



MODBUS RTU / TCP for MD4plus module manual v.1.1.0

2052-08

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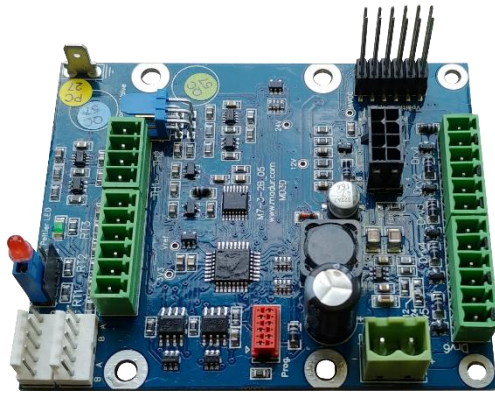
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1. Basic connection data

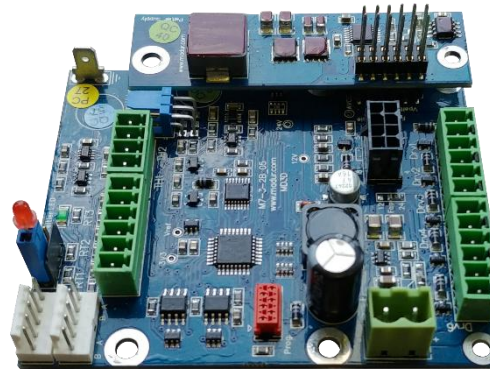
1.1. MD4Plus module

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

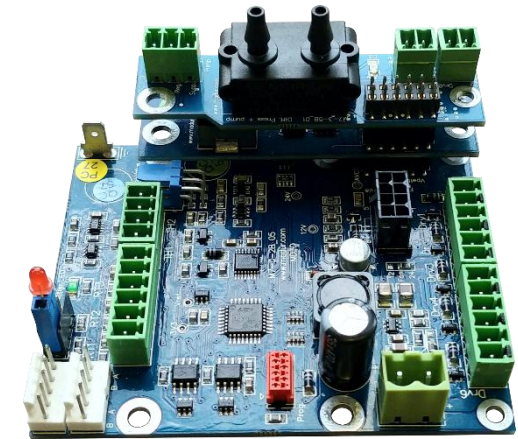
Mainly these devices are dependent on (mamos) gas analyser and mamos communicates and controls all subordinate equipment. However, in certain cases MD4plus module may work as a standalone device, and in such situations, it is possible to interact with module using MODBUS-RTU protocol.



MD4Plus module – base PCB

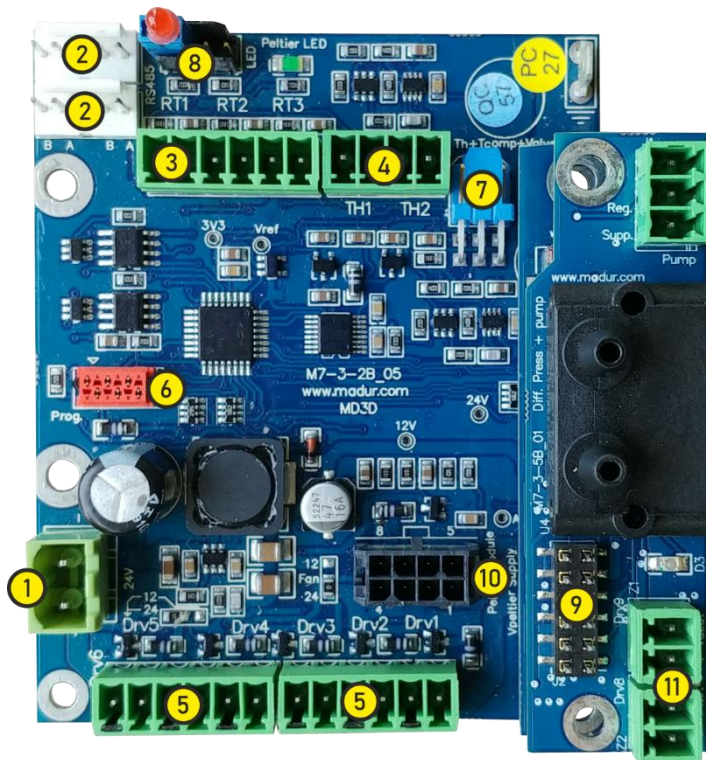


MD4Plus + dryer's extension



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
START BREAK minimum of 3.5 x time for single character transmission	START BREAK minimum of 3.5 × time for single character transmission
ADDRESS of the receiver 1 byte value 0-240	ADDRESS of the slave device 1 byte value 0-240
FUNCTION CODE 1 byte indicates the function code	FUNCTION CODE 1 byte indicates the function code
DATA REGION n x 1 byte	DATA REGION n × 1 byte
CRC (checksum) 2 bytes	DATA n × 1 byte
END BREAK	CRC (checksum)

