

MAMOS – PC SOFTWARE

User manual

Version: 1.2 12/2019 Software version: 13.1.8

madur

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1. INTRODUCTION

Madur PC software provides PC communication with several madur devices: mamos, SENma sensors, IRma sensors, INERma sensors and others. Program identifies the type of device it is connected to, and shows appropriate set of settings. This manual covers all possible settings, though, not every may appear with your device.

Installation file can be found on software CD (attached with every analyser) and on madur webpage.

2. 🛸 CONNECTING TO MAMOS

Program will try to connect to mamos using the last selected COM port. If the COM port has changed (e.g. due to different cable or connecting to a different mamos), it is necessary to select a proper one.

Select File \rightarrow Program settings. Or use icon

Program settings	×
Port Language	
Communication Port	
	twork card
COM port:	
	erminate after
COM4	device
COMA	
	Close

Select proper COM port (that "stands behind" the cable you use to communicate with mamos.

In case only one analyser is connected to PC, in order to speed-up the discovery process, select the option Terminate after finding the first device.

Press <u>Connect</u> to initialise discovery process.

It is possible to reconnect to a device (using the last selected options) by pressing 🧐 icon.

🛄 madur Software, v. 13.1.2		-	\times
File Data logger Memory card About			
No device	COM: 9 @ 115200,N,8,1		
•	U		

3. 🔊 PROGRAM LANGUAGE

- 1. From main menu, select: File \rightarrow Program settings, or click ¹/₁ icon.
- 2. Select the second tab: Language
- 3. From drop-down menu select your language
- 4. Close Settings window

madur can share language files for translation in order to prepare your language version - please contact our sales team: sales@madur.com

4. MAIN WINDOW

- 1. Main menu
- 2. Bar with icon short-cuts to the most common options (that are also available from main menu):
 - Restart communication
 - Program settings
 - Analyser settings
 - Results
 - Memory card
 - Analyser status
 - Work modes
 - Analogue outputs
 - Relays and digital outputs
- 3. Contents window, where sub-menus are opened
- 4. Status bar with information about:
 - connection status (Online / Offline)

	🔟 n	nadur Soft	ware, v. 13	3.1.3								_		\times
1	File	Settings	Results	Memory card	Displays	Work mode	Analogue ou	tputs Relay	/s 1-point ca	alibration	About			
2	Ø) 🍇					M 🌱	Currently co	nnected devic	e: -]				
3														
4		Online				COM	A: 3 @115200	N,8,1	MaMos III, 16	.3.6 - RS4	85 #1 (16)		1111111	1 //

- connection port (COM number, and COM settings)
- type of device and firmware version
- device serial number





5.1. Calculations of CO2

In case of analysis of a combustion process. CO2 value can be either measured directly (with CO₂ NDIR) or calculated using result from O2 sensor, and fuel parameters, according to formula:

$$CO_2 = CO_{2max} \cdot \left(1 - \frac{O_{2max}[\%]}{20,95\,[\%]}\right)$$

Where:

- CO₂ calculated CO₂ content in the combustion gas (as a percentage)
- CO_{2 max} parameter characteristic for a selected fuel
- O_{2 max} oxygen content in the combustion gas (as a percentage)

User can specify from where the results will be "taken":

- Always calculated
- Always a direct reading from CO 2 if CO 2 sensor is not present display will show "– – –"

Calculations of CO2
Specify if CO2 should be calculated based on result from O2 and fuel parameters
C Always calculate CO2 based on O2 (even if CO2 sensor is present)
 Never calculate CO2 (show error message if CO2 sensor is absent)

5.2. Calculations of NO_X

 $NO_x[ppm] = \frac{NO[ppm]}{0.97}$

Where:

NO – results from NO sensor 0,97 – percentage contents of NO in total contents of all NO_x (parameter modified in mamos software)

If both NO and NO2 sensors are installed:

 $NO_x[ppm] = NO[ppm] + NO_2[ppm]$

5.3. Fuel parameters

Mamos can estimate the total contents of NO_X concentration based on the results from NO sensor. It is assumed that circa 97% of all nitric oxides (NO_X) present in fumes is nitric oxide (NO). This percentage value can be modified in mamos PC program. In case both NO and NO2 sensors are installed in analyser, this coefficient is obsolete, as in this case, the concentration of total NO_X is assumed as a sum of nitric oxide and nitrogen dioxide concentrations.

Calculations	of NOx —			
Used for calc present	culating NOx	from NO. Unne	cessary if both	NO and NO2 sensors are
97 %	Percentage	e contents of N	IO in NOx	
				Default

Mamos analyser can perform calculations of different values, including combustion parameters, like stack loss, efficiency, etc. For these calculations analyser must "know" what kind of fuel is used for combustion, as different fuels have their unique parameters. Madur has over 20 different fuels listed in database, user can select one, from the list: Load standard fuel, or manually modify the parameters:

•	CO _{2max}	Concentration of carbon dioxide in fumes in case of stoichiometric combustion
•	HV	Heating Value - the amount of heat produced by stoichiometric combustion a unit quantity of a fuel
•	A ₁ ,B	Coefficients of Siegert's empirical formula
•	Alpha (α)	coefficient used for calculating the loss by incomplete combustion, its value differs for fuels: $\alpha = 69$ – for solid fuels $\alpha = 52$ – for liquid fuels $\alpha = 32$ – for gas fuels
•	O _{2ref}	reference oxygen - the parameter used for calculating the relative content of components
•	Vdf	Volume of Dry Fumes - amount of fumes from stoichiometric combustion, after water vapour has been condensed
•	VAIR	Volume of air required for stoichiometric combustion
•	T _d	Flue gas dew point – the temperature at which the water vapour in a sample of air at constant barometric pressure condenses into liquid water. Parameter that specifies contents of water vapour in flue gas.
•	Gaseous fuel	Switch for HV unit: MJ/kg or MJ/m

