FLUKE®

500 Series

Dry-Block Calibrator

Users Manual

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Introduction

The Fluke 500 Series Dry-Block Calibrators may be used as portable or benchtop instruments for calibrating temperature probes.

These dry-block calibrators feature interchangeable inserts to accommodate a wide range of temperature probe diameters.

The calibrator controller uses a precision, platinum RTD as a sensor. Models 514 and 517 use thermoelectric modules (TEDs) to control the heating and cooling of the well. Model 515 uses a solid state relay (triac) to control the heating of the well. Model 518 uses both TEDs and a triac to control heating and cooling.

The LED display continuously shows the current well temperature. You can use the front panel buttons to easily set any temperature within the range specified for the calibrator.

The dry-block calibrators are designed for portability, moderate cost, and easy operation. To safely and accurately calibrate temperature sensors and devices, familiarize yourself with the calibrator's safety guidelines and operating procedures described in this manual.

Contacting Fluke

To order accessories, receive assistance, or locate the nearest Fluke distributor or Service Center, call:

- USA: 1-888-99-FLUKE (1-888-993-5853)
- Canada: 1-800-36-FLUKE (1-800-363-5853)
- Europe: +31 402-678-200
- Japan: +81-3-3434-0181
- Singapore: +65-738-5655
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About this Manual

This manual describes Models 514, 515, 517, and 518 dry-block calibrators and the options for each model. Except where noted, the descriptions and instructions in this manual apply to all models.

In this manual, a **Warning** identifies conditions and actions that pose hazards to the user.

A **Caution** identifies conditions and actions that may damage the calibrator or the devices being calibrated.

International Electrical Symbols

Table 1 describes the symbols used in this manual and on the calibrator.

Table 1. International Electrical Symbols

~	AC (Alternating Current)
⏛	Fuse
⚠	Important information
CE	Complies with European Union directives
C SP US	Canadian Standards Association
CAT II	OVERVOLTAGE (Installation) CATEGORY II, Pollution Degree 2 per IEC1010-1 refers to the level of Impulse Withstand Voltage protection provided. Equipment of OVERVOLTAGE CATEGORY II is energy-consuming equipment to be supplied from the fixed installation. Examples include household, office, and laboratory appliances.
♨	Burn hazard

Specifications

Tables 2 through 4 give the specifications for the 500 Series Dry-Block Calibrators.

Notes

Accuracy specifications are applicable for a one-year calibration interval. In keeping with normal, prudent metrology practices, a short-cycle interval of six months is recommended for new units during the first year.

Temperature ranges and scan rates may vary depending on ambient temperature and line voltage.

Table 2. Models 514 and 517 Specifications

Power	115 VAC (±10 %), 50/60 Hz, 230 VAC (±10 %), 350 W	
Ambient Temperature	5 °C to 50 °C (40 °F to 120 °F)	
Operating Range	**Model 514**	**Model 517**
	–25 °C to +140 °C (–13 °F to +284 °F) at 23.3 °C (74 °F) ambient	–45 °C to +140 °C (–49 °F to +284 °F) at 23 °C (74 °F) ambient
Resolution	0.01 °C or 0.01 °F	
Accuracy of drilled wells	With reference: ±0.05 °C (0.09 °F) Without reference: –20 °C ±0.23 °C (0.42 °F); 0 °C ±0.1 °C (0.18 °F) 140 °C ±0.45 °C (0.81 °F)	
Accuracy of center well (with 0.25 in inserts)	±0.1°C (0.18 °F)	
Uniformity of drilled wells	±0.05 °C (0.09 °F)	
Uniformity of center well to drilled wells (with 0.25 in insert	–20 °C ±0.23 °C (0.42 °F); 0 °C ±0.01 °C (0.18 °F); 140 °C ±0.45 °C (0.81 °F)	
Control Stability	±0.02 °C (0.04 °F)	
Controller	Hybrid analog/digital controller with data retention	
Test Wells	One 3/4 in dia. x 6 in deep, two 1/4 in dia. x 6 in deep, one 3/16 in dia. x 6 in deep, and one 1/8 in x 6 in deep	
Size	12.5 in H x 8 in W x 10.5 in D (318 mm x 203 mm x 267 mm)	
Weight	30 lb including well insert (13.6 kg)	
Safety	OVERVOLTAGE (Installation) CATAGORY II, Pollution Degree 2 per IEC1010-1	
Computer Interface	RS-232 (IEEE optional)	
Fault Protection	Sensor burnout protection, over-temperature cut-out, and electrical fuses	

Table 3. Model 515 Specifications

Range	50 °C to 600 °C (95 °F to 1112 °F) at 25 °C (77 °F) ambient
Accuracy (with 0.25 in probe)	±0.1 °C to 300 °C, ±0.5 °C to 600 °C
Stability	±0.02 °C to 300 °C, ±0.05 °C to 600 °C
Uniformity	100 °C ±0.05 °C, typical ±0.03 °C; 600 °C ±0.2 °C, typical ±0.1 °C
Test Wells	6 in deep (multi-hole inserts available)
Computer Interface	RS-232 interface (IEEE optional)
Heating Time to Max	30 minutes from 100 °C to 600 °C
Resolution	0.01 °C or 0.01 °F
Display	LED, °C or °F, user selectable
Size	12.5 in H x 8 in W x 10.5 in D (318 mm x 203 mm x 267 mm)
Weight	25 lb (11.4 kg)
Power	115 VAC (±10 %), 50/60 Hz, 230 VAC [±10 %], 50/60 Hz, 1000 W
Controller	Hybrid analog/digital controller with data retention
Heater	Heater element PWM
Cooling	2 speed internal fan
Fault Protection	Sensor burnout protection, over temperature thermal cut-out, electrical fuse (10 A 115 VAC [±10 %], 5 A 230 VAC [±10 %])
Ambient Temperature	5 °C to 50 °C (41 °F to 122 °F)
Safety	OVERVOLTAGE (Installation) CATAGORY II, Pollution Degree 2 per IEC1010-1
Cooling time	2.5 hours from 600 °C to 100 °C

Table 4. Model 518 Specifications

Power	115 VAC (±10 %), 50/60 Hz, 230 VAC (±10 %), 1150 W (825 W hot, 325 W cold)
Ambient Temperature	5 °C to 50 °C (40 °F to 120 °F)
Operating Range	
Cold Side	-30 °C to 140 °C (ambient temperature of 23 °C)
Hot Side	100 °C to 670 °C
Display Resolution	0.01
Controller	Digital controller with data retention
Display Accuracy	
Cold Side with Probe diameter ≤ 0.25 in	
Insert to display	±0.25 °C, ±0.1 °C typical
Fixed hole to display	±0.65 °C, ±0.4 °C typical
Hot Side with Probe diameter ≤ 0.25 in	±0.5 °C (100 °C to 400 °C), ±0.15 °C typical ±1.0 °C (> 400 °C), ±0.3 °C typical
Control Stability	
Cold Side	±0.05 °C, ±0.01 °C typical
Hot Side	±0.10 °C, ±0.03 °C typical
Uniformity	
Cold Side with Probe diameter ≤ 0.25 in	
Insert	±0.05 °C, typical ±0.03 °C
Fixed hole	±0.05 °C, typical ±0.03 °C
Insert to fixed hole	±0.25 °C, typical ±0.15 °C
Hot side with Probe diameter ≤ 0.25 in	±0.20 °C, typical ±0.10 °C
Display	°C or °F
Well Diameter	
Cold Side	1.25 in (31.75 mm); 4 fixed holes: Two 1/4 in (6.35 mm), one 1/8 in (3.18 mm), one 3/16 in (4.76 mm)
Hot Side	1.45 in (36.83 mm)
Well Depth	
Cold Side	4.875 in (123.825 mm)
Hot Side	6 in (152.4 mm)

Table 4. Model 518 Specifications (cont.)

Heating Time	
Cold Side	15 minutes from –30 °C to +140 °C
Hot Side	30 minutes from 100 °C to 660 °C
Cooling Time	
Cold Side	20 minutes from 140 °C to –25 °C; 30 minutes from ambient (25 °C) to –30 °C
Hot Side	2.5 hours from 660 °C to 100 °C
Weight	36 lb (16.4 kg)
Dimensions	11.3 in H x 15.6 in W x 10.4 in D 28.7 cm H x 39.6 cm W x 26.4 cm D
Heating	
Cold Side	Thermal Electric Device (TED)
Hot Side	Heater Element
Cooling	
Cold Side	Thermal Electric Device (TED), Fan
Hot Side	Fan
Fault Protection	
Both sides	Sensor burnout protection, electrical fuse, high limit set, high internal temperature cut-out on PCB's
Hot side	Independent thermocouple cut-out with relay
Safety	OVERVOLTAGE (Installation) CATAGORY II, Pollution Degree 2 per IEC1010-1
Number of Wells	Interchangeable inserts
Interface	One RS-232 interface controls both sides. An external IEEE interface box is available.
Programmable Temperature Settings	8 for each side
Fuses	
Cold 115 V	4 AT 250 V
Cold 230 V	2 AT 150 V
Hot 115 V	10 AT 250 V
Hot 230 V	5 AT 250 V

Environmental Conditions

Although these calibrators have been designed for optimum durability and trouble-free operation, they must be handled with care. The calibrator should not be operated in an excessively dusty or dirty environment. Maintenance and cleaning recommendations are given in the "Maintenance" section of this manual.

The calibrators operates safely under the following conditions:

- Temperature range: 5 °C to 50 °C (41 °F to 122 °F)
- Ambient relative humidity: 15 % to 50 %
- Pressure: 75 kPa to 106 kPa
- Mains voltage: ±10 % of nominal
- Altitudes below 2000 m
- Vibrations in the calibration environment should be minimized

Safety Guidelines

⚠ Warning

To avoid personal injury or death, follow these guidelines:

- **Inspect the calibrator for damage before each use. Do not use the calibrator if it appears damaged or operates abnormally.**
- **Use only a grounded ac mains supply of the appropriate voltage to power the calibrator.**
- **Do not operate the calibrator without a properly grounded, properly polarized power cord.**
- **Do not connect the calibrator to a non-grounded, non-polarized outlet.**
- **Do use a ground fault interrupt device.**
- **Before working inside the calibrator, turn off the power and disconnect the power cord.**
- **Temperatures above 70 °C (158 °F) are considered hazardous. Use extreme care when working with these temperatures. Observe all warnings and cautions given in this manual.**
- **Before initial use, after transport, and anytime the dry-block has not been energized for more than 10 days, the calibrator must be energized for a dry-out period of 1 to 2 hours before it can be assumed to meet all of the safety requirements of the IEC 1010-1.**
- **Do not operate the calibrator near flammable materials.**
- **Always replace the fuse with one of the same rating, voltage, and type.**
- **Always replace the power cord with an approved cord of the correct rating and type.**
- **Do not operate the calibrator in an excessively wet, oily, dusty, or dirty environment. Always keep the well and inserts clean and clear of foreign material.**
- **Do not use fluids to clean out the well.**
- **Do not touch the calibrator's probe handle.**

- **Always be aware of the well temperature. The temperature of the probe terminal is the same as the temperature shown on the display. For example, if the unit is set to 600 °C and the display reads 600 °C, the well is at 600 °C.**
- **Do not touch the metal on the top of the calibrator while the calibrator is hot. The area around the probe terminal can get extremely hot.**
- **Insert and remove probes only when the calibrator is set at temperatures less than 50 °C.**
- **The air over the well can get hot enough to burn you.**
- **Do not turn off the calibrator at temperatures higher than 100 °C. Select a set-point less than 100 °C and let the calibrator cool down before turning it off.**
- **Do not remove inserts while the calibrator temperature is greater than 50 °C. Inserts are at the temperature shown on the display.**
- **Always use the tongs supplied with the calibrator to remove the inserts. After removing probes, always place the probes on a temperature-resistant surface until the probes are at room temperature.**
- **Always carry the calibrator in an upright position to prevent the inserts from dropping out.**
- **Overhead clearance is required. Do not place the calibrator under a cabinet or any other structure.**
- **Always leave enough clearance above the calibrator to allow for safe and easy insertion and removal of probes.**
- **Always operate the instrument at room temperatures between 41 °F and 122 °F (5 °C to 50 °C). Allow sufficient air circulation by leaving at least 6 inches (15 cm) of clearance around the calibrator.**
- **Do not place aluminum inserts in high-temperature calibrators that can heat up above 400 °C.**
- **Do not use the calibrator for applications other than calibration work.**
- **Do not use the calibrator in environments other than those listed in this manual.**
- **Use extra caution when operating the calibrator at high temperatures for extended periods of time.**
- **Unattended operation at high temperatures is not recommended.**
- **The high temperatures present in the calibrator may result in fires and severe burns if safety precautions are not observed.**
- **Do not use the calibrator without adequate training.**
- **Do not use in wet environments.**

⚠Caution

To avoid possible damage to the calibrator or the probes being calibrated:

- **Do not change the calibration constants from the factory settings. The factory settings are important for the safety and proper operation of the calibrator.**
- **Always turn off the calibrator immediately if the mains power supply fluctuates. Power fluctuations could damage the calibrator. Wait until the power has stabilized before re-energizing the calibrator.**
- **Never allow foreign material into the probe holes. Fluids and other materials can damage the calibrator or cause binding and damage to your probe.**
- **Allow for probe expansion inside the well as the dry block heats.**
- **Do not calibrate probes whose handles can be damaged by the hot air above the well. Use of a probe shield is recommended. Check the probe handle temperature limit before calibration.**
- **Do not place into the well any objects other than the inserts supplied for the calibrator.**
- **The master reset sequence should be performed only by authorized personnel if no other action is successful in correcting a malfunction. You must have a copy of the most recent Report of Calibration to restore the calibration parameters.**
- **For Model 517, always use the well insulator. See "Well Insulator for Model 517".**
- **Operating the calibrator continuously at high temperature can shorten the lifetimes of the heater and other calibrator components.**
- **If the calibrator is used in a manner not in accordance with the equipment design, the calibrator may malfunction or safety hazards may arise.**

⚠ Warning

- **Fluke 500 Series Dry-Block Calibrators are intended for indoor operation only.**

Getting Started

Unpacking

Unpack the calibrator carefully and inspect it for any damage that may have occurred during shipment. If there is shipping damage, notify the carrier immediately.

Verify that the following components are present:

- Dry-block calibrator
- Insert (One insert, specified by the customer, is include with the calibrator. See Tables 6 through 8.)
- One set of tongs
- Power cord
- Users manual
- Well insulator (517 only)
- RS-232 cable

Set-up

⚠Warning

To avoid personal injury:

Before initial use, after transport, and anytime the dry-block has not been energized for more than 10 days, the calibrator must be energized for a dry-out period of 1 to 2 hours before it can be assumed to meet all of the safety requirements of the IEC 1010-1.

Place the calibrator on a flat surface surrounded by at least 6 inches (15 cm) of free space with no overhead obstructions. Carefully slide the insert into the well. Inserts should have the smallest hole diameter possible that allows the probe to slide in and out easily. Inserts of various sizes are available from Fluke. The well must be clear of any foreign objects, dirt and grit before the insert is installed. Install the insert so the two small tong holes are positioned upward.

Power

Verify that the nominal ac voltage corresponds to that indicated on the back of the calibrator. Typically this will be 115 VAC (±10 %), 50/60 Hz or 230 VAC (±10 %), 50/60 Hz. Plug the calibrator power cord into a grounded ac outlet of the proper voltage, frequency, and current capability.

