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aMotion

Modbus communication - RD5 , aMotion

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1. Content and basic information

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Table of Contents

1.1 Purpose of the document

Description of communication and control range of DUPLEX series air handling units equipped with **RD5** or **aMotion** control using Modbus protocol.
The resolution of the type of the fitted control is the subject of chap. 2.

1.2 The purpose of communication with DUPLEX HVAC units

The modbus protocol provides the appropriate group of registers for normal control of the unit but also for setting some parameters affecting the behaviour of the HVAC unit.
Modbus communication with the air handling unit is one of the possible interfaces used to control the air handling unit, such as a connected controller or a user-operated web page of the air handling unit.

It is not recommended to interfere with the service parameter settings using the modbus protocol, although some unit types allow this in conjunction with the type of control fitted.

The recommended use of the modbus protocol in connection with DUPLEX air handling units should be limited to the normal control of the air handling unit.

What can be considered as normal control of the HVAC unit:

- Control of the required ventilation/circulation power
- Control of the desired temperature
- Control of the desired mode of operation (ventilation, circulation, etc.)
- Control of the desired zone
- Monitoring temperature sensors
- Monitoring the operation of individual elements (fans, dampers, heaters, cooler, etc.)
- Monitor unit statuses (alarms, alerts, etc.)
- Outdoor or indoor air temperature entry

1.3 Method of communication

A DUPLEX series air handling unit equipped with RD5 or aMotion control always has an Etherenet port for external communication, which can also be used for Modbus communication.
Due to the physical interface used, the **Modbus TCP** protocol can be used.
The HVAC unit is operating in **SLAVE** (server) mode on the port.

The Modbus address of the device is not differentiated, i.e. the HVAC unit responds to any request from a Modbus client that is addressed to an address different from address 0.

Details for communication settings:

Communication port: TCP 502

Address for ModBus: any value 1-255

Addressing of registries.

- Coils ~ #000001 to #065536
- Discrete input ~ #100001 to #165536
- Input register ~ #300001 to #365536
- Holding register ~ #400001 to #465536

Note for RD5 control:
When writing or reading multiple indexes in one batch, maintain at least a 5 s interval between sessions.

Notice for aMotion control:
The number of relations for reading and writting is limited to 30 during 30 s, no matter, whether the number of relation takes place within 5s or 20s. Following relations over the maximal limit are answered in the next 30s.

Command notation:
It is not necessary to repeat the entry of values into the control parameters periodically, unless another value is required. By writing the value, the value is applied and remembered.

2. HVAC type differentiation

Depending on the type of the installed control and the configuration of the unit is

To set up the communication correctly, it is necessary on the part of the communication implementer:

1) Determine the type of regulation installed in the DUPLEX air handling unit
2) Verify that Modbus communication is enabled on the HVAC unit
3) Verify the unit configuration; the unit configuration affects the range of use of each modbus address and the range of values set or read

The individual points can be done as described in the chapters below

2.1 Recognition of control type

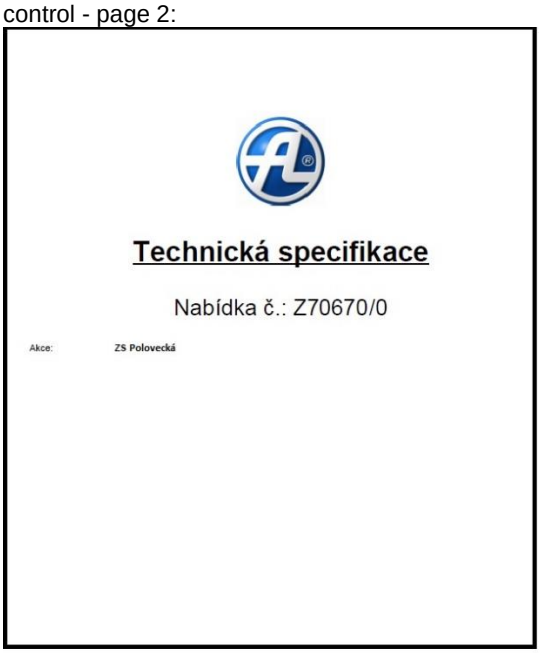
The type of regulation can be determined in several ways:

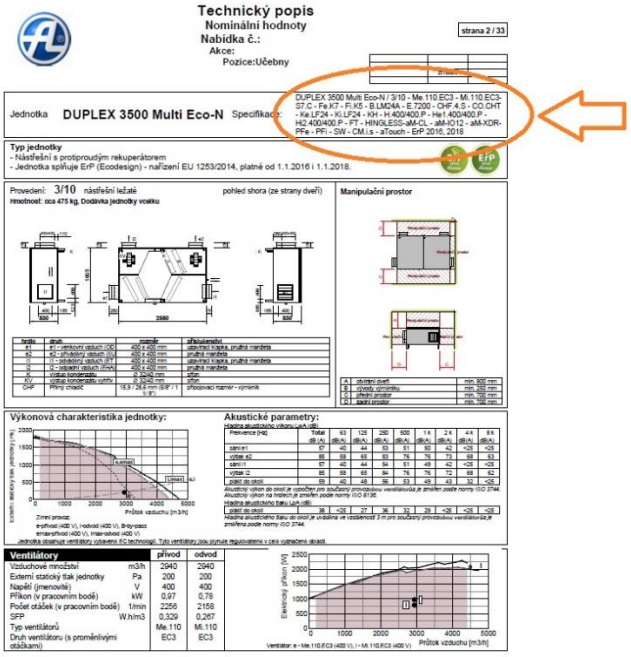
1) Documentation and label of the HVAC unit
2) Design of HW control installed in the unit
3) Type of controller connected to the HVAC unit
4) User interface (web) of the air handling unit
5) Specific value of selected Modbus indices

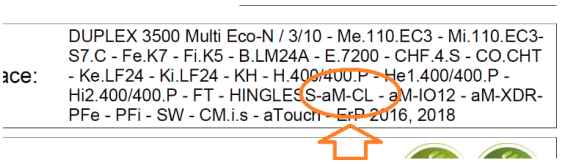
2.1.1 **Documentation and unit label**

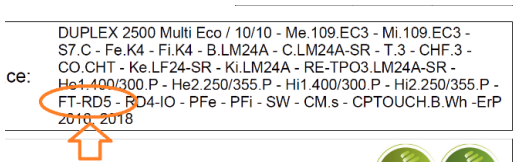
In the accompanying documentation for the HVAC unit, the type of control is indicated:

The technical specification of the supplied unit includes a description of the complete configuration of the unit including the type of control - page 2:









If the specification text contains:

- **aM-CL** or **aM-CE**, the air handling unit includes **aMotion** type control
- **RD5**, HVAC unit includes **RD5** type control

A similar specification is also included on the label of the air handling unit:

2.1.2 Design of HW control installed in the unit

RD5 and aMotion regulations differ fundamentally in the form of the motherboard. To check, you need to open the wiring and control cabinet.

