1 DEFINITIONS

Appliance / GAHP Unit / GA Unit terms used to refer to the GAHP (Gas Absorption Heat Pump) heat pump or the GA (Gas Absorption) chiller.
BMS (Building Management System) any non Robur supervisor controller.
TAC Robur authorised Technical Assistance Centre.
Common circulating pump circulating pump supplying a set of generators.
Independent circulating pump circulating pump supplying one generator only.
Primary circuit section of the air conditioning system starting from the generators to the hydraulic separator or heat exchanger (if installed).
Secondary circuit section of the air conditioning system downstream of the hydraulic separator or heat exchanger (if installed).
Parallel plumbing configuration set-up where the water inlet to each generator is in common.
Serial plumbing configuration set-up where all or part of the water flow into a generator is from another generator.
External request generic control device (e.g. thermostat, timer or any other system) equipped with a voltage-free NO contact and used as control to start/stop the GAHP/GA unit.
CCI Controller (Comfort Controller Interface) optional Robur control device which lets you manage up to three consistent modulating GAHP units (GAHP A, GAHP GS/WS) only for heating.
CCP Controller (Comfort Control Panel) = Robur control device which lets you manage in modulation mode up to 3 consistent GAHP units (GAHP A, GAHP GS/WS) and all system components (probes, diverter/mixing valves, circulating pumps), including any integration boiler.
DDC Control (Direct Digital Controller) optional Robur control device to control one or more Robur appliances (GAHP heat pumps, GA ACF chillers and AY00-120 boilers) in ON/OFF mode.
RB100/RB200 devices (Robur Box) optional interface devices complementary to DDC, which may be used to extend its functions (heating/cooling/DHW production requests, and control of system components such as third party generators, diverter valves, circulating pumps, probes).
Third Party Generator non Robur boiler or chiller, which cannot be directly managed from the DDC Panel and thus requires an additional interface device (RB200).
Robur generator Robur heat pump, boiler or chiller, that may be controlled directly via the DDC Panel.
Heat generator equipment (e.g. boiler, heat pump, etc.) for heat production for space heating and DHW.
Base group set of generators of the base system.
Separable/separate group set of generators of the separable/separate DHW system.
GUE (Gas Utilization Efficiency) efficiency index of gas heat pumps, equal to the ratio between the thermal energy produced and the energy of the fuel used (relative to NCV, net calorific value).
2 pipe system a system the primary and/or secondary circuit of which has one pair of pipes only (delivery/inlet), therefore unable to supply simultaneous hot and cold water services.
4 pipe system a system fitted with two pairs of pipes on both the primary and secondary circuit, therefore able to supply simultaneously two separate services.
Separable DHW system part of a primary circuit that is able to have two states by means of diverter valves:

- water plumbing connected to the base system ("included" state); in included state this part of the system integrates the space heating service;
- disconnected from the base system ("separate" state); in the separate state this part of the system is designated for DHW production, regardless of the service supplied by the base system.

Separate DHW system part of the primary circuit exclusively for DHW production, the plumbing of which is permanently disconnected from the base system.
DHW system a system only intended for domestic hot water production.
Base system part of the primary circuit on which generator's plumbing is permanently connected.
Heat system a system intended for production of hot water for heating and/or domestic hot water.
Cold system a system intended for production of cold water.
Integration coordinated control of various types of generators with the aim of maximizing the system's overall efficiency.
Power integration an integration mode where all generators produce power at the same temperature.
Temperature integration an integration mode where different types of generators may produce power at different temperatures.
"Integration and progressive replacement" operating mode operating mode possible for a serial plumbing configuration where the delivery temperature request is not compatible in certain operative conditions with the operating temperatures of certain generators (in particular GAHP).
"Integration and replacement" operating mode operating mode where the temperature request in certain operative conditions may not be compatible with the operating temperatures of certain generators (in particular GAHP).
"Integration" operating mode operating mode where the temperature request in all operative conditions is compatible with the operating temperatures of all generators.
Heat module for one Robur generator, it is the logic control unit that manages hot water production functions.
Cold module for one Robur generator, it is the logic control unit that manages cold water production functions.
First Start-up appliance commissioning operation which may only and exclusively be carried out by a TAC.
Service request it is the signal that turns on a certain service. Please note that certain service requests may be relayed to the Robur control system in different modes (directly to the DDC or through RB100/RB200).
S61/Mod10/W10/AY10 boards electronic boards on the GA/GAHP unit, to control all functions and to provide interfacing with other devices and with the user.
Service for Robur control systems, it is the term used to identify a specific functionality of the resources managed by the controllers (heating service, DHW service, conditioning service, valve service, circulating pump service, probe service...).
Hybrid system a system consisting of Robur heat pumps and boilers (Robur or third party units).
Mixed system a system consisting of Robur units and third party units.

2 ABSORPTION ADVANTAGES

- Extremely high winter energy efficiency
- High savings on management costs (up to 40%)

- Extremely high reliability thanks to the almost complete absence of moving parts
- Prevents installed electric power increase
- Option of combinations with boilers or chillers
- Stable and efficient operation even at very low outdoor temperatures (air versions)
- No efficiency decay over time
- Uninterrupted power delivery during defrosting (air versions)
- Thermodynamic circuit free from any scheduled maintenance (maintenance is comparable to that required for a condensing boiler)
- Service continuity thanks to modular regulation
- In geothermal space heating application, it halves the required probes
- No toxic refrigerants are used, harmful for the environment or the ozone layer
- Sealed circuit that does not require any refrigerant topping up
- No water consumption in conditioning (there is no evaporative cooling tower)
- Increase in the building's energy rating

3 ABSORPTION CYCLE

In the conventional cooling cycle (with vapour compression) the process by which the gaseous refrigerant goes from low pressure/low temperature on evaporator outlet to high pressure/high temperature conditions on the condenser inlet is performed by a mechanical compressor (usually electrical).
The substantial difference with the absorption cycle is that the same process is performed via "thermo-physical compression", divided into three main stages:

1. through a spontaneous refrigerant/absorbent reaction, the gaseous refrigerant is absorbed in low pressure liquid phase;
2. the pressure of the liquid solution is raised thanks to a pump;
3. the high pressure solution is heated to the point of releasing the refrigerant in gaseous phase again, at high temperature.

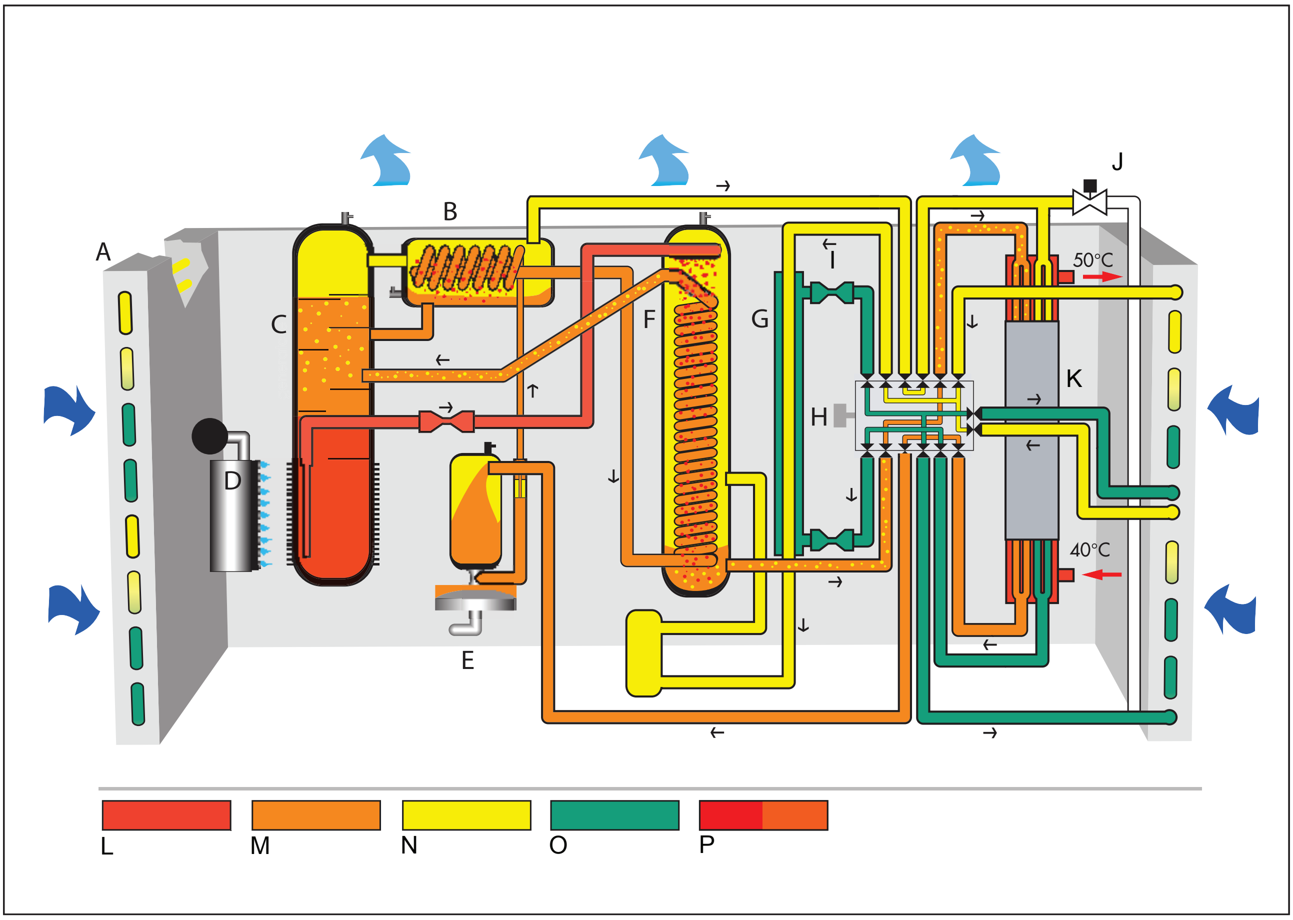
The advantages of this thermo-physical process compared to conventional mechanical compression are essentially as follows:

1. raising the pressure of a liquid requires far less energy (electricity) than compressing a gas;
2. the absorption reaction is highly exothermic and the released heat may be usefully exploited;
3. the "motive" energy of the process is primary energy (natural gas).

3.1 DETAILED DESCRIPTION

For a detailed description of a GAHP heat pump's thermodynamic cycle you should refer to Picture 3.1 *p. 3*, which shows the GAHP-AR cooling circuit in heating mode.
The multi gas burner (D) is used to heat the absorbent-refrigerant solution causing separation of the two components by evaporation of the refrigerant in the distillation column (C).
The burner-distillation column complex (C+D) is defined as generator and in absorption machines it replaces the typical compressor of electric heat pumps.
The refrigerant steam of the outlet of the generator goes through the rectifier (B) and separates from any residual water and goes into the shell and tube heat exchanger (M), which takes on the role of the machine's condenser-absorber in the winter season.
In this part of the cycle the heat exchanger acts as refrigerant condenser, which transfers the latent condensation heat to the water of the heating system.
This refrigerant state change therefore represents the machine's first useful effect.
The refrigerant on outlet of the condensation section goes through a first lamination section (I), a tube in tube heat exchanger (G) and a second lamination section where progressively, through subsequent decreases in pressure and temperature, it is taken to the ideal conditions to change state again into the gaseous phase.
In fact, in the finned coil (A) the refrigerant absorbs heat from the outdoor air and thus evaporates.
In this part of the circuit the heat pump imports into the cycle a portion of aerothermal renewable energy.
The refrigerant used by GAHP heat pumps in the finned coil (ammonia) may evaporate even at very low temperatures.
This thermodynamic feature of the refrigerant allows renewable energy to be taken from the air even when its temperature reaches highly negative figures, thus dispensing with the need to have backup boilers.
The ammonia evaporated in the finned coil (A), after overheating in the tube in tube heat exchanger (G) enters the pre-absorber (F) where it meets the atomized absorbent (water) thus giving rise to the actual absorption reaction.
Absorption is an exothermic chemical reaction whereby the emitted thermal energy needs to be removed.
In the pre-absorber (F) this energy is partially used to preheat the water-ammonia solution that is about to go back into the generator.
To complete the absorption reaction, the solution is sent into the shell and tube heat exchanger again (M).
In this stage of the cycle, the heat exchanger acts as absorber and allows a considerable amount of thermal energy, which represents the second useful effect of the machine, to be transferred to the heat transfer fluid of the heating system.
The water ammonia solution of the outlet of the heat exchanger (M) is conveyed by the solution pump (E) into the generator again, going through the pre-absorber (F) and the rectifier (B) again, where it is pre-heated, recovering heat from the cycle itself.
The thermodynamic cycle described above therefore restarts in the generator.
The inversion valve of the heat pump cycle (H), only provided for GAHP-AR units, consists of a mechanical component through which the refrigerant flow is diverted into the circuit.
This operation makes it possible to seasonally invert the operating mode and produce hot water in winter and chilled water in summer.
If required, the defrosting valve (L), only intended for GAHP A and GAHP-AR aerothermal heat pumps, allows the finned coil to defrost quickly, with no need to invert the cycle or switch on electrical auxiliary heaters.
This is because, as shown in Picture 3.1 *p. 3*, only one of the two evaporator energy intakes is diverted to the coil, namely hot ammonia vapour.
This makes it possible to assure quick ice removal while assuring 50% power to the heating circuit, without markedly altering the machine's efficiency.

Figure 3.1 *GAHP-AR absorption cycle (heating mode)*



A Finned coil
B Rectifier
C Distillation column
D Burner
E Solution pump
F Pre-absorber
G Tube in tube heat exchanger
H Cycle inversion valve
I Lamination valve
J Defrosting valve
K Shell and tube heat exchanger
L Ammonia-rich solution
M Ammonia-poor solution
N Ammonia in vapour state
O Ammonia in liquid state
P Heating system water

SECTION B INDEX

1 SPECIFICATION OF SUPPLY

Water-ammonia absorption heat pump, fed with natural gas or LPG, air-water version, modulating and condensing, for hot water production up to a delivery temperature of 65 °C (70 °C at 50% of maximum power), 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;
- stainless steel, flue gas latent heat recovery exchanger;
- 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 S1 fan *(specify the desired version)*.

Control and safety devices:

- electronic board with microprocessor;
- installation water flowmeter;
- generator limit thermostat, with manual reset;
- flue gas temperature thermostat, with manual reset;
- generator fin temperature sensor;
- 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;
- condensate discharge obstruction sensor.

2 FEATURES AND TECHNICAL DATA

2.1 DIMENSIONS

Figure 2.1 *Size (Standard ventilation)*

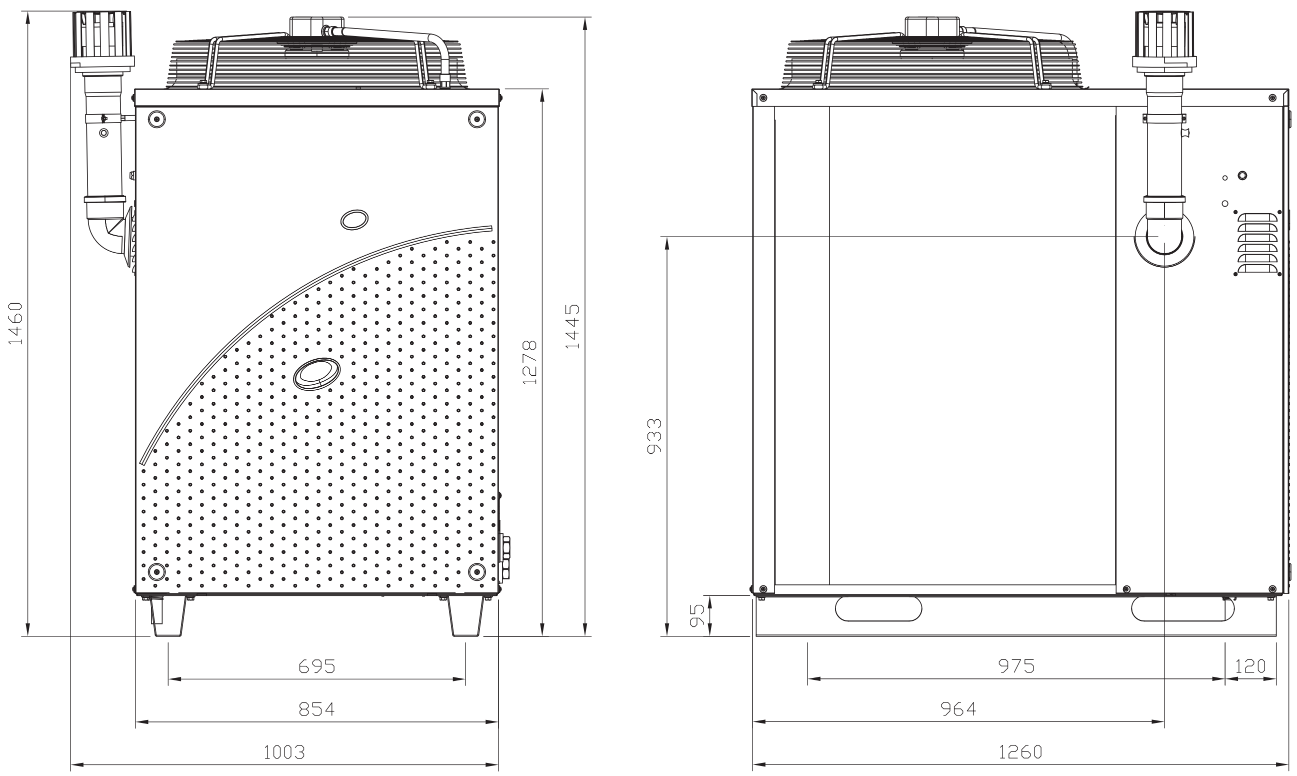


Figure 2.2 *Dimensions (low consumption silenced fan)*

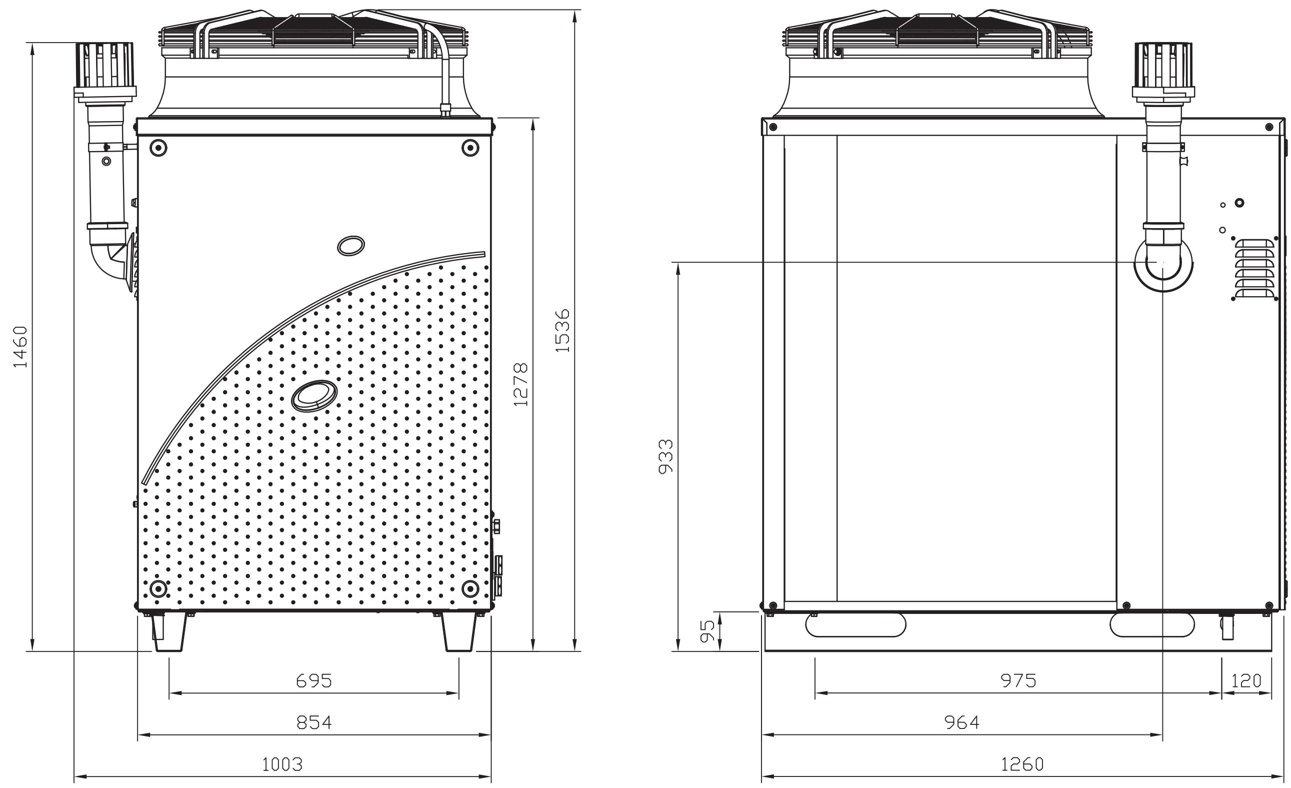
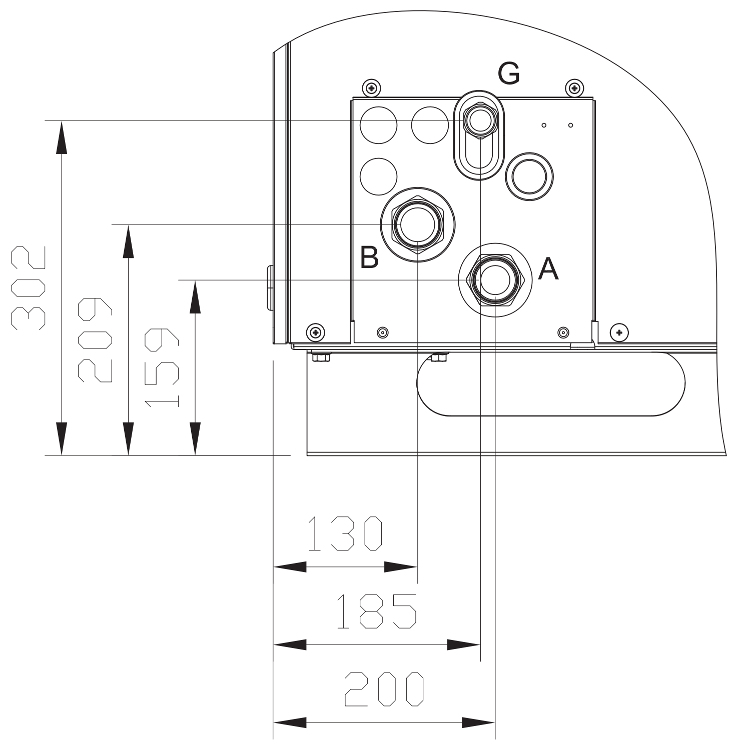


Figure 2.3 *Service plate - Hydraulic/gas unions detail*



G Gas fitting Ø ¾" F
B Inlet water fitting Ø 1¼" F
A Outlet water fitting Ø 1¼" F

2.2 OPERATION MODE

ON/OFF or modulating operation

The GAHP A unit may operate in two modes:

- mode (1) ON/OFF, i.e. On (at full power) or Off, with circulating pump at constant or variable flow;
- mode (2) MODULATING, i.e. at variable load from 50% to 100% of heating capacity, with circulating pump at variable flow.

For each mode, (1) or (2), specific control systems and devices are provided (Paragraph 2.3 *p. 4*).

2.3 CONTROLS

Control device

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

- (1) **DDC control**
- (2) **CCP/CCI control**
- (3) **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 Control system (2) with CCP/CCI (modulating GAHP unit)

The CCP/CCI control is able to control up to 3 GAHP units in modulating mode (therefore A/WS/GS only, excluding AR/ACF/AY), plus any integration ON/OFF boiler. For more information see Section C1.12.

2.3.3 Adjustment system (3) with external request (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 systems (1) and (2). It is advisable to possibly limit its use to simple applications only and with a single appliance.

2.4 TECHNICAL CHARACTERISTICS

Table 2.1 *GAHP A HT technical data*

				GAHP A HT Standard	GAHP A HT S1
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	41,3	
		A7W50	kW	38,3	
		A7W65	kW	31,1	
		A-7W50	kW	32,0	
GUE efficiency	Outdoor temperature/Delivery temperature	A7W35	%	164	
		A7W50	%	152	
		A7W65	%	124	
		A-7W50	%	127	
Heating capacity	nominal (1013 mbar - 15 °C)		kW	25,7	
	real		kW	25,2	
Hot water delivery temperature	maximum for heating		°C	65	
	maximum for DHW		°C	70	
Hot water return temperature	maximum for heating		°C	55	
	maximum for DHW		°C	60	
	minimum temperature in continuous operation		°C	30 (1)	
Thermal differential	nominal		°C	10	
Heating water flow	nominal		l/h	3000	
	maximum		l/h	4000	
	minimum		l/h	1400	
Pressure drop heating mode	nominal water pressure (A7W50)		bar	0,43 (2)	
Ambient air temperature (dry bulb)	maximum		°C	45	
	minimum		°C	-15 (3)	
Electrical specifications					
Power supply	voltage		V	230	
	type		-	SINGLE PHASE	
	frequency		50 Hz supply	50	

(1) In transient operation, lower temperatures are allowed.
(2) For flows other than nominal see Design Manual, Pressure losses Paragraph.
(3) As an option, a version for operation down to -30 °C is available.
(4) ±10% depending on power voltage and absorption tolerance of electric motors.
(5) PCI (G20) 34,02 MJ/m^3 (15 °C - 1013 mbar).
(6) PCI (G25) 29,25 MJ/m^3 (15 °C - 1013 mbar).
(7) PCI (G27) 27,89 MJ/m^3 (15 °C - 1013 mbar).
(8) PCI (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(9) Sound power values detected in compliance with the intensity measurement methodology set forth by standard EN ISO 9614.
(10) Maximum sound pressure levels in free field, with directionality factor 2, obtained from the sound power level in compliance with standard EN ISO 9614.
(11) Overall dimensions excluding fumes pipes.

			GAHP A HT Standard	GAHP A HT S1
Electrical power absorption	nominal	kW	0,84 (4)	0,77 (4)
	minimum	kW	-	0,50 (4)
Degree of protection	IP	-	X5D	
Installation data				
Gas consumption	methane G20 (nominal)	m^3/h	2,72 (5)	
	methane G20 (min)	m^3/h	1,34	
	G25 (nominal)	m^3/h	3,16 (6)	
	G25 (min)	m^3/h	1,57	
	G27 (nominal)	m^3/h	3,32 (7)	
	G27 (min)	m^3/h	1,62	
	G30 (nominal)	kg/h	2,03 (8)	
	G30 (min)	kg/h	0,99	
	G31 (nominal)	kg/h	2,00 (8)	
	G31 (min)	kg/h	0,98	
NO_x emission class		-	5	
NO_x emission		ppm	25,0	
CO emission		ppm	36,0	
Sound power L_w (max)		dB(A)	79,6 (9)	74,0 (9)
Sound power L_w (min)		dB(A)	-	71,0 (9)
Sound pressure L_p at 5 metres (max)		dB(A)	57,6 (10)	52,0 (10)
Sound pressure L_p at 5 metres (min)		dB(A)	-	49,0 (10)
Minimum storage temperature		°C	-30	
Maximum water pressure in operation		bar	4	
Maximum flow flue condensate		l/h	4,0	
Water content inside the apparatus		l	4	
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	80	
Type of installation		-	B23P, B33, B53P	
Dimensions	width	mm	854 (11)	
	depth	mm	1260	
	height	mm	1445 (11)	1540
Weight	in operation	kg	390	400
Required air flow		m^3/h	11000	
Fan residual head		Pa	40	
General information				
Cooling fluid	ammonia R717	kg	7,0	
	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) As an option, a version for operation down to -30 °C is available.
(4) ±10% depending on power voltage and absorption tolerance of electric motors.
(5) PCI (G20) 34,02 MJ/m^3 (15 °C - 1013 mbar).
(6) PCI (G25) 29,25 MJ/m^3 (15 °C - 1013 mbar).
(7) PCI (G27) 27,89 MJ/m^3 (15 °C - 1013 mbar).
(8) PCI (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(9) Sound power values detected in compliance with the intensity measurement methodology set forth by standard EN ISO 9614.
(10) Maximum sound pressure levels in free field, with directionality factor 2, obtained from the sound power level in compliance with standard EN ISO 9614.
(11) Overall dimensions excluding fumes pipes.

Table 2.2 *PED data*

			GAHP A HT S1	GAHP A HT Standard
PED data				
Components under pression	generator	l	18,6	18,6
	leveling chamber	l	11,5	11,5
	evaporator	l	3,7	3,7
	cooling volume transformer	l	4,5	4,5
	cooling absorber solution	l	6,3	6,3
	solution pump	l	3,3	3,3
Test pressure (in air)		bar g	55	55
Maximum pressure of the cooling circuit		bar g	32	32
Filling ratio		kg of NH_3/l	0,146	0,146
Fluid group		-	GROUP 1°	GROUP 1°

2.4.1 Pressure drops

Table 2.3 *GAHP A and GAHP A Indoor pressure drops*

Water flow rate	Vector fluid temperature at outlet		
	35 °C	50 °C	60 °C
	Bar	Bar	Bar
2000 l/h	0,23	0,21	0,19
3000 l/h	0,46	0,43	0,40
4000 l/h	0,78	0,72	0,67

2.4.2 Performances

Table 2.4 *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.

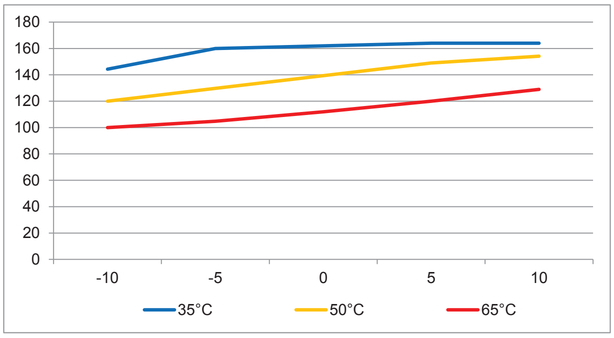
Table 2.4 *GAHP A and GAHP A Indoor heating power for each unit*

External air temperature	Water delivery temperature							
	35 °C	40 °C	45 °C	50 °C	55 °C	60 °C	65 °C	70 °C (1)
	KW	KW	KW	KW	KW	KW	KW	KW
-20 °C	33,9	31,5	29,6	27,7	25,7	23,7	22,7	9,3
-15 °C	35,2	32,8	30,9	29,0	27,0	24,9	23,9	10,0
-10 °C	36,4	34,0	32,1	30,2	28,2	26,2	25,2	10,6
-5 °C	40,3	37,7	35,2	32,7	30,6	28,5	26,4	11,1
0 °C	40,8	39,2	37,1	35,1	32,7	30,3	28,2	11,3
5 °C	41,3	40,0	38,8	37,5	34,8	32,0	30,2	11,8
7 °C	41,3	40,2	39,3	38,3	35,7	33,0	31,1	12,0
10 °C	41,3	40,6	39,8	38,9	36,6	34,4	32,5	12,4
15 °C	41,6	41,3	40,6	39,8	38,3	36,8	34,8	13,1
20 °C	41,6	41,4	40,8	40,2	39,5	38,5	37,1	13,8
25 °C	41,7	41,5	41,0	40,4	39,9	39,2	38,2	14,2
30 °C	41,8	41,6	41,1	40,5	40,1	39,4	38,4	14,4
35 °C	41,9	41,7	41,2	40,6	40,2	39,5	38,5	14,5

(1) Thermal input reduced to 50%

Picture 2.4 *p. 6* shows the GUE trend at full load 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 *GAHP A and GAHP A Indoor GUE*



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

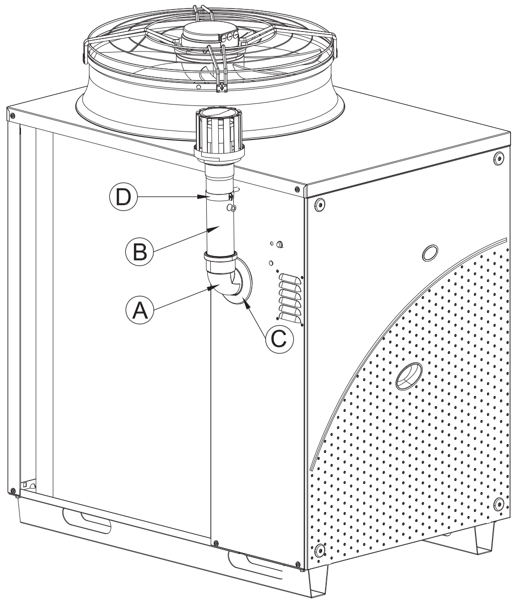
► Ø 80 mm (with gasket), on the left, at the top (Figure 3.1 *p. 7*).

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 pipe Ø 80 mm, length 300 mm, with terminal and socket for flue gas analysis;
► 1 support collar;
► 1 90° elbow Ø 80 mm;
► 1 rain cover.

Figure 3.1 *Fume outlet*



A 90° elbow Ø 80
B Pipe Ø 80 Lg.300 mm w/terminal
C Rain cover
D Collar

3.3.3 Possible flue

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

► Forfluesizingpleaserefertothespecificationsheetin Section C1.10.
► Ifseveralappliancesareconnectedtoasingleflue,itis oblig-atory to install a check valve on the exhaust of each.
► 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.

In case the flap valves are installed outside, an appropriate UV ray protection must be assured (if the valve is constructed in plastic material) as well as protection from potential winter freezing of condensate backflow into the siphon.

3.4 FLUE GAS CONDENSATE DISCHARGE

The GAHP A unit is a condensing appliance and therefore produces condensation water from combustion flue gases.

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 discharge is located on the left side of the appliance (Figure 3.2 *p. 8*).

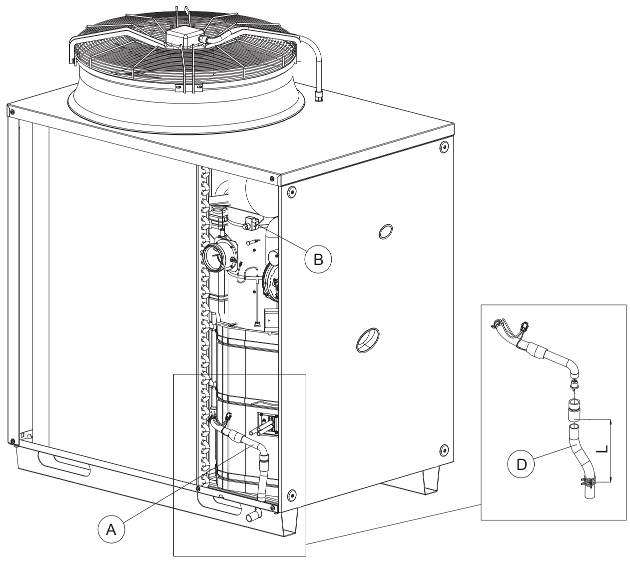
- The corrugated condensate discharge pipe must be connected to a suitable discharge manifold.
- The junction between the pipe and the manifold must remain visible.

3.4.2 Flue gas condensate discharge manifold

To make the condensate discharge manifold:

- Size the ducts for maximum condensation capacity (Table 2.1 *p. 4*).
- 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.

Figure 3.2 *Condensate drain position*



A Condensate discharge hose
D Corrugated hose

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, CCP/CCI or external request).

Control of water circulation pump

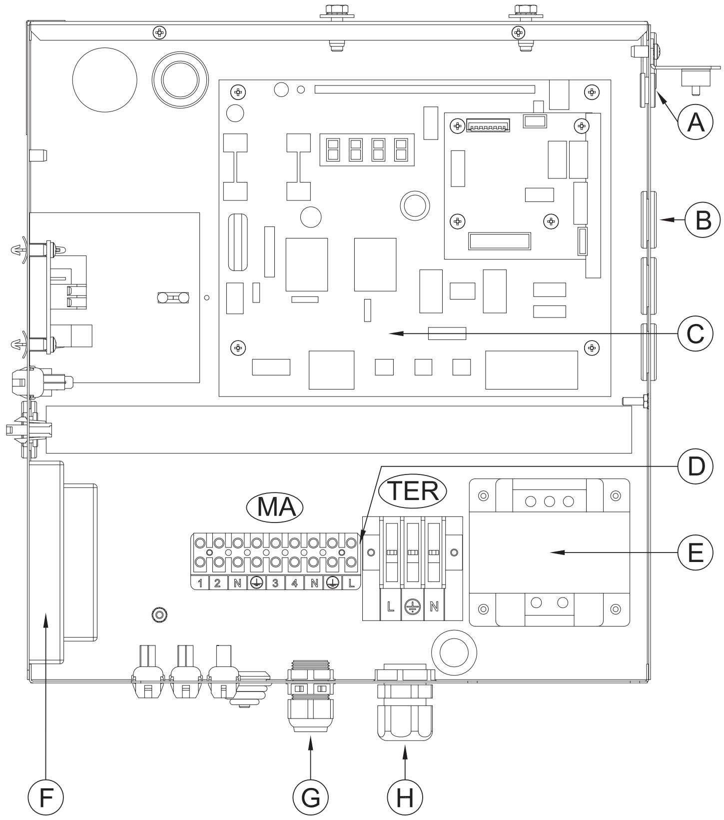
The water circulation pump of the water/primary circuit must mandatorily be controlled by the appliance's electronic boards. It is not admissible to start/stop the circulating pump with no request from the appliance.

3.5.2 Electrical systems

Electrical connections must provide:

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

Figure 3.3 *GAHP A 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 boxes
E transformer 230/23 V AC
F flame control unit
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

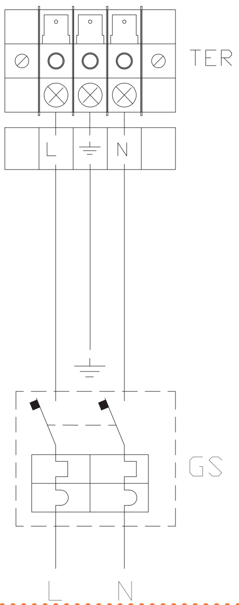
3.5.3 Electrical power supply

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 3.4 *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

Control systems, options (1) (2) (3)

Three separate adjustment systems are provided, each with specific features, components and diagrams (see 3.6 *p. 10*, 3.7 *p. 11*):

- System (1), with **DDC control** (with CAN-BUS connection).
- System (2), with **CCP/CCI control** (with CAN-BUS connection).
- System (3), 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 or CCP/CCI 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, CCI, ...), 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 or CCP/CCI controllers are 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*

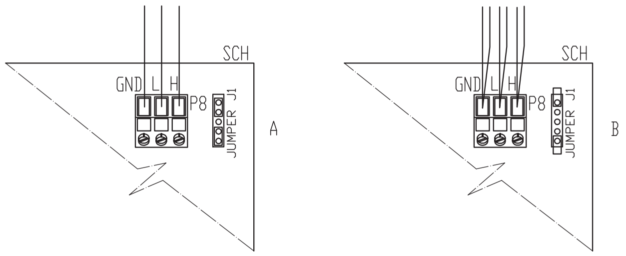
CABLE NAME	SIGNALS / COLOR			MAX LENGTH	Note
Robur					Ordering Code OCVO008
ROBUR NETBUS	H= BLACK	L= WHITE	GND= BROWN	450 m	
Honeywell SDS 1620					In all cases the fourth conductor should not be used
BELDEN 3086A	H= BLACK	L= WHITE	GND= BROWN	450 m	
TURCK type 530					
DeviceNet Mid Cable					
TURCK 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 3.5 *p. 10* and 3.6 *p. 10*):

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 J10 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 or the CCP/CCI to the CAN-BUS cable according to the instructions in the following Paragraphs and the DDC or CCP/CCI Manuals.

Figure 3.5 *Electrical wiring diagram - Connection cable CAN BUS to electronic board*

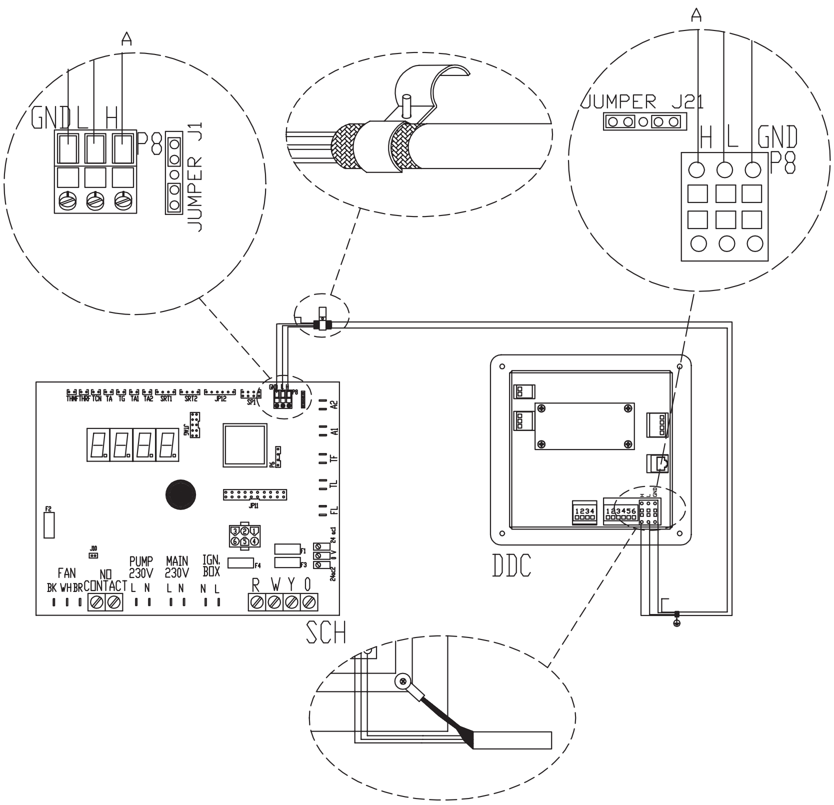


SCH Electronic board
GND Common data
L Data signal LOW
H Data signal HIGH
J1 Jumper CAN-BUS in board
A detail of "terminal node" case (3 wires; J1=jumper "closed")
B Detail of "intermediate node" case (6 wires; J1=jumper "open")
P8 CAN port/connector

GAHP Configuration (S61) + DDC or CCP/CCI

(Systems (1) and (2), Picture 3.6 *p. 10*, see also Paragraph 2.3 *p. 4*)

Figure 3.6 *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 (3), Picture 3.7 *p. 11*, see also Paragraph 2.3 *p. 4*).
It is required to arrange:

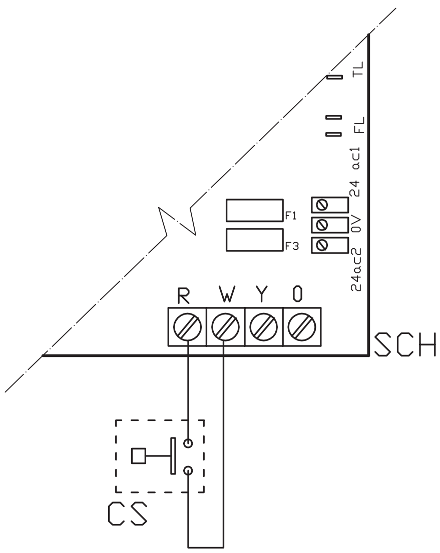
- request device (e.g. thermostat, clock, button, ...) fitted with a voltage-free NO contact.

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 3.7 *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), through two wires, to **terminals R and W** (respectively: common 24 V AC and heating request) of S61 electronic board.

Figure 3.7 *Wiring diagram, external heating enable connection*



SCH Electronic board
R Common
W Terminal consensus warming

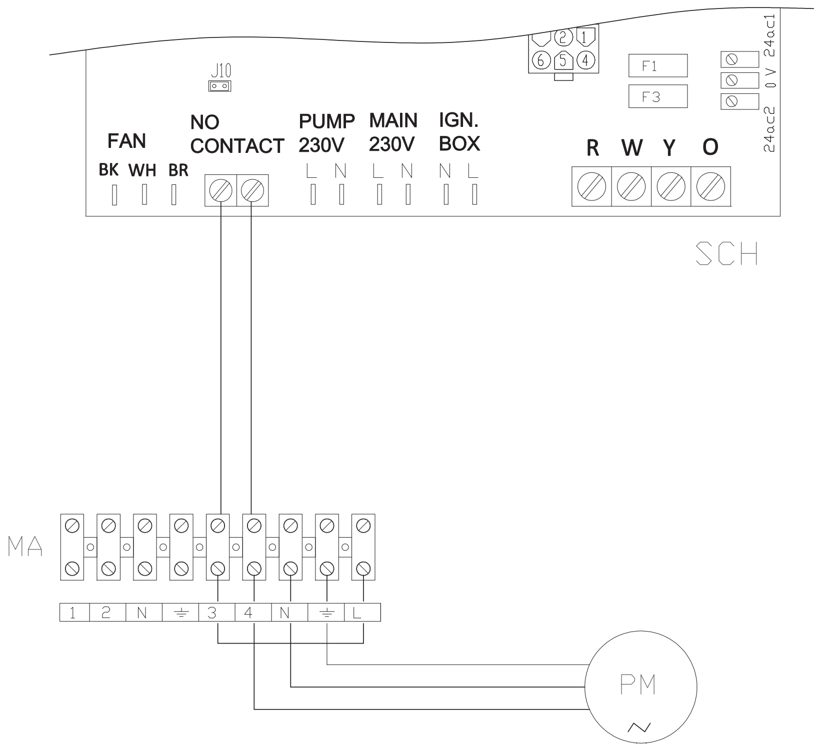
Components NOT SUPPLIED
CS external request

3.5.5 Water circulation pump

Option (1) CONSTANT FLOW circulating pump

It must be mandatorily controlled from the S61 electronic board. The diagram in Figure 3.8 *p. 11* is for pumps < 700 W. For pumps > 700 W it is required to add a control relay and arrange Jumper J10 OPEN.

Figure 3.8 *Water circulation pump connection - Connection of plant water circulation pumps (power absorption less than 700W), controlled directly by the appliance.*



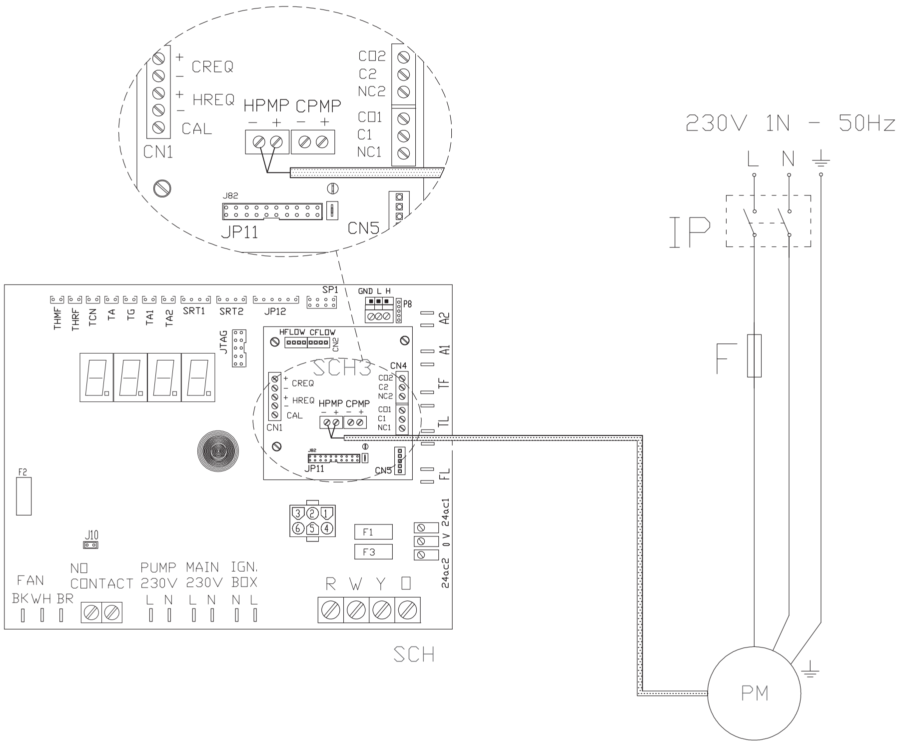
SCH electronic board
J10 closed jumper
N.O. CONTACT N.O voltage free contacts
MA unit terminal block
L phase
N neutral
Components NOT SUPPLIED
PM water pump < 700W

Option (2) VARIABLE FLOW circulating pump

It must be mandatorily controlled from the Mod10 electronic board (built into the S61).

The Wilo Stratos Para pump is already standard supplied with the power supply cable and signal cable, both 1.5m long. For longer distances, use respectively cable FG7 3Gx1.5mm^2 m and shielded cable 2x0.75 mm^2 suitable for 0-10V signal.

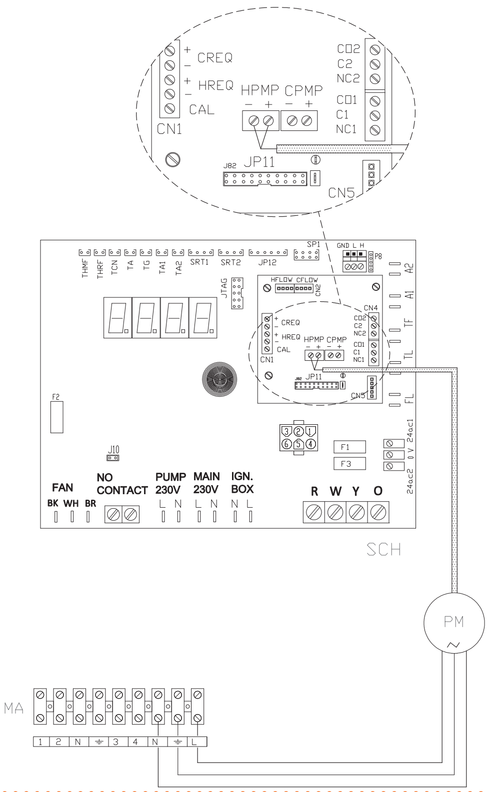
Figure 3.9 *Wiring diagram for connection of Wilo Stratos Para variable rate pump*



IP Two-position pump power switch
F Fuse
PM Hot water circulation pump (primary circuit)

Pump signal 0-10V wire colours
brown connect to -ve
white connect to +ve
black isolate
blue isolate

Figure 3.10 *Wiring diagram for hooking up the Wilo Stratos Para variable rate pump powered by the unit*



PM Hot water circulation pump (primary circuit)
MA unit terminal block

Pump signal 0-10V wire colours
brown connect to -ve
white connect to +ve
black isolate
blue isolate

1 SPECIFICATION OF SUPPLY

Water-ammonia absorption heat pump, fed with natural gas or LPG, air-water version, modulating and condensing, for hot water production up to a delivery temperature of 65°C (70°C at 50% of maximum power), for installation in technical room, consisting of:

- steel sealed circuit, externally treated with epoxy paint;
- Sealed combustion chamber (type C);
- 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;
- stainless steel, flue gas latent heat recovery exchanger;
- 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;
- low-noise fan S1.

Control and safety devices:

- electronic board with microprocessor;
- installation water flowmeter;
- generator limit thermostat, with manual reset;
- flue gas temperature thermostat, with manual reset;
- generator fin temperature sensor;
- 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;
- condensate discharge obstruction sensor.

2 FEATURES AND TECHNICAL DATA

2.1 DIMENSIONS

Figure 2.1 *GAHP indoor dimensions*

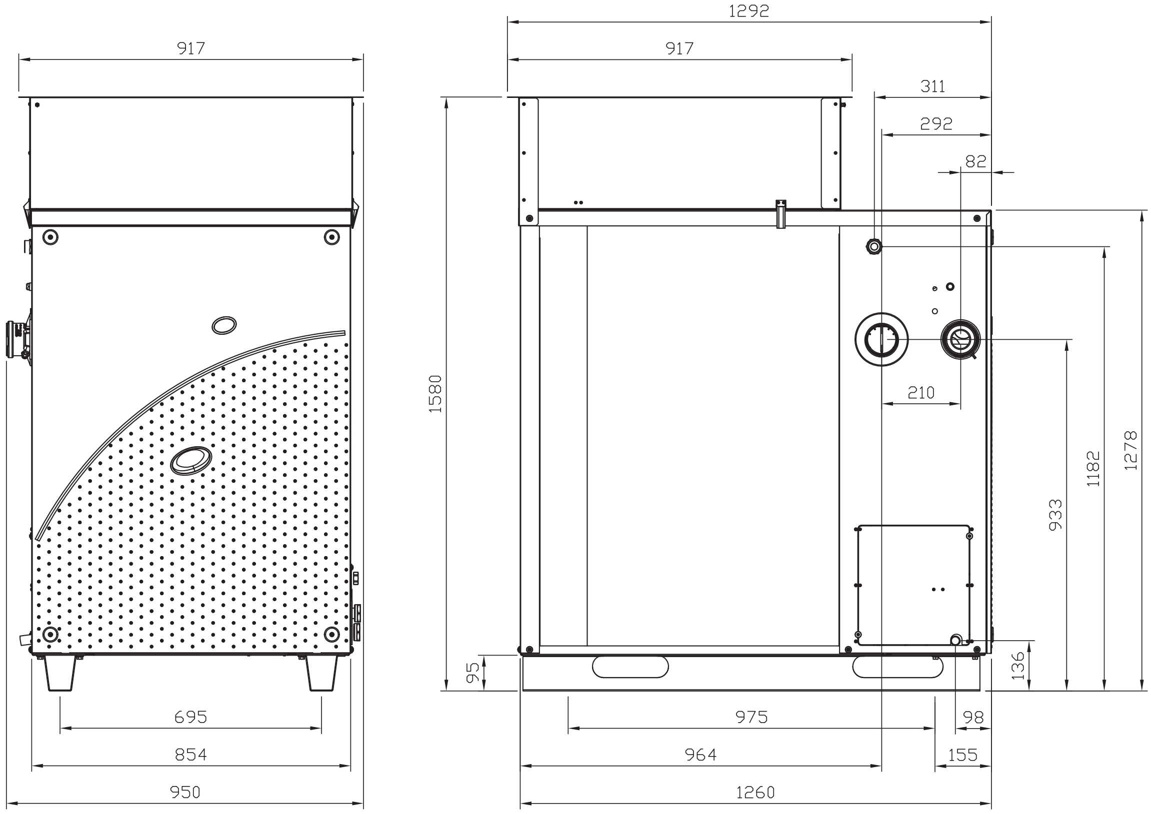
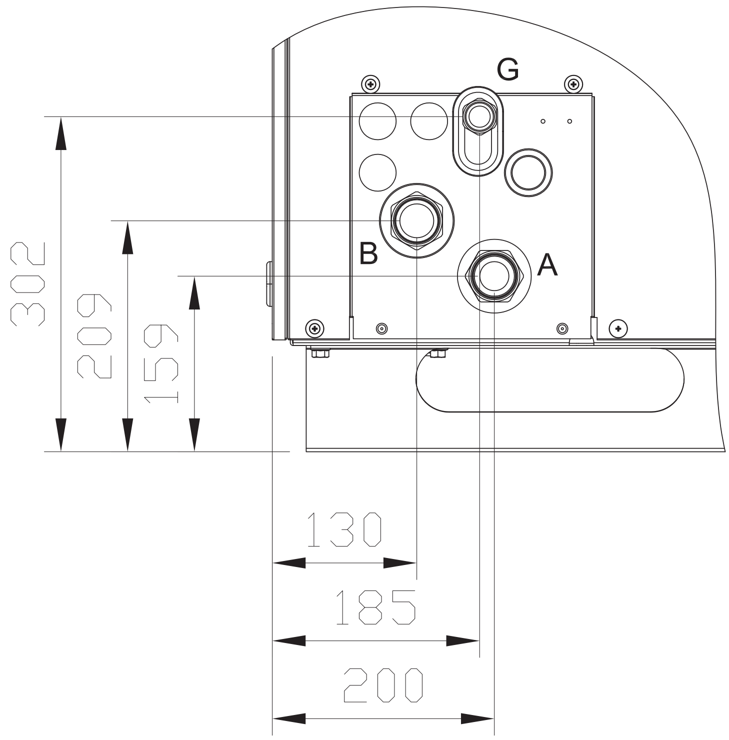


Figure 2.2 *Service plate - Hydraulic/gas unions detail*



G Gas fitting Ø ¾" F
B Inlet water fitting Ø 1¼" F
A Outlet water fitting Ø 1¼" F

2.2 OPERATION MODE

ON/OFF or modulating operation

The GAHP A Indoor unit may operate in two modes:

- mode (1) ON/OFF, i.e. On (at full power) or Off, with circulating pump at constant or variable flow;
- mode (2) MODULATING, i.e. at variable load from 50% to 100% of heating capacity, with circulating pump at variable flow.

For each mode, (1) or (2), specific control systems and devices are provided (Paragraph 2.3 *p. 3*).

2.3 CONTROLS

Control device

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

- (1) **DDC control**
- (2) **CCP/CCI control**
- (3) **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 Control system (2) with CCP/CCI (modulating GAHP unit)

The CCP/CCI control is able to control up to 3 GAHP units in modulating mode (therefore A/WS/GS only, excluding AR/ACF/AY), plus any integration ON/OFF boiler. For more information see Section C1.12.

2.3.3 Adjustment system (3) with external request (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 systems (1) and (2). It is advisable to possibly limit its use to simple applications only and with a single appliance.

2.4 TECHNICAL CHARACTERISTICS

Table 2.1 *GAHP-A Indoor technical data*

				GAHP A Indoor
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	41,3
		A7W50	kW	38,3
		A7W65	kW	31,1
		A-7W50	kW	32,0
GUE efficiency	Outdoor temperature/Delivery temperature	A7W35	%	164
		A7W50	%	152
		A7W65	%	124
		A-7W50	%	127
Heating capacity	nominal (1013 mbar - 15 °C)		kW	25,7
	real		kW	25,2
Hot water delivery temperature	maximum for heating		°C	65
	maximum for DHW		°C	70
Hot water return temperature	maximum for heating		°C	55
	maximum for DHW		°C	60
	minimum temperature in continuous operation		°C	30 (1)
Thermal differential	nominal		°C	10
Heating water flow	nominal		l/h	3000
	maximum		l/h	4000
	minimum		l/h	1400
Pressure drop heating mode	nominal water pressure (A7W50)		bar	0,43 (2)
Ambient air temperature (dry bulb)	maximum		°C	45
	minimum		°C	-15 (3)
Electrical specifications				
Power supply	voltage		V	230
	type		-	SINGLE PHASE
	frequency		50 Hz supply	50

(1) In transient operation, lower temperatures are allowed.
(2) For flows other than nominal see Design Manual, Pressure losses Paragraph.
(3) As an option, a version for operation down to -30 °C is available.
(4) Value stated with free drain. ±10% according to the power supply voltage and tolerance on electrical motors consumption.
(5) ±10% depending on power voltage and absorption tolerance of electric motors.
(6) PCI (G20) 34,02 MJ/m³ (15 °C - 1013 mbar).
(7) PCI (G25) 29,25 MJ/m³ (15 °C - 1013 mbar).
(8) PCI (G27) 27,89 MJ/m³ (15 °C - 1013 mbar).
(9) PCI (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(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) Value stated with free drain.

			GAHP A Indoor
Electrical power absorption	nominal	kW	0,87 (4)
	minimum	kW	0,50 (5)
Degree of protection	IP	-	X5D
Installation data			
Gas consumption	methane G20 (nominal)	m^3/h	2,72 (6)
	methane G20 (min)	m^3/h	1,34
	G25 (nominal)	m^3/h	3,16 (7)
	G25 (min)	m^3/h	1,57
	G27 (nominal)	m^3/h	3,32 (8)
	G27 (min)	m^3/h	1,62
	G30 (nominal)	kg/h	2,03 (9)
	G30 (min)	kg/h	0,99
	G31 (nominal)	kg/h	2,00 (9)
	G31 (min)	kg/h	0,98
NO_x emission class		-	5
NO_x emission		ppm	25,0
CO emission		ppm	36,0
Sound power L_w (max)		dB(A)	74,0 (10)
Sound power L_w (min)		dB(A)	71,0 (10)
Sound pressure L_p at 5 metres (max)		dB(A)	52,0 (11)
Sound pressure L_p at 5 metres (min)		dB(A)	49,0 (11)
Minimum storage temperature		°C	-30
Maximum water pressure in operation		bar	4
Maximum defrosting water flow		l/h	40
Maximum flow flue condensate		l/h	4,0
Water content inside the apparatus		l	4
Water fitting	type	-	F
	thread	" G	1 1/4
Gas connection	type	-	F
	thread	" G	3/4
Safety valve outlet channel fitting		" G	1 1/4
Fume outlet	diameter (Ø)	mm	80
	residual head	Pa	80
Type of installation		-	C13, C33, C43, C53, C63, C83
Dimensions	width	mm	917
	depth	mm	1292
	height	mm	1580
Weight	in operation	kg	405
Required air flow		m^3/h	11000
Required air flow at the maximum available head		m^3/h	10000
Fan residual head		Pa	40 (12)
General information			
Cooling fluid	ammonia R717	kg	7,0
	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) As an option, a version for operation down to -30 °C is available.
(4) Value stated with free drain. ±10% according to the power supply voltage and tolerance on electrical motors consumption.
(5) ±10% depending on power voltage and absorption tolerance of electric motors.
(6) PCI (G20) 34,02 MJ/m^3 (15 °C - 1013 mbar).
(7) PCI (G25) 29,25 MJ/m^3 (15 °C - 1013 mbar).
(8) PCI (G27) 27,89 MJ/m^3 (15 °C - 1013 mbar).
(9) PCI (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(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) Value stated with free drain.

Table 2.2 *PED data*

			GAHP A Indoor
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	0,146
Fluid group		-	GROUP 1°

2.4.1 Pressure drops

Table 2.3 *GAHP A and GAHP A Indoor pressure drops*

Water flow rate	Vector fluid temperature at outlet		
	35 °C	50 °C	60 °C
	Bar	Bar	Bar
2000 l/h	0,23	0,21	0,19
3000 l/h	0,46	0,43	0,40
4000 l/h	0,78	0,72	0,67

2.4.2 Performances

Table 2.4 *p. 5* 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.

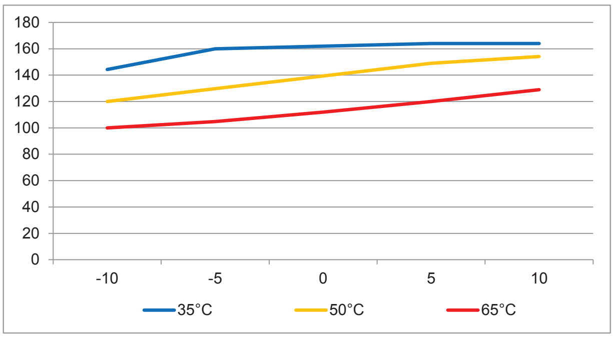
Table 2.4 *GAHP A and GAHP A Indoor heating power for each unit*

External air temperature	Water delivery temperature							
	35 °C	40 °C	45 °C	50 °C	55 °C	60 °C	65 °C	70 °C (1)
	KW	KW	KW	KW	KW	KW	KW	KW
-20 °C	33,9	31,5	29,6	27,7	25,7	23,7	22,7	9,3
-15 °C	35,2	32,8	30,9	29,0	27,0	24,9	23,9	10,0
-10 °C	36,4	34,0	32,1	30,2	28,2	26,2	25,2	10,6
-5 °C	40,3	37,7	35,2	32,7	30,6	28,5	26,4	11,1
0 °C	40,8	39,2	37,1	35,1	32,7	30,3	28,2	11,3
5 °C	41,3	40,0	38,8	37,5	34,8	32,0	30,2	11,8
7 °C	41,3	40,2	39,3	38,3	35,7	33,0	31,1	12,0
10 °C	41,3	40,6	39,8	38,9	36,6	34,4	32,5	12,4
15 °C	41,6	41,3	40,6	39,8	38,3	36,8	34,8	13,1
20 °C	41,6	41,4	40,8	40,2	39,5	38,5	37,1	13,8
25 °C	41,7	41,5	41,0	40,4	39,9	39,2	38,2	14,2
30 °C	41,8	41,6	41,1	40,5	40,1	39,4	38,4	14,4
35 °C	41,9	41,7	41,2	40,6	40,2	39,5	38,5	14,5

(1) Thermal input reduced to 50%

Picture 2.3 *p. 5* shows the GUE trend at full load 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 2.3 *GAHP A and GAHP A Indoor GUE*



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. 3*.

3.3.1 Flue gas exhaust connection

► Ø 80 mm (with gasket), on the left, at the top (Figure 2.1 *p. 2*).

3.3.2 Combustion air intake fitting

► Ø 80 mm (with gasket), on the left, at the top (Figure 2.1 *p. 2*).

3.3.3 Fume outlet

Some possible configurations are shown in the Figures 3.1 *p. 6*, 3.2 *p. 7*.

Figure 3.1 *Type C53 split wall flue gas exhaust*

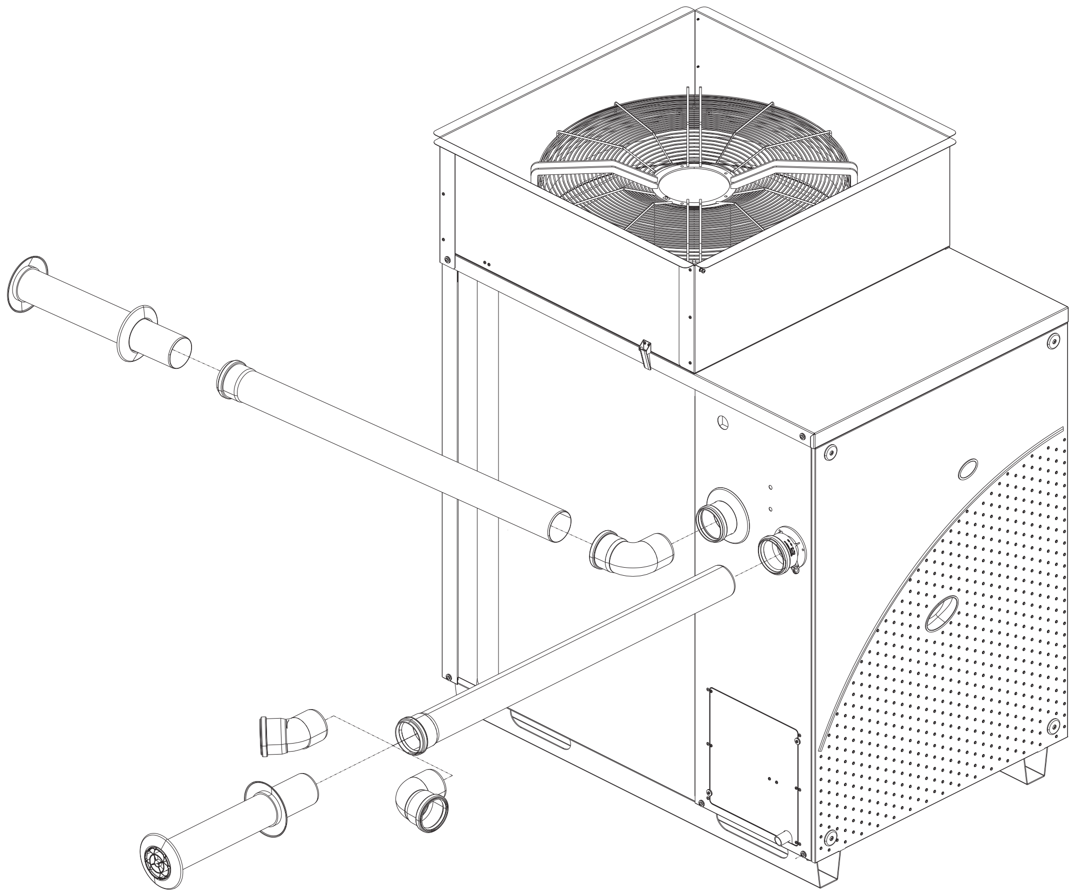
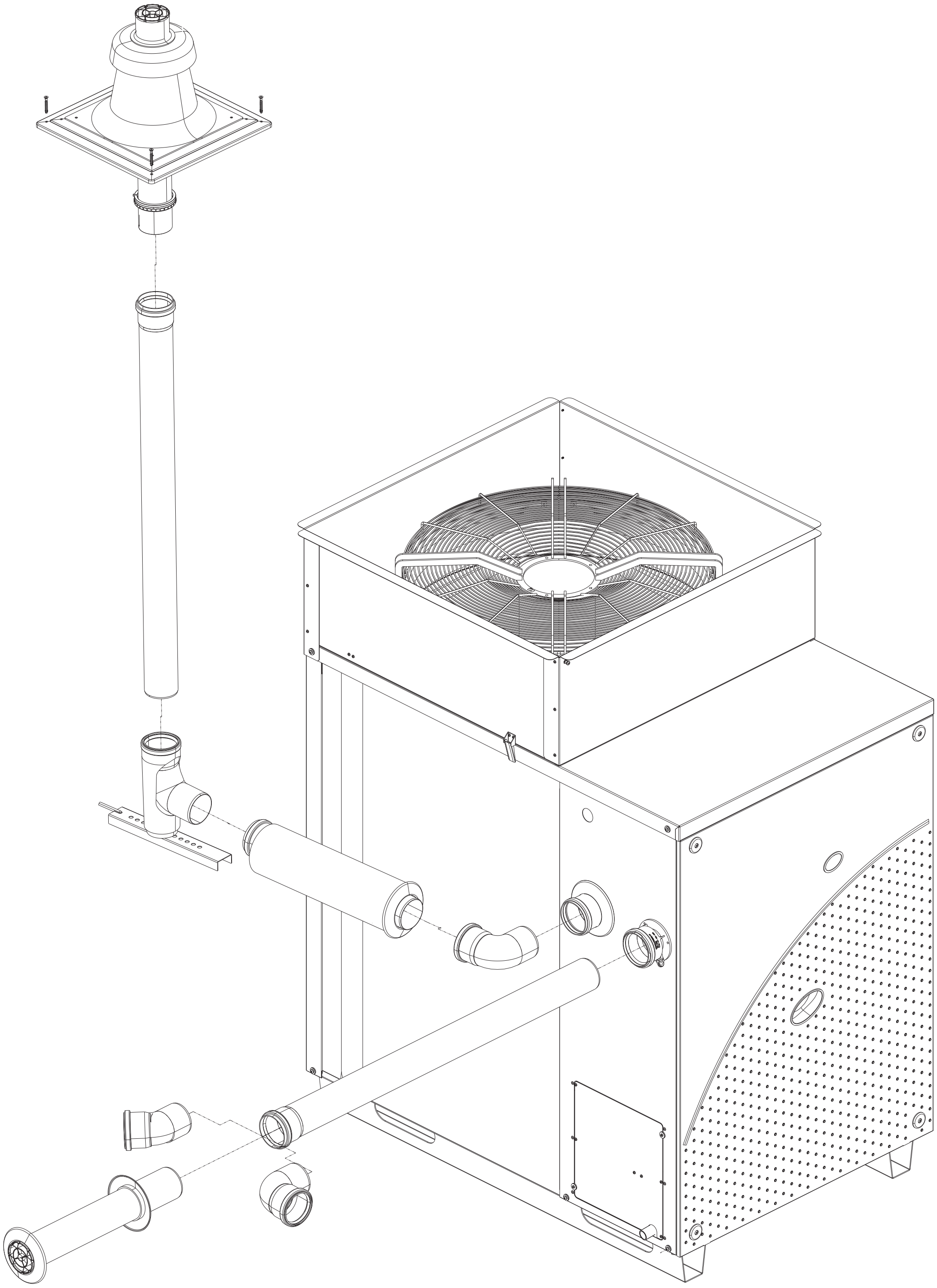


Figure 3.2 *Type C53 roof flue gas exhaust*



Flue

- ► Itisnotadmissibletoconnectseveralappliancestoasingle flue, but each appliance must have its own separate flue.
- ► For flue sizing please refer to the Table 3.1 *p. 8* 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.

Table 3.1 *Fumes temperature and flow*

Gas type	Heating capacity	CO_2 (%)	TF (C°)	Fumes flow (kg/h)	Residual head (Pa)
G20	Nominal	9,10	65	42	80
	Minimum	8,90	46	21	80
G25	Nominal	9,10	63,6	42	80
	Minimum	8,90	45,7	21	80
G25.1	Nominal	10,10	65	45	80
	Minimum	9,60	46	23	80
G27	Nominal	9,0	64	42	80
	Minimum	8,5	46	21	80
G2.350	Nominal	9,00	62,7	42	80
	Minimum	8,70	46,8	22	80
G30	Nominal	10,40	65	43	80
	Minimum	10,10	46	22	80
G31	Nominal	9,10	65	48	80
	Minimum	8,90	46	24	80

3.4 FLUE GAS CONDENSATE DISCHARGE

The GAHP A Indoor unit is a condensing appliance and therefore produces condensation water from combustion flue gases.

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 discharge is located on the left side of the appliance (Figure 3.3 *p. 8*).

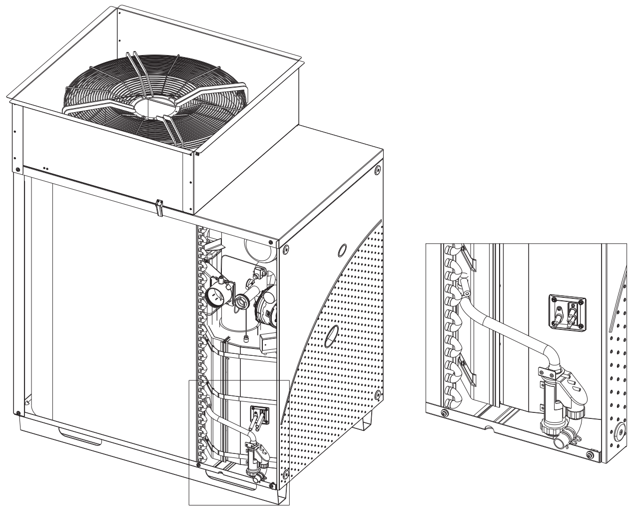
- ► The corrugated condensate discharge pipe must be connected to a suitable discharge manifold.
- ► The junction between the pipe and the manifold must remain visible.

3.4.2 Flue gas condensate discharge manifold

To make the condensate discharge manifold:

- ► Size the ducts for maximum condensation capacity (Table 2.1 *p. 3*).
- ► 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.

Figure 3.3 *Condensate drain component*



3.5 SAFETY VALVE DRAIN

The safety valve drain must be mandatorily ducted outside. Failure to comply with this provision jeopardizes first start-up.

Do not install any shut off device on the exhaust duct between the safety valve and the outside exhaust.

3.5.1 Safety valve drain ducting

The exhaust ducting shall be made in steel pipes (do not use copper or its alloys). Table 3.2 *p. 8* provides sufficient criteria of pipe sizing; alternatively, less compelling sizing is accepted, provided it is compliant with specific applicable norms (the manufacturer cannot be held liable).

Table 3.2 *Safety valve drain ducting*

Diameter	DN	Maximum length (m)
1" 1/4	32	30
2"	50	60

The exhaust duct must have an initial straight section of at least 30 cm.

Place the drain terminal outside the room, away from doors, windows and aeration vents, and at such a height that any coolant leaks cannot be inhaled by any people.

3.6 FAN AIR DUCTING

3.6.1 Air duct

The appliance is fitted with a flange for connecting to a fan outlet air duct.

- Arrange removable fitting/bellows between the air duct and the appliance's flange, for fan maintenance operations.
- A pressure socket is provided to measure the pressure differential.

3.7 ELECTRICAL AND CONTROL CONNECTIONS

3.7.1 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, CCP/CCI or external request).

Control of water circulation pump

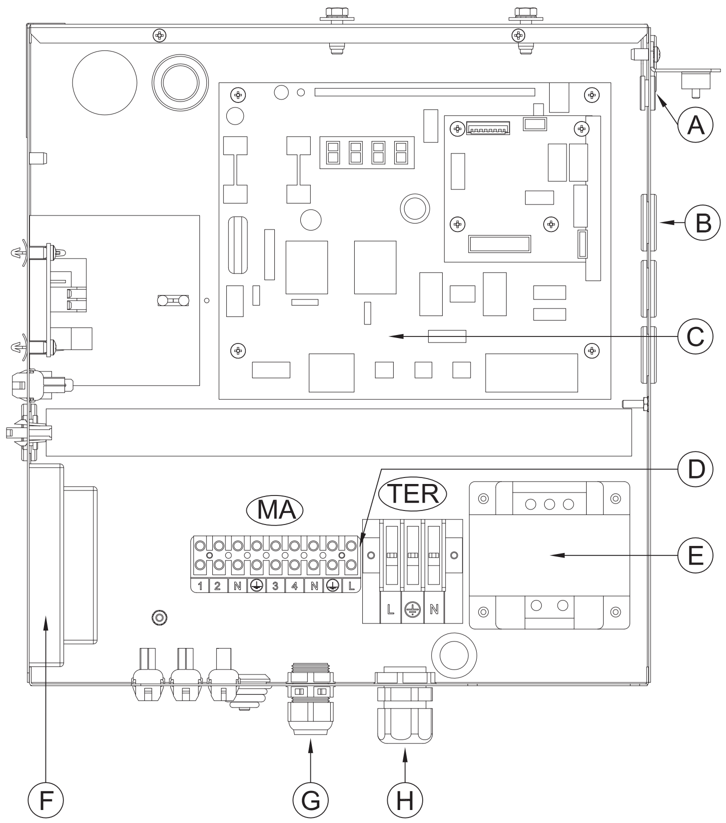
The water circulation pump of the water/primary circuit must mandatorily be controlled by the appliance's electronic boards. It is not admissible to start/stop the circulating pump with no request from the appliance.

3.7.2 Electrical systems

Electrical connections must provide:

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

Figure 3.4 *GAHP A 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 boxes
E transformer 230/23 V AC
F flame control unit
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

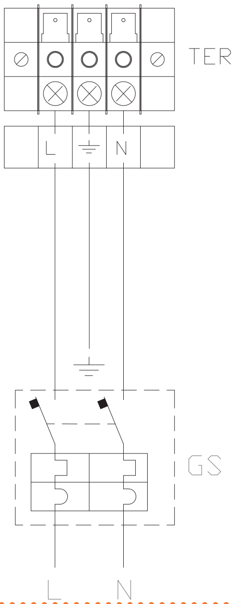
3.7.3 Electrical power supply

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 3.5 *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.

3.7.4 Set-up and control

Control systems, options (1) (2) (3)

Three separate adjustment systems are provided, each with specific features, components and diagrams (see 3.7 *p. 11*, 3.8 *p. 11*):

- System (1), with **DDC control** (with CAN-BUS connection).
- System (2), with **CCP/CCI control** (with CAN-BUS connection).
- System (3), 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 or CCP/CCI 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, CCI, ...), 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 or CCP/CCI controllers are connected to the appliance through the CAN-BUS signal cable, shielded, compliant to Table 3.3 *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 3.3 *CAN BUS cables type*

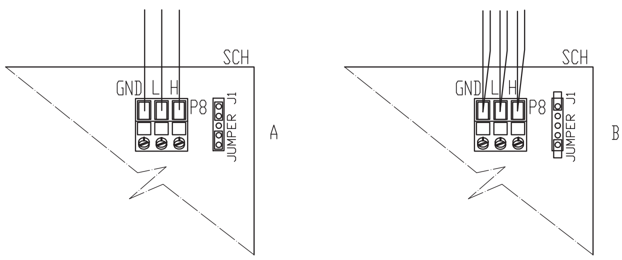
CABLE NAME	SIGNALS / COLOR			MAX LENGTH	Note
Robur					Ordering Code OCVO008
ROBUR NETBUS	H= BLACK	L= WHITE	GND= BROWN	450 m	
Honeywell SDS 1620					In all cases the fourth conductor should not be used
BELDEN 3086A	H= BLACK	L= WHITE	GND= BROWN	450 m	
TURCK type 530					
DeviceNet Mid Cable					
TURCK 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 electronic board, located in the Electrical Panel inside the appliance, (Pictures 3.6 *p. 10* and 3.7 *p. 11*):

1. Access the Electrical Board of the appliance according to the Procedure 3.7.2 *p. 9*);
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) <u>if the node is terminal</u> (one connected CAN-BUS cable section only), or OPEN (Detail B) <u>if the node is intermediate</u> (two connected CAN-BUS cable sections);
4. Connect the DDC or the CCP/CCI to the CAN-BUS cable according to the instructions in the following Paragraphs and the DDC or CCP/CCI Manuals.

Figure 3.6 *Electrical wiring diagram - Connection cable CAN BUS to electronic board*



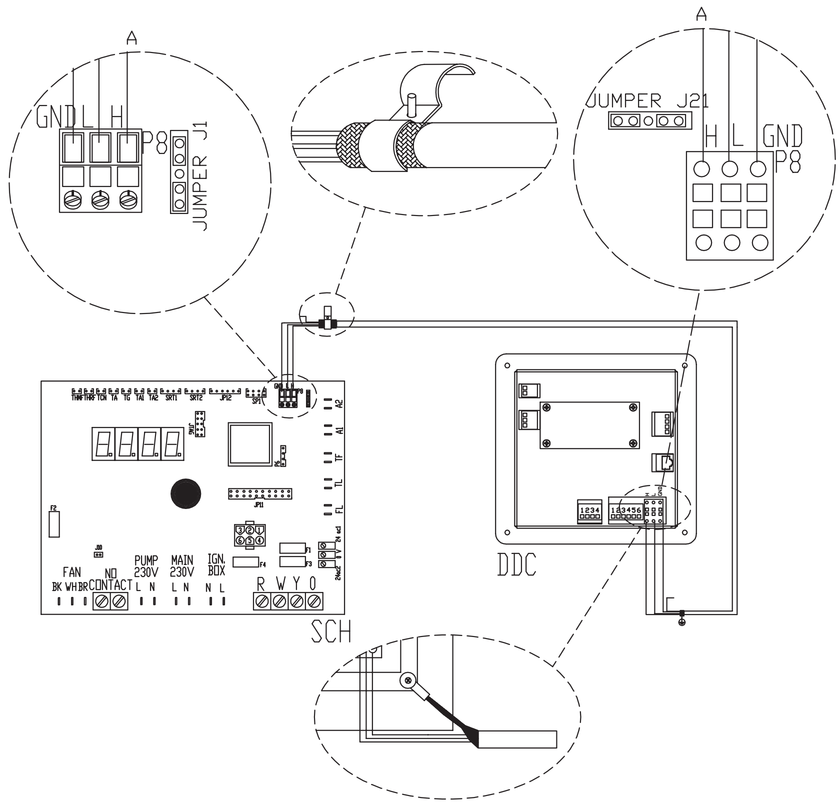
SCH Electronic board
GND Common data
L Data signal LOW
H Data signal HIGH
J1 Jumper CAN-BUS in board
A detail of "terminal node" case (3 wires; J1=jumper "closed")
B Detail of "intermediate node" case (6 wires; J1=jumper "open")
P8 CAN port/connector

GAHP Configuration (S61) + DDC or CCP/CCI

(Systems (1) and (2), Picture 3.7 *p. 11*, see also Paragraph

2.3 *p. 3*)

Figure 3.7 *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 (3), Picture 3.8 *p. 11*, see also Paragraph 2.3 *p. 3*).
It is required to arrange:

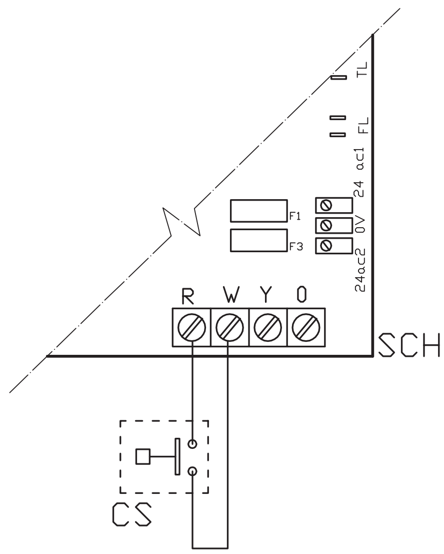
► request device (e.g. thermostat, clock, button, ...) fitted with a voltage-free NO contact.

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 3.8 *p. 11*):

1. Access the Electrical Board of the appliance according to the Procedure 3.7.2 *p. 9*.
2. Connect the voltage-free contact of the external device (Detail CS), through two wires, to **terminals R and W** (respectively: common 24 V AC and heating request) of S61 electronic board.

Figure 3.8 *Wiring diagram, external heating enable connection*



SCH Electronic board
R Common
W Terminal consensus warming

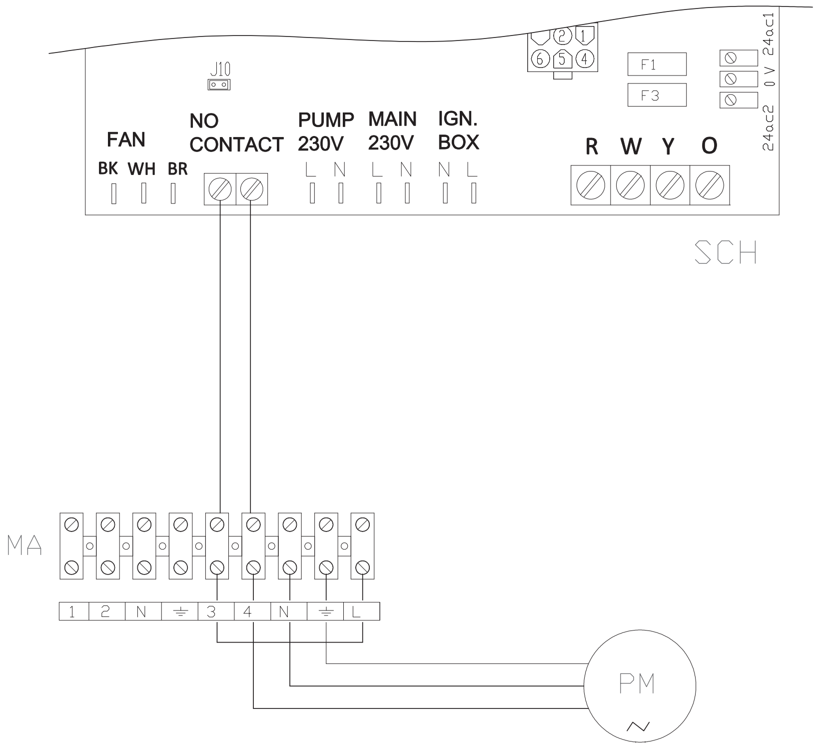
Components NOT SUPPLIED
CS external request

3.7.5 Water circulation pump

Option (1) CONSTANT FLOW circulating pump

It must be mandatorily controlled from the S61 electronic board. The diagram in Figure 3.9 *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 3.9 *Water circulation pump connection - Connection of plant water circulation pumps (power absorption less than 700W), controlled directly by the appliance.*



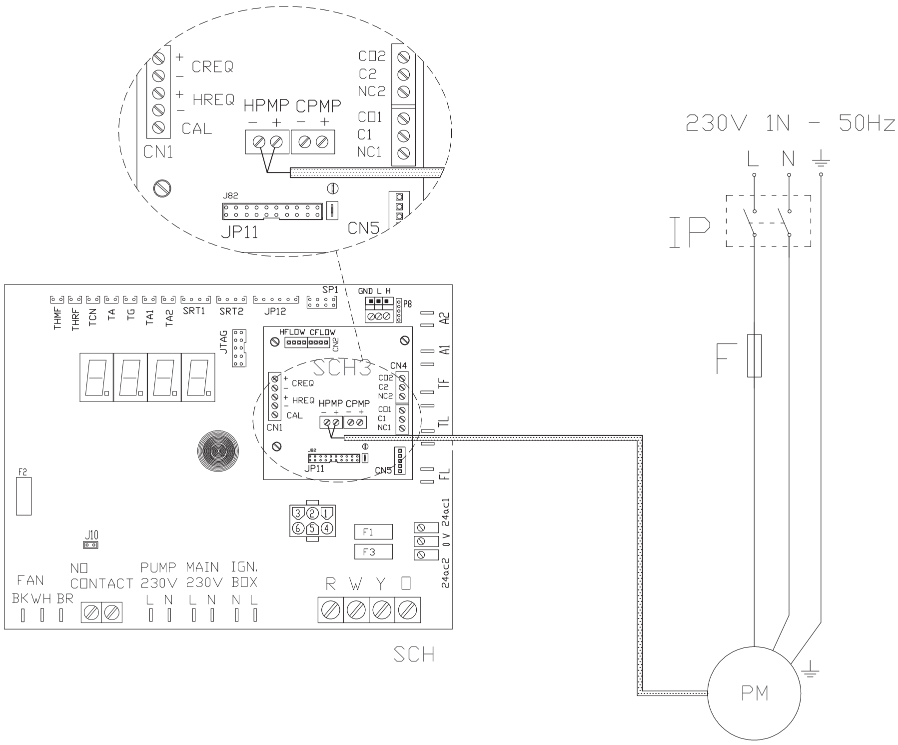
SCH electronic board
J10 closed jumper
N.O. CONTACT N.O voltage free contacts
MA unit terminal block
L phase
N neutral
Components NOT SUPPLIED
PM water pump < 700W

Option (2) VARIABLE FLOW circulating pump

It must be mandatorily controlled from the Mod10 electronic board (built into the S61).

The Wilo Stratos Para pump is already standard supplied with the power supply cable and signal cable, both 1.5m long. For longer distances, use respectively cable FG7 3Gx1.5mm² m and shielded cable 2x0.75 mm² suitable for 0-10V signal.

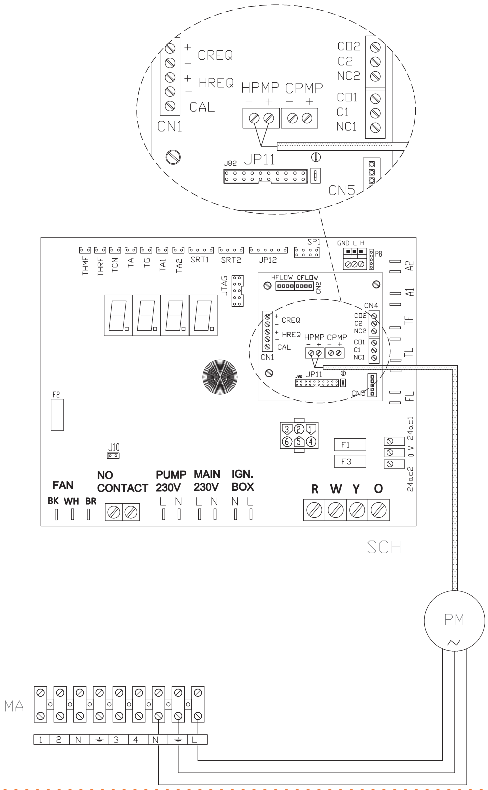
Figure 3.10 *Wiring diagram for connection of Wilo Stratos Para variable rate pump*



IP Two-position pump power switch
F Fuse
PM Hot water circulation pump (primary circuit)

Pump signal 0-10V wire colours
brown connect to -ve
white connect to +ve
black isolate
blue isolate

Figure 3.11 *Wiring diagram for hooking up the Wilo Stratos Para variable rate pump powered by the unit*



PM	Hot water circulation pump (primary circuit)
MA	unit terminal block

Pump signal 0-10V wire colours
brown connect to -ve
white connect to +ve
black isolate
blue isolate

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).

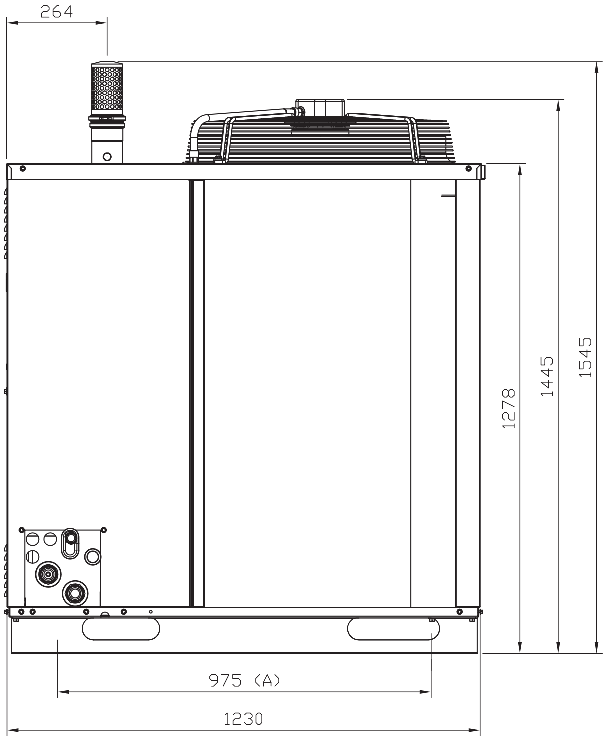
Control and safety devices:

- 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

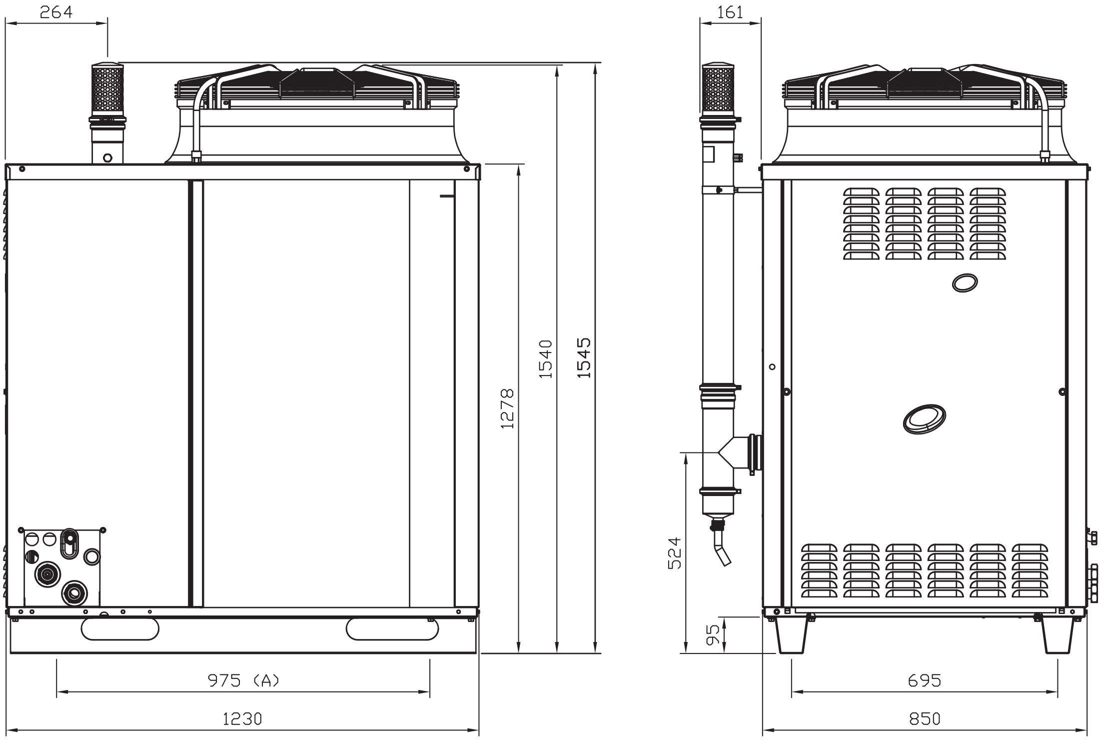
2.1 DIMENSIONS

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



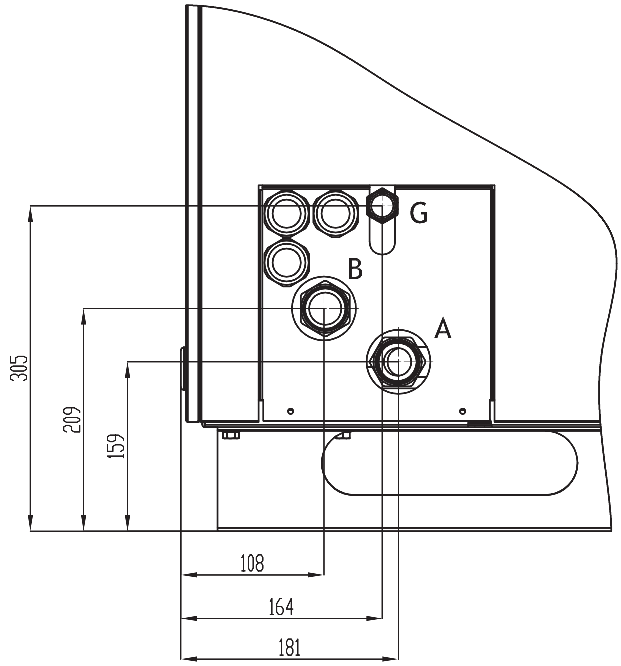
A Position of holes for fixing of anti-vibration joints

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

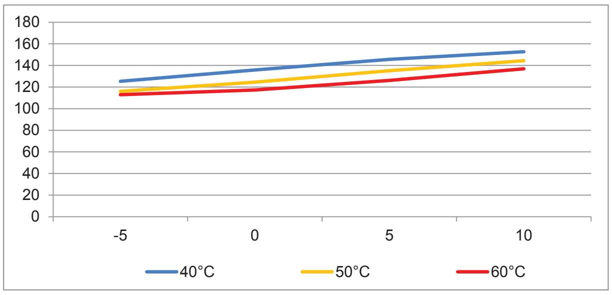
Table 2.5 *p. 6* shows the unitary thermal power at full load and in stable operation, depending on hot water delivery temperature to the system and outdoor temperature.
Please consider that, according to the actual heating request, the unit may often need to operate under partial load conditions and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

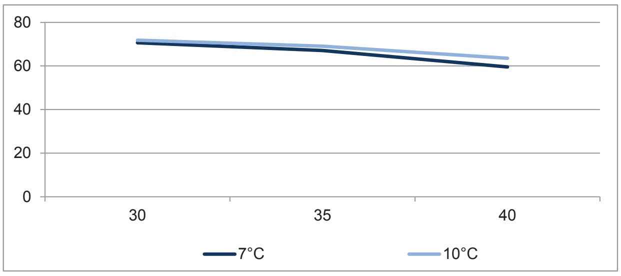
Table 2.6 *p. 6* shows the unitary cooling load at full load and in stable operation, depending on cold water delivery temperature to the system and outdoor temperature.
Please consider that, according to the actual cooling request, the unit may often need to operate under partial load conditions and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

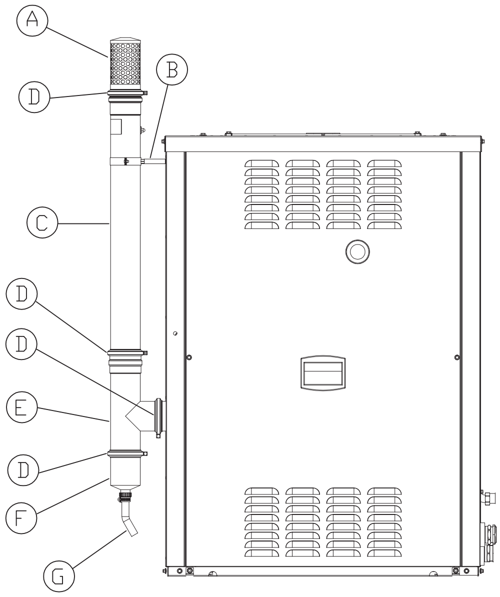
- Ø 80 mm (with gasket), on the left, at the top (Figure 3.1 *p. 7*).

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

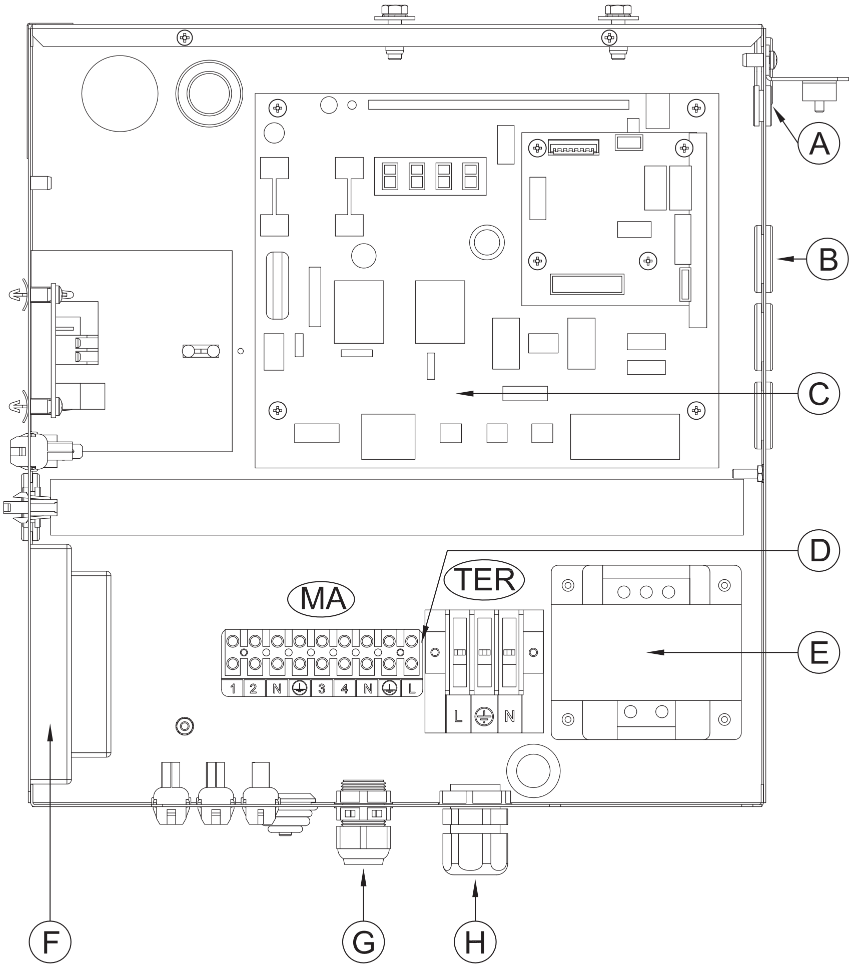
The water circulation pump of the water/primary circuit must mandatorily be controlled by the appliance's electronic boards. It is not admissible to start/stop the circulating pump with no request from the appliance.

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

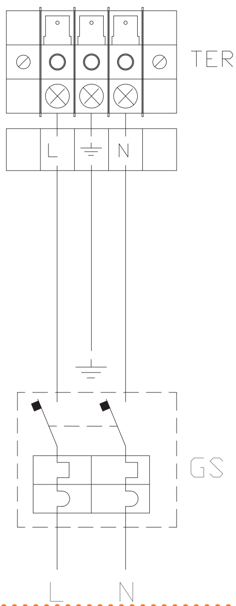
3.5.3 Electrical power supply

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*

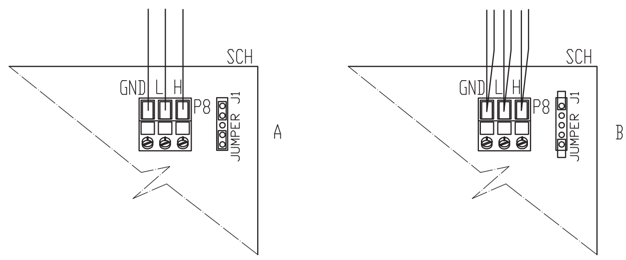
CABLE NAME	SIGNALS / COLOR			MAX LENGTH	Note
Robur					Ordering Code OCVO008
ROBUR NETBUS	H= BLACK	L= WHITE	GND= BROWN	450 m	
Honeywell SDS 1620					In all cases the fourth conductor should not be used
BELDEN 3086A	H= BLACK	L= WHITE	GND= BROWN	450 m	
TURCK type 530					
DeviceNet Mid Cable					
TURCK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

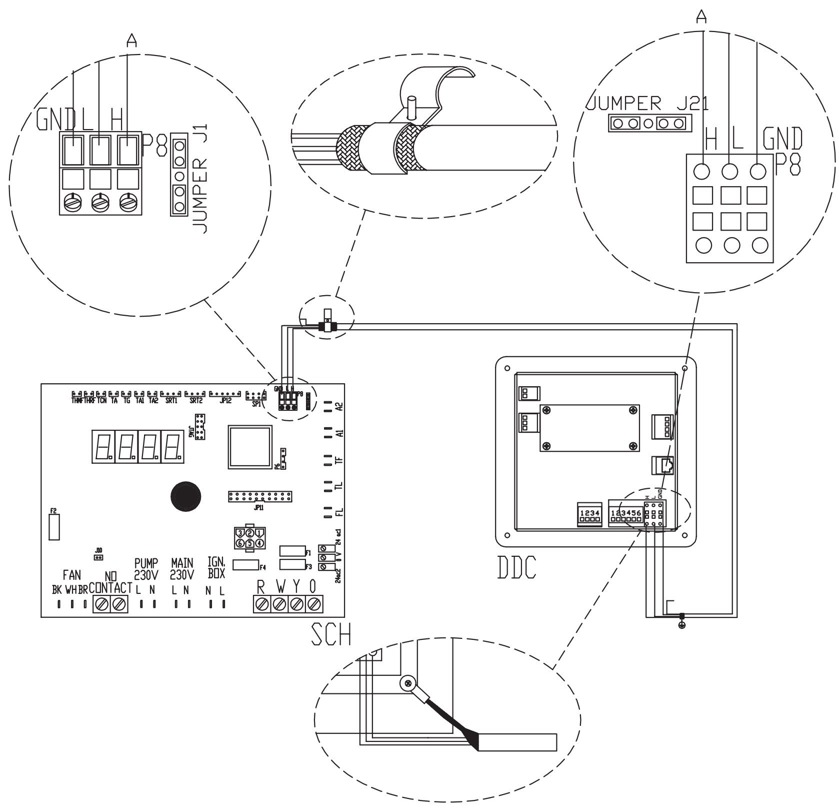


SCH Electronic board
GND Common data
L Data signal LOW
H Data signal HIGH
J1 Jumper CAN-BUS in board
A detail of "terminal node" case (3 wires; J1=jumper "closed")
B Detail of "intermediate node" case (6 wires; J1=jumper "open")
P8 CAN port/connector

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:

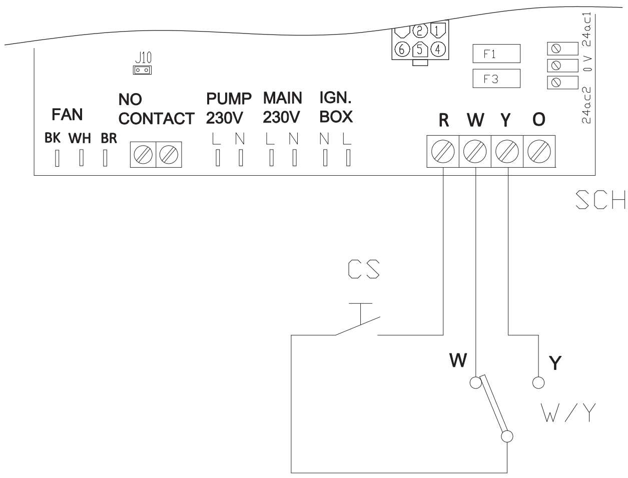
► request device (e.g. thermostat, timer, button, ...) fitted with a voltage-free NO contact;
► switching devicewinter/summer(heating/cooling, W and Y contacts on the S61 board).

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

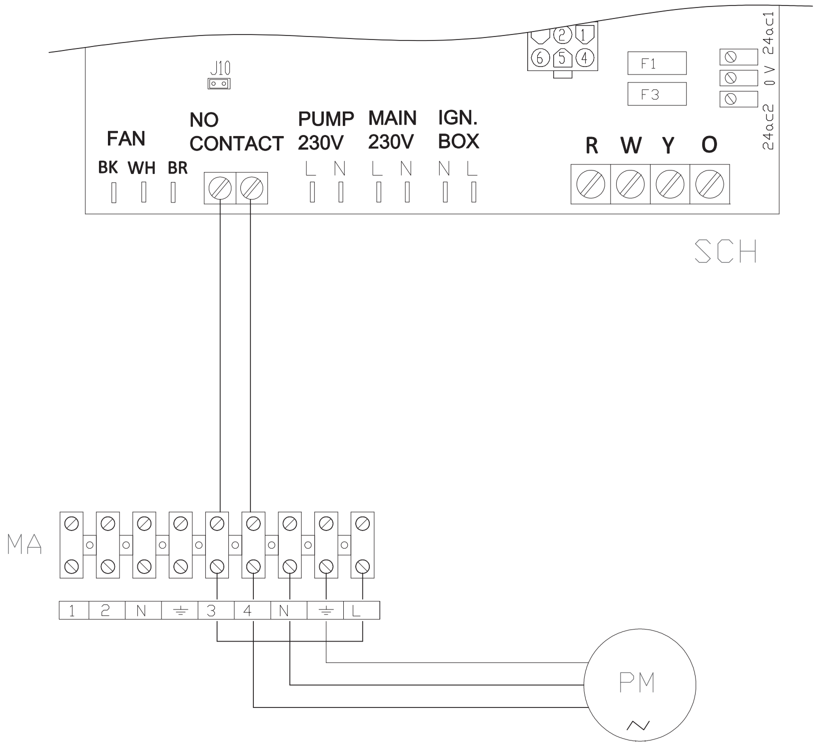
3.5.5 Water circulation pump

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

1 SPECIFICATION OF SUPPLY

1.1 GAHP GS

Water-ammonia absorption heat pump, fed with natural gas or LPG, brine-water version, modulating and condensing, for alternate or simultaneous hot water production up to a delivery temperature of 65°C (70°C at 50% of maximum power), and cold water even at negative temperature, for indoor *or outdoor installation (for outdoor version only)*, 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 exchanger (condenser), externally insulated;
- titanium stainless steel shell-and-tube water exchanger (evaporator), externally insulated;
- low power consumption refrigerant fluid oil pump;
- stainless steel, shell and tube recovery exchanger of flue gas latent heat.

Control and safety devices:

- electronic board with microprocessor;
- installation water flow meter (hot side);
- installation water flow switch (cold side);
- generator limit thermostat, with manual reset;
- flue gas temperature thermostat, with manual reset;
- generator fin temperature sensor;
- 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;
- condensate discharge obstruction sensor.

1.2 GAHP WS

Water-ammonia absorption heat pump, fed with natural gas or LPG, water-water version, modulating and condensing, for alternate or simultaneous hot water production up to a delivery temperature of 65°C (70°C at 50% of maximum power), and cold water, for indoor *or outdoor installation (for outdoor version only)*, 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 exchanger (condenser), externally insulated;
- titanium stainless steel shell-and-tube water exchanger (evaporator), externally insulated;
- low power consumption refrigerant fluid oil pump;
- stainless steel, shell and tube recovery exchanger of flue gas latent heat.

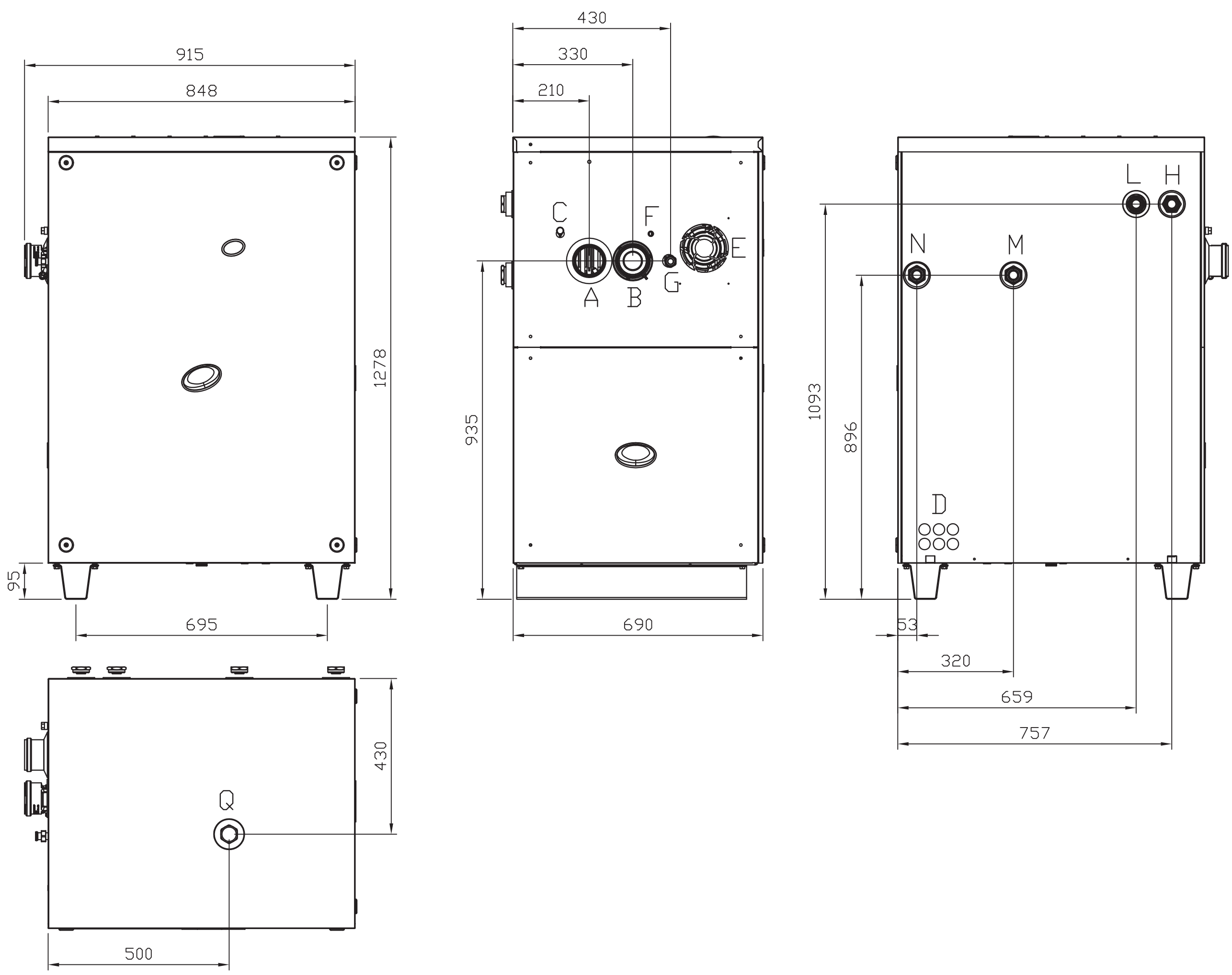
Control and safety devices:

- electronic board with microprocessor;
- installation water flow meter (hot side);
- installation water flow switch (cold side);
- generator limit thermostat, with manual reset;
- flue gas temperature thermostat, with manual reset;
- generator fin temperature sensor;
- 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;
- condensate discharge obstruction sensor.

