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# Service Manual

## 2100Q (*is*)





# Contents

|          |                                              |           |
|----------|----------------------------------------------|-----------|
| <b>1</b> | <b>General</b>                               | <b>1</b>  |
| 1.1      | Instrument versions                          | 1         |
| 1.2      | Specifications                               | 1         |
| 1.3      | Location of components in the turbidimeter   | 2         |
| <b>2</b> | <b>Error messages / Trouble shooting</b>     | <b>3</b>  |
| 2.1      | Error messages during the service inspection | 3         |
| 2.2      | Error messages from user interface           | 5         |
| <b>3</b> | <b>Test program</b>                          | <b>7</b>  |
| 3.1      | General                                      | 7         |
| 3.1.1    | Selecting a language                         | 7         |
| 3.1.2    | Instrument update                            | 7         |
| 3.1.3    | Password                                     | 8         |
| 3.2      | Testprogram-Mainmenu                         | 8         |
| 3.3      | Digital                                      | 9         |
| 3.3.1    | Display/Keys                                 | 9         |
| 3.3.2    | RTC                                          | 11        |
| 3.3.3    | RAM                                          | 11        |
| 3.3.4    | Flash                                        | 12        |
| 3.3.5    | Sound                                        | 12        |
| 3.3.6    | Battery                                      | 13        |
| 3.4      | Analog                                       | 13        |
| 3.4.1    | Read ADC                                     | 14        |
| 3.4.2    | Power                                        | 15        |
| 3.4.3    | Turbidity                                    | 15        |
| 3.5      | Module                                       | 16        |
| 3.6      | Inspection                                   | 17        |
| 3.7      | Options                                      | 17        |
| 3.7.1    | Factory setup                                | 18        |
| 3.7.2    | Update LP                                    | 19        |
| 3.8      | File Ops                                     | 19        |
| 3.8.1    | Backup                                       | 20        |
| 3.8.2    | Restore                                      | 21        |
| 3.8.3    | Copy Logger                                  | 21        |
| <b>4</b> | <b>Repairs</b>                               | <b>28</b> |
| 4.1      | Lamp removing (only 2100Q)                   | 28        |
| 4.2      | Lamp installing (only 2100Q)                 | 28        |
| 4.3      | Opening the Meter                            | 30        |
| 4.4      | Main board with Display                      | 31        |
| 4.5      | Battery contacts                             | 34        |
| 4.6      | Optical Bench                                | 35        |
| 4.7      | Location of component in beam path           | 36        |
| <b>5</b> | <b>Inspection</b>                            | <b>37</b> |
| 5.1      | General                                      | 37        |
| 5.2      | Inspection procedure                         | 37        |
| 5.3      | Apply silicone oil to a sample cell          | 37        |
| 5.3.1    | General                                      | 37        |

|                                            |           |
|--------------------------------------------|-----------|
| 5.3.2 Aids .....                           | 37        |
| 5.3.3 Description .....                    | 37        |
| 5.4 Calibration .....                      | 38        |
| 5.4.1 Aids .....                           | 38        |
| 5.4.2 Description .....                    | 38        |
| 5.5 Service Inspection (after repair)..... | 41        |
| 5.5.1 Aids .....                           | 41        |
| 5.5.2 Description .....                    | 41        |
| <b>6 Spare parts .....</b>                 | <b>56</b> |
| 6.1 Overview and assignment .....          | 56        |
| 6.2 Pictures .....                         | 57        |
| <b>7 Test aids and devices .....</b>       | <b>62</b> |
| 7.1 Hardware .....                         | 62        |
| 7.2 Maintenance and Servicing Report.....  | 63        |

# 1 General

The turbidimeter 2100Q measures turbidity from 0 to 1000 NTU. Primarily for field use, the portable meter operates on four AA batteries. Data can be stored and transferred to a printer, computer or USB storage device.

## 1.1 Instrument versions

The following models of the DR 2800 Spectrophotometer are available:

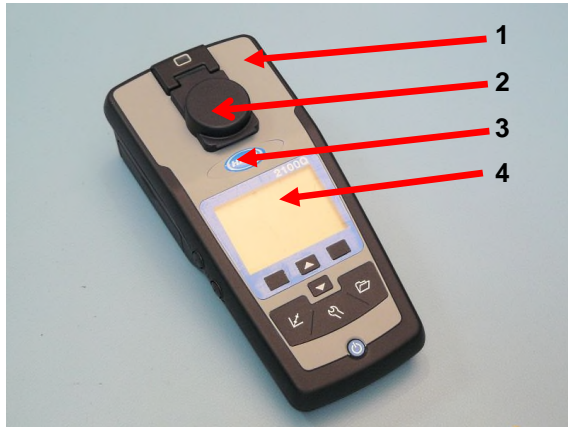
- LPG439.01.00002                    2100Q
- LPG439.01.00012                    2100Q is

## 1.2 Specifications

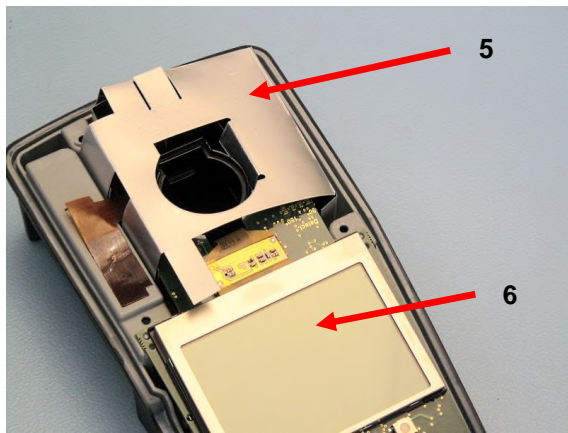
Specifications are subject to change without notice.

| Specification          | Details                                                                                                                                                             |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Measurement method     | Ratio turbidimetric determination using a primary nephelometric light scatter signal (90°) to the transmitted lightscatter signal.                                  |
| Regulatory             | <b>2100Q:</b> Meets EPA Method 180.1<br><b>2100Q is:</b> Meets ISO 7027                                                                                             |
| Lamp source            | <b>2100Q:</b> Tungsten filament lamp<br><b>2100Q is:</b> Light-emitting diode (LED) at 860 nm                                                                       |
| Range                  | 0–1000 NTU (FNU)                                                                                                                                                    |
| Accuracy               | ±2% of reading plus stray light from 0–1000 NTU (FNU)                                                                                                               |
| Repeatability          | ±1% of reading or 0.01 NTU (FNU), whichever is greater                                                                                                              |
| Resolution             | 0.01 NTU on lowest range                                                                                                                                            |
| Stray light            | ≤ 0.02 NTU (FNU)                                                                                                                                                    |
| Signal averaging       | Selectable on or off                                                                                                                                                |
| Detector               | Silicon Photodiode                                                                                                                                                  |
| Reading modes          | Normal (Push to Read), Signal Averaging or Rapidly Settling Turbidity™                                                                                              |
| Calibration options    | Single step RapidCal™ for Low-Level Regulatory Reporting from 0–40 NTU (FNU)<br>Full range calibration from 0–1000 NTU (FNU)<br>Calibration to degrees of turbidity |
| Calibration logger     | Records the last 25 successful calibrations                                                                                                                         |
| Verification logger    | Logs the last 250 successful verifications                                                                                                                          |
| Data logger            | 500 records                                                                                                                                                         |
| Power requirement      | AC 100–240 V , 50/60 Hz (with power or USB/power module)<br>4 AA alkaline batteries<br>Rechargeable NiMH (for use with USB/power module)                            |
| Operating conditions   | Temperature: 0 to 50 °C (32 to 122 °F)<br>Relative Humidity: 0–90% at 30 °C, 0–80% at 40 °C, 0–70% at 50 °C, noncondensing                                          |
| Storage conditions     | –40 to 60 °C (–40 to 140 °F), instrument only                                                                                                                       |
| Interface              | Optional USB                                                                                                                                                        |
| Sample required        | 15 mL (0.5 oz.)                                                                                                                                                     |
| Sample cells           | Round cells 60 x 25 mm (2.36 x 1 in.) borosilicate glass with screw caps                                                                                            |
| Dimensions             | 22.9 x 10.7 x 7.7 cm (9.0 x 4.2 x 3.0 in.)                                                                                                                          |
| Weight                 | 530 g (1.17 lb) without batteries<br>620 g (1.37 lb) with four AA alkaline batteries                                                                                |
| Meter enclosure rating | IP67 (closed lid, battery and module compartment excluded)                                                                                                          |
| Protection class       | Power supply: Class II                                                                                                                                              |
| Certification          | CE certified                                                                                                                                                        |
| Warranty               | 1 year                                                                                                                                                              |

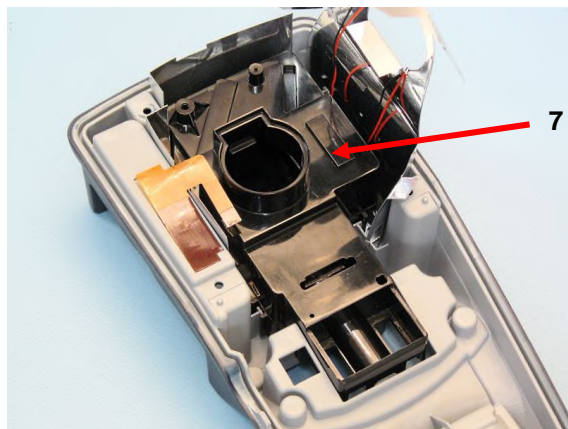
### 1.3 Location of components in the turbidimeter



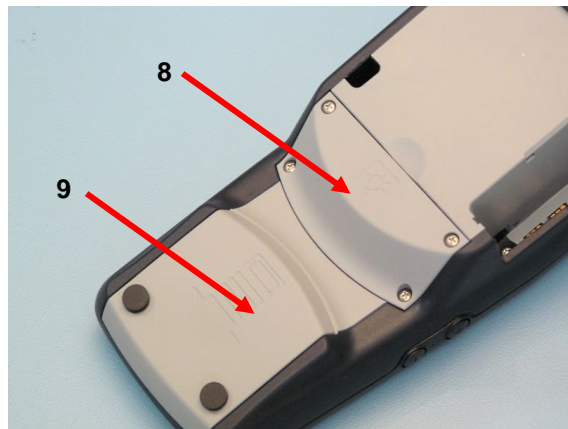
- 1 - Housing top
- 2 - Pick cap with magnet
- 3 - Label
- 4 - Display window



- 5 - EMC cover
- 6 - Main board with Display



- 7 - Optical bench



- 8 - Lamp cover (only 2100Q)
- 9 - Battery cover

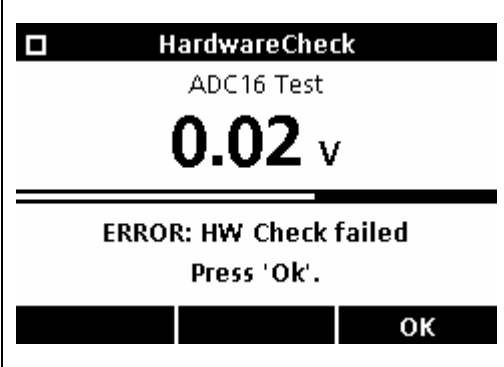
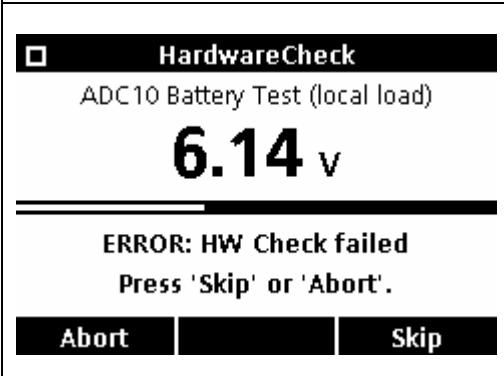
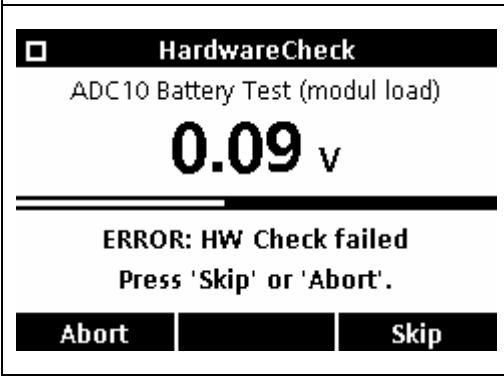
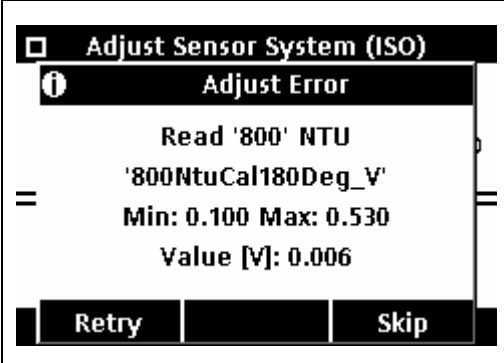
# 2 Error messages / Trouble shooting

The error messages listed here supplement the error messages in the User Manual.

## 2.1 Error messages during the service inspection

Hardware Check and Adjust Sensor System Errors.

For detailed description please refer to section 5.5 Service Inspection (after repair).

|                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <p>ADC16 Test error occurred in cases of:</p> <ul style="list-style-type: none"> <li>- Lamp/IrLED is defect or not plugged.</li> <li>- 90° Detector is defect or not plugged.</li> <li>- 180° detector is defect or not plugged.</li> <li>- Blue filter in beam path is not assembled.</li> <li>- Optical lens in beam path is not correctly assembled.</li> <li>- Main board (YAB110/YAB111) is defect.</li> </ul>                                                      |
|   | <p>Battery Test (<b>local load</b>) error occurred in cases of:</p> <ul style="list-style-type: none"> <li>- Bad battery contact.</li> <li>- Bad contact from battery package to main board.</li> <li>- Main board (YAB110/YAB111) is defect.</li> </ul>                                                                                                                                                                                                                 |
|  | <p>Battery Test (<b>module load</b>) error occurred in cases of:</p> <ul style="list-style-type: none"> <li>- Bad battery contact.</li> <li>- Bad contact from battery package to main board.</li> <li>- Bad contact from main board to module board in USB OTG Adapter (Module #7) (LZV813)</li> <li>- Main board (YAB110/YAB111) is defect.</li> </ul>                                                                                                                 |
|  | <p>Adjust Error (<b>different IDs</b>) occurred in cases of:</p> <ul style="list-style-type: none"> <li>- Wrong vial is plugged.</li> <li>- Lamp/IrLED is defect or not plugged.</li> <li>- 90° detector is defect or not plugged.</li> <li>- 180° detector is defect or not plugged.</li> <li>- Blue filter in beam path is not assembled.</li> <li>- Optical lens in beam path is not correctly assembled.</li> <li>- Main board (YAB110/YAB111) is defect.</li> </ul> |

|                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><input type="checkbox"/> <b>Adjust Sensor System (ISO)</b></p> <p><b>Calibration Read...</b></p> <p><b>Lamp_Error</b><br/>Please check hardware.</p> <p><b>Retry</b>   <b>Skip</b></p>      | <p>Lamp_Error occurred in cases of:</p> <ul style="list-style-type: none"> <li>- Lamp/IrLED is defect or not plugged.</li> <li>- 90° detector and 180° detector are defect or not plugged.</li> <li>- Beam path is darkened or cut off.</li> <li>- Main board (YAB110/YAB111) is defect.</li> </ul> |
| <p><input type="checkbox"/> <b>Adjust Sensor System (ISO)</b></p> <p><b>Calibration Read...</b></p> <p><b>RefToLow_Error</b><br/>Please check hardware.</p> <p><b>Retry</b>   <b>Skip</b></p>  | <p>RefToLow_Error occurred in cases of:</p> <ul style="list-style-type: none"> <li>- Lamp/IrLED is defect or not plugged.</li> <li>- 180° detector is defect or not plugged.</li> <li>- Beam path is darkened.</li> <li>- Main board (YAB110/YAB111) is defect.</li> </ul>                          |
| <p><input type="checkbox"/> <b>Adjust Sensor System (ISO)</b></p> <p><b>Calibration Read...</b></p> <p><b>Overrange_Error</b><br/>Please check hardware.</p> <p><b>Retry</b>   <b>Skip</b></p> | <p>Overrange_error occurred in cases of:</p> <ul style="list-style-type: none"> <li>- To much light at 90° detector.</li> <li>- To much light at 180° detector.</li> <li>- Main board (YAB110/YAB111) is defect.</li> </ul>                                                                         |
| <p><input type="checkbox"/> <b>Adjust Sensor System (EPA)</b></p> <p><b>Error</b></p> <p><b>Lid is open!</b><br/>Please close lid.</p> <p><b>OK</b></p>                                        | <p>'Lid is open' error occurred in cases of:</p> <ul style="list-style-type: none"> <li>- Lid is open...</li> <li>- Lid has no magnet assembled.</li> <li>- Main board (YAB110/YAB111) is defect.</li> </ul>                                                                                        |



## 2.2 Error messages from user interface

| Message |                | Close lid and push Read.                                                                                                         |
|---------|----------------|----------------------------------------------------------------------------------------------------------------------------------|
| 1       | Possible cause | The lid is open or lid detection failed.                                                                                         |
|         | Action         | Check with Testprogram-Digital-Display/Keys the function of the read contact on the Main board. (see section 3.3.1 Display/Keys) |

| Message |                | Low Battery!                                     |                                                                               |
|---------|----------------|--------------------------------------------------|-------------------------------------------------------------------------------|
| 1       | Possible cause | Battery is low. (Voltage < 4.1V in battery test) |                                                                               |
|         | Action         | 1                                                | Insert new batteries                                                          |
|         |                | 2                                                | Check with Testprogram-Digital-Power/Battery menu (see section 3.3.6 Battery) |

| Message |                | ADC Failure!                                                                                              |
|---------|----------------|-----------------------------------------------------------------------------------------------------------|
| 1       | Possible cause | Hardware error causing measurement to fail.<br>ADC16 / Main board is defect.                              |
|         | Action         | Check with Testprogram-Analog-Read menu (see section 3.4.1 Read ADC)<br>Change Main board (YAB110/YAB111) |

| Message |                | Detector signal too low!                             |                                                                      |
|---------|----------------|------------------------------------------------------|----------------------------------------------------------------------|
| 1       | Possible cause | Insufficient light on the 180° detector (< 0,010 V). |                                                                      |
|         | Action         | 1                                                    | Check with Testprogram-Analog-Read menu (see section 3.4.1 Read ADC) |
|         |                | 2                                                    | Check for obstructed light path.                                     |

| Message |                | Ovrange!                                                               |                            |
|---------|----------------|------------------------------------------------------------------------|----------------------------|
| 1       | Possible cause | Turbidity too high- caused probably by calibrating with QuickCal only. |                            |
|         | Action         | 1                                                                      | Calibrate the upper range. |
|         |                | 2                                                                      | Dilute the sample.         |

| Message |                | Underrange!                                             |
|---------|----------------|---------------------------------------------------------|
| 1       | Possible cause | The measured absorbance is below the calibration range. |
|         | Action         | Repeat calibration                                      |

| Message |                | Please check the lamp!                                                                      |                                                                                                                          |
|---------|----------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| 1       | Possible cause | Signals are too low on the 90° detector ( < 0.005 V ) <b>and</b> 180° detector (< 0,010 V). |                                                                                                                          |
|         | Action         | 1                                                                                           | The lamp is defective. Change the lamp (see section 4.1 Lamp removing (only 2100Q) and 4.2 Lamp installing (only 2100Q)) |
|         |                | 2                                                                                           | The LED is defective. Change the LED (see section 4.4 Main board with Display)                                           |

| Message |                | Temperature too high! Switch off instrument.                 |
|---------|----------------|--------------------------------------------------------------|
| 1       | Possible cause | Temperature has exceeded the meter limits (>60°C or >140°F). |
|         | Action         | 1                                                            |

| Message |                | RST: Average value!                                                           |
|---------|----------------|-------------------------------------------------------------------------------|
| 1       | Possible cause | Solids are settling too slowly. Reading Mode is not suitable for this sample. |
|         | Action         | 1 Select a different Reading Mode.                                            |

| Message |                | Confidence level is < 95%                                                                        |
|---------|----------------|--------------------------------------------------------------------------------------------------|
| 1       | Possible cause | The Reading Mode Rapidly Settling Turbidity did not meet the range of 95% confidence.            |
|         | Action         | 1 Shake the sample vigorously so that the solids allocate. Repeat the measurement again.         |
|         |                | 2 If the sample is stable and does not have settleable solids switch to normal measurement mode. |

| Message |                | Standard value out of range. Insert standard and push Read |
|---------|----------------|------------------------------------------------------------|
| 1       | Possible cause | Used incorrect standard value for measurement.             |
|         | Action         | 1 Insert the appropriate standard and read again.          |

| Message |                | ID already in use. Enter new ID                                     |
|---------|----------------|---------------------------------------------------------------------|
| 1       | Possible cause | The Operator or Sample ID is unavailable as it is already assigned. |
|         | Action         | 1 Create a new ID.                                                  |

| Message |                | Error - Security Please set password before activating security |
|---------|----------------|-----------------------------------------------------------------|
| 1       | Possible cause | No password is created.                                         |
|         | Action         | 1 Create a password.                                            |

| Message |                | Please enter at least one character.            |
|---------|----------------|-------------------------------------------------|
| 1       | Possible cause | Password must contain minimum of one character. |
|         | Action         | 1 Create a password of at least one character.  |

| Message |                | Password incorrect. Please retry.                               |
|---------|----------------|-----------------------------------------------------------------|
| 1       | Possible cause | Incorrect password was entered.                                 |
|         | Action         | 1 Enter the appropriate password.                               |
|         |                | 2 Enter Universal password: "HACH" (see section 3.1.3 Password) |

| Message |                | Please disconnect the USB cable from your computer.                          |
|---------|----------------|------------------------------------------------------------------------------|
| 1       | Possible cause | Data storage does not respond while connected to the meter and the computer. |
|         | Action         | 1 Disconnect the USB cable from the meter and try sending data again.        |

| Message |                | USB module memory full. Delete data and try again.                                                                              |
|---------|----------------|---------------------------------------------------------------------------------------------------------------------------------|
| 1       | Possible cause | Data storage is full.                                                                                                           |
|         | Action         | 1<br>1. Connect USB modul to the computer.<br>2. Download the stored data to the computer.<br>3. Delete Data Log on the module. |

# 3 Test program

## 3.1 General

The test program can be used to modify settings and test the correct functioning of the meter. Some of the test programs contain functions that are intended only for use by the development and production departments. Where this is the case, it is indicated in the program description.

