# DYNABLOT HEAT

# Service Manual

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Revision Table

| Revision | Date | Changes |
|---|---|---|
| 0 | 6.4.2016 | First official edition |
| 1 | 12.5.2016 | I-parameters table updating |
| 2 | 16.9.2016 | Real time clock compensation updating |
| 3 | 23.11.2016 | Regular maintenance operations updating |
| 4 | 23.2.2017 | Change in 6.2 Mainboard firmware update |
| 5 | 10.10.2019 | The capter 7 Auxiliary screens addition |
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## Content

# 1. Instrument general description

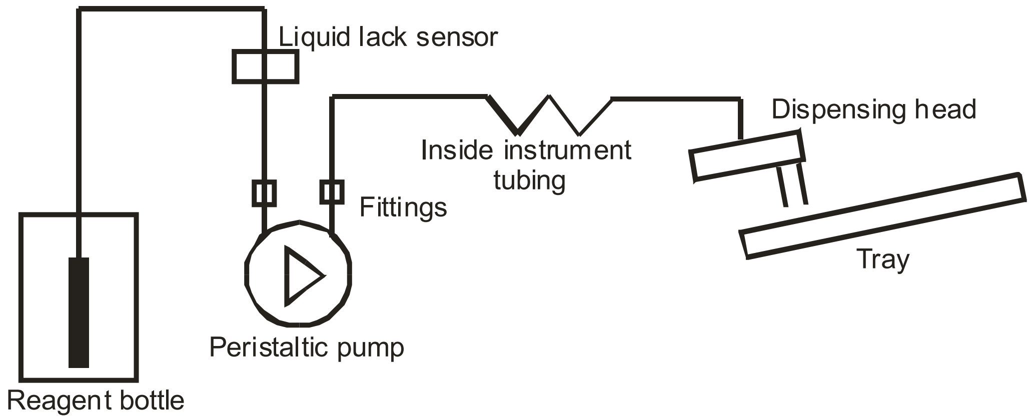
## 1.1. Instrument control

The instrument is controlled by the operator with the help of colour graphic display with touch screen buttons.

## 1.2. Dispensing system

Dispensing system contains 8 channels for the reagents. Each channel is equipped with the peristaltic pump, tubing, LED indicator and the sensor for the liquid lack in the tube. The tubes are connected to the dispensing head. The first version of the dispensing head has 2 outlets and 3 channel tubes are connected in each outlet. So the number of used reagents channels is 6 (2 channels are spare now – for the next possible use). 2 outlets head can be used for separation of the conjugate and the substrate – no contact in dispensing system.
The channels 7 and 8 are prepared for the heated reagents. The teflon tubing is used to reduce reagent heat loss during its transport. Also firmware function for tubing and pump head preheating before dispensing is added to these two channels.

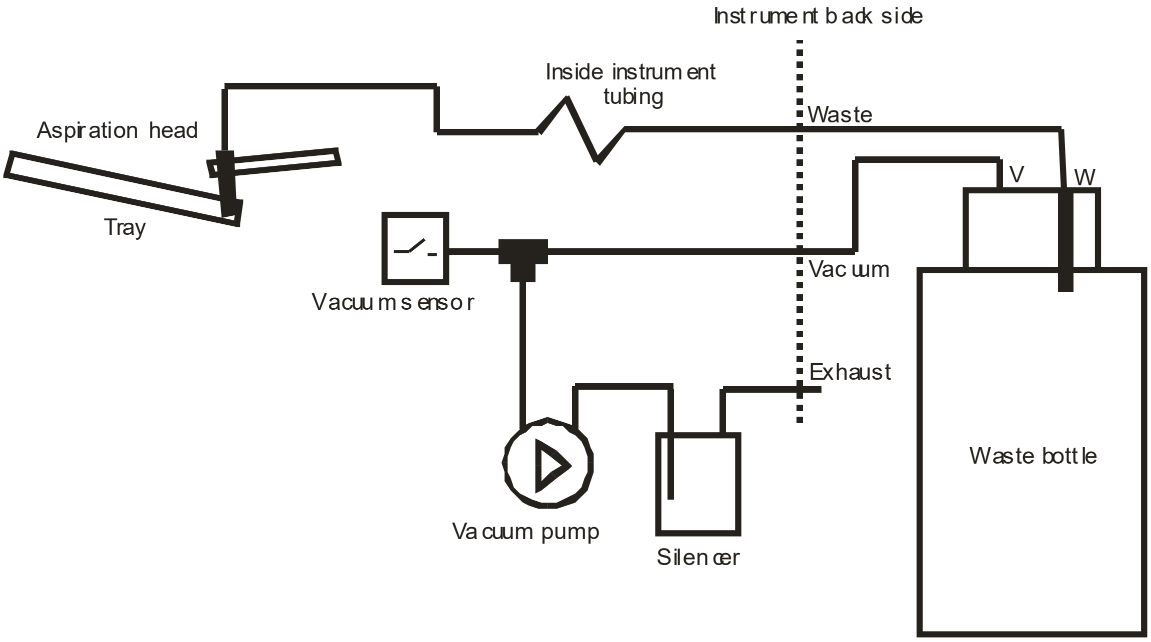
One dispensing channel diagram




## 1.3. Aspiration system

The well content is aspirated by vacuum to the waste bottle. The aspiration arm is placed together with dispensing head on the X-shift arm. The vacuum pump is placed inside the instrument together with the vacuum sensor and the exhaust silencer. The waste bottle input W is connected to the aspirating tube, the input V is connected to the vacuum pump. The waste bottle is equipped with two floaters for the level detection – the bottle is full and the bottle is overfilled.

Scheme of aspirating system




## 1.4. Rocking system

The rotating eccentric wheel makes the tray holder rocking via the small pulley. The rocking holder can be taken off around its spigot to get the good access bellow it.

## 1.5. Reaction trays heating and cooling system

The three identical blocks are used for the 10-well reaction trays. The block is heated by resistance heating segment that forms the bottom of the space for the tray. The cooler with two fans is placed on the other side of the heating element. The whole system is placed in the heat insulation. The temperature probe is placed in the centre of the cooler. The lid of the block contains the transparent heating foil.
The green LED in the front side of the block indicates heating activity.
Each block contains its control electronic board.
The 3 fans under the front instrument cover bring the air into working area during block cooling.

## 1.6. Reagents heating system

There are two heated positions for the reagent bottles at the drawer. The position is heated by the resistance heating segment and contains the internal temperature probe and the stepper motor for the magnetic stirrer. The external temperature probes could be connected to the connectors near the positions. They are used for the immersing into the reagents bottles.
The adaptors with heat insulation are placed to the heated positions and they fit to different bottles

# 2. System control

The instrument control system is a modular and it consists from the following electronic boards

- Main board
- Chassis board
- Sensor board
- Regulator boards (3)

Each board contains processor with its firmware which controls the devices in its neighborhood. It reduces the wiring inside the instrument. The firmware versions of all boards can be seen on the welcome screen after the switching on the instrument.

The system control is supplied with switching power supply 220 V AC / 24 V DC. It is placed on the back side of the instrument chassis.

## 2.1. Main board

The mainboard is placed in the housing on the left side of the drawer. It is responsible for the main control of the instrument and its peripheries placed in the drawer:

- Display with touch screen
- USB
- Peristaltic pumps
- Heating of the reagent positions
- Stepper motors of the magnetic stirres in the reagent positions

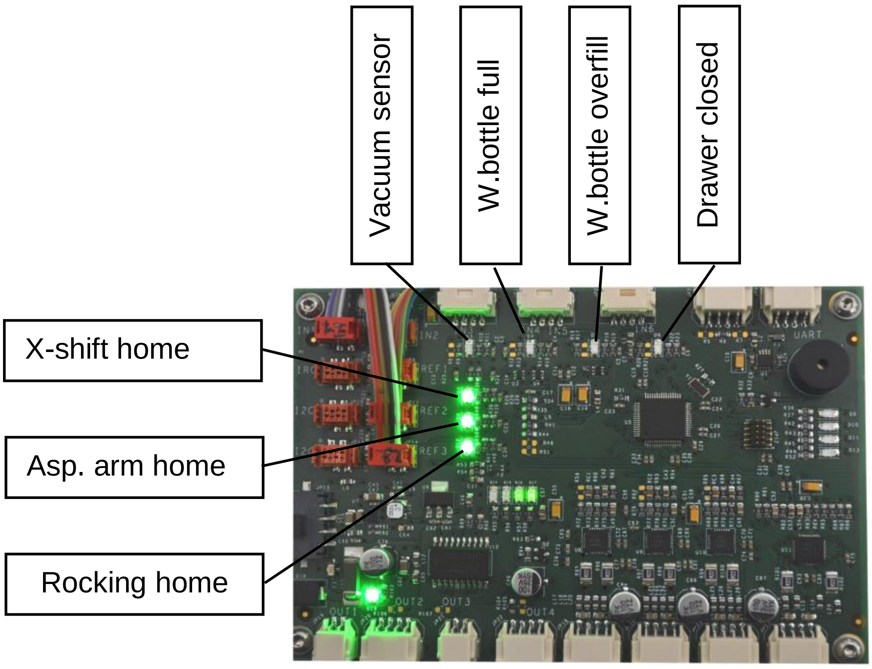
The main board contains the holder with SD card – memory space for assays, languages versions, log files, etc.
The holder with battery for the real time clock is placed near the mainboard.
The mainboard controls the serial communication with the others boards.

## 2.2. Chassis board

The chassis board is placed on the instrument back side. It controls the devices placed in the instrument chassis :

- X-shift stepper motor with the home sensor
- X-shift incremental sensor
- Aspiration arm stepper motor with the home sensor
- Rocking stepper motor with the home sensor
- Vacuum pump
- Drawer lock solenoid
- Reagents area lighting
- Vacuum sensor
- Waste bottle full sensor
- Waste bottle overfill sensor
- Drawer close sensor

The board contains the LED indicators of the inputs status which can be used during servis.




## 2.3. Sensor board

The sensor board is placed in the drawer above the peristaltic pumps and it contains the LED indicators and the sensors for the liquid lack in the tubes.

