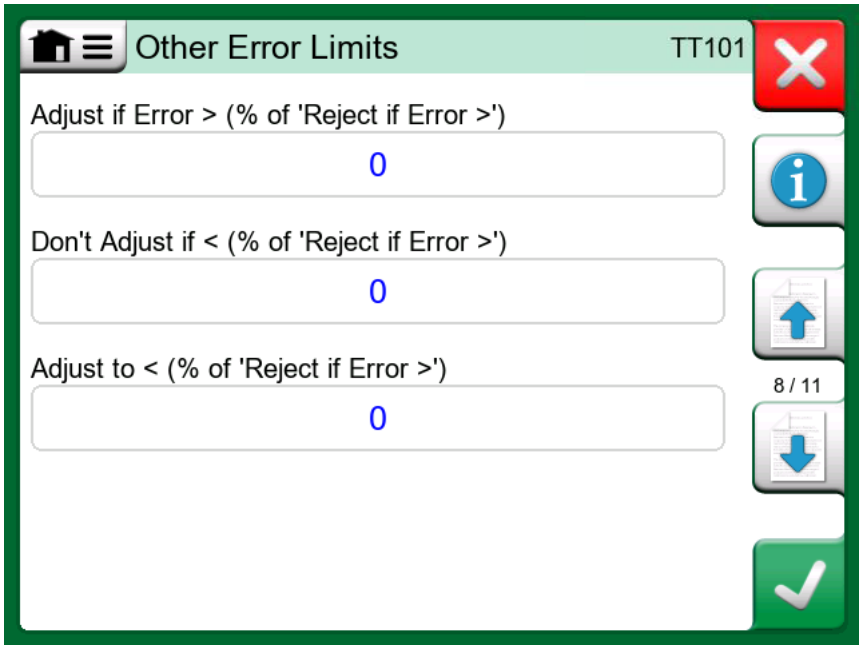


Figure 101: Other Error Limits advanced configuration page

Device Related Data

The **Device** configuration page lets you specify the Location, Sensor Serial Number, Manufacturer, and Model.

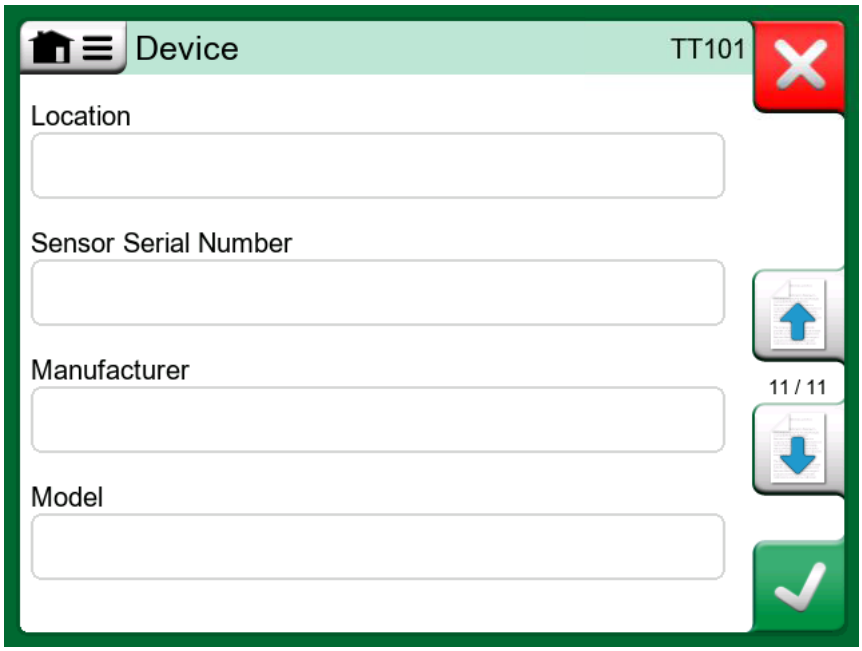


Figure 102: Device advanced configuration page

Group Calibration

The **Group Calibration** feature in the Documenting Calibrator lets you calibrate several instruments or functions individually, in sequence. This is especially useful when calibrating instruments or functions that are part of a loop or when input generation takes time (e.g., with temperature), and several devices need to be calibrated in one session.

Note: Grouped instruments may be created directly in MC6-T or received from CMX or LOGiCAL. However, groups can only be created in the calibrator itself, not in the calibration management software.

Tip: Examples of instruments and functions that are suitable for Group Calibration include:

- A measurement loop consisting of a temperature transmitter, a local temperature indicator, and a temperature indicator in the control room.
- A set of temperature sensors calibrated simultaneously using, for example, a dry block.

Note: The Group Calibration feature does not support switches.

Creating and Editing a Group

Collecting Instruments or Functions for Group Calibration

You can create a group in the Instrument List window. Open the Instrument List menu and select **Create New** > **Group**.

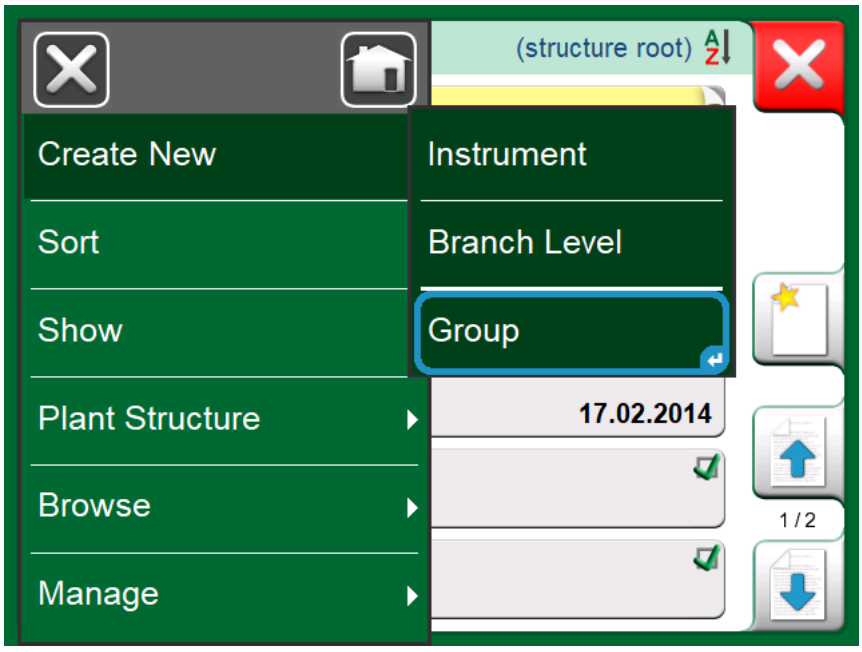


Figure 103: Creating a group

To add an instrument or function to the group, select it in the Instrument List view to open the Instrument Overview window and then press the **Add to Group** button ( ).

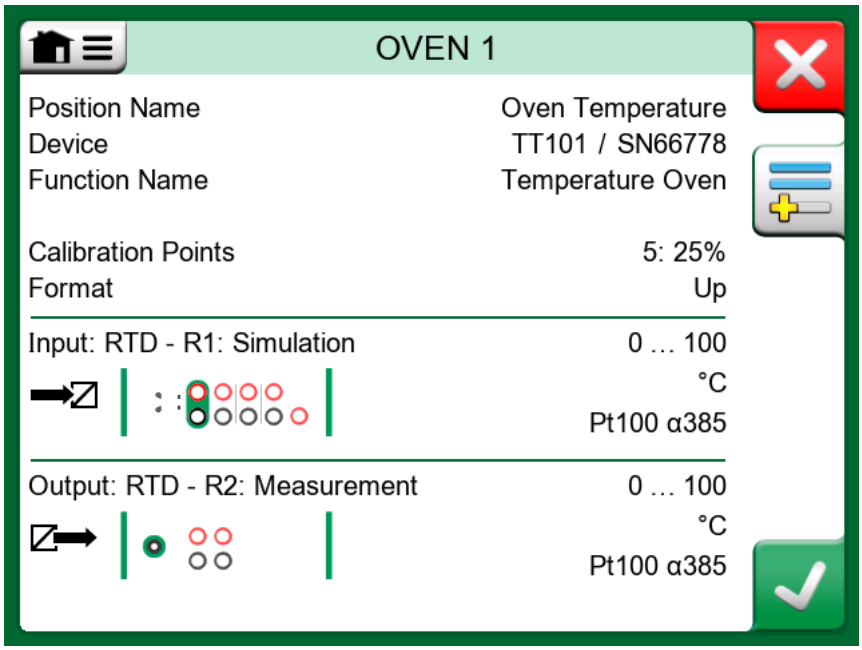


Figure 104: Instrument Overview window – Add to Group button

Instruments included in the group will have a blue background in the Instrument List.

Figure 105: Grouped instruments

Once an instrument is added to the group, MC6-T goes back to the Instrument List to allow selection of additional instruments. By default, calibration proceeds in the order the instruments or functions were added to the group.

Tap the **Group Info** button ( ) to view all grouped instruments in the Group Overview window.

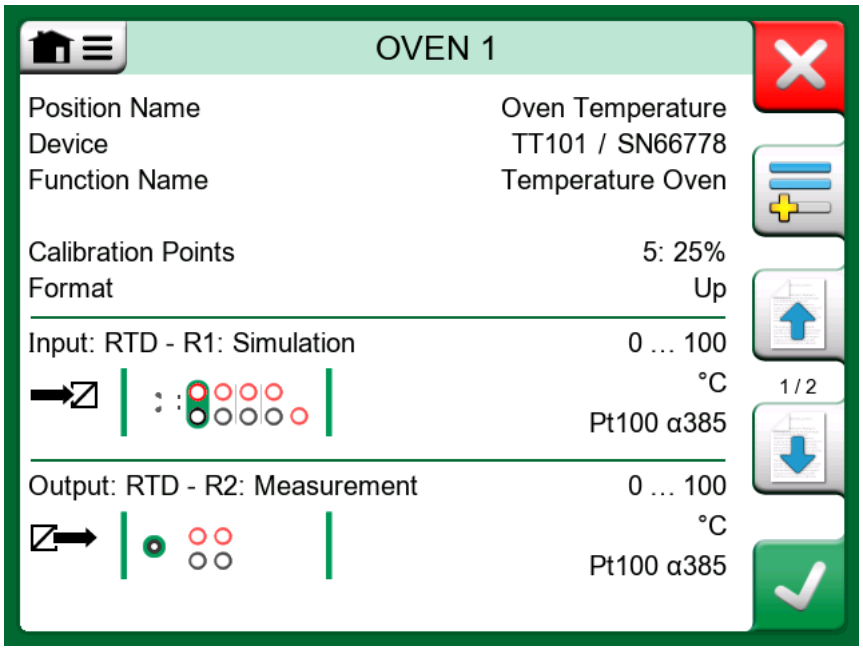


Figure 106: Group Overview window

Editing a Group

You can rearrange the order using the context-sensitive menu in the Group Overview window.

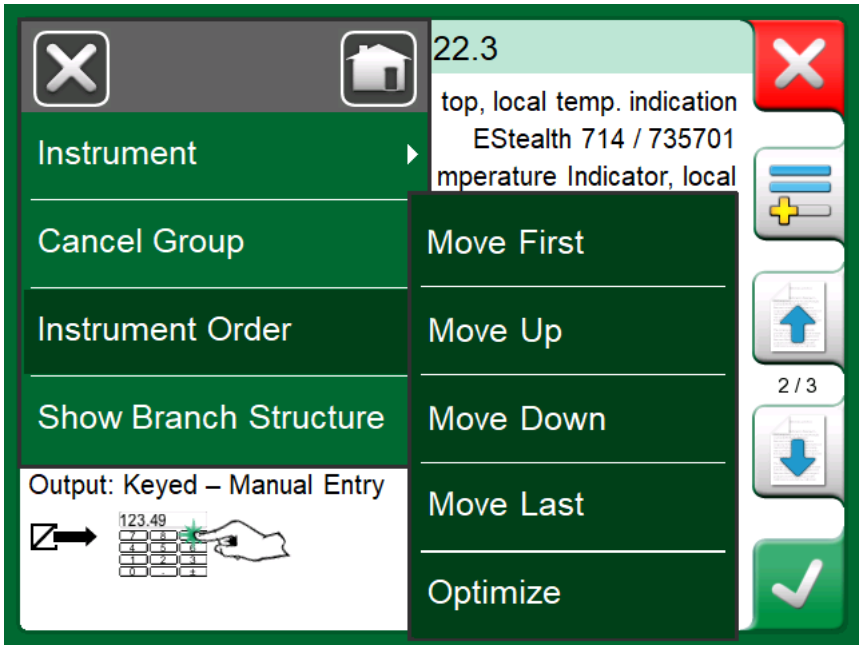


Figure 107: Group calibration – calibration order for the grouped instruments

Note: Selecting **Instrument Order** > **Optimize** will automatically sort the group so calibration starts with the instrument having the lowest calibration point.

To modify instrument configuration data for individual instruments, open the context-sensitive menu in the Group Overview window and select **Instrument** > **Settings**. The same menu also allows you to **Cancel Group** or remove the selected instrument or function from the group using the **Instrument** > **Remove from Group** option.

Note: When Group Calibration is active, the **Configure** ( ) and **View Results** ( ) buttons become options in the Group Overview window's context-sensitive menu.

Calibrating a Group

After you define a group, start the calibration process by tapping the **Accept** button ( ) in the Group Overview window. The **Calibration** window opens and displays the first instrument or function in the group.

Tap the **Start** button to begin the calibration.

Note: The **Info** button in the Calibration window now indicates which instrument or function is currently shown (see Figure 109: Calibration window – Settings and Group Settings). Press the button to view the instrument configuration data and connection diagrams.

Figure 108: Group calibration – instrument selection button

Note: To change the calibration order, tap the **Info** button and select a different instrument or function in the Group Overview window.

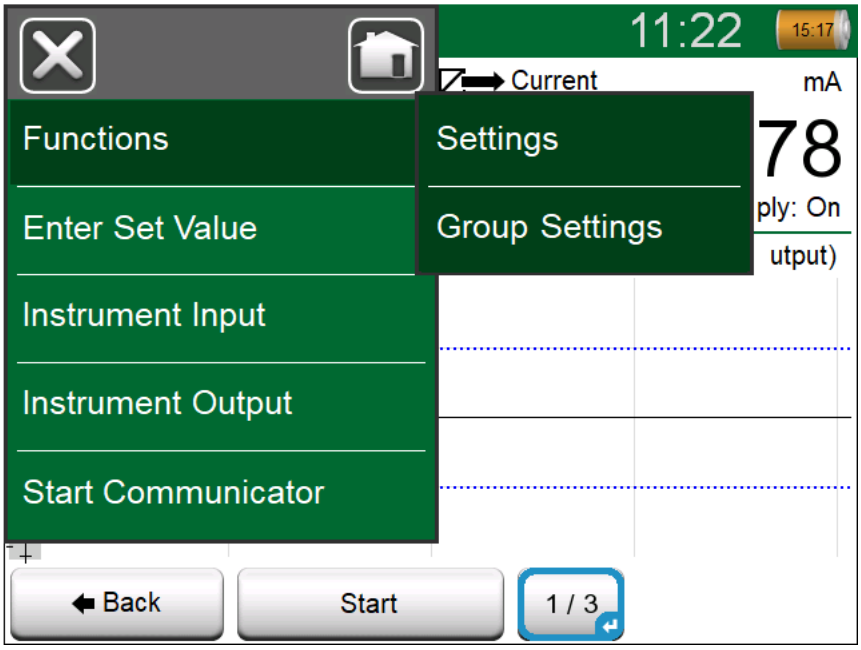


Figure 109: Calibration window – Settings and Group Settings

Before starting the group calibration, make sure to review the settings. Select **Functions** > **Settings** to access advanced options, such as displaying the **Function Name** in the Title bar. Descriptive function names can help identify instruments and functions more easily when calibrating items in a loop.

More details about group settings are available in section Group Settings.

Note: Remember to change the connections if needed when the instrument or function changes during the group calibration.

After all instruments or functions have been calibrated, the Calibration Results window opens and indicates whether the calibration **Passed** or **Failed** for each instrument or function individually. The results are shown on multiple pages, offering different views of the calibration data, such as numerical values, graphical representation, and general information.

You can save the results using the **Save** button ( ). Select whether the calibration is *As Found* or *As Left*. *As Left* result can be also combined with previous result by checking the **Combine with Previous Result** box. When enabled, the Calibration Management Software considers all combined results as a single calibration event with multiple repeats.

You can reject the result by pressing the **Delete** ( ) button if you do not want to save it.

After saving or rejecting the results, the Group Overview window opens (see Figure 106: Group Overview window). You can either start another calibration repeat by tapping the **Accept** button or return to the Instrument List to, for example, add or remove instruments or functions from the group.

Group Settings

To open the **Group Settings** window, select **Functions** > **Group Settings** from the context-sensitive menu in the Calibration window (see Figure 109: Calibration window – Settings and Group Settings).

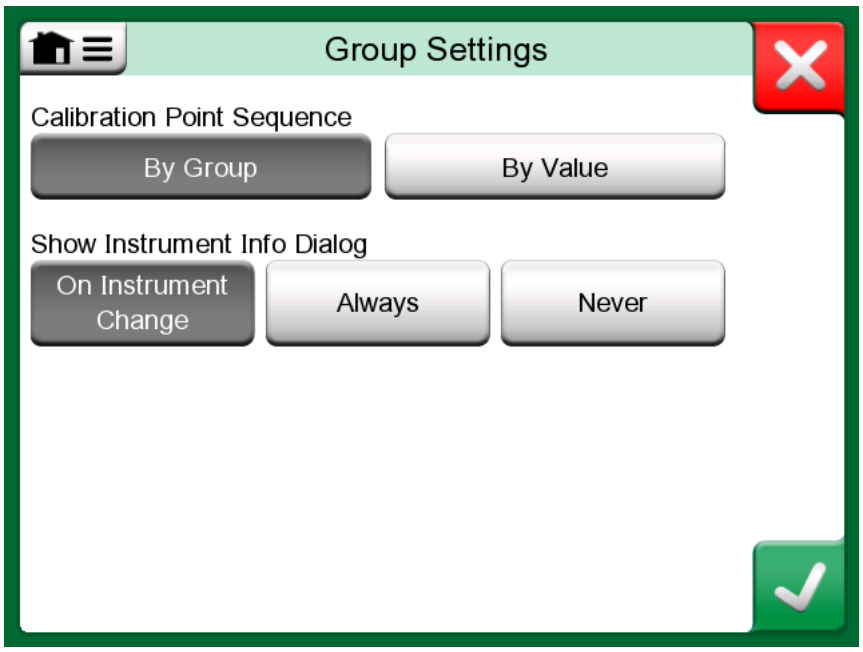


Figure 110: Group Settings window

Group Settings allow you to define the **Calibration Point Sequence**, which defines how calibration points are progressed through. Two options are available:

- By Group: Suitable when all instruments in the group have the same input range. The number of calibration points can vary, as long as the range is the same.
- By Value: Suitable for instruments with different spans. **The first instrument must have the lowest calibration point in the group.** If needed, use the sorting tool described in section Editing a Group.

The **Show Instrument Info Dialog** setting determines when the Instrument Overview window is displayed during Group Calibration.

Special Use Cases

The Documenting Calibrator offers versatile functionality and supports a wide range of use cases.

In some situations, the calibration range exceeds the measurement range of a pressure module or the control range of an external controller. In these

cases, the pressure module or controller must be changed during the calibration process.

If instruments have been sent from CMX Calibration Management Software, you can use the Work Order View as an alternative way to access the instrument list. These special scenarios are described in the following subchapters.

Changing a Pressure Module During Calibration

If a calibration involves using multiple pressure modules, you will need to change them "on the fly".

To change a pressure module during calibration:

1. Open the context-sensitive menu and choose either Instrument Input or Instrument Output, depending on where the module is connected.
2. Tap the **Port/Function** button and select the new pressure module from the list. If switching from one external pressure module to another, tap the **Change external pressure module** button () and follow the instructions shown on the display.

Using External Controllers in Calibration

Using an MC6-T together with a pressure controller or a temperature dry block enables fully automated calibration of various pressure and temperature instruments. To use the external controller in Documenting Calibrator, first pair it with the calibrator and define the required presets. For instructions, see chapter Enabling Communication with the Controller.

Pressure Controller

When using a pressure controller, select Pressure as the Input Quantity. To run the controller in full Controller mode, select it in Port/Function. In this mode, the controller sets the pressure setpoints and measures the reference pressure.

To use MC6-T internal pressure modules as the reference, choose the appropriate internal or external module in Port/Function. The Input page will display a prompt asking whether the controller should set the calibration points – activate the tickbox to confirm.

Temperature Dry Block

When working with a temperature dry block, the quantity selection depends on how the reference temperature is measured:

- Full Controller mode – the dry block controls setpoints and measures reference temperature. Select Temperature as Input Quantity and the dry block in Port/Function.
- MC6-T as a reference – MC6-T measures the reference temperature. Select RTD Temperature or TC Temperature as Input Quantity.

The Input page will display a prompt asking whether the controller should set the calibration points – activate the tickbox to confirm.

Details on the methods can be found in chapter Calibration Methods with External Controllers.

Changing a Controller During Calibration

Sometimes, calibration requires changing a controller during the process (for example, when the dry block's temperature range doesn't cover the instrument's full measurement range).

To change the controller during calibration:

1. Open the context-sensitive menu and choose **Instrument Input**.
2. Then tap the **Change Controller** button () in the Instrument Input window and follow the instructions shown on the display.

Work Order View Mode

Work Order View Mode offers an alternative way to view the instrument list when instruments are sent from CMX Calibration Management Software along with Work Orders in their Calibration Procedure. To activate Work Order View Mode, open the context-sensitive menu in the Documenting Calibrator Home view and select **Work Order** from the View Mode options.

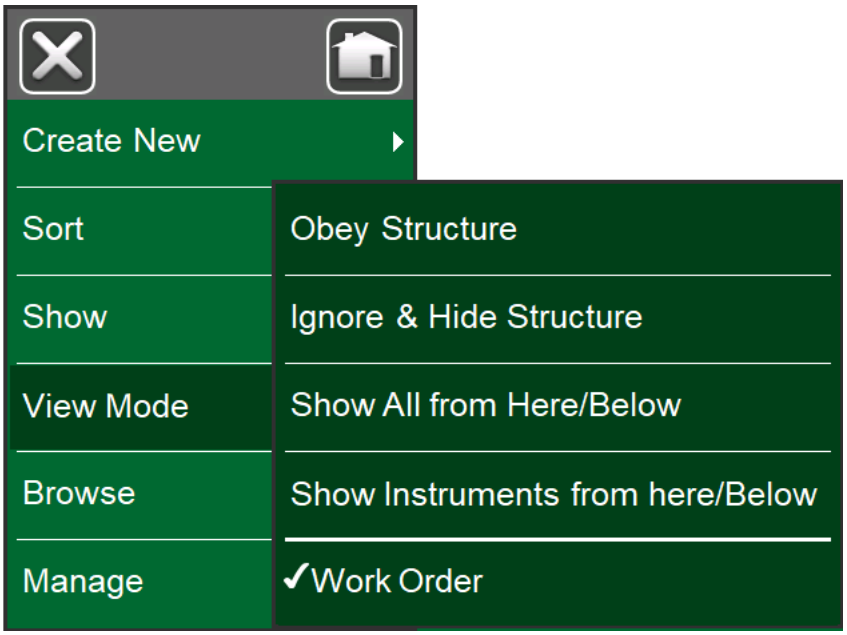


Figure 111: Activating Work Order View Mode

When Work Order View Mode is enabled, a list of Work Orders is shown.

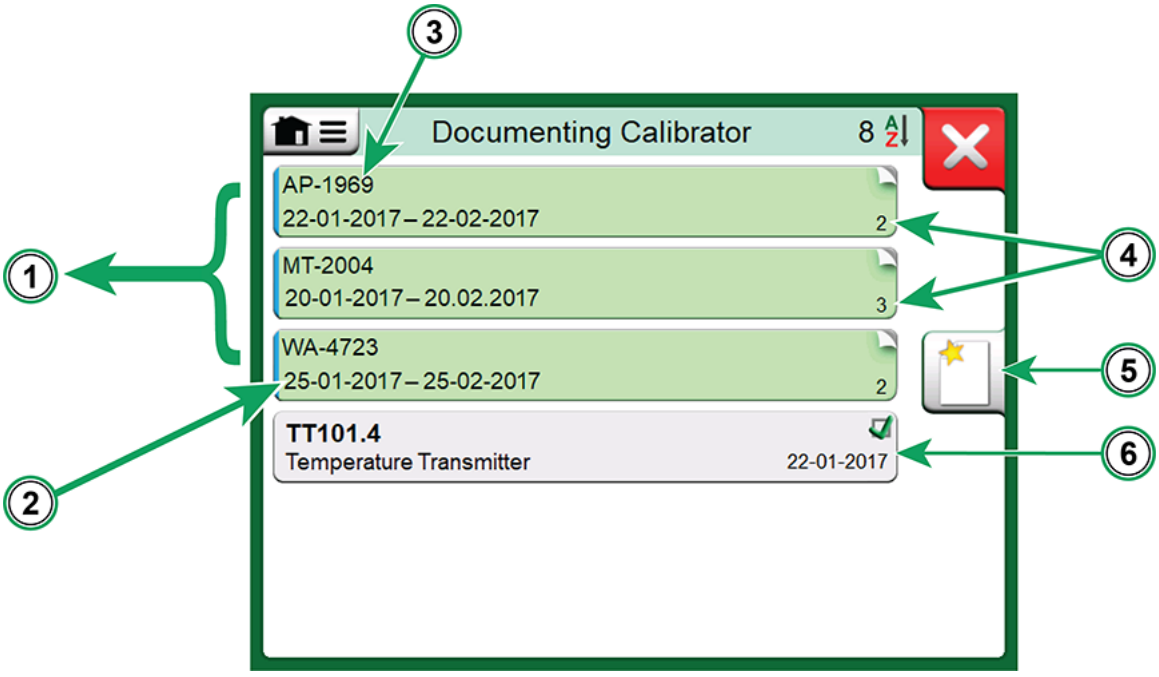


Figure 112: List of Work Orders

Legend:

1. Work Orders list (green background with light blue stripes indicating Work Order View Mode).
2. Start and End Dates.
3. Work Order Number.
4. Number of Instruments included in each Work Order.

5. **Create New** instrument button ( ).
6. Instrument without a Work order number.

Tip: Instruments without a Work Order number are displayed below the list of Work Orders.

Tapping a Work Order opens its list of instruments.

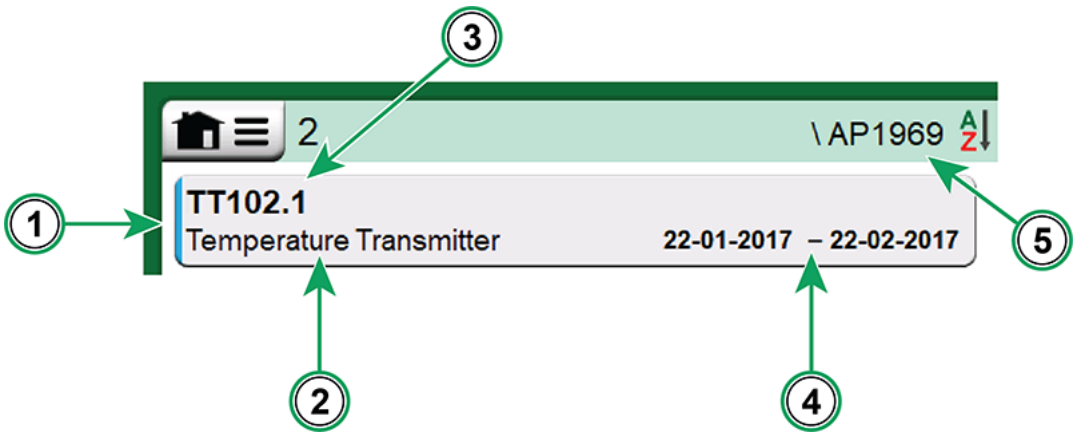


Figure 113: Instrument belonging to Work Order

Legend:

1. Instruments in a Work Order (highlighted with light blue stripes for Work Order View Mode).
2. Function Name.
3. Position ID.
4. Work Order Start and End Dates.
5. Work Order number.

Selecting a Work Order gives options in the context-sensitive menu to delete results of the current Work Order or remove the entire Work Order.

Calibrating an instrument within a Work Order follows the same procedure as with any other instrument.

Note: The Instrument Overview window displays the associated Work Order details within the instrument's general information and on a dedicated page. Work Order data such as number and dates are read-only in MC6-T.

Note: When Work Order View Mode is active, the Plant Structure is hidden, and you cannot move or copy instruments in the structure.

Mobile Security Plus Option

Beamex Mobile Security Plus technology helps maintain the integrity of calibration data even when calibrations are performed offline. Authentication is done with the CMX user ID and the mobile device password set by the user in CMX, ensuring protection against unauthorized data changes.

The Mobile Security Plus feature requires CMX Calibration Management Software version 2.11 or later, with Mobile Security Plus option installed in both CMX and the calibrator. For more information about Mobile Security Plus functionality, please refer to the *CMX User Manual*.

Applied Restrictions

Depending on the CMX configuration, the following Documenting Calibrator functions are either restricted by admin credentials or completely disabled:

- **Skipping** or **undoing** calibration points.
- **Rejecting** (exiting) incomplete calibrations without saving the results.
- **Changing** the date and time on the calibrator
- **Modifying** the calibration date and time of a keyed calibration.
- **Deleting** calibration results.
- **Deleting** an instrument that has saved calibration results.

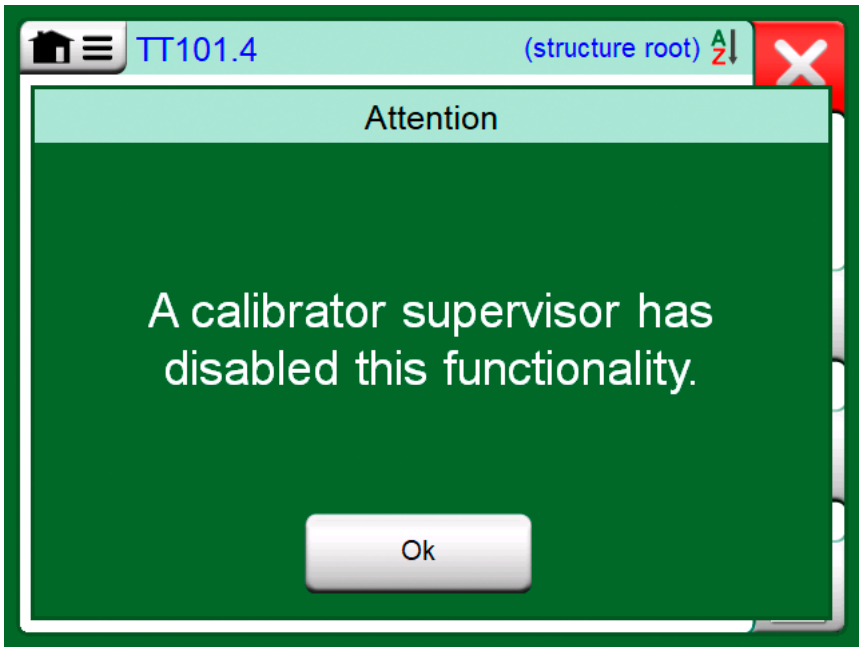


Figure 114: Message shown by the calibrator when functionality is blocked

Note: Changing Regional Settings and Date & Time also requires admin credentials.

Type B Uncertainty

About Uncertainty

Uncertainty is a measure of confidence in the measurement result and includes influences from both accuracy and precision.

> **Note:** Uncertainty calculations for process instruments are based on the “Guide to the Expression of Uncertainty in Measurement” (GUM), published by ISO, IEC, BIPM, OIML, and other organizations.

A measurement result is never completely accurate and always includes uncertainty. Uncertainty is caused, for example, by the quality of the measuring tool (such as a calibrator), the user’s skills, the measurement procedure, and environmental conditions like temperature.

A measurement result includes the measured value, an uncertainty interval, and a confidence level, for example:

The voltage is: 1.505 V ± 0.002 V at 95.45 % confidence level

For additional information, see the definitions below.

Average	Mean value of readings.
Uncertainty Inverval	The uncertainty range, for example 5.00 V ±0.01 V, that is part of the defined confidence level.
Confidence level	Describes the probability of a measurement being inside defined limits.
Coverage factor	A factor for expanding/decreasing the confidence level of normally distributed data.
Deviation	How widely spread, around the mean value, the measurements are.
Measurand	The measured quantity that is dependent on a number of input quantities. In Beamex's Calibration Management Software and calibrators, typically the instrument's output signal.
Resolution	The smallest detectable change of an indicator or recorder.

Standard deviation (of the mean)	Standard deviation defines where 67.27 % of the measurement readings are in a normal distribution. Standard deviation of the mean defines where 67.27 % of the average readings are in a normal distribution.
Uncertainty	Uncertainty of measurement: **Average uncertainty** applies to average calibration results. **Combined uncertainty** is the total uncertainties of all uncertainty components affecting input and/or output. **Expanded uncertainty** is the combined uncertainty multiplied by a coverage factor to provide an interval corresponding to a specified level of confidence. **Input uncertainty** is the uncertainty of all uncertainty components at the instrument's input. **Output uncertainty** is the uncertainty of all uncertainty components at the instrument's output. **Standard uncertainty** is the term used for 67.27 % confidence level.

Calculating Uncertainty

The uncertainty of a measurement is calculated after estimating the sources of uncertainties and their relevance. Once all uncertainty components are identified, they are combined to sum up a total uncertainty of a measurement.

There are two types of uncertainties:

- **Type A** uncertainties are uncertainty estimates based on repeated measurements in similar conditions.
- **Type B** uncertainties are estimates obtained by means other than statistical analysis of repeated observations. In calibration, they are typically derived from sources such as calibrator module specifications, calibration certificates, reference data, and prior knowledge of the measurement process.

To calculate uncertainties from measured data, you need to calculate the average and the deviation of the measurements.

Only Type B uncertainty is supported by MC6 family calibrators.

Enabling Uncertainty

When uncertainty is enabled in the Calibration Management Software, the MC6-T calibrator follows its configuration, automatically enabling uncertainty for the selected instrument.

When working only with the MC6-T calibrator, enable uncertainty on page three in **Settings mode** > **Documenting Calibrator**. You can also configure uncertainty to be considered in the Pass/Fail decision.

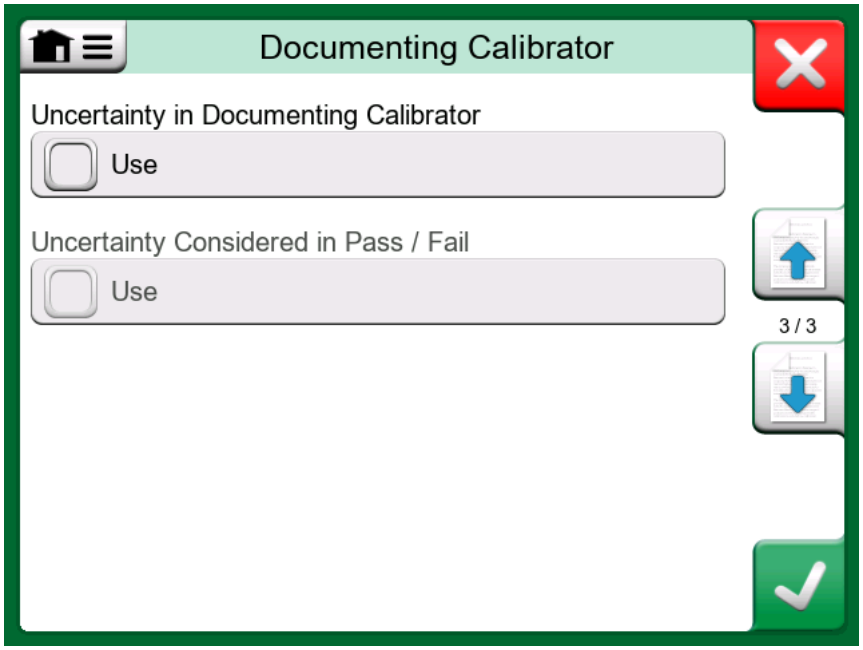


Figure 115: Enabling uncertainty in the calibrator

Note: A guard band with width w=U (expanded uncertainty, k=2) is applied to conformity assessment. The decision rule is:

|error| + U ≤ tolerance

where U is the 95 % expanded uncertanty.

