

**GENTWO<sup>®</sup>**  
**Oxygen Analyzer**  
**PMA1000 V2.2 / PMA1000L V2.2**

Instruction Manual

Version 1.00.05

Software Version: 2.11





Embracing Challenge

## Get help

For more information about using your M&C product, please contact M&C TechGroup. We will answer your questions about commissioning, handling and technical service. With our experience and know-how, we will get your M&C product running in no time - and with no charge.

**Please contact our service center in Ratingen, Germany,  
for US Service Ventura, California**

For faster service, please have this information ready when you contact us:

- Product model
- Product serial number
- M&C order or invoice number

- Germany service center:  
**+49 2102 935 - 888**  
**[service@mc-techgroup.com](mailto:service@mc-techgroup.com)**
- US service:  
**+1 805-654-6970**  
**[info-usa@mc-techgroup.com](mailto:info-usa@mc-techgroup.com)**

**For online service and support information go to:**

- [www.mc-techgroup.com](http://www.mc-techgroup.com)

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## 1 About this instruction manual

Welcome to the M&C product manual. The goal of this document is to give a broad overview of the main functions of the PMA1000(L) V2.2. It will help you to get started with using the GENTWO analyzer.

If you have any questions about this instruction manual, please contact M&C or one of our official distributors.

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This instruction manual does not claim to be complete and it may be subject to technical modifications. We appreciate any feedback you may have to this document .

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With the release of this version all older manual versions will no longer be valid.

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Viton®	is a registered trademark of Dupont Performance Elastomers L.L.C.
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## 2 Important safety information

Please read this important safety information carefully before installing the PMA1000(L) V2.2. Follow these safety precautions during commissioning, start-up and regular operation.

### 2.1 Intended use

This PMA1000(L) V2.2 gas analyzer is intended for use in general purpose areas (non-hazardous environments). It may only be operated in compliance with the information on page 15 chapter 'Technical data'. Particularly you must meet the requirements of the ambient temperature and characteristics.

Do not use this product for any other purpose. Improper use and handling can create hazards and cause damage. For more information, please refer to the safety information in this instruction manual.

### 2.2 Personal safety

Please read this instruction manual carefully before commissioning and operating the device. If you have any questions regarding the product or the application, please don't hesitate to contact M&C or an M&C authorized distributor.

Please follow all instructions and warnings closely.

The product described in this instruction manual has been built and tested in our production facility. All analyzers are packed to be shipped safely. To ensure the safe operation and to maintain the safe condition, all instructions and regulations stated in this manual need to be followed.

This instruction manual includes all information regarding proper transportation, storage, installation, operation and maintenance of this product by qualified personnel.

### 2.3 Warning signs and definitions



#### **DANGER**

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.



#### **WARNING**

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.



#### **CAUTION**

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

#### **NOTICE**

NOTICE is used to address practices not related to physical injury.

**High Voltage!**

Caution, risk of electric shock!

**High Pressure!**

Caution, system might be under pressure.

**Hot Surface!**

Caution, hot surface! Do not touch!

**Hazardous Gas!**

Caution, hazardous and toxic gas! Do not inhale!

**Qualified personnel**

'Qualified personnel' are experts who are familiar with the installation, mounting, commissioning and operation of these types of products.

**Safety Gloves!**

Put on safety gloves for your protection.

**Pull Main Plug!**

Unplug power supply before opening!

**Note**

'Note' indicates important information relating to the product or highlights parts of the documentation for special attention.

**Do you need help?**

Please contact M&C!



## 2.4 Safety instructions

Please follow these safety directions and instructions regarding installation, commissioning and operation of the PMA1000(L) V2.2.



### Qualified personnel

Installation, commissioning, maintenance, inspections and any repairs of all M&C products and components must be carried out by qualified personnel in compliance with the current regulations.

Install the device only in protected areas, sheltered from sun, rain and moisture.

Operate the device only in the permitted temperature and pressure ranges. For details please refer to the technical data on page 15 chapter 'Technical data'.

Don't repair or maintain this product without M&C's specific maintenance- and service instructions.

When replacing parts, use only original M&C spare parts.



### Pull Main Plug!

If there is any indication that safe operation of the PMA1000(L) V2.2 is no longer possible, turn off the power and disconnect the device from the power supply immediately.

Then protect the defective device against accidental switch-on and mark it clearly as defective.

## 2.5 Working on electrical and electronic devices

Only qualified and authorized personnel are permitted to work on equipment which operates on 115 or 230 VAC supply voltage. Please be sure to observe the generally accepted engineering standards and all of your national and local regulations.



### Note

Before connecting the device, please make sure that the supply voltage matches the specified voltage on the product label.



### High Voltage!

Protect yourself and others against damages which might be caused by high voltages. Disconnect the power supply before opening the device for access. Make sure that all external power supplies are disconnected.

Please make sure to take appropriate precautions even by working on unplugged or low-voltage devices. Unplugged devices need to be properly grounded to prevent damage to internal electronics from electrostatic discharges (ESD).



## 2.6 Not certified in hazardous areas

This device is NOT certified to be installed or operated in hazardous areas.

---



### **WARNING**

Explosion hazard!

For general purpose areas ONLY. Don't use the PMA1000(L) V2.2 in hazardous areas.

---



### 3 Introduction

Congratulations on your purchase of the PMA1000(L) V2.2 analyzer. We know from experience that you surely will enjoy this reliable and durable M&C product.

M&C is one of the premium and performance-driven companies in the business. With this in mind, our customers benefit from a number of significant advantages. We offer proven, durable and advanced products and solutions. We have listened to our customers needs, when designing our products, allowing M&C to provide premium products at a comparatively lower cost over the entire life cycle.

Our products and special systems are designed and tested in our own facilities by our highly skilled staff that are always quality-oriented. We carefully package our goods and send them to our customers worldwide.

With our 30-years of experience in customer specific solutions for almost 30 different industries and applications, it is our goal to supply you with an excellent product. Our products offer fast commissioning, safe and reliable day-to-day operation and low maintenance.

We expect that our products fully meet your expectations. If you have any question regarding the product or the application, please don't hesitate to contact M&C or your M&C authorized distributor. Our service does not end with delivery of the products.

Thanks again for your purchase.

We appreciate your business.

## 4 Product overview

The PMA1000(L) V2.2 oxygen analyzer is specially designed for continuous measurement of oxygen concentration in gases. With a dead space of only 2 ml [0.07 fl oz] inside the paramagnetic measuring cell, the response time of the oxygen analyzer is very fast. The PMA1000(L) V2.2 can be used for many applications with the exception of hazardous areas. The oxygen analyzer is ideal for combustion control, process optimisation, inertisation, fermentation processes, environmental protection and for laboratory measurements.

The PMA1000(L) V2.2 has an innovative menu-driven interface. The modular design gives us the flexibility to quickly adapt to various applications. The oxygen analyzer is user-programmable and easily programmed through the multilevel interface, which provides convenient access for changing display and menus.

The analyzer housing of the PMA1000(L) V2.2 is a 19" enclosure with FKM (Viton®) flexible tubing. The oxygen analyzer has a universal power supply, a seven inch colour touch screen display and a heated paramagnetic measuring cell (PMC) with sensors and I/O-electronics. There are also analyzer control features such as a pressure transducer to compensate the process pressure, temperature sensors and flow rate indicators. The PMA1000(L) V2.2 provides an output signal of 0 - 20 mA / 4 -20 mA which is proportional to the measured oxygen concentration. In addition there are also status, alarm and switching outputs available.

With the available switching outputs, the oxygen analyzer provides two user-programmable operating parameters to monitor the measurement.

A special feature of the PMA1000(L) V2.2 is the integrated data logger functionality which displays the temporal resolution and the long-term data recording of measurement, warning and alarm signals. The PMA1000(L) V2.2 provides excellent calibration ease of use for zero-point (off-set) and span adjustment.

There are currently two oxygen analyzer models available: PMA1000 V2.2 and PMA1000L V2.2. The functionality of the L-model includes manual calibration. The PMA1000 V2.2 features an automated calibration tool (AutoCal).

## 4.1 Receiving the analyzer

The PMA1000(L) V2.2 is usually delivered in one package. You will find the following items in the box:

- PMA1000(L) V2.2
- Instruction Manual
- 230 V AC power supply or 24 V DC connector (depending on your order)
- Digital/analog connectors (depending on your order)



### Note

Please note, that there are no materials or tools included in the package you might need for assembly or installation.

## 4.2 Product label and serial number

The product label with the serial number is located on the back of the PMA1000(L) V2.2.

Please refer to this serial number if you have any questions about your PMA1000(L) V2.2 or if you need to order spare parts.

Thanks for your help!



Fig. 1: Product label is on the back of the PMA1000(L) V2.2

**1** Product label

## 5 Measuring principle of the analyzer

### 5.1 Principle of measurement

All gases are diamagnetic but just a few gases have a paramagnetic behavior. Oxygen is a paramagnetic gas, which means that oxygen molecules are attracted into a strong magnetic field. This paramagnetic susceptibility distinguishes oxygen from most other gases.

The M&C PMA gas is working according to the magneto-mechanical principle: The paramagnetic measuring cell (PMC) uses this paramagnetic characteristic to measure the concentration of oxygen in a gas mixture.

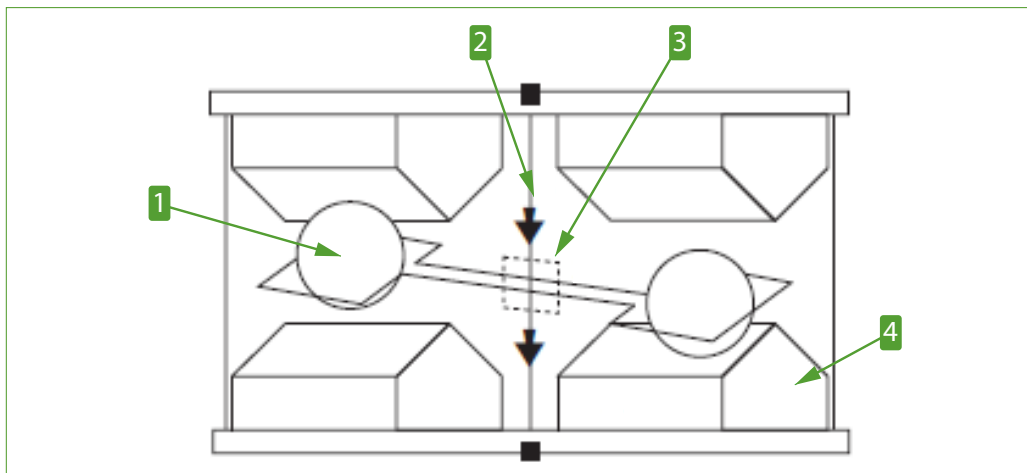
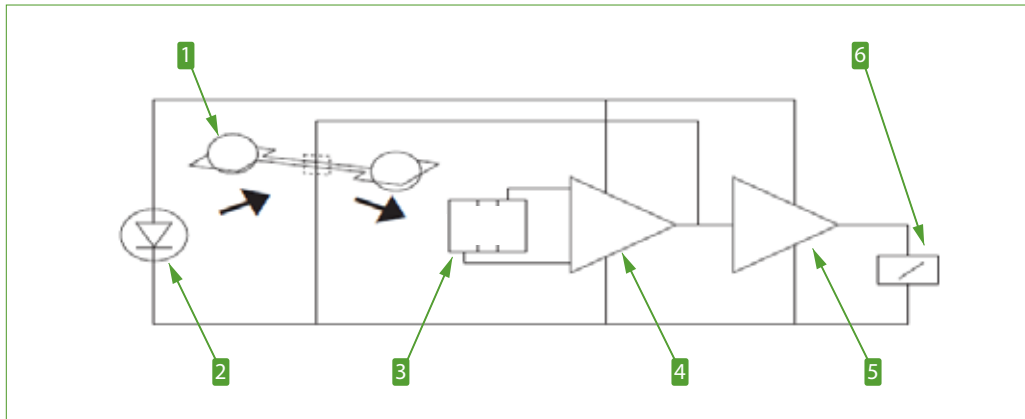


Fig. 2: Paramagnetic measuring cell

1 dumbbell  
3 mirror

2 suspension wire  
4 magnetic poles

The PMC used in this oxygen analyzer represents the so called 'dumbbell'-type. It consists of two nitrogen-filled spheres suspended on a fine platinum wire in an inhomogeneous magnetic field. Around the dumbbell is a single turn of platinum wire which is connected to the rest of the electronics through the platinum suspension. Before the measurement, the spheres are kept in balance in the inhomogeneous magnetic field. When the gas mixture with the oxygen concentration flows through the paramagnetic cell, the dumbbell starts moving.



**Fig. 3:** *Electronic evaluating system to measure oxygen concentration*

- |                                    |                    |
|------------------------------------|--------------------|
| <b>1</b> 'Dumbbell' measuring cell | <b>2</b> LED       |
| <b>3</b> Photo cells               | <b>4</b> Amplifier |
| <b>5</b> Amplifier                 | <b>6</b> Display   |

The oxygen molecules are pulled towards the stronger magnetic field zone, and the nitrogen-spheres are rotating out of the zone. The mirror, which is secured between the spheres at the center of the suspension wire, rotates with the dumbbell. Through the twist of the platinum wire, the mirror reflects light from a light source to a set of photo cells. When the dumbbell rotates out of the magnetic field, and the suspension wire is twisted, an opposing current is generated by the electronics to untwist the suspension wire to its original-state. This compensating current is proportional to the  $O_2$  concentration.

## 5.2 Flow chart

The following flow chart shows a PMA1000(L) V2.2 with one sensor combination and a par-amagnetic analyzer (PMA) measuring cell.

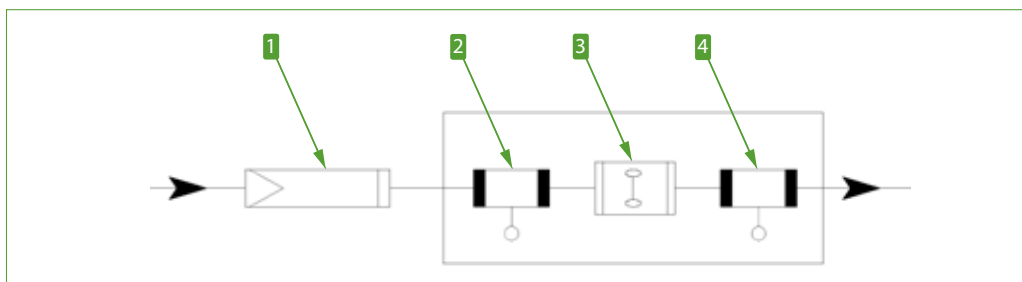


Fig. 4: Flow chart

**1** External fine filter

**2** Inlet gas pressure sensor

**3** Patented M&C oxygen-measuring cell (PMA)

**4** Outlet gas pressure sensor

Two pressure sensors before and behind the PMA cell are installed for determination of the flow being calculated from the differential pressure.

## 6 Technical data

Oxygen analyzer	PMA1000 V2.2	PMA1000L V2.2
Long enclosure Part-No.	08A2000	08A2005
Short enclosure Part.-No.	08A2010	08A2015
Sample gas	O <sub>2</sub>	
Measuring ranges	4 linear measuring ranges, 2 of those free selectable, lowest span 1%  Factory default 0-1, 0-10, 0-30 and 0-100 vol% O <sub>2</sub> , zero suppression applicable	
Limit of Detection (LOD)**	0.02 vol%	
Response time* for 90% FSD	< 3 seconds at 60 NI/h air	
Zero-point offset (drift)	< 0.06 vol% O <sub>2</sub> in 72 hours	
Linearity error	< ±0.1 vol% O <sub>2</sub>	
Accuracy after calibration**	Deviation ±1 % of full scale or 0.02 vol% O <sub>2</sub> , whichever value is greater.	
Reproducibility**	< ±0.01 vol%	
Flow rate of sample gas	25-60 NI/h air	
Influence of sample gas flow	Variation in gas flow between 25-60 NI/h air will cause a deviation of < 0.1 vol% O <sub>2</sub>	
Sample gas inlet pressure	0.6 - 1.6 bar	
Sample gas outlet pressure	Recommendation: discharge freely into atmosphere (requires higher pressure at the analyzer inlet compared to the outlet)	
Influence of sample gas pressure	< 1 % of full scale within the range of 0.6 to 1.6 bar abs. with activated pressure compensation	
Sample gas temperature and characteristics	0 to +50 °C [32 to +122 °F]; dry, oil- and dust free gas , avoid temperature dropping below dew point	
O <sub>2</sub> transducer temperature	Fixed at 55 °C [131 °F]	
Ambient temperature	0 to +50 °C [+32 to +122 °F], avoid temperature dropping below dew point	
Influence of ambient temperature	< 1 % of full scale	
Display	7" resistive touchscreen	
Output signals	Adjustable 0-20 mA / 4-20 mA, max 500 Ohms burden, short-circuit proof, electrically isolated, Modbus TCP/IP, AK protocol TCP/IP	
Relay outputs	4 x relay output (1 x status, 1 x Cal-mode, 1 x pump control, 1 x Cal-error), contacts: 24 V DC/ 3 A, 1 x change-over contact, potential-free	2 x relay output (1 x status, 1 x Cal-mode), contacts: 24 V DC/3 A, 1 x change-over contact, potential-free
Digital outputs (DO)	8 x DO 24 V DC, max. 3 A (2 x operating parameters, 2 x measuring range feedback, 4 x valve control)	4 x DO 24 V DC, max. 3 A (2 x operating parameters, 2 x measuring range feedback)
AutoCal-Function	Yes	No
Interfaces	Ethernet / USB	



Oxygen analyzer	PMA1000 V2.2	PMA1000L V2.2
Long enclosure Part-No.	08A2000	08A2005
Short enclosure Part.-No.	08A2010	08A2015
Storage temperature	-20 to +60 °C [-4 to +140 °F], avoid temperature dropping below dew point	
Power supply	115 to 230 V AC, 50 to 60 Hz power supply or 24 V DC connector plug	
Power consumption	Max. 150 VA	Max. 100 VA
Wetted materials	Platinum, Epoxy resin, glass, FKM (Viton®), Stainless Steel 316Ti, PVDF, PPS	
Sample gas connection	Bulkhead screw-on fitting with 1/4" internal thread, PVDF ( standard)	
Case protection	IP40, EN 60529	
Electrical standard	EN 61010	
Housing / front color	19 inch rack mounting (4RU)/white RAL 9003	
Maximum installation altitude	2000 m [6561.7 ft]	
Dimensions (W x H x D)	<p>Short enclosure with power supply (dimensions include front handles and power supply): 482 x 185 x 297 mm [19" x 7.3" x 11.7"] + approx. 60 mm [approx. 2.36"] connection depth</p> <p>Long enclosure with 230 V power supply (dimensions include front handles and power supply): 482 x 185 x 436 mm [19" x 7.3" x 17.1"] + approx. 60 mm [approx. 2.36"] connection depth</p>	
Weight	<p>Short enclosure: approx. 11 kg [approx. 24.3 lb] Long enclosure: approx. 13 kg [approx. 28.7 lb]</p>	

\* Depends on sample gas input pressure, density and flow rate at the analyzer input.