The test program contains menus to guide the user to the individual program options. When the test program is running, the menu is shown on the left side of the display. The right side of the display is the output window, in which status information and/or messages are shown. The full menu path is always shown in the title line at the top of the display.

### 3.1.1 Selecting a language



The test program is available in English, only.

To change the language of the user interface, press and hold the power button for at least 4s.

The language menu appears.

Choose a language with the Up/Down Arrow Keys and press "OK"

### 3.1.2 Instrument update

The meter firmware can be updated. The files are provided via Internet download and transferred from the PC to the module.

#### Note:

- **All customer specific information (User-ID, Sample-ID), stored measuring results are still in place after the update!**
- **The update will work only, if there a newer firmware on the module as on the meter!**

To update the meter firmware:

- Download the update file to the computer from the internet.
- Connect the module to the computer via USB cable.
- Unzip the downloaded file to the module.
- Plug the module into the meter.
- Push and hold the power button for more than 4 seconds.
- The meter starts with the bootloader software and updates the firmware.
- If the f/w update is complete, the instrument will power up automatically and start the application software.
- The meter displays the language menu so that that the user can select a language.

### 3.1.3 Password

Access to any programs of the meter can be protected by a password (see the Password section of the 2100Q (is) User Manual).

In an emergency (e.g. if you cannot remember the password) you can gain access with the help of a universal password:

Universal password: **HACH**

### 3.2 Testprogram-Mainmenu

Switch on the instrument with pressing continually the “setting” button and a short press on the “power” button.

Power

Setting



| Testprogram-Mainmenu |                 |    |
|----------------------|-----------------|----|
| Digital              | Marco Polo      |    |
| Analog               | Version 0.48    |    |
| Module               | HW Driver V0.29 |    |
| Inspection           | Prototype HW(0) |    |
| Options              | ISO - IrLED     |    |
| File Ops             |                 |    |
| Esc                  | Up/Down         | OK |

You are in the “**Testprogram-Mainmenu**”, now.

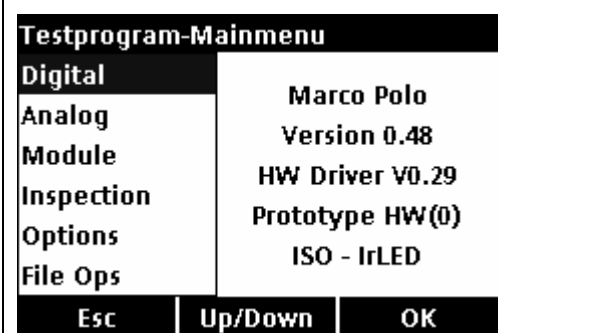
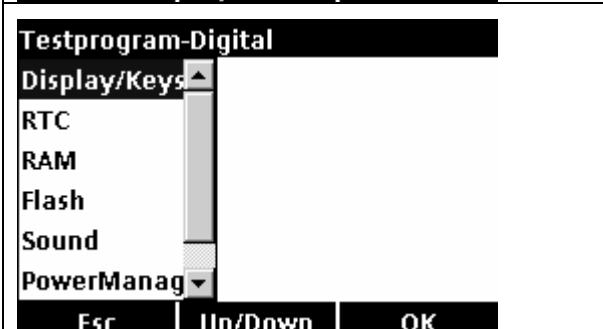
The table below contains the items shown in the main menu of the test program, with a brief description of their functions. A more detailed description is included in the following sections.

| Menu item  | Explanation                                                                                                 |
|------------|-------------------------------------------------------------------------------------------------------------|
| Digital    | Calls the test programs for the digital, battery and power part of the 2100Q (is) (see section 3.3 Digital) |
| Analog     | Calls the test programs for the analog part of the 2100Q (is) (see section 3.4 Analog)                      |
| Module     | Calls the test programs for the modules and peripherals of the 2100Q (is) (see section 3.5 Module)          |
| Inspection | Full Inspection, Service Inspection... (see section 3.6 Inspection)                                         |
| Options    | Various special test programs/settings. (see section 3.7 Options)                                           |
| File Ops   | Backup, Restore, Copy Logger (see section 3.8 File Ops)                                                     |

Explanation of the items in the window:

| Display              | Explanation                                                                                            |
|----------------------|--------------------------------------------------------------------------------------------------------|
| Marco Polo           | Name of project                                                                                        |
| Version:             | Shows the version number of the test program.                                                          |
| HW Driver:           | Shows the version number of the Hardware driver.                                                       |
| Prototype HW(0)      | Shows the hardware version of the photometer: “Prototype HW(0)”, “Pilotseries HW(1)” or “Series HW(2)” |
| ISO-IrLED / EPA-Lamp | Shows the instrument version: “ISO-IrLED” or “EPA-Lamp”                                                |

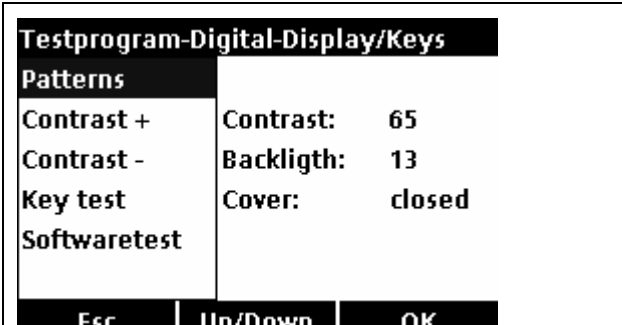
### 3.3 Digital

|                                                                                   |                                                                                                                                  |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"> <li>• Select “Digital” in the Testprogram-Mainmenu</li> <li>• Confirm it with “OK”</li> </ul> |
|  | <ul style="list-style-type: none"> <li>• “Testprogram-Digital” appears</li> </ul>                                                |

Explanation of the menu items:

| Menu item    | Explanation                                                               |
|--------------|---------------------------------------------------------------------------|
| Display/Keys | Settings and tests for display and keys. (see section 3.3.1 Display/Keys) |
| RTC          | Setting the date and time. (see section 3.3.2 RTC)                        |
| RAM          | Calls the test program for the RAM. (see section 3.3.3 RAM)               |
| Flash        | Calls the test program for the Flash. (see section 3.3.4 Flash)           |
| Sound        | Settings and tests for the sound. (see section 3.3.5 Sound)               |
| PowerManag   | <b>CAUTION – For use by the development department only!</b>              |
| Battery      | Settings and tests for the batteries. (see section 3.3.6 Battery)         |

#### 3.3.1 Display/Keys

|                                                                                     |                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"> <li>• Select “Display/Keys” in the Testprogram-Digital menu</li> <li>• Confirm it with “OK”</li> <li>• “Testprogram-Digital-Display/Keys” appears</li> </ul> |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

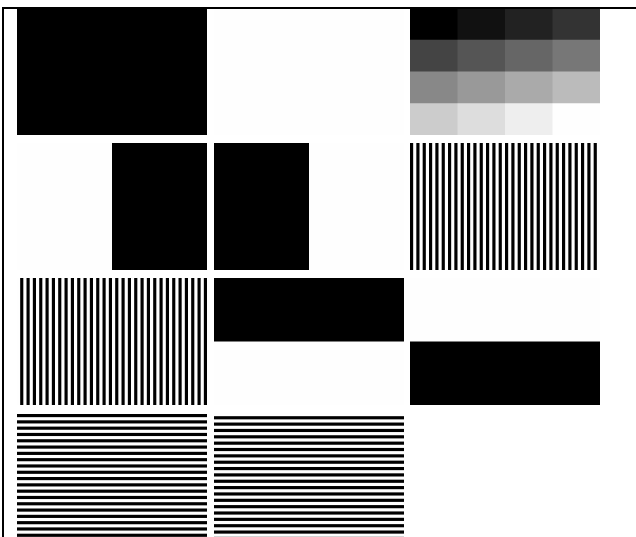




Explanation of the menu items:

| Menu item    | Explanation                                                                               |
|--------------|-------------------------------------------------------------------------------------------|
| Patterns     | Different patterns for display tests (see section 3.3.1.1 Patterns)                       |
| Contrast +   | Increments the contrast                                                                   |
| Contrast -   | Decrements the contrast                                                                   |
| Key test     | Calls the test program for keys (see section 3.3.1.2 Key test)                            |
| Softwaretest | Calls more softwaretests.<br><b>CAUTION – For use by the development department only!</b> |

Explanation of the items in the window:

| Display    | Explanation                                             |
|------------|---------------------------------------------------------|
| Contrast:  | Shows the current status of the contrast                |
| Backlight: | Shows the current status of the backlight               |
| Cover:     | Shows the current status of the lid: "open" or "closed" |

### 3.3.1.1 Patterns

|                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"> <li>• Select "Patterns" in the Testprogram-Digital-Display/Keys menu</li> <li>• Confirm it with "OK"</li> <li>•  and  changes the pattern</li> <li>•  lefts from  quit the pattern test</li> </ul> |
|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### 3.3.1.2 Key test

|                                                                  |                                                                                                                                                                                                                                                                           |    |  |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|--|
| <b>Testprogram-Digital-Display/Keys</b>                          | <ul style="list-style-type: none"> <li>• Select "Key test" in the Testprogram-Digital-Display/Keys menu</li> <li>• Confirm it with "OK"</li> <li>• Keys test appears</li> <li>• Press a key and in placed of "Press key!" the name of the pressed key appears.</li> </ul> |    |  |
| Patterns<br>Contrast +<br>Contrast -<br>Key test<br>Softwaretest | Press key!<br><br>Escape to abort!                                                                                                                                                                                                                                        |    |  |
| Esc                                                              | Up/Down                                                                                                                                                                                                                                                                   | OK |  |

### 3.3.2 RTC

|                                |                                                   |                                                                                                                                                                                                                                                                        |
|--------------------------------|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Testprogram-Digital-RTC</b> | <p>11-Feb-2009<br/>10:06:06<br/>Alarm:     ok</p> | <ul style="list-style-type: none"> <li>• Select "RTC" in the Testprogram-Digital menu</li> <li>• Confirm it with "OK"</li> <li>• The Testprogram-Digital-RTC menu appears</li> <li>• Chose "<b>Set RTC</b>" and press "<b>OK</b>" to set the date and time.</li> </ul> |
| <b>Set RTC</b>                 |                                                   |                                                                                                                                                                                                                                                                        |
| <b>Alarm</b>                   |                                                   |                                                                                                                                                                                                                                                                        |
| <b>Esc</b>                     | <b>Up/Down</b>                                    | <b>OK</b>                                                                                                                                                                                                                                                              |

Explanation of the menu items:

| Menu item | Explanation                                                                                                                                            |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Set RTC   | Opens the input window for the date and time.                                                                                                          |
| Alarm     | RTC alarm timer at main board is been set to current time plus 2 seconds. It will be checked if the alarm interrupt has been occurred after 2 seconds. |

Explanation of the items in the window:

| Display | Explanation                       |
|---------|-----------------------------------|
|         | Shows the current date            |
|         | Shows the current time            |
| Alarm:  | Shows the current status of Alarm |

### 3.3.3 RAM

|                                |                       |                                                                                                                                                                                  |
|--------------------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Testprogram-Digital-RAM</b> | <p>RAM write/read</p> | <ul style="list-style-type: none"> <li>• Select "RAM" in the Testprogram-Digital menu</li> <li>• Confirm it with "OK"</li> <li>• Testprogram-Digital-RAM menu appears</li> </ul> |
| <b>RAM write/read</b>          |                       |                                                                                                                                                                                  |
| <b>Esc</b>                     | <b>Up/Down</b>        | <b>OK</b>                                                                                                                                                                        |

Explanation of the menu items:

| Menu item      | Explanation                                     |
|----------------|-------------------------------------------------|
| RAM write/read | Perform the write/read test program for the RAM |

Explanation of the items in the window:

| Display     | Explanation                                |
|-------------|--------------------------------------------|
| RAM test OK | Shows the result of the performed RAM test |

### 3.3.4 Flash

|                                                                                                                                       |                                                                                                                                                                                |
|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Testprogram-Digital-Flash</b><br>Flash write/read<br>FFS get sizes<br>FFS write/read<br>Erase Lang Block<br><br>Esc   Up/Down   OK | <ul style="list-style-type: none"> <li>Select "Flash" in the Testprogram-Digital menu</li> <li>Confirm it with "OK"</li> <li>Testprogram-Digital-Flash menu appears</li> </ul> |
|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Explanation of the menu items:

| Menu item        | Explanation                                                                  |
|------------------|------------------------------------------------------------------------------|
| Flash write/read | Test internal Flash File System                                              |
| FFS get sizes    | Shows sizes of the FFS                                                       |
| FFS write/read   | <b>CAUTION – For use by the development and production departments only!</b> |
| Erase Lang Block | <b>CAUTION – For use by the development and production departments only!</b> |

Explanation of the items in the window:

| Display (example) | Explanation  |
|-------------------|--------------|
| Spanion           | Type         |
| Top 16*1MB        | Size         |
| erase ok          | Erase OK/NOK |
| write ok          | Write OK/NOK |
| read ok           | Read OK/NOK  |

### 3.3.5 Sound

|                                                                                                                                                     |                                                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Testprogram-Digital-Sound</b><br>Key Sound<br>Timer Sound<br>LTimer Sound<br>Read Sound<br>Error Sound<br>Softwaretest<br><br>Esc   Up/Down   OK | <ul style="list-style-type: none"> <li>Select "Sound" in the Testprogram-Digital menu</li> <li>Confirm it with "OK"</li> <li>Testprogram-Digital-Sound menu appears</li> </ul> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Explanation of the menu items:

| Menu item    | Explanation                                                  |
|--------------|--------------------------------------------------------------|
| Key Sound    | Plays the key sound                                          |
| Timer sound  | Plays the timer sound                                        |
| LTimer Sound | Plays the long timer sound                                   |
| Read Sound   | Plays the read sound                                         |
| Error Sound  | Plays the error sound                                        |
| Softwaretest | <b>CAUTION – For use by the development department only!</b> |



### 3.3.6 Battery

|                                          |                     |                                                                                                                                                                                                |
|------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Testprogram-Digital-Power/Battery</b> |                     | <ul style="list-style-type: none"> <li>• Select “Battery” in the Testprogram-Digital menu</li> <li>• Confirm it with “OK”</li> <li>• Testprogram-Digital-Power/Battery menu appears</li> </ul> |
| Battery Load ▲                           | Battery[V]: 5.411   |                                                                                                                                                                                                |
| 3.3V On/Off                              | Batt Cap[%]: 100    |                                                                                                                                                                                                |
| 5.0V On/Off                              | ExtPower[V]: 9.017  |                                                                                                                                                                                                |
| Lamp On/Off                              | Tempr.[°C]: 17.0    |                                                                                                                                                                                                |
| Offset                                   | Offset: 0.00        |                                                                                                                                                                                                |
| Batt Test ▼                              | [%] 100 [V] 5.313 1 |                                                                                                                                                                                                |
| Esc                                      | Up/Down             | OK                                                                                                                                                                                             |

Explanation of the menu items:

| Menu item    | Explanation                                                                                                                                                                                                                        |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Battery Load | Switch On/Off Load for battery                                                                                                                                                                                                     |
| 3.3V On/Off  | Switch On/Off 3.3V peripheral (sound/lid)                                                                                                                                                                                          |
| 5.0V On/Off  | Switch On/Off analog power                                                                                                                                                                                                         |
| Lamp On/Off  | Switch On/Off Lamp/IrLED                                                                                                                                                                                                           |
| Offset       | <b>CAUTION – For use by the development department only!</b>                                                                                                                                                                       |
| Batt Test    | Performs battery capacitance test. <ul style="list-style-type: none"> <li>• Set load to battery</li> <li>• Read voltage (load voltage)</li> <li>• Calculate capacitance with load voltage.</li> <li>• shows the results</li> </ul> |
| Force Charge | <b>CAUTION – For use by the development department only!</b>                                                                                                                                                                       |

Explanation of the items in the window:

| Display      | Explanation                                                               |
|--------------|---------------------------------------------------------------------------|
| Battery[V]:  | current battery voltage (Load value < 4.1 V shows “low battery!” message) |
| Batt Cap[%]: | Capacitance calculated from current battery voltage                       |
| ExtPower[V]: | External power from power adapter (9V Min:8.25V Max: 9.35V)               |
| Tempr.[°C]:  | Value of internal temperature sensor (it should be <60°C or <140°F)       |
| Offset:      | <b>CAUTION – For use by the development department only!</b>              |
| [%] [V]      | Result of “Batt Test” (Voltage < 4.1 V shows “low battery!” message)      |

### 3.4 Analog

|                             |                                                                                 |                                                                                                                                 |
|-----------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| <b>Testprogram-Mainmenu</b> |                                                                                 | <ul style="list-style-type: none"> <li>• Select “Analog” in the Testprogram-Mainmenu</li> <li>• Confirm it with “OK”</li> </ul> |
| Digital                     | Marco Polo<br>Version 0.48<br>HW Driver V0.29<br>Prototype HW(0)<br>ISO - IrLED |                                                                                                                                 |
| Analog                      |                                                                                 |                                                                                                                                 |
| Module                      |                                                                                 |                                                                                                                                 |
| Inspection                  |                                                                                 |                                                                                                                                 |
| Options                     |                                                                                 |                                                                                                                                 |
| File Ops                    |                                                                                 |                                                                                                                                 |
| Esc                         | Up/Down                                                                         | OK                                                                                                                              |

|                                                                                                            |                                                                                |
|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| <b>Testprogram-Analog</b><br>Read ADC<br>MUX ADC<br>Power<br>Turbidity<br>Adjust<br><br>Esc   Up/Down   OK | <ul style="list-style-type: none"> <li>“Testprogram-Analog” appears</li> </ul> |
|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|

Explanation of the menu items:

| Menu item | Explanation                                                     |
|-----------|-----------------------------------------------------------------|
| Read ADC  | Calls the Read menu for ADC (see section 3.4.1 Read ADC)        |
| MUX ADC   | <b>CAUTION – For use by the development department only!</b>    |
| Power     | Calls the Power menu for analog power (see section 3.4.2 Power) |
| Turbidity | Calls the turbidity menu (see section 3.4.3 Turbidity)          |
| Adjust    | <b>CAUTION – For use by the development department only!</b>    |

### 3.4.1 Read ADC

|                                                                                                                                                                                                                                                         |                                                                                                                                                                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Testprogram-Analog-Read</b><br>Lamp/IrLED    Ref(180°): 0.0014<br>Offset        Meas(90°): 0.0012<br>Poti 90°     Meas Filt1: 0.0253<br>ADC16-Int   Meas Filt2: 0.0012<br>Statistic     Lamp/Offset Off/0.00<br>ADC Int: 125ms<br>Esc   Up/Down   OK | <ul style="list-style-type: none"> <li>Select “Read ADC” in the Testprogram-Analog menu</li> <li>Confirm it with “OK”</li> <li>Testprogram-Analog-Read menu appears</li> </ul> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Explanation of the menu items:

| Menu item  | Explanation                                                                                               |
|------------|-----------------------------------------------------------------------------------------------------------|
| Lamp/IrLED | Switch On/Off Lamp/IrLED                                                                                  |
| Offset     | <b>CAUTION – For use by the development department only!</b>                                              |
| Poti 90°   | Sets gain potentiometer for 90° detector (0-99)<br>To test if read value changed by potentiometer change. |
| ADC16-Int  | <b>CAUTION – For use by the development department only!</b>                                              |
| Statistic  | <b>CAUTION – For use by the development department only!</b>                                              |