For Models 514, 515, and 517, turn the calibrator on using the power switch on the rear panel.

For Model 518, use the power switches on the front panel to turn on the hot and cold sides at the same time. (An error occurs if both sides are not turned on within 5 seconds of each other. Refer to Table 11.)

The fan should begin quietly blowing air through the calibrator and the front panel display should illuminate after 3 seconds. After a brief self-test, the controller should begin normal operation. The calibrator will begin to heat to the previously programmed temperature set-point. The front panel LED display will indicate the actual dry-block temperature. If the unit fails to operate, check the power connection.

Changing the Supply Voltage and Fuses on Models 515 and 517

To change the supply voltage and fuses on Models 515 and 517, proceed as follows:

⚠Warning

To avoid electric shock, burns, or damage to equipment:

- **Always replace the fuses with ones of the correct rating, voltage, and type.**
- **Always replace the power cord with an approved cord of the correct rating and type.**

1. Turn off the calibrator and unplug it from the ac outlet.
2. Insert a flat-blade screwdriver into the slot at the top of the power entry module (PEM). (Refer to Figure 17 under "Replacing the Fuses" in the "Care and Maintenance" section.) Gently open the module to access the fuse holder.
3. Remove the fuse holder. Replace the fuses with the correct fuses for the new voltage.
4. Replace the fuse holder, turning it so that the correct voltage shows in the voltage window on the PEM. Close the PEM.
5. Model 515: On the back of the calibrator, switch the HEATER VOLTAGE SELECTOR to the correct voltage.

Note

For proper operation, the HEATER VOLTAGE SELECTOR and PEM voltage window must match.

6. You may need to change the power cord to fit the ac outlet. Compatible power cords include the following:
   - 230 VAC Europe: 10 A approved cord with a CEE 7/7 plug (Schuko)
   - 230 VAC United States: 15 A approved cord with a NEMA 6-15 straight-blade plug
   - 115 VAC United States: 15 A approved cord with a NEMA 5-15 plug
7. Connect the calibrator to the ac outlet.

Changing the Display Units

The calibrator can display temperatures in degrees Celsius or Fahrenheit. The temperature units are set to Celsius at the factory. To switch between temperature units, use one of the following methods:

Press **UP** for 2-3 seconds until the display flashes.

Or

1. Press **SET** three times to display the units; then press **UP** or **DOWN** to change the units
2. Press **SET** to store the change or **EXIT** to proceed without storing the change.

Setting the Temperature

The later section "Setting the Temperature Set-Point" explains in detail how to set the temperature set-point on the calibrator using the front panel keys. The procedure is summarized here.

1. Press **SET** twice to access the set-point value.
2. Press **UP** or **DOWN** to change the set-point value.
3. Press **SET** to program in the new set-point.
4. Press and hold **EXIT** to return to the temperature display.

When you change the set-point temperature, the controller switches the well heater on or off to raise or lower the temperature. For Models 514, 515, and 517 the cycle indicator, a two color LED, will also indicate on (red and heating) or off (green and cooling). The displayed well temperature gradually changes until it reaches the set-point temperature. The well may require 5 to 30 minutes to reach the set-point depending on the span. Another 5 to 10 minutes is required for the temperature to stabilize. Table 5 shows the heating and stabilization times required for the 500 Series Calibrator models.

Table 5. Heating and Stabilization Times

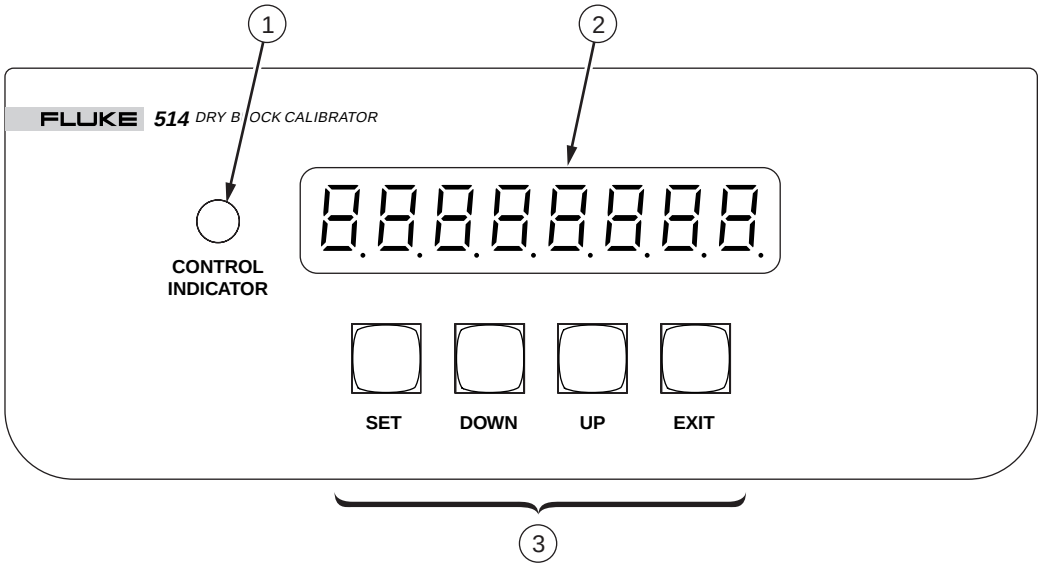
Model	Heating Time	Time to Stabilize within 0.1 °C of Set-Point (after reaching set-point)	Time to Reach Maximum Stability (after initial stabilization)
514/517	Ambient to 140 °C (284 °F): 15 minutes	5 to 10 minutes	15 to 20 minutes
515	Ambient to maximum: 15 minutes	5 to 10 minutes	20 to 30 minutes
518	Ambient to maximum: 30 minutes	10 to 20 minutes	20 to 30 minutes
* Time required depends on the magnitude of the temperature change.			

Setting the High Limit Parameter

The high limit parameter is set at the factory to the calibrator's maximum temperature limit. If a test probe's maximum temperature is less than the high limit parameter, set the parameter to the probe's maximum temperature. See "Setting the Calibrator's Operating Parameters".

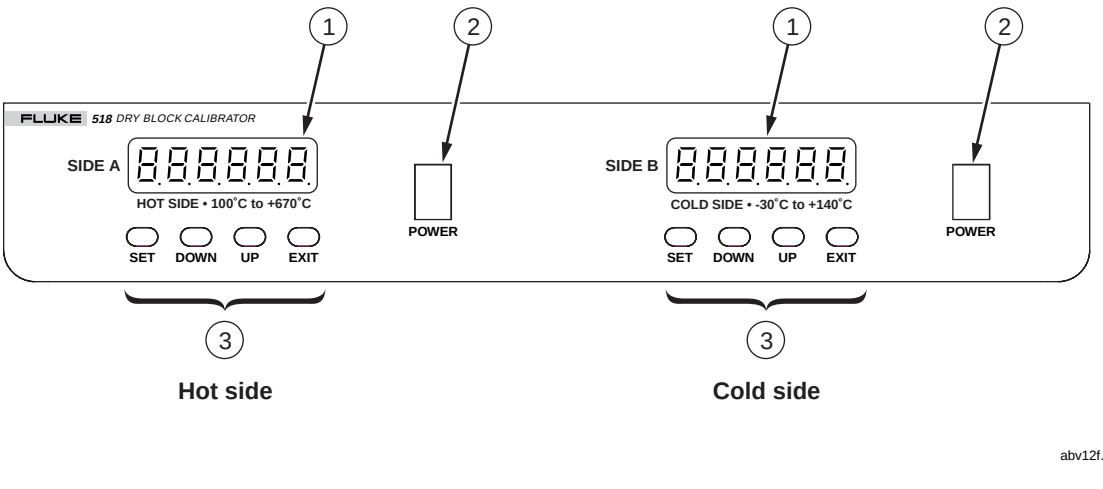
Front Panel

Figure 1 describes the front panel features for Models 514, 515, and 517 (Model 514 is shown). Figure 2 describes the front panel features for Model 518.



1	**Control Indicator (Models 514, 515, and 517)**: The Control Indicator is a two color, light emitting diode. This indicator shows the ratio of heating to cooling. When the indicator is constant red, the well is heating; when it is constant green, the well is cooling. When the indicator is flashing then the temperature is being held constant.
2	**Controller Display**: The digital display shows the set-points, actual well temperatures, and various calibrator functions, settings, and constants. The display shows temperatures in °C or °F with a resolution of one-hundredth of a degree C or F.
3	**Controller Keypad**: The control buttons (**SET**, **DOWN**, **UP**, and **EXIT**) are used to set the calibrator temperature set-point, access and set other operating parameters, and access and set calibration parameters. **SET**: Used to step through the menu and to store parameters to the displayed value. **DOWN**: Used to decrement the displayed value of parameters. **UP**: Used to increment the displayed value. **EXIT**: Used to skip a parameter without storing the parameter value. Hold down **EXIT** to exit the menu and display the temperature.

Figure 1. Models 514, 515, and 517 Front Panel Features

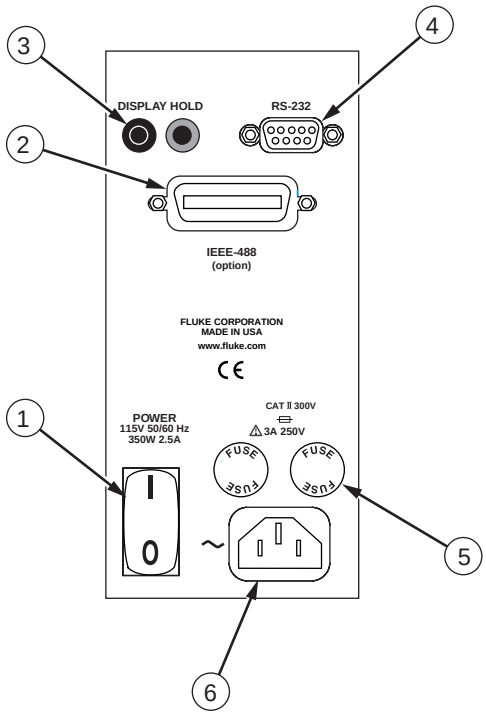


①	**Controller Displays**: The digital display shows the set-points, actual well temperatures, and various calibrator functions, settings, and constants for the hot (left) and cold (right) sides of the calibrator. The display shows temperatures in °C or °F with a resolution of one-hundredth of a degree C or F.
②	**Power Switches**: The power switches turn on power to the hot (left) and cold (right) sides of the calibrator.
③	**Controller Keypads**: The control buttons (**SET**, **DOWN**, **UP**, and **EXIT**) are used to set the calibrator temperature set-point, access and set other operating parameters, and access and set calibration parameters for the hot (left) and cold (right) sides of the calibrators. **SET**: Used to step through the menu and to store parameters to the displayed value. **DOWN**: Used to decrement the displayed value of parameters. **UP**: Used to increment the displayed value. **EXIT**: Used to skip a parameter without storing the parameter value. Hold down **EXIT** to exit the menu and display the temperature.

Figure 2. Model 518 Front Panel Features

Rear Panel

Figures 3 through 5 describe the rear panel features.



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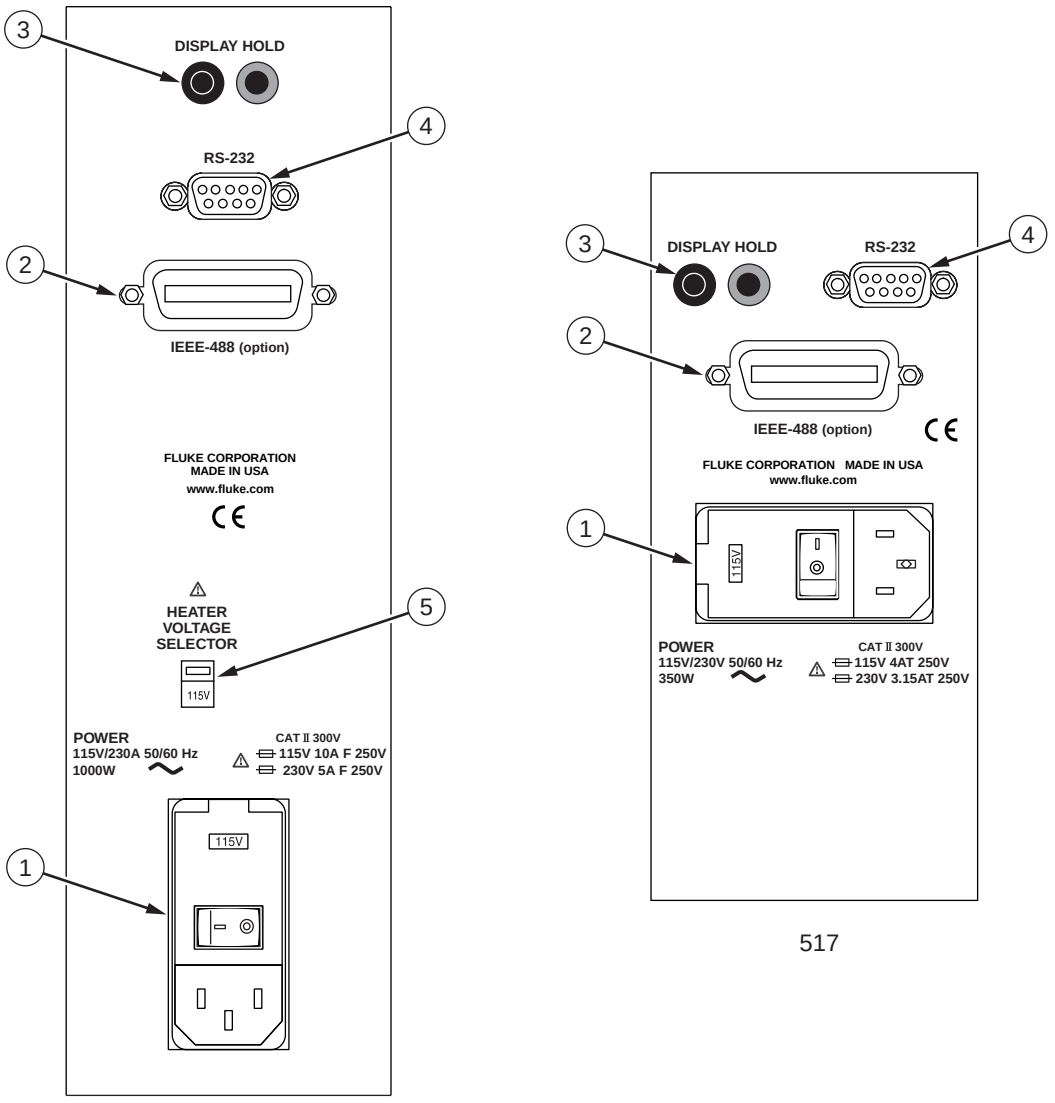
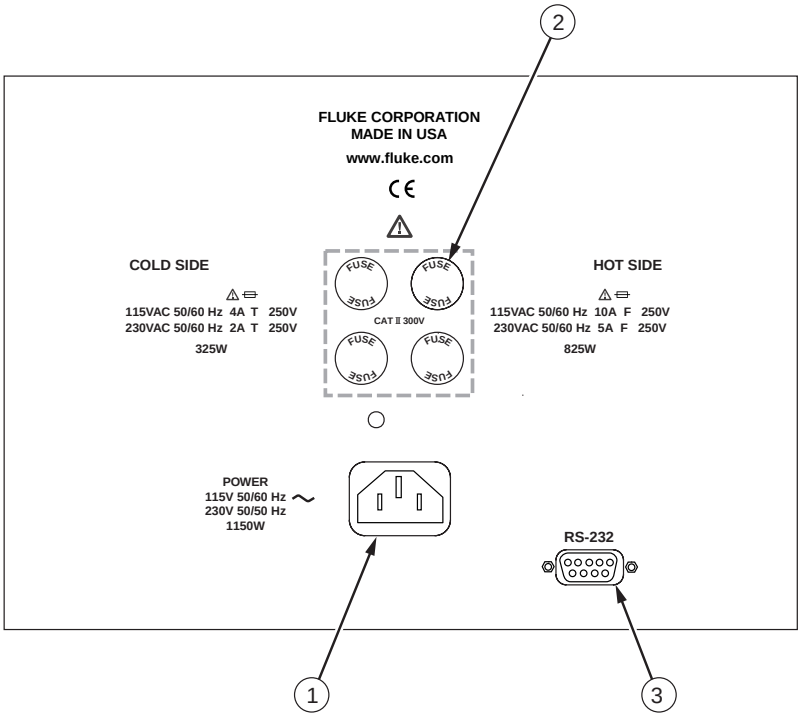
①	**Power Switch:** On/off switch for the calibrator.
②	**IEEE-488 Port (optional):** This connector is for interfacing the calibrator to an IEEE-488 (GPIB) bus for control and communications.
③	**Display Hold:** The two terminals may be wired to a thermal switch or cut-out to freeze the displayed well temperature when the device opens or closes.
④	**RS-232 Serial Port:** This DB-9 connector is for interfacing the calibrator to a computer or terminal for serial RS-232 communications.
⑤	**Fuse Holders:** User-accessible fuse holders. Refer to “Replacing the Fuses” in the “Care and Maintenance” section. **⚠Warning** **To avoid electric shock, burns, or damage to equipment always replace the fuses with ones of the correct rating, voltage, and type.**
⑥	**Power Connector:** Connector for the ac power cord. Connect the cord to a standard 115 VAC grounded socket (230 VAC optional).

