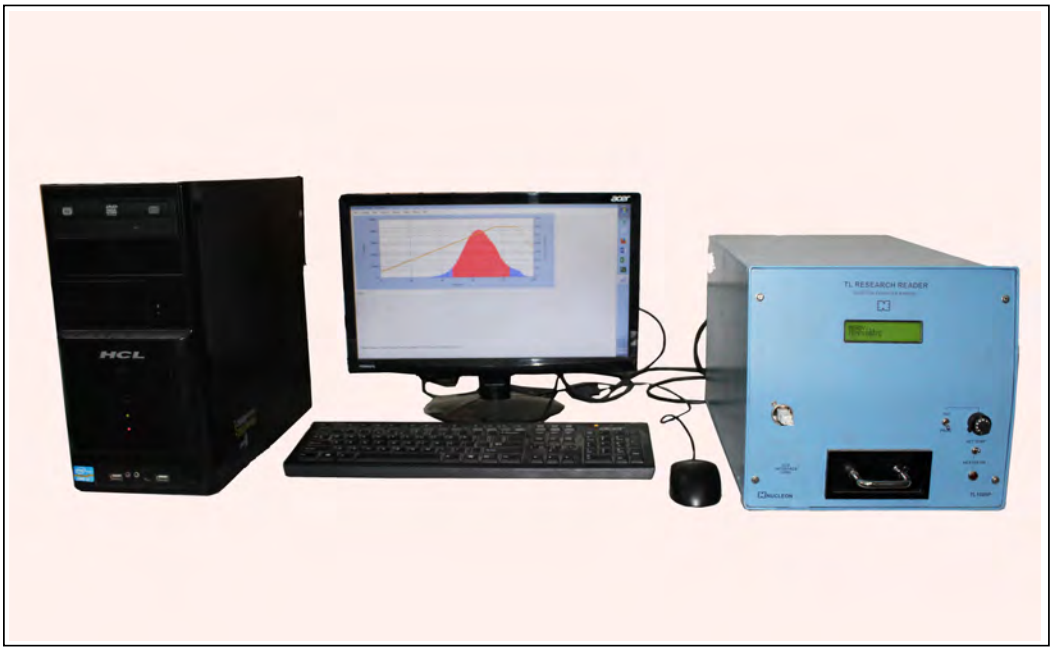
INSTRUCTION

M A N U AL

PC CONTROLLED TL RESEARCH READER



TYPE –TL 1009P

NUCLEONIX SYSTEMS PRIVATE LIMITED

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FILE_NAME : NSPL/DOC / MAN / TL 1009P/ 01

VER_20161122

Head of the Dept.

M PullaRao

Approved By

Note to Users

Users are advised to refer to SYSTEM HARDWARE REFERENCE/Part for understanding of the system, its constituent units, system integration and its functioning.

Also by referring to this manual, user will know how to unpack, assemble, inter connect/integrate the complete system, for use and operation.

SYSTEM SOFTWARE COMMANDS REFERENCE (Chapter-XII) is to be referred for using and operating the system under P.C. controlled mode, which is also part of this user manual. Also for TL glow curve acquisition, analysis and processing, this chapter is to be referred.

Important Notes

System performance is guaranteed only if a good 2KVA servo stabilizer is used. A highly stable, supply 230V, 50HZ AC is essential. Do not use the system without servo stabilizer. Also good earthing is to be ensured. Also A.C. room with dust free environment is preferred.

CONTENTS

UNPACKING

Please read the following lines and observe precautions, while unpacking the system. Unpack each box gently, avoid hammering &hard hitting.

1. Usually the system is packed in cardboard/wooden boxes / Plywood boxes.

2. **Equipment Packed** **Quantity**

Usually

a.	CPU Unit of Personal Computer(Optional)	One Box
b.	TFT Monitor with Keyboard(Optional)	One Box
c.	Printer (Optional)	One Box
d.	Integral TL Reader unit TL 1009P.	One Box

e. Annealing oven up to 350 / 400-degree C (optionally supplied). Annealing oven is to be placed separately in another room on the floor.

f. Nitrogen gas cylinder with regulator (optional) if you Are dealing with low dose samples, to suppress furious counts, cooling is suggested. Nitrogen flushing **may not be required.**

(Units (a), (b) &(c) are supplied, only if the order is placed, for personal computer system Plywood box.

3. Unpack these items (a, b, c, d) gently & place the items on the table.

Note: If user has PC already, then item no. (a), (b), & (c) will not be supplied,

(If PC is not ordered).

Fig: PC based TL Research Reader after unpacking.

4. Now either keep cap of the Nitrogen flushing nozzles (Inlet) in closed condition always, when gas is not connected or connect it through a flexible pipe from Nitrogen cylindrical to allow Nitrogen gas. (Optional). Since it is a single sample TL Research Reader, Nitrogen Flushing not required.

5. Now make Interconnections as given in the table in CHAPTER III, including A.C. Mains Cord for PC, Printer and Integral TL Reader.

CHAPTER -I
INTRODUCTION

Luminescence arises upon stimulation either thermally (TL) on minerals and other phosphors that have been previously exposed to ionizing radiation. During exposure, radiation energy accumulated and stored in the crystal lattice and metastable states are created. During the stimulation trapped charges recombine with opposite charges as a result luminescence (TL) occurs.

A versatile PC CONTROLLED TL RESEARCH READER, has been developed to meet the requirement of researchers to study TL of samples, in a single system and also to meet the following objectives.

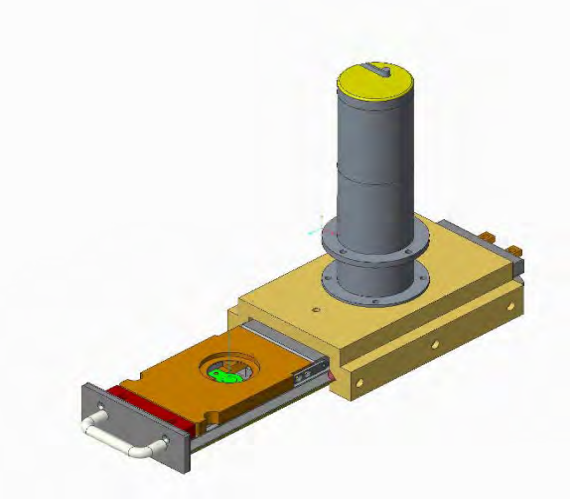
- To facilitate study of TL materials in different forms such as pellets, powders, discs, micro-rods, chips etc.
- Single board electronics PCB with microcontroller and embedded code makes it more compact & reliable.
- User friendly software and GUI to facilitate the researchers to be more comfortable in using the system.
- Minimal controls on front & rear panels for user convenience.
- Ease of temperature calibration through software, in TL mode.
- User configurable features facilitate one, to program for desired heating profile in TL mode.

CHAPTER -II
SPECIFICATIONS

PC CONTROLLED TL RESEARCH READER TL-1009P

Technical Data

TL Reader Isometric View



TL Stimulation & Detection Chamber

PC Controlled TL Reader TL 1009P manufactured by Nucleonix systems is a compact integral unit, designed primarily to meet the requirements of TL Research community in R&D labs & universities who are engaged in luminescence studies of TL materials. The drawer & sample holder of this system facilitates, single sample TL acquisition & analysis, at a time.

System has precisely designed electronics & photon counting module with appropriate filters, drawer assembly with heating arrangement all enclosed in a single mechanical chamber. System facilitates loading of the TL samples on to Kanthal strip.

TL data acquisition & analysis is controlled by PC software and electronic circuits &embedded code in the microcontroller. Photon counting module acquires luminous intensity data -for TL samples.

Specifications

I. TL READER-Light Detection System/Photon Counting Module

Photon counting module, is an integral part of the TL Reader. Photon counts received from the luminescence emission from the TL materials are counted in this module & the data counts are transferred to PC, thru RS232 or USB interface. This module essentially is plug-and play photo detector package, comprises of selected 25mm diameter end window PMT, a positive high voltage power supply, high speed amplifier- discriminator, counter & a microcontroller. All these are encapsulated with in a cylindrical mumetal case providing a high level of external magnetic shielding.

PMT: 25 mm PMT with ultra-low dark counts.

Count rate capacity: 100 MHz

High Voltage: Built in & set to optimum value.

PC Interface: RS 232 serial port or serial USB port.

II. TL Heating System

Heating Element: (Heater Strip)

Kanthal strip (72% Fe, 23% Al and 2% Cr or Nichrome) is used as a heating element. Kanthal Strip has a circular depression of 14mm to hold discs and powder samples. Additionally, flat heater strips also can be provided on request.

Sample Heating Process:

Sample heating can be done in two modes:

"PROG MODE" of Temp. Control through personal computer program.

"ISO MODE" (Internal mode) of Temperature Control, by varying the ten turn dial.

Temperature range / Programmed plateau heating:

From room temperature up to 500^0 C linear &plateau heating (Single / Two / Three plateau heating are possible).

Heating Rates:

Heater strip can be programmed to heat the sample from 1^0 C/sec up to 40^0 C/sec and a max set temperature allowed is 500^0 C.

Nitrogen Flushing Nozzle:

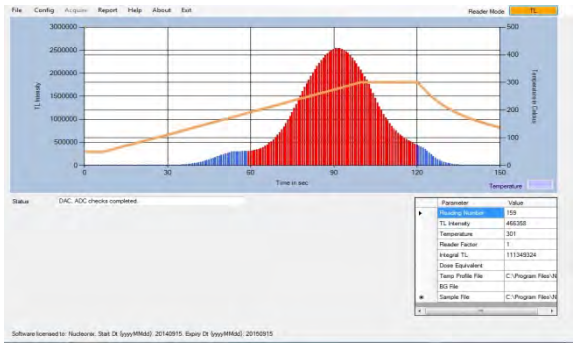
Nitrogen gas flushing nozzle, to suppress spurious luminescence from oxidation effects & also for cooling has been provided, on the rear panel.

V. PC Configuration

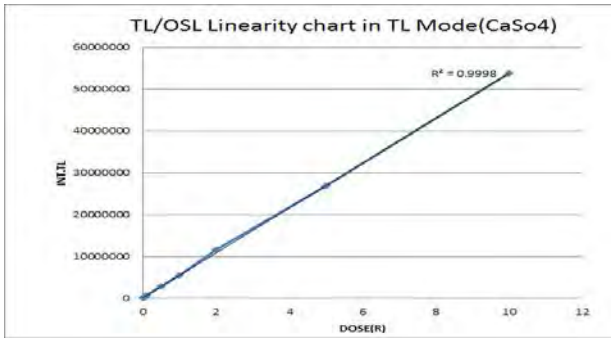
Branded computer system with Intel Core i3 @ 3.06Ghz, 2GB DDR2 RAM, 500GB SATA, DVD R/W, Keyboard and Internal Ready Optical scroll, 19" TFT Monitor, Laser jet printer, Windows licensed OS-Windows 7.0.

VI. Software features

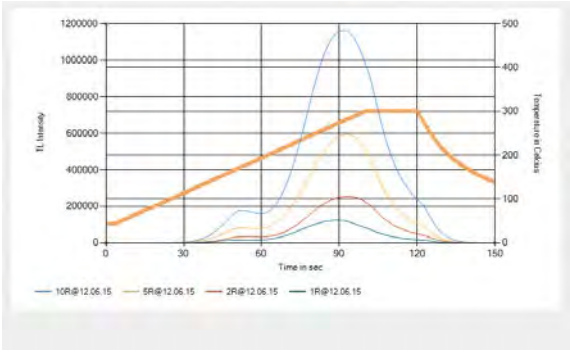
TL Research reader system operates thru PC controlled user friendly software. Software performs Self diagnostics of the system & reports faults. Software facilitates one to choose TL mode for sample data acquisition, allows the user to configure for the required heating profile in TL. Once data is acquired, acquired data can be saved or further processed depending upon the requirement.



TL Glow curve of $CaSO_4$ using photon counting module



TL Linearity chart in TL Mode



TL Glow Curves in Overlap Mode with Same Heating Profile

Software Key features:

- **Heating profiles in TL mode:** Various Heating profiles can be configured – Linear, Single & Multi-plateau.
- **Temperature Calibration:** The software provides an easy & user friendly method for Temperature calibration.
- **Acquisition:** Data is acquired based on the selected Mode & Profile. Background spectrum / Sample data can be acquired.
- **Background Subtraction:** There is a provision to do background subtraction automatically during acquisition.
- **Export Spectrum data to Excel:** Software allows the spectrum data to be exported to Excel, which gives the convenience to the user for further processing.
- **Spectrum overlap:** Multiple spectra can be overlapped (up to 10) for comparative studies.
- **Spectrum subtraction:** 2 spectra can be mutually subtracted & resulting spectrum can be saved.
- **Help:** Software manual is provided which gives installation & usage instructions clearly.

Applications:

TL Phosphor Characterization, Medical Dosimeter, Personal Monitoring Research, Archeology dating, Environmental Radiation Monitoring, Medicine, Biology, Neutron Dosimetry, Reactor Engineering, High Level Photon Dosimetry with TL materials, standardization and inter comparison of TL dosimeters used in personnel monitoring etc.

Applications in radiation oncology: Therapy machine calibration checks & inter-comparison studies with other centers, treatment planning accuracy verification using phantoms, patient specific dosimetry, studies in Brach therapy physics, in X-ray diagnostics to determine absorbed doses to patients & in research etc.

Optional accessories:

A.TL Materials & Phosphors`

(i) TL Phosphor $CaSO_4$: Dy Powder

(ii) TL Discs $CaSO_4$: Dy discs with Teflon base 13.3mm dia X 0.8mm thick.

(iii) LiF; Mg, Ti square chips (3.2mm x 3.2mm x 0.9mm)

(iv) Vacuum Tweezers

(v) Powder dispenser blocks

(vi) Neutral density filters.

(i)

(ii) & (iii)

(iii)

(iv)

(vi

(v)

B. Annealing Oven

Internal Dimensions 14 X 14 X 14 (inches)

Temp Range: up to 400^0c

Temp Indication: Digital

No. of trays: 2 nos.

Heating: High grade Nichrome wire placed in the ribs of sides and bottom for uniformity.

Power requirement: Single phase 220/230VAC supply.

Accuracy: +/-1^o or better

C.CCD Spectrometer (USB 2000+):

This is an optional attachment, which will facilitates one to record TL intensity Vs wave length in the range of 320-1020nm. This CCD spectrometer is a compact portable unit roughly the size of portable hard drive. It is provided with fiber optical patch cable with SMA connectors, high speed USB cable, software, etc. Software provides graphical user interface and can display spectra (color spectra) of TL intensity Vs wave length.

Important specifications of ccd spectrometer:

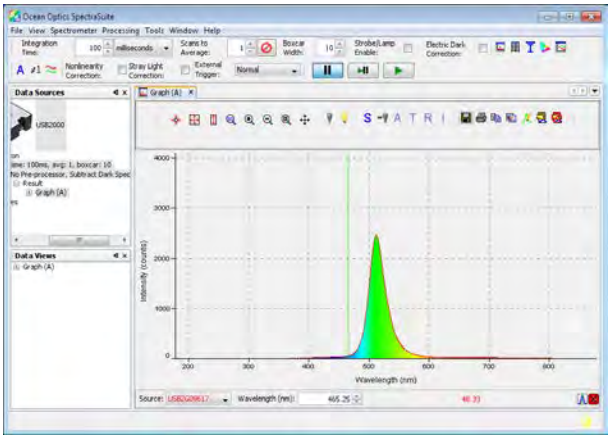
Linear Silicon CCD array detector type SONY ILX511B 2048 PIXELS

Wavelength response: 320-1020 nm

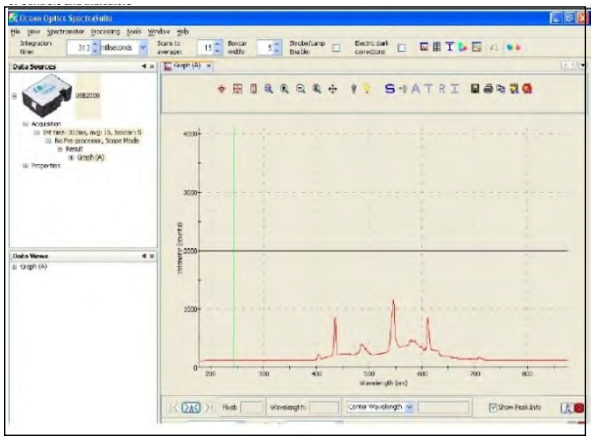
Data transfer speed: Full scans to memory every 3 ms w/USB 2.0 port

Dynamic range: 8.5 X 10^8(system): 1300:1 for a single acquisition

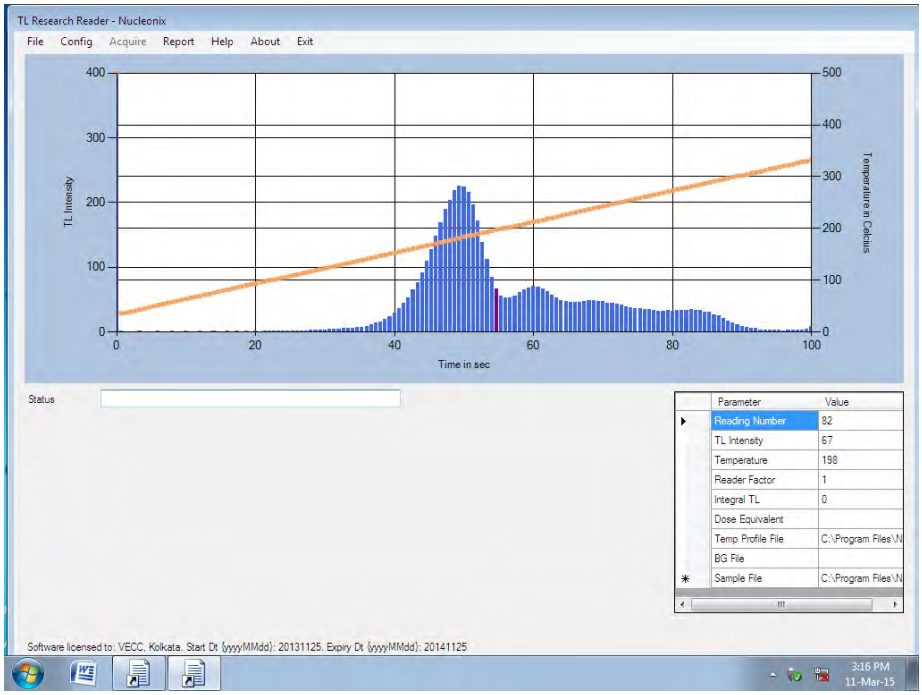
SNR(Single to Noise Ratio): 250:1 at full signal



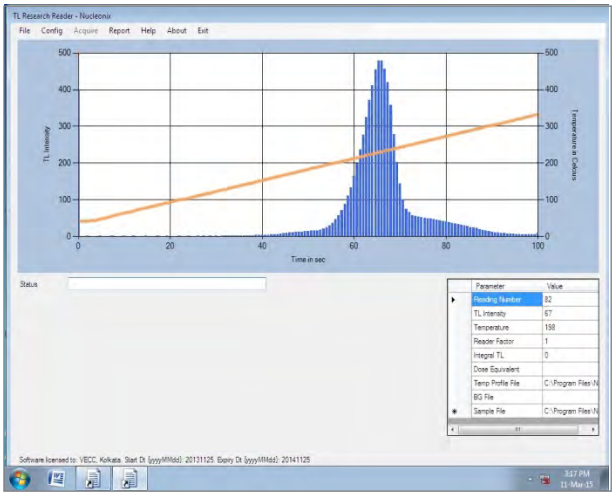
I.CCD spectrometer-Intensity Vs Wavelength record



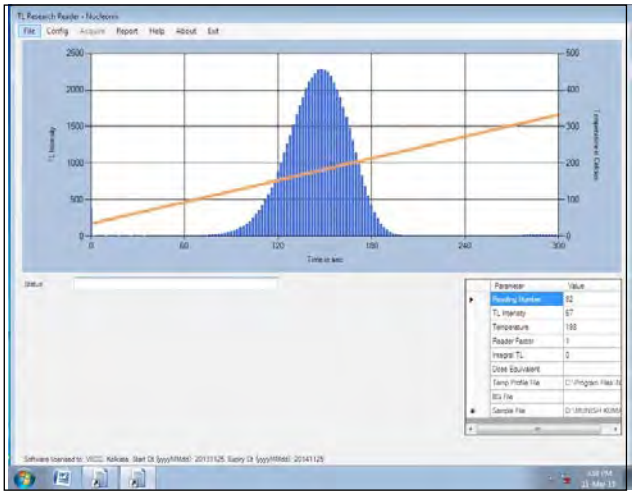
II. LiF- Glow Curve [LiF–N (Mg, Ti)]



II. LiF- Glow Curve [LiF–N (Mg, Ti)]



III. a) Glow Curve of LiF – Mg, Cu, P



b) Glow Curve of Al_2O_3 (ALUMINA)

CHAPTER-III
SYSTEM INTERCONNECTION DETAILS

System unpacking, installing PMT & mounting all the units on a table etc. have been covered under unpacking. Below table gives the details of interconnections between various units and sub-systems.