Explanation of the items in the window:

| Display     | Explanation                                          |
|-------------|------------------------------------------------------|
| Ref(180°)   | 180° detector value [V]                              |
| Meas(90°)   | 90° detector value [V]                               |
| Meas Filt1  | Second stage filter amplifier 90° detector value [V] |
| Meas Filt2  | 90° detector value [V]                               |
| Lamp/Offset | Status of Lamp/ status of Offset                     |
| ADC Int     | Sample time of analog / digital converter            |

### 3.4.2 Power

|                                 |                  |                                                                                                                                                                                    |
|---------------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Testprogram-Analog-Power</b> |                  | <ul style="list-style-type: none"> <li>• Select "Power" in the Testprogram-Analog menu</li> <li>• Confirm it with "OK"</li> <li>• Testprogram-Analog-Power menu appears</li> </ul> |
| <b>5.0V On/Off</b>              | +5 [V]: 5.016    |                                                                                                                                                                                    |
| <b>Offset</b>                   | -0.7 [V]: -0.684 |                                                                                                                                                                                    |
| <b>NumReadings</b>              | Offset: 0.00     |                                                                                                                                                                                    |
|                                 | Tempr.[°C]: 21.1 |                                                                                                                                                                                    |
| <b>Esc</b>                      | <b>Up/Down</b>   | <b>OK</b>                                                                                                                                                                          |

Explanation of the menu items:

| Menu item   | Explanation                                                  |
|-------------|--------------------------------------------------------------|
| 5.0V On/Off | Switch on/off analog power                                   |
| Offset      | <b>CAUTION – For use by the development department only!</b> |
| NumReadings | <b>CAUTION – For use by the development department only!</b> |

Explanation of the items in the window:

| Display    | Explanation                                                                     |
|------------|---------------------------------------------------------------------------------|
| +5 [V]     | Value of positive analog power voltage (+5V Min: 4.9V Max: 5.2V)                |
| -0.7 [V]   | Value of negative analog power voltage (-0.7V Min: -0.8V Max: -0.5V)            |
| Offset     | <b>CAUTION – For use by the development department only!</b>                    |
| Tempr.[°C] | Value of internal temperature sensor (the same sensor as section 3.3.6 Battery) |

### 3.4.3 Turbidity

|                                     |                         |                                                                                                                                                                                                                                                                                                             |
|-------------------------------------|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Testprogram-Analog-Turbidity</b> |                         | <ul style="list-style-type: none"> <li>• Select "Turbidity" in the Testprogram-Analog menu</li> <li>• Confirm it with "OK"</li> <li>• Testprogram-Analog-Turbidity menu appears</li> </ul> <p><b>Note:</b> Typical values for 10 NTU vial ( Turbidity, Ratio, Ref, Meas) are shown in picture left side</p> |
| <b>Lamp/IrLED</b>                   | Turbidity: 9.78         |                                                                                                                                                                                                                                                                                                             |
| <b>AutoRange</b>                    | Ratio* M/R: 0.7114      |                                                                                                                                                                                                                                                                                                             |
| <b>Gain Level</b>                   | Ref(180°): 2.4463       |                                                                                                                                                                                                                                                                                                             |
| <b>Offset</b>                       | Meas(90°): 0.8955       |                                                                                                                                                                                                                                                                                                             |
| <b>10x Average</b>                  | Cal/Lmp/Offs. 1 /On/--- |                                                                                                                                                                                                                                                                                                             |
| <b>Cal.Curve</b>                    | GnL./Aut./10x 1 /On/--- |                                                                                                                                                                                                                                                                                                             |
| <b>Esc</b>                          | <b>Up/Down</b>          | <b>OK</b>                                                                                                                                                                                                                                                                                                   |

Explanation of the menu items:

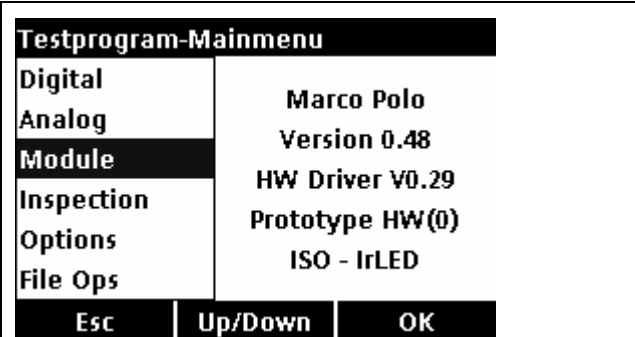
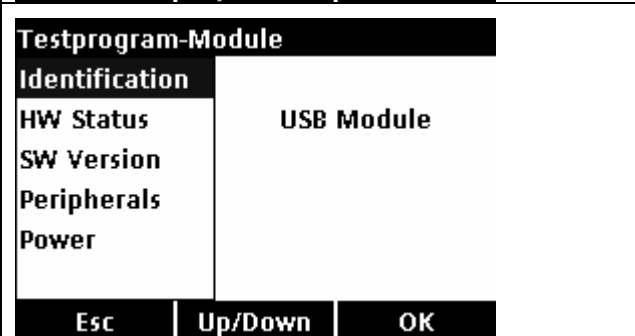
| Menu item   | Explanation                                                   |
|-------------|---------------------------------------------------------------|
| Lamp/IrLED  | Switch On/Off Lamp/IrLED                                      |
| AutoRange   | <b>CAUTION – For use by the development departments only!</b> |
| Gain Level  | <b>CAUTION – For use by the development departments only!</b> |
| Offset      | <b>CAUTION – For use by the development departments only!</b> |
| 10x Average | <b>CAUTION – For use by the development departments only!</b> |
| Cal.Curve   | <b>CAUTION – For use by the development departments only!</b> |
| Dark Adj.   | <b>CAUTION – For use by the development departments only!</b> |

|           |                                                               |
|-----------|---------------------------------------------------------------|
| Edit Poti | <b>CAUTION – For use by the development departments only!</b> |
|-----------|---------------------------------------------------------------|

Explanation of the items in the window:

| Display       | Explanation                                                                       |
|---------------|-----------------------------------------------------------------------------------|
| Turbidity     | Value of current calculated turbidity                                             |
| Ratio M/R     | Value of 180°/90° detector ratio                                                  |
| Ref(180°)     | 180° detector value [V]                                                           |
| Meas(90°)     | 90° detector value [V] regarding selected gain level                              |
| Cal/Lmp/Offs  | Index selected cal. curve / status of lamp/IrLED / status of offset               |
| GnL./Aut./10x | Status of gain level / status of automatic level selection / 10 times measurement |

### 3.5 Module

|                                                                                     |                                                                                                                                 |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
|   | <ul style="list-style-type: none"> <li>• Select “Module” in the Testprogram-Mainmenu</li> <li>• Confirm it with “OK”</li> </ul> |
|  | <ul style="list-style-type: none"> <li>• “Testprogram-Module” appears</li> </ul>                                                |

Explanation of the menu items:

| Menu item      | Explanation                                                   |
|----------------|---------------------------------------------------------------|
| Identification | Performs the identification of Modules                        |
| HW Status      | <b>CAUTION – For use by the development departments only!</b> |
| SW Version     | Reads SW version of Module firmware and shows the result      |
| Peripherals    | <b>CAUTION – For use by the development departments only!</b> |
| Power          | <b>CAUTION – For use by the development departments only!</b> |

Explanation of the items in the window:

| Display                          | Explanation                                                  |
|----------------------------------|--------------------------------------------------------------|
| USB Module /<br>Module not found | When USB Module is detected, then “USB Module” is been shown |
| SW Version (x.yyy)               | x: bootloaderversion    yyy: firmwareversion                 |

### 3.6 Inspection

| <table border="1"> <tr><th colspan="3">Testprogram-Mainmenu</th></tr> <tr> <td>Digital</td> <td rowspan="5"> <b>Marco Polo</b><br/> <b>Version 0.48</b><br/> <b>HW Driver V0.29</b><br/> <b>Prototype HW(0)</b><br/> <b>ISO - IrLED</b> </td> <td></td> </tr> <tr> <td>Analog</td> <td></td> </tr> <tr> <td>Module</td> <td></td> </tr> <tr> <td>Inspection</td> <td></td> </tr> <tr> <td>Options</td> <td></td> </tr> <tr> <td>File Ops</td> <td></td> <td></td> </tr> <tr> <td>Esc</td> <td>Up/Down</td> <td>OK</td> </tr> </table> | Testprogram-Mainmenu                                                                                               |    |  | Digital  | <b>Marco Polo</b><br><b>Version 0.48</b><br><b>HW Driver V0.29</b><br><b>Prototype HW(0)</b><br><b>ISO - IrLED</b> |  | Analog          |  | Module |               | Inspection |  | Options       |  | File Ops |               |  | Esc | Up/Down | OK      | <ul style="list-style-type: none"> <li>• Select “Inspection” in the Testprogram-Mainmenu</li> <li>• Confirm it with “OK”</li> </ul> |                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|----|--|----------|--------------------------------------------------------------------------------------------------------------------|--|-----------------|--|--------|---------------|------------|--|---------------|--|----------|---------------|--|-----|---------|---------|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Testprogram-Mainmenu                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                    |    |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |
| Digital                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Marco Polo</b><br><b>Version 0.48</b><br><b>HW Driver V0.29</b><br><b>Prototype HW(0)</b><br><b>ISO - IrLED</b> |    |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |
| Analog                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                    |    |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |
| Module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                    |    |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |
| Inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                    |    |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |
| Options                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                    |    |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |
| File Ops                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                    |    |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |
| Esc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Up/Down                                                                                                            | OK |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |
| <table border="1"> <tr><th colspan="3">Testprogram-Inspection</th></tr> <tr> <td>Test中文取消</td> <td></td> <td></td> </tr> <tr> <td>Full Inspection</td> <td></td> <td></td> </tr> <tr> <td>HardwareCheck</td> <td></td> <td></td> </tr> <tr> <td>Adjust/Calib.</td> <td></td> <td></td> </tr> <tr> <td>Service Insp.</td> <td></td> <td></td> </tr> <tr> <td>Esc</td> <td>Up/Down</td> <td>OK</td> </tr> </table>                                                                                                                      | Testprogram-Inspection                                                                                             |    |  | Test中文取消 |                                                                                                                    |  | Full Inspection |  |        | HardwareCheck |            |  | Adjust/Calib. |  |          | Service Insp. |  |     | Esc     | Up/Down | OK                                                                                                                                  | <ul style="list-style-type: none"> <li>• “Testprogram-Inspection” appears</li> </ul> |
| Testprogram-Inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                    |    |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |
| Test中文取消                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                    |    |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |
| Full Inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                    |    |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |
| HardwareCheck                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                    |    |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |
| Adjust/Calib.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                    |    |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |
| Service Insp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                    |    |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |
| Esc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Up/Down                                                                                                            | OK |  |          |                                                                                                                    |  |                 |  |        |               |            |  |               |  |          |               |  |     |         |         |                                                                                                                                     |                                                                                      |

Explanation of the menu items:

| Menu item       | Explanation                                                                                                                                |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| FI-Chinese      | <b>CAUTION – For use by the development and production departments only!</b>                                                               |
| Full Inspection | <b>CAUTION – For use by the development and production departments only!</b>                                                               |
| HardwareCheck   | This is the Hardware Check part from the Service Inspection, only.                                                                         |
| Adjust/Calib    | This is the Adjust-Calibration part from the Service Inspection, only.                                                                     |
| Service Insp    | This is the Service Inspection, included the Hardware Check and the Adjust/Calibration (see section 5.5 Service Inspection (after repair)) |

### 3.7 Options

| <table border="1"> <tr><th colspan="3">Testprogram-Mainmenu</th></tr> <tr> <td>Digital</td> <td rowspan="5"> <b>Marco Polo</b><br/> <b>Version 0.48</b><br/> <b>HW Driver V0.29</b><br/> <b>Prototype HW(0)</b><br/> <b>ISO - IrLED</b> </td> <td></td> </tr> <tr> <td>Analog</td> <td></td> </tr> <tr> <td>Module</td> <td></td> </tr> <tr> <td>Inspection</td> <td></td> </tr> <tr> <td>Options</td> <td></td> </tr> <tr> <td>File Ops</td> <td></td> <td></td> </tr> <tr> <td>Esc</td> <td>Up/Down</td> <td>OK</td> </tr> </table> | Testprogram-Mainmenu                                                                                               |    |  | Digital    | <b>Marco Polo</b><br><b>Version 0.48</b><br><b>HW Driver V0.29</b><br><b>Prototype HW(0)</b><br><b>ISO - IrLED</b> |  | Analog        |  | Module |  | Inspection |  | Options |         | File Ops |                                                                                   |  | Esc | Up/Down | OK | <ul style="list-style-type: none"> <li>• Select “Options” in the Testprogram-Mainmenu</li> <li>• Confirm it with “OK”</li> </ul> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|----|--|------------|--------------------------------------------------------------------------------------------------------------------|--|---------------|--|--------|--|------------|--|---------|---------|----------|-----------------------------------------------------------------------------------|--|-----|---------|----|----------------------------------------------------------------------------------------------------------------------------------|
| Testprogram-Mainmenu                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                    |    |  |            |                                                                                                                    |  |               |  |        |  |            |  |         |         |          |                                                                                   |  |     |         |    |                                                                                                                                  |
| Digital                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Marco Polo</b><br><b>Version 0.48</b><br><b>HW Driver V0.29</b><br><b>Prototype HW(0)</b><br><b>ISO - IrLED</b> |    |  |            |                                                                                                                    |  |               |  |        |  |            |  |         |         |          |                                                                                   |  |     |         |    |                                                                                                                                  |
| Analog                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                    |    |  |            |                                                                                                                    |  |               |  |        |  |            |  |         |         |          |                                                                                   |  |     |         |    |                                                                                                                                  |
| Module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                    |    |  |            |                                                                                                                    |  |               |  |        |  |            |  |         |         |          |                                                                                   |  |     |         |    |                                                                                                                                  |
| Inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                    |    |  |            |                                                                                                                    |  |               |  |        |  |            |  |         |         |          |                                                                                   |  |     |         |    |                                                                                                                                  |
| Options                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                    |    |  |            |                                                                                                                    |  |               |  |        |  |            |  |         |         |          |                                                                                   |  |     |         |    |                                                                                                                                  |
| File Ops                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                    |    |  |            |                                                                                                                    |  |               |  |        |  |            |  |         |         |          |                                                                                   |  |     |         |    |                                                                                                                                  |
| Esc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Up/Down                                                                                                            | OK |  |            |                                                                                                                    |  |               |  |        |  |            |  |         |         |          |                                                                                   |  |     |         |    |                                                                                                                                  |
| <table border="1"> <tr><th colspan="3">Testprogram-Options</th></tr> <tr> <td>HW-Version</td> <td rowspan="4"> <b>UITP V030048</b><br/> <b>LP V000014</b><br/> <b>SW reset</b><br/> <b>S/N 09060C000005</b> </td> <td></td> </tr> <tr> <td>Factory setup</td> <td></td> </tr> <tr> <td>Remote</td> <td></td> </tr> <tr> <td>Update LP</td> <td></td> </tr> <tr> <td>Esc</td> <td>Up/Down</td> <td>OK</td> </tr> </table>                                                                                                              | Testprogram-Options                                                                                                |    |  | HW-Version | <b>UITP V030048</b><br><b>LP V000014</b><br><b>SW reset</b><br><b>S/N 09060C000005</b>                             |  | Factory setup |  | Remote |  | Update LP  |  | Esc     | Up/Down | OK       | <ul style="list-style-type: none"> <li>• “Testprogram-Options” appears</li> </ul> |  |     |         |    |                                                                                                                                  |
| Testprogram-Options                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                    |    |  |            |                                                                                                                    |  |               |  |        |  |            |  |         |         |          |                                                                                   |  |     |         |    |                                                                                                                                  |
| HW-Version                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>UITP V030048</b><br><b>LP V000014</b><br><b>SW reset</b><br><b>S/N 09060C000005</b>                             |    |  |            |                                                                                                                    |  |               |  |        |  |            |  |         |         |          |                                                                                   |  |     |         |    |                                                                                                                                  |
| Factory setup                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                    |    |  |            |                                                                                                                    |  |               |  |        |  |            |  |         |         |          |                                                                                   |  |     |         |    |                                                                                                                                  |
| Remote                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                    |    |  |            |                                                                                                                    |  |               |  |        |  |            |  |         |         |          |                                                                                   |  |     |         |    |                                                                                                                                  |
| Update LP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                    |    |  |            |                                                                                                                    |  |               |  |        |  |            |  |         |         |          |                                                                                   |  |     |         |    |                                                                                                                                  |
| Esc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Up/Down                                                                                                            | OK |  |            |                                                                                                                    |  |               |  |        |  |            |  |         |         |          |                                                                                   |  |     |         |    |                                                                                                                                  |

Explanation of the menu items:

| Menu item     | Explanation                                                   |
|---------------|---------------------------------------------------------------|
| HW-Version    | <b>CAUTION – For use by the development departments only!</b> |
| Factory setup | Delivery State, Serial Number                                 |
| Remote        | <b>CAUTION – For use by the development departments only!</b> |
| Update LP     | Update the bootloader program                                 |
|               |                                                               |

Explanation of the items in the window:

| Display          | Explanation                                  |
|------------------|----------------------------------------------|
| UITP Vxxxxxx     | Firmware version                             |
| LP Vxxxxxx       | Bootloader version                           |
| SW/HW reset      | Last executed reset type                     |
| S/N YYMM0C0xxxxx | Xxxxx: counted number of instrument for YYMM |

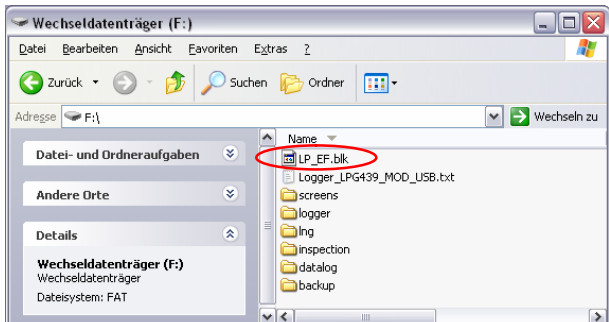
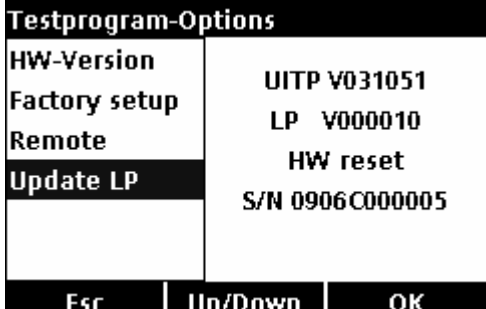
### 3.7.1 Factory setup

|  |                                                                                                                                                                                             |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"> <li>• Select “Factory setup” in the Testprogram-Options menu</li> <li>• Confirm it with “OK”</li> <li>• “TP.-Options-FactorySettings” appears</li> </ul> |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

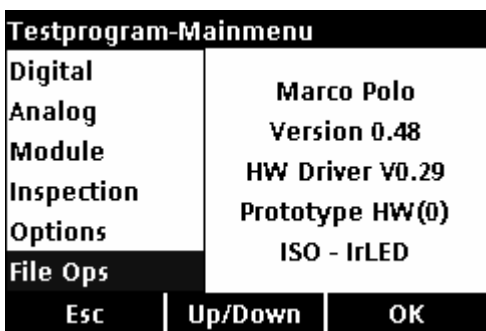
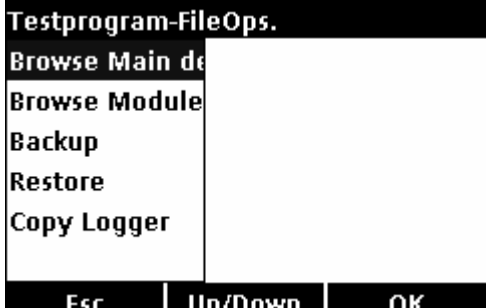
Explanation of the menu items:

| Menu item | Explanation                                                                                                                                                                                |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | <p>Touching the ‘OK’ key causes all instrument settings that have been changed by the customer to be reset to the default values (factory settings). All measurement data are deleted.</p> |
|           | <p>A window opens, in which the serial number of the photometer can be entered / changed.</p>                                                                                              |

### 3.7.2 Update LP

|                                                                                   |                                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"> <li>• If it necessary to update the loader program, copies the “LP_EF.blk” file from PC to the Module.</li> <li>• Plug in the module in the meter</li> </ul> |
|  | <ul style="list-style-type: none"> <li>• Select Update LP in the “Testprogram-Options” menu.</li> </ul>                                                                                         |