## 2.4. Regulator board

The block board is placed in every heated block. It controls the devices in the block:

- bottom heater
- temperature probe
- lid heating foil
- cooling fans
- green LED indicator

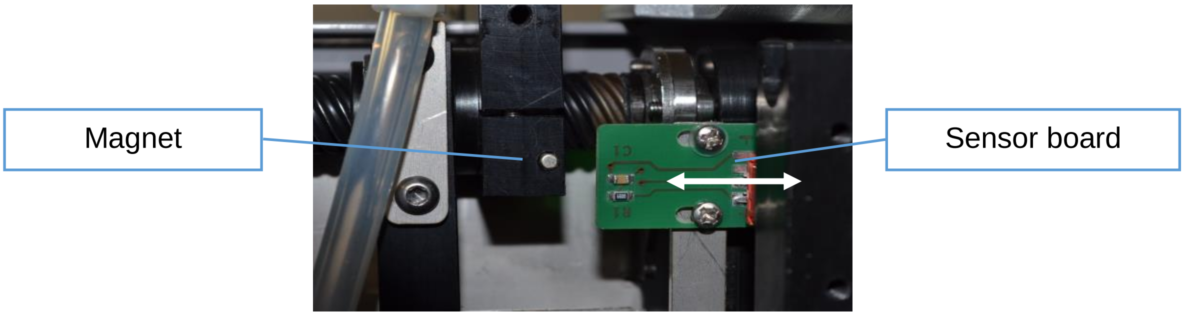
# 3. Moving mechanical parts

The instument contains three main moving parts driven by the stepper motors

- X-shift
- Aspiration arm
- Rocking

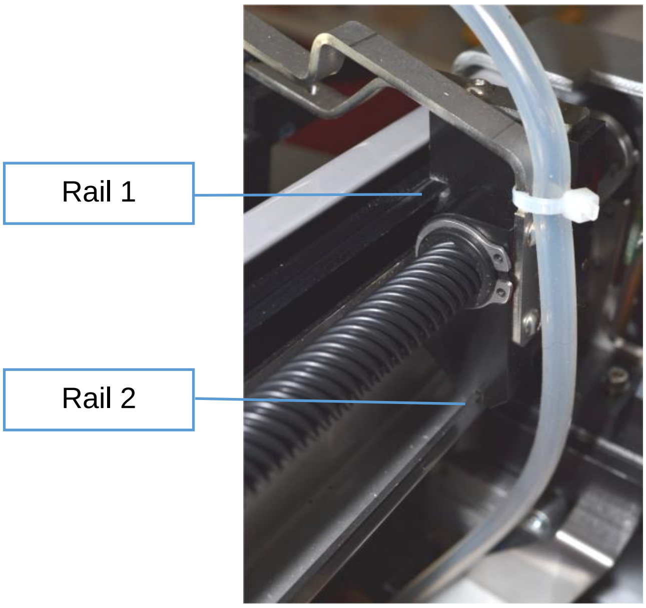
## 3.1. X-shift

The X-shift movement is driven by the stepper motor via the toothed belt and the threated rod. The home position is detected by the magnetic sensor.



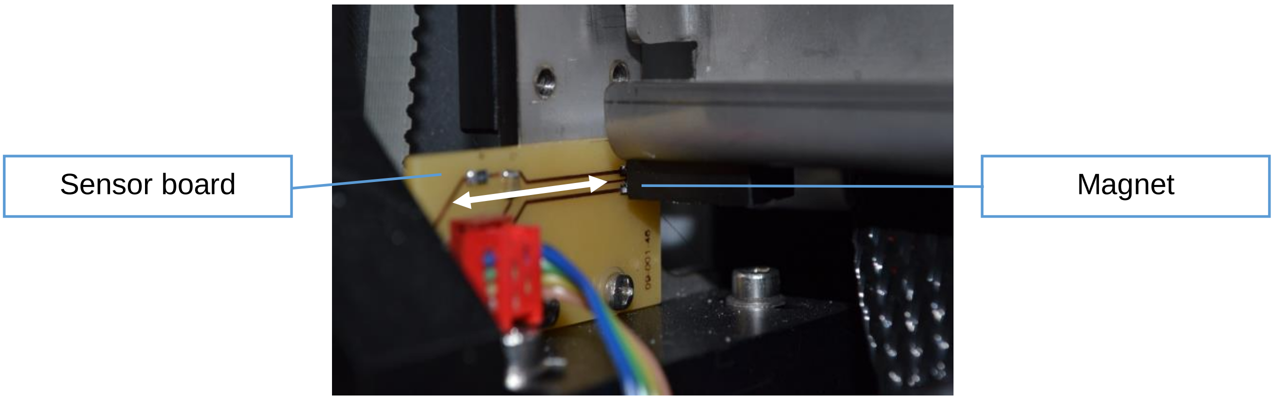

The sensor board can be slightly moved for the X-shift home position. For the proper board position the X arm stops after homing so that the aspiration tube is aproximately in the centre of the priming bowl.
The X-shift is checked during its movement by the magnetic incremental sensor. It is placed at the toothed beld pulley.

The maintenance of X-shift mechanism is performed by the lubrication of the two metal rails where the supports slide on it.




## 3.2. Aspiration arm

The aspiration arm is driven by the stepper motor via the toothed belt. The home position is detected by the magnetic sensor.

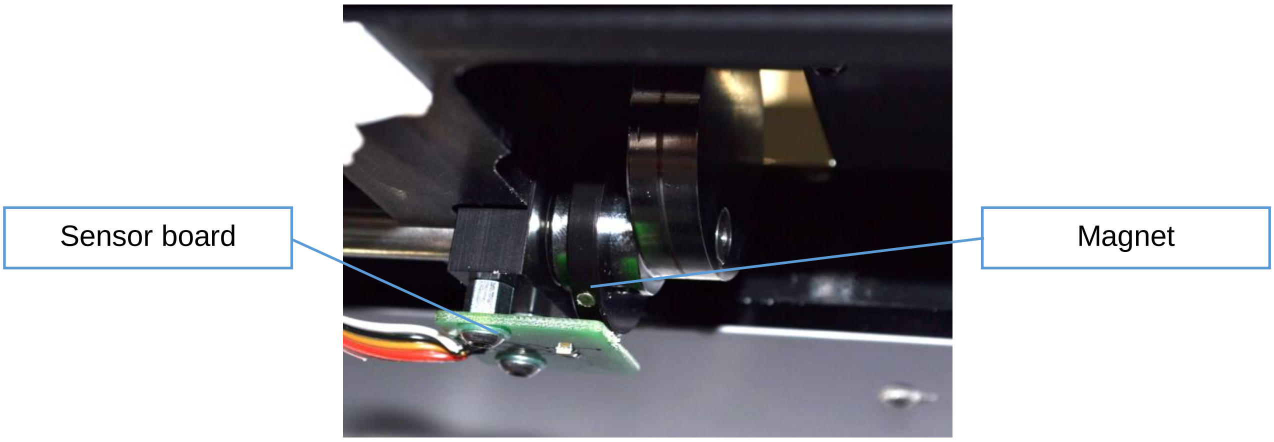



The sensor board can be slightly moved for the aspiration arm home position. For the proper board position the aspirating tube stops in upper position so it does not hit other parts during X-shift movement.

The aspiration arm mechanism does not need a special maintenance.

### 3.3. Rocking

The rocking is driven by the stepper motor via the toothed belt. The home position is detected by the magnetic sensor.

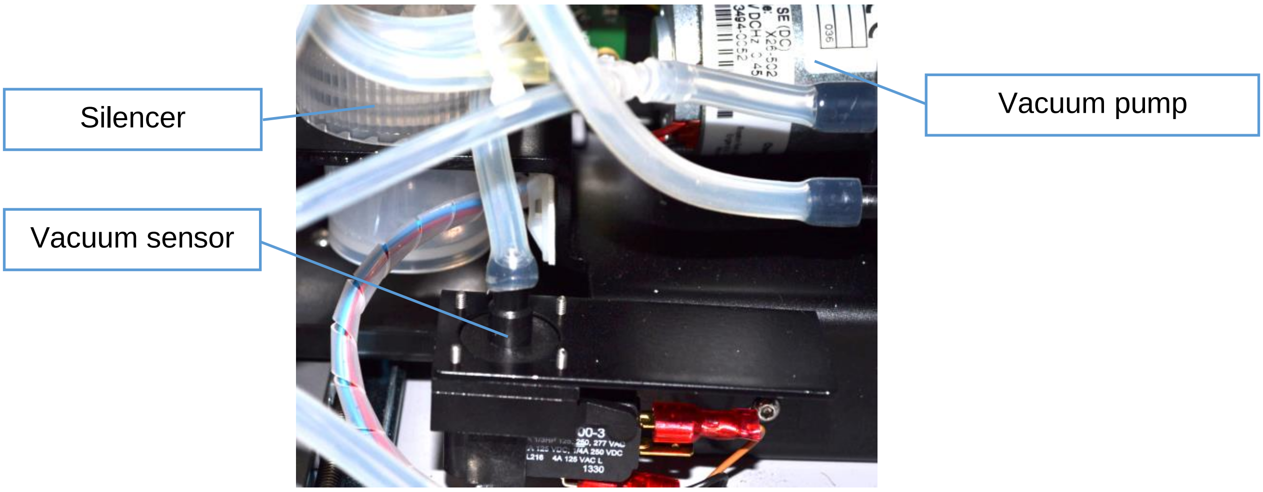



The magnet is placed in the plastic wheel. It is secured on the eccenter pivot with a small screw. For the proper plastic wheel position the tray holder stops very near to the horizontal position which comes after the holder passes upper position (the eccenter turns counterclockwise).

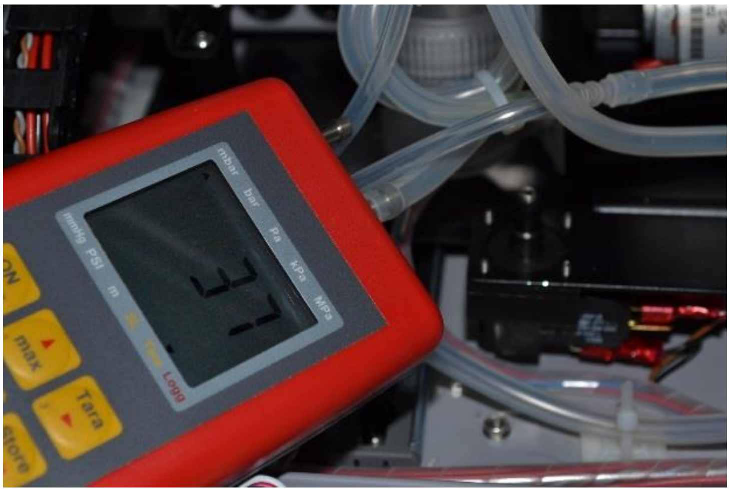
During maintenance must be checked if the pulley bellow the tray holder can turn easily. If it does not it must be replaced.

# 4. Vacuum checking and sensor adjustment

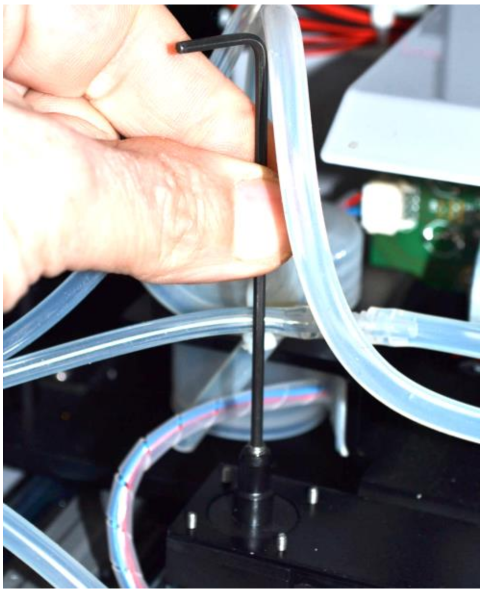
The vacuum is checked by the sensor placed near the vacuum pump. It is accessible when the back lid is open.




