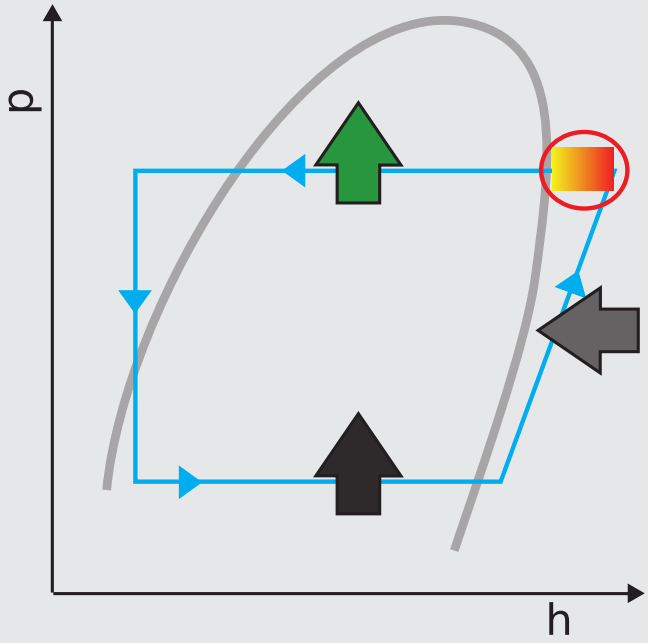
G.I. INDUSTRIAL HOLDING SPA

Installation, use and maintenance manual



Heat recovery

DS - HRT/P

CLINT

SUMMARY

1 INTRODUCTION

Refrigeration units used for air conditioning in an enclosed space operate by dissipating thermal energy, in the form of heat, to the external environment. Such units, if properly set up, can recover part or all of the waste heat.

- When the waste heat is partially recovered, we refer to a unit with DESUPERHEATER.
- When, on the other hand, the waste heat is fully recovered we refer to a unit with TOTAL HEAT RECOVERY.

Recovered heat can be used for various plant engineering purposes, such as storing hot water in a tank or in post-heating coils for air conditioning systems.

Partial and total heat recovery can be provided both on air-cooled and water-cooled units.

Heat recovery is only possible simultaneously with the production of chilled water on the user side. In particular, heat recovery in reversible units on the refrigerant side is possible only when the unit is operating in summer mode.

The controller that manages the heat recovery functionality is an ADDITIONAL BOARD inside the unit's electrical panel.

Access to the electrical panel is only allowed to highly trained and risk-informed personnel.

Legenda

Accessory	Description
DS	Desuperheater
HRT/P	Total heat recovery in parallel

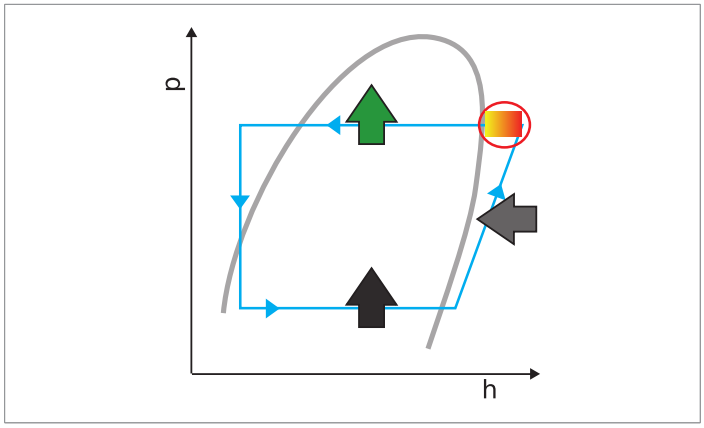
2 DESUPERHEATER - PARTIAL HEAT RECOVERY

2.1 Features

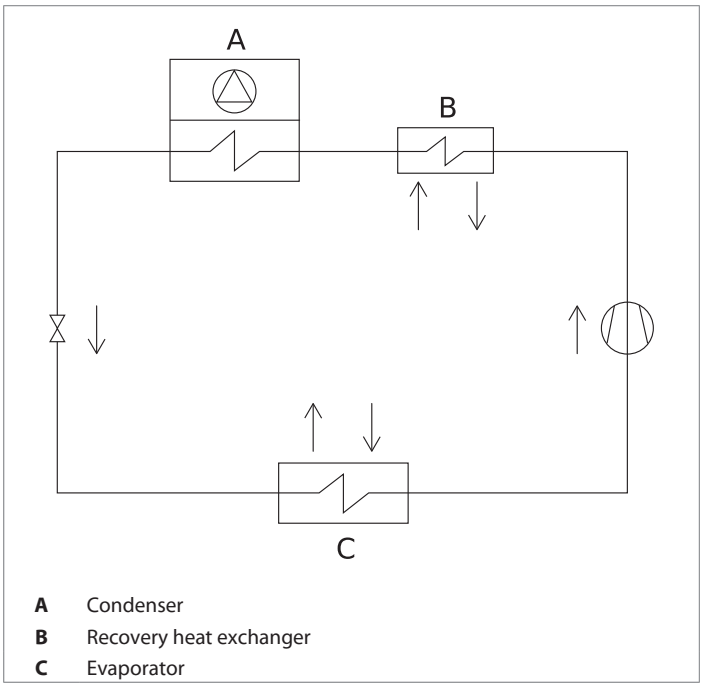
A refrigeration unit equipped with a DESUPERHEATER is equipped with an additional heat exchanger placed in an intermediate position between the compressor discharge and the condenser.

