1 SPECIFICATION OF SUPPLY

Water-ammonia absorption heat pump, fed with natural gas or LPG, air-water version, reversible, for hot water production up to a delivery temperature of 60°C and alternatively for cold water up to delivery temperature of 3°C, for external installation, consisting of:

- steel sealed circuit, externally treated with epoxy paint;
- sealed combustion chamber (type C) suitable for outdoor installations;
- metal mesh radiant burner equipped with ignition and flame detection device, controlled by an electronic control unit;
- titanium stainless steel shell-and-tube water heat exchanger, externally insulated;
- air exchanger with finned coil, with steel pipe and aluminium fins;
- automatic microprocessor-controlled finned coil automatic defrosting valve;
- low power consumption refrigerant fluid oil pump;
- standard fan *or* silenced fan *(specify the desired version)* with variable flow rate (cooling mode).

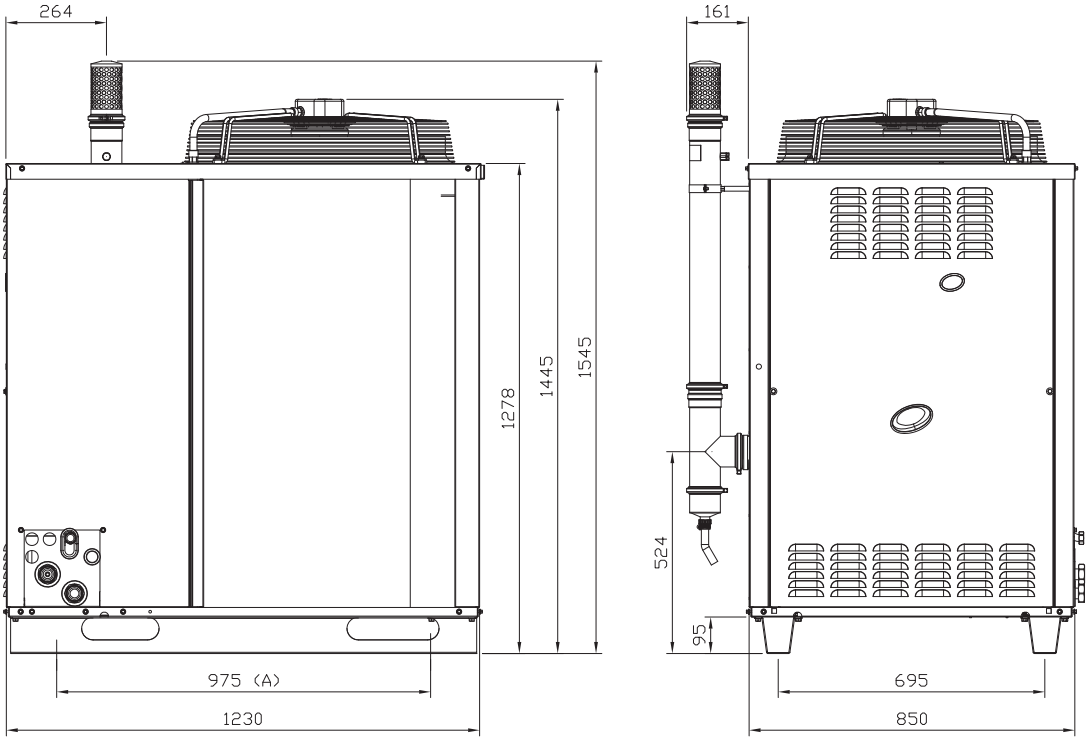
Control and safety devices:

- electronic board with microprocessor;
- circuit water flow switch;
- generator limit thermostat, with manual reset;
- generator fin temperature sensor;
- differential air pressure switch on the combustion circuit;
- sealed circuit safety relief valve;
- by-pass valve, between high and low pressure circuits;
- ionisation flame controller;
- gas solenoid valve with double shutter;
- antifreeze function for water circuit.