2 FEATURES AND TECHNICAL DATA

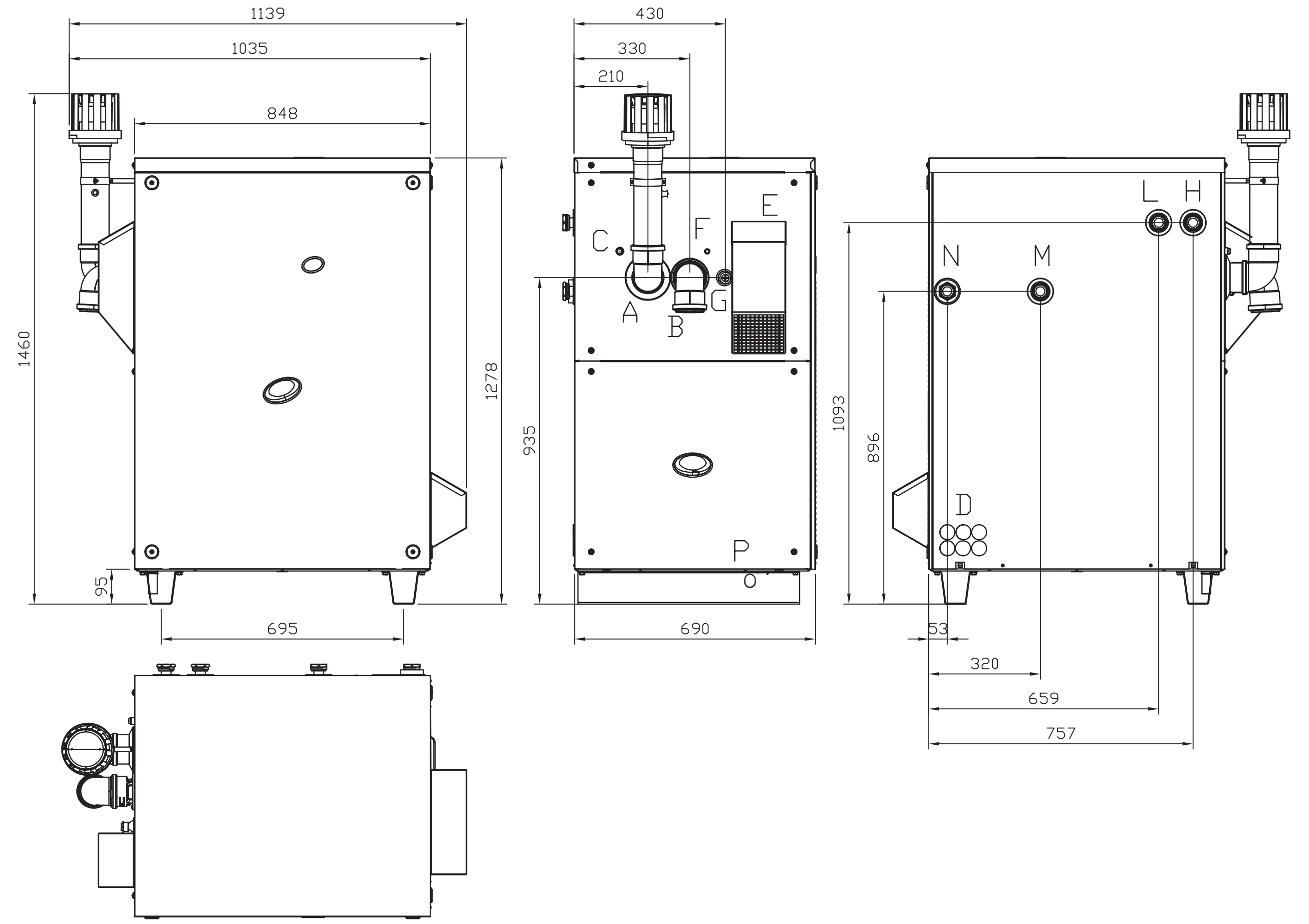
2.1 DIMENSIONS

Figure 2.1 *Indoor GAHP GS/WS dimensions*



A Flue gas output Ø 80
B Combustion air inlet Ø 80
C Fumes thermostat manual reset
D Power supply cables input
E Ventilation fan
F Burner on warning light
G Gas connection Ø 3/4"
H Hot water inlet Ø 1"¼
L Renewable source water return Ø 1"¼
M Renewable source water delivery Ø 1"¼
N Hot water delivery Ø 1"¼
Q Safety valve outlet ducting Ø 1"¼

Figure 2.2 *Outdoor GAHP GS/WS dimensional drawing*



A Flue gas output Ø 80
B Combustion air inlet Ø 80
C Fumes thermostat manual reset
D Power supply cables input
E Ventilation fan
F Appliance operation warning light
G Gas connection Ø 3/4"
H Hot water inlet Ø 1"¼
L Renewable source water return Ø 1"¼
M Renewable source water delivery Ø 1"¼
N Hot water delivery Ø 1"¼
P Condensate drain

2.2 OPERATION MODE

ON/OFF or modulating operation

The GAHP GS/WS units may operate in two modes:

- mode (1) ON/OFF, i.e. ON (at full power) or OFF, with circulating pumps at constant or variable flow (hot side only);
- mode (2) MODULATING, i.e. at variable load from 50% to 100% of power, with circulating pumps at variable flow (hot side) and constant flow (cold side).

For each mode, (1) or (2), specific control systems and devices are provided (Paragraph 2.3 *p. 3*).

2.3 CONTROLS

Control device

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

- (1) **DDC control**
- (2) **CCP/CCI control**
- (3) **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 Control system (2) with CCP/CCI (modulating GAHP unit)

The CCP/CCI control is able to control in heating only (and possibly passive cooling) up to 3 GAHP units in modulating mode (therefore A/WS/GS only, excluding AR/ACF/AY), plus any integration ON/OFF boiler. For more information see Section C1.12.

2.3.3 Adjustment system (3) with external request (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 systems (1) and (2). 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 GS/WS technical data*

				GAHP GS HT	GAHP WS
Heating mode					
Seasonal space heating energy efficiency class (ErP)	medium-temperature application (55 °C)		-	A++	
	low-temperature application (35 °C)		-	A+	
Unitary heating power	Evaporator inlet temperature/Delivery temperature	B0W35	kW	41,6	-
		B0W50	kW	37,6	-
		B0W65	kW	31,4	-
		W10W35	kW	-	43,9
		W10W50	kW	-	41,6
		W10W65	kW	-	35,8
GUE efficiency	Evaporator inlet temperature/Delivery temperature	B0W35	%	165	-
		B0W50	%	149	-
		B0W65	%	125	-
		W10W35	%	-	174
		W10W50	%	-	165
		W10W65	%	-	142
Heating capacity	nominal (1013 mbar - 15 °C)		kW	25,7	
	real		kW	25,2	
Hot water delivery temperature	maximum for heating		°C	65	
	maximum for DHW		°C	70	
Hot water return temperature	maximum for heating		°C	55	
	maximum for DHW		°C	60	
	minimum temperature in continuous operation		°C	30 (1)	
Thermal differential	nominal		°C	10	
Heating water flow	nominal		l/h	3170	3570
	maximum		l/h	4000	
	minimum		l/h	1400	
Pressure drop heating mode	for nominal water flow (B0W50)		bar	0,49 (2)	-
	for nominal water flow rate(W10W50)		bar	-	0,57 (2)
Ambient air temperature (dry bulb)	maximum		°C	45	
	minimum		°C	0	
Renewable source operating conditions					
Power recovered from renewable source	Evaporator inlet temperature/Delivery temperature	B0W35	kW	16,4	-
		B0W50	kW	12,1	-
		B0W65	kW	7,0	-
		W10W35	kW	-	18,7
		W10W50	kW	-	16,6
		W10W65	kW	-	10,6
Renewable source water return temperature	maximum		°C	45	
Renewable source delivery water temperature	minimum		°C	-5	3
Renewable source water flow rate (with 25% glycol)	nominal (B0W50)		l/h	3020	-
	maximum		l/h	4000	-
	minimum		l/h	2000	-
Renewable source water flow rate	nominal (W10W50)		l/h	-	2850
	maximum		l/h	-	4700
	minimum		l/h	-	2300

(1) In transient operation, lower temperatures are allowed.
(2) For flows other than nominal see Design Manual, Pressure losses Paragraph.
(3) ±10% depending on power voltage and absorption tolerance of electric motors.
(4) PCI (G20) 34,02 MJ/m³ (15 °C - 1013 mbar).
(5) PCI (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(6) Sound power values detected in compliance with the intensity measurement methodology set forth by standard EN ISO 9614; C type installation.
(7) Maximum sound pressure levels in free field, with directionality factor 2, obtained from the sound power level in compliance with standard EN ISO 9614; C type installation.
(8) Indoor variant only.
(9) Overall dimensions excluding fumes pipes.

			GAHP GS HT	GAHP WS
Renewable source pressure drop	at nominal water flow	bar	0,51 (2)	0,38 (2)
Electrical specifications				
Power supply	voltage	V	230	
	type	-	SINGLE PHASE	
	frequency	50 Hz supply	50	
Electrical power absorption	nominal	kW	0,41 (3)	
Degree of protection	IP	-	X5D	
Installation data				
Gas consumption	methane G20 (nominal)	m^3/h	2,72 (4)	
	methane G20 (min)	m^3/h	1,34	
	G25 (nominal)	m^3/h	3,16	
	G25 (min)	m^3/h	1,57	
	G30 (nominal)	kg/h	2,03 (5)	
	G30 (min)	kg/h	0,99	
	G31 (nominal)	kg/h	2,00 (5)	
	G31 (min)	kg/h	0,98	
NO_x emission class		-	5	
NO_x emission		ppm	25,0	
CO emission		ppm	36,0	
Sound power L_W (max)		dB(A)	66,1 (6)	
Sound pressure L_p at 5 metres (max)		dB(A)	44,1 (7)	
Minimum storage temperature		°C	-30	
Maximum water pressure in operation		bar	4	
Maximum flow flue condensate		l/h	4,0	
Water content inside the apparatus	hot side	l	4	
	cold side	l	3	
Water fitting	type	-	F	
	thread	" G	1 1/4	
Gas connection	type	-	F	
	thread	" G	3/4	
Safety valve outlet channel fitting		" G	1 1/4 (8)	
Fume outlet	diameter (Ø)	mm	80	
	residual head	Pa	80	
	product configuration		C63	
Type of installation		-	C13, C33, C43, C53, C63, C83, B23P, B33	
Dimensions	width	mm	848 (9)	
	depth	mm	690	
	height	mm	1278	
Weight	in operation	kg	300	
General information				
Cooling fluid	ammonia R717	kg	7,0	7,2
	water H_2O	kg	10,0	9,6
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% depending on power voltage and absorption tolerance of electric motors.
(4) PCI (G20) 34,02 MJ/m^3 (15 °C - 1013 mbar).
(5) PCI (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(6) Sound power values detected in compliance with the intensity measurement methodology set forth by standard EN ISO 9614; C type installation.
(7) Maximum sound pressure levels in free field, with directionality factor 2, obtained from the sound power level in compliance with standard EN ISO 9614; C type installation.
(8) Indoor variant only.
(9) Overall dimensions excluding fumes pipes.

Table 2.2 *PED data*

			GAHP GS HT	GAHP WS
PED data				
Components under pression	generator	l	18,6	
	leveling chamber	l	11,5	
	evaporator	l	3,7	
	cooling volume transformer	l	4,5	
	absorber/condenser	l	3,7	
	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	0,146	0,150
Fluid group		-	group 1°	

2.4.1 Pressure drops

Condenser

Table 2.3 *p. 6* shows the condenser side pressure drop data referring to GAHP GS HT unit.

Table 2.3 *Pressure drop GAHP GS condenser side*

Water flow rate	Vector fluid temperature at outlet		
	35 °C	50 °C	65 °C
	Bar	Bar	Bar
2000 l/h	0,23	0,21	0,19
3000 l/h	0,46	0,43	0,38
4000 l/h	0,78	0,72	0,64

Table 2.4 *p. 6* shows the condenser side pressure drop data referring to GAHP WS unit.

Table 2.4 *Pressure drop GAHP WS condenser side*

Water flow rate	Vector fluid temperature at outlet		
	35 °C	50 °C	65 °C
	Bar	Bar	Bar
2000 l/h	0,23	0,21	0,19
3000 l/h	0,46	0,43	0,38
4000 l/h	0,78	0,72	0,64

Evaporator

Table 2.5 *p. 6* shows the evaporator side pressure drop data referring to GAHP GS HT unit.

Table 2.5 *Pressure drop GAHP GS evaporator side*

Water flow rate	Vector fluid temperature at outlet		
	-5 °C	0 °C	5 °C
	Bar	Bar	Bar
2500 l/h	0,43	0,40	0,38
3000 l/h	0,57	0,54	0,52
3500 l/h	0,74	0,70	0,67

The data refer to operation with 25% glycol water.

Table 2.6 *p. 6* shows the evaporator side pressure drop data referring to GAHP WS unit.

Table 2.6 *Pressure drop GAHP WS evaporator side*

Water flow rate	Vector fluid temperature at outlet	
	3 °C	7 °C
	Bar	Bar
2500 l/h	0,31	0,30
3000 l/h	0,44	0,43
3500 l/h	0,60	0,58

The data refer to operation with no glycol in water.

2.4.2 Performances

Heating

Table 2.7 *p. 6* shows the unitary thermal power at full load and stable operation, depending on hot water delivery temperature to the system and cold water return temperature from the renewable source for GAHP GS HT unit.
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 2.7 *GAHP GS HT heating power for each unit*

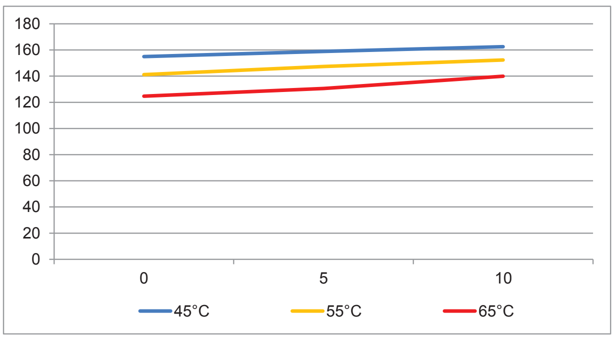
Evaporator inlet water temperature	Water delivery temperature							
	35 °C	40 °C	45 °C	50 °C	55 °C	60 °C	65 °C	70 °C (1)
	KW	KW	KW	KW	KW	KW	KW	KW
0 °C	41,6	40,5	39,0	37,6	35,6	33,5	31,4	13,6
5 °C	42,2	41,7	40,0	39,0	37,1	35,2	32,9	13,9
10 °C	42,3	41,8	40,9	40,0	38,4	37,1	35,2	15,5
15 °C	42,6	42,2	41,7	40,9	39,6	39,0	37,1	16,0

(1) Thermal input reduced to 50%

Data refer to hot water delivery temperature to system (condenser outlet). The nominal thermal gradient is considered to be 10 °C.
Data refer to cold water return temperature from renewable source (evaporator inlet). The nominal thermal gradient is considered to be 5 °C.

Picture 2.3 *p. 6* shows the GUE trend at full load in heating mode and in stable operation for three representative delivery temperatures for GAHP GS HT unit.
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 2.3 *GUE GAHP GS HT heating mode*



In abscissa the return water temperature from renewable source
In ordinate the full load GUE rate

Table 2.8 *p. 7* shows the unitary thermal power at full load and stable operation, depending on hot water delivery temperature to the system and cold water return temperature from the renewable source for GAHP WS unit.

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 2.8 *GAHP WS heating power for each unit*

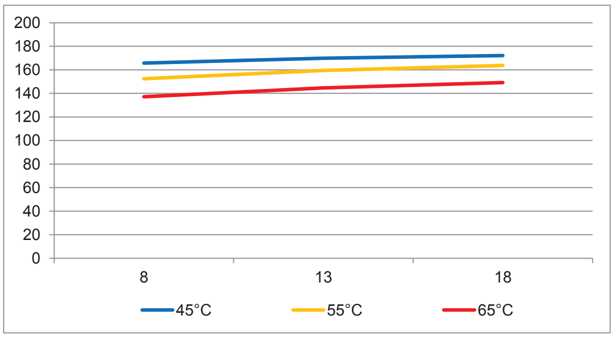
Evaporator inlet water temperature	Water delivery temperature							
	35 °C	40 °C	45 °C	50 °C	55 °C	60 °C	65 °C	70 °C (1)
	KW	KW	KW	KW	KW	KW	KW	KW
10 °C	43,9	43,2	42,4	41,6	39,6	37,7	35,8	13,6
15 °C	43,9	43,6	43,1	42,6	40,6	38,8	36,9	14,1
20 °C	43,9	43,6	43,6	43,6	41,7	39,9	38,1	14,6
25 °C	43,9	43,6	43,6	43,6	42,8	41,0	39,2	15,1

(1) Thermal input reduced to 50%

Data refer to hot water delivery temperature to system (condenser outlet). The nominal thermal gradient is considered to be 10 °C.
Data refer to cold water return temperature from renewable source (evaporator inlet). The nominal thermal gradient is considered to be 5 °C.

Picture 2.4 *p. 7* shows the GUE trend at full load in heating mode and in stable operation for three representative delivery temperatures for GAHP WS unit.
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 WS heating mode*



In abscissa the return water temperature from renewable source
In ordinate the full load GUE rate

Power recovered from renewable source

Conditioning efficiency corresponds to the power recovered from the renewable energy source

Table 2.9 *p. 7* shows the unitary power recovered from the renewable energy source at full load and stable operation, depending on hot water delivery temperature to the system and cold water return temperature from the renewable source for GAHP GS HT unit.
Please consider that, according to the actual heat exchange with the renewable source (or cooling request), the unit may often need to operate under partial load conditions and in non stationary operation.

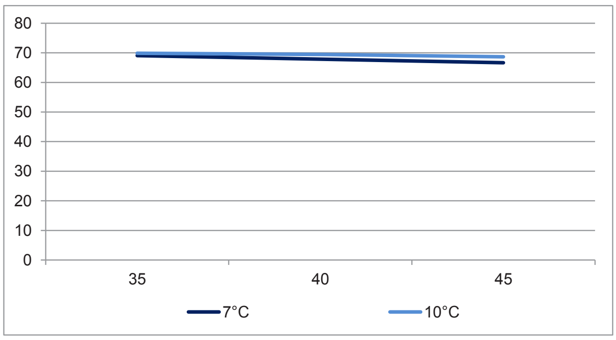
Table 2.9 *Power recovered from renewable source GAHP GS HT*

Evaporator inlet water temperature	Water delivery temperature					
	35 °C	40 °C	45 °C	50 °C	55 °C	60 °C
	KW	KW	KW	KW	KW	KW
12 °C	17,6	17,4	17,4	17,1	16,8	15,8
15 °C	17,9	17,7	17,6	17,5	17,3	16,6

Data refer to hot water delivery temperature to system (condenser outlet). The nominal thermal gradient is considered to be 10 °C.
Data refer to cold water return temperature from renewable source (evaporator inlet). The nominal thermal gradient is considered to be 5 °C.

Picture 2.5 *p. 7* shows the GUE trend at full load in conditioning mode and in stable operation for two representative delivery temperatures for GAHP GS HT unit.
Please consider that, according to the actual heat exchange with the renewable source (or cooling request), the unit may often need to operate under partial load conditions and in non stationary operation.

Figure 2.5 *GUE GAHP GS HT cooling mode*



In abscissa the return water temperature from renewable source
In ordinate the full load GUE rate

Table 2.10 *p. 8* shows the unitary power recovered from the renewable energy source at full load and stable operation, depending on hot water delivery temperature to the system and cold water return temperature from the renewable source for GAHP WS unit.
Please consider that, according to the actual heat exchange with the renewable source (or cooling request), the unit may often need to operate under partial load conditions and in non stationary operation.

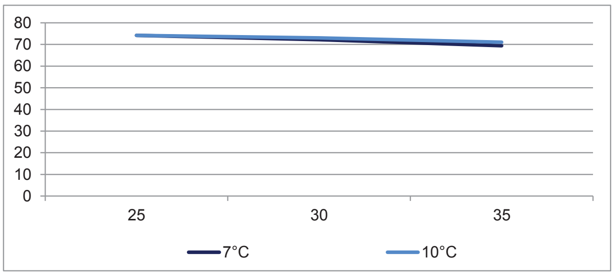
Table 2.10 *Power recovered from renewable source GAHP WS*

Evaporator inlet water temperature	Water delivery temperature			
	45 °C	50 °C	55 °C	60 °C
	KW	KW	KW	KW
12 °C	17,5	16,8	14,8	12,9
15 °C	17,9	17,4	15,4	13,6

Data refer to hot water delivery temperature to system (condenser outlet). The nominal thermal gradient is considered to be 10 °C.
Data refer to cold water return temperature from renewable source (evaporator inlet). The nominal thermal gradient is considered to be 5 °C.

Picture 2.6 *p. 8* shows the GUE trend at full load in conditioning mode and in stable operation for two representative delivery temperatures for GAHP WS unit.
Please consider that, according to the actual heat exchange with the renewable source (or cooling request), the unit may often need to operate under partial load conditions and in non stationary operation.

Figure 2.6 *GUE GAHP WS cooling mode*



In abscissa the return water temperature from renewable source
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 side, at the top, side panel (outlet A Pictures 2.1 *p. 2* and 2.2 *p. 3*).

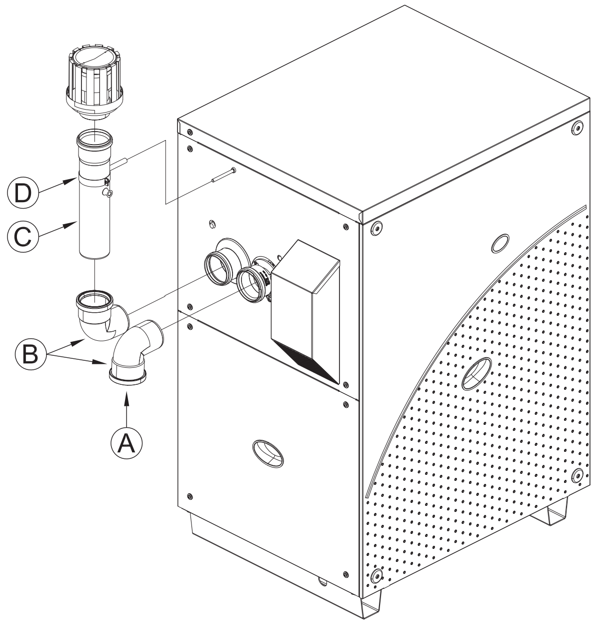
3.3.2 Indoor version

The appliance is supplied in configuration type B63.

3.3.3 Outdoor version

The appliance is supplied with flue gas exhaust kit, to be fitted by the installer, shown in Picture 3.1 *p. 9*.

Figure 3.1 *Flue gas exhaust outdoor version*

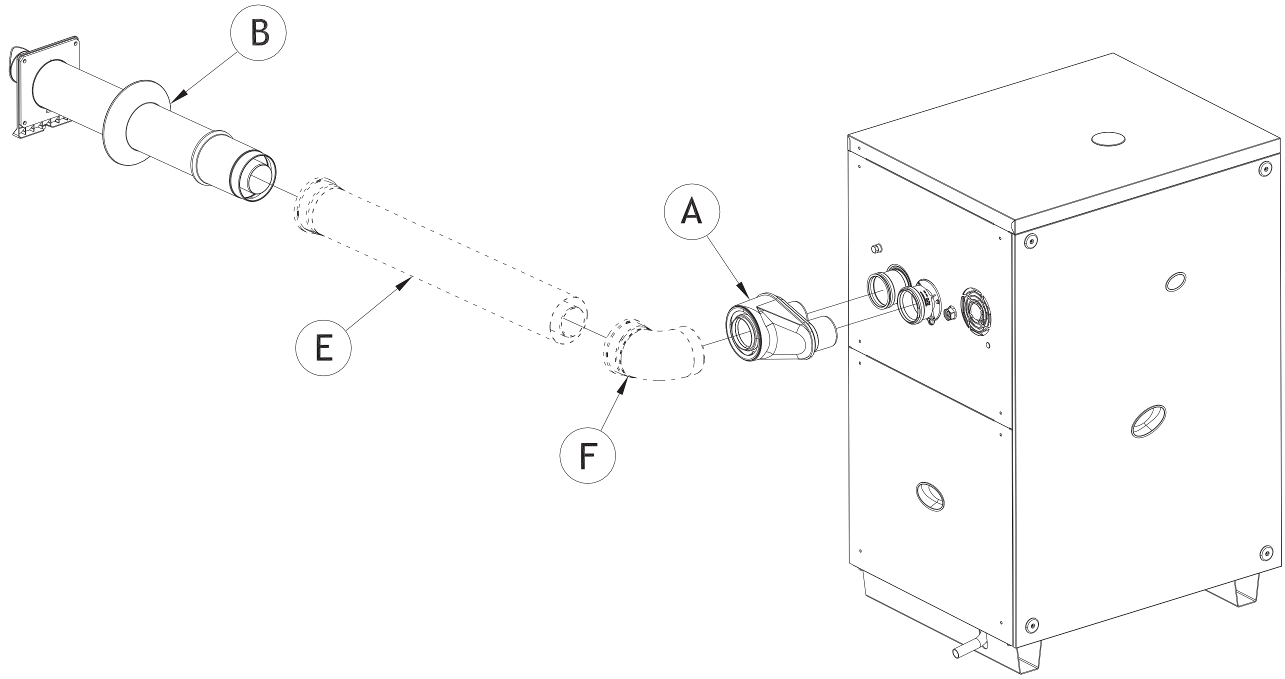


A Air intake
B 90° elbow Ø 80
C Pipe Ø 80 Lg.300 mm w/terminal
D Collar

3.3.4 Indoor version flue gas exhaust set-ups

The possible configurations are shown in the Figures 3.2 *p. 10*, 3.3 *p. 11*, 3.4 *p. 12*, 3.5 *p. 13*, 3.6 *p. 14*.

Figure 3.2 *Type C13 coaxial flue gas exhaust*



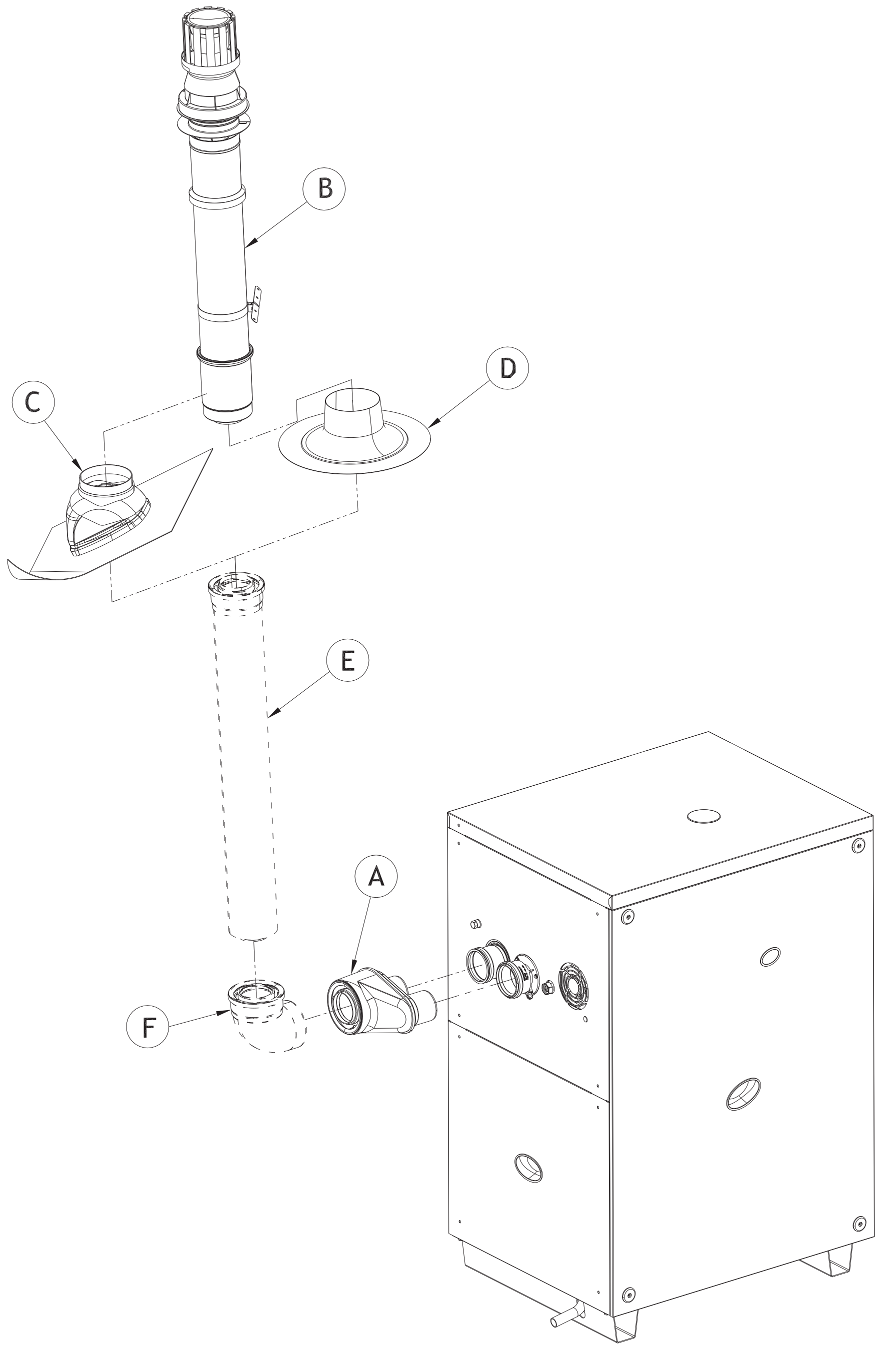
80/125

A Splitter DN80/125 2xDN80
B Wall coaxial terminal DN80/125
E Coaxial pipe 80/125 L= 1 m (o 2 m)
F Coaxial elbow 90° (or 45°) 80/125

60/100

A Splitter DN60/100 2xDN80
B Wall coaxial terminal DN60/100
E Coaxial pipe 60/100 L= 1 m (o 2 m)
F Coaxial elbow 90° (or 45°) 60/100

Figure 3.3 *Type C33 coaxial flue gas exhaust*



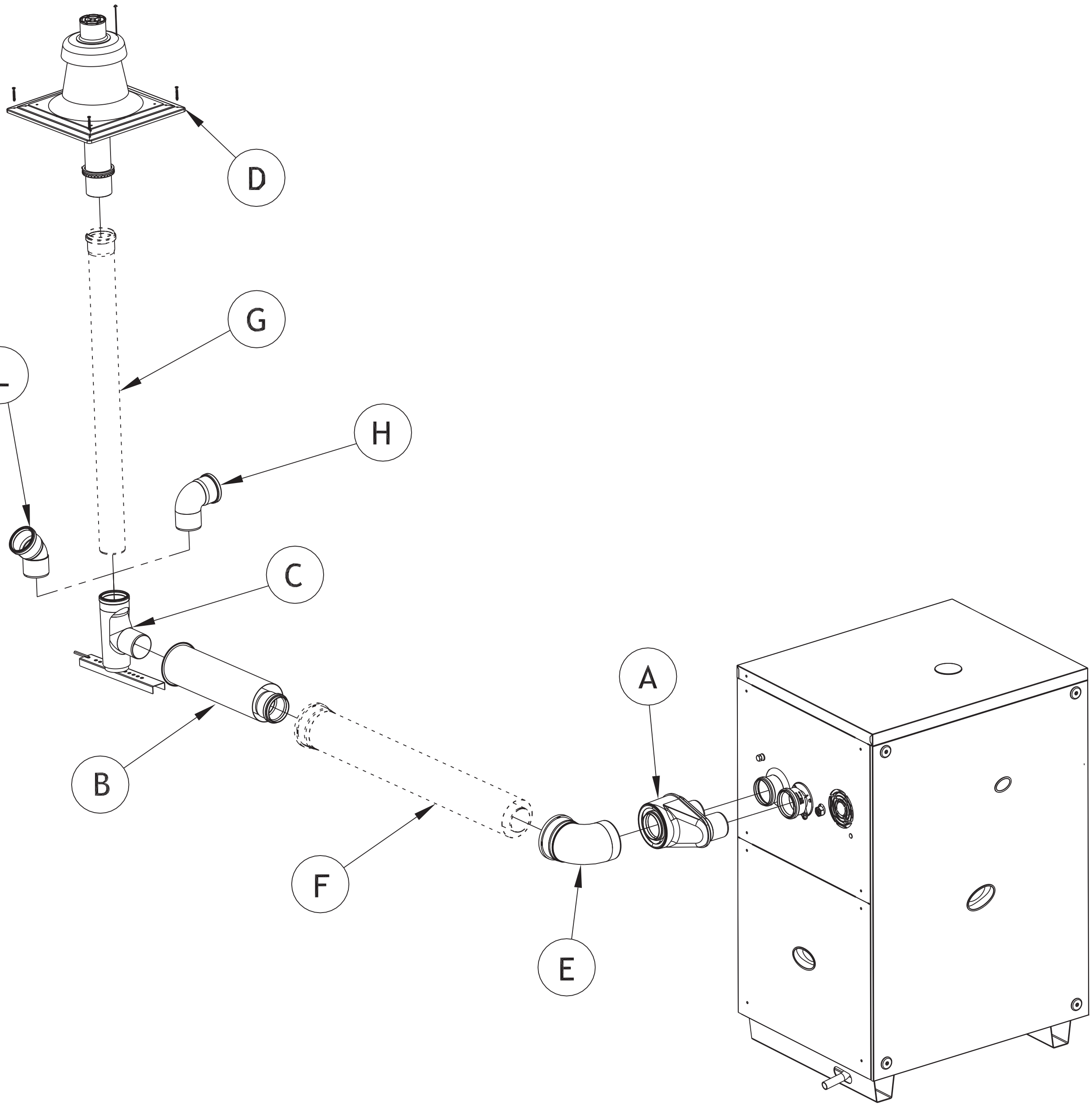
80/125

A DN80/125 2xDN80 double fitting
B Co-axial roof terminal 80/125
C Tile adaptor for sloped roof
D Tile adaptor for flat roof
E Roof coaxial pipe 80/125 L= 1 m (or 2 m)
F Coaxial elbow 90° (or 45°) 80/125

60/100

A DN60/100 2xDN80 double fitting
B Co-axial roof terminal 60/100
C Tile adaptor for sloped roof
D Tile adaptor for flat roof
E Roof coaxial pipe 60/100 L= 1 m (or 2 m)
F Coaxial elbow 90° (or 45°) 60/100

Figure 3.4 *Type C43 coaxial flue gas exhaust*



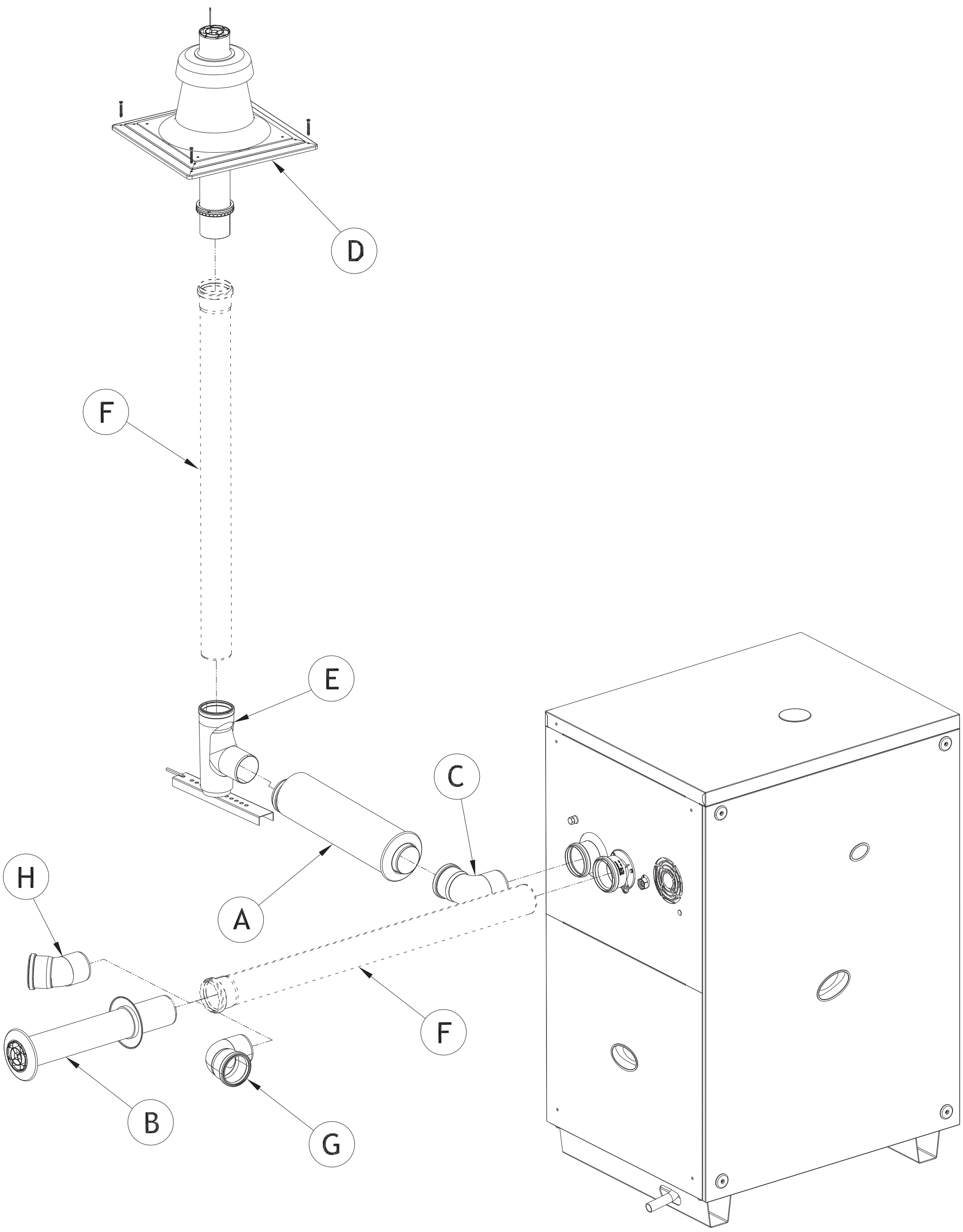
80/125

A Splitter DN80/125 2xDN80
B Wall passage DN 80/125
C Chimney support kit DN80
D Chimney cowl DN80 w/terminal
E Coaxial elbow 90° (or 45°) 80/125
G Pipe DN 80 L=1 m (or 2 m)
H 90° Elbow DN80
L 45° Elbow DN80

60/100

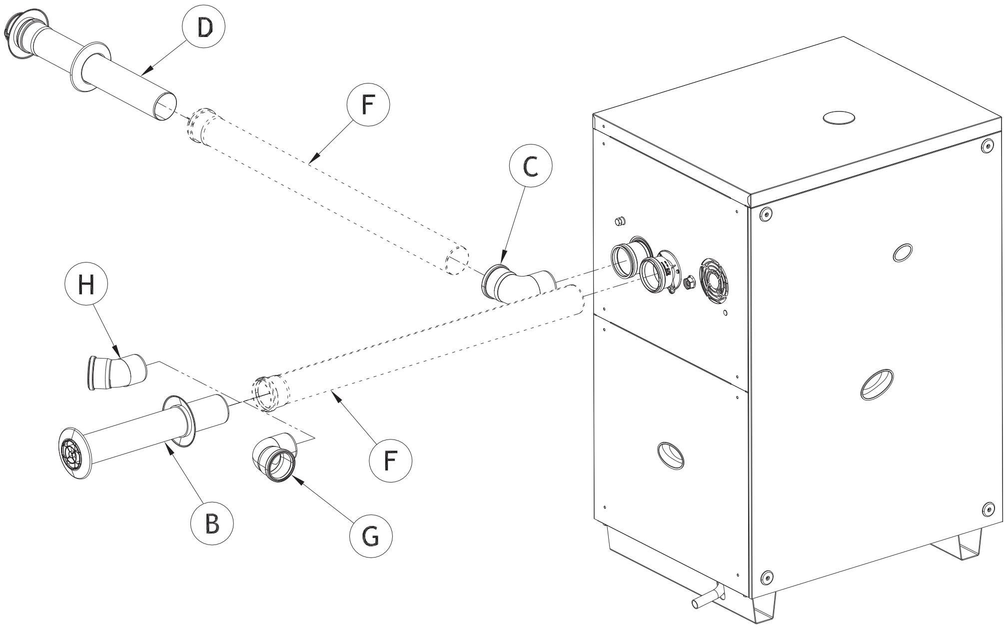
A Splitter DN60/100 2xDN80
B Wall passage DN 60/100
C Kit supporto camino DN60
D Chimney cowl DN60 w/terminal
E Coaxial elbow 90° (or 45°) DN60/100
F Coaxial pipe DN60/100 L=1 m (or 2m)
G Pipe DN 60 L=1 m (or 2 m)
H 90° Elbow DN60
L 45° Elbow DN60

Figure 3.5 *Type C53 roof flue gas exhaust*



80
A B C Split exhaust intake kit DN80
D Chimney cowl DN80 w/terminal
E Chimney support kit DN80
F Pipe DN80 L = 1 m (or 2 m)
G 90° Elbow DN80
H 45° Elbow DN80

Figure 3.6 *Type C53 split wall flue gas exhaust*



80
B C D Wall terminal kit DN80
F Pipe DN80 L=1 m (or 2 m)
G 90° Elbow DN80
H 45° Elbow DN80

3.3.5 Possible flue

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

- ► For flue sizing please refer to the specification sheet in Section C1.10.
- ► If several appliances are connected to a single flue, it is obligatory to install a check valve on the exhaust of each.
- ► 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.

In case the flap valves are installed outside, an appropriate UV ray protection must be assured (if the valve is constructed in plastic material) as well as protection from potential winter freezing of condensate backflow into the siphon.

3.4 FLUE GAS CONDENSATE DISCHARGE

The GAHP GS HT and GAHP WS units are condensing appliances and therefore produce condensation water from combustion flue gas.

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 discharge is located on the left side of the appliance (Figure 3.7 *p. 15*).

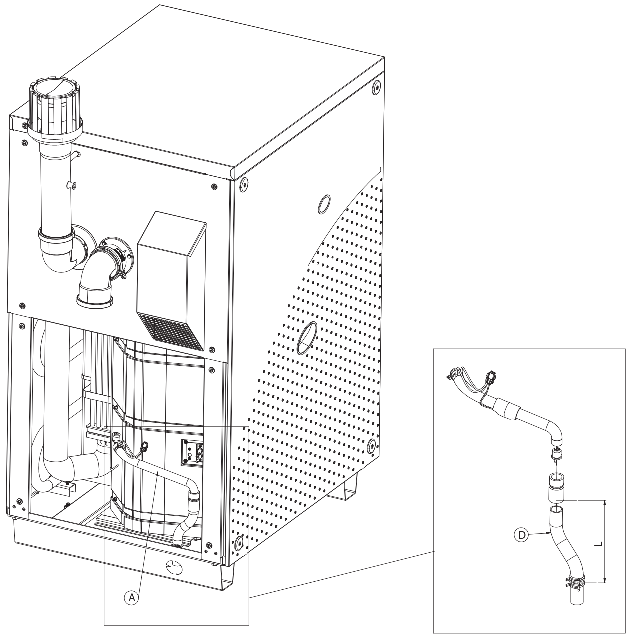
- ► The corrugated condensate discharge pipe must be connected to a suitable discharge manifold.
- ► The junction between the pipe and the manifold must remain visible.

3.4.2 Flue gas condensate discharge manifold

To make the condensate discharge manifold:

- ► Size the ducts for maximum condensation capacity (Table 2.1 *p. 4*).
- ► 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.

Figure 3.7 *Flue gas condensate drain manifold*



A Condensate discharge hose
D Corrugated hose

3.5 SAFETY VALVE EXHAUST (INDOOR VERSION)

The safety valve drain must be mandatorily ducted outside. Failure to comply with this provision jeopardizes first start-up.

Do not install any shut off device on the exhaust duct between the safety valve and the outside exhaust.

3.5.1 Safety valve drain ducting

The exhaust ducting shall be made in steel pipes (do not use copper or its alloys). Table 3.1 *p. 15* provides sufficient criteria of pipe sizing; alternatively, less compelling sizing is accepted, provided it is compliant with specific applicable norms (the manufacturer cannot be held liable).

Table 3.1 *Safety valve drain ducting*

Diameter	DN	Maximum length (m)
1" 1/4	32	30
2"	50	60

The exhaust duct must have an initial straight section of at least 30 cm.

Place the drain terminal outside the room, away from doors, windows and aeration vents, and at such a height that any coolant leaks cannot be inhaled by any people.

3.6 ELECTRICAL AND CONTROL CONNECTIONS

3.6.1 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, CCP/CCI or external request).

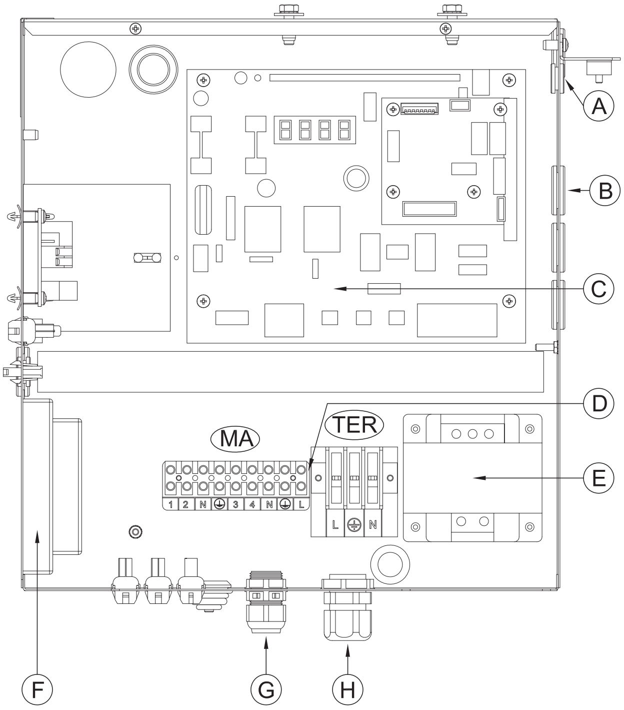
Control of water circulation pumps

The two water circulation pumps of the water/primary circuit, hot side and cold side, 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.

3.6.2 Electrical systems

Electrical connections must provide:
- (a) power supply;
- (b) control system.

Figure 3.8 *GAHP GS/WS Electrical Panel*

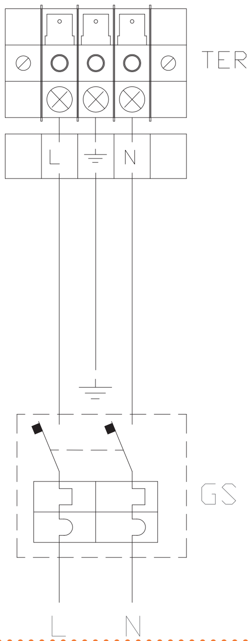


A CAN-BUS cable gland
B Signal cable gland 0...10 V pump Wilo Stratos Para
C Electronic boards S61+Mod10+W10
D Terminal blocks
E Transformer 230/23 V AC
F Flame control box
G Circulation pump power supply and control cable gland
H GAHP power supply cable gland

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

Figure 3.9 *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.

3.6.3 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.

3.6.4 Set-up and control

Control systems, options (1) (2) (3)

Three separate adjustment systems are provided, each with specific features, components and diagrams (see 3.11 *p. 17*, 3.12 *p. 18*):

- System (1), with **DDC control** (with CAN-BUS connection).
- System (2), with **CCP/CCI control** (with CAN-BUS connection).
- System (3), 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 or CCP/CCI 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, CCI, ...), 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 or CCP/CCI controllers are connected to the appliance through the CAN-BUS signal cable, shielded, compliant to Table 3.2 *p. 17* (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 3.2 *CAN BUS cables type*

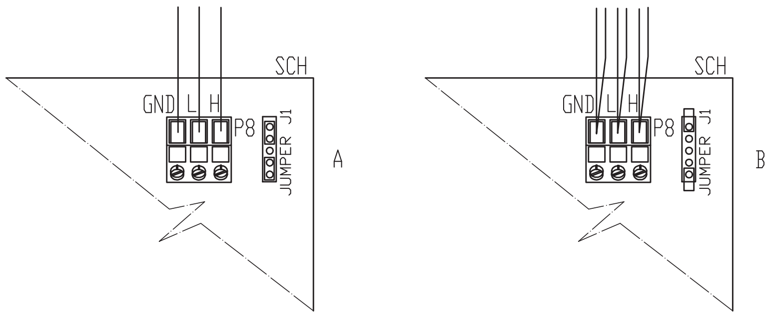
CABLE NAME	SIGNALS / COLOR			MAX LENGTH	Note
Robur					Ordering Code OCVO008
ROBUR NETBUS	H= BLACK	L= WHITE	GND= BROWN	450 m	
Honeywell SDS 1620					In all cases the fourth conductor should not be used
BELDEN 3086A	H= BLACK	L= WHITE	GND= BROWN	450 m	
TURCK type 530					
DeviceNet Mid Cable					
TURCK 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 3.10 *p. 17* and 3.11 *p. 17*):

1. Access the Electrical Board of the appliance according to the Procedure 3.6.2 *p. 15*);
2. Connect the CAN-BUS cable to terminals GND, L and H (shielding/earthing + two signal conductors);
3. Place the CLOSED J10 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 or the CCP/CCI to the CAN-BUS cable according to the instructions in the following Paragraphs and the DDC or CCP/CCI Manuals.

Figure 3.10 *Electrical wiring diagram - Connection cable CAN BUS to electronic board*

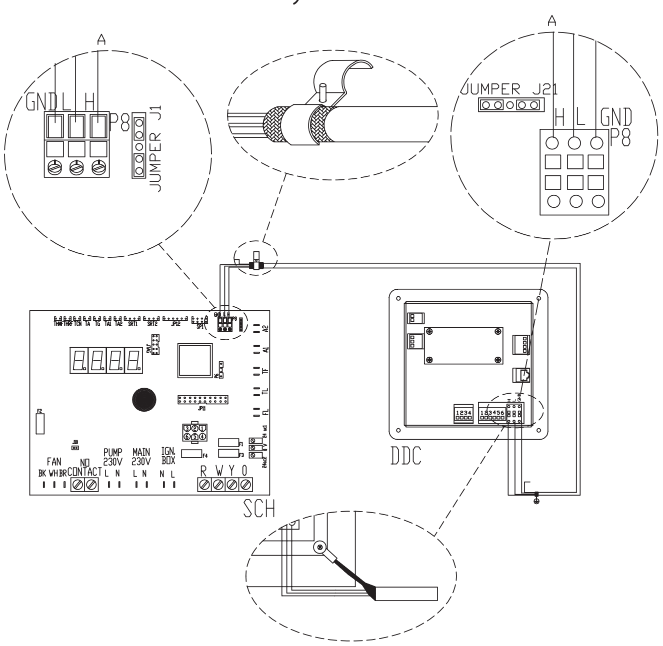


SCH Electronic board
GND Common data
L Data signal LOW
H Data signal HIGH
J1 Jumper CAN-BUS in board
A detail of "terminal node" case (3 wires; J1=jumper "closed")
B Detail of "intermediate node" case (6 wires; J1=jumper "open")
P8 CAN port/connector

GAHP Configuration (S61) + DDC or CCP/CCI

Systems (1) and (2), Figure 3.11 *p. 17*, see also Paragraph 2.3 *p. 3*.

Figure 3.11 *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 (3), Figures 3.12 *p. 18*, 3.13 *p. 18*, see also Paragraph 2.3 *p. 3*.

It is required to arrange:

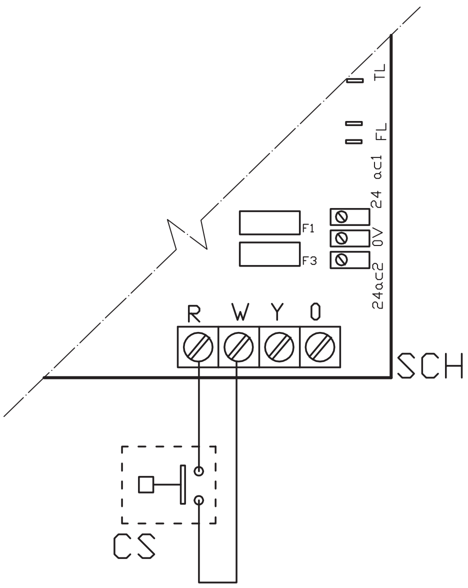
- ► request device (e.g. thermostat, clock, button, ...) fitted with a voltage-free NO contact.

How to connect the external request

Connection of external request is effected on the S61 board located in the Electrical Panel inside the appliance (Figure 3.12 *p. 18* 3.13 *p. 18*):

1. Access the Electrical Board of the appliance according to the Procedure 3.6.2 *p. 15*.
2. connect the voltage-free contact of the external device (Detail CS) through two lead wires to **terminals R and W** of electronic board S61, respectively common 24 V AC and heating request, if the unit works with heating priority, or to **terminals R and Y**, respectively common 24 V AC and cooling request, if the unit works with cooling priority.

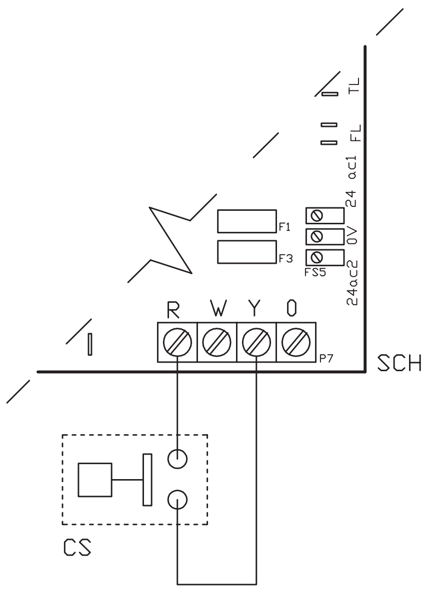
Figure 3.12 *Wiring diagram, external heating enable connection*



SCH Electronic board
R Common
W Terminal consensus warming

Components NOT SUPPLIED
CS external request

Figure 3.13 *Wiring diagram, external cooling enable connection*



SCH Electronic board
R Common
Y Cooling request terminal

Components NOT SUPPLIED
CS External request

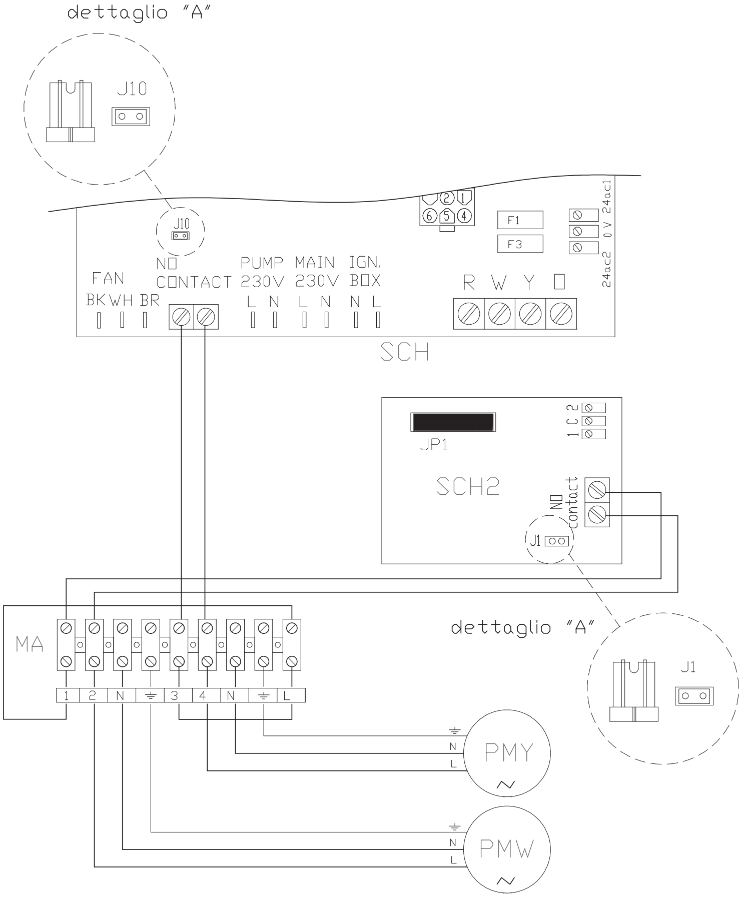
3.6.5 Water circulation pumps

Option (1) CONSTANT FLOW circulating pumps

The two primary pumps, hot side and cold side, must obligatorily be controlled by electronic board S61.

The diagram in Figure 3.14 *p. 19* is for pumps < 700 W. For pumps > 700 W it is necessary to add a control relay and arrange Jumper J1 (hot side pump) and J10 (cold side pump) OPEN.

Figure 3.14 *Constant rate pumps connection wiring diagram*



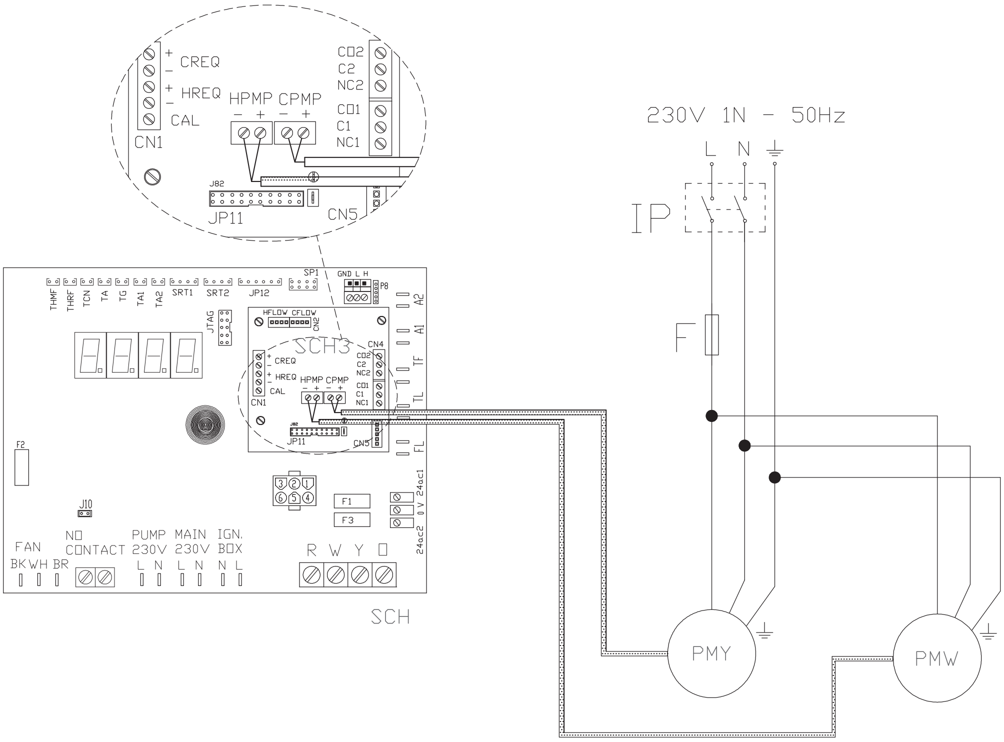
SCH electronic board
SCH2 circuit board
J10 closed jumper (cold side pump)
J1 closed jumper (hot side pump)
N.O. CONTACT N.O voltage free contacts
MA unit terminal block
L phase
N neutral

Components NOT SUPPLIED
PMW hot side water pump < 700W
PMY cold side water pump < 700W

3.6.5.1 Option (2) VARIABLE FLOW circulating pumps

The two primary pumps must obligatorily be controlled by electronic board Mod10 (built into S61).
The Wilo Stratos Para pump is already standard supplied with the power supply cable and signal cable, both 1.5m long.
For longer distances, use respectively cable FG7 3Gx1.5mm^2 m and shielded cable 2x0.75 mm^2 suitable for 0-10V signal.
Only the hot side pump will actually be controlled with variable flow. The cold side pump will in any case be controlled with constant flow.

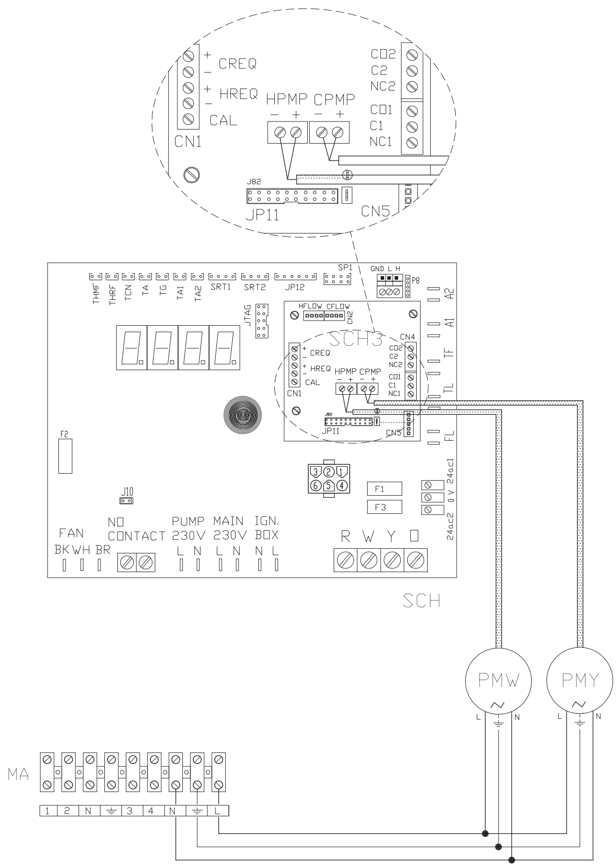
Figure 3.15 *Wiring diagram for connection of Wilo Stratos Para variable rate pumps*



IP Two-position pump power switch
F Fuse
PMW Hot side water circulation pump (primary circuit)
PMY Cold side water circulation pump
Pump signal 0-10V wire colours

brown connect to -ve
white connect to +ve
black isolate
blue isolate

Figure 3.16 *Wiring diagram for hooking up the Wilo Stratos Para variable rate pumps powered by the unit*



PMW Hot side water circulation pump (primary circuit)
PMY Cold side water circulation pump
MA unit terminal block
Pump signal 0-10V wire colours
brown connect to -ve
white connect to +ve
black isolate
blue isolate

1 SPECIFICATION OF SUPPLY

1.1 VERSIONS

The GA ACF unit is available in the following versions:

- ACF standard, for residential/retail/industrial cooling systems with chilled water up to +3 °C;
- HR with heat recovery exchanger, for residential/retail/industrial cooling systems with chilled water up to +3 °C, plus recovery exchanger hot water up to +75 °C (e.g. DHW production);
- TK for heavy duty use, for process systems and applications with chilled water up to +3 °C, in continuous operation year round;
- HT for very hot climates, for residential/retail/industrial cooling systems with chilled water up to +5 °C, with outside air up to 50 °C;
- LB for negative temperatures, for cooling systems with chilled water up to -10 °C (glycol indispensable).

ACF standard, TK, LB and HT models have 2 water fittings (chilled water inlet/outlet), model HR has 4 water fittings (chilled water and heat recovery exchanger hot water inlet/outlet).
Each version may be supplied with standard (STD) or silenced (S) fan.

1.2 SPECIFICATION OF SUPPLY

1.2.1 ACF standard

Water-ammonia absorption chiller, fed with natural gas or LPG, air-water version, for cold water production up to a delivery temperature of 3°C, for external installation.

1.2.2 HR with heat recovery exchanger

Water-ammonia absorption chiller, fed with natural gas or LPG, air-water version with heat recovery, for cold water production up to a delivery temperature of 3°C and simultaneously hot water production (up to a delivery temperature of 75°C), for external installation.

1.2.3 TK for heavy duty use

Water-ammonia absorption chiller, fed with natural gas or LPG, air-water version for process applications, for cold water production up to a delivery temperature of 3°C, for external installation.

1.2.4 HT for very hot climates

Water-ammonia absorption chiller, fed with natural gas or LPG, air-water version for use in areas with high ambient temperature and humidity, for cold water production up to a delivery temperature of 5°C, for external installation.

1.2.5 LB for negative temperatures

Water-ammonia absorption chiller, fed with natural gas or LPG, air-water version for chilling, for cold water production up to a delivery temperature of -10°C, for external installation.

1.3 COMMON CHARACTERISTICS

GA ACF units consist 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 exchanger (evaporator), externally insulated;
- air exchanger (condenser) with finned coil, with steel pipe and aluminium fins;
- titanium stainless steel shell-and-tube water exchanger (recovery exchanger) (HR version only);
- low power consumption refrigerant fluid oil pump;
- standard fan *or* silenced fan *(specify the desired version)* with variable flow rate.

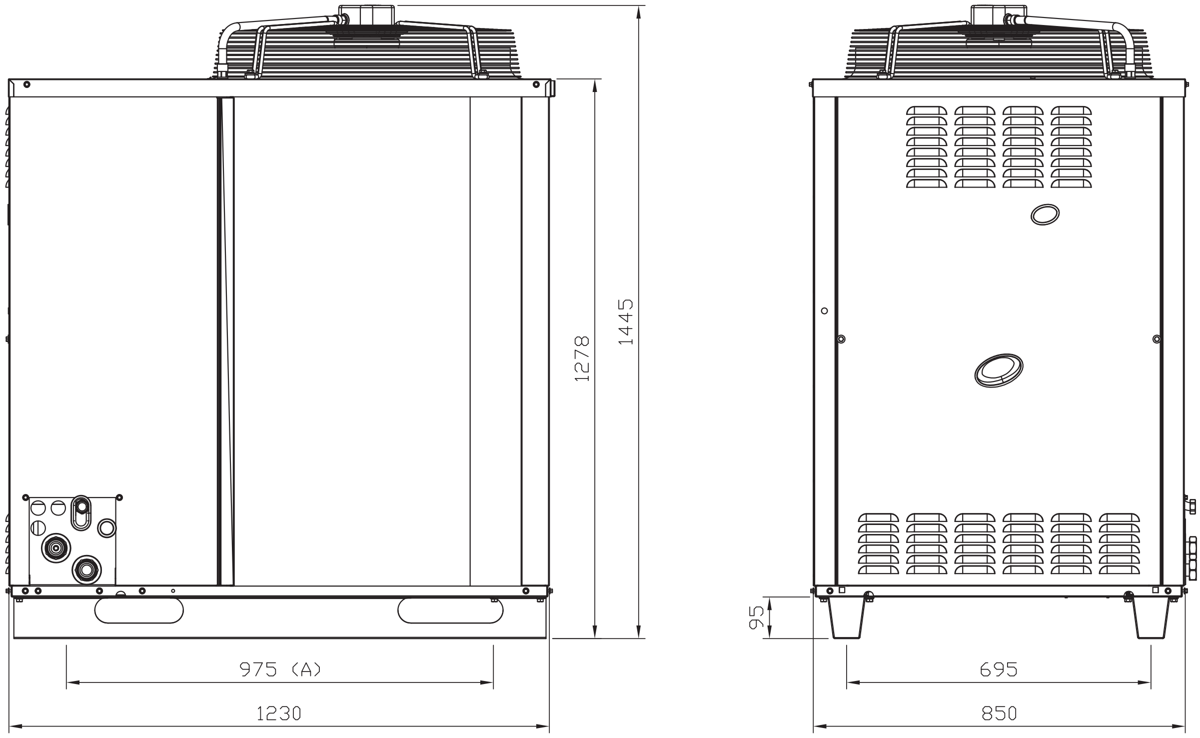
Control and safety devices:

- electronic board with microprocessor;
- circuit water flow switch;
- generator limit thermostat, with manual reset;
- automatically resettable flue gas thermostat;
- 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;
- heat recovery exchanger circulating pump relay (HR version only);
- antifreeze function for water circuit.

2 FEATURES AND TECHNICAL DATA

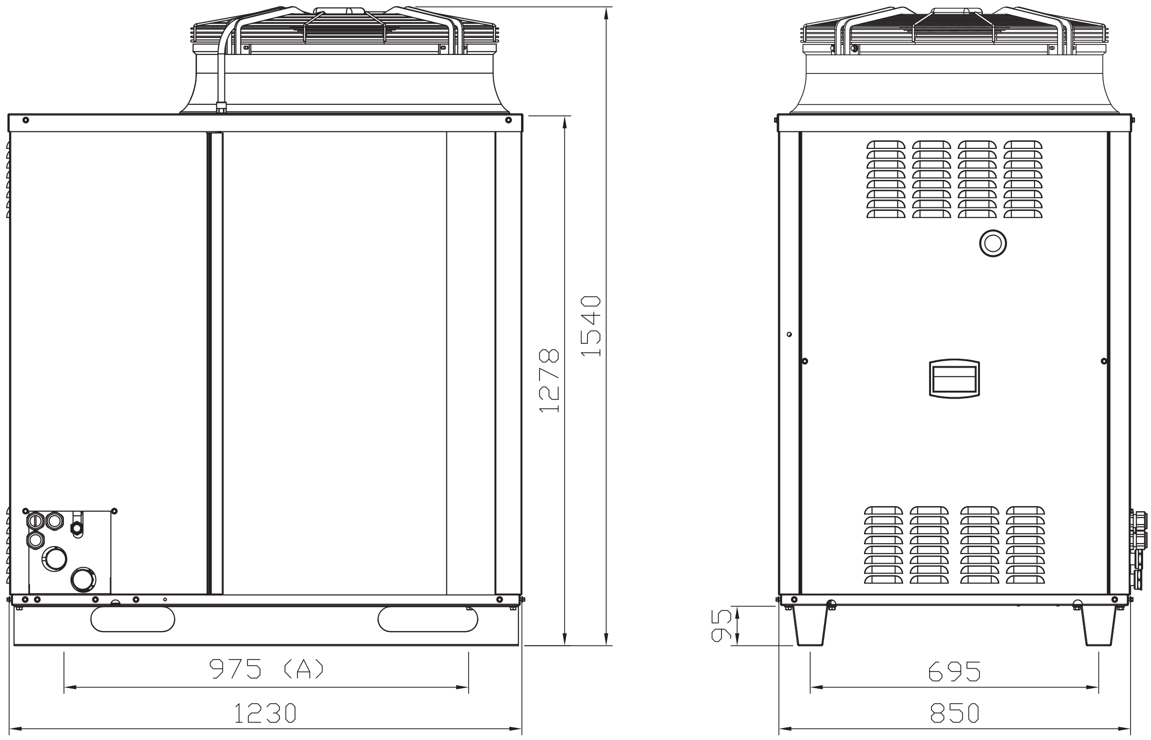
2.1 DIMENSIONS

Figure 2.1 *ACF standard version dimensions*



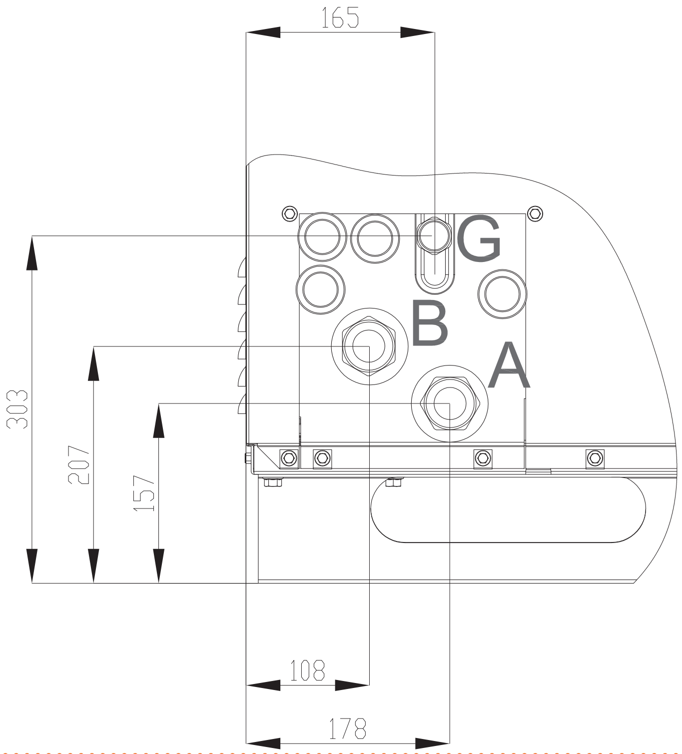
A Position of holes for fixing of anti-vibration joints

Figure 2.2 *ACF silenced version dimensions*



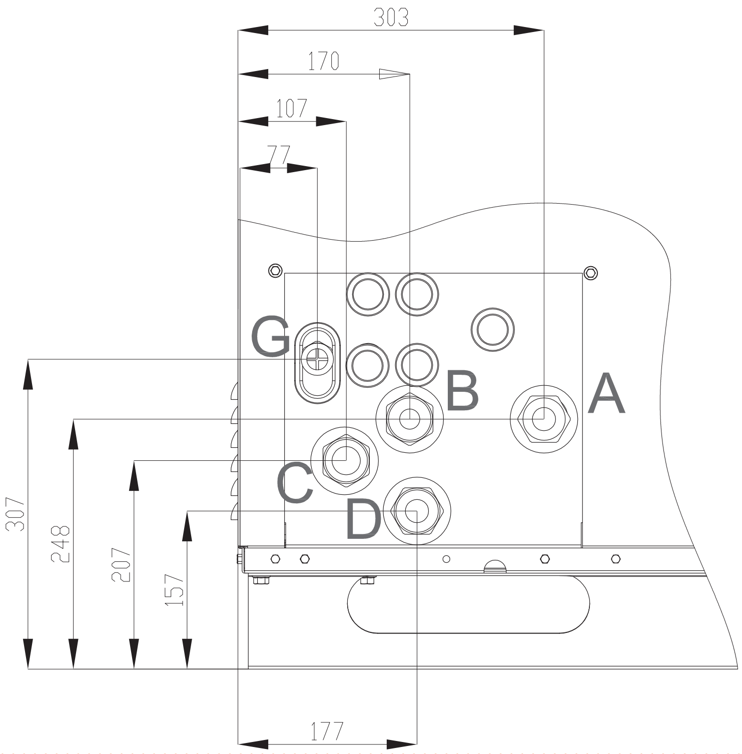
A Position of holes for fixing of anti-vibration joints

Figure 2.3 *ACF Service plate with plumbing and gas connections*



A WATER FLOW TO INSTALLATION 1"1/4 F
B WATER INLET TO UNIT 1"1/4 F
G GAS SUPPLY 3/4" F

Figure 2.4 *ACF-HR Service plate with plumbing and gas connections*



G GAS SUPPLY 3/4" F
Chiller - CHILLED WATER
D WATER FLOW TO INSTALLATION 1"1/4 F
C WATER INLET TO UNIT 1"1/4 F
Recovery exchanger - HOT WATER
A WATER FLOW TO INSTALLATION 1"1/4 F
B WATER INLET TO UNIT 1"1/4 F

2.2 OPERATION MODE

The GA ACF 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 GA 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), thus without the important system functions (1). It is advisable to possibly limit its use to simple applications only and with a single appliance.

2.4 TECHNICAL CHARACTERISTICS

Table 2.1 *GA ACF technical data*

				ACF 60-00	ACF 60-00 HR	ACF 60-00 TK	ACF 60-00 HT	ACF 60-00 LB
Operation in conditioning mode								
Unitary cooling power	Outdoor temperature/Delivery temperature	A35W7	kW	17,7			17,1	-
		A35W-5	kW	-				13,3
Heating capacity	nominal (1013 mbar - 15 °C)		kW	25,3				
	real		kW	25,0				
Cold water temperature (flow)	minimum		°C	3 (1)			5	-10
	nominal		°C	7				-5
Cold water temperature (inlet)	maximum		°C	45				
	minimum		°C	8				-7
Water flow rate	maximum		l/h	3500				2900
	nominal		l/h	2770			2675	2600
	minimum		l/h	2500				2300
Internal pressure drop	at nominal water flow		bar	0,29 (2)				0,42 (2)
External air temperature	nominal		°C	35				
	maximum		°C	45			50	45
	minimum		°C	0		-12	0	
Operating recovery circuit								
Recovery unit thermal capacity	Outdoor temperature/Inlet temperature/1000 l/h water flow	A35W40	kW	-	21,0	-		
Hot water temperature (inlet)	nominal		°C	-	40	-		
Hot water temperature (outlet)	nominal		°C	-	58	-		
Water flow rate	maximum		l/h	-	2500	-		
	minimum		l/h	-	0	-		
	nominal		l/h	-	1000	-		
Total GUE (40°C inlet temperature)	Outdoor temperature/Inlet temperature/1000 l/h water flow	A35W7	%	-	155	-		
Electrical specifications								
Power supply	voltage		V	230				
	type		-	single-phase				
	frequency		50 Hz supply	50				
Electrical power absorption	nominal		kW	0,82 (3)				
	nominal silenced		kW	0,87 (3)				
Degree of protection	IP		-	X5D				
Installation data								
Gas consumption	methane G20 (nominal)		m^3/h	2,68 (4)				
	GPL G30/G31 (nominal)		kg/h	1,97 (5)				1,94 (5)
Sound power L_W (max)			dB(A)	79,6 (6)				
Sound power L_W (max) silenced			dB(A)	75,0 (6)				
Sound pressure L_p at 5 metres (max)			dB(A)	57,6 (7)				
Sound pressure L_p at 5 m (maximum) silenced			dB(A)	53,0 (7)				
Maximum water pressure in operation			bar	4				
Water content inside the apparatus	hot side		l	-	3	-		
	cold side		l	3				
Water fitting	type		-	F				
	thread		" G	1 1/4				
Gas connection	type		-	F				
	thread		" G	3/4				

(1) To be set (on demand) during the first startup. Default Minimum Temperature = 4,5 °C.
(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 (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(6) Sound power values detected in compliance with the intensity measurement methodology set forth by standard EN ISO 9614.
(7) Maximum sound pressure levels in free field, with directionality factor 2, obtained from the sound power level in compliance with standard EN ISO 9614.

			ACF 60-00	ACF 60-00 HR	ACF 60-00 TK	ACF 60-00 HT	ACF 60-00 LB
Dimensions	width	mm	850				
	depth	mm	1230				
	height	mm	1445				
	silenced height	mm	1540				
Weight	in operation	kg	360	390	380		

(1) To be set (on demand) during the first startup. Default Minimum Temperature = 4,5 °C.
(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 (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(6) Sound power values detected in compliance with the intensity measurement methodology set forth by standard EN ISO 9614.
(7) Maximum sound pressure levels in free field, with directionality factor 2, obtained from the sound power level in compliance with standard EN ISO 9614.

Table 2.2 *PED data*

			ACF 60-00	ACF 60-00 HR	ACF 60-00 TK	ACF 60-00 HT	ACF 60-00 LB
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	0,157	0,166	0,165	0,148	0,150
Fluid group		-	1°				

2.4.1 Pressure drops

ACF standard, HR, TK, HT

Table 2.3 *GA ACF ACF standard, HR, TK, HT pressure drop*

Water flow rate	Vector fluid temperature at outlet	
	3 °C	7 °C
	Bar	Bar
2600 l/h	0,27	0,26
2900 l/h	0,33	0,31
3500 l/h	0,48	0,46

The data refer to operation with no glycol in water.

LB

Table 2.4 *GA ACF LB pressure drop*

Water flow rate	Vector fluid temperature at outlet		
	-10 °C	-5 °C	0 °C
	Bar	Bar	Bar
2300 l/h	0,44	0,37	0,30
2600 l/h	0,52	0,42	0,35
2900 l/h	0,55	0,47	0,41

The data refer to operation with 40% glycol water.

HR recovery exchanger

Table 2.5 *GA ACF HR heat recover exchanger pressure drop*

Water flow rate	Heat transfer fluid temperatures on inlet		
	30 °C	40 °C	70 °C
	Bar	Bar	Bar
500 l/h	0,01	0,01	0,01
1000 l/h	0,03	0,03	0,03
1500 l/h	0,06	0,06	0,06
2500 l/h	0,16	0,16	0,14

2.4.2 Performances

ACF standard

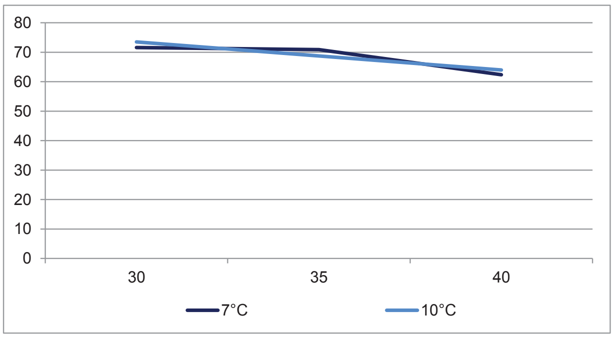
Table 2.6 *p. 5* shows the unitary cooling load at full load and in stable operation, depending on cold water outlet temperature to the system and outdoor temperature, referring to ACF 60-00 unit.
Please consider that, according to the actual cooling request, the unit may often need to operate under partial load conditions and in non stationary operation.

Table 2.6 *GA ACF standard cooling power for each unit*

External air temperature	Water delivery temperature	
	7 °C	10 °C
	KW	KW
30 °C	17,9	18,4
35 °C	17,7	17,2
40 °C	15,6	16,0
45 °C	11,9	14,8

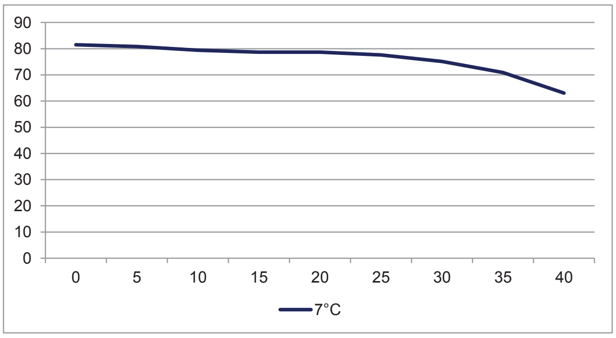
Picture 2.5 *p. 6* shows the GUE trend at full load in conditioning mode and in stable operation for two representative temperatures, referring to ACF 60-00 unit.
Please consider that, according to the actual cooling request, the unit may often need to operate under partial load conditions and in non stationary operation.

Figure 2.5 *GA ACF standard GUE*



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

Figure 2.6 *GA ACF TK GUE*



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

TK

Table 2.7 *p. 6* shows the unitary cooling load at full load and in stable operation, depending on cold water outlet temperature to the system and outdoor temperature, referring to ACF 60-00 TK unit.
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 2.7 *GA ACF TK cooling power for each unit*

External air temperature	Water delivery temperature	
	4 °C	7 °C
	KW	KW
-10 °C	20,9	20,9
-5 °C	20,6	20,6
0 °C	20,4	20,4
5 °C	20,1	20,2
10 °C	19,9	19,9
15 °C	19,7	19,7
20 °C	19,3	19,7
25 °C	18,6	19,4
30 °C	16,9	18,8
31 °C	16,4	18,6
35 °C	13,8	17,7
40 °C	/	15,8
45 °C	/	/

Picture 2.6 *p. 6* shows the GUE trend at full load in conditioning mode and in stable operation for a representative temperature, referring to ACF 60-00 TK unit.
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.

HT

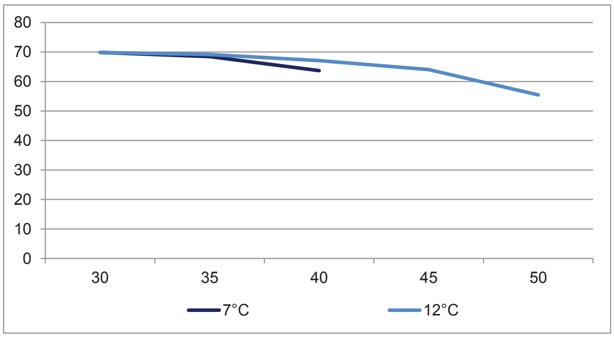
Table 2.8 *p. 6* shows the unitary cooling load at full load and in stable operation, depending on cold water outlet temperature to the system and outdoor temperature, referring to ACF 60-00 HT unit.
Please consider that, according to the actual cooling request, the unit may often need to operate under partial load conditions and in non stationary operation.

Table 2.8 *GA ACF HT cooling power for each unit*

External air temperature	Water delivery temperature	
	7 °C	10 °C
	KW	KW
30 °C	17,5	17,5
35 °C	17,1	17,1
40 °C	15,9	16,6
45 °C	/	15,2
50 °C	/	/

Picture 2.7 *p. 6* shows the GUE trend at full load in conditioning mode and in stable operation for two representative temperatures, referring to ACF 60-00 HT unit.
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 2.7 *GA ACF HT GUE*



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

LB

Table 2.9 *p. 7* shows the unitary cooling load at full load and in stable operation, depending on cold water outlet temperature to the system and outdoor temperature, referring to ACF

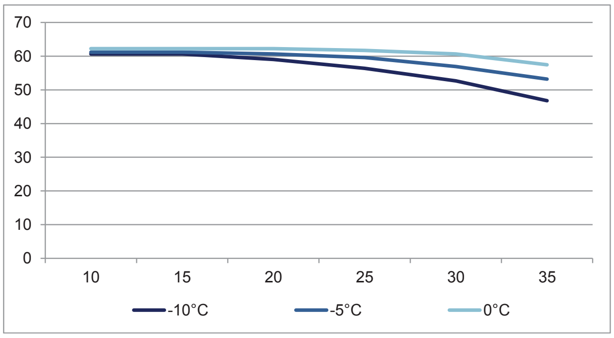
60-00 LB unit.
Please consider that, according to the actual cooling request, the unit may often need to operate under partial load conditions and in non stationary operation.

Table 2.9 *GA ACF LB cooling power for each unit*

External air temperature	Water delivery temperature		
	-10 °C	-5 °C	0 °C
	KW	KW	KW
10 °C	15,2	15,3	15,6
15 °C	15,2	15,3	15,6
20 °C	14,8	15,2	15,6
25 °C	14,1	14,9	15,4
30 °C	13,2	14,2	15,2
35 °C	11,7	13,3	14,4
40 °C	9,6	11,8	13,3

Picture 2.8 *p. 7* shows the GUE trend at full load in conditioning mode and in stable operation for three representative temperatures, referring to ACF 60-00 LB unit.
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 2.8 *GA ACF LB GUE*



Data for 40% glycol water.
In abscissa the outdoor temperature
In ordinate the full load GUE rate

HR

Table 2.10 *p. 7* shows the unitary cooling load at full load and in stable operation, depending on cold water outlet temperature to the system and outdoor temperature, referring to ACF 60-00 HR unit.
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 2.10 *GA ACF HR cooling power for each unit*

External air temperature	Water delivery temperature	
	7 °C	10 °C
	KW	KW
30 °C	17,7	18,2
35 °C	17,7	17,2
40 °C	16,8	16,1
45 °C	14,2	15,4

In the Tables 2.11 *p. 7* and 2.12 *p. 7*, the unitary recoverable thermic power at full load and in stable operating mode, depending on the temperature of the thermal input fluid to the recuperator and the external temperature for two reference water flow to the recuperator, respectively 1000 l/h (Table 2.11 *p. 7*) and 500 l/h (Table 2.12 *p. 7*), referring to the ACF 60-00 HR unit.
Consider that in the absence of a refrigeration request no recoverable thermal power will be available.

Table 2.11 *Recoverable thermal power for each GA ACF HR with 1000 l/h water flow*

External air temperature	Heat transfer fluid temperature on inlet			
	20 °C	30 °C	40 °C	50 °C
	KW	KW	KW	KW
30 °C	31,3	25,1	19,1	13,2
35 °C	32,0	26,2	21,0	15,5
40 °C	/	28,0	23,0	17,5
45 °C	/	30,0	25,1	19,2

The figures refer to temperature on recovery exchanger inlet, with flow rate to recovery exchanger of 1000 l/h.

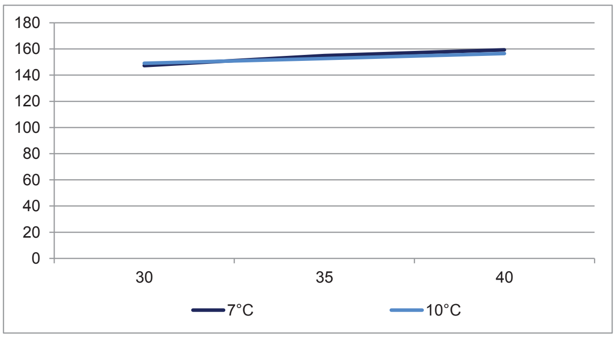
Table 2.12 *Recoverable thermal power for each GA ACF HR with 500 l/h water flow*

External air temperature	Heat transfer fluid temperature on inlet				
	10 °C	20 °C	30 °C	40 °C	50 °C
	KW	KW	KW	KW	KW
30 °C	27,5	23,0	18,1	13,5	9,3
35 °C	27,9	23,5	19,1	14,9	11,0
40 °C	28,2	24,4	20,1	16,3	12,8
45 °C	28,5	25,0	21,2	18,0	14,9

The figures refer to temperature on recovery exchanger inlet, with flow rate to recovery exchanger of 500 l/h.

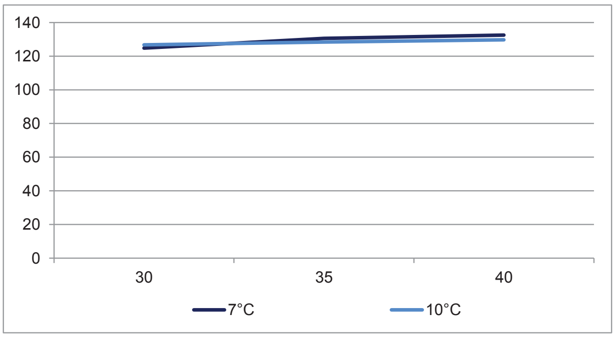
Pictures 2.9 *p. 7* and 2.10 *p. 8* shows the GUE trend at full load in conditioning mode and simultaneous heat recovery in stable operation for two representative temperatures and two water flow rates to the recovery exchanger, referring to ACF 60-00 HR unit.
Please consider that, according to the actual cooling request, the unit may often need to operate under partial load conditions and in non stationary operation.

Figure 2.9 *GA ACF HR GUE with heat recovery 1000 l/h return 40°C*



Data refer to simultaneous operation for conditioning and heat recovery.
Recovery exchanger conditions: flow rate 1000 l/h, inlet temperature 40°C.
In abscissa the outdoor temperature
In ordinate the full load GUE rate

Figure 2.10 *GA ACF HR GUE with heat recovery 500 l/h return 40°C*



Data refer to simultaneous operation for conditioning and heat recovery.
Recovery exchanger conditions: flow rate 500 l/h, inlet temperature 40°C.
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

The GA ACF units have no flue gas exhaust.

3.4 ELECTRICAL AND CONTROL CONNECTIONS

3.4.1 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

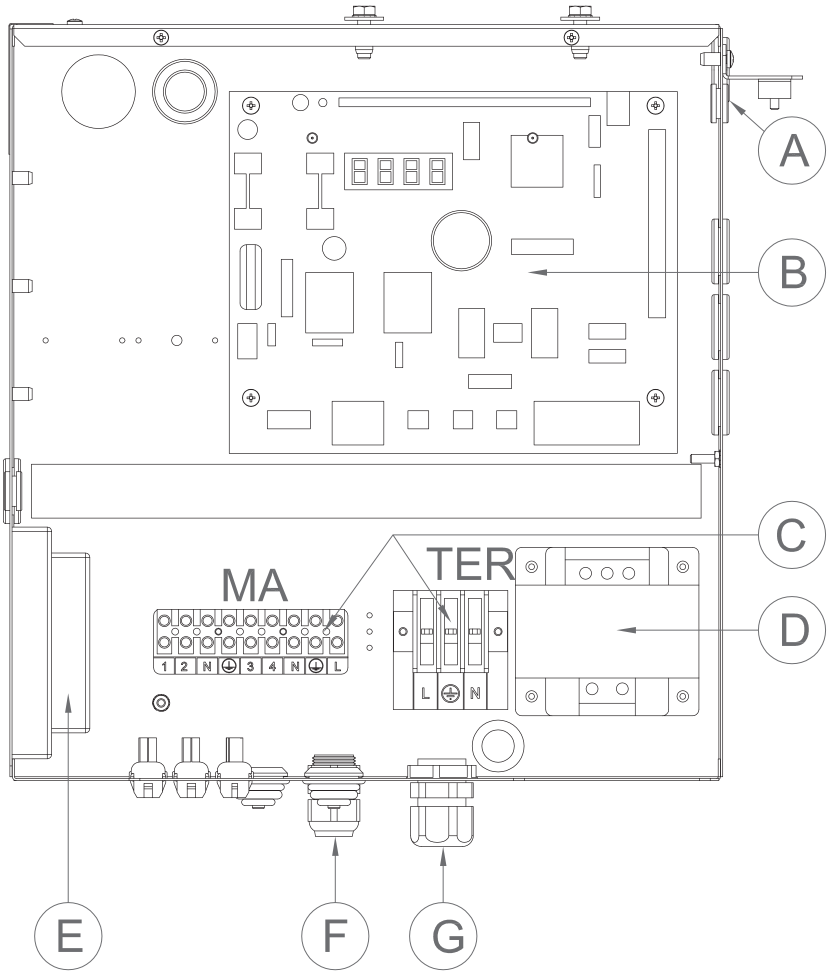
The water circulation pump of the water/primary circuit must mandatorily be controlled by the appliance's electronic boards. It is not admissible to start/stop the circulating pump with no request from the appliance.

3.4.2 Electrical systems

Electrical connections must provide:

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

Figure 3.1 *ACF Electrical Panel*



A CAN-BUS cable gland
B S61 electronic boards
C ME and TER terminal boards
D transformer 230/23 V AC
E flame control box
F circulation pump power supply and control cable gland
G GA power supply cable gland

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

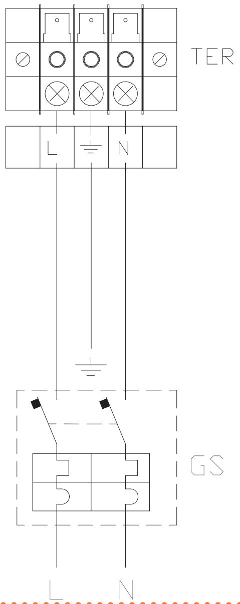
3.4.3 Electrical power supply

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 3.2 *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.

3.4.4 Set-up and control

Control systems, options (1) or (2)

Two separate control systems are provided, each with specific features, components and diagrams (Figures 3.4 *p. 12*, 3.5 *p. 12*):

- 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. 11* (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*

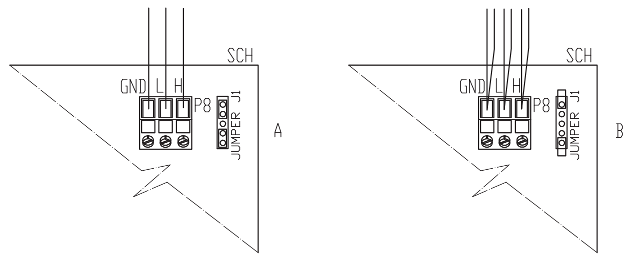
CABLE NAME	SIGNALS / COLOR			MAX LENGTH	Note
Robur					Ordering Code OCVO008
ROBUR NETBUS	H= BLACK	L= WHITE	GND= BROWN	450 m	
Honeywell SDS 1620					In all cases the fourth conductor should not be used
BELDEN 3086A	H= BLACK	L= WHITE	GND= BROWN	450 m	
TURCK type 530					
DeviceNet Mid Cable					
TURCK 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 3.3 *p. 11* and 3.4 *p. 12* Details A and B:

1. Access the Electrical Board of the appliance according to the Procedure 3.4.2 *p. 9*);
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 3.3 *Electrical wiring diagram - Connection cable CAN BUS to electronic board*

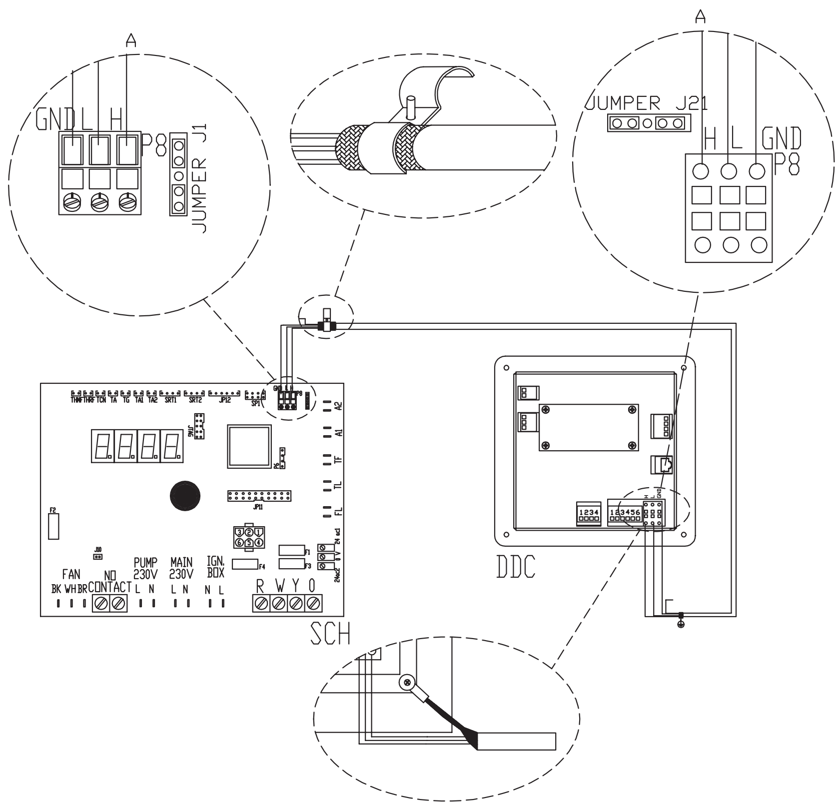


SCH Electronic board
GND Common data
L Data signal LOW
H Data signal HIGH
J1 Jumper CAN-BUS in board
A detail of "terminal node" case (3 wires; J1=jumper "closed")
B Detail of "intermediate node" case (6 wires; J1=jumper "open")
P8 CAN port/connector

GAHP Configuration (S61) + DDC

(System (1) Picture 3.4 *p. 12*, see also Paragraph 2.3 *p. 3*)

Figure 3.4 *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 3.5 *p. 12*, see also Paragraph 2.3 *p. 3*)
It is required to arrange:

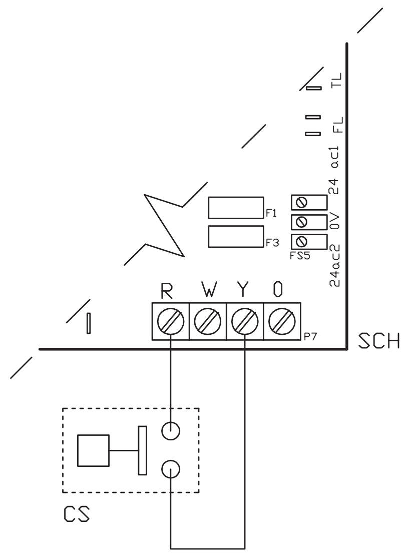
► request device (e.g. thermostat, clock, button, ...) fitted with a voltage-free NO contact.

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 3.5 *p. 12*):

1. Access the Electrical Board of the appliance according to the Procedure 3.4.2 *p. 9*.
2. Connect the voltage free contact of the external device (Detail CS), through two wires, to **terminals R and Y** (respectively: common 24 V AC and cooling request) of electronic board S61.

Figure 3.5 *Wiring diagram, external cooling enable connection*



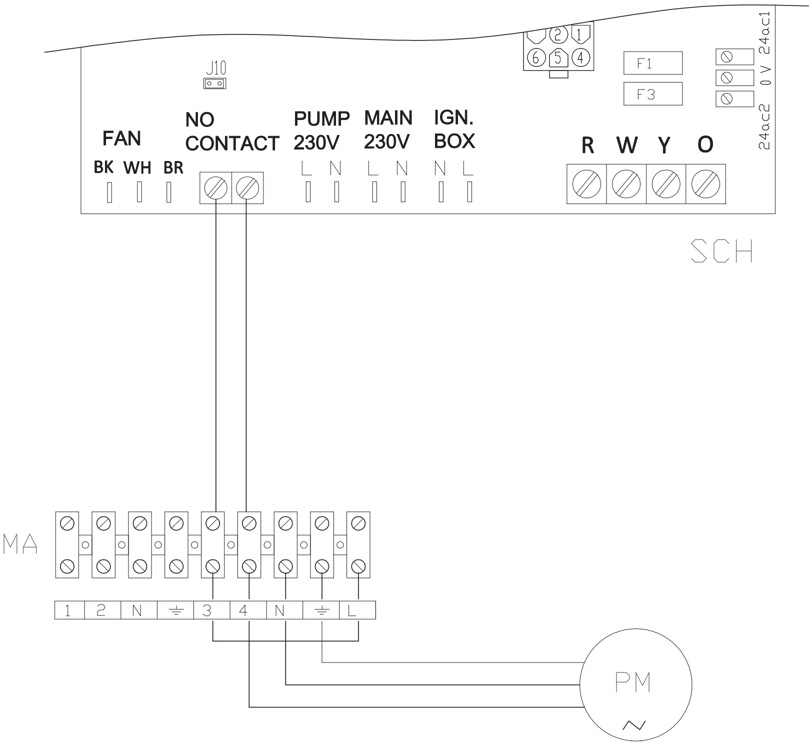
SCH Electronic board
R Common
Y Cooling request terminal
Components NOT SUPPLIED
CS External request

3.4.5 Water circulation pump

CONSTANT FLOW circulating pump

It must be mandatorily controlled from the S61 electronic board. The diagram in Figure 3.6 *p. 13* is for pumps < 700 W. For pumps > 700 W it is required to add a control relay and arrange Jumper J10 OPEN.

Figure 3.6 *Water circulation pump connection - Connection of plant water circulation pumps (power absorption less than 700W), controlled directly by the appliance.*

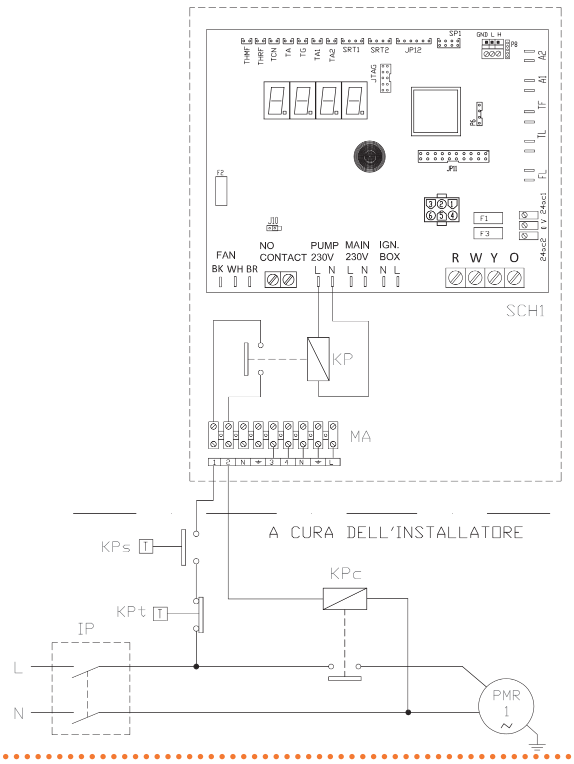


SCH electronic board
J10 closed jumper
N.O. CONTACT N.O voltage free contacts
MA unit terminal block
L phase
N neutral
Components NOT SUPPLIED
PM water pump < 700W

Heat recovery exchanger circulating pump

To be controlled through contacts 1 - 2 on terminal board MA (Figure 3.7 *p. 13*).

Figure 3.7 *Recovery exchanger pump connection wiring diagram*



KP Relay on the unit for recovery exchanger pump request
KPt Thermostat with setpoint calibration of DHW tank (not supplied)
KPs Thermostat calibrated at 35 °C with capillary tube in the lower part of the DHW tank (not supplied) [to be provided in the event the water flow rate on the recovery circuit exceeds the nominal value of 1000 l/h]
KPc Two-pole relay for recovery exchanger pump request (not supplied)
IP Two-pole isolation switch for recovery exchanger pump power supply (not supplied)
PMR Recovery exchanger pump (not supplied)

1 SPECIFICATION OF SUPPLY

4 star sealed chamber condensing boiler, fed with natural gas or LPG, to produce hot water up to a delivery temperature of 80°C, for indoor or outdoor installation.
The appliance is provided with an internal heat exchanger to separate internal hydraulic circuit from system hydraulic circuit.
The boiler consists of:

- premixed multi-gas burner with low NOx and CO emissions;
- stainless steel plate heat exchanger, combining a hydraulic separator;
- automatic and manual air bleeds on the internal circuit;
- flue gas discharge duct with relevant terminal, for type B53P configuration;
- condensate discharge siphon (with antifreeze function).

Control and safety devices:

- electronic board with microprocessor;
- automatically resettable water temperature limiting thermostat;
- flue gas limit thermostat, for single use (thermal switch);
- system circuit water differential pressure switch (PD1);
- internal circuit water differential pressure switch (PD2) with anti-sticking function;
- overpressure valve on internal circuit, set to trip at 3 bar;
- internal circuit expansion tank;
- ionisation flame controller;
- gas solenoid valve with double shutter;
- antifreeze function for water circuit;
- anti-freezing thermostat used for the activation of the heating element on the condensate drain.

2 FEATURES AND TECHNICAL DATA

2.1 DIMENSIONS

Figure 2.1 *Dimensions (front and right side views)*

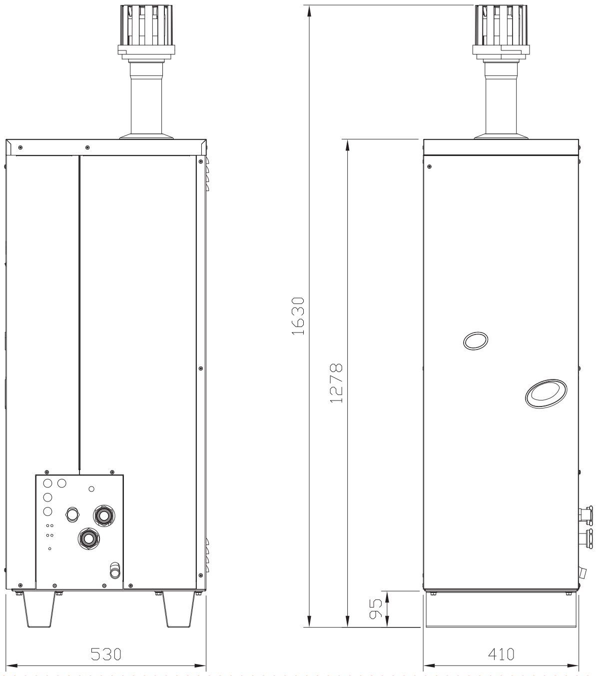
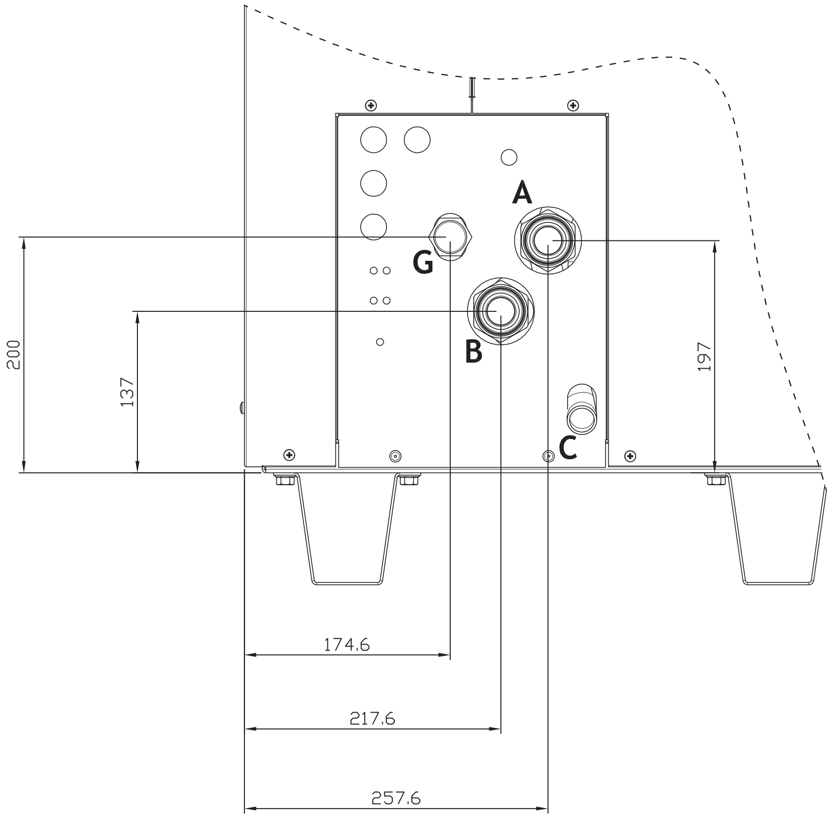


Figure 2.2 *Service plate - Hydraulic/gas unions detail*



G Gas connection Ø 3/4" M
A Water outlet connection Ø 1 1/4" F
B Water inlet connection Ø 1 1/4" F
C Condensate discharge connection (ext. D. 25 mm)

2.2 OPERATION MODE

The AY00-120 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) **CCP/CCI control**
- (3) **external request**

2.3.1 Adjustment system (1) with DDC control (ON/OFF unit)

The DDC controller is able to control the appliances, a single AY00-120 unit, or even several GAHP/GA/AY Robur units in cascade, only in ON/OFF mode (non modulating). For more information see Section C1.12.

2.3.2 Control system (2) with CCP/CCI (modulating GAHP unit)

The CCP/CCI control is able to control up to 3 GAHP units in modulating mode (therefore A/WS/GS only, excluding AR/ACF/AY), plus any integration ON/OFF boiler. For more information see Section C1.12.

2.3.3 Adjustment system (3) with external request (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), thus without the important system functions (1). It is advisable to possibly limit its use to simple applications only and with a single appliance.

2.4 TECHNICAL CHARACTERISTICS

Table 2.1 *Technical specifications AY00-120*

				AY00-120
Heating mode				
Seasonal space heating energy efficiency class (ErP)				A
Operating point 80/60	Nominal thermal capacity	effective power	kW	34,4
		efficiency	%	98,6
	Mean thermal capacity	efficiency	%	98,3
	Minimal thermal capacity	efficiency	%	97,3
Operating point 70/50	Nominal thermal capacity	efficiency	%	100,6
Operating point 50/30	Nominal thermal capacity	efficiency	%	104,6
Operating point Tr = 30 °C	Thermal capacity 30%	efficiency	%	107,5
Operating point Tr = 47 °C	Thermal capacity 30%	efficiency	%	100,3
Heating capacity	nominal (1013 mbar - 15 °C)		kW	34,9
	average		kW	21,5
	minimum		kW	8,0
Hot water delivery temperature	maximum		°C	80
	minimum		°C	25
	nominal		°C	60
Hot water return temperature	maximum		°C	70
	minimum		°C	20
	nominal		°C	50
Heating water flow	nominal		l/h	2950
	maximum		l/h	3200
	minimum		l/h	1500
Pressure drop heating mode	at nominal water flow		bar	0,40 (1)
Efficiency class				****
Heat loss	to jacket in operation		kW	0,15
	to jacket in operation		%	0,44
	to flue in operation		kW	0,86
	to flue in operation		%	2,54
	in off mode		kW	0,058
	in off mode		%	0,17
Ambient air temperature (dry bulb)	maximum		°C	45
	minimum		°C	-20 (2)
Electrical specifications				
Power supply	voltage		V	230
	type		-	single-phase
	frequency		50 Hz supply	50
Electrical power absorption	nominal		kW	0,18
Degree of protection	IP		-	XSD
Installation data				

(1) For flows other than nominal see Design Manual, Pressure losses Paragraph.
(2) As an option, a version for operation down to -40 °C is available.

			AY00-120
Gas consumption	methane G20 (nominal)	m^3/h	3,69
	methane G20 (min)	m^3/h	0,85
	G25 (nominal)	m^3/h	4,35
	G25 (min)	m^3/h	1,00
	G30 (nominal)	kg/h	2,75
	G30 (min)	kg/h	0,63
	G31 (nominal)	kg/h	2,71
	G31 (min)	kg/h	0,62
NO_x emission class		-	5
NO_x emission		ppm	19,5
CO emission		ppm	8,4
Minimum storage temperature		°C	-30
Maximum water pressure in operation		bar	4
Maximum flow flue condensate		l/h	5,5
Water content inside the apparatus	hot side	l	1
Water fitting	type	-	F
	thread	" G	1 1/4
Gas connection	type	-	M
	thread	" G	3/4
Fume outlet	diameter (Ø)	mm	80
	residual head	Pa	100
	product configuration		B53P
Type of installation		-	B32P, B33, B35P, C13, C33, C34, C53, C63, C83
Dimensions	width	mm	410
	depth	mm	530
	height	mm	1278
Weight	in operation	kg	71

(1) For flows other than nominal see Design Manual, Pressure losses Paragraph.
(2) As an option, a version for operation down to -40 °C is available.