Name Light oi	1	
CO2max	15,4	%
HV	42,7	MJ/kg
A1 coeff.	0,5	
B coeff.	0,01	
Alpha	52	
O2ref	3	%
Vdf	10,53	m3
Vair	11,2	m3
Td	48	°C
Gaseous fuel Fuel parameters are - CO2 from O2 - Stack loss and effit - Lambda and 'undilu - Gas concentration	necessary for calculat ciency ted' s related to O2	ions:
		Lond standard first

5.3.1. Standard fuels available in madur analysers

No.	Fuel name	CO _{2max} [%]	HV [MJ/unit]	A 1	В	Alpha (α)	O _{2REF} [%]	V _{DF} [m3]	V _{AIR} [m3]	T₀ [°C]	unit
1	Natural gas	11,7	35,90	0,3700	0,009	32	3	8,56	9,54	56,05	m ³
2	Natural gas with fan	12,1	35,90	0,4600	0,000	32	3	8,56	9,54		m ³
3	Town gas	13,1	16,10	0,3500	0,011	32	3	36,10	3,90	60,05	m ³
4	Town gas with fan	10,0	16,10	0,3800	0,000	32	3	3,61	3,90		m ³
5	LPG (Liquid gas)	14,0	93,20	0,4200	0,008	32	3	22,30	24,36	55,05	m ³
6	Coke-oven gas	10,2	17,40	0,2900	0,011	32	3	22,30	24,36	64,35	m ³
7	Propane	13,7	93,20	0,4750	0,000	32	3	22,30	24,36	51,5	m ³
8	Propane with fan	13,7	93,20	0,5000	0,000	32	3	22,30	24,36		m ³
9	Butane	14,1	123,80	0,4750	0,000	32	3	29,69	32,31	50,7	m ³
10	Butane with fan	14,1	123,80	0,5000	0,000	32	3	29,69	32,31		m ³
11	Biogas	11,7	35,90	0,7100	0,000	32	3	8,54	9,56		m ³
12	Biogas with fan	11,7	35,90	0,7800	0,000	32	3	8,54	9,56		m ³
13	Bio-Diesel	15,7	41,80	0,4567	0,005	52	3	10,44	11,15		m ³
14	Light oil	15,4	42,70	0,5000	0,007	52	3	10,53	11,20	48,05	kg
15	Extra light oil	15,3	41,80	0,5900	0,000	52	3	10,53	11,20	47,05	kg
16	Heavy oil	15,9	41,00	0,6100	0,000	52	3	10,08	10,73	50,50	kg
17	Gasoline (C8H18 average)	14,5	44,40	0,5000	0,007	52	3	11,26	12,19	49,3	kg
18	Coal-tar	18,0	37,70	0,6500	0,000	52	3	9,32	9,66		kg
19	Anthracite	19,1	31,50	0,6830	0,000	69	11	9,40	9,50	27,22	kg
20	Bituminous coal	18,4	26,75	0,6720	0,000	69	11	6,90	7,00	44,00	kg
21	Lignite	18,6	19,50	1,0000	0,000	69	11	5,70	8,40	44,35	kg
22	Coke	19,1	27,05	0,2900	0,000	69	11	8,40	8,00		kg
23	Peat	18,6	18,05	0,7000	0,000	69	11	5,70	5,90		kg
24	Dry wood / wood pellet	19,7	18,60	0,6500	0,000	69	11	4,40	5,00	57,55	kg

5.4. Conversion to mg/m³

mamos measures gas as volume concentrations, i.e. ppm or %vol. It is possible to convert volume concentration to mass concentration, i.e. mg/m3. Mass concentration depends on the temperature and pressure, and these parameters should be taken into account for conversion purposes. In mamos PC program it is possible to define conversion factors for several gases (those that can be measured with mamos).

Using Default button resets all the conversion factors to the STP conditions.

5.5. Pitot factor

If mamos analyser is equipped with differential pressure sensor, it is possible to use it for measurement of flow velocity. Flow velocity is measured indirectly, with the help of pitot tube. There are two types of tube available: L and S. Each of them has its own correction factor used for calculation.

5.6. Stabilisation of internal temperature

Stable temperature is important for accurate measurements. Even though the gas sensors have correction factors for thermal drift implemented into analyser's firmware, it is optimal to keep their temperature stable. Mamos has simplified temperature stabilisation mechanism, i.e. it has temperature sensor and fan with regulation. Mamos will try to keep internal temperature at constant (adjustable from PC program) level.

Stabilisation is performed with *hysteresis*, that is also adjustable.

Gas	Coefficient mg/m3 per ppm	Gas	Coefficient mg/m3 per ppm
02	1,428	H2S	1,521
02	1,964	H2	0,09
CH4	0,716	NH3	0,76
0	1,25	CI2	3,164
NO	1,34	HCI	1,627
102	2,056	N2O	1,964
VOx	2,056	CHF3	3,125
SO2	2,86	нсно	1,339

Correction factor for pitot tube



- Stabilisation of the device internal temperature	
I ✓ Enable temperature stabilisation	
28 Target temperature [°C]	
1 Regulation hysteresis [°C]	
	Default
	L

5.7. Gas pump

By default analyser's pump is adjusted to give flow 901/h. It is possible to modify the flow by changing pump's efficiency.