S.NO	Instrument/Unit (Name of the signal)	Connection from	Connection to	Type of Cable
1	A.C. power to unit	A.C Mains socket (230V A.C)	To TL 1009P on Rear panel MS-socket (3 pin)	3 pin MS connector with Three core mains cable to Three pin A.C plug
2	Profile configure signal (PC to µC board)	CPU Rear panel	TL Rear panel	USB-A to USB-B Cable
3	Photon Counting unit output to CPU (USB or RS232)	TL Rear panel	CPU Rear RS232/Front panel USB Socket	Serial Cable or USB-A to B cable, RS232 Cable (9 pin D type)
4	(Printing command)	CPU Rear panel/Front panel	Printer	USB-A to USB-B Cable
5	Nitrogen cylinder (optional)	Nitrogen cylinder	To TL 1009P rear panel Nitrogen gas inlet nozzle	Flexible Gas pipe
6	VGA Signal	Monitor (rear panel)	P.C Video connection	15-pin VGA cable
7	AC power supply	A.C Mains 230V, A.C.	Monitor (rear panel)	AC Mains cord

CHAPTER –IV
BLOCK DIAGRAM DESCRIPTION

i) Block Diagram Description of TL Reader Unit:

Entire system electronics in the form of functional block diagram is shown fig (1). This in conjunction with PC system and software, works, as the PC CONTROLLED TL RESEARCH READER.

Figure1 consists of the following blocks, namely:

- Low Voltage Supply Circuits (to generate +5V, +/- 12V)
- Electronics PCB consisting of Microcontroller with embedded code, peripheral devices such ADC, DAC, Temperature controller, serial port, etc.
- Personal computer system and
- Data acquisition and analysis software

Low Voltage Supplies: LV supplies namely +5V, +12V and -12V required by the system are generated using conventional power supply circuits and DC to DC converter.

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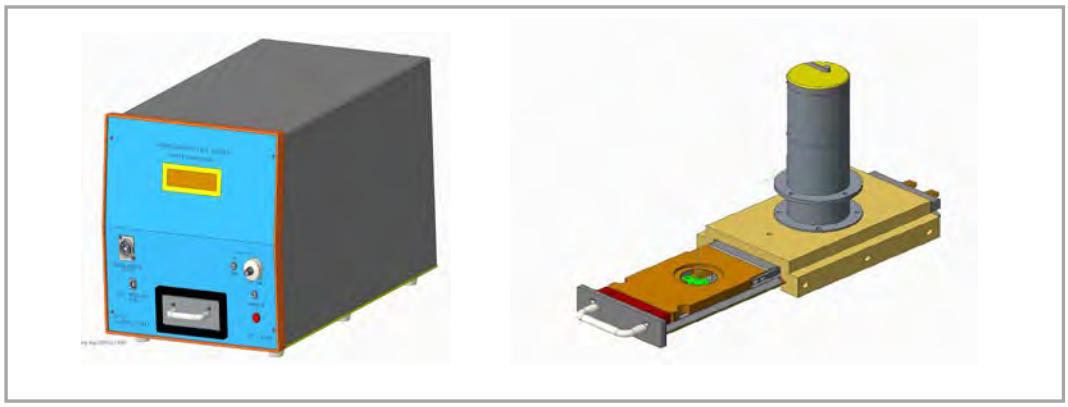


Fig: TL Reader Isometric View **Fig: TL Stimulation & Detection Chamber**

ii) TL READER-Light Detection System / Photon Counting Module:

The light detection system consists of a plug-and-play photo detector package configured for photon counting. It comprises of a selected 25mm diameter end window photomultiplier tube. Positive high voltage power supply, high speed amplifier-discriminator, counter and micro-controller. All are encapsulated within a cylindrical mu-metal case, providing a high level of immunity from the effects of external magnetic fields. Low voltage and signal output connections to these packages are by flying leads.

Three options from Electron Tubes range of 25mm end window photomultipliers are offered to cover the spectral range from UV to IR spectral response curves.

P25232: Selected bi-alkali photomultiplier with high blue sensitivity and ultra-low dark counts.

Fig: Photon Counting Module

Photon counting module provides a fast, accurate light measurement via an RS232 interface to a host PC. Some of the important features are-

Simplicity of operation, Minimal set up time, Compact cylindrical assembly, Electrostatic and magnetic shielding, RS 232 interface, UV window option, 100 MHz count rate capability, Automatic dead time correction, operates from +5V supply, Pre-set discriminator level and HV are factory set for optimal performance.

iii) TL Acquisition Mode:

In this mode of operation user has to set the following conditions for TL acquisition. The filter basket has to have heat absorbing glass/ IR filter combination. In the software menu select the TL mode. Followed by this, three-point temperature calibration is to be carried out. Set ISO/PROG switch to PROG mode place the heater ON/OFF switch to ON position. Now user can load the TL sample on to the Kanthal hater strip. One can configure for the required heating profile and carry out the TL acquisition. TL intensity is acquired and plotted on the y1 axis by the photon counting module. On y2 axis temperature is plotted.

iv) TL Heating System:

Heating Element: (Heater Strip)

Kanthal strip (72% Fe, 23% Al and 2% Cr or Nichrome) is used as a heating element.

Kanthal Strip has a circular depression of 14mm to hold discs and powder samples. Additionally, flat heater strips also can be provided on request.

Sample Heating Process:

Sample heating can be done in two modes:

"PROG MODE" of Temp. Control through personal computer program "ISO MODE" (Internal mode) of Temperature Control, by varying the ten turn dial.

From room temperature up to 500^0 C linear & plateau heating (Single / Two / Three plateau heating are possible).

v) Temperature controller circuit

Below Figure is the temperature controller & sample heating system**.** Thermocouple 'mv' output received from the Kanthal heater strip is, fed to a monolithic thermocouple amplifier with cold junction compensation. Output from this is fed to an op. amp. And it goes to ADC chip whose value is read by microcontroller& interpreted in terms of temperature through PC program, subsequently. Programmable heating of Kanthal heater strip is achieved, by firing a TRIAC & controlling the conduction angle of 230V, A.C power. Conduction angle control loop circuit essentially has a UJT oscillator synchronized with 50Hz A.C. power. UJT oscillator generates a trigger pulse through pulse

Transformer which controls the conduction angle of TRIAC. This enables 230V AC primary loop of a power transformer which is stepped down to 2.5V@ 40 ampere. Secondary of this transformer

heats up Kanthal strip. The control of conduction angle is by a D.C control voltage 0 to-500 mV which heats from room temperature up to500^{O}C. This control voltage is fed from a ten turn dial in ISO mode &from DAC1 which is programmed through microcontroller to generate various heating rates from 2^{0} C / sec to 40^{O} C / sec & also various heating profile(s) such as single / multiple plateaus.

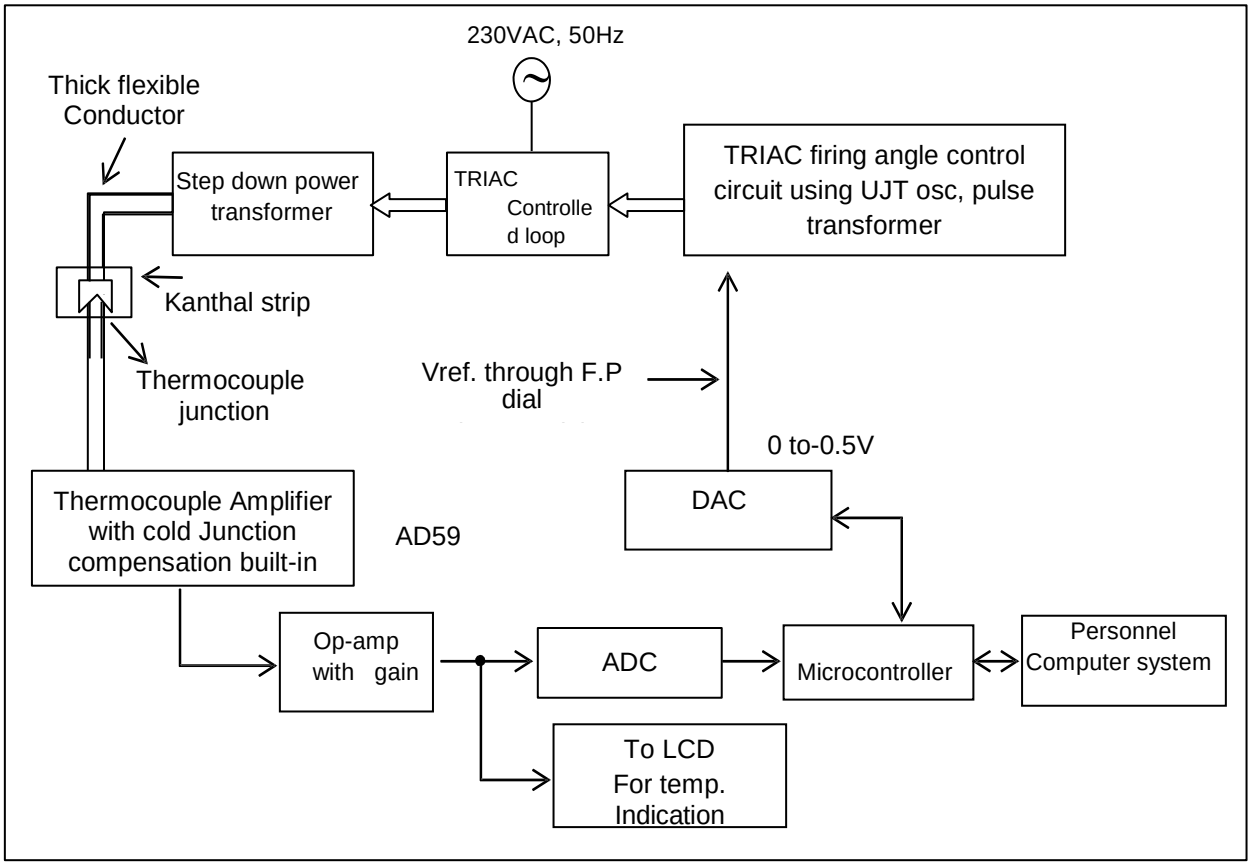


Fig: Temperature controller part of the circuit, for sample heating on Kanthal strip

CHAPTER -V
DEFAULT SETTINGS

After making all the connections user may set the switches and knobs to default values before proceeding with glow curve acquisition.

Default settings on the instrument:

* ISO/PROG Toggle Switch Check	-	Keep the Toggle switch to 'ISO' mode initially to The working of the reader by heating in ISO mode. Then to "PROG" mode, for normal acquisition of a glow curve.
* SET TEMPERATURE (DIAL)	-	Not Applicable in PROG mode. Applicable only in ISO mode. However, it can be left at minimum position. When operated in ISO mode approx. every two turns correspond to 100^0c.
* HEATER ON/OFF Switch	-	Initially OFF position, when the equipment is switch ON. Then change to ON position before ensuring that Temp in TC display should indicate room temperature or ambient temperature of Kanthal strip. If temperature indication shown is near to 'zero 'or -ve, then the thermocouple could be in broken condition/open condition. If found, so it should be rectified/replaced before switching ON the heater ON switch.
*A.C. Mains ON / OFF switch on (Rear panel)	-	F.P control store fault settings And ensuring connections between PC and TL 1009P, switch ON the A.C. mains switch on Rear panel to Power the instrument.

CHAPTER –VI

How to Make the System Operational / Functional to get the Accurate TL Measurements

- Unpack the unit and check for the physical damage (If found please contact product specialist through Nucleonix Customer Support Executive)
- Make all system interconnections and keep the unit in switch off condition.
- Put off the “Heater ON” switch and keep temperature Knob at minimum position.
- Keep the ISO/PROG heating mode switch in ISO mode, initially.
- Switch on the AC-Supply and switch ON the unit through (Rear Panel Rocker switch).
- LCD display shows ambient temperature as sensed by thermocouple, spot welded at the bottom of the Kanthal strip. (If not, check the thermo-couple connections and spot welding under Kanthal strips).
- Put ON the “Heater ON” switch and slowly increase the set temperature Knob and such that for each turn, the temperature increases by around 50^0 C (approximately).
- Check the temperature up to 500^0C in LCD for 10 Turns of the Set Temperature knob
- Minimize the Set temperature knob and change the Heating mode switch into PROG, mode allow the Kanthal strip to cool and temperature indication to reach, to 45 degrees (approx.).
- Load and Install the TL Research Reader application software from CD. (Refer the software instruction Manual). Your PC, if supplied by Nucleonix will have TL application software, installed already.
- Run the TL Research Reader application software in the PC and check if the proper COM Port is entered or not. Go through **software instructions/commands**, thoroughly before operating further.
- Do the “**temperature calibration**” as described in the instruction manual (Page no: __)
- Go through, already configured & recommended temperature profiles for various types of TL phosphors. Always remember to configure a temperature profile, to have minimum IR & max TL extraction (output) so that residual TL when acquired shall be less than 10% of the original TL glow curve.
- Create some Standard (or desired) temperature profiles for different TL Phosphors or Samples (optional)
- Try to use recommended profiles, if it meets your requirement

- For natural crystal chips, discs and powder samples, **Linear Heating with Natural cooling profile** is desired. Clamping may not be required.
- For Teflon based, pellets and discs samples, **Linear heating with some clamping time and natural cooling profile**s are advisable.
- Acquire a dummy glow curve by loading no sample on the Sample holder (Kanthal Strip)
- Run the background glow curve (If user wants to subtract the BG, save and select this file as Background file in Acquire menu)
- Now the System is ready to do the sample acquisition & analysis
- Refer to procedure & command instruction / sequence for TL glow curve acquisition as described at the end of this chapter.
- Then choose 'Main Screen' after configuration. (Refer to TL Software user manual for details on configuration and TL glow curve acquisition). Load the TL material in disc, pellet, crystal, chips or powder for under study on to the Kanthal strip after weighing accurately in case of powders and close the drawer.
    a. Before making any measurements or acquiring a glow curve for a TL sample, read the instruction manual on "How to make TL measurements more accurately &correctly".

- Acquisition will go on from ambient temperature to set temperature as per the selected heating profile. PC display will present digitized GLOW CURVE for acquisition channel indicating TL intensity Vs Time and Temperature

- Acquired glow curve can be saved as file with time and temperature parameters apart from TL. As per software features user can analyze, print, plot and do other functions as desired.

- Before you load another sample, rerun & acquire for back ground with the same sample & save it as a BG file.

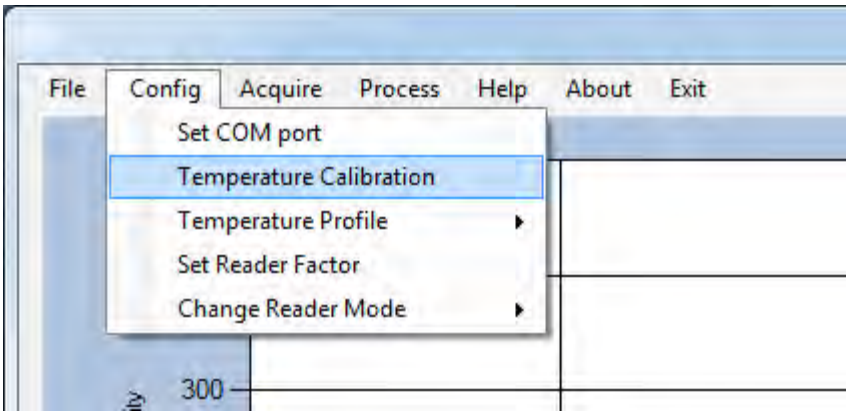
- Brush out the powder (or take out the disc) in to bottom collection tray & reuse.

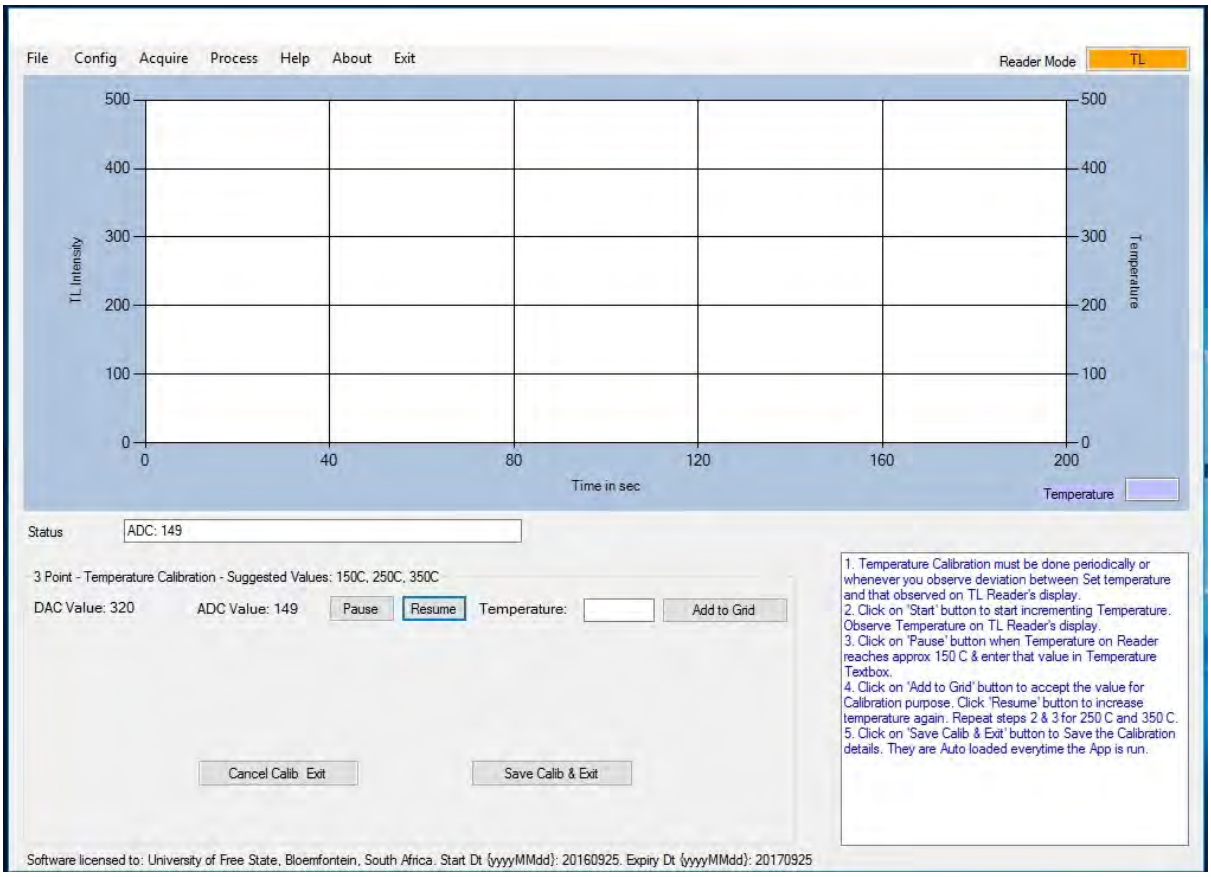
- Allow it to cool to at least 40^0C before next sample can be loaded & run.

