Software Manual for PM-04n

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Introduction

This text describes the software for PM-04n measuring instrument. Software is designed for controlling two PM-04n's simultaneously. Technically, in software, there are two almost independent windows for each PM-04n instrument. These windows share some configuration parameters and database, which stores the saved measurements, but the measuring procedures are completely separate.

In the first Chapter, the hardware will be presented. This includes the requirements on the computer running the program and basic description of two regulators which are inside the PM-04n instrument, together with description of their communication with PC.

The program is described in the second Chapter. Here, some remarks on installation are presented. There are some built-in constants, which user is not allowed to change - these constants will be presented in this Chapter as well. The biggest part of this Chapter is a description of graphical blocks of the program, so called GUI (graphical user interface).

In the last Chapter, the instructions for measuring and calibration procedures are presented. These should provide an user everything, what he needs, to operate this software.

Chapter 1

Hardware

1.1 Computer

Program is compiled as a 32-bit Windows application. It was successfully tested on both 32 and 64-bit versions of Windows XP, Windows 7 and Windows 8.1. It is not possible to run this program on different OS, such as Linux or OSX, without a proper Windows emulator.

PC requirements depend on the version of Windows, you are running on PC, where you want this program to be installed. Generally, 2 GHz CPU, 2 GB RAM, 1 GB Hard Drive free space, 256 MB Graphics Memory and Ethernet Connection should be enough for fluent run of the program, delivering enough disc space for storing thousands of measurements.

1.2 Regulators

PM-04n instrument contains two regulators, through which the program reads the instrument status and controls the measurement. Their description follows in this Section.

1.2.1 Eurotherm e3508

The first of these regulators, which can be seen on the front panel of the PM-04n instrument, is Eurotherm e3508 (Figure 1.1). The purpose of this regulator, is to control the furnace temperature, including the turning on/off the cooling ventilator and safety insurance to ensure the temperature in the furnace does not exceed the maximum allowed value.

Rare view of this regulator is shown in Figure 1.2. Table 1.1 shows the electrical connections, which are in PM-04n instrument in usage, together with their purpose. Safety relay turns the heating off, when the temperature in furnace exceeds 600 °C. The meaning of the remaining connections should be apparent.

Figure 1.1: Eurotherm e3508 front view

Connection	Usage
1A:1B	Furnace
2A:2B	Ventilator
V+:V-	Thermocouple
AB:AC	Safety relay
HA..HF	Ethernet

Table 1.1: Eurotherm electrical connection.

Eurotherm has its own program, independent on the PC. This program controls, e.g., the turning ventilator on/off, turning the safety relay on/off or PID regulation of furnace heating which ensures, the desired temperature is reached effectively.

Program reads/writes from/to e3508 the values on addresses shown in Table 1.2. Here, ramp units are chosen to be °C / min and ramp speed defines a speed, by which the temperature in furnace should be increased until the desired temperature is reached.

More information about this regulator can be found on the official pages of Eurotherm Company `http://www.eurotherm.com`. On these pages, the basic software package, caled *iTools*, for Eurotherm devices can be downloaded.

Address	Meaning
2	Reading thermocouple temperature
3	Writing desired temperature
36	Writing ramp speed
532	Writing ramp units

Table 1.2: Eurotherm addresses used in the program.

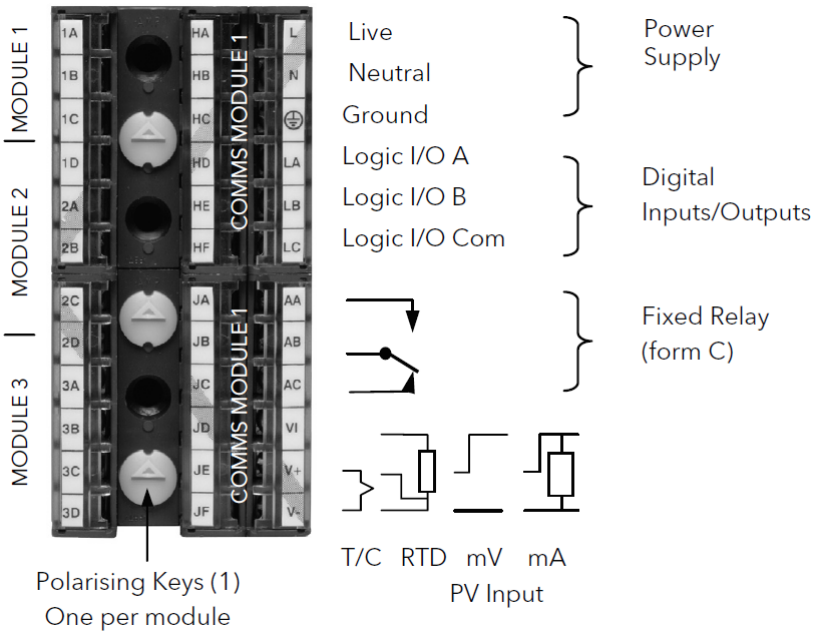


Figure 1.2: Eurotherm e3508 rare view

Connection	Usage
DAC0	Writing DC motor voltage
CIO2	Reading and Reseting counter
EIO0	Reading, if the head is down
EIO1	Writing to head goes down
EIO2	Reading, if the head is up
EIO3	Writing to head goes down
EIO5	Writing to turn the rotation on/off

Table 1.3: Labjack Connections and addresses used in the program.

1.2.2 LabJack T7

The second regulator, which can be found in PM-04n instrument, is LabJack T7 (Figure 1.3). This regulator is hidden inside the PM-04n instrument and its purpose is to control the measuring head. This includes the reading the position of the head, controlling its movement up/down and the most importantly, LabJack controls the rotational motor and measures the disc rotational speed.

Connections, which are used, together with their usage description, are shown in Table 1.3. Rotational speed of the head is controlled by the voltage of the DC motor.

