KAYE

Validation

IRTD

User's Manual

Amphenol
Advanced Sensors

M2845-6 Rev. C
March 2014

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Kaye Temperature Measurement Device

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Chapter 1. Introduction

The Intelligent RTD Probe (IRTD) is a self- contained, high precision temperature measurement device. It combines a high precision wire-wound platinum temperature sensing element with onboard electronics for resistance measurement, calibration, digital conversion and transmission. The output of the IRTD is a digital representation of the temperature which can be directly read by Kaye Validation equipment or by a PC. The IRTD provides premium accuracy by eliminating common sources of error, because its integrated electronics are calibrated as a single instrument.

The IRTD Probe (X0855) has a measurement range of -196°C to 420°C, an accuracy of 0.025°C (*refer to specifications) over the complete range, and resolution down to 0.001C. The unit comes with a calibration certificate and is traceable to ISO 17025. The accuracy, reliability, and ruggedness of the IRTD make it ideal as a Secondary Standard for calibration of other temperature devices.

For the Kaye Validation System (Kaye Validator, ValProbe, and RF ValProbe) the IRTD is the heart of the system providing the traceability of the system when performing sensor calibrations and verifications. The IRTD directly connects to the validation equipment and is integrated into the validation software.

The IRTD can also be utilized as a stand-alone secondary standard for measurement or calibration utilizing the IRTDWIN software. This software automatically records data computes any delta between two IRTDs so you can easily confirm the accuracy of your traveling standard. One convenient interface screen lets you track probe stability, both numerically and graphically, and confirm system accuracy.

1.1 Temperature Calibration

Built-in conversion firmware lets you read temperature according to:

- IPTS-48
- IPTS-68
- ITS-90 (International Temperature Scale of 1990)

Kaye highly recommends use of ITS-90 as this is the scale of law.

Figure 1 below shows an Intelligent RTD Probe used for calibration with a high temperature reference.

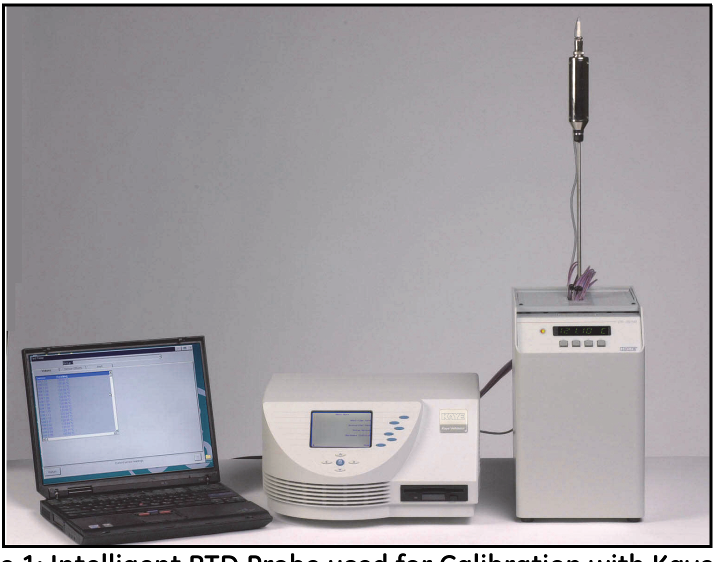


Figure 1: Intelligent RTD Probe used for Calibration with Kaye High Temperature Reference

CAUTION! **CAUTION! Users must handle the IRTD very carefully to guard against temperature fluctuations and shocks.**

The probe is carefully packaged to prevent mechanical stress and shock during shipping. Save the packing materials in case you need to ship the instrument for recalibration.

1.2 Communicating with the Probe

The Intelligent RTD Probe has its own applications program resident in firmware. As soon as power is applied, it runs by itself, ready to send data to a Validator, Base Station or computer. You can communicate with the probe using any RS-232C interface device that can send and receive ASCII characters.

1.2.1 Networking Multiple Probes

The Intelligent RTD Probe's digital communications interface is capable of high-speed multi-drop operation up to 1,000 feet, letting you connect multiple probes to the same 4-wire cable. The cable consists of one ground wire, one power supply wire, and separate wires for communication transmit and receive. It is important to note that the cable does not have to be shielded or twisted. Digital communication noise margin is extremely good since the signal swings by the amount of the power supply. This LAN capability is especially useful in manufacturing and process applications.

1.2.2 Probe Labels

The probe has three separate electronic labels. The first (LB, lb) contains the model and serial number. If it is changed, it will be reset when you send it to the factory or lab for service or recalibration. The calibration label (CL, cl) stores the calibration site and date. The user label (UL, ul) can be programmed with information relevant to your application. For example, you could give a probe the tag “Ice Bath.”

1.3 About the Manual

Chapter 2 of this *User's Manual* itemizes the accessories shipped with the probe, and tells you how to connect a single, complete Intelligent Probe System and a multiple probe network.

Chapter 3 describes the software shipped with the probe.

Chapter 4 is a technical description of the probe design and operation.

Chapter 2. Installation

When you remove the probe from its protective packaging, handle it only by the grip. Avoid touching the hollow sheath of the instrument in order to safeguard the sensor at the tip of the sheath. Make sure when you place the probe on the bench that it is secure against accidentally rolling off onto the floor.

2.1 Complete Intelligent RTD Probe System

The Intelligent RTD Probe (M2801, shown in Figure 2 below) is shipped with Win IRTD on a CD, the *User's Manual*, and a Certificate of Calibration. The serial number on the certificate matches the serial number on the IRTD label of the probe grip.

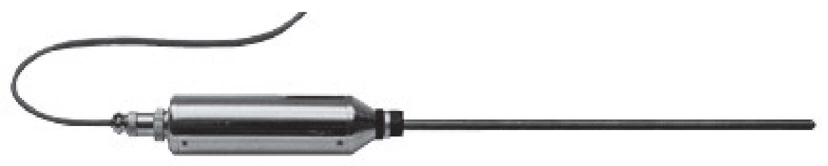


Figure 2: M2801 Intelligent RTD Probe

2.1 Complete Intelligent RTD Probe System (cont.)

The shipment also includes the following required accessories:

One cable (Model M2810, shown in Figure 3 below) to connect the probe to the calibration interface. The cable has a probe connector on one end and an RJ11/4 telephone-type plug on the other. Table 1 below shows the cable pin assignments.

