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6109A/7109A

Portable Calibration Baths

Operators Manual

January 2017

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Introduction

The Fluke Calibration 7109A and 6109A Portable Calibration Baths (the Product) accurately calibrate a variety of temperature sensors. The bath fluid volume is large enough to immerse up to four 38 mm (1.5 inch) flanged tri-clamp probes and a reference thermometer. The 7109A tests the temperature range of -25 °C to 140 °C. The 6109A covers the temperature range of 35 °C to 250 °C. Traceable NVLAP accredited calibration is included. Models that equipped with the Input Module can also measure an RTD, thermocouple, or 4-20 mA transmitter and a reference PRT. This functionality makes the Product a complete calibration solution.

Safety Information

A Warning identifies conditions and procedures that are dangerous to the user. A Caution identifies conditions and procedures that can cause damage to the Product or the equipment under test.

Warning











To prevent possible electrical shock, fire, or personal injury:

- Read all safety information before you use the Product.
- Do not keep the Product in operation and unattended at high temperatures.
- Use the Product only as specified, or the protection supplied by the Product can be compromised.
- Turn the Product off and remove the mains power cord. Stop for two minutes to let the power assemblies discharge before you open the fuse door.
- Replace a blown fuse with exact replacement only for continued protection against arc flash.
- Use only specified replacement fuses.
- Use only specified replacement parts.
- Disconnect the mains power cord before you remove the Product covers.
- Disable the Product if it is damaged.
- Do not use the Product if it is altered or damaged.
- Do not heat bath fluid above its flash point unless it is necessary, approved, and handled safely. The bath fluid or its vapor may be flammable.
- Connect an approved three-conductor mains power cord to a grounded power outlet.
- Use this Product indoors only.
- Do not use a two-conductor mains power cord unless you install a protective ground wire to the Product ground terminal before you operate the Product. Make sure that the Product is grounded before use.
- Do not touch parts of the Product that can be hot, including the area around the tank, the bath fluid, the overflow tube, overflow tank, and drain tube.
- Refer to the bath fluid and solvent's safety data sheets (SDS) as these may require additional safety precautions.
- Do not spill bath fluid on the floor. Spilled bath fluid creates a safety hazard.

Symbols

The symbols used in this manual and on the Product are shown in Table 1.

Table 1. Symbols

Symbol	Description
	WARNING. HAZARDOUS VOLTAGE. Risk of electric shock.
	WARNING. RISK OF DANGER.
	WARNING. HOT SURFACE. Risk of burns.
	Consult user documentation.
	Certified by CSA Group to North American safety standards.
	Conforms to European Union directives.
	Conforms to relevant Australian EMC standards.
	Fuse
	Conforms to relevant South Korean EMC Standards.
	This product complies with the WEEE Directive marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as category 9 "Monitoring and Control Instrumentation" product. Do not dispose of this product as unsorted municipal waste.

Specifications

The product specifications describe the Absolute Instrumental Uncertainty of the Product at 95 % level of confidence (coverage factor $k = 2$) within one year from calibration. The product specifications include environmental temperature effects from 13 °C to 33 °C.

Temperature Source Specifications

	6109A	7109A
Range (at 25 °C ambient temperature)	35 °C to 250 °C	-25 °C to 140 °C (-15 °C cover off)
Accuracy: Maximum Permissible Error	0.1 °C	0.1 °C
Stability	0.015 °C	0.01 °C
Typical Uniformity	0.03 °C up to 200 °C 0.04 °C above 200 °C	0.02 °C
Repeatability	0.04 °C	0.04 °C
Typical Heating Time	35 °C to 100 °C: 25 minutes 100 °C to 250 °C: 45 minutes	25 °C to 140 °C: 55 minutes -25 °C to 25 °C: 35 minutes
Typical Cooling Time	250 °C to 100 °C: 35 minutes 100 °C to 35 °C: 55 minutes	25 °C to -25 °C: 75 minutes 140 °C to 25 °C: 45 minutes
Typical Settling Time	15 minutes	10 minutes
<p>Notes:</p> <ul style="list-style-type: none"> The lower limit of the Temperature Range varies depending on the ambient temperature and whether the tank is covered. Operating time at negative temperatures may be limited by water condensation or ice build-up, especially if the tank is open. Accuracy covers all sources of error including calibration uncertainty, stability, uniformity, and repeatability. If the environment temperature is outside the Performance Environment Range but within the Operating Environment Range, multiply the specification by 1.25. Temperature Stability and Temperature Uniformity apply with the tank covered. If the Product is operated with the tank open, multiply the specifications by 1.25. Specifications are valid with fluid depth at least 130 mm and within the working volume defined as a 75 mm square centered in the tank opening from 15 mm above the bottom of the tank to 65 mm below the surface of the fluid. The specifications also apply with the recommended fluid in good condition. Results may vary if a different fluid is used. Temperature Stability is evaluated as two times the statistical standard deviation of the fluid temperature (2 sigma) during a 15-minute period after sufficient settling time is allowed. Temperature Uniformity is defined as half the difference between the maximum and minimum temperatures within the working volume. Repeatability includes hysteresis of the control sensor. It is defined as the difference between the maximum and minimum observed temperatures at a setpoint near the middle of the Product Temperature Range after that setpoint is alternately reached from both extremes of the Temperature Range. Cooling or heating time is measured from the time the setpoint is changed to when the fluid temperature reaches the setpoint within the Temperature Accuracy specification. Cooling and heating times vary depending on environment temperature, AC supply voltage, loading, and whether the tank is covered. At low ac supply voltages, heating time may be much longer. Settling time is measured from the end of the cooling or heating time to the time at which the fluid reaches its ultimate mean temperature within a tolerance equal to the Temperature Stability specification. 		

Input Module Option Specifications

The Product specifications describe the Absolute Instrumental Uncertainty of the Product at 95 % level of confidence (coverage factor $k = 2$) within one year from calibration. The Input Module specifications include calibration uncertainty, linearity, repeatability, resolution, stability, and environmental temperature effects from 13 °C to 33 °C.