More information about this regulator can be found on the official pages

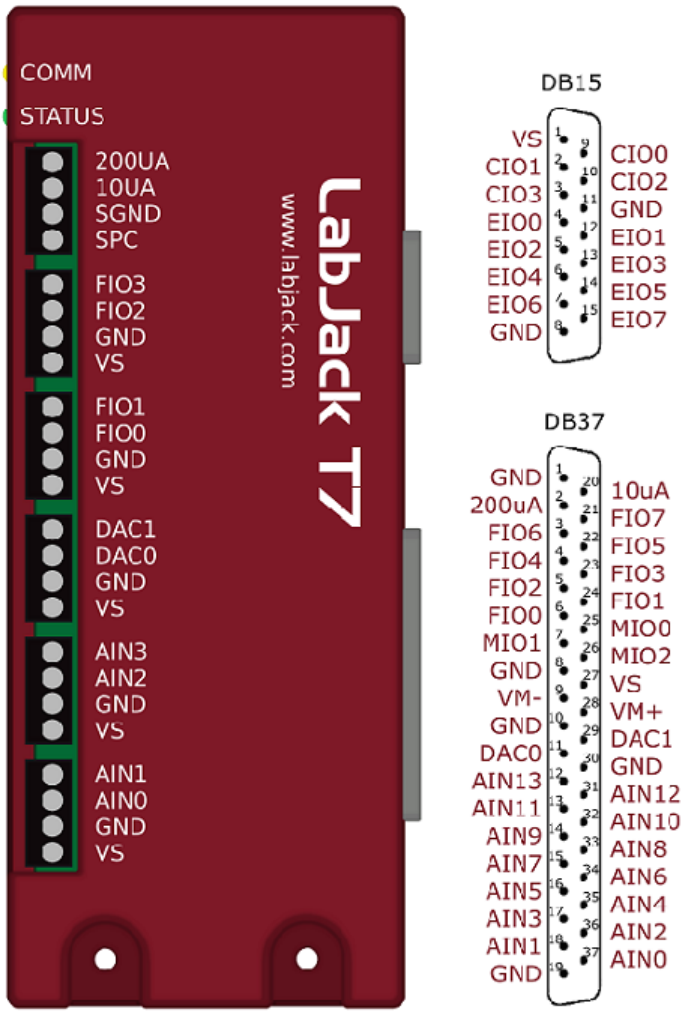


Figure 1.3: LabJack T7

of LabJack Company `http://labjack.com`. On these pages, the software package can be downloaded under the LabJack T7 bookmark. To connect to LabJack T7, the *Kipling* program serves.

1.3 Communication

Communication is done using TCP/IP protocol. Each device, namely PC, Eurotherm and LabJack, must have defined its own unique IP address and all devices have to be in local area network. Program is designed to be able to control two PM-04n instruments simultaneously, so be sure, each device has its own unique IP address.

IP address of Eurotherm, can be found/changed using the official software

Instrument	Device	IP
	PC	192.168.1.2
PM-04n 1	Eurotherm	192.168.1.233
	LabJack	192.168.1.208
PM-04n 2	Eurotherm	192.168.1.234
	LabJack	192.168.1.209

Table 1.4: IP addresses.

of Eurotherm Company, which was mentioned at the end of the Section 1.2.1. LabJack IP address can be found/changed with the official software of the LabJack Company - Section 1.2.2. Predefined addresses are shown in Table 1.4 - please, change them with caution.

Chapter 2

Program

2.1 Installation

There is no installation package for PM-04n controlling software. There are only a few files, which have to be copied into selected directory on hard drive (I recommend using C:/Program Files/Plastometer/*). Please, make sure, that users have read/write/modify privileges in that directory to avoid the data loss.

2.1.1 File System

Files needed by program are shown in Figure 2.1.

- **libmbusmaster.dll, sqlite3.dll**
  These are the external libraries which program needs to read/save data and to communicate with Eurotherm regulator.
- **marklar.db**
  Stores all measurements. To create back-up of measured data, please, store this file.
- **Plastometr.exe**
  Executable file by which the program is started.
- **Plastometr.ini**
  Configuration file, which stores the configuration.
- **langauge/CZ.ini, EN.ini, GE.ini**
  Different language versions of program are loaded from these files.
- **language/Translator.exe**
  Little application for simple translation between different language versions.

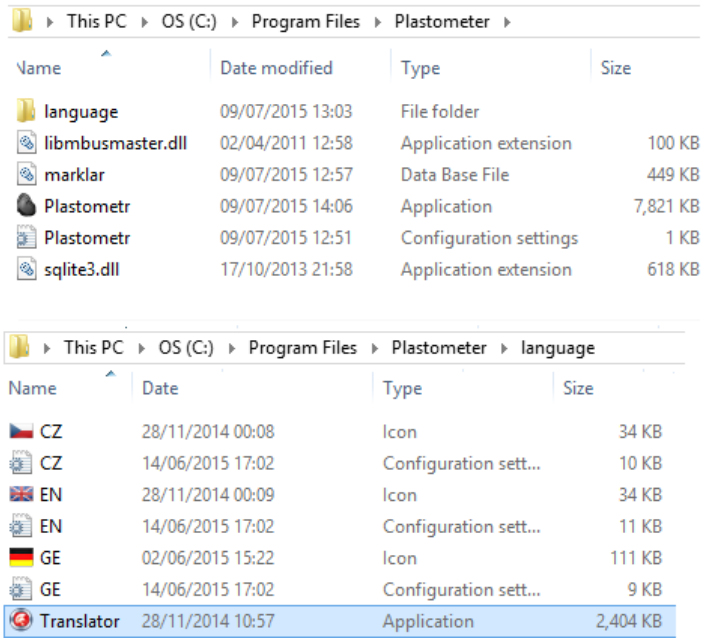


Figure 2.1: File System

2.2 Built-in Constants, Definitions

Although there are some values, user can change in GUI of the program, there are also some fixed, unchangeable, built-it constants, which are hidden from user.

- **MIN_TEMP_MOVE = 240 °C**
  When the measurement is running, then the movement of head is blocked by the program, if the temperature is below this value. Reason: Stannum in furnace could have not be melted and the user could damage the instrument.

- **MAX_TEMP = 600 °C**
  When the measurement is running and the temperature ramp is on, this is the temperature, at which the measurement will be stopped by the program. Reason: Eurotherm regulator has built-in safety relay, which turns the heating off at MAX_TEMP.

- **QUIT_TEMP = 20 °C**
  When the program is quit and regulators are still connected, this temperature is written on regulators. Reason: Instruments may be still on. This should ensure, the instrument will cool down.