- Heat recovery exchanger in series with the compressor and before the condenser.
- The capacity recovered is indicatively between 10% and 30% of the waste heat.
- Variability of recovered capacity depends on operating conditions and type of refrigerant.

Pressure-Enthalpy chart
DESUPERHEATING LOAD



Refrigerant circuit



A Condenser
B Recovery heat exchanger
C Evaporator

Desuperheater is specified in the description of the units by the abbreviations DS or HR depending on the model.

Energy can only be recovered when the compressors are switched on and simultaneously producing chilled water in the main heat exchanger.

It is not possible to recover heat independently of chilled water production.

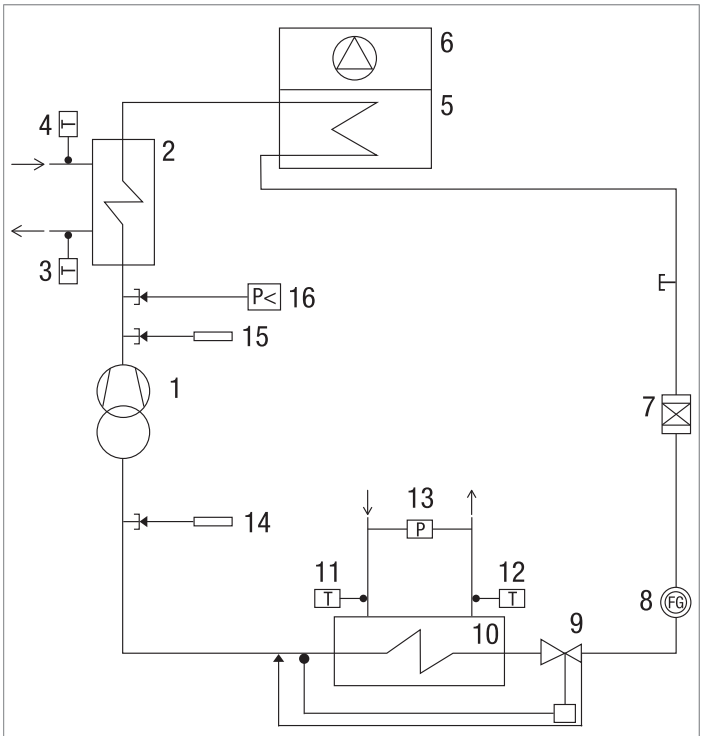
The desuperheater recovers energy from the superheated refrigerant leaving the compressor and releases it to a fluid, usually water, which heats up.

The maximum recoverable energy is equal to the difference in energy between the superheated gas at the compressor outlet and the saturated gas at the start of condensation.

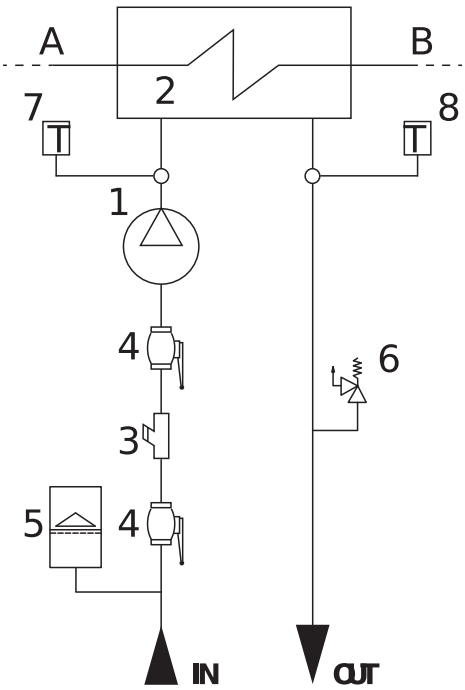
The recoverable energy is proportional to the mass flow rate of the refrigerant processed.

In summary, only the fraction of energy contained in the superheated gas is recovered.

The following is a typical diagram of the refrigeration circuit with the desuperheater indicated with the number “2”.



1 Compressor.
2 Desuperheater.
3 Recovery outlet water temperature probe.
4 Recovery inlet water temperature probe.
5 Coil.
6 Fans.
7 Filter drier.
8 Liquid indicator.
9 Expansion valve.
10 User heat exchanger.
11 User heat exchanger water outlet probe.
12 User heat exchanger water outlet probe.
13 Differential pressure switch.
14 Low pressure transducer.
15 High pressure transducer.
16 High pressure switch.