minimum of 3.5 x time for single character transmission

2 bytes

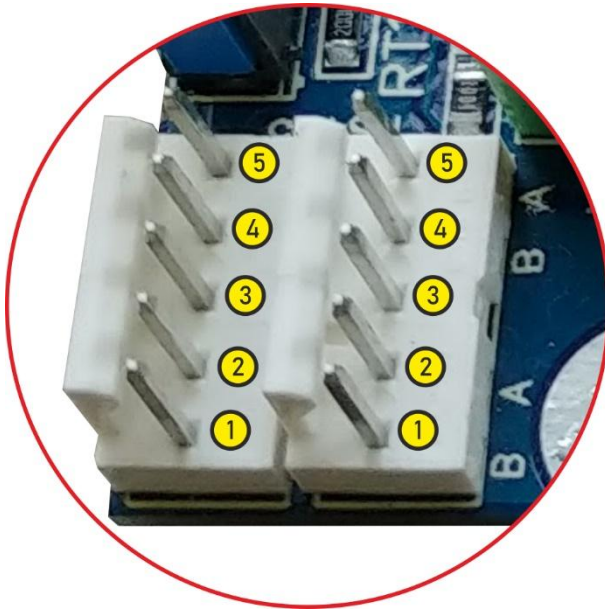
END BREAK

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).

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	COIL1	ForceBlowback	For use with the 3 rd party analyser	Sends an order to the gas probe to open the electromagnetic for the compressed air source. The valve remain open for a specific time (adjustable via PC software or Modbus holding register 40011 'BlowBackTime'), or until the 'StopBlowback' order is received.
00002	COIL2	StopBlowback	For use with the 3 rd party analyser	Terminates the ventilation of the gas probe = closes the electromagnetic valve on the gas probe
00003÷00016	COIL3÷COIL16	VACANT	For future use	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
10012		IsSensiron Presence of differential pressure sensor Pdif	1=present 0=absent

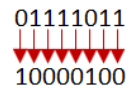
Address prefix for PLC	Name	Alt Name	Description
10013	IsDriver89	Presence of Driver 8 & 9 (Pdif+Pump PCB)	1=present 0=absent
10014	IsPump	Presence of brushless pump (Pdif+Pump PCB)	1=present 0=absent
10015	IsXTox	Presence of xTox module	1=present 0=absent
10016	PeltierBroken	Peltier module circuit probably 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)
10022	PabsActive	Indicator that Absolute pressure result should be broadcasted	1=broadcast result 0=result not available (module inactive / not installed)
10023	BlowBack	BlowBack phase indicator	1=Blowback phase in progress (probe's insitu filter is cleaned with the compressed air) 0=Blowback phase not active
10024	BBForcedByModbus	Indicator if the Blowback was initiated via modbus	1=Blowback phase initiated from the modbus 0=Blowback phase initiated from the mamos gas analyser

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	DeviceAddress	LSB – 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	TargetTermostat1Temp	Target temperature for thermostat #1 [0.1°C]	
40003	TargetTermostat2Temp	Target temperature for thermostat #2 [0.1°C]	
40004	TargetTermostat3Temp	Target temperature for thermostat #3 [0.1°C]	
40005	TargetTermostat4Temp	Target temperature for thermostat #4 [0.1°C]	
40006	TargetTermostat5Temp	Target temperature for thermostat #5 [0.1°C]	
40007	TargetTermostat6Temp	Target temperature for thermostat #6 [0.1°C]	
40008	PPumpTimeR	Right rotation time for peristaltic pump [s]	Adding water to gas cooling chamber (water stabilisation)
40009	PPumpTimeL	Left rotation time for peristaltic pump [s]	Condensate removal
40010	HREmpty		
40011	BlowBackTime	Cleaning time [s] of probe's in-situ filter via Drv4	For blowback option with compressed air.
40012	PdifZeroingTime	Zeroing time for Pdif sensor (15..60s)	

Address prefix for PLC	Name	Alt Name	Description
40013	HRForcePhase	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	HRForcePdifZeroing	Force zeroing of Pdif sensor	
40015	Pabs4FlowOnStart	On-start atmospheric pressure for flow calculation [0,1hPa]	Flow velocity measurement is performed indirectly by measuring static and complete pressures using Pitot's tube, complemented with measurement of gas temperature and atmospheric pressure (to calculate gas density).
40016	Tgas4FlowOnStart	On-start gas temperature [0,1°C]	Pitot tube type S is equipped with Tgas sensor by default, atmospheric pressure sensor is external (installed in gas analyser, or provided separately.)
40017	Pabs4Flow	Atmospheric pressure for flow calculation [0,1hPa] Value gets lost when device is powered down	It is possible to provide temperature and atmospheric pressure values from external device via modbus.
40018	Tgas4Flow	Gas temperature for flow calculation [0,1°C] Value gets lost when device is powered down	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.

