Technical Manual

iAN-MULTI-P

Environmental Analyser

INDEX

1 INTRODUCTION

The purpose of this document is to provide operation and maintenance instructions for the environmental analyzer iAN-MULTI-P delivered by Drass. The present manual does not replace the requirements and the guidelines of the applicable and present laws and rules, which have to be considered mandatory and additional to the manual.

2 WARRANTY

Each analyzer iAN-MULTI-P is calibrated and tested before delivery.

The user shall avoid opening items during warranty period, except for sensor replacement (see paragraph 11.3) if necessary.

Each part of the iAN-MULTI has 12 months of warranty. Warranty covers defects in workmanship and materials and does not extend to defects caused by the effects of normal wear and tear, erosion, corrosion, fire, explosion, misuse, use in any context or application for which the equipment is not designed or recommended, or unauthorized modification.

Following a valid warranty claim in accordance with the above rules, the equipment, upon return to Drass, will be repaired or replaced without cost or charge. Following Drass discretion, we may elect to instead provide to you whichever is the lesser, the cost of replacement or a refund of net purchase price paid as per invoice on initial purchase. Drass shall have no liability for losses, damages, costs or delays whatsoever or for any incidental or consequential losses or damages. All express or implied warranties as to satisfactory or merchantable quality, fitness for a particular or general purpose or otherwise are excluded and no such warranties are made or provided, save as set out in this clause.

In order to effectively notify a warranty claim, the claim with all relevant information and documentation (refer to chapter 15) should be sent in writing using one of the following modes of communication:

Postal service:	Drass Group U.T. Via Teresa Mattei 4 57121 Livorno ITALY
E-mail:	drass.info@drass.tech
Telephone:	+39 - 0586421221

Drass reserve the right to request from the customer the proof of dispatch of the notification of warranty claim by any of the above alternative means. The equipment should not be sent to Drass without prior written authority. All shipping and insurance costs of returned equipment are to be borne by customer and at customer's risk. All returned items must be properly and sufficiently packed.

3 SAFETY WARNINGS

3.1 General

- All operations on the iAN-MULTI must be performed by specialized personnel only.
- This equipment works under voltage: connect the electrical connections appropriately and always check that voltage of components is suitable. Never dismount parts or open the equipment under voltage; switch off power supply prior to all maintenance checks.
- Replace items only with Manufacturer original spare parts as per chapter 13 *Part List*.
- Drass cannot be held responsible for potential problems arising from improper use or unauthorized modification made by the user or maintainer.
- Each component of this equipment is designed to work at atmospheric environmental pressure.
- To prevent damage to the iAN-MULTI-P and its electronic components and to prevent accidental electric shock, the iAN-MULTI-P MUST NOT be operated with any casing removed.
- Never remove safely sealing installed on the items.
- Measuring ports and pressure compensating devices must be left unobstructed and clean.

3.2 Oxygen sensor – caustic electrolyte

- The oxygen sensor is an electrochemical device containing caustic electrolyte. When handling it (e.g. for replacement activities) ensure that it is not damaged or leaking and take care to avoid any contact with your body or clothing. If there is liquid around the cell while in the instrument, wear eye and hand protection. Before installing the replacement sensor cell, check the sensor cell for leakage. If the sensor cell leaks, do not use it.
- When replacing the oxygen sensor, dispose it according to local regulations, see chapter 14 *Disposal*.
- This new technology sensor does not contain lead as commonly found in similar products. The sensor main component is tin, which is not hazardous.
- In the event of an accidental contact with the internal electrolyte, use the following first aid procedures.
    - In case of contact with the skin or eyes, immediately flush with plenty of water for at least 15 minutes and remove all contaminated clothing. Get medical attention immediately.
    - If ingested, give large amounts of water and DO NOT INDUCE VOMITING. Obtain medical attention immediately.
    - If inhaled, remove to fresh air and obtain medical attention immediately.

3.3 Batteries

- The device must be used only with supplied four off D size alkaline batteries, which were subject to hyperbaric type test by Drass. Other battery types can be damaged during the hyperbaric exposure, resulting in loss of functionality of the device, damage to the batteries and to the device.
- It is suggested to maintain a set of batteries available onsite: they have to be replaced as needed and according to the indication of Battery Status on the iAN-MULTI-P display.
- Always take care to insert batteries correctly according to the designation of polarity (⊕ and ⊖) on the batteries and the equipment.
- When replacing batteries, replace all of them at the same time with new batteries supplied by Drass.
- Remove batteries from the device when they do not work, or when a long period of disuse is anticipated. A battery partially or completely exhausted may be more at risk of leakage than an unused battery.
- In case batteries are leaking, take care not to touch the chemicals and electrolyte from inside the batteries directly. Since alkaline solution is used in these batteries, there are risks of not only damage to cloth and skin resulting from adhesion of the solution, but also loss of eyesight if the solution gets into the eyes. In case of such an emergency where the solution gets into the eye, wash immediately with plenty of water and receive medical treatment from a doctor. If the solution adheres to the skin and/or clothes, wash with water and consult a doctor.
- Note: The device also contains a button cell battery CR2032, used for RTC (Real Time Clock): such battery is not intended to be replaced by end user, since the duration exceeds the time period for Drass periodical reconditioning of the device.

3.4 Pressurized gas

- Do not exceed the specified maximum pressures. Failure to do so may result in damage to the equipment and to personnel.
- Users of this equipment MUST be familiar with the handling of pressurized gas.
- Take particular care when handling toxic or flammable gases. In such cases ensure to operate in a well-ventilated area and manage to properly vent the exhaust gas.

3.5 Oxygen Systems

- Present document is not aimed to define a safe working method for oxygen systems. It is developed assuming that all personnel working with oxygen are skilled and competent to do so.

4 CONTENT CHECKLIST

a. Drass iAN-MULTI-P unit, complete with batteries and housed within the carrying case.

b. Cable with magnetic connector for external power (5Vdc - USB A connector).

c. Gas sensor calibration adaptor and tubing.

d. User Manual (on USB memory stick).

e. Test and Calibration Report.

5 ACRONYMS AND ABBREVIATIONS

CO_2	Carbon Dioxide
O_2	Oxygen
CO	Carbon Monoxide
T	Temperature
RH	Relative Humidity
D	Depth
EC	European Community
IACS	International Association of Classification Societies
PC	Personal Computer
PLC	Programmable Logic Controller
RAM	Random Access Memory
CSV	Comma Separated Values
PPM	Parts Per Million
PPB	Parts Per Billion
PP	Partial Pressure
MSW	Meters of Sea Water (based on a conversion factor of 1 bar = 9.94 MSW)
FW	FirmWare

Table 1 : List of Acronymns

6 QUICK START

This chapter is intended as a first approach with the iAN-MULTI-P analyser, and to find the appropriate part of the manual as required. Check below in the table through the typical queries and see if you can find appropriate guidance. If this is not possible, please contact Drass for further assistance.

No	Query	Guidance
1	Can I have some brief introduction to the device?	Chapter 7
2	How can I store the device?	Chapter 8
3	What should I check before powering on the system for the first time?	Paragraph 9.1
4	How can I calibrate the system?	Chapter 10
5	How can I log and export measured data?	Paragraph 9.4.5
6	How can I replace the spare parts?	Paragraph 11.3
7	How is it possible to upgrade firmware?	Paragraph 11.2
8	The device shows an error or it is working unexpectedly: what can I do?	Chapter 12
9	How can I dispose the old / expired / failed parts?	Chapter 14

Table 3 : Quick Start Checklist

7 GENERAL DESCRIPTION

7.1 System overview

iAN-MULTI-P is a portable device intended to monitor continuously main environmental parameters of a hyperbaric confined space. It is battery powered and intended to represent the ideal solution in case of a DISSUB scenario, because it is the only available solution capable of meeting the requirements of NATO STANAG 1476:2014 (ANEP/MNEP-86) including the carbon monoxide concentration analysis. Additionally, thanks to the high-resolution graphical display of the device, the user can monitor the trends of the measured parameters, in the aim to properly estimate the most suitable actions to increase survivability is such a difficult event.

Other than DISSUB scenario, the device is intended for any confined space activity, both at atmospheric and hyperbaric conditions, where a portable and compact unit is required to assure the safety of the occupants.

When battery powered and in normal use, the device can work for 2-3 months of continuous usage, 24 hours a day. In case it is required, external 5 Vdc supply can power the device for continuous usage via the supplied magnetic connector.

All measured data is continuously stored within the internal microSD memory, and it can be easily exported to a common USB memory stick connected to the USB port, located inside the device. In the unlikely event the device will be heavily damaged, logged data could be retrieved from the microSD memory card, thus representing a black-box recorder.

7.2 Data representation

Measured values related to gas (O_2, CO_2 and CO) are all represented with partial pressure (in mbar for O_2 andCO_2 and µbar for CO), so to be suitable for hyperbaric use. Temperature is represented in °C, relative humidity in %. Absolute pressure is represented in bar (so atmospheric pressure is 1.0 bar).

Battery status represents the residual capacity of the batteries: new batteries will always show 100% or a value close to that. Note that the battery status is estimated according to the actual voltage measured on the batteries; due to this, such value can change according to environment temperature and the actual usage of the device (e.g. battery status will drop of few % when activating the illumination and touch interface, returning to previous value after few minutes).

