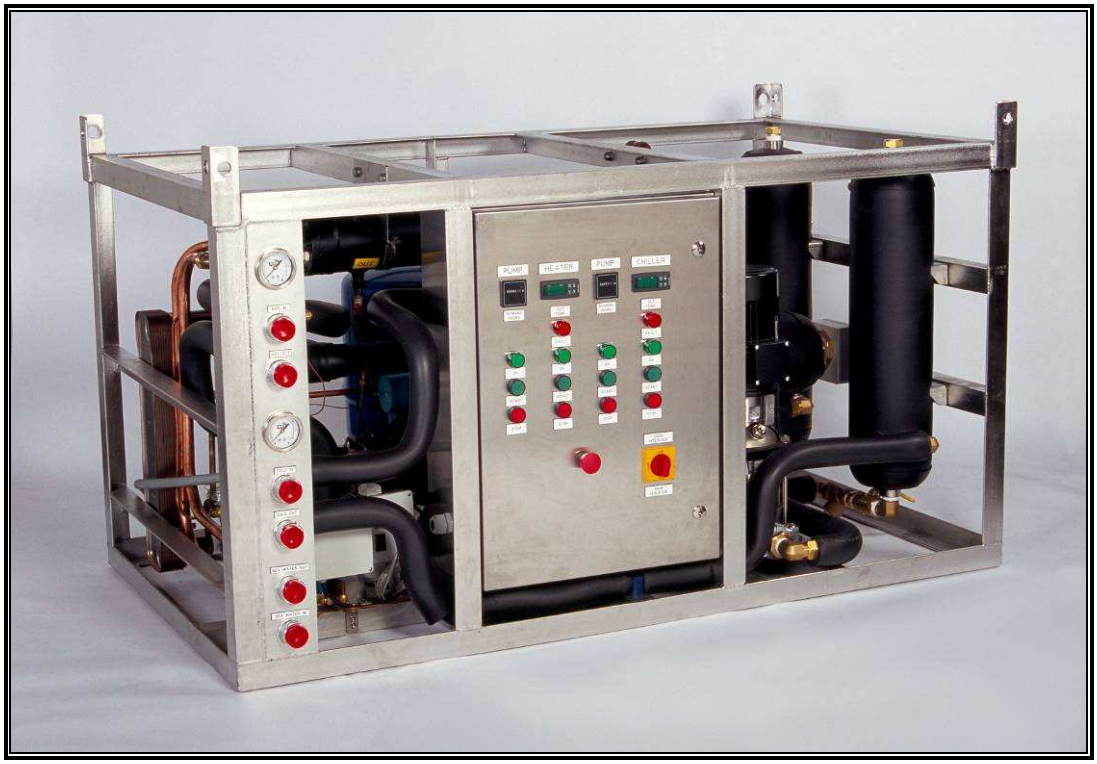
INSTALLATION, OPERATING AND MAINTENANCE MANUAL



HEATER CHILLER SKID

*(Formerly Control Master Unit, **CMU-2**)*

Supply Voltage	**:**	**380VAC**
Control Voltage	**:**	**24V**
MODEL	**:**	**HCS-1**

Document No. 05678-805

(Page Left Blank Intentionally)

DIVEX (PTY) LTD

I. ENGINEERING DOCUMENT FRONT SHEET

DOCUMENT NUMBER	**:**	05678-805
DOCUMENT TITLE	**:**	Installation, Operating & Maintenance Manual – HCS-1

REV.	DATE	BY	CHK	APP	COMMENTS
00	17/12/2009	R.C.	N.M.	R.F.	First Issue.
01	29/07/2010	D.H	N.M	R.F	Added parts to Spares – ECN CT00292
02	14/07/2011	R.C.	N.M.	N.M.	Updated as per ECN CT00311
03					
04					
05					
06					
07					
08					
09					

ORIGINAL ISSUE DATE	**:**	3 February 2006
ORIGINAL DOCUMENT BY	**:**	R. Carli
CHECKED BY	**:**	N. Maske
APPROVED BY	**:**	R. Faustmann

II. DATA SHEET

INSTALLATION & MAINTENANCE MANUAL NO. : 05678-805

FILENAME AND PATH : \\Milkyway\products\Kinergetics\CMU-2 (380VAC 50Hz 24V)\Manual\05678-805-R02 HCS-1 (380V) Installation Operating and Maintenance Manual.doc

EQUIPMENT TYPE : Heater Chiller Skid (HCS-1)
(with External Controls)

EQUIPMENT SERIAL NO. :

CUSTOMER :

VESSEL / LOCATION : (if known)

DATE OF ISSUE :

NOTE: PLEASE QUOTE THE ABOVE INFORMATION WHEN CONTACTING DIVEX REGARDING OPERATIONAL INFORMATION OR SPARE PARTS

III. DISCLAIMER

Whilst every effort has been made to ensure the accuracy of the information provided in this document, Divex makes no guarantees therefore.

Misuse of the equipment described in this manual could result in injury. It is the responsibility of the user to ensure that the equipment is used and maintained correctly and in accordance with the instructions provided in this manual in order to ensure safety of life and to prevent injury.

IV. CONFIDENTIAL INFORMATION

V. WARRANTY

Divex Ltd warrants that its **Heater/Chiller Skid (Type HCS-1)** conforms to the current product specification at the date of delivery and that the product will be free of patent defects in materials or workmanship for a period of twelve months from the date of delivery or for the first 3,000 operating hours, whichever occurs first.

Any component or sub-system which is established by Divex to be patently defective will, at Divex's option, be repaired or replaced on condition that such defective equipment is returned to Divex's manufacturing facility in Cape Town, South Africa, freight pre-paid. On completion of any repair or replacement, the equipment will be returned to the customer FOB Cape Town, South Africa. By agreement and upon prepayment by the customer of any transportation, on-site accommodation and subsistence expenses, Divex may dispatch personnel to perform on-site repairs.

The product specification and warranty terms are subject to alteration without prior notice and do not form part of any contract made between Divex and its customer.

This equipment should only be operated by suitably qualified persons conversant with the operation and maintenance of environmental conditioning equipment used in saturation dive systems. Before operating the equipment, the user must be fully acquainted with the instructions contained in this manual, as well as the individual component manufacturer's operating and maintenance information provided in the Appendixes.

Only genuine manufacturer's spare parts may be used in this Divex product. Use of other manufacturer's parts may cause degradation of performance or failure and will invalidate the warranty.

The following information is required by Divex when ordering spare parts:

- Customer's / owner's name
- Equipment serial number
- Spare part type / description
- Part number

VI. TABLE OF CONTENTS

VII. LIST OF FIGURES

(Page Left Blank Intentionally)

SECTION 1 GENERAL DESCRIPTION

1.1 Introduction

The Divex Heater Chiller Skid (HCS) is a self contained unit designed to provide supplies of heating and cooling fluids to be used for the environmental conditioning of Deck Decompression Chambers (DDC). This is achieved via the controlled distribution of heating and cooling fluids by a Chamber Environment Controller (CEC) unit to a Habitat Conditioning Unit (HCU) within the DDC. Additionally, the Heater Chiller Skid may be used to provide the heated and chilled fluid supply for an external regeneration unit (HCU-ER). Once commissioned this arrangement provides controlled delivery of heating, cooling and dehumidification capacity to a DDC, in order to create and maintain optimum living conditions for saturation diving personnel.

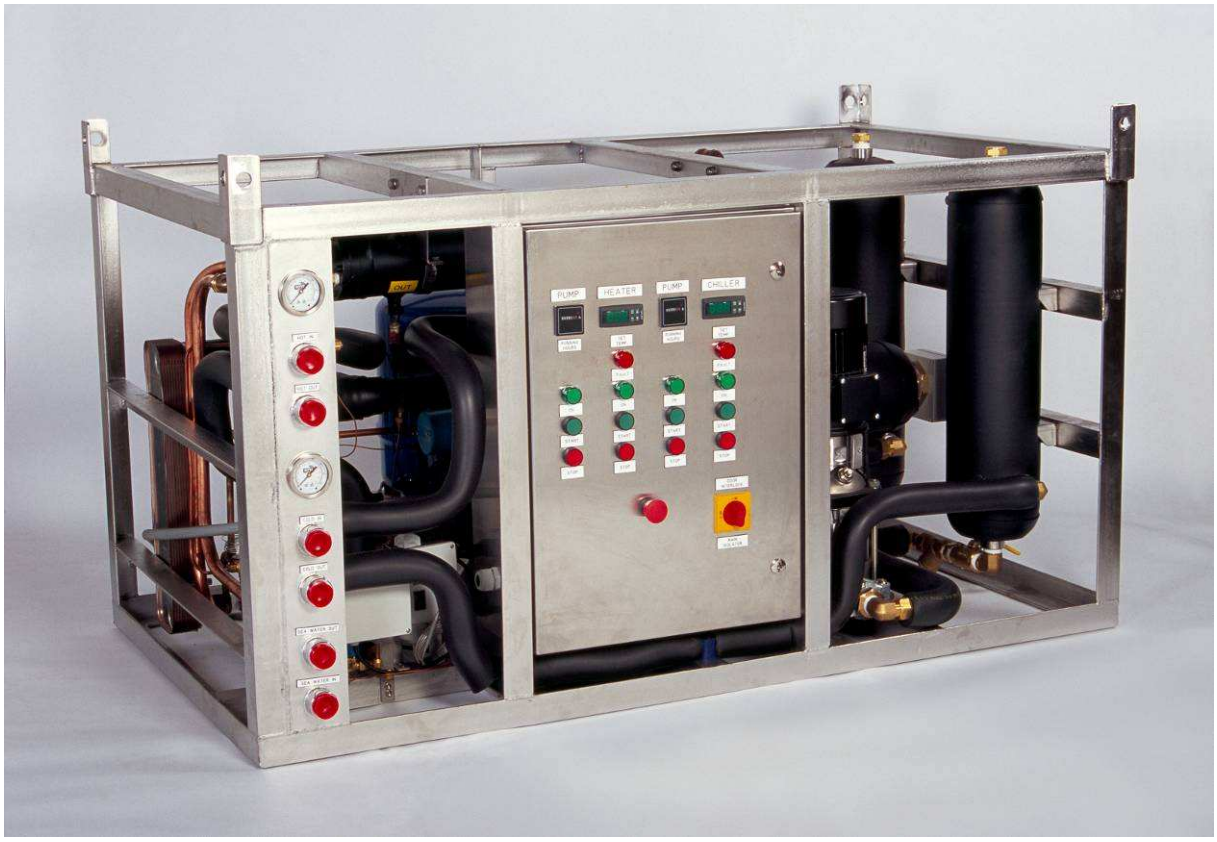


Figure 1 Front View of HCS-1

1.2 Basic Description

The HCS with external controls is designed to supply a ring main system, from which the fluid is taken to perform heating, cooling and dehumidification within a DCC. The flow of the hot or cold fluid is governed using a Chamber Environmental Controller (CEC). The CEC which may be mounted next to the chamber and some distance from the HCS, adjusts the flow rate of fluid diverted to the coils of an HCU within the DCC. A proportional, integral and derivative (PID) controller governs the valve positions based on feedback received from a temperature/humidity transmitter in the chamber.

The unit is run from a 380V 50HZ electrical supply and requires a cold water feed to cool the condenser of the refrigeration plant. The outputs are individual hot and cold heat transfer fluid circuits supplied at pressures up to 5bar and 30-35 litres per min.

The HCS-1 assembly includes the following systems: a refrigeration system, electrical heating system, two pumping circuits and the electrical control system.

The pumping circuits include two pumps that circulate the heat transfer fluid, (70/30 Glycol/water), through the separate hot and cold systems.

The refrigeration system chills the fluid of the cold circuit using a cross flow heat exchanger. Cold refrigerant in one side of the heat exchanger absorbs heat from the heat transfer fluid in the adjacent side of the heat exchanger.

The heating system heats the fluid of the hot circuit using electrical immersion heaters within the heater tank.

The entire arrangement is governed as individual heating and cooling supply systems, maintained within ±1ºC of their set temperature through the use of dedicated electronic controllers, sensors, indication and Human Interface (HI). The HI uses push button selectors and LED indication lighting for run and stop conditions. Interlock circuits prevent heating or refrigeration from being started unless the corresponding pumps are active.

The HI includes a controller display that indicates set points and measured values. Parameters of the controller are set using the buttons located on the controller face.

The heating system, cooling system, fluid pumps, interconnecting pipe work and electrical panel are mounted to a robust stainless steel frame.

The system requires a 380V, 3-phase, 50 Hz, 40Amp electrical supply and a cooling seawater supply for the condenser of the system. The cooling water should have sufficient flow rate as indicated in **Figure 10**of **Appendix P**.

1.3 Specifications

Weight	Approx. 727 kg (1600 pounds)
Size (mm)	1626 mm, 914 mm, 864 mm
Electrical Input	380 VAC, 3 Phase, 60 Hz, 40 Amp
Heating Capacity	9 kW
Cooling Capacity	9.5 kW
Temperature Control	Adjustable set point, ±1ºC hot/cold fluid
Circulation Pumps	30-35 litre /min at up to 5 bar
Cooling Water Input (sea water condenser)	47 ltr/min @ 32˚C, 8 bar max
Skid Fluid Connections	1” NPT (F)

1.4 Theory of Operation

1.4.1 Fluid Circuits

The HCS uses a water/glycol fluid mixture in both heating and cooling circuits with a concentration range of glycol between 30-50%. This concentration is required to prevent freezing of the fluid during the chilling process and when operated in ambient temperatures below freezing.
The fluid circuits are separated into distinct cold and hot circuits. The hot circuit is used to supply capacity for heating and the cold circuit is used to supply capacity for both cooling and dehumidification.

The hot and cold fluid circuits both run at a pressure of up to 5 bar (6 bar Max.) supplied by dedicated multistage vertical axis pumps. Each pump is driven by a 1.1 kW electric motor coupled to the pump. Pressure gauges, mounted on the front of the HCS, display the fluid pressures supplied by the unit. A pressure relief valve is fitted to each pumping circuit header tank to prevent damage that may occur if high pressure chamber gas escapes into the fluid lines.

A general layout schematic is provided in **Appendix D** showing both the water/glycol and refrigeration circuits and the component placement.

1.4.2 Refrigeration System

The Refrigeration System that cools the fluid in the cold circuit consists of the following major components.

- Compressor
- Condenser
- Receiver
- Filter Dryer
- Solenoid Valve
- Sight Glass
- Expansion Valve
- Evaporator
- Capacity Regulator
- HP and LP Control Switches
- Anti-Freeze Thermostat

IMPORTANT

Following the instigation of the Montreal Protocol; the release of CFC's into the atmosphere is prohibited. Although the system makes use of a non-prohibited refrigerant, venting of the gas is still prohibited and the system must be evacuated and the gas safely disposed of prior to carrying out work on the refrigeration system or its components.

A brief description of each of these components and their function in the refrigeration process as applied to the HCS is given below.

Compressor

The Compressor is the prime mover for the refrigerant fluid. Refrigerant at low pressure is drawn into the suction side of the compressor as a cool gas and discharged as hot, high pressure gas following compression. This hot high pressure gas then passes to the condenser.

Condenser

The Condenser is a heat exchanger that uses a seawater supply to cool the hot refrigerant gas supplied by the compressor. The heat exchanger cools the refrigerant gas to the point where it condenses into a liquid. The high pressure refrigerant now cooled to liquid at ±40ºC, then flows to the liquid receiver.

IMPORTANT

The seawater flow required for the condenser will vary depending on the ambient seawater temperature (See Appendix P). A control valve is fitted at the condenser's seawater exit, which controls the seawater flow rate. This valve monitors the refrigerant pressure at the condenser's refrigerant outlet and once set, automatically adjusts the seawater flow to keep the refrigerant pressure (and temperature) correct.

Liquid Receiver

The liquid receiver is a storage vessel for the liquefied refrigerant and is fitted with a pressure relief valve to prevent over pressure of the system. When the system is correctly charged the liquid receiver will contain sufficient refrigerant to supply the system under normal operation.

Filter Dryer

The filter dryer is mounted in the system to remove any residual moisture in the refrigerant. The filter prevents any moisture from passing to the expansion valves where it would freeze and block the refrigerant flow. As the oil of the compressor is also hygroscopic, lubrication will be compromised and the life of the unit will be reduced should any moisture be present in the system.

IMPORTANT
To prolong the life of the refrigeration system it is essential to replace the filter dryer if moisture penetration may have occurred during service or repair of the system.

Solenoid Valves

When the refrigeration system is switched off a solenoid valve in the circuit will shut off the liquid flow to the expansion valve and the capacity regulator. This ensures that a supply of liquid refrigerant is maintained on the high-pressure side of the expansion valve thus allowing immediate access to capacity when the system is restarted.

Sight Glass

A sight glass is provided for the visual inspection of the liquid line during operation. Low gas charge level may be identified through the presence of bubbles flowing in the liquid refrigerant stream. When moisture is present in the system the colour of the indicator in the centre of the sight glass will change from green to yellow.

Expansion Valve

The primary function of the Expansion Valve is to throttle the cooled liquid refrigerant as it flows from the high pressure to low pressure side of the refrigeration system. The secondary function is to regulate the mass flow of refrigerant to balance the mass flow required by the compressor.

As a result of the sudden pressure drop through the orifice plate of the expansion valve, the refrigerant expands to a cold vapour.

The expansion valve is fitted with a capillary bulb and a suction pressure line. These measure both the temperature and the pressure of the refrigerant at the evaporator outlet. The capillary bulb is affected by changes in the discharge temperature caused by varying evaporator loads and automatically adjusts the expansion valve setting to maintain a constant level of superheat at the evaporator discharge. This ensures that the compressor always receives only gaseous refrigerant.

As the expansion valve is only self-adjusting over a limited range of evaporator load conditions a capacity regulator is fitted to maintain the systems performance over more extensive range

of evaporator loading. Capacity regulation is provided by a hot gas bypass valve detailed below.

Evaporator

The evaporator is a cross-flow plate type heat exchanger. It consists of two fluid circuits, one with cold refrigerant and the other carrying the heat transfer fluid that flows to the CEC unit. The refrigerant draws heat from the fluid that in turn is used to draw heat from the DDC.

During the heat exchange the refrigerant vapour is heated. The heated refrigerant then passes back to the compressor inlet, where the entire cycle is repeated.

Capacity Regulator

When the heat load into the system is reduced the refrigerant is gains less heat causing the temperature of the refrigerant at the evaporator outlet to fall. The pressure will also drop due to the direct relationship between temperature and pressure.

A capacity regulator, (Hot gas bypass), reacts to the decrease in refrigerant pressure and adjusts to allow some hot refrigerant gas from the compressor discharge, to feed directly to the evaporator inlet. This hot gas is then mixed with the cold vapour leaving the expansion valve and raises the temperature and pressure of the vapour before it enters the evaporator. The higher pressure then restores the evaporator outlet pressure back to normal and the compressor continues to function at its optimum rate. This cyclic process of capacity control prevents the compressor from switching on and off frequently when the system capacity requirement drops.

High and Low Pressure Control Switches

The high pressure switch protects the system from overpressure in the event of the condenser failing to condense the high pressure gas. The low pressure switch prevents the compressor from drawing a vacuum if the capacity regulator fails to operate. The high and low pressure switches are both safety circuits used to protect the compressor and will require manual resetting if tripped.

Anti Freeze Thermostat

The antifreeze thermostat is a safety device that prevents the evaporator from freezing causing damage to the evaporator and pipe work in the event of a temperature control failure.

Refrigerant Gas

The refrigeration system is designed to use only R404A refrigerant and requires approximately 8.5kg of R404A to fully charge the system. The system must be liquid charged to avoid unbalancing the R404A gas mixture.

1.4.3 Electronic Control

The electrical control system as detailed in the wiring diagrams in **0** above consists of the following major components:

Control Transformer

The control transformer reduces the 380V main supply to 24V for use in the control circuits of the system.

Main Electrical Isolator 63A

The isolator provides complete electrical isolation of both the control and the power supply to the panel.

CAUTION

To avoid electric shock the isolator should always be switched off before opening the electrical panel.

Contactor

The coils of the contactors are activated by a 24V control signal. While the control signal is maintained the contactor is held in the closed position supplying power to the output terminals of the unit. Contactors are used to switch supply to the following:

a. Heater Pump Motor (Contactor - C1)

b. Chiller Pump Motor (Contactor - C3)

c. Heater No. 1 & 2 (Contactor - C2)

d. Refrigeration System (Contactor - C4)

Pump Contact Breakers (MCB1 & MCB3)

This protective device disconnects the power circuit to the pump if the current demand is higher than allowable rated current.

Thermal Overload Relay

Thermal overload relays are applied as protection in the event that the motor overheats due to overloading. Thermal overload is applied to the following:

a. Heating Pump Motor Overload Relay (0/L1)

b. Chiller Pump Motor Overload Relay (0/L2)

c. Compressor Motor Overload Relay (0/L3)

Heater Contact Breaker (MCB2)

This protective device disconnects the power circuit to the heaters if the current demand is higher than allowable rated current.

Heater Elements A and B

The heaters used are 380V, three-phase, 2 x 4.5 kW immersion heaters.

Sump Heater Circuit Breaker (MCB6)

This protective device disconnects the power circuit to the sump heater if the current demand is higher than allowable rated current.

Control Circuit Breaker (MCB7)

This protective device disconnects the power circuit to the heaters if the current demand is higher than allowable rated current.

Temperature Controllers (HC1/1 & CC1/1)

Electronic controllers are used to control the hot and cold circuit outlet fluid temperatures based on defined set points. The controllers provide a visual display of the fluid temperatures.

1.4.4 Mechanical Refrigeration Controls

The mechanical control of the refrigeration system consists of the following major components:

High Pressure Switch

(Mounted on bracket in front refrigerator compressor) This protective device disconnects the control circuit to the compressor motor contactor coil if the pressure rises above 22 bar (320 psi) and must be manually reset when the pressure drops.

Low Pressure Switch

(Mounted on bracket in front of the refrigeration compressor) This protective device disconnects the control circuit to the compressor motor contactor coil if the compressor suction pressure drops below 2 bar (30 psi) in refrigeration system. It resets automatically when the pressure rises above ± 3 bar (45 psi). The refrigeration system will then need to be manually restarted.

Anti Freeze Switch

(Mounted on bracket in front of the refrigeration compressor) This protective device disconnects the control circuit to the compressor motor contactor coil if the temperature of the fluid exiting the evaporator falls below -3ºC.

Over-Temperature Sensor (Thermostat)

Should the temperature controller fail on the hot circuit further protection against overheating of the fluid is provided by a thermostat. The thermostat trip is set at 70ºC with auto reset after a 5ºC temperature reduction.

1.4.5 Panel Switches

Operator interface during standard function is done through several panel mounted switches detailed below:

Hot Fluid Pump On-Off Switch

This is the manual input on-off switch for the hot fluid pump motor and closes the control circuit to the coil of the pump motor contactor.

Chiller Pump On-Off Switch

This is the manual input on-off switch for the cold fluid pump motor and closes the control circuit to the coil of the pump motor contactor.

Heater No.1 & 2 On-Off Switches

This is the manual input on-off switch for the heaters and closes the control circuit to the coil of the heater contactor.

Refrigeration System On-Off Switch

Turns control circuit power on and off to refrigeration compressor motor.

Emergency Stop Switch

This is used to stop the unit and break the supply of power to all of the operating circuits. The switch is a push button activated latching switch with a twist release. Once pressed, the emergency stop will remain active until released. When active the switch will prevent all circuits of the unit from operating and will stop the pumps, refrigeration of heating systems from being started.

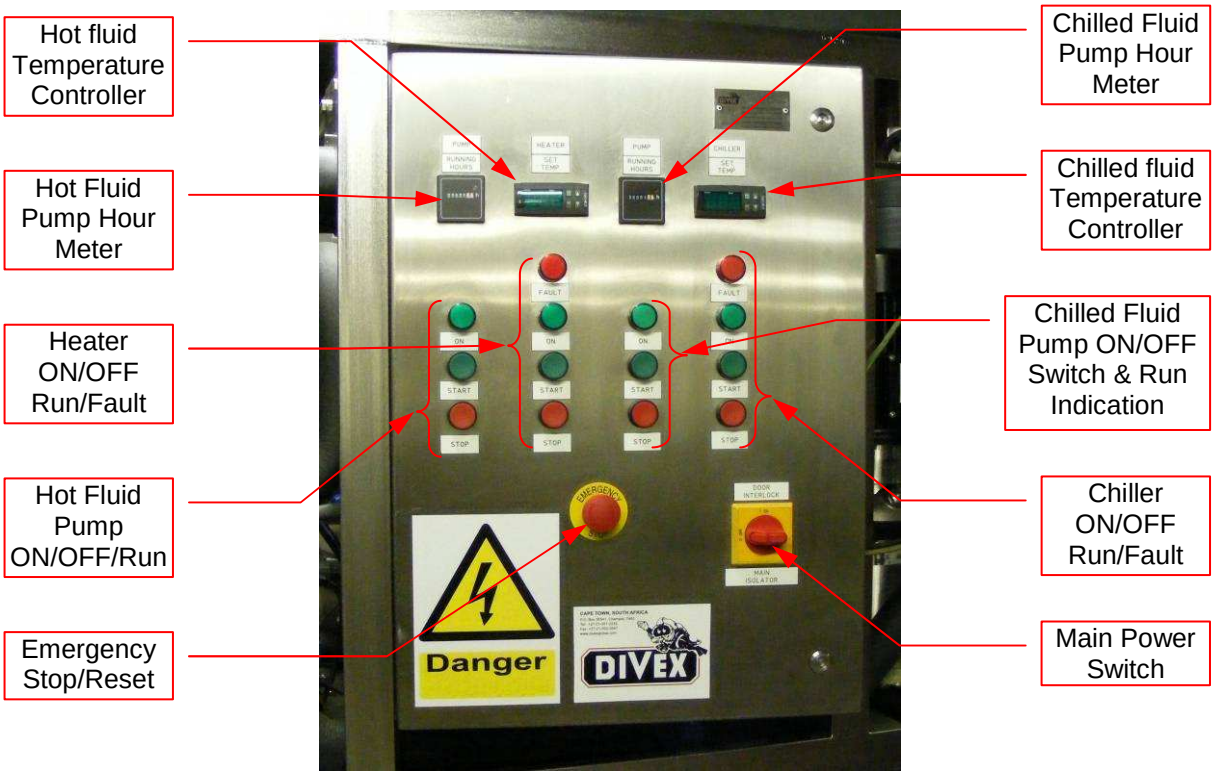


Figure 2 Control Panel

(Page Left Blank Intentionally)

SECTION 2 INITIAL SET UP

2.1 Piping Installation

For details on the installation of the pipe work of the HCS-1 refer to **Appendix E** and the following instruction.

2.1.1 Installation Instruction

a. The HCS-1 should be installed within 15 metres of the chamber. The HCS-1 should be secured on a level floor or deck. The HCS-1 may be stacked 2 high on top of other HCS or WHE units with the same frame footprint. In order to allow sufficient air circulation and maintenance access, 800mm of clearance should be made available on three sides of the unit.

b. If the HCS-1 is deck mounted, it must be rigidly secured in place.

c. Plumb hot and cold fluid circuits as per the piping schematic in **Appendix E** using 1" diameter piping.

IMPORTANT
Pipe work must be insulated as this provides more effective capacity delivery. It is recommended to use at least a ½" insulation, Armaflex or equivalent.

d. Plumb condenser cooling water supply with $^{3}/_{4}$" pipe.

IMPORTANT
Sufficient cooling water supply is essential for the correct operation of the refrigeration unit and to prevent tripping.

e. Leak checks are to be carried out on both fluid systems to prevent loss of fluid during normal operation.

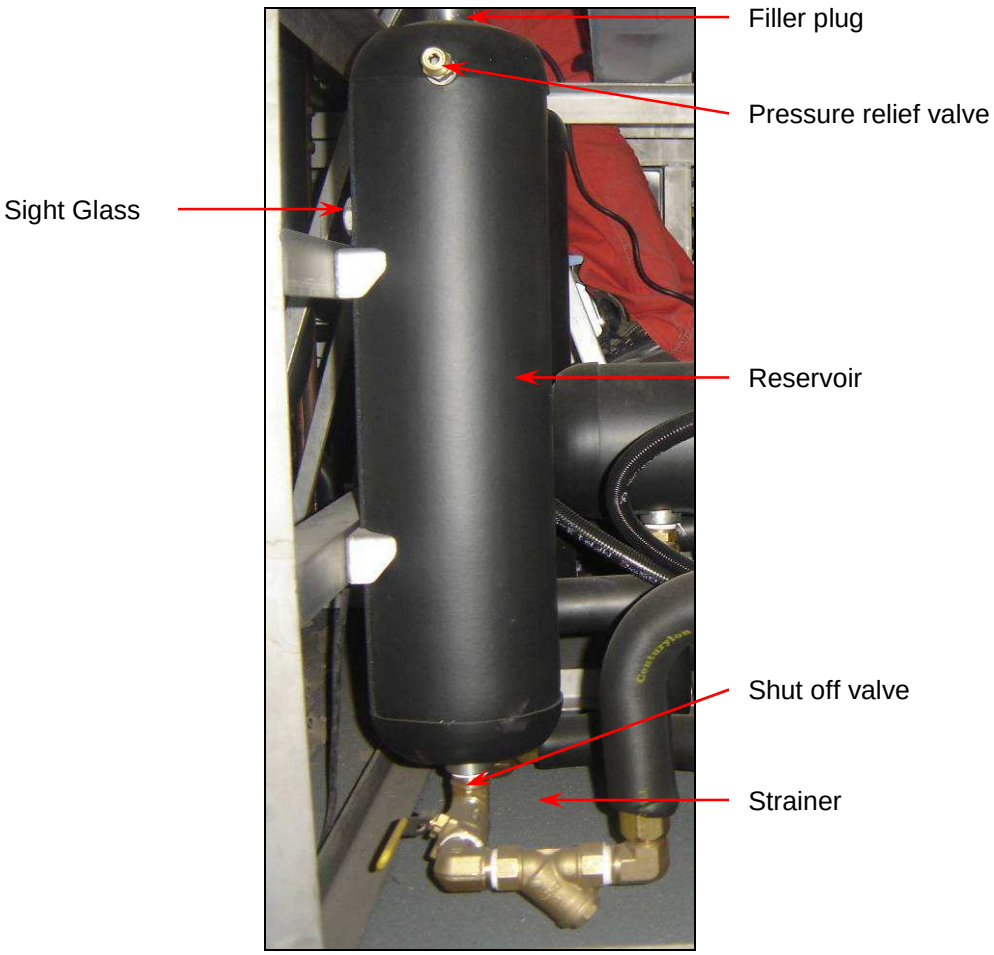


Figure 3 HCS-1 Reservoir

2.2 Leak Test Procedure

- Open all shut-off valves. Close the heater tank drain valve (mounted under the heater reservoir).
- Remove pressure relief valves on hot and cold circuit reservoirs and plug the fittings (**Figure 3**).
- Attach a regulated nitrogen or air supply to the hot fluid system via the reservoir filling cap and apply a pressure of 10 bar (145 psi) to the system.
- Check all fittings and lines for gas leaks. (Use liquid leak detector, snoop or equivalent).
- Run a pressure hold test on the system by closing off the pressure supply valve. Note the pressure at the start of the test (10 bar or 145 psi) on the hot fluid system pressure gauge. The pressure in the sealed off system should not drop below 9.5 bar in 30 minutes.
- If leaks are detected or pressure hold test indicates a leak, all connections on hoses and lines must be retightened and welds rechecked.
- Bench test the relief valve to confirm that it has been set to activate at 2 bar (30 psi).
- Slowly relieve the system test pressure then disconnect the test pressure supply.
- Replace the relief valve on the hot fluid system.
- Repeat the leak check procedure for the chilling fluid system.

2.3 Electrical Installation

	**WARNING**
	All electrical wiring must be installed in an approved manner for the specific installation. Consult company/local wiring regulations.
	**CAUTION**
	All pipe work must be complete and leak checked before proceeding with any electrical installation procedure.

a. The electrical supply must be able to deliver 3phase 40 Amp, 380 V, 50 Hz.

b. The mains supply cable must be a minimum of a 4 x 16 mm^2, use armoured cable if required.

c. Three phase connections are to be made to the power contactor as per correct wiring practices and ground connection via a cable gland into the panel.

d. Check that the pump motor rotation is as indicated on both of the pump bodies. If the pump rotation is incorrect, shut off the power supply to the unit and switch any two of the three supply phases at the main isolator connection. Re-check the motor rotation.

2.4 Initial System Checks and Setup Procedures

After installation is complete the system must be checked before being put into service. The full system setup procedure should be carried out as detailed below.

2.4.1 Fluid System Priming Procedure

IMPORTANT
Recommended system fluid must be a solution of 30% Ethylene Glycol and 70% water.

1. Close the heater tank drain valve.

2. Pour fluid into both fluid reservoirs until the fluid level is above sight glass (**Figure 1**).

3. Open both of the priming ports (**Figure 4**) on the pumps housings (See **Appendix N**). This will allow air to purge from the fluid systems. Continue filling until fluid flows out of bleed valves. Then close the bleed valves.

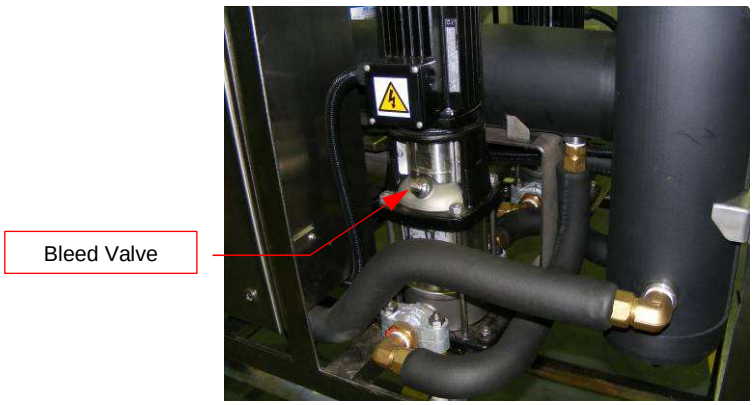


Figure 4 Circulation Pump

4. Refill the reservoir until the liquid is again visible though the sight glass.
5. Start the pump briefly to circulate fluid throughout the system. (Ensure that the reservoirs are closed before starting the motors to avoid fluid spillage)
6. Stop the pump and refill the reservoir
7. Repeat step 5 & 6 until the systems are filled with the fluid.
8. Allow both pumps to run for at least half an hour to ensure that any remaining air is accumulated in the reservoir.
9. Stop the pumps, refill the reservoirs as required.

The system is now primed and ready for testing with the heating and chilling systems operating.

2.4.2 Electrical Check

To ensure the safe and correct operation of the HCS-1 unit all electrical connection and checks including installation, setup and commissioning must be performed by suitably qualified and competent personnel.

1. Check all wiring for any loose connections that may have arisen during transporting or installation.
2. Confirm that that the 3 phase supply connections are made correctly and are tightened
3. Check that and that the supply voltage (380V and 50 Hz) (Ensure that the cables used are correctly sized and insulated)

2.4.3 System Operation Check

IMPORTANT
The circulating pumps must be primed and running before starting the heating or chilling system.

a) Check that all piping connections are made correctly

b) Ensure that cooling water is supplied to the unit at a minimum of 47l/min and <32℃ (See **Appendix P**)

c) Turn on the circulating pumps (Circuits must be fully primed)

d) Check the circuit pressure under free flow (No CEC activity and all valves open) 2-5bar.

e) Turn on the heater and refrigeration systems.

f) Monitor both systems until the set points are reached. When the cooling system approaches set point, 1℃±2℃, the hot gas bypass c apacity regulator is activated. When the hot system approaches set point, 60℃±2℃ the c ontroller switches off the heaters. (Processes are controlled by electronic controllers refer to **Appendix O** for controller manual).

IMPORTANT
The refrigerant sight glass should be clear with no bubbles in the refrigerant fluid stream. If bubbles are present or the sight glass indicates moisture in the fluid stream refer to the troubleshooting section.

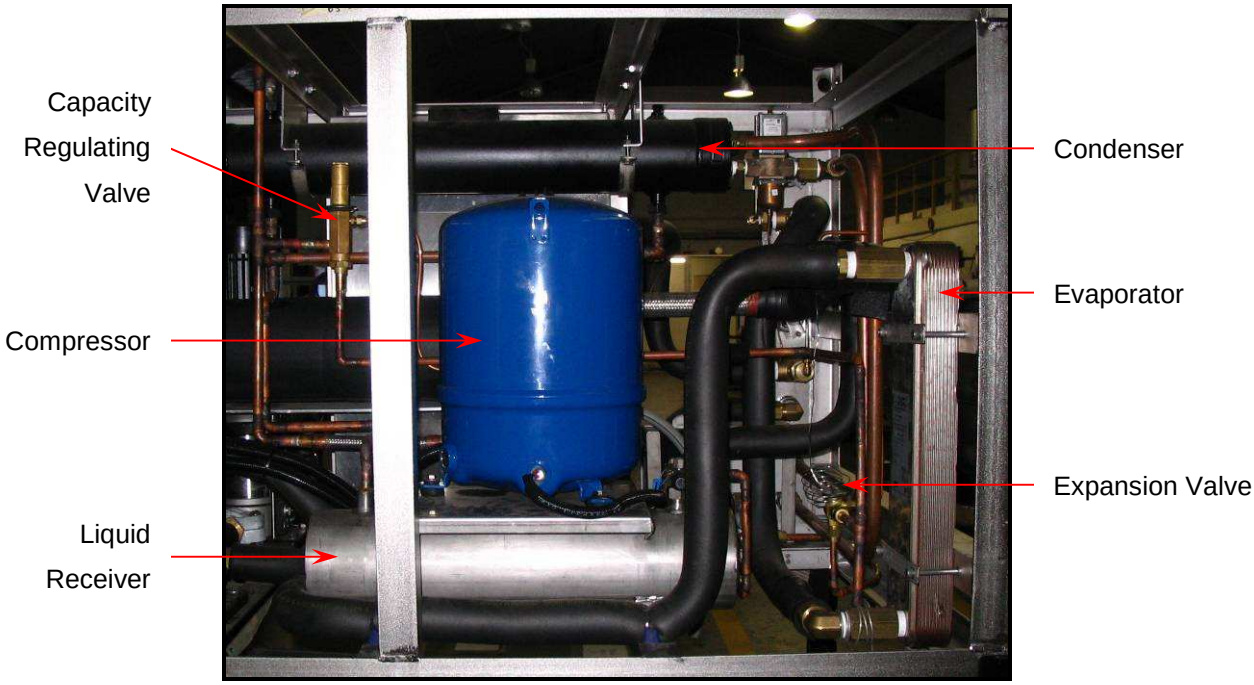


Figure 5 Refrigeration System Identification

Following the operational check remove and clean both Y-strainers at inlet to fluid pumps to clear out any debris that may have been introduced into the system during plumbing and installation. Check priming of the circuits and re check operation in necessary.

The HCS-1 is now ready for full integrated installation check with CEC and HCUs.

(Page Left Blank Intentionally)

SECTION 3 OPERATING INSTRUCTIONS

3.1 Operation

Both the refrigeration and heater systems are equipped with an interlocking circuit that prevents their operation unless the corresponding pumping circuit is also running. Once the pumps are running the refrigeration and heating systems may be turned on. As the heating and cooling processes are governed by electronic controllers there are no other required operator inputs.

CAUTION

All pipe work must be complete and leak checked before proceeding with any electrical installation procedure. To reduce the risk of electric shock when the isolator is switched on it should not be possible to open the electrical panel door.

IMPORTANT

If using the HCS-1 unit for the first time or after servicing or maintenance ensure that the initial setup tests and procedures have been conducted as outlined in Section 0. Ensure that all preliminary electrical, plumbing and setup checks have been conducted.

3.1.1 General Start Up Procedure

All electrical controls are mounted in the electrical panel door and are identified in **Figure 2** of **Section 1.4.5.**

Step	Procedure
1	Ensure all in-line valves are open and drain valves are closed.
2	Turn the mains isolator switch to the ON position. The controller displays will illuminate and show the current circuit temperatures.
3	Check the fluid levels in the reservoirs and system priming.
4	If the system is primed, the fluid circulating pumps can be started, green buttons.
5	Recheck the fluid levels in the reservoirs, if the level has dropped, the filling plug can be opened while the pump is running and the needed fluid added. If the level does not come up there is either a leak in the system or the system was not properly primed. The pump should be stopped and its liquid lines should be visually inspected for leaks.
6	When the pumps are running the pumped pressure should also be checked and be in the region of 2-5 bar (30-70 psi). If not, turn off the pumps and refer to trouble shooting in chapter 5.
7	Switch on the heater. (Green button)

8	The temperature of the heated fluid should begin to rise and stop at the controller's set-point. This is factory set to 60ºC.
9	Switch on the refrigerator system. (Green button)
10	The chilled fluid line will begin to cool and stop at the controller's set-point. This is factory set to 1ºC.
11	The condenser cooling water should also be flowing at this point. If not, the compressor will be stopped by the high pressure safety switch.

3.1.2 General Shut Down Procedure

Emergency Shut Down and Reset

Step	Procedure
1	To stop the entire system during and an emergency, firmly press the emergency stop button on the front of the control panel indicated in **Figure 2**.
2	The emergency stop button is a latching push button with a twist release. When the emergency stop is released all systems will remain stopped and may be restarted according to the general start-up procedure.

