Instruction Guide

PHOTON SYSTEMS INSTRUMENTS

Gas Mixing System
GMS 150/GMS 150-MICRO

Please read the Guide before operating this product

TABLE OF CONTENTS

1 SAFETY PRECAUTIONS

Read this manual carefully before operating the device. If you are not sure about something in the manual, contact the manufacturer for clarification.

⚠️	By accepting the device, the customer agrees to follow the instructions in this guide.

GENERAL CAUTIONS:
- Always follow corresponding manuals while working with the Gas Mixing System or doing the maintenance.
- It is forbidden to interfere with the hardware or software of the GMS in any way without previous agreement with the manufacturer.
- The manufacturer is not responsible for any damage due to improper operation or incompetent operation.
- The manufacturer is not responsible for any damage due to gas leak from any auxiliary units (gas containers, defective valves, etc.).

BEFORE OPERATING THE GMS 150 READ THE FOLLOWING INSTRUCTIONS AND WARNING CAREFULLY:
- To operate a gas handling equipment, you should be trained in its proper use or be under competent supervision.
- The device is primarily intended to mix CO_2, N_2 and air. Mixing of other gasses must be always consulted with manufacturer.
- Pressure regulator must be always used when connecting the GMS 150 with the gas tank. Never connect the gas tank directly to the GMS 150.
- Do not apply pressure in the gas inputs until the GMS 150 is switched on and fully operational.
- For GMS 150, gas input pressure should be 3 – 5 bars. Gas input pressure cannot exceed 8 bars.
- For GMS 150-MICRO, gas input pressure should be adjusted according the outlet flow. Gas input pressure cannot exceed 10 bars.
- Input gas must be free of oil, water or any other foreign substances.
- If working in wet conditions, dehumidifier must be used to prevent condensation of water in tubes and the system.
- Avoid flooding of the GMS 150 valves by proper device installation and operation. Place the GMS above the cultivation system. When the GMS is not in operation, disconnect all tubing to prevent fluid from being drawn into the GMS.
- The gas outlet should never be blocked, no pressure should be applied on the gas outlet.
- Follow the basic safety rules for work with CO_2 and other hazardous gases.
- Never heat or expose a gas tank or gas handling equipment to temperatures above 50 °C (120 °F).

GENERAL ELECTRICAL SAFETY GUIDELINES:
- Connect all peripheral units when the device is switched off.
- Routinely check the devices and their wiring.
- Use only cables supplied by the manufacturer.
- Replace worn or damaged cords immediately.
- Use electrical extension cords wisely and do not overload them.
- Place the devices on a flat and firm surface. Keep them away from wet floors and counters.
- Avoid touching the device, socket outlet or switch if your hands are wet.
- Do not perform any alterations to the electrical part of the devices or its components.

The following table presents basic highlight symbols used in this manual:

Symbol	Description
⚠️	Important information, read carefully.
ℹ️	Complementary and additional information.

Tab. 1 Used symbols.

2 TECHNICAL SPECIFICATION

	GMS 150 / TORA-10L / TORA-20L	GMS 150-MICRO
Measuring principle	Thermal mass flow measurement	Thermal mass flow measurement
Accuracy (Incl. Linearity)	± 0.5 % Rd plus ± 0.1 % FS (± 1 % FS for ranges 3 – 5 ml/min; ± 2 % FS for ranges < 3 ml/min)	± 1.5 % Rd plus ± 0.5 % FS
Turndown	1:187	n.d.
Flow range of inbuild valves	Max. total flow rate: 2, 10 or 20 l/min depending on the GMS version (customized max. flow rate between 1 ml/min – 1,000 l/min) Min. flow rate: 2 % of the max. flow rate	Max. total flow rate: 2 l/min typically (customized max. flow rate between 10 ml/min – 5 l/min) Min. flow rate: 2 % of the max. flow rate
Repeatability	< 0.2 % RD	For flows < 20 ml/min: ±0.5 % FS For flows > 20 ml/min: ±0.5 % RD
Control stability	< ± 0.1 % FS (typical for 1 l/min N_2)	n.d.
Settling time	1 – 2 seconds	700 msec
Warm-Up time	30 min for optimum accuracy, 2 min for accuracy ±2 % FS	30 min for optimum accuracy, 2 min for accuracy ± 2 % FS
Temperature sensitivity	Zero: < 0.05 % FS/°C; span: < 0.05 % FS/°C	Zero: < 0.01 % FS/°C; span: < 0.02 % FS/°C
Pressure sensitivity	0.1 %/bar typical N_2	n.d.
Attitude sensitivity	Max. error at 90° off horizontal 0.2 % at 1 bar, typical N_2	Max. error at 90° off horizontal 0.5 % at 1 bar, typical N_2
Input pressure	3 – 5 bars (don't exceed maximum operation pressure of 8 bars)	The required inlet pressure depends on the range of the outlet flow: ca. 3 bars for 2 l/min ca. 10 bars for 5 l/min Don't exceed maximum operation pressure of 10 bars
Operating temperature	+15 to +50 °C	+15 to +30 °C
Input/Output connectors	Parker Prestolok (6 mm)	Parker Prestolok (6 mm)
Seals	Viton	Viton
Display	8 x 21 characters LC display	8 x 21 characters LC display
Power supply	115 – 230 VAC	115 – 230 VAC
Dimensions	37 cm x 28 cm x 15 cm	37 cm x 28 cm x 15 cm
Weight	7 kg	5 kg
Warranty	1 year parts and labor	1 year parts and labor

3 GENERAL DESCRIPTION

Gas Mixing System GMS 150 can produce precise mixtures of up to 4 different gasses. The flows of the individual input gases are measured by thermal mass flow meters and adjusted by integrated mass flow controllers. The input and output gas connectors are Prestolok type allowing fast and secure connection to a variety of tubes.

