Embracing Challenge

GENTWO®

Oxygen Analyzer

PMA1000 / PMA1000L

Instruction Manual

Version 1.00.00

Software Version: 2.00

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,

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

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For online service and support information go to:

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Table of Contents

1 About this instruction manual 6

2 Important safety information 7
2.1 Intended use 7
2.2 Personal safety 7
2.3 Warning signs and definitions 7
2.4 Safety instructions 9
2.5 Working on electrical and electronic devices 9
2.6 Not certified in hazardous areas 10

3 Introduction 11

4 Product overview 12
4.1 Receiving the analyzer 13
4.2 Product label and serial number 13

5 Measuring principle of the analyzer 14
5.1 Principle of measurement 14
5.2 Flow chart 16

6 Technical data 17
6.1 Dimensions 18
6.2 Connections 19
6.3 Components 20
6.3.1 Sensor module 20
6.3.2 I/O module 21
6.4 Gas connections and pin assignment diagram 22

7 Using the analyzer 24
7.1 Graphical user interface (GUI) 24
7.2 How to use the touch screen 24
7.3 Menu structure 25
7.3.1 System status line 26
7.3.2 Main menu bar 27
7.3.3 Main display area 28
7.3.4 Language selection 28
7.3.5 M1/S1 and M1/S2 - M&C contact and GUI version number 29
7.3.6 M1/S3 - Pneumatic connections 31
7.3.7 M1/S4 - Operating hours counter 31
7.3.8 M2/S1, M2/S2 - Measured values, operating parameters and limits 31
7.3.9 M2/S3 - List view of the measured values 34
7.3.10 M3/S1 - Data logger/history archive 34
7.3.11 M4/S1 - Measuring range selection and parameter settings 36
7.3.12 M4/S2 - Settings menu/ parameters 39
7.3.13 M5/S1 and M5/S2 calibration menu 53
7.3.14 M6/S1 Help button 55

8 Mounting and installation 56
8.1 General 56
8.2 Installation examples 56

9 Starting-up and operating the analyzer 58
9.1 General 58
9.2 Start-up and operation 58

10 Calibration 60
10.1 General 60
10.2 M5/S1 Manual Calibration 60
10.3 Automatic Calibration (AutoCal) 66
10.4 Calibration of auxiliary variables 75
10.5 Cross-sensitivity of coexisting gases 76

11 Service and maintenance 79
11.1 Recommended maintenance work 79

12 Spare parts and consumables 80

13 Appendix 81
13.1 Trouble shooting 81
13.2 Additional Information 81
13.3 Declaration of conformity 81
13.4 Certificates 82
13.5 Warranty 82
13.6 Liability and disclaimer 82
13.7 Storage 83
13.8 Shipping and handling 83
13.9 Proper disposal of the device 83

14 About us 84
14.1 M&C's group of companies 84
14.2 The quality-oriented M&C catalog 85
14.3 Technical consulting services 86
14.3.1 Ideas, suggestions and feedback 86

Table of Illustrations

Fig. 1: Product label is on the back of the PMA1000/PMA1000L 13
Fig. 2: Paramagnetic measuring cell 14
Fig. 3: Electronic evaluating system to measure oxygen concentration 15
Fig. 4: Flow chart 16
Fig. 5: Enclosure front view 18
Fig. 6: Enclosure side view 19
Fig. 7: Rear view PMA1000 19
Fig. 8: Inside view PMA1000 20
Fig. 9: Sensor module 20
Fig. 10: I/O module 21
Fig. 11: Gas connections and pin assignment diagram 22
Fig. 12: Startup screen of the 1-Channel configuration 24
Fig. 13: Menu structure overview 26
Fig. 14: System status line 27
Fig. 15: Menu bar with the menu items M1 to M6 27
Fig. 16: Main display area 28
Fig. 17: Language selection window 29
Fig. 18: M1/S1 - M&C contact information 29
Fig. 19: Swipe to navigate through the sections 29
Fig. 20: M1/S2 - Analyzer configuration 30
Fig. 21: Detailed information about the GUI software version 30
Fig. 22: M1/S3 - Pneumatic connections of the analyzer 31
Fig. 23: M1/S4 - Operating hours counter (OHC) 31
Fig. 24: M2/S1 - Start screen of the home button 32
Fig. 25: M2/S2 - Detailed view of the measuring parameters 32
Fig. 26: M2/S2 - Detailed view during warm-up period 33
Fig. 27: M2/S2 - Using the zoom button 33
Fig. 28: Zoomed and highlighted area 33
Fig. 29: M2/S3 - List view of the measured values 34
Fig. 30: M3/S1 data logger screen 35
Fig. 31: M3/S1 - Recorded data selection screen 35
Fig. 32: Calibration symbols to highlight calibration procedures 36
Fig. 33: M4/S1 Edit buttons for measuring range and operating parameter settings 36
Fig. 34: Highlighted scroll bar to select measuring range 37
Fig. 35: Parameter list 37
Fig. 36: Highlighted scroll bar to set operating parameter Lim1 38
Fig. 37: Highlighted scroll bar to set operating parameter Lim2 38
Fig. 38: M4/S2 screen with 'Restart' button 39
Fig. 39: M4/S2 Settings menu and parameter screen 40
Fig. 40: Basic settings for channel 1 41
Fig. 41: Keypad 41
Fig. 42: Channel-specific settings list 42
Fig. 43: After selecting '2 = System', the screen with system settings opens 45
Fig. 44: Scroll bar with '4=Updates' displayed in the gray frame 46

Fig. 45: Buttons to get information and install hardware and software updates 46
Fig. 46: Screen to confirm the update of the application software 47
Fig. 47: M4/S2 screen with 'Factory reset' selected 47
Fig. 48: Default setting menu with four parameters to select 48
Fig. 49: Database import and export settings 48
Fig. 50: IP address input screen 49
Fig. 51: Date and time settings 49
Fig. 52: Supervisor settings for administrators 50
Fig. 53: Download a new PDF-file with the latest manual version 50
Fig. 54: Scroll bar with 'B=Diagnosis' displayed in the gray frame 51
Fig. 55: Schematic for diagnosis 51
Fig. 56: Display of the High-Side- and relay-outputs with the mA-output of I/O2 52
Fig. 57: Display of the highlighted SM2 components 52
Fig. 58: Scroll bar with 'C=Service' displayed in the gray frame 53
Fig. 59: Gas calibration screen 53
Fig. 60: Calibration of pressure gauges and flow sensor 54
Fig. 61: Help button screen 55
Fig. 62: Example: Span gas calibration with sample gas pump 57
Fig. 63: Example: Span gas calibration with calibration gas from a pressure cylinder 57
Fig. 64: Warm-up phase in M2/S1 and warm-up info on M2/S2 59
Fig. 65: Analyzer is ready to operate 59
Fig. 66: Manual calibration PMA1000L 60
Fig. 67: Setting the channel-specific calibration parameters 61
Fig. 68: Manual calibration with span gas 61
Fig. 69: First step of the manual calibration procedure 62
Fig. 70: Second step of the manual calibration procedure 62
Fig. 71: Third step of the manual calibration procedure 63
Fig. 72: End of the manual calibration procedure 63
Fig. 73: Data logger screen with green calibration symbol 64
Fig. 74: A terminated manual calibration procedure 64
Fig. 75: Manual calibration error 65
Fig. 76: Datalogger screen with red calibration symbol 65
Fig. 77: Screen showing details about a single calibration procedure 66
Fig. 78: AutoCal activation: open section M4/S2 67
Fig. 79: AutoCal activation: change system settings (first part of the list) 67
Fig. 80: AutoCal activation: change system settings (second part of the list) 68
Fig. 81: Scroll to 'AutoCal' to reach calibration start screen 69
Fig. 82: AutoCal start screen 69
Fig. 83: Parameter screen to adjust test gas measuring ranges and concentrations 70
Fig. 84: Tap on Start button to start AutoCal procedure 70
Fig. 85: Information displayed during AutoCal procedure 71
Fig. 86: Canceled AutoCal process 74
Fig. 87: Calibration of pressure gauges and flow sensor 75
Fig. 88: Formula to calculate the effects of coexisting gases 77
Fig. 89: Instruction manual available in PDF-format 81

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/PMA1000L. 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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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.

2 Important safety information

Please read this important safety information carefully before installing the PMA1000/PMA1000L. Follow these safety precautions during commissioning, start-up and regular operation.

2.1 Intended use

This PMA1000/PMA1000L 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 17 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/PMA1000L.

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 17 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/PMA1000L 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/PMA1000L in hazardous areas.

3 Introduction

Congratulations on your purchase of the PMA1000/PMA1000L 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/PMA1000L 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/PMA1000L 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/PMA1000L 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/PMA1000L 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/PMA1000L 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/PMA1000L 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/PMA1000L provides excellent calibration ease of use for zero-point (off-set) and span adjustment.

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

4.1 Receiving the analyzer

The PMA1000/PMA1000L is usually delivered in one package. You will find the following items in the box:

- PMA1000/PMA1000L
- Instruction Manual
- EU version: power cord rated 230 VAC with an IEC 320 female connector and a CEE 7/7-plug.

  US version: power cord rated 115 VAC with an IEC 320 female connector and a standard 3 prong plug.
- Digital/analog connectors (Phoenix printed circuit board connectors):

  2 pieces: MSTB 2,5/ 8-ST-5,08 (8 positions, pitch: 5.08 mm)

  2 pieces: MC 1,5/ 6-ST-3,5 (6 positions, pitch: 5.08 mm)

  1 piece: MSTB 2,5/ 2-ST-5,08 (2 positions, pitch: 5.08 mm)

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/PMA1000L.

Please refer to this serial number if you have any questions about your PMA1000/PMA1000L or if you need to order spare parts.

Thanks for your help!

Fig. 1: Product label is on the back of the PMA1000/PMA1000L

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

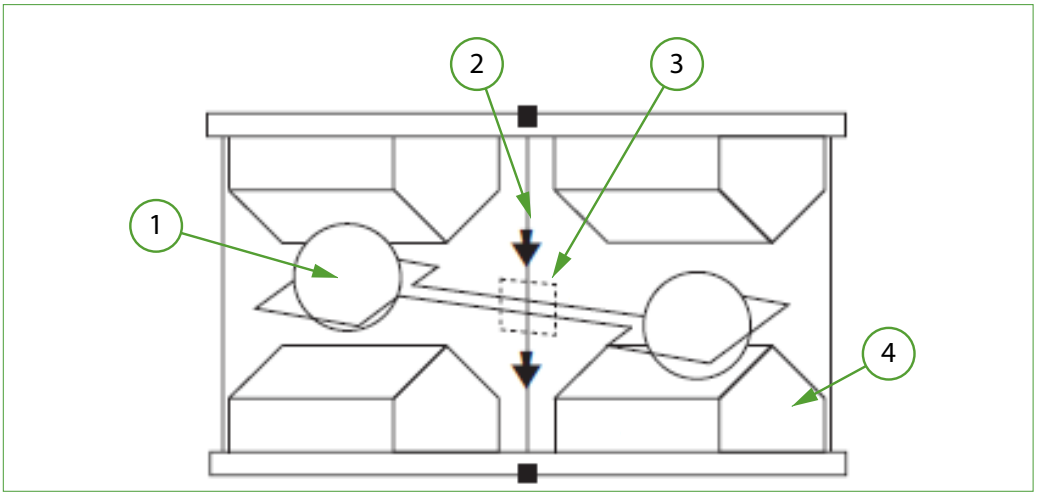


Fig. 2: Paramagnetic measuring cell

1 *dumbbell*
2 *suspension wire*
3 *mirror*
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.

