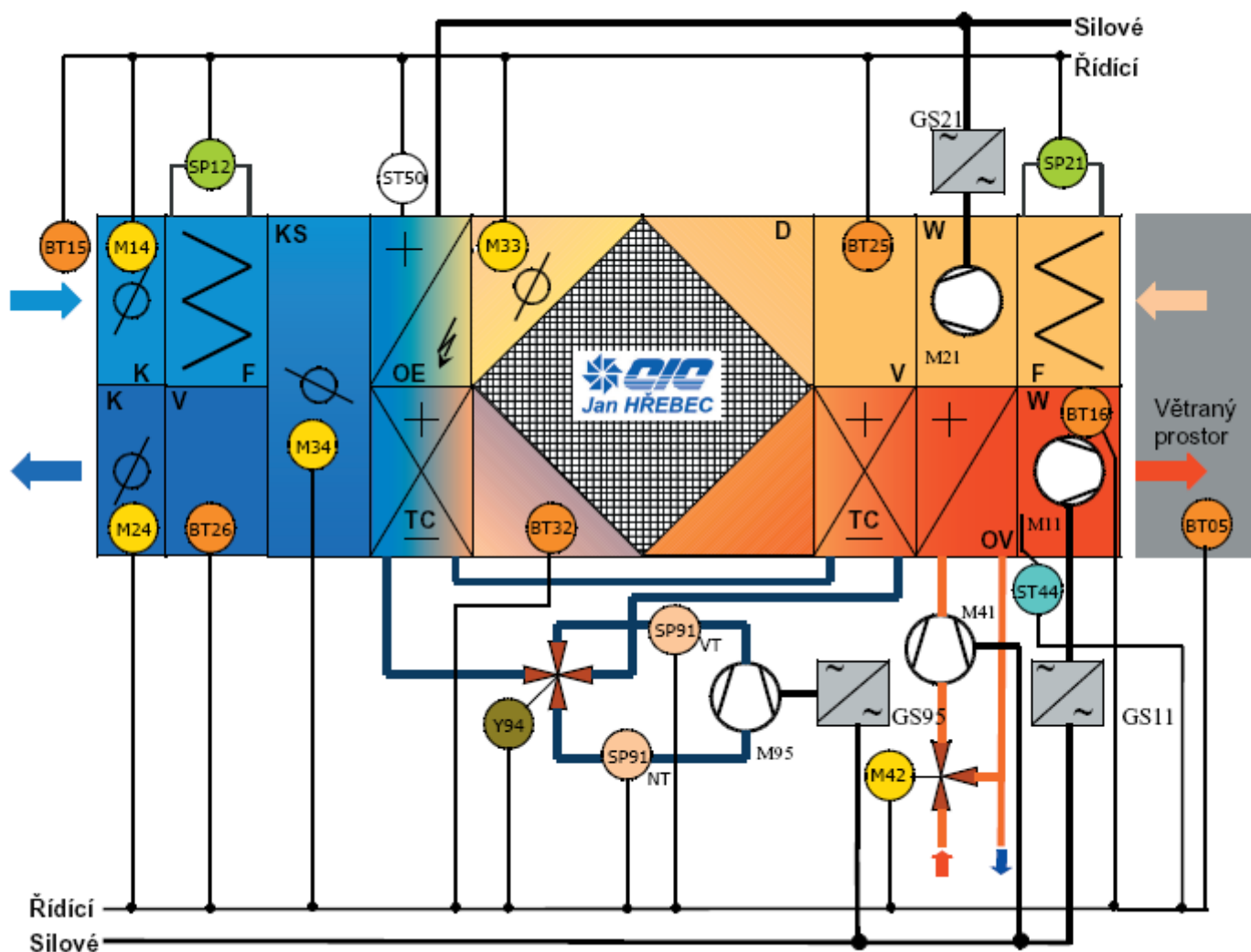


H-Control measurement and regulation system

INSTALLATION MANUAL



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1. General

For controlling the operation and regulation of thermal performance of air handling and conditioning units, set up, connect and check the proper functioning of the MaC system.

Measurement and regulation system consists of a power unit, auxiliary circuits, sensors, actuators and digital program regulator. Executions differ in the extent of regulatory circuits and operating states of air handling units.

The following tasks can only be performed by personnel meeting the qualification requirements under Decree 50/1978 Coll.

For installation you need a crossover UTP network cable and portable PC on which supporting software is installed!

