

Operating Manual
Handheld Double-Pressure-Meter
water-proof, with data logger

as of version 1.0

GMH 5155

- Please carefully read these instructions before use!
- Please consider the safety instructions!
- Please keep for future reference!



WEEE-Reg.-Nr. DE 93889386

Index

1	GENERAL NOTE	3
2	SAFETY	3
2.1	INTENDED USE	3
2.2	SAFETY SIGNS AND SYMBOLS	3
2.3	SAFETY GUIDELINES	3
3	PRODUCT SPECIFICATION	4
3.1	SCOPE OF SUPPLY	4
3.2	OPERATION AND MAINTENANCE ADVICE	4
4	HANDLING	5
4.1	DISPLAY ELEMENTS	5
4.2	PUSHBUTTONS	5
4.3	CONNECTIONS	6
4.4	POP-UP CLIP	6
5	START OPERATION	7
6	CONFIGURATION	7
7	REMARKS TO SPECIAL FEATURES	10
7.1	DIFFERENT PRESSURE UNITS	10
7.2	DIFFERENT KINDS OF MEASURING	11
7.3	WATER DEPTH / LEVEL MEASUREMENT	11
7.4	SEA-LEVEL CORRECTION FOR ABSOLUTE PRESSURE SENSORS	11
7.5	AVERAGING FUNCTION	12
7.6	CALC: PRESSURE CHANGE PER TIME DP/DT (ONLY FOR SENSOR 1)	12
7.7	CALC: PITOT MEASURING OF VELOCITY AND FLOW (ONLY FOR SENSOR 1)	13
8	DATA LOGGER	14
8.1	MANUAL RECORDING ("FUNC-STOR")	14
8.2	AUTOMATIC RECORDING WITH SELECTABLE CYCLE TIME ("FUNC CYCL")	15
9	UNIVERSAL OUTPUT	17
9.1	INTERFACE	17
9.2	ANALOG OUTPUT	18
10	INPUT ADJUSTMENT	18
11	PRESSURE CONNECTION TO THE SENSORS	18
12	ALARM ("AL.")	19
13	REAL TIME CLOCK ("CLOC")	19
14	ACCURACY CHECK / ADJUSTMENT SERVICE	19
15	REPLACING BATTERIES	19
16	ERROR AND SYSTEM MESSAGES	20
17	RESHIPMENT UND DISPOSAL	20
17.1	RESHIPMENT	20
17.2	DISPOSAL INSTRUCTIONS	20
18	SPECIFICATIONS	21

1 General Note

Read this document carefully and get used to the operation of the device before you use it. Keep this document within easy reach near the device for consulting in case of doubt.

Mounting, start-up, operating, maintenance and removing from operation must be done by qualified, specially trained staff that have carefully read and understood this manual before starting any work.

The manufacturer will assume no liability or warranty in case of usage for other purpose than the intended one, ignoring this manual, operating by unqualified staff as well as unauthorized modifications to the device. The manufacturer is not liable for any costs or damages incurred at the user or third parties because of the usage or application of this device, in particular in case of improper use of the device, misuse or malfunction of the connection or of the device.

The manufacturer is not liable for misprints.

2 Safety

2.1 Intended Use

This device must only be used with one or two "GMSD... - K51" or "MSDE" pressure sensors. Other usages are not intended.

The safety requirements (see below) have to be observed.

The device must be used only according to its intended purpose and under suitable conditions.

Use the device carefully and according to its technical data (do not throw it, strike it, ...)

Protect the device from dirt.

2.2 Safety signs and symbols

Warnings are labeled in this document with the followings signs:



Caution! This symbol warns of imminent danger, death, serious injuries and significant damage to property at non-observance.



Attention! This symbol warns of possible dangers or dangerous situations which can provoke damage to the device or environment at non-observance.








Note! This symbol point out processes which can indirectly influence operation or provoke unforeseen reactions at non-observance.

2.3 Safety guidelines

This device has been designed and tested in accordance with the safety regulations for electronic devices. However, its trouble-free operation and reliability cannot be guaranteed unless the standard safety measures and special safety advises given in this manual will be adhered to when using the device.

1. Trouble-free operation and reliability of the device can only be guaranteed if the device is not subjected to any other climatic conditions than those stated under "Specification".

If the device is transported from a cold to a warm environment condensation may cause in a failure of the function. In such a case make sure the device temperature has adjusted to the ambient temperature before trying a new start-up.

2.  If there is a risk whatsoever involved in running it, the device has to be switched off immediately and to be marked accordingly to avoid re-starting.
Operator safety may be a risk if:
 - there is visible damage to the device
 - the device is not working as specified
 - the device has been stored under unsuitable conditions for a longer time.
 In case of doubt, please return device to manufacturer for repair or maintenance.
3. When connecting the device to other devices the connection has to be designed most thoroughly as internal connections in third-party devices (e.g. connection GND with protective earth) may lead to undesired voltage potentials that can lead to malfunctions or destroying of the device and the connected devices.
-  This device must not be run with a defective or damaged power supply unit.
Danger to life due to electrical shock!
4.  Do not use these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury or material damage.
Failure to comply with these instructions could result in death or serious injury and material damage.
5.  This device must not be used at potentially explosive areas! The usage of this device at potentially explosive areas increases danger of deflagration, explosion or fire due to sparking.
6.  This device is not constructed for use in medical applications.

3 Product Specification

3.1 Scope of supply

The scope of supply includes:

- GMH 5155 with 2 AAA batteries
- Operation manual
- Short form manual

3.2 Operation and maintenance advice

1. Battery operation:

If 'bAt' is shown in the lower display the battery has been used up and needs to be replaced. However, the device will operate correctly for a certain time. If 'bAt' is shown in the upper display the voltage is too low to operate the device; the battery has been completely used up. Battery change: p.r.t. chapter 15.



The battery has to be taken out, when storing device above 50 °C.
We recommend taking out battery if device is not used for a longer period of time.
After recommissioning the real-time clock has to be set again.

2. Mains operation



The output voltage of a connected power supply unit has to be between 4.5 and 5.5 V DC.
Don't apply overvoltage!

3. Treat device and sensor carefully. Use only in accordance with above specification. (do not throw, hit against etc.). Protect plug and socket from soiling.

4. Connecting/changing sensors



Use only sensors of GMSD ... - K51 or MSD - series!
Other sensors may lead to damage to the device and the sensor.

