Operator Quick Guide
ORBISPHERE 510/511/512

HACH ULTRA™

EXCELLENCE IN PROCESS ANALYTICS

Operating Information

About this Guide

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Instrument Controls

The instrument front panel provides these user interfaces:

- A touch screen acting as display, touch pad and keyboard.
- A LED, showing when instrument is on.
- A buzzer sounds each time the screen is touched, and when an event alarm is set. Sound level and type can be adjusted.

Touch Screen

The user interface on the front panel is a 320x240 pixels color display with touch screen. To make navigation user friendly, the interface software is Windows CE based, providing easy selection through menus.

All the measurement, configuration, calibration and "standard service" routines can be called by pressing buttons and menus bar on screen.

Measurement display shows one measurement slope per sensor in function (up to 3 lines for a 3 channel Orbisphere 51x).

Special Keys on Portable Instruments

 The sample mode start/stop button starts the measurement process when in sample mode. Pressing the button again manually interrupts the process and an "aborted" message is displayed in the numeric view.

The state of the battery is indicated at the bottom of the measurement view. Pressing the battery icon calls the "Batteries" state window.

Menu Navigation

Pressing the "menu" button in the header bar calls the main menu. The display is made of three columns:

- Left column is the menus, or submenus (greyed out options are not available)
- Center column shows a tree view of the actual position inside the menu structure
- Right column has the following generic controls:
    - **Up** - Return to a previous menu
    - **Main** - Jump directly to the main menu
    - **Close** - Close the menu and return to the measurement view display
    - **Help** - Help topics relating to the current menu

Virtual Keyboard

When a text box (alphanumeric field) has to be edited and is pressed, a virtual keyboard appears on screen. It can be used as a PC keyboard (pressing CAP give access to special keys).
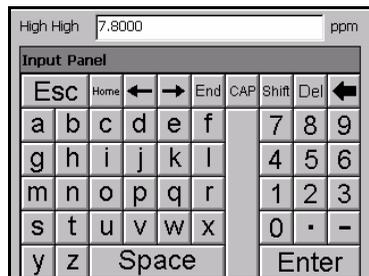
Once values have been entered, press the **Enter** key to confirm and exit the virtual keyboard.

Operating Information (cont)

## Identification and Authorization Level

Press the closed padlock icon 🔒 for two seconds to open the identification window. The user identification and password must be entered to access functionalities authorized by the security level of the user. By default, security is disabled.

Views

The numeric view is the default view and shows numeric measurement value identified for each gas measurement channel available, a graphic showing measurement value evolution during the set time frame, and sample temperature.
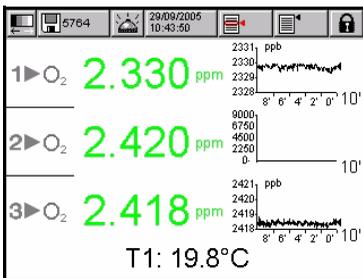

The diagnostic window contains useful information for troubleshooting purposes. The amount of information displayed depends on the gas measured and the channel configuration.
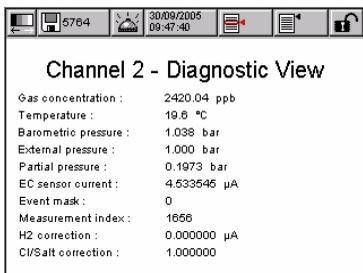

The statistical view offers statistical data that matches with Total Quality management tools. Statistics is a tool to better analyze how a process behaves.

The statistics are calculated from the data in the measurement file. The values are updated each time a new value is added to this file.
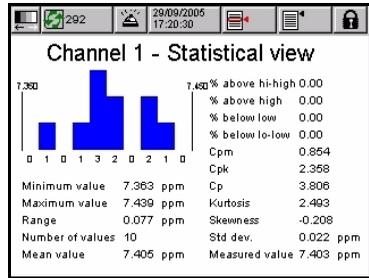
Abnormal Conditions