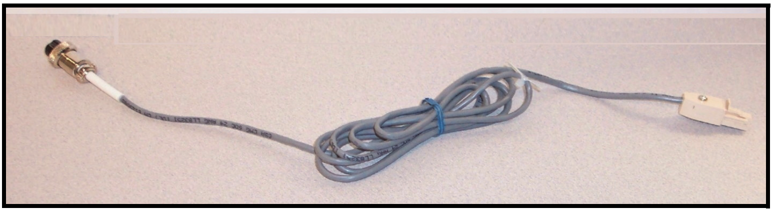


Figure 3: M2810 Cable

Table 1: M2810 Cable Pin Assignments

Conductor	Probe Pin	Signal
Yellow	1	+ DC Voltage
Green	2	Probe Transmit
Red	3	RS-232C Transmit
Black	4	Ground & common

Kaye Calibration Interface (Model X1715). The Calibration Interface is used with the Portable Validator and Digi product line.

Note: *If you are using Validator KL or Kaye Validator hardware, do not use the Calibration Interface box; all connections are made at the rear of each unit.*

The Calibration Interface lets you communicate with up to three probes and a high temperature reference on the same COM port. The probes, the power cable and the HTR/LTR/CTR can be plugged into any of the RJ11 connectors.

2.1 Complete Intelligent RTD Probe System (cont.)

Plug your terminal or computer into the PC port on the Calibration Interface. A 9 to 9-pin female RS-232 cable is included with the Calibration Interface.

Note: *Make sure that Pins 1 and 7 on your computer's serial port and your calibration block or salt bath are all properly grounded, otherwise you may get incorrect or erratic readings.*

One AC adapter (**Model M2831** for US or **M2835** for International). M2835 includes all plug adapters, M2831 only includes North America 110VAC plug.

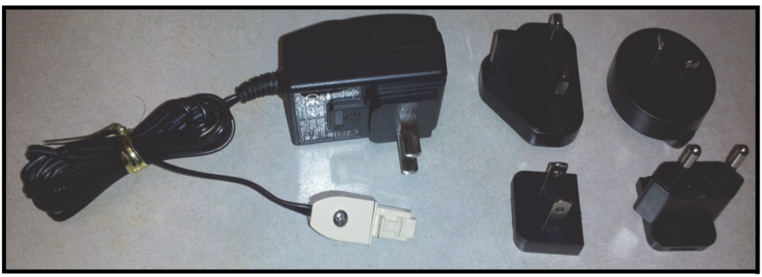


Figure 4: M2831 AC adapter and M2835 plug set

The AC adapter supplies DC power to the Calibration Interface, and can support up to 4 probes. (To power more than 4 probes in a single network, consult factory.) The power can be unregulated DC in the range from 10 to 25 volts.

Note: *Do not use the AC adapter with the Validator KL or the Validator 2000, damage may result. The power is provided internally.*

Each Intelligent RTD Probe has its own regulated power supply and is protected against spikes and supply reversals. Since each probe consumes only about 650 milliwatts at 10 to 25 volts, and the contact rating of the gold-plated RJ11/4 connectors is 1.5 A, interconnection is safe, reliable and economical.

2.1 Complete Intelligent RTD Probe System (cont.)

To communicate with the Intelligent RTD Probe system, you need an RS-232C interface device.

2.1.1 Optional Accessories

To increase the distance between any component of the network, use a 25-foot extension cable (Model M2855) with an RJ11/4 connector on each end, or a 25-foot M2810-25 cable.

2.2 Required Equipment

- One M2810 cable for each IRTD. Each cable has a probe connector on one end and an RJ11/4 telephone-type plug on the other.
- One Kaye Calibration Interface (Model X1715). The Kaye Calibration Interface lets you communicate with up to four IRTDs on the same COM Port. The IRTDs and the power cable can be plugged in to any of the RJ11 connectors.
- One 9 to 9-pin female RS-232 cable, supplied with the Calibration Interface, to connect the PC and the Calibration Interface.

One AC adapter (Model M2831 or Model M2835). The AC adapter supplies DC power to the Calibration Interface, and can support up to four probes.

2.3 Using IRTD with Kaye Products

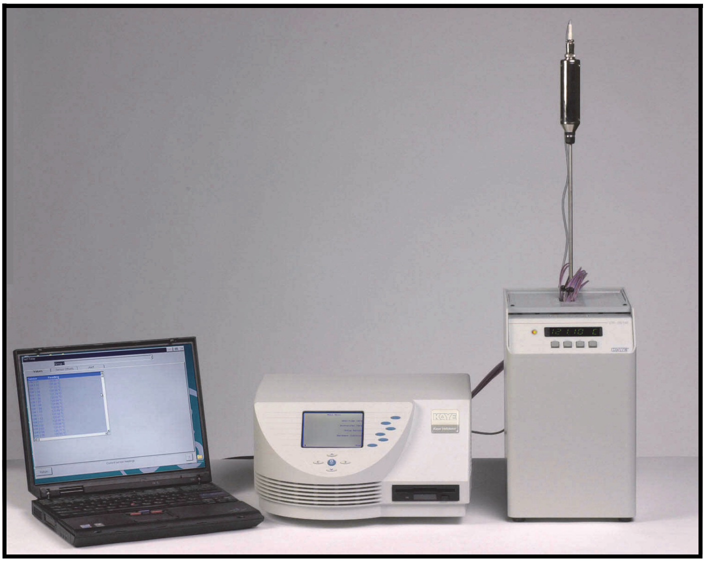


Figure 5: Complete Intelligent RTD Probe System

<u>CAUTION!</u> **Do not use the AC adapter with the Validator KL or the Kaye Validator; power is provided internally.**
ITS-90 is recommended when changing the IRTD temperature scale.