This corresponds to a Probability of False Acceptance (PFA) below 2.5 %.

When uncertainty is enabled, an additional page **Uncertainty Management** is available during instrument creation in Documenting Calibrator, where the

Uncertainty Type can be set to *Disabled*, *Fixed*, or *Calculated (Calibrator's Specifications)*.

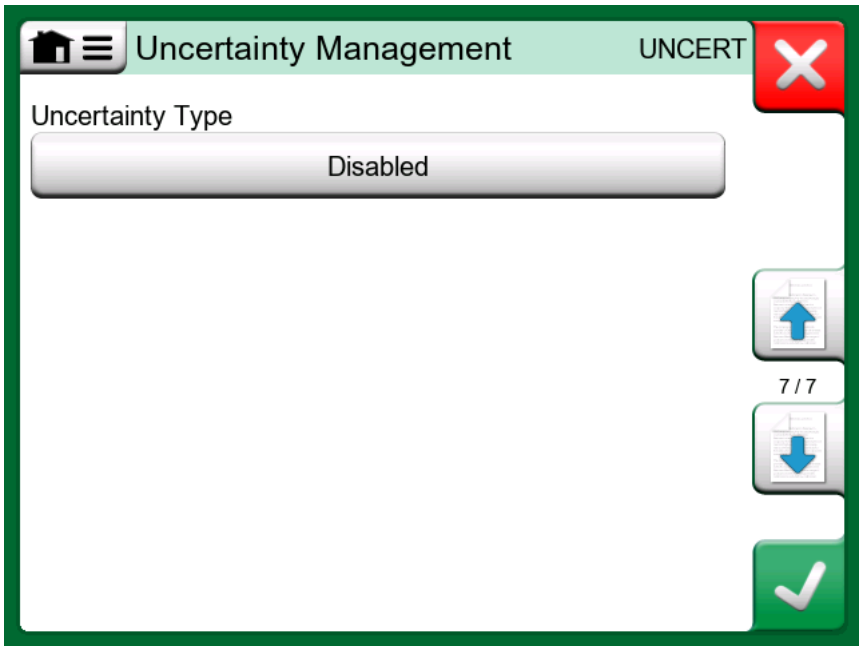


Figure 116: An additional page during instrument creation in Documenting Calibrator

Note: If the global uncertainty setting is disabled, the additional uncertainty page is not available in Documenting Calibrator, unless the instrument has been configured through the Calibration Management Software.

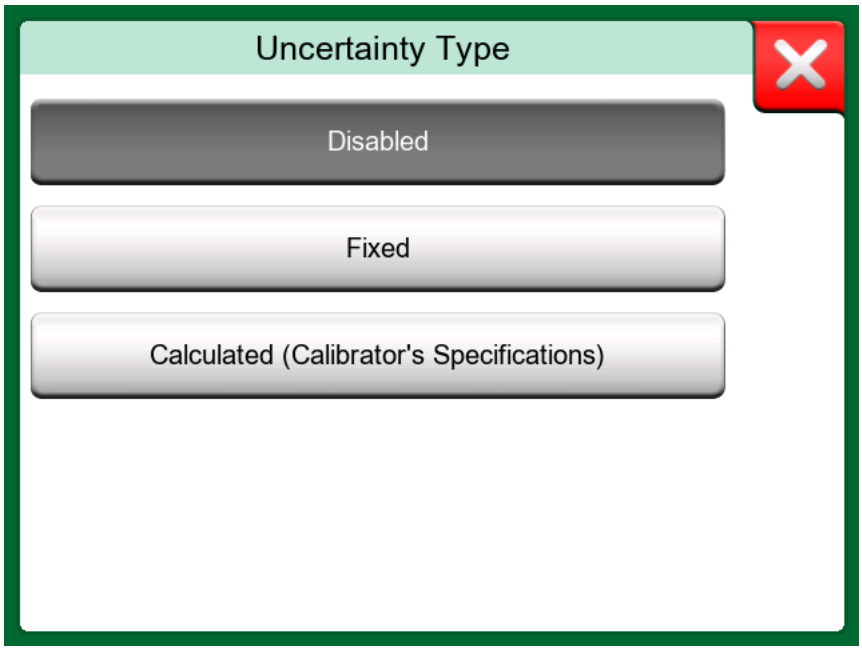


Figure 117: Uncertainty Type selection

When you select Uncertainty Type to be *Calculated (Calibrator's Specifications)*, the MC6-T calculates the uncertainty automatically based on its specifications.

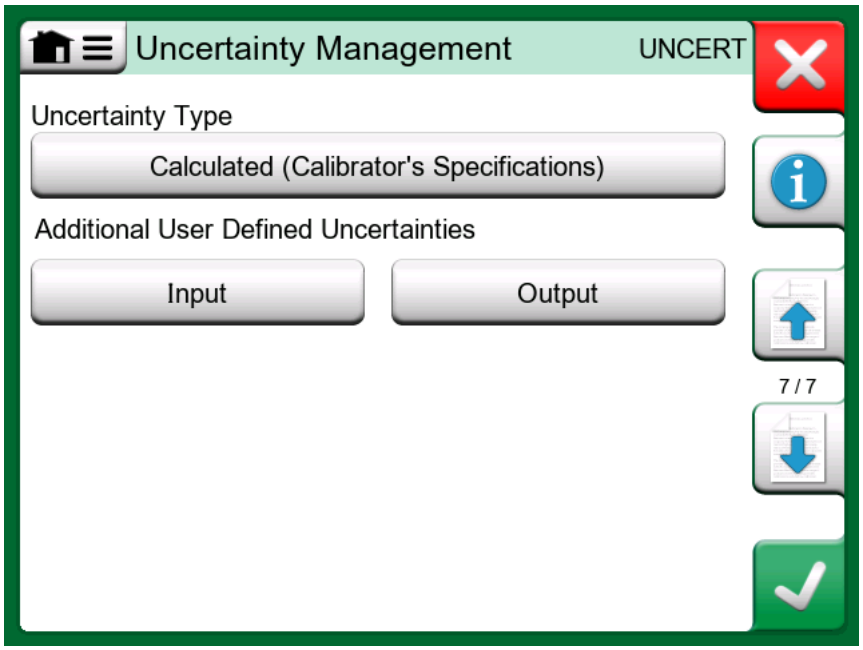


Figure 118: Uncertainty Management window

You can view the Uncertainty Components by tapping the **Info** button ( ).

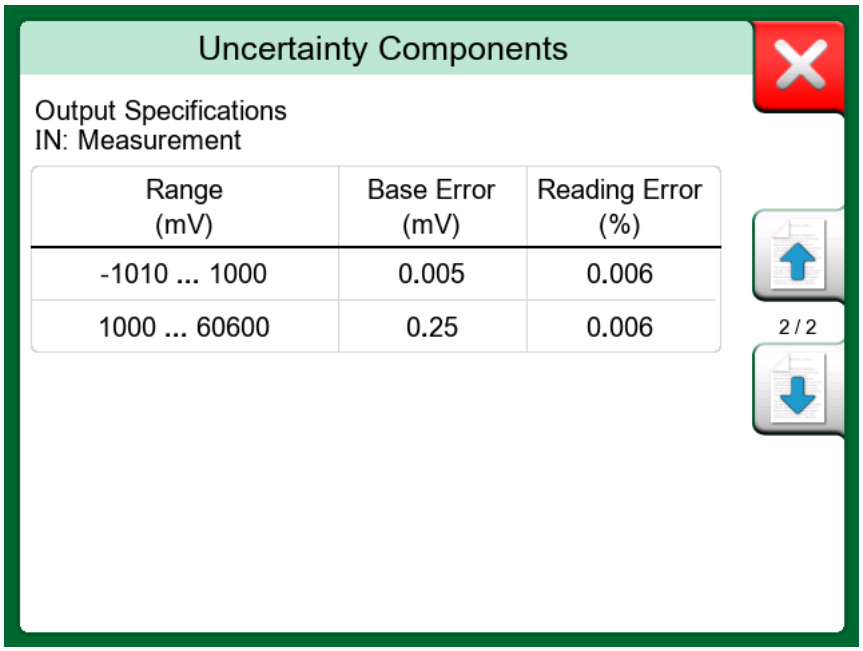


Figure 119: Uncertainty Components window – Output

You can also add additional uncertainty components for the Input and Output.

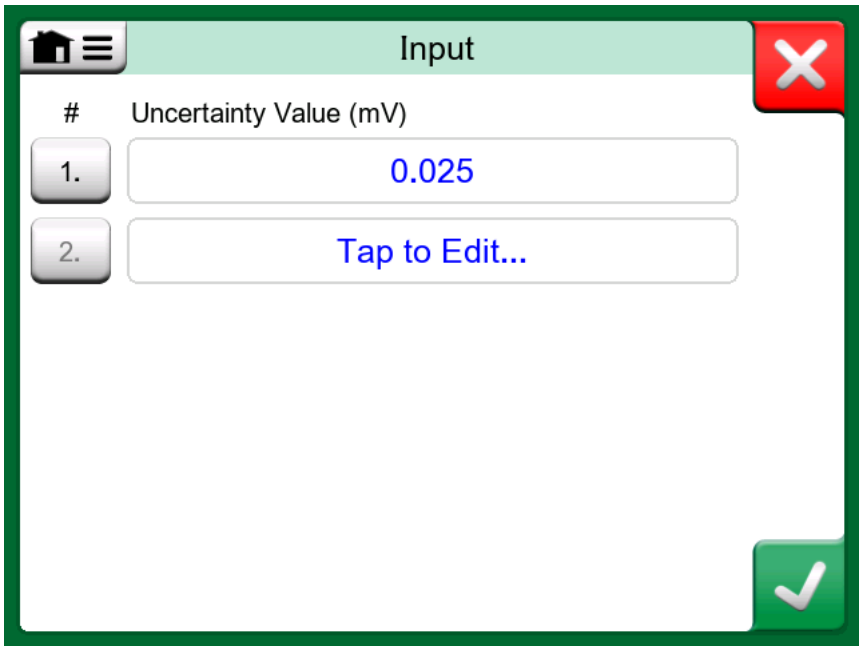


Figure 120: User Defined Uncertainties – Input

CMX-Specific Configuration

To include uncertainty when sending instruments from CMX to the MC6-T calibrator, make sure to enable the *Show uncertainty in MC6 family calibrators* setting in the Calibrator Settings window.

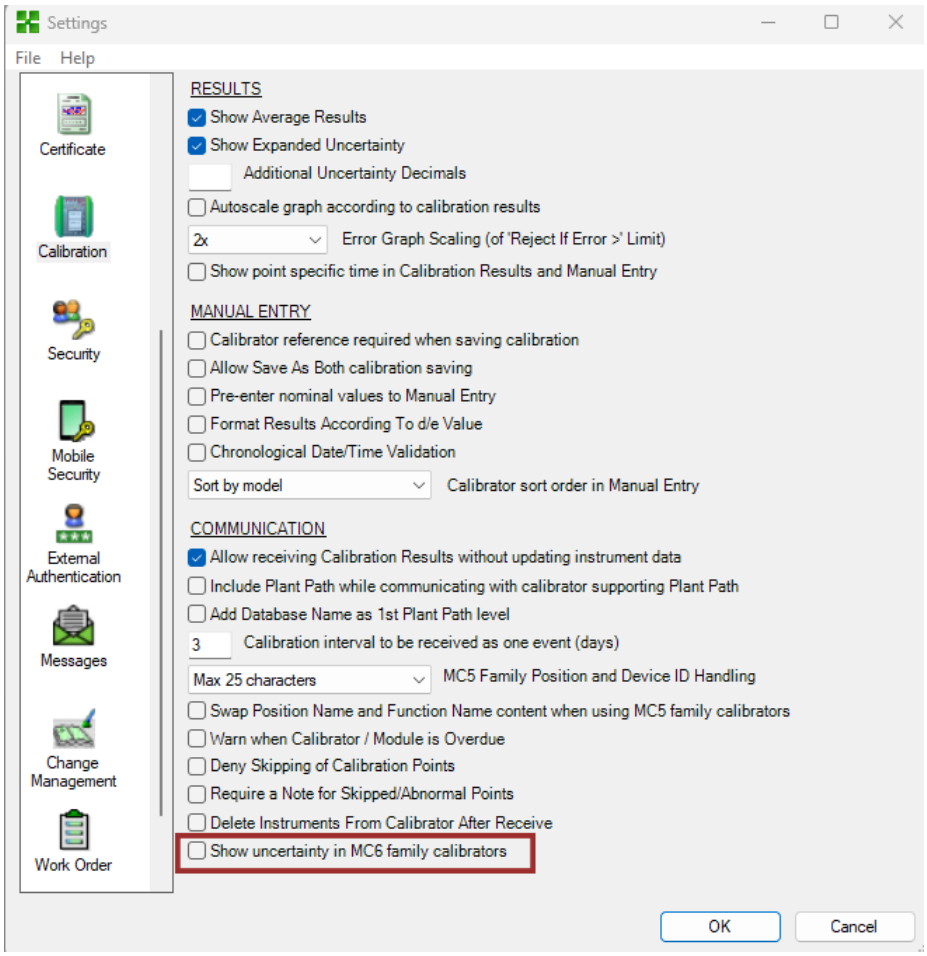


Figure 121: Enabling uncertainty in CMX Calibration Management Software

Note: When instruments are received from CMX, uncertainty is not considered in the Pass/Fail decision.

Note: CMX does not support the *Fixed* option for Uncertainty Type

Viewing Database Information

To view Database Information and check uncertainty settings, open the context-sensitive menu in the Instrument Overview window and select **Instrument** > **Database Information**.

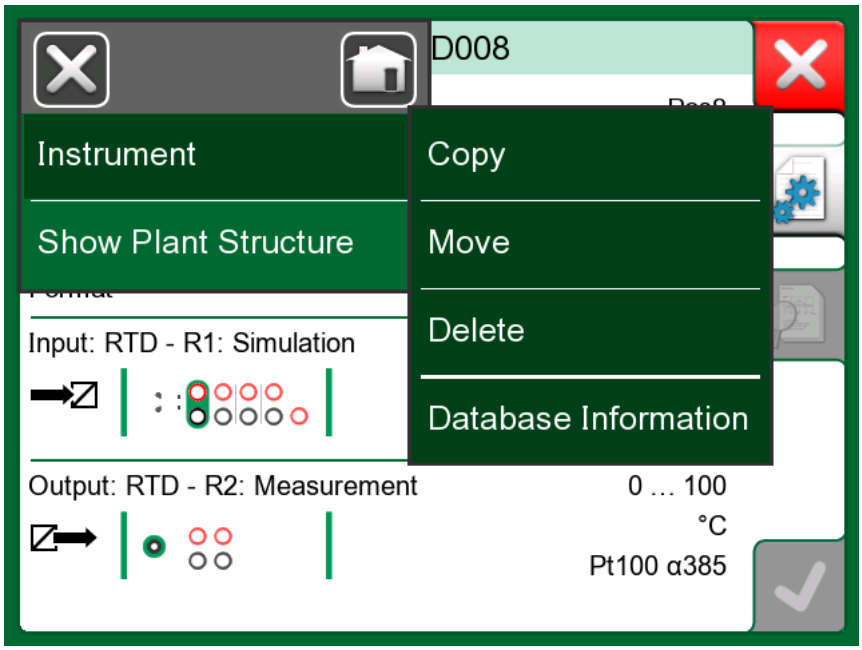


Figure 122: Instrument Overview Window – viewing Database Information

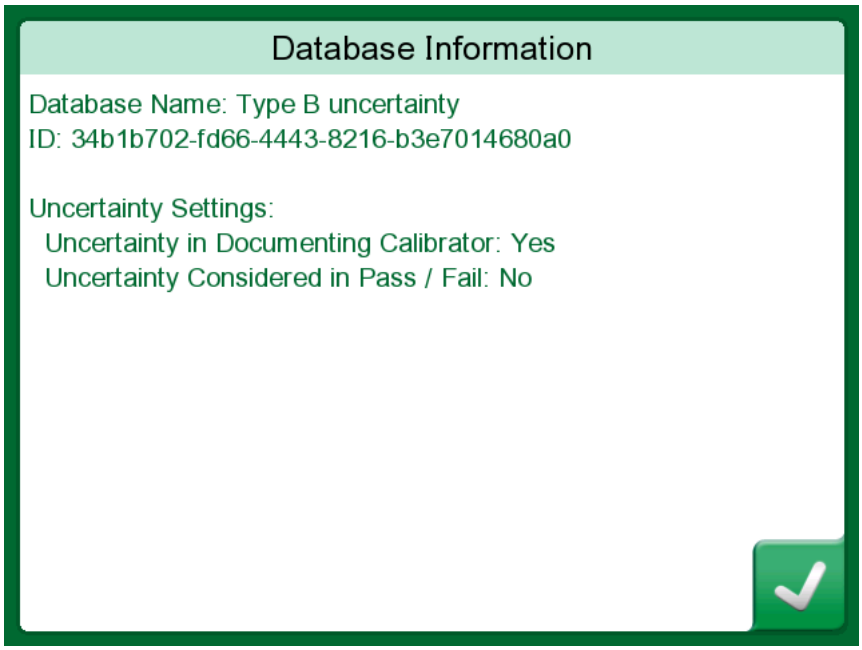


Figure 123: Example of Database Information – instrument received from CMX Calibration Management Software

Calibration Results with Uncertainty Enabled

When uncertainty is enabled, pages three and four in the Calibration Results window display uncertainty. See chapter Calibration Results Window for more information on how calibration results are presented.

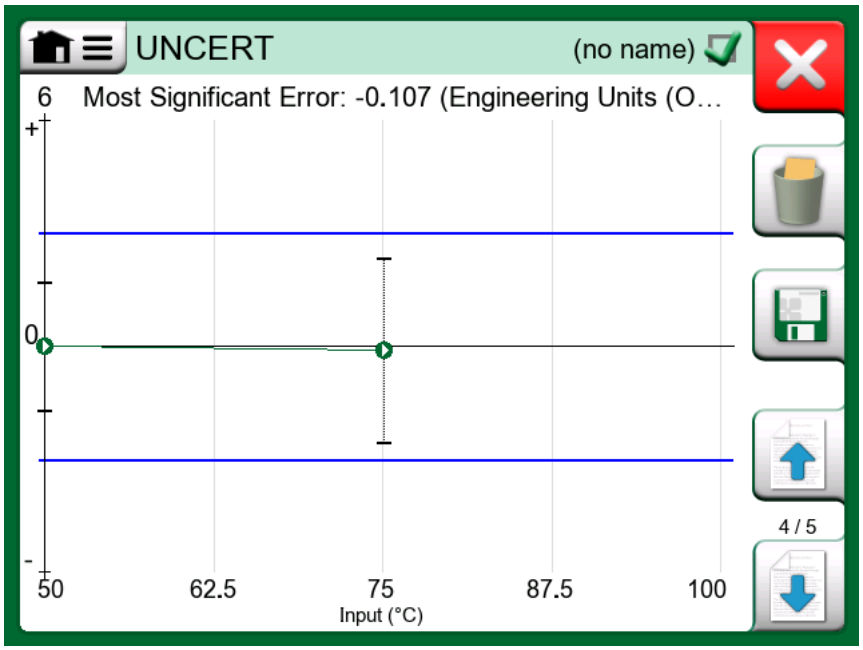


Figure 124: Calibration Results window with uncertainty – third page

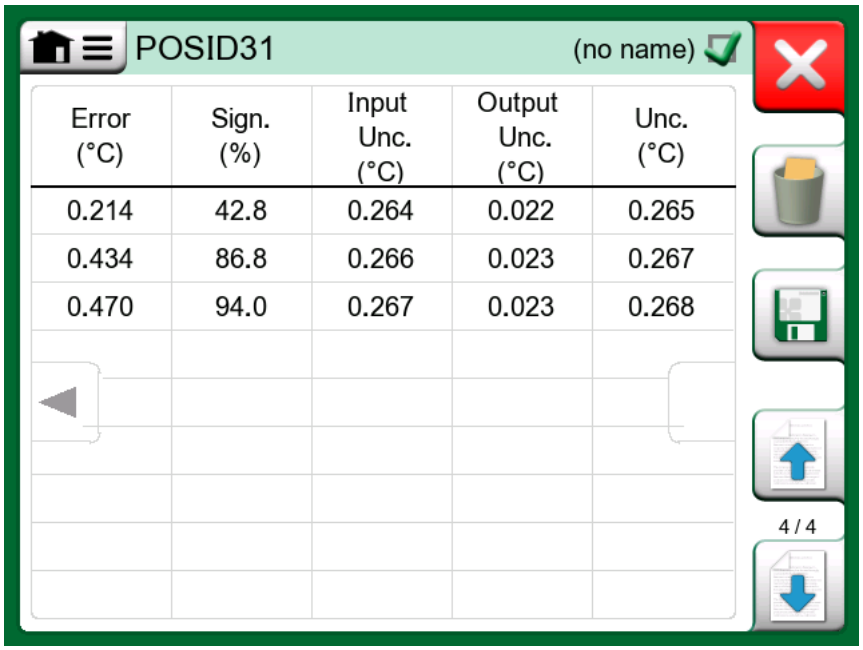


Figure 125: Calibration Results window with uncertainty – fourth page

Editing the Reference Sensor/Module Specifications

When uncertainty is enabled, the Reference Sensor specification selected for the Instrument Input can be edited.

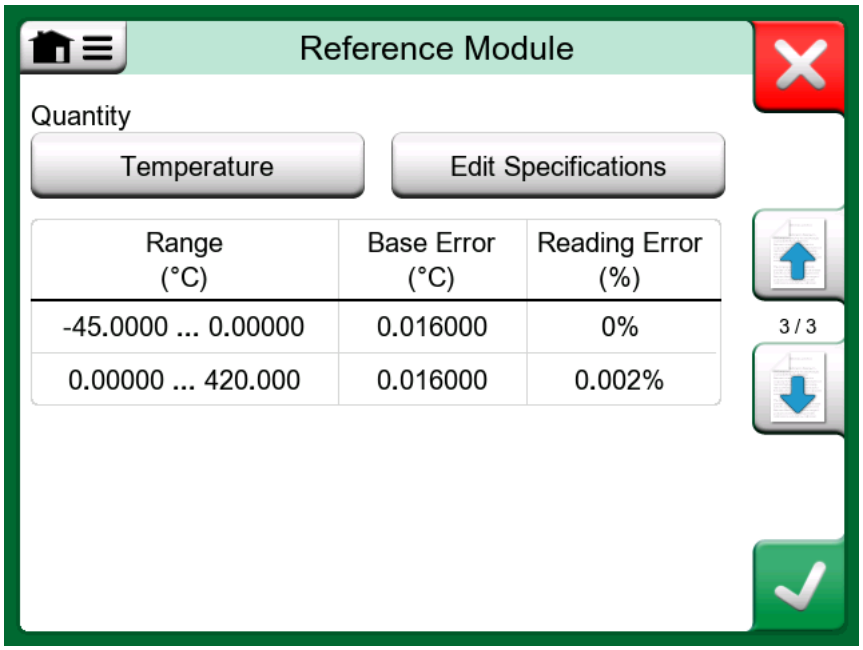


Figure 126: Reference Sensor – editing specifications

You can also edit the specifications of the selected Reference Module for the Instrument Output (when selected Quantity value is *Keyed*).

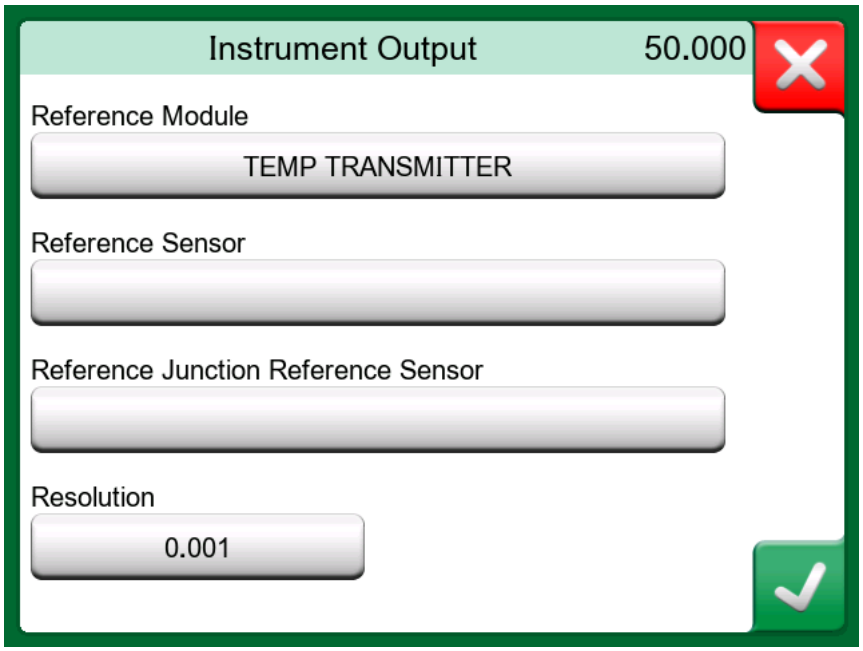


Figure 127: Instrument Output – editing Reference Module specifications

The Expanded Uncertainty of a Reading

Standard uncertainty can be expanded using a coverage factor. The results of these calculations are shown among the calibration results. The general equation for calculating the expanded uncertainty of a reading is as follows:

$$U_{rdg} = k \cdot \sqrt{\sum_{mx=1}^{nx} \left(\frac{U_{calibrator,mx}}{2}\right)^2 + \left(\frac{R_{rdg}}{\sqrt{12}}\right)^2 + \sum_{j=1}^{nu} \left(u_{user,j}\right)^2} \qquad (1)$$

Where:

U_{rdg}	is the expanded uncertainty of an input or output **reading**.
k	is the coverage factor for 95.45% level of confidence; value = 2.
nx	is the number of point repeats
$U_{calibrator, mx}$	is the expanded uncertainty of the calibrators/ modules at that calibration point, The uncertainties are calculated based on **Constant Error** and **Rel. Error (% of RDG)**.
R_{rdg}	is the resolution/readability of an indicator/recorder at that calibration point. For others than indicators/ recorders, the R_{rdg} term is zero.
$u_{user, j}$	are the user entered B type standard uncertainties for either the input or output.
nu	is the number of user-defined type B uncertainties.

Switch Specifics

The above mentioned equation for calculating the expanded uncertainty of a reading can also be calculated for switches. The expanded uncertainty of both the set and reset point is shown in the switch calibration result tables.

The calculation includes standard deviation. Set and reset values are handled separately, and the error direction is taken into account.

The Combined Standard Uncertainty of a Calibration Point

Combined standard uncertainty is the result of combining all individual standard uncertainty components that affect a measurement. To calculate it for a calibration point, input and output uncertainties must be comparable and expressed in the same unit. Therefore, uncertainties are converted from input to output, or vice versa, depending on how the error is presented.

The Combined Uncertainty Calculated for the Output

To calculate the combined output uncertainty, all input reading uncertainties must be converted to output value uncertainties. The conversion is performed using the following steps:

1. An intermediate variable called Δ is calculated for each input point using the following equation:

$$\Delta = \sqrt{\sum_{mi=1}^{ni}\left(\frac{U_{icalibrator,mi}}{2}\right)^2 + \sum_{j=1}^{nu}\left(u_{user,j}\right)^2} \qquad (2)$$

Where:

Δ	is the intermediate variable for output uncertainty calculations.
ni	is the number of input point repeats.
$U_{icalibrator, mi}$	are the expanded uncertainties (95.45 % confidence level) of the input calibrators/modules at that calibration point.
$u_{iuser, j}$	are the user-entered type B standard uncertainties for either the input or output.
nu	is the number of user-defined type B uncertainties.

2. To calculate the transfer function's slope at the proximity of an input point, ideal output values are calculated for input points *Input* - Δ and *Input* + Δ and the corresponding ideal output values are $O_{-\Delta}$ and $O_{+\Delta}$.

3. The slope, s_{io}, is calculated using the equation:

$$s_{io} = \frac{O_{+\Delta} - O_{-\Delta}}{2 \cdot \Delta} \quad (3)$$

Where:

s_{io}	is the slope based on ideal output values.
$O_{+\Delta}$	is the ideal output value, *Input* + Δ.
$O_{-\Delta}$	is the ideal output value, *Input* - Δ.
Δ	is the intermediate variable calculated by formula (2).

The combined standard uncertainty of a calibration point is calculated as follows:

$$u_{co} = \sqrt{\sigma_{(n)}^2 + \sum_{mo=1}^{no} \left(\frac{U_{ocalibrator,mo}}{2}\right)^2 + \left(\frac{R_{oreading}}{\sqrt{12}}\right)^2 + \sum_{j=1}^{nu} \left(u_{ouser,j}\right)^2 + \sum_{mi=1}^{ni} \left(\frac{s_{io} \cdot U_{icalibrator,mi}}{2}\right)^2 + \sum_{j=1}^{nu} \left(s_{io} \cdot u_{iuser,j}\right)^2} \quad (4)$$

Where:

u_{co}	is the combined standard uncertainty of a **calibration point**, calculated for the output.
$\sigma_{(n)}$	is, depending on what is calculated (uncertainties of calibration points in a single repeat on uncertainties of average results): • Always the **Standard Deviation of Output** (Standard Deviation, σ) when calculating the uncertainty of each point in a calibration repeat. • When calculating the uncertainty of average results, depending on user settings, either the **Standard Deviation of Average Output** (Standard Deviation of the Mean, σ_n) or the **Standard Deviation of Output** (Standard Deviation, σ).
no	is the number of output point repeats.

$U_{ocalibrator, mo}$	are the expanded uncertainties of the output calibrators/modules at that calibration point. The uncertainties are calculated based on **Constant Error** and **Rel. Error (% of RDG)**.
$R_{oreading}$	is the resolution/readability of an indicator/ recorder at that calibration point.
$u_{ouser, j}$	are the user-entered type B standard uncertainties for the output.
s_{io}	is the slope, calculated to convert input uncertainties to output uncertainties $$s_{io} = \frac{O_{+\Delta} - O_{-\Delta}}{2 \cdot \Delta_i} \quad (5)$$
$U_{icalibrator, mi}$	are the expanded uncertainties of the input calibrators/modules at that calibration point. The uncertainties are calculated based on **Constant Error** and **Rel. Error (% of RDG)**.
ni	is the number of input point repeats.
$u_{iuser, j}$	are the user-entered type B standard uncertainties for the input.
nu	is the number of user-defined type B uncertainties.

Other Average Result Specifics

The combined standard uncertainty of average results is calculated using the same equation as described above. In addition to the deviation calculation exception, note the following specifics:

- When calculating combined uncertainty for average results, the input and output calibrator uncertainties are taken as the calibrator's expanded uncertainties at the average input/output points.
- If user-entered Type B standard uncertainties are modified between repeats, their average values are used in the calculation of average results.
- If different modules are used across calibration repeats, average results are not calculated.

The Combined Uncertainty Calculated for the Input

To calculate the combined input uncertainty, all output reading uncertainties must be converted to input value uncertainties. The procedure follows the previous calculation in a mirrored manner: Δ is calculated based on output uncertainties (including possible resolution or readability of an indicator or recorder), and then used to calculate the slope s_{oi} and convert output uncertainties to corresponding input uncertainties.

The equation for combining the uncertainties is:

$$u_{ci} = \sqrt{\begin{array}{l}\left(s_{oi} \cdot \sigma_{(n)}\right)^2 + \sum_{mi=1}^{ni}\left(\frac{U_{icalibrator,mi}}{2}\right)^2 + \left(\frac{s_{oi} \cdot R_{oreading}}{\sqrt{12}}\right)^2 + \sum_{j=1}^{nu}\left(u_{iuser,j}\right)^2 \\ + \sum_{mo=1}^{no}\left(\frac{s_{oi} \cdot U_{ocalibrator,mo}}{2}\right)^2 + \sum_{j=1}^{nu}\left(s_{oi} \cdot u_{ouser,j}\right)^2\end{array}} \qquad (6)$$

Where:

u_{ci} is the combined standard uncertainty of a **calibration point**, calculated for the input.

s_{oi} is the slope, calculated to convert output uncertainties to input uncertainties:

$$s_{oi} = \frac{I_{+\Delta} - I_{-\Delta}}{2 \cdot \Delta_o} \qquad (7)$$

ni is the number of input point repeats.

$U_{icalibrator, mi}$ are the expanded uncertainties of the input calibrators/modules at that calibration point. The uncertainties are calculated based on **Constant Error** and **Rel. Error (% of RDG)**.

nu is the number of user-defined type B uncertainties.

$\sigma_{(n)}$ is, depending on what is calculated (standard uncertainties of calibration points in a single repeat or standard uncertainties of average results):

- Always the **Standard Deviation of Output** (Standard Deviation, σ), when calculating the standard uncertainty of each point in a calibration repeat.
- When calculating the standard uncertainty of average results, depending on user settings, either the **Standard Deviation of Average Output** (Standard deviation of the mean, σ_n) or the **Standard Deviation of Output** (Standard deviation, σ).

$u_{iuser, j}$ are the user-entered type B standard uncertainties for the input.

no is the number of output point repeats.

$U_{ocalibrator, mo}$	are the expanded uncertainties of the output calibrators/modules at that calibration point. The uncertainties are calculated based on **Constant Error** and **Rel. Error (% of RDG)**.
$R_{oreading}$	is the resolution/readability of an indicator/ recorder at that calibration point.
$u_{ouser, j}$	are the user-entered type B standard uncertainties for the output.

The Expanded Uncertainty of a Calibration Point, Process Instruments

For non-switches, the **Expanded Uncertainty** (of the error) is included in calibration results if it is selected in the Options window under Calibration settings.

Expanded uncertainty at a 94.95% confidence level is calculated by multiplying the combined uncertainty by a coverage factor of two.

Therefore:

$$U_E = k \cdot u_c \qquad (8)$$

Where:

U_E	is the expanded uncertainty of a calibration point.
k	is the coverage factor, value=2.
u_c	is the combined standard uncertainty of a calibration point, either u_{co} or u_{ci} (equations (4) and (6) respectively).

The Combined Expanded Uncertainty for Switches

In switch calibration, input and output uncertainties are not combined. Instead, uncertainties are calculated separately for set and reset readings. This is done for each repeat when multiple switch cycles are present, and also for average results when multiple repeats exist.

The equation:

$$U_{crs} = k \cdot \sqrt{\sigma_{(n)}^2 + \sum_{mrs=1}^{nrs} \left(\frac{U_{rscalibrator,mrs}}{2}\right)^2 + \sum_{j=1}^{nu} \left(u_{user,j}\right)^2} \qquad (9)$$

Where:

U_{crs}	is the combined expanded uncertainty of a set or reset point.
k	is the coverage factor, value=2.
$\sigma_{(n)}$	is, depending on what is calculated (combined uncertainties for switch cycles in a repeat or average results of multiple repeats): • Always the **Standard Deviation of Set Point or Reset Point** (σ) when calculating the combined expanded uncertainty of switch cycles in a calibration repeat. Headings in switch calibration repeat tables: "Set Expanded Uncertainty" and "Reset Expanded Uncertainty". • When calculating the combined expanded uncertainty of average results, depending on user settings, either the **Standard Deviation of the Mean** (σ_n) or the **Standard Deviation of Set Point or Reset Point** (σ).
nrs	is the number of set or reset readings.
$U_{rscalibrator, mrs}$	are the expanded uncertainties of the input calibrators/modules at that calibration point. The uncertainties are calculated based on **Constant Error** and **Rel. Error (% of RDG)**.
$u_{user, j}$	are the user-entered type B standard uncertainties for the input.
nu	is the number of user-defined type B uncertainties.

Temperature

Temperature calibration follows the same principles as the previous examples. Module specifications include a temperature coefficient that affects the constant or % of RDG term. If the temperature during calibration is outside the specified

temperature range, an additional uncertainty component is calculated and added to the defined module specifications.