A Exchanger.
B Desuperheater.
1 Heat recovery circulating pump (not provided).
2 Total recovery heat exchanger.
3 Water filter (not supplied).
4 Shut-off valves (not provided).
5 Expansion vessel (not supplied).
6 Safety valve (not provided).
7 Recovery inlet water temperature probe.
8 Recovery outlet water temperature probe.

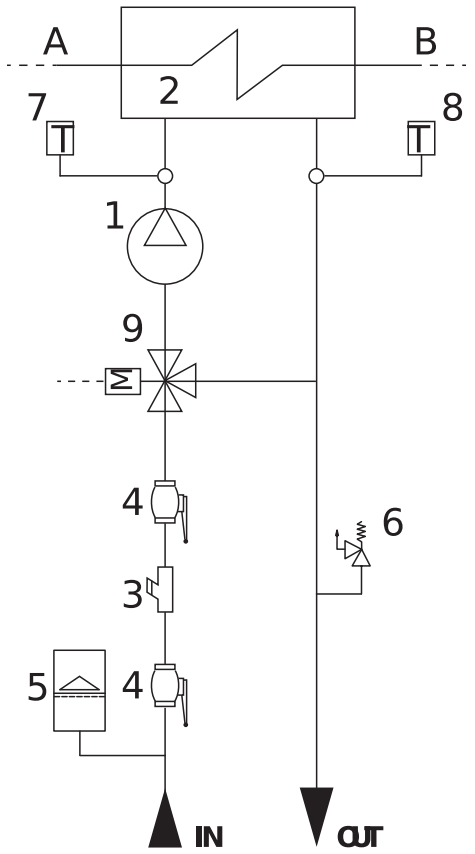
2.2 Hydraulic circuit for heat recovery.

The piping outside the unit is the responsibility of the installer and each component must be tested and suitable for the intended working conditions.

The following are two examples of recovery-side hydraulic system diagrams:

- Hydraulic circuit for heat recovery.
- Hydraulic circuit for heat recovery equipped with 3-way mixing valve for cold start.

The 3-way valve is not supplied, only a 0-10V signal is provided.



A Exchanger.
B Desuperheater.
1 Heat recovery circulating pump (not provided).
2 Total recovery heat exchanger.
3 Water filter (not supplied).
4 Shut-off valves (not provided).
5 Expansion vessel (not supplied).
6 Safety valve (not provided).
7 Recovery inlet water temperature probe.
8 Recovery outlet water temperature probe.
9 3-way mixing valve (not provided).

The proposed system diagrams are examples and purely indicative, they are not complete and have no design validity.

The user terminal can be a tank or a heat exchanger.

It is possible to circulate the water of the recovery circuit in a tank or inside the coil of a storage tank.

If the user terminal is a tank, consider a minimum of 10 l for each kW of heat output supplied by the heat recovery for its sizing. Sizing must be carried out in relation to the type of system.

If the water is sent to a heat exchanger, a storage tank ahead of the coil must be provided.

The minimum water temperature allowed at the inlet of the desuperheater is 25°C; lower temperatures may only be tolerated for limited periods.

It is forbidden to use heat recovery via open circuits.

It is forbidden to use heat recovery for direct domestic hot water production.

Temperatures in the desuperheater heat exchanger can exceed 100°C and therefore water may vapourise in the circuit.

The water contained in the desuperheater could heat up even with the recovery function disabled. This could trigger a natural circulation of water in the hydraulic circuit and a consequent heating of the entire water mass contained in the recovery hydraulic circuit.

All existing local regulations and laws governing hot water heating systems must be observed.

Provide a closed hydraulic circuit equipped with a hydraulic pump to circulate the fluid.

Check that all shut-off devices are open to allow free natural water circulation.

2.3 Operation

Units with desuperheater are equipped with certain functions managed by the unit controller which allow heat recovery, guaranteeing the reliability of the unit.

Special terminals are provided in the electrical panel, which must be used to manage the heat recovery:

- User heat recovery request: is a digital input through which the user can request the unit to allow and activate the recovery phase.
  - » CLOSED CONTACT: the unit is enabled for heat recovery.
  - » OPEN CONTACT: the unit excludes heat recovery.

The request can be controlled by a thermostat (not supplied).

- Heat recovery pump management: it's a digital output (free contact) that the user will use as a desuperheater pump consent. The contact responds to internal control rules (depending on the condensing pressure) and manages the start-up and shutdown of the hydraulic pump. A digital input is provided for the pump alarm in the electrical panel. The thermal alarm, if available on the recovery pump, can be connected to the appropriate input to handle this fault situation and exit the recovery function. The pump requires an external power supply.
- Heat recovery water inlet temperature probe: the temperature probe of the water entering the recovery exchanger is supplied with the unit.
- Heat recovery water inlet temperature probe: the temperature probe of the water entering the recovery exchanger is supplied with the unit.
- Analog output with 0-10V signal: The 0-10V signal is available, but optional in use. It is dedicated to driving a 3-way mixing valve that is modulated according to the temperature of the water entering the recuperator. The 3-way mixing valve installation is recommended in systems where cold starts and high inertia are critical.