Figure 3. Model 514 Rear Panel Features



①	**Power Entry Module (PEM):** The power entry module contains the ac power connector, power switch and fuses. For information on fuse replacement, see “Replacing the Fuses” in the “Care and Maintenance” section.
②	**IEEE-488 Port (optional):** This connector is for interfacing the calibrator to an IEEE-488 (GPIB) bus for control and communications.
③	**Display Hold:** The two terminals may be wired to a thermal switch or cut-out to freeze the displayed well temperature when the device opens or closes.
④	**RS-232 Serial Port:** This DB-9 connector is for interfacing the calibrator to a computer or terminal for serial RS-232 communications.
⑤	**Heater voltage selector switch:** This switch on Model 515 lets you change the calibrator’s ac supply voltage. For information on changing the supply voltage, see “Changing the Supply Voltage on Model 515”.

Figure 4. Models 515 and 517 Rear Panel Features



①	**Power Connector**: The power cord plugs into the power connector on the rear panel. Connect the cord to a standard 115 VAC grounded socket. (230 VAC optional)
②	**Fuse Holders**: Model 518 has four user accessible fuse holders. The two fuses on the left are for the cold side of the calibrator; the two fuses on the right are for the hot side. **⚠Warning** **To avoid electric shock, burns, or damage to equipment always replace the fuse with one of the correct rating, voltage, and type.**
③	**Serial Port**: This DB-9 connector is for interfacing the calibrator to a computer or terminal for serial RS-232 communications.

Figure 5. Model 518 Rear Panel Features

Cooling Fan

The fan inside the calibrator runs continuously to cool the calibrator during operation. Slots at the top and around the four corners of the calibrator are provided for airflow. The area around the calibrator must be kept clear to allow adequate ventilation. The airflow around the block is directed upward and can be extremely hot.

Constant Temperature Block Assembly

The constant temperature block provides a relatively constant and accurate temperature environment for the sensors to be calibrated. The block in Models 514 and 517 is made of aluminum. The block in Model 515 is made of aluminum-bronze. The block in the cold side of Model 518 is aluminum and the block in the hot side is aluminum-bronze. The holes in the blocks may be used for sensors of that size or may be reduced with various sized inserts. Attached to the block in Models 514, 517, and the cold side of 518 are Peltier thermoelectric modules that heat or cool the block to maintain a constant temperature. A high-quality platinum RTD embedded in the block senses the temperature and provides feedback to the temperature controller.

Figures 6 through 8 show the blocks for each model of calibrator.

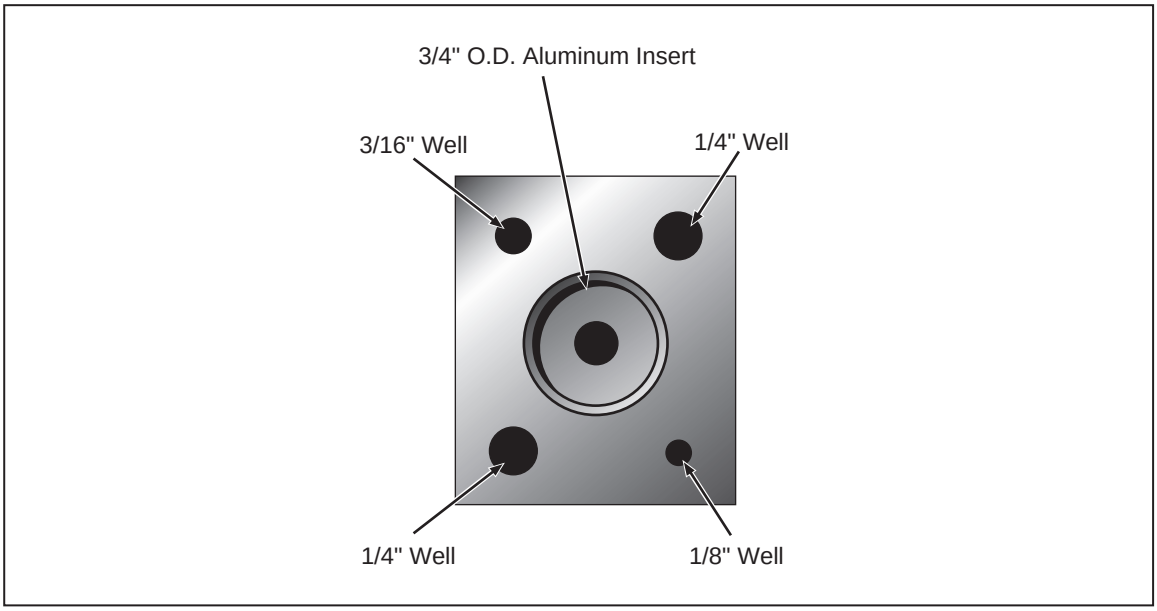


Figure 6. Constant Temperature Block Assembly for Models 514 and 517

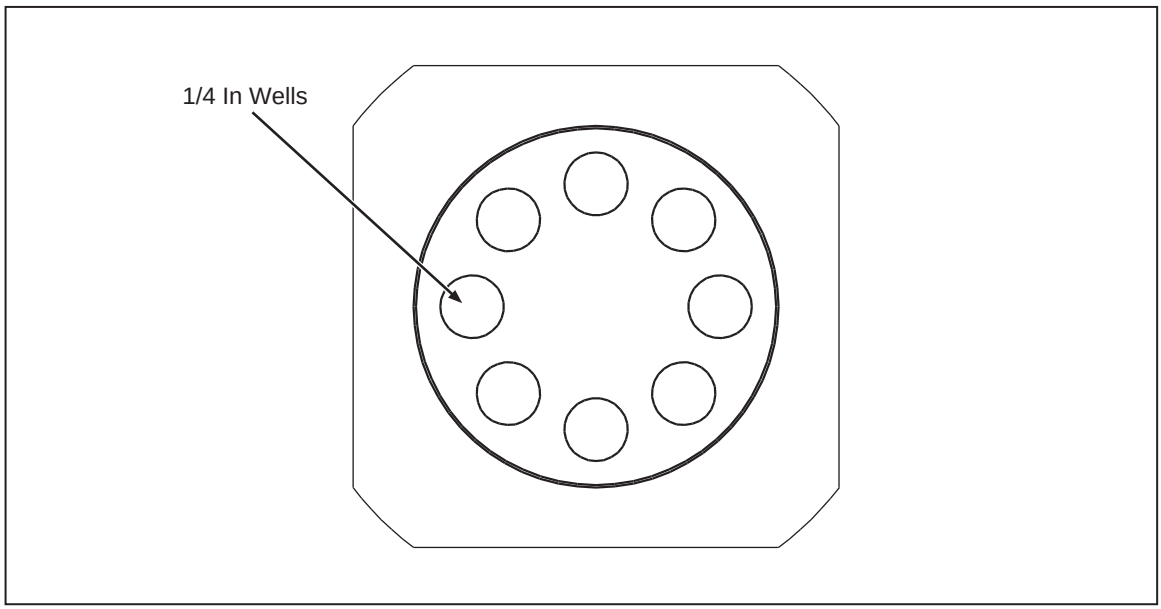


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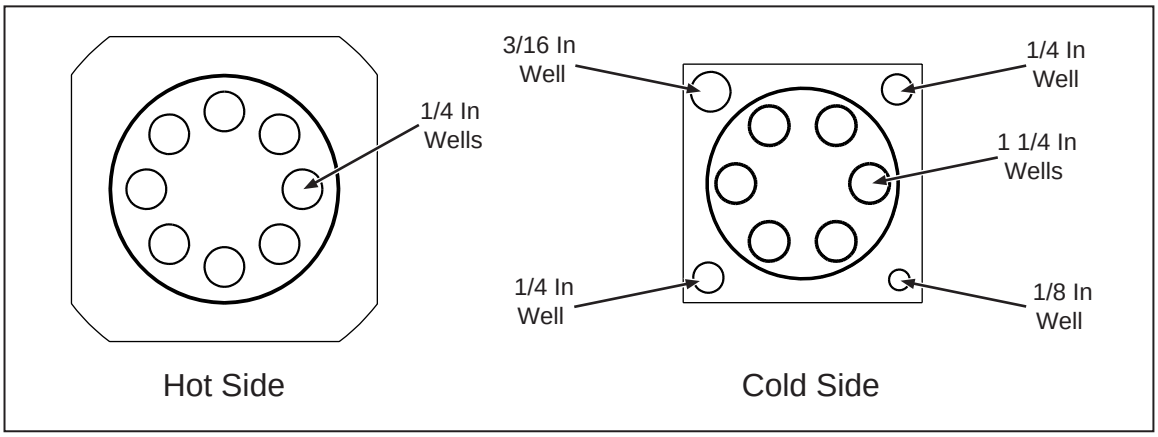
Figure 7. Constant Temperature Block Assembly for Model 515



abv16f.eps

Figure 8. Constant Temperature Block Assemblies for Model 518

Inserts and Tongs

Inserts with various internal hole sizes are available to provide a snug fit for probes of any diameter. Tables 6 through 8 list the inserts available for each model.

Tongs supplied with the calibrator let you safely insert and remove inserts from the block.

⚠Warning
Do not remove inserts while the calibrator is hot.

Table 6. Inserts for Models 514 and 517

Insert's Internal Hole Size	Fluke Part Number
Blank	1546612
1/16 in (1.59 mm)	1560613
1/8 in (3.18 mm)	667532
5/32 in (3.97 mm)	1560624
3/16 in (4.76 mm)	667535
1/4 in (6.35 mm)	1560636
5/16 in (7.94 mm)	667540
3/8 in (9.53 mm)	1560649
1/2 in (12.70 mm)	1560651
5/8 in (15.88 mm)	1560660
1 user-specified hole	1560672
2 user-specified holes	1560685

Table 7. Inserts for Model 515 and Hot Side of Model 518

Insert's Internal Hole Sizes	Fluke Part Number
Blank	667565
Variety comparison insert: Two 3/16 in (4.76 mm) holes, two 1/4 in (6.35 mm) holes, two 3/8 in (9.53 mm) holes	667568
Variety insert: 1/16 in (1.59 mm), 1/8 in (3.18 mm), 3/16 in (4.76 mm), 1/4 in (6.35 mm), 3/8 in (9.53 mm), 1/2 in (12.70 mm) holes	1560697
Comparison insert: Eight 1/4 in (6.35 mm) holes	667573

Table 8. Inserts for Cold Side of Model 518

Insert's Internal Hole Size	Fluke Part Number
Blank	1288309
Variety comparison insert: Two 3/16 in (4.76 mm) holes, two 1/4 in (6.35 mm) holes, two 3/8 in (9.53 mm) holes	1288327
Variety insert: 1/16 in (1.59 mm), 1/8 in (3.18 mm), 3/16 in (4.76 mm), 1/4 in (6.35 mm), 3/8 in (9.53 mm), 1/2 in (12.70 mm) holes	1288311
Comparison insert: Six 1/4 in (6.35 mm) holes	1546647

Well Insulator for Model 517

Model 517 includes a well insulator made of white polymer foam that fits into the opening above the block (see Figure 9). The well insulator has three purposes:

- It insulates the top of the block to minimize the vertical temperature gradient in the block.
- It insulates the top of the block to prevent excessive heat from flowing into or out of the block, which may prevent it from reaching its minimum or maximum temperatures.
- It shields the top of the block from open air, thus reducing the potential for excessive water condensation on the block. Excessive water on the block can cause corrosion over a long period of time. Water condensation that freezes expands and can damage the block.

For these reasons, Model 517 must always have the well insulator installed during operation. The well insulator fits snugly into the rectangular cavity just above the block. For best results, do not push the well insulator all the way down into the cavity. Instead, leave the top of the well insulator flush with the top of the cavity. Insert probes through the slots in the well insulator.

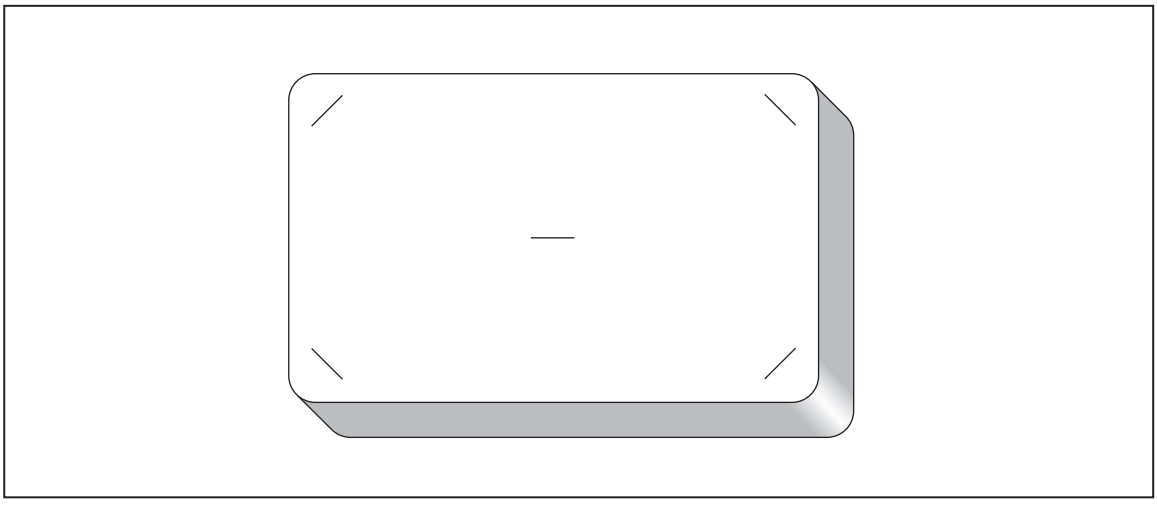


Figure 9. Well Insulator for Model 517

Tips for Calibrating Probes

Following are some tips for calibrating probes:

- Probes inserted into the block may be compared to the well temperature displayed on the front panel of the calibrator. The probes should be inserted the full depth of the well since the temperature at the bottom of the well most closely agrees with the displayed temperature.
- For greater accuracy when using a calibrator with multiple wells, the probes may be compared to a reference thermometer inserted into the block. The reference thermometer may be inserted into one hole while the probes to be calibrated are inserted into another. A disadvantage to this method is that temperature variations throughout the block may cause a small temperature difference between one hole and another, which can cause errors.
- Using the same hole for the reference thermometer and the test probe may produce better results. This, however, requires switching the probes, which takes more time. You must allow a few minutes after inserting the probes for the temperature to stabilize before making measurements. Because of temperature variations along the depth of the well, best results are obtained when comparing probes of similar construction and inserting them the same depth into the well.
- Using the same diameter probes, switch them between holes several times to reduce the uncertainty of the measurement caused by fit and well gradients. For precise measurements, you should determine the measurement uncertainty.