Whenever an abnormal event is encountered, a sign is displayed on the upper left of the screen. Pressing on the sign calls a window giving further details about the actual situation.
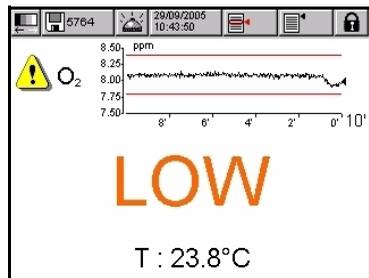
There are three levels of abnormal conditions:

Alarm - There is a severe problem causing the channel to be out of action, and the system alarm relay to be enabled

Warning - Events less critical than a system alarm (e.g. measurement alarm)

**Information -** For information only, no action is required

Measurement

Continuous Mode vs. Sample Mode

The continuous mode is typically used for process measurement, whereas sample mode is aimed at lab measurements of small volume individual samples such as cans or bottles. The measurement mode is a parameter defined for the entire instrument, not for each channel.

In continuous mode, measurements are taken every 2 seconds. In sample mode, measurements are initiated by the user when the sample to be measured has been prepared. TPO or TPA calculation is only available for portable instruments in sample mode.

Measurement Mode Configuration
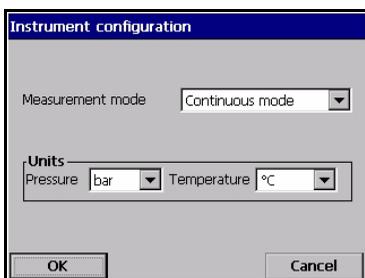
- Measurement mode:
  Continuous for on line process
  Sample for lab sample analysis (portable instruments only)
- Selection of units for barometric and external pressure and temperature

Stop Criteria Configuration (portable only)
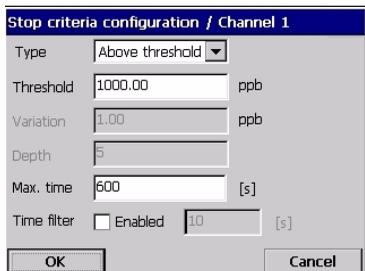
Available in sample measurement mode for configuring the stop criteria for each channel:

- Above threshold: The stop criteria is met when the gas concentration is greater than that entered in "Threshold".
- Below threshold: The stop criteria is met when the gas concentration is smaller than that entered in "Threshold".
- Stability: The stop criteria is met when the variation of the gas concentration is smaller than that entered in "Variation".
- Time: The stop criteria is met when the elapsed time reaches the "Max. time" parameter.

The parameter "Max. time" is the maximum time allowed to reach the target. When this value is reached the measurement stops.

The "Time filter" allows filtering the stop criteria. Measurement is stopped when the stop criteria is fulfilled for a time greater than this parameter.

If TPO or TPA calculation has been enabled, then when the stop criteria is reached, a screen is displayed to input the package size and volume of liquid in the package before computing the TPO or TPA value.

Measurement Configuration (EC Sensor)
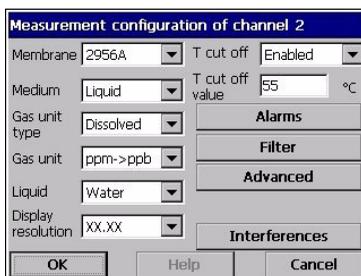
- Sensor's membrane number selection
- Medium: Liquid or Gas Phase
- Gas unit type: Partial, Fraction, Dissolved
- Gas unit: The list of available units depends on unit type selected above
- Liquid: When medium is liquid, select water or a liquid with a different solubility (if available)
- Display resolution: Maximum resolution depends on gas, membrane and unit. A maximum of 5 digits can be displayed. Decimals can be limited to 0, 1, 2 or 3 decimals for easier reading.
- Thermal cutoff: To protect the sensor, the thermal cutoff function allows for setting a sample high temperature limit. If exceeded the electrical signal to the sensor is cut off, the measurement session is suspended and the system displays a "HOT" alarm message.

Measurement Configuration (TC Sensor)

The measurement configuration for a TC sensor is same as for an EC sensor with the addition of one extra selection criteria:

Purge gas: From the drop-down list, select the purge gas being used for the TC sensor.

Measurement Alarms Configuration

Set the thresholds for the low/high concentration levels, according to the application. Each alarm type can be individually enabled or disabled without losing its settings. These events can activate the relays and can be displayed.

