



Gas Mixing System (GMS)

Installation and Operation Manual

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Safety notes

Please follow these safety guidelines to protect yourself from potential hazards. Please note that this list is not exhaustive and careful handling of the device is required at all times. Loligo® Systems is not liable for any injuries arising from inappropriate operation of the device.

Please follow these general guidelines:

- **Read all instructions prior to installing, operating and servicing this product**
- **Install your equipment as specified in the instruction manual.**
- **The GMS must not be installed and operated by unqualified personnel.**
- **Connect the product to the specified electrical, gas and pressure sources.**
- **Ensure that all power cables and gas tubing are in proper condition and securely connected. Disconnect all power sources when maintenance is being performed, to prevent electrical shock and personal injury.**
- **Do not operate this instrument in excess of the specifications marked on and supplied with this product. Failure to heed this warning can result in serious personal injury and/or damage to the equipment.**
- **Do not operate the GMS with gases other than oxygen, nitrogen and carbon dioxide to avoid risk to health and damage of the device**
- **Only use the GMS in well aerated spaces to avoid depletion of oxygen or harmful levels of carbon dioxide.**
- **Do not use the product if it is damaged or defective.**
- **References should always be made to the Health and Safety data supplied with any chemicals used. Generally accepted laboratory procedures for safe handling of chemicals should be employed.**

Symbols

Follow all **CAUTION** and **WARNING** notes marked on and supplied with this product to avoid serious injury or damage to the device.

Symbol	Meaning
	A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.
	A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.
	Danger from electrical voltage . Failure to heed this warning may lead to serious injury or death.
	Information about any essential requirements or actions to operate the instrument.
	Helpful information that may improve the usability of the instrument.
	CE mark indicating that the product has been assessed to meet safety and health requirements for products sold in the EEA.
	According to the directive 2002/96/EG (WEEE), any product labelled with this WEEE symbol must not be disposed of with the domestic waste.

Intended use of the product

The Loligo® Systems **Gas Mixing System (GMS)** is a scientific instrument and exclusively designed to mix oxygen (O₂), carbon dioxide (CO₂) and nitrogen (N₂) gas in research laboratories.

Only use gases and apply chemicals with the GMS as specified in Table 1. Loligo® Systems will not be liable for any use of gases and chemicals not contained therein.

Table 1: Use and application of chemicals approved for the GMS.

Chemical/Agent	Application
Deionized water	Cleaning, gas humidification
Ethanol	Cleaning
N ₂ gas	Gas mixing
O ₂ gas	
CO ₂ gas	

The GMS instruments may not be retrofitted by users.

Only original parts and accessories as well as pressure rated tubing and connectors must be used for operation and maintenance the GMS instruments.

Do not operate the GMS in damp and wet areas or outdoors.

The GMS is not designed for medical applications.

Any other use as specified in this manual is not permitted.

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1 Introduction

1.1 Product overview

The Gas Mixing System (GMS) by Loligo® Systems performs automated fine-scale mixing of oxygen (O₂), carbon dioxide (CO₂) and nitrogen (N₂) gas using in-built mass flow controllers. The GMS can be readily connected and operated with the Loligo® Systems Blood Oxygen Binding System (BOBST™) or customized to any other application, which requires precise mixing of gases.

Features

- Broad and fine-scaled range of O₂ mixtures (0.01% - 100%)
- CO₂ mixing from 0.03% to 6%
- Software controlled automated gas mixing
- Customizable to different gas ranges and gas types