If the process is at slight overpressure (within acceptable range for mamos analyser), it is possible to disable the pump during measurement phase – then the gas is fed by process itself. It is still necessary to use the pump to drive the ambient air for ventilation purposes.

Every mamos analyser is equipped with differential pressure sensor that controls the flow through the analyser. Gas flow may drop to a number of reasons (e.g. due to clogging of filters, pump malfunction, blockage of gas tubes, etc.). When flow drops below sea level (by default set to 30 l/h), then mamos reports "Flow too low error"

5.8. Blow-Back valve

mamos that is equipped with stationary gas probe with filter and cleaning option, sends electric signal to the pilot electromagnetic valve that enables compressed air source for filter's cleaning. Cleaning of probe's filter is synchronised with ventilation of gas sensors. User can set the duration of filter's purging (max 60 seconds)

5.9. Data-logger

Measurement results can be stored on SD card. Storage must be enabled in PC program – then, whenever SD card is detected in data-logger, analyser will start recording.

It is possible to set how often the results will be stored. And also to define the starting number for the files' counter – new file is created, e.g. when limit of 10.000 results in a file has been reached.

- Pump efficiency	
220 A Pump (100 to 254)	
Turn on the pump only during Ventilation' phase	
Default	
	Pump efficiency 220 Pump (100 to 254) Turn on the pump only during 'Ventilation' phase

- Pump flow control	
30.0 Minimum flow level [l/h]	
1	
Enable flow control	

Blow-back valve	is enabled through:
	lo onabioa un olign.
60	Purging (in seconds) of probe's filter with compressed air.
	Purging is enabled with ventilation phase.

Storage to SD o	ard	
Enable data	storage to SD card	
30	Storage interval in seconds (min. 10s)	
0	File number	
		<u>D</u> efault

5.10. Display configuration

Mamos allows for a flexible adjustment of parameters that will be shown on display – only available parameters can be selected (non-available are greyed out).

It has 4 lines, so in case one wants to show more than 4 variables, display will switch PC software also allows to set visibility duration of different screens: Screen 0 – status, Screen 1,2: results.

-4-rows Display		Select variable to be s	hown		×
Screen 0 duration		All variables measu	red/calculated by the ar	alyser:	
Measurins: B 1:20	Display's settings Assign measurement block to display #0 02 [%] Change	Components ⓒ 02 [0,01%] ⓒ C02 [0,01%]	Combustion param. C SL [0,1%] C Eta [0,1%] C Lambda [0,01]	Temperatures C Tamb [??] C Tgas [??] C T3 [??] C T4 [??] C Tint [0,01°C]	Pressure, flow C PumpFlow [??] C PressAbs [??] C PressDif [??] C Flow [0,1m/s]
Time: 14:24.41 Next: A 16:00.00	#1 CO2 [%] Change #2 Change #3 Change #4 Change	Toxic gases (vol.) C CH4 (0.001 ppm) C CO (??) C NO (??) C NO (??) C NO2 (??) C NO2 (??) C SO2 (??) C SO2 (??)	Tox mg C CH4mg [0,001 ppm] C Comg [??] C NOmg [??] C NO2mg [??] C NO2mg [??] C S02mg [??]	Tox rel C CH4rel (0,001ppm) C Corel [??] N N0rel [??] N N02rel [??] C N02rel [??] C N02rel [??] C S02rel [??]	Uor I C [22] C [22] C [22] C [22] C [22] C [22] C [22]
0a 20.95 % C0a %	#5 Change #6 Change #7 Change	C H25 [??]	C H2Smg[??]	C H2Stel [??]	C [??] C [??] Ext. Inputs C [1ppm] <- U/I_1 C [1ppm] <- U/I_1
		C ···		ОК	Cancel

User can define how display will behave during Ventilation phase:

- Presented values can continue measurements they will start to drop at the beginning of ventilation and go to the (near) zero values
- Values can be "latched" display will show the last measured value before Ventilation phase begins
- Display will clearly inform user that results are meaningless due to Ventilation display will show Pur instead a value.

If selected sensor is installed in auxiliary channel, user can specify what will happen when AUX sensor is disabled (ventilated with air). Selection is identical to behaviour during Ventilation.

Behaviour during the 'Ventilation' phase (applies to all values)

O Show the currently measured value

 $\ensuremath{\mathbb{C}}$ Show the last result from the 'Measurement' phase

Show "Pur"

CO2 [%]	Change	AUX channel
Behaviour during the 'M	leasurement' l	M phase for AUX channel
C Show the currently	measured va	lue
C Show the last resul	It from the ME	ASUREMENT phase
Show "Pur"		
	CO2 [%] Behaviour during the 'N C Show the currently C Show the last resu (Show "Pur"	CO2 [%] Change Behaviour during the 'Measurement' I C Show the currently measured va C Show the last result from the ME. C Show "Pur"

5.11. Storage to PC's HDD

Even if the analyser is not equipped with data-logger, it still allows to perform storage of results directly to PC hard disk to a CSV file.

User can specify if program should create a new file if size exceeds certain capacity, and if a new header should be added (as a row) every time a new data recording begins.