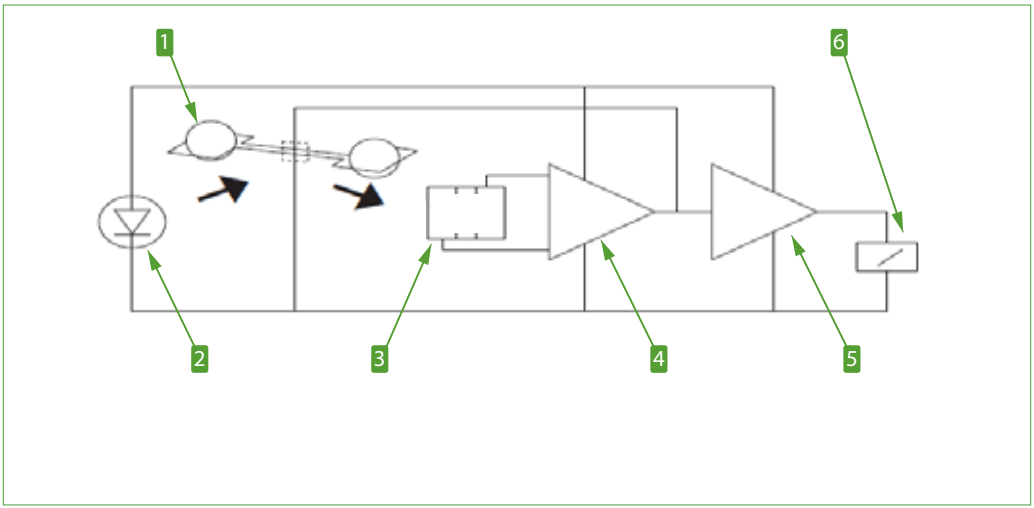


Fig. 3: Electronic evaluating system to measure oxygen concentration

1 *'Dumbbell' measuring cell*
2 *LED*
3 *Photo cells*
4 *Amplifier*
5 *Amplifier*
6 *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/PMA1000L with one sensor combination and a paramagnetic analyzer (PMA) measuring cell.

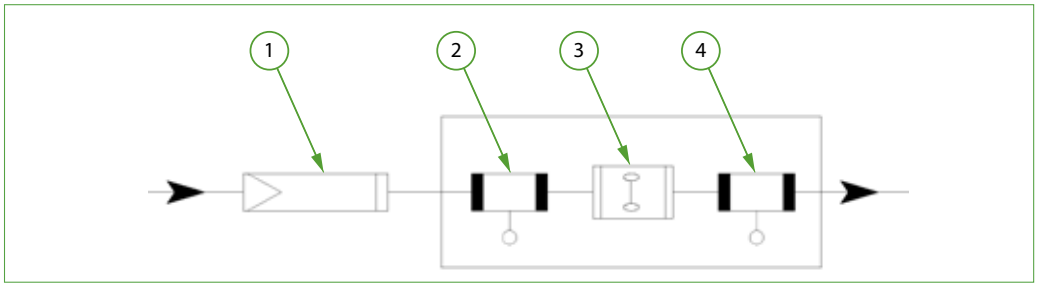


Fig. 4: Flow chart

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	PMA1000L
Part-No.	**08 A 1000**	**08 A 1010**
Sample gas	O_2	
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_2, zero suppression applicable	
Limit of Detection (LOD)**	0.02 vol%	
Response time* for 90% FSD	< 3 seconds at 60 Nl/h air	
Zero-point offset (drift)	< 0.06 vol% O_2 in 72 hours	
Linearity error	< ±1 vol% O_2	
Accuracy after calibration**	Deviation ±1 % of full scale or 0.02 vol% O_2, whichever value is greater.	
Reproducibility**	< ±0.01 vol%	
Flow rate of sample gas	25-60 Nl/h air	
Influence of sample gas flow	Variation in gas flow between 25-60 Nl/h air will cause a deviation of < 0.1 vol% O_2	
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 °C up to +50 °C (+32 °F up to +122 °F); dry, oil- and dust free gas , avoid temperature dropping below dew point	
O_2 transducer temperature	Fixed at +55 °C (+131 °F)	
Ambient temperature	0 °C up to +50 °C (+32 °F up 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 / 2 A, 1 x change-over contact, potential-free	2 x relay output (1 x status, 1 x Cal-mode), contacts: 24 V / 2 A, 1 x change-over contact, potential-free
Binary outputs	8 x High-Side output 24 V, max. 100 mA (2 x operating parameters, 2 x measuring range feedback, 4 x valve control)	4 x High-Side output 24 V, max. 100 mA (2 x operating parameters, 2 x measuring range feedback)
AutoCal-Function	Yes	No

Oxygen analyzer	PMA1000	PMA1000L
Part-No.	**08 A 1000**	**08 A 1010**
Interfaces	Ethernet / USB	
Storage temperature	-20 °C up to +60 °C (~-4 °F up to +140 °F), avoid temperature dropping below dew point	
Power supply	3-pole chassis plug, internal power unit for 100 - 240 VAC, 50 - 60 Hz	
Power consumption	max. 150 VA	max. 100 VA
Wetted materials	Platinum, Epoxy resin, glass, FKM (Viton®), Stainless Steel 316Ti, PVDF, PPS	
Sample gas connection	Tube connector PV-DN 4/6 (standard)	
Case protection	IP 20, 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)	
Dimension / weight	Width x Height x Depth: 482.5 mm x 177 mm x 390 mm (19" x 6.97" x 15.35")+ approx. 60 mm (approx. 2.36") connection depth / Approx.11 kg (approx. 24.25 lbs)	

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

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

6.1 Dimensions

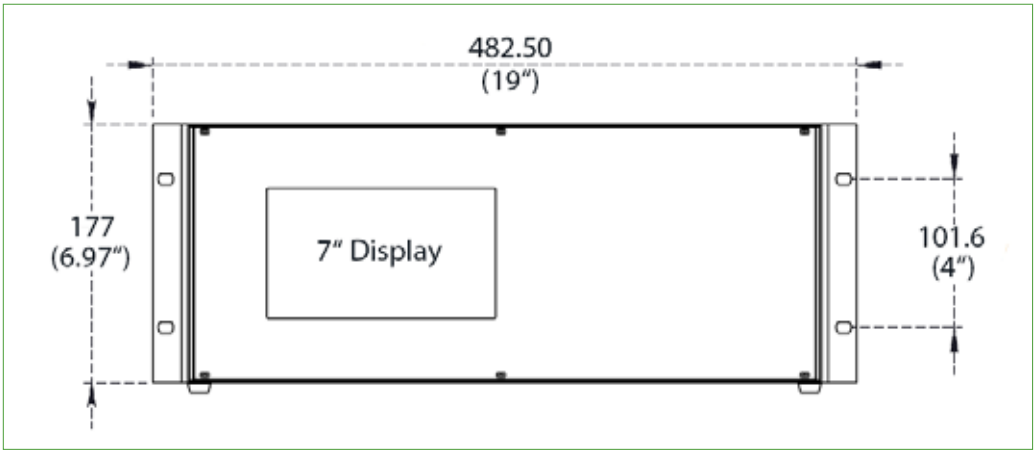


Fig. 5: Enclosure front view

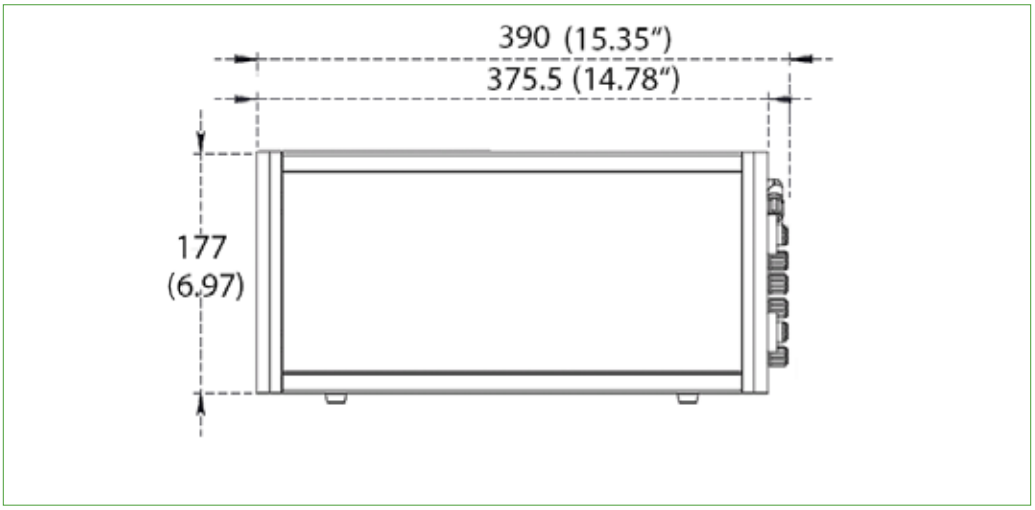


Fig. 6: Enclosure side view

6.2 Connections

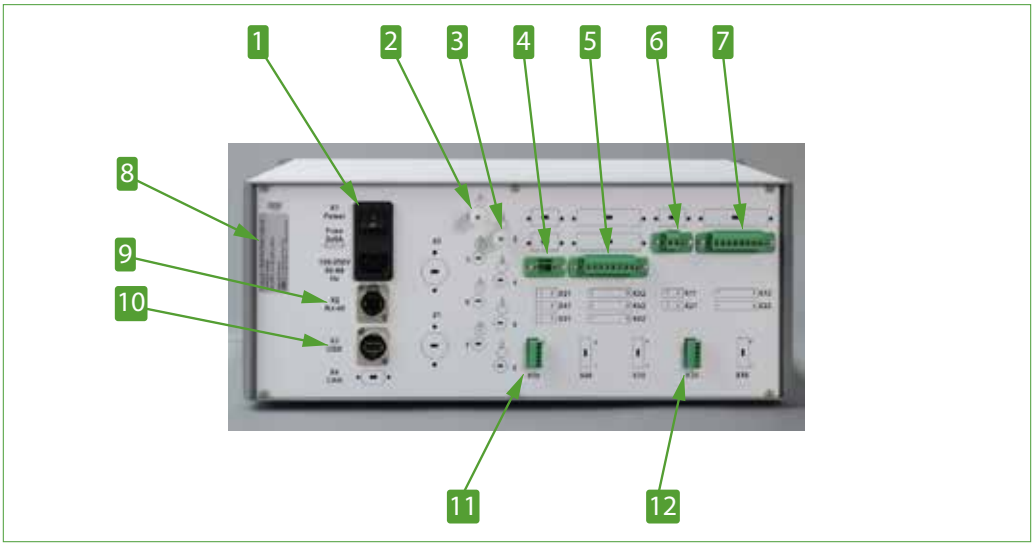


Fig. 7: Rear view PMA1000

1 *Combination power switch and fuse*
2 *Sample gas input '1'*
3 *Sample gas output '2'*
4 *Not in use*
5 *Digital outputs IO5 - HSS1...HSS4 (PMA1000 only)*
6 *mA-output- measurement value*
7 *Digital outputs IO2 - HSS1...HSS4*
8 *Product label*
9 *Ethernet connector*
10 *USB connector*
11 *Digital outputs IO5 - RS1, RS2 (PMA1000 only)*
12 *Digital outputs IO2 - RS1, RS2*

6.3 Components

Fig. 8: Inside view PMA1000

1 *Sample gas lines*
2 *Power supply*
3 *Interface control unit with CPU-circuit board*
4 *Sensor module*
5 *PMA Transmitter*
6 *I/O2 module*
7 *I/O5 module (only PMA1000)*

6.3.1 Sensor module

Fig. 9: Sensor module

The MUC O2S SM - printed circuit board is a multifunctional sensor module. The sensor measures the pressure of the sample gas before and after the measuring equipment. The sensor module measures the temperature of an unheated sensor and controls the temperature of a heated sensor, like the paramagnetic measuring cell.

