physitemp

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OPERATING MANUAL

THERMES USB – WFI
Single and Multiple Thermes with DasyLab12.0 Lite-Basic.

OPERATING MANUAL

THERMES USB
Temperature Data Acquisition System

INDEX

1.0   INTRODUCTION

Summary of Operation

The Thermes USB and Thermes WFI are Physitemp's latest addition to its product line of high-accuracy type T Thermocouple monitoring systems and sensors. It permits the user to turn any desktop or laptop computer with a USB port into a highly accurate seven-channel type T Thermocouple thermometry system. Additional units may be added to accommodate more inputs. The standard version, Thermes USB, connects via a cable to your computer USB port.

The wireless version Thermes USB WFI can be either directly connected to a USB port or, with the included wireless receiver, positioned up to 100 feet from the host computer.

A high accuracy electronic cold-junction compensation circuit maintains a typical system accuracy of ± 0.2°C over an ambient temperature range of 15 to 35°C. Thermes USB and USB WFI are designed to work with DasyLab software giving the user a variety of features for capturing, displaying and logging the data. DasyLab Lite is the most economical software package and will run a single Thermes USB or Thermes WFI data acquisition system. For operating more than one Thermes USB or USB WFI, either the **DasyLab Basic or Pro version** is required.

Package Contents

Depending on which system and accessories are ordered, the package should contain the following items:

Thermes USB

Thermes USB Data Acquisition Hardware (1 per system)
3 ft. USB male A-B Cables (1 per system)
Calibration data file CD-ROM
MCC Daq "InstaCal" Software and drivers
Operating Manual

DasyLab Lite, Basic or Pro versions
Operating Manual

Thermes USB WFI
Thermes USB WFI Data Acquisition Hardware
USB WFI IFC Receiver (1 per system)
3 ft. USB male A-B cables (1 per system)
5-volt wall-mounting power supply with USB male A-B cable (1 per system)
Calibration data file CD-ROM
MCC Daq "InstaCal" Software, drivers
Operating Manual

BP-1 Li Ion battery pack
Li lon rechargeable battery
Wall mount AC charger
AC power cord
Assortment of Laptop connectors
3 ft. USB male A-B cable
12V DC charger cable
Operating Instructions

OPT-1 USB Optical Isolation Link
10-meter optical fiber with built in optical receiver and transmitter
Medical grade 5 volt DC power supply
3 ft. USB male A to 3.5mm DC power plug
AC power cable
Operating Instructions
OPT-1 'Black box" optoisolator 4500V isolation (medical grade)
3 ft. USB cable

In the event that any of the above items in the packages described are found damaged or missing, please contact our customer service dept. at 1-800-452-8510 for instructions.

2.0   INSTALLATION OF SOFTWARE.

2.1   The **"InstaCal"** software is to be used only to **install** Thermes USB- DAC **board drivers.** The licensed **DasyLab** program is required with Thermes **"Worksheet"** to measure **accurate-calibrated** temperature.

Find the disk labeled MCC DAQ Software and insert into CD-Rom drive. Software installation will begin automatically. Select all the options and click 'Install'. Follow the instructions and click 'Finish', Click 'Cancel' when you reach the "Hardware Users Guides" screen. For an "InstaCal" ver. 6.30 and higher upgrade go to **www.mccdaq.com**.

Connect your Thermes USB System to an available USB port of your Windows® supported host computer. If you are using the Thermes Wireless System with wireless interface WLS-IFC unit, connect wireless unit WLS-IFC with USB cable to USB port of computer. Connect Thermes System with filtered USB cable and 5Volt adapter to an AC outlet or to a BP-1 LiIon Battery Pack. Wait for **'New Hardware Found'** dialog box to install **driver** and then start the "InstaCal" program.

The program will identify the single Thermes board with its internal serial number as:

   PC Boards List, USB, Board # 0-USB-TC (serial #---) for Thermes USB System

   PC Boards List, Board # 0-WLS-TC (serial #---) and
   Universal Serial Bus, Board # 1-WLS-IFC (serial #----) For Thermes WFI Wireless System.

Thermes with **DasyLab Basic** version will allow you to operate more than one Thermes System. **Connect lowest Thermes serial number first and other with higher serial number next**. Run "InstaCal" program for selected boards individually.

For Multiple Thermes operation, the examples of boards are recognized as:

   PC Boards List, USB, Board # 0-USB-TC (serial #---) and
   PC Boards List, USB, Board # 1-USB-TC (serial #---) for Thermes USB systems.

   PC Boards List, Board # 0-WLS-TC (serial #---) and
   Universal Serial Bus, Board # 1-WLS-IFC (serial #----) for first WLS Thermes.

   PC Boards List, Board # 2-WLS-TC (serial #---) and
   Universal Serial Bus, Board # 3-WLS-IFC (serial #----) for second WLS Thermes.

Select the **hardware identified board** (USB-TC or WLS-TC) and click "Calibrate" from the toolbar. Select 'A/D'/ click "Calibrate" button/OK to finish calibration.