5.12. Auxiliary channel

If mamos is equipped with auxiliary channel for sensitive sensors user can select how channel is disabled (= sensors in AUX channel are ventilated with air). It is either:

- time threshold sensors in AUX channel measures only for the first XX minutes of the Measurement phase (in this case 15 minutes)
- concentration threshold sensors in AUX channel will be disabled if range on a selected sensor is exceeded
 - \circ in the example: AUX channel is disabled when concentration of CO₂ is higher than 10%
 - it is possible that AUX channel is disabled by sensor installed in AUX channel (self-protection of sensor) in this case AUX channel is disabled when CO₂ concentration exceeds 10%. Channel is disabled for 5 minutes, after which channel is enabled to check the current CO₂ concentration. If it is within safe range, AUX channel stays enabled. If CO₂ concentration is still dangerously high, AUX channel is disabled for another 5 minutes for another check ????

5.13. RS485 settings

If more than one mamos works in one network, it is possible to communicate with all of them (one at a time) using one instance of PC program – in this case each mamos analyser must be assigned with a unique address.

After address is assigned it is possible to select (on the fly) a device for communication – using drop-down list located in a short-cuts bar

Ste	prage to CVS
- · · ·	
☑	Add a new heading to csv file when starting a new measurement session.
Γ	Create a new csv file when size of the current file exceeds
	5 MB



 concentration threshold 	
00:05:00 AUX channel working time	
Acceptable ranges	
1. O2 73,49 % time threshold:	
2. CO2 I 10,00 % AUX channel is enabled at the beginning of measurement cycle and is active for set the	feach me (ALIX
3. CH4 C channel working time). Next the channel is	
4. CO	the rest
5. NO	
6. NO2 Concentration threshold:	
7. NOx 🔽 Additional channel is enabled until the three	shold
8. SO2 value of any of the sensor in the main cha	nnel is annel is
9. H2S enabled again (under condition that values	ofall
sensors in the additional channel are less	than the
half of their threshold values).	
0	



6. 📑 RESULTS



This window allows to view results (independently from device display) and to store them directly to CSV file on hard disk (under condition that this window is active)

5. Value of the selected variable

Variable's label, also allows to change variable's assignment to the selected display

Only the selected variables (check box Storage to CSV ticked) are saved to hard disk, others are ignored Storage interval (how often results will be stored to CSV file. 1, 2, 5, 10, 30 and 60 seconds. Switch that turns on storage to hard drive

Elle - allows to define location of the CSV file on a hard drive

Path to the CSV file. By default, CSV file is stored in an installation folder (or other system related folder) – depends on the version of Windows operating system

7. 🖾 ANALYSER STATUS

	Cyclic	measure	ements			2016-00-30		2.53.3
Info on the current	phase					2010-03-00		2.00.0
Source of gas s	ample	Α				Results		
Current phase:		'Measu	rement'			Elow too low		
Ends in		19:34:0	2			FIOW LOO IOV	•	
Time since begi	nina:	02:10:5	8					
Next zeroing:	Ū.	[2016-0	9-30 22:30	0:001				
The next source	of gas sample:	в		1				
						02	E-07	%
AUX channel:		Enable	d (main ch	annel o	nly)			
Analyser's Inputs/0	Dutputs					со	0	ppm
			11:	4,0	mA	NO	•	
)	Relay 1: O	ff	12:	4,0	mA	NO	U	ppm
IN1: Hi	Relay 2: O	ff	13:	20,0	mA mA	PressAbs	991.2	hPa
	PV3 : O	ff	14.	0,0	V			
IN2 : Hi	Relay 4 · O	ff	U2	0.0	v			
IN2 : Hi	Roldy 4.			40.0	V			
IN2 : Hi	PWM : 12	298	U3	10.0	v			
IN2 : Hi	PWM : 12	298	U3 U4	10,0	v			

This a general view on the analyser most important parameters:

Type of selected work mode

Information on the current measurement phase:

- from where the gas sample is collected (for twin-split configuration)
- which phase currently occurs
- how long until the end of the current phase
- how long is analyser in the current phase (time since the previous phase)
- when is the next zeroing of gas sensors (=the final moment of ventilation)
- from where the sample will be collected in the next Measurement phase
- Status of the AUX channel

Status of analyser's inputs and outputs

Current date and time (according to analyser's clock

Results from sensors (only those assigned to display)

Reports (*.MRP)

The list of seconds in the f

- - X

8. 🖾 MEMORY CARD

- Mamos PC program allows to read and convert reports stored by analyser's data-logger to binary files. Binary files, with MRP extension stored on data-logger's SD card must be copied to a user-selected folder – that must be specified in mamos PC program:
- 2. List of MRP report files stored in the selected folder. Contains following information:
 - index number
 - file's name
 - date of creation
 - file's size
 - number of records
 - date and time when files was created (beginning and end)
 - serial number of the device that created records
- 3. Select a specific file and press open