Motherboard design:

RD5 - RD5int board

aMotion - aM-CL board

2.1.3 Type of controller connected to the HVAC unit

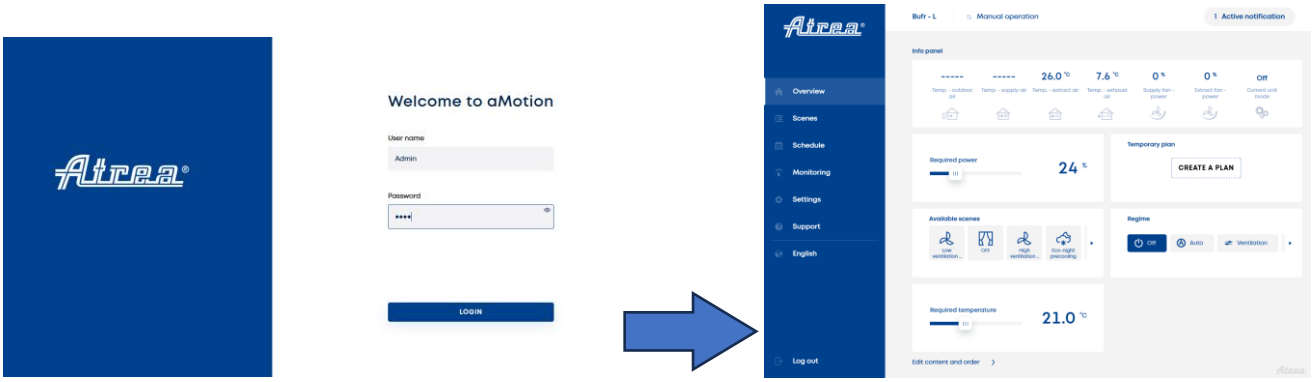
CP-Touch controller for **RD5** control:

aTouch touch controller and a simplified **aDot** controller for **aMotion** control:

2.1.4 User interface (web) of the air handling unit

Web for **RD5** control - login dialog and first page

Web for **aMotion** control - login dialog and first page



2.1.5 Specific value of selected Modbus indices

The RD5 control provides the current date and time of the HVAC unit on the INPUT indices below:

Index	Format	Meaning of
I 0x0004	rrrr	current year
I 0x0005	MM	current month
I 0x0006	Dd	current day
I 0x0007	hh	current hour
I 0x0008	mm	current minute
I 0x0009	ss	current second

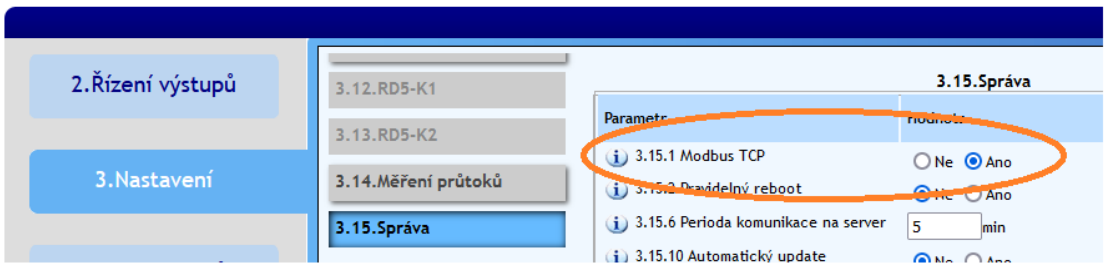
2.2 Enabling Modbus communication on the air handling unit

Modbus communication must be enabled on the HVAC unit. The communication is always disabled at the factory. Communication can be enabled via the web interface or by using the touchscreen controller

2.2.1 HVAC with RD5 control

Using the web interface, you need to go to the Service Setup. Enabling Modbus communication is done in the menu:

- 3. Settings / 3.15. Administration / **3.15.1 Modbus TCP**



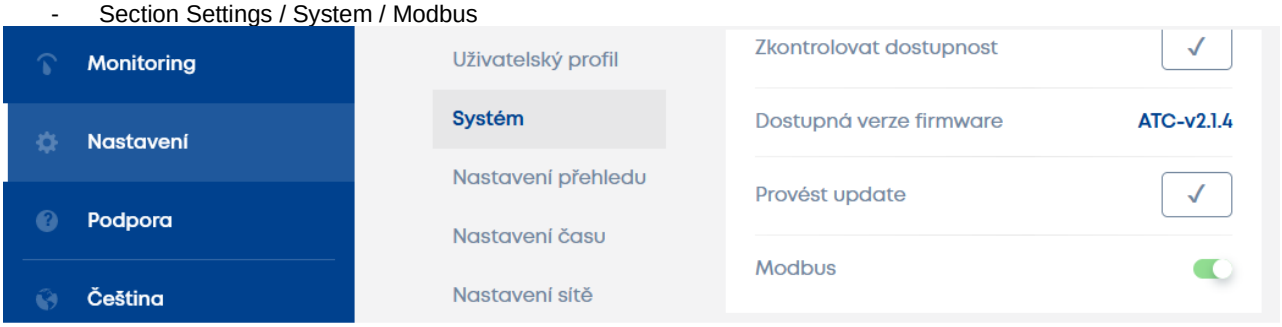
The setting of parameter 3.15.1 can also be done using the CP-Touch driver.