- **TOLER_TEMP = 5 °C**

If the program has to check, if the desired temperature t_0 has been reached, then this is the allowed tolerance, i.e., if the temperature is in interval $(t_0 - \text{TOLER\_TEMP}, t_0 + \text{TOLER\_TEMP})$, then t_0 is assumed to be reached.

- **RAMP_TEMP = 3 °C/min**
  The rate the furnace is increasing its temperature with time during a measurement.
- **STAB_TIME = 600 s**
  During measurement, when the retort goes down to the furnace, this is the dead time, during which the temperature in furnace has time to stabilize. If it stabilizes, then measurement goes on, if not, the measurement stops.
- **TOLER_TEST = 50**
  When the sample is prepared, the user has chance to perform a test on sample, i.e. try to shortly attach voltage three times greater than the voltage attached during the measurement. If there is fewer than 50 pulses counted during the test, the test is marked as OK.

Each partial measurement has as a result 5 constants

- **T1**
  Temperature, at which the first pulse was measured.
- **T2**
  Temperature, at which the maximum value of pulses per minute was reached.
- **T3**
  Temperature, at which the last pulse was measured.
- **fmax**
  Maximum value of pulses per minute measured. This occurs at temperature *T2*.
- **ftotal**
  Total value of pulses measured during measurement.

2.3 Graphical User Interface

In this Section, the basic blocks of the program GUI (graphical user interface) are described. In can be seen, that most of the following figures, contain the blue question mark in it. By clicking on this question mark, a little help is displayed inside the program, which, in the most cases, should answer an user question. For more concise information about GUI, you are welcome in this Section.

Figure 2.2: Top Panel

2.3.1 Top Panel

Top panel is shown in Figure 2.2. It can be seen, the *Top Panel* is divided into two parts. The top part serves for switching between PM-04n instruments, the bottom part offers some basic features including saving measurements/connecting to regulators/starting measurement.

Firstly, let's look at the structure of the top part. User can switch between 3 tabs. The first two tabs are named according to the following logic

- **Instrument Name**
  The name of the instrument the tab switches to. This can be changed in the *Settings* bookmark (see Section 2.3.3). In Figure 2.2, the instruments are named *Left* and *Right*.
- **Measurement Number**
  Each measurement has its own unique number. Here is shown the number of active measurement. If the number is *#-1*, then the measurement is new and not saved yet. After saving, the number is automatically assigned.
- **Connection Status**
  CONNECTED or *DISCONNECTED*.
- **Measuring Status**
  MEASURING or *PAUSED*. In the first case, the measured temperature and dd/min are shown also.

The last tab contains only *Instrument 1 Name* | *Instrument 2 Name* and should be used during measurement, where I recommend the program lookup as shown in Figure 2.3.

The bottom part of the *Top Panel* contains some image buttons, which have some built-in hint help. These buttons are

- **Create a New Measurement**
  A new measurement is prepared. Data are cleared, graph emptied and the *Measurement Number* is changed to -1. This number changes after saving the measurement.
- **Save/Update Measurement**
  The actual measurement is either saved or updated.

- **Create a Protocol and Export Data**
  There is a fixed path, where all the protocols and data are exported. This path is defined in configuration file *Plastometr.ini* under *ProtocolPATH=* and can be changed here. By default, this path is set to */Desktop/Protocols/*. Inside this directory, program creates a new directory with the structure

  MeasurementNumber_SampleName_SomeOtherNumber/

  and adds two files in it. First of these is a protocol in pdf format, which is shown in Section 2.3.8 and the second is exported data in txt format, which is described in more details in Section 2.3.9.

- **Create a Connection with Regulators**
  Connects to both regulators. There are some messages which should help detect a problem, if there is any. If the connection is not successful, try to connect again.

- **Disconnect from Regulators**
  Connection to both regulators is closed. If program is measuring, then the measurement is stopped.

- **Start Measurement**
  Starts the measurement and the periodic reading data from instrument. The starting temperature (see Section 2.3.6) is automatically written and *Settings* and a*List of Measurements* bookmarks are disabled. Note that buttons controlling the head movement up/down are enabled only when temperature is above a certain threshold (see Section 2.2).

- **Stop Measurement**
  Stops the measurement and the periodic reading data from instrument. The head rotation is disabled, *Settings* and *List of Measurements* bookmarks are enabled and the buttons controlling the head movement up/down are enabled.

- **Language Buttons**
  Switches between different language versions of the program.

2.3.2 List of Measurements

First of the bookmarks on the left is the *List of Measurements* bookmark. It is shown in Figure 2.4 and its purpose is to search in the saved measurements. Measurement is loaded after mouse click on it in the table. There are two ways, how to find the desired measurement.

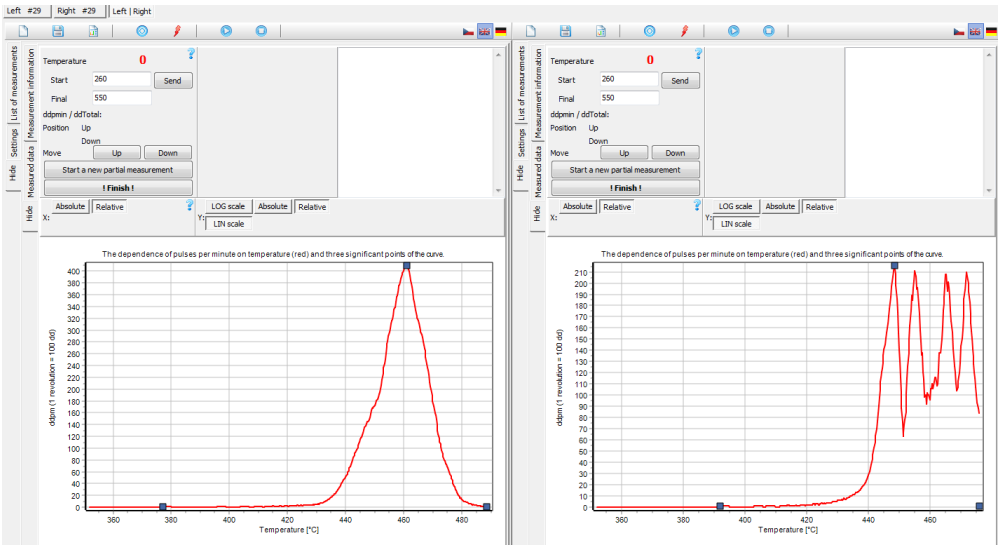


Figure 2.3: Recommended program lookup for measuring on two PM-04n's simultaneously.