Switch off device before changing the sensor.

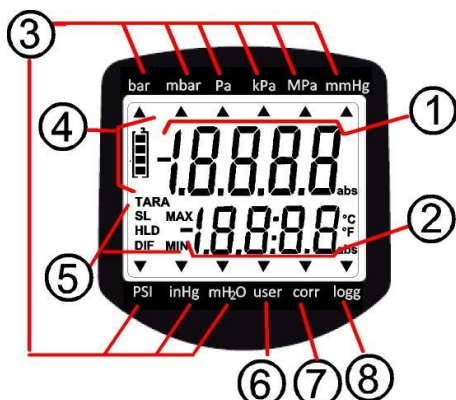
The sensors are coupled to the instrument via bayonet connectors

To connect a sensor, plug in the connector in the right position and then rotate the ribbed ring ½ turn.

To disconnect rotate the ribbed ring ½ turn and then pull out the connector.

4 Handling

4.1 Display elements



- | | | |
|---|--|---|
| 1 | Main display: | measuring value sensor 1 |
| 2 | Secondary display: | measuring value sensor 2 or difference sensor 1 – sensor 2 / "CALC" |
| 3 | Arrows for selected measuring unit | |
| 4 | Rating of battery status | |
| 5 | Display elements to show minimum / maximum / memorized measuring value as well as tare-function and sea-level-correction | |
| 6 | user arrow: | measuring value is shown in freely adjustable user-unit (please refer to chapter 7.1) |
| 7 | corr arrow: | zero-point or slope correction is active |
| 8 | logg arrow: | logger is ready
arrow flashing: automatic recording (Logg CYCL) is active |

4.2 Pushbuttons



On / off key, backlight

press shortly: activate backlight or switch on instrument
press longer: switch off instrument

set / menu:

press shortly: display change:
- measuring value sensor 2
- difference sensor 1 – sensor 2
- calculated value ("CALC", please refer to chapter 7.6 and 0

press for 2 sec. (menu): invoke configuration menu



min / max:

press shortly: min. or max. value is displayed

press for 2 sec: the corresponding value is deleted



press shortly: tare-function: display is set to 0. All measuring values are displayed relatively to this set tare-value from now on.

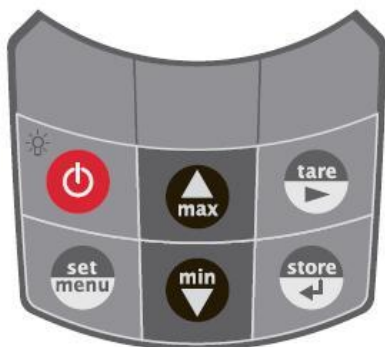
press for 2 sec: deactivate tare-function

store / enter:

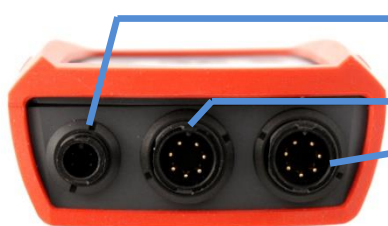
Logger off: hold and save current measuring value ('HLD' is displayed)

(Logger on: Operation of data logger - chapter 8)

(Set/Menu: confirm settings, return to measuring)



4.3 Connections



Universal output: interface, supply, analog output
(p.r.t. chapter 9 "Universal Input")

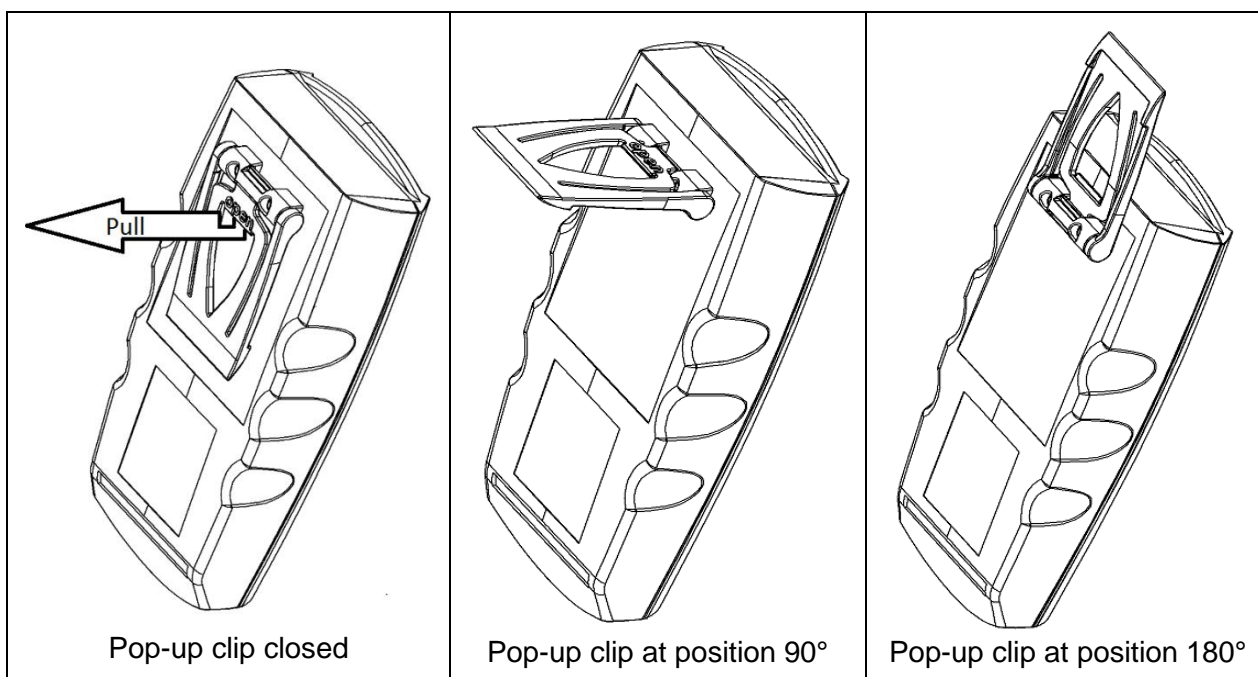
7-pole bayonet connector: connection for sensor 2