Elapsed time is represented in days (d) and hours (h), and it is intended as the elapsed time since the first power on or after the last device reset; when the device is powered OFF, elapsed time is paused, and continues at next device power ON. This value is intended to help to evaluate the elapsed period in a DISSUB or similar emergency scenario.

The following table shows the values with relevant ranges:

Measured value	Representation (unit of measurement)	Range
Oxygen (O_2)	Partial pressure (pp mbar)	0 to 2000 mbar
Carbon Dioxide (CO_2)	Partial pressure (pp mbar)	0.0 to 100.0 mbar
Carbon Monoxide (CO)	Partial pressure (pp µbar)	0.0 to 500.0 µbar
Temperature	Celsius Degree (°C)	-5.0 to 55.0 °C
Relative Humidity (RH)	Percentage (%)	0 to 100 %
Absolute Pressure	(bar)	0.0 to 10.0 bar
Battery status	(%)	100 to 0 %
Elapsed Time	Days (d) and hours (h)	0_d 0_h to 99_d 23_h

Table 4 : List of Data Shown on Display

7.3 Interface with external systems

Five ports are provided in the back of the CP to connect the iAN-MULTI with external systems. Drass will supply on request connectors for such ports. Pinout for all ports are detailed in paragraph **Error! Reference source not found.**. The functionalities of the ports are the following:

- "External power supply magnetic connector" for a 5Vcd power supply.
- "USB Com" port is intended to connect USB memory stick (FAT32 formatted) for datalogging of data and FW updates.

7.4 Technical data

PHYSICAL DATA		
Height	mm	179
Width	mm	225
Depth	mm	90
Weight	kg	< 1.4
Touch Screen	inch	6
Enclosure material	Plastic	
OPERATIONAL DATA		
Power supply	Four D alkaline batteries or 5 Vdc external source	
Current consumption	A	< 0.1

Recommended operating temperature	°C	-5 ÷ +55
Recommended operating relative humidity	%	Up to 100
Recommended operating pressure	bar	Up to 10
Recommended actual usable life for sensor	years	5
Allowable inlet gas flow for calibration	l/min	0.3 ÷ 1
Grade protection	IP	65
Vibration and EMC	Class A (*)	
Rules compliance	NATO STANAG 1476:2014 ANEP/MNEP-85:2018 ANEP/MNEP-86:2014 IACS UR E10:2022 CE marking	

Table 5 : Technical Data

(*) Class A is defined from IACS UR E10 (Unified Requirements - Test Specification for Type Approval), DNVGL-CG-0339.

8 STORAGE AND PRESERVATION

When the iAN MULTI-P has been received, it is packaged in a suitable box. Before storage, check the integrity of packaging: ensure that no damage has been caused during transportation. If necessary open the box to check condition of item (see paragraph **Error! Reference source not found.** *Storage in Warehouse*). The customer should officially confirm the acceptance of the goods to the Manufacturer.

Keep each iAN MULTI-P in a dry and clean location, not outdoors, with a maximum temperature of 55 °C, minimum 0 °C and a maximum humidity of 80%.

The item must be placed far from heat sources, organic solvents, flammable liquid stores and working areas; in the event that this is unavoidable, ensure that suitable protection is used.

In case of storage of oxygen sensor as spare parts, it is recommended a maximum storage time of one year, in order to avoid a reduction in the guaranteed life of the O_2 sensor (five years).

9 OPERATION

9.1 Preliminiary operation

Before the first use of the device, few simple operations must be performed, as below described:

a. Remove (if still present), the protective film placed on the display of the iAN-MULTI-P; it is intended only for transport, and it will impair correct operations of the display.

b. Open the two sealed battery containers, rotating 90° counterclockwise the caps. Install Drass supplied batteries (4 x D size alkaline cells) in the two battery containers (two cells for each container), taking care of the polarity: the ⊕ must be placed on top, see below image. Close again the battery containers, placing the caps and rotating them 90° clockwise until they firmly stop.

Figure 1 : Installation of Batteries

c. Check calibration report accompanying the iAN-MULTI-P unit:

   - if the calibration has been done more than three months before, it is highly suggested to perform a calibration check of O_2, CO_2 and CO readings, using suitable calibration gas mixtures;
   - if the calibration has been performed less than three months before, still consider the opportunity to check for calibration, in accordance with the intended use of the device.

   See chapter 10 for calibration procedures;

d. If interested in the timestamp (date and time) of the logged data, check date and time are correct, accessing Advanced Operations page (see paragraph 9.4); date and time are set during factory test and calibration activities, and they are maintained by the RTC (Real Time Clock) module present inside the device.

The device is now ready for the first power ON, see following chapter.

9.2 Power supply

The iAN-MULTI-P is designed to be operated with four supplied “D” size alkaline batteries (hyperbarically tested), which ensure an endurance of minimum 2-3 months considering continuous use (24 hours each day), and a reasonable use of illumination and touch interface.

However, end user can power the unit via the supplied cable, connecting it to the magnetic connector located on the bottom of the case, at the left of the battery containers. Supplied cable is equipped with a magnet on the case side: simply put the cable connector near to the case connector, the two connectors will properly mate; at the other end, the cable is supplied with a standard USB type A connector: any standard mobile phone charger (or power bank, laptop port, etc) can be used to power the unit, since its extremely low power needs (0.01A @ 5Vdc in average conditions). Once the external power supply is applied, internal alkaline batteries will remain unused.

When external power is supplied, an icon “” is shown on the Home Page of the display.

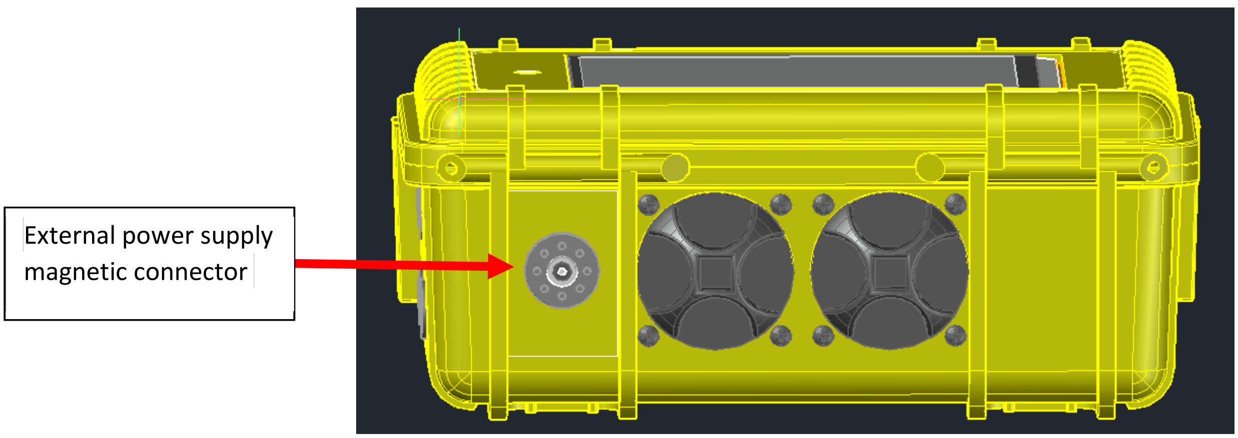

Figure 2 : Bottom view of the iAN-MULTI-P

9.3 Basic operations

To power ON the device, simply press the soft touch pushbutton on the left of the display; the unit will be powered and ready to work in few seconds; data logging will immediately start with a period of 10 seconds.

Home page is shown, and the display is refreshed at a dynamical rate, according to the changes of the measured parameters: every time a value changes significantly, all values are refreshed.

The blinking purple led at the center of the pushbutton visually shows the operativity of the device.