2.2.2 AHU with aMotion control

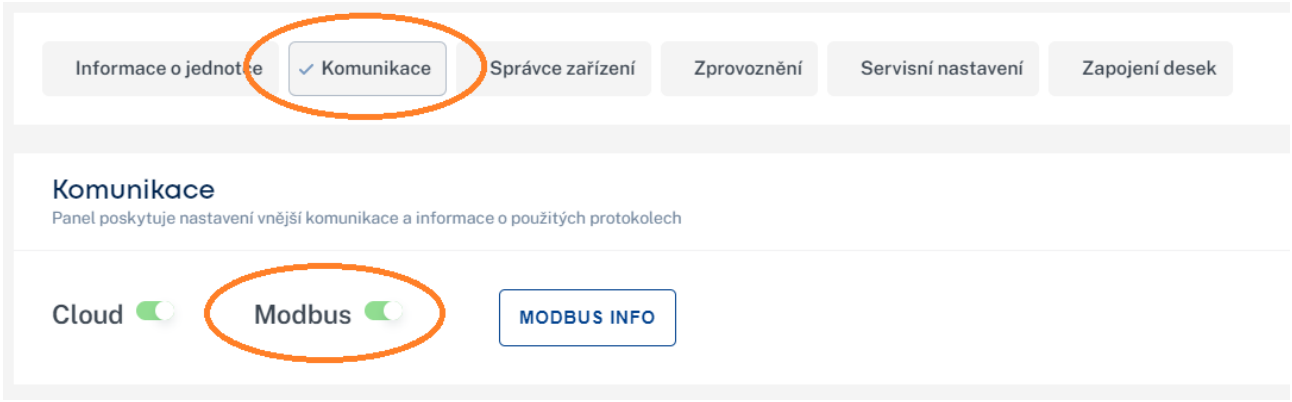
The Modbus communication can be set up on the user interface (web) or using the aTouch driver or the aTool service application. The aTool application can only be used by a technician with the appropriate certification from the manufacturer.

User interface and aTouch:

- Section Settings / System / Modbus



Service application aTool:



2.3 Verification of HVAC configuration

The use of some variables/indexes in the control and monitoring of the air handling unit depends on the configuration and settings of the air handling unit.

An important parameter affecting the use of indices is the way the fans are controlled. With the fan control method set, the range of values entered changes, or the group of indices used to set the desired ventilation capacity of the HVAC unit may also change - see ch. 3 section on the respective fan control method settings.

In chapters 2.3.1 and 2.3.2, indices containing information about the configuration of the HVAC unit are listed, which affect the use of other indices for monitoring and controlling the HVAC unit.
Each of the controls offers a different range of information about the unit configuration, but sufficient range for complete monitoring and control of the HVAC unit by Modbus protocol.

2.3.1 HVAC with RD5 control

The indices below reflect the current configuration of the HVAC unit in use, which is determined by the type of unit, its factory setting and the setting at commissioning**. The values of these indices must not be changed!**
The register list only pays for HVAC units with RD5 control.

HVAC unit configuration element	Index	Value	Meaning of
Method of fan control	Holding 10510	0	Direct fan speed control. Range of power control values: 12 to 100 (12 to 100% of speed relative to maximum speed)
		1	Costant flow control. Range of power control values: 1 to 100 (1 to 100% of measurable flow; 100% of the maximum operating flow of the unit type)
		2	Constant pressure control in the pipeline. Range of power control values: 0,1,2 (The set values correspond to the preset pressure level in the pipe: 0~off, 1~lower pressure, 2~higher pressure)
		3	Control by external source. Power control is done via analog inputs, writing to the power control index does not affect the value

		4	Costant flow control for multi-thickness units (polyport) The range of performance management values is enumerative - see Chapter 3 for a specific description.
HVAC orientation	Holding 10501	0	The supply fan is not designed - the **HVAC unit is not commissioned!**
		1	The supply fan is set to the M1 fan
		2	The supply fan is set to the M2 fan
Heater	Holding 10503	0-5	0~heater is not equipped, 1-5~some type of heater is set, see ch.3
Cooler	Holding 10507	0-2	0~heatsink is not fitted, 1,2~some type of heatsink is set, see ch.3
Type of temperature control	Holding 10515	0,1,2	Sensor control: 0 ~ in space/air, 1 ~ supply, 2 ~ automatic switching according to season
Circulation flap	Holding 11700	0,1	0~ circulation damper is not fitted, 1~ circulation damper is fitted

2.3.2 **AHU with aMotion control**

The indices below reflect the current configuration of the HVAC unit in use, which is determined by the type of unit, its factory setting and the setting at commissioning**.**
The register list is only valid for HVAC units with RD5 control. aMotion control does not allow changing any configuration parameter using the Modbus protocol.

HVAC unit configuration element	**Index**	**Value**	**Meaning of**
Method of fan control	Input 1201	0	Direct fan speed control. Range of power control values: 1 to 100 (1 to 100% of the permitted speed control range. The minimum and maximum are set by the technician when commissioning the HVAC unit)
		1	Constant pressure control in the pipeline. Range of power control values: 0,1,2 (The set values correspond to the preset pressure level in the pipe: 0~off, 1~lower pressure, 2~higher pressure)
		2	Costant flow control. Range of power control values: minimum to maximum value for a given HVAC unit. Min. and max. value in indices I1203 and I1202. Any value outside the min. to max. range is not accepted.
		3	Control by external source. Power control is done via analog inputs, writing to the power control index does not affect the value
		4	Direct fan speed control - each fan separately The fan control range is the same as for I1201=0, but each fan is controlled by a separate power requirement.
		5	Constant flow control - each fan separately The fan control range is the same as for I1201=2, but each fan is controlled by a separate flow requirement.
Max. adjustable flow rate	Input 1202	-	The value corresponds to the given type of HVAC unit. The value conversion coefficient is 0.1, i.e. e.g. the value 230 on this index expresses the maximum value of the adjustable flow rate is 2300m3/h.
Min. adjustable flow rate	Input 1203	-	The value corresponds to the given type of HVAC unit. The value conversion coefficient is 0.1, i.e. e.g. the value 20 on this index expresses the maximum value of the adjustable flow rate is 200m3/h.
Circulation flap control method	Input 1205	0-4	0~circulation cup not fitted, 1~ ON/OFF, 2~Eco, 3~Comfort, 4~Adjustable position
Bypass flap control method	Input 1206	0-2	0~ Bypass flap not fitted, 1~ Controlled from user interface, 2~ Automatically according to temperatures

3. Index table selection

The following chapters list groups of indices that can be used for monitoring the operation of the HVAC unit and for its normal control.

