FLUKE®
Calibration

4180, 4181
Precision Infrared Calibrator

Operators Manual

November 2020

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Introduction

The Fluke Calibration 4180, 4181 Precision Infrared Calibrator (The Product) is a portable instrument or bench-top temperature calibrator used to calibrate point IR thermometers. The Product is small enough to use in the field, and accurate enough to use in the lab.

The Product features:

- Rapid heating and cooling
- RS-232 interface capability

Built in programmable features include:

- Temperature scan rate control
- Eight set-point memory
- Adjustable readout in °C or °F
- Adjustable Emissivity

The temperature is accurately controlled by the digital controller. The controller uses a precision platinum RTD as a sensor and controls the surface temperature with a solid state relay (triac) driven heater (4181) and FET driven Peltier modules (4180).

The LCD (display) continuously shows the current temperature. The temperature is easily set with the control buttons to any desired temperature within the specified range. The Product's multiple fault protection devices ensure user and Product safety and protection.

With proper use, the Product will provide continued accurate calibration of IR temperature measurement devices. Familiarize yourself with the safety guidelines and operating procedures of the Product. See *Safety Information*.

- **Do not force cool the surface. The surface should not be cooled by any method other than natural convection. Forced air can often have oil or water in it. Even water can leave mineral deposits on the surface. Trying to cool the surface too quickly can also cause thermal shock to the emissive surface.**
- **Do not use liquid nitrogen (LN2) to quick cool the target.**
- **Do not plug the Product into 230 V if the fuse holder reads 115 V. This action will cause the fuses to blow and may damage the Product.**
- **Component lifetime can be shortened by continuous high temperature operation.**
- **Do not change the values of the calibration constants from the factory set values. Calibration constants shall only be changed by qualified and authorized personnel. The correct setting of these parameters is important to the safety and proper operation of the Product.**
- **Use a ground fault interrupt device.**
- **Always operate this Product at room temperatures as stated in *Specifications and Environmental Conditions*.**
- **The Product is a precision instrument. Handle the Product with care. It is important to keep the calibration well and the IR target surface clean and clear of any foreign matter.**
- **If a main supply power fluctuation occurs, immediately turn off the Product. Wait until the power has stabilized before re-energizing the Product.**
- **Always carry the Product in an upright position. The convenient pull-up handle allows one hand carrying.**
- **Do not operate the instrument in excessively wet, oily, dusty, or dirty environments.**
- **DO NOT operate near flammable materials.**
- **Use the target cover at temperatures below ambient (25 °C). If ice or liquid water forms on the target, IR thermometers will not indicate the correct temperature.**

Service Information

Contact an authorized Fluke Calibration Service Center if the Product needs calibration or repair during the warranty period. See *Contact Fluke Calibration*. Please have Product information such as the purchase date and serial number ready when you schedule a repair.

Unpack the Product

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

Verify that these components are present:

- 4180, 4181 IR Calibrator Report of Calibration
- *4180, 4181 Safety Information*
- Power Cord
- Target Cover
- Serial Cable

Specifications and Environmental Conditions

Specifications

Product specifications are in Table 1.

Table 1. Specifications

	4180	4181
Temperature range (@ 23 °C ambient, 0.95 emissivity)	-15 °C to 120 °C	35 °C to 500 °C
Power	115 V ac (±10%), 50/60 Hz, 250 W 230 V ac (±10%), 50/60 Hz, 250 W	115 V ac (±10%), 50/60 Hz, 1100 W 230 V ac (±10%), 50/60 Hz, 1100 W
Display Accuracy [1]	±0.40 °C at -15 °C ±0.40 °C at 0 °C ±0.50 °C at 50 °C ±0.50 °C at 100 °C ±0.55 °C at 120 °C	±0.35 °C at 35 °C ±0.50 °C at 100 °C ±0.70 °C at 200 °C ±1.20 °C at 350 °C ±1.60 °C at 500 °C
Stability	± 0.10 °C at -15 °C ± 0.05 °C at 0 °C ± 0.10 °C at 120 °C	± 0.05 °C at 35 °C ± 0.20 °C at 200 °C ± 0.40 °C at 500 °C
Uniformity [2] (12.7 cm (5.0 in) diameter of center of target)	±0.15 °C at -15 °C ±0.10 °C at 0 °C ±0.25 °C at 120 °C	± 0.10 °C at 35 °C ±0.50 °C at 200 °C ±1.00 °C at 500 °C
Uniformity [3] (5.08 cm (2.0 in) diameter of center of target)	±0.10 °C at -15 °C ±0.10 °C at 0 °C ±0.20 °C at 120 °C	± 0.10 °C at 35 °C ±0.25 °C at 200 °C ±0.50 °C at 500 °C
Heating time	15 min: -15 °C to 120 °C 14 min: 23 °C to 120 °C	20 min: 35 °C to 500 °C
Cooling time	15 min: 120 °C to 23 °C 20 min: 23 °C to -15 °C	100 min: 500 °C to 35 °C 40 min: 500 °C to 100 °C
Stabilization time	10 min	
Nominal emissivity [3]	0.95	
Thermometer emissivity compensation range	0.9 to 1.0	
Target diameter	152.4 mm (6 in)	
Computer interface	RS-232	
Size (HxWxD)	356 x 241 x 216 mm (14 x 9.5 x 8.5 in)	