GMS 150 is typically used to control flow of air, carbon dioxide, and nitrogen. Additional gases like nitrogen dioxide, ammonia and others can also be added to simulate various technological mixtures or smokestack gasses.

The GMS is available in two types - GMS 150 (including TORA versions) and GMS 150-MICRO - that differ in the mass flowmeters used. GMS 150 offers higher accuracy, extended operation conditions, and wider selection of the customized flowmeters compared to the GMS 150-MICRO (for more technical specifications, see chapter 2).

For standard GMS 150 configurations, please see the tables below. If requested, the standard gas flow rates can be customized from ca. ml/min to tens of l/min depending on the GMS type.

The typical GMS 150 and GMS 150-MICRO configuration (intended preferably for small-scale Photobioreactors):

GMS 150	Channel 1	Air/N_2	40 – 2,000 ml/min
	Channel 2	CO_2	0.8 – 40 ml/min
GMS 150-MICRO	Channel 1	Air/N_2	40 – 2,000 ml/min
	Channel 2	CO_2	0.8 – 40 ml/min

Gas Mixing Systems TORA are designed for large scale Photobioreactors:

GMS 150/TORA-10L	Channel 1	Air/N_2	200 – 10,000 ml/min
	Channel 2	CO_2	8 – 400 ml/min
GMS 150/TORA-20L	Channel 1	Air/N_2	400 – 20,000 ml/min
	Channel 2	CO_2	16 – 800 ml/min

The GMS 150 can be used as a stand-alone instrument or in a system with the Photobioreactors, Multi-Cultivators and FytoScopes. It can be controlled locally from its front display or by the Photobioreactor Control Software. The required gas mixture can be defined either in absolute or percentage mode. Absolute mode: the gas mixture is defined via the individual gasses' flows given in absolute units (for example 980 ml/min of N_2 and 20 ml/min of CO_2). Percentage mode: the mixture is defined via a relative gas proportion given in relative unit % or ppm (for example 2% CO_2) and via the total gas mixture flow rate in absolute unit (1,000 ml/min).

The side installation requirements for the proper operation of the GMS include pressurized gas sources (air, CO_2, N_2, etc.) with the appropriate pressure regulators. Pressurized air used for the GMS must be dry and oil free. The inlet pressure must be adjusted depending on the GMS 150 version and configuration (see chapter 2 for technical specification). The accuracy cannot be declared when the pressure is lower than 3 bars.

⚠️	Please note that inlet pressure exceeding 8 bars causes valve damage in GMS 150 version. In GMS 150-MICRO version, the inlet pressure must be adjusted according the required outlet flow rate and must not exceed 10 bars.
ℹ️	Should the GMS 150 be used linked with Photobioreactor, Multi-Cultivator or FytoScope, read also instruction manual for these instruments to connect the GMS with these devices properly.

4 COMPONENTS OF THE GMS 150 DEVICE

Standard version of the GMS package consists:

- Gas Mixing System GMS 150 (Fig. 1)
- Cables and Connectors – Power cable, 5 m of Parker Prestolok tubing Ø 6 mm, 3 pieces of blinding plugs (Fig. 2)
- Operation Manual (printed version)
- Optional Accessories (according to your specific order)

ℹ️	If any item is missing, please, contact the manufacturer. Also check the carton for any visible external damage. If any damage is found, notify the carrier and the manufacturer immediately. The carton and all packing materials should be retained for inspection by the carrier or insurer. For customer support, please write to: support@psi.cz.

Fig. 1 GMS 150.

Fig. 2 Cables and blinding plugs.

5 DESCRIPTION OF THE GMS 150 DEVICE

Front panel:

Fig. 3 GMS front panel.

1) Two gas inputs. When switched on, the device detects and displays automatically all connected valves. CO_2 input is connected to valve 1. Air/N_2 input is connected valve 2. 2) Four UP/DOWN keys. Each UP/DOWN key controls one particular valve (more on valve control in Chapter 7.1 – Display & Control Screen). 3) Four control keys for the device setting (more on device setting in Chapter 0 – Setting Screen). 4) Gas output. 5) Display.

> GMS 150 can produce precise mixtures of up to 4 different gasses, but standardly there are only two gas inputs.

Rear panel:

Fig. 4 GMS rear panel.

1) Power connector. 2) ON/OFF Main switch. 3) Serial connector. 4) Device serial number.

6 INSTALLATION AND OPERATION PROTOCOL

General information:

- Pressurized air and CO_2 should only be applied to the GMS 150 when the device is on and fully operational.
- For GMS 150, gas input pressure should be 3 – 5 bars. Gas inlet pressure cannot exceed 8 bars.
- For GMS 150-MICRO, gas input pressure should be adjusted according the outlet flow (ca. 3 and 10 bars for 2 and 5 l/min, respectively). Gas inlet pressure cannot exceed 10 bars.
- The gas outlet should never be blocked, no pressure should be applied on the gas outlet.
- Parker Polyflex Presto TPU 6x1 tubing should be used.
- See also chapter Safety precautions.

⚠️	It is necessary to avoid flooding of the GMS 150 valves. The warranty doesn't cover any damage of the valves caused by water or moisture. Please, pay attention to this fact as cleaning, repair and recalibration of the valves are expensive and won't be covered by warranty. Place the GMS 150 on the shelf above the associated equipment (Photobioreactor, Multi-Cultivator, etc.). When the GMS is not in operation, disconnect all tubing to prevent fluid from being drawn into the GMS.

How to switch on the GMS:

- Connect all peripheral units when the device is switched off.
- Turn on the device and wait one minute.
- Connect Parker Prestolok tubing to GMS 150 gas inputs and output.
- Connect the tubing with gas sources using pressure regulators.
- Turn on pressurized gas for air and CO_2 inlets (3 bars each).
- Set appropriate flow rates for each channel on the device.
- Allow the device to equilibrate for 30 min prior to use.