Heat recovery is permitted if and only if:

- the user recovery request contact has been closed by the user;

- the desuperheater pump is switched on and is not in a fault or alarm situation. The controller activates the pump when the condensing pressure is above a minimum value defined in the parameterization; the parameter defining the minimum condensation threshold cannot be modified;
- the heat pump is in summer mode (chilled water production).

Heat recovery ceases when:
- the heat recovery request contact is open;
- the compressors are switched off;
- the request for chilled water supply to the main system ceases;
- the unit is in alarm;
- the heat recovery pump is in alarm;
- the condensing pressure falls below a threshold limit.

In air cooled units, the fan speed is modulated according to the operating conditions.

Operating with active partial heat recovery may lead to a change in the efficiency of the unit.

Units with desuperheater must be equipped with condensation control.

- For AIR-COOLED COOLING-ONLY UNITS, the CC – Condensation Control option must be selected:
  - » Fan speed controller: continuously regulates the fans rotation speed, decreasing or increasing it according to the refrigerant pressure measured by the pressure transducer. The speed of the fans is regulated continuously through phase cutting.
  - » Pressure transducer: positioned on the cooling circuit on the compressor discharge line, it measures the refrigerant pressure in the circuit.
  - » Electrical heater on electrical panel, with temperature sensor. Heats the control panel when temperature inside the electrical panel falls below preset levels, protecting it from freezing damage.
- For WATER COOLED UNITS, one of the following options must be selected on SOURCE SIDE:
  - » PV2 – 2-way electronic pressostatic valve (0-10V signal included - IVV)
  - » PV3 – 3-way electronic pressostatic valve (0-10V signal included - IVV)
  - » IVV - 0-10V signal for the management of the electronic pressostatic valve source side (valve supplied by the user).

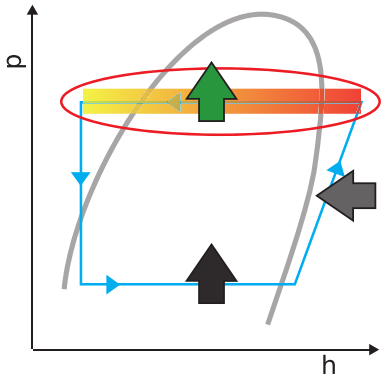
3 TOTAL HEAT RECOVERY IN PARALLEL

3.1 Features

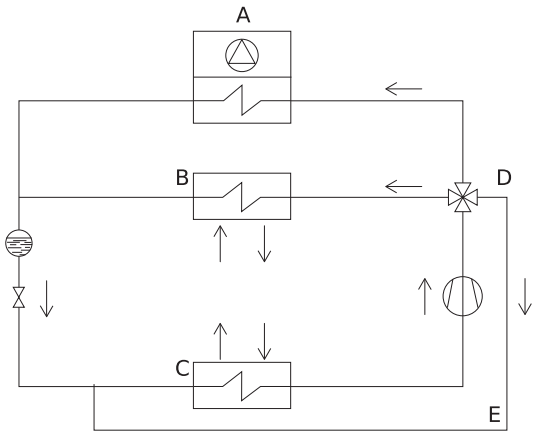
A refrigeration unit with TOTAL HEAT RECOVERY IN PARALLEL is equipped with an additional heat exchanger inserted in parallel to the condenser. A 4-way valve allows the refrigerant to be intercepted and diverted into the total recovery.

- Heat recovery exchanger in parallel to the condenser
- The recovered capacity is the total (100%) of the waste heat.

Pressure-Enthalpy chart
CONDENSING THERMAL LOAD



Refrigerant circuit



A Condenser
B Recovery heat exchanger
C Evaporator
D 4-way valve
E Equalization line

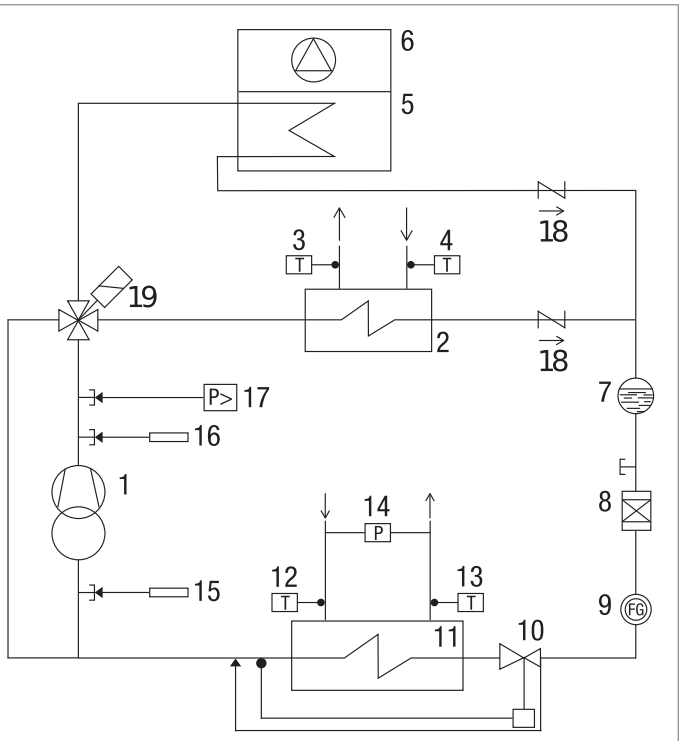
Total heat recovery in parallel is specified in the description of the units by the abbreviation HRT/P.