Using Figure 5 above as a guide, refer to the section for your validation system and follow the associated steps.

2.3.1 Kaye Validator

IMPORTANT: *Do not use the Calibration Interface box with the Validator KL or the Kaye Validator.*

The back of the Validator has ports for electrical and communication connections. Each connection port is labeled with an icon representing its function. Three 6-pin RJ11 connectors, labeled with a temperature reference icon, are available for connecting IRTDs and one Kaye temperature reference.

Note: *The Validator can accept data from 2 IRTDs at a time and the temperature can be displayed.*

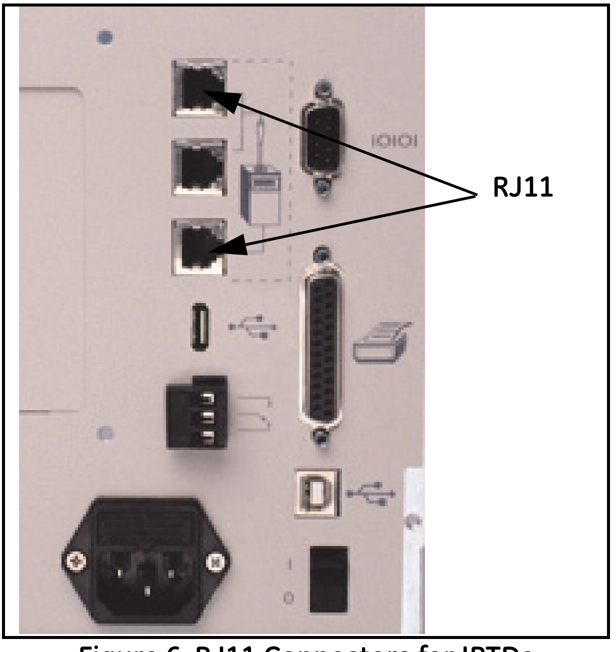


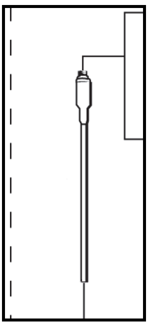
Figure 6: RJ11 Connectors for IRTDs

Connect the IRTD to one of the RJ11 sockets, using the M2810 cable supplied with the IRTD.

2.3.2 Kaye ValProbe

The backs of the ValProbe Readers have connection ports for electrical and communication connections. Each connection port is labeled with an icon representing its function.

<u>CAUTION!</u> **Make sure the Reader is powered off before making any connections.**



There are three 6-pin RJ11 connectors, labeled with an IRTD icon, on the Standard Reader for connecting the IRTD. (On the Reader 2, there are two RJ11 connectors.) The IRTD temperature measurement standard is a self-contained measurement system providing temperature data directly to the Kaye ValProbe software during calibration and calibration verification.

Connect the IRTD to one of the RJ11 sockets, using the M2810 cable supplied with the IRTD.

2.3.3 RF ValProbe and Other Validation Systems

1. Attach the cable to the probe.
2. Plug the IRTD cable into one of the sockets on the Calibration Interface.
3. Plug the RJ11 connector on the AC adapter cable into an RJ11 socket on the Calibration Interface.
4. If your computer has a 25-pin RS-232 port, attach a 9 to 25-pin adapter to the 9 to 9-pin cable supplied with the Calibration Interface.
5. Connect the Calibration Interface to your computer with the supplied RS-232 cable.
6. Plug the AC adapter into a wall outlet.
7. Turn on your computer and Base Station.

2.4 Using the IRTD in Standalone Mode

2.4.1 Connecting Your System Hardware

1. Plug the RJ11 connector on each IRTD into one of the RJ11 sockets on the Kaye Calibration Interface, using the M2810 cable supplied with the IRTD.

2. Plug the RJ11 connector on the AC adapter cable into one of the RJ11 sockets on the Kaye calibration Interface.

3. If your computer has a 25-pin RS-232 port, attach a 9 to 25-pin adapter to the 9 to 9-pin RS-232 cable (W1890-1) supplied with the Calibration Interface.

4. Connect one end of the RS-232 cable to the Calibration Interface port labeled PC.

5. Connect the other end of the RS-232 cable to an available COM port on your PC.

6. Plug the AC adapter into a wall outlet.

7. Power up your computer.

Chapter 3. IRTDWin Data

3.1 Overview

The IRTDWin software is a time saving tool that allows you to compare your travelling IRTDs to a stationary IRTD in order to verify the accuracy of your temperature standards. Simply plug in your stationary and travelling IRTDs to your PC and the software does the rest. The IRTDWin software displays temperature values and computes the delta so you can easily check that your Kaye probe has maintained calibration. One convenient interface screen lets you track probe stability and view the difference between the two IRTDs numerically or graphically. You can also create a spreadsheet-compatible file and import the data into Microsoft Excel, where you can generate custom reports.

With the IRTDWin software you can:

- View readings for up to two probes in three resolutions
- Specify standard and test probes
- Specify a scan interval from 5 to 60 seconds
- Specify one of three temperature scales (IPTS-48, IPTS-68, ITS-90)
- Specify one of four temperature units (C, F, K, or Ohms)
- View test results numerically or graphically
- Change IRTD settings

3.2 Required Equipment

- One M2810 cable for each IRTD. Each cable has a probe connector on one end and an RJ11/4 telephone-type plug on the other.
- One Kaye Calibration Interface (Model X1715). The Kaye Calibration Interface lets you communicate with up to four IRTDs on the same COM Port. The IRTDs and the power cable can be plugged in to any of the RJ11 connectors.
- One 9 to 9-pin female RS-232 cable, supplied with the Calibration Interface, to connect the PC and the Calibration Interface.
- One AC adapter (Model M2831 for 110 VAC, or Model M2835 for 220 VAC). The AC adapter supplies DC power to the Calibration Interface, and can support up to four probes.

3.3 Connecting Your System Hardware

1. Plug the RJ11 connector on each IRTD into one of the RJ11 sockets on the Kaye Calibration Interface, using the M2810 cable supplied with the IRTD.