Abbreviations used:
C ~ coil register, D ~ discrete register, I ~ input register, H ~ holding register

3.1 RD5 regulation

3.1.1 Control of the air handling unit

Control parameters - current request values

Index	Variable function	Scope	Transfer function/enumeration
H10704	Required performance	0-100	according to the table "Performance"
H10705	Desired mode	0-7	0 = Off, 1 = Automatic, 2 = Ventilation, 3 = Circulation with Ventilation, 4 = Circulation, 5 = Night Precooling, 6 = Balancing, 7 = Overpressure
H10706	Required temperature	100-400	10-40°C
H10707	Required zone	0,1,2	0 = zone 1, 1 = zone 2, 2 = zone 1+2
I11401	Current season	0,1	0 = heating season, 1 = non-heating season

Control parameters - write requirements

Index	Variable function	Scope	Transfer function/enumeration
H10708	Required performance	0-100	according to the table "Performance"
H10709	Desired mode	0-7	0 = Off, 1 = Automatic, 2 = Ventilation, 3 = Circulation with Ventilation, 4 = Circulation, 5 = Night Precooling, 6 = Balancing, 7 = Overpressure
H10710	Required temperature	100-400	10-40°C
H10711	Required zone	0,1,2	0 = zone 1, 1 = zone 2, 2 = zone 1+2
H11401	Current season	0-3	0 = heating season, 1 = non-heating season, 2 = auotmatic change, 3 = automatic change + heat gain

Required performance

Fan control	Fan control description	R/W performance indices	Value	Transfer function/enumeration
H10510=0	Direct management	H10704/H10708	0	Off
			12-100	Power 12..100%
H10510=1	Constant flow	H10704/H10708	0	Off
			1..100	1..100 minimum to maximum flow rate depending on unit type
H10510=2	Constant pressure	H10704/H10708	0	Off
			1, 2	1~ lower pressure, 2~ higher pressure
H10510=3	by IN1 / IN2	H10704, read only	0	Off
			12-100	Power 12..100%
H10510=4	Constant flow for R_5 series units	H10704/H10708	0	Off
			10	Min - Ventilation
			11	Norm - Ventilation
			12	Max - Ventilation
			20	Min - Circulation
			21	Norm - Circulation
			22	Max - Circulation
			30	Min/Min (circulation power/ ventilation power)
			31	Min/Norm (circulation power/ventilation power)
			32	Min/Max (circulation power/ventilation power)
			33	Norm/Min (circulation power/ ventilation power)
			34	Norm/Norm (circulation power/ventilation power)
			35	Norm/Max (circulation power/ventilation power)
			36	Max/Min (circulation power/ventilation power)
			37	Max/Norm (circulation power/ventilation power)
			38	Max/Max (circulation power/ventilation power)

Relation to the weekly program running on the HVAC unit
The HVAC unit can be controlled by commands from the controllers, i.e. by manual intervention, which is valid until the next change made on the controller or on another user interface, or it can be operated according to its own weekly program, which automatically sets the values of control parameters according to time.
During control according to the weekly program, an intervention can be made to a control parameter and in order for the change to take effect, it is necessary to make an entry in the indexes that represent control in manual operation or in operation according to the weekly program according to the following rules:

Management	Parameter	Reading	Minutes	Status
Desired mode	Manual H10701 = 0	H10705	H10709	-
	Weekly program / Temporary H10701 = 1 / 2	H10705	H10709	required entry H10701 = 2
Required performance	Manual H10700 = 0	H10704	H10708	-
	Weekly programme / Temporary H10700 = 1 / 2	H10704	H10708	required entry H10700 = 2
Required temperature	Manual H10702 = 0	H10706	H10710	-
	Weekly programme / Temporary H10702 = 1 / 2	H10706	H10710	required entry H10702 = 2
Required zone	Manual H10703 = 0	H10707	H10711	-
	Weekly programme / Temporary H10703 = 1 / 2	H10707	H10711	required entry H10703 = 2

Recommendation:
For control from BMS it is better to operate Manual control mode, i.e. H10700 to H10703=0

Desired mode of operation of the unit
Some of the operating modes can only be requested if the AHU has the appropriate equipment or if the unit has the appropriate type. You must always follow the rules in the following table:

Index	Meaning of	Value	When the value can be used
H10705, H10709	Off	0	No restrictions
	Automat	1	C10508=0
	Ventilation	2	No restrictions
	Circulation with ventilation	3	C10508=0, C10509=1
	Circulation	4	C10508=0, H11700=1
	Night Pre-Cold	5	I11401=1
	Balancing	6	C10508=0
	Overpressure	7	C10508=0

Indoor and outdoor temperature recordable
If the parent control system contains information about the outdoor air temperature (T-ODA) or indoor air temperature (T-IDA), this data can be used to control the ventilation unit (HVAC). The following indices are used to send temperature values. The value needs to be refreshed periodically, if the value is not sent to the corresponding indices for more than 90s, the HVAC declares a temperature sensor fault where the data is missing.

Index	Variable function	Scope	Transfer function/enumeration
C10510	T-ODA measurement source setting	0/1	0 ~ internal HVAC sensor, 1 ~ data from BMS (Modbus)
H10213	Index for writing T-ODA from BMS	0..65535	65036 ~ -50.0°C ..65535 ~ -0.1°C 1..1300 ~ 0.1..130.0°C
H10514	T-IDA measurement source setting	0..3	0 = CP, 1 = T-ETA, 2 = TRKn, 3 = BMS(Modbus)
H10214	Index for writing T-IDA from BMS	0..65535	65036 ~ -50.0°C ..65535 ~ -0.1°C, 1..1300 ~ 0.1..130.0°C

3.1.2 **Measured values, traffic monitoring**

Controlled elements of the HVAC unit configuration

Index	Item	Value, description
H10200	M1 fan	When H10200 > 1000 the fan runs (1000 ~ 1V)
H10201	M2 fan	When H10201 > 1000 the fan runs (1000 ~ 1V)
C10200	Water heater	Heating water pump runs if C10200 = 1
C10201	Valve for water heating.	The heating water valve is open if C10201 = 1
H10203	Regulation of the heater	Heating (water or electric) is active if H10203 > 0
C10215	Heating signal	Heat pump heats if C10215 = 1
C10216	TC signal cooling	Heat pump cools if C10216 = 1
H10207	TC control	Heat pump runs if H10207 > 0

