

# Temperature Measurements using: DeLogger DataTaker Remote Lab instructions

DeLogger, DataTaker, dtUSB, Arduino

V4

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# Temperature Measurement Instructions

## For using DeLogger DataTaker

### Preliminary instructions to setup the exercise

#### 1.1 Objectives

- To calculate the temperature change, and response time for different thermocouple and RTD installations.

#### 1.2 Open the relevant programs

- Logon to Electromet (Follow the How to Connect to Remote Labs\_Electromet\_HTML5 instructions)
- DeLogger is installed on **Remote Lab 10**
- On the remote lab, you will find a folder on the desktop called **IPKIT** which contains the shortcuts to the software to be used.

#### 1.3 Equipment Used:

- 1 x K Thermocouple (sheathed or enclosed) **TT 301**
- 1 x K Thermocouple (bare) **TT 302**
- 1 x RTD - Pt 100 **TT 303**
- 1 x Controlled heating element (Controlled by microcontroller and relay)
- Datalogger (DT80)
- DeLogger Datataker software resident on remote lab

*(Feel free to check out the Remote Lab 10 Webcam view of the rig. See Remote Lab Instructions on how to access a lab's webcam view)*

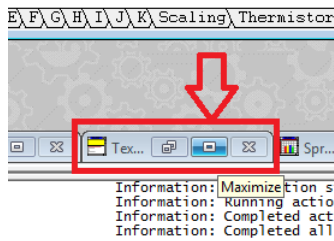
#### 1.4 Temperature response and accuracy

The response time is the time it takes to get to 63.2% of the final settling value. This is independent of the range of the device. If the device were a Pt 100 with a range of operation of -200 to 630°C and the temperature being monitored changed from 100 to 200 °C, then the response time would be the time it takes to go from 100 °C to 163.2 °C.

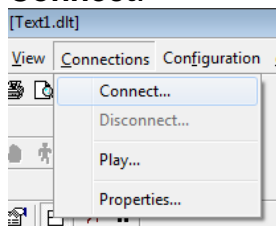
##### 1.4.1 Software Initialisation

1. On the remote labs, specified above, you will find a folder on the desktop called **IPKIT** which contains the shortcuts to the software to be used.
2. Click/Run the UsbSerialiser program (It will detect the device automatically) – minimise this screen.
3. Click/Run dtUSB (ignore/minimise the browser window that opens)
4. Click/Run DeLogger icon in the folder.
5. In DeLogger, create new project (“Temp”) if prompted. You will then see a bewildering number of screens to select from. Select the Text1.dlt (minimized)

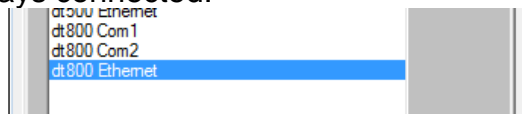
at the middle/bottom of the program) by clicking on it from the list of programs (Form1.dlf, Chart1.dlc, **Text1.dlt**,...Prog1.d80).



6. The connection is preconfigured, so no need to configure the network etc.
7. At the Toolbar at the top of the screen; Select **Connections** and then **Connect**.

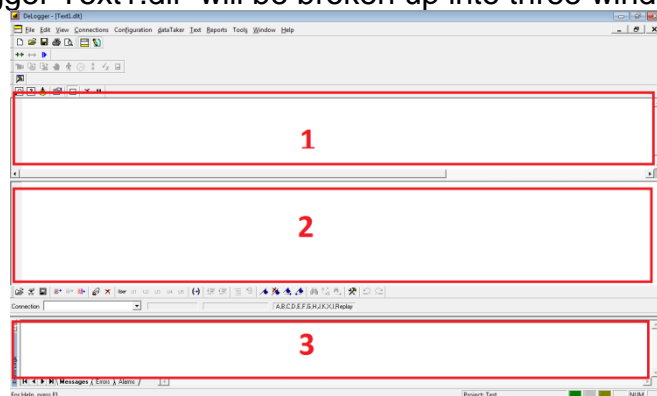


8. Select Network "dt800 Ethernet" under Connection. Click OK. You will receive confirmation that you have selected the correct settings when the software says connected.



Please read Note1 at the end of this write-up if you cannot initiate communications between logger and computer.