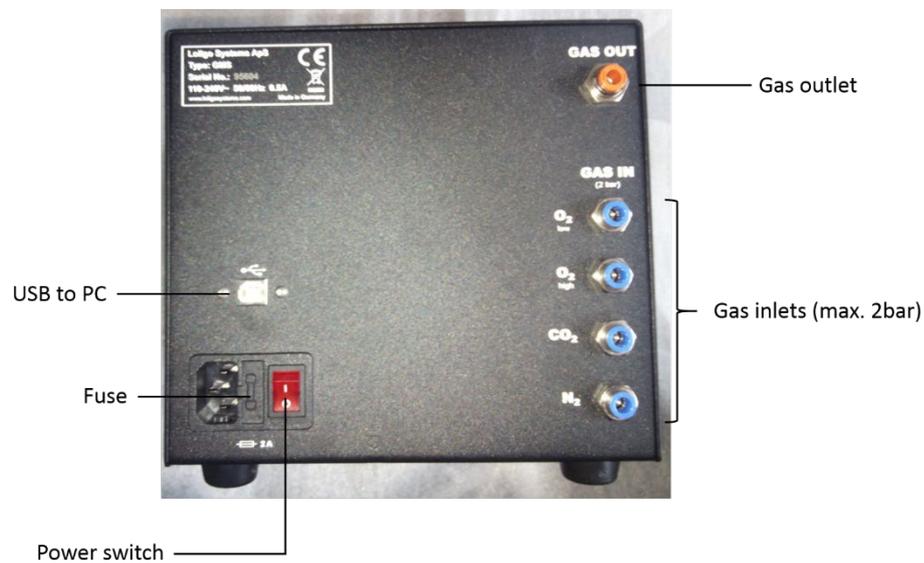


Figure 1: GMS rear view

1.2 Instrument specifications

Type gas flow controller	Brooks Instruments SLA5850 Rev B Mass Flow Controller
Recommended input pressure*	2 bar (± 0.3 bar)
Maximum input pressure	2.5 bar
Permitted gas types**	N ₂ , O ₂ , CO ₂
Gas ranges	O ₂ 0.01 – 100%, CO ₂ 0.03 – 6%
Gas connector type	6 mm push-in
Maximum flow rate***	O ₂ : 500 mL / min N ₂ : 500 mL / min CO ₂ : 15 mL / min
Communication interface	USB 2.0
Flow Accuracy****	$\pm 0.9\%$ of set point (S.P.) (20-100% F.S.), $\pm 0.18\%$ of F.S. (2-20% F.S., 1-20% F.S. from 1-50 lpm)
Repeatability & Reproducibility	0.20% S.P.
Response Time	2 s
Zero stability	$< \pm 0.2\%$ F.S. per year
Power supply	100-240 VAC 50/60Hz
Dimensions	Height 194 mm, Width 199 mm, Depth 227 mm
Weight	11 kg
Operating temperature	0 - +65 °C (32-149 °F)

*Other input pressures may lead to inaccurate gas mixing

**Other gas types on request

***Other flow rates on request

**** Flow accuracy N₂ equivalent typical

1.3 Shipment components

Please check for completeness of the listed components when unpacking.



Figure 2: GMS & accessories.

- Gas mixing system
- Power cable + adapter
- USB cable
- 5 meter 6 mm PU tubing
- T-piece push-in fitting
- 4 x push-in hose adapter 6 mm

2 Installation

This chapter outlines how to perform the initial set-up of the GMS software and hardware.

2.1 System requirements

- One free USB port on your PC
- Windows® 10
- PC with minimum 2.4 GHz processor and 8 GB RAM or better
- Recommended monitor resolution of 1280x1024 pixels

2.2 Software

2.2.1 Overview

The GMS can be operated as standalone device using the GMS software or as part of the Loligo® System's Blood Oxygen Binding Systems (BOBS™) using the BOBS software (for details see BOBS™ manual). Both software enable automated and customizable gas mixing experiments.

The software setup installs all drivers and the user interface required to operate the GMS.

2.2.2 Installation



To install the GMS software you need to be logged in as administrator or start the installation as administrator.

1. Turn on the PC.
2. Verify that the monitor display is set to a minimum of 1280x1024.
3. Visit www.loligosystems.com/downloads and download the latest version of the **Gas Mixing System software**. If not logged in as administrator, right-click on 'GMS.exe' and select '**Run as administrator**' from the pop-up menu.
4. Setup now guides you through the installation procedure. Follow the on-screen instructions as they appear.
5. After installation is complete, **restart your PC**.

2.2.3 Settings

1. Double-click on the GMS icon on your desktop.
2. Go to Settings (Figure 3)
3. Adjust the user interface to your preferred graph background or language.

