

# MODBUS RTU / TCP for MD4plus module manual v.1.0.1

2022-09

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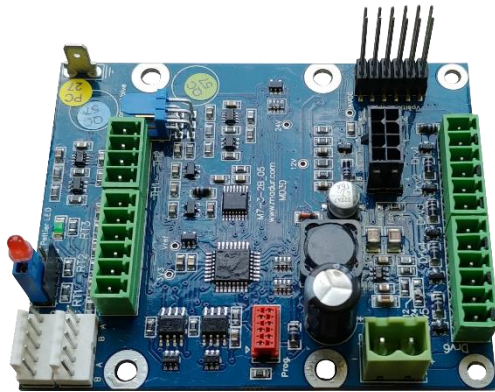
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## 1. Basic connection data

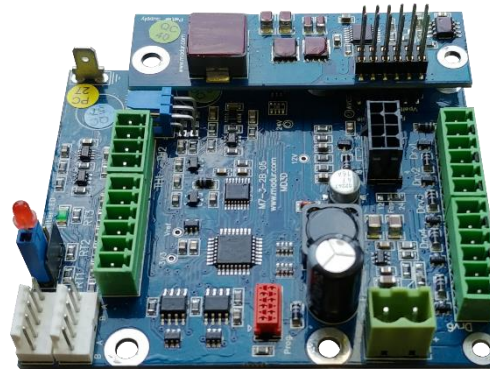
### 1.1. MD4Plus module

MD4plus module is a universal platform that supports various madur equipment: MD4 gas dryer, Stationary pitot tube, Heated line, etc.

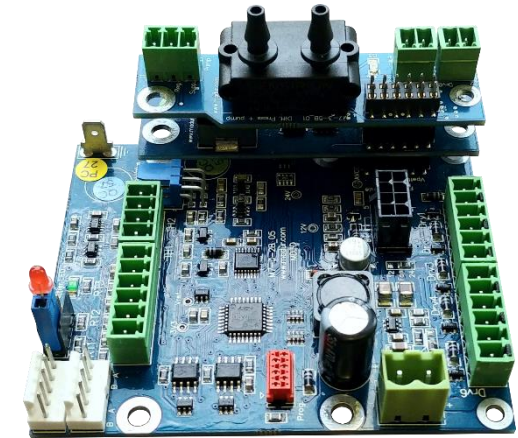
Mainly these devices are dependent on (mamos) gas analyser and mamos communicates and controls all subordinate equipment. However, in certain cases MD4plus module may work as a standalone device, and in such situations it is possible to interact with module using MODBUS-RTU protocol.