Procedure for TL glow curve acquisition and analysis

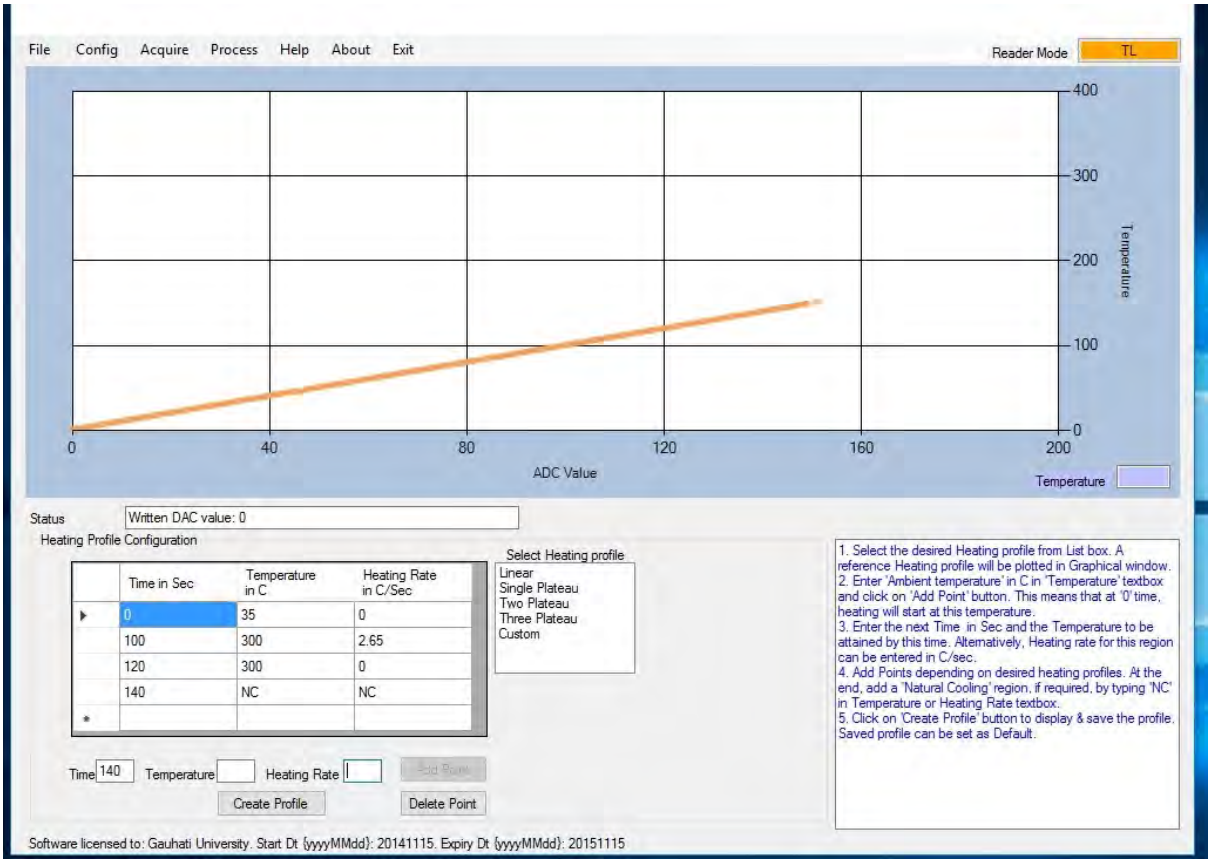
- Keep the temperature in PROG mode and Put ON the "Heater ON" switch
- Switch ON the Reader, by using 'Rocker switch' on the Rear panel.
- Open the TL Research Reader Application Software.
- Mode will be shown in the GUI screen on the top right extreme corner as **Reader Mode**

- Do the Temperature Calibration as described in the Software Manual (It is recommended to do the Temperature Calibration once in fortnight (15Days))

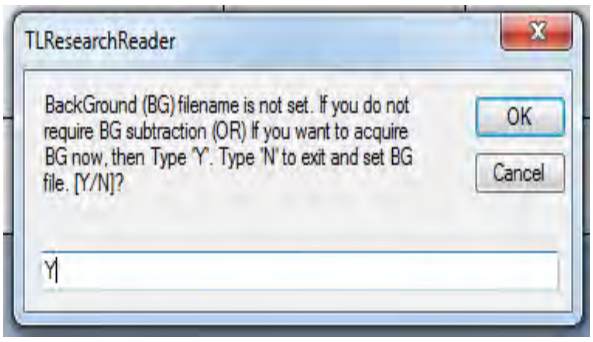


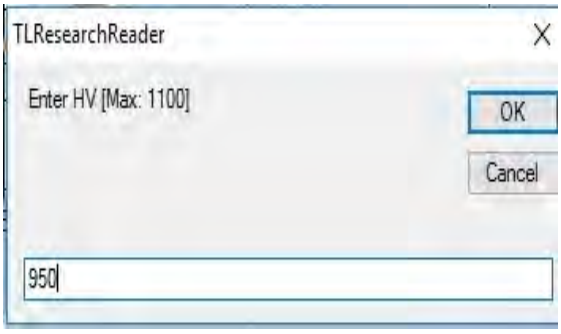


- Now Create a Temperature Profile to get the maximum Illumination from with min. IR.

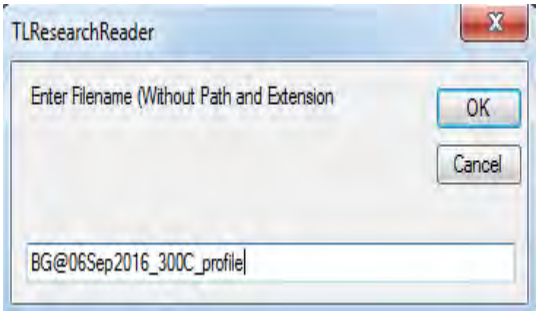


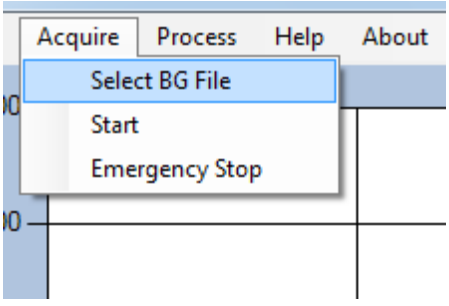
- Acquire the Background by placing **NO** sample on the Kanthal Strip by clicking acquire menu➔ start
- (If user interested to subtract the background. Otherwise we can skip this one)





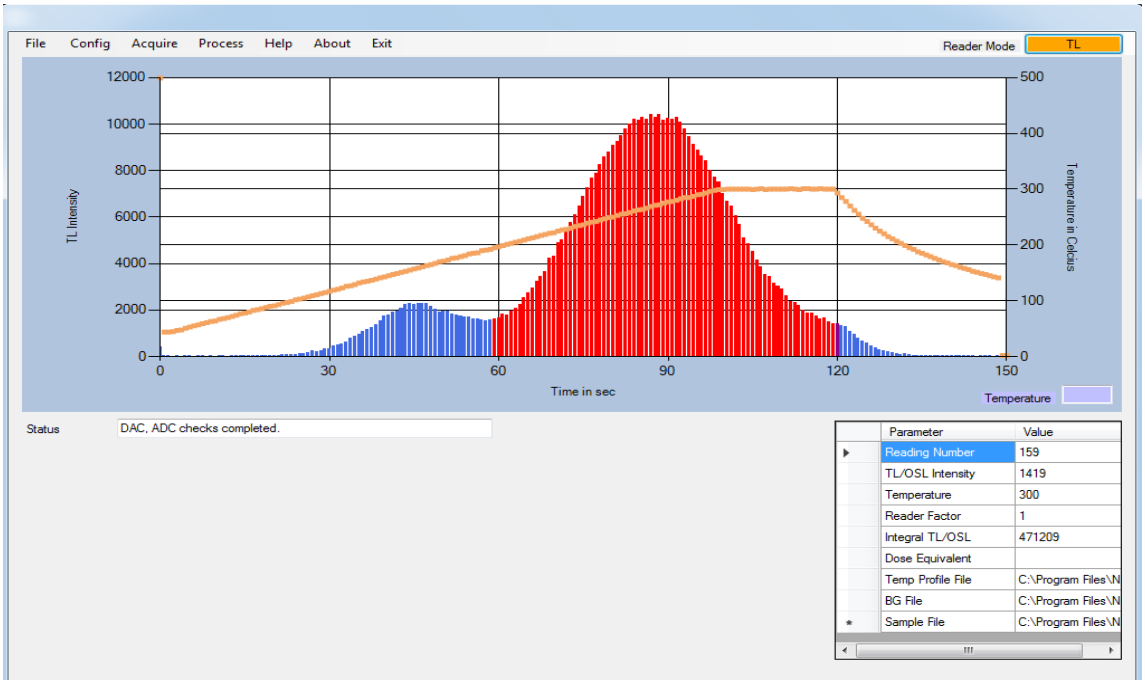
- Save the background glow curve and select the same file to subtract automatically from the sample data



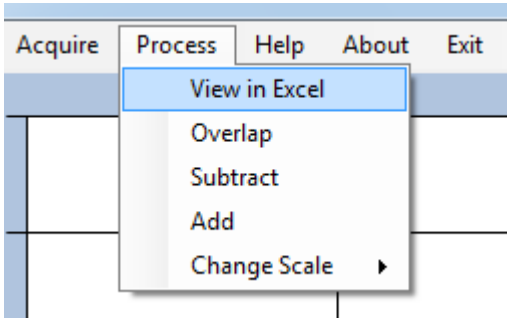


- Now place the irradiated sample on the Kanthal at middle.
- Acquire the glow curve and save the file.

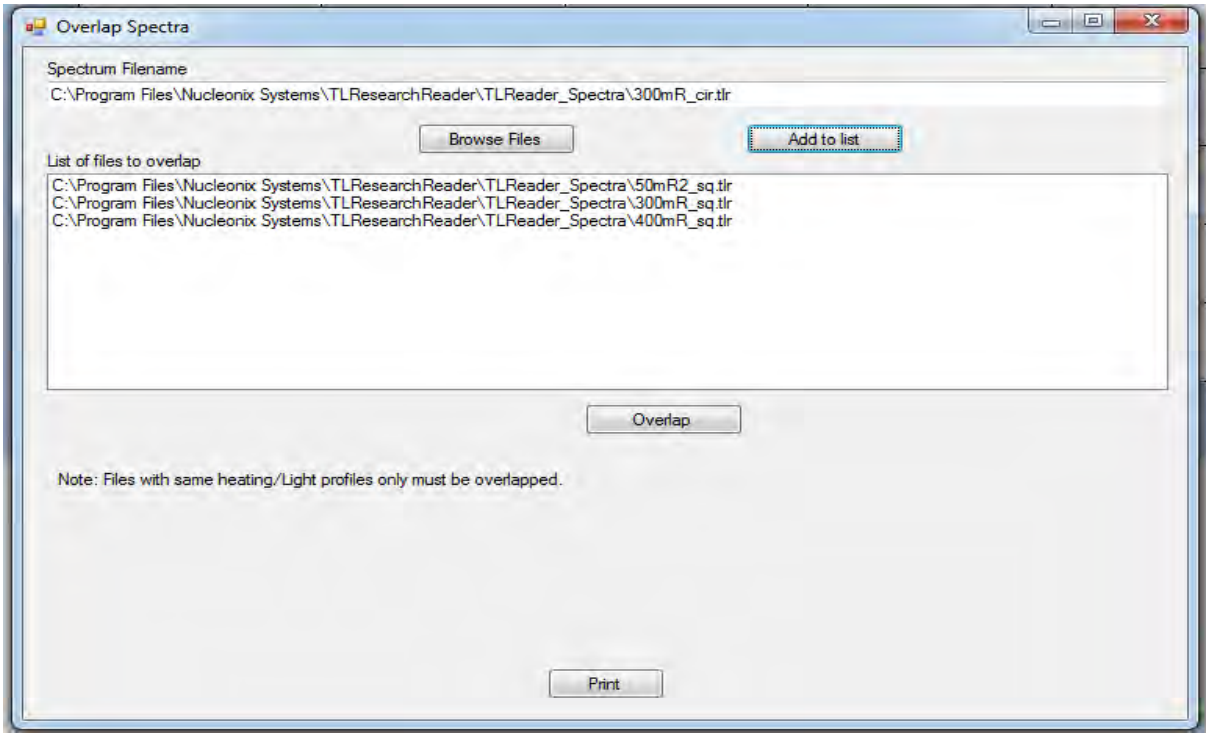
- User can select the Region of Interest (ROI) by clicking the required extreme points on the glow curve. Integral TL will be displayed in Table on the right bottom of application Software



- One can open the previous glow curves from the File menu➔Open➔ select the desired file.
- We can process or utilize the raw data (Temperature, Illumination Intensity) by viewing in excel format (Process menu➔View in Excel➔ select the desired file)

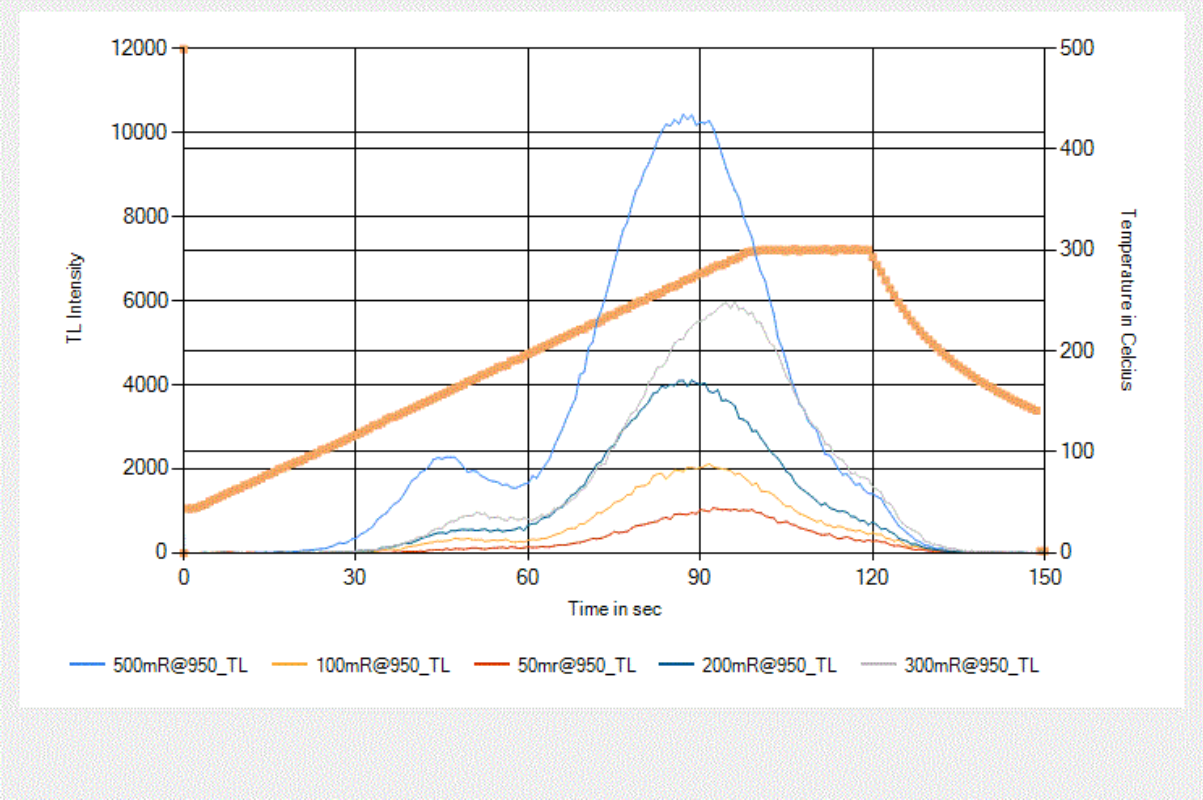


- In order to do comparative studies one can overlap different glow curves (With same temperature Profiles)
- Go to process menu➔ Overlap ➔ browse the required files and add to list one by one

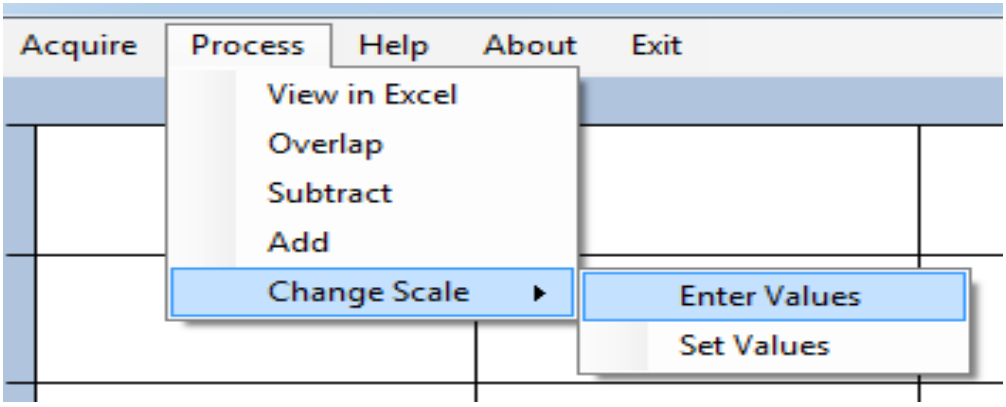


- Now click Overlap and save the file at desired destination

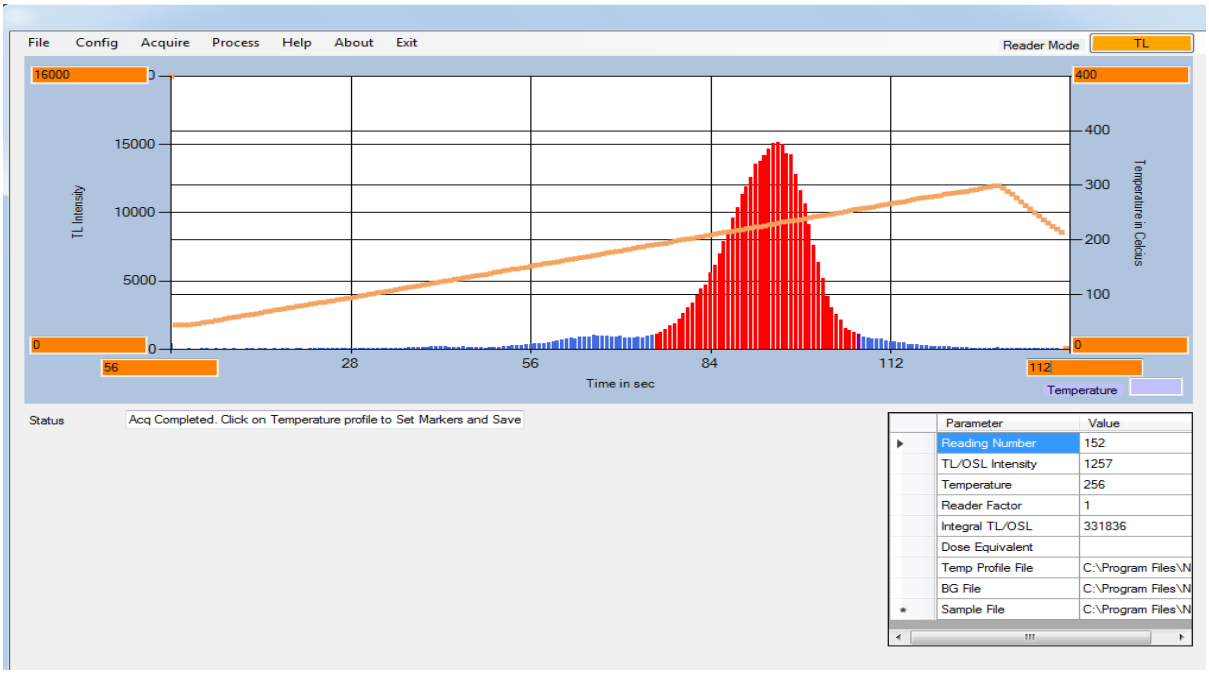
- Typical overlap file will be as shown in figure



- If user want to observe particular region interest of glow curve then click on Process➔Change Scale➔ Enter values