2 FEATURES AND TECHNICAL DATA

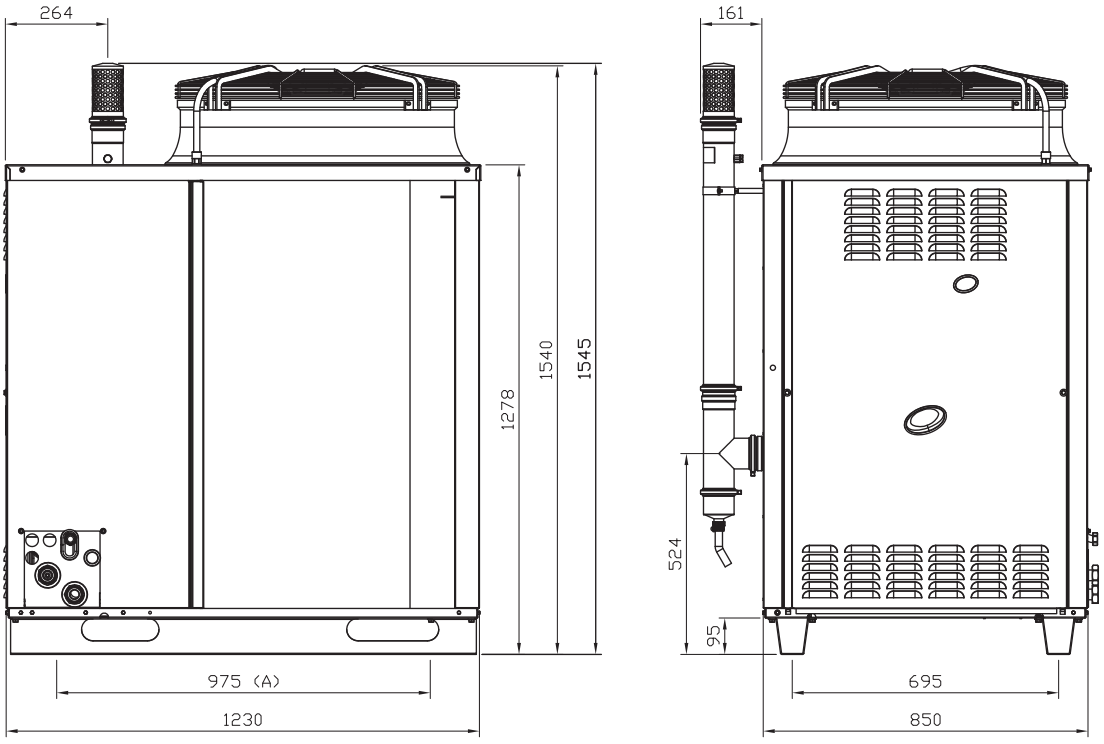
2.1 DIMENSIONS

Figure 2.1 *GAHP-AR dimensions - Front and right side views (dimensions in mm)*



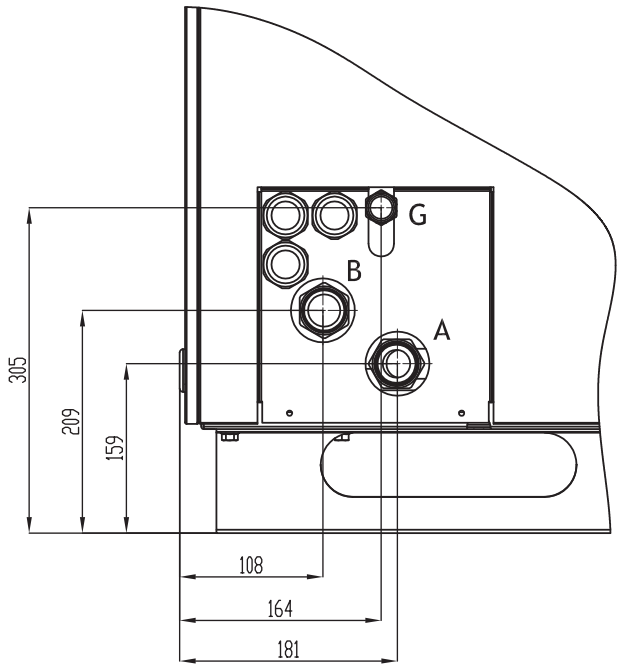
A Position of holes for fixing of anti-vibration joints

Figure 2.2 *GAHP-AR S dimensions - Front and right side views (dimensions in mm)*



A Position of holes for fixing of anti-vibration joints

Figure 2.3 *GAHP-AR service plate - Detail of hydraulic and gas connections (dimensions in mm)*



G Gas supply 3/4" F
A Water flow to installation 1"1/4 F
B Water inlet to unit 1"1/4 F

2.2 OPERATION MODE

The GAHP-AR unit may only work in the ON/OFF mode, i.e. ON (at full power) or OFF, with circulating pump at constant flow.

2.3 CONTROLS

Control device

The appliance may only work if it is connected to a control device, selected from:

► (1) **DDC control**
► (2) **external request**

2.3.1 Control system (1) with DDC (GAHP unit ON/OFF)

The DDC controller is able to control the appliances, a single GAHP unit, or even several Robur GAHP/GA/AY units in cascade, only in ON/OFF mode (non modulating). For more information see Section C1.12.

2.3.2 Adjustment system (1) with DDC (GAHP unit ON/OFF)

The appliance may also be controlled via generic enable devices (e.g. thermostat, timer, button, contactor...) fitted with voltage-free NO contact. This system only provides elementary control (on/off, with fixed setpoint temperature), hence without the important functions of system (1). It is advisable to possibly limit its use to simple applications only and with a single appliance. There are two control options: heating request or cooling request.