Function	Range	Accuracy: Maximum Permissible Error
Reference Input Resistance	0 Ω to 42 Ω	0.0025 Ω
	42 Ω to 400 Ω	0.006 %
Reference Input Temperature	-25 °C to 250 °C	0.007 % + 0.015 °C
Resistance Sensing Current	1 mA	8 %
DUT 4-wire Resistance	0 Ω to 31 Ω	0.0025 Ω
	31 Ω to 400 Ω	0.008 %
DUT 3-wire Resistance Accuracy	0 Ω to 400 Ω	0.12 Ω
Thermocouple mV	-10 mV to 100 mV	0.025 % + 0.01 mV
Reference Junction Temperature	0 °C to 40 °C	0.35 °C
Thermocouple Temperature	-25 °C to 250 °C	J: 0.44 °C K: 0.49 °C T: 0.53 °C E: 0.44 °C N: 0.57 °C M: 0.48 °C L: 0.42 °C U: 0.48 °C
	0 °C to 250 °C	R: 1.92 °C S: 1.88 °C C: 0.84 °C D: 1.12 °C G/W: 3.34 °C
mA	0 mA to 22 mA	0.02 % + 0.002 mA
Notes <ul style="list-style-type: none"> • Specifications stated in percent are percent of reading. • If the environment temperature is outside the Performance Environment Range but within the Operating Environment Range, multiply the accuracy specifications by 1.5. • Reference Input Temperature Accuracy assumes a 4-wire, 100 Ω, $\alpha = 0.00392$ PRT. The specification does not include accuracy of the thermometer (see Table 4 of this manual). • DUT Input Resistance Accuracy specification for 2-wire sensors is 0.05 Ω plus lead wire resistance. • Thermocouple Input Temperature Accuracy specification includes Thermocouple Input mV and Reference Junction Temperature, combined using the root-sum-square method. The specification does not include the accuracy of the thermocouple. 		

General Specifications

Performance Environment Range.....	13 °C to 33 °C 5 % to 90 % (non-condensing)
Operating Environment Range	0 °C to 40 °C 5 % to 90 % (non-condensing)
Maximum Operating Altitude	2000 m (6600 ft)
Storage Range	-40 °C to 70 °C 5 % to 95 % (non-condensing)
Supply Voltage	115 V nominal: 100 V to 120 V ac (±10 %), 50 Hz or 60 Hz 230 V nominal: 200 V to 230 V ac (±10 %), 50 Hz or 60 Hz 1150 W
Fuses.....	115 V nominal: 10 A, 250 V 3AG slow 230 V nominal: 5 A, 250 V 5x20 slow
4-20 mA Input Loop Power Voltage	24 V dc ±6 V
4-20 mA Fuse	0.05 A, 250 V 5x20 fast
Size ^[1]	Height: 382 mm (15 in) Width: 242 mm (9.5 in) Depth: 400 mm (15.7 in)
Weight ^[2]	7109A: 20 kg (45 lb) 6109A: 16 kg (35 lb)
Fluid Volume.....	2.5 liters (0.66 gal)
Fluid Working Area	75 mm x 75 mm (3 in x 3 in)
Maximum Fluid Depth.....	154 mm
Remote Interface	RS-232 port, 1200 to 38400 baud USB 2.0 device port USB 2.0 host port (for data recording)
Compliance.....	EN 61010-1 (2010), category II, degree 2 IEC 61326-1, basic RoHS SCPI 1999.0

Notes

- [1] Size does not include the optional overflow kit or other attached accessories.
- [2] Weight does not include bath fluid or accessories.

Unpack the Product

Carefully unpack the Product. Save the shipping carton for later use in case the Product needs to be shipped or moved to another facility. Make sure that there is no damage to the Product. If any parts are damaged, contact Fluke Calibration. If it is necessary to reship the Product, use the original container. To order a new container, see *Contact Fluke Calibration*.

Warning

To prevent possible electrical shock, fire, or personal injury:

- **Disable the Product if it is damaged.**
- **Do not use the Product if it is damaged or altered.**

Check that all items listed below are present and have no visible damage.

- The Product
- Mains power cord (see Figure 6)
- USB cable
- Probe access cover
- Transport tank cover
- Printed safety information
- Product CD
- Report of calibration with label
- Clamp-on ferrite (-P models)
- Din connector (-P models)
- Test lead kit (-P models)

The Product CD contains:

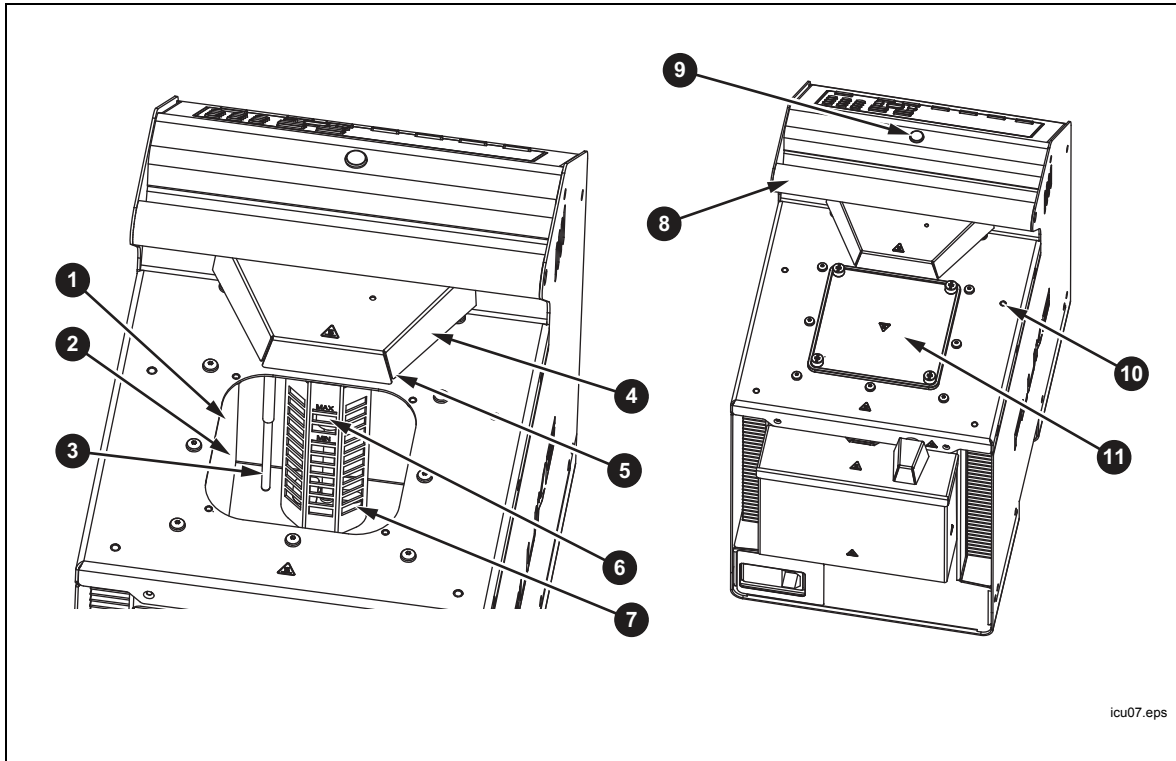
- Operators manual in multiple languages
- USB driver
- Software distribution licenses
- Source code for public-domain software

Product Overview

This section is a reference for the Product features, parts, and user interface (UI).

Top

The Product top and tank are shown in Figure 1.