The total recovery exchanger is sized to be able to exchange with water the entire heat otherwise lost to the environment through the condenser; an air-water unit will therefore behave like a water-water unit in recovery operation.

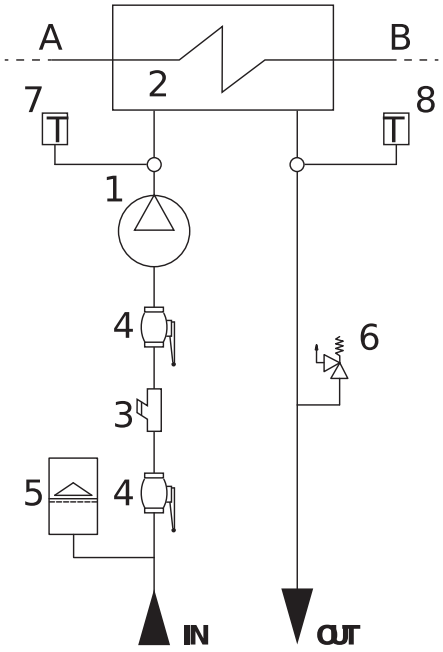
Energy can only be recovered when the compressors are switched on and simultaneously producing chilled water in the main heat exchanger.

It is not possible to recover heat independently of chilled water production.

Below is a typical diagram of the refrigeration circuit with the total recovery in parallel indicated by the number “2”.



1 Compressor.
2 Total heat recovery in parallel.
3 Recovery outlet water temperature probe.
4 Recovery inlet water temperature probe.
5 Coil.
6 Fans.
7 Liquid reciever.
8 Filter drier.
9 Liquid indicator.
10 Expansion valve.
11 User heat exchanger.
12 User heat exchanger water outlet probe.
13 User heat exchanger water outlet probe.
14 Differential pressure switch.
15 Low pressure transducer.
16 High pressure transducer.
17 High pressure switch.
18 Check valve.
19 4-way valve.



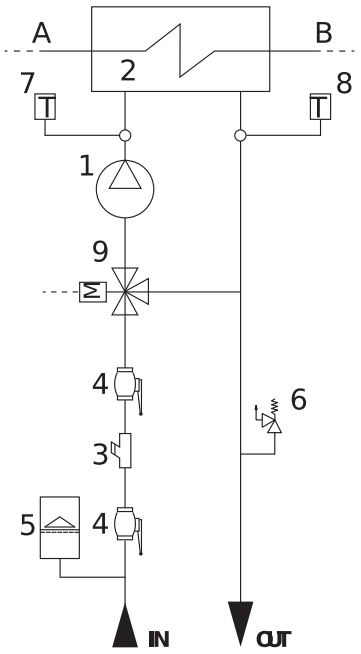
A Exchanger.
B Desuperheater.
1 Heat recovery circulating pump (not provided).
2 Total recovery heat exchanger.
3 Water filter (not supplied).
4 Shut-off valves (not provided).
5 Expansion vessel (not supplied).
6 Safety valve (not provided).
7 Recovery inlet water temperature probe.
8 Recovery outlet water temperature probe.

3.2 Hydraulic circuit for heat recovery.

The piping outside the unit is the responsibility of the installer and each component must be tested and suitable for the intended working conditions.

The following are two examples of recovery-side hydraulic system diagrams:

- Hydraulic circuit for heat recovery.
- Hydraulic circuit for heat recovery equipped with 3-way mixing valve for cold start.



A Exchanger.
B Desuperheater.
1 Heat recovery circulating pump (not provided).
2 Total recovery heat exchanger.
3 Water filter (not supplied).
4 Shut-off valves (not provided).
5 Expansion vessel (not supplied).
6 Safety valve (not provided).
7 Recovery inlet water temperature probe.
8 Recovery outlet water temperature probe.
9 3-way mixing valve (not provided).

The proposed system diagrams are examples and purely indicative, they are not complete and have no design validity.

The user terminal can be a tank or a heat exchanger.

With total heat recovery, do not circulate the water of the recovery circuit directly inside a coil.

If the user terminal is a tank, consider a minimum of 10 l for each kW of heat output supplied by the heat recovery for its sizing. Sizing must be carried out in relation to the type of system.

The water temperature probes located at the recovery inlet and recovery outlet are factory-fitted.

The minimum temperature allowed at the inlet of the total heat recovery is 25°C; lower temperatures may only be tolerated for limited periods.

If the recovery circuit is connected to a buffer tank, the use of a 3-way mixing valve is recommended if cold starts are possible. The 3-way valve is not provided; only a 0-10V signal is provided.