\*\* At constant pressure, temperature and sample gas flow rate.

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Please note: NI/h and NI/min refer to the German standard DIN 1343 and are based on these standard conditions: 0 °C [32 °F], 1013 mbar.

## 6.1 Dimensions

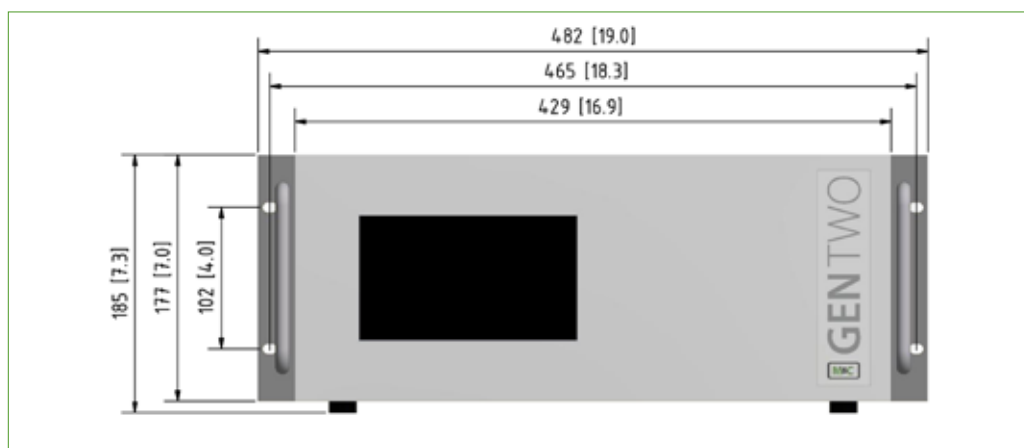


Fig. 5: Enclosure front view

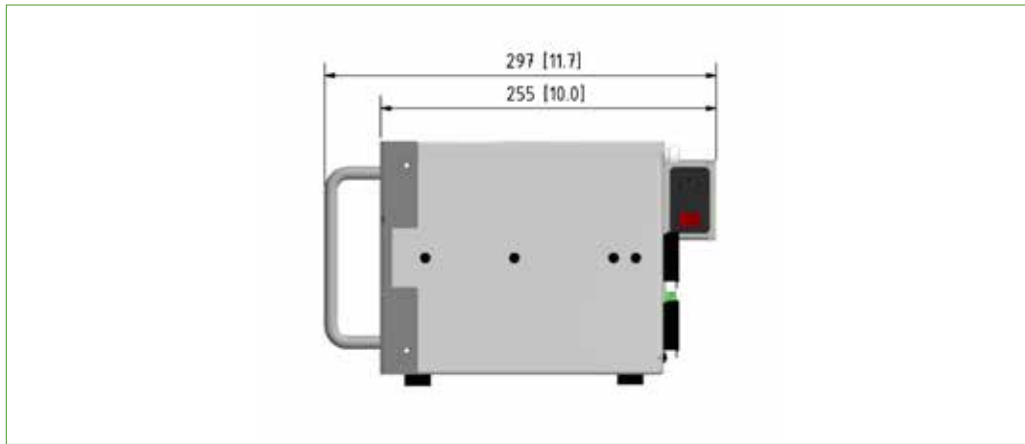


Fig. 6: Short enclosure side view with 230 V power supply

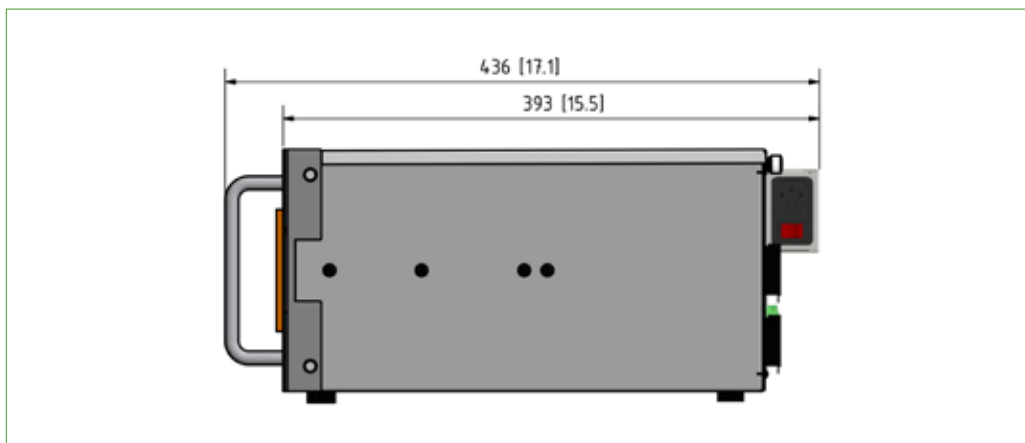


Fig. 7: Long enclosure side view with 230 V power supply

## 6.2 Connections

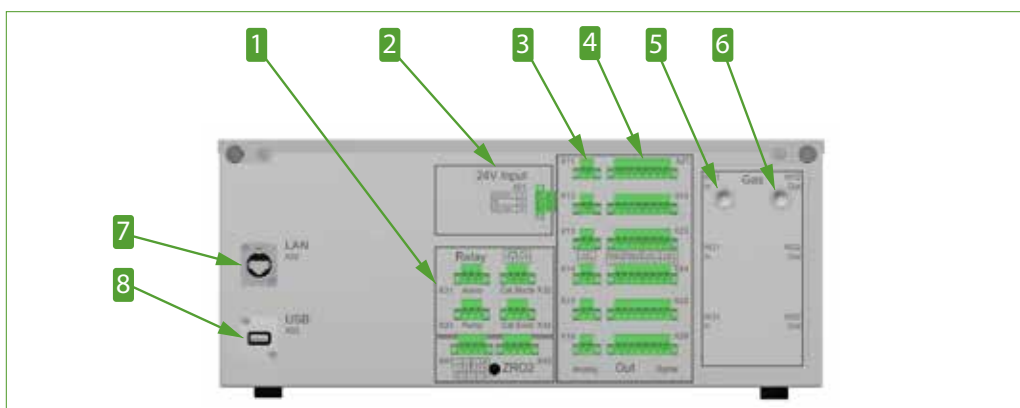


Fig. 8: Rear view 24 V DC PMA1000 V2.2 (fully equipped)

- |  |  |
|--|--|
| <b>1</b> Relay outputs with 3-pin connectors (X33 and X34 PMA1000 V2.2 only) | <b>2</b> Connector for 24 V DC power supply  |
| <b>3</b> mA-output (measurement value) with 2-pin connectors per channel     | <b>4</b> Digital outputs with 8-pin connectors per channel (4 x valve control PMA1000 V2.2 only) |
| <b>5</b> Sample gas input '1'  | <b>6</b> Sample gas output '1'   |
| <b>7</b> Ethernet connector  | <b>8</b> USB connector   |

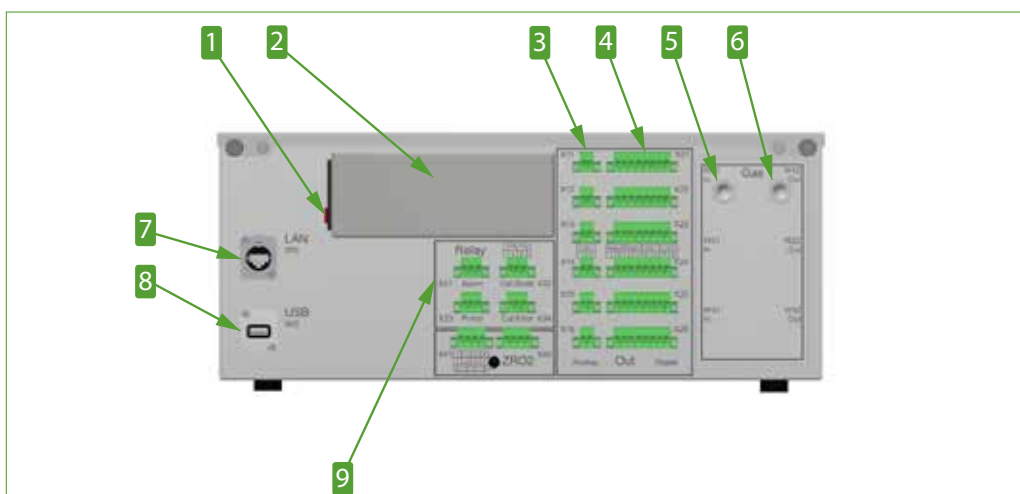


Fig. 9: Rear view 230 V AC PMA1000 V2.2 (fully equipped)

- |  |  |
|--|--|
| <b>1</b> Power switch  | <b>2</b> Power supply unit 115 to 230 VDC  |
| <b>3</b> mA-output (measurement value) with 2-pin connectors per channel     | <b>4</b> Digital outputs with 8-pin connectors per channel (4 x valve control PMA1000 V2.2 only) |
| <b>5</b> Sample gas input '1'  | <b>6</b> Sample gas output '1'   |
| <b>7</b> Ethernet connector  | <b>8</b> USB connector   |
| <b>9</b> Relay outputs with 3-pin connectors (X33 and X34 PMA1000 V2.2 only) |  |

### 6.3 Gas connections and pin assignment diagram

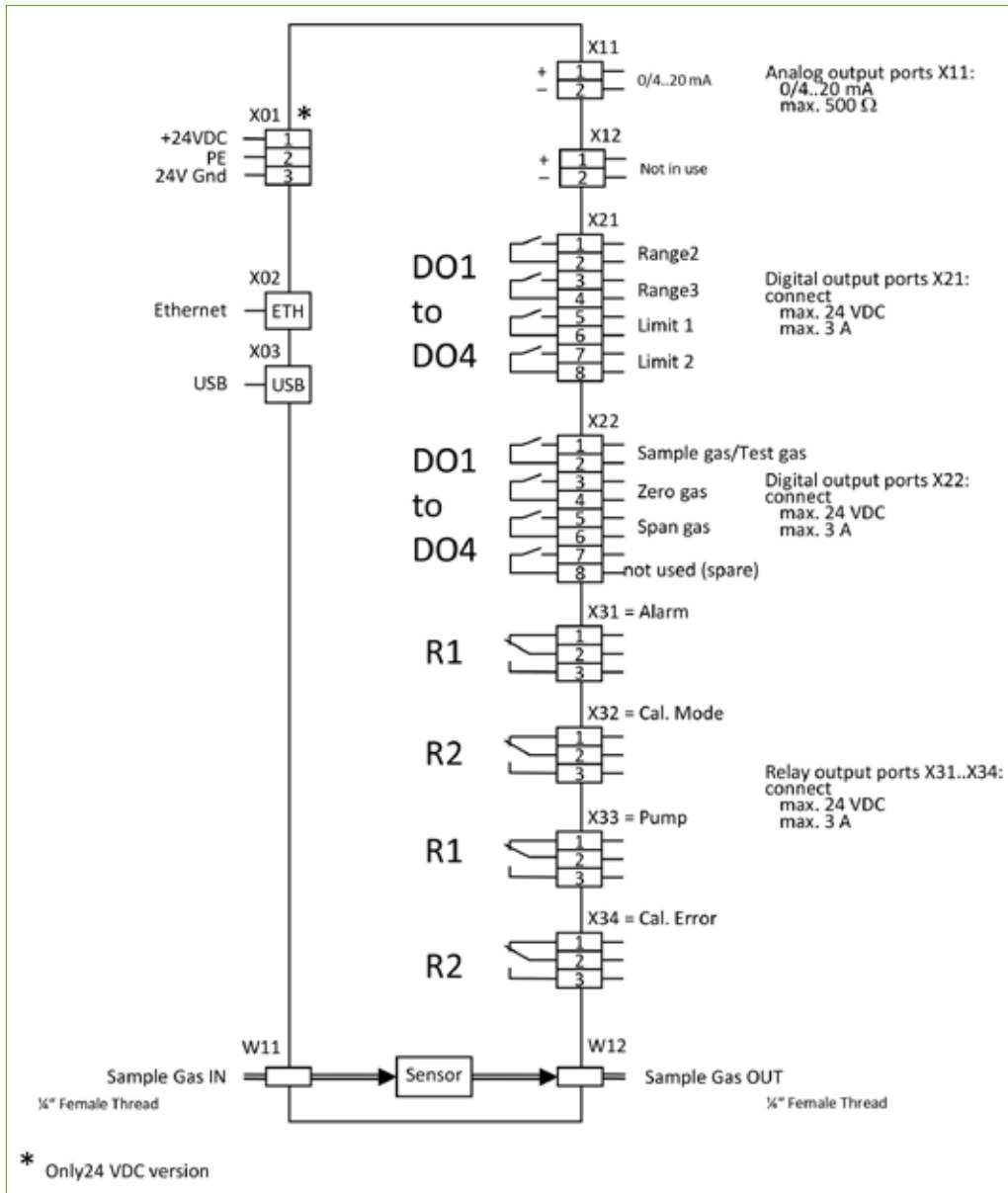


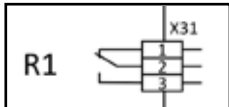
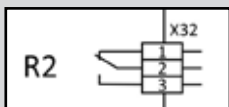
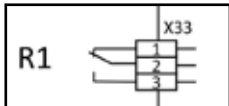
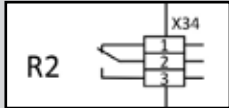
Fig. 10: Gas connections and pin assignment diagram PMA1000 V2.2



#### Note

Please note, that the AutoCal valve ports are available for the PMA1000 V2.2 analyzer only.

The following table shows the states and functions of relays R1 and R2.

Relay	Displayed state	Description
	De-energized	<p>X31 = Alarm</p> <p>The alarm output represents a so-called collective alarm to which various individual alarms are connected in series. In measuring mode, when all single alarms are in the good state, the relay is energized.</p> <p>PMA1000(L) V2.2 single alarms:</p> <ul style="list-style-type: none"> <li>• Sensor temperature out of specification 55 °C <math>\pm 3K</math> or in warm up</li> <li>• P-IN (inlet pressure) outside 600-1600 mbar or pressure difference <math>\Delta P</math> too small.</li> <li>• Flow rate outside 25-120 l/h, this single alarm can be deactivated (with parameter).</li> <li>• Power failure (Power OFF/Fail)</li> </ul>
	De-energized	<p>X32 = Cal. Mode</p> <p>This status shows whether the device is being calibrated or not. During calibration, the relay is energized.</p>
	De-energized	<p>X33 = Pump, relay for PMA1000 V2.2 only</p> <p>This contact controls an externally connected load up to 24 V DC, 3 A. In measuring mode with the load switched on, the relay is de-energized.</p>
	De-energized	<p>X34 = Cal. Error, relay for PMA1000 V2.2 only</p> <p>This status indicates whether an error occurred during the last AutoCal calibration. The relay is energized if an error occurred.</p>

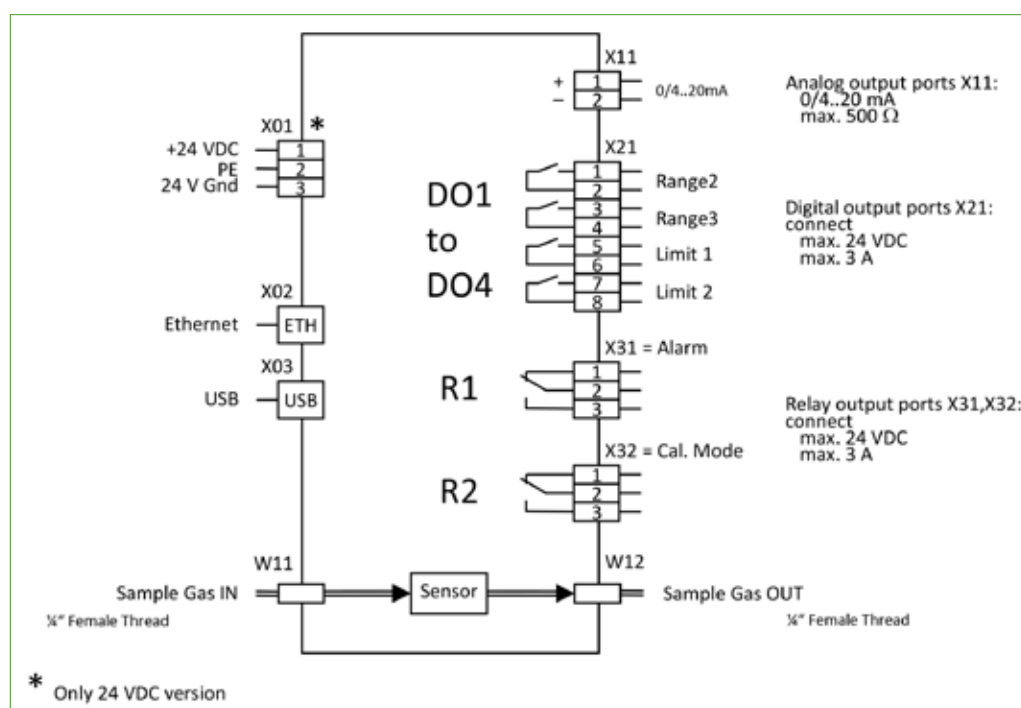


Fig. 11: Gas connections and pin assignment diagram PMA1000L V2.2

## 7 Using the analyzer

### 7.1 Graphical user interface (GUI)

The PMA1000(L) V2.2 is equipped with a 7" touch screen and an intuitive graphical user interface (GUI). The GUI is designed to easily navigate through the menus and sections. The concept behind the interface is as intuitive as operating a smart phone.



*Fig. 12: Startup screen of the 1-Channel configuration*

The PMA1000(L) V2.2 has a touch-sensitive display. Unlike the capacitive touch screen panel of a smart phone, this is a resistive touch screen. It responds to pressure on its surface. The display is made out of several transparent layers. The most important layers are two electrically-resistive layers, which are separated by a thin space. Both layers have conductive connections facing each other. By pressing down on the touch screen, the two layers touch each other to become connected at this point. The resistance of the layers changes and the precise location of the touch is registered by the touch-sensitive display. The display can also be used with any kind of stylus-like objects or gloved fingers.

The GUI collects all the information from the sensor modules, processes the individual input signals and initiates the necessary actions. The I/O module gets a signal from the GUI to switch an output 'on' or 'off' or change the mA output. The GUI is the heart of the PMA1000(L) V2.2 analyzer. All settings and configurations can be controlled by the GUI and displayed and edited right on the touch screen.