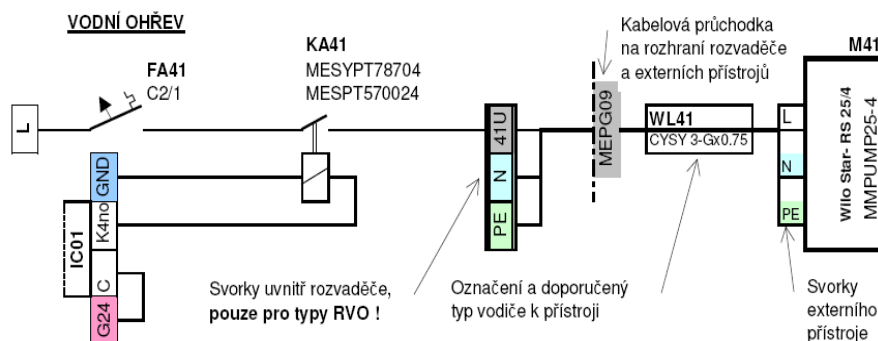
2. Switchboard

Switchboards by C.I.C. Jan Hřebec Company are designed in IP 54 protection class. To maintain this protection, use appropriate cable gland (included). The switchboard can be mounted vertically on the wall or to the empty space on air handling unit. Always keep at least 800 mm free handling area around the switchboard! After the installation, the main switch must be located in height of 0.6 to 1.9 m above the control plane (from the floor). RVO type switchboards (steel sheet boxes) should be connected appropriately to the grounding system. The switchboard is designed only for power supply and control of devices that are necessary for running the air handling unit. Don't connect your own devices to the switchboard!

2.1. Wiring diagram

In the switchboard documentation you will find the diagram of wiring and connection of external devices (demonstrative connection of water heating pump), see Figure 1.

Figure 1



3. Main switch

The main and emergency switch is used to completely disconnect the air handling unit from power supply in case of service, accident etc. It is placed on the mounting rail (plastic version of the switchboard) or into the metal coat of the steel sheet switchboard. Lead the power cord directly to the terminals of the main switch (plastic version of the switchboard) or to the appropriate terminals of the steel sheet switchboard marked 01U (phase L1), 01V (phase L2), 01W (phase L3) and to the terminals N and PE. Switchboards are according to the customer connected load ready for connection to the 3x 400 V, N, PE AC 50 Hz, TN-S power grid.

4. Source of low-voltage

A 24Vss voltage source is used. **The negative terminal of this source is connected to PE terminal according to the wiring diagram.** The proper function of power supply is indicated by green LED on its cover. In case of over-load or short circuit this LED is not lit.

5. Programmable regulator

Using a simple fitting system, connect conductors to the regulator terminals; these conductors do not use ferrules. Conductors of the RS-485 communication line are connected to the regulator and further led to devices (frequency inverters) by bus topology, see Figure 2. The recommended length for a single RS-485 communication line is 100 m. Use shielded conductors. The internal diagram of program regulator is shown in Annex 1.

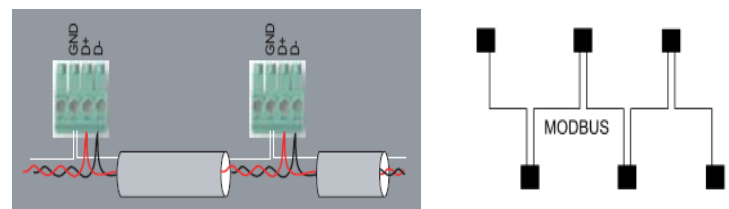
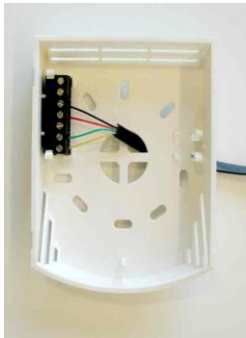


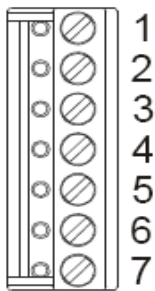
Figure 2

6. Room controller



If not stated otherwise, connect the controller via 6-wire telephone cable (included). Crimp a RJ 12 connector at one end and connect the other to the appropriate terminal of room controller according to the wiring diagram. Always verify the communication with the remote control. If the controller display does not update time (it shows only zeroes) and there are no symbols after connecting to power, the communication is not okay. Check if the communication cable is properly connected. Terminal diagram is shown on Figures 3 and 4. The maximum length of remote control cable is 100 m.

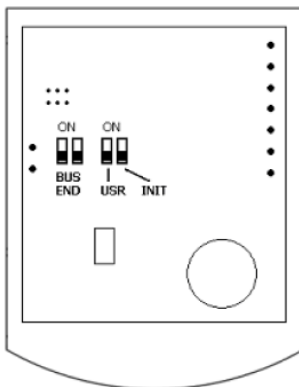
Always verify the communication with the remote control. If the controller display does not update time (it shows only zeroes) and there are no symbols after connecting to power, the communication is not okay. Check if the communication cable is properly connected. Terminal diagram is shown on Figures 3 and 4. The maximum length of remote control cable is 100 m.