2.4.1 Pressure drops

Table 2.2 *Pressure drop AY*

Water flow rate	Outlet water temperature
	20 °C
	Bar
2007 l/h	0,20
2400 l/h	0,27
3000 l/h	0,41

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;
- 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

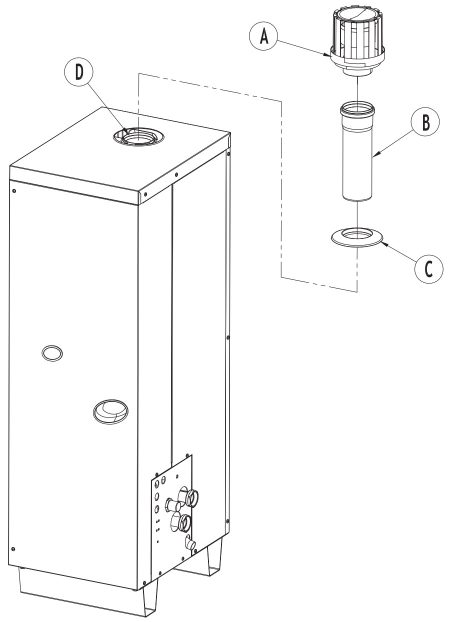
Compliance with standards

The appliance is approved for connection to a combustion products exhaust duct for the types shown in Table 2.1 *p. 3*.

3.3.1 Flue gas exhaust kit

The appliance, supplied in B53P configuration, is standard supplied with a DN80 flue gas kit, to be set up by the installer.
The fitting (DN80) for connecting the flue gas kit is located in the upper part of the appliance with vertical outlet.

Figure 3.1 *Flue gas exhaust kit*



A roof terminal (DN80)
B extension pipe (DN80)
C rain cover (DN80)
D flanged fitting (DN80) on upper panel
A+B+C flue gas exhaust duct kit

3.3.2 Flue gas ducting for type B installation

The flue must be sized with reference to the following Table 3.1 *p. 5*.

Table 3.1 *Fumes evacuation pipe ducting (type B)*

Useful residual head	100 Pa
Maximum length of straight DN80 pipe sections	31.0 m
Equivalent DN80 curve length at 90°	2.0 m

Example: to install a horizontal fumes pipe using n. 1 DN80 90° curve, the maximum extension possible with DN80 straight pipe sections is 29 m.

3.3.3 Air/flue gas ducting for type C installation

The appliance is approved to be configured also for type C installations.
The possible configurations are set out in Table 2.1 *p. 3*.
Refer to Table 3.2 *p. 6* below for sizing the combustion flue gas exhaust and combustion air intake ducts.

Table 3.2 *Ducting for fumes evacuation and air intake pipes (type C)*

				AY00-120
Installation data				
Fume outlet	residual head		Pa	100
Percentage CO_2 in fumes	Nominal thermal capacity	G25	%	9,40
		G20	%	9,40
		G25.1	%	10,70
		G27	%	9,35
		G2.350	%	9,15
		G30	%	12,40
		G31	%	10,60
	Minimal thermal capacity	G25	%	8,90
		G20	%	8,90
		G25.1	%	10,20
		G27	%	8,90
		G2.350	%	8,80
		G30	%	11,50
		G31	%	10,20
Flue temperature	Nominal thermal capacity	G25	°C	72,0
		G20	°C	72,5
		G25.1	°C	72,0
		G27	°C	72,0
		G2.350	°C	72,0
		G30	°C	71,5
		G31	°C	72,5
	Minimal thermal capacity	G25	°C	72,0
		G20	°C	71,6
		G25.1	°C	71,0
		G27	°C	71,5
		G2.350	°C	72,0
		G30	°C	71,5
		G31	°C	71,5
FUMES FLOW RATE	Nominal thermal capacity	G25	kg/h	62
		G20	kg/h	55
		G25.1	kg/h	49
		G27	kg/h	55
		G2.350	kg/h	56
		G30	kg/h	49
		G31	kg/h	56
	Minimal thermal capacity	G25	kg/h	15
		G20	kg/h	13
		G25.1	kg/h	12
		G27	kg/h	13
		G2.350	kg/h	13
		G30	kg/h	12
		G31	kg/h	13

Examples of the two principal type C configurations:

- C13 - using a 90° concentric elbow DN60/100, the maximum possible extension with straight concentric DN60/100 ducts is 5.75 m, while the minimum extension to be assured is 0.75 m.
- C33 - the maximum permitted extension with concentric DN60/100 straight pipe sections is 6.25 m.

The exhaust ducts exposed to weathering must be made of black polypropylene or equivalent material that withstands weather.

3.3.4 Possible flue

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

- For flue sizing please refer to the specification sheet in Section C1.10.
- If several appliances are connected to a single flue, it is obligatory to install a check valve on the exhaust of each.
- 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.

In case the flap valves are installed outside, an appropriate UV ray protection must be assured (if the valve is constructed in plastic material) as well as protection from potential winter freezing of condensate backflow into the siphon.

3.4 FLUE GAS CONDENSATE DISCHARGE

The AY00-120 unit is a condensing appliance and therefore produces condensation water from combustion flue gases.

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 discharge is located on the right side of the appliance (Figure 2.2 *p. 2*) at the connection plate.

3.4.2 Flue gas condensate discharge manifold

To make the condensate discharge manifold:

- Size the ducts for maximum condensation capacity (Table 2.1 *p. 3*).
- 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, CCP/CCI or external request).

Control of water circulation pumps

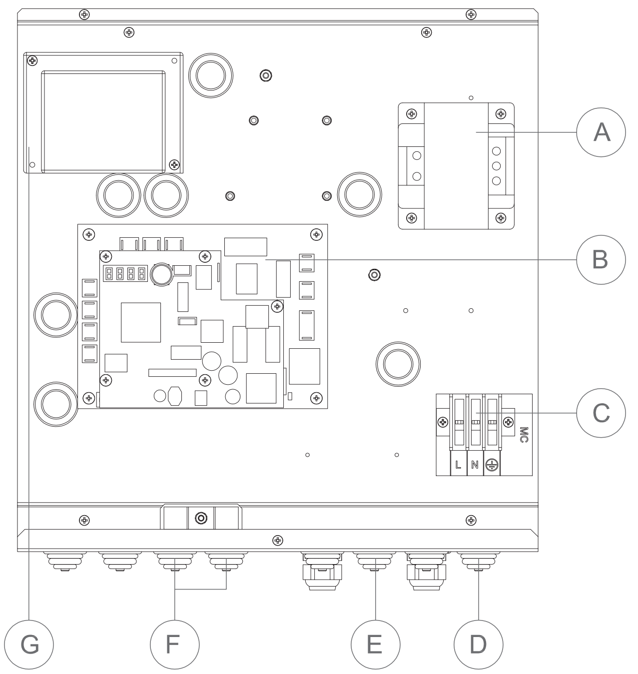
The water circulation pump of the water/primary circuit must mandatorily be controlled by the appliance's electronic boards. It is not admissible to start/stop the circulating pump with no request from the appliance.

3.5.2 Electrical systems

Electrical connections must provide:

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

Figure 3.2 *Electrical Panel*



A Transformer 230/23 V AC
B AY10+S70 electronic boards
C MC terminal block
D Power supply cable gland
E Circulating pump cable gland
F CAN-BUS cable gland
G Flame control box

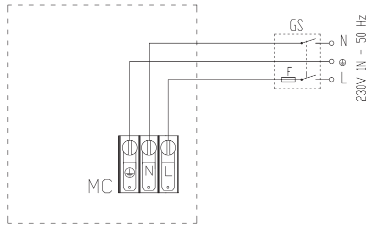
3.5.3 Electrical power supply

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 2 2A type T fuses, (GS) or 1 4A magnetothermic breaker.

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



MC power terminal block
GS General switch
F Fuse(s)
N Neutral terminal
Ground Earth terminal
L Single phase line terminal

The switches must also provide disconnect capability, with min contact opening 3 mm.

3.5.4 Set-up and control

Control systems, options (1) or (2)

Two separate control systems are provided, each with specific features, components and diagrams (Figures 3.5 *p. 8*, 3.6 *p. 9*):

- 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 or CCP/CCI 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, CCI, ...), 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 3.3 *p. 8* (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 3.3 *CAN BUS cables type*

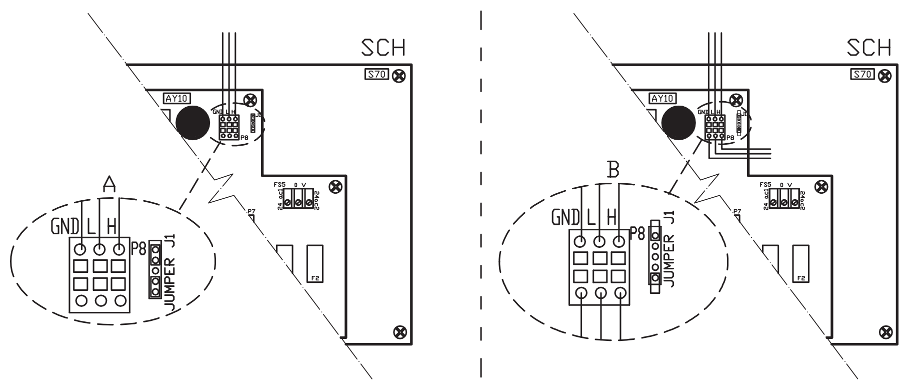
CABLE NAME	SIGNALS / COLOR			MAX LENGTH	Note
Robur					Ordering Code OCVO008
ROBUR NETBUS	H= BLACK	L= WHITE	GND= BROWN	450 m	
Honeywell SDS 1620					In all cases the fourth conductor should not be used
BELDEN 3086A	H= BLACK	L= WHITE	GND= BROWN	450 m	
TURCK type 530					
DeviceNet Mid Cable					
TURCK 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 AY10 electronic board, located in the Electrical Panel inside the appliance (Picture 3.4 *p. 8*):

1. Access the Electrical Board of the appliance according to the Procedure 3.5.2 *p. 7*);
2. Connect the CAN-BUS cable to terminals GND, L and H (shielding/earthing + two signal conductors) of the P8 connector;
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*

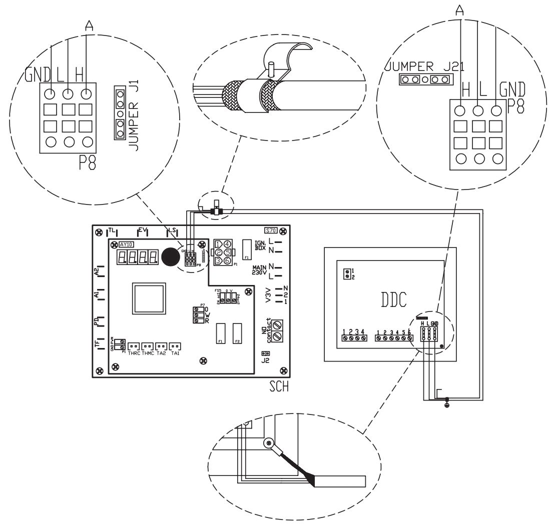


SCH Electronic board
J1 Jumper CAN-BUS in board
A detail of "terminal node" case (3 wires; J1=jumper "closed")
B Detail of "intermediate node" case (6 wires; J1=jumper "open")
GND Common data
L Data signal LOW
H Data signal HIGH
P8 CAN port/connector

AY configuration (AY10) + DDC

(System (1) Picture 3.5 *p. 8*, 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 (AY10+S70)
J1 CAN-BUS Jumper on AY10 board
J21 Jumper CAN-BUS in board DDC
A terminal node connection (3 wires; J1 and J21 = "closed")
H,L,GND data signal wires

External request

(System (2), Picture 3.6 *p. 9*, see also Paragraph 2.3 *p. 3*)

It is required to arrange:

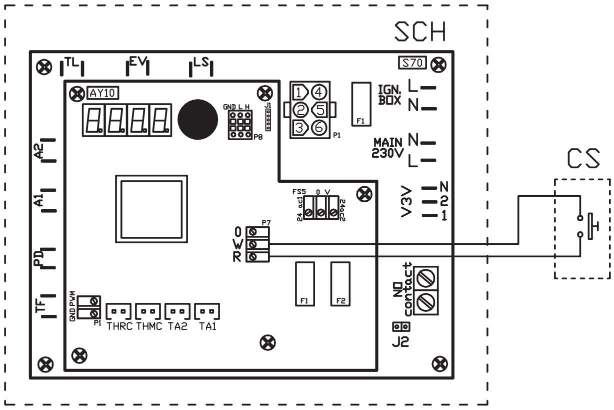
► request device (e.g. thermostat, clock, button, ...) fitted with a voltage-free NO contact.

How to connect the external request

Connection of external request is effected on the AY10 terminal block located in the Electrical Panel inside the appliance (Picture 3.6 *p. 9*).

1. Access the Electrical Board of the appliance according to the Procedure 3.5.2 *p. 7*.
2. Connect the voltage free contact of the external device (Detail CS), through two wires, to **terminals R and W** (respectively: common 24 V AC and heating request) of AY10 electronic board.

Figure 3.6 *Wiring diagram, external heating enable connection*



SCH Electronic board
R Common
W Terminal consensus warming

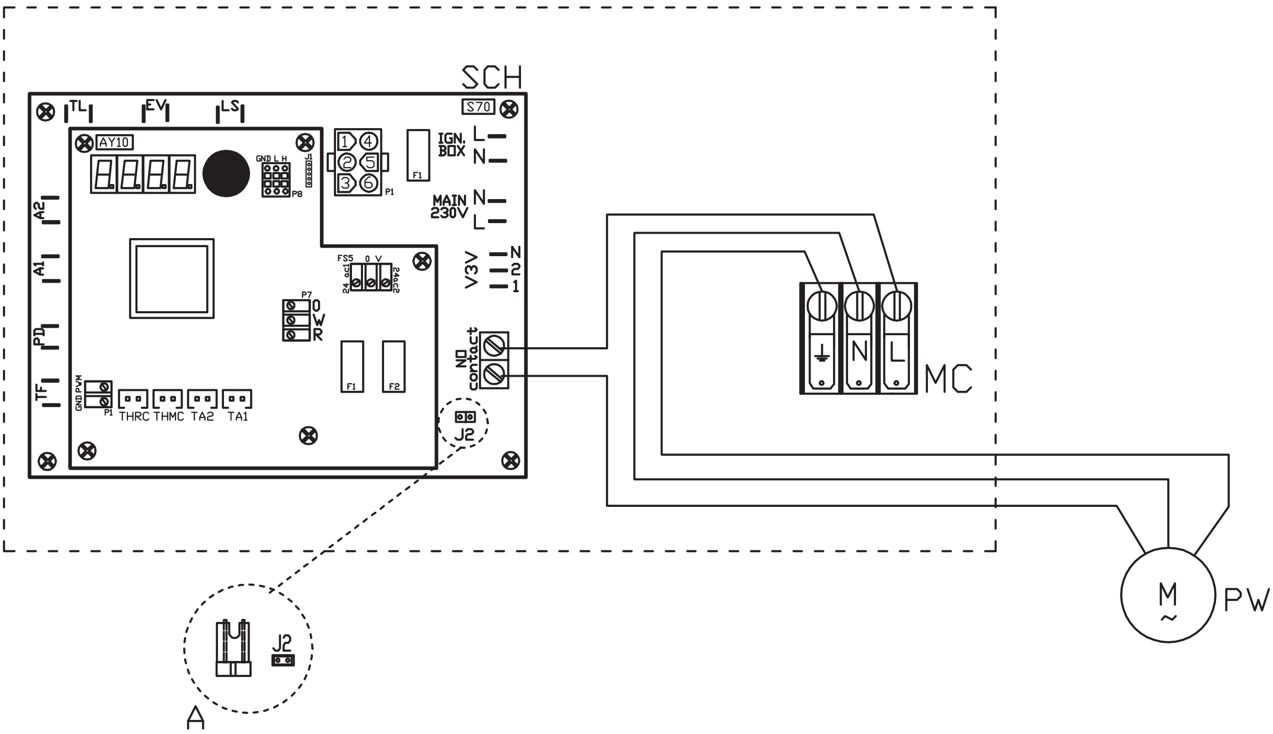
Components NOT SUPPLIED
CS external request

3.5.5 Water circulation pump

It must be mandatorily controlled from the S70 electronic board.

The diagram in Picture 3.7 *p. 9* is for pumps < 700 W. For pumps > 700 W it is required to add a control relay and set up Jumper J2 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
NO contact system water circulating pump control terminals (voltage-free normally open contact, maximum absorbed power 700 W)
J2 system water circulating pump control jumper
A "closed" jumper detail
MC 230 VAC power supply terminal block
Components NOT SUPPLIED
PW water pump < 700 W

1 SPECIFICATION OF SUPPLY

The Gitié AHAY/4 C0 group consists of a GAHP A heat pump and a AY00-120 condensing boiler.
For the specifications of supply of the individual units making up the group refer to Section B01 (GAHP A) and Section B06 (AY00-120).

1.1 AHAY INTEGRATED PACKAGE FEATURES

The Gitié AHAY group is available in the following versions (Picture 2.5 *p. 4*):

- **Version /4 C0 (standard or silenced)**
- **Version /4 C1 (standard or silenced)**
- **Version /2 C0 (standard or silenced)**
- **Version /2 C1 (standard or silenced)**

In all versions units operation may be simultaneous or independent.
The Table 1.1 *p. 1* shows the features of the various versions in detail.

Table 1.1 *Gitié AHAY package versions*

Version	Pipes	Circulating pumps	Motorised 2-way valves	Hydraulic circuits	Fan
/4 C0	4	No	No	independent	standard
/4 C0 S1	4	No	No	independent	silenced modulating
/4 C1	4	Yes	No	independent	standard
/4 C1 S1	4	Yes	No	independent	silenced modulating
/2 C0	2	No	Yes	single	standard
/2 C0 S1	2	No	Yes	single	silenced modulating
/2 C1	2	Yes	No	single	standard
/2 C1 S1	2	Yes	No	single	silenced modulating

2 FEATURES AND TECHNICAL DATA

2.1 DIMENSIONS

Figure 2.1 *Dimensions (Standard ventilation) - Front and side view (dimensions in mm)*

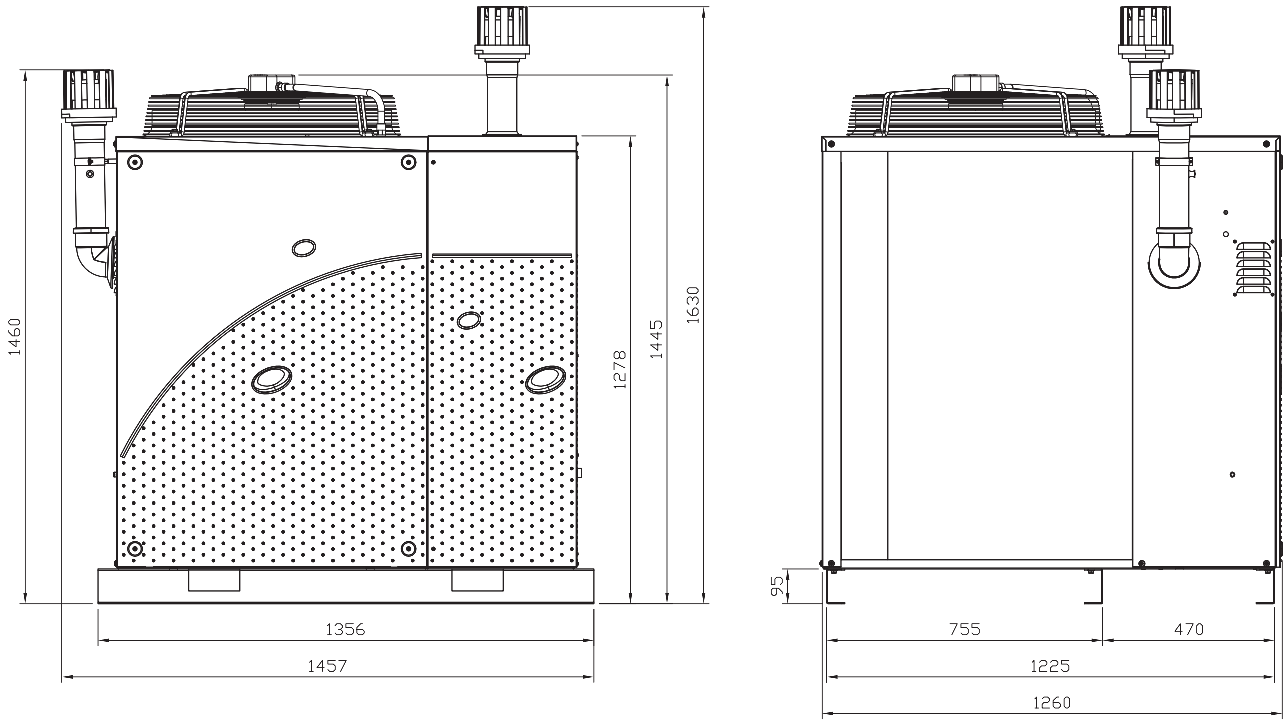


Figure 2.2 *Dimensions (S1 Silenced ventilation) - Front and side view (dimensions in mm)*

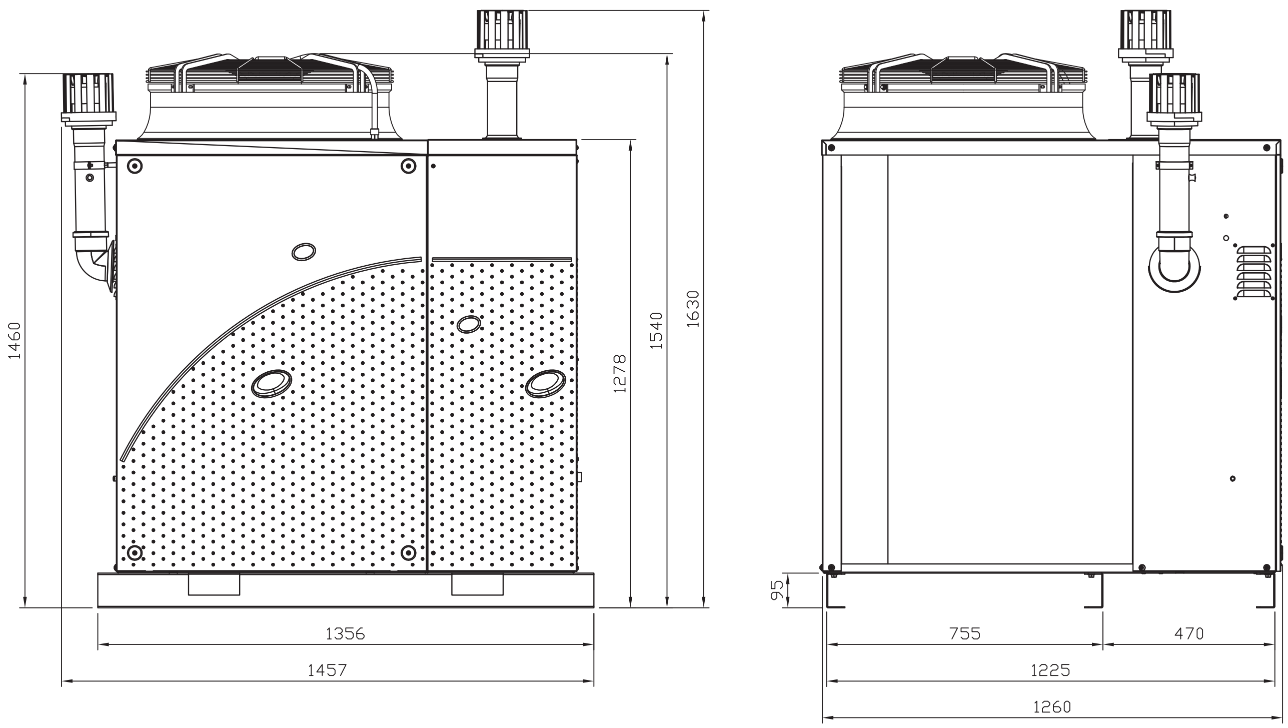
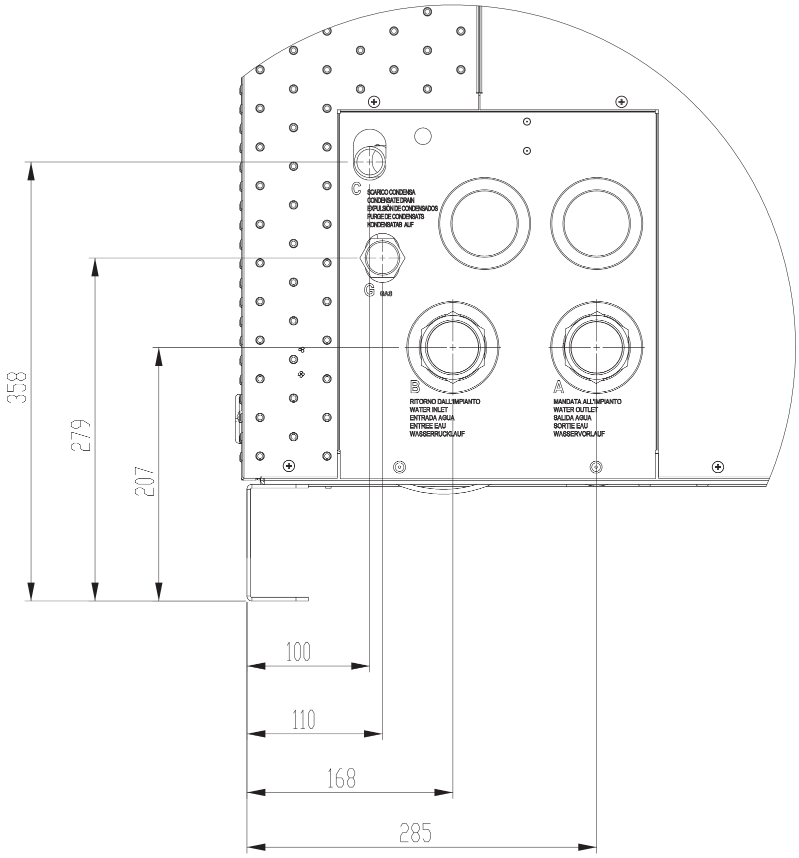
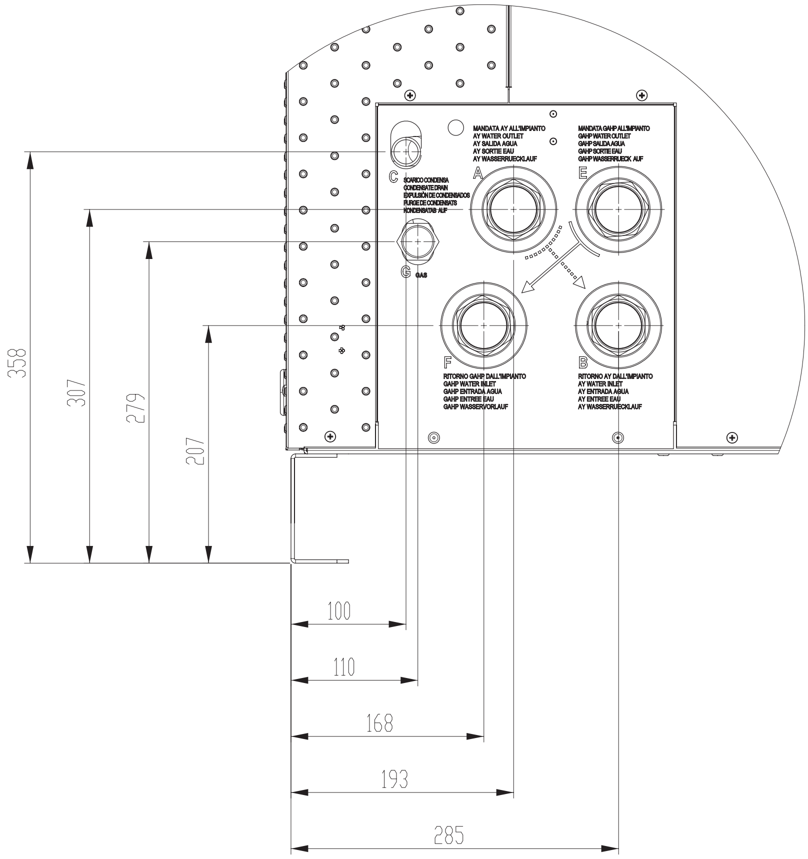


Figure 2.3 *Service plate 2-pipe group (KIT/2 C0 and C1) - Detail of water/gas fittings*



A Outlet water fitting Ø 1 1/2"F
B Inlet water fitting Ø 1 1/2"F
C Boiler condensate drain AY00-120
G Gas fitting Ø 3/4"M

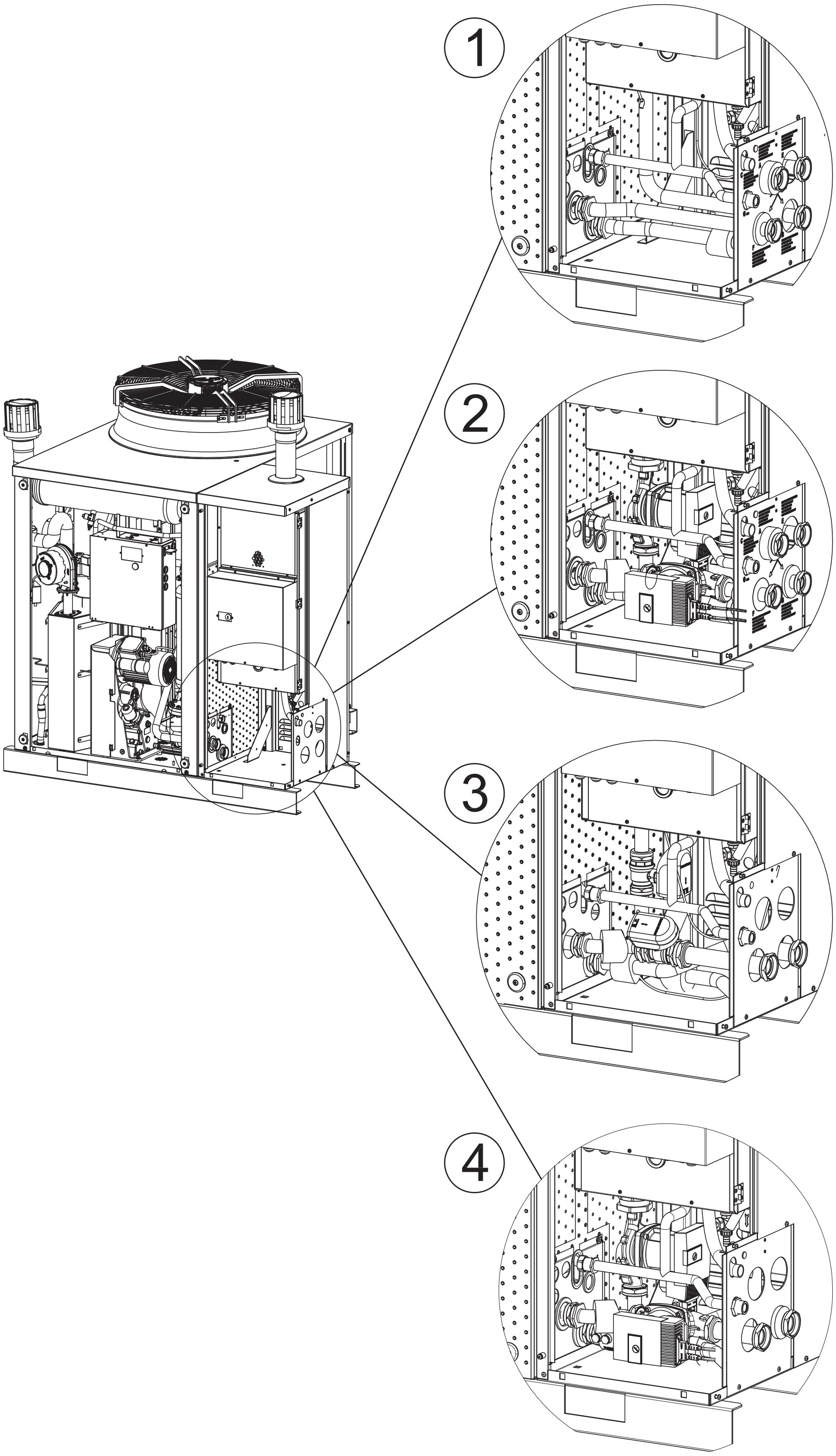
Figure 2.4 *Service plate 4-pipe group (base version and KIT/4 C1) - Detail of water/gas fittings*



A AY - Water outlet fitting Ø 1 1/4"F
B AY - Water inlet fitting Ø 1 1/4"F
C Boiler condensate drain AY00-120
E GAHP/GA - Water outlet fitting Ø 1 1/4"F
F GAHP/GA - Water inlet fitting Ø 1 1/4"F
G Gas fitting Ø 3/4"M

2.2 VERSIONS

Figure 2.5 *Version components*



1 BASE version (2 independent circuits without circulating pumps)
2 Kit/4 C1 (2 independent circuits with on board circulating pumps)
3 Kit/2 C0 (single circuit with two 2-way motorised valves)
4 Kit/2 C1 (single circuit with on board circulating pumps)

2.3 OPERATION MODE

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

2.4 CONTROLS

Control device

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

- (1) **pre-configured DDC control**
- (2) **external enables**

2.4.1 Adjustment system (1) with pre-configured DDC control

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.

2.4.2 Adjustment system (2) - control with external enables

The appliance may also be controlled via generic enable devices (e.g. thermostats, clocks, buttons, contactors...) fitted with voltage-free NO contacts. This system only provides elementary control (on/off, with fixed set-point temperature), without the important functions of system (1). Control of the cascade between GAHP/GA and AY00-120 is left to the user.

2.5 TECHNICAL CHARACTERISTICS

2.5.1 AHAY Integrated package technical specifications

Table 2.1 *Technical specifications Gitié AHAY*

			AHAY/4 C0	AHAY/4 C1	AHAY/2 C0	AHAY/2 C1	AHAY/4 C0 S1	AHAY/4 C1 S1	AHAY/2 C0 S1	AHAY/2 C1 S1
Heating mode										
Seasonal space heating energy efficiency class (ErP)	medium-temperature application (55 °C)	-	A++							
	low-temperature application (35 °C)	-	A+							
Heating capacity	real	kW	60,1							
Ambient air temperature (dry bulb)	maximum	°C	40							
	minimum	°C	-15 (1)							
Water flow rate 4 pipes	maximum (GAHP)	l/h	4000		-		4000		-	
	nominal (GAHP)	l/h	3000		-		3000		-	
	minimum (GAHP)	l/h	1400		-		1400		-	
	maximum (AY120)	l/h	3200		-		3200		-	
	nominal (AY120)	l/h	2950		-		2950		-	
	minimum (AY120)	l/h	1500		-		1500		-	
Water flow rate 2 pipes	maximum	l/h	-		7200		-		7200	
	nominal	l/h	-		5950		-		5950	
	minimum	l/h	-		2900		-		2900	
Pressure loss at nominal flow rate	version /4 C0 GAHP	bar	0,43	-			0,43	-		
	version /4 C0 AY120	bar	0,40	-			0,40	-		
	version /2 C0	bar	-		0,56	-			0,56	-
Residual pressure head at nominal flow rate	version /4 C1 GAHP	bar	-	0,56	-			0,56	-	
	version /4 C1 AY120	bar	-	0,60	-			0,60	-	
	version /2 C1	bar	-			0,52	-			0,52
Electrical specifications										
Power supply	voltage	V	230							
	type	-	single-phase							
	frequency	50 Hz supply	50							
Electrical power absorption	nominal	kW	1,02 (2)	1,40 (2)	1,02 (2)	1,40 (2)	0,95 (2)	1,33 (2)	0,95 (2)	1,33 (2)
Degree of protection	IP	-	X5D							
Installation data										
Gas consumption	G20 (maximum)	m^3/h	6,4 (3)							
	G25 (maximum)	m^3/h	7,5 (4)							
	G30 (maximum)	kg/h	4,8 (5)							
	G30 (maximum)	kg/h	4,7 (5)							
Water fitting	delivery/inlet	"F	1 1/4		1 1/2		1 1/4		1 1/2	
Gas connection	thread	"M	3/4							

(1) As an option, a version for operation down to -30 °C is available.
(2) ±10% depending on power voltage and absorption tolerance of electric motors.
(3) PCI (G20) 34,02 MJ/m^3 (15 °C - 1013 mbar).
(4) PCI (G25) 29,25 MJ/m^3 (15 °C - 1013 mbar).
(5) PCI (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(6) Sound power values detected in compliance with the intensity measurement methodology set forth by standard EN ISO 9614.
(7) Maximum sound pressure levels in free field, with directionality factor 2, obtained from the sound power level in compliance with standard EN ISO 9614.

			AHAY/4 C0	AHAY/4 C1	AHAY/2 C0	AHAY/2 C1	AHAY/4 C0 S1	AHAY/4 C1 S1	AHAY/2 C0 S1	AHAY/2 C1 S1
Dimensions	width	mm	1457							
	depth	mm	1260							
	height	mm	1630							
Weight	in operation	kg	490	515	490	515	500	525	500	525
Sound power L_w (max)		dB(A)	79,6 (6)				74,0 (6)			
Sound pressure L_p at 5 metres (max)		dB(A)	57,6 (7)				52,0 (7)			
Minimum storage temperature		°C	-30							
Maximum water pressure in operation		bar	4							
Water content inside the apparatus		l	6							

(1) As an option, a version for operation down to -30 °C is available.
(2) ±10% depending on power voltage and absorption tolerance of electric motors.
(3) PCI (G20) 34,02 MJ/m³ (15 °C - 1013 mbar).
(4) PCI (G25) 29,25 MJ/m³ (15 °C - 1013 mbar).
(5) PCI (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(6) Sound power values detected in compliance with the intensity measurement methodology set forth by standard EN ISO 9614.
(7) Maximum sound pressure levels in free field, with directionality factor 2, obtained from the sound power level in compliance with standard EN ISO 9614.

2.5.2 GAHP A Unit technical data

Table 2.2 *GAHP A Unit technical data*

				GAHP A HT Standard	GAHP A HT S1
Heating mode					
Unitary heating power	Outdoor temperature/Delivery temperature	A7W35	kW	41,3	
		A7W50	kW	38,3	
		A7W65	kW	31,1	
		A-7W50	kW	32,0	
GUE efficiency	Outdoor temperature/Delivery temperature	A7W35	%	164	
		A7W50	%	152	
		A7W65	%	124	
		A-7W50	%	127	
Heating capacity	nominal (1013 mbar - 15 °C)		kW	25,7	
	real		kW	25,2	
Hot water delivery temperature	maximum for heating		°C	65	
	maximum for DHW		°C	70	
Hot water return temperature	maximum for heating		°C	55	
	maximum for DHW		°C	60	
	minimum temperature in continuous operation		°C	30 (1)	
Installation data					
NO_x emission class			-	5	
NO_x emission			ppm	25,0	
CO emission			ppm	36,0	
Maximum flow flue condensate			l/h	4,0	
Fume outlet	diameter (Ø)		mm	80	
	residual head		Pa	80	
Type of installation			-	B23P, B33, B53P	
General information					
Cooling fluid	ammonia R717		kg	7,0	
	water H_2O		kg	10,0	
Maximum pressure of the cooling circuit			bar	32	
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	
Filling ratio			kg of NH_3/l	0,146	
Fluid group			-	GROUP 1°	

(1) In transient operation, lower temperatures are allowed.

2.5.3 AY00-120 Unit technical data

Table 2.3 *Technical specifications AY00-120*

	AY00-120
Heating mode	

				AY00-120
Operating point 80/60	Nominal thermal capacity	effective power	kW	34,4
	Minimal thermal capacity	efficiency	%	97,3
	Nominal thermal capacity	efficiency	%	98,6
	Mean thermal capacity	efficiency	%	98,3
Operating point 70/50	Nominal thermal capacity	efficiency	%	100,6
Operating point 50/30	Nominal thermal capacity	efficiency	%	104,6
Operating point Tr = 30 °C	Thermal capacity 30%	efficiency	%	107,5
Operating point Tr = 47 °C	Thermal capacity 30%	efficiency	%	100,3
Heating capacity	nominal (1013 mbar - 15 °C)		kW	34,9
	average		kW	21,5
	minimum		kW	8,0
Hot water delivery temperature	maximum		°C	80
	minimum		°C	25
	nominal		°C	60
Hot water return temperature	maximum		°C	70
	minimum		°C	20
	nominal		°C	50
Efficiency class				****
Heat loss	to jacket in operation		kW	0,15
	to jacket in operation		%	0,44
	to flue in operation		kW	0,86
	to flue in operation		%	2,54
	in off mode		kW	0,058
	in off mode		%	0,17
Installation data				
NO_x emission class			-	5
NO_x emission			ppm	19,5
CO emission			ppm	8,4
Maximum flow flue condensate			l/h	5,5
Fume outlet	diameter (Ø)		mm	80
	residual head		Pa	100
Type of installation			-	B32P, B33, B35P, C13, C33, C34, C53, C63, C83

2.5.4 Pressure drop table

Table 2.4 *GAHP A and GAHP A Indoor pressure drops*

Water flow rate	Vector fluid temperature at outlet		
	35 °C	50 °C	60 °C
	Bar	Bar	Bar
2000 l/h	0,23	0,21	0,19
3000 l/h	0,46	0,43	0,40
4000 l/h	0,78	0,72	0,67

Table 2.5 *Pressure drop AY*

Water flow rate	Outlet water temperature
	20 °C
	Bar
2007 l/h	0,20
2400 l/h	0,27
3000 l/h	0,41

2.5.5 Performance table

Table 2.6 *p. 8* shows the unitary thermal power at full load and stable operation, depending on hot water outlet temperature to the system and outdoor temperature, for the single GAHP A unit.
For AY00-120 see Table 2.3 *p. 6.*
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.

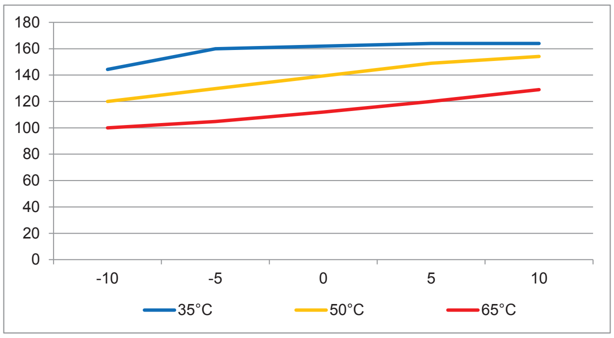
Table 2.6 *GAHP A and GAHP A Indoor heating power for each unit*

External air temperature	Water delivery temperature							
	35 °C	40 °C	45 °C	50 °C	55 °C	60 °C	65 °C	70 °C (1)
	KW	KW	KW	KW	KW	KW	KW	KW
-20 °C	33,9	31,5	29,6	27,7	25,7	23,7	22,7	9,3
-15 °C	35,2	32,8	30,9	29,0	27,0	24,9	23,9	10,0
-10 °C	36,4	34,0	32,1	30,2	28,2	26,2	25,2	10,6
-5 °C	40,3	37,7	35,2	32,7	30,6	28,5	26,4	11,1
0 °C	40,8	39,2	37,1	35,1	32,7	30,3	28,2	11,3
5 °C	41,3	40,0	38,8	37,5	34,8	32,0	30,2	11,8
7 °C	41,3	40,2	39,3	38,3	35,7	33,0	31,1	12,0
10 °C	41,3	40,6	39,8	38,9	36,6	34,4	32,5	12,4
15 °C	41,6	41,3	40,6	39,8	38,3	36,8	34,8	13,1
20 °C	41,6	41,4	40,8	40,2	39,5	38,5	37,1	13,8
25 °C	41,7	41,5	41,0	40,4	39,9	39,2	38,2	14,2
30 °C	41,8	41,6	41,1	40,5	40,1	39,4	38,4	14,4
35 °C	41,9	41,7	41,2	40,6	40,2	39,5	38,5	14,5

(1) Thermal input reduced to 50%

Picture 2.6 *p. 8* shows the GUE trend at full load and in stable operation for three representative delivery temperatures, according to outdoor temperature, for the GAHP A unit.

Figure 2.6 *GAHP A and GAHP A Indoor GUE*



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

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.

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 GAHP A UNIT COMBUSTION PRODUCTS EXHAUST

Compliance with standards

The appliance is approved for connection to a combustion products exhaust duct for the types shown in Table 2.2 *p. 6*.

3.3.1 Flue gas exhaust connection

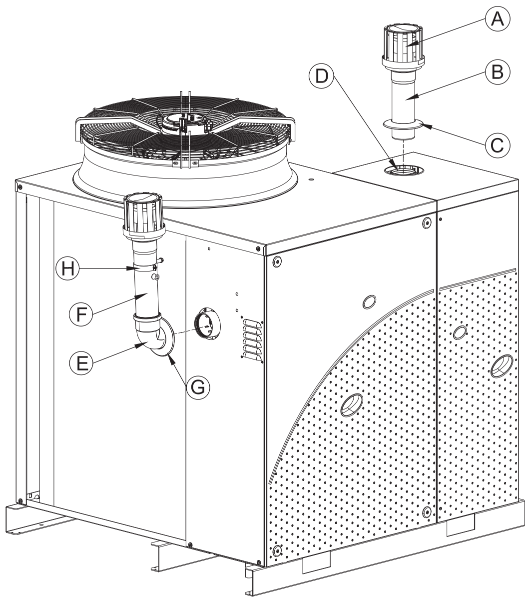
► Ø 80 mm (with gasket), on the left, at the top (Figure 3.1 *p. 9*).

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. 9*):

► 1 pipe Ø 80 mm, length 300 mm, with terminal and socket for flue gas analysis;
► 1 support collar;
► 1 90° elbow Ø 80 mm;
► 1 rain cover.

Figure 3.1 *Fume outlet*



A Terminal
B Pipe
C Rain cover
D Flanged fitting
E 90° bend
F Pipe w/terminal
G Rain cover
H Collar

3.4 AY00-120 UNIT COMBUSTION PRODUCTS EXHAUST

Compliance with standards

The appliance is approved for connection to a combustion products exhaust duct for the types shown in Table 2.3 *p. 6*.

3.4.1 Flue gas exhaust connection

► Ø 80 mm

in the upper part (Figure 3.1 *p. 9*).

3.4.2 Flue gas exhaust kit

The appliance is supplied with flue gas exhaust kit, to be fitted by the installer, including (Figure 3.1 *p. 9*):

► 1 terminal;
► 1 extension pipe Ø 80 mm, length 209 mm;
► 1 rain cover;

3.5 COMBUSTION PRODUCTS EXHAUST THROUGH THE FLUE

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

► For flue sizing please refer to the specification sheet in Section C1.10.
► If the flue gas exhaust of the GAHP A and that of the AY00-120 boiler are connected to a single flue, it is mandatory to install a flap valve on the exhaust of each.

- 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.

In case the flap valves are installed outside, an appropriate UV ray protection must be assured (if the valve is constructed in plastic material) as well as protection from potential winter freezing of condensate backflow into the siphon.

3.6 FLUE GAS CONDENSATE DISCHARGE

The GAHP A and AY00-120 units are condensing appliances and therefore produce condensation water from combustion flue gas.

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 (Tables 2.2 *p. 6* e 2.3 *p. 6*).

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.

3.6.1 GAHP A unit flue gas condensate fitting

The fitting for flue gas condensate discharge is located on the left side of the appliance (Figure 3.2 *p. 10*).

- The distance L between the sleeve and the base must not exceed 110 mm.
- The corrugated condensate discharge pipe must be connected to a suitable discharge manifold.
- The junction between the pipe and the manifold must remain visible.

3.6.2 AY00-120 Unit flue gas condensate fitting

The connection for flue gas condensate discharge is located on the right side of the appliance at the service plate (Figure 2.3 *p. 3* and Figure 2.4 *p. 3*).

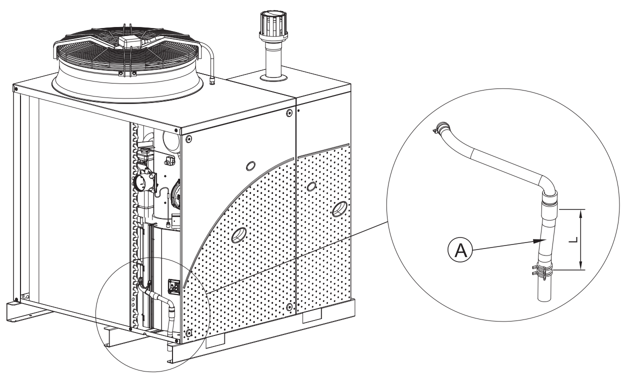
- The condensate discharge pipe must be connected to a suitable discharge manifold.
- The junction between the pipe and the manifold must remain visible.

3.6.3 Flue gas condensate discharge manifold

If necessary the condensate discharge manifold may be in common between the 2 units the Gitié group consists of.
To make the condensate discharge manifold:

- Size the ducts for maximum condensation capacity (Tables 2.2 *p. 6* and 2.3 *p. 6*).
- 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.

Figure 3.2 *Condensate drain position*



A Condensate discharge hose
L ≤ 110 mm

3.7 ELECTRICAL AND CONTROL CONNECTIONS

3.7.1 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

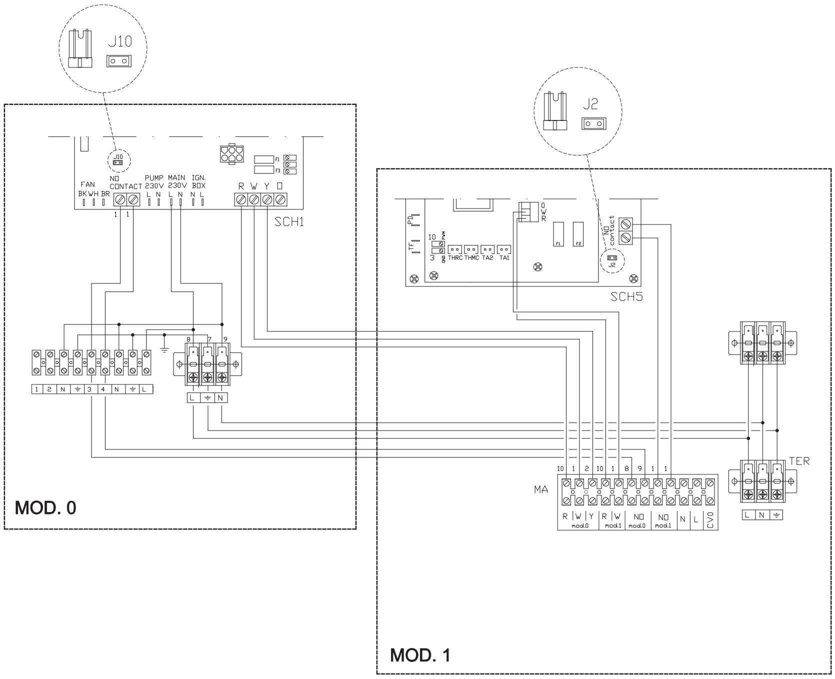
- Never use the external isolation switch (GS) to turn the appliance on and off, since it may be damaged in the long run (occasional black outs are tolerated).
- To turn the appliance on and off, exclusively use the suitably provided control device (DDC or external enable).

Control of water circulation pump

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

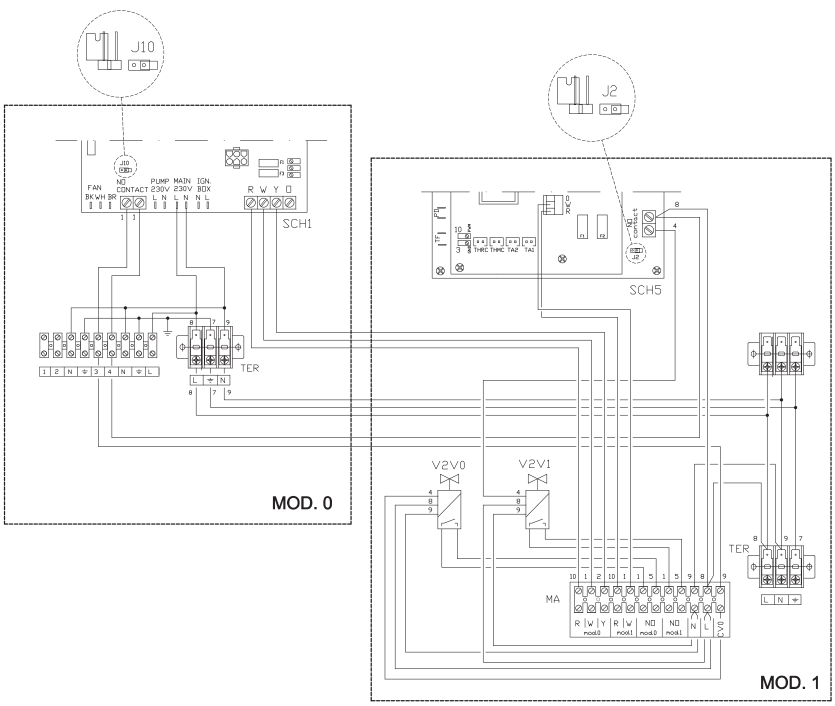
3.7.2 Wiring diagrams

Figure 3.3 *Gitié package wiring diagram - base version*



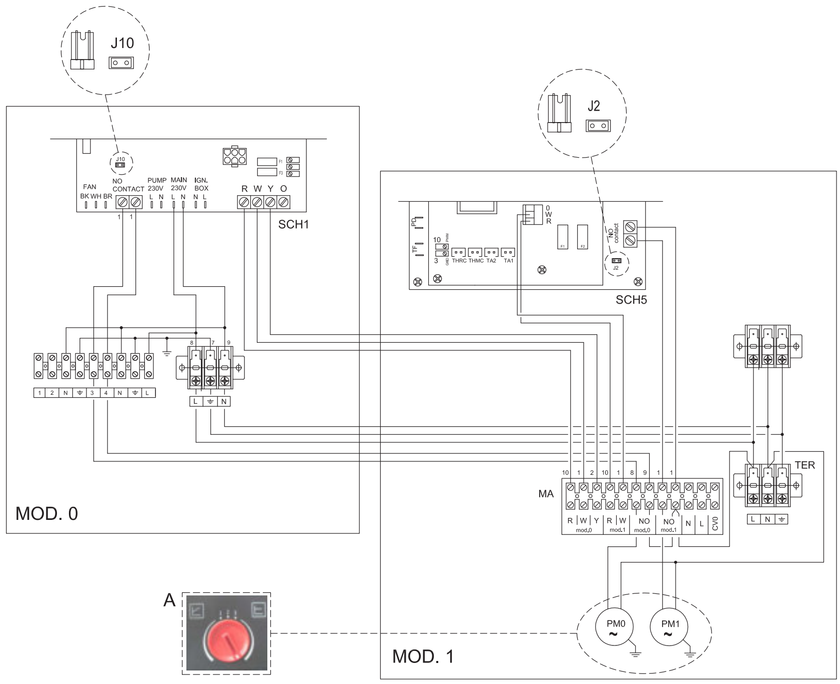
MA Terminal block
MOD.0 GAHP or ACF unit
MOD.1 unit AY00-120
SCH1 electronic board S61
SCH5 electronic boards S70+AY10
TER unit power supply terminal box
J2-J10 control jumpers of system water pumps ("closed")

Figure 3.4 *Gitié package wiring diagram with KIT/2 C0*



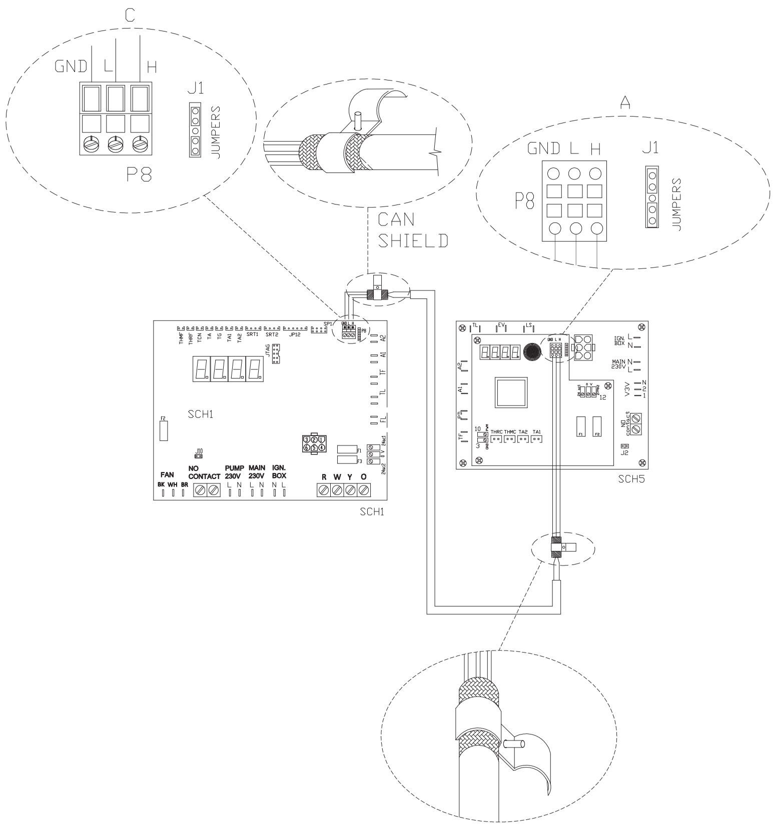
MOD.0 GAHP or ACF unit
MOD.1 unit AY00-120
SCH1 electronic board S61
SCH5 electronic boards S70+AY10
TER unit power supply terminal box
J2-J10 control jumpers of system water pump ("open")
MA connection terminal block
V2V0-V2V1 motorised valves

Figure 3.5 *Gitié package wiring diagram with KIT/2 C1 or with KIT/4 C1*



MOD.0 GAHP or ACF unit
MOD.1 unit AY00-120
SCH1 electronic board S61
SCH5 electronic boards S70+AY10
TER unit power supply terminal box
J2-J10 control jumpers of system water pumps ("closed")
MA connection terminal block
PM0-PM1 system water pumps
A Position of pumps flow rate adjustment screw

Figure 3.6 *CAN connection between AY10 board and S61 (pre-wired in the factory)*



SCH5 electronic board S70+AY10
SCH1 electronic board S61
J1 Jumpers CAN-BUS on AY10 board and S61 board
A terminal node connection - (3 wires; J1 jumpers = "closed")
C terminal node connection - (3 wires; J1 jumpers = "closed")
H,L,GND data signal wires (ref. cables table)

3.7.3 Electrical systems

Electrical connections must provide:

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

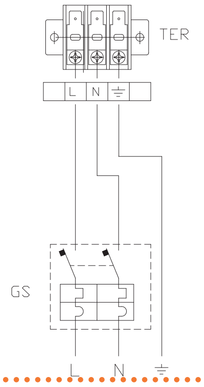
3.7.4 Electrical power supply

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 2 8A type T fuses, (GS) or 1 10A magnetothermic breaker.

Figure 3.7 *Appliance connection to the mains power supply (230V 1N - 50 Hz)*



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.

3.7.5 Set-up and control

Control systems, options (1) (2)

Two separate adjustment systems are provided, each with specific features, components and diagrams (see Paragraph 2.4 *p. 5*):

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

Control with DDC

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 device.

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, AY00-120, Gitié, ...) or control device (DDC, RB100, RB200, CCI, ...), 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. 13* (admissible types and maximum distances).

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

Table 3.1 *CAN BUS cables type*

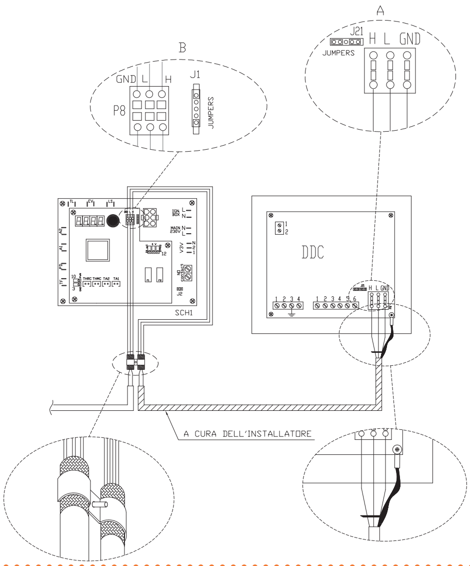
CABLE NAME	SIGNALS / COLOR			MAX LENGTH	Note
Robur					Ordering Code OCVO008
ROBUR NETBUS	H= BLACK	L= WHITE	GND= BROWN	450 m	
Honeywell SDS 1620					In all cases the fourth conductor should not be used
BELDEN 3086A	H= BLACK	L= WHITE	GND= BROWN	450 m	
TURCK type 530					
DeviceNet Mid Cable					
TURCK 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 AY10 electronic board, located in the Electrical Panel inside the AY00-120 unit, Picture 3.8 *p. 14*, Details A and B:

1. Access the Electrical Board of the appliance according to the Procedure 3.7.3 *p. 12*);
2. Connect the CAN-BUS cable to terminals GND + L and H (shielding/earthing + two signal conductors) of the AY10 board;
3. Place the Jumper J1, of the AY10 board, OPEN;
4. Connect the DDC to the CAN-BUS cable to terminals GND + L and H (shielding/earthing + two signal conductors) of the DDC;
5. The CAN connection between the AY10 board and the S61 board is pre-wired (Picture 3.9 *p. 14*);

Figure 3.8 *CAN-BUS connection between Gitié and DDC*



DDC Direct Digital Control
SCH5 electronic board S70+AY10
J1 Jumpers CAN-BUS on AY10 board
J21 Jumper CAN-BUS in board DDC
A terminal node connection - (3 wires; J21 jumpers = "closed")
B intermediate node connection - (3 wires; J1 jumpers ="open")
H,L,GND data signal wires (ref. cables table)

Control with external enables

(System (2), see also Paragraph 2.4 *p. 5*).

For each external request to be provided, it is required to arrange:

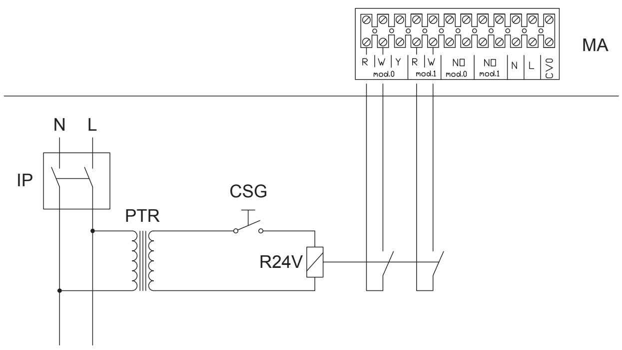
- ► <u>request device</u> (e.g. thermostat, clock, button, ...) fitted with a voltage-free NO contact.

How to connect external enables

Connection of external requests is effected on the terminal block located in the Electrical Panel inside the AY00-120 unit.

If you wish the heating enables of the two units to be simultaneous follow the connection diagram shown in Figure 3.9 *p. 14*.
Should you wish the enables of the two units to be separate follow the connection diagram shown in Figure 3.10 *p. 14*.

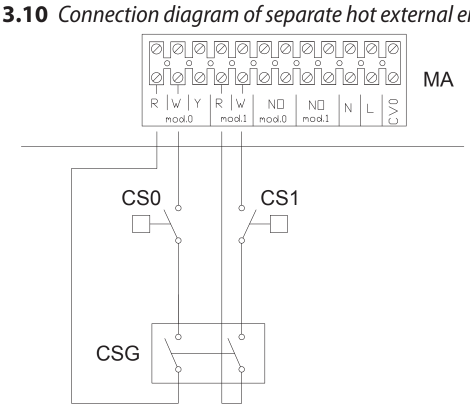
Figure 3.9 *Connection diagram of simultaneous hot external enables*



MA unit terminal block

Components NOT SUPPLIED
IP two-pole switch
PTR safety transformer SELV
CSG general enable
R24V 24V relay

Figure 3.10 *Connection diagram of separate hot external enables*



MA unit terminal block

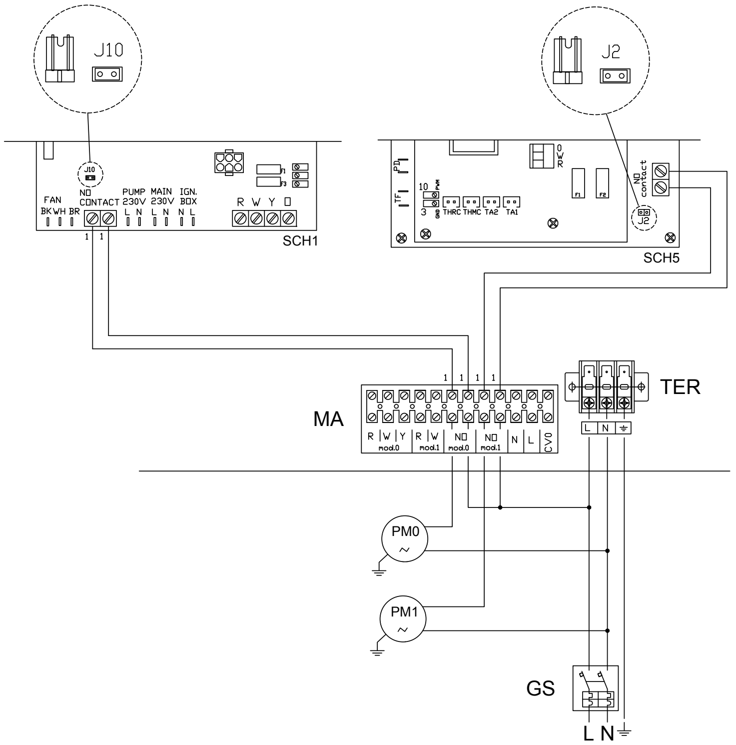
Components NOT SUPPLIED
CSG general enable
CS0 heating request AY00-120
CS1 heating request AY00-120

3.7.6 Water circulation pumps (versions C0)

System water pumps will be controlled at constant flow.

4-pipe versions

Figure 3.11 *System pump connection diagram Gitié package BASE version (P < 700 W)*



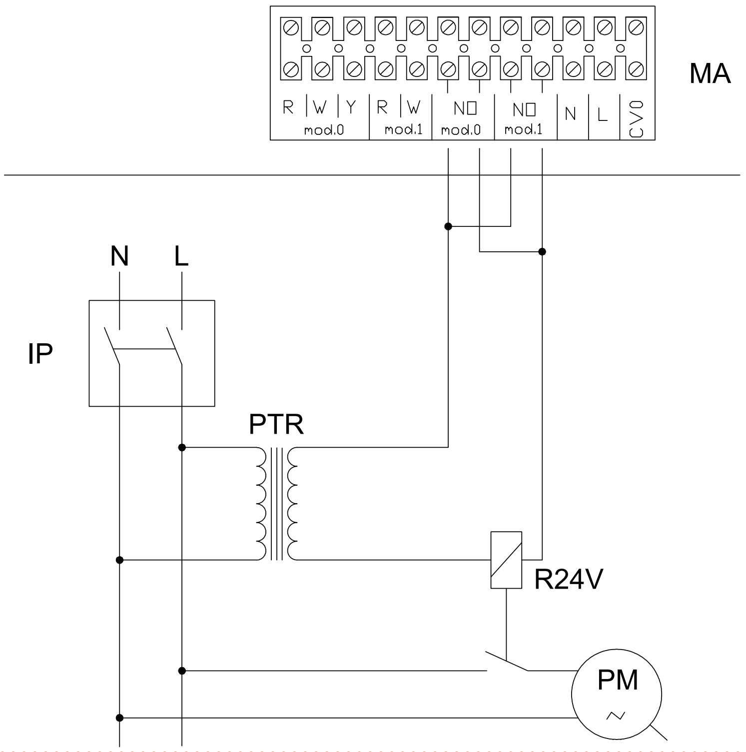
SCH1 electronic board S61
SCH5 electronic boards S70+AY10
MA unit terminal block
J2-J10 control jumpers of system water pumps ("closed")

Components NOT SUPPLIED
PM0 water pump (P < 700 W) unit GAHP or ACF
PM1 water pump (P < 700 W) AY00-120 unit
GS general switch

The diagram in Figure 3.11 *p. 15* is for pumps < 700 W. For pumps > 700 W it is necessary to add a control relay and arrange Jumpers J10 and J2 OPEN.

2-pipe versions

Figure 3.12 *System pump connection diagram Gitié package 2 pipe version (KIT/2 C0)*



MA unit terminal block

Components NOT SUPPLIED
PM water pump
IP two-pole switch
PTR safety transformer SELV
R24V pump control relay

1 SPECIFICATION OF SUPPLY

The Gitié ARAY group consists of a GAHP-AR heat pump and a AY00-120 condensing boiler.
For the specifications of supply of the individual units making up the group refer to Section B03 (GAHP-AR) and Section B06 (AY00-120).

1.1 ARAY INTEGRATED PACKAGE FEATURES

The Gitié ARAY group is available in the following versions (Picture 2.5 *p. 4*):

- **Version /4 C0 (standard or silenced)**
- **Version /4 C1 (standard or silenced)**
- **Version /2 C0 (standard or silenced)**
- **Version /2 C1 (standard or silenced)**

In all versions units operation may be simultaneous or independent.
The Table 1.1 *p. 1* shows the features of the various versions in detail.

Table 1.1 *Gitié ARAY package versions*

Version	Pipes	Circulating pumps	Motorised 2-way valves	Hydraulic circuits	Simultaneous operation	Fan
/4 C0	4	No	No	independent	Yes	standard
/4 C0 S	4	No	No	independent	Yes	silenced
/4 C1	4	Yes	No	independent	Yes	standard
/4 C1 S	4	Yes	No	independent	Yes	silenced
/2 C0	2	No	Yes	single	No(1)	standard
/2 C0 S	2	No	Yes	single	No(1)	silenced
/2 C1	2	Yes	No	single	No(1)	standard
/2 C1 S	2	Yes	No	single	No(1)	silenced

(1) In 2 pipe versions operation may only be simultaneous when the GAHP-AR unit operates in heating mode.

2 FEATURES AND TECHNICAL DATA

2.1 DIMENSIONS

Figure 2.1 *Dimensions (Standard ventilation) - Front and side view (dimensions in mm)*

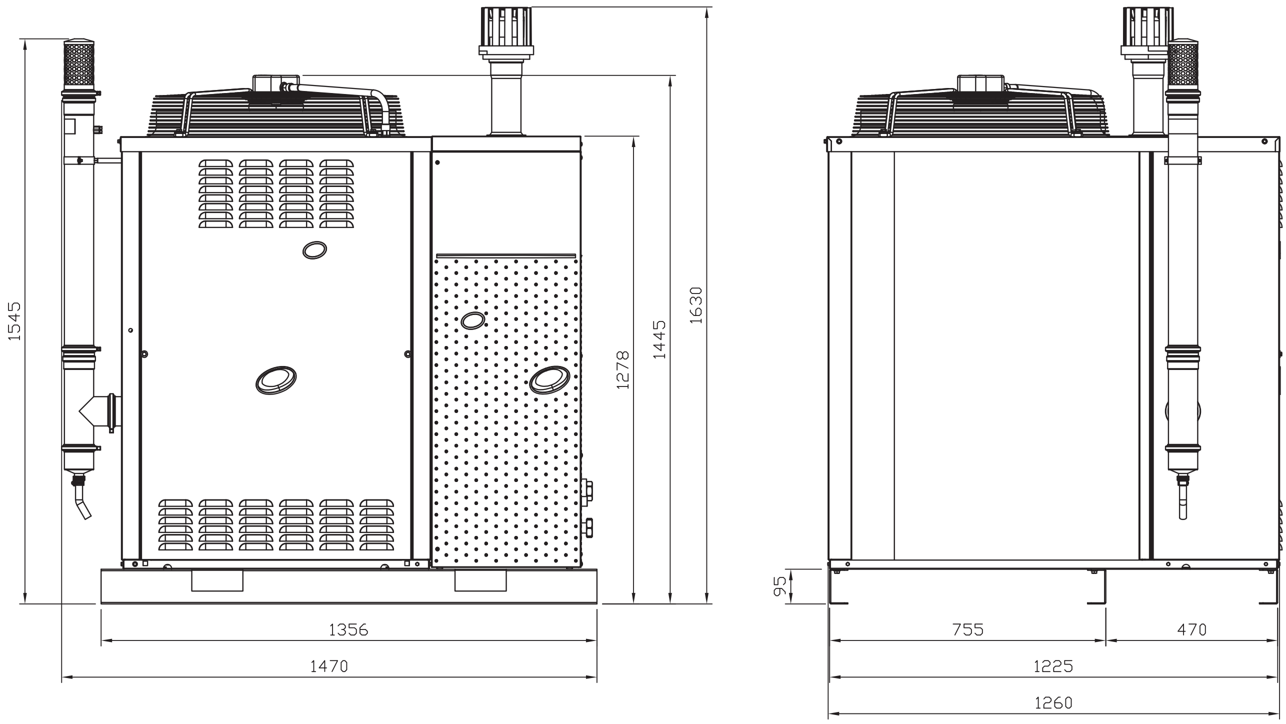


Figure 2.2 *Dimensions (Silenced ventilation) - Front and side view (dimensions in mm)*

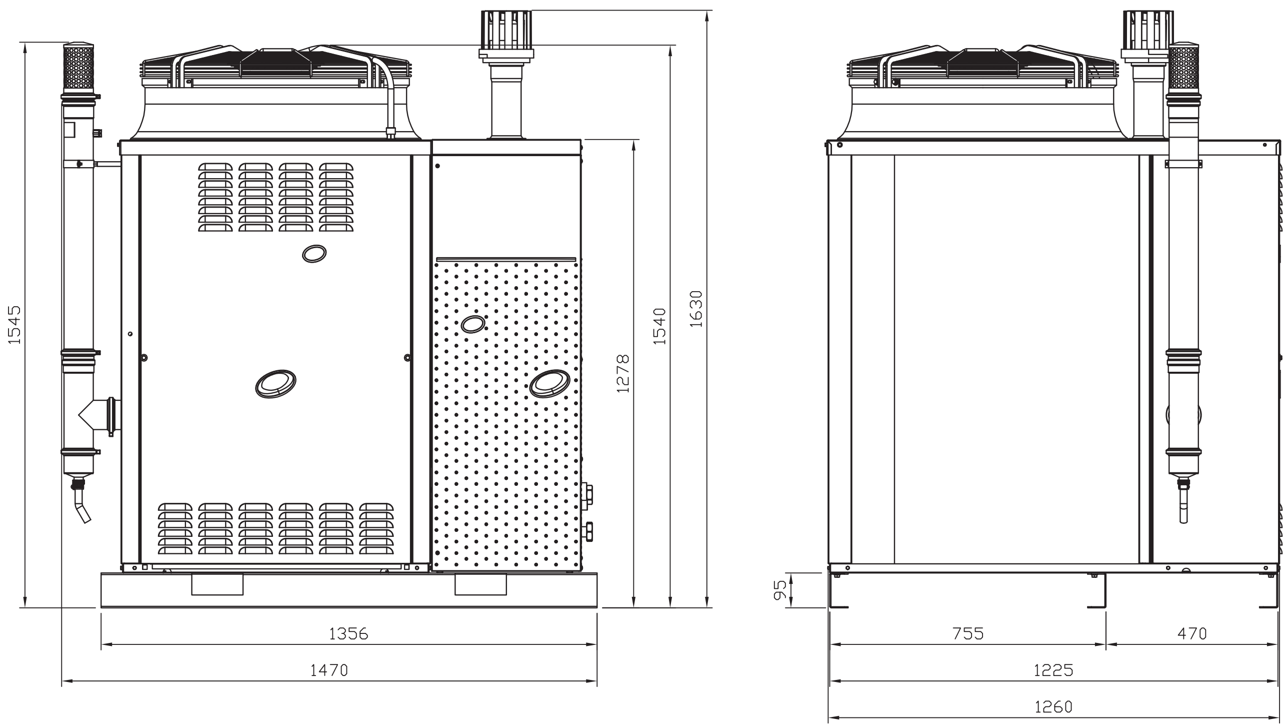
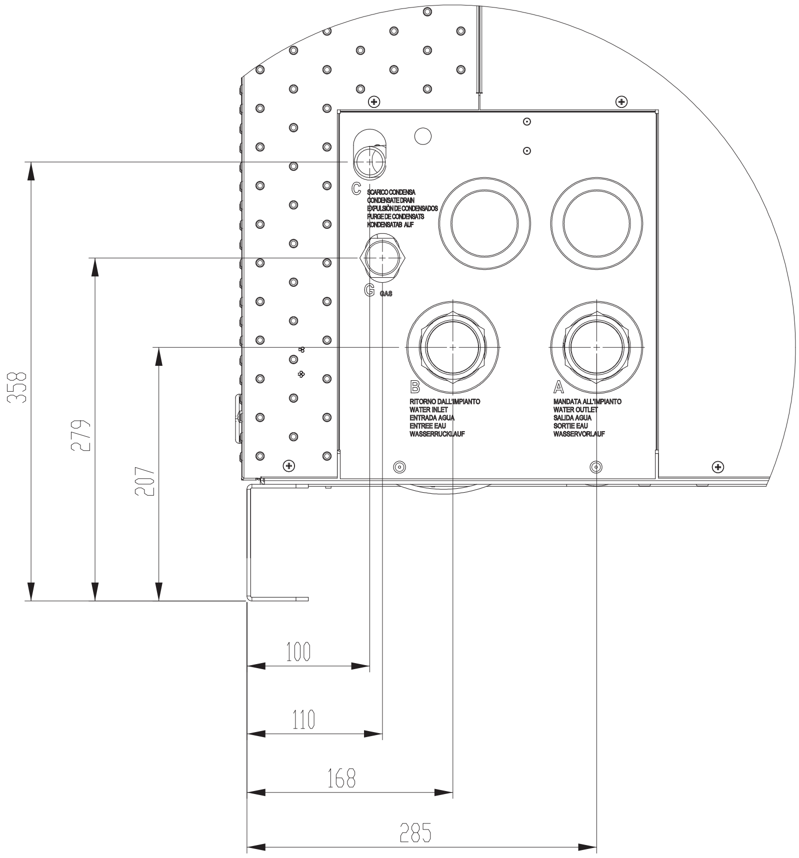
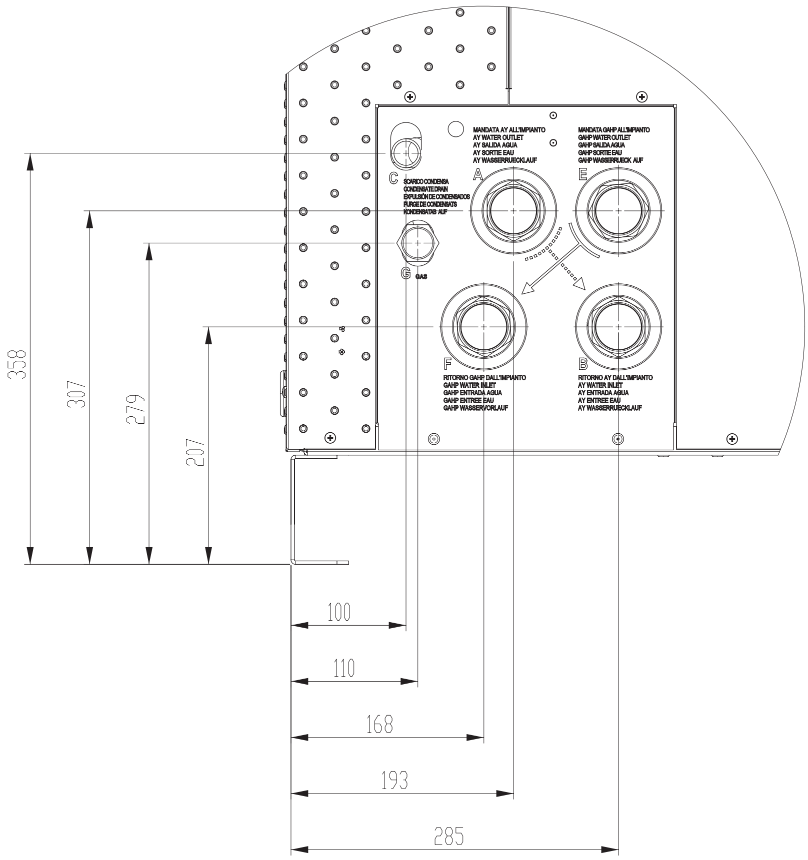


Figure 2.3 *Service plate 2-pipe group (KIT/2 C0 and C1) - Detail of water/gas fittings*



- A Outlet water fitting Ø 1 1/2"F
- B Inlet water fitting Ø 1 1/2"F
- C Boiler condensate drain AY00-120
- G Gas fitting Ø 3/4"M

Figure 2.4 *Service plate 4-pipe group (base version and KIT/4 C1) - Detail of water/gas fittings*



- A AY - Water outlet fitting Ø 1 1/4"F
- B AY - Water inlet fitting Ø 1 1/4"F
- C Boiler condensate drain AY00-120
- E GAHP/GA - Water outlet fitting Ø 1 1/4"F
- F GAHP/GA - Water inlet fitting Ø 1 1/4"F
- G Gas fitting Ø 3/4"M

2.2 VERSIONS

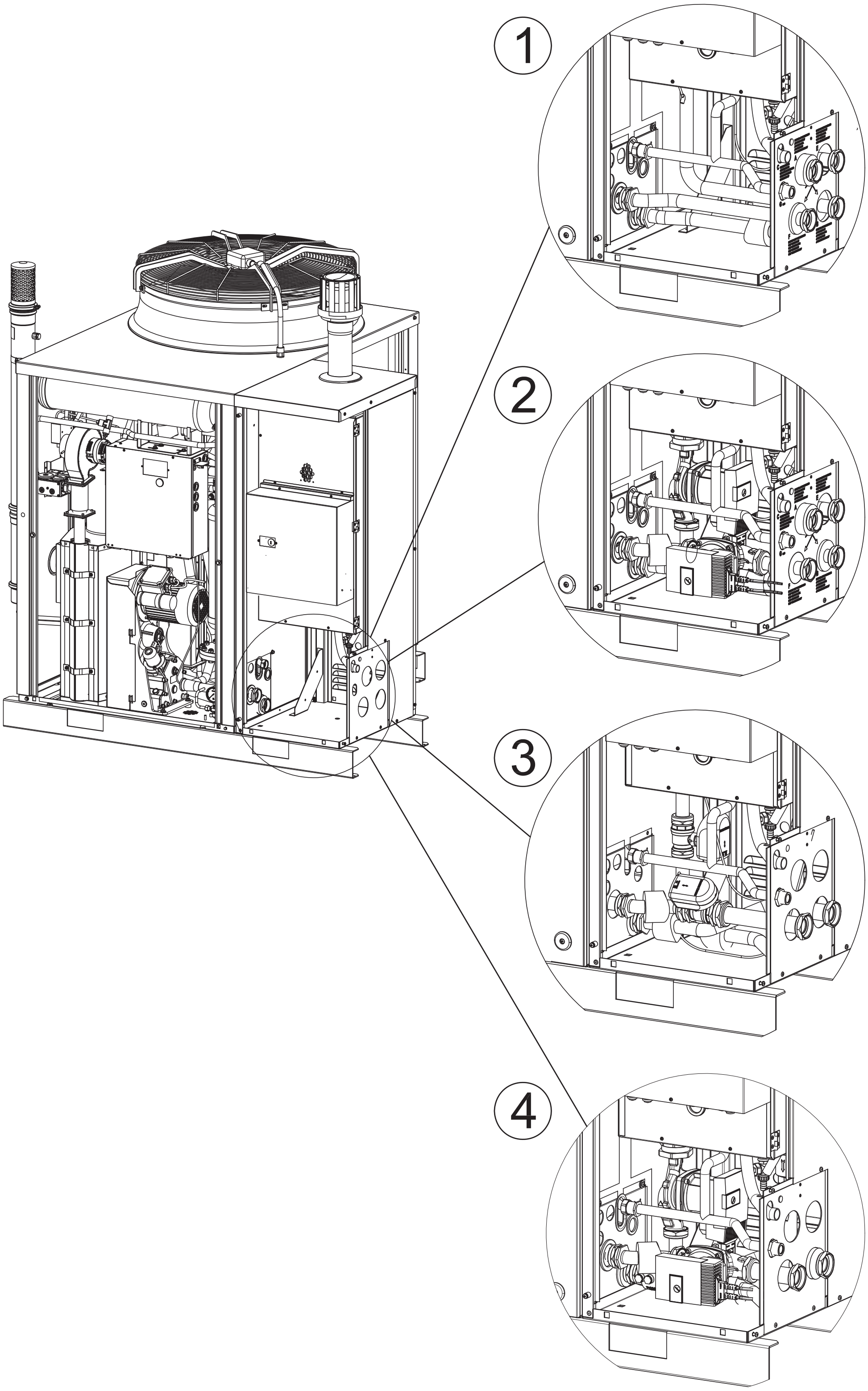


Figure 2.5 *Version components*

1 BASE version (2 independent circuits without circulating pumps)
2 Kit/4 C1 (2 independent circuits with on board circulating pumps)
3 Kit/2 C0 (single circuit with two 2-way motorised valves)
4 Kit/2 C1 (single circuit with on board circulating pumps)

2.3 OPERATION MODE

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

2.4 CONTROLS

Control device

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

- (1) **pre-configured DDC control**
- (2) **external enables**

2.4.1 Adjustment system (1) with pre-configured DDC control

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.

2.4.2 Adjustment system (2) - control with external enables

The appliance may also be controlled via generic enable devices (e.g. thermostats, clocks, buttons, contactors...) fitted with voltage-free NO contacts. This system only provides elementary control (on/off, with fixed set-point temperature), without the important functions of system (1). Control of the cascade between GAHP/GA and AY00-120 is left to the user.

2.5 TECHNICAL CHARACTERISTICS

2.5.1 ARAY Integrated package technical specifications

Table 2.1 *Technical data Gitié ARAY*

			ARAY/4 C0	ARAY/4 C1	ARAY/2 C0	ARAY/2 C1	ARAY/4 C0 S	ARAY/4 C1 S	ARAY/2 C0 S	ARAY/2 C1 S
Heating mode										
Seasonal space heating energy efficiency class (ErP)	medium-temperature application (55 °C)	-	A+							
	low-temperature application (35 °C)	-	A							
Heating capacity	real	kW	60,1							
Ambient air temperature (dry bulb)	maximum	°C	35							
	minimum	°C	-20							
Water flow rate 4 pipes	maximum (GAHP)	l/h	3500		-		3500		-	
	nominal (GAHP)	l/h	3040		-		3040		-	
	minimum (GAHP)	l/h	2500		-		2500		-	
	maximum (AY120)	l/h	3200		-		3200		-	
	nominal (AY120)	l/h	2950		-		2950		-	
	minimum (AY120)	l/h	1500		-		1500		-	
Water flow rate 2 pipes	maximum	l/h	-		6700		-		6700	
	nominal	l/h	-		5990		-		5990	
	minimum	l/h	-		4000		-		4000	
Pressure loss at nominal flow rate	version /4 C0 GAHP	bar	0,29	-			0,29	-		
	version /4 C0 AY120	bar	0,40	-			0,40	-		
	version /2 C0	bar	-		0,56	-			0,56	-
Residual pressure head at nominal flow rate	version /4 C1 GAHP	bar	-	0,70	-			0,70	-	
	version /4 C1 AY120	bar	-	0,60	-			0,60	-	
	version /2 C1	bar	-			0,52	-			0,52
Operation in conditioning mode										
Heating capacity	nominal (1013 mbar - 15 °C)	kW	25,7							
	real	kW	25,2							
External air temperature	maximum	°C	45							
	minimum	°C	0							
Water flow rate	maximum	l/h	3500							
	nominal	l/h	2900							
	minimum	l/h	2500							
Pressure loss at nominal flow rate	version /4 C0 GAHP	bar	0,31	-			0,31	-		
	version /2 C0	bar	-		0,56	-			0,56	-
Residual pressure head at nominal flow rate	version /4 C1 GAHP	bar	-	0,68	-			0,68	-	
	version /2 C1	bar	-			0,52	-			0,52
Electrical specifications										
Power supply	voltage	V	230							
	type	-	single-phase							
	frequency	50 Hz supply	50							
Electrical power absorption	nominal	kW	1,02 (1)	1,40 (1)	1,02 (1)	1,40 (1)	0,95 (1)	1,33 (1)	0,95 (1)	1,33 (1)
Degree of protection	IP	-	X5D							
Installation data										
Gas consumption	G20 (maximum)	m^3/h	6,4 (2)							
	G25 (maximum)	m^3/h	7,5 (3)							
	G30 (maximum)	kg/h	4,8 (4)							
	G30 (maximum)	kg/h	4,7 (4)							
Water fitting	delivery/inlet	"F	1 1/4		1 1/2		1 1/4		1 1/2	
Gas connection	thread	"M	3/4							
Dimensions	width	mm	1470							
	depth	mm	1260							
	height	mm	1630							
Weight	in operation	kg	480	505	480	505	490	515	490	515
Sound power L_w (max)		dB(A)	79,6 (5)				75,0 (5)			
Sound pressure L_p at 5 metres (max)		dB(A)	57,6 (6)				53,0 (6)			

(1) ±10% depending on power voltage and absorption tolerance of electric motors.
(2) PCI (G20) 34,02 MJ/m³ (15 °C - 1013 mbar).
(3) PCI (G25) 29,25 MJ/m³ (15 °C - 1013 mbar).
(4) PCI (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(5) Sound power values detected in compliance with the intensity measurement methodology set forth by standard EN ISO 9614.
(6) Maximum sound pressure levels in free field, with directionality factor 2, obtained from the sound power level in compliance with standard EN ISO 9614.

		ARAY/4 C0	ARAY/4 C1	ARAY/2 C0	ARAY/2 C1	ARAY/4 C0 S	ARAY/4 C1 S	ARAY/2 C0 S	ARAY/2 C1 S
Minimum storage temperature	°C	-30							
Maximum water pressure in operation	bar	4							
Water content inside the apparatus	l	6							

(1) ±10% depending on power voltage and absorption tolerance of electric motors.
(2) PCI (G20) 34,02 MJ/m³ (15 °C - 1013 mbar).
(3) PCI (G25) 29,25 MJ/m³ (15 °C - 1013 mbar).
(4) PCI (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(5) Sound power values detected in compliance with the intensity measurement methodology set forth by standard EN ISO 9614.
(6) Maximum sound pressure levels in free field, with directionality factor 2, obtained from the sound power level in compliance with standard EN ISO 9614.

2.5.2 GAHP-AR Unit technical data

Table 2.2 *GAHP-AR Unit technical data*

				GAHP-AR Standard	GAHP-AR S
Heating mode					
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)	
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	
Installation data					
NO_x emission class			-	5 (2)	
NO_x emission			ppm	30,0 (3)	
CO emission			ppm	23,0 (3)	
Fume outlet	diameter (Ø)		mm	80	
	residual head		Pa	12	
Type of installation			-	B23, B53	
General information					
Cooling fluid	ammonia R717		kg	7,1	
	water H_2O		kg	10,0	
Maximum pressure of the cooling circuit			bar	32	
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	
Filling ratio			kg of NH_3/l	0,148	
Fluid group			-	1°	

(1) In transient operation, lower temperatures are allowed.
(2) All values measured with G20 (natural gas) as reference gas.
(3) 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).

2.5.3 AY00-120 Unit technical data

Table 2.3 *Technical specifications AY00-120*

				AY00-120
Heating mode				
Operating point 80/60	Nominal thermal capacity	effective power	kW	34,4
	Minimal thermal capacity	efficiency	%	97,3
	Nominal thermal capacity	efficiency	%	98,6
	Mean thermal capacity	efficiency	%	98,3

				AY00-120
Operating point 70/50	Nominal thermal capacity	efficiency	%	100,6
Operating point 50/30	Nominal thermal capacity	efficiency	%	104,6
Operating point Tr = 30 °C	Thermal capacity 30%	efficiency	%	107,5
Operating point Tr = 47 °C	Thermal capacity 30%	efficiency	%	100,3
Heating capacity	nominal (1013 mbar - 15 °C)		kW	34,9
	average		kW	21,5
	minimum		kW	8,0
Hot water delivery temperature	maximum		°C	80
	minimum		°C	25
	nominal		°C	60
Hot water return temperature	maximum		°C	70
	minimum		°C	20
	nominal		°C	50
Efficiency class				****
Heat loss	to jacket in operation		kW	0,15
	to jacket in operation		%	0,44
	to flue in operation		kW	0,86
	to flue in operation		%	2,54
	in off mode		kW	0,058
	in off mode		%	0,17
Installation data				
NO_x emission class			-	5
NO_x emission			ppm	19,5
CO emission			ppm	8,4
Maximum flow flue condensate			l/h	5,5
Fume outlet	diameter (Ø)		mm	80
	residual head		Pa	100
Type of installation			-	B32P, B33, B35P, C13, C33, C34, C53, C63, C83

2.5.4 Pressure drop table

Table 2.4 *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	/

Table 2.5 *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.

Table 2.6 *Pressure drop AY*

Water flow rate	Outlet water temperature
	20 °C
	Bar
2007 l/h	0,20
2400 l/h	0,27
3000 l/h	0,41

2.5.5 Performance table

Table 2.7 *p. 8* shows the unitary thermal power at full load and stable operation, depending on hot water outlet temperature to the system and outdoor temperature, for the single GAHP-AR unit.

Table 2.8 *p. 8* shows the unitary cooling power at full load and stable operation, depending on cold water outlet temperature to the system and outdoor temperature, for the single GAHP-AR unit.

For AY00-120 see Table 2.3 *p. 7*.

Please consider that, according to the actual heating or cooling request, the unit may often need to operate under partial load conditions and in non stationary operation.

Table 2.7 *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

Table 2.8 *GAHP-AR cooling power for each unit*

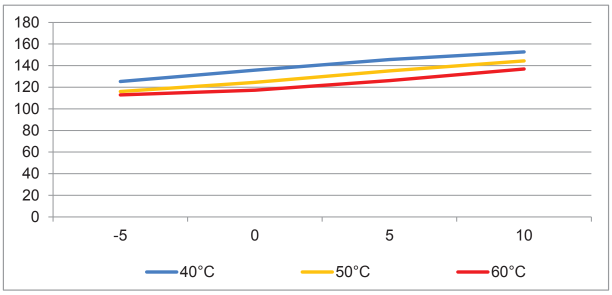
External air temperature	Water delivery temperature	
	7 °C	10 °C
	KW	KW
30 °C	17,8	18,1
35 °C	16,9	17,4
40 °C	15,0	16,0
45 °C	/	13,5

Picture 2.6 *p. 9* shows the GUE trend at full load in heating mode and in stable operation for three representative delivery temperatures for GAHP-AR unit.

Picture 2.7 *p. 9* shows the GUE trend at full load in conditioning mode and in stable operation for two representative delivery temperatures for GAHP-AR unit.

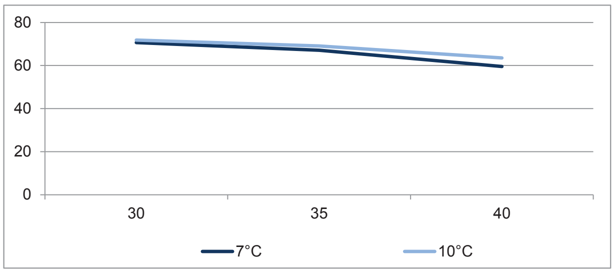
Please consider that, according to the actual heating or cooling request, the unit may often need to operate under partial load conditions and in non stationary operation.

Figure 2.6 *GUE GAHP-AR heating*



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

Figure 2.7 *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 GAHP-AR UNIT COMBUSTION PRODUCTS EXHAUST

Compliance with standards

The appliance is approved for connection to a combustion products exhaust duct for the types shown in Table 2.2 *p. 7*.

3.3.1 Flue gas exhaust connection

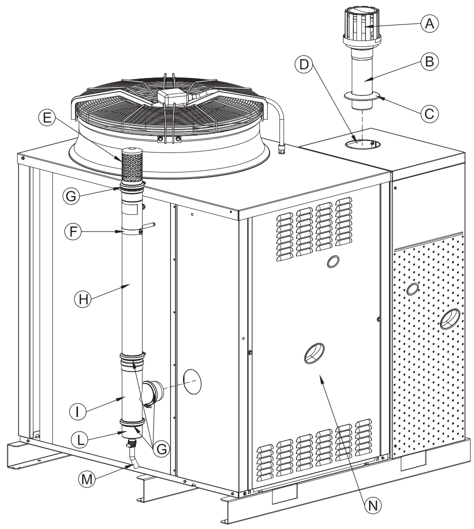
► Ø 80 mm (with gasket), on left side (Picture 3.1 *p. 10*).

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. 10*):

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

Figure 3.1 *Fume outlet*



A Terminal
B Pipe
C Rain cover
D Flanged fitting
E Terminal
F Clamp for fixing pipe
G Hoseclamp
H Exhaust air pipe L=750 mm
I "T" connector;
L Condensate trap
M Hose fitting + condensate exhaust pipe
N Front panel

3.4 AY00-120 UNIT COMBUSTION PRODUCTS EXHAUST

Compliance with standards

The appliance is approved for connection to a combustion products exhaust duct for the types shown in Table 2.3 *p. 7*.

3.4.1 Flue gas exhaust connection

► Ø 80 mm

in the upper part (Figure 3.1 *p. 10*).

3.4.2 Flue gas exhaust kit

The appliance is supplied with flue gas exhaust kit, to be fitted by the installer, including (Figure 3.1 *p. 10*):

► 1 terminal;
► 1 extension pipe Ø 80 mm, length 209 mm;
► 1 rain cover;

3.5 COMBUSTION PRODUCTS EXHAUST THROUGH THE FLUE

If necessary, the appliance may be connected to a flue.

► For flue sizing please refer to the specification sheet in Section C1.10.
► Modules GAHP-AR and AY00-120 have different flue gas exhaust characteristics and cannot therefore be connected to the same flue, but must be connected to different and separate flues.

- If several AY00-120 modules are connected to a single flue, it is obligatory to install a flap valve on the exhaust of each.
- 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.

In case the flap valves are installed outside, an appropriate UV ray protection must be assured (if the valve is constructed in plastic material) as well as protection from potential winter freezing of condensate backflow into the siphon.

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

3.6 FLUE GAS CONDENSATE DISCHARGE

The AY00-120 unit is a condensing boiler which therefore produces condensation water from combustion fumes.
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 (Table 2.3 *p. 7*).

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.

3.6.1 GAHP-AR unit 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. 10*).

3.6.2 AY00-120 Unit flue gas condensate fitting

The connection for flue gas condensate discharge is located on the right side of the appliance at the service plate (Figure 2.3 *p. 3* and Figure 2.4 *p. 3*).

- The condensate discharge pipe must be connected to a suitable discharge manifold.
- The junction between the pipe and the manifold must remain visible.

3.6.3 Flue gas condensate discharge manifold

If necessary the condensate discharge manifold may be in common between the 2 units the Gitié group consists of.
To make the condensate discharge manifold:

- Size the ducts for maximum condensation capacity (Table 2.3 *p. 7*).
- 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.

3.7 ELECTRICAL AND CONTROL CONNECTIONS

3.7.1 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

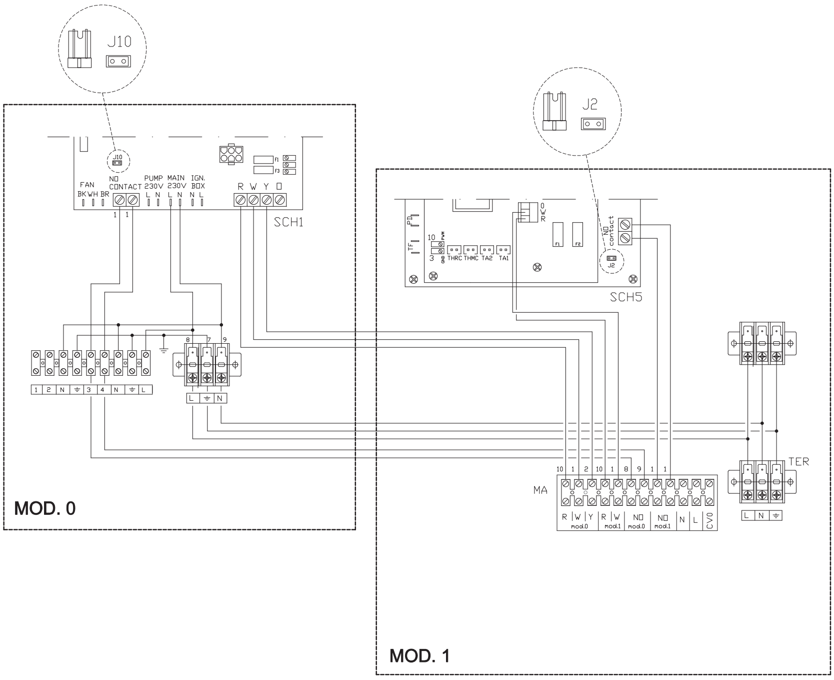
- Never use the external isolation switch (GS) to turn the appliance on and off, since it may be damaged in the long run (occasional black outs are tolerated).
- To turn the appliance on and off, exclusively use the suitably provided control device (DDC or external enable).

Control of water circulation pumps

In C0 versions the water circulation pumps of the hydraulic circuit must mandatorily be controlled by the unit's electronic boards. It is not admissible to start/stop circulating pumps with no enable from the appliance.

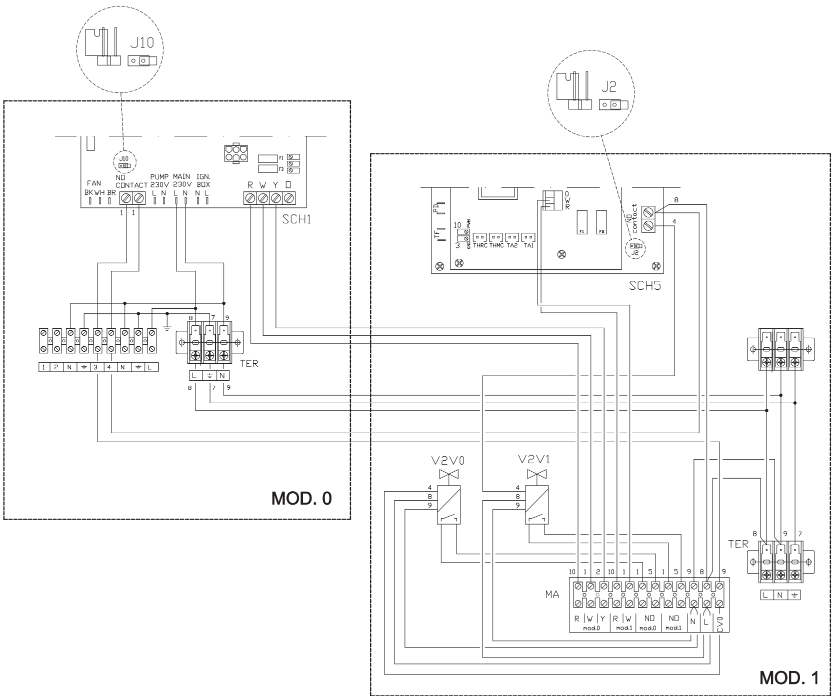
3.7.2 Wiring diagrams

Figure 3.2 *Gitié package wiring diagram - base version*



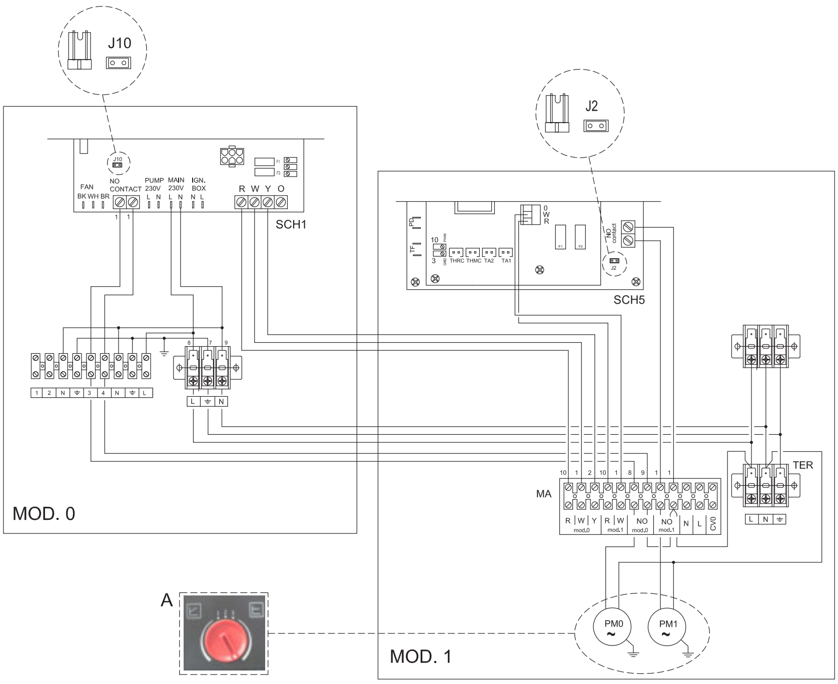
MA Terminal block
MOD.0 GAHP or ACF unit
MOD.1 unit AY00-120
SCH1 electronic board S61
SCH5 electronic boards S70+AY10
TER unit power supply terminal box
J2-J10 control jumpers of system water pumps ("closed")

Figure 3.3 *Gitié package wiring diagram with KIT/2 C0*



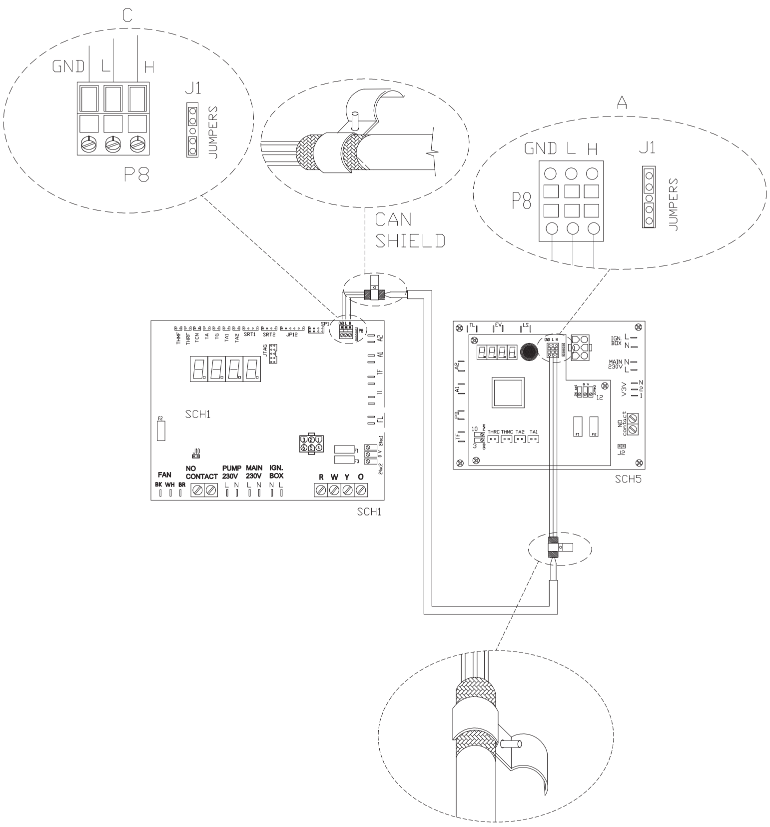
MOD.0 GAHP or ACF unit
MOD.1 unit AY00-120
SCH1 electronic board S61
SCH5 electronic boards S70+AY10
TER unit power supply terminal box
J2-J10 control jumpers of system water pump ("open")
MA connection terminal block
V2V0-V2V1 motorised valves

Figure 3.4 *Gitié package wiring diagram with KIT/2 C1 or with KIT/4 C1*



MOD.0 GAHP or ACF unit
MOD.1 unit AY00-120
SCH1 electronic board S61
SCH5 electronic boards S70+AY10
TER unit power supply terminal box
J2-J10 control jumpers of system water pumps ("closed")
MA connection terminal block
PM0-PM1 system water pumps
A Position of pumps flow rate adjustment screw

Figure 3.5 *CAN connection between AY10 board and S61 (pre-wired in the factory)*



SCH5 electronic board S70+AY10
SCH1 electronic board S61
J1 Jumpers CAN-BUS on AY10 board and S61 board
A terminal node connection - (3 wires; J1 jumpers = "closed")
C terminal node connection - (3 wires; J1 jumpers = "closed")
H,L,GND data signal wires (ref. cables table)

3.7.3 Electrical systems

Electrical connections must provide:

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

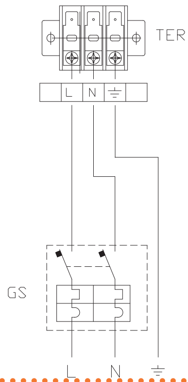
3.7.4 Electrical power supply

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 2 8A type T fuses, (GS) or 1 10A magnetothermic breaker.

Figure 3.6 *Appliance connection to the mains power supply (230V 1N - 50 Hz)*



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.

3.7.5 Set-up and control

Control systems, options (1) (2)

Two separate adjustment systems are provided, each with specific features, components and diagrams (see Paragraph 2.4 *p. 5*):

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

Control with DDC

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 device.

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, AY00-120, Gitié, ...) or control device (DDC, RB100, RB200, CCI, ...), 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. 14* (admissible types and maximum distances).

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

Table 3.1 *CAN BUS cables type*

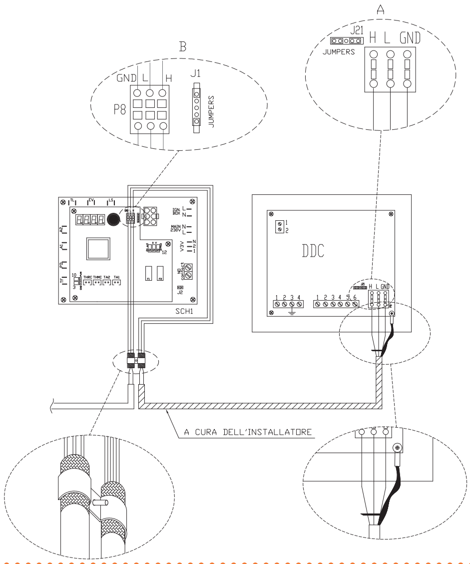
CABLE NAME	SIGNALS / COLOR			MAX LENGTH	Note
Robur					Ordering Code OCVO008
ROBUR NETBUS	H= BLACK	L= WHITE	GND= BROWN	450 m	
Honeywell SDS 1620					In all cases the fourth conductor should not be used
BELDEN 3086A	H= BLACK	L= WHITE	GND= BROWN	450 m	
TURCK type 530					
DeviceNet Mid Cable					
TURCK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

To connect the CAN-BUS cable to the AY10 electronic board, located in the Electrical Panel inside the AY00-120 unit, Picture 3.7 *p. 15*, Details A and B:

1. Access the Electrical Board of the appliance according to the Procedure 3.7.3 *p. 13*);
2. Connect the CAN-BUS cable to terminals GND + L and H (shielding/earthing + two signal conductors) of the AY10 board;
3. Place the Jumper J1, of the AY10 board, OPEN;
4. Connect the DDC to the CAN-BUS cable to terminals GND + L and H (shielding/earthing + two signal conductors) of the DDC;
5. The CAN connection between the AY10 board and the S61 board is pre-wired (Picture 3.8 *p. 15*);

Figure 3.7 *CAN-BUS connection between Gitié and DDC*



DDC Direct Digital Control
SCH5 electronic board S70+AY10
J1 Jumpers CAN-BUS on AY10 board
J21 Jumper CAN-BUS in board DDC
A terminal node connection - (3 wires; J21 jumpers = "closed")
B intermediate node connection - (3 wires; J1 jumpers ="open")
H,L,GND data signal wires (ref. cables table)

Control with external enables

(System (2), see also Paragraph 2.4 *p. 5*).
For each external request to be provided, it is required to arrange:

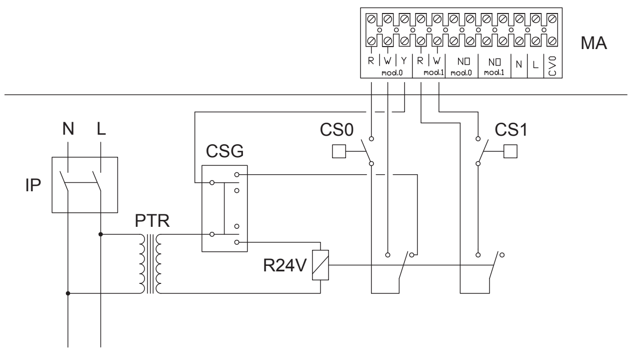
► request device (e.g. thermostat, clock, button, ...) fitted with a voltage-free NO contact.

How to connect external enables

Connection of external requests is effected on the terminal block located in the Electrical Panel inside the AY00-120 unit.

If you wish the heating enables of the two units to be simultaneous follow the connection diagram shown in Figure 3.8 *p. 15*.
Should you wish the enables of the two units to be separate follow the connection diagram shown in Figure 3.9 *p. 15*.

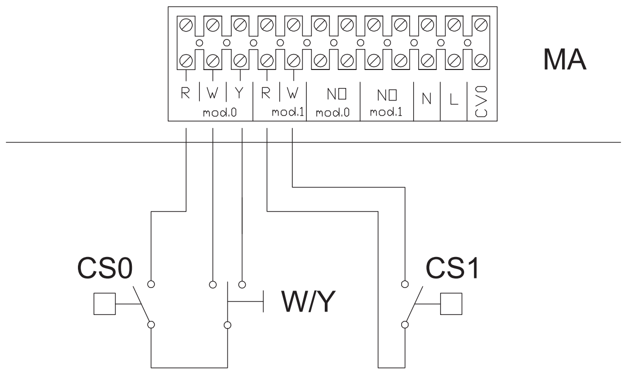
Figure 3.8 *Connection diagram of simultaneous hot external enables*



MA unit terminal block

Components NOT SUPPLIED
IP two-pole switch
PTR safety transformer SELV
CSG general enable
CS0 GAHP-AR unit enable
CS1 heating request AY00-120
R24V 24V relay

Figure 3.9 *Connection diagram of separate hot external enables*



MA unit terminal block

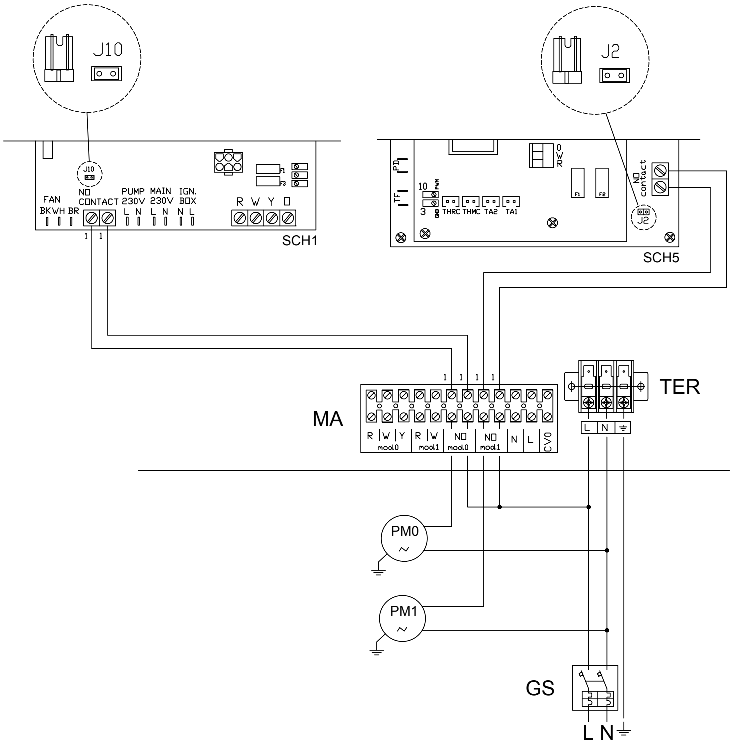
Components NOT SUPPLIED
CS0 GAHP-AR unit enable
CS1 heating request AY00-120
W/Y hot/cold diverter (summer/winter)

3.7.6 Water circulation pumps (versions C0)

System water pumps will be controlled at constant flow.