You will find a detailed description of the menu structure on page 22 chapter 'Menu structure'.

### 7.2 How to use the touch screen

The touch screen of the PMA1000(L) V2.2 is easy to use. A few simple gestures - tap, horizontal and vertical swipe - are all you need.

To select a menu item, please tap on one of the buttons on the menu bar at the right-hand side of the display. To navigate through the sections of the menu item, please 'swipe' horizontally through the corresponding sections (S1 up to S4).

Gestures are predefined motions, like the tap or swipe motion, which are used to interact with the PMA1000(L) V2.2. Some of the predefined motions are supported only in certain areas of the screen.

The graphical user interface does not support multi-touch gestures.








**Note**

The horizontal 'swipe' gesture is not activated in active areas like lists or scroll bars.

Vertical 'swipe' gestures are only activated in list and scroll bars.

Gestures like zoom, pinch, two finger scroll and two finger tap are not supported by the GUI.

Gesture	What it means
	Swipe your finger to the left. You will reach the next section of the menu item.
	Swipe your finger to the right. You will go back to the previous section of the menu item.
	Swipe your finger down to scroll down a list.
	Swipe your finger up to scroll up a list.
	Tap your finger on an active area to select a menu item or open another section.



**Note**

Instead of swiping to the right to reach the previous section, you can also get back by tapping on the highlighted (green) menu button.

**7.3 Menu structure**

The menu structure of the PMA1000(L) V2.2 features only two levels. This makes it even easier to navigate through the user-interface. The first level, the main menu, has six menu items with the menu bar always visible on the right side of the screen. Therefore the main menu can be reached from any section.

We call the second level of our menu structure the 'sections'. The sections display various functions and more detailed information about the corresponding menu items.

There are up to four sections available for one menu item. A little bar with dots in the system status line shows which section is currently displayed on the screen.



#### Note

Please note, that depending on the operation mode, the actual display on your device can differ from the screen shots in this instruction manual. We recommend you get familiar with navigating through the menus and sections directly at the PMA1000(L) V2.2.

In this chapter we introduce you to the menus and sections of the GUI. For better navigation, we labeled the section numbers as following:

### 'Menu 1 – Section 1' = M1/S1

Any settings and functions will be described separately.

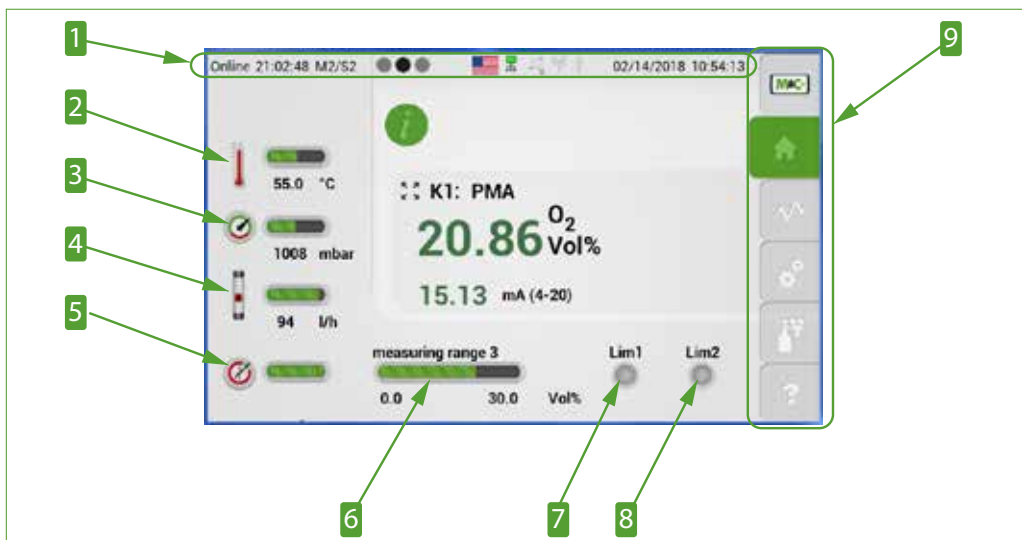


Fig. 13: Menu structure overview

- |   |                      |
|---|----------------------|
| 1 System status line                            | 2 Sensor temperature |
| 3 Pressure during operation                     | 4 Gas flow           |
| 5 Display of deviation from factory calibration | 6 Measuring range    |
| 7 Operating limit 1                             | 8 Operating limit 2  |
| 9 Menu bar M1 to M6 (home button activated)     |                      |

#### 7.3.1 System status line

The system status line is the first line displayed at the top of the touch screen. Starting on the left side, it shows the on-line time of the unit. The on-line time displays how long the PMA1000(L) V2.2 is on-line since the last time the device was switched on. Next to the on-line time is the little bar with dots to show the number of sections available for this menu item. A black dot indicates the current section and the gray dots the available sections.



The flag symbol shows the language you are currently using. To change the language setting just tap on the flag symbol. The following four symbols indicate from left to right:

- Internal data bus indicator (green blinking light: 1 Hz- pulse; red light: error)
- LAN interface
- Wi-Fi (not supported by the current GUI version)
- USB interface

On the right side of the system status line, the date and the actual time in your time zone is displayed.

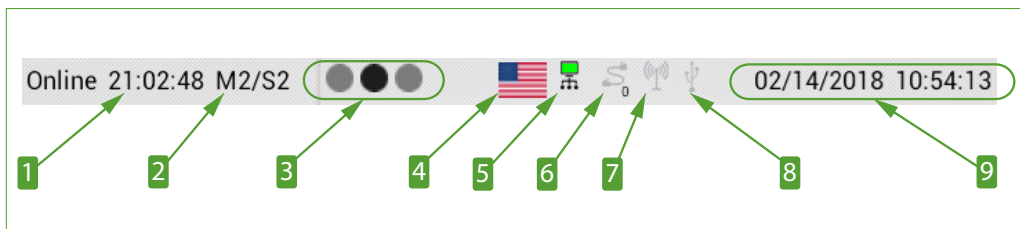


Fig. 14: System status line

- |   |                                   |
|---|-----------------------------------|
| 1 On-line time                                      | 2 Menu item number/section number |
| 3 Section indicator: current section shown in black | 4 Language selection              |
| 5 Internal data bus indicator                       | 6 LAN interface                   |
| 7 Wi-Fi (not supported by current GUI version)      | 8 USB                             |
| 9 Current date and time                             |                                   |

### 7.3.2 Main menu bar

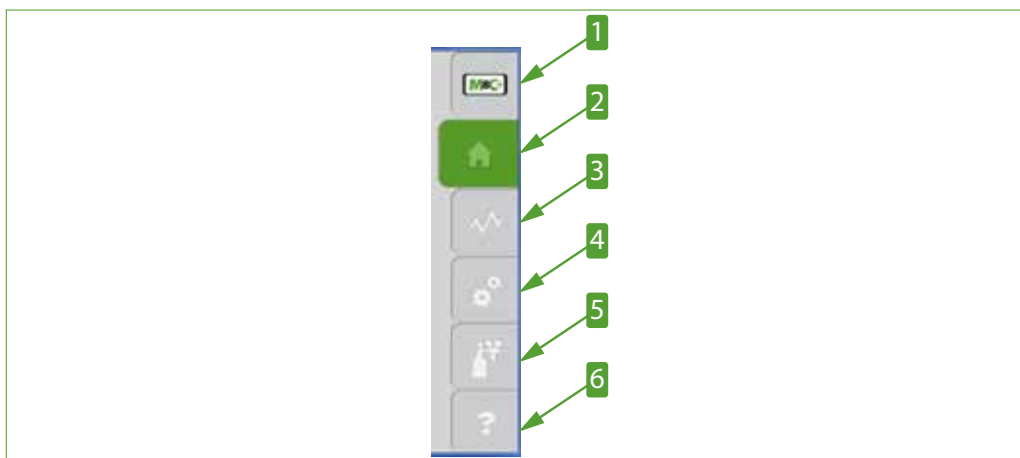


Fig. 15: Menu bar with the menu items M1 to M6

- |                         |                          |
|-------------------------|--------------------------|
| 1 M&C info button M1    | 2 Home button M2, active |
| 3 Data logger button M3 | 4 Settings button M4     |
| 5 Calibration button M5 | 6 Help button M6         |

### 7.3.3 Main display area

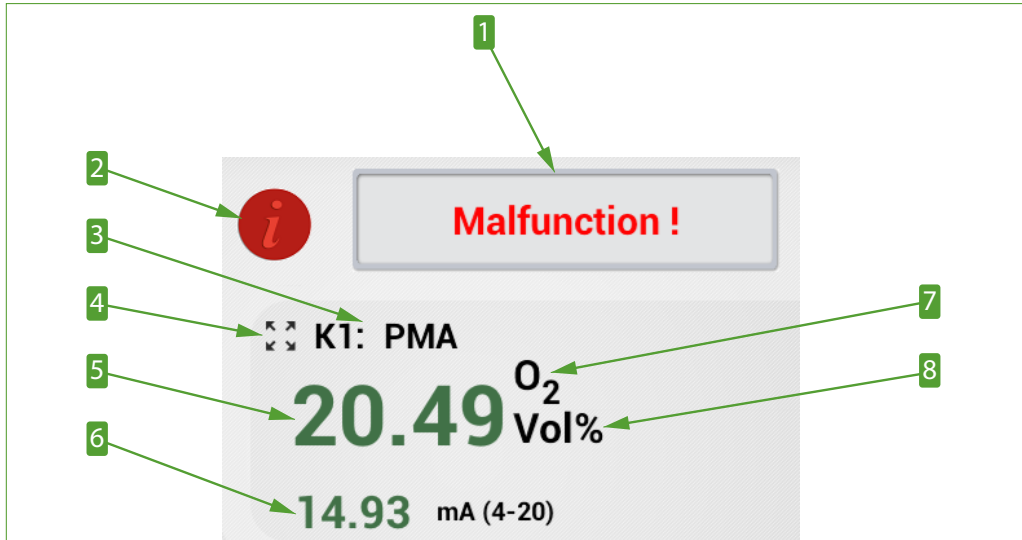


Fig. 16: Main display area

- |                                   |  |
|-----------------------------------|--|
| <b>1</b> Message box              | <b>2</b> Info button (changes color depending on status) |
| <b>3</b> Channel Name: channel ID | <b>4</b> Zoom button                                     |
| <b>5</b> Measured value           | <b>6</b> mA-Display (measuring range)                    |
| <b>7</b> Molecule (sensor type)   | <b>8</b> Unit of the measured value                      |

### 7.3.4 Language selection

The language can be selected from any section displayed on the screen. With a tap on the flag symbol the language window opens. Another tap on the selected flag symbol, closes the window and changes the language of the GUI.

Some of the languages are not supported by the current software version.



#### Note

Please note, if the selected language is not available, the flag in the system status line does not change and the language window stays on the screen.



*Fig. 17: Language selection window*

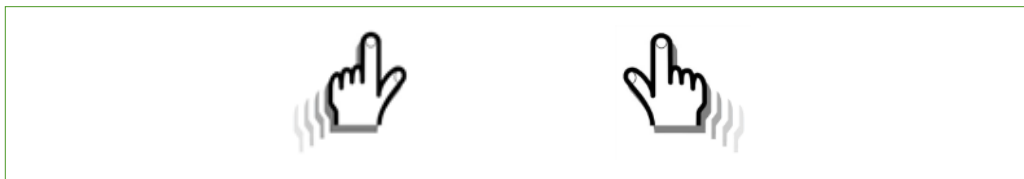
### 7.3.5 M1/S1 and M1/S2 - M&C contact and GUI version number

You will reach menu 1 (M1) by tapping on the button with the M&C-logo on the right hand side. If you tap on the M&C-logo, the first section opens.



*Fig. 18: M1/S1 - M&C contact information*

To navigate through the sections, please swipe horizontally. Swipe to the left side to reach the next sections. By swiping to the right side you will go back to the previous sections.



*Fig. 19: Swipe to navigate through the sections*

The second section of M1 shows information about the current software version, type and components of the analyzer. To get more information about the analyzer configuration, please tap on the green information button.

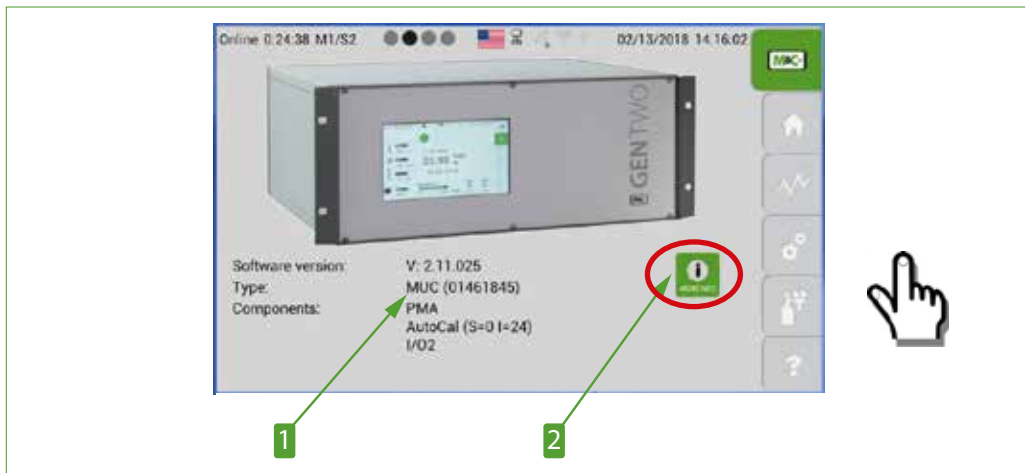


Fig. 20: M1/S2 - Analyzer configuration

- 1** Software version, type and components      **2** Button for more detailed information

After tapping on the green button, a screen with more detailed information about the current software version of the GUI opens.



Fig. 21: Detailed information about the GUI software version

To get back to the M1/S1 screen, please swipe horizontally to the right side or tap on the M&C button M1.



Fig. 22: Navigate back to the M1/S1 screen

### 7.3.6 M1/S3 - Pneumatic connections

This window shows the schematic of the gas connections and the gas lines inside the PMA1000(L)V2.2 analyzer.

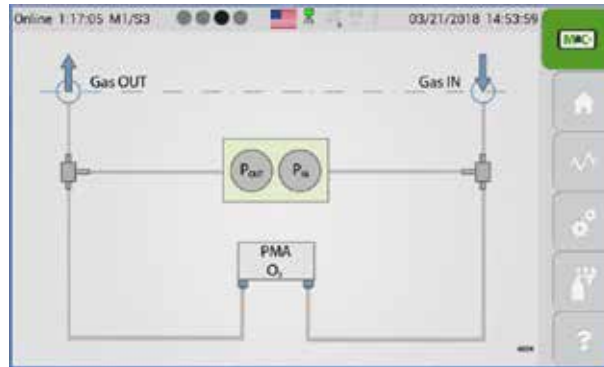


Fig. 23: M1/S3 - Pneumatic connections of the analyzer

### 7.3.7 M1/S4 - Operating hours counter

The operating hours counter shows the days and hours that the entire device and the individual channels are in operation. Under 'Service' the operating times are listed, according to which the components of the used channels should be serviced.

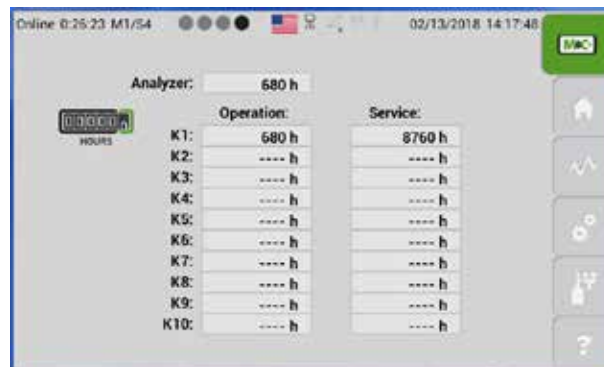


Fig. 24: M1/S4 - Operating hours counter (OHC)

### 7.3.8 M2/S1, M2/S2 - Measured values, operating parameters and limits

To reach the sections of the second menu item of the menu bar M2, please tap on the home button. The main display area shows:

- currently used channel with channel name
- measured value
- unit of your measured value
- type of gas you are measuring
- bar graph with measuring range of your measurement and an indicator light

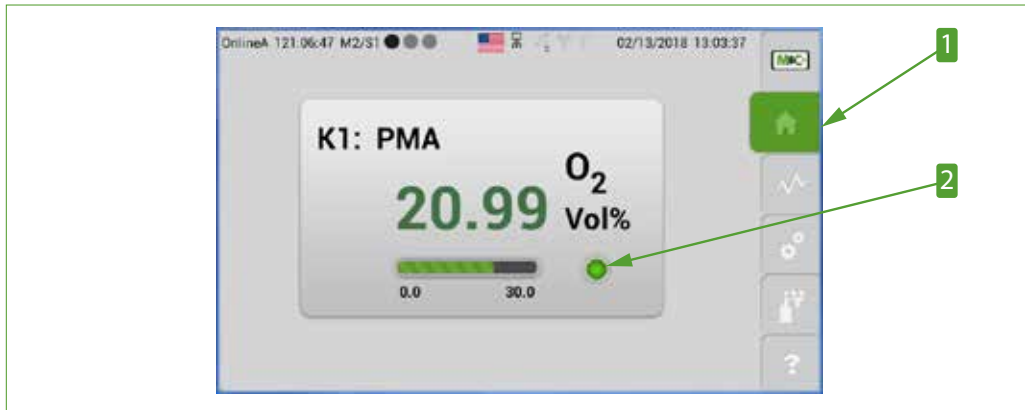


Fig. 25: M2/S1 - Start screen of the home button

**1** Home button M2

**2** Indicator light (status: green, yellow or red)

The second section shows a more detailed view of the measuring parameters. The info button on the next screen is green, that indicates that the instrument is in standard operation mode.



Fig. 26: M2/S2 - Detailed view of the measuring parameters

To get back to the start screen M2/S1, please swipe to the right or tap on the home button.



Fig. 27: Navigate back to the start screen

The warm-up period of the PMA1000(L) V2.2 takes about six minutes, starting from 25 °C. During the warm-up period the info button on the M2/S2 screen turns yellow, to show that the device is not ready for operation yet. Instead of the mA-measuring range, a line will appear saying 'warmup'.

During warm-up the mA-measuring range and the operating parameters are not activated. The default value for the mA-output is set to zero mA.



*Fig. 28: M2/S2 - Detailed view during warm-up period*

The zoom button on the M2/S2 section lets you zoom-in into the main display area. Please tap on the zoom button next to the channel information.

In the zoomed view the measurement value display is highlighted and the data is displayed larger with less information.