### 3.8 File Ops

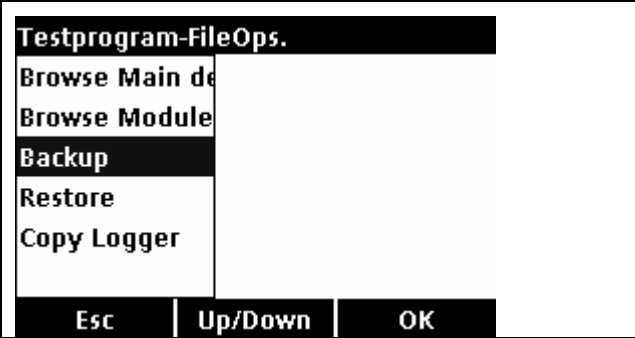


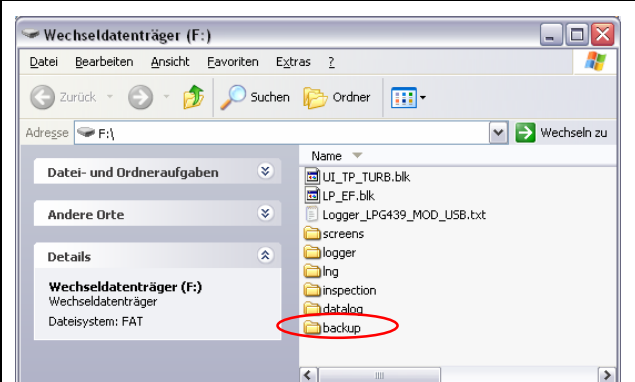
|                                                                                     |                                                                                                                                   |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"> <li>• Select “File Ops” in the Testprogram-Mainmenu</li> <li>• Confirm it with “OK”</li> </ul> |
|  | <ul style="list-style-type: none"> <li>• “Testprogram-File Ops” appears</li> </ul>                                                |

Explanation of the menu items:

| Menu item     | Explanation                                                              |
|---------------|--------------------------------------------------------------------------|
| Browse Main   | <b>CAUTION – For use by the development department only!</b>             |
| Browse Module | <b>CAUTION – For use by the development department only!</b>             |
| Backup        | Makes a backup from the 2100Q (is) (see section 3.8.1 Backup)            |
| Restore       | Restores a saved backup from the 2100Q (is) (see section 3.8.2 Restore)  |
| Copy Logger   | Copies the logger file to the USB module (see section 3.8.3 Copy Logger) |

### 3.8.1 Backup

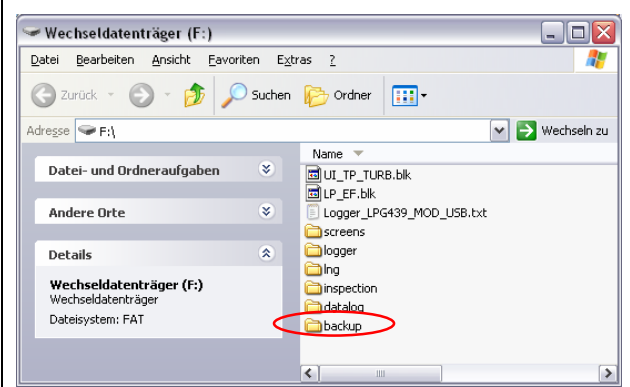
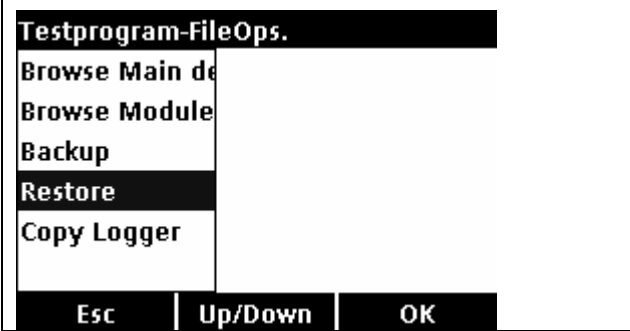


The menu "Backup" offers the possibility to store all measuring data, Operator ID, Sample ID, password and all adjustable data on a USB OTG Adapter (Module #7)

|                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>Testprogram-FileOps.<br/>Browse Main de<br/>Browse Module<br/>Backup<br/>Restore<br/>Copy Logger</p> <p>Esc   Up/Down   OK</p>                                                                                                                                       | <ul style="list-style-type: none"> <li>• Plug in a USB OTG Adapter (Module #7)</li> <li>• Select "Backup" in the FileOps-Submenu</li> <li>• Confirm it with "OK"</li> </ul>                                               |
|  <p>Backup</p> <p>Press Start to backup instrument!</p> <p>Cancel   Start</p>                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>• Press "Start" to backup the instrument!</li> <li>• It will take up to 30 sec...</li> </ul> <p><b>Note:</b> Are already backup files on the module, they will be overwritten!</p> |
|  <p>Backup</p> <p>Backup complete<br/>082 files processed.</p> <p>Exit</p>                                                                                                                                                                                             | <ul style="list-style-type: none"> <li>• Press "Exit" when the backup is complete</li> </ul> <p><b>Note:</b> If "000" files are shown then the copy process was failed.</p>                                               |
|  <p>Wechseldatenträger (F:)</p> <p>Name</p> <ul style="list-style-type: none"> <li>UI_TP_TURB.bik</li> <li>LP_EF.bik</li> <li>Logger_LPG439_MOD_USB.txt</li> <li>screens</li> <li>logger</li> <li>log</li> <li>inspection</li> <li>data.log</li> <li>backup</li> </ul> | <ul style="list-style-type: none"> <li>• Connect the USB OTG Adapter (Module #7) with a PC.<br/>On the Module would create the folder "backup".</li> </ul>                                                                |



### 3.8.2 Restore

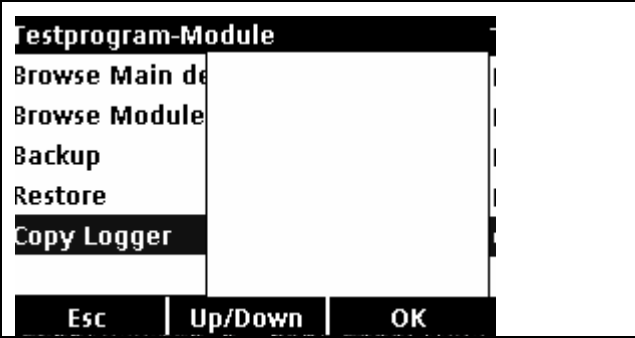
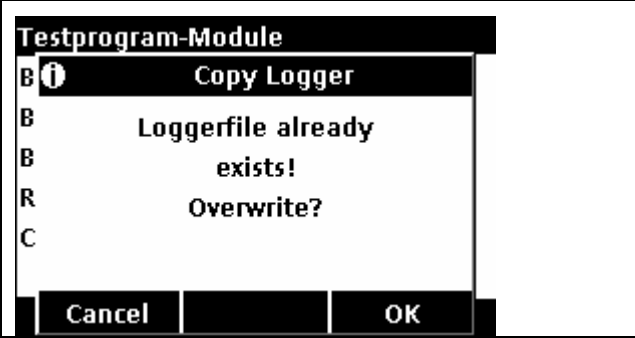
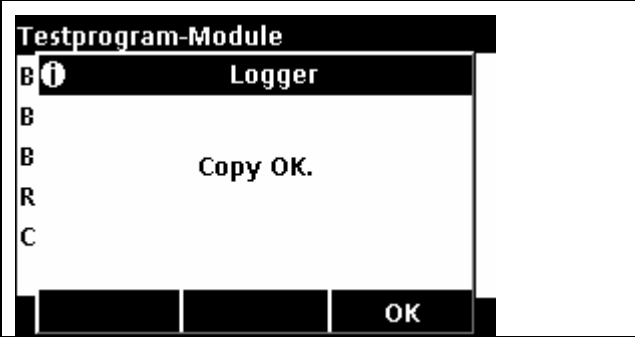
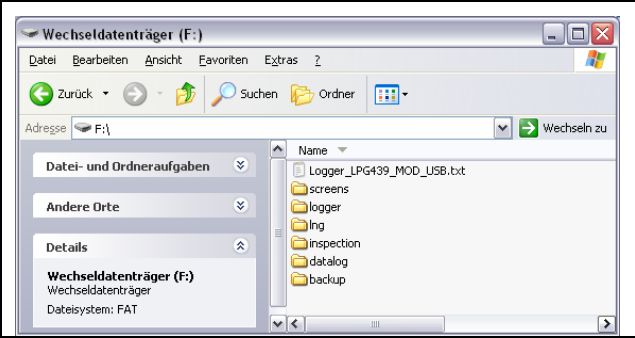
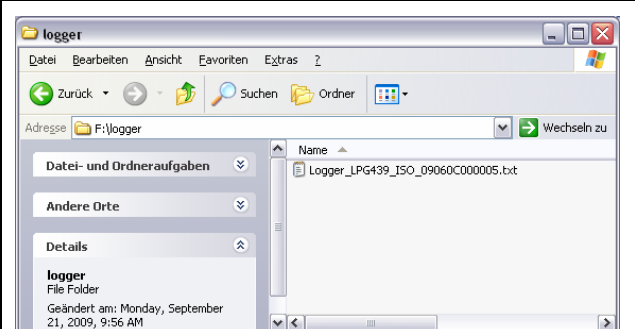
**Note:** All current data on the meter will be overwritten when restoring the backup files!

|                                                                                     |                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <ul style="list-style-type: none"> <li>On the USB OTG Adapter (Module #7) must be the folder “backup” which would be created by carried out the backup routine.</li> </ul>                                       |
|   | <ul style="list-style-type: none"> <li>Select “Restore” in the FileOps-Submenu</li> <li>Confirm it with “OK”</li> </ul>                                                                                          |
|  | <ul style="list-style-type: none"> <li>Press “Start” to restore the instrument!</li> </ul>                                                                                                                       |
|  | <ul style="list-style-type: none"> <li>Press “Exit” when the restore is complete</li> <li>The backup is restored, now.</li> </ul> <p><b>Note:</b> If “000” files are shown then the copy process was failed.</p> |

### 3.8.3 Copy Logger

The ‘Copy Logger’ function copies the meter’s event log to the USB modul. The event log contains the instrument history and a record of any error messages.

This function can help service personnel to identify errors more quickly, especially when it is not clear what is wrong or when customers’ are unable to provide sufficient information.

|                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>Testprogram-Module<br/>Browse Main de<br/>Browse Module<br/>Backup<br/>Restore<br/>Copy Logger</p> <p>Esc   Up/Down   OK</p>                                                                                             | <ul style="list-style-type: none"> <li>• Select “Copy Logger” in the “Testprogram-File Ops” menu</li> <li>• Confirm it with “OK”</li> </ul>                                                                                                                            |
|  <p>Testprogram-Module</p> <p>B ⓘ Copy Logger</p> <p>B Loggerfile already exists!<br/>B Overwrite?<br/>R<br/>C</p> <p>Cancel   OK</p>                                                                                        | <ul style="list-style-type: none"> <li>• If the Loggerfile exists on the module, the message “Logger already exists! Overwrite?” appears.</li> <li>• Confirm it with “OK”</li> </ul>                                                                                   |
|  <p>Testprogram-Module</p> <p>B ⓘ Logger</p> <p>B<br/>B Copy OK.<br/>R<br/>C</p> <p>OK</p>                                                                                                                                  | <ul style="list-style-type: none"> <li>• When the copy of the event log is on the module the message “Copy OK.” appears.</li> </ul>                                                                                                                                    |
|  <p>Wechseldatenträger (F:)</p> <p>Name</p> <ul style="list-style-type: none"> <li>Logger_LPG439_MOD_USB.txt</li> <li>screens</li> <li>logger</li> <li>log</li> <li>inspection</li> <li>datalog</li> <li>backup</li> </ul> | <ul style="list-style-type: none"> <li>• There are two logger files on the module, now.<br/>In the main folder of the module is “<b>Logger_LPG439_MOD_USB.txt</b>”<br/>This is the logger of the module.</li> </ul>                                                    |
|  <p>logger</p> <p>Name</p> <ul style="list-style-type: none"> <li>Logger_LPG439_ISO_09060C000005.txt</li> </ul> <p>logger<br/>File Folder<br/>Geändert am: Monday, September 21, 2009, 9:56 AM</p>                         | <ul style="list-style-type: none"> <li>• The log of the instrument is saved on the module in the folder “logger” as a text file with the name:<br/>“<b>Logger_LPG439_ISO/EPA_S/N.txt</b>”<br/>For example:<br/>“<b>Logger_LPG439_ISO_09060C000005.txt</b>”.</li> </ul> |

**Explanation of the content of the event logs:**

| Display           | Explanation                                                                                        | Example                                              |
|-------------------|----------------------------------------------------------------------------------------------------|------------------------------------------------------|
| First line:       | Instrument name and serial number                                                                  | 2100Q (is),S/N 09060C000005                          |
| Second line:      | Software version                                                                                   | Instrument Version:.,0.27                            |
| Additional lines: | Time and date of the log entry and an index number that provides more information about the entry. | 2006-01-12 12:45:43,2,<br>2006-01-12 12:45:46,4,130, |

**Explanation of the index numbers of the event logs from the instrument:**

| Indexnumber    | Explanation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------|-----|---------------------|-----|----------------|-----|-----------------|-----|---------------------|-----|-----------------------|-----|----------------------------|-----|----------------------|-----|-----------------------|-----|-------------------|------|------------------------------|
| <b>1</b>       | <b>Enter comments</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| <b>2</b>       | <b>Start User Interface</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| <b>3</b>       | <b>Start Testprogram</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| <b>4, xxx</b>  | <b>Read Ratio</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
|                | <table border="1"> <thead> <tr> <th>xxx</th> <th>Explanation</th> </tr> </thead> <tbody> <tr> <td>[1]</td> <td>ADC Error</td> </tr> <tr> <td>[2]</td> <td>Overrange</td> </tr> <tr> <td>[3]</td> <td>Underrange</td> </tr> <tr> <td>[4]</td> <td>Exceeds Range Limit</td> </tr> <tr> <td>[5]</td> <td>Undercuts Range Limit</td> </tr> <tr> <td>[6]</td> <td>Ref Detector Signal to low</td> </tr> <tr> <td>[7]</td> <td>Lid open</td> </tr> <tr> <td>[8]</td> <td>Lamp error</td> </tr> <tr> <td>[9]</td> <td>Low Batterie</td> </tr> </tbody> </table>                                                                                             | xxx   | Explanation | [1] | ADC Error           | [2] | Overrange      | [3] | Underrange      | [4] | Exceeds Range Limit | [5] | Undercuts Range Limit | [6] | Ref Detector Signal to low | [7] | Lid open             | [8] | Lamp error            | [9] | Low Batterie      |      |                              |
| xxx            | Explanation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [1]            | ADC Error                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [2]            | Overrange                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [3]            | Underrange                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [4]            | Exceeds Range Limit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [5]            | Undercuts Range Limit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [6]            | Ref Detector Signal to low                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [7]            | Lid open                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [8]            | Lamp error                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [9]            | Low Batterie                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| <b>5</b>       | <b>HW Reset</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| <b>6,xxxx</b>  | <b>Low Batterie</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| <b>7,xxxx</b>  | <b>Temperature too high</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| <b>8</b>       | <b>RST: Average value</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| <b>9</b>       | <b>RST: Confidence level too low</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| <b>10</b>      | <b>Send Data during connecting PC</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| <b>11,xxxx</b> | <b>USB Module out of memory</b><br>xxxx                      freespace in Bytes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| <b>12,xxxx</b> | <b>Filesystem error</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
|                | <table border="1"> <thead> <tr> <th>xxxxx</th> <th>Explanation</th> </tr> </thead> <tbody> <tr> <td>[1]</td> <td>Delete Last Reading</td> </tr> <tr> <td>[2]</td> <td>Delete Datalog</td> </tr> <tr> <td>[3]</td> <td>Read/Seek Error</td> </tr> <tr> <td>[4]</td> <td>Store Data</td> </tr> <tr> <td>[5]</td> <td>Store Reading Log</td> </tr> <tr> <td>[6]</td> <td>Store VerifyCalLog</td> </tr> <tr> <td>[7]</td> <td>Compress Reading Log</td> </tr> <tr> <td>[8]</td> <td>Compress VerifyCalLog</td> </tr> <tr> <td>[9]</td> <td>Store Calibration</td> </tr> <tr> <td>[10]</td> <td>Compress Calibration History</td> </tr> </tbody> </table> | xxxxx | Explanation | [1] | Delete Last Reading | [2] | Delete Datalog | [3] | Read/Seek Error | [4] | Store Data          | [5] | Store Reading Log     | [6] | Store VerifyCalLog         | [7] | Compress Reading Log | [8] | Compress VerifyCalLog | [9] | Store Calibration | [10] | Compress Calibration History |
| xxxxx          | Explanation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [1]            | Delete Last Reading                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [2]            | Delete Datalog                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [3]            | Read/Seek Error                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [4]            | Store Data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [5]            | Store Reading Log                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [6]            | Store VerifyCalLog                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [7]            | Compress Reading Log                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [8]            | Compress VerifyCalLog                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [9]            | Store Calibration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |
| [10]           | Compress Calibration History                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |       |             |     |                     |     |                |     |                 |     |                     |     |                       |     |                            |     |                      |     |                       |     |                   |      |                              |

14,xx,yyyyyy Communication Error, Message lost

| xx | OP Code                 |
|----|-------------------------|
| a  | General CommandTxTask   |
| b  | PrinterCommandTask      |
| c  | FileSystemCommandTxTask |
| d  | UartReceptionTask       |
| A0 | GET_IDENT               |
| A1 | GET_SW_VER              |
| A2 | GET_STATUS              |
| A3 | ENABLE_CHARGING         |
| A4 | SET_DATE_TIME           |
| A5 | GET_DATE_TIME           |
| A6 | BARCODE_READER          |
| A7 | SEND_TEMP               |
| A8 | BARCODE_EVENT           |
| A9 | GET_TEMP                |
| AA | READ_POWER_STATUS       |
| AB | SET_CHARGING_TYPE       |
| AC | GO_TO_SLEEP_MODE        |
| AD | SET_BATT_LOAD           |
| AE | FORCE_CHARG             |
| B0 | CREATE_PAGE             |
| B1 | DELETE_PAGE             |
| B2 | CLEAR_PAGE              |
| B3 | SEND_PAGE               |
| B4 | GET_PIXEL               |
| B5 | PUT_PIXEL               |
| B6 | DRAW_LINE               |
| B7 | PAINT_RECT              |
| B8 | GET_PRINTER_STATUS      |
| C0 | SEND_STRING             |
| C1 | GET_BARCODE             |
| C2 | UPLOAD_STATUS           |
| C3 | SET_FW_FILENAME         |
| C4 | UPLOAD_FW               |
| C5 | F_OPEN                  |
| C6 | F_CLOSE                 |
| C7 | F_GET_VERSION           |
| C8 | F_INIT                  |
| C9 | F_ENTER_FS              |
| CA | F_RELEASE_FS            |
| CB | F_FORMAT                |
| CC | F_GET_FREE_SPACE        |
| CD | F_MK_DIR                |
| CE | F_CH_DIR                |
| CF | F_RM_DIR                |
| D0 | F_GET_DRIVE             |
| D1 | F_CH_DRIVE              |
| D2 | F_GET_CWD               |
| D3 | F_GET_DCWD              |
| D4 | F_RENAME                |
| D5 | F_MOVE                  |
| D6 | F_DELETE                |
| D7 | F_FILE_LENGTH           |

|                   |                                     |
|-------------------|-------------------------------------|
| D8                | F_FIND_FIRST                        |
| D9                | F_FIND_NEXT                         |
| DA                | F_SET_TIME_DATE                     |
| DB                | F_GET_TIME_DATE                     |
| DC                | F_TRUNCATE                          |
| DD                | F_FLUSH                             |
| DE                | F_WRITE                             |
| DF                | F_READ                              |
| E0                | F_SEEK                              |
| E1                | F_TELL                              |
| E2                | F_SET_EOF                           |
| E3                | F_EOF                               |
| E4                | F_REWIND                            |
| E5                | F_PUTC                              |
| E6                | F_GETC                              |
| E7                | F_STAT                              |
| E8                | F_CHECK_VOL                         |
| E9                | F_GET_OEM                           |
| EA                | F_SET_ATTR                          |
| EB                | F_GET_ATTR                          |
| EC                | F_TRUNCATE                          |
| FF                | OP_OUT_OF_RANGE                     |
| <b>yyyyyyyyyy</b> | <b>Errorcode</b>                    |
| 0x00000001        | GENERAL_MAIL_BOX_OUT_OF_RANGE       |
| 0x00000002        | FS_MAIL_BOX_OUT_OF_RANGE            |
| 0x00000004        | PRINTER_MAIL_BOX_OUT_OF_RANGE       |
| 0x00000008        | MAIL_BOX_OUT_OF_RANGE               |
| 0x00000010        | SEM_GENERAL_PACKET_ACK_OUT_OF_RANGE |
| 0x00000020        | SEM_FS_PACKET_ACK_OUT_OF_RANGE      |
| 0x00000040        | SEM_PRINTER_PACKET_ACK_OUT_OF_RANGE |
| 0x00000080        | SEM_RESPONSE_DATA_OUT_OF_RANGE      |
| 0x00000100        | UART_TX_OUT_OF_RANGE                |
| 0x00000200        | UART_TX_NOT_OWNED                   |
| 0x00000400        | UART_GET_STRING_ERROR               |
| 0x00000800        | UART_TX_ERROR                       |
| 0x00001000        | GENERAL_COMMAND_Q_FULL              |
| 0x00002000        | FS_COMMAND_Q_FULL                   |
| 0x00004000        | PRINTER_COMMAND_Q_FULL              |
| 0x00008000        | SEM_PRINTER_PKT_OUT_OF_RANGE        |
| 0x00010000        | GENERAL_COMMAND_Q_NOT_CREATED       |
| 0x00020000        | FS_COMMAND_Q_NOT_CREATED            |
| 0x00040000        | PRINTER_COMMAND_Q_NOT_CREATED       |
| 0x00100000        | SEM_FS_MAIN_OUT_OF_RANGE            |
| 0x00200000        | FS_NO_MESG_BLOCKS                   |
| 0x00400000        | FS_COMMAND_ACK_TIMEOUT              |
| 0x00800000        | FS_COMMAND_NO_Q_SLOT                |
| 0x01000000        | GM_SEM_ERROR                        |
| 0x02000000        | GM_MAILBOX_ERROR                    |
| 0x04000000        | GM_MAILBOX_TIMEOUT_ERROR            |
| 0x08000000        | GM_QUEUE_ERROR                      |
| 0x10000000        | Q_OUT_OF_RANGE_CODE                 |
| 0x20000000        | CHECKSUM_ERROR_CODE                 |
| 0x40000000        | NO_MODULE_COM                       |
| 0x80000000        | OPCODE_OUT_OF_RANGE_CODE            |

|    |                  |                                                  |
|----|------------------|--------------------------------------------------|
| 15 | <b>Language</b>  |                                                  |
|    | <b>Error no.</b> | <b>Explanation</b>                               |
|    | [1]              | Selecting failed (write to language flash block) |
|    | [2]              | Updating from Module failed                      |

