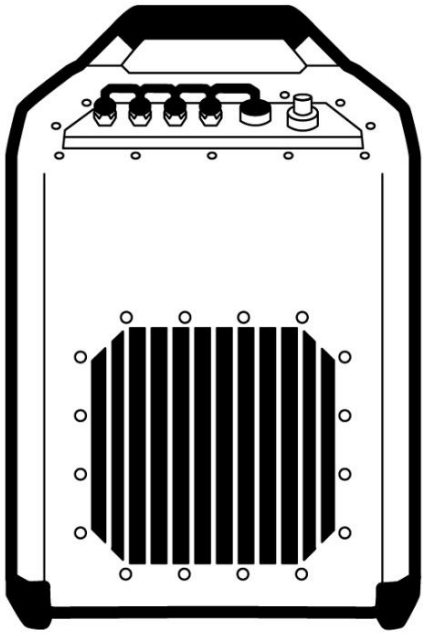
GT5000 Terra FTIR Gas Analyzer



Instruction and Operating Manual

v.E.1.00

Warranty Statement

This warranty applies to the Gasmet brand name products sold with this warranty statement. This warranty is applicable in all countries and may be enforced in any country where Gasmet Technologies Oy or its subsidiaries or its authorized service providers offer warranty service subject to the terms and conditions set forth in this warranty statement. The warranty period varies by product, check the warranty period, if necessary.

Gasmet Technologies Oy and its subsidiaries guarantee that all products manufactured and sold by it are free of defects in materials and workmanship under normal use during the warranty period. The products of Gasmet Technologies Oy and its subsidiaries are manufactured using new materials or new and used materials equivalent to new in performance and reliability. Spare parts may be new or equivalent to new.

Gasmet Technologies Oy and its subsidiaries agree to either replace or repair free of charge (Ex Works Helsinki, Incoterms 2010) any such defective product or part that is returned to its repair facility within one (1) year of the delivery date. All parts or products removed under this warranty become the property of Gasmet Technologies Oy or its subsidiaries. The replacement product or part takes on the warranty status of the removed product or part.

The warranty does not extend to any product from which the serial number has been removed or that has been damaged or rendered defective (a) as a result of accident, misuse, abuse, normal wear of components or other external causes; (b) by operation outside the usage parameters stated in the user documentation that is provided with the product; (c) by the use of parts not manufactured by Gasmet Technologies Oy and its subsidiaries; or (d) by modification or service by anyone other than Gasmet Technologies Oy and its subsidiaries. Gasmet Technologies Oy and its subsidiaries are not liable for any damages caused by the product or the failure of the product to perform, including any loss of profits or savings, incidental damages, or consequential damages.

⚠ WARNING. READ BEFORE USING ANALYZER

To avoid possible electrical shock or personal injury, follow these guidelines:

- Use the analyzer only as specified in this manual or the analyzer could be irreversibly damaged.

- Do not use the analyzer or probe or external AC/DC power supply unit[1] or battery if they appear damaged, or if they operate incorrectly. If in doubt, have the analyzer serviced by trained service personnel.

- Always use the proper original Gasmet parts, and respect Gasmet suggested measurement conditions.

- Do not apply an input AC voltage to the external AC/DC power supply unit different than what indicated on the external AC/DC power supply unit name plate.

- Always use a proper earth ground under external AC/DC power supply unit use.

- Do not use the analyzer in EX rated areas.

-The AC/DC PSU must not be used in wet conditions

-In humid conditions, the analyser and battery should be operated only in portable mode with battery lid closed

- Do not drop or cause mechanical shock to the analyzer.

- Ensure that a sample tube is connected to SAMPLE IN connector before starting the sample pump. Otherwise the valve in the sample inlet will not open.

- The GT5000 Terra Instruction and Operating Manual should be read and understood before operating your unit.

1: AC/DC PSU will later refer to external AC/DC power supply unit.

SYMBOLS

AC (Alternating Current)	**DC** (Direct Current)
Important information, refer to manual	**WEEE symbol** (Waste Electrical and Electronic Equipment Directive)
Conforms to European Union Directives	**Canadian Standards Association**

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1. Introduction

GT5000 Terra is an ambient temperature FTIR gas analyzer designed for on-site measurements of inorganic and organic gases in various applications such as industrial hygiene, research on soil greenhouse gas fluxes and cargo container monitoring.

This manual provides operation instructions for GT5000 Terra. Manuals for the Calcmet Easy and Calcmet Expert software complement this manual and are referred to in matters considering the Calcmet software.

Before starting to operate the GT5000 Terra gas analyzer, read this Instruction & Operating Manual carefully and thoroughly. Improper use of the analyzer may damage the equipment.

If you do not understand something or you are unsure what to do, please do not hesitate to contact your local distributor or Gasmet Technologies Oy. The contact information is at the bottom of every page.

Please remember that measuring conditions should be non-condensing. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

2. Technical data

SYSTEM SPECIFICATIONS

Measuring principle	Fourier transform infrared, FTIR	
Multigas capability	Simultaneous analysis of up to 50 gas compounds	
Response Time	Typically < 120 s, depending on the measured components and measuring time	
Battery	Li-ion battery, approximately 3-hour operation time	
Power supply	115 / 230 VAC	
Analysis Software	Calcmet Required operating system Windows 7 or 10	
Data Connection	USB, Ethernet, Bluetooth, WiFi Access Point and WiFi Station. Remote operable.	
Sample pump flow	2 liters / minute	
Sample gas filtration	**Recommended filtration:** Gasmet sampling probe with 2 µm PTFE filter	
Sample inlet/outlet fittings	6 mm quick-connect	
Enclosure	**Dimensions:** (H x W x D) **Material:** **IP class:**	450 x 287 x 166 mm (17,7 x 11,3 x 6,5 inches) ABS PC IP54 in portable field use
Weight	9.4 kg (with battery), 8.0 kg (without battery)	
Spectrometer	**Resolution:** **Scan frequency:** **Detector:** **Beamsplitter:** **Wave number range:**	8 cm^{-1} 10 scans / s Peltier cooled MCT ZnSe 900 - 4 200 cm^{-1}
Sample cell	**Structure:** **Mirrors:** **Volume:**	Multipass, fixed path length 5.0 m Fixed, gold coated 0.5 liters

OPERATING CONDITIONS

Sample gas pressure	Ambient pressure
Sample gas temperature	Ambient temperature (-5 – 40 °C), non-condensing
Operating temperature	Short term -5 – 40 °C, Long term 5 – 30 °C

PERFORMANCE SPECIFICATIONS	
Zero-point drift	< 2 % of measuring range per per 24 h background measurement interval
Sensitivity drift	None
Linearity deviation	< 2 % of measuring range
Temperature drift	< 1 % of measuring range per 10 K temperature change.* Ambient temperature changes are measured and compensated. (* = Typical GHG Application.)
Pressure influence	1 % change of measuring value for 1 % sample pressure change. Ambient pressure changes are measured and compensated.
Background measurement interval	Recommended 24 h

3. List of Items Delivered for GT5000 Terra

The standard GT5000 Terra includes the following parts:
> GT5000 Terra FTIR gas analyzer
> AC/DC PSU for GT5000 Terra
> USB cable for GT5000 Terra
> Gasmet USB flash drive including software, manuals and other relevant documentation

The options available are:
> Gasmet tablet
> Gasmet probe with one PTFE filter, flexible Tygon tube and connectors
> Ethernet cable for GT5000 Terra
> 6mm PTFE sample lines
> Gasmet battery
> Transport case for GT5000 Terra
> Additional filters
> Calcmet Expert License Key
> Coupling insert for GT5000 Terra in the analyzer end
> Gasmet battery table charger
> Additional AC/DC PSU for GT5000 Terra
> Additional USB-cable for GT5000 Terra

The following functions have been factory set up in accordance with customer order specification:

> Installation of software and analysis options in Calcmet software on the Gasmet tablet.
> Configuration of Bluetooth connection on the Gasmet tablet
> Library and analysis options in Calcmet library if the Gasmet tablet is not ordered.

4. Installation

This chapter describes the requirements and safety precautions considering installation and installation location. When using the analyzer for the first time, perform the analyzer inspection described below.

During installation of the analyzer, the safety of any system incorporating the equipment is the responsibility of the assembler of the system.

4.1. Analyzer Inspection

The analyzer must be inspected within 30 days from the date of delivery, to ensure that the warranty is valid in full. If you noticed that something is missing or the analyzer is damaged during transportation, please contact the nearest distributor or Gasmet Technologies Oy. Before you make this inspection, it is recommended to read *Gasmet Instruction & Operating Manual*, especially *Chapter Equipment operation.*

1. Check the condition of the shipping box.
2. Check that no items listed in Chapter *List of Items Delivered* are missing.
3. Check visually that the analyzer's enclosure is undamaged.
4. Switch the analyzer power on.
5. Connect the analyzer to PC. (See instructions in chapter 5.4)
6. Connect a sample line with appropriate filter to *Sample In*
7. Verify that the analyzer is warmed up after possible transport to non-condensing temperature internally, before activating the measurement and sample pump

Wait before the analyzer has reached the stable operating conditions. Measure hardware status. Observe that Status is showing OK. Otherwise wait for the analyzer to fully warm up and stabilize, and repeat the hardware status measurement.

4.2. Lifting and carrying instructions

When operating the analyzer, place the analyzer in vertical position or in horizontal position front panel facing the user. Carry the analyzer from the handle or with the optional Gasmet backpack harness. Do not use any carrying equipment that is not approved by Gasmet. See below instructions for attaching the harness to the analyzer.

Figure 1. Attaching the backpack harness to GT5000 Terra. 1. Attach the connective metal pieces to the loops on the back of the analyzer. 2. Place the harness on top of the analyzer. Align it so that the loops on the sides of the metal pieces go through the holes on the harness. Pull the Velcro taped strands downwards through the metal pieces, under the edge of the harness, back through the metal loops and attach. 3. Make sure that the harness is well attached.