WARNING

SERVICE AND REPAIR

If the emergency condition requires any service or repair of the unit or any related systems ensure that the main isolator is also turned off.

Normal Stopping and Shutdown Procedure

Step	Procedure
1	Stop the refrigeration and heating systems
2	Stop the fluid pumps
3	Switch off the main isolator

SECTION 4 MAINTENANCE AND REPAIR

4.1 Routine Maintenance Schedule

4.1.1 Recommended Tools and Supplies

Together with a comprehensive technician's toolkit, the following items will be required.

- Multi-meter and probes. (Preferably with temperature measurement capability)
- Low temperature brazing rods, e.g. Silflos no. 5 brazing alloy or equivalent silver solder
- Refrigerant R-404A (8.5 kg for full system charge)
- Compressor oil (Ester RL32S)

4.1.2 Recommended Maintenance Schedule

To ensure correct function, facilitate fault finding and extend the life of the HCS-1 unit it is essential to perform scheduled cleaning and inspection of the unit. Service and maintenance schedules should be based on the amount of running hours and periods where the unit is out of service extended. As working conditions are unique for each installation the following is a guide for the structure of servicing.

WARNING

DISCONNECT ELECTRICAL SUPPLY

To avoid electric shock and damage to equipment disconnect external electrical power before continuing with this procedure.

Cleaning and Inspection

Regular cleaning and inspection schedules may be used to identify potential problem areas for maintenance or repair.

Step	Procedure
1	Using a clean, dry air source (30 psi / 2 bar) blow out the inside of electrical control box, electrical wiring and refrigeration section of HCS-1.
2	Using clean, lint free cloth, wipe inside of electrical control box. Remove any debris that has collected. Inspect all wiring for damage from excessive heat or physical damage. Wiring insulation should show no indication of heat damage, frayed or chafed. Replace all damaged wiring during repair.

CAUTION

Do not allow any moisture intrusion into the electrical control box during cleaning

3	Using hot mild soap solution, clean sheet metal. Wipe with a damp clean cloth to remove soap residue and dry with air.
4	Wipe stainless steel sheet metal with lemon oil or vinegar. This will clean the stainless sheet metal and prevent oxidization.
5	Visually inspect the fluid pumps for leaking shaft seals and worn bearings. If any sign of leaks or rumbling bearings are noted replace the parts if necessary. (Refer to **Appendix N** for the pump manual)
6	Visually inspect all couplings and joints in the pipe runs for leaks and repair or replace as required.
7	Use Snoop or equivalent to inspect the refrigeration system for any refrigerant gas leaks. Have any leaks repaired by a competent refrigeration technician.
8	Check that all bolting points, fixtures and mountings are secure.

Motors, Pump Stands and Compressor – Paint and Corrosion Check

Certain components of the HCS-1 are painted. These units are vulnerable to corrosion if the protective paint layer is compromised. Paint checks should be conducted every 4-6 months and repair work conducted as required.

Clean Water Cooled Condenser

To maintain the efficient heat transfer and performance of the refrigeration unit the tubes of the water cooled condenser should be cleaned out on an annual basis or during a convenient service interval.

Step	Procedure
1	Remove end plates of the condenser.
2	Brush out the cooling tubes inside of condenser to remove any deposits and improve the heat transfer surface.
3	Inspect/replace condenser anode every 3 months
4	Inspect the end cap sealing gaskets and replace if they are unserviceable.
5	Replace the end caps securely with the gaskets in place
6	Check the end caps for leaks during post service testing

4.2 Removal and Replacement

	**CAUTION** **Components should only be removed or replaced by trained technicians with a complete understanding of the overall unit and all its sub systems. Relevant safety equipment and procedures must always be employed during repair and maintenance work.**
	**WARNING** **ISOLATE EQUIPMENT** **Ensure that the main electrical power supply has been turned off before conducting any repair work.**

4.2.1 Refrigeration System Service

1. Refrigerant Safety

	**WARNING** **SUFFOCATION HAZARD** **R404 refrigerant is an oxygen depletion agent. Ensure sufficient ventilation of any work area to avoid suffocation. To reduce the chance of refrigerant leaks, pump down the system and close hand shut off valves when conducting repair work.**
	**CAUTION** **Following the instigation of the Montreal Protocol preventing the release of CFC's into the atmosphere, the use of CFC refrigerant is prohibited. Although the system makes use of a non-prohibited refrigerant, intentional venting of this gas is barred and if the system is to be evacuated an acceptable gas reclamation process must be used. The gas must then be safely disposed off or stored prior to service or repair of the refrigeration system.**

	**WARNING** **HALOCARBON SAFETY** **Halocarbon gives no indication to the human senses of dangerous concentrations. Dizziness can occur without warning and remaining in the environment will lead to unconsciousness and suffocation, unless escape to fresh air is immediate.**

2. The Refrigerant System

a. Only competent personnel with an authorised permit should be allowed to work on the refrigerant system.

b. Do not start up the plant until the Operating and Safety Instructions have been read and understood and all component locations and function have been identified.

c. Use only approved tubing, hoses and couplings when topping up and draining refrigerant. Never fill containers to more than 80% of their maximum volume.

d. Work on the refrigerant plant is to be done in compliance with the rules and provisions of the local or national codes and standards.

e. Prior to working on a system or any part of a system make sure that it is depressurised with regard to its surroundings.

f. Some surfaces in the plant that are colder than 0ºC and hotter than 40ºC and can cause skin injuries if touched.

g. Refrigerant in liquid form must never be enclosed in a closed area such that it occupies all the available space.

h. Exercise caution when operating valves that separate parts of the system at different pressures in order to avoid shock and impact loads.

i. Care is to be exercised in order to avoid shock and impact loading which may result from rapid pressure changes and the transfer of liquid or gas, when switching between different operational modes such as start-up, shutdown, defrosting and cleaning.

j. Before doing any work, make sure that the machine cannot be operated or started from any other site or automatically, by means of a sensor, timer relay or the like.

4.3 Refrigeration Compressor

This section identifies the main refrigeration components and general function of the components.

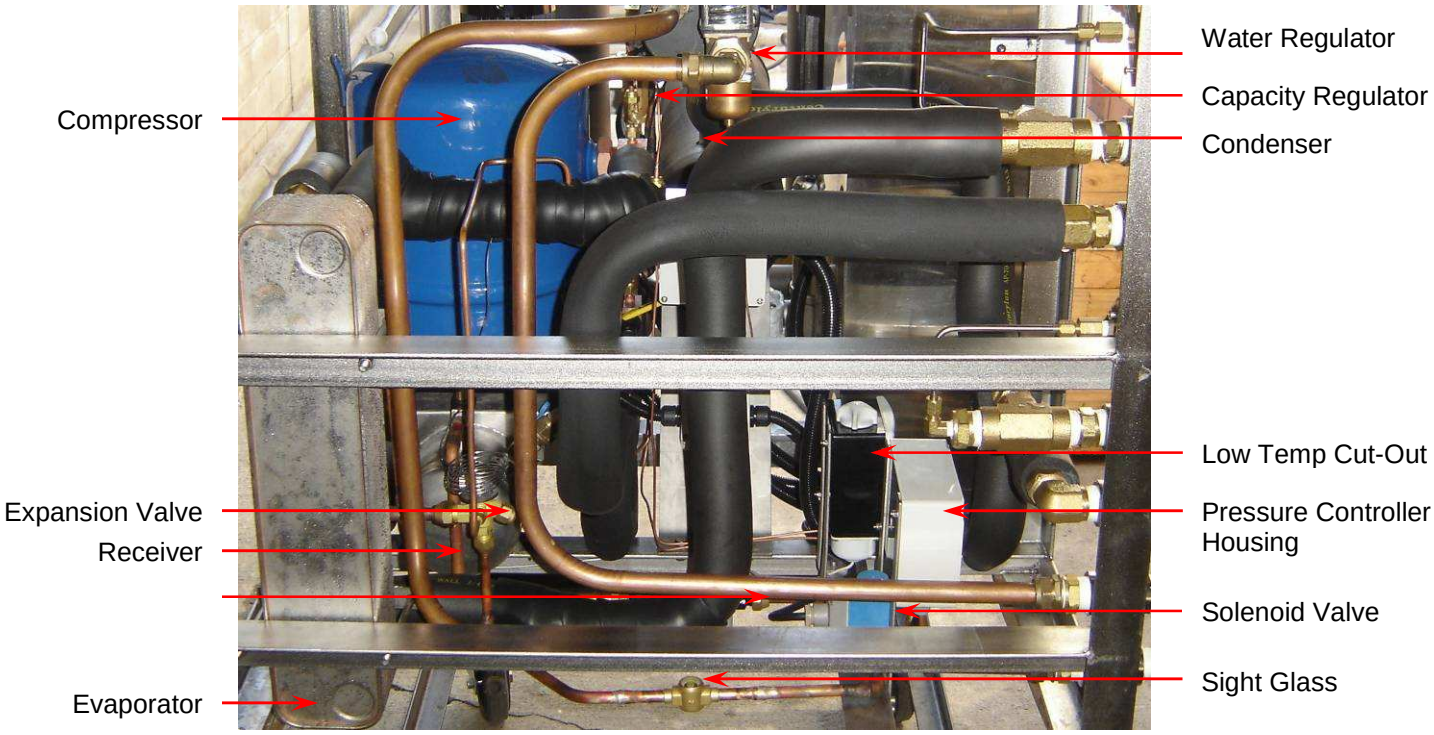


Figure 6 Refrigeration Circuit

4.3.1 Compressor Installation

The compressor must be installed using the rubber anti-vibration mounting feet.

IMPORTANT NOTES

- Suction Line: horizontal sections shall be sloped down towards the compressor.
- Suction line piping must be insulated when the evaporating temperature is below -10ºC.
- Discharge line: piping to the condenser must be designed to prevent liquid return to the compressor.
- Oil charge: Maneurop MTZ compressors are charged with specific Ester Lubricants reference 160PZ. The use of a different lubricant from the above may cause circuit contamination or may unfavourably react with the original lubricant and damage the compressor.
- The compressor is protected against motor overheating and overloading by internal protectors. For the three phase compressors the protector is connected to the neutral point of the start connected stator windings and cuts out all 3 phases simultaneously.

IMPORTANT
When the protection has cut out it may take up to 2 or 3 hours to reset and restart the compressor.

4.3.2 Crankcase Heater

- The crankcase heater has to be fitted with thermal contact grease between the element and the thermal well and permanently connected to a power source. (Self regulating PTC heater).
- When removing the heater avoid pulling on the cables as this may damage the part.

4.3.3 Compressor Start Up (After Replacement)

1) Preliminary Instructions and Precautions

	CAUTION
	Do not use the compressor to draw a vacuum in the circuit as it may damage the compressor.

a) Do not use a Mega meter or apply power to the compressor while it is under vacuum, this may cause damage to the motor windings.

b) Before initial start-up or after a prolonged shut down period it is recommended to energise the crankcase heater by switching on the power to the main control panel for a minimum of 12 hours before compressor start-up. This is necessary to boil off any refrigerant liquid under the compressor oil displacing it and reducing lubrication of critical components.

c) Before start up check that the compressor oil level is within operational limits. ($^{1}/_{4}$ to $^{3}/_{4}$ of the oil level sight glass).

d) Ester oil 160PZ characteristics are different from the mineral lubricants, they absorb moisture very quickly. It is strongly recommended to keep the nitrogen gas pressure in the compressor until final connection to the system. Do not expose compressor to the air for more than 20 minutes as it may absorb moisture from the atmosphere.

2) Leak check and charging

a) With the service valves of the compressor shut, pressurise the system with R404A and perform leak detection. (Use Snoop or an equivalent leak detector).

b) Draw a vacuum on the system, first with the compressor valves shut. The minimum standing vacuum should be 0.25 mmHg (0.33 mbar).

c) Use a two-stage vacuum pump reserved for working with HFC refrigerants. Connect the pump using suitably sized connections of $^{3}/_{8}$″ minimum.

d) Switch the crankcase heater on.

e) Break the vacuum with nitrogen and open the compressor valves.

f) Draw a vacuum on the entire system including the compressor, minimum standing vacuum to be reached: 0.25 mm Hg.

g) Charge the system with R404A at the receiver drawing the refrigerant in liquid phase from the bottle and get as close as possible to the nominal charge before starting the compressor.

h) Start the compressor.

i) Slowly, add the required refrigerant in liquid phase, on the low pressure side at the furthest point from the compressor.

3) Service and setup guidelines

a) Connect test gauges to measure the operating pressures of the system.

4) System running checks

a) After 2-3 hours of operation, stabilize the system operating conditions and check the oil level in compressor again. Add oil if necessary and repeat the operation.

b) Under steady load conditions check refrigeration piping or capillary tubes for abnormal vibrations (movement amplitude of more than 1.5 mm of a refrigeration line necessitates corrective actions, pipe bracket, etc...).

4.3.4 Compressor Maintenance

	CAUTION
	**The Maneurop compressors used are sealed units and are under pressure from the refrigerant gas inside their body. They also include electrical components. It is therefore recommended that the installation and maintenance of these compressors is performed by qualified technicians only.**

These systems are charged with azeotropic refrigerants and to ensure optimum compressor performance and reliability they must be serviced by personnel with comprehensive theoretical and practical training.

Regular checks and tests:

- Check compressor operating conditions (evaporator temp., condenser temp., and discharge temp) make sure that all parameters are in line with the application and within the compressor operating limits specified in the catalogue.
- Check a safety switch set points.
- Check compressor oil level.
- Perform a refrigerant leak detection test.
- Check compressor suction superheat.
- When servicing a system charged with R404A always replace the filter drier.
- Circuit dehydration is mandatory and maximum residual moisture in the system is 100ppm.

4.4 Refrigeration Condenser

The Refrigeration Condenser used is an Alfa Laval, seawater-cooled Shell and Tube Condenser. It requires a flow of sea water through the shell to remove heat from the refrigerant flowing in the tubes of the condenser.

The condenser is suitable for all CFC/HFC-refrigerants and has the following operating pressure and temperature.

- Refrigerant side: Max. 28 bar/-10ºC to 120ºC
- Water side: Max. 10 bar/-10ºC (with antifreeze agent) to 95ºC

For further details see **Appendix G**.

4.5 Refrigeration Evaporator

The Refrigeration System Evaporator is an Alfa Laval Compact Brazed Heat Exchanger. Cold refrigerant flowing through the unit removes heat from the water/glycol heat transfer fluid.

The evaporator should be mounted in the vertical position with the small port at the bottom of the arrangement. In all refrigerant applications it is very important that every refrigerant channel is enclosed by a water/glycol channel on both sides. Connecting the refrigerant instead of the water/glycol to the first and last channel may drop the evaporation temperature and result in freezing and reduced performance.

The expansion valve should be placed close to the inlet connection of the evaporator whereas the bulb should be mounted on the refrigerant outlet connection. The pipe diameter between the expansion valve and the heat exchanger should be the same as the diameter of the liquid line.

Ensure that threaded connections are not over-tightened. It is advisable to use a connection with a bonded seal positioned between the fitting and the heat exchanger boss.

4.6 Thermostatic Expansion Valve

See Part Documentation in **Appendix L** for component manual

4.7 Capacity Regulator

See Part Documentation in **Appendix K** for component manual

4.8 Safety Switches

See Part Documentation in **Appendix I** and **Appendix J** for both the pressure and anti freeze switch component manual.

4.9 Replace Filter/Dryer

4.9.1 Preparation

- Gain clear access to the filter drier.
- Close accumulator outlet valve
- Pump down the refrigeration system and allow compressor to shut off by tripping the low pressure switch at least twice. With the condenser outlet valve closed the compressor will pump R404A into the condenser. By closing the condenser outlet valve, no R404A will flow back into system.
- Close the condenser inlet valve
- Set up a refrigerant recovery system to evacuate the low pressure (LP) part of the refrigeration system.

	**WARNING** **EVACUATE PIPE WORK BEFORE BRAZING** **Do not braze or apply heat to the refrigeration system or components for at least 5 minutes after evacuation as heated refrigerant produces a dangerous gas.**
	**CAUTION** **Install new filter-drier immediately following any piping repair. Do not allow refrigeration system to be opened to atmosphere for a long period of time. The system will absorb water which will contaminate new driers as well as the entire refrigeration system.**

4.9.2 Remove Filter-Drier and Install New Component

- Loosen flare nuts or for brazed fittings use acetylene torch to un-solder and remove the old filter/drier.
- Install the new filter/drier. Make sure that the arrow on the filter/dryer, indicating the direction of flow, is pointing in direction of the system refrigerant flow. Tighten the flare nuts or re-solder the new unit.

4.9.3 Evacuate and Test Run

- Connect an R404A gauge manifold set onto the compressor. Connect the red hose to the discharge service valve and the blue hose to the suction service valve.
- Set up refrigerant recovery system and evacuate the LP part of the refrigeration system to remove any air and moisture.
- Open the condenser shut off valves.
- Turn the refrigeration system on and run for 10 to 15 minutes. Check the refrigeration sight glass to see if any bubbles are visible in the refrigerant stream indicating a low gas charge. If necessary add refrigerant to the system until the bubbles disappear.

- Close service valves and remove gauge manifold set.

4.10 Fluid Pumps

1. General

If pumps are not primed properly, or lose their prime during start up, they should be shut down and re-primed before start up is repeated. Normal pressures for the fluid pumps are, 2-5 bar (30-70 psi).

	**CAUTION**
	Do not run pumps if pressures are not in the allowable range as this may damage the pumps.

2. Maintenance

Pump bearings and shaft seals are maintenance free however service kits are available from Divex.

See **Appendix N** for more details

4.11 Temperature Control (Hot and Cold Fluids)

When replacing a controller it is necessary to reprogram the unit. As heating and cooling processes are governed by separate controllers there are two programming procedures. These procedures are detailed in the following two sections.

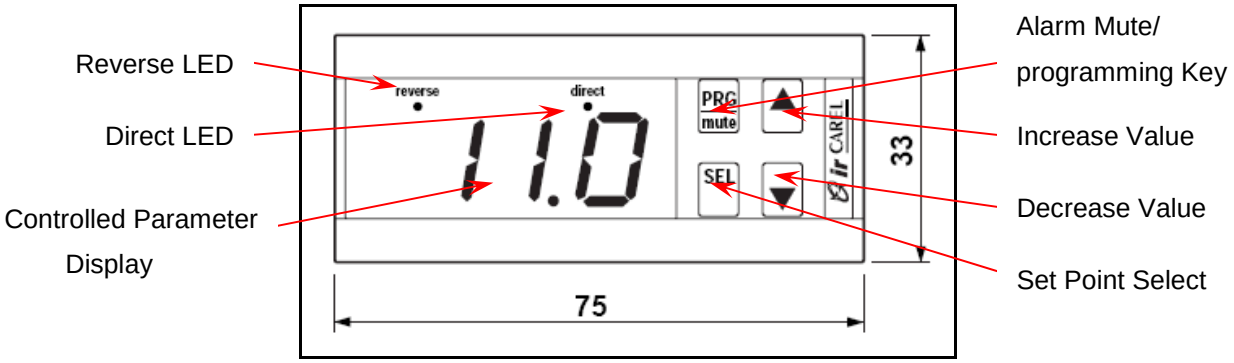


Figure 7 IR 32 Controllers

4.11.1 Heating System Controller Set-up

The controller must be in reverse control mode as will be noted by the flashing LED on the front panel. This is the Carel factory default setting. There are a number of other parameters that need to be set up all of which can be done by following the sequence

IMPORTANT
The controller uses ºC exclusively for all inputs and displays. A full description of each function number is given in Appendix O.

Setting reverse mode

- Push the SEL and PRG keys simultaneously for 5 sec.
- Use the arrows keys to page to 77, press SEL.
- Use the arrow keys to page to C 50, press SEL.
- Change the number to 1 using the arrow keys.
- Press the SEL key to return to the C 50 screen.
- Use the arrow keys to page to C 0, press SEL.
- Change the number to 2 using arrow keys.
- Press the SEL key to return to the C 0 screen.

Setting the sensor type

- Use the arrow keys to change the display to C 13, and then press SEL.
- Change the value to 0 with the arrow keys.
- Press the SEL key to return to the C 13 screen.

The unit must be calibrated as the temperature displayed may differ from the actual temperature. Although the exact temperature is not critical in this case, it is good practice to set the controller as accurately as possible. Measure the ambient temperature and then compare the controller's displayed temp to this.

- Push the SEL and PRG keys simultaneously for 5 sec.
- Use the arrows keys to get 77, press SEL.
- Use the arrow keys to go to C 50, press SEL.
- Change the number to 1 with arrow keys.
- Press the PRG key to return to the normal operating mode.
- Press PRG for 5 sec.
- Use the arrow keys to go to P 14, press SEL.
- Change the number by the difference between the actual temperature and the displayed temperature with arrow keys.
- Press SEL to return to the P 14 menu.

From this step the temperature band can also be set for temperature differential about the set point.

- In P go to P1 with the arrow keys, press SEL.
- Change the number value to allow a differential of 2 degrees.
- Press PRG to return to the normal operating mode.

This completes the programming of the hot fluid temperature controller. Generally the set point of the hot fluid is 60ºC. It is not advised to increase the set point above this as fluid at this temperature could scold and cause injury. The set point is programmed as follows:

- Press SEL for 1 sec and release.
- Using the arrow keys adjust the set point to the required value.
- Press SEL again to return to the normal operating mode.

4.11.2 Chilling System Control Set-Up

The controller must be in Direct control mode as will be noted by the flashing LED on the controller display. (This is not the Carel factory default setting). There are a number of other parameters that need to be set up all of which can be done by following the sequence

IMPORTANT
The controller uses ºC exclusively for all inputs and displays. A full description of each function number is given in Appendix O.

Setting reverse mode.

- Push the SEL and PRG keys simultaneously for 5 sec.
- Use the arrows keys to get 77, press SEL.
- Use the arrow keys to go to C 50, press SEL.
- Change the number to 1 with arrow keys.

- Press the SEL key to return to the C 50 screen.
- Use the arrow keys to go to C 0, press SEL.
- Change the number to 1 with arrow keys.
- Press the SEL key to return to the C 0 screen.

Setting the sensor type

- Use arrow keys to change the display to C 13, and then press SEL.
- Change value to 0 with the arrow keys.
- Press the SEL key to return to the C 13 screen.

The unit will now have to be calibrated as the temperature displayed can possibly be different from the actual temperature by as much as 3ºC. Although the exact temperature is not critical in this case, it is good practice to set the controller as accurately as possible. Measure the ambient temperature and then compare the controller's displayed temp to this.

- Push the SEL and PRG keys simultaneously for 5 sec.
- Use the arrows keys to get 77, press SEL.
- Use the arrow keys to go to C 50, press SEL.
- Change the number to 1 with arrow keys.
- Press the PRG key to return to the normal operating mode.
- Press PRG for 5 sec.
- Use the arrow keys to go to P 14, press SEL.
- Change the number by the difference between the actual temperature and the displayed temperature with arrow keys.
- Press SEL to return to the P 14 menu.

From this step the temperature band can also be set for temperature differential about the set point.

- In P go to P1 with the arrow keys, press SEL
- Change the number value to allow a differential of 1 degrees; this can be changed to suite the specific controller as different output units may be supplied. Single output unites use 1, two output units 2, three output units 3 and four outputs 4)
- Press PRG to return to the normal operating mode.

This completes the programming of the cold fluid temperature controller. Generally the set point of the cold fluid is 1ºC. It is not advised to decrease the set point below this as the fluid may freeze and excessive condensation may occur on exposed piping. The set point is programmed as follows.

- Press SEL for 1 sec.
- Release it and then using the arrow keys adjust the set point.
- Press SEL again to return to the normal operating mode.

(Page Left Blank Intentionally)

SECTION 5 TROUBLESHOOTING

1. FLUID SYSTEMS		
PROBLEM	**PROBABLE CAUSE**	**SOLUTION**
A. No Fluid Pressure	Pumps turning backwards due to incorrect phase connection	Check the pump motor power phasing. Pumps should be rotating in the direction of the arrows shown on the motor.
	Air in fluid system.	**a)** Prime pumps in accordance with priming procedure. **b)** Check for leaks in fluid system.
	Pump motor burned out.	Replace pump motor.
B. Low Fluid Pressure	Air in fluid system.	**a)** Prime pumps in accordance with priming procedure. **b)** Check for leaks in fluid system
	Leak in fluid return line plumbing.	**a)** Shut down unit and check for leaks. **b)** Repair leaks, refill and prime system as required.
	Restriction in fluid return line	**a)** Clean all fluid return lines. **b)** Check for dented, crushed or restricted plumbing. Remove and replace/repair as necessary. **c)** Check for return line smaller than 1”.
	Pump shaft seal leaking.	Replace pump shaft seal.
	Y-Filter in return line clogged.	Remove filter screen and clean. Replace screen and prime. Retest.
C. High Fluid Pressure	Restriction in fluid output line.	**a)** Clean all fluid discharge lines. **b)** Check for dented, crushed, or restricted plumbing. Remove and replace/repair as necessary.
D. Line Filter Clogs Repeatedly	Incorrect anti-freeze in fluid system.	Drain, flush, and refill system with a proper anti-freeze. Anti-freeze should not have a high content of “stop leak”
	System plumbing has become contaminated.	Drain, clean and flush the complete fluid system. Check all bearings, valves etc. for damage and replace/repair as necessary.

2. ELECTRONIC CONTROLS		
PROBLEM	**PROBABLE CAUSE**	**SOLUTION**
A. Temperature Controller Indicates Fault	Faulty calibration.	Refer to **Appendix O**. for recalibration procedure
	Open circuit in sensor wiring.	Trace wiring and repair.
	Faulty temperature transmitter.	Replace temperature transmitter. Temperature transmitter failure will cause loss of heating/cooling control.
	Wiring fault	Check integrity of wiring and all connections according to the wiring diagrams.
	Defective temperature controller	Replace controller.
B. Controlled Temp. Does Not Agree With Displayed Temp.	Improper calibration.	Re-calibrate the temperature controller.

3. ELECTRICAL		
PROBLEM	**PROBABLE CAUSE**	**SOLUTION**
A. HCS-1 Will Not Start	Improper/Faulty input voltage and/or frequency.	Provide HCS-1 with proper input power.
	Defective Electrical Circuit.	**a)** Check ON-OFF switch for broken or missing connection. Repair as necessary. **b)** Check wires on main power contactor. Repair as necessary. **c)** Check primary pump overload relay. 1. Turn to manual and depress RESET. 2. Turn back to AUTO. 3. Check voltage across overload switch. If there is voltage and depressing the RESET did not reset the switch (and the RESET was allowed to cool), replace overload relay **d)** Check power across main power contactor coil when ON-OFF switch is in ON position. If there is 220 volts and contact does not close, replace contactor. **e)** Check that ON-OFF switch makes contact when turned. If not, replace ON-OFF switch.
B. Refrigeration Compressor Won't Operate	Defective K106 Contactor.	Check K106 and verify 220 volts across coil and contactor does not close; replace contactor.
C. Contactors Chattering	Low frequency	Check frequency; should be minimum of 50 Hz. If frequency is low, have problem corrected.
	Rust on contactor lamination (steel bar)	Sand rust off and coat with WD-40 (Do not saturate)
	Dirt on coil or lamination	Strip, clean and reassemble
D. Overload Relay Trips Repeatedly With No Apparent Reason	Undersized thermal element	Check for proper element size and replace elements if needed.
	Defective overload relay	Replace overload relay.

4. GENERAL		
PROBLEM	**PROBABLE CAUSE**	**SOLUTION**
A. Refrigeration Compressor Will Not Operate	Fluid pump is not switched on or interlock is still engaged.	Turn on the fluid pump before starting the refrigeration. If refrigeration does not start check the interlock circuit.
	Compressor thermal overload relay has tripped	Allow 30 minutes for compressor motor to cool before attempting to restart.
	Defective compressor motor	If compressor does not start or starts and stops again very quickly after a cool down, to determine if compressor motor is defective, check the following: Remove the three wires from refrigeration compressor motor If there is continuity to ground or short between legs the motor is defective or damaged. Replace the compressor.
B. Cold Fluid At Ambient	Low refrigerant charge	Check sight glass for bubbles & recharge refrigeration system.
	Temperature control not properly set up or calibrated	Check the controller set up. Calibrate temperature control.
	Faulty refrigeration system	Refer to refrigeration system section
C. Main Input Breaker Trips When System Is Energised	Short in input wiring	Check and repair input wiring as necessary.
	Defective compressor motor	Check and replace compressor motor if needed.
	Defective fluid pump motor	Check and replace pump motor if needed.
	Internal wiring crimped and shorted	Check all internal wiring for shorts and repair if necessary.
D. Compressor, Fan And/Or Main Power Contactors Chattering	Input power frequency incorrect	Supply unit with correct power and frequency.
E. Hot Fluid Circuit Not Heating Effectively; Contactors On But No Current Flow	Open immersion heater fuses	Replace fuses.
	Defective immersion heater; open circuit	Replace immersion heater.

4. GENERAL		
PROBLEM	**PROBABLE CAUSE**	**SOLUTION**
F. Chattering Sound From HCS-1	Relief valve venting on fluid system due to high pressure	**a)** Check for high system pressure. **b)** Valve shut-off in primary system, security valves, bulkhead valve etc. Open system valves. System pressure should be between 2 and 5 bar. **c)** Crimped line on primary system. **d)** Gas leak into fluid system from chamber internal piping.

5. REFRIGERATION SYSTEM		
PROBLEM	**PROBABLE CAUSE**	**SOLUTION**
A. Cannot Locate Refrigerant Leak	Internal refrigerant leak into evaporator	Drain small quantity of fluid from system and check with refrigerant leak detector. Replace evaporator, if required.
B. Low Suction Pressure When System Is Known To Be Charged	Water in refrigerant	Replace drier/filter recharge refrigeration system.
C. Compressor Rapidly Cycles	Low refrigerant charge resulting in low suction pressure turning compressor on and off on low pressure switch	**a)** Find and repair leak in refrigeration system and re-prime. **b)** Recharge refrigeration system in accordance with page 87-89
	Clogged or blocked condenser - turning on and off on high pressure switch	Check and clean condenser
	Inoperative condenser water regulating causing high discharge pressure	Check that cooling water is flowing. If not: **a)** Water supply is turned off. **b)** Water discharge is blocked.
	Water shut off on water cooled condenser	**a)** Turn water on **b)** Defective water valve. Replace.
D. Low Suction Pressure; Low Discharge Pressure; Very Little Cooling	Clogged drier/filter	To determine this, feel drier/filter. It will feel cooler than the receiver. If this is the case, change drier/filter.
	Low on refrigerant charge	**a)** Check for leak. Repair. **b)** Charge system with refrigerant.
D. Low Suction Pressure; Low Discharge Pressure; Very Little Cooling…cont	Clogged suction drier	Determine this by attaching gauge manifold set to fitting on suction drier, then attach to suction service valve and check suction pressure. There should be no more than 4 psi pressure drop across drier. If pressure drop is high, replace suction drier.

5. REFRIGERATION SYSTEM		
PROBLEM	**PROBABLE CAUSE**	**SOLUTION**
E. Compressor Icing Up Past Suction Service Valve	Super heat set too low on expansion valve	Remove cap from expansion valve and turn one turn at a time, clockwise, looking at super heat adjusting screw. Allow 10 minutes between adjustments. Continue until frost line breaks at suction service valve.
F. Secondary Fluid Too Cold Or Too Hot	Temperature control set improperly	Secondary fluid should be limited to a low temperature of 30ºF (-3ºC). Install a temperature measuring device on secondary fluid line to measure temp.
G. High Discharge Pressure	Water cooled unit: water shut off	**a)** Turn water on. **b)** Insufficient flow to condenser. Increase line size and pressure.
H. Low Suction Pressure	Low on refrigerant charge	Charge unit with refrigeration.
	Expansion valve defective	Expansion valve could be defective, broken sensor, or dirt in valve. Replace.

(Page Left Blank Intentionally)

SECTION 6 APPENDICES

Appendix A Part Identification

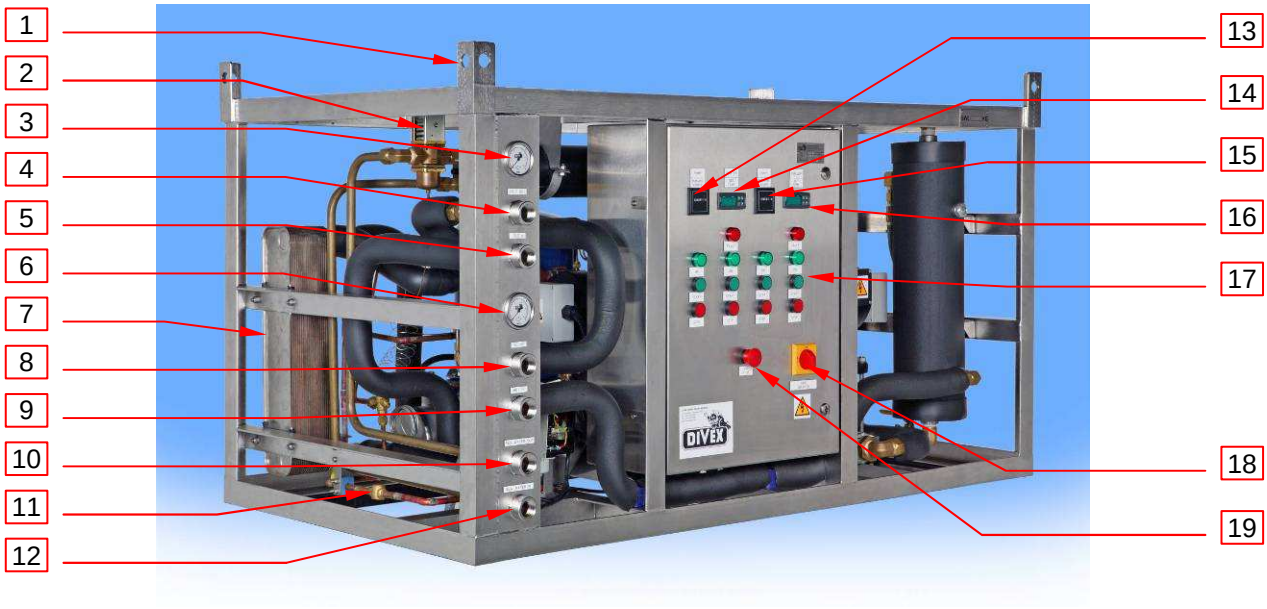


Figure 8 Part Identification - Front View

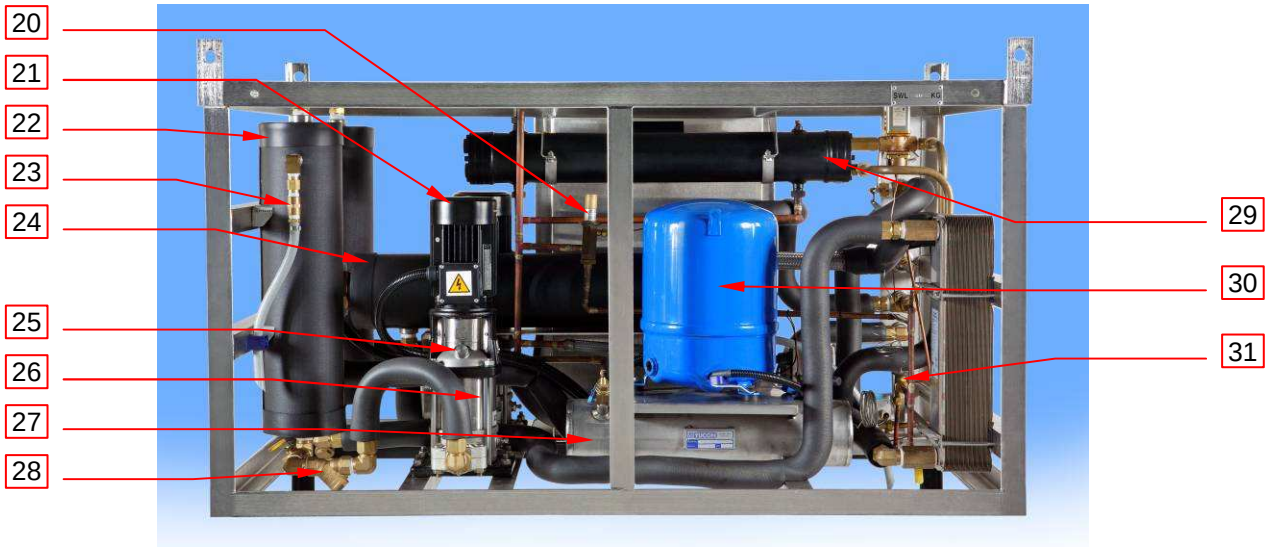


Figure 9 Part Identification – Rear View

Item	Description	Divex SA Part No.
1	Lifting Eye	-
2	Condenser Water Capacity Control Valve	04819
3	Cold Out Pressure Gauge	PBBV63BB02QJ2A
4	Cold Out Connection	-
5	Cold In (Return) Connection	-
6	Hot Out Pressure Gauge	PBBV63BB02QJ2A
7	Evaporator (Plate Heat Exchanger)	04927
8	Hot Out Connection	-
9	Hot In (Return) Connection	-
10	Sea Water Out Connection	-
11	Sight Glass	02617
12	Sea Water In Connection	-
13	Hot Circuit Pump Run Hour Meter	05670
14	Heater Temperature Controller (24V)	05711
15	Cold Circuit Pump Run Hour Meter	05670
16	Chiller Temperature Controller (24V)	05711
17	Electrical Control Panel, Selectors and Run/Trip Indication	-
18	Main Isolator (63A)	02877
19	Emergency Stop Button	-
20	Hot Gas Bypass Valve (Capacity Regulation Valve)	02621
21	Pump and Motor Assembly	02607
22	Glycol/Water Reservoir	-
23	Reservoir Relief Valve	02304
24	Heater Chamber (Element)	05213
25	Circulating Pump Bleed Valve	-
26	Circulating Pump	*(See 21, 02607)*
27	Liquid Receiver	02685
28	Strainer	02682
29	Condenser	02610
30	Compressor	02612
31	Expansion Valve	02618

Appendix B List of Recommended Spares

Description	Qty.	Divex Part No.	Indicated In:
Pump, St/St, Grundfoss	1	02607	Figure 9, Item 25
Element, 4.5kW, 380VAC 3Ph, 2" BSP	1	05213-SPARE	Figure 9, Item 24
Compressor, Maneurop, R404a	1	02612	Figure 9, Item 30
Filter, Drier, Refrigeration, ½" Flare	1	02838	Figure 6
Valve, Expansion, Thermostatic, TES2 MOP	1	02618	Figure 9, Item 31
Orifice, Refrigeration, No. 4	1	02849	Figure 9, Item 31
Valve, Capacity Regulating	1	02621	Figure 9
Switch, Pressure, KP 15, 60-2008	1	02619	Figure 6
Valve, Pressure Actuated, ¾"	1	04819	Figure 9
Controller, Temperature, Carel, 24V	1	05711	Figure 8, Item 14 & 16
Contact Element, N/O, Contact Block	2	02889	Figure 8, Item 17
Overload, Thermal, 2.5-4.0A, RF38.0400	1	05709	Figure 8, Item 17
Contactor, 12.5kW, 32 Amp, 3-Pole, DC	1	04836	Figure 8, Item 17
Contactor, 4.2kW 3Pole, 24VDC Coil, Din	1	03255	Figure 8, Item 17
Sensor, NTC 015	1	02787	-
Coil, Solenoid, 24VDC, 50Hz, 20 Watt	1	05210	Figure 6
Contact Element, N/C, Contact Block	2	02891	Figure 8, Item 17
Relay, Miniature, 24VDC Coil, 4 C/O	2	04171	Figure 8, Item 17
Light, Pilot, LED Cluster 24VAC/DC Red	2	04992	Figure 8, Item 17
Light, Pilot, LED Cluster 24VAC/DC Green	2	04990	Figure 8, Item 17
Overload, Thermal, 9-14A, RF38.1400	1	02904	Figure 8, Item 17
Contactor, Auxiliary Add-on Block	2	03716	Figure 8, Item 17
Circuit Breaker, Miniature, 1Ph 2A 5kA	1	02883	Figure 8. Item 17
Circuit Breaker, Miniature, 2Ph 2A 5kA	1	02882	Figure 8, Item 17
Circuit Breaker, Miniature, 3Ph 16A 10kA	1	02881	Figure 8, Item 17
Circuit Breaker, Miniature, 3Ph 10A 10kA	1	02880	Figure 8, Item 17
Power Supply, 380-500V, 24VDC, 5A	1	03904	Figure 8, Item 17
Hour Meter, 7-Digit, 48mm^2, 24VDC	1	05670	Figure 8, Item 13 & 15
Module, Plug-In, 6-220VDC	3	03910	Figure 8, Item 17
Diode, Safety, Back EMF, 24VDC Contactor	3	04924	Figure 8, Item 17
Fuse, Glass 5x20, 5 Amp	10	03914	Figure 8, Item 17
Fuse, Glass 5x20, 1 Amp,	10	03913	Figure 8, Item 17
Transformer, 400-230VAC, 40V	1	05710	Figure 8, Item 17
Thermostat, 70 ℃, 220V, 10A, Bi metal	1	03657	-
Valve, Relief, 1/2" MNPT, 3-50 psi, Brass	1	02304	-
Defrost, Thermostat, CMU-2	1	02609	-
Anode, CMU Condenser	2	04925	-
Kit, O-Ring, Rubber Type: EPDM	1	06511	-
Kit, Shaft Seal, HQQE	1	06512	-
Kit, Wear Parts, Material Type: Silicon Carbide	1	06513	-