Measured temperatures of the air handling unit

Index	Item	Description of the measured temperature	Value, description
I10211	T-ODA	Outdoor air temperature	65036 ~ -50.0°C ..65535 ~ -0.1°C, 1..1300 ~ 0.1..130.0°C
I10212	T-SUP	Supply air temperature	
I10213	T-ETA	Exhaust air temperature	
I10214	T-EHA	Waste air temperature	
I10215	T-IDA	Indoor air temperature	

Flow measurement:

- Some HVAC units are equipped with metering and controlled air flow

Index	Item	Value, description
I11600	Required supply flow (SUP)	0 ~ 0 m3/h ... 15000 ~ 15000 m3/h
I11601	Required exhaust flow rate (ETA)	
I11602	Current supply flow (SUP)	
I11603	Current exhaust flow rate (ETA)	
I11604	Required fresh air flow (for R_5 only)	
I11605	Current fresh air flow (only for R_5)	

3.1.3 **Alarms and warnings**

Index	Description	Alarm / Warning	Scope	Meaning of
D11100	Overheating of the unit	A	0/1	Inactive/Active
D11101	Unset orientation	A	0/1	Inactive/Active
D11102	Not set heater type	A	0/1	Inactive/Active
D11103	2. frost protection	A	0/1	Inactive/Active
D11104	STP contact active	A	0/1	Inactive/Active
D11105	DP1 pressure gauge failure	A	0/1	Inactive/Active
D11106	DP2 pressure gauge failure	A	0/1	Inactive/Active
D11107	TU1 sensor failure	A	0/1	OK/Failure
D11108	TU2 sensor failure	A	0/1	OK/Failure
D11109	TEa sensor failure	A	0/1	OK/Failure
D11110	TEb sensor failure	A	0/1	OK/Failure
D11111	TA2 sensor failure	A	0/1	OK/Failure
D11112	Communication failure with RD-IO	A	0/1	OK/Failure
D11114	Unbalanced flow	A	0/1	Inactive/Active
D11115	1. frost protection	A	0/1	Inactive/Active
D11116	Sensor failure in the interior	A	0/1	Inactive/Active

D11117	Recuperator frost	U	0/1	OK/Freeze
D11118	Defrosting of the recuperator	U	0/1	Inactive/Active
D11119	High tariff	U	0/1	Inactive/Active
D11120	Insufficient flow	U	0/1	Inactive/Active
D11121	Insufficient primary heating performance	U	0/1	Inactive/Active
D11122	Clogged filter	U	0/1	Inactive/Active
D11123	Failure of AI input IN1	U	0/1	Inactive/Active
D11124	Failure of AI input IN2	U	0/1	Inactive/Active
D11125	Failure of AI input INk1/1	U	0/1	Inactive/Active
D11126	Failure of AI input INk2/1	U	0/1	Inactive/Active
D11127	Failure of AI input INk3/1	U	0/1	Inactive/Active
D11128	Failure of AI input INk4/1	U	0/1	Inactive/Active
D11129	Failure of AI input INk1/2	U	0/1	Inactive/Active
D11130	Failure of AI input INk2/2	U	0/1	Inactive/Active
D11131	Failure of AI input INk3/2	U	0/1	Inactive/Active
D11132	Failure of AI input INk4/2	U	0/1	Inactive/Active
D11140	Unit is not operational	U	0/1	Inactive/Active
D11141	Missing configuration file	A	0/1	Inactive/Active
D11143	Insufficient preheating performance	A	0/1	Inactive/Active
D11144	Unauthorised combination of heaters	A	0/1	Inactive/Active
D11145	DP3 pressure gauge failure	A	0/1	Inactive/Active
D11146	External pressure gauge failure	A	0/1	Inactive/Active
D11147	RD5-K/1 module failure	A	0/1	Inactive/Active
D11148	RD5-K/2 module failure	A	0/1	Inactive/Active
D11149	Defrosting the CH	A	0/1	Inactive/Active
D11150	TRk1 sensor failure - Module adr.1	A	0/1	Inactive/Active
D11151	TRk2 sensor failure - Module adr.1	A	0/1	Inactive/Active
D11152	TRk3 sensor failure - Module adr.1	A	0/1	Inactive/Active
D11153	TRk4 sensor failure - Module adr.1	A	0/1	Inactive/Active
D11154	TRk5 sensor failure - Module adr.1	A	0/1	Inactive/Active
D11155	TRk1 sensor failure - Module adr.2	A	0/1	Inactive/Active
D11156	TRk2 sensor failure - Module adr.2	A	0/1	Inactive/Active
D11157	TRk3 sensor failure - Module adr.2	A	0/1	Inactive/Active
D11158	TRk4 sensor failure - Module adr.2	A	0/1	Inactive/Active
D11159	TRk5 sensor failure - Module adr.2	A	0/1	Inactive/Active
D11160	Update in progress	U	0/1	Inactive/Active
D11162	Unauthorised cooling configuration	A	0/1	Inactive/Active
D11165	Safe mode active	U	0/1	Inactive/Active
D11166	Frost protection-capillary	A	0/1	Inactive/Active
D11167	Frost protection configuration	A	0/1	Inactive/Active
D11168	Incomplete learning units	U	0/1	Inactive/Active
D11169	T-ODA sensor failure	A	0/1	Inactive/Active
D11170	T-ETA/T-IDA sensor failure	A	0/1	Inactive/Active
D11171	Cooling not available	U	0/1	Inactive/Active
D11172	Heating not available	A	0/1	Inactive/Active
D11173	Evaporation active	U	0/1	Inactive/Active
D11174	Increased performance during flooding	U	0/1	Inactive/Active
D11175	Unauthorised flow settings	A	0/1	Inactive/Active
D11183	Filter change interval	U	0/1	Inactive/Active

D11184	Filter test configuration	U	0/1	Inactive/Active

3.1.4 **Example of controlling an air handling unit**

Case 1 - the unit is set for "manual" control

The indices H10700, H10701, H10702 and H10703 have the value 0

Changing the desired temperature
1. read the value of the H10706 index (i.e. find the current desired temperature)
2. the result is e.g. 225, i.e. the desired temperature has a value of 22.5°C (see the "Full list" tab)
3. If we want to change the desired temperature to a value of e.g. 24°C, the value 240 must be written to index H10710
4. Check the entry of the new required temperature on the H10706 index - the value should be 240

Change the desired mode
1. read the H10705 index value (i.e. find out the current desired mode)
2. the result is e.g. 0, i.e. the desired mode is "Off" (see the "Full list" tab)
3. If we want to change the desired mode to e.g. "Ventilation", the value 2 must be written to index H10709
4. Check the execution of the entry of the new required mode on index H10705 - the value should be 2

Case No.2 - the unit is set for weekly program control

The indices H10700, H10701, H10702 and H10703 have the value 1 or 2 (the value 2 means that a manual change of a parameter (desired mode or desired temperature etc.) has been made within the weekly program control.