Table 1. Specifications (cont.)

	4180	4181
Weight	9.1 Kg (20 lb)	9.5 Kg (21 lb)
Ambient temperature	5 °C to 35 °C (41 °F to 95 °F)	
Ambient relative humidity	maximum 80% for temperature <31 °C, decreasing linearly to 50 % at 40 °C	
Altitude	<2000 meters	
Fuse(s)	115 V: T 6.3 A, 250 V 230 V: T 3.15 A, 250 V	115 V: F 10 A, 250 V 230 V: F 5 A, 250 V
Safety	IEC 61010-1: Overvoltage Category II, Pollution Degree 2 IEC 61010-2-010	
Electromagnetic Compatibility (EMC)	International..... IEC 61326-1: Basic Electromagnetic Environment CISPR 11: Group 1, Class A *Group 1: Equipment has intentionally generated and/or uses conductively-coupled radio frequency energy that is necessary for the internal function of the equipment itself.* *Class A: Equipment is suitable for use in all establishments other than domestic and those directly connected to a low-voltage power supply network that supplies buildings used for domestic purposes. There may be potential difficulties in ensuring electromagnetic compatibility in other environments due to conducted and radiated disturbances.* *Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.* Korea (KCC) .....Class A Equipment (Industrial, Broadcasting, & Communication Equipment) *Class A: Equipment meets requirements for industrial electromagnetic wave equipment and the seller or user should take notice of it. This equipment is intended for use in business environments and not to be used in homes.* USA (FCC)..... 47 CFR 15 subpart B. This product is considered an exempt device per clause 15.10	

[1] For 8 µm to 14 µm spectral band thermometers with emissivity set between 0.9 and 1.0.
[2] The uniformity specification refers to how IR thermometers with different spot sizes both focused at the center of the target will measure the same temperature.
[3] The target has a nominal emissivity of 0.95, however it is radiometrically calibrated to minimize emissivity related uncertainties.
[4] Due to physical limitations of the product, the maximum temperature of the 4181 is limited for emissivity settings greater than 0.95. See Table 5 for more information.

Environmental Conditions

Although the Product has optimum durability and trouble-free operation, it must be handled with care. The Product should not be operated in an excessively dusty or dirty environment.

Quick Start

Setup

Note

*The Product will not heat, cool, or control until the **SET PT.** parameter is Enabled.*

Place the Product on a flat surface with at least 15 cm (6 in) of free space around the Product. Overhead clearance is required. Do not place under a cabinet or structure.

Plug the power cord of the Product into a mains outlet of the proper voltage, frequency, and current capability (see *Specifications and Environmental Conditions* for power details). Confirm that the nominal voltage corresponds to that indicated on the power entry model at the back of the Product. Remove the target cover.

Power on the Product

Toggle the switch on the power entry module to turn on the power to the Product. After a brief self-test, the controller should begin normal operation. The main screen appears within 30 seconds. If the Product fails to operate, check the power connection. The display shows the target surface temperature, and waits for user input before further operation.

Push **SET PT.** and use the arrow buttons to set the desired set-point temperature. Push **ENTER** to save the set-point and enable the Product. After 5 seconds the Product starts to operate normally and heat or cool to the designated set-point.

Parts and Controls

This section describes the exterior features of the Product. All interface buttons are found on the front of the Product (see Table 2). Power and serial connections are on the back of the Product (see Table 4).