(Page Left Blank Intentionally)

Spares Acquisition Sheet

CS-4 Serial No.:	**CMU/ /**				
Request for:	**Quotation & Delivery Details**	YES	NO	**Order Date:**	DD / MM / YYYY
(Mark appropriate)	**Supply Based on Order No.**	YES	NO	**Order No:**	

Note: *Please attach full contact details to this sheet when placing orders and fill in required quantities in the table below before faxing or e-mailing this request to the nearest Divex Sales Office.*

Description	Divex SA Part No.	Qty
Pump, St/St, Grundfoss	02607	
Element, 4.5kW, 440VAC 3Ph, 2" BSP	05213-SPARE	
Compressor, Maneurope, R404a	02612	
Filter, Drier, Refrigeration, ½" Flare	02838	
Valve, Expansion, Thermostatic, TES2 MOP	02618	
Orifice, Refrigeration, No. 4	02849	
Valve, Capacity Regulating	02621	
Switch, Pressure, KP 15, 60-2008	02619	
Valve, Pressure Actuated, ¾"	04819	
Controller, Temperature, Carel, 24V	05711	
Contact Element, N/O, Contact Block	02889	
Overload, Thermal, 2.5-4.0A, RF38.0400	05709	
Contactor, 12.5kW, 32 Amp, 3-Pole, DC	04836	
Contactor, 4.2kW 3Pole, 24VDC Coil, Din	03255	
Sensor, NTC 015	02787	
Coil, Solenoid, 24VDC, 50Hz, 20 Watt	05210	
Contact Element, N/C, Contact Block	02891	
Relay, Miniature, 24VDC Coil, 4 C/O	04171	
Light, Pilot, LED Cluster 24VAC/DC Red	04992	
Light, Pilot, LED Cluster 24VAC/DC Green	04990	
Overload, Thermal, 9-14A, RF38.1400	02904	
Contactor, Auxiliary Add-on Block	03716	
Circuit Breaker, Miniature, 1Ph 2A 5kA	02883	
Circuit Breaker, Miniature, 2Ph 2A 5kA	02882	

Description	Divex SA Part No.	Qty
Circuit Breaker, Miniature, 2Ph 2A 5kA	02882	
Circuit Breaker, Miniature, 3Ph 16A 10kA	02881	
Circuit Breaker, Miniature, 3Ph 10A 10kA	02880	
Power Supply, 380-500V, 24VDC, 5A	03904	
Hour Meter, 7-Digit, 48mm2, 24VDC	05670	
Module, Plug-In, 6-220VDC	03910	
Diode, Safety, Back EMF, 24VDC Contactor	04924	
Fuse, Glass 5x20, 5 Amp	03914	
Fuse, Glass 5x20, 1 Amp	03913	
Transformer, 400-230VAC, 40V	05710	
Thermostat, 70 ℃, 220V, 10A, Bi metal	03657	
Valve, Relief, 1/2" MNPT, 3-50 psi, Brass	02304	
Defrost, Thermostat, CMU-2	02609	
Anode, CMU Condenser	04925	
Kit, O-Ring, Rubber Type: EPDM	06511	
Kit, Shaft Seal, HQQE	06512	
Kit, Wear Parts, Material Type: Silicon Carbide	06513	

(Page Left Blank Intentionally)

Appendix C Electrical Schematics

(Page Left Blank Intentionally)

Project: *CMU-2*	Supplier: *Divex Cape Town*
Technical Data :	
Degree of Protection	: *IP 55 (Minimum)*
Rated Voltage / Frequency	: *380V @ 50hZ*
Rated Current	: *63 Amps*
Control Voltage	: *24VDC*

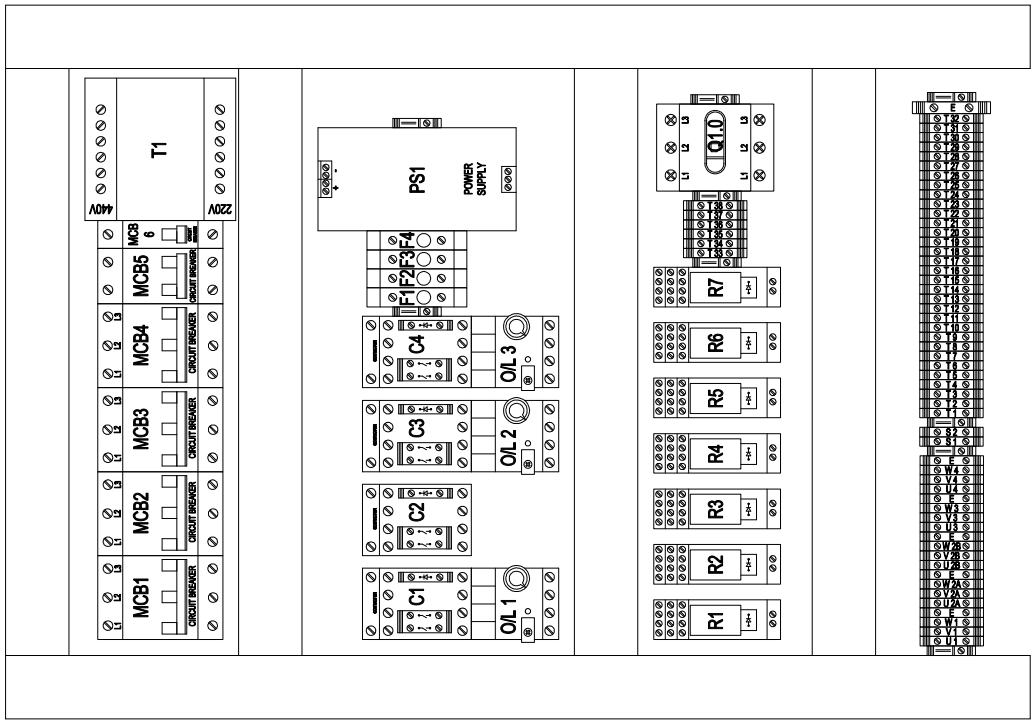
Wire Size	Wire Specification
0.75mm²	Silicone Rubber (Type RD7) Insulated (Halogen Free), SANS IEC 60332-1-2, SANS 1574, SANS 1411 & VDE 0282
2.5mm²	Silicone Rubber (Type RD7) Insulated (Halogen Free), SANS IEC 60332-1-2, SANS 1574, SANS 1411 & VDE 0282
4mm²	Silicone Rubber (Type RD7) Insulated (Halogen Free), SANS IEC 60332-1-2, SANS 1574, SANS 1411 & VDE 0282
6mm²	Silicone Rubber (Type RD7) Insulated (Halogen Free), SANS IEC 60332-1-2, SANS 1574, SANS 1411 & VDE 0282
10mm²	Silicone Rubber (Type RD7) Insulated (Halogen Free), SANS IEC 60332-1-2, SANS 1574, SANS 1411 & VDE 0282
16mm²	Silicone Rubber (Type RD7) Insulated (Halogen Free), SANS IEC 60332-1-2, SANS 1574, SANS 1411 & VDE 0282

Power Wiring:

Phase 1: Brown
Phase 2: Black
Phase 3: Grey
Earth: Green / Yellow

Control Wiring:

24 VDC: Red
0 VDC: Black



THIRD ANGLE PROJECTION

MATERIAL:

FINISH:

MASS: (kg)

REV	DESCRIPTION OF REVISION	ECN	DRAWN	DATE	DRAFTING CHECK BY	DATE	ENGINEER CHECK BY	DATE	APPROVAL BY	DATE
R02	CHANGES AS PER ECN CT00311	CT00311	R.C	14/07/11	G.D	14/07/11	N.M	14/07/11	N.M	14/07/11

OVER-TO	±	±	±
0-6	0.1	0.2	0.5
6-30	0.2	0.5	1.0
30-100	0.3	0.8	1.5
100-300	0.5	1.2	2.0
300-1000	0.8	2.0	3.0
1000-3000	1.2	3.0	5.0
3000-PLUS	2.0	4.0	8.0
ANGLE	0.25°	0.5°	1°

SCALE: NTS

PRODUCT/PROJECT: CMU-2

ALL DIMENSIONS IN MM (UOS) DO NOT SCALE

ALL DIMENSIONS BEFORE PLATING (UOS)

REMOVE SHARP EDGES & BURRS

DIVEX (PTY) LTD
11 DAWN ROAD
MONTAGUE GARDENS
CAPE TOWN, 7441
SOUTH AFRICA
TEL : +27 (0)21 551-2233
FAX : +27 (0)21 552-3547
email : info@divexglobal.com
www.divexglobal.com

A3

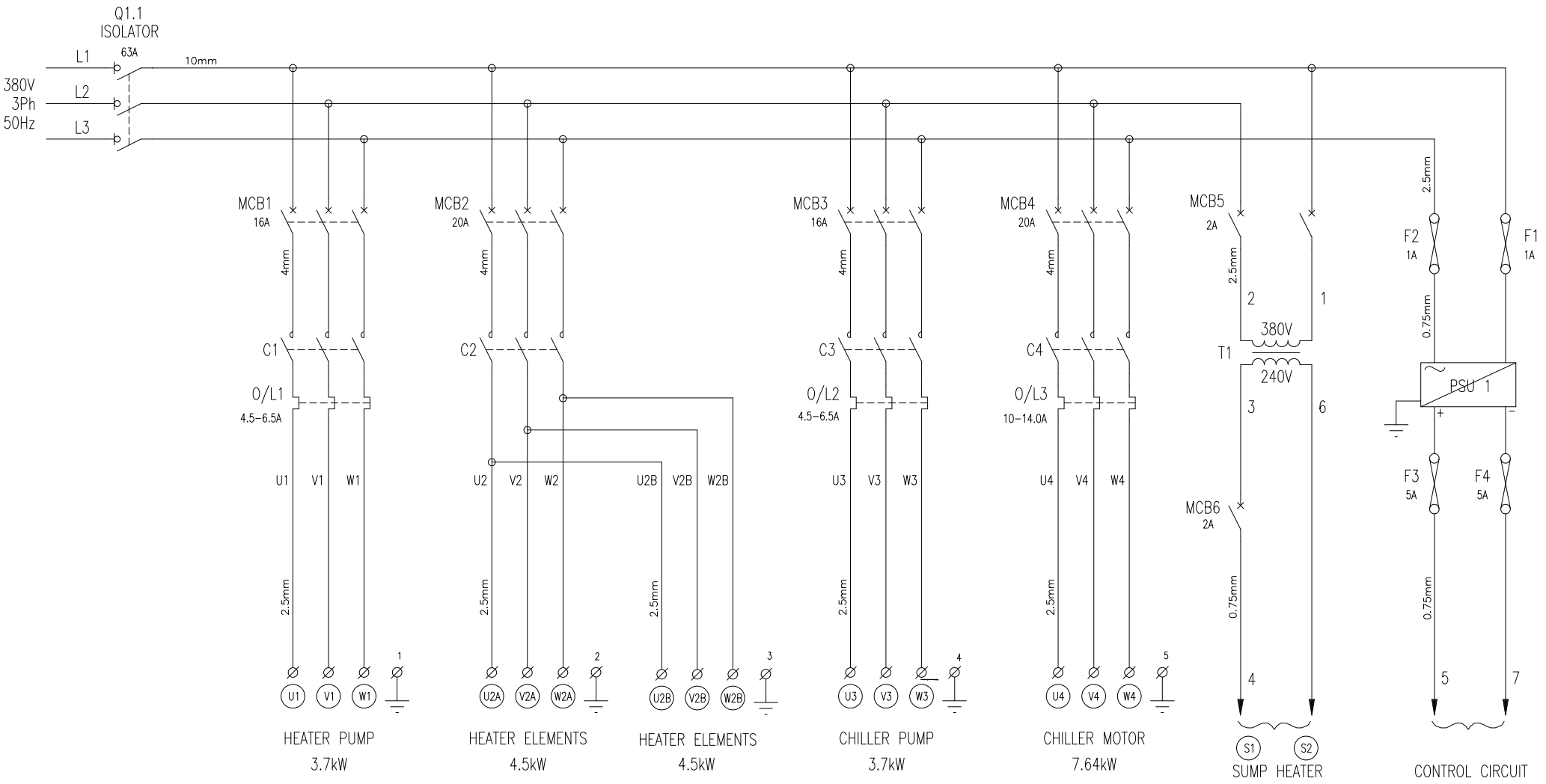
TITLE: CMU-2 ELECTRICAL PANEL LAYOUT (380VAC 50HZ 24VDC)

PART No. 05713

REV R02

CAD REF/DRG No. 05713

SHT 1 OF 3



THIRD ANGLE PROJECTION

MATERIAL:

FINISH:

MASS: (kg)

DIVEX (PTY) LTD
11 DAWN ROAD
MONTAGUE GARDENS
CAPE TOWN, 7441
SOUTH AFRICA
TEL : +27 (0)21 551-2233
FAX : +27 (0)21 552-3547
email : info@divexglobal.com
www.divexglobal.com

A3

REV	DESCRIPTION OF REVISION	ECN	DRAWN	DATE	DRAFTING CHECK BY	DATE	ENGINEER CHECK BY	DATE	APPROVAL BY	DATE
R02	CHANGES AS PER ECN CT00311	CT00311	R.C	14/07/11	R.H	14/07/11	N.M	14/07/11	N.M	14/07/11
R01	CHANGES AS PER ECN CT00203	CT00203	D.H	11/02/09	R.H	11/02/09	N.M	11/02/09	N.M	11/02/09
R00	FIRST ISSUE	–	D.H	10/11/08	G.D	10/11/08	N.M	10/11/08	N.M	10/11/08

OVER-TO	±	±	±
0-6	0.1	0.2	0.5
6-30	0.2	0.5	1.0
30-100	0.3	0.8	1.5
100-300	0.5	1.2	2.0
300-1000	0.8	2.0	3.0
1000-3000	1.2	3.0	5.0
3000-PLUS	2.0	4.0	8.0
ANGLE	0.25°	0.5°	1°

SCALE: NTS

PRODUCT/PROJECT: CMU-2

ALL DIMENSIONS IN MM (UOS) DO NOT SCALE

ALL DIMENSIONS BEFORE PLATING (UOS)

REMOVE SHARP EDGES & BURRS

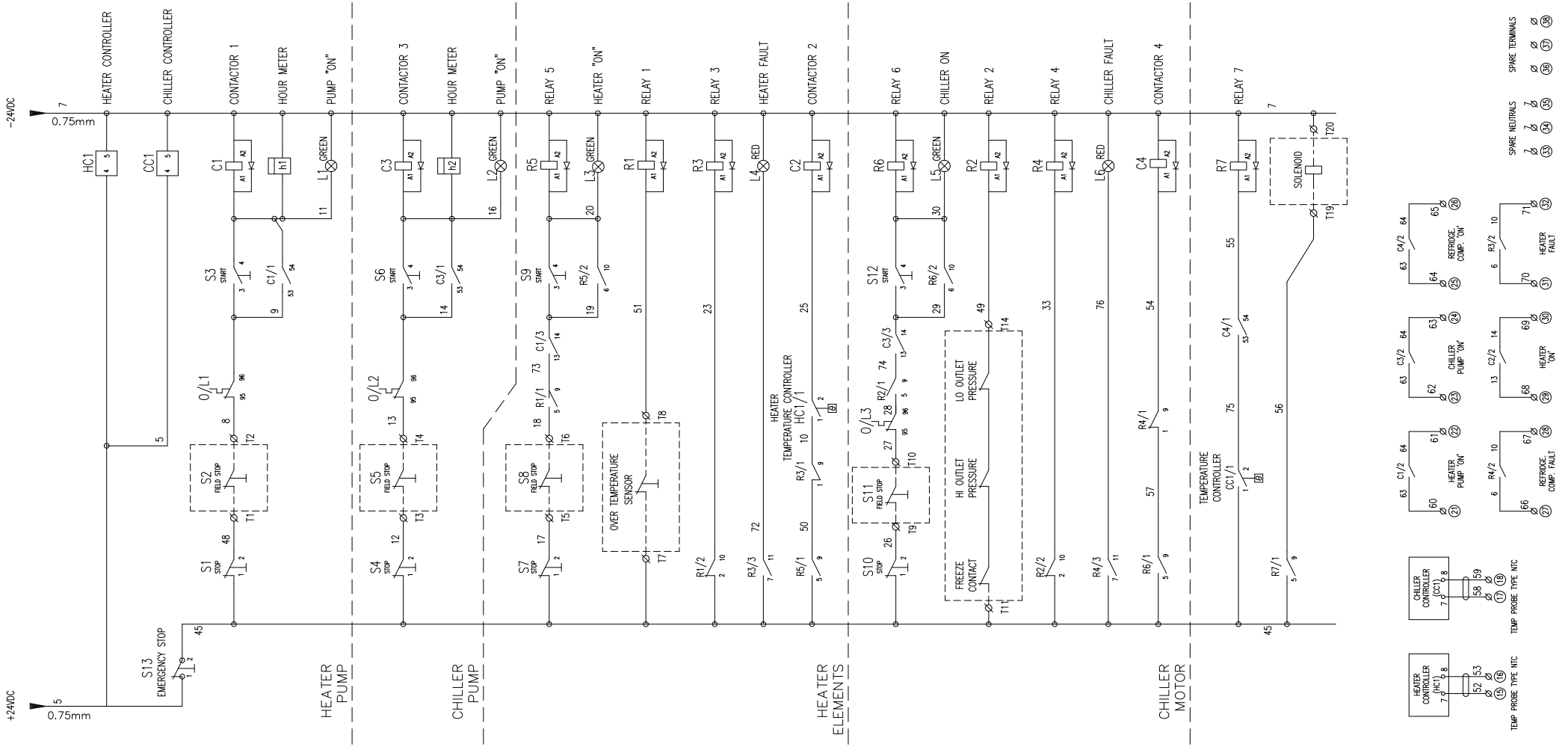
TITLE: CMU-2 ELECTRICAL SUPPLY CIRCUIT (380VAC 50HZ 24VDC)

PART No. 05713

REV R02

CAD REF/DRG No. 05713

SHT 2 OF 3



THIRD ANGLE PROJECTION	MATERIAL:	FINISH:	MASS: (kg)

DIVEX (PTY) LTD
11 DAWN ROAD
MONTAGUE GARDENS
CAPE TOWN, 7441
SOUTH AFRICA
TEL : +27 (0)21 551-2233
FAX : +27 (0)21 552-3547
email : info@divexglobal.com
www.divexglobal.com

A3

REV	DESCRIPTION OF REVISION	ECN	DRAWN	DATE	DRAFTING CHECK BY	DATE	ENGINEER CHECK BY	DATE	APPROVAL BY	DATE
R02	CHANGES AS PER ECN CT00311	CT00311	R.C	14/07/11	G.D	14/07/11	N.M	14/07/11	N.M	14/07/11
R01	CHANGES AS PER ECN CT00203	CT00203	D.H	13/02/09	G.D	13/02/09	N.M	13/02/09	N.M	13/02/09
R00	FIRST ISSUE	–	D.H	10/11/08	G.D	10/11/08	N.M	10/11/08	N.M	10/11/08

OVER-TO	±	±	±
0-6	0.1	0.2	0.5
6-30	0.2	0.5	1.0
30-100	0.3	0.8	1.5
100-300	0.5	1.2	2.0
300-1000	0.8	2.0	3.0
1000-3000	1.2	3.0	5.0
3000-PLUS	2.0	4.0	8.0
ANGLE	0.25°	0.5°	1°

SCALE: NTS

PRODUCT/PROJECT: CMU-2

ALL DIMENSIONS IN MM (UOS) DO NOT SCALE

ALL DIMENSIONS BEFORE PLATING (UOS)

REMOVE SHARP EDGES & BURRS

TITLE: CMU-2M ELECTRICAL CONTROL CIRCIT (380VAC 50HZ 24VDC)

PART No. 05713

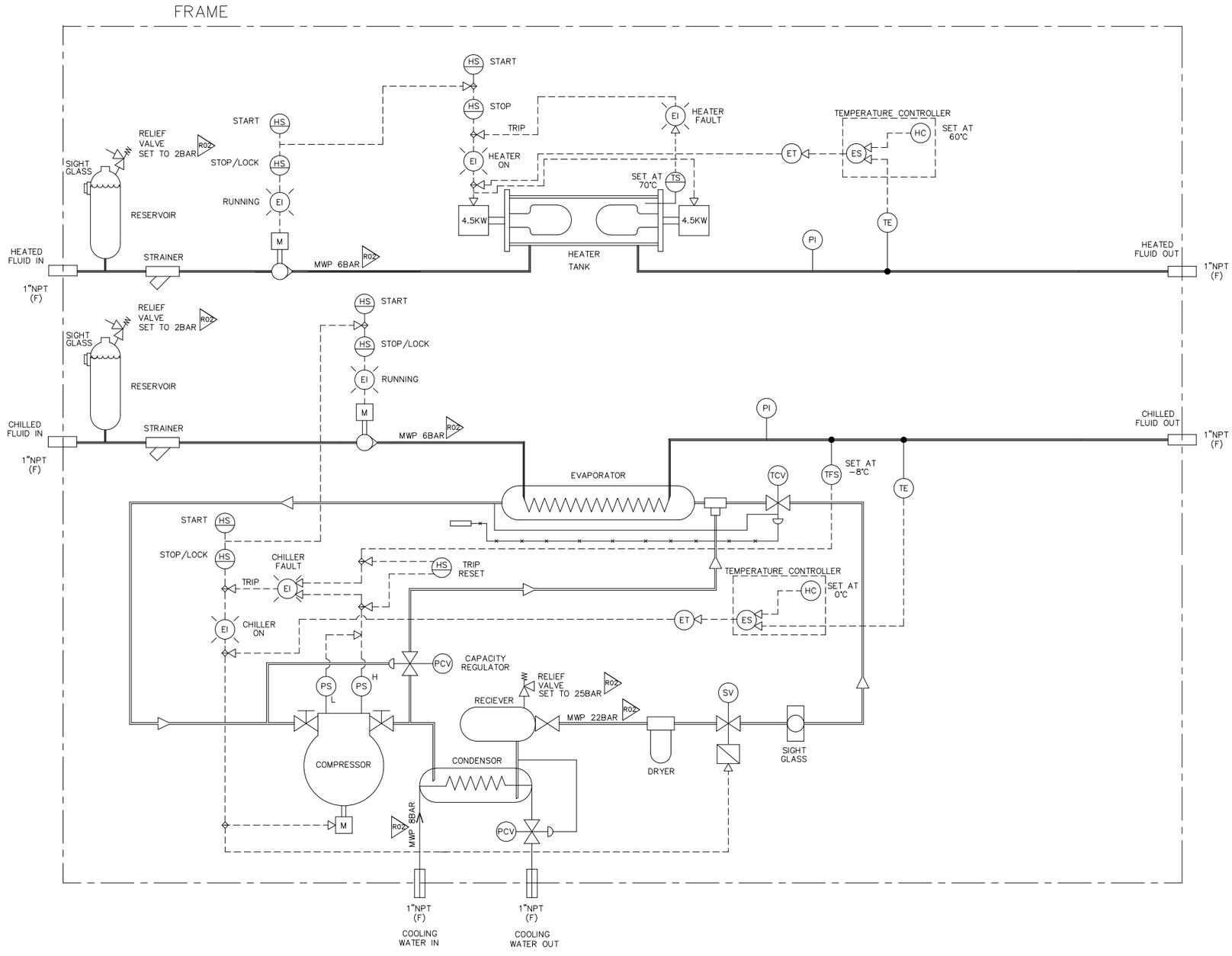
REV R02

CAD REF/DRG No. 05713

SHT 3 OF 3

Appendix D General Schematic

(Page Left Blank Intentionally)



LEGEND

EI	ELECTRICAL INDICATOR		WATER/GLYCOL
ES	ELECTRICAL SWITCH		REFRIDGERANT FLUID
ET	ELECTRICAL TIMER	- - - -	INSTRUMENT SIGNAL
FS	FLOW SWITCH	-x-x-x-	CAPILLARY
HS	HAND SWITCH		
HC	HAND CONTROL		
PCV	PRESSURE CONTROL VALVE		
PS	PRESSURE SWITCH		
SV	SOLONOID VALVE		
TCV	TEMPERATURE CONTROL VALVE		
TI	TEMPERATURE INDICATOR		
PI	PRESSURE INDICATOR		
TE	TEMPERATURE SENSOR		
TFS	TEMPERATURE ANTI FREEZE SENSOR		
TS	TEMPERATURE SWITCH		

THIRD ANGLE PROJECTION

MATERIAL:

FINISH:

MASS: (kg)

DIVEX (PTY) LTD
11 DAWN ROAD
MONTAGUE GARDENS
CAPE TOWN, 7441
SOUTH AFRICA.

TEL : +27 (0)21 551-2233
FAX : +27 (0)21 551-2275
email : info@divexglobal.com
www.divexglobal.com

A3

REV	DESCRIPTION OF REVISION	ECN	DRAWN	DATE	DRAFTING CHECK BY	DATE	ENGINEER CHECK BY	DATE	APPROVAL BY	DATE
R02	Updated as per ECN CT00298 R02	CT00298	R.C	21/09/10	R.C	21/09/10	N.M	21/09/10	N.M	21/09/10
R01	Rerouted and added accum	00099	A.B	13/06/07	A.B	14/06/07	N.M	14/06/07	N.M	14/06/07
R00+	CHECK PRINT ISSUE	—	O.L	03/05/06	A.B	04/05/06	N.M	05/05/06	A.B	08/05/06

OVER-TO	±	±	±
0-6	0.1	0.2	0.5
6-30	0.2	0.5	1.0
30-100	0.3	0.8	1.5
100-300	0.5	1.2	2.0
300-1000	0.8	2.0	3.0
1000-3000	1.2	3.0	5.0
3000-PLUS	2.0	4.0	8.0
ANGLE	0.25°	0.5°	1°

SCALE: NTS

PRODUCT/PROJECT: CMU-2

ALL DIMENSIONS IN MM (UOS) DO NOT SCALE

ALL DIMENSIONS BEFORE PLATING (UOS)

REMOVE SHARP EDGES & BURRS

TITLE: CMU-2 SCHEMATIC

PART No. 03617

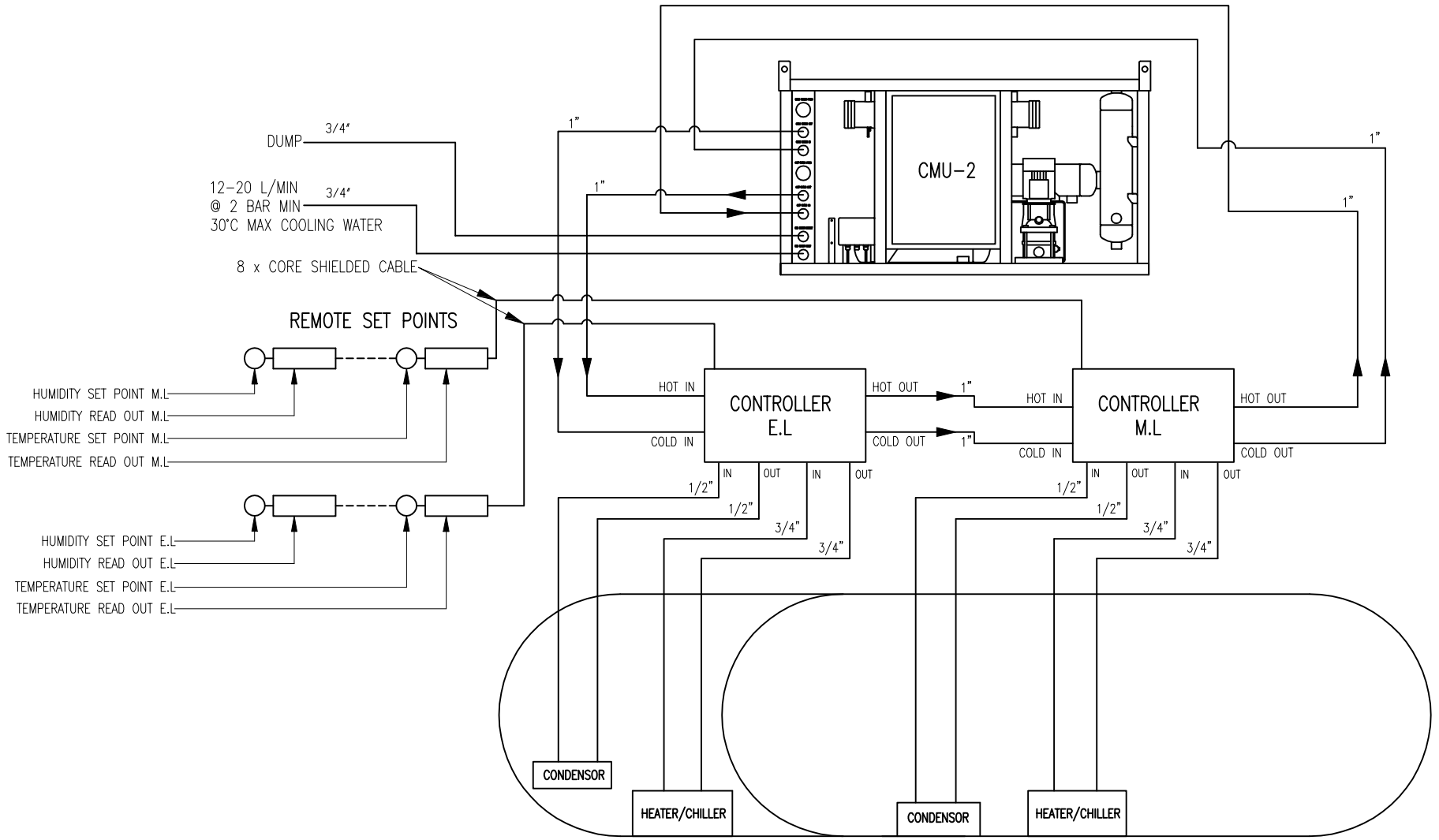
REV R02

CAD REF/DRG No. 03617

SHT 1 OF 1

Appendix E Flow Diagram

(Page Left Blank Intentionally)



(DIVEX ENGINEERING REFER TO 04319)

THIRD ANGLE PROJECTION

MATERIAL:

FINISH:

MASS: (kg)

REV	DESCRIPTION OF REVISION	ECN	DRAWN BY	DATE	DRAFTING CHECK BY	DATE	ENGINEER CHECK BY	DATE	APPROVAL BY	DATE
R02	CHANGES AS PER ECN CT00202	CT00202	D.H	06/02/09	R.C	06/02/09	N.M	06/02/09	N.M	06/02/09
R01	CHANGES AS PER ECN CT00077	CT00077	D.H	07/02/07	A.B	07/02/07	N.M	07/02/07	N.M	07/02/07
R00	CHECK PRINT ISSUE	---	O.L	16/11/05	A.B	22/03/06	S.W	22/03/06	N.M	24/03/06

DIVER-TO	±	±	±
0-6	0.1	0.2	0.5
6-30	0.2	0.5	1.0
30-100	0.3	0.8	1.5
100-300	0.5	1.2	2.0
300-1000	0.8	2.0	3.0
1000-3000	1.2	3.0	5.0
3000-PLUS	2.0	4.0	8.0
ANGLE	0.25°	0.5°	1°

SCALE 1:20

PRODUCT/PROJECT CMU-2

ALL DIMENSIONS IN MM (UOS) DO NOT SCALE

ALL DIMENSIONS BEFORE PLATING (UOS)

REMOVE SHARP EDGES & BURRS

DIVEX (PTY) LTD
11 DAWN ROAD
MONTAGUE GARDENS
CAPE TOWN, 7441
SOUTH AFRICA.

TEL : +27 (0)21 551-2233
FAX : +27 (0)21 552-3547
EMAIL : info@divexglobal.com
www.divexglobal.com

A3

TITLE: FLOW DIAGRAM

PART No. 03030

REV R02

CAD REF/DRG No. 03030

SHT 1 OF 1

Appendix F Compressor

(Page Left Blank Intentionally)

MAKING MODERN LIVING POSSIBLE

Maneurop® reciprocating compressors

MT/MTZ 50 - 60 Hz

R-22, R-407C, R-134a, R-404A / R-507A

REFRIGERATION &
AIR CONDITIONING DIVISION

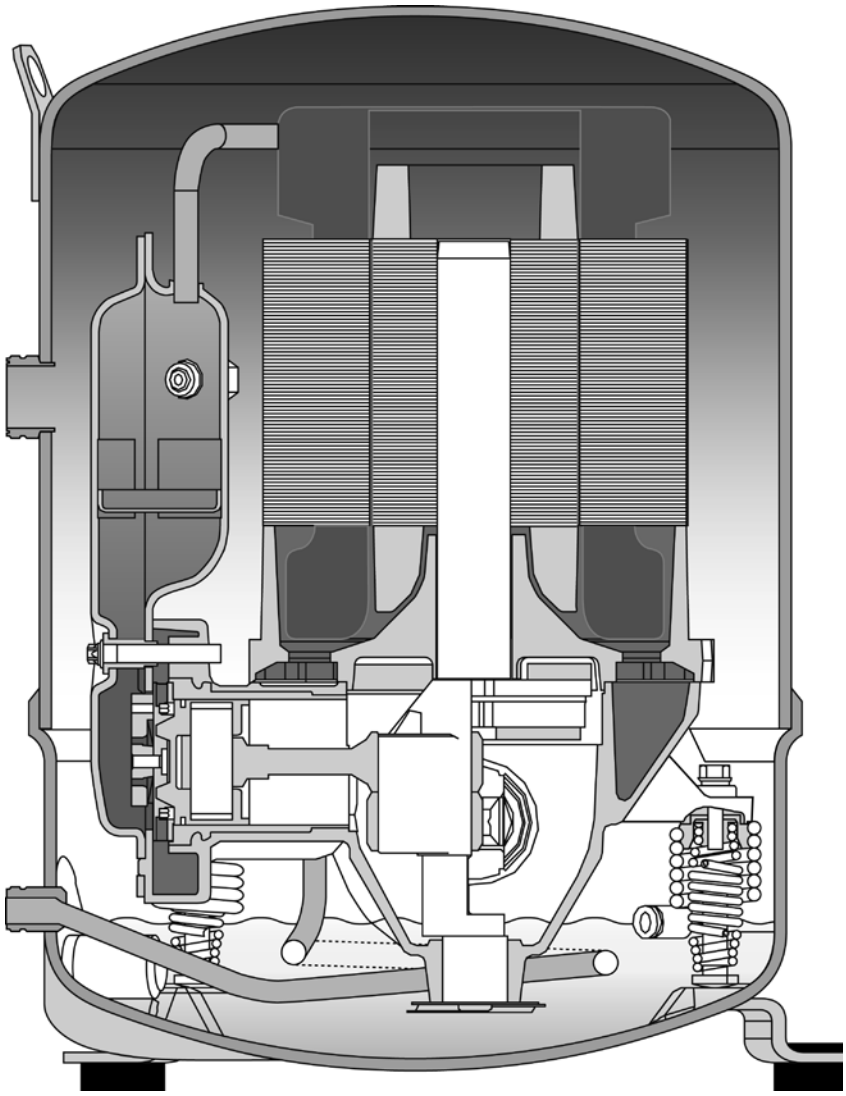
SELECTION &
APPLICATION GUIDELINES

CONTENTS

MANEUROP® RECIPROCATING COMPRESSORS

Maneurop® reciprocating compressors from Danfoss Commercial Compressors are specially designed for applications with a wide range of operating conditions. All components are of high quality and precision in order to assure a long product life.

Maneurop® MT and MTZ series compressors are of the hermetic reciprocating type and are designed for medium and high evaporating temperature applications.



The compressor design allows for the motor to be 100% suction-gas cooled.

The positive benefits of internal motor protection, high efficiency circular valve design and high torque motors provide for a quality installation.

The MT series is designed for use with the "traditional" R-22 refrigerant, using Danfoss mineral oil 160P as lubricant.
The MT series can also be applied with several R-22 based refrigerant blends (substitute refrigerants), using 160 ABM alkylbenzene as lubricant. The MTZ series is specifically designed for use with the HFC refrigerants R-407C, R-134a, R-404A, and R-507A, using 160PZ polyester oil as lubricant.
MTZ compressors can be used in new installations and also to replace Maneurop® MTE compressors in existing installations.

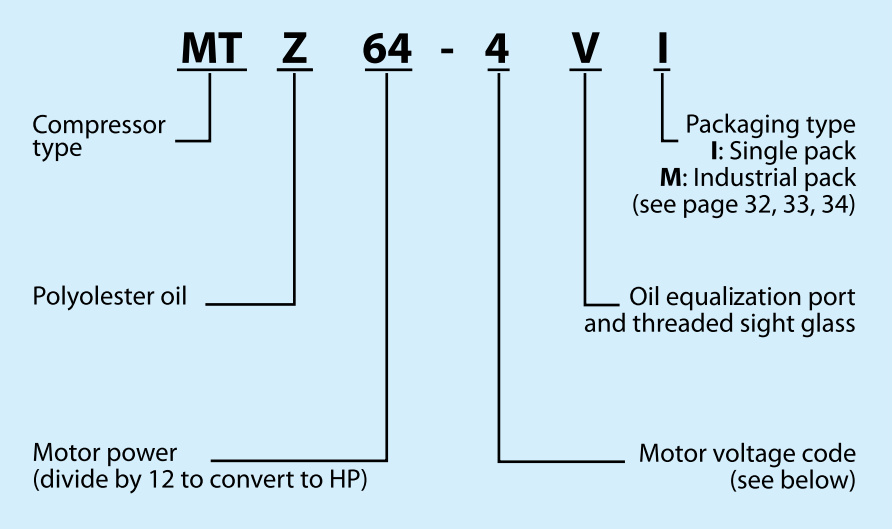
MT and MTZ compressors have a large internal free volume that protects against the risk of liquid hammering when liquid refrigerant enters the compressor.

MT and MTZ compressors are fully suction-gas cooled. This means that no additional compressor cooling is required and allows the compressors to be insulated with acoustic jackets to obtain lower sound levels, without the risk of the compressor overheating.

MT and MTZ compressors are available in 26 different models with displacement ranging from 231 to 4142 cfh. Seven different motor voltage ranges are available for single and three phase power supplies at 50 and 60 Hz. Most compressors exist in two versions:
- standard version
- VE version (oil equalization + oil sight glass).

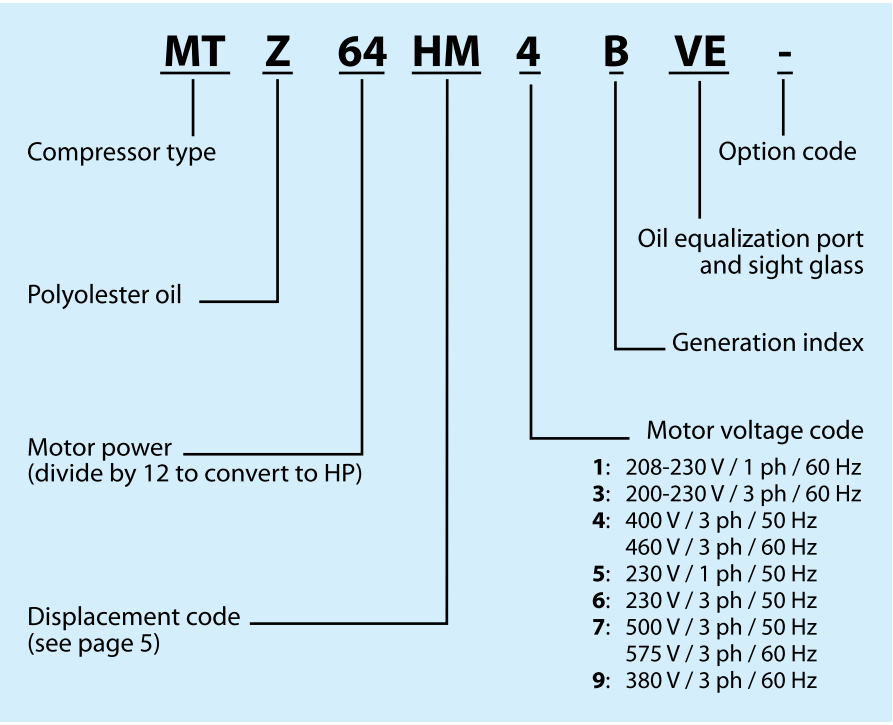
COMPRESSOR MODEL DESIGNATION

Code numbers
(for ordering)



Available code numbers are listed on pages 32-33

Compressor reference
(indicated on the compressor nameplate)



Versions

	S version (standard)		VE version (optional)	
Models	**Oil sight glass**	**Oil equalization connection**	**Oil sight glass**	**Oil equalization connection**
MT/MTZ018-040 (1 cyl.)	-	-	threaded	3/8"flare
MT/MTZ044-081 (2 cyl.)	-	-	threaded	3/8"flare
MT/MTZ100-160 (4 cyl.)	brazed	-	threaded	3/8"flare

SPECIFICATIONS

Technical specifications

Compressor model	Displacement			Cyl. number	Oil charge	Net weight	Available motor voltage codes						
	Code	in³/rev	cfh at 3600 rpm		oz	lbs	1	3	4	5	6	7	9
MT/MTZ018	**JA**	1.84	231	1	32	46	●	●	●	●	○	-	-
MT/MTZ022	**JC**	2.33	291	1	32	46	●	●	●	●	●	-	●
MT/MTZ028	**JE**	2.93	367	1	32	51	●	●	●	●	●	-	●
MT/MTZ032	**JF**	3.29	411	1	32	53	●	●	●	●	●	○	○
MT/MTZ036	**JG**	3.69	461	1	32	55	●	●	●	●	●	○	●
MT/MTZ040	**JH**	4.14	518	1	32	57	●	●	●	-	●	-	-
MT/MTZ044	**HJ**	4.65	581	2	61	77	●	●	●	-	●	●	●
MT/MTZ045	**HJ**	4.65	581	2	61	77	-	●	●	-	-	-	-
MT/MTZ050	**HK**	5.23	653	2	61	77	●	●	●	●	●	●	●
MT/MTZ051	**HK**	5.23	653	2	61	77	-	●	●	-	-	-	-
MT/MTZ056	**HL**	5.87	733	2	61	82	●	●	●	-	●	●	●
MT/MTZ057	**HL**	5.87	733	2	61	82	-	●	●	-	-	-	-
MT/MTZ064	**HM**	6.57	822	2	61	82	●	●	●	-	●	-	●
MT/MTZ065	**HM**	6.57	822	2	61	82	-	●	●	-	-	-	-
MT/MTZ072	**HN**	7.38	922	2	61	88	-	●	●	-	●	-	●
MT/MTZ073	**HN**	7.38	922	2	61	88	-	●	●	-	-	-	-
MT/MTZ080	**HP**	8.29	1036	2	61	88	-	●	●	-	●	-	●
MT/MTZ081	**HP**	8.29	1036	2	61	88	-	●	●	-	-	-	-
MT/MTZ100	**HS**	10.45	1306	4	132	132	-	●	●	-	●	●	●
MT/MTZ125	**HU**	13.15	1643	4	132	141	-	●	●	-	●	●	○
MT/MTZ144	**HV**	14.76	1845	4	132	148	-	●	●	-	●	●	●
MT/MTZ160	**HW**	16.57	2071	4	132	152	-	●	●	-	●	●	●

● Available in MT and MTZ ○ Available in MTZ only

Approvals and certificates

Maneurop® MT/MTZ compressors comply with the following approvals and certificates

Certificates are listed on the product datasheets:
http://www.danfoss.com/odsg

CE (European Directive) 0062	All models
UL (Underwriters Laboratories) c UL us	All 60 Hz models
CCC (China Compulsory Product Certification)	Depending on the model and motor voltage code.
Gost certificate (for Russia)	Depending on the model and voltage code.