Terminal explanation:

- 1: NC not connected
- 2: NC not connected
- 3: K- communication RS485 -
- 4: K+ communication RS485 +
- 5: TE (earth)
- 6: G0 power supply – reference point
- 7: G power supply

Figure 3



PSB back:

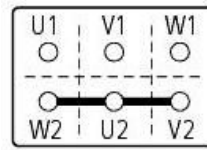
BUS END: v the ON position terminates the bus, we recommend it to use

USR: not used, reserve
INIT: sets the regulator to default communication parameters: address 1, baud rate 9600 bps

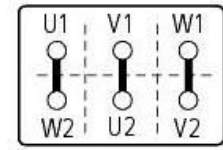
Figure 4

7. Motors

Always connect motors according to the motor rating plate, not according to the rating plate affixed to the fan section door (they may vary). Screw terminal connection (D/Y Figure 5) depends on the voltage system to which the motor is connected (pay attention to frequency inverters).



Y Connection



D Connection

Figure 5

A frequency inverter powered from the mains by single-phase voltage of 1x230 V has on the output side (the side of the motor) voltage of 3x230 V. Connection of motor screw terminal must therefore be done according to the motor plate for voltage of 230 V!

A frequency inverter powered from the mains by three-phase voltage of 3x400 V has on the output side (the side of the motor) voltage of 3x400 V. Connection of motor screw terminal must therefore be done according to the motor plate for voltage of 400 V!

In case of low power motors tighten the screw terminal with caution, otherwise you might strip the tread. Supply conductors will be fitted with cable lugs. If there are motor thermal protections, thermocontacts or thermistors, connect them between the terminals No. 50 and 29 of the frequency inverter (for FC 51 type inverters). Check the following parameters on the frequency inverter display:

- 1-90 [2] (turning off by thermal protection)
- 1-93 [6] (digital input No. 29, terminal No. 29)

When setting these parameters, switch the frequency inverter to the "OFF/RESET" mode.

8. Frequency inverters

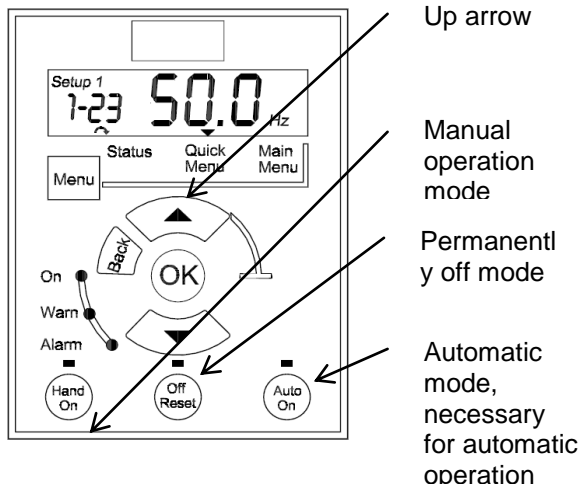
First fit the frequency inverters with terminal covers and remove the number of blind plugs corresponding to the number of power cables (usually 4). Fit the conductors using cable glands and connect them using ferrules and the PE terminal using cable lugs. Because the frequency inverter is controlled via a RS-485 data line, set the necessary communication parameters.

When setting these parameters, switch the frequency inverter to the "OFF/RESET" mode.

Set the following parameters:

- 8-30 [2] Modbus
- 8-31 address 11 for supply inverter or 21 for output inverter, or 31 for rotary heat recovery inverter
- 8-32 baud rate set [2] 9600 Baud default

- 8-33 set transfer parameters [2] without parity, 1 stopbit



Visual checks of the correct data bus function are done by synchronous flashing of LED controls for data terminals of the inverter. The rest of the parameters will be overwritten after connecting the regulator to the PC using the service logon to the regulation system. See Chapter 15.

8.1. Control of fan rotating direction

If you press the “Hand On” button, the frequency inverter will work in manual mode. To find the fan rotation direction, use this mode of operation. Press the “Hand On” button and then long press the “Up arrow” button to increase the output frequency of the inverter.

Check the rotation direction and **turn the frequency inverter mode back to OFF/RESET**. If the frequency inverter reports error or warning, look at its cause, see Table 1.

Figure 6

Error No.	Description	Warning	Alarm	Blockage	Problem cause
2	Live zero error	X	X		The signal on terminal 53 or 60 is less than 50% of the value set in par. 6-10, 6-12 and 6 to 22.
4	Phase loss	X	X	X	There is a phase missing on supply side, or unbalance of supply voltage is too high. Check supply voltage.
7	Overvoltage in the intermediate circuit	X	X		Voltage in intermediate circuit has exceeded the limit.
8	Undervoltage in the intermediate circuit	X	X		Voltage in intermediate circuit has dropped below low voltage warning limit.
9	Invertor overloaded	X	X		More than 100% load for too long.
10	ETR motor overheated	X	X		Motor is too hot due to more than 100% load for too long.
11	Motor thermistor overheated	X	X		Thermistor/thermocontact or thermistor connection is disconnected.
12	Torque limit		X		Torque has exceeded the value set in par. 4-16 or 4-17.
13	Overcurrent	X	X	X	Peak current of inverter has been exceeded.
14	Earth fault		X	X	There is a discharge from the output phases and earth.
16	Short circuit		X	X	Short circuit in motor or motor terminals.
17	Command word timeout	X	X		Frequency convertor does not communicate with PLC (restart PLC)
25	Braking resistor short circuit		X	X	There is a short circuit in braking resistor – brake function is disabled.
27	Braking chopper short circuit		X	X	There is a short circuit in braking chopper – brake function is disabled.
28	Brake check		X		Braking resistor is not connected/working.
29	Power card overheated	X	X	X	Temperature for cooler switch off has been reached.
30	Motor phase U missing		X	X	Motor phase U is missing. Check phase.
31	Motor phase V missing		X	X	Motor phase V is missing. Check phase.
32	Motor phase W missing		X	X	Motor phase W is missing. Check phase.
38	Internal fault		X	X	Contact local Danfoss supplier.
47	Control voltage error	X	X	X	It is possible that 24 V DC source has been