It is forbidden to use heat recovery via open circuits.

It is forbidden to use heat recovery for direct domestic hot water production.

It is forbidden to use the hydraulic circuit with the 3-way mixing valve for 2-circuit condenserless liquid chillers.

Temperatures in the recovery heat exchanger can exceed 100°C and therefore water may vapourise in the circuit.

The water contained in the desuperheater could heat up even with the recovery function disabled. This could trigger a natural circulation of water in the hydraulic circuit and a consequent heating of the entire water mass contained in the recovery hydraulic circuit.

All existing local regulations and laws governing hot water heating systems must be observed.

Provide a closed hydraulic circuit equipped with a hydraulic pump to circulate the fluid.

Check that all shut-off devices are open to allow free natural water circulation.

3.3 Operation

Units with total recovery are equipped with certain functions managed by the unit controller that allow heat recovery while guaranteeing the reliability of the unit.

Special terminals are provided in the electrical panel, which must be used to manage the heat recovery:

- User heat recovery request: is a digital input through which the user can request the unit to allow and activate the recovery phase.
  - » CLOSED CONTACT: the unit is enabled for heat recovery.
  - » OPEN CONTACT: the unit excludes heat recovery.
  - » The request can be controlled by a thermostat (not supplied).
- Heat recovery pump management: it's a digital output (free contact) that the user will use as a heat recovery pump consent. The contact responds to internal control rules (depending on the condensing pressure) and manages the start-up and shutdown of the hydraulic pump. A digital input is provided for the pump alarm in the electrical panel. The thermal alarm, if available on the recovery pump, can be connected to the appropriate input to handle this fault situation and exit the recovery function. The pump requires an external power supply.
- Heat recovery water inlet temperature probe: the temperature probe of the water entering the recovery exchanger is supplied with the unit.
- Heat recovery water inlet temperature probe: the temperature probe of the water entering the recovery exchanger is supplied with the unit.
- Analog output with 0-10V signal: The 0-10V signal is available, but optional in use. It is dedicated to driving a 3-way mixing valve that is modulated according to the temperature of the water entering the recuperator. The 3-way mixing valve installation is recommended in systems where cold starts and high inertia are critical.

TOTAL HEAT RECOVERY IN PARALLEL

Heat recovery is permitted if and only if:

- the user recovery request contact has been closed by the user;

- the total heat recovery pump is switched on and is not in a fault or alarm situation. The controller activates the pump when the condensing pressure is above a minimum value defined in the parameterization; the parameter defining the minimum condensation threshold cannot be modified.
- the heat pump is in summer mode (chilled water production).

Heat recovery ceases when:

- the heat recovery request contact is open;
- the compressors are switched off;
- the request for chilled water supply to the main system ceases;
- the unit is in alarm;
- the heat recovery pump is in alarm;
- the temperature at the heat recovery inlet is higher than a threshold set on the controller;
- the condensing pressure falls below a threshold limit.

If the 3-way mixing valve is present on heat recovery side, it will manage the initial transient to ensure a temperature above a minimum threshold at the recovery inlet.

For air cooled units, the fans will be switched off when the total heat recovery function is active.

The 4-way valve is energized when the total recovery phase is active. The 4-way valve diverts refrigerant to the total recovery exchanger. Conversely, if recovery is off, the 4-way valve is de-energized and the refrigerant is diverted to the condenser.

In some cases, the 4-way valve can be replaced with 2 motorised 2-way valves; when there are two 2-way valves in place of a 4-way valve, the valves are suitably installed to perform the same function.

Operating with active total heat recovery may lead to a change in the efficiency of the unit.