The pressure meter can be connected to the vacuum sensor tubing and the vacuum can be measured by the pressure meter. The vacuum pump must be switched on (see User manual, Instrument checking) and the waste bottle conected. The vacuum must be about 40 mBar.




The pressure threshold of the sensor can be adjusted by the screw after disconnection of the tube.



For the control of the correct adjustment:

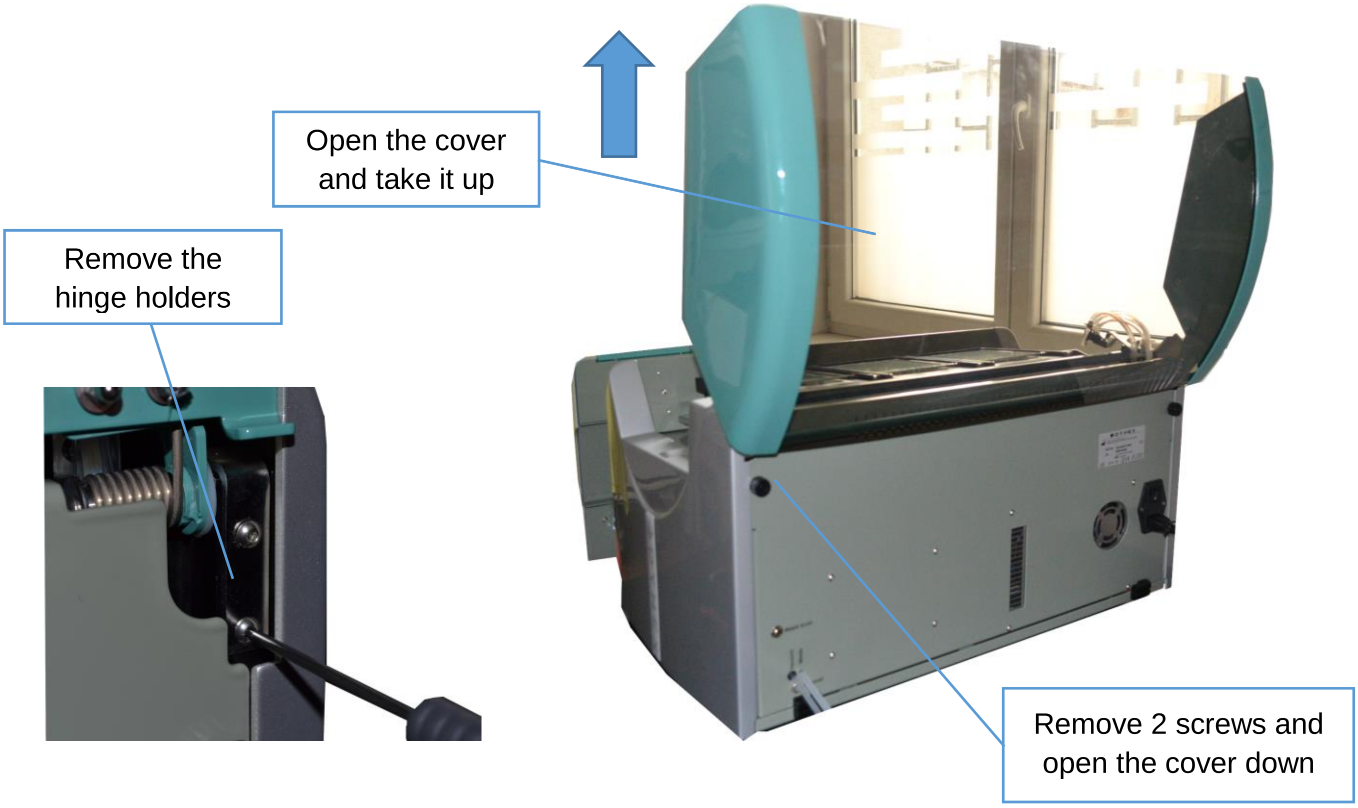
- Connect the waste bottle and switch on the vacuum pump
- The sensor must be switched on (see the LED on the chassis board or the icon on the instrument checking screen)
- Slightly unscrew the waste bottle cap (1/4 turn)
- The sensor must be switched off

# 5. Regular maintenance operations

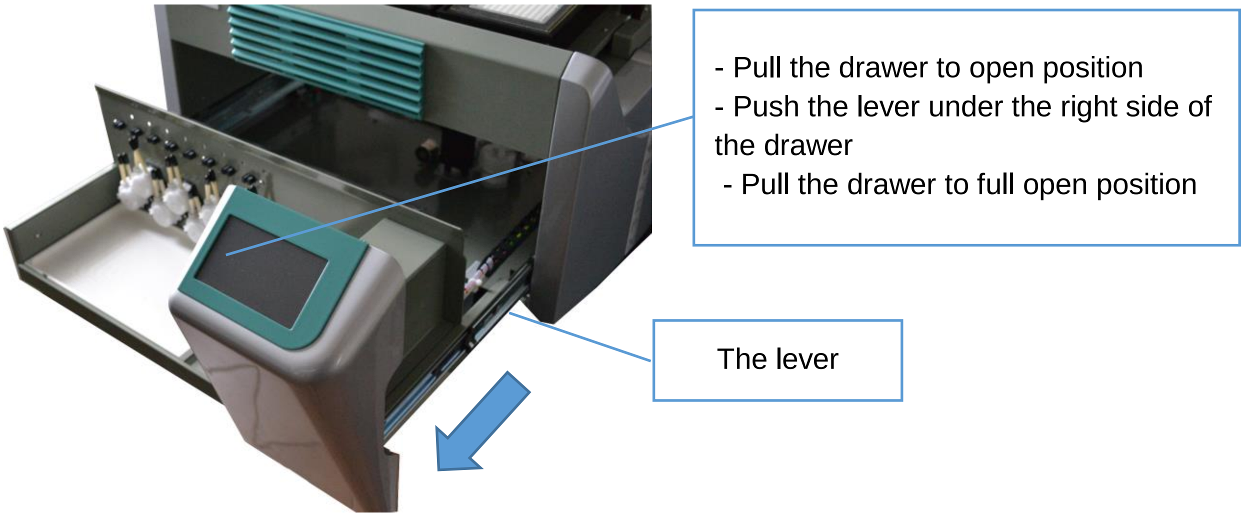
## 5.1. Reagent tubing and pump casettes replacement

To get the good acces to the instrument for tube replacement

- open the rear removable cover
- remove the workspace cover

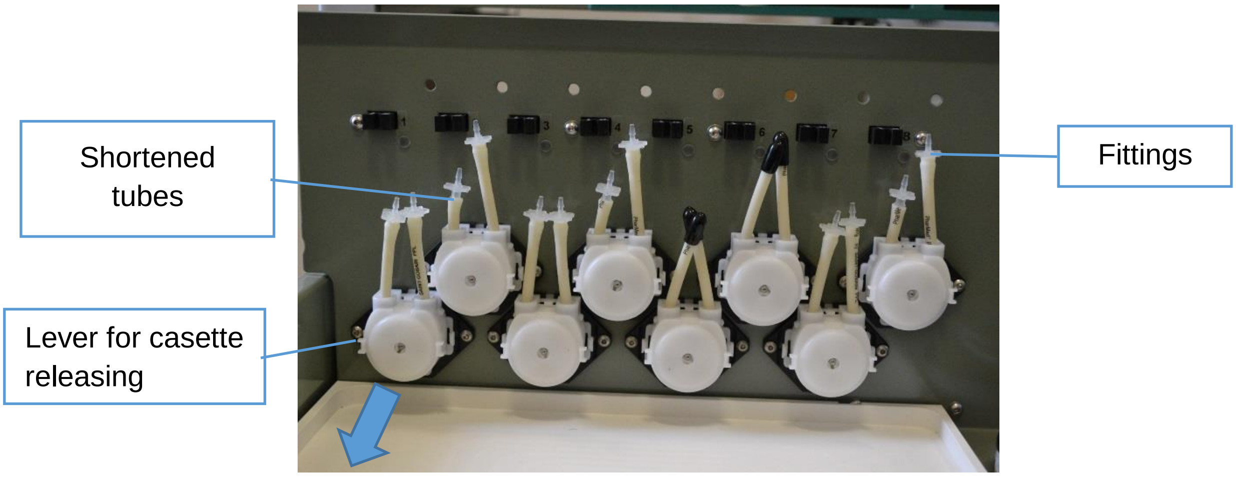



- open the drawer to the full front position (see picture)



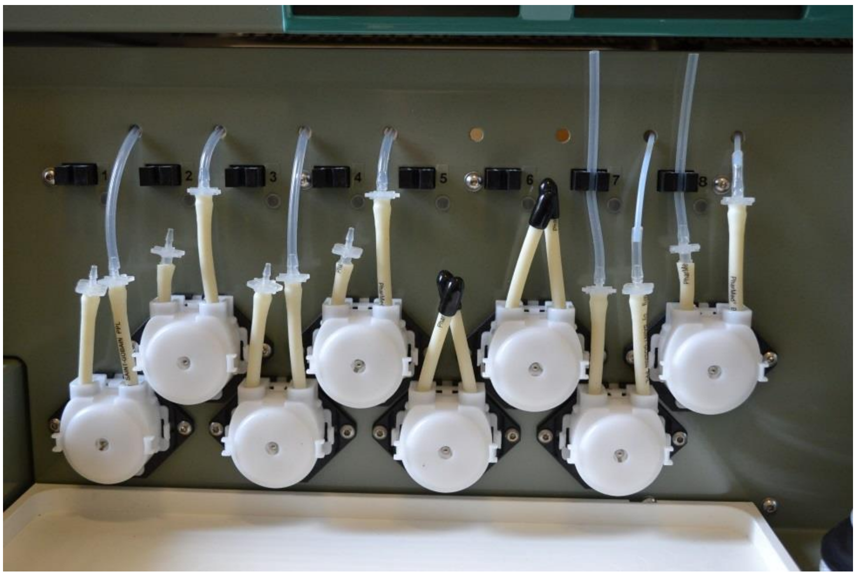

For the peristaltic pump casette replacement push two levers on left and right side of the cassette and pull the cassette down from the shaft. The shaft can be slightly roughen by a fine sandpaper in the longitudinal direction (for better adhese between shaft and the casette cylinders).

If the new peristaltic pump cassettes are used, shorten the left side tubes at pumps 2,4,6 and 8. Put on the fittings to the pump tubing.