Changing the desired temperature
1. read the value of the H10706 index (i.e. find the current desired temperature)
2. the result is e.g. 190, i.e. the desired temperature has a value of 19.0°C (see the "Full list" tab)
3. If we want to change the desired temperature to a value of e.g. 21.5°C, the value 215 has to be written to the index H10710
4. it is necessary to write the value 2 on the index H10702 - indication of temporary change of the required temperature
5. Check the entry of the new required temperature on the H10706 index - the value should be 215

Change the desired mode
1. read the H10705 index value (i.e. find out the current desired mode)
2. the result is e.g. 2, i.e. the desired mode is "Ventilation" (see the "Full list" tab)
3. If we want to change the desired mode to e.g. "Unbalance", it is necessary to write the value 6 to the index H10709
4. it is necessary to write the value 2 on the indexes H10701 - indication of temporary change of the required mode
5. Check the write order of the new required mode on index H10705 - the value should be 6

3.2 aMotion regulation

3.2.1 **Control of the air handling unit**

Control parameters - current requirement values

Index	Variable function	Scope	Transfer function/enumeration
I1001	Current desired mode	0-8	Off=0, Auto=1, Ventilation=2, Circulation with ventilation=3, Circulation=4, Night cooling=5, Balancing=6, Overpressure=7, Ventilation Mix=8
I1002	Current desired temperature	100-400	10-40°C (value
I1003	Current requested zone	0-2	Zones 1+2 =0, Zone 1 = 1, Zone 2 =2
I1004	Current required fan power	0-100	Power 0..100% of adjustable power range
I1005	Current required ventilation flow rate	0-max.flow rate	Value*10 = flow rate m3/h, e.g. I1005=230 -> required flow rate=2300 m3/h
I1006	*Current required circulation flow*	*0-max.flow rate*	*Not yet supported*
I1007	Current required pressure level	0-2	Off=0, Low=1, Normal=2
I1008	Current required circulation ratio	0-100	0-100%, 0~full ventilation, 100~full circulation
I1009	Current bypass flap command	0-2	Automatic=0 (automatic control according to temperature), Open=1, Closed=2
I1010	Current season	2,3	2 = Heating season, 3 = Non-heating season
I1011	Current Required Power - Inlet	0-100	Power 0..100% of adjustable power range
I1012	Current Required Performance - Towing	0-100	Power 0..100% of adjustable power range
I1202	Maximum adjustable flow rate	max.flow rate	Value*10 = flow rate m3/h, e.g. I1202=560 -> max. adjustable flow rate=5600 m3/h
I1203	Minimum adjustable flow rate	max.flow rate	Value*10 = flow rate m3/h, e.g. I1203=120 -> min. adjustable flow rate=1200 m3/h
1205	Circulation damper control method	0-4	Circulation not=0, ON/OFF=1, Eco=2, Comfort=3, Adjustable position=4
1206	Bypass flap control method	0-2	Bypass not=0, User=1, Automatic=2

Control parameters - write requirements

Index	Variable function	Conversion	Min	Max
H1001	Desired mode	Off=0, Auto=1, Ventilation=2, Circulation with ventilation=3, Circulation=4, Night cooling=5, Balancing=6, Overpressure=7, Ventilation Mix=8		
H1002	Required temperature	value *0.1°C	100*0.1 C	400*0.1 C
H1003	Required zone	Zones 1+2 =0, Zone 1 = 1, Zone 2 =2		
H1004	Required fan power	1	0%	100%
H1005	Required ventilation flow rate	value *10°C	min. according to I1203	max. according to I1202
H1006	*Required circulation flow*	*value *10°C*	*Not yet supported*	
H1007	Required pressure level	Off=0, Low=1, Normal=2		
H1008	Required circulation ratio	100%	0%	100%
H1009	Bypass flap command	Automatic=0, Closed=1, Open=2		
H1010	Season settings	According to average T-ODA=0 | According to average T-ODA+profit = 1 | Heating season (TS) = 2 | Non-heating season(NTS) = 3		
C8001	Resetting alarms	It is used to acknowledge (reset) alarms whose reason for triggering is no longer valid and which require manual intervention of the operator to terminate.		
C8002	Reset filter change interval	Reset filter operation counter - apply after filter replacement		

Required performance:

Fan control	Fan control description	Read/write performance indices	Value	Transfer function/enumeration

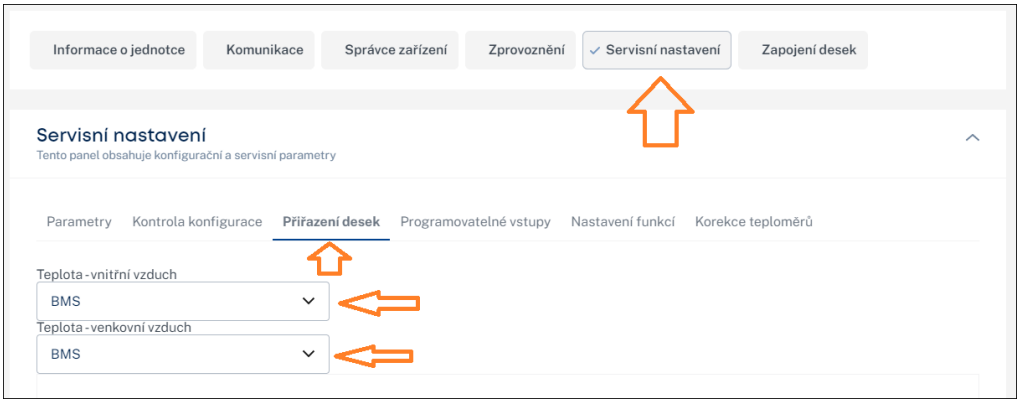
I1201=0	Direct management	I1004/H1004	1-100	Performance 1..100%
I1201=1	Constant pressure	I1007/H1007	0	Off
			1, 2	1~ lower pressure, 2~ standard pressure
I1201=2	Constant flow	I1005/H1005	0	Off
			min..max. flow/10	min. to max. flow according to I1203 and 1202
I1201=3	external management	-	-	-
I1201=4	Direct control - fans separately	Inlet: I1107/H1011 Outlet: I1108/H1012	1-100	Performance 1..100%
I1201=5	Constant flow - fans separately	Inlet: I1109/ - Outlet: I1110/ -	min..max. flow/10	min. to max. flow according to I1203 and 1202