#	File name	Date of creation	Size	Number of	records	Start time	9	End time		Serial number
2) 1	1 0000000.MRP	02.08.2016	10,25 KB		39	2016-08	3-02 12:46:41	2016-08	-02 13:05:4	1 111111
		1								
3	Open									
-										
_										
										Close
Result	ts: 0000000.MRP								<u></u>	- 0
Result	ts: 0000000.MRP Results		(5)	Show	/ Hide colu	mns			<u></u>	- 0
Result	ts: 0000000.MRP Results	Status	5	Show	/ Hide colu	mns	Dipplay 2		inclose 4	- D
Result	ts: 0000000.MRP Results Date/Time 2016.08.02 12:58:41	Status	5 Dis	Show	/ Hide colu Displa	mns	Display 3	B Di	isplay 4	
Result	ts: 0000000.MRP Results Date/Time 2016.08.02 12:58:41 2016.20 3 13:59:14	Ventilation	5 Dis 02:	Show play 1 0,00 % 0,00 %	/ Hide colu Displa CO: 0	mns ay 2 ppm	Display 3	B Di Prest	isplay 4 sAbs: 994,3	-
Result	ts: 0000000.MRP Results Date/Time 2016-08-02 12:58:41 2016-08-02 12:59:11	Status 'Ventilation' Ventilation'	Dis 02: 02:	Show play 1 0,00 % 0,00 %	/ Hide colu Displa CO: 0 CO: 0	mns ay 2 ppm ppm	Display 3	Di Press	isplay 4 sAbs: 994,3 sAbs: 994,2	- AnaOut U O2: 0,00 %; 10 O2: 0,00 %; 10 O2: 0,00 %; 10
Result	ts: 0000000.MRP Results Date/Time 2016-08-02 12:58-11 2016-08-02 12:59:11 2016-08-02 12:59:11	Status 'Ventilation' 'Ventilation'	5 Dis 02: 02: 02:	Show play 1 0,00 % 0,00 % 0,00 %	/ Hide colu Displa CO: 0 CO: 0 CO: 0	mns ay 2 ppm ppm ppm	Display 3	Di Press Press Press	isplay 4 sAbs: 994,3 sAbs: 994,2 sAbs: 994,2	
Result 25 26 27 28	ts: 0000000.MRP Results Date/Time 2016-08-02 12:58:41 2016-08-02 12:59:41 2016-08-02 13:00:11	Ventilation' Ventilation' Ventilation' Ventilation'	5 Dis 02: 02: 02: 02: 02:	Show play 1 0,00 % 0,00 % 0,00 % 0,00 %	/ Hide colu Displa CO: 0 CO: 0 CO: 0 CO: 0	mns ay 2 ppm ppm ppm ppm	Display 3 	Press Press Press Press	isplay 4 sAbs: 994,3 sAbs: 994,2 sAbs: 994,2 sAbs: 994,3	
Result 25 26 27 28 29	ts: 0000000.MRP Results Date/Time 2016-08-02 12:58:41 2016-08-02 12:59:41 2016-08-02 12:59:41 2016-08-02 13:00:11 2016-08-02 13:00:41	Status Ventilation' Ventilation' Ventilation' Ventilation'	5 Dis 02: 02: 02: 02: 02: 02:	Show play 1 0,00 % 0,00 % 0,00 % 0,00 % 0,00 %	/ Hide colu Displa CO: 0 CO: 0 CO: 0 CO: 0 CO: 0	mns ay 2 ppm ppm ppm ppm ppm ppm	Display 3	Di Press Press Press Press Press	isplay 4 sAbs: 994,3 sAbs: 994,2 sAbs: 994,2 sAbs: 994,3 sAbs: 994,2	- 2: 0,00 %; 10 02: 0,00 %; 10
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- 4. Preview of recorded results
- 5. Options to preview and export allows to select what data will be presented
- 6. General information about device that recorded data
- 7. Binary file conversion options:
 - Copy previously selected data to clipboard. Later on data can be pasted to txt file, word, excel, email, etc.
 - Export to CSV file to hard drive user will be prompt to specify file's name and storage location
 - Delimiter what character should be used for separation of each column

maMoS

9. 🕑 WORK MODES

9.1. Cyclic measurements

- 1. Adjustment of duration of cycle phases:
 - Full cycle time adjustable in range 0÷100 h with 1 sec. step. Full cycle time = Ventilation + Measurements + Stand-by (Stand-by occurs only if TC>TV+TM)
 - Ventilation adjustable in range 5÷15 min., with 5 min. step
 - Infusion fixed to 1 minute informally it is the last moment of ventilation this is when process
 gas begins to be fed to sensors, therefore readings on sensors are still uncertain.
 - First zeroing work phase that occurs right after Warming Up. Time is fixed to 2 minutes
 - Measurement the essential phase. User-adjustable in range 0÷100 h, with 1 min. resolution.
 - Warm Up after device is turned on, it requires to prepare components to work, e.g. to stabilise internal temperature.
 - AUX channel AUX channel is enabled at the beginning of the Measurement phase, after T_A time it is disabled.