1. **According to the Measurement Number**
   In this case, you simply enter the measurement number into the *Measurement Number* edit. If the measurement with this number exists, it is shown in table, if not, the table is left empty.

2. **According to the Remaining Parameters**
   There are 4 additional parameters, you can search by, namely

   - Sample
   - Operator
   - Date (in format *YYYY-MM-DD*)
   - Finished

   In the table, the measurements fulfilling all the criteria, you enter, are displayed. In the example in Figure 2.4, the measurements performed in *2015-07* with operator starting at *Loch* are displayed.

Next, the number of found measurements is shown. You can go to the last measurement by pressing the *Last Measurement* button. It is also possible to remove selected measurement by pressing the *Remove Measurement* button at the bottom.

2.3.3 Settings

Next to the *List of Measurements* bookmark, there is the *Settings* bookmark. This is shown in Figure 2.5. This bookmark is divided into several blocks,

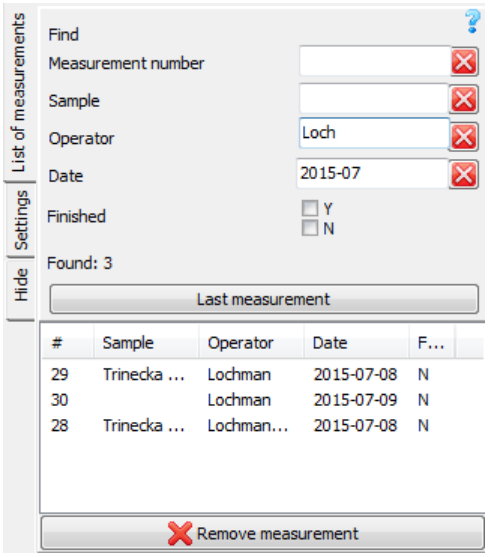


Figure 2.4: List of Measurements bookmark

each of them has its own built-in help.

- **Save Settings**
  This button simply saves the current settings. These include not only the values displayed in the *Settings* bookmark, but some values shown elsewhere in the GUI of the program. These include the *Start* and *Finish Temperature* (Figure 2.8) and the current axis settings (Figure 2.9).

- **Instrument, LabJack IP, Eurotherm IP**
  Instrument characterizes the name of the instrument and is displayed at the top of the *Top Panel* (Figure 2.2). Instrument is defined by IP addresses of two regulators, which must be entered here.

- **Company Name, Name Supplement**
  Are shown in the head of the protocol, as it is demonstrated in Figure 2.10.

- **Data Reading Interval**
  Interval, the data are read from the regulators. The pulses per minute are displayed and calculated in this interval as well.

- **Calibration**
  Calibration starts by the pressing the *Calibrate* button. After this, the voltage shown in the edit is written on the LabJack. Calibration is done using the *QWEASD* keys and is stopped either by pressing the *Save Settings* button, or by pressing the *ESC* key. Calibration is described in more detail in Section 3.2

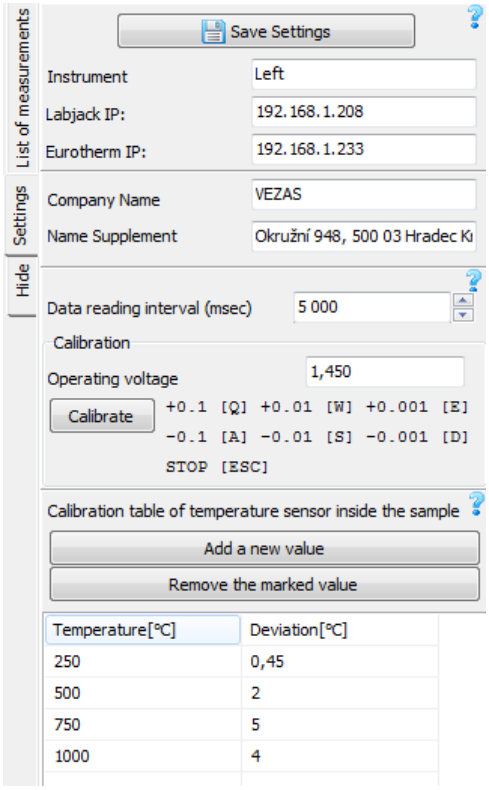


Figure 2.5: Settings bookmark

- **Calibration Table**
  Is delivered together with the temperature sensor. The row with values $(500, 2)$ means, that if regulator shows a temperature 500 °C, than the real temperature is about 2 °C higher. There are two buttons over the table allowing adding/removing the selected row in table.

2.3.4 Measurement Information

Measurement Information bookmark contains the basic informations about the measurement and is shown in Figure 2.6. It can be filled during the measurement. Some of these informations are used to search the measurement in the *List of Measurement* bookmark described in Section 2.3.2, remaining informations are used in the head of the protocol, which is shown in Figure 2.10.

- **Measurement Record**
  Unique measurement number assigned to the measurement. This is done automatically by the program after the first measurement save and cannot be changed.

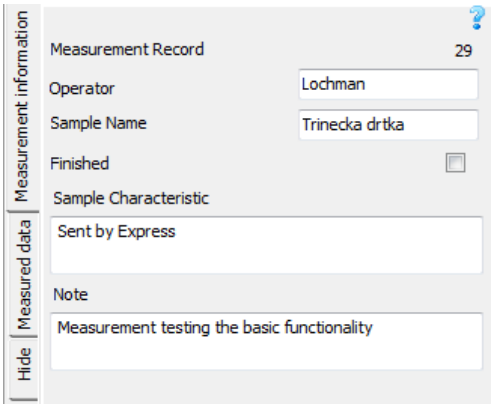


Figure 2.6: Measurement Information bookmark

- **Operator**
  Name of the person performing the measurement.

- **Sample Name**
  Short name of the measured sample.

- **Finished**
  If there is no interest in adding additional partial measurement into measurement, then *Finished* can be checked.

- **Sample Characteristic**
  Additional characteristic of the measured sample.