2.4 TECHNICAL CHARACTERISTICS

Table 2.1 *GAHP-AR technical data*

				GAHP-AR Standard	GAHP-AR S
Heating mode					
Seasonal space heating energy efficiency class (ErP)	medium-temperature application (55 °C)		-	A+	
	low-temperature application (35 °C)		-	A	
Unitary heating power	Outdoor temperature/Delivery temperature	A7W35	kW	37,8	
		A7W50	kW	35,3	
GUE efficiency	Outdoor temperature/Delivery temperature	A7W35	%	150	
		A7W50	%	140	
Heating capacity	nominal (1013 mbar - 15 °C)		kW	25,7	
	real		kW	25,2	
Hot water delivery temperature	maximum		°C	60	
	nominal		°C	50	
Hot water return temperature	maximum		°C	50	
	minimum temperature in continuous operation		°C	30 (1)	
Thermal differential	nominal		°C	10	
Heating water flow	nominal (Delta T = 10 °C)		l/h	3040	
	maximum		l/h	3500	
	minimum		l/h	2500	
Pressure drop heating mode	at nominal water flow		bar	0,29 (2)	
Ambient air temperature (dry bulb)	nominal		°C	7	
	maximum		°C	35	
	minimum		°C	-20	
Operation in conditioning mode					
Unitary cooling power	Outdoor temperature/Delivery temperature	A35W7	kW	16,9	
GUE efficiency	Outdoor temperature/Delivery temperature	A35W7	%	67	
Cold water temperature (inlet)	maximum		°C	45	
	minimum		°C	8	
Water flow rate	nominal (Delta T = 5 °C)		l/h	2900	
	maximum		l/h	3500	
	minimum		l/h	2500	
Internal pressure drop	at nominal water flow		bar	0,31 (2)	
External air temperature	nominal		°C	35	
	maximum		°C	45	
	minimum		°C	0	
Electrical specifications					
Power supply	voltage		V	230	
	type		-	single-phase	
	frequency		50 Hz supply	50	
Electrical power absorption	nominal		kW	0,84 (3)	0,87 (3)
Degree of protection	IP		-	X5D	
Installation data					
Gas consumption	methane G20 (nominal)		m^3/h	2,72 (4)	
	G25 (nominal)		m^3/h	3,16 (5)	
	G27 (nominal)		m^3/h	3,32 (6)	
	G30 (nominal)		kg/h	2,03 (7)	
	G31 (nominal)		kg/h	2,00 (7)	
NO_x emission class			-	5 (8)	
NO_x emission			ppm	30,0 (9)	
CO emission			ppm	23,0 (9)	
Sound power L_w (max)			dB(A)	79,6 (10)	75,0 (10)
Sound pressure L_p at 5 metres (max)			dB(A)	57,6 (11)	53,0 (11)
Maximum water pressure in operation			bar	4	
Water content inside the apparatus			l	3	

(1) In transient operation, lower temperatures are allowed.
(2) For flows other than nominal see Design Manual, Pressure losses Paragraph.
(3) ±10% according to the power supply voltage and tolerance on electrical motors consumption. Measured at outdoor temperature of 30 °C.
(4) PCI (G20) 34,02 MJ/m^3 (15 °C - 1013 mbar).
(5) PCI (G25) 29,25 MJ/m^3 (15 °C - 1013 mbar).
(6) PCI (G27) 27,89 MJ/m^3 (15 °C - 1013 mbar).
(7) PCI (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(8) All values measured with G20 (natural gas) as reference gas.
(9) Values measured with G20 (methane), as gas of reference. NOx and CO levels measured in compliance with EN 483 (combustion values at 0% of O2).
(10) Sound power values detected in compliance with the intensity measurement methodology set forth by standard EN ISO 9614.
(11) Maximum sound pressure levels in free field, with directionality factor 2, obtained from the sound power level in compliance with standard EN ISO 9614.
(12) Overall dimensions excluding fumes pipes.

			GAHP-AR Standard	GAHP-AR S
Water fitting	type	-	F	
	thread	" G	1 1/4	
Gas connection	type	-	F	
	thread	" G	3/4"	
Fume outlet	diameter (Ø)	mm	80	
	residual head	Pa	12	
Type of installation		-	B23, B53	
Dimensions	width	mm	850	
	depth	mm	1230	
	height	mm	1445 (12)	1540 (12)
Weight	in operation	kg	380	390
General information				
Cooling fluid	ammonia R717	kg	7,1	
	water H_2O	kg	10,0	
Maximum pressure of the cooling circuit		bar	32	

(1) In transient operation, lower temperatures are allowed.
(2) For flows other than nominal see Design Manual, Pressure losses Paragraph.
(3) ±10% according to the power supply voltage and tolerance on electrical motors consumption. Measured at outdoor temperature of 30 °C.
(4) PCI (G20) 34,02 MJ/m³ (15 °C - 1013 mbar).
(5) PCI (G25) 29,25 MJ/m³ (15 °C - 1013 mbar).
(6) PCI (G27) 27,89 MJ/m³ (15 °C - 1013 mbar).
(7) PCI (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(8) All values measured with G20 (natural gas) as reference gas.
(9) Values measured with G20 (methane), as gas of reference. NOx and CO levels measured in compliance with EN 483 (combustion values at 0% of O2).
(10) Sound power values detected in compliance with the intensity measurement methodology set forth by standard EN ISO 9614.
(11) Maximum sound pressure levels in free field, with directionality factor 2, obtained from the sound power level in compliance with standard EN ISO 9614.
(12) Overall dimensions excluding fumes pipes.