Front Panel

Table 2 shows the front panel.

Table 2. Front Panel

1	The **Display** is a 240 x 160 pixel monochrome graphics LCD device with a bright LED backlight. The display shows current control temperature, measurements, status information, operating parameters, and softkey functions.

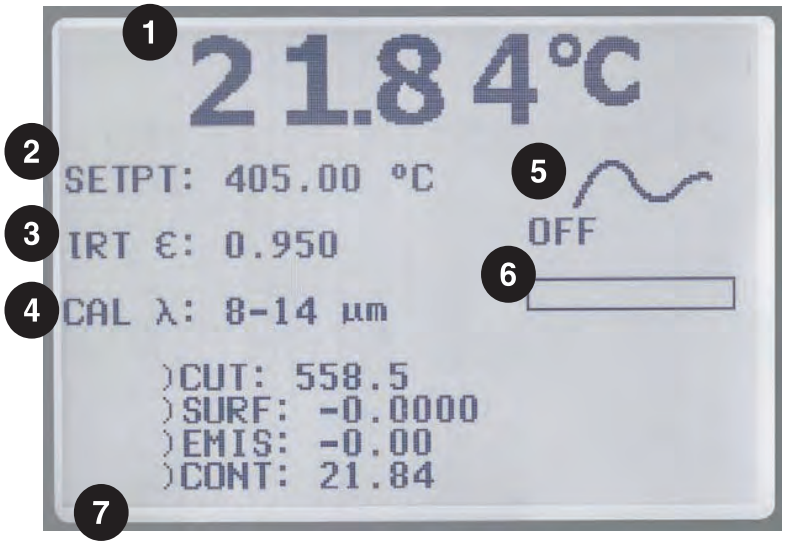
Table 2. Front Panel (cont.)

❷	The **SET PT.** button enables the Product to heat or cool to a desired set-point. Until **SET PT.** is enabled, the Product will not heat or cool. The Product is in a sleep state for safety of the operator and Product.
❸	The **°C/°F** button changes the displayed temperature units from °C to °F and °F to °C.
❹	The **MENU** button accesses all parameter and settings menus. From the main menu, use the softkeys to access submenus and functions.
❺	The **EXIT** button exits menus and cancels newly entered values.
❻	The arrow buttons move the cursor on the display, change the display layout, and adjusts the display contrast.
❼	The **ENTER** button selects menus and accepts new values.
❽	The Softkeys are the four buttons immediately below the display (**F1** to **F4**). The functions of the softkeys are indicated on the display above the buttons. The function of the keys may change depending on the menu or function that is selected.
❾	The block temperature indicator shows when it is safe to install the target cover. The indicator illuminates when the target exceeds approximately 50 °C. The indicator illuminates until the target cools to less than approximately 50 °C. If the Product is disconnected from mains power, the indicator flashes until the target temperature is less than approximately 50 °C.

Display

Table 3 shows the display.

Table 3. The Display



❶	**Process Temperature** - The most recent block temperature measurement is shown in large digits.
❷	The current **set-point temperature**.
❸	The current infrared thermometer **emissivity setting (IRT ε)**.
❹	The current **calibration wavelength (CAL λ)** selected. The wavelength band at which the Product was calibrated.
❺	**Stability Status** - A graph shows the current status of the stability of the Product.
❻	**Heating/Cooling Status** - A bar graph indicates HEATING, COOLING, or CUT-OUT. This status graph indicates the current level of heating or cooling if the Product is not in cutout mode.
❼ (not shown)	**Softkey Functions** (not shown) - The four sets of text at the bottom of the display indicate the functions of the softkeys (**F1**-**F4**). These functions change with each menu.
❽ (not shown)	During Product setup and use, you are often required to enter or select parameters. **Editing windows** appear on the display to show the values of parameters and allow edits.

Back Panel

Table 4 shows the back panel.

Table 4. Back Panel

❶	The **fan** is located in the center of the back of the Product. Do not obstruct the airflow of the fan. Leave at least 6 inches of air flow around the Product.
❷	The **power supply cord** attaches to the **power-entry module**. Plug the cord into an ac mains supply appropriate for the voltage displayed on the power entry module and as specified in *Specifications and Environmental Conditions*. The **power switch** is located on the power-entry module of the Product. The Product **fuses** are located inside the power-entry module of the Product. If necessary, fuses must be replaced according to *Specifications and Environmental Conditions*.
❸	The **serial (RS-232) interface** can be used to transmit measurements and control the operation of the Product.