MD4Plus module – base PCB

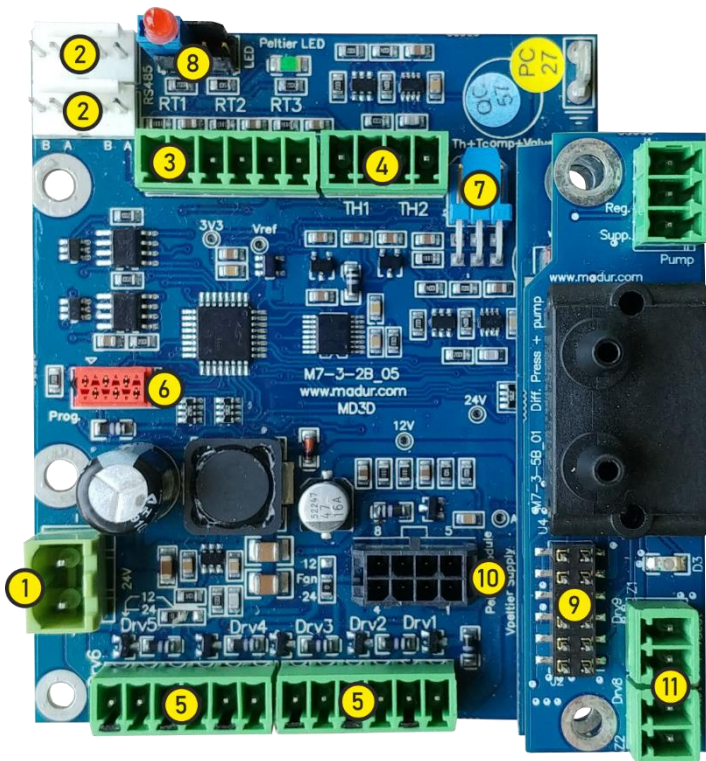


MD4Plus + dryer's extension



MD4Plus + dryer's and Pitot tube's extensions

## 1.2. MD4plus construction



1. 24VDC supply connector
2. 2x RS485 (MODBUS) communication connector. Pins, left to right:  
B,A – madur internal (service) communication. **MODBUS communication.**  
GND  
B,A – communication with gas analyser and other components.
3. RT1÷RT3 – resistance thermometers (PT500 / PT100, NTC, etc.)
4. TH1÷TH2 – thermocouples
5. External devices (to some extent configurable via software, initially defined by madur):  
Drv1 – heated filter / probe heater  
Drv2 – heated hose  
Drv3 – IP55 fan / AC module  
Drv4 – probe's blowback cleaning valve / Ventilation valve  
Drv5 – peristaltic pump (12VDC or 24VDC)  
Drv6 – cooler fan (12VDC or 24VDC)
6. Programming connector
7. "PROBE" connector in MD3 dryer
8. Information LEDs
9. 12pin BUS to connect MD4plus extension modules
10. MD3 connector:  
Pitot's tube drivers:  
Drv8 – Pitot tube zeroing pins  
Drv9 – Vacant

### 1.3. MODBUS RTU

Default address	194
Hardware standard	RS485
Frame format	RTU
Bit rate	9600 bps
Data bits	8
Parity bit type	E
Stop bits	1

## 2. General information about modbus

Modbus works based on master-slave relation between devices connected in the network, with one master device and all others working as slaves. Master is the only device that can ask questions, while all slaves can only answer. MD4plus module works in slave mode.

### 2.1. MODBUS RTU

Command in RTU format from master to slave	Answer message in RTU format from slave to master
<b>START BREAK</b> minimum of 3.5 x time for single character transmission	<b>START BREAK</b> minimum of 3.5 × time for single character transmission
<b>ADDRESS</b> of the receiver 1 byte value 0-240	<b>ADDRESS</b> of the slave device 1 byte value 0-240
<b>FUNCTION CODE</b> 1 byte indicates the function code	<b>FUNCTION CODE</b> 1 byte indicates the function code
<b>DATA REGION</b> n x 1 byte	<b>DATA REGION</b> n × 1 byte
<b>CRC</b> (checksum) 2 bytes	<b>DATA</b> n × 1 byte
<b>END BREAK</b>	<b>CRC</b> (checksum)

minimum of 3.5 x time for single character transmission

2 bytes

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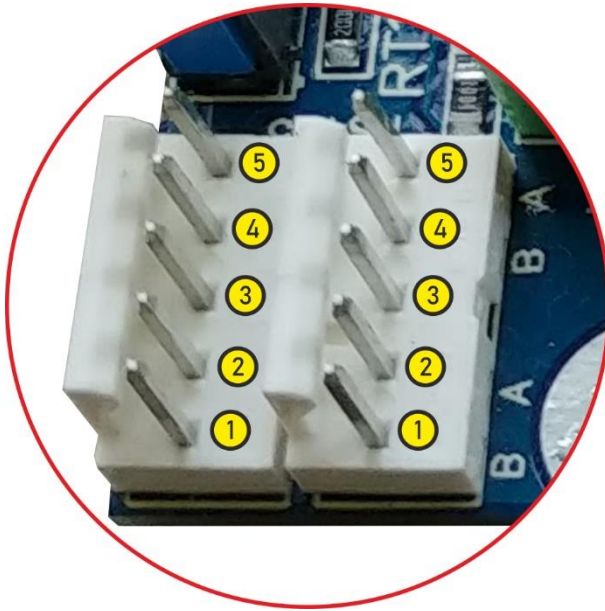
**END BREAK**

minimum of 3.5 × time for single character transmission

Maximal length of communicate (with address and CRC) – 256 bytes (**for mamos 128 bytes only**)

Silence longer than 1.5 characters resets the incoming buffer.