To test selected board, Click "Test" from toolbar/Analog/Select 'No Scale' and check all the channel boxes on right with Thermocouple probes attached to inputs. Hit the 'Start/Stop' test button to ensure that channel '0' reads approximately 0.025 Volts and all other channels read less than ±30 microvolts. Channels without a probe connected will display -9999.0. The System will display **non-calibrated (approx.1 to 1.25 deg. higher)** Cold-junctions temperature readings in Centigrade. Once the Thermes is communicating with USB port of your computer, Click "Ok" and **close** "InstaCal" program.

2.2 Installation instructions for DasyLab12.0 software.

IMPORTANT NOTE:

Thermes System "Worksheet" works with DasyLab12 only.
DO NOT INSTALL DasyLab13 ON YOUR COMPUTER.

For new users, Go to www.DasyLab.com and download the **Evaluation version of DasyLab12** with service pack-1 and drivers. In the event if you do not have access to internet, then use non activated backup copy of the "Evaluation version" zip-file "DasyLab-12_0_1_CD" from Physitemp Thermes USB Data File CDROM.

Once the installation is complete, click Start/All Programs/DasyLab12.0 select "Configurator12.0"program. Open and click the "Packages" tab next to the "registration" tab dialog box. Expand the data acquisition node to select hardware by Clicking **(+)** box in "**Data Acquisition**" and "Enable" the "**Measurement Computing (Classic)**" for MCC-DAQ driver.

 Important: **Do not select** "**Measurement Computing**".

To activate "DasyLab12" program, open the package of "DasyLab13" CD ROM software for a **license number** only. Click the "Configurator12" program registration tab and enter the 34-character serial number (from DasyLab13 package) from inside cover label or instruction sheet to activate full version. Click "OK" to save the changes. Save the label or sheet with license number that came with DasyLab13 package in case you need to reinstall DasyLab12 program.

DasyLab12 Lite and Basic versions are 32 bit programs based on Windows XP, Vista and Win7 operating systems environment. The program can be operated in compatibility mode for 64 bit Windows system. After completion of installation, click "Start Menu" from desk top, select "All Programs" and find installed "DasyLab12" program. Click "DasyLab12" and select "Configuration", then right click and enable "Properties" window. Select "Compatibility". Check box with "Run this program in compatibility mode for" and select appropriate "Windows". Click "Apply" to accept changes and click OK to exit configuration program.

When installation has finished, insert Physitemp Thermes USB Data File disk. The disk contains Calibration-data files specific to your Thermes system. The disk has "worksheets" (Thermes operating program created to work under DasyLab main program) for WINDOWS XP, VISTA and WIN7, select appropriate "Worksheet" for your computer "Windows" operating system.

The Following steps are needed before functional "Worksheet" can be operational.

First, copy the "Thermocouple conversion" file from Physitemp "Data File" disk to DasyLab program folder in the **path** described below.

Open "Physitemp Thermes USB Data File" disk, copy and paste or drag and drop **"RTD to T thermocouple conversion"** file in to the opened DasyLab program folder. This file is required to run the Thermes "Worksheet". The Thermes system "Worksheet" is ready to use once "InstaCal" and "DasyLab12.0" programs are installed. The paths are described below for RTD Conv. File.

C:\Documents and Settings\All users\Documents\DasyLab\ 12.0\ENG\ RTD to T thermocouple conversion.DPF for "Windows XP".

C:\Users\Public\Public documents\DasyLab\ 12.0\ENG\ RTD to T thermocouple conversion.DPF for "Windows Vista and Windows7"

To start measuring with your Thermes USB system, connect up to seven type T thermocouple sensor probes to the inputs to each Thermes. If you have disconnected the USB port from Thermes System or computer was turned "Off" then you may have to run "InstaCal" one more time as in step 2.1.

Please note: When "InstaCal" is open, DasyLab program must be closed and vice versa.

Double click on "DasyLab12" shortcut icon or Open via:

C:\ Program files\DasyLab12\DasyLab executable program icon.

Now an "unknown" worksheet will appear on the screen.

To load "Worksheet" from blue Physitemp "Data File" disk, Click File\Open\select CD-ROM\select Thermes Single or Dual Thermes worksheet. If selected file does not open with ".DSB" extension then right click on the file, Click properties and open with "DasyLab Data acquisition system laboratory" program. To confirm proper installation of program, **C**lick on the "Modules"/ "input\output"/ MCC-DAQ must be present at the bottom of the list of modules. If not, you must re-install "Hardware" driver using "Configurator12" program.

The Dual worksheet (with Black box modules) will be functional only if you have two Thermes and **DasyLab Basic** version software installed. The each "Black box" module has worksheets assigned to single **Thermes system. The worksheet consists of factory set data for "Offset and Slope" modules. Do not change values in either of modules nor modify data from "RTD to thermocouple conversion file".** Select correct worksheet identified with respective serial number and "Windows" operating system. Now, the executable worksheet will appear on screen, Click Measurement\Start to begin displaying data from Thermes USB-WFI. If the display window does not open, select the "Restore of all Windows" icon to the left of the white box in the middle of lower toolbar (function toolbar). The digital meter will display temperature read out for each Thermes with serial number. The CJC "0" channel is for thermal block cold junction reference temperature. Digital channels between 1 and 7 will display current temperature readout. For the dual Thermes system it will be displayed with two sets digital meters.