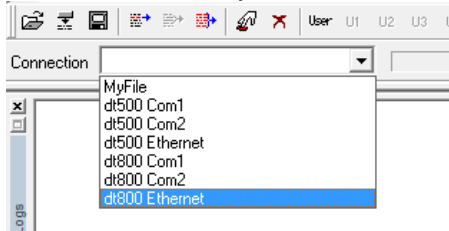
9. Your DeLogger Text1.dlf will be broken up into three windows:



- The Top windows which gives the datalogger responses (displays data returned from the data logger)
- The middle window is where you will type in commands to be sent to the data logger.
- The bottom windows which selects connection and reports errors and status in the communications with the logger.

Resize the top and middle window of Text1.dlf so that each is approximately a third of the computer screen; to make for easier reading.

10. In the bottom part of the window of Text1.dlf there is an option to select a **Connection** drop-down menu, click it, and select **dt800 Ethernet**.



### 1.4.2 Sending commands to the Data Logger

1. The currently highlighted line of information in the middle window can be sent to the data logger by entering the commands and hitting the <Enter> key
2. Go to the middle window and type in:  
RESET (press <Enter>)

You should see feedback in the top screen showing the reset was successful.

### 1.4.3 Obtaining Readings

1. The best way to achieve this is by creating a whole series of readings which will be taken at regular intervals. To perform this task a schedule is sent to the logger. A schedule is a list which tells the device which channels to read and when.
2. A standard reporting schedule which reads the thermocouple temperature and voltage on channel 1 every second, can be sent to the data logger by sending the command line:

**RA1S 1TK 1V** (press <Enter>)

*[The meaning of the ASCII character sequence which makes up the schedule command is as follows:*

- *RA1S is the schedule command to report schedule A (or scan the channel list) every 1s.*
- *1TK is the channel command to read the K-type thermocouple temperature on channel 1.*
- *1V is the channel command to read the differential voltage input on channel 1.*
- *Additional channels may be added and read simultaneously e.g. RA1S 1TK 4TJ*

3. To temporarily halt the schedule RA, send the command:

**HA** (press <Enter>)

4. To continue send the command line:

**GA** (press <Enter>)

### Thermocouples (Sheathed)

The K-type **sheathed** thermocouple **TT 301** is connected to channel 1 of the data logger as shown in the figure below.

Check equipment details:

Tag no.: TT 301  
Model: K-type thermocouple  
Details: Sheath - Yellow  
Positive - Yellow  
Negative - Red

The ANSI MC96.1 standard for thermocouples and extension wire specifies that for 'K' type thermocouples the shielding is yellow and the terminals are as follows:

- Positive (+) terminal is yellow.
- Negative (-) terminal is red.

How can you distinguish quickly between a thermocouple and RTD using a multimeter ? (Clue: Resistance of a RTD will be about 100 Ohms and thermocouple will be a few ohms).

The differential measurement configuration shown is most commonly used where the signals from the sensor/transducer are very small and more susceptible to the effects of noise and/or where the cables from the transducer to the measuring equipment are very long and also more susceptible to noise.

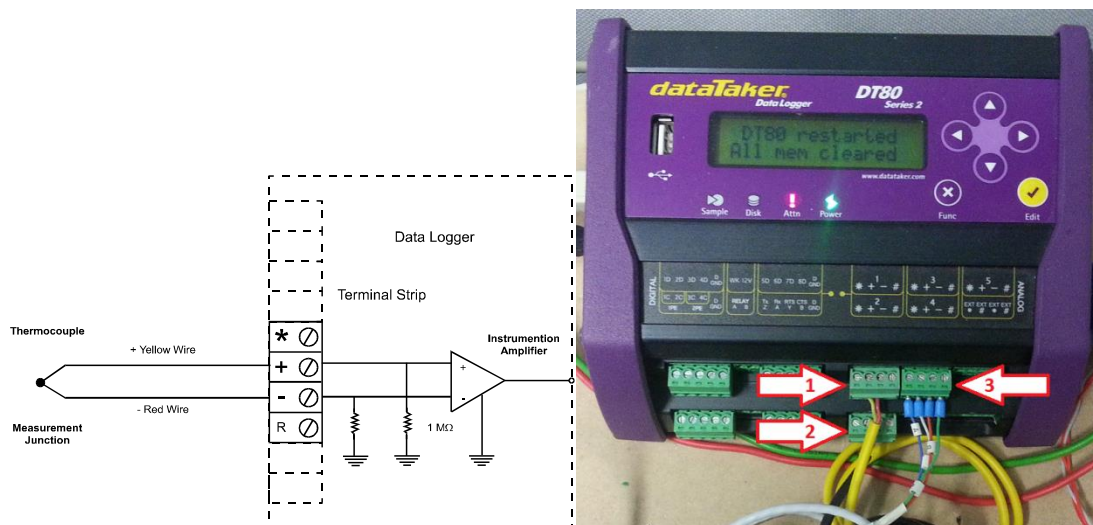


Figure E3.1: Differential Thermocouple Configuration

1. In order to make a simultaneous continuous temperature measurement type the following at the highlighted command bar:

**RA2S 1TK** (press <Enter>)

Try and interpret the flood of readings that come back from the data logger. These responses can be simplified; but the key parameters will be the last values on each line of the response from the logger.