Languages

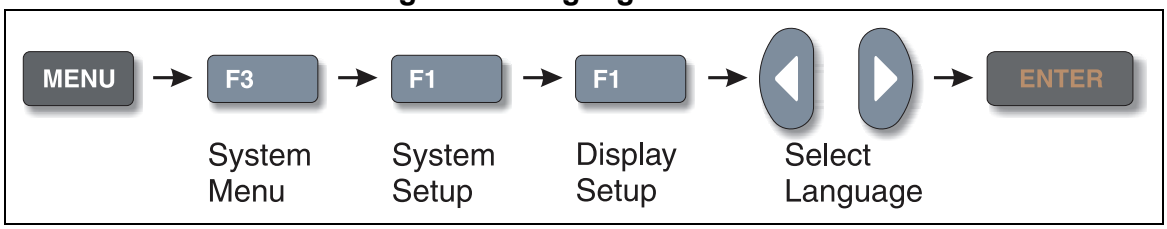
Set the display to different languages depending on the configuration.

- European: English, French, Spanish, Italian, German, Chinese, Japanese
- Russian: Russian, English

Language Selection

The languages in the Menu system under the System Menu/Display Setup. Select the language to be displayed with the left and right arrow buttons (see *SYSTEM MENU* in the *Technical Guide*). See Figure 1.

Figure 1. Language Selection



Reset to English Language

F1 + **F4** temporarily displays English, or returns to the selected language. The selected language resumes after the power is switched off and on. To permanently select English, follow the instructions in *Language Selection*.

Ice Buildup and Purge Procedure (4180 Only)

At the factory, the Product calibration is done with the target free of any ice or moisture. Ice or moisture on the target changes the emissivity of the target and apparent temperature. If there is any ice or moisture (even though it is a slight amount) on the target, the display temperature accuracy is invalid. In addition, ice buildup can damage the surface coating causing the radiometric calibration to drift.

Always avoid ice buildup. To facilitate this, use the cover with a purge inlet provided with the Product. Fluke Calibration recommends that the target cover be used at any set-point below the dew point. Depending on the ambient humidity of the environment where the target is used, the dew point can be as high as the ambient temperature of that environment.

Purge Procedure

The Cover allows the target to be used at temperatures below the dew point. The target is less likely to form ice while the target is covered. The target cover has a purge inlet to further prevent ice buildup. To use the purge, the user needs a 6 mm (0.25 in) outside diameter tube. Connect tubing to the purge inlet on the target cover. Use a dry gas for the purge. This means the gas should have a dew point <-15 °C. Fluke Calibration recommends nitrogen or dried air. If the gas contains any water vapor, ice or moisture will form on the target. Use a relatively-low flow rate of 2.4 liters/min to 4.8 liters/min (5 CFH to 10 CFH) for the purge.

Do not leave the target uncovered for more than 5 seconds, since it can cause ice to form on the target. To make measurements below the dew point:

1. Put the target cover in place.
2. Adjust the set-point to the desired temperature and allow the instrument to stabilize at that temperature.
3. Remove the target cover when the target stabilizes.
4. Take a sample.
5. Replace the target cover.

Remove the Ice Buildup on the Target

If a small amount of ice has formed, place the cover back on the target and allow the purge gas to sublime the ice. If there is more ice or you do not have a purge available, change the Product set-point to a temperature equal to or greater than 50 °C with the target uncovered. Allow all ice to melt and all water to dry before returning target to use. **Do not** wipe the target.

Set the Emissivity of the IR Thermometer

The Product is calibrated with a radiometric calibration. This calibration is done with a highly accurate IR thermometer. This IR thermometer emissivity setting is 0.950 during Product calibration. When you calibrate IR thermometers with the Product, it is best practice to use an IR thermometer emissivity setting of 0.950. Some IR thermometers do not have an adjustable emissivity setting. Most of these will have emissivity set at 0.95. In either case, the apparent emissivity setting of the Product should also be set to 0.95. Due to safety issues and the physical limits of the instrument, temperature range of the instrument may be limited from the specified range when using an emissivity setting other than 0.95. A table of this limitation is shown in Table 5.