7-pole bayonet connector: connection for sensor 1

4.4 Pop-up clip

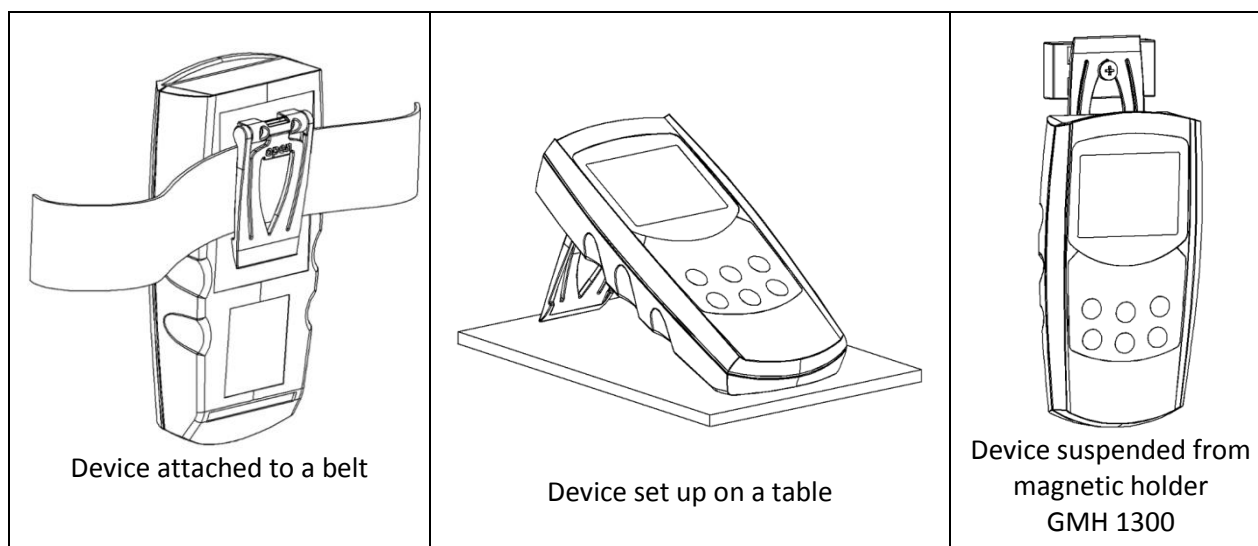
Handling:

- Pull at label "open" in order to swing open the pop-up clip.
- Pull at label "open" again to swing open the pop-up clip further.




Function:

- The device with a closed pop-up clip can be plainly laid onto a table or attached to a belt, etc.
- The device with pop-up clip at position 90° can be set up on a table, etc.
- The device with pop-up clip at position 180° can be suspended from a screw or the magnetic holder GMH 1300.





5 Start Operation


Connect sensors, turn device on via  key.



After segment test the device displays some configuration:

 if standard measurement is selected

 if fast measurement is selected





 if peak value detection is selected



After that the device is ready for measuring.


6 Configuration




Some menu points depend on current device settings (e.g. some points are locked if logger memory contains data sets).

To change device settings, press “**menu**”  for 2 seconds. This will activate the configuration menu (main display: “SET”). Pressing “**menu**”  changes between the menus points, pressing  jumps to the referring parameters, which can be selected with key .

The parameters can be changed with  or .

Pressing “**menu**”  again jumps back to the main configuration menu and saves the settings.












“**enter**”  finishes the configuration and returns to standard measuring operation.









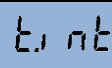
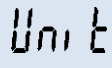

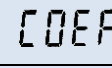
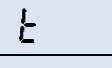
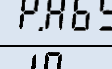
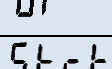










Pressing “**menu**” and “**store**” at the same time for more than 2 seconds will reset the device to factory defaults.














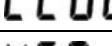
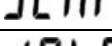



If there are data sets stored and logger is set to “manual recording” (“Func Stor”) the first menu point displayed is “rEAd Logg” (p.r.t. chapter 8 “Data Logger”)

If no key is pressed for more than 2 minutes the configuration will be aborted. All changes will not be saved!

Menu	Parameter	Value	Description		
		 Or 			
	Set Configuration: General configurations				
		Unit: Select measuring unit		* ** ,	
		Arrow to bar , mbar ...	Measuring value is displayed in corresponding unit, the selectable units depend on connected sensor		
		Arrow to “ user ”	Measuring value is displayed in freely adjustable user-unit		
		bar , mbar	Unit “user”: base unit		
		0000, 000.0,0000“	Unit “user”: decimal point setting (only if user-unit selected)		
		-19999...19999	Unit “user”: multiplication factor		
		Sea Level: Sea-level correction		* ** ,	
		oFF	Sea-level correction off		
		on	Sea-level correction on (p.r.t. 7.4)		
		-2000 ... 9999	Sea-level in [m] (only available by Sensor1 SL = on)	* ** ,	

Menu	Parameter	Value	Description		
		 or 			
	Rate: Measuring rate			*	
	Slo		Slow measuring rate (4 Hz filtered, low power consumption)		
	FASt		Fast measuring rate, filtered (1000 Hz)		
	P.dEt		Peak detection: fast measuring rate, unfiltered (1000 Hz)		
	Averaging Filter			*	
	1 ... 120		Averaging period in seconds		
	oFF		Averaging function is deactivated		
	Auto Power-Off: Select power-off delay				
	1 ... 120		Power-off delay in minutes. Device will be automatically switched off as soon as this time has elapsed if no key is pressed/no interface communication takes place		
	oFF		Automatic power-off function deactivated (continuous operation)		
	Background illumination				
	oFF		Illumination deactivated		
	5 ... 120		Turn off illumination after 5 ... 120s (factory settings: 5 s)		
	on		Illumination always on		
	Set Calculation: Calculated display values (based on Sensor 1)			*	
		Choice of function			
		oFF	No calculated display		
		dP:dt	Pressure change per time (leak rate measurements, ...)		
		SPED	Flow speed measurement with pitot tube etc.		
		FLo	Volumetric flow rate measurement with pitot tube etc.		
		“dP:dt”: Settings			
		Time unit of pressure change rate			
		Per.S	Pressure change rate unit per second, e.g. mbar/s		
		Per.n	Pressure change rate unit per minute, e.g. mbar/min		
		Per.h	Pressure change rate unit per hour, e.g. mbar/h		
		Test period, for which the pressure change rate is calculated			
		0:01... 1:00	Period in [minutes:seconds], ex works: 1s		
		“SPED” or “FLo”: Settings			
		SPED: speed unit			
		n:S	meter per second, m/s		
		kn:h	kilometer per hour, km/h		
		nPh	miles per hour, mph		
		knot	knots		
		FLo: Volumetric flow unit			
		n3:s	cubic meter per second, m³/s		
		n3:n	cubic meter per minute, m³/min		
		n3:h	cubic meter per hour, m³/h		
		L:S	liter per second, l/s		
		L:n	liter per minute, l/min		
		FLo: Volumetric flow - cross section			
		10.0 ... 1999.9, 2000 ... 14000	cross section in cm²		
		0.1000 ... 1.9999	coefficient, (Prandtl pitot tube = 1.0000 please refer to chapter 7.7)		
		-100.0 ... 1000.0 °C	air flow temperature		
		100.0 ... 1999.9 mbar	ambient pressure		
		0000, 000.0 ... 00.00	decimal point setting		
		oFF, 1 ... 1000	minimum display, below always display 0		