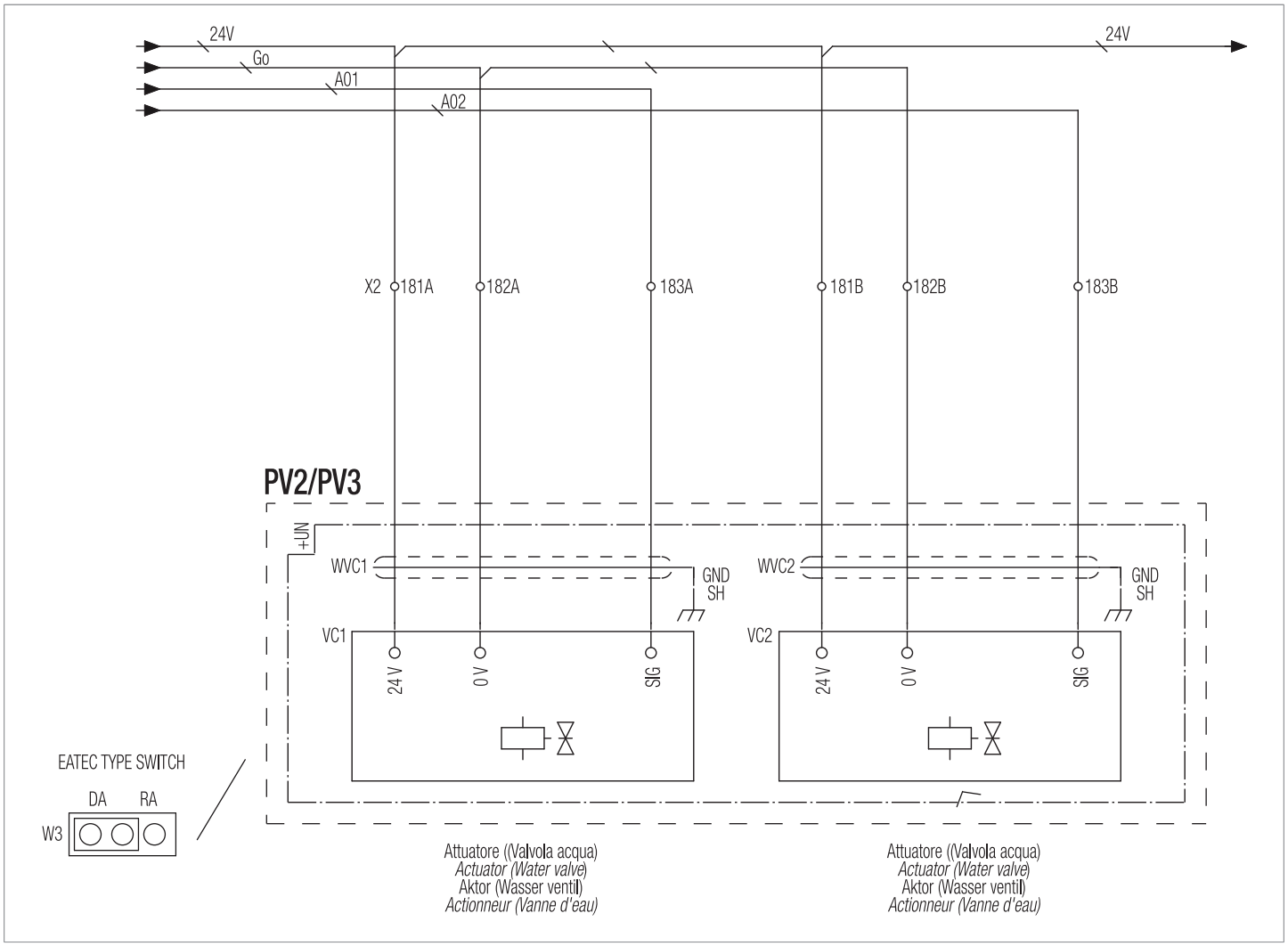
Units with total heat recovery must be equipped with condensation control.

- For AIR-COOLED COOLING-ONLY UNITS, the CC – Condensation Control option must be selected:
  - » Fan speed controller: continuously regulates the fans rotation speed, decreasing or increasing it according to the refrigerant pressure measured by the pressure transducer. The speed of the fans is regulated continuously through phase cutting.
  - » Pressure transducer: positioned on the cooling circuit on the compressor discharge line, it measures the refrigerant pressure in the circuit.
  - » Electrical heater on electrical panel, with temperature sensor. Heats the control panel when temperature inside the electrical panel falls below preset levels, protecting it from freezing damage.
- For WATER COOLED UNITS, one of the following options must be selected on SOURCE SIDE:
  - » PV2 – 2-way electronic pressostatic valve (0-10V signal included - IVV)
  - » PV3 – 3-way electronic pressostatic valve (0-10V signal included - IVV)
  - » IVV - 0-10V signal for the management of the electronic pressostatic valve source side (valve supplied by the user).