Table 2.2 *PED data*

			GAHP-AR S	GAHP-AR Standard
PED data				
Components under pression	generator	l	18,6	
	leveling chamber	l	11,5	
	evaporator	l	3,7	
	cooling volume transformer	l	4,5	
	cooling absorber solution	l	6,3	
	solution pump	l	3,3	
Test pressure (in air)		bar g	55	
Maximum pressure of the cooling circuit		bar g	32	
Filling ratio		kg of NH_3/l	0,148	
Fluid group		-	1°	

2.4.1 Pressure drops

Heating

Table 2.3 *Pressure drop GAHP-AR heating mode*

Water flow rate	Vector fluid temperature at outlet		
	35 °C	50 °C	60 °C
	Bar	Bar	Bar
2500 l/h	0,22	0,21	0,20
3000 l/h	0,30	0,29	0,28
3500 l/h	0,40	0,38	/

Cooling

Table 2.4 *Pressure drop GAHP-AR cooling mode*

Water flow rate	Vector fluid temperature at outlet		
	3 °C	7 °C	10 °C
	Bar	Bar	Bar
2500 l/h	0,26	0,24	0,23
3000 l/h	0,35	0,33	0,32
3500 l/h	0,48	0,46	0,45

The data refer to operation with no glycol in water.

2.4.2 Performances

Heating

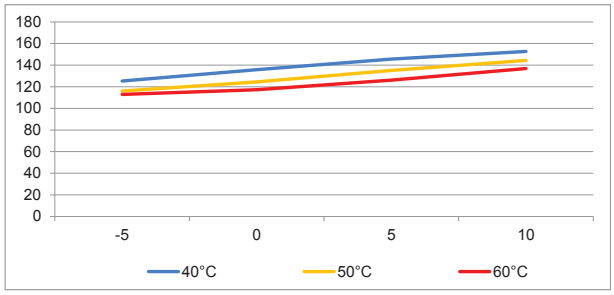
Table 2.5 *p. 6* shows the unitary thermal power at full load and in stable operation, depending on hot water delivery temperature to the system and outdoor temperature.
Please consider that, according to the actual heating request, the unit may often need to operate under partial load conditions and in non stationary operation.

Table 2.5 *GAHP-AR heating power for each unit*

External air temperature	Water delivery temperature					
	35 °C	40 °C	45 °C	50 °C	55 °C	60 °C
	KW	KW	KW	KW	KW	KW
-15 °C	27,7	27,0	26,2	25,8	25,5	25,1
-10 °C	29,8	28,8	27,7	27,0	26,7	26,4
-5 °C	32,6	31,6	30,6	29,2	28,8	28,4
0 °C	34,9	34,2	33,6	31,4	30,5	29,6
5 °C	37,0	36,7	36,4	34,1	32,9	31,8
7 °C	37,8	37,6	37,5	35,3	34,2	33,0
10 °C	38,5	38,5	38,4	36,4	35,5	34,5
15 °C	39,2	39,2	39,1	37,6	36,7	35,8

Picture 2.4 *p. 6* shows the GUE trend at full load in heating mode and in stable operation for three representative delivery temperatures, according to outdoor temperature.
Please consider that, according to the actual heating request, the unit may often need to operate under partial load conditions and in non stationary operation.

Figure 2.4 *GUE GAHP-AR heating*



In abscissa the outdoor temperature
In ordinate the full load GUE rate

Cooling

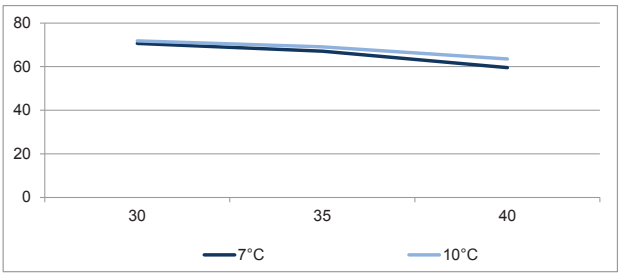
Table 2.6 *p. 6* shows the unitary cooling load at full load and in stable operation, depending on cold water delivery temperature to the system and outdoor temperature.
Please consider that, according to the actual cooling request, the unit may often need to operate under partial load conditions and in non stationary operation.

Table 2.6 *GAHP-AR cooling power for each unit*

External air temperature	Water delivery temperature	
	7 °C	10 °C
	KW	KW
30 °C	17,8	18,1
35 °C	16,9	17,4
40 °C	15,0	16,0
45 °C	/	13,5

Picture 2.5 *p. 6* shows the GUE trend at full load in cooling mode and in stable operation for two representative delivery temperatures.
Please consider that, according to the actual cooling request, the unit may often need to operate under partial load conditions and in non stationary operation.

Figure 2.5 *GUE GAHP-AR cooling*



In abscissa the outdoor temperature
In ordinate the full load GUE rate

3 DESIGN

Compliance with installation standards

Design and installation must comply with applicable regulations in force, based on the installation Country and site, in matters of safety, design, implementation and maintenance of:

- heating systems;
- cooling systems;
- gas systems;
- flue gas exhaust;
- flue gas condensate discharge.

Design and installation must also comply with the manufacturer's provisions.

3.1 PLUMBING DESIGN

Please refer to Section C1.04.