2. Plug the RJ11 connector on the AC adapter cable into one of the RJ11 sockets on the Kaye calibration Interface.

3. If your computer has a 25-pin RS-232 port, attach a 9 to 25-pin adapter to the 9 to 9-pin RS-232 cable (W1890-1) supplied with the Calibration Interface.

4. Connect one end of the RS-232 cable to the Calibration Interface port labeled PC.

5. Connect the other end of the RS-232 cable to an available COM port on your PC.

6. Plug the AC adapter into a wall outlet.

7. Power up your computer.

3.4 Main Screen

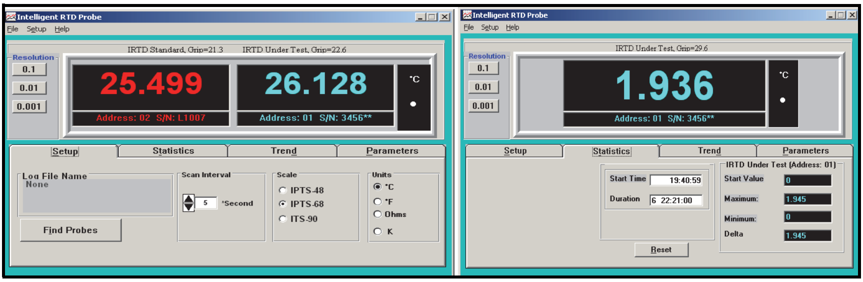


Figure 7: Main Screen

The Main screen provides a convenient interface that lets you view probe readings and access the program menus and tabs.

At the top of the Main screen is a menu bar with three menus:

- **File** - options for opening and closing a log file, and exiting the program.
- **Setup** - option for accessing the Communications Setup screen, where you can search for probes, specify the number of search addresses (1 - 99), specify the IRTD Standard and IRTD Under Test, select a COM port, and change COM port settings to match the IRTD settings.
- **Help** - options for accessing online help and product support.

Below the menu bar is a window that displays the temperature readings of up to two IRTDs, the address and serial number of each IRTD, and the temperature units of the readings. The IRTD Standard values are displayed in red on the left side of the window. The IRTD Under Test values are displayed in cyan on the right side of the window.

You can display temperature readings in one of three resolutions: 0.1, 0.01, or 0.001. Click the associated resolution command button to display the temperature readings in that resolution.

At the bottom of the screen are four tabs: **Setup, Statistics, Trend**, and **Parameters**. Click on the tab label to access a specific tab.

3.4.1 Setup Tab

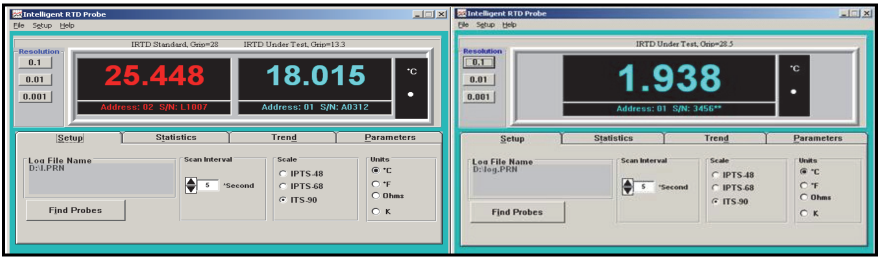


Figure 8: The Setup Tab

The Setup tab displays the current scan interval, temperature scale and temperature units defined for your test. You can change any of these settings on this tab. If you opened a log file, the log file name is also displayed on this tab.

3.4.1a Scan Interval

The default scan interval setting is 5 seconds. You can change the scan interval at any time during a test to record data from 5 to 60 seconds, using spin buttons or direct entry.

To specify a scan interval:

- On the Setup tab, click the spin button controls to change the scan interval, or change the scan interval number directly.

3.4.1b Selecting or Changing the Temperature Scale

When you start the program, the program compares the temperature scale of each IRTD. If the scales do not match, you are prompted to set the temperature scale on the Setup tab. You can change the temperature scale at any time during a test.

You can select one of three temperature scales for your test: IPTS-48, IPTS-68, or ITS-90. When you select a temperature scale, the temperature scale settings for the IRTD Standard and the IRTD under Test are automatically updated to reflect the new temperature scale.

3.4.1b Selecting or Changing the Temperature Scale

To select or change the temperature scale:

- On the Setup tab, click the associated radio button to select a temperature scale.

Note: *If you have a log file open, and you change the temperature scale during a test, the log file will be closed.*

3.4.1c Changing the Temperature Units

You can specify one of four temperature units for your test: C, F, K, or Ohms. You can change temperature units at any time during a test. The change takes place immediately, and affects the displayed readings and the Y axis coordinates on the graph. The next time you run the program, the temperature units you select here will be in effect

To specify temperature units:

- On the Setup tab, click the associated radio button to select a temperature scale.

Note: *If you have a log file open, and you change the temperature units during a test, the log file will be closed.*

Find Probes command button - Click to search for probes, specify the number of search addresses (1 - 99), specify the IRTD Standard and IRTD Under Test, select a COM port, and change COM port settings to match the IRTD settings.