Note: This applies to all calibrations.

Thermocouple

In some cases, module uncertainty specifications are expressed in a different unit than the calibrated quantity, such as thermocouple Type B. CMX uses the Newton–Raphson method to solve a polynomial and convert the uncertainty to degrees Celsius from specifications and mV readings.

The MC6-T calibrator uses Brent's method to convert mV specifications into temperature uncertainty.

This difference may become visible when comparing uncertainty values between CMX and MC6-T.

MC6-T-Specific Uncertainty Calculations

In MC6-T calibrator, uncertainty components are specified separately, whereas in CMX they are combined into a single value.

With Internal Reference

For an internal reference sensor, the combined uncertainty is calculated using the following equation:

$$2 \cdot \sqrt{\left(\frac{Stab.}{\sqrt{3}}\right)^2 + \left(\frac{Ax.\,grad._{40mm}}{\sqrt{3}}\right)^2 + \left(\frac{Ra.\,grad.}{\sqrt{3}}\right)^2 + \left(\frac{Load.\,eff.}{\sqrt{3}}\right)^2 + \left(\frac{Disp.\,acc.}{\sqrt{3}}\right)^2 + \left(\frac{Hyst.}{\sqrt{3}}\right)^2} \quad (10)$$

With External Reference

For an external reference sensor, the combined uncertainty is calculated using the following equation:

$$2 \cdot \sqrt{\left(\frac{Stab.}{\sqrt{3}}\right)^2 + \left(\frac{Ax.\,grad._{40mm}}{\sqrt{3}}\right)^2 + \left(\frac{Ra.\,grad.}{\sqrt{3}}\right)^2 + \left(\frac{Load.\,eff.\,ext.}{\sqrt{3}}\right)^2 + \left(\frac{Ref.\,Junction}{\sqrt{3}}\right)^2} \quad (11)$$

Data Logger

The **Data Logger** is an optional user interface mode that allows you to collect data with MC6-T. The **Data Logger** supports logging up to nine channels simultaneously, including measurements, generations, or simulations.

You can view the data log results in numerical or graphical format and transfer them to a PC for further analysis using the **Beamex MC6 Data Log Viewer** (for details, see subchapter Data Log Viewer).

Note: In many industrial settings, signals need to be measured over a period of time and the results stored for later analysis, such as for troubleshooting, monitoring, or calibration.

If the Data Logger option is not installed on your MC6-T, the icon in the Home View will appear disabled. To upgrade your calibrator, please contact Beamex.

To start the Data Logger mode, tap the **Data Logger** button in the Home view.

Figure 128: Home view, Data Logger user interface mode

Configuring a Data Log

Make sure to define the general settings before starting your data log. Tap the grey area in the bottom-left corner of the main configuration window to open the **General Configuration** window. There, you can set how data is logged, what values are saved, and how long the logging will run, among other configurable parameters.

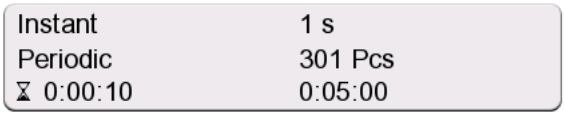


Figure 129: Data Logger – General Configuration window button

The start of data logging depends on the general settings:

- **Delayed Start** – You may configure a delay before logging begins, either as a countdown (e.g., 5 minutes) or a scheduled start time (e.g., 5:15 PM). During the delay, an hourglass icon with a countdown will be shown.

> **Note:** After the delay, any channel-specific triggers may further delay the start. Logging begins as soon as one of the triggers is activated.

- **Logging Method** – Choose how data is logged. The **Periodic** method allows automatic logging based on additional settings. The **Key Press** method enables manual logging.

> **Note:** If **Key Press** is selected, data is logged each time you tap the **Manual Trigger** button ( ). In this case, any channel-specific triggers will be ignored.

To configure a channel, tap one of the numbered areas in the **Data Logger**'s main configuration window.

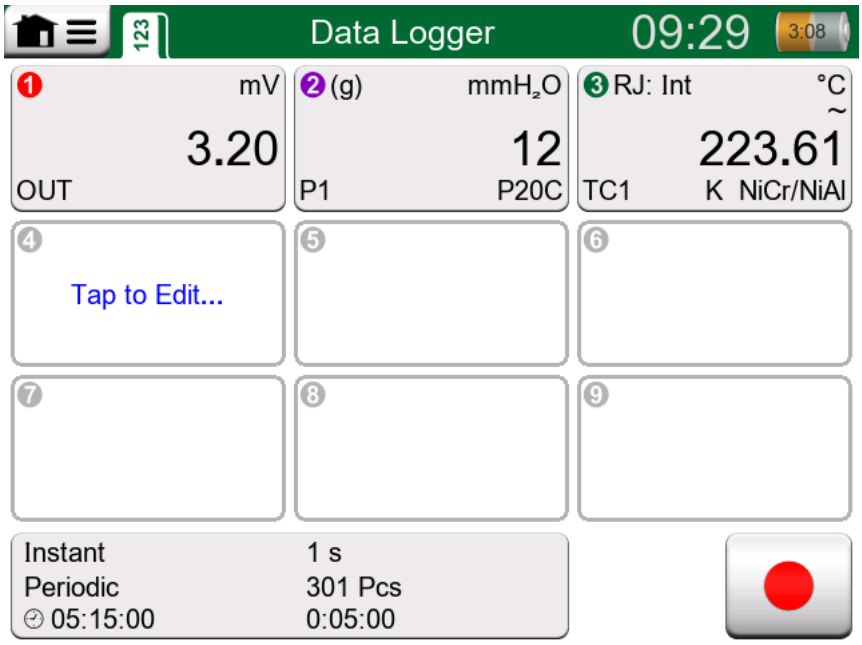


Figure 130: Three configured channels in the main configuration window

Each channel can be set up independently. Measurement channels include three configuration pages, while generation and simulation channels have two:

- Measurements/generations/simulations: A page used to define the quantity being measured, generated, or simulated, along with its additional settings.

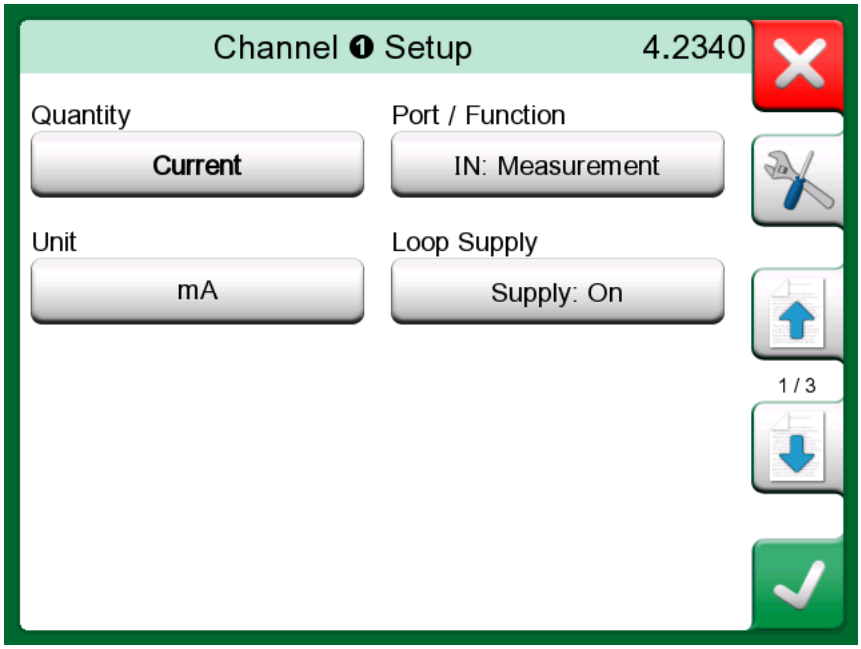


Figure 131: Data log Channel Setup window – 1st page

- Measurements/generations/simulations: A page that lets you configure the graph range, enter an optional function name, and select the color of the plot.

- Measurements: A page for defining a trigger that starts data logging. When a trigger is configured, a trigger symbol ( ) appears in the channel area.

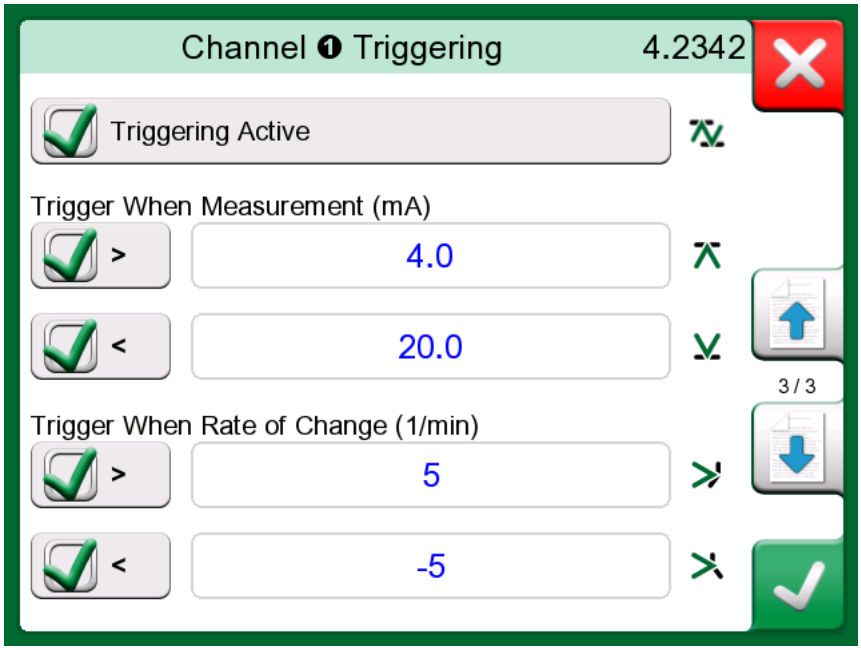


Figure 132: Data log Channel Setup window – 3rd page

In this example, all four trigger methods are active. You can use just one or combine several. If multiple methods are enabled, they are combined using a **logical OR**, and data logging begins as soon as one of the following is TRUE:

- The measured value is larger than 4.0
- The measured value is smaller than 20.0
- The rate of change exceeds 5
- The rate of change drops below -5

Note: When using pressure modules, you can zero the gauge module either through the context-sensitive menu in the main configuration window or directly in the Channel Setup window, if available.

Saving and Opening Configurations

MC6-T remembers your latest data log settings, and you can also save custom configurations. To save or open a previously saved configuration, open the context-sensitive menu in the main configuration window and select **Configuration** > **Open Configuration/Save as**.

Logging Data

To start the data log, tap the **Record** button ( ) in the main configuration window. The button will change to a **Stop** button ( ), allowing you to stop the log at any time.

Note: The actual start of data logging depends on the general settings. See Configuring a Data Log.

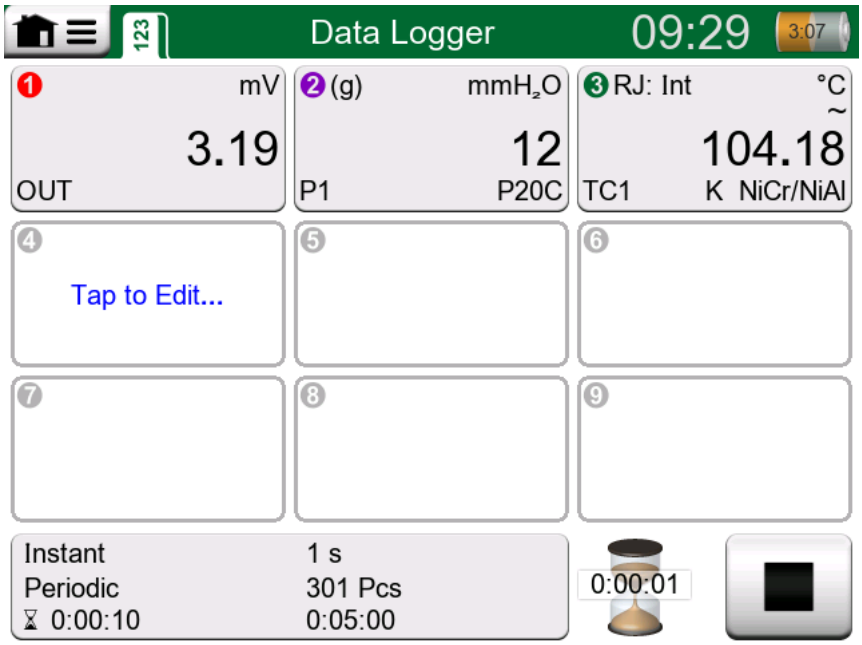


Figure 133: Counting down the delay

To change a generation or simulation value during data logging, tap the channel and enter a new **Set Value**.

Tip: You can switch between the main configuration window and the graph view by tapping the toggle area in the title bar.

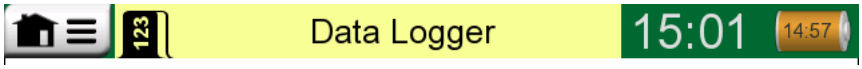


Figure 134: Toggle area in the title bar (highlighted in yellow)

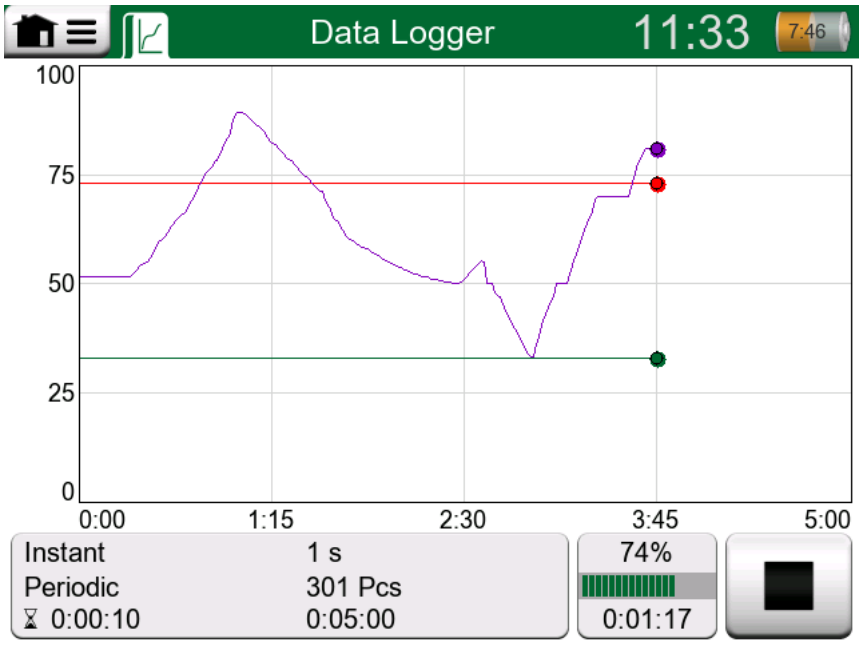


Figure 135: Graph view during a data log

Data Log Results

After data logging has been finished or stopped, the Result Preview window shows the data log results across three pages: general information, a graph, and a numeric table.

Tip: For large numeric tables, use scroll buttons or the scroll bar to access any hidden rows and columns.

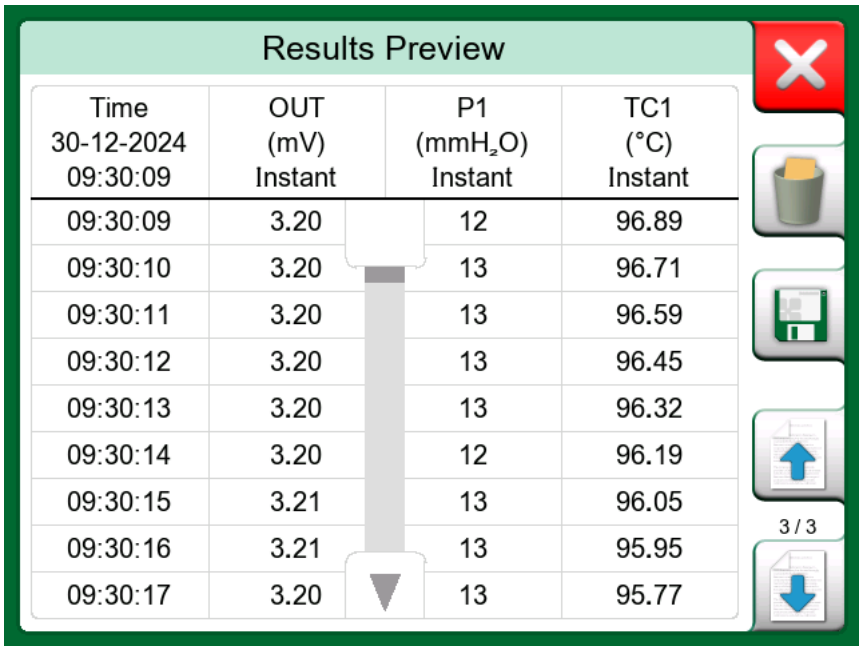


Figure 136: Data log Results Preview window

Note: MC6-T automatically adds a timestamp (date and time) to each data log result.

On each page, you can either **Save** () or **Delete** () the data log results.

Tip: When saving, you can give the data log results a descriptive name.

Viewing Saved Data Log Results

To view previously saved data logs, go to the main configuration window in the Data Logger and select **View Data Log Results** from the context-sensitive menu.

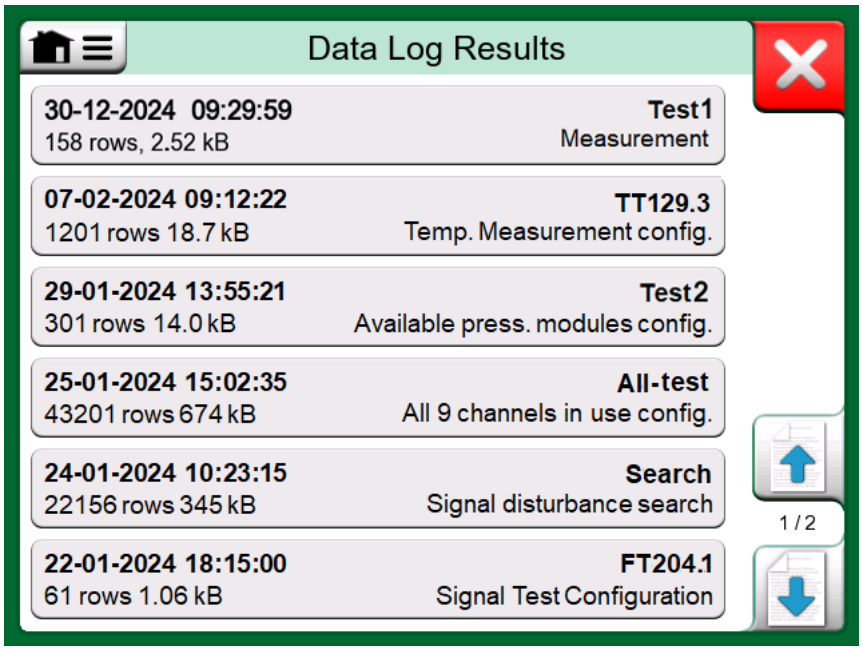


Figure 137: Data log Results list

Each saved log displays its time, date, and result name in the top row. The bottom row shows the file size and, if available, the name of the configuration used.

Tip: You can use the context-sensitive menu in the Data Log Results window to **Delete All** saved data log results.

When viewing a specific result, the menu also offers options to **rename** or **delete** the selected log.

Data Log Viewer

Beamex MC6 Data Log Viewer is a free PC tool used to transfer data log results from MC6-T to a PC. You can download the MC6 Data Log Viewer under the Resources tab on the MC6-T product page on the Beamex website.

After installing the MC6 Data Log Viewer on your PC, open the program and connect the calibrator using a USB cable. The tool will automatically detect the calibrator, provided it is powered on. You can then download and view the results from the MC6-T calibrator. Data can be saved in the tool's native format (.LG6) or exported as .CSV files, which can be easily imported into spreadsheet programs.

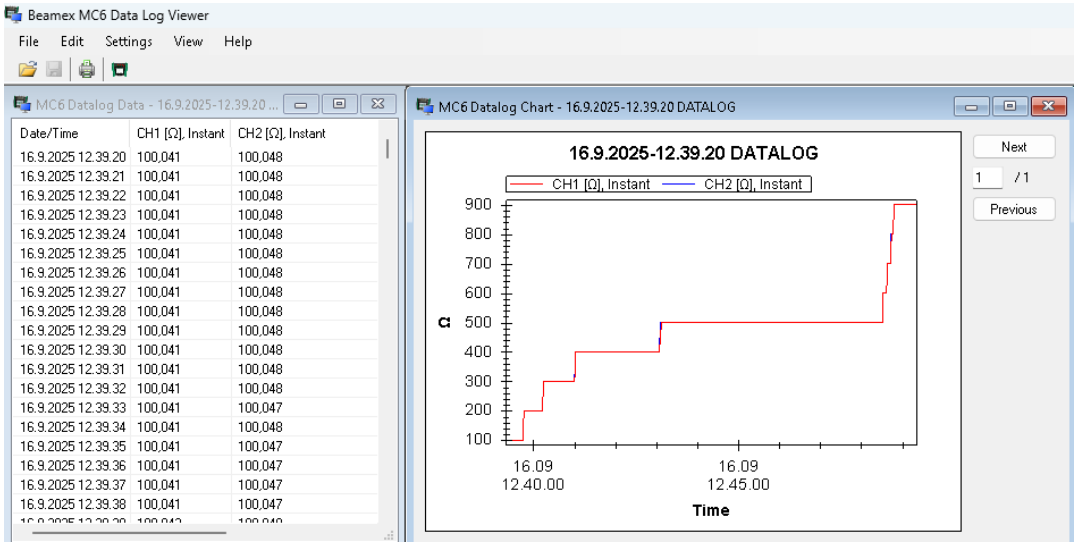


Figure 138: Beamex MC6 Data Log Viewer

Communicator

The MC6-T calibrator can be used as a fieldbus communicator to calibrate, configure, and trim your smart instruments. The **Communicator** is an optional user interface mode that allows you to connect with smart instruments, using one of the following communication protocols:

- **HART** (MC6-T supports HART instruments using HART Protocols 5 and 7);

  (https://www.fieldcommgroup.org/)

  MC6-T can be used as a primary or secondary master of a segment.
- **FOUNDATION Fieldbus H1**;

  (https://www.fieldcommgroup.org/technologies/foundation-fieldbus/)

  MC6-T is seen as a guest device (visitor) and, when necessary, as a secondary master of a segment using Link Active Scheduler (LAS).
- **PROFIBUS PA**;

  (https://www.profibus.com/)

  MC6-T takes the role of PROFIBUS master when connected to a PROFIBUS segment.

To start the Communicator mode and see the communication protocols installed in your calibrator, tap the **Communicator** button in the Home view. If your MC6-T does not have communicator options installed, the Communicator icon in the Home View will be disabled. Contact Beamex for an upgrade.

Figure 139: Home view, Communicator user interface mode

All three communication protocols can be installed simultaneously, and the Communicator user interface mode is activated if any of the three protocols is installed. The Communicator mode is primarily meant for viewing and editing the configuration of smart instruments. The three supported communication protocols are available as a quantity in Temperature Calibrator, Calibrator, Documenting Calibrator and Data Logger user interface modes. For more information on smart instruments see chapter Working With Smart Instruments.

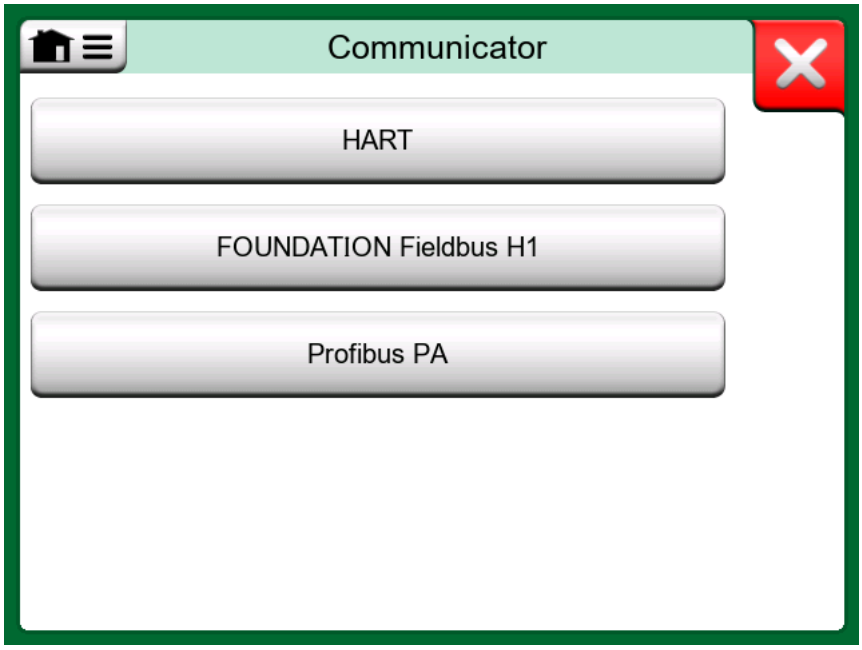


Figure 140: Communication protocols

Note: Each fieldbus communication protocol is a separate option, therefore not all protocols are necessarily enabled in your MC6-T calibrator.

This manual is not intended as an introduction to HART and fieldbus instruments. For basic knowledge and terminology, refer to books specifically dedicated to HART and fieldbus technology.

The Communicator user interface may display text in a language different from the language set up in the MC6-T settings. The language of the instrument's fields etc. may differ from MC6-T calibrator's language.

Device Description Files

Device Description (DD) files describe the smart instrument functionality and are required for communication. The MC6-T calibrator supports hundreds of HART and fieldbus devices from dozens of manufacturers, depending on the Communicator options installed. If a specific device is not supported, MC6-T uses the generic DD file that only supports basic functionalities.

To view DD files currently installed in the calibrator:

1. Open **Settings** and select the protocol (HART / FOUNDATION Fieldbus H1 / Profibus PA).
2. In the context-sensitive menu, choose **Available Device Descriptions**. The calibrator will show a list of DDs by manufacturer, with the option to view each file individually.

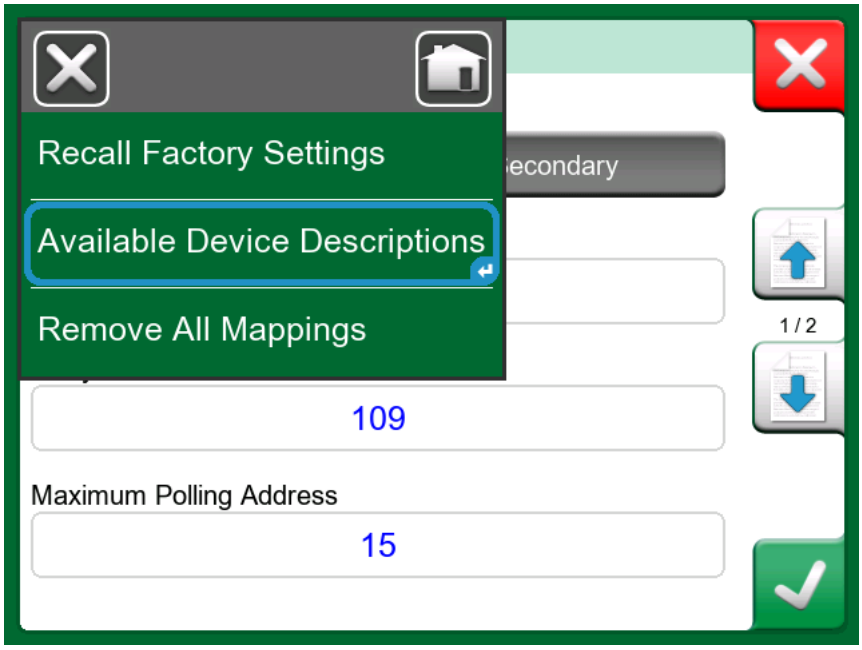


Figure 141: Context-sensitive menu – Available Device Descriptions

New DD files for the MC6-T are released regularly. When available, they can be downloaded from the Beamex website and installed in your calibrator using the **MC6 Device Description Installer** tool. Each DD package includes a release note listing all supported devices and the DDs added in the latest package. Downloads are available under the Resources tab on the MC6-T page on the Beamex website.

Note: It is not possible to download DD files from the smart instrument manufacturer's website and install them directly onto the calibrator. The DD files must be downloaded from the Beamex website.

Device Descriptions settings

Using device-specific DD files is the recommended method. However, for HART or Profibus PA it is also possible to define that a Generic or Standard Profile DD file should be used, even though a device-specific DD file would be available. For FOUNDATION Fieldbus H1, only the Device Specific DD files can be used. A simplified method for using HART instruments, called Basic View, is also available. The default setting of Active Device Descriptions can be defined in MC6-T Settings.

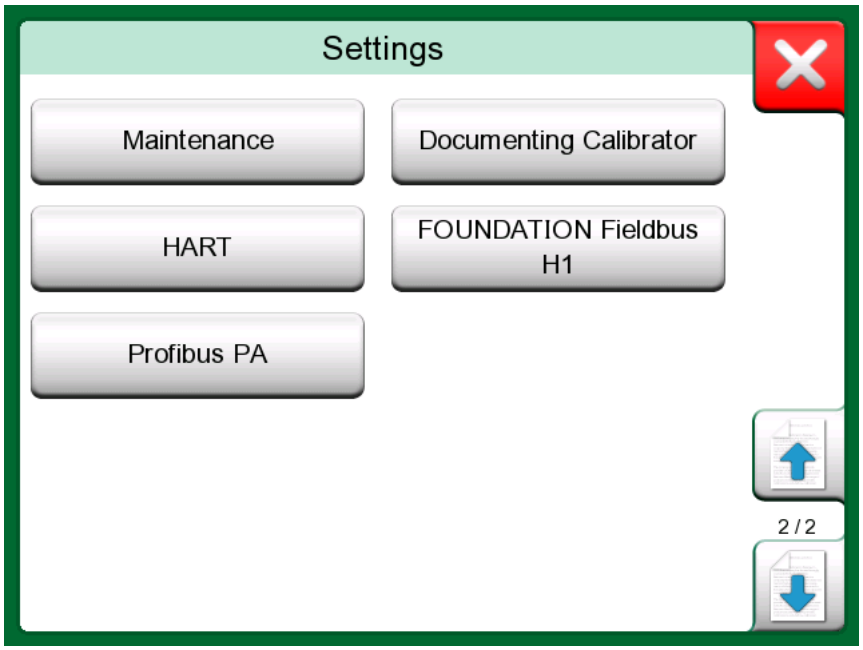


Figure 142: Communication protocol settings in MC6-T Settings mode

MC6-T supports three kinds of Active Device Descriptions for smart instruments:

- **Device Specific**, i.e. custom DD file for smart instrument, stored in MC6-T memory. Full instrument data is available.
- **Generic**, i.e. a library of Common DD files applying to most HART instruments. Only a standard set of instrument data is available.

> **Note:** Profibus PA: this option is called Standard Profile.

- **Basic View**, a simplified HART DD file available in MC6-T.

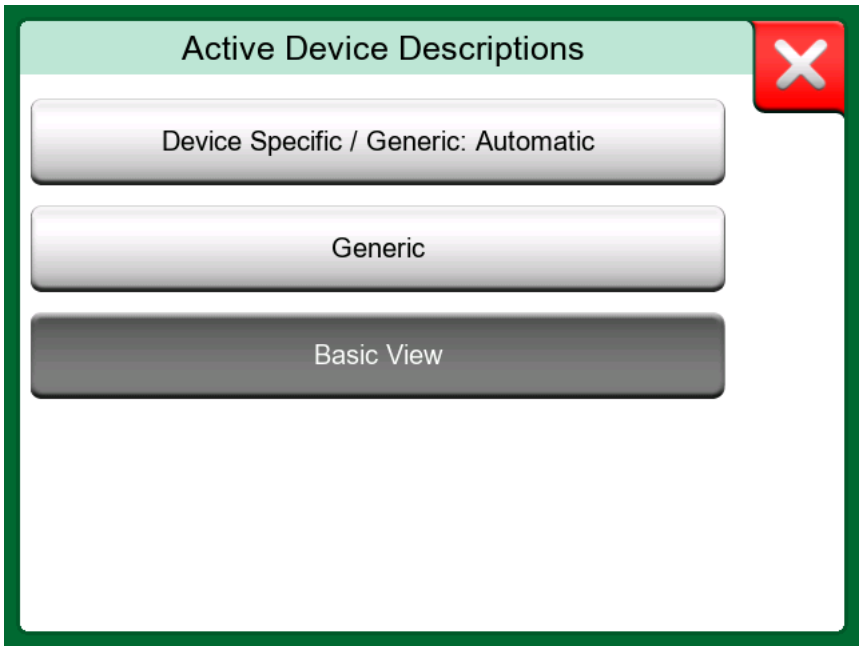


Figure 143: Active Device Descriptions window

Note: You can also define the Active Device Descriptions method in other user interface modes by pressing **Tools** button ( ) in the Supply view for selecting output Quantity. This option is available in **Temperature Calibrator**, **Calibrator**, **Documenting Calibrator**, **Data Logger** and **Communicator** user interface modes.

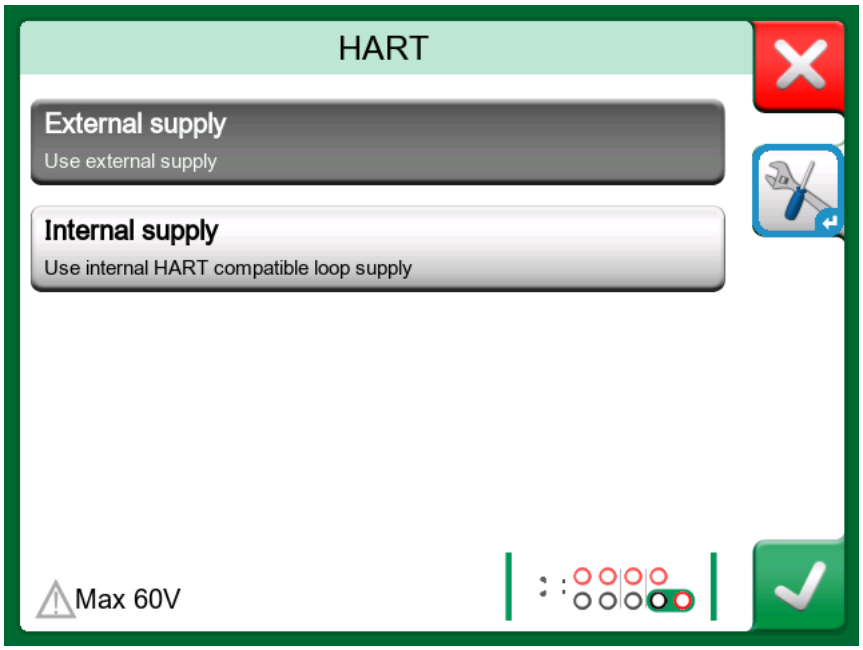


Figure 144: Tools button in Supply view for selecting output Quantity

Basic View

The Basic View window presents the instrument's Value Parameters, basic Device Setup settings, and Process Variable settings. You can select any available value parameter for calibration, data logging etc.