Care should be taken when using the backpack harness. The user is responsible of the safekeeping and correct use of the harness.

4.3. Storage and Packaging Conditions

The analyzer must be stored in a dry and condensation-free place. Gasmet original package (wooden box) or optionally GT5000 Terra transport case must be used to store the equipment. The following long-term storage conditions should be respected:

- +10 - +35 °C storage temperature
- 5 - 95 % relative humidity, non-condensing
- Gasmet battery should be stored at 15 % to 50 % state of charge with an ambient temperature preferably not exceeding +30 °C.

For short term storage, e.g. during shipping, the following conditions can be tolerated:

- -20 - +45 °C for a period of 12 hours
- 5 - 95 % relative humidity, non-condensing

⚠ **Do not drop the analyzer even when stored in its original package (wooden box) or in its transport case.**

Keep the box and packaging materials, in case the unit needs to be returned for service.

4.4. Safety precautions

4.4.1. Installation Location

The analyzer must be installed and operated in a dry and condensation-free place. The environment should be clean enough so that no dirt will accumulate on or inside of analyzer.

The installation location must be preferably free of strong vibrations. Shocks during transport, for example, can cause serious damage. When transporting the instrument, use the original wooden box or transport case with original shock absorbing materials.

The equipment must not be operated in wet conditions when the battery hatch is open.

Locate the AC/DC PSU so that the appliance coupler of it is easily reachable. The socket outlet to which the AC/DC PSU is connected shall be in vicinity of the equipment and easily reachable.

Disconnect the equipment from mains by mains plug from AC/DC PSU.

In some cases, large temperature changes may affect the analysis results and the accuracy of the measurements decreases. If the sample gas temperature significantly differs from the temperature the background was measured at, re-measuring the background improves the analysis.

4.4.2. Ventilation Requirements

Care should be taken in order to ensure a free convection airflow around the GT5000 Terra and avoid fan obstruction when in long term operation with AC/DC PSU. Do not block fans air circulation. This would decrease life expectancy of most of the internal components.

4.4.3. Protective Earthing Instructions

Precautions should be taken so that the protective earthing scheme on the analyzer is not defeated.

Never connect AC/DC PSU to an AC mains socket that has no protective earth. Use only certified Power Supply Cord.

4.4.4. AC/DC PSU Connection

The AC/DC PSU must be connected to a power source with the AC voltage specified in this manual. Do not use with an extension cord or receptacle unless all three blades can be fully inserted to prevent blade exposure.

Connect the power supply cord to Gasmet AC/DC PSU that is equipped with an appliance inlet. Use an uninterruptible power supply (UPS) if the electric power is subject to major disturbances or power failures.

All cautions and warnings on the equipment must be noted. If the equipment is not in use for a long time, disconnect it from the mains to avoid damage from transient over-voltage.

Please make sure that before connecting the AC/DC PSU to the analyzer or inserting the battery to the analyzer that the manual power switch is in off position.

For safety reasons, make the DC connection (⎓) between the PSU and the analyzer before connecting the PSU to the AC mains (~). If the power cord is not in use (battery mode), disconnect the power inlet from the analyzer and reinstall power inlet protective cover.

The equipment must not be operated in wet conditions when the battery hatch is open.

The AC power supply cord should be routed so that it is unlikely that it will be damaged. If the AC power supply cord is damaged, DO NOT OPERATE THE UNIT!

4.4.5. Battery Connection

Follow the direction of the arrow located on top of the battery in order to insert the battery in the correct way into the GT5000 Terra analyzer. Ensure that the battery is fully inserted. If using the analyzer in wet conditions, ensure that the battery compartment lid is properly closed.

4.4.6. Sound Level

The highest sound pressure level of the analyzer has been measured at a point 1 m from the enclosure of the equipment and with the sample pump switched on. The maximum sound level is 60 dBA. Many authorities consider sound level created by the GT5000 Terra as below hazard threshold. Special means, such as the use of protective earpieces, can decrease the sound level for the operator.

4.4.7. Explosion Protection

For your own safety, the equipment must not be used in hazardous areas (EX-rated areas). The standard enclosure is not explosion proof. The equipment should not be used to measure explosive gas mixtures or gases that might form an explosive gas mixture with the ambient air.

Gasmet Technologies Oy assumes no responsibility if GT5000 Terra is used in hazardous areas.

5. Setup and operation

This chapter provides instructions to software installation, setup of software and analyzer, and basic operation of the analyzer. Please refer to Calcmet Easy and Calcmet Expert manuals for further instructions on the use and features of the software.

5.1. Quick Tablet Guide

Refer to Windows 10 user guide for further instructions. Below are some advises regarding the use of the tablet:

- Turn on the device: Press the power button for few seconds to turn on your device.
- Turn off the device: Press the power button for a few seconds and slide down with your finger to turn off.
- Entering the Suspend Mode: Your device automatically suspends after a period of inactivity. To manually suspend the device, briefly press the power button.
- To access software functions requiring the use of right-click, press the screen for a few seconds.

5.2. Software installation and setup

Calcmet installation file is located on USB Flash drive supplied with the analyzer. If you have purchased optional tablet, Calcmet software has already been installed and the Bluetooth connection is already configured.

C++ redistributable packages are required to be installed before installing Calcmet Software. Redistributable packages are available in the same folder where Calcmet installer package resides.

Files	Calcmet version	Description
vcredistx86_2010.exe	32-bit (32-bit Windows)	Visual C++2010 Redistributable Package
vcredist_x64_2010.exe	64-bit (64-bit Windows)	Visual C++2010 Redistributable Package
vcredist_x86_2015.exe	32-bit (32-bit Windows)	Visual C++2015 Redistributable Package
vcredist_x64_2015.exe	64-bit (64-bit Windows)	Visual C++2015 Redistributable Package

Table 1. C++ redistributable packages required for Calcmet installation.

It is recommended that the program would be installed to its default location in **C:\Gasmet Technologies\Calcmet** directory. The software works on other directories too, but the demo library settings will not work, as they need the files to be located in these specific folders.

> It is not recommended to install Calcmet under program files at all, as administrator privileges are required to write to program files, which may cause issues.

To install Calcmet to your PC, run the Calcmet installer package from your Calcmet software. You may also optionally create the folders listed in Table 2 to your hard disk, although they are created during the install or when the directory is first required once the software is running.

C:\CalcmetLibrary\	recommended folder for reference spectra
C:\CalcmetDemoLib\	recommended folder for demo libraries
C:\CalcmetSamples\	recommended folder for sample spectra and residuals
C:\CalcmetResults\	recommended folder for analysis results
C:\CalcmetBackgrounds\	recommended folder for background spectra
C:\CalcmetLog\	recommended folder for log files

Table 2. Folders for Calcmet software.

After the setup procedure, you should have the files listed in Table 3 in **C:\Gasmet Technologies\Calcmet** directory.

Windows 10 32-bit	Windows 10 64-bit	Description
Calcmet.exe	Calcmet.exe	The executable main program file
LibFT260.dll	LibFT260-64.dll	Application extension file
hasp_windows_82882.dll	hasp_windows_x64_82882.dll	Application extension file
ftd2xx.dll	ftd2xx.dll	Application extension file
Calcmet.MET	Calcmet.MET	Preset analysis method definitions

CalibrationInfo.dat	CalibrationInfo.dat	Latest calibration information (example)
CALCMET.BKGX	CALCMET.BKGX	Latest background (example)
Version history.txt	Version history.txt	Version information text file

Table 3. List of files after Calcmet setup.

Once the files have been installed, it will still be necessary to set the reference spectrum libraries (calibrations), and other settings to make the measurements and analysis. Refer to the later chapters of this manual for description on setting all the analysis and measuring parameters.

The installation also includes the default library and some demo libraries tailored for different applications. These are for demonstration and training purposes only and should not be used for analyzing any real measurements.

All the demo library files can be found in **C:\CalcmetDemoLib** and the reference spectra for the demo libraries are situated in respective sub folders under the same path. During software installation setup the user can choose not to install the demo libraries, if desired.

An optional compiled html help file (**Calcmet.chm**) on the Calcmet program features can also be dropped into the installation folder for quick reference. The in-program help is accessible from the 'F1' key or by clicking help menu option.

5.2.1. Installing calibration files

Optionally there can be analyzer specific calibrations supplied with the analyzer. To use the calibrations, copy the folder including the reference spectra and the .CLIB file under the C:/ from Gasmet USB.

If the reference spectrum files (*.REFX) and library files (*.CLIB) were copied from the Gasmet USB, it may be that the files are write protected. To later make any changes to settings, it will be necessary to deactivate write protection from these files. This can be done by opening the file properties of all these files and unchecking the "Read-Only" option.

5.2.2. Calcmet Software Configuration

When the Calcmet software starts, a welcome window "Welcome to Calcmet" appears. You can select the communication mode and the corresponding settings. Click OK.
If you have a Calcmet Expert License Key, insert it now.

5.3. Connecting sample lines

There are four gas inlet/outlet fittings in the front panel. Connect sample inlet tubing to the Sample in, nitrogen for background measurement to Zero gas, possible sample outlet to Sample out and possible purge gas to the Purge air. All the fittings are quick-connect fittings. To connect a line, make sure that the collar is pressed in before inserting the line. The line is properly connected when the collar releases from the pressed in state. To disconnect, release the line by pressing the collar of the fitting and pull the tube gently out.

5.4. Startup and connecting to PC/tablet

Connecting to analyzer can be divided into two parts. One relates to configuration of laptop/tablet and other relates to configuration of the analyzer. In this section, only settings for the laptop/tablet are discussed. In order to make changes in the configuration for the analyzer, please refer to Calcmet Easy manual. If optional tablet is purchased with the analyzer, it is already paired and settings can be found in *Configuration* menu. Default settings for each mode can be found in Table 4.