4-pipe versions

Figure 3.10 *System pump connection diagram Gitié package BASE version (P < 700 W)*



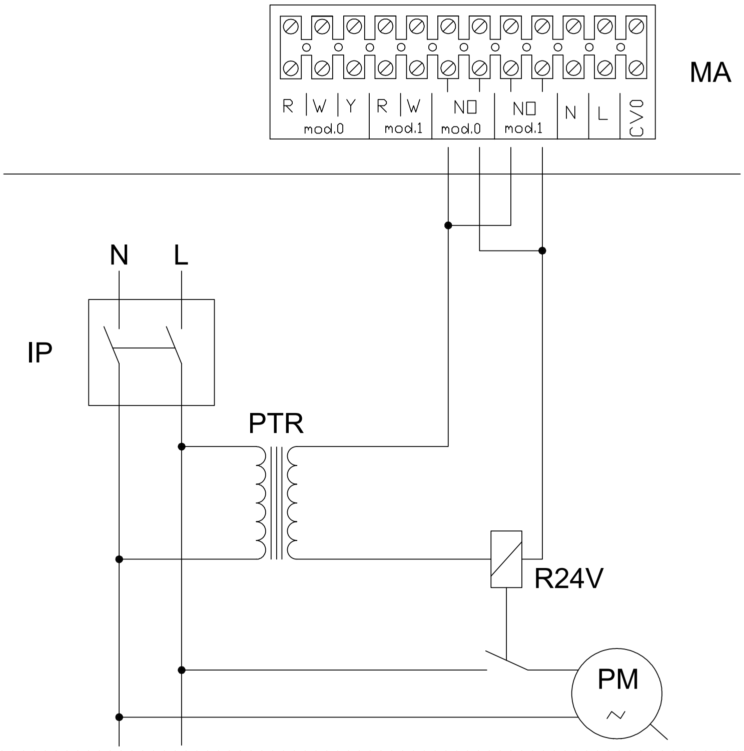
SCH1 electronic board S61
SCH5 electronic boards S70+AY10
MA unit terminal block
J2-J10 control jumpers of system water pumps ("closed")

Components NOT SUPPLIED
PM0 water pump (P < 700 W) unit GAHP or ACF
PM1 water pump (P < 700 W) AY00-120 unit
GS general switch

The diagram in Figure 3.10 *p. 16* is for pumps < 700 W. For pumps > 700 W it is necessary to add a control relay and arrange Jumpers J10 and J2 OPEN.

2-pipe versions

Figure 3.11 *System pump connection diagram Gitié package 2 pipe version (KIT/2 C0)*



MA unit terminal block

Components NOT SUPPLIED
PM water pump
IP two-pole switch
PTR safety transformer SELV
R24V pump control relay

1 SPECIFICATION OF SUPPLY

The Gitié ACAY group consists of a GA ACF chiller and a AY00-120 condensing boiler.
For the specifications of supply of the individual units making up the group refer to Section B05 (GA ACF) and Section B06 (AY00-120).

1.1 ACAY INTEGRATED PACKAGE FEATURES

The Gitié ACAY group is available in the following versions (Picture 2.5 *p. 4*):

- ► **Version /4 C0 (standard or silenced)**
- ► **Version /4 C1 (standard or silenced)**
- ► **Version /2 C0 (standard or silenced)**
- ► **Version /2 C1 (standard or silenced)**

In 4-pipe versions units operation may be simultaneous or independent.
The Table 1.1 *p. 1* shows the features of the various versions in detail.

Table 1.1 *Gitié ACAY package versions*

Version	Pipes	Circulating pumps	Motorised 2-way valves	Hydraulic circuits	Simultaneous operation	Fan
/4 C0	4	No	No	independent	Yes	standard
/4 C0 S	4	No	No	independent	Yes	silenced
/4 C1	4	Yes	No	independent	Yes	standard
/4 C1 S	4	Yes	No	independent	Yes	silenced
/2 C0	2	No	Yes	single	No	standard
/2 C0 S	2	No	Yes	single	No	silenced
/2 C1	2	Yes	No	single	No	standard
/2 C1 S	2	Yes	No	single	No	silenced

2 FEATURES AND TECHNICAL DATA

2.1 DIMENSIONS

Figure 2.1 *Dimensions (Standard ventilation) - Front and side view (dimensions in mm)*

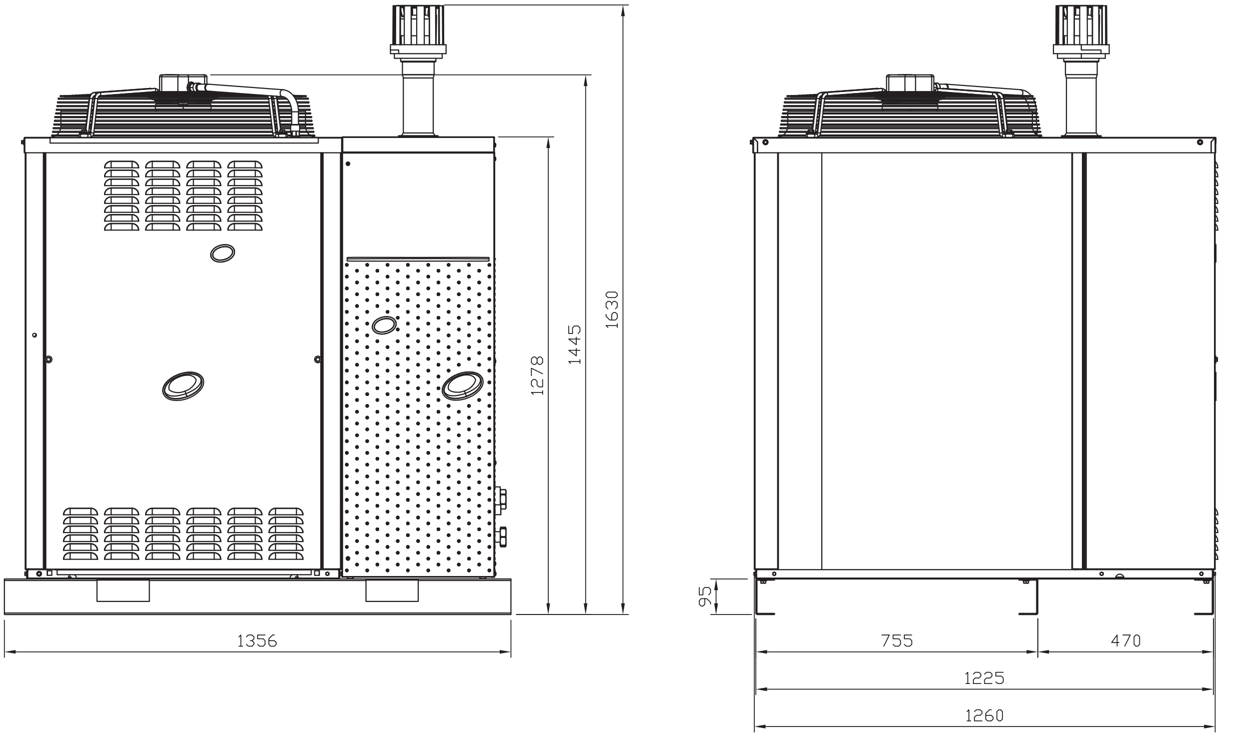


Figure 2.2 *Dimensions (Silenced ventilation) - Front and side view (dimensions in mm)*

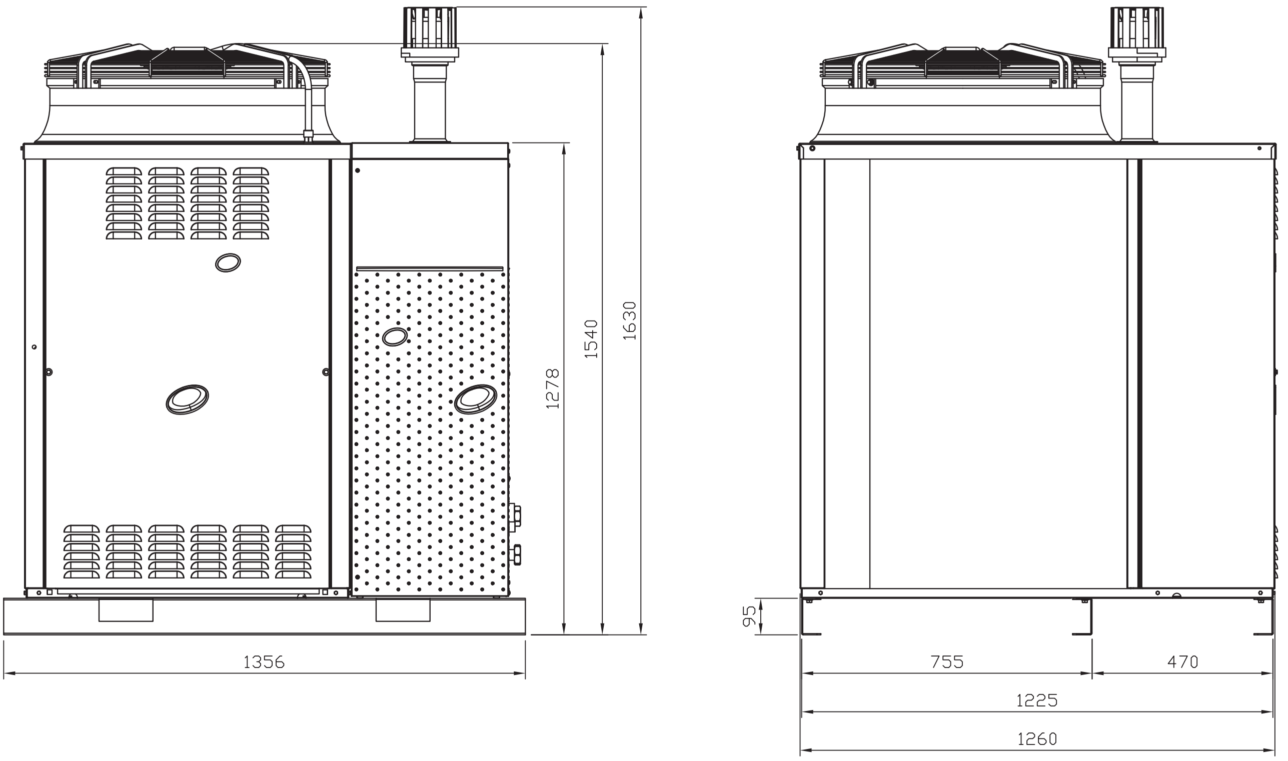
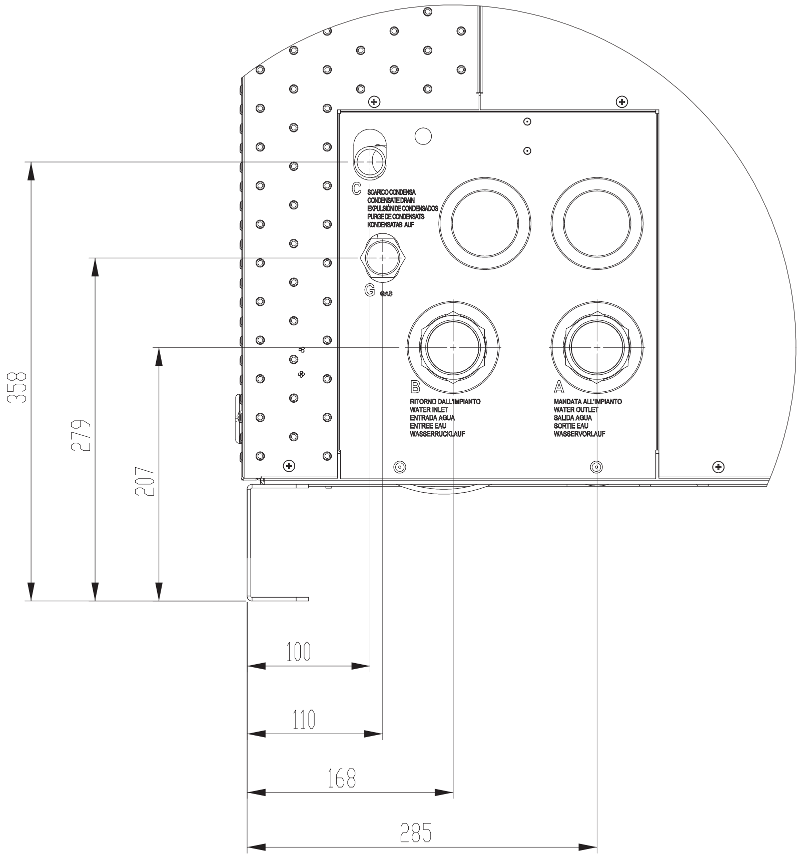
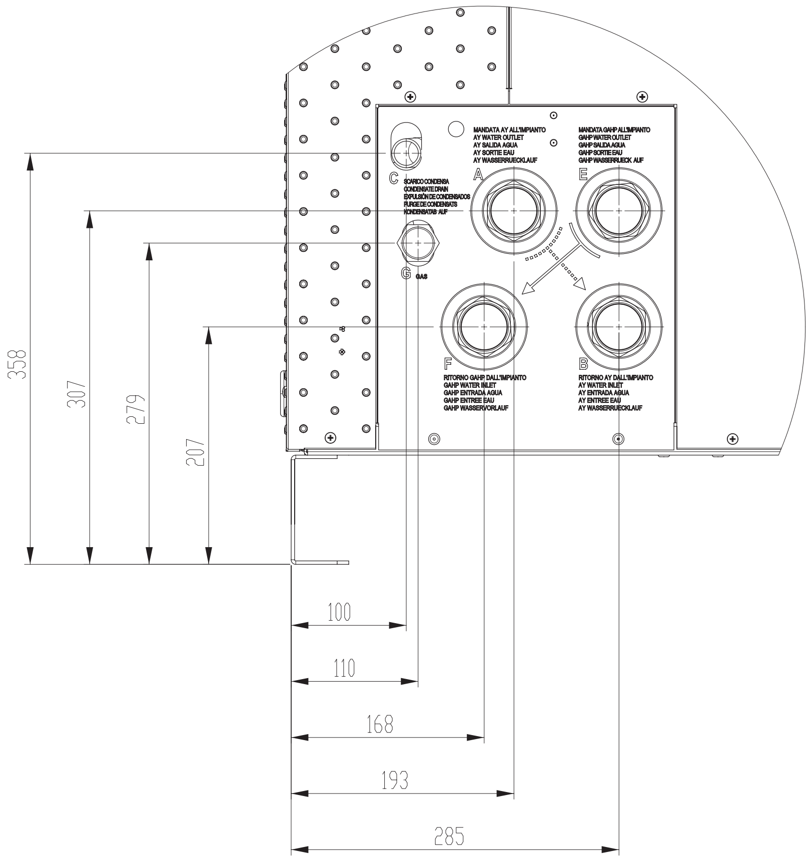


Figure 2.3 *Service plate 2-pipe group (KIT/2 C0 and C1) - Detail of water/gas fittings*



A Outlet water fitting Ø 1 1/2"F
B Inlet water fitting Ø 1 1/2"F
C Boiler condensate drain AY00-120
G Gas fitting Ø 3/4"M

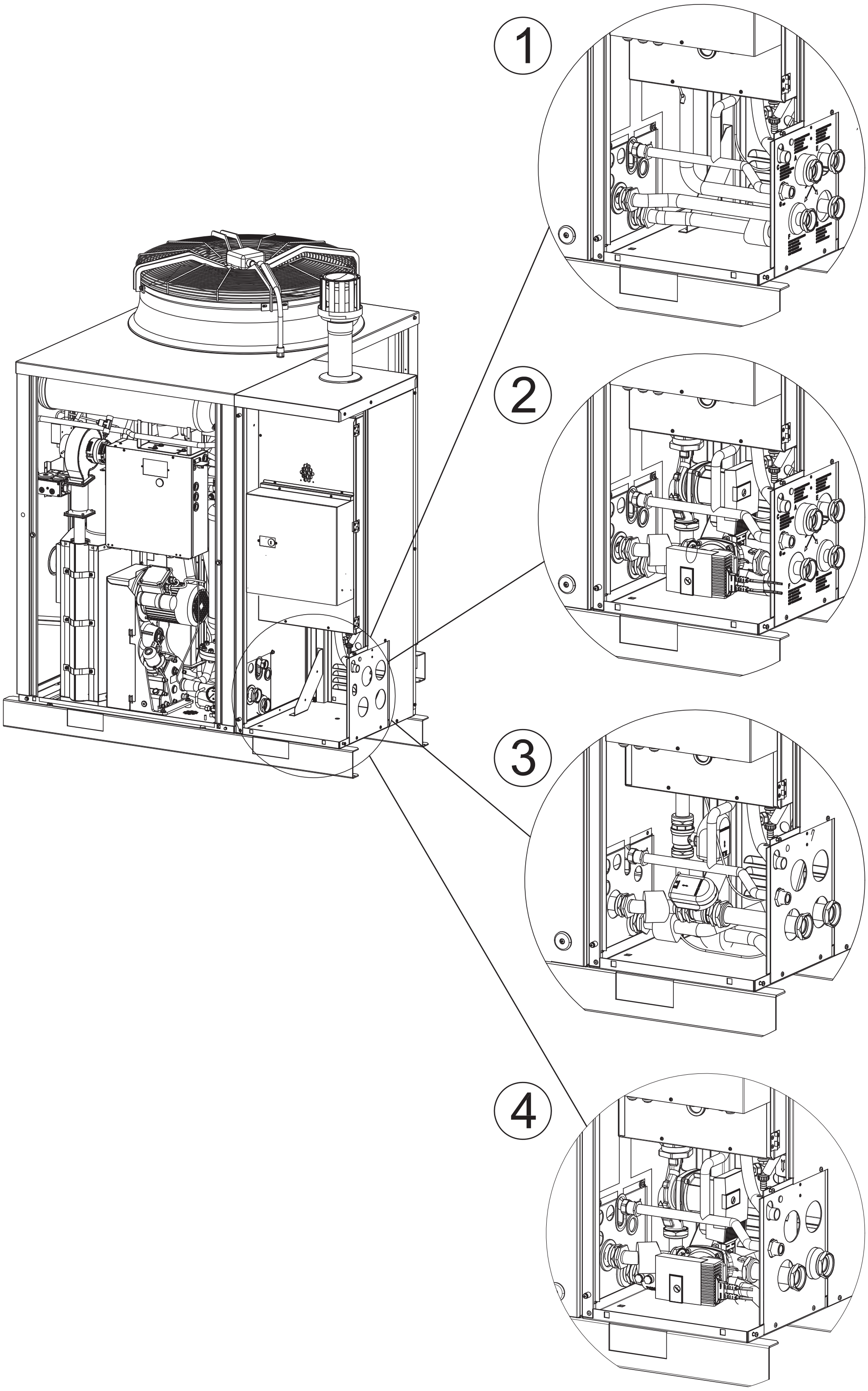
Figure 2.4 *Service plate 4-pipe group (base version and KIT/4 C1) - Detail of water/gas fittings*



A AY - Water outlet fitting Ø 1 1/4"F
B AY - Water inlet fitting Ø 1 1/4"F
C Boiler condensate drain AY00-120
E GAHP/GA - Water outlet fitting Ø 1 1/4"F
F GAHP/GA - Water inlet fitting Ø 1 1/4"F
G Gas fitting Ø 3/4"M

2.2 VERSIONS

Figure 2.5 *Version components*



1 BASE version (2 independent circuits without circulating pumps)
2 Kit/4 C1 (2 independent circuits with on board circulating pumps)
3 Kit/2 C0 (single circuit with two 2-way motorised valves)
4 Kit/2 C1 (single circuit with on board circulating pumps)

2.3 OPERATION MODE

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

2.4 CONTROLS

Control device

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

- (1) **pre-configured DDC control**
- (2) **external enables**

2.4.1 Adjustment system (1) with pre-configured DDC control

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.

2.4.2 Adjustment system (2) - control with external enables

The appliance may also be controlled via generic enable devices (e.g. thermostats, clocks, buttons, contactors...) fitted with voltage-free NO contacts. This system only provides elementary control (on/off, with fixed set-point temperature), without the important functions of system (1). Control of the cascade between GAHP/GA and AY00-120 is left to the user.

2.5 TECHNICAL CHARACTERISTICS

2.5.1 ACAY Integrated package technical specifications

Table 2.1 *Technical data Gitié ACAY*

			ACAY/4 C0	ACAY/4 C1	ACAY/2 C0	ACAY/2 C1	ACAY/4 C0 S	ACAY/4 C1 S	ACAY/2 C0 S	ACAY/2 C1 S
Heating mode										
Heating capacity	nominal (1013 mbar - 15 °C)	kW	34,9							
Ambient air temperature (dry bulb)	maximum	°C	45							
	minimum	°C	-20							
Heating water flow	maximum	l/h	3200							
	nominal	l/h	2950							
	minimum	l/h	1500							
Pressure loss at nominal flow rate	version /4 C0 AY120	bar	0,40	-			0,40	-		
	version /2 C0	bar	-		0,56	-			0,56	-
Residual pressure head at nominal flow rate	version /4 C1 AY120	bar	-	0,60	-			0,60	-	
	version /2 C1	bar	-			0,52	-			0,52
Operation in conditioning mode										
Heating capacity	nominal (1013 mbar - 15 °C)	kW	25,3							
	real	kW	25,0							
External air temperature	maximum	°C	45							
	minimum	°C	0							
Water flow rate	maximum	l/h	3500							
	nominal	l/h	2770							
	minimum	l/h	2500							
Pressure loss at nominal flow rate	version /4 C0 ACF	bar	0,29	-			0,29	-		
	version /2 C0	bar	-		0,56	-			0,56	-
Residual pressure head at nominal flow rate	version /4 C1 ACF	bar	-	0,68	-			0,68	-	
	version /2 C1	bar	-			0,52	-			0,52
Electrical specifications										
Power supply	voltage	V	230							
	type	-	single-phase							
	frequency	50 Hz supply	50							
Electrical power absorption	nominal	kW	1,00 (1)	1,38 (1)	1,00 (1)	1,38 (1)	1,05 (1)	1,43 (1)	1,05 (1)	1,43 (1)
Degree of protection	IP	-	X5D							
Installation data										
Gas consumption	G20 (maximum)	m^3/h	6,4 (2)							
	G25 (maximum)	m^3/h	7,5 (3)							
	G30 (maximum)	kg/h	4,7 (4)							
	G30 (maximum)	kg/h	4,7 (4)							
Water fitting	delivery/inlet	"F	1 1/4		1 1/2		1 1/4		1 1/2	
Gas connection	thread	"M	3/4							

(1) ±10% depending on power voltage and absorption tolerance of electric motors.
(2) PCI (G20) 34,02 MJ/m³ (15 °C - 1013 mbar).
(3) PCI (G25) 29,25 MJ/m³ (15 °C - 1013 mbar).
(4) PCI (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(5) Sound power values detected in compliance with the intensity measurement methodology set forth by standard EN ISO 9614.
(6) Maximum sound pressure levels in free field, with directionality factor 2.

			ACAY/4 C0	ACAY/4 C1	ACAY/2 C0	ACAY/2 C1	ACAY/4 C0 S	ACAY/4 C1 S	ACAY/2 C0 S	ACAY/2 C1 S
Dimensions	width	mm	1356							
	depth	mm	1260							
	height	mm	1630							
Weight	in operation	kg	440	465	440	465	460	485	460	485
Sound power L_W (max)		dB(A)	82,1 (5)				76,1 (5)			
Sound pressure L_p at 5 metres (max)		dB(A)	60,1 (6)				54,1 (6)			
Minimum storage temperature		°C	-30							
Maximum water pressure in operation		bar	4							
Water content inside the apparatus		l	6							

(1) ±10% depending on power voltage and absorption tolerance of electric motors.
(2) PCI (G20) 34,02 MJ/m³ (15 °C - 1013 mbar).
(3) PCI (G25) 29,25 MJ/m³ (15 °C - 1013 mbar).
(4) PCI (G30/G31) 46,34 MJ/kg (15 °C - 1013 mbar).
(5) Sound power values detected in compliance with the intensity measurement methodology set forth by standard EN ISO 9614.
(6) Maximum sound pressure levels in free field, with directionality factor 2.

2.5.2 GA ACF unit technical data

Table 2.2 *GA ACF unit technical data*

			ACF 60-00
Operation in conditioning mode			
Operating point A35W7	cooling output	kW	17,72 (1)
	G.U.E. gas usage efficiency	%	71
Heating capacity	nominal (1013 mbar - 15 °C)	kW	25,3
	real	kW	25,0
Cold water temperature (inlet)	maximum	°C	45
	minimum	°C	8
Installation data			
NO_x emission class		-	4
NO_x emission		ppm	56,0
CO emission		ppm	17,0
General information			
Cooling fluid	ammonia R717	kg	6,8
	water H_2O	kg	10,0
Maximum pressure of the cooling circuit		bar	32
PED data			
Components under pression	generator	l	18,6
	leveling chamber	l	11,5
	evaporator	l	3,7
	cooling absorber solution	l	6,3
	solution pump	l	3,3
Test pressure (in air)		bar g	55
Filling ratio		kg of NH_3/l	0,157
Fluid group		-	1°

(1) As per standard EN12309.

2.5.3 AY00-120 Unit technical data

Table 2.3 *Technical specifications AY00-120*

				AY00-120
Heating mode				
Operating point 80/60	Nominal thermal capacity	effective power	kW	34,4
	Minimal thermal capacity	efficiency	%	97,3
	Nominal thermal capacity	efficiency	%	98,6
	Mean thermal capacity	efficiency	%	98,3
Operating point 70/50	Nominal thermal capacity	efficiency	%	100,6
Operating point 50/30	Nominal thermal capacity	efficiency	%	104,6
Operating point Tr = 30 °C	Thermal capacity 30%	efficiency	%	107,5
Operating point Tr = 47 °C	Thermal capacity 30%	efficiency	%	100,3
Heating capacity	nominal (1013 mbar - 15 °C)		kW	34,9
	average		kW	21,5
	minimum		kW	8,0

			AY00-120
Hot water delivery temperature	maximum	°C	80
	minimum	°C	25
	nominal	°C	60
Hot water return temperature	maximum	°C	70
	minimum	°C	20
	nominal	°C	50
Efficiency class			****
Heat loss	to jacket in operation	kW	0,15
	to jacket in operation	%	0,44
	to flue in operation	kW	0,86
	to flue in operation	%	2,54
	in off mode	kW	0,058
	in off mode	%	0,17
Installation data			
NO_x emission class		-	5
NO_x emission		ppm	19,5
CO emission		ppm	8,4
Maximum flow flue condensate		l/h	5,5
Fume outlet	diameter (Ø)	mm	80
	residual head	Pa	100
Type of installation		-	B32P, B33, B35P, C13, C33, C34, C53, C63, C83

2.5.4 Pressure drop table

Table 2.4 *GA ACF ACF standard, HR, TK, HT pressure drop*

Water flow rate	Vector fluid temperature at outlet	
	3 °C	7 °C
	Bar	Bar
2600 l/h	0,27	0,26
2900 l/h	0,33	0,31
3500 l/h	0,48	0,46

The data refer to operation with no glycol in water.

Table 2.5 *Pressure drop AY*

Water flow rate	Outlet water temperature
	20 °C
	Bar
2007 l/h	0,20
2400 l/h	0,27
3000 l/h	0,41

2.5.5 Performance table

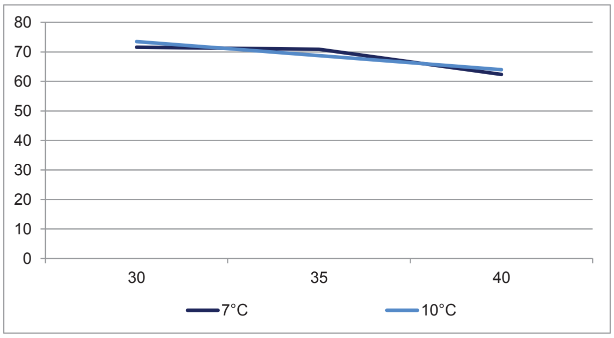
Table 2.6 *p. 7* shows the unitary cooling power at full load and stable operation, depending on cold water outlet temperature to the system and outdoor temperature, for the single GA ACF unit.
For AY00-120 see Table 2.3 *p. 6*.
Please consider that, according to the actual heating or cooling request, the unit may often need to operate under partial load conditions and in non stationary operation.

Table 2.6 *GA ACF standard cooling power for each unit*

External air temperature	Water delivery temperature	
	7 °C	10 °C
	KW	KW
30 °C	17,9	18,4
35 °C	17,7	17,2
40 °C	15,6	16,0
45 °C	11,9	14,8

Picture 2.6 *p. 7* shows the GUE trend at full load in conditioning mode and in stable operation for two representative delivery temperatures for GA ACF unit.
Please consider that, according to the actual heating or cooling request, the unit may often need to operate under partial load conditions and in non stationary operation.

Figure 2.6 *GA ACF standard GUE*



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 GA ACF UNIT COMBUSTION PRODUCTS EXHAUST

The GA ACF units have no flue gas exhaust.

3.4 AY00-120 UNIT COMBUSTION PRODUCTS EXHAUST

Compliance with standards

The appliance is approved for connection to a combustion products exhaust duct for the types shown in Table 2.3 *p. 6*.

3.4.1 Flue gas exhaust connection

► Ø 80 mm

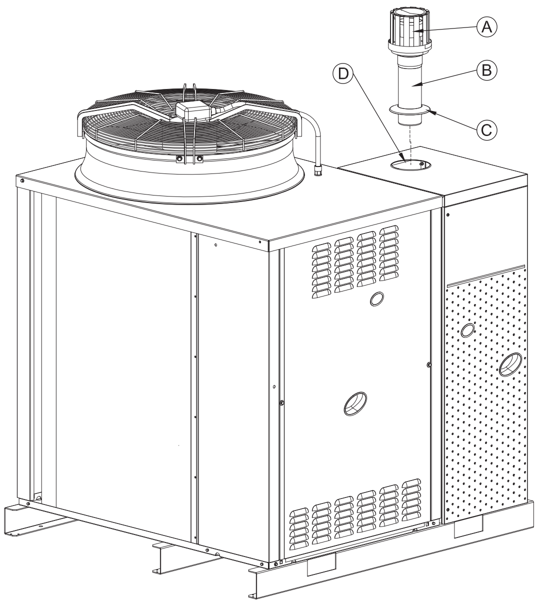
in the upper part (Figure 3.1 *p. 8*).

3.4.2 Flue gas exhaust kit

The appliance is supplied with flue gas exhaust kit, to be fitted by the installer, including (Figure 3.1 *p. 8*):

► 1 terminal;
► 1 extension pipe Ø 80 mm, length 209 mm;
► 1 rain cover;

Figure 3.1 *Fume outlet*



A Terminal
B Pipe
C Rain cover
D Flanged fitting

3.5 COMBUSTION PRODUCTS EXHAUST THROUGH THE FLUE

If necessary, the appliance may be connected to a flue.

► The GA ACF units have no flue gas exhaust.
► For flue sizing please refer to the specification sheet in Section C1.10.
► If several AY00-120 modules are connected to a single flue, it is obligatory to install a flap valve on the exhaust of each.
► 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.

In case the flap valves are installed outside, an appropriate UV ray protection must be assured (if the valve is constructed in plastic material) as well as protection from potential winter freezing of condensate backflow into the siphon.

3.6 FLUE GAS CONDENSATE DISCHARGE

The AY00-120 unit is a condensing boiler which therefore produces condensation water from combustion fumes.

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 (Table 2.3 *p. 6*).

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.

3.6.1 AY00-120 Unit flue gas condensate fitting

The connection for flue gas condensate discharge is located on the right side of the appliance at the service plate (Figure 2.3 *p. 3* and Figure 2.4 *p. 3*).

- The condensate discharge pipe must be connected to a suitable discharge manifold.
- The junction between the pipe and the manifold must remain visible.

3.6.2 Flue gas condensate discharge manifold

To make the condensate discharge manifold:

- Size the ducts for maximum condensation capacity (Table 2.3 *p. 6*).
- 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.

3.7 ELECTRICAL AND CONTROL CONNECTIONS

3.7.1 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

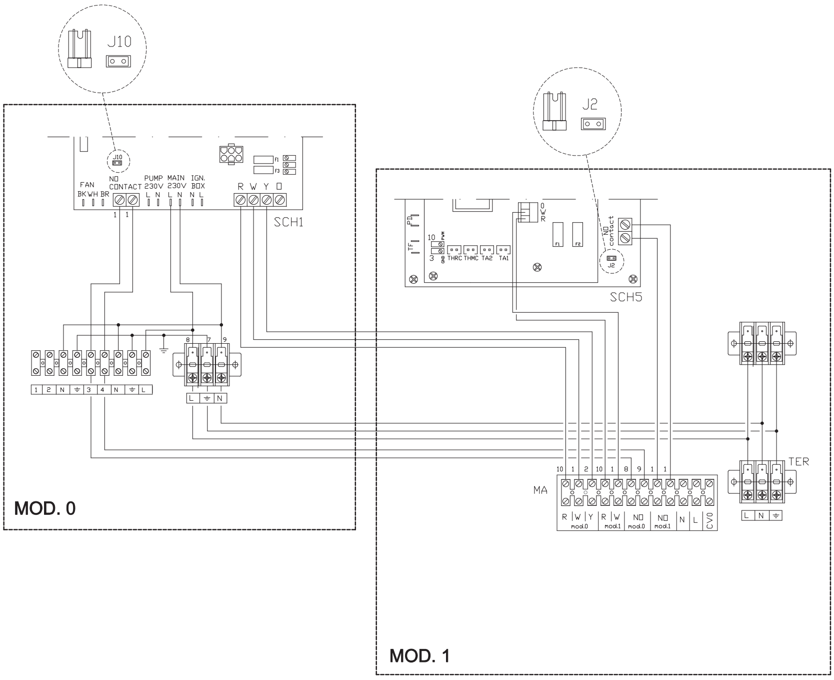
- Never use the external isolation switch (GS) to turn the appliance on and off, since it may be damaged in the long run (occasional black outs are tolerated).
- To turn the appliance on and off, exclusively use the suitably provided control device (DDC or external enable).

Control of water circulation pumps

In C0 versions the water circulation pumps of the hydraulic circuit must mandatorily be controlled by the unit's electronic boards. It is not admissible to start/stop circulating pumps with no enable from the appliance.

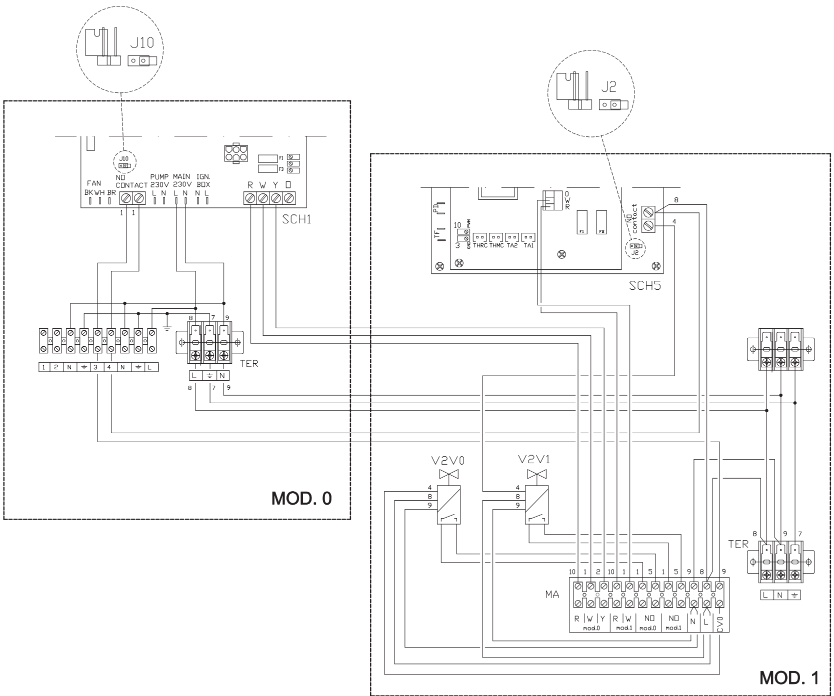
3.7.2 Wiring diagrams

Figure 3.2 *Gitié package wiring diagram - base version*



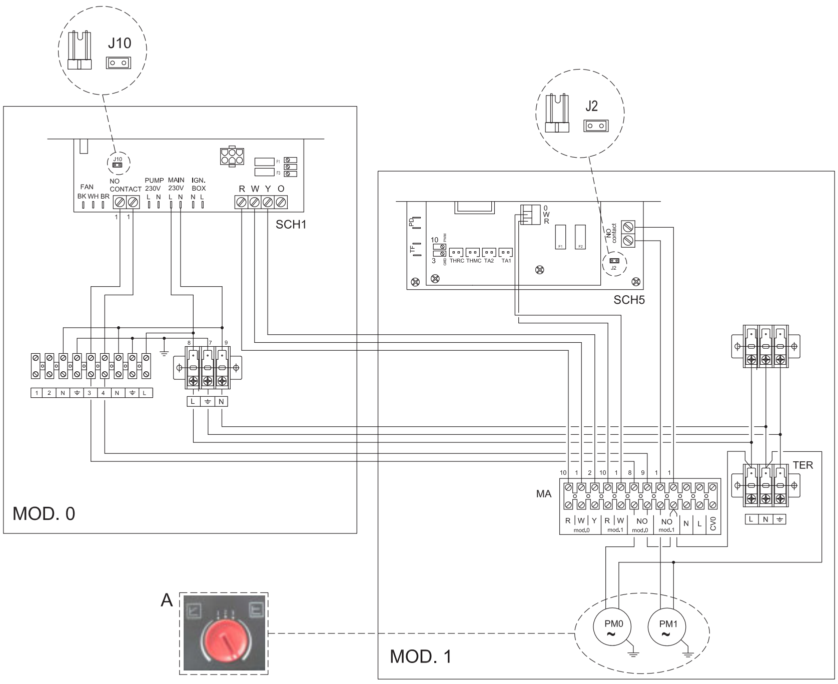
MA Terminal block
MOD.0 GAHP or ACF unit
MOD.1 unit AY00-120
SCH1 electronic board S61
SCH5 electronic boards S70+AY10
TER unit power supply terminal box
J2-J10 control jumpers of system water pumps ("closed")

Figure 3.3 *Gitié package wiring diagram with KIT/2 C0*



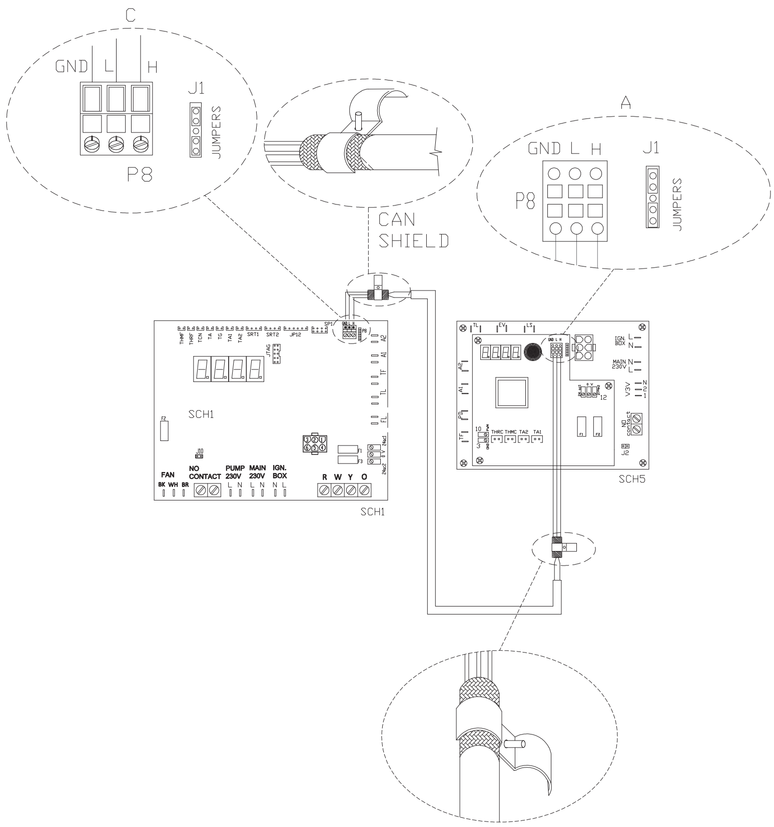
MOD.0 GAHP or ACF unit
MOD.1 unit AY00-120
SCH1 electronic board S61
SCH5 electronic boards S70+AY10
TER unit power supply terminal box
J2-J10 control jumpers of system water pump ("open")
MA connection terminal block
V2V0-V2V1 motorised valves

Figure 3.4 *Gitié package wiring diagram with KIT/2 C1 or with KIT/4 C1*



MOD.0 GAHP or ACF unit
MOD.1 unit AY00-120
SCH1 electronic board S61
SCH5 electronic boards S70+AY10
TER unit power supply terminal box
J2-J10 control jumpers of system water pumps ("closed")
MA connection terminal block
PM0-PM1 system water pumps
A Position of pumps flow rate adjustment screw

Figure 3.5 *CAN connection between AY10 board and S61 (pre-wired in the factory)*



SCH5 electronic board S70+AY10
SCH1 electronic board S61
J1 Jumpers CAN-BUS on AY10 board and S61 board
A terminal node connection - (3 wires; J1 jumpers = "closed")
C terminal node connection - (3 wires; J1 jumpers = "closed")
H,L,GND data signal wires (ref. cables table)

3.7.3 Electrical systems

Electrical connections must provide:

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

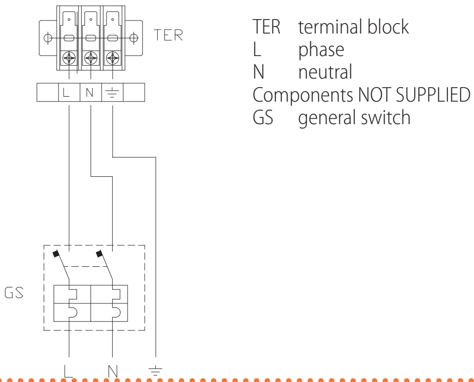
3.7.4 Electrical power supply

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 2 8A type T fuses, (GS) or 1 10A magnetothermic breaker.

Figure 3.6 *Appliance connection to the mains power supply (230V 1N - 50 Hz)*



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

3.7.5 Set-up and control

Control systems, options (1) (2)

Two separate adjustment systems are provided, each with specific features, components and diagrams (see Paragraph 2.4 *p. 5*):

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

Control with DDC

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 device.

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, AY00-120, Gitié, ...) or control device (DDC, RB100, RB200, CCI, ...), 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. 12* (admissible types and maximum distances).

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

Table 3.1 *CAN BUS cables type*

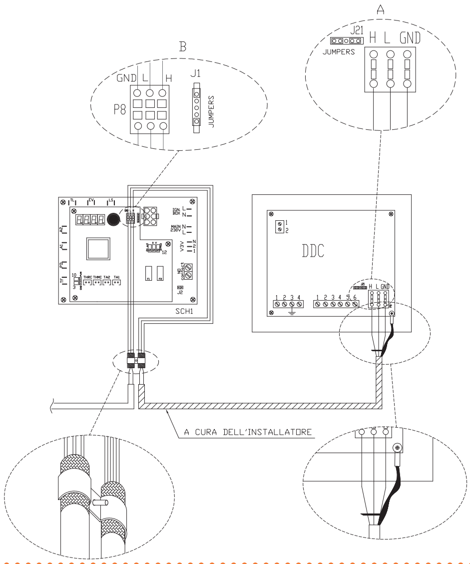
CABLE NAME	SIGNALS / COLOR			MAX LENGTH	Note
Robur					Ordering Code OCVO008
ROBUR NETBUS	H= BLACK	L= WHITE	GND= BROWN	450 m	
Honeywell SDS 1620					In all cases the fourth conductor should not be used
BELDEN 3086A	H= BLACK	L= WHITE	GND= BROWN	450 m	
TURCK type 530					
DeviceNet Mid Cable					
TURCK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

To connect the CAN-BUS cable to the AY10 electronic board, located in the Electrical Panel inside the AY00-120 unit, Picture 3.7 *p. 13*, Details A and B:

1. Access the Electrical Board of the appliance according to the Procedure 3.7.3 *p. 11*);
2. Connect the CAN-BUS cable to terminals GND + L and H (shielding/earthing + two signal conductors) of the AY10 board;
3. Place the Jumper J1, of the AY10 board, OPEN;
4. Connect the DDC to the CAN-BUS cable to terminals GND + L and H (shielding/earthing + two signal conductors) of the DDC;
5. The CAN connection between the AY10 board and the S61 board is pre-wired (Picture 3.8 *p. 13*);

Figure 3.7 *CAN-BUS connection between Gitié and DDC*



DDC Direct Digital Control
SCH5 electronic board S70+AY10
J1 Jumpers CAN-BUS on AY10 board
J21 Jumper CAN-BUS in board DDC
A terminal node connection - (3 wires; J21 jumpers = "closed")
B intermediate node connection - (3 wires; J1 jumpers ="open")
H,L,GND data signal wires (ref. cables table)

Control with external enables

(System (2), see also Paragraph 2.4 *p. 5*).
For each external request to be provided, it is required to arrange:

- request device (e.g. thermostat, clock, button, ...) fitted with a voltage-free NO contact.

How to connect external enables

Connection of external requests is effected on the terminal block located in the Electrical Panel inside the AY00-120 unit.

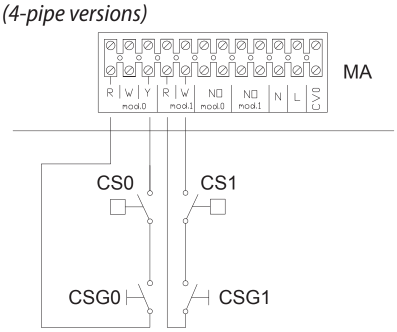
4-pipe versions

Should you wish the enables of the two units to be independent follow the connection diagram shown in Picture 3.8 *p. 13*.
Should you wish the enables of the two units to be separate follow the connection diagram shown in Figure 3.9 *p. 13*.

2-pipe versions

Should you wish the enables of the two units to be separate follow the connection diagram shown in Figure 3.9 *p. 13*.

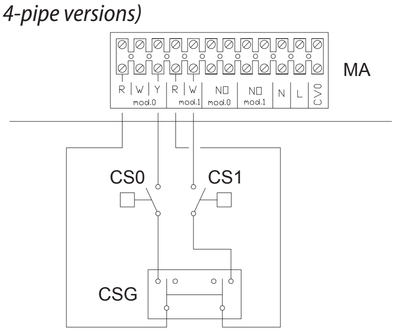
Figure 3.8 *Diagram of independent external enables connection (4-pipe versions)*



MA unit terminal block

Components NOT SUPPLIED
CSG0 cold general enable
CSG1 general hot enable
CS0 GA ACF cold enable
CS1 heating request AY00-120

Figure 3.9 *Diagram of alternated external enables connection (2 and 4-pipe versions)*



MA unit terminal block

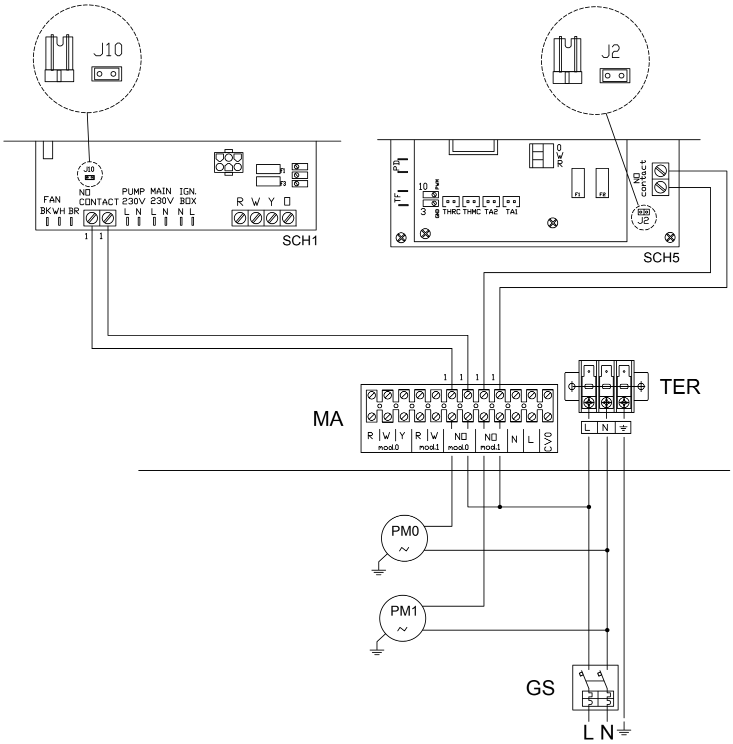
Components NOT SUPPLIED
CSG general enable
CS0 GA ACF cold enable
CS1 heating request AY00-120

3.7.6 Water circulation pumps (versions C0)

System water pumps will be controlled at constant flow.

4-pipe versions

Figure 3.10 *System pump connection diagram Gitié package BASE version (P < 700 W)*



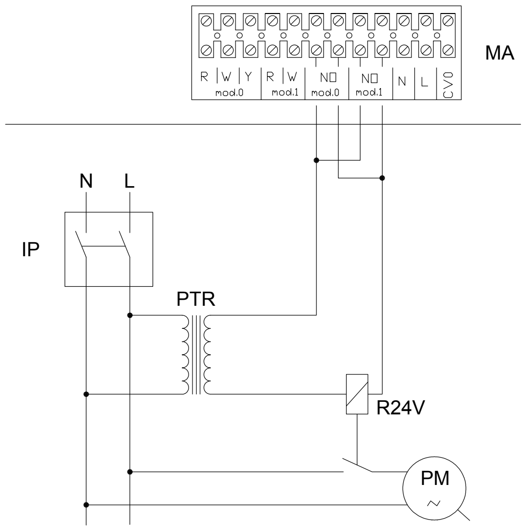
SCH1 electronic board S61
SCH5 electronic boards S70+AY10
MA unit terminal block
J2-J10 control jumpers of system water pumps ("closed")

Components NOT SUPPLIED
PM0 water pump (P < 700 W) unit GAHP or ACF
PM1 water pump (P < 700 W) AY00-120 unit
GS general switch

The diagram in Figure 3.10 *p. 14* is for pumps < 700 W. For pumps > 700 W it is necessary to add a control relay and arrange Jumpers J10 and J2 OPEN.

2-pipe versions

Figure 3.11 *System pump connection diagram Gitié package 2 pipe version (KIT/2 C0)*



MA unit terminal block

Components NOT SUPPLIED
PM water pump
IP two-pole switch
PTR safety transformer SELV
R24V pump control relay

SECTION C INDEX

SECTION C01 INDEX

1 PREMISE

As known, the calculation of the design heat demand of a building (power) provides the winter peak value on which to size the heating system.
In an installation with boiler only, the result of this calculation actually provides sufficient criteria for selecting the boiler.
In the case of absorption heat pumps, correct sizing cannot disregard a more comprehensive system analysis, also involving emission devices, and above all their behaviour at the operating temperatures of heat pumps.
In fact it is essential, for efficient system operation, that the temperatures of terminals are adequate to the specific operative limits of heat pumps, summarised in Table 1.1 *p. 1* below, in particular for return temperatures.

Table 1.1 *GAHP heating temperature limits*

			GAHP A	GAHP-AR	GAHP GS/WS	AY00-120
Heating mode						
Hot water delivery temperature	maximum for heating	°C	65	-	65	-
	maximum	°C	-	60	-	80
Hot water return temperature	maximum for heating	°C	55	-	55	-
	maximum	°C	-	50	-	70

After successfully passing this indispensable check, one should consider a more advanced sizing approach than the mere winter peak power calculation, aimed at optimising the return on the investment.
This approach involves covering with absorption heat pumps only a part of the nominal heating requirements of the building (the so-called “base load”), with integration boilers in charge of covering the remaining share (“peak load”); the limited number of hours per year of operation at peak load in fact, makes the total contribution of the peak negligible in terms of seasonal energy (and therefore in economic terms).
It should be emphasised that absorption heat pumps maintain uninterrupted operation even at extremely low outdoor temperatures. Therefore, the role of supplementary boilers is not that of backup units (as in a "bivalent" system typical of electric heat pumps, i.e. with replacement of the heat pumps below a certain outdoor temperature), but is indeed to integrate the power supplied by the heat pumps, which does not cover the peak load due to a technical-economic design choice.
This different sizing criterion is reflected in the choice of the best compromise between base load and peak load, i.e. the number of heat pumps to be installed in view of the building’s design load.
The assessment is complex and involves a number of parameters, the two main ones being:

- trend of the actual thermal load in the heating season, which in its turn depends on the geographical position of the building to be heated and on its utilisation profile;
- operating temperature of the systems, also in relation to the features of the heat pump model that is intended to be used.

To be able to give some useful indications of a general nature, below is an analysis based on the calculation models provided by European Directive 2009/125/EC and related ErP Regulations (Energy Related Products, 811/2013 in particular), as well as by the European product regulations EN 12309:2014.
The graphs in the following Paragraphs are always in percentage terms with respect to the design power for the building in question (to be determined based on applicable regulations) and therefore are generally valid.
Sizing cases that are placed in intermediate positions between those proposed will be evaluated through appropriate interpolations.

> It is essential to emphasize once again that the proposed sizing criteria is geared to the best economic return on investment in the presence of systems consisting of heat pumps and boilers. However, proper sizing can not ignore a more complete evaluation of the system, which also involves the emission devices, and especially the behavior of the same at the operating temperatures of the heat pumps.

1.1 THE REGULATION 811/2013

Regulation 811/2013 sets forth:

- three climatic zones (warm climate, medium climate and cold climate);
- a building model of reference;
- a typical profile of seasonal temperature trends, in terms of bins. The bins represent the number of hours/year for which the system is intended to operate at a given outdoor temperature.

The three climatic zones are identified by the following conditions of reference:

- Athens for the hot climate (design outdoor temperature 2°C);
- Strasbourg for the medium climate (design outdoor temperature -10°C);
- Helsinki for the cold climate (design outdoor temperature -22°C).

1.2 THE STANDARD EN 12309

For the three climate zones described in Paragraph 1.1 *p. 1*, the system operating temperatures are defined within the product standard EN 12309:2014 according to the distribution system type (underfloor heating, fancoil, radiators,...).
In particular, the standard defines four temperature profiles, each of which may be fixed delivery or variable delivery according to a weather curve as a function of the outdoor temperature (hence of the climate zone)
The four temperature profiles are as follows:

- low temperature, corresponding to a nominal delivery temperature of 35°C;
- medium temperature, corresponding to a nominal delivery temperature of 45°C;
- high temperature, corresponding to a nominal delivery temperature of 55°C;
- high temperature, corresponding to a nominal delivery temperature of 65°C.

> **Pay attention to the terminological misalignment between the definitions in standard EN 12309 and**

Regulation 811/2013

The profile corresponding to 55°C delivery temperature is defined "high temperature" in EN 12309 (as per the list above), while it is defined "medium temperature" in Regulation 811/2013.

2 MEDIUM CLIMATE

Table 2.1 *p. 2* shows the main data obtained from the aforementioned standards, with regards to medium climate (reference Strasbourg, design temperature -10°C).

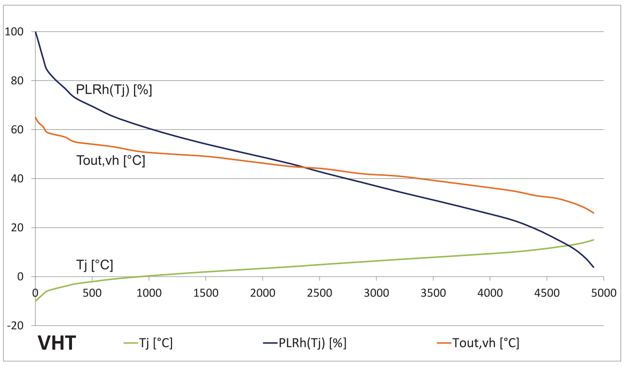
Table 2.1 *Table of medium climate ErP profiles*

Tj [°C]	Hj [h/y]	ΣHj	PLRh(Tj) [%]	Tout,vh [°C]	Tout,h [°C]	Tout,m [°C]	Tout,l [°C]
-10	1	1	100	65	55	45	35
-9	25	26	96	63	54	44	34
-8	23	49	92	62	53	43	34
-7	24	73	88	61	52	43	34
-6	27	100	85	59	50	42	33
-5	68	168	81	58	49	41	33
-4	91	259	77	57	48	41	32
-3	89	348	73	55	47	40	32
-2	165	513	69	54	46	39	31
-1	173	686	65	53	45	39	31
0	240	926	62	51	44	38	30
1	280	1206	58	50	43	37	30
2	320	1526	54	49	42	37	30
3	357	1883	50	47	40	36	29
4	356	2239	46	45	39	35	28
5	303	2542	42	44	38	34	28
6	330	2872	38	42	37	33	27
7	326	3198	35	41	36	33	27
8	348	3546	31	39	34	32	26
9	335	3881	27	37	33	31	25
10	315	4196	23	35	32	30	25
11	215	4411	19	33	31	29	24
12	169	4580	15	32	30	28	24
13	151	4731	12	30	28	27	23
14	105	4836	8	28	27	26	22
15	74	4910	4	26	26	25	22

Tj [°C] = bin outdoor temperature
Hj [h/y] = annual hours of operating at outdoor temperature Tj
ΣHj = cumulative annual hours of operating at temperature equal to or lower than Tj
PLRh(Tj) [%] = system partial load factor at outdoor temperature Tj
Tout,vh [°C] = temperature profile for operating at very high temperature
Tout,h [°C] = temperature profile for operating at high temperature
Tout,m [°C] = temperature profile for operating at medium temperature
Tout,l [°C] = temperature profile for operation at low temperature

The graphs for each temperature profile let one appreciate at a glance the relationship between outdoor temperature, load profile (represented by the power percentage with respect to the nominal design power) and system water flow temperature in relation to the cumulative number of hours of operation of the heating system at a given outdoor temperature Tj, for the climate zone considered.
The choice of this reference axis makes it possible to quickly extract useful information for sizing, as detailed in Paragraph 5 *p. 9*.
For the "very high temperature" profile (VHT) see Figure 2.1 *p. 2*.

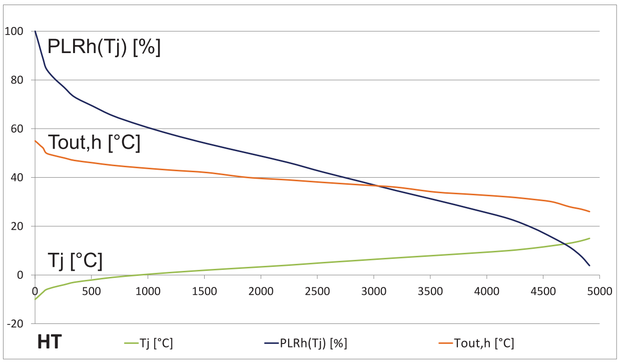
Figure 2.1 *Graph of VHT medium climate ErP profiles*



Tj [°C] bin outdoor temperature
PLRh(Tj) [%] plant partial load ratio at outdoor temperature Tj
Tout,vh [°C] temperature profile for operation at very high temperature

For the "high temperature" profile (HT) see Figure 2.2 *p. 3*.

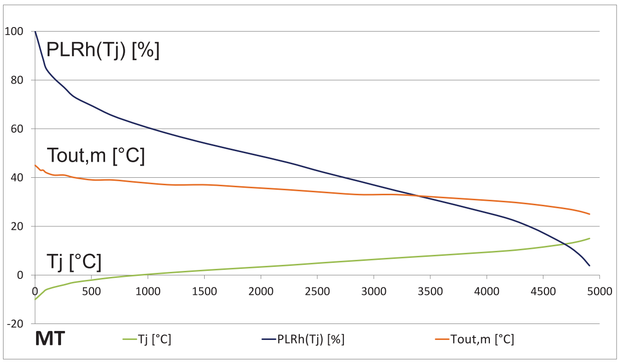
Figure 2.2 *Graph of HT medium climate ErP profiles*



Tj [°C] bin outdoor temperature
PLRh(Tj) [%] plant partial load ratio at outdoor temperature Tj
Tout,h [°C] temperature profile for high temperature operation

For the "medium temperature" profile (MT) see Figure 2.3 *p. 3.*

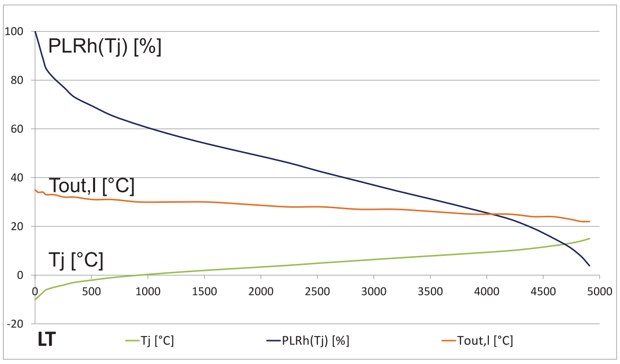
Figure 2.3 *Graph of MT medium climate ErP profiles*



Tj [°C] bin outdoor temperature
PLRh(Tj) [%] plant partial load ratio at outdoor temperature Tj
Tout,m [°C] temperature profile for medium temperature operation

For the "low temperature" profile (LT) see Figure 2.4 *p. 3.*

Figure 2.4 *Graph of LT medium climate ErP profiles*



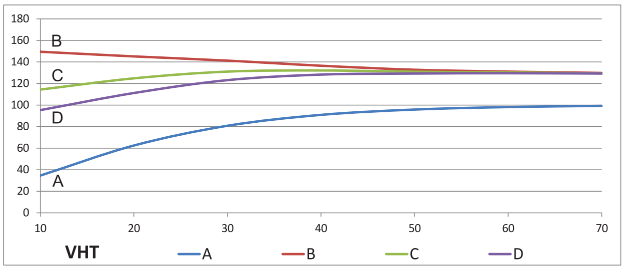
Tj [°C] bin outdoor temperature
PLRh(Tj) [%] plant partial load ratio at outdoor temperature Tj
Tout,h [°C] temperature profile for low temperature operation

For each of the profiles it is possible to determine, on the basis of the power share covered with GAHP with respect to the design power (both referred to design conditions for the climate zone and chosen temperature profile):

- ► The percentage of energy produced with GAHP;
- ► The average seasonal efficiency (SGUE) of the GAHP units alone;
- ► The average seasonal efficiency (SGUE) of the GAHP hybrid system and supplementary condensing boilers;
- ► The average seasonal efficiency (SGUE) of the hybrid system GAHP and existing supplementary boilers (assumed with 80% efficiency).

The following Figures show these data for the medium climate zone and for each of the temperature profiles.
For the "very high temperature" profile (VHT) see Figure 2.5 *p. 3.*

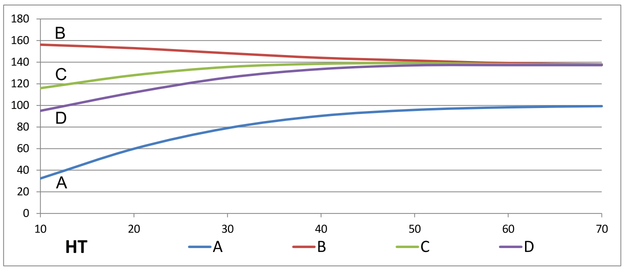
Figure 2.5 *Graph of VHT medium climate ErP energy performance*



In abscissa the power percentage with GAHP compared to the design power (both calculated at conditions A-10W65)
A percentage of energy produced with GAHP
B SGUE (seasonal GUE) GAHP only
C SGUE (seasonal GUE) GAHP and condening boilers
D SGUE (seasonal GUE) GAHP and existing boilers (assumed with 80% efficiency)

For the "high temperature" profile (HT) see Figure 2.6 *p. 3.*

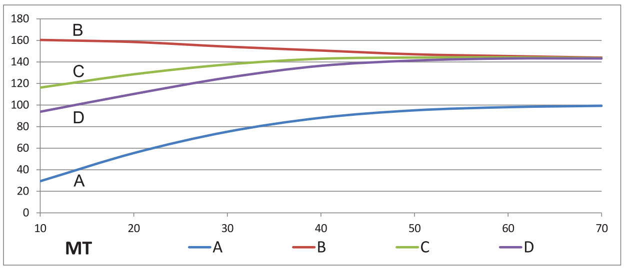
Figure 2.6 *Graph of HT medium climate ErP energy performance*



In abscissa the power percentage with GAHP compared to the design power (both calculated at conditions A-10W55)
A percentage of energy produced with GAHP
B SGUE (seasonal GUE) GAHP only
C SGUE (seasonal GUE) GAHP and condening boilers
D SGUE (seasonal GUE) GAHP and existing boilers (assumed with 80% efficiency)

For the "medium temperature" profile (MT) see Figure 2.7 *p. 4.*

Figure 2.7 *Graph of MT medium climate ErP energy performance*

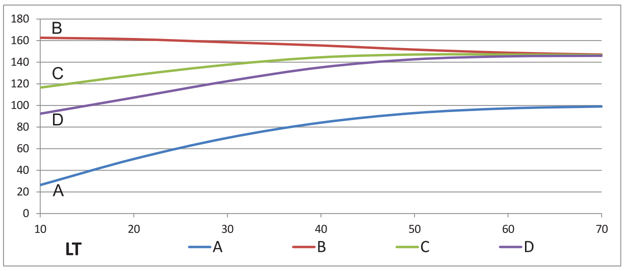


In abscissa the power percentage with GAHP compared to the design power (both calculated at conditions A-10W45)

A percentage of energy produced with GAHP
B SGUE (seasonal GUE) GAHP only
C SGUE (seasonal GUE) GAHP and condening boilers
D SGUE (seasonal GUE) GAHP and existing boilers (assumed with 80% efficiency)

For the "low temperature" profile (LT) see Figure 2.8 *p. 4*.

Figure 2.8 *Graph of LT medium climate ErP energy performance*



In abscissa the power percentage with GAHP compared to the design power (both calculated at conditions A-10W35)

A percentage of energy produced with GAHP
B SGUE (seasonal GUE) GAHP only
C SGUE (seasonal GUE) GAHP and condening boilers
D SGUE (seasonal GUE) GAHP and existing boilers (assumed with 80% efficiency)

3 HOT CLIMATE

Table 3.1 *p. 4* shows the main data obtained from the aforementioned standards, with regards to hot climate (reference Athens, design temperature +2°C).

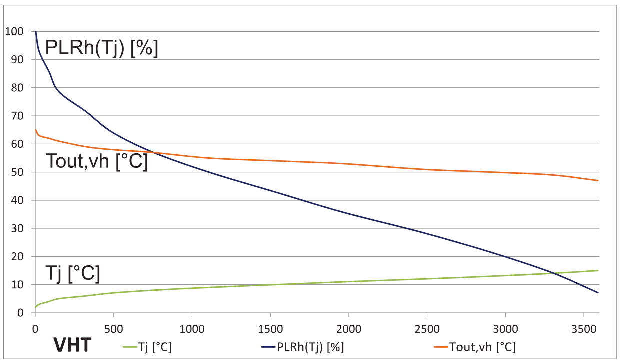
Table 3.1 *Table of hot climate ErP profiles*

Tj [°C]	Hj [h/y]	ΣHj	PLRh(Tj) [%]	Tout,vh [°C]	Tout,h [°C]	Tout,m [°C]	Tout,l [°C]
2	3	3	100	65	55	45	35
3	22	25	93	62	53	43	34
4	63	88	86	60	51	42	33
5	63	151	79	57	49	41	32
6	175	326	71	55	47	40	31
7	162	488	64	53	46	39	31
8	259	747	57	50	43	37	30
9	360	1107	50	47	41	35	29
10	428	1535	43	44	38	34	28
11	430	1965	36	41	36	32	27
12	503	2468	29	39	34	31	26
13	444	2912	21	36	31	29	25
14	384	3296	14	33	29	27	24
15	294	3590	7	30	26	26	23

Tj [°C] = bin outdoor temperature
Hj [h/y] = annual hours of operating at outdoor temperature Tj
ΣHj = cumulative annual hours of operating at temperature equal to or lower than Tj
PLRh(Tj) [%] = system partial load factor at outdoor temperature Tj
Tout,vh [°C] = temperature profile for operating at very high temperature
Tout,h [°C] = temperature profile for operating at high temperature
Tout,m [°C] = temperature profile for operating at medium temperature
Tout,l [°C] = temperature profile for operation at low temperature

The graphs for each temperature profile let one appreciate at a glance the relationship between outdoor temperature, load profile (represented by the power percentage with respect to the nominal design power) and system water flow temperature in relation to the cumulative number of hours of operation of the heating system at a given outdoor temperature Tj, for the climate zone considered.
The choice of this reference axis makes it possible to quickly extract useful information for sizing, as detailed in Paragraph 5 *p. 9*.
For the "very high temperature" profile (VHT) see Figure 3.1 *p. 5*.

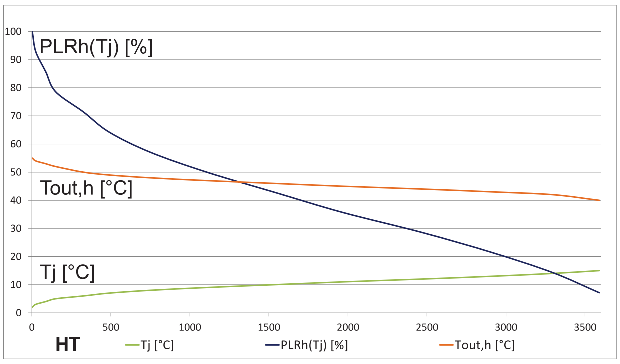
Figure 3.1 *Graph of VHT hot climate ErP profiles*



Tj [°C] bin outdoor temperature
PLRh(Tj) [%] plant partial load ratio at outdoor temperature Tj
Tout,vh [°C] temperature profile for operation at very high temperature

For the "high temperature" profile (HT) see Figure 3.2 *p. 5*.

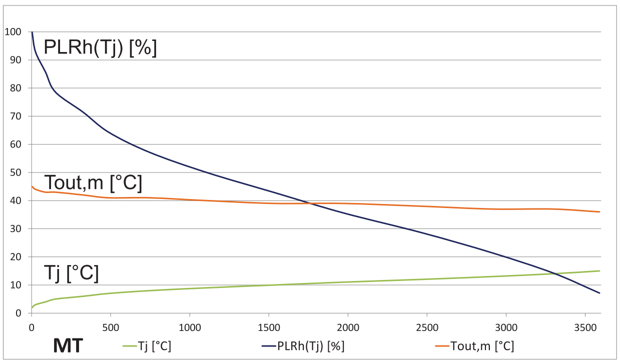
Figure 3.2 *Graph of HT hot climate ErP profiles*



Tj [°C] bin outdoor temperature
PLRh(Tj) [%] plant partial load ratio at outdoor temperature Tj
Tout,h [°C] temperature profile for high temperature operation

For the "medium temperature" profile (MT) see Figure 3.3 *p. 5*.

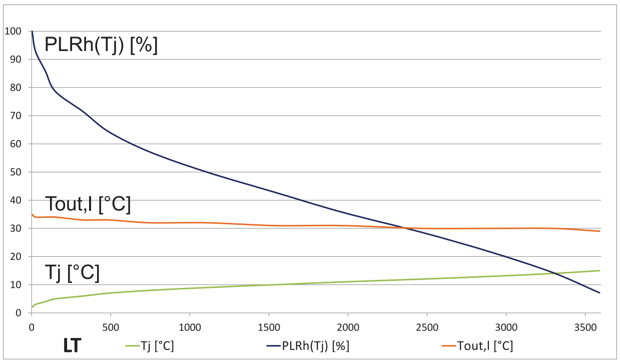
Figure 3.3 *Graph of MT hot climate ErP profiles*



Tj [°C] bin outdoor temperature
PLRh(Tj) [%] plant partial load ratio at outdoor temperature Tj
Tout,m [°C] temperature profile for medium temperature operation

For the "low temperature" profile (LT) see Figure 3.4 *p. 5*.

Figure 3.4 *Graph of LT hot climate ErP profiles*



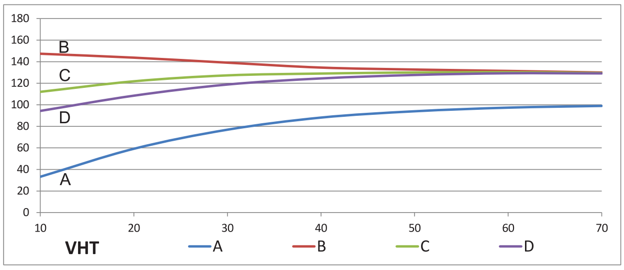
Tj [°C] bin outdoor temperature
PLRh(Tj) [%] plant partial load ratio at outdoor temperature Tj
Tout,h [°C] temperature profile for low temperature operation

For each of the profiles it is possible to determine, on the basis of the power share covered with GAHP with respect to the design power (both referred to design conditions for the climate zone and chosen temperature profile):

- The percentage of energy produced with GAHP;
- The average seasonal efficiency (SGUE) of the GAHP units alone;
- The average seasonal efficiency (SGUE) of the GAHP hybrid system and supplementary condensing boilers;
- The average seasonal efficiency (SGUE) of the hybrid system GAHP and existing supplementary boilers (assumed with 80% efficiency).

The following Figures show these data for the medium climate zone and for each of the temperature profiles.
For the "very high temperature" profile (VHT) see Figure 3.5 *p. 5*.

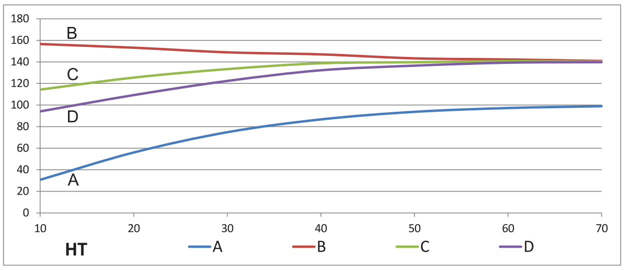
Figure 3.5 *Graph of VHT hot climate ErP energy performance*



In abscissa the power percentage with GAHP compared to the design power (both calculated at conditions A2W65)
A percentage of energy produced with GAHP
B SGUE (seasonal GUE) GAHP only
C SGUE (seasonal GUE) GAHP and condening boilers
D SGUE (seasonal GUE) GAHP and existing boilers (assumed with 80% efficiency)

For the "high temperature" profile (HT) see Figure 3.6 *p. 6*.

Figure 3.6 *Graph of HT hot climate ErP energy performance*

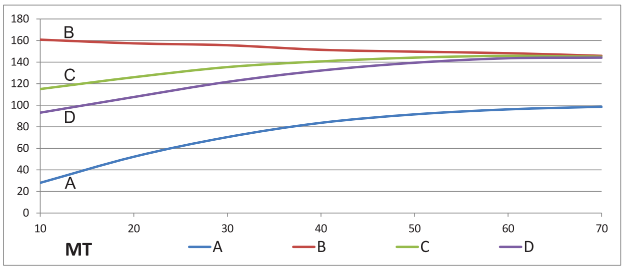


In abscissa the power percentage with GAHP compared to the design power (both calculated at conditions A2W55)

A percentage of energy produced with GAHP
B SGUE (seasonal GUE) GAHP only
C SGUE (seasonal GUE) GAHP and condening boilers
D SGUE (seasonal GUE) GAHP and existing boilers (assumed with 80% efficiency)

For the "medium temperature" profile (MT) see Figure 3.7 *p. 6.*

Figure 3.7 *Graph of MT hot climate ErP energy performance*

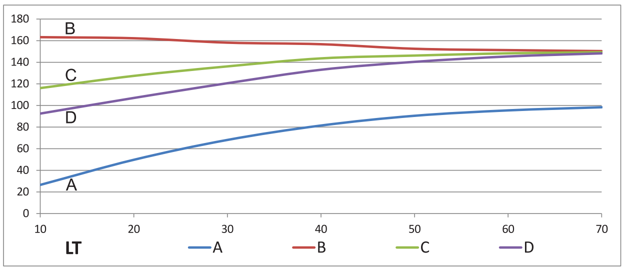


In abscissa the power percentage with GAHP compared to the design power (both calculated at conditions A2W45)

A percentage of energy produced with GAHP
B SGUE (seasonal GUE) GAHP only
C SGUE (seasonal GUE) GAHP and condening boilers
D SGUE (seasonal GUE) GAHP and existing boilers (assumed with 80% efficiency)

For the "low temperature" profile (LT) see Figure 3.8 *p. 6.*

Figure 3.8 *Graph of LT hot climate ErP energy performance*



In abscissa the power percentage with GAHP compared to the design power (both calculated at conditions A2W35)

A percentage of energy produced with GAHP
B SGUE (seasonal GUE) GAHP only
C SGUE (seasonal GUE) GAHP and condening boilers
D SGUE (seasonal GUE) GAHP and existing boilers (assumed with 80% efficiency)

4 COLD CLIMATE

Table 4.1 *p. 7* shows the main data obtained from the aforementioned standards, with regards to cold climate (reference Helsinki, design temperature -22°C).

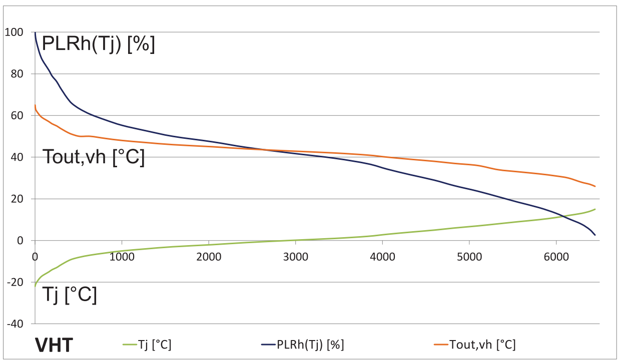
Table 4.1 *Table of cold climate ErP profiles*

Tj [°C]	Hj [h/y]	ΣHj	PLRh(Tj) [%]	Tout,vh [°C]	Tout,h [°C]	Tout,m [°C]	Tout,l [°C]
-22	1	1	100	65	55	45	35
-21	6	7	97	63	54	44	34
-20	13	20	95	62	53	43	34
-19	17	37	92	61	52	43	33
-18	19	56	89	60	51	42	33
-17	26	82	87	59	50	42	32
-16	39	121	84	58	49	41	32
-15	41	162	82	57	49	41	32
-14	35	197	79	56	48	40	31
-13	52	249	76	55	47	40	31
-12	37	286	74	54	47	39	31
-11	41	327	71	53	46	39	31
-10	43	370	68	52	45	39	30
-9	54	424	66	51	45	38	30
-8	90	514	63	50	44	38	30
-7	125	639	61	50	44	38	30
-6	169	808	58	49	43	37	29
-5	195	1003	55	48	42	36	29
-4	278	1281	53	47	41	36	29
-3	306	1587	50	46	40	35	28
-2	454	2041	47	45	40	35	28
-1	385	2426	45	44	39	34	28
0	490	2916	42	43	38	34	27
1	533	3449	39	42	37	33	27
2	380	3829	37	41	37	33	27
3	228	4057	34	40	36	32	26
4	261	4318	32	39	35	31	26
5	279	4597	29	38	34	31	25
6	229	4826	26	37	33	30	25
7	269	5095	24	36	32	30	25
8	233	5328	21	34	31	29	24
9	230	5558	18	33	30	28	24
10	243	5801	16	32	29	27	24
11	191	5992	13	31	28	26	24
12	146	6138	11	30	28	26	24
13	150	6288	8	28	27	25	23
14	97	6385	5	27	26	24	23
15	61	6446	3	26	25	23	23

Tj [°C] = bin outdoor temperature
Hj [h/y] = annual hours of operating at outdoor temperature Tj
ΣHj = cumulative annual hours of operating at temperature equal to or lower than Tj
PLRh(Tj) [%] = system partial load factor at outdoor temperature Tj
Tout,vh [°C] = temperature profile for operating at very high temperature
Tout,h [°C] = temperature profile for operating at high temperature
Tout,m [°C] = temperature profile for medium temperature operating
Tout,l [°C] = temperature profile for operation at low temperature

The graphs for each temperature profile let one appreciate at a glance the relationship between outdoor temperature, load profile (represented by the power percentage with respect to the nominal design power) and system water flow temperature in relation to the cumulative number of hours of operation of the heating system at a given outdoor temperature Tj, for the climate zone considered.
The choice of this reference axis makes it possible to quickly extract useful information for sizing, as detailed in Paragraph 5 *p. 9*.
For the "very high temperature" profile (VHT) see Figure 4.1 *p. 7*.

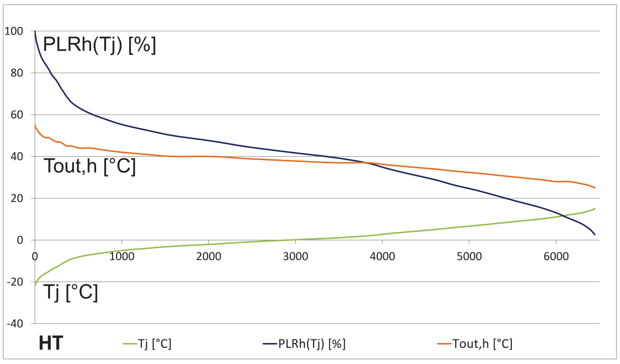
Figure 4.1 *Graph of VHT cold climate ErP profiles*



Tj [°C] bin outdoor temperature
PLRh(Tj) [%] plant partial load ratio at outdoor temperature Tj
Tout,vh [°C] temperature profile for operation at very high temperature

For the "high temperature" profile (HT) see Figure 4.2 *p. 8*.

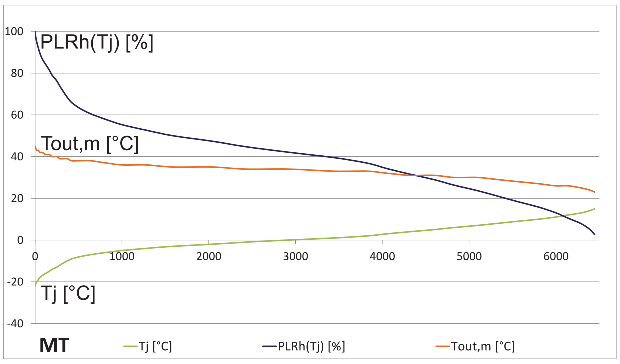
Figure 4.2 *Graph of HT cold climate ErP profiles*



Tj [°C] bin outdoor temperature
PLRh(Tj) [%] plant partial load ratio at outdoor temperature Tj
Tout,h [°C] temperature profile for high temperature operation

For the "medium temperature" profile (MT) see Figure 4.3 *p. 8*.

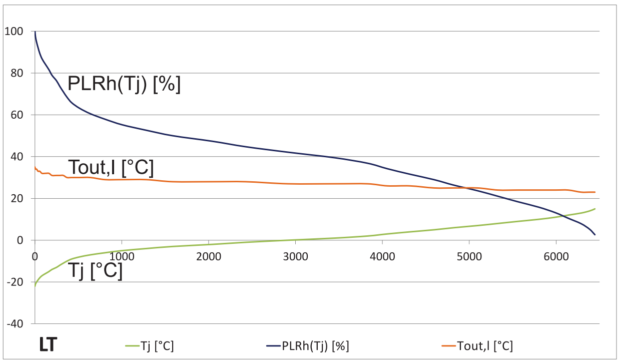
Figure 4.3 *Graph of MT cold climate ErP profiles*



Tj [°C] bin outdoor temperature
PLRh(Tj) [%] plant partial load ratio at outdoor temperature Tj
Tout,m [°C] temperature profile for medium temperature operation

For the "low temperature" profile (LT) see Figure 4.4 *p. 8*.

Figure 4.4 *Graph of LT cold climate ErP profiles*



Tj [°C] bin outdoor temperature
PLRh(Tj) [%] plant partial load ratio at outdoor temperature Tj
Tout,h [°C] temperature profile for low temperature operation

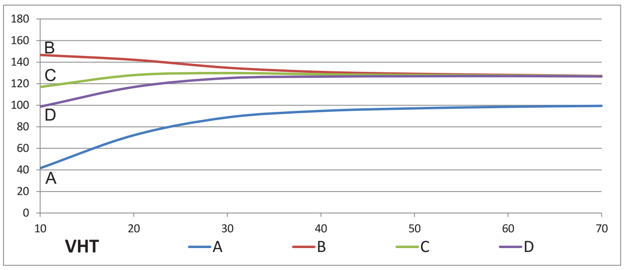
For each of the profiles it is possible to determine, on the basis of the power share covered with GAHP with respect to the design power (both referred to design conditions for the climate zone and chosen temperature profile):

- The percentage of energy produced with GAHP;
- The average seasonal efficiency (SGUE) of the GAHP units alone;
- The average seasonal efficiency (SGUE) of the GAHP hybrid system and supplementary condensing boilers;
- The average seasonal efficiency (SGUE) of the hybrid system GAHP and existing supplementary boilers (assumed with 80% efficiency).

The following Figures show these data for the medium climate zone and for each of the temperature profiles.

For the "very high temperature" profile (VHT) see Figure 4.5 *p. 8*.

Figure 4.5 *Graph of VHT cold climate ErP energy performance*

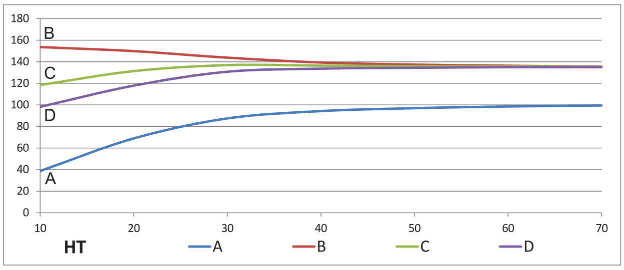


In abscissa the power percentage with GAHP compared to the design power (both calculated at A-22W65 conditions)

A percentage of energy produced with GAHP
B SGUE (seasonal GUE) GAHP only
C SGUE (seasonal GUE) GAHP and condening boilers
D SGUE (seasonal GUE) GAHP and existing boilers (assumed with 80% efficiency)

For the "high temperature" profile (HT) see Figure 4.6 *p. 8*.

Figure 4.6 *Graph of HT cold climate ErP energy performance*

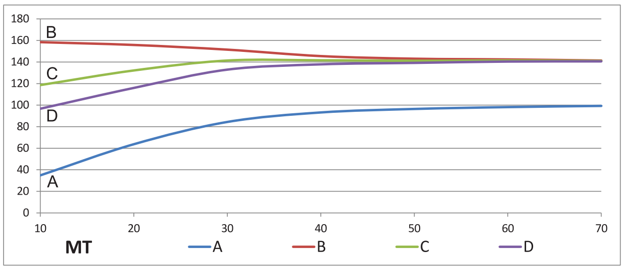


In abscissa the power percentage with GAHP compared to the design power (both calculated at A-22W55 conditions)

A percentage of energy produced with GAHP
B SGUE (seasonal GUE) GAHP only
C SGUE (seasonal GUE) GAHP and condening boilers
D SGUE (seasonal GUE) GAHP and existing boilers (assumed with 80% efficiency)

For the "medium temperature" profile (MT) see Figure 4.7 *p. 9*.

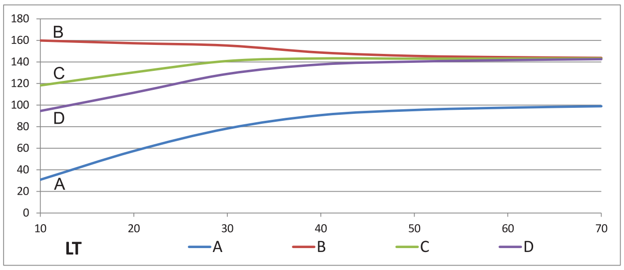
Figure 4.7 *Graph of MT cold climate ErP energy performance*



In abscissa the power percentage with GAHP compared to the design power (both calculated at A-22W45 conditions)

- A percentage of energy produced with GAHP
- B SGUE (seasonal GUE) GAHP only
- C SGUE (seasonal GUE) GAHP and condening boilers
- D SGUE (seasonal GUE) GAHP and existing boilers (assumed with 80% efficiency)

Figure 4.8 *Graph of LT cold climate ErP energy performance*



In abscissa the power percentage with GAHP compared to the design power (both calculated at A-22W35 conditions)

- A percentage of energy produced with GAHP
- B SGUE (seasonal GUE) GAHP only
- C SGUE (seasonal GUE) GAHP and condening boilers
- D SGUE (seasonal GUE) GAHP and existing boilers (assumed with 80% efficiency)

For the "low temperature" profile (LT) see Figure 4.8 *p. 9*.

5 SIZING EXAMPLES

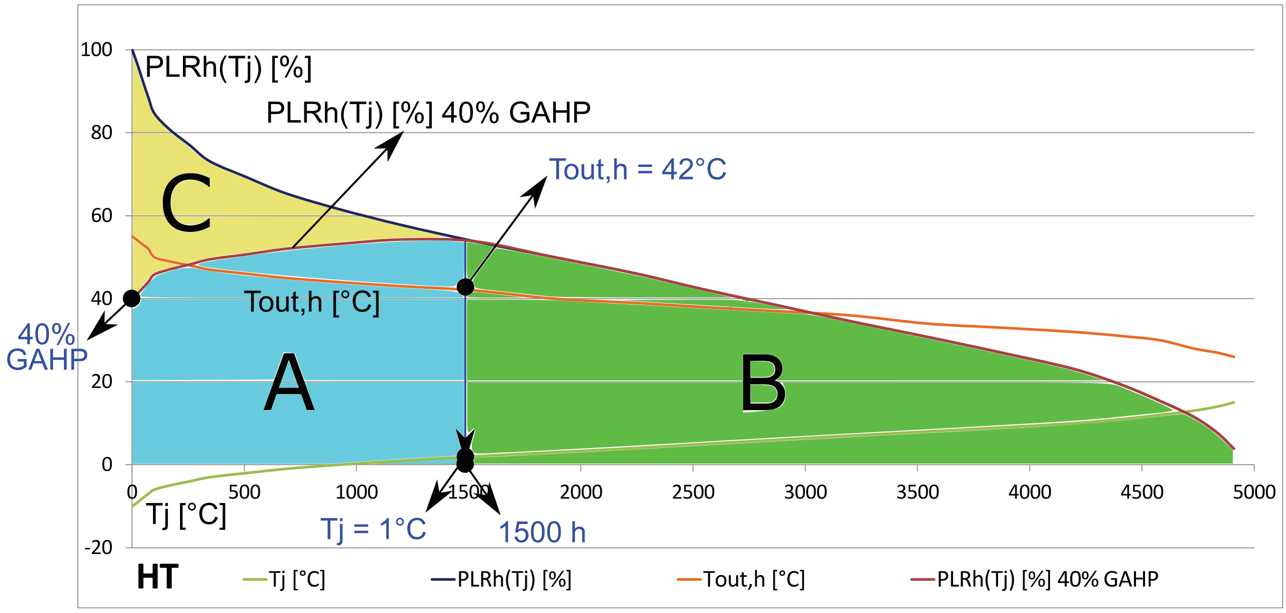
The graphs set out in the previous Paragraphs may be used to obtain useful sizing informations, specifically for the selection of the threshold between base load and peak load (proportion to be covered with heat pumps with respect to design power).

Taking Figure 2.2 *p. 3* and related Figure 2.6 *p. 3* as an example, we assume said threshold between base load and peak load to be set at 40%, i.e. to cover with GAHP 40% of the design power (calculated exactly at the design conditions for the medium climate with HT temperature profile, i.e. A-10W55).

Specifically, in the Figure 5.1 *p. 10* you see how if in case in hypothesis you have:

- ► The GAHP system (which has operating priority) is at full power for about 1500 h (area A, in blue). In this period, the supplementary boilers power will be modulated to keep up with the building load (area C, in yellow);
- ► For the remaining hours the GAHP system will operate in capacity control (area B, in green), autonomously covering the building load (supplementary boilers off);
- ► The outdoor temperature Tj corresponding to the transition between base and peak load (i.e. the transition temperature between GAHP full power operation and capacity control operation) is equal to 1°C;
- ► The outdoor temperature Tj below which the supplementary boilers are turned on (GAHP still on at full power) is equal to 1°C;
- ► The delivery temperature Tout,h corresponding to the transition between base and peak is equal to 42°C;
- ► The delivery temperature Tout,h corresponding to turning on the supplementary boilers is equal to 42°C;

Figure 5.1 *Example of 40% sizing of design load with GAHP*



Tj [°C] bin outdoor temperature
PLRh(Tj) [%] plant partial load ratio at outdoor temperature Tj
PLRh(Tj) [%] 40% GAHP partial load factor covered by GAHP assuming 40% power with GAHP with respect to total design power
Tout,h [°C] temperature profile for high temperature operation
A GAHP operating area at full load
B GAHP operating area at partial load
C integration boilers operating area

By examining the comparison between the sum of areas A and B, which represents the amount of energy covered by the GAHP units, and the total area underneath the blue PLRh(Tj) curve one immediately sees how the energy share actually covered by the GAHP units is decidedly greater than 40% of the mere power sizing.

The data set out in Figure 2.6 *p. 3* may be used to obtain further useful data for assessing optimal sizing.

From the Fgure we can in fact realize that under these conditions:

- The GAHP units would cover about 90% of the building energy needs
- The average seasonal efficiency (SGUE) of the GAHP units alone is equal to 144%
- The average seasonal efficiency (SGUE) of the GAHP hybrid system and asupplementary condensing boilers is equal to 139%
- The average seasonal efficiency (SGUE) of the GAHP hybrid system and existing supplementary boilers (assumed with 80% efficiency) is equal to 134%

With this methodology it is therefore possible to calculate the energy share covered by the GAHP units as a function of the base/peak load share (calculated as percentage with respect to the design power), but also assess the expected average efficiency both for the GAHP units alone and for hybrid systems, either with condensing boilers or with the existing boilers.

Therefore, having established the base/peak threshold value that optimises the investment, one may infer the number of required GAHP units for the system from the building design load by dividing it by the power yielded by the individual GAHP under the same design conditions (minimum outdoor temperature of the climate zone and relevant heating water delivery temperature).

Naturally, the calculation is discreet by its nature, i.e. the result must then be adapted to a whole number of GAHP units.

Intuitively, one may understand how, in colder climates, a higher number of GAHP units is required to cover the same power share, conversely, a lower number is sufficient in warmer climates.

6 IN SUMMARY

From the above in the preceding paragraphs, the following sizing criterion can be drawn, valid in general terms:

- The optimal nominal thermal power share to be covered with GAHP units is between 30% and 40%;
- In the presence of warm climates and low delivery water temperatures it is recommended to move about 40%;
- In the presence of rigid climates and high flow temperatures it is recommended to move about 30%.

1 SPECIFICATION OF SUPPLY

The RT_ Links are gas powered (natural gas or LPG) heating/cooling sets, to supply hot and/or chilled water. Each group consists of a certain number of individual gas powered modules/heating/cooling appliances (GAHP/GA/AY units). The set of appliances and components is preassembled at the factory, forming a complete hydronic group already predisposed to be simply connected to the system.

1.1 APPLICATION

Each preassembled group according to its configuration (RTAR, RTCF, RTY, RTAY, RTYR, RTA, ... Link) is able to simultaneously or alternatively deliver heating, cooling, DHW production and heat recovery, according to the needs of each single installation, with a significantly extensive range of heating and cooling power. The various hydronic models (RTAR, RTCF, ... Link) are suitable for all heating and cooling systems operating with hot and/or chilled water, with common terminals (e.g. radiators, fan coils, radiant panels, fan heaters, air handling units, DHW production boilers, pool heat exchangers...), including process plants (industrial heat exchangers).

1.2 COMPOSITION (GAHP/GA/AY MODULES)

The gas heating/cooling modules that make up a Link RT_ can be:

- GAHP units, A/AR/GS/WS versions, absorption heat pumps;
- GAHP units, A/AR/GS/WS versions, absorption chillers;
- AY unit, condensing boiler.

distinguished in:

- aerothermal units (A, AR, ACF, HR, TK, LB);
- hydrothermal (WS) and geothermal (GS) units.

in variable number:

- from 2 to 5 in the case of GAHP/GA only
- from 2 to 8 in the case of GAHP/GA and AY

Groups with aerothermal units must be installed exclusively outside, while others may be installed either indoors or outdoors.
The aerothermal modules of RT_ Links may be in configuration:

- with standard fans (STD);
- with silenced fans (SIL or S1).

1.3 CONFIGURATIONS

- without circulators or with circulators (standard or oversize circulators);
- 2, 4 or 6 pipes, ie 1, 2 or 3 pairs of delivery/return hydraulic collectors/connections for hot and/or cold water, connected as needed.

1.4 SPECIFICATION OF SUPPLY

The specifications sheets of the individual units making up the preassembled group are set out in Section B, divided by product.
The preassembled group composition is available:

- on the online configurator (from the portal Robur);
- in the documentation supplied with the commercial offer;
- on demand from the presale service or sales network.

The composition of the preassembled group is identified by its code, as detailed in Paragraph 1.7 *p. 1*.

To be specified in drawing up the chapter

- The preassembled group composition;
- The detail of any versions of the units making up the group, if several versions are available;
- The circulating pump configuration (included *or* not, standard *or* oversized type);
- For aerothermal preassembled groups, the choice of standard *or* silenced fans (SIL or S1).

1.5 MANUFACTURING FEATURES

Each preassembled group, in addition to the GAHP/GA/AY heating/cooling modules/units gas powered, is composed of:

- delivery/return stainless steel hydraulic manifolds, insulated with rigid cups lined with aluminum sheet;
- galvanized steel gas outlet manifold;
- flexible connecting couplings of individual units to hydraulic and gas manifolds;
- condensate discarge manifold (only if A/GS/WS/AY condensing appliances are included);
- electrical panel with protection devices (2 electrical panels with more than 5-6 modules);
- bearing structure with galvanized steel sections.

Table 2.1 *p. 14* shows the connection diameters for the connecting piping of the preassembled group.

1.6 CIRCULATING PUMPS

1.6.1 Preassembled groups without water circulation pumps

If the RT_ Link is without circulating pumps, at least one circulation pump must be installed on the water/primary circuit, appropriately selected and rated.

Preassembled groups with water circulation pumps

In the RT_ links already provided with circulators, each individual GAHP/GA/AY module that is part of the group has (at least) an independent single circulator.
The available head at the hydraulic connections of the preassembled group should be considered net of internal pressure drops, in the units and in the hydraulic manifolds.
The Table 2.2 *p. 14* provides the minimum residual head to the nominal flow in the maximum configuration.
For more detailed flow, head and load loss data see Pargraph 2.6.2 *p. 14*.

1.7 CODING

Each group is encoded with a series of letters and digits that distinguish its composition and configuration. In order:

1. (3 or 4 letters) = group type (eg RTAR, RTCF, RTAY, RTA, RTY, ...), based on composing modules (GAHP A/AR/WS/GS, GA ACF/HR/TK/LB, AY00-120;
2. (2 or 3 digits) = cold power, given by the sum of the cold powers of the individual modules;
3. (2 or 3 digits) = heat power, given by the sum of the heat powers of the individual modules;
4. (_, /4 or /6) = number of pipes, ie delivery/return manifold pairs (1, 2 or 3);
5. (2 letters) = modules type;
6. (_, S, S1) = standard or silenced fans (only for aerothermal units);
7. (MET/NAT, G25, GPL/LPG) = fuel gas (natural gas or LPG);
8. (2 or 3 letters) = nationality;
9. (2 letters) circulators (with or without) and type (standard or oversize);

10. (1 letter) predispositions, if any.

The 1.1 *p. 2* table/figure exemplifies the meaning of the encoding in detail, providing the key for reading any possible composition and configuration, starting from an example.

Figure 1.1

1	2	3	4	5	6	7	8	9	10	<-- CAMPO/FIELD
RTRH	118	312	/6	HR	S	MET/NAT	ITA	VW		<-- NOME/LINK NAME

10 – Predisposizione

descrizione	unità e/o serbatoio
	NESSUNA Predisposizione
A	A
B	ACF
B	AR
C	HR
D	AY
E	HR+AY
F	ACF+AY
F	AR+AY
G	A+AY
J	SERB.200
K	SERB.300
O	OUTDOOR GS/WS

9 – VW – Configurazione / Configuration

descrizione	Tipo circolatore		
	senza HR	con HR, GS, WS	
	lato C/F	lato C/F	lato II°
SC	senza	-	-
CV	standard	-	-
CW	maggior.	-	-
NN	-	senza	senza
VN	-	standard	senza
VV	-	standard	standard
VW	-	standard	maggior.
WN	-	maggior.	senza
WV	-	maggior.	standard
WW	-	maggior.	maggior.

8 – ITA – Mercato/Destinazione

	Paese
ITA	Italia/Italy
DE	Germania/Germany
CH	Svizzera
AT	Austria
FR	Francia/France
KR	Croazia
ES	Spagna/Spain
UK	Inghilterra/United Kingdom
BE	Belgio
NL	Olanda

7 – MET/NAT – Alimentazione / Gas supply

descrizione	Tipo gas
MET/NAT	Metano (G20)
G25	Metano (G25)
GPL/LPG	GPL/LPG

6 – S – Ventilazione

descrizione	Motoventilante
	standard
S o S1	silenziata

5 – HR – Versione / Version

descrizione	Tipo Unità/Unit
	AR, ACF STD, AY
TK	ACF TK
LB	ACF LB
HR	ACF HR
HT	ACF HT
HT	GAHP HT
LT	GAHP LT

4 – /6 – Tipo / Type

descrizione	N° Tubi
	2 tubi
/4	4 tubi
/6	4+2 (HR+AY)

3 – 312 – Calorie Caldo

calorie	UNIT'/UNIT
0	ACF
72	HR
120	AR
133	A-HT
141	A-LT
120	AY
142	WS
128	GS-HT
145	GS-LT

2 – Calorie Freddo

calorie	UNIT'/UNIT
60	ACF
60	HR
58	AR
0	A, GS, WS, AY

1 – RTRH – Serie/Codice / Serie/Code

SERIE	Codice	Composizione
RTAR	F-GAR	multiple di AR
RTCF	F-GCF	multiple di ACF
RTY	F-YYC	multiple di AY
RTRH	F-HRY	HR-AR-AY
RTAH	F-HAR	HR-AR
RTRC	F-FRY	AR-ACF-AY
RTCR	F-ARC	AR-ACF
RTYR	F-ARY	AR-AY
RTYH	F-HFY	HR-ACF-AY
RTHF	F-HCH	HR-ACF
RTYF	F-GFY	ACF-AY
RTAY	F-AAY	A-AY
...	...	...

2 FEATURES AND TECHNICAL DATA

For the features of the individual modules/appliances (GAHP/GA/AY units) that are part of the RT_ Link refer to Section B.

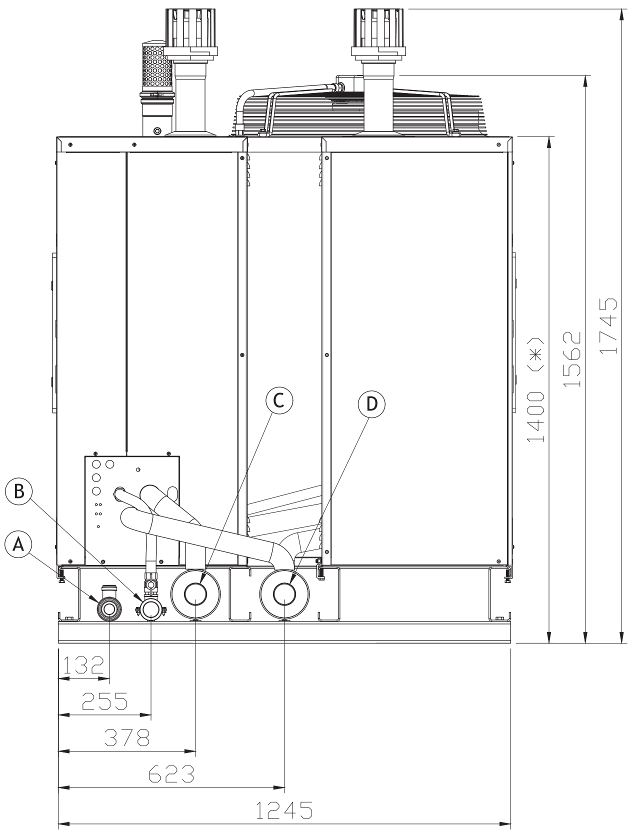
2.1 DIMENSIONS AND WEIGHTS

The dimensions are given for the maximum footprint configuration.

The weights are given for the maximum weight configuration.