If the IR thermometer does not have an emissivity setting of 0.95, the Product allows adjustment of emissivity (IRT ε, from 0.90 to 1.00). Refer to *Forced Air and Convection* for information on how to access IRT ε in the controller menu.

If uncertain of the emissivity setting of the IR thermometer you are calibrating, consult your IR thermometer's User's Guide or your IR thermometer's manufacturer.

Table 5. Apparent Temperature Limits

	4180		4181	
ε	HI (°C)	LO (°C)	HI (°C)	LO (°C)
0.90	120.0	-15.0	500.0	35.0
0.91	120.0	-15.0	500.0	35.0
0.92	120.0	-15.0	500.0	35.0
0.93	120.0	-15.0	500.0	35.0
0.94	120.0	-15.0	500.0	35.0
0.95	120.0	-15.0	500.0	35.0
0.96	119.2	-14.5	496.6	35.0
0.97	118.4	-14.0	493.2	35.0
0.98	117.6	-13.5	489.8	35.0
0.99	116.8	-13.0	486.4	35.0
1.00	116.0	-12.5	483.0	35.0

Forced Air and Convection

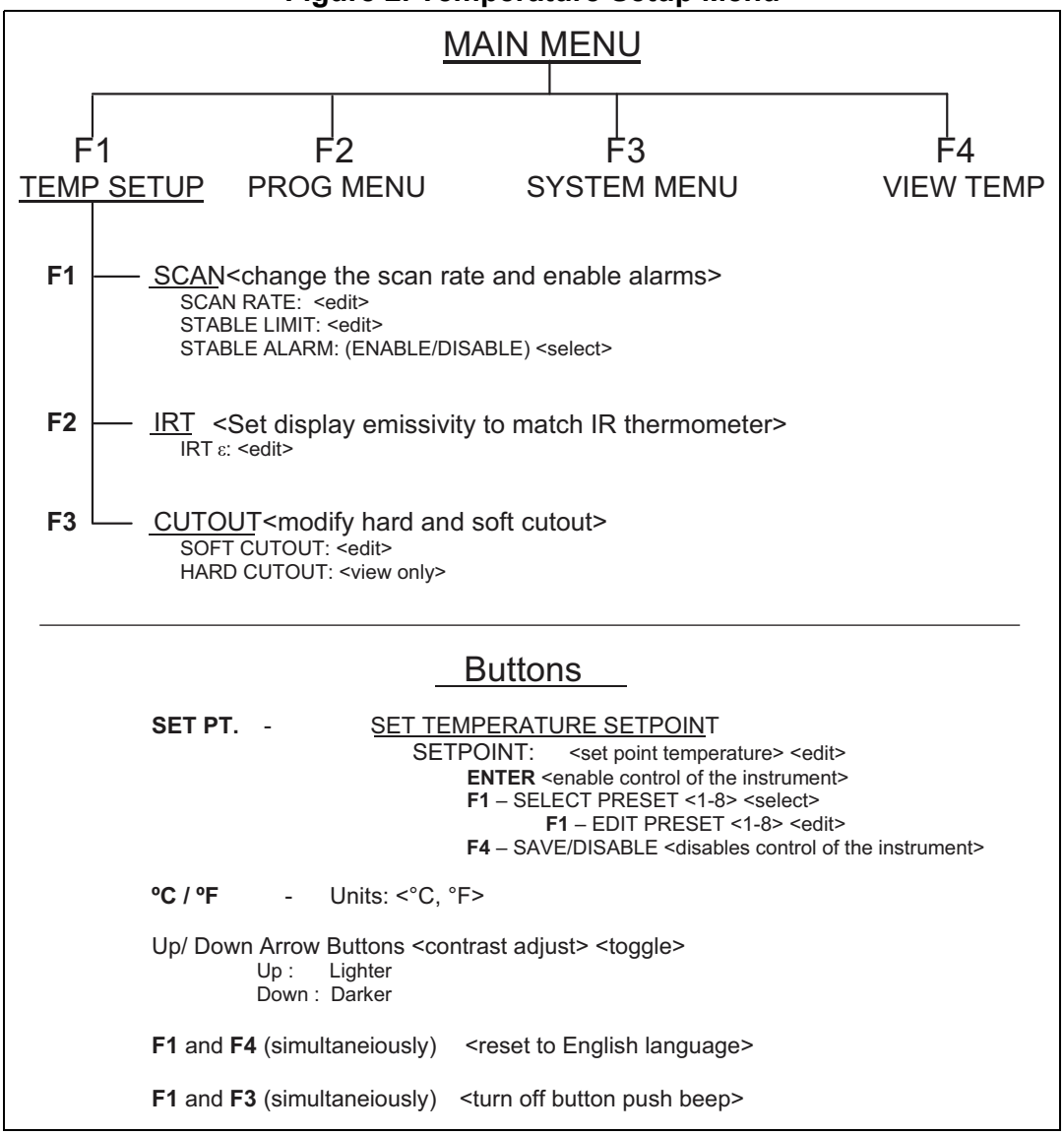
Since the Product has a large surface area, a major component of the temperature uncertainty is caused by changes in convection. Because of this, keep the Product away from areas with large amounts of air flow or drafts.