*Fig. 29: M2/S2 - Using the zoom button*

To get back from the zoomed view to the standard view, please tap anywhere on the highlighted area.



Fig. 30: Zoomed and highlighted area

### 7.3.9 M2/S3 - List view of the measured values

This screen shows an overview of all measured values in chronological order. The values can also be selected by channels, if your device features more than one channel.

The notifications on the list are color-coded:

- Green: OK
- Yellow: Warning/ the value reached or exceeded the operating parameter limit
- Red: Error or malfunction
- White: Zero (offset) and Span (Gradient)

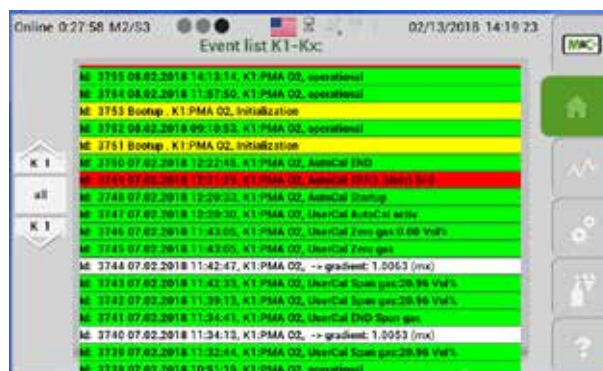


Fig. 31: M2/S3 - List view of the measured values

You can reach this screen by swiping through the sections of menu item M2 or by tapping on the info button.



### 7.3.10 M3/S1 - Data logger/history archive

The data logger screen opens, when you tap on the third menu item of the menu bar. This screen shows the recorded data in a diagram.

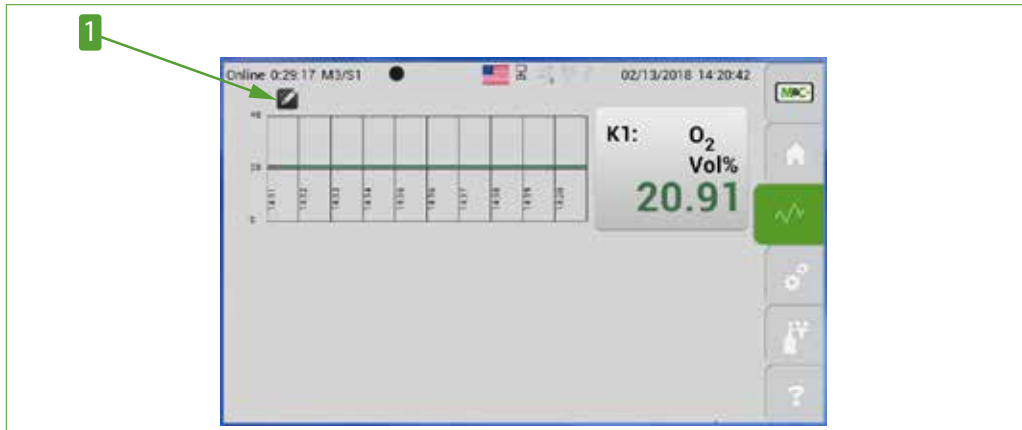


Fig. 32: M3/S1 data logger screen

**1** Edit button

Please tap on the edit button. The calendar display opens. It displays month, day and hour in separate scroll bars. To select a prior measurement, please scroll to the date and time of the measurement you are looking for.



#### Note

If the month, day or hour of your selected measurement is already displayed, please tap on the corresponding scroll bar to reconfirm this selection.

The history archive can store data up to 365 days. The data structure of the data logger is a circular buffer. To load the recorded data, please tap on the green 'Data update' button.



Fig. 33: M3/S1 - Recorded data selection screen

**1** Area for displaying the calibration symbols

**2** 'Data update' button

**3** '\*.csv exporting' button

The measured data can be saved as a CSV-file on a USB stick. The CSV-file can be opened in a spreadsheet application like MS Excel.

To export data please select month, day and hour of the required data recordings. Each file can only store one hour of recorded data.

Please tap on the ‘\*.csv exporting’ button to export the selected data.



**Note**

If you don’t select the hour of the recorded data, the measurements of the whole month or day will be displayed in the diagram.

This amount of data is too large to save in one file. To prevent a larger file size the ‘\*.csv exporting’ button will not be displayed if the data is recorded for more than an hour.



**Fig. 34: Calibration symbols to highlight calibration procedures**

The calibration symbols are displayed in the upper half of the diagram in section M3/S1. They indicate successfully completed and failed calibration processes. The red symbol shows failed calibration processes and the green symbol indicates a successful calibration.

### 7.3.11 M4/S1 - Measuring range selection and parameter settings

To set your measuring range and operating parameter limits, please tap on the settings button M4 in the menu bar. For each setting an edit button appears on the screen.

To select a predefined measuring range and set the two available limit values, press the corresponding edit button.

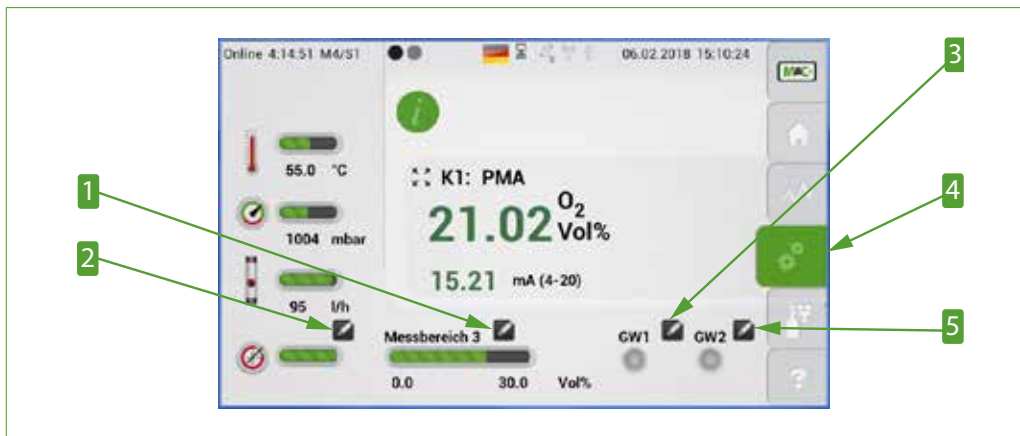


Fig. 35: M4/S1 Edit buttons for measuring range and operating parameter settings

- |  |   |
|--|---|
| <b>1</b> Edit button for measuring range selection | <b>2</b> Edit button for parameter list |
| <b>3</b> Edit button for alarm limit Lim1          | <b>4</b> Settings button M4             |
| <b>5</b> Edit button for alarm limit Lim2          |   |

When you tap on the edit button close to the measuring range the highlighted scroll bar opens. The active edit button changes to a green check mark. Please scroll through the predefined measuring ranges by swiping vertically.

The selected measuring range needs to be displayed in the gray frame in the middle of the scroll bar. Please tap on the green check mark to confirm your selection.



Fig. 36: Highlighted scroll bar to select measuring range

1 Scroll bar to select measuring range

2 Active edit button changes into a check mark

There are four measuring ranges:

Measuring ranges [Vol.-%]			
MR1	MR2	MR3	MR4
0.0 to 1.00 (can not be modified)	0.0 to 10.0	0.0 to 30.0	0.0 to 100.00 (can not be modified)

You will find a more detailed description about the measuring range selection on page 36 chapter 'M4/S2 - Settings menu/ parameters'.

The parameter list shows the real measured gradient and the real offset of the oxygen concentration and, for comparison, the factory setting of the gradient and the offset. The real gradient and offset can deviate from the factory settings as long as the values are staying in the stated range. Is the current gradient or offset higher or lower than the permitted range, the indicator below the edit button turns from green to red, but only if the parameter 'Rating active' is turned on.

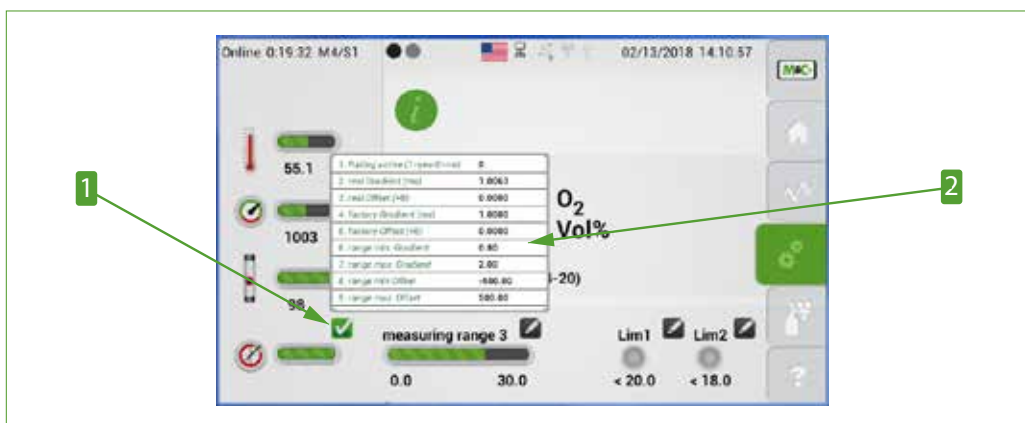


Fig. 37: Parameter list

1 Edit button to open parameter table

2 Parameter list of the sensor ratings

To change the value of Lim1, please tap on the edit button to the right of operating parameter 'Lim1'. A scroll bar will open, where you can select numbers before and after the decimal point. The selected value needs to be displayed in the gray frame in the middle of the operating parameter scroll bar. Please tap on the green check mark to confirm your selection.



Fig. 38: Highlighted scroll bar to set operating parameter Lim1

- 1 Selected value for Lim1
- 2 Active edit button changes into a check mark
- 3 Indicators for operating parameter Lim1 and Lim2
- 4 Current operating parameter values Lim1 and Lim2 (setting not activated by default)

To select operating parameter Lim2, please follow the same steps as for Lim1.



Fig. 39: Highlighted scroll bar to set operating parameter Lim2

- 1 Selected value for Lim2
- 2 Active edit button changes into a check mark
- 3 Indicators for exceeding the value of operating parameters Lim1 and Lim2

To define operating parameter values and change the calculation method behind the values, please refer to chapter 'M4/S2 - Settings menu/ parameters'.

### 7.3.12 M4/S2 - Settings menu/ parameters



#### Qualified personnel

Changing settings can only be done by qualified personnel.

In section M4/S2 you can define the parameters for the scroll bars you are using in section M4/S1. The screen of section M4/S2 shows a scroll bar and a green 'Restart' button.

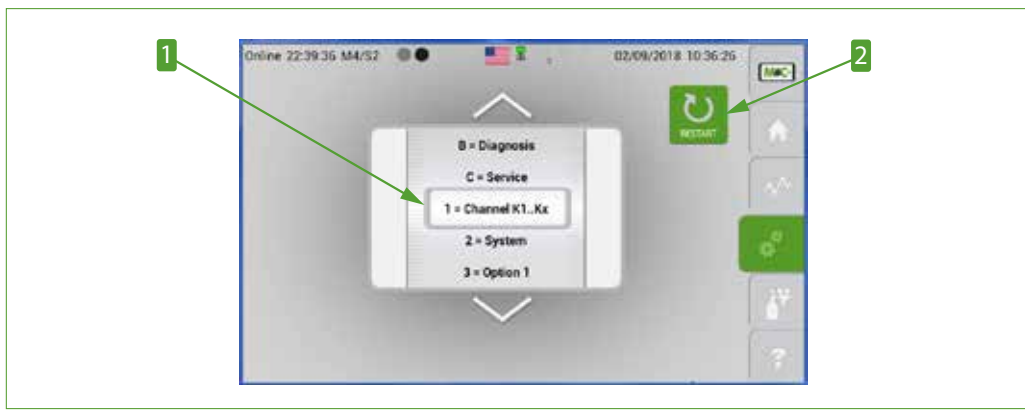


Fig. 40: M4/S2 screen with 'Restart' button

**1** Scroll bar

**2** Restart-Button

After tapping on the 'Restart' button, a screen opens where you need to confirm the restart of the analyzer. The restart of the analyzer interrupts the measurement and deletes all data collected during this day.

The RAM stores data collected from 12:00 a.m. until the next day at 12:00 a.m. After 24 hours of collecting data in the RAM, this data will be stored permanently in the flash memory of the analyzer. Any measuring values collected from 12:00 a.m. to the restart of the analyzer will be deleted from the RAM.

Loss of data!

#### NOTICE

By tapping on the 'Restart' button, the measuring process is interrupted. The current measuring values in the RAM which are not permanently saved, are lost.

With the scroll bar in section M4/S2 you can select different parameters. In the first range there are 9 parameters and in the second range two, A and B.

To make sure that the settings will not be changed by accident, you will need to select the parameter first by displaying it in the gray frame, and then tap on the 'hidden password'.



#### Note

To select the parameters in the settings menu, please display the selected parameter in the gray frame of the scroll bar, and then tap on the word 'Online' on the left-hand side of the system status line.

With tapping on the hidden password, you are opening the settings screens, where you can change the current settings.

## NOTICE

The measuring process is idle as long as a settings screen is open. In this case alarm and status information are not current.

Immediately close any settings screens to prevent potentially dangerous situations, which will not be recognized by the analyzer during its idle time.



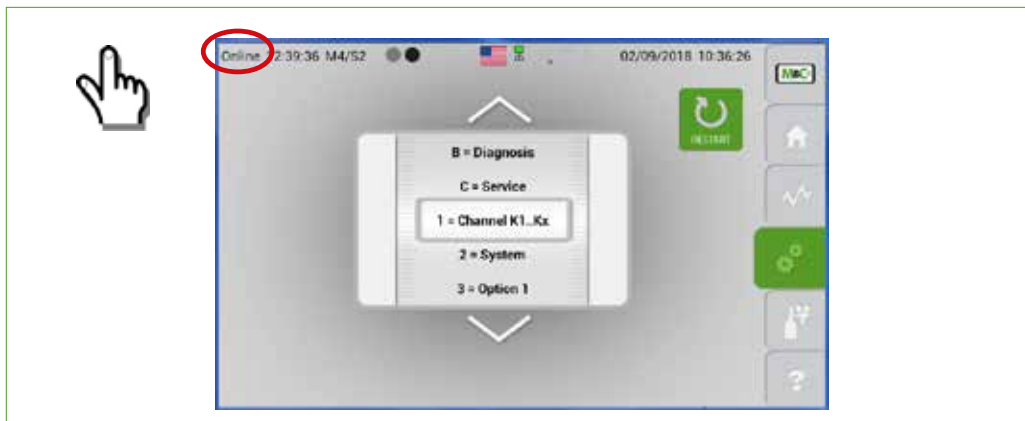
## Note

When a settings screen is open, the display stays on this settings screen.

All other screens jump back to the start menu M2/S1, if the touch-screen has not been used for 3 Minutes.

### ■ 1 = Channel K1-Kn settings

The first screen of the M4/S2 Settings menu/parameter-section shows the channel selection '1 = Channel K1-Kn'. Please tap on the word 'Online'. The next display shows a list of the basic channel settings.



*Fig. 41: M4/S2 Settings menu and parameter screen*



## Note

The display shows only part of the list. Scroll down the list by swiping vertically or by pressing the arrow buttons to have a look at all parameters.

Here you can change the name of your channel. To change the name, please tap on the 'channel ID' field. The whole field will be highlighted in orange and the name 'channel ID' will be displayed in the message box.

Tap on the message box to open the keypad.



Fig. 42: Basic settings for channel 1

- 1 Selection button
- 2 Channel selection scroll bar
- 3 Message box
- 4 Highlighted field

Here you can enter the new channel name.

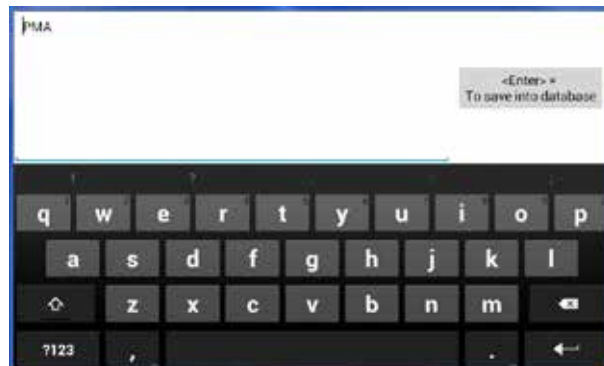


Fig. 43: Keypad

Please tap on the '<Enter> = To save into database' button to confirm your new channel name. After your confirmation, you will get back to the parameter list.

There are several more detailed parameters regarding the channel settings. To open a list with these detailed parameters, please tap on the 'Selection' button. In this list you will find the following channel-specific settings:

- 1 = Basic settings
- 2 = Hardware configuration
- 3 = Calibration /Adjustment
- 4 = Measuring range setting
- 5 = Operational limits
- 6 = Sensor rating
- 7 = Linearization



By tapping on the items of the list, you will reach the corresponding screen to enter the settings.

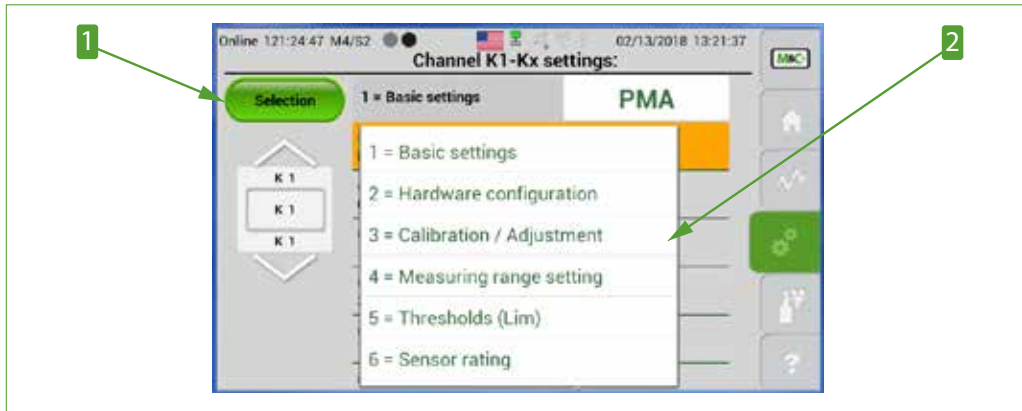


Fig. 44: Channel-specific settings list

**1** Selection button

**2** Channel-specific settings list

Here is a list of the parameters which belong to the '1 = Channel K1-Kn settings'.