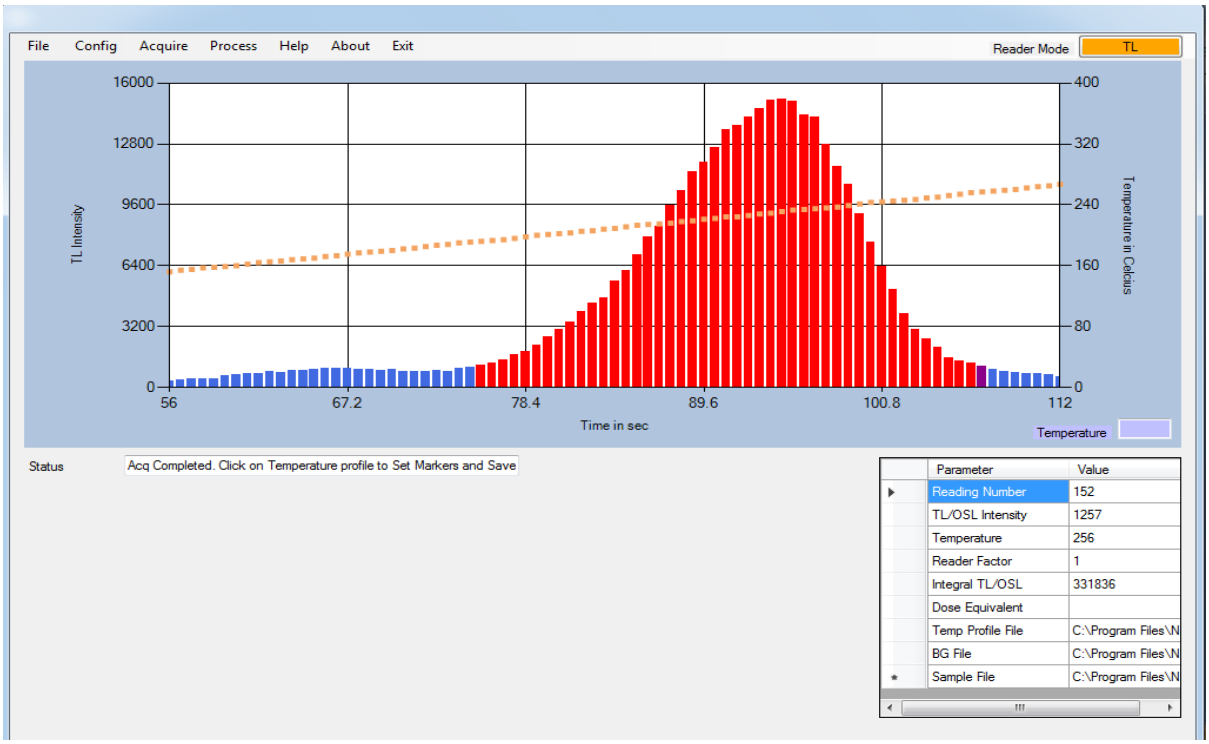


- Enter the min and max range of interest as shown in the figure



- Click on Process Menu➔ Change Scale➔ Set Values (to apply these settings to the glow curve)

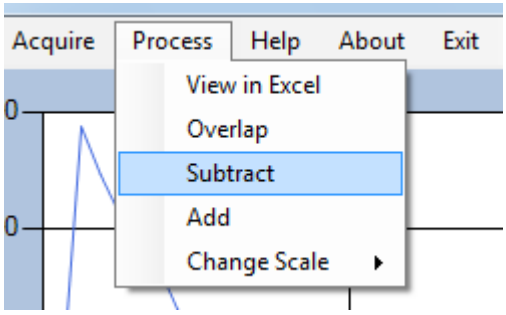
- Hence Glow Curve will be transformed (or zoomed in) as shown in figure



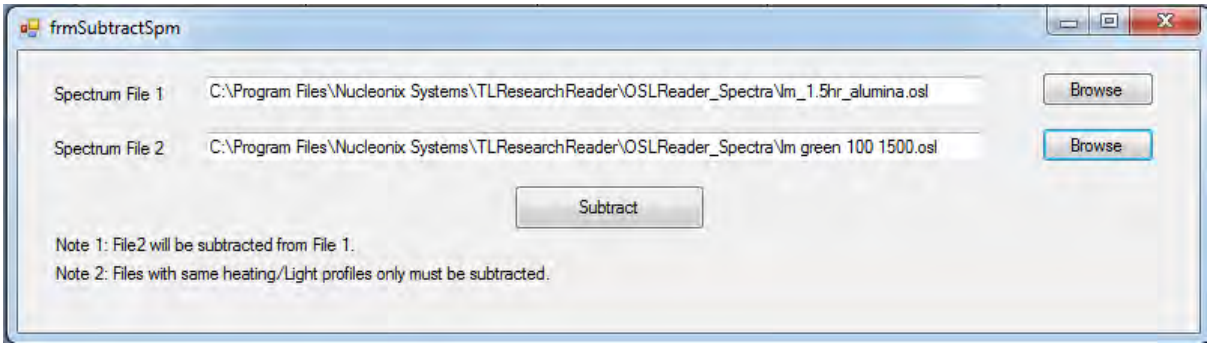
- These settings will be saved permanently until the software is re-opened.

Subtraction/Addition of two spectra (Glow Curves)

- Arithmetic operation like Addition or subtraction of two spectra can be done, depends upon the requirement of user
- For that click in Process Menu➔Subtract (or Add)



- Select the files required for the arithmetic operation



- Save the resultant file for the analysis (if, required)

CHAPTER -VII
PRECAUTIONS /OBSERVATIONS/LABORATORY RECOMMENDATIONS

a. Before the power is switched ON ensure all proper connections & default control settings are made.

b. See that the 20X2 LCD display is working and is indicating the ambient temperature at as seen by spot welded thermocouple at the bottom of Kanthal strip. If LCD display indicates temperature value as near zero or-ve value, then thermocouple connection may be opened. (Keep the temperature switch in ISO Mode and switch ON the HEATER ON switch and slightly increase the SET TEMP. knob by two turns, if temperature is not increased then check or replace Kanthal strip welded with thermocouples)

c. After switching ON the equipment allow ten minutes warm up time before useful measurements are taken up.

d. Ensure 'HEATER ON' toggle switch to OFF position, each time before switching on the power to equipment.

e. Ensure ISO / PROG toggle switch to 'ISO' position and 'SET TEMP' dial to minimum on before switching ON, the instrument.

f. Whenever a new Kanthal strip with thermocouple spot welded is changed ensure proper thermocouple output polarity signal to temperature controller circuit. In case Kanthal strip burns off or temperature reading is not proper, then replace the damaged Kanthal Strip with thermocouple wires by a new one (as per the detailed procedure given in Chapter VIII) and go through 3-point temperature calibration.

g. To Quit the TL Research Reader software, it is recommended to use exit menu.

h. It is recommended to do the **temperature calibration** once or twice in a fortnight (15days).

i. Ensure that filter basket meant for '**TL mode**' only is loaded.

(C) Laboratory recommendations:

a. **Power requirements:** System is designed to work at 220V ± 10% A.C. @ 50 HZ frequency. Operating the system at any other voltage or frequency is strictly not advised & it may mal-function. A good servo stabilizer is recommended to provide stable supply.

b. **PC requirement:**

Branded computer system with Intel Core i3 @ 3.06Ghz, 2GB DDR2 RAM, 500GB SATA, DVD R/W, Keyboard and Internal Ready Optical scroll, 19" TFT Monitor, Laser jet printer, Windows licensed OS-Windows 7.0 or Higher and MS-Office.

c. **Temp & humidity:** AC room at 25^0C to 30^0C & RH below 75% with dust free environment is recommended.

d. **Nitrogen gas requirement:**

For TL measurements, for very low level dose rate measurements & when heating to higher temperatures, only to eliminate spurious counts due to oxidation effects on Kanthal strip, one may flush with Nitrogen gas at very low flow rates, if required. Care should be taken while using powder samples. It is also advised to clean the Kanthal strip surface with a soft tissue or Acetone gently (periodically, if required).

e. Placement of TL samples on Kanthal strip for measurements :
(i) **TL samples/phosphors:** TL materials under study which are in different physical form such as discs, micro-rods, chips, crystals etc. of equal weight and size/shape can be placed directly in contact with the Kanthal heater strip surface. Ensure to keep it at the center, each time, you make measurements. If you are using powder samples, use powder dispenser block and fill the powder into the hole, make it flat by taking off extra powder from the dispenser block surface or one can use precision balance to weight the powder samples. After each measurement, brush out the powder completely from the Kanthal surface.

(D) In Emission spectra mode (with CCD SPECTROMETER)

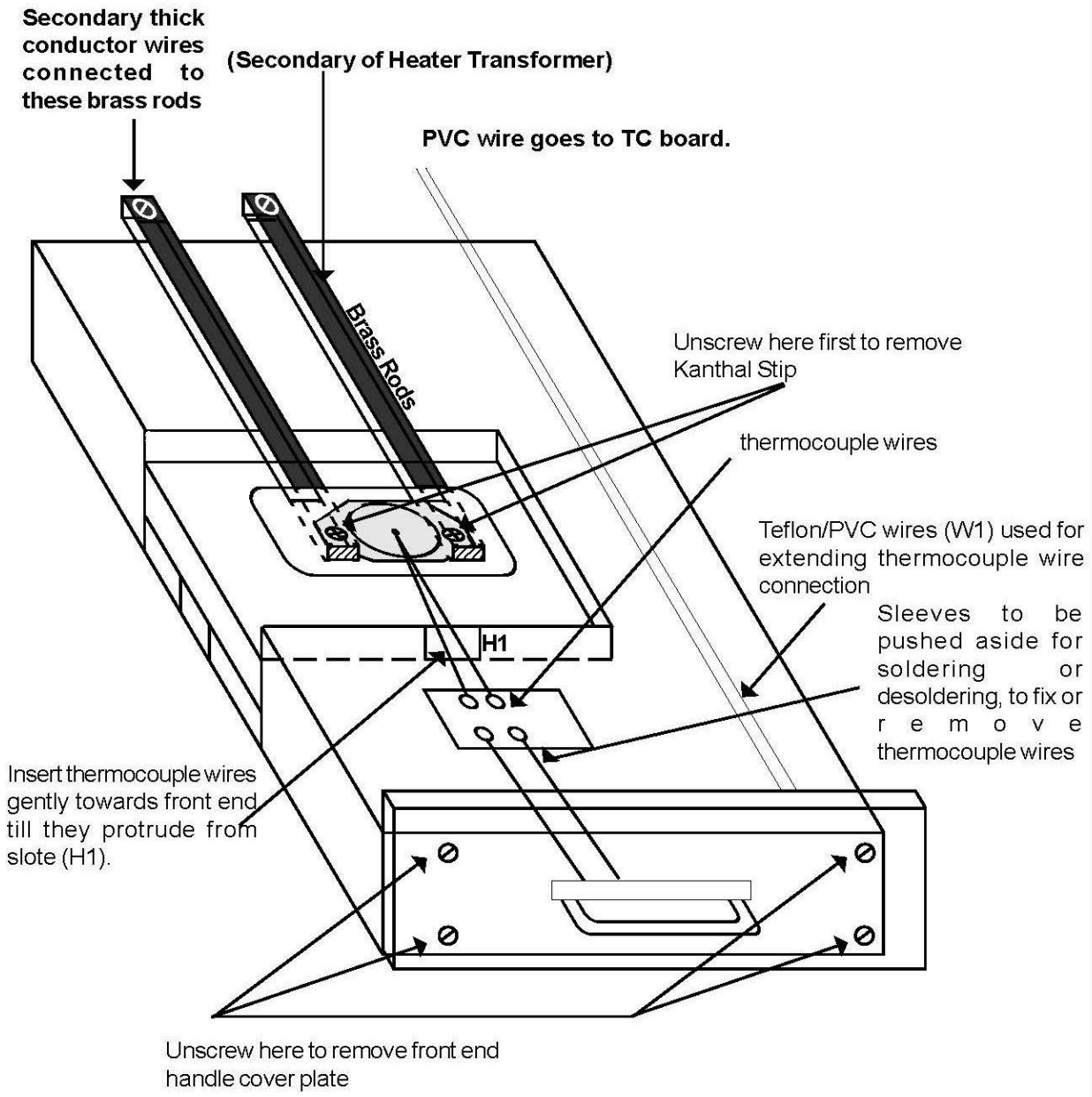
i. Pull the drawer assembly and place the stopper boot over the Drawer Assembly.
ii. Now push the drawer (so that, the Kanthal will be facing the optical fiber, which will collect the emission)
iii. Insert the corresponding filters for the sample under the emission study of TL (If required)

CHAPTER -VIII
PROCEDURE FOR REPLACING THE DAMAGED KANTHAL STRIP

- Once it is identified that either a thermocouple wire is broken, damaged or Kanthal strip is burnt, then one can proceed with dismantling operation as detailed in following steps.
- Unscrew & remove the Cap near the Kanthal.
- Take a star/flat screw driver of appropriate size and unscrew the Kanthal strip, from top of the brass rods, in the drawer assembly.
- Lift the front flap, below which thermocouple is soldered to long wires.
- Move the sleeves on wires a side and de –solder thermocouple wire and de-solder thermocouple ends if there is terminal block. Now hold the burnout Kanthal Strip and gently remove it out.
- Hold the thermocouple such that thermocouple wires should be your side.
- Land the Kanthal Strip on the Brass rail bars & screw it up loosely.
- Now insert the thermos-couples wire in the Slot provided (H1 Slot)
- Solder the Thermocouple wires on the one side Bridge such that the color of sleeves should match on the other side.
- Now, tightly fix the Kanthal on the Brass Bars.
- Now, **Put OFF** the TEMP ON Switch & Power up the TL Research Reader.
- The Display Should Show Room Temperature.
- Touch the Kanthal Strip with Solder rod, then the Temp on the LCD Should Increase.
- Increase not reverse polarity the thermocouple Wires/ Teflon Wires.
- Now we can say that the Polarity of thermocouple is Correct.
- Turn OFF the Unit & fix the Cap over the Bridge & Screw it up.

After this, the heater ON switch on heater ON switch can be made ON and check heating in ISO mode by slowly increasing the dial by one turn and observe the temperature to be 50^0C (100^0C in old design). For two turns approx.100^0 C and for three turns 150^0C etc. and reduce the dial and switch OFF the unit. Now the unit is ready for use.

THERMOCOUPLE WIRE ROUTING IN PMT HOUSING



CHAPTER -IX
HOW TO MAKE TL MEASUREMENTS MORE ACCURATE USING NUCLEONIX PC BASED TL READER SYSTEM.

Precautions to be observed for measurements and screening of dosimeters. (Chips, Micro-rods, discs, mini discs etc.)

If you are working with Teflon coated discs,

a. Choose a set of discs from the same batch production from your supplier.

b. Preserve them in clean conditions.

c. Do not allow dust, dirt, scratches on disc.

d. Do not handle with bare hands. Better to use forceps and place them gently on to the Kanthal strip.

e. Discard buckled or wrapped discs if you find them either initially or after few measurements.

f. Disc should make total contact onto the Kanthal strip.

g. Each disc isotope screened before being accepted for doing meaningful measurements.

h. Expose a set of discs from the same batch for a known dose and acquire for TL glow curve for each disc at least 3/ 5times.

For each disc and each compute, the average area and deviations from the Average area. These deviations shall be in close limits (limits can be decided by the user), then Accept them and use for measurements (Say, the deviation is within 10% to 13% as per user's Choice). If any disc is found to give inconsistent / large variations, and then discard such dosimeters from using for measurements permanently.

i. Out of the screened discs you may find a few of them giving excellent reproducibility. Such discs could be put separately and can used for calibration and evaluation of reader factor in a particular range. These are called **"calibration dosimeters"**. The rest of dosimeters which have fairly good, reproducibility within acceptable limits (deviation within 10% or 15% as set by user) can be called as field dosimeters (In medical dosimetry they are called patient dosimeters).

All the above points mentioned hold good for micro rods and chips also. The advantage of using these discs, mini discs, micro rods and chips is that one need not weigh them, as they are supposed to be of equal weight.

Precautions to be observed for measurements with Tl materials in powder form

j. It is very important to measure the powder accurately and place it on to the Kanthal strip.

k. Accuracy depends mainly on the accurate weight measurement.

l. Powder should not be placed on the Kanthal strip as a heap but should be spread uniformly.

This ensures that while heating takes place all the particles in the powder get heated up to the same temperature.

m. While disposing from the Kanthal strip, it should be gently brushed aside, so that powder Particles fall onto the collection tray.

n. Any particles left out may contribute to the next measurement as residual TL adding to the next sample.

Choosing Appropriate Heating Profile

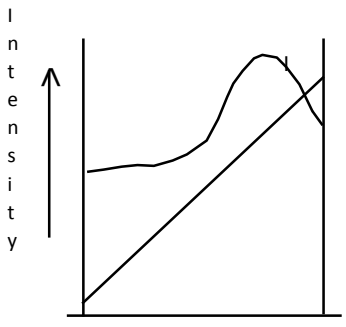
o. Depending on the type of TL material (CaSO4, LiF or other material) and the form in which (disc, rod, chip, powder crystals, pellets etc.)The heating profile is to be chosen.

p. The purpose of choosing most appropriate heating profile is primarily to maximize TL Output and leave minimum residual TL in it. Also to minimize the contributions due to the Thermal &I Remissions.

q. Most commonly used heating profiles are

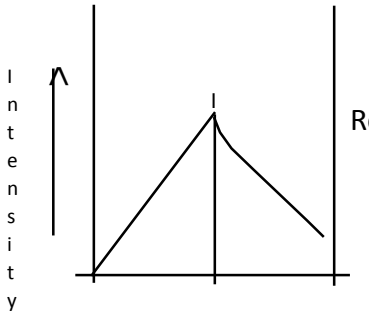
i. Linear

ii. Linear with cooling region included in total run Time



Profile 1

TIME/TEMPERATURE



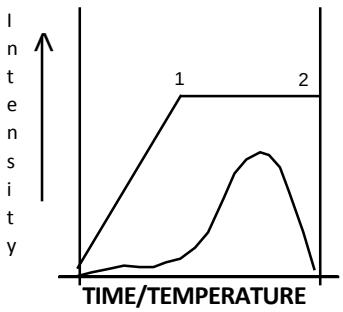
Recommended Profile

Profile 2

TIME/TEMPERATURE

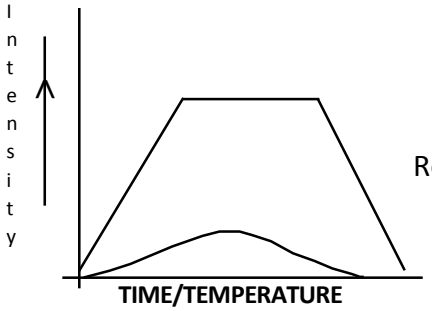
iii. **Linear clamped (Single Plateau)**

iv. Linear clamped with cooling region included in runtime



Profile 3

TIME/TEMPERATURE



Profile 4

Recommended

TIME/TEMPERATURE

r. For Teflon coated disc, it is desirable to choose either linear clamped or linear clamped with Cooling region. Longer clamping duration may be required to ensure that TL emissions Complete and residual TL is completely removed.

s. Clamping temperature around 300^0C is more than enough in majority of cases for normal TL Materials (other than pottery, sand and geological samples).

t. Thermal emission starts above 300^0C on wards hence it is important that we restrict Heating to set temperature up to a maximum of 300^0C. Up to 350^0C in some cases provided There is good IR cut-off filtering done.

u. For low level TL measurements nitrogen flushing is strongly advised. In fact, for all Measurements if it is provided it helps in any spurious signal due to oxidation and other effects.

v. For low level TL measurements, it is better to choose a heating profile of "Linear clamped With cooling region included". Because some TL curve may extend into this region. Also, restrict clamping to 300^0C to restrict thermal contribution.

w. The most recommended heating profiles are "profile 2" & "profile 4" as shown fig. for powders such as CaSo4 and micro rods etc. Typical heating rate may be 5^0C /sec. (i.e., Time to be selected for profile region (0-1) will be approx. 60sec. Profile region.

(1-2) will be "0 (zero)" sec and total run time can be selected as 75 sec (this makes the cooling region to be approx. 15sec. enabling glow curve acquisition to be recorded in this regional so). If user wants to select other heating rate, say10^0C /sec, then select profile region time between (0-1) as 30 sec., between (1-2) as zero & run time as 45 or 50 sec. This is linear profile with cooling included, but without clamped region.