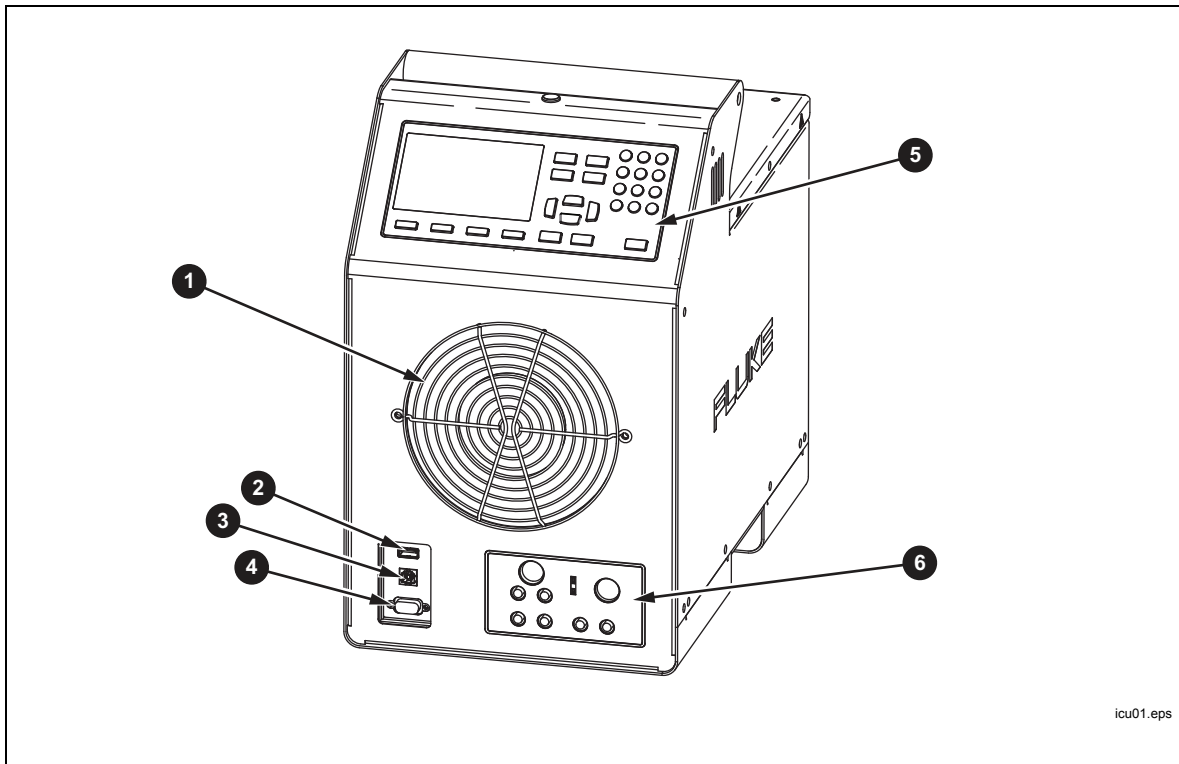
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Number	Description
1	Tank - The stainless steel tank contains the bath fluid.
2	Bath Fluid - Temperature sensors are inserted into the bath fluid for calibration. Heating and cooling devices attached to the walls of the tank heat and cool the bath fluid.
3	Control Sensor - The precision platinum resistance thermometer (PRT) measures and controls the temperature of the bath fluid.
4	Stir Motor Cover - Protects the stir motor.
5	Stir Motor (under the Stir Motor cover) - The stir motor drives the propeller that circulates the fluid to produce a uniform temperature. The stir motor turns on when control is enabled.
6	Stir Guard - Separates the working area of the tank from the stir propeller. MIN and MAX marks on the stir guard show the correct fill levels.
7	Propeller - Stirs the bath fluid.
8	Carrying Handle - Use the handle to lift or move the Product. There are also recessed handles on the sides of the Product (not shown).
9	Ready Indicator - Changes from amber to green when the bath fluid temperature has settled at the setpoint. Green indicates that the Product is ready for measurement.
10	Threaded Holes (M4) - Used to attach accessories to the Product.
11	Tank Cover - Isolates the bath fluid from the environment, reduces fumes, prevents objects from falling into the tank, and keeps the fluid temperature stable. The tank cover attaches to the top panel with four thumb screws.

Figure 1. Top of the Product

Front

The front of the Product is shown in Figure 2.



Number	Description
1	Fan - Cools the tank and heating devices. Keep at least 150 mm of open space around the Product and 300 mm behind it to avoid obstruction of the air flow. Keep objects away from the fan opening as the fan produces strong suction.
2	USB Host Port - Use this port to record temperature data to a memory device.
3	USB Device Port - Like the RS-232 Port, this USB device port can be used to control the Product.
4	RS-232 Port - Like the USB Device Port, this port can be used to control the Product remotely.
5	Control Panel - See <i>Control Panel</i> .
6	Process Input Module - This optional module measures electrical temperature sensors for calibration.

Figure 2. Front of the Product

Control Panel

The control panel is shown in Figure 3.