Mode		Configuration Mode	Default settings
Cable mode	HID	USB	Baud rate: 115200
	Ethernet	TCP/IP	IP address: 192.168.64.64 Port: 23
Wireless mode	Bluetooth	Bluetooth	Baud rate: 115200
	Wi-Fi station	TCP/IP	IP address: 192.168.64.64 Port: 8080
	Wi-Fi access point	TCP/IP	IP address: 192.168.64.64 Port: 8080 SSID: Gasmet_SNxxxxx Pre-shared key: password64

Table 4. Communication settings.

5.4.1. Cable mode

4.3.1.1. USB

To operate the analyzer via USB connection, switch the analyzer to cable mode from front panel, connect analyzer and laptop/tablet via USB cable and select *USB* as connection mode in *Configuration* dialog. Baud rate to be used is 115200.

4.3.1.2 Ethernet

To operate the analyzer via Ethernet connection, switch the analyzer to cable mode, connect analyzer and laptop/tablet via Ethernet cable and select *TCP/IP* as connection mode in *Configuration* dialog. Enter IP address of the analyzer and use port 23. Default IP address is 192.168.64.64.

5.4.2. Wireless connections

5.4.2.1. Wi-Fi Station

Wi-Fi Station means when analyzer and laptop/tablet are connected to common wireless network, and both act as Wi-Fi stations. For this purpose, connect your laptop/tablet to a wireless network. Analyzer can be connected to the same wireless network by configuring the analyzer by setting SSID, pre-shared key and static IP address from *Analyzer setup* menu option. Details for configuring this can be found in Calcmet Easy user manual. Once analyzer is configured, turn the knob to Wi-Fi station option. At this point, both analyzer and laptop/tablet are connected to the same Wi-Fi network. In *Configuration* dialog, choose TCP/IP mode and enter the static IP in the settings. Port for this option is 8080.

5.4.2.2. Wi-Fi Access Point

In this mode, analyzer is configured as a *Wi-Fi Access Point*. Turn the knob on the analyzer to Wi-Fi access point option. On the laptop/tablet, analyzer can be found in available wireless networks. For example, if analyzer's serial number is 12345, SSID visible in available networks would be Gasmet_SN12345. Default password is password64. Connect to this Wi-Fi access point from laptop/tablet. In the *Configuration* dialog, select TCP/IP mode and enter IP address and port number. Default IP address is 192.168.64.64 and port is 8080.

5.4.2.3. Bluetooth

If laptop/tablet and analyzer are already paired via Bluetooth, *Mode* can be selected to Bluetooth in *Configuration* dialog and analyzer's Bluetooth address can be entered. This address can be found from Control Panel's 'Device and Printers' option. Right click on paired Gasmet device and select 'Properties'. Navigate to the tab 'Bluetooth' and write down the 'Unique identifier', twelve hexadecimal digits. This is the analyzer's Bluetooth address based on which Calcmet will find the correct analyzer. Baud rate to be used for this option is 115200.

If they are not already paired, instructions about how to pair are explained in Calcmet Easy user manual. As pairing needs exchange of randomly generated six digits number, that is possible using *Analyzer Setup* options only.

5.4.3. Remote use

Calcmet Easy can be utilized to operate the analyzer remotely. For this purpose, *Wi-Fi station* or *Ethernet* options can be used. Make sure both devices are in the same network.

5.5. Calcmet setup

This chapter lists the most important settings in Calcmet Easy. For further information, see Calcmet Easy manual.

5.5.1. Autosaving

Select *Autosave* in the menu. Select which files are saved and where. It is recommended to save both the results and the sample spectra. Sample spectra can be re-analyzed later if needed as the original raw data is stored, whereas result files only contain the results of the initial analysis. Make sure that data is being saved before starting the measurements.

5.5.2. Selecting measuring times

Select *Measuring Times* to configure flush time, pump time, sampling time and measuring interval for continuous measurements.

5.5.3. Selecting the application

Select and load the application by clicking *Select Application* in the menu.

5.5.4. Selecting the measured component and their settings

If necessary, edit the analysis settings by selecting *Edit Application* in the menu.

5.6. Hardware status

Before making the background measurement, ensure that the analyzer has been powered up for at least 30 minutes. At the end of this warm-up time, measure the hardware status by selecting *Hardware*. Hardware status measurement will be taken and a dialog with list of hardware parameters, their values and units will be displayed. If “OK” is displayed for the “Status” in the list, it means all the parameters are within the normal range and analyzer is ready for measurements. If it shows “Not OK”, it means some parameters are out of defined limits for normal functioning and measurements taken will not be valid. If the problem persists, service should be contacted in this case to fix the issues. At the same time, “Details” button will appear in the dialog that can be clicked to view the details of the issues as shown in Figure 3.

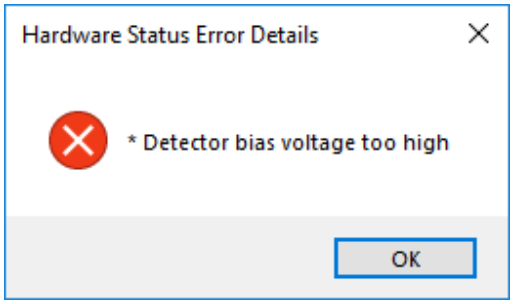


Figure 2. Hardware status error details

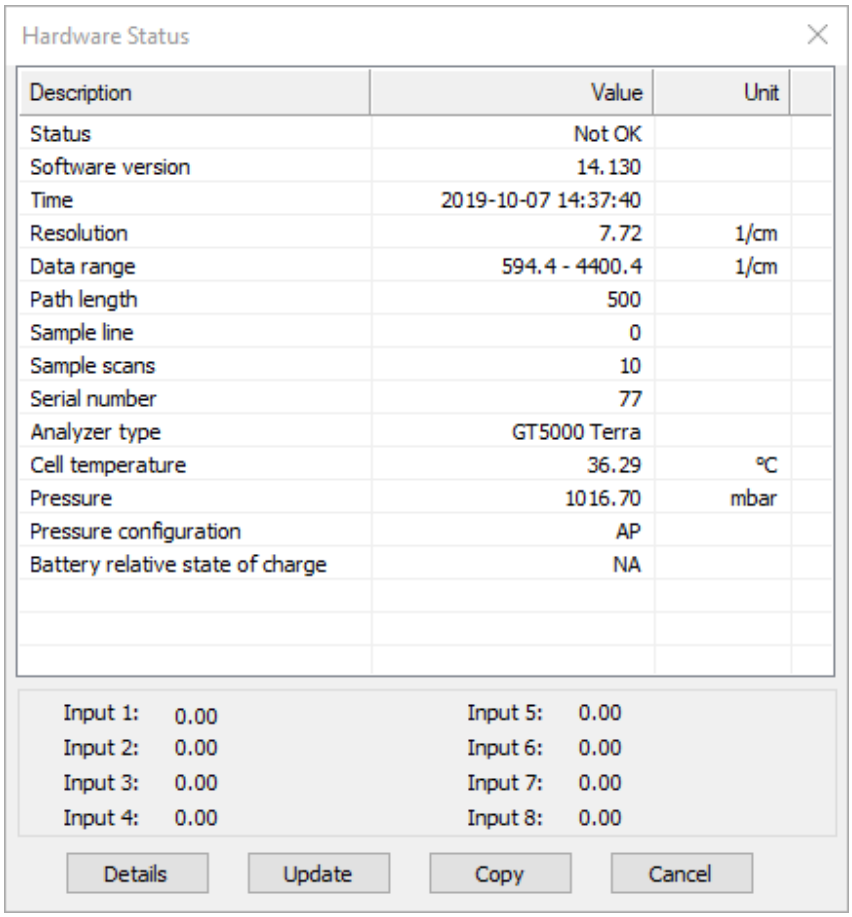


Figure 3. Hardware status. If "Not OK" Details button is displayed

5.7. Interferometer purge

If you are performing high accuracy measurements, you can purge the interferometer with nitrogen or instrument air to avoid absorption occurring inside interferometer. Connect zero gas to purge inlet and adjust the flow to approximately 0.5 l/min in order to purge interferometer. Purge the interferometer for 15 minutes for adequate level of purity. Only N_2 or dry and clean instrument air should be used to purge the analyzer. You can purge continuously or fill the interferometer with zero gas and measure in the field. GT5000 Terra enclosure is tight and will hold majority of the purge gas in the interferometer for hours. If you are performing extremely high accuracy measurements, purge for longer time or increase the zero gas flow to 2.0 l/min.

When measuring in the field while the interferometer is filled with purge gas, it is recommended to fill the interferometer again after 12 hours. Background measurement is recommended to be done as close to the measurements as possible.

If the interferometer is not filled with purge gas periodically when measuring, purge gas will eventually leak out.

5.8. Background measurement

Perform a background measurement with nitrogen every day before measurements. Good background is required to obtain accurate analysis results.

Connect nitrogen bottle with a regulator and flow controller to the zero gas in in the front panel. 5.0 purity nitrogen should be used for the background measurement. Remove probe or line from Sample in -connector. Adjust the flow to approximately 2 l/min. Wait for 5 minutes to be certain that the sample cell is completely filled with nitrogen. Click *Background* in Calcmet Easy top banner to start the background measurement. When you do a background measurement, the view will automatically change to the Background view. If background is successfully measured, “Background OK” -message is displayed in the bottom banner.

The default measurement time for the background measurement is 3 minutes. The background measurement time can be changed in the Calcmet Expert, see Calcmet Expert manual for instructions.
The background spectrum is used in following measurements of sample gas as the reference level of signal strength at various wavelengths. Measuring a new background spectrum constitutes the zero calibration of the gas analyzer and is the only calibration required for operation. You are now ready to start sample measurements.