### Thermocouples (Unsheathed)

Now see the **unsheathed K-type thermocouple connected to channel 2**

1. Repeat the exercise by adjusting the commands for the new channel number.

**RA2S 1TK 2TK** (press <Enter>)

*(They are both measuring the temperature at the same point)*

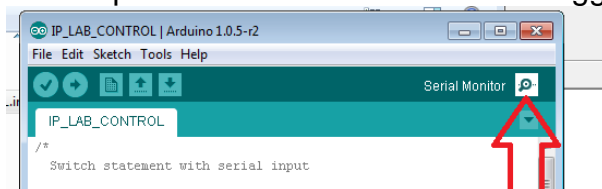
- A) What do you notice? **Write these temperatures down.**


### Response Times

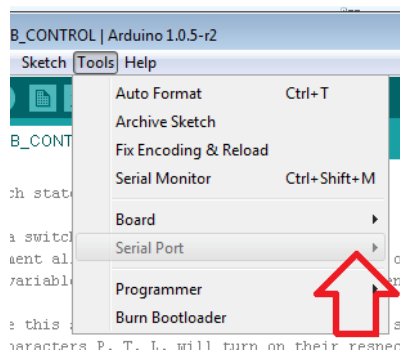
Now compare the response times for the two thermocouple measurements to “settle down” when a temperature change is applied, as below.

In this case a heating source is applied by using a heating element. This can be switched on and off by doing the following (return to the deLogger window/program once you switched on the heater, to quickly take measurements):

1. Open the Arduino program “IP\_LAB\_Control.ino” (Shortcut in the “IPKIT/ IP\_LAB\_Control” folder)
2. Open the “Serial Monitor” (Drag the new window to the right in order to see the temperature measurements in DeLogger in the background)



3. It should open a connection automatically. If it does not, go to “Tools” -> “Serial Port”, and select the COM 8/10 port shown. (If no serial port is shown, close the Arduino program and re-open it, and try again. If more than one port shown, go to device manager and click on COM ports to see on which one the Leonardo is connected. If it fails again, reprogram, , and try again)



- In "Serial Monitor" type the following command (Write down the time just before you press Enter. Also be sure the temperature values are visible to the left of your current window) (Remember to type the # at the end. It is case sensitive):

**TempOn#** (press Enter)

- Allow about 5 minutes for the readings to change. (Return to your deLogger window, which should still be taking readings, if you cannot see the temperature values)

B) What do you notice? (*Response times?*) Write the final temperatures down after 5 minutes when the temperature controller times-out.

### Examine the influence of thermowells on RTD

The RTD (with thermowell with thermopaste) is connected to channel 3 of the data logger using the four-wire configuration as shown in the figure below.

Check equipment details:

Tag no.: TT 303  
Model: RTD  
Type: Pt100

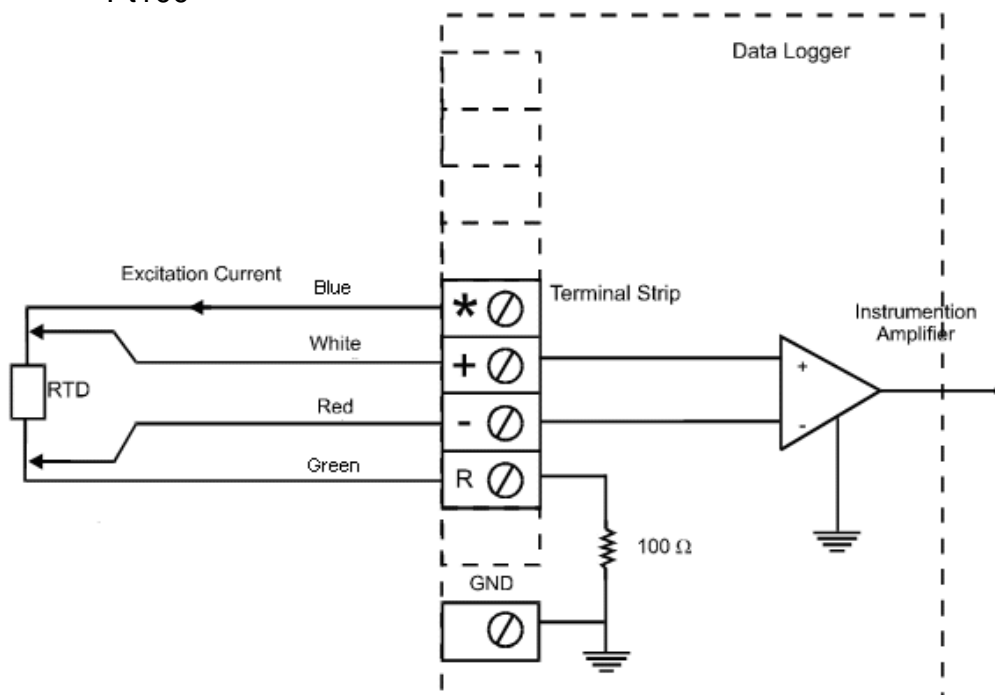


Figure E3.2  
Four-wire RTD input.

In the four wire configuration two excitation leads carry the constant excitation current which flows through the RTD. The value of this current should remain constant irrespective of the excitation lead resistance or the resistance of the RTD.

The other two measurement leads are used to measure the voltage drop across the RTD. The actual current flowing in these leads is very small due to the very high input impedance of the voltage measurement circuit. Therefore, voltage drops across the lead resistances are so small they can be assumed to be negligible.

1. In deLogger, create a schedule of readings by typing and pressing enter:

**RA2S 1TK 2TK 3PT385(4W)**

2. Cool down the system, by returning to the Arduino serial monitor, and typing:

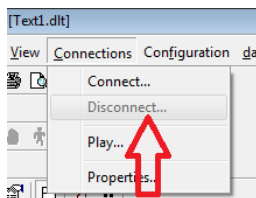
**Cool#** (then press Enter)

3. This will cool the system down for 30 seconds.
4. You Can now reheat the system as previously explained - For exercise C below:

- C) **Write down four (4) temperature readings over about 1-3min time span of all three probes as the temperature slowly increases (Also, take a screenshot!!)**  
Since the heating source has been re-applied, the temperature values will slowly increase. What do you notice?

**PLEASE FOLLOW THE REMAINDER OF THESE INSTRUCTIONS TO RESET THE LOGGER WHEN DONE -Go to the middle window and type in RESET (press <Enter>)**

**in deLogger, click "Connections" then "Disconnect".**



**Close deLogger and DON'T save if asked,  
Close FanControl  
close dtUSB, (dataTaker – Loggers)  
close Serialiser**

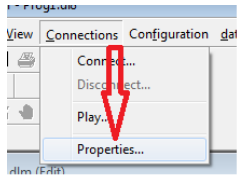


## Note 1:

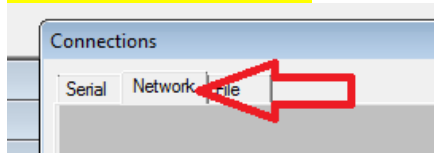
If you cannot establish communications with the Ethernet port listed, check the Ethernet settings.

Go to Connection in top row in DeLogger.

Click Properties

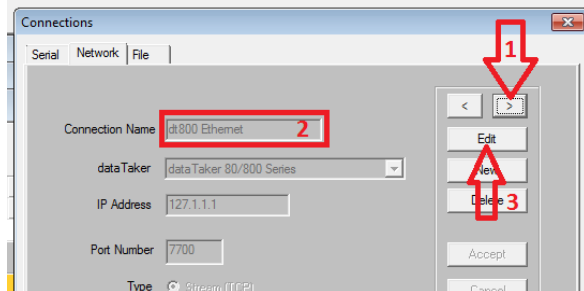


Click on Network Tab

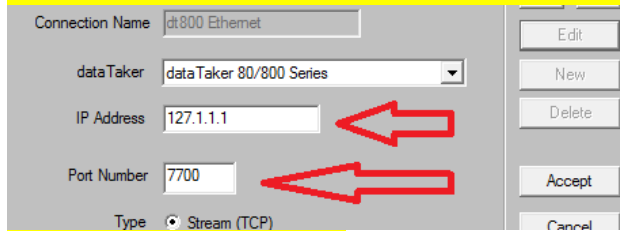


Click the ">" button to reach dt800

Click Edit



Check that the IP is 127.1.1.1 and the Port 7700



Click Accept and Close.