### 3. Modbus connection



Modbus RTU, terminal is located at one of the corners of MD4plus PCB. It is MOLEX KK-254, 5-pin male connector (22-23-2051), matching housing is MOLEX 22-01-3057.

There are two connectors, both with identical pins layouts. Allow to connect through and through. Pin layout is as follows:

1,2 – madur internal service communication. **MODBUS communication.**

3 – GND

4,5 – MD4plus internal communication (between modules and gas analyser)

## 4. Data type available via modbus:

### Coils (single bit)

read/write

command code: 1 (read coil status)/5 (force single coil)

addresses: 00001÷00016

### Discrete Input (single bit)

read only

command code 2 (read input status)

addresses: 10001-10021

### Holding registers (16-bit word)

read/write

command code: 3 (read holding register)/6 (pre-set single register)

addresses: 40001-40018

### Input registers (16-bit word)

read only

command code: 4 (read input register)

Addresses: 30001-30064

Maximal length of a message for MODBUS RTU (with address and CRC) for MD4plus module is **128 bytes**.

## 5. MODBUS MAP

### 5.1. Coils

Coils are customarily numbered from 0 (what corresponds to address 0).

Currently it is not planned to make adjustments to MD4 device via modbus, therefore the list of coils variables is empty.

This read/write one bit data is available via modbus under these codes:

**READ COILS**                      **Command: 1**

**WRITE SINGLE COIL**            **Command: 5**

Address	Name	Alt Name	Description
00001÷00016	COIL1÷COIL16	VACANT	For future use

## 5.2. Discrete inputs

Discrete Inputs are customarily numbered from 10001 (what corresponds to address 0).

This read only one bit data is available via modbus under these codes:

### READ DISCRETE INPUT

Command: 2

Address prefix for PLC	Name	Alt Name	Description
10001	Drv1		Status of Driver#1 1=ON 0=OFF
10002	Drv2		Status of Driver#2 1=ON 0=OFF
10003	Drv3		Status of Driver#3 1=ON 0=OFF
10004	Drv4		Status of Driver#4 1=ON 0=OFF
10005	Drv5		Status of Driver#5 1=ON 0=OFF
10006	Drv6	FanOn	Status of Driver#6 (Dryer's Fan) 1=ON 0=OFF
10007	Drv7		Status of Driver#7 1=ON 0=OFF
10008	Drv8	Pdif	Status of Driver#8 (Differential pressure sensor) 1=ON 0=OFF
10009	Drv9	Pump	Status of Driver#9 (Brushless pump) 1=ON 0=OFF
10010		PumpOn	Brushless pump steering 1=pump enabled 0=pump disabled
10011		IsPeltierSupply	Presence of peltier module (presence of gas dryer) 1=present 0=absent



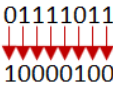
Address prefix for PLC	Name	Alt Name	Description
10012		IsSensiron	Presence of differential pressure sensor Pdif 1=present 0=absent
10013		IsDriver89	Presence of Driver 8 & 9 (Pdif+Pump PCB) 1=present 0=absent
10014		IsPump	Presence of brushless pump (Pdif+Pump PCB) 1=present 0=absent
10015		IsXTox	Presence of xTox module 1=present 0=absent
10016		PeltierBroken	Peltier module circuit probably open 1=circuit open (malfunction) 0=circuit closed (correct operation)
10017		TgasActive	Indicator that Tgas result should be broadcasted 1=broadcast result 0=result not available (module inactive / not installed)
10018		XTgas1Active	Indicator that xTgas1 result should be broadcasted 1=broadcast result 0=result not available (module inactive / not installed)
10019		XTgas2Active	Indicator that xTgas2 result should be broadcasted 1=broadcast result 0=result not available (module inactive / not installed)
10020		PdfiActive	Indicator that Pdif result should be broadcasted 1=broadcast result 0=result not available (module inactive / not installed)
10021		XToxActive	Indicator that xTox result should be broadcasted 1=broadcast result 0=result not available (module inactive / not installed)

### 5.3. Holding registers

Holding registers are customarily numbered from 40001 (what corresponds to address 0).