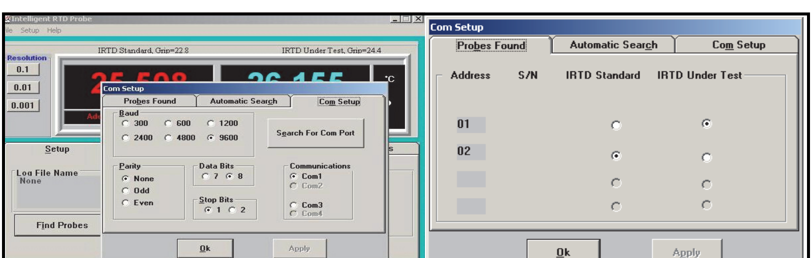


Figure 9: Find Probes Command

3.4.2 Statistics Tab

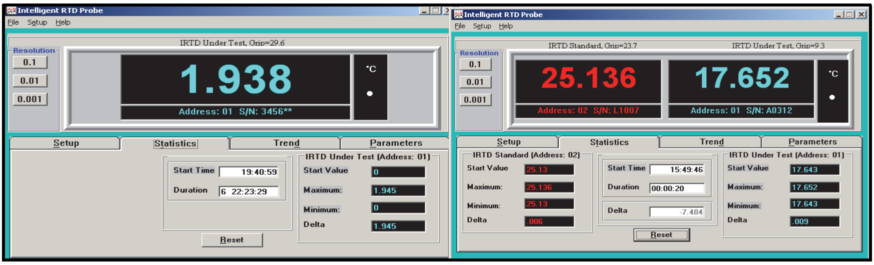


Figure 10: Statistics Tab

The Statistics tab displays statistical information about the IRTD Standard, the IRTD Under Test, and the test as a whole. The IRTD Standard data is displayed in red text on the left side of the tab. The IRTD Under Test data is displayed in cyan text on the right side of the tab. For each IRTD you can view the:

- Starting temperature
- Maximum and minimum temperatures reached during the test
- Difference between the maximum and minimum temperatures

The start time of the test, the time duration of the test, and the difference between the IRTD Standard and the IRTD Under Test are displayed in black text on the middle of the tab.

3.4.3 Resetting Statistical Calculations

During a test, you can reset all statistical calculations. Statistical calculations include:

- Starting temperatures of the IRTD Standard and the IRTD Under Test
- Maximum and minimum temperatures reached during the test for the IRTD Standard and the IRTD Under Test
- Difference between the maximum and minimum temperatures for the IRTD Standard and the IRTD Under Test
- Starting time of the test
- Time duration of the test
- Difference between the IRTD Standard and the IRTD Under Test

When you reset statistical calculations, the new values are displayed on the Statistics tab, and the Y axis graph coordinates on the Trend tab are reset.

To reset statistical calculations:

- On the Statistics tab, click **Reset**.

3.4.4 Trend Tab

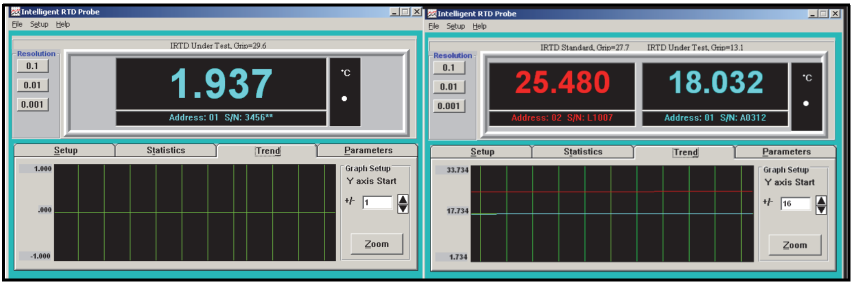


Figure 11: The Trend Tab

The Trend tab provides a graphic display of the IRTD Standard and the IRTD Under Test. The graph is updated at the scan interval.

- The green horizontal line represents the starting temperature of the IRTD Under Test. The red horizontal line represents the real time temperature reading of the IRTD Standard. The cyan horizontal line represents the real time temperature reading of the IRTD Under Test. The green vertical lines represent each scan interval.
- The Y axis midpoint coordinate is the starting temperature of the IRTD Under Test. The upper and lower Y axis coordinates are determined by the Y Axis Start number you selected. The Y Axis Start values range from 1 to 37 (1, 2, 4, 8, 16, 32, 37). You can change the upper and lower Y axis coordinates using the spin buttons. For example, if you set the Y Axis Start value to 4, the upper Y axis coordinate is 4 degrees higher than the midpoint, and the lower Y axis coordinate is 4 degrees less than the midpoint.
- When you reset the values on the Statistics tab, the midpoint value on the Y axis is updated to reflect the new starting temperature value of the IRTD Under Test.
- You can also expand the graph to view a smaller section of the graph in more detail by clicking the **Zoom** button.

3.4.5 Parameters Tab

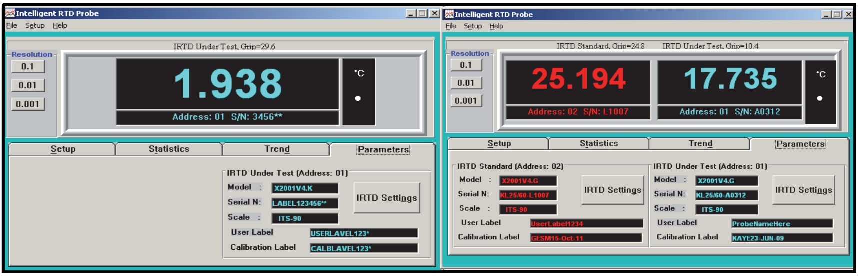


Figure 12: The Parameters Tab

The Parameters tab displays the address, model number, serial number, temperature scale, user label, and calibration label for the IRTD Standard and the IRTD Under Test. The IRTD Standard data is displayed in red. The IRTD Under Test data is displayed in cyan.

For each IRTD, you can view and/or change IRTD settings by clicking the **IRTD Settings** button.

3.4.5a Changing the Probe Address

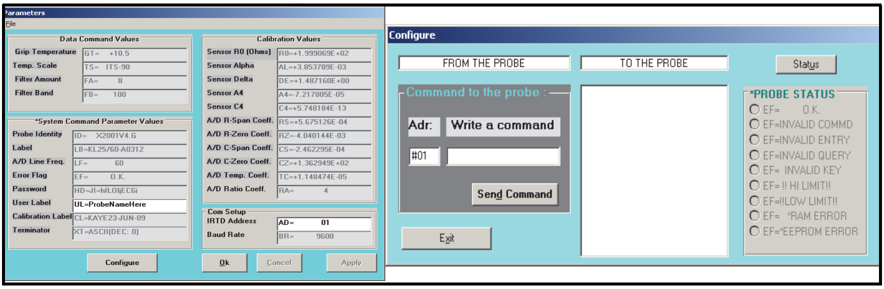


Figure 13: Probe Address

1. On the Parameters tab, click **IRTD Settings** for the IRTD Standard or the IRTD Under Test.

The Parameters screen displays.