Operating the Calibrator

This section discusses in detail how to operate the calibrator using the front control panel. Using the front panel keys and LED display, you can do the following:

- Monitor the well temperature.
- Reset the heater cut-out.
- Set the temperature set-point in degrees C or F.
- Set a scan rate for the well temperature.
- Use the display hold feature to test a thermal switch.
- Set up ramp and soak programs.
- Monitor the heater output power.
- Adjust the controller’s proportional band.
- Program the probe calibration parameters, operating parameters, serial and IEEE-488 interface configuration, and controller calibration parameters.

Figures 10 through 12 summarize the operation of the control panel.

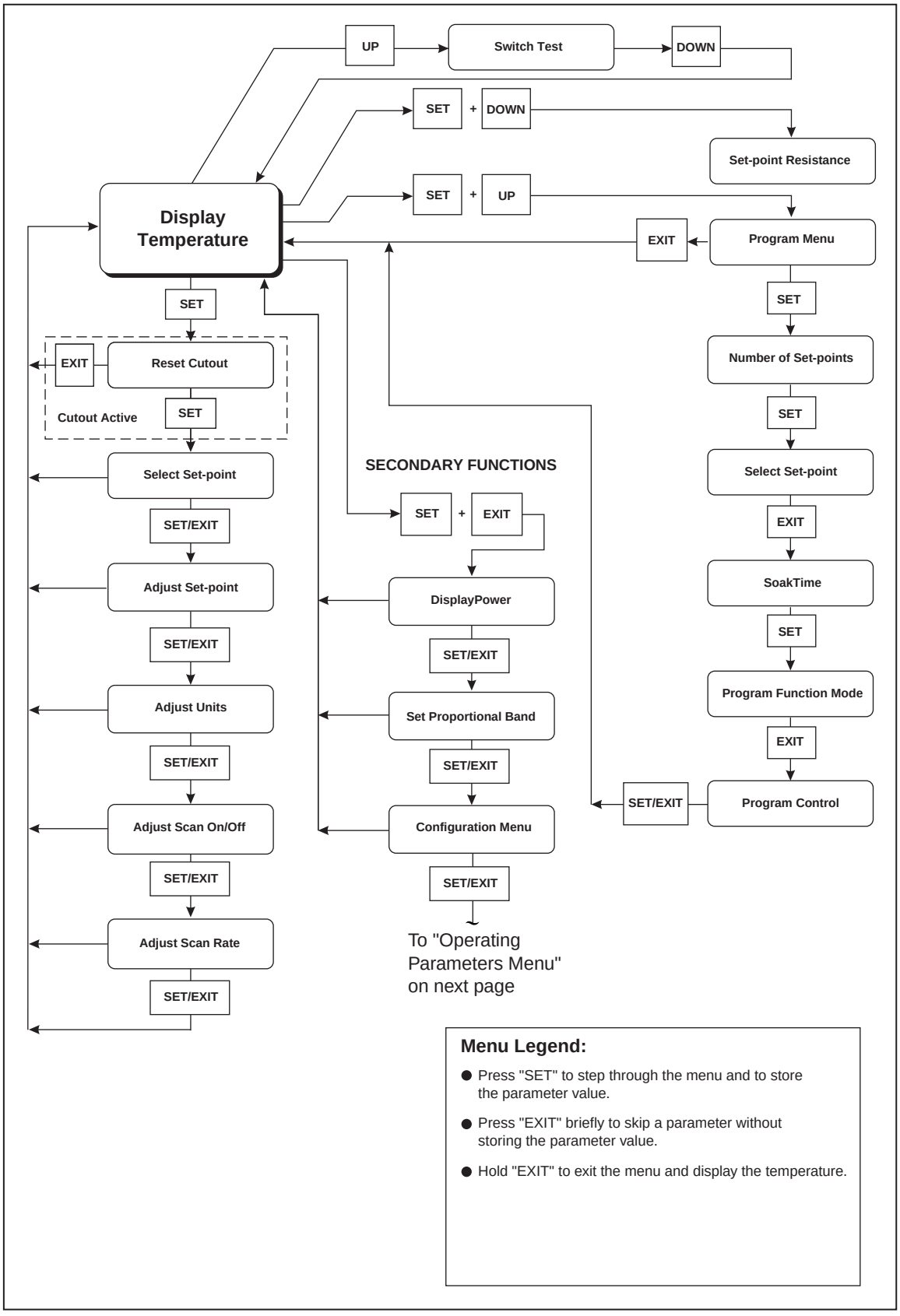


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Figure 10. Flowchart of Calibrator Functions (Part 1) for All Models

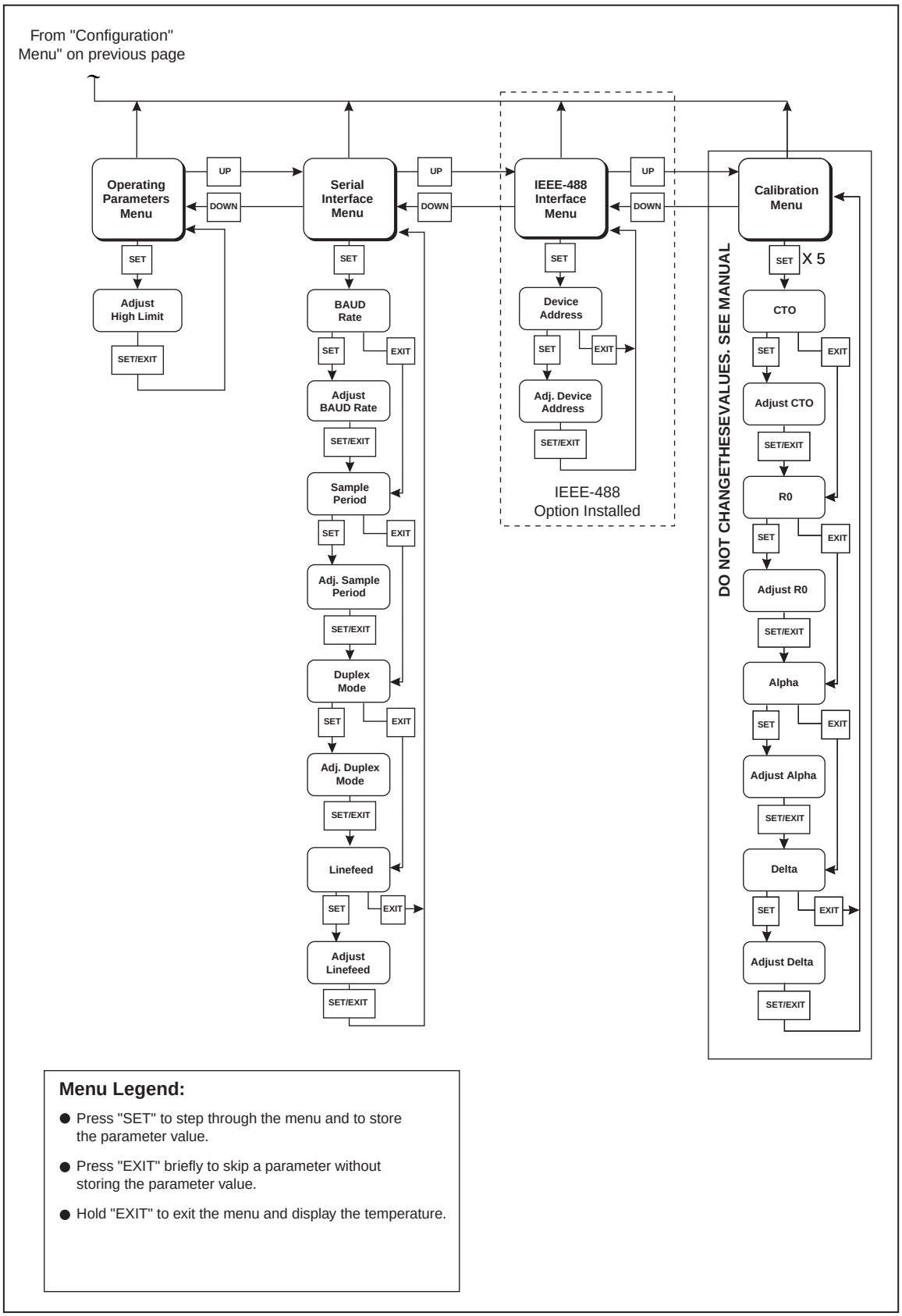

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Figure 11. Flowchart of Calibrator Functions (Part 2) for Model 515

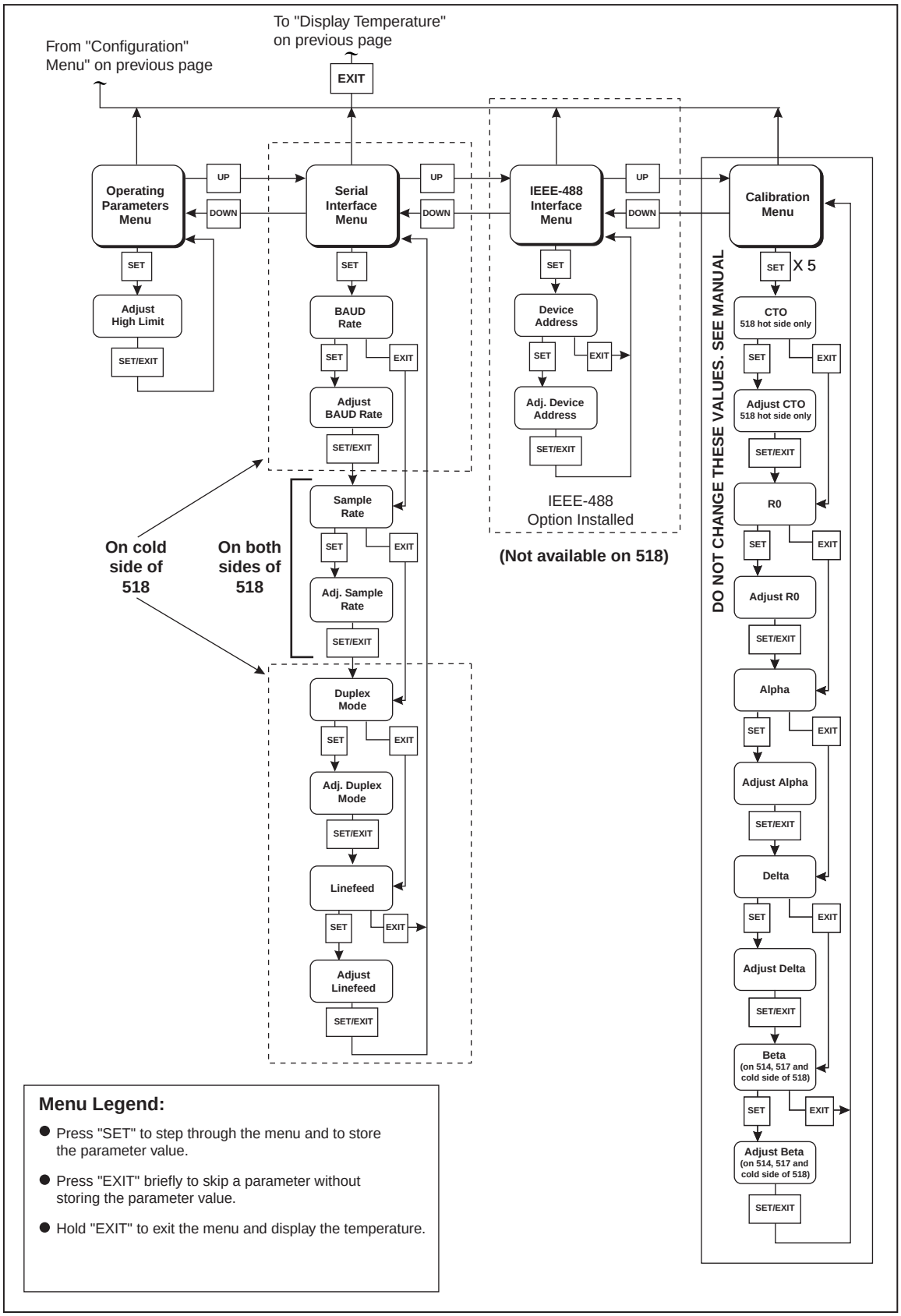

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Figure 12. Flowchart of Calibrator Functions (Part 2) for Models 514/517/518

Monitoring the Well Temperature

The digital LED display on the front panel allows direct viewing of the actual well temperature. This temperature value is what is normally shown on the display. The units, C or F, of the temperature value are displayed at the right, as shown below:

20.00 C	*Well temperature in degrees Celsius*

You can access the temperature display function from other functions by holding down the **EXIT** key for 2 seconds.

Resetting the Heater Cut-Out

If the over-temperature cut-out has been triggered, power to the heater is shut off and the temperature display will flash the following message:

cut-out	*Indicates cut-out condition (flashing display)*

The message continues to flash until the temperature is reduced and the cut-out is reset.

The cut-out must be reset by the operator after the temperature falls below the set-point.

When the cut-out has been triggered, the display flashes “cut-out” until you reset the cut-out. To access the reset cut-out function press **SET**.


SET

Access the cut-out reset function

The display indicates the reset function:

rESEt ?	*Cut-out has been triggered, with the reset mode set to manual*

Press **SET** once more to reset the cut-out.


SET

Reset cut-out

Resetting the cut-out also switches the display to the set temperature function. To return to displaying the well temperature, press **EXIT**. If the cut-out circuit is still in the over-temperature fault condition the display continues to flash “cut-out”. The well temperature must drop a few degrees below the cut-out set-point before the cut-out can be reset.

Setting the Temperature Set-Point

You can set the temperature set-point to any value within the calibrator’s operating range and with resolution as given in the specifications. Be careful not to exceed the safe upper temperature limit of any device inserted into the well. The high limit should be properly adjusted to help prevent this occurrence.

Setting the temperature involves two steps: (1) selecting the set-point memory and (2) adjusting the set-point value.

Accessing the Programmable Set-Points

The controller stores 8 set-point temperatures in memory. The set-points can be quickly recalled to set the calibrator to a previously programmed temperature.

To set the temperature, you must first select the set-point memory. This function is accessed from the temperature display function by pressing **SET**. The number of the set-point memory currently being used is shown at the left on the display, followed by the current set-point value.