The MUC O2S SM has an internal data bus. The raw data acquired from the sensor transmitter will be processed and transferred via bus, and then displayed on the user-interface.

6.3.2 I/O module

Fig. 10: I/O module

The I/O module has one analog output. The parameter of this analog output is freely selectable via GUI/HMI. There are also four High-side outputs and two relay outputs (dry contacts). An internal data bus controls these outputs and switches the outputs 'On' or 'Off'.

6.4 Gas connections and pin assignment diagram

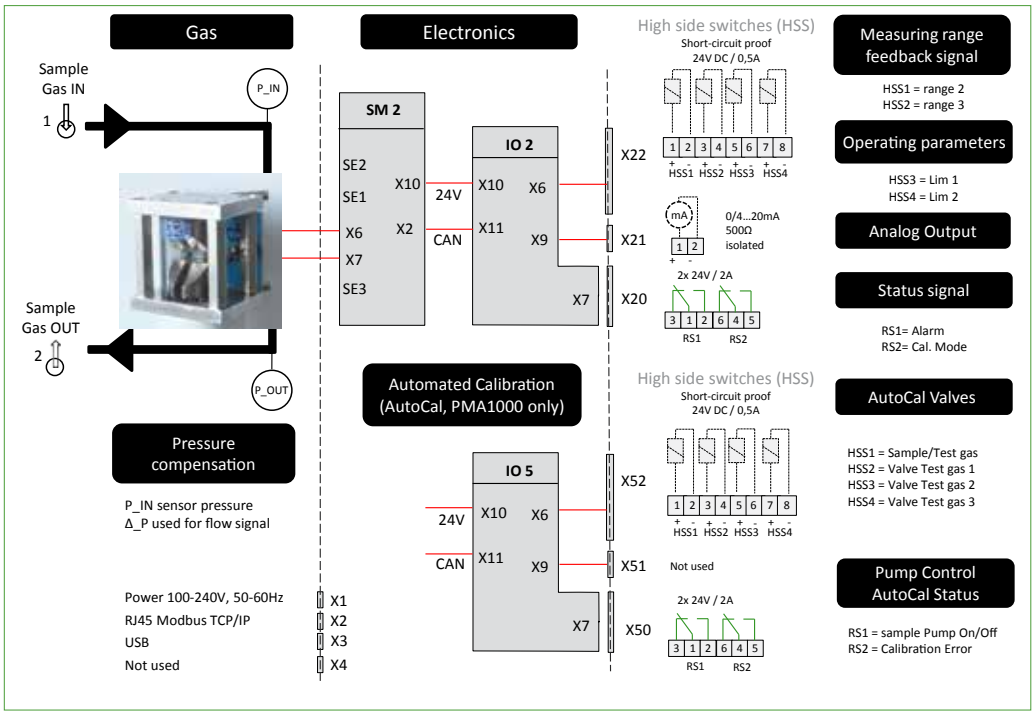


Fig. 11: Gas connections and pin assignment diagram

Note The HSS-outputs for the AutoCal valves are only available for the PMA1000 analyzer.

The pin assignment diagram and the status signal RS1 use the following definitions:

- Electronics:

HSS1...4	High-Side-outputs 1…4 (voltage level 0/24V, 500mA to connect magnetic valves or coupling relays directly)
RS	Relays (potential-free relay output, max. 24V/2A)
P_IN	Pressure sensor input (measures the pressure compensation during operation)
P_OUT	Pressure sensor input (measures the pressure compensation during operation)
ΔP	Pressure difference between P_IN and P_OUT

Lim	Operating parameter (HSS sends output signal, which operating parameter, Lim1 or/and Lim2, has or have been reached or exceeded)
MB	Measuring range (HSS sends output signal, which of the measuring ranges, MB 2 or MB 3, is selected)

- Status signal (RS1)

  The alarm output is a collective alarm with various single alarms connected in series. The collective alarm RS1 is in the GO-state and the relay contact is closed, when all single alarm signals are in the GO-state (Safety first).

  The collective alarm includes the following single alarm messages:

  - Sensor temperatur is higher or lower than stated in the specifications: 55 °C ±3 °C (131 °F ±5.4 °F) or during warmup
  - P_IN (incomming pressure) is higher or lower than 600-1600 mbar or the pressure difference between P_IN and P_OUT is too low
  - Gas flow is higher or lower than 25-120 l/h, it is possible to deactivate this alarm message (using a parameter)
  - Power outage (Power OFF/Fail)

The gas connection diagram uses the following definitions:

- Gas connections:

Sample gas-input (1)	DN4/6 bulkhead union PVDF
Sample gas-output (2)	DN4/6 bulkhead union PVDF

7 Using the analyzer

7.1 Graphical user interface (GUI)

The PMA1000/PMA1000L 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/PMA1000L 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/PMA1000L 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 25 chapter 'Menu structure' .

7.2 How to use the touch screen

The touch screen of the PMA1000/PMA1000L 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/PMA1000L. 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/PMA1000L 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/PMA1000L.

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.

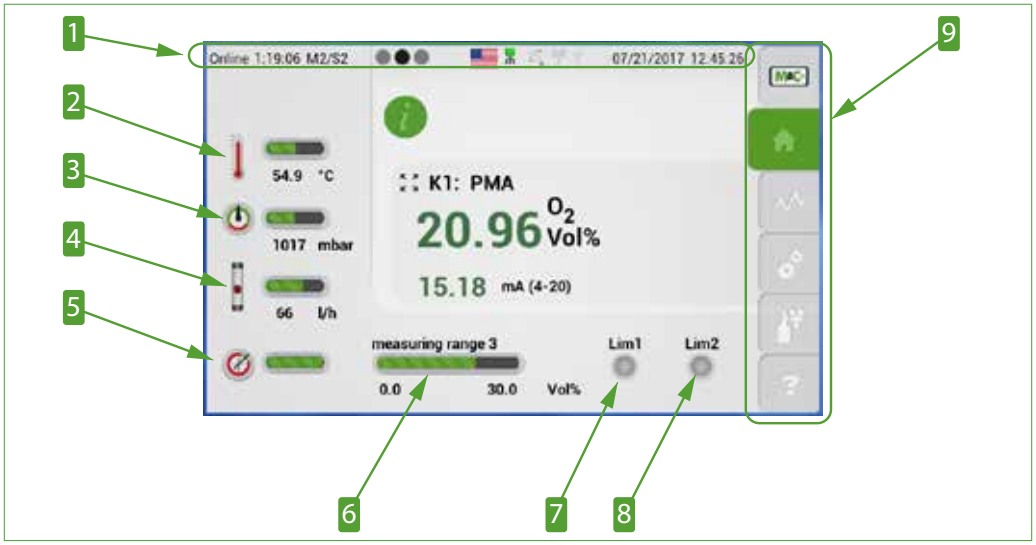


Fig. 13: Menu structure overview

1 *System status line*
2 *Sensor temperature*
3 *Pressure during operation*
4 *Gas flow*
5 *Parameter list indicator*
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/PMA1000L 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.

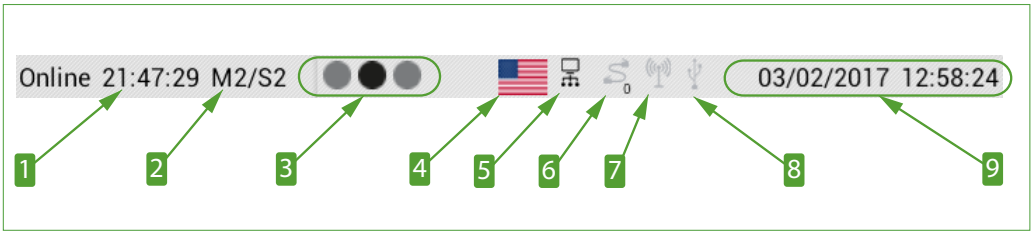


Fig. 14: System status line

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

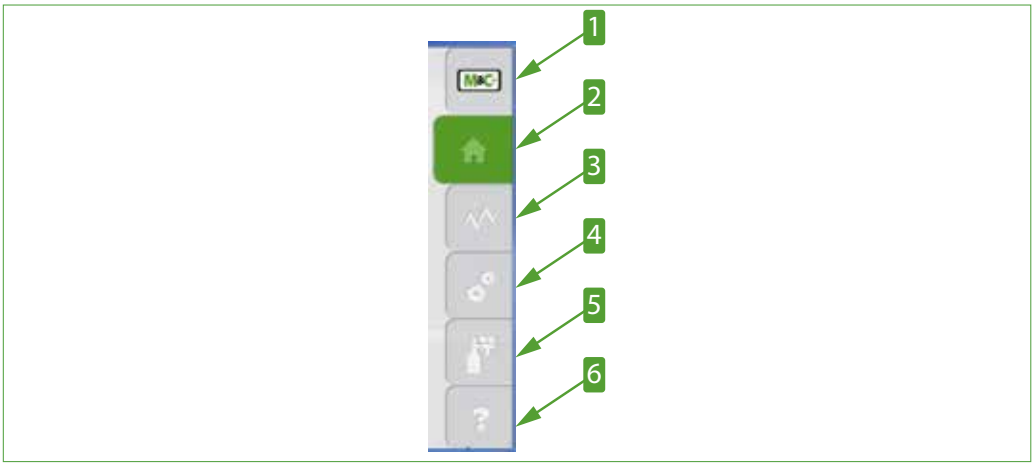


Fig. 15: Menu bar with the menu items M1 to M6

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

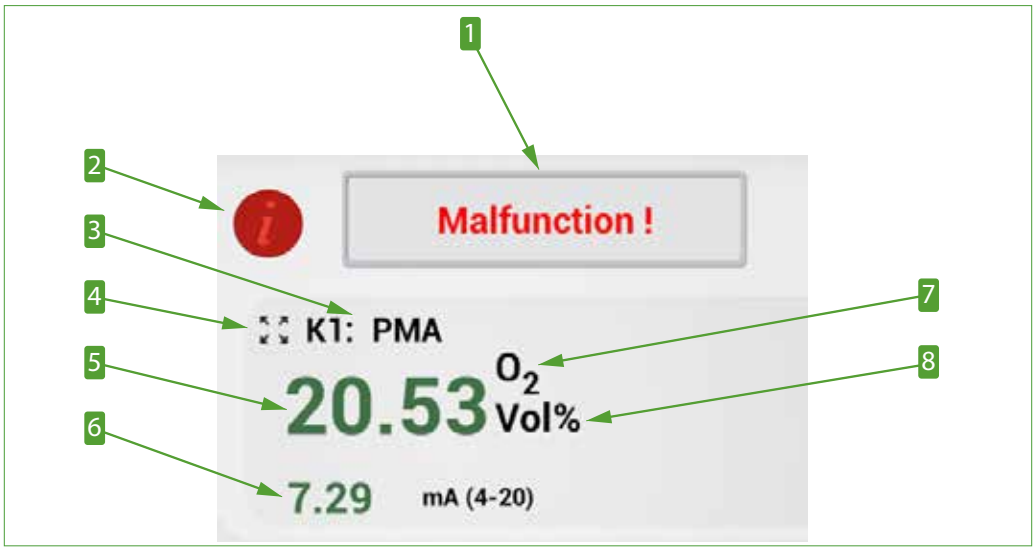


Fig. 16: Main display area

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

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.