Relation to the weekly program running on the HVAC unit
The HVAC unit can be controlled by commands from the controllers, i.e. by manual intervention, which is valid until the next change made on the controller or on another user interface, or it can be operated according to its own weekly program, which automatically sets the values of control parameters according to time.
If the HVAC unit is running according to a weekly program and the value of one of the control parameters is changed via the Modbus protocol, the currently entered value can be changed at the moment of the next entry in the calendar.

Indoor and outdoor temperature recordable
If the parent control system contains information about the outdoor air temperature (T-ODA) or indoor air temperature (T-IDA), this data can be used to control the ventilation unit (HVAC). The following indices are used to send temperature values. The value needs to be refreshed periodically, if the value is not sent to the corresponding indices for more than 90s, the HVAC declares a temperature sensor fault where the data is missing.
In order for the temperature recording via the modbus protocol to be accepted by the HVAC unit, the appropriate service parameters must be set using the aTool service application (can be done by a trained technician):

Outdoor air temperature (T-ODA):
- Service settings / Board assignment / Temperature - outside air: set to **BMS**

Indoor air temperature (T-IDA):
- Service settings / Board assignment / Temperature - indoor air: set to **BMS**



T-IDA and T-ODA temperature notation indices

Index	Function variables	Scope	Transfer function/enumeration
H1500	Index for writing T-IDA from BMS	0..65535	65036 ~ -50.0°C ..65535 ~ -0.1°C 1..1300 ~ 0.1..130.0°C
H1501	Index for writing T-ODA from BMS	0..65535	65036 ~ -50.0°C ..65535 ~ -0.1°C, 1..1300 ~ 0.1..130.0°C

3.2.2 Measured values, traffic monitoring

Controlled elements of the HVAC unit configuration

Index	Item	Value, description
D2301	Fan status (at least 1 fan)	Off = 0, On = 1

D2302	Inlet and outlet flaps	Closed = 0, Open = 1
D2303	Preheater status	Off = 0, On = 1
D2310	Heating status	Off = 0, On = 1
D23I11	Heater status A	Off = 0, On = 1
D2312	Heater status B	Off = 0, On = 1
D2321	Heater pump A	Off = 0, On = 1
D2322	Heater pump B	Off = 0, On = 1
D2330	Radiator status A	Off = 0, On = 1
D2341	Radiator pump A	Off = 0, On = 1
I1107	M-SUP supply fan control command	0..100 ~ 0%..100%
I1108	M-ETA exhaust fan control command	
I1113	Circulation damper control command	0-100%, 0~full ventilation, 100~full circulation
I1114	Preheater control command	0-100%, 0~off, 100~maximum power
I1115	Heater control command A	
I1116	Heater control command B	
I1117	Cooler control command	

Measured temperatures of the air handling unit

Index	Item	Value, description
I1101	Outdoor air temperature (T-ODA)	65036 ~ -50.0°C ..65535 ~ -0.1°C, 1..1300 ~ 0.1..130.0°C
I1102	Supply air temperature (T-SUP)	
I1103	Temperature of exhaust air (T-ETA)	
I1104	Indoor air temperature (T-IDA)	
I1105	Exhaust air temperature (T-EHA)	
I1106	Average outdoor air temperature	

Measured flows and other quantities

Index	Item	Value, description
I1109	Current flow rate on the M-SUP fan	Value*10 = flow rate m3/h, e.g. I1005=230 -> required flow rate=2300 m3/h
I1110	Current flow rate on the M-ETA fan	
I1112	Bypass flap travel time	Total transit time between extreme positions in ms
I1119	Current operating mode of the unit	see table of operating modes

Operating modes of the HVAC unit:

I 1119	Operating mode
15	Safety stop
14	Preventive stop
13	Frost protection
12	Preheating
11	Narrative
10	Forced circulation
9	Defrosting of the recuperator
8	Reduction of ventilation
7	Ventilation interval
6	Proxy proceedings
5	Stabilization of flows
4	Filter test
3	Normal
2	Period

1	Evaporation of condensate
0	Off

3.2.3 **HVAC unit states**

Unit statuses represent fault, safety or just informative messages about the current status of the HVAC unit.
Depending on the significance of the condition, external intervention of a technician or operator is or is not required - the relevant explanation of the conditions and necessary actions is given in the service documentation of the HVAC unit.