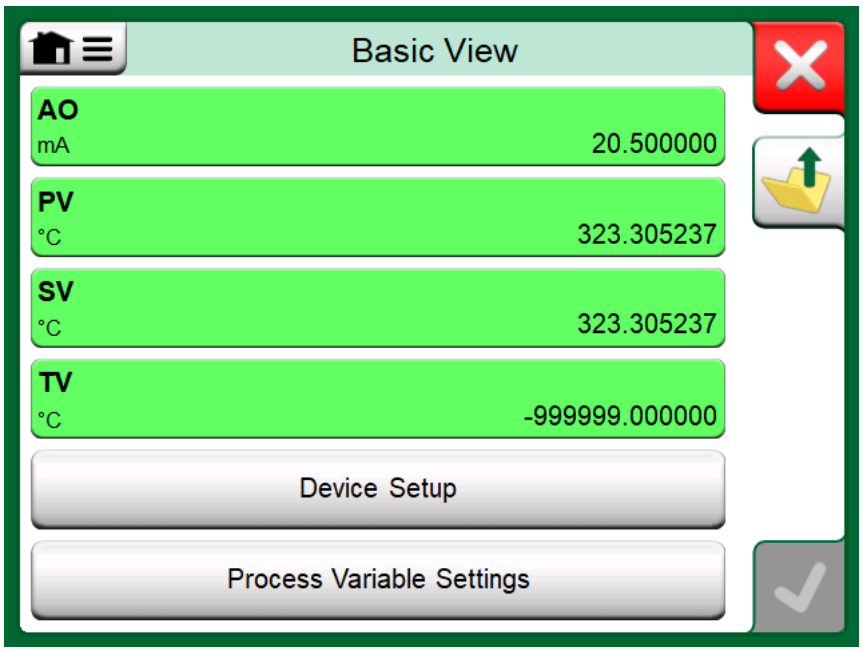


Figure 145: HART Basic View window example

Editable fields are presented in the following examples of Device Setup window and Process Variable Settings window.

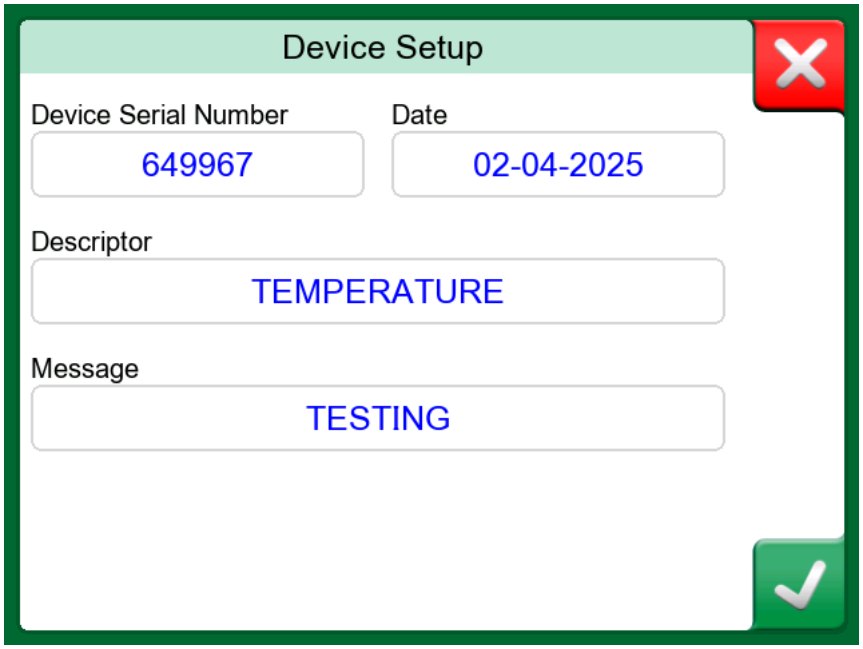


Figure 146: HART Device Setup window example

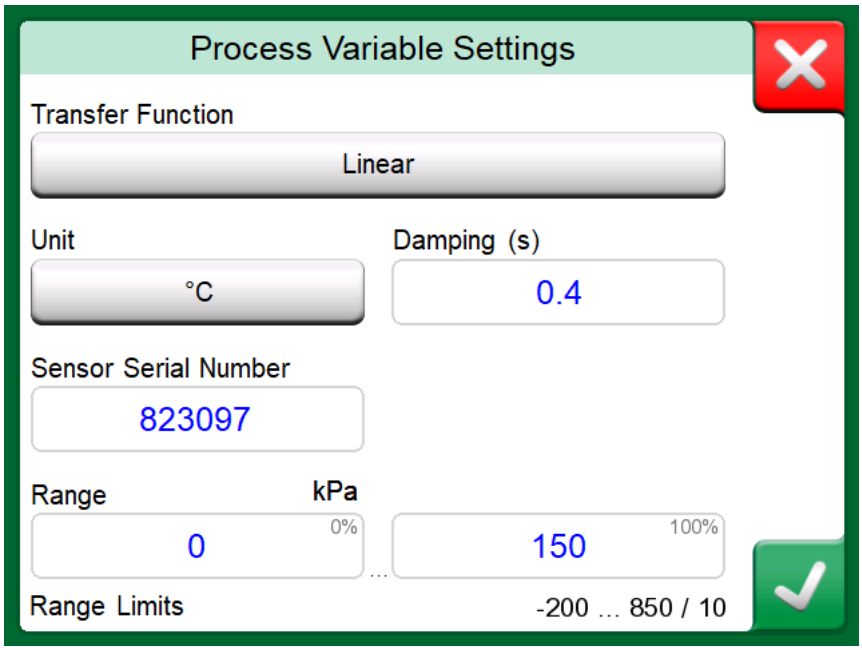


Figure 147: HART Process Variable Settings window example

Note: HART trimming is not supported using Basic View DD file. Use another Device Description method when trimming a HART instrument.

Managing Smart Instrument Configurations in MC6-T

You can manage smart instrument configuration data using MC6-T and a free PC tool - **Beamex MC6 Fieldbus Configuration Viewer**. You can download the MC6 Fieldbus Configuration Viewer under the Resources tab on the MC6-T page on the Beamex website.

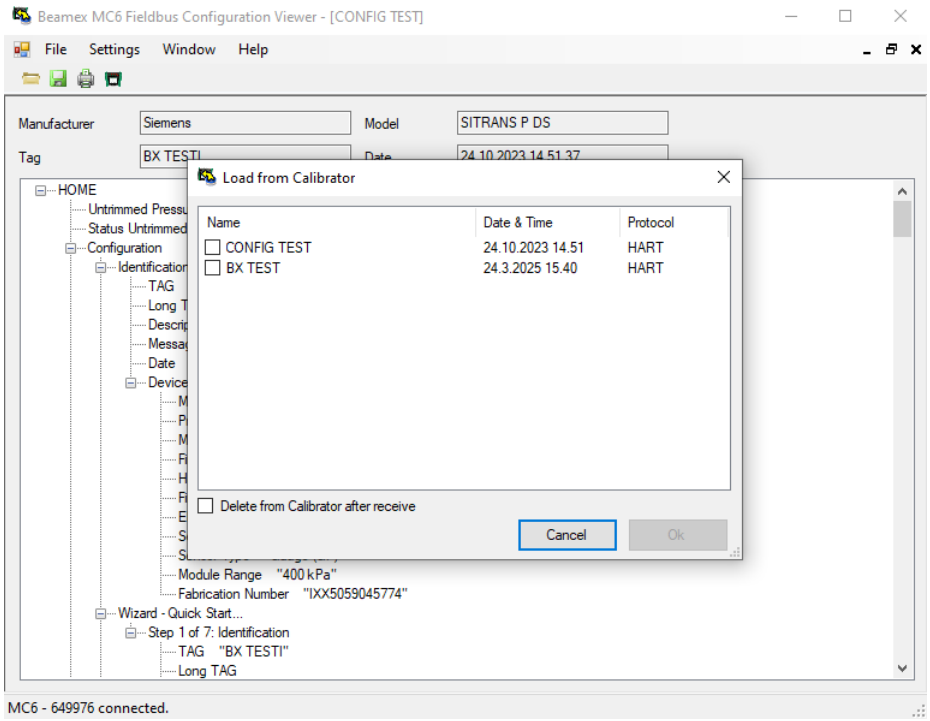


Figure 148: Beamex MC6 Fieldbus Configuration Viewer

Note: With **Fieldbus Configuration Viewer**, you can:

- Load the configuration files from MC6-T calibrator
- View the configuration files
- Save the configuration files in PC (e.g. proprietary *.fc file).
- Print the configuration files

Saving Configurations

You can save the instrument's configuration data when connected to a smart instrument. Open the context-sensitive menu and select **Configuration** > **Save As** to download all configuration data. After configuration download is completed, MC6-T will prompt you to give the configuration file a name. The default file name is the smart instrument's Tag name.

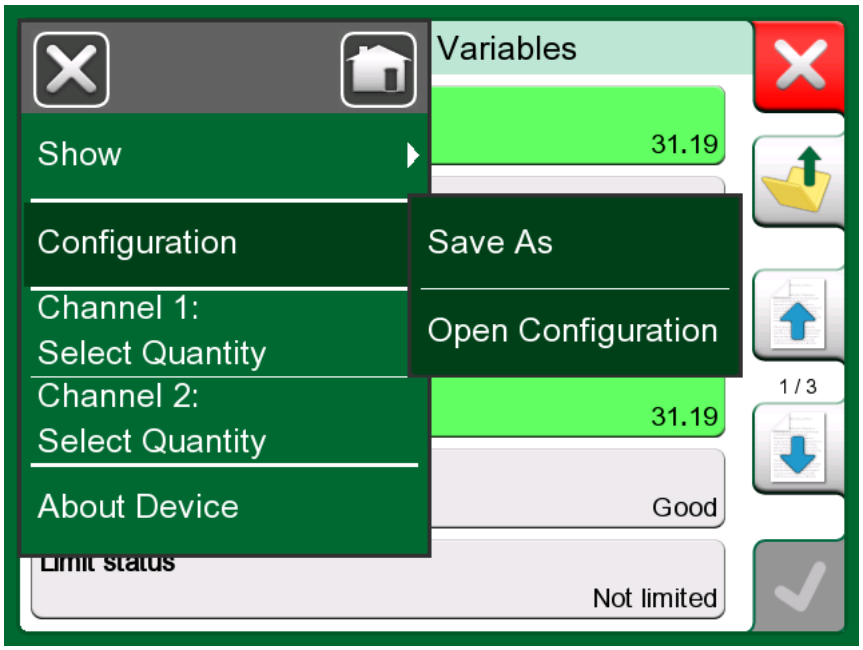


Figure 149: Smart instruments – saving the configuration

This feature is handy especially when you have an analog DCS (Distributed Control System) and HART smart instruments in the field. You can use this functionality to create a database of all the configuration files of your smart instruments. If a transmitter breaks, all settings are stored in MC6-T (alternatively on a PC), for an easy configuration of the new transmitter replacing the broken one.

Note: It is not possible to upload the saved configuration file from MC6-T back to the transmitter.

Viewing or Opening Configurations

You can open the list of saved configurations anywhere in **Communicator** mode. Open the context-sensitive menu and select **Configuration** > **Open Configuration** to display the list of saved configurations.

Note: Saved configurations can also be opened in the communication protocol selection window, where no protocol has been selected yet.

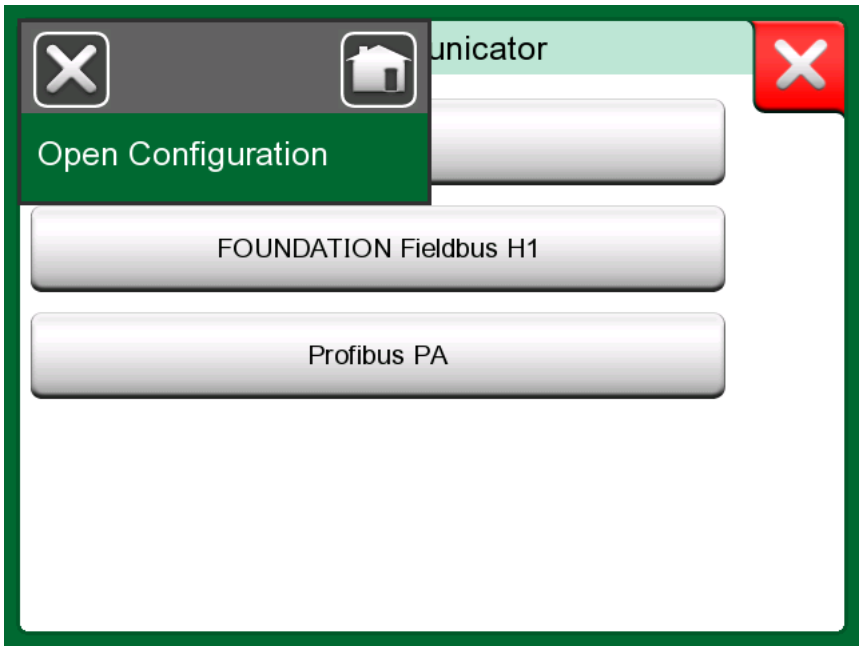


Figure 150: Open Configuration option in protocol selection window

The list shows the following information about each saved configuration file:

- Name of the file
- Manufacturer/Model
- Date/Time when saved
- Protocol name

You can sort the list of configurations with the help of the sorting tools available in the context-sensitive menu. Tap on a configuration to view the saved configuration data.

Note: The configuration file data cannot be edited.

Linking Configurations to CMX

If applicable, the configurations can also be sent to **CMX Calibration Management Software**, as linked documents in a Position/Device field. Use this feature to link the *.fc files to CMX. Double click the link to open the configuration file in the Fieldbus Configuration Viewer.

Working With Smart Instruments

Smart instruments are advanced devices equipped with digital communication capabilities and microprocessors. To work with smart instruments, you need to establish a connection. This enables communication, access to data, and the ability to perform tasks such as configuration, calibration, and diagnostics.

In MC6-T you can start communication with a smart instrument from the following user interface modes:

- **Communicator**,
- **Calibrator**,
- **Temperature Calibrator**,
- **Documenting Calibrator**,
- **Data Logger**.

When creating a new instrument in Documenting Calibrator using fieldbus or HART instruments' digital output, select HART, FOUNDATION Fieldbus H1, or Profibus PA as the Output quantity. In other user interface modes where communication may be started, the communication protocols are available in the Quantity selection window. See the picture below.

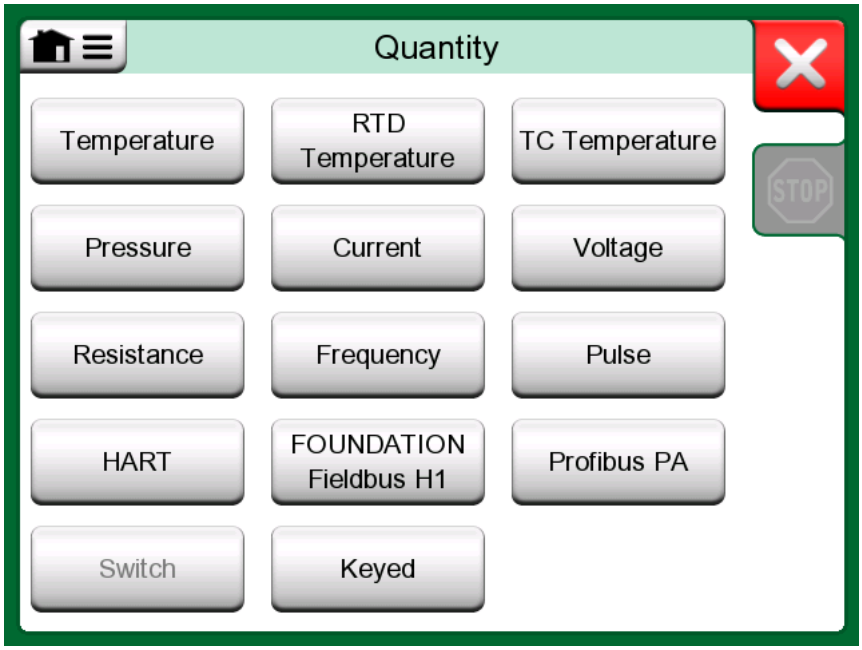


Figure 151: Quantity selection window in Documenting Calibrator mode

Note: For the analog output of a HART instrument, select **Current** as the Output quantity.

See also chapter Get Mapped Values feature.

Additional Options During Calibration

The context-sensitive menu in the Calibration window offers additional options available. For both HART and fieldbus instruments, you can start the Communicator mode to edit instrument data and, if needed, start a HART trim method. Additionally, for fieldbus instruments, there is a specific option for trimming the instrument.

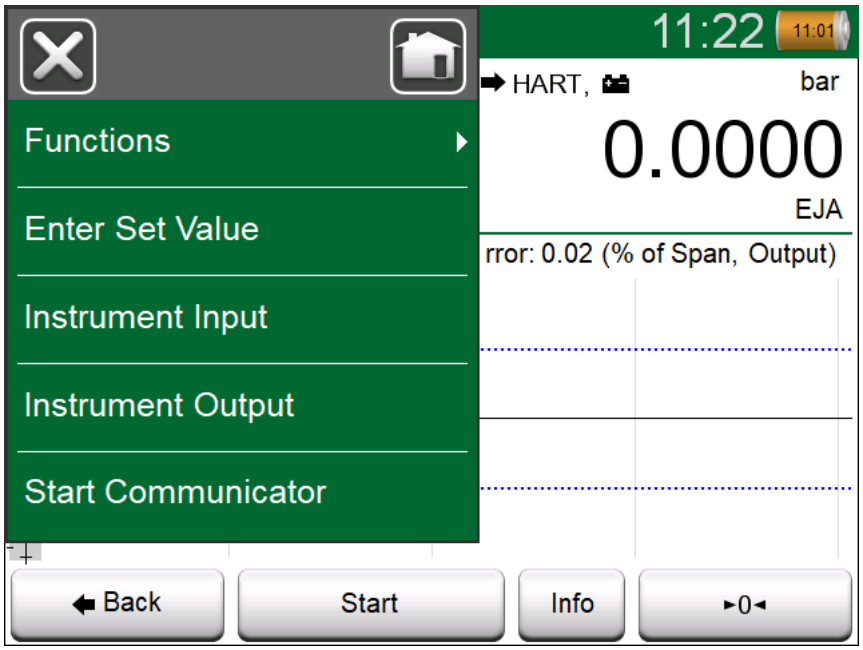


Figure 152: Context-sensitive menu options in HART instrument Calibration window

About Smart Instrument Parameters

This chapter briefly describes how to view, configure and access the smart instrument data in MC6-T.

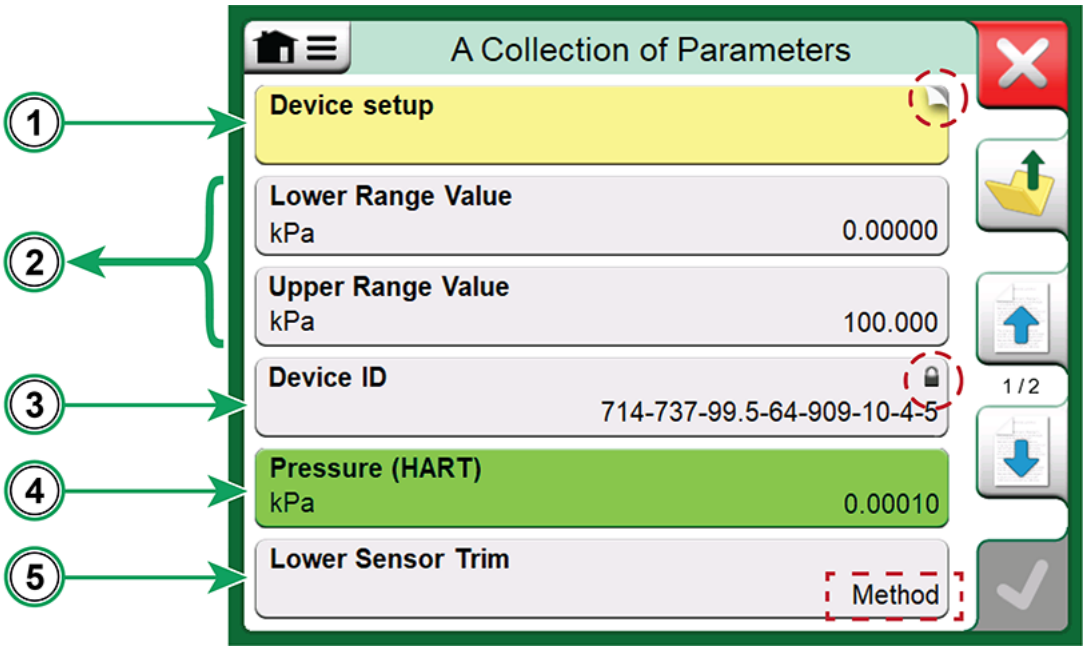


Figure 153: Blocks and Parameters view example in MC6-T

Legend:

1. **Blocks** and **Records**- may contain sub-blocks, sub-records, editable parameters and read-only parameters. Tap on the Block/Record to see its contents.
2. **Editable parameters** - fields that can be numeric, text, single select, multi select or date type. Tap to edit the field data.
3. **Read-only parameters** - data that you may view/read but cannot edit. The "lock" icon indicates that the parameter cannot be edited.
4. **Value parameter** - a special case of the read-only parameter. The Value parameter is a live measurement and cannot be edited, but it can be opened for viewing and selected for use in **Temperature Calibrator**, **Calibrator**, **Documenting Calibrator** or **Data Logger** modes.
5. **Methods** - automated procedures for e.g. calibration of HART instruments. Note that the word "Method" helps to distinguish a method from a parameter.

Note: Select **Show** > **Measurable Variables** from the context-sensitive menu to display only the Value parameters.

Note: If you select a Value parameter and you started the communication from **Communicator** mode, the value is taken into use in **Calibrator**. If you started the communication from any other supported user interface mode, e.g. **Data Logger**, the selected Value parameter is taken into use only in that particular user interface mode.

Editing Parameters

Editing parameters means changing any editable parameter in the instrument's memory, such as selecting the type of process connection fitted to the instrument.

Tap on a parameter to start editing it in a new window. The type of window depends on the type of parameter selected for editing, e.g. a selection list, a text or a numeric field.

When you edit a parameter that is not a part of a record containing several parameters, the edited value is sent to the instrument as soon as you press the **Accept** button ( ).

HART instruments: If a parameter is part of a record (i.e. several parameters together), each parameter can be edited separately. However, the edited values are not sent to the instrument until the **Accept** button ( ) of the record window is pressed. Prior to sending, edited parameters have a blue background.

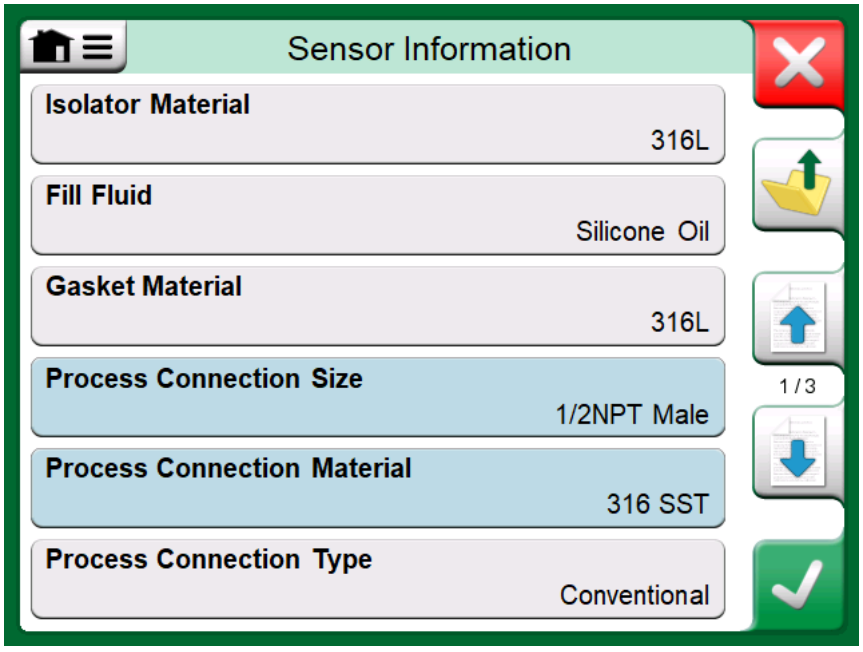


Figure 154: Sensor Information record example

Note: This manual explains how the parameters can be accessed and viewed using MC6-T calibrator. For detailed information on smart instrument data, refer to the manual of the instrument itself.

Beamex cannot be held responsible for any damages caused by changing parameters of smart instruments.

Selecting Instruments

When a communication protocol is selected, a window opens to choose whether to use the MC6-T internal 24 V supply or an external supply. Additionally, with the FOUNDATION Fieldbus H1 protocol, you need to specify whether you are connecting to an offline device or a device that is part of a live segment.

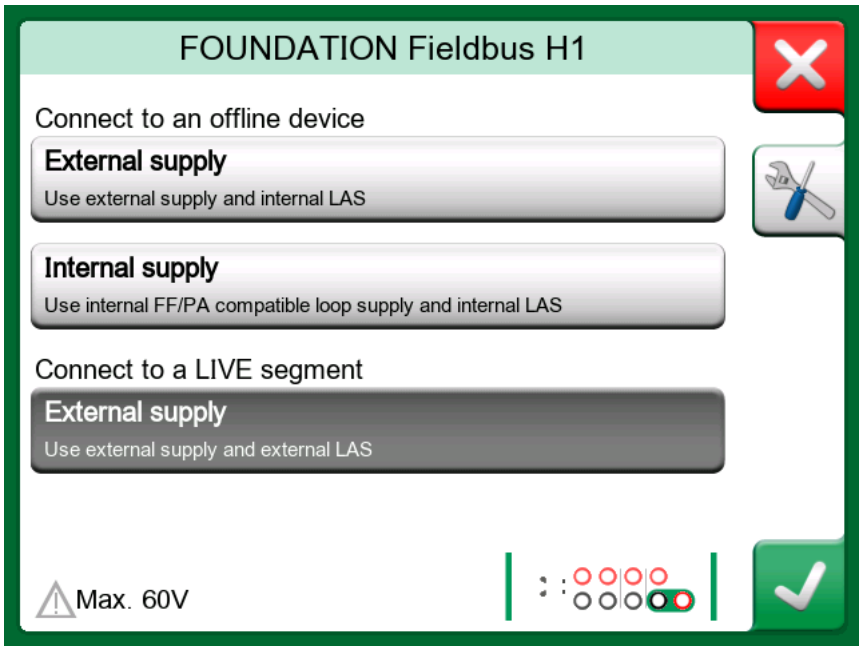


Figure 155: External supply voltage for FOUNDATION Fieldbus H1 for LIVE segment use

When using an external supply, ensure communication by using either a HART or fieldbus compliant power supply or by adding a suitable resistor between the power supply and the bus. Check the chapter Smart Instrument Connections and consult your power supply's manual for detailed instructions.

Additionally, there is a **Tools** button () for editing or checking the **Protocol Settings**. You can also access the protocol settings through the Settings user interface mode.

Note: If HART instrument is not found, it might be because of low loop impedance. Increasing the signal sensitivity might help improve communication.

Normal Sensitivity setting follows HART specifications, while High Sensitivity option allows the calibrator to send stronger signals and detect weaker ones. To change the Sensitivity, go to **Settings** > **HART** and set it to **High**.

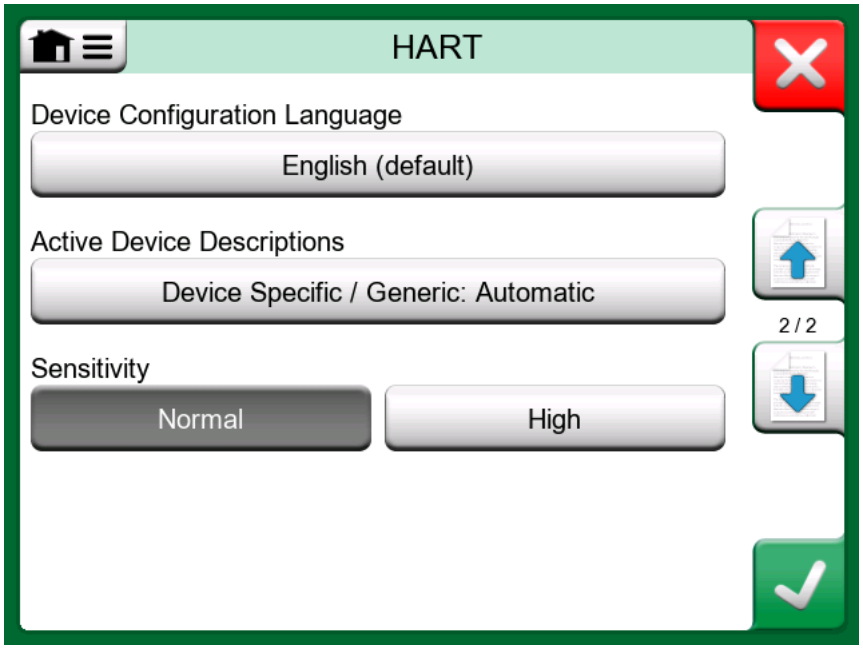


Figure 156: HART Sensitivity settings

The default settings should apply, so avoid making changes unless you are certain. In case of communication issues, refer to the HART or fieldbus instrument's manual.

See also chapter Device Description Files.

List of Found Devices

After selecting the supply voltage, MC6-T searches (monitors) for connected instruments and opens a window displaying a list of found devices. The window includes a **Refresh** button ( ) to restart the search for connected instruments.

The **Configure** button ( ) allows you to quickly edit the tag and address for the listed instruments. When edit mode is activated, the instrument's background changes to blue.

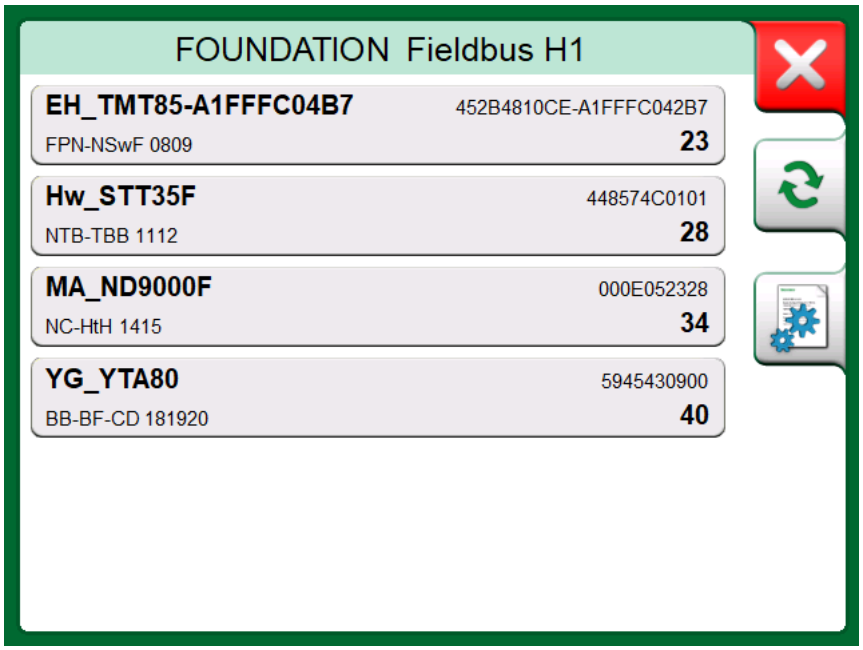


Figure 157: List of found devices

To connect to the instrument, simply tap on its name in the displayed list. The MC6-T calibrator will then retrieve the instrument's data, save it in its memory, and display the information when it is ready.

Note: If the MC6-T calibrator does not have the Device Description file for the selected instrument, a **Device Description Missing** window will appear to notify you of the situation. Further information on downloading new DD files is available in chapter Device Description Files.

Warning: When the calibrator is searching for connected fieldbus or HART instruments in the segment, DO NOT disconnect or reconnect the calibrator to or from the segment. Doing so may cause the segment to become unstable.

Get Mapped Values feature

The Get Mapped Values feature allows you to automatically populate some of the instrument data when creating a new instrument in MC6-T. This is particularly useful for long data fields, as they don't need to be manually entered into the MC6-T.

The MC6-T includes default mappings for smart instrument fields, but you can customize the mapping configuration for each instrument model you use.

Note: To use this feature, make sure that your MC6-T has the necessary communication protocol installed. It should correspond to the type of the connected smart instrument.

To populate the CMX or LOGiCAL Instrument database, simply map the instrument data to MC6-T first, and then transfer the instruments to CMX or LOGiCAL.

Note: To transfer instruments, the user must have the permission to create instruments in CMX or LOGiCAL.

Preparations

You can map data to either a new instrument or an existing instrument in MC6-T. The instrument's Output should be one of the following:

- Current (measurement),
- HART,
- FOUNDATION Fieldbus H1,
- Profibus PA.

Note: When the instrument's Output is set to Current Measurement, communication is possible only with the HART instrument at poll address 0.

Mapping the Instrument Data

To map the instrument's data when creating a **new instrument**, follow these steps:

1. Open the Documenting Calibrator mode and connect the smart instrument leads.
2. Select a communication protocol as the Output.
3. Specify the supply voltage.
4. Choose the instrument from the list of found devices.
5. Select the correct Value Parameter for calibration. The MC6-T will automatically return to the Output configuration page for creating instrument.
6. Open the context-sensitive menu and tap **Get Mapped Values**.

To map the instrument's data for an **existing instrument**, follow these steps:

1. Open the Documenting Calibrator mode and connect the smart instrument leads.
2. Select the instrument from the Instrument List.
3. Select supply voltage and wait for the instrument to connect.
4. Tap **Configure** button ( ).
5. Open the context-sensitive menu and select **Get Mapped Values**.

Note: Always review the mapped instrument data.

The default mapping settings can be customized. For more information check chapter Customizing the Mappings.

Note: For HART instruments, the input setting is automatically read from the transmitter. For other instruments, you need to manually add the instrument's input data.

Customizing the Mappings

You can customize the mappings on two different levels: protocol level (Protocol Defaults) for **HART**, **FOUNDATION Fieldbus H1** or **Profibus PA**, and device model level (Device Model Defaults). Customizable settings for both levels can be found under context-sensitive menu option **Mapping**.

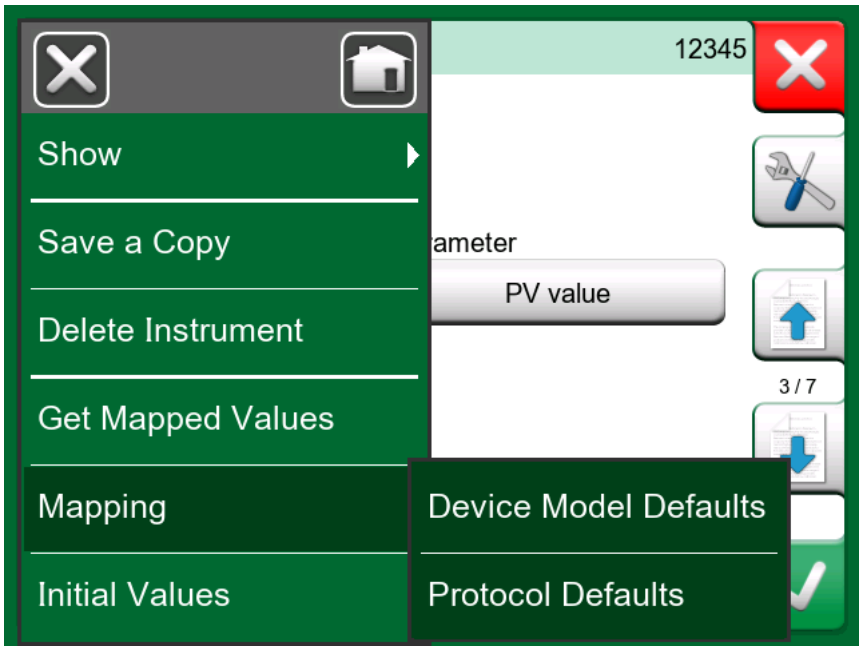


Figure 158: Customizing mappings

MC6-T uses the **Protocol Defaults** if no device model mappings are defined for the connected device model. However, if **Device Model Defaults** are defined for the connected device model, they are used instead of the **Protocol Defaults**. For both levels, you can either edit an existing mapping or add a new one.