3.2 FUEL GAS SUPPLY

Please refer to Section C1.09.

3.3 COMBUSTION PRODUCTS EXHAUST

Compliance with standards

The appliance is approved for connection to a combustion products exhaust duct for the types shown in Table 2.1 *p. 4*.

3.3.1 Flue gas exhaust connection

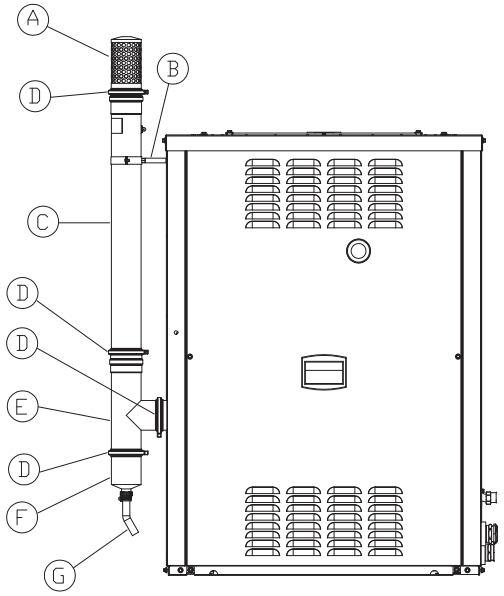
► Ø 80 mm (with gasket), on the left, at the top (Figure 3.1 *p. 7*).

3.3.2 Flue gas exhaust kit

The appliance is supplied with flue gas exhaust kit, to be fitted by the installer, including (Figure 3.1 *p. 7*):

► 1 Ø 80 mm flue gas exhaust pipe, length 750 mm (C);
► 1 "T" connector (E);
► 1 condensate trap (F);
► 1 terminal (A);
► 1 clamp for fixing pipe (B) to left side panel;
► 4 pipe clamps (D);
► 1 condensate drain hose fitting and silicone hose (G).

Figure 3.1 *Components of exhaust air duct kit*



A Terminal
B Clamp for fixing pipe
C Drain pipe L=750mm
D Hoseclamp
E "T" connector;
F Condensate drip pan
G Hose adaptor + condensate drain pipe

3.3.3 Possible flue

If required, the appliance may be connected to a flue of appropriate type for non condensing appliances.

► For flue sizing please refer to Table 2.1 *p. 4* and the specification sheet in Section C1.10.
► The flue must be designed, sized, tested and constructed by a skilled form, with materials and components complying with the regulations in force in the country of installation.
► Always provide a socket for flue gas analysis, in an accessible position.

If several GAHP-AR appliances are connected to a single flue, NO check valves must be installed.

To avoid corrosion phenomena, convey the GAHP-AR acid condensate discharge to the base of the flue gas exhaust duct.

3.4 FLUE GAS CONDENSATE DISCHARGE

The GAHP-AR unit produces condensation water from combustion flue gas only during the cold start-up transient.

Condensate acidity and exhaust regulations

The flue gas condensate contains aggressive acid substances. Refer to applicable regulations in force for condensate exhaust and disposal.

- If required, install an acidity neutraliser of adequate capacity.

Do not use gutters to discharge the condensate

Do not discharge the fume condensate in gutters, due to the risk of materials corrosion and ice formation.

3.4.1 Flue gas condensate connection

The fitting for flue gas condensate drain is located on the base of the flue gas exhaust duct (Figure 3.1 *p. 7*).

3.4.2 Flue gas condensate discharge manifold

To make the condensate discharge manifold:

- ► Size ducts with diameter no less than 15 mm.
- ► Use plastic materials resistant to acidity pH 3-5.
- ► Provide for min. 1% slope, i.e. 1 cm for each m of the length (otherwise a booster pump is required).
- ► Prevent icing.
- ► Dilute, if possible, with domestic waste water (e.g. bathrooms, washing machines, dish washers...), basic and neutralising.

3.5 ELECTRICAL AND CONTROL CONNECTIONS

3.5.1 Warnings

Earthing

- The appliance must be connected to an effective earthing system, installed in compliance with regulations in force.
- It is forbidden to use gas pipes as earthing.

Cable segregation

Keep power cables physically separate from signal ones.

Do not use the power supply switch to turn the appliance on/off

- Never use the external isolation switch (GS) to turn the appliance on and off, since it may be damaged in the long run (occasional black outs are tolerated).
- To turn the appliance on and off, exclusively use the suitably provided control device (DDC or external enable).