Menu Structure

Temperature Setup Menu

The Temperature Setup menu is shown in Figure 2.

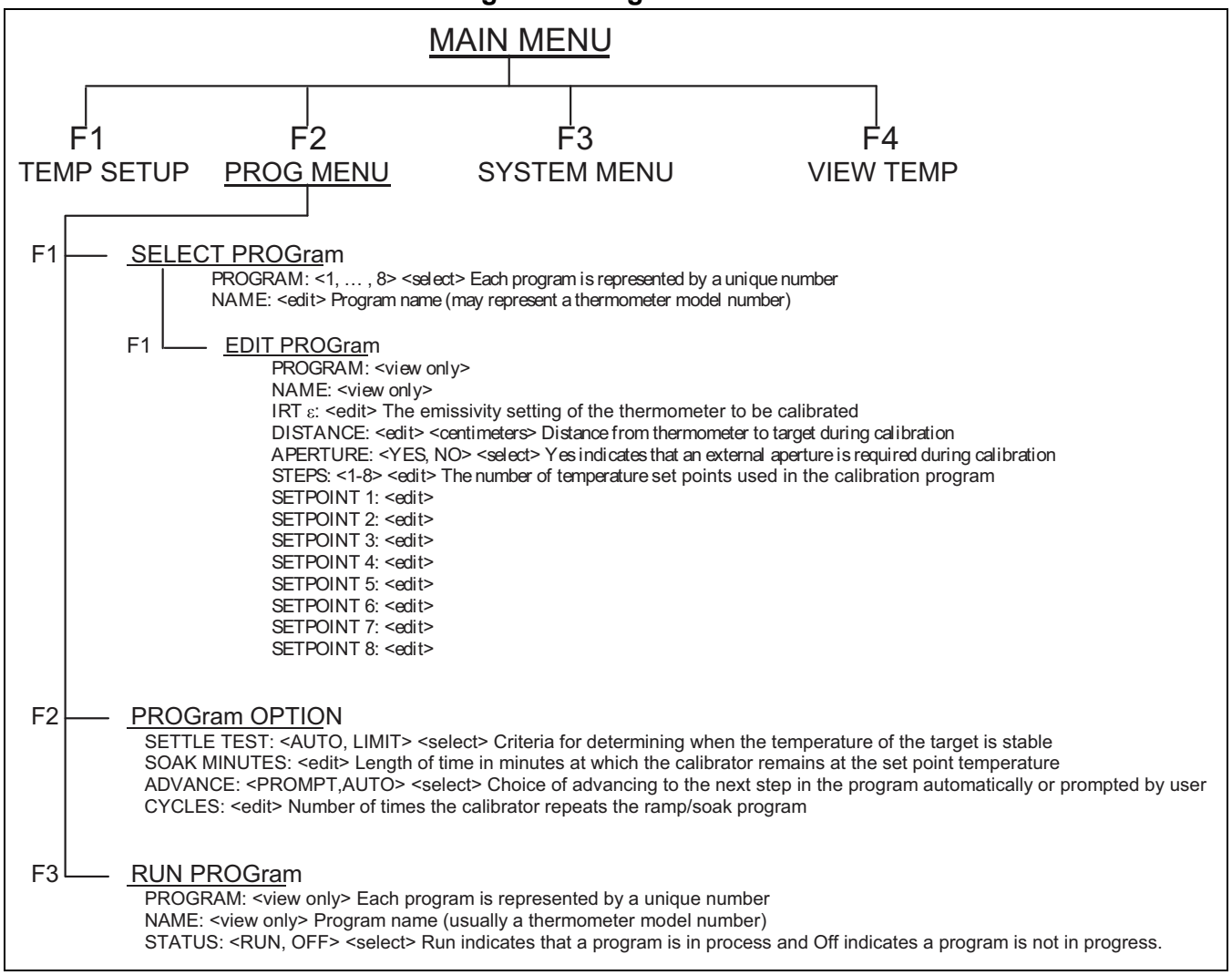
Figure 2. Temperature Setup Menu