5.9. Measurement and results

This chapter gives brief instructions on how to measurements using the Calcmet Easy software. For further instructions on the use of Calcmet Easy, please refer to the Calcmet Easy user manual. For the use of Calcmet Expert, refer to Calcmet Expert user manual.

5.9.1. Starting a measurement

Do a single 5 s or 60 s measurement by clicking the respective icons. Start a continuous measurement by clicking *Continuous*. Stop the measurement by clicking *Stop*. You can configure the measurement time from the menu by selecting *Measuring Times*.

5.9.2. Looking at the results

In Calcmet Easy there are five different views that you can use to visualize the results. You can change the view from the arrows in the top right corner. Look at the top left corner to see which view you are in.

5.9.2.1. Results View

Look at the results view to see the concentrations of the components in the sample gas. You can see the used ranges for each component in the column *Range*. The ranges can be modified for each component by selecting *Edit Application* in the menu, and then selecting the desired component and clicking *Measuring Ranges*.

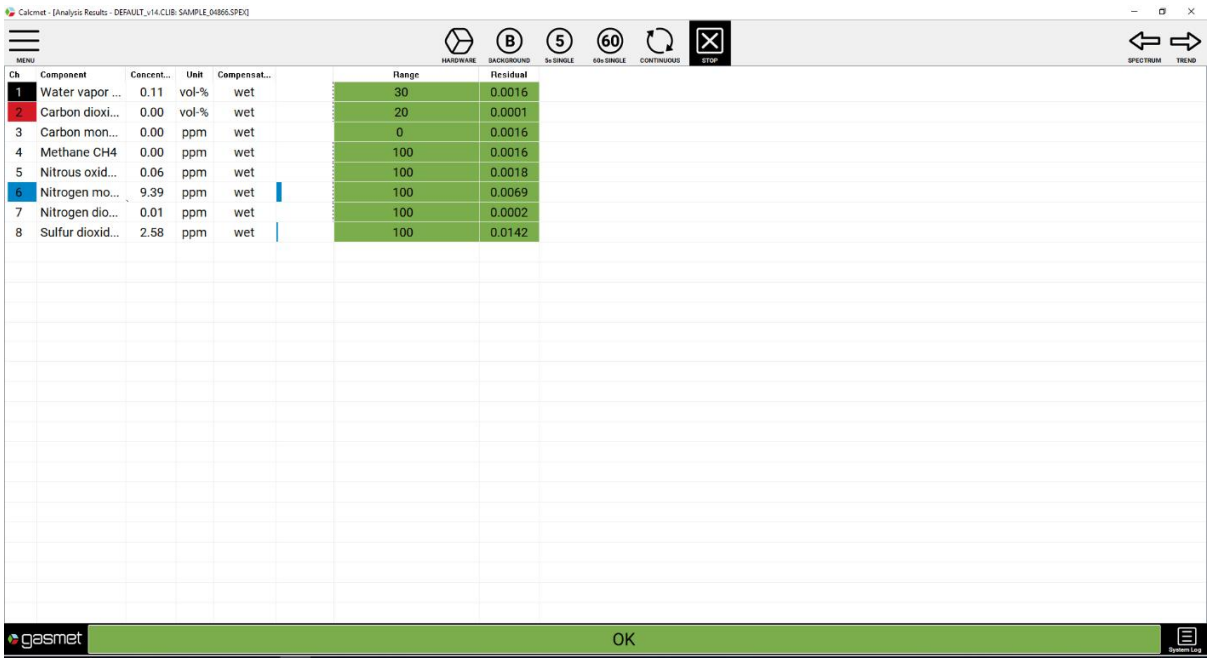


Figure 4. Results view shows the results of the analysis.

Residual-column shows the difference between the sample spectrum and the calculated model spectrum in absorption units. If the residual value is too high, a warning will appear. High residual values can indicate the presence of an unknown component.

You can hide columns by right clicking a column (or pressing for few seconds, if you are using a touchscreen device) and unticking the columns you want to hide.

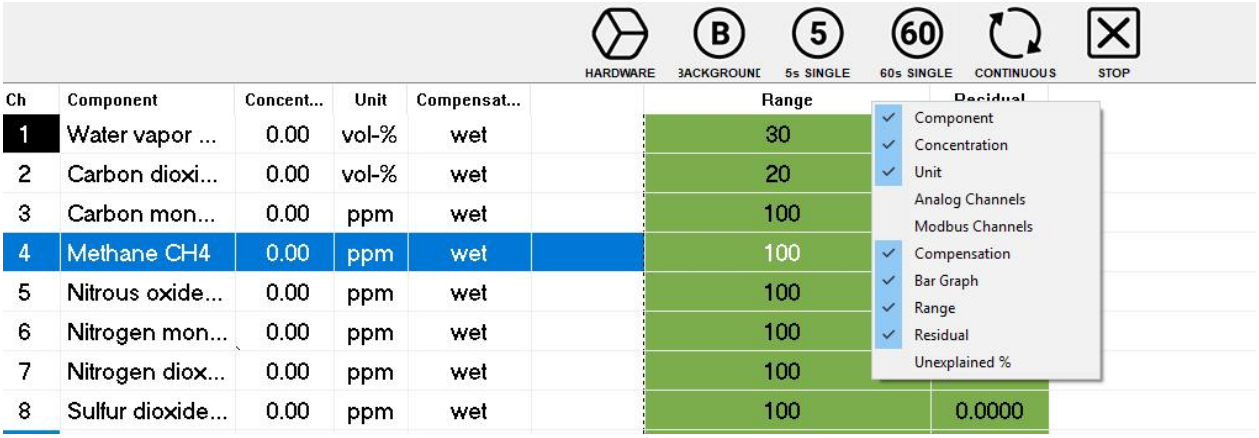


Figure 5. In results view columns can be hidden or displayed by right-clicking the column header.

You can hide a component by right-clicking it (or pressing for few seconds, if you are using a touchscreen device) and selecting Do not display. Hidden components will still be included in the analysis.

Figure 6. In results view components can be hidden or displayed by right-clicking the component.

5.9.2.2. Spectrum View

In the spectrum view, you can see the sample spectrum. This is the default view displayed when you open Calcmet Easy. X-axis shows the wavenumber and y-axis the absorbance.
Zoom in by dragging the desired area in the spectrum. Zoom out with a right click (or by pressing few seconds, if using a touchscreen device), or by using the toolbar on the right.

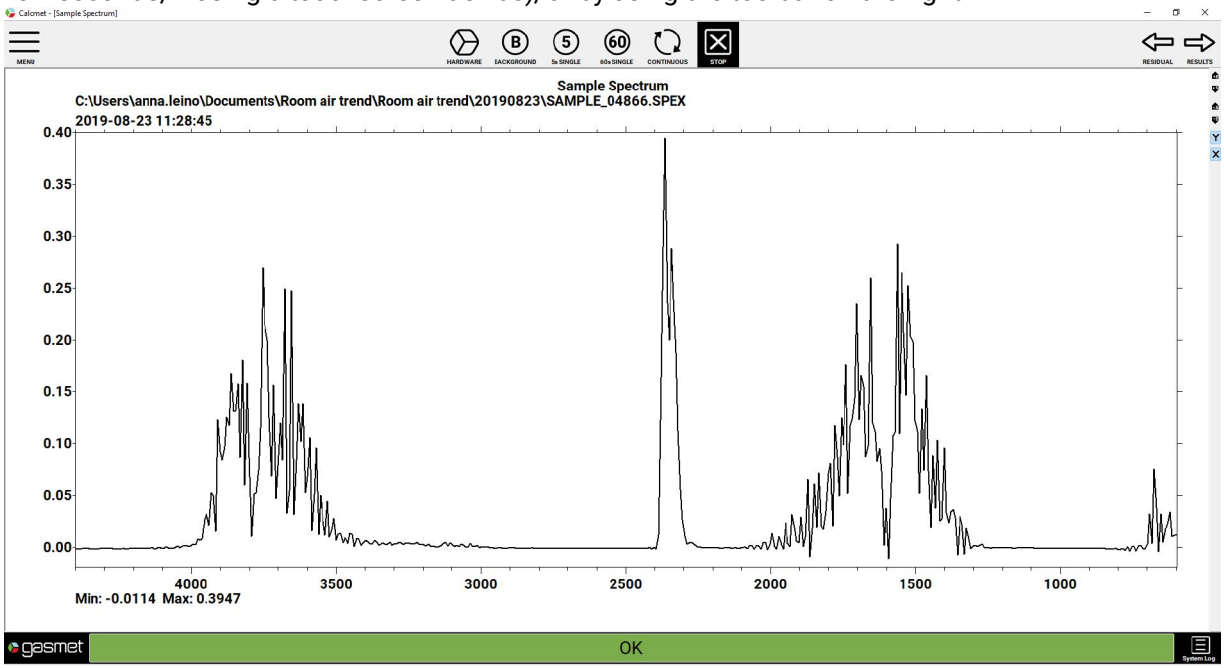


Figure 7. Spectrum view shows the measured/loaded sample spectrum. Zooming buttons are located on the right.

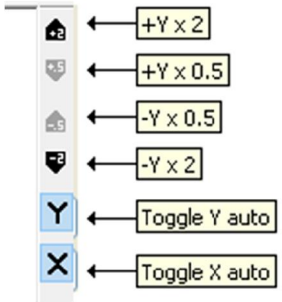


Figure 8. Zooming toolbar allows you to zoom the sample spectrum.