uration of cycle's phase	5				Work mode		
) Il cycle time	04:	00:00		Ends in	Cyclic measurement	nts	2.
nase: 'Ventilation'	00:	15:00			Description of the cl	hosen mode	-
ase: 'Infusion'	00:	01:00			00:30:00 ÷ Tim	e of the first zeroing	(3)
ase: 'First zeroing'	00:	02:00					
ase: 'Measurement'	01:	45:00					
ase: 'Warm-up'	00	15:00			Davies works o	colorably available the follo	wing phases:
IX channel	00	15:00			"Ventilation', 'Meas	urement', 'Stand-by', accor	rding to settings
Input IN1		γ	Input IN2				
Input IN1		1	Input IN2				
No action	cycle	γ	Input IN2	+			
Input IN1 No action Restart measurement Terminate measurement	cycle ent cycle	<u> </u>	Input IN2	+			
Input IN1 No action Restart measurement Terminate measurement he analyser restarts me put is low (0V) for longe	cycle ent cycle assurement cy rr than 2 seco	rcle when the nds. The new	Input IN2	+++++++++++++++++++++++++++++++++++++++			
Input IN1 No action Restart measurement Terminate measurement e analyser restarts me put is low (0V) for longe rcle begins with "Ventila	cycle ent cycle assurement cy r than 2 seco tion' phase.	rcle when the nds. The new	Input IN2				
Input IN1 No action Restart measurement Terminate measurement he analyser restarts me put is low (07) for longe role begins with Ventila	cycle ent cycle assurement cy r than 2 seco tion' phase.	rcle when the nds. The new	Input IN2				
Input IN1 No action Restart measurement Terminate measurement he analyser restarts me put is low (0V) for longe cele begins with Ventila	cycle ent cycle asurement cy tion 2 seco tion' phase.	rcle when the nds. The new	9 , 10 , 11		14 , 15 , 16 , 17 ,	18 19 20 21 22	,23 0
Input IN1 No action Restart measurement Terminate measurement he analyser restarts me put is low (0V) for longe cole begins with Ventila	cycle ent cycle assurement cy er than 2 seco tion' phase.	rcle when the nds. The new	9 . 10 . 11	+	14 15 16 17	18 19 20 21 22	,23,0,,
Input IN1 No action Restart measurement Terminate measurement he analyser restarts me he analyser restarts me put is low (00%) for longe role begins with Ventila	cycle ent cycle assurement cy tr than 2 seco tion' phase.	rcle when the nds. The new	Input IN2	+ + + + + + + + + + + + + +	14 15 16 17 .	18 19 20 21 22 6	, 23 , 0 ,
Input IN1 No action Restart measurement Terminate measurement e analyser restarts me uit silow (007) for longe role begins with Ventila	cycle assurement cycle itan 2 seco tion' phase.	rcle when the nds. The new	9 10 11	12 13 1 4 entilation'	14 15 16 17 . 5	18 19 20 21 22 6 ent' AUX cha	, 23 , 0 ,

- 2. Selection of work mode
- Start time for the first zeroing parameter characteristic for Cyclic measurement work mode. Allows to 4.
 adjust the Cycles along a day.
- 6. Function buttons:
 - Preview of the current settings (see chapter: 9.8.)
 - Save current settings to analyser
 - Restore Default settings

Assigning actions to digital inputs

Graphical representation for the current work cycle

- Send signal to the analyser to Restart the measurement cycle
- Send signal to the analyser to Terminate the measurement cycle

9.2. Measurements according to scheduler

۱	Nork mode				
4	Duration of cycle's phases hh:mm:ss Phase: Ventilation' 00:10:00 * Phase: 'Influsion' 00:00:10 * Phase: 'Influsion' 00:00:00 * Phase: 'Measurement' 01:56:00 * Phase: 'Warm-up' 00:00:00 * Autocalibration1 00:03:00 * Autocalibration2 00:06:00 *	Ends in	Work mode Measurements according to Scheduler 2 1 07 00:00	9. 00.00.00 * Off 10. 00.00.00 * Off 11. 00.00.00 * Off 12. 00.00.00 * Off 13. 00.00.00 *	▼ 17. 00:00:00 * Off 18. 00:00:00 * Off 19. 00:00:00 * Off 20. 00:00:00 * Off 21. 00:00:00 * Off 21. 00:00:00 * Off
	Input IN1 Input IN2 C No action C Restart measurement cycle C Terminate measurement cycle The analyser restarts measurement cycle when the input is low (0) for longer than 2 seconds. The new cycle begins with Ventilation' phase.		6. 14:15:00 Ch:A Call:Off Call:On 7. 15:00:00 Ch:A Measure. 8. 00:00:00 Off	14. 00:00:00	22. 00.00.00 Off 23. 00.00.00 Off 24. 00.00.00 Off 24. 00.00.00 Off Off 24. 00.00.00 Off Off 25. 00.00.00 Off Off 26. 00 Off Off 27. 00 Off
	9 1	10 11 1 4	2 13 14 15 16 56 7	17 18 19 20 21	22 23 0
	Preview Sa <u>v</u> e	<u>D</u> efault	Restart cycle Terr	minate cycle	Close

- 1. Adjustment of duration of cycle phases
- Scheduler allows to select 1÷24 cycles during a day. User can freely specify the start time of each cycle. Cycle will start with ventilation, go to measurements and finally to standby.

Active cycles are marked with green rectangle Times of each phase is also adjustable.

- 3. Graphical representation for the current work cycle in Scheduled work mode, each cycle is labelled with own number.
- 4. Duration of calibration phase
- 5. Number of cycle being adjusted

9.3. Auto-calibration with reference gases

If mamos analyser is equipped with calibration module, scheduler work mode allows to specify when the calibration with reference gases occurs, and to specify parameters of reference gases:

Cycle No	:	1 (5)				
Active	hannel					
Gas channel n	umber:	A	• 7			
	00					
Callibration gas	es					
Enable Che	cking1 in					
AutoCalibra	tion cycle					
Gas 1	10		1,00	%		
Gas 2		•				
9 Enable Che	cking2 in					
AutoCalibra	tion cycle		1.00	0/		
Gast In	102		1,00	20		
Gas 2 -		•				
Save			Í	<u>C</u> los	e	

- 6. Checkbox that enables/disables cycle in scheduler
- 7. Selection of gas sources (in case of twin-split configuration)
- 8. Checkbox that enables/disables autocalibration at the beginning of adjusted cycle
- 9. Specify which calibration channel will be used (only one can be selected at a time
- 10. Specify parameters of connected reference gas (type of gas and concentration)
- 11. ÷ 14. Information on parameters the cycle (below cycle's start time):
 - Ch: gas source (twin-split configuration)
 - Cal1 / Cal2 autocalibration enabled from reference gas 1/2

In the example above: At 7.00 A.M.: Cycle #1 and Cycle #2 are auto-calibration ones (respectively with reference gas #1 and #2). Because their only purpose are to calibrate sensors, they are interrupted by another cycle with starting point in the middle of measurement phase of the previous cycle. Cycle #3 and #4 are "normal" measurements with full-length cycles. This process repeats at 2.00 P.M.