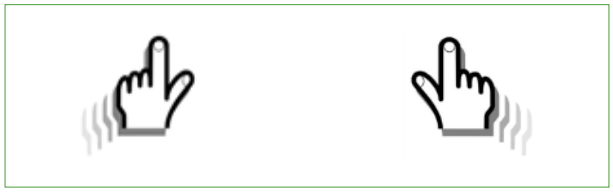


Fig. 19: Swipe to navigate through the sections

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.

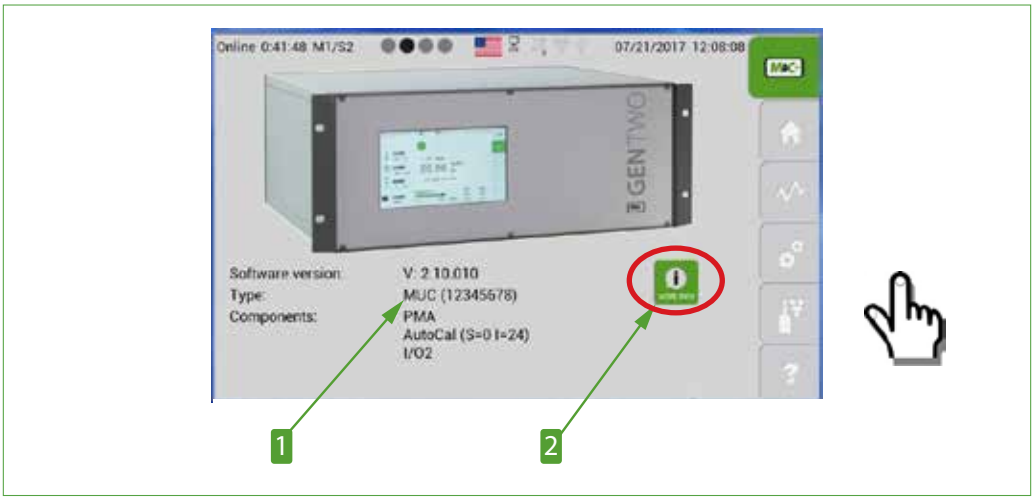


Fig. 20: M1/S2 - Analyzer configuration

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.

7.3.6 M1/S3 - Pneumatic connections

This window shows the schematic of the gas connections and the gas lines inside the PMA1000/PMA1000L analyzer.

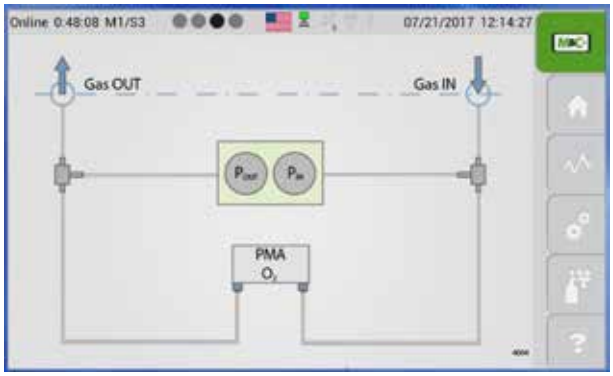


Fig. 22: M1/S3 - Pneumatic connections of the analyzer

7.3.7 M1/S4 - Operating hours counter

The operating hours counter screen shows the days and hours the whole unit and the components were in operating mode.

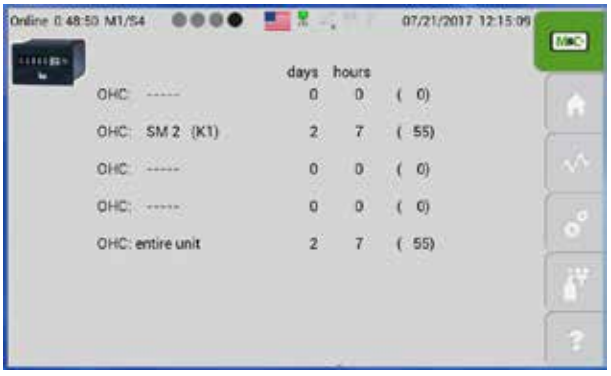


Fig. 23: M1/S4 - Operating hours counter (OHC)

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 and 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

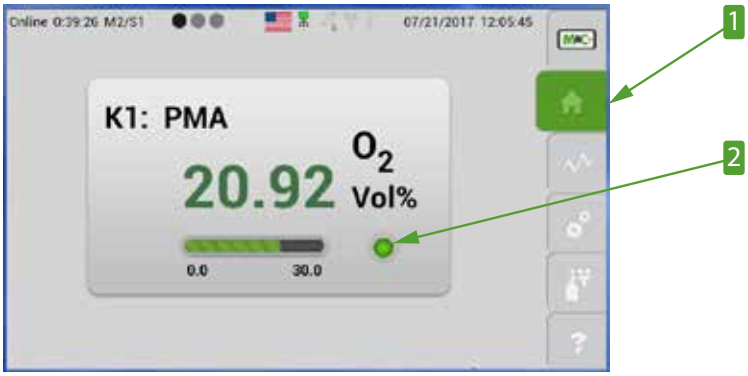


Fig. 24: M2/S1 - Start screen of the home button

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. 25: 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.

The warm-up period of the PMA1000/PMA1000L takes about two minutes. 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. 26: 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. 27: 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. 28: 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. 29: 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. 30: M3/S1 data logger screen

1 *Edit button*

Please tap on the edit button. The calender 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. 31: 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.

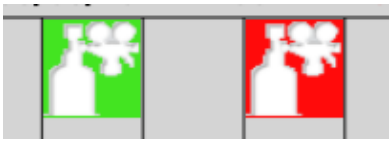


Fig. 32: Calibration symbols to highlight calibration procedures

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.

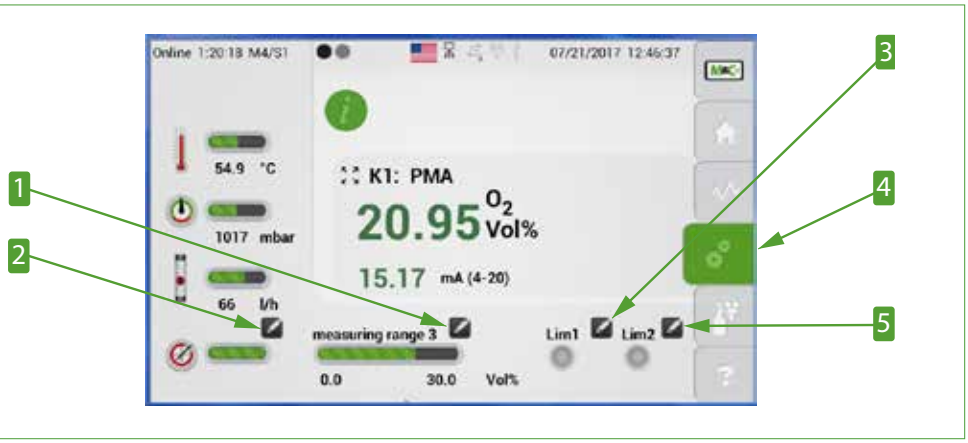


Fig. 33: M4/S1 Edit buttons for measuring range and operating parameter settings

1 *Edit button for measuring range selection*
2 *Edit button for parameter list*
3 *Edit button for alarm limit Lim1*
4 *Settings button M4*
5 *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.

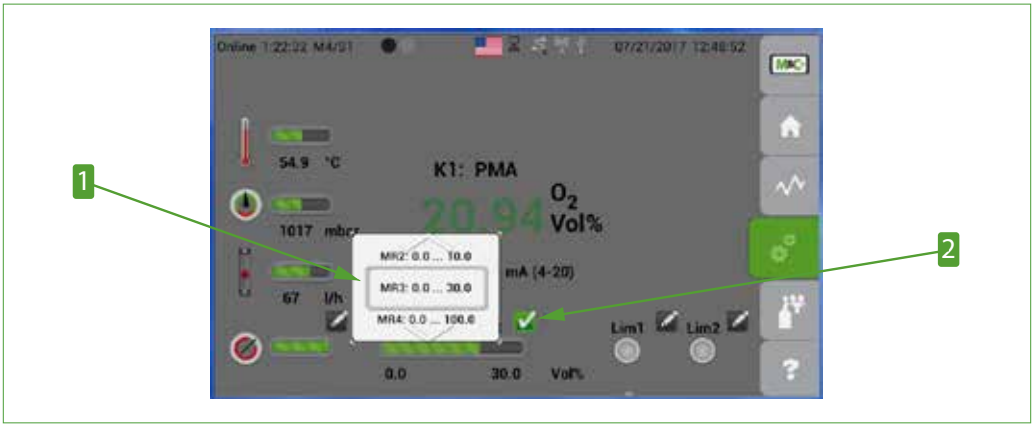


Fig. 34: Highlighted scroll bar to select measuring range

1 *Scroll bar to select measuring range* 2 *Active edit button changes into a check mark*

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 current ('real'), as well as the factory set gradient and offset parameters. 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.

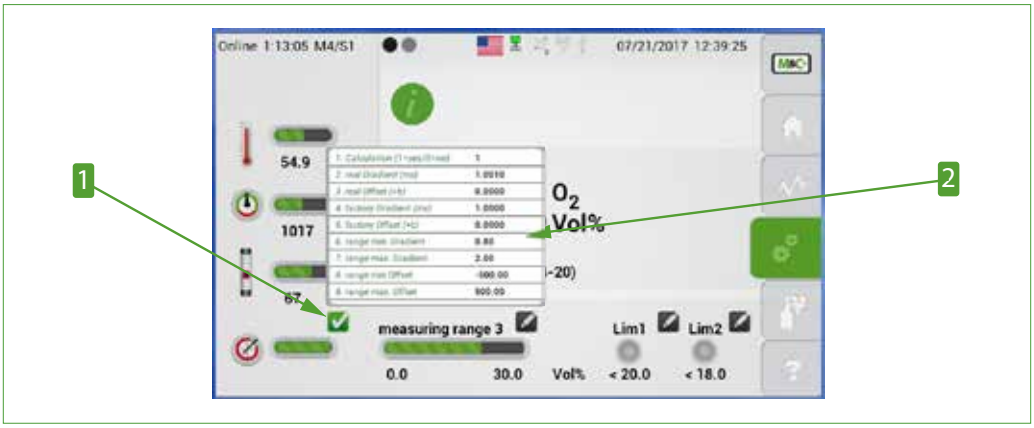


Fig. 35: Parameter list

1 *Edit button to open parameter table* 2 *Parameter list*

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.