Parameter description	Default value
<b>Selection: 1= Basic settings</b>	
channel ID	PMA
concentration averaging value: no=0, yes=1..100	0
unit temperature (1 = °C, 2 = °F)	1
unit pressure (1 = bar, 2 = hPa, 3 = mbar, 4 = psi)	3
unit sample flow (1 = l/h, 2 = l/min)	1
number of decimal digits	2
<b>Selection: 2= Hardware configuration</b>	
correction factor sample flow	1.000
mA range 1=0-20 mA, 2=4-20 mA	2
gas flow from Kx (1...n)	1
pressure reading on screen Kx (1...n) enable=0, disable=1	0
flow reading on screen Kx (1...n) enable=0, disable=1	0
Negative reading enable: 0=yes, 1=no active	0
pressure compensation: 0=no, 1=P-In, 2=P-Out	2
Assignment sensor module values (No. 1-3)	1

Parameter description	Default value
<b>Selection: 3= Calibration / Adjustment</b>	
pressure calibration offset P-IN	0.000
pressure calibration offset P-OUT	0.000
zero gas [vol%]	0.000
span gas [vol%]	20.960
Calibration: gradient (mx)	1.000
Calibration: Offset (+b)	0.000
Holding time [s] of digital out 2, Cal. mode after calibration	1
Calibration: MIN range zero gas [vol%]	-2.000
Calibration: MAX range zero gas [vol%]	2.000
Calibration: MIN range span gas [vol%]	19.000
Calibration: MAX range span gas [vol%]	24.000
Calibration: MeasRange for zero gas	1
Calibration: MeasRange for span gas	4
AutoCal: zero gas [vol%]	0.000
AutoCal: span gas [vol%]	20.960
AutoCal: MIN range zero gas [vol%]	-2.000
AutoCal: MAX range zero gas [vol%]	2.000
AutoCal: MIN range span gas [vol%]	19.000
AutoCal: MAX range span gas [vol%]	24.000
AutoCal: MeasRange for zero gas	1
AutoCal: MeasRange for span gas	3
<b>Selection: 4= Measuring range setting</b>	
measuring range at start	3
measuring range 2 from [vol%]	0.000
measuring range 2 to [vol%]	10.000
measuring range 3 from [vol%]	0.000
measuring range 3 to [vol%]	30.000
<b>Selection: 5= Thresholds (Lim)</b>	
op. Lim1 [vol%]	- (20.000*)
op. Lim2 [vol%]	- (18.000*)
op. mode Lim1 0: inactive, 1: <, 2: ≤, 3: >, 4: ≥	0 (1*)
op. mode Lim2 0: inactive, 1: <, 2: ≤, 3: >, 4: ≥	0 (1*)
threshold pressure [mbar] min	600
threshold pressure [mbar] max	1600

Parameter description	Default value
<b>Selection: 6= Sensor rating</b>	
Sensor rating: Rel. deviation\nCalculation active: 0=no, 1=yes	0
Sensor rating: Rel. deviation\nRange min Gradient (mx)	0.800
Sensor rating: Rel. deviation\nRange max Gradient (mx)	1.200
Sensor rating: Rel. deviation\nRange min Offset (+b)	-5.000
Sensor rating: Rel. deviation\nRange max Offset (+b)	5.000
Sensor rating: Factory value\nGradient (mx)	1.000
Calibration: Factory value\nOffset (+b)	0.000
<b>Selection: 7= Linearization</b>	
Linearisation polynomial m. range 1 active=1, inactive=0	0
Linearisation polynomial m. range 2 active=1, inactive=0	0
Linearisation polynomial m. range 3 active=1, inactive=0	0
Linearisation polynomial m.range 4 active=1, inactive=0	0

\* If the operating modes for Lim1 and Lim2 are set to '1', the current operating parameters Lim1 [vol%] and Lim2 [vol%] are displayed on the M4/S1 screen. The default operating parameters are for Lim1: 20.000 vol%, and for Lim2: 18.000 vol%.

## ■ 2 = System settings

The system parameters are the second group of parameters which can be set by the user.

To go from the channel settings screen to the system settings, please tap on the settings button M4. The section M4/S1 opens. Please swipe horizontally to reach section M4/S2 with the scroll bar.

Swipe the scroll bar vertically or tap on the arrows to display '2= System' in the gray frame, then tap on the hidden password 'Online'.

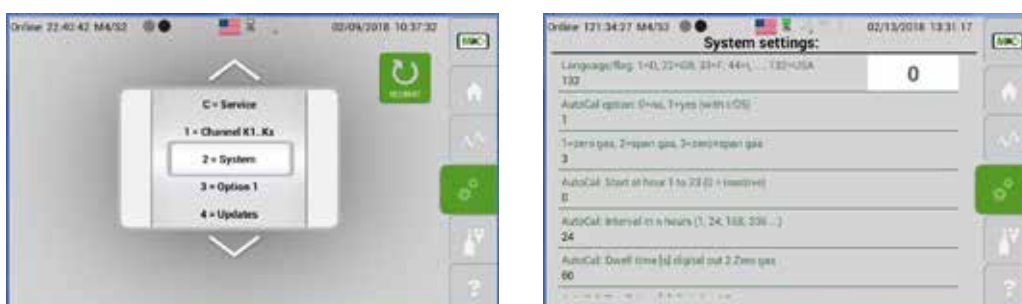


Fig. 45: After selecting '2 = System', the screen with system settings opens



### Note

A restart of the analyzer is necessary after changing the system settings.

Here is an overview of the system settings.

Parameter description	Default value
Language: 1 = D; 22 = GB; 33 = F; 44 = I, ..., 132=USA	132
AutoCal option: 0 = no; 1=yes (with I/O-AC)	1
1 = zero gas, 2 = span gas, 3 = zero + span gas	1
AutoCal: Start at hour 1 to 23 (0 = inactive)	0
AutoCal: Interval in n hours (1, 24, 168, 336...)	24
AutoCal: Dwell time [s] Digital-Out 2 Zero gas	60
AutoCal: Dwell time [s] Digital-Out 3 Span gas	60
AutoCal: Dwell time [s] RS1 AutoCal end	60
System time [s] until back to the main menu display	120
Screensaver Brightness: 20 ... 100%	35
flow error ignore: 0=no, 1=active	0
Interval time [h]: main unit	8760
1. Operating hours counter	0
1. Interval time [h]	8760
...	...
10. Operating hours counter	0
10. Interval time [h]	0

### ■ 3 = not available

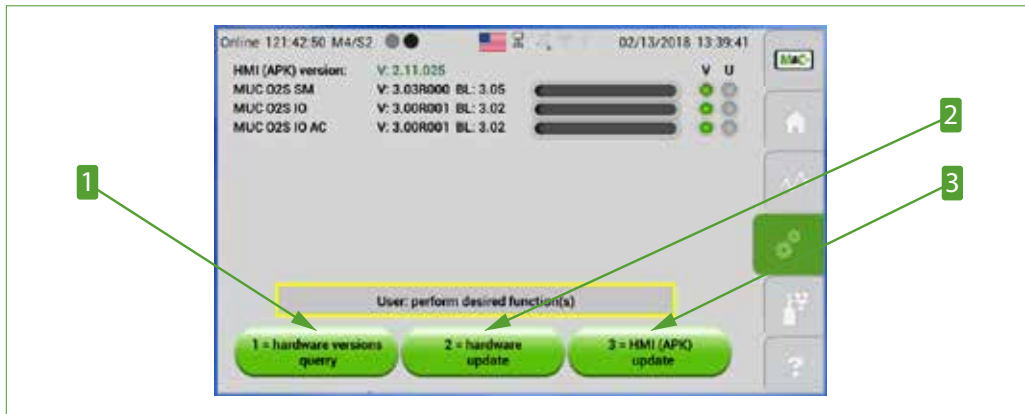
This feature is not available.

### ■ 4 = Updates

To update the firm ware, please open the 'Updates'-screen.



Fig. 46: Scroll bar with '4=Updates' displayed in the gray frame



**Fig. 47: Buttons to get information and install hardware and software updates**

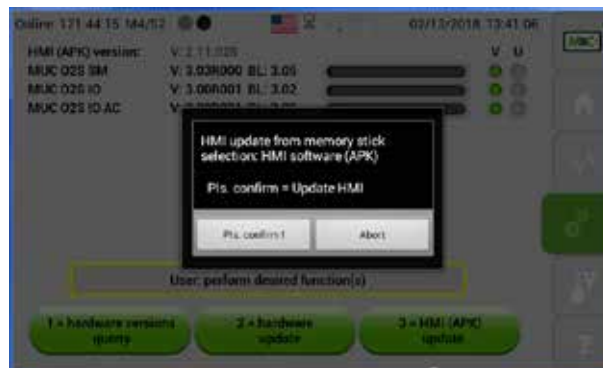
**1** Hardware versions inquiry button

**2** Hardware update button (not active)

**3** HMI (APK App) update button

To get information about the current hard- and software version of all the components in your device, please tap on the '1 = Hardware versions inquiry' button.

With the '3 = HMI (APK App) update' button on the right-hand side the application software can be updated. This update is often called the 'software update' of the device.



**Fig. 48: Screen to confirm the update of the application software**

Please insert a USB stick with the latest version of the software in the USB port located at the rear side of the analyzer. Tap the 'Pls. confirm!' button to start the download of the update.



#### Note

This ends the measurement. After a software update, an update of the database might be also necessary.

Please make sure that the user-defined parameter settings are saved and loaded via the csv-export or import functions.

It might be necessary to enter the user-defined parameter settings again, if the user defined parameters are not properly saved.

■ 5 = Factory reset

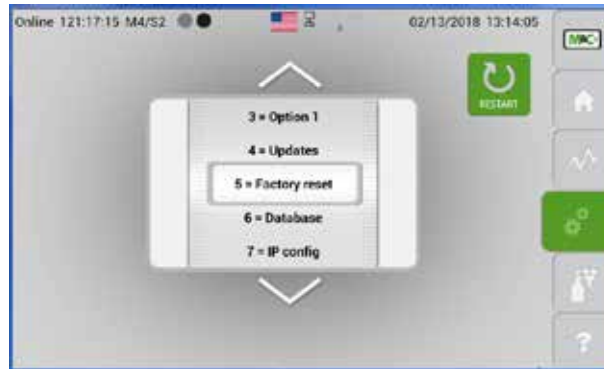


Fig. 49: M4/S2 screen with 'Factory reset' selected

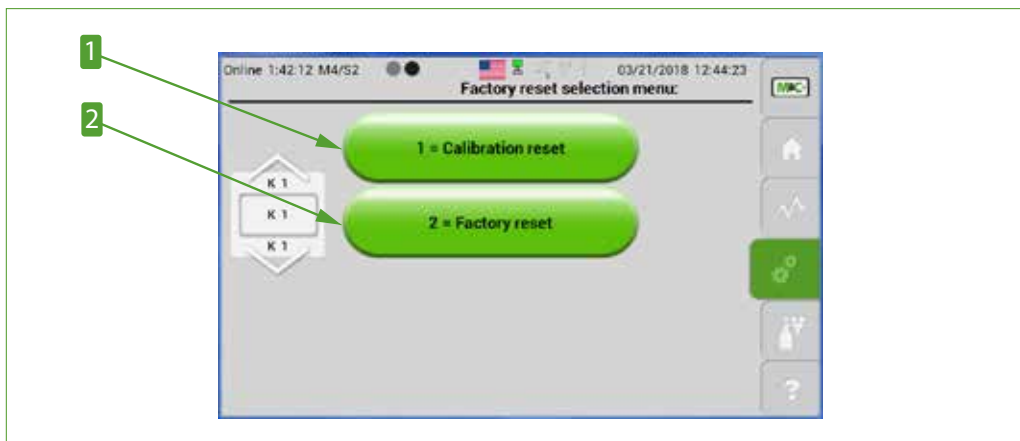


Fig. 50: Default setting menu with two parameters to select

1 Calibration reset

2 Factory defaults

■ 6 = Database



Fig. 51: Database import and export settings

With the '1 = CSV import' and '2 = CSV export' buttons, csv-files can be imported and exported. The '3 = CSV export restoring' button lets you restore an exported csv-file.

■ 7 = IP config



*Fig. 52: IP address input screen*

To enter a new IP address, please tap on the first block of numbers. A keypad to enter numbers opens. Please enter the first block of numbers and press the 'Next' button. Then you can enter the second block of numbers. For the last block of numbers, the 'Done' button appears on the screen. After tapping the 'Done' button, you will get back to the IP address input screen. Please check your new IP address and confirm your entries with the 'Safe & Exit' button.

A window with the info 'IP address: Pls. restart if IP address has been changed' and the 'Pls. confirm!' button opens.



**Note**

If you don't want to change the IP address, please tap on the 'Cancel' button. The 'IP address: Pls. restart if IP address has been changed' window opens, and with tapping on the 'Pls. confirm!' button you will get back to the M4/S1 screen.



**Note**

To successfully change the IP address, it is necessary to restart the analyzer. If you don't reboot your device, the new IP address will not be activated.

### ■ 8 = Date & Time



*Fig. 53: Date and time settings*

Independent from the date and time settings, the format of the date changes from 'DD.MM.YYYY' to 'MM.DD.YYY', when you choose the American flag symbol in the system status line.

### ■ 9 = Supervisor

The administrator settings are only for M&C Service personnel. For questions or more information please contact your M&C contact or authorized M&C distributor.



*Fig. 54: Supervisor settings for administrators*



#### **Note**

If you tap on the hidden password here, the M2/S1 page will open.



#### ■ A = PDF1 update

With the PDF1 update you can download a new PDF-file, which will be displayed, when you tap on the Help button M6.



*Fig. 55: Download a new PDF-file with the latest manual version*

Download the new PDF file to a USB stick. Please contact M&C for instructions. The USB input of the analyzer is located on the back of the device. Tap the 'Pls. confirm!' button to start the download of the PDF-file.

#### ■ B = Diagnosis



*Fig. 56: Scroll bar with 'B=Diagnosis' displayed in the gray frame*

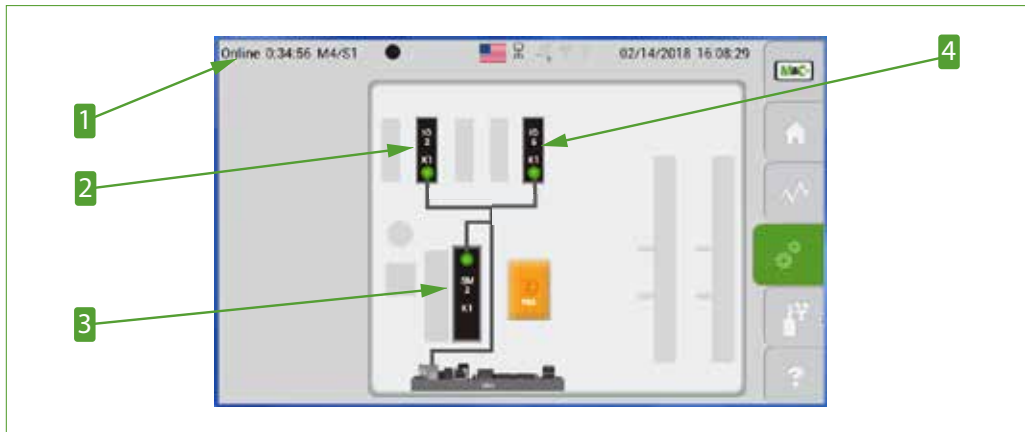


Fig. 57: Schematic for diagnosis

1 Hidden password

3 SM2 hardware components

2 IO2 hardware components

4 IO-AC hardware components (PMA1000 V2.2 only)



### Qualified personnel

Changing settings can only be done by qualified personnel. After tapping on the hidden password the analyzer stops the measuring process. This process is idle as long as the settings screens are open.

To diagnose a part of the analyzer, please tap on the components displayed in the schematic. In the example shown on page 49 in Fig. 58 the IO2 components are selected.

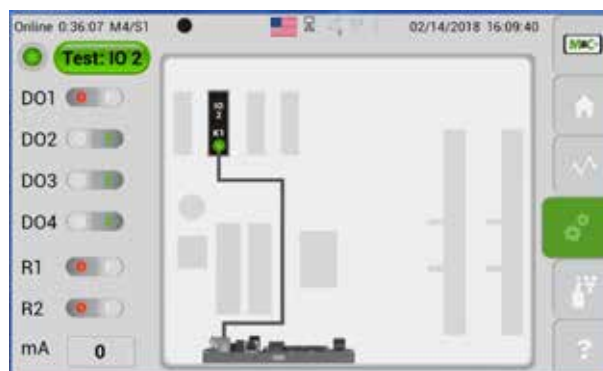
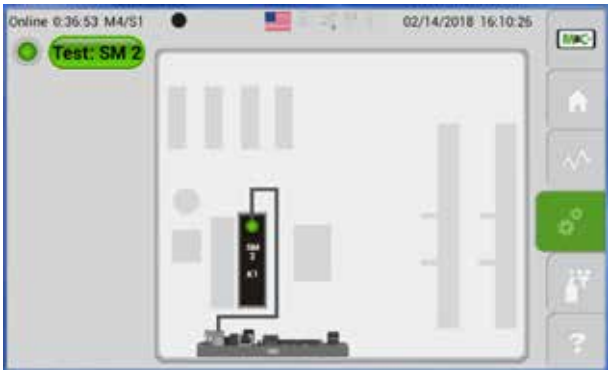


Fig. 58: IO2 components: DO1 to 4, relay outputs R1, R2 and mA output

Here all of the DO- and relay-outputs with the mA-output of IO2 are displayed on the left side of the screen. The switches are active, and you can test them by switching them off ('0') or on ('1'). The mA-output can be changed by tapping on the displayed value. The keypad opens, and there you can enter the new output value. Please tap on the '<Enter>' button to confirm your entry.

To check another part of the hardware, please tap on the module to get back to the M4/S1 diagnosis screen. You can also swipe horizontally to go back to the M4/S2 screen with the scroll bar. Display 'B=Diagnosis' in the gray frame of the scroll bar. Then tap on the hidden password again. The screen on page 49 in Fig. 57 opens. Please tap on the hardware components to select and highlight them.



**Fig. 59: Display of the highlighted SM2 components**

To test the internal data bus, please tap on the SM2 components. The screen displayed on page 50 in Fig. 59 opens.

Please tap on the 'Test SM2' button to initiate the test. The line 'Connection check in progress' appears on the screen.

To return from the M4/S1 diagnosis menu to the start screen, please swipe through the pages or tap on the M&C button M1.



**Note**

You need to tap on the Home button to re-initialise the internal data bus and to set all DO and relay-output settings back to the initial values. A 60 seconds reset phase starts.

This reset is necessary to delete the test data.

■ **C = Service**



**Fig. 60: Reset the operational hour counter for each channel**

After pressing the '1=Operational hours counter' button, a screen with the hours counter and a reset button opens. Here you can reset for each channel the operational hours to zero.