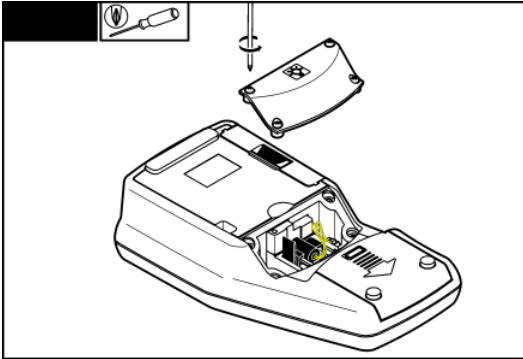
Explanation of the index numbers of the event logs from the modul:

| Indexnumber | Explanation                              |                                           |
|-------------|------------------------------------------|-------------------------------------------|
| 101         | Enter comments                           |                                           |
| 102         | Reset                                    |                                           |
| 103,xxxx    | <b>Communication Error, message lost</b> |                                           |
|             | <b>xx</b>                                | <b>OP Code</b>                            |
|             | 0xA5                                     | GET_DATE_TIME                             |
|             | 0xA8                                     | BARCODE_EVENT                             |
|             | 0xA9                                     | GET_TEMP                                  |
|             | 0xAA                                     | GET_POWER_STATUS                          |
| 104,x,yyyy  | <b>Communication Error, low layer</b>    |                                           |
|             | <b>x</b>                                 |                                           |
|             | 1                                        | UART reset                                |
|             |                                          | <b>yyyy</b> <b>Explanation</b>            |
|             |                                          | 0x08      Arbitration lost detected       |
|             |                                          | 0x10      Overrun error                   |
|             |                                          | 0x20      Framing error                   |
|             |                                          | 0x40      Parity error                    |
|             |                                          | 0x...      undefined errors               |
|             | 2                                        | Packet corrupt                            |
|             |                                          | <b>yyyy</b> <b>Explanation</b>            |
|             |                                          | invOC      invalid opcode                 |
|             |                                          | invOcL      invalid opcode length         |
|             |                                          | invQ      invalid queue                   |
|             |                                          | invCS      invalid checksum               |
|             |                                          | invPackL      invalid packet length       |
|             | 3                                        | Resource error                            |
|             |                                          | <b>yyyy</b> <b>Explanation</b>            |
|             |                                          | getFS      get filesystem resource failed |
|             |                                          | putFS      put filesystem resource failed |
|             |                                          | getGen      get general resource failed   |
|             |                                          | putGen      put general resource failed   |
|             |                                          | getBC      get barcode resource failed    |
|             |                                          | putBC      put barcode resource failed    |
|             |                                          | getPrnt      get printer resource failed  |
|             |                                          | putPrnt      put printer resource failed  |
|             | 4                                        | Message error                             |
|             |                                          | <b>yyyy</b> <b>Explanation</b>            |
|             |                                          | errFS      filesystem message error       |
|             |                                          | timeoutFS      filesystem message timeout |
|             |                                          | gen      general message error            |
|             |                                          | bc      barcode message error             |
|             |                                          | prnt      printer message error           |

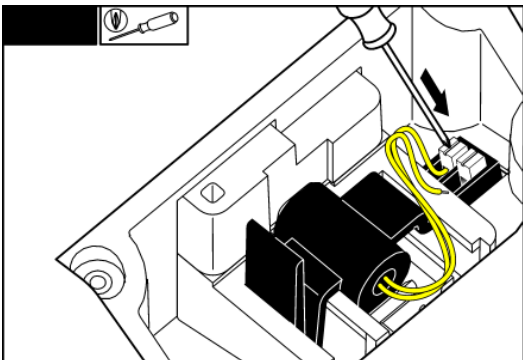
|                 |                           |                                           |
|-----------------|---------------------------|-------------------------------------------|
| <b>105,xxxx</b> | <b>Batterie Detection</b> |                                           |
|                 | <b>xxxx</b>               | <b>Explanation</b>                        |
|                 | 1;...V                    | Threshold uncertainty (BattChargeVoltage) |
|                 | 2;...V                    | Deep Discharged (BattLoadVoltage)         |
| <b>106,xxxx</b> | <b>Batterie Charging</b>  |                                           |
|                 | <b>xxxx</b>               | <b>Explanation</b>                        |
|                 | 1;...h                    | Charge timeout (ChargeTime)               |
|                 | 2;...c                    | Overtemperature (Temperature)             |
|                 | 3;...V                    | Overvoltage (BattChargeVoltage)           |
| <b>107,xxxx</b> | <b>Memory</b>             |                                           |
|                 | <b>xxxx</b>               | <b>Explanation</b>                        |
|                 | 1;...                     | Flash CRC error (MemoryName)              |
|                 | 2;...                     | Filesystem CRC error (FileName)           |
|                 | 3; ...                    | Filesystem access error (FileName)        |
|                 | 4; -                      | Filesystem format                         |

# 4 Repairs

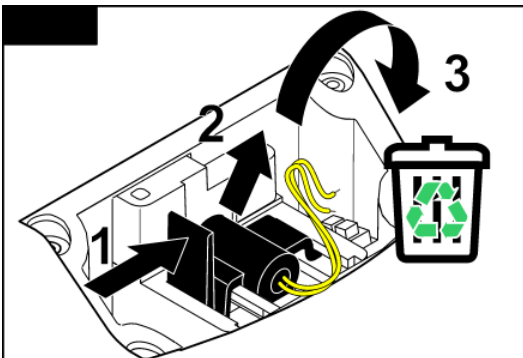
## 4.1 Lamp removing (only 2100Q)



1. Loosen the four screws from the lamp cover

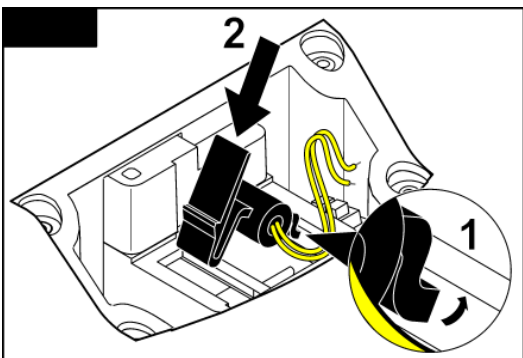


2. Plug out the wires from the lamp with pressing the noses.



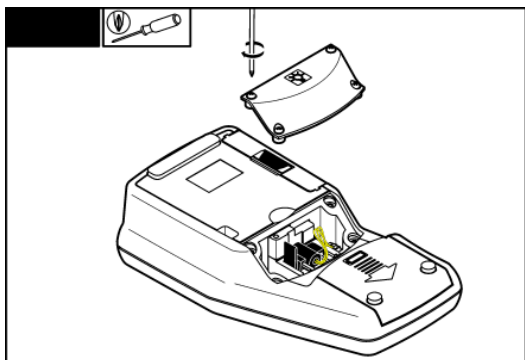
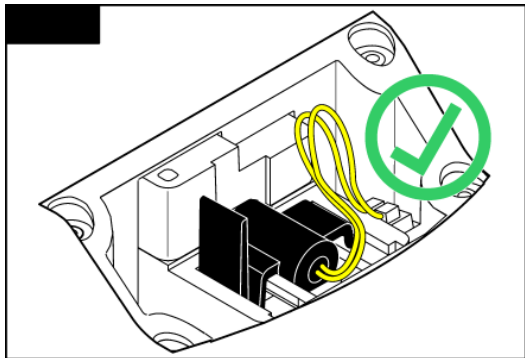
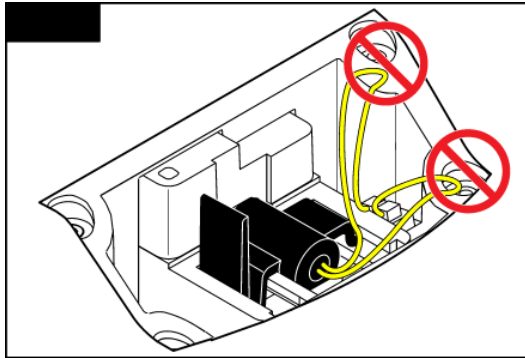
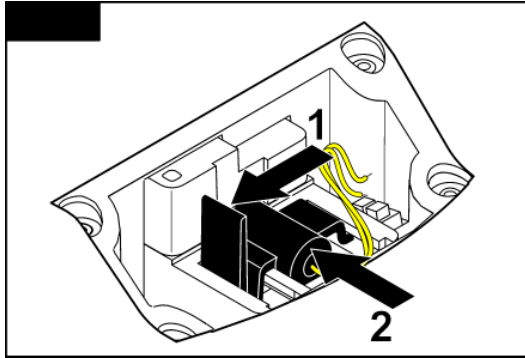
3. Remove the lamp, now.

## 4.2 Lamp installing (only 2100Q)



1. Plug in the Lamp





2. **Note:** Don't squash the wires

3. Replace the lamp cover

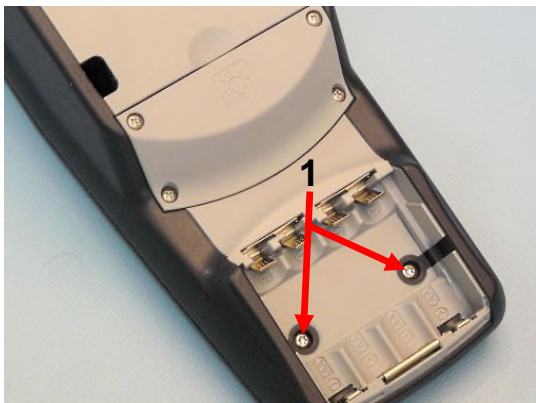
## 4.3 Opening the Meter

### Only 2100Q:

1. Remove the Lamp (see section 4.1 Lamp removing (only 2100Q))

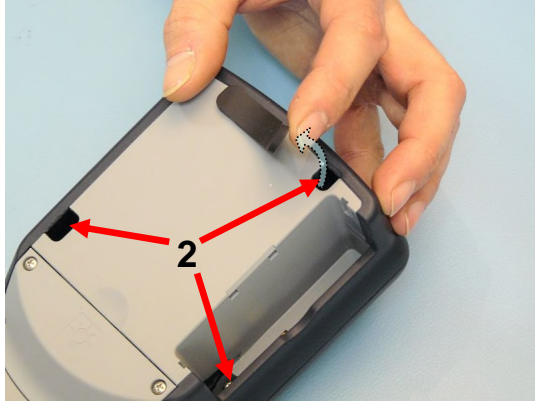
### For 2100Q and 2100Q is

2. Remove the battery cover.
3. Remove the batteries, if they are installed.

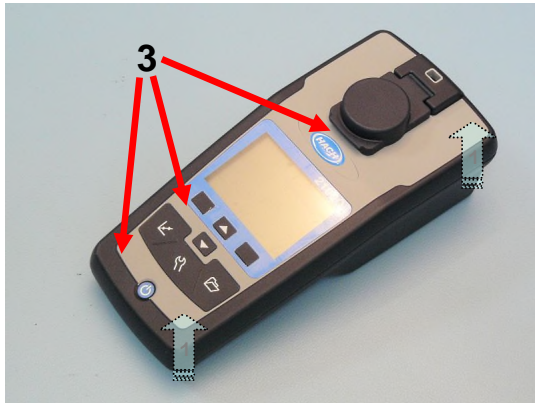


4. Loosen the two screws (1) in the battery compartment

5. Remove the module on the left side of the meter: Pull outside the noses, and pull down the module



6. Lift the right side from the large rubber foot
7. Loosen the three screws (2)

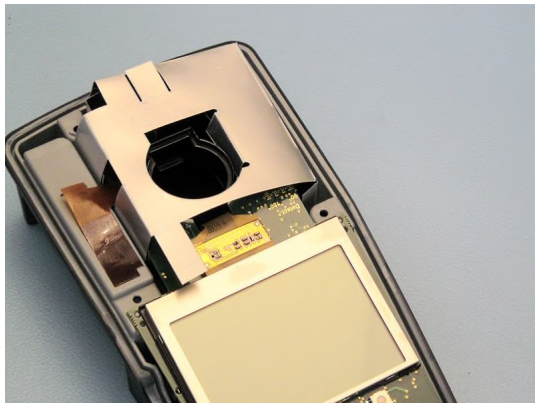


8. Lift the housing top (3) of the photometer.

**Note:** Before replace the housing check that the seal is intact.

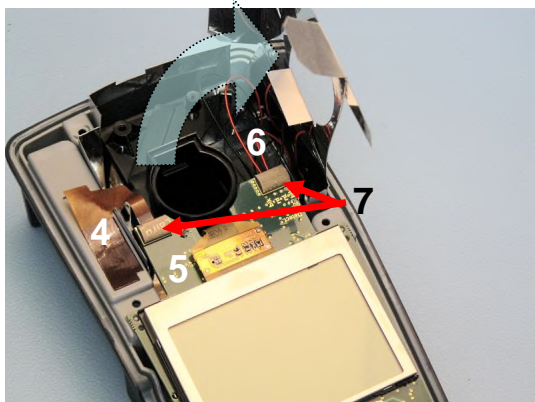
Return the turbidimeter to its original state by carrying out steps 1 to 8 in reverse order.

#### 4.4 Main board with Display



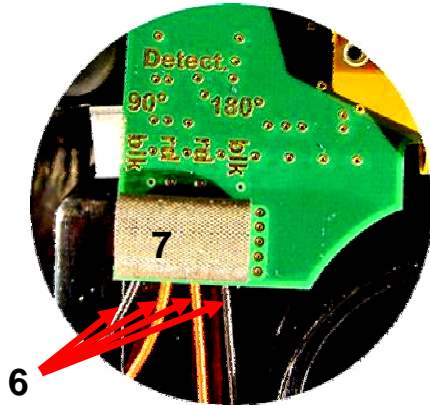
1. Open the turbidimeter (see section 4.3 Opening the Meter)

**Note:** By close the turbidimeter check that the ESD shield contacts the display



2. Fold the Cap of the ESD shield out.

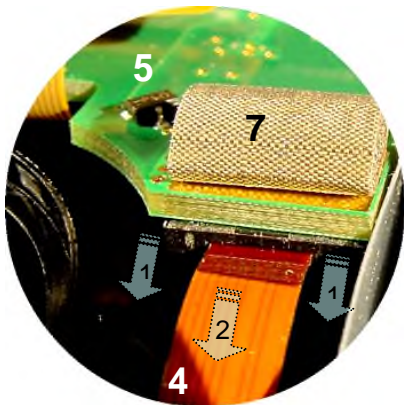
**Note:** By fold the shield back, check that both conductive EMI Gaskets (7) are in place and contacts the ESD shield!



3. Plug out the four detector wires (6) from the optical bench.

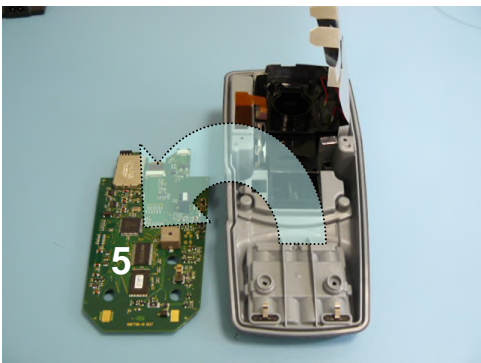
→To determine the wires at 90° and at 180° see the picture at section 4.6 Optical Bench

**Note:** By install a new main board (5) it requires definitely more forces to plug in the detector wires (6). Use a pliers to plug in!

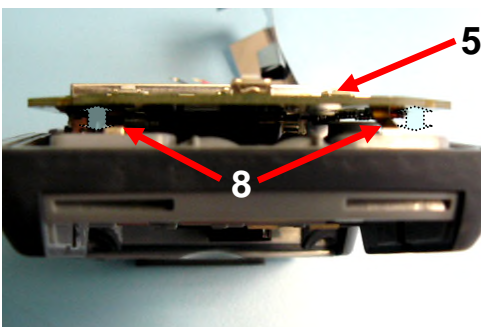


4. Disconnect the connector board (4) from the main board (5).

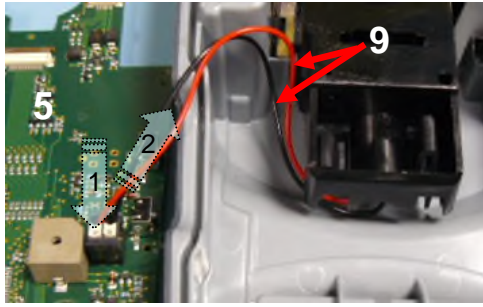
**Note:** It's a zero force socket in use for the connection. At first pull the clip from the zero force socket, then pull the connector from connector board.



5. Remove the main board (5) with display



**Note:** By install the main board (5) both battery contacts (8) should be have enough springiness (min: 1.5 mm distance)!



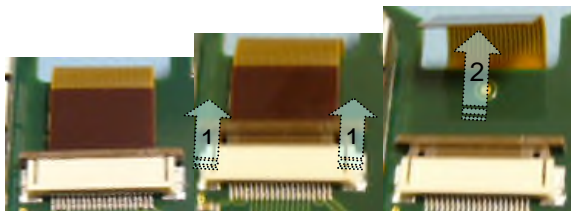
**Only 2100Q is:**

Disconnect the LED:

6. Press the noise, and Pull the LED – wire



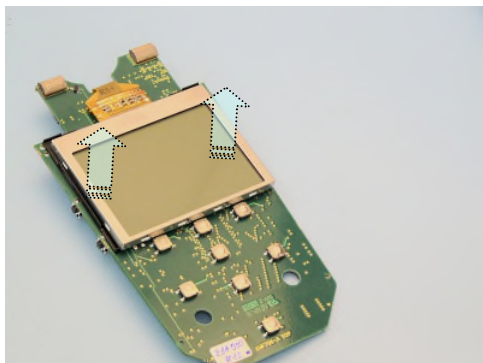
**Note:** By install the main board (5) the LED wires (9) should be have there place left from the optical bench!



**For 2100Q and 2100Q is**

7. Disconnect the display.

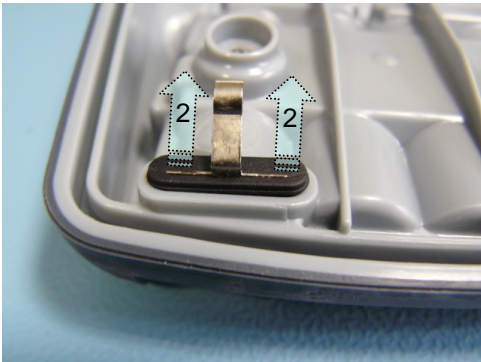
**Note:** It's a zero force socket in use for the connection. At first pull the clip from the zero force socket, then pull the display - connector.



8. Now, you can lift the display from the main board

Return the turbidimeter to its original state by carrying out steps 1 to 8 in reverse order.