Program Menu

The Program menu is shown in Figure 3.

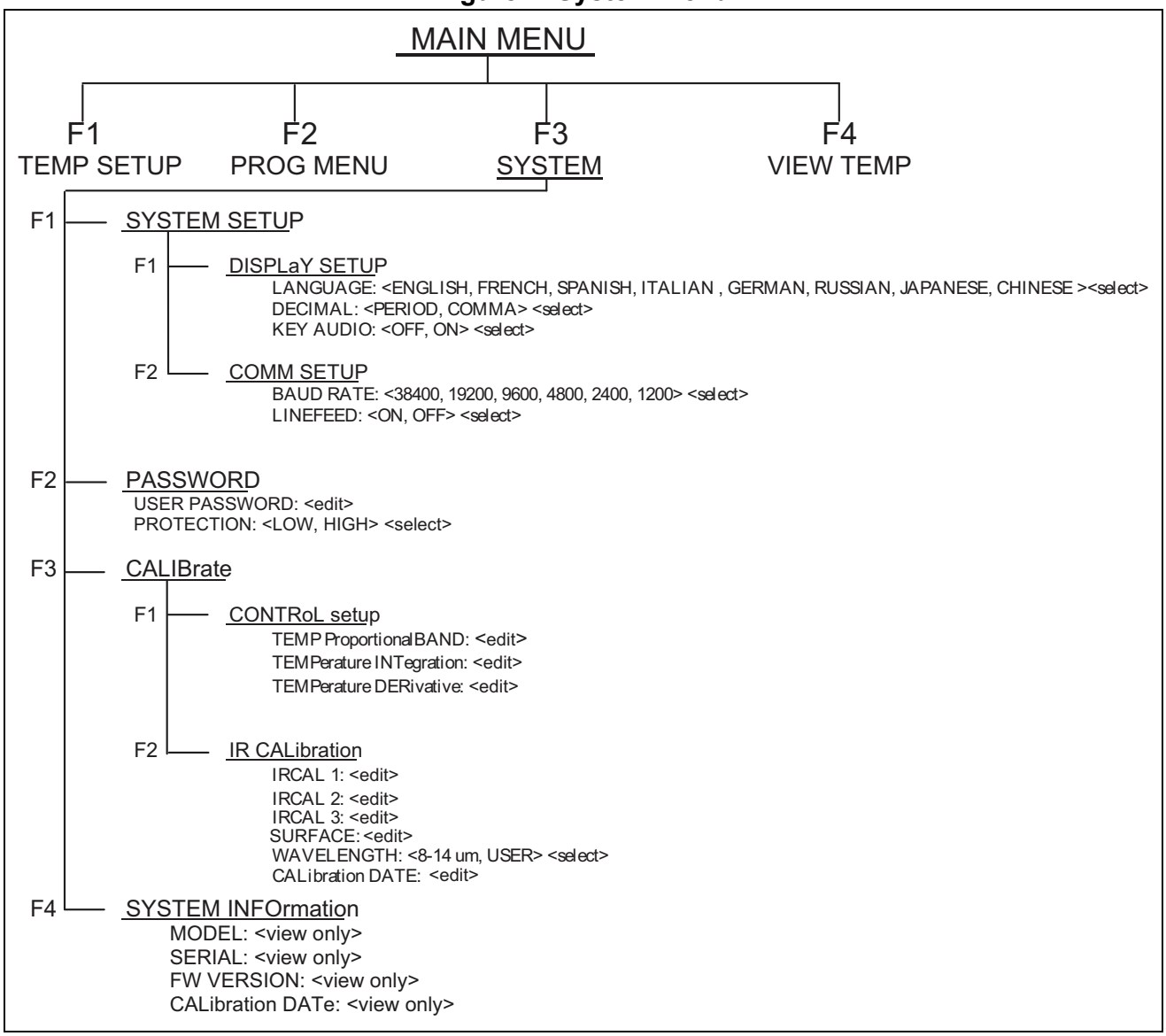
Figure 3. Program Menu



System Menu

The System menu is shown in Figure 4.