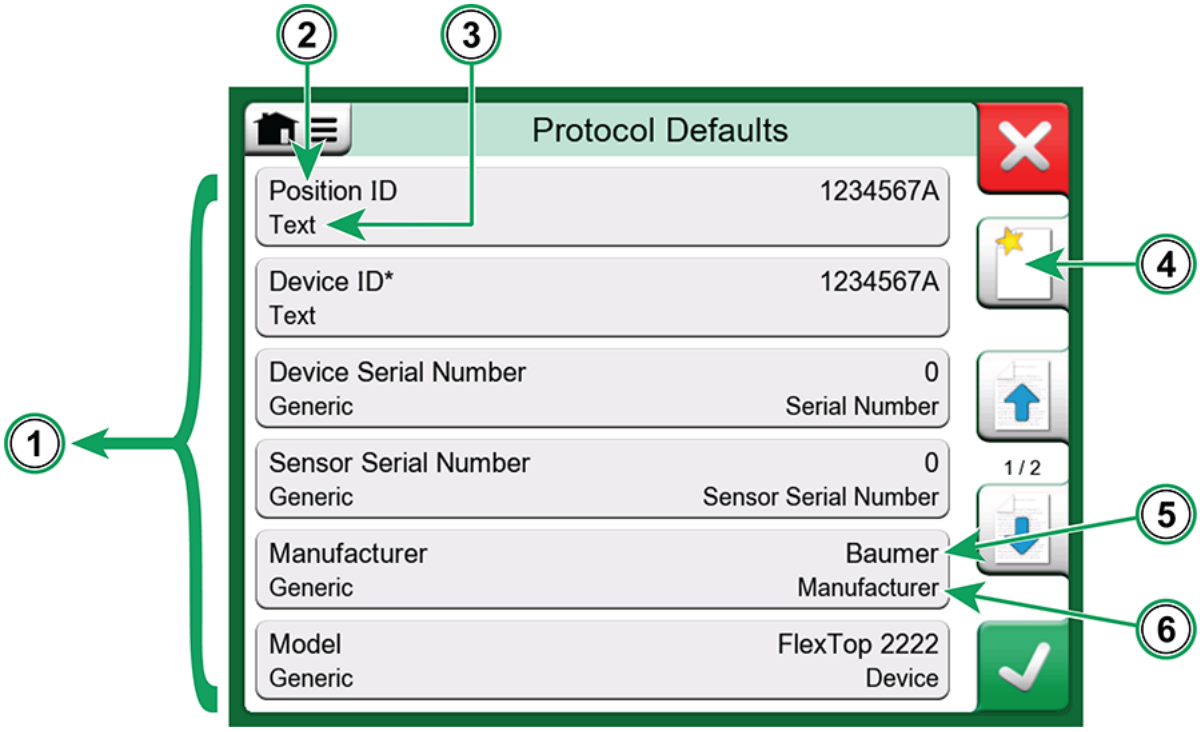


Figure 159: Protocol Default mappings example for HART instrument

Legend:

1. Protocol Defaults mappings.
2. Target field in MC6-T.
3. Mapping mode.
4. **Create new** button ( ).
5. Value of the connected instrument's field.
6. Name of the connected instrument's field.

To edit a mapping, simply tap on it. To create a new mapping, tap the **Create New** button ( ). Both actions will open the Field Mapping window, where you can either edit the existing mapping or create a new one.

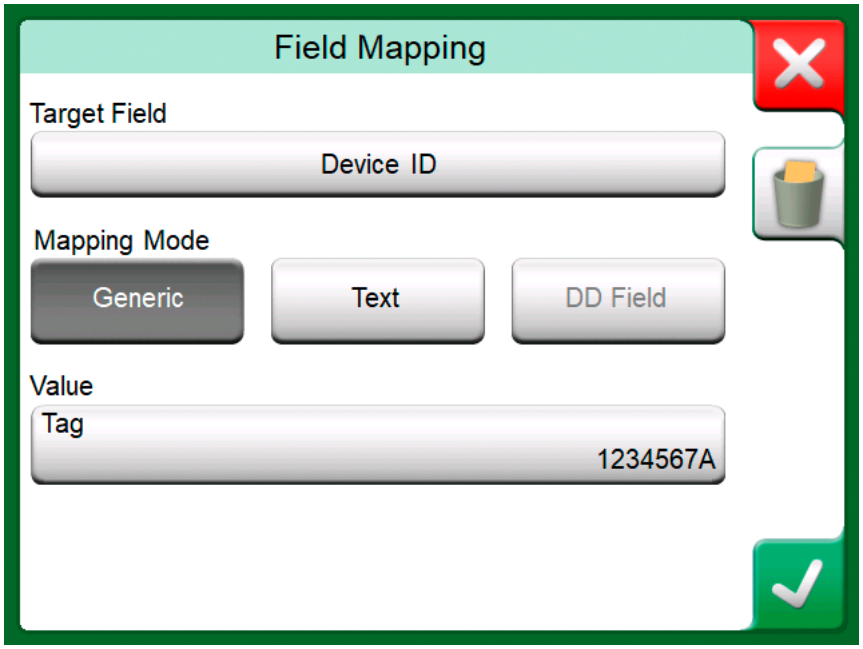


Figure 160: Field Mapping window

In the Field Mapping window, you can configure the following settings:

- **Target Field** is the field in MC6-T to which data will be mapped.
- **Value** is the field and its value in the connected device that will be mapped.
- **Mapping Mode** is the method used for mapping.

There are three available Mapping Modes:

- **Generic**: Displays a list of common fields from the protocol.

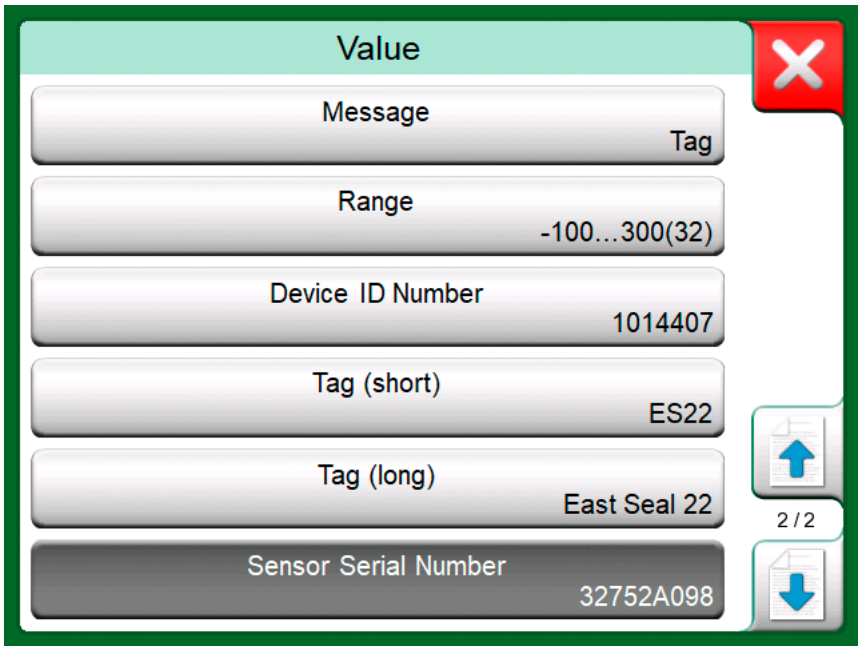


Figure 161: Available Value list in Mapping mode Generic

- **Text**: Assigns a fixed text value to the selected MC6-T field.

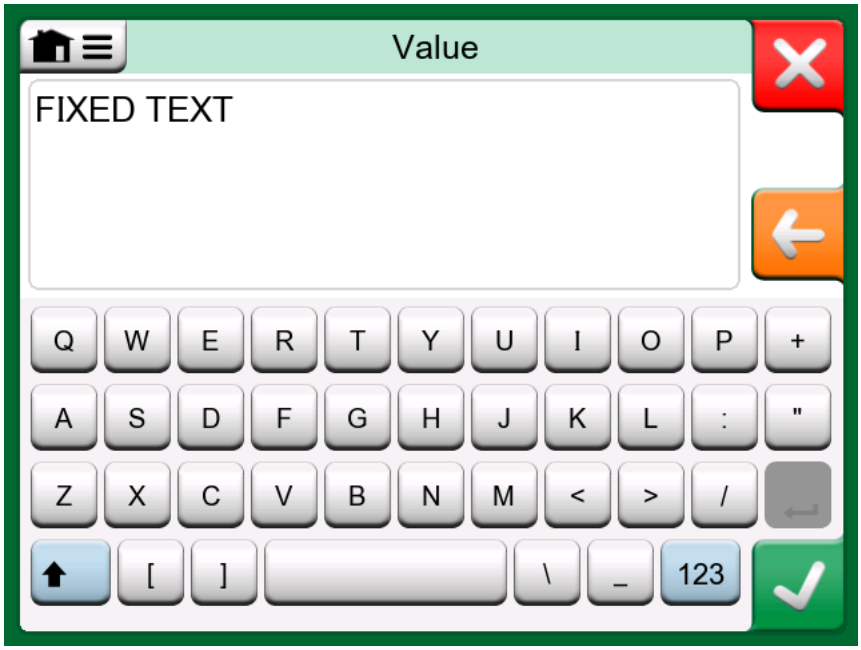


Figure 162: Text editing in Mapping Mode Text

- **DD Field**: Provides a list of all fields available in the device model's Device Description file.

> **Note:** This mapping mode can be used only with Device Model Defaults and is not supported for Protocol Defaults.

> **Tip:** You can map the same transmitter field into several MC6-T fields. For example, a device's Tag can be mapped both to Position ID and Device ID in the MC6-T instrument data.

When adding or editing a mapping, target fields that are already in use are disabled (grayed out). Once you change the mapping, it will be saved as the default for future use. After modifying the mapping, you need to read the data again using the **Get Mapped Values** menu command.

> **Note:** To delete a single mapping line, open it and press the **Delete** button ( ).

Calibrating Smart Instruments

Calibrating or Data Logging HART Instruments

Calibrating HART Instruments

To create a **new HART instrument** for calibration, follow these steps:

1. Select the **HART** communication protocol as the Output.
2. Browse the list of blocks, records, and parameters to locate the Value Parameter you want to select.

> **Note:** Use the context-sensitive menu to select **Show** > **Measurable Variables**, which will display only the Value Parameters. Remember that Value Parameters have a green background.

3. Tap the **Accept** button ( ) to confirm your selection.
4. The MC6-T will return to the instrument configuration pages. Continue to configure the instrument data.
5. Follow the calibration process described in chapter Calibrating an Instrument.

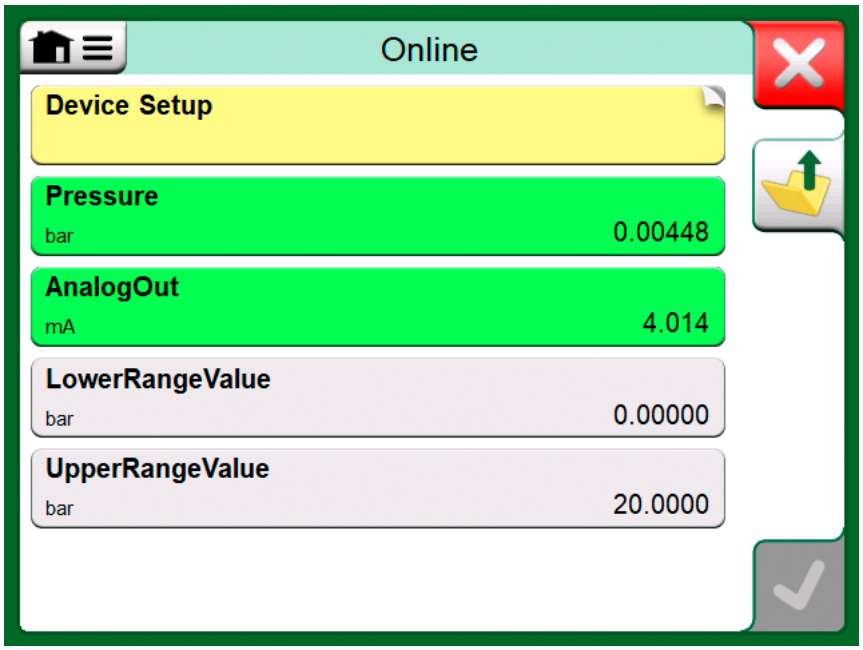


Figure 163: Variable list example in HART transmitter

For the **existing instruments**, select the instrument from the Instrument List.

Data Logging for HART Instruments

To configure a channel for HART instrument data logging, follow these steps:

1. Tap the channel you want to configure.
2. Set **HART** communication protocol as the Quantity.
3. Select the supply voltage.
4. Choose the instrument from the Instrument list.
5. Browse the list of blocks, records, and parameters to locate the Value Parameter you want to select.

> **Note:** Use the context-sensitive menu to select **Show** > **Measurable Variables**, which will display only the Value Parameters. Remember that Value Parameters have a green background.

6. Tap the **Accept** button (✓) to confirm your selection.
7. Start logging the data.

> **Note:** Unfortunately, the structure of data and naming conventions in HART instruments vary between different makes and models.

Tip: Refer to your instrument's manual to find the blocks where the parameters are located.

Calibrating or Data Logging Fieldbus Instruments

This is a quick guide for selecting a **FOUNDATION Fieldbus H1**or **Profibus PA** instrument's Value Parameter for calibration or data logging. If you want to make more extensive configurations, refer to the chapter About Smart Instrument Parameters and the manual of your instrument at hand.

Calibrating Fieldbus Instruments

To create a **new fieldbus instrument** for calibration, follow these steps:

1. Select either **FOUNDATION Fieldbus H1** or **Profibus PA** communication protocol as the Output.
2. Browse the list of blocks, records, and parameters to locate the Value Parameter you want to select.

Tip: The typical name of the Block (folder) where measurement parameters are located is ***Transducer***. However, the Block name can vary depending on the instrument. If you are uncertain, refer to your instrument's user manual for guidance.

Note: Use the context-sensitive menu to select **Show** > **Measurable Variables**, which will display only the Value Parameters. Remember that Value Parameters have a green background.

3. Tap the **Accept** button ( ) to confirm your selection.
4. The MC6-T will return to the instrument configuration pages. Continue to configure the instrument data.
5. Follow the calibration process described in chapter Calibrating an Instrument.

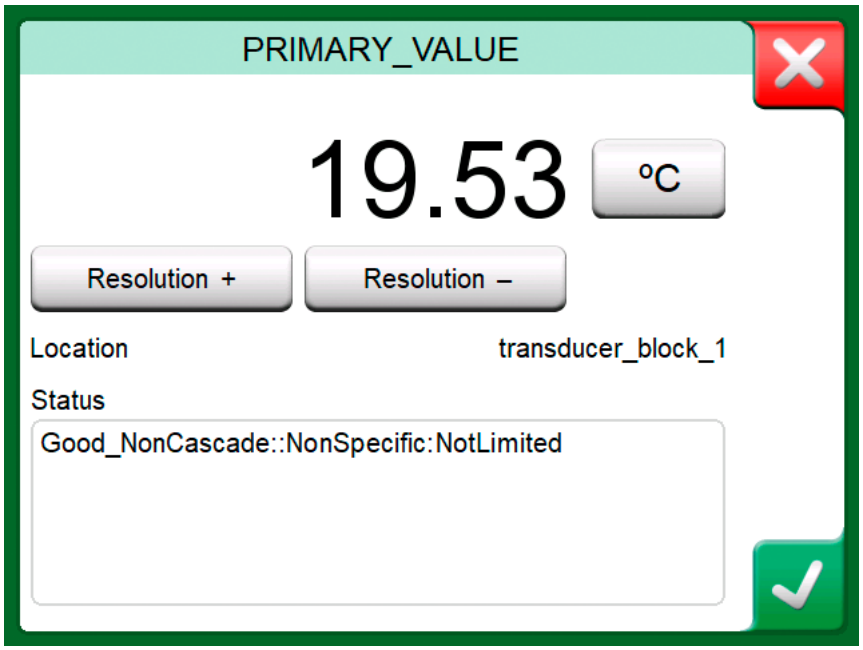


Figure 164: Accepting a parameter

For the **existing instruments**, select the instrument from the Instrument list.

Data Logging for Fieldbus Instruments

To configure a channel for fieldbus instrument data logging, follow these steps:

1. Tap the channel you want to configure.
2. Set **FOUNDATION Fieldbus H1** or **Profibus PA** communication protocol as the Quantity.
3. Select the supply voltage.
4. Choose the instrument from the Instrument list.
5. Browse the list of blocks, records, and parameters to locate the Value Parameter you want to select.

> **Note:** Use the context-sensitive menu to select **Show** > **Measurable Variables**, which will display only the Value Parameters. Remember that Value Parameters have a green background.

6. Tap the **Accept** button ( ) to confirm your selection.
7. Start logging the data.

> **Tip:** Refer to your instrument's manual to find the blocks where the parameters are located.

Trimming Smart Instruments

One of the most valuable benefits of calibrating smart instruments with MC6-T is that it can also be used for trimming the instrument.

Tip: Remember to perform As Left calibration after trimming.

Trimming a HART Instrument

Trimming a HART instrument can only be started from the Communicator user interface mode. However, you can access the Communicator mode from other user interface modes by selecting **Start Communicator** in the context-sensitive menu (see Figure 152: Context-sensitive menu options in HART instrument Calibration window).

To locate and start a trimming method for both analog and digital signals or sensors, refer to the instrument's user manual. Once you have found the method, follow the provided instructions.

Note: Typically, the correct order for trimming is to start with the digital output first, followed by the analog output.

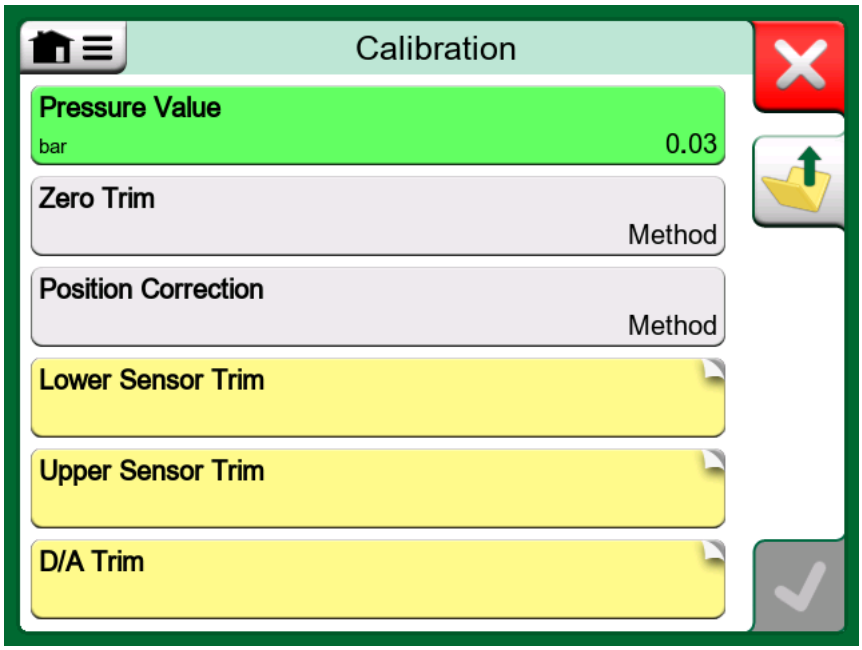


Figure 165: Sensor trim method

At some point during the trimming process, you will need to apply an applicable input signal.

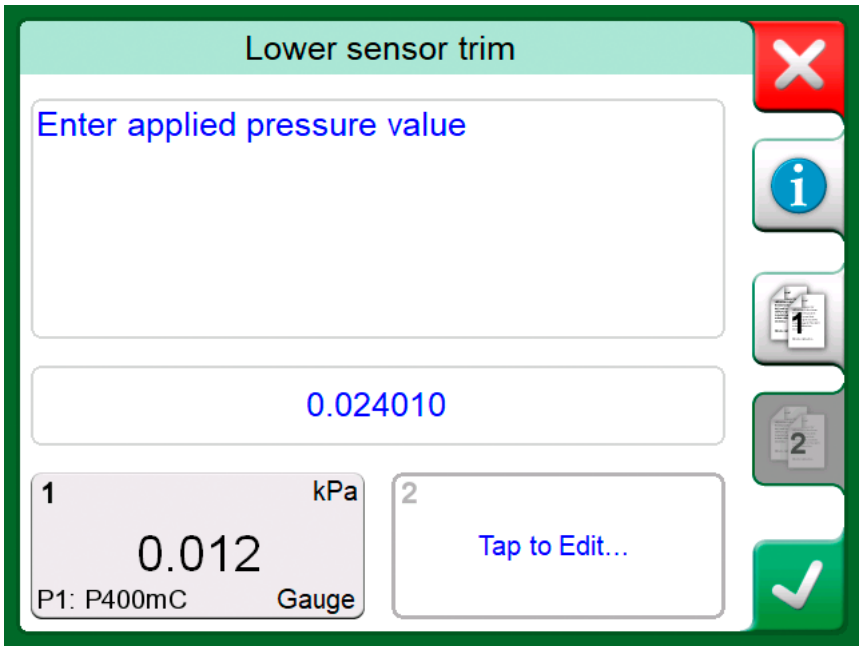


Figure 166: Trim method in progress – channels (1) and (2)

Trimming procedure started in the Documenting Calibrator mode:

- The lower part of the window will display channels showing the instrument's input (1) and possibly also the output (2) readings. Use the input signal channel to verify the correct reading.

Trimming procedure started in another MC6-T user interface mode, such as Communicator:

- Tap on one of the channels reserved for the calibrator readings and select a suitable Quantity for measurement.

When the input signal meets the requirements, use one of the **Copy** buttons () to transfer the correct value to the numeric field. Alternatively, you can manually enter the value into the numeric field.

To finalize the trim, continue following the instructions displayed on the MC6-T screen.

Note: Some HART instrument manuals and user interfaces incorrectly use the term *calibration* when they actually refer to a trim procedure.

Be cautious during the trimming procedure and closely follow the instructions in the instrument's user manual. Skipping any step may result in an unsuccessful trim.

Trimming a Fieldbus Instrument

Trimming a **FOUNDATION Fieldbus H1** or **Profibus PA** instrument can be started from the **Documenting Calibrator**, provided the relevant communicator option is installed and the parameter is trimmable.

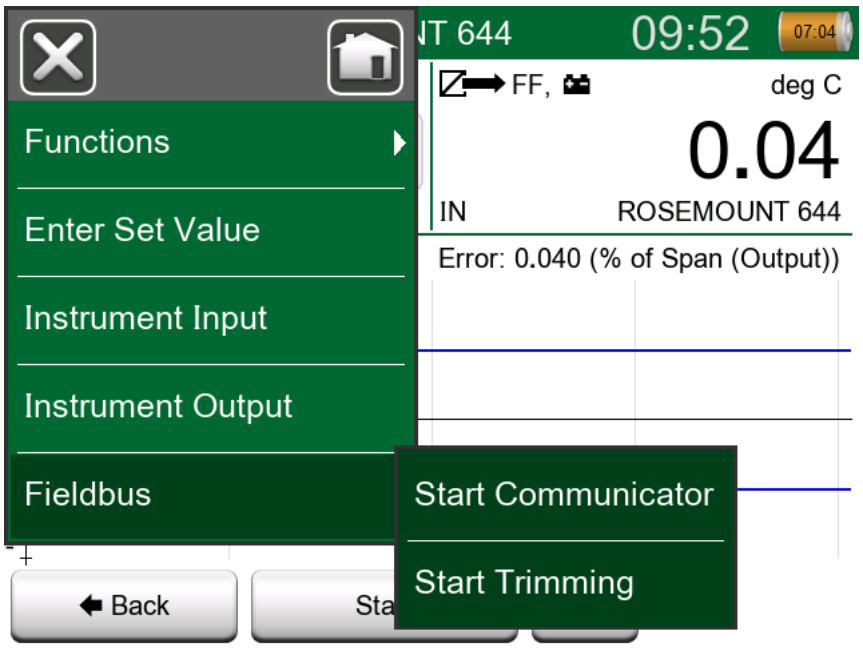


Figure 167: Context-sensitive menu in Documenting Calibrator – calibrating a fieldbus instrument

The **Start Trimming** menu option opens a window similar to the Figure 168: Fieldbus instrument Trim window example. The list of Blocks and Parameters displayed depends on instrument's Device Description file. The lower part of the window will display channels showing the instrument's input (1) and output (2) readings.

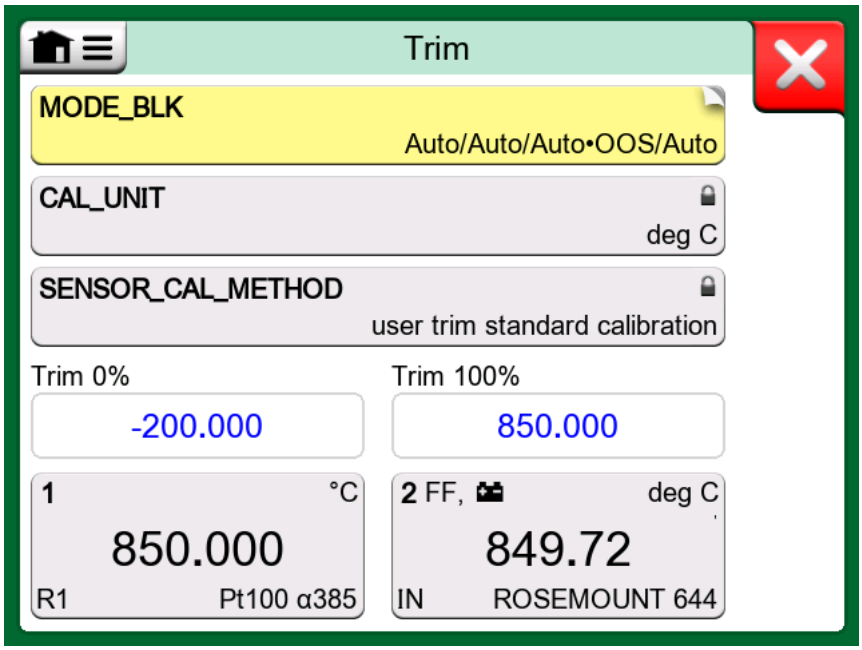


Figure 168: Fieldbus instrument Trim window example

Refer to the instrument's user manual for detailed information on how the trim procedure progresses. Typically, you first set the **Mode Block**'s Target to OOS (Out Of Service) and then proceed to edit the other data.

The actual trim is performed by tapping the **Trim 0 %** or **Trim 100 %** values after a valid input signal is generated, simulated or measured. When the input signal meets the requirements, use one of the **Copy** buttons ( ) to transfer the correct value to the numeric field. Alternatively, you can manually enter the value into the numeric field.

To finalize the trim, continue following the instructions provided in the instrument's user manual.

Note: Some fieldbus instrument manuals and user interfaces incorrectly use the term *calibration* when they actually refer to a trim procedure.

Be cautious during the trimming procedure and closely follow the instructions in the instrument's user manual. Skipping any step may result in an unsuccessful trim.

Advanced Features

Tools

Certain subwindows include a **Tools** button ( ). Some tools are intended for measurements only, while others are designed for generations and simulations only.

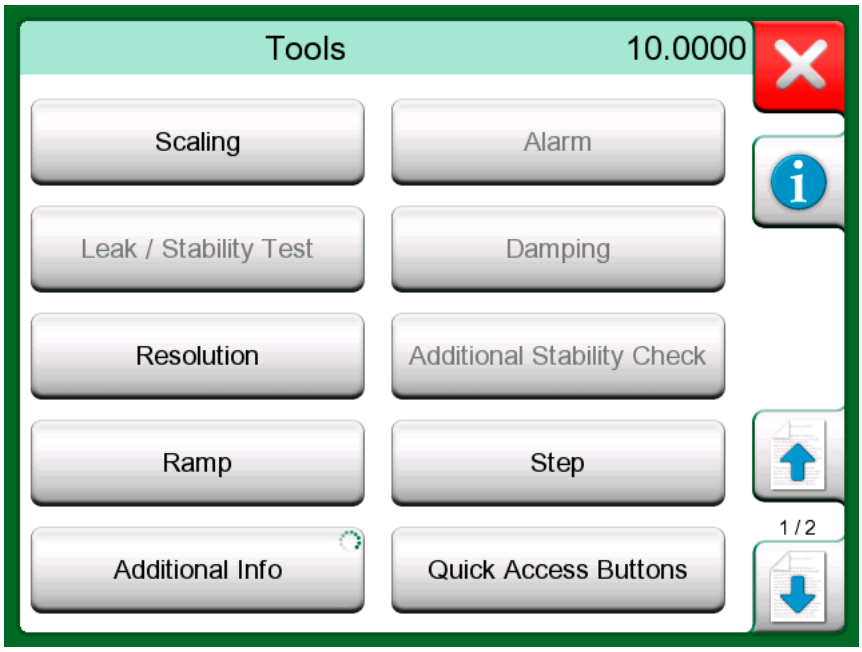


Figure 169: Tools (Calibrator user interface mode view)

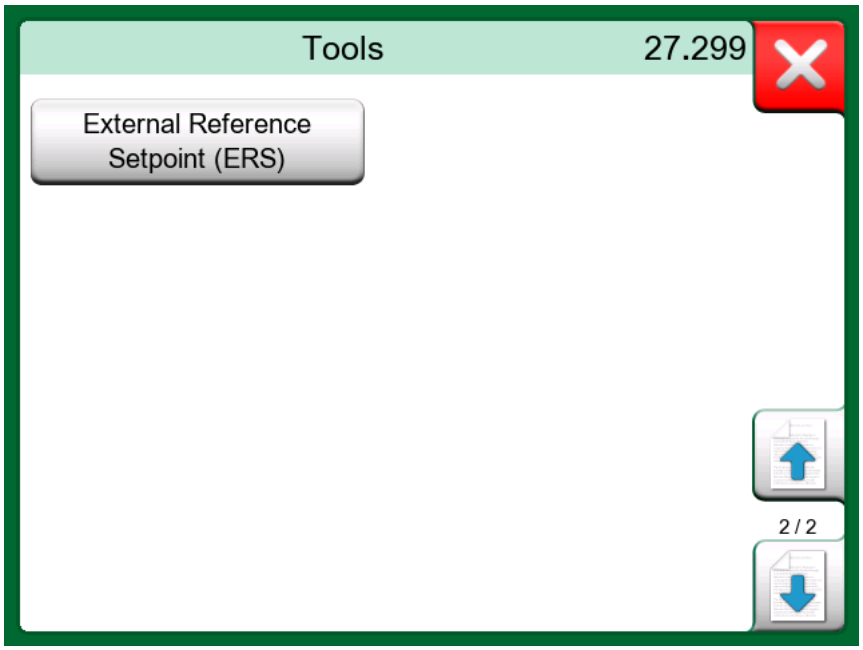


Figure 170: Tools – second page

Note: The available tools also depend on the selected Quantity and Function. For example, switches offer only a limited number of tools.

Note: Several tools include a **Stop** button (STOP) in the pop-up window where the tool is configured. To stop a function, such as Damping, open its configuration window and tap the **Stop** button. This action restores the function's default settings.

Note: Changing the Quantity of a subwindow resets all tools to their default configurations, except for the Additional Info settings, which remain unchanged.

Tip: Calibrator user interface mode: Additional Info fields with black text can be zeroed "on the fly". Zeroing options are available in the context-sensitive menu of the Additional Info window.

Tool	Description	Available in
Scaling 	Any signal can be scaled provided the conversion is known. When **Scaling** is active, it is indicated by a triangle next to the unit. The true measurement value is displayed in the additional info row at the bottom of the subwindow.	√ Measurements √ Generations/Simulations **User Interface Modes** √ Temperature Calibrator √ Calibrator √ Documenting Calibrator[1] √ Data Logger
Alarm 	Four **Alarm** limits can be assigned to main measurements: high, low, high change rate and low change rate. Active alarms are displayed above the main measurement. When an alarm limit is exceeded, a warning signal is heard. A button for acknowledging the alarm appears when necessary.	√ Measurements ✗ Generations/Simulations **User Interface Modes** √ Temperature Calibrator √ Calibrator ✗ Documenting Calibrator ✗ Data Logger

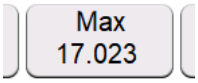
[1] Scaled units are not supported in CMX or LOGiCAL.

Tool	Description	Available in
Leak / Stability Test	A **Leak / Stability Test** can be assigned to main measurements. This test evaluates the leak or stability of, for example, a pressure measurement system. In the Leak / Stability Test configuration window, enter the Test time and start recording. If needed use the "**+30 sec**" button to extend the test time.	√ Measurements ✗ Generations/ Simulations **User Interface Modes** √ Temperature Calibrator √ Calibrator √ Documenting Calibrator √ Data Logger
Damping 	**Damping** can be activated when a measurement signal contains unwanted noise. Select one of the available options. When damping is used, a funnel icon appears to the left of the main measurement. When damping is active, the following symbol is shown above the unit button: 	√ Measurements ✗ Generations/ Simulations **User Interface Modes** √ Temperature Calibrator √ Calibrator √ Documenting Calibrator √ Data Logger
Resolution 	The **Resolution** of any signal can be increased or decreased. Changes in resolution are shown in the subwindow. For example, ".-2" means two fewer decimal places.	√ Measurements √ Generations/ Simulations **User Interface Modes** √ Temperature Calibrator √ Calibrator √ Documenting Calibrator √ Data Logger

Tool	Description	Available in
Additional Stability Check	An **Additional Stability Check** is available for temperature measurements. This addition to the default stability check ensures that slow temperature transients are handled correctly. For more information see chapter Additional Stability Check.	√ Measurements ✗ Generations/ Simulations **User Interface Modes** √ Temperature Calibrator √ Calibrator √ Documenting Calibrator[2] √ Data Logger
External Reference Setpoint	An **External Reference Setpoint** allows MC6-T users to generate an exact temperature based on the selected reference sensor. For more information see chapter External Reference Setpoint (ERS).	√ Measurements √ Generations/ Simulations **User Interface Modes** √ Temperature Calibrator √ Documenting Calibrator √ Data Logger
Ramp 	The **Ramp** tool opens a window that allows you to define a ramp function for the generated or simulated signal.	✗ Measurements √ Generations/ Simulations **User Interface Modes** ✗ Temperature Calibrator √ Calibrator ✗ Documenting Calibrator √ Data Logger

[2] CMX has a fixed default of 1 minute when sending to the calibrator. However, if the user changes this setting in the calibrator, CMX will receive the updated time and store it with the results.

Tool	Description	Available in
Step 	The Step tool allows you to define a step function for generated or simulated signals. It enables the signal to increase or decrease in a predefined manner and provide the signal for a fixed duration. This feature is particularly useful when documenting data manually. The step time option specifies the delay time, which begins after the stability criteria have been met. For more information see chapter User-Defined Steps/Calibration Points.[3]	✗ Measurements √ Generations/ Simulations **User Interface Modes** ✗ Temperature Calibrator √ Calibrator ✗ Documenting Calibrator √ Data Logger

Tool	Description	Available in
Additional Info 	With **Additional Info** tool you can add additional information fields at the bottom of a subwindow. The available fields depend on the quantity and settings. Up to four fields can be added to each subwindow. The settings for the additional information rows are saved for future use.	√ Measurements √ Generations/Simulations **User Interface Modes** √ Temperature Calibrator √ Calibrator ✗ Documenting Calibrator ✗ Data Logger
Quick Access Buttons 	**Quick Access Buttons** tool opens a window where you can define five shortcuts for user-defined generation or simulation values. These Quick Access shortcuts appear at the bottom of the subwindow, using the space reserved for possible Additional Info data.	✗ Measurements √ Generations/Simulations **User Interface Modes** √ Temperature Calibrator √ Calibrator ✗ Documenting Calibrator ✗ Data Logger

[3] When using the Step tool I for temperature generation, it is recommended to activate the tool's stability check to ensure that the temperature has stabilized before moving to the next step.

Tool	Description	Available in
Function Info 	√ Measurements √ Generations/Simulations Function Info button opens a pop-up window with information about the current function, including measurement range, calibration date and other relevant details.	√ Measurements √ Generations/Simulations **User Interface Modes** √ Temperature Calibrator √ Calibrator √ Documenting Calibrator √ Data Logger

Additional Stability Check

The **Additional Stability Check** is an advanced method for determining when a temperature signal is stable enough for reliable calibration. You can activate this tool for RTD and TC sensor measurements. You can select a one-minute or two-minute time window, or define custom values for time and the 2σ (two sigma) stability limit for the rolling 2 x STDDEV (2σ) stability calculation.