### 7.3.13 M5/S1 and M5/S2 calibration menu

#### ■ Calibration screen



Fig. 61: Gas calibration screen

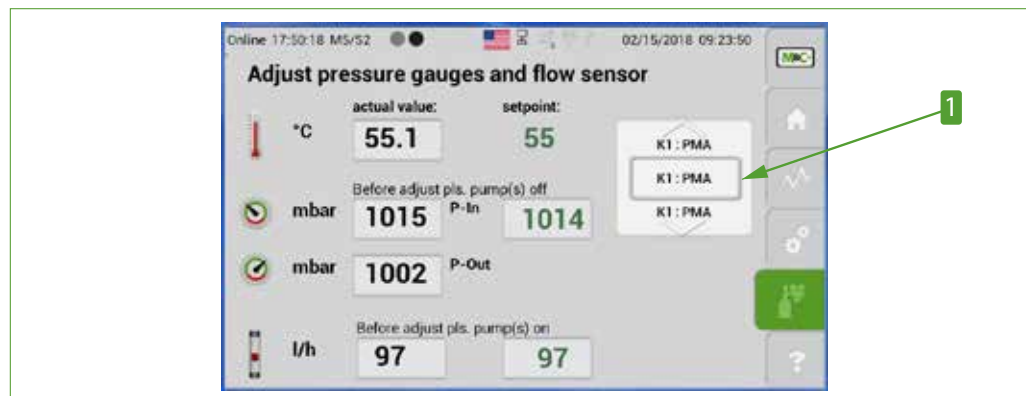


Fig. 62: Adjust pressure gauges and flow sensor

#### 1 Channel selection scroll bar

This section shows the actual value and the set point of the pressure gauges and flow sensor. By tapping on the set point values, the temperature, pressure or flow rate can be adjusted. The actual values change to the new set points.



#### Note

To set P-IN and P-OUT values for the barometric pressure correction, the gas connections must be disconnected, and the analyzer must be free of any gas flow.



#### Note

Please be careful when changing these values. Make sure that you enter the correct values. These values have a direct impact on the measuring values and ranges.

For more information about the calibration of the analyzer, please go to page 57 chapter 'Calibration'.

### 7.3.14 M6/S1 Help button



*Fig. 63: Help button screen*

**1** Zoom buttons

**2** Help button M6

If you tap on the help button M6, a PDF with a short form of the instruction manual opens. This reference guide helps you to answer questions about calibration and operation of the PMA1000(L) V2.2 analyzer.

With the zoom buttons at the bottom of the screen, you can display a whole page on the screen and zoom in and out of the document.

To scroll through the reference guide, please swipe vertically up and down.

## 8 Mounting and installation

### 8.1 General

The PMA1000(L) V2.2 is enclosed in a 19" housing. This gas analyzer is intended for use as a stationary device. The correct installation of the device and proper sample gas conditioning guarantees a long life-time and a minimum of maintenance work. You can optimise the sample gas conditioning by mounting a cooler and fine filter in line before the sample gas enters the analyzer.

If you are planning to use the analyzer outdoors, please make sure to protect the device against any weather influences. The climate conditions should be kept as constant as possible.

Please mount the PMA1000(L) V2.2 in a vibration-free environment. If the environment is not vibration-free, you will need to mount vibration control air springs to de-couple the enclosure from the vibration source.

The analyzer should not be mounted close to a heat source. The normal operating position for the instrument is the horizontal position. The sample gas needs to freely pass through the air outlet of the analyzer without any special precautions.



#### **WARNING**

Explosion hazard!

For general purpose areas ONLY. Don't use the PMA1000(L) V2.2 in hazardous areas or for the measurement of explosive gases.

### 8.2 Installation examples

The PMA1000 V2.2 is equipped with an automatic calibration feature.

The time intervals of the sequence control and the switching outputs are integrated in the functionality of the gas analyzer. Here are two ways to calibrate the analyzer with the AutoCal feature:

- **AutoCal with two test gas lines**

(for example PG1= zero gas, PG2=span gas)

The sample gas pump turns off after valve Y1 is activated.

- **AutoCal with test gas and ambient air**

(for example PG1 = zero gas, PG2 = span gas = ambient air)

The sample gas pump stays on after valve Y1 is activated. The sample gas pump turns off after valve Y2 is activated.

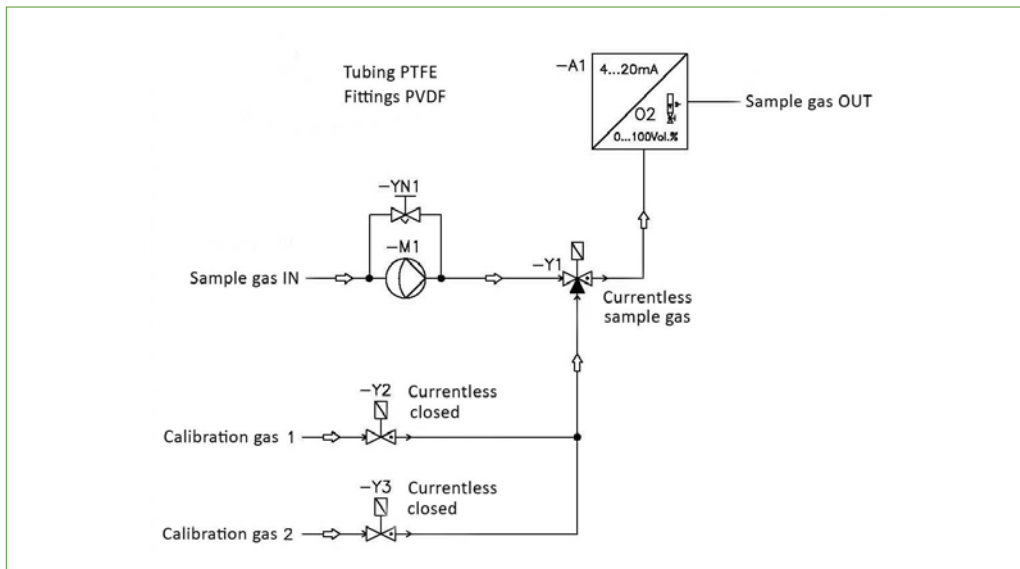


Fig. 64: Example: Span gas calibration with sample gas pump

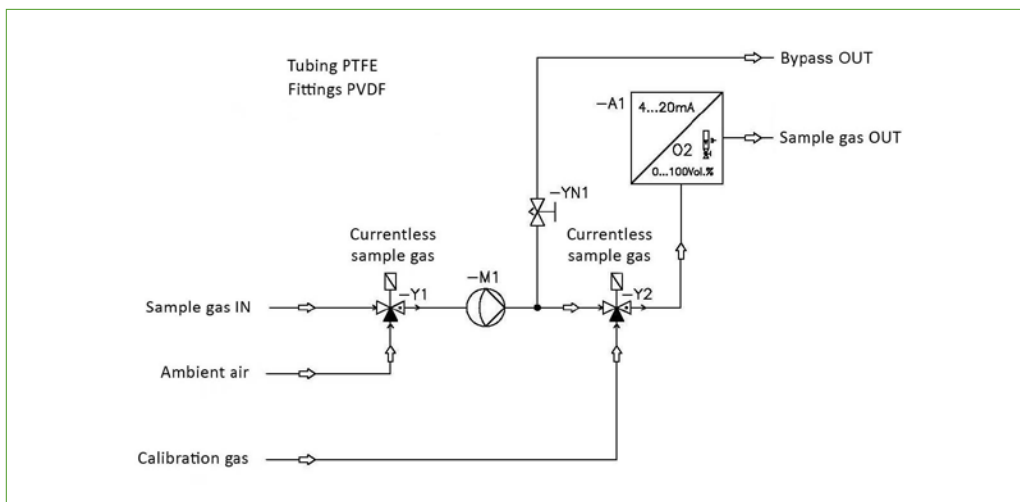


Fig. 65: Example: Span gas calibration with calibration gas from a pressure cylinder



#### Note

The sample gas pump switches off during calibration if you are using a pump controller with the PMA1000(L) V2.2.

## 9 Starting-up and operating the analyzer

### 9.1 General

Please be sure to observe the generally accepted engineering standards, and all of your national and local regulations before starting up the analyzer. Before a real value is displayed, the display remains at 0.00 Vol% for approx. 10 seconds after the analyzer is switched on. After 10 s, the current temperature is displayed during the warm-up phase.

Ensure that the specified voltage displayed on the product label matches the available supply voltage before connecting the device to the supply voltage.

#### NOTICE

Incorrect voltage may damage the device.

The supply voltage must match the technical data displayed on the product label.

### 9.2 Start-up and operation

The operation temperature of the analyzer is 55 °C [131 °F]. After turning the analyzer on, the device starts to warm-up. During this warm-up phase, the current temperature is shown on the screen. The yellow light indicates that the device is not ready to operate yet.

An accurate measurement during the warm-up phase is not possible. After the device has reached the operation temperature, the start screen with the measured values will be automatically displayed on the screen.



Fig. 66: Warm-up phase in M2/S1 and warm-up info on M2/S2



The green indicator light on screen M1/S1 shows that the analyzer is ready to operate.



*Fig. 67: Analyzer is ready to operate*



#### Note

When a settings screen is open, the display stays on this settings screen. This means the analyzer is not in operating mode.

All other screens jump back to the start menu M2/S1, if the touch-screen has not been used for 3 Minutes. The analyzer is still in operating mode.

## 10 Calibration

### 10.1 General

There are currently two analyzer models available: PMA1000 V2.2 and PMA1000L V2.2. The functionality of the L-model includes manual calibration. The PMA1000 V2.2 features an automated calibration tool (AutoCal).

To calibrate the analyzer, you need a test gas with a known oxygen concentration. During the calibration phase the corresponding mA value to the known oxygen concentration is applied to the mA-output.



#### Hazardous Gas!

Caution, hazardous gas! Do not inhale!

### 10.2 M5/S1 Manual Calibration

#### ■ Select your test gas and set calibration parameters

The manual calibration of the analyzer is easy and simple. Please start by selecting your test gas. You can choose between zero gas or span gas.



#### Note

Please don't forget to use the scroll bar and select 'Zero gas' or 'Span gas'. An error message will open, when the test gas is not selected.

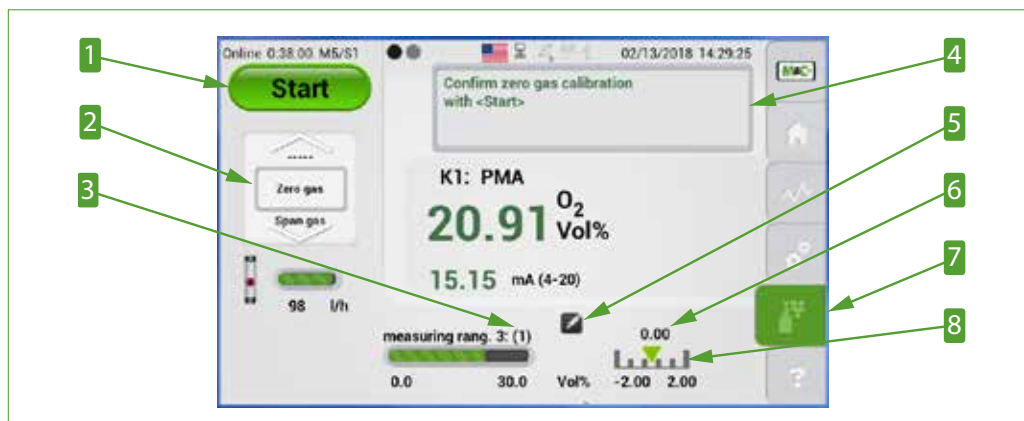


Fig. 68: Manual calibration PMA1000L V2.2

- |  |                                 |
|--|---------------------------------|
| 1 Start button                               | 2 Scroll bar to select test gas |
| 3 Measuring range of calibration in brackets | 4 Message box                   |
| 5 Edit button                                | 6 Test gas concentration        |
| 7 Calibration button M5                      | 8 Calibration range             |

On the calibration screen M5/S1 the measuring range '3 (1)' indicates the current '3' and the calibration measuring range '(1)'.



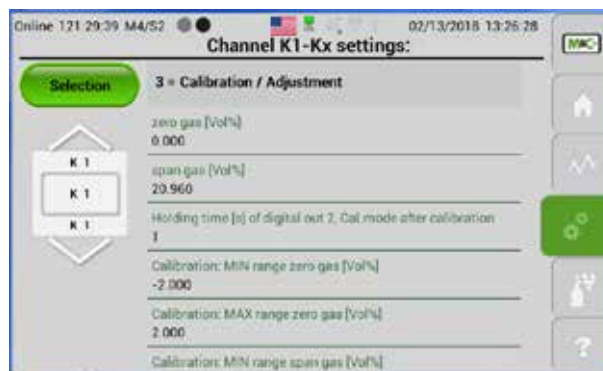
#### Note

The measuring range adjusts automatically to various calibration gas concentrations while in calibration mode.

The test gas concentration, here '0.0', is shown above the green arrow on the right hand-side at the bottom of the screen. The green arrow is pointing at a calibration range of '-2.0 to +2.0 vol%'. The value of the actual gas and the test gas concentration needs to be in this predefined measuring range.

To adjust the calibration range or test gas concentration, please tap on the edit button.

The M4/S2 screen opens with the channel-specific parameter '3 = Calibration'. Here you can enter the parameters of your test gas and change the calibration range.



**Fig. 69: Setting the channel-specific calibration parameters**

Please set the values to meet your calibration requirements. After adjusting the parameters, please tap on the Calibration button M5 to confirm your entries.

#### ■ Example of a manual calibration procedure with span gas



**Fig. 70: Manual calibration with span gas**

Example: in 'Fig. 70 Manual calibration with span gas' the test gas has a 20.96 vol% oxygen concentration.



### Note

The concentration of the sample gas and the test gas must be within the maximum calibration range.

If you change the test gas concentration, you must adjust the maximum calibration range to the new test gas concentration. An error message appears if the test gas used does not fit within the maximum calibration range.

Please tap on the start button to initiate the manual calibration procedure. This tap on the start button triggers the status relay R2, which is part of the IO2 hardware components (digital output port X32).



**Fig. 71: First step of the manual calibration procedure**

The label on the start button changes to '1. Step' button.

Please tap on '1. Step' button to confirm the next step of the manual calibration procedure.



### Note

PMA1000 V2.2 only: This tap activates the AutoCal valves DO1 (switching between sample/test gas) and in addition DO2 for zero gas or DO3 for span gas. The AutoCal valves are triggered by the IO-AC hardware components (digital output port X22).

For PMA1000L V2.2: The test gas lines need to be manually connected and disconnected to the analyzer for calibration. This tap confirms that the test gas is correctly connected.



*Fig. 72: Second step of the manual calibration procedure*

The label on the start button changes to '2. Step' button. Now you have to wait until the measured value is stabilized.

When the measured value on the screen displays a stable reading, please tap on the '2. Step' button to confirm this step of the manual calibration procedure.



*Fig. 73: Third step of the manual calibration procedure*

The label on the start button changes to '3. Step' button.



#### Note

PMA1000(L) V2.2: By tapping on the '3. Step' button, the AutoCal valves DO1 (switching between sample/test gas) and also DO2 (for zero gas) or DO3 (for span gas) will be deactivated. This resets the trigger of the IO-AC hardware components (digital output port X22).



**Fig. 74: End of the manual calibration procedure**

The label on the start button changes to 'Complete'.



**Note**

To continue the manual calibration procedure with another test gas, please scroll to 'Zero gas' or 'Span gas'.

Manual calibration with 'Zero gas' or 'Span gas' can be repeated at any time.

Please tap on the 'Complete' button to reset the status relay R2, which is part of the IO2 hardware components (digital output port X32). This tap ends the calibration mode.

After you tap on the 'Complete' button the display immediately goes back to the start screen.



**Fig. 75: Data logger screen with green calibration symbol**

Calibration procedure are shown in the data logger M3/S1 screen. The green symbols indicate successfully completed calibrations, and red symbols failed calibration procedures.

### ■ Termination of a manual calibration procedure



*Fig. 76: A terminated manual calibration procedure*

A manual calibration procedure can be terminated before the measured values are confirmed and saved. To terminate the procedure, please scroll to the '-----' line. The label on the green button changes to 'Abort'. Tap on the 'Abort' button and the screen changes to the M2/S1 section.

You can also exit the calibration menu by tapping on another menu item. All terminated calibration processes are recorded in M2/S3. This section is shown in this manual on page 31 in Fig. 31.

### ■ Errors during manual calibration procedure



*Fig. 77: Manual calibration error*

An error occurs during the manual calibration procedure, when the test gas has the wrong gas concentration or the actual value does not fit into the predefined measuring range of the gas concentration (calibration range limits).

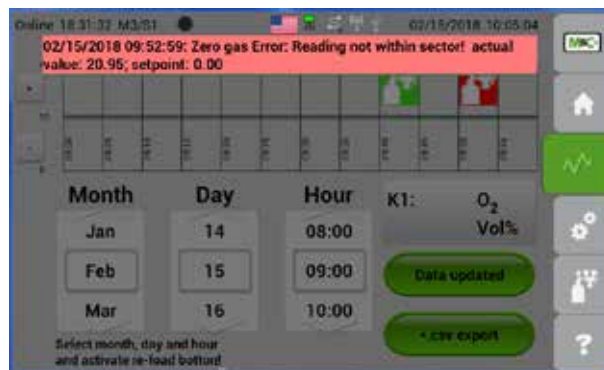
The label on the green button changes to 'Error' and the manual calibration procedure can not be completed.

In the example above, ambient air was used for the calibration procedure. The calibration range was predefined from -2.0 to +2.0 vol%. The oxygen concentration in ambient air does not fit into this predefined calibration range. The calibration procedure could not be completed.



*Fig. 78: Datalogger screen with red calibration symbol*

The data logger shows the failed calibration attempt with a red symbol. Tapping the red calibration symbol makes the screen in Fig. 79 appear.



*Fig. 79: Screen showing details about a single calibration procedure*

A screen with detailed information about the failed calibration procedure opens. In this example it says that the measured value is too high. The measuring range needs to be adjusted to include the measured value.



**Note**

Manual calibration with 'Zero gas' or 'Span gas' can be repeated at any time.



### 10.3 Automatic Calibration (AutoCal)

The PMA1000 V2.2 features an automated calibration tool (AutoCal).

The analyzer is able to activate 3 magnetic valves to switch between sample gas and two test gases (zero and span gas). The magnetic valves are triggered by an integrated time-based sequencing control unit. By using the 24 V DC, 3 A relay outputs DO1 to DO3 (digital output port X22), the corresponding magnetic valves can be opened or closed.