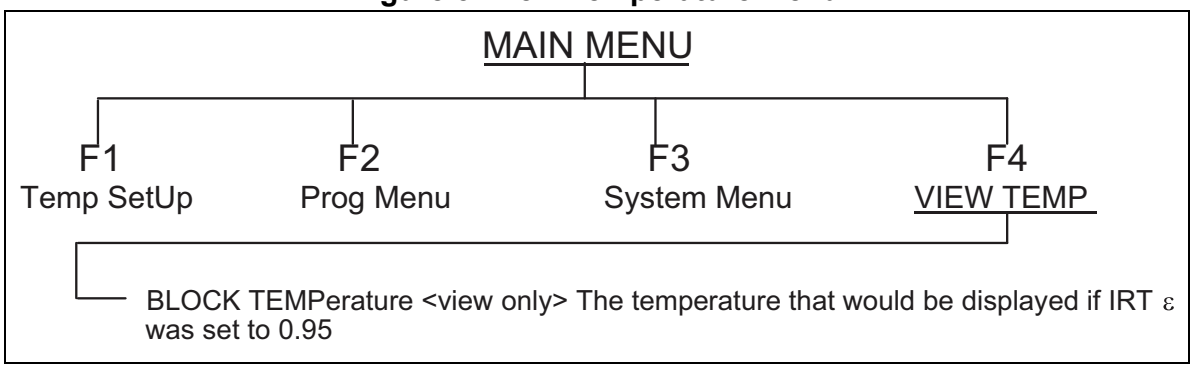
Figure 4. System Menu



View Temperature Menu

The View Temperature menu is shown in Figure 5.

Figure 5. View Temperature Menu



Troubleshooting

If the Product appears to function abnormally, Table 6 may help to find and solve the problem. Several possible problem conditions are described along with likely causes and solutions. If a problem arises, read this section carefully and attempt to understand and solve the problem. If the Product seems faulty or the problem cannot otherwise be solved, contact an Authorized Service Center for assistance. Be sure to have the instrument model number, serial number, and voltage available.

Table 6. Troubleshooting, Problems, Causes and Solutions

Problem	Causes and Solutions
The Product does not power up	**Check the fuses.** If a fuse blows, it may be due to a power surge or a component failure. Replace the fuse once. DO NOT replace the fuse with one of a higher current rating. Always replace the fuse with one of the same rating, voltage, and type. If the fuse blows a second time, it is likely caused by failure of a component part. Power Cord. Check that the power cord is plugged in and connected to the instrument. AC Mains Power. Insure the circuit supplying power to the instrument is on.
The display is blank The Product powers up: 4180 – fan turns on, 4181 – the power relay clicks, but the display remains blank	**Contrast.** Check the screen contrast. Toggle the down arrow key to see if the screen contrast lightens. If the contrast is not the issue, contact an Authorized Customer Service Center.
The Product heats slowly	**Scan Rate.** Check the Scan Rate settings. The Scan Rate may be set with too low a rate per minute for the current application.
If the display shows an abnormal temperature	The sensor is disconnected, open or shorted. Contact a Service Center for further instructions.
If the display shows cutout	**Cutout.** If the Product exceeds the temperature set in the soft cutout menu or if it exceeds the maximum operating temperature of the Product a cutout condition occurs. If this happens, the unit enters cutout mode and will not actively heat or cool until the user issues this command to clear the cutout or resets the instrument using the **SET PT.** key to clear the cutout mode and activate the Product. **Reset.** The software cutout may need to be adjusted for the application. Check and adjust the cutout setting by entering CUTOUT menu: MENU|TEMPSETUP|CUTOUT.
Apparent Temperature is not the displayed temperature OR Incorrect temperature reading	**Operating Parameters.** Ensure that all operating parameters for the Product match the Report of Certification that was sent with the Product. **Electrical Interference.** Look for sources of electrical interference, such as motors, welders, or RF-generating equipment nearby, or ground loops.