How to switch off the GMS:

- Turn off the pressure for air and CO_2 inlets and let the system equilibrate.
- Remove the Parker tubing.
- Turn off the device.

ℹ️	To remove Parker tubing from gas output or input, switch off device and hold the rim of connectors for save removal of the tubing.

An illustrative example of GMS 150 linked with PBR FMT 150:

Recommended set-up includes one GMS 150 linked with one cultivation system (for example PBR FMT 150 unit) as is shown in Fig. 5. Such a configuration allows to use a full potential of GMS 150:

- Precise and independent regulation of total aeration flow in the individual PBR.
- Independent control of CO_2 concentration for individual PBR.
- The configuration is a well-tested and problem free set-up.
- The set-up allows to maintain pH at certain level via a feedback regulation of CO_2 sparging concentration. This function is available only with FMT 150/MC 1000 Control Software (Advanced License) using JavaScript created by user itself or purchased from PSI.
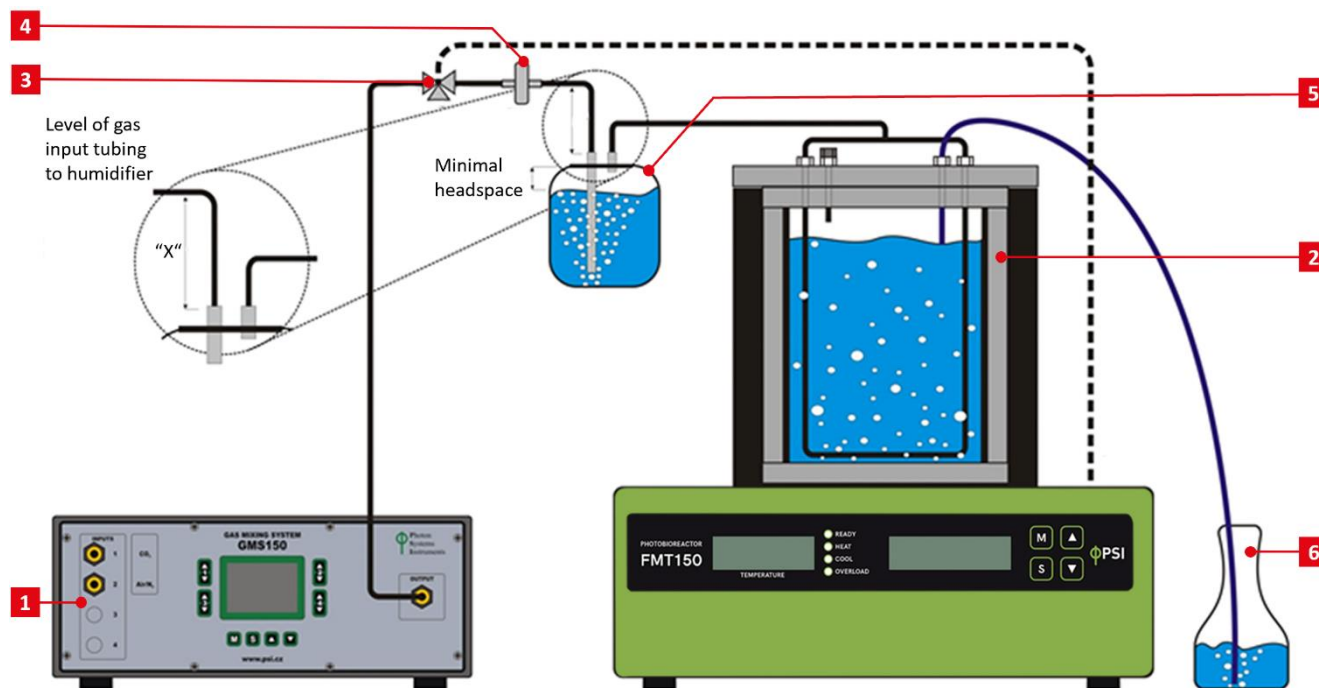
Fig. 5 GMS 150 connection to Photobioreactor FMT 150 cultivation unit.

Mixed gas of given composition is pumped from GMS (1) to the PBR FMT 150 (2) via air interruption valve (3), filter (4) and humidifier (5). Aeration gas is led through the cultivation vessel lid into the U-tube sparger. Medium overflow is collected using the medium outlet (6).

ℹ️	Place the GMS on a shelf at least 30 cm above the humidifier to prevent liquid from being drawn back into the GMS outlet port. In addition, the aeration tubing can be pulled through

7 OPERATION INSTRUCTIONS

The device is operated and controlled via two different screen-modes of the digital display:
1. **Display & Control Screen** – values for actual flow, target flow and output mixture flow of the gases are shown (Fig. 6 A).
2. **Setting Screen** - menu tree is shown (Fig. 6 B).

To change between these two modes:
- Use the **S** key (below the digital display) to switch from the **Display & Control Screen** to the **Setting Screen**.
- Use the **M** key (below the digital display) to return from the **Setting Screen** to the **Display & Control Screen**.

Fig. 6 A) Display & Control Screen. B) Setting Screen.