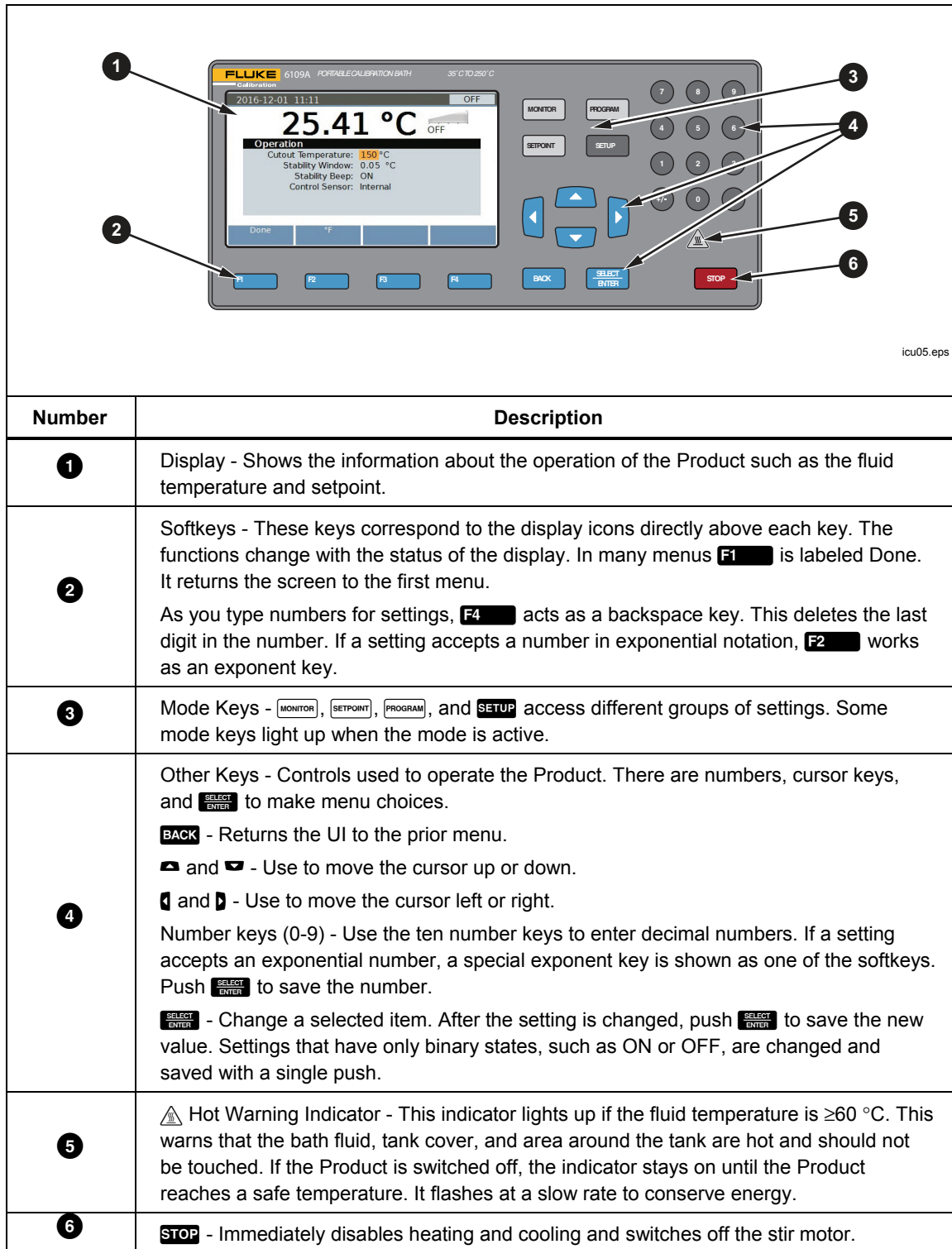
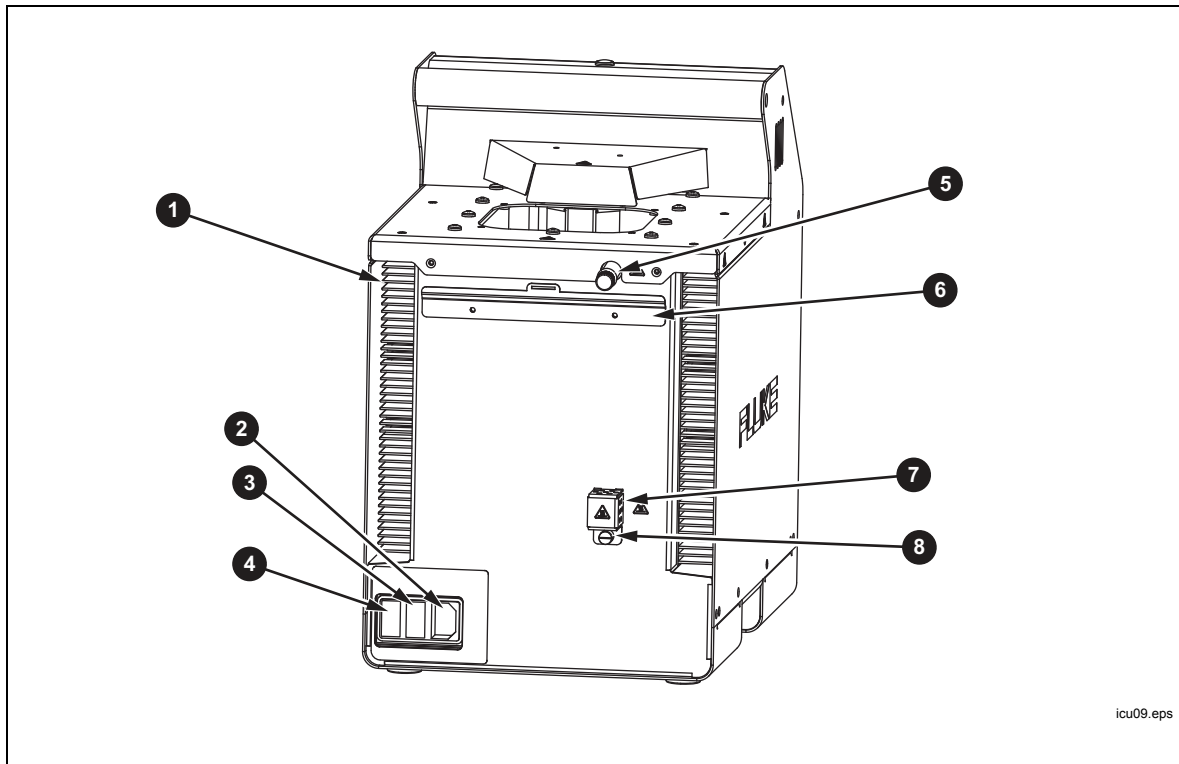


Figure 3. Control Panel

Back

The back of the Product is shown in Figure 4.