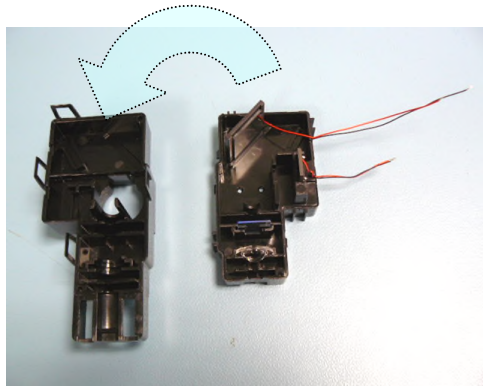
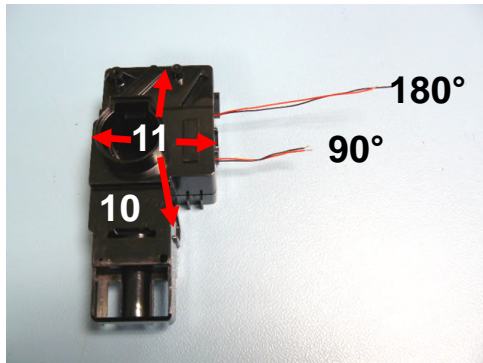
## 4.5 Battery contacts



1. Open the turbidimeter (see section 4.3 Opening the Meter).
2. Remove the main board with display (see section 4.4 Main board with Display)
3. Pull the battery contact in the battery compartment.
4. Turn the housing
5. Lift the battery contact out of the housing

**Note:** While inserts the contact press it outside

## 4.6 Optical Bench

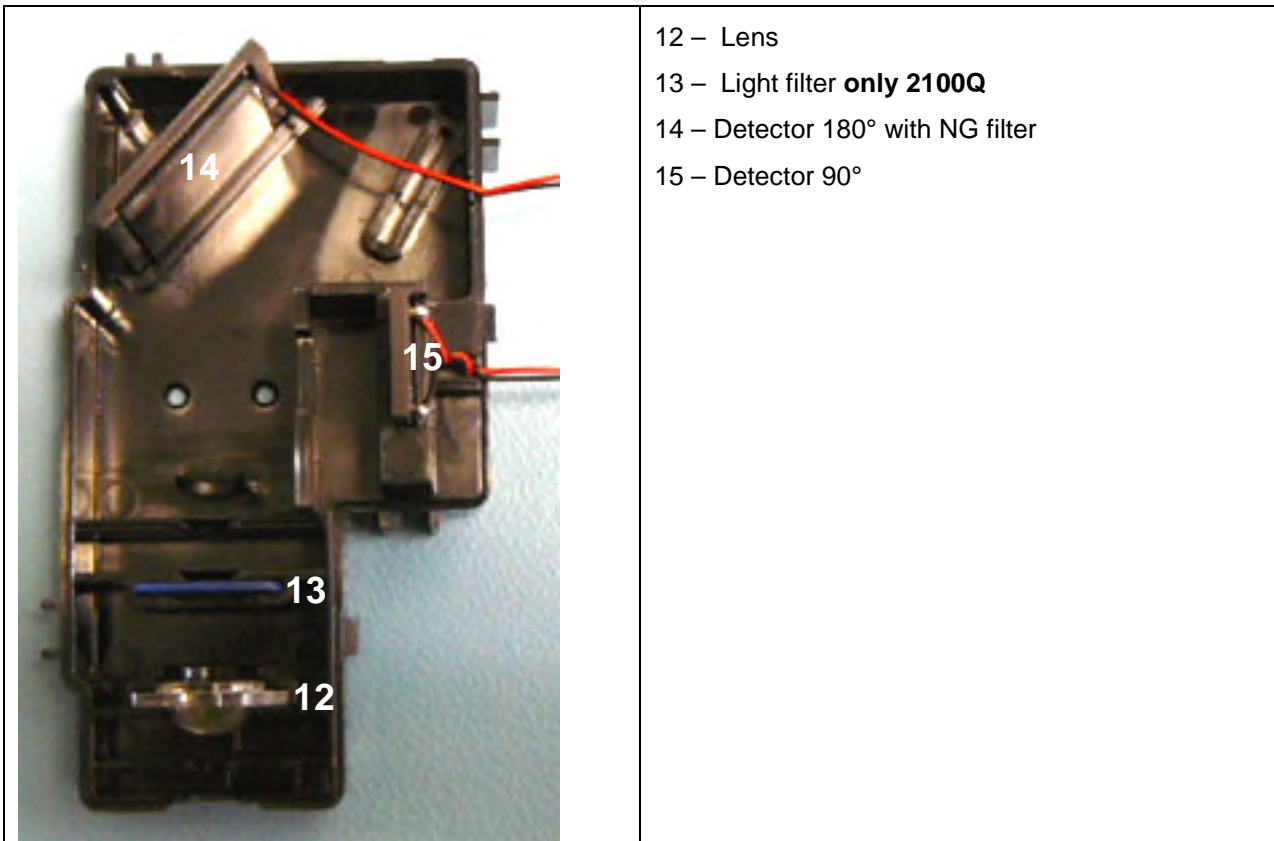


1. Open the turbidimeter (see section 4.3 Opening the Meter).
2. Remove the main board with display (see section 4.4 Main board with Display)
3. Remove the Optical Bench (10)
4. Gently release the 4 latches (11)
5. Lift the top of the optical bench

**Note:** By replacing the top *don't squash the wires*

Return the turbidimeter to its original state by carrying out steps 1 to 5 in reverse order.

## 4.7 Location of component in beam path



- 12 – Lens
- 13 – Light filter **only 2100Q**
- 14 – Detector 180° with NG filter
- 15 – Detector 90°

### **Cleaning the components:**

**Note:** Cleaning with ethanol, alcohol, or similarities, only the light filter (13)(only 2100Q) and the NG filter from the 180° detector(14)!

**Method 1: Cleaning with air:** Settled dust can be blown off with a rubber bellows or an oil-free air gun or ionization gun.

**Method 2: Cotton swabs:** Dust particles can be carefully removed from small parts with a cotton swab if cleaning with air does not succeed



# 5 Inspection

## 5.1 General

After a component has been replaced, the service inspection must always be carried out (see section 5.5 Service Inspection (after repair))

Otherwise, in case of cleaning the components only, the calibration with StablCal Full Range Mode in the User Interface is sufficient (see section 5.4 Calibration).

**Note:** For more information about StablCal follow the instruction manual “STABLCAL Stabilized Formazin Turbidity Standards For Use With Any Turbidimeter” **DOC022.98.00646**

## 5.2 Inspection procedure

| What?                                        | How?                                                                      |
|----------------------------------------------|---------------------------------------------------------------------------|
| Check the housing for damage and/or soiling. | Visual check                                                              |
| Clean the components of the optical bench:   | See sections 4.6 Optical Bench and 4.7 Location of component in beam path |
| Calibration                                  | See sections 5.3 Apply silicone oil to a sample cell and 5.4 Calibration  |

## 5.3 Apply silicone oil to a sample cell

### 5.3.1 General

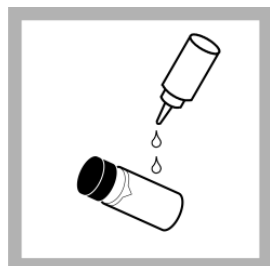
Sample cells and caps must be extremely clean and free from significant scratches. Apply a thin coating of silicone oil on the outside of the sample cells to mask minor imperfections and scratches that may contribute to light scattering.

**Note:** Use only the provided silicone oil. This silicone oil has the same refractive index as the sample cell glass.

### 5.3.2 Aids

| Order no. | Description  |
|-----------|--------------|
| 4707600   | Oiling Cloth |
| 126936    | Silicone Oil |

### 5.3.3 Description



To coat the cell with a thin layer of oil apply a small bead of silicone oil from the top to the bottom of the cell.



Use the provided oiling cloth to spread the oil uniformly. Wipe off the excess so that only a thin coat of oil is left. The sample cell should be almost dry with little or no visible oil.

**Note:** Store the oiling cloth in a plastic storage bag to keep the cloth clean.

## 5.4 Calibration

**Note:** At [http://app.hach.com/coaweb/customer\\_coa\\_request.asp](http://app.hach.com/coaweb/customer_coa_request.asp) are the “Certificate of Analysis” of the StablCal vials downloadable.

### 5.4.1 Aids

| Order no.                            | Description                                  |
|--------------------------------------|----------------------------------------------|
| LZV803<br>or 1938004<br>or 4x LZM195 | Power supply<br>or 4 AA Alkaline batteries   |
| 2659405                              | StablCal Set 0.1,20,100,800 NTU sealed vials |
| 2961701                              | 10 NTU Verification Standard                 |

### 5.4.2 Description

Power



1 - Push the **ON/OFF** key to turn on the meter.



2 - Push the **Calibration** key to enter the Calibration mode.

Cal: StablCal®  
NTU

3 - Push **Options**

20 NTU 100 NTU 800 NTU

Insert standard, close lid, and push Read to start calibration.

Cancel Options Read

Calibration Options

Calibration History

Calibration Curves: StablCal®

Cal Reminder Repeat: Off

Restore Factory Calibration

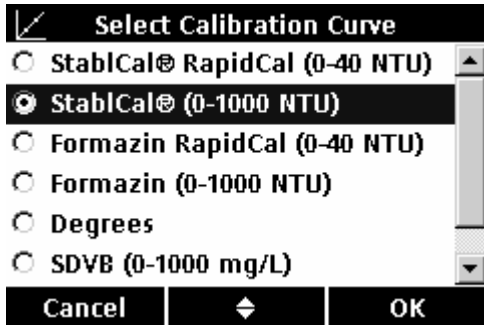
4 - Chose **Calibration Curves**

5 - Push **Select**

Exit



Select

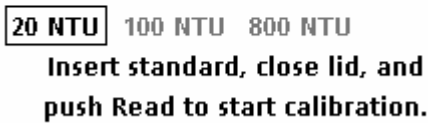


- 6 - Chose **StablCal®(0-1000 NTU)**
- 7 - Push **OK**



- 8 - Follow the instructions on the display.

**Note:** Gently invert each standard before inserting.



- 9 - Insert the the 20 NTU StablCal Standard and close the lid.



- 10 - Push **Read**. The display shows Stabilizing... and then displays the result.




- 11 - Repeat Step 9 and 10 with the 100 NTU and 800 NTU StablCal Standard.

**Note:** Gently invert each standard before inserting.



- 12 - Push **Done** to review the calibration details.



 **Calibration Details**  
 2009-09-22 07:43:51  
 Cal Curve: StabCal®  
 Standard 1: 20 NTU 19.8  
 Standard 2: 100 NTU 99.9  
 Standard 3: 800 NTU 800  
 VOLDEMORT  
 Exit Store

- 13 - Push **Store** to save the results.
- 14 - Upon a successful calibration, the turbidimeter automatically turns into the Verify Cal mode.

 **Verify Cal**  
 NTU

10.0 NTU  
 Insert verification standard,  
 close lid and push Read.

- 15 - Insert the 10.0 NTU verification standard and close the lid.
- 16 - Push **Read**. The display shows “Stabilizing...”

Cancel Options Read

 **Verify Cal: Passed**

 **9.91** NTU

- 17 - The display shows the result and tolerance range. It should be written in the Service Inspection Protocol!
- 18 - Push **Done**

Calibration Verification Passed.  
 9.00 <---+---> 11.0 07:46:34  
 Reading within limits. 2009-09-22

Done

 OK Turbidity 

 **0.05** NTU

- 19 - Insert the StabCal < 0.1 NTU standart
- 20 - Push Read
- 21 - The display shows the result. It should be written in the Service Inspection Protocol!

14:12:06  
 2009-10-14

Verify Cal Options Read

## 5.5 Service Inspection (after repair)

After a component has been replaced, this service inspection must always be carried out.

Update the instrument software, if it necessary (see section 3.1.2 Instrument update).

**Note:** At [http://app.hach.com/coaweb/customer\\_coa\\_request.asp](http://app.hach.com/coaweb/customer_coa_request.asp) are the “Certificate of Analysis” of the StablCal vials downloadable.

### 5.5.1 Aids

| Order no.               | Description                                  |
|-------------------------|----------------------------------------------|
| 1938004<br>or 4x LZM195 | 4 AA Alkaline batteries                      |
| LZV813                  | USB OTG Adapter (Module #7)                  |
| 2659405                 | StablCal Set 0.1,20,100,800 NTU sealed vials |
| 2961701                 | 10 NTU Verification Standard                 |
| 2971401                 | 1 NTU Gelex vial                             |

### 5.5.2 Description

The following description explains the tests which have to be done during the Service Inspection of LPG439 devices. The Service Inspection is split in two parts: Hardware Check and Adjust-Calibration.

#### Hardware Check tests:

These tests will check all general hardware parts. Each test is described with ID (header to identify the test), typical value (verification parameter) and description how the test software perform the test.

Power



Setting



Plug in the USB OTG Adapter (Module #7) with Power supply.

Install 4 alkaline or rechargeable NiMH batteries, also.

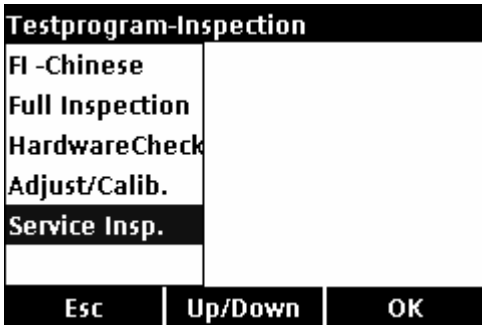
Switch on the instrument with pressing continually the “setting” button and a short press on the “power” button.

You are in the “**Testprogram-Mainmenu**”, now.

| Testprogram-Mainmenu |                 |    |
|----------------------|-----------------|----|
| Digital              | Marco Polo      |    |
| Analog               | Version 0.36    |    |
| Module               | HW Driver V0.25 |    |
| <b>Inspection</b>    | Betaboard       |    |
| Options              | EPA - Lamp      |    |
| File Ops             |                 |    |
| Esc                  | Up/Down         | OK |

#### Testprogram-Mainmenu

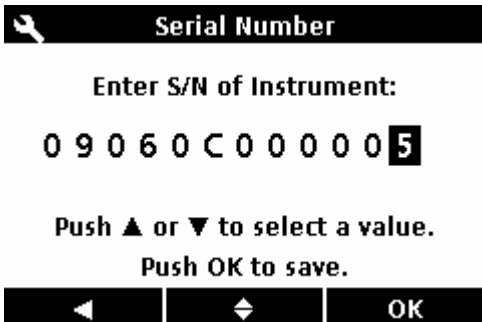
Choose the menu point “Inspection” and confirm this with “OK”.



### Inspection Menu

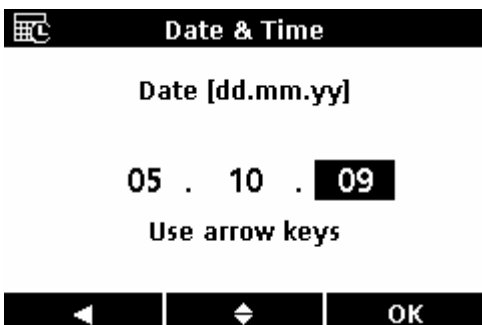
Choose the menu point "Service Insp." and confirm this with "OK".

Now, the service inspection routine starts!



### Serial Number

If it necessary, change the serial number. Confirm the serial number with "OK"



### Date

Corrects the date (format dd.mm.yy), if it necessary, and confirms with "OK". "OK" is available when the cursor is by "yy"



### Time

Corrects the time (format 24h hh:mm), if necessary. And confirm with "OK"



**HardwareCheck**  
Sound Test

2 x loud, 2 x quite Beep?  
Press 'YES'/'NO'.  
No Yes

**HardwareCheck**  
Standby Mode Test

Device dark for 1s?  
Press 'YES'/'NO'.  
No Yes

**HardwareCheck**  
ADC16 Filter Test  
**9.35**  
Press 'Skip' or 'Abort'.  
Abort Skip

### Sound Test

If you heard 2x loud and 2x quite beeps, please press button **YES**.

If you heard no beeps please press **NO**.

*Description:* Speaker will be checked by the operator. Operator has to listen to the Beep-Signal from instrument with two different loudness (volume 100% and volume 40%) values.

### Standby Mode Test

If the backlight of the device was for 1 s dark, please press button **YES**.

If the backlight was not switched off for 1 s, please press **NO**.

*Description:* StandBy-mode of instrument will be checked by operator. Operator has to check if backlight is switched 'OFF' for 1 second. This Standby-Mode is used to save power consumption.

### Automatically Test

RTC-, Flash-, Modul-Connect-, ADC10-.ADC16- and RTC-Alarm-Test.

These tests will checked automatically and only if there is a failure the inspection will stopped and an error message will be show in the display.

#### Descriptions:

##### RAM:

RAM will be tested by executing write/read test on several addresses at SRAM on mainboard. Checksum will be calculated.

##### Flash:

Flash will be tested by executing write/read test on several addresses at Flash-IC on mainboard. Checksum will be calculated.

##### ModulConnect:

Connection to module port will be tested by sending an identification command to module via serial interface. Used port is P8 at mainboard connected to module board with contact board (XMF802).

##### Temperature\_C: (Typical-Value 23)

Temperature sensor on mainboard will be tested by reading the voltage set by NTC and calculate the temperature.

##### BattPowerNoLoad\_V: (Typical-Value 6)

Battery power supply will be tested by reading voltage at battery input port on mainboard ( P6/P7).

**Remark:** Take care that battery contacts will establish reliable connection to mainboard.

##### BattPowerLocalLoad\_V: (Typical-Value 0.16)

Battery power supply will be tested by reading voltage at battery input port on mainboard ( P6/P7). The battery port will be loaded with 600mA current by the local load resistor placed of the mainboard.

**Remark:** Take care that battery contacts will establish reliable connection to mainboard.

##### BattPowerModulLoad\_V: (Typical-Value 0.13)

Battery power supply will be tested by reading voltage at battery input port on mainboard ( P6/P7). The mainboard sends command via serial port to



module to load battery. The battery port will be loaded with 300mA current by the external load resistor placed at the module board via port (P6) to module board.

**Remark:** Take care that battery contacts will establish reliable connection to mainboard. Take care that contact board is connected to LZV813 and mainboard

**ExternalPower\_V:** (Typical-Value 9)

External power supply will be tested by reading the voltage at external power port connected to LZV813 (P8).

**AnalogPowerOffPos\_V:** (Typical-Value 0)

Analog power supply (5V DC/DC regulator) will be tested by reading the voltage at DC/DC-Regulator output. -> Power 'OFF' Value

**AnalogPowerOffNeg\_V:** (Typical-Value 0)

Analog power supply (-0.7V linear regulator) will be tested by reading the voltage at linear regulator output. ->Power 'OFF' Value

**AnalogPowerOnPos\_V:** (Typical-Value 5)

Analog power supply (5V DC/DC regulator) will be tested by reading the voltage at DC/DC-Regulator output. ->Power 'ON' Value

**AnalogPowerOnNeg\_V:** (Typical-Value -0.65)

Analog power supply (-0.7V linear regulator) will be tested by reading the voltage at linear regulator output. ->Power 'ON' Value

**LampOff180Deg\_V:** (Typical-Value 0)

180 degree detector value will be tested by reading the output voltage of preamplifier. ->Lamp 'OFF' value is tested for checking if no straylight is occurred.

**LampOff90DegPoti0\_V:** (Typical-Value 0)

90 degree detector value will be tested by reading the output voltage of preamplifier. ->Lamp 'OFF' value is tested for checking if no straylight is occurred.

**LampOn180Deg\_V:** (Typical-Value 2.45)

180 degree detector value will be tested by setting a lamp beam to detector and reading the output voltage of preamplifier. -> Lamp 'ON' value

**LampOn90DegPoti0\_V:** (Typical-Value 0.13)

90 degree detector value will be tested by setting a straylight lamp beam to detector and reading the output voltage of preamplifier. -> Lamp 'ON' value with maximum gain (Potentiometer is set to '0').

**LampOn90DegFilterPoti0\_V:** (Typical-Value 1.3)

90 degree detector value for very low signal will be tested by setting a lamp beam to detector and reading the output voltage of active filter amplifier (10 times higher than the output voltage of preamplifier). -> Lamp 'ON' value with maximum gain (Potentiometer is set to '0').

**LampOn90DegPoti99\_V:** (Typical-Value 0.001)

90 degree detector value will be tested by setting a lamp beam to detector and reading the output voltage of preamplifier. -> Lamp 'ON' value with minimum gain (Potentiometer is set to '99').

**LampOnOffDiff\_V:** (Typical-Value 2.6)

**Lamp** will be tested by **calculated** difference value between **LampOn-Value** and **LampOFF-Value**. Channel **180 degree** has 1<sup>st</sup> rank. Channel **90 degree** has 2<sup>nd</sup> rank. The calculated difference value shall identify that Lamp/IrLED has been switched ON/OFF.