5.9.2.3. Residual View

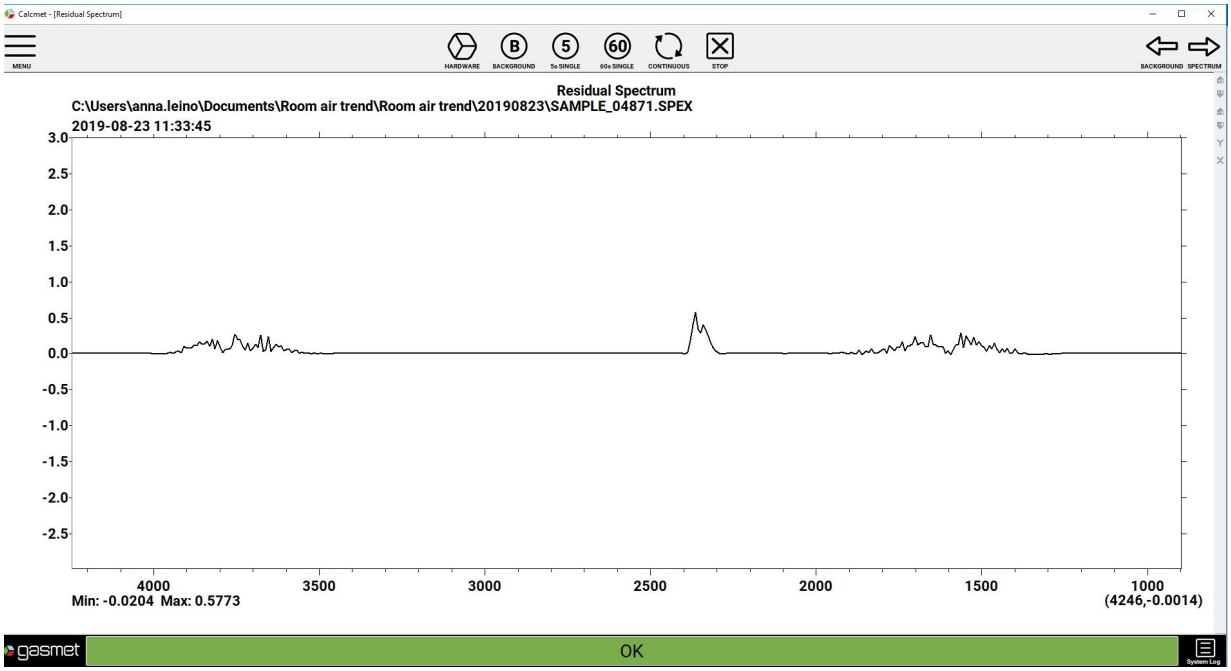


Figure 9. Residual view shows the residual spectrum. Zooming buttons are located on the right.

Residual view shows the difference between the sample spectrum and the calculated model spectrum as a spectrum.

5.9.2.4. Trend View

Trend view shows the change of the concentration of chosen components as functions of time. You make the components visible in the trend view in the Results view by clicking the respective number in the first column.

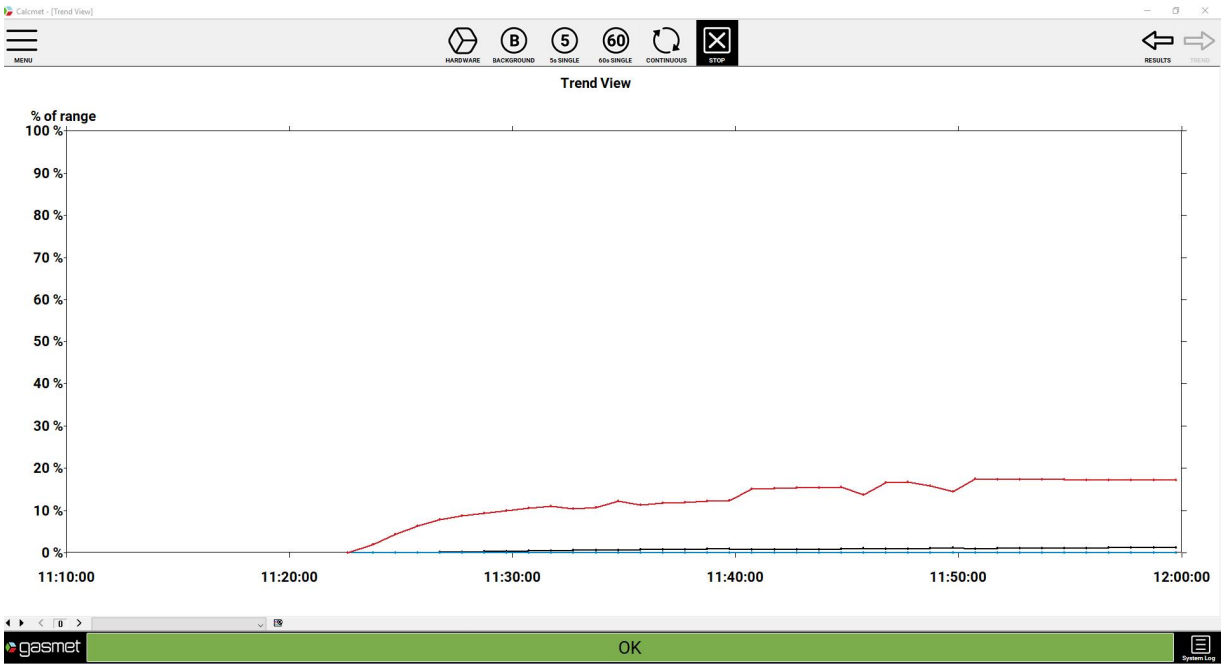


Figure 10. Trend view shows the concentration of selected components as a function of time.

Ch	Component	Concent...	Unit	Compensat...	Range	Residual
1	Water vapor ...	0.00	vol-%	wet	30	0.0000
2	Carbon dioxi...	0.00	vol-%	wet	20	0.0000
3	Carbon mon...	0.00	ppm	wet	100	0.0000
4	Methane CH4	0.00	ppm	wet	100	0.0000
5	Nitrous oxide...	0.00	ppm	wet	100	0.0000

Figure 11. Components can be selected to be shown in the trend view by clicking the number of the component. The color in the first column indicates the component depicted in the trend view as well as the color representing it.

5.9.2.5. Opening and reanalyzing spectrum files

You can open previously measured spectra either by selecting *Load Spectrum* from the menu, or by dragging the spectrum file to Calcmet. You can also reanalyze the loaded spectrum by editing the analysis settings.

5.10. Stopping the measurement

Flush the analyzer with nitrogen, instrument air or clean ambient air until the analysis result show that no sample gas remains in the analyzer. Stop the measurement by clicking Stop. Switch the analyzer off by turning the switch to OFF-position.

Disconnect the equipment from AC outlet before cleaning the enclosure. Check the probe filter and replace it if necessary. If there is dirt on the analyzer enclosure, use a soft cloth to wipe it off.

6. Analyzer safety and maintenance

This chapter describes the maintenance plan and instructions for the maintenance. Proper handling and damage prevention are also explained. Read these instructions carefully to keep your analyzer in good condition.

6.1. Damage prevention

Improper handling of any components inside the analyzer may damage it. Thus, adjustment of any components inside the analyzer voids the warranty. Any service operations that require opening the case of the analyzer should be performed only by a trained service personnel. The case should only be opened when the analyzer is turned off, battery pack, AC power cord and the gas lines are disconnected/removed.

The user should pay attention to the following points:

> Every time after the measurements, the sample cell should be carefully flushed with nitrogen gas or dry instrument air. If corrosive gases remain in the sample cell, the optics inside the sample cell will be damaged. Measuring strongly acidic or caustic gases will irreversibly damage the sample cell.

> If the sample gas contains solid particles, it should be filtered before introducing it into the sample cell. Check regularly the filters you use and replace them when necessary to prevent particulates entering the sample cell. If it is not filtered, dirt will accumulate in the sample cell and lower the quality of the measurements. Any liquid droplets or aerosols inside the gas cell may destroy sample cell mirrors or optical windows.

> After power has been switched off for a longer period or the unit is used in extremely humid ambient conditions, it is recommended to purge the interferometer and sample cell with dry nitrogen gas to avoid condensation on optical components.

> The pressure and temperature of the sample gas should always be kept as stable as possible. However, the gas entering the sample cell should already be as close as possible to the sample cell temperature.

> Intensive shocks may damage the analyzer. Be always very careful when you move or transport the instrument.

> Use a soft cloth to wipe off the dirt on the case. Do not use strong detergents or acetone.

> Never replace Gasmet Power supply cord by an inadequately rated cord.

6.2. Maintaining the analyzer

6.2.1. Maintenance plan

To keep your analyzer in optimal condition, maintenance is recommended at certain intervals. Recommended maintenance and intervals are defined in Table 5. After maintenance, the analyzer is visually inspected and correct operation is ensured.

Maintenance interval	Maintenance work
After every use	Disconnect the equipment from AC outlet before cleaning the enclosure. Check the probe filter and replace it if necessary. Read the instructions given below.
1 month	Visual inspection (according to the instructions given below).
Approximately 12 months	Annual service: analyzer inspection, cleaning, mirror drive service, and water calibration (performed by trained service personnel).
2 – 3 years	Infrared source replacement (performed by trained service personnel).
3 – 5 years	Laser source replacement (performed by trained service personnel).

Table 5. Maintenance intervals for GT5000 Terra.

6.2.2. Visual Inspection

When you make the visual inspection, check that:

- Analyzer cover is somewhat clean and unharmed.
- Front panel, gas fittings, connectors are in good condition.
- Sample gas flow is correct: when pump is on, you can feel a gas flow from the sample outlet.