Menu	Parameter	Value	Description		
		 or 			
Set Output:	Universal output adjustments				
	Out	oFF	Interface and analog output off		
		SEr:	Serial interface activated		
		dAC:	Analog output activated		
	Adr.	01, 11..91	Base address for serial interface communication (only at Out = SEr)		
	dAC	CH 1, CH 2 or DIF CH	Channel that should be used for analog output (only at Out = dAC)		
	dAC.0	sensor dep. e.g.-5.00..5.00 mbar	Zero-point setting for Out = dAC: Measuring value which should correspond to output 0 V		
	dAC.1	sensor dep. e.g.-5.00..5.00 mbar	Slope setting for Out = dAC: Measuring value which should correspond to output 1 V		
Set Corr:	Input adjustment			*	
	OF5.1	Zero adjustment/offset of sensors 1			
		oFF	No zero adjustment of sensors 1		
		Sensor dep. e.g.-5.00..5.00 mbar	The offset of sensor 1 will be displaced by this value to compensate for deviations of the probe or of the measuring device.		
	SCL.1	Slope adjustment of sensors 1			
		oFF	No slope adjustment of sensor 1		
		-2.000 ... 2.000	The slope of sensor 1 will be changed by this factor [%] to compensate deviations of probe or measuring device		
	OF5.2	Zero adjustment/offset of sensors 2			
		oFF	No zero adjustment of sensors 1		
		Sensor dep. e.g.-5.00..5.00 mbar	The offset of sensor 2 will be displaced by this value to compensate for deviations of the probe or of the measuring device.		
	SCL.2	Slope adjustment of sensors 2			
		oFF	No slope adjustment of sensor 2		
		-2.000 ... 2.000	The slope of sensor 2 will be changed by this factor [%] to compensate deviations of probe or measuring device		
Set AL:	Settings for alarm function				
	AL. 1	On/No.So	Alarm Sensor 1 on, with/without buzzer		
		OFF	No alarm function for Sensor 1		
	ALLo/1	Sensor1-Min ... AL.1-Hi	Min-alarm-limit sensor 1 (not if AL.1 = oFF) Sensor1-Min is lower display range limit of sensor 1		
	ALHi/1	AL.1-Lo ... Sensor1-Max	Max-alarm-limit sensor 1 (not if AL.1 = oFF) Sensor1-Max is upper display range limit of sensor 1		
	AL. 2	On/No.So	Alarm Sensor 2 on, with/without buzzer		
		OFF	No alarm function for Sensor 2		
	ALLo/2	Sensor2-Min ... AL.2-Hi	Min-alarm-limit sensor 2 (not if AL.2 = oFF) Sensor2-Min is lower display range limit of sensor 2		
	ALHi/2	AL.2-Lo ... Sensor2-Max	Max-alarm-limit sensor 2 (not if AL.2 = oFF) Sensor2-Max is upper display range limit of sensor 2		
	AL. DIF	On/No.So	Alarm sensor difference on with/without buzzer		
		OFF	No alarm function for sensor difference		
		ALLo DIF	Min-alarm-limit difference (not if AL.DIF = oFF)		
	ALHi DIF	AL.DIF-Lo ... 19999	Max-alarm-limit difference (not if AL.DIF = oFF)		

Menu	Parameter	Value	Description		
		 or 			
	Set Logger: Settings for logger function			*	
 		Selection of logger function		*	
		CYCL	Cyclic: cyclic logger		
		Stor	Store: manual recording		
		oFF	No logger activated		
		0:01 .. 60:00	Cycle time in [minutes: seconds] (for cyclic logger)	*	
		on/oFF	Low-power-logger with low power consumption (only for cyclic logger and slow measuring rate)	*	
	Set Clock: Settings for real time clock				
 		HH:MM	Clock: set time hours: minutes		
		YYYY	Year: set year		
		TT.MM	Date: set date day. month		
 	rEAd Logg: Read calibration data: p.r.t. chapter 8.1 Manual Recording ("Func-Stor")				

- (*) *If logger memory contains data sets parameters marked with (*) cannot be called. You have to clear memory to change these parameters! (button 6, p.r.t. chapter 8)*
- (**) *Parameter can only be called if corresponding sensor is plugged to connection 1. The settings are applied to the sensor at connection 2 (if any connected).*

7 Remarks to Special Features

7.1 Different Pressure Units

Depending on the connected sensors different units can be selected via menu (Unit). The measuring range of the sensors may restrict the choice!

User-Unit

For pressure units, which are not covered by the ones printed on the display, there can be done a manual setting for a "user-defined" unit.

Example:

To enable a GMSD 2 BR - K51 (-1000 ... 2000 mbar) to display the unit kg/cm², following settings (bold) have to be entered:

	kg/cm²	Torr	atm	at	
bASE user:	bar	mbar	bar	bar	
DP user:	.0000	.0000	.0000	.0000	
FAcT user:	1.0197	.7433	0.9869	1.0197	

7.2 Different kinds of measuring

Three different kinds of pressure measuring are supported. Two of them (P.dEt and FASt) are working with high measuring frequency of more than 1000 measurings per second.

7.2.1 Standard measuring (slow)

rAtE
SL

Measuring rate 4 Hz, averaging and filter functions are active.

Application: Measuring of slowly changing or static pressures, e.g. measuring of leakproofness, atmospheric pressure...

Highest accuracy, high noise immunity, low power consumption.

7.2.2 Peak detection (Peak detection)

rAtE
P.dEt

Measuring rate >1000 Hz, the value is displayed unfiltered.