- **Note**
  Additional information e.g. about the non-standard measurement procedure.

It is recommended to save the measurement after editing this information.

2.3.5 Measured Data

Measured Data bookmark contains the data measured during the measurement and is shown in Figure 2.7. Table at the top contains the data measured during one concrete partial measurement. The partial measurement, which is displayed, is shown at the top. At the bottom, the results of partial measurements are shown and from the checked measurements, the final results are calculated. These are shown at the bottom. The meaning of the symbols used here, is defined in Section 2.2. More details to each building block follows.

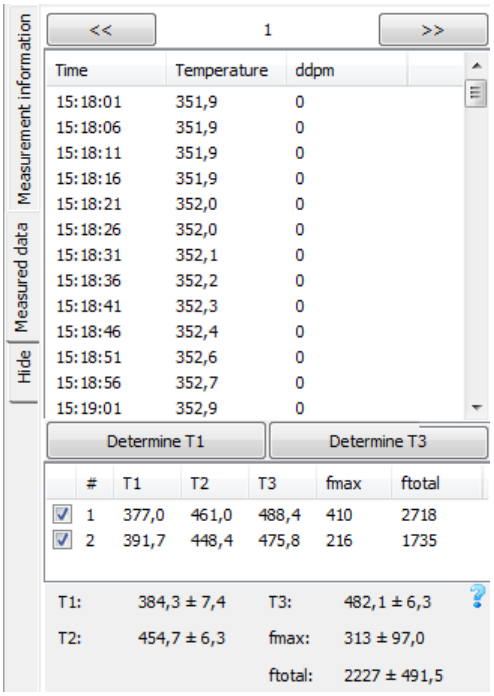


Figure 2.7: Measured Data bookmark

- **Listing Between Partial Measurements**
  Using buttons << and >>. Between these buttons, the partial measurement number is shown together with the instrument, which this partial measurement performed.
- **Table Time,Temperature,ddpm**
  Shows the measured data for the selected partial measurement. ddpm are the pulses per minute. 100 pulses equals one revolt.
- **Determine T1, Determine T3**
  Although T1 and T3 are determined automatically by the program, user can change these values by moving the corresponding points on the graph. When these buttons are pressed, program determines T1 or T3 again.
- **Table T1,T2,T3,fmax,ftotal**
  Results for partial measurements.
- **Results at the Bottom**
  From the checked measurements, the average and variance of measurement characteristic values are calculated.

In protocol, only checked partial measurements are used. This can be seen from Figure 2.10.

2.3.6 Measurement Control Panel

This panel is the basic operational block of the program and is shown in Figure 2.8. It shows the actual values read from the instrument, allows user to write a temperature, set the measurement final temperature, manipulate with the measurement head, finish the measurement and guide the user around the measurement. The description of building blocks follows.

- **Temperature**
  Actual temperature value from regulator. *Start temperature* is the temperature at which the measurements starts, *Final temperature* is the temperature at which the measurement will be stopped by the program automatically.

- **ddpmin/ddTotal**
  Actual value of pulses per minute (ddpmin) and total number of pulses (ddTotal).

- **Position**
  Shows the head position.

- **Move**
  Controls the movement of the measuring head. If the measurement is in progress, then these buttons are disabled for temperature below a certain threshold defined in Section 2.2.

- **Start a New Partial Measurement**
  Prepares a new partial measurement inside the opened measurement.

- **Finish**
  Completes the measurement, i.e. forces the measuring head to move up, turns the rotation off and writes the starting temperature, so the instrument is prepared for a new measurement as soon as possible.

- **Preparation of Measurement**
  Sample preparation. Checks three events:

  1. **Furnace Heated up**
     The furnace has to be heated up to the starting temperature. If the error is smaller than the allowed tolerance defined in Section 2.2, the *OK* is displayed.
  2. **Sample Test** (ARBITRARY)
     User can try to attach shortly a voltage three times greater than the voltage applied during the measurement, to test, if the sample is prepared correctly. The test starts by pressing the *Test* button and ends automatically. Test is assumed to be successful, if

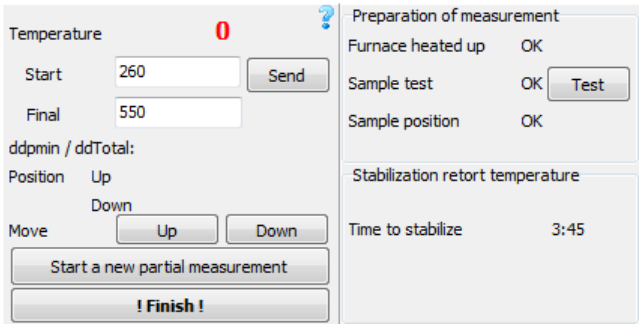


Figure 2.8: Measurement control panel

a number of pulses counted during test is smaller than built-in constant defined in Section 2.2. *OK* is then displayed.

3. **Sample Position**
   When the furnace is heat up, user must put the sample inside the furnace, i.e. by pressing the *Move Down* button. If the position *Down* is read, then *OK* is displayed.

- **Stabilization Retort Temperature**
  Program waits time defined in Section 2.2 to the temperature in furnace stabilizes. If it happens, the measurement continues automatically after time counter.

2.3.7 Graph

The purpose of this block is to graphically display a measured data of one selected partial measurement. This block is shown in Figure 2.9 and you can see, next to the red line representing the measured data, three blue points are displayed - these are the three characteristic temperature points T1, T2 and T3 defined in Section 2.2. Above the graph, there are some options to configure the graph axes.

- **X Axis**
  You can switch between *Absolute* and *Relative* options. In *Absolute* case, the axis range is entered manually and graph is repainted after pressing *Enter* key. In *Relative* case, the axis range is chosen automatically to comprise all the measured data. When a protocol is created (see Section 2.3.8), then all graphs in it are set according to this settings.