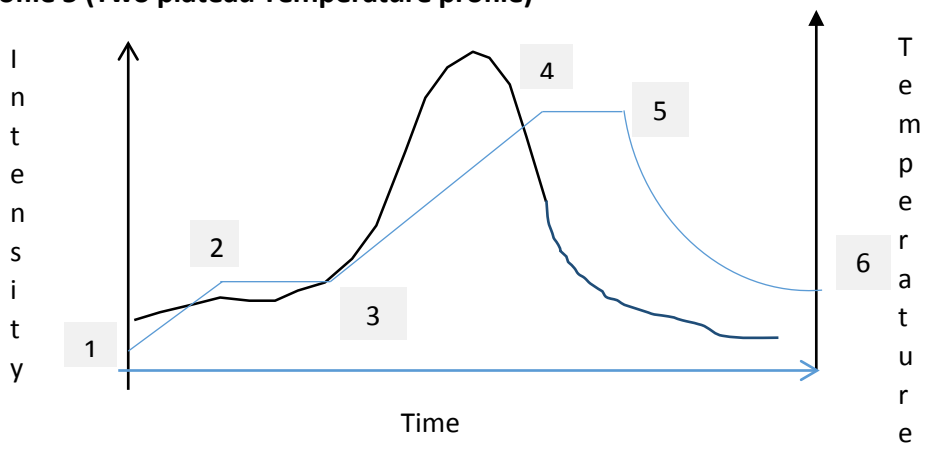
Sometimes it may be better to clamp at 300^0C for certain time say 5 to 10 sec or even more to ensure that no residual TL is left. In which choose profile "profile 4". For powders clamping for 5 to 10 sec maybe enough.

After first time TL acquisition, if your reunite same sample, you will get back ground profile, which will also indicate if there is some residual TL.

For Teflon embedded /coated discs, recommended profile is "profile 4"and it is essential to clamp it for longer duration of the order of 40 to 60 sec. (Profile region {1-2}). Linear heating region (0-1) may be about 60 sec and total run time can be about 150 secs to include some cooling region.

Typical profiles, glow curves & print outs obtained on this system have been enclosed for ready information and reference for user convenience.

Profile 5 (Two plateau Temperature profile)



This Profile consists of following regions of temperatures

1. (1-2) Linear Heating } (Pre-Heating)
2. (2-3) Clamping Temperature (To Eliminate Low/ Unwanted temperature Peaks)
3. (3-4) Linear Heating } (Read Cycle)
4. (4-5) Second clamping temperature } To get the desired glow curve)
5. (5-6) Natural cooling

Note: user can configure more than 2 plateau temperatures provided that the maximum temperature is not exceeding 500 ^{0} C

Earlier, users used to run a Temperature profile to eliminate the low temperature peak and then they had to Re-read the sample to get the Glow curve which is under stable meta-stable.

Now, in this software user can configure a temperature profile with one plateau temperature to eliminate lower Temperature Glow Curve Peak or unwanted glow curve. And other plateau to get the actual (desired) glow curve So that we can easily capture the ROI from the Glow Curve

Annealing of TL phosphors (power or disc or crystals etc.):

Proper annealing the TL phosphors in a Hot air circulating Annealing oven is essential, each time TL is read. Powder can be placed in a SS pan and discs, micro-rods etc. on a SS tray inside the oven.

Temperature of the order of 240 to 280^{0}C (Typically for $CaSO_4$: Dy disc samples) or slightly higher temp. May be adequate for most of the TL Phosphors. Time of annealing can be suitably chosen by the experimentalist. If the annealing is not complete, then it will give rise to Residual TL emission. For any TL laboratory annealing oven is must, without which TL measurements cannot be carried out.

Computing Reader Factor and Range correlation factors and other observation to be made for accurate measurements.

x. **Reader Factor (RF):** It is the ratio of the "Total dose" (absorbed by the dosimeter in mR or R etc.). By the "Net TL glow curve area under the markers" (after background subtraction).
Say,

$$R.F = \frac{\text{Total Dose}}{\text{Net area of glow curve}}$$

Note: i. for computing R.F use screened dosimeters.

ii. Also this is valid for a set of same class of dosimeters of same weight or size and TL material.

y. OnceR.F.is computed, the system remembers it and for all other measurements it Computes and reports the dose equivalent.

Calibration of Dosimeters for Your Application &Measurement

Your application could be a kind of measurement involving X-rays and gamma radiation etc., either using machines directly or indirect measurements such as scattered radiation or through phantoms or other attenuating media. Application can be personal dosimetry, medical dosimetry, TL material characterization, environmental radiation measurement etc., for every kind of measurement to obtain the dose absorbed (equivalent) in terms of mR, R, we need to go through the calibration process.

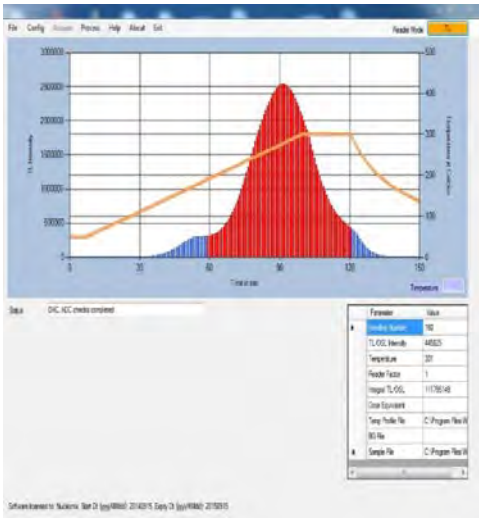
The best way is to choose calibration dosimeters after screening and expose them under a cobalt machine for known dose. Then read it using our PC based TL Reader and acquire glow curve and obtain Reader Factor (RF), as explained.

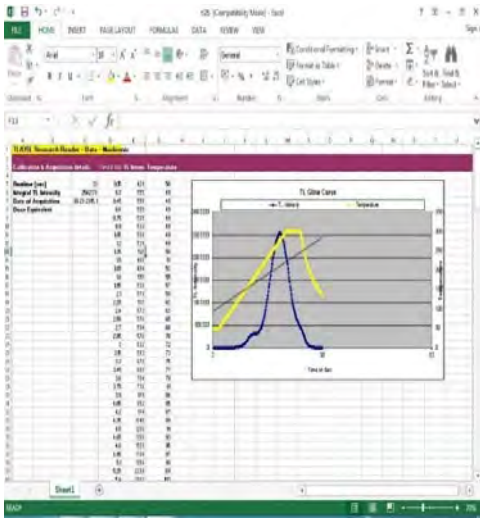
Then put the dosimeter (same) after annealing to the actual application, where the radiation, its energy and conditions may be different and make a measurement.

After acquiring the glow curve one can obtain the dose equivalent, by the following computation, which is built into the software.

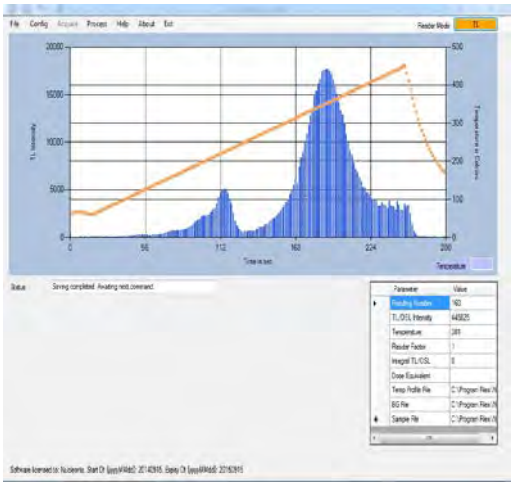
Dose Equivalent = (Area obtained) X RF (for dosimeter under measurement)

For better accuracy it is advised to make a few iterative measurements and average the obtained results.

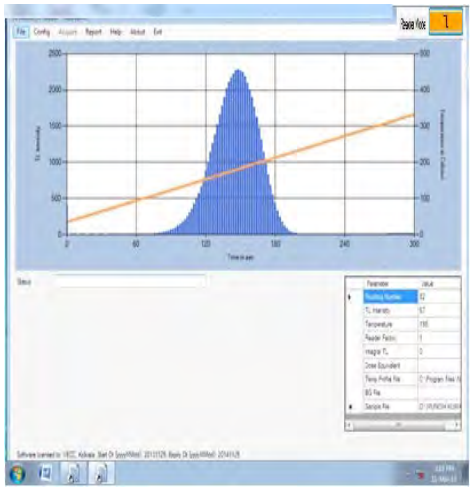




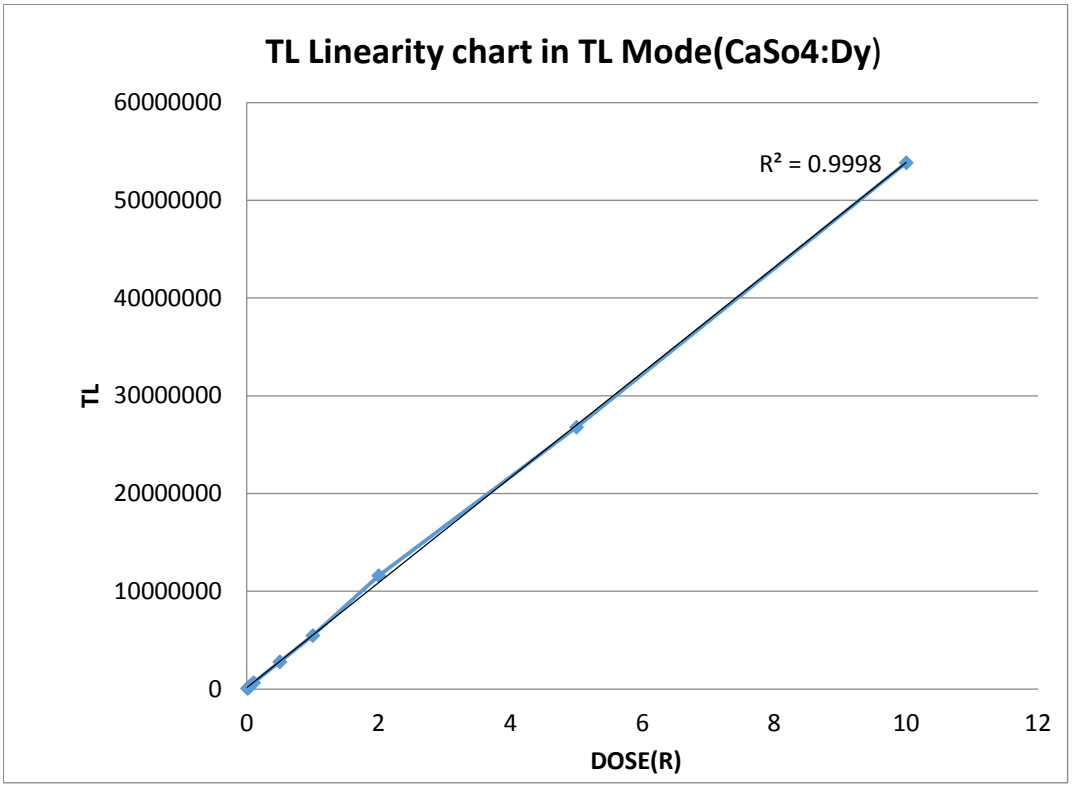
$CaSo_4$: Dy Glow curve & it's excel graph



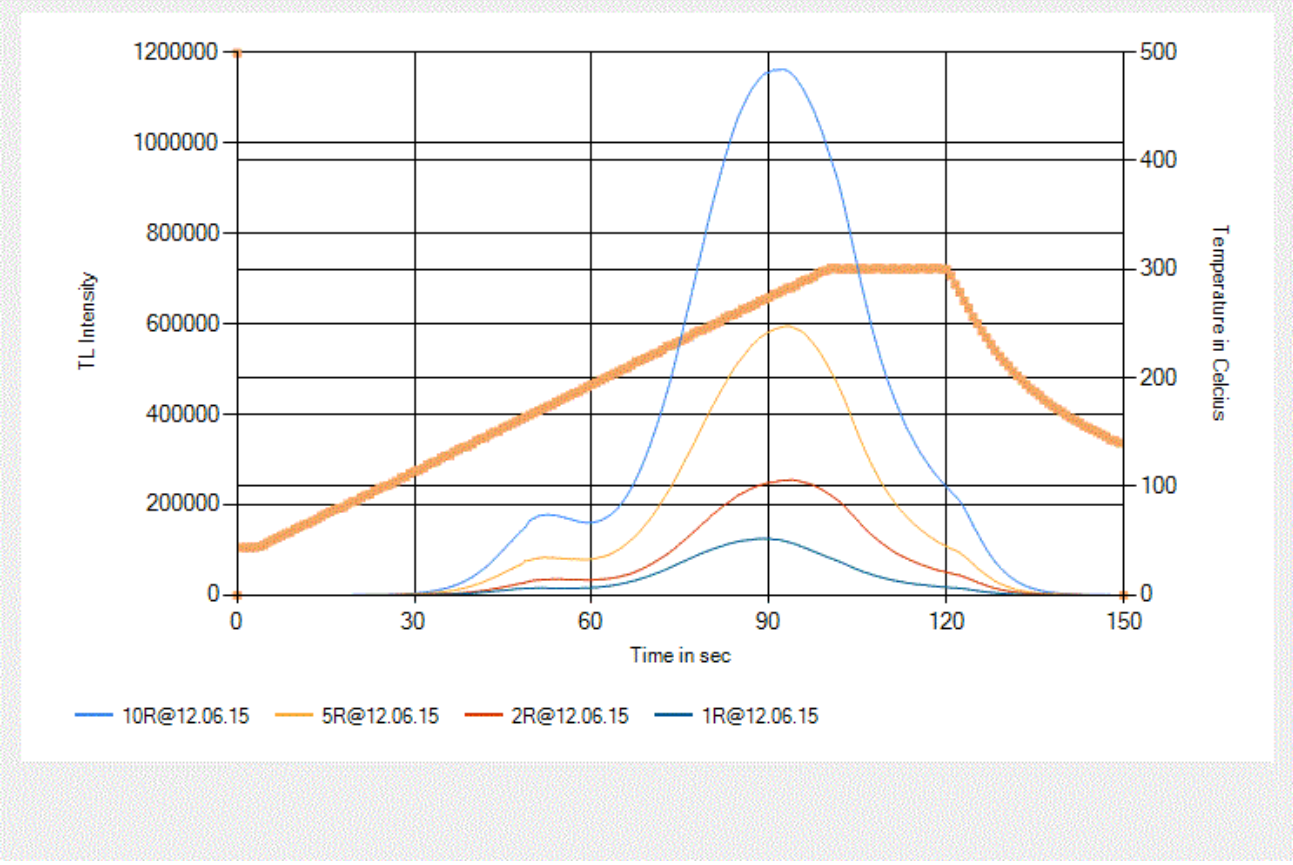
LiF: Mg, Ti (MTS, equivalent TLD-100) Glow curve



Glow curve of Al_2O_3: C



Typical TL Linearity Chart



Typical TL Over lap

CHAPTER X
CHANGING FILTERS IN THE DETECTION CHAMBER

One can place 3 filters (25mm diameter) at a time in the TL Research Reader System. Out of three, two will be under the PMT/PDM. Other will be in the flip of the drawer.

Generally, we can place Heat Absorbing Filter, IR cut off filter & Neutral Density (ND) Filter each 25mm dia.

When the researchers dealing with ultra-high dose, it is recommended to use Neutral Density filters with proper Optical Density.

Nucleonix will supply the neutral density filters on their Purchase Order.

CHAPTER –XI
FIRST LEVEL OF PREVENTIVE MAINTENANCE AND ATTENDING TO SERVICE OF TL READER

Once the software is installed and working satisfactorily for every day measurement, whenever the unit is switched ON, user can follow the following sequence

Put all the controls in default settings.

1. Put the heater ON switch to 'OFF 'position. After initial warm-up time of 5min. load light source. Put the ISO / Program switch at program Position and set temperature to 0^0c.
2. Through acquisition button run for acquisition cycle. Note the counts for the channel.
3. Repeat every day if you make measurements. It should give same measurements.
4. In acquisition you can see a band with constant light source counts.
5. Without light source, run for a profile without any sample, the background should be very Low.

The movements you switch on you look at the temperature display. It should show close to Ambient temperature, as sensed at the thermocouple. If by chance thermocouple connection Broken, the display shows very near to zero or small negative display. Then check for the thermocouple breakage or any other connector breakage up to the TC board. If Kanthal strip is burnt or TC may be broken same will be replaced.

In case instrument not displays anything check Rear panel low voltage supplies and report the problem accordingly.

Each day before you start the experiment, you go through the temperature calibration after warm-up time. When you are using light source you should keep the heater ON/OFF switch to 'OFF' position

RECOMENDED HEATING PROFILES

A. POWDER SAMPLE

For power samples & also for Natural crystals / micro-rods / discs etc., low heating rate is recommended. The Normal profile to get accurate output is

Heating Rate = Typical (2^0c/sec)
(range permitted is 0.5^0c/sec to 40^0c/sec

Set Temp	=	300^0c(typical)
Rise Time	=	100sec
Clamp Time	=	20sec
Natural cooling Time	=	20sec

B. DISCS (Fixed wt.) with Teflon base material for fixed samples say caso4: Dy discs, ` 2^0c/sec to 5^0c/sec is recommended Heating Rate=10^0c/sec(typical)=5^0c/sec

Set Temp	=	300°c
Rise Time	=	60sec
Clamp Time	=	30sec
Natural Cooling time	=	20sec

CHAPTER XII
SOFTWARE USER MANUAL

SYSTEM REQUIREMENTS:

PC (Minimum configuration): Intel i3 CPU or better, 2 GB RAM, 160 GB HDD.
OS: Windows 7. (Windows Vista / XP is not supported)
Antivirus: Norton / Quick heal / Kaspersky
Internet connectivity & Team viewer/Skype software: For remote trouble-shooting
Serial Port (9-pin D-type)/USB cable: Interfacing of PDM to PC

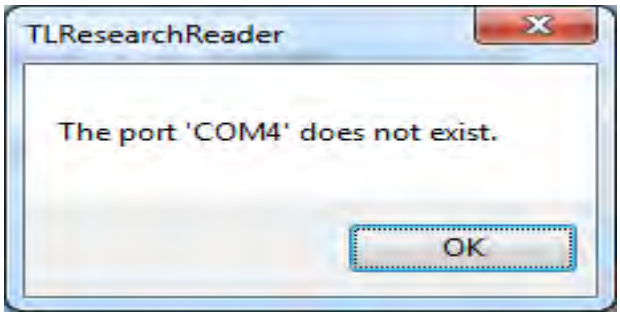
COM Port (USB) for connecting Electronic unit to PC.

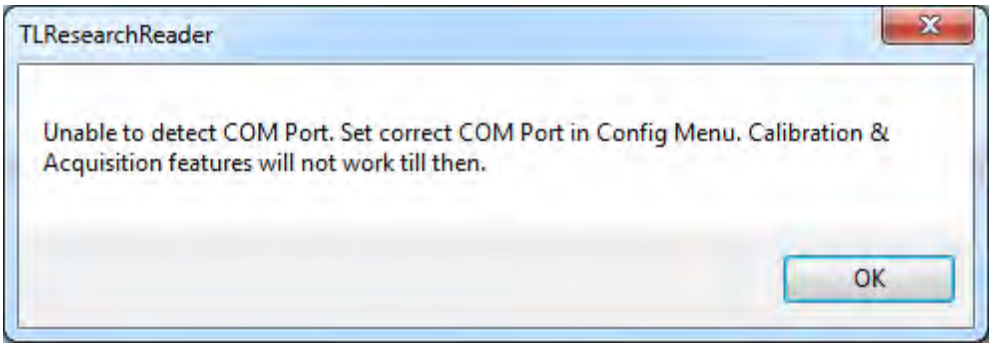
MAKING CONNECTIONS AND IDENTIFYING COM PORT:

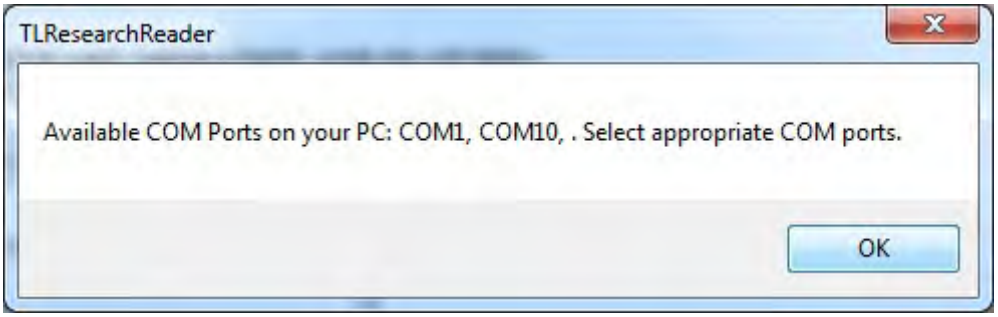
Prepare the Reader as per Hardware user manual. Connect the Serial cable (USB A-B) from TL Research Reader Electronic Unit to PC USB COM port and connect the RS-232/USB cable from electronic unit to PC serial port. After making connections, the COM port numbers must be identified. For the first run of TL application the software itself gives the com port numbers connected to the pc. Alternatively, the user can know the com port numbers for that, Right click on "My computer" icon on Desktop. Select Properties -> Device Manager -> Ports. You will find the COM port numbers. For eg. If you find "COM3", it means that COM port number is 3.