6.2.3. Replacing the probe filter

Sample probe maintenance includes the replacement of the probe filter and the cleaning with pressurized air blown through the probe. If the probe has been badly stained, water and suitable detergent can be used to clean it.
It is highly recommended to check the probe filter after every use and replace it if necessary.
To check or replace the probe filter, follow the instructions below:

> Pull the tube out of the probe by simultaneously pressing the connector on the probe and pulling the probe tube.
> Unscrew the two screws under the probe using a 2.5 mm hexagonal key.
> Lift the lid of the probe. Lift the main body of the probe and pull it out from the lid.
> Remove the filter cover from the main body of the probe by pulling gently.
> Check the filter and replace if necessary.
> Push the filter cover back to its place. Place the plastic cover pieces on top of each other so that the holes on the probing end align. Hold the cover open and insert the probe body through the hole and push it to the lid. You will hear a click when the probe body is in its place.
> Insert the lid of the probe back and screw the screws back. Insert the probe tube back.

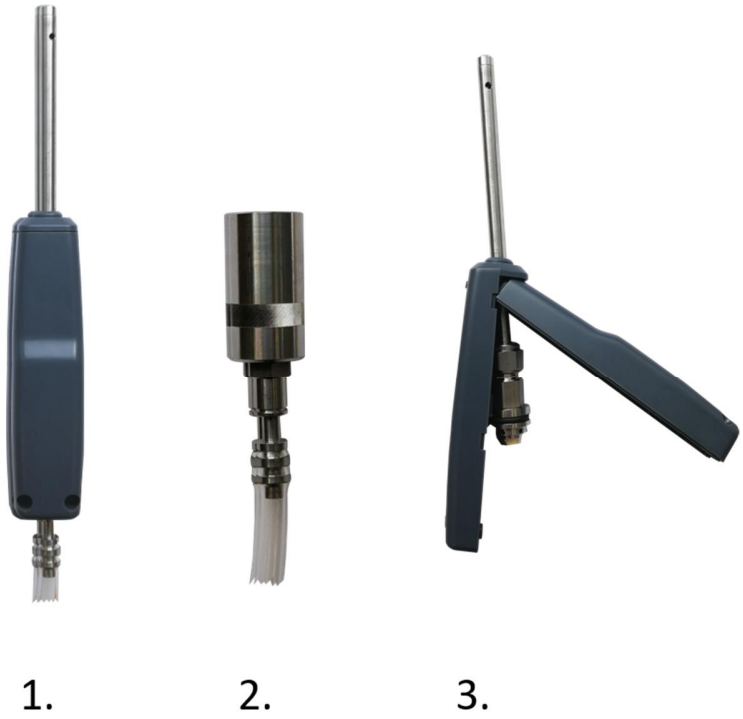


Figure 12. 1. Screws are located on the backside of the probe. 2. Filter is located inside the filter body. 3. To reassemble the probe, hold the cover open and insert the probe body through the hole and push it to the lid.

6.2.4. Sample Cell Inspection

The sample cell inspection can be made for all types of sample cells. Only a trained service personnel may perform sample cell inspection. The operation includes following procedures:

- Sample cell optical window check.
- Sample cell mirror inspection.
- Water calibration.
- Operational test.

7. GT5000 Terra technical description

7.1. Analyzer Enclosure

GT5000 Terra specially designed enclosure is made of ABS/PC, material used for hard-plastic parts. In order to comply with EMC (Electromagnetic Compatibility), the enclosure receives a thin layer of copper coating.

7.2. Power Supply

⚠ GT5000 Terra can be operated with a battery or with external power. Only a Gasmet specified battery or a Gasmet specified AC/DC PSU must be used with GT5000 Terra analyzer.

7.2.1. Battery

The GT5000 Terra analyzer uses 11.25 VDC lithium ion rechargeable battery with SMBus features and LED display. It has a rated energy of 153 Wh that leads to a functioning time of approximately three hours in continuous measurement mode, depending of external temperature. The lower the temperature is, the shorter the functioning time especially with temperatures below 5 °C.
As the battery capacity is quite high, this battery is submitted to strict legislation regarding battery shipping. Those batteries benefit of a transportation certificate specifying that the batteries meet the requirements of the UN Recommendations on the transport of dangerous goods, Part III, sub-section 38.3. Depending upon the transportation, the batteries are shipped according to the country of shipment, rules on dangerous goods. The shipper is solely responsible for proper packaging of the batteries. It is strongly advised to contact the shipping company in your own country before shipping battery in order to ensure correct and safe shipping.

The battery is compliant with the Smart Battery standard. Charge indicator LEDs are visible on the front end of the battery as well as a push button. Use the push button in order to monitor the status of charge of the battery. Batteries can be charged or discharged at the same temperatures than the analyzer operating temperature 0 - 50 °C). Batteries can be charged inside the analyzer in the same time than the analyzer is functioning using the AC/DC PSU at the expense of a longer charge time as the supply is split in between the analyzer and the battery charge. When the analyzer is switched off and the battery needs to be fully charged, the charge time is approximately 4 hours. This charge time is similar on the entire operating temperature range.

Batteries are recommended to be charged at ambient temperature. If a battery is too cold (less than 0 °C) or too warm (more than 50 °C), charge of the battery is discarded by the embedded charger in order to prevent possible damages to the battery. If the battery voltage is too low (below +9 V) and the GT5000 Terra is switched ON only under battery mode, the analyzer will remain off in order to prevent voltage depletion and damage to the battery. For best performance, keep the battery within 15 - 50 % of full charge for long-term battery storage.

The status of battery LEDs is specified in Figure 13.

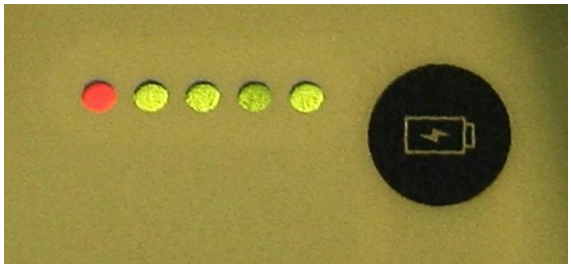


Figure 13. Battery LED indicator.

When the button located on the battery side is pushed, user can monitor the absolute state of charge of the battery. Each LED represents 20 % of battery charge. If the battery state of charge is below or equal to 10 %, the red LED blinks showing the user that battery should be recharged.
For more information regarding battery use, please refer to Appendix B: LI-ION BATTERIES GENERAL USAGE INSTRUCTIONS and Appendix C: RECOMMENDATIONS TO THE END-USERS OF BATTERIES.

7.2.2. AC/DC PSU

A 120-watt AC/DC PSU is used to power the GT5000 Terra and to charge the battery. DC power supply input is located on the side of the analyzer, behind the battery hatch. The required mains input is from 100 VAC up to 240 VAC, 50 Hz- 60 Hz. Hold-up time of the analyzer is 20 ms from loss of AC input.

7.2.3. Power Inlet

Only Gasmet AC/DC PSU is recommended for GT5000 Terra operation. AC/DC PSU should only be used indoors. Note that the analyzer should not be operated in wet conditions when the battery hatch is open.

Figure 14. 1. Battery hatch closed. 2. Opening the battery hatch. 3. Battery and power inlet are located inside the battery hatch.

7.2.4. Fuses

The AC/DC PSU has an internal resettable fuse. Any error condition will blow the internal fuse. The fuse will automatically reset after the fault condition is corrected. If the AC/DC PSU is potentially damage, please contact Gasmet before starting any maintenance.
Battery is overcharge, over discharge and over current protected in order to prevent possible damage or potential explosion. The overcharge and over discharge protection by cell voltage control is reversible; the fuse protecting against overcurrent is irreversible. Reversible protection of the battery is reversed by applying +12V DC voltage on battery power supply pins (Pin 1: Batt- and Pin 2: Batt+).

7.3. Front Panel

GT5000 Terra front panel (Figure 15) gathers the main functionalities of the analyzer: gas inlets/outlet fittings, communication port and communication method rotary switch.

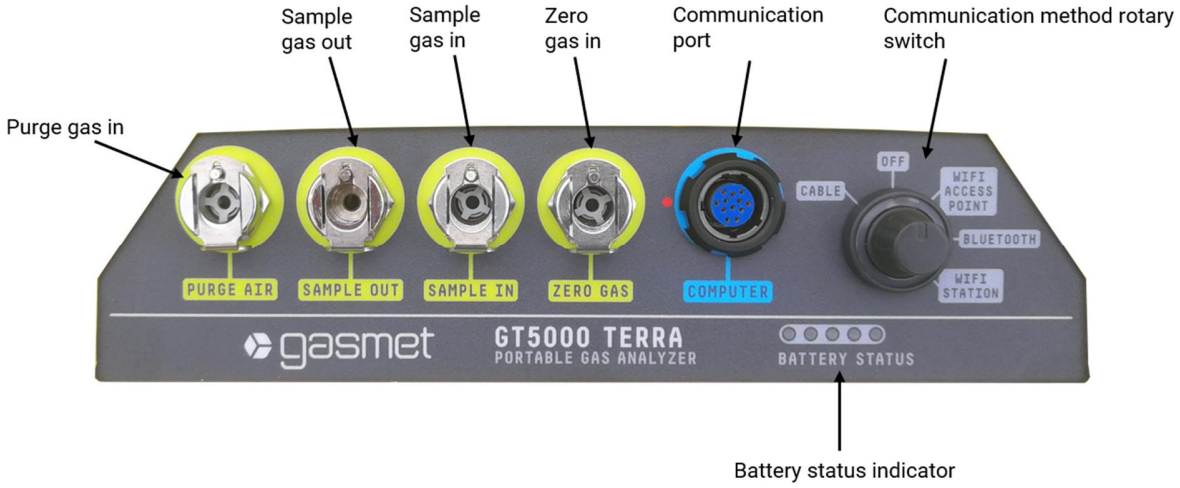


Figure 15. GT5000 Terra front panel.