Control of water circulation pump

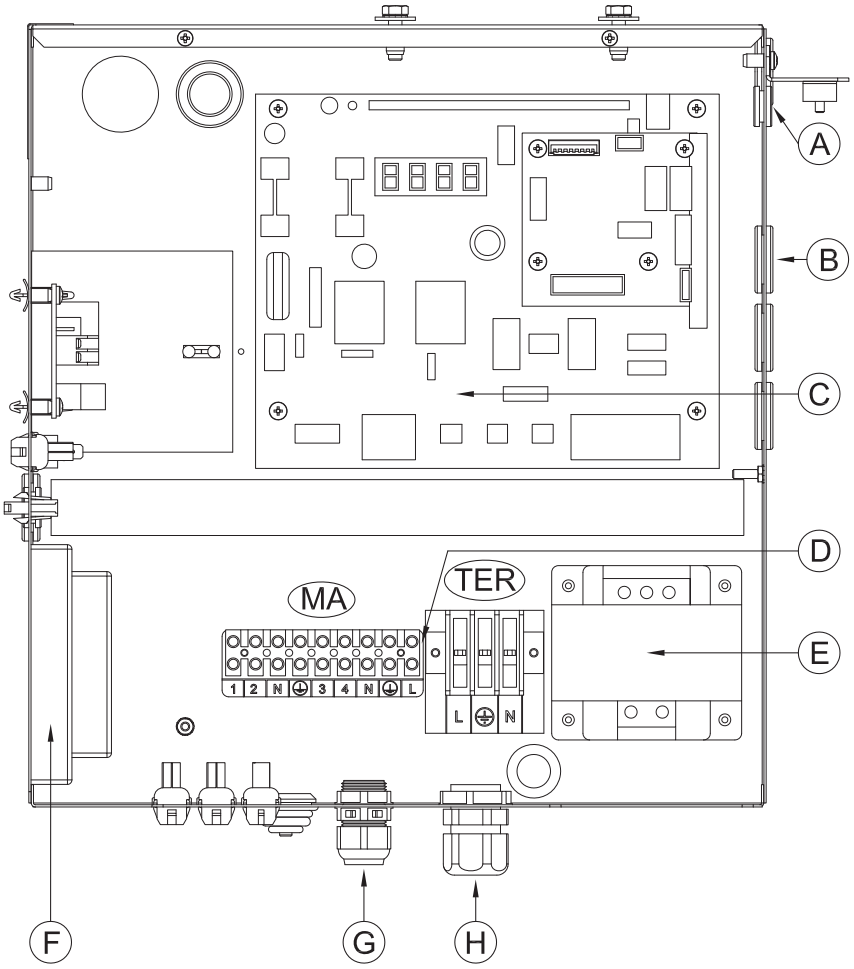
The water circulation pump of the water/primary circuit must mandatorily be controlled by the appliance's electronic boards. It is not admissible to start/stop the circulating pump with no request from the appliance.

3.5.2 Electrical systems

Electrical connections must provide:

- ► (a) power supply;
- ► (b) control system.

Figure 3.2 *GAHP-AR electrical panel*



A CAN-BUS cable gland
B signal cable gland 0...10 V pump Wilo Stratos Para
C Electronic boards S61+Mod10+W10
D terminal blocks
E transformer 230/23 V AC
F flame control box
G circulation pump power supply and control cable gland
H GAHP power supply cable gland

Terminals:
TER terminal box
L-(PE)-N phase/earth/neutral GAHP power supply
MA terminal box
N-(PE)-L neutral/earth/phase circulation pump power supply
3-4 circulation pump enable

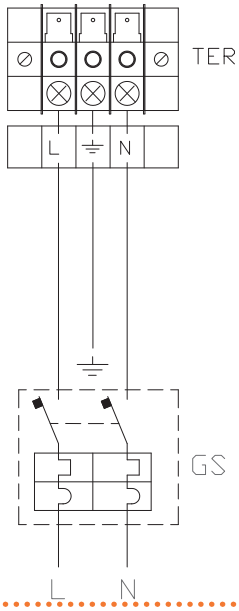
3.5.3 Electrical power supply

Power supply line

Provide (by the installer) a protected single phase line (230 V 1-N 50 Hz) with:

- 1 three-pole cable type FG7(O)R 3Gx1.5;
- 1 two-pole switch with two 5A type T fuses, (GS) or one 10A magnetothermic breaker.

Figure 3.3 *Electrical wiring diagram - Example of connection of appliance to 230 V 1 N - 50 Hz electricity supply*



TER terminal block
L phase
N neutral

Components NOT SUPPLIED
GS general switch

The switches must also provide disconnector capability, with min contact opening 4 mm.

3.5.4 Set-up and control

Switching for reversible units

Use that entails frequent switching between heating/cooling operation modes are to be avoided for reversible units

Control systems, options (1) or (2)

Two separate control systems are provided, each with specific features, components and diagrams (Figures 3.5 *p. 11*, 3.6 *p. 11*):

- ► System (1), with **DDC control** (with CAN-BUS connection).
- ► System (2), with an **external request**.

CAN-BUS communication network

The CAN-BUS communication network, implemented with the cable of the same name, makes it possible to connect and remotely control one or more Robur appliances with the DDC control devices.

It entails a certain number of serial nodes, distinguished in:

- ► intermediate nodes, in variable number;
- ► terminal nodes, always and only two (beginning and end);

Each component of the Robur system, appliance (GAHP, GA, AY, ...) or control device (DDC, RB100, RB200, ...), corresponds to a node, connected to two more elements (if it is an intermediate node) or to just one other element (if it is a terminal node) through two/one CAN-BUS cable section/s, forming an open linear communication network (never star or loop-shaped).