					overloaded.
51	AMT Unom and Inom check		X		Wrong setting of motor voltage, current or electric power.
52	AMT - low Inom		X		Motor current is too low. Check setting.
59	Current restriction	X			VLT convertor is overloaded.
63	Low value for mechanical brake		X		Actual value of motor current has not exceeded "Brake release" current in "Start delay" time period.
80	Convertor has been initialized to default setting		X		All parameter settings have been initialized to default.

Table 1: Frequency inverters error reports

9. Differential pressure switches

Connect the terminals according to the wiring diagram. Filter clogging sensor are usually connected to frequency convertor terminals (GS11, GS21). Put the pressure test points into already prepared holes (if they are not prepared, pre-drill them).

The + outlet in the hole with higher pressure (in front of filter), the – outlet to lower pressure (behind filter)

Set the pressure loss to a value greater than the pressure loss of the filter itself + reserve. These details can be found contract documentation datasheets.

10. Servomotors

They are different types of servomotors and various types of their management. For outdoor and exhaust air dampers 24 V open/close type or 3-point servomotors are used. If the servo rotates in the opposite direction and it is not possible to access it, you can change the direction of rotation by swapping the polarity of control conductors.

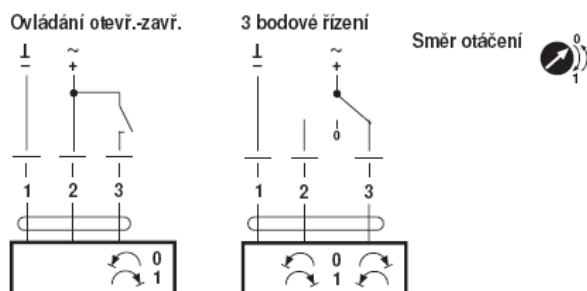
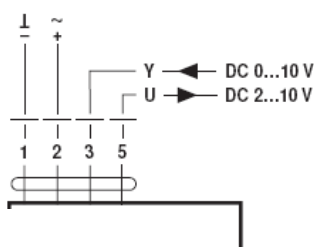


Figure 7

To control continuous motors (3-way valves, in case of mixing all servo valves) the servomotors with 0-10 V continuous control are used.



TP12109NI

Figure 8

These servomotors have relatively short power conductors and therefore install a junction box to the unit to extend the power conductors. The junction box is installed either inside or outside of the air handling unit, as appropriate. To change the rotation, turn the rotary switch.

When the air handling unit is turned off, the outdoor and exhaust air dampers must be closed. For setting we recommend to mark the position of rotary switches on individual servomotors.

11. Thermometers

Thermometers are installed to the appropriate parts of the air handling unit. As a holder, you can use a cable screw gland (see figure 11) for cable type of temperature sensor. This thermometer also works as an antifreeze protection. You can place the thermometers for example according to figure 9.

The outside air thermometer plays an important role. If the air handling unit does not have a mixing chamber, you can place this thermometer directly in the outside air space. If the unit is equipped with mixing, place the temperature sensors for each branch separately, see figure 10.