- Low-low: 2nd stage for too low concentration
- Low: 1st stage for too low concentration
- High: 1st stage for too high concentration
- High-high: 2nd stage for too high concentration
- Hysteresis in % of above set values. The hysteresis is used to prevent relay "flickering" when the measurement is just at the alarm levels. Set this to a minimum, but enough to eliminate flickering
- Delay in seconds before alarms go on whenever concentration values are above "High alarms" or below "Low alarms". Set this to a minimum, but enough to avoid alarms for non representative peaks beyond the set level.

Measurement Filter Configuration

The filters are aimed at "flattening" the measurement curve in situations where the process shows atypical peak values that could otherwise hamper the interpretation of measurement readings. The filter is applied on the last set of measurements each time a measurement is taken.

- Mean: Mathematical average of the last set (depth) of measurement values.
- Median filter: Allows for eliminating atypical peak measurement values, and averages the remaining ones. The calculation sorts the last measurements set (depth) by values, then deletes the highest and lowest values, and averages the remaining values (central depth)

Example for depth 7, central depth 5:
Sorted values, both ends eliminated, the average of the center five is then 3.88.

0.7	1.1	4.0	4.3	4.4	5.6	7.0

Example for depth 5, central depth 3:
Sorted values, both ends eliminated, the average of the center three is then 4.23.

1.1	4.0	4.3	4.4	5.6

Example for depth 8, central depth 4:
Sorted values, both ends eliminated, the average of the center four is then 4.43.

0.7	1.1	4.0	4.3	4.4	5	5.6	7.0

Measurement (cont)

Advanced Configuration (EC Sensor)

- Enable ext. pressure sensor: Check as appropriate
- Enable negative concentration: Check as appropriate
- Enable TPO or TPA calculation: Check if required (portable instrument only)

Advanced Configuration (TC Sensor)

- Enable ext. pressure sensor: Check as appropriate.
- Enable negative concentration: Check as appropriate.
- Continuous purge during thermal cut off: If thermal cutoff has been enabled, then check this box to ensure that a continuous purge of the TC sensor takes place while the measurement session is suspended due to the thermal cutoff temperature value being exceeded.
- Offset and slope corrections: Enable correction as appropriate.
- If enabled, the correction values for offset and slope must be entered. These values cannot be negative.

- Liquid to gas factor: Enable correction as appropriate.
- If checked, the percentage correction factor must be entered. This value cannot be negative.

Note :

*To manually set the TC sensor into a continuous purge mode, press the **Continuous Purge** button that is available from the **Services - Diagnostic - Channel x - Amplifiers** menu.*

Interferences Configuration (EC Sensor)

These options are available to take into account the influence of some components or gases in the sample during the measurement. By default all available interference corrections are disabled.

- Select CO_2, H_2S or All disabled depending on the type of sensor and application.
- Select Chlorinity, Salinity or disabled. For chlorinity and salinity, enter the actual concentration in the sample.
- Select H_2 enabled or disabled. If enabled, enter the interfering gas pressure (the partial pressure of H_2 in the sample).
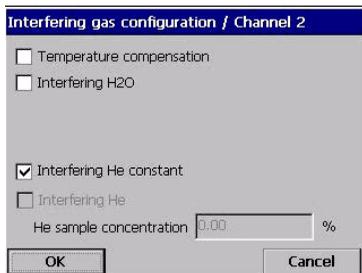
Note :

When enabled, the H_2 interference must be calibrated. A warning pop-up window is displayed to remind the user for this action.

Interferences Configuration (TC Sensor)

A number of different interfering gas options are available (temperature, H_2O, He, O_2 and H_2), depending on the instrument configuration and the gas being measured.

- Temperature compensation: If there is a significant fluctuation in the sample temperature enable temperature compensation to reduce the influence of these temperature fluctuations.
- Interfering H2O: This only applies to measurements taken in 100% humid gases or in traces of dissolved gas in water. It allows a correction to the slope and temperature coefficients calculated during calibration.
- Interfering gas: Enable this option to allow the instrument to correct for the presence of specific gases in the sample. If the interfering gas is helium, you can enter the concentration percentage if known.