The chart recorder can be displayed by clicking lower left bottom corner "chart recorder" box of displayed "Worksheet". Each channel being recorded with a thermocouple probe is individually numbered and differentiated with a colored trace.

The current displayed **worksheet** can be saved in the DasyLab standard program folder. Click **File\save as** with Standard folder for worksheets, black boxes, and other files such as bitmaps or variables under file **path** name as

C:\ Users\Public\Public documents\DasyLab12.0\ENG**worksheet**\ write file name-Thermes USB-WFI (S/N).... for Windows Vista and Win7

C:\Documents and Settings\All users\Documents\DasyLab12.0\ENG**worksheet**\write file name-Thermes USB-WFI(s/n)\ Select type (*.DSB). for "Windows XP" .

The DasyLab program folder is *write* protected; it saves the paths in the file DasyLab.INI which is in this folder together with all other INI files. The path selection and the path display in the module dialog boxes is in line with the new path structure, for example, in the modules Switch, Reference Curve, or Write Data. The paths must not be longer than 128 characters. In a Windows Vista, 7 and XP supported DasyLab program, it will not allow other additional program files to be loaded in the same folder.

The Data folder has data collection from your recent experiment of temperature measurements in an ASCII format. An ASCII data file can be displayed as a chart recorder and Bar graph. The data file can be read directly from "Data folder" as text with MS office Excel program. Please read next chapter 2.3 for details.

The following explanation of how Thermes System works.

This measurement program as it is called, manipulates the data from the acquisition system in the following manner. Channels "0" constantly measure the voltage across a wire-wound platinum resistor element or RTD imbedded in a cold junction block. Also imbedded in this block are seven Type T reference thermocouples, one for each of the seven display channels and one additional thermocouple sensor that are used to monitor the temperature of the cold junction block. The connection to this thermocouple can be found in the front panel of Thermes USB and is identified as 'CJC'. This output is normally only used during calibration to confirm the temperature of the block during ambient temperature oven test performed at our factory. The relationship between the voltage across the RTD and ambient temperature is essentially a straight-line approximation whose origin is non-zero. By taking voltage measurements across the RTD at two different ambient temperatures, we can solve the equation for zero offset and slope. This allows us to calculate the block temperature from measurements of voltage across the RTD. The two mathematical blocks associated with channel zero do this by subtracting the zero offset and dividing the remaining figure by the slope to obtain the temperature of the block in degrees C. This temperature is displayed digitally as 'CJC'.

Confirmation of this temperature can be obtained by monitoring the 'CJC output' on the Thermes front panel with an accurate thermocouple temperature monitor. Small adjustments to the slope and zero offset can be made in software to accurately match these two figures over a wide range of ambient temperatures. For information about wider ambient ranges of operation, please consult with our engineering department at 800-452-8510 or 973 779 5577.

A piecewise linear approximation is then used to convert this temperature back into the microvolt equivalent of a type T thermocouple which is then added to the microvolt output from each channel and converted to an absolute temperature reading.

Before displaying the temperature reading for each channel two additional modules provide data averaging to reduce noise and an individually programmable offset for each channel to compensate for any probe errors. These offsets must be typed in manually for each channel. The default value is Zero.

2.3   Read Data files as a Bar Graph and Chart Recorder

The saved data file name by factory default is DEFWRITE-xxx.ASC in Data folder. The data file path operating under Windows Vista and 7 is:

    C:\ Users\Public\Public documents\DasyLab\12.0\ENG**data**\DEFWRITE.ASC and under Windows XP

    C:\ Documents and Settings\All users\Documents\DasyLab\12.0\ENG**data**\DEFWRITE.ASC

This data folder can be created, by dragging and dropping, as a short cut on the desk top to simplify access. The data can be readily displayed as a Bar Graph or Chart Recorder. There are separate worksheets on the CD-ROM Thermes USB - WFI Data File disk labeled as "Read Data Dasy 12.0 Thermes Serial ----". For Windows XP, Vista or Win7 specifically for this purpose. Select appropriate worksheet for your "Windows" operating system.

The "Chart Recorder" module can read ASCII data and display it as a chart that may be printed out for hard copy reference. Save the worksheet to a folder on your computer to read and display stored data files. The current displayed worksheet can be saved in the DasyLab standard program folder. Click File\save as\ in the Standard folder for worksheets, black boxes, and other files such as bitmaps or variable files under:

"Windows" Vista and Win7 support as
    C:\Users\Public\Public documents\DasyLab\12.0\ENG**worksheet** \Thermes…..with ".DSB" extension.

"Windows XP" support as
    C:\Documents and Settings\AllUsers\Documents\DasyLab\12.0 \ENG**worksheet** \ Thermes….. With
    ".DSB" extension.

Write file name as Read Data (s/n)\click save, for future access without Thermes USB Data File disk present in the CD Rom Drive The data file can be selected and opened by double clicking on the first module in worksheet labeled "Read ASCII", it will display a "Read Data" dialog box. In the same box, under "file information" change file name path C:\…….\DEFWRITE.ASC (default set at factory) to your stored data file name.

If the path is not defined properly then a "Load Measurement Data" dialog box will appear.   Select proper file under data\file name\DEFWRITE. Select "files of type" to ASCII format (*.ASC).