- **Y Axis**
  What holds for the X Axis is holds for Y Axis as well. There is,

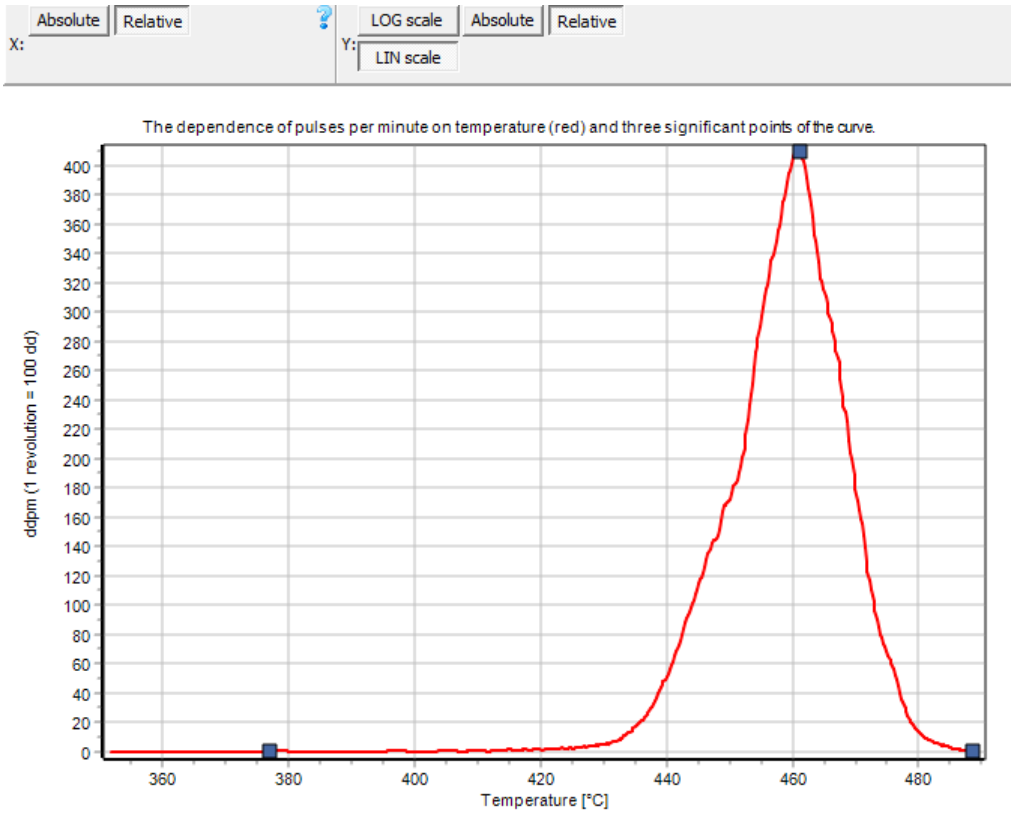


Figure 2.9: Graph

however, one additional option for the Y Axis: You can switch between logarithmic and linear scale.

- **Graph**
  Red line represents the measured data and three blue-square points represent the three significant temperatures T1, T2 and T3 defined in Section 2.2. The T1 and T3 can be dragged by the mouse, but the T2 is fixed, unchangeable.

2.3.8 Protocol

When the *Create a Protocol and Export Data* button (see Section 2.3.1) is pressed, two files are created. First of these files is the measurement protocol in pdf format, whose structure is described in this Section, the second file is the exported data in txt format. Its structure is described in the next Section. The path, where these files are saved, is defined in Section 2.3.1.

After files are created, the protocol is opened automatically by the default program for .pdf extension (I recommend the use of *Adobe Acrobat Reader*,

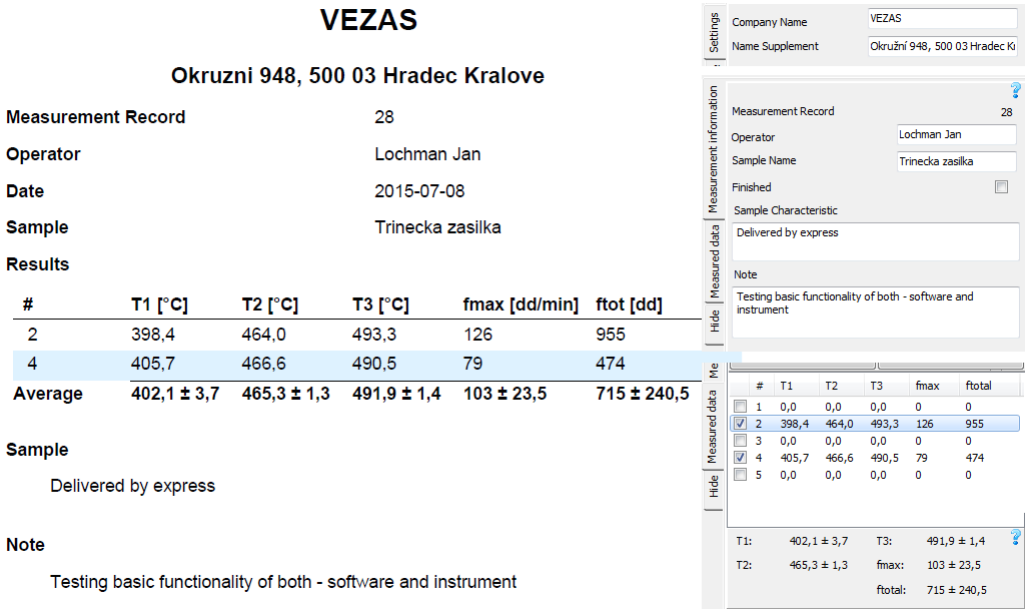


Figure 2.10: Example of the first protocol page.

but other programs should serve as well). Using this program, you can easily print the created protocol.

The first page of the protocol has the structure shown in Figure 2.10.

- **Title**
  Is loaded from the *Settings* bookmark (Section 2.3.3).

- **Information above Results**
  Is loaded from the *Measurement Information* bookmark (Section 2.3.4). Only *Date* is not shown in this bookmark, it is loaded directly from the database.

- **Results**
  Are loaded from the *Measured Data* bookmark (Section 2.3.5). You can see, that only checked partial measurements are included in the protocol and that the mean and variance is calculated from these measurements only.

- **Sample, Note**
  Are loaded from the *Measurement Information* bookmark (Section 2.3.4).

The second (and any other) page of the protocol has the structure shown in Figure 2.11 and generally, it displays the results of partial measurements shown in the first protocol page.