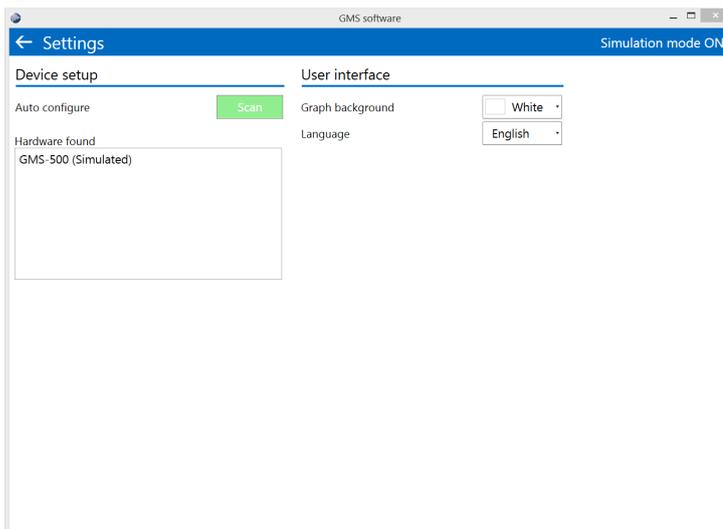


Figure 3: Software settings.



The GMS software identifies the COM ports allocated to the in-built mass flow controllers automatically. However, communication may fail if two digit COM ports were allocated by Windows®. In this case, change the GMS COM ports to one digit numbers in the Windows® device manager.

2.3 Hardware

2.3.1 Overview

Please follow these instructions to connect the GMS to your PC.

2.3.2 GMS installation



You must install the GMS software prior to connecting the GMS to the PC.



The GMS weighs 11kg. Please consult help from another person if you are unable to safely lift the device alone.



Only install and operate the GMS in well aerated spaces to avoid depletion of O₂ or harmful levels of CO₂.

1. Unpack the GMS and place the device **safely** on an **even and stable surface**. Leave approximately **20 cm space** at each site to allow for **sufficient air circulation** at the ventilation slots. Keep the packaging for future transport.
2. Connecting the GMS with gas supplies
 - a. Cut the 6 mm tubing to the required length.
 - b. Push the 6 mm tubing into one of the blue fittings at the rear of the GMS (Figure 4).
 - c. Connect the other end of the tubing to the corresponding gas supply as indicated by the gas type label (Figure 4).
 - d. To connect O₂ gas you may branch the O₂ gas supply into two tubes using the supplied T-piece. The two ends are then connected to the two O₂ gas fittings at the rear of the GMS (Figure 4).

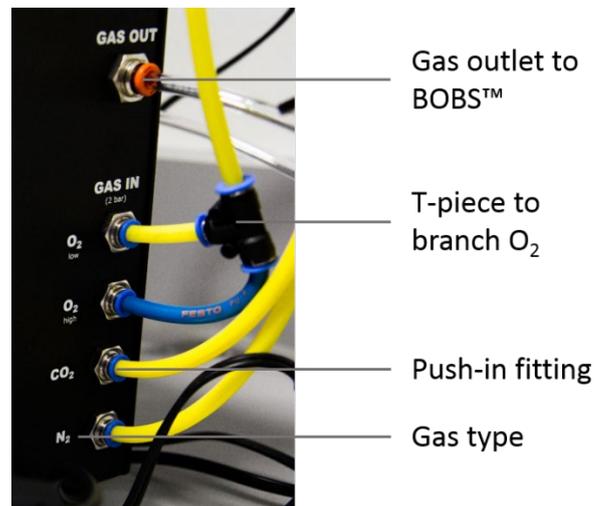


Figure 4. Rear of the GMS.



Only connect O₂, N₂ and CO₂ gas supplies to the GMS.

3. Connect one end of the provided 6 mm tubing with the **orange** push-in fitting located at the top-rear of the GMS labelled as 'GAS OUT' (Figure 4) and the other end with the gas input port of your experimental device.
4. Connect the provided power cable **first** to the rear of the device and then to a **100-240 VAC 50/60 Hz** power supply.



To avoid electrical shock, use a grounded receptacle. Do not connect the GMS to AC power mains without an earthed ground connection. Always connect the AC power cable to the device first and then to the power source.



Operation at AC input levels outside of the specified operating voltage range may damage the GMS.