2. Change the Probe Address for the selected probe directly on this screen. The Probe Address field accepts 01 to 99.
3. Click **Apply**, and then click **OK** when prompted.

   The Com Setup screen displays while the system automatically reads your probes. When this process is complete, the Probes Found tab displays.
4. Click **OK**.

The Main screen displays with the new address.

3.4.5b Change the Baud Rate

1. On the Parameters tab, click **IRTD Settings** for the IRTD Standard or the IRTD Under Test.

The Parameters screen displays.

2. Click **Configure.** A Warning dialog box displays.
3. Click **OK**. The Configure screen displays.

3.4.5b Change the Baud Rate (cont.)

4. Enter a command in the command text box and click **Send Command**.

br: Write Probe Baud Rate
Format: #A1A2brNNNN
Where:
# = command lead-in
A1A2 = probe address 01-99
br = command for writing the baud rate to the probe
NNNN = four digit baud rate: 9600, 4800, 2400, 1200, 0600 or 0300

For example, to write a baud rate of 2400 to Probe 53, enter: #53br2400

Note: *When you write a new baud rate to a probe, be sure to change the baud rate at the terminal or computer. Otherwise, you will not be able to communicate with the probe.*

BR: Read Probe Baud Rate
Format: #A1A2BR
Where:
# = command lead-in
A1A2 = probe address 01-99
BR = command for reading the probe baud rate

For example, to read the baud rate of Probe 03, enter:#03BR

The RTD Intelligent Probe responds with a value, such as: BR = 9600

5. Repeat step 4 for each parameter you are changing.

6. Click **Exit**. The Main screen displays.

7. From the Setup menu, click **Communications Port**.
The Communication Setup screen displays while the system automatically reads your probes. When this process is complete, the Probes Found tab displays.

8. Click **OK**.

3.4.5c Creating a Log File

During a test, you can log data to a spreadsheet-compatible file that can then be imported into Microsoft Excel for further analysis.

To open a log file:

1. .From the File menu, click **Open Log File.**
   The Open Log File dialog box displays.
2. Select a drive and directory for the log file.
3. Enter the filename in the File name text box. The system will automatically append a .PRN extension.
4. Click **Open**. Test data will now be written to the log file at the scan interval. The log file name is displayed on the Setup tab.

When you finish collecting data, you can close the log file. If you do not close the log file, the file will be closed when you exit the software.

To close a log file:

- From the File menu, click **Close Log File**.

3.4.5d Importing the Log File into Excel

You can import the log file into Microsoft Excel to generate a document with the raw data and delta values as they were captured, or format the data to create a custom report. You import the file as a comma delimited file.

To import the log file into Excel:

1. Start Microsoft Excel.

2. From the File menu, click **Open**.

3. Navigate to the drive and directory where your log file is stored.

4. Select your file and click **Open**.

The Text Import Wizard - Step 1 of 3 screen displays.

5. In the Data Type field, click **Delimited**, and then click **Next**.

The Text Import Wizard -Step 2 of 3 screen displays.

6. In the Delimiters field, click **Comma**, and then click **Finish**.

The log file data displays in the spreadsheet.

3.5 Specifying IRTD Standard and IRTD Under Test

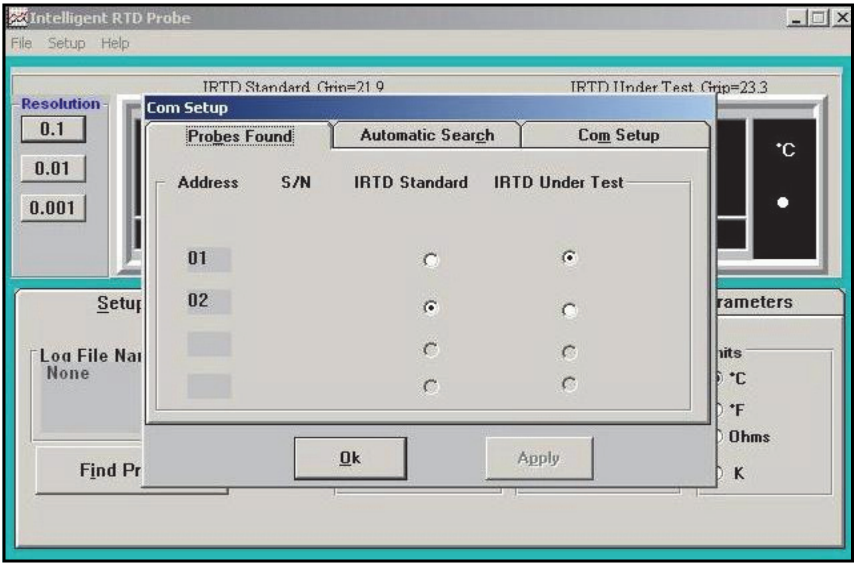


Figure 14: Probes Found Tab

When you start the IRTDWin software, the program automatically searches for all probes that are communicating with the software. If you have only one probe connected, the program defines that probe as the IRTD Under Test. If you have more than one probe connected (maximum of four probes can be connected at one time), the software assigns the probe with the lowest address number to be the IRTD Under Test, and assigns the probe with the next lowest address to be the IRTD Standard. You can change these selections at any time.

To specify the IRTD Standard and IRTD Under Test:

1. From the Setup menu, click **Communications Port,** or
   On the Setup tab, click **Find Probes**.
2. If you have a log file open, you are prompted that the log file will be closed. Click **OK**.
   The Communications Setup screen displays.

3.5 Specifying IRTD Standard and IRTD Under Test (cont.)

3. On the Probes Found tab:

- Click the **IRTD Standard** radio button next to the probe you want to designate as your standard probe.
- Click the **IRTD Under Test** radio button next to the probe you want to designate as your test probe.

4. Click **OK**.

Your selections display on the Main screen.