Select the correct file then click the "open" button and the new path will be stored.

Click "OK" button. The new updated worksheet will appear with three modules.

To "Run" new data file click "Experiment or Measurement" and then "Start". As the program is reading data, Recorder and Bar graph can be loaded by clicking lower left toolbar "RESTORE UP" icon for Recorder or Bar graph respectively.

Remember to save the new worksheet under a different file name, since this now will have the new file path name.

Read Data files as ASCII text Format.

To read stored data file in ASCII text format. For "Windows" Vista and Win7, open path from:

C:\Users\Public\Publicdocuments\DasyLab\12\ENG**data**\DEFWRITE_xx.

For "Windows" XP support the file path under:

C:\Documents and Settings\Allusers\Documents\DasyLab\12\ENG**data**\DEFWRITE_xx.

The data file DEFWRITE.xx can be read in "US ASCII" or as a "Word" file or it can be converted in Microsoft Excel Format. To read ASCII data file in Excel, open Excel Program/file/ select to open "All Files" as path described above. Select "Delimited" and "US-ASCII (20127)". In the next box, select "semicolon" and "tab" activated.

Start importing data file. Displayed data can be reviewed and printed out for reference.

2.4 Thermes USB - WFI operation summary

Install "InstaCal" Programs on your computer. Please note that "InstaCal" program is only to recognize Thermes System hardware and to install required driver.

Install "DasyLab12.0" Lite/Basic with "DasyLab13" License number. Run "Configurator12.0" and select "**measurement computing** (**Classic**) from packages.

Connect Thermes USB with USB cable to computer for single Thermes System. For Wireless System, Connect filtered USB cable with 5 Volts adapter to Thermes USB-WFI System and connect USB cable with WLS-IFC receiver to computer.
Connect at least one probe in First Channel or more in other channels.
Run "**InstaCal"** program for each Thermes system board.
InstaCal will find Thermes Board/s
Select the board USB-TC or WLS-TC
Click "Calibrate" from toolbar
Click" A/D"
Click "Calibrate" button
Click "OK" to finish calibration.
Select "Test" from toolbar
Select "Analog"
Select "No Scale"
Click all the channels on right.
Press "Start/Stop" Test button
Only channels with probe connected will be active. Channel 0
will read 0.025
If it prompts "the temperature channels are open", ignore, and press "OK"
To exit test, press "OK"

Close "InstaCal" program.

To Run **DasyLab12.0** Program with **Thermes System** "Worksheet"

First **install** "RTD to T thermocouple conversion" file from Thermes USB Data File disk to DasyLab main program folder. Open Physitemp Thermes Data File CDROM copy or drag and drop "RTD to T thermocouple conversion" file in the path described as

> C:\Users\public\publicDocuments\DasyLab\12.0\ENG\ RTD to T thermocouple conversion for "Windows Vista and 7" or

> C:\Documents and Settings\All users\Documents\DasyLab\ 12.0\ENG\ RTD to T thermocouple conversion for "Windows XP".

Click DasyLab executable program logo from main program folder or Short cut from Desk top.
Unknown Worksheet will appear on the screen

Click File from menu.
Open Physitemp Data File CD Rom from computer CD drive.
Select appropriate "worksheet" with Thermes Serial number XP, Vista or 7, file to run program and to display temperatures

Click Measurement and Start

Connected input channels will display temperature in Digital Meter.

The Chart Recorder can be maximized by clicking lower left "Chart record" box.

The recorded data files can be read from "Data" folder as path described as follows.

> C:\Users\public\publicDocuments\DasyLab\ 12.0\ENG\ **data**\DEFWRITE_..ASC for "Windows Vista and 7" or

> C:\Documents and Settings\All users\Documents\DasyLab\ 12.0\ENG**data**\DEFWRITE…ASC for "Windows XP".

The factory set data collection time is 1.0 sec from READY to use "Worksheet".
To change data write time, Click from toolbar, measurement/ Time base/ all settings/ Select DasyLab Sampling rate to desired time by clicking down arrow in each boxes, i.e. 1.0000 and unit S (seconds). Repeat the same parameters for "Driver", check block size to automatic and click "OK"
Double click last module in worksheet "Tempfile", click "option" and select appropriate time format with or without date option. Select "computer time", and decimal format to "Dot" selected, click "OK" and save the changes before exiting program.

3.0 THERMES USB-WFI GENERAL INFORMATION.

Table of Contents

About this User's Guide

What you will learn from this user's guide

This user's guide explains how to install, configure, and use the Thermes USB so that you get the most out of its USB-based temperature measurement features.

Conventions in this user's guide

For more information on …

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

<#:#> Angle brackets that enclose numbers separated by a colon signify a range of numbers, such as those assigned to registers, bit settings, etc.

bold text **bold** text is used for the names of objects on the screen, such as buttons, text boxes, and check boxes. For example: **1.** Insert the disk or CD and click the **OK** button.

italic text *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase. For example: The *Insta*Cal® installation procedure is explained in the *Quick Start Guide*. *Never* touch the exposed pins or circuit connections on the board.

Introducing the Thermes USB

Overview: Thermes USB features

This user's guide contains all of the information you need to connect the Thermes USB to your computer and to the signals you want to measure.