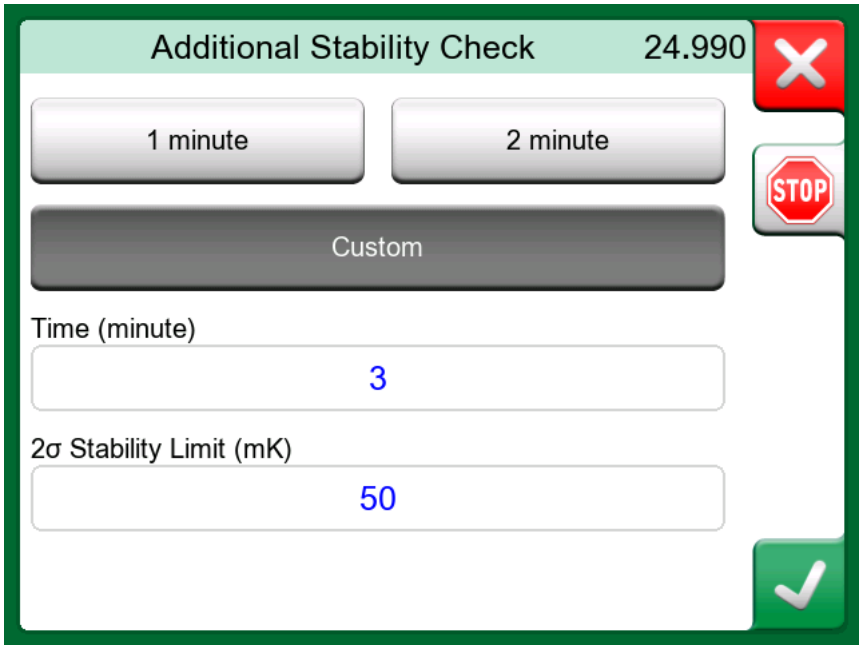


Figure 171: Additional Stability Check – custom time window

The 2σ value, commonly used to evaluate stability, is calculated with the formula:

$$2\sigma = 2 \times \sqrt{\frac{\sum(X-\mu)^2}{N}}$$

Where:

X	is the measurement sample value,
μ	is the mean of all measurement samples,
N	is the number of measurement samples.

Note: For temperature generation, the Temperature Block always uses a 1-minute Additional Stability Check.

When the **Additional Stability Check** is enabled for a temperature measurement, the calculated 2σ. Stability value can be viewed in several places. For example, it may appear as an additional info box below the measurement or as a thin line in the graph view of the Temperature Calibrator mode.

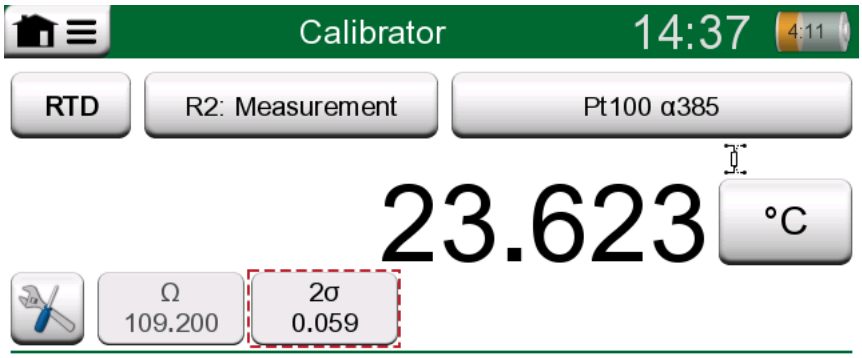


Figure 172: Additional Stability Check – info box

The temperature signal is considered to be stable (the unstable symbol disappears) when the 2σ Stability value is below the Stability Limit (2σ ≤ Device Stability Specification). The Stability Limit corresponds to the stability specification of the **Temperature Block**. Please refer to the detailed specifications of the device for more information.

Note: The Internal Reference and the Temperature Block do not have a valid Stability Limit for temperatures outside the specification temperature range. This means that the unstable symbol will never disappear outside this range. However, for RTD and TC sensors, the Stability Limit is valid and extends outside this range with constant values.

External Reference Setpoint (ERS)

The External Reference Setpoint (ERS) feature allows MC6-T users to generate an exact temperature based on the selected reference sensor. When enabled, ERS automatically applies and stores regulation offsets for temperature points locally. These points are device-specific and influenced by multiple factors. Predefined offset tables help speed up calibration and reduce deviation from the target setpoint.

ERS can apply corrections up to 10 °C. MC6-T maximum and minimum temperature are still respected, ensuring the internal block and sensor remain within the calibrator's temperature range.

If the setpoint is not available in the offset table, MC6-T first generates temperature using the internal sensor, waits for stability, calculates the offset, and then switches to generation based on the external reference sensor.

ERS is available in the following user interface modes:

- Temperature Calibrator
- Documenting Calibrator
- Data Logger

In all these modes, the ERS can be accessed from the second page of Tools by clicking the **External Reference Setpoint (ERS)** button. Mode-specific requirements and settings are described in the sections below.

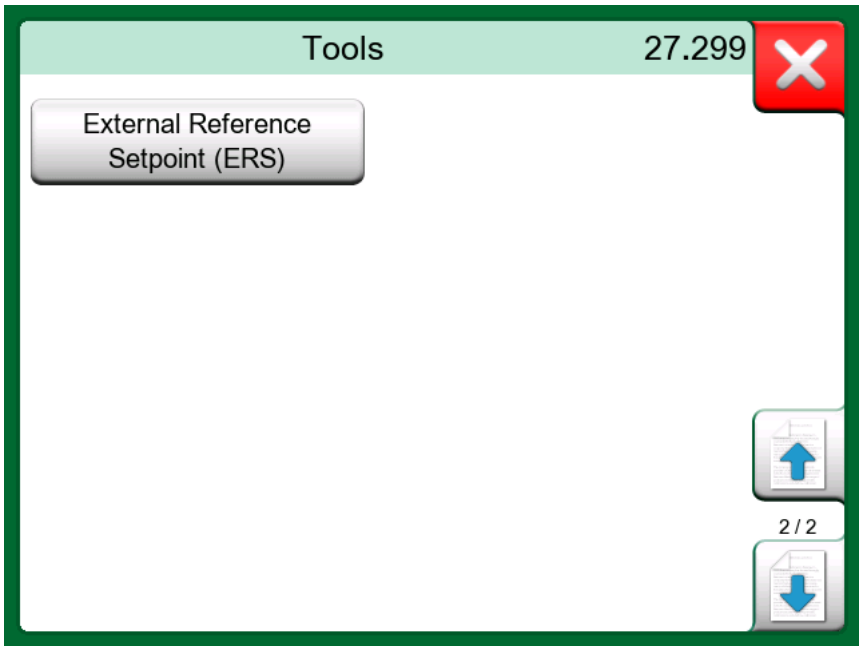


Figure 173: External Reference Setpoint (ERS) in the second page of Tools

ERS can also be activated from the Calibration Management System. While it activates the tool, the reference tables are stored locally. For each new instrument received from the Calibration Management System, an ERS table is automatically created using the instrument name.

The icon ( ) indicates that ERS is active.

Temperature Calibrator Mode

Temperature Calibrator mode requires selecting a suitable reference sensor for the reference sensor channel.

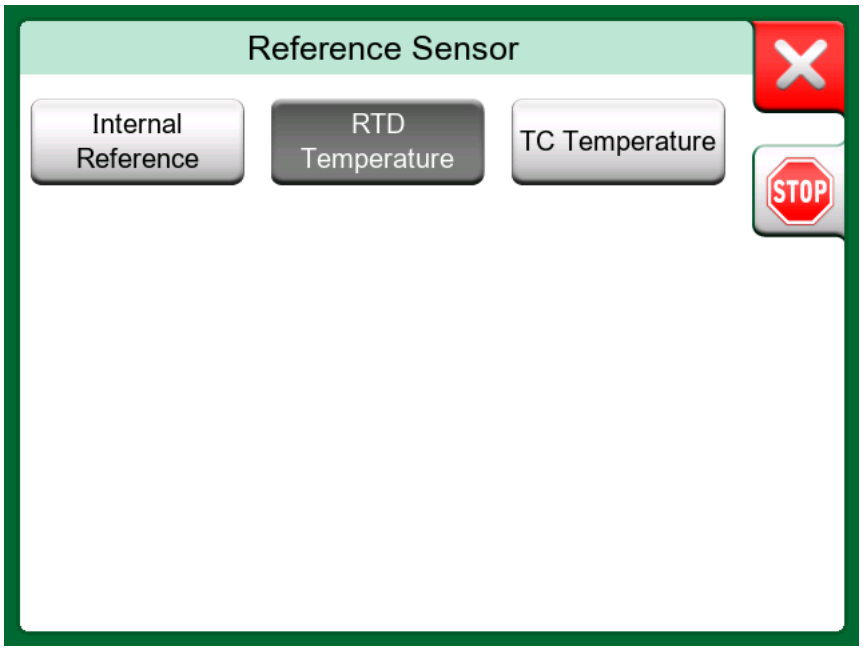


Figure 174: Temperature Calibrator mode – Reference Sensor selection

If external reference sensor offset data is not available, leave the table empty, and it will be filled automatically.

Figure 175: Edit Offset Table window with no offset information

When offset values are available, enter them in the table to improve calibration speed. Rising and falling setpoints are handled separately. The Offset Table may contain one rising section and one falling section at maximum.

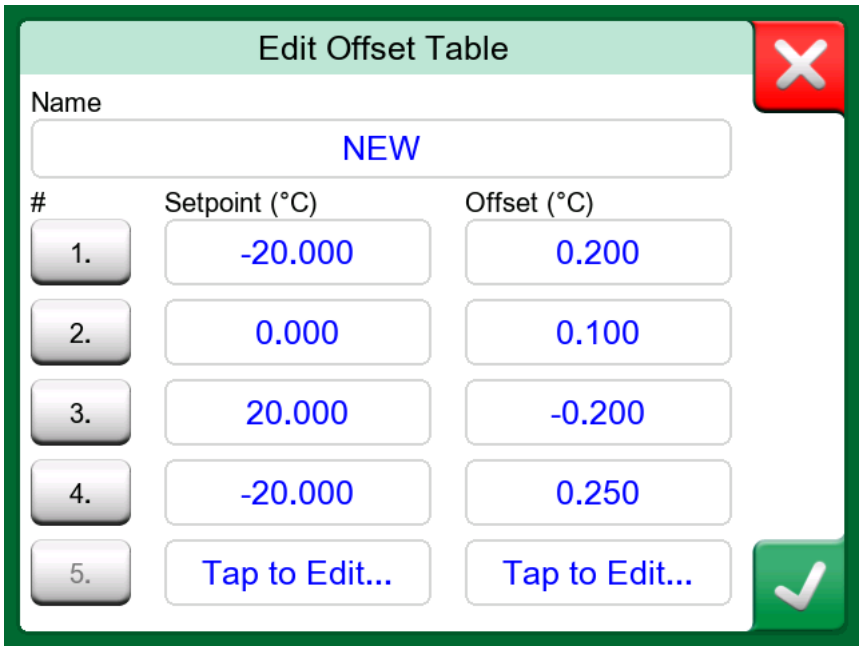


Figure 176: Edit Offset Table window showing known offset values

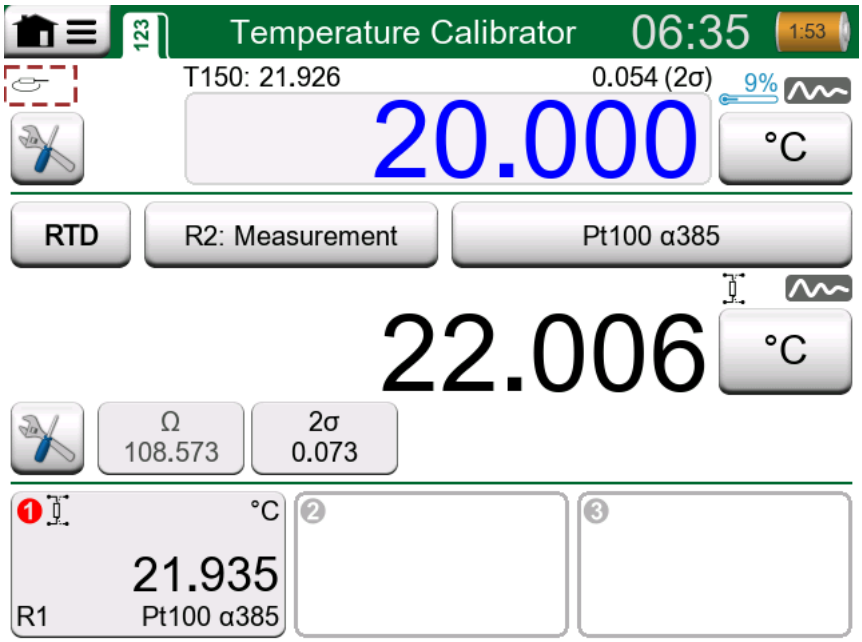


Figure 177: ERS enabled in Temperature Calibrator mode

Documenting Calibrator Mode

In Documenting Calibrator mode, ERS can be activated only when the instrument input is temperature measurement and MC6-T Automatic Control is used.

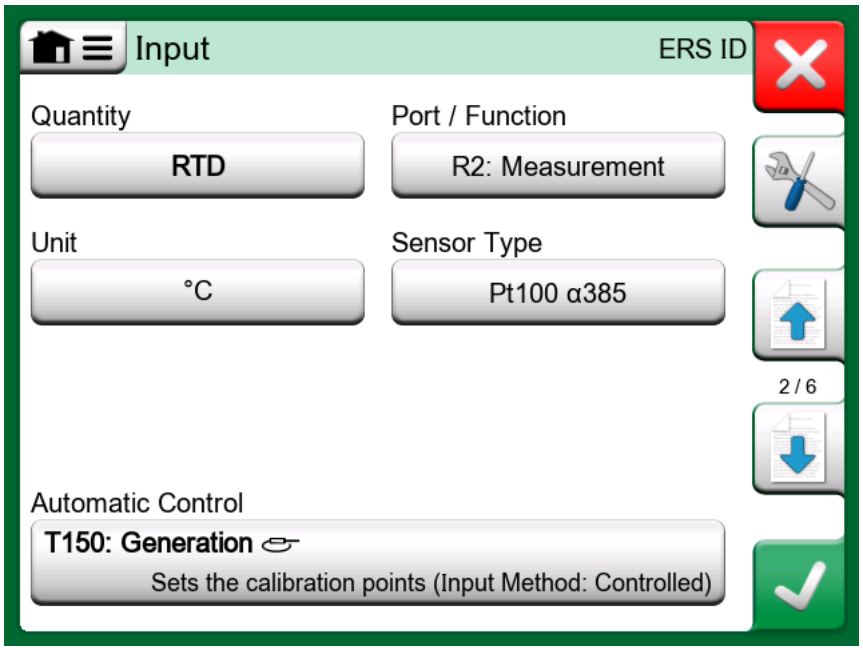


Figure 178: ERS – Input in Documenting Calibrator mode

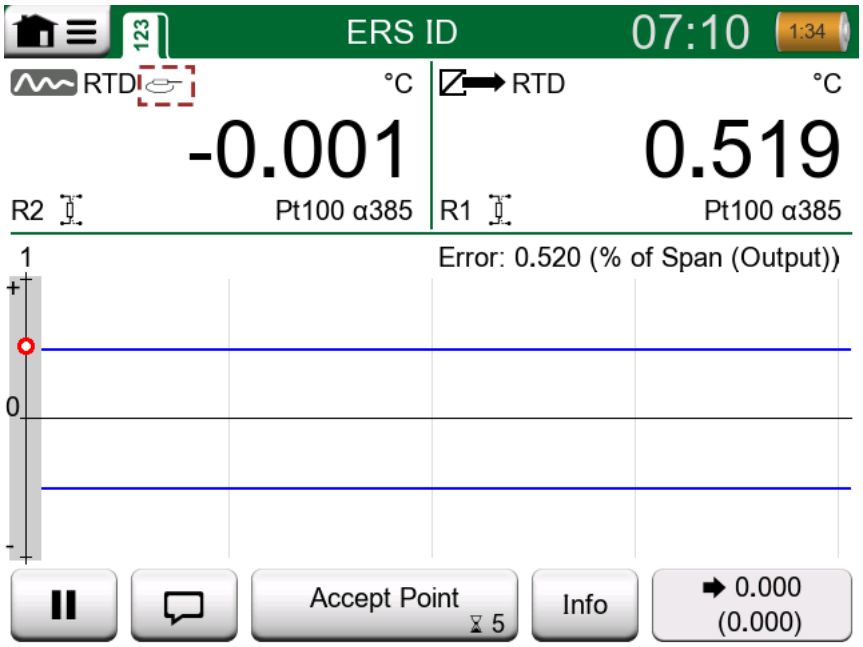


Figure 179: ERS enabled in Documenting Calibrator mode

Data Logger Mode

In Data Logger mode, ERS is activated through the temperature generation channel.

First reference sensor channel must be set up. Set up the reference sensor channel first, then select a suitable reference sensor in the temperature generation channel.

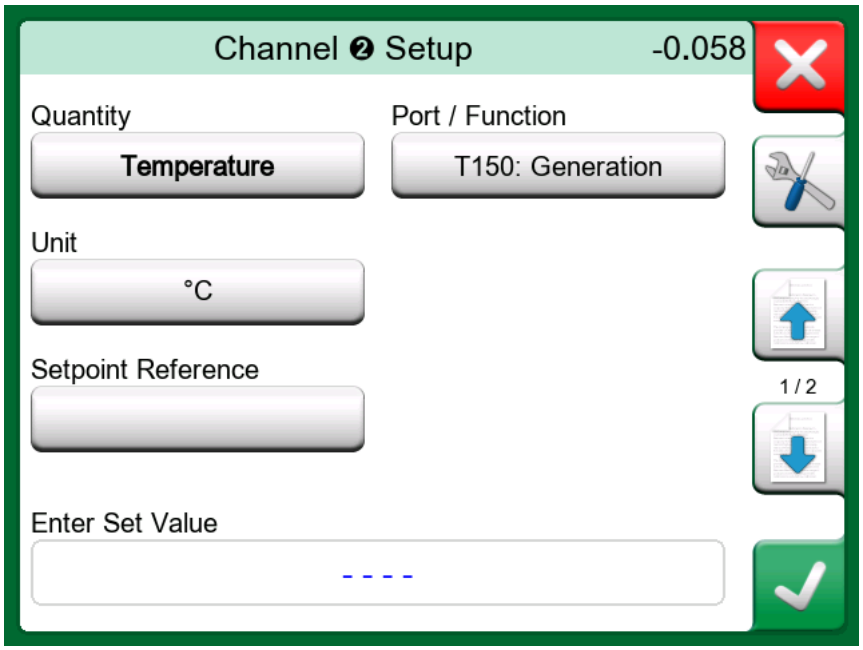


Figure 180: ERS in Data Logger Channel Setup window

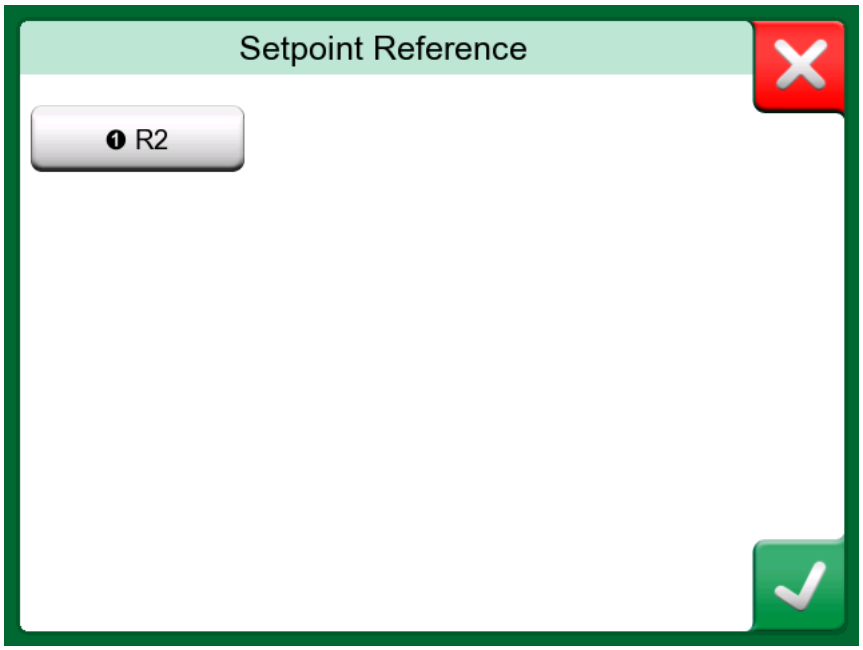


Figure 181: ERS in Data Logger Setpoint Reference window

In the Temperature Controller channel, ERS is indicated together with the reference channel number.

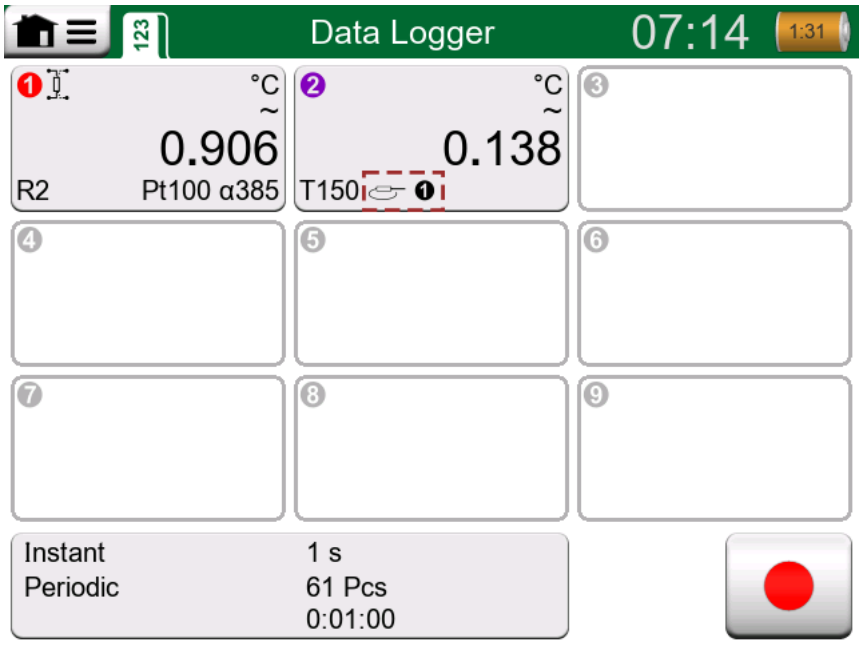


Figure 182: ERS enabled in Data Logger mode

User-Defined Transfer Functions

Transfer Functions are available in the **Scaling** Tool found in the Calibrator, Data Logger and in the Instrument Function Related Data configuration page in the Documenting Calibrator mode.

When creating or selecting a user-defined transfer function, tap on the **Transfer Function** button and navigate to the **User Transfer Function** page.

The configuration consists of two (or more) pages, as shown in the figures below. The first page is for general definitions, and the second page is for entering known transfer function points. If you enter more points than can be displayed on one page, an additional page is automatically added.

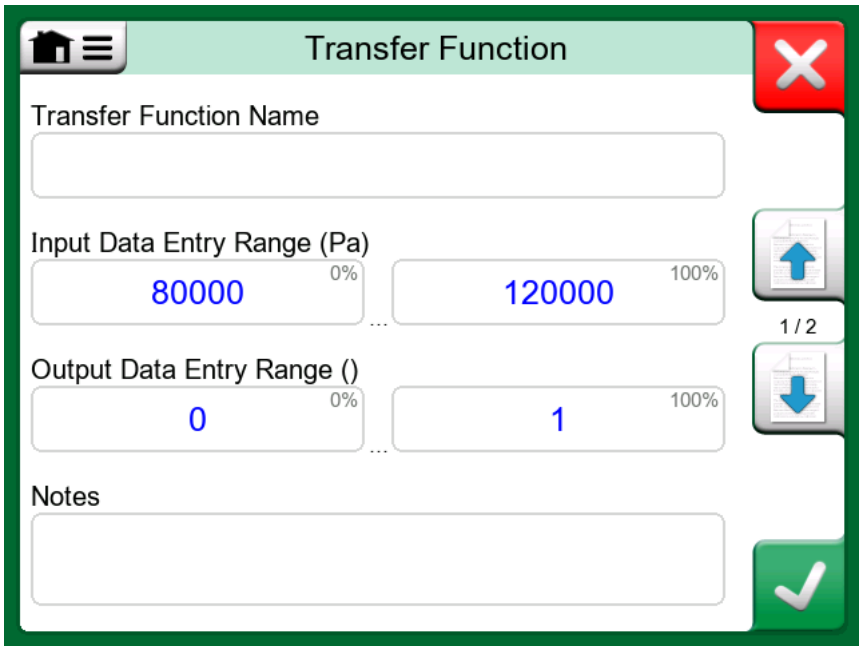


Figure 183: Transfer Function configuration page – general definitions

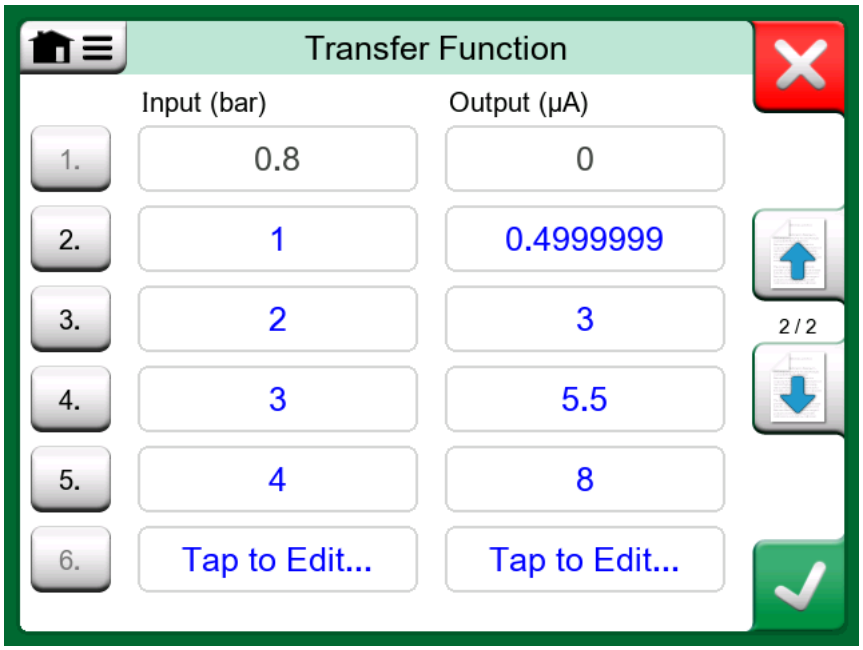


Figure 184: Transfer Function configuration page – transfer function points

When entering transfer function points, please follow these rules:

- The first point is always pre-entered and cannot be edited. It represents the 0 % values of the range.
- Points must be entered in increasing order.
- The last point must be equal to or greater than the 100 % value of the range.

Additionally:

- The row number acts as a button. Click it to open a window where you can delete the current point or add a new row either before or after the current point.
- Added points are assigned default values, which are the averages of the points before and after them.

User-Defined Steps/Calibration Points

User-defined steps can be accessed through the **Step** tool in the Calibrator and Data Logger user interface modes. The **Step** tool opens a window to define a step function for the generated or simulated signal. User-defined calibration points are available in the Calibration Procedure Related Data configuration page in the **Documenting Calibrator** mode.

When creating or selecting user-defined steps, use the **Step Definition** button.

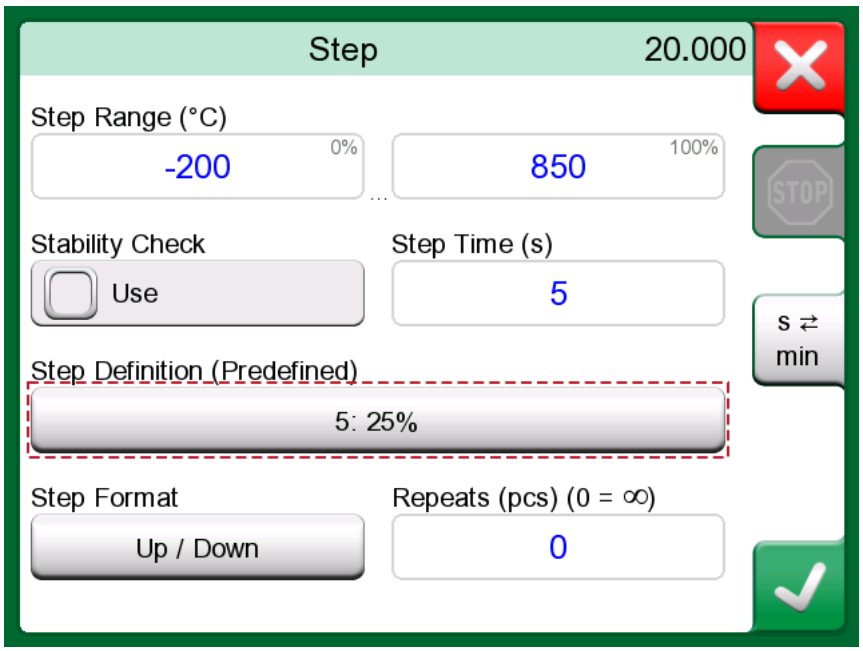


Figure 185: User-defined steps – Step definition button

For user-defined calibration points, use the **Calibration Points** button. In the opened window, navigate to **User Test Points** page. The configuration consists of two (or more) pages, as shown in the figures below. The first page is for general definitions, and the second page is for entering test points. If you enter more points than can be displayed on one page, an additional page is automatically added.

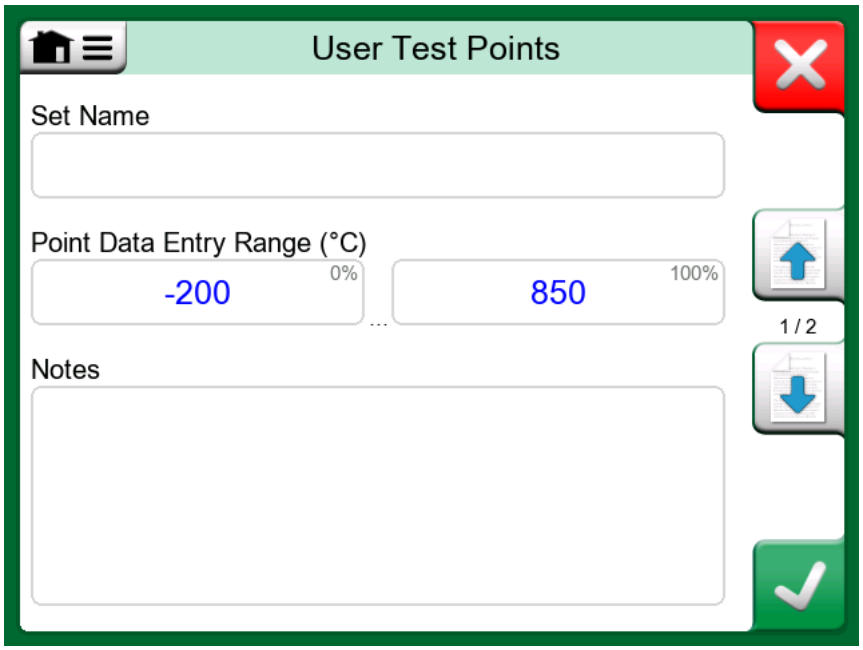


Figure 186: User Test Points – general definitions

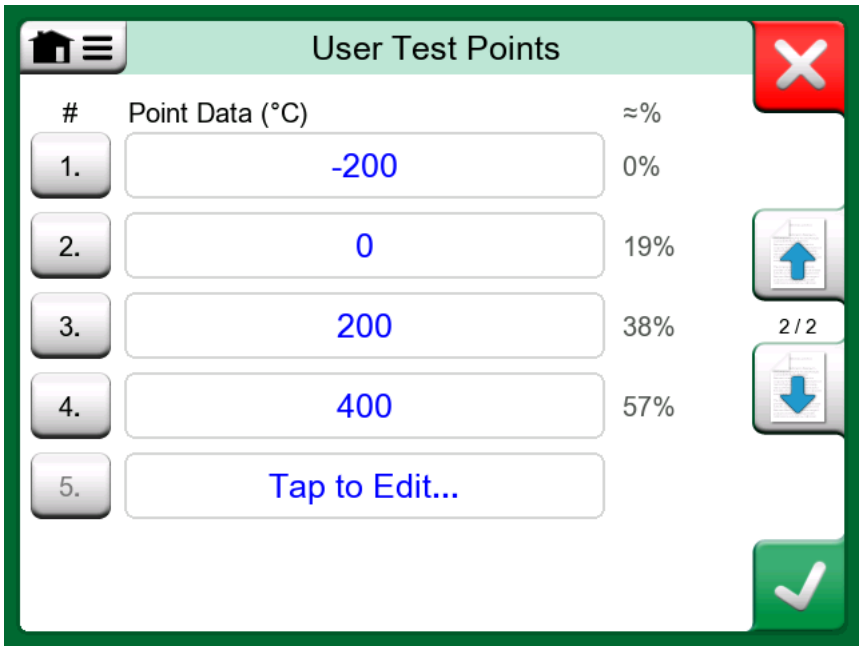


Figure 187: User Test Points – steps/calibration points

There are no specific rules regarding the values you are allowed to enter. They may be outside the predefined point data entry range and can be input in any order.

Additionally:

- The row number acts as a button. Click it to open a window where you can delete the current point or add a new row either before or after the current point.
- Added points are assigned default values, which are the averages of the points before and after them.

User Sensors

MC6-T includes a wide selection of pre-configured standard Platinum Resistance Temperature (PRT) type RTD sensors. These are available whenever **RTD Temperature** is selected as the Quantity. If correction coefficients are required for a specific sensor, you can create a User Sensor. Further instructions are provided in chapter Creating a New User Sensor.

When a temperature sensor with a built-in memory chip is connected to the R2 connector, the calibrator automatically recognizes the sensor and can read ITS-90 correction coefficients from the memory, provided they were added by the calibration laboratory. Using Beamex RPRT, IPRT, or SIRT sensors calibrated in Beamex calibration laboratories ensures that the correction coefficients are stored and ready to use.

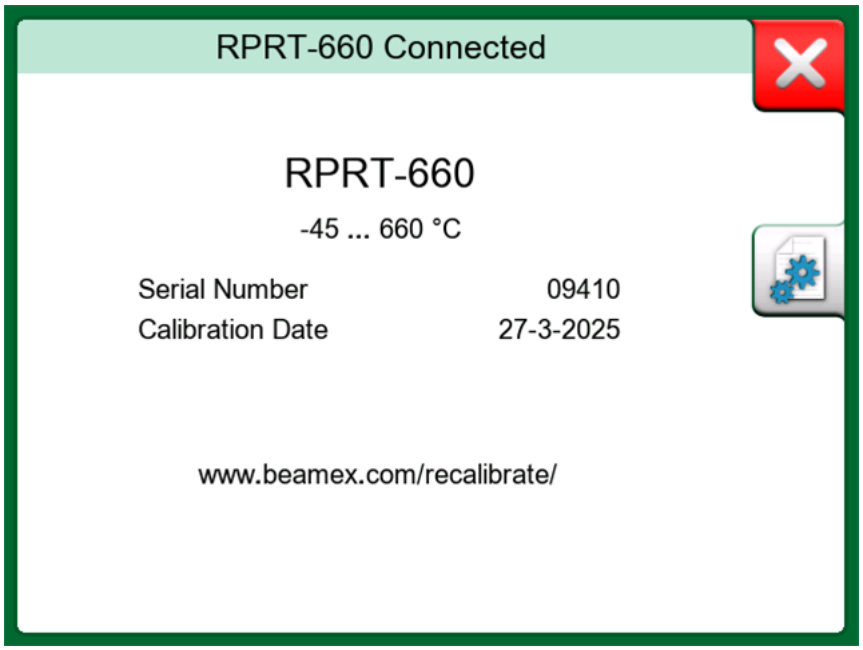


Figure 188: Sensor with built-in memory chip automatically recognized, example

If the sensor is not recognized, verify that the following conditions are met:

- The sensor is connected to the **R2 connector** (R1 and R3 terminals do not support smart sensor functionality).
- No adapter cable is used between the calibrator and the sensor's own LEMO connector.
- The sensor is equipped with a built-in memory chip:
  - Beamex IPRT sensors must have a serial number starting with **33025 or higher**.
  - Beamex SIRT sensors must have a serial number starting with **25 or higher**.
- The calibrator firmware version is **5.20 or later**.