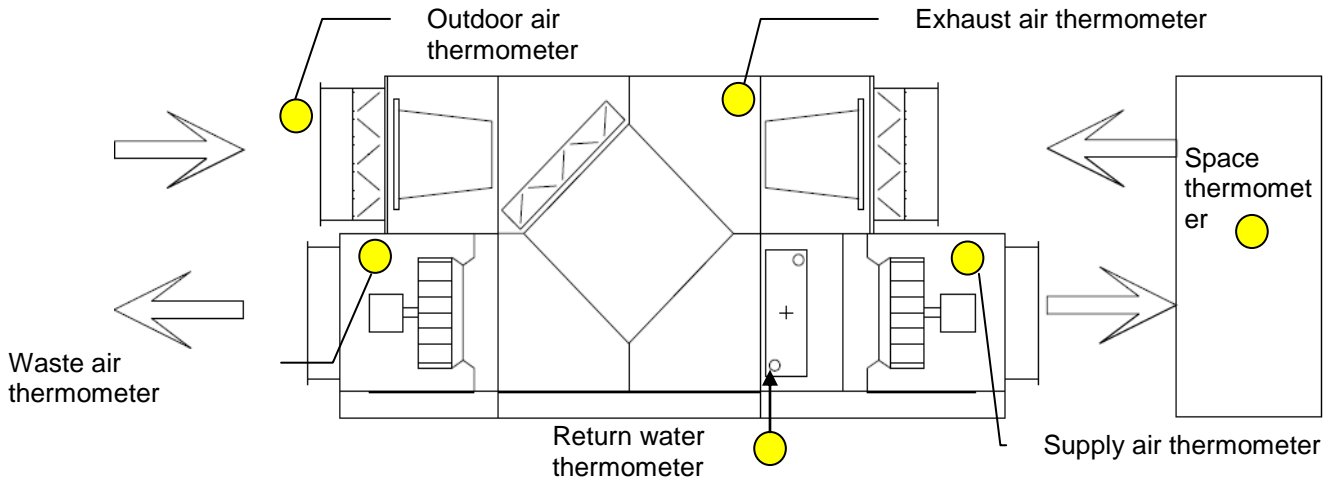


Figure 9

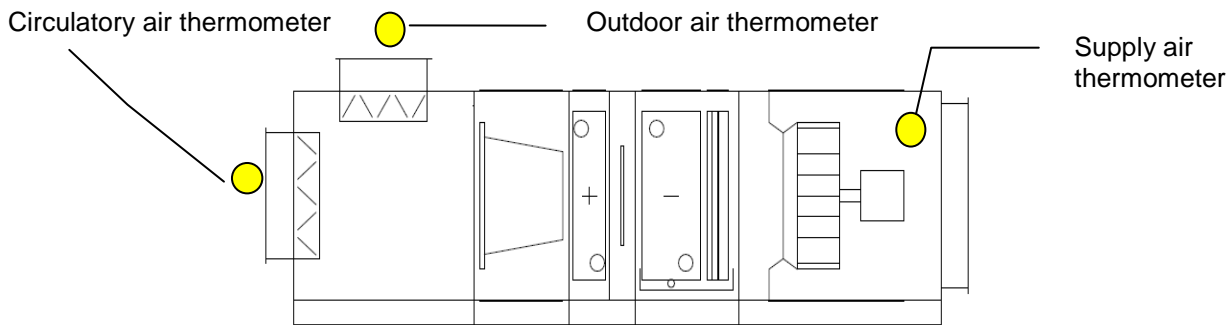


Figure 10

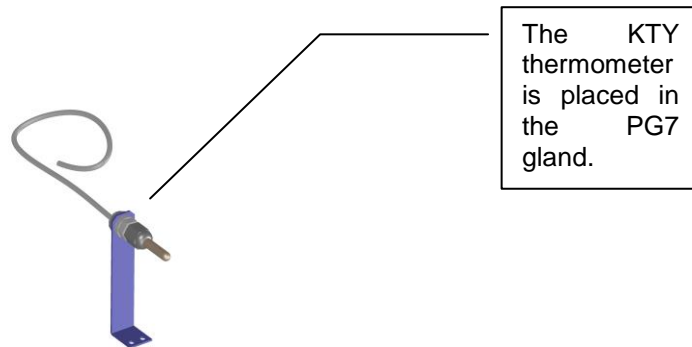


Figure 11

12. Circulator pumps

Water heat pump as well as a 3-way valve servomotor are located on the control node. **Pay attention to the correct working position of the circulator pump!**

If you need to test the control system, and the heating system is not pressurized, do not let the circulator pump run "dry". In this case it can be temporarily disabled using a protective element inside of the switchboard. **Same rules apply to water cooling circulator pumps.**

13. Electric heater

The electric heater may be composed of several sections. Each section is switched either by contactor or SSR relay. In case when SSR relays are used, these relays are mounted to the electric heater base plate, and on the air flow side they are filled with an aluminum heat sink (by factory default). Fit the SSR relay power conductors with cable lugs for stranded conductors. Solid core conductors should be properly bended and fitted to the input terminals of the SSR relay. Connect the thermostats according to the wiring diagram and check their function. Pay special attention to the safety

thermostat – it must as an irreversible fuse disabling power of heating elements. The heater may include a heating section of unsymmetrical character. For such section, **always plug a zero conductor in addition to the phase conductor and the protective conductor!**

14. Compressor and cooling circuit

If the unit is equipped with its own compressor and cooling circuit, connect the compressor motor while always **following the order of phases for compliance with the desired direction of rotation**. The compressor must rotate in the opposite direction than its operating direction. Motor terminals can be labeled L1, L2, L3 or U, V, W or R, S, T. Compressor motors are usually not Y/D switchable, therefore always check the their operating voltage and wiring on their rating plates. Protective elements should be connected to the cooling circuit according to wiring diagram. High and low pressure protections are implemented by switching contacts; it is always necessary to check the pressure at which the protection has been set. Pressure sensors are implemented by semiconductor sensors with 4-20 mA output. It is necessary to observe the correct polarity when connecting these sensors. All conductors leading around the cooling circuit must not touch the circuit or be attached to it, as this could cause their damage due to extreme temperatures.