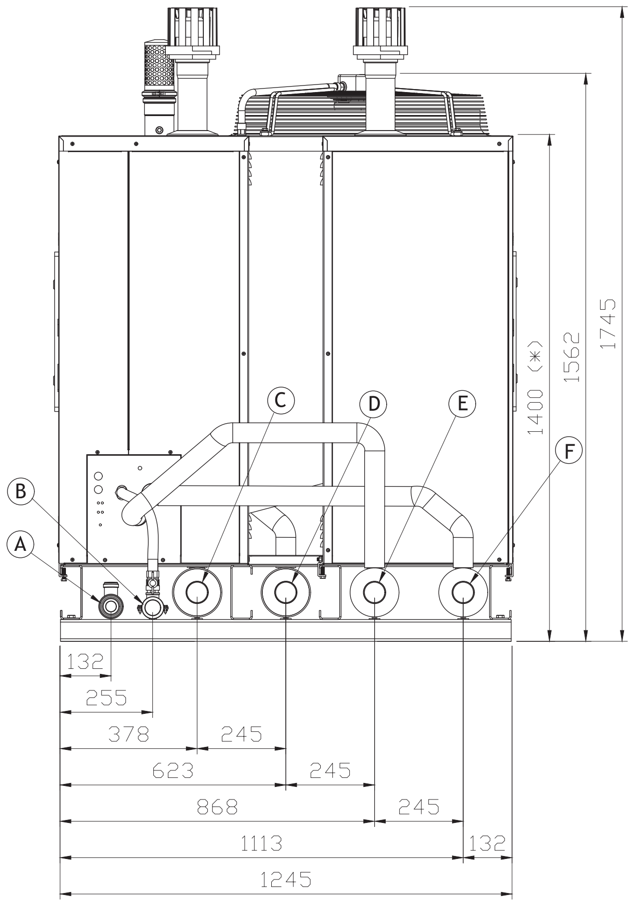
2.1.1 Hydraulic/gas connections

Figure 2.1 *Water, gas and condensate discharge fittings position, for 2 pipes groups - Right side view (dimensions in mm)*



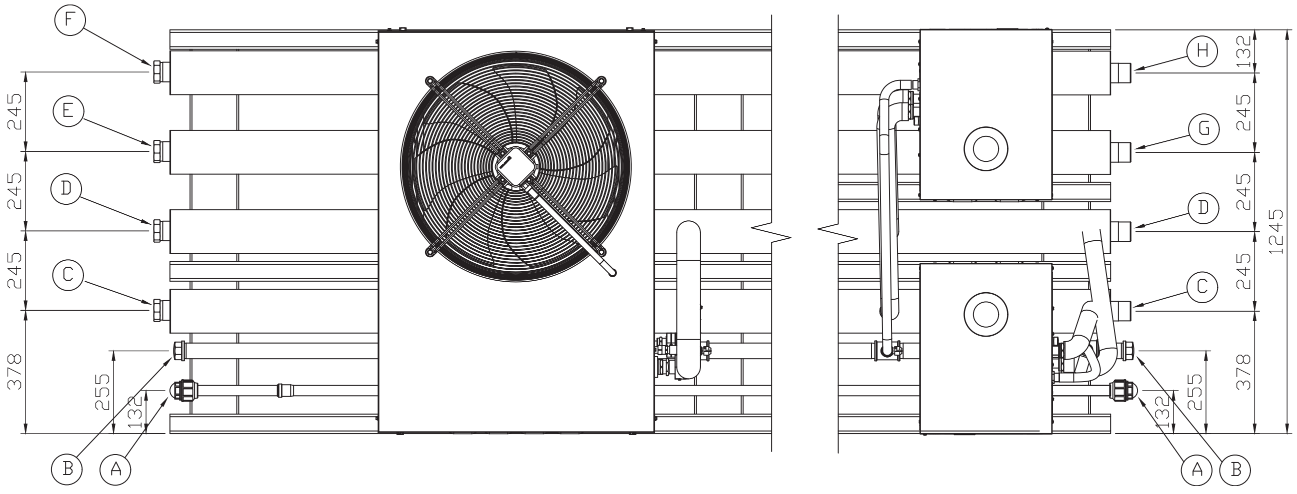
A Condensate discharge connection ["G 1 F] (only for groups with more than one condensing unit)
B Gas connection ["G 1 1/2 F]
C Cold/hot water outlet [2" M]
D Cold/hot water inlet [2" M]
* The height of low-noise model is 1650 mm

Figure 2.2 *Position of water, gas and condensate connections for 4-pipe groups - Right side view (dimensions in mm)*



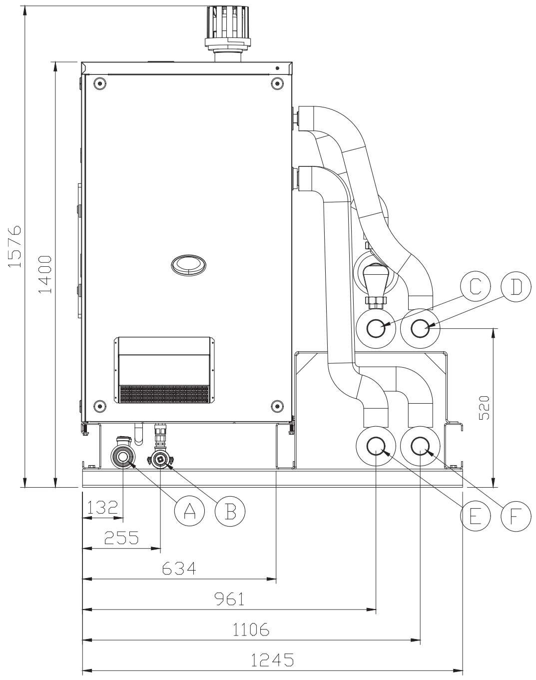
A Condensate discharge connection ["G 1 F] (only for groups with more than one condensing unit)
B Gas connection ["G 1 1/2 F]
C Cold/hot water outlet [2" M]
D Cold/hot water inlet [2" M]
E Hot return [2" M]
F Hot delivery [2" M]
* The height of low-noise model is 1650 mm

Figure 2.3 *Position of water, gas and condensate connections for 6-pipe groups - Top view (dimensions in mm)*



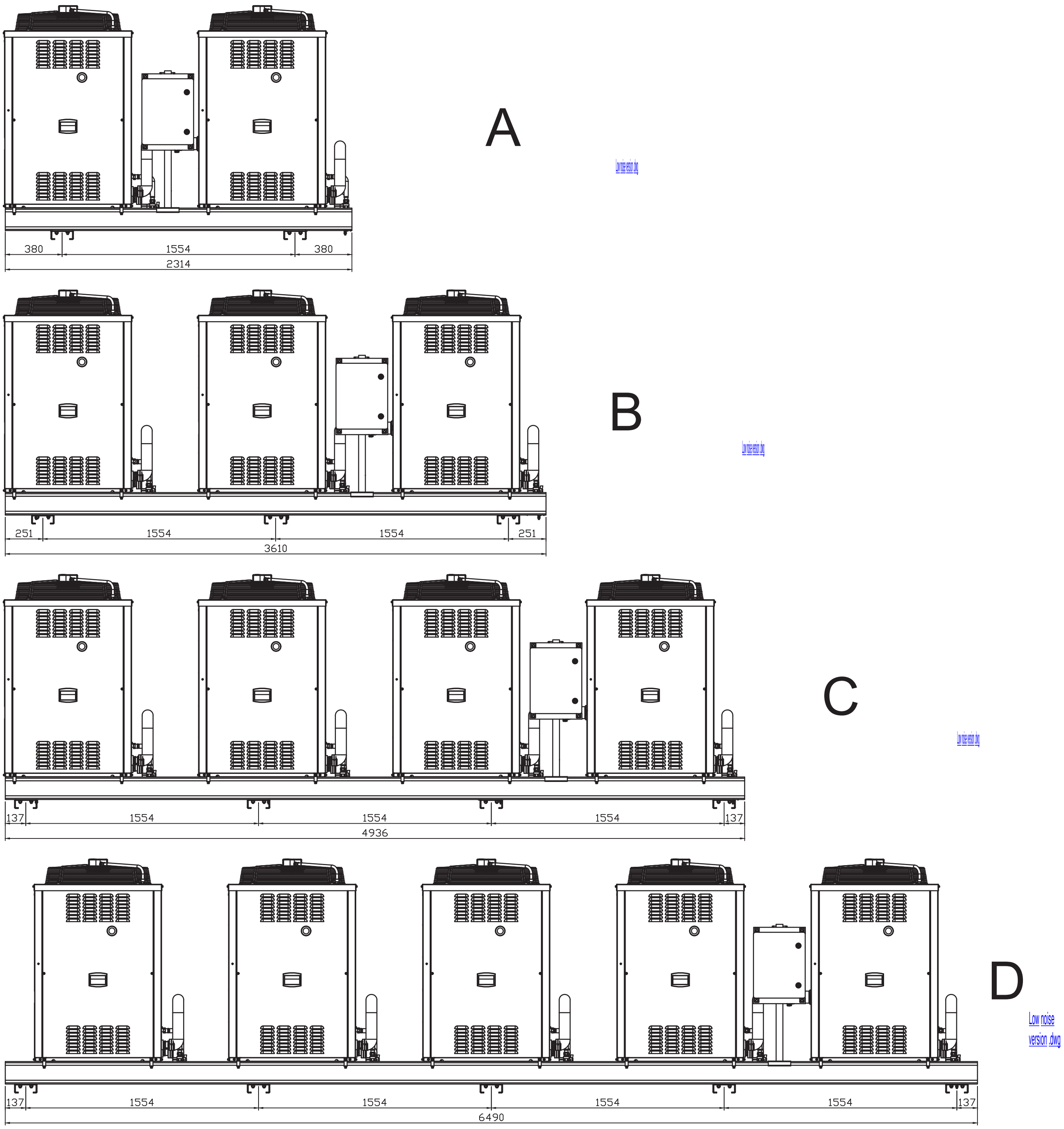
A Condensate discharge connection ["G 1 F] (only for groups with more than one condensing unit). Sloping manifold, strictly connect on right side
B Gas connection ["G 1 1/2 F]
C Cold/hot water outlet [2" M]
D Cold/hot water inlet [2" M]
E ACF HR recovery hot delivery (only left connection) [2" M]
F ACF HR recovery hot return (only left connection) [2" M]
G Hot return (only right connection) [2" M]
H Hot delivery (only right connection) [2" M]

Figure 2.4 *Position of water, gas and condensate connections for RTGS/WS groups - Right side view (dimensions in mm)*



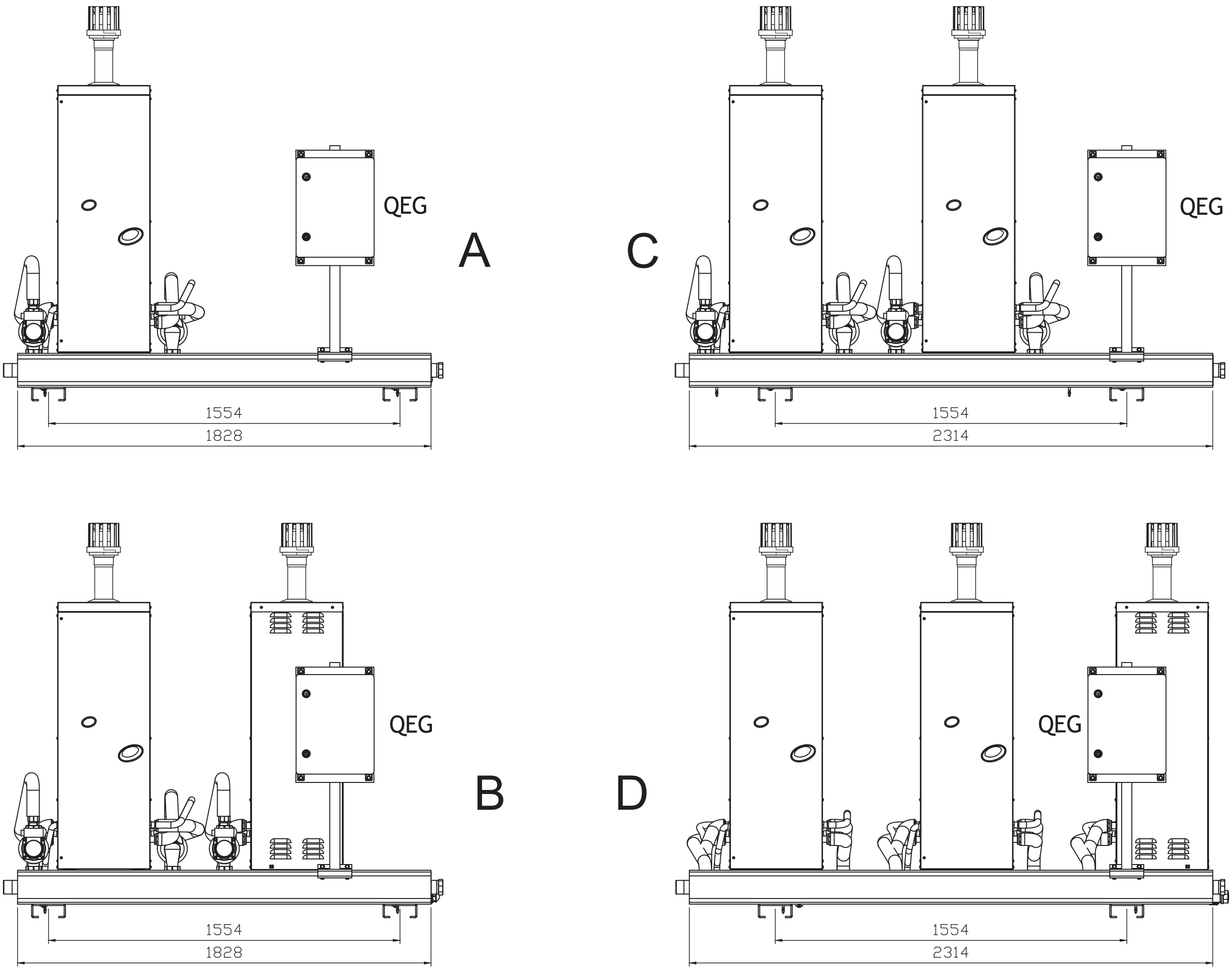
A Condensation drain connection ["G 1 F]
B Gas connection ["G 1 1/2 F]
C Hot return [2" M]
D Cold return [2" M]
E Hot delivery [2" M]
F Cold delivery [2" M]

Figure 2.5 *Preassembled ACF/A/AR group (with 2, 3, 4 and 5 units) - Dimensions and weights of preassembled units - front view (dimensions in mm)*



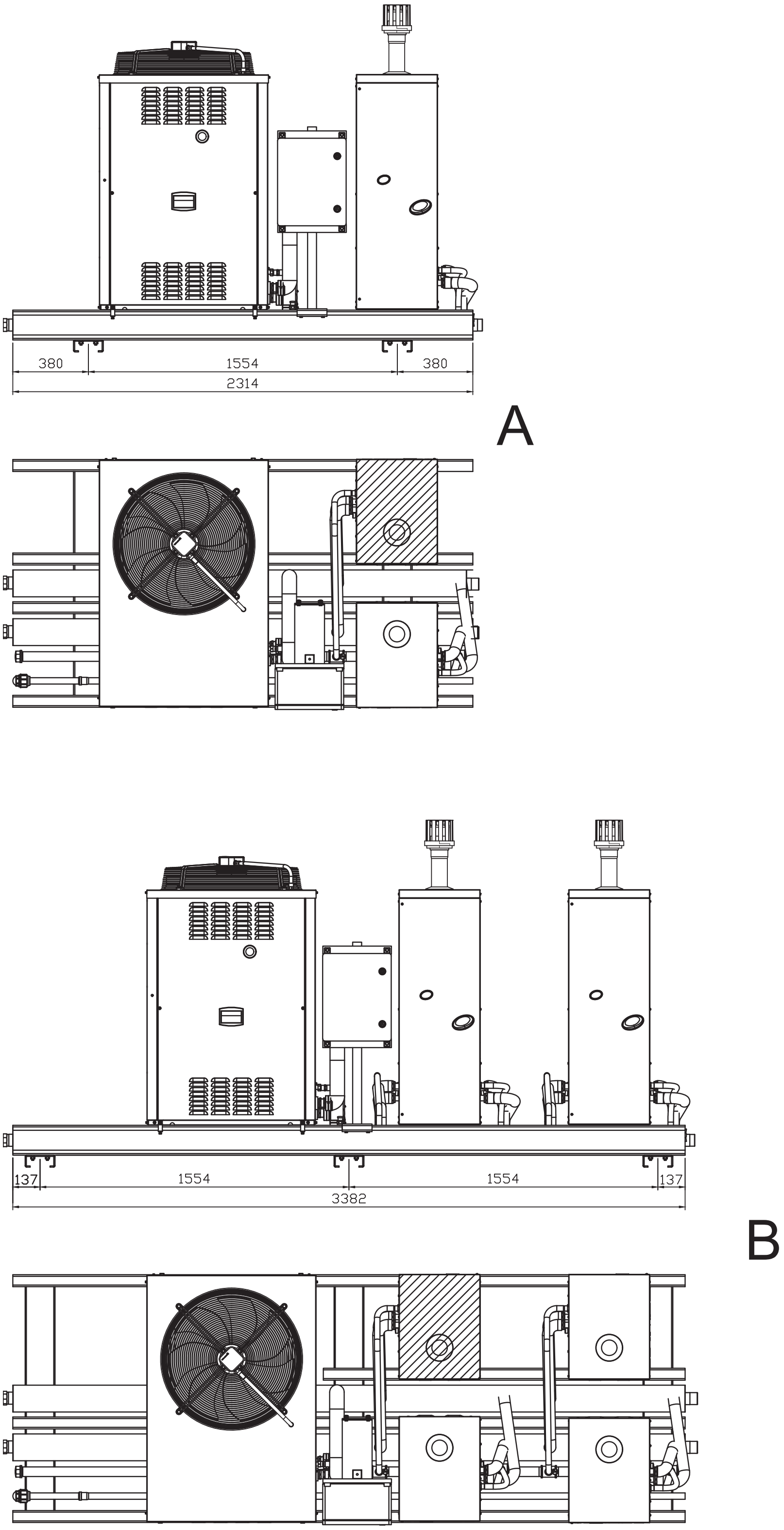
A 960 kg
B 1440 kg
C 1920 kg
D 2410 kg

Figure 2.6 *Preassembled AY group (with 2, 3, 4 and 5 units) - Dimensions and weights of preassembled groups - front view (dimensions in mm)*



A 2 AY 330 kg
B 3 AY 450 kg
C 4 AY 580 kg
D 5 AY 700 kg
Note: The weight refers to links configured with oversize circulators

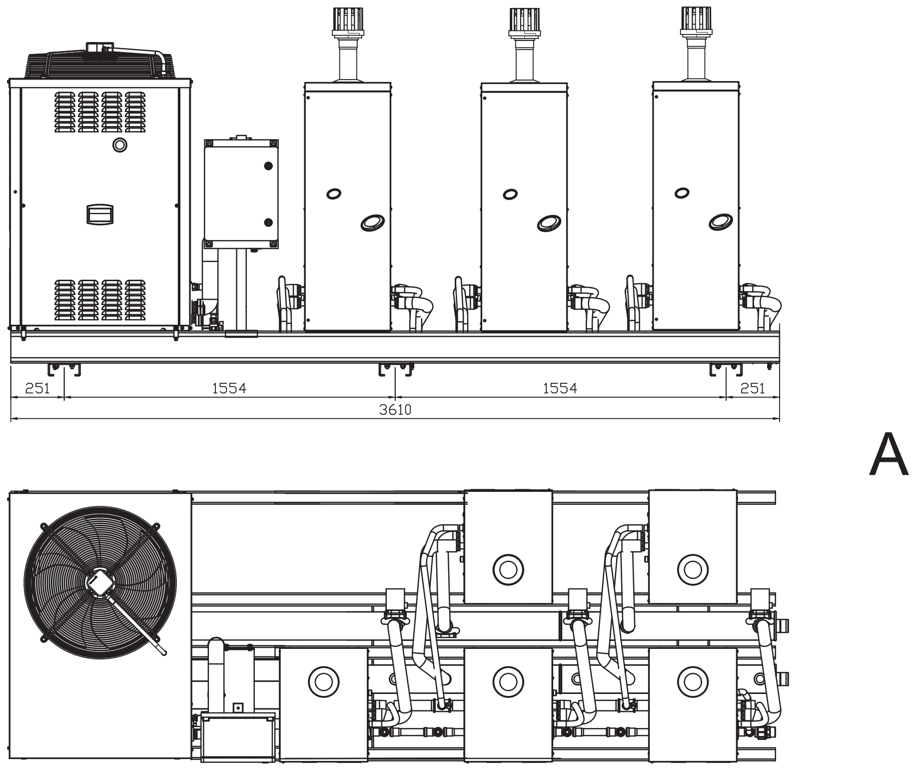
Figure 2.7 *Preassembled ACF or A or AR + AY group (with 1+1, 1+2, 1+3, 1+4 units) - Dimensions and weights of preassembled groups - front and top view (dimensions in mm)*

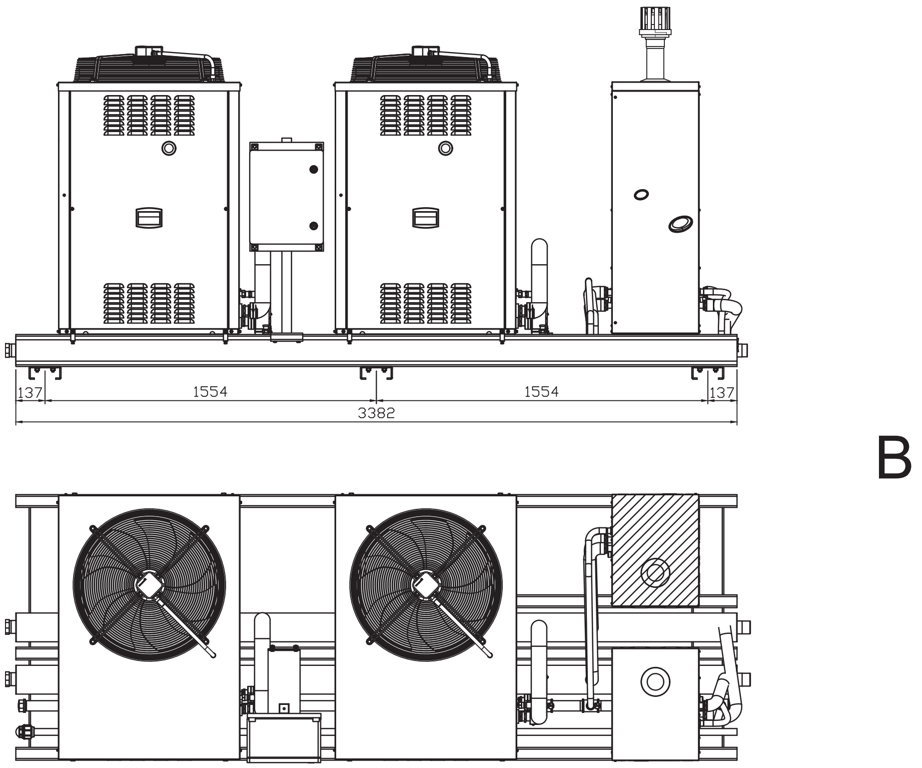


A 1+2 790 kg (*)
B 1+3 970 kg 1+4 1070 kg (*)
(*) The weight refers to a 2 pipe link (silent ventilation, "S"), configured with oversize circulators

Configurations 1 GAHP/GA + 1 AY are replaced by GITIE units. Please refer to the relevant Installation, Use and Maintenance Manuals.

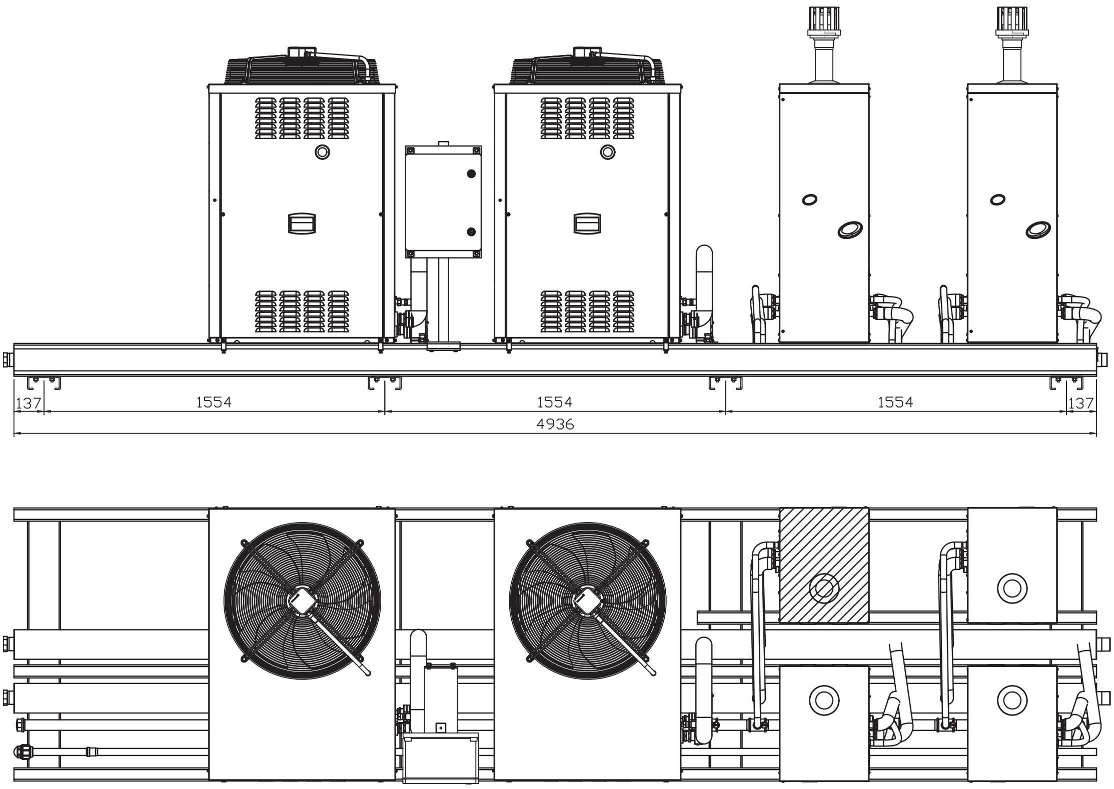
Figure 2.8 *Preassembled ACF/A/AR + AY group (with 1+5, 2+1 and 2+2 units) - Dimensions and weights of preassembled groups - front and top view (dimensions in mm)*



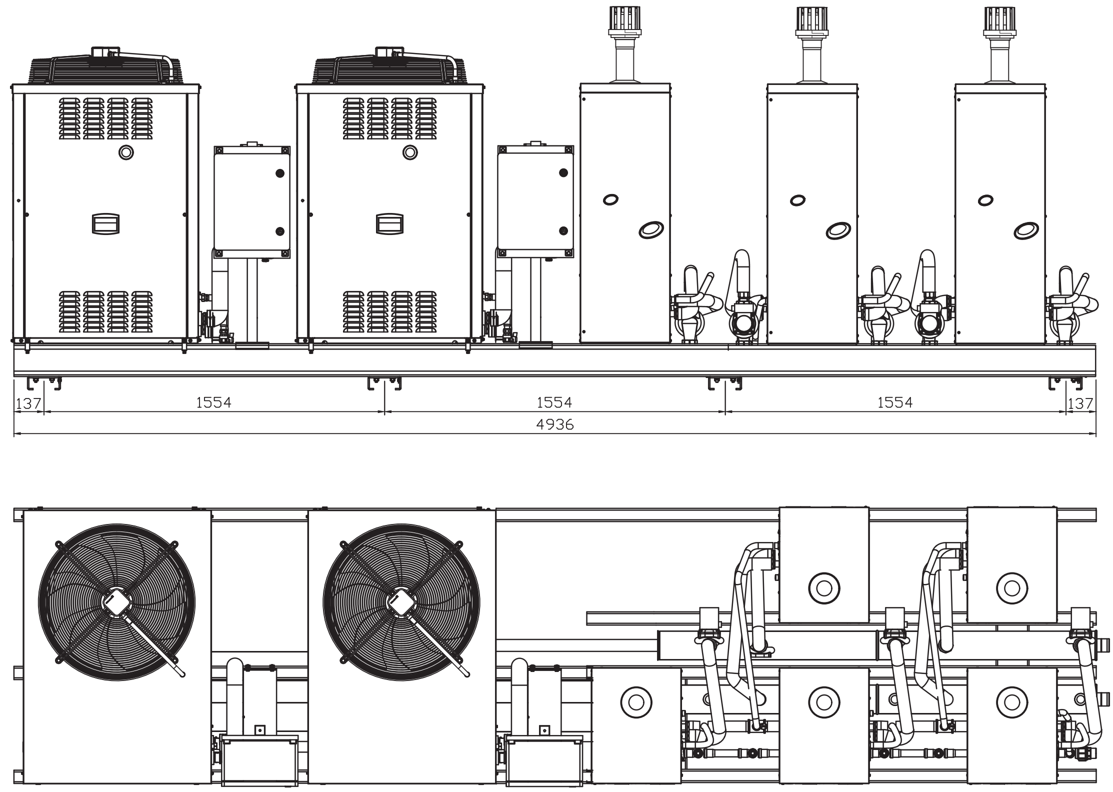


A 1+5 1210 kg (**)
B 2+1 1150 kg (*) 2+2 1270 kg (*)
(*) The weight refers to a 2 pipe link (silent ventilation, "S"), configured with oversize circulators
(**) The weight refers to a 4 pipe link (silent ventilation, "S"), configured on both circuits with oversize circulators

Figure 2.9 *Preassembled ACF/A/AR + AY group (with 2+3, 2+4 and 2+5 units) - Dimensions and weights of preassembled groups - front and top view (dimensions in mm)*



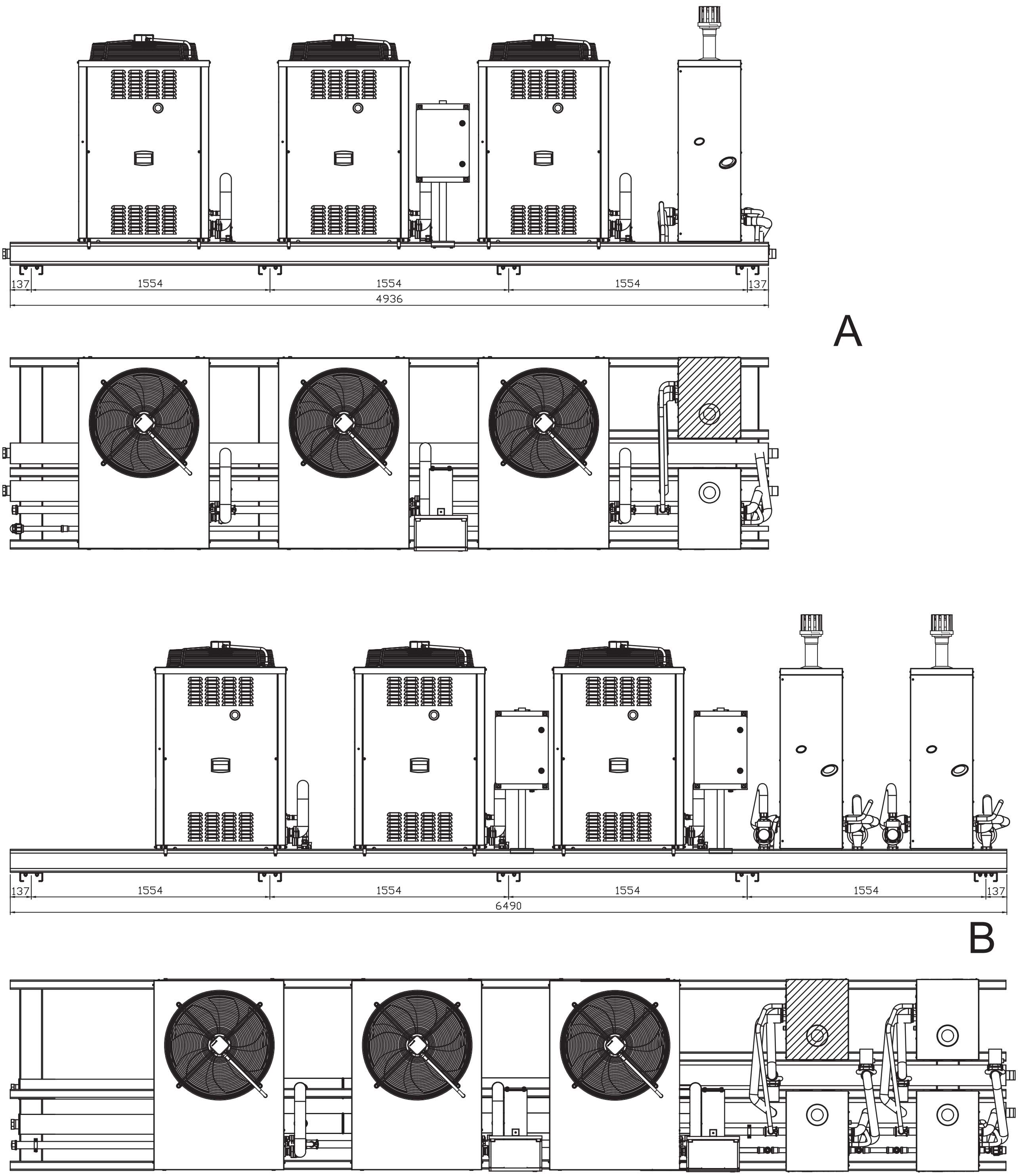
A



B

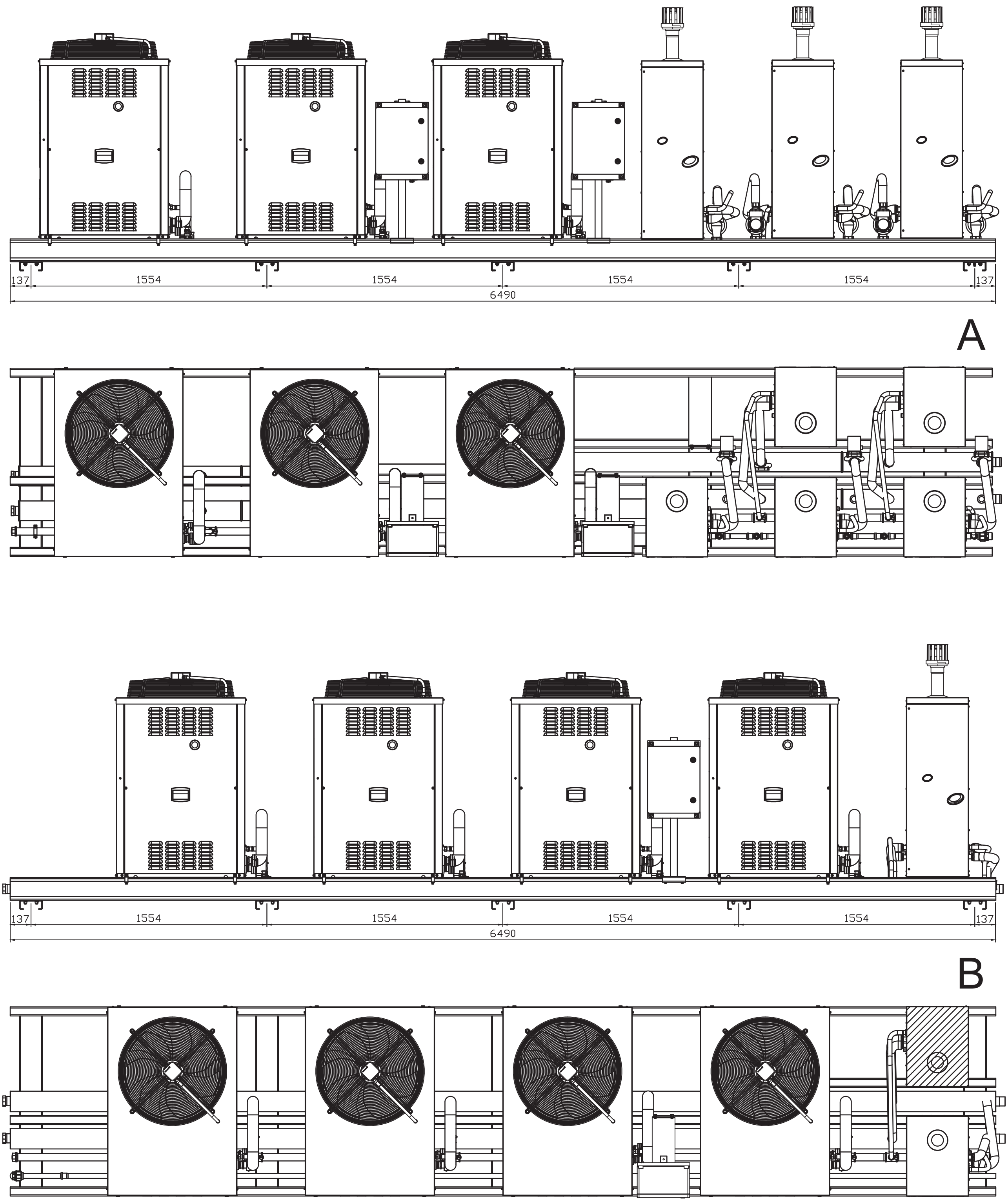
A 2+3 1460 kg (*) 2+4 1560 kg (**)
B 2+5 1700 kg (**)
(*) The weight refers to a 2 pipe link (silent ventilation, "S"), configured with oversize circulators
(**) The weight refers to a 4 pipe link (silent ventilation, "S"), configured on both circuits with oversize circulators

Figure 2.10 *Preassembled ACF/A/AR + AY group (with 3+1, 3+2, 3+3 and 3+4 units) - Dimensions and weights of preassembled groups - front and top view (dimensions in mm)*



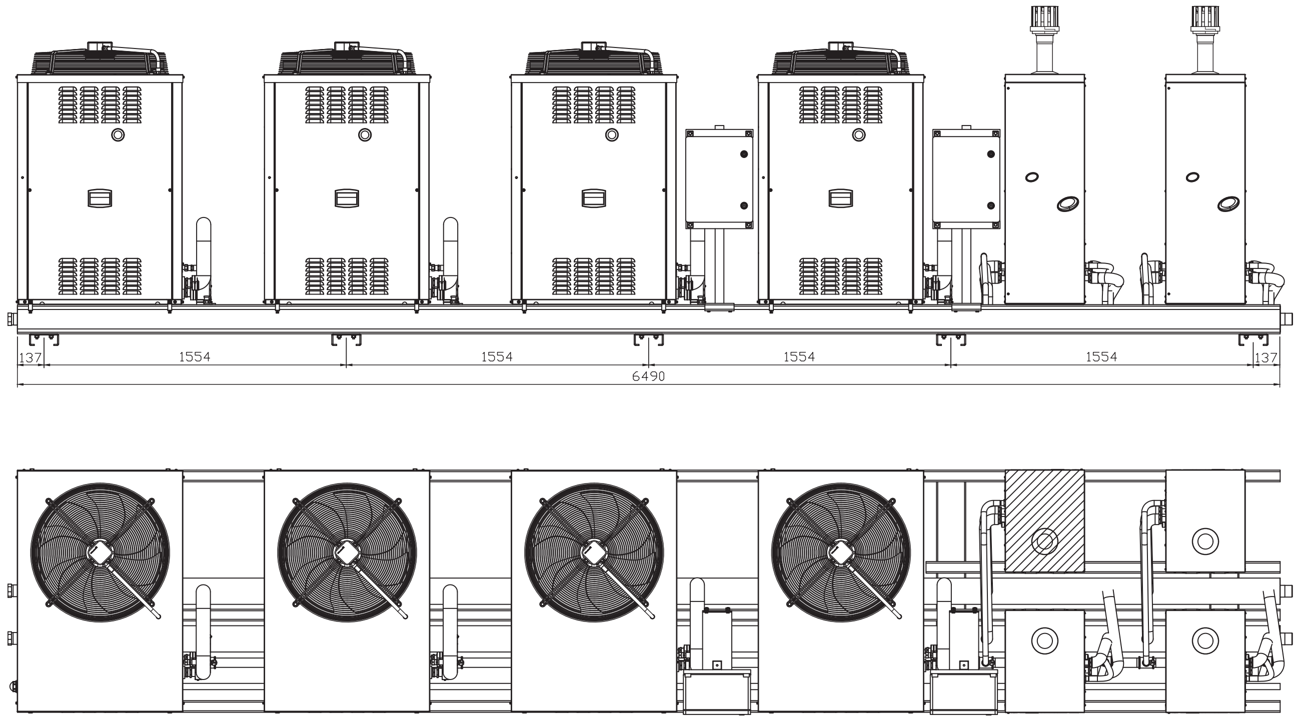
A 3+1 1630 kg (*) 3+2 1750 kg (*)
B 3+3 1880 kg (**) 3+4 2060 kg (**)
(*) The weight refers to a 2 pipe link (silent ventilation, "S"), configured with oversize circulators
(**) The weight refers to a 4 pipe link (silent ventilation, "S"), configured on both circuits with oversize circulators

Figure 2.11 *Preassembled ACF/A/AR + AY group (with 3+5, 4+1 and 4+2 units) - Dimensions and weights of preassembled groups - front and top view (dimensions in mm)*



A 3+5 2190 kg (**)
B 4+1 2120 kg (*) 4+2 2240 kg (**)
(*) The weight refers to a 2 pipe link (silent ventilation, "S"), configured with oversize circulators
(**) The weight refers to a 4 pipe link (silent ventilation, "S"), configured on both circuits with oversize circulators

Figure 2.12 *Preassembled ACF/A/AR + AY group (with 4+3 and 4+4 units) - Dimensions and weights of preassembled groups - front and top view (dimensions in mm)*

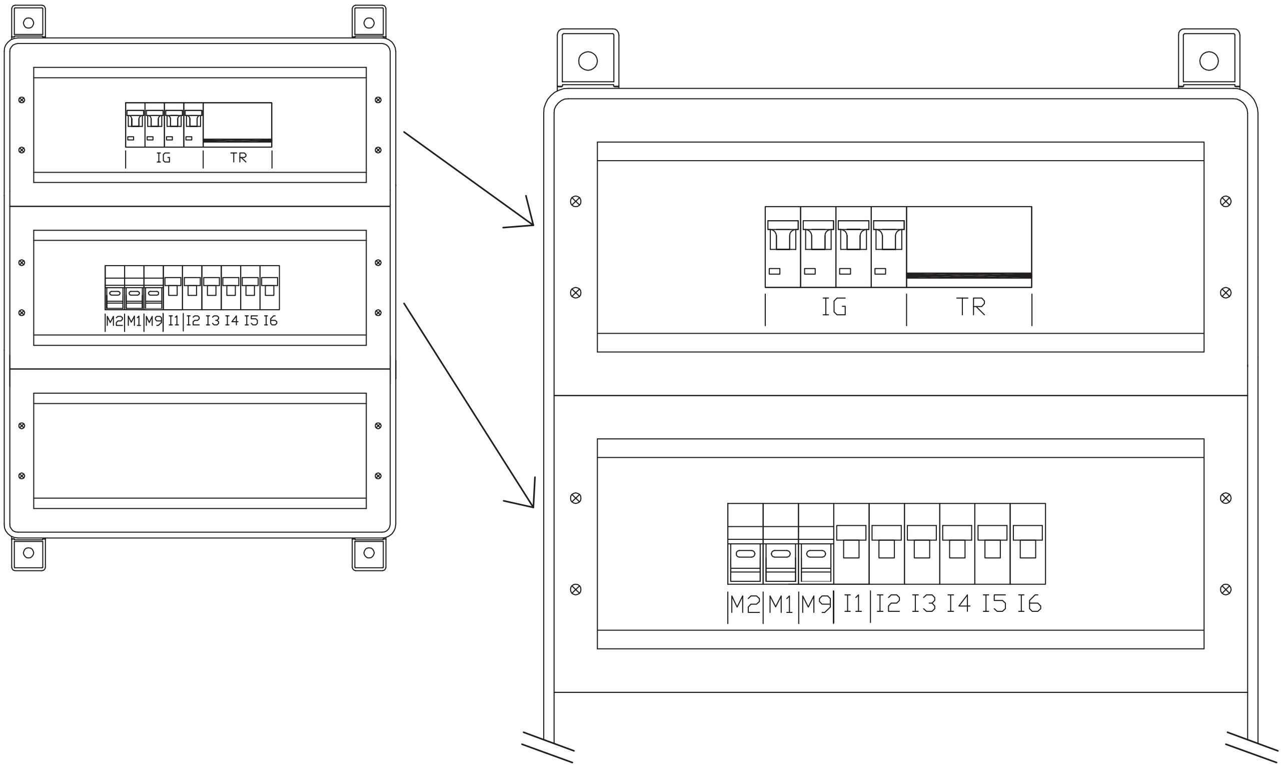


4+3 2380 kg (*)
4+4 2480 kg (*)
(**) The weight refers to a 4 pipe link (silent ventilation, "S"), configured on both circuits with oversize circulators

2.2 ELECTRICAL SPECIFICATIONS

2.2.1 Group Electrical Panel

Figure 2.13 *Group Electrical Panel*



IG Group electrical panel (QEG) switch disconnector
TR transformer 230/24 Vac
M1 transformer primary fuse
M2 condensate heating resistance protection fuse
M9 transformer secondary fuse
A blind panel (for detail of internal terminal blocks see specific figure)
I1 "ID00" unit magnetothermic breaker
I2 "ID01" unit magnetothermic breaker
I3 "ID02" unit magnetothermic breaker
I4 "ID03" unit magnetothermic breaker
I5 "ID04" unit magnetothermic breaker
I6 "ID05" unit magnetothermic breaker
Note: the components within the QEG may have an order and/or position other than the one shown in the figure

2.2.2 Power supply

The power supply of preassembled groups is 400 V three-phase or 230 V single-phase.

2.2.3 Degree of protection

Preassembled groups have degree of protection IP X5D.

2.3 ELECTRONIC BOARDS

Each GAHP/GA/AY module/unit that is part of the group contains one or more prewired electronic boards, interconnected and wired to the preassembled group Electrical Panel with CAN-BUS cable.

2.4 OPERATION MODE

2.4.1 ON/OFF or modulating operation

Depending on the types, the GAHP / GA / AY modules present on a Link RT_ can work in one of the two following ways:

► mode (1) ON/OFF, i.e. On (at full power) or Off, with circulating pump at constant or variable flow;

► mode (2) MODULATING, i.e. at variable load from 50% to 100% of heating capacity, with circulating pump at variable flow.

The GAHP A, GAHP GS/WS modules can operate both in mode (1) and mode (2).

GAHP-AR, GA ACF/HR/TK, and AY00-120 modules can only operate in mode (1).

For each mode, (1) or (2), specific control systems and devices are provided (Paragraph 2.5 *p. 13*).

2.5 CONTROLS

2.5.1 Control device

The preassembled group can only work when connected to a control device, chosen from:

► (1) **DDC controller** (for ON/OFF operation);

► (2) **CCP/CCI controller** (for modulating operation, only for A/WS/GS).

For connection the selected device to the RT_ Link Electrical Panel (Figure 3.4 *p. 18*), see pargraph 3.5.4 *p. 17*.

2.5.2 Control system (1) with DDC (ON/OFF units)

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.

2.5.3 Control system (2) with CCP/CCI (modulating GAHP unit)

The CCP/CCI control is able to control up to 3 GAHP units in modulating mode (therefore A/WS/GS only, excluding AR/ACF/AY), plus any integration ON/OFF boiler. For more information see Section C1.12.

2.6 TECHNICAL CHARACTERISTICS

Refer to the technical data of individual GAHP/GA/AY modules making up the group, set out in Section B for the specific product.

2.6.1 Fittings diameter

Table 2.1 *Fittings diameter*

Installation data	
Gas fitting diameter	1 1/2" F
Water fittings diameter (inlet/outlet)	2" M
Condensation discharge fitting diameter	1" F

2.6.2 Pressure drops

In the RT_ links already provided with circulators, each individual GAHP/GA/AY module that is part of the group has (at least) an independent single circulator.
The available head at the hydraulic connections of the preassembled group should be considered net of internal pressure drops, in the units and in the hydraulic manifolds.
The Table 2.2 *p. 14* provides the **minimum** residual head at nominal flow in maximum configuration.
In this way it is possible to perform an immediate preliminary check of the selected independent circulating pump's suitability with respect to the expected system pressure drops:

- if the indicated minimum head is sufficient, no additional checks are required;
- if the indicated minimum head is not sufficient, the actual pressure drop of the specific RT_ Link must be calculated, on the basis of the indications in Paragraph 2.6.2.1 *p. 14* and the actual head of the circulating pumps under design conditions must be checked. For more detailed data on flow rate and head of circulating pumps please refer to Section C1.05.

Table 2.2 *Minimum residual head*

	Residual head [m w.c.]
Wilo Yonos 25/0,5-7	2,0
Wilo Yonos 25/0,5-10	3,5
Wilo Stratos Para 25/1-11	2,0
Wilo Stratos Para 25/1-12	5,0

In RT_ Links without circulating pumps, the circulation pump of the primary circuit must be appropriately selected and rated, considering both pressure drops associated to the individual modules, and the pressure drops arising from pre-assembly, calculated on the basis of the indications in Paragraph 2.6.2.1 *p. 14* below.

2.6.2.1 Preassembled group pressure drop calculation

The pressure drop associated to the specific RT_ preassembled group is given by the sum of pressure drops associated to the individual modules and the pressure drops arising from preassembly.
For pressure drop data of individual modules of the preassembled group please refer to Section B, concerning the pressure drop data of the individual module considered.

Pressure drop associated to preassembly

This figure derives from the pressure drop associated to the water manifolds supplied with the preassembled group, it is constant and equal to 0,02 bar.

Module pressure drop

The pressure drop of individual modules must not be added up, but that referring to the unit with the highest level with respect to operating conditions is simply to be considered. This is because the modules are hydraulically parallel on the manifolds.

2.6.3 Performances

For heating/cooling efficiency and GUE efficiency of the individual modules making up the preassembled group, refer to Section B of the specific product.

3 DESIGN

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 apliances that make up a preassembled group (GAHP/AY modules/units) are approved for connection to a discharge duct of combustion products.

3.3.1 Flue gas exhaust connection

The diameters (mm) of the connections, the residual head (Pa), the flow rate (kg/h), the temperature (°C) and other flue gas exhaust properties of individual GAHP/AY appliances making up the group are indicated in Section B, for the corresponding product.
For further information also see Section C1.10.

3.3.2 Flue gas exhaust kit

GAHP/AY units that are part of the group are equipped as standard with smoke exhaust kits, already assembled or to be assembled by the installer, which generally includes:

- 1 pipe complete with terminal and socket of sampling;
- 1 support collar;
- 1 possible 90° curve;
- 1 rain cover.

Possible flue

If necessary, the preassembled group can be connected to one or more flue(s).
For sizing the flue(s), refer to the data and information in Section B of the specific product and Section C1.10.

3.4 FLUE GAS CONDENSATE DISCHARGE

If the preassembled group include GAHP A, GAHP GS/WS and AY00-120 condensing appliances, condensation water is produced from combustion fumes, which must be evacuated in compliance with current regulations.

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.

Flue gas condensate connection

The fitting for flue gas condensate discharge is located on the right side of the preassembled group (condensate discharge manifold below Figures 2.1 *p. 3*, 2.2 *p. 3*, 2.3 *p. 4*, 2.4 *p. 4*).

The condensate drain cap can not be moved on the opposite side as the condensate manifold is sloping towards the right side.

Flue gas condensate evacuation

To make the condensate evacuation duct:

- Size the ducts for maximum condensation flow rate (kg/h), equal to the sum of the flow rates of the individual GAHP/AY appliances/modules (see Manuals of the individual GAHP/AY units attached);
- Use plastic materials resistant to acidity with pH 3 to 5;
- Provide for min. 1% slope, i.e. 1 cm for each m of pipe length (otherwise a booster pump is required);
- Prevent freezing;
- Dilute, if possible, with domestic waste water (bathrooms, washing machines, dish washers...), basic and neutralising.

3.5 ELECTRICAL AND CONTROL CONNECTIONS

3.5.1 Warnings

Earthing

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

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

- Never use the external switch to turn the preassembled group on and off, as it may cause damage to the appliances and the system.
- To turn the preassembled group on and off, exclusively use the suitably provided control device (DDC or CCP/CCI).

Control of water circulation pump

In the case of RT_ Links without circulators:

- The common hydraulic/primary circuit water pump must be controlled by the Electrical Panel of the preassembled group (terminals KK, PP, 12).
- Circulator start/stop is not allowed without the request of the preassembled group.

Cable segregation

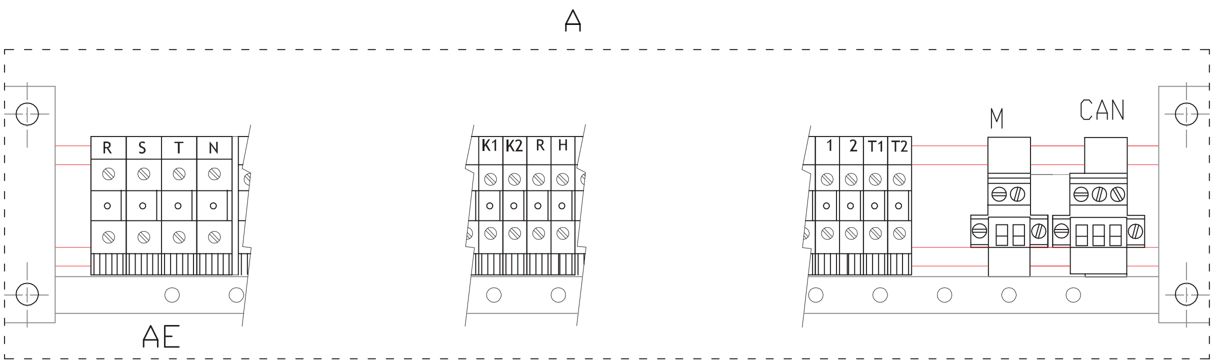
Keep power cables physically separate from signal ones.

3.5.2 Electrical systems

Electrical connections must provide:

- (a) power supply line (three-phase or single-phase)
- (b) control system.

Figure 3.1 *Blind panel: detail of internal terminal blocks on DIN rail*



A blind panel of QEG
AE power supply input terminals
K1-K2 24 V coil terminals for circulator request (hot/cold circuit side)
R-H condensate heating resistor terminals
1-2 24 V coil terminals for circulating pump request (HR recovery circuit side)
T1-T2 DHW tank thermostat terminals (HR recovery circuit side)
M 2-pole 24 Vac connector for service uses
CAN 3-pole connector for CAN-BUS network connection

3.5.3 Electrical power supply

Electrical protection

A 4-pole (three-phase) disconnector GS Figure 3.2 *p. 16* or bipolar (single-phase) IR+Id Figure 3.3 *p. 17* must be provided by the installer in the external power supply electrical panel, with fuses suitable for phases, minimum contact opening 3 mm. No fuse on the neutral is allowed. Indirect contact protection by means of differential switch and overload must be guaranteed by means of a sufficiently dimensioned automatic switch or fuse.

Do not modify the RT_ Link Electric Panel or add components inside it (relays, ...).

Power supply line (three-phase or single-phase)

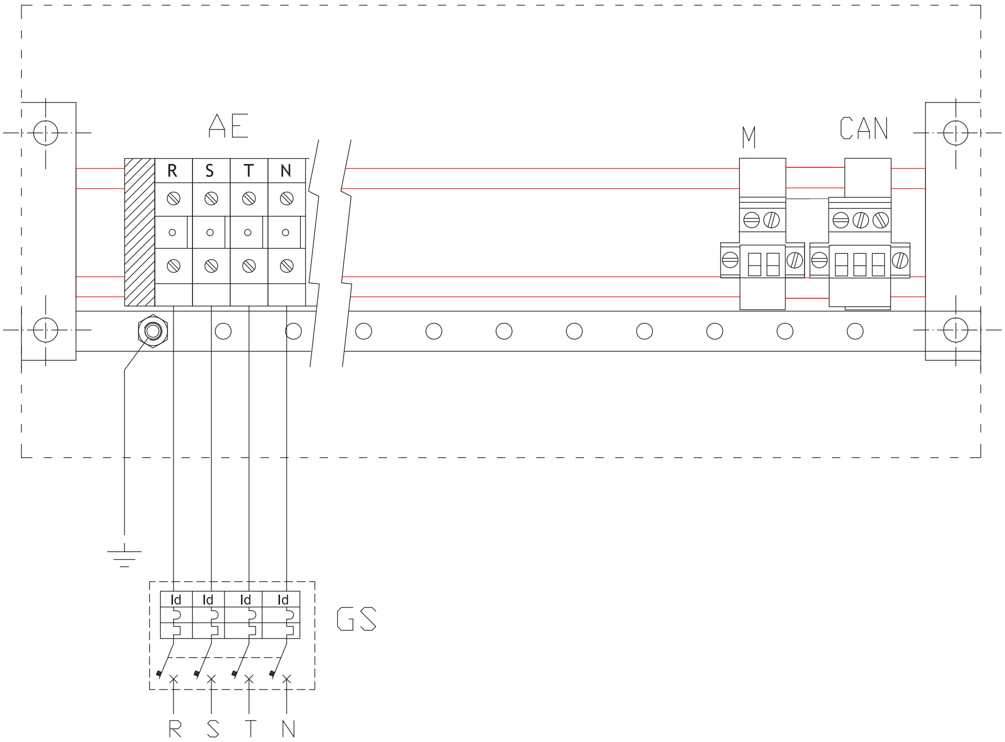
Provide a protected line (by the installer), which may be:

► three phase 400 V 3N - 50 Hz (Figure 3.2 *p. 16*),

or as an alternative,

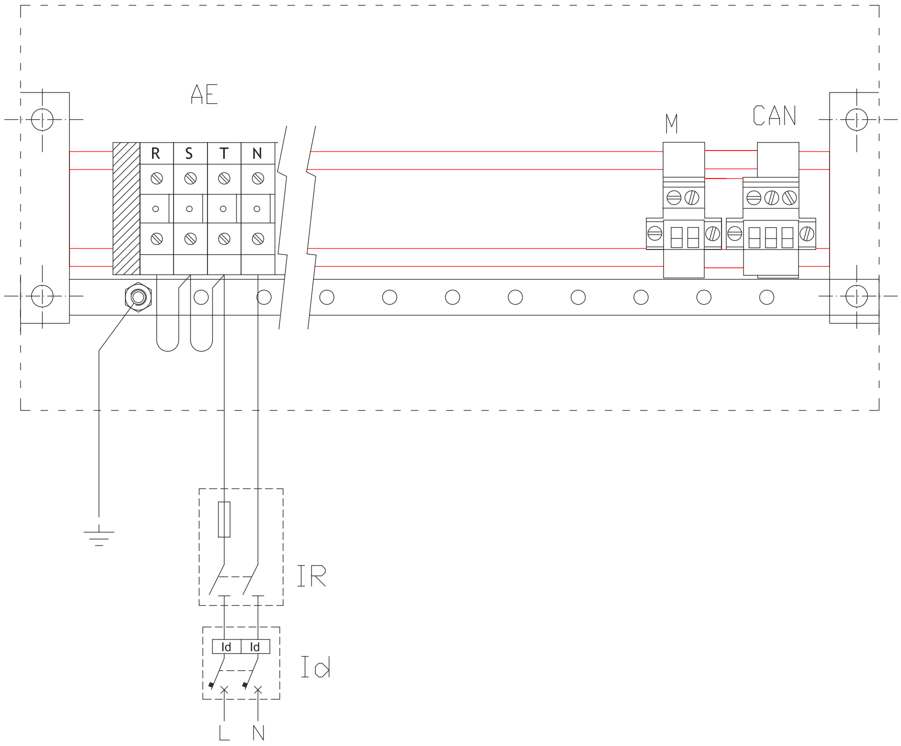
► single phase 230 V 1N - 50 Hz (Figure 3.3 *p. 17*).

Figure 3.2 *Three phase power supply electrical connection 400 V 3N - 50 Hz*



AE power supply input terminals
GS three-phase magnetothermic switch
RSTN phases/neutral

Figure 3.3 *Single phase power supply electrical connection 230 V 1N - 50 Hz*



AE power supply input terminals
IR bipolar disconnector with suitable fuse and minimum contact opening of 3 mm
LN phase/neutral

3.5.4 Set-up and control

Switching for reversible units

Use that entails frequent switching between heating/conditioning operating modes are to be avoided for reversible units.

Control systems, options (1) or (2)

Two separate control systems are provided for RT_ Links, (1) and (2), each with specific features, components and diagrams:

- System (1), with **DDC control** (with CAN-BUS connection);
- System (2), with **CCP/CCI control** (with CAN-BUS connection).

For electrical connections and hookup Figure 3.4 *p. 18*.

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 or CCP/CCI 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, CCI, ...), 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 or CCP/CCI controllers are connected to the RT_ Link through the CAN-BUS cable, shielded, compliant to Table 3.1 *p. 17* (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*

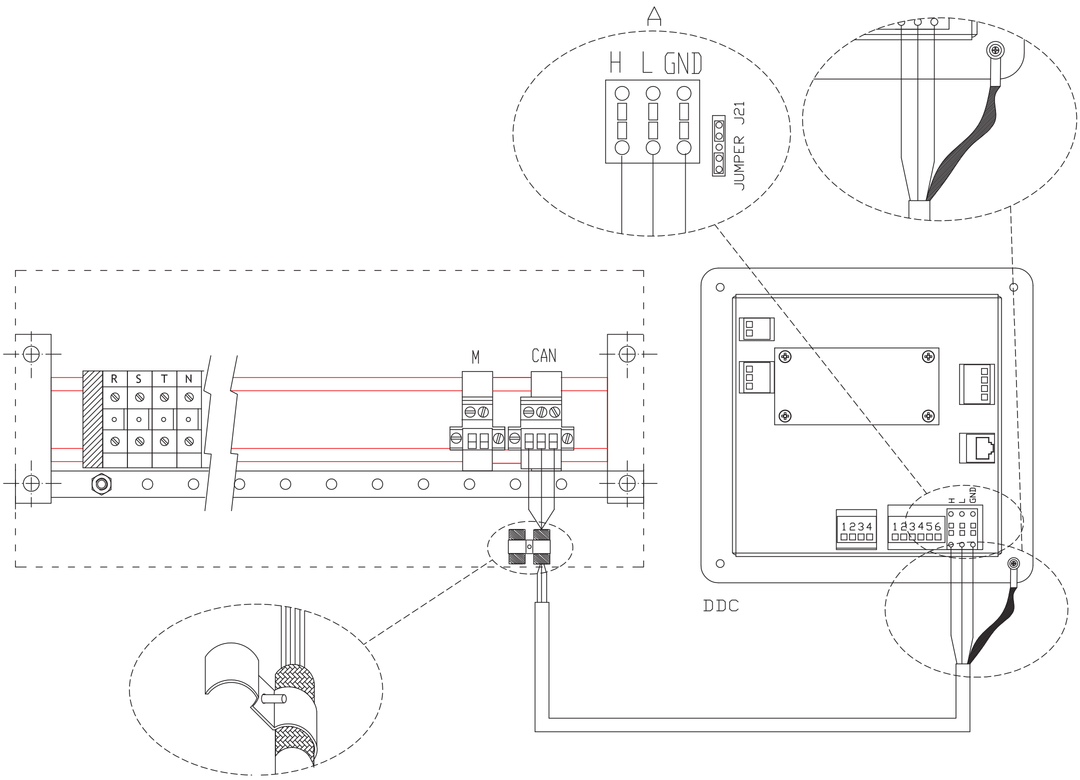
CABLE NAME	SIGNALS / COLOR			MAX LENGTH	Note
Robur					Ordering Code OCVO008
ROBUR NETBUS	H= BLACK	L= WHITE	GND= BROWN	450 m	
Honeywell SDS 1620					In all cases the fourth conductor should not be used
BELDEN 3086A	H= BLACK	L= WHITE	GND= BROWN	450 m	
TURCK type 530					
DeviceNet Mid Cable					
TURCK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

To connect the CAN-BUS cable to the preassembled group Electrical Panel, hence to the pre-wired S61/AY10 boards of the appliances it consists of (Figure 3.4 *p. 18*):

1. Access the terminal blocks in the Electrical Panel of the group (Paragraph 3.5.2 *p. 15*).
2. Connect the CAN-BUS cable to the GND (shielding/earthing) + L and H terminals (two signal wires).
3. Block the cable with the earthing terminal located behind the DIN bar, ensuring a good electrical contact is made with the shielding braid and the bare conductor (if any); see detail in Figure 3.4 *p. 18*.
4. Position the J1 jumpers of the board of the last appliance on the left of the Link_RT closed if the node is terminal (case of one Link_RT only) or open if the node is intermediate (case of several Link_RT in the same system) Figure 3.6 *p. 20*.
5. connect the CCI or DDC (and possibly the RB100 or RB200) by means of the CAN-BUS cable according to the instructions in the relevant Manuals and in Section C1.12.

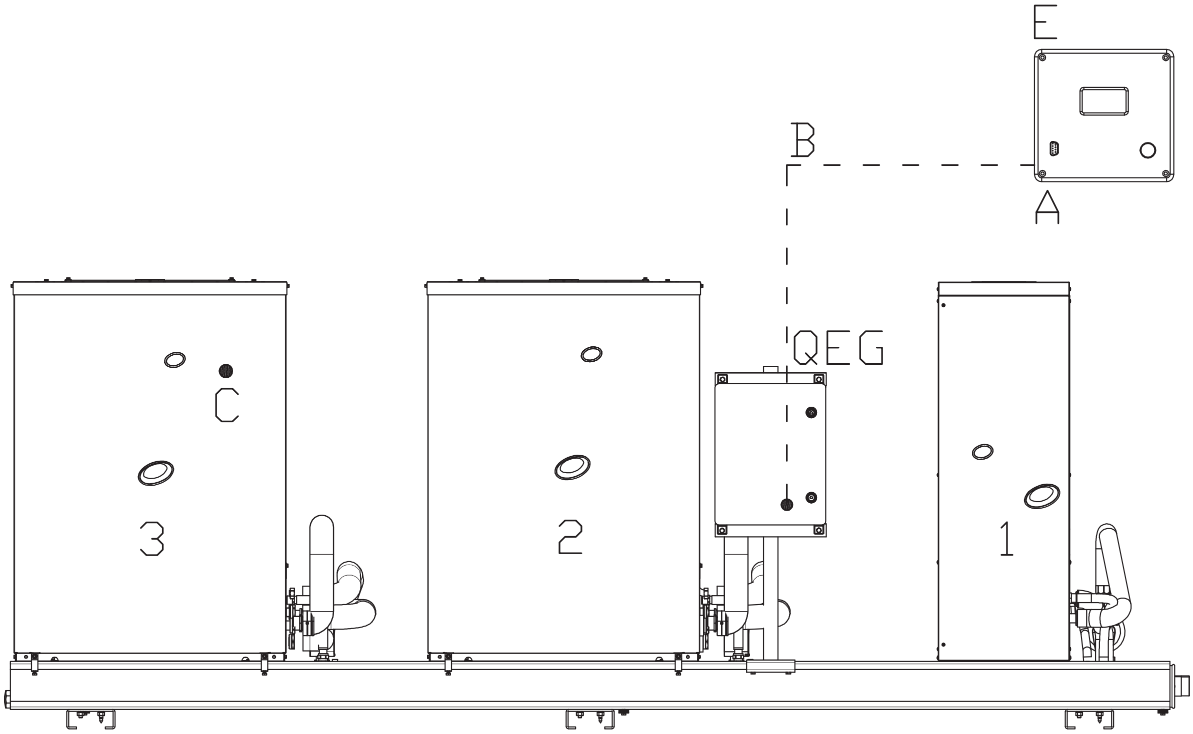
Figure 3.4 *Connection with CAN-BUS cable between 1 CCI/DDC and the electrical panel of the preassembled group*



CAN 3-pole connector for CAN-BUS network connection
DDC CCI/DDC (rear view)

1 Link RT_ + DDC/CCI configuration

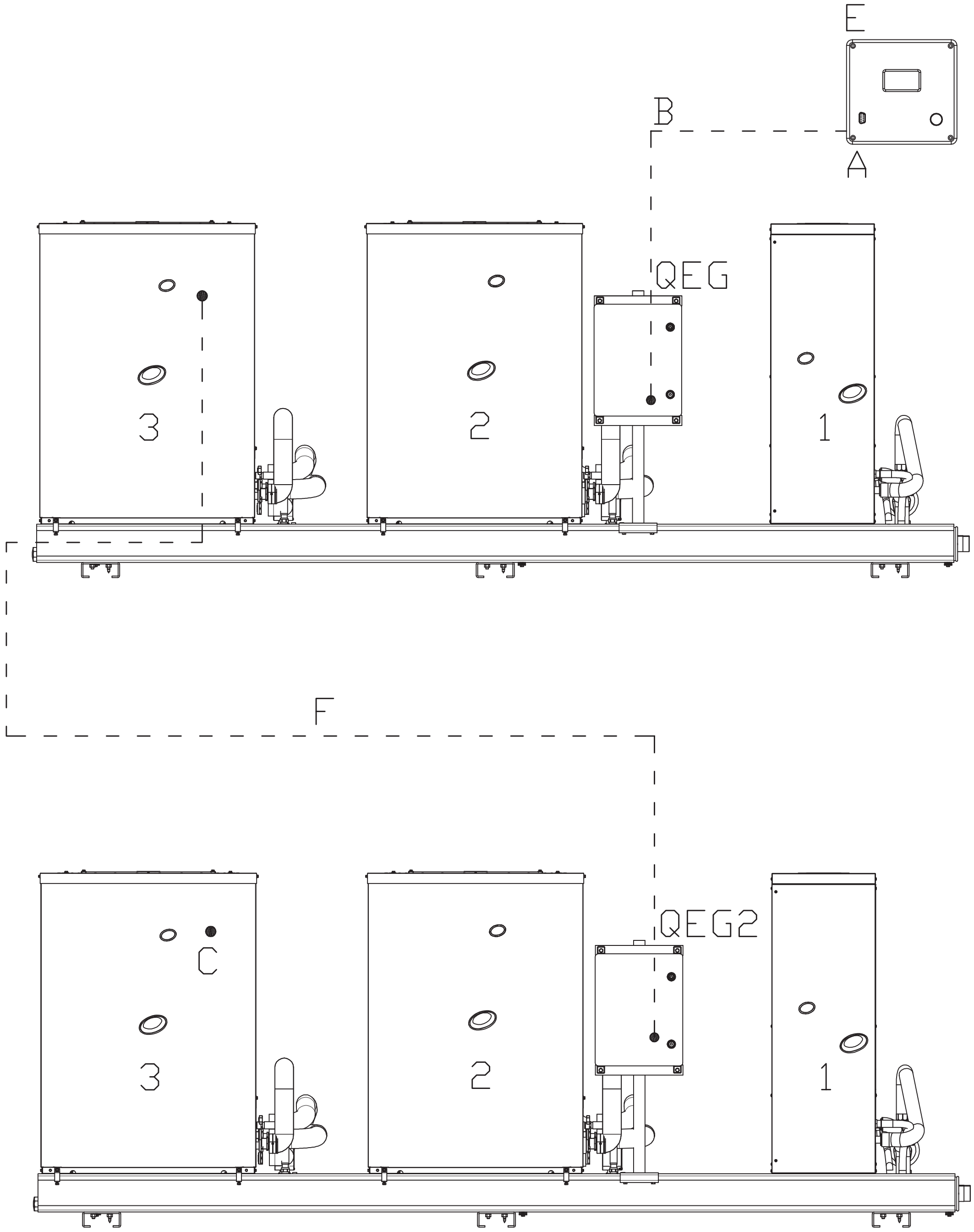
Figure 3.5 *CAN-BUS connection for systems with one unit*



A terminal node connection to CCI/DDC
B CAN-BUS cable (not supplied - see table)
C terminal node on last unit (prewired)
QEG group electrical panel
E CCI/DDC
3 last unit of appliance (with "ID00")

2 Link RT_ + DDC configuration

Figure 3.6 *Example of CAN network with 7 nodes (1 CCI/DDC + 2 appliances connected on a single hydraulic circuit).*



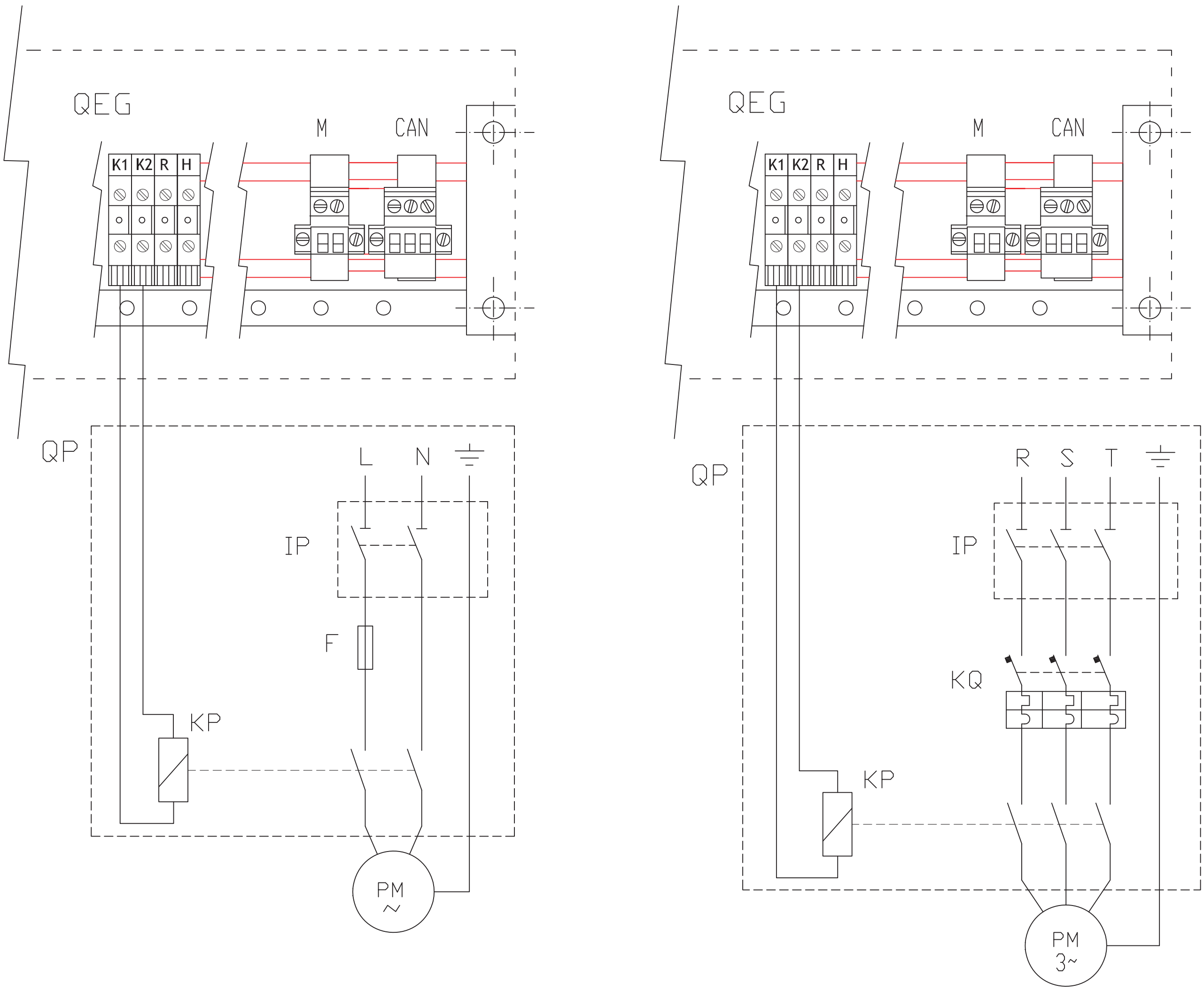
A terminal node connection to CCI/DDC
B CAN-BUS cable (not supplied - see table)
C terminal node on last unit (prewired)
QEG1 first appliance group electrical panel
QEG2 second appliance group electrical panel
E CCI/DDC
F CAN-BUS cable (not supplied - see table)
3 last unit of appliance (with "ID00")

3.5.5 Water circulation pumps

In RT_ Links with circulating pumps, the individual independent circulating pumps (1 or 2 for each GAHP/GA/AY module) are already mounted and pre-wired on the preassembled group.
In RT_ Links without circulating pumps, electrical connections must be made (both for power supply and control) of the common water circulation pump of the primary water circuit, as shown in the diagrams Figures 3.7 *p. 21*, 3.8 *p. 22*.

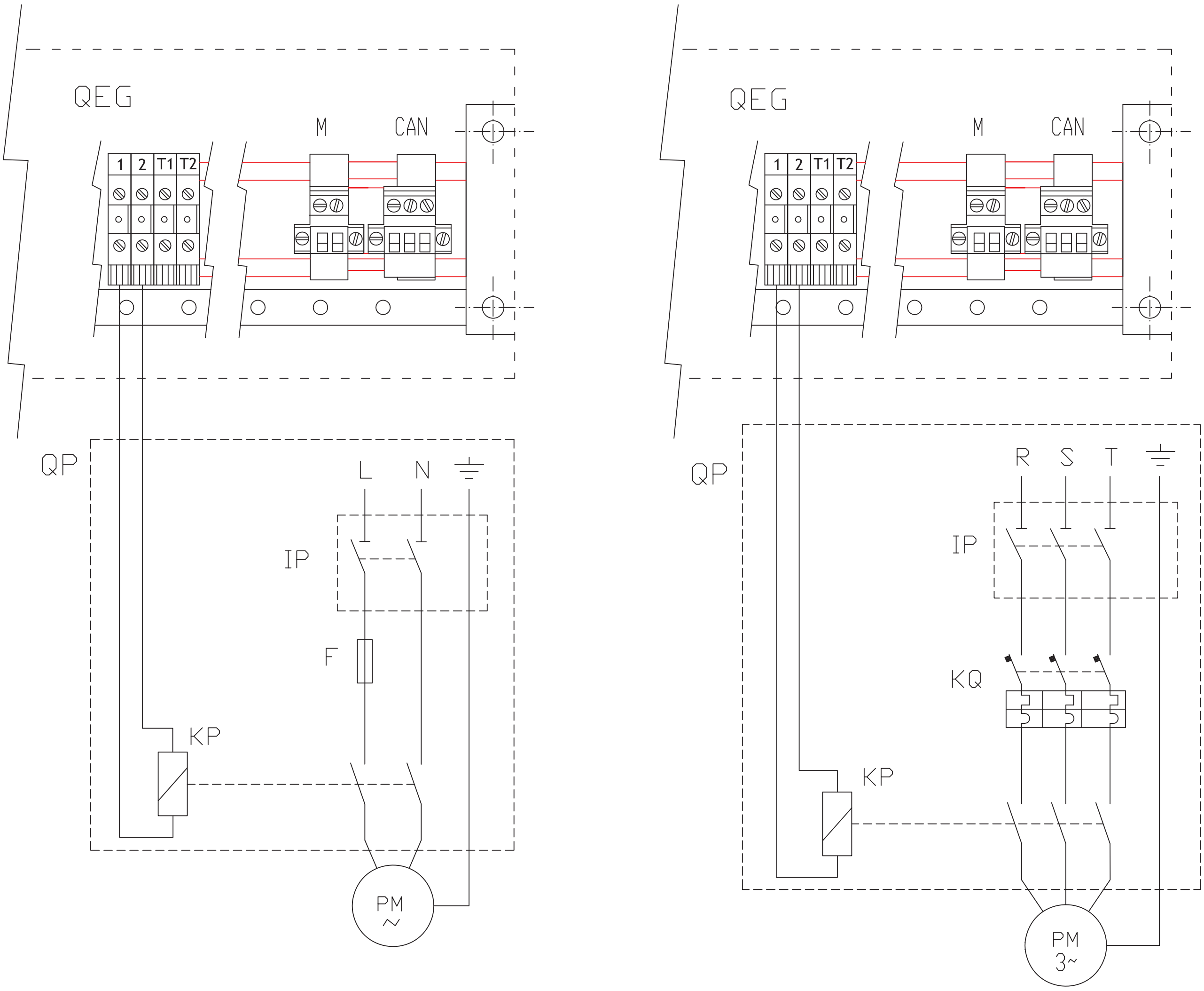
Common circulation pump of a Link RT_ SC

Figure 3.7 *Electrical connection of single- or three-phase circulator directly controlled by the group (configurations "without circulators")*



PM primary system water circulator (not supplied)
QP circulator electrical panel (external)
QEG preassembled group electrical panel
N/L neutral/phase single-phase circulation pump power supply
RST three-phase circulator power supply phases
IP circulating pump disconnector (not supplied)
F appropriate fuse for protecting the circulating pump used
KQ appropriate motor protection switch for the circulating pump used
KP NO relay for controlling the circulating pump (not supplied)
K1-K2 24 Vac coil terminals for the common circulating pump request of the hot/cold link circuit

Figure 3.8 *Heat recovery exchanger: electrical connection of single- or three-phase circulator directly controlled by the group (configurations "without circulators")*



PM	primary system water circulator (not supplied)
QP	circulator electrical panel (external)
QEG	preassembled group electrical panel
N/L	neutral/phase single-phase circulation pump power supply
RST	three-phase circulator power supply phases
IP	circulating pump disconnector (not supplied)
F	appropriate fuse for protecting the circulating pump used
KQ	appropriate motor protection switch for the circulating pump used
KP	NO relay for controlling the circulating pump (not supplied)
1-2	24 Vac coil terminals for the common circulating pump request of the heat recovery circuit of link with HR

How to connect the common circulation pump

To connect the common circulation pump (single-phase or three-phase) of an RT_ Link without any circulating pumps fitted on (Figure 3.7 *p. 21* or 3.8 *p. 22*)

1. Access the terminal blocks in the Electrical Panel of the group (QEG) (Paragraph 3.5.2 *p. 15*).
2. Connect the two enable conductors to the appropriate terminals K1-K2 or 1-2.

1 APPLIANCE POSITIONING

1.1 WARNINGS

Aggressive substances in air

Halogenated hydrocarbons containing chlorine and fluorine compounds cause corrosion. The air of the installation site must be free of aggressive substances.

Environmental or operational heavy conditions

In especially heavy-duty environmental or use conditions (e.g. intensive use of the equipment, brackish environment etc.) increase the frequency of the unit maintenance and cleaning operations.

1.2 AEROTHERMAL APPLIANCES

Do not install aerothermal appliances indoors

Aerothermal appliances, fitted with finned coil and fan, are approved for outdoor installation, with the exception of the GAHP A Indoor unit alone, which is approved for indoor installation.

- Do not install aerothermal appliances inside a room, not even if it has openings.
- In no event start an aerothermal appliance inside a room.

Special notes for the GAHP A Indoor

The GAHP A Indoor unit is approved for installation in a machine room. Refer to Paragraph 1.3 *p. 1*.

Ventilation of aerothermal appliances

- Aerothermal appliances require a large space, ventilated and free from obstacles, to enable smooth flow of air to the finned coils and free air outlet above the mouth of the fan, with no air recirculation.
- Incorrect ventilation may affect efficiency and cause damage to the appliance.
- <u>The manufacturer shall not be liable for any incorrect choices of the place and setting of installation</u>

1.3 APPLIANCES SUITABLE FOR INSTALLATION IN A TECHNICAL ROOM

1.3.1 GAHP A Indoor

The installation premises must meet all requirements set forth by laws, standards and regulations of the Country and place of installation concerning gas appliances and cooling appliances

Do not install inside a room that has no aeration openings.

GAHP A Indoor unit ventilation

- The aerothermal appliance requires a ventilated room to assure regular air flow to the finned coil.
- The air outlet above the fan mouth must be ducted outside in order to prevent air recirculation towards the ventilation openings.
- Incorrect ventilation may affect efficiency and cause damage to the appliance.
- <u>The manufacturer shall not be liable for any incorrect choices of the premises and setting of installation.</u>

Other appliances

Any other gas appliances in the room must necessarily be type C.

Features of the installation premises

- The premise must be provided with permanent and sufficiently wide ventilation openings to permit even air flow to the finned coil (11000 m^3/h)
- The appliance flue gas exhaust must be ducted to the outside.
- The appliance's flue must not be immediately close to openings or air intakes of buildings, and must comply with environmental regulations.
- Combustion air intake must be ducted from the outside (type C installation).

1.3.2 GAHP GS/WS units (indoor version) and AY00-120 boilers

Features of the installation premises

The hydrothermal and geothermal preassembled groups (made up with GAHP GS/WS modules) and boilers AY00-120 may be installed either indoors or outdoors.
In the event of indoor installation, the installation premises must comply with the applicable local standards.

Do not install in a room that has no aeration openings.

- The premises must be provided with permanent and sufficiently wide ventilation openings to permit even air flow for aeration and possibly for combustion (if type B installation).
- The appliance flue gas exhaust must be ducted to the outside.
- The appliance's flue must not be immediately close to openings or air intakes of buildings, and must comply with environmental regulations.
- Combustion air intake may be ducted from the outside (type C installation).

1.4 WHERE TO INSTALL THE APPLIANCE

In general, the appliances:

- May be installed at ground level, on a terrace or on a roof, compatibly with their size and weight.
- May be only installed out of the dripping line of rain gutters or the like. Do not require protection from weathering.
- No obstruction or overhanging structure (e.g. protruding roofs, canopies, balconies, ledges, trees, ...) must interfere with the exhaust flue gas.
- The appliances flue gas exhaust must not be immediately close to openings or air intakes of buildings, and must comply with environmental regulations.

In particular, aerothermal appliances:

- They must be installed outside buildings, in an area of natural air circulation.
- No obstruction or overhanging structure (e.g. protruding

roofs, canopies, balconies, ledges, trees) must interfere with the air flowing out from the top of the appliances fitted with fans.

- They must not be installed near the exhaust of flues, chimneys or hot polluted air. In order to work correctly, aerothermal appliances require clean air.

1.5 DEFROSTING WATER DRAINAGE

In winter, it is normal for frost to form on the finned coil and for the appliance to perform defrosting cycles.

- To prevent overflowing and damage provide for a drainage system.

1.6 ACOUSTIC ISSUES

- Pre-emptively assess the appliance's sound effect in connection to the site, taking into account that building corners, enclosed courtyards, restricted spaces may amplify the acoustic impact due to the reverberation phenomenon.
- In case of appliances suitable for installation in utility room, assess beforehand the appliances' sound effect inside the room and to the adjacent rooms and outside.
- Section C1.15 sets out additional indications for acoustic design.

2 MINIMUM CLEARANCE DISTANCES

2.1 DISTANCES FROM COMBUSTIBLE OR FLAMMABLE MATERIALS

- Keep the appliance away from combustible or flammable materials or components, in compliance with applicable regulations.

2.2 CLEARANCES AROUND THE APPLIANCE

The minimum clearance distances shown in the following Figures (barring any stricter regulations) are required for safety, operation and maintenance.

- For GAHP and GA ACF units and for preassembled groups, see Figure 2.1 *p. 2*
- for AY00-120 units see Figure 2.2 *p. 2*

Figure 2.1 *GAHP and GA ACF clearance destances*

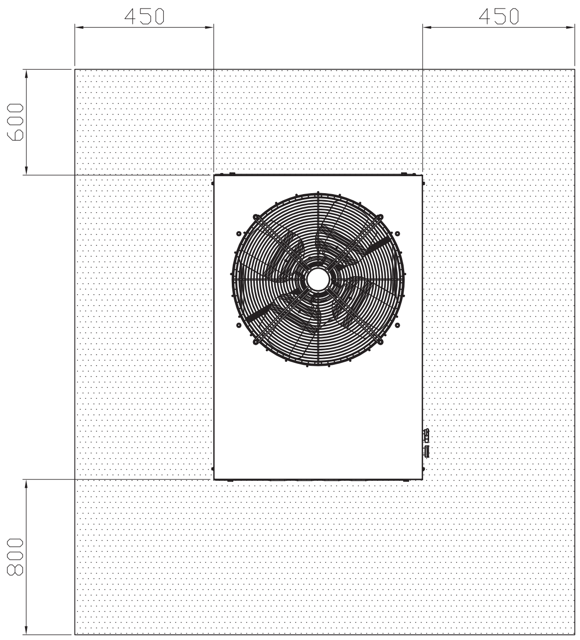
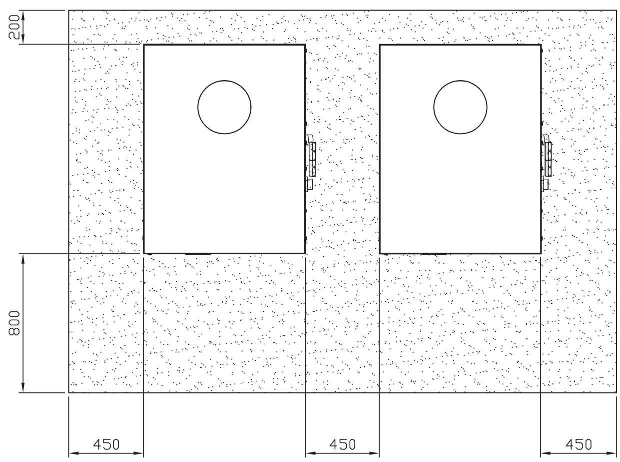


Figure 2.2 *Clearances*



3 MOUNTING BASE

3.1 MOUNTING BASE CONSTRUCTIVE FEATURES

- ► Place the appliance on a levelled flat surface made of fireproof material and able to withstand its weight.

3.2 INSTALLATION AT GROUND LEVEL

- ► Failing a horizontal supporting base, make a flat and levelled concrete base, at least 150 mm larger than the appliance size per side.

3.3 INSTALLATION ON TERRACE OR ROOF

- ► The structure of the building must support the total weight of the appliance and the supporting base.
- ► If necessary, provide a maintenance walkway around the appliance.

3.4 ANTI VIBRATION MOUNTINGS

Although the appliance's vibrations are minimal, resonance phenomena might occur in roof or terrace installations.

- ► Use anti-vibration mountings.
- ► Also provide anti-vibration joints between the appliance and water and gas pipes.

1 HYDRAULIC SYSTEM

1.1 DESIGN AND IMPLEMENTATION

The system must be designed and installed consistently with the features and functions of the individual unit or RT_ preassembled group.

- Especially pay attention to variable or constant flow rate operation of the units (see Paragraph 1.5 *p. 4*)

Sizing of the water piping and any circulation pump must assure the required nominal water flow for correct operation of the unit or RT_ preassembled group:

- For the pressure drop data of individual units, refer to Section B
- For the pressure drop data of RT_ preassembled groups, refer to Section C1.02
- For the data of circulating pumps, refer to Section C1.05

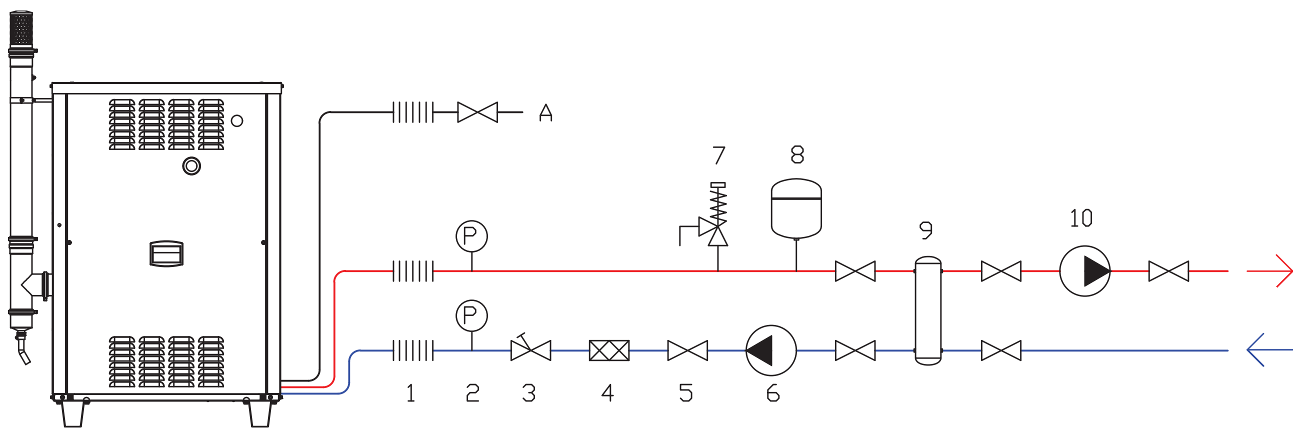
1.2 PRIMARY AND SECONDARY CIRCUIT

In many cases it is advisable to divide the hydraulic system into two parts, primary and secondary circuit(s), uncoupled by a hydraulic separator, or possibly by a tank that also acts as inertial volume/thermal inertia.
Installation of inertial volume/thermal inertia is recommended if the system has low water content.
For indications on sizing the inertial volume/thermal inertia refer to Paragraph 1.4 *p. 4*.
For further information on the buffer tank and hydraulic separator refer to Section C1.08.

1.3 WATER FLOW

The individual units are always supplied without circulating pumps, which must be appropriately selected on the basis of the unit features and its connected circuit (possibly from those listed as optional features in the catalogue).
Figure 1.1 *p. 1* shows an example of plumbing diagram for an individual aerothermal unit.

Figure 1.1 *Hydraulic plan*

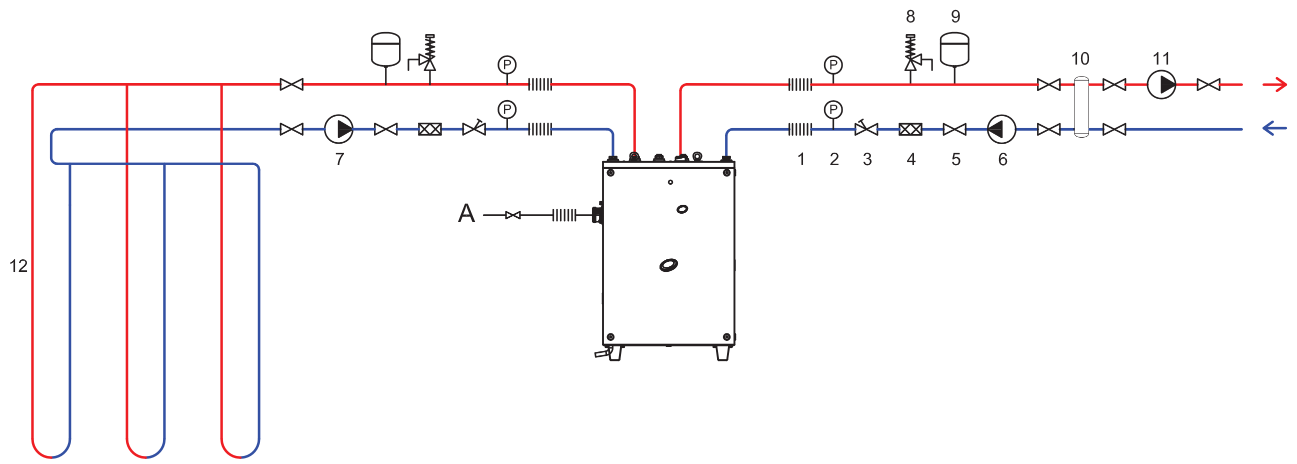


The flow regulator valve must only be used when the primary circuit circulation pump is constant flow type

A Gas connection
1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valves
6 Water pump (primary circuit)
7 Safety valve (3 bar)
8 Expansion tank
9 Hydraulic separator / inertial tank with 4 fittings
10 Water pump (secondary circuit)

Figure 1.2 *p. 2* shows an example of plumbing diagram for an individual GAHP GS HT unit.

Figure 1.2 *GAHP GS Water diagram*

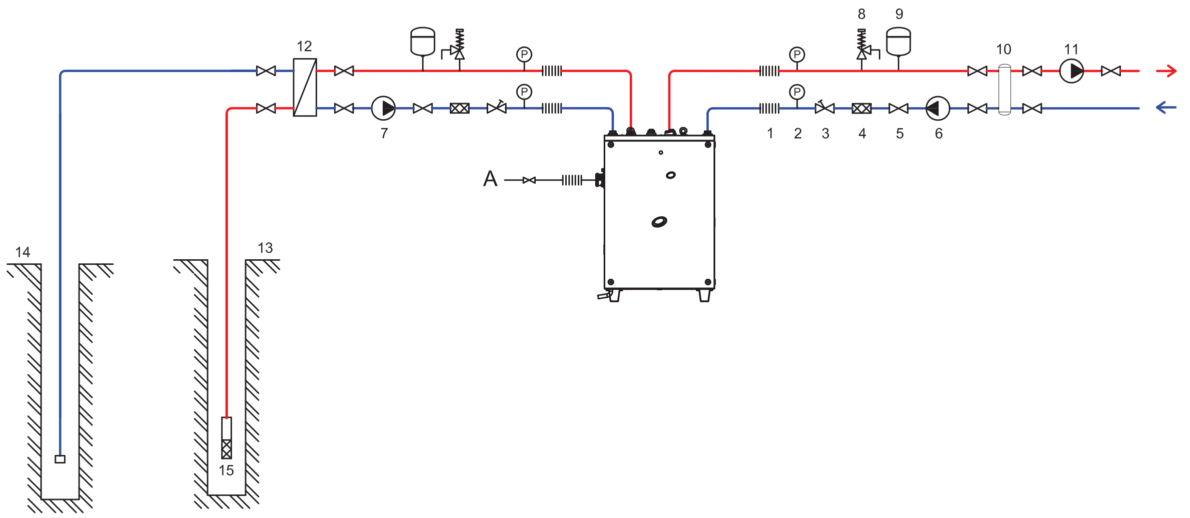


The flow regulator valve must only be used when the primary circuit circulation pump is constant flow type

A Gas connection
1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valves
6 Hot side circulation pump (primary circuit)
7 Cold side circulation pump (primary circuit)
8 Safety valve (3 bar)
9 Expansion tank
10 Hydraulic separator/4-pipe buffer tank
11 Hot side circulation pump (secondary circuit)
12 Geothermal field probes

Figure 1.3 *p. 2* shows an example of plumbing diagram for an individual GAHP WS unit.

Figure 1.3 *GAHP WS Water diagram*



The flow regulator valve must only be used when the primary circuit circulation pump is constant flow type

A Gas connection
1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valves
6 Hot side circulation pump (primary circuit)
7 Cold side circulation pump (primary circuit)
8 Safety valve (3 bar)
9 Expansion tank
10 Hydraulic separator/4-pipe buffer tank
11 Hot side circulation pump (secondary circuit)
12 Heat exchanger
13 Pumping sump
14 Drain sump
15 Submersible pump

The primary circulating pumps for single units must be controlled by the unit electronic board (see Section B for the specific unit involved).

The RT_ preassembled group may be:

► already fitted with circulating pumps for each individual appliance/module (preferrable configuration in a number of applications)
► without circulating pumps, in which case it is required to install at least one common circulation pump, on the primary circuit (option to be assessed carefully)

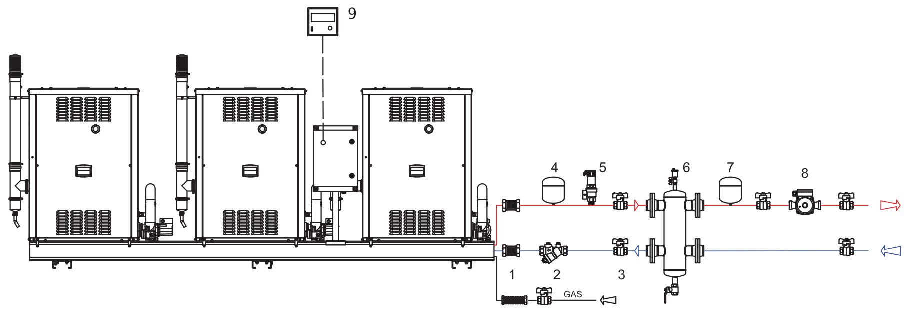
Figures 1.4 *p. 3* and 1.5 *p. 3* show examples of plumbing diagrams of preassembled groups with independent circulating pumps.
Figures 1.6 *p. 4* and 1.7 *p. 4* show examples of plumbing diagrams of preassembled groups without circulating pumps (with common circulating pump, not supplied with the preassembled group).

The common circulating pump does not allow the water flow to bypass generators that are temporarily turned off from normal cascade control.

Under partial load conditions, it is not therefore possible to ensure the general setpoint is reached and maintained.
With high delivery setpoint, GAHP units may exceed their operative limits to offset the mixing that is brought about with inactive units.
The solution with common circulating pump is therefore recommended only if the thermal or cooling load applied is constant in any operating condition.

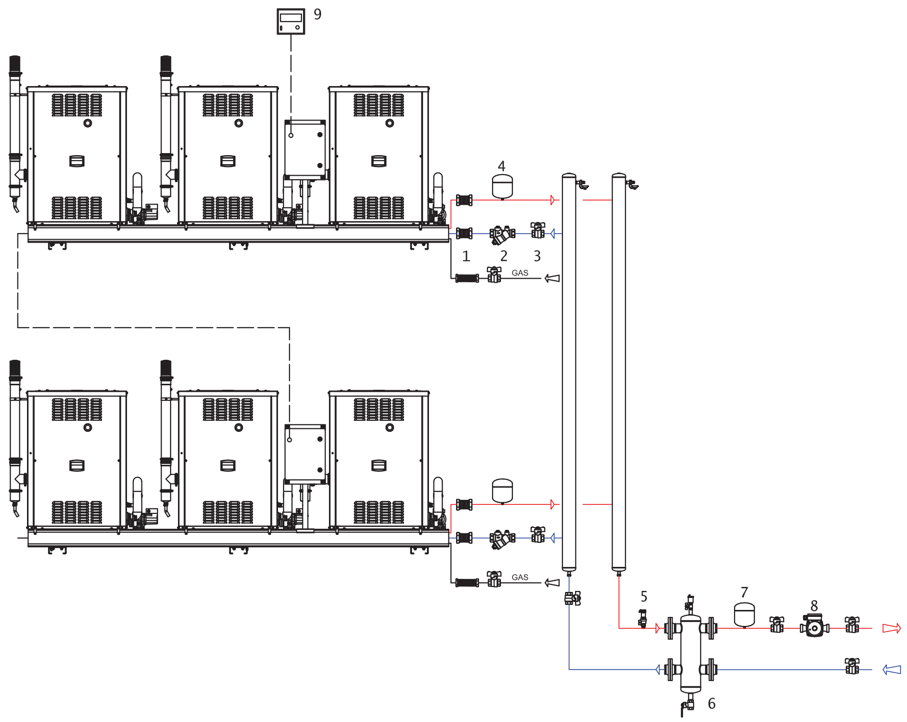
The common primary circulating pump must be controlled by the request on the preassembled group electrical panel (see Section C1.02).

Figure 1.4 *Example of hydraulic system diagram for connection of n. 1 RTCR version with circulating pumps*



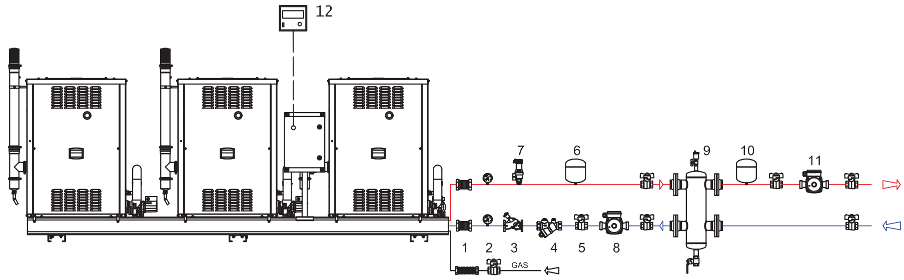
1 anti-vibration connections
2 water filter (mesh min. 0.7 mm and max 1 mm)
3 shut-off valve
4 expansion tank of the primary circuit
5 3 bar safety valve
6 hydraulic separator (with air vent valve and drain cock)
7 expansion tank of the secondary circuit
8 circulating pump of the secondary circuit
9 DDC control panel

Figure 1.5 *Example of hydraulic system diagram for connection of n. 2 RTCR, version with circulating pumps*



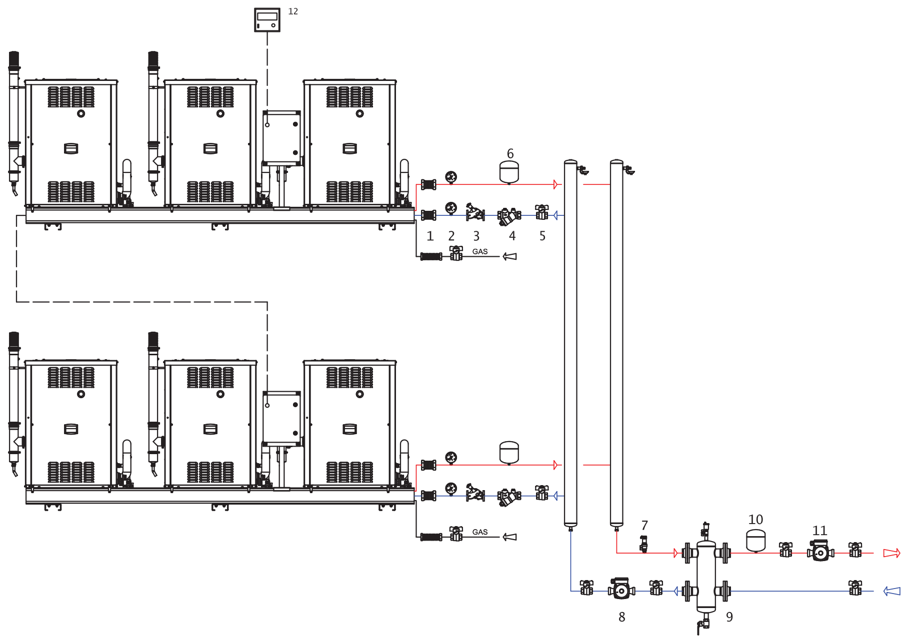
1 anti-vibration connections
2 water filter (mesh min. 0.7 mm and max 1 mm)
3 shut-off valve
4 expansion tank of the primary circuit
5 3 bar safety valve
6 hydraulic separator (with air vent valve and drain cock)
7 expansion tank of the secondary circuit
8 circulating pump of the secondary circuit
9 DDC control panel

Figure 1.6 *Example of hydraulic system diagram for connection of n. 1 RTCR version without circulating pumps*



1 anti-vibration connections
2 pressure gauge
3 flow regulator valve
4 water filter (mesh min. 0.7 mm and max 1 mm)
5 shut-off valve
6 expansion tank of the primary circuit
7 3 bar safety valve
8 primary circuit circulating pump
9 hydraulic separator (with air vent valve and drain cock)
10 expansion tank of the secondary circuit
11 circulating pump of the secondary circuit
12 DDC control panel

Figure 1.7 *Example of hydraulic system diagram for connection of n. 2 RTCR version without circulating pumps*



1 anti-vibration connections
2 pressure gauge
3 flow regulator valve
4 water filter (mesh min. 0.7 mm and max 1 mm)
5 shut-off valve
6 expansion tank of the primary circuit
7 3 bar safety valve
8 primary circuit circulating pump
9 hydraulic separator (with air vent valve and drain cock)
10 expansion tank of the secondary circuit
11 circulating pump of the secondary circuit
12 DDC control panel

1.4 PRIMARY CIRCUIT WATER CONTENT

It is required to assure a minimum water volume in the primary circuit equal to at least 70 litres for each intended GAHP module, GA ACF or AY00-120, both on the conditioning and renewable source circuit (only for systems with GAHP GS/WS), in order to absorb the energy (heating or cooling) delivered by the unit in the switch-off stage.
In order to provide thermal inertia to the system, especially in low load conditions, and consequently optimise performance, it is possible to provide a greater water volume, according to the details in Section C1.08.

1.5 CONSTANT OT VARIABLE WATER FLOW

Units GAHP A and GAHP GS/WS are able to operate with constant or variable water flow (only on the hot side) regardless of operative mode, ON/OFF or modulating.
All other single units may only work with constant water flow.
The RT_ preassembled groups fitted with independent circulating pumps work at variable flow, as only the circulating pumps of the actually active modules are on.
The RT_ preassembled groups without independent circulating pumps, however, work at constant flow.

2 HYDRAULIC CONNECTIONS

2.1 PLUMBING FITTINGS

The water connections are detailed in the technical data tables of the individual units (see Section B) or of the RT_ preassembled group (see Section C1.02).
The connections of the preassembled group may be moved to the left side by moving the blind plugs supplied.

2.2 HYDRAULIC PIPES, MATERIALS AND FEATURES

Use pipes for heating/cooling installations, protected from weathering, insulated for thermal losses, with vapour barrier to prevent condensation.

Pipe cleaning

Before connecting the units, accurately wash the water and gas piping and any other system component, removing any residue.

2.3 MINIMUM COMPONENTS OF PRIMARY PLUMBING CIRCUIT

Always provide, near the water connections of the unit or preassembled group:

— on water piping, both output and input (m/r)
- 2 antivibration joints on water fittings;
- 2 pressure gauges;
- 2 isolation ball valves;

— on the input water piping (r)
- 1 separator filter;
- 1 flow regulation valve, if the circulation pump is with constant flow;
- 1 water circulation pump, with thrust towards the appliance (only for single units and preassembled groups without circulating pumps);

— on the output water piping (m)
- 1 safety valve (3 bar);
- 1 expansion tank (for the single unit or preassembled group).

Both components must be installed before any isolation valves, so they cannot be bypassed

— on the inlet gas piping (r)
- 1 Anti-vibration connection;
- 1 Isolation ball valves

For GAHP WS units with open circuit it is always mandatory to use a heat exchanger on the renewable source side

See Paragraph 1.3 *p. 1* for example water diagrams.

3 SPECIFICATIONS OF DIVERTER VALVES

Table 3.1 *p. 5* shows the minimum and maximum flow rate to be assured to Robur units in all operating conditions, hence also during the switching stage of any diverter valves installed on the system.
These flow rates are valid both for DHW separation valves and for hot/cold switching valves.
The valve (hence its kvs indicating pressure drops) must consequently be selected in connection with the required flow rates, so that the indicated flow rate range is complied with even in the switching stage.

Table 3.1 *Diverter valves water flow*

			GAHP GS/WS		GAHP A	AY00-120	GA ACF		GAHP-AR
			GAHP WS	GAHP GS HT				ACF 60-00 LB	
Heating mode									
Heating water flow	minimum	l/h	1400		1400	1500			2500
	maximum	l/h	4000		4000	3200			3500
Operation in conditioning mode									
Water flow rate	minimum	l/h					2500	2300	2500
	maximum	l/h					3500	2900	3500
Renewable source operating conditions									
Renewable source water flow rate	minimum	l/h	2300						
	maximum	l/h	4700						
Renewable source water flow rate (with 25% glycol)	minimum	l/h		2000					
	maximum	l/h		4000					

4 DEFROSTING WATER DRAINAGE

Defrosting

In winter, frost may form on the finned coil of aerothermal heat pumps and the appliance performs defrosting cycles.

4.1 COLLECTION BASIN AND DRAINAGE SYSTEM

Provide for a collection basin or containment rim and a discharge system of the defrosting water, to avoid overflowing, icing and damage.

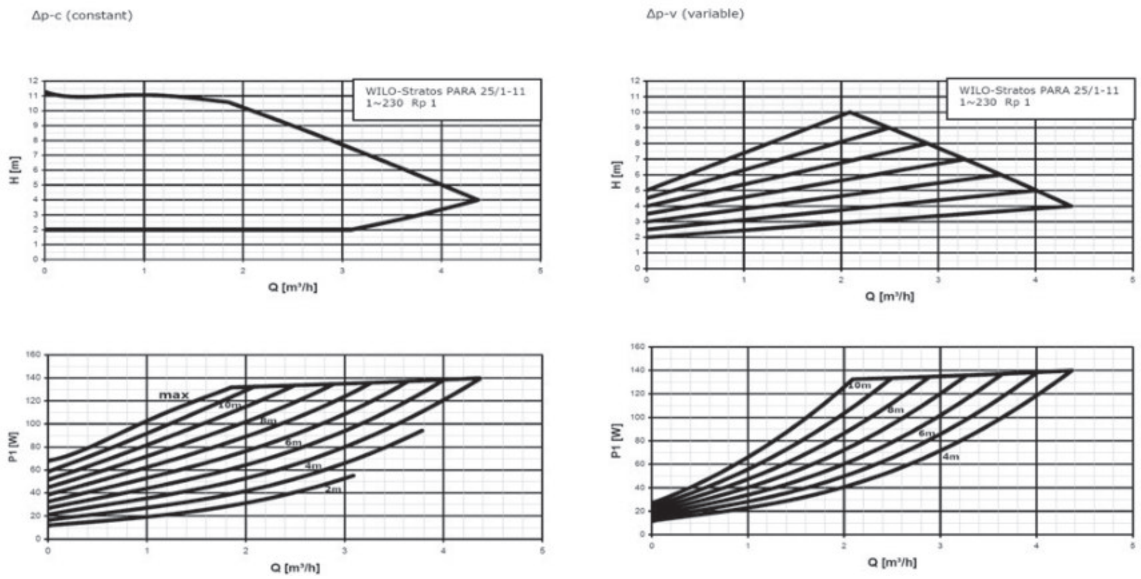
1 SINGLE UNITS

For single units the circulating pumps are always supplied as an optional and may only be high efficiency modulating type, in standard version or with oversized pressure head.

1.1 STANDARD MODULATING CIRCULATING PUMPS

The graph in Figure 1.1 *p. 1* gives the data regarding the useful head and power draw of a single standard modulating circulator.

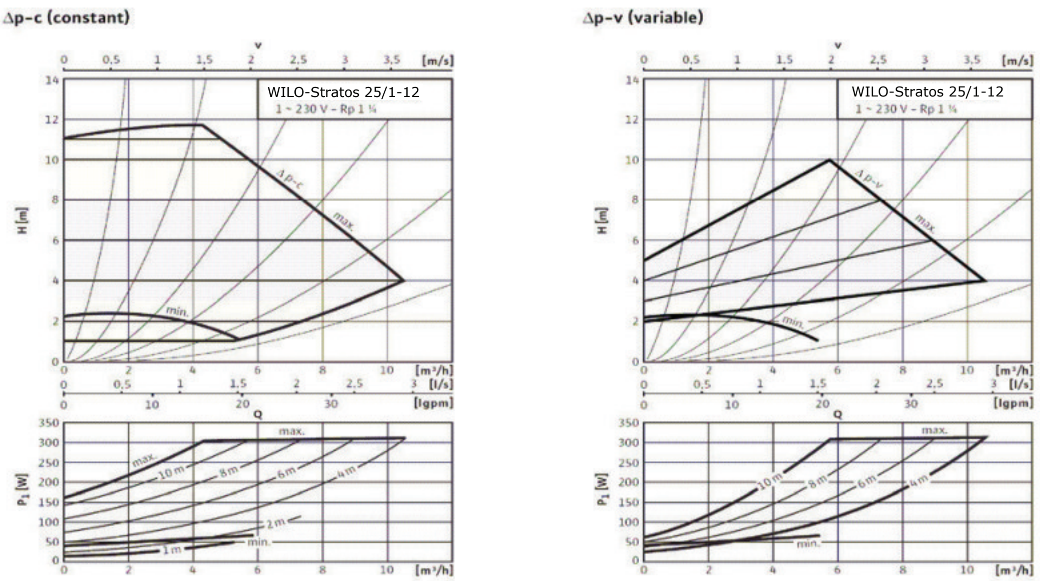
Figure 1.1 *Standard modulating circulating pump characteristic curves*



1.2 OVERSIZED PRESSURE HEAD MODULATING CIRCULATING PUMPS

The graph in Figure 1.2 *p. 1* gives the data regarding the useful head and power draw of a single standard modulating circulator.

Figure 1.2 *Oversized modulating circulating pump characteristic curves*



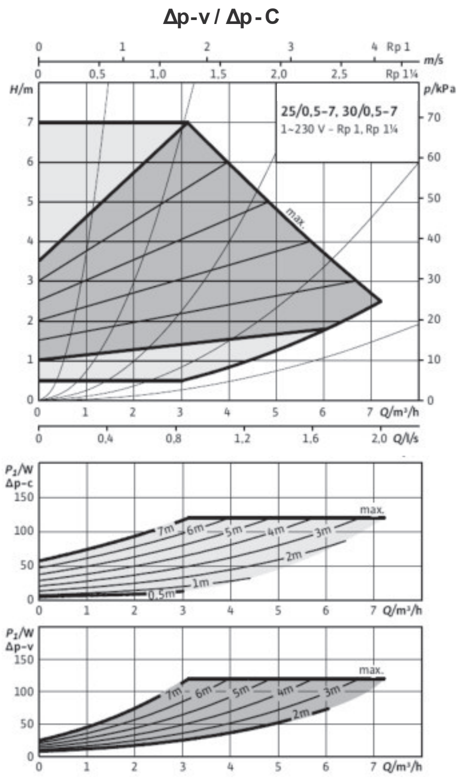
2 PREASSEMBLED GROUPS

For preassembled groups, available configurations are with or without circulating pumps, which may also be standard or with oversized pressure head.

2.1 SINGLE STANDARD CIRCULATING PUMPS

The graph in Figure 2.1 *p. 2* gives the data regarding the useful head and power draw of a single standard circulator.

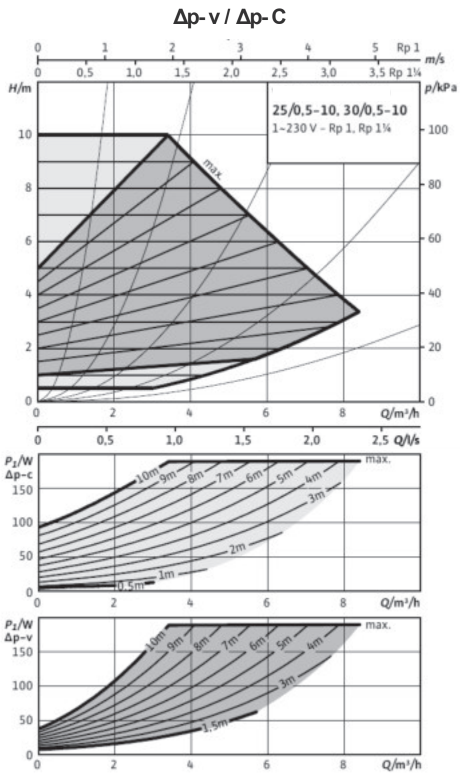
Figure 2.1 *Standard single circulating pump characteristic curves*



2.2 SINGLE OVERSIZED PRESSURE HEAD CIRCULATING PUMPS

The graph in Figure 2.2 *p. 2* sets out the data of useful pressure head and electrical consumption of the single oversized pressure head circulating pump.

Figure 2.2 *Oversized pressure head circulating pump characteristic curves*



1 SYSTEM WATER CHARACTERISTICS

Free chlorine or water hardness may damage the appliance. Adhere to the chemical-physical parameters in Table 1.1 *p. 1* and the regulations on water treatment for residential and industrial heating systems.

Table 1.1 *Chemical and physical parameters of water*

CHEMICAL AND PHYSICAL PARAMETERS OF WATER IN HEATING/COOLING SYSTEMS		
PARAMETER	**UNIT OF MEASUREMENT**	**ALLOWABLE RANGE**
pH	/	> 7 (1)
Chlorides	mg/l	< 125 (2)
Total hardness ($CaCO_3$)	°f	< 15
	°d	< 8.4
Iron	mg/kg	< 0,5 (3)
Copper	mg/kg	< 0,1 (3)
Aluminium	mg/l	< 1
Langelier's index	/	0-0,4
HARMFUL SUBSTANCES		
Free chlorine	mg/l	< 0,2 (3)
Fluorides	mg/l	< 1
Sulphides		ABSENT

1 with aluminium or light alloys radiators, pH must also be lower than 8 (in compliance with applicable rules)
2 value referred to the maximum water temperature of 80 °C
3 in compliance with applicable rules

2 CHOICE OF TREATMENT

The features of the plant water must be as detailed in the 1 *p. 1* section.
The choice of a possible chemical conditioning system or the addition of plant water additives is subject to the designer, depending on the quality of water detected by qualified personnel.

It must always be verified (through the technical office of the company producing the additive) that adding it to the plant water does not cause any such alterations to come out of the required parameters.

3 WATER TOPPING UP

The chemical-physical properties of the system's water may alter over time, resulting in poor operation or excessive topping up.

► Ensure there are no leaks in the installation.
► Periodically check the chemical-physical parameters of the water, particularly in case of automatic topping up.

Chemical conditioning and washing

Water treatment/conditioning or system washing carried out carelessly may result in risks for the appliance, the system, the environment and health.

- Contact specialised firms or professionals for water treatment or system washing.
- Check compatibility of treatment or washing products with operating conditions.
- Do not use aggressive substances for stainless steel or copper.
- Do not leave washing residues.

1 ANTIFREEZE FUNCTION

1.1 ACTIVE ANTIFREEZE SELF-PROTECTION

The appliance is equipped with an active antifreeze self-protection system to prevent icing.
The antifreeze function (on by default) automatically starts the primary circulation pump (if controlled by the unit) and, if required, the burner as well (in heating mode), when the outdoor temperature or water temperature in the system gets close to zero.

Electrical and gas continuity

The active antifreeze self-protection is only effective if the power and gas supplies are assured. Otherwise, antifreeze liquid might be required.

Unit ACF 60-00 HR

The GA ACF units version HR are fitted with antifreeze function for the conditioning circuit, while the recovery circuit has no antifreeze function.
The recovery circuit antifreeze protection must therefore be assured with alternative methods if not used (e.g. by adding antifreeze liquid or by starting up the circulation pump with timer or thermostat).

Unit AY00-120

The function is double, both for the water circuit inside the appliance, and for the system's water circuit.
The function concerning the internal circuit cannot be disabled as it is also used to protect the electronic components.

Secondary circuit

Arrange for appropriate measures to prevent water freezing in any secondary side circuits not used in winter (e.g. controlling, by timer or thermostat, the operation of the circulating pumps in that branch of the system).

2 ANTIFREEZE LIQUID

Precautions with glycol

- ► Always check product suitability and its expiry date with the glycol supplier. Periodically check the product's preservation state.
- ► Do not use car-grade antifreeze liquid (without inhibitors), nor zinc-coated piping and fittings (incompatible with glycol).
- ► Glycol modifies the physical properties of water (density, viscosity, specific heat...). Size the piping, circulation pump and thermal generators accordingly.
- ► Do not use zinc-plated piping or unions because they might be subject to corrosion if exposed to glycol.
- ► With automatic system water filling, a periodic check of the glycol content is required.