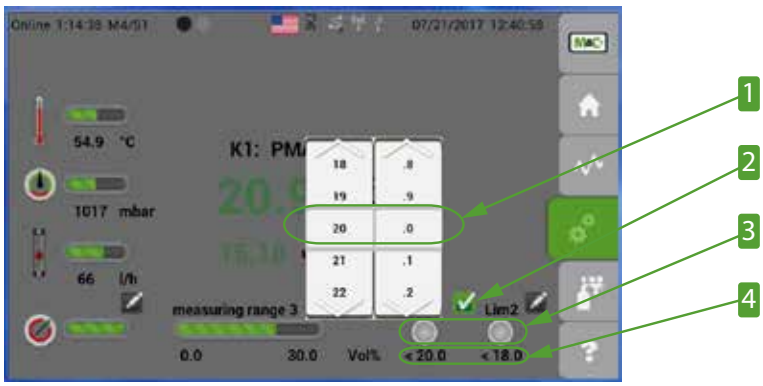


Fig. 36: Highlighted scroll bar to set operating parameter Lim1

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. 37: 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 operating parameter 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 red 'Restart' button.

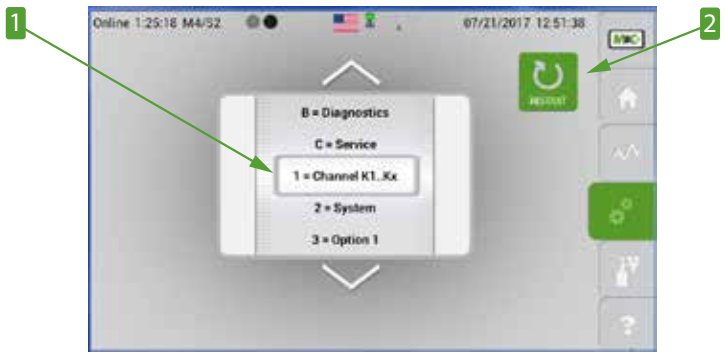


Fig. 38: M4/S2 screen with 'Restart' button

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.

NOTICE	Loss of data! 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 touchscreen 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. 39: 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.

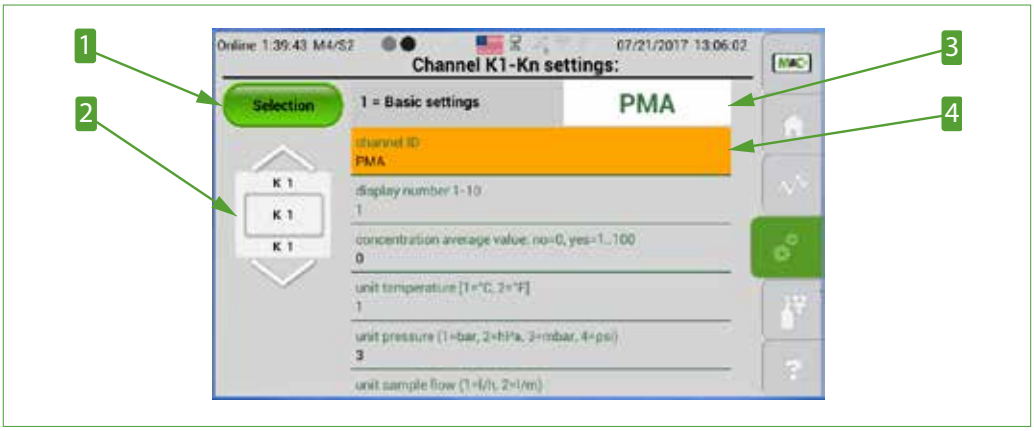


Fig. 40: Basic settings for channel 1

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

Here you can enter the new channel name.

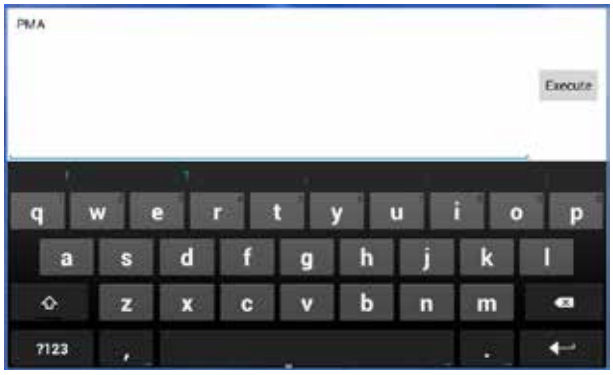


Fig. 41: Keypad

Please tap on the 'Execute' 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
4 = Measuring range selection
5 = Operational limits
6 = Sensor assignment

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

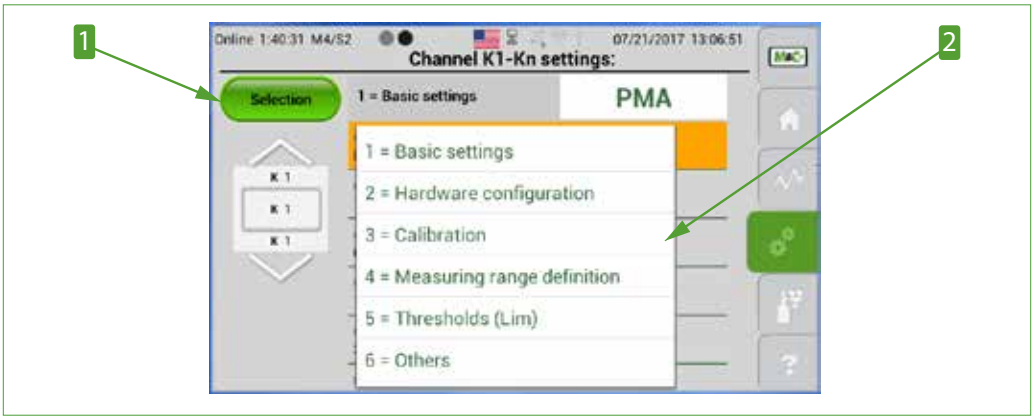


Fig. 42: Channel-specific settings list

1 *Selection button* 2 *Channel-specific settings list*

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

Channel	Parameter description	Default value
Selection: 1= Basic settings		
K1	channel ID	PMA
K1	display number 1 - 10	1
K1	op. Lim1 [vol%]	- (20.000*)
K1	op. Lim2 [vol%]	- (18.000*)
K1	op. mode Lim1 0: inactive, 1: <, 2: ≤, 3: >, 4: ≥	0 (1*)
K1	op. mode Lim2 0: inactive, 1: <, 2: ≤, 3: >, 4: ≥	0 (1*)
K1	concentration averaging value: no=0, yes=1..100	0
K1	unit temperature (1 = °C, 2 = °F]	1
K1	unit pressure (1 = bar, 2 = hPa, 3 = mbar, 4 = psi)	3
K1	pressure calibration offset P-IN	0.000
K1	pressure calibration offset P-OUT	0.000
K1	threshold pressure [mbar] min	600
K1	threshold pressure [mbar] max	1600
K1	unit sample flow (1 = l/h, 2 = l/min)	1
K1	correction factor sample flow	1.000
K1	threshold digit min	0
K1	threshold digit max	0
K1	threshold digit default	1300
K1	number of decimal digits	2

Channel	Parameter description	Default value
Selection: 2= Hardware configuration		
K1	mA range 1=0-20 mA, 2=4-20 mA	2
K1	Gas flow from Kx (1...n)	1
K1	pressure reading on screen Kx (1...n) enable=0, disable=1	0
K1	flow reading on screen Kx (1...n) enable=0, disable=1	0
K1	Option negative reading ignore: 0=no, 1=yes, active	0
K1	Option pressure compensation: 0=no, 1=P_In, 2=P_Out	0
Selection: 3= Calibration		
K1	zero gas [vol%]	0.000
K1	span gas [vol%]	20.960
K1	Holding time [s] of relay 2 after calibration	1
K1	Calibration: MIN range zero gas [vol%]	-2.000
K1	Calibration: MAX range zero gas [vol%]	2.000
K1	Calibration: MIN range span gas [vol%]	19.000
K1	Calibration: MAX range span gas [vol%]	24.000
K1	Calibration: MeasRange for zero gas	1
K1	Calibration: MeasRange for span gas	4
K1	AutoCal: zero gas [vol%]	0.000
K1	AutoCal: span gas [vol%]	20.960
K1	AutoCal: MIN range zero gas [vol%]	-2.000
K1	AutoCal: MAX range zero gas [vol%]	2.000
K1	AutoCal: MIN range span gas [vol%]	19.000
K1	AutoCal: MAX range span gas [vol%]	24.000
K1	AutoCal: MeasRange for zero gas	1
K1	AutoCal: MeasRange for span gas	3
Selection: 4= Measuring range selection		
K1	measuring range at start	3
K1	measuring range 2 from [vol%]	0.000
K1	measuring range 2 to [vol%]	10.000
K1	measuring range 3 from [vol%]	0.000
K1	measuring range 3 to [vol%]	30.000
Selection: 5= Thresholds (Lim)		
K1	range op. lim 1 lim2 +- [vol%]	0.000
Selection: 6= Sensor assignment		
K1	Assignment sensor module values (No. 1-3)	1
K1	..IR bench OUT3A-HSSW output for active Kxn (0=not active)	0
K1	..IR bench A8-OUT Meas. ch2 for active Kxn (0=not active)	0
K1	..IR bench A8-OUT Meas. ch3 for active Kxn (0=not active)	0

Channel	Parameter description	Default value
Selection: 7= Linearitzation		
K1	Linearisation polynomial m.range 1 active=1, inactive=0	0
K1	Linearisation coefficient A measuring range 1	0.000
K1	Linearisation coefficient B measuring range 1	0.000
K1	Linearisation coefficient C measuring range 1	0.000
K1	Linearisation coefficient D measuring range 1	0.000
K1	Linearisation coefficient E measuring range 1	1.000
K1	Linearisation polynomial m.range 2 active=1, inactive=0	0
K1	Linearisation coefficient A measuring range 2	0.000
K1	Linearisation coefficient B measuring range 2	0.000
K1	Linearisation coefficient C measuring range 2	0.000
K1	Linearisation coefficient D measuring range 2	0.000
K1	Linearisation coefficient E measuring range 2	1.000
K1	Linearisation polynomial m.range 3 active=1, inactive=0	0
K1	Linearisation coefficient A measuring range 3	0.000
K1	Linearisation coefficient B measuring range 3	0.000
K1	Linearisation coefficient C measuring range 3	0.000
K1	Linearisation coefficient D measuring range 3	0.000
K1	Linearisation coefficient E measuring range 3	1.000
K1	Linearisation polynomial m.range 4 active=1, inactive=0	0
K1	Linearisation coefficient A measuring range 4	0.000
K1	Linearisation coefficient B measuring range 4	0.000
K1	Linearisation coefficient C measuring range 4	0.000
K1	Linearisation coefficient D measuring range 4	0.000
K1	Linearisation coefficient E measuring range 4	1.000

* 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. 43: 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; 2 = GB; 3 = I; 4 = F; 5 = ES;, ..., 132=USA	132
AutoCal option: 0 = no; 1=yes (with I/O5)	0
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: Test Mode (0=inactive, 1=active)	0
AutoCal: Dwell time [s] HSS2 Zero gas	60
AutoCal: Dwell time [s] HSS3 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
Option pressure compensation: (not in use)	1
Option flow error ignore: 0=no, 1=active	0
ZRO2 Faktor T [Kelvin]	885

- 3 = not available

This feature is not available.