**180DegOnOffDiff\_V:** (Typical-Value 2.6)

**180 degree detector** will be tested by **calculated** difference value between LampOn-Value and LampOFF-Value. The calculated difference value shall identify that 180 degree detector has been plugged to the mainboard.

**90DegOnOffDiff\_V:** (Typical-Value 0.13)

**90 degree detector** will be tested by **calculated** difference value between LampOn-Value and LampOFF-Value. The calculated difference value shall identify that 90 degree detector has been plugged to the mainboard.

**90DegPoti0Poti99Diff\_V:** (Typical-Value 0.13)

**Calculated** difference value 90 degree-detector for **minimum gain**

(potentiometer set to 99) and maximum gain (potentiometer set to 0). The calculated difference value shall identify that the electronic potentiometer for 90 degree detector was able to set to minimum and maximum.

**90DegFilterVoltQuot:** (Typical-Value 10)  
Calculated quotient between 90 degree-preamplifier value and 90 degree active filter amplifier value. The quotient value shall identify that the 2<sup>nd</sup>-stage active filter amplifier for 90 degree detector has correct gain.

**RtcTimer:**  
RTC timer at mainboard has been set in the beginning of Hardware-Check. Now it will be checked if the timer is showing an ongoing time step. Check is with the following Date/Time: '02-06-2009 11:30:00' plus the process time of Hardware-Check. ( at least < 1 second)

**RtcAlarm:**  
RTC alarm timer at mainboard is been set to current time plus 2 seconds. It will be checked if the alarm interrupt has been occurred after 2 seconds.

## Adjust-Calibration tests:

These tests will adjust and calibrate the analog system ( beam path, detector, preamplifier, analog digital converter...) of the LPG439 instrument. . Each test is described with ID (header to identify the test), typical value (verification parameter) and description how the test software perform the test.

**Adjust Sensor System (EPA)**  
Start Adjust & Calibration

All adjust data will be removed  
and set to default.

Abort Start

800 NTU StablCal vial

**Adjust Sensor System (EPA)**  
StablCal: '800' NTU

Please insert StablCal -> '800' NTU  
Close Lid!

Abort OK

**Adjust Sensor System (EPA)**  
Stabilizing...

Please wait!  
Executing Adjust...

Abort

## Adjust Sensor System (EPA)/(ISO)

Press "Start" to continues with the Adjust & Calibration routine

## Adjust Sensor System (EPA)/(ISO)

Please move the vial '800 NTU' and then insert the vial '800 NTU' in the right direction and close the lid.

By closing the lid, the Adjust starts automatically.

## Adjust Sensor System (EPA)/(ISO)

Please wait, don't open the lid!

### Descriptions:

**800NtuAdjPotiL090Deg\_V** (Typical-Value 2.5)  
Potentiometer adjustment for 90 degree preamplifier gain (level 0):  
Potentiometer will be set step by step to higher gain until the measured value at 90 degree preamplifier shows the required value. -> Adjusted voltage value for Level 0. / Adjust vial 800NTU StablCal

**800NtuAdjPotiL0** (Typical-Value 60)  
Potentiometer adjustment for 90 degree preamplifier gain (level 0):  
-> Adjusted potentiometer value for Level 0. (0...99)

**800NtuDarkL0180Deg\_mV** (Typical-Value 0.0)  
Dark reading for 180 degree detector. Dark reading value is been measured with Lamp switched 'OFF' and includes straylight of beam path; electrical

noise of detector and electrical offset of preamplifier. The dark value will be stored as part of calibration values.

**800NtuDarkL090Deg\_mV** (Typical-Value 0.0)

Dark reading for 90 degree detector, gain setting for Level 0. Dark reading value is been measured with Lamp switched 'OFF' and includes straylight of beam path; electrical noise of detector and electrical offset of preamplifier. The dark value will be stored as part of calibration values.

**800NtuCal180Deg\_V** (Typical-Value 0.240)

Reading for 800 NTU test vial at 180 degree detector. Represents the light beam intensity at 180 degree detector for high turbidity values.

**Remark:** This value is not adjusted and will be influenced by components like Lamp/IrLED; blue filter; neutral filter, detector sensitivity and the beam path in general.

**800NtuCal90Deg\_V** (Typical-Value 2.5)

Reading for 800 NTU test vial at 90 degree detector preamplifier. Represents the light beam intensity at 90 degree detector for high turbidity values. This value is been adjusted with potentiometer gain.

**Remark:** This value will be influenced by components like Lamp/IrLED, blue filter, detector sensitivity and the beam path in general.

**800NtuCalRatio** (Typical-Value 450 (Lamp))

(Typical-Value 275 (IR-LED))

**Calculated** ratio of 180 degree detector value and 90 degree detector value for 800 NTU test vial. Represents the calculated ratio of light beam intensity at 90 degree detector and 180 degree detector.

**Remark:** This value will be influenced by components like Lamp/IrLED, blue filter, neutral filter, detector sensitivity and the beam path in general.

**800NtuCalTurb\_NTU** (Typical-Value 800)

**Calculated** turbidity of current ratio reading. Turbidity is calculated using the default coefficients and can be different for each instrument.

**800NtuCalTurbMinMaxRange\_NTU** (Typical-Value 3)

**Calculated** difference between maximum value and minimum value of 12 single turbidity readings. Represents the stability of 800 NTU StablCal vial and instrument reading.

**Remark:** This parameter is highly influenced by the performance of shaking the StablCal vial.

## 100 NTU StablCal vial

### Adjust Sensor System (EPA)

StablCal: '100' NTU

Please insert StablCal -> '100' NTU  
Close Lid!

Abort

OK

### Adjust Sensor System (EPA)

Stabilizing...

Please wait!  
Executing Adjust...

Abort

## Adjust Sensor System (EPA)/(ISO)

Please move the vial '100 NTU' and then insert the vial '100 NTU' in the right direction and close the lid.

By closing the lid, the Adjust starts automatically

## Adjust Sensor System (EPA)/(ISO)

Please wait, don't open the lid!

### Descriptions:

**100NtuCal180Deg\_V** Typical-Value 1.750  
Reading for 100 NTU test vial at 180 degree detector. Represents the light beam intensity at 180 degree detector for medium turbidity values.  
**Remark:** This value is not adjusted and will be influenced by components like Lamp/IrLED; blue filter; neutral filter, detector sensitivity and the beam path in general.

**100NtuCal90Deg\_V** Typical-Value 0.42  
Reading for 100 NTU test vial at 90 degree detector preamplifier. Represents the light beam intensity at 90 degree detector for medium turbidity values.  
**Remark:** This value will be influenced by components like Lamp/IrLED; blue filter, detector sensitivity and the beam path in general.

**100NtuCalRatio** Typical-Value 10.5 (Lamp)  
Typical-Value 6.6 (IR-LED)  
**Calculated** ratio of 180 degree detector value and 90 degree detector value for 100 NTU test vial. Represents calculated ratio of light beam intensity at 90 degree detector and 180 degree detector.  
**Remark:** This value will be influenced by components like Lamp/IrLED; blue filter; neutral filter, detector sensitivity and the beam path in general.

**100NtuCalTurb\_NTU** Typical-Value 100  
**Calculated** turbidity of current ratio reading. Turbidity is calculated using the default coefficients and can be different for each instrument.

**100NtuCalTurbMinMaxRange\_NTU** Typical-Value 0.26  
**Calculated** difference between maximum value and minimum value of 12 single turbidity readings. Represents the stability of 100 NTU StablCal vial and instrument reading.  
**Remark:** This parameter is highly influenced by the performance of shaking the StablCal vial.

## 20 NTU StablCal vial

### Adjust Sensor System (EPA)

StablCal: '20' NTU

Please insert StablCal -> '20' NTU  
Close Lid!

Abort

OK

### Adjust Sensor System (EPA)

Stabilizing...

Please wait!  
Executing Adjust...

Abort

## Adjust Sensor System (EPA)/(ISO)

Please move the vial '20 NTU' and then insert the vial '20 NTU' in the right direction and close the lid.

By closing the lid, the Adjust starts automatically

## Adjust Sensor System (EPA)/(ISO)

Please wait, don't open the lid!

### Descriptions:

**20NtuAdjPotiL190Deg\_V** (Typical-Value 1.5)  
Potentiometer adjustment for 90 degree preamplifier gain (level 1):  
Potentiometer will be set step by step to higher gain until the measured value at 90 degree preamplifier shows the required value. -> Adjusted voltage value for Level 1. / Adjust vial 20 NTU StablCal

**20NtuAdjPotiL1** (Typical-Value 3)  
Potentiometer adjustment for 90 degree preamplifier gain (level 1):  
-> Adjusted potentiometer value for Level 1. (0...99)

**20NtuAdjMinVoltL090Deg\_V** (Typical-Value 0.092)  
Reading the threshold voltage (minimum value) for 90 degree detector in Level-0 mode. This adjusted threshold voltage is been stored in instrument hardware adjust file.

**Remark:** The threshold voltage is needed to select best gain value for the 90 degree detector (automatic mode). If the reading voltage of 90 degree detector (set to Level 0 gain ) is below this threshold voltage then the analog system switch to Level 1 gain.

### Factor-Adjust ( Level 0 to Level 1).

The adjustment is needed for linear consistency during the switch from level 0 to level 1 gain. Adjust is been executed by performing 14 average readings (each with calculated ratio from 90 degree detector value and 180 degree detector value) for both gain level and calculating the correction factor.

The following IDs represent the values of both detector readings for low gain (level 0) and higher gain (level 1).

**20NtuAdjL1Low180Deg\_V** (Typical-Value 2.2)  
Factor Adjust (90 degree detector preamplifier) Level 0 to Level 1: Value of 180 Degree detector as reference for low gain measurement (level 0).  
Reading is been calculated by 14 times average read.

**20NtuAdjL1Low90Deg\_V** (Typical-Value 0.083)  
Factor Adjust (90 degree detector preamplifier) Level 0 to Level 1: Value of 90 degree detector with low gain measurement (level 0). Reading is been calculated by 14 times average read.

**20NtuAdjL1High180Deg\_V** (Typical-Value 2.2)  
Factor Adjust (90 degree detector preamplifier) Level 0 to Level 1: Value of 180 degree detector as reference for higher gain measurement (level 1).  
Reading is been calculated by 14 times average read.

**20NtuAdjL1High90Deg\_V** (Typical-Value 1.74)  
Factor Adjust (90 degree detector preamplifier) Level 0 to Level 1: Value of 90 degree detector with higher gain (level 1). Reading is been calculated by 14 times average read.

**20NtuAdjL1Factor** (Typical-Value 1.0)  
Factor Adjust (90 degree detector preamplifier) Level 0 to Level 1: The

correction factor value will be **calculated** with average values of **low gain (level 0) RATIO** values and **higher gain (level 1) RATIO** values. The correction factor is based to level 0 ratio values. Factor will be stored in hardware adjust file.

**20NtuAdjL1Offset\_V** (Typical-Value 0.0)  
Factor Adjust (90 degree detector preamplifier) Level 0 to Level 1: Offset is set to Zero (0.000)

**20NtuDarkL190Deg\_mV** (Typical-Value 0.0)  
Dark reading for 90 degree detector, gain setting for Level 1. Dark reading value is been measured with Lamp switched 'OFF' and includes straylight of beam path; electrical noise of detector and electrical offset of preamplifier. The dark value will be stored as part of calibration values.

**20NtuCal180Deg\_V** (Typical-Value 2.3)  
Reading for 20 NTU test vial at 180 degree detector. Represents the light beam intensity at 180 degree detector for low turbidity values. **Remark:** This value is not adjusted and will be influenced by components like Lamp/IrLED; blue filter; neutral filter, detector sensitivity and the beam path in general.

**20NtuCal90Deg\_V** (Typical-Value 1.75)  
Reading for 20 NTU test vial at 90 degree detector preamplifier. Represents the light beam intensity at 90 degree detector for low turbidity values. This value is been adjusted with potentiometer gain. **Remark:** This value will be influenced by components like Lamp/IrLED; blue filter; detector sensitivity and the beam path in general.

**20NtuCalRatio** Typical-Value 1.6 (Lamp) / Typical-Value 1.06 (IR-LED)  
**Calculated** ratio of 180 degree detector value and 90 degree detector value for 20 NTU test vial. Represents calculated ratio of light beam intensity at 90 degree detector and 180 degree detector.  
**Remark:** This value will be influenced by components like Lamp/IrLED; blue filter; neutral filter, detector sensitivity and the beam path in general.

**20NtuCalTurb\_NTU** (Typical-Value 20)  
**Calculated** turbidity of current ratio reading. Turbidity is calculated using the default coefficients and can be different for each instrument.

**20NtuCalTurbMinMaxRange\_NTU** (Typical-Value 0.15)  
**Calculated** difference between maximum value and minimum value of 12 single turbidity readings. Represents the stability of 20 NTU StablCal vial and instrument reading.  
**Remark:** This parameter is highly influenced by the performance of shaking the StablCal vial.

## 1 NTU GELEX vial

**Adjust Sensor System (EPA)**

GELEX: '1' NTU

### Adjust Sensor System (EPA)/(ISO)

Please insert the Gelex vial '1 NTU' in the right direction and close the lid.

**Please insert GELEX -> '1' NTU  
Close Lid!**

By closing the lid, the Adjust starts automatically

Abort

OK

Adjust Sensor System (EPA)

Stabilizing...



Please wait!  
Executing Adjust...

Abort

Adjust Sensor System (EPA) /(ISO)

Please wait, don't open the lid!

Descriptions:

**1NtuAdjPotiL290Deg\_V** Typical-Value 1.5  
Potentiometer adjustment for 90 degree preamplifier gain (level 2):  
Potentiometer will be set step by step to higher gain until the measured value at 90 degree preamplifier shows the required value. -> Adjusted voltage value for Level 2. / Adjust vial 1 NTU GELEX.

**1NtuAdjPotiL2** Typical-Value 1  
Potentiometer adjustment for 90 degree preamplifier gain (level 2):  
-> Adjusted potentiometer value for Level 2. (0...99)

**1NtuAdjMinVoltL190Deg\_V** Typical-Value 0.135  
Reading the threshold voltage (minimum value) for 90 degree detector in Level-1 mode. This adjusted threshold voltage is been stored in instrument hardware adjust file.

**Remark:** The threshold voltage is needed to select best gain value for the 90 degree detector (automatic mode). If the reading voltage of 90 degree detector (set to Level 1 gain ) is below this threshold voltage then the analog system switch to Level 2 gain and the reading channel is active filter amplifier.

Start of Factor-Adjust ( Level 1 to Level 2).

The adjustment is needed for linear consistency during the switch from level 1 to level 2 gain. This adjustment is performed in two stages: linear regression stage and ratio correction stage.

First stage adjust (linear regression) is been executed by performing a two point linear regression measurement ( x1,y1 vs. x2,y2). Used channel is **90 degree detector only**. 1<sup>st</sup> reading ( 7 times average reading with high gain) 90 degree preamplifier and 90 degree active filter amplifier (x1,y1). 2<sup>nd</sup> reading ( 7 times average reading with lower gain) 90 degree preamplifier and 90 degree active filter amplifier (x2,y2). Than calculating the factor and offset by using linear regression formula: Factor = (y1 - y2) / (x1 - x2); Offset = (x2\*y1 - x1\*y2)/(y1-y2). Cause of calculating the correction factor only with 90 degree detector values, there is no drift correction yet. So it is needed to perform second stage adjustment...

Second stage adjust (ratio correction) is been executed by performing 7 average readings (each with calculated **ratio** from 90 degree detector value and 180 degree detector value) for both gain level and calculating the correction factor.

The following IDs represent the value of both detector readings for lower gain (level 1) and high gain (level 2).

-> **First stage adjust**

**1NtuAdjL2High90Deg\_V** Typical-Value 0.190  
Factor Adjust (90 degree detector preamplifier and active filter amplifier)  
Level 1 to Level 2: High value reading for 90 degree detector preamplifier.  
Reading is been executed by 7 times average read. -> **x1**

**1NtuAdjL2High90DegFilter\_V** Typical-Value 1.88  
Factor Adjust (90 degree detector preamplifier and active filter amplifier)  
Level 1 to Level 2: High value reading for 90 degree detector active filter amplifier. Reading is been executed by 7 times average read. -> **y1**

**1NtuAdjL2Low90Deg\_V** Typical-Value 0.075  
Factor Adjust (90 degree detector preamplifier and active filter amplifier)  
Level 1 to Level 2: Low value reading for 90 degree detector preamplifier.  
Reading is been executed by 7 times average read. -> **x2**

**1NtuAdjL2Low90DegFilter\_V** Typical-Value 0.760  
Factor Adjust (90 degree detector preamplifier and active filter amplifier)  
Level 1 to Level 2: Low value reading for 90 degree detector active filter amplifier. Reading is been executed by 7 times average read. -> **y2**

The following IDs represent the value of both turbidity (ratio) readings for lower gain (level 1) and high gain (level 2).

-> **Second stage adjust**

**1NtuAdjL2TurbL1\_NTU** Typical-Value 1.0  
Factor Adjust (90 degree detector preamplifier and active filter amplifier)  
Level 1 to Level 2: Turbidity (Ratio) reading for Level 1. Reading is been executed by 7 times average read.

**1NtuAdjL2TurbL2\_NTU** Typical-Value 1.0  
Factor Adjust (90 degree detector preamplifier and active filter amplifier)  
Level 1 to Level 2: Turbidity (Ratio) reading for Level 2. Reading is been executed by 7 times average read.

**1NtuAdjL2TurbFactor** Typical-Value 1.0  
Factor Adjust (90 degree detector preamplifier and active filter amplifier)  
Level 1 to Level 2: Turbidity (Ratio) correction factor value will be **calculated** with the two values of Turbidity reading. This correction factor is needed because of the missing drift correction during 1<sup>st</sup> stage factor adjustment.

**1NtuAdjL2Factor** Typical-Value 0.1  
Factor Adjust (90 degree detector preamplifier and active filter amplifier)  
Level 1 to Level 2: Factor value will be **calculated** with low and high value of 90 degree detector preamplifier and active filter amplifier reading and corrected by the two values of turbidity reading ( turbidity factor ). Level 2 adjust factor will be stored in hardware adjust file.

**1NtuAdjL2Offset\_V** Typical-Value 0.000  
Factor Adjust (90 degree detector preamplifier and active filter amplifier)  
Level 1 to Level 2: Offset value will be **calculated** with low and high value of 90 degree detector preamplifier and active filter amplifier reading. Level 2 adjust offset will be stored in hardware adjust file.

-> End of Factor-Adjust (Level 1 to Level 2).

**1NtuDarkL290Deg\_mV** Typical-Value 0.0  
Dark reading for 90 degree detector, gain setting for Level 2. Dark reading value is been measured with Lamp switched 'OFF' and includes straylight of beam path; electrical noise of detector; electrical offset of preamplifier and electrical offset of active filter amplifier. The dark value will be stored as part of calibration values.

**1NtuRead180Deg\_V** Typical-Value 2.9  
Reading for 1 NTU test vial at 180 degree detector. Represents the light beam intensity at 180 degree detector for very low turbidity values.  
**Remark:** This value is not adjusted and will be changed by components like Lamp/IrLED; blue filter; neutral filter, detector sensitivity and the beam path in general.

**1NtuRead90Deg\_V** Typical-Value 1.9  
Reading for 1 NTU test vial at 90 degree detector active filter amplifier. Represents the light beam intensity at 90 degree detector for very low turbidity values.  
**Remark:** This value is been adjusted with potentiometer gain and will be influenced by components like Lamp/IrLED; blue filter; neutral filter, detector sensitivity and the beam path in general.

**1NtuReadRatio** Typical-Value 0.084 (Lamp) /  
Typical-Value 0.054 (IR-LED)  
**Calculated** ratio of 180 degree detector value and 90 degree detector value for 1 NTU test vial. Represents calculated ratio of light beam intensity at 90 degree detector and 180 degree detector.  
**Remark:** This value will be influenced by components like Lamp/IrLED; blue filter; neutral filter, detector sensitivity and the beam path in general.

**1NtuReadTurb\_NTU** Typical-Value 1.14  
**Calculated** turbidity of current ratio reading. Turbidity is calculated using the factory calibrated coefficients and shall be read regarding nominal value.  
**Remark:** Keep in mind that GELEX vial shows different turbidity values for different instruments.

**1NtuReadTurbMinMaxRange\_NTU** Typical-Value 0.003  
**Calculated** difference between maximum value and minimum value of 12 single turbidity readings. Represents the stability of instrument reading.



< 0.1 NTU StabCal vial / Dilution-Water vial

**Adjust Sensor System (EPA)**

StabCal: 'DI'-Water

**Adjust Sensor System (EPA)/(ISO)**

Please insert the vial 'DI water' or "StabCal: <0.1 NTU", it's the same, in the right direction and close the lid.

Please insert StabCal -> 'DI'-Water  
Close Lid!