The Thermes USB is a USB 2.0 full-speed type T thermocouple input data acquisition system that is supported under popular Microsoft$^{®}$ Windows® operating systems. The Thermes USB is fully compatible with both USB 1.1 and USB 2.0 ports.

The Thermes USB incorporates seven differential thermocouple input channels.

An open thermocouple detection feature lets you detect a broken thermocouple. The Thermes USB is a standalone plug-and-play data acquisition system which draws power from the USB cable. No external power supply is required. All configurable options are software programmable.

The Thermes USB is fully software calibrated.

Connecting a Thermes USB to your computer is easy

- Installing a data acquisition device has never been easier.

The Thermes USB relies upon the Microsoft Human Interface Device (HID) class drivers. The HID class drivers ship with every copy of Windows that is designed to work with USB ports. We use the Microsoft HID because it is a standard, and its performance delivers full control

and maximizes data transfer rates for your THERMES USB. No third-party device driver is required.

- The Thermes USB is plug-and-play. There are no jumpers to position, DIP switches to set, or interrupts to configure.

- You can connect the Thermes USB before or after you install the software, and without powering down your computer first. When you connect an HID to your system, your computer automatically detects it and configures the necessary software. You can connect and power multiple HID peripherals to your system using a USB hub.

- You can connect your system to various devices using a standard four-wire cable. The USB connector replaces the serial and parallel port connectors with one standardized plug and port combination.

- You do not need a separate power supply module. The USB automatically delivers the electrical power required by each peripheral connected to your system.

- Data can flow two ways between a computer and peripheral over USB connections.

Installing the Thermes USB

What comes with your Thermes USB shipment?

The following items are shipped with the Thermes USB.
Thermes USB
USB cable (2 meter length)
Calibration CD-Rom
MCC InstaCal software, Labview Drivers
Operating Manual

Unpacking the Thermes USB

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the Thermes USB from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

If your Thermes USB is damaged, notify Physitemp Instruments Inc. immediately by phone, fax, or e-mail.

Phone: 800-452-8510
Fax: 973-779-5577
Email: Physitemp@aol.com

Installing the software

To connect the Thermes USB to your system, turn your computer on, and connect the USB cable to a USB port on your computer or to an external USB hub that is connected to your computer. The USB cable provides power and communication to the Thermes USB.

When you connect the Thermes USB for the first time, a **Found New Hardware** popup balloon (Windows XP) or dialog (other Windows versions) opens as the Thermes USB is detected.

When this balloon or dialog closes, the installation is complete. The **USB LED** should flash and then remain lit. This indicates that communication is established between the Thermes USB and your computer.

CAUTION! Do not disconnect **any** device from the USB bus while the computer is communicating with the Thermes USB, or you may lose data and/or your ability to communicate with the Thermes USB.

If the LED turns off

If the LED is lit but then turns off, the computer has lost communication with the Thermes USB. To restore communication, disconnect the USB cable from the computer, and then reconnect it. This should restore communication, and the LED should turn back on.

Configuring the Themes USB

All hardware configuration options on the Thermes USB are programmable with software. Use *InstaCal* to set the thermocouple to Type T for each channel pair. Configuration options are stored on the Thermes USB isolated micro controller in EEPROM, which is non-volatile memory on the Thermes USB module. Configuration options are loaded on power up.

Allow the Thermes USB to warm up for 30 minutes after powering up before taking measurements. This warm up time minimizes thermal drift and achieves the specified rated accuracy of measurements.

Calibrating the Thermes USB

The Thermes USB is fully calibrated via *Insta*Cal. Allow a 30-minute warm up before calibrating.

Thermocouple connections

The Thermes USB makes fully differential thermocouple measurements without the need of ground-referencing resistors. A 32-bit floating-point value in either a voltage or temperature format is returned by software.

Wiring configuration

Connecting the thermocouple to the Thermes USB uses a differential configuration.

When thermocouples are attached to conductive surfaces, the voltage differential between multiple thermocouples must remain within ±1.4 V. For best results, we recommend the use of insulated or ungrounded thermocouples when possible.

Maximum input voltage between analog input and ground

The absolute maximum input voltage between an analog input and the isolated GND pins is ±25 VDC when the Thermes USB is powered on and ±40 VDC when the Thermes USB is powered off.

Functional Details

Thermocouple measurements

A thermocouple consists of two dissimilar metals that are joined together at one end. When the junction of the metals is heated or cooled, a voltage is produced that correlates to temperature.

The Thermes USB hardware level-shifts the thermocouple's output voltage into the A/D's common mode input range by applying +2.5 V to the thermocouple's low side input. Always connect thermocouple sensors to the Thermes USB in a floating fashion.

Cold junction compensation (CJC)

Cold junction compensation is provided in the Thermes USB by a platinum resistance element (RTD). The RTD is mounted vertically in the center of a cylindrical aluminum block. A reference thermocouple for each channel embedded in the block exits radically in a horizontal plane from the center of the cylinder. The RTD compensates for changes in block temperature, which in turn reflects the reference thermocouple temperature. The symmetry of the arrangement ensures that there are no significant thermoelectric gradients between the reference thermocouple associated with each channel and the RTD accurately tracks changes in block temperature.