7.1 DISPLAY & CONTROL MENU SCREEN

- Use the **S** key (below the digital display) to switch from the **Display & Control Screen** to the **Setting Screen**.
- Use the **M** key (below the digital display) to return from the **Setting Screen** to the **Display & Control Screen**.
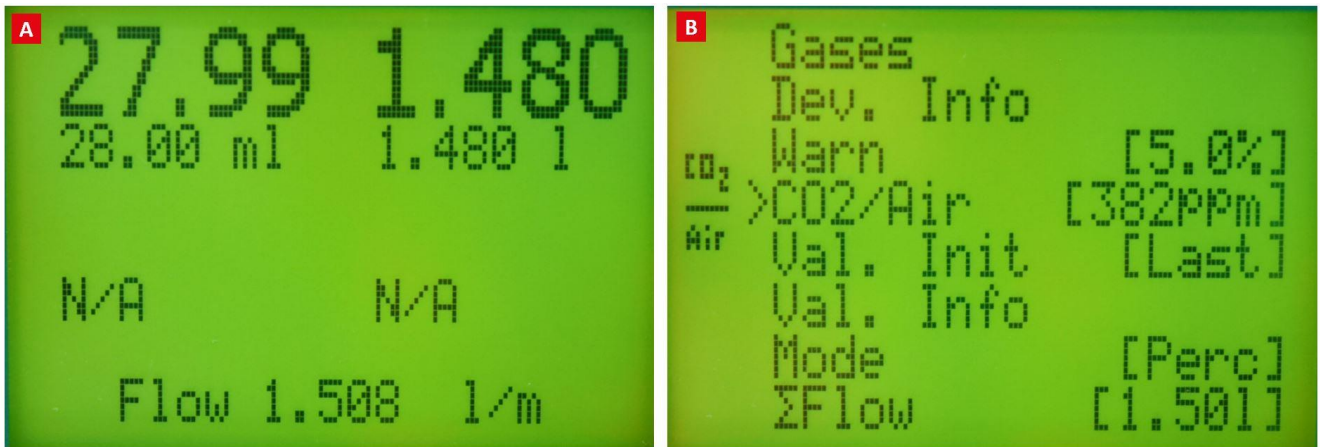- The **Display & Control Screen** shows the actual, current gas flow as well as the target flow values for each installed valve. These values can be displayed either in **absolute gas flow units** (ml/min or l_n/min) or in **percentage units** (% or ppm) which specifies relative contents of the given gas in the output gas mixture.
- The **absolute** or **percentage units** can be selected in the **Setting Screen** → Use the **S** key to switch from **Display & Control Screen** to the **Setting Screen**. Use **UP/DOWN** keys situated below the screen and select Mode in the menu tree. Use the **S** key again to switch between **absolute mode** and **percentage mode**.
- The target values for the single valves are set by four **UP/DOWN** keys situated at both sides of the screen. The keys are used to change actual gas flow in corresponding valves (UP/DOWN = add/subtract). The keys are numbered 1 – 4 (see the picture below Fig. 7).

Fig. 7 UP/DOWN keys.

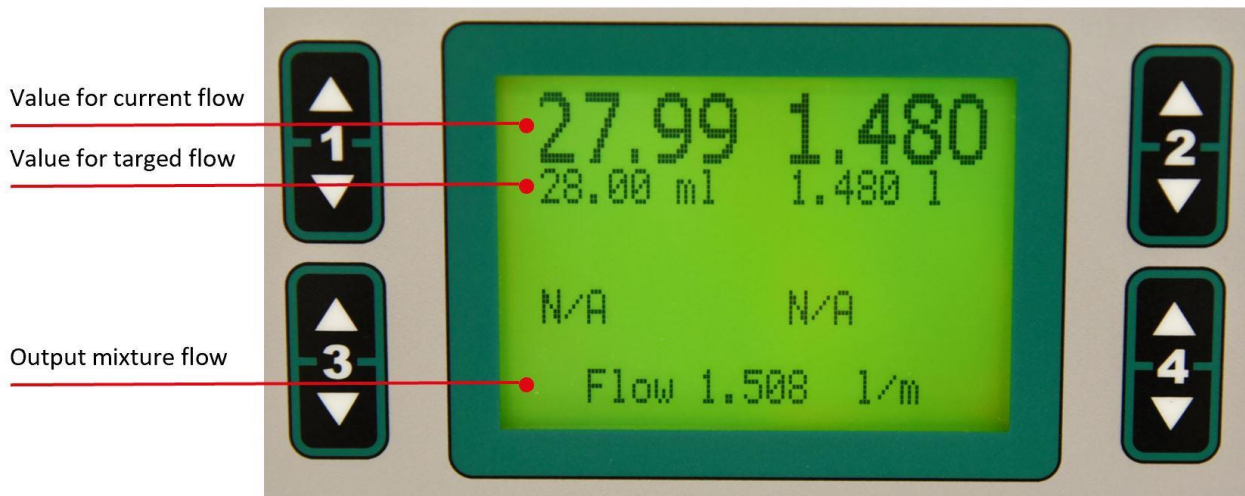### 7.1.1 DISPLAY WITH ABSOLUTE FLOW UNITS

Value for current flow

Value for targed flow

Output mixture flow

Fig. 8 Display with absolute flow units.

Values for current flow
- The current flow values for gases used are shown on the top of the display, on left side is usually current gas flow for CO_2, on the right side is usually current gas flow for Air/N_2 (Fig. 8).
- N/A means that this gas is not available.

> ⓘ If the current value is different from the target value in range larger than set tolerance value ("Tol".) the number of current gas flow is flickering. "Tol" is user-defined tolerance. You can set this tolerance value in menu → Press **S** key (below the digital display) to switch from the **Display & Control Screen** to the **Setting Screen**. Use ↕ keys for moving in menu and press **S** key on option **Warn**. Use ↕ keys to the required value (for example 10 %) a press **S** key to confirm.

Values for target flow
- The target flow value can be adjusted by using the corresponding **UP/DOWN** key (numbered 1, 2, 3, 4 on sides of display). The maximum setting range is limited by used valve (usually 2,000 ml). Information about valve you can find in menu → Press **S** key (below the digital display) to switch from the **Display & Control Screen** to the **Setting Screen**. Use ↕ keys for moving in menu and press **S** key on option **Val. info**.
- The absolute gas flow units are either liters per minute (l/min) or milliliters per minute (ml/min). You cannot set the flow rate below 2 % of maximum valve.
- In some Gas Mixing Systems, the valve control keys on the front panel are not labelled with the particular gas type. Instead, labels Valve 1 – 4 are used and gas type can be shown on display. To display the gas type on the screen → Press **S** key (below the digital display) to switch from the **Display & Control Screen** to the **Setting Screen**. Use ↕ keys for moving in menu and press **S** key on option **Gases → Valve X**.