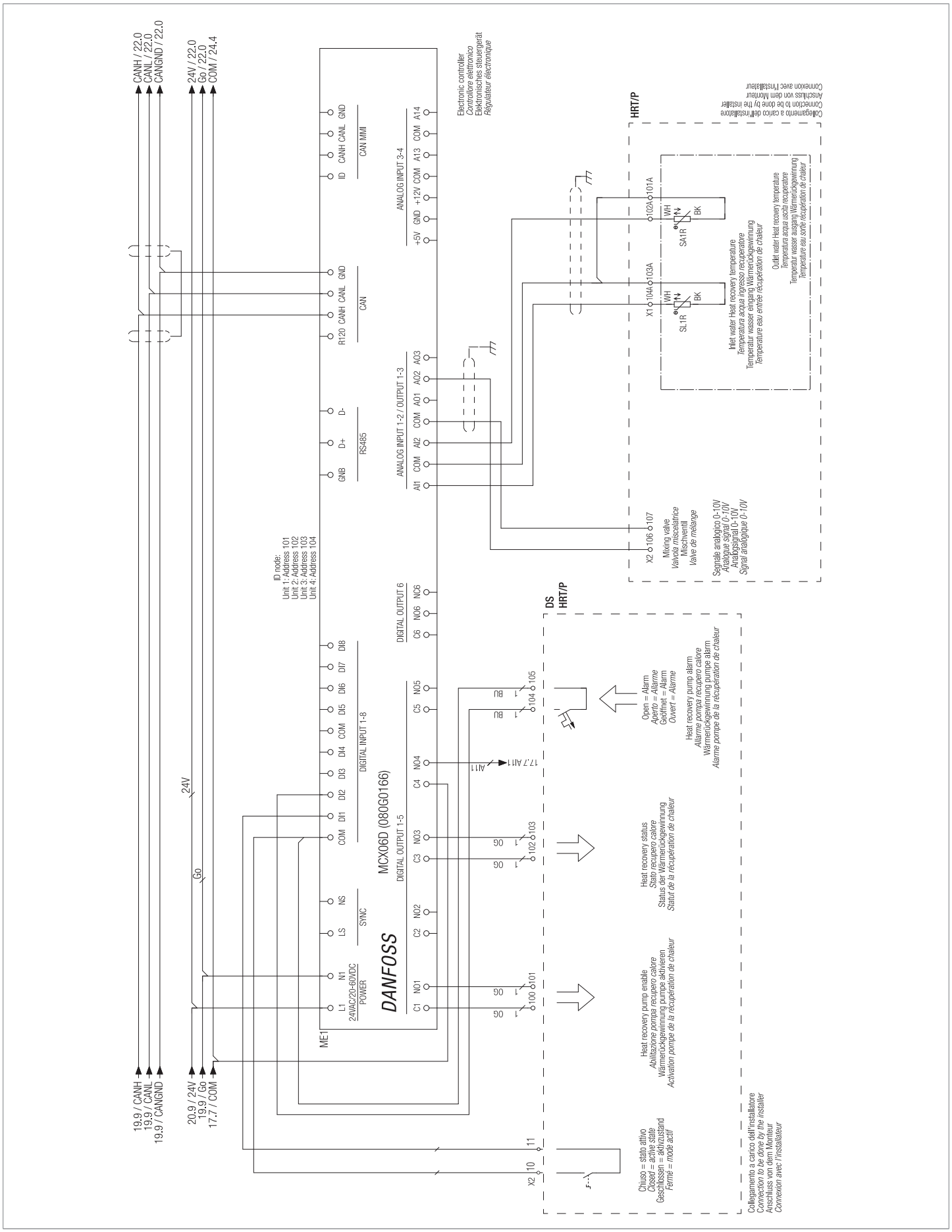
4 EXAMPLES - WIRING DIAGRAMS

The schemes presented are generic and purely indicative.
Please refer to the wiring diagrams of the specific unit for detailed information.

The following is an example of a wiring diagram of a water-cooled unit for the connection of accessories PV2 (2-way electronic pressure relief valve) and PV3 (3-way electronic pressure relief valve) on the SOURCE SIDE.



The following is an example of a wiring diagram of the unit for enabling the partial and total heat recovery functions.


CANH / 22.0
CANL / 22.0
CANGND / 22.0
24V / 22.0
Go / 22.0
COM / 24.4
19.9 / CANH
19.9 / CANL
19.9 / CANGND
20.9 / 24V
19.9 / Go
17.7 / COM
24V
Go
ME1
DANFOSS
MCX06D (080G0166)
POWER
SYNC
DIGITAL INPUT 1-8
DIGITAL OUTPUT 1-5
DIGITAL OUTPUT 6
RS485
CAN
CAN MM
ANALOG INPUT 1-2 / OUTPUT 1-3
ANALOG INPUT 3-4
ID node:
Unit 1: Address 101
Unit 2: Address 102
Unit 3: Address 103
Unit 4: Address 104
Electronic controller
Controllore elettronico
Elektronisches steuergerät
Régulateur électronique
HRT/P
DS
Heat recovery status
Stato recupero calore
Status der Wärmerückgewinnung
Statut de la récupération de chaleur
Heat recovery pump enable
Abilitazione pompa recupero calore
Wärmerückgewinnung pumpe aktivieren
Activation pompe de la récupération de chaleur
Heat recovery pump alarm
Allarme pompa recupero calore
Wärmerückgewinnung pumpe alarm
Alarme pompe de la récupération de chaleur
Open = Alarm
Aperto = Allarme
Geöffnet = Alarm
Ouvert = Alarme
Chiuso = stato attivo
Closed = active state
Geschlossen = aktivzustand
Fermé = mode actif
Mixing valve
Valvola miscelatrice
Mischventil
Valve de mélange
Segnale analogico 0-10V
Analogsignal 0-10V
Signal analogique 0-10V
Inlet water Heat recovery temperature
Temperatura acqua ingresso recuperatore
Temperatur wasser eingang Wärmerückgewinnung
Temperature eau entrée récupération de chaleur
Outlet water Heat recovery temperature
Temperatura acqua uscita recuperatore
Temperatur wasse ausgang Wärmerückgewinnung
Temperature eau sortie récupération de chaleur
SA1R
SL1R
WH
BK
Collegamento a carico dell'installatore
Connection to be done by the installer
Anschluss von dem Monteur
Connexion avec l'installateur

Series	
Heat recovery	
Review	Language
1	ENGLISH
Catalogue	
CL	

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