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		IRTRt1	Temperature read from Rt1 thermometer [0,1°C]	
30002		IRTRt2	Temperature read from Rt2 thermometer [0,1°C]	
30003		IRTRt3	Temperature read from Rt3 thermometer [0,1°C]	
30004		IRTthcpl1	Temperature read from Thcpl1 thermocouple [0,1°C]	
30005		IRTthcpl2	Temperature read from Thcpl2 thermocouple [0,1°C]	
30006		IRPdif	Pressure read from Pdif sensor [0,1Pa]	
30007		IRTpdif	Temperature read from Pdif sensor [0,1°C]	
30008		IRTcpu	Temperature read from CPU sensor [0,1°C]	
30009		IRTRt10	Temperature read from Rt10 thermometer [0,1°C]	Tcooler
30010		IRTRt11	Temperature read from Rt11 thermometer [0,1°C]	Theatsink
30011		IRTRt12	Temperature read from Rt12 thermometer [0,1°C]	TcompProbe
30012		IRIptier	Peltier's module current [0,1mA]	
30013		IRTcasing	Housing temperature [0,1°C]	Read from a selected sensor or Tcpu
30014		IRTcomp	Temperature for thermocouple's cold joint [0,1°C]	Read from a selected sensor or Tcpu
30015		IRTthcpl1Rel	Temperature of Thcpl1 thermocouple excluding Tcomp [0,1°C]	
30016		IRTthcpl2Rel	Temperature of Thcpl2 thermocouple excluding Tcomp [0,1°C]	
30017		IRFlow	Linear gas flow velocity calculated by Pdif using Pitot tube	
30018		IRTgas	Temperature read from Tgas thermocouple [0,1°C]	Gas temperature read by gas probe via one of the dedicated Tgas connectors (installed in the analyser or one of the gas dryers). If there are more than one Tgas connectors in use, then each of them should have assigned a unique label (Tgas÷Tgas4). Labels can be assigned via dedicated madur PC software
30019		IRXTgas1	Temperature read from Tgas1 thermocouple [0,1°C]	
30020		IRXTgas2	Temperature read from Tgas2 thermocouple [0,1°C]	
30021		IRXTgas3	Temperature read from Tgas3 thermocouple [0,1°C]	

Address prefix for PLC	Name	Alt Name	Description
30022	IRXTgas4	Temperature read from Tgas4 thermocouple [0,1°C]	called MaMoS_peripherals_Setup
30023÷30029	VACANT		
30030	IRBlowBackTimer	Timer counting how long Blowback option has been enabled	Counter counts from zero.
30031	IRUnitDP_TRt1	Temperature read from Rt1 thermometer	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30032	IRUnitDP_TRt2	Temperature read from Rt2 thermometer	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30033	IRUnitDP_TRt3	Temperature read from Rt3 thermometer	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30034	IRUnitDP_Tthcpl1	Temperature read from Thcpl1 thermocouple	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30035	IRUnitDP_Tthcpl2	Temperature read from Thcpl2 thermocouple	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30036	IRUnitDP_Pdif	Pressure read from Pdif sensor	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30037	IRUnitDP_Tpdif	Temperature read from Pdif sensor	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30038	IRUnitDP_Tcpu	Temperature read from CPU sensor	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30039	IRUnitDP_TRt10	Temperature read from Rt10 thermometer	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30040	IRUnitDP_TRt11	Temperature read from Rt11 thermometer	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30041	IRUnitDP_TRt12	Temperature read from Rt12 thermometer	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30042	IRUnitDP_Ipeltier	Peltier's module current	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30043	IRUnitDP_Tcasing	Housing temperature	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)

Address prefix for PLC	Name	Alt Name	Description	
30044		IRUnitDP_Tcomp	Temperature for thermocouple's cold joint Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)	
30045		IRUnitDP_Tthcpl1Rel	Temperature of Thcpl1 thermocouple excluding Tcomp Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)	
30046		IRUnitDP_Tthcpl2Rel	Temperature of Thcpl2 thermocouple excluding Tcomp Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)	
30047		IRUnitDP_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		IRUnitDP_Tgas	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)	
30049		IRUnitDP_XTgas1	Gas temperature read by gas probe via one of the dedicated Tgas connectors (installed in the analyser or one of the gas dryers). Labeled Tgas, XTgas1÷XTgas4	Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30050		IRUnitDP_XTgas2		Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30051		IRUnitDP_XTgas3		Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30052		IRUnitDP_XTgas4		Unit code (MS byte) and precision point (LS byte) (unit type code description in tables below)
30053÷30060		VACANT		
30061		IRMode	Returns information about the current work phase 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.)	
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	11	UnitmV	mV
1	UnitPROCENT	%	12	UnitV	V
2	UnitDEGC	°C	13	UnitmA	mA
3	UnitDEGF	°F	14	UnitA	A
4	UnitMGM3	mg/m ³	15	UnitNONE	_ (dimensionless)
5	UnitGGJ	g/GJ	16	UnitGM3	g/m ³
6	UnitHPA	hPa	17	UnitLPH	l/h
7	UnitPA	Pa	18	UnitM3pH	m ³ /h
8	UnitMMH2O	mmH ₂ O	19	UnitKGpH	kg/h
9	UnitINH2O	inH ₂ O	20	UnitMJM3	MJ/m ³
10	UnitMS	m/s			