5. Connect the supplied USB cable between the USB port at the rear of the GMS with the USB port of your PC.
6. **Check if all tubing is connected tightly and safely.**



Do not turn on the gas supply until you are certain that all tubing and gas connections are fitted tightly. Failure to heed this warning can result in serious personal injury.

7. Turn the pressure regulator of all gas sources to the lowest level. Then, open the gas supply and **slowly increase the pressure** till you reach **2 bar** for all three gas types. Carefully evaluate tubing and connections for any gas leaks.



The GMS will only operate accurately if the input pressure matches the specified calibration pressure of 2 bar.



Do not exceed the specified maximum input pressure of 2.5 bar as this may result in serious personal injury and damage to the device.

8. Switch on the red power button at the rear of the GMS.
9. Start the GMS software.
10. The GMS is now ready to use.

3 Experiment

3.1 Overview

Title bar

The title bar displays the experimental time and an arrow to return to the main menu.

Tool bar

The tool bar contains a gas unit selector and a STOP EXPERIMENT button to terminate the experiment.

Graph

The graph window displays the setpoints and actual percentage/flow readings of all three gas types.

Graph legend

The graph legend explains the symbols and lines of the current graph display. It further displays data values that are currently selected by the vertical selection bar, which appears when you move over the graph.

The display of data can be activated/deactivated by clicking on the check mark adjacent to the corresponding data type.

Gas settings

In the gas settings, concentration/flow of O₂ and CO₂ can be changed.

Data

Under data, concentration and flow of gases are displayed.

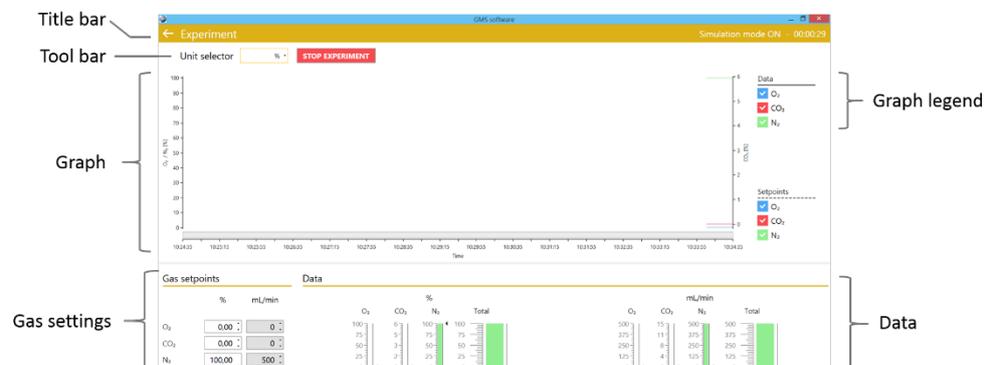


Figure 5: Experiment overview.

3.2 Running an experiment

3.2.1 Choose experiment mode

1. Start the GMS software
2. Click on 'Experiment'
3. In the Experiment checklist choose 'Manual' or 'Automated' experiment type from the drop down field (1, Figure 6).
4. Choose a location for the log file to be saved (2, Figure 6).
5. START the experiment (3, Figure 6)