9.4. Measurements triggered by digital input

Duration of cycle's phases —	hh:mm:ss	Ends in	Work mode Measurement triggered by a digital input
Phase: "Ventilation" Phase: "Infusion" Phase: 'First zeroing' Phase: 'Measurement'	00:15:00 00:01:00 00:02:00 01:45:00 •		Description of the chosen mode
AUX channel	00:15:00		Device executes single measurement cycle (Ventilation' followed by 'Measurement' - according to settings in 'Duration of cycle's phases' section) when it is triggered by IN1 and/or IN2 input. After the measurements, the device goes to STAND-By ohase until it is triggered again. It is also possible
			to terminate the cycle in progress with the other input (IN1 or IN2)
Input IN1		Input IN2	to terminate the cycle in progress with the other input (IN1 or IN2)
Input IN1 C No action C Restart measurement cycl Terminate measurement cy The analyser terminates curry when the input is low (0V) for Unit then goes to 'Pre Stand-B	ie rycle ent measurement cycle longer than 2 seconds. by' phase.	Input IN2	to terminate the cycle in progress with the other input (IN1 or IN2)

- 1. Adjustment of duration of cycle phases
- 2. Assigning actions to digital inputs:
- Restart measurement cycle start a new cycle (if measurements are in process, interrupts them) with Ventilation then goes to Measurement according to defined times.
 If Measurements are set to 00:00:00, then mamos will measure until it receives Terminate signal on digital input.

Use with caution! Sensors require periodical ventilation for proper work!

• Terminate measurement cycle – Interrupts Measurements and goes to Stand-by

9.5. Long-term, monthly-cyclic mode

- 1. Adjustment of duration of cycle phases
- 2. Definition of the cycle's start:
- Time of the first zeroing
- Date of the first zeroing

Measurement phase lasts for 1 month – the following zeroing will be performed in the next month (in the example, on 2016-08-14) at the same time, i.e. half past midnight.

User should also specify the ventilation time and time when AUX channel (if present) is enabled. Use with caution! Sensors require periodical ventilation for proper work!

Work mode			
Duration of cycle's phases hh	:mm:ss	Ends in	Work mode
Phase: 'Ventilation' 00:18 Phase: 'Infusion' 00:01 Phase: 'First zeroing' 00:02	5:00 • 1:00 • 2:00 •		Description of the chosen mode 00:30:00 Time of the first zeroing 14.07.2016 Date of the first zeroing
Phase: 'Warm-up' 00:12 AUX channel 00:12	5:00 ± 5:00 ±		Work cycle (in turns: measurement and zeroing) is repeated with a monthly interval. The first zeroing is performed in a given date and time, and repeated at the same time each month. Moreover, the zeroing is performed after warm-up phase and can be triggered via RS232. Standby phase occurs only before the first zeroing. If the month is shorter than the given day, then the zeroing is performed on the last day of the month.
Input IN1 C No action Restart measurement cycle C Terminate measurement cycle The analyser restarts measurement cycl input is low (0V) for longer than 2 second cycle begins with "Ventilation" phase.	Input IN2		
Preview	Save	Default	Restart cycle Terminate cycle Close

9.6. Long-term mode with adjustable length

- 3. Adjustment of duration of cycle phases
- 4. Definition of the cycle's start
- Definition of the cycle's duration in days (adjustable in range 1÷30) This mode work similar to monthly mode, but Measurement phase is shorter. Use with caution! Sensors require periodical ventilation for proper work!

Duration of cycle's phases -	hh	:mm:ss	Ends in	Work mode Long-term mode with adjustable length (1-30 days)
Phase: 'Ventilation' Phase: 'Infusion' Phase: 'First zeroing'	00:15	5:00 + 1:00 + 2:00 +		Description of the chosen mode 00:30:00 Time of the first zeroing 14.07.2016 Date of the first zeroing 1 Length of the cycle (in days 130)
Phase: 'Warm-up' AUX channel	00:16	5:00 ÷		Work cycle (in turns: measurement and zeroing) is repeated with the set interval. The first zeroing is performed in a given date and time, and repeated at the same time every period. Moreover, the zeroing is performed after warm-up phase and more the thermody de DC220. Extended the same tweether
				before the first zeroing.
Input IN1		Ir	nput IN2	can be inggered via K3232. Standoy phase occurs only before the first zeroing.
Input IN1 C No action Restart measurement cy C Terminate measurement The analyser restarts meas input is low (0V) for longer th cycle begins with Ventilation	rcle cycle urement cyc han 2 second i' phase.	le when the ds. The new	nput IN2	before the first zeroing.