Increasing the thermocouple length

If you need to increase the length of your thermocouple, use the same type of thermocouple wires to minimize the error introduced by thermal EMFs.

Open-thermocouple detection (OTD)

The Thermes USB is equipped with an open-thermocouple detection for each analog input channel. With OTD, any open-circuit or short-circuit condition at the thermocouple sensor is detected by the software. An open channel is detected by driving the input voltage to a negative value outside the range of any thermocouple output. The software recognizes this as an invalid reading and flags the appropriate channel. The software continues to sample all channels when OTD is detected.

USB connector

The USB connector provides +5V power and communication. No external power supply is required.

LED

LED indicates the communication status of the Thermes USB. It uses up to 5 mA of current. It defines the function of the Thermes USB LED

Table: LED Illumination

LED Illumination	Indication
Steady green	The Thermes USB is connected to a computer or external USB hub.
Pulsing green	Data is being transferred. Upon connection, the LED should flash three times and then remain lit (indicates a successful installation).

Interface Specifications

Memory

Table: Memory specifications

EEPROM	1,024 bytes isolated micro reserved for sensor configuration 256 bytes USB micro for external application use

Microcontroller

Table: Microcontroller specifications

Type	Two high performance 8-bit RISC microcontrollers

USB +5V voltage

Table: USB +5V voltage specifications

Parameter	Conditions	Specification
USB +5V (VBUS) input voltage range		4.75 V min. to 5.25 V max.

Power

Table: Power specifications

Parameter	Conditions	Specification
Supply Current	USB enumeration	<100 mA
Supply Current (Note 1)	Continuous mode	140mA type.
Isolation	Measurement system to PC	500 VDC min.

Note 1: This is the total current requirement for the Thermes USB, which includes up to 10 mA for the status LED

USB specifications

Table: USB specifications

USB device type	USB 2.0 (full-speed)
Device compatibility	USB 1.1, USB 2.0
	Self-powered, 100 mA consumption max
USB cable type	A-B cable, UL type AWM 2527 or equivalent. (min. 24 AWG VBUS/GND, min 28 AWG D+/D–)
USB cable length	3 meters max.

Environmental

Table: Environmental specifications

15 to 35 ° C	Operating temperature range
-40 to 85 ° C	Storage temperature range
0 to 90% non-condensing	Humidity

Mechanical

Table: Mechanical specifications

Dimensions	9-1/2"L x 6-1/2"W x 1-1/2"H
User connection length	3 meters max.

4.0   OPT-1 and OPT-2 OPTO ISOLATION LINKS

OPT-1

Install software and follow procedures for installation of Thermes USB onto host computer with a hard-wired USB connection to ensure Data Acquisition system is recognized by the host computer.

Run **InstaCal** software and then **DasyLab** software to verify the system is recognized with a wired USB connection.

Disconnect the USB cable at computer and connect it to the optical receiver on the OPT-1 fiber optic cable.

Connect the OPT-1 optical transmitter to the USB input on host computer.

Connect the medical grade wall mount power supply or BP-1 5v battery to the 3.5 mm power socket on the side of the OPT-1 transmitter module.

Check Data Acquisition System activity LED to ensure 5V power is present

Check with **InstaCal** software to ensure Data Acquisition board is identified and operating. If the board is not being recognized, remove the OPT-1 isolation link and connect the Thermes USB directly to the computer for re-identification before reconnecting the OPT-1 isolation link.

OPT-2

The USB to USB Isolator is a single port USB 1.1 port isolator intended for industrial, medical and other harsh environment applications.

The Upstream port is configured with a high retention USB type B connector and the Downstream port is configured with a high retention USB type A connector.

The Power LED when lit indicates the device is powered and ready to be used. The USB isolator receives power directly from the host PC or hub that is plugged into the upstream port of the isolator.

The isolator will work with USB 1.1 or 2.0 ports but has a fixed USB data rate of 12 Mbps.

USB cables up to the standard 5 meter length may be used on either the upstream and/or downstream ports of the isolator.

   Note: Surrounding Air Ambient Temperature: -40 to 80°C

Installation

1. Plug the included one meter USB cable into the port marked Upstream (Type-B connector) and the other end of the cable into the host PC or hub.
   Note: A one meter cable is included for convenience. Other USB cables up to the 5 meter standard are ok to use.

2. The Power LED will light, indicating power is being received from the host and that the isolator is ready to be used.

3. Plug the downstream device into the port marked downstream (Type-A connector). This cable is not included.

4. The USB isolator is transparent to the host operating system and does not require configuration or software installation.

   Note: The isolators are USB bus powered and can provide up to 100 mA of current to the attached downstream device. This is possible when the isolator is connected to a high power USB host port.

5.0   INSTALLATION OF BP-1 LI ION BATTERY

Operating instructions are packed in the box with the battery pack.