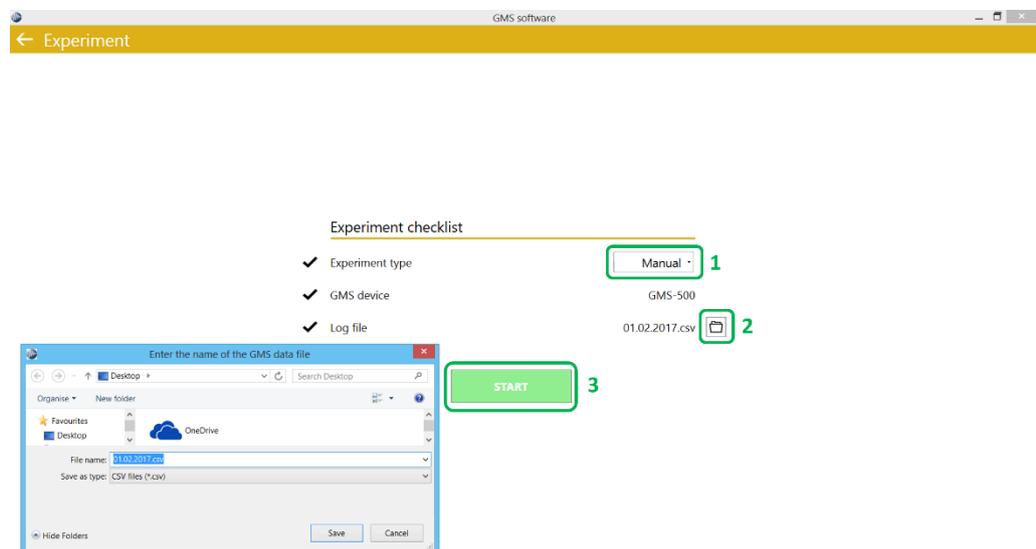


Figure 6: Experiment checklist

Manual

Choose this option if you want flexibility and be able to change gas concentrations manually during the experiment. This mode is most appropriate for establishing new protocols. Afterwards, the settings may then be transferred to the automated protocol.

1. Select a gas unit (1, Figure 7).
2. Set the O₂ concentration/flow in the gas setpoints field (2, Figure 7).
3. Set the carbon dioxide concentration/flow in the gas setpoints field (3, Figure 7).
4. Stop the experiment upon completion (4, Figure 7).



The nitrogen gas concentration is set automatically to obtain a cumulative gas concentration of 100%.

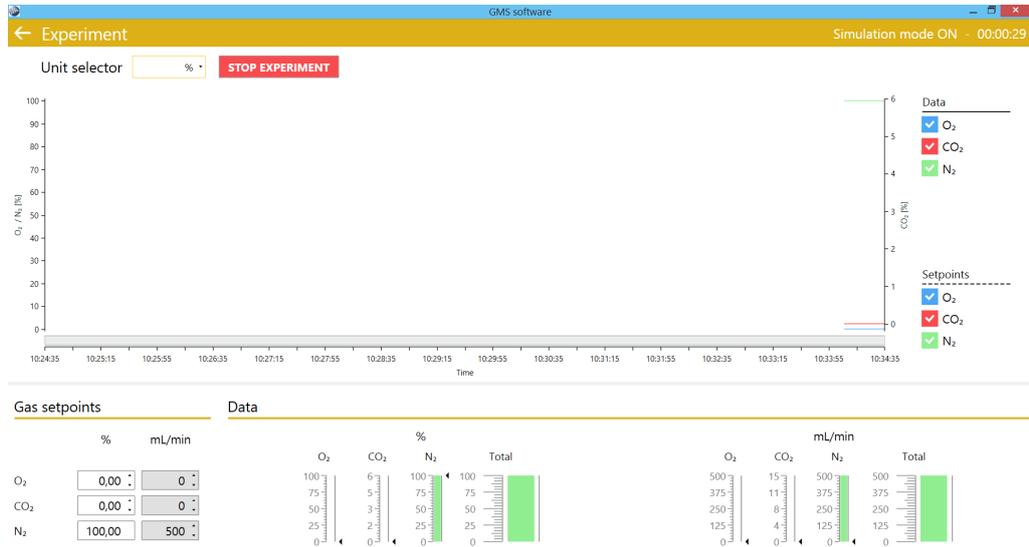


Figure 7: Manual mode.