Measured Data Storage
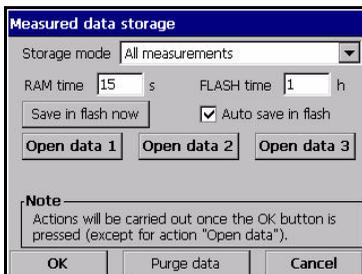
There is one measurement file per channel which contains the data generated by the measurement cycle. The current measurement files are updated in volatile memory, and are regularly copied in non-volatile memory (file back-up). At start up, the measurement files in volatile memory are updated with the files from the non volatile memory.

Adjust the parameters for recording and storing measured data. Two storage mode selections are available depending on the measurement mode selected:

Continuous measurement mode:

- No storage
- Store once: When volatile memory is full (10,000 positions), measurement recording stops
- Rolling buffer: When volatile memory is full, the latest measurement set replaces the oldest (first-in, first-out basis)

Sample measurement mode:

- Only final measurement: The measurement when the stop criteria are met is saved (one per sample)
- Only when sample mode started: The measurements when the sample mode is started are saved
- All measurements: All measurements stored continuously

Additional parameters:

- RAM time (volatile memory): Delay in seconds between two recordings of measured data.
- FLASH time (non-volatile memory): Delay in seconds between two data file transfers from volatile memory into non-volatile memory. Last data file erases previous one.

Buttons:

- Purge data: Clear all data in the volatile and non-volatile memories
- Start logging measurement: In store once mode, starts and stops the measurement recording session. Measurement recording is stopped when buffer is full
- Open data 1,2, or 3 (and TPO or TPA data if enabled): Opens the table showing the measured value which are stored in the volatile memory (RAM)

Calibration

General

We define 2 types of calibration:

- the calibration of the gas to measure
- the calibration of interferences

To calibrate the gas to measure (main gas), the user usually puts the sensor in the main gas without any interfering gas.

To calibrate the interferences, the user usually puts the sensor in the interfering gas without any of the main gas.

Calibrations can only be performed once the instrument has been installed, configured and each channel has been set up. You must also ensure that you have the correct access rights to access the calibration menu.

Select Sensor calibration from the calibration menu, and then select which channel must be calibrated (option).

There are two types of gas sensor calibration available, depending on the gas being measured and the type of sensor in use:

1) In Air: For Oxygen and Ozone
2) Direct value: Any gas. This calibration exposes the sensor to a gas with a known partial pressure, or a liquid sample with a known gas concentration.

EC Gas Sensor Calibration

Calibration of the Measured Gas

Before initiating a calibration process, the calibration parameters must be set by pressing on the *Modify* button. Last calibration parameters are memorized, so this step can be ignored if correct parameters are already set.

Modify Calibration Parameters

- Calibration mode: 2 types available, depending on the gas being measured:
  - *Direct value*: Any gas
  - *In Air*: For O_2 or O_3 (default)
- Medium: Select *liquid* or *gas* (direct calibration only)
- Concentration unit type: *Partial*, *fraction* or *dissolved* (dissolved is for calibration in a liquid only)
- Concentration unit: The list of available units depends on unit type selected above.
- Liquid: Select as appropriate, available when liquid has been selected in *medium* (above).
- Enter the gas concentration according to value in the calibration media, when *direct value* is used
- Hold during calibration: On by default, this stops any output from the instrument during the calibration process to avoid sending invalid information to any connected device.
- Interference enabled: If selected, this takes into account the influence of interferences during calibration. By default the same interferences as during measurement is selected

Press OK to start calibration

Calibration Results

A calibration screen will be displayed showing current measurement data which is continually refreshed.

The value "% ideal current" is a percentage of the current against the ideal current for the membrane type selected. If this percentage is not within the accepted range, an error message is displayed and the calibration process fails. A warning message can be displayed when this value is close to the boundaries, but when calibration can be accepted.

The message is first displayed in the result box. The dialog box with the error message or the warning is displayed when the finish button is pressed.

The value "% last calibration" shows the ratio between current measurement and the previous sensor calibration.