SPECIFICATIONS

Nominal performance data for R-404A and R-22

R-404A	Refrigeration											
Compressor model	50 Hz, EN12900 ratings To = 14°F, Tc = 113°F, SC = 0 F, SH = 18°F				50 Hz, ARI ratings To = 20°F, Tc = 120°F, SC = 0°F, SH = 20°F				60 Hz, ARI ratings To = 20°F, Tc = 120°F, SC = 0°F, SH = 20°F			
	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh
MTZ018-4*	6500	1.21	2.73	5.40	7070	1.31	2.86	5.40	8980	1.76	2.86	5.09
MTZ022-4*	8950	1.48	3.06	6.04	9665	1.62	3.24	5.96	12300	2.05	3.27	6.00
MTZ028-4*	11700	1.96	4.04	5.98	12600	2.14	4.30	5.88	15980	2.68	4.23	5.95
MTZ032-4*	13600	2.16	4.25	6.28	14550	2.37	4.56	6.15	17450	2.98	4.56	5.85
MTZ036-4*	15950	2.58	4.95	6.18	17400	2.83	5.33	6.02	20150	3.33	5.09	6.04
MTZ040-4*	18200	2.95	5.87	6.18	19400	3.24	6.29	5.97	23000	3.76	5.88	6.11
MTZ044-4	17600	3.16	6.37	5.57	18900	3.43	6.66	5.51	24250	4.18	6.58	5.79
MTZ045-4*	18350	2.77	5.35	6.59	19750	3.02	5.67	6.53	24250	3.85	5.85	6.30
MTZ050-4	27000	3.61	6.53	5.81	22470	3.92	6.92	5.73	28300	4.82	7.04	5.87
MTZ051-4*	21380	3.22	5.95	6.63	22880	3.50	6.33	6.54	28550	4.42	6.53	6.46
MTZ056-4	23900	4.00	7.07	5.98	25600	4.38	7.57	5.85	31800	5.44	7.80	5.84
MTZ057-4*	22900	3.51	6.83	6.52	24750	3.85	7.25	6.43	32400	4.98	7.52	6.50
MTZ064-4	27760	4.54	8.30	6.11	29700	4.96	8.84	5.99	36730	6.11	8.98	5.91
MTZ065-4*	27250	4.20	7.82	6.49	29340	4.60	8.35	6.37	36000	5.67	8.31	6.35
MTZ072-4	31250	4.99	8.64	6.28	33330	5.45	9.28	6.11	40470	6.91	9.76	5.85
MTZ073-4*	30460	4.69	8.95	6.49	32680	5.11	9.50	6.39	40850	6.53	9.73	6.25
MTZ080-4	35930	5.84	10.12	6.15	38250	6.38	10.87	5.99	45760	8.03	11.35	5.70
MTZ081-4*	35750	5.61	10.20	6.39	38780	6.14	10.94	6.22	46450	7.81	11.35	5.94
MTZ100-4*	41940	6.76	12.21	6.22	44500	7.35	12.94	6.11	52850	8.72	12.79	6.06
MTZ125-4*	53650	8.44	13.79	6.35	57380	9.21	14.86	6.22	68200	11.37	15.41	6.00
MTZ144-4*	63150	9.78	16.29	6.45	67240	10.65	17.47	6.31	80350	12.99	17.93	6.18
MTZ160-4*	69350	11.08	18.26	6.25	73970	12.09	19.64	6.11	87300	14.73	20.17	5.92

* 50 Hz, EN12900 data for indicated models are ASERCOM certified

R-404A data are also valid for refrigerant R-507A

R-22	Refrigeration				Air Conditioning							
Compressor model	50 Hz, EN12900 ratings To = 14°F, Tc = 113°F, SC = 0 F, SH = 18°F				50 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F				60 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F			
	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. W/W	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh
MT018-4	5770	1.00	2.27	5.77	13250	1.45	2.73	9.16	15900	1.74	2.73	9.16
MT022-4	8500	1.29	2.55	6.63	18305	1.89	3.31	9.69	22000	2.27	3.31	9.69
MT028-4	12750	1.81	3.59	7.04	25200	2.55	4.56	9.87	30200	3.06	4.56	9.87
MT032-4	13500	2.11	3.73	6.39	27500	2.98	4.97	9.22	33000	3.58	4.97	9.22
MT036-4	16400	2.35	4.30	6.97	31650	3.37	5.77	9.38	38000	4.05	5.77	9.38
MT040-4	17800	2.67	4.86	6.66	35800	3.86	6.47	9.27	42900	4.63	6.47	9.27
MT044-4	18100	2.72	6.03	6.66	37700	3.89	7.37	9.69	45200	4.66	7.37	9.69
MT045-4	16600	2.46	5.02	6.76	35900	3.53	6.37	10.17	44000	4.32	6.42	10.18
MT050-4	19850	2.95	5.22	6.73	42100	4.32	8.46	9.74	50500	5.18	8.46	9.74
MT051-4	20050	2.94	5.53	6.83	41800	4.19	7.20	9.97	50200	5.04	7.26	9.95
MT056-4	23300	3.44	6.21	6.80	47000	5.04	10.27	9.32	56400	6.05	10.27	9.32
MT057-4	22000	3.18	6.39	6.93	47000	4.58	8.19	10.24	56400	5.58	8.23	10.10
MT064-4	26100	3.89	7.06	6.69	54000	5.66	9.54	9.53	64800	6.80	9.54	9.53
MT065-4	26470	3.64	7.03	7.27	53700	5.27	9.16	10.18	64400	6.32	9.33	10.18
MT072-4	29100	4.29	7.58	6.80	58500	6.31	10.54	9.26	70200	7.57	10.54	9.26
MT073-4	29750	4.19	8.48	7.10	62100	6.12	10.98	10.15	74600	7.33	10.77	10.16
MT080-4	33200	4.84	8.24	6.86	66700	7.13	11.58	9.36	80000	8.55	11.58	9.36
MT081-4	35380	4.89	9.52	7.24	70800	7.08	12.48	9.99	85000	8.50	12.34	10.00
MT100-4	38700	5.79	11.82	6.69	79900	7.98	14.59	10.00	95900	9.58	14.59	10.00
MT125-4	52100	7.55	12.28	6.90	103900	10.66	17.37	9.74	124700	12.80	17.37	9.74
MT144-4	59000	8.47	17.06	6.97	117300	11.95	22.75	9.80	140700	14.35	22.75	9.80
MT160-4	65540	9.49	16.81	6.90	130700	13.40	22.16	9.75	156900	16.08	22.16	9.75

To: Evaporating temperature at dew point (saturated suction temperature)
Tc: Condensing temperature at dew point (saturated discharge temperature)
SC: Subcooling,
SH: Superheat

ARI capacity and power input data are +/- 5%
ASERCOM: Association of European Refrigeration Compressor and Controls Manufacturers
ARI: Air Conditioning and Refrigeration Institute

SPECIFICATIONS

Nominal performance data for R-407C and R-134a

R-407C	Air Conditioning											
Compressor model	50 Hz, EN12900 ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F				50 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F				60 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F			
	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh
MTZ018-4*	11850	1.27	2.73	9.32	13150	1.38	2.86	9.53	17250	1.73	2.82	9.98
MTZ022-4*	15540	1.71	3.27	9.12	17140	1.86	3.47	9.23	21450	2.26	3.45	9.48
MTZ028-4*	20080	2.17	4.30	9.29	22340	2.36	4.57	9.45	28070	2.82	4.41	9.93
MTZ032-4*	22700	2.43	4.57	9.36	25030	2.65	4.90	9.43	30702	3.20	4.80	9.61
MTZ036-4*	25650	2.93	5.58	8.74	28280	3.21	5.99	8.82	34120	3.90	5.78	8.74
MTZ040-4*	29580	3.40	6.46	8.71	32720	3.71	6.92	8.81	40030	4.46	6.69	8.98
MTZ044-4	30530	3.34	6.10	9.12	33710	3.63	6.49	9.27	43030	4.36	6.84	9.85
MTZ045-4*	31180	3.12	5.84	10.01	34490	3.38	6.18	10.21	43480	4.25	6.34	10.23
MTZ050-4	34800	3.79	6.90	9.19	38490	4.11	7.34	9.34	48150	4.95	7.33	9.72
MTZ051-4*	35590	3.69	6.51	9.66	39380	4.01	6.95	9.82	48190	4.87	7.06	9.89
MTZ056-4	39960	4.32	7.85	9.26	44190	4.69	8.36	9.42	54370	5.66	8.41	9.60
MTZ057-4*	39900	4.02	7.45	9.90	44400	4.37	7.91	10.16	54880	5.40	8.03	10.15
MTZ064-4	45010	4.84	8.79	9.29	49830	5.26	9.35	9.47	60450	6.35	9.47	9.50
MTZ065-4*	45630	4.61	8.35	9.90	50720	5.02	8.91	10.10	61750	6.14	9.01	10.05
MTZ072-4	50540	5.50	9.81	9.19	55940	5.97	10.48	9.36	67930	7.21	10.78	9.41
MTZ073-4*	52230	5.42	9.85	9.66	58230	5.87	10.48	9.91	70970	7.30	10.61	9.72
MTZ080-4	57204	6.29	11.02	9.08	63280	6.83	11.83	9.25	76910	8.24	12.35	9.33
MTZ081-4*	59360	6.29	11.31	9.43	66010	6.83	12.08	9.67	78100	8.24	11.99	9.47
MTZ100-4*	69940	7.38	13.05	9.49	77520	8.00	13.83	9.69	96380	9.86	14.22	9.77
MTZ125-4*	91880	9.48	15.14	9.70	101740	10.32	16.28	9.85	121650	12.83	18.07	9.47
MTZ144-4*	101670	10.68	17.55	9.53	112940	11.59	18.80	9.74	139680	14.42	19.81	9.68
MTZ160-4*	116420	12.40	20.08	9.39	129160	13.46	21.50	9.59	154430	16.64	22.46	9.27

* 50 Hz, EN12900 data for indicated models are ASERCOM certified

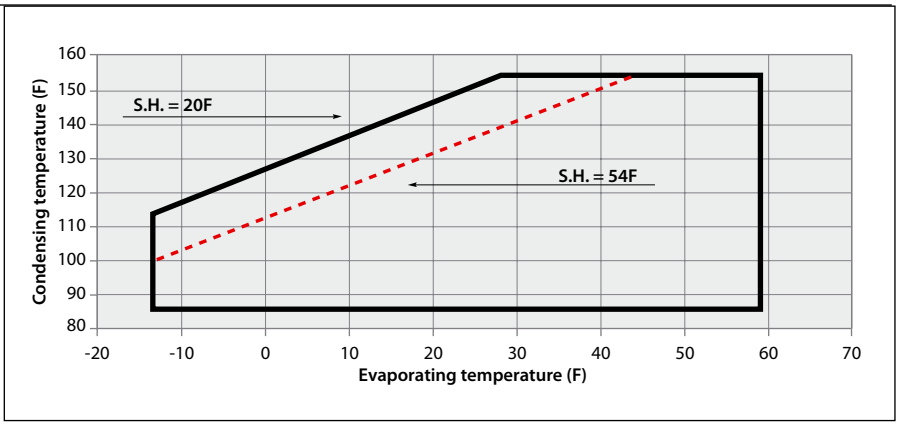
R-134a	Air Conditioning											
Compressor model	50 Hz, EN12900 ratings To = 41 °F, Tc = 122 °F, SC = 0 °F, SH = 18 °F				50 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F				60 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F			
	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh
MTZ018-4	7890	0.92	2.12	8.57	8710	0.99	2.19	8.81	11200	1.22	2.09	9.20
MTZ022-4	10250	1.11	2.42	9.22	11440	1.20	2.51	9.56	14860	1.54	2.56	9.63
MTZ028-4	12740	1.41	3.18	9.05	14380	1.53	3.30	9.40	19260	2.04	3.37	9.43
MTZ032-4	14990	1.74	3.80	8.61	16910	1.87	3.94	9.03	20940	2.39	3.89	8.76
MTZ036-4	18240	1.97	3.88	9.26	20490	2.13	4.09	9.60	24490	2.75	4.20	8.91
MTZ040-4	19470	2.15	4.58	9.08	27860	2.33	4.89	9.36	27870	3.08	4.72	9.03
MTZ044-4	20900	2.36	5.51	8.88	23460	2.52	5.65	9.29	29850	3.14	5.47	9.51
MTZ045-4	20800	2.06	4.56	10.11	23390	2.22	4.73	10.53	30120	2.84	4.70	10.59
MTZ050-4	24490	2.68	5.33	9.12	27560	2.88	5.50	9.57	34460	3.60	5.36	9.57
MTZ051-4	24280	2.44	5.02	9.96	27360	2.63	5.20	10.39	34530	3.29	5.33	10.48
MTZ056-4	27460	2.99	5.61	9.19	30980	3.21	5.83	9.63	38010	3.95	5.92	9.62
MTZ057-4	26230	2.62	5.93	10.01	29780	2.84	6.17	10.47	38870	3.82	6.37	10.16
MTZ064-4	31280	3.36	6.66	9.32	35350	3.62	6.96	9.77	45290	4.68	7.11	9.67
MTZ065-4	30600	3.02	6.53	10.11	34700	3.26	6.81	10.63	44400	4.20	6.77	10.56
MTZ072-4	36000	3.74	6.83	9.63	40470	4.01	7.20	10.09	50000	5.19	7.59	9.64
MTZ073-4	34940	3.50	7.66	9.97	39790	3.78	7.99	10.52	50000	4.81	7.88	10.39
MTZ080-4	47260	4.31	8.03	9.56	46380	4.64	8.45	10.00	56520	5.99	8.79	9.42
MTZ081-4	40130	4.02	8.44	9.97	45490	4.35	8.83	10.44	56320	5.47	8.68	10.29
MTZ100-4	47030	4.89	9.84	9.60	53040	5.28	10.24	10.04	63970	6.50	10.11	9.84
MTZ125-4	57990	5.84	10.24	9.94	65130	6.29	10.80	10.35	79920	7.71	11.09	10.23
MTZ144-4	71820	7.27	13.11	9.87	80670	7.83	13.78	10.30	96960	9.81	14.28	9.87
MTZ160-4	78820	7.98	13.90	9.87	88320	8.57	14.67	10.29	107650	10.91	15.54	9.86

To: Evaporating temperature at dew point (saturated suction temperature)
Tc: Condensing temperature at dew point (saturated discharge temperature)
SC: Subcooling,
SH: Superheat

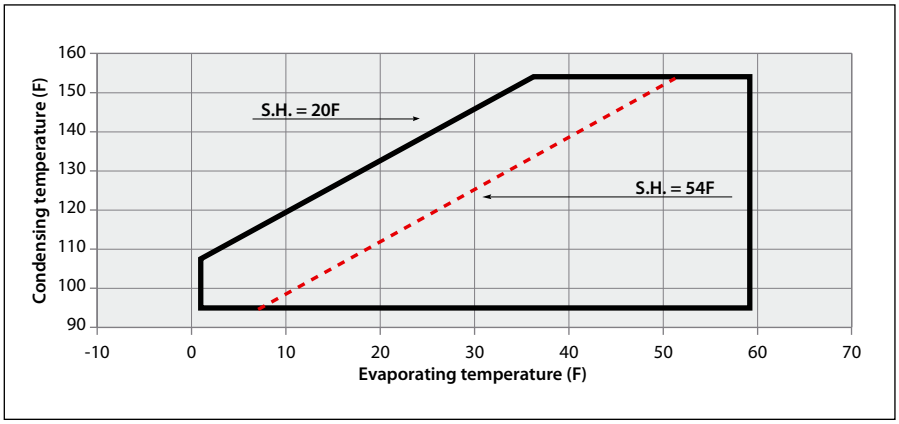
ARI capacity and power input data are +/- 5%
ASERCOM: Association of European Refrigeration Compressor and Controls Manufacturers
ARI: Air Conditioning and Refrigeration Institute

OPERATING ENVELOPES

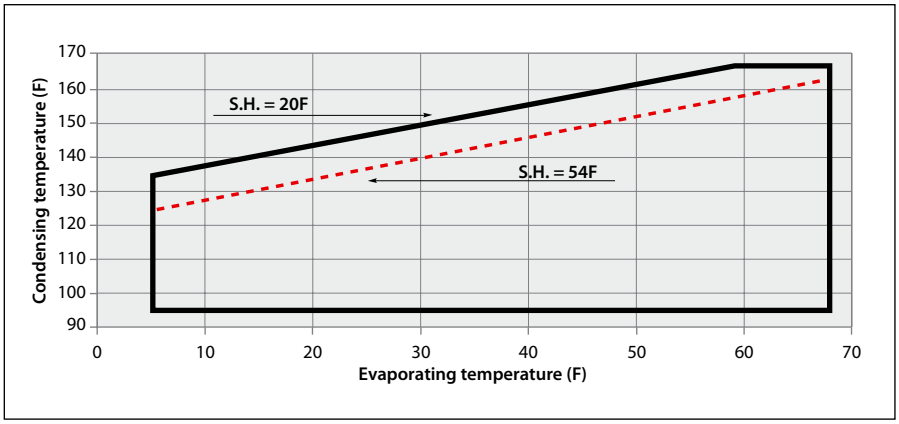
MT
R-22



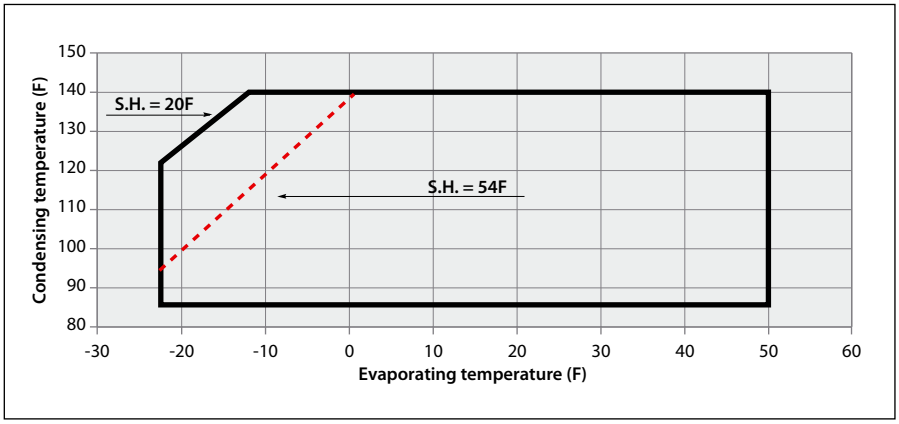
MTZ
R-407C at DEW point



MTZ
R-134a



MTZ
R-404A/R-507A



OPERATING ENVELOPES

Zeotropic refrigerant mixtures

Refrigerant mixtures can be either zeotropic or azeotropic.
In a zeotropic mixture (like R-407C) on the other hand the composition of vapor and liquid changes during the phase transition. When the effect of this phase transition is very small, the mixture is often called a near-azeotropic mixture. R-404A is such a near-azeotropic mixture.

An azeotropic mixture, on the other hand, (like R-502 or R-507A) behaves like a pure refrigerant. During a phase transition (from vapor to liquid or from liquid to vapor) the composition of vapor and liquid stays the same.
The composition change causes phase shift and temperature glide.

Phase shift

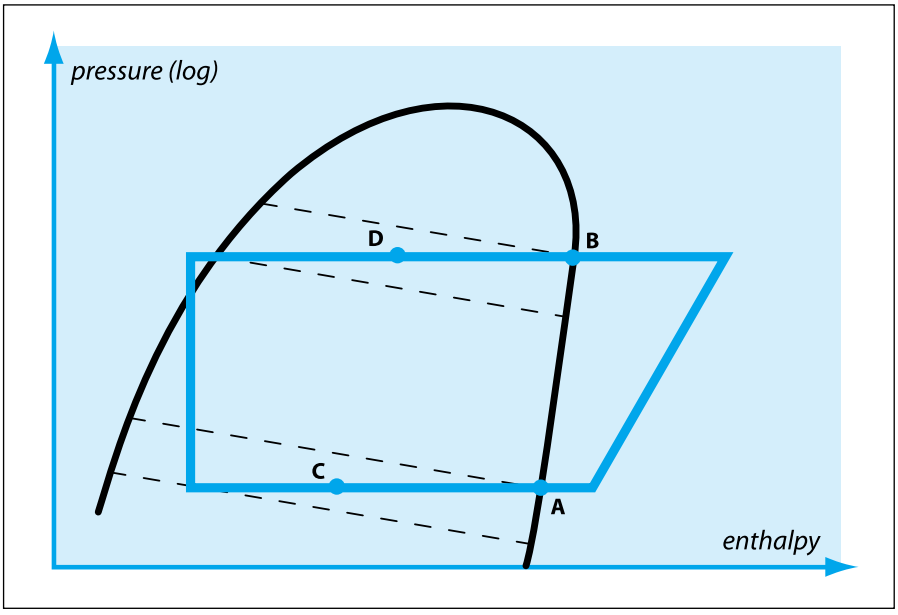
In parts of the system where both vapor and liquid phase are present (evaporator, condenser, liquid receiver), the phases do not have the same composition. In fact both phases form two different refrigerants. Therefore zeotropic refrigerants need some special attention.

Zeotropic refrigerants must always be charged in liquid phase. Flooded evaporators and suction accumulators should not be applied in systems with zeotropic refrigerants. This also applies to near-azeotropic mixtures.

Temperature glide

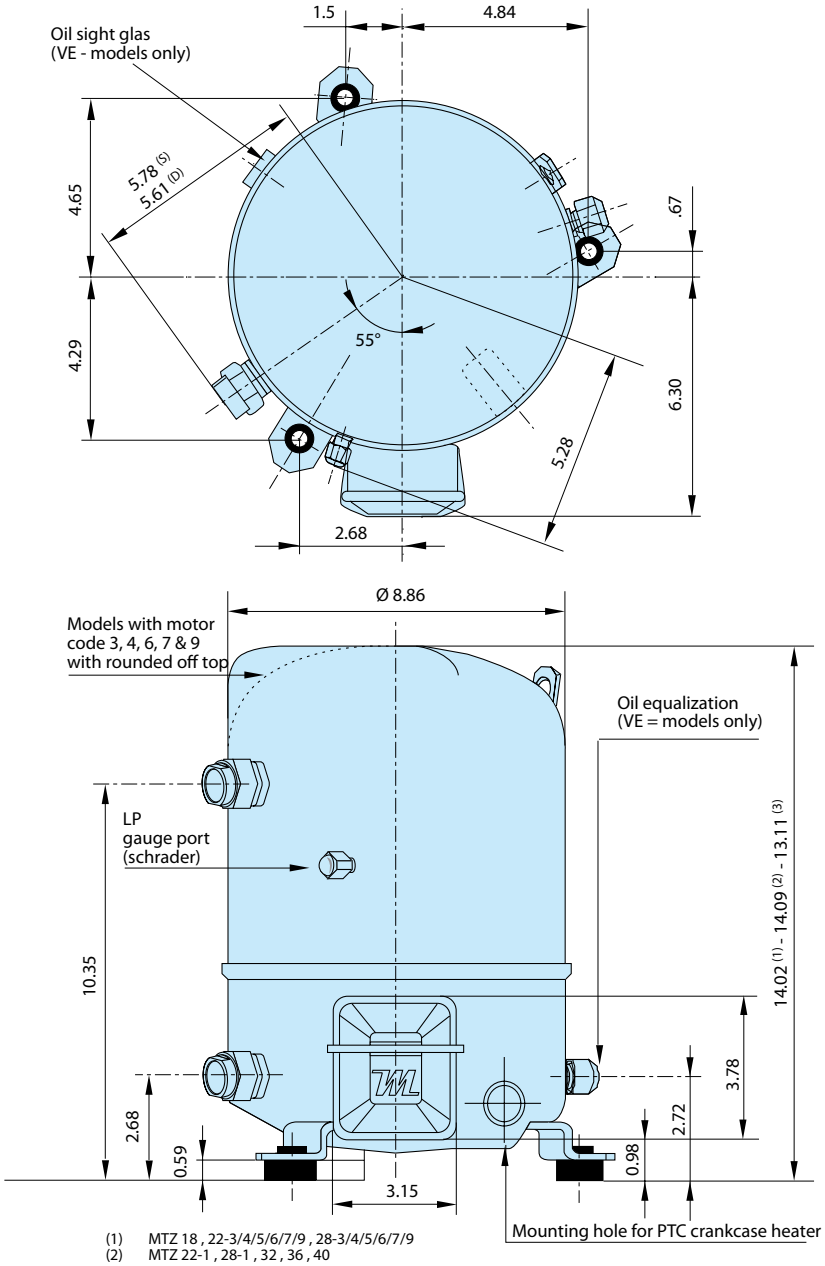
During the evaporating process and the condensing process at constant pressure, the refrigerant temperature will decrease in the condenser and rise in the evaporator. Therefore when speaking about evaporating and condensing temperatures, it is important to indicate whether the temperature under discussion is a dew point temperature or a mean point value.
In the figure below, the dotted lines are lines of constant temperature. They do not correspond to the lines of constant pressure. Points A and B are dew point values on the saturated vapor line. Points C and D are mean point values.
These are temperatures that correspond more or less with the average temperature during the evaporating and condensing process. For the same R-407C cycle, mean point temperatures are typically about 3.5°F to 5.5°F lower than dew point temperatures. In accordance with ASERCOM recommendations, Danfoss Commercial Compressors uses dew point temperatures for selection tables, application envelopes, etc.
To obtain exact capacity data at mean point temperatures, the mean point temperatures must be converted to dew point temperatures, using refrigerant data tables from the refrigerant manufacturer.

Dew point temperature and mean temperature for R-407C



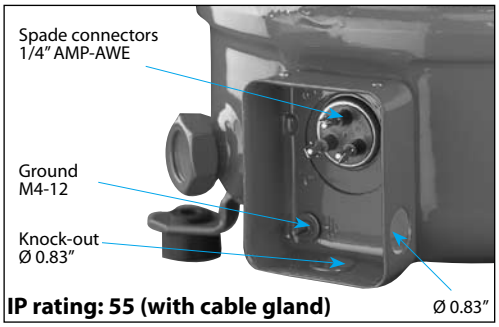
OUTLINE DRAWINGS

1 cylinder

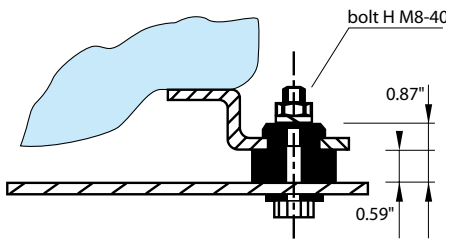


(1) MTZ 18 , 22-3/4/5/6/7/9 , 28-3/4/5/6/7/9
(2) MTZ 22-1 , 28-1 , 32 , 36 , 40

Terminal box



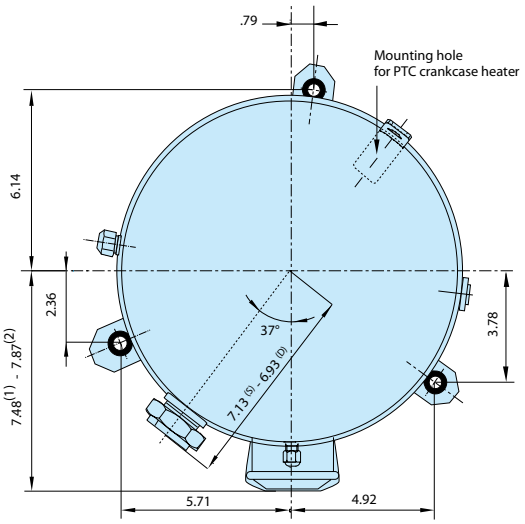
Silent block

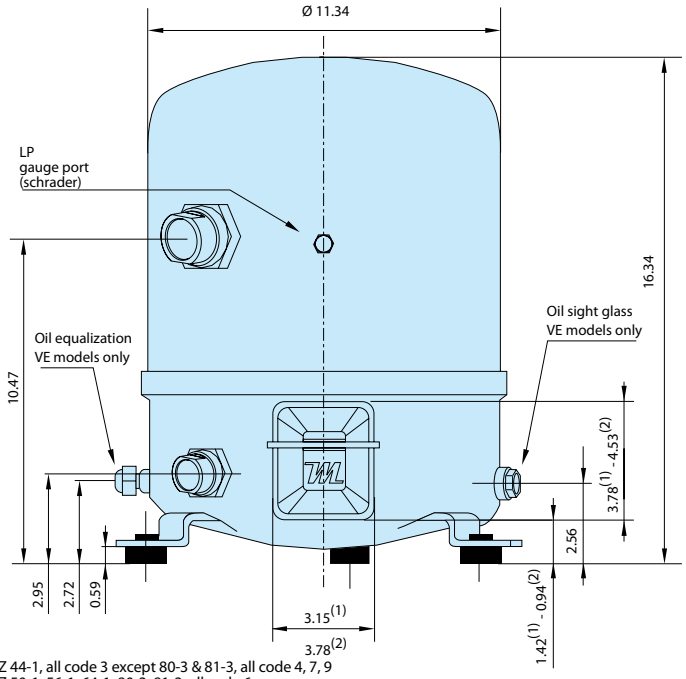


	Rotolock connections size		Pipe sizing		Rotolock valve	
	Suction	Discharge	Suction	Discharge	Suction	Discharge
MT/MTZ018 MT/MTZ022 - 3/4/5/6 MT/MTZ028 - 3/4/5/6	1"	1"	1/2"	3/8"	V06	V01
MT/MTZ022 - 1	1"1/4	1"	5/8"	3/8"	V09	V01
MT/MTZ028 - 1 MT/MTZ032 MT/MTZ036 MT/MTZ040	1"1/4	1"	5/8"	1/2"	V09	V06

OUTLINE DRAWINGS

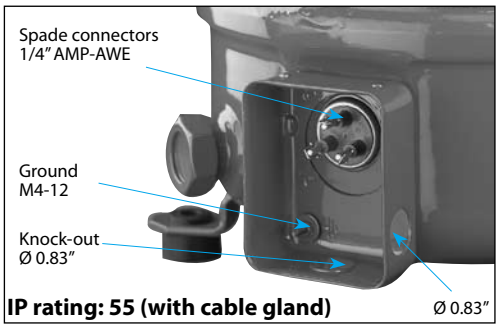
2 cylinders





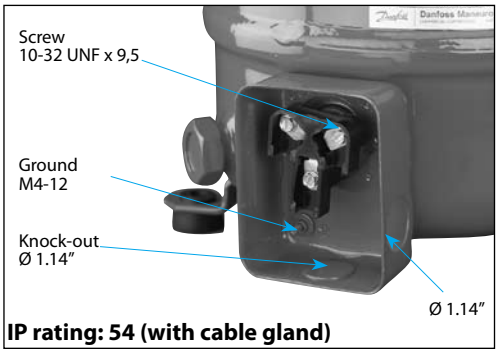
(1) MTZ 44-1, all code 3 except 80-3 & 81-3, all code 4, 7, 9
(2) MTZ 50-1, 56-1, 64-1, 80-3, 81-3, all code 6

Terminal box for model (1)



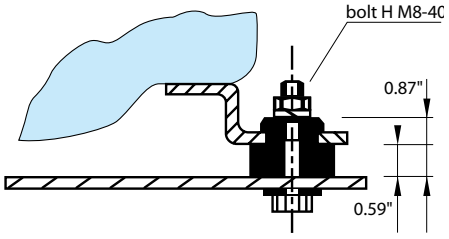
IP rating: 55 (with cable gland)

Terminal box for model (2)



IP rating: 54 (with cable gland)

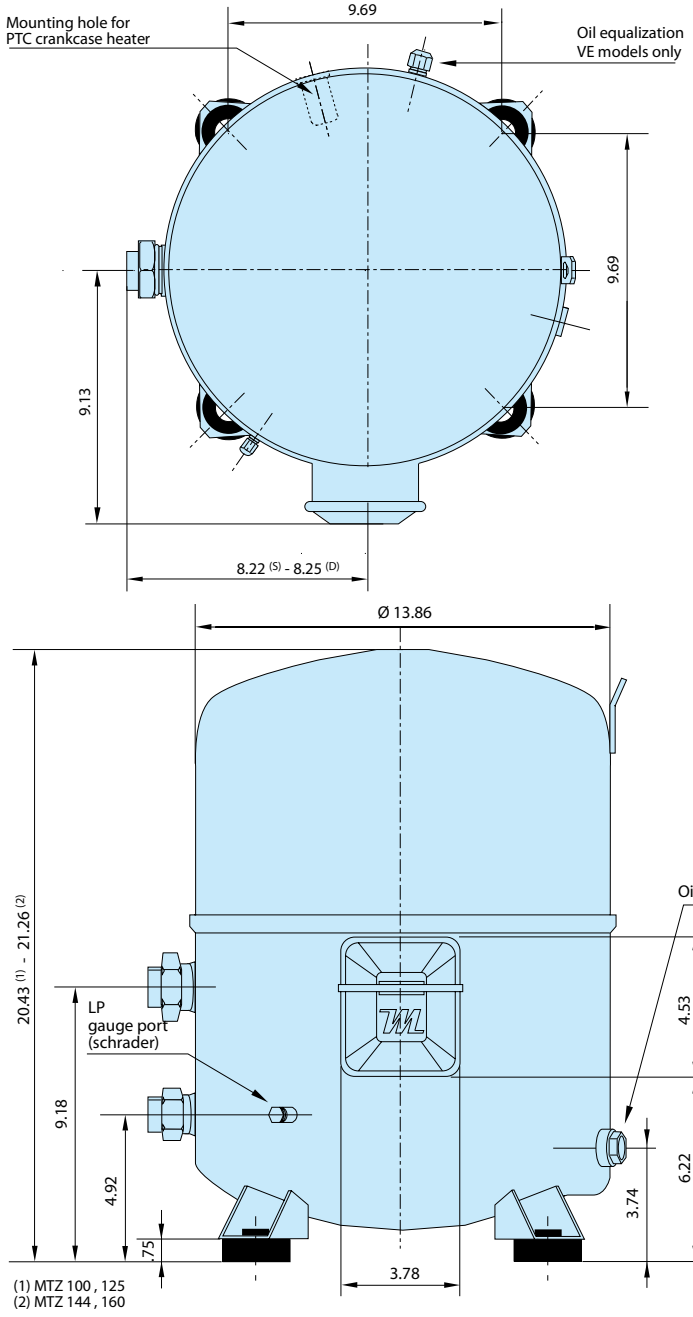
Silent block



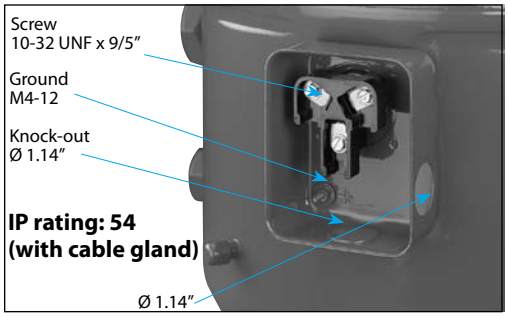
	Rotolock connections size		Pipe sizing		Rotolock valve	
	Suction	**Discharge**	**Suction**	**Discharge**	**Suction**	**Discharge**
MT/MTZ044 MT/MTZ045 MT/MTZ050 MT/MTZ051 MT/MTZ056 MT/MTZ057 MT/MTZ064 MT/MTZ065 MT/MTZ072 MT/MTZ073	1"3/4	1"1/4	7/8"	3/4"	V07	V04
MT/MTZ080 MT/MTZ081	1"3/4	1"1/4	1"1/8	3/4"	V02	V04

OUTLINE DRAWINGS

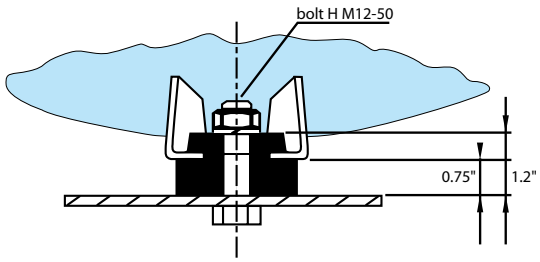
4 cylinders



Terminal box



Silent block



	Rotolock connections size		Pipe sizing		Rotolock valve	
	Suction	Discharge	Suction	Discharge	Suction	Discharge
MT/MTZ100 MT/MTZ125 MT/MTZ144 MT/MTZ160	1"3/4	1"1/4	1"1/8	3/4"	V02	V04

ELECTRICAL CONNECTIONS AND WIRING

Single phase electrical characteristics

	LRA - Locked Rotor Current (A)		MCC - Maximum Continuous Current (A)		Winding resistance (Ω) (± 7 % at 68° F)			
Motor Code	1	5	1	5	1		5	
Winding					run	start	run	start
MT/MTZ018	51	40	13	10	1.36	4.82	1.80	4.70
MT/MTZ022	49.3	41	17	15	1.25	2.49	1.78	4.74
MT/MTZ028	81	51	25	20	0.74	1.85	1.16	3.24
MT/MTZ032	84	70	26.5	20	0.64	2.85	0.90	4.30
MT/MTZ036	84	60	30	22	0.64	2.85	0.89	4.35
MT/MTZ040	99	-	34	-	0.53	2.00	-	-
MT/MTZ044	97	-	31	-	0.45	1.90	-	-
MT/MTZ050	114	92	36	29	0.37	1.79	0.52	2.65
MT/MTZ056	136	-	42.5	-	0.32	1.61	-	-
MT/MTZ064	143	-	46	-	0.32	2.10	-	-

Nominal capacitor values and relays

50 Hz	PSC/CSR*		CSR only	
Models	**Run capacitors (1)**		**Start capacitors (2)**	**Start relay**
	(A) µF	**(C) µF**	**(B) µF**	
MT/MTZ018 JA-5	20	10	100	3ARR3J4A4
MT/MTZ022 JC-5	20	10	100	
MT/MTZ028 JE-5	20	10	100	
MT/MTZ032 JF-5	25	10	135	
MT/MTZ036 JG-5	25	10	135	
MT/MTZ050 HK-5	30	15	135	

60 Hz	PSC/CSR*		CSR only	
Models	**Run capacitors (1)**		**Start capacitors (2)**	**Start relay**
	(A) µF	**(C) µF**	**(B) µF**	
MT/MTZ018 JA-1	15	10	100	3ARR3J4A4
MT/MTZ022 JC-1	30	15	100	
MT/MTZ028 JE-1	25	25	135	
MT/MTZ032 JF-1	25	20	100	
MT/MTZ036 JG-1	25	20	100	
MT/MTZ040 JH-1	35	20	100	
MT/MTZ044 HJ-1	30	15	135	
MT/MTZ050 HK-1	30	15	135	
MT/MTZ056 HL-1	35	20	200	
MT/MTZ064 HM-1	30	25	235	

* PSC: Permanent Split Capacitor
CSR: Capacitor Start Run

(1) Run capacitors: 440 volts

(2) Start capacitors: 330 Volts

Trickle circuit

The trickle circuit provides for heating the compressor crankcase by feeding a small current to the auxiliary winding and the run capacitor. *See the drawings page 14.*
By using PSC or CSR starting systems, compressor models MT/MTZ018-022 can be operated without crankcase heaters as the heater function is provided by the trickle circuit. For the larger single phase compressor models MT/MTZ028-064, the use of the PTC crankcase heater is recommended.