With high glycol percentage (> 20…30%)

If the glycol percentage is ≥30% (for ethylene glycol) or ≥20% (for propylene glycol) the TAC must be alerted before first start-up.

When producing DHW by DHW buffer tank, use propylene glycol only.

Used with chilled water under 3°C

Glycol may still be required, if the chilled water flow temperature is equal to or less than 3°C.

2.1 TYPE OF ANTIFREEZE GLYCOL

Inhibited type glycol is recommended to prevent oxidation phenomena.

2.2 GLYCOL EFFECTS

The Table 2.1 *p. 1* shows, indicatively, the effects of using a glycol depending on its %.

Table 2.1 *Technical data for filling the hydraulic circuit*

GLYCOL %	WATER-GLYCOL MIXTURE FREEZING TEMPERATURE	PERCENTAGE OF INCREASE IN PRESSURE DROPS	LOSS OF EFFICIENCY OF UNIT
10	-3 °C	-	-
15	-5 °C	6,0%	0,5%
20	-8 °C	8,0%	1,0%
25	-12 °C	10,0%	2,0%
30	-15 °C	12,0%	2,5%
35	-20 °C	14,0%	3,0%
40	-25 °C	16,0%	4,0%

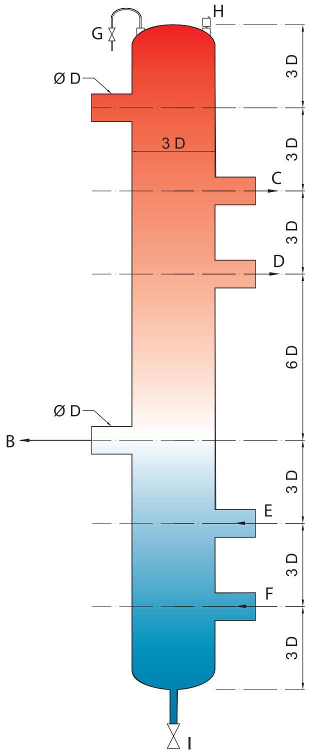
1 HYDRAULIC SEPARATOR

The hydraulic separator is used to make the primary and secondary circuit independent, to prevent interferences and mutual disruptions, especially when the flow rates on the circuits are different.
The separator cannot replace the buffer tank, except where it has an adequate volume (see Paragraph 2 *p. 2*).
The hydraulic separator should have the following features:

- Maximum water speed in the separator 0.1 m/s;
- Maximum water speed in inlet/outlet 0.9 m/s;
- Branch connections for circuits at higher temperature upwards (for heating applications);
- In case of several take-off points at the same temperature use a single branch connection and install a distribution manifold.

Sizing must be carried out on the basis of the maximum flow rate between primary and secondary.
For optimal sizing it is recommended to follow the so-called "3 D" rule, shown in Figure 1.1 *p. 1*.
This is based on the diameter D of the hydraulic separator's connections to define the dimensional features and position of the branch connections, based on multiples of the diameter.
Figure 1.1 *p. 1* shows the use for heating applications.
For conditioning applications, the inlet of the primary circuit should be at the bottom, so that natural circulation does not trigger parasitic mixing phenomena.
Similarly, for conditioning applications, branch connections at lower temperature must be at the bottom and those at higher temperature must be at the top.

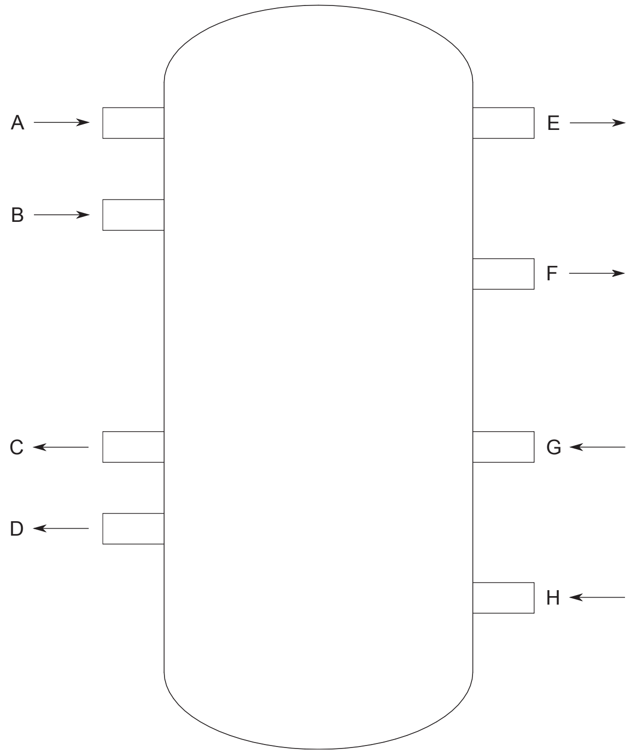
Figure 1.1 *6-connection hydraulic separator*



A Hot primary circuit delivery
B Hot primary circuit return
C High temperature secondary circuit delivery
D Low temperature secondary circuit delivery
E High temperature secondary circuit return
F Low temperature secondary circuit return
G Manual air vent
H Automatic air vent
I Sludge purge

If different types of generators are installed on the primary circuit, connected to the same separator, one should refer to Picture 1.2 *p. 1*, related to heating applications.
Branch connections at higher temperature, on inlet or outlet, must be positioned higher, in order to prevent excessively hot water reaches the heat pumps from the boilers.

Figure 1.2 *8-connection hydraulic separator*



A Boiler primary circuit delivery
B GAHP primary circuit delivery
C Boiler primary circuit return
D GAHP primary circuit return
E High temperature secondary circuit delivery
F Low temperature secondary circuit delivery
G High temperature secondary circuit return
H Low temperature secondary circuit return

2 BUFFER TANK

The buffer tank has the purpose of providing thermal inertia to the system, especially in low load conditions, thus reducing the number of heat generators ON/OFF, particularly significant for the system general efficiency.
In the appropriate plumbing configuration, it may also be used as hydraulic separator (see Paragraph 1 *p. 1*).
The buffer tank may also be used for disposing of thermal and cooling power during unit switching off, in order to prevent the water temperature to rise or drop excessively.

The heating or cooling energy accumulated during normal operation of the system, which also depends on the buffer tank capacity, can only be exploited effectively with a control system which, on the basis of the secondary temperature, switches off the generation system and relevant circulating pumps and chokes the water flow on the secondary circuit, for example by means of mixing valves.

Failing this type of control system, the buffer tank is unable to prevent the units from switching off, regardless of the buffer tank size, as soon as the set-point temperature is reached, without being able to store energy hence running the risk of triggering a high number of switching ON/OFF especially in the event of low load.
For more information on control systems Robur see Section C1.12.

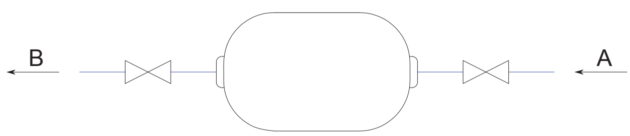
Buffer tanks are divided into:
- in line (2 connections) (see Paragraph 2.1 *p. 2*);
- with hydraulic separation (3 or 4 connections) (see Paragraph 2.2 *p. 2*).

It is required to assure a minimum water volume in the primary circuit equal to <u>at least 70 litres for each intended</u> GAHP module, GA ACF or AY00-120, both on the conditioning and renewable source circuit (only for systems with GAHP GS/WS), in order to absorb the energy (heating or cooling) delivered by the unit in the switch-off stage.
The recommended dimensions for optimising efficiency by reducing the number of ON/OFF switching are however greater:
- Single unit: 300÷500 litres;
- Multiple units: from 500 to 1000 litres in total.

2.1 IN LINE BUFFER TANK

The in line buffer tank, or 2-connection buffer tank, only has the purpose of storing the heating and/or cooling energy.
It must be installed on return to the units, preferably before the circulation pumps.
Figure 2.1 *p. 2* schematically shows an in line buffer tank with 2 connections.

Figure 2.1 *2-connection inertial buffer tank*



A Distribution circuit return (or hydraulic separator)
B Circulation pumps return (or unit Robur)

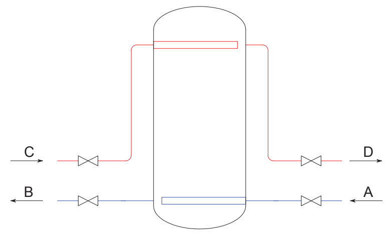
2.2 BUFFER TANK WITH HYDRAULIC SEPARATION

The buffer tank with hydraulic separation performs both functions of thermal buffer tank and hydraulic separator.
There are two types:
- 4 connections;
- 3 connections.

2.2.1 4 connections

The 4-connection buffer tank represents the most typical case of buffer tank with hydraulic separation functions.
Figure 2.2 *p. 2* shows an example of 4-connection buffer tank installation.

Figure 2.2 *4-connection inertial buffer tank*



A Secondary circuit return
B Primary circuit return
C Primary circuit delivery
D Secondary circuit delivery

One should ensure the selected buffer tank includes certain measures to reduce mixing the water flows inside the tank, consequently altering the temperatures and undermining comfort and efficiency:
- correct sizing (especially the relationship between height and diameter);
- installation of anti-mixing devices.

The main types of anti-mixing devices are:
- anti-mixing baffles (see Figure 2.3 *p. 2*);
- conveying pipes (see Figure 2.4 *p. 2*);
- diffuser pipes (see Figure 2.5 *p. 3*);

Figure 2.3 *Tank with dividing baffles*

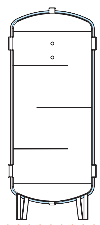


Figure 2.4 *Tank with conveying pipes*

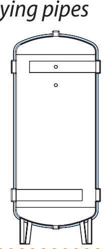
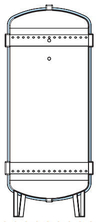


Figure 2.5 *Tank with diffuser pipes*



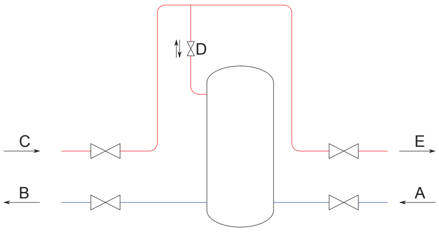
2.2.2 3 connections

The 3-connection buffer tank is actually identical to the more popular 4-connection one, except for the water connection.
A pipe section is installed, indicated by D in Figure 2.6 *p. 3*, featuring minimal pressure drop, where water may flow in both directions.
The water flow is:

- on buffer tank inlet if the primary circuit flow rate is higher than the secondary circuit;
- on buffer tank outlet if the primary circuit flow rate is lower than the secondary circuit.

For the buffer tank to also act as hydraulic separator, it is essential not to close the shut-off valve fitted on pipe D, which must only be closed for maintenance operations on the tank.

Figure 2.6 *3-connection inertial buffer tank*



A Secondary circuit return
B Primary circuit return
C Primary circuit delivery
D Pipe performing hydraulic separation, with shut-off valve
E Secondary circuit delivery

The significant advantage of this configuration, compared to the more popular 4-connection one, lies in the fact that when there are balanced flow rates the water flow is directly transferred from primary to secondary circuit, without mixing inside the buffer tank.
This is particularly useful in high temperature systems, where it is important to reduce temperature drops in order not to undermine the energy efficiency of heat pumps.
This configuration is also possible in cooling, provided the C, D, E sections are positioned at the bottom to better exploit thermal stratification.

2.3 BUFFER TANKS FOR CHILLED WATER

If the buffer tank (of any type) must be used also for chilled water, one should ensure it has specific surface treatments to prevent condensate formation leading to buffer tank decay in a short time.

1 GAS CONNECTION

- for single GAHP units and GA ACF: 3/4" GF
- for single units AY00-120 and groups Gitié: 3/4" GM
- for pre-assembled groups: 1" 1/2 F

on the right side, at bottom (see dimensional diagrams of individual units or preassembled group).

For preassembled groups the gas connection may be moved to the left side by moving the blind plug.

- Install an anti-vibration connection between the appliance and the gas piping.

2 MANDATORY SHUT-OFF VALVE

- Provide a gas shut-off valve (manual) on the gas supply line, next to the appliance, to isolate it when required.
- Perform connection in compliance with applicable regulations.

3 GAS PIPES SIZING

The gas pipes must not cause excessive load losses and, consequently, insufficient gas pressure for the appliance.

4 SUPPLY GAS PRESSURE

The appliance gas supply pressure, both static and dynamic, must comply with 4.1 *p. 1* Table below, with tolerance ± 15%.

Gas pressure non compliant with the Table may damage the appliance and be hazardous.

Table 4.1 *Gas network pressure*

		Gas supply pressure							
Product category	**Countries of destination**	**G20** [mbar]	**G25** [mbar]	**G30** [mbar]	**G31** [mbar]	**G25.1** [mbar]	**G25.3** [mbar]	**G27** [mbar]	**G2,350** [mbar]
$II_{2H3B/P}$	AL, BG, CY, CZ, DK, EE, FI, GR, HR, IT, LT, MK, NO, RO, SE, SI, SK, TR	20		30	30				
	AT, CH	20		50	50				
II_{2H3P}	BG, CH, CZ, ES, GB, HR, IE, IT, LT, MK, PT, SI, SK, TR	20			37				
	RO	20			30				
	AT	20			50				
$II_{2ELL3B/P}$	DE	20	20	50	50				
II_{2Esi3P}; II_{2Er3P}	FR	20	25		37				
$II_{2HS3B/P}$	HU	25		30	30	25 (1) (2)			
II_{2E3P}	LU	20			50				
$II_{2L3B/P}$	NL		25	30	30				
$II_{2EK3B/P}$	NL	20		30	30		25 (1) (2)		
$II_{2E3B/P}$	PL	20		37	37				
$II_{2ELwLs3B/P}$		20		37	37			20 (2)	13 (2)
$II_{2ELwLs3P}$		20			37			20 (2)	13 (2)
$I_{2E(S)}$; I_{3P}	BE	20	25		37				
I_{3P}	IS				30				
I_{2H}	LV	20							
$I_{3B/P}$	MT			30	30				
I_{3B}				30					

(1) GAHP-AR not approved for G25.1, G25.3 gases.

(2) GA ACF not approved for G25.1, G27, G2.350, G25.3 gases.

5 VERTICAL PIPES AND CONDENSATE

- Vertical gas pipes must be fitted with siphon and discharge of the condensate that may form inside the pipe.
- If necessary, insulate the piping.

6 LPG PRESSURE REDUCERS

With LPG the following must be installed:

- a first stage pressure reducer, close to the liquid gas tank;

- a second stage pressure reducer, close to the appliance.

1 FLUE GAS COLLECTION

According to the permitted type of installation, both individual units and preassembled groups may be connected to one or more flue(s).
For sizing the flue serving a single unit, refer to the data and informations in Section B of the specific product.
If sizing a flue serving several units, Table 1.1 *p. 2* below summarises the main combustion parameters for each single unit.
If sizing a flue serving several units, consider the following:

- The flues must be designed, sized, verified and realized by a qualified firm, with materials and components in accordance with regulations.
- Always provide the necessary sockets for smoke analysis in an accessible position.
- The GAHP A, GAHP GS/WS and AY00-120 modules are condensation units and require exhaust of the flue gas with appropriate piping, with forced draft and residual head shown in Table 1.1 *p. 2*.

If several forced draft appliances (GAHP A, GAHP GS/WS and AY00-120) are connected to a single flue, it is obligatory to install a check valve on the exhaust of each.

In case the flap valves are installed outside, an appropriate UV ray protection must be assured (if the valve is constructed in plastic material) as well as protection from potential winter freezing of condensate backflow into the siphon.

- GAHP/AY modules with different flue gas exhaust features cannot be connected to the same flue, but must be connected to different and separate flues.
- GAHP-AR modules are fitted with a combustion blower towards the combustion system, but the residual head indicated in Table 1.1 *p. 2* is sufficient only to reach the terminal of the exhaust kit supplied. If flue gas exhaust of GAHP-AR modules must be extended over the supplied kit, the pressure head at the exhaust kit terminal must be considered equal to 0 Pa.
- If the exhaust kit of GAHP-AR modules supplied with other types of flue is replaced, the residual head indicated in Table 1.1 *p. 2* must be considered.
- It is recommended to insulate the stainless steel flues of GAHP-AR units .

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

- The GA ACF units have no flue gas exhaust.

Table 1.1 *Combustion products characteristics*

			GAHP GS/WS	GAHP A	AY00-120	GA ACF	GAHP-AR
FUMES FLOW RATE							
Nominal thermal capacity	G20	kg/h	42	42	55	-	42
	G25	kg/h	42	42	62	-	42
	G25.1	kg/h	45	45	49	-	- (1)
	G27	kg/h	42	42	55	-	42
	G2.350	kg/h	42	42	56	-	42
	G30	kg/h	43	43	49	-	43
	G31	kg/h	48	48	56	-	42
Minimal thermal capacity	G20	kg/h	21	21	13	-	-
	G25	kg/h	21	21	15	-	-
	G25.1	kg/h	23	23	12	-	-
	G27	kg/h	21	21	13	-	-
	G2.350	kg/h	22	22	13	-	-
	G30	kg/h	22	22	12	-	-
	G31	kg/h	24	24	13	-	-
Flue temperature							
Minimal thermal capacity	G20	°C	46,0	46,0	71,6	-	-
	G25	°C	45,7	45,7	72,0	-	-
	G25.1	°C	46,0	46,0	71,0	-	-
	G27	°C	46,0	46,0	71,5	-	-
	G2.350	°C	46,8	46,8	72,0	-	-
	G30	°C	46,0	46,0	71,5	-	-
	G31	°C	46,0	46,0	71,5	-	-
Nominal thermal capacity	G20	°C	65,0	65,0	72,5	190,0	186,0
	G25	°C	63,6	63,6	72,0	193,9	178,0
	G25.1	°C	65,0	65,0	72,0	-	- (1)
	G27	°C	64,0	64,0	72,0	-	169,0
	G2.350	°C	62,7	62,7	72,0	-	165,0
	G30	°C	65,0	65,0	71,5	190,0	181,0
	G31	°C	65,0	65,0	72,5	181,0	190,0
Percentage CO_2 in fumes							
Nominal thermal capacity	G20	%	9,10	9,10	9,40	8,70	8,70
	G25	%	9,10	9,10	9,40	8,50	8,70
	G25.1	%	10,10	10,10	10,70	-	- (1)
	G27	%	9,00	9,00	9,35	-	8,54
	G2.350	%	9,00	9,00	9,15	-	8,48
	G30	%	10,40	10,40	12,40	9,30	10,20
	G31	%	9,10	9,10	10,60	9,10	10,50
Minimal thermal capacity	G20	%	8,90	8,90	8,90	-	-
	G25	%	8,90	8,90	8,90	-	-
	G25.1	%	9,60	9,60	10,20	-	-
	G27	%	8,50	8,50	8,90	-	-
	G2.350	%	8,70	8,70	8,80	-	-
	G30	%	10,10	10,10	11,50	-	-
	G31	%	8,90	8,90	10,20	-	-
Installation data							
NO_x emission class		-	5	5	5	4	5 (2)
NO_x emission		ppm	25,0	25,0	19,5	56,0	30,0 (3)
CO emission		ppm	36,0	36,0	8,4	17,0	23,0 (3)
Fume outlet	diameter (Ø)	mm	80	80	80	-	80
	residual head	Pa	80	80	100	-	12

(1) Not available.
(2) All values measured with G20 (natural gas) as reference gas.
(3) 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).

Table 1.2 *Type of installation*

		GAHP A			GAHP-AR	GAHP GS/WS	AY00-120	GA ACF
		GAHP A Indoor	GAHP A HT Standard	GAHP A HT S1				
Installation data								
type of installation	-	C13, C33, C43, C53, C63, C83	B23P, B33, B53P	B23, B53		C13, C33, C43, C53, C63, C83, B23P, B33	B32P, B33, B35P, C13, C33, C34, C53, C63, C83	-

1 ELECTRICAL DESIGN

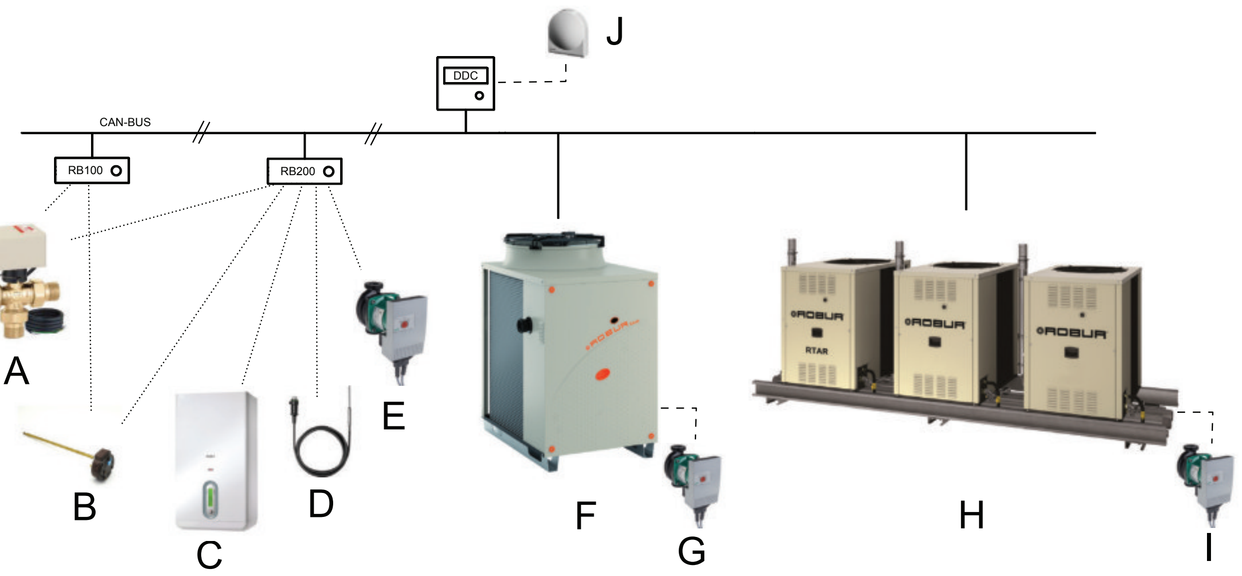
Electrical design is strictly connected to the units and control devices included in the project.

- ► For single units, refer to Section B;
- ► For RT_ preassembled groups , refer to Section C1.02;
- ► For Robur control systems , refer to Section C1.12.

1 DDC CONTROL ARCHITECTURE

The diagram shown in Figure 1.1 *p. 1* sets out the elements of the control system Robur based on the DDC Panel and the types of available connections.

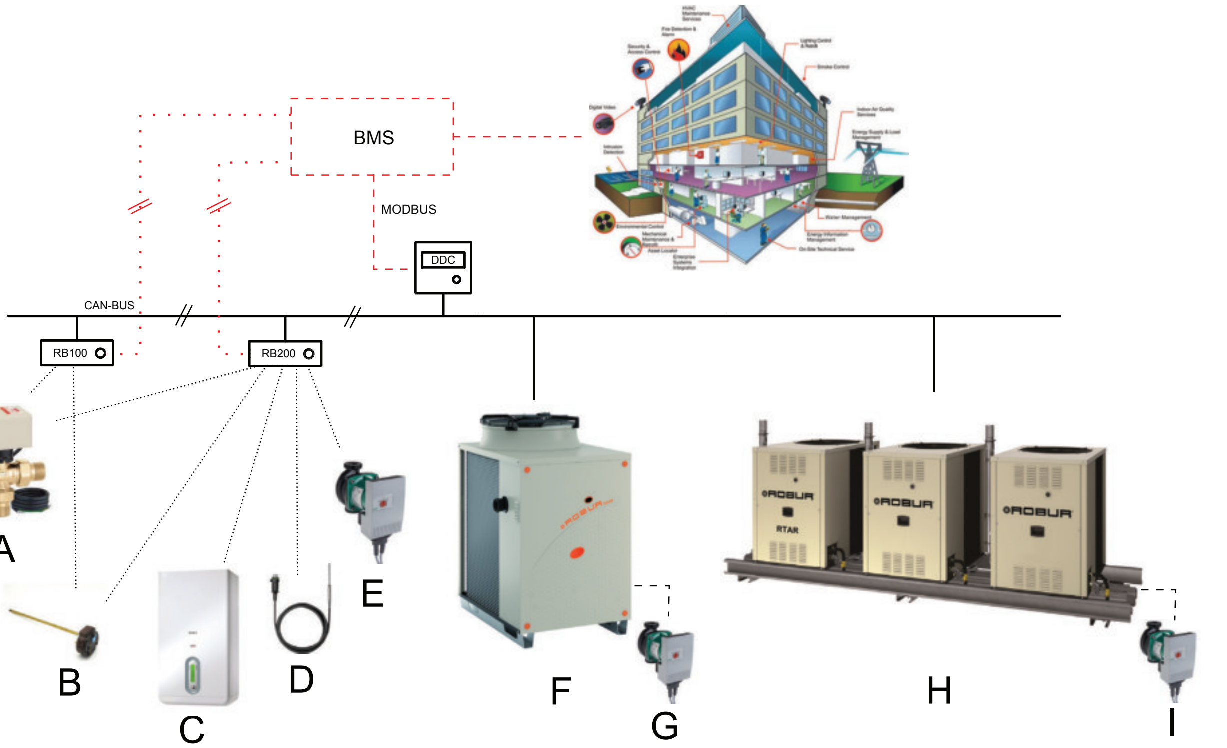
Figure 1.1 *DDC control architecture*



In solid line the CAN-BUS connection connecting control devices Robur
In dotted line the connection with analogue/digital signals connecting the RB100/RB200 devices with the objects that may be controlled by them
In dashed line the connections with analogue/digital signals between DDC and outdoor temperature probe and of unit Robur circulating pumps that must be controlled by the electronic boards inside the units
A ON/OFF type three-way diverting valves
B Thermostats
C Third party generators
D Temperature probes
E Secondary circulating pumps
F Single Robur units
G Single Robur units circulating pumps
H Robur preassembled groups
I Robur preassembled group circulating pumps (independent or common)
J Outdoor temperature probe

The Robur units and Robur control devices are always connected via CAN-BUS connections.
All connections towards other devices are effected via analogue signals (0-10 V or resistive probe readings) and digital signals.
The diagram shown in Figure 1.2 *p. 2* shows the elements of the control system and the types of available connections if the DDC Panel is installed and a users control system such as BMS, SCADA and similar.
Connection with the DDC Panel will always be via Modbus protocol, while any analogue/digital type signals from the BMS system (only useful if the BMS does not communicate via Modbus with the DDC Panel) will be connected to the RB100/RB200 devices.
Third party generators or other system components may be controlled by the DDC Panel (via the RB100/RB200 devices) or directly by the BMS.
Users control is always managed by the BMS.

Figure 1.2 *Control architecture with BMS*



In solid line the CAN-BUS connection connecting control devices Robur
In dotted line the connection with analogue/digital signals connecting the RB100/RB200 devices with the objects that may be controlled by them
In dashed line the connections with analogue/digital signals between DDC and outdoor temperature probe and of unit Robur circulating pumps that must be controlled by the electronic boards inside the units
In red dashed line the MODBUS connection between the DDC Panel and the fixture control system (BMS, SCADA, etc.)
In red dotted line the connection with analogue/digital signals connecting the fixture control system with the RB100/RB200 devices

A ON/OFF type three-way diverting valves
B Thermostats
C Third party generators
D Temperature probes
E Circulating pumps
F Single Robur units
G Single Robur units circulating pumps
H Robur preassembled groups
I Robur preassembled group circulating pumps (independent or common)

1.1 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 or CCP/CCI 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, CCI, ...), 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).

1.1.1 CAN-BUS signal cable

Robur control devices are connected between them and to their units via the CAN-BUS signal cable, shielded, compliant to Table 1.1 *p. 2* (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 1.1 *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	

2 DDC

The DDC controller is able to control the appliances, a single GAHP unit, or even several GAHP/GA/AY Robur units in cascade, only in ON/OFF mode (non modulating).
Each individual DDC Panel is able to manage up to 16 units
Up to 3 DDC panels may be coupled to control up to 48 units.

2.1 MAIN FUNCTIONS

The main functions of the DDC panel are:

1. regulation and control of one (or more) Robur units (GAHP, GA, AY) with ON/OFF unit control;
2. data display and parameters setting;
3. hourly programming;
4. climate curve control;
5. diagnostics;
6. errors reset;
7. possibility to interface with a BMS;

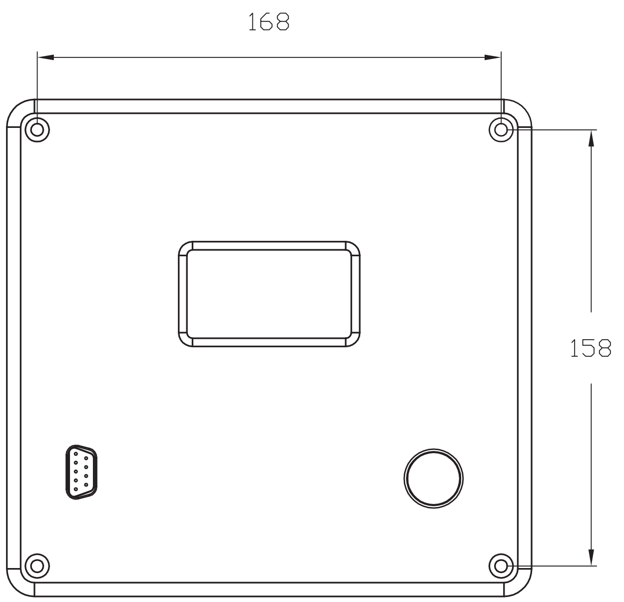
DDC functionality may be extended with auxiliary Robur devices RB100 and RB200 (e.g. service requests, DHW production, Third Party generator control, probe control, system valves or circulating pumps, ...).
Below is a synthetic description of the main DDC Panel functions:

1. Regulation and control of one (or more) unitsRobur makes it possible to manage cascade operation of the various types of appliance, using the more efficient ones with priority.
2. Values view and parameters setting allow you to optimize the adjustment parameters in order to best exploit the efficiency of the absorption technology, while safeguarding user comfort.
3. The hourly programming makes it possible to turn the generation system on only if an actual service request is expected, preventing fuel waste.
4. Weather curve management, both in winter and summer, makes it possible to only deliver the energy actually required in the specific environmental conditions. This on one hand prevents wasting energy when the conditioning system does not require it, and on the other it makes it possible to prevent appliances from stopping in conditions of limit thermostating due to the applied load being too low with respect to the temperature set on the DDC Panel.
5. Diagnostics lets you know at any time the operating status, warnings or errors of appliances and identify the possible causes of any malfunctions, as well as manage a log of recorded events.
6. The error reset lets you restore appliance availability following resolution of an error that involved shutdown by the control system.
7. The BMS interfacing option (or other external supervision and control system) makes it possible to manage the DDC Panel (and the appliances controlled by it) through an external device, within more complex and integrated domotics or integrated building/installation control systems. In practice, interfacing is carried out either via simple analogue/digital signals, or (more comprehensively) via the Modbus protocol, detailed in Paragraph 2.5 *p. 7*.

2.2 INSTALLATION

The DDC Panel is suitable for internal installation and must be fixed onto an electrical panel, into which a 155 x 151 mm rectangular opening must be made.
Figure 8.2 *p. 34* indicates the position of the fixing holes.

Figure 2.1 *DDC/CCI front view with fixing dimensions*

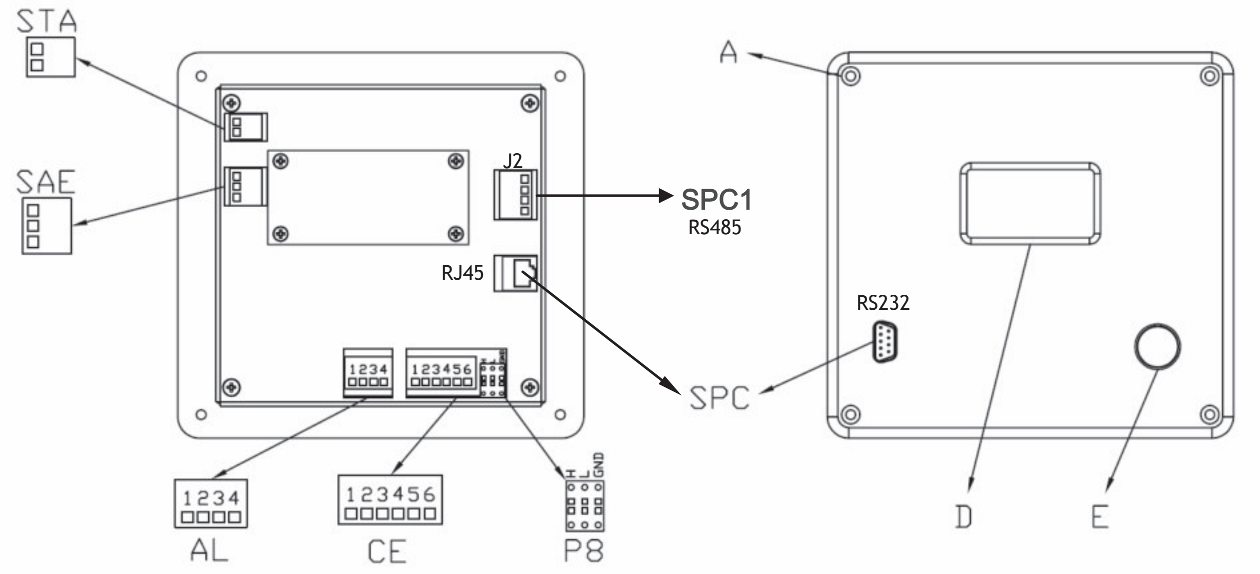


The DDC Panel has IP20 degree of protection, and must be installed in premises with ambient air temperature between 0°C and 50°C, away from direct sunlight exposure.

2.3 CONNECTIONS

The DDC Panel provides the connection terminals shown in Picture 2.2 *p. 4*.

Figure 2.2 *Detail of DDC connectors*



On the right the front view, on the left the rear view of the DDC Panel
STA = Outdoor temperature probe NTC 10k - 2-pole connector
SAE = Output for external alarm systems - 3-pole connector, max 24V voltage
- 1 = COM
- 2 = NO
- 3 = NC

AL = 24Vac electrical power supply - 4 pole connector
- 1 = 24Vac
- 2 = 0Vac
- 3 = earth

CE = External requests - 6-pole connector
- 1 = R (24Vac output)
- 2 = W (heating request)
- 3 = Y (conditioning request)
- 4 = 0 (0Vac)
- 5 = NA (not connected)
- 6 = R (24Vac output)

P8 = CAN-BUS network connector (orange)
SPC = RS232 serial port
- RJ45 (connection MODBUS / supervision system / monitoring)
- DB9 (connection MODBUS / supervision system / monitoring)

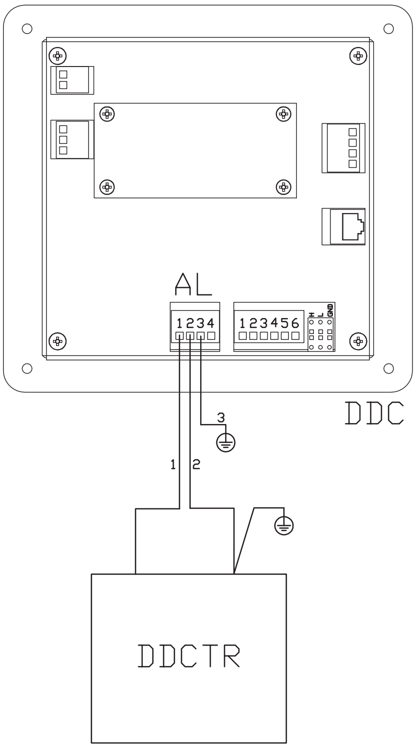
SPC1 = J2 port (MODBUS protocol RS485):
- 1 = A (TXD/RXD +)
- 2 = B (TXD/RXD -)
- 3 = Common (earth & GND)
- 4 = Cable shielding (earth & GND)

A = DDC fixing holes
E = Encoder
D = Display

2.3.1 Electrical power supply

The DDC Panel must be supplied by a 230/24 V AC - 50/60 Hz safety transformer with power no less than 20 VA (not supplied); in particular, this transformer must comply with standard EN 61558-2-6.
Use a 3 x 0.75 mm2 electrical connecting cable and make the connections on the terminals of the 4-pole connector located at the bottom left of the DDC rear, complying with the polarity as shown in Picture 2.3 *p. 5*.
The maximum specified length for this cable is 1m.

Figure 2.3 *DDC power supply*



AL = 24 Vac electrical power supply - 4 pole connector
- 1 = 24 Vac
- 2 = 0 Vac
- 3 = earth

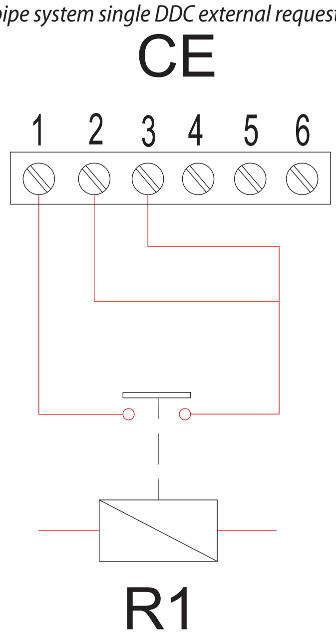
DDCTR = Safety transformer (240/24 Vac - 50/60 Hz - min 20 VA)

2.3.2 Inputs/Outputs

External requests

Switching on/off of the appliances controlled by the DDC Panel may be managed via a general external request.
To use this function it is required to appropriately configure the DDC Panel and set up the electrical connections as detailed in the following Pictures.
Figure 2.4 *p. 5* shows the case of connecting an external request for a two-pipe system (alternative hot/cold).
The operating mode to be configured on the DDC Panel is RWYm (see DDC Panel Booklet D-LBR246-257).

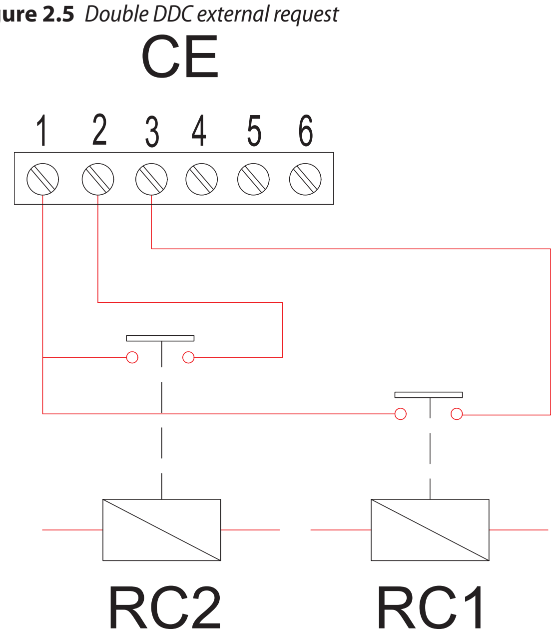
Figure 2.4 *2-pipe system single DDC external request*



Details of CE connector (see Figure 2.2 *p. 4*)
R1 relay for system switch-on external request (not supplied)

Figure 2.5 *p. 5* shows the case of connecting two external requests for a two/four-pipe system (alternative or simultaneous hot/cold).
The operating mode to be configured on the DDC Panel is RWYa (see DDC Panel Booklet D-LBR246-257).

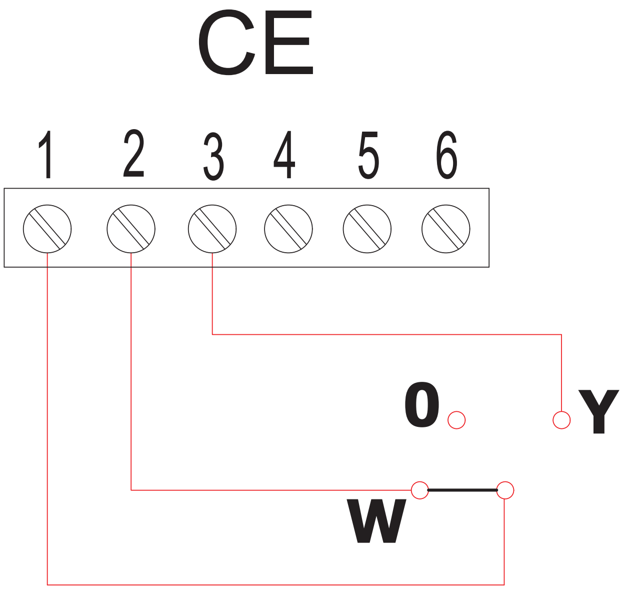
Figure 2.5 *Double DDC external request*



Details of CE connector (see Figure 2.2 *p. 4*)
RC1 relay for cooling system switch-on external request (not supplied)
RC2 relay for heating system switch-on external request (not supplied)

Figure 2.6 *p. 6* shows the case of connecting a three-position external selector for a two-pipe system (alternative hot/cold).
The operating mode to be configured on the DDC Panel is RWYa (see DDC Panel Booklet D-LBR246-257).

Figure 2.6 *DDC 2 pipe external request selector*



Details of CE connector (see Figure 2.2 *p. 4*)
Operating mode external selector (not supplied)

- Position W to turn on heating
- Position Y to turn on cooling
- Position 0 for system off

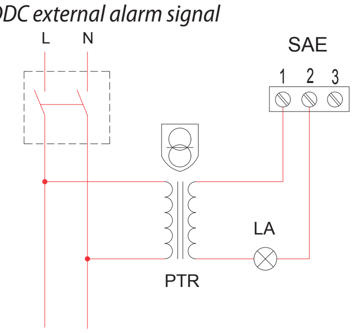
External alarm signal output

The DDC Panel provides a digital type SELV output for turning on an external alarm signal (such as a warning light, siren or other) NO/NC type in the event of an alarm condition (on the units or on the water temperature):

- ► NO is closed if an alarm condition occurs
- ► NC is opened if an alarm condition occurs

Maximum applicable voltage 24 Vac.
Maximum applicable current 1 A.
Figure 2.7 *p. 6* below shows a connection diagram for SELV type external alarm connected to the NO terminal.
If the connected alarm device is not SELV type, a control relay must be installed.

Figure 2.7 *DDC external alarm signal*



L-N phase/neutral 230V 1N - 50Hz
PTR Safety transformer (240/24 Vac - 50Hz)
LA External alarm signalling device (lamp, siren, etc.)
SAE terminals (SELV, maximum 24 Vac voltage, maximum 1 A current):
1 Common
2 NO
3 NC

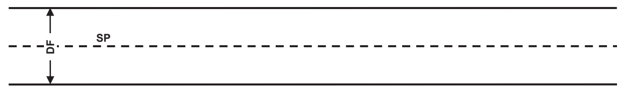
2.3.3 CAN-BUS connections

For CAN-BUS connection of the DDC Panel to the individual appliances refer to Section B concerning the specific appliance, and to Section C1.02 for preassembled groups.

2.4 CONTROL AND SETUP

The DDC Panel regulates the water temperature with the aim of keeping it within a range centred around the set-point.
The width of said range is defined by a parameter (called differential) whose default is 2 °C (i.e. ± 1 K with respect to the set-point).
The purpose of the differential is to define the maximum acceptable deviation of water temperature from the set-point, before the control system intervenes.

Figure 2.8 *DDC setpoint and differential*



SP water setpoint
DF water differential

To make the regulation, the DDC manages switch-on and switch-off in cascade mode of the different types of machines available, adapting the power supplied to the system thermal or cooling load.
It is possible to choose whether to regulate the delivery or the return temperature.
Up to four daily time bands may be set, possibly using different values for the set-point.

2.4.1 Regulation of the cascade

On the basis of their type, the units are assigned to **categories** which have different properties, so as to allow the control panel to manage the various types of units with differentiated logic and parameters.
However, the units within a category have equivalent features.
The **power** of the individual third party unit that belongs to it must be set for each category.
Each category must be associated to a **switching on priority**, defined by the user, that determines the priority of utilisation of the units in that category.
The **number of stages** used by the control system must be defined for each category, settable in the range from 1 to 10.
Four additional parameters must be defined for each category, in order to adapt as much as possible the regulation to the specific features of the category:

- ► **inhibition time**, which makes it possible to wait for stable operation of a stage before allowing the energy lack to be calculated (and therefore turn on the next);
- ► **enabling integral**, that represents the energy lack beyond which the next stage of the category is unlocked;
- ► **inhibition integral**, which represents the excess energy over which the previous stage of the category is turned off and the one previously unlocked is locked;
- ► **minimum switching on time**, which allows preventing a stage from being kept on too briefly.

The regulation algorithm may be synthesised with the following rules:

- ► At a given time, the controller works with a certain number of stages unlocked and the remaining ones locked;
- ► The first stage of the category with the highest priority is never locked;
- ► All locked stages are always turned off; all unlocked stages, except the last one, are always turned on; the last unlocked stage is turned on or off when the water temperature, respectively dropping or rising, leaves the differential range;
- ► A locked stage is unlocked (and turned on) if the area that

represents the energy shortage, calculated starting from expiry of the inhibition time, reaches the value of the enable integral;

- An unlocked stage is locked (and the previous stage is switched off) if the excess energy reaches the inhibition integral setting.

2.4.2 Mixed systems

If there are mixed conditioning systems, i.e. consisting of Robur units and third party units (boilers and/or chillers), the need arises for an interface device that makes it possible to control in a coordinated manner the various appliances, which otherwise are unable to communicate, as well as the set of sensors (manifold temperature probes) and any auxiliary plumbing components (circulation pumps and diverter valves).
The optional RB200 interface device is available to this end which, coupled to the DDC Panel, performs the following functions:

- Controlling third party boilers and/or chillers in addition to Robur units;
- Managing the circulating pumps of controlled third party units and primary and secondary circuits;
- Managing the delivered power and temperature according to the set-points, optimising the efficiency obtained from the system (priority assigned to the generator with the highest efficiency);
- Managing the domestic hot water function (possibility to change the set-point if there is a request for this service);
- Managing the switching of any three-way diverter valves to feed DHW tanks for production of domestic hot water or for seasonal summer/winter switching;
- Managing any heating, conditioning and domestic hot water requests by external control devices.

For additional information on the RB200 device refer to Paragraph 4 *p. 13*.
For additional information on the control methods of mixed conditioning systems refer to Paragraph 6 *p. 23*.

2.5 MODBUS

The DDC Panel supports interfacing with external devices also via Modbus RTU protocol in slave mode.
With the Modbus protocol it is possible to acquire information concerning the operation data of the units and systems managed by the DDC (temperatures, statuses, meters, etc.).
It can also acquire information regarding alarms, both current and registered in the alarms log.
It can also act on the plant to set a variety of operational parameters such as unit On/Off, hot/cold inversion, setpoints, differentials, power steps, and operating time bands.
Paragraph 9.2 *p. 38* sets out the Modbus mapping implemented in the current version of the DDC Panel.

3 RB100

3.1 MAIN FUNCTIONS

The RB100 device has the purpose of:
- ► interfacing requests from external control systems (heating, cooling service, DHW0 and DHW1);
- ► actuate switching valves (for DHW or hot/cold inversion).

The requests from external control systems may be:
- ► 0-10 V analogue input signals;
- ► digital signals (voltage free contacts).

The requests from external control systems are only effective if the relevant service is active on the DDC.

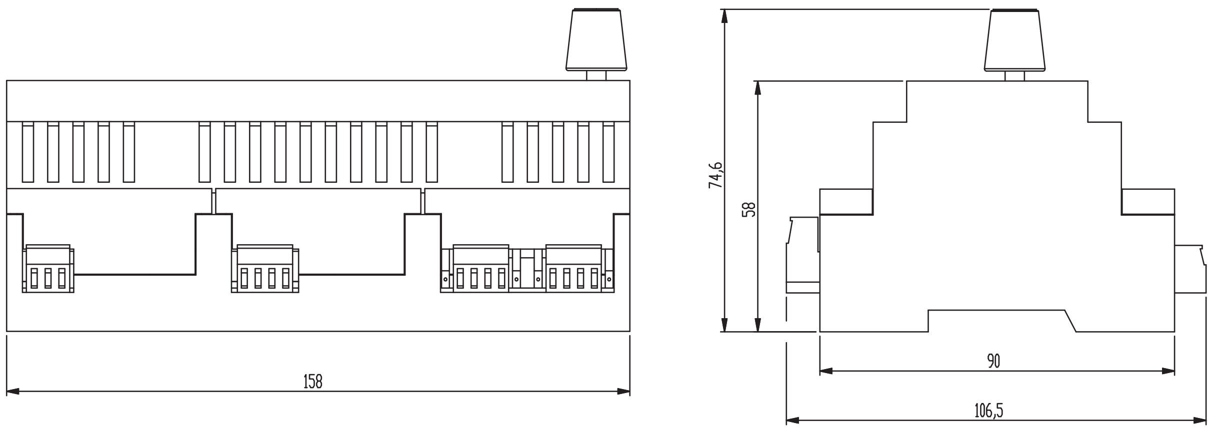
The outputs for driving the valves are digital signals (voltage free contacts) with the following features:
- ► maximum voltage 250 Vac;
- ► maximum current for resistive loads 4 A;
- ► maximum current for inductive loads 3 A.

The RB100 device may only be used jointly with the DDC Panel.

3.2 INSTALLATION

The RB100 device is suited to internal installation and must be fitted on 35 mm DIN rail in an electrical panel (EN 60715).
The space requirement is equal to 9 modules, as shown in Figure 3.1 *p. 8*.

Figure 3.1 *RB100 device dimensions*

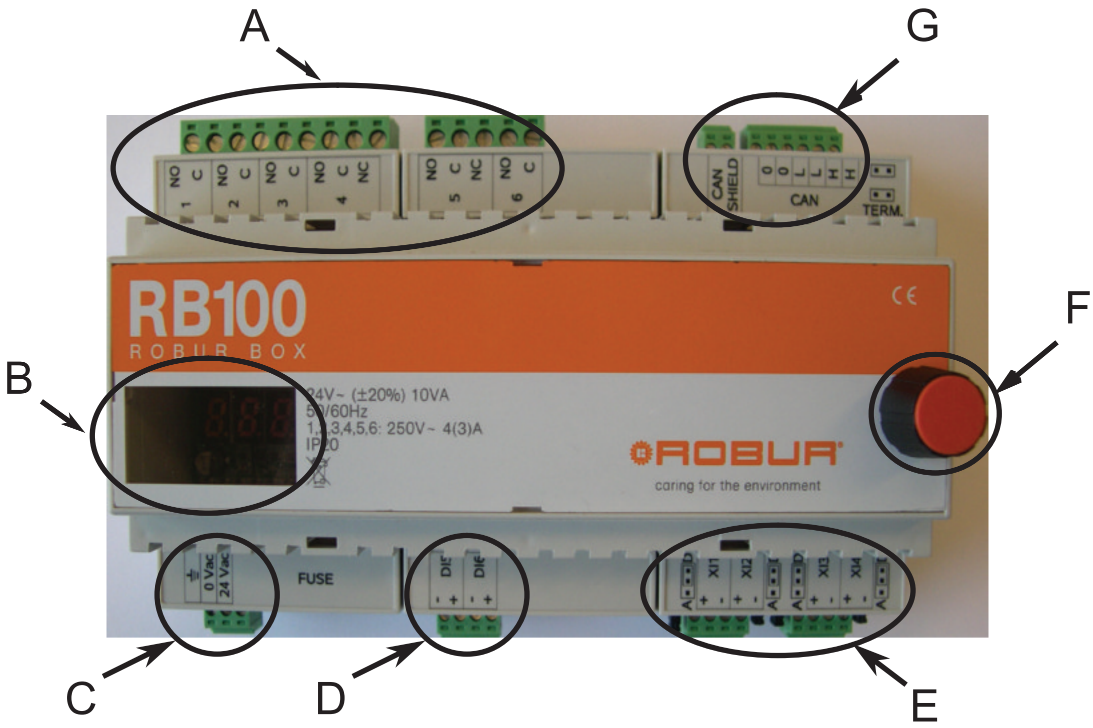


The RB100 device has protection rating IP20, and must be installed in premises with ambient air temperature between 0°C and 50°C.

The RB100 device provides the connection terminals shown in 3.2 *p. 9*.

3.3 CONNECTIONS

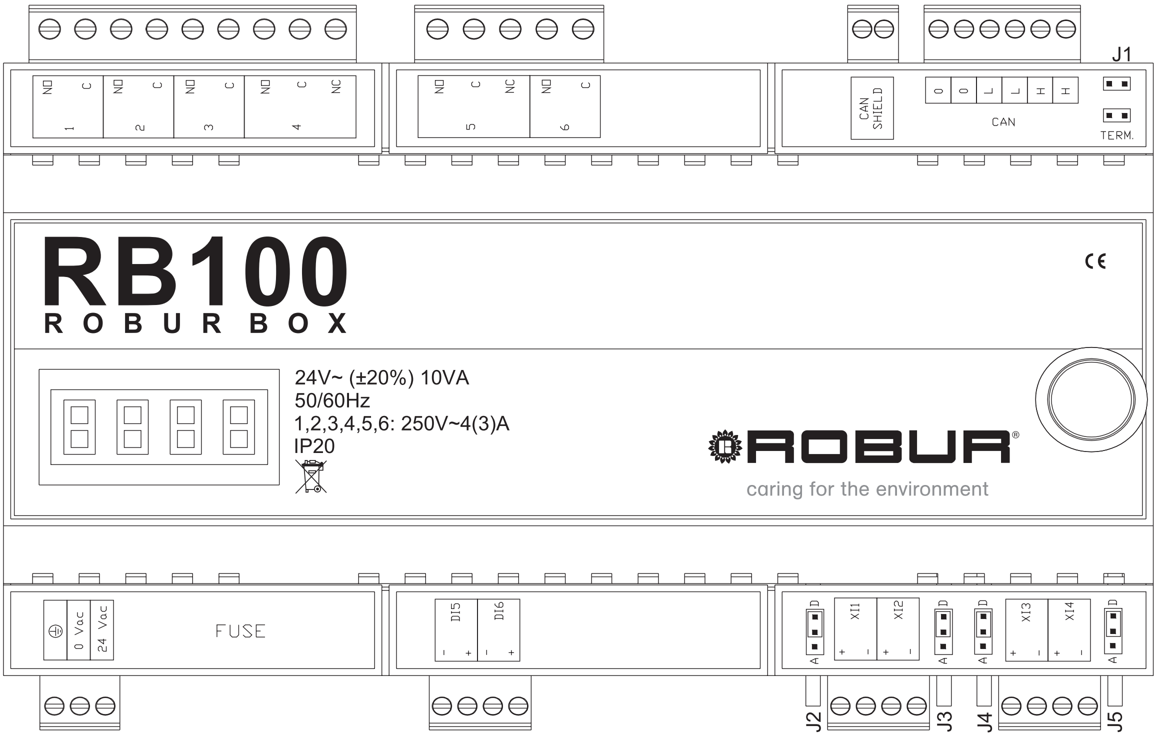
Figure 3.2 *RB100 device connections*



A	Output relay		D	Limit switch auxiliary contacts input		G	CAN-BUS connection
B	Display		E	Service requests analogue/digital inputs			
C	24 V AC power supply		F	Knob (encoder)			

Figure 3.3 *p. 10* shows the detail of connection terminals.

Figure 3.3 *Detail of RB100 device connections*



A Terminals:
4 = Valve service NO/NC contact
C Terminals:
Device power supply connector
E terminals:
XI1 = Cooling service request analogue/digital input
XI2 = Heating service request analogue/digital input
XI3 = DHW0 service request analogue/digital input
XI4 = DHW1 service request analogue/digital input
J2 = Jumper to select input type (analogue/digital) for cooling service request
J3 = Jumper to select input type (analogue/digital) for heating service request
J4 = Jumper to select input type (analogue/digital) for DHW0 service request
J5 = Jumper to select input type (analogue/digital) for DHW1 service request
G terminals:
CAN SHIELD = CAN-BUS cable shielding connector
CAN = CAN-BUS cable connector
J1 = CAN-BUS Jumpers

Each of the four inputs XI1...XI4 may be configured either as analogue or digital. Configuration must be carried out by correctly positioning the jumpers on the board as well as by correctly setting the configuration parameters.

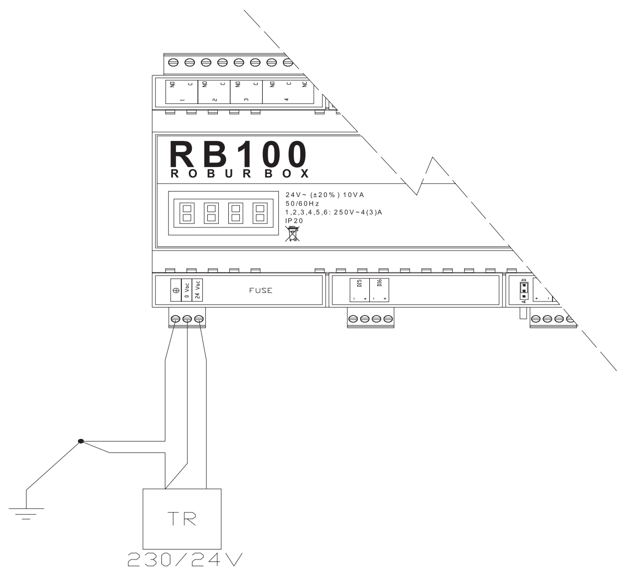
3.3.1 Electrical power supply

The RB100 device must be supplied by a 230/24 V AC - 50/60 Hz safety transformer with power no less than 10 VA (not supplied); in particular, this transformer must comply with standard EN 61558-2-6.

Use a connecting 3 x 0.75 mm² electrical cable and perform connections on C terminals (see Figure 3.2 *p. 9*) complying with the polarity indicated in Figure 3.4 *p. 10*.

The maximum specified length for this cable is 1m.

Figure 3.4 *RB100 power supply connection*



TR Safety transformer 230 Vac/24 Vac min 10 VA (not supplied)

3.3.2 Inputs/Outputs

Service requests analogue inputs

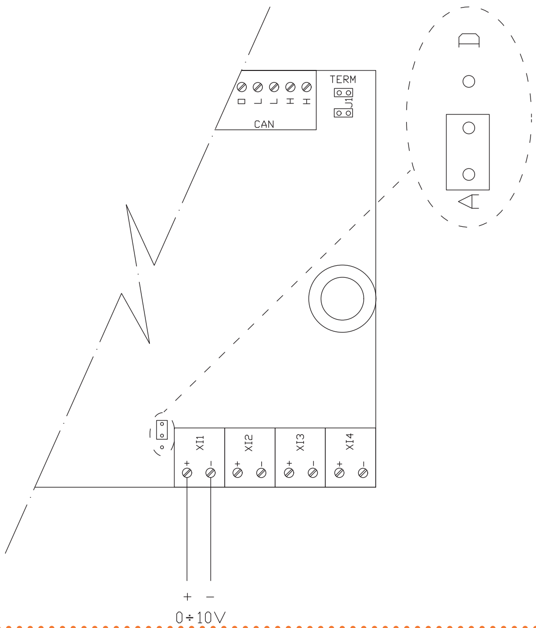
For service request analogue inputs the input voltage must be between 0 and 10 Vdc.
The maximum length of the connecting cables and their section are detailed in Table 3.1 *p. 11* below.
The cable must be shielded and with shield earthed at one end.

Table 3.1 *RB100/RB200 analogue input cables*

Maximum cable length (m)	Wire cross section (mm²)
300	1,5
100	0,5

Figure 3.5 *p. 11* details the connecting diagram for input XI1, valid for any analogue input XI1...XI4.

Figure 3.5 *RB100 services requests analogue inputs*



Service requests digital inputs

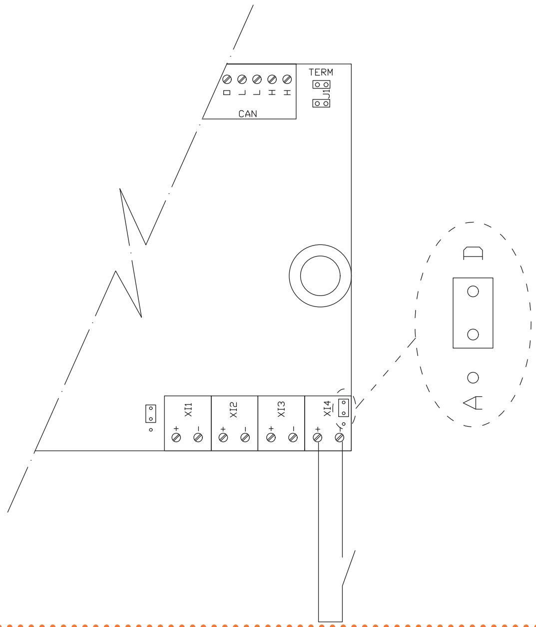
For service requests digital inputs the external contact must have operating voltage of at least 12 Vdc and must assure closing with minimum current of 5 mA.
The maximum length of the connecting cables and their resistance are detailed in Table 3.2 *p. 11* below.
The cable must be shielded and with shield earthed at one end.

Table 3.2 *RB100/RB200 digital input cables*

Max resistance for On (Ω)	Min resistance for Off (Ω)	Maximum cable length (m)
200	50	300

Figure 3.6 *p. 11* details the connecting diagram for input XI4, valid for any digital input XI1...XI4.

Figure 3.6 *RB100 services requests digital inputs*



Diverter valves output

The digital output to control the diverter valves is a NO/NC diverter voltage free contact:

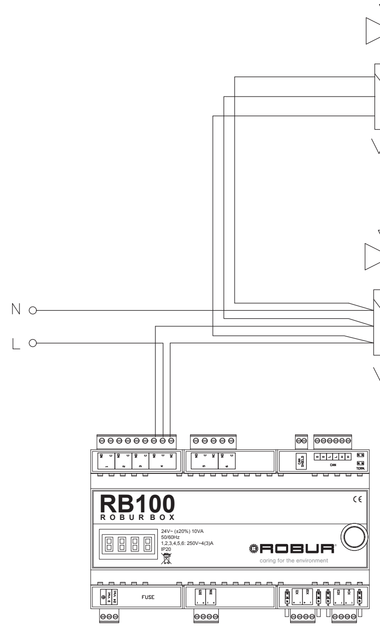
- NO is closed when the valves are towards the heating circuit or towards the separable group;
- NC is closed when the valves are towards the conditioning circuit or towards the base group.

The relay retains its position even in the event of power supply interruption.
Maximum applicable voltage 250 Vac.
Maximum applicable current:

- Resistive loads 4 A;
- Inductive loads 3 A.

Maximum cable length 300 m.
Figure 3.7 *p. 12* details the connection diagram for diverter valves.

Figure 3.7 *RB100 diverter valves output*



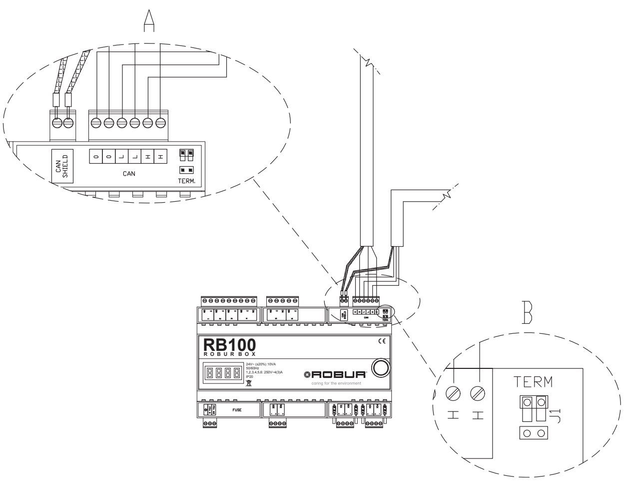
VD1 system delivery pipes 3-way motorised valve
VD2 system return pipes 3-way motorised valve

3.3.3 CAN-BUS connections

For general concepts on the CAN-BUS communication network, see Paragraph 1.1 *p. 2*.
For the features of the CAN-BUS cable see Paragraph 1.1.1 *p. 2*.
The RB100 device may be an intermediate or terminal node of the CAN-BUS network.
If the RB100 device is an **intermediate node**, make the connection as shown in the Figure 3.8 *p. 12*.

If the RB100 device is an intermediate node, the J1 jumpers (position B in Figure 3.8 *p. 12*) must be **open**.

Figure 3.8 *CAN-BUS RB100 intermediate node connection*

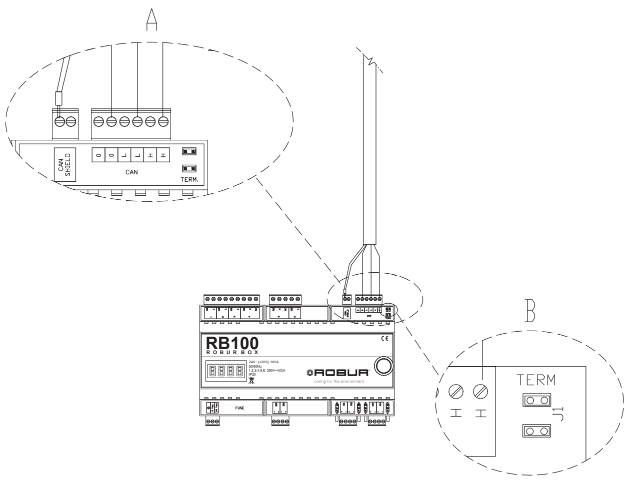


A CAN-BUS screen connection detail
B Detail of J1 jumpers position

If the RB100 device is a **terminal node**, make the connection as shown in the Figure 3.9 *p. 12*.

If the RB100 device is a terminal node, the J1 jumpers (position B in Figure 3.9 *p. 12*) must be **closed**.

Figure 3.9 *CAN-BUS RB100 terminal node connection*



A CAN-BUS screen connection detail
B Detail of J1 jumpers position

4 RB200

4.1 MAIN FUNCTIONS

The RB200 device has the purpose of:

- interfacing requests from external control systems (heating, cooling service, DHW0 and DHW1);
- actuate switching valves (for DHW and/or hot/cold inversion);
- interface third party generators;
- interface system temperature probes;
- interface common circulating pumps.

The requests from external control systems may be:

- 0-10 V analogue input signals;
- digital signals (voltage free contacts).

The requests from external control systems are only effective if the relevant service is active on the DDC.

The inputs/outputs to control third party generators may be:

- a digital output (voltage free contact) to switch on the generator;
- a digital output (voltage free contact) to control the generator circulating pump;
- an analogue 0-10 V output for the generator water temperature set-point;
- a digital input (voltage free contact) for the generator alarm signal.

The system temperature probes must be resistive type NTC 10 kΩ, and may concern four types of service:

- manifold delivery and return probes conditioning only or conditioning/heating 2 pipes;
- manifold delivery and return probes heating only;
- manifold delivery and return probes separable DHW;
- GAHP return manifold probe.

The common water circulating pumps are controlled through digital outputs (voltage free contacts) and there may be 5 types:

- secondary circulating pump conditioning only or conditioning/heating 2 pipes;
- primary circulating pump heating only;
- separable primary circulating pump;
- secondary circulating pump conditioning only or conditioning/heating 2 pipes;
- secondary circulating pump heating only.

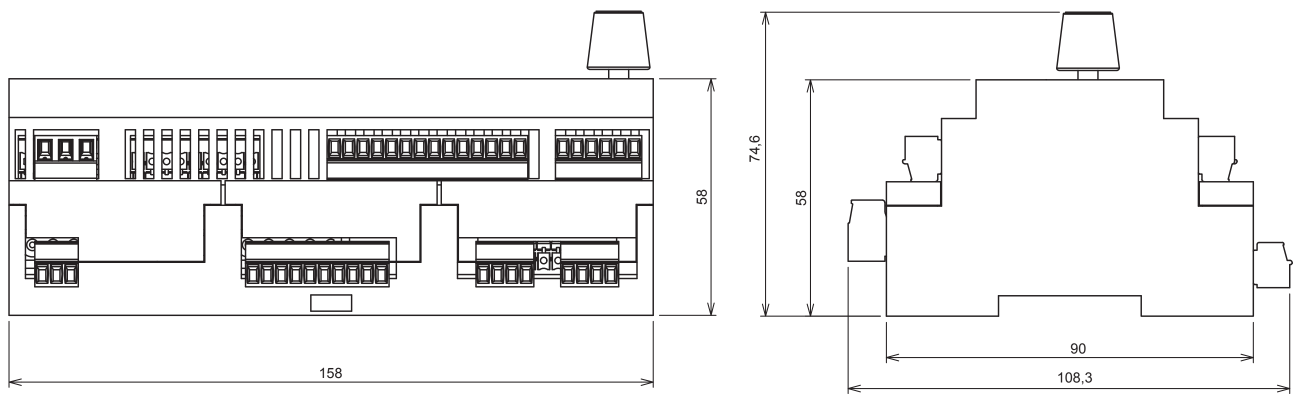
The RB200 device may only be used jointly with the DDC Panel.

4.2 INSTALLATION

The RB200 device is suited to internal installation and must be fitted on 35 mm DIN rail in an electrical panel (EN 60715).

The space requirement is equal to 9 modules, as shown in Figure 4.1 *p. 13*.

Figure 4.1 *RB200 device dimension drawing*

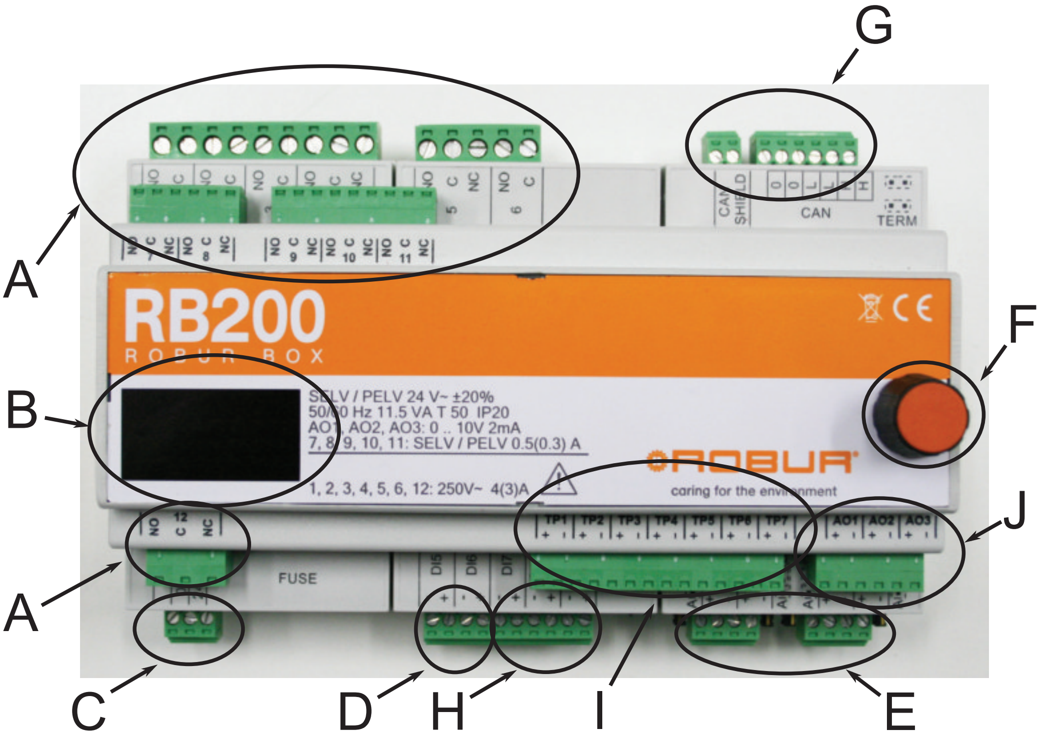


The RB200 device has protection rating IP20, and must be installed in premises with ambient air temperature between 0°C and 50°C.

4.3 CONNECTIONS

The RB200 device provides the connection terminals shown in Figure 4.2 *p. 14*.

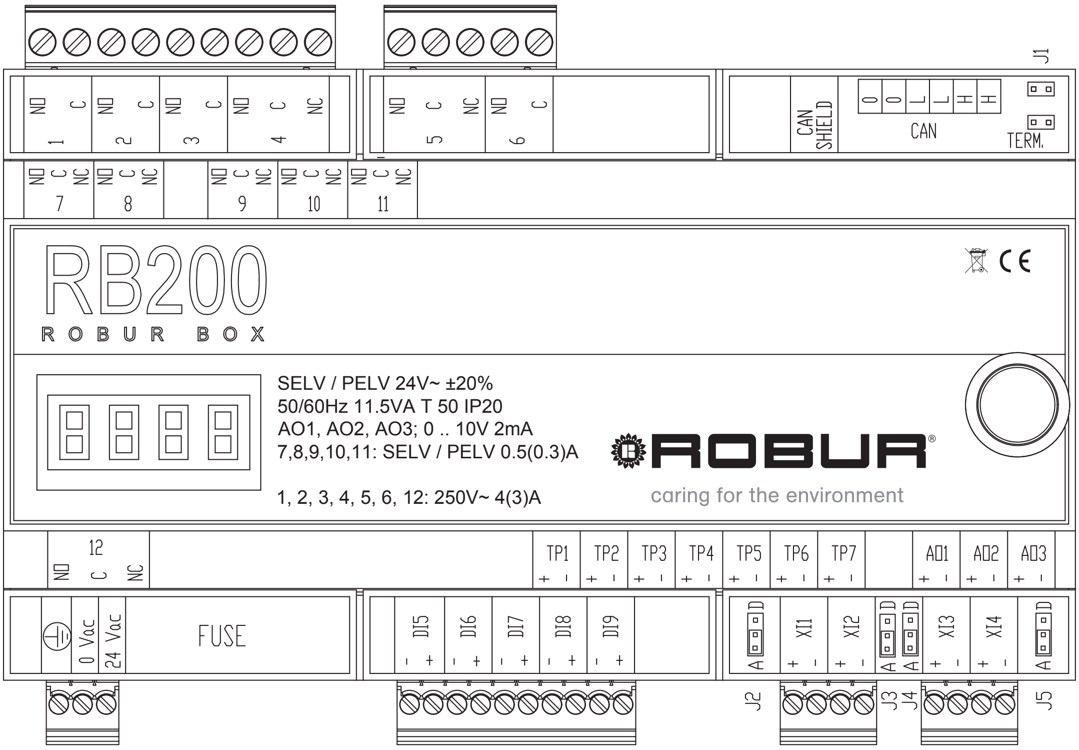
Figure 4.2 *RB200 device connections*



A Output relay
B Display
C 24 V AC power supply
D Limit switch auxiliary contacts input
E Service requests analogue/digital inputs
F Knob (encoder)
G CAN-BUS connection
H Digital inputs for signalling third party generators unavailability
I Inputs of temperature probes
J Third party generator set-point analogue outputs

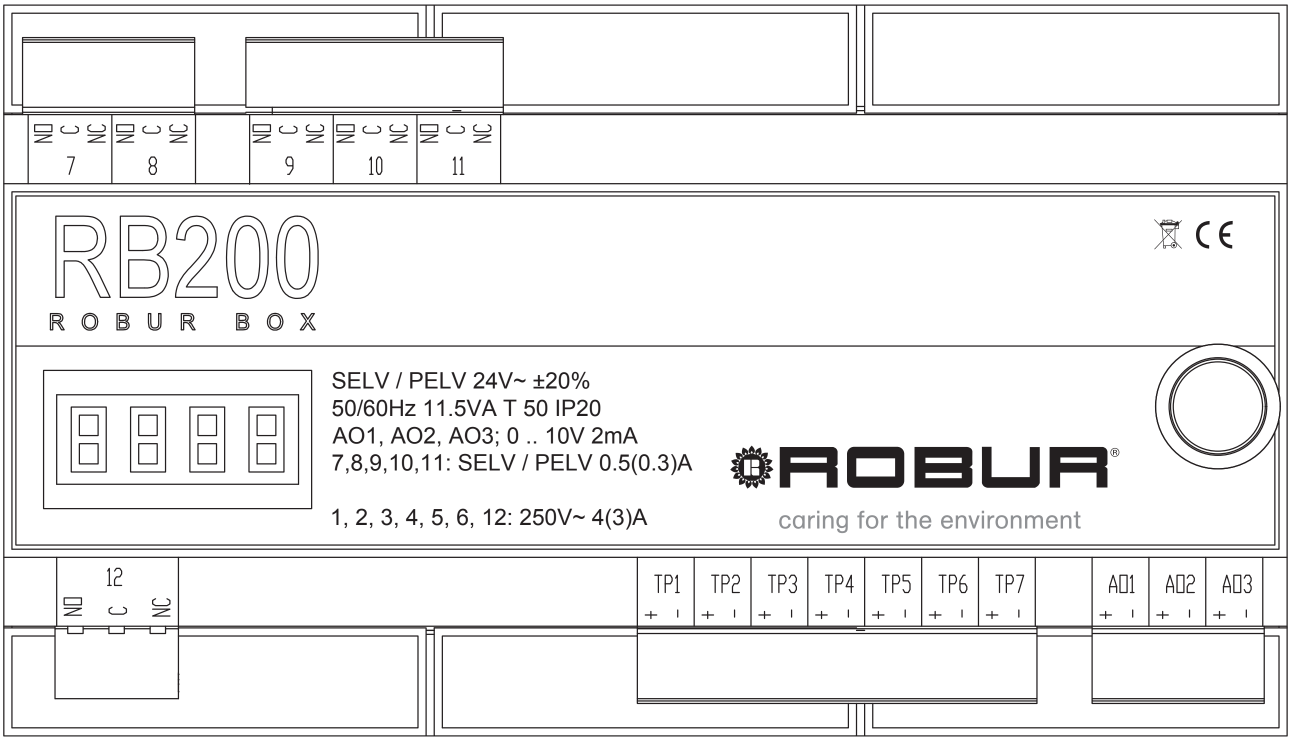
The following Figures show in detail the connection terminals, divided by lower level (Figure 4.3 *p. 15*) and upper level (Figure 4.4 *p. 16*).

Figure 4.3 *Detail of RB200 device connections lower level*



A Terminals:
1 = NO contact 1 generator circulating pump or 1 circulating pump service
2 = NO contact generator 2 circulating pump or circulating pump 2 service
3 = NO contact circulating pump 3 service
4 = NO/NC contact valve 1 service or circulating pump 4 service
5 = NO/NC contact generator 1 start up
6 = NO/NC contact generator 2 start up
C Terminals:
Device power supply connector
E terminals:
XI1 = Cooling service request analogue/digital input
XI2 = Heating service request analogue/digital input
XI3 = DHW0 service request analogue/digital input
XI4 = DHW1 service request analogue/digital input
J2 = Jumper to select input type (analogue/digital) for cooling service request
J3 = Jumper to select input type (analogue/digital) for heating service request
J4 = Jumper to select input type (analogue/digital) for DHW0 service request
J5 = Jumper to select input type (analogue/digital) for DHW1 service request
G terminals:
CAN SHIELD = CAN-BUS cable shielding connector
CAN = CAN-BUS cable connector
J1 = CAN-BUS Jumpers
H terminals:
DI7 = generator 1 alarm input
DI8 = Generator 2 alarm input

Figure 4.4 *Detail of RB200 device connections upper level*



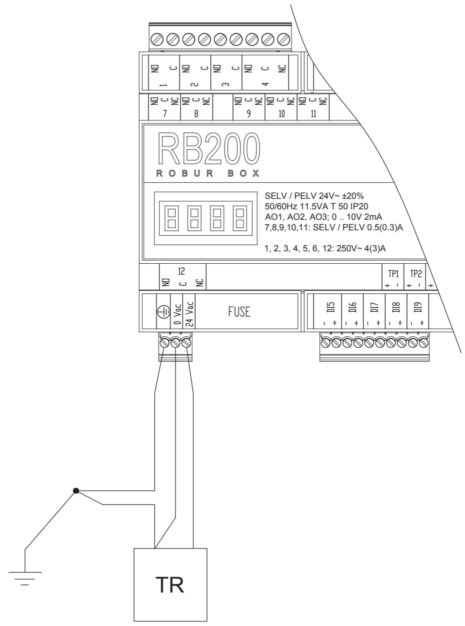
A Terminals:
12 = NO/NC contact valve 2 service or circulating pump 5 service
I terminals:
TP1 = Conditioning return temperature probe input
TP2 = Conditioning delivery temperature probe input
TP3 = Heating return temperature probe input
TP4 = Heating delivery temperature probe input
TP5 = Separable DHW return temperature probe input
TP6 = Separable DHW delivery temperature probe input
TP7 = GAHP return temperature probe input
J terminals:
AO1 = 1 generator set-point 0-10 V output
AO2 = 2 generator set-point 0-10 V output

Each of the four inputs XI1...XI4 may be configured either as analogue or digital. Configuration must be carried out by correctly positioning the jumpers on the board as well as by correctly setting the configuration parameters.

4.3.1 Electrical power supply

The RB200 device must be supplied by a 230/24 V AC - 50/60 Hz safety transformer with power no less than 12 VA (not supplied); in particular, this transformer must comply with standard EN 61558-2-6.
Use a connecting 3 x 0.75 mm² electrical cable and perform connections on C terminals (see Figure 4.2 *p. 14*) complying with the polarity indicated in Figure 4.5 *p. 16*.
The maximum specified length for this cable is 1m.

Figure 4.5 *RB200 power supply connection*



TR Safety transformer 230 Vac/24 Vac min 12 VA (not supplied)

4.3.2 Inputs/Outputs

The digital outputs (voltage free contacts) have these features:
- maximum voltage 250 Vac;
- maximum current for resistive loads 4 A;
- maximum current for inductive loads 3 A.

Service requests analogue inputs

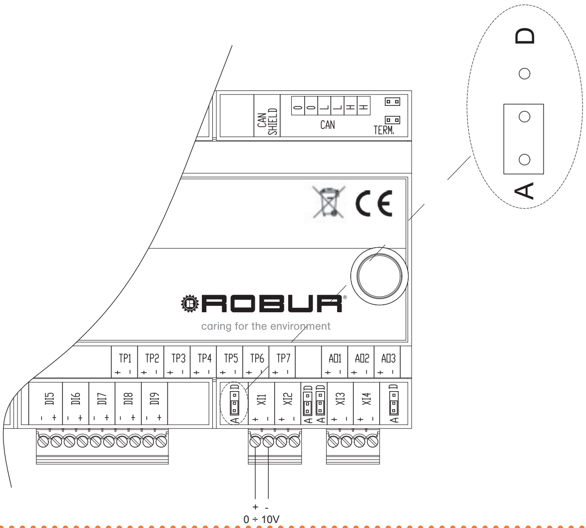
For service request analogue inputs the input voltage must be between 0 and 10 Vdc.
The maximum length of the connecting cables and their section are detailed in Table 3.1 *p. 11* below.
The cable must be shielded and with shield earthed at one end.

Table 4.1 *RB100/RB200 analogue input cables*

Maximum cable length (m)	Wire cross section (mm^2)
300	1,5
100	0,5

Figure 4.6 *p. 17* details the connecting diagram for input XI1, valid for any analogue input XI1...XI4.

Figure 4.6 *RB200 services requests analogue inputs*



Service requests digital inputs

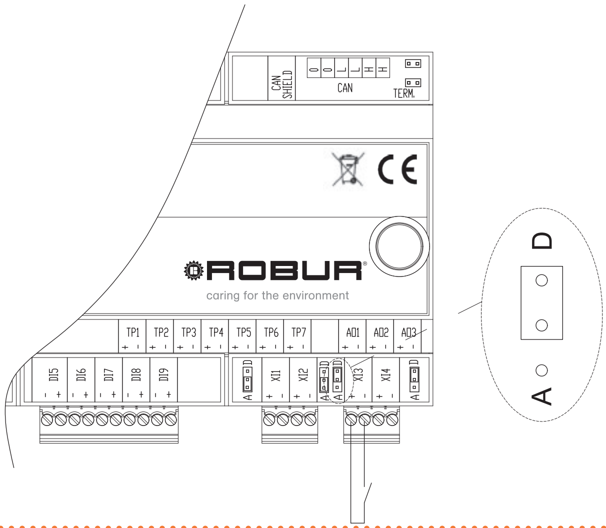
For service requests digital inputs the external contact must have operating voltage of at least 12 Vdc and must assure closing with minimum current of 5 mA.
The maximum length of the connecting cables and their resistance are detailed in Table 3.2 *p. 11* below.
The cable must be shielded and with shield earthed at one end.

Table 4.2 *RB100/RB200 digital input cables*

Max resistance for On (Ω)	Min resistance for Off (Ω)	Maximum cable length (m)
200	50	300

Figure 4.7 *p. 17* details the connecting diagram for input XI4, valid for any digital input XI1...XI4.

Figure 4.7 *RB200 services requests digital inputs*



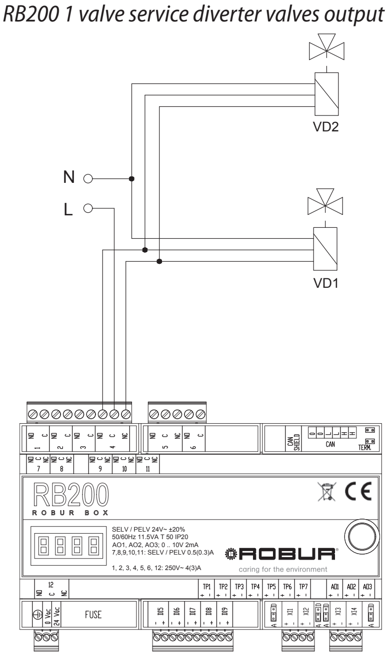
Diverter valve outputs

The digital outputs (contact 4 in Figure 4.3 *p. 15* and contact 12 in Figure 4.4 *p. 16*) to control the diverter valves are NO/NC diverter voltage free contacts:

- ► NO is closed when the valves are towards the heating circuit or towards the separable group;
- ► NC is closed when the valves are towards the conditioning circuit or towards the base group.

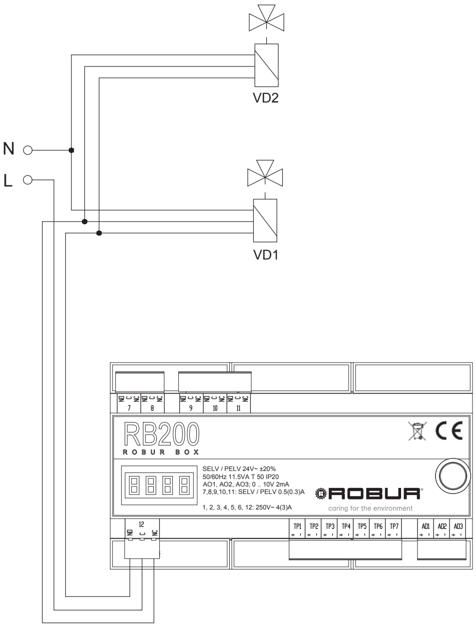
The relay retains its position even in the event of power supply interruption.
Maximum cable length 300 m.
Figures 4.8 *p. 17* and 4.9 *p. 18* show in detail the connection diagram of the diverter valves to each of the two available digital outputs.

Figure 4.8 *RB200 1 valve service diverter valves output*



VD1 system delivery pipes 3-way motorised valve
VD2 system return pipes 3-way motorised valve

Figure 4.9 *RB200 2 valve service diverter valves output*



VD1 system delivery pipes 3-way motorised valve
VD2 system return pipes 3-way motorised valve

Third party generators services

To control third party generators, the following outputs are available for each generator:

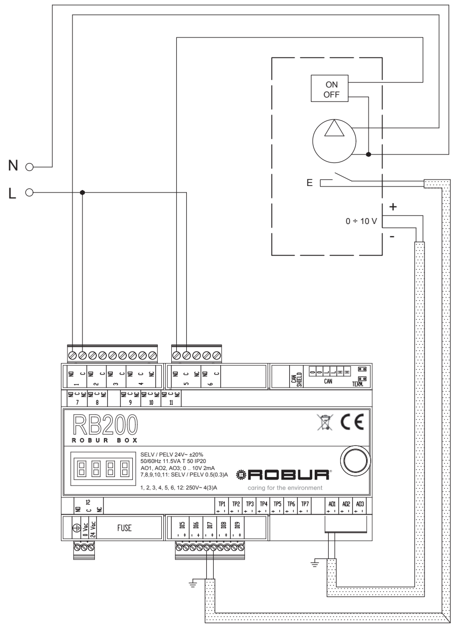
- One NO voltage free contact for ON/OFF generator command (contact 5 for generator 1, contact 6 for generator 2, see Figure 4.3 *p. 15*);
- One NO voltage free contact for ON/OFF generator circulating pump command (contact 1 for generator 1, contact 2 for generator 2, see Figure 4.3 *p. 15*);
- One analogue 0-10 V output for the generator temperature set-point (output AO1 for generator 1, output AO2 for generator 2, see Figure 4.4 *p. 16*).

NO contacts are closed when the system requires switching on (ON) the generator or circulating pump.
For the analogue output the features of the cable to be used are set out in Table 4.1 *p. 17*.
The cable of the analogue output must be shielded with shield earthed at one end.
The following are available for signalling the alarm status of each generator:

- one digital input (voltage free contact) (contact DI7 for generator 1, contact DI8 for generator 2, see 4.3 *p. 15*).

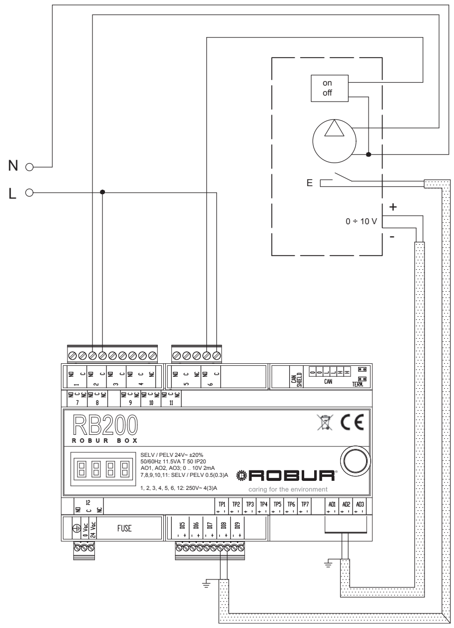
The alarm signal is on with closed contact.
The cable of the digital input must be shielded with shield earthed at one end.
For the digital input the features of the cable to be used are set out in Table 4.2 *p. 17*.
Maximum input/ouput cable length 300 m.
Figure 4.10 *p. 18* shows the connection diagram for the signals relating to generator 1, whereas Figure 4.11 *p. 18* shows the connection diagram for the signals relating to generator 2.

Figure 4.10 *RB200 1 generator service connection*



E Third party generator alarm output

Figure 4.11 *RB200 2 generator service connection*



E Third party generator alarm output

Circulating pumps service outputs

The circulating pump command outputs are NO voltage free contacts (contacts 1, 2, 3, 4, 12 for circulating pump services 1, 2, 3, 4, 5, see Figure 4.3 *p. 15*)
NO contacts are closed when the system requires switching on (ON) the circulating pump.
Maximum cable length 300 m.

Some contacts are common for two types of services, which therefore cannot be configured simultaneously on the RB200 device.

Figure 4.12 *p. 19* shows the connection diagram for the circulating pump 3 service.

For the other circulating pump services, only the contact to be connected changes.

Figure 4.12 *RB200 3 circulating pump service connection*

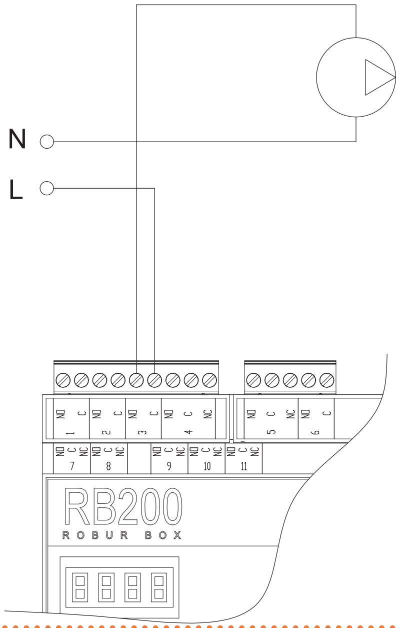
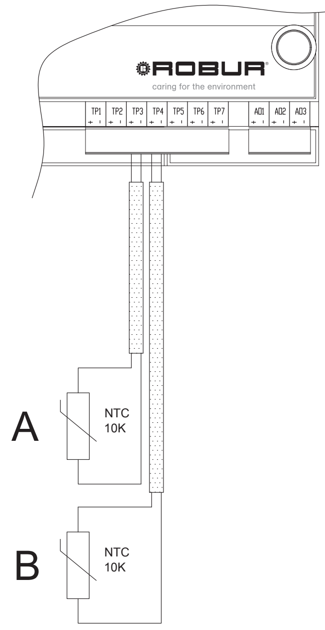


Figure 4.13 *RB200 heating temperature probes connection*



A Heating return probe
B Heating delivery probe

Temperature probes inputs

The analogue inputs TP1 - TP7 (see Figure 4.4 *p. 16*) are intended for resistive type temperature probes NTC 10 kΩ:

- TP1-TP2: manifold probes conditioning only or conditioning/heating 2 pipes;
- TP3-TP4: manifold probes heating only;
- TP5-TP6: separable DHW manifold probes;
- TP7: GAHP return manifold probe.

Table 4.1 *p. 17* sets out the features of the connecting cables for the temperature probes.

Figure 4.13 *p. 19* shows an example connection for the heating manifold probes.

For the other temperature probes, only the contact to be connected changes.

4.3.3 CAN-BUS connections

For general concepts on the CAN-BUS communication network, see Paragraph 1.1 *p. 2*.

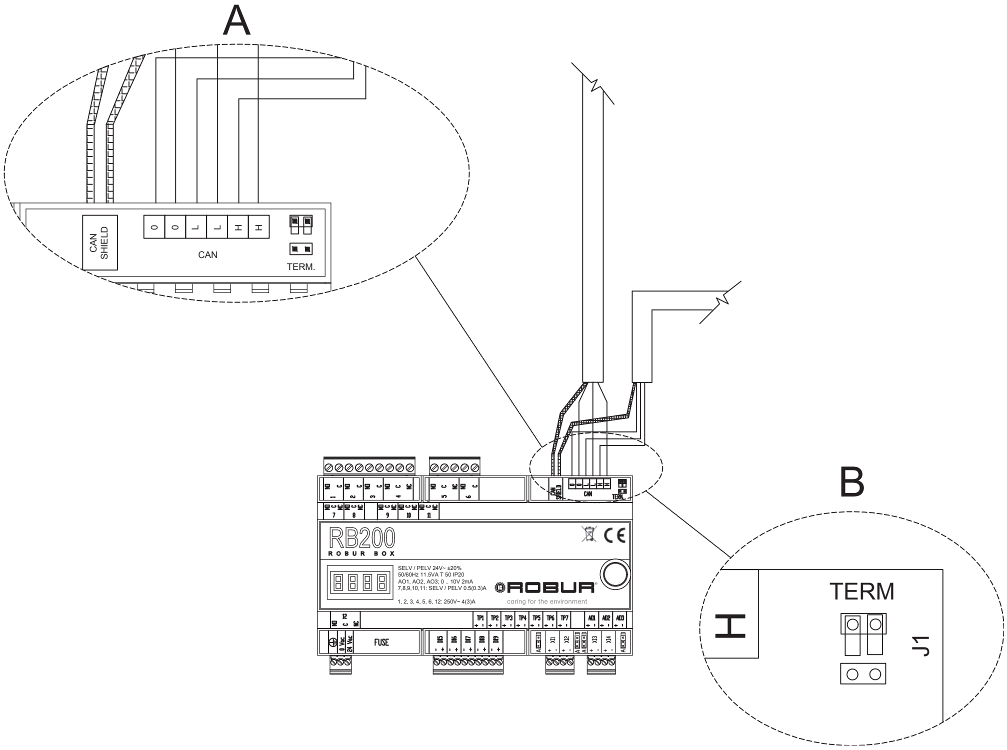
For the features of the CAN-BUS cable see Paragraph 1.1.1 *p. 2*.

The RB200 device may be an intermediate or terminal node of the CAN-BUS network.

If the RB200 device is an **intermediate node**, make the connection as shown in the Figure 4.14 *p. 20*.

If the RB200 device is an intermediate node, the J1 jumpers (position B in Figure 4.14 *p. 20*) must be **open**.

Figure 4.14 *CAN-BUS RB200 intermediate node connection*

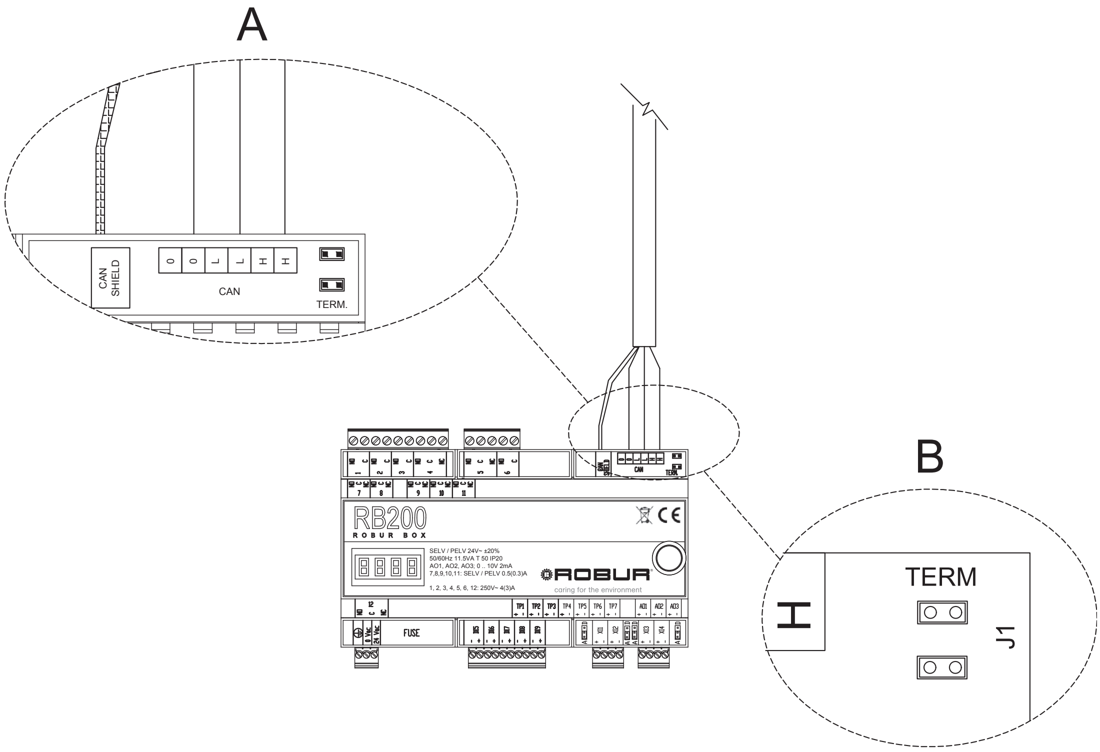


A CAN-BUS screen connection detail
B Detail of J1 jumpers position

If the RB200 device is a **terminal node**, make the connection as shown in the Figure 4.15 *p. 20*.

If the RB200 device is a terminal node, the J1 jumpers (position B in Figure 4.15 *p. 20*) must be **closed**.

Figure 4.15 *CAN-BUS RB200 terminal node connection*



A CAN-BUS screen connection detail
B Detail of J1 jumpers position

5 ENGINEERING APPLICATIONS

A number of installation configurations can be supported with the DDC panel, if required jointly with the RB100 and RB200 devices.
The control logic resides in the DDC Panel, while the RB100 and RB200 devices act as interface for the inputs and outputs towards the system's components.

5.1 MANAGEMENT OF SERVICE REQUESTS

The service requests make it possible to interface devices fitted on the system (e.g. thermostats) as well as external control devices (BMS).
These requests may be:
- ► digital signals (voltage free contact);
- ► analogue signals (0-10 V);
- ► via Modbus RTU protocol.

The following services may be managed through these requests:
- ► heating service;
- ► conditioning service;
- ► base DHW service;
- ► servizio ACS separabile.

The service set-points may be set either on the DDC or on the RB100/RB200 devices.

5.1.1 DDC

The DDC panel provides two digital inputs for service request:
- ► Conditioning service request (RY contact);
- ► Heating service request (RW contact).

For positioning the digital inputs see Figure 2.2 *p. 4*, whereas for details on connecting methods see Paragraph *p. 5*.

The same inputs may be used to switch operating mode in 2-pipe hot/cold systems.

The DDC panel also supports interfacing via Modbus protocol to receive service requests from BMS devices. For further information see Paragraph 9.2 *p. 38*.

5.1.2 RB100/RB200

The RB100/RB200 devices provide four service request inputs, independently configurable as analogue (0-10 V) or digital:
- ► heating service;
- ► conditioning service;
- ► DHW service (0);
- ► DHW service (1).

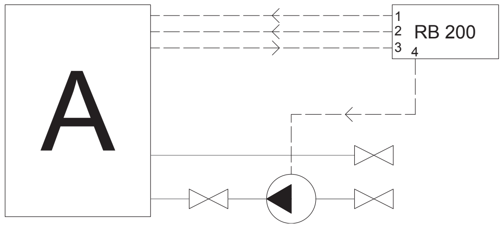
DHW services are independently configurable as base DHW or separable DHW.
Digital type requests consist of voltage-free contacts, whereas analogue type requests are 0-10 V signals corresponding to the set-point for the service.
In the case of digital type requests the service set-point is set on the DDC Panel or on the RB100/RB200 device.

The service requests to RB100/RB200 devices do not involve switching the operating mode.

5.2 THIRD PARTY GENERATORS CONTROL

For each RB200 it is possible to configure up to two third party generators, and up to eight RB200 devices may be set up for each installation.
Figure 5.1 *p. 21* shows the signals that RB200 is able to exchange with each third party generator.

Figure 5.1 *Third party generators control*



A third party generators
1 generator ON/OFF digital output
2 analogue 0-10 V output for temperature set-point (where the generator is arranged to receive it)
3 digital input for generator error/unavailability (where the generator makes it available)
4 digital output for controlling independent generator circulating pump (if installed and if not driven by the generator)

All the combinations of the aforementioned signals are possible to control the generator, according to its features.

Refer to the third party generator manufacturer for the features of the signals required to control it.

Manifold temperature probes

When third party generators are involved, the manifold temperature probes must be installed and configured for the part of the system in which the generators are present.

Third party generator errors and settings

If the third party generator error/unavailability signal is available, the event is recorded in the DDC Panel event log as generic error, whereas the details on the type of error are only available on the generator (if provided by the manufacturer).
Any customisations of the generator settings in terms of regulation dynamics and any temperature lags compared to the system set point must be set directly on the generator regulator.

Controller for control in cascade of several third party generators

If there are several third party generators fitted with their own controller for control in cascade, it is possible to interface directly with the cascade controller via RB200 through the signals described in Figure 5.1 *p. 21*. In this case the control system manages the cascade as if it were a single third party generator. However, this is not an optimal situation because the cascade controller might generate undesirable and not easily foreseeable behaviour.

5.3 SYSTEM CIRCULATING PUMPS CONTROL

Up to five common circulating pumps (i.e. serving a group of units) may be controlled via RB200, driven in ON/OFF mode. Any modulation must be managed independently by the circulating pumps (e.g. constant Δt or Δp).
The following types of circulating pumps may be controlled:

- 2-pipe primary cold or hot/cold common circulating pump;
- Primary hot common circulating pump;
- Separable primary common circulating pump;
- 2-pipe secondary cold or hot/cold common circulating pump;
- Secondary hot common circulating pump.

In general, it is not obligatory to have a circulating pump on the secondary circuit and it is not obligatory to control it with RB200. If there are probes installed on the secondary circuit, however, it is *recommended* to install a secondary circulating pump and configure it on RB200, to correctly control flushing of the probes, as they must be constantly flushed when the system is active.

If the third party units are fitted with directly controlled circulating pump (i.e. not connected to RB200), then the antifreeze protection must be assured by the third party units, or the appropriate precautions must be taken to protect the system from icing.

5.4 TEMPERATURE PROBES CONTROL

The following temperature probes may be configured on the RB200 device, all resistive type NTC 10 kΩ:

- hot delivery and return;
- cold delivery and return;
- separable DHW delivery and return;
- GAHP return (only used for "integration and progressive replacement" control mode).

Manifold temperature probes are required:

- if third party generators are installed;
- for plumbing systems with generators hydraulically in series;
- should one wish to perform system control on the secondary circuit.

Water flow on the manifold probes must always be assured when the relevant system (hot/cold/DHW) is on.

5.5 VALVE SERVICES

Two types of valve driving services may be configured on the RB100 and RB200 devices:

- hot/cold commutation valves;
- basic/separable commutation valves.

These services are alternative on the RB100 device, whereas both may be used independently on the RB200 device.
The output to control the valves consists of a diverter voltage free contact (NO/NC), with the following logic:

- NO closed: valve on heating system or on separable group;
- NC closed: valve on cooling system or on base group.

The diverter valves must be such as to assure to Robur generators the flow rates set out in Table 5.1 *p. 22* under all operating conditions (including the switching stage).

Table 5.1 *Diverter valves water flow*

			GAHP GS/WS		GAHP A	AY00-120	GA ACF		GAHP-AR
			GAHP WS	GAHP GS HT				ACF 60-00 LB	
Heating mode									
Heating water flow	minimum	l/h	1400		1400	1500			2500
	maximum	l/h	4000		4000	3200			3500
Operation in conditioning mode									
Water flow rate	minimum	l/h					2500	2300	2500
	maximum	l/h					3500	2900	3500
Renewable source operating conditions									
Renewable source water flow rate	minimum	l/h	2300						
	maximum	l/h	4700						
Renewable source water flow rate (with 25% glycol)	minimum	l/h		2000					
	maximum	l/h		4000					

6 INTEGRATION METHODS

The methods for controlling mixed conditioning systems, i.e. consisting of Robur units and third party appliances (boilers and/or chiller) are detailed below.
Three different methods are available for the space heating service (integration between heat pumps and boilers):

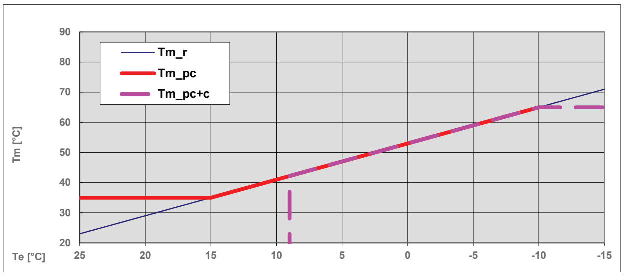
- ► Integration method (either parallel or series plumbing configuration);
- ► Integration and replacement method (either parallel or series plumbing configuration);
- ► Integration and progressive replacement method (series plumbing configuration only).

Only the integration mode is available for the conditioning service (either parallel or series plumbing configuration), and it is possible to set the priority between Robur systems and third party chillers.

6.1 HEATING: INTEGRATION

This operating mode makes it possible to manage heating systems consisting either of GAHP units or boilers where, in all operative conditions, the required set-point (fixed or variable) is compatible with the operating range of all generators.
Therefore, in this mode it is not expected to have operative conditions requiring such a high set-point that GAHP units must be excluded.
The power contribution of each generator is therefore controlled by the DDC Panel simply according to the efficiency of each type of generator in view of the system load.
The integration mode is possible either in parallel or series plumbing configurations, even at different operative temperatures by type of generator, as long as remaining within the permitted operating range of the individual generators.
In this operating mode it is therefore assumed that the total installed power (GAHP + boilers) is equal to the building maximum thermal load.
Figure 6.1 *p. 23* shows an example of weather curve set-up to illustrate this operating mode.
For higher outdoor temperatures, the GAHP units cover on their own the low load required by the system, at low delivery temperature. When the outdoor temperature decreases, the load increases and higher delivery temperatures are required.
GAHP units and boilers therefore operate in parallel at the same temperature, with GAHP units active at full power and boilers integrating the power according to the load.

Figure 6.1 *Integration heating weather curve*



Tm_r Delivery temperature required by the system (linear weather curve)
Tm_pc Delivery temperature required for GAHP units alone
Tm_pc+c Delivery temperature required for GAHP units + integration boilers

Table 6.1 *Integration heating weather curve*

	Te	Tm
1st point	-10	65
2nd point	15	35
T max p.c.	-10	65
T min	15	35
T max boiler	-10	65

Te = Outdoor temperature
Tm = Heating flow temperature

This operating mode is set out by the European regulation 811/2013 and illustrated in Section C1.01.

In addition to the delivery set-point, it is very important to ensure the return temperature from the building is compatible with the GAHP operative range: if the delta between delivery and return is low (lower than the nominal 10 °C), the GAHP units stop due to the return temperature being too high and no longer contribute to covering the total load, contrary to the intended sizing.

Refer to Table 6.2 *p. 23* which sets out the maximum delivery and return temperatures for GAHP units in heating mode.

Table 6.2 *GAHP heating temperature limits*

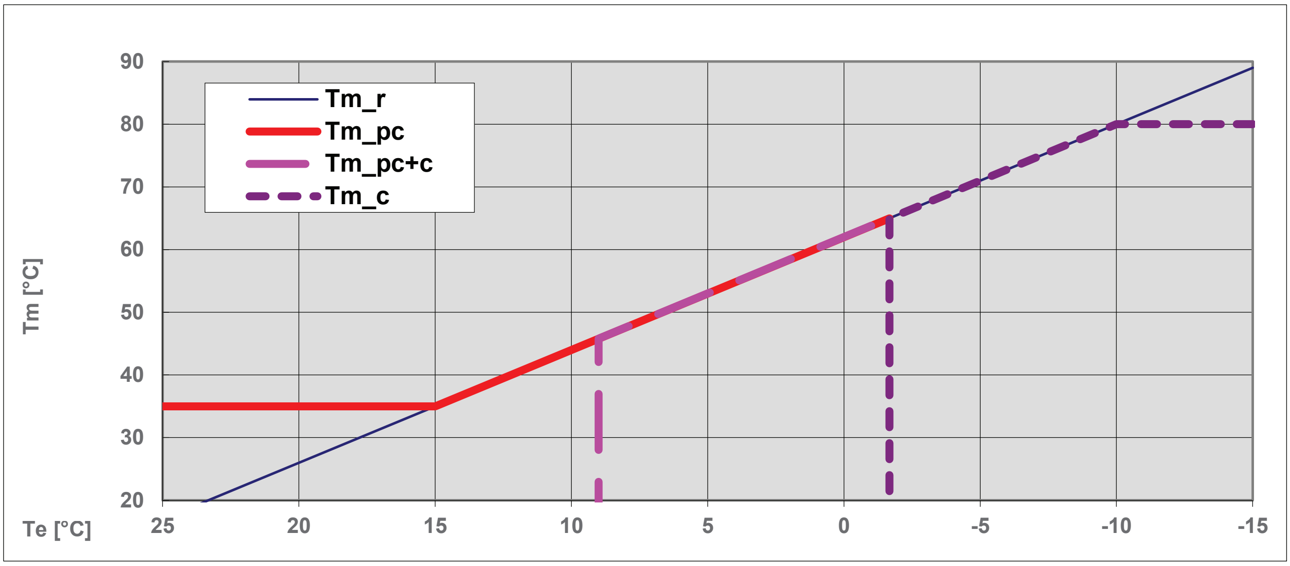
			GAHP A	GAHP-AR	GAHP GS/WS	AY00-120
Heating mode						
Hot water delivery temperature	maximum for heating	°C	65	-	65	-
	maximum	°C	-	60	-	80
Hot water return temperature	maximum for heating	°C	55	-	55	-
	maximum	°C	-	50	-	70

6.2 HEATING: INTEGRATION AND REPLACEMENT

This operating mode makes it possible to control heating systems consisting of both GAHP units and boilers where the operative conditions entail the possibility of the set-point required by the weather curve exceeding the maximum temperatures that may be reached by the GAHP units (see Table 6.2 *p. 23*).
Therefore the DDC Panel manages situations where the entire building thermal load (peak load) is covered by the boilers alone, whereas the GAHP units contribute to covering the base load only for as long as permitted by the required temperatures.
Clearly, in these systems the total installed power (GAHP units + boilers) is higher than the maximum power required by the building (peak load).
The Figure shows an example of weather curve set-up to illustrate this operating mode.
For high outdoor temperatures the system will work at low load and low temperature with the GAHP units only (Tm_pc section).
When the outdoor temperature decreases, the system load

increases: GAHP units and boilers will work together at the same temperature, with GAHP units at full power and boilers following the load (Tm_pc+c section).
When the outdoor temperature decreases further, under a certain level the required delivery temperature will be higher than that reached by the GAHP units, which therefore will be off: heating will then only be supplied by the boilers (Tm_c section).

Figure 6.2 *Integration and replacement heating weather curve*



Tm_r Delivery temperature required by the system (linear weather curve)
Tm_pc Delivery temperature required for GAHP units alone
Tm_pc+c Delivery temperature required for GAHP units + integration boilers
Tm_c Delivery temperature required for boilers alone

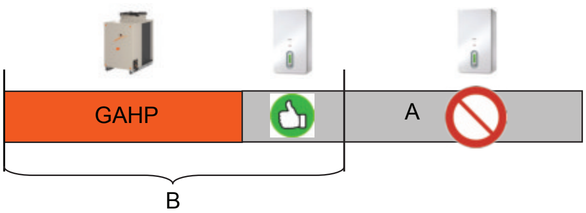
Table 6.3 *Integration and replacement heating weather curve*

	Te	Tm
1st point	-10	80
2nd point	15	35
T max p.c.	-2	65
T min	15	35
T max boiler	-10	80

Te = Outdoor temperature
Tm = Heating flow temperature

For as long as the required temperature remains within the operating range of the GAHP units, the DDC Panel only makes a part of the boilers available for start-up, so the total power (GAHP units + active boilers) does not exceed the design power; the other boilers remain inhibited (Figure 6.3 *p. 24*).