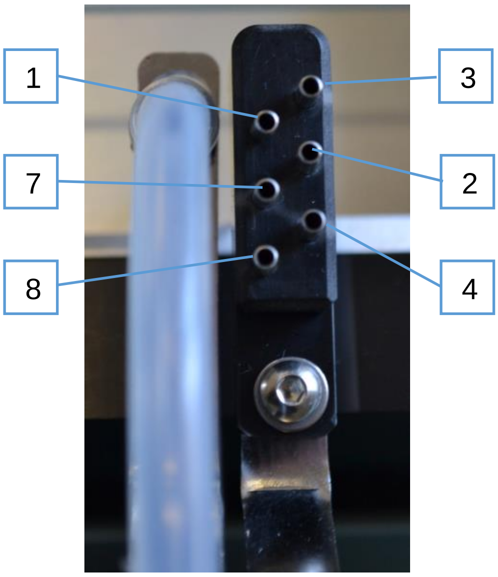


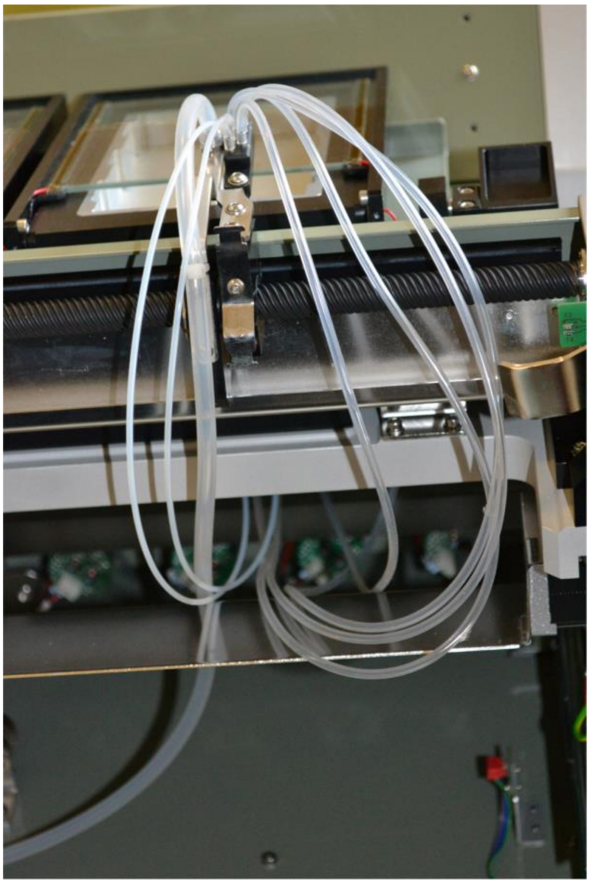

Put the silikon tube conjuctions to the pump 7 and 8 (it will be used for the teflon tube connection).

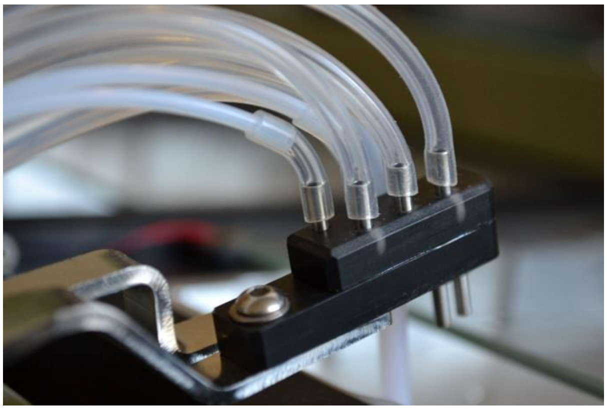
Put the silicon and teflon tubes to all pumps and push it through the holes into the instrument inside.



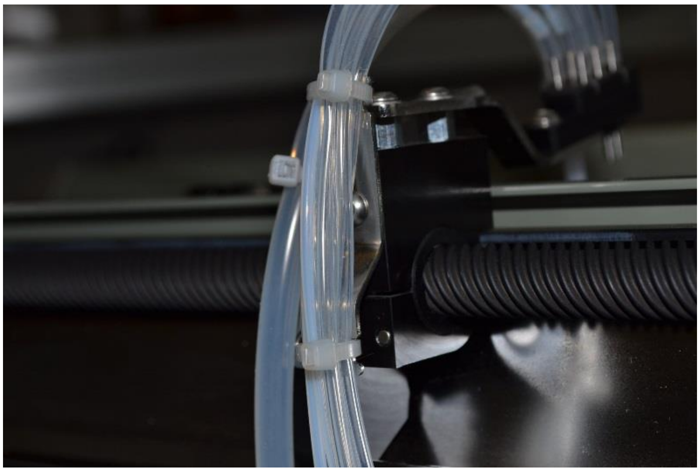
Put the tubes to the dispensing head according to the picture. Use the silicon tube conjuctions for the channnels 7 and 8.


1
3
7
2
8
4

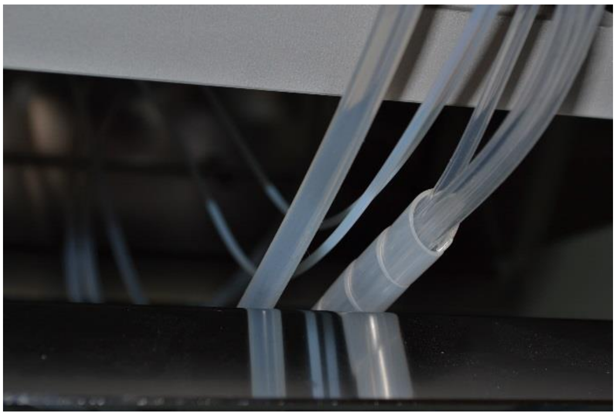




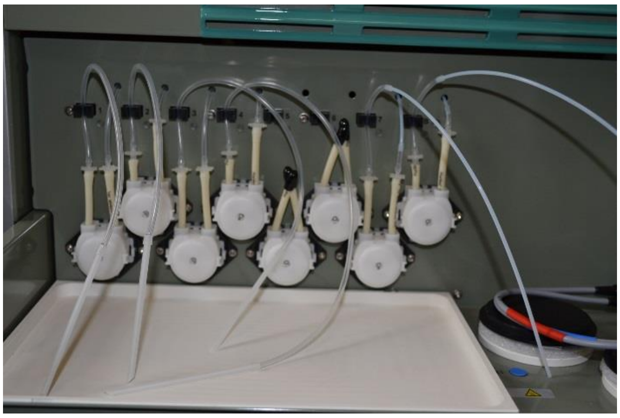
Secure the tubes to the holder on the back side of the x-shift arm. Use the plastic bindings.



Put the binding spiral on the silikon tubes and move it to position according to the second picture.

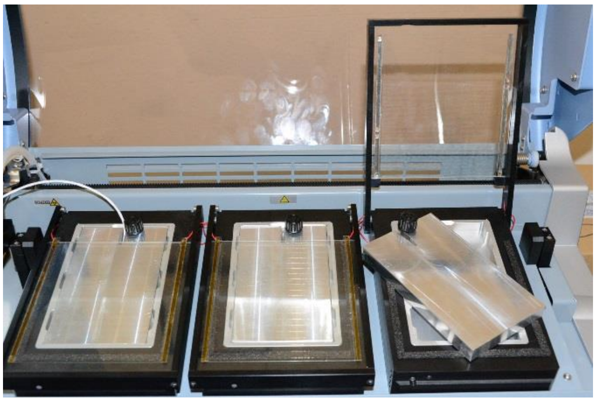


Put the bottle tubes with straws to pumps. Place it into the sensors bodies.



## 5.2. Heated blocks temperature precision check

Use the ***Setup/Instrument checking/Heating bloks/Heating block 1,2*** or 3 menu **–** set Setpoint 40,0 and 60,0 °C. Wait for temperature stabilization. Measure the real temperature of the heating blocks by the adapters. The real temperature deviation must be less than +/- 0,5 °C.
The time effective method is to use 3 adapters. First set the 40 °C setpoint. After temperatures value on the instrument display stabilization put the temperature probe step by step to the adapters. Then repeat it for 60 °C setpoint. During heating and measurement keep the instrument cover closed.
In case the real temperature is out of range the temperature calibration must be done (see User manual, capter 4.7.1 Temperature calibration).



## 5.3. Reagents heating positions temperature precision check

<u>Temperature – internal thermo probes</u>

Select the external reag. Positions sensors (***Setup/Reag.positions sensor/Internal***).
Use the ***Setup/Instrument checking/Heating bloks/Reagent positions 1*** or ***2*** menu **–** set Setpoint 50,0 °C. Wait for temperature value on the instrument display stabilization. Measure the real temperature at the heating plates by the adapter. Actual temperature range 49,5 - 50,5 °C. Surface temperature 49,0 – 51,0 °C.

Temperature – external thermo probes

Select the external reag. Positions sensors (***Setup/Reag.positions sensor/External***)
Use the ***Setup/Instrument checking/Heating bloks/Reagent positions 1*** or ***2*** menu **–** set Setpoint 50,0 $^{o}$C. Wait for temperature value on the instrument display stabilization – it will oscilate a little around the set point.  Measure the real temperature in the bottles with DI H2O. Actual temperature range 49,0 – 51,0 $^{o}$C. DI H2O measurement temperature +/- 1 $^{o}$C around actual temperature.

# 6. DynLab software

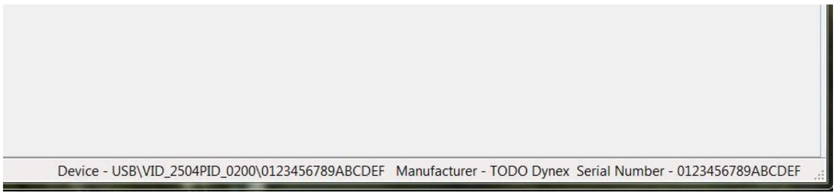
DynLab is the service software. It can be used for the instrument firmware and update of parameters. Settings must be set according to the manufacturer instruction to avoid the instrument malfunction.

## 6.1. DynLab connection

Switch on the instrument and set the connection
Main menu / PC connection

Connect the USB cable (Instrument – PC)

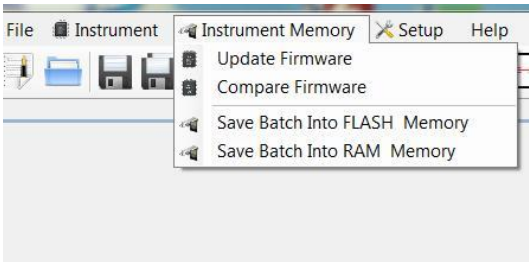
Open the DynLab software. If the instrument is correctly connected the identification data are in the bottom bar




## 6.2. Mainboard firmware update

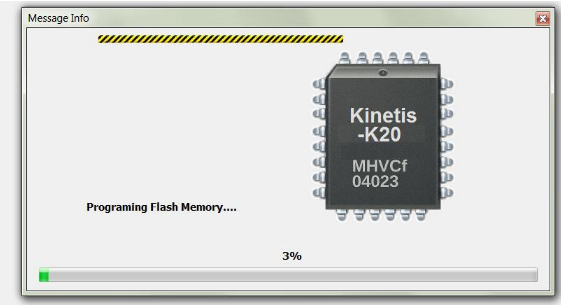
The firmware for the mainboard can be updated by PC with DynLab SW.
It is distributed as the *DBH_MB_a.b.c.d.S19* files.
a, b – numbers of FW version. It apperars on the display after the instrument switch on (f.e. 1.3)
c – number which must fit with language files versions that are saved in the directory LANG at the instrument SD card. (f.e. C=1 then English 1.0 or English 1.1, ...)
d – everytime d = 0. It means released version of the firmware.