PSC wiring

PSC wiring may be used for refrigerant circuits with capillary tubes or expansion valves with bleed ports. Pressure equalization must be ensured before start-up because of the low starting torque characteristics of this system.

CSR wiring

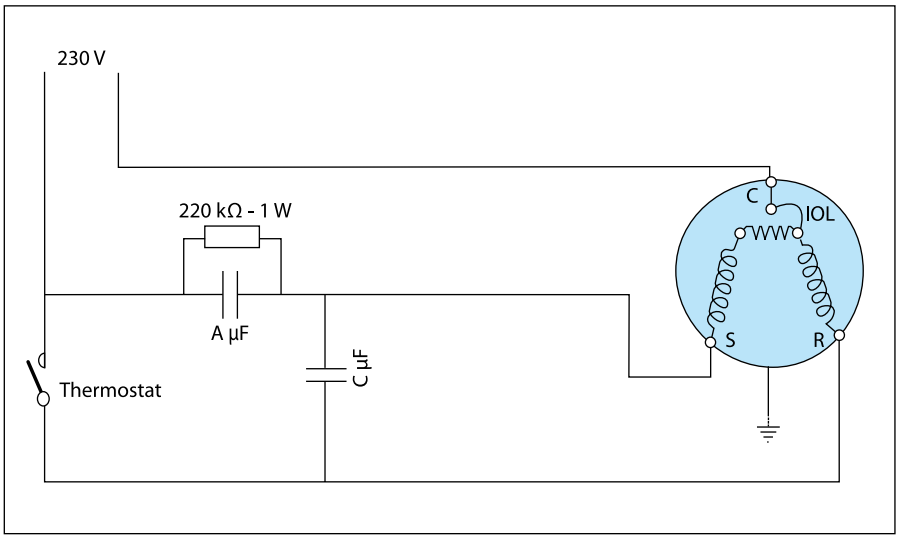
CSR wiring provides additional motor torque at start-up by the use of a start capacitor in combination with the run capacitor. This system can be used for refrigerant circuits with capillary tubes or expansion valves. The start capacitor is only connected during starting; a potential relay is used to disconnect the capacitor after the start sequence.
Single phase compressor motors are internally protected by a temperature and current sensing bimetallic protector, which senses the main and start winding currents and the winding temperature. Once the protector has tripped, it may take from two to four hours for the compressor to reset and restart.
Check that the power supply corresponds to compressor characteristics (refer to compressor nameplate).

ELECTRICAL CONNECTIONS AND WIRING

Suggested wiring diagrams

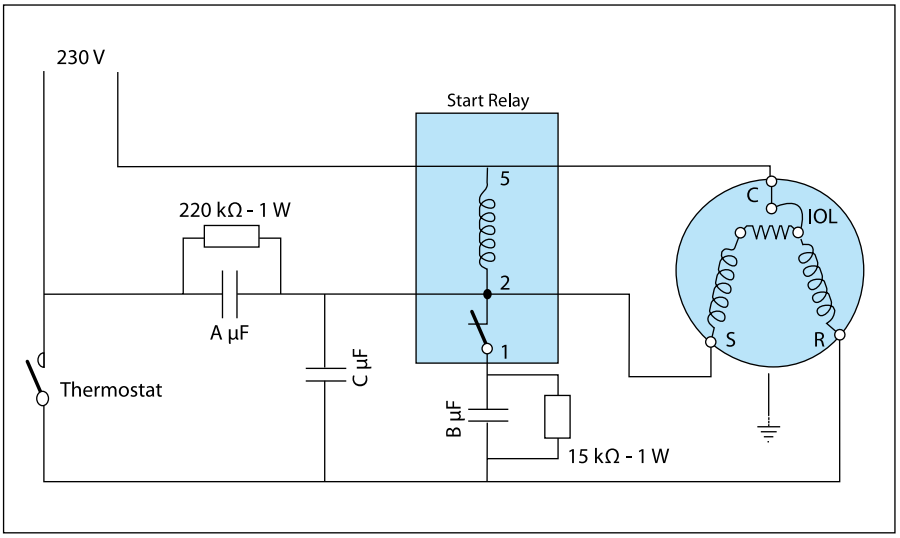
Single phase PSC wiring with trickle circuit

IOL Motor protector
A & C Run capacitors
C Common
S Start winding (auxiliary)
R Run winding (main)



Single phase CSR wiring with trickle circuit

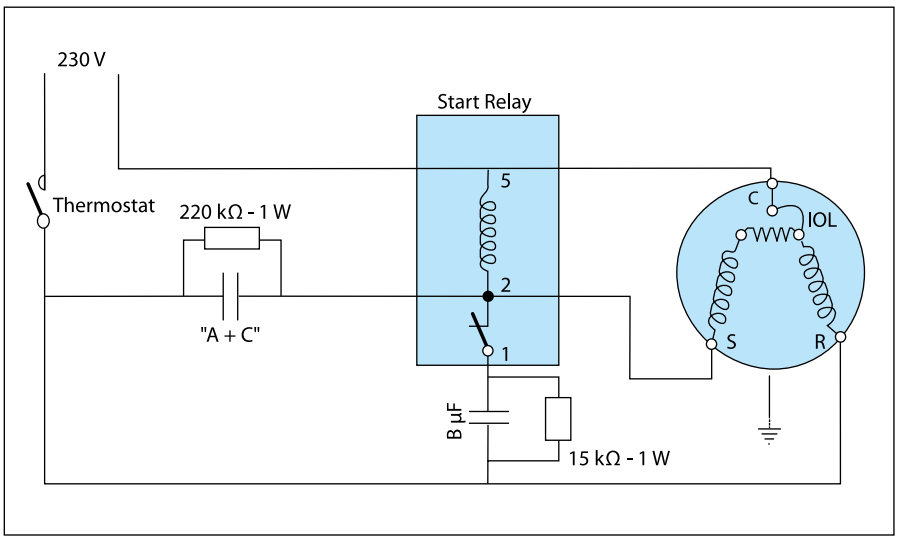
IOL Motor protector
A & C Run capacitors
B Start capacitor
C Common
S Start winding (auxiliary)
R Run winding (main)



Single phase CSR wiring without trickle circuit

IOL Motor protector
A + C Run capacitors
B Start capacitor
C Common
S Start winding (auxiliary)
R Run winding (main)

Capacitors **A** and **C** are replaced by a single capacitor of size **A + C**



ELECTRICAL CONNECTIONS AND WIRING

Three phase electrical characteristics

	LRA - Locked Rotor Current (A)					MCC - Maximum Continuous Current (A)					Winding resistance (Ω) (± 7 % at 68° F)				
Motor Code	**3**	**4**	**6**	**7**	**9**	**3**	**4**	**6**	**7**	**9**	**3**	**4**	**6**	**7**	**9**
MT/MTZ018	38	20	30	-	-	9	5	7	-	-	2.49	10.24	3.38	-	-
MT/MTZ022	38	16	-	-	22.5	11	6	8.5	-	6	2.49	10.24	3.38	-	6.58
MT/MTZ028	57	23	-	-	32	16	7.5	11.5	-	8.5	1.37	7.11	2.30	-	4.80
MT/MTZ032	60	25	44	22	35	18	8	13	5.5	9	1.27	6.15	1.27	8.90	4.20
MT/MTZ036	74	30	74	26	35	17	9	17	7	9.5	1.16	5.57	1.16	8.60	4.10
MT/MTZ040	98	38	74	-	-	22	10	18	-	-	0.95	4.56	0.95	-	-
MT/MTZ044	115	42	77	44	78	22	9.5	16	8.5	13	0.74	3.80	1.13	5.83	1.68
MT/MTZ045	115	48.5	-	-	-	17	9.5	-	-	-	0.69	3.22	-	-	-
MT/MTZ050	115	42	77	44	78	25	12	19	10	13.5	0.72	3.80	1.39	5.83	1.68
MT/MTZ051	120	48.5	-	-	-	22	11.5	-	-	-	0.69	3.60	-	-	-
MT/MTZ056	130	60	105	50	72	26	12	23	11	15	0.57	2.41	0.76	3.86	-
MT/MTZ057	130	64	-	-	-	24	12	-	-	-	0.55	2.39	-	-	-
MT/MTZ064	137	67	124	-	72	29	15	25	-	17.5	0.57	2.41	0.76	-	1.64
MT/MTZ065	135	64	-	-	-	28	14	-	-	-	0.55	2.39	-	-	-
MT/MTZ072	135	80	143	-	100	30	15.5	27	-	18.5	0.55	1.90	0.56	-	1.32
MT/MTZ073	155	80	-	-	-	32	17	-	-	-	0.48	1.90	-	-	-
MT/MTZ080	140	80	132	-	102	36	18	29	-	22.5	0.48	1.90	0.56	-	1.30
MT/MTZ081	140	80	-	-	-	36	19	-	-	-	0.48	1.90	-	-	-
MT/MTZ100	157	90	126	62	110	43	22	35	17	26	0.50	1.85	0.67	3.10	1.26
MT/MTZ 125	210	105	170	75	150	54	27	43	22	30	0.38	1.57	0.43	2.51	0.84
MT/MTZ 144	259	115	208	90	165	64	30	51	25	40	0.27	1.19	0.37	2.00	0.72
MT/MTZ 160	259	140	208	99	165	70	36	51	29	46	0.27	1.10	0.37	1.76	1.10

Motor protection and suggested wiring diagrams

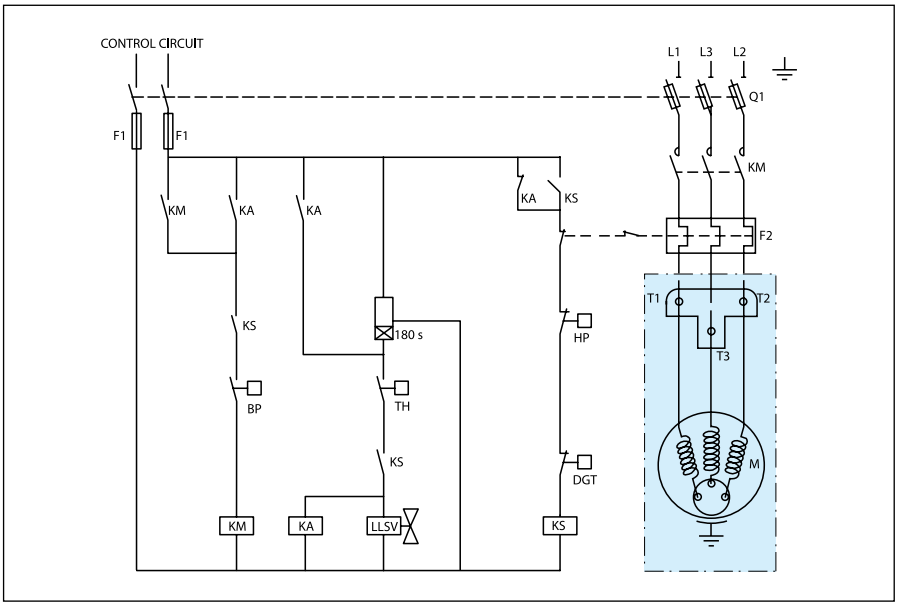
MT and MTZ 3-phase compressors are protected by an internal motor protector connected to the neutral point of star connected stator windings. The protector cuts out all 3 phases simultaneously.

Note: once the overload protector has tripped it may take up to 3 hours to reset and restart the compressor.

For all 3-phase compressors, a PTC crankcase heater is required.

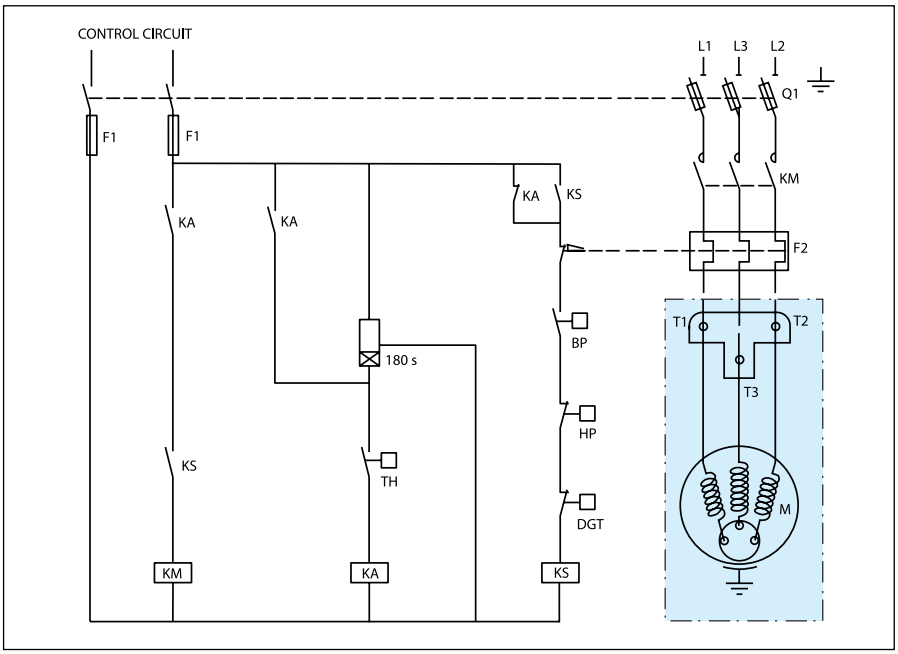
Wiring diagram with pump-down cycle

Control device ..... TH
Optional short cycle timer (3 min) 5 pts ..... 180 s
Control relay ..... KA
Liquid Solenoid valve ..... LLSV
Compressor contactor ..... KM
Safety lock out relay ..... KS
Pump-down control & L.P. switch ..... BP
H.P. switch ..... HP
Fused disconnect Q1
Fuses F1
External overload protection F2
Compressor motor ..... M
Motor safety thermostat ..... thM
Discharge gas thermostat ..... DGT



ELECTRICAL CONNECTIONS AND WIRING

Wiring diagram without pump-down cycle



Control device ..... TH
Optional short cycle timer (3 min) 5 pts ..... 180 s
Control relay ..... KA
Compressor contactor ..... KM
Safety lock out relay ..... KS
H.P. switch ..... HP
Fused disconnect Q1
Fuses F1
External overload protection F2
Compressor motor ..... M
Discharge gas thermostat ..... DGT

Soft starters

Starting current of Maneurop® 3-phase compressors can be reduced by using a soft starter. Two different versions are available: CI-tronic™ soft starters type MCI (recommended) and soft start kits with statoric resistors (type SCR). Starting current can be reduced by up to 50% depending on the compressor model and the type of soft starter. Also mechanical stresses that occur at starting are reduced, which increases the life of internal components.

For details of the CI-tronic™ MCI soft starters, please refer to literature DKACT.PD.C50.C1.02.

For details of the SCR soft start kits, please contact Danfoss.

The number of starts should be limited to 6 per hour. HP/LP pressure equalization is required before starting.

Voltage application range

Motor Code	Nominal voltage	Voltage application range
1	208-230 V / 1 ph / 60 Hz	187 - 253 V
3	200-230 V / 3 ph / 60 Hz	180 - 253 V
4	400 V / 3 ph / 50 Hz	360 - 440 V
	460 V / 3 ph / 60 Hz	414 - 506 V
5	230 V / 1 ph / 50 Hz	207 - 253 V
6	230 V / 3 ph / 50 Hz	207 - 253 V
7	500 V / 3 ph / 50 Hz	450 - 550 V
	575 V / 3 ph / 60 Hz	517 - 632 V
9	380 V / 3 ph / 60 Hz	342 - 418 V

IP rating

The IP rating of the compressor terminal boxes, according to CEI 529, are shown in the outline drawings section.

The IP ratings are only valid when correctly sized cable glands of the same IP rating are applied.

IP 5 5

First numeral, level of protection against contact and foreign objects
5 Complete protection against contact and against harmful dust deposits

Second numeral, level of protection against water
4 Protection against water splashing from any direction
5 Protection against jets of water from any direction

General information

When choosing a refrigerant, various factors must be taken into consideration:
- Legislation (now and in the future)
- Safety
- Application envelope in relation to expected running conditions
- Compressor capacity and efficiency
- Compressor manufacturer recommendations & guidelines

Additional points could influence the final choice:
- Environmental considerations
- Standardization of refrigerants and lubricants
- Refrigerant cost
- Refrigerant availability

The table below gives an overview of the different refrigerant - lubricant - compressor combinations for Maneurop®, MT & MTZ compressors.

Refrigerant	Type	Compressor type	Lubricant type	Danfoss lubricant	Application
R-22	HCFC	MT	Mineral	White oil, **160P**	Medium / High temperature
R-407C	HFC	MTZ	Polyolester	Polyolester oil **160PZ**	Medium / High temperature
R-134a	HFC	MTZ	Polyolester	Polyolester oil **160PZ**	Medium / High temperature
R-404A	HFC	MTZ	Polyolester	Polyolester oil **160PZ**	Medium temperature
R-507A	HFC	MTZ	Polyolester	Polyolester oil **160PZ**	Medium temperature
Transitional refrigerants, R-22 based		MT	Alkylbenzene (ABM)	Alkylbenzene oil **160 ABM** **Note:** Initial mineral oil charge has to be replaced by 160 ABM oil.	Medium / High temperature
Hydrocarbons		Danfoss does not authorise the use of hydrocarbons in Maneurop® MT/MTZ compressors			

The Montreal protocol states that CFC refrigerants such as R-12 and R-502 may no longer be applied in new installations in the signatory members countries.
Therefore capacity and other data for these refrigerants are not published in this document. Maneurop® MT compressors, however, are suitable for use with these refrigerants and can still be used as replacements in existing installations.

R-22

R-22 is an HCFC refrigerant and is still a wide use today. It has a low ODP (Ozone Depletion Potential) and therefore it will be phased out in the future. Check local legislation. Always use mineral white oil 160P with R-22.

The Maneurop® MT compressor is dedicated for R-22 and is supplied with an initial mineral oil charge.

R-407C

Refrigerant R-407C is an HFC refrigerant with thermodynamic properties similar to those of R-22.
R-407C has zero ozone depletion potential (ODP=0). Many installers and OEMs consider R-407C to be the standard alternative for R-22. R-407C is a zeotropic mixture and has a temperature glide of about 11 K. For more specific information about zeotropic refrigerants; refer to section "Zeotropic refrigerant mixtures". R-407C must be charged in the liquid phase.

Always use Danfoss 160PZ polyolester oil with Maneurop® MTZ compressors which is supplied with the MTZ compressor for R-407C applications.
Maneurop® MT compressors should never be used with R-407C, even when the mineral oil is replaced with polyolester oil.

REFRIGERANTS AND LUBRICANTS

R-134a

Refrigerant R-134a is an HFC refrigerant with thermodynamic properties comparable to those of the CFC refrigerant R-12. R-134a has zero ozone depletion potential (ODP=0) and is commonly accepted as the best R-12 alternative. For applications with high evaporating and high condensing temperatures, R-134a is the ideal choice. R-134a is a pure refrigerant and has no temperature glide. For R-134a applications always use the Maneurop® MTZ compressor. Use Danfoss 160PZ polyolester oil, which is supplied with the MTZ compressor.
Maneurop® MT compressors should never be used for R-134a, even when the mineral oil is replaced by polyolester oil.

R-404A

Refrigerant R-404A is an HFC refrigerant with thermodynamic properties comparable to those of the CFC refrigerant R-502. R-404A has zero ozone depletion potential (ODP = 0) and is commonly accepted as one of the best R-502 alternatives. R-404A is especially suitable for low evaporating temperature applications but it can also be used with medium evaporating temperature applications. R-404A is a mixture with a very small temperature glide, therefore must be charged in its liquid phase, but for most other aspects this small glide can be ignored. Because of the small glide, R-404A is often called a near-azeotropic mixture. For more information refer to section "Zeotropic refrigerant mixtures". For low evaporating temperature applications down to -49°F, Maneurop® NTZ compressors should be used. Refer to the NTZ selection and application guidelines. For medium temperature R-404A applications, always use the Maneurop® MTZ compressor with 160PZ polyolester oil, which is supplied with the MTZ compressor.
Maneurop® MT compressors should never be used with R-404A, even if the mineral oil replaced by polyolester oil.

R-507A

Refrigerant R-507A is an HFC refrigerant with thermodynamic properties comparable to those of the CFC refrigerant R-502 and virtually equal to those of R-404A. R-507A has no ozone depletion potential (ODP = 0) and is commonly accepted as one of the best R-502 alternatives. As with R-404A, R-507A is particularly suitable for low evaporating temperatures but it can also be used in medium evaporating temperature applications. R-507A is an azeotropic mixture with no temperature glide. For low evaporating temperature applications down to -49°F, Maneurop® NTZ compressors should be used. Refer to the NTZ selection and application guidelines. For medium temperature R-507A applications, always use the Maneurop® MTZ compressor and Maneurop® 160PZ polyolester oil which is supplied with the MTZ compressor.
Maneurop® MT compressors should never be used for R-507A, even with the mineral oil replaced by polyolester oil.

R-22 based transitional refrigerants

A wide variety of R-22 - based transitional refrigerants exist (also called service refrigerants or drop-in blends). These were developed as temporary R-12 or R-502 alternatives. Some examples are R401A, R401B, R409A and R409B as R-12 alternatives and R402A, R402B, R403A and R403B as R-502 alternatives. Because of the R-22 component, they all have a (low) ozone depletion potential. Maneurop® MT compressors can be applied with these transitional refrigerants. In such applications, the initial mineral oil charge must be replaced by Maneurop®160 ABM alkylbenzene oil.

Hydrocarbons

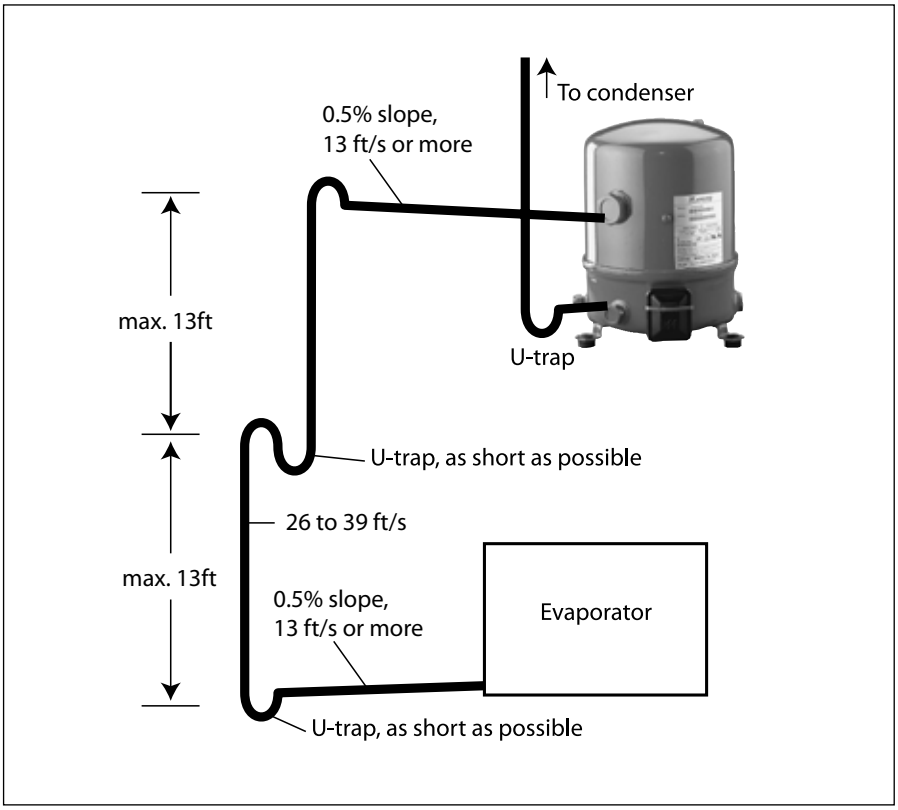
Hydrocarbons such as propane, isobutane, etc. are extremely flammable. Danfoss does not approve the use of hydrocarbons with Maneurop® MT or MTZ compressors in any way, even with a reduced refrigerant charge.

Piping design

Oil in a refrigeration circuit is required to lubricate moving parts in the compressor. During normal system operation small quantities of oil will continually leave the compressor, with the discharge gas. With good system piping design this oil will return to the compressor. As long as the amount of oil circulating through the system is small it will contribute to good system operation and improved heat transfer efficiency. Excess oil in the system, however, will have a negative effect on condenser and evaporator efficiency. If, in a poorly designed system, the amount of oil returning to the compressor is lower than the amount of oil leaving the compressor, the compressor will become starved of oil and the condenser, evaporator and/or refrigerant lines will become filled with oil. In such situations, additional oil charge will only correct the compressor oil level for a limited period of time and increase the amount of surplus oil in the rest of the system.
Only correct piping design can ensure a good oil balance in the system.

Suction lines

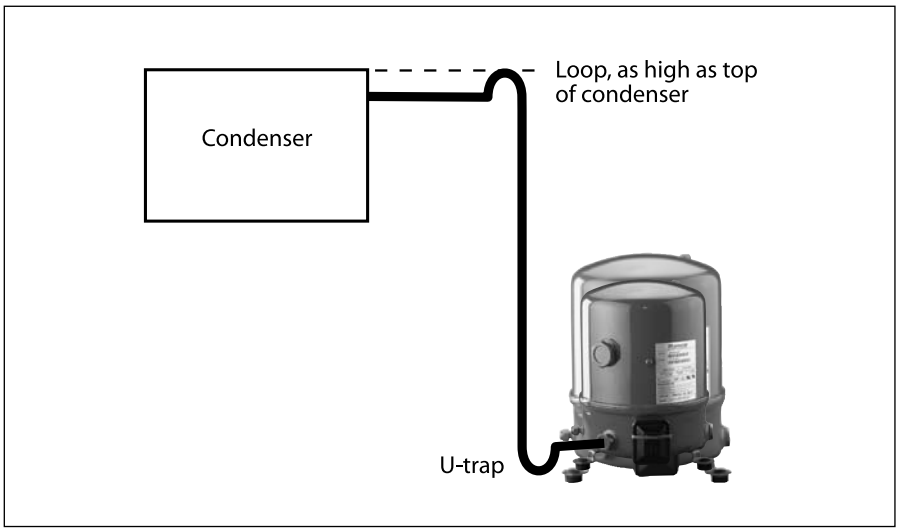
Horizontal suction line sections shall have a slope of 0.5% in the direction of refrigerant flow (5/8" for every 10' of pipe). The cross-section of horizontal suction lines shall be such that the resulting gas velocity is at least 13 fps. In vertical risers, a gas velocity of 26 to 40 fps is required to ensure proper oil return. A U-trap is required at the foot of each vertical riser. If the riser is higher than 13 ft, additional U-traps are required for each additional 13 ft. The length of each U-trap must be as short as possible to avoid the accumulation of excessive quantities of oil (see figure below).
For compressors mounted in parallel, the common suction riser should be designed as a double riser. Also refer to the News bulletin "Mounting instructions for installation of Maneurop® compressors in parallel" and "Parallel application guidelines".
Gas velocities higher than 40 fps will not contribute significantly to better oil return. They will, however, cause higher noise levels and result in higher suction line pressure drops which will have a negative effect on system capacity.



The suction rotolock valves that can be ordered from Danfoss as accessories are designed for average pipe sizes, and selected for systems running at nominal conditions.
The pipe sizes selected for specific systems may differ from these recommended sizes.
It is recommended that the suction lines be insulated to limit suction gas superheat.

Discharge line

When the condenser is mounted above the compressor, a loop above the condenser and a U-trap close to the compressor are required to prevent liquid draining from the condenser into the discharge line during standstill.



Oil charge and oil separator

In most installations the initial compressor oil charge will be sufficient. In installations with line runs exceeding 20 m, or with many oil traps, or an oil separator, additional oil may be required. In installations with risk of slow oil return, such as in multiple evaporator or multiple condenser installations, an oil separator is recommended. Also refer to page 29.

Filter driers

For new installations with MTZ compressors, Danfoss recommends using the Danfoss DML 100%-molecular sieve solid core filter drier. Molecular sieve filter driers with loose beads from third party suppliers should be avoided.

For servicing of existing installations where acid formation is present, Danfoss DCL solid core filter driers containing activated alumina are recommended.

The drier should be oversized rather than undersized. When selecting a drier, always take into account its capacity (water content capacity), the system refrigerating capacity and the system refrigerant charge.

Operating limits

High Pressure

A high pressure safety switch is required to stop the compressor should the discharge pressure exceed the values shown in the table below. The high pressure switch can be set to lower values depending on the application and ambient conditions. The HP switch must either be in a lockout circuit, or be a manual reset device to prevent compressor cycling around the high pressure limit. When a discharge valve is used, the HP switch must be connected to the service valve gauge port, which cannot be isolated.

SYSTEM DESIGN RECOMMENDATIONS

Low pressure

A low pressure safety switch is recommended to avoid compressor operation at too lower suction pressures.

		MT R-22	MTZ R-407C	MTZ R-134a	MTZ R-404A / R-507A
Test pressure low side	psig	360	360	360	360
Working pressure range high side	psig	158 - 402	181 - 426	115 - 328	191 - 402
Working pressure range low side	psig	15 - 102	20 - 96	9 - 68	15 - 104
Relief valve opening pressure difference	psig	435	435	435	435
Relief valve closing pressure difference	psig	115	115	115	115

Low ambient temperature operation

At low ambient temperatures, the condensing temperature and condensing pressure in air cooled condensers will decrease. These lower pressures may be insufficient to supply enough liquid refrigerant to the evaporator. As a result, the evaporator temperature will sharply decrease with risk of frosting. At compressor start-up, the compressor can pull a deep vacuum and it can be cut off by low pressure protection. Depending on the low pressure switch setting and delay timer, short cycling can occur. To avoid these problems, several solutions are possible, all based on reducing condenser capacity:

- Locating condensor indoors
- Liquid flooding of condensers (note: this solution requires extra refrigerant charge, which can introduce other problems. A non-return valve in the discharge line is required and special care should be taken when designing the discharge line.)
- Reduce air flow to condensers.

Other problems can occur when the compressor is operating at low ambient temperature. For example, during shut down periods, liquid refrigerant can migrate to a cold compressor. For such conditions a belt-type crankcase heater is strongly recommended.

Because Maneurop compressor motors are 100% suction gas cooled, they can be externally insulated.

Refer to section "Liquid refrigerant migration & charge limits" for more details.

Operating voltage and cycle rate

Operating voltage range

Operating voltage limits are shown in the table on page 4. The voltage applied to the motor terminals must always be within these limits. The maximum allowable voltage unbalance for 3-phase compressors is 2%. Voltage unbalance causes high current draw on one or more phases, which in turn leads to overheating and possible motor damage.

Voltage unbalance is given by the formula:

$$\% \text{ voltage unbalance: } \frac{|V_{avg} - V_{1\text{-}2}| + |V_{avg} - V_{1\text{-}3}| + |V_{avg} - V_{2\text{-}3}|}{2 \times V_{avg}} \times 100$$

V_{avg} = Mean voltage of phases 1, 2 and 3
$V_{1\text{-}2}$ = Voltage between phases 1 and 2
$V_{1\text{-}3}$ = Voltage between phases 1 and 3
$V_{2\text{-}3}$ = Voltage between phases 2 and 3.

Cycle rate limit

There may be no more than 12 starts per hour (6 when a soft start accessory is used). A higher number reduces the service life of the motor-compressor unit. If necessary, use an anti-short-cycle timer in the control circuit.

A time-out of six minutes is recommended. The system must be designed in such a way to guarantee a minimum compressor run time in order to provide proper oil return and sufficient motor cooling after starting.

Note that the oil return rate varies as a function of the system design.

Liquid refrigerant control and charge limits

Refrigeration compressors are basically designed as gas compressors. Depending on the compressor design and operating conditions, most compressors can also handle a limited amount of liquid refrigerant. Maneurop® MT and MTZ compressors have a large internal volume and can therefore handle relatively large amounts of liquid refrigerant without major problems. However even when a compressor can handle liquid refrigerant, it is not favorable to a long service life. Liquid refrigerant can dilute the oil, wash oil out of bearings and result in high oil carry over, resulting in loss of oil from the sump. Good system design can limit the amount of liquid refrigerant in the compressor, and have a positive effect on the compressor service life.
Liquid refrigerant can enter a compressor in different ways, with different effects on the compressor.

Off-cycle migration

During system standstill and after pressure equalization, refrigerant will condense in the coldest part of the system. The compressor can easily be the coldest spot, for example when it is placed outside in low ambient temperatures. After a while, the full system refrigerant charge can condense in the compressor crankcase. A large amount will dissolve in the compressor oil until the oil is completely saturated with refrigerant. If other system components are located at a higher level, this process can be even faster because gravity will speed the flow of liquid refrigerant to flow back to the compressor. When the compressor is started, the pressure in the crankcase decreases rapidly.
At lower pressures the oil holds less refrigerant, and as a result part of the refrigerant will violently evaporate from the oil, causing the oil to foam. This process is often called "boiling".
The negative effects on the compressor from migration are:

- oil dilution by liquid refrigerant
- oil foam, transported by refrigerant gas and discharged into the system, causing loss of oil and in extreme situations risk of oil slugging
- in extreme situations with high system refrigerant charge, liquid slugging could occur (liquid entering the compressor cylinders).

Liquid floodback during operation

During normal and stable system operation, refrigerant will leave the evaporator in a superheated condition and enter the compressor as a superheated vapor.
Normal superheat values at compressor suction are 9°F to 54°F. The refrigerant leaving the evaporator, however, can contain an amount of liquid refrigerant for various reasons:

- wrong dimensioning, wrong setting or malfunction of expansion device
- evaporator fan failure or blocked air filters.

In these situations, liquid refrigerant will continuously enter the compressor.
The negative effects from continuous liquid floodback are:

- permanent oil dilution
- in extreme situations with high system refrigerant charge and large amounts of floodback, liquid slugging could occur.

Liquid floodback at changeover cycles in reversible heat pumps

In heat pumps, changeover from cooling to heating cycles, defrost, and low load short cycles may lead to liquid refrigerant floodback or saturated refrigerant return conditions.
The negative effects are:

- oil dilution
- in extreme situations with high system refrigerant charge and large amounts of floodback, liquid slugging could occur.

Liquid floodback and zeotropic refrigerants

Liquid floodback in systems working with a zeotropic refrigerant such as R-407C introduces additional negative effects. A part of the refrigerant leaves the evaporator in liquid phase and this liquid has a different composition than the vapor.
This new refrigerant composition may result in different compressor operating pressures and temperatures.

SYSTEM DESIGN RECOMMENDATIONS

Crankcase heater

A crankcase heater protects against the off-cycle migration of refrigerant and proves effective if oil temperature is maintained 18°F above the saturated LP temperature of the refrigerant. Tests must be conducted, therefore, to ensure that the appropriate oil temperature is maintained under all ambient conditions. A PTC crankcase heater is recommended on all stand-alone compressors and split systems. PTC crankcase heaters are self-regulating.
Under extreme conditions such as very low ambient temperature a belt type crankcase heater could be used in addition to the PTC heater, although this is not a preferred solution for 1 and 2 cylinder compressors. The belt crankcase heater must be positioned on the compressor shell as close as possible to the oil sump to ensure good heat transfer to the oil.
Belt crankcase heaters are not self-regulating. Control must be applied to energize the belt heater once the compressor has been stopped and then to de-energize it while the compressor is running. The belt heater must be energized 12 hours before restarting the compressor following an extended down period.
If the crankcase heater is not able to maintain the oil temperature 18°F above the saturated LP temperature of the refrigerant during off cycles or if repeated floodback is occuring, a pumpdown cycle using an LLSV is required. In such cases, a suction accumulator is recommended.

Liquid line solenoid valve & pump-down

In refrigeration applications, a Liquid Line Solenoid Valve (LLSV) is highly recommended. During the off-cycle, the LLSV isolates the liquid charge in the condenser side, thus preventing refrigerant transfer or excessive migration of refrigerant into the compressor. Furthermore, when using an LLSV in with a pumpdown cycle, the quantity of refrigerant in the low-pressure side of the system will be reduced.
A pump-down cycle design is also required when evaporators are fitted with electric defrost heaters.

Suction accumulator

A suction accumulator offers considerable protection against refrigerant floodback at start-up, during operation or after the defrost operation. This device also helps to protect against off-cycle migration by means of providing additional internal free volume to the low pressure side of the system.
The suction accumulator must be selected in accordance with the accumulator manufacturer's recommendations. As a general rule, Danfoss recommends sizing the accumulator for at least 50% of the total system charge. Tests, however, must be conducted to determine the optimal size.
A suction accumulator must not be used in systems with zeotropic refrigerant mixtures.

Sound

Running compressors cause sound and vibration. These phenomena are closely related.
Sound produced by a compressor is transmitted in every direction in all media: ambient air, the mounting feet, the pipework and the refrigerant in the pipework.
The easiest way to reduce the sound transmitted in ambient air is to fit a Danfoss acoustic hood accessory. Because Maneurop® compressors are 100% suction gas cooled, and require no body cooling, they can be insulated. Values for the sound reduction achieved with acoustic hoods are shown also in the table below. For compressors mounted inside, sound insulation of the plantrom is an alternative to sound insulation of the compressor.
Sound transmitted by mounting feet, pipework and refrigerant should be reduced in the same way as vibration.
Please refer to the next section.

Sound power level for MTZ with R-404A, motor code 4
Te = 14°F,
TC = 113°F

	Sound power level at 50 Hz dB(A)		Sound power level at 60 Hz dB(A)	
	without hood	with hood*	without hood	with hood*
MTZ018	73	65	73	66
MTZ022	74	68	77	71
MTZ028	71	64	73	66
MTZ032	71	64	73	66
MTZ036	70	64	76	69
MTZ040	70	65	72	67
MTZ044	80	74	82	76
MTZ045	80	74	82	76
MTZ050	83	76	84	78
MTZ051	83	76	84	78
MTZ056	81	74	81	74
MTZ057	81	74	81	74
MTZ064	80	74	84	78
MTZ065	80	74	84	78
MTZ072	79	72	82	75
MTZ073	79	72	82	75
MTZ080	79	73	84	78
MTZ081	79	73	84	78
MTZ100	85	79	87	81
MTZ125	84	78	86	80
MTZ144	83	77	86	80
MTZ160	83	77	86	80

* Sound data with hood are valid for the Danfoss acoustic hood accessory.

Model	Acoustic hood accessory	code no.
MT/MTZ018 - 040	Acoustic hood for 1 cyl compressors	**7755001**
MT/MTZ044 - 081	Acoustic hood for 2 cyl compressors	**7755002**
MT/MTZ100 - 160	Acoustic hood for 4 cyl compressors	**7755003**

Vibration

The mounting grommets delivered with the compressor should always be used. They reduce vibration transmitted by the compressor mounting feet to the base frame.
The base on which the compressor is mounted should be sufficiently rigid and of adequate mass to ensure the full effectiveness of the mounting grommets.
The compressor should never be directly mounted to the base frame without the grommets. If it is, significant high vibration transmission will occur and the compressor service life will be reduced.
Suction and discharge lines must have adequate flexibility in 3 planes. Vibration absorbers may be required.
Care must be taken to avoid tubing having frequencies resonant close to the compressor frequency.
Vibration is also transmitted by the refrigerant gas. Maneurop® compressors have built in mufflers to reduce this vibration.
To further reduce vibration an additional muffler can be installed.

Note: Maneurop® MT & MTZ compressors have been designed and qualified for stationary equipment used in A/C and refrigeration applications.
Danfoss does not warrant these compressors for use in mobile applications, such as trucks, railways, subways, etc.

System cleanliness

System contamination is one of the main factors affecting equipment reliability and compressor service life.
It is, therefore, important to ensure system cleanliness when constructing a refrigeration system. During the building process, system contamination can be caused by:

- Brazing and welding oxides
- Filings and particles from removing burrs from pipe-work
- Brazing flux
- Moisture and air.

Only use clean and dehydrated refrigeration grade copper tubes and silver alloy brazing material. Clean all parts before brazing and always purge nitrogen or CO_2 through the pipes during brazing to prevent oxidation. If flux is used, take every precaution to prevent it entering the piping. Do not drill holes (e.g. for Schräder valves).
in parts of the installation that are already completed, when filings and burrs can not be removed. Carefully follow the instructions below regarding brazing, mounting, leak detection, pressure test and moisture removal. All installation and service work must be done only by qualified personnel using correct procedures and using tools (charging systems, tubes, vacuum pump, etc.) dedicated for the refrigerant that will be used.

Compressor handling, mounting and connection to the system

Compressor handling

Maneurop® MT and MTZ compressors are provided with a lifting lug. This lug should always be used to lift the compressor. Once the compressor is installed, the compressor lifting lug should never be used to lift the complete installation.
Keep the compressor in an upright position during handling.

Compressor mounting

Mount the compressor on a horizontal plane with a maximum slope of 3°. All MT and MTZ compressors are supplied with three or four rubber mounting grommets, each complete with metal sleeves, nuts, and bolts. Refer to the outline drawings on page 18 to 21.