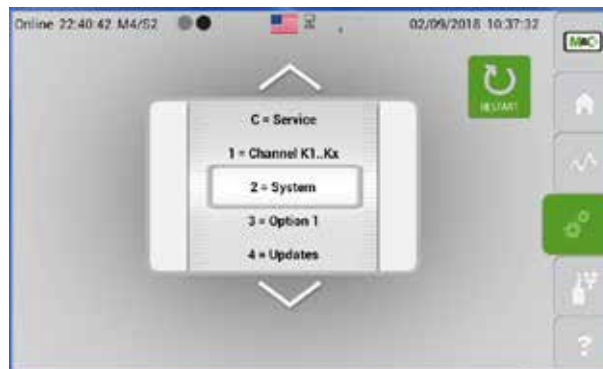
At delivery, the 'Option AutoCal' function is deactivated on the PMA1000L V2.2 and activated on the PMA1000 V2.2.

To prevent the AutoCal function from being started unintentionally by the user, the automatic start in the delivery state is "inactive" (0=inactive). This prevents the analyzer from starting the AutoCal function without prior input of the user-defined settings.

To activate AutoCal, please follow these steps:

#### ■ Go to M4/S2

Please tap on the settings button. Scroll to '2 = System' and tap on the gray frame to confirm your selection, then tap on the hidden password 'Online'.



*Fig. 80: AutoCal activation: open section M4/S2*

The screen with the system settings opens.




Fig. 81: AutoCal activation: change system settings (first part of the list)

- 1 Choice of zero, span or zero and span gas
- 2 Start time (24 hour format)
- 3 AutoCal interval in hours

#### ■ Enter settings

Please change the following system settings to activate the AutoCal functionality:

System settings to activate AutoCal	
1	Choose your calibration gas: zero gas, span gas or zero + span gas.
2	Enter the time of the first AutoCal procedure. E.g. the current time is 13:25 and the required start time for the AutoCal procedure 18:00. In this case, enter '18' for 18 o'clock. A device restart, see note below, is absolutely necessary.
3	Enter the period the AutoCal procedure should be repeated. E.g. 24 h means that the procedure starts daily at 18:00. Further intervals are e.g.: 168h = 1 week, 336h = 2 weeks.
<div>  <div> <p><b>Note</b></p> <p>The interval starts again with each restart of the analyzer.</p> </div> </div>	
4	Waiting period until the measured value of the zero gas is displayed on the screen (DO2).
5	Waiting period until the measured value of the span gas is displayed on the screen (DO3).
6	Waiting period, R1 AutoCal, until analyzer is in operating mode again.

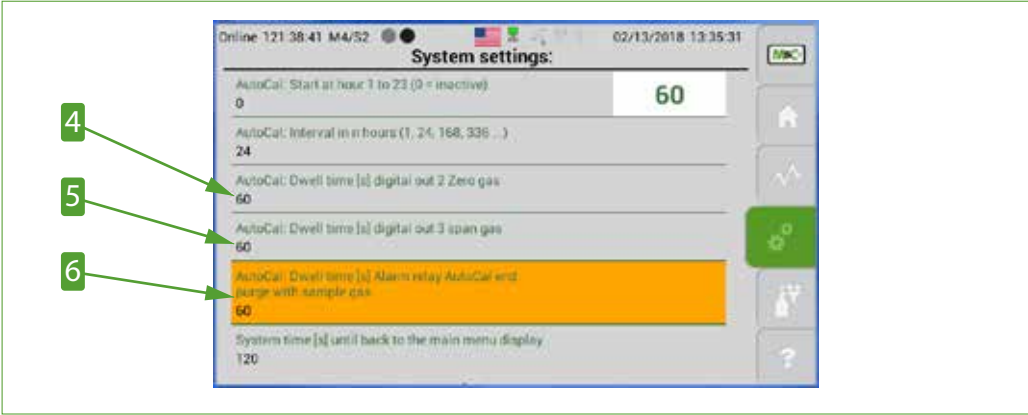


Fig. 82: AutoCal activation: change system settings (second part of the list)

- 4
- Waiting period DO2 zero gas
- 5
- Waiting period DO3 span gas
- 6
- Waiting period R1 AutoCal

After switching from manual calibration to AutoCal, the display changes to: 'Please re-start the device OFF and ON again!'.



**Note** The analyzer needs to be restarted after changing the parameters.

■ Start AutoCal procedure

Please tap on the calibration button. The M5/S1 screen opens. Scroll to 'AutoCal' on the scroll bar at the left hand side.



Fig. 83: Scroll to 'AutoCal' to reach calibration start screen

To the right of the sample gas measuring range, two calibration ranges (1,3) for the test gas concentrations are displayed. These calibration ranges are used to monitor the gas concentration for the automated calibration of zero and span gas.

On the right hand side there are two calibration ranges. The upper calibration range has a range from -2.0 to +2.0 vol%. The value on top of the green arrow is the currently set zero gas concentration, in this example 0.0 vol%.

The lower calibration range, has a range from 19.0 to 24.0 vol%. The currently set span gas concentration value is in this example 21.0 vol%.



Fig. 84: AutoCal start screen

- |   |   |
|---|---|
| <b>1</b> 'AutoCal' selected in gray frame of scroll bar         | <b>2</b> Edit button  |
| <b>3</b> Zero gas: maximum calibration range from -2 to +2 vol% | <b>4</b> Span gas: maximum calibration range from 19 to 24 vol% |



**Note**

The maximum calibration range must include the measured value when a test gas concentration is set.

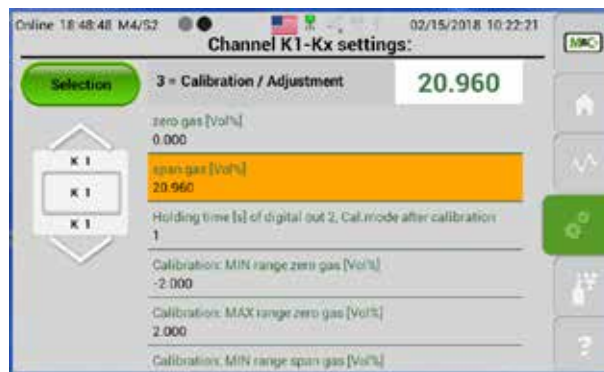
If you change the test gas concentration, you must adjust the maximum calibration range to the new test gas concentration. An error message appears, when the concentration value, measured for the current test gas, does not fit within the maximum calibration range.

These values are predefined. If the actual test gas concentration differs from these values, please tap on the Edit button. The 'Channel K1 - Kn settings' with '3 = Calibration' screen will open, where you can change parameters and values of the test gas concentrations.



**Note**

To reach the AutoCal settings of this screen, please scroll down the parameter list.



**Fig. 85: Parameter screen to adjust test gas measuring ranges and concentrations**

After adjusting the parameters, please tap on the Calibration button to return to section M5/S1. To start the AutoCal procedure, please tap on the green Start button.



**Fig. 86: Tap on Start button to start AutoCal procedure**

The automated calibration procedure starts. AutoCal begins with the zero gas calibration. If you have also set a span gas calibration, this will follow as a second AutoCal procedure.

Info boxes display the current steps during the automated calibration process. The system informs about waiting periods, and shows the actual switching states of the DO and relay outputs.

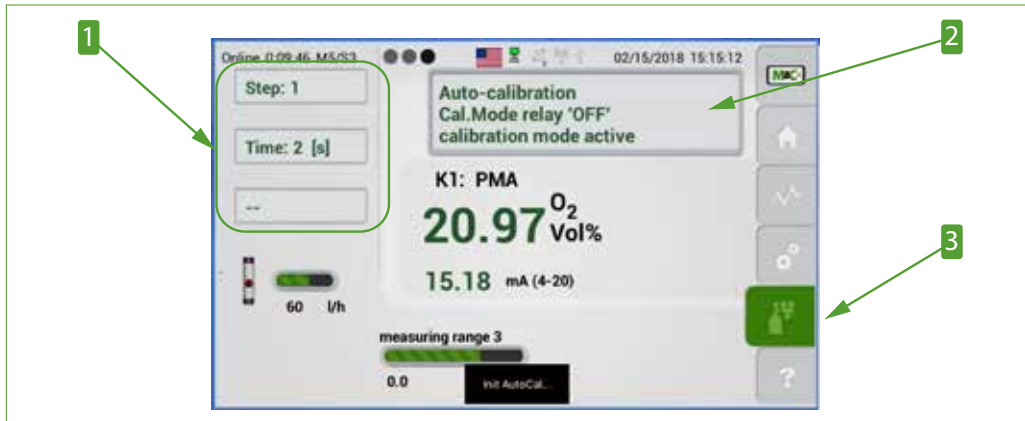


Fig. 87: Information displayed during AutoCal procedure



1 Info boxes



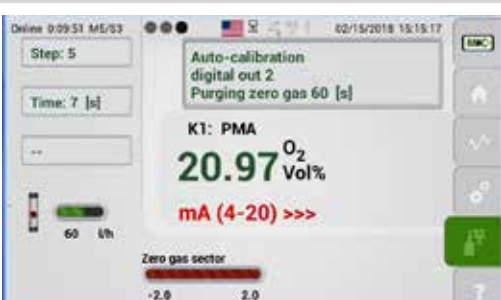

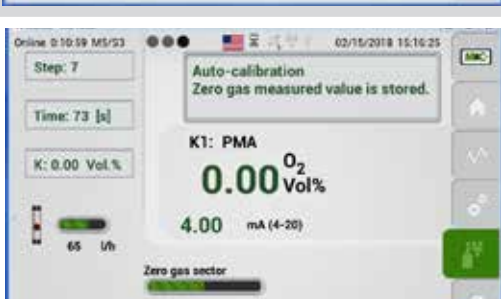
2 Message box

3 Calibration button

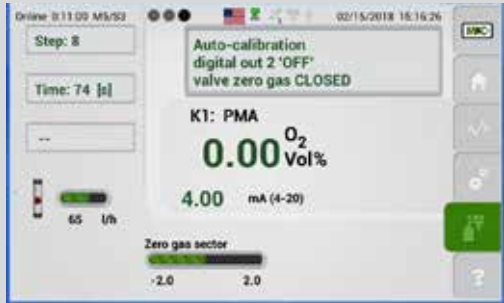
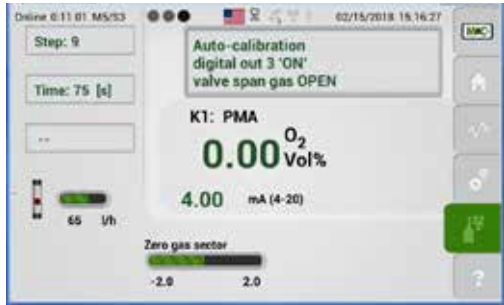
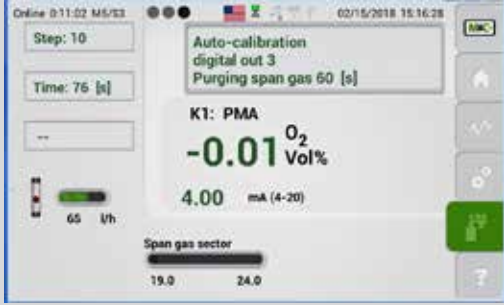


### 10.3.1 AutoCal steps

The AutoCal calibration consists of 17 steps.


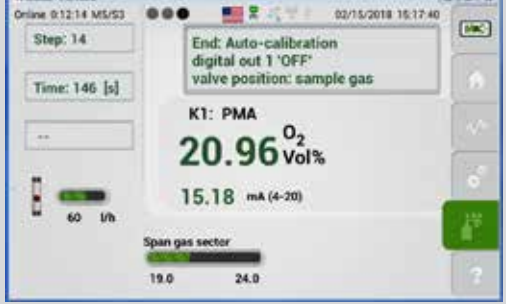
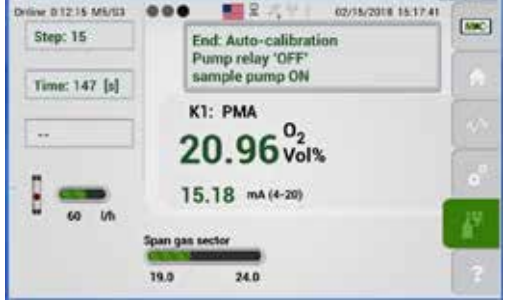
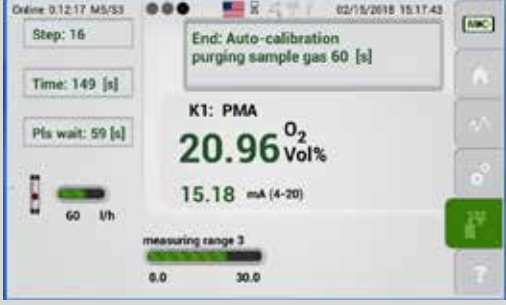

	AutoCal calibration steps	Screen
1	Auto-calibration IO2: Relay R2 (X32) 'OFF'	
2	Auto-calibration IO-AC: Relay R1 (X33) 'ON' sample pump 'OFF'	

	AutoCal calibration steps	Screen
3	Auto-calibration IO-AC: DO1 'ON' Valve position test gas	
4	Auto-calibration IO-AC: DO2 'ON' Valve zero gas	
5	Auto-calibration Dwell time for DO2	
6	Auto-calibration Pls. wait until reading is stable ...	
7	Auto-calibration Zero gas measured value will be stored	



	AutoCal calibration steps	Screen
8	Auto-calibration IO-AC: DO2 'OFF' Valve zero gas	
9	Auto-calibration IO-AC: DO3 'ON' Valve PG1 span gas	
10	Auto-calibration Dwell time for DO3	
11	Auto-calibration Pls. wait until reading is stable ...	
12	Auto-calibration Span gas measured value will be stored	



AutoCal calibration steps	Screen
<b>13</b> End: Auto-calibration IO-AC: DO3 'OFF' Valve span gas	
<b>14</b> End: Auto-calibration IO-AC: DO1 'OFF' Valve sample gas	
<b>15</b> End: Auto-calibration IO-AC: R1 (X33) 'OFF' Sample pump ON	
<b>16</b> End: Auto-calibration Dwell time for R1	
<b>17</b> End: Auto-calibration IO2: R2 (X32) 'ON' calibration completed	

### 10.3.2 AutoCal abort by operator

You can cancel the AutoCal process by tapping on any menu button.



#### Note

After a cancellation, the analyzer is not ready to operate for about 70 seconds.

The screen, after you canceled the AutoCal process, shows 'abort by operator, Pls. wait ... [s]' and the system counts down from 70 seconds. After the timeout period has expired, you can start the AutoCal process again.

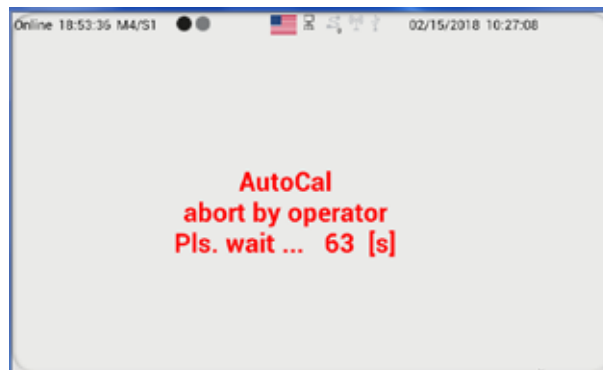


Fig. 88: Canceled AutoCal process

### 10.4 Adjust pressure gauges and flow sensor

Pressure gauges and the flow sensor can be adjusted in the M5/S2 section. You can reach this section by tapping on the Calibration button and swiping left.

While this screen is open, the analyzer is still in operating mode.

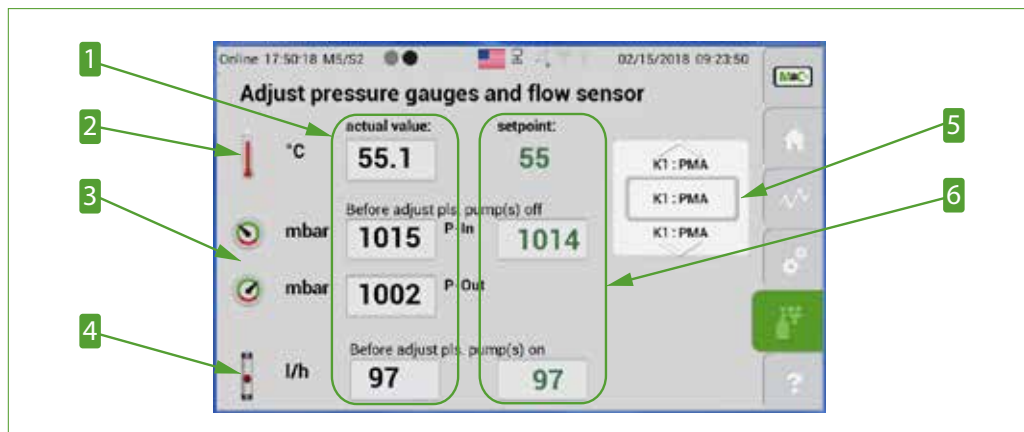


Fig. 89: Adjust pressure gauges and flow sensor

- |                                   |                     |
|-----------------------------------|---------------------|
| 1 Actual values                   | 2 Temperature in °C |
| 3 Pressure P-IN and P-OUT in mbar | 4 Flow rate in l/h  |
| 5 Channel scroll bar              | 6 Set point values  |

By tapping on the set point values, the temperature, pressure or flow rate can be adjusted. The actual values change to the new set points.

**Note**

Please note, that in some configurations the temperature is fixed and cannot be changed.

The pressure sensors P-IN and P-OUT can be calibrated when there is no gas present in the analyzer. The calibration point is set at the atmospheric pressure of the ambient air.

The pressure sensors should be calibrated occasionally. To calibrate the pressure sensors, please remove all gas lines from the analyzer. The removing of the gas lines makes sure that there is no gas flow during the sensor calibration. The pressure sensors will adapt to the atmospheric pressure. Please use a pressure measuring device to determine the current barometric pressure. Enter this value in the 'Set point' field. The pressure sensors are now calibrated and the gas lines need to be connected to the analyzer again.

**Note**

If you change the P-IN set point and don't disconnect the gas connections, both P-IN and P-OUT will accept the same value. In this case the gas flow rate is set to zero and the flow measurement after this change will not reflect the true flow value.

The sample gas flow can be adjusted, when a preset gas flow is present. The correction factor for the flow rate can also be changed in the channel specific settings list (see page 40 'Fig. 44 Channel-specific settings list')

After leaving the section M5/S2, the set points will adopt the actual values shown on the screen. If you open this section again, the actual values and the set points will have the same values.

## 10.5 Cross-sensitivity of coexisting gases

Oxygen is a paramagnetic gas, which means that oxygen molecules are attracted into a strong magnetic field. This paramagnetic susceptibility distinguishes oxygen from most other gases.

The PMC uses this paramagnetic characteristic to measure the concentration of oxygen in a gas mixture.

Here are two examples of coexisting gases which have an effect on the accuracy of the oxygen concentration measurement.