> ⚠ The mass flow meters are calibrated for a particular gas type. The reading may be incorrect if a different, non-compatible gas is used.

Output mixture flow
It shows absolute air flow on the valves used. The absolute target flow is computed as a sum of flow on each individual valve (Fig. 8). Example from Fig. 8: 27.99 ml/min of CO_2 + 1.480 l/min Air = 1.508 l/min.

7.1.2   DISPLAY WITH PERCENTAGE GAS FLOW UNITS

Current percentage content
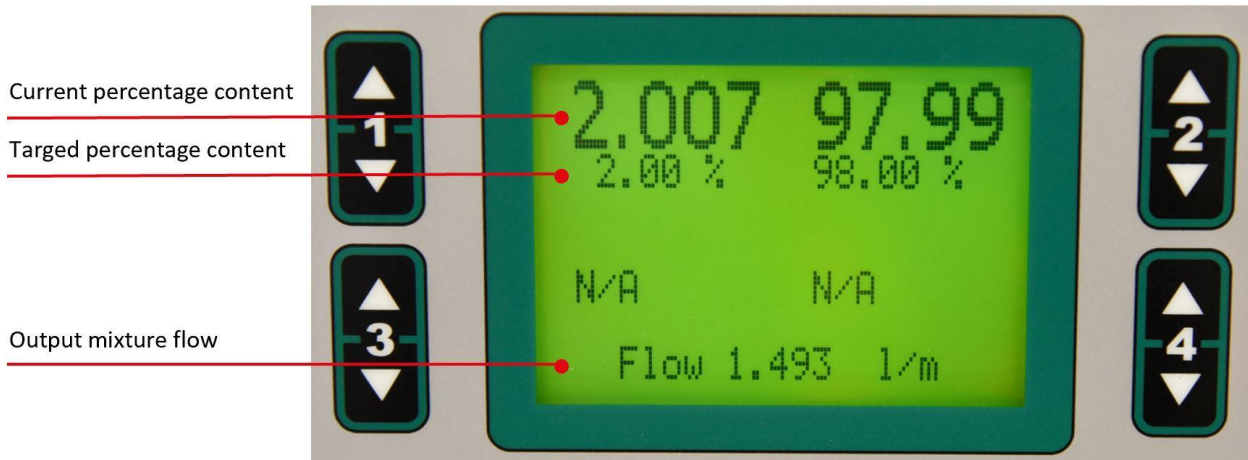
Targed percentage content

Output mixture flow

Fig. 9 Display with percentage gas flow units.

Current percentage content
- The current flow values for gases used are shown on the top of the display, on left side is usually current gas flow for CO_2, on the right side is usually current gas flow for Air/N_2 (Fig. 9).
- N/A means that this gas is not available.

	If the current value is different from the target value in range larger than set tolerance value ("Tol".) the number of current gas flow is flickering. "Tol" is user-defined tolerance. You can set this tolerance value in menu → Press **S** key (below the digital display) to switch from the **Display & Control Screen** to the **Setting Screen**. Use **UP/DOWN** keys for moving in menu and press **S** key on option **Warn**. Use **UP/DOWN** keys to set the required value (for example 10 %) a press **S** key to confirm.

Target percentage content
- The target flow value can be adjusted by using the corresponding **UP/DOWN** key (numbered 1, 2, 3, 4 on sides of display).
  The maximum setting range is limited by used valve (usually 2 l). Information about valve you can find in menu → Press **S** key (below the digital display) to switch from the **Display & Control Screen** to the **Setting Screen**. Use **UP/DOWN** keys for moving in menu and press **S** key on option **Val. Info**.
- The percentage gas content units are either parts per million (ppm) or percents (%). Sum of percent has to be 100 % (for example 2 % CO_2 and 98 % Air). You cannot set the ratio, which corresponds to the minimal flow rate to 2 % of maximum valve – an error message appears (see image Fig. 10).
- In some Gas Mixing Units, the valve control keys on the front panel are not labeled with the particular gas type. Instead, labels Valve 1 – 4 are used and the gas type can be shown on display. Displaying the gas type can be achieved through the **Setting Screen → Gases option → Valve X**.

Fig. 10 Error message.

	The mass flow meters are calibrated for a particular gas type. The reading may be incorrect if another gas is used.

Output mixture flow
- The total flow of the gas mixture is determined by the instrument so that the percentage gas content is adjusted with a maximum accuracy. The user can optimize gas mixture flow using the Setting Screen → Press **S** key (below the digital display) to switch from

the **Display & Control Screen** to the **Setting Screen**. Use **UP/DOWN** keys for moving in menu and press **S** key on option **∑Flow**. Use **UP/DOWN** keys to set the required value (for example 0.030 l/min – see Fig. 11) and press **S** key to confirm. This function is available only for Percentage Gas Flow Units (not for Absolute Gas Flow Units).

	If the gas flow is too low (for example setting our of the range, blocked tubes or source of gas is empty) the display shows an exclamation mark ! (see picture below Fig. 11). Be aware that in this case an optimal gas mixing precision cannot be granted.

Fig. 11 Exclamation mark.

IMPORTANT REMARKS:

- The percentage content of CO_2 in the output mixture is set as described above when mixed with N_2. However, when CO_2 is added to air that contains, for example, 380 ppm of CO_2, the target value is added to the offset of 380 ppm. The offset CO_2 concentration in the air can vary depending on the air source and, also, some of the air sources can have changing CO_2 content, e.g. during the day and night.
- The correction for the CO_2 concentration in the air can also be done automatically if the local CO_2 level is specified in the Setting Screen → CO_2/Air.