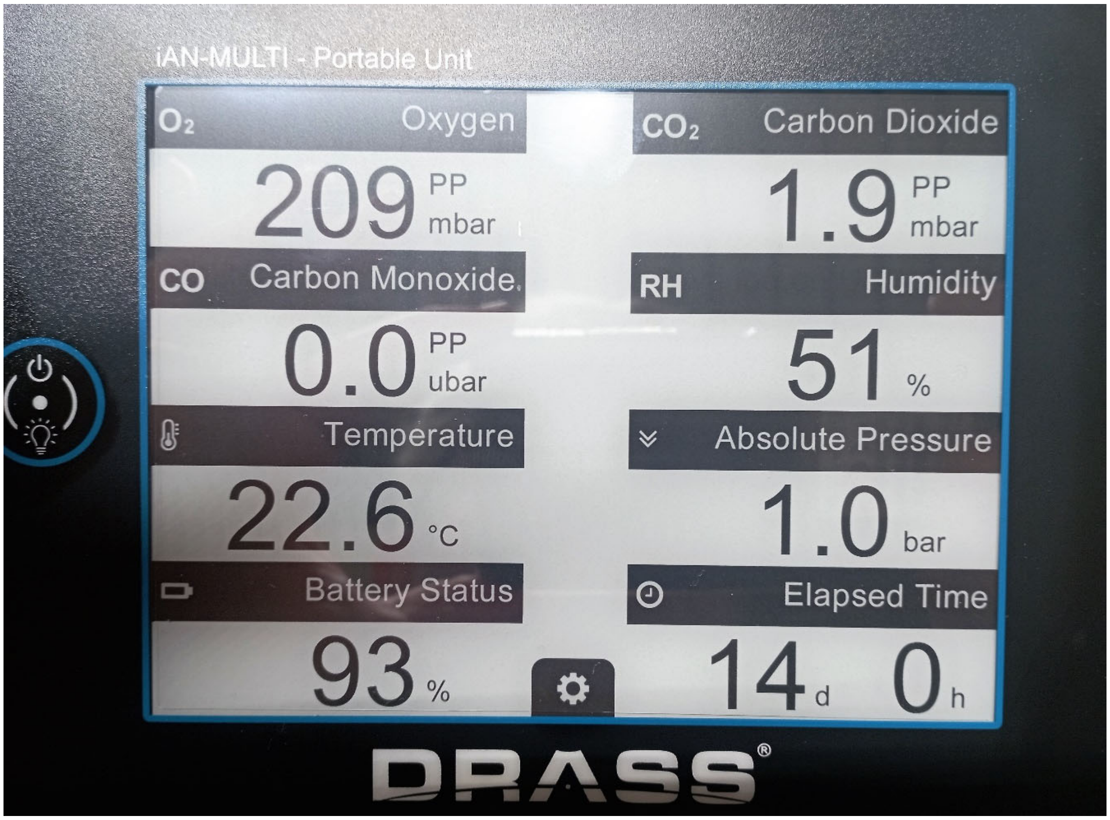

Figure 3 : Home Page

To power OFF the device, keep pressed the soft touch pushbutton on the left of the display for few seconds, until the display shows a confirmation message about powering off the device. Such confirmation message is intended to avoid unintentional powering off the device. After confirming the display goes off. In case the confirmation is denied or not given within few seconds, the display return to the Home Page.

Shortly pressing the pushbutton, the following functions will be activated:

- Illumination of the display for 20 seconds; during this period, measured data is continuously updated;
- Enabling of the touch interface for the whole display; this can be used for advanced functionality explained in paragraph 9.4.

Note: the touch interface of the display and the power button are tuned to be operable in wet environment, as it is common within a submarine environment; even if the iAN-MULTI-P would be not damaged by such, the presence of liquid water on the display and/or the power button could impair their usage; in case water drops are present on the device, simply wipe them off using a clean towel or paper; water will not damage the device.

9.4 Advanced operations

9.4.1 Introduction

This paragraph describes advanced operations which are accessible using the touch interface of the display, which is enabled shortly pressing the power soft pushbutton. The illumination is turned ON to hep to interact with the device in case of dark environment. To save battery, illumination and touch interface are disabled after 20 seconds of inactivity, and they can be enabled again shortly pressing the power pushbutton. Moreover, the device will return to Home Page in case if inactivity.

Once the touch interface (and the illumination) is active, shortly press the gear icon (⚙) located on the bottom of the display, to access the advanced operation page, devoted to the following functions:

a. Set date and clock;
b. Calibration:
c. Reset Device;
d. Save log on USB.

The firmware version is shown on the bottom right of the display.

To return to the Home Page, shortly press the "🏠" icon placed on the upper part of the display.

Figure 4 : Advanced Operations Page

9.4.2 Set date and clock

This page is intended to check and modify the date and clock: to operate, simply press on the field to be modified (year, month, day, minute, hour or minute) and change it as needed.

Once modifications are completed, simply press "OK" to save and return to the previous page; in case no changes are needed, press "Abort" to leave all fields unchanged and return to previous page. Date and clock are used for data logging timestamp.

Date and clock are maintained by internal button cell battery.

9.4.3 Calibration

This page is intended to calibrate O_2, CO and CO readings; see chapter 10 for all details.

9.4.4 Reset device

This page is intended to reset the device, restarting the elapsed time, shown on the Home Page and to delete all logged data; this action is not reversible, so ensure to export data on USB memory stick, if needed, before resetting the device (see next paragraph for data export instructions).

It is expected that the reset is performed at the beginning of a DISSUB scenario.

9.4.5 Save log on USB

The iAN-MULTI-P is configured to continuously log the measured values into an internal micro-SD memory card, located on the internal main board. Such memory is not intended to be accessible to the user, since the data can be easily exported to an external USB memory stick, as described below. However, in case of major fault of the iAN-MULTI-P, resulting in an unusable device, such micro-SD memory card can be retrieved to be read by any standard PC reader. Data is stored in the format described below.

Present function is used to export all logged data to a USB memory stick, which must preliminarily be formatted in FAT32 format.

Data will be saved each day in a file, named with the date in format yymmdd (e.g. L_230222 for logged data relevant to 2023, February 22nd); data is exported in CSV format with following format:

Timestamp	Oxygen (mbar)	Carbon Monoxide (µbar)	Temperature (°C)	Battery Status (%)	Carbon Dioxide (mbar)	Humidity (%)	Absolute Pressure (bar)
00:00:00	205	0.3	23.6	76	0.5	54	0.9
00:00:10	205	0.3	23.6	76	0.5	54	0.9
00:00:20	237	0.3	23.5	76	0.5	54	0.9

Table 6 : Example of Data Export

Data is saved every 10 seconds, clearly during the period when the iAN-MULTI-P is operational. In case the device is switched off, logged data will miss the unpowered period.

Please note that the timestamp of the logged data is taken according to the actual RTC (Real Time Clock): in case that date/time is adjusted, logged data will follow; avoid adjusting date/time during a logging period of interest, to avoid discrepancy in the data.

The USB port is located inside the iAN-MULTI-P case. When opening the case, ensure the activity is performed on a clean and dry environment: damp air entering and remaining within the case may produce condensation/water when the case is brought to cold environment. The case is supplied with a silica gel bag to reduce residual humidity: please ensure such bag is still dry when opening the case.

Before exporting data on USB memory stick, a warning message informs about the fact that files with the same name, eventually present on the memory stick, will be overwritten.

The log exporting is limited to the last 30 days of usage.

9.4.6 Errors

In case errors or anomalies are detected by the device, they will be recorded and shown on the Main Page by a " △" icon at the bottom center, in place of the normal "⚙" icon. Activating the touch interface and shortly pressing the icon, the Advanced Operations Page will show the codes of such alarms. User should take note of such alarms before clearing them, so to be able to inform Drass about such events, which may be caused by a number of issues (e.g. damages on sensors, connections, etc…).

9.4.7 Trend graphs

An additional feature has been introduced in the aim to help the user to be able to evaluate the time trends of measured parameters; this is especially useful in a DISSUB or similar emergency scenario, where it is important to evaluate how fast the environmental parameters are changing, other than observing the actual values.

Activating the touch interface and pressing over the relevant value (O_2, CO_2, CO, T, RH, P), a graph of the logged data, over the last 24 hours period, will be shown. The graph includes the minimum and maximum values, recorded in the 24 hours.

The data shown will not cover the last 24 hours, in case the iAN-MULTI-P has been switched on less than 24 hours before, or when the device has been switched off during last 24 hours.

See below an example of trend graph of temperature.

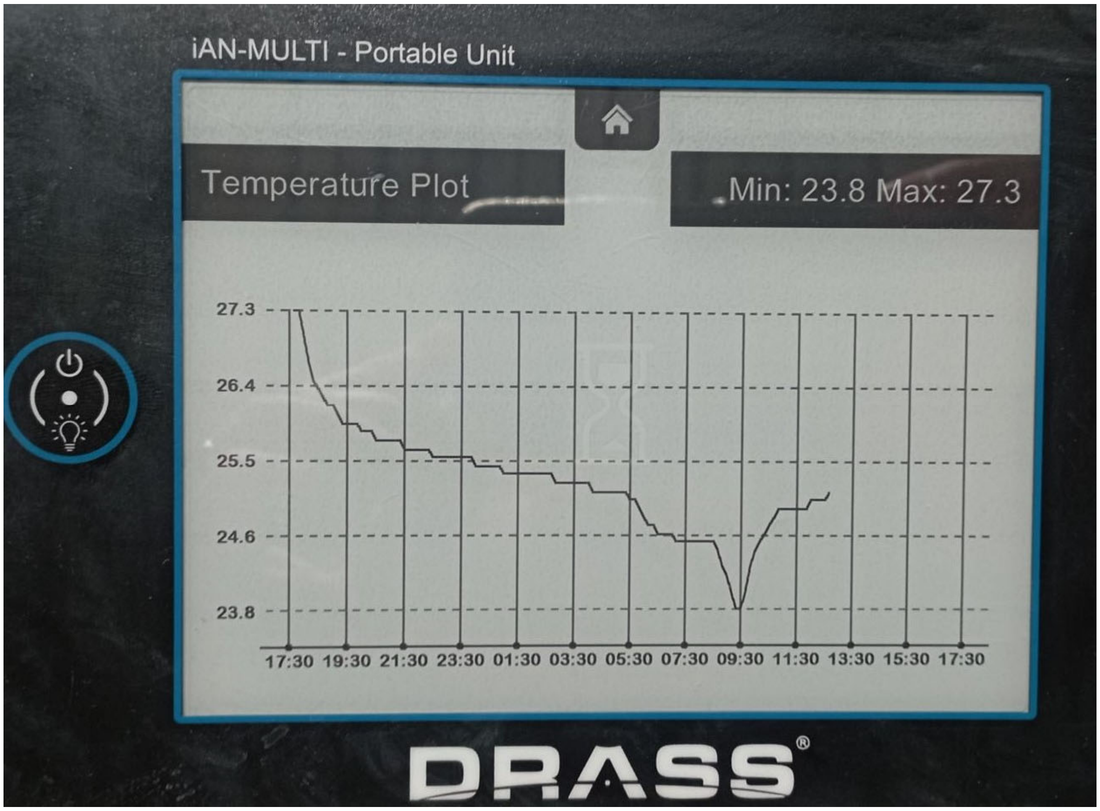

Figure 5 : Trend Graph Page

To return to the Home Page, simply press on the "🏠" icon located on the upper part of the display. Once returned to the Home Page, press over another parameter to observe its graph.