- 4 = Updates

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

Fig. 44: Scroll bar with '4=Updates' displayed in the gray frame

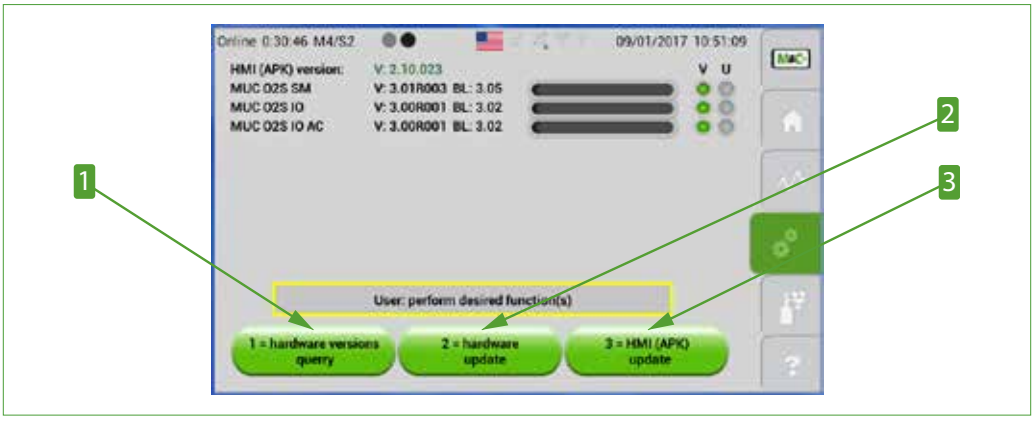


Fig. 45: Buttons to get information and install hardware and software updates

1 *Hardware versions inquiry button*
2 *Hardware update button*
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. 46: 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. 47: M4/S2 screen with 'Factory reset' selected

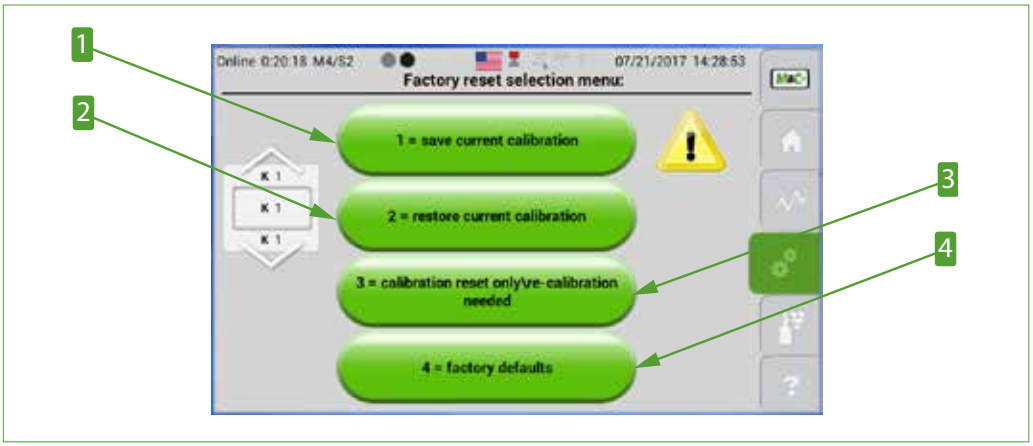


Fig. 48: Default setting menu with four parameters to select

1 *Save current calibration*
2 *Restore current calibration*
3 *Calibration reset only\re-calibration needed*
4 *Factory defaults*

- 6 = Database

Fig. 49: 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. 50: 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. 51: 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 = Supervisior

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. 52: 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.

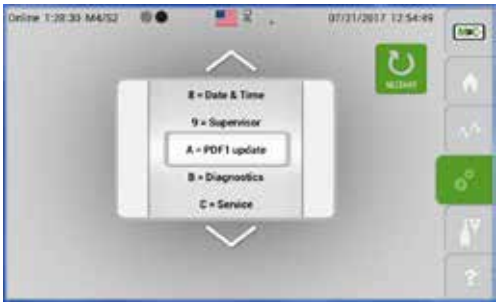


Fig. 53: Download a new PDF-file with the latest manual version

Please insert a USB stick with the latest instruction manual version in the USB port located at the rear side of the analyzer. Tap the 'Pls. confirm!' button to start the download of the PDF-file.

- B = Diagnosis

Fig. 54: Scroll bar with 'B=Diagnosis' displayed in the gray frame

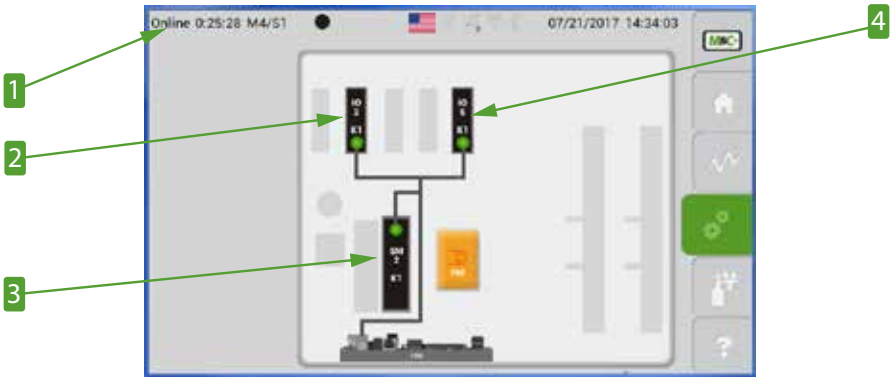


Fig. 55: Schematic for diagnosis

1 *Hidden password*
2 *I/O2 hardware components*
3 *SM2 hardware components*
4 *I/O5 hardware components (PMA1000 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 52 in Fig. 56 the I/O2 components are selected.

Fig. 56: Display of the High-Side- and relay-outputs with the mA-output of I/O2

Here all of the High-Side- and relay-outputs with the mA-output of I/O2 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 'Execute' button to confirm your entry.

To check another part of the hardware, please tap on the module to get back to the M4/S3 schematic 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 51 in Fig. 55 opens. Please tap on the hardware components to select and highlight them.

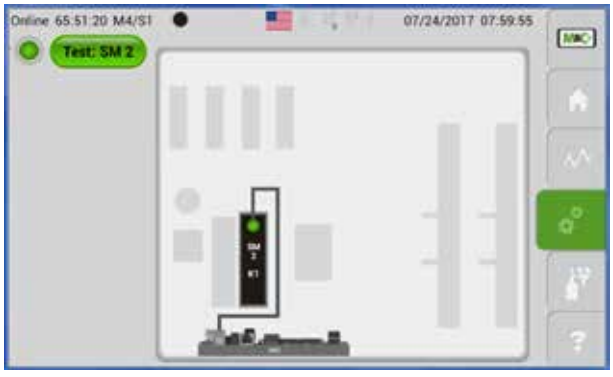


Fig. 57: Display of the highlighted SM2 components

To test the internal data bus, please tap on the SM2 components. The screen displayed on page 52 in Fig. 57 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/S3 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 HS and RS settings back to the initial values.

- C = Service

Fig. 58: Scroll bar with 'C=Service' displayed in the gray frame

The 'Service' feature is not active for PMA devices.

7.3.13 M5/S1 and M5/S2 calibration menu

- Calibration screen

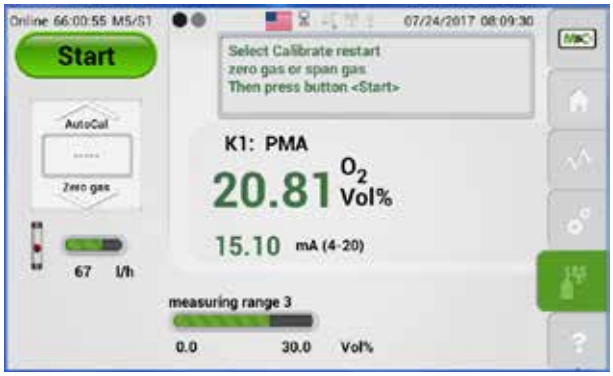


Fig. 59: Gas calibration screen

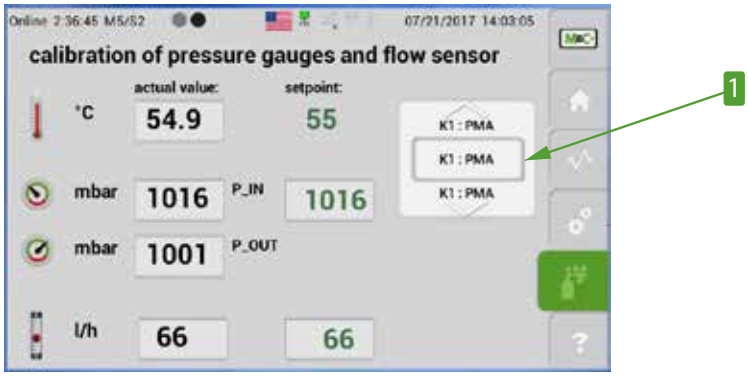


Fig. 60: Calibration of pressure gauges and flow sensor

1 Channel selection scroll bar

This section shows the actual value and the set point of auxiliary variables. 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 you change 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 60 chapter 'Calibration' .

7.3.14 M6/S1 Help button

Fig. 61: 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/PMA1000L 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/PMA1000L 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/PMA1000L 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/PMA1000L in hazardous areas or for the measurement of explosive gases.

8.2 Installation examples

The PMA1000 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.

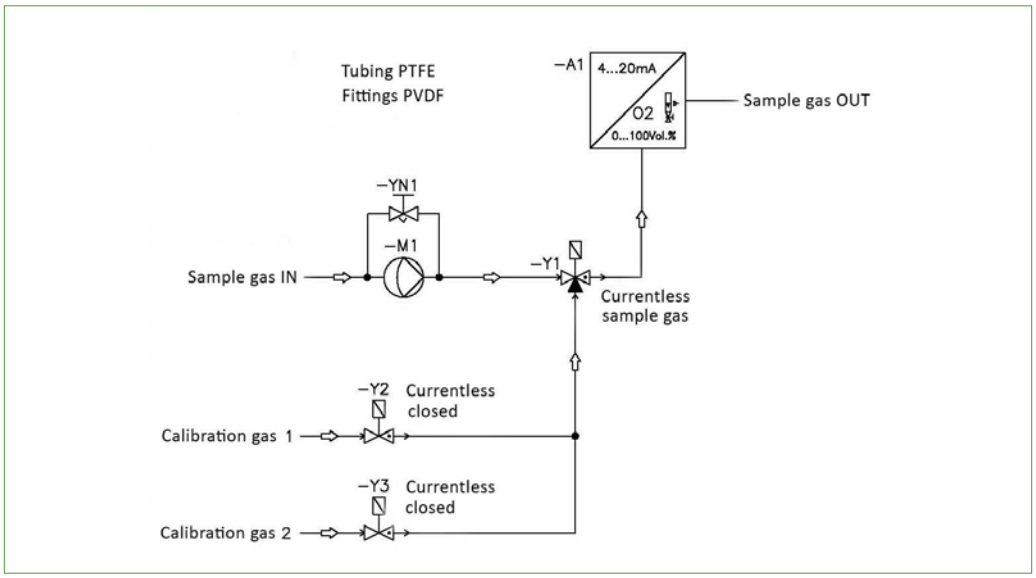


Fig. 62: Example: Span gas calibration with sample gas pump

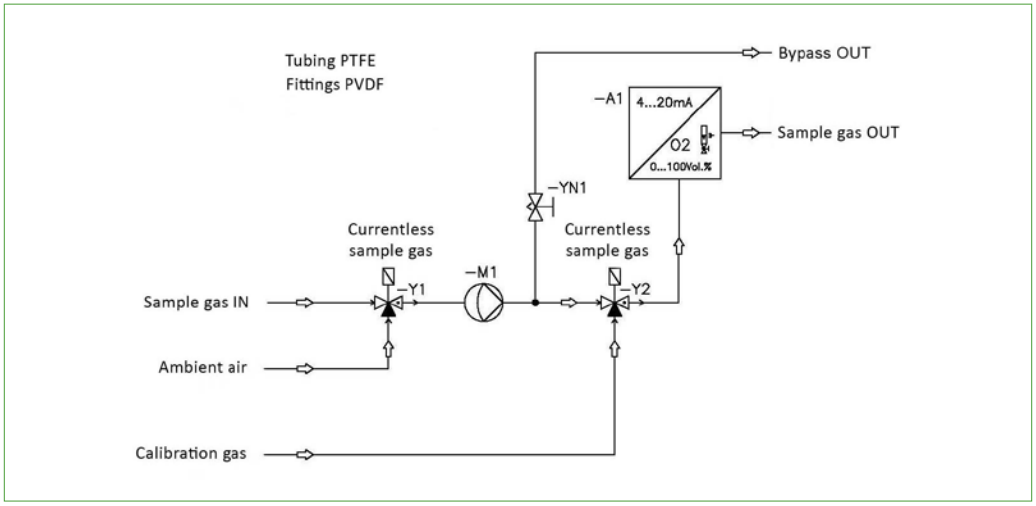


Fig. 63: Example: Span gas calibration with calibration gas from a pressure cylinder

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.