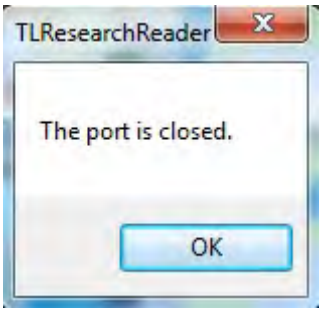
SOFTWARE OPERATION AND FEATURES:

If COM port settings are incorrect, then following windows appear.



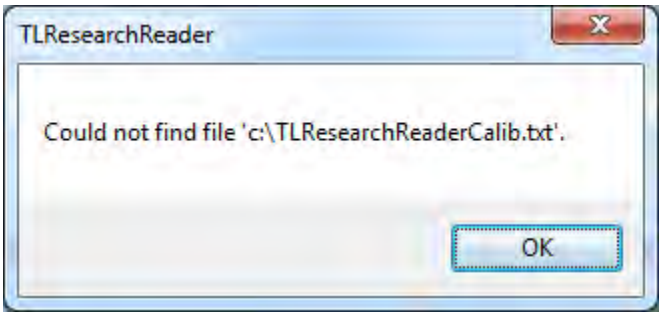


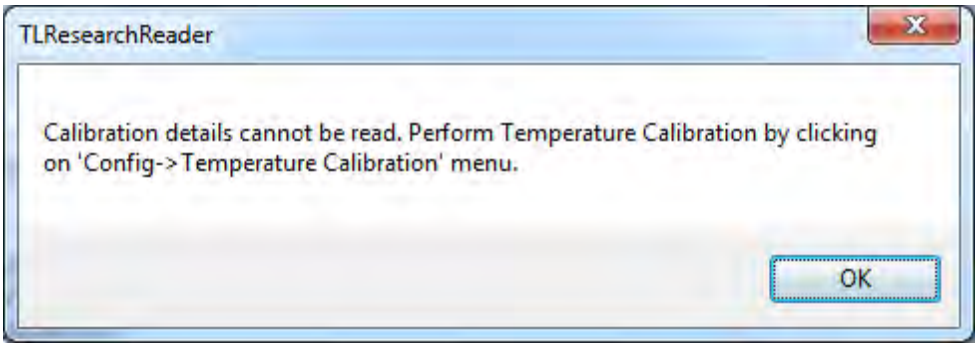




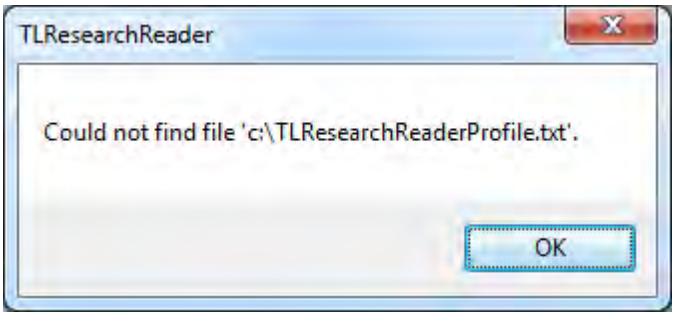
Recheck the COM port number and enter the correct COM port (Second COM port only) numbers in "Config-> Set COM Port" menu.

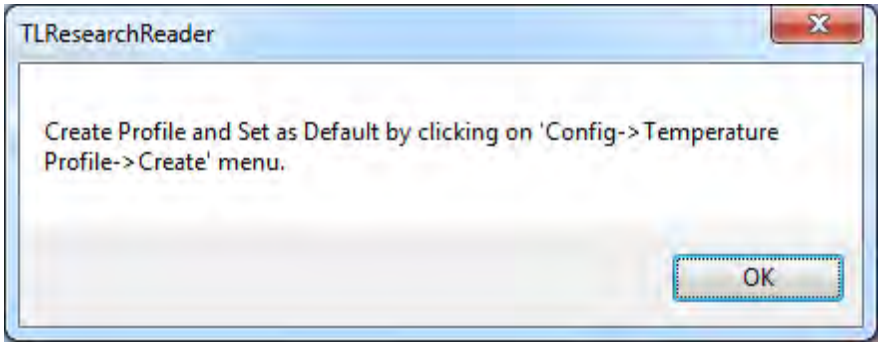
The very first time the application is executed, the below message appears.





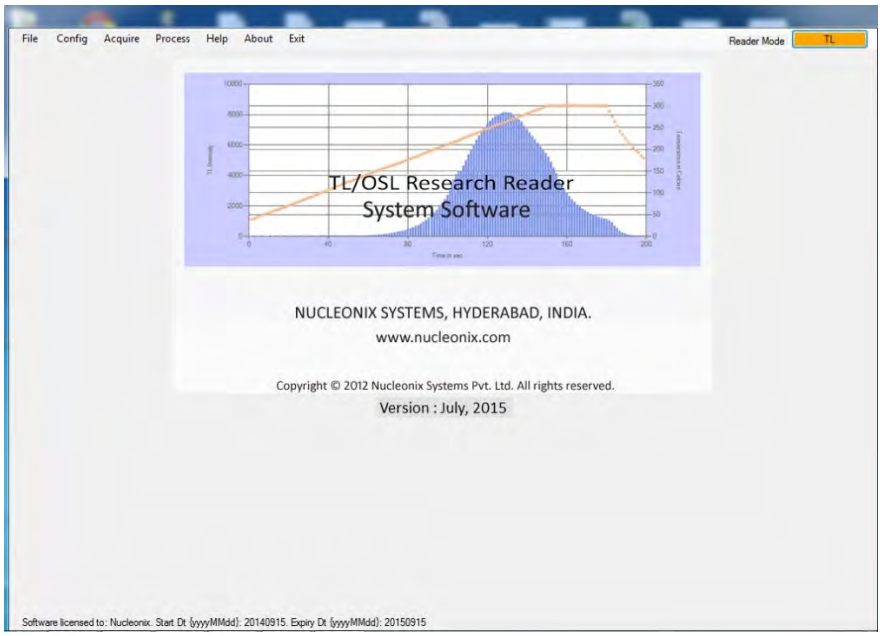
This means that no previous Temperature Calibration file exists and hence Temperature Calibration is to be performed.





This means that no previous Temperature Profile file exists and hence Temperature Profile is to be created. Click on “Ok“.

The main screen of TL Research Reader appears as below:



Config Menu:

Setting the COM Port

To set COM port, select Config menu and click on “Set COM port“. In the window that pops up, enter the COM port numbers and click Ok. The application is terminated for the new settings to take effect. Now Rerun the application.

Temperature Calibration

a. Temperature Calibration must be done for the very first time the Software is executed. Also, it is to be done periodically or whenever you observe deviation between set temperature and that observed on TL Reader's display. To do this, select Config menu and click on Temperature Calibration.

b. Click on Start button to start incrementing Temperature. Observe the temperature on TL Reader’s display.

c. Click on 'Pause' button when Temperature on Reader reaches approx. 150^0 C & enter that value in Temperature Textbox.

d. Click on 'Add to Grid' button to accept the value for Calibration purpose.

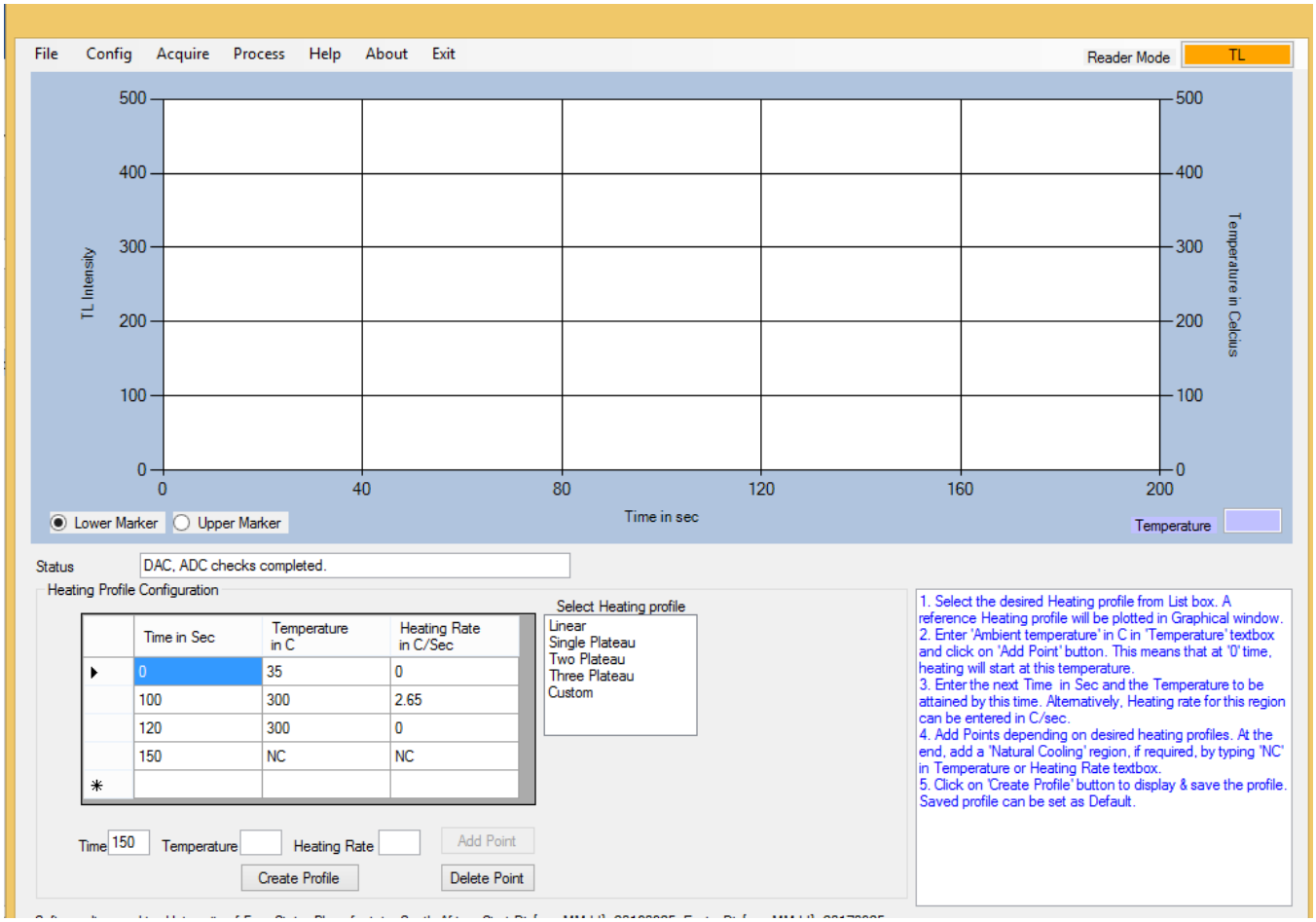
e. Click 'Resume' button to increase temperature again. Repeat steps (c) & (d) for 250 C and 350 C.

f. Click on 'Save Calib & Exit' button to Save the Calibration details. They are Auto loaded every time the App is run.

Configuring the Heating Profile

User can **create** a new Heating Profile of the following types: Linear, Single Plateau, Two Plateau, Three Plateau and Custom and Save the Profile for re-use.

This can be done by clicking on Config Menu, “Temperature Profile” and “Create”. The screen looks like below:



The below steps can be followed to configure:

a. Select the desired Heating profile from List box. A reference heating profile will be plotted in Graphical window.

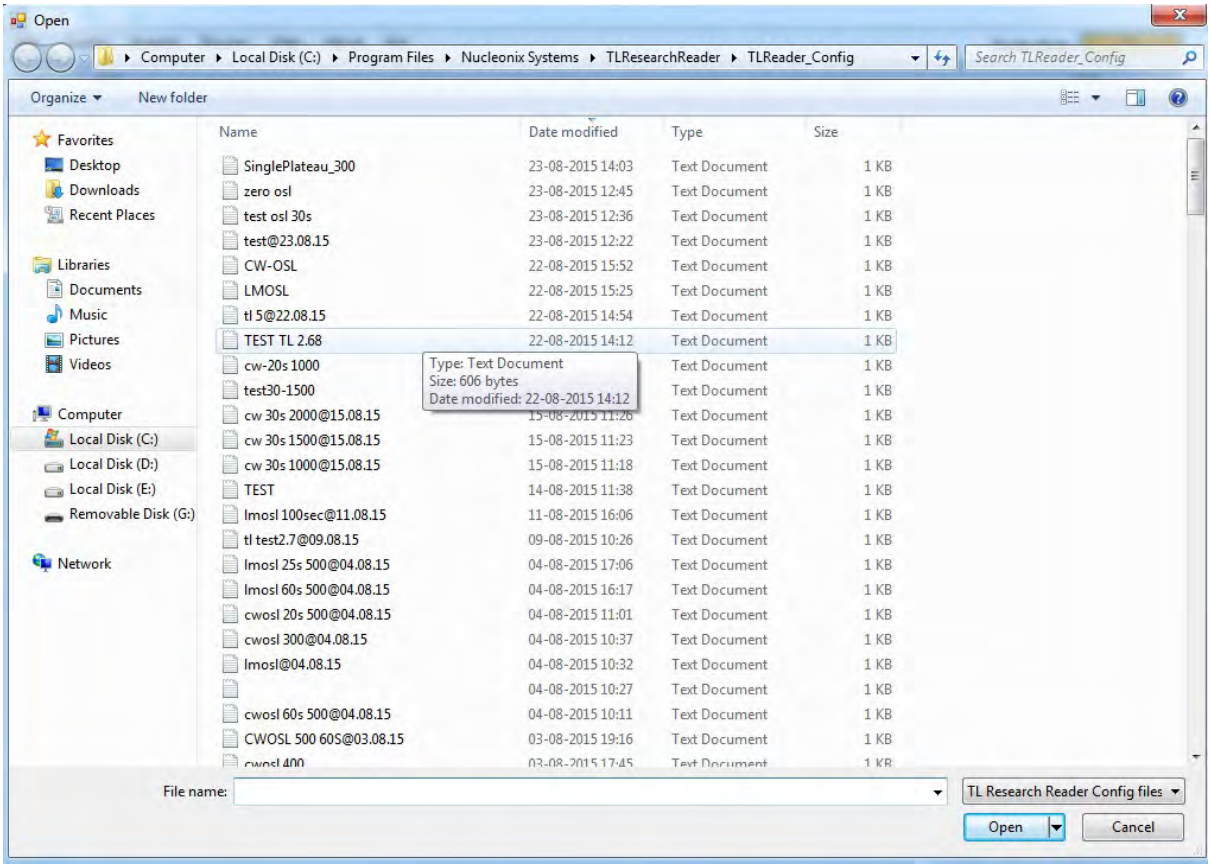
b. Enter 'Ambient temperature' in C in 'Temperature' textbox and click on 'Add Point' button. This means that at '0' time, heating will start at this temperature.

c. Enter the next Time in Sec and the Temperature (maximum is 500C) to be attained by this time. Alternatively, Heating rate for this region can be entered in C/sec (maximum is 40C/sec).

d. Add Points depending on desired heating profiles. At the end, add a 'Natural Cooling' region, if required, by typing 'NC' in Temperature or Heating Rate textbox.

e. Click on 'Create Profile' button to display & save the profile. User must give an appropriate name to the Profile for easy identification. For eg, a linear heating profile with 300 sec runtime can be given the name “LinearProfile_300”. Saved profile can be set as Default, so that every time the application is executed, the default profile is automatically loaded and this profile will be used for Acquisition.

To **Load** a specific Heating Profile other than the default one, click on Config Menu, “Temperature Profile” and “Load”. A dialog box opens as shown below:



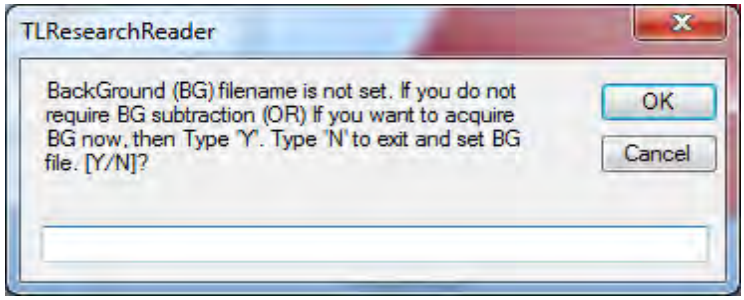
It shows the filenames of heating profiles. Select the desired one and click open. A message appears to confirm that heating profile is loaded.
Now, we are ready to acquire the TL spectrum.

Setting Reader Factor to obtain 'Dose Equivalent'
Setting Reader Factor enables us to get the Dose Equivalent in „Integral TL" computation.

Acquire Menu:

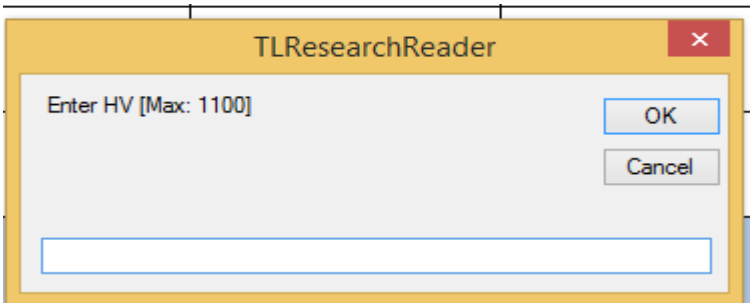
After Temperature Calibration (if executing for the first time) and creating / loading desired Heating Profile, we are ready to acquire the spectrum. Ensure that Heater switch is ON

Acquiring Background Spectrum
A background spectrum must be acquired before loading the sample. This can be done by clicking on "Acquire Menu" and "Start".
A window pops up as given below:



Select “Y” as we are acquiring the Background spectrum.

Now, it will prompt HV msg to enter the Biasing HV



Save this file by clicking on “File Menu‟ and “Save‟. A Window pops up in which the User must enter a filename. Enter an appropriate name like “BG_Aug182015‟. The user can save this file in his desired location by choosing “Save As” option in the file menu.

Setting BG Filename for Auto subtraction

Before acquiring Sample spectrum, we must set the Background filename to the most recently acquired background spectrum filename.

This is done by clicking on “Acquire Menu‟ and “Select BG File‟.

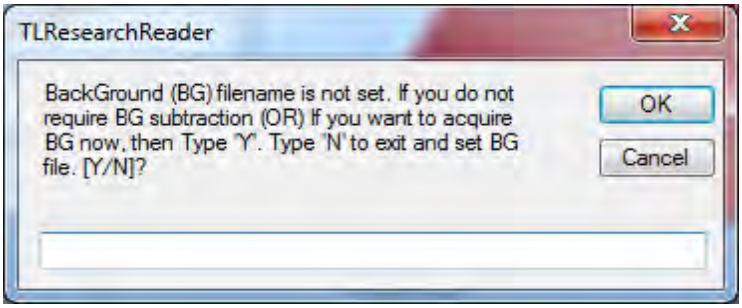
Once this is done, background data will automatically be subtracted from all the acquired samples.