Application with logger function: Measuring of short pressure peaks or fast changing pressures with a resolution of <1 ms. The cyclic logger function records the arithmetic mean value, the highest and the lowest peak of the referring time interval.

Attention: higher power consumption, measuring is sensitive to noise (EMI, ...).



Measuring is sensitive to noise (EMI, ...) and higher power consumption.

7.2.3 Fast filtered measuring (fast)

rAtE
FASt

Measuring rate >1000 Hz, but the value is filtered (higher noise immunity than P.dEt, small peaks will be filtered out), apart from that identical behavior like rAtE-P.dEt.

7.3 Water depth / level measurement



Water-proof sensors have to be used for water depth / level measurement.

Select the unit [m] for meters water column (selection mH₂O) in menu "Unit". 10 m water column (=water depth) corresponds roughly 1 bar overpressure.

Measurements can be made e.g. like described below: (for abs. pressure sensors SL has to be deactivated)

- With one abs. pressure sensor: Press 'Tara' when sensor is at ambient air and then bring sensor to the depth to be measured. The display shows now the depth in [m].
- With two abs. pressure sensors: Sensor 2 at ambient air (does not have to be waterproof), waterproof sensor 1 at water depth to be measured. Don't press 'Tara', the depth can already read from the DIF-display and is compensated for pressure changes in ambient air.
- With one rel. pressure sensor: bring tube connection for lower press. in contact to ambient air by means of a tube (no water contact!) and bring the sensor with its open pressure connection for higher pressure to water depth to be measured (display and is compensated for pressure changes in ambient air).

7.4 Sea-level correction for absolute pressure sensors

The device displays the absolute pressure. This is not necessarily the same like the values given by weather stations! The weather stations are displaying the pressure at sea level. Usually the sensor is placed above sea level and therefore the pressure loss resulting from the actual level above sea level has to be considered, if the value at sea level (zero) should be measured! To correct the measuring display, activate the "Sea-Level-Function" (SL, p.r.t. chapter 6, setting is only possible, if an abs. pressure sensor is connected to sensor connection 1). Then enter the altitude above sea level of the sensor's location in meters (Alti, p.r.t. chapter 6). When activated, the display shows the SL-arrow and the device displays the pressure value at sea level.



When two absolute pressure sensors are connected, the sea level function for both corresponds to the setting of sensor 1.

7.5 Averaging function



The averaging function concerns the display values (LCD and interface).

It is completely independent from the averaging of the logger function FAST and P.dEt!

The averaging integrates the measuring values during a selectable period of time and then calculates the average display value. It is independent from the selected kind of measuring (slow, fast, peak detect).

As long as not enough values have been collected (i. e. for the selected averaging time) to calculate an average value, the upper display shows “----”, the lower display a ‘countdown’.

During an active low-power-logging procedure the averaging is always deactivated.

Function of min/max-value memory during averaging:

- If averaging is activated and slow measuring is selected (rAtE-Slo), the min-/max-value memory refers to the average display value.
- If averaging is activated and fast measuring is selected (rAtE-FAST or P.dEt), the min-/max-value memory refers to the internal measured values (fast peaks can be detected).

7.6 CALC: Pressure change per time dP/dt (only for sensor 1)

The CALC function “dPdt” allows displaying pressure changes per time directly. The corresponding measuring intervals (t.int) can be freely chosen. The device automatically saves pressure values during this period and calculates the pressure change rate “pressure change / time” from the current measuring value and historical data.

Tare button: Historical data is deleted, calculation restarts.

Example: Tightness testing for sewage ducts according to EN 1610 with requirements less than -3 mbar/min in a 5 minutes test duration at a test pressure of 250 mbar

Equipment/presetting:

- Sealing bladder and pressure pump
- Sensor: GMSD 2 BR - K51 (measuring range -1000 ... +2000 mbar)
- bASE= Pet.n (minutes) time unit for pressure change rate
- t.int = 1:00 (1 minutes) test duration, for which the pressure change rate is calculated
- Logger: Cycl, 5 sek

Procedure:

- Connect all parts, arrange all necessary sealings
- Start logger
- Charge with pressure, wait for sufficient time
- Restart calculation with “tare” button
- Current pressure value is displayed, button “set” changes to dP:dt display
- The display can give some preliminary information about the test result
- Release pressure after 5 minutes
- Stop logger

Evaluation:

Read out data logger with GSOFT3050, input at register “comment”:

Client, place of inspection, date, time, address / duct number, as-built data (duct type, nominal size, etc), test instructions, pressures, tolerances, etc. as well as test result.

Therefore a comment sample can be prepared as file, company logo etc. can be added for printing.



t.int- setting: If there are set high values the displayed values can be easily misinterpreted, because the displayed value responds very slowly.

The pressure change is monitored during the selected time interval t.int and calculated referring to the time base („bASE“). It is assumed, that the pressure continues to change the same way in the following.

Example.: t.int = 10 sec; „bASE“ = Per.n (minutes) ; pressure change in 10 seconds = -2mbar
Resulting display CALC = -12 mbar

The displayed value is calculated: $P(T_{\text{current}}) - P(T_{\text{current}} - t.\text{int}) / T.\text{int}$

If there are not data for the whole t.int-period yet the values are extrapolated with the already available data.

7.7 CALC: Pitot measuring of Velocity and Flow (only for sensor 1)

7.7.1 Velocity measurement in air: "CALC SPEd"

The air velocity is calculated by means of the pressure difference at a Prandtl pitot tube or comparable measuring setup.

$$v = s \cdot \sqrt{\frac{2 \cdot \Delta p}{\rho}} \quad \text{with} \quad \rho = \frac{p_a}{R_i \cdot T}$$

v = velocity (m/s)

Δp = dynamic pressure (Pa) => $p(A) - p(B)$ = measured pressure difference

s = pitot tube factor (= 1.0 for Prandtl pitot tube) value input at "COEF" in the CALC menu

ρ = air density (kg/m³)

p_a = air pressure (Pa) value input at "P.abs" in the CALC menu

R_i = gas constant (at air = 287 (J / kg • K))

T = absolute temperature (K) value input in °C at "t" in the CALC menu
(0 °C = 231.15K)

Generally the pressure differences evaluated are very small, therefore it is recommended to use pressure sensors with high resolution.