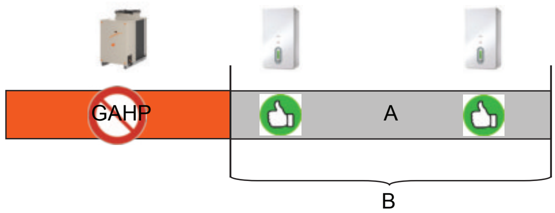
Figure 6.3 *Low temperature operation (integration)*



A Integration boilers B Design power

As the temperature rises above the admissible limits for the GAHP units, their operation is inhibited and the boilers alone meet the entire thermal requirement (Figuure 6.4 *p. 24*).

Figure 6.4 *High temperature operation (replacement)*



A Integration boilers B Design power

Switching from operating mode at low temperature ("integration" part) to that at high temperature ("replacement" part) takes place as soon as the actual delivery or return temperature of one of the GAHP units reaches its operative limit (see Table 6.2 *p. 23*). The GAHP units are automatically restored as soon as permitted by the conditions.

The "integration and replacement" operating mode makes it possible to simply "upgrade" the energy efficiency of a building, by installing GAHP alongside existing boilers without intervening in any way on the existing boilers, which are left to cover the higher loads.

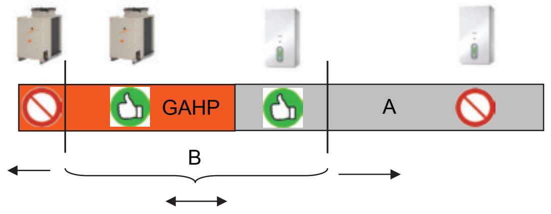
6.3 HEATING: INTEGRATION AND PROGRESSIVE REPLACEMENT

This operating mode requires plumbing configuration in series between GAHP units and boilers, complying with the indicative diagrams in Paragraphs 7.1.3 *p. 27* and 7.1.4 *p. 27*.

This operating mode makes it possible to achieve a temperature

"staging" , i.e. to obtain overall delivery temperatures higher than the operative limits of the GAHP units yet without inhibiting them (for as long as possible), integrating in temperature with the boilers.
Unlike the "integration and replacement" mode, this mode seeks to use the GAHP units as much as possible before definitely switching over to the boilers alone, which occurs when the return temperature from the system (and not the required delivery) becomes incompatible for the operative limits of the GAHP units.
In the "integration and replacement" mode, in fact, as soon as one of the GAHP units reaches the operative limit condition, all the GAHP units are inhibited until the temperatures fall back within the operative limits.
To ensure that the regulation is effective, it is therefore necessary for the building to develop a high thermal gradient (at least greater than 10°C) when the requested delivery temperature exceed the operating limits of the GAHP.

Figure 6.5 *Progressive replacement operation*



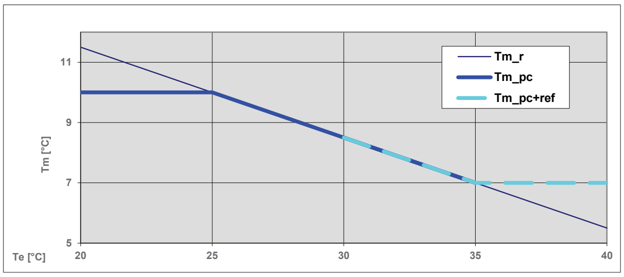
A Integration boilers
B Design power

The DDC Panel identifies the maximum number of GAHP units that may be activated according to the operative conditions.
To do so, the temperature probes of the delivery and return manifolds are required, as well as the designated return temperature probe for the GAHP units alone.
Furthermore, certain additional parameters must be set in the DDC Panel, specific for this operating mode; in particular, the building design thermal load must be set (which is correlated to the mobile "band" B in Figure 6.5 *p. 25*).

6.4 CONDITIONING: INTEGRATION

This operating mode makes it possible to manage conditioning systems featuring both GAHP heat pumps and GA ACF chillers, and third party chillers.
The required set-point (fixed or variable) must be compatible with the temperature limits of all generators installed in the system.
For this operating mode, a parameter is available on the DDC to define the priority between Robur units and third party chillers, in order to assure maximum flexibility in the choice of the generators in charge of the base load, according to the system specific features.
In the case of conditioning, the third party chillers might cover the base load (hence active in the Tm_pc section of the weather curve in Figure 6.6 *p. 25*), whereas Robur chillers are only active to cover peak loads (Tm_pc+ref section), or vice versa.
Figure 6.6 *p. 25* shows an example of weather curve set-up to illustrate this operating mode.
In this case, the minimum temperature that may be reached by the third party chiller and by the Robur units is the same, and corresponds to the minimum temperature request of the system.
For the first operation section (section Tm_pc), the chillers chosen to cover the base load are able to cover the requirement on their own.
As the outdoor temperature rises, so does the system load and lower temperatures are required; the base chillers and the peak ones are therefore working in parallel at the same temperature (section Tm_pc+ref), with base chillers at full power and peak ones keeping up with the load.

Figure 6.6 *Integration conditioning weather curve*



Tm_r Delivery temperature required by the system (linear weather curve)
Tm_pc Required delivery temperature for active chillers on base load
Tm_pc+ref Required delivery temperature for active chillers on base load and active chillers on peak load

Table 6.4 *Integration conditioning weather curve*

	Te	Tm
1st point	25	10
2nd point	35	7
T max p.c.	25	10
T min	35	7

6.5 PLUMBING CONFIGURATIONS AND INTEGRATION METHODS

The integration methods described above may be used either with series or parallel plumbing configurations, with the exception of the integration and progressive replacement mode, which requires mandatory series configuration.
The series configuration is advantageous when the system, faced with a high thermal load, requires a temperature exceeding the GAHP operative limits and at the same time, under these conditions, a thermal gradient exceeding 10°C might develop on the system.

7 SYSTEM BLOCK DIAGRAMS FOR THIRD PARTY UNIT CONTROL

In order to illustrate in a more general manner the control options of third party generators and other system components (temperature probes, circulating pumps, diverter valves) supported by Robur control systems, block diagrams are set out below, divided by:

- primary circuit (see Paragraph 7.1 *p. 26*);
- secondary circuit (see Paragraph 7.2 *p. 27*);
- separable circuit (see Paragraph 7.3 *p. 29*);

Table 7.1 *p. 26* sets out the permitted combinations between system blocks.

Table 7.1 *System block combinations*

	Plumbing configuration		Separable	
			A1	A2
Primary	Parallel circuit	P1	S1	X
		P2	X	S1
	Series	P3	S2	X
		P4	S1	X

X Combination not managed by the control systems Robur

The control of third party generators and system components such as temperature probes and circulating pumps is only possible by using the DDC Panel together with the RB200 device, as described in Paragraph 2.4.2 *p. 7*.

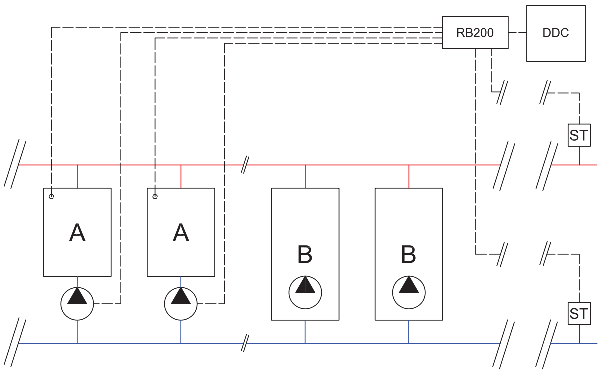
Table 7.1 *p. 26* intentionally refers to the generic secondary S1 (see Paragraph 7.2.1 *p. 27*), without specifying one of the three possible versions, as the combination is possible with any of the three versions. However, the "X" means that the combination cannot be managed by Robur control systems.
Paragraph 7.4 *p. 29* sets out some example diagrams of possible combinations.

7.1 PRIMARY CIRCUIT BLOCKS

Below is a series of system configurations of possible primary circuits supported by Robur control systems.

7.1.1 Primary P1

Figure 7.1 *Primary P1*



A Third party generators
B Generators Robur
ST Temperature probes on secondary circuit

Figure 7.1 *p. 26* shows type P1 primary block, with the following features:

- Robur Generators with circulating pumps controlled by the unit electronics;
- Third party generators with circulating pumps controlled by RB200;
- A pair of temperature probes on the secondary circuit connected to RB200.

The temperature probes connected to RB200 are mandatory if third party generators are installed.

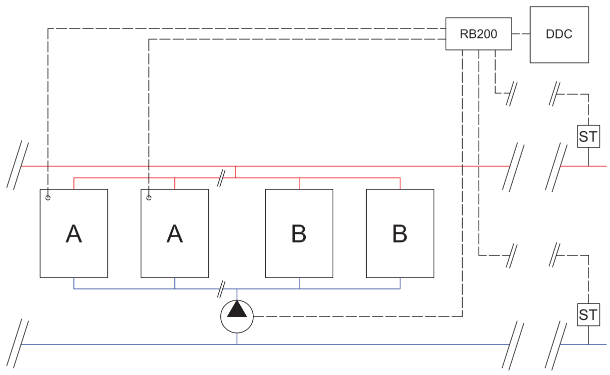
The circulating pumps of third party units are exclusively controlled in ON/OFF mode.

Any water flow modulation must be controlled directly by the circulating pumps.

This plumbing layout supports the "integration" mode (see Paragraph 6.1 *p. 23*) and "integration and replacement" mode (see Paragraph 6.2 *p. 23*) for the heating and DHW function with base system.
For the conditioning function, only the "integration" mode described in Paragraph 6.4 *p. 25* is available.

7.1.2 Primary P2

Figure 7.2 *Primary P2*



A Third party generators
B Generators Robur
ST Temperature probes on secondary circuit

Figure 7.2 *p. 26* shows type P2 primary block, with the following features:

- Robur generators and third party generators with common circulating pump controlled by RB200;
- A pair of temperature probes on the secondary circuit connected to RB200.

The temperature probes connected to RB200 are mandatory if third party generators are installed.

The common circulating pump does not allow the water flow to bypass generators that are temporarily turned off from normal cascade control.

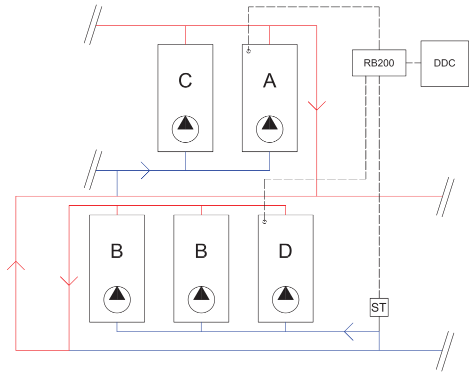
It is not therefore possible to ensure the general setpoint is reached and maintained under any conditions.
With high delivery setpoint, GAHP units may exceed their operative limits to offset the mixing that is brought about with inactive units.

The common circulating pump is exclusively controlled in ON/OFF mode.

This plumbing layout supports the "integration" mode (see Paragraph 6.1 *p. 23*) and "integration and replacement" mode (see Paragraph 6.2 *p. 23*) for the heating and DHW function with base system.
For the conditioning function, only the "integration" mode described in Paragraph 6.4 *p. 25* is available.

7.1.3 Primary P3

Figure 7.3 *Primary P3*



A Third party generators
B Generators Robur
C AY00-120 Robur boilers
D Third party chillers
ST GAHP return temperature probe

Figure 7.3 *p. 27* shows type P3 primary block, with the following features:

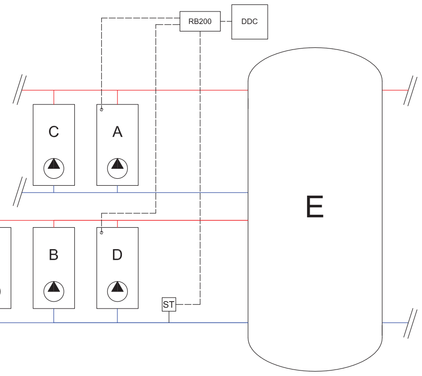
- Robur Generators with circulating pumps controlled by the unit electronics;
- Third party generators with circulating pumps controlled by their own electronics;
- Series plumbing configuration;
- Probe on the return manifold for "integration and progressive replacement" function (see Paragraph 6.3 *p. 24*).

The temperature probe on return connected to RB200 is mandatory for the "integration and progressive replacement" function.

This plumbing layout supports the "integration" mode (see Paragraph 6.1 *p. 23*) and "integration and replacement" mode (see Paragraph 6.2 *p. 23*) and "integration and progressive replacement" mode (see Paragraph 6.3 *p. 24*) for the heating and DHW function with base system.
For the conditioning function, only the "integration" mode described in Paragraph 6.4 *p. 25* is available.

7.1.4 Primary P4

Figure 7.4 *Primary P4*



A Third party generators
B Generators Robur
C AY00-120 Robur boilers
D Third party chillers
E Buffer tank
ST GAHP return temperature probe

Figure 7.4 *p. 27* shows type P4 primary block, with the following features:

- Robur Generators with circulating pumps controlled by the unit electronics;
- Third party generators with circulating pumps controlled by their own electronics;
- Series plumbing configuration serving a buffer tank;
- Probe on the return manifold for "integration and progressive replacement" function (see Paragraph 6.3 *p. 24*).

The temperature probe on return connected to RB200 is mandatory for the "integration and progressive replacement" function.

This plumbing layout supports the "integration" mode (see Paragraph 6.1 *p. 23*) and "integration and replacement" mode (see Paragraph 6.2 *p. 23*) and "integration and progressive replacement" mode (see Paragraph 6.3 *p. 24*) for the heating and DHW function with base system.
For the conditioning function, only the "integration" mode described in Paragraph 6.4 *p. 25* is available.

7.2 SECONDARY CIRCUIT BLOCKS

Below is a series of system configurations of possible secondary circuits supported by Robur control systems.
It should be noted that the diagrams show always include a hydraulic separator as the residual head of the circulators installed on the machine (if any) is often not sufficient for distribution to the services.
Please also note that the functions of the control systems do not include controlling tapping towards fixtures.

It is important for the DDC panel to receive a secondary circuit disabling signal, in order to maintain generation active only if there is an actual request.

This simple measure makes it possible to further optimise overall efficiency.

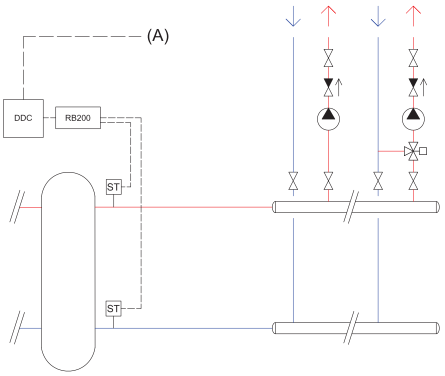
7.2.1 Secondary S1

This type of secondary circuit is divided into three versions: S1A, S1B and S1C.

In all three variants, the temperature probes are required in the following cases:

- Presence of third party generators controlled by Robur control systems;
- Primary system in series configuration.

Figure 7.5 *Secondary S1A*



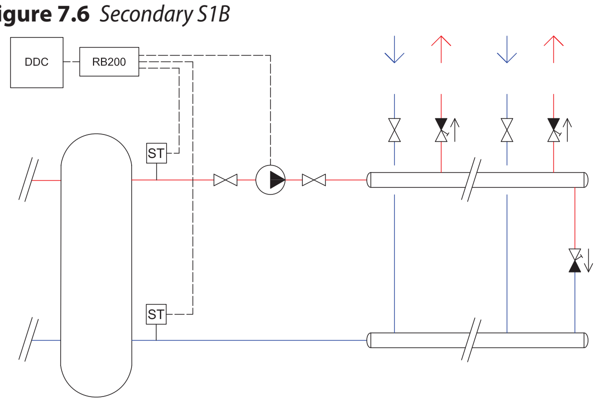
(A) Service request signal from secondary circuits control system (not supplied)
ST Temperature probes on secondary circuit

Figure 7.5 *p. 28* shows type S1A secondary block, with the following features:

- Common manifold with tapping and check valves;
- Circulating pumps designated for each tap, not controlled by Robur control systems;
- Pair of temperature probes on secondary circuit.

As set out in Paragraph 7.2 *p. 27*, it is recommended for the DDC Panel to receive from the fixture management system a digital signal for enabling/disabling them, in order to optimise operation of the generation system.

Figure 7.6 *Secondary S1B*



ST Temperature probes on secondary circuit

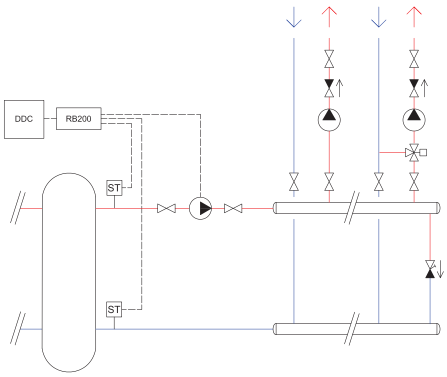
Figure 7.6 *p. 28* shows type S1B secondary block, with the following features:

- Common manifold with tapping and balancing valves;
- Common circulating pump controlled by RB200;
- Plumbing bypass with balancing valve;
- Pair of temperature probes on secondary circuit.

The common circulating pump is exclusively controlled in ON/OFF mode.

Any water flow modulation must be controlled directly by the circulating pump.

Figure 7.7 *Secondary S1C*



ST Temperature probes on secondary circuit

Figure 7.7 *p. 28* shows type S1C secondary block, with the following features:

- Common manifold with tapping and check valves;
- Circulating pumps designated for each tap, not controlled by Robur control systems;
- Common circulating pump controlled by RB200;
- Plumbing bypass with balancing valve;
- Pair of temperature probes on secondary circuit.

The common circulating pump is exclusively controlled in ON/OFF mode.

Any water flow modulation must be controlled directly by the circulating pump.

7.2.2 Secondary S2

Type S2 secondary circuit includes an additional common circulation pump upstream of any hydraulic separator (called secondary pump); for this reason, if the separator is actually included, the downstream circulating pump is called tertiary. The type S2 secondary circuit must be used in combination with type P3 primary circuit (described in Paragraph 7.1.3 *p. 27*).

Figure 7.8 *Secondary S2*

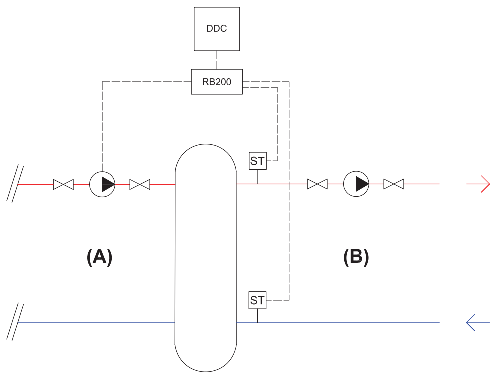


Diagram only applicable for series plumbing configuration, if type P3 primary circuit is installed (see 7.1.3 *p. 27*)
(A) Secondary circuit
(B) Tertiary circuit
ST Temperature probes on tertiary circuit

Figure 7.8 *p. 28* shows type S2 secondary block, with the following features:

- Secondary circulating pump controlled by RB200;
- Tertiary circulating pump (only if hydraulic separator is included);
- Hydraulic separator (optional);

► Pair of secondary circuit temperature probes (or tertiary, if the hydraulic separator is included).

The tertiary circuit circulator can be controlled via RB200, controlled in parallel to the secondary circulator.

The common circulating pump is exclusively controlled in ON/OFF mode.

Any water flow modulation must be controlled directly by the circulating pump.

7.3 SEPARABLE CIRCUIT BLOCKS

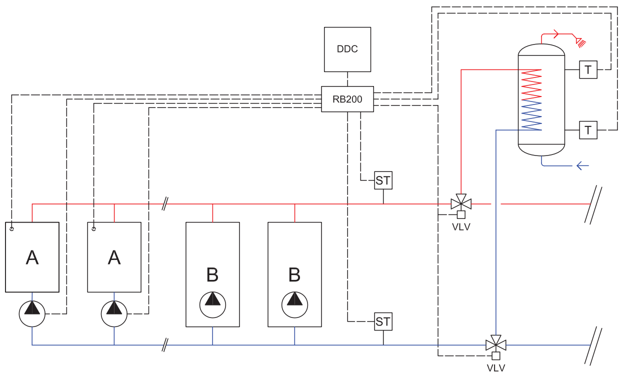
Below is a series of system configurations for possible separable circuits for production of domestic hot water and space heating alternatively, supported by Robur control systems.

Only the "integration" mode described in Paragraph 6.1 *p. 23* is available for separable systems.

In no case may reversible or 4-pipe Robur generators be used on the separable system.

7.3.1 Separable A1

Figure 7.9 *Separable A1*



A Third party generators
B GAHP A or AY00-120
ST Temperature probes on separable circuit
T DHW tank thermostats
VLV ON/OFF type diverting valves

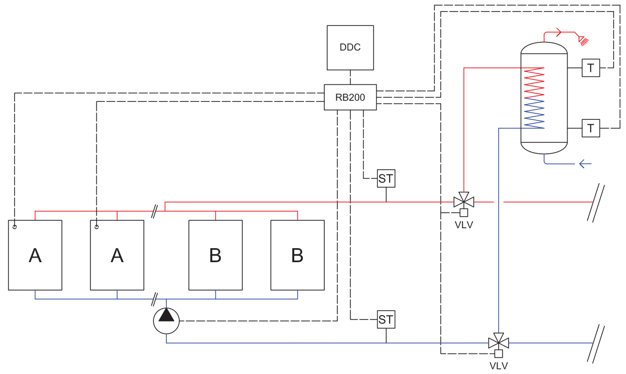
Figure 7.9 *p. 29* shows type A1 separable block, with the following features:

- ► Robur Generators with circulating pumps controlled by the unit electronics;
- ► Third party generators with circulating pumps controlled by RB200;
- ► Pair of 3-way diverter valves controlled by RB200;
- ► Thermostat(s) in the DHW tank for DHW service request;
- ► Pair of temperature probes on the separable circuit connected to RB200.

The temperature probes connected to RB200 are mandatory if third party generators are installed.

7.3.2 Separable A2

Figure 7.10 *Separable A2*



A Third party generators
B GAHP A or AY00-120
ST Temperature probes on separable circuit
T DHW tank thermostats
VLV ON/OFF type diverting valves

Figure 7.10 *p. 29* shows type A2 separable block, with the following features:

- ► Robur generators and third party generators with common circulating pump controlled by RB200;
- ► Pair of 3-way diverter valves controlled by RB200;
- ► Thermostat(s) in the DHW tank for DHW service request;
- ► Pair of temperature probes on the separable circuit connected to RB200.

The temperature probes connected to RB200 are mandatory if third party generators are installed.

The common circulating pump does not allow the water flow to bypass generators that are temporarily turned off from normal cascade control.

It is not therefore possible to ensure the general setpoint is reached and maintained under any conditions.
With high delivery setpoint, GAHP units may exceed their operative limits to offset the mixing that is brought about with inactive units.

The common circulating pump is exclusively controlled in ON/OFF mode.

Any water flow modulation must be controlled directly by the circulating pump.

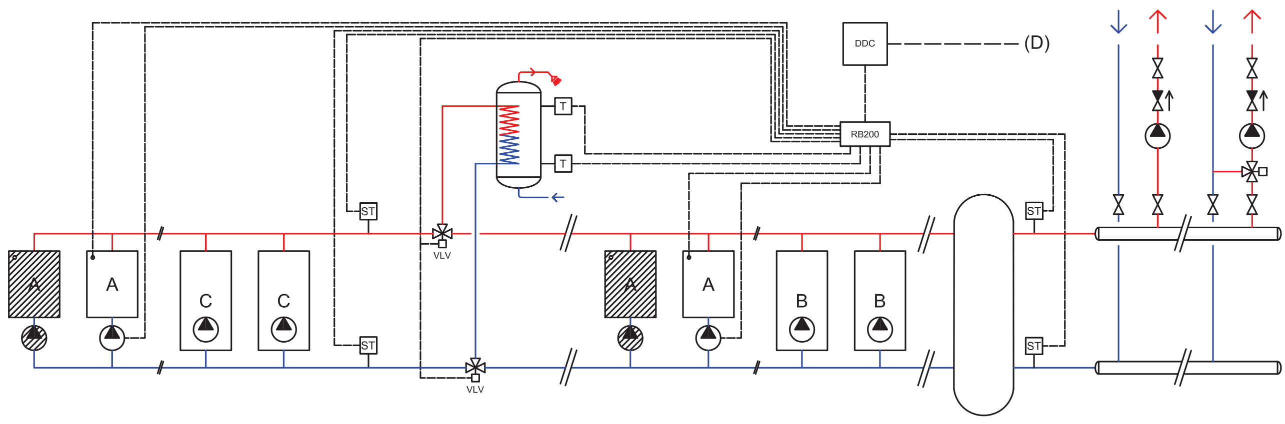
7.4 INDICATIVE BLOCK DIAGRAMS

For type S1 secondary circuit, it is possible to use any of the three versions S1A, S1B or S1C (see Paragraph 7.2.1 *p. 27*). For the sake of simplicity, the pictures show one version only.

The shaded generators are shown to comply with the original block structure described in the relevant chapters, but cannot be controlled with a single RB200, because (as illustrated in Paragraph 4 *p. 13*) each RB200 makes it possible to control up to two third party units.

7.4.1 Primary P1 with separable A1 and secondary S1

Figure 7.11 *P1+A1+S1 system*

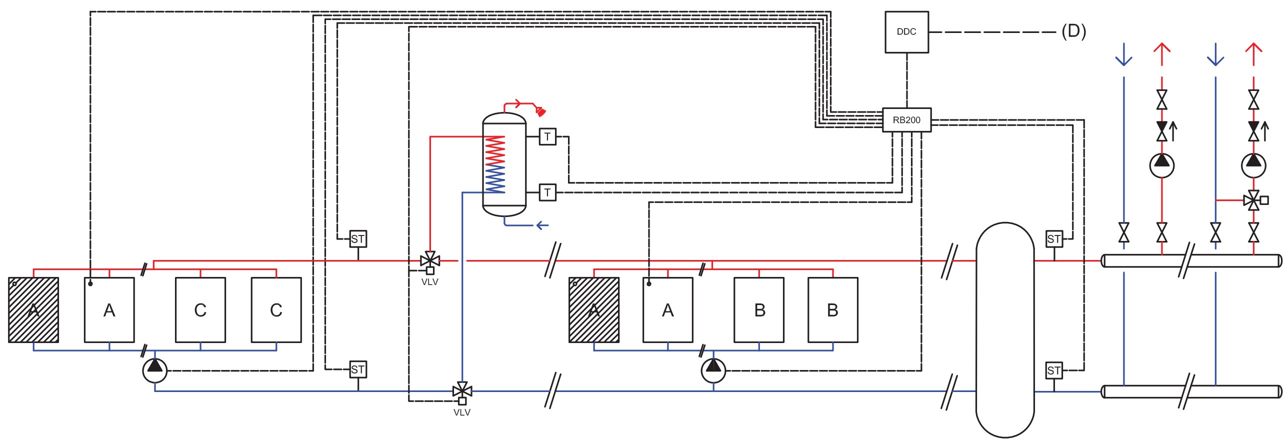


A Third party generators
B Generators Robur
C GAHP A or AY00-120
(D) Service request signal from secondary circuits control system (not supplied)
ST Temperature probes of secondary and/or separable circuits
T DHW tank thermostats
VLV ON/OFF type diverting valves

Figure 7.11 *p. 30* shows a general diagram for a system arising from the combination, according to the rules set out in Paragraph 7 *p. 26*, of type P1 primary (see Paragraph 7.1.1 *p. 26*) with secondary type S1A (see Paragraph 7.2.1 *p. 27*), with the addition (if required) of separable type A1 (see Paragraph 7.3.1 *p. 29*).
The probes are located both on the separable and on the secondary circuit, and the secondary control system (not supplied) is intended to provide an operation request to the DDC Panel.

7.4.2 Primary P2 with separable A2 and secondary S1

Figure 7.12 *P2+A2+S1 system*

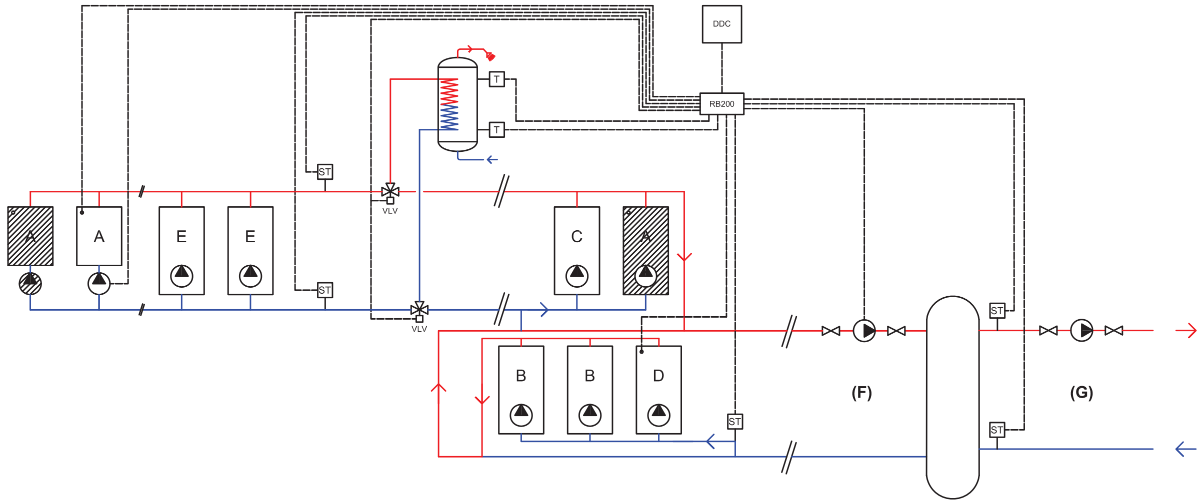


A Third party generators
B Generators Robur
C GAHP A or AY00-120
(D) Service request signal from secondary circuits control system (not supplied)
ST Temperature probes of secondary and/or separable circuits
T DHW tank thermostats
VLV ON/OFF type diverting valves

Figure 7.12 *p. 30* shows a general diagram for a system arising from the combination, according to the rules set out in Paragraph 7 *p. 26*, of type P2 primary (see Paragraph 7.1.2 *p. 26*) with secondary type S1A (see Paragraph 7.2.1 *p. 27*), with the addition (if required) of separable type A2 (see Paragraph 7.3.2 *p. 29*).
The probes are located both on the separable and on the secondary circuit, and the secondary control system (not supplied) is intended to provide an operation request to the DDC Panel.

7.4.3 Primary P3 with separable A1 and secondary S2

Figure 7.13 *P3+A1+S2 system*

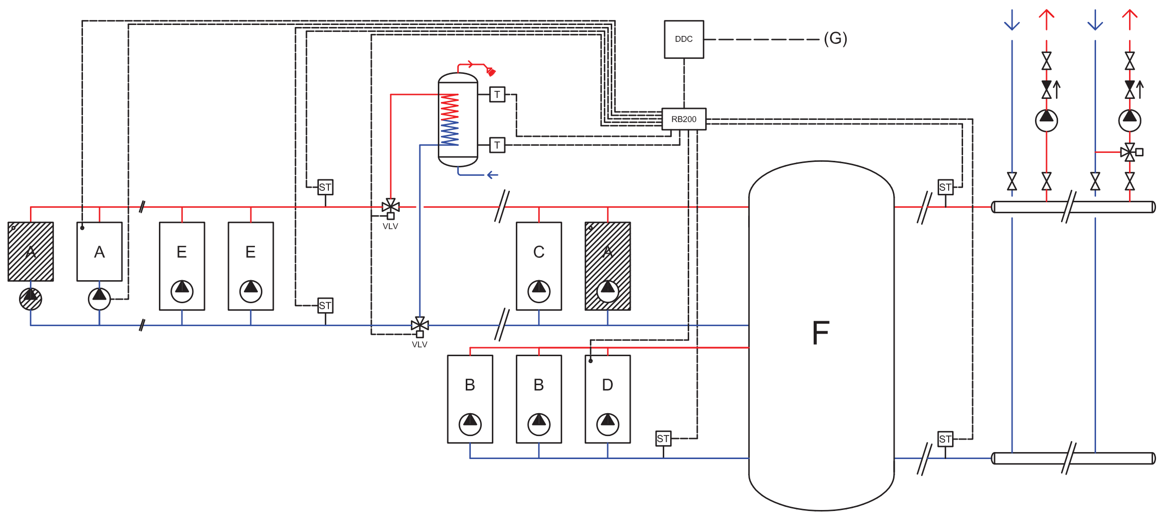


A Third party generators
B Generators Robur
C AY00-120 boilers
D Third party chillers
E GAHP A or AY00-120
(F) Secondary circuit
(G) Tertiary circuit
ST GAHP return temperature probe and/or tertiary and/or separable circuit temperature probes
T DHW tank thermostats
VLV ON/OFF type diverting valves

Figure 7.13 *p. 31* shows a general diagram for a system arising from the combination, according to the rules set out in Paragraph 7 *p. 26*, of type P3 primary (see Paragraph 7.1.3 *p. 27*) with secondary type S2 (see Paragraph 7.2.2 *p. 28*), with the addition (if required) of separable type A1 (see Paragraph 7.3.1 *p. 29*).
The probes are located both on the separable and on the secondary circuit (or tertiary if the buffer tank is installed), as well as on the GAHP inlet branch (the latter is only required if one should wish to use the integration and progressive replacement mode, described in Paragraph 6.3 *p. 24*).
The common circulating pump of the secondary circuit is controlled by RB200.

7.4.4 Primary P4 with separable A1 and secondary S1

Figure 7.14 *P4+A1+S1 system*



A Third party generators
B Generators Robur
C AY00-120 boilers
D Third party chillers
E GAHP A or AY00-120
F Buffer tank
(G) Service request signal from secondary circuits control system (not supplied)
ST GAHP return temperature probe and/or secondary and/or separable circuit temperature probes
T DHW tank thermostats
VLV ON/OFF type diverting valves

Figure 7.14 *p. 31* shows a general diagram for a system arising from the combination, according to the rules set out in Paragraph7 *p. 26*, of type P4 primary (see Paragraph 7.1.4 *p. 27*) with secondary type S1A (see Paragraph

7.2.1 *p. 27*), with the addition (if required) of separable type A1 (see Paragraph 7.3.1 *p. 29*).
The probes are located both on the separable and on the secondary circuit, as well as on the GAHP inlet branch (the latter is only required if one should wish to use the integration and progressive replacement mode, described in Paragraph 6.3 *p. 24*) and the control system of the secondary circuit (not supplied) is intended to provide an operation request to the DDC Panel.

8 CCI

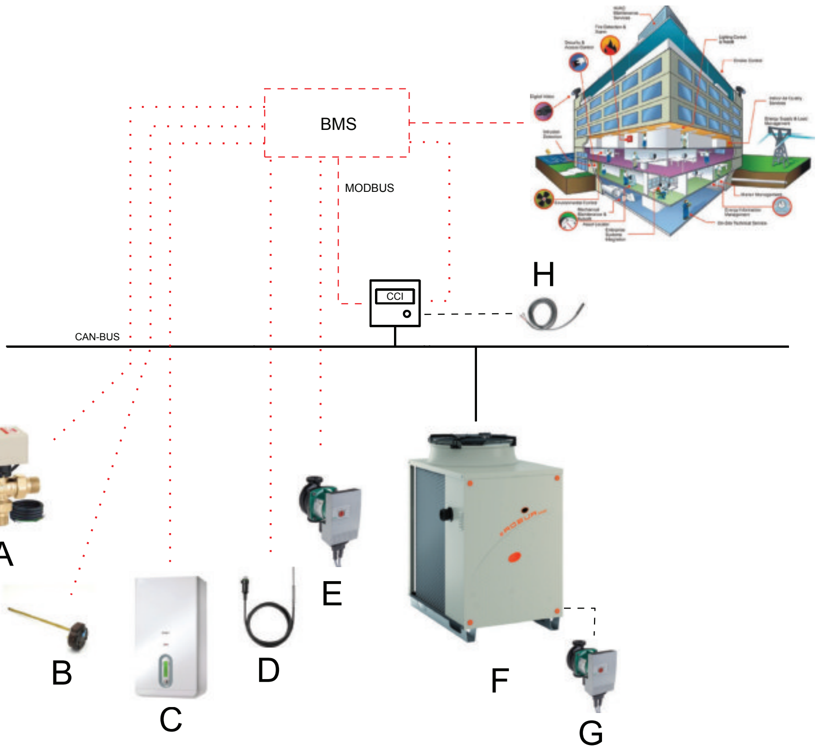
8.1 CCI CONTROL ARCHITECTURE

The CCI control is able to control the appliances, from a single unit up to three consistent GAHP A or GAHP GS/WS units, in modulating mode (for heating and DHW production) and any free-cooling (GAHP GS/WS units only).

The CCI Panel requires to receive the appropriate request signals from an external system as it is designed for operation in combination with a system control.

The diagram shown in Figure 8.1 *p. 33* shows the elements of the control system and the types of available connections if the CCI Panel is installed and a fixture control system such as BMS, SCADA and similar.

Figure 8.1 *BMS control architecture with CCI*



In solid line the CAN-BUS connection connecting Robur control devices to the units
In dashed line the connections with analogue/digital signals between CCI Panel and manifold water temperature probe and of unit Robur circulating pumps that must be controlled by the electronic boards inside the units
In red dashed line the MODBUS connection between the CCI Panel and the fixture control system (BMS, SCADA, etc.)
In red dotted line the connection with analogue/digital signals connecting the fixture control system with the CCI Panel and with the other devices in the system

A ON/OFF type three-way diverting valves
B Thermostats
C Third party generators
D Temperature probes
E Circulating pumps
F Single Robur units (only GAHP A and GAHP GS/WS and maximum three, mutually consistent)
G Single Robur units circulating pumps
H Manifold water temperature probe

Connection with the CCI Panel will always be via Modbus protocol, while any analogue/digital type signals from the BMS system (only useful if the BMS does not communicate via Modbus with the CCI Panel) will be connected to the CCI directly. With the CCI Panel, the possibility of using the DDC Panel or the RB100/RB200 devices is not provided.

8.1.1 CAN-BUS communication network

See Paragraph 1.1 *p. 2*.

8.2 MAIN FUNCTIONS

The main functions of the CCI Panel are:

1. Setup and control of up to three homogeneous Robur units (GAHP A or GAHP GS/WS) with control in modulation of the units;
2. data display and parameters setting;
3. manifold water temperature probe interface;
4. diagnostics;
5. errors reset;
6. possibility to interface with a BMS;

The CCI Panel in combination with an external system control supports the following functions:

- heating;
- DHW production;
- free cooling (GAHP GS/WS units only).

Below is a synthetic description of the main CCI Panel functions:

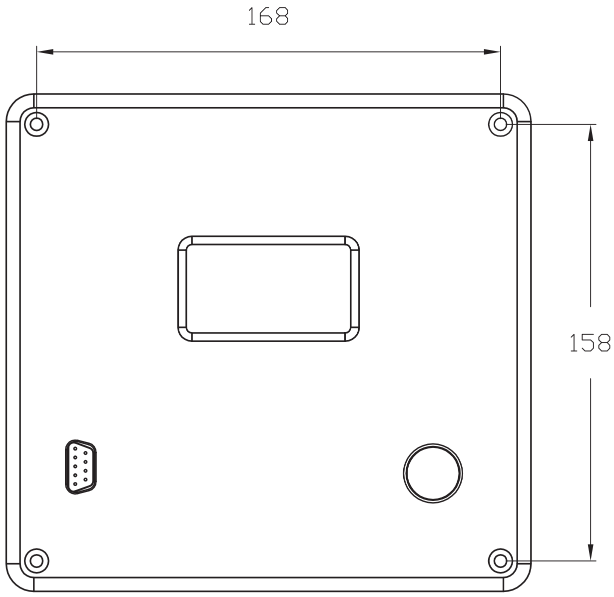
1. Set-up and control of up to three unitsRobur makes it possible to control operation in modulation of the supported types of appliance.
2. Values view and parameters setting allow you to optimize the adjustment parameters in order to best exploit the efficiency of the absorption technology, while safeguarding user comfort.
3. Interfacing for the manifold water temperature probe makes it possible to know exactly the actual temperature on the manifold feeding the fixtures, and to use this reading as feedback to optimise control.
4. Diagnostics lets you know at any time the operating status, warnings or errors of the appliances and identify the possible causes of any malfunctions, as well as manage a log of recorded events.
5. The error reset lets you restore appliance availability following resolution of an error that involved shutdown by the control system.
6. The BMS interfacing option (or other external supervision and control system) makes it possible to manage the CCI Panel (and the appliances controlled by it) through an external device, within more complex and integrated domotics or integrated building/installation control systems. In practice, interfacing is carried out either via simple analogue/digital signals, or (more comprehensively) via the Modbus protocol, detailed in Paragraph 8.6 *p. 37*.

8.3 INSTALLATION

The CCI Panel is suitable for internal installation and must be fixed onto an electrical panel, into which a 155 x 151 mm rectangular opening must be made.

Figure 8.2 *p. 34* indicates the position of the fixing holes.

Figure 8.2 *DDC/CCI front view with fixing dimensions*



The CCI Panel has protection rating IP20, and must be installed in premises with ambient air temperature between 0°C and 50°C, away from direct sunlight exposure.

8.4 CONNECTIONS

The CCI Panel provides the connection terminals shown in Figure 8.3 *p. 35*.

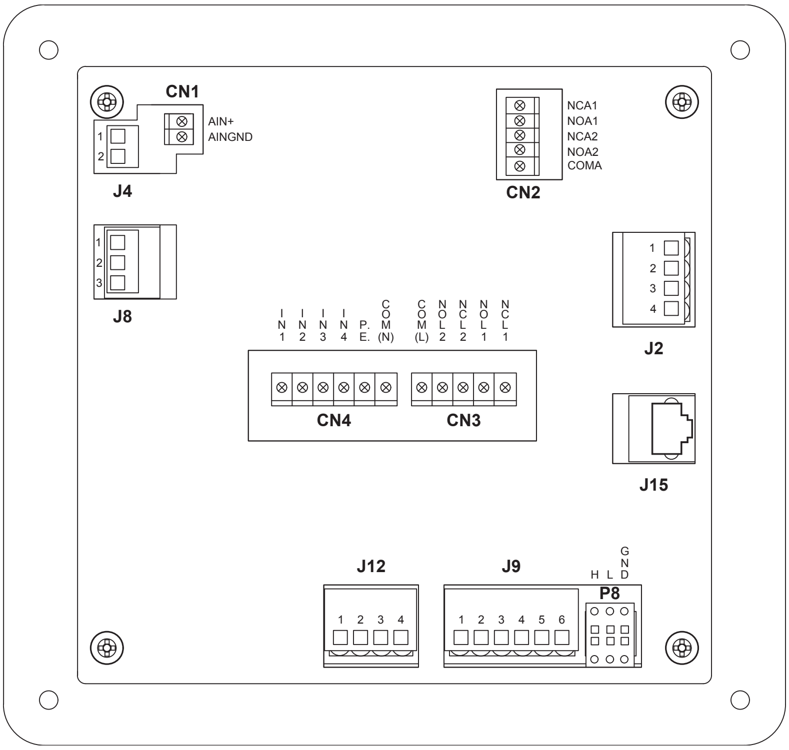


Figure 8.3 *CCI panel connections*

CN12 = Set-point request connections
- AIN+ = 0-10 V input for set-point request
- AINGND = ground reference for AIN+

J4 = Delivery or return manifold temperature probe input

CN4 = Service request inputs
- IN1 = Input (phase 230 V) for GAHP start up request
- IN2 = Input (phase 230 V) for DHW service request
- IN3 = Not used
- IN4 = Input (phase 230 V) for free cooling request
- P.E. = Safety earthing
- COM(N) = Reference (neutral 230 V) IN1-IN4 inputs

J9 = Auxiliary generator turning on signal
- 1 = Reference for contact 2
- 2 = Auxiliary generator active signal input

CN3 = service alarms signal outputs
- COM(L) = Common contact
- NOL2 = NO contact impossibility to continue DHW service with GAHP
- NCL2 = NC contact impossibility to continue DHW service with GAHP
- NOL1 = NO contact general alarm
- NCL1 = NC contact general alarm

J8 = First GAHP unit alarm signal outputs
- 1 = Common contact
- 2 = NC first GAHP alarm contact
- 3 = NO first GAHP alarm contact

CN2 = Second and third GAHP unit alarm signal outputs
- COMA = Common contact
- NOA2 = NO third GAHP alarm contact
- NCA2 = NC third GAHP alarm contact
- NOA1 = NO second GAHP alarm contact
- NCA1 = NC second GAHP alarm contact

J12 = CCI panel power supply contacts
- 1 = 24 VAC, 20 VA SELV power supply
- 2 = 0 Vac
- 3 = Safety earthing

P8 = CAN-BUS network connector (orange)

J2 = Serial Modbus RS485 connection
- 1 = A (TXD/RXD +)
- 2 = B (TXD/RXD -)
- 3 = Common (earth & GND)
- 4 = Cable shielding (earth & GND)

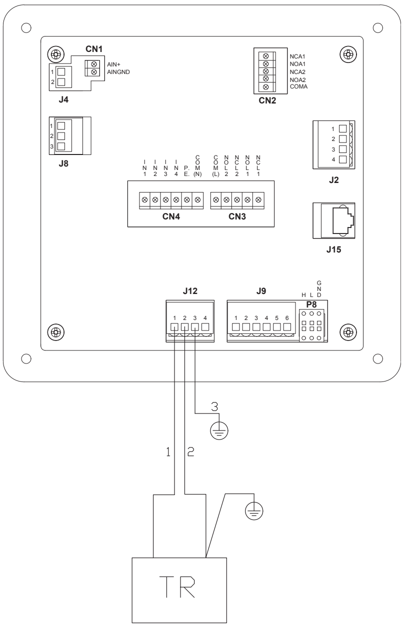
8.4.1 Electrical power supply

The CCI Panel must be supplied by a 230/24 V AC - 50/60 Hz safety transformer with power no less than 20 VA (not supplied); in particular, this transformer must comply with standard EN 61558-2-6.

Use a connecting 3 x 0.75 mm² electrical cable and perform connections on the J12 connector terminals (see Figure 8.3 *p. 35*) complying with the polarity indicated in Figure 8.4 *p. 36*.

The maximum specified length for this cable is 1m.

Figure 8.4 *CCI power supply connection*



J12 24 Vac electrical power supply - 4 pole connector
- 1 = 24 Vac
- 2 = 0 Vac
- 3 = earth

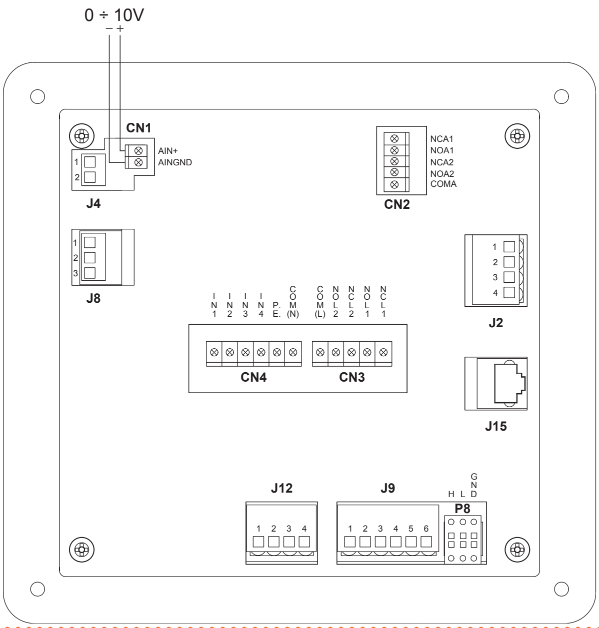
TR Safety transformer (240/24 Vac - 50/60 Hz - min 20 VA)

8.4.2 Inputs/Outputs

Set-point request analogue input

Connector CN12 (see Figure 8.3 *p. 35*) is used for connecting the set-point request 0-10 Vdc analogue signal from the external control system.
Maximum length of the connecting cables is 10 m.
Figure 8.5 *p. 36* shows the connection diagram.

Figure 8.5 *CCI set-point request connection*

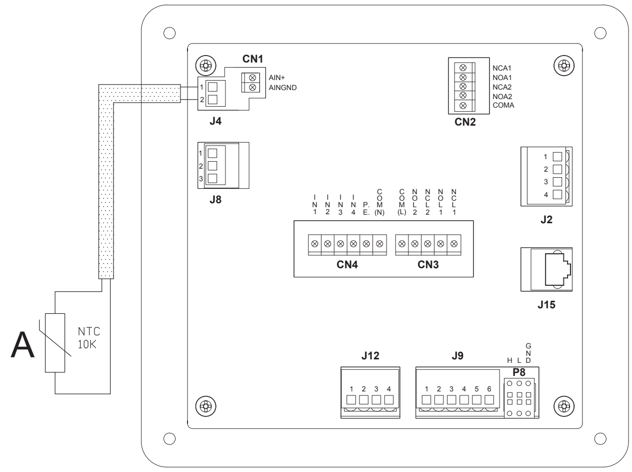


Manifold temperature probe input

The J4 analogue input (see Figure 8.3 *p. 35*) is used for the delivery (or return) manifold temperature probe, resistive type NTC 10 kΩ.

Maximum length of the connecting cable is 100 m.
Figure 8.6 *p. 36* shows the connection diagram.

Figure 8.6 *CCI manifold probe connection*



A Heating manifold delivery or return probe

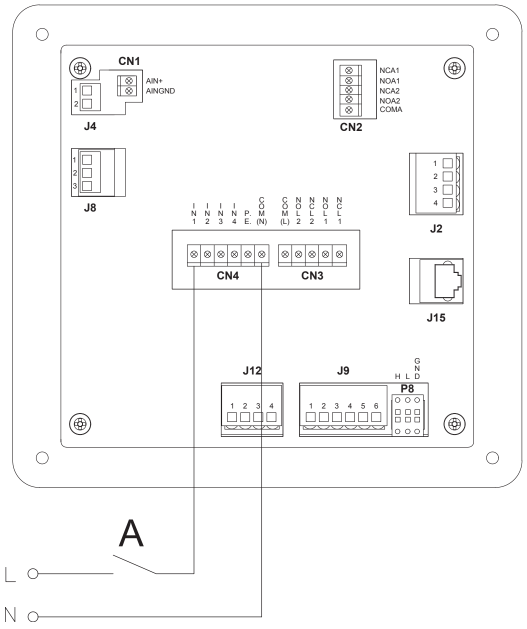
External request digital inputs

Connector CN4 (see Figure 8.3 *p. 35*) is used for connecting the service request digital signal from the external control system.
The inputs have the following features:

- ► IN1: phase 230 Vac, value 0 V if GAHP OFF, value 230 V if GAHP ON;
- ► IN2: phase 230 Vac, value 0 V if heating service, value 230 V if DHW service;
- ► IN3: not used;
- ► IN4: phase 230 Vac, value 0 V if free cooling OFF, value 230 V if free cooling ON;
- ► P.E.: safety earth connection;
- ► COM(N): neutral 230 Vac from mains.

Maximum length of the connecting cables is 10 m.
Figure 8.7 *p. 37* shows an example connection for the GAHP start-up contact IN1.
For the other start-up requests, only the contact to be connected changes.

Figure 8.7 *CCI services digital input connections*

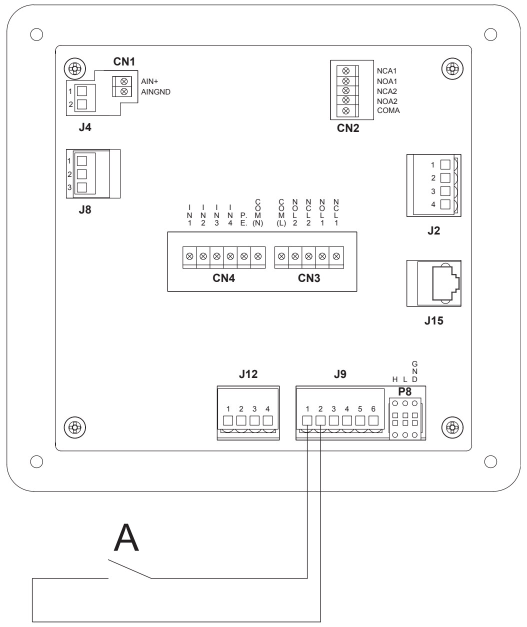


A Enable turning on request from external controller

Auxiliary generator start-up digital input

Connector J9 (see Figure 8.3 *p. 35*) is used for connecting the auxiliary generator start-up digital signal from the external control system.
This contact has the purpose of overriding the GAHP units at maximum power when the external control system starts up an auxiliary generator (typically a boiler).
Maximum length of the connecting cables is 10 m.
Figure 8.8 *p. 37* shows the connection diagram.

Figure 8.8 *CCI auxiliary generator digital input connection*



A Auxiliary generator turning on signal from external controller

8.4.3 CAN-BUS connections

For CAN-BUS connection of the CCI Panel to the individual appliances refer to Section B concerning the specific appliance.

The CCI Panel cannot be connected:

- To GAHP units other than GAHP A and GAHP GS/WS;
- To the RB100/RB200 devices;
- To the DDC Panel.

8.5 CONTROL AND SETUP

To start up the GAHP units controlled by the CC Panel, an external system control must enable the request signal on IN1 input of connector CN4 (see Paragraph *p. 36*).
The water set-point may be fixed or variable.
Should one wish a variable set-point, this must be relayed by the external system control through the 0-10 V signal connected to connector CN1 (see Paragraph *p. 36*), or received by the CCI via Modbus (see Paragraph 8.6 *p. 37*).
The CCI Panel enables GAHP units control with the purpose of controlling water temperature (measured by the manifold probe connected to connector J4, see Paragraph *p. 36*) at the set-point.
For the space heating service, the CCI panel is able to modulate power as follows:

- up to 50% for a single GAHP;
- up to 30% of the overall power with two or three GAHP units.

Under the minimum modulation threshold the CCI Panel controls the units in ON/OFF mode, either directly or through the external controller.
If there is DHW request (request signals IN1 and IN2 simultaneously on, see Paragraph *p. 36*), the DHW set-point may also in this case be either fixed or variable.
If the set-point needs to be variable, the same rules that apply for the space heating set-point also apply when relaying it to the CCI.
No modulation control is provided for the DHW service, but ON/OFF only, being able to specify the number of GAHP units that may be used for the DHW service, which will be started up at maximum power.

The CCI does not directly control an auxiliary generator (such as a boiler) which must be controlled by the external system control.

For the free cooling service (request signal IN4 active, see Paragraph *p. 36*) the CCI only starts up the circulating pumps on the cold side of GAHP GS/WS units.

8.6 MODBUS

The CCI Panel supports interfacing with external devices also via Modbus RTU protocol in slave mode.
With the Modbus protocol it is possible to acquire information concerning the operation data of the units and systems managed by the CCI (temperatures, statuses, meters, etc.).
It can also acquire information regarding alarms, both current and registered in the alarms log.
Finally, it is possible to act on the system to set a number of operating parameters such as unit On/Off, set-point, differential.
Paragraph 9.3 *p. 38* sets out the Modbus mapping implemented in the current version of the CCI Panel.

9 MODBUS MAPPING

The documents of reference for Modbus interface with the DDC and CCI controls are listed below.
Interface with the RB100 and RB200 devices is not provided. The relevant data, where available, are accessible via Modbus from the DDC Panel.

9.1 MAIN FUNCTIONS

The following main functions are obtained via Modbus protocol interface:

- Reading the system delivery and return temperatures;
- Reading the active set-point on the system;
- Reading the general alarm;
- Reading the digital statuses of each individual machine (On/Off, alarm, flame status etc.);
- Reset alarms, excluding the flame lock-out (only resettable directly from the control panel);
- Reading machine temperatures and analogues;
- Service switch on/off setting (Heating, conditioning, DHW);
- Summer/winter switching setting;
- System sliding temperature setting.

9.2 DDC

The document with Modbus Mapping may be obtained from the Robur Pre-Sale Service.

The FW version of the DDC Panel must be specified, as Modbus Mapping depends on the FW version.

9.3 CCI

The document with Modbus Mapping may be obtained from the Robur Pre-Sale Service.

The FW version of the CCI Panel must be specified, as Modbus Mapping depends on the FW version.

1 DHW PRODUCTION;

Absorption heat pumps may also be used for DHW production, taking into account their specific features, namely:

1. maximum operative temperatures, summarised in Table 1.1 *p. 1* below;
2. time required to be fully operational.

Table 1.1 *GAHP heating temperature limits*

			GAHP A	GAHP-AR	GAHP GS/WS	AY00-120
Heating mode						
Hot water delivery temperature	maximum for heating	°C	65	-	65	-
	maximum	°C	-	60	-	80
Hot water return temperature	maximum for heating	°C	55	-	55	-
	maximum	°C	-	50	-	70

These specific features are reflected in the need to use the "indirect" mode (non instantaneous) for DHW production, with a buffer tank having appropriate exchange surface (tank expressly designed for being coupled to heat pumps, see Paragraph 2 *p. 1*) and adequate capacity for the requirements.
For correct operation of heat pumps, it is essential for the exchange surface of the tank to be able to develop a thermal gradient of at least 10 °C in any operating condition.
The "DHW" mode may be activated for units GAHP A and GAHP GS/WS which allows the maximum delivery temperature to be raised up to 70°C (return at 60°C), nevertheless halving the thermal input upon exceeding the temperatures indicated in Table 1.1 *p. 1*.
If the power required for DHW is less than 20 kW, it is recommended to arrange for two independent systems, avoiding GAHP use for DHW, since the investment for the DHW buffer tank would not be justified.

The use of compact buffer tanks for high temperature storage should be avoided.

DHW production in instantaneous mode is not possible.

Use of ACF 60-00 HR units for DHW production is only possible in recovery mode. The thermal power is therefore only available in case of simultaneous cooling request. Therefore, the ACF 60-00 HR unit cannot be used as the only DHW source.

The permitted number of annual hot/cold inversions of GAHP-AR units is limited. Therefore, the GAHP-AR unit must not be used to meet DHW requests in summer.

2 DHW TANK SIZING

The DHW buffer tank must be sized on the basis of the DHW need established according to design regulations in force.
With regards to sizing the exchange coil, the following parameters must be considered for coupling to a GAHP heat pump:

- buffer tank temperature between 45°C and 50°C;
- coil inlet temperature between 50°C and 60°C;
- nominal thermal gradient 10°C;
- water flow within the operative limits of GAHP units, if the buffer tank is installed on the primary circuit.

The minimum recommended surfaces according to buffer tank size are summarised in Table 2.1 *p. 1* below.

Table 2.1 *DHW buffer tank minimum coil surface*

Buffer tank capacity (l)	Coil surface (m2)
300	4,0
400	5,0
500	6,0
800	7,0
1000	8,0

The nominal coil exchange capacity data published by manufacturers must be used with much caution, since these data usually refer to inlet water at 80°C and thermal gradient 20°C, not applicable to the case of heat pumps.

3 DHW SERVICE REQUESTS

DHW service requests may be relayed in two different ways:

1. with devices RB100/RB200 through digital or analogue signals (see Section C1.12);
2. directly to DDC Panel or CCI Panel via Modbus protocol, by setting the appropriate adjustments (see Section C1.12) through an external system regulator.

DHW service requests may be associated with separation of any separable system section, according to the set configuration.
Temperature control in the DHW tank is performed alternatively with:

- two thermostats in the DHW tank directly connected to RB100/RB200;
- temperature probes in the DHW tank, serving an external regulator.

The DHW production service always has operating priority over the heating service.

3.1 DHW TANK WITH THERMOSTATS

If the DHW tank temperature is controlled with thermostats, two separate thermostats must be installed, appropriately set on the desired temperatures:

- DHW heating service;
- Legionella disinfection service.

The digital outputs of these thermostats must be connected to the two digital inputs for DHW available on the RB100/RB200 devices (see Section C1.12), setting up the relevant configuration both on the RB100/RB200 devices and on the DDC Panel.

3.2 DHW TANK WITH TEMPERATURE PROBES

If the DHW tank temperature is controlled with temperature probes, an external electronic regulator must be installed able to provide a 0-10 V signal or a voltage free contact for request to the DHW analogue/digital input of RB100/RB200 devices (see Section C1.12), setting up the relevant configuration both on the RB100/RB200 devices and on the DDC Panel.
The external electronic regulator therefore deals with reading the probes as well as with the switching-on logic of DHW or Legionella services, including the set-point and any schedule.

4 LEGIONELLA DISINFECTION

The Legionella disinfection obligation complies with the regulations in force.
Legionella disinfection may be performed with a number of methods, either physical or chemical.
The most widely used method, despite less than optimal effectiveness and high energy consumption, is disinfection through thermal shock, which consists in raising the temperature (above 55°C) for at least 1 h in the heat buffer tank and distribution and recirculation circuit.
It is recommended to assure Legionella disinfection with methods other than thermal shock (such as chemical methods, UV lamps or adding ozone) in order to:

- achieve optimal disinfection (in fact the thermal shock is not effective on the system branches where water is standing);
- avoid excessively undermining the efficiency of GAHP units.

In order to perform Legionella disinfection through thermal shock it may be advisable to install at least one AY 00-120 boiler or a third party boiler in the system.

5 INDICATIVE DHW DIAGRAMS

Below are some example diagrams, which are useful to understand the various methods for producing DHW using Robur units.
It is useful to look at some definitions from the glossary (see Section A):

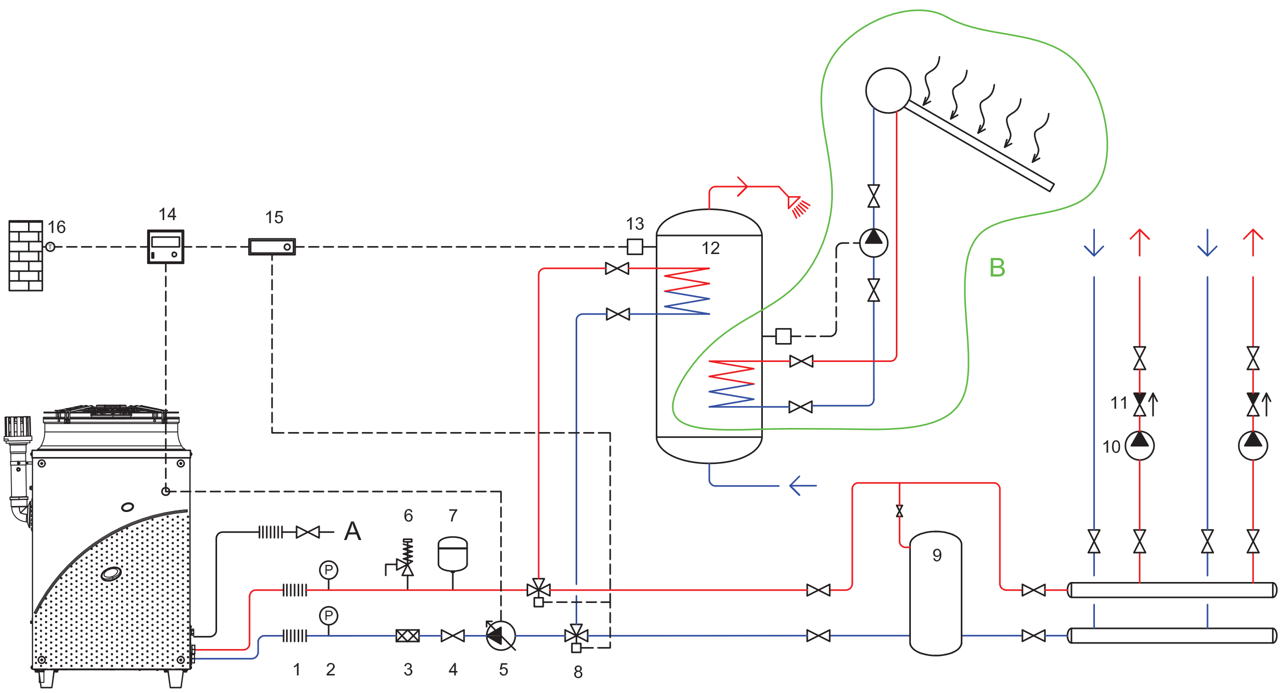
- **Separable DHW system** part of a primary circuit that is able to have two states by means of diverter valves:
  1. water plumbing connected to the base system ("included" state); in included state this part of the system integrates the space heating service;
  2. disconnected from the base system ("separate" state); in the separate state this part of the system is designated for DHW production, regardless of the service supplied by the base system.
- **Separate DHW system** part of the primary circuit exclusively for DHW production, the plumbing of which is permanently disconnected from the base system.
- **DHW system** a system only intended for domestic hot water production.
- **Base system** part of the primary circuit on which generator's plumbing is permanently connected.

5.1 SINGLE GAHP BASE DHW

The diagram shown in Figure 5.1 *p. 3* illustrates the case of a single GAHP A with solar integration in a system for space heating and DHW production only.

Solar integration is useful in the summer if there are no other thermal requirements, in order to avoid the GAHP being turned on too often and too briefly.
The same broad diagram is applicable to GAHP GS/WS units if used for space heating and DHW production only.

Figure 5.1 *Single GAHP A heating and DHW base plumbing diagram*

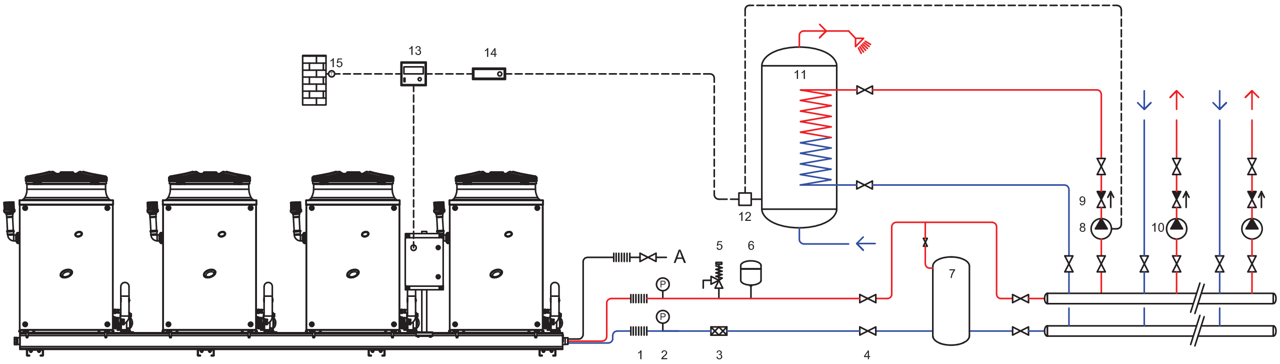


A Gas connection
B Solar heating integration (not supplied)
System components:
1 Anti-vibration connection
2 Pressure gauge
3 Water filter
4 Shut-off valve
5 Primary circuit water pump (variable flow)
6 3 bar safety valve
7 Expansion tank
8 3-way diverter valves for DHW
9 Buffer tank (and hydraulic separator)
10 Heating circuit water pump
11 Check valve
12 DHW accumulation tank
13 Thermostat with adjustable differential for DHW
14 DDC panel
15 RB100 device
16 External temperature probe (for weather curve)

5.2 MULTI GAHP BASE DHW

The diagram shown in Figure 5.2 *p. 4* illustrates the case of a system with several GAHP A in a medium/high power system for space heating and DHW production only.
One should point out that in this type of system the heating service must always be kept on in order to meet any DHW requests.
Alternatively, the same thermostat that turns on the DHW request must also turn on the heating request, in order to switch on the generation system.
The same broad diagram is applicable to GAHP GS/WS units if used for space heating and DHW production only.

Figure 5.2 *Multi GAHP base DHW*



A Gas connection
Notes:
- Pump 8 of the DHW circuit must only turn on when the heating system is on

System components:
1 Anti-vibration connection
2 Pressure gauge
3 Water filter
4 Shut-off valve
5 3 bar safety valve
6 Expansion tank
7 Buffer tank (and hydraulic separator)
8 DHW circuit water pump
9 Check valve
10 Heating circuit water pump
11 DHW accumulation tank
12 Thermostat with adjustable differential for DHW
13 DDC panel
14 RB100 device
15 External temperature probe (for weather curve)

5.3 SEPARABLE DHW

The diagram shown in Figure 5.3 *p. 5* illustrates the case of a system for conditioning and DHW production with a preassembled group consisting of GAHP-AR and AY00-120 units.

DHW production is assured by:

- preheating spillage from the secondary manifold;
- boiler separation.

Preheating spillage must only be turned on if:

- the temperature in the manifold is suitable for correct heat exchange in the DHW tank;
- the system is active in heating.

Preheating must be designed in order to operate with the same nominal thermal gradient intended for the GAHP units, i.e. 10 °C, in order not to risk excessive return heating to the GAHP units which would result in turning them off due to limit thermostating.

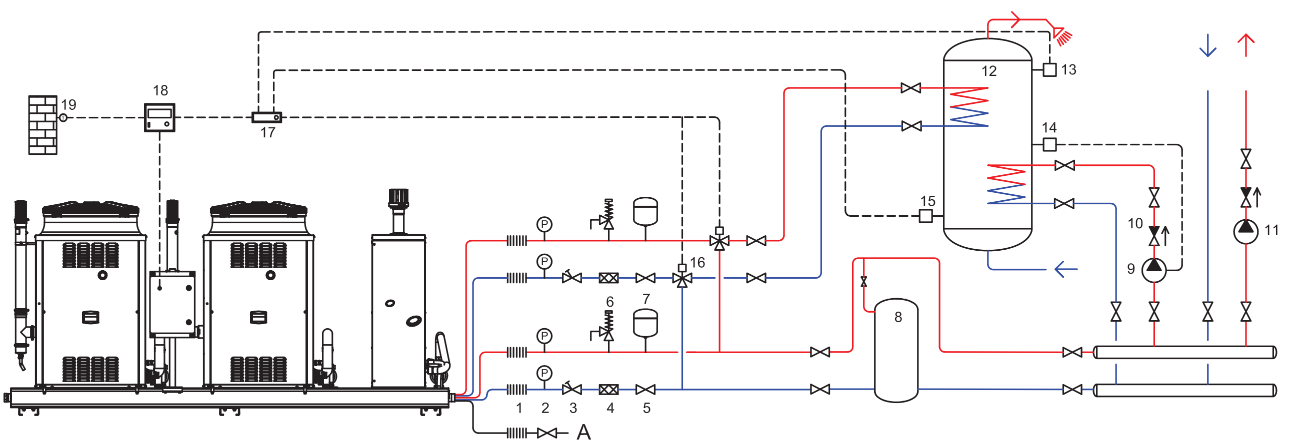
If there is a separable DHW request from thermostat 13 the boiler is turned on and separation valves 16 are switched.

The diagram shown also supports thermal Legionella disinfection, also by turning on a separable DHW request by thermostat 15.

If the DHW requirement and the heating power are high, one may decide to use a separate pre-heating tank.

The same broad diagram is more generally applicable to all systems including at least one boiler (Robur or third party, for the latter case see Section C1.12) on the separable circuit.

Figure 5.3 *Separable DHW plumbing diagram*



A Gas connection

Notes:

- Pump 9 of DHW pre-heating must only turn on if the temperature difference between manifold and buffer tank is sufficient for correct heat exchange on the pre-heating coil
- Pump 9 for DHW pre-heating must be turned off in summer

System components:

1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valve
6 3 bar safety valve
7 Expansion tank
8 Buffer tank (and hydraulic separator)
9 DHW winter pre-heating water pump
10 Check valve
11 Conditioning circuit water pump
12 DHW accumulation tank
13 Thermostat with adjustable differential for DHW
14 Thermostat with adjustable differential for DHW pre-heating
15 Thermostat with adjustable differential for Legionella function
16 3-way diverter valves for DHW
17 RB100 device
18 DDC panel
19 External temperature probe (for weather curve)

5.4 SEPARABLE DHW WITH HEAT RECOVERY

The diagram shown in Figure 5.4 *p. 6* illustrates the case of a system for conditioning and DHW production with a preassembled group consisting of GAHP-AR and ACF 60-00 HR units, with heat recovery and AY00-120.

DHW production is assured by:

- preheating spillage from the secondary manifold;
- preheating from ACF 60-00 HR recovery freely available during summer conditioning;
- boiler separation.

Preheating spillage must only be turned on if:

- the temperature in the manifold is suitable for correct heat exchange in the DHW tank;
- the system is active in heating.

Manually switching selector 15 from heating to conditioning turns on the request to the heat recovery exchanger through thermostat 16, thus performing preheating with the free heat from thermal recovery.

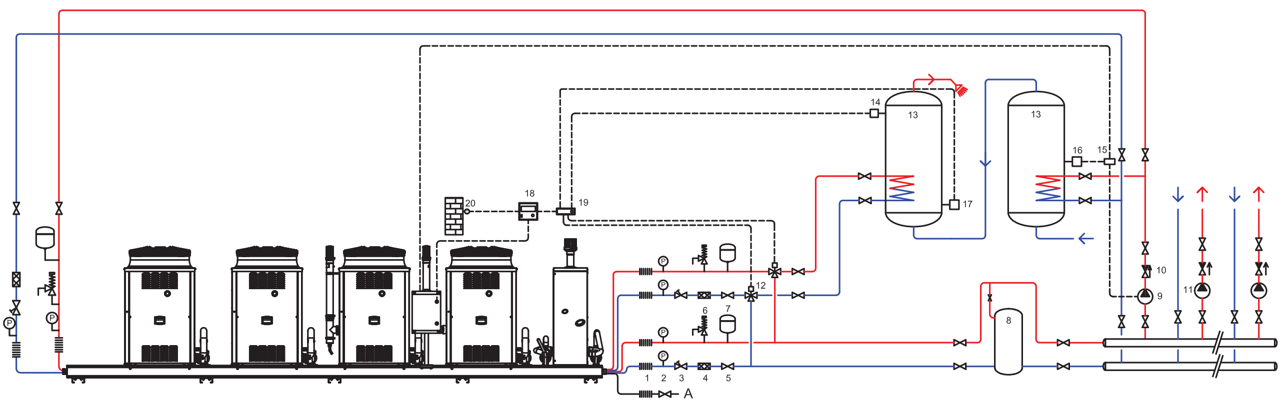
Winter-time pre-heating must be designed in order to operate with the same nominal thermal gradient intended for the GAHP units, i.e. 10 °C, in order not to risk excessive return heating to the GAHP units which would result in turning them off due to limit thermostating.

If there is a separable DHW request from thermostat 14 the boiler is turned on and separation valves 12 are switched.

The diagram shown also supports thermal Legionella disinfection, also by turning on a separable DHW request by thermostat 17.

The same broad diagram is more generally applicable to all systems including at least one boiler (Robur or third party, for the latter case see Section C1.12) on the separable circuit and a chiller ACF 60-00 HR.

Figure 5.4 *Separable DHW plumbing diagram with heat recovery*



A Gas connection

Notes:

- Pump 9 of DHW pre-heating must only turn on if the temperature difference between manifold and buffer tank is sufficient for correct heat exchange on the pre-heating coil
- Pump 9 for DHW pre-heating must be turned off in summer
- Selector 15 allows thermostat 16 tu turn on the heat recovery exchanger request of chillers ACF 60-00 HR in the summer

System components:

1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valve
6 3 bar safety valve
7 Expansion tank
8 Buffer tank (and hydraulic separator)
9 DHW pre-heating water pump
10 Check valve
11 Conditioning circuit water pump
12 3-way diverter valves for DHW
13 DHW accumulation tank
14 Thermostat with adjustable differential for DHW
15 Summer/winter selector
16 Thermostat with adjustable differential for DHW pre-heating
17 Thermostat with adjustable differential for Legionella function
18 DDC panel
19 RB100 device
20 External temperature probe (for weather curve)

1 PREMISE

The plumbing and wiring diagrams set out below provide examples of possible Robur unit applications and relevant controls.

The diagrams shown are for purely indicative purposes and are not valid for installation purposes.

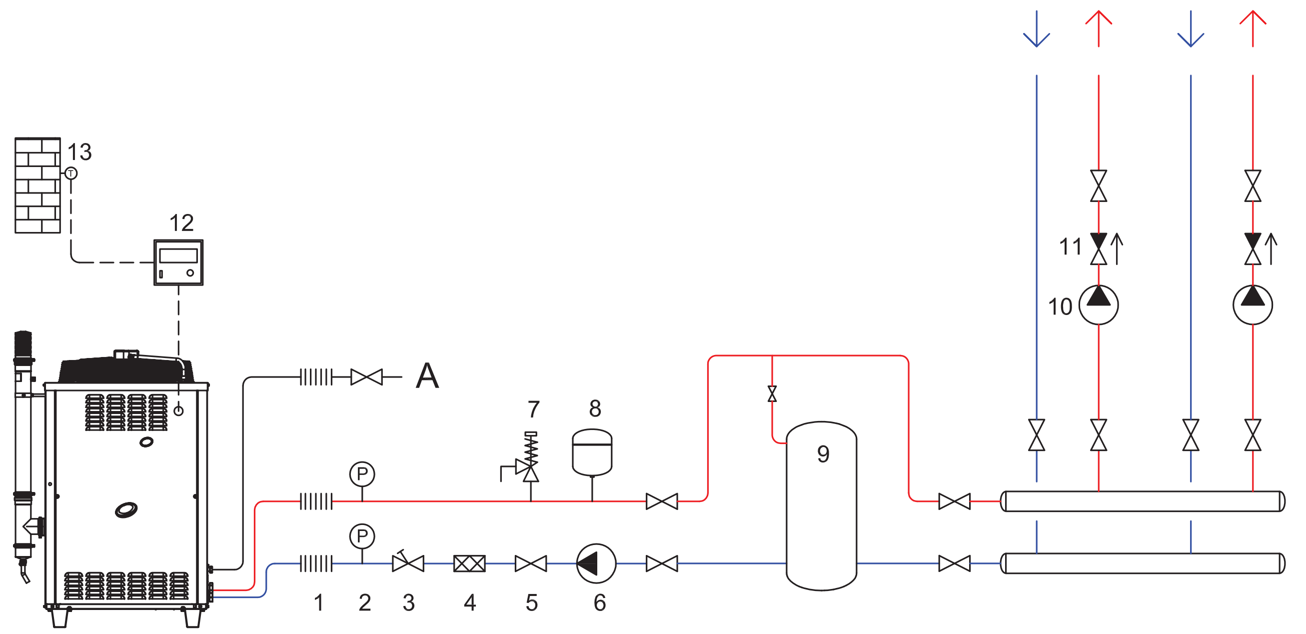
2 CONDITIONING GAHP-AR

2.1 DESCRIPTION

The plumbing diagram in Figure 2.1 *p. 1* shows the use of a single GAHP-AR for conditioning, coupled to a primary/secondary system with 3-pipe hydraulic separator.

2.2 HYDRAULIC PLAN

Figure 2.1 *Single conditioning GAHP-AR plumbing diagram*



The flow regulator valve must only be used when the primary circuit circulation pump is constant flow type

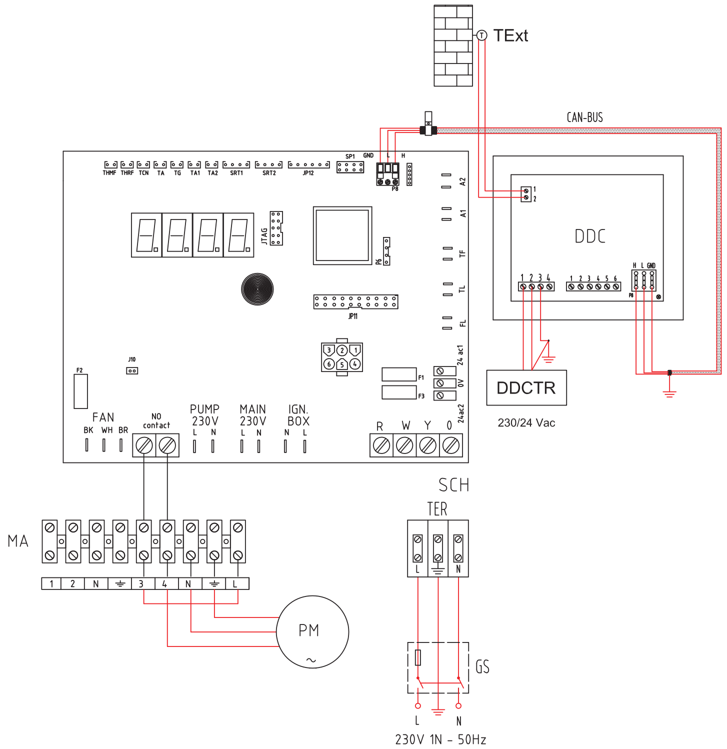
A Gas connection

System components:

1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valve
6 Primary circuit water pump
7 3 bar safety valve
8 Expansion tank
9 3-pipe buffer tank
10 Conditioning circuit water pump
11 Check valve
12 DDC panel
13 External temperature probe (for weather curve)

2.3 ELECTRICAL WIRING DIAGRAM

Figure 2.2 *Single conditioning GAHP-AR wiring diagram*



DDC Direct Digital Control
SCH electronic board
N.O. CONTACT N.O voltage free contacts
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
CAN terminal block
GND Common data
L Data signal LOW
H Data signal HIGH
Components NOT SUPPLIED
DDCTR Safety transformer (240/24 Vac - 50/60 Hz - min 20 VA)
TExt external temperature probe (for weather curve)
PM water pump < 700W

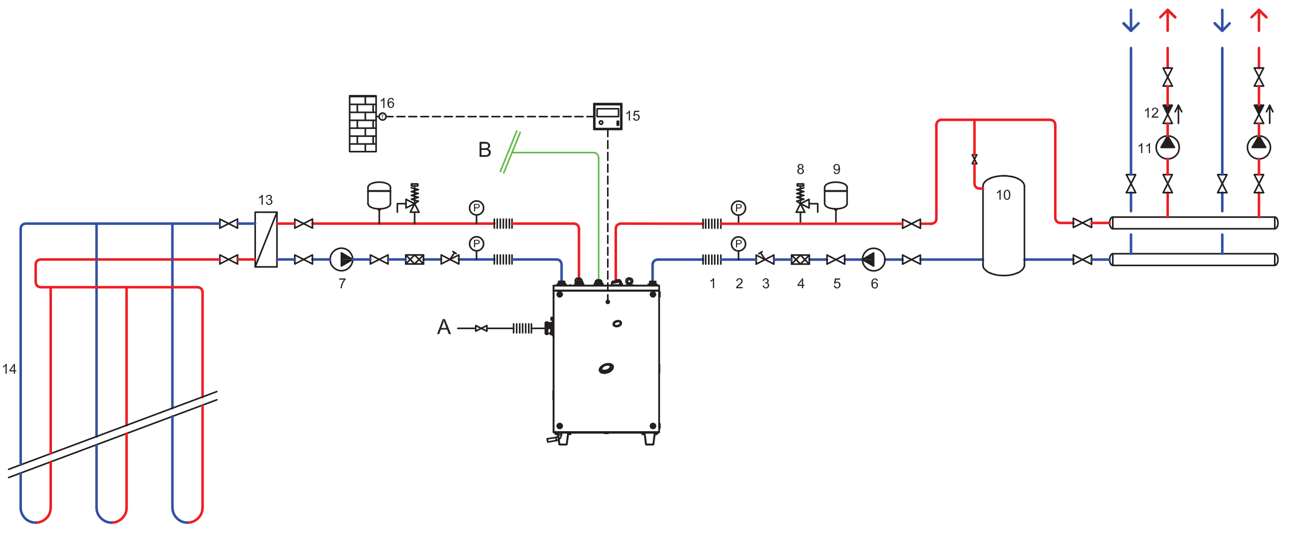
3 HEATING GAHP GS WITH GEOTHERMAL PROBES

3.1 DESCRIPTION

The plumbing diagram in Figure 3.1 *p. 3* shows the use of a single GAHP GS HT for heating, coupled to a primary/secondary system with 3-pipe hydraulic separator and geothermal probes with heat exchanger (in order not to convey and glycol-added water into the ground).

3.2 HYDRAULIC PLAN

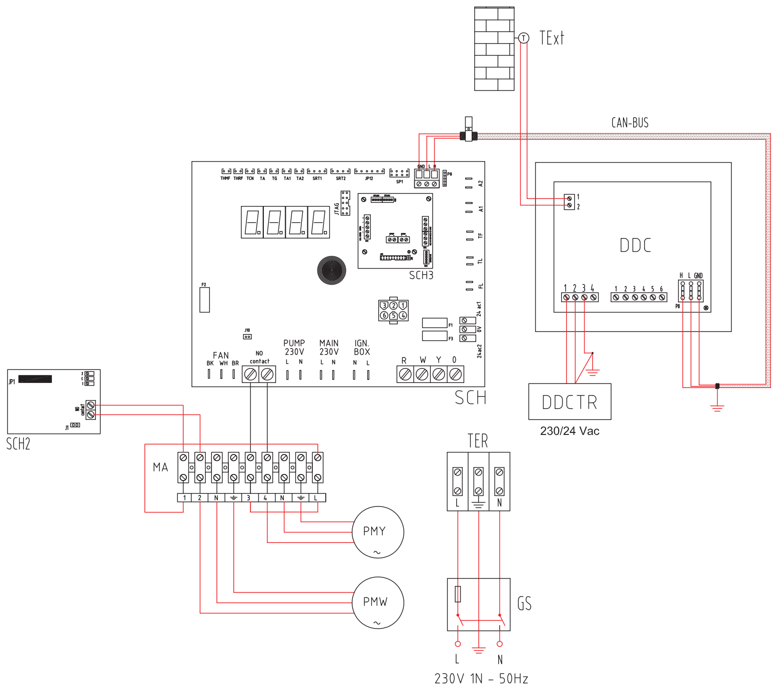
Figure 3.1 *Single heating GAHP GS plumbing diagram with geothermal probes*



The flow regulator valve must only be used when the primary circuit circulation pump is constant flow type
A Gas connection
B Safety valve exhaust (indoor version)
System components:
1 Anti-vibration connection
2 Pressure gauge
3 Flow regulation valve (only if fixed flow pump)
4 Water filter
5 Shut-off valve
6 Heating primary circuit water pump (fixed or variable flow)
7 Cooling primary circuit water pump (fixed flow)
8 3 bar safety valve
9 Expansion tank
10 3-pipe buffer tank
11 Heating circuit water pump
12 Check valve
13 Heat exchanger
14 Geothermal exchange system
15 DDC panel
16 External temperature probe (for weather curve)

3.3 ELECTRICAL WIRING DIAGRAM

Figure 3.2 *Single heating GAHP GS/WS wiring diagram*



DDC Direct Digital Control
SCH electronic board
SCH2 circuit board
N.O. CONTACT N.O voltage free contacts
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
1-2 heating side circulation pump request
3-4 cooling side circulation pump request
CAN terminal block
GND Common data
L Data signal LOW
H Data signal HIGH
Components NOT SUPPLIED
DDCTR Safety transformer (240/24 Vac - 50/60 Hz - min 20 VA)
TExt external temperature probe (for weather curve)
PMW hot side water pump < 700W
PMY cold side water pump < 700W

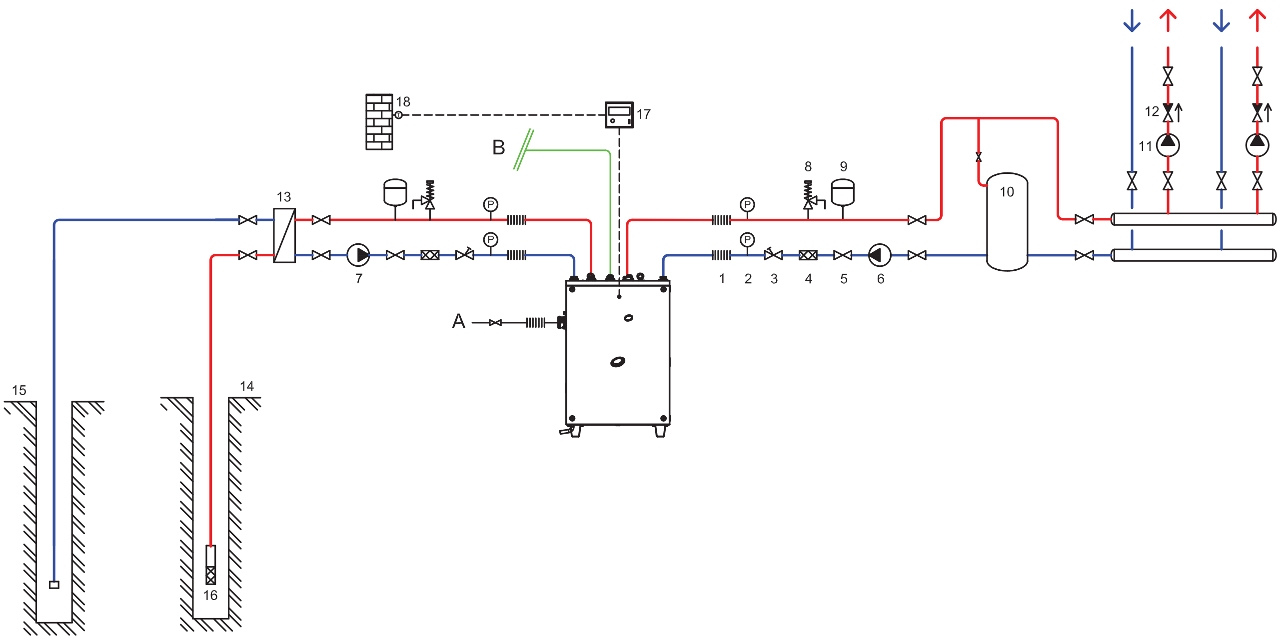
4 HEATING GAHP WS WITH GROUND WATER

4.1 DESCRIPTION

The plumbing diagram in Figure 4.1 *p. 5* shows the use of a single GAHP WS for heating, coupled to a primary/secondary system with 3-pipe hydraulic separator and energy recovery from ground water with heat exchanger (mandatory) with pump back well.

4.2 HYDRAULIC PLAN

Figure 4.1 *Single heating GAHP WS plumbing diagram with ground water*



The flow regulator valve must only be used when the primary circuit circulation pump is constant flow type

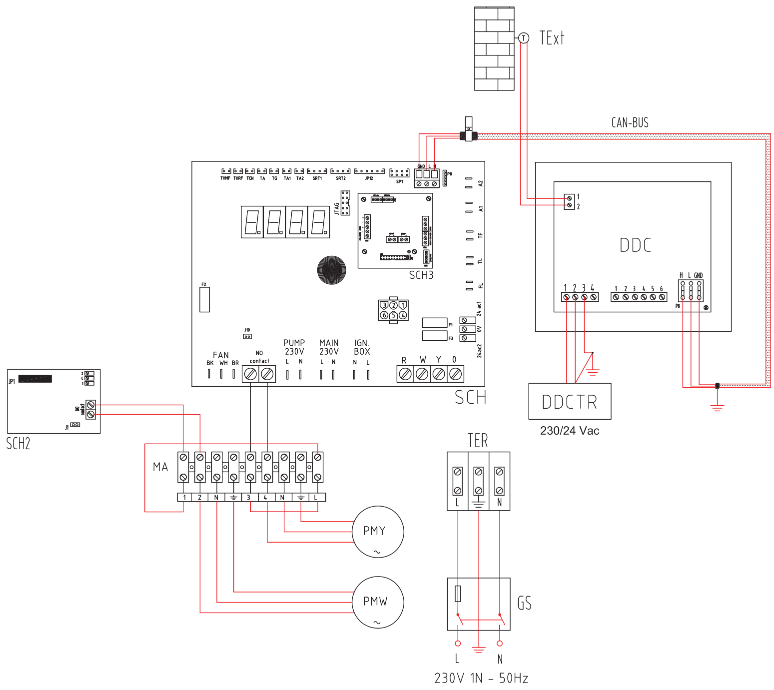
A Gas connection
B Safety valve exhaust (indoor version)

System components:

1 Anti-vibration connection
2 Pressure gauge
3 Flow regulation valve (only if fixed flow pump)
4 Water filter
5 Shut-off valve
6 Heating primary circuit water pump (fixed or variable flow)
7 Cooling primary circuit water pump (fixed flow)
8 3 bar safety valve
9 Expansion tank
10 3-pipe buffer tank
11 Heating circuit water pump
12 Check valve
13 Heat exchanger
14 Pumping well
15 Pumping back well
16 Drawing pump with filtering
17 DDC panel
18 External temperature probe (for weather curve)

4.3 ELECTRICAL WIRING DIAGRAM

Figure 4.2 *Single heating GAHP GS/WS wiring diagram*



DDC Direct Digital Control
SCH electronic board
SCH2 circuit board
N.O. CONTACT N.O voltage free contacts
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
1-2 heating side circulation pump request
3-4 cooling side circulation pump request
CAN terminal block
GND Common data
L Data signal LOW
H Data signal HIGH
Components NOT SUPPLIED
DDCTR Safety transformer (240/24 Vac - 50/60 Hz - min 20 VA)
TExt external temperature probe (for weather curve)
PMW hot side water pump < 700W
PMY cold side water pump < 700W

5 HEATING AND DHW GAHP A

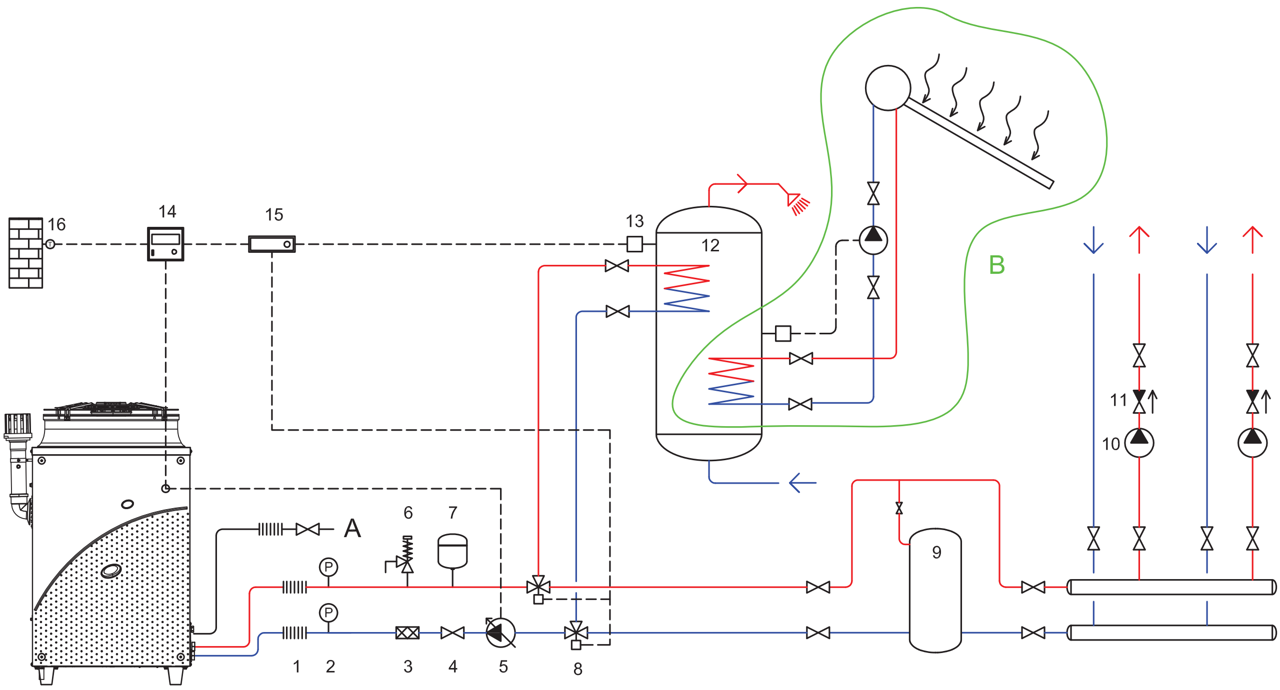
5.1 DESCRIPTION

The plumbing diagram in Figure 5.1 *p. 7* shows the use of a single GAHP A for conditioning and DHW production on the base circuit (with any solar integration), coupled to a primary/secondary system with 3-pipe hydraulic separator.

DHW is produced through the base circuit, by diverting hot water towards the DHW tank through diverter valves on the basis of the DHW service request by a thermostat in the DHW tank.

5.2 HYDRAULIC PLAN

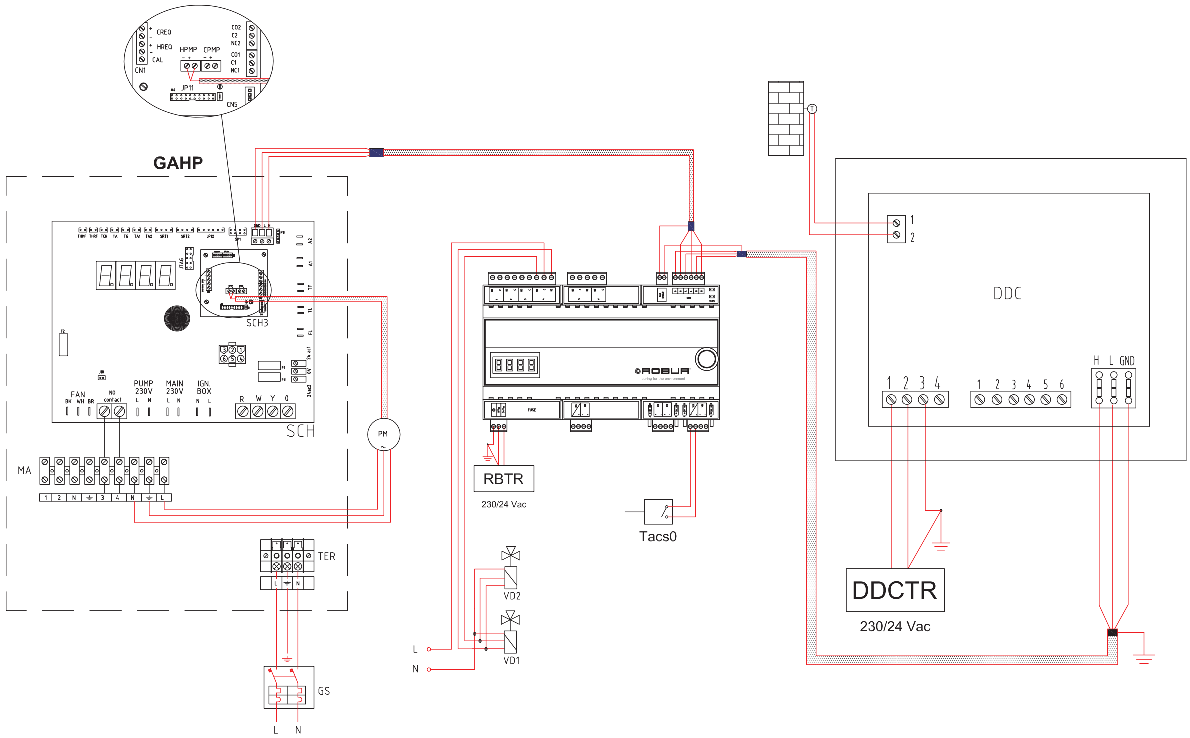
Figure 5.1 *Single GAHP A heating and DHW base plumbing diagram*



A Gas connection
B Solar heating integration (not supplied)
System components:
1 Anti-vibration connection
2 Pressure gauge
3 Water filter
4 Shut-off valve
5 Primary circuit water pump (variable flow)
6 3 bar safety valve
7 Expansion tank
8 3-way diverter valves for DHW
9 Buffer tank (and hydraulic separator)
10 Heating circuit water pump
11 Check valve
12 DHW accumulation tank
13 Thermostat with adjustable differential for DHW
14 DDC panel
15 RB100 device
16 External temperature probe (for weather curve)

5.3 ELECTRICAL WIRING DIAGRAM

Figure 5.2 *Single GAHP A heating and DHW base wiring diagram*



DDC Direct Digital Control
RB100 RB100 device
SCH electronic board
SCH3 electronic board
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
CAN terminal block
GND Common data
L Data signal LOW
H Data signal HIGH
Components NOT SUPPLIED
DDCTR Safety transformer (240/24 Vac - 50/60 Hz - min 20 VA)
RBTR Safety transformer (240/24 Vac - 50/60 Hz - min 10 VA)
TExt external temperature probe (for weather curve)
PM water pump
Tacs0 DHW request thermostat
VD1 3-way motorised valve
VD2 3-way motorised valve
Pump signal 0-10V wire colours
brown connect to -ve
white connect to +ve
black isolate
blue isolate

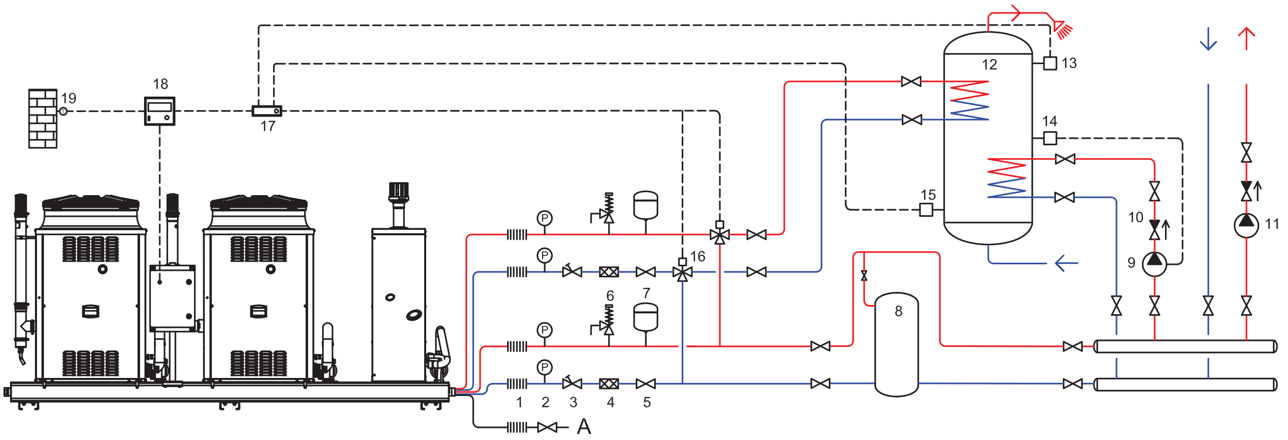
6 CONDITIONING AND SEPARABLE DHW

6.1 DESCRIPTION

The plumbing diagram in Figure 6.1 *p. 9* shows the use of a pre-assembled RTYR group (consisting of GAHP-AR and AY00-120) for conditioning and separable DHW production, coupled to a primary/secondary system with 3-pipe hydraulic separator. DHW is produced through boiler separation, by diverting hot water towards the DHW tank through diverter valves on the basis of the DHW service request by the thermostats in the DHW tank, divided by normal DHW request and request for thermal Legionella disinfection.
Pre-heating pump 9, only useful if significant DHW consumption is expected and for systems constantly on for heating, is only turned on if the temperature difference between buffer tank and manifold is sufficient for correct heat exchange, and must be turned off in the summer.

6.2 HYDRAULIC PLAN

Figure 6.1 *Separable DHW plumbing diagram*

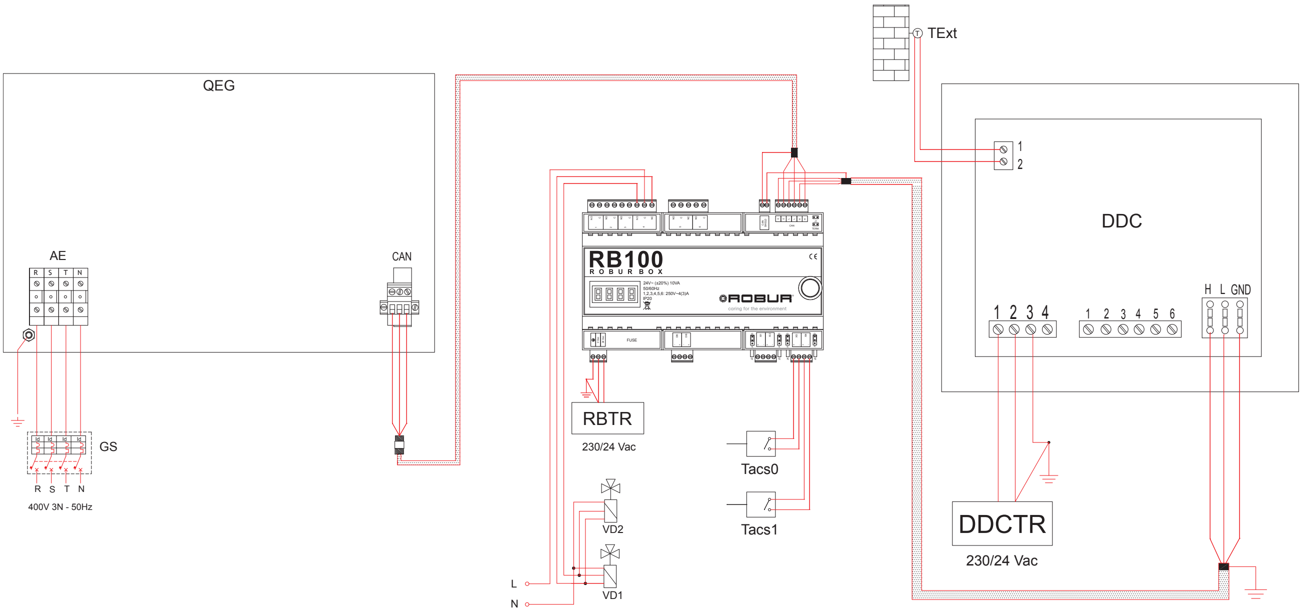


A Gas connection
Notes:
- Pump 9 of DHW pre-heating must only turn on if the temperature difference between manifold and buffer tank is sufficient for correct heat exchange on the pre-heating coil
- Pump 9 for DHW pre-heating must be turned off in summer

System components:
1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valve
6 3 bar safety valve
7 Expansion tank
8 Buffer tank (and hydraulic separator)
9 DHW winter pre-heating water pump
10 Check valve
11 Conditioning circuit water pump
12 DHW accumulation tank
13 Thermostat with adjustable differential for DHW
14 Thermostat with adjustable differential for DHW pre-heating
15 Thermostat with adjustable differential for Legionella function
16 3-way diverter valves for DHW
17 RB100 device
18 DDC panel
19 External temperature probe (for weather curve)

6.3 ELECTRICAL WIRING DIAGRAM

Figure 6.2 *Conditioning and separable DHW wiring diagram*



DDC Direct Digital Control
RB100 RB100 device
QEG preassembled group electrical panel
AE power supply input terminals (three-phase - neutral)
GS three-phase magnetothermic breaker
RSTN phases/neutral
CAN terminal block
GND Common data
L Data signal LOW
H Data signal HIGH
Components NOT SUPPLIED
DDCTR Safety transformer (240/24 Vac - 50/60 Hz - min 20 VA)
RBTR Safety transformer (240/24 Vac - 50/60 Hz - min 10 VA)
TExt external temperature probe (for weather curve)
Tacs0 DHW request thermostat
Tacs1 Legionella DHW request thermostat
VD1 3-way motorised valve
VD2 3-way motorised valve

7 CONDITIONING AND SEPARABLE DHW WITH HEAT RECOVERY

7.1 DESCRIPTION

The plumbing diagram in Figure 7.1 *p. 11* shows the use of a pre-assembled RTRH group (consisting of GAHP-AR, ACF 60-00 HR and AY00-120) for conditioning and separable DHW production with summer heat recovery, coupled to a primary/secondary system with 3-pipe hydraulic separator.

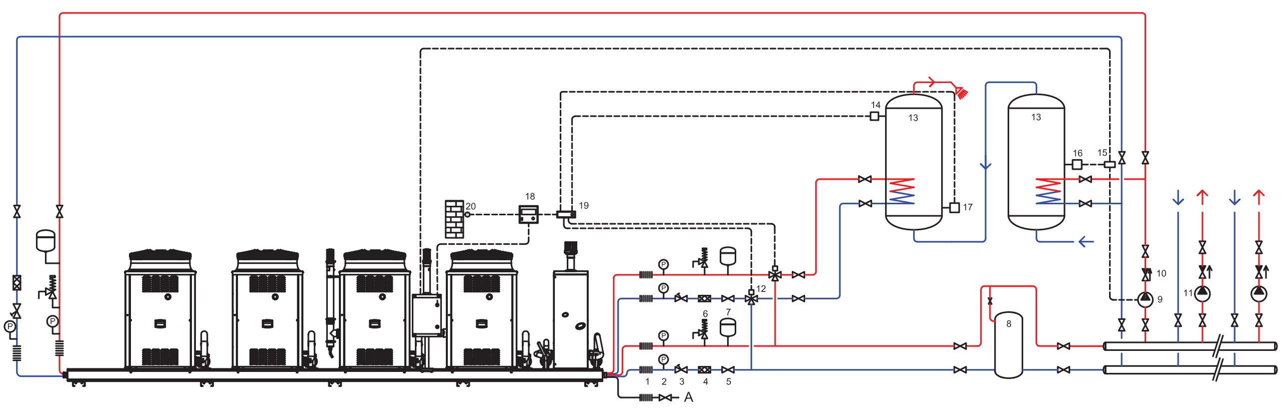
DHW is produced through boiler separation, by diverting hot water towards the DHW tank through diverter valves on the basis of the DHW service request by the thermostats in the DHW tank, divided by normal DHW request and request for thermal Legionella disinfection.

Preheating pump 9, only useful if significant DHW consumption is expected, is only turned on if the temperature difference between buffer tank and manifold is sufficient for correct heat exchange, and must be turned off in the summer.

In the summer the manual selector 15 is switched in order to relay the pre-heating request to the heat recovery exchanger of modules ACF 60-00 HR.

7.2 HYDRAULIC PLAN

Figure 7.1 *Separable DHW plumbing diagram with heat recovery*



A Gas connection

Notes:

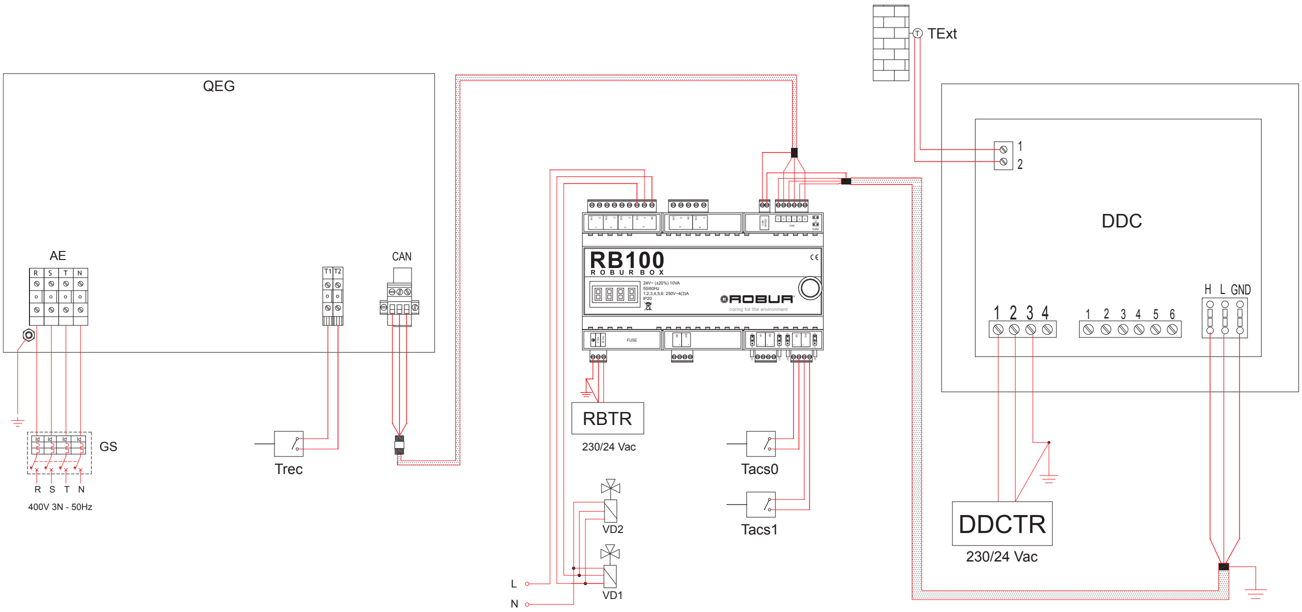
- Pump 9 of DHW pre-heating must only turn on if the temperature difference between manifold and buffer tank is sufficient for correct heat exchange on the pre-heating coil
- Pump 9 for DHW pre-heating must be turned off in summer
- Selector 15 allows thermostat 16 tu turn on the heat recovery exchanger request of chillers ACF 60-00 HR in the summer

System components:

1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valve
6 3 bar safety valve
7 Expansion tank
8 Buffer tank (and hydraulic separator)
9 DHW pre-heating water pump
10 Check valve
11 Conditioning circuit water pump
12 3-way diverter valves for DHW
13 DHW accumulation tank
14 Thermostat with adjustable differential for DHW
15 Summer/winter selector
16 Thermostat with adjustable differential for DHW pre-heating
17 Thermostat with adjustable differential for Legionella function
18 DDC panel
19 RB100 device
20 External temperature probe (for weather curve)

7.3 ELECTRICAL WIRING DIAGRAM

Figure 7.2 *Separable DHW wiring diagram with heat recovery*



DDC Direct Digital Control
RB100 RB100 device
QEG preassembled group electrical panel
AE power supply input terminals (three-phase - neutral)
GS three-phase magnetothermic breaker
RSTN phases/neutral
T1-T2 DHW tank thermostat terminals (HR recovery circuit side)
CAN terminal block
GND Common data
L Data signal LOW
H Data signal HIGH
Components NOT SUPPLIED
DDCTR Safety transformer (240/24 Vac - 50/60 Hz - min 20 VA)
RBTR Safety transformer (240/24 Vac - 50/60 Hz - min 10 VA)
TExt external temperature probe (for weather curve)
Tacs0 DHW request thermostat
Tacs1 Legionella DHW request thermostat
Trec heat recovery request thermostat
VD1 3-way motorised valve
VD2 3-way motorised valve

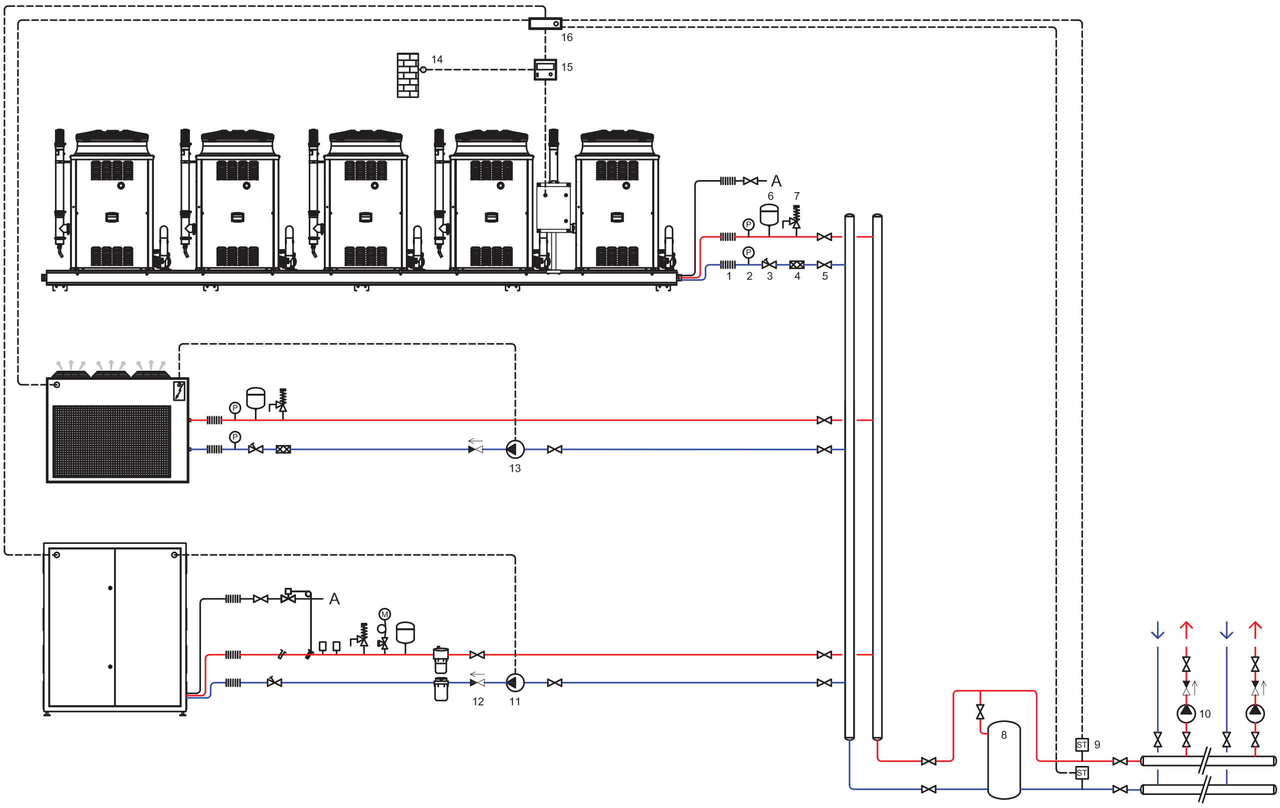
8 CONDITIONING WITH THIRD PARTY INTEGRATION

8.1 DESCRIPTION

The plumbing diagram in Figure 8.1 *p. 13* shows the use of a preassembled RTAR group (consisting of GAHP-AR) and third party units (boiler and chiller) for conditioning, coupled to a primary/secondary system with 3-pipe hydraulic separator.
Using the RB200 device allows the third party units and secondary circuit temperature to be controlled.