3.6 Viewing and/or Changing IRTD Settings

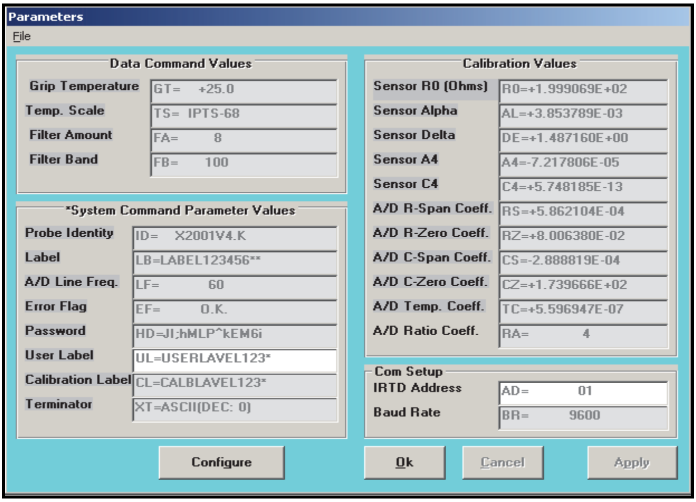


Figure 15: Parameter Values

You can view and/or change Data Command Values, System Command Parameter Values, Calibration Values, and Communication Parameters for the IRTD Standard and the IRTD Under Test.

All changes other than User Label and Probe Address require you to enter Write commands that send system configuration data to nonvolatile memory. You should not change IRTD settings unless you are an expert user familiar with IRTD programming and codes. Contact the service team for command formats.

Chapter 4. Technical Description

The Intelligent RTD Probe's very high precision, wirewound platinum temperature sensing element is in the tip of the 18" stem, as shown in Figure 16 on the next page. Wires lead from the element to the grip, where they connect to the A/D converter.

The resistance of the element is a nonlinear function of temperature. This resistance is measured by monitoring the voltage drop across the element with a 4-wire ratiometric Kelvin sensing configuration.

4.1 Electronic Circuitry

The A/D converter is designed to allow direct interfacing to the sensing element without prior signal conditioning or amplification. The converter, a high-speed, ratiometric offset dual-slope design, resolves the resistance of the temperature sensing element to better than the equivalent of 0.001°C more than 30 times per second over a range of -200°C to 420°C. Controlled by the microcomputer, the converter is corrected for its own long-term zero drift, measures its own ambient temperature, and corrects itself for its own temperature-induced zero and span drift. Additionally, the converter corrects itself for any linearity errors.

The microcomputer consists of a CPU and an application-specific integrated circuit (ASIC) that interfaces the CPU to the A/D converter. All calibration data and characteristic coefficients of the sensing element, together with the probe's address and communication parameters, are stored in nonvolatile Flash. Certain sections of this memory require a password, ensuring security of calibration constants and other parameters.

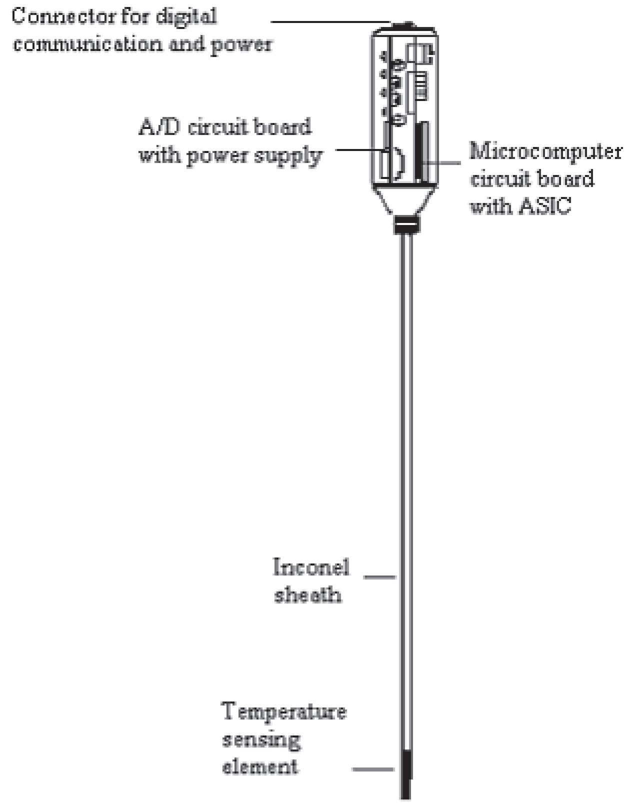


Figure 16: Intelligent RTD Probe Sectional View

4.1 Electronic Circuitry (cont.)

The analog and digital electronic circuitry requires very low power, which is provided by a switching regulator power supply in the grip. This means that the probe can be used with inexpensive, wall-mounted AC power supplies that do not need highly filtered or regulated outputs. In daisy chain applications where one source powers up to five probes, supply reversals or voltage drops caused by lead wire resistance have no effect on the integrity of the digital output data.

4.2 Sequence of Operation

The microcomputer instructs the A/D converter to obtain the next measurement of sensor element resistance. This measurement might take 30 ms to make, since the A/D is optimized to reject line power interference.

During this time, the microcomputer processes the data from the previous measurement so that the algorithmic execution of the firmware is optimally interlaced with the data conversion timing of the A/D.

The first stage in the processing calibrates the resistance measurement. There are five steps:

1. Correction of data for A/D zero and span coefficients, using previously calibrated and stored coefficients.
2. Correction of data for long-term A/D zero drift. This is carried out by an interlaced measurement cycle whereby the A/D measures its own drift, filters it appropriately, and stores that value in memory.
3. Correction of data for ambient temperature effects on the A/D parameters of zero and span. This is accomplished by an interlaced measurement cycle of a temperature sensor mounted in the grip of the Intelligent RTD Probe and located optimally to critical analog components. Under microcomputer control, the A/D measures this sensor, determines the equivalent ambient temperature, and corrects the data according to previously calibrated and stored values.

4.2 Sequence of Operation (cont.)

4. Correction of data for A/D linearity errors according to previously calibrated and stored characteristic A/D parameters.