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 paramagnetic measuring cell 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. 64: 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. 65: 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 and PMA1000L. The functionality of the L-model includes manual calibration. The PMA1000 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. 66: Manual calibration PMA1000L

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*

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 measuring range of '-2.0 to +2.0 vol%'. The value of the actual gas concentration needs to be in this predefined measuring range.

To adjust a calibration parameter, 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 parameters.

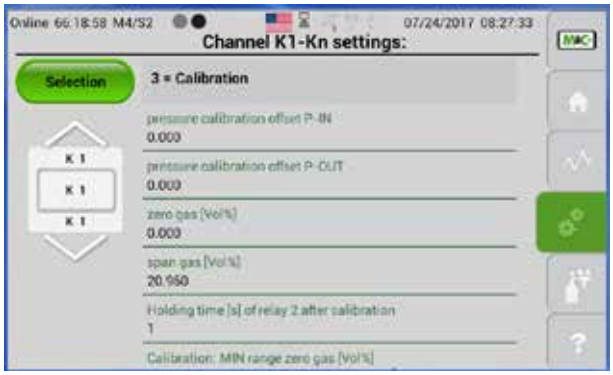


Fig. 67: Setting the channel-specific calibration parameters

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

Fig. 68: Manual calibration with span gas

Example: in 'Fig. 68 Manual calibration with span gas' the test gas has a 20.91 vol% oxygen concentration.

Please tap on the start button to initiate the manual calibration procedure. This tap on the start button triggers the status relay RS2, which is part of the I/O2 hardware components (connector X20).

Fig. 69: 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 only: This tap activates the AutoCal valves HSS1 (switching between sample/test gas) and in addition HSS2 for zero gas or HSS3 for span gas. The AutoCal valves are triggered by the I/O5 hardware components (connector X52).

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

Fig. 70: 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. 71: Third step of the manual calibration procedure

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

Note

PMA1000 only: Tapping on the '3. Step' button deactivates the valves HSS1 (switching between sample/test gas) and also HSS2 (for zero gas) or HSS3 (for span gas). This resets the trigger of the I/O5 hardware components (connector X52).

Please tap on the '3. Step' button to save the measured value.

Fig. 72: 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 RS2, which is part of the I/O2 hardware components (connector X20). This tap ends the calibration mode.

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

Fig. 73: 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. 74: 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 34 in Fig. 29.

- Errors during manual calibration procedure

Fig. 75: 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.

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 measuring range was predefined from -2.0 to +2.0 vol%. The oxygen concentration in ambient air does not fit into this predefined measuring range. The calibration procedure could not be completed.

Fig. 76: 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. 77 appear.

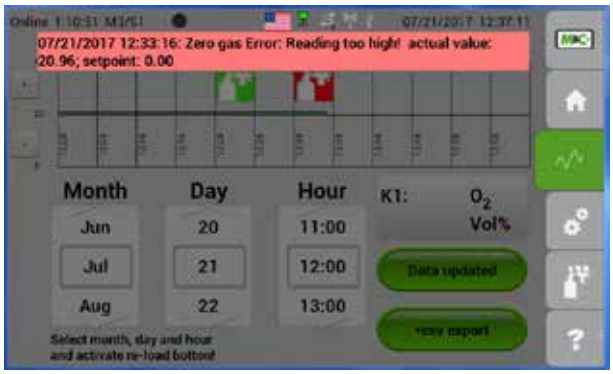


Fig. 77: Screen showing details about a single calibration procedure

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 features an automated calibration tool (AutoCal).

The analyzer is able to activate up to 4 magnetic valves to switch between sample gas and test gas. The magnetic valves are triggered by an integrated time-based sequencing control unit. Because of the internal power supply of 24 V DC, which is connected to the four High-Side-outputs (HSS1…HSS4, connector X52), the corresponding magnetic valves can be opened or closed. An external 24 V DC power supply is not necessary.

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

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 simple 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'.

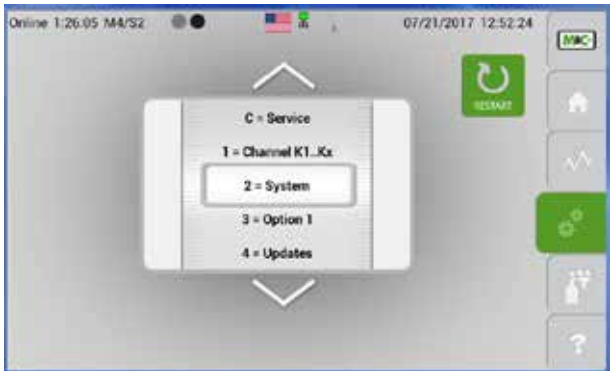


Fig. 78: AutoCal activation: open section M4/S2

The screen with the system settings opens.

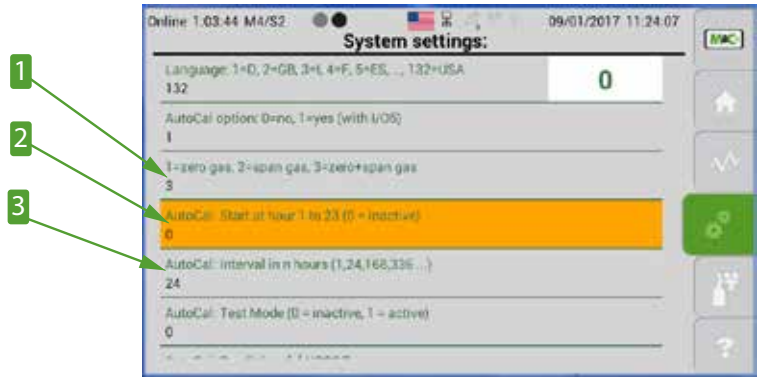


Fig. 79: AutoCal activation: change system settings (first part of the list)

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 please enter '4'.
3	Enter the period the AutoCal procedure should be repeated. E.g. 24h means that the procedure starts daily at 18:00.
4	Set the AutoCal test mode option to '0' (inactive)
5	Waiting period until the measured value of the zero gas is displayed on the screen (HSS2).

	System settings to activate AutoCal
6	Waiting period until the measured value of the span gas is displayed on the screen (HSS3).
7	Waiting period, RS1 AutoCal, until analyzer is in operating mode again.

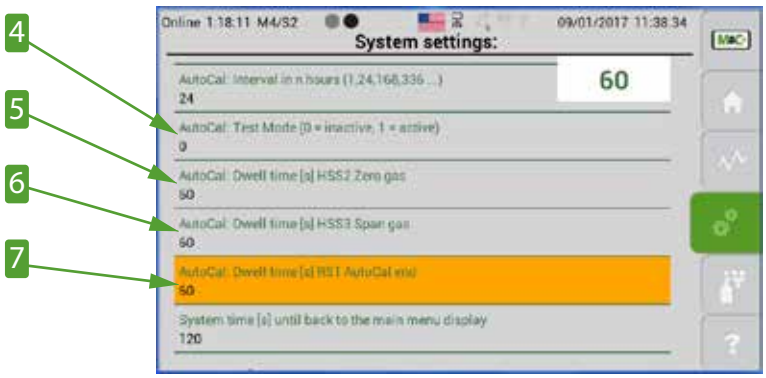


Fig. 80: AutoCal activation: change system settings (second part of the list)

4 Option AutoCal test mode
5 Waiting period HSS2 zero gas
6 Waiting period HSS3 span gas
7 Waiting period RS1 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. 81: Scroll to 'AutoCal' to reach calibration start screen

To the right of the sample gas measuring range, two measuring ranges (1,3) for the test gas concentrations are displayed. These measuring ranges are used to monitor the gas concentration for the automated calibration of zero and span gas. The first measuring range (1) has a range from -2.0 to +2.0 vol%. The value on top of the green arrow is the zero gas concentration, in this example 0.0 vol%.

The second measuring range (3), has a range from 19.0 to 24.0 vol%. The span gas concentration value in this example is 21.0 vol%.

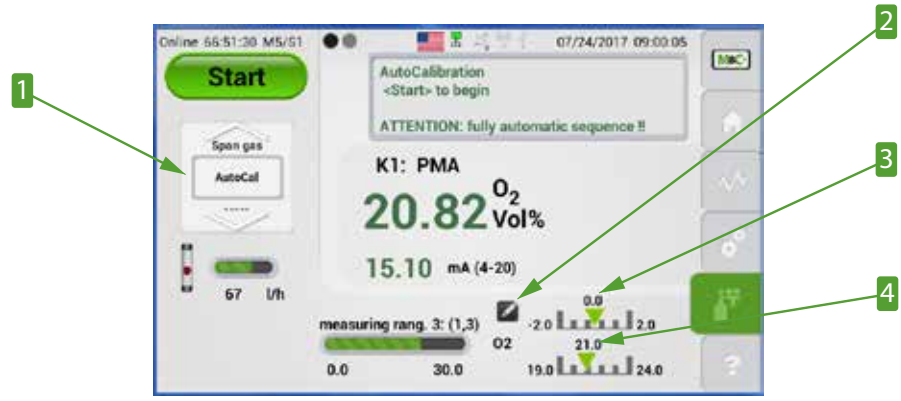


Fig. 82: AutoCal start screen

1 *'AutoCal' selected in gray frame of scroll bar*
2 *Edit button*
3 *Zero gas measuring range from -2 to +2 vol%*
4 *Span gas measuring range from 19 to 24 vol%*

Note

The measuring range needs to include the value of the test gas concentration.

Please make sure, to adjust the corresponding measuring range, after you have changed the test gas concentration. An error will occur, when the test gas concentration does not fit into the measuring 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.

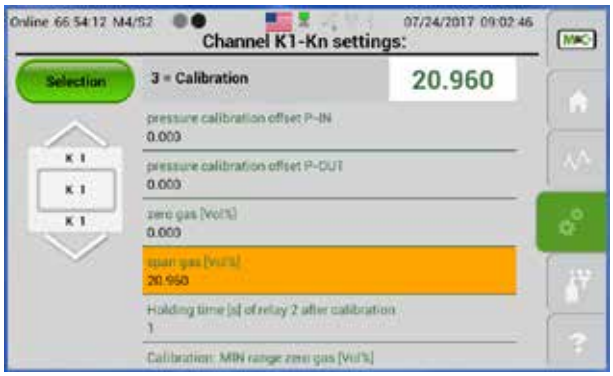


Fig. 83: Parameter screen to adjust test gas measuring ranges and concentrations

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. 84: 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 High-side and relay outputs.