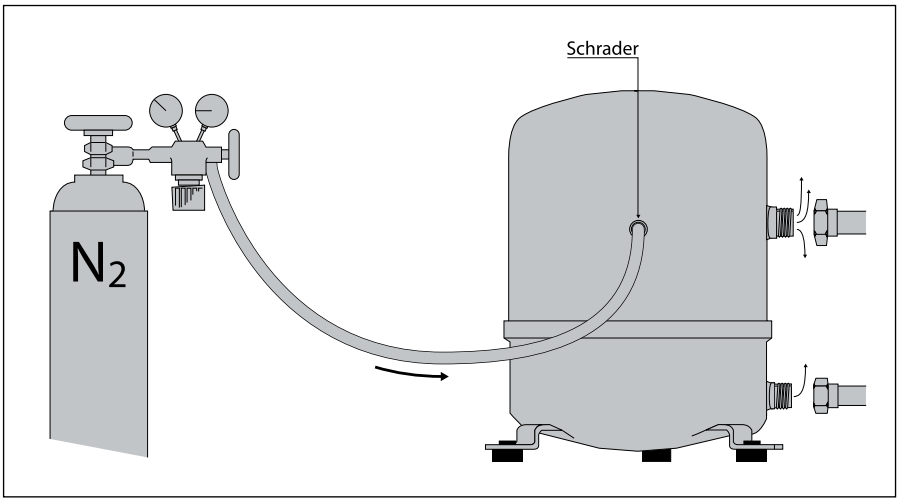
The grommets largely attenuate compressor vibration transmitted to the base frame. The compressor must always be mounted with these grommets. Refer to the table below for torque values.

Designation		Recommended torque in. lb
Cable screw of T connector in electrical box	screw 10/32 - UNF x 3	17
Rotolock valves and solder sleeves	1"	59
	1"1/4	66
	1"3/4	81
Mounting grommet bolts	1 - 2 - 4 cylinder	11
Oil sight glass	-	37
Oil equalization connection	1 - 2 - 4 cylinder	22

Compressor connection to the system

New compressors have a protective nitrogen holding charge. The suction and discharge caps should only be removed just before connecting the compressor to the installation to avoid air and moisture entering the compressor.
Whenever possible the compressor must be the last component to be integrated in the system. It is advisable to braze the solder sleeves or service valves to the pipework before the compressor is mounted. When all brazing is finished and when the entire

system is ready, the compressor caps can be removed and the compressor connected to the system with a minimum exposure to ambient air.
If this procedure is not possible, the sleeves or valves may be brazed to the pipes when mounted on the compressor.
In this situation nitrogen or CO_2 must be purged through the compressor via the Schräder valve to prevent air and moisture ingress. Purging must start when the caps are removed and continue during the brazing process.
When rotolock valves are used on the compressor, they must be closed immediately after mounting, thus keeping the compressor isolated from the atmosphere or from a system not yet dehydrated.
Note: When the compressor is built into a "rack" or "pack" configuration that is not installed immediately in its final location, a vacuum pull-down and moisture removal must be performed to the rack as if it were a complete system (see below). The rack must be charged with nitrogen or CO_2 and open tubes must be blocked with caps or plugs.



System pressure test

It is recommended that an inert gas or nitrogen be used for pressure testing. Dry air may also be used but care should be taken since it can form a flammable mixture with the compressor oil. When performing a system pressure test, the maximum allowed pressure for the different components should not be exceeded.
For MT/MTZ compressors the maximum test pressures are shown in the table below.

	1-2-4 cylinder compressors
Maximum compressor test pressure, low side	362 psi(g)
Maximum compressor test pressure, high side	435 psi(g)

Do not exceed 435 psig pressure differential between high pressure side and low pressure side of the compressor because this will open the internal compressor relief valve.

Leak detection

Whenever possible (if valves are present) the compressor must be kept isolated from the system. Perform leak detection using the final refrigerant. Pressurize with nitrogen or another system-neutral gas and use a leak detector for the applied refrigerant. A helium leak detector can also be used.
Leaks must be repaired respecting the instructions written above. Use of other gasses such as oxygen, dry air, or acetylene is not recommended, as these gasses can form a

flammable mixture. Never use CFC or HCFC refrigerants for leak detection in HFC systems.
Note 1: Leak detection with refrigerant may not be allowed in some countries. Check local regulations.

Note 2: Leak detecting additives shall not be used as they may affect the lubricant properties.
Warranty may be voided if leak detecting additives have been used.

Vacuum pull-down moisture removal

Moisture interferes with proper functioning of compressors and refrigeration systems.
Air and moisture reduce service life, increase condensing pressure, and cause excessively high discharge temperatures, that can destroy the lubricating properties of the oil. Air and moisture also increase the risk of acid formation, giving rise to copper plating. All these phenomena can cause mechanical and electrical compressor failure.
To eliminate these factors, a vacuum pull-down according to the procedure given below is recommended.

1. Whenever possible (if valves are present) the compressor must be kept isolated from the system.

2. After leak detection, the system must be pulled down under a vacuum of 500 microns. A two stage vacuum pump must be used, with a capacity appropriate to the system volume. Use connection lines with a large diameter and connect them to the service valves and (not to the Schräder connection) to avoid too high pressure losses.

3. When a vacuum level of 500 microns is reached, the system must be isolated from the vacuum pump. Wait 30 minutes, during which the system pressure should not rise. When the pressure rapidly increases, the system is not leak tight. Leak detection must be repeated and the vacuum pull-down procedure should be restarted from step 1. When the pressure slowly increases, this indicates the presence of moisture. In this case steps 2 and 3 should be repeated.

4. Connect the compressor to the system by opening the valves. Repeat steps 2 and 3.

5. Break the vacuum with nitrogen or the final refrigerant.

6. Repeat steps 2 and 3 on the total system.
At commissioning, system moisture content may be up to 100 ppm. During operation the filter drier must reduce this to a level < 20 ppm.
Warning :
Do not use a megohmmeter or apply power to the compressor while it is under vacuum, as this may cause motor winding damage.
Never run the compressor under vacuum as it may cause compressor motor burn-out.

Start-up

Before initial start-up, or after a prolonged shut down period, energize the crankcase heater (if fitted) 12 hours prior to start-up, or turn on power for single phase compressors with trickle circuit.

Refrigerant charging

Zeotropic and "near-azeotropic" refrigerant mixtures such as R-407C and R-404A must always be charged in the liquid phase. For the initial charge, the compressor must not run and service valves must be closed. Charge refrigerant as close as possible to the nominal system charge before starting the compressor. Then slowly add refrigerant in the liquid phase, on the low pressure side as far away as possible from the running compressor.
The refrigerant charge quantity must be suitable for both winter and summer operation. Refer also to section "Protection against flooded starts and liquid floodback" for information about refrigerant charge limits.
Warning: when a liquid line solenoid valve is used, the vacuum in the low pressure side must be broken before applying power to the system.

Oil charge and oil level

The oil charge must be checked before commissioning (1/4 to 3/4 of the oil sight glass). Check the oil level again after a minimum of 2 hours operation at nominal conditions. In most installations the initial compressor oil charge will be sufficient. In installations with line runs exceeding 20 m or with many oil traps or an oil separator, additional oil may be required. Normally the quantity of oil added should be no more than 2% of the total refrigerant charge (this percentage does not take into account oil contained in accessories such as oil separators or oil traps). If oil has already been added, and the oil level in the compressor keeps decreasing, the oil return in the installation is insufficient. Refer also to section "Piping design".
In installations where slow oil return is likely such as in multiple evaporator or multiple condenser installations, an oil separator is recommended. Refer to the table on page 17 to select the correct oil.

Suction gas superheat

Optimum suction gas superheat is 15°F. A lower superheat will contribute to better system performance (higher mass flow and more efficient use of evaporator surface). Low superheat values however increase the risk of unwanted liquid floodback to the compressor.
For very low superheat values an electronically controlled expansion valve is recommended.
Maximum allowable superheat is about 54°F. Higher values can be accepted but in these cases, tests have to be performed to check that the maximum discharge temperature of 265°F will not be exceeded. Note that high superheat values decrease the compressor application envelope and system performance.

ACCESSORIES AND SPAREPARTS

The tables below show an extract of the available accessories and spare parts for Maneurop® reciprocating compressors. For an exhaustive list please refer to Accessories & Spare parts catalogue, ref. FRCC.EK.002.A1.02

Rotolock accessories

Type	Code no.	Description	Application	Packaging	Pack size
V06-V01	**7703004**	Valve set, V06 (1"~1/2"), V01 (1"~3/8")	MT/MTZ018-028 (exept 028 code 1)	Multipack	4
V09-V06	**7703005**	Valve set, V09 (1-1/4"~5/8"), V06 (1"~1/2")	MT/MTZ032-040 (& 028 code 1)	Multipack	4
V07-V04	**7703006**	Valve set, V07 (1-3/4"~7/8"), V04 (1-1/4"~3/4")	MT/MTZ044-072	Multipack	6
V02-V04	**7703009**	Valve set, V02 (1-3/4"~1-1/8"), V04 (1-1/4"~3/4")	MT/MTZ080-160	Multipack	6
C06-C01	**7703011**	Angle adapter set, C06 (1"~1/2"), C01 (1"~3/8")	MT/MTZ018-028 (exept 028 code 1)	Multipack	4
C09-C06	**7703012**	Angle adapter set, C09 (1-1/4"~5/8"), C06 (1"~1/2")	MT/MTZ032-040 (& 028 code 1)	Multipack	4
C07-C04	**7703013**	Angle adapter set, C07 (1-3/4"~7/8"), C04 (1-1/4"~3/4")	MT/MTZ044-072	Multipack	6
C02-C04	**7703014**	Angle adapter set, C02 (1-3/4"~1-1/8"), C04 (1-1/4"~3/4")	MT/MTZ080-160	Multipack	6
G01	**8156130**	Gasket, 1"	Models with 1" rotolock connection	Multipack	10
G01	**7956001**	Gasket, 1"	Models with 1" rotolock connection	Industry pack	50
G09	**8156131**	Gasket, 1-1/4"	Models with 1-1/4" rotolock connection	Multipack	10
G09	**7956002**	Gasket, 1-1/4"	Models with 1-1/4" rotolock connection	Industry pack	50
G07	**8156132**	Gasket, 1-3/4"	Models with 1-3/4" rotolock connection	Multipack	10
G07	**7956003**	Gasket, 1-3/4"	Models with 1-3/4" rotolock connection	Industry pack	50
	8156009	Gasket set, 1", 1-1/4", 1-3/4", Oil sight glass gaskets black & white	All 1-2-4 cylinder models	Multipack	10

Crankcase heaters

Type	Code no.	Description	Application	Packaging	Pack size
PTC35W	**7773001**	PTC crankcase heater, 35 W, incl. heat transfer paste	All models	Multipack	10
PTC35W	**7973009**	PTC crankcase heater, 35 W, incl. heat transfer paste	All models	Industry pack	50
PTC35W	**7773125**	PTC crankcase heater, 35 W, mounting without paste	All models	Multipack	10
PTC35W	**7973011**	PTC crankcase heater, 35 W, mounting without paste	All models	Industry pack	50
	7773106	Belt type crankcase heater, 55 W, 230 V, CE mark, UL	MT/MTZ018-040	Multipack	4
	7773002	Belt type crankcase heater, 54 W, 240 V, UL	MT/MTZ018-040	Multipack	4
	7773013	Belt type crankcase heater, 54 W, 400 V, UL	MT/MTZ018-040	Multipack	4
	7773111	Belt type crankcase heater, 54 W, 460 V, UL	MT/MTZ018-040	Multipack	4
	7773109	Belt type crankcase heater, 65 W, 110 V, CE mark, UL	MT/MTZ044-081	Multipack	6
	7973001	Belt type crankcase heater, 65 W, 110 V, CE mark, UL	MT/MTZ044-081	Industry pack	50
	7773107	Belt type crankcase heater, 65 W, 230 V, CE mark, UL	MT/MTZ044-081	Multipack	6
	7973002	Belt type crankcase heater, 65 W, 230 V, CE mark, UL	MT/MTZ044-081	Industry pack	50
	7773117	Belt type crankcase heater, 65 W, 400 V, CE mark, UL	MT/MTZ044-081	Multipack	6
	7773010	Belt type crankcase heater, 50 W, 110 V, UL	MT/MTZ044-081	Multipack	6
	7773003	Belt type crankcase heater, 50 W, 240 V, UL	MT/MTZ044-081	Multipack	6
	7773009	Belt type crankcase heater, 50 W, 400 V, UL	MT/MTZ044-081	Multipack	6
	7773006	Belt type crankcase heater, 50 W, 460 V, UL	MT/MTZ044-081	Multipack	6
	7773119	Belt type crankcase heater, 75 W, 575 V, UL	MT/MTZ044-081	Multipack	6
	7773110	Belt type crankcase heater, 75 W, 110 V, CE mark, UL	MT/MTZ100-160	Multipack	6
	7773108	Belt type crankcase heater, 75 W, 230 V, CE mark, UL	MT/MTZ100-160	Multipack	6
	7973005	Belt type crankcase heater, 75 W, 230 V, CE mark, UL	MT/MTZ100-160	Industry pack	50
	7773118	Belt type crankcase heater, 75 W, 400 V, CE mark, UL	MT/MTZ100-160	Multipack	6
	7773004	Belt type crankcase heater, 75 W, 240 V, UL	MT/MTZ100-160	Multipack	6
	7773014	Belt type crankcase heater, 75 W, 400 V, UL	MT/MTZ100-160	Multipack	6
	7773008	Belt type crankcase heater, 75 W, 460 V, UL	MT/MTZ100-160	Multipack	6
	7773105	Belt type crankcase heater, 75 W, 575 V, UL	MT/MTZ100-160	Multipack	6

Acoustic hoods

Type	Code no.	Description	Application	Packaging	Pack size
	7755001	Acoustic hood for 1 cylinder compressor	MT/MTZ018-040	Single pack	1
	7755002	Acoustic hood for 2 cylinder compressor	MT/MTZ044-081	Single pack	1
	7755003	Acoustic hood for 4 cylinder compressor	MT/MTZ100-160	Single pack	1

ACCESSORIES AND SPAREPARTS

3-phase soft start equipment

Type	Code no.	Description	Application	Packaging	Pack size
SCR01	**7702003**	Soft start kit with statoric resistors, prewired box, SCR01	MT/MTZ044-081	Single pack	1
SCR03	**7705001**	Soft start kit with statoric resistors, prewired box, SCR03	MT/MTZ100-160	Single pack	1
MCI 15 C	**7705006**	Electronic soft start kit, MCI 15C	MT/MTZ018-081	Single pack	1
MCI 25 C	**7705007**	Electronic soft start kit, MCI 25C	MT/MTZ100-160	Single pack	1

Single phase PSC starting kits

Type	Code no.	Description	Application	Packaging	Pack size
PSC	**7701026**	PSC starting kit, 20 µF, 10 µF	MT/MTZ018-028 code 5	Multipack	4
PSC	**7701024**	PSC starting kit, 25 µF, 10 µF	MT/MTZ032-036 code 5	Multipack	4
PSC	**7701025**	PSC starting kit, 15 µF, 10 µF	MT/MTZ018 code 1	Multipack	4
PSC	**7701035**	PSC starting kit, 30 µF, 15 µF	MT/MTZ022 & 044-050 code 1 & 050-5	Multipack	4
PSC	**7701151**	PSC starting kit, 25 µF, 25 µF	MT/MTZ028 code 1	Multipack	4
PSC	**7701152**	PSC starting kit, 25 µF, 20 µF	MT/MTZ032-036 code 1	Multipack	4
PSC	**7701153**	PSC starting kit, 35 µF, 20 µF	MT/MTZ040 code 1	Multipack	4
PSC	**7701036**	PSC starting kit, 30 µF, 20 µF	MT/MTZ056 code 1	Multipack	6
PSC	**7701037**	PSC starting kit, 30 µF, 25 µF	MT/MTZ064 code 1	Multipack	6

Single phase CSR starting kits & starting kits in prewired box

Type	Code no.	Description	Application	Packaging	Pack size
CSR	**7701022**	CSR starting kit, 20 µF, 10 µF, 98 µF	MT/MTZ018-028 code 5	Multipack	4
CSR	**7701030**	CSR starting kit, 25 µF, 10 µF, 98 µF	MT/MTZ032-036 code 5	Multipack	4
CSR	**7701021**	CSR starting kit, 15 µF, 10 µF, 98 µF	MT/MTZ018 code 1	Multipack	4
CSR	**7701038**	CSR starting kit, 15 µF, 30 µF, 98 µF	MT/MTZ022 code 1	Multipack	4
CSR	**7701154**	CSR starting kit, 25 µF, 25 µF, 140 µF	MT/MTZ028 code 1	Multipack	4
CSR	**7701155**	CSR starting kit, 25 µF, 20 µF, 98 µF	MT/MTZ032-036 code 1	Multipack	4
CSR	**7701156**	CSR starting kit, 35 µF, 20 µF, 98 µF	MT/MTZ040 code 1	Multipack	4
CSR	**7701042**	CSR starting kit, 30 µF, 15 µF, 140 µF	MT/MTZ044-051 code 1	Multipack	6
CSR	**7701043**	CSR starting kit, 30 µF, 20 µF, 98 µF + 98 µF	MT/MTZ056 code 1	Multipack	6
CSR	**7701044**	CSR starting kit, 30 µF, 25 µF, 98 µF + 140 µF	MT/MTZ064 code 1	Multipack	6
CSR	**7701028**	CSR starting kit, prewired box, 20 µF, 10 µF, 98 µF	MT/MTZ018-028 code 5	Single pack	1
CSR	**7701054**	CSR starting kit, prewired box, 25 µF, 10 µF, 98 µF	MT/MTZ032-036 code 5	Single pack	1
CSR	**7701147**	CSR starting kit, prewired box, 15 µF, 30 µF, 98 µF	MT/MTZ022 code 1	Single pack	1
CSR	**7701148**	CSR starting kit, prewired box, 25 µF, 25 µF, 140 µF	MT/MTZ028 code 1	Single pack	1
CSR	**7701149**	CSR starting kit, prewired box, 25 µF, 20 µF, 98 µF	MT/MTZ032-036 code 1	Single pack	1
CSR	**7701150**	CSR starting kit, prewired box, 35 µF, 20 µF, 98 µF	MT/MTZ040 code 1	Single pack	1
CSR	**7701049**	CSR starting kit, prewired box, 30 µF, 15 µF, 140 µF	MT/MTZ044-050 code 1	Single pack	1

Kickstart kits

Type	Code no.	Description	Application	Packaging	Pack size
	7701060	Kickstart kit; relay + start capacitor 227 µF	MT/MTZ018 code 1 & 5	Single pack	1
	7701059	Kickstart kit; relay + start capacitor 280 µF	MT/MTZ022-064 code 1 & 5 excl 050-5	Single pack	1

Lubricants

Type	Code no.	Description	Application	Packaging	Pack size
160PZ	**7754019**	POE lubricant, 160PZ, 33.8 oz can	MTZ with R-404A, R-507A, R-134a,	Multipack	12
160PZ	**7754020**	POE lubricant, 160PZ, 67.6 oz can	MTZ with R-404A, R-507A, R-134a,	Multipack	8
160P	**7754001**	Mineral oil, 160P, 67.6 oz can	MT or LT with R-22 or R-502	Multipack	8
160P	**7754002**	Mineral oil, 160P, 169 oz can	MT or LT with R-22 or R-502	Multipack	4
160ABM	**7754009**	Alkylbenzene oil 160ABM, 67.6 oz can	MT or LT with transitional refrigerants	Multipack	8

ORDERING INFORMATION AND PACKAGING

Ordering information

Maneurop® MT & MTZ reciprocating compressors can be ordered from Danfoss Commercial Compressors in either industrial packs (also called multiple packaging) or in single packs (also called individual packaging).

The code numbers ending in "M" in the tables represent compressors in industrial pack. For ordering single units, please replace the last letter "M" by letter "I".

MT compressors in industrial pack (multiple packaging) R-22

Compressor model	Design[1])	Code no.						
		1	3	4	5	6	7	9
		208-230/1/60	200-230/3/60	460/3/60 400/3/50	230/1/50	230/3/50	575/3/60 500/3/50	380/3/60
MT018	S	-	MT18-3M	MT18-4M	MT18-5M	-	-	-
	VE	MT18-1VM	MT18-3VM	MT18-4VM	MT18-5VM	-	-	-
MT022	S	MT22-1M	MT22-3M	MT22-4M	MT22-5M	-	-	-
	VE	MT22-1VM	MT22-3VM	MT22-4VM	MT22-5VM	MT22-6VM	-	MT22-9VM
MT028	S	MT28-1M	MT28-3M	MT28-4M	MT28-5M	MT28-6M	-	-
	VE	MT28-1VM	MT28-3VM	MT28-4VM	MT28-5VM	MT28-6VM	-	MT28-9VM
MT032	S	-	MT32-3M	MT32-4M	MT32-5M	MT32-6M	-	-
	VE	MT32-1VM	MT32-3VM	MT32-4VM	MT32-5VM	MT32-6VM	-	-
MT036	S	-	MT36-3M	MT36-4M	MT36-5M	MT36-6M	-	-
	VE	MT36-1VM	MT36-3VM	MT36-4VM	MT36-5VM	MT36-6VM	-	MT36-9VM
MT040	S	MT40-1M	MT40-3M	MT40-4M	-	MT40-6M	-	-
	VE	MT40-1VM	MT40-3VM	MT40-4VM	-	MT40-6VM	-	-
MT044	S	MT44-1M	MT44-3M	MT44-4M	-	-	-	MT44-9M
	VE	MT44-1VM	MT44-3VM	MT44-4VM	-	MT44-6VM	MT44-7VM	MT44-9VM
MT045	S	-	-	MT45-4M	-	-	-	-
	VE	-	MT45-3VM	MT45-4VM	-	-	-	-
MT050	S	-	MT50-3M	MT50-4M	-	-	-	MT50-9M
	VE	MT50-1VM	MT50-3VM	MT50-4VM	MT50-5VM	MT50-6VM	MT50-7VM	MT50-9VM
MT051	S	-	MT51-3M	MT51-4M	-	-	-	-
	VE	-	MT51-3VM	MT51-4VM	-	-	-	-
MT056	S	-	MT56-3M	MT56-4M	-	-	MT56-7M	MT56-9M
	VE	MT56-1VM	MT56-3VM	MT56-4VM	-	MT56-6VM	MT56-7VM	MT56-9VM
MT057	S	-	-	MT57-4M	-	-	-	-
	VE	-	MT57-3VM	MT57-4VM	-	-	-	-
MT064	S	-	MT64-3M	MT64-4M	-	-	-	MT64-9M
	VE	MT64-1VM	MT64-3VM	MT64-4VM	-	MT64-6VM	-	MT64-9VM
MT065	S	-	MT65-3M	MT65-4M	-	-	-	-
	VE	-	MT65-3VM	MT65-4VM	-	-	-	-
MT072	S	-	MT72-3M	MT72-4M	-	-	-	MT72-9M
	VE	-	MT72-3VM	MT72-4VM	-	MT72-6VM	-	MT72-9VM
MT073	S	-	MT73-3M	MT73-4M	-	-	-	-
	VE	-	MT73-3VM	MT73-4VM	-	-	-	-
MT080	S	-	-	MT80-4M	-	-	-	MT80-9M
	VE	-	MT80-3VM	MT80-4VM	-	MT80-6VM	-	MT80-9VM
MT081	S	-	-	MT81-4M	-	-	-	-
	VE	-	MT81-3VM	MT81-4VM	-	-	-	-
MT100	Sv	-	MT100-3M	MT100-4M	-	MT100-6M	MT100-7M	MT100-9M
	VE	-	MT100-3VM	MT100-4VM	-	MT100-6VM	MT100-7VM	MT100-9VM
MT125	Sv	-	MT125-3M	MT125-4M	-	MT125-6M	MT125-7M	-
	VE	-	MT125-3VM	MT125-4VM	-	MT125-6VM	MT125-7VM	-
MT144	Sv	-	MT144-3M	MT144-4M	-	-	-	MT144-9M
	VE	-	MT144-3VM	MT144-4VM	-	MT144-6VM	MT144-7VM	MT144-9VM
MT160	Sv	-	MT160-3M	MT160-4M	-	MT160-6M	-	MT160-9M
	VE	-	MT160-3VM	MT160-4VM	-	MT160-6VM	MT160-7VM	MT160-9VM

[1]) S = Single compressor, no oil sight glass, no oil equalization connection
Sv = Single compressor, brazed oil sight glass, no oil equalization connection
VE = Single compressor, threaded oil sight glass, 3/8" oil equalization connection

ORDERING INFORMATION AND PACKAGING

MTZ compressors in industrial pack (multiple packaging)

R-404A / R-507A / R-134a / R-407C

Compressor model	Design[1])	Code no.						
		1	3	4	5	6	7	9
		208-230/1/60	200-230/3/60	460/3/60 400/3/50	230/1/50	230/3/50	575/3/60 500/3/50	380/3/60
MTZ018	S	MTZ18-1M	MTZ18-3M	MTZ18-4M	MTZ18-5M	-	-	-
	VE	MTZ18-1VM	MTZ18-3VM	MTZ18-4VM	MTZ18-5VM	MTZ18-6VM	-	-
MTZ022	S	MTZ22-1M	MTZ22-3M	MTZ22-4M	MTZ22-5M	MTZ22-6M	-	-
	VE	MTZ22-1VM	MTZ22-3VM	MTZ22-4VM	MTZ22-5VM	MTZ22-6VM	-	MTZ22-9VM
MTZ028	S	MTZ28-1M	MTZ28-3M	MTZ28-4M	MTZ28-5M	MTZ28-6M	-	-
	VE	MTZ28-1VM	MTZ28-3VM	MTZ28-4VM	MTZ28-5VM	MTZ28-6VM	-	MTZ28-9VM
MTZ032	S	MTZ32-1M	MTZ32-3M	MTZ32-4M	MTZ32-5M	MTZ32-6M	MTZ32-7M	-
	VE	MTZ32-1VM	MTZ32-3VM	MTZ32-4VM	MTZ32-5VM	MTZ32-6VM	MTZ32-7VM	MTZ32-9VM
MTZ036	S	MTZ36-1M	MTZ36-3M	MTZ36-4M	MTZ36-5M	MTZ36-6M	-	-
	VE	MTZ36-1VM	MTZ36-3VM	MTZ36-4VM	MTZ36-5VM	MTZ36-6VM	MTZ36-7VM	MTZ36-9VM
MTZ040	S	MTZ40-1M	MTZ40-3M	MTZ40-4M	-	MTZ40-6M	-	-
	VE	MTZ40-1VM	MTZ40-3VM	MTZ40-4VM	-	MTZ40-6VM	-	-
MTZ044	S	-	MTZ44-3M	MTZ44-4M	-	-	MTZ44-7M	MTZ44-9M
	VE	MTZ44-1VM	MTZ44-3VM	MTZ44-4VM	-	MTZ44-6VM	MTZ44-7VM	MTZ44-9VM
MTZ045	S	-	-	MTZ45-4M	-	-	-	-
	VE	-	MTZ45-3VM	MTZ45-4VM	-	-	-	-
MTZ050	S	-	MTZ50-3M	MTZ50-4M	-	-	MTZ50-7M	MTZ50-9M
	VE	MTZ50-1VM	MTZ50-3VM	MTZ50-4VM	MTZ50-5VM	MTZ50-6VM	MTZ50-7VM	MTZ50-9VM
MTZ051	S	-	-	MTZ51-4M	-	-	-	-
	VE	-	MTZ51-3VM	MTZ51-4VM	-	-	-	-
MTZ056	S	-	MTZ56-3M	MTZ56-4M	-	-	MTZ56-7M	MTZ56-9M
	VE	MTZ56-1VM	MTZ56-3VM	MTZ56-4VM	-	MTZ56-6VM	MTZ56-7VM	MTZ56-9VM
MTZ057	S	-	-	MTZ57-4M	-	-	-	-
	VE	-	MTZ57-3VM	MTZ57-4VM	-	-	-	-
MTZ064	S	-	MTZ64-3M	MTZ64-4M	-	-	-	MTZ64-9M
	VE	MTZ64-1VM	MTZ64-3VM	MTZ64-4VM	-	MTZ64-6VM	-	MTZ64-9VM
MTZ065	S	-	-	MTZ65-4M	-	-	-	-
	VE	-	MTZ65-3VM	MTZ65-4VM	-	-	-	-
MTZ072	S	-	MTZ72-3M	MTZ72-4M	-	MTZ72-6M	-	MTZ72-9M
	VE	-	MTZ72-3VM	MTZ72-4VM	-	MTZ72-6VM	-	MTZ72-9VM
MTZ073	S	-	-	MTZ73-4M	-	-	-	-
	VE	-	MTZ73-3VM	MTZ73-4VM	-	-	-	-
MTZ080	S	-	-	MTZ80-4M	-	-	-	MTZ80-9M
	VE	-	MTZ80-3VM	MTZ80-4VM	-	MTZ80-6VM	-	MTZ80-9VM
MTZ081	S	-	-	MTZ81-4M	-	-	-	-
	VE	-	MTZ81-3VM	MTZ81-4VM	-	-	-	-
MTZ100	Sv	-	MTZ100-3M	MTZ100-4M	-	MTZ100-6M	MTZ100-7M	MTZ100-9M
	VE	-	MTZ100-3VM	MTZ100-4VM	-	MTZ100-6VM	MTZ100-7VM	MTZ100-9VM
MTZ125	Sv	-	MTZ125-3M	MTZ125-4M	-	MTZ125-6M	MTZ125-7M	MTZ125-9M
	VE	-	MTZ125-3VM	MTZ125-4VM	-	MTZ125-6VM	MTZ125-7VM	MTZ125-9VM
MTZ144	Sv	-	MTZ144-3M	MTZ144-4M	-	MTZ144-6M	MTZ144-7M	MTZ144-9M
	VE	-	MTZ144-3VM	MTZ144-4VM	-	MTZ144-6VM	MTZ144-7VM	MTZ144-9VM
MTZ160	Sv	-	MTZ160-3M	MTZ160-4M	-	MTZ160-6M	-	MTZ160-9M
	VE	-	MTZ160-3VM	MTZ160-4VM	-	MTZ160-6VM	MTZ160-7VM	MTZ160-9VM

[1]) S = Single compressor, no oil sight glass, no oil equalization connection
Sv = Single compressor, brazed oil sight glass, no oil equalization connection
VE = Single compressor, threaded oil sight glass, 3/8" oil equalization connection

Packaging

Model	Single pack		Multipack				Industrial pack			
	Dimensions in	Net weight lb	Nbr	Dimensions in	Gross weight lb	Static stacking	Nbr	Dimensions in	Gross weight lb	Static stacking
1 cylinder										
MT/MTZ018	l: 13.0 w: 11.6 h: 15.2	46	6	l: 39.4 w: 23.6 h: 20.0	313	4	12	l: 47.2 w: 31.5 h: 19.7	615	4
MT/MTZ022		46			313				615	
MT/MTZ028		51			333				650	
MT/MTZ032		53			348				672	
MT/MTZ036		55			362				710	
MT/MTZ040		57			370				725	
2 cylinders										
MT/MTZ044-050	l: 15.6 w: 14.4 h: 17.9	77	6	l: 45.3 w: 31.5 h: 22.0	500	4	6	l: 47.2 w: 31.5 h: 21.7	648	4
MT/MTZ045-051		82			527				675	
MT/MTZ056-064		82			527				675	
MT/MTZ057-065		86			560				734	
MT/MTZ072-080		88			567				754	
MT/MTZ073-081		90			578				765	
4 cylinders										
MT/MTZ100	l: 19.1 w: 15.6 h: 23.6	132	6	l: 47.2 w: 39.4 h: 28.7	877	4	6	l: 47.2 w: 31.5 h: 25.6	855	4
MT/MTZ125		141			912				891	
MT/MTZ144		148			948				926	
MT/MTZ160		152			979				957	

Single pack: One compressor in a cardboard box.
In some publications this packaging may be indicated as 'individual packaging'.

Multipack: A full pallet of compressors, each individually packed in a cardboard box. Mainly available for to wholesalers and Danfoss distribution centers.

Industrial pack: A full pallet of unpacked compressors. Mainly available for to OEM customers.
In some publications this packaging may be indicated as 'Multiple packaging'.

Nbr: Number of compressor in a pack

The Danfoss product range for the refrigeration and air conditioning industry

Danfoss Refrigeration & Air Conditioning is a worldwide manufacturer with a leading position in industrial, commercial and supermarket refrigeration as well as air conditioning and climate solutions.

We focus on our core business of making quality products, components and systems that enhance performance and reduce total life cycle costs – the key to major savings.

Controls for Commercial Refrigeration

Controls for Industrial Refrigeration

Electronic Controls & Sensors

Industrial Automation

Household Compressors

Commercial Compressors

Sub-Assemblies

Thermostats

We are offering a single source for one of the widest ranges of innovative refrigeration and air conditioning components and systems in the world. And, we back technical solutions with business solution to help your company reduce costs, streamline processes and achieve your business goals.

Danfoss A/S • www.danfoss.com

Danfoss Inc. · Refrigeration & Air Conditioning Division · 7941 Corporate Drive · Baltimore, MD 21236
Ph 410-931-8250 · Fax 410-931-8256 · E-mail: baltimore@danfoss.com · Internet: www.danfoss.com/North_America

USCO.PC.004.A3.22 - Replace GA 035 - 03/03 US

Produced by Danfoss USCO-mks - 03/2007

Appendix G Condenser

(Page Left Blank Intentionally)

Water cooled condensers

Shell and tube condensers for fresh and sea water applications

Water cooled condensers

The widest range

Alfa Laval's shell and tube production includes a wide range of condensers and desuperheaters with 7 different series providing individual solutions for each conditioning, refrigeration and cooling application. Standard models fulfil condensation capacities ranging from 3 to 900 kW and 1680 kW can easily be reached with the extension of the new CDEW series.
The different condenser series have been carefully optimised for the most used HFC refrigerants. All condenser models can be opened for inspection and maintenance purposes.
CFC, CRS, CPLUS, ACFL and CDEW series are designed to operate with fresh water and CFC/M and McDEWseries are dedicate to sea water applications thanks to material selection and correct sizing in order to prevent fouling and corrosion. All condenser models can be supplied in HR desuperheater version for water heating in a partial or total heat recovery system. Thanks to HRC configuration, CDEW and CPLUS can be supplied with two heat exchanger assembled in one shell. This configuration allows to operate alternatively the condenser and the total heat recovery functions.
Alfa Laval quality systems are certified in accordance with ISO9001 from TÜV-D, a further warranty of the shell and tube condenser's high quality level.

A world of applications

Alfa Laval's shell and tube condensers represent the optimal solution for all the application where HFC condensation is required. Water cooled chillers and heat pumps for air conditioning or industrial cooling in combination with several types of processes. Commercial and industrial refrigeration plants with water condensation. On-board or all the other applications where sea, lake or river water is available.

Air Conditioning

Process Cooling

Commercial and Industrial Refrigeration

Marine

1 High performances due to special design finned Cu and Cu/Ni tubes and tube geometry.

2 7 different condenser series for a total of 105 models: the correct solution for each application.

3 The only shell and tube condenser series optimised for R407C.

4 2 passes & 4 passes version.

5 Easy installation.

6 Desuperheater version.

7 All models can be opened for inspection & maintenance

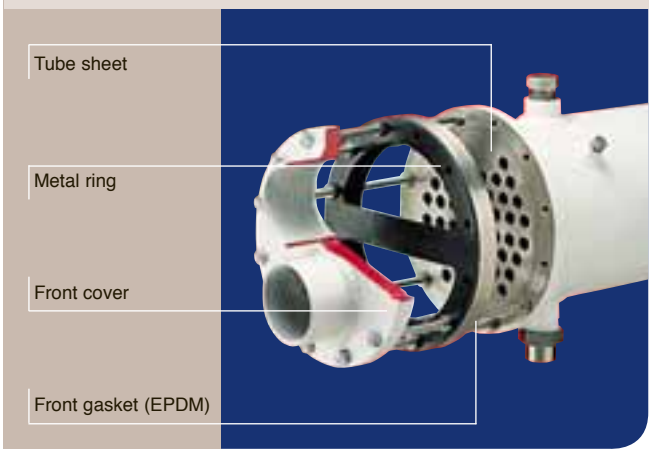
8 Solutions for applications with fresh water & sea water

9 All the most diffused pressure vessel approvals are available as a standard.

Specific approvals available on request.

10 Every single condenser is pressure & leak tested before delivery ensuring top quality products.

Header configuration



The perfect solution for R407C

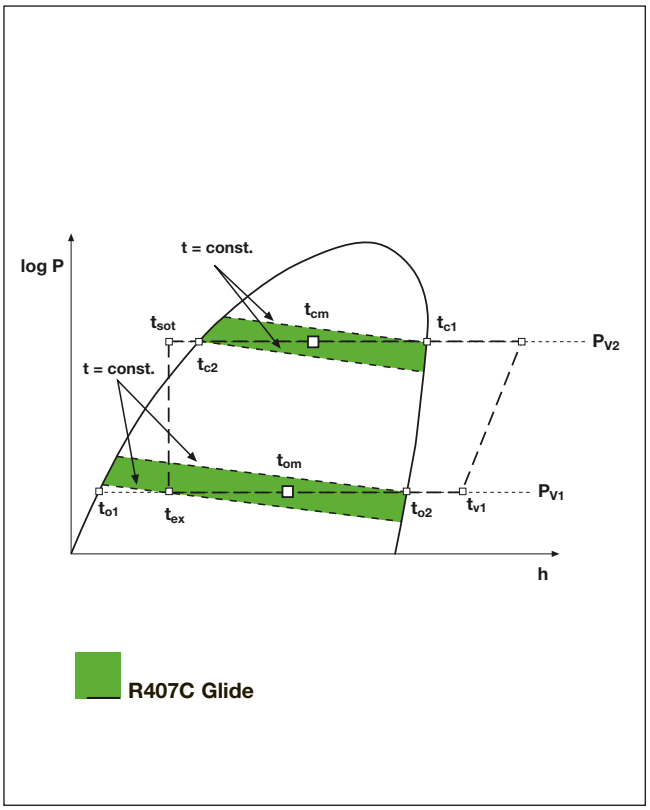
CDEW series of shell and tube condensers has been optimised by Alfa Laval's R&D dept. and Laboratory in order to ensure the highest performance with HFC-R407C. This refrigerant is particularly affected by glide and this phenomenon can be relevant during the condensing phase causing losses in performance if standard condensers designed to operate with azeotrop refrigerant are used. Thanks to its special design and sizing, CDEW condensers can now reduce 3K the condensation temperature with respect to the standard condenser series. In a water chiller this means:

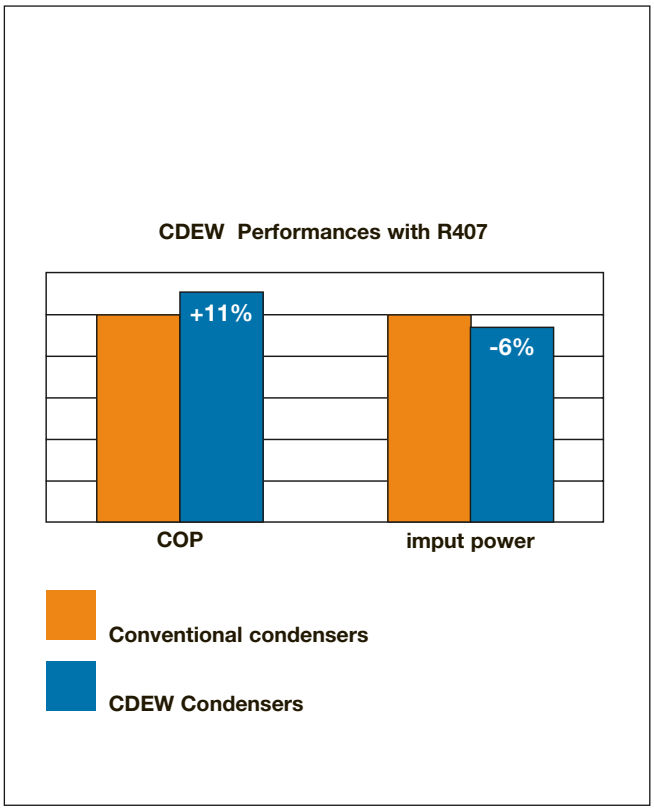
- COP improvement +11%
- Input power -6%

Also supports and brackets costs are reduced by the condenser square tube sheets that provide a simple and cheap solution.

Performance on a wide range

The new CDEW series capacity range is from 57 to 840 kW with standard models and up to 1680 kW. CDEW shell and tube heat exchangers are available in condenser and desuperheater version in order to provide partial or total heat recovery in cooling systems.
CDEW heat exchangers are available in accordance with the major pressure vessel codes as CE (Europe), UDT (Poland), GOST (Russia), SQL (China), ASME (USA).