20.00 C	*Well temperature in degrees Celsius*

Access set-point memory

1. 20.0	*Set-point memory 1 (20.0 °C) currently used*

To change the set-point memory location, press **UP** or **DOWN**.

3. -10.0	*New set-point memory 3, –10.0 °C*

Press **SET** to accept the new selection and access the set-point value.

Accept selected set-point memory

Adjusting a Set-Point Value

The set-point value may be adjusted after selecting the set-point memory and pressing **SET**. The set-point value is displayed with the units, C or F, at the left.

C -10.0	*Set-point 3 value in °C*

If the set-point value need not be changed then press **EXIT** to resume displaying the well temperature. Press **UP** or **DOWN** to adjust the set-point value.

C -12.00	*New set-point value*

When the desired set-point value is reached, press **SET** to accept the new value and access the temperature scale units selection. If you press **EXIT**, any changes made to the set-point are ignored.

Accept new set-point value

Temperature Scale Units

You can set the controller's temperature scale units to degrees Celsius (°C) or Fahrenheit (°F). The units are used to display the well temperature and set-points.

After adjusting the set-point value, press **SET** to change display units.

Access display units

Un : C

Scale units currently selected

Press **UP** or **DOWN** to change the units.

Un : F

New units selected

Setting a Scan Rate

The scan rate can be set and enabled so that when the set-point is changed the dry-block will heat or cool at a specified rate (degrees per minute) until it reaches the new set-point. With the scan disabled, the dry-block will heat or cool at the maximum possible rate.

Enabling or Disabling Scanning

The scan is controlled with the scan on/off function that appears in the main menu after the set-point function.

Sc : OFF

Model 518: Scan function off

ScAn: OFF

Models 514, 515, and 517: Scan function off

Press **UP** or **DOWN** to toggle the scan on or off.

Sc : On

Model 518: Scan function on

ScAn: On

Models 514, 515, and 517: Scan function on

Press **SET** to accept the present setting and continue.

Accept scan setting

Scan Rate

The next function in the main menu is the scan rate. On Models 514, 515, 517, and 518 the scan rate can be set from 0.1 °C/min to 100 °C/min. The maximum scan rate is limited by the natural heating or cooling rate of the calibrator. This is often less than 100 °C/min, especially when cooling.

The scan rate function appears in the main menu after the scan control function. The scan rate units are in degrees per minute (C or F depending on the selected units).

Sr: 10.0	*Scan rate in °C/min*

Press **UP** or **DOWN** to change the scan rate.

Sr: 2.0	*New scan rate*

Press **SET** to accept the new scan rate and continue.

Accept the scan rate

Testing a Thermal Switch

The calibrator has a switch test function that allows an external switch to freeze the displayed temperature and stop the set-point from scanning. This function is useful for testing thermal switches. This section explains the switch test and provides an example describing how to set up and use this feature.

Enabling the Switch Test

To enable the switch test feature, press **UP** when the temperature is displayed. The switch test display shows the temperature on the right and the switch status on the left. The status "c" means the switch is closed; "o" means the switch is open. The status flashes when the switch is active (opposite the normal position). When a new set-point is selected, the new status becomes the normal position.

103.5 C	*Well temperature in degrees Celsius*

Access switch test

c 103.5	*Switch status and temperature (switch closed)*

To return to the well temperature display, press **DOWN**.

Display Hold

Display hold mode is active when the switch test and scan functions are enabled. This mode automatically stores a new set-point when the thermal switch changes states.

Switch Wiring

Wire the thermal switch to the back of the calibrator at the two terminals labeled "DISPLAY HOLD". You can connect the switch wires to the terminals either way. Internally, the black terminal connects to ground; the red terminal connects to +5 V through a 100 kΩ resistor. The calibrator measures the voltage at the red terminal and interprets +5 V as an open switch and 0 V as a closed switch.

Switch Test Example

This section describes how to set up and operate the calibrator for an example application of the switch test feature.

In this example, you have a thermal switch that is supposed to open at about 75 °C and close at about 50 °C. You can use the switch test feature and the scan function to test the accuracy and repeatability of the switch's response. You can read measurements on the display or, preferably, collect the data using a computer connected to the RS-232 port.

To set up the test, follow the steps below:

1. Connect the switch wires to the "DISPLAY HOLD" terminals on the back of the calibrator. Place the switch in the well.
2. Enable the set-point scanning by setting the scan to "ON" in the primary menu (see "Enabling or Disabling Scanning").
3. Set the scan rate to a low value, 1.0 °C/ min for example (see "Scan Rate"). If the scan rate is too high you may lose accuracy because of transient temperature gradients. If the scan rate is too low the duration of the test may be longer than necessary. You may need to experiment to find the best scan rate.
4. Set the first program set-point to a value above the expected upper switch temperature, for example 90 °C.
5. Set the second program set-point to a value below the expected lower switch temperature, for example 40 °C.
6. Collect data on a computer connected to the RS-232 port. Refer to "Digital Communications" for instructions on configuring the RS-232 communications interface.

Ramp and Soak Program Menu

The ramp and soak program feature lets you program a number of temperature set-points and have the dry-block automatically cycle between the temperatures, holding at each for a specified length of time. You can select one of four different cycle functions.

The program parameter menu is accessed by pressing **SET** and then **UP**.

Well temperature

Access program menu

Flashes "ProG" for program menu; then enters the menu.

Setting the Number of Program Set-points

The first parameter in the program menu is the number of set-points to cycle through. You can use up to 8 set-points in a ramp and soak program.

Pn: 8	*Number of program set-points*

Use the **UP** or **DOWN** buttons to change the number from 2 to 8.

Pn: 3	*New number of program set-points*

Press **SET** to continue. If you press **EXIT**, any changes made to the parameter to be ignored.


SET *Save new setting*

Setting the Temperature Set-Points

The next parameters are the program set-points.

1 25.0	*First set-point*

Use **UP** or **DOWN** to select any of the set-points.

3 10.0	*Third set-point*

Press **SET** to change the set-point.

[10.00	*Set-point value*

Use **UP** and **DOWN** to change the set-point value.

[13.50	*New set-point value*

Press **SET** to save the new set-point value.

The other set-points can also be set in the same manner. Once the set-points are programmed as desired press **EXIT** to continue.


EXIT *Continue to the next menu function*

Setting the Program Soak Time

The next parameter in the program menu is the soak time. This is the time, in minutes, for which each of the program set-points is maintained (after settling) before proceeding to the next set-point. The duration is counted from the time the temperature settles to within a specified stability. You can set the stability requirement in the parameter menu as explained in "Setting the Calibrator's Operating Parameters". The default is ±0.1 °C.

Pt : 15	*Soak time in minutes*

Use **UP** or **DOWN** to change the time.

Pt : 5	*New soak time*

Press **SET** to continue.

Save new setting

Selecting a Program Function Mode

The next parameter is the program function mode. There are four modes: (1) the program scans up (from set-point 1 to n) only, (2) the program scans both up and down (from set-point n to 1), (3) the program stops after one cycle, and (4) the program repeats the cycle indefinitely. Table 9 summarizes the four program mode settings.

Table 9. Ramp and Soak Program Modes

Function	Action
1	up-stop
2	up-down-stop
3	up-repeat
4	up-down-repeat

PF: 1	*Program mode*

Use **UP** or **DOWN** to change the mode.

PF: 4	*New mode*

Press **SET** to continue.

Save new setting

Starting and Stopping the Program

The final parameter in the program menu is the control parameter. You may choose from three options: (1) start the program from the beginning, (2) continue the program from where it was when it was stopped, (3) or stop the program.

Pr: OFF	*Program presently off*

Use **UP** or **DOWN** to change the status.

Pr: StArt	*Start cycle from the beginning*

Press **SET** to activate the new program control command and return to the temperature display.

Activate the new command

Secondary Functions

Functions used less often are available in the secondary menu. *You can access the secondary menu by pressing* **SET** *and* **EXIT** *simultaneously and then releasing the buttons.* The first function in the secondary menu is the heater power display.

Monitoring the Heating Power

The temperature controller controls the temperature of the well by heating or cooling the well with the thermoelectric modules or triacs (depending on the model). The amount of heating or cooling power depends on the temperature set-point of the well. This heating (or cooling) power value may be estimated by watching the red/green LED or read directly from the digital display. By knowing the amount of heating, the user can tell if the calibrator is heating up to the set-point, cooling down, or maintaining a constant temperature. The fluctuations in the heater power percentage represent the stability of the well temperature. With good stability, the heating power percentage should not fluctuate more than ±1 % within one minute.

The heater power display is accessed in the secondary menu. Press **SET** and **EXIT** simultaneously, then release the buttons. The heater power is displayed as a percentage of full power.

20.00 C	*Well temperature*

Access the heater power in the secondary menu

SEC	*Flashes "SEC" for secondary menu; then displays the heater power*
-12 Pct	*Heater power in percent*

For Models 514, 517, and the cold side of 518, negative numbers indicate the well is being cooled. Negative 100 % means the well is being cooled at maximum power. Zero percent means the well requires neither heating nor cooling. One-hundred percent means the well is being heated at maximum power.

For Model 515 and the hot side of 518, zero percent means maximum cooling (no heater power is applied). The power percentage is never negative for these models.

To exit out of the secondary menu press **EXIT**. To continue on to the proportional band setting function press **SET**.

Setting the Proportional Band

In a proportional controller such as this, the heater output power is proportional to the well temperature over a limited range of temperatures around the set-point. This range of temperature is called the proportional band. At the bottom of the proportional band the heating is 100 %. At the top of the proportional band the cooling is 100 %. Thus, as the temperature rises the heater power is reduced, which tends to lower the temperature back down. In this way, a fairly constant temperature is maintained.

The well's temperature stability and response time depend on the width of the proportional band. See Figure 13. If the band is too wide the well temperature will deviate excessively from the set-point due to varying external conditions. This is because the heater power changes very little with temperature and the controller cannot respond very well to changing conditions or electrical or thermal noise in the system. If the proportional band is too narrow the temperature may swing back and forth because the controller overreacts to temperature variations. For best control stability the proportional band must be set for the optimum width.

The proportional band width is set at the factory and printed on the Report of Calibration included with all models. The proportional band width may be altered by the user if he desires to optimize the control characteristics for a particular application.

The proportional band width is easily adjusted from the front panel. The width may be set to discrete values in degrees C or F depending on the selected units. The proportional band adjustment is accessed within the secondary menu. *Press* **SET** *and* **EXIT** *to enter the secondary menu and show the heater power.*

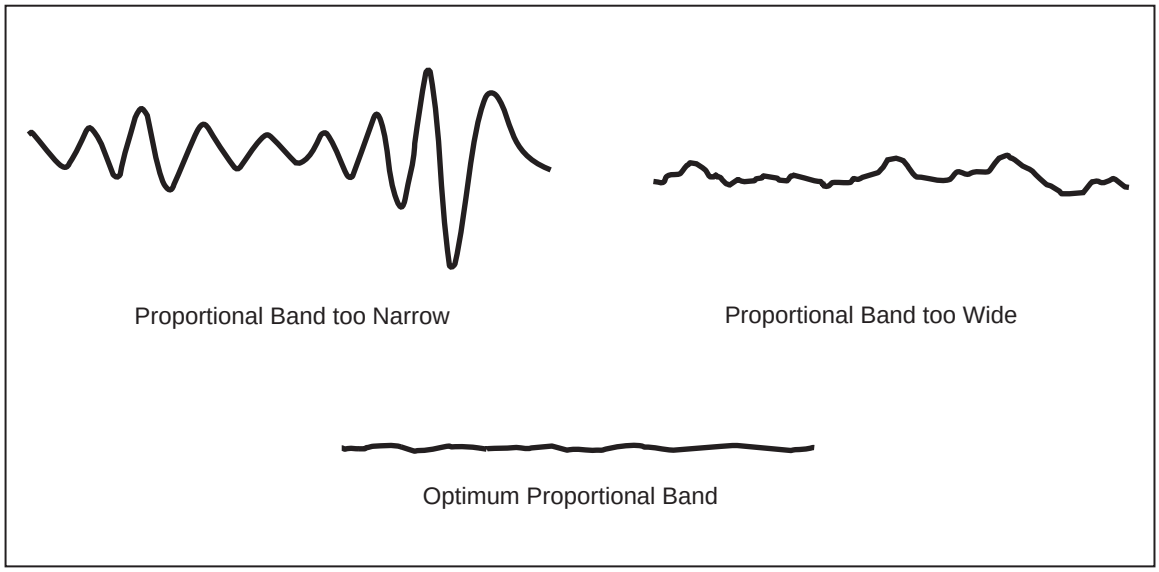


Figure 13. Well Temperature Fluctuation at Various Proportional Band Settings

Access the secondary menu

SEC

Flashes "SEC" for secondary menu, then displays the heater power

-12 Pct

Heater power in percent

Access the proportional band setting

PrOP

Model 518: Flashes "PrOP" for proportional band setting, then displays the setting

5.0

Model 518: Proportional band setting

Pb:523 C

Models 514, 515, and 517: Proportional band setting

To change the proportional band press **UP** or **DOWN.**

7.0

New proportional band setting

To accept the new setting and continue, press **SET**. *Pressing* **EXIT** *will exit the secondary menu without making changes to the proportional band value.*

Accept the new proportional band setting

Configuring the Temperature Controller

The calibrator's temperature controller has a number of configuration and operating options and calibration parameters that are programmable from the front panel. *These are accessed from the secondary menu*. There are 4 sets of configuration parameters: operating parameters, serial interface parameters (if applicable), IEEE-488 interface parameters (if applicable), and controller calibration parameters. *The menus are selected using* **UP** *and* **DOWN** *and then pressing* **SET.**

Press **SET** to enter the configuration menu.

ConF iG?

Flashes "ConFiG?" to designate the beginning of the menu

Setting the High Limit Parameters

Use the high limit parameter to adjust the upper set-point temperature, which automatically sets the soft cut-out. For safety, you can reduce the high limit parameter to restrict the maximum temperature set-point.

The high limit parameter is in the operating parameters menu, which is indicated by the following:

PAr	*Operating parameters menu*

Press **SET** to enter the menu.

Press **SET** again to enable adjustment of the high limit parameter.

H: 126	*Model 518: Current high limit setting*
HL: 126C	*Models 514, 515, and 517: Current high limit setting*

Adjust the parameter using **UP** or **DOWN.**

H: 90	*Model 518: New high limit setting*
HL: 90C	*Models 514, 515, and 517: New high limit setting*

Press **SET** to accept the new high limit parameter.

Serial Interface Parameters

The serial interface parameters menu controls the operation of the serial interface. These controls only apply to calibrators fitted with the serial interface. The parameters in the menu are baud rate, sample period, duplex mode, and linefeed. See “RS-232 Communications” for instructions on using the serial interface.

IEEE-488 Parameters

The calibrator may optionally be fitted with an IEEE-488 GPIB interface. In this case the user may set the interface address within the IEEE-488 parameter menu. This menu does not appear on instruments not fitted with the interface. See “IEEE-488 Communications” for instructions on using the IEEE-488 interface.

Calibration Parameters

You can access a number of the instrument calibration constants, such as CTO, RO, ALPHA, DELTA, and BETA (Models 514, 517, and 518). These values are set at the factory and must not be altered. The correct values are important to the accuracy and proper and safe operation of the calibrator. Access to these parameters is available only so that if the controller's memory fails, you can restore these values to the factory settings. The report of calibration lists these constants and their settings.