10 CALIBRATION

10.1 Introduction

iAN-MULTI-P units are delivered fully tested and calibrated by Drass.

Calibration is a key periodical activity, which must be performed by skilled technicians, and which requires some special materials. Calibration can only be done on gas sensors (O_2, CO_2 and CO).

WARNING: a calibration performed in the wrong way (error in the calibration gas, in following the procedure, etc…) could impair the operations of the iAN-MULTI-P; proceed only after having read and fully understood following instructions.

End user must plan in advance if he decides to perform periodical calibration, or if he prefers this to be done by Drass (e.g. over a six months period). Additionally, Drass suggests replacing the oxygen sensor every five years of use (see chapter 11). See the paragraph 11.3 for gas sensors replacement.

To calibrate each gas, two calibration gas are required: Zero and Span gas. iAN-MULTI-P can be calibrated using many commercially available calibration gases, since the span gas concentrations are freely adjustable according to the span gas which are sourced locally. Calibration gas can be supplied to the iAN-MULTI-P using the supplied tubing and sensor adaptor (see below for all details).

Please find below a table resuming the recommended gas mixture for iAN-MULTI-P calibration:

Sensor	Zero Gas	Suggested Span Gas	Notes
O_2	100% Nitrogen	20% O_2 in nitrogen	Any known concentration of O_2 between 20% and 100% in nitrogen is usable
CO_2	100% Nitrogen	5% (50000 ppm) CO_2 in nitrogen	Any known concentration of CO_2 between 2% (20000 ppm) and 10% (100000 ppm) in nitrogen is usable
CO	100% Nitrogen	500 ppm CO in nitrogen	Any known concentration of CO between 100 ppm and 500 ppm in nitrogen is usable

Table 7 : Suggested Calibration Gas Details

As shown above, pure nitrogen is used as Zero gas for all activities, while specific Span gas are required for each gas sensor; eventually, a single calibration span gas mixture (containing proper quantities of O_2, CO_2 and CO in nitrogen) can be used as Span gas for all three gas sensors.

Gas must be supplied at atmospheric pressure and with a flow rate of about 0.3-1 l/min.

Suggested solutions are single use portable bottles, which can be supplied complete with flow adapter, so to be directly connected to supplied calibration tubing and adaptor.

Calibration is performed one sensor at a time, always starting from Zero and then completing with

Span.

Note: Zero and Span gas concentrations are to be input in the unit shown by the display (% for O_2 and ppm for CO_2 and CO), even if the Home Page shows values in partial pressure.

To compare these units considers the following equivalencies valid at atmospheric pressure (1 bar abs):

$\%O_2$ = ppO_2 (mbar) x 10 – example 20% O_2 = 200 mbar ppO_2;

Ppm CO_2 = ppCO2 (mbar) / 1000 – example 50000 ppm CO_2 = 50 mbar $ppCO_2$;

Ppm CO = ppCO (µbar) – example 500 ppm CO = 500 µbar ppCO.

To start a calibration routine, access to the Calibration Page as shown in paragraphs 9.3 and 9.4).

In the Calibration Page, the user can choose the gas for which calibration must be performed (O_2, CO_2 or CO) by pressing over it. Please see following paragraphs for details on calibration for oxygen, carbon dioxide and carbon monoxide.

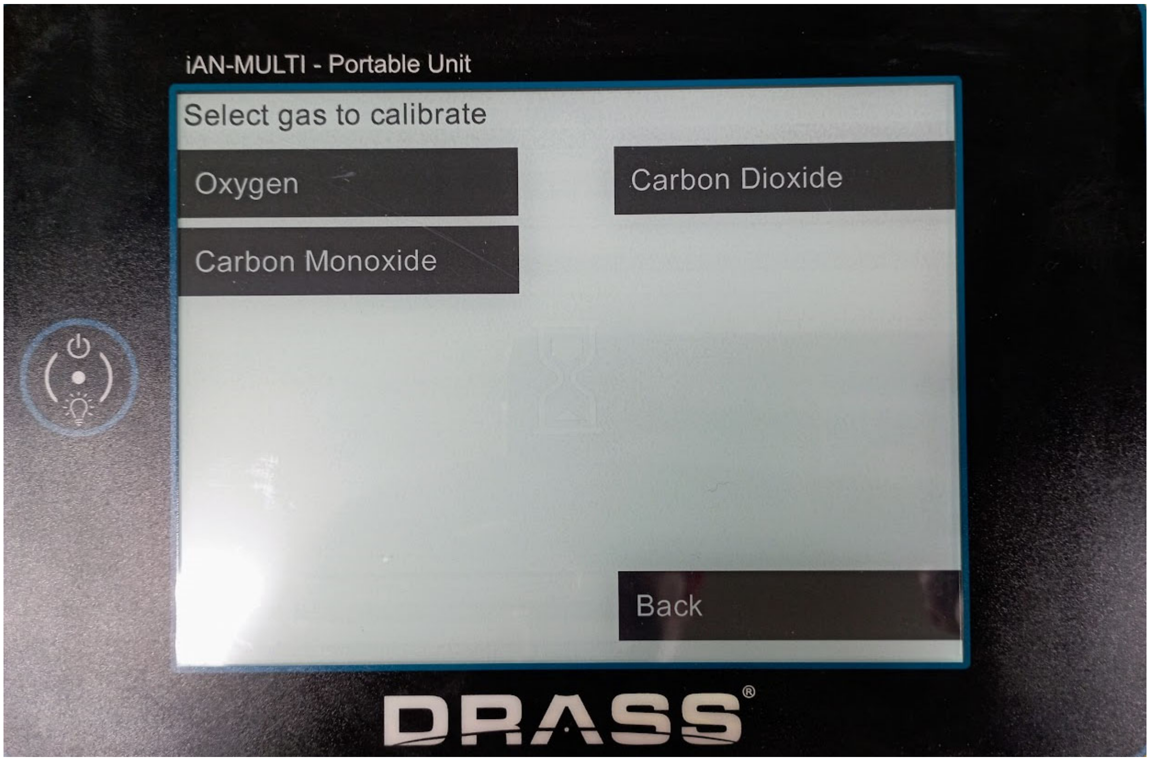

Figure 6 : Calibration Page

10.2 Oxygen calibration

After selecting oxygen calibration on the Calibration Page, the display will show following page with the details of the calibration gas intended for the activity.

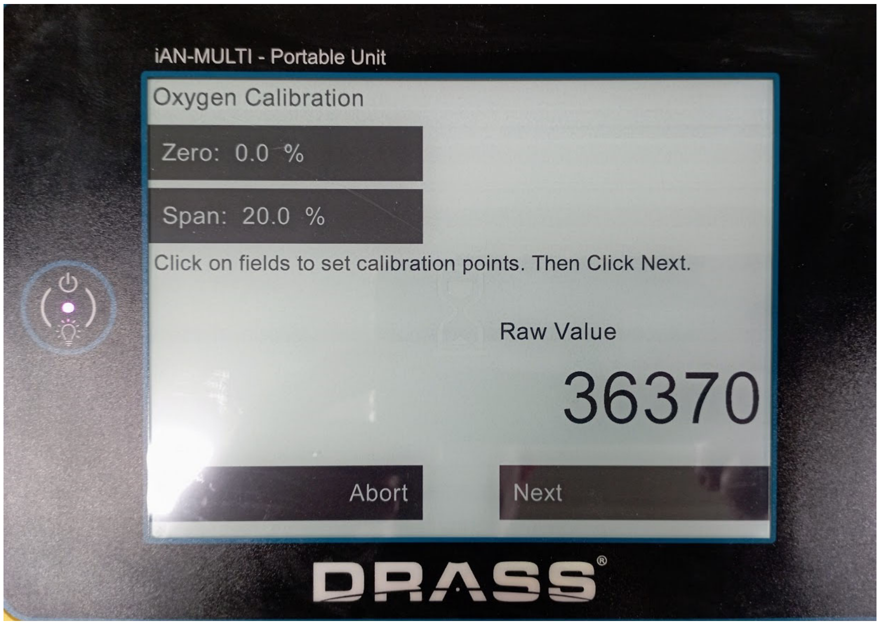

Figure 7 : Oxygen Calibration Page (Zero and Span Gas Values)

User must check the oxygen concentration values for Zero and Span Gas: if they need to be changed according to the available calibration gas, simply press on the value to be amended, and the display will show following page (Span and Zero values are changed in the same way).