Setting Menu Screen

- The **Setting Screen** is operated by the **M**, **S** and **UP/DOWN** keys situated below the screen (see the picture below, Fig. 12).
- Use the **S** key to switch from the **Display & Control Screen** to the **Setting Screen** and to confirm change in the menu tree or to save the selected value (parameter).
- Use the **M** key to return from the **Setting Screen** to the **Display & Control Screen** and to move back in the main menu or to exit.
- Use the **UP/DOWN** key to add/subtract the desired value or to move up/down in the menu tree.

Fig. 12 Setting Screen – main menu and keys for operating the menu.

7.1.3 MENU TREE

Gases > Valve X (Fig. 13)

Use this option to change the gas type for selected valve. Only compatible gases are shown in selection. Usually you see valve 1 (CO_2) and valve 2 (Air).
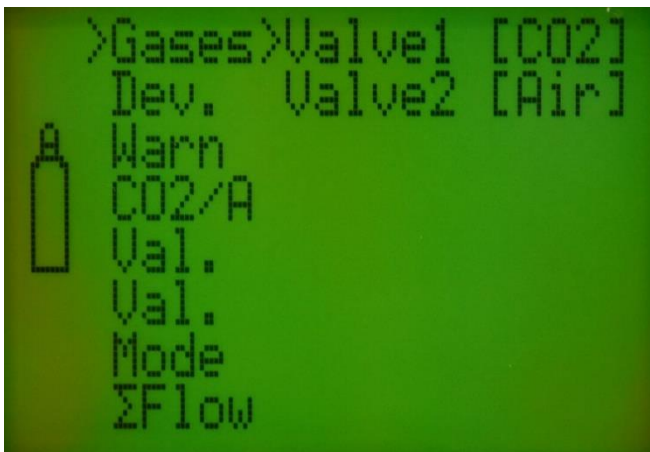
Fig. 13 Menu Tree – Gases.

Dev. Info (Fig. 14)

This option specifies the device type, firmware version, firmware date, name and build number. Press **S** key (below the digital display) to switch from the **Display & Control Screen** to the **Setting Screen**. Use **UP/DOWN** keys for moving in menu and press **S** key on option **Device Info**.
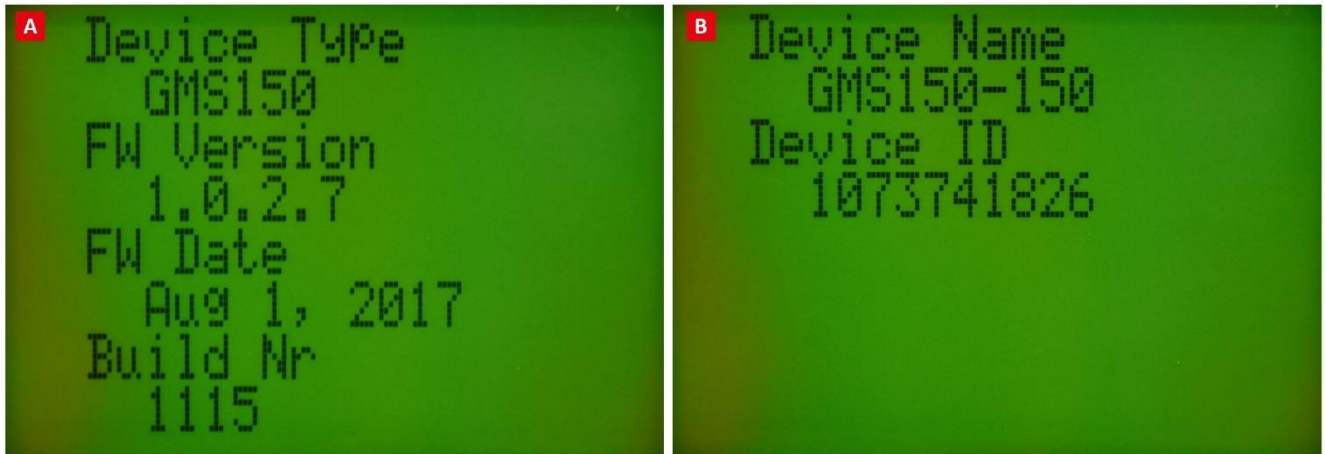

Fig. 14 Menu Tree – Device Info.

Warn

Use this option to set tolerance range (tolerated difference between the target and actual values). Use **UP/DOWN** key to set the required value. If the current value is different from the target value in range larger than set tolerance value ("Tol".) the number of current gas flow is flickering. "Tol" is user-defined tolerance. You can set this tolerance value in menu → Press **S** key (below the digital display) to switch from the **Display & Control Screen** to the **Setting Screen**. Use **UP/DOWN** keys for moving in menu and press **S** key on option **Warn**. Use **UP/DOWN** keys to the required value (for example 10 %) a press **S** key to confirm.

CO2/Air

Use this option to define the offset CO_2 concentration in the air source. Press **S** key (below the digital display) to switch from the **Display & Control Screen** to the **Setting Screen**. Use **UP/DOWN** keys for moving in menu and press **S** key on option **CO2/Air**. Use **UP/DOWN** key to set the required CO_2 concentration and hold **S** key to confirm.
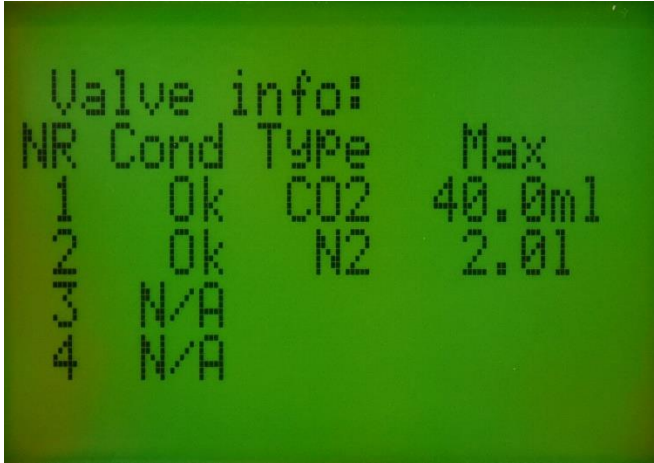
Valve Init

Use this option to specify whether valves are initialized to last known target flow or shut (zero flow). Use **UP/DOWN** key to set the **LAST** or **SHUT** option and confirm by **S** key.