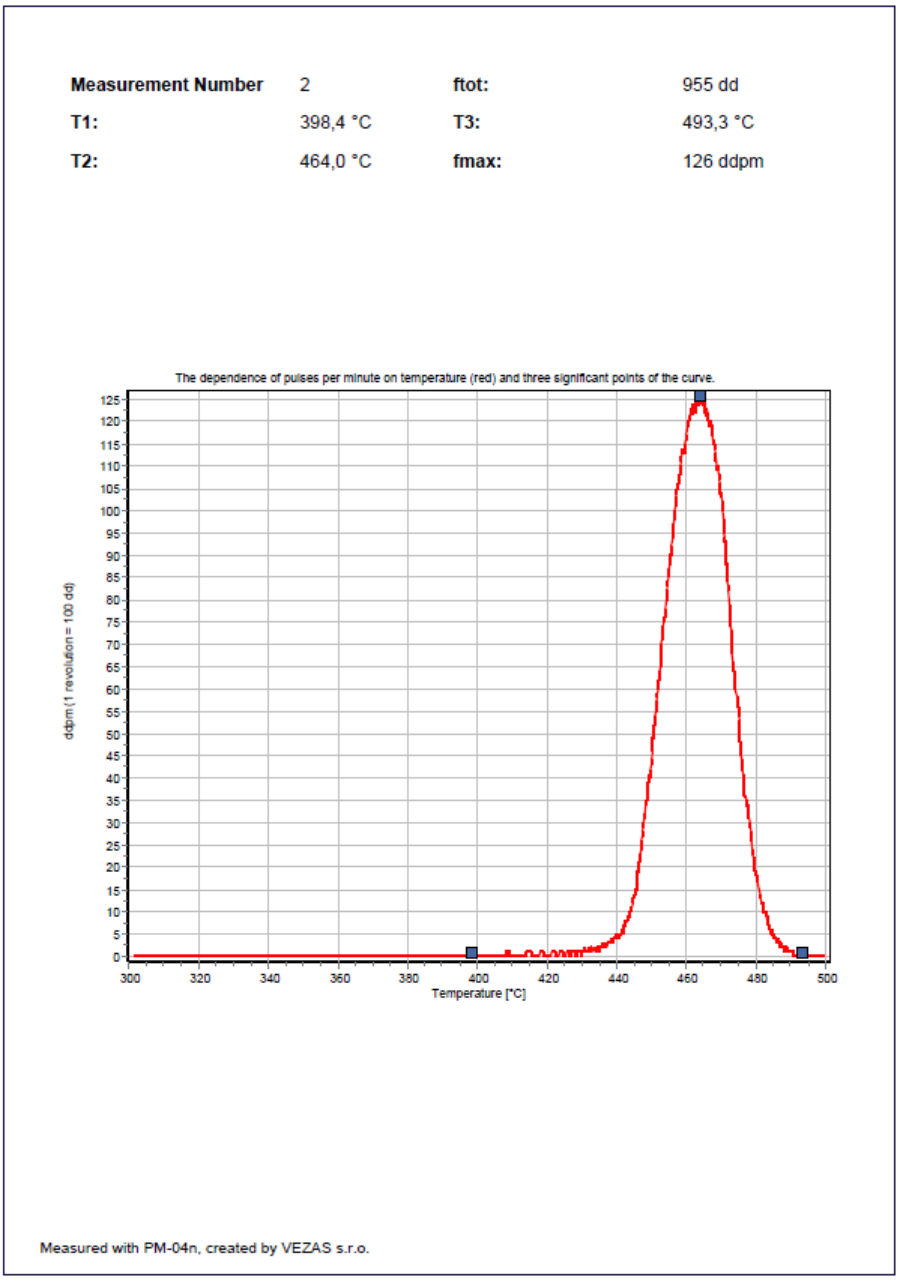


Figure 2.11: The second protocol page. The first page of this protocol is shown in Figure 2.10.

- **Header**
  Partial measurement number together with the results of characteristic values. These values are the values shown in one row in the table from Figure 2.10.

- **Graph**
  Uses the axis settings defined in Section 2.3.7.

2.3.9 Data Export

Next to the protocol, the data are exported into separate file. This serves for further processing in table-oriented programs such as *Microsoft Excel*. The structure of data exported is shown in Figure 2.12.

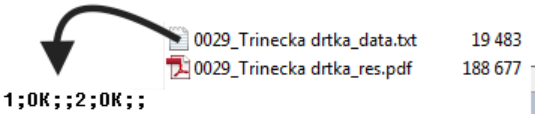
By closer look at the data structure on the left, you can see, the data are semicolon separated values, which can be easily loaded as table, so you get the table structure on the right.

Each partial measurement is displayed on three columns with the structure

- **Finished**
  In the first row, there is shown, if the measurement is checked as *Finished* or not. This means, also the results of the unchecked measurements are exported.

- **Characteristic Values**
  Next 5 rows contain the measurement characteristic values defined in Section 2.2.

- **Measured Data**
  Table containing all the data measured during the partial measurement.




```
1;OK;;2;OK;;
TStart;377,0;;TStart;391,7;;
TMax;461,0;;TMax;448,4;;
TFinish;488,4;;TFinish;475,8;;
ddMax;410,0;;ddMax;216,0;;
ddTot;2718,0;;ddTot;1735,0;;
Time;Temperature;ddpm;Time;Temperature;ddpm;
15:18:01;351,9;0;15:23:38;352,1;0;
15:18:06;351,9;0;15:23:43;352,1;0;
15:18:11;351,9;0;15:23:48;352,1;0;
15:18:16;351,9;0;15:23:53;352,2;0;
15:18:21;352,0;0;15:23:58;352,2;0;
15:18:26;352,0;0;15:24:03;352,3;0;
15:18:31;352,1;0;15:24:08;352,4;0;
15:18:36;352,2;0;15:24:13;352,5;0;
15:18:41;352,3;0;15:24:18;352,6;0;
15:18:46;352,4;0;15:24:23;352,7;0;
```

1	OK		2	OK	
TStart	377,0		TStart	391,7	
TMax	461,0		TMax	448,4	
TFinish	488,4		TFinish	475,8	
ddMax	410,0		ddMax	216,0	
ddTot	2718,0		ddTot	1735,0	
Time	Temperature	ddpm	Time	Temperature	ddpm
15:18:01	351,9	0	15:23:38	352,1	0
15:18:06	351,9	0	15:23:43	352,1	0
15:18:11	351,9	0	15:23:48	352,1	0
15:18:16	351,9	0	15:23:53	352,2	0
15:18:21	352,0	0	15:23:58	352,2	0
15:18:26	352,0	0	15:24:03	352,3	0
15:18:31	352,1	0	15:24:08	352,4	0
15:18:36	352,2	0	15:24:13	352,5	0
15:18:41	352,3	0	15:24:18	352,6	0
15:18:46	352,4	0	15:24:23	352,7	0

Figure 2.12: Data exported by the program.