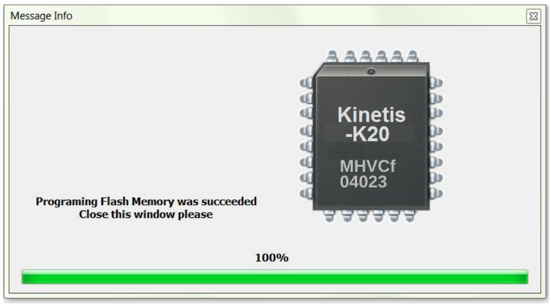
Update procedure:
Use the menu Instrument memory / Update Firmware




The instrument connects as the Bootloader now


Select appropriate .S19 file in the dialog window and open it. The data transfer starts.






When programming is finished close the Message info window and DynLab.
Switch off the instrument and disconnect the USB cable.
If the new firmware is not compatible with language files saved in the directory LANG at the instrument SD card the default small english font is used for texts displaying. Copy correct versions of langusge files to the SD card and use *Setup / Language* menu for required language selection.

### 6.3. The other board firmwares update

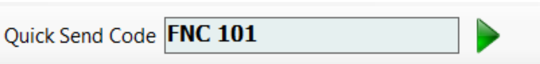
The chassis board, sensor board and 3 regulator boards firmwares can be updated via files saved on the SD card.

Update procedure :
Connect the instrument with PC via USB

Use file explorer and open SD card (drive called DBH), copy the updated firmware files to corresponding directories in the FW directory:

CHASSIS – DBH_CHASSIS_BTLD_x_xx.bin
SENSOR - DBH_SENSOR_BTLD_x_xx.bin
REGULATOR – DBH_REGULATOR_BTLD_x_xx.bin

- open the Dynlab SW. Use Quick Send Code line for corresponding command sending



. Write instructions and press  ( or Enter):

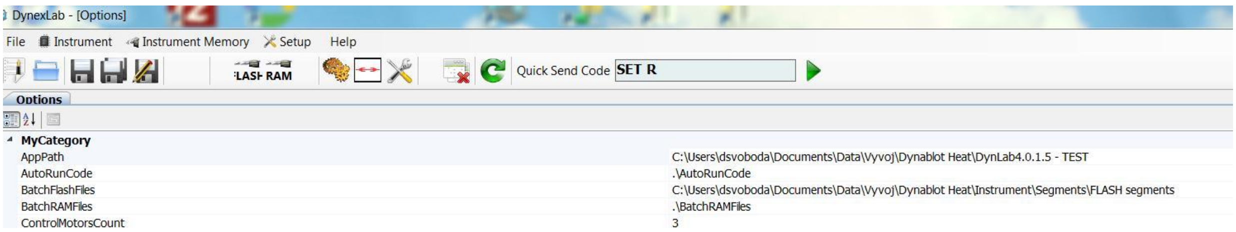
| Board | Instruction |
|---|---|
| Regulator of the 1. block | FNC 101 |
| Regulator of the 2. block | FNC 102 |
| Regulator of the 3. block | FNC 103 |
| Sensor board | FNC 104 |
| Chassis board | FNC 105 |
| All boards | FNC 110 |

The instrument comes to FW programming mode. The display showes the programming procedure messages :
(example for the chassis board)
BOOT CHASSISBOARD
Load: 0:\FW\CHASSIS\ DBH_CHASSIS_BTLD_1_11.bin
Clear FLASH
Done
Ctc : xxxxxxx Adr : xxxxxxx
Programming finished. Please reboot.
Switch OFF the instrument. Switch ON the instrument and check the FW number in the initial display.

## 6.4. Segments update

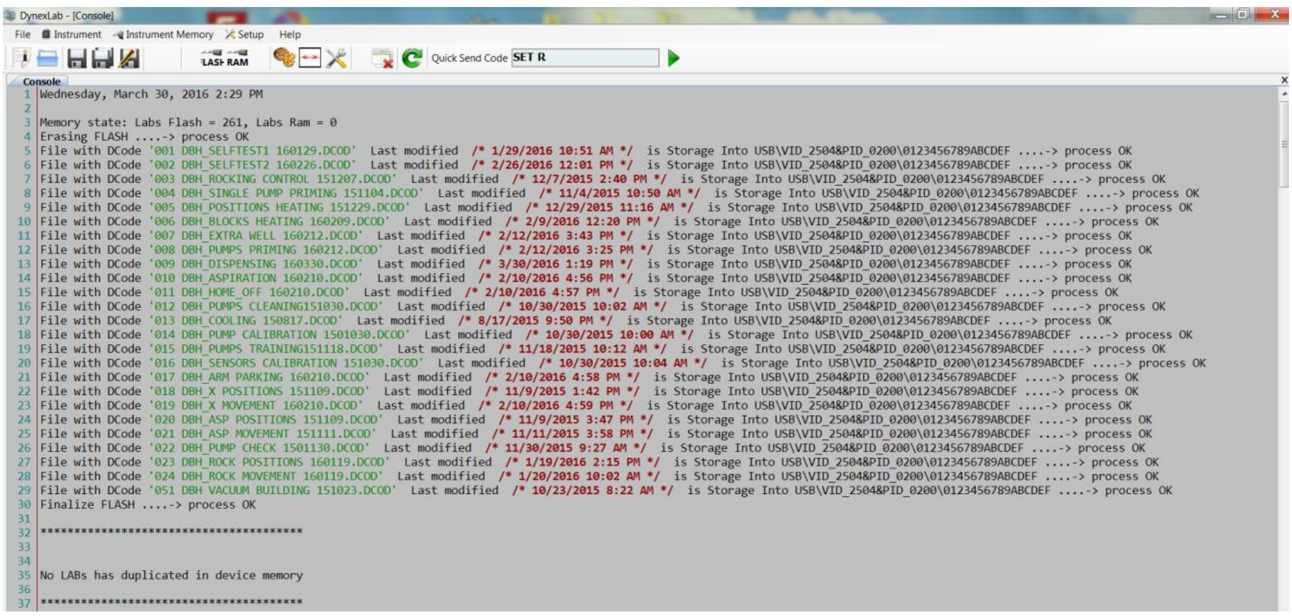
The segments are short subroutines in the D-code language and they are issued in the segment package – a directory with files. Name of the segment package and directory is
DBH_segment_pack_YYMMDD     (year, month and day of the release)

Update procedure:
Copy the pack files to a directory. The path to this directory must be set in Setup/Options/ BatchFlashFiles or use the button 




Then select  Instrument memory/Save Batch into FLAHSH memory or use the button  .

The segments will be saved to the instrument memory.




Close the DynLab and safely remove the USB cable.

## 6.5. I-parameters update

The I-parameters are numeric constants saved in the instrument FLASH memory. It is used for the adjustment of the instrument operation.

| Number | Typ. | Name | Comment |
|---|---|---|---|
| [Motors calculation] | | | |
| R1001 | 1 | Steps calculation, multiplier ASP ARM | Don´t change this parameters |
| R1002 | 1 | Steps calculation, factor ASP ARM | |
| R1003 | -120 | Home switche Offset ASP ARM | |
| R1004 | 0 | Zero Offset ASP ARM | |
| R1005 | 0 | Home direction ASP ARM | |
| R1006 | 15 | Low current ASP ARM | |
| R1007 | 40 | High current ASP ARM | |
| R1008 | 500 | Initial movement speed ASP ARM | |
| R1011 | 10 | Steps calculation, multiplier X | |
| R1012 | 1 | Steps calculation, factor X | |
| R1013 | -500 | Home switche Offset X | |
| R1014 | 0 | Zero Offset X | |
| R1015 | 0 | Home direction X | |
| R1016 | 15 | Low current X | |
| R1017 | 35 | High current X | |
| R1018 | 500 | Initial movement speed X | |
| R1021 | 1 | Steps calculation, multiplier ROCKING | |
| R1022 | 1 | Steps calculation, factor ROCKING | |
| R1023 | 200 | Home switche Offset ROCKING | |
| R1024 | -200 | Zero Offset ROCKING | |
| R1025 | 1 | Home direction ROCKING | |
| R1026 | 1 | Low current ROCKING | |
| R1027 | 20 | High current ROCKING | |
| R1028 | 400 | Initial movement speed ROCKING | |
| [Calibration] | | | |
| R1031 | 80 | Pump 1 calibr. | These parameters are saved during the peristaltic pumps calibration |
| R1032 | 80 | Pump 2 calibr. | |
| R1033 | 80 | Pump 3 calibr. | |
| R1034 | 80 | Pump 4 calibr. | |
| R1035 | 80 | Pump 5 calibr. | |
| R1036 | 80 | Pump 6 calibr. | |
| R1037 | 80 | Pump 7 calibr. | |
| R1038 | 80 | Pump 8 calibr. | |
| R1039 | 3 | Pumps calibr.correction | Correction of the pump calibration constants. It is used during constants saving. 0% - without correction, Value can be -/+ X %. |
| R1700 | 0 | Blok1 calib. A1 1/2 | These parameters are saved during the Blocks temperature calibration. Typ. Values of the parameters are for neutral calibration. |
| R1701 | 16256 | Blok1 calib. A1 2/2 | |
| R1702 | 0 | Blok1 calib. B1 1/2 | |
| R1703 | 0 | Blok1 calib. B1 2/2 | |
| R1704 | 0 | Blok2 calib. A1 1/2 | |
| R1705 | 16256 | Blok2 calib. A1 2/2 | |