Valve Info (Fig. 15)

This option displays information about the installed valves (number of inputs, condition, valve type, maximum flow).

Fig. 15 Menu Tree – Valve Info.

Mode

This option is used to switch between **absolute** and **percentage** flow mode. Press **S** key (below the digital display) to switch from the **Display & Control Screen** to the **Setting Screen**. Use **UP/DOWN** keys for moving in menu and press **S** key on option **Mode**. Use **UP/DOWN** key to set the absolute or percentage mode and press **S** key to confirm.

∑Flow

This option is active only when the percentage mode for gas mixture flow is used. It is used to modify the **total output flow** of the gas mixture. The user can optimize gas mixture flow using the Setting Screen → Press **S** key (below the digital display) to switch from the **Display & Control Screen** to the **Setting Screen**. Use **UP/DOWN** keys for moving in menu and press **S** key on option **∑Flow**. Use **UP/DOWN** keys to set the required flow value, and press **S** key to confirm.

Should the total output flow be set out of the valve's flow range (< 2 % and/or > 100 %), an error message appears (Fig. 10). Also, an exclamation mark appears before the value (Fig. 11).

ℹ️	This function is available only for percentage mode (not for absolute mode).

Menu Tree – Main

Gases

Press [S] to change gas type for selected valve. Press [M] to return.
Example: Valve 1 (CO2)
            Valve 2 (Air)

Dev. Info

Press [S] to see device info. Press [M] to return.
Example: Device type
            GMS 150
            FW version
            1.0.2.3
            FW date
            March 14, 2014
            Build Nr
            842
            Device name
            GMS Lab
            GMS ID
            107371824

Warn

Press [S] to set torelance range. Press [▲] or [▼] to set required value (for example 10 %).
Press [S] to confirm. Press [M] to return.

CO2/Air

Press [S] to define CO2 concentration in air source used for CO2/Air gas mixture. Press [▲] or [▼] to
set required CO2 concentration. Press [S] to confirm. Press [M] to return.

Val. Init

Press [S] to specify whether valves are initialized to last known target flow or shut. Use [▲] or [▼]
to set LAST or SHUT option and confirm by [S] . Press [M] to return.

Val. Info

Press [S] to see info about installed valves. Press [M] to return.
Example: NR Cond.   Type   Max
            1   Ok   CO2   400.0ml
            2   Ok   N2   20.0ml
            3   N/A
            4   N/A

Mode

Press [S] to switch between absolute and percent flow mode. Use [▲] or [▼] to set absolute or
percent flow mode. Confirm by [S] Press [M] to return.

ΣFlow

Press [S] to set flow in relative units (% or ppm). It is used to modify the total output flow of the
mixture. Use [▲] or [▼] to set required flow value. Press [S] to confirm. Press [M] to return.
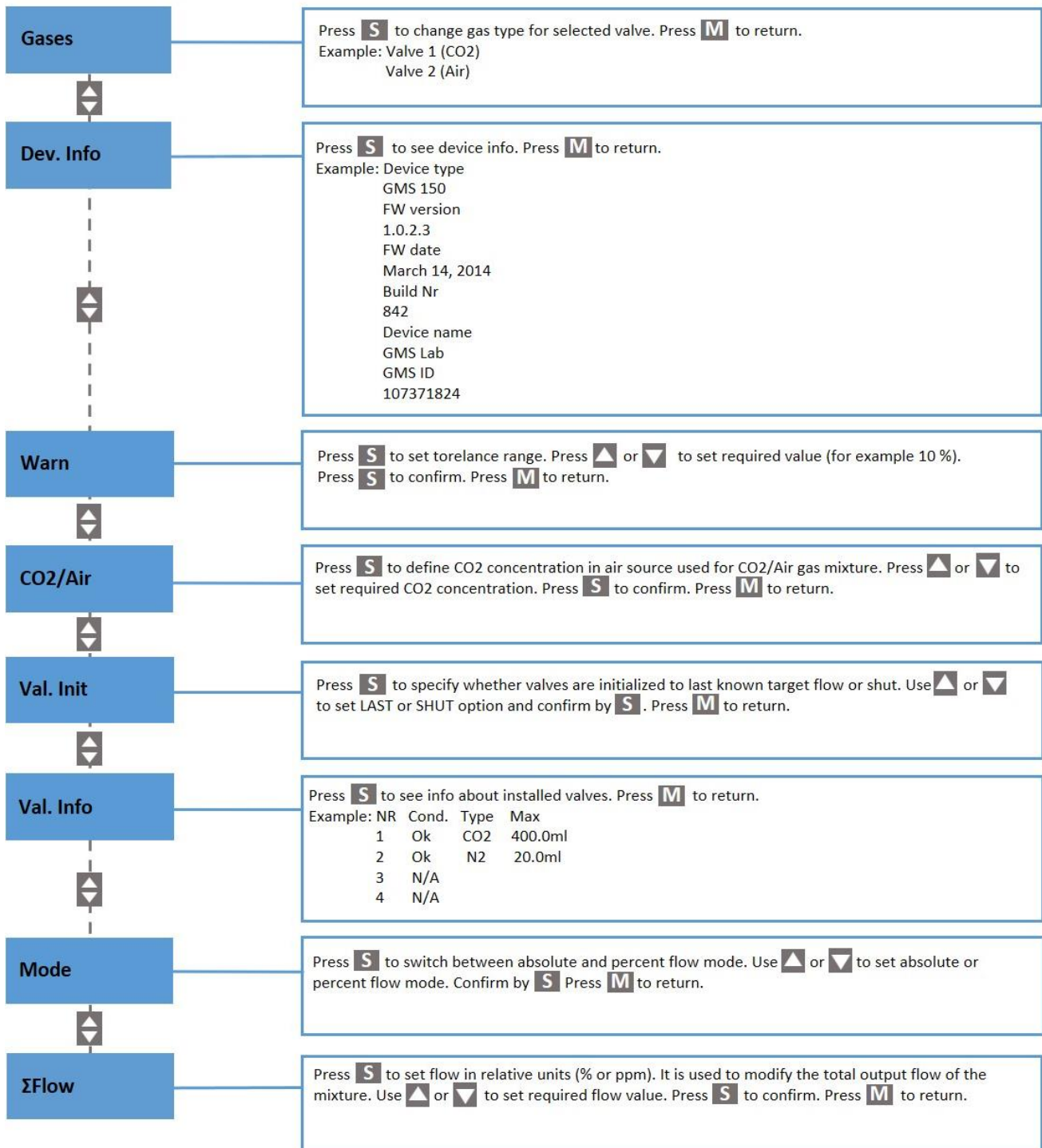
Fig. 16 Main menu.