Chapter 3

Usage

This Chapter describes the basic instructions to perform a measurement and calibration on PM-04n instrument. Some informations from the previous chapters are, for convenience, written here as well, but for more information, a references to previous Sections are provided.

3.1 Measurement

3.1.1 Select the Instrument

Firstly, it is needed to select the instrument, you are going to measure on. For this purpose, the top of the *Top Panel* serves. This is shown in Section 2.3.1.

3.1.2 Connect to the Regulators

Next, you must connect program to regulators. This is done using the *Create a Connection with Regulators* button, which is the fourth button on the *Top Panel* (Section 2.3.1).

If there is any problem with connection, you are welcome to try pressing the *Create a Connection with Regulators* button a few times (if the PM-04n instrument was turned on recently, the regulators can not be initialized yet). Program has built-in messages to help you indicate the problem. When the connection is successful, the program let you know about the success.

If you are unable connect to regulators, see Section 1.3 for more details - probably, there is a problem with the network settings and you will need an assistance from the network administrator.

3.1.3 Select the Measurement

Before the measurement starts, it is needed to choose, where the measurement will be added. Basically, there are two possibilities

1. **Add a Partial Measurement to an Existing Measurement** You have a sample, which was already measured and the measurement was successfully saved and you want to add to this measurement a new partial measurement.

   You must load your measurement using the *List of Measurements* bookmark (Section 2.3.2) and press the *Start a New Partial Measurement* button in the *Measurement Control Panel* (Section 2.3.6).

2. **Start a New Measurement** You have a new sample, which was not measured yet. By pressing the *Create a New Measurement* button in the *Top Panel* (it is the first button, Section 2.3.1), a new measurement is prepared.

   I recommend to fill *Operator* and *Sample Name* in the *Measurement Information* bookmark (Section 2.3.4) and save the measurement using the *Save/Update Measurement* button at the *Top Panel* (it is the second button, Section 2.3.1).

Generally, you can edit the information in *Measurement Information* bookmark (Section 2.3.4) anytime, even during the measurement. If you make some changes to it, do not forget to save them.

3.1.4 Start the Measurement

Now, everything is prepared to measurement could start. This is done by pressing the *Start Measurement* button at the *Top Panel* (it is the sixth button, Section 2.3.1).

By pressing this button, the Start Temperature is automatically written, but it can be changed easily using the *Send* button in the *Measurement Control Panel* (Section 2.3.6). Please, check, if the *Final Temperature* is set correctly as well.

Note: *The List of Measurements and Settings bookmarks are disabled, when the measurement is on. To enable them, you must press Stop Measurement button, which is next to the Start Measurement button. Use this with a caution.*

Note: *The movement of the measuring head is disabled, if the temperature in the furnace is below the cutoff defined in Section 2.2.*

3.1.5 Prepare Sample

In this step, no interaction between user and program is needed. After retort is prepared and placed in the measuring head, continue to next step.

3.1.6 Test Sample (Arbitrary)

The sample test is arbitrary and is performed by pressing the *Test* button in the *Measurement Control Panel* (Section 2.3.6).

3.1.7 Wait for the Furnace is Heated Up

Wait until the furnace is heated up to the desired starting temperature. This is checked automatically by the program and user can see this in the *Preparation of Measurement* part of the *Measurement Control Panel* (Section 2.3.6). If there is *OK* next to the *Furnace heated up*, you can proceed to next step.

Note: *Every time, the program checks, if temperature has reached a desired value, there is a built-in tolerance defined in Section 2.2.*

3.1.8 Move Sample into the Furnace

By pressing the *Move Down* button, the measuring head goes down to the furnace and measurement starts automatically. You are welcome to enter the next step.

Note: *The movement of the measuring head is disabled, if the temperature in the furnace is below the cutoff defined in Section 2.2.*

3.1.9 Make a Coffee

The measurement is now fully controlled by the program. Firstly, there is a fixed time interval, defined in Section 2.2, which program waits for temperature to stabilize after the sample entered the furnace. If the temperature stabilizes, the measurement goes on, if not, the measurement goes to the Stage 3.1.10.

After successful stabilization of temperature, program enables the temperature ramp (fixed value defined in Section 2.2) and sends the *Final Temperature*. Next to this, the head starts to rotate with the voltage defined in *Settings* bookmark (Section 2.3.3).

If the *Final Temperature* is reached, the measurement goes to the last stage. User can evoke this event by pressing the *! Finish !* button in the *Measurement Control Panel* (Section 2.3.6).

Note: *Every time, the program checks, if temperature has reached a desired value, there is a built-in tolerance defined in Section 2.2.*

3.1.10 Finish the Measurement

Finalization of the measurement. Program moves the measuring head up, disables the temperature ramp, sends the *Start Temperature* and disables

the head rotation, so the instrument is prepared for next measurement as soon as possible. Measurement is saved automatically as well.

If you want to make a new partial measurement, proceed to Stage 3.1.5.

Otherwise, stop the measurement by pressing *Stop Measurement* button (the last button on the *Top Panel*, Section 2.3.1) and continue to Stage 3.1.3.

3.2 Calibration

To perform a calibration, go to the *Settings* bookmark (Section 2.3.3). Here, in part *Calibration*, the *Operating Voltage* item is located. This voltage has to be set during the process of calibration. The way, this voltage is set, is defined by the norm.

To start the calibration, press the *Calibrate* button (make sure, the program is connected to regulators). This causes the motor to start rotate. Now, by pressing the *QWEASD* keys, find the voltage which satisfies the conditions stated by the norm.

Calibration ends either by pressing *ESC* key (do not forget to save a new settings thereafter) or by pressing *Save Settings* button. Both of these actions cause the rotation to stop.