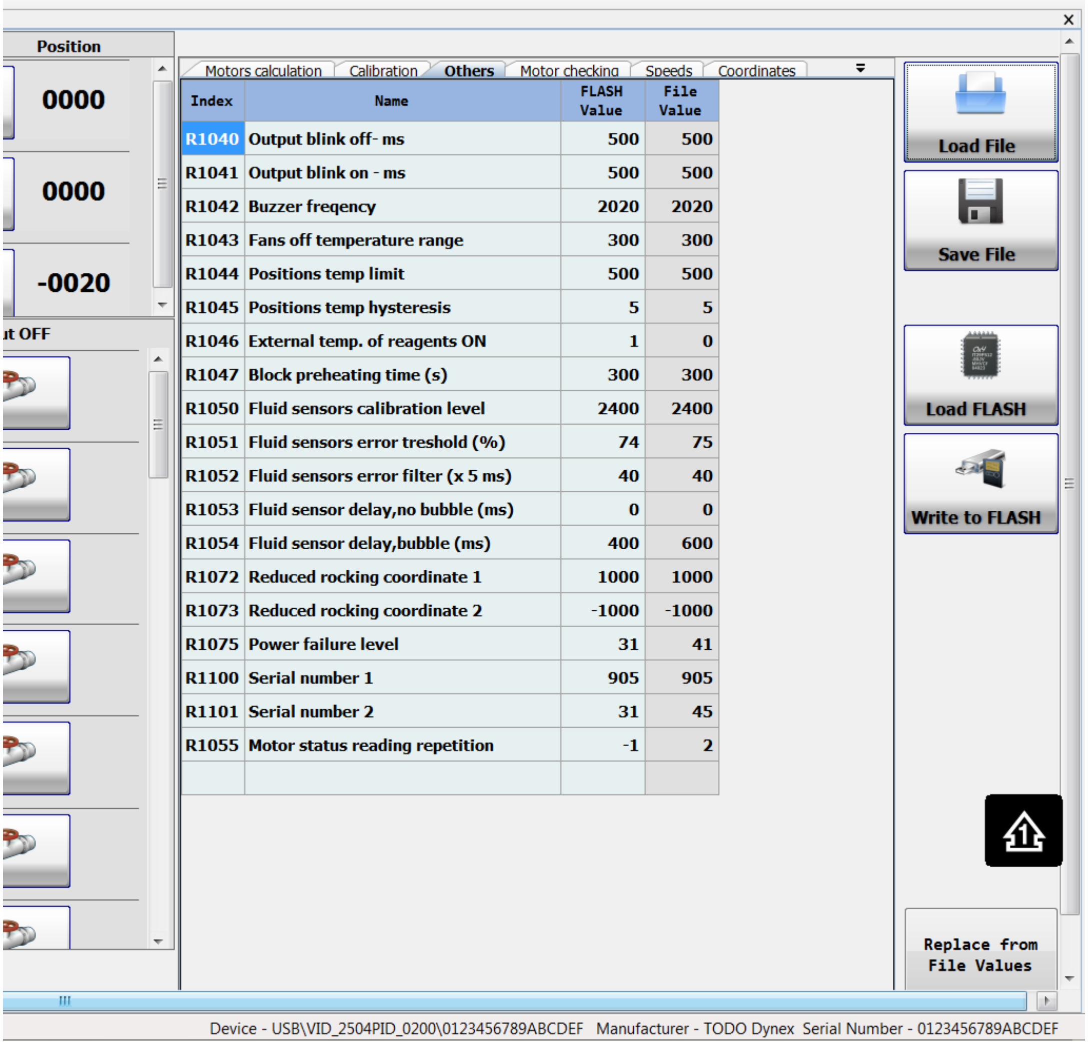
| | | | |
|---|---|---|---|
| R1706 | 0 | Blok2 calib. B1 1/2 | |
| R1707 | 0 | Blok2 calib. B1 2/2 | |
| R1708 | 0 | Blok3 calib. A1 1/2 | |
| R1709 | 16256 | Blok3 calib. A1 2/2 | |
| R1710 | 0 | Blok3 calib. B1 1/2 | |
| R1711 | 0 | Blok3 calib. B1 2/2 | |
| | | [Others] | |
| R1040 | 500 | Output blink off- ms | Don´t change this parameters |
| R1041 | 500 | Output blink on - ms | |
| R1042 | 2020 | Buzzer freqency | |
| R1043 | 300 | Fans off temperature range | Temperature change per minute to stop the block cooling. 100 equal 0,1ºC |
| R1044 | 500 | Positions temp limit | Don´t change this parameters |
| R1045 | 5 | Positions temp hysteresis | |
| R1046 | 0 | External temp. of reagents ON | The parameret is saved according to selection in Setup/Reag.positions sensor |
| R1047 | 300 | Block preheating time (s) | The time for the blocks preheating after external reagent sensors meassure temperatures over the thresholds. |
| R1050 | 2400 | Fluid sensors calibration level | Don´t change this parameters |
| R1051 | 50 | Fluid sensors error treshold (%) | |
| R1052 | 8 | Fluid sensors error filter (x 25 ms) | |
| R1053 | 300 | Fluid sensor delay (ms) | |
| R1054 | -1 | Reserve | |
| R1055 | 2 | Motor status reading repetition | |
| R1056 | 15 | Communication check mask | 4 bits, 8-sensor b. 4-Block b.3 2-Block b.2 1-Block b.1 |
| R1072 | 1000 | Reduced rocking coordinate 1 | Don´t change this parameters |
| R1073 | -1000 | Reduced rocking coordinate 2 | |
| R1075 | 41 | Power failure level | |
| R1100 | 905 | Serial number 1 | Instrument serial number in two parts |
| R1101 | | Serial number 2 | |
| R1102 | 0 | Setup code | Setup menu access code |
| | | [Motor checking] | |
| R1060 | 95 | ASP ARM front range | Don´t change this parameters |
| R1061 | 50 | ASP ARM rear range | |
| R1062 | 30 | ASP ARM microsteps tolerance | |
| R1063 | 600 | ASP ARM reference timeout | |
| R1064 | -19700 | X IRC coeficient | |
| R1065 | -1 | Reserve | |
| R1066 | 300 | X microsteps tolerance | |
| R1067 | 6000 | X reference timeout | |
| R1068 | 200 | ROCKING front range | |
| R1069 | 200 | ROCKING rear range | |
| R1070 | 150 | ROCKING microsteps tolerance | |
| R1071 | 12000 | ROCKING reference timeout | |
| | | [Speeds] | |
| R1500 | 100 | Asp.arm accel -low | Don´t change this parameters |
| R1501 | 100 | Asp.arm speed- low | |
| R1502 | 300 | Asp.arm accel -high | |

| | | | |
|---|---|---|---|
| R1503 | 500 | Asp.arm speed- high | |
| R1504 | 100 | X accel -low | |
| R1505 | 100 | X speed- low | |
| R1506 | 80 | X accel -high | |
| R1507 | 1000 | X speed- high | |
| R1508 | 50 | Rocking accel - default | |
| R1509 | 800 | Rocking speed- default | |
| | | [Coordinates] | |
| R1550 | | X priming bowl | These parameters are saved by adjusting in Setup/X-shift position menu |
| R1551 | | X 1. block | |
| R1552 | | X 2. block | |
| R1553 | | X 3. block | |
| R1554 | | Asp.arm priming bowl | These parameters are saved by adjusting in Setup/Aspiration arm position menu |
| R1555 | | Asp.arm well | |
| R1556 | -2300 | Rocking up | Rocking up coordinate |
| R1557 | | Rocking horizontal | These parameter are saved by adjusting in Setup/Rocking position menu |
| R1558 | 3100 | Rocking down | Rocking down coordinate |
| R1559 | 94 | X well offset | X-shift step between wells |
| R1560 | 2000 | Rocking down -disp.mixing | Rocking coordinate for mixing after filling of every 3 wells |
| R1561 | 400 | Asp.arm ready offset | Coordinate for the aspiration arm above well bottom. The arm moves slowly down from this position. |
| | | [Constants] | |
| R1601 | 30 | Priming volume Pump 1 | Volume in 0,1 ml used for the first pump priming when Drop button is pressed.<br>It is used for reagent saving too.<br>Adjust this values for reagents tube lenght. It is important for Auto preparation. |
| R1602 | 30 | Priming volume Pump 2 | |
| R1603 | 30 | Priming volume Pump 3 | |
| R1604 | 30 | Priming volume Pump 4 | |
| R1605 | 30 | Priming volume Pump 5 | |
| R1606 | 30 | Priming volume Pump 6 | |
| R1607 | 20 | Priming volume Pump 7 | |
| R1608 | 20 | Priming volume Pump 8 | |
| R1609 | 5 | Priming volume reduced | Volume in 0,1 ml used for next pump primings when Drop button is pressed and priming before dispensing |
| R1610 | 1300 | Aspiration time (ms) | Time for well aspiration |
| R1611 | 2000 | Aspiration time extra(ms) | Not used |
| R1612 | 20 | Extra well volume | Volume in 0,1 ml for extra wells filling |
| R1613 | -14 | Saving vol.heated reag. Pump 7 | Volume in 0,1 ml for reagent saving during heated reagent channel preheating |
| R1614 | -14 | Saving vol.heated reag. Pump 8 | |
| R1615 | 13 | Priming vol.heated reag. Pump 7 | Volume in 0,1 ml for reagent priming during heated reagent channel preheating |
| R1616 | 13 | Priming vol.heated reag. Pump 8 | |
| R1621 | 5 | Bloks temp.warning limit high | Temperature range in 0,1°C for blocks temperature out of range warning |
| R1622 | 15 | Bloks temp.warning limit low | |
| R1623 | 15 | Reag.pos.temp. warning limit high | Temperature range in 0,1°C for reag.positions temperature out of range warning |
| R1624 | 15 | Reag.pos.temp warning limit low | |
| R1625 | | Time compensation register | See capter 6.5 Real time clock compensation |
| R1626 | | Compensation interval register | |
| | | [PID param] | |

| | | | |
|---|---|---|---|
| R1650 | 0 | Blok1 Temperature sensor offset | Don´t change this parameters |
| R1651 | 200 | Blok1 P | |
| R1652 | 1000 | Blok1 I | |
| R1653 | 0 | Blok1 D | |
| R1654 | 0 | Blok2 Temperature sensor offset | |
| R1655 | 200 | Blok2 P | |
| R1656 | 1000 | Blok2 I | |
| R1657 | 0 | Blok2 D | |
| R1658 | 0 | Blok3 Temperature sensor offset | |
| R1659 | 200 | Blok3 P | |
| R1660 | 1000 | Blok3 I | |
| R1661 | 0 | Blok3 D | |
| R1662 | 0 | Pozice1 Temperature sensor offset | |
| R1663 | 700 | Pozition1 P | |
| R1664 | 500 | Pozition1I | |
| R1665 | 0 | Pozition1D | |
| R1666 | 0 | Pozice2 Temperature sensor offset | |
| R1667 | 700 | Pozition2 P | |
| R1668 | 500 | Pozition2 I | |
| R1669 | 0 | Pozition2 D | |

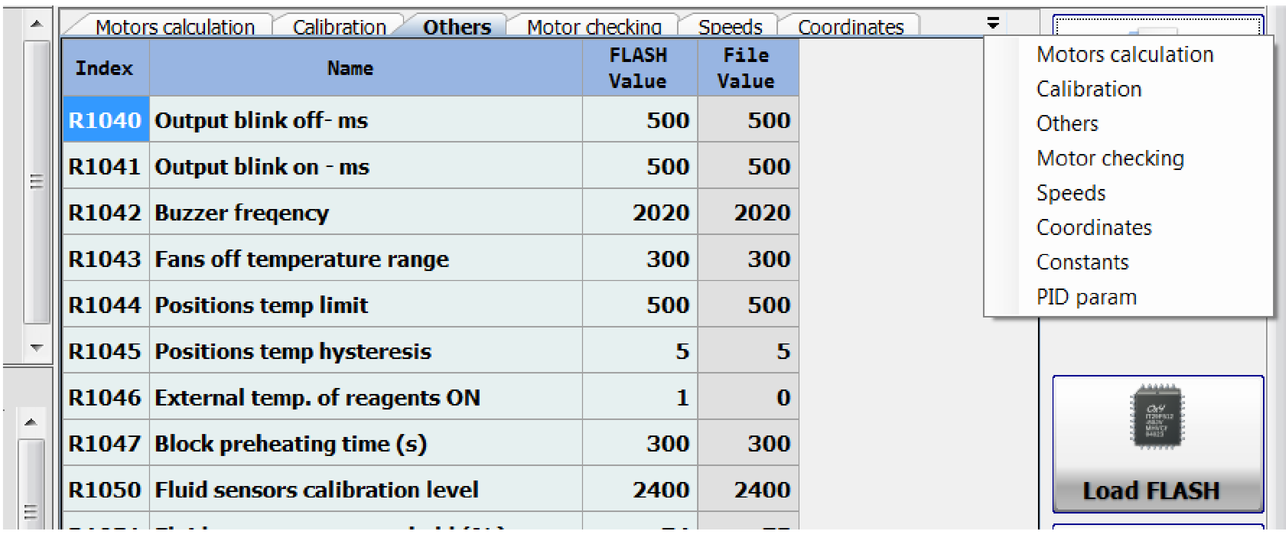
Use Instrument / Components control menu or the button  . The Component control folder opens.