6.0   TROUBLESHOOTING

Symptom	Solution
DasyLab not recognizing Thermes USB	Check green 'Activity LED' on Thermes to ensure power is present Check under 'Modules' input/output to ensure 'MCC-DAQ' is present in list. If not, reinstall *DasyLab* and choose 'modify'.
Data File too large	Reduce sample rate -Experiment – time base settings -Driver-reset sample rate Check properties of A/D are set for time base set up and driver

7.0 SPECIFICATIONS

	THERMES USB	THERMES USB-WFI
Accuracy	±0.1°C ±0.2% of reading over ambient range 15 to 35°C	±0.1°C ±0.2% of reading over ambient range 15 to 35°C
Stability	±0.1°C	±0.1°C
Resolution	0.01°C	0.01°C
Range	-100 to 400°C	-100 to 400°C
Inputs	7 subminiature type T Thermocouple sockets	7 subminiature type T Thermocouple sockets
Response Time	16 measurements per second maximum	16 measurements per second maximum
Output Format (using DasyLab)	User selectable display formats, analog or digital readout, real-time graphics, ASCII-text file	User selectable display formats, analog or digital readout, real-time graphics, ASCII-text file
Display	Celsius, Fahrenheit and Kelvin scales, Differential, MinMax & normal modes. Alarm thresholds independently configurable for all channels	Celsius, Fahrenheit and Kelvin scales, Differential, MinMax & normal modes. Alarm thresholds independently configurable for all channels
Dimensions	9-1/2"L x 6-1/2"W x 1-1/2"H	9-1/2"L x 6-1/2"W x 1-1/2"H
Weight	0.7 Kg or 1.5 lbs.	0.7 Kg or 1.5 lbs.
Power Supply	5 volts DC at 100 mA, powered by host computer or external supply	5 volts DC at 100 mA, powered by host computer or external supply
Computer Requirements	Pentium class computer running Windows XP or 2000, 10MB hard drive space, CD-Rom drive and one open USB port	Pentium class computer running Windows XP or 2000, 10MB hard drive space, CD-Rom drive and one open USB port
Interface	USB 2.0 (backwards compatible with USB 1.1)	USB 2.0 (backwards compatible with USB 1.1)
Wireless Capability		Up to 100 ft using 802.15.4 wireless protocol

8.0   TEMPERATURE MEASUREMENT WITH THERMOCOUPLE SENSORS

8.1   The thermocouple is a simple and widely accepted device for measuring temperature. It comprises two wires of dissimilar metals fused together to form a junction, which produces an electrical output proportional to temperature. The National Institute of Standards and Technology (NIST Monograph 125, 1974) has tabulated the voltage/temperature relationships of many commonly used thermocouple pairs; their tables on Copper-Constantan form the basis for calibration of Physitemp thermometers.

8.2   At one time, accurate thermocouple temperature measurements needed elaborate potentiometers and reference to a source of know temperature, such as an ice bath. The advent of modern solid state devices has made possible the design of an inexpensive thermocouple thermometer, which is direct reading. The first of these was Bailey thermometer BAT-4, which was designed in 1969. Your Thermes USB is an advanced version of the original equipment using the latest low power digital technology and compensated electronic reference circuitry.

8.3   As compared with thermistor sensors, which were formerly used exclusively in portable thermometers, thermocouples have these advantages:

> (a) Wide temperature range, e.g. – 200°C to over +1300°C.
> (b) High stability of output.
> (c) Interchangeability – no recalibration required.
> (d) Accuracy traceable to NIST calibrations.
> (e) Low cost; users can even make their own sensors.
> (f) Microscopic size when needed, as in Physitemp microprobes.
> (g) Nearly instant response.
> (h) Better measurement accuracy due to low mass with smaller heat loss.

8.4   The main disadvantage of the thermocouple, low sensitivity, was overcome by the development of auto zeroing amplifiers, which are now used in all Physitemp thermometers. This type of amplifier is essentially drift-free. It makes possible an electronic thermometer, which is permanently calibrated, just like a mercury thermometer. The following notes may help the user to avoid some of the errors most frequently made in temperature measurement.

8.5   Faulty measurement technique with any type of thermometer can produce errors of several degrees. Errors attributed to "out of calibration" equipment can often be corrected by a simple change of technique.
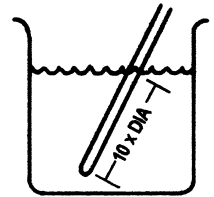
8.6   Thermocouple probes, like all other temperature sensing devices, must be placed so that they reach, as closely as possible, the temperature of the material to be measured. Probes are tip-sensitive, but when measuring the temperatures of liquids, semi-solids or hard surfaces, it is not sufficient to bring only the tip into contact with the material being measured. This is because there will be loss of heat long both the thermocouple wires and their sheath, so readings will be low. The effect can be greatly reduced if part of the metal sheath is also placed in contact with the material. In liquids and semi-solids, the tip and sheath are simply immersed; on solid surfaces, the sheath is laid against the surface.