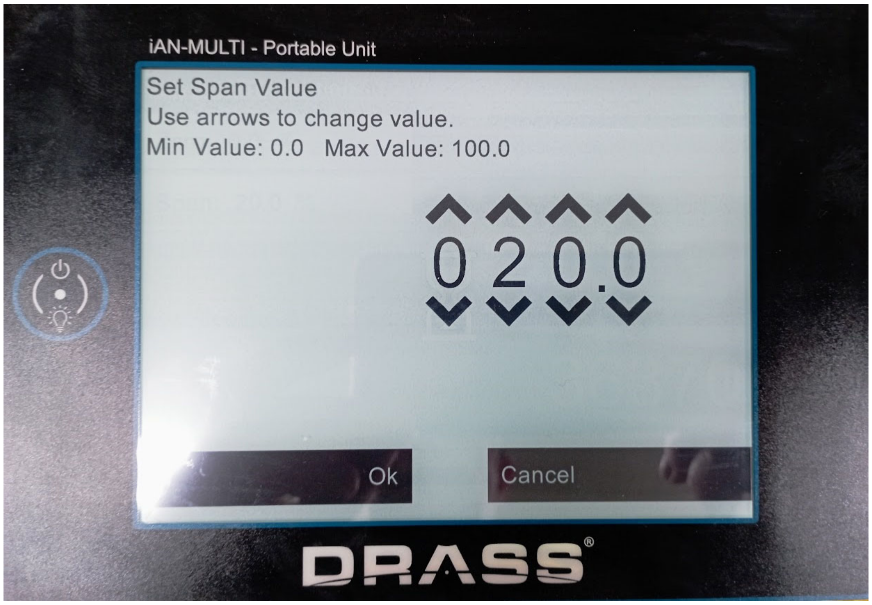

Figure 8 : Oxygen Span Gas value adjustment

Values can be adjusted using the up or down arrows shown above and below the relevant digit.

Once the adjustments are completed, simply press the "OK" button to return to previous page, where adjusted values are shown for an easy check before starting the calibration routine. Also, the display shows the raw value of the signal received from the oxygen sensor: this is useful during next steps to be able to evaluate when a steady state is reached.

After this, install the calibration adaptor over the relevant gas sensor (O_2) gently pushing it over the sensor port, and follow below procedure:

a. Connect the calibration tubing with the Zero gas source, open the gas source with a flow of 0.3 to 1.0 l/min and start the procedure pressing the NEXT button;

b. The display shows the raw data received from the sensor; wait for the reading to become stable: this will take 1 to 3 minutes. Then press NEXT so the device will store the Zero gas value; take note of the raw value shown with Zero gas: it may be useful for future checks, or in case anomalies are to be communicated to Drass.

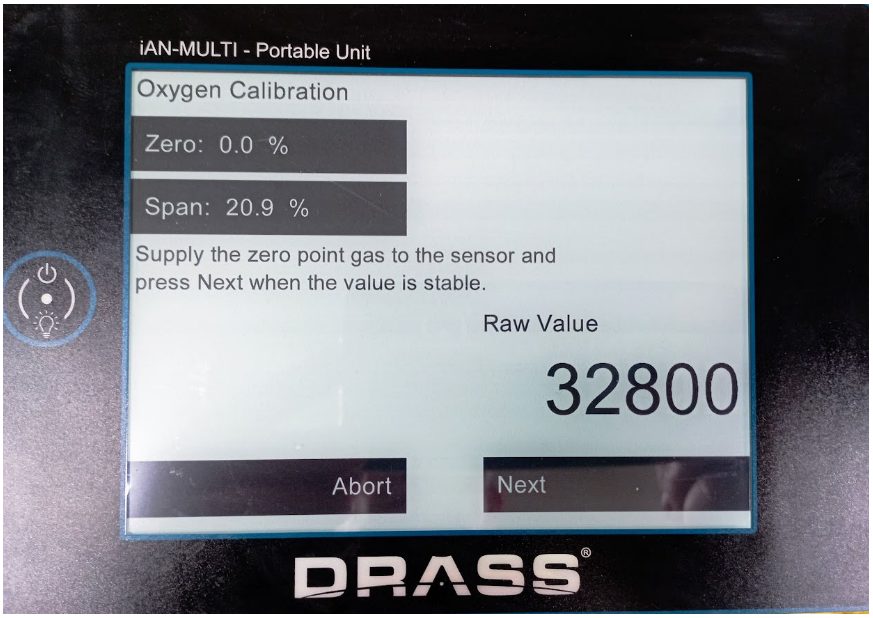

Figure 9 : Oxygen Calibration Page (Zero Gas)

c. Change the calibration gas source with the Span gas, wait again for the reading to become stable, and then press NEXT to store the Span gas value; again, take note of the raw value shown with Span gas; observe that the raw value related to the Span gas must be bigger than the ones of the Zero Gas. In case the raw value is not changing as described, double check the calibration gas bottles and the procedure: if everything is correct, the oxygen sensor may require replacement.

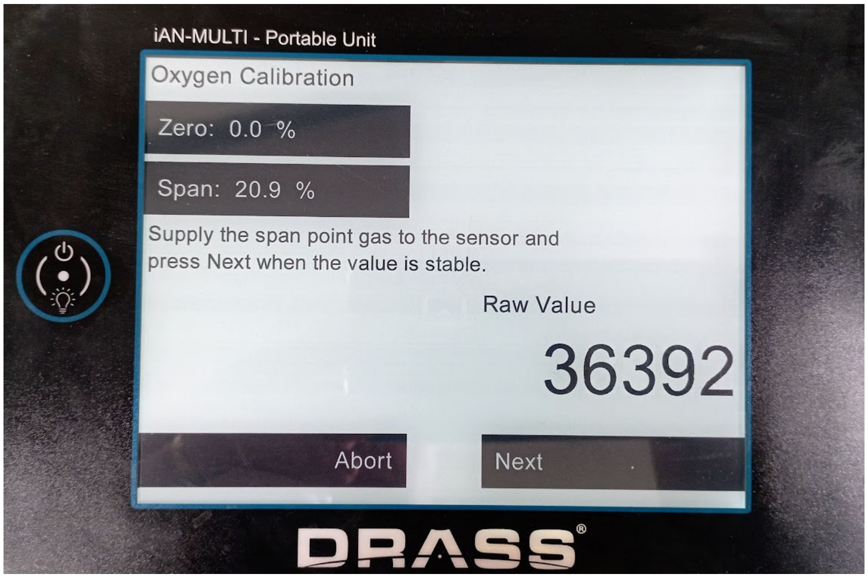

Figure 10 : Oxygen Calibration Page (Span Gas)

d. To complete the procedure, press NEXT, so the stored calibration data is applied to the device and the procedure is completed.
e. Gently remove the calibration adaptor and tubing, storing it in the iAN-MULTI-P case.

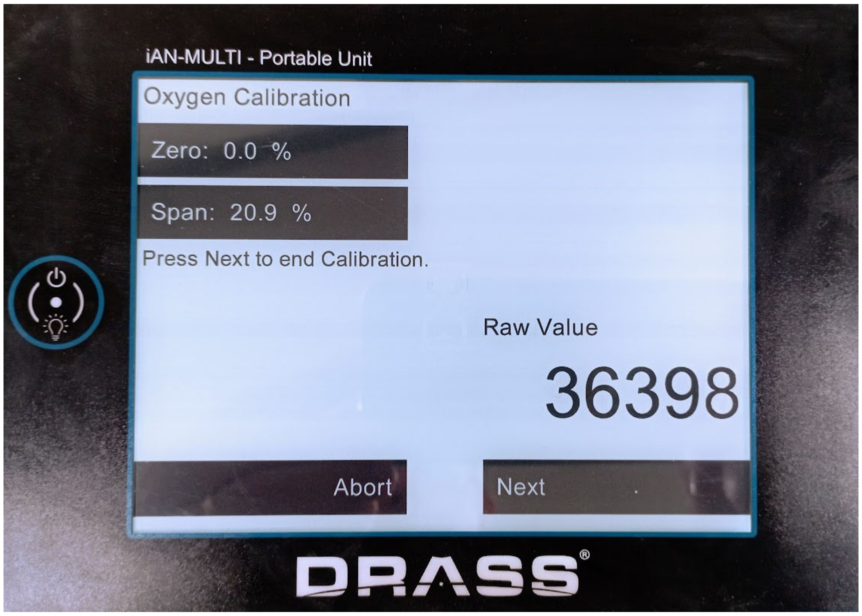

Figure 11 : Oxygen Calibration completion

During the whole process, press ABORT to stop the calibration routine and return to the previous page without affecting the calibration points.

10.3 Carbon Dioxide calibration

After selecting Carbon Dioxide calibration on the Calibration Page, the display will show following page with the details of the calibration gas intended for the activity.