5. Digital filtering of the data so that it appears smooth and stable. You can select the magnitude of the “capture band” (outside of which filtering will not take place) and the amount of filtering to be applied once the data value falls inside the capture band.

At this point, the processed data accurately represents the value of resistance of the temperature sensing element. This resistance value is continuously stored so that it can be transmitted on request.

In the next stage in the processing, the microcomputer, using the stored IPTS-68 temperature calibration coefficients, converts resistance data to temperature data according to the selected temperature scale. The default is the IPTS-68 scale, but you can select the IPTS-48 or the new ITS-90 scale. The microcomputer uses the exact equations specified by the selected temperature scale.

The temperature is simultaneously converted into °F, °C, and Kelvins, so you can request a value in any measurement unit without having to wait for further processing.

The value is stored in local memory and updated with each new measurement. Upon request, the Intelligent RTD Probe transmits the most recent value within a few milliseconds.

Appendix A. Specifications

A.1 IRTD 400

A.1.1 Temperature Range

-195 to 420°C

A.1.2 Accuracy Over Range

±0.025°C *= Accuracy may degrade in strong RF fields below 1 GHz. If this occurs, move the device away from the interference.

A.1.3 Resolution

0.001°C

A.1.4 Sensor Element

200 Ohm Platinum sensor

A.1.5 Sheath Material

Inconel™ 600

A.1.6 Immersion Depth (Minimum)

101.6 mm (4")

A.1.7 Dimensions

Overall length:	603 mm (23.75")
Grip:	89 mm x 32 mm (3.5" x 1.25")
Sensor sheath:	457 mm x 6.35 mm (18" x 0.25")

A.1.8 Calibration

Traceable to NIST or PTB;
Recommended calibration period: 1 year

A.1.9 User-Selectable Parameters

IPTS-48, IPTS-68 or ITS-90 Temperature units:
°C, °F, or KSensor resistance in ohms;
grip temperature in °C

A.1.10 Power to Probe

Unregulated DC, 10 to 25V;
first probe: 850 mW at 15 V;
each additional probe: 550 mW

A.1.11 Power Supply

Input M2831 and M2835 100-240 VAC, 50-60 Hz, 0.03A. Output 12 VDC 0.5A. M2831 includes only US adapter M2835 includes US, UK, EU, AU, and CC interchangeable plug adapters. See Figure 4.

A.1.12 User-Programmable Functions (Stored in FLASH)

Probe address and label, baud rate
Calibration constants, sensor and A/D
Password, filtering coefficients for filter band and filter magnitude

A.1.13 Communications

RS-232C interface, Command/Response protocol with baud rates of 300, 600, 1200, 2400, 4800 or 9600; 30 readings per second

A.1.14 Environmental

Ambient temperature: 0 to 60°C (32 to 140°F)
Humidity: 0-95% non-condensing

A.1.15 Warranty

12 months parts and labor

*For power supply requirements other than those listed, or to power more than 4 probes in a network, consult factory or local representative.

Warranty

Each instrument manufactured by Amphenol Advanced Sensors is warranted to be free from defects in material and workmanship. Liability under this warranty is limited to restoring the instrument to normal operation or replacing the instrument, at the sole discretion of Amphenol Advanced Sensors. Fuses and batteries are specifically excluded from any liability. This warranty is effective from the date of delivery to the original purchaser. If Amphenol Advanced Sensors determines that the equipment was defective, the warranty period is:

- one year from delivery for electronic or mechanical failures
- one year from delivery for sensor shelf life

If Amphenol Advanced Sensors determines that the equipment was damaged by misuse, improper installation, the use of unauthorized replacement parts, or operating conditions outside the guidelines specified by Amphenol Advanced Sensors, the repairs are not covered under this warranty.

The warranties set forth herein are exclusive and are in lieu of all other warranties whether statutory, express or implied (including warranties or merchantability and fitness for a particular purpose, and warranties arising from course of dealing or usage or trade).

Return Policy

If a Amphenol Advanced Sensors instrument malfunctions within the warranty period, the following procedure must be completed:

1. Notify Amphenol Advanced Sensors, giving full details of the problem, and provide the model number and serial number of the instrument. If the nature of the problem indicates the need for factory service, Amphenol Advanced Sensors will issue a RETURN AUTHORIZATION NUMBER (RAN), and shipping instructions for the return of the instrument to a service center will be provided.
2. If Amphenol Advanced Sensors instructs you to send your instrument to a service center, it must be shipped prepaid to the authorized repair station indicated in the shipping instructions.
3. Upon receipt, Amphenol Advanced Sensors will evaluate the instrument to determine the cause of the malfunction.

Then, one of the following courses of action will then be taken:

- If the damage is covered under the terms of the warranty, the instrument will be repaired at no cost to the owner and returned.
- If Amphenol Advanced Sensors determines that the damage is not covered under the terms of the warranty, or if the warranty has expired, an estimate for the cost of the repairs at standard rates will be provided. Upon receipt of the owner's approval to proceed, the instrument will be repaired and returned.

Customer Support Centers

U.S.A.
For Sales and Services (Repair/Calibration):
Amphenol Thermometrics, Inc.
St Marys Center
967 Windfall Road
St Marys, Pennsylvania 15857
U.S.A.
T: 814-834-9140
F: 814-781-7969

U.S.A.
For Technical Support:
Amphenol Thermometrics, Inc.
St Marys Center
967 Windfall Road
St Marys, Pennsylvania 15857
U.S.A.
T: 814-834-9140
F: 814-781-7969

Europe, Asia and Middle East Sales and Service:
Amphenol Advanced Sensors GmbH
Sinsheimer Strasse 6
D-75179 Pforzheim
Germany
T: +49(0)7231-14335 0
F: +49(0)7212 391 035

China:
Amphenol (Changzhou)
Connector Systems
305 Room, 5D
Jintong Industrial Park
Wujin, Changzhou, Jiangsu, China
T:+86 519 8831 8080 ext. 50087
F:+86 519 8831 2601

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www.amphenol-sensors.com

M2845-6 Rev. C / March 2014