7.3.1. Gas Fittings

All gas connectors in the GT5000 Terra analyzer are grouped together on the front panel. The quick-connect fittings accept 6 mm OD PTFE or PFA tubing and the Gasmet 6 mm tube adapter, which allows the use of more flexible tubing such as Tygon. The quick-connect fittings engage the tube when the tube is pushed in, and the tube is released by pressing the collar while pulling the tube gently. The connectors for SAMPLE IN, ZERO GAS IN and SYSTEM PURGE have check valves, which shut off when the tube is uncoupled. The SAMPLE OUT connector has no valve and remains open when uncoupled. A connector cover protects the fittings when the GT5000 Terra is not used.

⚠ There is a check valve for gas flow in the inlet connector, so ensure that a sample tube is connected to SAMPLE IN connector before starting the sample pump!

The sample gas connectors are:

> *SAMPLE IN:* Connection of the sample gas inlet. Internal pump will pump the sample gas from this inlet.
> *SAMPLE OUT:* Sample gas outlet permanently opened.
> ZERO GAS: Connection of zero/span gas inlet for background or span measurement. Pump should be switched off for proper background measurement.
> PURGE AIR: Connection of a low flow (0.5 l/min) zero gas inlet in order to purge interferometer. This option can be used for high accuracy measurements. Only N_2 or dry and clean instrument air should be used to purge the analyzer.

Follow the instructions below in order to connect/disconnect 6 mm OD PTFE, PFA tube or Gasmet Tygon tube adapter to/from the quick-connect fittings:

To connect a tube to the analyzer:

> Remove the connector covers
> Insert a tube to the appropriate inlet/outlet by pushing the tube as far as it goes into the connector.

To disconnect a tube from the analyzer:

> Push the connector collar downwards with thumb and index finger and simultaneously pull the tube upwards.
> Place the connector cover on the connectors if necessary.

7.3.2. Communication Port

Gasmet USB or Ethernet cable is connected to the communication port.

7.3.3. Power Switch and LEDs

GT5000 Terra is started up using the rotary switch located in the top right end corner of the front panel. Around the rotary switch, five LEDs display the status of charge of the battery.
Using the power switch, five modes of operation are possible:

> Power switch in Off mode
> Power switch in Cable mode (USB/Ethernet)
> Power switch in Bluetooth mode
> Power switch in Wi-Fi access point mode
> Power switch in Wi-Fi station mode

7.3.3.1. Power Switch in Off Mode

Table 6 below sums up the different options possible when power switch is in Off mode.

OPTION	CURRENT	LED	ANALYZER	CHARGE OF BATTERY
Battery not connected + AC/DC PSU not connected	No current drawn	OFF – Nothing displayed	OFF	OFF
Battery connected + AC/DC PSU not connected	No current drawn	OFF – Nothing displayed	OFF	OFF
Battery connected + AC/DC PSU connected to mains + battery fully charged	Small current drawn from mains	ON – Relative state of charge of the battery displayed. Communication mode LEDs OFF.	OFF	OFF
Battery connected + AC/DC PSU connected to mains + battery requires charge	Large current drawn from mains	ON – Charge status of the battery displayed. Communication mode LEDs OFF.	OFF	ON
Battery not connected + AC/DC PSU connected	Small current drawn coming from mains	ON – Battery error displayed because no battery connected. Communication mode LEDs OFF.	OFF	OFF

Table 6. Power switch in Off mode.

7.3.3.2. Power Switch in Cable Mode

Table 7 below sums up the different options possible when power switch is in Cable mode.

	CURRENT	LED	ANALYZER	CHARGE OF BATTERY
Battery not connected + AC/DC PSU not connected	No current drawn	OFF – Nothing displayed	OFF	OFF
Battery connected + AC/DC PSU not connected	Large current drawn from battery	ON – Relative state of charge of the battery displayed. ON Cable LED ON. Other communication mode LEDs OFF.	ON	OFF
Battery connected + AC/DC PSU connected to mains + battery fully charged	Large current drawn from mains	ON – Relative state of charge of the battery displayed. ON Cable LED ON. Other communication mode LEDs OFF.	ON	OFF
Battery connected + AC/DC PSU connected to mains + battery requires charge	Large current drawn from mains	ON – Charge status of the battery displayed. ON Cable LED ON. Other communication mode LEDs OFF.	ON	ON
Battery not connected + AC/DC PSU connected	Large current drawnfrom mains	ON – Battery error displayed because no battery connected. ON Cable LED ON. Other communication mode LEDs OFF.	ON	OFF

Table 7. Power switch in Cable mode.

7.3.3.3. Power Switch in WiFi Access Point Mode

Table 8 below sums up the different options possible when power switch is in WiFi Access point mode

	CURRENT	LED	ANALYZER	CHARGE OF BATTERY
Battery not connected + AC/DC PSU not connected	No current drawn	OFF – Nothing displayed	OFF	OFF
Battery connected + AC/DC PSU not connected	Large current drawn from battery	ON – Relative state of charge of the battery displayed. ON WIFI Access Point LED ON. Other communication mode LEDs OFF.	ON	OFF
Battery connected + AC/DC PSU connected to mains + battery fully charged	Large current drawn from mains	ON – Relative state of charge of the battery displayed. ON WIFI Access Point LED ON. Other communication mode LEDs OFF.	ON	OFF
Battery connected + AC/DC PSU connected to mains + battery requires charge	Large current drawn from mains	ON – Charge status of the battery displayed. ON WIFI Access Point LED ON. Other communication mode LEDs OFF.	ON	ON
Battery not connected + AC/DC PSU connected	Large current drawn from mains	ON – Battery error displayed because no battery connected. ON WIFI Access Point LED ON. Other communication mode LEDs OFF.	ON	OFF

Table 8. Power switch in WIFI Access Point mode.

7.3.3.4. Power Switch in Bluetooth Mode

Table 9 below sums up the different options possible when power switch is in Bluetooth mode.

OPTION	CURRENT	LED	ANALYZER	CHARGE OF BATTERY
Battery not connected + AC/DC PSU not connected	No current drawn	OFF – Nothing displayed	OFF	OFF
Battery connected + AC/DC PSU not connected	Large current drawn from battery.	ON – Relative state of charge of the battery displayed. ON Bluetooth LED ON. Other communication mode LEDs OFF.	ON	OFF
Battery connected + AC/DC PSU connected to mains + battery fully charged	Large current drawn from mains.	ON – Relative state of charge of the battery displayed. ON Bluetooth LED ON. Other communication mode LEDs OFF.	ON	OFF
Battery connected + AC/DC PSU connected to mains + battery requires charge	Large current drawn from mains because battery needs to be charged	ON – Charge status of the battery displayed. ON Bluetooth LED ON. Other communication mode LEDs OFF.	ON	ON
Battery not connected + AC/DC PSU connected	Large current drawn from mains.	ON – Battery error displayed because no battery connected. ON Bluetooth LED ON. Other communication mode LEDs OFF.	ON	OFF

Table 9. Power switch in Bluetooth mode.

7.3.3.5. Power Switch in WiFi Station Mode

Table 10 below sums up the different options possible when power switch is in WiFi station mode

	CURRENT	LED	ANALYZER	CHARGE OF BATTERY
Battery not connected + AC/DC PSU not connected	No current drawn	OFF – Nothing displayed	OFF	OFF
Battery connected + AC/DC PSU not connected	Large current drawn from battery	ON – Relative state of charge of the battery displayed. ON WIFI Station LED ON. Other communication mode LEDs OFF.	ON	OFF
Battery connected + AC/DC PSU connected to mains + battery fully charged	Large current drawn from mains	ON – Relative state of charge of the battery displayed. ON WIFI Station LED ON. Other communication mode LEDs OFF.	ON	OFF
Battery connected + AC/DC PSU connected to mains + battery requires charge	Large current drawn from mains	ON – Charge status of the battery displayed. ON WIFI Station LED ON. Other communication mode LEDs OFF.	ON	ON
Battery not connected + AC/DC PSU connected	Large current drawn from mains	ON – Battery error displayed because no battery connected. ON WIFI Station LED ON. Other communication mode LEDs OFF.	ON	OFF

Table 10. Power switch in WIFI Station mode.

7.3.3.6. Battery Charge Indicator

The Battery charge indicator displays relative state of charge of the battery when one is inserted into the analyzer. This display allows also monitoring the charge status and errors from battery/charger. The tables Table 11 - Table 18 below list the different possible battery charge indicator status.

	Battery relative state of charge status (% of full charge)				
	10 – 20 % charged	20 – 40 % charged	40 – 60 % charged	60 – 80 % charged	80 – 100 % charged
Charge indicator status					

Table 11. Battery relative state of charge status.

	Battery charge at time T					
	T + 0 sec.	T + 1,3 sec.	T + 2,6 sec.	T + 3,9 sec.	T + 5,2 sec.	T + 6,5 sec.
Charge indicator status if the battery is 30 % charged						

Table 12. Battery charging – LED status.

	Battery relative state of charge status (% of full charge)	
	0 to 10 % charged T + 0 sec.	0 to 10 % charged T + 1,3 sec.
Charge indicator status		

Table 13. Battery relative state of charge status (0 % to 10 %).

	Time	
	T + 0 sec.	T + 1,3 sec.
Charge indicator status Battery disconnected		

Table 14. Battery disconnected.

	Time	
	T + 0 sec.	**T + 1,3 sec.**
Charge indicator status **Battery temperature or charger temperature** **not correct.**		

Table 15. Battery temperature or charger temperature not correct.

	Time	
	T + 0 sec.	**T + 1,3 sec.**
Charge indicator status **AC/DC PSU error**		

Table 16. AC/DC PSU error.

	Time	
	T + 0 sec.	**T + 1,3 sec.**
Charge indicator status **SMBus error**		

Table 17. SMBus error.

	Time	
	T + 0 sec.	**T + 1,3 sec.**
Charge indicator status **Charger communicator error**		

Table 18. Charger communication error.