Creating a New User Sensor

Note: Although custom sensors can be created and maintained in the MC6-T, it is strongly recommended to define and manage user sensors (including correction coefficients) in CMX or LOGiCAL. This ensures centralized maintenance and availability for all compatible calibrators supporting the sensors.

Note: Duplicate sensor names are not allowed.

You can create a new User Sensor whenever **RTD Temperature** is selected as the Quantity. To create a new User Sensor:

1. Press the button with sensor name.
2. Go to the second page of the User Sensor window.
3. Tap **Create New** button ( ).
4. Use the sensor's data sheet and calibration certificate to fill in the required details:
   - Sensor name
   - Serial number
   - Calculation formula and correction coefficients
   - Temperature range
   - Manufacturer and model
   - Calibration date

Make sure to select the correct Sensor Calculation Formula. It defines which settings and fields are available on the configuration pages. The calculation formula and correction coefficients can be found on the sensor's calibration certificate. For more details about the available calculation formulas and their use, see chapters Callendar-Van Dusen Formula, ITS-90, and Factor.

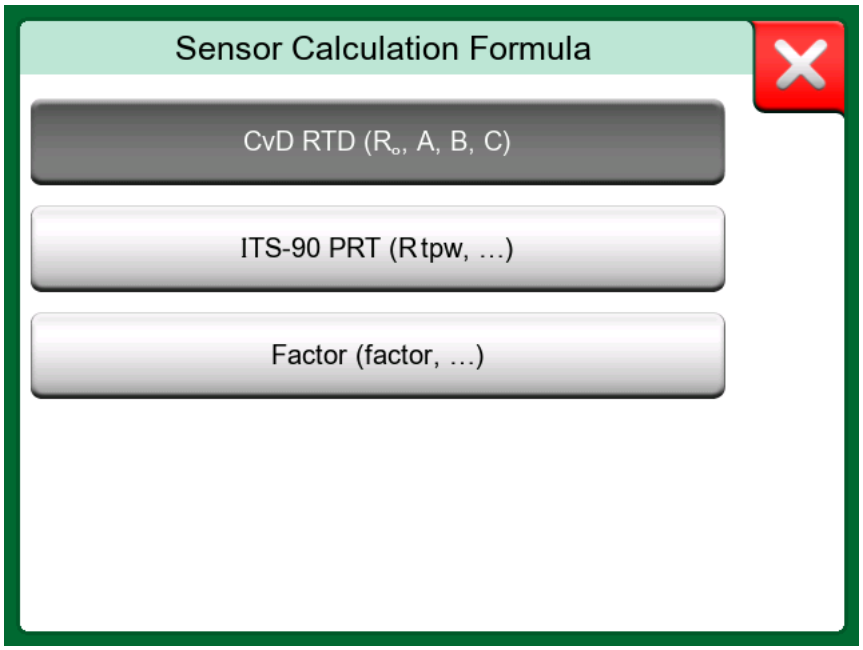


Figure 189: Sensor Calculation Formula options

Note: For more detailed information about sensor calculation formulas, refer to literature related on calibrating Platinum Resistance Temperature (PRT) sensors.

When a temperature sensor with a memory chip is connected to the R2 connector, the calibrator automatically recognizes it and displays a pop-up window with the sensor information. Press **Create New** button ( ) to create a new User Sensor. Sensor data will be automatically populated into the correct fields. Review all pre-populated data and provide any missing information.

Note: The connected smart sensor appears in bold.

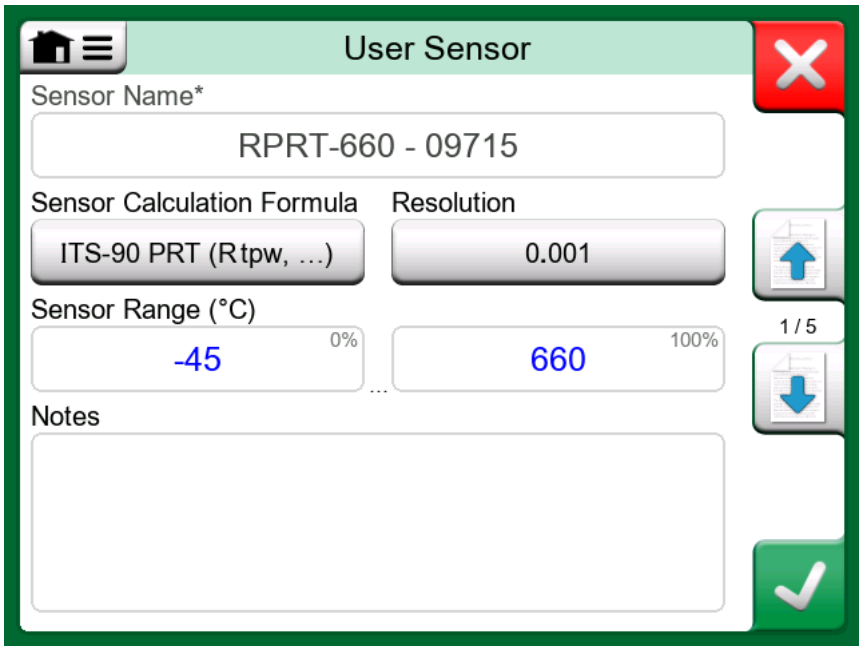


Figure 190: User Sensor configuration window, first page example

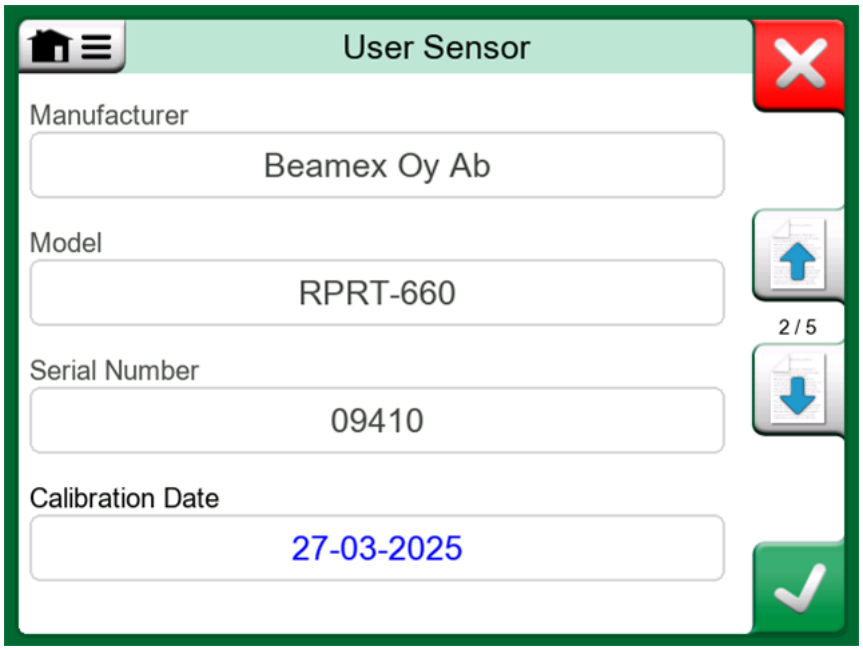


Figure 191: User Sensor configuration window, second page example

Using User Sensor

User Sensors are available for RTD Temperature input or output in any user interface mode. When a user sensor is in use, the sensor button shows a warning symbol (⚠) together with the name of the user sensor.

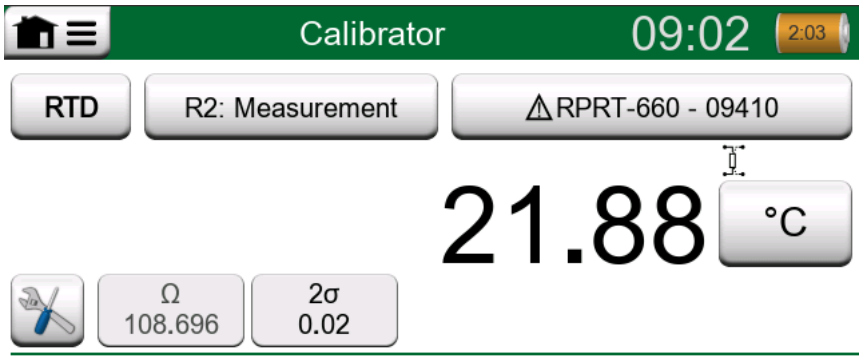


Figure 192: Example of a User Sensor in Calibrator mode

Note: Deleting a user sensor will stop any ongoing measurement, generation, or simulation that is using it.

Updating User Sensor Data

After the sensor has been recalibrated and the coefficients have changed, the User Sensor data saved in the calibrator needs to be updated. You can access Update mode the same way as when creating a new sensor. Update the coefficients according to the latest calibration certificate and save using the **Accept** button (✅). If a sensor has a built-in memory chip with updated correction coefficients from the calibration laboratory, these can be read directly from the sensor. Connect the sensor and press the **Settings** button in the pop-up window (which replaces the Create icon if the sensor is already stored). Confirm the values with the calibration certificate and save the updated data using the **Accept** button (✅).

Note: If calibration results for the User Sensor have been saved in the Documenting Calibrator and the correction coefficients are updated, the new coefficients will also apply to existing calibration results. Always transfer the results to the calibration management software or save them using other means before updating the sensor coefficients.

You can also edit sensor data directly in the calibrator and save it to the sensor's memory. This may be useful, for example,when recalibrating a sensor in a calibration laboratory that cannot write new coefficients to the sensor's memory. Attributes that can be updated include the calculation formula, correction coefficients, temperature range, and calibration date. Sensor name, manufacturer, model, and serial number cannot be changed.

After updating the User Sensor data, press the **Accept** button (✅) to save it. Any changes written to the sensor's memory must be confirmed with the calibrator's adjustment PIN code.

> **Note:** When a sensor is connected, saving the User Sensor data applies the updates to both the calibrator and the sensor. The calibrator will request the adjustment PIN code before saving.

Callendar-Van Dusen Formula

When you select **CvD RTD (R_0, A, B, C)** sensor calculation formula, you can configure the sensor's coefficients according to the Callendar–Van Dusen standard.

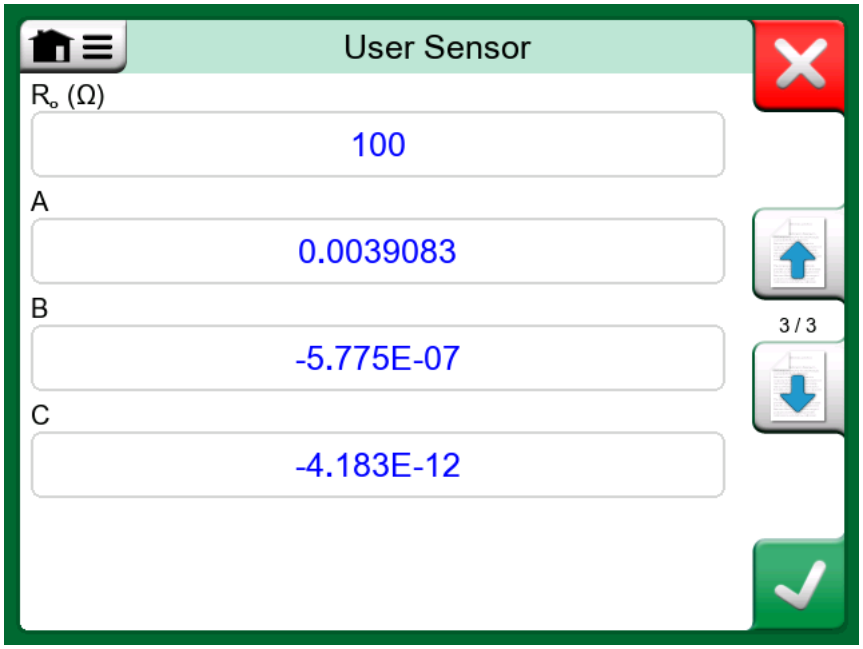


Figure 193: Constant and coefficients example for Callendar-Van Dusen

The Callendar-Van Dusen formula for PRTs can be defined using one of two equations, each with its own set of coefficients: A, B and C or α (alpha), δ (delta), and β (beta). In both cases, the R_0 constant is also required.

MC6-T supports only the equation using coefficients A, B and C only. If your PRT's calibration certificate provides coefficients α, δ and β, use the following equations to convert them to A, B and C:

$$A = \alpha \cdot \left(1 + \frac{\delta}{100}\right) \qquad B = \frac{-\alpha \cdot \delta}{10^4} \qquad C_{T<0} = \frac{-\alpha \cdot \beta}{10^8}$$

Figure 194: Callendar-Van Dusen – equations for converting coefficients

ITS-90

The ITS-90 (International Temperature Scale of 1990) is a standard used for high-accuracy temperature measurements and calibration of precision thermometers.

When you select the **ITS-90 PRT (R tpw,…)** sensor calculation formula, you can configure the sensor using the R tpw constant. You can also enter one or more deviation coefficients (a_x, b_x, …), where x typically ranges from 4 to 11, depending on the deviation formula used in the calibration.

If the x identifiers are missing from the coefficients in your calibration certificate, refer to the table below to identify which coefficients have been provided.

Note: The definitions of coefficient notations for the ITS-90 subranges are provided in the NIST Technical Note 1265, *Guidelines For Realizing the International Temperature Scale of 1990*.

Calibration ranges, corresponding coefficients and examples of calibration points:

Calibration Ranges(*	Corresponding Coefficients	Example of fixed calibration points(#, °C				
Negative (sub-)ranges:						
-189 … 0 °C	**a_4, b_4**	–189.3442,	–38.8344,	0.01		
-38 … 30 °C	**a_5, b_5(†**	–38.8344,	0.01,	29.7666		
Positive (sub-)ranges:						
0 … 30 °C	**a_{11}**	0.01,	29.7666			
-38 … 30 °C	**a_5, b_5(***	–38.8344,	0.01,	29.7666		
0 … 157 °C	**a_{10}**	0.01,	29.7666,	156.5985		
0 … 232 °C	**a_9, b_9**	0.01,	156.5985,	231.928		
0 … 420 °C	**a_8, b_8**	0.01,	231.928,	419.527		
0 … 660 °C	**a_7, b_7, c_7**	0.01,	231.928,	419.527,	660.323	
0 … 962 °C	**a_6, b_6, c_6, d**	0.01,	231.928,	419.527,	660.323,	961.78

*) The range limits in the list are rounded and displayed as they appear in the MC6-T user interface.

†) Subrange 5 appears twice because it must be entered separately for both negative and positive temperature ranges.

#) Not all calibration laboratories necessarily use the same reference points. The ones listed here are for guidance only.

Note: If your calibration certificate includes two sets of coefficients —one for zero current and another for 1 mA current—enter the latter one into the MC6-T calibrator.

When you select the ITS-90 PRT (R tpw,…) sensor calculation formula, the **Sensor Range** entered on the first configuration page determines how many additional **User Sensor** pages are added to the MC6-T. If the range includes temperatures below zero, the total number of configuration pages will be four:

- **The first page** contains the general settings.
- **The second page** is used to enter the **R tpw** constant value.
- **The third page** allows you to select the deviation formula for the negative temperature subrange and enter the corresponding coefficients (a_4 and b_4 or a_5 and b_5).
- **The fourth page** is for selecting the deviation formula for the positive temperature subrange and entering the relevant coefficients (a_5, a_6, a_7 … etc.).

Note: When the calibration does not include a negative subrange, the third page mentioned above is excluded, and the total number of configuration pages is three.

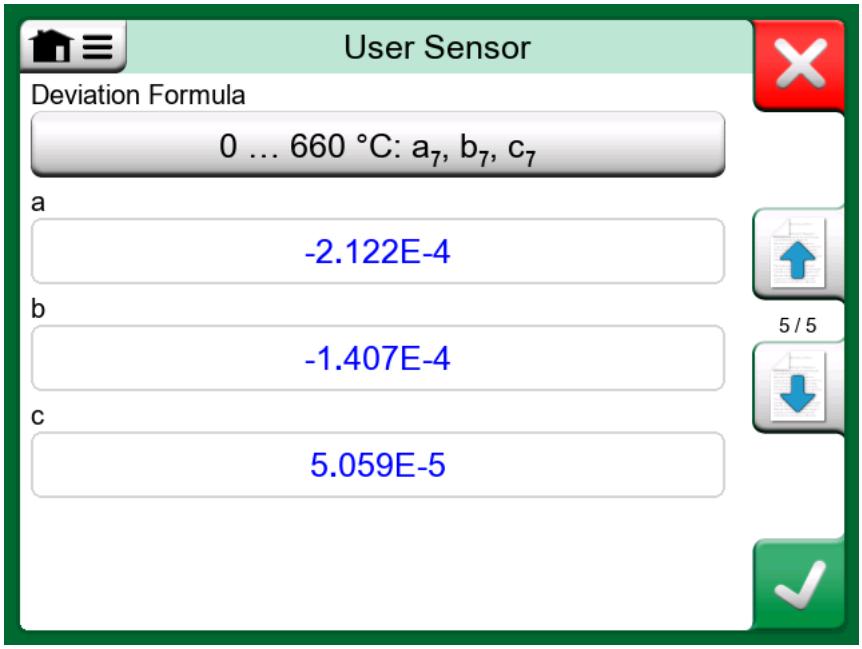


Figure 195: Coefficients example for ITS-90

Factor

The third method for customizing an RTD sensor (not just PRTs but all types of RTDs) is by using the **Factor**. This approach is suitable for sensors that show a consistent relative error across the entire span, effectively behaving as if there is an offset in their output.

To configure a User Sensor using the Factor, follow these steps:

1. Select a standard RTD **Sensor Type** from the available options.
2. Input a Factor that offsets the standard temperature curve to match your sensor's characteristics.
3. Use a simple reference example. One practical method is to select a standard RTD sensor with a resistance of 1 ohm at 0 °C, such as Pt1.
4. Enter your sensor’s actual resistance at 0 °C as the Factor value.

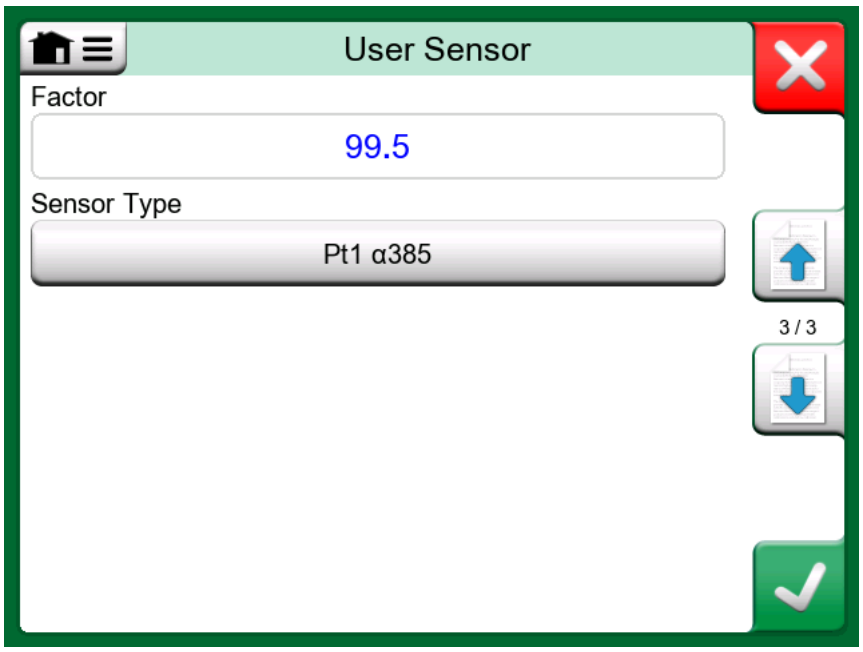


Figure 196: Configuration page example for Factor

Check Sensor Conversion

You can test sensors in the window that displays both pre-entered and custom RTD sensors.

To access **Check Sensor Conversion** feature, open the context-sensitive menu in the User Sensor configuration page.

The Figure 197: Check Sensor Conversion configuration page shows the first of the **Check Sensor Conversion** pages. This page allows you to select a sensor, choose the unit to be used, and test a single point. This feature is especially useful when you have entered coefficients for a custom sensor and want to verify that they were entered correctly.

To test, enter a temperature value from the calibration certificate and check whether the calculated resistance in the MC6-T matches the value on the certificate.

Enter, e.g. a temperature that is in the calibration certificate and check if the calculated resistance in MC6-T is the same as on the calibration certificate. If the values match, the coefficients have been entered correctly. If not, review and correct the coefficients you entered.

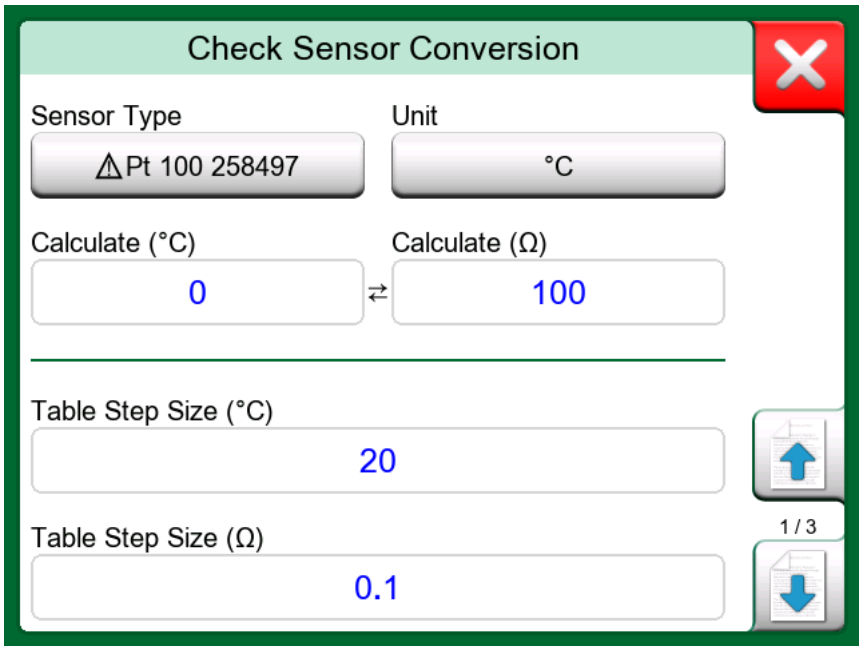


Figure 197: Check Sensor Conversion configuration page

The lower part of the first page allows you to define step sizes for the tables shown on the second and third pages. These tables display the correlation between temperature and resistance (and vice versa).

Short and Sanitary Sensor Calibration

The MC6-T150 is designed to accurately calibrate short and sanitary sensors. These types of sensors are often challenging to calibrate due to their short immersion depth and the presence of a flange for clamp-style installation.

The MC6-T150 is designed to support the calibration of flanged sensors. Its top cover includes slots for flexible reference sensor cables, allowing the sensor's flange to rest directly on the calibrator surface and enabling maximum immersion. Additionally, special inserts that are slightly longer than standard ones are available to reach the top surface of the calibrator. These inserts help increase both the immersion depth and the thermal contact between the sensor and the insert.

When calibrating a short sensor, it is strongly recommended to use a short external reference sensor with a flexible cable. This allows the reference sensor to be immersed to the same depth as the sanitary sensor being calibrated. An external reference sensor can measure the temperature more accurately at the top end of the insert, compared to the internal reference sensor, which is located at the bottom of the Temperature Block.

Note: Ensure that the stabilization time is long enough before accepting calibration points. Due to the short immersion depth of the sensor, the required stabilization time is longer than usual.

Carefully monitor the temperature readings, or use the **Point Delay** setting in the Documenting Calibrator mode to extend the delay time. A recommended delay of 30 minutes helps ensure that the readings have fully stabilized.

The illustration below shows the calibration of a short sensor with a flange. An external short reference sensor with a flexible cable is used, allowing it to fit under the sensor's flange.

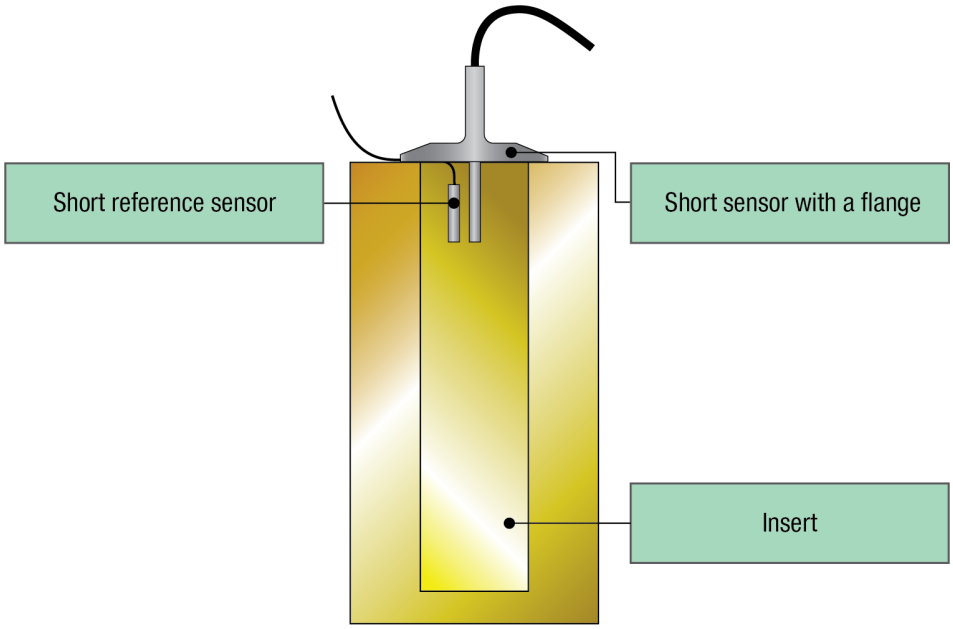


Figure 198: Short sensor calibration

For inserts and reference sensors used in calibrating short sensors, please contact Beamex.

Controller Communication

Using MC6-T together with a pressure controller or a temperature dry block enables fully automated calibration of various pressure and temperature instruments. Optional communication drivers are available for a range of Beamex and third-party pressure controllers and temperature dry blocks. For a complete list of available communication drivers, please contact Beamex.

To view the installed options on your calibrator navigate to **Settings** > **About**.

Enabling Communication with the Controller

The MC6-T does not automatically recognize an external controller. To pair the devices, you must configure the controller communication settings. Once the units are paired, communication is plug-and-play when connected to the calibrator. A maximum of four controllers can be assigned to Controller Presets channels.

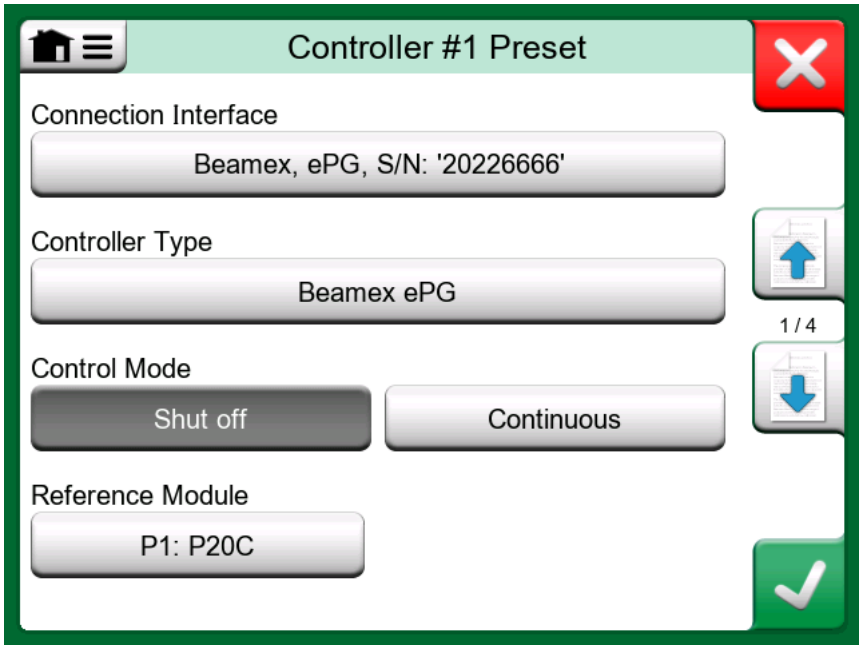


Figure 199: Controller Preset example

To set up the connection between the calibrator and the external controller:

1. Connect the devices using a suitable communication cable. Use any available USB-A port on the calibrator.
2. Power on both the calibrator and the controller.
3. From MC6-T **Home View**, go to **Settings** > **Controller Presets**.
4. Specify the following parameters:
   - **Connection Inferface**: Displays the connected controllers and their serial numbers. Select the unit you want to pair.
   - **Controller Type**: Choose the appropriate type for the connected controller. The list of options varies according to the controller drivers installed. Each communication driver is a separate option that must be purchased individually.
   - **Control Mode** (Shut off or Continuous): Determines whether pressure adjustment stops at the setpoint or continues after reaching it.

Once an external controller is connected and configured, it is also available in the MC6-T Port/Function selection when Pressure or Temperature is selected as the input quantity.

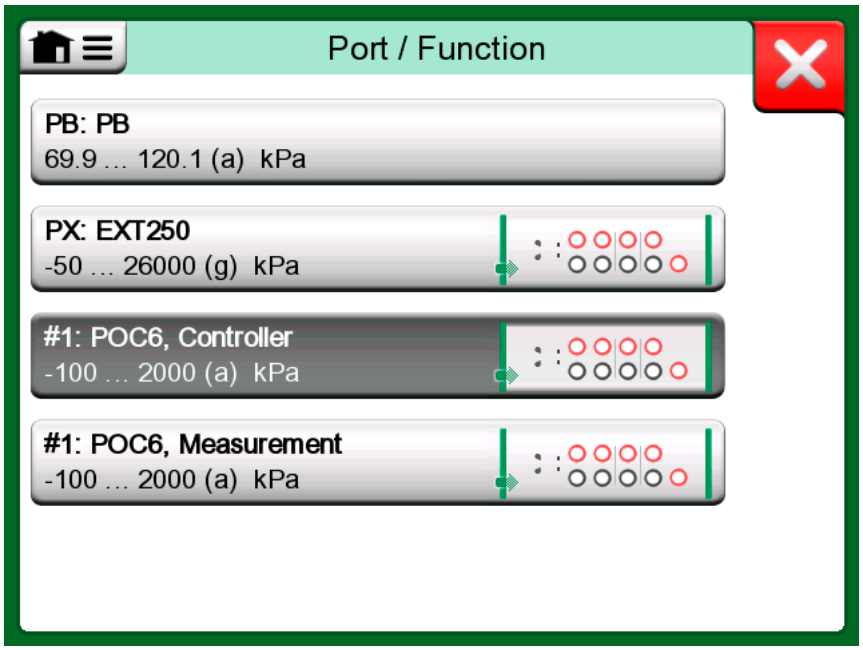


Figure 200: Pressure Port / Function list with controllers available

The context-sensitive menu in the **Controller Preset** window includes additional tools for configuring communication settings. The additional settings in the context-sensitive menu can be configured independently for each preset.

The Controller Preset context-sensitive menu also provides access to the **Communication Log**. In the Communication Log window, you can choose the log format: either text-format or binary-format.

Note: If you experience communication issues, check the communication settings of the connected controller. These settings may have been modified from the default values. The MC6-T calibrator always uses the default values of the controller.

Note: When connecting a Beamex FB or MB Temperature Dry Block, make sure both devices are powered on before connecting the communication cable and starting communication between them.

Calibration Methods with External Controllers

There are three alternative methods of using an external controller with the MC6-T calibrator:

- **Controlled and Measured** (full use)

  In Controller mode, the calibrator controls an external controller to set the calibration points, and the controller's internal measurement is used to measure the reference signal. Controllers without internal measurement capability, such as the Beamex ePG, cannot use this mode. For pressure controllers, select this mode with Quantity set to Pressure. For temperature dry blocks, select this mode with Quantity set to Temperature.

> **Note:** This method is available in the Temperature Calibrator, Calibrator, Documenting Calibrator, or Data Logger user interface modes. In CMX and LOGiCAL Calibration Management Software, it corresponds to selecting the Controlled and Measured Input method.

- **Controlled**

  In Controlled mode, the calibrator manages an external controller to set the calibration points, while the input signal generated is measured by the calibrator. The measurement channel is chosen in the Input Port / Function. For pressure controllers, select this mode with Quantity set to Pressure. For temperature dry blocks, select RTD Temperature or TC Temperature as the Quantity, depending on the reference measurement type.

> **Note:** This method is available only in the Documenting Calibrator mode. In CMX and LOGiCAL, it corresponds to selecting Controlled Input method.

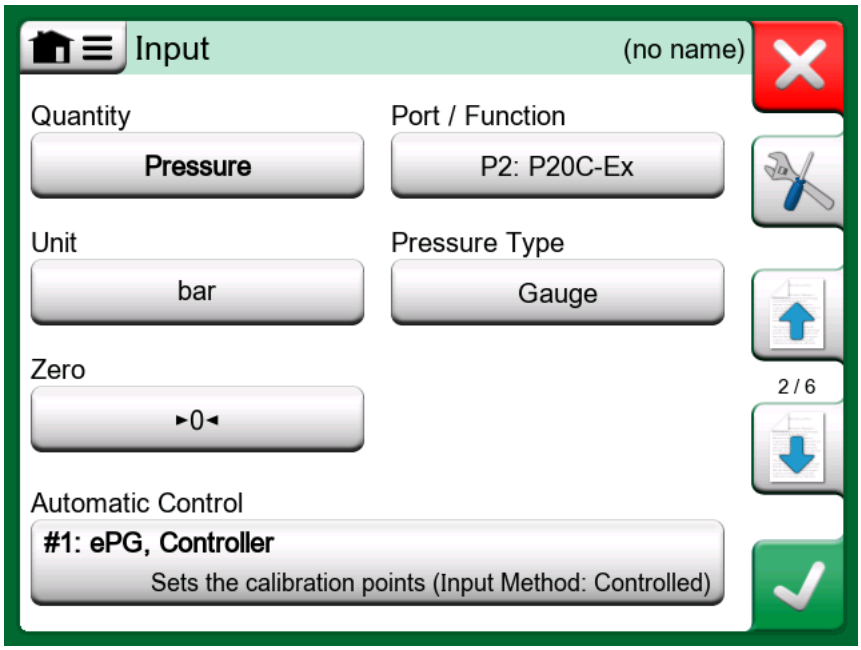


Figure 201: Instrument Input settings with Controlled method selected

- **Measured**

  In CMX and LOGiCAL, you can also choose Measured as the input method. When using this method for pressure or temperature quantities, the reference signal must be generated by an external source that the calibrator does not control, such as a hand pump for pressure or an ice bath for temperature.

Wireless Communication

The optional Wireless Communication feature enables Bluetooth data transfer between the MC6-T and Beamex Calibration Management Software. This functionality eliminates the need for USB cable, simplifying the communication.

Connect the Bluetooth adapter to the calibrator's USB-A port, enable Bluetooth communication in the calibrator's settings, and pair it with a PC. Data can then be transferred between the calibrator and the Beamex Sync client, the CMX Send/Receive window, or the CWSI client. For more information, see chapter Enabling Communication with a Client Device.

Detailed system requirements can be found in chapter Requirements.

Connection Security

Beamex Wireless Communication uses Bluetooth Low Energy (BLE) technology. We ensure security by authenticating the pairing process and

encrypting connections with 128-bit AES encryption. This setup aligns with Security Mode 1, Level 3, providing robust protection.

Requirements

For Wireless Communication to function, the following criteria must be met:

- ASUS USB Bluetooth adapter provided by Beamex

> **Note:** If the Beamex-provided ASUS USB Bluetooth adapter is not approved in your country, you may use a locally sourced micro Bluetooth adapter that meets the following requirements:
>
> - Supports Bluetooth Low Energy (BLE).
> - Compatible with Bluetooth 4.2 or higher.
> - Maximum height: 8 mm / 0.315".
> - Interface: USB-A.