**CAUTION: Don't move the vial!**

Abort

OK

**Adjust Sensor System (EPA)**

Stabilizing...

**Adjust Sensor System (EPA)/(ISO)**

Please wait, don't open the lid!

**The value for the "StabCal: <0.1 NTU" is displayed, now. It should be written in the Service Inspection Protocol!**

Please wait!  
Executing Adjust...

Abort

**Descriptions:**

**WaterNtuRead180Deg\_V** Typical-Value 2.36  
Reading for Dilution Water 'DI' vial at 180 degree detector. Represents the light beam intensity at 180 degree detector for very low turbidity values.  
**Remark:** This value is not adjusted and will be influenced by components like Lamp/IrLED; blue filter; neutral filter, detector sensitivity and the beam path in general.

**WaterNtuRead90Deg\_V** Typical-Value 0.041  
Reading for Dilution Water 'DI' test vial at 90 degree detector active filter amplifier. Represents the light beam intensity at 90 degree detector for very low turbidity values.  
**Remark:** This value will be influenced by components like Lamp/IrLED; blue filter; detector sensitivity and the beam path in general.

**WaterNtuReadRatio** Typical-Value 0.002  
(Lamp) / 0.002 (IR-LED)  
**Calculated** ratio of 180 degree detector value and 90 degree detector value for Dilution Water 'DI' test vial. Represents calculated ratio of light beam intensity at 90 degree detector and 180 degree detector.  
**Remark:** This value will be influenced by components like Lamp/IrLED; blue filter; neutral filter, detector sensitivity and the beam path in general.

**WaterNtuReadTurb\_NTU** Typical-Value 0.030  
**Calculated** turbidity of current ratio reading. Turbidity is calculated using the factory calibrated coefficients and shall be read regarding nominal value.  
**Remark:** Please note that the 'DI' StabCal vial shall not be shaken before any reading!

**WaterNtuReadTurbMinMaxRange\_NTU** Typical-Value 0.002  
**Calculated** difference between maximum value and minimum value of 12 single turbidity readings. Represents the stability of Dilution Water 'DI' StabCal vial and instrument reading.  
**Remark:** Please note that the 'DI' StabCal vial shall not be shaken before any reading!

## 10 NTU StablCal vial

### Adjust Sensor System (EPA)

StablCal: '10' NTU

Please insert StablCal -> '10' NTU  
Close Lid!

Abort

OK

### Adjust Sensor System (EPA)

Stabilizing...

Please wait!  
Executing Adjust...

Abort

### Adjust Sensor System (EPA) /(ISO)

Please move the vial '10 NTU' and then insert the vial '10 NTU' in the right direction and close the lid.

By closing the lid, the Adjust starts automatically

### Adjust Sensor System (EPA) /(ISO)

Please wait, don't open the lid!

**The value for the "10 NTU StablCal" is displayed, now. It should be written in the Service Inspection Protocol!**

#### Descriptions:

**10NtuRead180Deg\_V** Typical-Value 2.3  
Reading for 10 NTU test vial at 180 degree detector. Represents the light beam intensity at 180 degree detector for low turbidity values.

**Remark:** This value is not adjusted and will be changed by components like Lamp/IrLED; blue filter; neutral filter, detector sensitivity and the beam path in general.

**10NtuRead90Deg\_V** Typical-Value 0.88  
Reading for 10 NTU test vial at 90 degree detector preamplifier. Represents the light beam intensity at 90 degree detector for low turbidity values.

**Remark:** This value will be influenced by components like Lamp/IrLED; blue filter; detector sensitivity and the beam path in general.

**10NtuReadRatio** Typical-Value 0.77 (Lamp) /  
Typical-Value 0.53 (IR-LED)

**Calculated** ratio of 180 degree detector value and 90 degree detector value for 10 NTU test vial. Represents calculated ratio of light beam intensity at 90 degree detector and 180 degree detector.

**Remark:** This value will be influenced by components like Lamp/IrLED; blue filter; neutral filter, detector sensitivity and the beam path in general.

**10NtuReadTurb\_NTU** Typical-Value 10

**Calculated** turbidity of current ratio reading. Turbidity is calculated using the factory calibrated coefficients and shall be read regarding nominal value.

**Remark:** This parameter is highly influenced by the performance of shaking the StablCal vial.

**10NtuReadTurbMinMaxRange\_NTU** Typical-Value 0.448

**Calculated** difference between maximum value and minimum value of 12 single turbidity readings. Represents the stability of 10 NTU StablCal vial and instrument reading.

**Remark:** This parameter is highly influenced by the performance of shaking the StablCal vial.

## Adjust Sensor System (EPA)

End Adjust/Calibration

## Adjust Sensor System (EPA)/(ISO)

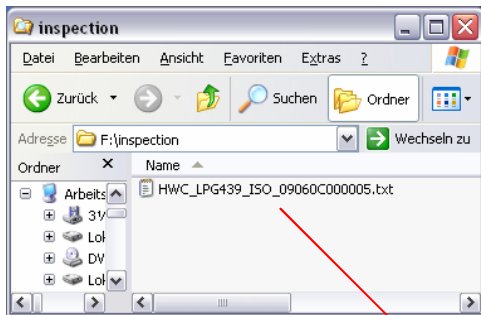
The inspection is finished, please press "OK".

Please remove cuvette!

Press 'OK'!

Abort

OK



## Evaluation

Connect the USB OTG Adapter (Module #7) with a PC. On the Module would created a folder "inspection" with the result in a \*.txt file. It can be opening with MS Excel, for example, and it including the both values for the Service Inspection Protocol.

**Note:** Within the filename is the S/N of the checked device. At a second inspection of the same device the file will be replaced.

| #testType       | VaaType                         | Actual     | Nominal | Min  | Max   | Result | ResultString |
|-----------------|---------------------------------|------------|---------|------|-------|--------|--------------|
| 89              | 1NtuRead180Deg_V                | 3.1        | 2.9     | 0.8  | 4.7   | OK     |              |
| 90              | 1NtuRead90Deg_V                 | 1.97       | 1.9     | 1.2  | 2.8   | OK     |              |
| 91              | 1NtuReadRatio                   | 0.0807     | 0.084   |      | 0     |        |              |
| 92              | 1NtuReadTurb_NTU                | 1.152      | 1.14    | 0.7  | 1.3   | OK     |              |
| 93              | 1NtuReadTurbMinMaxRange_NTU     | 0.0063     | 0.003   | 0    | 0.022 | OK     |              |
| 94              | WaterNtuRead180Deg_V            | 2.556      | 2.36    |      | 0     |        |              |
| 95              | WaterNtuRead90Deg_V             | 0.0606     | 0.041   |      | 0     |        |              |
| 96              | WaterNtuReadRatio               | 0.003      | 0.002   |      | 0     |        |              |
| 97              | WaterNtuReadTurb_NTU            | 0.0419     | 0.04    | 0.02 | 0.094 | OK     |              |
| 98              | WaterNtuReadTurbMinMaxRange_NTU | 0.0059     | 0.002   |      | 0     |        |              |
| 99              | 10NtuRead180Deg_V               | 2.454      | 2.3     |      | 0     |        |              |
| 100             | 10NtuRead90Deg_V                | 0.9135     | 0.88    |      | 0     |        |              |
| 101             | 10NtuReadRatio                  | 0.7232     | 0.77    |      | 0     |        |              |
| 102             | 10NtuReadTurb_NTU               | 9.853      | 10.2    | 9.28 | 11.2  | OK     |              |
| 103             | 10NtuReadTurbMinMaxRange_NTU    | 0.0936     | 0.448   |      | 0     |        |              |
| 104 [CALIBDATA] |                                 |            |         |      |       |        |              |
| 105             | e1                              | 1.021      |         |      |       |        |              |
| 106             | e2                              | 1.45       |         |      |       |        |              |
| 107             | e3                              | 0.274      |         |      |       |        |              |
| 108             | e4                              | 0.28       |         |      |       |        |              |
| 109             | a0                              | 15.893601  |         |      |       |        |              |
| 110             | a1                              | -2.500733  |         |      |       |        |              |
| 111             | a2                              | -4277.0252 |         |      |       |        |              |
| 112             | a3                              | 4268.6944  |         |      |       |        |              |
| 113             | #END                            |            |         |      |       |        |              |
| 114             |                                 |            |         |      |       |        |              |
| 115             |                                 |            |         |      |       |        |              |

# 6 Spare parts

## 6.1 Overview and assignment

| Order no.               | LPG439.01.00002 2100Q |                          | Description                                  |
|-------------------------|-----------------------|--------------------------|----------------------------------------------|
|                         |                       | LPG439.01.00012 2100Q is |                                              |
| 2961701                 | X                     | X                        | 10 NTU Verification Standard                 |
| 2684801                 | X                     | X                        | StablCal 20 NTU Standard                     |
| 2684901                 | X                     | X                        | StablCal 100 NTU Standard                    |
| 2660501                 | X                     | X                        | StablCal 800 NTU Standard                    |
| 2971205                 | X                     | X                        | StablCal ampule calibration kit, 2100Q       |
| 2971210                 | X                     | X                        | StablCal 100mL calibration kit, 2100Q        |
| 2971200                 | X                     | X                        | StablCal 500mL calibration kit, 2100Q        |
| 1938004 or<br>4x LZM195 | X                     | X                        | 4 AA Alkaline batteries                      |
| 4707600                 | X                     | X                        | Oiling Cloth                                 |
| 126936                  | X                     | X                        | Silicone Oil                                 |
| 2434706                 | X                     | X                        | 1inch sample cell (10ml ) w/cap (Turb) pkg/6 |
| LZV797                  | X                     | X                        | Blank Module                                 |
| 2971500                 | X                     | X                        | Carrying Case, 2100Q, ASSY                   |
| 2684701                 | X                     | X                        | <0.1 NTU StablCal Ampule                     |
| LZV824                  | X                     | X                        | Module Cover                                 |
| LZV825                  | X                     | X                        | Connector Cover, USB+Power Module            |
| LZV826                  | X                     | X                        | Connector Cover, Power Module                |
| 4653900                 | X                     |                          | Lamp assy 2100P                              |
| LZV827                  | X                     | X                        | Cap,2100Q,ASSY                               |
| LZV821                  | X                     | X                        | Rubber Foot, 2100Q, Set                      |
| LZV822                  | X                     |                          | Lamp Cover, 2100Q, ASSY                      |
| LZV823                  | X                     |                          | Battery Cover, 2100Q, Set                    |
| YAB110                  | X                     |                          | Main Board EPA                               |
| YAB111                  |                       | X                        | Main Board ISO                               |
| LZV828                  | X                     | X                        | Display Set                                  |
| LZV829                  | X                     |                          | Enclosure Bottom EPA                         |
| LZV830                  |                       | X                        | Enclosure Bottom ISO                         |
| LZV831                  | X                     |                          | Enclosure Top EPA, ASSY                      |
| LZV832                  |                       | X                        | Enclosure Top ISO, ASSY                      |
| LZV833                  | X                     |                          | Optic EPA, ASSY                              |
| LZV834                  |                       | X                        | Optic ISO, ASSY                              |
| LZV835                  | X                     | X                        | ESD Shield                                   |
| LZV836                  | X                     | X                        | Service Kit, 2100Q                           |
| LZV837                  |                       | X                        | LED Lamp 2100Q ISO, ASSY                     |
| 2971401                 | X                     | X                        | 1 NTU Gelex vial                             |

## 6.2 Pictures

10 NTU Verification Standard  
Order No.: 2961701



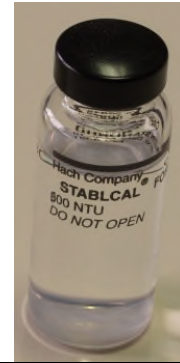
StablCal 20 NTU Standard  
Order No.: 2684801



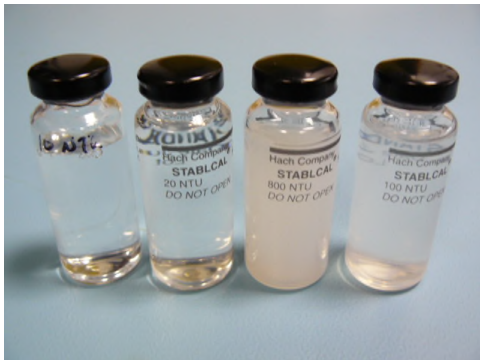
StablCal 100 NTU Standard  
Order No.: 2684901



StablCal 800 NTU Standard  
Order No.: 2660501



StablCal ampule calibration kit, 2100Q  
Order No.: 2971205



StablCal 100mL calibration kit, 2100Q  
Order No.: 2971210



StablCal 500mL calibration kit, 2100Q  
Order No.: 2971200

4 AA Alkaline batteries  
Order No.: 1938004 or 4x LZM195



Oiling Cloth  
Order No.: 4707600



Silicone Oil  
Order No.: 126936



1inch sample cell (10ml ) w/cap (Turb) pkg/6  
Order No.: 2434706



Blank Module  
Order No.: LZV797



Carrying Case, 2100Q, ASSY  
Order No.: 2971500



<0.1 NTU StablCal Ampule  
Order No.: 2684701



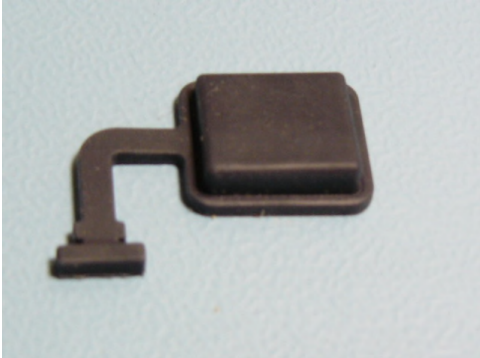
Module Cover  
Order No.: LZV824



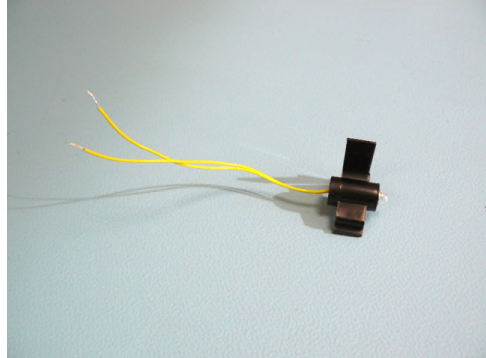
Connector Cover, USB+Power Module  
Order No.: LZV825



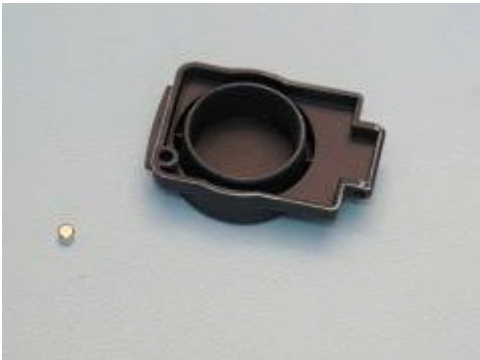
Connector Cover, Power Module  
Order No.: LZV826



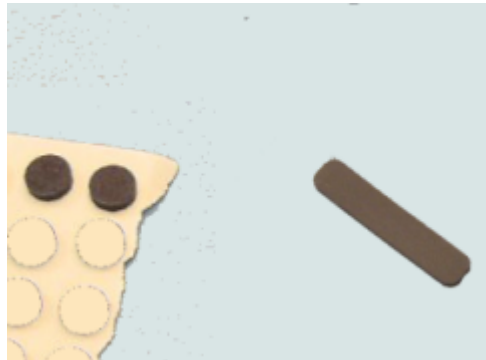
Lamp assy 2100P  
Order No.: 4653900



Cap,2100Q,ASSY  
Order No.: LZV827



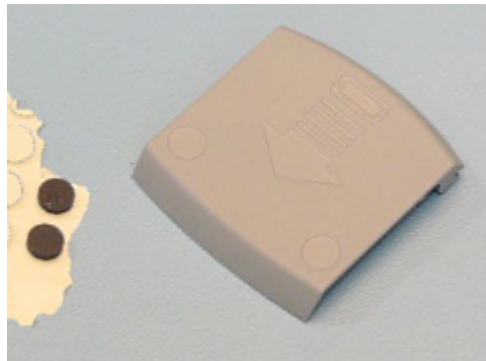
Rubber Foot, 2100Q, Set  
Order No.: LZV821



Lamp Cover, 2100Q, ASSY  
LZV822



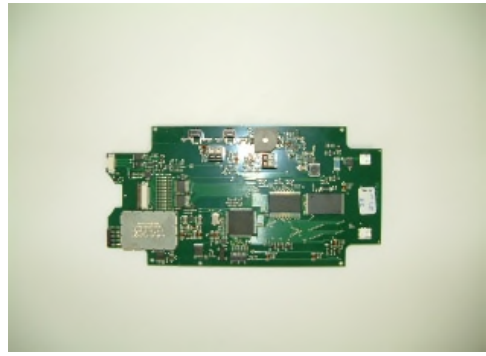
Battery Cover, 2100Q, Set  
LZV823



Main Board EPA  
Order No.: YAB110



Main Board ISO  
Order No.: YAB111



Display Set  
Order No.: LZV828



Enclosure Bottom EPA  
Order No.: LZV829



Enclosure Bottom ISO  
Order No.: LZV830



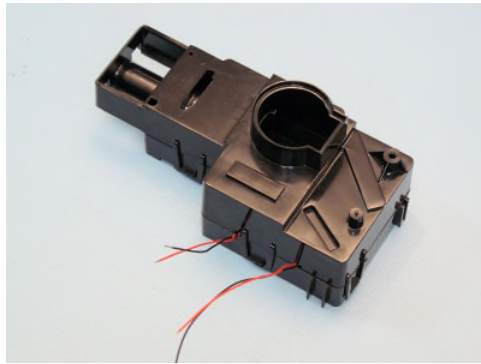
Enclosure Top EPA, ASSY  
Order No.: LZV831



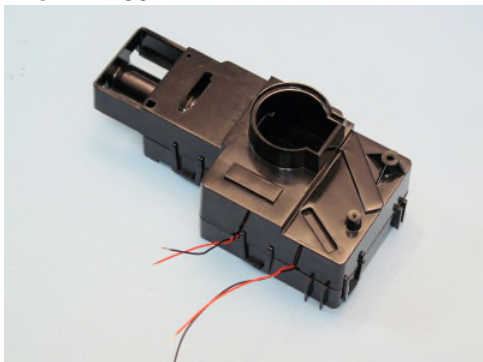
Enclosure Top ISO, ASSY  
Order No.: LZV832



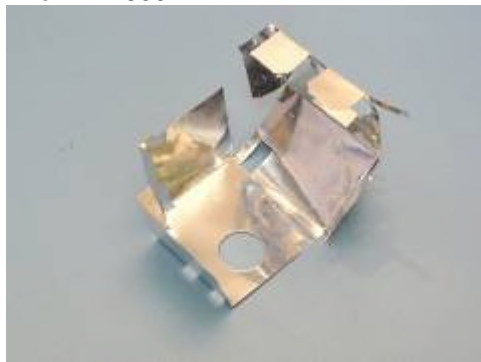
Optic EPA, ASSY  
Order No.: LZV833



Optic ISO, ASSY  
Order No.: LZV834



ESD Shield  
Order No.: LZV835

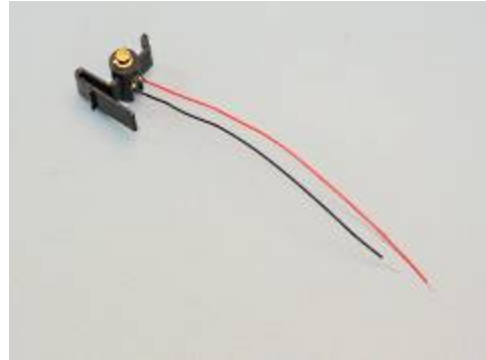




Service Kit, 2100Q  
Order No.: LZV836



LED Lamp 2100Q ISO, ASSY  
Order No.: LZV837



1 NTU Gelex vial  
Order No.: 2971401



# 7 Test aids and devices

## 7.1 Hardware

### Aids for calibration

| Order no.                            | Description                                 |
|--------------------------------------|---------------------------------------------|
| LZV803<br>or 1938004<br>or 4x LZM195 | Power supply<br>or 4 AA Alkaline batteries  |
| 2659405                              | StabCal Set 0.1,20,100,800 NTU sealed vials |
| 2961701                              | 10 NTU Verification Standard                |
| 4707600                              | Oiling Cloth                                |
| 126936                               | Silicone Oil                                |

### Aids for service inspection

| Order no.               | Description                                 |
|-------------------------|---------------------------------------------|
| 1938004<br>or 4x LZM195 | 4 AA Alkaline batteries                     |
| LZV813                  | USB OTG Adapter (Module #7)                 |
| 2659405                 | StabCal Set 0.1,20,100,800 NTU sealed vials |
| 2961701                 | 10 NTU Verification Standard                |
| 2971401                 | 1 NTU Gelex vial                            |
| 4707600                 | Oiling Cloth                                |
| 126936                  | Silicone Oil                                |