The right part of the screen is used for I-parameters handling.
Buttons:
Load file – the file ( .ipar) with previously saved parameters is opened in File Value column and parameters are loaded from the instrument to FLASH Value column
Save file – saving values from FLASH Value column to the file (.ipar)
Load FLASH - parameters are loaded from the instrument to FLASH Value column, the default file (FlashParams.ipar in DynLab directory) is used for FILE Value column
Write to FLASH – saving values from FLASH Value column to the instrument memory and after confirmation to the file (.ipar)
Replace from file values – all values from File Value column are copied to FLASH Value column.




| Index | Name | FLASH Value | File Value |
|---|---|---|---|
| R1040 | Output blink off- ms | 500 | 500 |
| R1041 | Output blink on - ms | 500 | 500 |
| R1042 | Buzzer freqency | 2020 | 2020 |
| R1043 | Fans off temperature range | 300 | 300 |
| R1044 | Positions temp limit | 500 | 500 |
| R1045 | Positions temp hysteresis | 5 | 5 |
| R1046 | External temp. of reagents ON | 1 | 0 |
| R1047 | Block preheating time (s) | 300 | 300 |
| R1050 | Fluid sensors calibration level | 2400 | 2400 |
| R1051 | Fluid sensors error treshold (%) | 74 | 75 |
| R1052 | Fluid sensors error filter (x 5 ms) | 40 | 40 |
| R1053 | Fluid sensor delay,no bubble (ms) | 0 | 0 |
| R1054 | Fluid sensor delay,bubble (ms) | 400 | 600 |
| R1072 | Reduced rocking coordinate 1 | 1000 | 1000 |
| R1073 | Reduced rocking coordinate 2 | -1000 | -1000 |
| R1075 | Power failure level | 31 | 41 |
| R1100 | Serial number 1 | 905 | 905 |
| R1101 | Serial number 2 | 31 | 45 |
| R1055 | Motor status reading repetition | -1 | 2 |

The parameters value can be changed in the FLASH Value column. They are organized in the folders. Pay atention - not all folders can be seen above the table. Some hidden ones are accessible from right pop menu.




| Index | Name | FLASH Value | File Value |
|---|---|---|---|
| R1040 | Output blink off- ms | 500 | 500 |
| R1041 | Output blink on - ms | 500 | 500 |
| R1042 | Buzzer freqency | 2020 | 2020 |
| R1043 | Fans off temperature range | 300 | 300 |
| R1044 | Positions temp limit | 500 | 500 |
| R1045 | Positions temp hysteresis | 5 | 5 |
| R1046 | External temp. of reagents ON | 1 | 0 |
| R1047 | Block preheating time (s) | 300 | 300 |
| R1050 | Fluid sensors calibration level | 2400 | 2400 |

## 6.6. Real time clock compensation

Built in real time clock needs the compensation for accurate operation. It can be done by saving the correction values to the processor registers.

Procedure :
Clear the compensation registers before the clock accuracy measurement.
Reset the parameters, save them to FLASH and switch the instrument off and on ( zero values are active now)

| | | |
|---|---|---|
| R1625 | 0 | Time compensation register |
| R1626 | 0 | Compensation interval register |

To find accuracy error set the instrument clock with some accurate clock (for example PC).
After 1or 2 days of measured time find the difference between clocks.

Count correction constants, use DBH_RTC_correction .xlsx table (see Help in it).

Set the compensation registers:

| | | |
|---|---|---|
| R1625 | [Correction] | Time compensation register |
| R1626 | [Intreval] | Compensation interval register |

Switch the instrument off and on ( new values are active now)

Example :

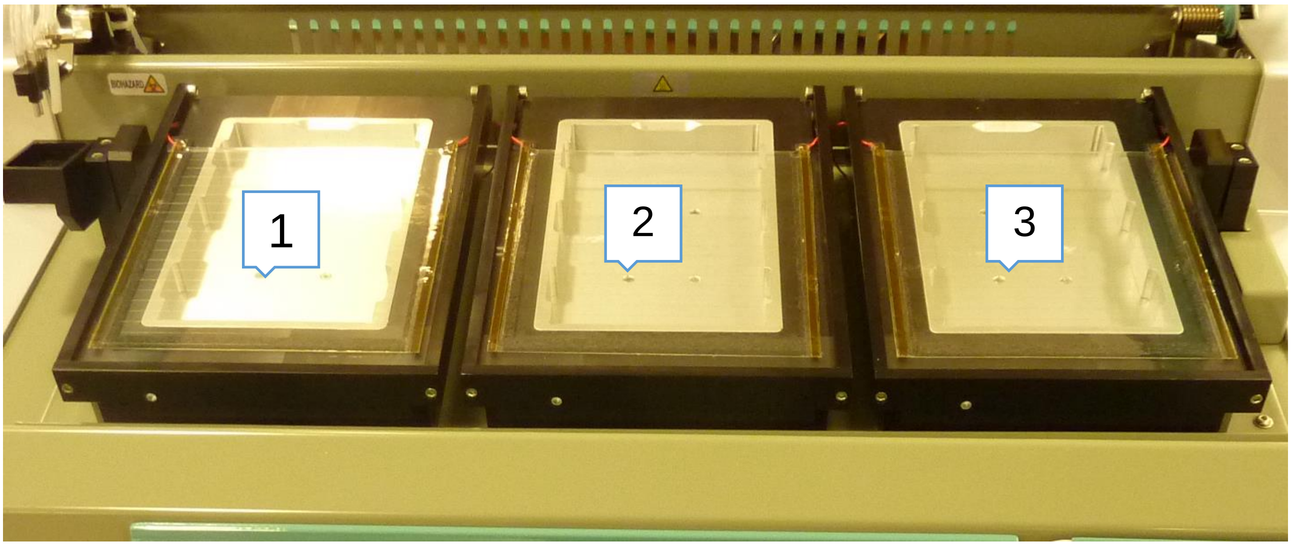
| | PC | Instrument |
|---|---|---|
| Clock setting | 20.9.2016 | 17:42:00 |
| Time and clock reading | 21.9.2016 10:47:00 | 10:47:18 |
| Meassured time / RTC error | 61 500 s | +18 s |

The smallest number (0,007) is in green column A. In this row the green column E contains absolute value of Time compensation constant (115) and the G column contains raw compensation interval (12).
Set the compensation registers:

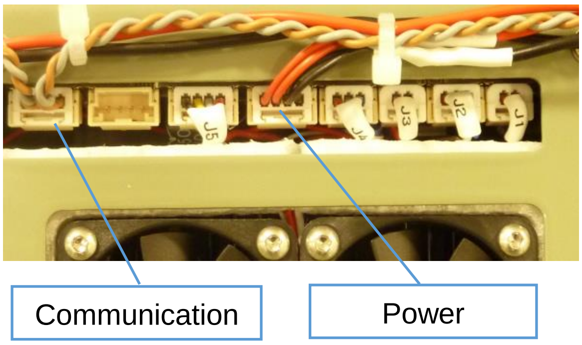
| | | |
|---|---|---|
| R1625 | -115 | RTC was faster therefore negativ value. |
| R1626 | 11 | Value from the table decreased by one. |

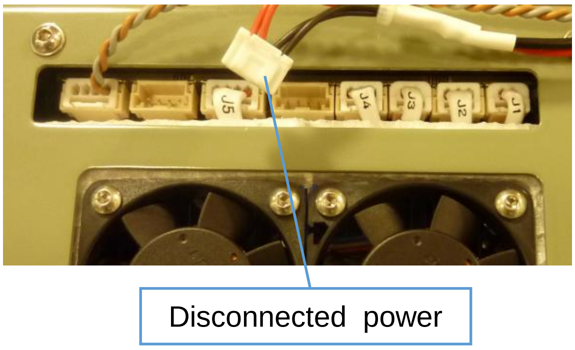
## 6.7. Block address

When the heated block is replaced its address must be set according to the block position on the rocking holder. Address numbers are 1, 2, 3 form the left side to right side.




When you look for the block current address disconnect the power connectors of the other two blocks. (Note : The new spare heated block are set to address 1).



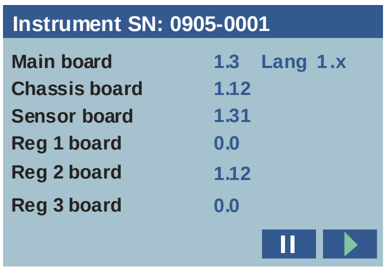




The communication connectors of all three blocks must be connected.
Switch on the instrument and check the number of the block 1,2,3 firmware versions - position the number of which is not equal 0.0 is the address of the connected block.

Its address can be changed by using the Quick send code line. Write instructions and press ( or Enter):

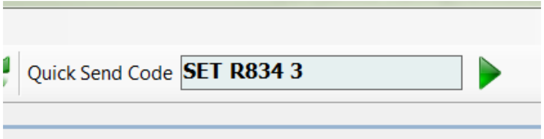
| Current addres | Instruction |
|---|---|
| 1 | SET R833 [new address] |
| 2 | SET R834 [new address] |
| 3 | SET R835 [new address] |

Example:
After replacement of the block on the 3. position disconnect the power on the 1. and 2. positions and switch on the instrument.




that means the current replaced block address is 2

We want to change it to 3.
Instruction is  SET R834 3




Switch off the instrument and connect the power of all blocks.

### 6.8. Block temperature sensor compensation

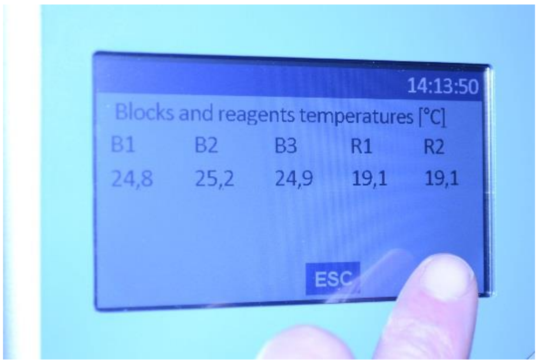
The block temperature built in probe offset can be compensated by saving the compensation constant to the block control board FLASH memory.
The measurement of compensation constants is doing at ambient temperature with the adaptor and the external thermometer. The constant is difference between temperature displayed by the instrument and by the external thermometer. After conpensation these two values are near the same.