> **Note:** It is recommended to use adapters from known manufacturers with all required approvals, such as CE/UKCA.

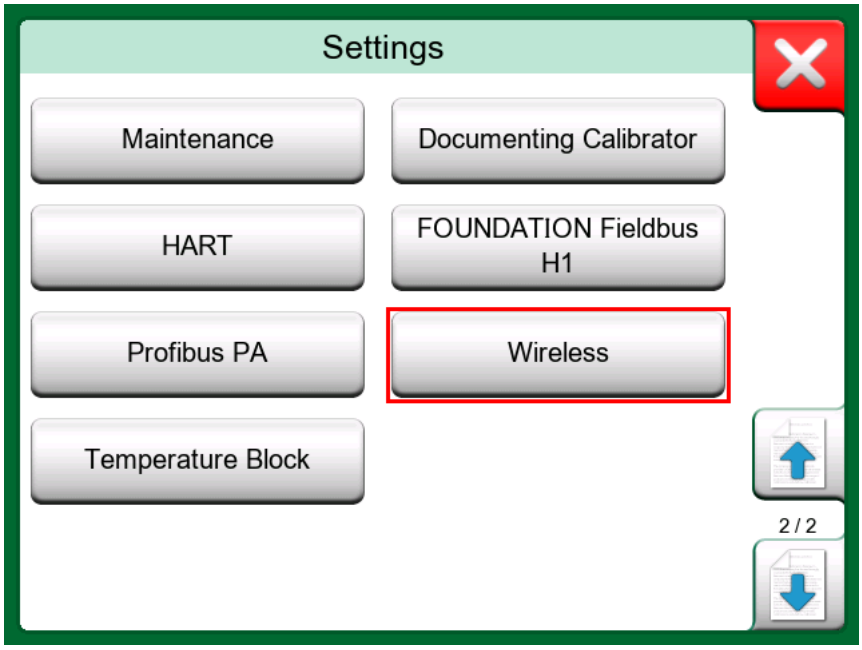
- Computer or Smart device with Bluetooth Low Energy and support for at least Bluetooth 4.2. From this point onward, referred to as the **Client device**.

> **Note:** CMX Calibration Management Software: Bluetooth is supported in version 2.15.1 or later.

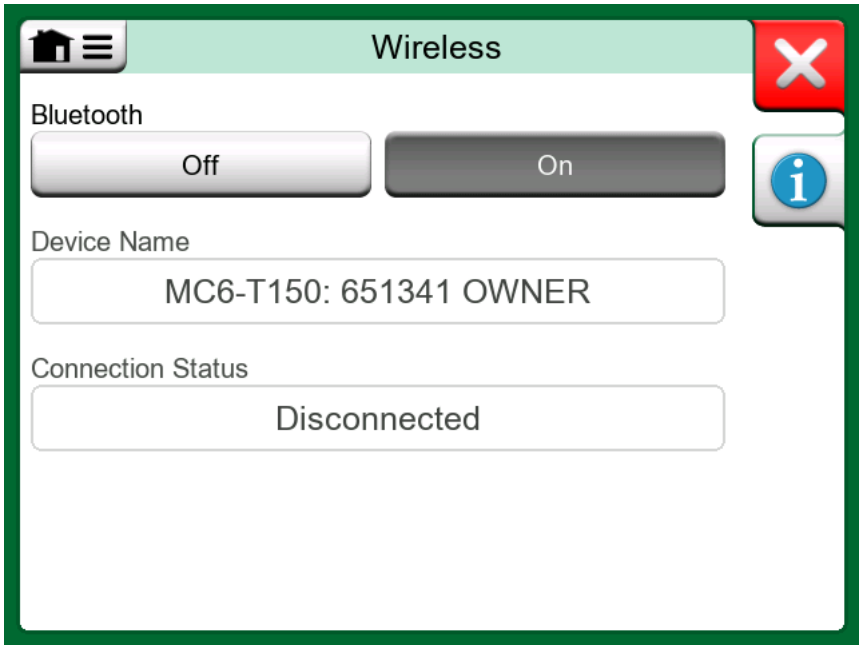
Enabling Communication with a Client Device

To enable Wireless Communication between an MC6-T calibrator and a Client device, you must first pair them. Follow the steps below to pair your MC6-T with the Client device:

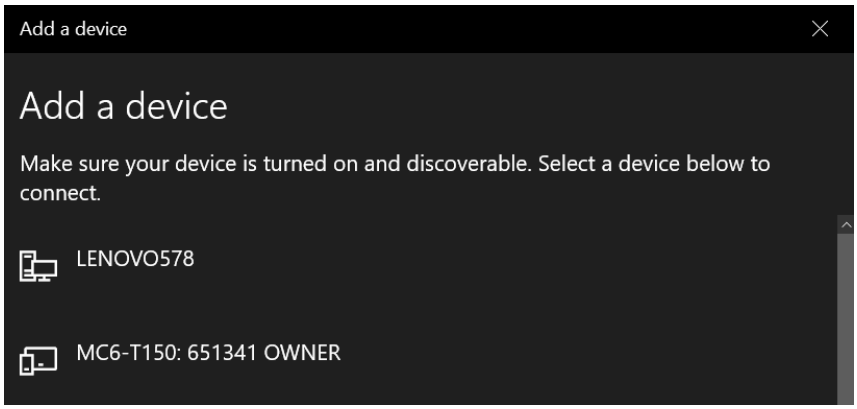
1. Plug the USB Bluetooth adapter into your MC6-T.
2. Go to **Home View** > **Settings** > **Wireless**. The Wireless button should be visible and accessible on the second page of the Settings. If it is not visible, check the Troubleshooting chapter.



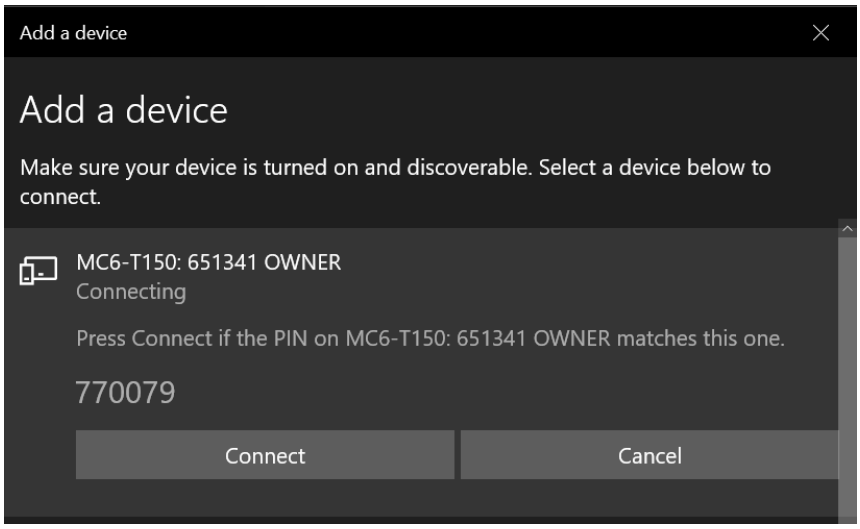
3. Turn Bluetooth on.



4. Search for available Bluetooth devices on the Client device.

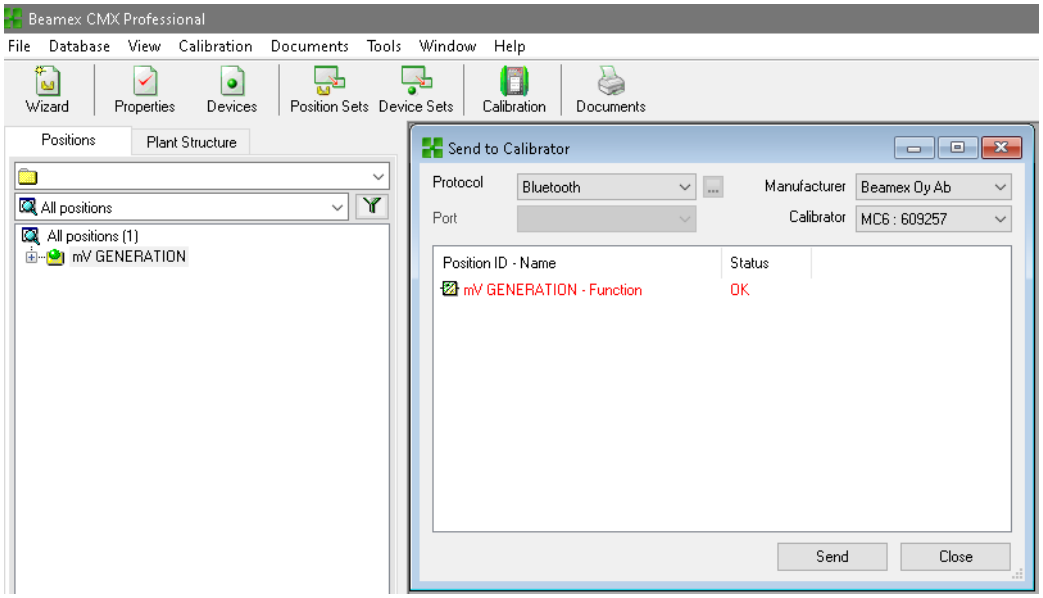


5. Select your calibrator.



6. Check that the passcode displayed on both the MC6-T and the Client device matches, then press **Pair** / **Connect**.

7. After successful pairing, your MC6-T will appear in the Beamex Calibration Management Software. See the example below (CMX Calibration Management Software).



Tip: If you need to swap the adapter between calibrator units, first unpair the USB Bluetooth adapter from both the calibrator and the Client device to enable new pairing. Note, that unpairing on the calibrator is only possible when Bluetooth is turned on.

Information Window

Wireless Communication Information window can be accessed by pressing the **Info** button ( ).

The Information window displays the main connection parameters, such as the host's and client's MAC addresses and names. For a detailed description and examples of these parameters, see the picture and the explanation table below.

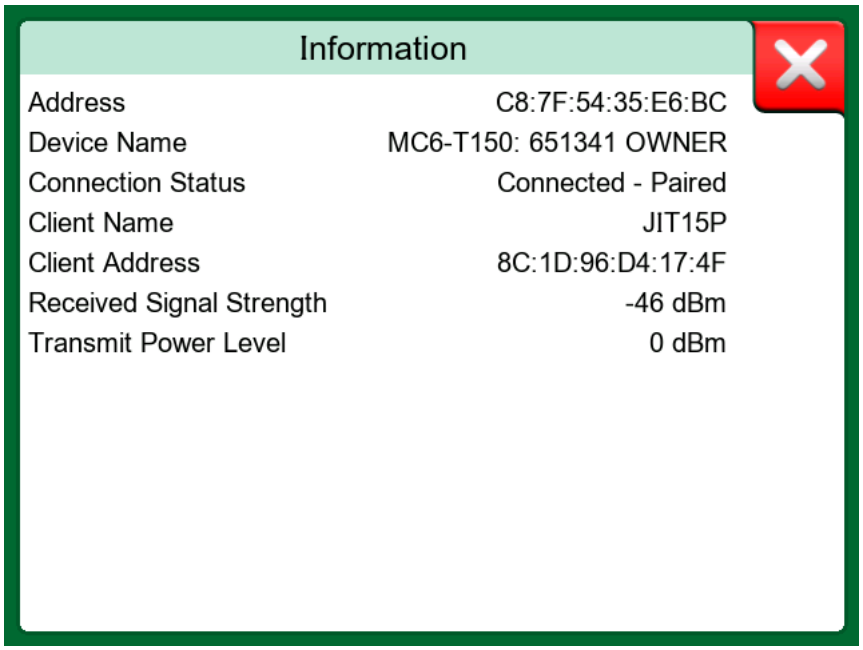


Figure 202: Information window example

Table 8: Information window - parameters and their descriptions

Address	MAC address of the host device
Name	Name of the host device, formatted as: "*Device model: Serial number Owner*"
State	Connection status as follows: • *Disconnected* – the devices are not connected • *Connected - not paired* – the devices are connected but not paired • *Connected - paired* – the devices are connected and successfully paired
Client Name	Name of the client device
Client Address	MAC address of the client device
Received Signal Strength	Strength of the received radio signal
Transmit Power Level	Level of transmit power, automatically controlled by the Bluetooth protocol

Troubleshooting

The Wireless button is greyed out.	
POSSIBLE REASON	SOLUTION
The Wireless Communication option has not been installed.	Contact Beamex Sales to request an upgrade.
No compatible Bluetooth adapter is present.	Check that the adapter meets the requirements, or insert a Beamex-recommended adapter.

It is not possible to pair or establish the connection.	
POSSIBLE REASON	SOLUTION
The USB Bluetooth adapter was swapped between different calibrators.	Unpair the USB Bluetooth adapter from both the calibrator and the Client device to enable new pairing. Note that unpairing on the calibrator is only possible when Bluetooth is turned on.

MC6-T is not discoverable, or the wireless connection process is not functioning correctly.	
POSSIBLE REASON	SOLUTION
	Turn Bluetooth off and then back on to potentially resolve the issue

Connection is lost.	
POSSIBLE REASON	SOLUTION
The environment is noisy.	Try changing the Connection setting to **Maximum Range** (see picture below). It offers lower speed but better coverage.
There is a long distance between Client device and the calibrator.	

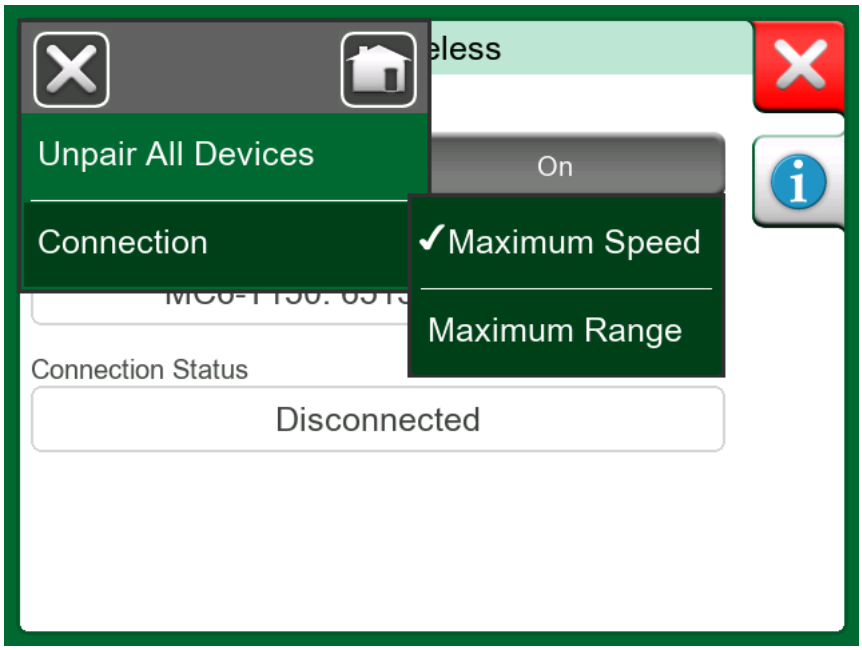


Figure 203: Connection, Maximum Range

Settings

The **Settings** user interface mode allows you to configure MC6-T according to your needs.

Figure 204: Home view, Settings user interface mode

The following settings are available for configuration:

- **Language** – Allows you to select the user interface language.
- **About** – Provides access to information such as the serial number, firmware version, installed modules and options.
- **Power Management** – Lets you define auto-off delays and adjust display brightness.
- **Sound Volumes** – Allows you to set volume levels for different sounds emitted by the calibrator.

- **Date & Time** – Lets you configure the date, time, time zone, and Daylight Saving Time.

> **Note:** If the Mobile Security Plus option is enabled, certain settings can only be changed with restrictions:
>
> - Changing Date & Time and Regional Settings requires admin credentials.
> - The default PIN code 2010 for changing module data is disabled, and a device-specific code must be used instead.
> - Factory reset cannot be performed.
>
> Additional details are available in chapter Mobile Security Plus Option.

> **Note:** The calibrator automatically synchronizes its date and time with the computer during communication with the calibration management software, ensuring correct time settings.

- **Regional Settings** – Used to define default values for the temperature unit and scale, set the local net frequency, and select the barometric pressure unit.

> **Note:** Changing Regional Settings requires reselecting the Port/ Function for the changes to take effect.

- **Owner** – Lets you enter owner information, which is displayed in the Home View.
- **Controller Presets** – Gives you access to preset configurations when controller communication option is installed. Further information can be found in chapter Controller Communication.
- **Maintenance** – Allows you to set the calibration date, update the firmware, align the touch screen, perform a factory reset, and delete usage data.

> **Note:** The PIN code for changing the module data is **2010**.
> The PIN code for MC6-T adjustment is device-specific and was provided with the MC6-T calibrator. More information is available in chapter Recalibrating and Adjusting MC6-T.

> **Note:** Use a stylus when aligning the touch screen.

- **Documenting Calibrator** – Contains settings related to instrument calibration, such as enabling “Save as Both,” which allows a single calibration run to be saved as both As Found and As Left.
- **HART**, **FOUNDATION Fieldbus H1** and **Profibus PA** – Provides access to settings for defining communication parameters of smart instruments. For further explanation and descriptions of the available parameters, refer to chapters Communicator and Working With Smart Instruments.
- **Wireless** – If enabled, allows you to turn on Bluetooth and check the Connection Status.
- **Temperature Block** - Opens a window for configuring how the heating and cooling is defined in the temperature block. This setting is also available in Temperature Calibrator menu.

Tip: You can **Recall Factory Settings** from the context-sensitive menu in several subsettings, such as Documenting Calibrator settings or HART settings.

Maintenance

Beamex calibrators are designed for long service life and to be as easy as possible to repair, maintain, and upgrade. The capabilities of the MC6-T can be expanded with software and hardware options. For available options, see chapters Software Options and Pressure Modules.

After purchasing a software option for an existing calibrator, Beamex will create and deliver an option file (.opt) to you. The software options can be installed using the free **MC6 Option Installer** PC tool, see section Available PC Tools. All hardware options must be installed by Beamex.

The **Beamex Care Plan** is the easiest way to maintain the accuracy and reliability of your MC6-T throughout its lifetime. It is a service contract that covers annual recalibration, repairs (including accidental damage), a simplified service return process, and more. For details, visit the https://www.beamex.com/services/service-plans/.

Warning: Repair of the MC6-T must only be performed by an authorized partner. There are no user-replaceable parts within the calibrator, except the battery pack that has its own compartment on the back side of the calibrator. Do not open the enclosure!

Accessories and spare parts, such as chargers, cases, and communication cables, can be ordered from the Beamex Webshop.

Caution: When replacing the Mains cord, make sure it has the correct rating and type and includes a protective earth connection.

Warning: Before performing any maintenance, switch off the Mains switch and disconnect the Mains cord. Detach the remaining cables as well.

Caution: If an item is dropped inside the calibrator, switch off the Mains switch and disconnect the Mains cord immediately. The item must then be removed by an authorized person.

Cleaning Instructions

Warning: Disconnect the Mains cord and switch off the Mains switch before performing any cleaning. Ensure the device is completely dry before using it again.

Note: Before using any cleaning or decontamination method not officially recommended by Beamex, consult an authorised service centre to ensure the method will not damage the equipment.

If MC6-T requires cleaning, use a cloth soaked in a mild solution of tall oil soap (pine soap) or a common liquid dish soap. After wiping, wait a few minutes before cleaning the surface again with a cloth dampened with clean water. Never use strong detergents.

Note: To clean the display, use a microfiber cloth. If needed, apply a mild detergent and remove it thoroughly afterwards.

Caution: Isopropanol-based cleaning spray is not recommended for cleaning the MC6-T, as it may damage the surfaces. However, it can be used to clean the pressure connectors.

Special Instructions for Cleaning the Inserts and Inside of the Temperature Block

Due to the high operating temperatures of the Temperature Block, inserts should be removed after each use and gently buffed with a Scotch-Brite® pad or emery cloth. Ensure no textile fibers remain on the insert or the Temperature Block surface.

Oxidation on the outer surface of the insert may cause it to become jammed in the Temperature Block boring. To prevent this, periodically clean the inserts with an abrasive pad or fine sandpaper (grit 400 or higher).

In case of oil contamination, the Temperature Block boring and insert borings can be cleaned using a mild alcohol-based solvent.

Warning: Do not allow any liquid to enter the connectors, Mains switch, or mains inlet socket! If any liquid enters the device, discontinue use and contact Beamex, as safe operation can no longer be guaranteed.

Firmware Update

Beamex products are constantly evolving. Firmware updates are regularly published to introduce new features and enhance performance.

Note: To check the current firmware version of your calibrator go to **Settings** > **About** and compare it with the latest release to see whether an update is required.

Firmware update files and instruction can be found under the Resources tab on the MC6-T page on the Beamex website. Save the firmware update file to a USB flash drive, then install it on the calibrator.

The calibrator firmware can be updated through the user interface by navigating to **Settings** > **Maintenance** > **Update Firmware**.

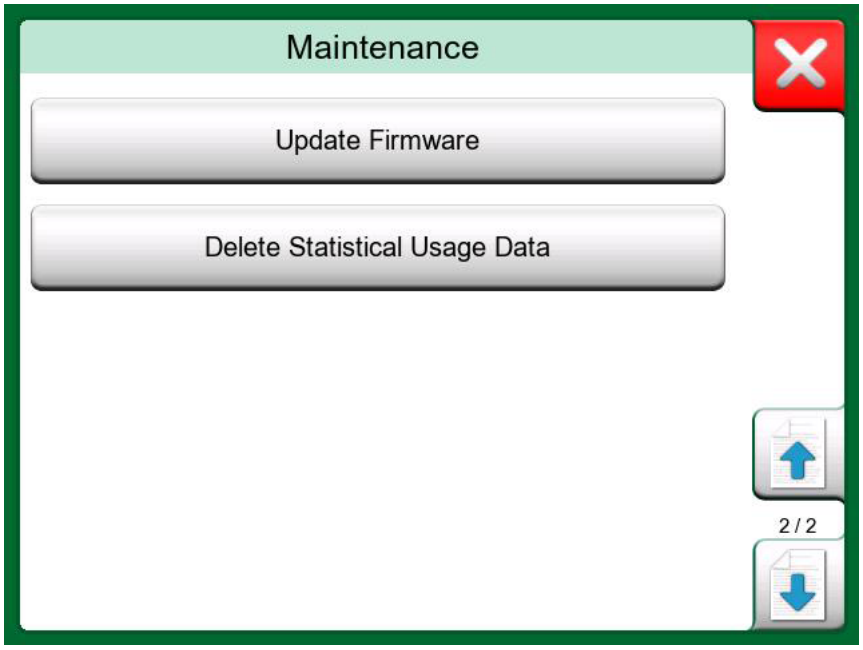


Figure 205: Update Firmware button in Settings user interface mode

Note: Updating the firmware does not erase the time, date, or any user-entered data (such as instruments, calibration results, or data logs).

Teaching the Battery

To ensure accurate battery readings, the calibrator must undergo a full battery cycle — this means charging it to 100%, discharging it completely to 0%, and then charging it back to 100% again without interruptions.

If the calibrator does not go through a full charge-discharge cycle, it may display incorrect capacity and charge level information.

To restore accurate readings, complete a full battery cycle, then teach the calibrator the new battery capacity by following these steps:

Note: Make sure the calibrator is powered on and running on battery power. Charger must not be connected. Make sure the calibrator is powered on and that the Main switch is turned off.

1. Go to **Settings** > **Power Management** and set the **Calibrator Auto-off Delay** value to 0.
2. Wait until the unit powers down due to an empty battery pack.
3. Charge the battery pack by switching the Main switch on.
4. Allow the battery pack to fully charge without interruptions. A plug icon ( ) will appear on the display when charging is complete.

Note: If the battery is replaced by Beamex service, the teaching cycle is not required.

Replacing the Mains Fuses

To replace the mains fuses, follow the steps below:

1. Switch off the device using the Mains switch, then unplug the Mains cord.

Warning: To guarantee safety, always disconnect the Mains cord to fully eliminate Mains Voltage from the device.

2. Remove the fuse holder caps. Since the caps are spring-loaded, use a screwdriver press gently and rotate them 30° counter-clockwise to release.
3. Ensure that the replacement fuses have the correct rating and type for the applicable mains voltage region. Refer to the sticker above the fuse holder for specifications.

Warning: Using fuses of an incorrect type may result in a safety hazard.

4. After replacing the fuses, securely reattach the fuse holder caps.
5. Connect the Mains cord and switch on the Mains switch. If the fuse blows again, first confirm that the correct fuse type was used. If the fuse is correct and the issue persists, contact an authorized service center for further instructions.

Suitable replacement fuses are available in the Beamex Webshop.

Overtemperature Protection Test Mode

The MC6-T is equipped with an additional safety mechanism called **Overtemperature Protection Test Mode**. This feature allows you to verify that power is disconnected from the Temperature Block if it exceeds the maximum setpoint temperature.

To enter **Overtemperature Protection Test mode**, go to **Settings** user interface mode and tap the **Maintenance** button. Then select the **Change module data** option and enter the required PIN code: **5656**. Test mode is activated once the changes are confirmed.

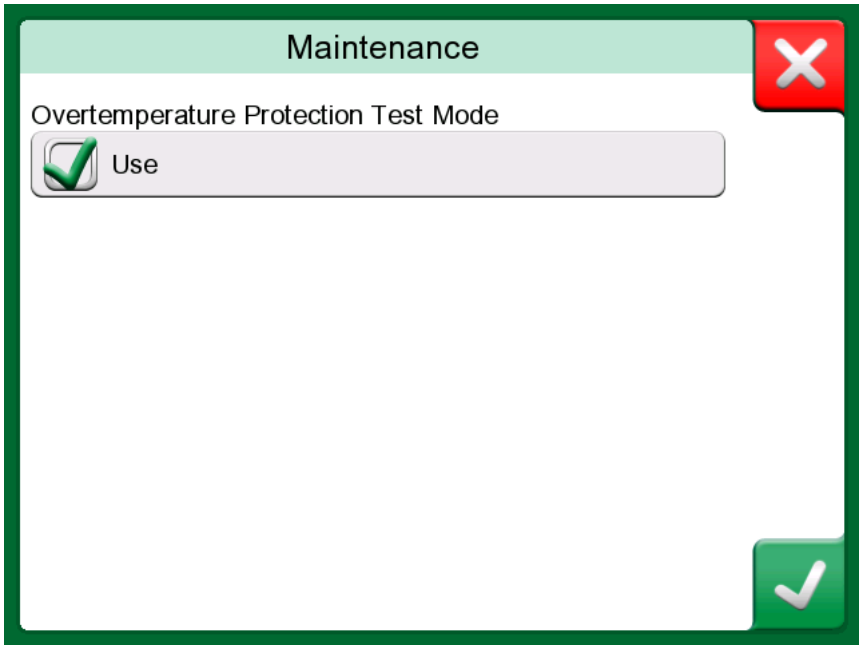


Figure 206: Overtemperature Protection Test Mode window

To test the feature, set the temperature generation to the maximum setpoint supported by your model. If the protective mechanism functions correctly, a message will appear as shown in the image below.

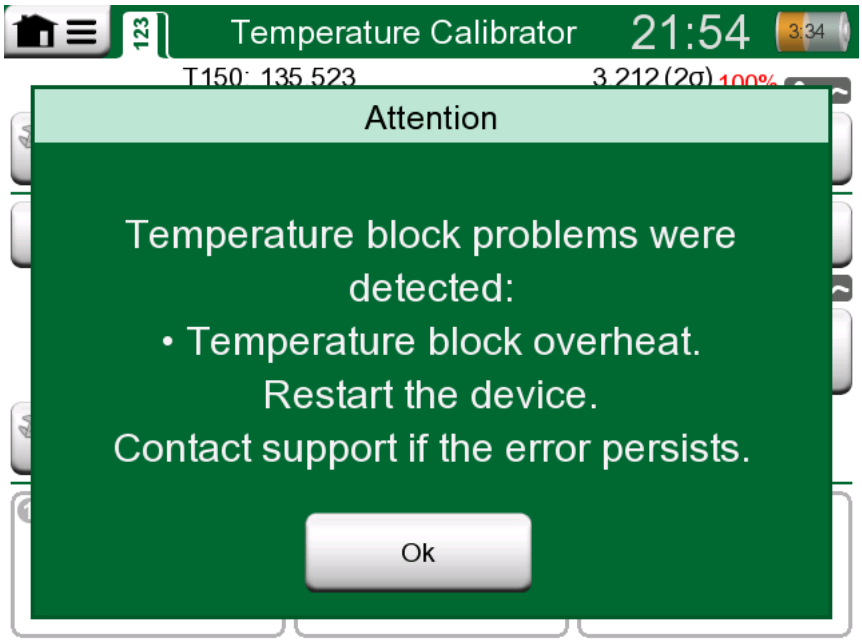


Figure 207: Overtemperature Protection Test Mode prompt message

The power will be disconnected from the Temperature Block, and the device will begin cooling. To clear the error and return to standard mode, turn the Mains switch off and then back on.

Caution: If the maximum setpoint temperature stabilizes without displaying an error message, contact Beamex. Safe operation of the MC6-T can no longer be guaranteed.

Recalibrating and Adjusting MC6-T

Recalibrating the Calibrator

As with any test and measurement device, the MC6-T must be recalibrated at regular intervals. Beamex recommends annual recalibrations to maintain optimal accuracy and reliability throughout the calibrator's lifetime.

The MC6-T is a high-accuracy instrument and should only be recalibrated at laboratories capable of ensuring low measurement uncertainty. It is strongly recommended to use an ISO 17025-accredited laboratory with a certified quality management system. Recalibration through Beamex or a Beamex-authorized service center ensures the calibrator is cleaned, fully tested, updated with

the latest firmware, and recalibrated in a facility that meets the calibrator's specifications.

Note: If the calibrator is used in higly contaminated environments or the Temperature Block becomes contaminated, it must be sent for recalibration, as its thermal properties may be affected.

Before sending any equipment for recalibration or repair, submit a service or quotation request through the Beamex Service Portal at https://services.beamex.com.

Calibration and Adjustment Instructions

Detailed MC6-T calibration and adjustment instructions are available for calibration laboratories. To request access, please submit a support request at https://support.beamex.com. Beamex will verify the request before providing the instructions.

Changing Calibration Date and Interval

To change the calibration date and interval of the calibrator or its modules, go to **Settings** > **Maintenance** > **Change Module Data**. When prompted, enter the PIN code **2010**.

Once the correct PIN is entered, the **Change Module Data** window opens, allowing you to edit the calibration dates and intervals for all built-in modules and connected EXT External Pressure Modules.

Tip: To reset the recalibration notification, set a new calibration date or extend the calibration interval.

Note: If the **Mobile Security Plus** option is installed, the default PIN code **2010** is disabled. Use the unit-specific PIN code provided with the calibrator.

Adjusting the Calibrator

A calibration laboratory can adjust the calibrator modules by navigating to **Settings** > **Maintenance** > **Adjust Calibrator**. A PIN code entry window will

appear. The adjustment PIN code is unit-specific and was shipped with your calibrator.

If the adjustment PIN is lost:

1. Submit a support request to Beamex at https://support.beamex.com.
2. Provide your calibrator's serial number and be prepared to verify your identity and ownership of the unit.
3. Beamex will perform the necessary verifications before providing the PIN code.

Preparing the MC6-T for Service Returns

If you need to return the unit to the factory for any reason, contact Beamex first. Submit a service or quotation request through the Service Portal at https://services.beamex.com.

Before shipping your calibrator, review the instructions for service returns and Beamex policy on shipping equipment with Lithium-ion (Li-ion) batteries at https://www.beamex.com/services/service-returns/.

Note: Always check and follow all local regulations for shipping equipment with Lithium-ion (Li-ion) batteries.

Note: Do not ship equipment to Beamex without prior notice. Always contact Beamex first.

Note: Beamex recommends downloading and removing all saved calibration results from the MC6-T before shipping. Use calibration management software to store your results permanently.

Place the MC6-T in its original packaging as received upon delivery from Beamex. If the original packaging is not available, use 40 mm softeners on all sides to ensure safe delivery.

Special Instructions for Transporting MC6-T Units for Service

Caution: MC6-T units under a service plan must be returned in the Beamex transport case for MC6-T and packed according to instructions attached to the lid of the transport case.

If your unit is equipped with the **Accessory holder**, use the **Back transport support** during transportation to protect the rear structures of the device. Slide

the Back transport support into the Accessory holder as shown in the picture below.

Note: Before sending the unit for service, make sure to remove the insert from the Temperature Block and all accessories from the Accessory holder.

Figure 208: Back transport support secured in place for safe transport

The MC6-T660 model is equipped with a **Transport tap**, as shown in the picture below, which must be used when sending the calibrator for service. It helps prevent damage to the Temperature Block that could occur during transportation under extreme conditions.

Figure 209: MC6-T660 Transport tap

If you are using another service provider, follow Beamex packing instructions for service returns.

Resetting the Calibrator

There are two types of resets:

- **Reset/Restart**: Used if the calibrator becomes unresponsive. This reset does not erase any user-entered data.
- **Factory Reset**: Restores the calibrator to its original factory state. This reset erases all user-entered data, and the deleted data cannot be recovered.

To reset or restart the calibrator, press and hold the **Home** and **Enter** keys at the same time for 7 seconds.

Note: Resetting/restarting the MC6-T does not erase the time, date, or any user-entered data (such as instruments, calibration results, or data logs). Only the main processor is reset. However, any open files may be lost.

To perform a Factory Reset, navigate to **Settings** > **Maintenance** > **Change Module Data** and enter the PIN code **926535**.

Note: Factory reset erases all user-entered data (such as instruments, calibration results, or data logs), and the deleted data cannot be recovered. Factory reset does not erase installed firmware updates, software options, or Device Descriptions.

Caution: Deleted data cannot be recovered.

Note: A factory reset causes the touch screen alignment to break (alignment becomes mirrored). To re-adjust the touch screen navigate to **Settings** > **Maintenance** > **Touch Screen Alignment** and follow the on-screen tapping instructions.

Note: Factory reset cannot be performed if the calibrator has Mobile Security Plus option installed.

Disposing of Waste Electrical and Electronic Equipment

Sustainability is a core component of the Beamex design philosophy. We want our customers to continue using their Beamex products for many years, so they are designed to have a long service life and to be as easy as possible to repair, maintain, and upgrade. This supports the circular economy and conserves valuable natural resources. The environmental management system used at Beamex is ISO 14001:2015 certified.

In the European Union (EU) and other regions with separate collection systems, waste electrical and electronic equipment (WEEE) is subject to specific regulations.

The **EU WEEE Directive 2012/19/EU** requires producers of electronic equipment to take responsibility for the collection, reuse, recycling, and proper treatment of WEEE placed on the EU market after August 13, 2005.

The directive aims to:

- Preserve, protect, and improve the quality of the environment
- Safeguard human health
- Conserve natural resources

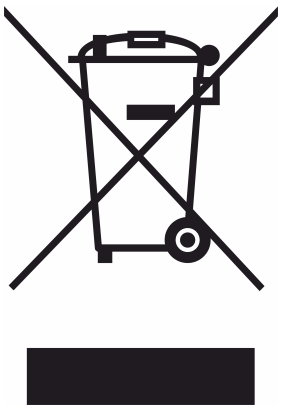


Figure 210: Symbol for recycling of electrical and electronic equipment

The symbol presented in the figure above is engraved on the back of the product. It indicates that the product must be taken to an appropriate collection point for the recycling of electrical and electronic equipment.

By returning your calibrator to Beamex for recycling, you can ensure the calibrator is recycled in an environmentally safe and secure manner. The dismantle and disposal process is handled according to Beamex ISO 14001 Environmental management system. Beamex will provide a Certificate of Recycling that certifies that you are released from liability for materials.

For more detailed information about recycling this product, please contact Beamex or waste disposal service provider.

Statements

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The Beamex MC6-T contains licensed software which requires that its source code is available for you. Please contact Beamex to obtain it.

The Beamex MC6-T is based in part on the FLTK project (http://www.fltk.org).

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