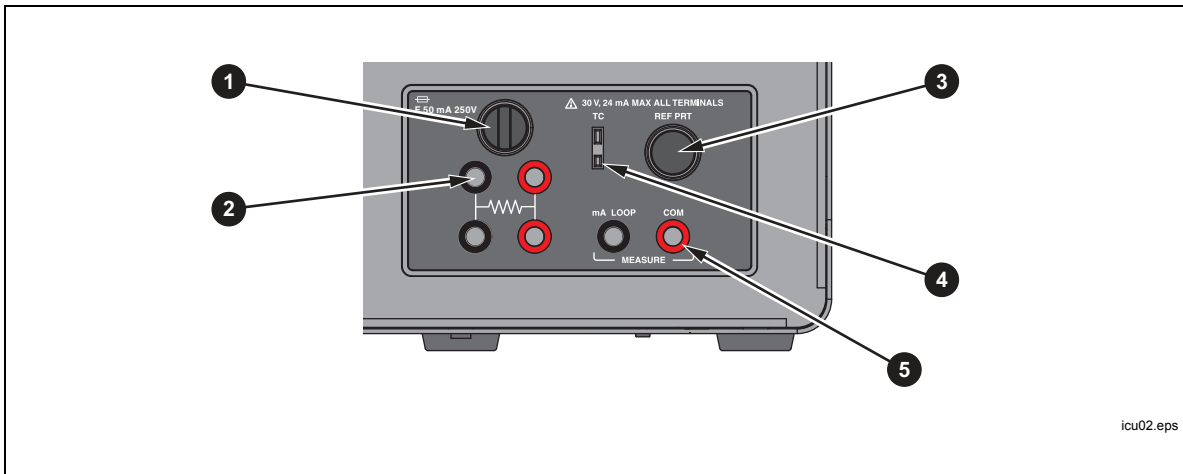


Number	Description
1	Fan Vents - As the Product cools, a heavy air stream flows from the fan vents. Keep at least 300 mm of open space behind the Product to avoid an obstructed air flow. There are also ventilation slots on the sides of the Product (not shown).
2	Mains Power Socket - A grounded male three-prong connector that accepts the mains power cord. Connect the Mains power cord here.
3	Power Switch - Toggle this switch to I to turn on the Product. Toggle this switch to O to turn off the Product.
4	Fuses - Protect the Product from excessive current. If a fuse appears to be blown, contact Fluke Calibration for assistance. See <i>Contact Fluke Calibration</i> .
5	Overflow Tube - Directs excess bath fluid into the optional overflow container. If the overflow kit is not used, keep the overflow tube plugged and reduce the fluid level to allow for thermal expansion.
6	Overflow Container Mounting Bracket – Holds the optional overflow container (not shown).
7	Drain Cover - Keep the drain plug (not shown) on tight and the drain cover in place for normal operation.
8	Drain Tube - The drain tube (not visible) makes it easy to remove the bath fluid for replacement or Product transport.

Figure 4. Back of the Product

Input Module (Option)

The 7109A-P and 6109A-P come with an Input Module that measures various types of temperature sensors. This optional input module is shown in Figure 5.



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Number	Description
1	Current Fuse - Protects the Input Module and connected devices from accidental short circuit. Replace the fuse only with the same type: 5 mm × 20 mm, 50 mA, fast-acting.
2	RTD Terminals - A test RTD connects to these terminals. The graphic on the panel shows the circuit diagram for a four-wire RTD.
3	Reference PRT Connector - A reference probe plugs into this socket. The connector accepts a Fluke INFO-CON plug with a memory device that stores probe coefficients.
4	Thermocouple Input - A miniature thermocouple connector.
5	Transmitter Terminals - A 4-20 mA transmitter connects to the two transmitter terminals labeled mA LOOP and COM.

Figure 5. Input Module Option

Installation

The subsequent sections explain safe and correct Product installation.

Product Placement

⚠️⚠️ Warnings

To prevent possible electrical shock, fire, or personal injury, do not restrict access to the Product mains power cord. The mains power cord is the mains disconnecting device.

Place the unpacked Product on a clean, sturdy, flat surface in a spacious location with good environmental control. There must be at least 150 mm (6 inches) of space around the front and sides and 300 mm of open space behind the Product for the ventilation and cooling fans to operate properly. The environment must maintain a steady, moderate temperature and dissipate up to 1000 W of heat produced by the Product. Avoid air drafts and temperature fluctuations that could adversely affect the temperature stability of the Product.

Provide Ventilation

⚠ Warning

To prevent personal injury:

- Read the bath fluid safety data sheet (SDS) and take necessary precautions. Some fluids are corrosive, toxic, or irritate the skin, eyes, nose, and respiratory organs.
- Use a ventilation system to remove vapor.
- Do not use fluids that are corrosive to stainless steel.

Harmful substances such as benzene and formaldehyde can be produced above a certain temperature. The safety data sheet for a silicone fluid typically states 149 °C for this temperature.

Bath fluid vapors present a fire hazard, especially when the bath fluid is operated above its flash point. Bath fluid vapors tend to condense onto surrounding surfaces. This can contaminate materials and inhibit laboratory cleanliness. If enough condensation accumulates on the floor, the floor becomes slippery and creates a safety hazard.

For appropriate fume extraction use a ventilation duct of at least 75 mm (3 inches) in diameter with an air flow rate between 1.4 cubic meters and 1.7 cubic meters per minute (50 cfm to 60 cfm). Place the inlet of the ventilation duct near the top of the tank.

Add Bath Fluid

The choice of bath fluid is important for the Product to achieve full temperature range and performance specifications. Table 2 lists the recommended bath fluid for each model.

Table 2. Recommended Bath Fluids

7109A	6109A
Fluke 5012 Silicone, 10 centistoke	Fluke 5014 Silicone, 50 centistoke

Other bath fluids can be used, but the temperature range may be more limited. Temperature stability and uniformity also varies when other fluids are used. As a rule, bath fluid viscosity should be no greater than 50 centistokes at any operating temperature. See *Fluid Selection* for more information.

Silicone fluid expands as it is heated. This can cause the bath fluid to spill out of the tank. Use the optional overflow kit or fill the tank to a lower level. The stir guard has marks MAX and MIN to show the proper fill levels. Fill the tank to the MIN level if the plug is left in the overflow tube. Fill to the MAX level if the overflow kit is used. Table 3 gives the recommended fill levels as measured from the bottom of the tank.

Table 3. Fluid Fill Levels

Overflow Kit Installed	Overflow Tube Plugged
MAX level, 154 mm	MIN level, 128 mm

Note

Remove the plug from the overflow tube if the tank is filled to maximum depth.

To add bath fluid:

1. Remove the tank cover.
2. Pour the bath fluid in through the tank opening.
3. Replace the cover and tighten its thumb screws.
4. Clean up any drips or spills. Do not get fluid on the control panel.

Attach the Probe Access Cover

Keep the tank covered when you operate the Product to ensure temperature stability, uniformity, and accuracy. Use the provided probe access cover. The cover holes fit many types of temperature sensors. Use the thumb screws to fasten the cover to the top panel. Make sure the rubber gasket is properly seated.

Connect to Mains Power

 Warning

To prevent possible electrical shock, fire, or personal injury, connect the factory-supplied three-conductor mains power cord to a properly-grounded power outlet. Do not use a two-conductor adapter or extension cord, as it will break the protective ground connection.

Use the provided mains power cord to connect the Product to a 150 V ac or 230 V ac outlet (this depends on the model). The circuit, outlet, and mains power cord must all be rated at 115 V ac, 10 A at 230 V ac.

The Product comes with the appropriate line power plug for the country of purchase. If a different type is necessary, refer to Figure 6 for the correct mains line power plug types available from Fluke Calibration.