Here is a useful rough rule: Heat leakage effects are substantially reduced

*When an amount of probe equal to 10 or more sheath diameter is
Immersed or laid on the surface. For example, with a probe of 1/16"
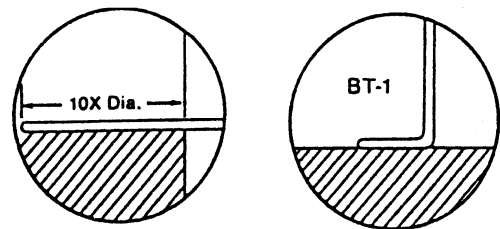Diameter , 10 x 1/16"=.625"=the minimum immersion depth.*

8.7   Errors between thermocouple probes. All Physitemp clinical probes and sensors are made
with thermocouple wire that has been specially tested to meet our own stringent standards. Our
clinical probes are guaranteed accurate to within 0.1°C in the range 0-50°C. Copper-Constantan
(type T) thermocouples from other manufacturers are not normally this accurate. Probes made
from wire to "special limits of error" may be accurate to ±0.5°C in this range. This
interchangeability of sensor, including microprobes, is a major advantage of Physitemp
thermocouple thermometers.

8.8   Measurements in Liquids. These are quite easy to make, because there is good thermal
contact between liquid and probe. The latter quickly reaches liquid
temperature and readings can be taken within a few seconds. However, a
liquid, which has been heated above or cooled below ambient, will be losing or
gaining heat, and convection currents will give rise to temperature variations of
up to several degrees. These variations can be reduced by vigorous stirring.
This simple precaution must always be taken.

8.9   Measurements of Air Temperature. Temperature can vary widely in
different parts of the room; differences of at least several degrees will be noted. When a
microprobe is used to indicate air temperature, readings will often fluctuate rapidly, responding to
actual temperature changes caused by air currents. Breathing near the microprobe will produce
wide fluctuations. These effects indicate the sensitivity of the Thermes USB microprobe
combination, due to high discrimination of the instrument and almost instant response of the probe.
Fluctuations can easily be eliminated by bringing the probe into contact with a metallic object, thus
increasing its effective mass and slowing the response. Using a larger probe will have the same
results.

8.10   Measurements on Solid Surfaces. These are most easily made with surface probes such as
our BT-1 and MT-D. The right angled tip provides the 10 diameters of probe contact specified in
Section 8.6 . Straight probes may also be used, provided that sufficient shaft length is in contact
with the surface to be measured. In general, the
smaller the probe, the more accurately it will
measure the surface temperature of a solid. For
instance, an MT-29 microprobe, because of its small
size, needs to be contact with the surface for as little
as 1/8". SST-1 has a ¼" gold disc sensor. Gold is
an excellent conductor, and is non-allergenic and
non-polluting. It makes a fine skin surface probe.

8.11   Measurements in Electronics. Thermes USB and ICT-4 provide the
quickest and cheapest method of getting accurate reading on both discreet components and
integrated circuits used in electronic equipment. ICT-4 has two important differences from the
regular MT-4 probe. There is a 5-1/2" handle suitable for use in the hand or in a micromanipulator
and the micro-thermocouple protrudes lightly beyond the steel sheath and has some thermal
isolation from it. This probe was designed for use on areas of 5-100 microns in diameter and is
used perpendicular to the surface to be measured. The heat loss described in Section 7.6 occurs
and temperature readings are slightly low – normally about 0.5°C low. Each probe can be readily
calibrated on a larger surface. First lay it parallel to the surface and note the reading. Then take a

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reading with it perpendicular to the surface; note the difference. Add this difference to the subsequent reading when using the perpendicular position.

8.12 Thermes USB with a suitable probe has the ability to measure surface gradients, giving almost instant readings at each point. This feature enables heat sinks to be designed without guesswork, for maximum efficiency with minimum metal. It is equally easy to check the adequacy of thermal bonding between a power transistor or rectifier and its heat sink. General purpose probe BT-1 is suitable for this and many other measurements. When probes such as BT-1 and the larger HT-1 and HT-2 are used for surface measurements, speed of response and accuracy can often be improved by use of a conductive material such as 'thermal grease' or silicone grease applied between the probe and surface. Note: BT-1, HT-1 and HT-2 should not be used on electrical equipment where voltages are present as the sensor is connected to the stainless steel sheath. The following probes are isolated and suitable for use on certain electrical equipment: TFT series, RET-1, ESO-1, IT-14, IT-18, IT-21. Check with our technical department for details.

9.0 MAINTENANCE, WARRANTY AND SERVICE

9.1   Warranty

Physitemp Instruments Inc. warrants this system to be free from defects in material or
workmanship for 12 months from date of shipment. Repair or replacement will be made at no
charge at the discretion of Physitemp if the defect is not the result of misuse or abuse. Physitemp
accepts no consequential liability for delay in delivery, alleged faulty performance of the product or
any other cause.

Cables and probes are considered expendable and are not covered by this warranty.

9.2   Repairs and Recalibration

for technical applications information on this instrument contact us at:
> Tel: 973-779-5577
> Fax: 973-779-5954
> E-mail: info@physitemp.com

In the event that any part of this system is to be returned for repair or recalibration, please pack it
with care (in the original packing material if possible) and send it prepaid to:

> Service Department
> PHYSITEMP INSTRUMENTS INC.
> 154 Huron Avenue
> Clifton, NJ 07013   USA

Please include with the instrument:

1.   A note describing any problems encountered
2.   The name and telephone number of a person we can contact.
3.   The complete return address for shipping

For your protection, please pack the item carefully and insure against possible damage or loss.
Physitemp will not be responsible for damage resulting from careless packaging. Please return
freight prepaid.