CAN-BUS signal cable

The DDC controller is connected to the appliance through the CAN-BUS signal cable, shielded, compliant to Table 3.1 *p. 10* (admissible types and maximum distances).

For lengths ≤200 m and max 4 nodes (e.g. 1 DDC + 3 GAHP), a simple 3x0.75 mm shielded cable may even be used.

Table 3.1 *CAN BUS cables type*

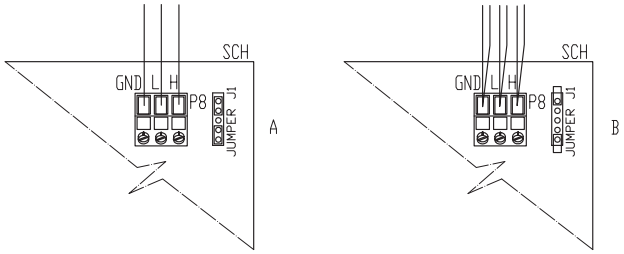
CABLE NAME	SIGNALS / COLOR			MAX LENGTH	Note
Robur					Ordering Code OCVO008
ROBUR NETBUS	H= BLACK	L= WHITE	GND= BROWN	450 m	
Honeywell SDS 1620					In all cases the fourth conductor should not be used
BELDEN 3086A	H= BLACK	L= WHITE	GND= BROWN	450 m	
TURCK type 530					
DeviceNet Mid Cable					
TURCK type 5711	H= BLUE	L= WHITE	GND= BLACK	450 m	
Honeywell SDS 2022					
TURCK type 531	H= BLACK	L= WHITE	GND= BROWN	200 m	

How to connect the CAN BUS cable to the appliance

To connect the CAN-BUS cable to the S61 electronic board, located in the Electrical Panel inside the appliance, Pictures 3.4 *p. 10* and 3.5 *p. 11* Details A and B:

1. Access the Electrical Board of the appliance according to the Procedure 3.5.2 *p. 8*);
2. Connect the CAN-BUS cable to terminals GND, L and H (shielding/earthing + two signal conductors);
3. Place the CLOSED J1 Jumpers (Detail A) if the node is terminal (one connected CAN-BUS cable section only), or OPEN (Detail B) if the node is intermediate (two connected CAN-BUS cable sections);
4. Connect the DDC to the CAN-BUS cable according to the instructions of the following Paragraphs and DDC Manual.

Figure 3.4 *Electrical wiring diagram - Connection cable CAN BUS to electronic board*

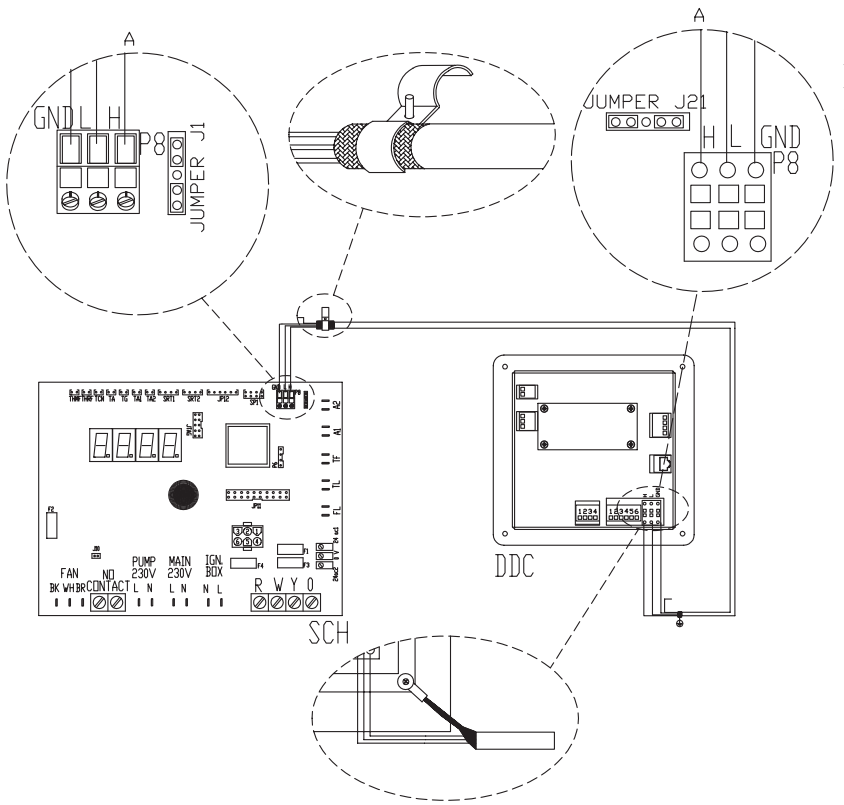


SCH	Electronic board
GND	Common data
L	Data signal LOW
H	Data signal HIGH
J1	Jumper CAN-BUS in board
A	detail of "terminal node" case (3 wires; J1=jumper "closed")
B	Detail of "intermediate node" case (6 wires; J1=jumper "open")
P8	CAN port/connector

GAHP Configuration (S61) + DDC

(System (1) Picture 3.5 *p. 11*, see also Paragraph 2.3 *p. 3*)