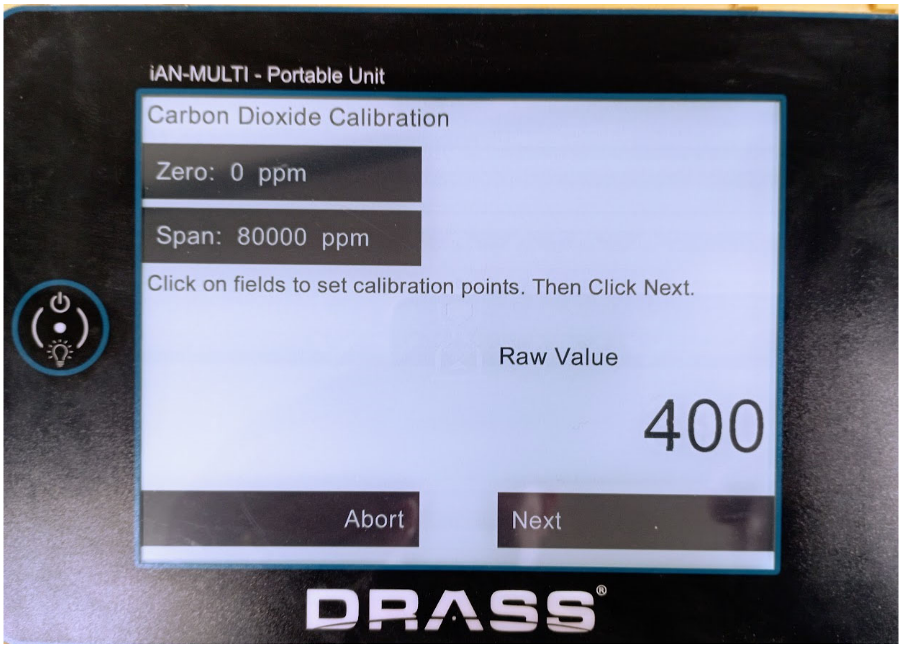

Figure 12 : Carbon Dioxide Calibration Page (Zero and Span Gas Values)

User must check the carbon dioxide concentration values for Zero and Span Gas: if they need to be changed according to the available calibration gas, simply press on the value to be amended, and the display will show a page where values can be adjusted using the up or down arrows shown above and below the relevant digit (Span and Zero values are changed in the same way).

Note that values are expressed in ppm; use following conversion formula in case carbon dioxide concentrations are expressed in % on calibration gas bottles:

CO2_ppm = CO2_% x 10000 (e.g. if Span Gas is 8% CO2, this equals to 80000 ppm)

Once the adjustments are completed, simply press the "OK" button to return to previous page, where adjusted values are shown for an easy check before starting the calibration routine. Also, the display shows the raw value of the signal received from the carbon dioxide sensor: this is useful during next steps to be able to evaluate when a steady state is reached.

After this, install the calibration adaptor over the relevant gas sensor (CO_2) gently pushing it over the sensor port, and follow below procedure:

a. Connect the calibration tubing with the Zero gas source, open the gas source with a flow of 0.3 to 1.0 l/min and start the procedure pressing the NEXT button;
b. The display shows the raw data received from the sensor; wait for the reading to become stable: this will take 1 to 3 minutes. Then press NEXT so the device will store the Zero gas value; take note of the raw value shown with Zero gas: it may be useful for future checks, or

in case anomalies are to be communicated to Drass.

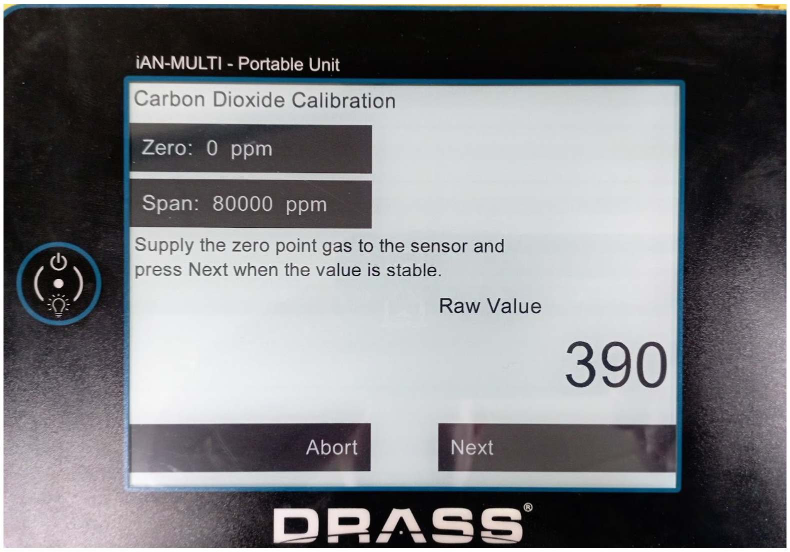

Figure 13 : Carbon Dioxide Calibration Page (Zero Gas)

c. Change the calibration gas source to the SPAN gas, wait again for the reading to become stable, and then press NEXT to store the Span gas value; again, take note of the raw value shown with Span gas; observe that the raw value related to the Span gas must be bigger than the ones of the Zero Gas. In case the raw value is not changing as described, double check the calibration gas bottles and the procedure: if everything is correct, the oxygen sensor may require replacement.

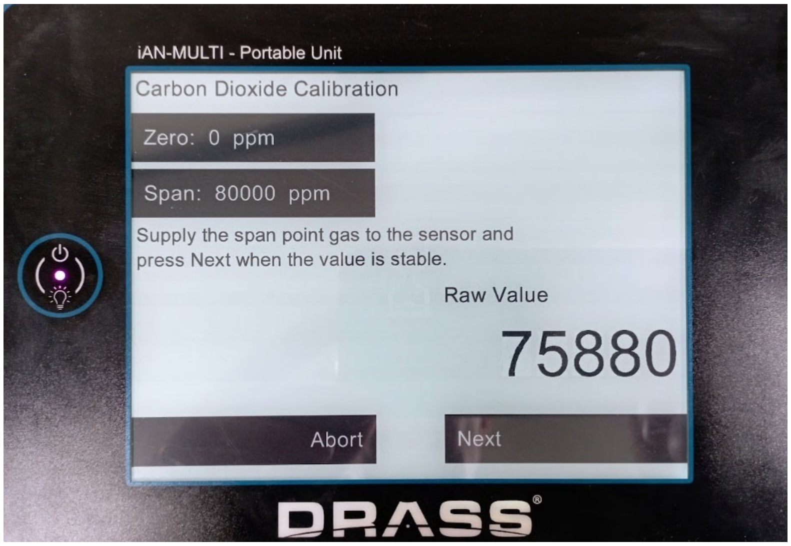

Figure 14 : Carbon Dioxide Calibration Page (Span Gas)

d. To complete the procedure, press NEXT so the stored calibration data is applied to the device and the procedure is completed.

e. Gently remove the calibration adaptor and tubing, storing it in the iAN-MULTI-P case.

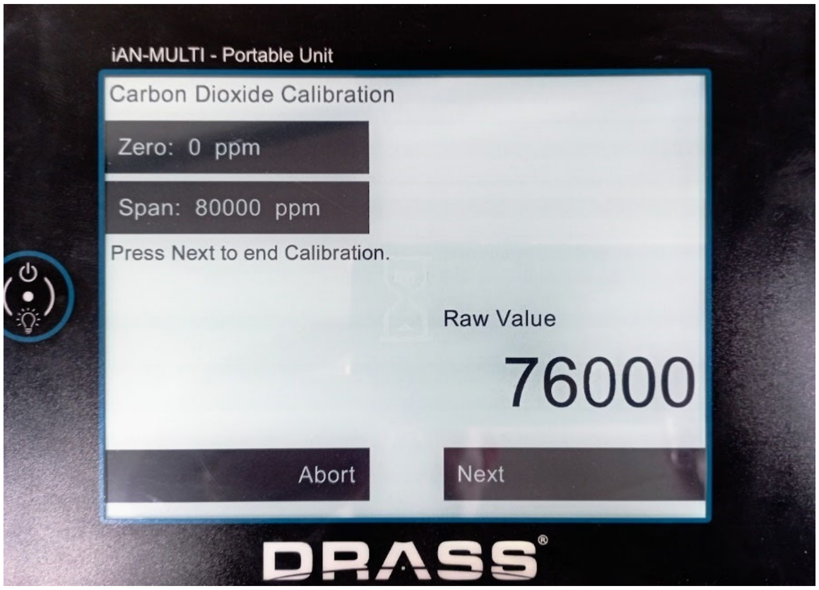

Figure 15 : Carbon Dioxide Calibration completion

During the whole process, press ABORT to stop the calibration routine and return to the previous page without affecting the calibration points.

10.4 Carbon Monoxide calibration

After selecting Carbon Monoxide calibration on the Calibration Page, the display will show following page with the details of the calibration gas intended for the activity.