### ■ Example 1

To determine the residual oxygen content of a 100% carbon dioxide (CO<sub>2</sub>) inert gas atmosphere at +20 °C [+68 °F], please take a look at the table in this chapter.

If the PMA1000 V2.2 is calibrated at zero point with nitrogen the reading will show -0.27 %. Then due to the Cross-sensitivity of CO<sub>2</sub> at +20 °C [+68 °F] the analyzer shows a value of -0.27 %. This means, if you calibrate the analyzer with 100 % N<sub>2</sub>, the zero point needs to be set to +0.27 %. This zero point adjustment compensates the effect of CO<sub>2</sub> in the measurement and 100 % CO<sub>2</sub> show a reading of 0 %.

This is an example for a gas composition with CO<sub>2</sub> and O<sub>2</sub> only. To eliminate the cross-sensitivity effects, we can simply use CO<sub>2</sub> instead of N<sub>2</sub> for the zero point adjustment.

### ■ Example 2:

To determine the oxygen content of a gas mixture at +20 °C [+68 °F], please take a look at the following values from the table.

<b>C2H6</b> (Ethane)	1 vol%
<b>O2</b>	5 vol%
<b>CO2</b>	40 vol%
<b>N2</b>	54 vol%

N<sub>2</sub> will be used for the zero point adjustment. The cross-sensitivity values from the table are referring to 100 vol% of the corresponding gases.

To estimate the actual cross-sensitivity of the existing gases, the values need to be adjusted to the real concentrations in the gas mixture.

In general the following formula is applicable:

$$\text{actual. cross-sensitivity} = \frac{\text{value given in the table} \times \text{volume concentration}}{100} \quad (\text{Vol.-%})$$

**Fig. 90: Formula to calculate the effects of coexisting gases**

The adjusted concentration values of the gas mixture components have the following values:

<b>C2H6</b> (Ethane)	- 0.0045 vol%
<b>CO2</b>	- 0.1134 vol%
<b>N2</b>	0.0000 vol%

The value of the sum of the cross-sensitivities is -0.1179 vol%. This value is needed to adjust the zero point. The zero point needs to be set to +0.1179 vol%.

As you see here, the cross-sensitivity is not negligible. If you don't consider the effects of coexisting gases, it could mean an approximately 2% relative error for the whole measurement.

The following table shows the cross-sensitivity of the most important gases at +20 °C [+68 °F] and +50 °C [+122 °F].



#### Note

The cross-sensitivity values from the table are referring to 100 vol% of the corresponding gas at +20 °C [+68 °F] and +50 °C [+122 °F].

All values are corresponding to a zero point calibration of 100 vol% N<sub>2</sub>, and a limit point calibration of 100 vol% O<sub>2</sub>.

Gas	Chemical formula	+ 20 °C [+68 °F]	+50 °C [+122 °F]
Cross-sensitivity values			
Argon	Ar	- 0.23	- 0.25
Acetylene	C <sub>2</sub> H <sub>2</sub>	- 0.26	- 0.28
Acetone	C <sub>3</sub> H <sub>6</sub> O	- 0.63	- 0.69
Acetaldehyde	C <sub>2</sub> H <sub>4</sub> O	- 0.31	- 0.34
Ammonia	NH <sub>3</sub>	- 0.17	- 0.19
Benzene	C <sub>6</sub> H <sub>6</sub>	- 1.24	- 1.34
Bromine	Br <sub>2</sub>	- 1.78	- 1.97
Butadiene	C <sub>4</sub> H <sub>6</sub>	- 0.85	- 0.93
Methyl propene	C <sub>4</sub> H <sub>8</sub>	- 0.94	- 1.06
n-Butane	C <sub>4</sub> H <sub>10</sub>	- 1.10	- 1.22
Chlorine	Cl <sub>2</sub>	- 0.83	- 0.91
Hydrogen chloride	HCl	- 0.31	- 0.34
Nitrous oxide	N <sub>2</sub> O	- 0.20	- 0.22
Diacetylene	(CHCl) <sub>2</sub>	- 1.09	- 1.20
Ethane	C <sub>2</sub> H <sub>6</sub>	- 0.43	- 0.47
Ethylene oxide	C <sub>2</sub> H <sub>4</sub> O <sub>2</sub>	- 0.54	- 0.60
Ethylene	C <sub>2</sub> H <sub>4</sub>	- 0.20	- 0.22
Ethylene glycol	(CH <sub>2</sub> OH) <sub>2</sub>	- 0.78	- 0.88
Ethylbenzene	C <sub>8</sub> H <sub>10</sub>	- 1.89	- 2.08
Hydrogen fluoride	HF	+ 0.12	+ 0.14
Furan	C <sub>4</sub> H <sub>4</sub> O	- 0.90	- 0.99
Helium	He	+ 0.29	+ 0.32
n-Hexane	C <sub>6</sub> H <sub>14</sub>	- 1.78	- 1.97
Krypton	Kr	- 0.49	- 0.54
Carbon monoxide	CO	- 0.06	- 0.07



Gas	Chemical formula	+ 20 °C [+68 °F]	+50 °C [+122 °F]
Cross-sensitivity values			
Carbon dioxide	CO <sub>2</sub>	- 0.27	- 0.29
Methane	CH <sub>4</sub>	- 0.16	- 0.17
Methylene chloride	CH <sub>2</sub> Cl <sub>2</sub>	- 1.00	- 1.10
Neon	Ne	+ 0.16	+ 0.17
n-Octane	C <sub>8</sub> H <sub>18</sub>	- 2.45	- 2.70
Phenol	C <sub>6</sub> H <sub>6</sub> O	- 1.40	- 1.54
Propane	C <sub>3</sub> H <sub>8</sub>	- 0.77	- 0.85
Propylene	C <sub>3</sub> H <sub>6</sub>	- 0.57	- 0.62
Propylene oxide	C <sub>3</sub> H <sub>6</sub> O	- 0.90	- 1.00
Propylene chloride	C <sub>3</sub> H <sub>7</sub> Cl	- 1.42	- 1.44
Monosilane	SiH <sub>4</sub>	- 0.24	- 0.27
Styrene	C <sub>8</sub> H <sub>8</sub>	- 1.63	- 1.80
Nitrogen	N <sub>2</sub>	0.00	0.00
Nitrogen oxide	NO	+ 42.70	+ 43.00
Nitrogen dioxide	NO <sub>2</sub>	+ 5.00	+ 16.00
Oxygen	O <sub>2</sub>	+100.00	+100.00
Sulphur dioxide	SO <sub>2</sub>	- 0.18	- 0.20
Sulphur fluoride	SF <sub>6</sub>	0.98	- 1.05
Hydrogen sulphide	H <sub>2</sub> S	- 0.41	- 0.43
Toluene	C <sub>7</sub> H <sub>8</sub>	- 1.57	- 1.73
Vinyl chloride	C <sub>2</sub> H <sub>3</sub> Cl	- 0.68	- 0.74
Vinyl fluoride	C <sub>2</sub> H <sub>3</sub> F	- 0.49	- 0.54
Water (steam)	H <sub>2</sub> O	- 0.03	- 0.03
Hydrogen	H <sub>2</sub>	+ 0.23	+ 0.26
Xenon	Xe	- 0.95	- 1.02

## 11 Service and maintenance

Before starting any service or maintenance work, please make sure that any work done on the analyzer is in compliance with all relevant regulations and standards.



### **Qualified personnel**

The service and maintenance work should be carried out exclusively by qualified personnel, preferably by M&C or your authorized M&C distributor.



### **High Voltage!**

Disconnect power supply before opening the device for access.  
Make sure that all external power supplies are disconnected.

Please make sure that you also follow the proper precautions by working on unplugged or low-voltage devices. Unplugged devices need to be properly grounded to prevent damage to internal electronics from electrostatic discharges (ESD).

- In case of an error, please check if the conditioning of the sample gas, before the gas enters the analyzer, is in good working condition.
- Please make sure that there are no leaks in the sample gas lines. Check all gas fittings if they are connected correctly.
- To ensure a long analyzer lifetime and accurate operation use only original spare parts and consumables from M&C.

### 11.1 Recommended maintenance work

The routine maintenance work is only limited to monitoring the zero point or limit point, and if necessary, calibrating these values.

The intervals between servicing are dependent on the process and system conditions in your facility.

The facility QA/QC plan should address the frequency for maintenance and should be updated based on your operations and analyzer functionality.

## 12 Options and spare parts list

Option: Filters for front mounting		
Part-No.	Description	Comments
04 F 2100	Filter for front mounting FPF+	Material der medienberührten Teile: PTFE, Glas, FPM
The following parts can only be used in combination with the above-mentioned front installation filter FPF+		
90 F 0002	Filter element type F-2T, length: 75 mm, material: PTFE, pore size: 2 µm	
90 F 0004	Filter element type F-20T, length: 75 mm, material: PTFE, pore size: 20 µm	
90 F 0003	Filter element type F-50T, length: 75 mm, material: PTFE, pore size: 50 µm	
90 F 0005	Filter element type F-3G, length: 75 mm, material: glass, pore size: 3 µm	
90 F 0011	Filter element type F-2GF, length: 75 mm, material: glass fiber, pore size: 2 µm, packs of 25 pieces (2 x adapter rings Part-No. 93S0050 are needed to mount the filter element)	
90 F 0016	Filter element type F-0,1GF, length: 64 mm, material: glass fiber, pore size: 0.1 µm, (2 x adapter rings Part-No. 93 S 0050 are needed to mount the filter element)	
90 F 0550	Filter element type F-0,05SiC, length: 75 mm, material: ceramic, pore size: 0.05 µm.	
90 F 0006	Filter element type F-2K, length: 75 mm, material: ceramic, pore size: 2 µm	
90 F 0007	Filter element type F-20K, length: 75 mm, material: ceramic, pore size: 20 µm	
90 F 0008	Filter element type F-3SS, length: 75 mm, material: SS 316L, pore size: 3 µm	
90 F 0010	Filter element type F-20SS, length: 75 mm, material: SS 316L, pore size: 20 µm	
90 F 0115	Filter wool holder element FW-1 for universal filters, without filling, material: SS 316Ti	
90 F 0117	Filter wool holder element FW-2 for universal filters, without filling, material: PVDF	
93 S 2083	Special glass wool, resistant to high temperature for filter wool holder element FW. Content: 1000 g	
93 S 0050	Adapter ring for filter element F-0,1GF and F-2GF, material: PTFE (1 piece)	



Option: Flow meter		
Part-No.	Description	Comments
09 F 4000	Flow meter for front mounting	7-70 NI/h air, Measuring range calibrated at 1 bar abs, 20 °C, material of the wetted parts: PVDF, glass, Hastelloy C4, FPM, the flow meter is equipped with a fine adjustment valve in the inlet for precise flow rate adjustment.

Option: Telescopic slides for 19"-Rack		
Part-No.	Description	Comments
98 A 2500	US-version: Set of telescopic slides for 19"-Rack	Allows the analyzer enclosure to be completely extended from the 19" rack. Kit for retrofitting to enclosure and rack. Telescopic slide type: GeneralDevices C-300-S-124 Incl. mounting adapter and mounting material
98 A 2550	European-version: Set of telescopic slides for 19"-Rack	Allows the analyzer enclosure to be completely extended from the 19" rack. Kit for retrofitting to enclosure and rack. Telescopic slide type: Rittal RP 3659.180 Incl. mounting adapter and mounting material

The replacement interval for spare parts and consumables depends on the specific operating condition of the analyzer.

The product label with the serial number is located on the back of the PMA1000(L) V2.2. Please refer to this serial number if you need to order spare parts or consumables.

Spare parts: Fuses		
Part-No.	Description	Comments
S10012	Spare fuse TR5 50 mAT	Type TR5, current 50 mA, Protection type: Time delay
S10009	Spare fuse TR5 200 mAT	Type TR5, current 200 mA, Protection type: Time delay
S10015	Spare fuse TR5 500 mAT	Type TR5, current 500 mA, Protection type: Time delay
S10011	Spare fuse TR5 1 AT	Type TR5, current 1 A, Protection type: Time delay
S10021	Spare fuse TR5 2 AT	Type TR5, current 2 A, Protection type: Time delay



Spare parts: Enclosure spare parts		
Part-No.	Description	Comments
MM0090	Set with 4 pieces of device feet (rubber)	
GH4G2.2/08	19"-mounting bracket	order 2 pieces per device, steel, powder-coated dust-grey RAL7037
GH-4SCC-S/10	Handle for 19"-mounting bracket	Steel, matt-finished chrome, order 2 pieces per device

## 13 Appendix

### 13.1 Trouble shooting

For easy access to information about calibration and operation of the PMA1000(L) V2.2, please look at the instruction manual in section M6/S1. You will reach this screen by tapping on the Help button.



*Fig. 91: Instruction manual available in PDF-format*



#### **Do you need help?**

Please contact M&C, if you need help with trouble shooting!

### 13.2 Additional Information

More information about the analyzer can be found on our website:

**[www.mc-techgroup.com](http://www.mc-techgroup.com)**

### 13.3 Declaration of conformity

#### **CE - Certification**

The PMA1000(L) V2.2 complies with the following EU directives:

#### **EMC directives**

The PMA1000(L) V2.2 complies with the EC directive 2014/30/EU 'Electromagnetic compatibility'.

#### **Low Voltage Directive**

The PMA1000(L) V2.2 meets the requirements of the Low Voltage Directive 2014/35/EU.

To ensure the compliance with this EC directive, the PMA1000(L) V2.2 conforms to the DIN EN 61010 standard.



### **Declaration of conformity**

The EU Declaration of conformity can be downloaded from the M&C website or directly requested from M&C.

### **13.4 Certificates**

Certificates are available on our website:

**[www.mc-techgroup.com](http://www.mc-techgroup.com)**

### **13.5 Warranty**

In case of a device failure, please contact M&C immediately or your authorized M&C distributor.

We have a warranty period of 12 months from the delivery date. The warranty covers only appropriately used products and does not cover the consumable parts. Please find the complete warranty conditions in our terms and conditions.

The warranty includes a free-of-charge repair at a M&C facility or the free replacement of the device. If you return a device to M&C, please be sure that it is properly packaged and shipped with protective packaging. The repaired or replaced device will be shipped free of delivery charges to the point of use.

For more information about shipping and handling of returned devices, please see page 84 '13.8 Shipping and handling'.

### **13.6 Liability and disclaimer**

This instruction manual is an original M&C document. It does not claim to be complete and it may be subject to technical modifications. We are not responsible for any printing errors or errors in the content of the manual. Please be assured that precautions have been taken to prevent errors in our product documentation to provide you with the best possible and accurate information.

Liabilities for indirect and direct damages that are related to the delivery or the usage of this instruction manual are excluded.

We are not liable for the content of translations from sources which are not authorized by M&C.

Copy of this document or of its content is not allowed without explicit approval of M&C.

With the release of this version all older instruction manual versions will no longer be valid.

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### **13.7 Storage**

If you plan to store your M&C product before installing and operating, please follow these storage recommendations. Make sure that the device is stored in a protected, dry and well ventilated area. Please cover the device with an appropriate cover to protect it from dirt and liquids.

If you have any questions about proper storage of your M&C products, please feel free to contact us.

### **13.8 Shipping and handling**

If you need to ship your M&C product to another department inside your company or back to M&C, please follow these shipping and handling recommendations.

Please ship the device in its original packaging. This is the best way to protect the device. If the original packaging is not available any more, please use a sturdy cardboard box with enough packaging material to protect the device from damages during shipping.

If you send your M&C product in for maintenance work at our M&C facility, please send the properly packaged device to the M&C TechGroup address in the USA or Germany as needed.

### **13.9 Proper disposal of the device**

At the end of the life cycle of our products, it is important to take care of the appropriate disposal of obsolete electrical and non-electrical devices. To help protect our environment, please follow the rules and regulations of your country regarding recycling and waste management.

## 14 About us

### 14.1 M&C's group of companies

The M&C group of companies with its German headquarter and world wide market activities, has earned the reputation as one of the well-known and strongest partners in the market.

Our company, our products, special systems and overall performances are well established in the market. We continuously belong to the best of the best of our industry. This makes us very proud. Our core competences are to find qualified solutions for even the most complex and demanding measuring tasks. We are developing answers to solve the technical demands of the future. With our focus on premium services, we are reliable, innovative and an overall cost effective market partner worldwide.



To learn more about M&C, please visit our website:

**[www.mc-techgroup.com](http://www.mc-techgroup.com)**

For even quicker access, please use our QR-code:



## 14.2 The quality-oriented M&C catalog

M&C offers national and international services, project planning and construction of special systems with a wide range of products. Our catalog covers a large variety of high quality products with in-depth knowledge of various customer applications. Our product excellence and innovative solutions continues to make M&C a world class company.

You can find the following product groups in our catalog. The combination of products from these groups offers a complete solution for most industrial needs. We develop, manufacture and test our products in accordance with a wide range of national and international standards.



Probes

Comprehensive range of probes with a large spectrum of available options for an almost unlimited range of applications.  
Different materials available (Hastelloy, Titan, PTFE etc.)



Cooler

Optimised gas and condensate separation, low maintenance and self monitoring.  
Compact design for wall mounting or 19" rack.



Filter

Suitable for all processes, due to the modular and user-specific configuration possibilities of the filter components.  
Filter enclosures available in glass, stainless steel, PVDF, PTFE or in different metal combinations.



Portable components

Developed for high quality gas analysis at different locations.



Compact systems

Compact standard systems designed for a 19" enclosure or a plate structure.



Oxygen analyzer

A broad variety of products with high measuring accuracy.  
Direct measuring is based on paramagnetic measuring principle (dumb-bell-type).



### **14.3 Technical consulting services**

M&C has earned a reputation as one of the most capable and experienced companies in the world, especially when it comes to difficult or complex measurement projects. We are proud that our customers have confidence in our products and continue to experience repeat business.

We also offer technical consulting for our components, devices and complete systems. We support our customers in finding individual solutions for their specific measuring tasks.

These individual solutions lead to new concepts of designing and building custom-made devices or complete systems. The dedication and commitment to finding solutions to the most complex and challenging tasks for our customers sets us apart from our competitors.

We have custom-made application experiences in many different fields worldwide. With this experience we are able to support our customers by seeking and finding errors, trouble shooting during day-to-day operation or identifying hard to find interferences.

#### **14.3.1 Ideas, suggestions and feedback**

All our activities are designed to meet and exceed the demands of the market and the specific interests of our customers. That's why M&C is very interested in developing products, processes and services which are in demand and up to date.

This means that your feedback, ideas and suggestions are very important to us.

Please let us know what kind of new improvements and innovations you would like to see at M&C. Tell us, what you like about M&C and what needs improvement.

Please send us an email or feel free to just call us ...

We appreciate your comments.



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