Figure 3.5 *CAN-BUS connection for systems with one unit*



DDC Direct Digital Control
SCH electronic board S61
J1 Jumper CAN-BUS in board S61
J21 Jumper CAN-BUS in board DDC
A terminal node connection (3 wires; J1 and J21 = "closed")
H,L,GND data signal wires (ref. cables table)

External request

(System (2), Picture 3.6 *p. 11*, see also Paragraph 2.3 *p. 3*)
It is required to arrange:

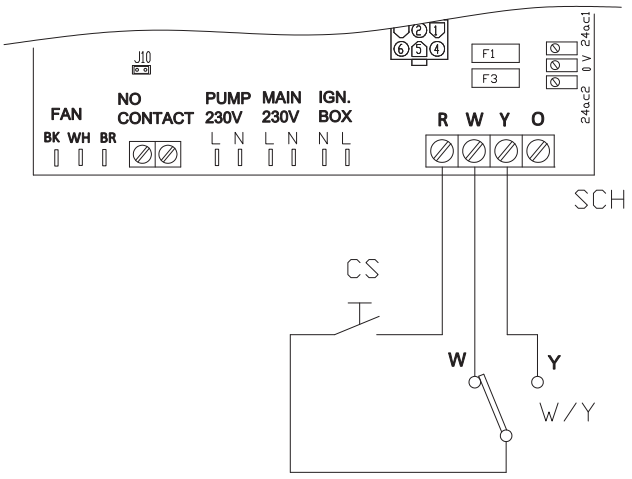
- ► request device (e.g. thermostat, timer, button, ...) fitted with a voltage-free NO contact;
- ► switching devicewinter/summer(heating/cooling, W and Y contacts on the S61 board).

How to connect the external request

Connection of external request is effected on the S61 board located in the Electrical Panel inside the unit (Figure 3.6 *p. 11*):

1. Access the Electrical Board of the appliance according to the Procedure 3.5.2 *p. 8*.
2. Connect the voltage-free contact of the external device (Detail CS), with winter/summer switching, through three wires, to **terminals R, W and Y** (respectively: common 24 V AC, heating request and cooling request) of S61 electronic board.

Figure 3.6 *Example of electrical connection of on/off commands*



SCH electronic board S61
CS consent switch (on/off; room thermostat; programmable timer; other)
W/Y hot/cold diverter (summer/winter)
R 24 Vac common power supply terminal
W hot consent terminal
Y On/Off command terminal - cold operation

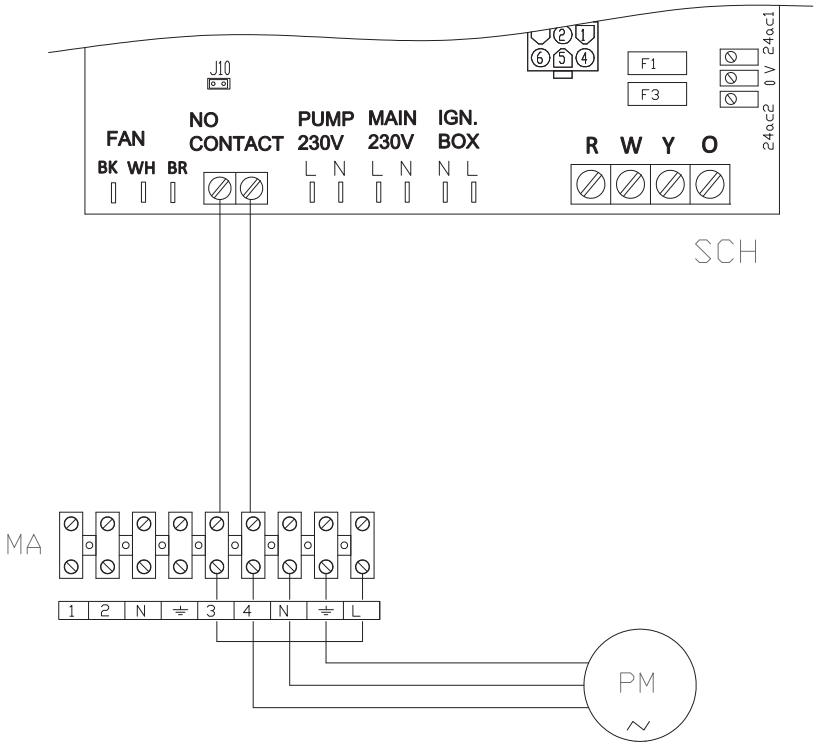
3.5.5 Water circulation pump

CONSTANT FLOW circulating pump

It must be mandatorily controlled from the S61 electronic board. The diagram in Figure 3.7 *p. 12* is for pumps < 700 W. For pumps > 700 W it is required to add a control relay and arrange

Jumper J10 OPEN.

Figure 3.7 *Water circulation pump connection - Connection of plant water circulation pumps (power absorption less than 700W), controlled directly by the appliance.*



SCH electronic board
J10 closed jumper
N.O. CONTACT N.O voltage free contacts
MA unit terminal block
L phase
N neutral
Components NOT SUPPLIED
PM water pump < 700W