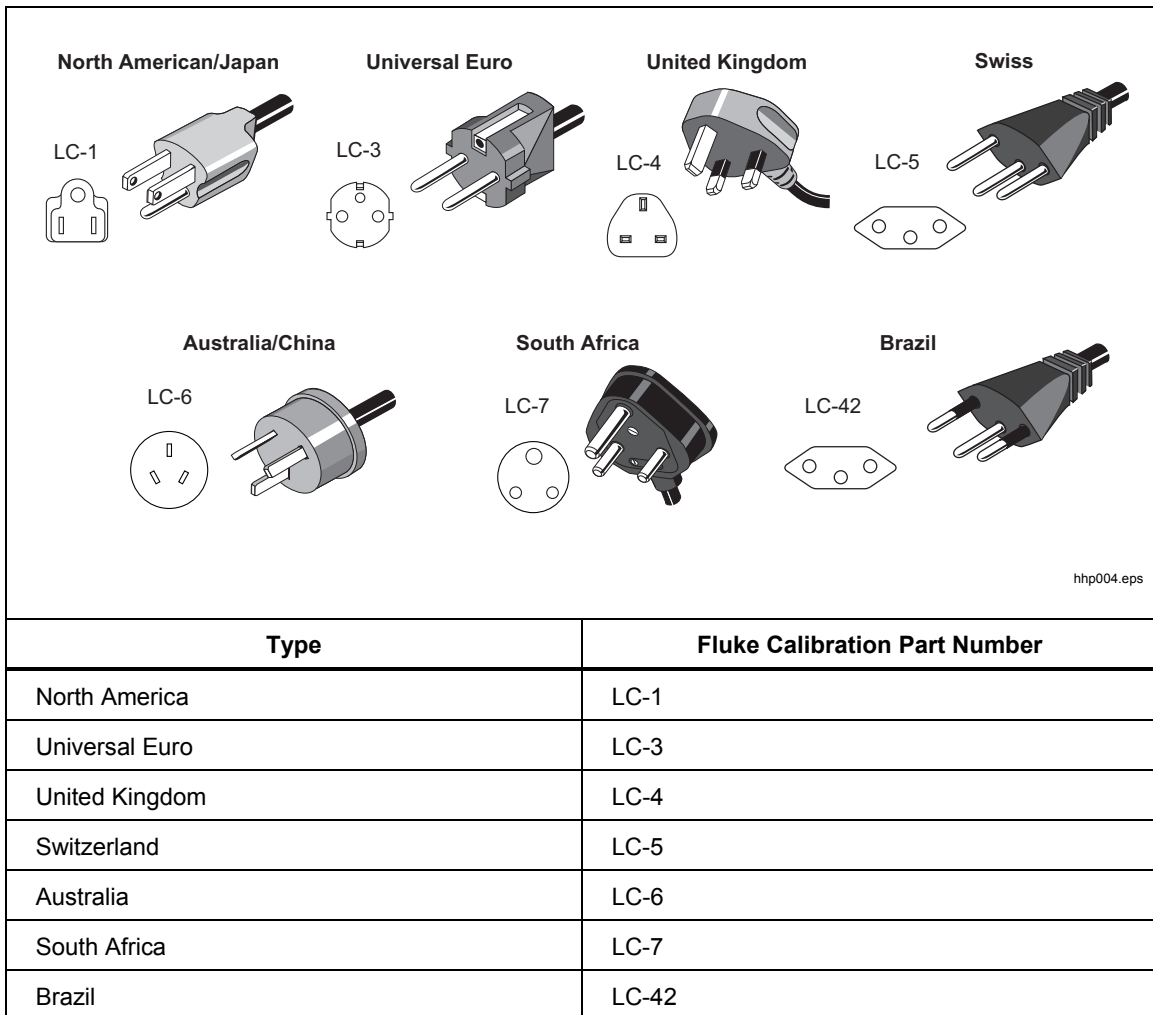


Figure 6. Available Mains Power Cord Types

Attach Accessories

Accessory attachment is explained in the subsequent sections.

Fluid Overflow Accessory

Fluke Calibration recommends the fluid overflow accessory kit (model 7109-2083) to avoid spills caused by thermal expansion of the fluid or an overfilled tank.

To install the bath fluid overflow accessory, see Figure 7:

1. Remove the plug **2** from the overflow tube **1**.
2. Place the overflow container onto the mounting bracket **3** and align it below the overflow tube.
3. Place the cover (not shown) on the overflow container.

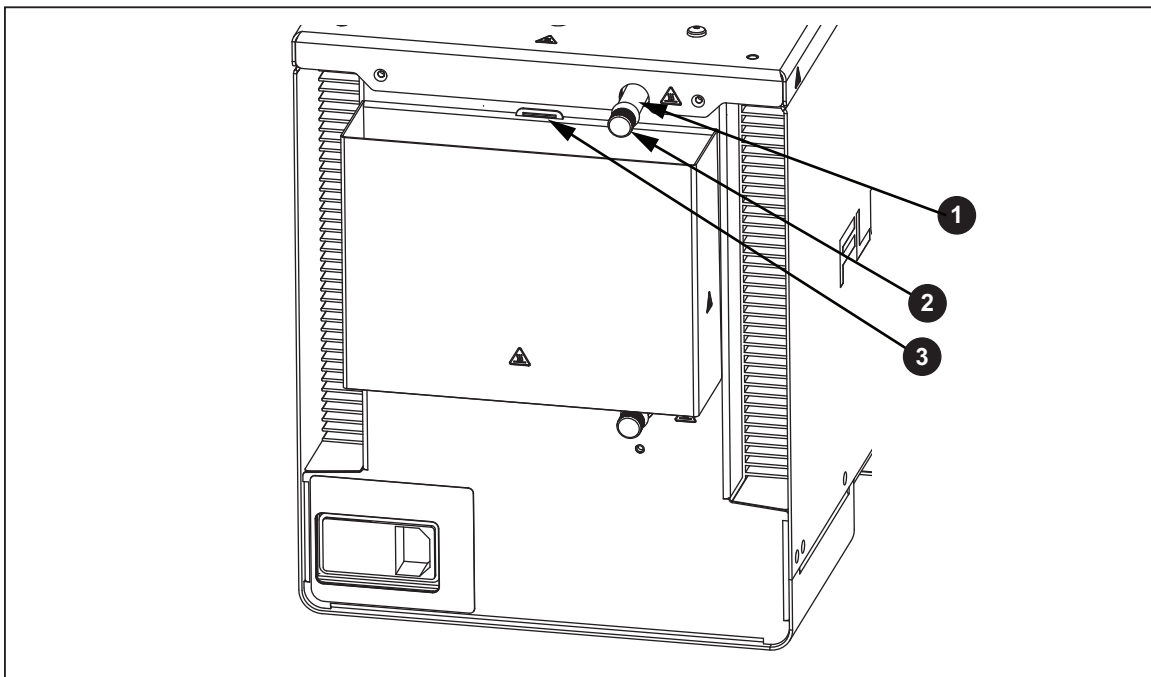
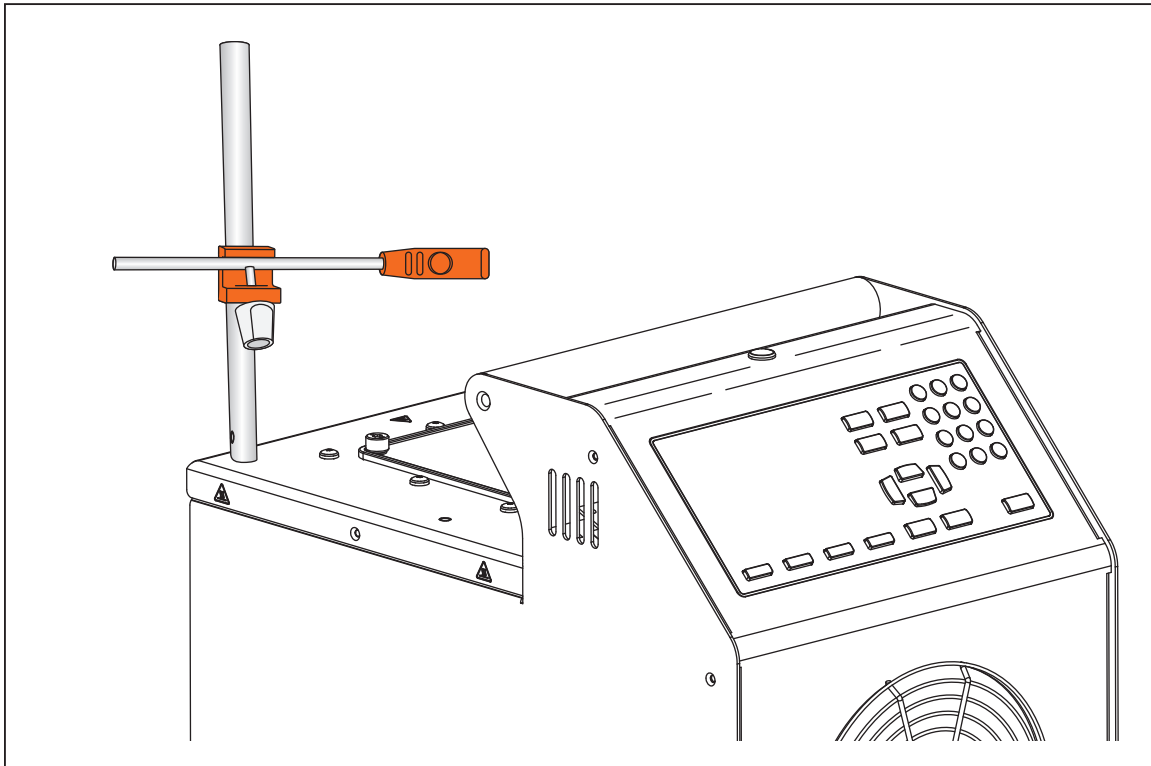