7.3.4. On-board Sample Pump

The GT5000 Terra model is equipped with an on-board sample pump, which has a neoprene diaphragm membrane. Pump power supply is +12 VDC, maximum pressure is 1.4 bar and flow is 2 l/min. The sample gas of GT5000 Terra should be at ambient temperature and no condensing.

7.3.5. Probe

GT5000 Terra specifically designed light probe combines an embedded gas filter. Filter cleanliness is important to insure correct measurements. Filters provided by Gasmet Technologies Oy are the only one usable. Sample gas should be at ambient temperature and avoid sudden changes in ambient gas temperature in order to prevent condensation in sample cell.

Follow the instructions below in order to connect/disconnect the Gasmet 6 mm tube adapter to/from the probe: To connect the tube to the probe, insert the 6 mm tube to the probe inlet by pushing the tube as far as it goes into the connector.

To disconnect the tube from the probe, push the connector collar downwards with thumb and index finger and simultaneously pull the tube out.

Instructions regarding the change of probe filters are detailed in chapter 6.2.3.

7.3.6. Carrying Handle and Carrying Harness

A carrying handle is used to carry the analyzer safely in vertical position. For backpack use, a specifically designed sturdy and adjustable carrying harness can be used. Refer to Chapter 4.2 for instructions for attaching the backpack harness and proper carrying of the analyzer.

Appendix A: Gasmet Sales and Support Offices

MANUFACTURER	SUBSIDIARY IN GERMANY
Gasmet Technologies Oy Mestarintie 6, 01730 Vantaa, Finland contact@gasmet.fi +358 9 7590 0400	**Gasmet Technologies GmbH** Ostring 4, 76131 Karlsruhe, Holstenstraße 27, 24568 Kaltenkirchen, Germany sekretariat@gasmet.com +49 721 62656-0
SUBSIDIARY IN UNITED KINGDOM	**SUBSIDIARY IN NORTH AMERICA**
Gasmet Technologies (UK) Ltd. Woolleys Farm, Welford Road, Naseby Northampton, NN6 6DP, United Kingdom contact.uk@gasmet.com +44 1908 227722	**Gasmet Technologies Inc.** 956A The Queensway, Toronto, Ontario, M8Z 1P5, Canada sales@gasmet.com (+1) 866 685 0050
SUBSIDIARY IN ASIA	**DISTRIBUTORS**
Gasmet Technologies (Asia) Ltd. Unit 1, 7/F, Fook Hong Industrial Building, No. 19 Sheung Yuet Road, Kowloon Bay, Kowloon, Hong Kong sales@gasmet.com.hk +852 3568 7586	Please see our website at www.gasmet.com

⚠ Appendix B: LI-ION BATTERIES GENERAL USAGE INSTRUCTIONS

The following precautions should be observed when using Gasmet Li-ion batteries for GT5000 Terra.

Storage:

1. In order to avoid short circuits, handle batteries carefully. Always ensure that terminals are insulated.
2. Prior to use, keep the battery at a temperature preferably not exceeding 30 °C.
3. Initial state of charge of batteries before storage should be between 15 % and 50 % of capacity and is defined by taking into account:
    1. The maximum consumption of electronic devices
    2. The self-discharge of the cells (the higher the state of charge, the higher the rate of the self-discharge)
    3. A minimum of 5 % of state of charge is required at the end of storage to avoid any 'overcharge'.
4. If after storage, the battery voltage is low or even 0 V, the battery protection circuit has probably gone into 'sleep mode'. In such case, reset the battery with Gasmet charger.

Use mode:

1. Your battery has been designed for a specific application. Do not use it for any other application without the agreement of Gasmet.
2. Do not connect batteries in series or parallel. Irreversible damage can be done.
3. Observe correct polarities during installation and charging.
4. Use only a Gasmet charger designed for use with smart Li-ion batteries. Otherwise irreparable damage to the battery electronics could ensue.
5. Do not heat above 70 °C. The batteries contain thermal fuses which could activate and make batteries inoperable.
6. Your battery is designed with an electronic device to protect against overdischarge, overcharge and short-circuiting between the terminals.
7. If you cannot discharge the battery, it may be overdischarged. Charge the battery for ½ hour and check again.
8. If you cannot charge the battery, it may be overcharged. Discharge the battery and check again.
9. If the battery has been short-circuited, charge it to reset the electronics with the Gasmet charger.
10. If the battery has been short-circuited, status of charge can be wrong. Charge the battery for ½ hour and discharge the battery in order to reset smart battery values.
11. If the battery still does not work, please contact Gasmet.
12. Do not apply pressure that will deform the batteries.

End of life:

1. After numerous cycles, it is normal to observe a decrease in the battery capacity.
2. Do not try to open or dismantle the battery since it would invalidate the warranty.
3. Do not dispose of in fire.
4. Recycle the battery by a specialist company.

Appendix C: RECOMMENDATIONS TO THE END-USERS OF BATTERIES

The following represents a typical, but non-exhaustive, list of good advice to be provided by the manufacturer of secondary cells and batteries to equipment manufacturers and battery assemblers.

a) Do not dismantle, open or shred cells. Batteries should be dismantled only by trained

personnel. Multicell battery cases should be designed so that they can be opened only

with the aid of a tool.

b) Do not short-circuit a cell or battery. Do not store cells or batteries haphazardly in a box or drawer where they may short-circuit each other or be short-circuited by conductive materials.

c) Do not remove a cell or battery from its original packaging until required for use.

d) Do not expose cells or batteries to heat or fire. Avoid storage in direct sunlight.

e) Do not subject cells or batteries to mechanical shock.

f) In the event of a cell leaking, do not allow the liquid to come into contact with the skin or eyes. If contact has been made, wash the affected area with copious amounts of water and seek medical advice.

g) Equipment should be designed to prohibit the incorrect insertion of cells or batteries and should have clear polarity marks. Always observe the polarity marks on the cell, battery and equipment and ensure correct use.

h) Do not mix cells of different manufacturer, capacity, size or type within a battery.

i) Seek medical advice immediately if a cell or battery has been swallowed.

j) Consult the cell/battery manufacturer on the maximum number of cells, which may be

assembled in a battery and on the safest way in which cells may be connected.

k) A dedicated charger should be provided for each equipment. Complete charging instructions should be provided for all secondary cells and batteries offered for sale.

l) Keep cells and batteries clean and dry.

m) Wipe the cell or battery terminals with a clean dry cloth if they become dirty.

n) Secondary cells and batteries need to be charged before use. Always refer to the cell or battery manufacturer's instructions and use the correct charging procedure.

o) Do not maintain secondary cells and batteries on charge when not in use.

p) After extended periods of storage, it may be necessary to charge and discharge the cells or batteries several times to obtain maximum performance.

q) Secondary cells and batteries give their best performance when they are operated at

normal room temperature.

r) Retain the original cell and battery literature for future reference.

s) When disposing of secondary cells or batteries, keep cells or batteries of different electrochemical systems separate from each other.

Appendix D: LASER SAFETY INFORMATION

GT5000 Terra user should be aware that the apparatus contains a potentially harmful laser device. GT5000 Terra fulfils the requirements for Laser Class 1 according to the standard EN 60825-2007 (IEC 60825-2007). The laser device, included into the GT5000 Terra, is fully enclosed and only trained service personnel should open the enclosure in case of service of the analyzer. Please, read carefully the following remarks:

CLASS 1 LASER PRODUCT

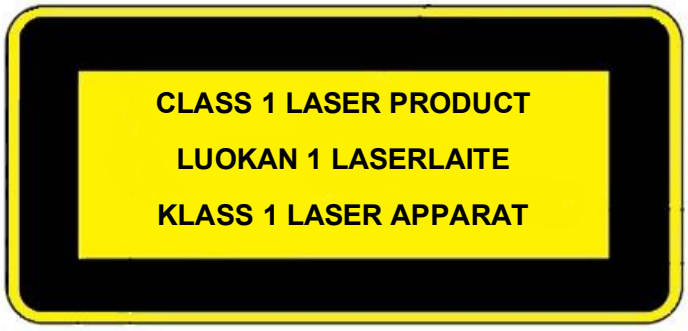
EN 60825-1:2007

CAUTION – CLASS 3R LASER RADIATION WHEN OPEN

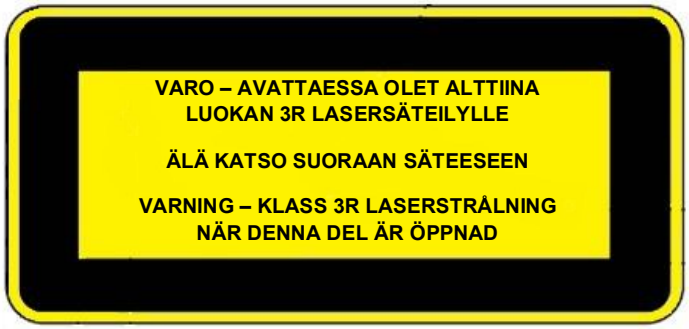
AVOID DIRECT EYE EXPOSURE

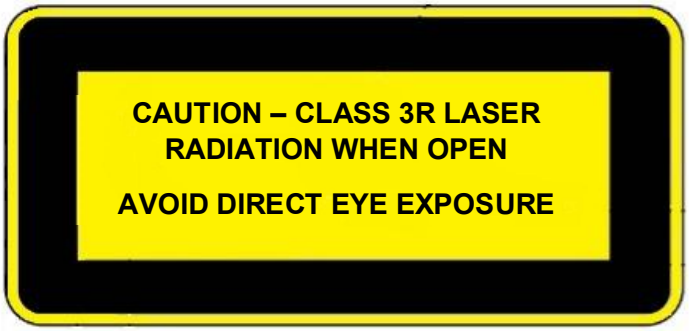
Caution – Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Label on the analyzer:



Label on the interferometer:





Appendix E: CERTIFICATION

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This Class A digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.