5. Choose to open or save the log file (1, Figure 8) and return to the main menu by clicking on the arrow (2).

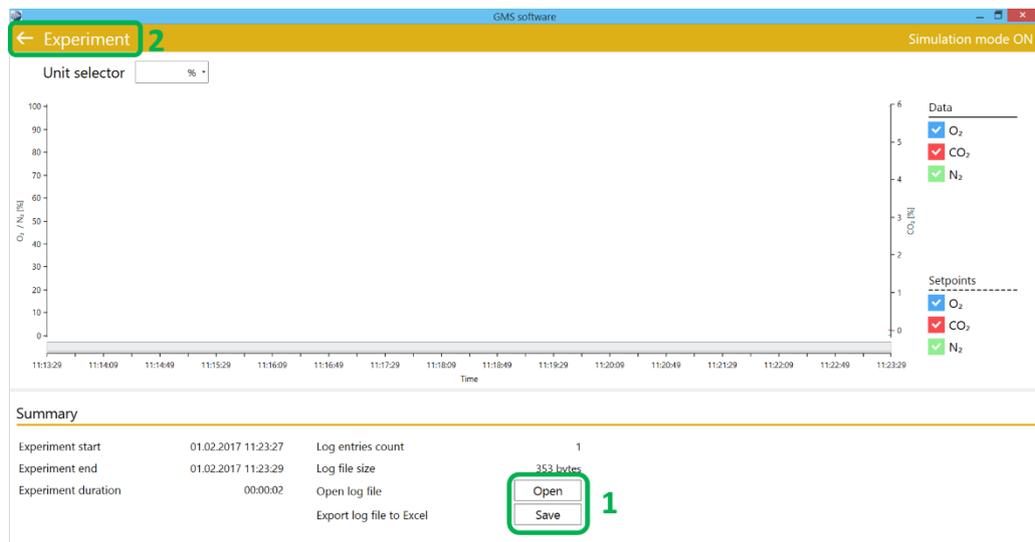


Figure 8: Experiment summary.

Automated

This mode combines flexibility with automation. You can upload your own customized protocol, which the GMS software will run automatically. This mode is most appropriate for established experiments that do not fit the standard protocol.

1. In the Experiment checklist choose 'Automated' experiment type from the drop down field (1, Figure 9).

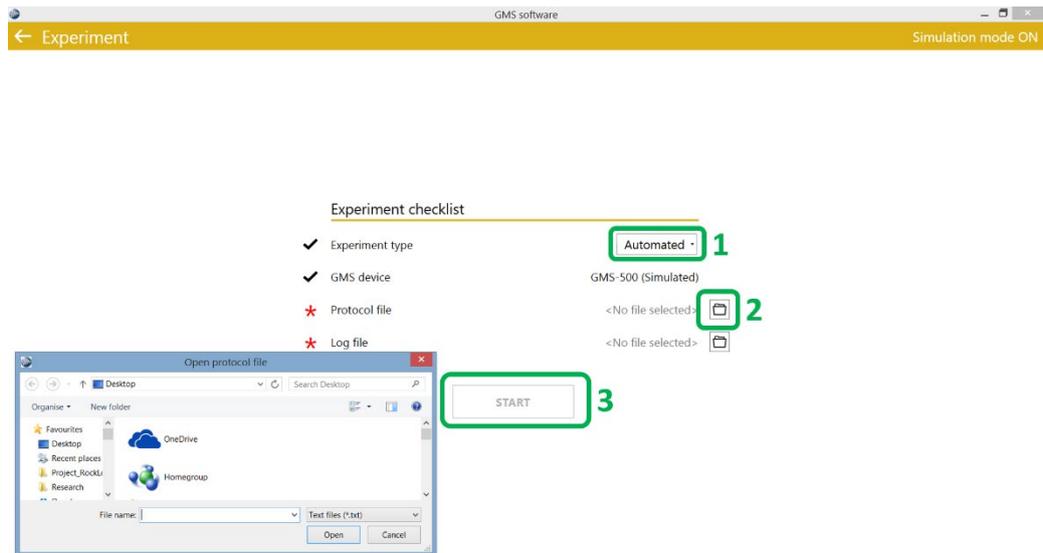


Figure 9: Automated experiment

2. Select an automated protocol (2).

- You can create an automated protocol in a standard spreadsheet software according to the format in Figure 10, saved as tab delimited txt file.

	A	B	C	D	E
1	Time	O2	CO2	Temp	
2	0	100	0	20	
3	10	0	0	20	
4	20	0	0	20	
5	25	1	0	20	
6	30	2	0	20	
7	35	3	0	20	
8	40	4	0	20	
9	45	5	0	20	
10	50	6	0	20	
11	55	100	0	20	
12	65	0	0	20	
13	75	0	0	20	
14					

Figure 10: Automated protocol.