Figure 7. Fluid Overflow Accessory

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Probe Clamp

Use the probe clamp accessory (Model 7109-2051, purchased separately) to hold temperature probes in place while they are calibrated. The post of the probe clamp screws into any of the four the M4 size threaded holes located near the corners of the top panel. See Figure 8.



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Figure 8. Probe Clamp Accessory

Adjustable Probe Fixture

Use the adjustable probe fixture (model 7109-2027) to hold up to four tri-clamp temperature sensors. The device fits inside the tank opening and attaches to the top panel of the Product with four thumb screws. The height of the platform can be adjusted for proper immersion of the stems and flanges of the temperature sensors. To adjust the height, slightly squeeze the tabs inward on the height adjustment bracket **1** shown in Figure 9.

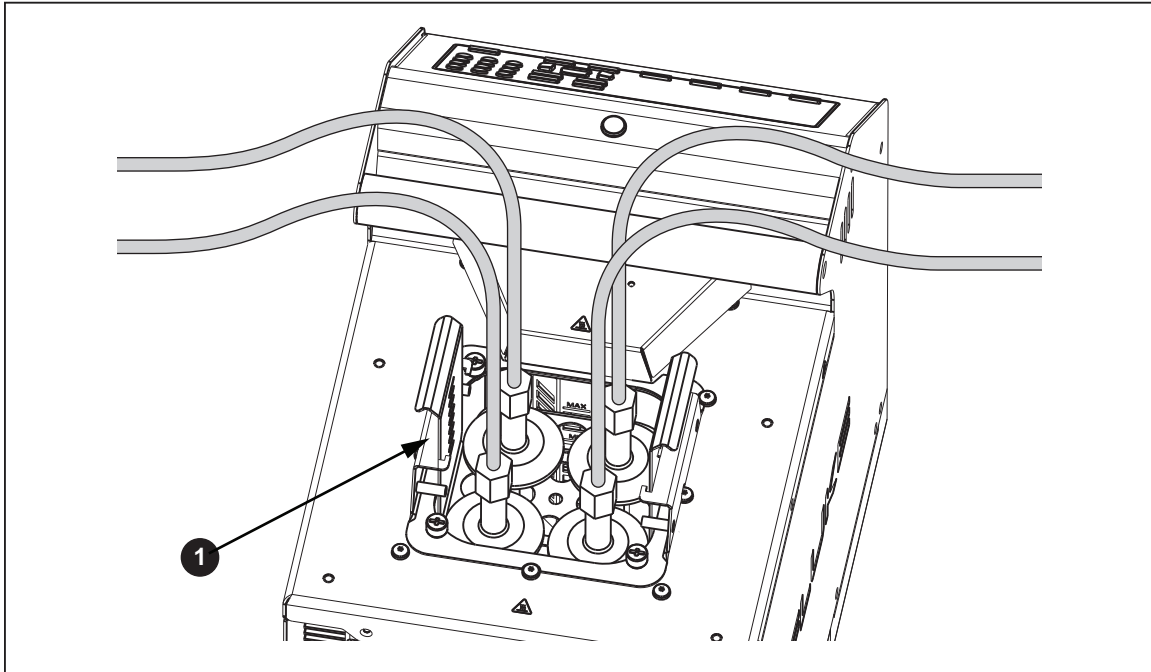


Figure 9. Adjustable Probe Fixture

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Turn On the Product

Push the power switch on the back panel of the Product to the I side to turn on the Product. The Product can take up to 40 seconds for the Product to become fully operational.

Set the Language, Time, and Date

Set the display language, time, date, and other operator preferences in the Setup Instrument screen. The UI is available in:

- English
- French
- German
- Portuguese
- Spanish
- Russian
- Simplified Chinese
- Japanese
- Korean

To change the language, time, or date:

1. Push **SETUP**.
2. Push **F2**.
3. Push **▼** to move the focus to an item.
4. Push **SELECT ENTER**.
5. Push **▼** to move the selection to the necessary value.
6. Push **SELECT ENTER** to save the change.
7. Push the **F1** (**Done**) to return to the first screen.

Set the Password

The Product ships from Fluke Calibration with minimal security settings. Except for calibration parameters, any settings are easily changed.

To change the security level and set a new password to prevent unauthorized use:

1. Push **SETUP**.
2. Push **F2**.
3. Push **F4** (**More**).
4. Push **F3** (**Password**).
5. Use the number keys to type in the factory password 1234.
6. Push **SELECT ENTER** to access the Password screen.
7. Push **SELECT ENTER** to edit the password.
8. Use the number keys to type in a new password.
9. Push **SELECT ENTER** save the new password.
10. Push **▼** to move to the Security setting.
11. Push **SELECT ENTER** to change the security level.
12. Push **F1** (**Done**) to return the first screen.