If Background data is not required to be subtracted from sample data, then this step is to be skipped.

Acquiring Sample data

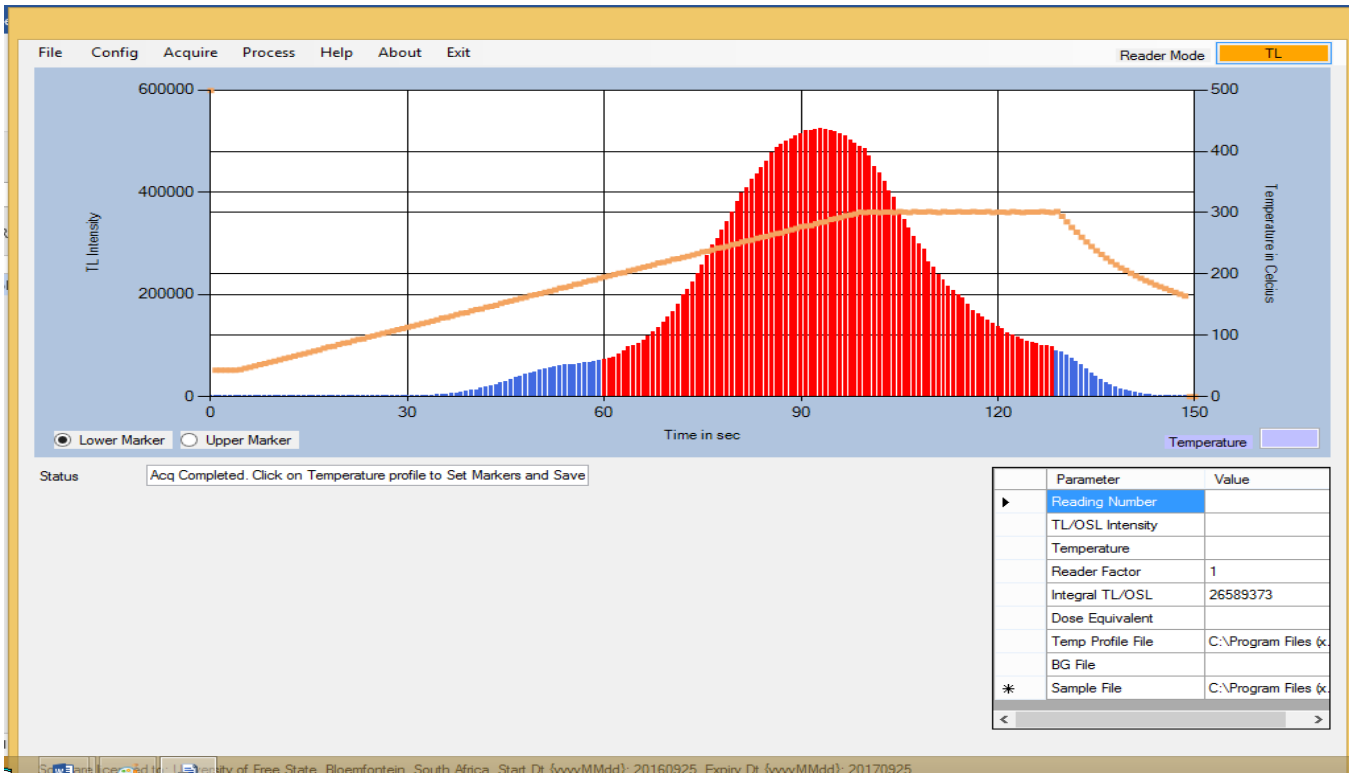
Load the sample in the sample holder and close the drawer tightly. To acquire spectrum for a Sample, click “Acquire Menu‟ and “Start‟.

The below message pops up if you have forgotten to set the BG filename.



If you choose to acquire sample data without BG subtraction, type “Y‟. Otherwise type “N‟ to set BG file name and return later.

Live acquisition and plotting of TL glow curve and Temperature profile starts as per the selected Heating profile. A typical profile after acquisition would look like below:



Notice the grid on bottom right. During acquisition, Reading Number, TL Intensity and Temperature are updated for every data point that is acquired.

Setting the Region of Interest (ROI) and calculation of Dose Equivalent

Select Lower marker (which is at left bottom of the Plot) to select the start point of ROI and select the upper marker to select the terminating point of ROI. Selected ROI will be turned into Red color. And Integral TL will be displayed in the parameters table. Dose Equivalent (in mR or R) is calculated by

multiplying Integral TL Intensity and Reader Factor. Also find that Temperature Profile file name, BG File name and Sample file name is listed in the grid.

Saving the acquired spectrum

To save the acquired spectrum, click on File Menu and save. User is asked to enter the filename without path and Extension. The spectrum data is saved in a text file and also exported to Excel. These files are located in c:\Program Files\Nucleonix Systems\TLResearchReader\TL Reader Spectra and TL Reader Reports.

Stopping Acquisition before completion

User can choose to stop the acquisition, turn off heating / Lighting and stop by clicking on “Acquire Menu” and “Emergency Stop”. The acquisition process will be stopped.

Viewing Saved Spectra

Saved Spectra can be viewed in TL Research Reader application or in Excel. To view in application, click on “File” Menu and “Open”. Select the filename to open and click ok.

The spectrum is retrieved and plotted. The Grid parameters including Dose Equivalent are updated. Also, Region of Interest is highlighted in Red Color.

To view the file in MS Excel, click on “Process” menu and “View in Excel” Further processing of data, if required, can be done in MS Excel.

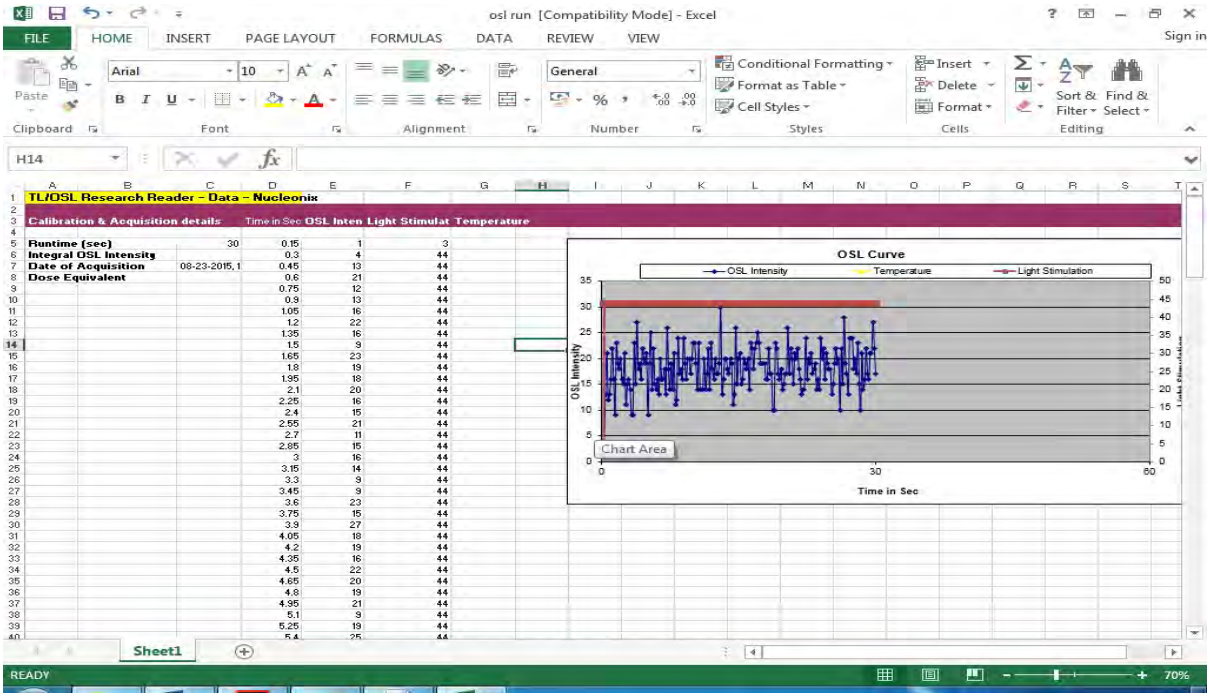
Process Menu:

With this menu user can do the desired manipulations to the saved spectrum file.

View in Excel

This function gives the user to open spectrum file in MS-EXCEL sheet. User can use this data for further processing’s.

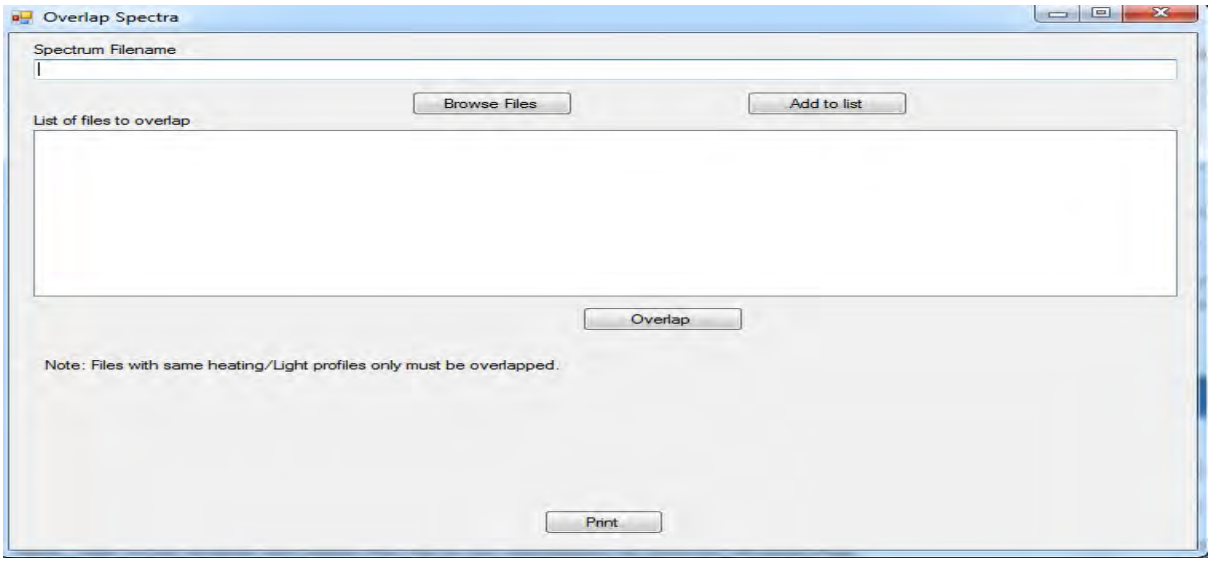
A sample TL spectrum file in Excel sheet looks as follows.



Overlapping up to 10 Spectra

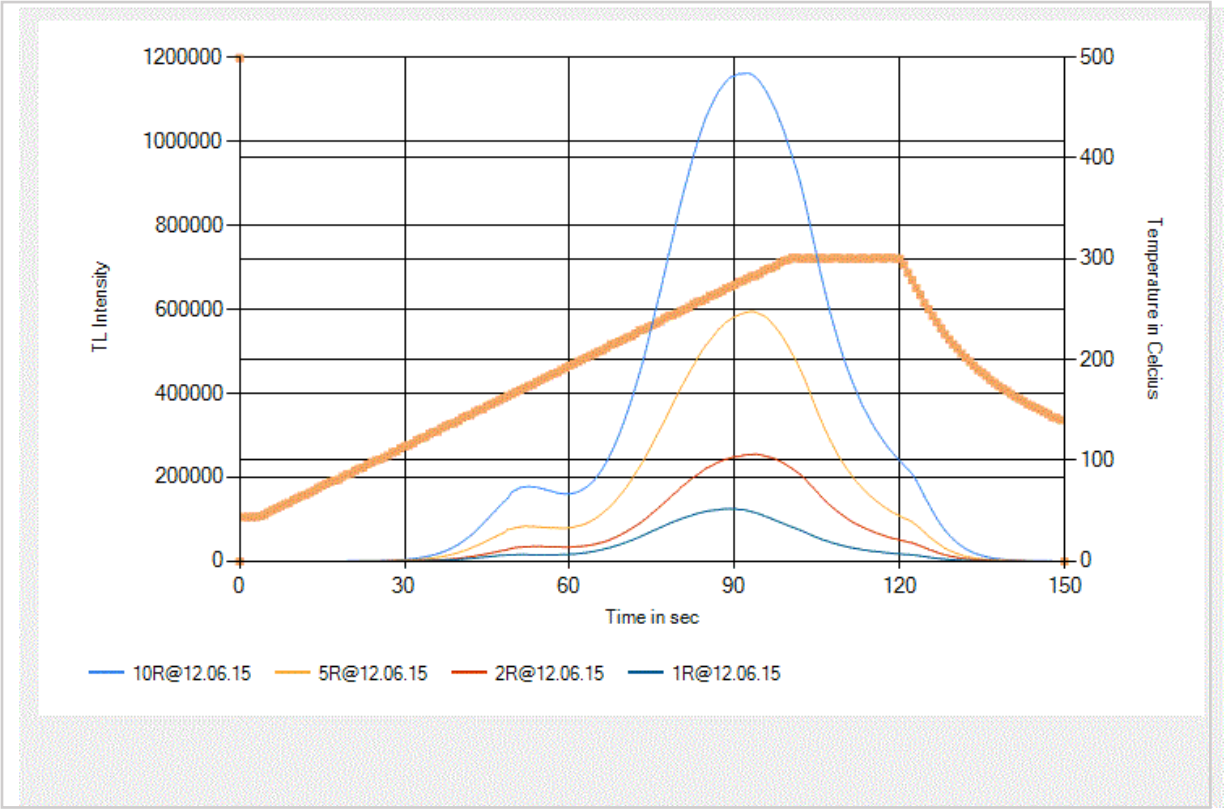
This is a powerful feature that can be used to overlap spectra acquired using same Heating profile. User can visually compare and print the overlapped spectra.

To overlap spectra, User must click on „Report" menu and „Overlap". It shows the below screen:



Here, User must browse and select the file to be overlapped by clicking „Browse Files" button. Then, the file should be added to list by clicking on „Add to list" button. Up to 10 files can be added to the list. Then, click on Overlap button. Given below is an overlap image of 4 files (TL mode), which is saved as

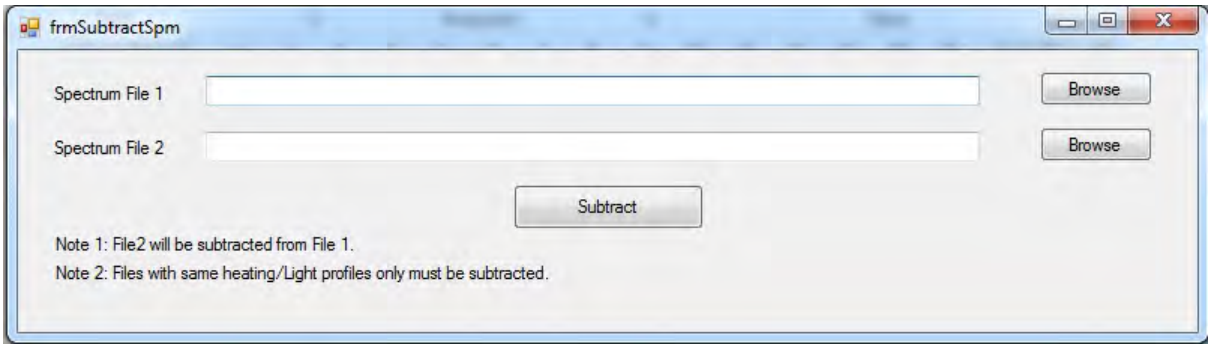
D:\File name\TL Research Reader Overlapfile.gif



Subtract function

User can subtract the two spectrum files by using this subtract function. In this spectrum file2 will be subtracted from the file1 and the result will be plotted, user can save this subtracted plot with new file name.

By clicking on the subtract function it opens a window which looks as follows.

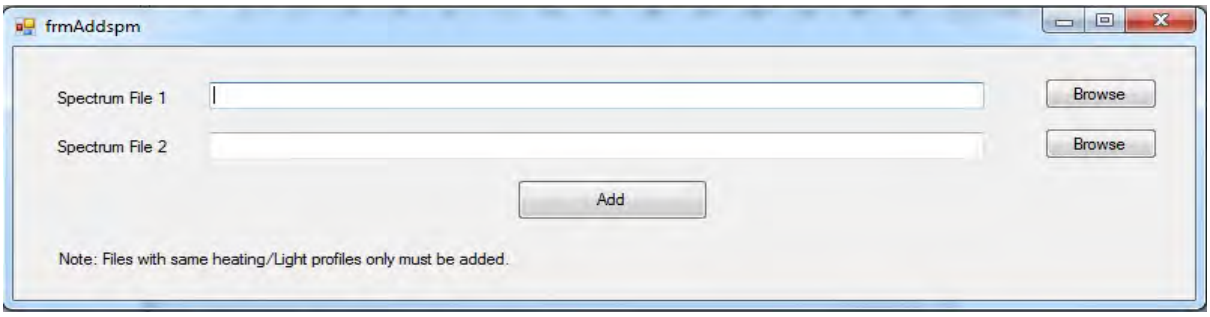


Here the spectrum files which have the same heating/Light profiles only must be subtracted. If the user gives spectrum files with two different Light/heating profiles, then it gives a message that “only the spectrum files with same heating/light profiles will be subtracted.”

Add Function

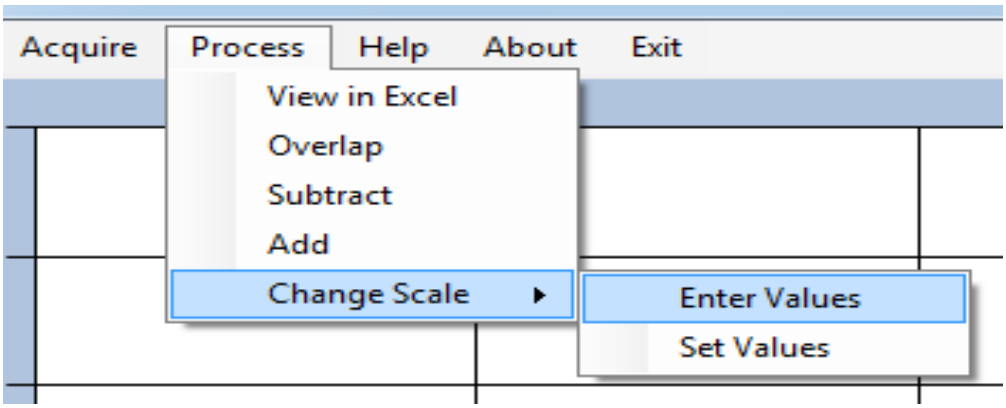
User can add two spectrum files by choosing this add function. In this spectrum file1 and spectrum file2 are added and the result is spectrum output will be plotted. User can save this new spectrum file under file menu.