9.7. Flip-flop mode for Twin-Split configuration

			Work mode
Full cycle time	hh:mm:ss	Ends in	Flip-flop for Twin Split configuration
Phase: 'Ventilation'	00:15:00		Description of the chosen mode
Phase: 'Infusion'	00:01:00		00:00:00 🔹 Time of the first zeroing
Phase: 'First zeroing'	00:02:00		
Phase: 'Measurement'	00:30:00 +		
'hase: 'Warm-up'	00:00:00		Device works cyclically, executing the following phases: "Ventilation', 'Measurement', 'Stand-by', according to settings in 'Duration of cycle's phases' section.
Input IN1 No action Restart measurement cy Terminate measurement The input does not affect me	cle cycle assurement cycle.		
		2 I	
0 1 2 3 4 56 7 8 9	5 6 7 8 9 10 101 12 13 14 156 17 18 19 201 22	11 12 13 1 12 13 1 23 24 2£6 27 28 29 33	4 15 16 17 18 19 20 21 22 23 0 1 32 33 34 386 37 38 39 48 142 43 44 486 47 48 49 561 52 53

Flip-flop mode is designed for Twin-split configuration. In this work mode Ventilation phase occurs only every N-measurement phases (depends on the set times). When time of Measurement-A finishes, instead of going into Ventilation, analyser continues with Measurement-B. It is advised to set the Measurement time to short period (5÷10min).

Every Measurement phase is preceded with infusion time (non-adjustable, 60 sec).

9.8. Preview of analyser's work status



- 1. Animated presentation of gas flow through the analyser
- 2. Information how much time is left until the end of the current work phase
- 3. Information on the current work phase
- 4. Time marker; changes the colour according to the current work phase

10. 📥 ANALOGUE OUTPUTS

- 1. All available analogue outputs in analyser divided into 8 tabs: 4x voltage (U1÷U4) and 4x current (I1÷I4)
- 2. Summary on all analogue outputs: assigned value and min, max values for output
- 3. Adjustment of selected output:
 - a) Y axis:
 - Specify the minimum _____(for current output)
 - or maximum range for voltage output: 5/10
 - b) X axis:
 - Assign the value to represent on a selected analogue output: x = 02
 - Assign minimum from sensor / calculated value to the output's minimum e.g. 1%
 - Assign maximum from sensor / calculated value to the output's maximum e.g. 10%
- 4. Visualisation which terminals refer to the selected output
- 5. Button that enables test signal (output's mid-range value) allows to verify if the cables are properly connected.
- 6. Definition of the outputs' behaviour these settings apply to all outputs:
 - a) During Ventilation
 - Continue measurements values will be slowly drop to zero when ventilating (in case of O2 sensor will rise to 20,95%). After Ventilation, when process gas will reach start to reach sensors, the results will also start o to rise.
 - Latch the last measured value to avoid above said, it is possible to "remember" the last measured values and keep them on analogue outputs until Ventilation is over.
 - b) During standby
 - Set to minimum user's system may be informed that mamos is ventilating, by setting all outputs to minimum
 - Set to maximum user's system may be informed that mamos is ventilating, by setting all outputs to
 maximum
- 7. For the Twin-Split configuration odd outputs (U1,I1, U3, I3) are assigned to measurement place A, while even ones (U2, I2, U4, I4) are assigned to measurement place B. User can specify how "place A" outputs will behave when measurements are taken from the "place B" and vice versa:
 - always active (= Continue measurements for Ventilation phase)
 - keep the last value (latch)



- c) When error occurs
 - Only two possibilities are available. User can inform own system be setting all outputs to minimum or to maximum
 - go to max
 - go to min

11. 🖤 RELAYS AND DIGITAL OUTPUTS

Mamos analyser is by default equipped with 2x open drain digital outputs (Relay #3 and Relays #4). Relay #4 is fully controlled via MODBUS communication.

Optionally, mamos can be equipped with 2x SPDT relays (Relay #1 and Relay #2).

Relays #1, #2, #3 are configurable via PC program:

- 1. Available relays, divided into 3 tabs
- 2. Summary on all relays: selected mode (20), assigned value and current status (ON / OFF)
- 3. Visualisation which terminals refer to the selected relay
- 4. Button that enables test relay allows to verify if the cables are properly connected.
- 5. Mode for relay output:
 - a) Controlled by analogue output used for alarm setting see point 20 below
 - b) Follow digital input IN1 / IN2 mimics action on digital inputs transfers this signal further
 - c) Follow Measurements phase informs user's application when mamos performs measurements. In other phases, like Ventilation or Stand-by, relay is OFF
 - d) Flow control ON when flow is within acceptable range. OFF when flow drops below threshold value (see chapter 9)
 - e) ON during odd / even cycles informs user's system about the sampling point (for Twin-Split configuration)
 - f) No action
- 6. Relay may work as an alarm, if its mode is set to "controlled by analogue output". Then user can specify:
 - a) source of alarm by selecting appropriate output from drop-down list (Relay's mode (20)) Because relay may work with hysteresis, both ON and OFF thresholds are assigned:
 - b) Alarm's ON level; expressed as % of the corresponding analogue output's range in this example 60% of U1 output \rightarrow 6,4% of O₂ (shown on X axis 6d) 60% of outputs range = 60% (max-min) + level assigned to output's min.= 60% × (10% of O₂ 1% of O₂) + 1% of O₂ = 60% × 9% of O₂ + 1% of O₂ = (5,4% + 1%) Of O₂ = 6,4% of O₂
 - c) Alarm's OFF level; 40% of U1 output (6e)

40% of outputs range = 40% (max-min) + level assigned to output's min.= 40% × (10% of $O_2 - 1\%$ of $O_2 + 1\%$ of $O_2 = 40\%$ × 9% of $O_2 + 1\%$ of $O_2 = (3,6\% + 1\%)$ Of $O_2 = 4,6\%$ of O