Index	Description	Type of condition	Meaning of
D6003	1. frost protection	alarm	Not=0, Active = 1
D6004	2. frost protection	alarm	Not=0, Active = 1
D6005	Stop signal	alarm	Not=0, Active = 1
D6006	Defrosting the recuperator	info	Not=0, Active = 1
D6012	Overheating of the unit	alarm	Not=0, Active = 1
D6013	HDO - higher tariff	info	Not=0, Active = 1
D6014	Unbalanced flow	alarm	Not=0, Active = 1
D6015	Insufficient flow	Notice	Not=0, Active = 1
D6017	Insufficient preheating	Notice	Not=0, Active = 1
D6018	Defrosting of the CH	Notice	Not=0, Active = 1
D6021	The learning process	info	Not=0, Active = 1
D6044	PF1 activation - filter clogging	info	Not=0, Active = 1
D6045	PF2 activation - filter clogging	info	Not=0, Active = 1
D6046	PF3 activation - filter clogging	info	Not=0, Active = 1
D6051	Maximum heater output A	info	Not=0, Active = 1
D6052	Maximum heater output B	info	Not=0, Active = 1
D6055	Pressure gauge failure in the supply line	alarm	Not=0, Active = 1
D6056	Exhaust manifold pressure gauge failure	alarm	Not=0, Active = 1
D6058	Activation of fault input IN1	info	Not=0, Active = 1
D6059	Activation of fault input IN2	info	Not=0, Active = 1
D6060	Activation of fault input IN3	info	Not=0, Active = 1
D6062	Frost protection - DI1 input	info	Not=0, Active = 1
D6063	Frost protection - DI2 input	info	Not=0, Active = 1
D6064	Frost protection - DI3 input	info	Not=0, Active = 1
D6065	Frost protection - DI4 input	info	Not=0, Active = 1
D6066	Heater failure A	alarm	Not=0, Active = 1
D6067	Failure of heater B	alarm	Not=0, Active = 1
D6070	Radiator failure A	alarm	Not=0, Active = 1
D6071	Internal bus failure	alarm	Not=0, Active = 1
D6072	External bus failure	alarm	Not=0, Active = 1
D6073	Communication failure on Ethernet	alarm	Not=0, Active = 1
D6074	T-EHA temperature sensing fault	alarm	Not=0, Active = 1
D6075	T-ETA temperature sensing failure	alarm	Not=0, Active = 1
D6076	T-ODA temperature sensing failure	alarm	Not=0, Active = 1
D6077	T-IDA temperature sensing failure	alarm	Not=0, Active = 1
D6078	T-SUP temperature sensing failure	alarm	Not=0, Active = 1
D6081	Confirmed stop signal	alarm	Not=0, Active = 1
D6082	Frost protection - capillary	alarm	Not=0, Active = 1
D6084	Recuperator frost	Notice	Not=0, Active = 1
D6085	The device is not ready	alarm	Not=0, Active = 1
D6086	Overloading of heaters	Notice	Not=0, Active = 1
D6087	Learning process of flows	Notice	Not=0, Active = 1
D6088	Increase flow rate for heating	info	Not=0, Active = 1
D6089	UVC lamps change interval	Notice	Not=0, Active = 1

D6090	Equipment check interval	info	Not=0, Active = 1
D6091	end of test operation	Notice	Not=0, Active = 1
D6099	Cooler overload	Notice	Not=0, Active = 1
D6104	Clogged filters	Notice	Not=0, Active = 1
D6105	Filter change interval	info	Not=0, Active = 1
D6106	Active unit overheat input	alarm	Not=0, Active = 1
D6107	Cooling operation is blocked	Notice	Not=0, Active = 1
D6108	Increase in flow rate after defrosting the recuperator	info	Not=0, Active = 1
D6109	Supply flow sensor failure(SUP)	alarm	Not=0, Active = 1
D6110	Exhaust flow sensor (ETA) failure	alarm	Not=0, Active = 1
D6111	Fresh air flow sensor failure (ODA)	alarm	Not=0, Active = 1

3.2.4 **Example of controlling an air handling unit**

Case No.1 - The HVAC unit has the fan control method set to "Direct Control"

Index I1201=0

Change the required power
1. read the value of the I1004 index (i.e. find out the current required performance)
2. the result is e.g. 40, i.e. the required performance is 40%
3. If we want to change the required performance to a value of e.g. 55%, the value 55 must be written to index H1004
4. Check the execution of the entry of the new required power on the I1004 index - the value should be 55

Change the desired mode
1. read the I1001 index value (i.e. find out the current desired mode)
2. the result is e.g. 0, i.e. the desired mode is "Off"
3. If we want to change the desired mode to e.g. "Ventilation", the value 2 has to be written to index H1001
4. Check the execution of the entry of the new required mode on index I1001 - the value should be 2

Case No.2 - The HVAC unit has the fan control method set to "Constant flow"

Index I1201=2

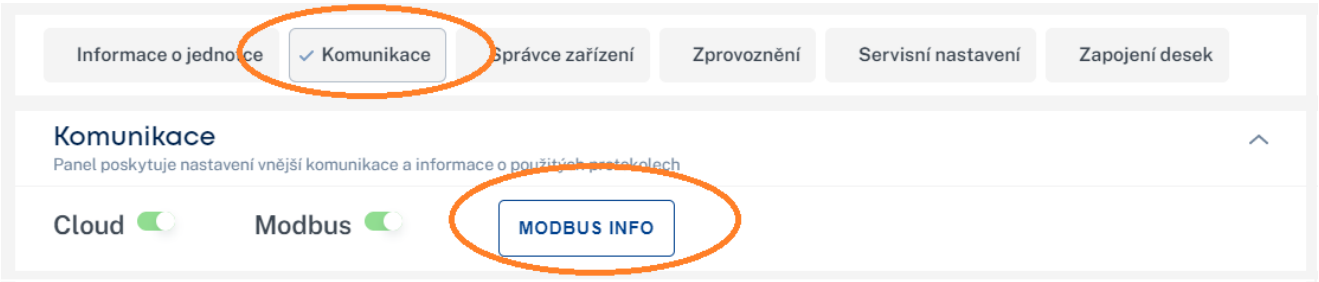
Change the required flow rate
1. read the I1005 index value (i.e. find the current required flow)
2. the result is e.g. 140, i.e. the required flow rate is 1400 m3/h
3. Check the value of indexes I1202 and I1203 (max. and min. adjustable flow)
4. If the required flow rate is to be changed to e.g. 450m3/h, it is necessary to check whether this value is within the interval between the adjustable min. and max. If the setpoint is in the interval between min and max (I1203 to i1202), then enter the value 45 on index H1005.
5. Check that the new required flow rate has been entered on the I1005 index - the value should be 45

Case No.3 - HVAC unit to be switched to circulation mode
1. Read the value of the I1001 index (i.e. find out the current desired mode)
2. the result is e.g. 2, i.e. the desired mode is "Ventilation"
3. Circulation mode can only be set if the HVAC unit is equipped with a circulation damper - index I1205 must = 1 to 4.
4. If bid 3 is valid, a value of 4 (circulation) can be entered in the H1001 index
5. Check the execution of the entry of the new required mode on index I1001 - the value should be 4

3.2.5 **Checking the index values on the HVAC unit side**

The aTool service application lists all Modbus indexes and allows you to check the current value of each index.
The aTool service application is available to a trained technician who operates the DUPLEX air handling unit.

Check the content of modbus indexes:
- After connecting the HVAC unit, go to the **Communication** section - **MODBUS** INFO button
-


Informace o jednotce
Komunikace
Správce zařízení
Zprovoznění
Servisní nastavení
Zapojení desek
Komunikace
Panel poskytuje nastavení vnější komunikace a informace o použitých protokolech
Cloud
Modbus
MODBUS INFO