The value "% variation" indicates the variation during the last 3 measurements, which is the stability of the measurements. A variation as low as possible is needed for a precise calibration

The display shows the actual calibration parameters, and the actual readings (temperature, barometer, current).

In case of a calibration failure, consider replacing the membrane. See the EC Sensor Maintenance Manual for details.

Verification

Similar to the calibration procedure, but for verification of the actual calibration values. The result of the measurements made during the verification is not stored and the actual calibration data is not modified.

O_2 Sensor Calibration

The sensor is in contact with either:

- Air at atmospheric pressure (In Air)
- O_2 at known concentration (Direct value).

O_2 In Air Calibration

This calibration procedure places the O_2 sensor in water-saturated air, to provide a known oxygen reference against which to calibrate.

Dry the sensor thoroughly, before placing the sensor storage cap under tap water. Shake off any excess water, but leave a few drops inside the cap. Verify that the screw-on protection cap is in place on the sensor head.

Then, loosely place the storage cap back on the sensor, holding it in place with a few turns of its collar.

Set the calibration parameters accordingly and press calibrate.

O_2 Direct Calibration

This procedure calibrates the oxygen sensor against a liquid sample containing a known level of dissolved O_2 flowing through the sample line.

The instrument displays the sensitivity of the sensor as a percentage of the sensitivity determined when calibration was last performed.

Set the calibration parameters accordingly and press calibrate.

O$_3$ Sensor Calibration

The sensor is either in contact with:

- Air at atmospheric pressure (In Air)
- O$_3$ at known concentration (Direct Value).

The procedure is the same as for the O$_2$ sensor. In the case of the "In air" calibration, the sensor measures O$_2$ during calibration. The O$_3$ coefficient is deduced taking into account how the sensor behaves in O$_2$.

As a different voltage is used at the anode to measure O$_2$ and O$_3$, the O$_3$ measurement takes a long time to stabilize. To facilitate the follow up after an "O$_3$ in air" calibration, negative values can be displayed.

H$_2$ Sensor Calibration

The recommended method is at known concentration (Direct value). The gas can be pure H$_2$ or a mixture of H$_2$ with an inert gas (e.g. a mixture of H$_2$/N$_2$). The known concentration is entered by the user in the calibration parameter window. The sensor is in contact with calibration gas (Direct Value) in gas phase at atmospheric pressure.

Make sure the H$_2$ concentration used for calibration is within the acceptable range for the membrane.

TC Gas Sensor Calibration

Calibration of the Measured Gas

Before initiating a calibration process, the calibration parameters must be set by pressing on the *Modify* button. The last calibration parameters are memorized, so this step can be ignored if the correct parameters are already set.

Similarly, if only the calibration value has changed, then this can be updated directly instead of pressing the *Modify* button.

Modify Calibration Parameters

- Gas Phase: Select *liquid* or *gas* (direct calibration only)
- Gas unit type: *Partial*, *fraction* or *dissolved*
  (dissolved is for calibration in a liquid only)
- Gas unit: The list of available units depends on unit type selected above.
- Liquid: Select as appropriate.
- Enter the gas concentration according to the value in the calibration media.
- Hold during calibration: On by default, this stops any output from the instrument during the calibration process to avoid sending invalid information to any connected device.
- Automatic calibration stop: If selected, when the stability criteria is reached, the calibration process stops automatically.
- Interferences enabled: If selected, this takes into account the influence of interferences during calibration. By default the same interferences as during measurement are selected.

Press OK to start calibration

Calibration (cont)

Calibration Results

A calibration screen will be displayed showing current measurement data which is continually refreshed.

The value "% ideal slope" is a percentage of the slope against the ideal slope. If this percentage is not within the accepted range, an error message is displayed and the calibration process fails. A warning message will be displayed when this value is close to the boundaries, but when calibration can be accepted.

The message is first displayed in the result box. The dialog box with the error message or the warning is displayed when the finish button is pressed.

The value "% last calibration" shows the ratio between the current measurement and the previous sensor calibration.

The value "% variation" indicates the variation during the last 3 measurements, which is the stability of the measurements. A variation as low as possible is needed for a precise calibration.

The display shows the actual calibration parameters, and the actual readings (temperature, barometer, slope).

