Lake Shore Temperature Ramp Documentation

J. Sheldon

August 29, 2017

1 Brief Overview

This Python script serves as automated way to step through, read several channels' resistances / temperatures, and plot data from the Lake Shore Model 372. The end user will need to have several dependencies installed on their system, edit the 'config.ini' file provided with the Python code to suit their needs, and run the python code. The resulting output is a 'live-ish' plot and a comma separated list in '.csv' format (naming convention 'YYYYMMDD-HHmm_UserDescription.csv') located in a folder 'captures'. This document serves as instructions for typical use and for future reference in development.

2 Using The Script

2.1 Install Directions

This software should be OS agnostic, however you will need to install several pieces of software and python packages for it to work. It is suggested to install 'Anaconda, Python 2.7 version' to simplify the install process. You can find that here: `https://www.continuum.io/downloads`. Following that, you will need to install 'numpy', 'pandas', and 'configparser'. You can install these in Anaconda Navigator's 'Environment' menu. You will also want to add Anaconda to either your user PATH or system PATH variable. Check how to do this online. After completing these steps, your software environment should be set up to run the application

2.2 Usage

You are almost ready! The next to final step is to edit the 'config.ini' file to your specific needs. When you are ready to use the application, please run 'python ls_tempramp.py' in your system shell (CMD or suitable terminal). The script will ask you for an identifier/description – this is meant to be a short description of what you are testing. This will be the 'UserDescription' part of the filename. Your script will run and display a progressbar in the shell and should shortly plot some data. After completion, note that you should now have a plot and a '.csv' file in the 'captures' folder. (You can zoom/pan around in the plot. You may wish to save the plot immediately – unlike the '.csv' file, it is not saved automatically.)

2.3 Configuration File

The 'config.ini' file holds all of the configuration data for your run. These are the units and descriptions for each variable stored in the file:

Section	Variable	Description
connection	serialport	Port to connect to (eg. 'COM3' or '/dev/ttyS3')
	baudrate	communication rate (eg. 9600 or 115200)
sampleheater	resistance	Resistance of heater (in Ohms)
	maxcurrent	current limit (in Amps)
	range	integer 0-8. See Figure 3.1.3
	deltapc	percentage of current range applied to heater (0.0-100.0)
	initpc	initial current percentage (0.0-100.0)
	finalpc	final current percentage (0.0-100.0)
	disp	0 for current, 1 for power
scanner	autoscan	1 for autoscanning, 0 for no autoscanning
mcthermometer	channel	mixing chamber thermometer channel
	tempcoeff	mixing chamber thermometer temperature coefficient (0=neg, 1=pos)
	curvenumber	mixing chamber thermometer calibration curve number
	filterwindow	windowing percentage of filter (0.0-100.0 allowed)
	t_settle	Filter settle time
	t_dwell	Scanner dwell time
	t_pause	Scanner pause time
sample1	channel	Scanner channel
	tempcoeff	temperature coefficient
	curvenumber	calibration curve number
	filterwindow	windowing percentage of filter (0.0-100.0 allowed)
	description	Short descriptor
	t_settle	Filter settle time
	t_dwell	Scanner dwell time
	t_pause	Scanner pause time
sample2	channel	Scanner channel
	tempcoeff	temperature coefficient
	curvenumber	calibration curve number
	filterwindow	windowing percentage of filter (0.0-100.0 allowed)
	description	Short descriptor
	t_settle	Filter settle time
	t_dwell	Scanner dwell time
	t_pause	Scanner pause time
timeconstants	t_therm	Thermalization time
	t_switch	Switching time

Figure 1: Variables stored in the 'config.ini' file

3 Development Notes

3.1 Class: LakeShore372

3.1.1 Description / Use

This object holds member functions for opening/closing of a serial port in addition to a simple command set used to communicate with the Lake Shore AC / Resistance Bridge.

3.1.2 Member Variables

Variable	Datatype	Description
ID	string	ID of the instrument
sampleheater	dictionary	sample heater prefs.
scanner	dictionary	scanner prefs
mcthermo	dictionary	mixing chamber thermometer prefs
sample1	dictionary	sample 1 prefs
sample2	dictionary	sample 2 prefs
timeConstants	dictionary	global time constants

Figure 2: Built in variables / objects for the LakeShore372 class. The dictionary indices share the names of the variables in the ini file.

3.1.3 Member Functions

Member Function	Description
open(x,y)	Open a serial connection on port 'x' with baudrate 'y'
close()	Close the serial connection
getConfig(x)	Loads in the ini file 'x'.
setCHParams(x,y,z,a,b,c)	Sets CH 'x' to have a dwell time 'y', pause time 'z', curve number 'a', temp coeff 'b' (0=neg,1=pos). If 'c' = 1, channel is on, 0 it is off.
setFilterParams(w,x,y,z)	sets ch 'w' filter to have settle time 'x', window 'y'. Filter on if 'z' = 1, filter off if 'z' = 0
ReadCHStatus(x)	Read the status of the channel. See below for how to interpret response
ReadResistance(x)	Reads the resistance of ch 'x'
ReadKelvin(x)	Reads the temperature of ch 'x'
ScanTo(x,y)	Scans to ch 'x'. Autoscan is on if $y = 1$, off if $y = 0$
SetSampleHeaterRange(x)	Sets heater current range. See below for valid inputs.
SetSampleHeaterCurrent(x,y,z)	Sets sample heater (Resistance = 'x') maximum current to percentage (inputs 0-100 valid) of range. $z = 1$ sets display mode to current, 0 to power

Figure 3: Built in member functions for the LakeShore372 class

Return	Meaning
1	CS OVL
2	VCM OVL
4	VMIX OVL
8	VDIF OVL
16	R. OVER
32	R. UNDER
64	T. OVER
128	T. UNDER

Figure 4: Return values for ReadCHStatus(x) and their meanings

Integer Input	Desired Range
0	off
1	31.6 μA
2	100 μA
3	316 μA
4	1.0 mA
5	3.16 mA
6	10.0 mA
7	31.6 mA
8	100 mA

Figure 5: 'x' inputs for SetSampleHeaterRange(x) and their corresponding ranges.

3.2 Class: LakeShore372Data

3.2.1 Description / Use

This object largely serves as a data handler for the data coming from the Lake Shore device, and contains several functions for manipulating / saving this data.

3.2.2 Member Variables

Member Vars / Objects	Datatype	Description
MCThermoR[ ]	float	list of resistances for the mixing chamber thermometer
MCThermoK[ ]	float	list of temperatures for the mixing chamber thermometer
Sample1R[ ]	float	list of resistances for sample 1
Sample2R[ ]	float	list of resistances for sample 2
MCThermoRL	float	last read resistances for the mixing chamber thermometer
MCThermoKL	float	last read temperatures for the mixing chamber thermometer
Sample1RL	float	last read resistance for sample 1
Sample2RL	float	last read resistance for sample 2
DataFile	file stream	CSV file to write to

Figure 6: Member variables/objects for the LakeShore372Data class.

3.2.3 Member Functions

Member Function	Description	
	string	ID of the instrument

Figure 7: Member functions for the LakeShore372Data class