15. System configuration and putting into operation

15.1. Connecting to PC

For installation you need a crossover UTP network cable and portable PC on which supporting software is installed!

1. **Connect the PC to the switchboard regulator** using a crossover UTP network cable (to connect the PC and regulator directly use a crossover cable, to connect the regulator with a hub etc. use a straight cable).
2. **Run the “@CHIPTOOL” software tool**, which you can find it in the documentation on the enclosed CD. In case you do not have it installed, do so and run the program.
3. If the program does not display the **status bar** indicating the found regulator, check:
 - if a correct UTP cable is used
 - if protective features of the operating system, that ensures the operation of network communication, such as all antivirus programs, firewalls, etc. are turned off
 - if the adapter for connecting to the local network is activated

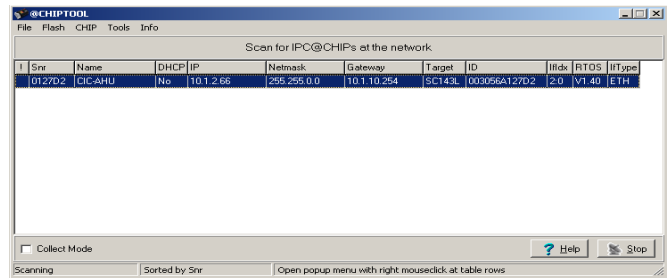


Figure 12

4. Communication verification

Correct setting of network environment can be verified using the “ping” function.

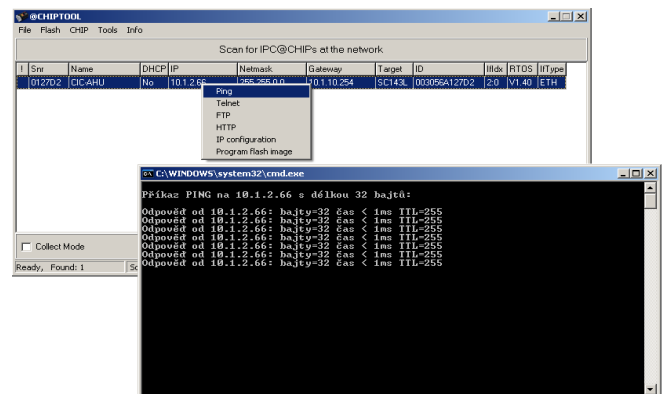


Figure 13

If setting is correct, the command "ping" returns the response, as shown in Figure 12, if not, the command returns "Request timed out".

In this case, check the configuration of your network IP address and subnet mask of your PC.

For example by using the @CHIPTOOL program you may find out that the regulator has the following network values:

IP: 192.168.0.100
Mask: 255.255.0.0
Gateway: irrelevant

On your PC, adjust the parameters of the TCP / IP network communication protocol:

IP: 192.168.0.1
Mask: 255.255.0.0
Gateway: irrelevant

Re-try the “ping” function. If response is available, choose the “HTTP” function which will open a Web browser set to default, and type this address:
http://192.168.0.100

The Web browser displays the home screen of the measuring and control system.

5. Problems with Web browser display

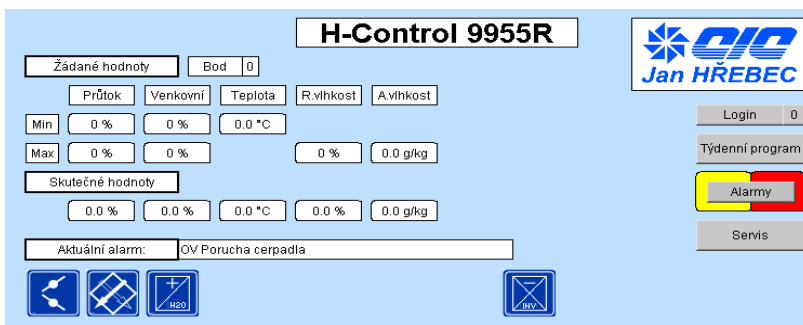
If there are problems with the display in the Web browser of your PC, make sure you have installed the current version of Java (TM) for your browser. The current version can be downloaded from the website <http://www.java.com>, or it can be found in the documentation on the enclosed CD.

Check the setting table for frequency inverters, in particular the data on motors, motor current, applied thermal protection, voltage, rotation speed etc. See table 2.

15.2. Checks before first run

If the home screen has displayed correctly, fulfill the following tasks before first run.

1. Login under the "Level 1" service level.



Press the "login" button.