Recommended sensors for use with a Prandtl pitot tube:

Sensor	Meas. range Pmax	Vmin		Vmax		CALC-Menu „dP“	CALC-Menu „Strt“	ConF-Menu „t.AVG“
GMSD 2,5 MR - K51	2.500 mbar	1 m/s	4 km/h	20 m/s	72 km/h	000.0	1.0	2
GMSD 25 MR - K51	25.00 mbar	5 m/s	18 km/h	64 m/s	230 km/h	0000	5	2

It is not recommended to measure velocities below Vmin, because therefore the resolution of the sensors is too low.



Display value "-1 digit":

If -1 digit is displayed at velocity of flow measurement the connected sensor gives a negative pressure value -> check offset!

Velocity or flow calculation cannot be done with negative values.

7.7.2 Volumetric flow measurement in air: "CALC FLo"

The flow measurement is based on the velocity measurement (see above). Velocity multiplied with the cross-section area (input in CALC menu by "A") offers the volumetric flow at the selected display.

8 Data Logger

The device supports two different logger functions:

“**Func-Stor**”: Manual recording by keypress “store”
Additional input of measuring point (L-Id) is needed

“**Func-CYCL**”: Automatic recording at intervals of set cycle time

The logger stores 9 measuring values per data set:

- measuring or average (depends on function), min-peak and max-peak sensor 1
- measuring or average (depends on function), min-peak and max-peak sensor 2
- measuring or average (depends on function), -“CALC off”*): min-peak and max-peak sensor 1 – sensor 2
- “CALC active” *): Calculated value and dummy value

Min- and max-peak are the minimum and the maximum of the measured values since the last recording. This allows precise analysis of the current pressure as well as pressure fluctuations.

For the evaluation of the data the software GSOF3050 (version V3.0 or higher) has to be used. The software also allows easy configuration and starting of the logger.

When the logger is activated (Func Stor or Func CYCL) the hold function is no more available, the key “store” is solely used for the operation of the logger functions.



8.1 Manual Recording (“Func-Stor”)

a) Save measurements manually:

Up to 1000 measurements can be saved if logger function “Func store” is selected (p.r.t. “Configuration”):



Press “store” shortly: data set is saved (“St. XX” is displayed shortly, where XX is the number of the data set)

Input of measuring point “L-Id”: Selection of measuring point via keys  or .
Number 0 ... 19999 or text assigned to number 1 ... 40 (comfortable assignment of texts can be done with gratis software GMHKonfig)

Confirm input with .



One data set contains:

- Sensor 1: **measuring value** at the time of the recording
- Sensor 1: **min-peak, max-peak** since the last recording
- Sensor 2: **measuring value** at the time of the recording
- Sensor 2: **min-peak, max-peak** since the last recording
- Difference sensor 1-sensor 2: **measuring value** at the time of the recording
- CALC off *) Difference sensor 1-sensor 2: **min-peak, max-peak** since the last recording
- CALC active *) Calculated value at the time of the recording and dummy value
- time and date of the recording

Lo66
FULL

is displayed if logger storage is full.

*) CALC-Function: see chapter 7.6, 7.7

b) Read manual recordings:

Saved data sets can be viewed both with PC-software GSOF3050 and directly on the device display.



Do not change the pressure sensor if manual recording is selected and values are already stored, because otherwise invalid data may be read-out. The pressure sensor used during the recording has to be connected!



Press “menu” for 2 seconds: $rEAd$
LoGg is displayed



“rEAd LoGg” is only displayed if data sets have been already stored. Otherwise the configuration menu is displayed: SEt
LoGg



Press shortly: Change between measuring values, measuring point and date+time of the data set



or



Change between different data sets



End display of recordings

c) Clear manual recordings:

If data sets have been stored, they can be deleted with the “store” key:



Press for 2 seconds: Call menu “Clear”

Select with or :



Clear nothing (cancel menu)



Clear all recordings



Clear the last recording



Confirm selection and quit menu “Clear”

8.2 Automatic Recording with Selectable Cycle Time (“Func CYCL”)

If logger function “Func CYCL” is selected (p.r.t. “Configuration”) the device will automatically record measuring values at intervals of the set cycle time.

The logger’s cycle time can be set from 1s to 60min (p.r.t. “Configuration”).

Storable data sets: 8000



A data set contains at slow measuring rate (**rAtE SLo**):

- Sensor 1: **measuring value** at the time of the recording
- Sensor 1: **min-peak, max-peak** since the last recording
- Sensor 2: **measuring value** at the time of the recording
- Sensor 2: **min-peak, max-peak** since the last recording
- Difference sensor 1-sensor 2: **measuring value** at the time of the recording
- CALC off *) Difference sensor 1-sensor 2: **min-peak, max-peak** since the last recording
- CALC active *) Calculated value at the time of the recording and dummy value

At data set contains at fast measuring rate (**rAtE FASt** and **rAtE P.dEt**):

- Sensor 1: **arithmetic average** since the last recording
- Sensor 1: **min-peak, max-peak** since the last recording
- Sensor 2: **arithmetic average** since the last recording
- Sensor 2: **min-peak, max-peak** since the last recording
- Difference sensor 1-sensor 2: **arithmetic average** since the last recording
- CALC off *) Difference sensor 1-sensor 2: **min-peak, max-peak** since the last recording
- CALC active *) Calculated value at the time of the recording and dummy value


*) CALC-Function: see chapter 7.6, 7.7



At measuring kind "rAtE-Slo" a power saving function is selectable: "Lo.Po". If activated a measurement is only done if it is also logged (i.e. no additional measurements between the saved values). This seriously reduces the power consumption and is therefore especially appropriate for long-term measurements (e.g. leak test) without an external power supply.

a) Start recording:



Press "store" for 2 seconds: Start Menu, press  again: automatic recording will be started.

Each storage process is signaled by the short display of 'St.XXXXX', where XXXXX is the number of the saved data set.

If the logger memory is full, the recording stops automatically and the display shows


If Low-Power-Logger-Function Lo.Po = on the device switches itself off as soon as the memory gets filled.


b) Stop recording:



Press "store" for 2 seconds: If recording is running the "stop" menu is displayed

Select with  or .

 Do not stop recording
(cancel menu)

 Stop recording



Confirm selection and quit "stop" menu




If you try to switch off the device while cyclic recording is active you will be asked whether the recording should really be stopped.

The device can only be switched off if the recording is stopped.