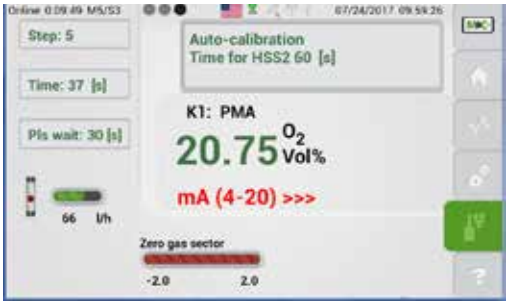
Fig. 85: Information displayed during AutoCal procedure

1 *Info boxes*
2 *Message box*
3 *Calibration button*

10.3.1 AutoCal steps

The AutoCal procedure consists of 17 steps.

	AutoCal steps	Screen
1	Auto-calibration IO5: relay RS2 ‚ON‘	
2	Auto-calibration IO5: relay RS1 ‚ON‘	
3	Auto-calibration IO5: HSS1 ‚ON‘ Valve position test gas	

	AutoCal steps	Screen
4	Auto-calibration IO5: HSS2 ‚ON' Valvel zero gas	
5	Auto-calibration Time for HSS2	
6	Auto-calibration Pls. wait until measuring value is stable ...	
7	Auto-calibration Zero gas measured value is stored.	
8	Auto-calibration IO5: HSS2 ‚OFF' Valve zero gas	
9	Auto-calibration IO5: HSS3 ‚ON' Valve PG1 span gas	
10	Auto-calibration Time for HSS3	
11	Auto-calibration Pls. wait until measured value is stable ...	

	AutoCal steps	Screen
12	Auto-calibration span gas measurement value is stored.	
13	End: Auto-calibration IO5: HSS3 ‚OFF' Valve test gas	
14	End: Auto-calibration IO5: HSS1 ‚OFF' Valve sample gas	
15	End: Auto-calibration IO5: RS1 ‚OFF' Pump on	
16	End: Auto-calibration Time for RS1	
17	Auto-calibration completed IO5: RS2 ‚OFF' Auto-calibration finished	

10.3.2 AutoCal Abort

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 'USER-abort, Pls. wait ... [s]' and the system counts down from 70 seconds.

After the timeout period has expired, you can start the AutoCal process again.

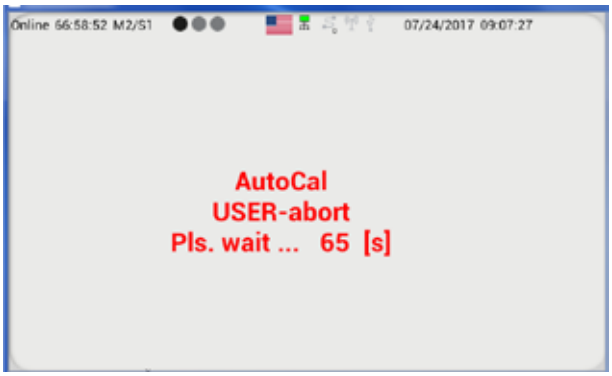


Fig. 86: Canceled AutoCal process

10.4 Calibration of auxiliary variables

Auxiliary variables can be adjusted in the M5/S2 section. You can reach this section by tapping on the Calibration button and swiping left.

The closed lock shows, that the analyzer is still in operating mode, while this screen is open.

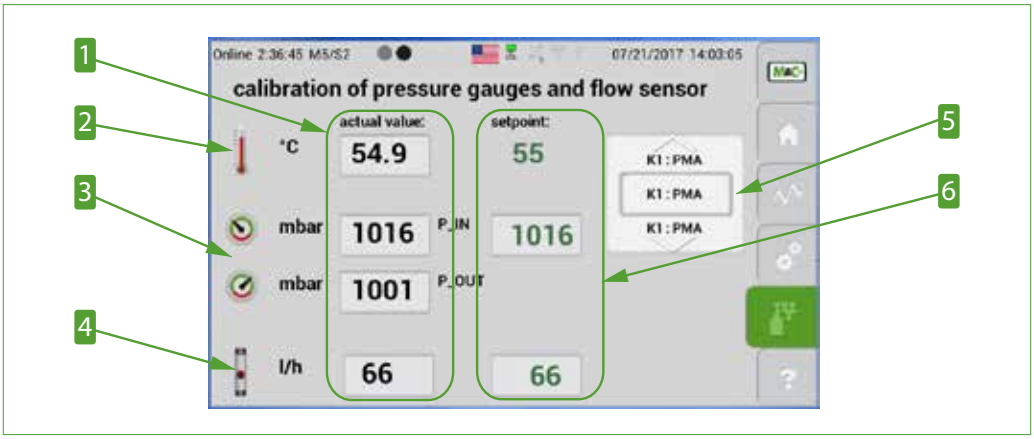


Fig. 87: Calibration of pressure gauges and flow sensor

1 *Actual values*
2 *Temperature in °C*
3 *Pressure P-IN and P-OUT in mbar*
4 *Flow rate in l/h*
5 *Lock (closed)*
6 *Channel selection scroll bar*
7 *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 42 'Fig. 42 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_2) inert gas atmosphere at +20 °C (+68 °F), please take a look at the table in this chapter.

If the PMA1000 is calibrated at zero point with nitrogen the reading will show -0.27 %. Then due to the Cross-sensitivity of CO_2 at +20 °C (+68 °F) the analyzer shows a value of -0.27 %. This means, if you calibrate the analyzer with 100 % N_2, the zero point needs to be set to +0.27 %. This zero point adjustment compensates the effect of CO_2 in the measurement and 100 % CO_2 show a reading of 0 %.

This is an example for a gas composition with CO_2 and O_2 only. To eliminate the cross-sensitivity effects, we can simply use CO_2 instead of N_2 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.

C2H6 (Ethane)	1 vol%
O2	5 vol%
CO2	40 vol%
N2	54 vol%

N_2 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. 88: Formula to calculate the effects of coexisting gases

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

C2H6 (Ethane)	- 0.0043 vol%
CO2	- 0.080 vol%
N2	0.0000 vol%

The value of the sum of the cross-sensitivities is -0.1123 vol%. This value is needed to adjust the zero point. The zero point needs to be set to +0.1123 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_2, and a limit point calibration of 100 vol% O_2.

Gas	Chemical formula	Cross-sensitivity values	
		+ 20 °C (+68 °F)	+50 °C (+122 °F)
Argon	Ar	- 0.23	- 0.25
Acetylene	C_2H_2	- 0.26	- 0.28
Acetone	C_3H_6O	- 0.63	- 0.69
Acetaldehyde	C_2H_4O	- 0.31	- 0.34
Ammonia	NH_3	- 0.17	- 0.19
Benzene	C_6H_6	- 1.24	- 1.34
Bromine	Br_2	- 1.78	- 1.97
Butadiene	C_4H_6	- 0.85	- 0.93
Methyl propene	C_4H_8	- 0.94	- 1.06
n-Butane	C_4H_{10}	- 1.10	- 1.22
Chlorine	Cl_2	- 0.83	- 0.91
Hydrogen chloride	HCL	- 0.31	- 0.34

Gas	Chemical formula	Cross-sensitivity values	
		+ 20 °C (+68 °F)	+50 °C (+122 °F)
Nitrous oxide	N_2O	- 0.20	- 0.22
Diacetylene	$(CHCl)_2$	- 1.09	- 1.20
Ethane	C_2H_4	- 0.43	- 0.47
Ethylene oxide	$C_2H_4O_2$	- 0.54	- 0.60
Ethylene	C_2H_4	- 0.20	- 0.22
Ethylene glycol	$(CH_2OH)_2$	- 0.78	- 0.88
Ethylbenzene	C_8H_{10}	- 1.89	- 2.08
Hydrogen fluoride	HF	+ 0.12	+ 0.14
Furan	C_4H_4O	- 0.90	- 0.99
Helium	He	+ 0.29	+ 0.32
n-Hexane	C_6H_{14}	- 1.78	- 1.97
Krypton	Kr	- 0.49	- 0.54
Carbon monoxide	CO	- 0.06	- 0.07
Carbon dioxide	CO_2	- 0.27	- 0.29
Methane	CH_4	- 0.16	- 0.17
Methylene chloride	CH_2Cl_2	- 1.00	- 1.10
Neon	Ne	+ 0.16	+ 0.17
n-Octane	C_8H_{18}	- 2.45	- 2.70
Phenol	C_6H_6O	- 1.40	- 1.54
Propane	C_3H_8	- 0.77	- 0.85
Propylene	C_3H_6	- 0.57	- 0.62
Propylene oxide	C_3H_6O	- 0.90	- 1.00
Propylene chloride	C_3H_7Cl	- 1.42	- 1.44
Monosilane	SiH_4	- 0.24	- 0.27
Styrene	C_8H_8	- 1.63	- 1.80
Nitrogen	N_2	0.00	0.00
Nitrogen oxide	NO	+ 42.70	+ 43.00
Nitrogen dioxide	NO_2	+ 5.00	+ 16.00
Oxygen	O_2	+100.00	+100.00
Sulphur dioxide	SO_2	- 0.18	- 0.20
Sulphur fluoride	SF_6 -	0.98	- 1.05
Hydrogen sulphide	H_2S	- 0.41	- 0.43
Toluene	C_7H_8	- 1.57	- 1.73
Vinyl chloride	C_2H_3Cl	- 0.68	- 0.74
Vinyl fluoride	CH_3F	- 0.49	- 0.54
Water (steam)	H_2O	- 0.03	- 0.03
Hydrogen	H_2	+ 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 Spare parts and consumables

The replacement interval for spare parts and consumables depends on the specific operating condition of the analyzer. The quantities recommended in the following table are based on experience. Your replacement intervals will be based on your operating conditions.

The product label with the serial number is located on the back of the PMA1000/PMA1000L.

Please refer to this serial number if you need to order spare parts or consumables.

PMA1000/PMA1000L						
		(C) Consumables (R) recommended spare parts (S) spare parts		recommended amount based on number of years of operation [years]		
Part-No.	**Name**			**1**	**2**	**3**
90 A 0010	Measuring cell PMC1	S				1

13 Appendix

13.1 Trouble shooting

For easy access to information about calibration and operation of the PMA1000/PMA1000L, please look at the instruction manual in section M6/S1. You will reach this screen by tapping on the Help button.

Fig. 89: 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

13.3 Declaration of conformity

CE - Certification

The PMA1000/PMA1000L complies with the following EU directives:

EMC directives

The PMA1000/PMA1000L complies with the EC directive 2014/30/EU 'Electromagnetic compatibility'.

Low Voltage Directive

The PMA1000/PMA1000L meets the requirements of the Low Voltage Directive 2014/35/EU.

To ensure the compliance with this EC directive, the PMA1000/PMA1000L 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

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 83 '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.

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

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

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 (dumbbell-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.

Notes

Notes

Your contact to M&C in Germany and the USA

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- E-mail: **info-usa@mc-techgroup.com**

Your M&C contacts world-wide

http://www.mc-techgroup.com/en/Locations-and-regions/