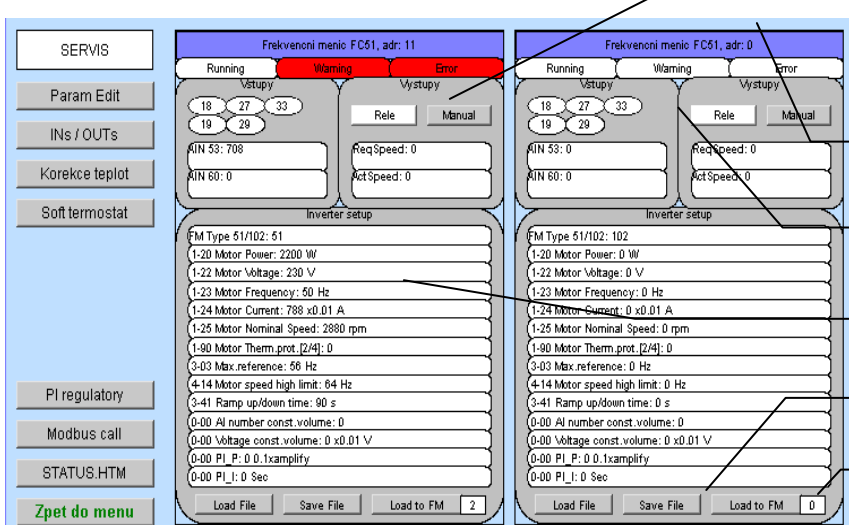
Figure 14

Into the "New group" field enter level "1" (service) and into password field a valid service password (ask at your service organization).

After correct login, the "SERVICE" button is displayed.

In this login mode you can change and set all parameters!

To change settings, press the SERVICE button, which will display setting tables for frequency inverters.



The current state of an inverter, or no communication between FM and regulator. For FM setting see Chapter 8.

Input/output inverter address

FM input/output signalization

Fan parameter setting

Setting buttons

Control counter

Figure 15

Parameter:	Value:	Note:
FM type 51/102	For Danfoss FC 51 Microdrive inverter type enter "51", for Danfoss FC 102 VLT HVAC Drive inverter type enter "102"	You'll find this data on frequency inverter rating plates
1-20 Motor Power	Motor power [W]	See motor rating plate
1-22 Motor Voltage	Motor voltage [V]	See motor rating plate
1-23 Motor Frequency	Rated motor frequency [Hz]	See motor rating plate
1-24 Motor Current	Rated motor current [A]	Check with motor plate for correct connection of D/Y, enter the value in integers, e.g. 4.21 A = 421
1-25 Motor Nominal Speed	Motor nominal speed [rpm]	See motor rating plate
1-90 Motor Term. prot.	Choice of protection by inverter calculation [4] or by thermistor/thermocontact [2], see Chapter 7.	According to implemented protection.
3-03 Max Reference	Maximum desired value [Hz]. value for 100% air volume	This value can be changed during the implementation of air regulation of air handling unit
4-14 Motor Speed High Limit	Restriction for maximum possible frequency [Hz]	No fan can exceed this value! Do not change!
3-41 Ramp Up/Down time	Fan ramp up/down time [s]	
0-00 AI Number const. volume	AI number for constant volume regulator sensor [-]	Only for applications with regulation to constant volume
0-00 Voltage const. volume	Voltage value [V]	Only for applications with regulation to constant volume
0-00 PI_P amplify	Proportional amplification constant [-]	Only for applications with regulation to constant volume
0-00 PI_I sec	Integral time constant [-]	Only for applications with regulation to constant volume

Table 2

If you are sure about the settings, save the changed parameters in the regulator memory by the "Save File" button. Make sure you switch the frequency inverter to the OFF/RESET mode, see Chapter 8. Next, press the **"Load to FM" button – by doing so you enter the selected values into the frequency inverter.** For rechecking, watch the control counter next to the **"Load to FM" button; this counter must count to about 32 and then return to zero value.** If the counter stops at for example 2 (or any other non-zero value), it may indicate:

- Incorrectly set communication parameters at the frequency inverter (see Chapter 8).
- Incorrectly connected control bus, its termination or excessive length.
- Incorrectly set parameters in the setting table, which requires an accurate data format (decimal point when entering a numeric value of motor current, a non-integer or nonsensical number in parameter, an invalid character in parameter, parameter out of range of the machine etc.).

- Wrong type of frequency inverter.
- The inverter is not set to OFF/RESET mode.

If the control counter counts to about 32 and goes back to zero value and the "XY inverter error" alarm disappears from the error list, **the frequency inverter is set correctly.** Turn its mode back to the "Auto/On" position using the button on control panel.

Do the same for all the other frequency inverters of the system (supply/exhaust fan, rotary heat exchanger etc.).

The active warning "clogging of filter inserts" stays in the error list. This warning is removed by pressing "ALARMS" and then the "ACKNOWLEDGE ALARMS" buttons on the home screen.

If the system reports any other errors, check its cause (sensor connection, low temperatures etc.)

15.3. Damper and temperature sensor checking

For unit to work properly, check the temperature sensor function and damper position setting. For this purpose use a visualization window, which opens from the system home window under this symbol:



Figure 16

Check proper position of a thermometer, e.g. placing your hand on the thermometer's sensing tip and watch the appropriate increase in temperature on the visualization. If the unit is equipped with water heater, do not forget the return heating water sensor. Also check the positions of outdoor air, exhaust air and mixing damper servomotors and plate heat recovery servomotor (if used).