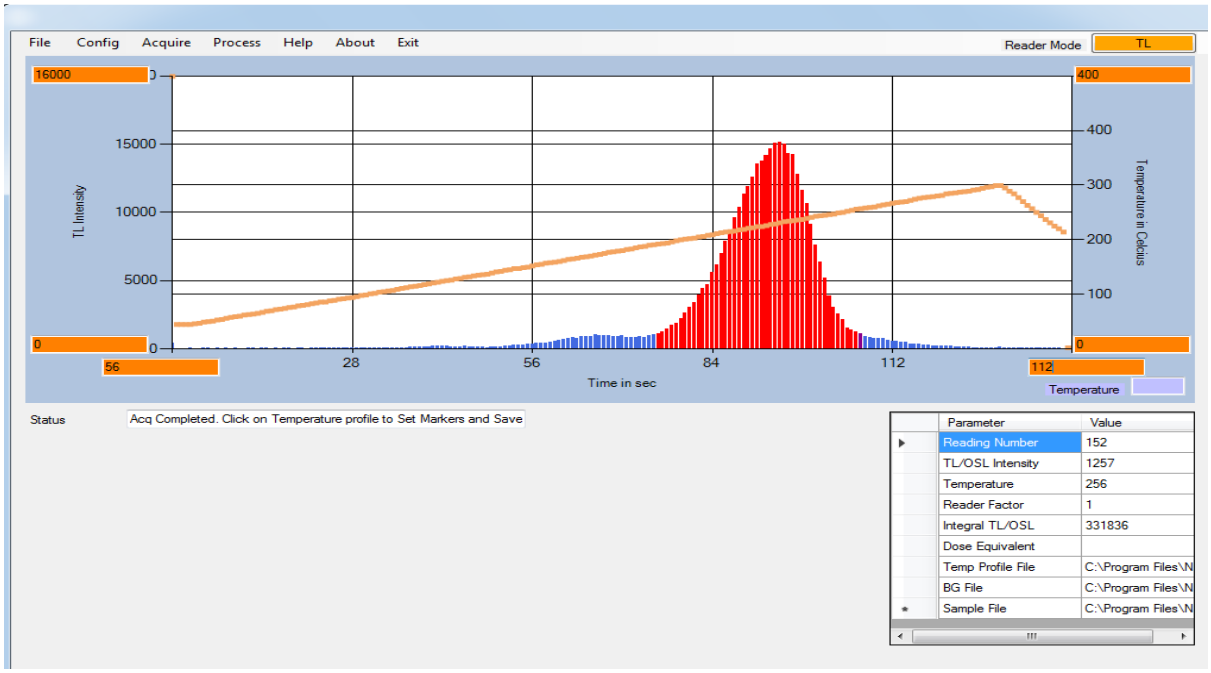
By clicking on the add function it opens a window which looks as follows.



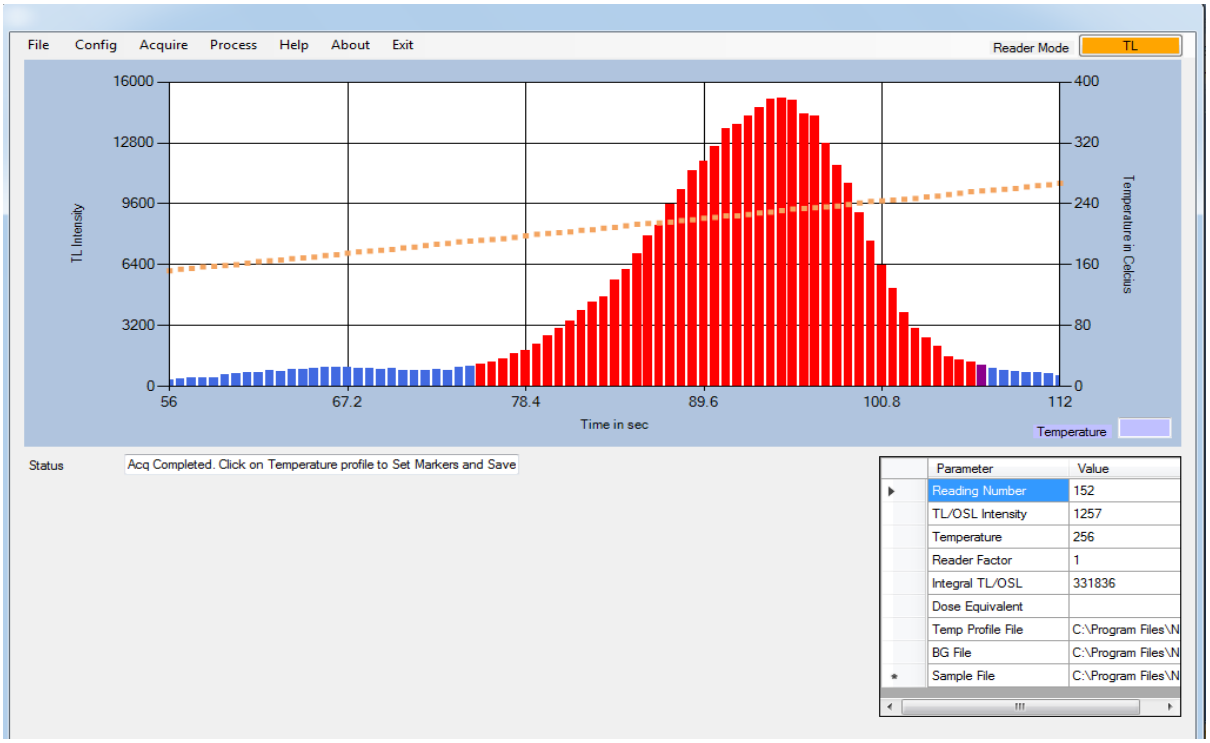
Change Scale

By using this user can configure the scales such as x, y and y1 axis to the desired values, for that user has to click on “Change Scale”, “Enter Values” function. By clicking that function it opens a window which looks as follows.





It open boxes for each axis user has to give the minimum and maximum limit values in that corresponding box. After that to effect these new settings to the spectrum file user has click on “Process” menu in that “Change Scale”, “Set Values”. With this new settings are adopted to the all the axis (x, y and y1).



File Menu:

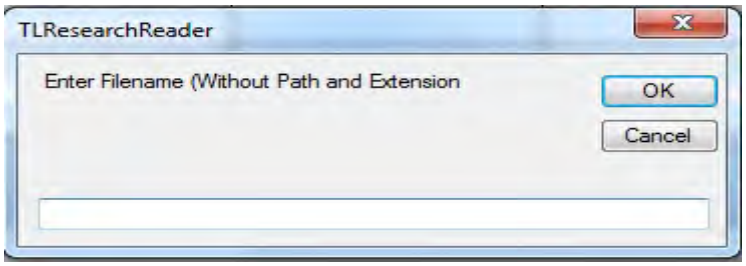
The various functions under file menu are briefly given as follows.

Open

This function gives the user to open the earlier saved spectrum files. By clicking this it pop-up a window which gives a message that “Current glow curve data. If any, will be lost unless it is saved. Proceed anyway(Y/N)”. By giving ‘Y’ to that window as acknowledgement then it opens a list of files which are earlier acquired and saved spectrum files.

Save

To save the presently acquired spectrum, user has to click on “File” menu “save” option with this it opens a pop-up window which looks as follows.



User has to give name to that spectrum file without any path and extension. After that click on “OK” button with this presently acquired spectrum is saved with given file name.

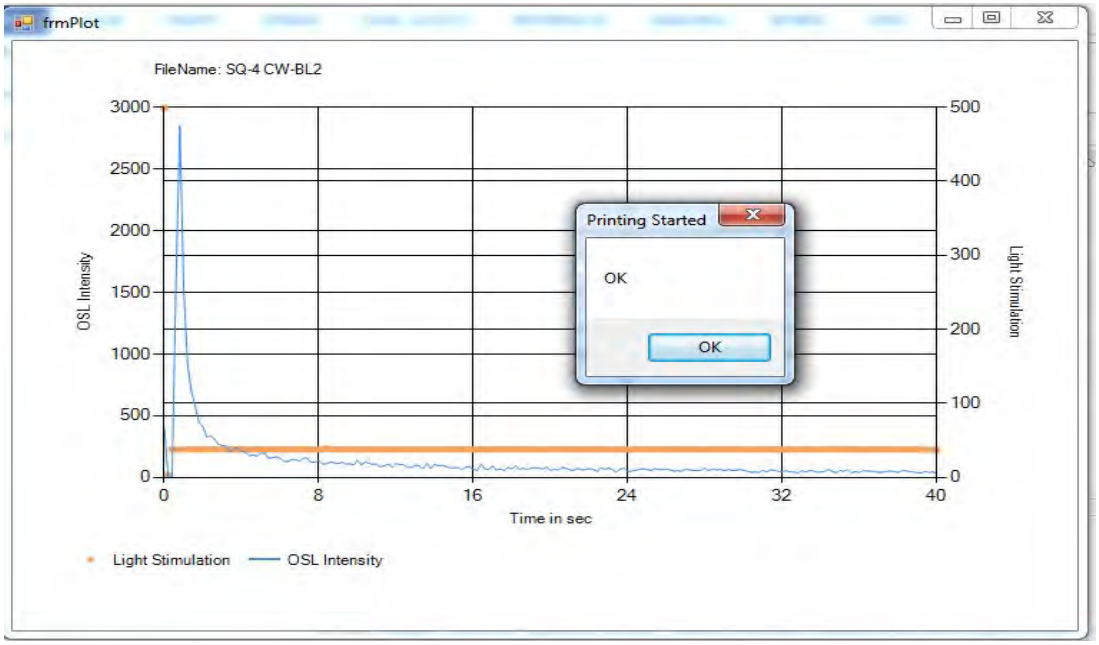
Save As

To save the presently acquired spectrum to the desired memory location, user has to click on “File” menu “Save As” option with this it opens window user can select the desired memory partition to save the spectrum after that click on save button, with this the files is successfully saved to the desired memory lo0action.

Plot

To print the any file user has to click on “File” menu “plot” function, with this it opens a window which looks as follows.

In that window click on “open file & plot” button with that it opens all the saved spectra files. User has to select the file for print and click on open. After that it just shows the spectra file and gives a window that printing started which looks as follow.



Erase

To clear the main application window screen or earlier spectrum file glow curve, user has to click on “file” menu “Erase” option with that the main application screen will be cleared.

Help:

By clicking this help option it gives a window shows the path for software user manual.

About this Software

The version number of this software is displayed when “About” menu is clicked. Please check with Nucleonix for the latest upgrades.

CHAPTER –XIII

EQUIPMENT MAINTENANCE SERVICES AND WARRANTY C L A U S E

General

As per the warranty clause of the company we provide one-year warranty during which period we provide free service at our works. Hence in case of any mal-function in our instruments you are requested to send the unit back to our works by RPP / COURIER / SPEED POST PARCEL / GATI / XPS / door delivery. We shall arrange immediate rectification / replacement within two weeks from the date of receipt of the equipment at our place. Please note that the equipment will be serviced at our works only. **There is no warranty for the photon counting module and filter baskets because photon counting module is a light sensitive device, due to any mishandlings of the module or improper filter basket selection will affect the working of photon counting module.**

The equipment is to be sent to:

The Servicing Department
NUCLEONIX SYSTEMS PRIVATE LIMITED
Plot No: 162A&B, PHASEII, I.D.A.Cherlapally,
Hyderabad-500051 Ph: + 91-7207034546, 68888777 ,
Mobile: 7331104480, 7331104481, 7331104482
E-mail:info@nucleonix.com www.nucleonix.com

For all the Radiation monitoring equipment, detectors built-in or external probes will not have one-year warranty, only inspection warranty at the time of supply is provided. Since detectors will / may have fragile glass construction we do not provide warranty. In case of failure of these components at cost price as per Nucleonix price list user has to buy.

Note: In respect of all types of portable radiation monitors, it may be necessary to check up and recalibrate the equipment once a year a tour works.

Equipment Repairs /Servicing Policy (With In India)

During Warranty

The following procedure is to be followed by the customers with in India for availing services / repairing facility during warrantee period.

- Equipment's are to be sent to our works for availing free repair services during warrantee, after the customer receives approval from the customer support division, by sending an e-mail.
- For all equipment's, costing less than 6.0 lakhs one-year warrantee &free service is offered, when the equipment's are sent to our works only. For larger systems such as installed systems, networked systems, specialized systems, costing more than 6.0 lakhs during one-year warrantee, free service is offered at site. Field service Engineer will be deputed subject to warrantee terms & conditions.

- This does not include personal computer related problems, for which local computer service provider of the PC vendor is to be contacted. Also for software related problems online support will be provided. Software support doesn't include cleaning of virus problems etc.

- When the equipment's are sent to our works for warrantee services, they are to be properly packed with adequate cushion top reventany transportation damages. Nucleonix Systems is not responsible for damages or loss during transportation.

- Packing / Freight charge is to be borne by customer when he sends the equipment to our works. However, when we return after servicing packing will be Nucleonix responsibility & Freight charges will be to your account. Only services are free.
-
- Please indicate in your correspondence equipment model & serial number.

- All the equipment's are to be sent to our works only on door delivery basis.

- For Door Delivery Transportation contact XPS/GATI cargo in your city / town or a reliable courier service to pick the consignment from your place. For their nearest local address & phone no's look into their websites. Transit insurance if the customer feels is necessary it is to be covered.

- Nucleonix Systems will not receive the equipment's sent by other modes of transportation, such as Rail / Road.

- After servicing, equipment's will be sent back by same mode of transport such as XPS

/GATI /COURIER / RPP

- All types of Radiation detectors, glass ware (filter baskets), PMTs etc. Which are fragile are not covered in warrantee, if the failure is due to physical damage, external or internal due to shock, dropping, miss-handling etc. If the failure is due to a natural fault, then only it is covered under warrantee for a limited period of three months. However complete electronics is covered for 1-year warrantee.

- You can also send the equipment personally to our works for repairs either during or after warrantee, after fixing up with our service dept. (Customer Support Division). If possible we may repair on same day or your person can stay for a day or two &get it repaired & or calibrated.

After Warranty Services

- On expiry of 1yr warrantee if you like to send the equipment (low cost less than 6.0 lakhs) for repairs to our works, you may please observe the following procedure.

- Send an e-mail with details mentioning that you agree to pay service charges which includes: Basic service charges per unit / module in the range of Rs : 2500 to Rs : 10,000 depending on the sophistication of the unit calibration charges (if applicable for your equipment) + cost of components + packing charges + Return Freight charges @actual.

- Once our customer support department responds & requests you to dispatch the equipment to our works for repairs, you may do so by following the steps given below.

- Followed by this you can send the equipment straight away if it is within 5yr sold. If the equipment is beyond 5yrs. old, then also you can send it for repairs, however only after you receive confirmation from Customer Support Division, that it is repairable & is not an obsolete model. If the design is obsolete then customer support division (CSD) may give you 'buy back' offer to replace with new model or upgrade it with electronic circuit boards & enclosure.

- For all installed equipment's costing above Rs: 6.0 lakhs which are larger in size & for which field servicing only is recommended, you can obtain a quotation with relevant details by sending an e-mail& avail the services accordingly.

- For all field servicing jobs, since we need to depute engineers, it is likely, to take time & also it will cost more which includes Engineer's TA & DA etc., apart from basic service charges + cost of spares etc. Please note that basic service charges will be different for different products depending upon sophistication.

- Also in some cases it may not be possible to fix-up the problems in the field itself, in such cases we may advise you to send them to our works.

- For all jobs to be serviced in the field, customer is requested to provide adequate details on the nature of problems, to enable our engineer to come prepared with Adequate Spares

- For any additional information send an e-mail to info@nucleonix.com, attention: Customer support division.

Equipment Repairs / Servicing Policy (For Exports)

Equipment's, manufactured & exported are subjected to a well-defined quality assurance (QA) plan & Factory acceptance tests (FAT). sNucleonix systems has the following policy to provide maintenance support to overseas customers either directly or through international dealers/distributors.

During & after warranty:

- Form in or problems, which can be handled by customers, servicing tips have been provided in the user manual/ servicing manual.

- Also most of the equipment's have built-in fault diagnostic features which will indicate to the user nature of problem in the equipment. Based on the visual indication in the instrument Display, user can take corrective action or contact Nucleonix systems by email for help.

- Nucleonixsystemswillguideinlocalizingthedefectivepart/moduleorsub-systembyinteractingwiththecustomerifrequired.Skypewillbeusedforcommunication.

- During warranty free replacement of sub-system or board (PCB) will be done. However customer has to send defective sub-system back to Nucleonix system with-in15days on arranging replacement.

- During & after warranty, any Freight charges & customs clearance charges are to be borne by customers, both ways.

- If it is a manufacturing defect, then Nucleonix system will bear the replacement cost of sub-system / unit. However any Freight charges & customs clearance charges in their country are to be borne by customer.

- After warranty, services will be similar to that of services during warranty. However, customer will have to pay for cost of parts replaced freight charges both ways & customs clearance charges in both the countries. Nucleonix systems plan to introduce audio visuals on web or on CDs to facilitate product demonstration, installation & minor maintenance very soon.

CHAPTER –XIV

CONTACT US FOR AVAILING SERVICES

Postal/Mailing Address (Phone / Fax / Email)

Nucleonix Systems Pvt Ltd.
Plot No. 162 A&B, Phase II, I.D.A.,
Cherlapally, Hyderabad - 500 051, Telangana, India.
Phone: 040-29706483 / 84 / 85
Mobile No: 7331104481 / 82
Email : info@nucleonix.com

For any information, Contact by email is always appreciated.
(This will help us to respond to you quickly)

Marketing Department :

a) Sales / Commercial Information / Field installation and servicing

For any Commercial, Price information, Product information, customer coordination & quotation of our products customer related commercial services, please contact front office marketing staff through the listed Email Ids or Phone Nos. given below

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Whom to Contact:

Business Executives:	Contact Numbers	Contact by E-mail ID
1.R.Maniram (Sr. Business Executive)	Mob: 7331104481, Ph: 040-29706483 / 84 / 85	info@nucleonix.com
2.K.Sarika (Business Executive)	Mob: 7331104481, Ph: 040-29706483 / 84 / 85	info@nucleonix.com
3.Pranaya (Business Executive)	Mob: 7331104481, Ph: 040-29706483 / 84 / 85	info@nucleonix.com

Note: Our business executives will also connect you to concerned Engineer or General Manager for any technical clarifications if required

b) Factory Services

for **Servicing and Calibration** factory services & follow up on the above jobs including dispatch related/payment related issues of serviced & calibrated items please contact

Ms .T.Sowmya **Mob:**7331104482 **E-mail:** info@nucleonix.com
(Executive services)

She will also connect you to concerned engineer or general manager if required, for any clarifications & deficiencies in services

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c) Dispatch Related Issues (Production Items)

For dispatch related issues of your ordered equipments, including delays, purchase order related document deficiencies, payment proofs, dispatch docket details and bills etc,.contact

Ms. V.Anusha / Renuka Devi **E-mail:** info@nucleonix.com
(Executive Dispatch)

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d) Product Technical Information / Clarifications

Whom To Contact:

Contact any front office "Business Executive"- He / She will take your details and connect you to concerned product engineer for any technical clarifications. Best thing is to email your technical queries and obtain the reply, rather than on telephone.

You can also contact General Manager or Director (Tech) if required.

e) Marketing Manager

On business matters for all your marketing services / techno commercial requirements about Nucleonix Products contact :

Bhaskara I.V.
Mob:8019662500
Email: info@nucleonix.com

f) General Manager

Dr.M.S.R.Murthy PhD (Nuclear physics)
Email: info@nucleonix.com

Contact General Manager for all sales / servicing and technical information including customer support

related issues, on the delays, gaps & lapses by our staff. Contact G.M. regarding field installations & field servicing jobs schedule etc.

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g) H.R -Incharge

Contact her regarding, job vacancies, sending resume for employment, H.R. related issues etc. contact

Ms. Shanthi Sri.P **Mob:**7331104480 **Email:** recruit@nucleonix.com

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h) Director -Technical

Mr. J. Dheeraj Reddy
Email: jdreddy@nucleonix.com
Mobile No. +91-7674009005

Contact him for, any Technical Information and clarifications on products, which cannot be answered by General Manager / Customer support executives.

For any technical deficiencies in products, related issues & suggestions on product improvements you may contact by email or telephone. This will help the company to improve the product & serve you better.

Dealer's complaints, on commercials, lapses by our commercial staff, or any other discripancy, or you like to give any feedback on any Nucleonix staff doing any wrong thing against cleaner / ethical business principles / practices can be complained to any of the directors or managing director.

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i) Director - IT

Mr. J. Nishanth Reddy
Email: nishureddy@yahoo.com; info@nucleonix.com
Mobile No. +91-9966691000

For any deficiencies in product software's, related issues, & any suggestions or improvisations in software's can be contact by email or telephone. This will help the company to improve the product & serve you better.

j) Managing Director

Shri. J.Narender Reddy (Managing Director)

Email : jnreddy@nucleonix.com; info@nucleonix.com

Contact Managing Director for, Foreign relations, International Business co-operation, Joint ventures, Exports, Dealership in other countries, Policy matters, Technology tie-ups etc.

k) Dealers Complaints :

Dealers complaints, on commercials, lapses by our commercial staff, or any other discripancy, or you like to give any feedback on any Nucleonix staff doing any wrong thing against cleaner / ethical business principles / practices can be complained to any of the directors or managing director.

An innovative company working towards excellence in the field of Nuclear Instrumentation

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