8.2 HYDRAULIC PLAN

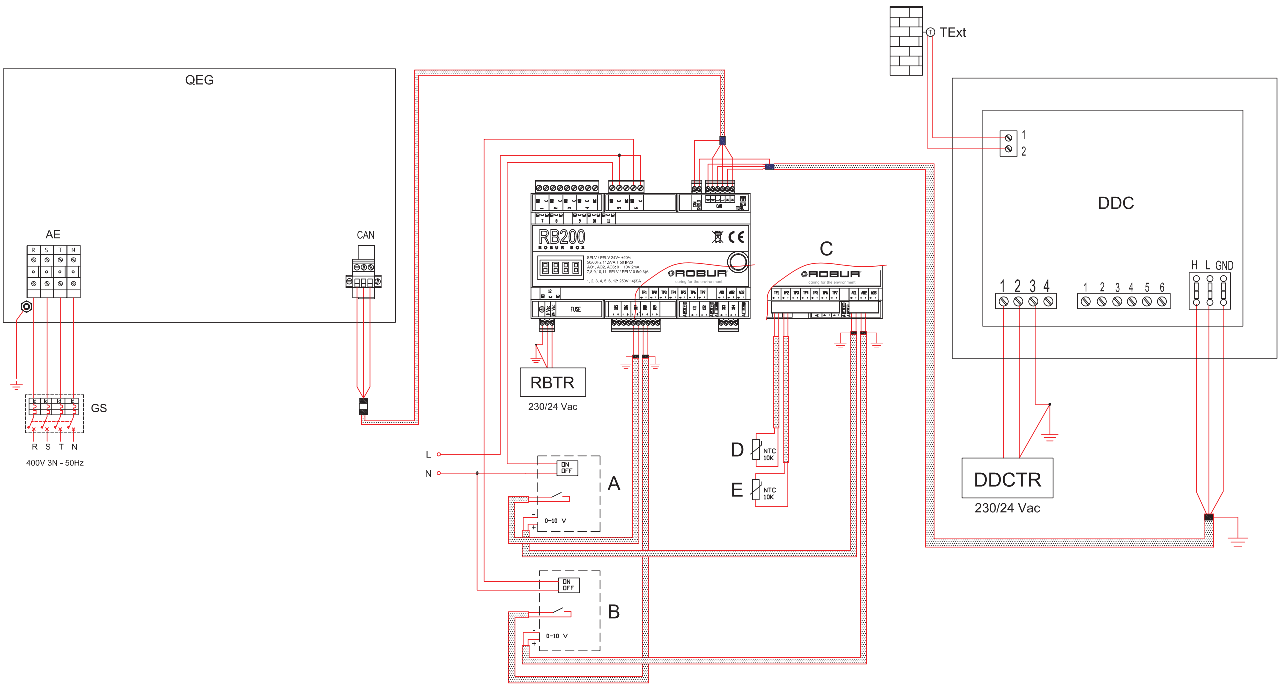
Figure 8.1 *Conditioning plumbing diagram with third party integration*



A Gas connection
System components:
1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valve
6 Expansion tank
7 3 bar safety valve
8 Buffer tank (and hydraulic separator)
9 Secondary temperature probes
10 Conditioning circuit water pump
11 Third party unit water pump (boiler)
12 Check valve
13 Third party unit water pump (chiller)
14 External temperature probe (for weather curve)
15 DDC panel
16 RB200 device

8.3 ELECTRICAL WIRING DIAGRAM

Figure 8.2 *Conditioning wiring diagram with third party integration*



A Third party generator with own circulating pump
B Third party generator with own circulating pump
C Detail of upper RB200 terminal block
D Conditioning return temperature probe
E Conditioning flow temperature probe
DDC Direct Digital Control
RB200 RB200 device
QEG preassembled group electrical panel
AE power supply input terminals (three-phase - neutral)
GS three-phase magnetothermic breaker
RSTN phases/neutral
CAN terminal block
GND Common data
L Data signal LOW
H Data signal HIGH

Components NOT SUPPLIED
DDCTR Safety transformer (240/24 Vac - 50/60 Hz - min 20 VA)
RBTR Safety transformer (240/24 Vac - 50/60 Hz - min 12 VA)
TExt external temperature probe (for weather curve)

9 HEATING AND BASE AND SEPARABLE DHW WITH THIRD PARTY INTEGRATION

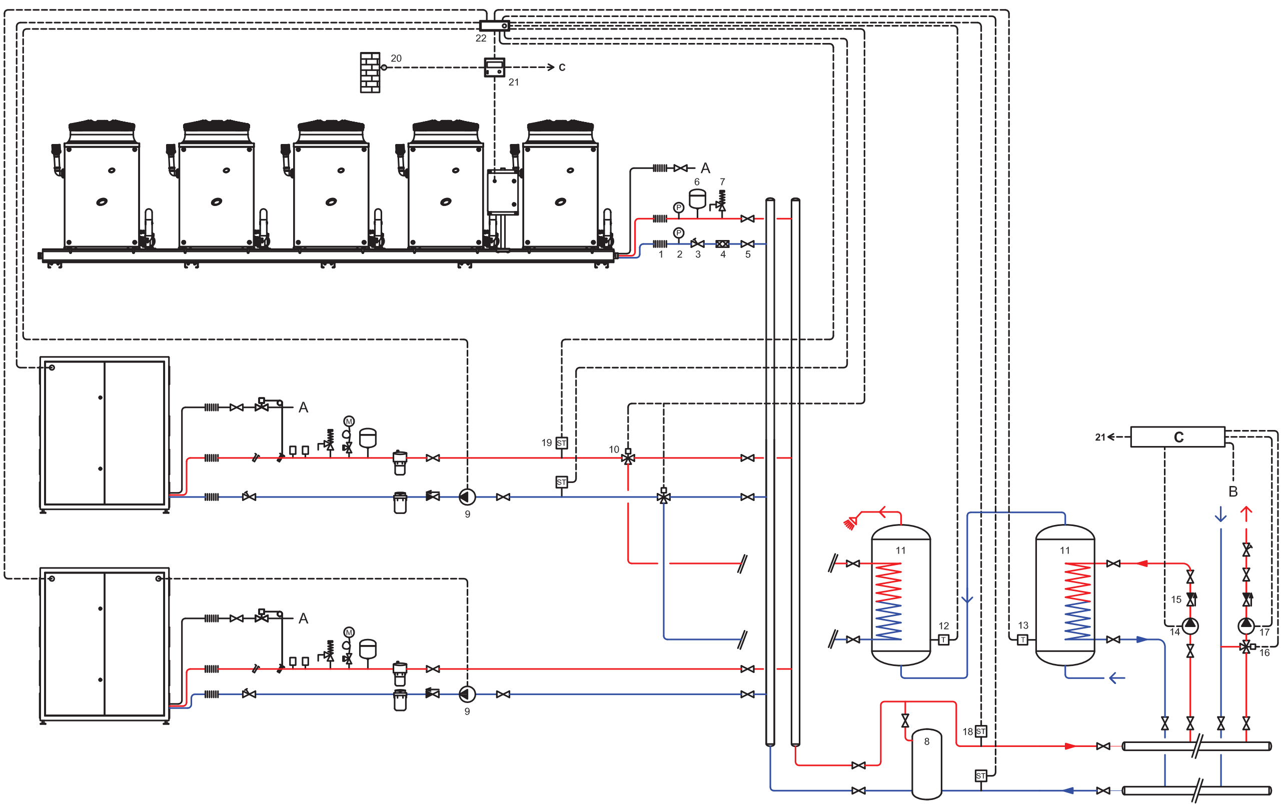
9.1 DESCRIPTION

The plumbing diagram in Figure 9.1 *p. 15* shows the use of a preassembled RTA group (consisting of GAHP A) and third party units (boilers) for heating and DHW both base and separable, coupled to a primary/secondary system with 3-pipe hydraulic separator.

Using the RB200 device makes it possible to control the third party units, including the circulating pump of the third party unit on the separable circuit, as well as secondary circuit and separable circuit temperature.

9.2 HYDRAULIC PLAN

Figure 9.1 *Base and separable heating and DHW plumbing diagram*

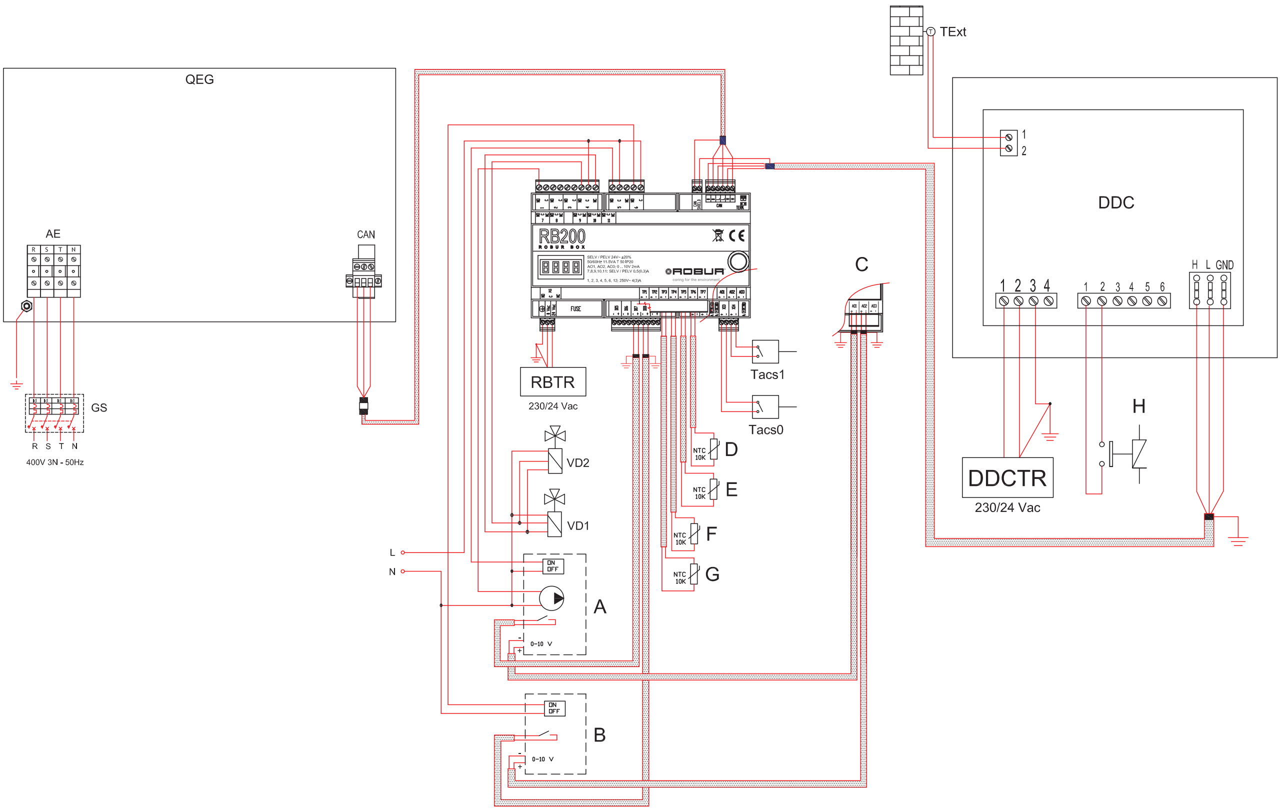


A Gas connection
B Heating system
C Secondary circuit control system
Notes:
- Pump 14 of DHW preheating must be turned off when the heating system is off, or if the temperature difference between manifold and buffer tank is not sufficient for correct heat exchange on the preheating coil

System components:
1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valve
6 Expansion tank
7 3 bar safety valve
8 Buffer tank (and hydraulic separator)
9 Third party unit water pump (boiler)
10 3-way diverter valves for DHW
11 DHW accumulation tank
12 Thermostat with adjustable differential for DHW
13 Thermostat with adjustable differential for DHW pre-heating
14 DHW pre-heating water pump
15 Check valve
16 3-way mixing valve
17 Hot circuit water pump
18 Secondary temperature probes
19 Separable temperature probes
20 External temperature probe (for weather curve)
21 DDC panel
22 RB200 device

9.3 ELECTRICAL WIRING DIAGRAM

Figure 9.2 *Base and separable heating and DHW wiring diagram*



A Third party generator with circulating pump controlled by RB200
B Third party generator with own circulating pump
C Detail of upper RB200 terminal block
D Separable flow temperature probe
E Separable return temperature probe
F Heat flow temperature probe
G Heat return temperature probe
DDC Direct Digital Control
RB200 RB200 device
QEG preassembled group electrical panel
AE power supply input terminals (three-phase - neutral)
GS three-phase magnetothermic breaker
RSTN phases/neutral
CAN terminal block
GND Common data
L Data signal LOW
H Data signal HIGH
Components NOT SUPPLIED
DDCTR Safety transformer (240/24 Vac - 50/60 Hz - min 20 VA)
RBTR Safety transformer (240/24 Vac - 50/60 Hz - min 12 VA)
TExt external temperature probe (for weather curve)
Tacs0 DHW pre-heating request thermostat
Tacs1 DHW request thermostat
VD1 3-way motorised valve
VD2 3-way motorised valve

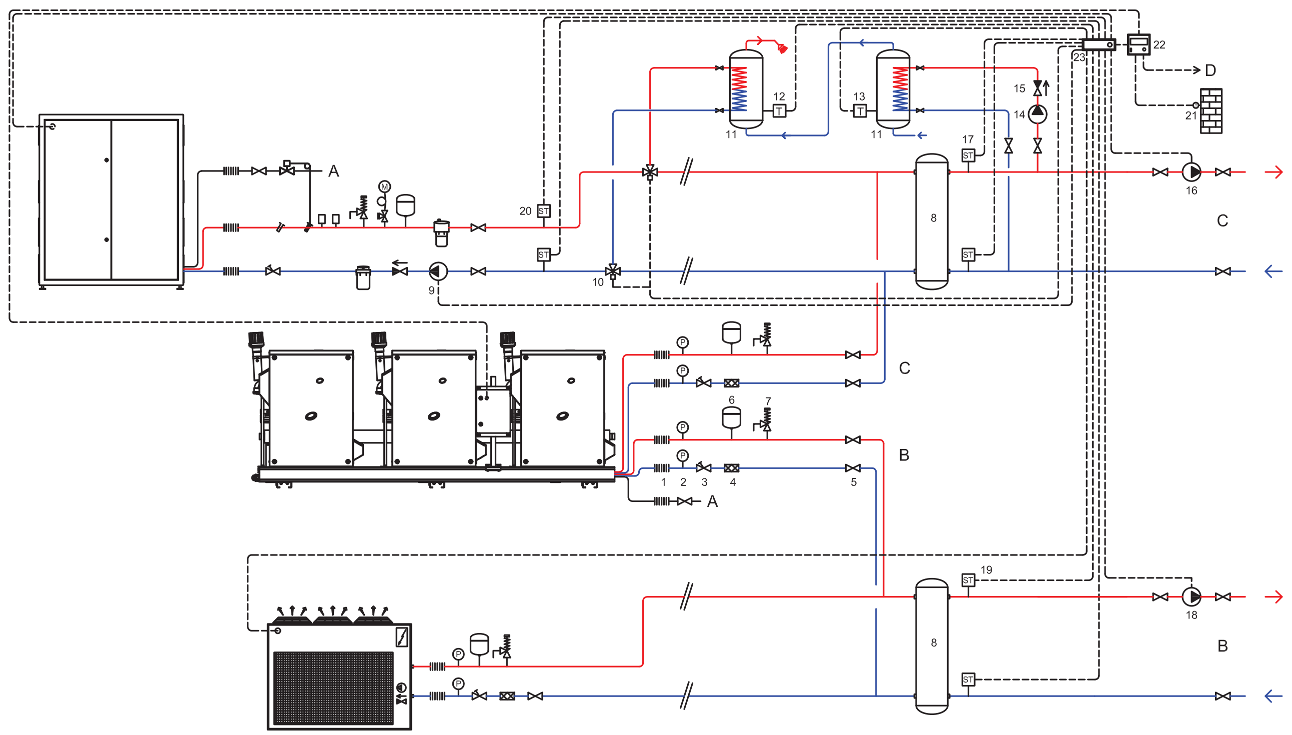
10 SIMULTANEOUS HEATING/COOLING USE AND DHW BASE AND SEPARABLE WITH THIRD PARTY INTEGRATION

10.1 DESCRIPTION

The plumbing diagram in Figure 10.1 *p. 17* shows the use of a preassembled RTGS/RTWS group (consisting of GAHP GS/WS) and third party units (boilers and chiller) for process applications or however entailing simultaneous use of hot water and chilled water with possibility to produce DHW both base and separable, coupled to a primary/secondary system with hydraulic separator and common circulating pump on the secondary circuit.
Using the RB200 device makes it possible to control the third party units, including the circulating pump of the third party unit on the separable circuit, the temperature of all three circuits (hot, cold, separable) as well as the common secondary circuit circulating pumps.

10.2 HYDRAULIC PLAN

Figure 10.1 *Plumbing diagram for simultaneous heating/cooling use and DHW base and separable with third party integration*



A Gas connection
B Cooling circuit
C Heating circuit
D Secondary circuit control system

Notes:

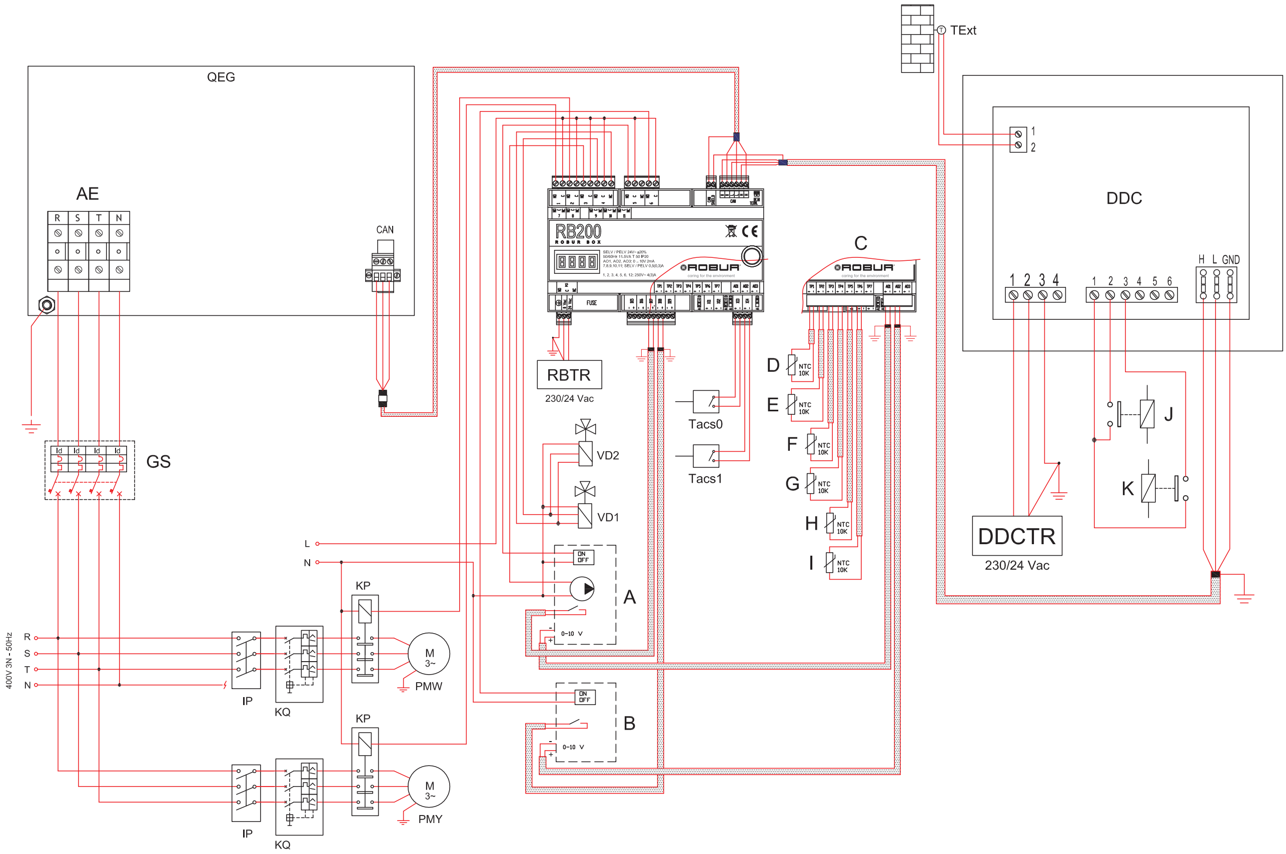
- Pump 14 of DHW preheating must be turned off when the heating system is off, or if the temperature difference between manifold and buffer tank is not sufficient for correct heat exchange on the preheating coil

System components:

1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valve
6 Expansion tank
7 3 bar safety valve
8 Buffer tank (and hydraulic separator)
9 Third party unit water pump (boiler)
10 3-way diverter valves for DHW
11 DHW accumulation tank
12 Thermostat with adjustable differential for DHW
13 Thermostat with adjustable differential for DHW pre-heating
14 DHW pre-heating water pump
15 Check valve
16 Hot circuit water pump
17 Heating secondary temperature probes
18 Hot circuit water pump
19 Cooling secondary temperature probes
20 Separable temperature probes
21 External temperature probe (for weather curve)
22 DDC panel
23 RB200 device

10.3 ELECTRICAL WIRING DIAGRAM

Figure 10.2 *Wiring diagram for simultaneous heating/cooling use and DHW base and separable with third party integration*



A Third party generator with circulating pump controlled by RB200
B Third party generator with own circulating pump
C Detail of upper RB200 terminal block
D Cooling return temperature probe
E Cooling flow temperature probe
F Heating return temperature probe
G Heating flow temperature probe
H Separable return temperature probe
I Separable flow temperature probe
J Heating external request
K Cooling external request
DDC Direct Digital Control
RB200 RB200 device
QEG preassembled group electrical panel
AE power supply input terminals (three-phase - neutral)
GS three-phase magnetothermic breaker
RSTN phases/neutral
CAN terminal block
GND Common data
L Data signal LOW
H Data signal HIGH
Components NOT SUPPLIED
DDCTR Safety transformer (240/24 Vac - 50/60 Hz - min 20 VA)
RBTR Safety transformer (240/24 Vac - 50/60 Hz - min 12 VA)
TExt external temperature probe (for weather curve)
Tacs0 DHW pre-heating request thermostat
Tacs1 DHW request thermostat
VD1 3-way motorised valve
VD2 3-way motorised valve
PMW hot side water pump < 700W
PMY cold side water pump < 700W
IP pump supply four-pole disconnector
KQ 400 Vac pump motor protector
KP water pump control relay

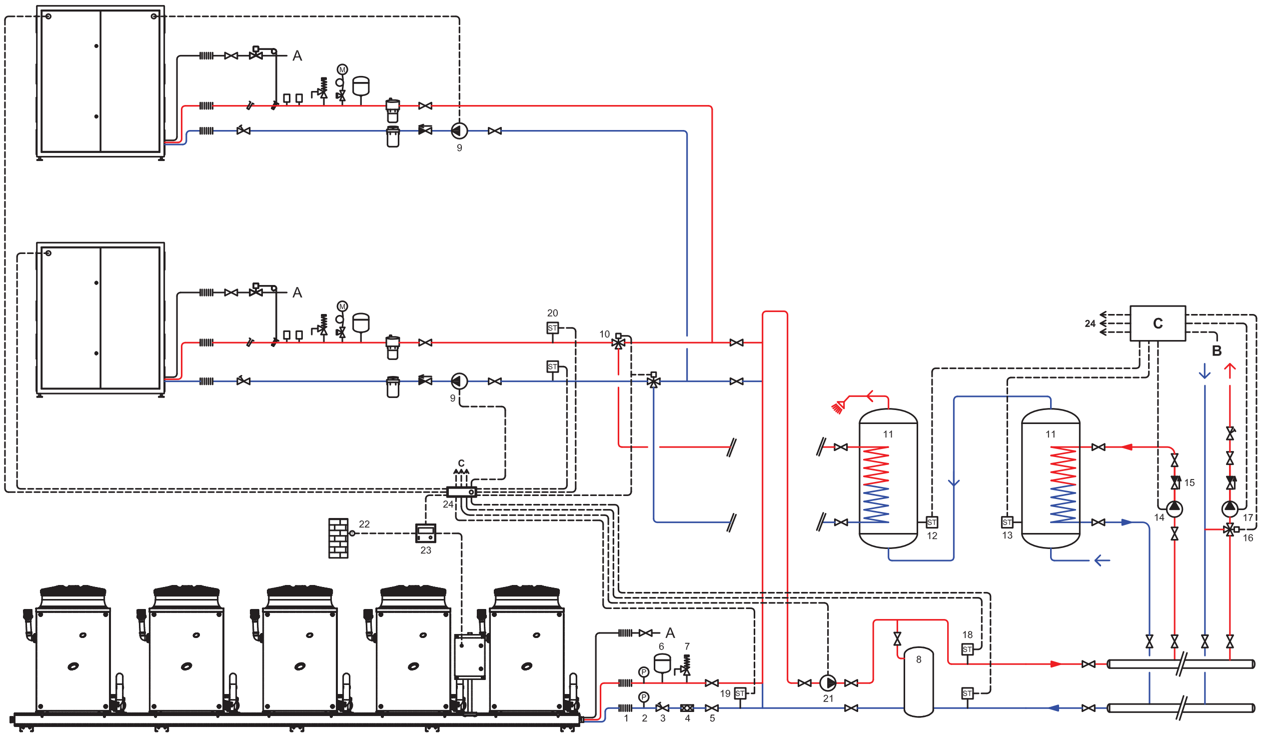
11 SERIES HEATING (TYPE P4) AND BASE AND SEPARABLE DHW WITH THIRD PARTY INTEGRATION

11.1 DESCRIPTION

The plumbing diagram in Figure 11.1 *p. 19* shows the use of a preassembled RTA group (consisting of GAHP A) and third party units (boilers) for heating and DHW both base and separable, coupled to a series system (type P4, see Section C1.12) with hot loop fitted with common circulating pump controlled by RB200 and 3-pipe hydraulic separator.
Installation in series also entails inserting the GAHP return probe, should one wish to use the integration and progressive replacement regulation mode (see Section C1.12).
The setpoints are relayed to the RB200 device by the secondary circuit control system through analogue 0-10 V signals.
Using the RB200 device makes it possible to control the third party units, including the circulating pump of the third party unit on the separable circuit and the hot loop circulating pump, as well as secondary and separable circuit temperature.

11.2 HYDRAULIC PLAN

Figure 11.1 *Base and separable series (P4) heating and DHW plumbing diagram*

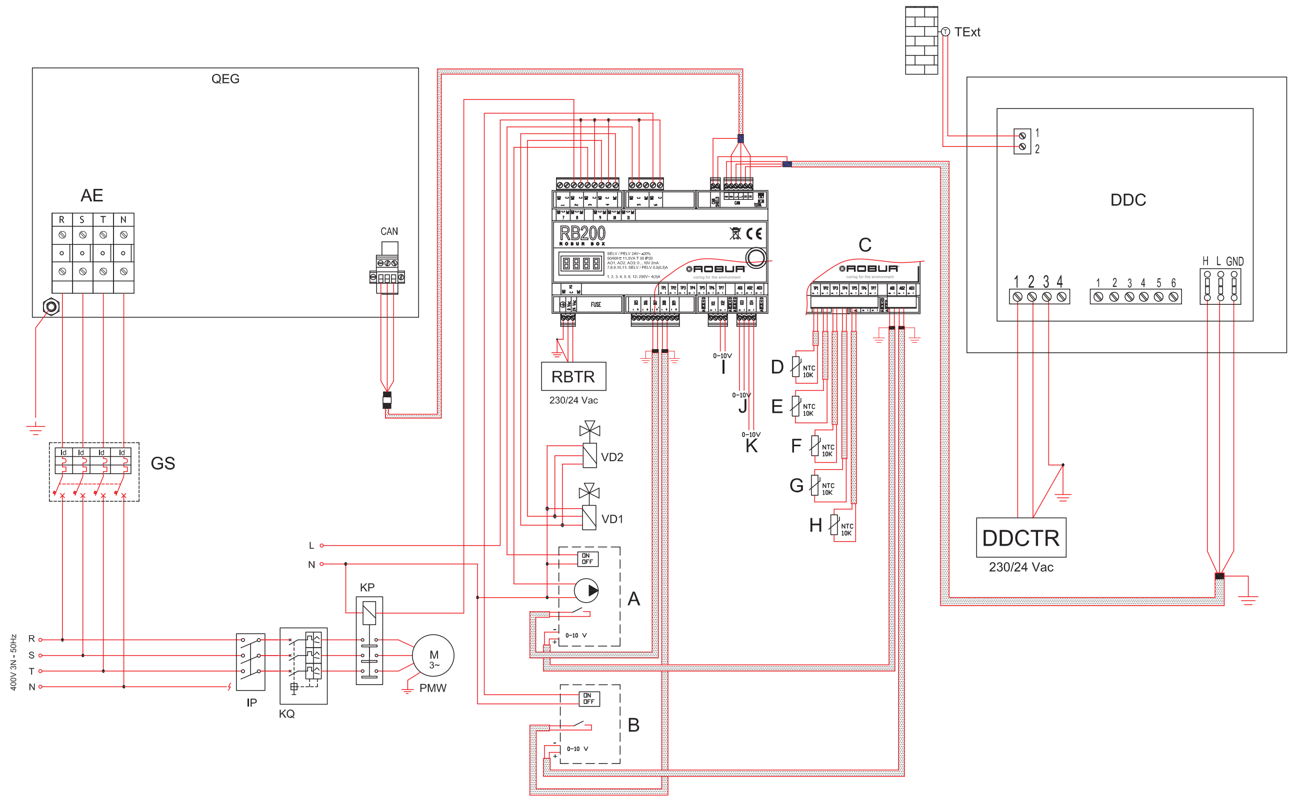


A Gas connection
B Heating system
C Secondary circuit control system
Notes:
- Pump 14 of DHW preheating must be turned off when the heating system is off, or if the temperature difference between manifold and buffer tank is not sufficient for correct heat exchange on the preheating coil

System components:
1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valve
6 Expansion tank
7 3 bar safety valve
8 Buffer tank (and hydraulic separator)
9 Third party unit water pump (boiler)
10 3-way diverter valves for DHW
11 DHW accumulation tank
12 Thermostat with adjustable differential for DHW
13 Thermostat with adjustable differential for DHW pre-heating
14 DHW pre-heating water pump
15 Check valve
16 3-way mixing valve
17 Hot circuit water pump
18 Secondary temperature probes
19 GAHP return temperature probe
20 Separable temperature probes
21 Common hot loop pump
22 External temperature probe (for weather curve)
23 DDC panel
24 RB200 device

11.3 ELECTRICAL WIRING DIAGRAM

Figure 11.2 *Base and separable series (P4) heating and DHW wiring diagram*



A Third party generator with circulating pump controlled by RB200
B Third party generator with own circulating pump
C Detail of upper RB200 terminal block
D Separable flow temperature probe
E Separable return temperature probe
F Heat flow temperature probe
G Heat return temperature probe
H GAHP return temperature probe
I Heating 0-10 V setpoint input
J Heating 0-10 V setpoint input
K 0-10 V ACS1 setpoint input
DDC Direct Digital Control
RB200 RB200 device
QEG preassembled group electrical panel
AE power supply input terminals (three-phase -neutral)
GS three-phase magnetothermic switch
RSTN phases/neutral
CAN terminal block
GND Common data
L Data signal LOW
H Data signal HIGH
Components NOT SUPPLIED
DDCTR Safety transformer (240/24 Vac - 50/60 Hz - min 20 VA)
RBTR Safety transformer (240/24 Vac - 50/60 Hz - min 12 VA)
TExt external temperature probe (for weather curve)
VD1 3-way motorised valve
VD2 3-way motorised valve
PMW hot side water pump < 700W
IP pump supply four-pole disconnector
KQ 400 Vac pump motor protector
KP water pump control relay

12 SERIES HEATING (TYPE P5) AND BASE DHW WITH THIRD PARTY INTEGRATION

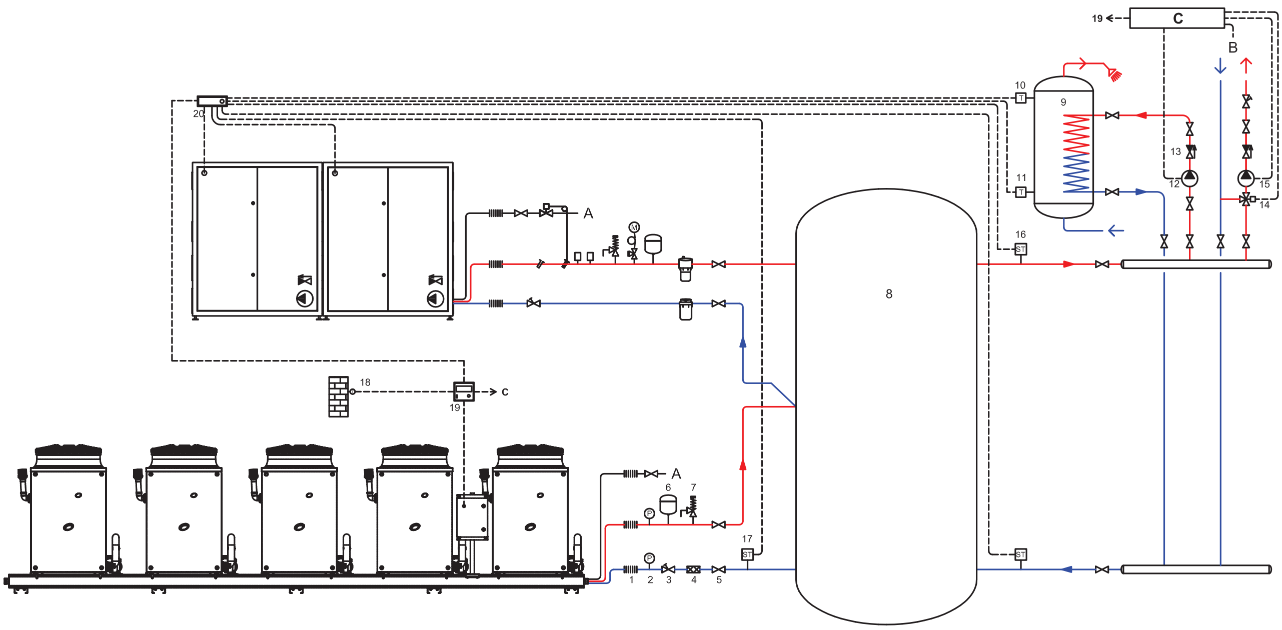
12.1 DESCRIPTION

The plumbing diagram in Figure 12.1 *p. 21* shows the use of a preassembled RTA group (consisting of GAHP A) and third party units (boilers) for heating and base DHW, coupled to a series system (type P5, see Section C1.12) large 4-pipe heat buffer tank.

Installation in series also entails inserting the GAHP return probe, should one wish to use the integration and progressive replacement regulation mode (see Section C1.12).
Using the RB200 device allows the third party units and secondary temperature to be controlled.

12.2 HYDRAULIC PLAN

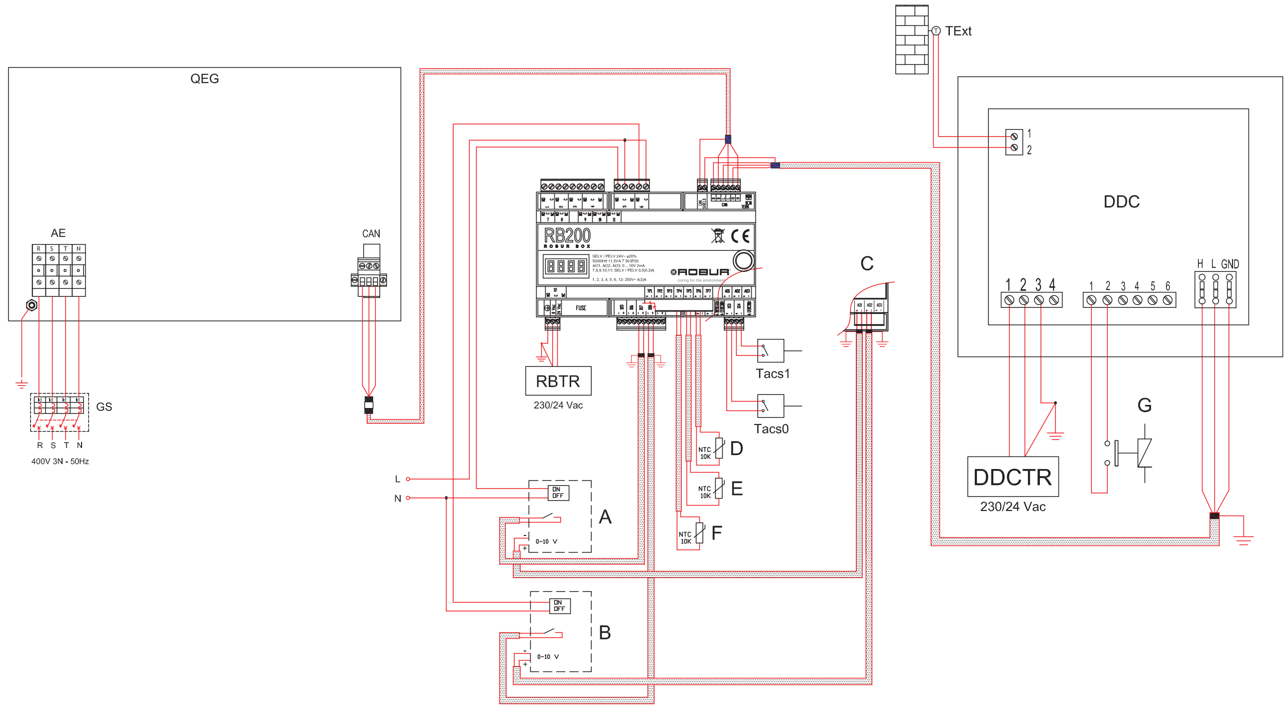
Figure 12.1 *Base series (P5) heating and DHW plumbing diagram*



A Gas connection
B Heating system
C Secondary circuit control system
System components:
1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valve
6 Expansion tank
7 3 bar safety valve
8 Buffer tank (and hydraulic separator)
9 DHW accumulation tank
10 Thermostat with adjustable differential for DHW
11 Thermostat with adjustable differential for Legionella function
12 DHW water pump
13 Check valve
14 3-way mixing valve
15 Hot circuit water pump
16 Secondary temperature probes
17 GAHP return temperature probe
18 External temperature probe (for weather curve)
19 DDC panel
20 RB200 device

12.3 ELECTRICAL WIRING DIAGRAM

Figure 12.2 *Base series (P5) heating and DHW wiring diagram*



A Third party generator with own circulating pump
B Third party generator with own circulating pump
C Detail of upper RB200 terminal block
D Heat flow temperature probe
E Heat return temperature probe
F GAHP return temperature probe
G Heating external request
DDC Direct Digital Control

RB200 RB200 device
QEG preassembled group electrical panel
AE power supply input terminals (three-phase -neutral)
GS three-phase magnetothermic switch
RSTN phases/neutral
CAN terminal block
GND Common data
L Data signal LOW
H Data signal HIGH

Components NOT SUPPLIED
DDCTR Safety transformer (240/24 Vac - 50/60 Hz - min 20 VA)
RBTR Safety transformer (240/24 Vac - 50/60 Hz - min 12 VA)
TExt external temperature probe (for weather curve)
Tacs0 DHW pre-heating request thermostat
Tacs1 DHW request thermostat

1 ACOUSTIC ISSUES

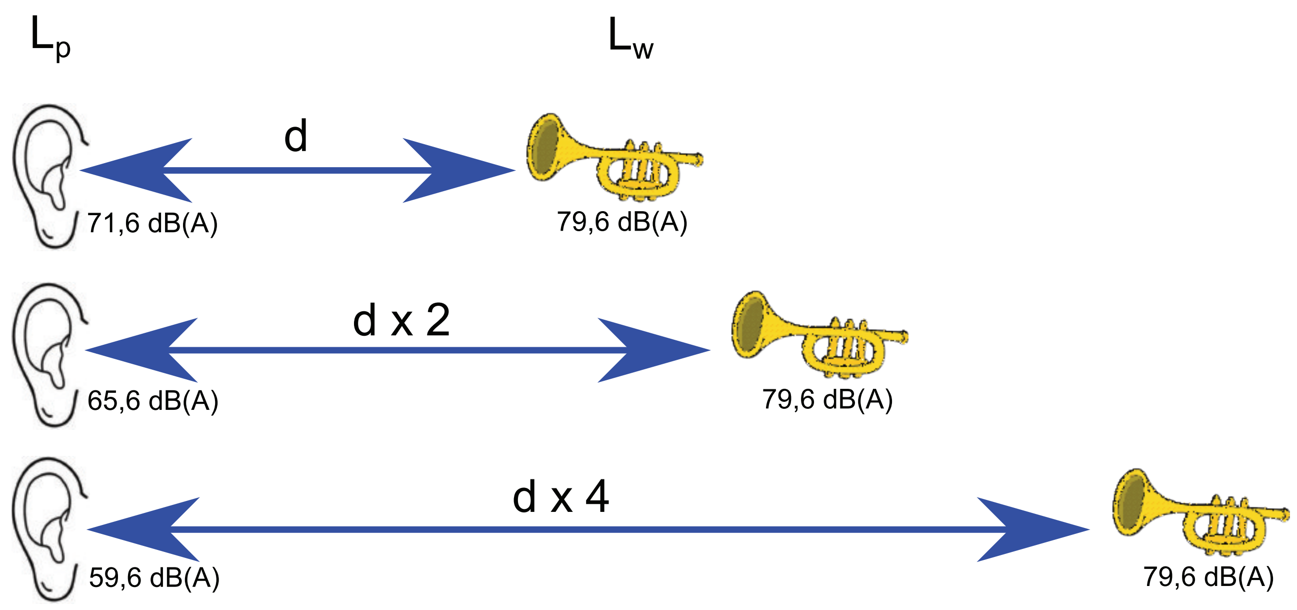
In the case of heat pumps and air/water coolers, in view of the outdoor installation, it is important to assess the noise aspect connected with the units' positioning, both to check compliance with regulatory limits, and to assess the acoustic comfort of users surrounding the installation site.

2 DEFINITIONS

Firstly, a distinction should be made between sound power Lw and sound pressure Lp.

Figure 2.1 *p. 1* lets you intuitively appreciate the difference between sound power Lw and sound pressure Lp.

Figure 2.1 *Sound power and pressure*



Lw [dB(A)] is the sound power
Lp [dB(A)] is the sound pressure at a precise distance, with precise source position

2.1 SOUND POWER LW

The sound power Lw in dB(A) characterises the overall sound emission capacity of the source: it is an intrinsic property of the sound source, regardless of distance.
This figure is usually measured in appropriately equipped laboratories and makes it possible to compare different emission sources (appliances).

2.2 SOUND PRESSURE LP

The sound pressure Lp, also expressed in dB(A), however, is an index of the sound level perceived in a given place and therefore depends on a number of factors:

- distances of the various sound sources;
- directionality factors;
- environmental conditions (reverberation);
- background noise.

Since it is a local parameter, it is usually measured on site with a sound level meter.

3 ACOUSTIC ASSESSMENT

Acoustic assessment cannot disregard correct unit positioning, also in connection with the installation context and the level of naturally occurring background noise (which is higher e.g. in urban settings than in rural settings).
Table 3.1 *p. 2* shows a generic indication of the levels of naturally occurring background noise in certain environments of reference, expressed as Equivalent Continuous Sound Pressure (Leq), which represents an average of the sound energy level.
This type of table is established by national and/or local regulations, since they are necessarily affected by lifestyles, climate and architecture of the buildings.

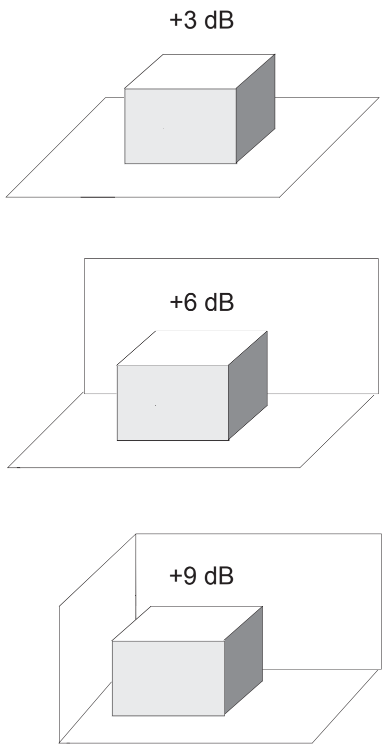
Table 3.1 *Sound source limit values - Leq [dB (A)]*

Type of area	Day	Medium	Night
Hospitals, rest areas, protected natural areas	45	40	35
Rural or peripheral residential areas, with low traffic (vehicular/aircraft)	50	45	40
Urban residential areas	55	50	45
Residential and retail areas with medium high traffic (vehicular/aircraft)	60	55	50
Retail and industrial areas (light industry)	65	60	55
Industrial areas (heavy industry)	65	65	65

Limit emission figures according to Italian regulations DPCM 14/11/97

Figure 3.1 *p. 2* sets out the sound pressure increase depending on source positioning with respect to any obstacles able to reflect sound.
As reference (increase equal to zero) the sound source is considered to be sufficiently removed from any obstacle.

Figure 3.1 *Sound reflection factors*



One should take into account that any sound shielding may be combined with visual screening, often required regardless of any critical sound aspects.

4 OVERALL RESULTING SOUND PRESSURE

The overall sound pressure resulting from the simultaneous presence of several sound sources may be calculated either in a simplified or analytical manner.

4.1 SIMPLIFIED CALCULATION

Simplified calculation may only be used if there are two appliances, due to the simplifications it implements.
One considers the difference between the sound pressure Lp of the appliances (both referring to the same distance and under the same measurement conditions), and on its basis, the figure indicated in Table 4.1 *p. 2* is added to the highest Lp.

Table 4.1 *Lp resulting simplified calculation table*

Difference in dB(A) between L_p figures	DB(A) to be added to the highest L_p
0-1	3
2-3	2
4-6	1
6+	0

Example of calculation with identical units

Two identical GAHP A HT Standard (sound pressure Lp at 5 metres (max) 57,6 dB(A)) give an overall resulting sound pressure Lp of (57,6 + 3 = 60.6 dB) since the difference between the Lp levels of the two sound sources is 0 dB therefore the figure to be added to the highest Lp is 3 dB.

Example of calculation with different units

One GAHP A HT S1 (sound pressure Lp at 5 metres (max) 52,0 dB(A)) operating simultaneously with a ACF 60-00 (sound pressure Lp at 5 metres (max) 57,6 dB(A)) give an overall resulting sound pressure Lp of (57,6 + 1 = 58.6 dB) since the difference between the Lp levels of the two sound sources is between 4 and 6 dB therefore the figure to be added to the highest Lp is 1 dB.

4.2 ANALYTICAL CALCULATION

The Formula 4.1 *p. 3* must be used to analytically calculate the overall resulting sound pressure.

Figure 4.1 *Sound pressure calculation formula*

$$L_p = 10\log_{10}\left(\sum_{i=1}^{n} 10^{\frac{(L_p)_i}{10}}\right)$$

Lp is the overall resulting sound pressure level and (Lp) is the sound pressure level of the individual sources (all referring to the same distance and the same measurement conditions).

Example of calculation

Two GAHP-AR S (sound pressure Lp at 5 metres (max) 53,0 dB(A) each) operating with a GAHP A HT S1 (sound pressure Lp at 5 metres (max) 52,0 dB(A)) lead, after applying Formula 4.2 *p. 3* to an overall resulting sound pressure of 57.5 dB(A).

Figure 4.2 *Example of sound pressure calculation*

$$L_p = 10\log_{10}\left(10^{\frac{53}{10}} + 10^{\frac{53}{10}} + 10^{\frac{52}{10}}\right)$$

5 EN ISO 9614 TABLES

After the general remarks of the previous paragraphs, one may now analyse the specific sound data of Robur units.
The technical data in section B set out the sound pressure level Lp referring to a distance of 5 m, in front of the source, considering a directionality factor equal to 2 (corresponding to a semi-reflective surface).
The sound intensity levels shown below have been measured according to standard EN ISO 9614:2009.
The sound intensity test, compliant with standard EN ISO 9614, is a method for determining the sound power levels of a source with stationary noise, by measuring the sound intensity on the surfaces of an ideal parallelepiped and/or semi-sphere that contains the source.

5.1 GAHP-AR AND GA ACF

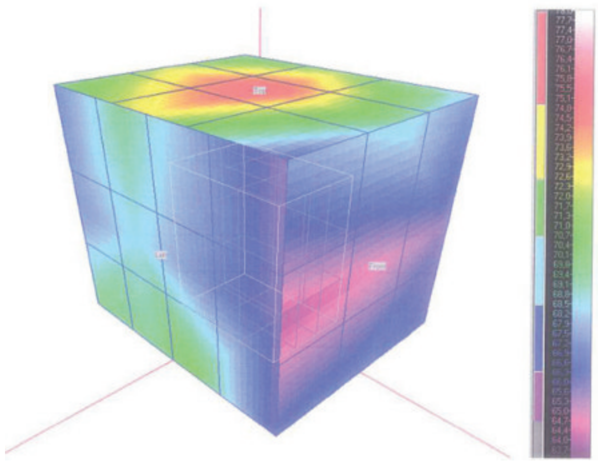
For units GAHP-AR Standard**,** GAHP A HT Standard and GA ACF standard versions see Table 5.1 *p. 3* and Figure 5.1 *p. 3*.

Table 5.1 *Sound levels EN 9614 standard GAHP-AR, GAHP A and ACF*

Frequency	Surface					Sum over frequencies
	Top	Left	Front	Right	Back	
Hz	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	A [dBA]
50	53,2	-	-	-	-	-
63	59,0	58,3	51,3	-	46,0	-
80	59,3	-	-	-	-	-
100	59,8	56,5	57,4	56,3	56,3	64,5
125	61,7	60,7	55,2	56,7	49,8	65,5
160	60,2	-	-	-	-	-
200	69,8	59,1	64,0	64,2	62,9	72,4
250	64,8	61,0	58,0	58,2	62,9	68,8
315	63,0	60,4	57,1	57,4	59,1	67,0
400	66,1	60,5	61,6	60,9	62,5	69,9
500	66,1	63,3	59,7	62,5	63,1	70,4
630	67,1	64,6	61,6	62,6	64,8	71,5
800	67,9	66,2	61,3	64,9	65,8	72,7
1000	67,7	64,8	61,2	65,1	65,4	72,3
1250	66,7	64,2	61,0	64,1	64,0	71,4
1600	66,3	63,6	60,6	63,2	63,3	70,8
2000	65,8	63,1	59,9	62,2	62,7	70,1
2500	65,3	62,6	60,9	61,7	62,2	69,8
3150	62,1	59,9	59,6	60,0	59,2	67,3
4000	59,4	58,6	58,0	58,1	58,3	65,5
5000	56,7	57,5	56,2	56,1	56,5	63,6
6300	53,8	53,3	-	53,3	54,6	-
A [dBA]	**78,1**	**74,8**	**72,5**	**74,1**	**74,7**	**82,1**

Front refers to the unit side that has the removable maintenance panel

Figure 5.1 *EN 9614 standard unit sound intensity*



For units GAHP-AR S and GA ACF silenced versions (S) see Table 5.2 *p. 4* and Figure 5.2 *p. 4*.

Table 5.2 *Sound levels EN 9614 silenced GAHP-AR and GA-ACF*

Frequency	Surface					Sum over frequencies
	Top	Left	Front	Right	Back	
50 Hz supply	DB(A)	DB(A)	DB(A)	DB(A)	DB(A)	A [dBA]
50	50,5	-	-	-	-	-
63	48,6	-	-	-	-	-
80	51,5	-	-	-	-	-
100	57,9	60,3	62,3	58,3	62,0	67,5
125	58,1	43,7	43,6	44,3	44,6	58,7
160	-	-	-	-	-	-
200	-	-	-	-	-	-
250	55,5	51,7	53,4	49,9	51,9	59,9
315	56,7	55,4	52,0	55,8	54,1	62,1
400	56,9	55,1	53,6	54,9	55,2	62,3
500	58,5	57,7	56,7	59,7	56,3	65,0
630	58,9	59,6	58,0	58,5	58,6	65,7
800	60,7	60,9	57,7	60,1	59,6	66,9
1000	60,9	57,4	53,2	56,6	57,0	64,7
1250	61,9	57,3	53,9	57,1	58,0	65,4
1600	59,1	56,1	55,5	56,0	55,1	63,6
2000	56,9	55,0	54,8	53,4	54,5	62,1
2500	55,1	54,3	56,9	54,8	53,4	62,1
3150	56,7	57,7	54,9	56,6	55,8	63,5
4000	56,8	57,1	50,9	54,0	58,1	63,0
5000	57,2	57,3	55,0	56,5	56,2	63,5
6300	-	46,0	-	51,4	50,3	-
A [dBA]	**70,6**	**69,2**	**68,0**	**68,7**	**69,0**	**76,1**

Front refers to the unit side that has the removable maintenance panel

Figure 5.2 *EN 9614 GAHP-AR S and GA ACF S sound intensity*

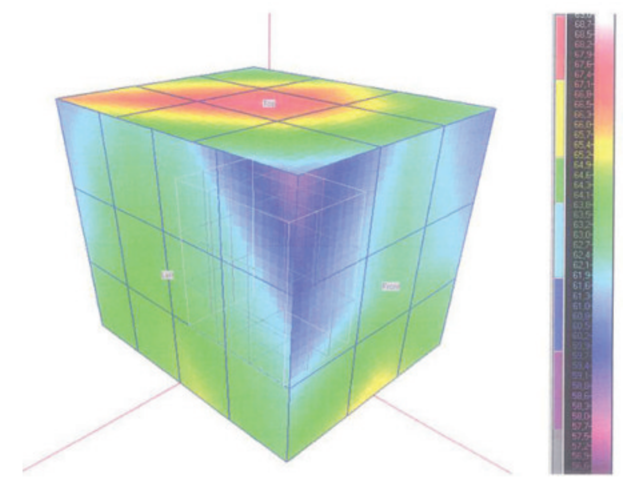
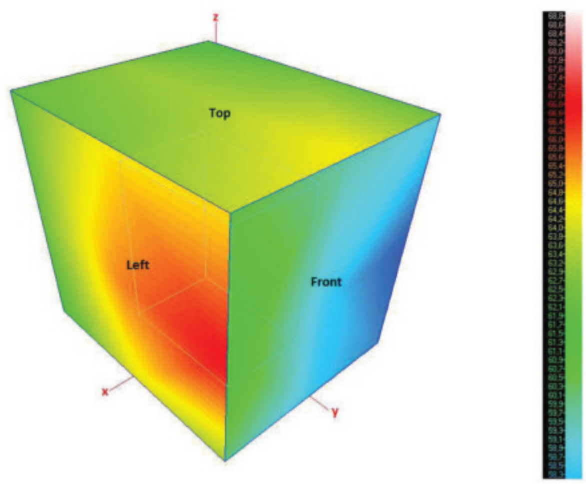


Table 5.3 *Sound levels EN 9614 GAHP A S1*

Frequency	Surface					Sum over frequencies	
	Top	Left	Front	Right	Back		
50 Hz supply	DB	DB	DB	DB	DB	L [dB]	A [dBA]
50	79,0	75,2	69,9	78,7	74,0	83,4	53,2
63	62,2	60,3	55,4	60,8	58,6	67,0	40,8
80	66,4	58,8	59,2	57,6	59,1	68,7	46,2
100	73,8	72,4	70,4	69,8	71,2	78,8	59,7
125	58,2	55,6	55,3	55,5	54,3	62,9	46,8
160	66,5	61,5	60,1	60,3	60,8	69,6	56,2
200	61,1	60,9	60,5	59,0	57,5	67,0	56,1
250	63,2	58,9	58,2	55,7	56,9	66,4	57,8
315	61,9	60,0	58,4	57,8	59,2	66,7	60,1
400	61,5	60,9	56,8	59,5	59,2	66,9	62,1
500	62,3	64,6	60,1	64,0	62,3	69,9	66,7
630	62,6	64,5	58,1	61,5	59,3	68,8	66,9
800	62,0	64,8	57,3	59,4	59,0	68,3	67,5
1000	60,7	63,6	57,4	58,2	57,7	67,2	67,2
1250	58,3	61,5	54,9	55,2	54,8	64,8	65,4
1600	55,6	56,4	49,9	54,9	54,4	61,7	62,7
2000	53,0	52,2	46,0	51,8	51,0	58,3	59,5
2500	52,6	53,8	46,2	53,8	53,0	59,6	60,9
3150	46,6	45,3	38,3	44,9	44,8	51,7	52,9
4000	44,0	44,0	37,1	43,6	43,2	50,0	51,0
5000	41,1	40,0	35,2	41,0	29,6	46,8	47,3
6300	38,0	37,6	33,7	36,5	36,4	43,6	43,5
L [dB]	**81,1**	**78,5**	**74,7**	**79,8**	**76,9**	**85,7**	**75,3**
A [dBA]	**69,1**	**70,8**	**65,1**	**67,5**	**66,8**		

Front refers to the unit side that has the removable maintenance panel

Figure 5.3 *EN 9614 GAHP A S1 front sound intensity*

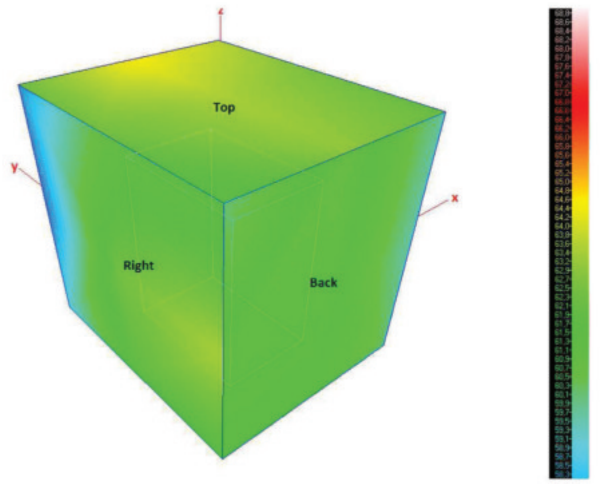


Sound intensity measured on unit GAHP A HT S1 surface, front, top and left side view

5.2 GAHP A

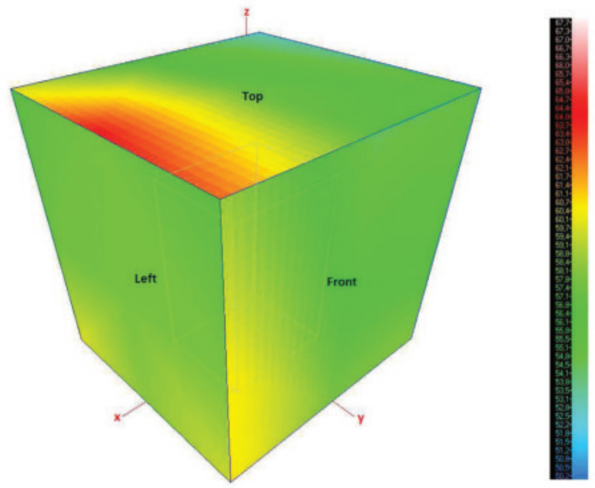
For unit GAHP A HT Standardsee Table 5.1 *p. 3* and the relevant Figure 5.1 *p. 3*.
For unit GAHP A HT S1 see Table 5.3 *p. 4* and Figures 5.3 *p. 4* and 5.4 *p. 5*.

Figure 5.4 *EN 9614 GAHP A S1 rear sound intensity*



Sound intensity measured on unit GAHP A HT S1 surface, rear, top and right side view

Figure 5.5 *EN 9614 GAHP GS/WS front sound intensity*



Sound intensity measured on unit GAHP GS/WS surface, front, top and left side view

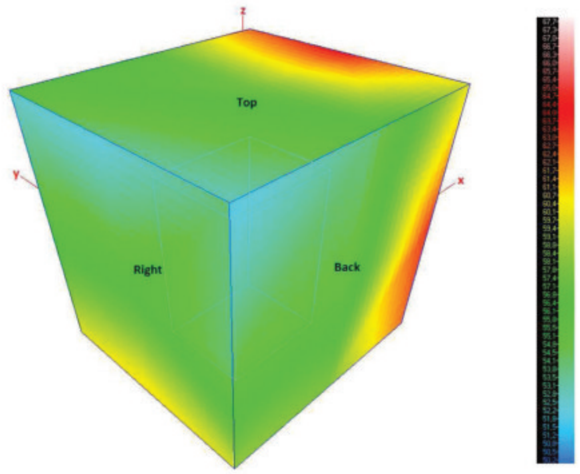
5.3 GAHP GS/WS

Table 5.4 *Sound levels EN 9614 GAHP GS/WS*

Frequency	Surface					Sum over frequencies	
	Top	Left	Front	Right	Back		
50 Hz supply	DB	DB	DB	DB	DB	L [dB]	A [dBA]
50	59,2	61,9	61,9	60,1	60,2	67,8	37,6
63	52,2	61,4	59,6	56,7	58,0	65,5	39,3
80	52,3	56,5	57,7	59,1	58,4	64,3	41,8
100	55,3	72,5	64,7	56,6	65,1	73,9	54,8
125	55,8	57,4	60,4	57,9	57,2	65,0	48,9
160	49,8	54,3	56,7	53,2	52,0	60,8	47,7
200	57,2	57,1	57,9	55,4	56,8	64,0	53,1
250	52,8	53,7	56,6	52,0	56,4	61,7	53,1
315	55,1	58,3	56,4	57,3	58,8	64,3	57,7
400	50,7	54,3	53,8	53,6	52,8	60,2	55,4
500	53,0	59,1	56,2	52,9	56,6	63,2	60,0
630	56,4	57,7	58,9	58,9	59,6	65,4	63,5
800	54,5	53,9	54,6	53,1	55,3	61,3	60,5
1000	57,8	51,6	54,5	50,7	55,7	61,8	61,8
1250	59,3	51,6	53,6	49,0	57,7	62,8	63,4
1600	49,7	45,8	48,4	46,1	48,4	54,9	55,9
2000	44,6	42,9	46,7	47,7	43,7	52,4	53,6
2500	40,0	40,0	41,9	44,9	40,4	48,9	50,2
3150	41,1	38,2	44,8	48,2	41,2	51,1	52,3
4000	37,4	35,9	38,7	48,2	39,7	49,7	50,7
5000	34,5	33,9	34,1	35,5	33,4	41,3	41,8
6300	32,4	33,0	31,7	32,4	32,6	39,4	39,3
L [dB]	**67,5**	**74,1**	**70,6**	**68,1**	**70,4**	**77,8**	**70,4**
A [dBA]	**64,1**	**62,9**	**63,2**	**62,0**	**64,3**		

Front refers to the unit side that has the removable maintenance panel
The sound levels have been measured with type C unit installation

Figure 5.6 *EN 9614 GAHP GS/WS rear sound intensity*



Sound intensity measured on unit GAHP GS/WS surface, rear, top and right side view

1 FIRST START-UP

The purpose of First Start-Up is:

- Ensure the units have been installed correctly;
- Ensure the units are able to be operated and maintained safely;
- Correctly set up and configure the units.

1.1 PRELIMINARY CHECKS

1.1.1 Abnormal or hazardous installation situations

Should any abnormal or hazardous installation situations be found, the TAC shall not perform First start-up and the appliance shall not be commissioned.

These situations may be:

- appliance installed within premises (excluding GAHP A Indoor, GAHP GS/WS in indoor version and AY00-120);
- appliance installed within premises without safety valve drain ducting (only for GAHP A Indoor and GAHP GS/WS indoor versions);
- appliance installations other than type C (only for GAHP A Indoor);
- failed compliance with minimum clearances;
- insufficient distance from combustible or flammable materials;
- conditions that do not warrant access and maintenance in safety;
- appliance switched on/off with the main switch, instead of the control device provided (DDC, CCP/CCI or external request);
- appliance defects or faults caused during transport or installation;
- gas smell;
- non-compliant mains gas pressure;
- non-compliant flue gas exhaust;
- lack of air ducts exhausted by the fan (only for GAHP A Indoor);
- all situations that may involve operation abnormalities or are potentially hazardous.

1 EFFICIENCY

For increased appliance efficiency:

- Keep the finned coil clean;
- Adjust the maximum water temperature to the actual system requirements;
- Reduce repeated switch-ons to the minimum (low loads);
- Program appliance activation for actual periods of use;
- Keep water and air filters on plumbing and ventilation systems clean.

1 PRE-EMPTIVE MAINTENANCE

For pre-emptive maintenance, comply with the recommendations in Table 1.1 *p. 1*.

Table 1.1

		GAHP A	GAHP GS/WS	AY00-120	GA ACF	GAHP-AR
Guidelines for the preventive maintenance operations						
Check of the unit	visually check of the general condition of the unit and of its air heat exchanger	√ (1)	-	-	√ (1)	√ (1)
	check the correct operation of the device used for monitoring the water flow	√	√	√	√	√
	check the % value of CO_2	√	√	√	-	-
	check gas pressure to the burners	-	-	-	√	√
	check that the condensate discharge is clean (If necessary, frequency of the maintenace operation must be increased)	√	√	√	-	-
	replace the belts after 6 years or 12,000 hours of operation	√	√	-	√	√
	check/restore the pressure of the primary hydronic circuit	-	-	√	-	-
	check/restore the air pressure inside of the expansion vessel of the primary hydronic circuit	-	-	√	-	-
Check for every DDC or CCI	check that the plant is able to achieve the setpoint temperature	√	√	√	√	√
	download the event history	√	√	√	√	√

(1) It is suggested to clean the finned coil once every 4 years (optimal frequency of the cleaning operation is in any case strongly affected by the installation site).

2 SCHEDULED ROUTINE MAINTENANCE

For scheduled routine maintenance, perform the operations in Table 2.1 *p. 1*, at least once every 2 years.

Table 2.1

		GAHP A	GAHP GS/WS	AY00-120	GA ACF	GAHP-AR
Routine scheduled maintenance (to be performed at least once every TWO YEARS)						
Check of the unit	clean the combustion chamber	√ (1)	√ (1)	√	√	√ (1)
	clean the burner	√ (1)	√ (1)	√	√	√ (1)
	clean the electrodes of ignition and flame sensing	√	√	√	√	√
	check that the condensate discharge is clean	√	√	√	-	-
	replace the silicone gasket between the front plate and the exchanger	-	-	√	-	-

(1) Only in case the analysis of combustion products is non-compliant.

1 GAHP A

Figure 1.1

Table 8
COMMISSION DELEGATED REGULATION (EU) No 811/2013
Technical parameters for heat pump space heaters and heat pump combination heaters

Model(s):	GAHP A HT
Air-to-water heat pump:	yes
Water-to-water heat pump:	no
Brine-to-water heat pump:	no
Low-temperature heat pump:	no
Equipped with a supplementary heater:	no
Heat pump combination heater:	no
Parameters shall be declared for medium-temperature application.	
Parameters shall be declared for average, colder and warmer climate conditions.	

Item	Symbol	Value	Unit	Item	Symbol	Value	Unit
AVERAGE CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	29,6	kW	**Seasonal space heating energy efficiency**	η_s	111	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7 °C	*Pdh*	26,1	kW	Tj = -7 °C	*PERd*	96	%
Tj = +2 °C	*Pdh*	16,0	kW	Tj = +2 °C	*PERd*	120	%
Tj = +7 °C	*Pdh*	10,4	kW	Tj = +7 °C	*PERd*	117	%
Tj = +12 °C	*Pdh*	4,4	kW	Tj = +12 °C	*PERd*	111	%
T_j = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
Annual energy consumption	Q_{HE}	198	GJ				
COLDER CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	29,4	kW	**Seasonal space heating energy efficiency**	η_s	107	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7 °C	*Pdh*	17,9	kW	Tj = -7 °C	*PERd*	109	%
Tj = +2 °C	*Pdh*	10,9	kW	Tj = +2 °C	*PERd*	117	%
Tj = +7 °C	*Pdh*	7,1	kW	Tj = +7 °C	*PERd*	112	%
Tj = +12 °C	*Pdh*	3,2	kW	Tj = +12 °C	*PERd*	111	%
Tj = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
T_j = operation limit temperature	*Pdh*	29,4	kW	Tj = operation limit temperature	*PERd*	87	%
For air-to-water heat pumps: T_j = –15 °C (if TOL < –20 °C)	*Pdh*	24,1	kW	For air-to-water heat pumps: Tj = –15 °C (if TOL < –20 °C)	*PERd*	90	%
Annual energy consumption	Q_{HE}	244	GJ				
WARMER CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	36,4	kW	**Seasonal space heating energy efficiency**	η_s	116	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = +2 °C	*Pdh*	36,4	kW	Tj = +2 °C	*PERd*	119	%
Tj = +7 °C	*Pdh*	23,3	kW	Tj = +7 °C	*PERd*	122	%
Tj = +12 °C	*Pdh*	10,6	kW	Tj = +12 °C	*PERd*	116	%
Tj = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
Annual energy consumption	Q_{HE}	151	GJ				

Figure 1.2

Bivalent temperature	T_{biv}	TOL < $T_{designh}$	°C	For air-to-water heat pumps: Operation limit temperature	*TOL*	-22	°C
				Heating water operating limit temperature	*WTOL*	65	°C
Power consumption in modes other than active mode				Supplementary heater			
Off mode	P_{OFF}	0,000	kW	Rated heat output	*Psup*	-	kW
Thermostat-off mode	P_{TO}	0,021	kW	Type of energy input	monovalent		
Standby mode	P_{SB}	0,005	kW				
Crankcase heater mode	P_{CK}	-	kW				
Other items							
Capacity control		variable		For air-to-water heat pumps: Rated air flow rate, outdoors	—	11000	m³/h
Sound power level, indoors/ outdoors	L_{WA}	- / 80	dB	For water- or brine-to-water heat pumps: Rated brine or water flow rate, outdoor heat exchanger	—	-	m³/h

(*) For heat pump space heaters and heat pump combination heaters, the rated heat output *Prated* is equal to the design load for heating *Pdesignh*, and the rated heat output of a supplementary heater *Psup* is equal to the supplementary capacity for heating *sup(Tj)*.

Additional information required by COMMISSION REGULATION (EU) No 813/2013, Table 2:

Emissions of nitrogen oxides:	NO_x	40	mg/ kWh

2 GAHP A S1

Figure 2.1

Table 8

COMMISSION DELEGATED REGULATION (EU) No 811/2013

Technical parameters for heat pump space heaters and heat pump combination heaters

Model(s):	GAHP A HT S1
Air-to-water heat pump:	yes
Water-to-water heat pump:	no
Brine-to-water heat pump:	no
Low-temperature heat pump:	no
Equipped with a supplementary heater:	no
Heat pump combination heater:	no
Parameters shall be declared for medium-temperature application.	
Parameters shall be declared for average, colder and warmer climate conditions.	

Item	Symbol	Value	Unit	Item	Symbol	Value	Unit
AVERAGE CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	29,6	kW	**Seasonal space heating energy efficiency**	η_s	113	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7 °C	*Pdh*	26,1	kW	Tj = -7 °C	*PERd*	97	%
Tj = +2 °C	*Pdh*	16,0	kW	Tj = +2 °C	*PERd*	122	%
Tj = +7 °C	*Pdh*	10,4	kW	Tj = +7 °C	*PERd*	119	%
Tj = +12 °C	*Pdh*	4,4	kW	Tj = +12 °C	*PERd*	113	%
T_j = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
Annual energy consumption	Q_{HE}	195	GJ				
COLDER CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	29,4	kW	**Seasonal space heating energy efficiency**	η_s	109	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7 °C	*Pdh*	17,9	kW	Tj = -7 °C	*PERd*	110	%
Tj = +2 °C	*Pdh*	10,9	kW	Tj = +2 °C	*PERd*	119	%
Tj = +7 °C	*Pdh*	7,1	kW	Tj = +7 °C	*PERd*	114	%
Tj = +12 °C	*Pdh*	3,2	kW	Tj = +12 °C	*PERd*	113	%
Tj = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
T_j = operation limit temperature	*Pdh*	29,4	kW	Tj = operation limit temperature	*PERd*	88	%
For air-to-water heat pumps: T_j = –15 °C (if TOL < –20 °C)	*Pdh*	24,1	kW	For air-to-water heat pumps: Tj = –15 °C (if TOL < –20 °C)	*PERd*	91	%
Annual energy consumption	Q_{HE}	239	GJ				
WARMER CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	36,4	kW	**Seasonal space heating energy efficiency**	η_s	117	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = +2 °C	*Pdh*	36,4	kW	Tj = +2 °C	*PERd*	120	%
Tj = +7 °C	*Pdh*	23,3	kW	Tj = +7 °C	*PERd*	123	%
Tj = +12 °C	*Pdh*	10,6	kW	Tj = +12 °C	*PERd*	118	%
Tj = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
Annual energy consumption	Q_{HE}	150	GJ				

Figure 2.2

Bivalent temperature	T_{biv}	TOL < $T_{designh}$	°C	For air-to-water heat pumps: Operation limit temperature	*TOL*	-22	°C
				Heating water operating limit temperature	*WTOL*	65	°C
Power consumption in modes other than active mode				Supplementary heater			
Off mode	P_{OFF}	0,000	kW	Rated heat output	*Psup*	-	kW
Thermostat-off mode	P_{TO}	0,021	kW				
Standby mode	P_{SB}	0,005	kW	Type of energy input	monovalent		
Crankcase heater mode	P_{CK}	-	kW				
Other items							
Capacity control	variable			For air-to-water heat pumps: Rated air flow rate, outdoors	—	11000	m³/h
Sound power level, indoors/ outdoors	L_{WA}	- / 74	dB	For water- or brine-to-water heat pumps: Rated brine or water flow rate, outdoor heat exchanger	—	-	m³/h

(*) For heat pump space heaters and heat pump combination heaters, the rated heat output *Prated* is equal to the design load for heating *Pdesignh*, and the rated heat output of a supplementary heater *Psup* is equal to the supplementary capacity for heating *sup(Tj)*.

Additional information required by COMMISSION REGULATION (EU) No 813/2013, Table 2:

Emissions of nitrogen oxides:	NO_x	40	mg/kWh

3 GAHP A INDOOR

Figure 3.1

Table 8

COMMISSION DELEGATED REGULATION (EU) No 811/2013

Technical parameters for heat pump space heaters and heat pump combination heaters

Model(s):	GAHP A INDOOR
Air-to-water heat pump:	yes
Water-to-water heat pump:	no
Brine-to-water heat pump:	no
Low-temperature heat pump:	no
Equipped with a supplementary heater:	no
Heat pump combination heater:	no
Parameters shall be declared for medium-temperature application.	
Parameters shall be declared for average, colder and warmer climate conditions.	

Item	Symbol	Value	Unit	Item	Symbol	Value	Unit
AVERAGE CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	30,1	kW	**Seasonal space heating energy efficiency**	η_s	112	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7 °C	*Pdh*	26,5	kW	Tj = -7 °C	*PERd*	96	%
Tj = +2 °C	*Pdh*	16,3	kW	Tj = +2 °C	*PERd*	121	%
Tj = +7 °C	*Pdh*	10,5	kW	Tj = +7 °C	*PERd*	117	%
Tj = +12 °C	*Pdh*	4,5	kW	Tj = +12 °C	*PERd*	111	%
T_j = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
Annual energy consumption	Q_{HE}	200	GJ				
COLDER CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	29,8	kW	**Seasonal space heating energy efficiency**	η_s	108	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7 °C	*Pdh*	18,2	kW	Tj = -7 °C	*PERd*	109	%
Tj = +2 °C	*Pdh*	11,0	kW	Tj = +2 °C	*PERd*	118	%
Tj = +7 °C	*Pdh*	7,2	kW	Tj = +7 °C	*PERd*	113	%
Tj = +12 °C	*Pdh*	3,3	kW	Tj = +12 °C	*PERd*	111	%
Tj = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
T_j = operation limit temperature	*Pdh*	29,8	kW	Tj = operation limit temperature	*PERd*	87	%
For air-to-water heat pumps: T_j = –15 °C (if TOL < –20 °C)	*Pdh*	24,4	kW	For air-to-water heat pumps: Tj = –15 °C (if TOL < –20 °C)	*PERd*	90	%
Annual energy consumption	Q_{HE}	245	GJ				
WARMER CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	36,6	kW	**Seasonal space heating energy efficiency**	η_s	116	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = +2 °C	*Pdh*	36,6	kW	Tj = +2 °C	*PERd*	119	%
Tj = +7 °C	*Pdh*	23,4	kW	Tj = +7 °C	*PERd*	122	%
Tj = +12 °C	*Pdh*	10,6	kW	Tj = +12 °C	*PERd*	117	%
Tj = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
Annual energy consumption	Q_{HE}	152	GJ				

Figure 3.2

Bivalent temperature	T_{biv}	TOL < $T_{designh}$	°C	For air-to-water heat pumps: Operation limit temperature	*TOL*	-22	°C
				Heating water operating limit temperature	*WTOL*	65	°C
Power consumption in modes other than active mode				Supplementary heater			
Off mode	P_{OFF}	0,000	kW	Rated heat output	*Psup*	-	kW
Thermostat-off mode	P_{TO}	0,021	kW				
Standby mode	P_{SB}	0,005	kW	Type of energy input		monovalent	
Crankcase heater mode	P_{CK}	-	kW				
Other items							
Capacity control		variable		For air-to-water heat pumps: Rated air flow rate, outdoors	—	11000	m³/h
Sound power level, indoors/ outdoors	L_{WA}	- / 74	dB	For water- or brine-to-water heat pumps: Rated brine or water flow rate, outdoor heat exchanger	—	-	m³/h

(*) For heat pump space heaters and heat pump combination heaters, the rated heat output *Prated* is equal to the design load for heating *Pdesignh*, and the rated heat output of a supplementary heater *Psup* is equal to the supplementary capacity for heating *sup(Tj)*.

Additional information required by COMMISSION REGULATION (EU) No 813/2013, Table 2:

Emissions of nitrogen oxides:	NO_x	40	mg/ kWh

4 GAHP-AR

Figure 4.1

Table 8

COMMISSION DELEGATED REGULATION (EU) No 811/2013

Technical parameters for heat pump space heaters and heat pump combination heaters

Model(s):	GAHP-AR
Air-to-water heat pump:	yes
Water-to-water heat pump:	no
Brine-to-water heat pump:	no
Low-temperature heat pump:	no
Equipped with a supplementary heater:	no
Heat pump combination heater:	no
Parameters shall be declared for medium-temperature application.	
Parameters shall be declared for average, colder and warmer climate conditions.	

Item	**Symbol**	**Value**	**Unit**	**Item**	**Symbol**	**Value**	**Unit**
AVERAGE CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	28,4	kW	**Seasonal space heating energy efficiency**	η_s	110	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7 °C	*Pdh*	25,0	kW	Tj = -7 °C	*PERd*	93	%
Tj = +2 °C	*Pdh*	15,3	kW	Tj = +2 °C	*PERd*	118	%
Tj = +7 °C	*Pdh*	9,9	kW	Tj = +7 °C	*PERd*	116	%
Tj = +12 °C	*Pdh*	4,3	kW	Tj = +12 °C	*PERd*	118	%
T_j = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
Annual energy consumption	Q_{HE}	207	GJ				
COLDER CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	26,7	kW	**Seasonal space heating energy efficiency**	η_s	105	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7 °C	*Pdh*	16,3	kW	Tj = -7 °C	*PERd*	103	%
Tj = +2 °C	*Pdh*	9,9	kW	Tj = +2 °C	*PERd*	116	%
Tj = +7 °C	*Pdh*	6,4	kW	Tj = +7 °C	*PERd*	114	%
Tj = +12 °C	*Pdh*	2,9	kW	Tj = +12 °C	*PERd*	112	%
Tj = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
T_j = operation limit temperature	*Pdh*	26,7	kW	Tj = operation limit temperature	*PERd*	89	%
For air-to-water heat pumps: T_j = –15 °C (if TOL < –20 °C)	*Pdh*	21,9	kW	For air-to-water heat pumps: Tj = –15 °C (if TOL < –20 °C)	*PERd*	92	%
Annual energy consumption	Q_{HE}	242	GJ				
WARMER CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	32,6	kW	**Seasonal space heating energy efficiency**	η_s	120	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = +2 °C	*Pdh*	32,6	kW	Tj = +2 °C	*PERd*	121	%
Tj = +7 °C	*Pdh*	20,9	kW	Tj = +7 °C	*PERd*	128	%
Tj = +12 °C	*Pdh*	9,5	kW	Tj = +12 °C	*PERd*	111	%
Tj = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
Annual energy consumption	Q_{HE}	141	GJ				

Figure 4.2

Bivalent temperature	T_{biv}	TOL < $T_{designh}$	°C	For air-to-water heat pumps: Operation limit temperature	*TOL*	-22	°C
				Heating water operating limit temperature	*WTOL*	60	°C
Power consumption in modes other than active mode				Supplementary heater			
Off mode	P_{OFF}	0,000	kW	Rated heat output	*Psup*	-	kW
Thermostat-off mode	P_{TO}	0,023	kW	Type of energy input		monovalent	
Standby mode	P_{SB}	0,007	kW				
Crankcase heater mode	P_{CK}	-	kW				
Other items							
Capacity control		fixed		For air-to-water heat pumps: Rated air flow rate, outdoors	—	11000	m^3/h
Sound power level, indoors/ outdoors	L_{WA}	- / 80	dB	For water- or brine-to-water heat pumps: Rated brine or water flow rate, outdoor heat exchanger	—	-	m^3/h

(*) For heat pump space heaters and heat pump combination heaters, the rated heat output *Prated* is equal to the design load for heating *Pdesignh*, and the rated heat output of a supplementary heater *Psup* is equal to the supplementary capacity for heating *sup(Tj)*.

Additional information required by COMMISSION REGULATION (EU) No 813/2013, Table 2:

Emissions of nitrogen oxides:	NO_x	48	mg/kWh

5 GAHP-AR S

Figure 5.1

Table 8

COMMISSION DELEGATED REGULATION (EU) No 811/2013

Technical parameters for heat pump space heaters and heat pump combination heaters

Model(s):	GAHP-AR S
Air-to-water heat pump:	yes
Water-to-water heat pump:	no
Brine-to-water heat pump:	no
Low-temperature heat pump:	no
Equipped with a supplementary heater:	no
Heat pump combination heater:	no
Parameters shall be declared for medium-temperature application.	
Parameters shall be declared for average, colder and warmer climate conditions.	

Item	Symbol	Value	Unit	Item	Symbol	Value	Unit
AVERAGE CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	28,4	kW	**Seasonal space heating energy efficiency**	η_s	111	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7 °C	*Pdh*	25,0	kW	Tj = -7 °C	*PERd*	94	%
Tj = +2 °C	*Pdh*	15,3	kW	Tj = +2 °C	*PERd*	119	%
Tj = +7 °C	*Pdh*	9,9	kW	Tj = +7 °C	*PERd*	118	%
Tj = +12 °C	*Pdh*	4,3	kW	Tj = +12 °C	*PERd*	121	%
T_j = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
Annual energy consumption	Q_{HE}	207	GJ				
COLDER CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	26,7	kW	**Seasonal space heating energy efficiency**	η_s	105	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7 °C	*Pdh*	16,3	kW	Tj = -7 °C	*PERd*	103	%
Tj = +2 °C	*Pdh*	9,9	kW	Tj = +2 °C	*PERd*	116	%
Tj = +7 °C	*Pdh*	6,4	kW	Tj = +7 °C	*PERd*	114	%
Tj = +12 °C	*Pdh*	2,9	kW	Tj = +12 °C	*PERd*	112	%
Tj = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
T_j = operation limit temperature	*Pdh*	26,7	kW	Tj = operation limit temperature	*PERd*	89	%
For air-to-water heat pumps: T_j = –15 °C (if TOL < –20 °C)	*Pdh*	21,9	kW	For air-to-water heat pumps: Tj = –15 °C (if TOL < –20 °C)	*PERd*	92	%
Annual energy consumption	Q_{HE}	242	GJ				
WARMER CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	32,6	kW	**Seasonal space heating energy efficiency**	η_s	120	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = +2 °C	*Pdh*	32,6	kW	Tj = +2 °C	*PERd*	121	%
Tj = +7 °C	*Pdh*	20,9	kW	Tj = +7 °C	*PERd*	120	%
Tj = +12 °C	*Pdh*	9,5	kW	Tj = +12 °C	*PERd*	113	%
Tj = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
Annual energy consumption	Q_{HE}	141	GJ				

Figure 5.2

Bivalent temperature	T_{biv}	TOL < $T_{designh}$	°C	For air-to-water heat pumps: Operation limit temperature		*TOL*	-22	°C
				Heating water operating limit temperature		*WTOL*	60	°C
Power consumption in modes other than active mode				Supplementary heater				
Off mode	P_{OFF}	0,000	kW	Rated heat output		*Psup*	-	kW
Thermostat-off mode	P_{TO}	0,023	kW					
Standby mode	P_{SB}	0,007	kW	Type of energy input		monovalent		
Crankcase heater mode	P_{CK}	-	kW					
Other items								
Capacity control		fixed		For air-to-water heat pumps: Rated air flow rate, outdoors		—	11000	m³/h
Sound power level, indoors/ outdoors	L_{WA}	- / 75	dB	For water- or brine-to-water heat pumps: Rated brine or water flow rate, outdoor heat exchanger		—	-	m³/h

(*) For heat pump space heaters and heat pump combination heaters, the rated heat output *Prated* is equal to the design load for heating *Pdesignh*, and the rated heat output of a supplementary heater *Psup* is equal to the supplementary capacity for heating *sup(Tj)*.

Additional information required by COMMISSION REGULATION (EU) No 813/2013, Table 2:

Emissions of nitrogen oxides:	NO_x	48	mg/kWh

6 GAHP GS

Figure 6.1

Table 8

COMMISSION DELEGATED REGULATION (EU) No 811/2013

Technical parameters for heat pump space heaters and heat pump combination heaters

Model(s):				GAHP GS			
Air-to-water heat pump:				no			
Water-to-water heat pump:				no			
Brine-to-water heat pump:				yes			
Low-temperature heat pump:				no			
Equipped with a supplementary heater:				no			
Heat pump combination heater:				no			
Parameters shall be declared for medium-temperature application.							
Parameters shall be declared for average, colder and warmer climate conditions.							
Item	**Symbol**	**Value**	**Unit**	**Item**	**Symbol**	**Value**	**Unit**
AVERAGE CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	37,4	kW	**Seasonal space heating energy efficiency**	η_s	125	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7 °C	*Pdh*	32,9	kW	Tj = -7 °C	*PERd*	128	%
Tj = +2 °C	*Pdh*	20,2	kW	Tj = +2 °C	*PERd*	130	%
Tj = +7 °C	*Pdh*	13,1	kW	Tj = +7 °C	*PERd*	128	%
Tj = +12 °C	*Pdh*	5,6	kW	Tj = +12 °C	*PERd*	123	%
T_j = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
Annual energy consumption	Q_{HE}	223	GJ				
COLDER CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	37,4	kW	**Seasonal space heating energy efficiency**	η_s	124	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7 °C	*Pdh*	22,8	kW	Tj = -7 °C	*PERd*	129	%
Tj = +2 °C	*Pdh*	13,8	kW	Tj = +2 °C	*PERd*	128	%
Tj = +7 °C	*Pdh*	9,0	kW	Tj = +7 °C	*PERd*	126	%
Tj = +12 °C	*Pdh*	4,1	kW	Tj = +12 °C	*PERd*	122	%
Tj = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
T_j = operation limit temperature	*Pdh*	37,4	kW	Tj = operation limit temperature	*PERd*	128	%
For air-to-water heat pumps: T_j = –15 °C (if TOL < –20 °C)	*Pdh*	30,7	kW	For air-to-water heat pumps: Tj = –15 °C (if TOL < –20 °C)	*PERd*	128	%
Annual energy consumption	Q_{HE}	268	GJ				
WARMER CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	37,4	kW	**Seasonal space heating energy efficiency**	η_s	124	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = +2 °C	*Pdh*	37,4	kW	Tj = +2 °C	*PERd*	128	%
Tj = +7 °C	*Pdh*	23,9	kW	Tj = +7 °C	*PERd*	129	%
Tj = +12 °C	*Pdh*	10,9	kW	Tj = +12 °C	*PERd*	127	%
Tj = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
Annual energy consumption	Q_{HE}	145	GJ				

Figure 6.2

Bivalent temperature	T_{biv}	TOL < $T_{designh}$	°C		For air-to-water heat pumps: Operation limit temperature	*TOL*	-	°C
					Heating water operating limit temperature	*WTOL*	65	°C
Power consumption in modes other than active mode					Supplementary heater			
Off mode	P_{OFF}	0,000	kW		Rated heat output	*Psup*	-	kW
Thermostat-off mode	P_{TO}	0,019	kW		Type of energy input	monovalent		
Standby mode	P_{SB}	0,005	kW					
Crankcase heater mode	P_{CK}	-	kW					
Other items								
Capacity control	variable				For air-to-water heat pumps: Rated air flow rate, outdoors	—	-	m³/h
Sound power level, indoors/ outdoors	L_{WA}	- / 66	dB		For water- or brine-to-water heat pumps: Rated brine or water flow rate, outdoor heat exchanger	—	3,0	m³/h

(*) For heat pump space heaters and heat pump combination heaters, the rated heat output *Prated* is equal to the design load for heating *Pdesignh*, and the rated heat output of a supplementary heater *Psup* is equal to the supplementary capacity for heating *sup(Tj)*.

Additional information required by COMMISSION REGULATION (EU) No 813/2013, Table 2:

Emissions of nitrogen oxides:	NO_x	40	mg/kWh

7 GAHP WS

Figure 7.1

Table 8

COMMISSION DELEGATED REGULATION (EU) No 811/2013

Technical parameters for heat pump space heaters and heat pump combination heaters

Model(s):	GAHP WS
Air-to-water heat pump:	no
Water-to-water heat pump:	yes
Brine-to-water heat pump:	no
Low-temperature heat pump:	no
Equipped with a supplementary heater:	no
Heat pump combination heater:	no

Parameters shall be declared for medium-temperature application.

Parameters shall be declared for average, colder and warmer climate conditions.

Item	Symbol	Value	Unit	Item	Symbol	Value	Unit
AVERAGE CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	41,5	kW	**Seasonal space heating energy efficiency**	η_s	127	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7 °C	*Pdh*	36,5	kW	Tj = -7 °C	*PERd*	139	%
Tj = +2 °C	*Pdh*	22,4	kW	Tj = +2 °C	*PERd*	135	%
Tj = +7 °C	*Pdh*	14,5	kW	Tj = +7 °C	*PERd*	127	%
Tj = +12 °C	*Pdh*	6,2	kW	Tj = +12 °C	*PERd*	121	%
T_j = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
Annual energy consumption	Q_{HE}	243	GJ				
COLDER CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	41,5	kW	**Seasonal space heating energy efficiency**	η_s	125	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7 °C	*Pdh*	25,3	kW	Tj = -7 °C	*PERd*	135	%
Tj = +2 °C	*Pdh*	15,4	kW	Tj = +2 °C	*PERd*	128	%
Tj = +7 °C	*Pdh*	10,0	kW	Tj = +7 °C	*PERd*	124	%
Tj = +12 °C	*Pdh*	4,6	kW	Tj = +12 °C	*PERd*	119	%
Tj = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
T_j = operation limit temperature	*Pdh*	41,5	kW	Tj = operation limit temperature	*PERd*	142	%
For air-to-water heat pumps: T_j = –15 °C (if TOL < –20 °C)	*Pdh*	34,0	kW	For air-to-water heat pumps: Tj = –15 °C (if TOL < –20 °C)	*PERd*	138	%
Annual energy consumption	Q_{HE}	294	GJ				
WARMER CLIMATE CONDITIONS							
Rated heat output (*)	*Prated*	41,5	kW	**Seasonal space heating energy efficiency**	η_s	126	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature Tj				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj = +2 °C	*Pdh*	41,5	kW	Tj = +2 °C	*PERd*	142	%
Tj = +7 °C	*Pdh*	26,6	kW	Tj = +7 °C	*PERd*	136	%
Tj = +12 °C	*Pdh*	12,0	kW	Tj = +12 °C	*PERd*	125	%
Tj = bivalent temperature	*Pdh*	-	kW	Tj = bivalent temperature	*PERd*	-	%
Annual energy consumption	Q_{HE}	158	GJ				

Figure 7.2

Bivalent temperature	T_{biv}	TOL < $T_{designh}$	°C	For air-to-water heat pumps: Operation limit temperature	*TOL*	-	°C
				Heating water operating limit temperature	*WTOL*	65	°C
Power consumption in modes other than active mode				Supplementary heater			
Off mode	P_{OFF}	0,000	kW	Rated heat output	*Psup*	-	kW
Thermostat-off mode	P_{TO}	0,019	kW				
Standby mode	P_{SB}	0,005	kW	Type of energy input	monovalent		
Crankcase heater mode	P_{CK}	-	kW				
Other items							
Capacity control	variable			For air-to-water heat pumps: Rated air flow rate, outdoors	—	-	m³/h
Sound power level, indoors/ outdoors	L_{WA}	- / 66	dB	For water- or brine-to-water heat pumps: Rated brine or water flow rate, outdoor heat exchanger	—	2,9	m³/h

(*) For heat pump space heaters and heat pump combination heaters, the rated heat output *Prated* is equal to the design load for heating *Pdesignh*, and the rated heat output of a supplementary heater *Psup* is equal to the supplementary capacity for heating *sup(Tj)*.

Additional information required by COMMISSION REGULATION (EU) No 813/2013, Table 2:

Emissions of nitrogen oxides:	NO_x	40	mg/ kWh

8 AY00-120

Figure 8.1

Table 7

COMMISSION DELEGATED REGULATION (EU) No 811/2013

Technical parameters for boiler space heaters, boiler combination heaters and cogeneration space heaters

Model(s):				AY120			
Condensing boiler:				yes			
Low-temperature (**) boiler:				no			
B11 boiler:				no			
Cogeneration space heater:		no		If yes, equipped with a supplementary heater:		no	
Combination heater:				no			
Item	**Symbol**	**Value**	**Unit**	**Item**	**Symbol**	**Value**	**Unit**
Rated heat output	*Prated*	34,9	kW	**Seasonal space heating energy efficiency**	η_s	90,7	%
For boiler space heaters and boiler combination heaters: Useful heat output				For boiler space heaters and boiler combination heaters: Useful efficiency			
At rated heat output and high-temperature regime (*)	P_4	34,4	kW	At rated heat output and high-temperature regime (*)	η_4	98,6	%
At 30 % of rated heat output and low-temperature regime (**)	P_1	8,6	kW	At 30 % of rated heat output and low-temperature regime (**)	η_1	107,5	%
Auxiliary electricity consumption				Other items			
At full load	*elmax*	0,185	kW	Standby heat loss	P_{stby}	0,058	kW
At part load	*elmin*	0,080	kW	Ignition burner power consumption	P_{ign}	0	kW
In standby mode	P_{SB}	0,005	kW	Annual energy consumption	Q_{HE}	286,2	GJ
				Sound power level, indoors	L_{WA}	- / 57,0	dB

(*) High-temperature regime means 60 °C return temperature at heater inlet and 80 °C feed temperature at heater outlet.

(**) Low temperature means for condensing boilers 30 °C, for low-temperature boilers 37 °C and for other heaters 50 °C return temperature (at heater inlet).

Additional information required by COMMISSION REGULATION (EU) No 813/2013, Table 1:

Emissions of nitrogen oxides:	NO_x	31	mg/kWh

9 DDC PANEL

Figure 9.1 *DDC Technical Data Sheets*

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IT	:	REGOLAMENTO DELEGATO (UE) N. 811/2013 DELLA COMMISSIONE	DISPOSITIVI DI CONTROLLO DELLA TEMPERATURA
EN	:	COMMISSION DELEGATED REGULATION (EU) No 811/2013	TEMPERATURE CONTROLS
FR	:	RÈGLEMENT DÉLÉGUÉ (UE) N o 811/2013 DE LA COMMISSION	RÉGULATEURS DE TEMPÉRATURE
DE	:	DELEGIERTE VERORDNUNG (EU) Nr. 811/2013 DER KOMMISSION	TEMPERATURREGLER
NL	:	GEDELEGEERDE VERORDENING (EU) Nr. 811/2013 VAN DE COMMISSIE	TEMPERATUURREGELAARS
CS	:	NAŘÍZENÍ KOMISE V PŘENESENÉ PRAVOMOCI (EU) č. 811/2013	REGULÁTORY TEPLOTY
PL	:	ROZPORZĄDZENIE DELEGOWANE KOMISJI (UE) NR 811/2013	REGULATORY TEMPERATURY

IT	Il nome o marchio del fornitore	L'identificativo del modello del fornitore	La classe del dispositivo di controllo della temperatura	Il contributo del dispositivo di controllo della temperatura all'efficienza energetica stagionale di riscaldamento d'ambiente in %, arrotondata alla cifra intera più vicina
EN	Supplier's name or trade mark	Supplier's model identifier	The class of the temperature control	The contribution of the temperature control to seasonal space heating energy efficiency in %, rounded to one decimal place
FR	Le nom du fournisseur ou la marque commerciale	La référence du modèle donnée par le fournisseur	La classe du régulateur de température	La contribution du régulateur de température à l'efficacité énergétique saisonnière pour le chauffage des locaux, en %, arrondie à la première décimale
DE	Name oder Warenzeichen des Lieferanten	Modellkennung des Lieferanten	Die Klasse des Temperaturreglers	Beitrag des Temperaturreglers zur jahreszeitbedingten Raumheizungs-Energieeffizienz in Prozent, auf eine Dezimalstelle gerundet
NL	De naam van de leverancier of het handelsmerk	De typeaanduiding van de leverancier	De klasse van de temperatuurregelaar	De bijdrage van de temperatuurregelaar aan de seizoensgebonden energie-efficiëntie voor ruimteverwarming in %, afgerond tot op één decimaal
CS	Název nebo ochranná známka dodavatele	Identifikační značka modelu používaná dodavatelem	Třída regulátoru teploty	Přínos regulátoru teploty k sezonní energetické účinnosti vytápění, vyjádřený v % a zaokrouhlený na jedno desetinné místo
PL	Nazwa dostawcy lub jego znak towarowy	Identyfikator modelu dostawcy	Klasa regulatora temperatury	Udział regulatora temperatury w sezonowej efektywności energetycznej ogrzewania pomieszczeń w %, w zaokrągleniu do jednego miejsca po przecinku
	Robur	**DDC**	**III**	**2%**

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10 CCI PANEL

Figure 10.1 *Fiches Tecniche CCI*

ROBUR
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IT	:	REGOLAMENTO DELEGATO (UE) N. 811/2013 DELLA COMMISSIONE	DISPOSITIVI DI CONTROLLO DELLA TEMPERATURA
EN	:	COMMISSION DELEGATED REGULATION (EU) No 811/2013	TEMPERATURE CONTROLS
FR	:	RÈGLEMENT DÉLÉGUÉ (UE) N o 811/2013 DE LA COMMISSION	RÉGULATEURS DE TEMPÉRATURE
DE	:	DELEGIERTE VERORDNUNG (EU) Nr. 811/2013 DER KOMMISSION	TEMPERATURREGLER
NL	:	GEDELEGEERDE VERORDENING (EU) Nr. 811/2013 VAN DE COMMISSIE	TEMPERATUURREGELAARS
CS	:	NAŘÍZENÍ KOMISE V PŘENESENÉ PRAVOMOCI (EU) č. 811/2013	REGULÁTORY TEPLOTY
PL	:	ROZPORZĄDZENIE DELEGOWANE KOMISJI (UE) NR 811/2013	REGULATORY TEMPERATURY

IT	Il nome o marchio del fornitore	L'identificativo del modello del fornitore	La classe del dispositivo di controllo della temperatura	Il contributo del dispositivo di controllo della temperatura all'efficienza energetica stagionale di riscaldamento d'ambiente in %, arrotondata alla cifra intera più vicina
EN	Supplier's name or trade mark	Supplier's model identifier	The class of the temperature control	The contribution of the temperature control to seasonal space heating energy efficiency in %, rounded to one decimal place
FR	Le nom du fournisseur ou la marque commerciale	La référence du modèle donnée par le fournisseur	La classe du régulateur de température	La contribution du régulateur de température à l'efficacité énergétique saisonnière pour le chauffage des locaux, en %, arrondie à la première décimale
DE	Name oder Warenzeichen des Lieferanten	Modellkennung des Lieferanten	Die Klasse des Temperaturreglers	Beitrag des Temperaturreglers zur jahreszeitbedingten Raumheizungs-Energieeffizienz in Prozent, auf eine Dezimalstelle gerundet
NL	De naam van de leverancier of het handelsmerk	De typeaanduiding van de leverancier	De klasse van de temperatuurregelaar	De bijdrage van de temperatuurregelaar aan de seizoensgebonden energie-efficiëntie voor ruimteverwarming in %, afgerond tot op één decimaal
CS	Název nebo ochranná známka dodavatele	Identifikační značka modelu používaná dodavatelem	Třída regulátoru teploty	Přínos regulátoru teploty k sezonní energetické účinnosti vytápění, vyjádřený v % a zaokrouhlený na jedno desetinné místo
PL	Nazwa dostawcy lub jego znak towarowy	Identyfikator modelu dostawcy	Klasa regulatora temperatury	Udział regulatora temperatury w sezonowej efektywności energetycznej ogrzewania pomieszczeń w %, w zaokrągleniu do jednego miejsca po przecinku
	Robur	**CCI**	**III**	**2%**

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11 BUFFER TANKS AND DHW TANKS

Table 11.1 *Buffer tanks and DHW tanks*

Item code	Description	Loss (W)	Loss (kWh/24h)	Specific loss (W/K)	Volume (l)	Energy efficiency class
OSRB000	300-litre thermal tank	90	2,24	2,07	270	C
OSRB001	500-litre thermal tank	126	3,02	2,79	476	D
OSRB004	300-litre DHW tank	85	2,03	1,88	263	C
OSRB005	500-litre DHW tank	130	3,13	2,90	470	D
OSRB006	500-litre DHW tank with integrated coil	130	3,13	2,90	470	D

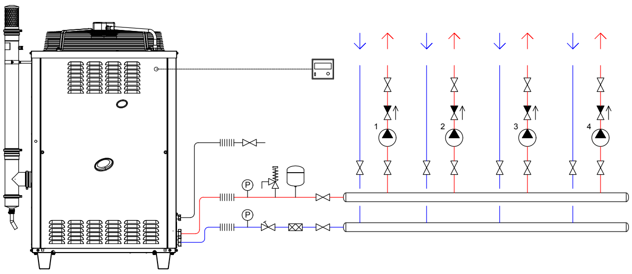
SECTION C02 INDEX

1 FLOW BALANCING

After the sizing of the generating system and the choice of distribution terminals has been completed, it is advisable to carefully consider that the system currently in the design does not present any interference between the hydraulic circuits such as to alter the setpoint in comparison with the regulation systems, resulting in reduced comfort, efficiency and even the life of the components of the system.
Referring to the system shown in Figure 1.1 *p. 1* the following occurs:

- at the system off, the output and return manifold pressures will be identical, so the Δp between the manifolds will be zero;
- When the first delivery is activated, a pressure differential will be created, equal to the pressure drop through the generator. Check valves are essential to prevent the risk of reverse flow on inactive delivery;
- The activation of subsequent delivery entails an increase in the water flow rate on the generator and as a consequence of the pressure drops, with the risk that they become so high that it will not allow the delivery pumps to function properly.

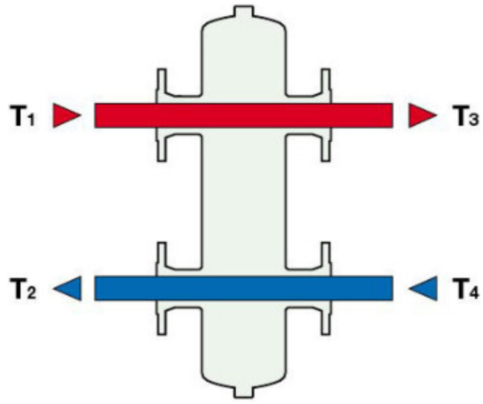
Figure 1.1 *System without hydraulic separator*



In general these systems characterized by strong imbalances in the flow rates are unlikely to work under the design conditions and therefore to ensure efficiency and comfort.
The hydraulic separator, referred to in Section C1.08, is the component commonly used to avoid interference between the hydraulic circuits, precisely because it allows constant working with null Δp between the manifolds.
However, careful balancing of the water flow between the primary and the secondary must be carefully considered, as inadequate balancing can trigger flow mixing phenomena, resulting in temperature changes.
In the optimal case the flow rates are perfectly balanced (see Figure 1.2 *p. 1*) and the primary and secondary temperatures are identical (T1 = T3 and T2 = T4).
Mixing becomes influential when the difference between primary and secondary flow exceeds 10%.
In this case two scenarios may occur:

- Primary flow rate lower than secondary flow rate (secondary recirculation)
- Primary flow rate higher than secondary flow rate (primary recirculation)

Figure 1.2 *Balanced separator*

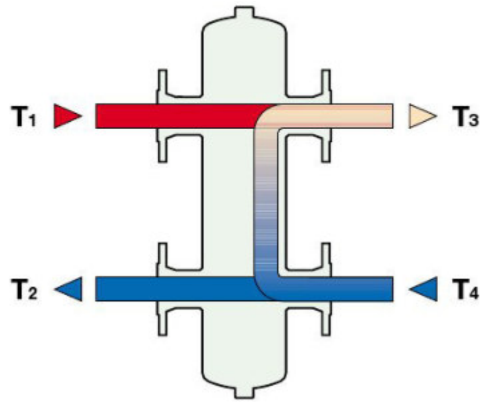


T1	Primary delivery temperature
T2	Primary return temperature
T3	Secondary delivery temperature
T3	Secondary return temperature

1.1 PRIMARY FLOW RATE LOWER THAN SECONDARY FLOW RATE

In this case, as shown in Figure 1.3 *p. 1*, the primary flow rate is lower than that of the secondary and there is partial recirculation of the secondary return flow, with consequent lowering of the delivery temperature T3 to the secondary as a result of mixing.

Figure 1.3 *Primary flow rate lower than secondary flow rate*



T1	Primary delivery temperature
T2	Primary return temperature
T3	Secondary delivery temperature
T3	Secondary return temperature

In this scenario, therefore:

- The delivery temperature T3 at the secondary is lower than the primary delivery temperature T1;
- The return temperature T2 of the primary and T4 of the secondary coincides.

These are the possible consequences:

- Reduction in the efficiency of the generating system due to the power generation at higher temperature needed to compensate for mixing;
- Potential reduction in comfort for utilities, due to the lower supply temperature of the emission devices, which therefore also significantly reduce heat exchange.

This case typically occurs when the secondary circuit works with a thermal leap lower than the primary circuit.

In the worst case scenario, GAHP units can work at maximum temperature, but the serviced users still experience the cold feeling due to inefficient heat exchange due to temperature drop.

Reduced thermal exchange could easily also lead to a reduction in the thermal leap on the secondary, hence a return temperature increase and, ultimately, to the shutdown of the units for limit thermostating for return temperature too high.

The Table 1.1 *p. 2* shows the maximum temperatures that can be reached by the Robur units.

Table 1.1 *GAHP heating temperature limits*

			GAHP A	GAHP-AR	GAHP GS/WS	AY00-120
Heating mode						
Hot water delivery temperature	maximum for heating	°C	65	-	65	-
	maximum	°C	-	60	-	80
Hot water return temperature	maximum for heating	°C	55	-	55	-
	maximum	°C	-	50	-	70

To calculate the amount of lowering of the delivery temperature to the secondary, it is sufficient to determine the thermal leap Δt on the secondary, based on the flow rate and the power generated by the primary, according to the relationship:

$Q = m \cdot cp \cdot \Delta t$

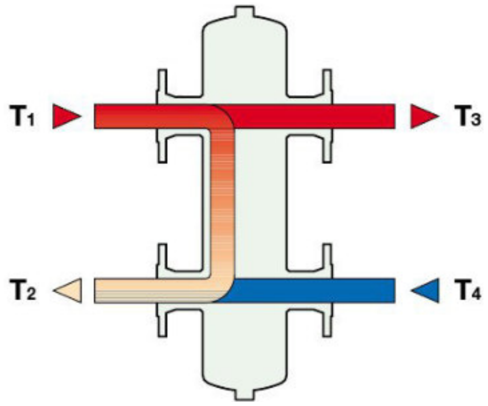
Where Q is the power generated in the primary expressed in [kW], m is the secondary water flow rate expressed in [kg/s], cp is the specific water heat in [kJ/kg ·°C] and Δt is the secondary thermal leap in [°C].

This thermal leap is added to the return temperature T4 of the secondary to determine the delivery temperature T3 of the secondary.

1.2 PRIMARY FLOW RATE HIGHER THAN SECONDARY FLOW RATE

In this case, as shown in Figure 1.4 *p. 2*, the primary flow rate is higher than that of the secondary and there is partial recirculation of the primary return flow, with a consequent increase in the return temperature T2 of primary due to mixing.

Figure 1.4 *Primary flow rate higher than secondary flow rate*



T1 Primary delivery temperature
T2 Primary return temperature
T3 Secondary delivery temperature
T3 Secondary return temperature

In this scenario, therefore:

- The delivery temperature T3 to the secondary is equal to the primary supply temperature T1;
- The return temperature T2 of the primary is higher than T4 of the secondary return.

These are the possible consequences:

- Significant reduction in the efficiency of the generation system due to the rise in the return temperature of the primary;
- Potential blocking of the Robur units for return thermostating;
- Heavy repercussions on comfort if the units reach the limit thermostating condition.

This case typically occurs when the secondary circuit works with a thermal leap higher than the primary circuit.

This involves the risk of rapidly reaching the thermostating condition on return temperature (see the Table 1.1 *p. 2*) and then switches off the units, even though there is a demand for service from the system, with heavy repercussions on the comfort of the users.

To calculate the magnitude of the rise in the primary return temperature, it is sufficient to determine the thermal leap Δt on the primary, based on its flow rate and the power absorbed by the secondary, according to the relationship:

$Q = m \cdot cp \cdot \Delta t$

Where Q is the power absorbed by the secondary expressed in [kW], m is the water flow rate of the primary expressed in [kg/s], cp is the specific heat of water in [kJ/kg ·°C] and Δt is the primary thermal leap in [°C].

This thermal leap is subtracted from the primary delivery temperature T1 to determine the primary return temperature T2.

2 HOW TO MAKE BALANCING

The guidelines to ensure that the system is properly balanced can be summarized as follows:

- Check the water flow of the Robur units on the technical data tables (see Section B);
- Pay attention to the fact that water flow rates for heating and conditioning are usually very similar;
- Pay attention to the fact that the thermal leap for the heating service is 10 °C, while the one for the cooling service is 5 °C