⚠Caution

Do not change the values of the calibration constants from the factory set values. The correct setting of these parameters is important for the safety and proper operation of the calibrator.

The calibration parameters menu is indicated by the following:

CAL	*Calibrations parameters menu*

Press **SET** five times to enter the menu.

Parameter CTO sets the calibration of the over-temperature cut-out. This parameter is adjusted with an internal potentiometer only by qualified service technicians. For Models 514 and 517, this parameter should read between 150 and 170. For Model 515, this parameter should read between 610 and 630. For Model 518, the cold side does not have the CTO parameter and the hot side should read between 680 and 690.

Methods for Calibrating Probes

For optimum accuracy and stability, allow Models 514 or 517 to warm up for 10 minutes after power-up. Allow Models 515 or 518 to warm up for 30 minutes. After warm-up, allow adequate stabilization time after reaching the set-point temperature. After completing calibration, allow the block to cool before switching the power off.

For information on automating your testing, contact Fluke Corporation.

Direct Calibration

Direct calibration involves testing a probe directly against the dry-block's temperature display. The method has the advantage of being quick and easy.

Insert the probe to be calibrated into the well of the dry-block calibrator. The probe should fit snugly in the calibrator, yet should not be so tight that it cannot be easily removed. Remove any dirt or grit that may cause the probe to jam in the insert. For best results, insert the probe to the full depth of the well. Once the probe is inserted into the well, allow adequate stabilization time to allow the test probe temperature to settle as described. Once the probe has settled to the temperature of the well, it may be compared to the calibrator display temperature. The display temperature should be stable to within 0.1 °C for best results.

⚠Caution

Never allow foreign material into the probe holes. Fluids and other materials can damage the calibrator or cause binding and damage to your probe.

Comparison Calibration

Comparison calibration involves testing a probe against a similar reference probe. This method can be more accurate because errors due to dry-block tolerances, the stem effect, and temperature gradients are reduced.

After inserting the probes to be calibrated, allow sufficient time for the probes to settle and the temperature of the dry-block to stabilize.

Both the reference probe and the probe under test should be the same size and construction. Probes with different lengths, diameters and materials have different stem effects, causing an unknown temperature difference. All dry-blocks have horizontal and vertical gradients that change with temperature. This is an unknown variable that can be factored out if probes are the same type, length, diameter, and material. Probes should be inserted to the same depth in the well.

Use the following procedure to calibrate a probe against a reference while eliminating error due to temperature gradients between wells.

1. Place the reference probe in one well.
2. Place the probe to be calibrated in another well.
3. After allowing the probe temperatures to settle, take a temperature reading from each.
4. Swap the locations of the reference probe and probe under test. Allow plenty of time for thermal settling.
5. Make another set of temperature readings from the reference probe and the probe under test.
6. Average the two readings of the reference probe. Average the two readings of the probe under test. Averaging the two readings eliminates error due to temperature gradients between the two wells.
7. You may now compare the averaged reading of the probe under test with the averaged reading of the reference probe.

For best results repeat the test several times at the same temperature and at different temperatures.

You can use this method with different types of probes but you must determine the uncertainty of the measurement.

Calibrating Multiple Probes

Fully loading the calibrator with probes increases the time required for the temperature to stabilize after inserting the probes. Be sure that the temperature has stabilized before starting the calibration.

You can calibrate multiple probes simultaneously by using either the direct or comparison calibration method. Stem effect will cause less error in the comparison calibration method than with the direct calibration method.

Dry-Block Characteristics

Understanding the thermal characteristics of the dry-block calibrator can help you achieve the best accuracy and efficiency possible.

Vertical Gradient

Heat losses from the top of the calibrator create a vertical temperature gradient in the well. The heater has been applied to the block in a way that compensates for nominal heat losses from the top of the dry-block and minimizes vertical temperature gradients. However, actual heat losses will vary depending on the number and types of probes inserted into the calibrator and the block temperature. For best results, insert probes the full depth of well.

Stabilization and Accuracy

The stabilization time for the dry-block calibrator depends on the conditions and temperatures involved. Table 5 near the beginning of this manual shows the heating and stabilization times for each model of the calibrator.

Another period of stabilization is required after a cold probe is inserted into a well. The stabilization time depends on the magnitude of the thermal disturbance and the accuracy required. For example, a ¼ inch diameter room-temperature probe inserted into a 300 °C hole will take approximately 5 minutes to be within 0.1 °C of its set-point and will take 10 minutes to achieve maximum stability.

You can decrease the calibration time by knowing how soon to make measurements. These times can be established by making typical measurements at the desired temperatures with the desired test probes.

Digital Communication Interface

The dry-block calibrator can communicate with and be controlled by other equipment through the digital interface. You can use remote communications equipment to set the set-point temperature, monitor the temperature, and access any of the other controller functions. Two types of digital interface are available: the RS-232 serial interface and the optional IEEE-488 GPIB interface.

RS-232 Communications

The calibrator is installed with an RS-232 serial interface that allows serial digital communications over fairly long distances. With the serial interface the user may access any of the functions, parameters and settings discussed under “Operating the Calibrator”, with the exception of the baud rate setting.

For Model 518, the baud rate, duplex made, and linefeed are set using the cold side commands (C:). The sample rate can be set for both the cold and hot side.

Cable Wiring and Data Protocol

The serial communications cable attaches to the DB-9 connector at the back of the calibrator.

Figure 14 shows the pin-out of this connector and suggested cable wiring. To eliminate noise, the serial cable should be shielded with low resistance between the connector (DB9) and the shield.

The serial interface uses 8 data bits, one stop bit, and no parity.

Setup

To use the RS-232 interface, you must set the baud rate and other configuration parameters. These parameters are accessed in the serial interface menu.

You can access the serial parameters menu as follows:

1. Enter the secondary functions menu by pressing **EXIT** and **SET** together; then releasing the buttons.
2. Press **SET** repeatedly until the display reads `ProbE`.
3. Press **UP** repeatedly until the display shows the following:

   `SErIAL` *Serial RS-232 interface parameters menu*

4. Press **SET** to enter the serial parameter menu. The menu includes the baud rate, the sample rate, the duplex mode, and the linefeed parameter.

Baud Rate

The baud rate is the first parameter in the menu. The baud rate setting determines the serial transmission rate.

`bAUd` *Flashes "bAUd" for baud rate, then displays the setting*

`2400 b` *Current baud rate*

You can set the baud rate to 300, 600, 1200, or 2400 baud. Use **UP** or **DOWN** to change the baud rate value; then press **SET**.

`1200 b` *New baud rate*

Sample Period

The sample period is the second parameter in the serial interface parameter menu. The sample period is the time period in seconds between temperature measurements transmitted from the serial interface. For example, if the sample rate is set to 5, the calibrator transmits the current measurement over the serial interface approximately every five seconds. The sampling is disabled with a sample period of 0.

`SAMPLE` *Flashes "SAMPLE" for sample rate, then displays the setting*

`SA:  1` *Current sample period in seconds*

Adjust the value with **UP** or **DOWN** and then use **SET** to set the sample rate to the displayed value.

`SA:  60` *New sample rate*

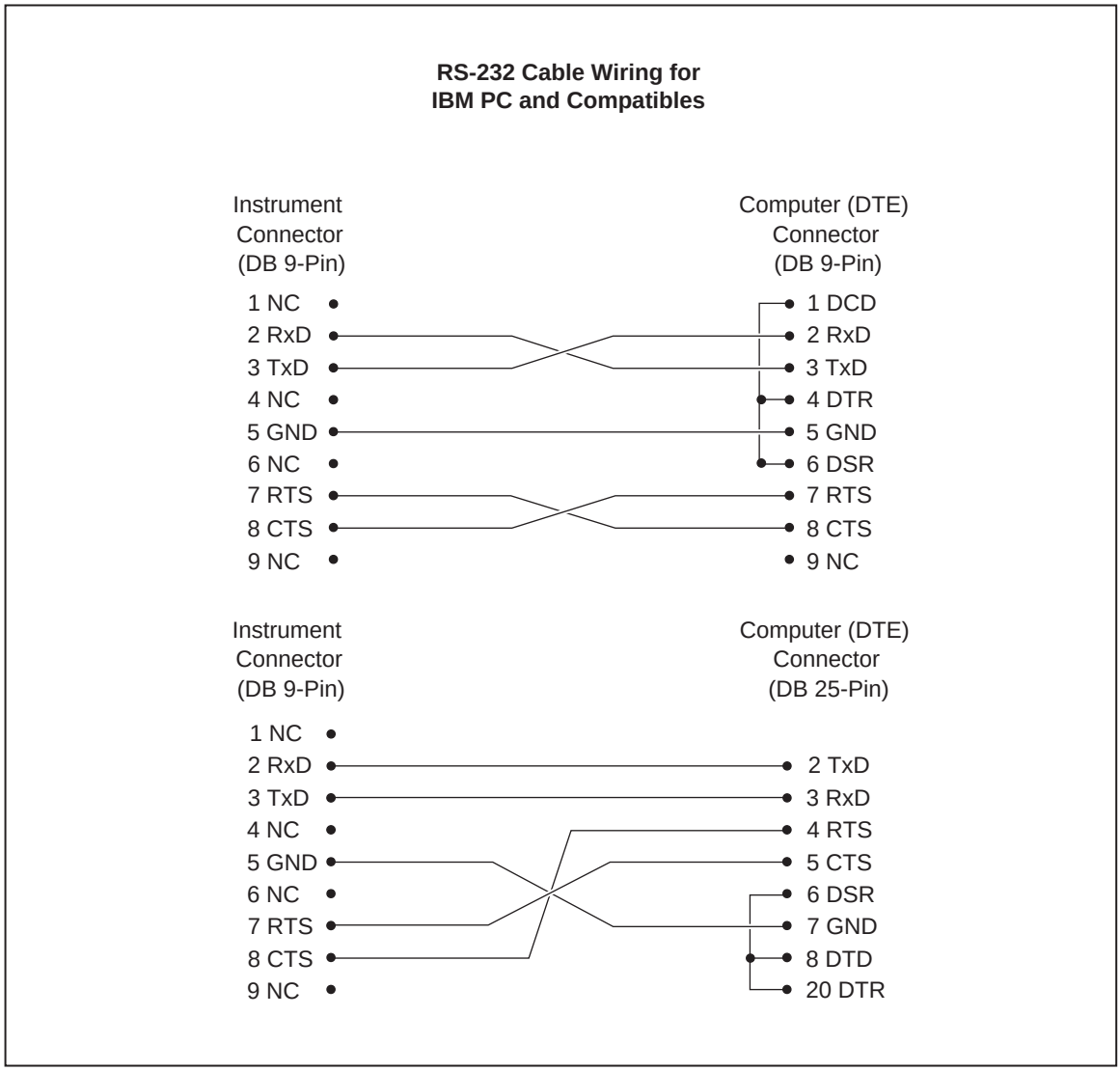


Figure 14. Serial Cable Wiring Diagram

Duplex Mode

The third parameter is the duplex mode. The duplex mode may be set to full duplex or half duplex. With full duplex, any commands received by the calibrator through the serial interface are immediately echoed or transmitted back to the device of origin. With half duplex, the commands are executed but not echoed.

dUPL	*Flashes "dUPL" for duplex mode, then displays the setting*
dUP:FUL	*Model 518: Current duplex mode setting (full duplex)*
dUP:FULL	*Models 514, 515, and 517: Current duplex mode setting (full duplex)*

Use **UP** or **DOWN** to change the mode; then press **SET**.

dUP:HAL	*Model 518: New duplex mode setting (half duplex)*
dUP:HALF	*Models 514, 515, and 517: New duplex mode setting (half duplex)*

Linefeed

The last parameter in the serial interface menu is the linefeed mode. This parameter enables (on) or disables (off) transmission of a linefeed character (LF, ASCII 10) after transmission of any carriage-return.

LF	*Flashes "LF" for linefeed, then displays the setting*
LF:On	*Current linefeed setting (on)*

Use **UP** or **DOWN** and to change the parameter; then press **SET**.

LF:OF	*Model 518: New linefeed setting (off)*
LF:OFF	*Models 514, 515, and 517: New linefeed setting (off)*

RS-232 Operation

Once you have attached the cable and properly set up the interface, the calibrator will immediately begin transmitting temperature readings at the programmed rate. The set-point and other commands may be sent by a remote device to set the temperature set-point and view or program the various parameters. The interface commands are discussed under "RS-232 and IEEE-488 Interface Commands". All commands are ASCII character strings terminated with a carriage-return character (CR, ASCII 13).

IEEE-488 Communications

The IEEE-488 interface is available as an option. Instruments supplied with this option may be connected to a GPIB type communication bus, which allows many instruments to be connected and controlled simultaneously. To eliminate noise, the GPIB cable should be shielded.

Setup

To use the IEEE-488 interface first connect an IEEE-488 standard cable to the back of the calibrator. Next set the device address. This parameter is programmed within the IEEE-488 interface menu. (The IEEE-488 interface parameters menu is outlined in Table 10.)

The menu is indicated by the following:

IEEE	_IEEE-488 parameters menu_

Press **SET** to enter the menu.

IEEE-488 Address

The IEEE-488 interface must be configured to use the same address as the external communicating device. The address is indicated by the following:

AddrESS	_IEEE-488 interface address_

Press **SET** to access the address setting.

Add: 22	_Current IEEE-488 interface address_

Adjust the value with **UP** or **DOWN** and then use **SET** to set the address to the displayed value.

Add: 15	_New IEEE-488 interface address_

Termination

The next parameter in the menu is the transmission termination character selection. The parameter is indicated on the display by “EOS”. It can be set to carriage return only (Cr), linefeed only (LF), or carriage return and linefeed. Regardless of the option selected, the instrument interprets either a carriage return or linefeed as a command termination during reception.

IEEE-488 Operation for Models 514, 515, and 517

Commands may now be sent via the IEEE-488 interface to read or set the temperature or access other controller functions. All commands are ASCII character strings and are terminated with a carriage-return (CR, ASCII 13). Interface commands are described in the section “RS-232 and IEEE Interface Commands”.

IEEE-488 Operation for Model 518

The IEEE-488 communication for Model 518 is managed by the calibrator’s serial connection and converted to IEEE via an external conversion box. Cables are provided for connection to a PC and to the instrument.