3. Choose a location for the log file to be saved (2, Figure 9).

4. START the experiment (3, Figure 9).
5. The experiment will now run and terminate automatically according to the automated protocol. The timer (1, Figure 11) displays the remaining time for each step and the whole experiment. You may also abort the experiment before automatic completion (2).

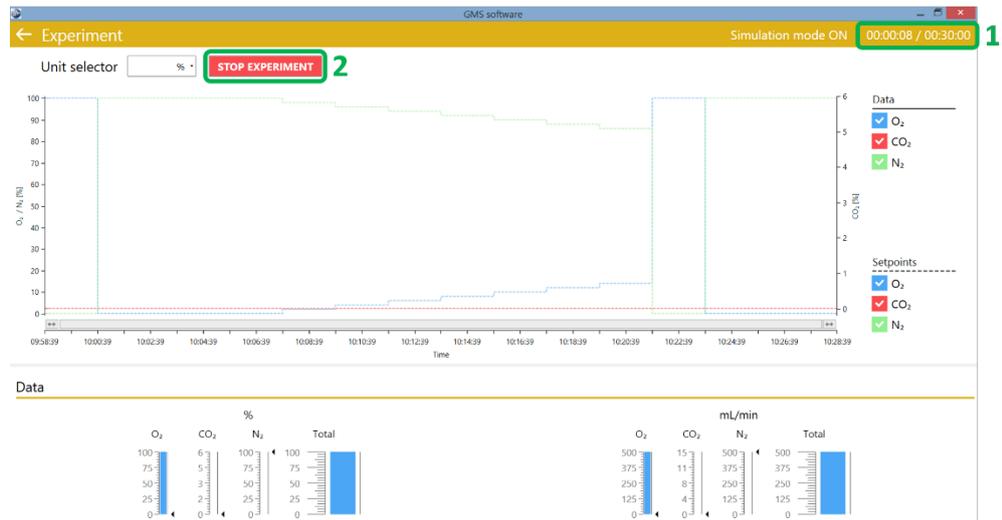


Figure 11: Automated experiment



Once the experiment completes, all gas flows are set to zero to preserve gas supplies.

3.2.2 End of experiment

1. Once experiments are completed close the GMS software.
2. Turn off all gas supplies.
3. Switch off the GMS using the power button at the rear.

4 Troubleshooting

This chapter gives advice and tips to solve problems that may occur while operating the BOBS™.

Symptom	Cause	Remedy
No gas flow	GMS not switched on	Switch on GMS
No gas flow	Gas supply turned off	Turn on gas supply
No gas flow	Gas tubing blocked	Assure all tubing is connected tightly to all push-in fittings and connectors
No gas flow	Leaky gas connection	Check for any gas leaks in tubing or connections
Low gas flow	Insufficient input pressure	Assure input pressure of all supply gases is 2 bar
GMS software runs slow or stops unexpectedly	Insufficient RAM	Use a PC with minimum 4 GB RAM

* Always contact Loligo® Systems ApS **prior to** shipping the instrument for service.

5 Appendix

5.1 Maintenance

5.1.1 Cleaning

- Use a moist cloth to clean the surfaces of the GMS device.
- Only use water, ethanol, non-aggressive, non-corrosive and non-abrasive cleaning agents for cleaning. Do not use solvents.



Disconnect the GMS from the AC power source before cleaning. Do not wet electrical contacts. Failure to heed this warning may lead to death or serious injury.

5.1.2 Change of fuse

The GMS is secured with a fuse to protect the device from high currents. Follow these steps to replace the fuse if blown.

1. Disconnect the power cord at the rear of the GMS.



Always disconnect the GMS from the AC power source during any maintenance work. Failure to heed this warning may lead to death or serious injury.

2. Carefully lift up the fuse holder using a slotted electrical screw driver (Figure 12A).

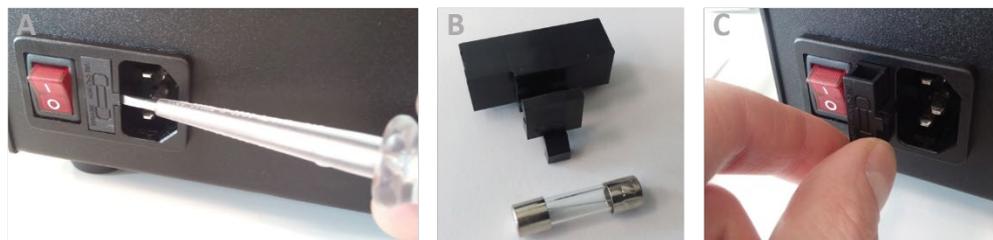


Figure 12: Change of fuse.