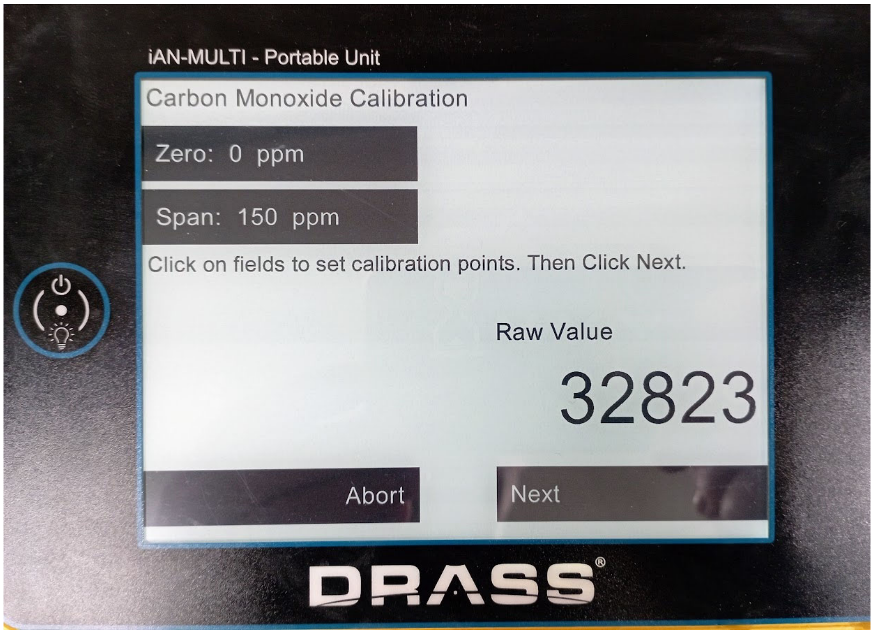

Figure 16 : Carbon Monoxide Calibration Page (Zero and Span Gas values)

User must check the carbon dioxide concentration values for Zero and Span Gas: if they need to be changed according to the available calibration gas, simply press on the value to be amended, and the display will show a page where values can be adjusted using the up or down arrows shown above and below the relevant digit (Span and Zero values are changed in the same way).

Once the adjustments are completed, simply press the "OK" button to return to previous page, where adjusted values are shown for an easy check before starting the calibration routine. Also, the display shows the raw value of the signal received from the carbon dioxide sensor: this is useful during next steps to be able to evaluate when a steady state is reached.

After this, install the calibration adaptor over the relevant gas sensor (CO) gently pushing it over the sensor port, and follow below procedure:

a. Connect the calibration tubing with the Zero gas source, open the gas source with a flow of 0.3 to 1.0 l/min and start the procedure pressing the NEXT button;
b. The display shows the raw data received from the sensor; wait for the reading to become stable: this will take 1 to 3 minutes. Then press NEXT so the device will store the Zero gas value; take note of the raw value shown with Zero gas: it may be useful for future checks, or in case anomalies are to be communicated to Drass.

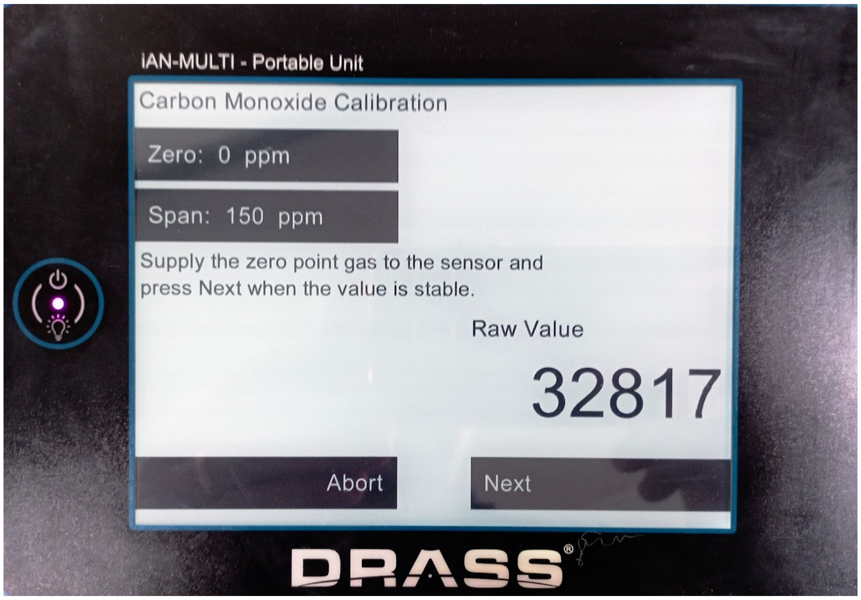

Figure 17 : Carbon Monoxide Calibration Page (Zero Gas)

c. Change the calibration gas source to the SPAN gas, wait again for the reading to become stable, and then press NEXT to store the Span gas value; again, take note of the raw value shown with Span gas; observe that the raw value related to the Span gas must be bigger than the ones of the Zero Gas. In case the raw value is not changing as described, double check the calibration gas bottles and the procedure: if everything is correct, the carbon dioxide sensor may require replacement.

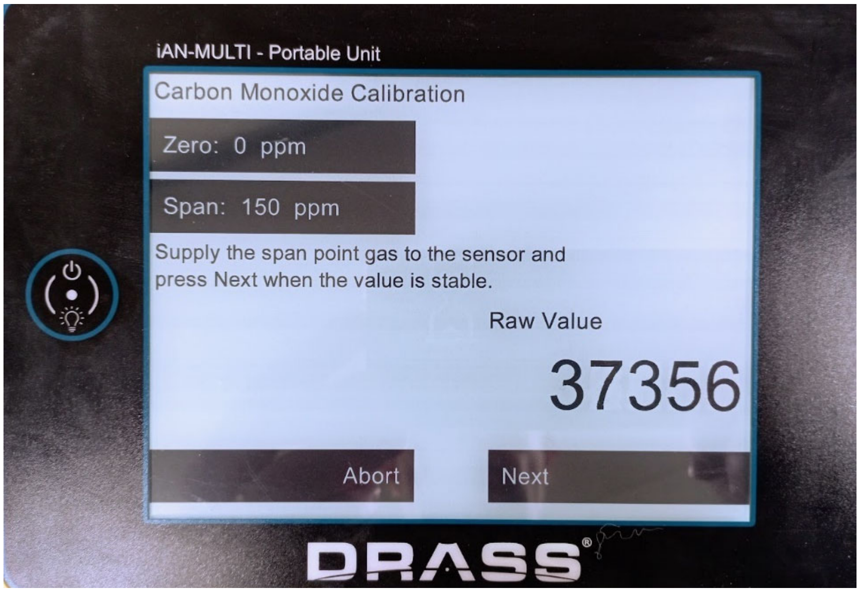

Figure 18 : Carbon Monoxide Calibration Page (Span Gas)

d. To complete the procedure, press NEXT so the stored calibration data is applied to the device and the procedure is completed.
e. Gently remove the calibration adaptor and tubing, storing it in the iAN-MULTI-P case.

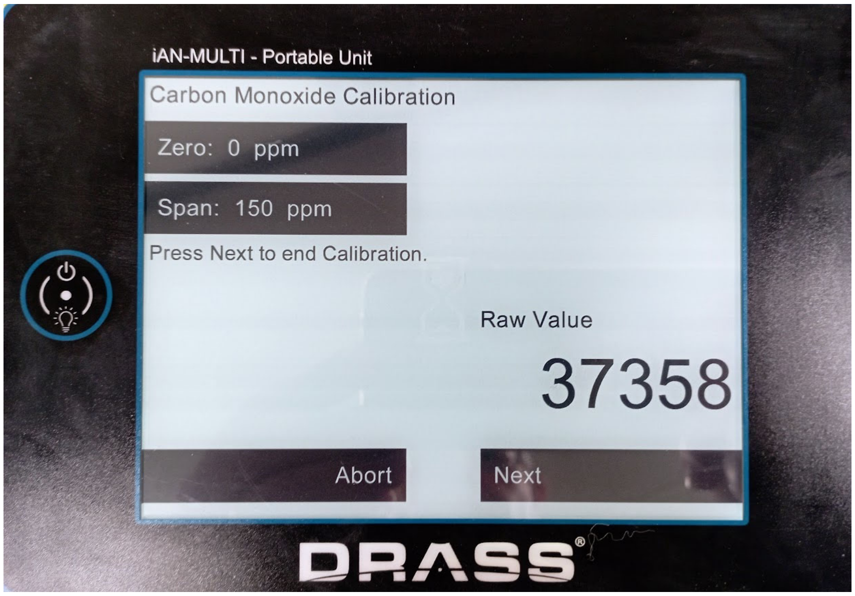

Figure 19 : Carbon Monoxide Calibration completion

During the whole process, press ABORT to stop the calibration routine and return to the previous page without affecting the calibration points.

11 MAINTENANCE

11.1 Routine and periodical maintenance

In order to maintain optimum performance of iAN MULTI, an appropriate maintenance and checks of the equipment must be performed and routine inspections are recommended. Damaged or inefficient parts must be replaced with original spare parts. See chapters 12 and 13.

MAINTENANCE EVERY SIX MONTHS

Perform a visual examination, a function test and a calibration of all sensors of iAN MULTI-P. See chapter 10.

MAINTENANCE EVERY FIVE YEARS

It is suggested a complete reconditioning of the iAN MULTI-P to be performed by Drass.