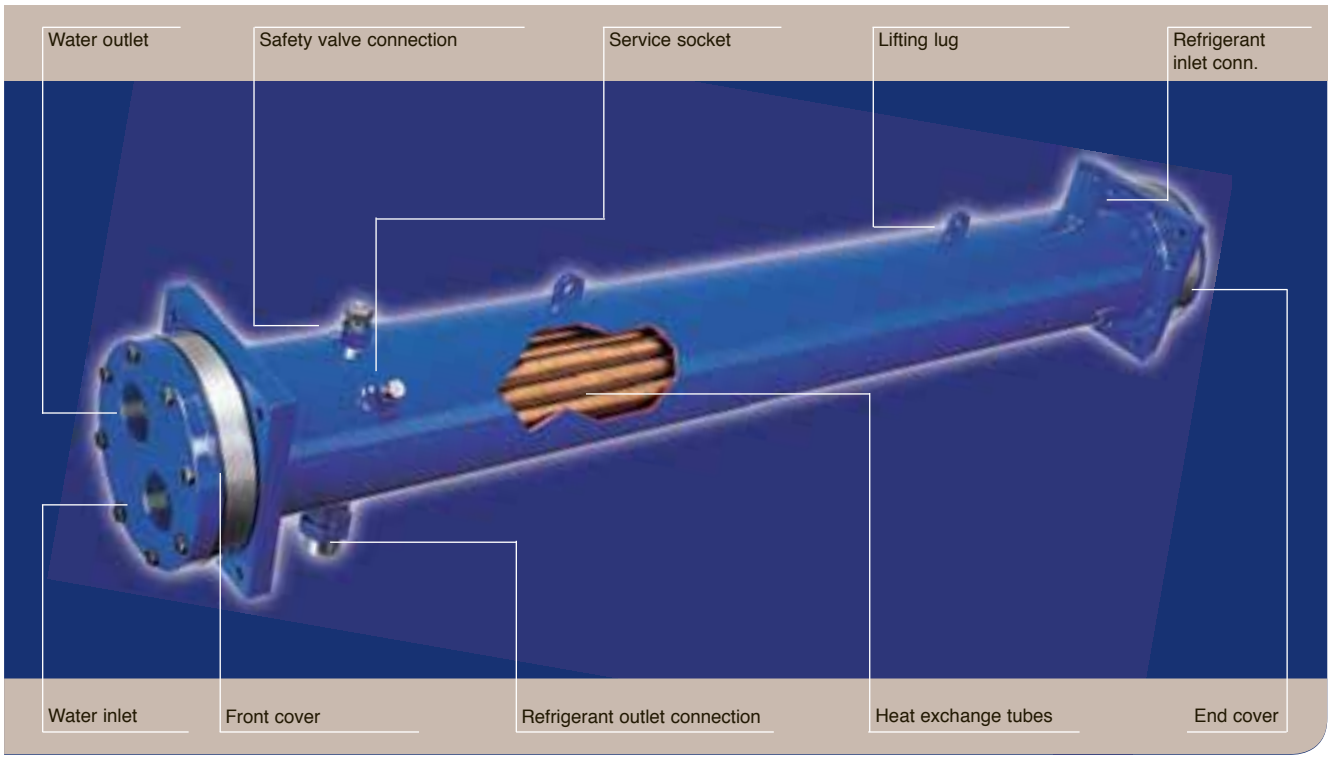


Highest level in component design and manufacturing quality

Models designed for fresh water applications (series CFC, CRS, ACFL, CPLUS and CDEW) use the following components:

- Shell: carbon steel
- Tube sheets: carbon steel
- Tubes: integrally finned thick wall copper tubing
- Covers: carbon steel
- Gasket: thermopolymer compound
- Baffles: teflon

All the carbon steel components are sand blasted, including the internal wall of the shell. The precise fit of the tube exchanger baffle eliminates the risk of copper filings collecting. Models belonging to series CFC, CPS and CDEW on request can be manufactured in stainless steel execution. The new header configuration for CPLUS and CDEW allows an increase in water pressure to 10 bar. The special gasket configuration resists high pressure and gives the best resistance to ageing in the working temperature range. For models with shell diameter larger than 219 mm a sight glass is available as an option.



Quality tests and pressure vessel approvals

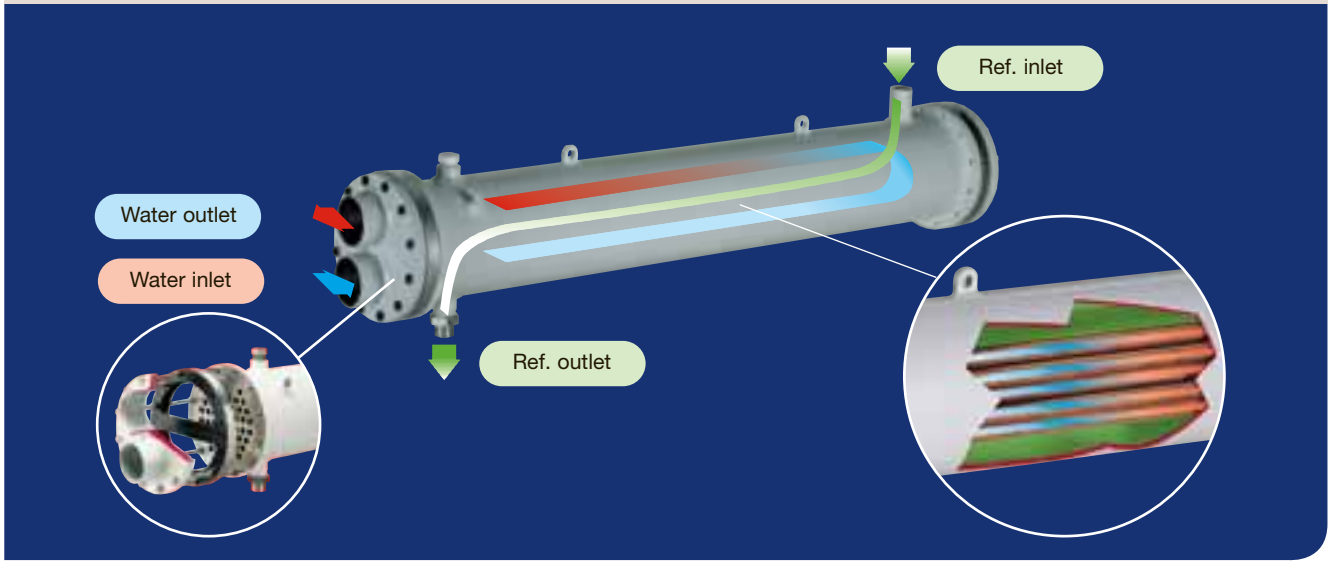
The working limits are defined by the design pressure (i.e. the maximum working pressure) and the working temperature range. These limits depend on the pressure vessel approval required. Alfa Laval's condensers are available as a standard with the most diffused pressure vessel approvals. On request marine or other specific approvals are available.
Alfa Laval shell and tube condensers are manufactured in accordance with ISO9001. Each unit undergoes an individual pressure and leak test as specified by the relevant authority and in accordance with Alfa Laval internal quality procedures.

NOMINAL DATA		ALFA LAVAL (self inspected)	CE (PED 97/23 EC)	UDT PxV>50 bar x dm^3	ASME OD ≥ 6"	SQL	GOST
Design pressure refrigerant side	bar	30	30	24,5	30	24,5	24,5
Test pressure refrigerant side	bar	33	43	27	45	27	27
Design pressure water side (1)	bar	10	10	10	10,3	10	10
Test pressure water side (2)	bar	15	15	15	15,5	15	15
Design temperature range	°C	-10/+90	-10/+90	-10/+90	-10/+90	-10/+90	-10/+90

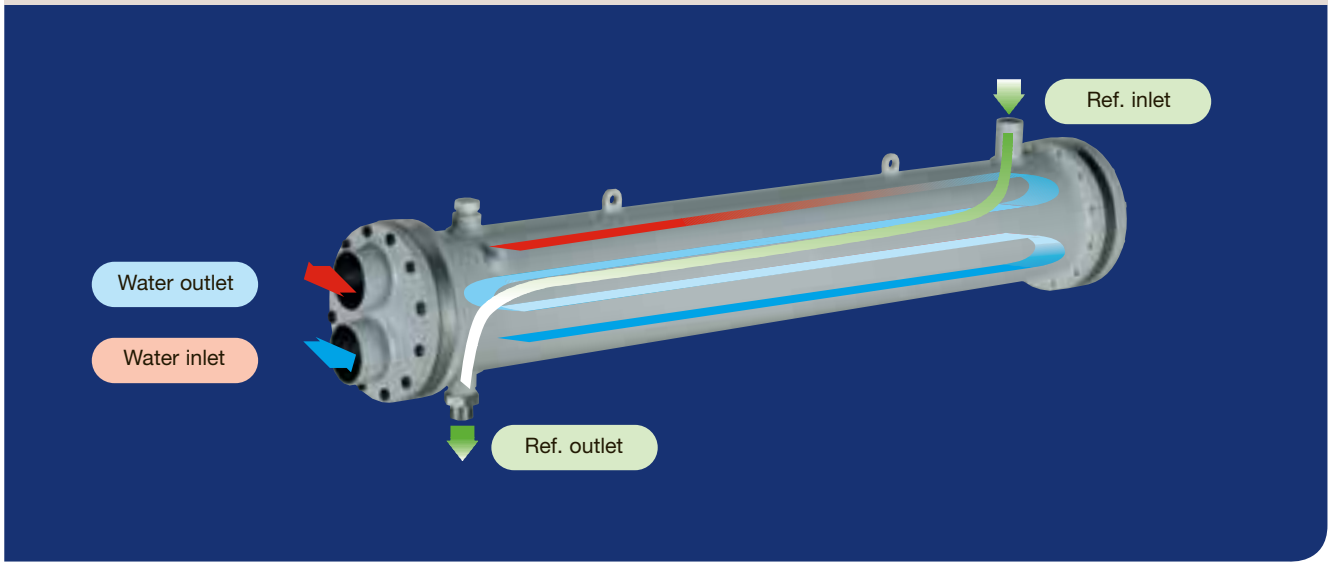
(1) 5 bar design pressure for CFC, CRS, ACFL models.
(2) 8 bar test pressure for CFC, CRS, ACFL models.

Versions

2 passes (Cooling tower water)



4 passes (City water)



Sea water for a trouble-free condensation

McDEW and CFC/M condenser series are dedicated to sea water, for on board marine applications and for all the other installations where it is possible to use the sea as a natural source of cooling water.
Standard capacity range from 7 to 770 kW. Special units up to 1700 kW. Marine models are equipped with the following components:

- Shell: carbon steel
- Tube sheets: AISI 316 stainless steel
- Tubes: integrally finned Cu/Ni tubing
- Covers: AISI 316 stainless steel
- Gasket: thermopolymer compound
- Baffles: carbon steel/teflon

Marine units are provided with interchangeable anodes made of mild iron.

Where the water flows

The nominal performances have been calculated on the basis of an FF equal to 0.000043 m2K/W (0.00005 h m2K/kcal).

v > 1.2 m/s	Normal city water Treated tower water Clear river water Clean Sea Water	FF 0.000043 m² K/W
v > 1.2 m/s	City lime water Normal tower water Brine Dirty Sea Water	FF 0.000086 m² K/W
v > 1.2 m/s	Tower lime water Muddy river water	FF 0.00172 m² K/W

The ideal choice, when maintenance is needed

Shell and tube condensers are often used in combination with not perfectly clean water for heavy duty applications. It is an exciting challenge for a product designed in order to have a long working life.
In these cases, periodical cleaning is required in order to keep the heat exchanger's performances unchanged time by time.

Alfa Laval fresh and sea water condensers ensure easy opening for inspection, cleaning and maintenance purposes.

Fittings

CDEW, CDEWH and McDEW condensers are equipped with square tube sheets ensuring a simple solution for the unit positioning. CPLUS and all the other series can be supplied with bolt-on supports (fig. A) or with supports welded directly to the shell body (fig. B). Universal brackets to be easily mounting during the condenser installation can be supplied (fig. C). The type of required support should be specified when ordering.

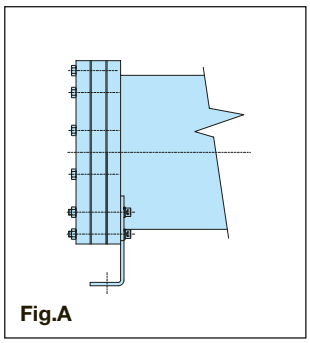


Fig.A

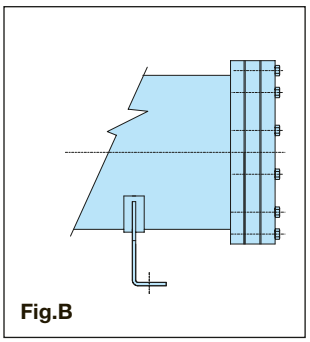
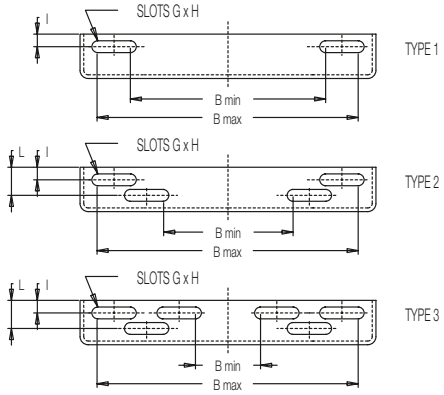


Fig.B

Universal Brackets: dimensions (mm)												
Code	A	B		C	D	E	F	SLOTS			I	L
		min	max					G	H	Type		
55341700	140	82	178	220	60	50	40	12	60	1	25	-
55341710	168	112	208	250	60	50	40	12	60	1	25	-
55341720	194	46	238	280	60	50	40	12	60	2	15	32
55341730	219	82	276	320	80	50	40	12	60	2	15	32
55341740	273	176	352	400	100	60	50	16	60	2	17	38
55341750	324	108	372	420	100	60	50	16	60	3	17	38
55341760	406	216	468	520	120	80	60	18	60	3	20	54



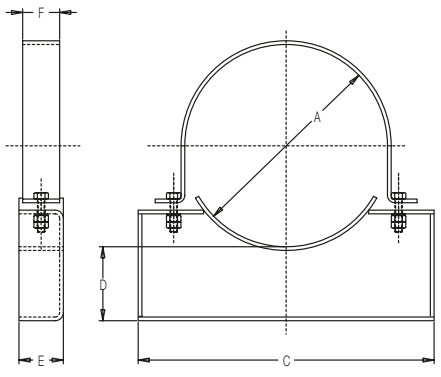


Fig.C

Model	CDEW	60	80	100	120	135	165	190	215	240	260	300	360	400	450	470	520	550	610	680	760	840
Cooling Tower Water (2 passes)																						
R407c Refrigerant	Qn [kW]	57	75	100	118	135	165	190	215	233	260	300	360	400	450	470	520	550	610	680	760	840
Tc, mean = 42° C	Wn [m³/h]	9,5	12,7	17,5	20,6	20,2	25,5	27,7	30,7	33,6	37	44	53,3	59,2	62,9	68,4	75,8	83,4	90,8	99,9	110,5	121,7
Ti = 29.4° C	Wm [m³/h]	12,3	16,4	22,5	26,6	27,6	35,8	38,9	43	43	51,1	61,4	73,6	81,8	86,9	94,1	104	114	122,7	135	151,4	167,7
FF = 0.000043 m²K/W	Dpn [bar]	0,33	0,33	0,33	0,33	0,33	0,33	0,33	0,33	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38
City Water (4 passes)																						
R407c Refrigerant	Qn [kW]	60	81	109	130	146	182	203	225	250	280	330	396	452	487	510	566	635	670	740	828	924
Tc, mean = 37° C	Wn [m³/h]	3,4	4,5	6,1	7,2	7,5	9,3	10,2	11,3	12,1	14	16,8	20	22,1	23,8	25,6	28	31,5	33,8	37,1	41,6	46,2
Ti = 15° C	Wm [m³/h]	4,1	5,5	7,5	8,9	8,9	11,8	12,9	14,3	14,5	17,1	20,4	24,4	26,9	28,9	31,8	34,9	39	43	47,3	53	58,7
FF = 0.000043 m²K/W	Dpn [bar]	0,35	0,35	0,35	0,35	0,38	0,38	0,38	0,38	0,42	0,42	0,42	0,42	0,42	0,42	0,42	0,42	0,42	0,43	0,43	0,43	0,43

Model	CDEWH	900	940	1040	1100	1220	1360	1520	1680
R407c Refrigerant	Qn [kW]	900	75	1040	1100	1220	1360	1520	1680
Tc, mean = 42° C	Wn [m3/h]	119	125	140	142	161	183	209	231
Ti = 29.4° C	Wm [m3/h]	173	188	208	229	245	270	302	335
FF = 0.000043 m2K/W	Dpn [bar]	0,33	0,32	0,33	0,29	0,33	0,35	0,35	0,38

Model	CPS	35	45	60	80	70	100	120	145	160	180	210	235	260	285	335	390	440	520
Cooling Tower Water (4 passes CPS 35-60 and CPS 80; 2 passes CPS 70 and CPS 100-520)																			
R22 Refrigerant	Qn [kW]	33,5	46,2	59,1	81,8	68	96,1	120,7	144,3	162,4	182	208	236	260	285	336	388	438	522
Tc, mean = 40.6° C	Wn [m³/h]	5,2	6,9	8,6	11,7	10,3	13,8	17,3	20,7	23,3	25,9	29,4	32,8	36,3	41,4	48,4	55,3	62,2	73,4
Ti = 29.4° C	Wm [m³/h]	6,2	8,3	10,4	14	12,4	16,6	20,7	24,9	28	31,1	35,2	39,4	43,5	49,7	58	66,3	74,6	88,1
FF = 0.000043 m²K/W	Dpn [bar]	0,44	0,44	0,44	0,44	0,37	0,37	0,37	0,37	0,37	0,37	0,37	0,37	0,37	0,37	0,37	0,37	0,37	0,37
City Water (8 passes CPS 35-60 and CPS 80; 4 passes CPS 70 and CPS 100-520)																			
R22 Refrigerant	Qn [kW]	37	50,1	6,1	87,1	69,9	98,6	121,5	146,7	165,6	182	207	234	260	288	339	389	442	523
Tc, mean = 35° C	Wn [m³/h]	2	2,6	3,3	4,4	4	5,3	6,5	7,9	8,8	9,8	11,2	12,4	13,7	15,6	18,3	20,9	23,5	27,1
Ti = 15° C	Wm [m³/h]	2,6	3,5	4,3	5,8	5,2	6,9	8,6	10,4	11,7	13	14,7	16,4	18,1	20,7	24,2	27,6	31	36,7
FF = 0.000043 m²K/W	Dpn [bar]	0,5	0,5	0,5	0,5	0,42	0,42	0,42	0,42	0,42	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,42

Model	CFC	8	12	15	20	25	30	40	50	60
Cooling Tower Water (4 passes)										
R22 Refrigerant	Qn [kW]	8,1	12,2	15,2	20,3	25,3	30,4	40,5	50,6	60,8
Tc, mean = 40.6° C	Wn [m³/h]	1,5	2,2	2,2	3	3,7	4,5	6	7,5	9
Ti = 29.4° C	Wm [m³/h]	1,7	2,6	2,6	3,4	4,3	5,1	6,8	8,6	10,3
FF = 0.000043 m²K/W	Dpn [bar]	0,38	0,38	0,43	0,43	0,43	0,43	0,43	0,43	0,43
City Water (4 passes)										
R22 Refrigerant	Qn [kW]	9,1	13,6	15,7	21	26,2	31,5	42	52,5	63
Tc, mean = 35° C	Wn [m³/h]	0,6	0,9	0,9	1,2	1,5	1,7	2,3	2,9	3,5
Ti = 15° C	Wm [m³/h]	0,8	1,3	1,3	1,7	2,1	2,6	3,4	4,3	5,1
FF = 0.000043 m²K/W	Dpn [bar]	0,48	0,48	0,54	0,54	0,54	0,54	0,54	0,54	0,54

Model	CRS	3	6	8	12	15	20	25
Cooling Tower (2 passes CRS 3-6; 4 passes CRS 8-25)								
R22 Refrigerant	Qn [kW]	3,2	6,5	8,1	12,2	15,2	20,3	25,3
Tc, mean = 40.6° C	Wn [m³/h]	0,8	1,6	1,5	2,2	2,2	3	3,7
Ti = 29.4° C	Wm [m³/h]	0,9	1,8	1,7	2,6	2,6	3,4	4,3
FF = 0.000043 m²K/W	DPn [bar]	0,22	0,22	0,38	0,38	0,43	0,43	0,43
City Water (4 passes CRS 3-6; 8 passes CRS 8-25)								
R22 Refrigerant	Qn [kW]	3,8	7,7	9,1	13,6	15,7	21	26,2
Tc, mean = 35° C	Wn [m³/h]	0,3	0,6	0,6	0,9	0,9	1,2	1,5
Ti = 15° C	Wm [m³/h]	0,5	0,9	0,8	1,3	1,3	1,7	2,1
FF = 0.000043 m²K/W	DPn [bar]	0,28	0,28	0,48	0,48	0,54	0,54	0,54

Model	ACFL	450/360	450/414	450/468	450/522	450/576	750/648	750/738	750/828	750/900
Cooling Tower Water (2 passes)										
R22 Refrigerant	Qn [kW]	360	414	468	522	576	648	738	828	900
Tc, mean = 40.6° C	Wn [m³/h]	48,9	56,2	63,5	70,9	78,2	88	100	112	122
Ti = 29.4° C	Wm [m³/h]	55,5	63,9	72,2	80,5	88,9	99	113	127	138
FF = 0.000043 m²K/W	Dpn [bar]	0,33	0,33	0,33	0,33	0,33	0,33	0,33	0,33	0,33
City Water (4 passes)										
R22 Refrigerant	Qn [kW]	360	414	468	522	576	-	-	-	-
Tc, mean = 35° C	Wn [m³/h]	18,9	21,7	24,5	27,4	30,2	-	-	-	-
Ti = 15° C	Wm [m³/h]	27,8	31,9	36,1	40,3	44,4	-	-	-	-
FF = 0.000043 m²K/W	Dpn [bar]	0,43	0,43	0,43	0,43	0,43	-	-	-	-

Qn nominal condensation capacity
Wn nominal water flow rate
Wm maximum water flow rate
Tc condensing temperature
Ti water inlet temperature
FF fouling factor

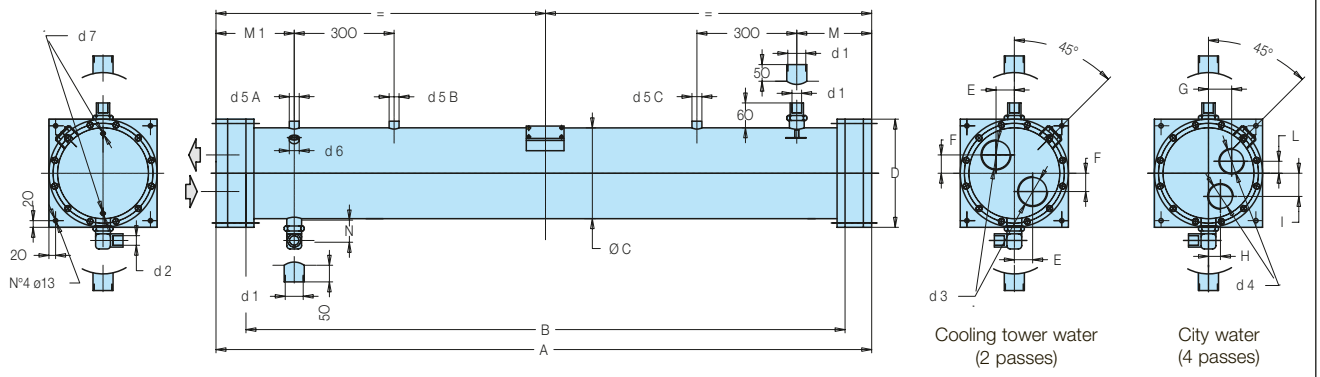
Model	CFC/M	8	12	15	20	25	30	40	50	60
Sea Water	**passes**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
R22 Refrigerant	Qn [kW]	7	10,6	13,2	17,8	22,2	26,8	35,6	44,7	53,6
Tc = 40.6°C	Wn [m³/h]	1,23	1,8	1,8	2,45	3,06	3,7	4,9	6,1	7,38
Ti = 29.4°C	Wm [m³/h]	1,4	2,1	2,1	2,86	3,57	4,3	5,7	7,12	8,61
FF = 0.000043 m²K/W	DPn [bar]	0,26	0,25	0,29	0,3	0,3	0,3	0,3	0,3	0,3
Sea Water	**passes**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**
R22 Refrigerant	Qn [kW]	9,1	13,6	15,7	21	26,2	31,5	42	52,5	63
Tc = 35°C	Wn [m³/h]	0,6	0,9	0,9	1,2	1,5	1,7	2,3	2,9	3,5
Ti = 15°C	Wm [m³/h]	0,8	1,3	1,3	1,7	2,1	2,6	3,4	4,3	5,1
FF = 0.000043 m²K/W	DPn [bar]	0,48	0,48	0,54	0,54	0,54	0,54	0,54	0,54	0,54

Model	McDEW	15	25	34	48	50	67	90	105	123
Sea Water	**passes**	**4**	**4**	**4**	**4**	**2**	**2**	**2**	**2**	**2**
R407C Refrigerant	Qn [kW]	15	24,5	34	48	51	67	90	106	123
Tc, mean = 43°C	Wn [m³/h]	2,4	3,6	4,8	6	7,2	9,59	13,19	15,59	16,19
Ti = 29.4°C	Wm [m³/h]	2,88	4,32	5,76	7,2	8,64	11,508	15,828	18,708	19,428
FF = 0.000043 m²K/W	DPn [bar]	21	21	21	21	19	19	19	19	21
Sea Water	**passes**	**8**	**8**	**8**	**8**	**4**	**4**	**4**	**4**	**4**
R407C Refrigerant	Qn [kW]	22,2	33,2	46,1	57,5	60	81	109	130	146
Tc, mean = 38°C	Wn [m³/h]	1,2	1,8	2,4	3	3,4	4,5	6,1	7,2	7,5
Ti = 15°C	Wm [m³/h]	1,44	2,16	2,88	3,6	4,08	5,4	7,32	8,64	9
FF = 0.000043 m²K/W	DPn [bar]	40	40	41	40	34	34	34	34	34

Model	McDEW	153	175	200	205	238	275	330	370	410
Sea Water	**passes**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
R407C Refrigerant	Qn [kW]	153	175	198	206	238	276	331	367	413
Tc, mean = 43°C	Wn [m³/h]	20,99	22,78	25,18	25,18	29,98	35,98	43,17	47,97	50,96
Ti = 29.4°C	Wm [m³/h]	25,188	27,336	30,216	30,216	35,976	43,176	51,804	57,564	61,152
FF = 0.000043 m²K/W	DPn [bar]	22	22	22	22	24	25	24	24	24
Sea Water	**passes**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
R407C Refrigerant	Qn [kW]	182	203	225	250	280	330	396	452	487
Tc, mean = 38°C	Wn [m³/h]	9,3	10,2	11,3	12,6	14	16,8	20	22,1	23,8
Ti = 15°C	Wm [m³/h]	11,16	12,24	13,56	15,12	16,8	20,16	24	26,52	28,56
FF = 0.000043 m²K/W	DPn [bar]	34	34	40	40	40	40	40	40	40

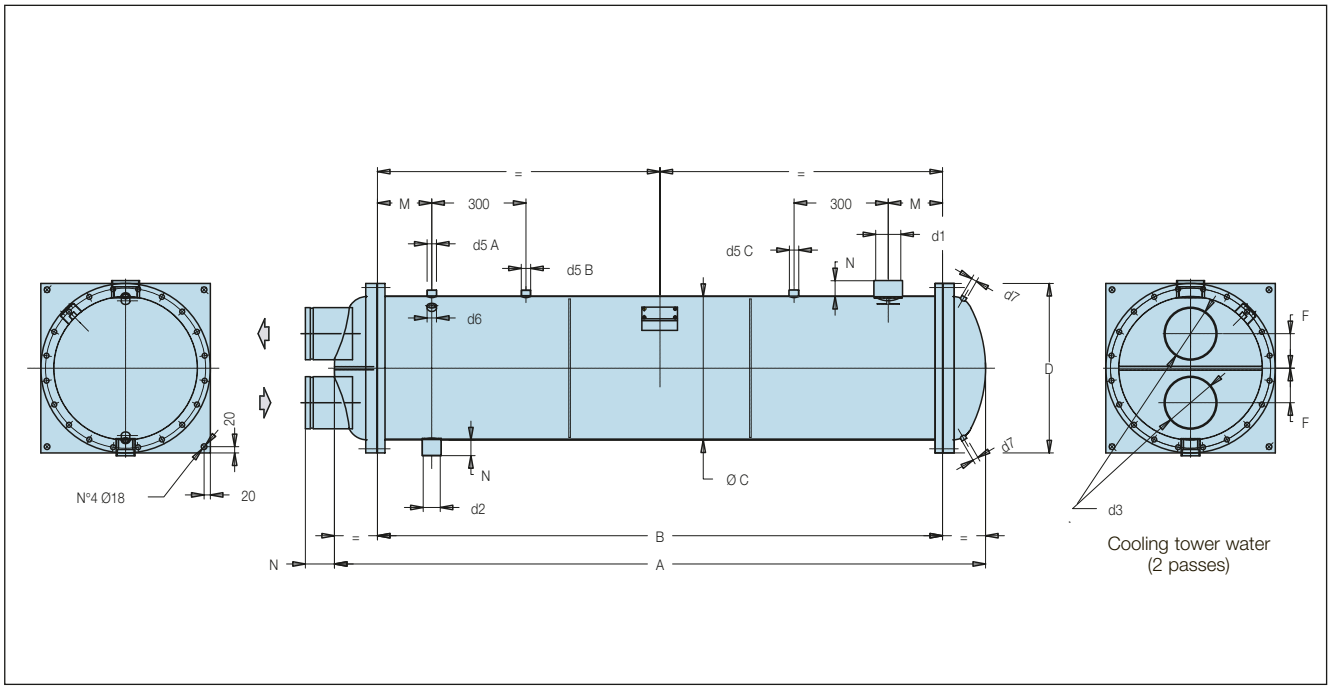
Model	McDEW	430	480	505	555	620	700	770
Sea Water	**passes**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
R407C Refrigerant	Qn [kW]	431	477	505	555	619	696	772
Tc, mean = 43°C	Wn [m³/h]	55,16	61,16	67,15	71,95	79,15	88,74	98,33
Ti = 29.4°C	Wm [m³/h]	66,192	73,392	80,58	86,34	94,98	106,488	117,996
FF = 0.000043 m²K/W	DPn [bar]	24	24	24	24	24	24	24
Sea Water	**passes**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
R407C Refrigerant	Qn [kW]	510	566	635	670	740	828	924
Tc, mean = 38°C	Wn [m³/h]	25,6	28	31,5	33,8	37,1	41,6	46,2
Ti = 15°C	Wm [m³/h]	30,72	33,6	37,8	40,56	44,52	49,92	55,44
FF = 0.000043 m²K/W	DPn [bar]	40	40	41	41	41	41	41

Qn nominal condensation capacity
Wn nominal water flow rate
Wm maximum water flow rate
Tc condensing temperature
Ti water inlet temperature
FF fouling factor



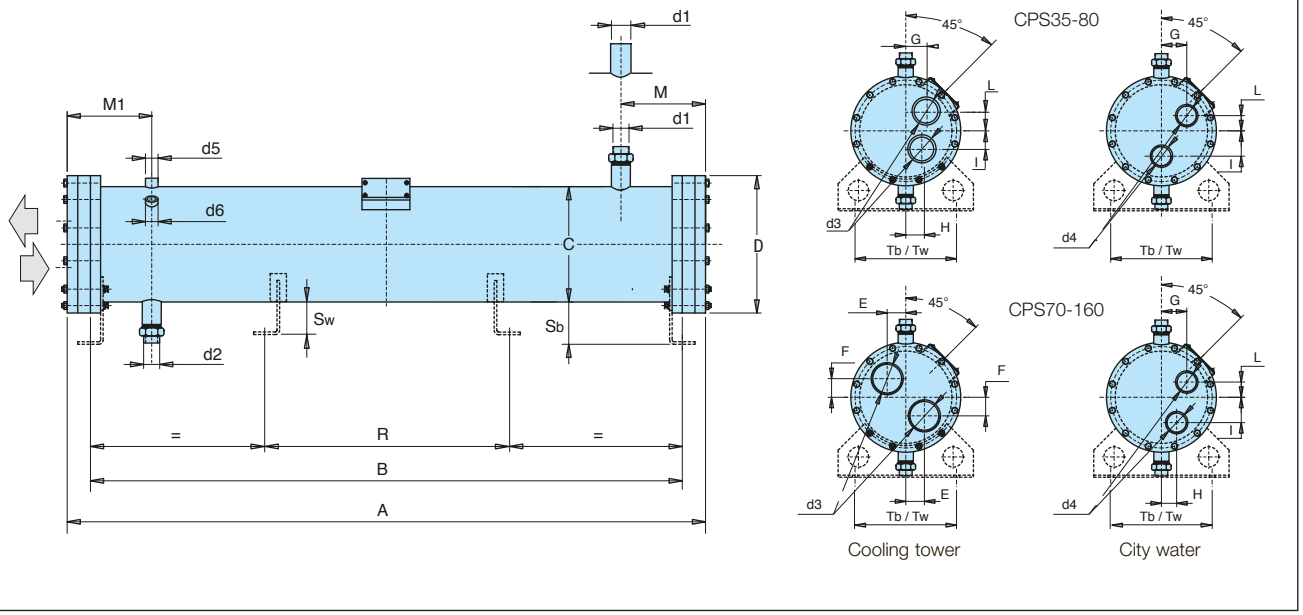
Model CDEW			60	80	100	120	135	165	190	215	240	260	300	360	400	450	470	520	550	610	680	760	840
Dimensions	A	[mm]	1500				1700	1740			1940	1970					1980			1980			
	B	[mm]	1400				1600	1600			1800	1800					1800			1800			
	C	[mm]	168					194				273					324			406			
	D	[mm]	215					245				325					380			480			
	E	[mm]	30					35				55					65			-			
	F	[mm]	30					35				55					65			105			
	G	[mm]	43					55				75					90			70			
	H	[mm]	22					25				45					55			70			
	i	[mm]	43					55				75					90			80			
	L	[mm]	22					25				45					55			80			
	M	[mm]	170					200				225					250			260			
	M1	[mm]	180					210				235					260			270			
	N	[mm]	65					65				75					75			75			
Connections	d1	[mm]	RC35					WA42				WA54					WA54			WA80			
	d2	[mm]	RCL28					RCL35				WA42					WA42			WA54			
	d3	in-G	T2					T21				T3					T4			T5			
	d4	in-G	T11					T11				T2					T3			T4			
	d5-A	in-NPT	1/2					3/4				1					1			1			
	d5-B	in-NPT	-					-				-					1			1			
	d5-C	in-NPT	-					-				-					-			1			
	d6	in-NPT	1/4					1/4				1/4					1/4			1/4			
	d7	in-G	1/4					1/4				1/4					1/4			1/4			
Volumes	Vr	[dm³]	22.3	20.8	19.4	18.1	20.1	24.9	23.7	21.9	24.9	70.6	66.1	57.0	53.1	50.6	90.5	86.1	81.7	152.1	146.0	137.8	129.6
	L res	[dm³]	3.8	3.8	3.4	3.1	0.9	7.1	6.7	2.8	3.1	10.0	10.0	8.4	8.4	3.4	5.2	5.2	4.7	14.8	14.8	14.8	14.8
	VH_2O	[dm³]	4.8	5.9	7.3	8.2	10.1	13.3	14.2	15.4	17.1	24.7	27.7	31.2	33.9	35.7	41.0	44.1	47.5	52.4	57.7	64.7	71.7
Weight	P	[kg]	58	61	65	68	85	105	108	111	121	195	203	215	222	227	293	304	313	441	452	467	482

d1 refrigerant
d2 refrigerant outlet
d3=d4 water connections
d5-A,B,C, safety valve connection
d6 Service socket
d7 Drain - Vent
Vr gas side volume
L res Liquid reserve
VH_2O water side volume
P weight



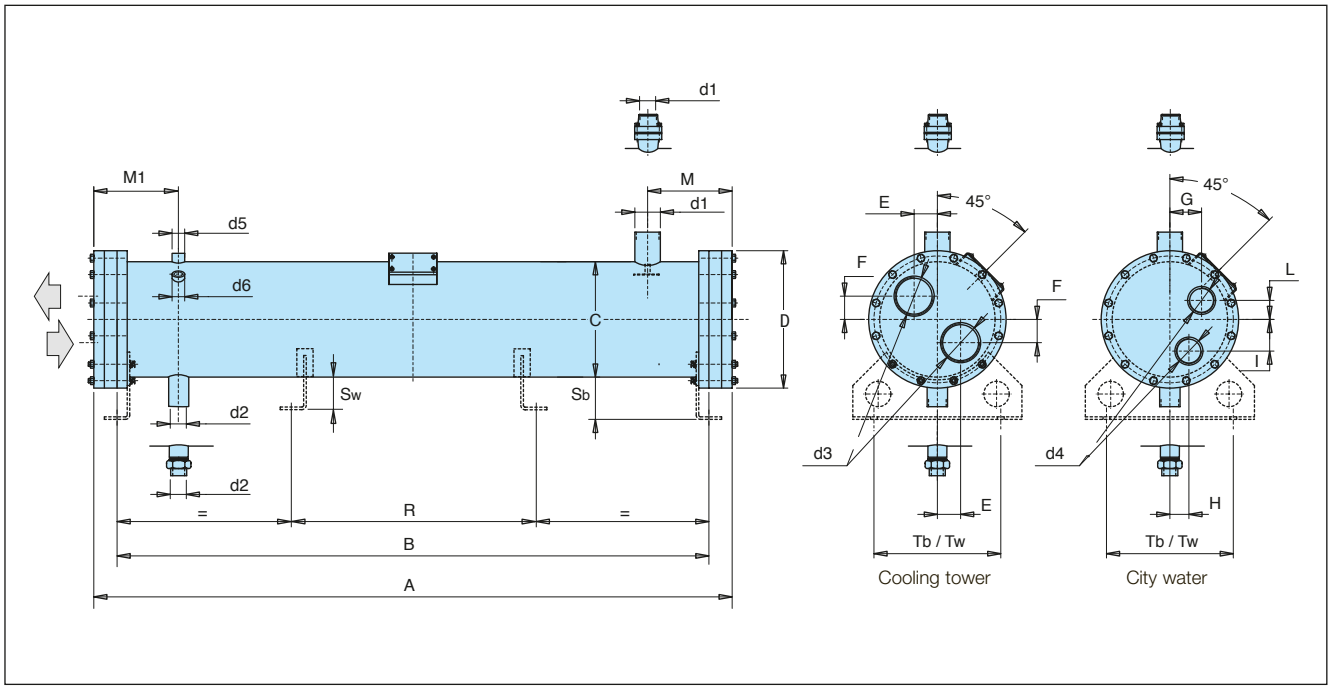
Model CDEW			900H	940H	1040H	1100H	1220H	1360H	1520H	1680H
Dimensions	A	[mm]	2075			2105			2115	
	B	[mm]	1800			1800			1800	
	C	[mm]	457,2			508			558,8	
	D	[mm]	540			590			640	
	E	[mm]	-			-			-	
	F	[mm]	120			150			140	
	G	[mm]	-			-			-	
	H	[mm]	-			-			-	
	i	[mm]	-			-			-	
	L	[mm]	-			-			-	
	M	[mm]	-			-			-	
	N	[mm]	93			88			82	
Connections	d1	[mm]	WA80			WA89			WA100	
	d2	[mm]	WA54			WA80			WA89	
	d3	in-G	J6			J6			J8	
	d4	in-G	-			-			-	
	d5-A	in-NPT	1			1			1	
	d5-B	in-NPT	1			1			1	
	d5-C	in-NPT	1			1			1	
	d6	in-NPT	1/4			1/4			1/4	
	d7	in-G	1/4			1/4			1/4	
Volumes	Vr	[dm³]	176,0	170,0	160,0	212,0	204,0	192,0	243,0	227,0
	L res	[dm³]	17,0	17,0	17,0	21,0	21,0	21,0	15,0	15,0
	VH_2O	[dm³]	88,0	92,0	99,0	116,0	121,0	129,0	152,0	163,0
Weight	P	[kg]	597	608	627	736	750	773	913	943

d1 refrigerant
d2 refrigerant outlet
d3=d4 water connections
d5-A,B,C, safety valve connection
d6 Service socket
d7 Drain - Vent
Vr gas side volume
L res Liquid reserve
VH_2O water side volume
P weight