Auto-off function is deactivated as long as cyclic recording is active.


c) Clear recordings:





Press "store" for 2 seconds: If there are data sets stored and recording is already stopped  is displayed

Select  with  or  to call the clear-menu

Select with  or .

 Clear nothing (cancel menu)

 Clear all recordings

 Clear the last recording



Confirm selection and quit menu "Clear"

9 Universal Output

The output can be used either as serial interface (for USB 5100 interface converter) or as analog output (0-1V). If the output is not needed, it is strongly recommended to deactivate it (Out oFF) to lower power consumption. This increases battery life time.

If the device is used together with interface adapter USB 5100 the device is supplied from the interface.

Pin assignment:



- 1: external supply +5V, 50 mA
- 2: GND
- 3: TxD/RxD (3.3V Logic)
- 4: +U_{DAC}, analog output



Only suitable adaptor cables are permitted (accessories)!

9.1 Interface

The device can be connected to a USB interface of a PC by the electrically isolated interface converter USB 5100 (accessory). The data is transmitted binary-coded and protected against transmission errors by complex safety mechanism (CRC).

The following standard software packages are available:

- **GSOFT3050:** Operating and evaluation software for the integrated logger function
- **EBS20M / -60M:** 20-/60-channel software for measuring value display
- **GMHKonfig:** Configuration Software (for free on internet)

In case you want to develop your own software we offer a **GMH3000-development package** including:

- a universally applicable Windows functions library ('GMH3x32e.DLL') with documentation, can be used by all 'established' programming languages, suitable for:
Windows XP™, Windows Vista™, Windows 7™
- Programming examples Visual Basic 4.0™, Delphi 1.0™, Testpoint™ etc.

The device has 9 channels:

- Channel 1: current measuring value (sensor 1) and base address
- Channel 2: min peak (sensor 1)
- Channel 3: max peak (sensor 1)
- Channel 4: current measuring value (sensor 2)
- Channel 5: min peak (sensor 2)
- Channel 6: max peak (sensor 2)
- Channel 7: current measuring value (difference sensor 1 – sensor 2)
- Channel 8: min peak (difference sensor 1 – sensor 2) or CALC-value
- Channel 9: sensor 1 max peak (difference sensor 1 – sensor 2) or Dummy, if CALC is active



The measuring-/ alarm- and display range values read back from the interface are always in the selected measurement unit (mbar, bar...)!

9.2 Analog output

An analog voltage 0-1V can be tapped at the universal output connector (mode: "Out dAC").

The analog output can be easily scaled with DAC.0 and DAC.1.

Please take care not to load the analog output too heavily, otherwise the output value will be distorted and the power consumption will rise. Loads up to approx. 100 kOhm are unproblematic.

If the displayed value goes beyond DAC.1 the output voltage will be 1V.

If the displayed value falls below DAC.0 the output voltage will be 0V.

In error case (Err.1, Err.2, ----, etc.) the output voltage will be slightly higher than 1V.

The interface converter USB 5100 has a screw/plug connection; therefore no further cable is necessary if USB 5100 is used.

10 Input Adjustment

The zero point and slope of each measuring inputs can be adjusted with the parameters offset ("OFFS") and scale ("SCAL").

A reasonable adjustment presumes reliable references (e.g. ice water, controlled precision water bath, etc.).

If the inputs are adjusted (i.e. offset and scale are different from default settings) the device will shortly display "Corr" after turned on.

Default setting for offset and scale are 'off' = 0.0, i.e. inputs are not changed.

Zero point correction:

$$\text{Displayed value} = \text{measured value} - \text{OFFS}$$

Zero point and slope correction:

$$\text{Displayed value} = (\text{measured value} - \text{OFFS}) * (1 + \text{SCAL} / 100)$$

11 Pressure Connection to the Sensors

The device is designed to be connected to the sensors of the GMSD/GMXD...-series without a new calibration being necessary. Therefore a great variety of replaceable sensors of e.g. -1.999 ... 2.500 mbar relative up to 0 ... 1000 bar absolute pressure can be connected to the device.

Relative pressure sensors (types: GMSD ... MR - K51, GMSD ... BR - K51)

- **For measurements of over- or under pressure:**

Pressure sensors GMSD 2,5 MR - K51, GMSD 25 MR - K51 and GMSD 350 MR - K51 allow for measurements of under pressure up to the entire over pressure measuring range by re-plugging the tube to pressure port "A".

Please note that all values are displayed as positive values. No minus sign will be shown. (Example for GMSD 25 MR - K51: For tube connection "B" the measuring range covers -19.99 to 25.00 mbar. If you replug to port "A" under pressure measurements down to -25.00 mbar could be carried out with the display showing the value 25.00 (no minus sign).

- **For measurements of pressure differences:**

Connect both plastic tubes with an internal diameter of 4 mm to pressure port "B" and "A"; make sure to apply higher pressure to port "B".

Absolute pressure sensors (types: GMSD ... BA - K51)

Connect plastic tube with an inner diameter of 4 mm to pressure port "A". (Port "B" is not used.)

Stainless steel sensors (types: MSD ... MRE, MSD ... BRE, MSD ... BAE)

For measurements of over-, under- or absolute pressure screw sensor to G1/2" pressure terminal or plug plastic tube to a suitable adapter. Connection to instrument: Use cable MSD-K51.

Pressure measurements with two sensors

Pressure differences of any sensor combinations can be measured by means of the calculation sensor1 – sensor2 (DIF).

12 Alarm (“AL.”)

There are 3 possible settings:

off (AL.oFF), on with buzzer (AL.on), on without buzzer (AL.no.So).

Alarm is given in the following cases (if alarm active, AL.on or AL.no.So):

- Lower alarm boundary (AL. Lo) under-run
- Upper alarm boundary (AL. Hi) over-run
- Sensor error
- Low battery (bAt)
- Err.7: system error (always with buzzer!)

In case of an alarm (and when polling the interface) the prio-flag is set in the returned interface message.

13 Real Time Clock (“CLOC”)

The real time clock is used for chronological assignment of the logger data and calibration points. Please check the settings when necessary.

14 Accuracy Check / Adjustment Service

You can send the device to the manufacturer for adjustment and inspection.

Calibration certificate - DKD certificate - official certifications:

If the measuring instrument is supposed to receive a calibration certificate, it has to be sent to the manufacturer (declare test points).

If the device is certificated together with a suitable sensor very high overall accuracies are possible.