Otherwise replace the Oxygen sensor, the Carbon Monoxide sensor and the Carbon Dioxide sensor with new one (see chapter 13), after five years from their removal from the sealed packaging or if faulty (see chapter 12). For O_2, CO and CO_2 sensor replacement procedure, see relevant paragraph 11.3. The replaced sensor shall be disposed safely in accordance with local regulations (see chapter 14).

11.2 Firmware update

iAN-MULTI-P firmware is updatable simply using a USB memory stick. Firmware update is to be performed only if instructed by Drass to do so.

USB port is located inside the iAN-MULTI-P case. When opening the case, ensure the activity is performed on a clean and dry environment: damp air entering and remaining within the case may produce condensation/water when the case is brought to cold environment. The case is supplied with a silica gel bag to reduce residual humidity, please ensure such bag is still dry when opening the case.

To update the firmware, follow instructions below:

a. Take a FAT32 formatted USB memory stick and copy the Drass supplied firmware in its root folder; the firmware file is a ".bin" extension named "MPU_xxx", where xxx is the firmware version in x.xx format (e.g. MPU_102 is firmware version 1.02).
b. If powered, power OFF the iAN-MULTI-P, by keeping pressed the power button for few seconds; the display will change to blank.
c. Open the iAN-MULTi-P case, connect the USB memory stick the USB port on the back of the display and close the iAN-MULTI-P case.
d. Power ON the iAN-MULTI-P, by pressing the power button; as soon as the USB with the firmware is detected during the boot phase, the display will show a message informing to

press the display to update the firmware; touch the display.

e. The firmware will be updated within few seconds; at the end, the iAN-MULTI-P will reboot.

f. To check the firmware version, access the Advanced Page and check the version shown on the bottom right of the display.

11.3 Gas sensors replacement

11.3.1 Introduction

The iAN-MULTI-P is designed to be easily serviceable by the end-user, even if Drass can offer a complete service activity, suggested every five years, or as needed in case of malfunction.

Apart from the periodical calibration of gas sensors (see chapter 10), no other activities are commonly required.

<u>Unless similar devices on the market, the iAN-MULTI-P includes a new technology oxygen sensor with very long life, declared as five years minimum when exposed to air at atmospheric pressure.</u>

Since the oxygen sensor will deplete according to the partial pressure of oxygen at which it is exposed, the replacement period must be evaluated according to the real usage of the device; in most cases, where the device is mainly exposed to air at atmospheric pressure, the expected life of the oxygen sensor is five year minimum; in case the device is exposed for long periods at increased oxygen partial pressure (e.g. air in hyperbaric conditions or oxygen-enriched air), the replacement period must be reduced accordingly. Calibration will give the real status of the oxygen sensor.

CO_2 and CO sensors have an expected life of five years minimum, and they are installed in a single PCB including the RH/T sensor.

The three gas sensors plus the RH/T sensor are located on the left side of the iAN-MULTI-P case and maintained by retainer rings.

The procedures for the replacement are written below.

11.3.2 O_2 sensor replacement

This procedure does not require expert skills, because it can be performed by an electrical technician in few minutes.

Tools and materials required:

- A working table, preferably clean and non-metallic (an insulating layer can be used over a metallic table, such as cartoon, paper, rubber, etc…).
- A Phillip screwdriver.

Replacement procedure:

a. Power OFF the iAN-MULTI-P.

b. Open the iAN-MULTI-P case and unplug the electrical connector on the oxygen sensor.

c. Remove the O_2 sensor external retainer ring.

d. Extract the O_2 sensor from the case.

e. Install the new sensor (supplied by Drass in sealed enclosure), placing it in the case and maintaining in position by the retainer ring.

f. Plug the electrical connector on the sensor and close the iAN-MULTI-P case.

NOTE: AFTER REPLACING THE OXYGEN SENSOR, A COMPLETE OXYGEN CALIBRATION MUST BE PERFORMED TO ENSURE THE CORRECT OXYGEN READING (SEE CHAPTER 10).

11.3.3 CO and CO_2 sensors replacement

This procedure does not require expert skills, because it can be performed by an electrical technician in few minutes.

Tools and materials required:

- A working table, preferably clean and non-metallic (an insulating layer can be used over a metallic table, such as cartoon, paper, rubber, etc…).
- A Phillip screwdriver.

Replacement procedure:

a. Power OFF the iAN-MULTI-P.

b. Open the iAN-MULTI-P case.

c. Remove the CO, CO_2 and RH/T sensors external retainer rings (three in total).

d. Remove the screws retaining the sensor to be replaced.

e. Extract the sensor from the cap.

f. Install the new sensor (supplied by Drass in sealed enclosure), placing it on the PCB, then installing again the cap and finally repositioning the retainer rings.

g. Plug the electrical connector on the PCB and close the iAN-MULTI-P case.

NOTE: AFTER REPLACING THE CO / CO_2 SENSOR, A COMPLETE CALIBRATION OF SUCH SENSOR MUST BE PERFORMED TO ENSURE THE CORRECT READING (SEE CHAPTER 10).

12 TROUBLESHOOTING

This chapter includes the main issues which may be encountered using the iAN-MULTI-P, with suggested remedy actions. End-user is encouraged to report to Drass any issue experienced during the use of iAN-MULTI-P.

Item	Issue	Action
1	Wrong O_2, CO_2 or CO readings	Check that gas sensor ports are free from obstruction, water and they are not damaged. Note that CO_2 sensor can be affected by water vapor, mist or condensation: ensure they are not present. Check the last date of sensor replacement: sensors are suggested to be replaced every five years. Recalibrate the sensor, see chapter 10. Replace the sensor if required (see paragraph 11.3) and always calibrate the sensor after replacement (see chapter 10).
2	Wrong temperature or humidity readings	Check the T/RH port is clean and free from debris and water; ensure the environment is not producing condensation on the iAN-MULTI-P. If unable to solve the issue, the iAN-MULTI-P must be returned to Drass for repair.
3	Wrong pressure reading	The sensor is located internally of the device case, and if it is not user serviceable, the iAN-MULTI-P must be returned to Drass for repair.
4	Error shown on the Main Page ("△" icon)	Take note of the error code by enabling the touch interface and touching the display on the "△" icon; clear the error. Sporadic errors can be due to temporary anomaly and may not necessarily require a service activity. If errors are repeating, inform Drass about the error and the scenario of use.
5	Low or wrong Battery Status	Battery Status is evaluated on the voltage across the series of the four installed D size batteries: a low or unexpected value may be due to a faulty battery; check batteries with a tester/multimeter, replacing where needed. Always ensure to replace all four batteries at the same time, with new items listed in chapter 13.

Item	Issue	Remedy actions
6	Wrong date/time	Date and time can be adjusted by accessing the Advanced Operations Page (see paragraph Figure 4); in case date/time is not maintained over periods, the reason may be due to a faulty or discharged RTC battery. This is not intended to be user serviceable, so the iAN-MULTI-P must be returned to Drass.
7	Unable to save log using USB port	Check the used USB memory stick is correctly working and formatted FAT32; try using a different USB memory stick. Reformat the memory stick if required.
8	The display shows signs of “ghosting” or reduced contrast	E-paper display (often called E-INK) are known to be sometime subject to a certain amount of ghosting or reduced contrast after long period of usage (or store without use); this normally will not impair the readability of the display. Try to refresh the page by enabling the touch interface and changing from Home Page to another page, and then return to Home Page (even multiple times): this should reduce the phenomena. In case the display is still “blurry” or “ghosty”, the unit must be serviced by Drass.
9	Unable to use the external power	Ensure the magnetic connector is properly mated and the contact surface of mating faces are clean and free from residual; note that metallic debris may be attracted by the magnet on the connector and then impair the proper connection. Check the 5 Vdc power supply is present, and that the USB type A connector is properly mated to the power source. Check cable integrity: a replacement power cable may be requested to Drass.
10	iAN-MULTI-P powered but unresponsive to commands	If the unit becomes unresponsive, try to power OFF by keeping pressed the power button, and then powering ON again. In case this does not solve the issue, try to remove batteries and wait for few minutes.

Table 8 : Troubleshooting

13 PART LIST

Following spare parts can be ordered to Drass.

Drass PN	Description
08CZ3216	D size alkaline battery hyperbarically validated. To be ordered by multiply of four
08CZ4160	O_2 sensor
08CZ3212	CO_2 sensor
08CZ3014	CO sensor

Table 9 : Spare Parts

14 DISPOSAL

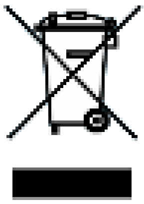

Figure 20 : Symbol of Disposal Product

According to WEEE 2012/19/EU regulation, this electronic product cannot be placed in household waste bins. Please check local regulations for information on the disposal of electronic products in your area.

When the life of a sensor has expired or otherwise damaged, it must be returned to Drass, who will dispose of it safely.

15 FAULT REPORTING TO DRASS

Date	
CUSTOMER DETAILS:	
Customer Contact	
Address	
Country	
Telephone	
Email	
EQUIPMENT DETAILS (where applicable):	
Serial No	
Others	
System Operating Voltage	
Customer's Description of Fault	
TO BE COMPLETED BY DRASS:	
Date of Manufacturing	
Firmware Version	
Design Change Note Ref (if applicable)	
Comments	

Table 10 : Fault Reporting