In case of a calibration failure, consider replacing the membrane. See the TC Sensor Maintenance Manual for details.

Verification

Similar to the calibration procedure, but for verification of the actual calibration values. The result of the measurements made during the verification is not stored and the actual calibration data is not modified.

Calibration Errors (EC and TC sensors)

Calibration is not possible:

- When "ratio ideal current" is greater than 170% or smaller than 30%
- When sensor cannot measure
- When "ratio ideal current" is greater than 150% or smaller than 50%, a warning is displayed but calibration is valid
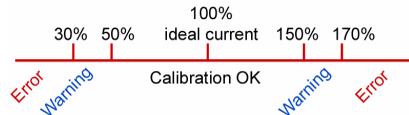
Calibration (cont)

Interference Calibration (EC Sensor)

The hydrogen interference calibration is available for EC sensors measuring O_2 concentrations, and is required when H_2 interference has been enabled. The lower part of the screen displays the actual measurement.

- Enter in the upper box the purity of the hydrogen that is used for this calibration. A reasonably pure (e.g. 99.8% or better) hydrogen source and an accurate pressure gauge are needed.
- Hold during calibration: Selected by default, this holds the measurement sequence to avoid storing invalid values.

Instructions

Using a flow chamber, expose the sensor to the H_2 source at the same barometric pressure that is shown on the display. Press **Start** to initiate the H_2 interference calibration.

Interference Calibration (TC Sensor)

This calibration is available for TC sensors and is required when one of the interferences has been enabled. The lower part of the screen displays the actual measurement.

- Select from the interfering gas to be calibrated from those available, or press the **Change configuration** button to reconfigure.
- Hold during calibration: Selected by default, this holds the measurement sequence to avoid storing invalid values.

The following instructions refer to the different gas interference combinations:

Instructions

For interfering oxygen on measured hydrogen or nitrogen, expose both sensors to ambient air, or a 100% oxygen source, and press **Start** to initiate the calibration.

For interfering hydrogen on measured oxygen or nitrogen, expose both sensors to a 100% hydrogen source and press **Start** to initiate the calibration.

Calibration (cont)

Calibration Reports

Once a measured gas calibration is completed, a report is issued showing the log file of the last actions. The calibration report will contain the data for the last 50 calibrations. Each calibration record will contain parameters useful for traceability.

For interfering gas calibration reports, you will be asked to select the interfering gas from those available.

Barometric Pressure Calibration

Upper box shows the barometric pressure measured by the instrument.

Using a precision certified barometer, measure barometric pressure in the location where the measuring instrument is used. Compare the values; if values are the same press *cancel*; otherwise enter the new barometric value in the lower box and *validate* the new setting.

External Pressure Calibration (optional)

Two calibration methods for the external pressure sensor can be selected:

- Two point calibration (recommended)
- One point calibration

By default the two point calibration is selected.

Two Point Calibration (recommended)

Connect a certified absolute pressure gauge to the sample line, and use a certified precision barometer.

- The two point calibration starts with barometric pressure for the lower point. Expose the external pressure sensor to the atmosphere. Enter the barometric pressure read on the barometer in the upper window and *validate P1*.
- Expose the external pressure sensor to line pressure, making sure it is exposed to the same pressure as the certified absolute pressure gauge. Enter the absolute pressure value read on the certified absolute pressure gauge in the lower box, and *validate P2*.

One Point Calibration

Connect a certified absolute pressure gauge to the sample line.

- Expose the external pressure sensor to line pressure, making sure it is exposed to the same pressure as the certified absolute pressure gauge. Enter the absolute pressure value read on the certified absolute pressure gauge in lower box, and *validate P1*.