Basic settings can only be checked and – if necessary – corrected by the manufacturer.

A calibration protocol is enclosed to the device ex works. This documents the precision reached by the production process.

15 Replacing Batteries

Before changing batteries, please read the following instruction and follow it step by step.

Not following the instruction may cause harm to the instrument or the protection against ingress of water and dust may be lost!

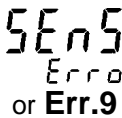
Avoid unnecessary opening of the instrument!

1. Open the 3 Phillips screws at the backside of the instrument.
2. Lay down the still closed instrument, so that the display side points upwards.
The lower half of the housing incl. the electronics should be kept lying down during battery change.
This avoids loss of the sealing rings of the screw holes..
3. Lift upper half of housing. Keep an eye on the six function keys, to be sure not to damage them.
4. Change carefully the two batteries (Type: AAA).
5. Check: Are the 3 sealing rings placed in the housing?
Is the circumference seal of the upper half sound and clean?
6. Close the housing, taking care that it is positioned correctly, otherwise the sealing may be damaged. Afterwards press the two halves together, lay the instrument with display pointing downwards and screw it together again

Take care to screw only until you feel increasing resistance, higher screwing force does not result in higher water protection!



16 Error and System Messages

Display	Description	What to do?
 or Err.9	No sensor connected	Switch off device and connect sensor
	Connected sensor or device defective	If 2nd sensor available, check if device is ok. Return defective device/sensor to manufacturer for repair
	Value extremely out of measuring range	Check: pressure not within sensor range?
No display or confused characters, device does not react on keypress	Battery empty	Replace battery
	Mains operation: wrong voltage or polarity	Check power supply, replace it when necessary
	System error	Disconnect battery and power supplies, wait shortly, then reconnect
	Device defective	Return to manufacturer for repair
Err.1	Measured value above allowable range	Check: pressure not within sensor range? -> measuring value too high!
	Sensor defective	Return to manufacturer for repair
Err.2	Measured value below allowable range	Check: pressure not within sensor range? -> measuring value too low!
	Sensor defective	Return to manufacturer for repair
Err.3	Display range overflow	Check: value above 19999 -> too high to be displayed
Err.4	Display range underflow	Check: value below -19999 (Tara?) -> too low
Er.11	Value could not be calculated	Choose different unit
	Calculation overflow happened	Choose different unit
Err.7	System error	Return to manufacturer for repair
-----	Sensor not present / recognised	reconnect sensor, during logging: stop the logger and restart it
	could not calculate value	suitable sensor / unit combination necessary

If “bAt” is flashing the battery will be exhausted soon. Further measurements are possible for short time. If “bAt” is displayed continuously the battery is ultimately exhausted and has to be replaced. Further measurements aren’t possible any more.

17 Reshipment und Disposal

17.1 Reshipment



All devices returned to the manufacturer have to be free of any residual of measuring media and/or other hazardous substances. Measuring residuals at housing or sensor may be a risk for persons or environment



Use an adequate transport package for reshipment, especially for fully functional devices. Please make sure that the device is protected in the package by enough packing materials.

17.2 Disposal instructions



Batteries must not be disposed in the regular domestic waste but at the designated collecting points.

The device must not be disposed in the unsorted municipal waste! Send the device directly to us (sufficiently stamped), if it should be disposed. We will dispose the device appropriately and environmentally sound.

18 Specifications

Display range		maximal -19999...19999 digit, depends on used sensor
Number of channels		2
Suitable probes		GMSD ... - K51 and MSD ... sensors with connection cable MSD-K51
Available ranges/resolutions		ranging from -1.999 ... 2.500 mbar / 0.001 mbar to 0 ... 1000 bar / 1 bar
Connections	sensor	two 7-pole bayonet connectors
	output / ext. supply	4-pole connector for serial interface and supply (USB Adapter USB 5100) analog output 0-1V, adjustable
Display units		depends on meas. range selection (depends on connected sensor): mbar, bar, Pa, kPa, MPa, mmHg, inHg, PSI, mH ₂ O
User unit		freely adjustable
Measuring frequency		4 / s or 1000 / s
Accuracy		± 0.1 % FS ± 1 digit
Working conditions		-25 ... 50 °C; 0 ... 95 %RH (non condensing)
Storage conditions		-25 ... 70 °C
Display		4 ½ digit 7-segment display, illuminated (white)
Correction function		offset / slope (via menu), if offset/slope value not equal zero: "corr" is displayed
Leakage test function		Pressure change rate display, configurable time base
Air velocity / volume flow		measuring with pitot tube
Real-time clock		integrated clock with date and year
Data logger	cyclic	8000 data sets
	manual	1000 data sets (with measuring point input, 40 adjustable measuring point text numbers)
Alarm	channels	3 (sensor 1, sensor 2, difference) with individual alarm boundaries
	types	buzzer/visual/interface
Additional functions		min- / max- / hold- function
Averaging		adjustable, 1 ... 120 seconds
Housing	protection class	IP65 and IP67
	dimensions L*W*H [mm]	160 * 86 * 37 incl. protective covering,
	weight	approx. 250 g incl. batteries and protective covering
Power supply		2*AAA-batteries (included in delivery)
	current consumption	2.0 mA (at Out = Off, equivalent to 500 h), illumination ~10mA (turns off automatically)
Battery-change indicator		automatically if battery exhausted "bAt", warning "bAt" flashing
Auto-off-function		Device will be automatically switched off if no key is pressed/no interface communication takes place for the time of the power-off delay. The power-off delay can be set to values between 1 and 120 min.; it can be completely deactivated.
Directives / standards		The instruments confirm to following European Directives: <div style="display: flex; justify-content: space-around;"> <div>2014/30/EU</div> <div>EMC Directive</div> </div> <div style="display: flex; justify-content: space-around;"> <div>2011/65/EU</div> <div>RoHS</div> </div> Applied harmonized standards: <div style="display: flex; justify-content: space-between;"> <div>EN 61326-1 : 2013</div> <div>emissions level: class B</div> </div> <div style="display: flex; justify-content: space-between;"> <div></div> <div>emi immunity according to table 3 and A.1</div> </div> <div style="display: flex; justify-content: space-between;"> <div></div> <div>Additional fault: <1%</div> </div> <div style="display: flex; justify-content: space-between;"> <div>EN 50581 : 2012</div> <div></div> </div>