3. Replace the blown fuse with a new one with the exact power rating as specified on the fuse label below (Figure 12B).
4. Replug the fuse holder into the power socket with the plastic clip facing right (Figure 12C).



The use of fuses with power ratings other than specified may damage the device and will void the warranty.

5.1.3 Calibration service GMS

To assure continued accuracy of the GMS we recommend to re-calibrate the GMS every 1-3 years (depending on the frequency of use) using Loligo® Systems' gas flow meters or by returning the instrument to Loligo® Systems.

5.2 Warranty

5.2.1 Warranty policy

We offer a 2 year warranty against defects in material or workmanship from date of purchase. If a problem develops during that period, please contact Loligo® Systems with a detailed description. If the problem cannot be solved at a distance, we will issue you with a Return of Materials Authorization number (RMA). Loligo® Systems cannot accept responsibility for goods returned without an RMA number. Contact Loligo® Systems **prior to shipping** the product to arrange shipping, payment and documentation. Loligo® Systems will at its discretion repair or replace the instrument. The warranty specifically excludes damages caused by misuse, abuse or unauthorized modifications or repairs.

5.2.2 Limitation of Warranty

In no event shall Loligo® Systems be responsible for any damages suffered by buyer arising out of buyer's own negligence or willful acts or failure to act in connection with the storage, handling or use of Loligo® Systems Instruments by buyer or its transferee of risk of loss or damage thereto.

After the warranty period has expired Loligo® Systems offers a repair, update, and retro-fit service at a fee.

5.2.3 Limitation of Remedies:

Loligo® Systems shall not be liable under any circumstances for any special, consequential, incidental, punitive or exemplary damages arising out of or in any way connected with this agreement to sell goods to buyer of the goods, including, but not limited to, damages for lost profits, loss of use, lost data, or for any damages or sums paid by buyer to third parties, even if Loligo® Systems has been advised of the possibility of such damages. The foregoing limitation of liability shall apply whether the claim is based upon principles of contract, warranty, negligence, or other tort, breach of any statutory duty, principles of indemnity or contribution, the failure of any limited or exclusive remedy to achieve its essential purpose, or otherwise.

5.3 Disposal

Before disposal, the device must be decontaminated and cleaned to protect people, the environment and property.

Always observe the statutory requirements when disposing the product.

According to the directive 2002/96/EG (WEEE), any devices supplied after August 13, 2005, to the business-to-business area this product is assigned to, must not be disposed of with the domestic waste.

Because disposal regulations may differ from one country to another, please contact your supplier if necessary.



This symbol of the crossed out garbage bin points out that the unit must not be disposed of with the domestic waste.

5.4 Declaration of Conformity



Declaration of conformity

Konformitätserklärung
Déclaration de conformité
Declaración de homologación

The undersigned, representing the following manufacturer:

Loligo® Systems ApS
Toldboden 3, 2nd floor
8800 Viborg
Denmark

herewith declares that the product:

#BG11000 - Gas Mixing System (GMS)

is in conformity with the provisions of the following EU directives, including the latest amendments:

2014/30/EU EMC Directive

and that the following standards have been applied:

EN 16010-1: 2011	Safety requirements for electrical equipment for measurement control and laboratory use. Part 1: General requirements.
EN ISO 12100:2011-03	Specifications for basic terminology, principles and a methodology for achieving safety in the design of machinery.
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements.
EN 61000-3-2:2006+A1:2009+A2:2009	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions.
EN 61000-3-3:2013	Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.

Standards for Canada and USA

FCC Part 15 Subclause B, UL 61010-1:2012 (3rd Edition), CAN/CSA-C22.2 No. 61010-1:2012 (3rd Edition)



Jannik Herskin, CEO

January, 5, 2017, DK-8800 Viborg

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