Maintenance and Troubleshooting

Services

A number of maintenance and diagnostic options are available from the **Services** menu.
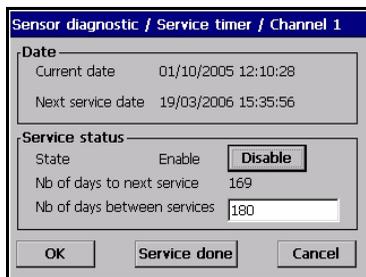
Sensor Diagnostics - Calibration Timer
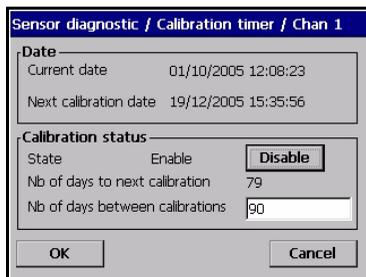
The instrument can automatically remind the user when the next sensor calibration is due. Select the channel, enable it and enter a delay in days. The display shows current instrument date and time, next calibration due date and time, and the remaining days.

The next calibration date is updated when the sensor is calibrated.

Sensor Diagnostics - Service Timer

The instrument can automatically remind the user when the next sensor service is due. Select the channel, enable it and enter a delay in days. The display shows current instrument date and time, next calibration due date and time, and remaining days.

The next service date is updated when the button **Service done** is pressed after a service.

The sensors attached to your instrument will require periodic servicing and maintenance. For more information on this, please refer to the manual(s) delivered with your sensor(s).

Language

Check the language as required and restart the instrument to apply the change. The instrument will restart in the selected language.

Other Options

These include:

- **Time/Date** - Used to set the time, date and the display settings
- **Screen** - Used to set the screen contrast
- **Buzzer** - Used to set the alarm parameters (sound, volume, etc.)
- **Main board info** - Displays instrument model, ID and software version
- **Batteries** - On all instruments this display gives the real time clock battery charge level and voltage. On portable instrument there is a battery level indicator for the main batteries.

Instrument Maintenance

Any instrument maintenance should be carried out by a qualified Hach Ultra Service Technician. Please contact your local representative should you feel any maintenance or instrument adjustments are required.

Troubleshooting - List of Events

The possible events, along with the text message displayed on the instrument numeric view screen, the reason for the event and its criticality are listed in the following table.

Maintenance and Troubleshooting (cont)

Type	Name	Description
Information	Measure	Normal measurement mode.
	Filter enabled	The gas measurements are filtered.
	Sample measurement	The sample measurement is started.
	Meas. not ready	The measurement is not ready (e.g. at startup)
	Autotest in progress	The autotest is running.
	Autotest failed	The autotest has failed.
	Alarm snooze	The alarm snooze is ON.
	Sample mode user aborted	The sample mode has been stopped because the user has pressed the stop button.
	Sample mode stopped because of time out	The sample mode has been stopped because the maximum time to reach the target has elapsed.
	Sample mode stopped because of an error	The sample mode has been stopped because of a measurement error (sensor out, purge failure, etc.).
Warning	Calibration	Channel in calibration.
	Hold	The measurement is frozen.
	Alarm low low	The gas concentration is below the Alarm LowLow limit.
	Alarm low	The gas concentration is below the Alarm Low limit.
	Alarm high	The gas concentration is above the Alarm High limit.
	Alarm high high	The gas concentration is above the Alarm HighHigh limit.
	Calibration required	The calibration of the sensor is required.
	Service required	The sensor requires a service.
Alarm	Channel disabled	The channel has been disabled.
	Channel out	The measurement board has been disconnected (or does not answer).
	Sensor out	The sensor has been disconnected.
	Ext. pressure sensor out	The external pressure sensor is out.
	Thermal cut off	The temperature is above the thermal cut off.
	Interfering gas error	For this channel, an interfering gas is taken into account (i.e. O_2 over N_2). This interfering gas is measured by another channel. This event occurs when the other channel: • is in error (sensor out, thermal cut off, calibration, etc.) • does not exist anymore • does not measure the right gas (i.e. O_2).
	PROFIBUS-DP value not updated	The PROFIBUS-DP module has not received measurements from the instrument for 30 seconds.

Global Headquarters

6, route de Compois, C.P. 212,
1222 Vésenaz, Geneva, Switzerland
Tel   ++ 41 (0)22 594 64 00
Fax ++ 41 (0)22 594 64 99

Americas Headquarters

481 California Avenue,
Grants Pass, Oregon 97526, USA
Tel   1 800 866 7889 / 1 541 472 6500
Fax 1 541 479 3057

www.hachultra.com

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