This read only two byte data is available via modbus under these codes:

**READ HOLDING REGISTERS**      **Command: 3**

Address prefix for PLC	Name	Alt Name	Description
			Address and anti-address coding in binary system.
40001		MSB – address MSB – anti-address Both for modbus and XSPI communication	123      address in decimal system 01111011      address in binary system  10000100      anti-address in binary system
40002	MBGetTargetTermostat1Temp	Target temperature for thermostat #1 [0.1°C]	
40003	MBGetTargetTermostat2Temp	Target temperature for thermostat #2 [0.1°C]	
40004	MBGetTargetTermostat3Temp	Target temperature for thermostat #3 [0.1°C]	
40005	MBGetTargetTermostat4Temp	Target temperature for thermostat #4 [0.1°C]	
40006	MBGetTargetTermostat5Temp	Target temperature for thermostat #5 [0.1°C]	
40007	MBGetTargetTermostat6Temp	Target temperature for thermostat #6 [0.1°C]	
40008	MBGetPPumpTimeR	Right rotation time for peristaltic pump [s]	Adding water to gas cooling chamber (water stabilisation)
40009	MBGetPPumpTimeL	Left rotation time for peristaltic pump [s]	Condensate removal
40010	MBGetHREmpty		
40011	MBGetBlowBackTime	Cleaning time [s] of probe's in-situ filter via Drv4	For blowback option with compressed air.
40012	MBGetPdifZeroingTime	Zeroing time for Pdif sensor (15..60s)	

Address prefix for PLC	Name	Alt Name	Description
40013	MBGetHRForcePhase	Force change of measurement phase (with confirmation)	0 = Idle – default phase for device without communication with mamos analyser, initial phase right after start-up 1 = Service 2 = Warming (for internal use only) 3 = Zeroing 4 = MeasuringA - measurements 5 = MeasuringB – for twin-split configuration measurement from place B 6 = Standby – device turns off its peripherals (e.g. peltier module, fan, peristaltic pump, etc.) 7 = for internal use only 8 = for internal use only
40014	MBGetHRForcePdifZeroing	Force zeroing of Pdif sensor	
40015	MBGetPabs4FlowOnStart	On-start atmospheric pressure for flow calculation [0,1hPa]	<a href="#">Flow velocity measurement is performed indirectly</a> by measuring static and complete pressures using Pitot's tube, complemented with measurement of gas temperature and atmospheric pressure (to calculate gas density). Pitot tube type S is equipped with Tgas sensor by default, atmospheric pressure sensor is external (installed in gas analyser, or provided separately.) It is possible to provide temperature and atmospheric pressure values from external device via modbus. To preserve Flash memory it is suggested to use registers 4017, 4018 for temporal use. And use registers 4015, 4016 occasionally to store default values (that MD4 device will load when powered on). Those default values may be also used when no Tgas and atmospheric pressure sensors are installed in MD4 system.
40016	MBGetTgas4FlowOnStart	On-start gas temperature [0,1°C]	
40017	MBGetPabs4Flow	Atmospheric pressure for flow calculation [0,1hPa] Value gets lost when device is powered down	
40018	MBGetTgas4Flow	Gas temperature for flow calculation [0,1°C] Value gets lost when device is powered down	

#### 5.4. Input registers

Input registers are customarily numbered from 30001 (what corresponds to address 0).