Note

Make sure to save the new password and do not lose it.

Connect the Reference Probe and Test Sensor

The 7109A-P and 6109A-P include the Input module to which a reference thermometer and one DUT (Device Under Test) sensor can be connected. Temperatures show on the display and are automatically recorded as a program runs. This section explains how to set up these models to operate the sensor inputs.

Connect the Reference Probe

A reference probe provides improved temperature accuracy and serves as a reference standard to test other sensors. For best results, use a high-quality, 100 Ω , four-wire, platinum resistance thermometer (PRT) calibrated with low uncertainty such as Fluke 5615-6. Table 4 shows how a reference probe can be used to improve temperature accuracy.

Table 4. Typical Accuracy with a Fluke 5615 as a Reference Probe

Temperature	Expanded Uncertainty (k = 2)
-25 °C	0.020 °C
0 °C	0.022 °C
140 °C	0.031 °C
250 °C	0.043 °C

Use the provided clamp-on ferrites to reduce radio-frequency emissions and to ensure electromagnetic compatibility with other equipment. Loop a section of cable near the connector through the ferrite as shown in Figure 10. Fluke Calibration also recommends a ferrite for the test sensor.

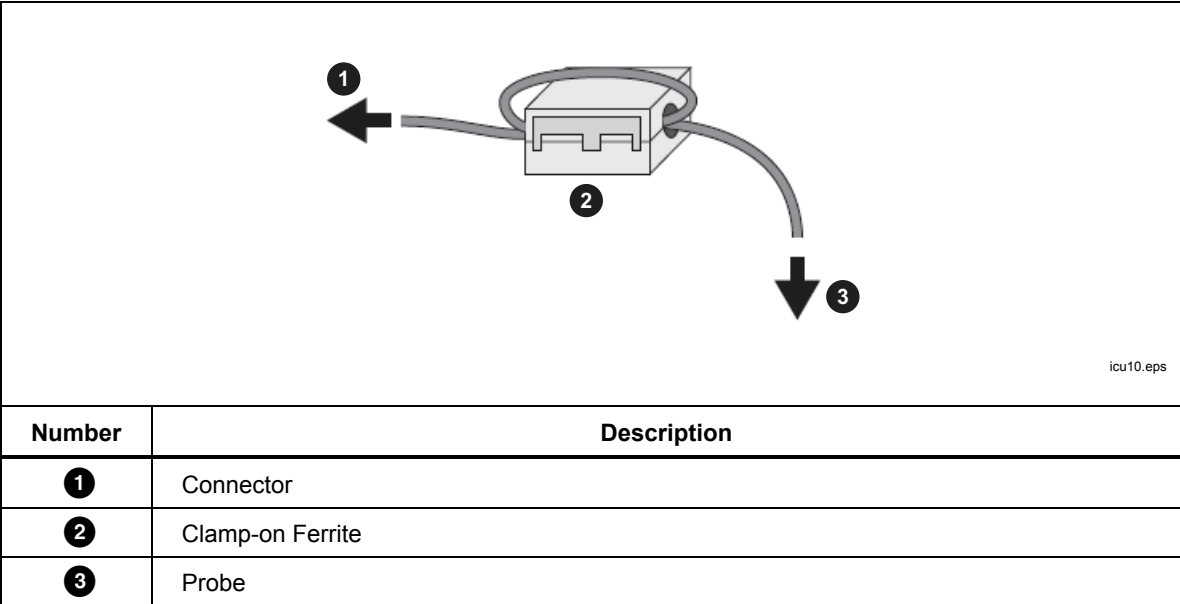


Figure 10. Ferrite Installation

The reference probe plugs into the REF PRT input. It requires a 6-pin DIN connector wired as shown in Figure 11.

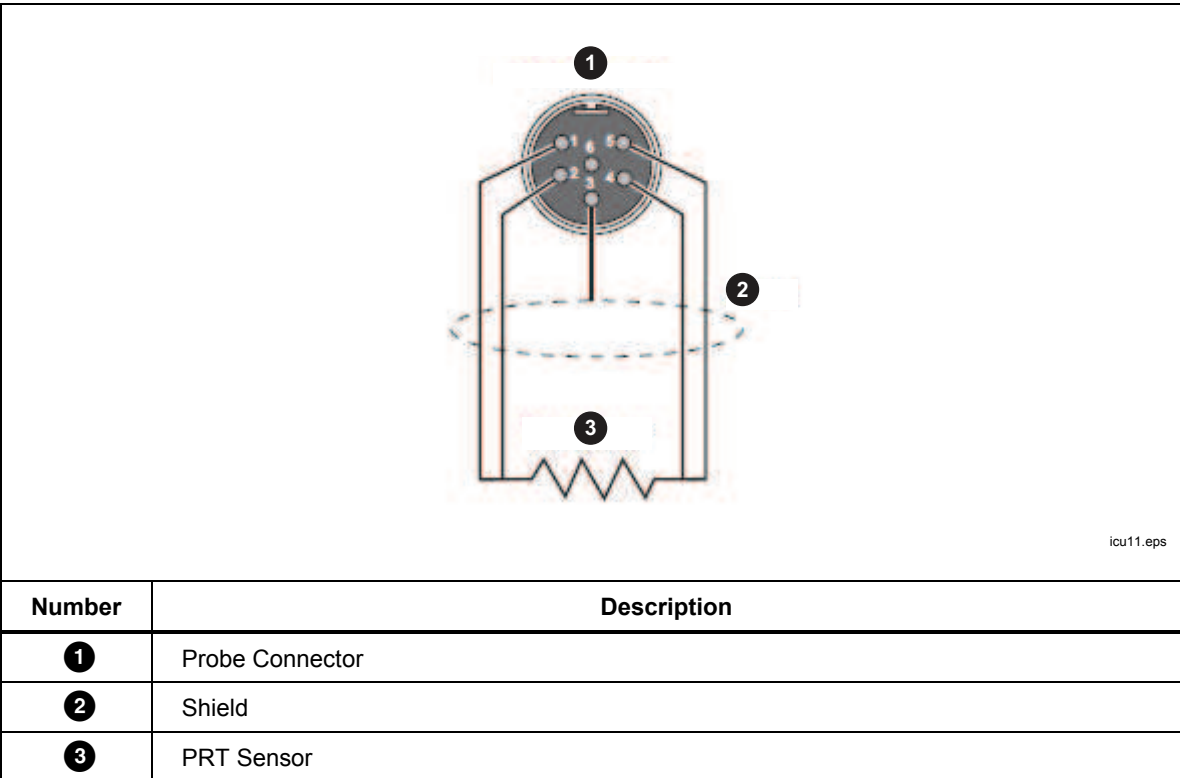


Figure 11. Reference Probe Connections