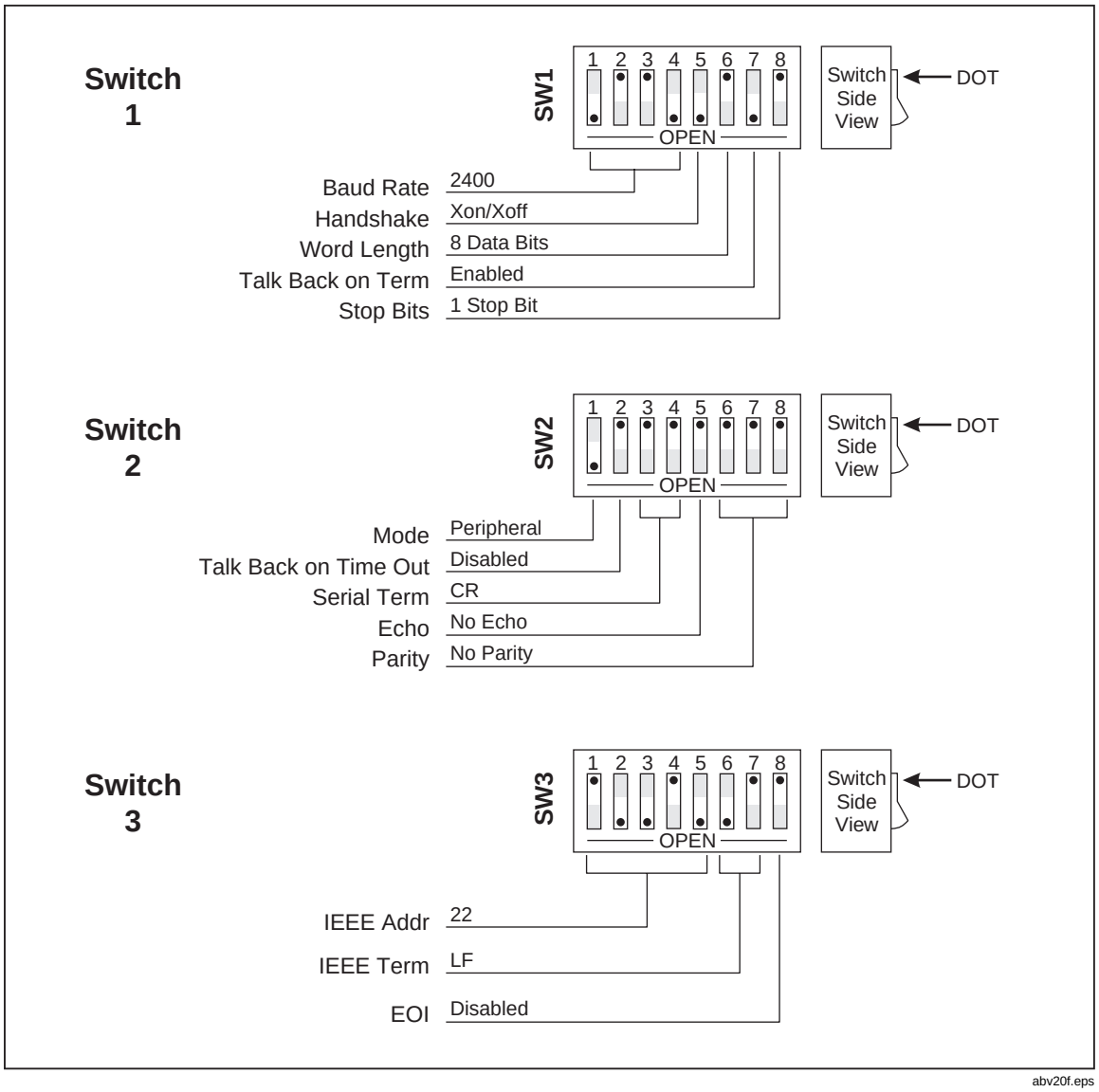
The IEEE converter box is configured at the factory and tested using IEEE address 22. Refer to the converter box manual, which is supplied with the box, for instructions on changing this address.

Note that for Model 518, all commands should be proceeded by a “C:” for the cold side or an “H:” for the hot side. Refer to Table 10 for a complete set of IEEE-488 commands.

To ensure proper communication with the IEEE converter box, make the following settings on the 518 calibrator's serial interface menu:

- Sample Period = 0
- Duplex = Half
- Line Feed = Off

The switches on the IEEE converter box are set at the factory for communication with the 518 calibrator. Figure 15 shows these switches and their factory settings.



abv20f.eps

Figure 15. IEEE Converter Box Switch Settings for Model 518

RS-232 and IEEE-488 Interface Commands

The commands for accessing the calibrator functions via the digital interfaces are shown in Table 10.

These commands are used with both the RS-232 serial interface and the IEEE-488 GPIB interface. In either case, the commands are terminated with a carriage-return character.

The interface makes no distinction between upper and lower case letters, hence either may be used. Commands may be abbreviated to the minimum number of letters that defines a unique command.

A command may be used to either set a parameter or display a parameter depending on whether or not a "=" character followed by a value is sent with the command. For example "s"<CR> returns the current set-point and "s=50.00"<CR> sets the set-point to 50.00 degrees.

In the following list of commands, characters or data within brackets, "[" and "]", are optional for the command. A slash, "/", denotes alternate characters or data. Numeric data, denoted by "n", may be entered in decimal or exponential notation.

Spaces may be added within command strings and will be ignored. Backspace (BS, ASCII 8) may be used to erase the previous character. A terminating CR is implied with all commands.

Note

For Model 518, all commands are preceded by either a "C:" for cold or an "H:" for hot. If the "C:" or "H:" are not used with the command, the command accesses the cold side functions.

Table 10. IEEE-488 Communication Commands

Command Description	Command Format	Command Example	Returned	Returned Example	Acceptable Values
Display Temperature					
Read current set-point	s[etpoint]	s	set: 9999.99 {C or F}	set: 150.00 C	
Set current set-point to n	s[etpoint]=n	s=450			Instrument Range
Read temperature units	u[nits]	u	u:{C or F}	u:C	
Set temperature units:	u[nits]=c/f				C or F
Set temperature units to Celsius	u[nits]=c	u=c			
Set temperature units to Fahrenheit	u[nits]=f	u=f			
Read scan function	sc[an]	sc	scan: {ON or OFF}	scan: ON	
Set scan function:	**sc[an]=on/of[f]**				ON or OFF
Turn scan function on	sc[an]=on	sc=on			
Turn scan function off	sc[an]=of[f]	sc-of			
Read scan rate	sr[ate]	sr	srat: 999.99 {C or F}/min	srat: 10.0 C/min	
Set scan rate to n degrees per minute	sr[ate]=n	sr=5			.1 to 100°C
Read temperature	t[emperature]	t	t: 9999.99 {C or F}	t: 55.69 C	
Read hold status	ho[ld]	ho	ho:{closed or open}, 9999.9 {C or F}	ho: open, 75.0 C	
Secondary Menu					
Read proportional band setting	pr[op-band]	pr	pb: 999.99	pb: 15.9	
Set proportional band to n	pr[op-band]=n	pr=8.83			Depends on Configuration
Read heater power (duty cycle)	po[wer]	po	p%: 9999	po: 1	

Table 10. IEEE-488 Communication Commands (cont.)

Command Description	Command Format	Command Example	Returned	Returned Example	Acceptable Values
Ramp and Soak Menu					
Read number of programmable set-points	pn	pn	pn: 9	pn: 2	
Set number of programmable set-points to n	pn=n	pn=4			1 to 8
Read programmable set-point number n	psn	ps3	psn: 9999.99 {C or F}	ps1: 50.00 C	
Set programmable set-point number n to n	psn=n	ps3=50			1 to 8, Instrument Range
Read program set-point soak time	pt	pt	ti: 999	ti: 5	
Set program set-point soak time to n minutes	pt=n	pt=5			0 to 500
Read program control mode	pc	pc	prog: {OFF or ON}	prog: OFF	
Set program control mode:	**pc=g[o]/s[top]/c[ont]**				GO or STOP or CONT
Start program	pc=g[o]	pc=g			
Stop program	pc=s[top]	pc=s			
Continue program	pc=c[ont]	pc=c			
Read program function	pf	pf	pf: 9	pf: 3	
Set program function to n	pf=n	pf=2			1 to 4
Configuration Menu					
Serial Interface Menu					
Read serial sample setting	sa[mple]	sa	sa: 9	sa: 1	
Set serial sampling setting to n seconds	sa[mple]=n	sa=0			0 to 4000
Set serial duplex mode:	**du[plex]=f[ull]/h[alf]**				FULL or HALF
Set serial duplex mode to full	du[plex]=f[ull]	du=f			
Set serial duplex mode to half	du[plex]=h[alf]	du=h			
Set serial linefeed mode:	**lf[eed]=on/of[f]**				ON or OFF
Set serial linefeed mode to on	lf[eed]=on	lf=on			
Set serial linefeed mode to off	lf[eed]=of[f]	lf=of			

Table 10. IEEE-488 Communication Commands (cont.)

Command Description	Command Format	Command Example	Returned	Returned Example	Acceptable Values
Calibration Menu (⚠Warning: Changing the following calibration values may change the accuracy of the calibrator.)					
Read R0 calibration parameter	r[0]	r	r0: 999.999	r0: 100.578	
Set R0 calibration parameter to n	r[0]=n	r=100.324			98.0 to 104.9
Read ALPHA calibration parameter	al[pha]	al	al: 9.9999999	al: 0.0038573	
Set ALPHA calibration parameter to n	al[pha]=n	al= 0.0038433			.00370 to .00399
Read DELTA calibration parameter	de[lta]	de	de: 9.99999	de: 1.46126	
Set DELTA calibration parameter to n	de[lta]=n	de=1.45			0.0 to 2.9
Read BETA calibration parameter	be[ta]	be	be: 9.999	be: 0.342	
Set BETA calibration parameter to n	be[ta]=n		be=0.342		–100.0 to 100.0
Miscellaneous (not on menus)					
Read firmware version number	*ver[sion]	*ver	ver.9999,9.99	ver.514,1.00	
Read structure of all commands	h[elp]	h	list of commands		
Legend: [] Optional Command data					
/ Alternate characters or data					
{} Returns either information					
n Numeric data supplied by user—may be entered in decimal or exponential notation					
9 Numeric data returned to user					
x Character data returned to user					
Note: When DUPLEX is set to FULL and a command is sent to READ, the command is returned followed by a carriage return and linefeed. Then the value is returned as indicated in the RETURNED column.					

Calibrating Models 514, 517, and 518 (cold side)

The dry-block calibrator should be calibrated at regularly scheduled intervals by qualified, authorized personnel in accordance with your company's policy. Accuracy specifications apply for a one-year calibration interval. Following is the recommended calibration procedure for Models 514 and 517 and the cold side of Model 518.

Calibration Equipment

Calibration requires a standard thermometer with acceptable accuracy that fits properly into one of the reference holes in the block. Recommended equipment includes a laboratory grade PRT (platinum resistance thermometer) with a length of 230 mm to 300 mm (9 in to 12 in) and a diameter of 4.76 mm or 6.35 mm (3/16 in or 1/4 in). The combined accuracy of the PRT and the readout should be 0.025 °C or better.

Calibration Parameters

The calibration parameters for the calibrator's RTD probe are in the secondary menu (see Figure 11 or 12). The calibration menu is indicated by the following:

CAL	*Calibration menu*

The calibration parameters are accessed by pressing **SET** *after the name of the parameter is displayed.* Use the **UP** and **DOWN** buttons to change the value of the parameter. Press **SET** to set the parameter to the new value. Pressing **EXIT** skips the parameter, ignoring any changes that may have been made.

The calibration menu contains the following probe parameters:

R_0

This probe parameter refers to the resistance of the RTD probe at 0 °C. The value of this parameter is set at the factory for best accuracy.

ALPHA

This probe parameter refers to the average sensitivity of the RTD probe between 0 °C and 100 °C. The value of this parameter is set at the factory for best accuracy.

DELTA

This parameter relates to the second-order nonlinearity of the sensor. The value is set at the factory for best accuracy.

BETA

This parameter relates to the higher order nonlinearity of the sensor below 0 °C. The value is set at the factory for best accuracy.

Calibration Procedure

The calibrator's accuracy over the full range is determined by the values of the calibration parameters R0, ALPHA, DELTA, and BETA. Refer to the Report of Calibration shipped with you calibrator for the temperature range value.

The calibration procedure for Models 514 and 517 involves measuring the error between the instrument and the reference thermometer at several temperatures throughout the range, then adjusting the calibration parameters as necessary to reduce the errors to within acceptable limits. The stated accuracy of the instrument can be found in the specifications (see Tables 2 through 4). Because of the way the calibration parameters affect the temperature, the simplest way to proceed is to measure the errors at 0 °C, 100 °C, 140 °C, and –25 °C and adjust R0, ALPHA, DELTA, and BETA at each point respectively. Follow these steps:

1. If "as found" data is required, then first measure the error at various temperatures throughout the range (for example –25 °C, 0 °C, 25 °C, 50 °C, 75 °C, 100 °C, and 140 °C). Measure the errors by setting the controller to the desired temperature, allowing the block to reach the temperature and stabilize, then reading the actual temperature of the block with the standard thermometer. If the measured errors are all within acceptable limits, no further action is required. If the accuracy needs improvement, continue with Step 2.
2. Set the set-point to 0 °C and allow adequate time for the block to reach this temperature and stabilize. Adjust the R0 calibration parameter to make the block temperature as measured with the standard thermometer match the set-point. The approximate ratio between a change in R0 and a change in temperature at 0 °C is about 0.4 to 1. For example, if the block temperature is high by 0.1 °C at 0 °C then decrease R0 by 0.04.
3. Set the set-point to 100 °C and allow adequate time for the block to reach this temperature and stabilize. Adjust the ALPHA calibration parameter to make the block temperature as measured with the standard thermometer match the set-point. The approximate ratio between a change in ALPHA and a change in temperature at 100 °C is about 0.00004 to 1. For example, if the block temperature is high by 0.1 °C at 100 °C then decrease ALPHA by 0.000004.
4. Set the set-point to 140 °C and allow adequate time for the block to reach this temperature and stabilize. Adjust the DELTA calibration parameter to make the block temperature as measured with the standard thermometer match the set-point. The approximate ratio between a change in DELTA and a change in temperature at 140 °C is about -1.7 to 1. For example, if the block temperature is high by 0.1 °C at 140 °C then increase DELTA by 0.17.
5. Set the set-point to –25 °C and allow adequate time for the block to reach this temperature and stabilize. Adjust the BETA calibration parameter to make the block temperature as measured with the standard thermometer match the set-point. The approximate ratio between a change in BETA and a change in temperature at –25 °C is about -50 to 1. For example, if the block temperature is high by 0.1 °C at –25 °C then increase BETA by 5.0.
6. Repeat Step 1 to ensure the calibrator is now accurate throughout the full range.

Calibrating Models 515 and 518 (hot side)

Model 515 and the hot side of Model 518 are calibrated by adjusting the controller probe calibration constants $\mathbf{R_0}$ and **ALPHA** so that the temperature of the dry-block as measured with a standard thermometer agrees more closely with the set-point. The thermometer used must be able to measure the well temperature with higher accuracy than the desired accuracy of the dry-block calibrator. By using a good thermometer and carefully following this procedure, the calibrator can be calibrated to an accuracy of better than 0.5 °C over a range of 600 °C.

Calibration Points

Adjust $\mathbf{R_0}$ and **ALPHA** to minimize the set-point error at each of two different dry-block temperatures. Any two reasonably separated temperatures may be used for the calibration. Refer to the Report of Calibration shipped with your calibrator for the temperature values used. Improved results can be obtained for shorter ranges when using temperatures that are just within the most useful operating range of the dry-block. The farther apart the calibration temperatures, the larger the calibrated temperature range will be, but the calibration error will also be greater over that range. If for instance 150 °C and 500 °C are chosen as the calibration temperatures, then the calibrator may achieve an accuracy of ±0.2 °C, for example, over the range 100 °C to 550 °C. Choosing 200 °C and 300 °C may allow the calibrator to have a better accuracy of ±0.05 °C, for example, over the range 175 °C to 325 °C; however, outside that range, the accuracy may be only ±0.4 °C.

Measuring the Set-point Error

The first step in the calibration procedure is to measure the temperature errors (including sign) at the two calibration temperatures. First set the calibrator to the lower set-point called t_L. Wait for the well to reach the set-point and allow 30 to 60 minutes to stabilize at that temperature. Check the stability with the thermometer. When both the well and the thermometer have stabilized, measure the temperature with the thermometer and calculate the temperature error err_L, which is the actual well temperature minus the set-point temperature. If, for example, the calibrator is set for a lower set-point of t_L=200 °C and it reaches a measured temperature of 199.7 °C then the error is –0.3 °C.