Before the measurement must be actual constant saved in the block board FLASH memory set to 0 by using the Quick send code line.

| Block address | Instruction |
|---|---|
| 1 | SET R839 0 |
| 2 | SET R840 0 |
| 3 | SET R841 0 |

The special service screens can be used for the display of the block temperatures. It is accessible by the hidden button pressing :


and





Use buttons for listing in regulators screens.

Insert the adaptor to block, insert the probe to adaptor, close the lid and wait for both values stabilization.


Then calculate value :
Correction = Ext.termometer temp - Block temp.

Rounded value in tenths of °C set to FLASH.

| Block address | Instruction |
|---|---|
| 1 | SET R839 [Correction] |
| 2 | SET R840 [Correction] |
| 3 | SET R841 [Correction] |

Example :

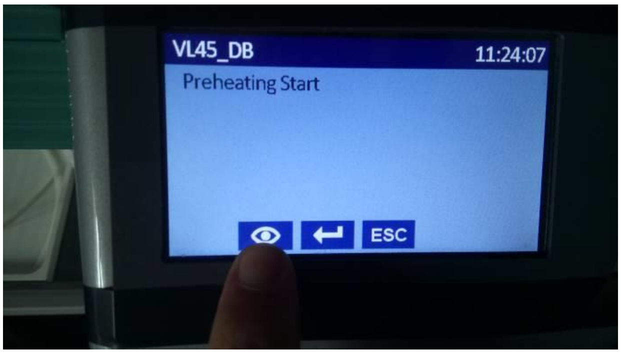
Block temperature: 26,54 °C
External thermometer temp.: 25,82 °C

Correction = 25,82 - 26,54 = -0,72

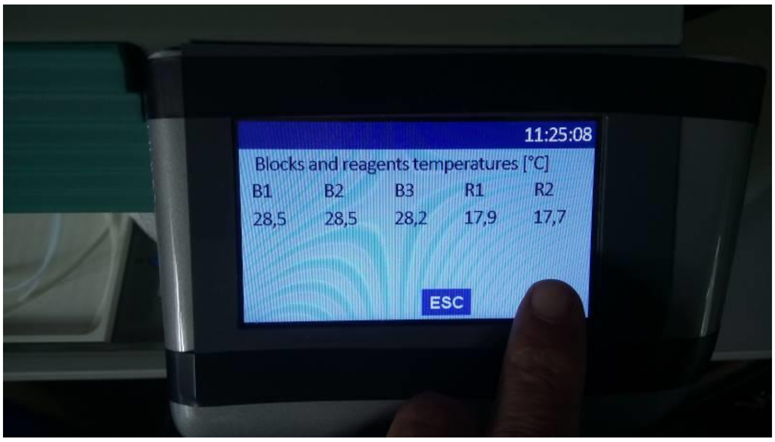
In case of the block 1 : SET R839 -7

## 7. Auxiliary screens

The auxiliary screens can be used during the service works for the analysis of some instrument components operation.
First open the screen *Block and reagents temperatures*. It can be done by the „Eye“ button or the hidden button in the right bottom button in the *Main menu* sceen.




Push the hidden button in the right bottom button in the *Block and reagents temperatures* sceen.




The first auxiliary screen is opened. The movement among the screens is done by the arrow buttons left and right. For the auxilary screen closing use the ESC button.

List of the scrennss :

1. Temperature controller 1 – the lid heating of the 1. heating block
2. Temperature controller 2 – the body heating of the 1. heating block
3. Temperature controller 3 – the lid heating of the 2. heating block
4. Temperature controller 4 – the body heating of the 2. heating block
5. Temperature controller 5 – the lid heating of the 3. heating block
6. Temperature controller 6 – the body heating of the 3. heating block
7. Temperature controller 7 – the reagent position 1. (blue)
8. Temperature controller 8 – the reagent position 2. (red)
9. Test I2C
10. Test KM
11. The liquid sensors of the reagent lack
12. Real time clock
13. Various system internal parameters

### 7.1.1 – 8 Temperature controler screens



| | | |
|---|---|---|
| PWM | 1 – 8 OFF / ON | The controller number, the status OFF or ON |
| Zadana | Number x.xx °C | The temperature setpoint |
| PID P | Number | The controller Proporcional constant |
| PID I | Number | The controller Integrative constant |
| PID D | Number | The controller Derivative constant |
| TAct | Number 0 – 100 % | The controler output |
| FANInt | Neprobehl / Probehl | Test of the blocks fans turning. Neprobehl – no turning, Probehl - turning |
| Skutecna | Number x.xx °C | The temperature measured by probe, in case controllers 7 and 8 the internal or external probe is displayed acccording to Reagents position sensors setting. |
| Maximalni | Number x.xx °C | Limit of temperature |
| PID Fix | Number 0 – 100 % | The controler output fix value ( no regulation to a setpoint) |
| PID Max | Number 0 – 100 % | Max alloved value of the controller output |
| PID Sum | Number | The controller Integrative variable current value |
| FANPer | Number | The variable displayed the fan of the blocks rotation |

### 7.2.9 I2C screen

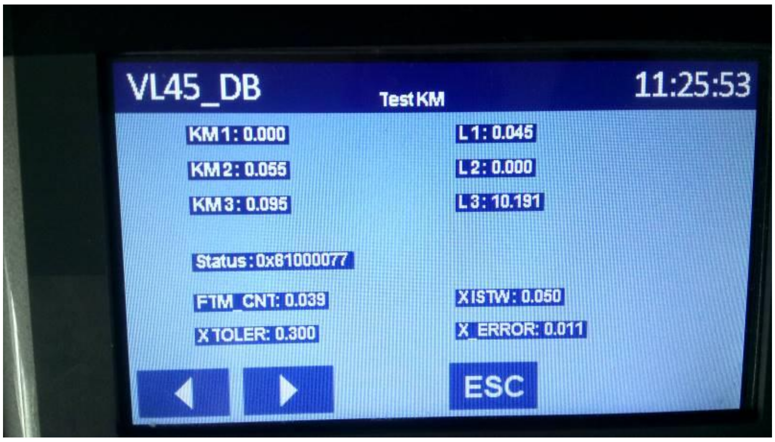
The temperature values [xx.xx oC] of the sensors of the reagent positions 1 and 2


The temperature values at the address lines are assigned to sensors related to setting of the menu Setup / 02 Reag positions sensors :

| Address | Reag. position probes setting : Internal | Reag. position probes setting : External |
|---|---|---|
| 0x90 | Internal probe of the position 1 | External probe of the position 1 (blue) |
| 0x94 | Internal probe of the position 2 | External probe of the position 2 (red) |
| 0x98 | External probe of the position 1 (blue) | Internal probe of the position 1 |
| 0x9C | External probe of the position 2 (red) | Internal probe of the position 2 |

### 7.3.10 Test KM

The stepper motors coordinates




| | | |
|---|---|---|
| KM1 | Number | Aspiration arm actual position coordinate |
| L1 | Number | Aspiration arm number of steps lost at the time to going back to 0 coordinate |
| KM2 | Number | X shift actual position coordinate |
| L2 | - | Not used |
| KM3 | Number | Rocking actual position coordinate |
| L3 | Number | Aspiration arm number of steps lost at the time to going through 0 coordinate |
| Status | Number | Internal status word of the motors control |
| FTM_CNT | Number | Counter of pulses from x-shift incremental sensor |
| XISTW | Number | Counter of the x-shift stepper motor steps |
| X_TOLER | Number | Max allowed tolerance between FTM_CNT and XISTW (set by i-parameter R1066 X microsteps tolerance) |
| X_ERROR | Number | X_ERROR = XISTW - X_TOLER, if (X_ERROR > X_TOLER) -> *105 X shift error* appears |

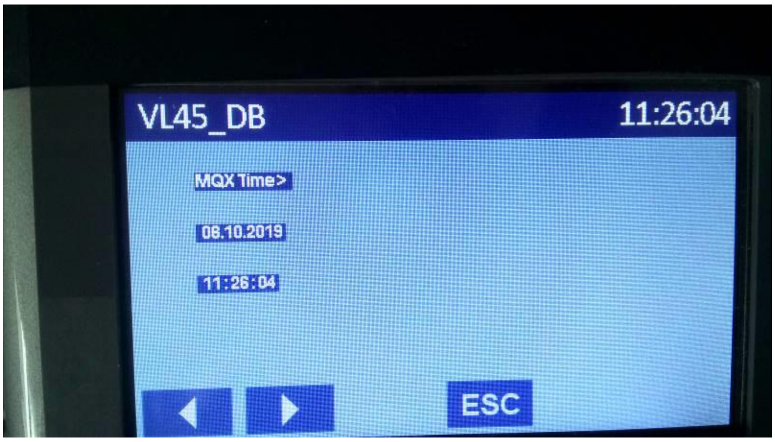
### 7.4.11 The liquid sensors of the reagent lack

The value of signal from the liquid sensors ( Cannnel 1- 8)

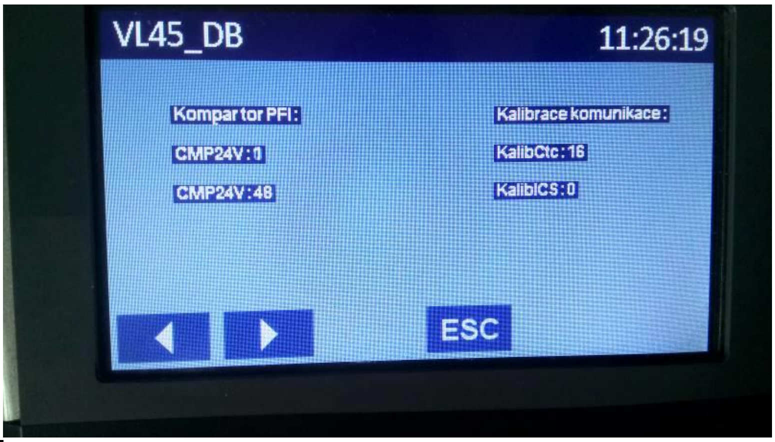

| | | |
|---|---|---|
| ADC0 : 0 - 7 | Number / _ K or E | The signal from the sensors.<br>_ - the calibration has not done<br>K - the calibration was successfully done, the value is near 2,4<br>E - the calibration was done but without sucess ( warning message is generated) |
| BublError | Number | Reagent lack detection during the dispensing |

### 7.5.12 Real time clock

On line value of the date and the time in the RTC on the mainboard.




### 7.6.13 Various system internal parameters




-

Komparator PFI – comparator of the power supply level used for the power supply failure handling

| | | |
|---|---|---|
| CMP24V | 0/1 | O and 1 quickly change when the comparator is in the balance |
| CMP24V | Number | Value proportional to the supply voltage. When this value fails down bellow the value of the i-parameter *R1075 Power failure level* the instrument saves the protocol run status for recovery. |

Kalibrace komunikace – counter value of the baud speed calibration between the mainboard and auxiliary boards

| | | |
|---|---|---|
| KalibCtc | Number | Value changes according to the baud speed calibration |
| KalibICS | Number | Calibraton status |