8 QUICK GUIDE

8.1 HOW TO SET GMS 150 IN ABSOLUTE MODE

- Press **S** key to switch from the **Display & Control Screen** to the **Setting Screen.**
- Use **UP/DOWN** keys for moving in menu and press **S** key on option **Mode.** Use **UP/DOWN** key to set the **absolute mode** and press **S** key to confirm.
- Use the **M** key to return from the **Setting Screen** to the **Display & Control Screen.**
- The target values for the single valves are set by four **UP/DOWN** keys situated at both sides of the screen. The keys are used to change actual gas flow in corresponding valves (UP/DOWN = add/subtract). The keys are numbered 1 – 4 (see the picture Fig. 12).
- Example from Fig. 17:
  Valve 1 – CO_2 – set target flow of 28.00 ml/min
  Valve 2 – Air – set target flow of 1.480 l/min
  The absolute target flow is automatically computed as a sum of actual valves flows:
  28.00 ml/min of CO_2 + 1.480 l/min Air = 1,508 ml/min = 1.508 l/min.

Fig. 17 Display in absolute mode.

8.2 HOW TO SET GMS 150 IN PERCENTAGE MODE

- Press **S** key to switch from the **Display & Control Screen** to the **Setting Screen**
- Use **UP/DOWN** keys for moving in menu and press **S** key on option Mode. Use **UP/DOWN** key to set the **percentage mode** and press **S** key to confirm.
- Use the **M** key to return from the **Setting Screen** to the **Display & Control Screen.**
  The target values for the single valves are set by four **UP/DOWN** keys situated at both sides of the screen. The keys are used to change actual gas flow in corresponding valves (UP/DOWN = add/subtract). The keys are numbered 1 – 4 (see the picture Fig. 18).
- The total flow of the gas mixture is determined by the instrument so that the percentage gas content is adjusted with a maximum accuracy. The user can optimize gas mixture flow using the **Setting Screen** → Press **S** key (below the digital display) to switch from the **Display & Control Screen** to the **Setting Screen**. Use **UP/DOWN** keys for moving in menu and press **S** key on option **∑Flow**. Use **UP/DOWN** keys to set the required value (for example 1.493 l/min – see Fig. 18) a press **S** key to confirm. This function is available only for Percentage Gas Flow Units (not for Absolute Gas Flow Units).
- Example from Fig. 18:
  Valve 1 – CO_2 – set target flow of 2 %
  Valve 2 – Air - target flow 98 % - automatically calculated
  The target total flow set in the menu: 1.493 l/min.

Fig. 18 Display in percentage mode.

9 WARRANTY TERMS AND CONDITIONS

- This Limited Warranty applies only to the Gas Mixing System GMS 150. It is valid one year from the date of shipment.
- If at any time within this warranty period the instrument does not function as warranted, return it and the manufacturer will repair or replace it at no charge. The customer is responsible for shipping and insurance charges (for the full product value) to PSI. The manufacturer is responsible for shipping and insurance on return of the instrument to the customer.
- No warranty will apply to any instrument that has been (i) modified, altered, or repaired by persons unauthorized by the manufacturer; (ii) subjected to misuse, negligence, or accident; (iii) connected, installed, adjusted, or used otherwise than in accordance with the instructions supplied by the manufacturer.
- The warranty is return-to-base only, and does not include on-site repair charges such as labor, travel, or other expenses associated with the repair or installation of replacement parts at the customer's site.
- The manufacturer repairs or replaces faulty instruments as quickly as possible; the maximum time is one month.
- The manufacturer will keep spare parts or their adequate substitutes for a period of at least five years.
- Returned instruments must be packaged sufficiently so as not to assume any transit damage. If damage is caused due to insufficient packaging, the instrument will be treated as an out-of-warranty repair and charged as such.
- PSI also offers out-of-warranty repairs. These are usually returned to the customer on a cash-on-delivery basis.
- Wear & Tear Items (such as sealing, tubing, padding, etc.) are excluded from this warranty. The term Wear & Tear denotes the damage that naturally and inevitably occurs as a result of normal use or aging even when an item is used competently and with care and proper maintenance.
- A watering of the GMS is not covered by the warranty

10 TROUBLESHOOTING AND CUSTOMER SUPPORT

In case of troubles and for customer support, please, write to support@psi.cz or contact your local distributor.

11 LIST OF PICTURES