Next, set the calibrator for the upper set-point t_H. After stabilization, measure the well temperature and calculate the error err_H. For this example, suppose the calibrator was set for 400 °C and the thermometer measured 400.1 °C giving an error of +0.1 °C.

Computing R_0 and ALPHA

Before computing the new values for R_0 and ALPHA, the current values must be known. The values may be found by either accessing the probe calibration menu from the controller panel or by inquiring through the serial interface. You should keep a record of these values in case they may need to be restored in the future. The new values $R_{0'}$ and ALPHA′ are calculated by entering the old values for R_0 and ALPHA, the calibration temperature set-points t_L and t_H, and the temperature errors err_L and err_H into the following equations:

$$Ro' = \left[\frac{err_H t_L - err_L t_H}{t_H - t_L} ALPHA + 1 \right] Ro$$

$$ALPHA' = \left[\frac{(1 + ALPHA\, t_H) err_L - (1 + ALPHA\, t_L) err_H}{t_H - t_L} + 1 \right] ALPHA$$

If for example R_0 and ALPHA were previously set for 100.2695 and 0.0038319 respectively and the data for t_L, t_H, err_L, and err_H were as given above then the new values $R_{0'}$ and ALPHA′ would be calculated as 100.193 and 0.0038272 respectively. Program the new values R_0 and ALPHA into the controller. Check the calibration by setting the temperature to t_L and t_H and measuring the errors again. If desired, the calibration procedure may be repeated to further improve the accuracy.

Calibration Example

The calibrator will be used between 125 °C and 325 °C and maximum accuracy is desired within this range. The current values for R_0 and ALPHA are 100.000 and 0.0038500 respectively. The calibration points are chosen to be 150.00 °C and 300.00 °C. The measured well temperatures are 149.943 °C and 299.814 °C respectively. Figure 16 shows how to calculate the new probe constants for this example.

R_0 = 100.000

ALPHA = 0.0038500

t_L = 150.00 °C

measured t = 149.943 °C

t_H = 300.00 °C

measured t = 299.814 °C

Calculate the errors:

err_L = 149.943 - 150.00 °C = -0.057 °C

err_H = 299.814 - 300.00 °C = -0.186 °C

Calculate R_0':

$$Ro' = \left[\frac{(-0.186 \; x \; 1500.0 - (-0.057) \; x \; 300.0}{300.0 - 150.0} 0.00385 + 1 \right] 100.000 = 99.9723$$

Calculate ALPHA':

$$ALPHA' = \left[\frac{(1 + 0.00385 \text{ x } 300.0)(-0.057) - (1 + 0.00385 \text{ x } 150.0(-0.186)}{300.0 - 150.0} + 1 \right] 0.00385 = 0.0038544$$

Figure 16. Calibration Example for Model 515 and the Hot Side of Model 518

Care and Maintenance

With proper care the calibrator requires very little maintenance. The following guidelines describe how to care for and maintain your calibrator.

- Avoid operating the instrument in an oily, wet, dirty, or dusty environment.
- If the outside of the calibrator becomes soiled, it may be wiped clean with a damp cloth and mild detergent. Do not use harsh chemicals on the surface because the paint might be damaged.
- If the ac supply cord is damaged, replace it with a cord with the appropriate gauge wire for the calibrator's current rating. If you have any questions, call Fluke Customer Service for more information.
- Before using any cleaning or decontamination method except those recommended by Fluke, check with Fluke Customer Service to be sure that the proposed method will not damage the equipment.
- It is important to keep the well of the calibrator clean and clear of any foreign matter. **DO NOT** use fluid to clean out the well.
- The dry-block calibrator should be handled with care. Avoid knocking over or dropping the calibrator.
- For dry-blocks with removable inserts, the inserts can become covered with dust and carbon material. If the buildup becomes too thick, it could cause the inserts to become jammed in the wells. Avoid this build up by periodically buffing the inserts clean with a Scotchbrite® fine-grit pad or an emery cloth.
- If an insert is dropped, examine it for deformities before inserting it in the well. If there is any chance of the insert jamming in the well, file or grind off the protuberance.
- **DO NOT** slam the probe stems into the well. Doing so can cause a shock to the sensor.
- If a hazardous material is spilt on or inside the equipment, you are responsible for taking the appropriate decontamination steps as outlined by the national safety council with respect to the material.
- If the instrument is used in a manner not in accordance with the equipment design, the calibrator may malfunction or safety hazards may arise.

Replacing the Fuses

⚠Warning

To avoid electric shock, burns, or damage to equipment, always replace the fuses with ones of the correct rating, voltage, and type.

1. Turn off the calibrator and unplug it from the ac outlet.
2. Replace the fuses as follows:
   - For Models 514 and 518, unscrew the fuse holders on the back of the calibrator to access the fuses. Replace the fuses as necessary; then replace the fuse holders.
   - For Models 515 and 517, insert a flat-blade screwdriver into the slot at the top of the power entry module (PEM) as shown in Figure 17. Gently open the module to access the fuse holder. Replace the fuses as necessary; then close the PEM
3. Connect the calibrator to the ac outlet.

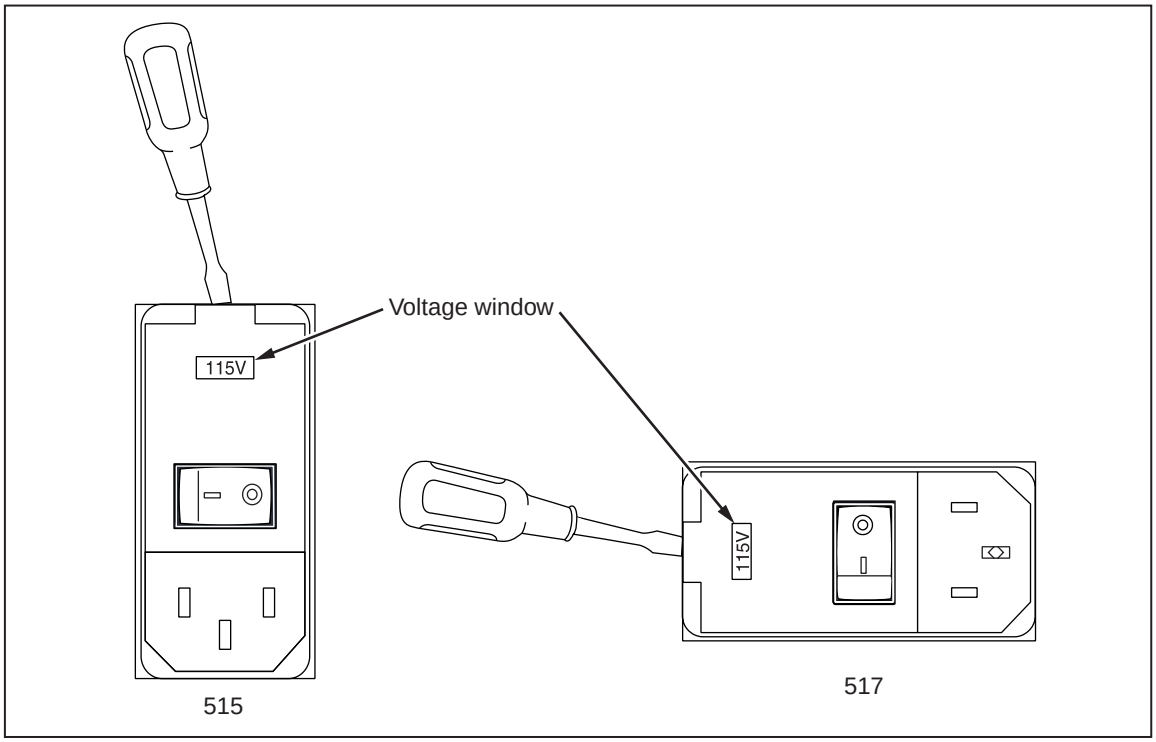


Figure 17. Fuse Access for Models 515 and 517

Troubleshooting

If problems arise while operating the calibrator, refer to Table 11 for some suggestions that may help you solve the problem.

Table 11. Troubleshooting the Calibrator

Incorrect temperature reading Turn on the calibrator and watch the display. If the first number displayed is less than “-0005-”, the unit has been re-initialized. The unit needs to be reprogrammed for R0, ALPHA, DELTA, BETA, and the proportional band. These numbers can be found on the Report of Calibration that was shipped with the unit.
Display is off • Check the fuses. • Verify that the power cord is plugged in and connected to the unit.
The unit heats slowly Check the Scan and Scan Rate settings. Scan may be on with the Scan Rate set to a low value.
An “o” or “c” is displayed at the left of the display The external switch is open causing the displayed temperature to be frozen and keeping the set-point from scanning. Turn the Switch Test off by pressing **DOWN**.
The display flashes “err 1” through “err 8” Initialize the system by performing the master reset sequence (described below). If the unit repeats the error code, contact Fluke Customer Support for a return authorization and for instructions on returning the unit. **Master Reset Sequence** **⚠Caution** **The master reset sequence should be performed only by authorized personnel if no other action is successful in correcting a malfunction. You must have a copy of the most recent Report of Calibration to restore the calibration parameters.** To reset the unit, turn the unit off and back on. When all segments of the display light up ("8.8.8.8.8.8." on the display), during the power on sequence, immediately press and hold the **SET** and **EXIT** buttons. The display will indicate "-init-" and all parameters in memory will be cleared and set to the default values. Release the buttons to allow the power on sequence to complete. You must subsequently reprogram calibration parameters R0, ALPHA, DELTA, and BETA (if applicable) to ensure that the unit operates with full accuracy. These numbers can be found on the Report of Calibration that was shipped with the calibrator.
The display flashes “-273°C” or “-459°F” The sensor is disconnected or shorted. Please contact Fluke Customer Support for further instructions.
The display flashes “cut-out” The high limit is set too low. Check the high limit setting in the parameters menu.
The display shows “ICL” (518 only) An intercommunication link error has occurred. The hot and cold sides were not turned on within 5 seconds of each other. If RS-232 communication is not required for the hot side, press **SET** on both the hot and cold sides. If RS-232 communication is required, turn both sides off; then turn them both on within 5 seconds of each other.

Replacement Parts

Table 12 lists the replacement parts available from Fluke for the 500 Series Dry-Block Calibrators. Inserts available for the calibrators are listed in Tables 6 through 8.

Table 12. Replacement Parts

Description	Fluke Part Number	Quantity
Filter-Fuse-Switch, 10 A 250 V, 517	1570686	1
Fuse, 4 A 250 V (115 V), 517	1570699	2
Output PCB, 517	1570702	1
Power Supply, 517	1570716	2
Power Supply, 20 W, 518	1577903	1
Power Supply, 150 W, 518	1577915	1
IEEE-488 PCB, 514, 515, 517	1570725	1
IEEE Converter Accessory, 518	1577892	1
Cooling Well Cover, 514, 517	1570733	1
Chassis Bail Handle Side, 514, 515, 517	1570740	2
Chassis Bail Handle, 514, 515, 517	1570757	1
Right Side Skin, 514, 515, 517	1570769	1
Left Side Skin, 514, 515, 517	1570778	1
Inner Wall, 517	1570784	1
Well Insulator, 517	1570791	2
Vented Well Cover, 518	1577814	1
Bottom Panel, 518	1577838	1
Front Panel, 518	1577845	1
Rear Panel, 518	1577850	1
Top Panel, 518	1577861	1
Right Side Panel, 4009, 518	1570804	1
Left Side Panel, 4009, 518	1570819	1
Well Cover, 515	1570828	1
Label, "Caution Hot Surface", 515, 518	1577877	1
Controller Front Panel Label, 4010, 514	1577926	1
Controller Front Panel Label, 4011, 517	1577932	1
Controller Front Panel Label, 4013, 515, 518	1577889	1

Table 12. Replacement Parts (cont.)

Description	Fluke Part Number	Quantity
Label, Control Panel, 4009, 518	1577944	1
Filter Module, 514	1570837	1
Filter Module, 15 A Tabs, 518	1570843	1
Filter, Fuse, Switch, 10 A, 250 V, 515	1570855	1
Cooling Block Assembly, 514	1570862	1
Cooling Block Assembly, 517	1570870	1
Cold Well Assembly, 518	1570881	1
Hot Well Assembly, 515, 518	1570896	1
Fuse Holder, 10 A 250 V VDE (115 V), 514	1570908	2
Fuse Holder, 5x20 10 A VDE (230 V), 514	1570913	2
Fuse Holder, 5X20 10 A 250 V VDE, 518	1570924	4
Switch, Rock DPDT 12A BLK, 518	1570936	1
Switch, Rock DPST 16 A, 514	1570949	1
Relay, 2P2T 10 A 24 V, 514, 515, 517, 518	1570951	1
Switch, Slide, DPDT 10 A, 518	1570960	1
Fuse 3 A 250 V SB (115 V), 514	1570972	2
Fuse, 4 A 250 V SB, 518	1570985	2
Fuse, 10 A 250 V, 515, 518	1570997	2
Fuse, 5x20 1.6 A 250 V (230 V), 514	1571002	2
Fuse, 5x20 3.15 A 250 V (230 V), 517	1571016	2
Fuse, 5X20 3.15 A 250 V SB, 518	1571025	2
Fuse, 5X20 5 A 250 V, 518	1571033	2
Analog PCB, 514, 515, 517, 518	1571040	1
Digital PCB, 514, 515, 517, 518	1571057	1
Panel PCB, 514, 515, 517, 518	1571069	1
Triac, 25A 400 V ISOL to-3B, 515, 518	1571078	1
PCB Assembly Digital, 518	1571084	2
PCB Assembly, Panel, 518	1571091	2
PCB Assembly, Analog (Hot), 518	1571103	1

Table 12. Replacement Parts (cont.)

Description	Fluke Part Number	Quantity
PCB Assembly, Analog (Cold), 518	1571115	1
Output PCB, 514	1571126	1
Switching PCB, 514	1571132	1
Switching PCB, 515	1571144	1
Handle, Flush Pocket Pull, 518	1571159	2
Fan Finger Guard, 514	1571167	1
Guard, Finger - 5" Fan, 518	1571171	2
Finger Guard, 515	1571180	1
Finger Guard - 6" Fan, 517	1571198	1
Fan, 235 CFM 6.7" 48 V, 517	1571209	1
Fan, 115 V 50/60 Hz, 514	1571211	1
Line Cord, 16AWG 6.7’ Black (115 V), 514, 515, 517, 518	1571227	1
Line Cord, European (230 V), 514, 515, 517, 518	1571230	1

CE Comments

EMC Directive

Fluke equipment has been tested to meet the European Electromagnetic Compatibility Directive (EMC Directive, 89/336/EEC). Selection of Light Industrial or Heavy Industrial compliance has been based on the intended use of the instrument. Units designed for use in a calibration laboratory have been tested to Light Industrial Standards. Units designed to be used in the "field" have been tested to both Light Industrial and Heavy Industrial Standards. The Declaration of Conformity for your instrument lists the specific standards to which the unit was tested.

Low Voltage Directive (Safety)

In order to comply with the European Low Voltage Directive (73/23/EEC), Fluke equipment meets the IEC 1010-1 (EN 61010-1) and IEC 1010-2-010 (EN 61010-2-010) standards.