15.4. Further settings

All parameters can be changed in the "Param Edit" menu. For each function section of the air handling unit there is a separate set of parameters which affects its functions. A list and description of appropriate parameters are listed in the following document: TP12109NP_ENG Description of the H-Control parameters.

Jmeno:	V_IN1	0	Index v aVest	1
Instance:	1	1	Vyrobni cislo	9955
IN1	MB_S	2	DI Zanes Filtr1 Priv	10
IN2	UI010	3	DI Zanes Filtr2 Priv	11
SHED	TS	4	DI Zanes Filtr1 Odv	20
		5	DI Zanes Filtr2 Odv	0
D		6	DO Hlas. CHOD	4
R	SM	7	DO Hlas.VYSTRAHA	0
RG	W	8	DO Hlas.NE PORUCHA	5
		9	Ti venkovni vzduch	1
OV	CV	10	Ti privadeny	2
OE1	CP	11	Ti odvadeny	3
OE2	CI	12	Ti odpadni	4
OG1	CI2	13	Ti teplota ref	2
		14	PL_P0.1x zes.tepl.	200
TC		15	PL_I. cas v Sec	480
TC2	ZP			

- IN1 – Input parameters 1
- IN2 – Input parameters 2
- SHED – AHU operation control
- MB_S – Modbus Slave
- UI010 – Room controller
- TS – Software thermostats
- D – Plate heat recovery
- R – Rotary heat recovery
- RG – Glycolic recovery
- W – Starting unit
- SM – Mixing
- OV – Water heater
- CV – Water cooler
- OE1 – Electric heater 1
- OE2 – Electric heater 2
- CP – Direct cooling
- CI – Inverter cooling
- TC – C.I.C. heat pump
- ZP – steam humidifier

Figure 17

If you are not completely sure how to change these parameters, consult the manufacturer first!!!

For editing parameters you must save the implemented changes and restart the regulator!

15.5. Manual inputs/outputs checking

To display inputs/outs and manually set them, use the INs/OUTs submenu in the Service menu. In the "MANUAL" mode you can change the inputs/outputs values by manually overwriting them.

Figure 18

This function is good for e.g. servomotor control checking, el. heater section checking etc.

After the checking, do not forget to change the MANUAL back to AUTO by pressing the button!!!

The system is also capable of correcting thermometers, setting PI regulators and testing the RS-485 bus.

15.6. Operating point setting

To start the machine, you must set an operating point for air handling unit operation. You will find this setting in the main menu after pressing the "Weekly schedule" button.

Figure 19

Each operating point - the first column with numbers 0-8 - is assigned indicative symbols and can be assigned the desired values for air volume, % of outdoor air, temperature and other parameters (if the device allows changing these parameters). Running under these operating points can then be selected by:

1. Pressing the appropriate button at operating point symbol (at Web interface).
2. Setting the operating point at remote (room) controller.
3. Setting the operating point by digital input (external management).
4. Time schedule.
5. Modbus RTU (Slave).

16. Operation control

16.1. General

Operation control is governed by the following priorities: The Stop command has the highest priority. If the Stop command is chosen, e.g. using the Web interface, remote control, digital input or directly by regulator buttons, the system is always brought to the Stop state and it is not allowed to run, when at least one Stop command is active!

If there is no request to stop, you can choose to run the machine under an operating point.

If there is a request of running according to an operating point, the system starts to run under this operating point.

If there is a request of running multiple operating points at once, the item with the higher number is activated (according to the "Operating point setting" Web interface, higher number means higher priority).

If there is neither request to stop nor request for operation of the unit, the unit works according to the time schedule.

16.2. From Web interface

By pressing the appropriate button (next to the symbol, in the "weekly schedule" menu) choose to run under an operating point directly from the Web browser. if you do not use Web browser for constant control of the machine, do not forget to deactivate the run under an operating point selected in this way before disconnecting the regulator from the PC!

16.3. From remote (room) controller

From the remote (room) controller you can choose these 4 operating states:

- ⏻ Turned off - stop (turned off)
- ⚙️ Operating point 1 - running under the operating point 1
- ⌚ Operating point 2 - running under the operating point 2
- 🕒 Time schedule – running under a time schedule (if set)

16.4. Setting the operating point by digital input (external management)

You can control the system run by digital inputs. The voltage of these inputs is 24 V DC. If the machine is equipped with terminals for external management from

master system, you can control the run using a digital input. Such control can be set according to special manuals (available at the manufacturer upon request).

17. Time schedule

If you request the run under the time schedule, you must set the time schedule correctly. In one day, you can set up to 6 instants when there is a change of operating point. For correct operation of the time schedule, **choose the time data for individual days in ascending order. If the time data are not arranged in ascending order or the same activation times are chosen for one day, the time schedule will not work!**



Figure 20

After any change of the time schedule do not forget to save the changes by the "Enter points and Calendar" button.

18. Contacts

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. The manufacturer reserves the right to change the hardware and software of the measurement and control system.

In case of questions and ambiguity, do not hesitate to contact us.