This read only two byte data is available via modbus under these codes:

**READ INPUT REGISTERS**

**Command: 4**

Address prefix for PLC	Name	Alt Name	Description
30001		MBGetlRTRt1	Temperature read from Rt1 thermometer [0,1°C]
30002		MBGetlRTRt2	Temperature read from Rt2 thermometer [0,1°C]
30003		MBGetlRTRt3	Temperature read from Rt3 thermometer [0,1°C]
30004		MBGetlRTthcpl1	Temperature read from Thcpl1 thermocouple [0,1°C]
30005		MBGetlRTthcpl2	Temperature read from Thcpl2 thermocouple [0,1°C]
30006		MBGetlRPdif	Pressure read from Pdif sensor [0,1Pa]
30007		MBGetlRTpdif	Temperature read from Pdif sensor [0,1°C]
30008		MBGetlRTcpu	Temperature read from CPU sensor [0,1°C]
30009		MBGetlRTRt10	Temperature read from Rt10 thermometer [0,1°C] Tcooler
30010		MBGetlRTRt11	Temperature read from Rt11 thermometer [0,1°C] Theatsink
30011		MBGetlRTRt12	Temperature read from Rt12 thermometer [0,1°C] TcompProbe
30012		MBGetlRlpeltier	Peltier's module current [0,1mA]
30013		MBGetlRTcasing	Housing temperature [0,1°C] Read from a selected sensor or Tcpu
30014		MBGetlRTcomp	Temperature for thermocouple's cold joint [0,1°C] Read from a selected sensor or Tcpu
30015		MBGetlRTthcpl1Rel	Temperature of Thcpl1 thermocouple excluding Tcomp [0,1°C]
30016		MBGetlRTthcpl2Rel	Temperature of Thcpl2 thermocouple excluding Tcomp [0,1°C]
30017		MBGetlRFlow	Linear gas flow velocity calculated by Pdif using Pitot tube
30018÷30030		VACANT	
30031		MBGetlRUnitDP_TRt1	Temperature read from Rt1 thermometer Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)

Address prefix for PLC	Name	Alt Name	Description
30032		MBGetIRUnitDP_TRt2	Temperature read from Rt2 thermometer Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30033		MBGetIRUnitDP_TRt3	Temperature read from Rt3 thermometer Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30034		MBGetIRUnitDP_Tthcpl1	Temperature read from Thcpl1 thermocouple Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30035		MBGetIRUnitDP_Tthcpl2	Temperature read from Thcpl2 thermocouple Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30036		MBGetIRUnitDP_Pdif	Pressure read from Pdif sensor Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30037		MBGetIRUnitDP_Tpdif	Temperature read from Pdif sensor Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30038		MBGetIRUnitDP_Tcpu	Temperature read from CPU sensor Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30039		MBGetIRUnitDP_TRt10	Temperature read from Rt10 thermometer Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30040		MBGetIRUnitDP_TRt11	Temperature read from Rt11 thermometer Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30041		MBGetIRUnitDP_TRt12	Temperature read from Rt12 thermometer Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30042		MBGetIRUnitDP_Ipeltier	Peltier's module current Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30043		MBGetIRUnitDP_Tcasing	Housing temperature Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30044		MBGetIRUnitDP_Tcomp	Temperature for thermocouple's cold joint Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30045		MBGetIRUnitDP_Tthcpl1Rel	Temperature of Thcpl1 thermocouple excluding Tcomp Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)

Address prefix for PLC	Name	Alt Name	Description
30046		MBGetIRUnitDP_Tthcpl2Rel	Temperature of Thcpl2 thermocouple excluding Tcomp Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30047		MBGetIRUnitDP_Flow	Linear gas flow velocity calculated by Pdif using Pitot tube Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30048÷30060		VACANT	
30061		MBGetIRMode	Module' current work mode
30062÷30064		VACANT	

## 6. Additional tables

### 6.1. Unit type code table for results presented on analyser's LCD

Value	Name	Unit	Value	Name	Unit
0	UnitPPM	ppm	10	UnitMS	m/s
1	UnitPROCENT	%	11	UnitmV	mV
2	UnitDEGC	°C	12	UnitV	V
3	UnitDEGF	°F	13	UnitmA	mA
4	UnitMGM3	mg/m <sup>3</sup>	14	UnitA	A
5	UnitGGJ	g/GJ	15	UnitNONE	–
6	UnitHPA	hPa	16	UnitGM3	g/m <sup>3</sup>
7	UnitPA	Pa	17	UnitLPH	l/h
8	UnitMMH2O	mmH <sub>2</sub> O	18	UnitUnknown	Unknown unit
9	UnitINH2O	inH <sub>2</sub> O			