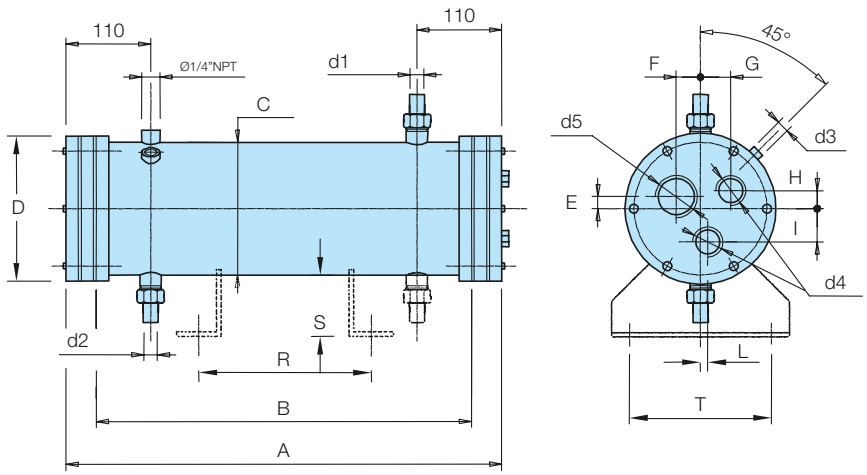
Model			CPS35	CPS45	CPS60	CPS80	CPS70	CPS100	CPS120	CPS145	CPS160
Dimensions	A	mm	800	800	800	800	1500	1500	1500	1500	1500
	B	mm	700	700	700	700	1400	1400	1400	1400	1400
	C	mm	168	168	168	168	168	168	168	168	168
	D	mm	215	215	215	215	215	215	215	215	215
	E	mm	–	–	–	–	30	30	30	30	30
	F	mm	–	–	–	–	30	30	30	30	30
	G	mm	Tower 43 - City 45				43	43	43	43	43
	H	mm	Tower 22				22	22	22	22	22
	I	mm	Tower 43 - City 55				43	43	43	43	43
	L	mm	Tower 22 - City 32				22	22	22	22	22
	M	mm	160	160	160	160	170	170	170	170	190
	M1	mm	170	170	170	170	180	180	180	180	200
Supports	R	mm	350	350	350	350	900	900	900	900	900
	Sb	mm	80	80	80	80	80	80	80	80	80
	Sw	mm	60	60	60	60	60	60	60	60	60
	Tb	mm	210	210	210	210	210	210	210	210	210
	Tw	mm	160	160	160	160	160	160	160	160	160
Connections	d1	–	RC28	RC28	RC28	RC28	RC35	RC35	RC35	RC35	WA42
	d2	–	RB22	RB22	RB22	RB22	RC28	RC28	RC28	RC28	RC35
	d3	–	T11	T11	T11	T11	T2	T2	T2	T2	T2
	d4	–	T1	T1	T1	T1	T11	T11	T11	T11	T11
	d5	in	3/8	3/8	3/8	3/8	1/2	1/2	1/2	1/2	1/2
	d6	in	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Volumes	VR	dm^3	11	10,3	9,6	8,5	22,7	21,3	19,9	16,5	17,5
	V_{H2O}	dm^3	2,4	2,9	3,4	4,4	4	5	6,1	7,2	8
Weight	P	Kg	43	45	47	49	60	63	66	69	72

d1 refrigerant inlet
d2 refrigerant outlet
d3/d4 water connections
d5/d6 safety valve connection
VR gas side volume
VH_2O fouling factor
P net weight



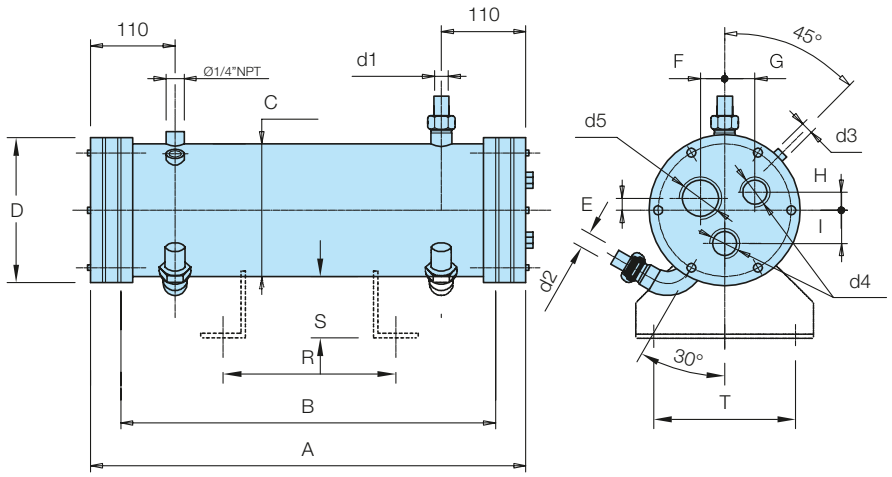
Model			CPS180	CPS210	CPS235	CPS260	CPS285	CPS335	CPS390	CPS440	CPS520
Dimensions	A Tower/City	mm	1540/1535	1540/1535	1540/1535	1540/1535	1570/1560	1570/1560	1570/1560	1570/1560	1570/1560
	B	mm	1400	1400	1400	1400	1400	1400	1400	1400	1400
	C	mm	194	194	194	194	273	273	273	273	273
	D	mm	245	245	245	245	325	325	325	325	325
	E	mm	35	35	35	35	55	55	55	55	55
	F	mm	35	35	35	35	55	55	55	55	55
	G	mm	55	55	55	55	75	75	75	75	75
	H	mm	25	25	25	25	45	45	45	45	45
	I	mm	55	55	55	55	75	75	75	75	75
	L	mm	25	25	25	25	45	45	45	45	45
	M	mm	200	200	200	200	225	225	225	225	225
	M1	mm	210	210	210	210	235	235	235	235	235
Supports	R	mm	900	900	900	900	900	900	900	900	900
	Sb	mm	80	80	80	80	100	100	100	100	100
	Sw	mm	60	60	60	60	100	100	100	100	100
	Tb	mm	210	210	210	210	300	300	300	300	300
	Tw	mm	160	160	160	160	300	300	300	300	300
Connections	d1	–	WA42	WA42	WA54	WA54	WA54	WA54	WA54	WA54	WA54
	d2	–	RC35	RC35	RC35	RC35	WA42	WA42	WA42	WA42	WA42
	d3	–	T21	T21	T21	T21	T3	T3	T3	T3	T3
	d4	–	T11	T11	T11	T11	T2	T2	T2	T2	T2
	d5	in	3/4	3/4	3/4	3/4	1	1	1	1	1
	d6	in	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Volumes	VR	dm^3	24,8	23,4	22	20,6	54,7	51,9	49,1	46,3	41,8
	V_{H2O}	dm^3	9,4	10,5	11,6	12,6	16,2	18,3	20,5	22,6	26,1
Weight	P	Kg	91	94	97	100	164	170	176	182	195

d1 refrigerant inlet
d2 refrigerant outlet
d3/d4 water connections
d5/d6 safety valve connection
VR gas side volume
VH_2O fouling factor
P net weight



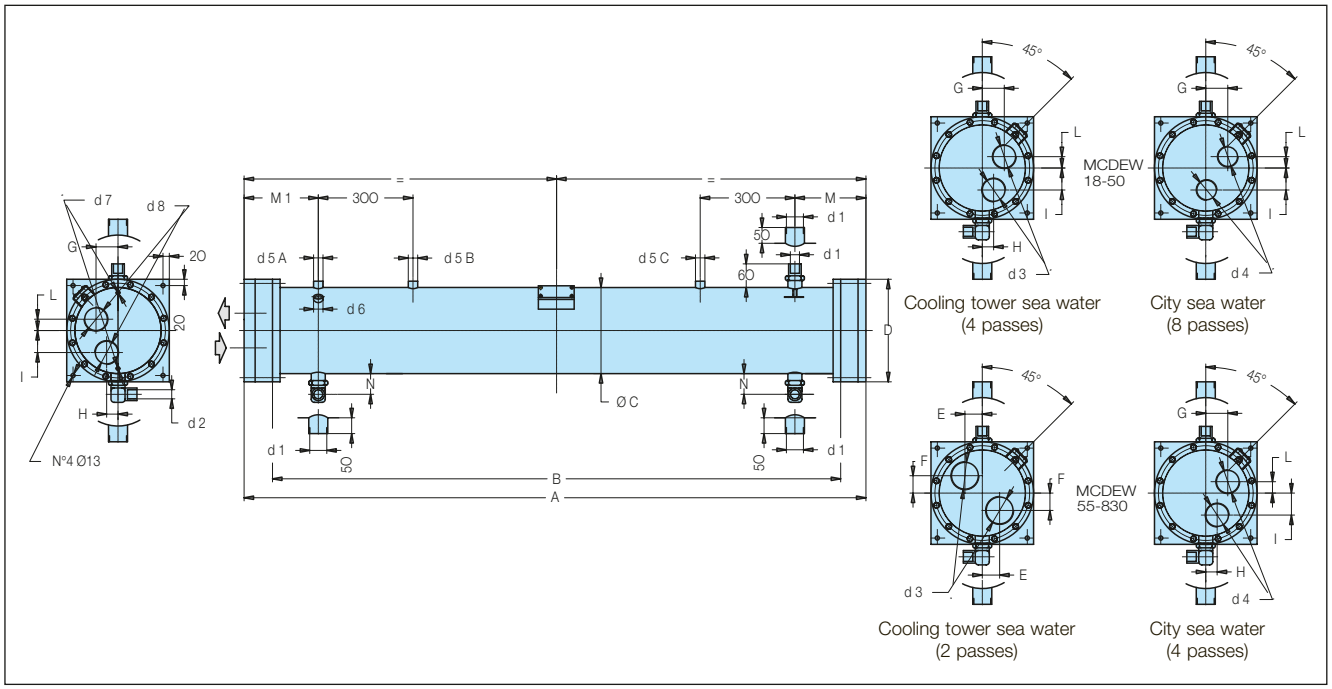
			CFC 8	CFC 12	CFC 15	CFC 20	CFC 25	CFC 30	CFC 40	CFC 50	CFC 60
Dimensions	A	mm	660	660	860	860	870	870	870	870	870
	B	mm	600	600	800	800	800	800	800	800	800
	C	mm	114	114	114	114	168	168	168	193	193
	D	mm	120	120	120	120	170	170	170	195	195
	E	mm	13	13	13	13	19	19	19	20	20
	F	mm	28	28	28	28	44	44	44	50	50
	G	mm	23	23	23	23	44	44	44	50	50
	H	mm	28	28	28	28	32	32	32	35	35
	I	mm	28	28	28	28	52	52	52	58	58
	L	mm	23	23	23	23	0	0	0	0	0
	R	mm	300	300	500	500	500	500	500	500	500
	S	mm	60	60	60	60	60	60	60	60	60
	T	mm	160	160	160	160	160	160	160	160	160
	d1	RT	1”	1”	1”	1”	1 1/4”	1 1/4”	1 1/4”	1 1/4”	1 1/4”
	d2	RT	1”	1”	1”	1”	1”	1”	1”	1 1/4”	1 1/4”
	d3	NPT	3/8”	3/8”	3/8”	3/8”	3/8”	3/8”	3/8”	3/8”	3/8”
	d4	FPT	1/2”	1/2”	1/2”	1/2”	3/4”	3/4”	3/4”	1 1/4”	1 1/4”
	d5	FPT	3/4”	3/4”	3/4”	3/4”	1 1/4”	1 1/4”	1 1/4”	1 1/2”	1 1/2”
	VR	dm^3	4,3	3,9	5,3	4,8	12,5	12	11	14,9	12,5
	VH_2O	dm^3	0,75	1,0	1,2	1,5	2,1	2,4	3,0	3,6	4,2
	P	kg	13,5	14,5	17	18,5	33	34,5	37,5	49,5	52,5
	ES	m^2	0,82	1,23	1,67	2,23	2,79	3,35	4,5	5,6	6,7

d1 refrigerant inlet
d2 refrigerant outlet
d3 safety valve connection
d4 = d5 water connections
VR gas side volume
VH_2O fouling factor
P net weight
ES exchange surface



			CRS 3	CRS 6	CRS 8	CRS 12	CRS 15	CRS 20	CRS 25
Dimensions	A	mm	670	670	670	670	870	870	870
	B	mm	600	600	600	600	800	800	800
	C	mm	168	168	168	168	193	193	193
	D	mm	170	170	170	170	195	195	195
	E	mm	19	19	19	19	20	20	20
	F	mm	41	41	44	44	50	50	50
	G	mm	44	44	44	44	50	50	50
	H	mm	27	27	32	32	35	35	35
	I	mm	52	52	52	52	58	58	58
	R	mm	300	300	300	300	500	500	500
	S	mm	60	60	60	60	60	60	60
	T	mm	160	160	160	160	160	160	160
	d1	RT	1”	1”	1”	1”	1 1/4”	1 1/4”	1 1/4”
	d2	RT	1”	1”	1”	1”	1”	1”	1”
	d3	NPT	3/8”	3/8”	3/8”	3/8”	3/8”	3/8”	3/8”
	d4	FPT	3/4”	3/4”	3/4”	3/4”	1 1/4”	1 1/4”	1 1/4”
	d5	FPT	1”	1”	1”	1”	1 1/2”	1 1/2”	1 1/2”
	VR	dm^3	10,8	10,4	10,4	10	18,5	18	17,5
	VH_2O	dm^3	0,8	1,0	1,2	1,4	1,8	2,1	2,4
	P	kg	23	24	24	25	39	40,5	42
	ES	m^2	0,41	0,82	0,82	1,23	1,67	2,23	2,79

d1 refrigerant inlet
d2 refrigerant outlet
d3 safety valve connection
d4 = d5 water connections
VR gas side volume
VH_2O fouling factor
P net weight
ES exchange surface

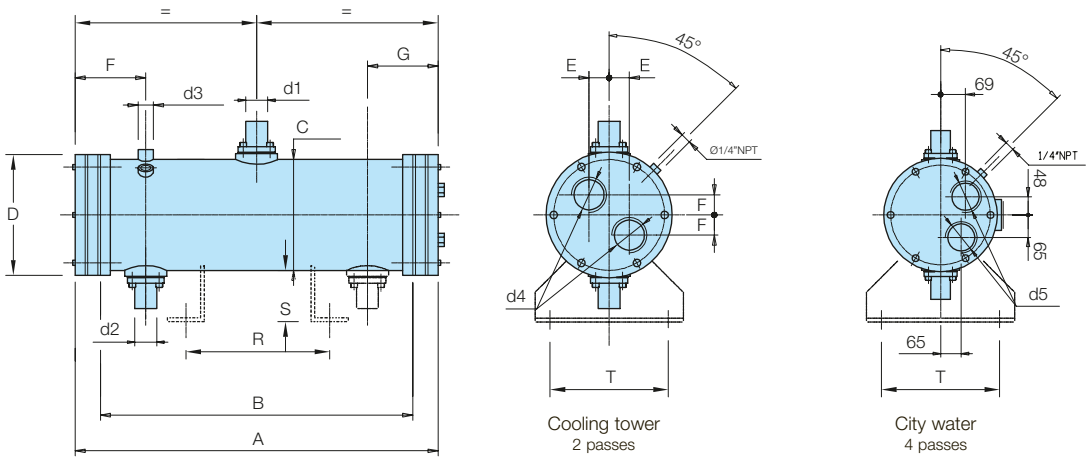


Model McDEW			15	25	34	48	50	67	90	105	123	153	175	200	205	238	275	330	370	410	430	480	505	555	620	700	770
Dimensions	A	mm	800				1500				1700	1740			1940	1970					1980			1980			
	B	mm	700				1400				1600	1600			1800	1800					1800			1800			
	C	mm	168				168					194				273					324			406			
	D	mm	215				215					245				325					380			480			
	E	mm	-				30					35				55					65			-			
	F	mm	-				30					35				55					65			105			
	G	mm	Tower 43-City 55				43					55				75					90			70			
	H	mm	Tower 22				22					25				45					55			70			
	I	mm	Tower 43-City 55				43					55				75					90			80			
	L	mm	Tower 22-City 32				22					25				45					55			80			
	M	mm	160				170					200				225					250			260			
	M1	mm	170				180					210				235					260			270			
	N	mm	65				65					65				75					75			75			
Connections	d1	mm	RC28				RC35					WA42				WA54					WA54			WA80			
	d2	mm	RBL22				RCL28					RCL35				WA42					WA42			WA54			
	d3	in-G	T11				T2					T21				T3					T4			T5			
	d4	in-G	T1				T11					T11				T2					T3			T4			
	d5-A	in-NPT	3/8				1/2					3/4				1					1			1			
	d5-B	in-NPT	-				-					-				-					1			1			
	d5-C	in-NPT	-				-					-				-					-			1			
	d6	in-NPT	1/4				1/4					1/4				1/4					1/4			1/4			
	d7	in-G	1/4				1/4					1/4				1/4					1/4			1/4			
	d8	in-G	1				1					1-1/4				2					2			2-1/2			
Volumes	Vr	dm^3	11.7	11.0	10.3	8.7	22.3	20.8	19.4	18.1	20.1	24.9	23.7	21.9	24.9	70.6	66.1	57.0	53.1	50.6	90.5	86.1	81.7	152.1	146.0	137.8	129.6
	L res	dm^3	1.9	1.9	1.9	1.9	3.8	3.8	3.4	3.1	0.9	7.1	6.7	2.8	3.1	10.0	10.0	8.4	8.4	3.4	5.2	5.2	4.7	14.8	14.8	14.8	14.8
Weight	VH_2O	dm^3	1.9	2.4	2.9	3.7	4.8	5.9	7.3	8.2	10.1	13.3	14.2	15.4	17.1	24.7	27.7	31.2	33.9	35.7	41.0	44.1	47.5	52.4	57.7	64.7	71.7
	P	Kg	41	43	45	47	58	61	65	68	85	105	108	111	121	195	203	215	222	227	293	304	313	441	452	467	482

Qn nominal condensation capacity
Wn nominal water flow rate
Wm maximum water flow rate
Tc condensing temperature
Ti water inlet temperature
FF Fouling factor

d1 refrigerant inlet
d2 refrigerant outlet
d3=d5 water connections
d5-A,B,C, safety valve connection
d6 Service socket
d7 Drain - Vent

d8 anodes
Vr gas side volume
L res Liquid reserve
VH_2O water side volume
P weight



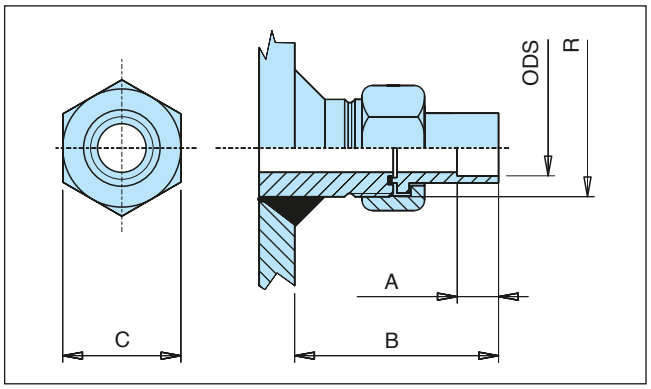
			ACFL 450/360	ACFL 450/414	ACFL 450/468	ACFL 450/522	ACFL 450/576	ACFL 750/648	ACFL 750/738	ACFL 750/828	ACFL 750/900
Dimensions	A	mm	2500	2500	2500	2500	2500	2540	2540	2540	2540
	B	mm	2400	2400	2400	2400	2400	2400	2400	2400	2400
	C	mm	324	324	324	324	324	406	406	406	406
	D	mm	325	325	325	325	325	410	410	410	410
	E	mm	56	56	56	56	56	70	70	70	70
	F	mm	205	205	205	205	205	225	225	225	225
	G	mm	200	200	200	200	200	220	220	220	220
	R	mm	1700	1700	1700	1700	1700	1700	1700	1700	1700
	S	mm	100	100	100	100	100	120	120	120	120
	T	mm	300	300	300	300	300	400	400	400	400
	d1	FL	100x100	100x100	100x100	100x100	100x100	145	145	145	145
	d2	FL	70x70	70x70	70x70	70x70	70x70	90x90	90x90	90x90	90x90
	d3	NPT	2x1"	2x1"	2x1"	2x1"	3x1"	3x1"	3x1"	3x1"	3x1"
	d4	FPT	4"	4"	4"	4"	4"	5"	5"	5"	5"
	d5	FPT	3"	3"	3"	3"	3"	-	-	-	-
	VR	dm^3	133,8	126,9	120	113,1	106,2	205	193,7	182,5	173,8
	VH_2O	dm^3	33,4	37,8	42,2	46,7	51,1	62,8	70,2	77,6	83,7
	P	kg	295	309,5	324	338,5	353	494	518	541	559
	ES	m^2	42	48,3	54,5	60,8	67,1	75,5	86	96,5	104,9

d1 refrigerant inlet
d2 refrigerant outlet
d3 safety valve connection
d4 = d5 water connections
VR gas side volume
VH_2O fouling factor
P net weight
ES exchange surface

Refrigerant connections

Refrigerant inlet and outlet can be equipped with Rotalock brazing (ODS), welding (OD) or flanged (F) connections. All data concerning the different connections available are indicated in the following table.
Sea water series have two refrigerant outlet connections.

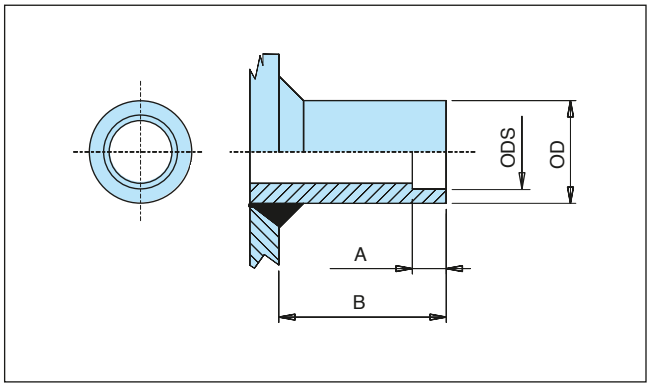
Rotalock connection (R)



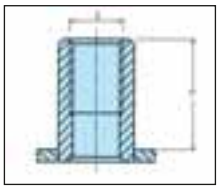
Rotalock (CPLUS - CDEW - McDEW)							
Type	A	B	C	RT	Name	ODS	ID
	[mm]	[mm]	[mm]			[mm]	[mm]
B	20	80	36	1 1/4" - 12UNF	RB22	22	22,5
C	20	80	50	1 3/4" - 12UNF	RC28	28	28,3
	20	80	50	1 3/4" - 12UNF	RC35	35	35,3

Rotalock (• CFC • CRS • CFL • ACFC • ACFL)				
B	C	RT	Name	ODS
[mm]	[mm]			[mm]
63	30	1" - 14UNF	RB16	16
36	36	1 1/4" - 12UNF	RC22	22
63	50	1 3/4" - 12UNF	RC38	35

Welding connection (W)

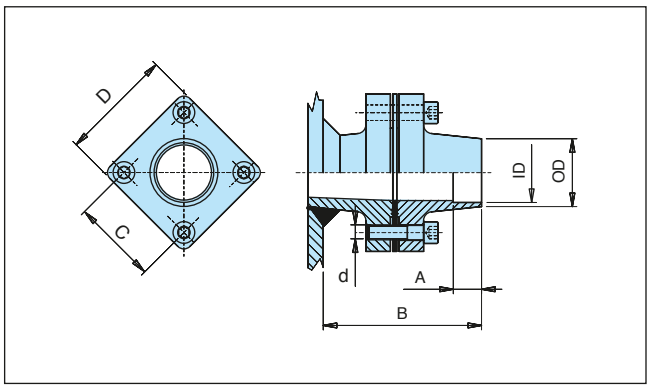


Welding (CPLUS - CDEW - McDEW)						
Type	A	B	Name	ODS	ID	OD
	[mm]	[mm]		[mm]	[mm]	[mm]
A	20	70	WA42	42	42,4	48,3
	20	70	WA54	54	54,4	60,3
	20	70	WA80	80	80,6	88,9

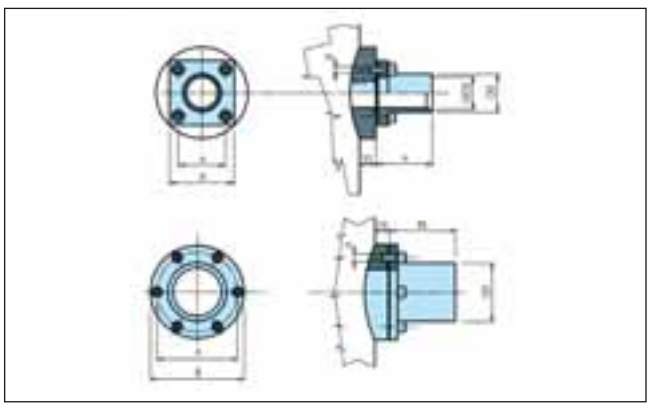


NPT (• CFC • CRS • CFL • ACFC •ACFL)				
D	1/4"	3/8"	1/2"	1"
d (mm)	20	24	30	40
H (mm)	22	22	25	25

Flange connection (F)



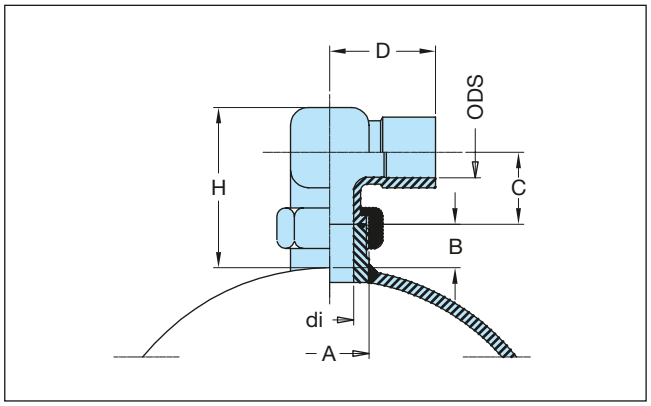
Flange (CPLUS - CDEW - McDEW)									
Type	A	B	C	D	d	Name	ODS	ID	OD
	[mm]	[mm]	[mm]	[mm]			[mm]	[mm]	[mm]
A	20	110	55	75	M10	FA35	35	35,3	-
	20	110	55	75	M10	FA42	42	42,4	-
	20	110	55	75	M10	FA54	54	54,4	-
B	20	130	70	90	M10	FB54	54	54,4	-
	20	130	70	90	M10	FB67	67	67,4	76
C	20	130	90	110	M12	FC67	67	67,4	76
	20	130	90	110	M12	FC80	80	80,6	88,9



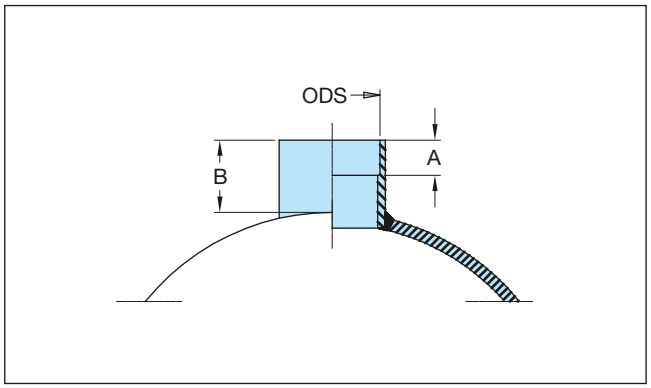
Flange (• CFC • CRS • CFL • ACFC • ACFL)						
FL	60X60	70X70	90X90	100X100	145	160
A (mm)	60	70	90	100	Ø145	Ø160
B (mm)	80	90	110	125	Ø170	Ø190
ODS (mm)	42	54			-	-
OD (mm)			76,1	88,9	101,6	114,3
H (mm)	70	85	100	125		
d	M10	M10	M12	M12	M12	M16

Special connections (CPLUS - CDEW - McDEW)

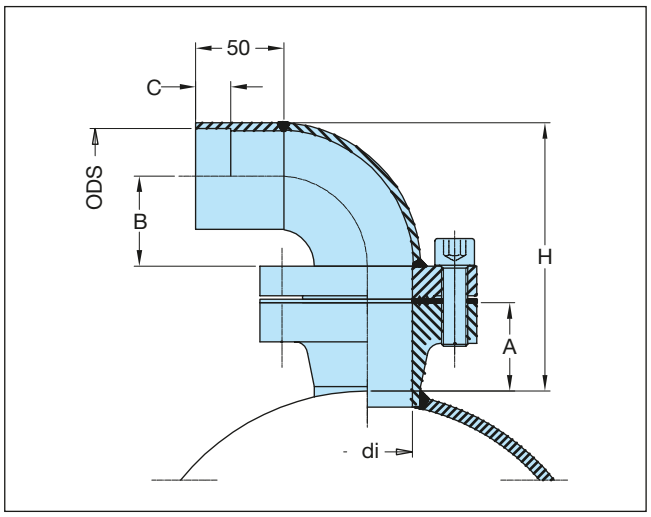
CPS	160	180	210	235	260	285	335	390	440	520
Refrigerant intlet (d1)	Type A					Type B				
Refrigerant outlet (d2)	-	-	-	-	-	Type A				



Rotalock (CDEW - McDEW)			Type B	Type C	
Rotalock Type	Name		RBL 22	RCL 28	RCL 35
	A	UNF	1 1/4"	1 3/4"	
	B	mm	28	27	27
	C	mm	29	38	
	D	mm	44	47	52
	di	mm	19	31	
	H	mm	71	83	
	ODS	mm	22	28	35



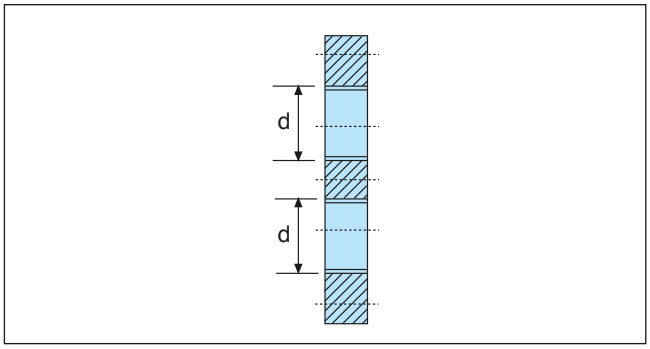
Welding connections (CDEW - McDEW)			Type A	Type B	Type C	Type D
Welding Type	Name		WA 42	WA 54	WA 67	WA 80
	A	mm	20	20	25	25
	B	mm	50	50	50	50
	ODS	mm	42	54	67	80
	OD	mm	48.3	60.3	76.1	88.9



Special flange connections (CDEW - McDEW)			Type A		Type B	Type C	
Flange Type	Name		FA 35	FA 42	FB 54	FC 67	FC 80
	A	mm	45		45	45	
	B	mm	32	38	51	63	76
	C	mm	20		20	25	
	di	mm	39		51	75	
	H	mm	119	128	152	172	191
	ODS	mm	35	42	54	67	80
	OD	mm	42.4	48.3	60.3	76.1	88.9

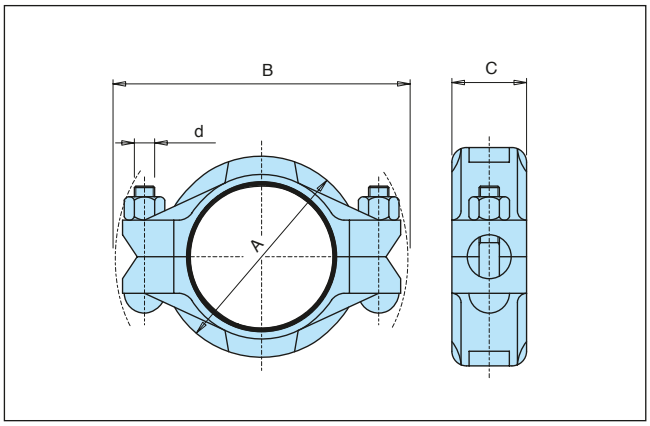
CDEW, McDEW, CPLUS

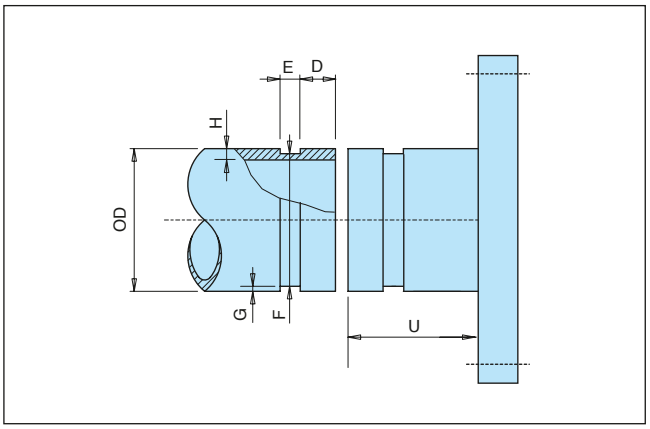
Water inlet and outlet connections on the condenser are ISO 228/1-G female threaded connections. As an optional for models CPS285-520, the connection can be provided via a flexible joint using a clamp and a gasket in EPDM. A stub-end is supplied to which the water pipework can be welded.



Threaded connections (T)				
Model	TOWER		CITY	
	Name	d	Name	d
		(in)		(in)
CPS 35-80/McDEW 15-48	T11	$1^{1/2}$	T1	1
CPS 70-160/CDEW 60-135/McDEW 50-123	T2	2	T11	$1^{1/2}$
CPS 180-260/CDEW 165-240/McDEW 153-205	T21	$2^{1/2}$	T11	$1^{1/2}$
CPS 285-520/CDEW 260-450/McDEW 238-410	T3	3	T2	2
CDEW 470-550/McDEW 430-505	T4	4	T3	3
CDEW 610-840/McDEW 555-770	T5	5	T4	4

Flexible joint with connection pipe (J)

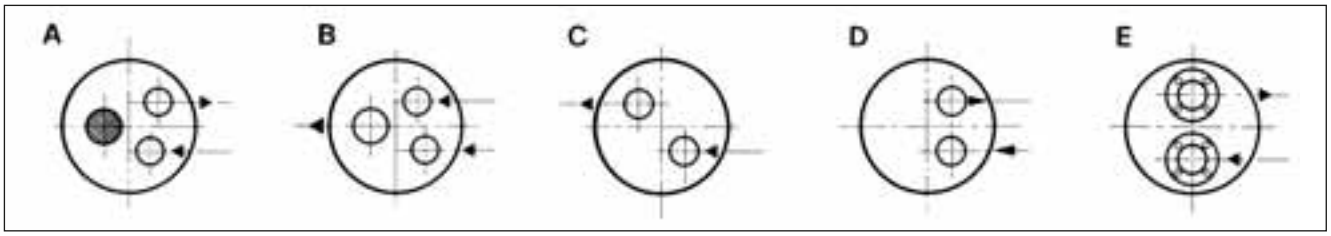




Model	FLEXIBLE JOINT							CONNECTION PIPE							
	A	B	C	d	Name	OD	DN	OD	DN	D	E	F	G	H	U
	[mm]	[mm]	[mm]			[mm]		[mm]		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
CPS 285-520	117,5	181	44,5	M12	JP	88,9	80 (3")	88,9	80 (3")	15,9	7,9	84,9	2	4,8	73

CFC • CRS • CFL • ACFC • ACFL

Condensers series CFC, CRS, CFL, ACFC series up to model 150/183 and ACFL series up to model 180/207 can have two types of connections: city water (scheme A) and tower water (scheme B). Condensers series ACFC starting with model 240/183 and ACFL series starting with model 300/207 are provided with tower water connection (scheme C, 2 passes) or on request with city water connection (scheme D, 4 passes). Starting from ACFL 750/648 only tower connection is available (scheme C or scheme E, 2 passes). Marine condensers are not available with A or B connections.



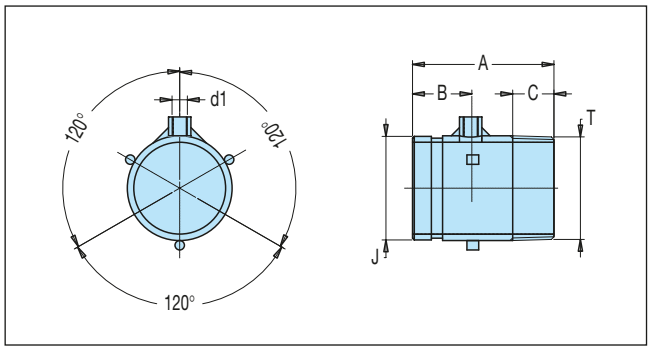
Special adapter from threaded to flexible joint connection

CDEW, CPLUS

It is possibile to convert the standard female threaded connections to a flexible joint solution with or without temperature sockets.

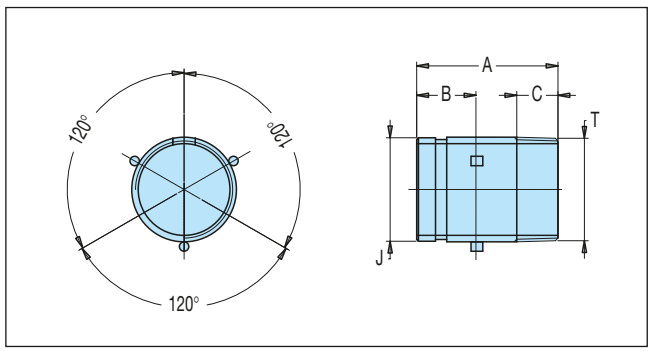
Different adaptor kits can be supplied.

Water inlet with temperature socket



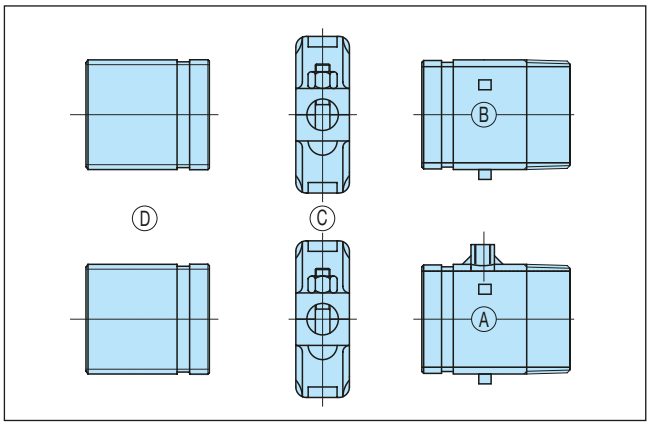
CONNECTION PIPE						
Type	A	B	C	T	J	d1
	[mm]	[mm]	[mm]	(in-G)	(in)	(in-G)
T21-14 - J21	170	100	30	2-1/2	2-1/2	1/4
T3-14 - J3	120	50	35	3	3	1/4
T4-14 - J4	170	100	40	4	4	1/4
T5-14 - J5	170	100	45	5	5	1/4

Water outlet



CONNECTION PIPE						
Type	A	B	C	T	J	DN x sp
	[mm]	[mm]	[mm]	(in-G)	(in)	[mm]
T21 - J21	100	50	30	2-1/2	2-1/2	76,1x5
T3 - J3	100	50	35	3	3	88,9x5,49
T4 - J4	100	50	40	4	4	114,3x3,2
T5 - J5	100	50	45	5	5	139,7x4

Kit



COMPONENTS				
Type	Adapter IN Ⓐ	Adapter OUT Ⓑ	Flex. Joint Ⓒ	Count. Pipe Ⓓ
	(n°)	(n°)	(n°)	(n°)
KIT T21 - J21	1	1	2	2
KIT T3 - J3	1	1	2	2
KIT T4 - J4	1	1	2	2
KIT T5 - J5	1	1	2	2

Appendix H Pressure Actuated Water Regulating Valve

(Page Left Blank Intentionally)

V46 Series Pressure-Actuated Water-Regulating Valves

The V46 pressure-actuated modulating valves come in two types of control action: direct acting or reverse acting. Direct-acting V46 valves are typically used for regulating refrigerant head pressure in water-cooled condensers. Reverse-acting V46N valves are typically used for bypass service on refrigeration systems and heat pump applications. Commercial V46 valves may be used with standard non-corrosive refrigerants. V46 models are also available for ammonia refrigerant. For applications where the coolant may be corrosive to the valve trim, maritime models are available, which have nickel copper (monel) valve trim.

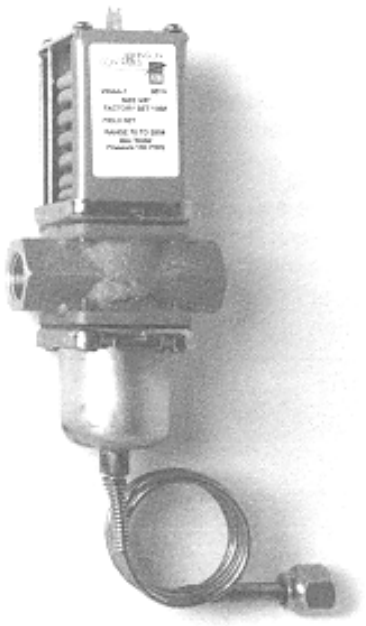


Figure 1: V46 Pressure-Actuated Water-Regulating Valve

Features and Benefits	
❑ **No Close Fitting or Sliding Parts in Water Passages**	Provides robust control in less than ideal conditions
❑ **Corrosion Resistant Material for Parts that Come in Direct Contact with Water**	Promotes longer valve life
❑ **Accessible Range Spring**	Allows easy manual flushing, if required
❑ **Take-apart Construction**	Interior of valves accessible without removing valve from refrigeration system or pumping down
❑ **Pressure-balanced Design**	Valve maintains consistent setpoint against both gradual and sudden water pressure changes

Part No. 24-8414-4, Rev. —
Code No. LIT-125687

Application Overview

The V46 direct-acting models open on an increase in pressure. Models A, B, and C are typically used for regulating water-cooled condensers, while the low flow "D" model is generally used in ice machines. The reverse-acting V46N valve model closes on an increase in pressure and is typically used for bypass service on refrigeration systems and heat pumps that control water temperature.

Commercial V46 valves are available in 3/8 in. through 2-1/2 in. sizes. Commercial all range models (3/8 through 1-1/2 in.), may be used with standard non-corrosive refrigerants, or ammonia refrigerant applications, depending on the model.

V46 series valves also come in models designed for Navy or maritime salt water applications. These valve bodies are constructed of bronze, and any metal parts that come into contact with salt water are constructed of nickel copper (monel), which withstands the corrosive action of salt water.

IMPORTANT:	All V46 Series water regulating valves are designed for use **only** as operating devices. Where system closure, improper flow, or loss of pressure due to valve failure can result in personal injury and/or loss of property, a separate pressure relief or safety shutoff valve, as applicable, must be added by the user.

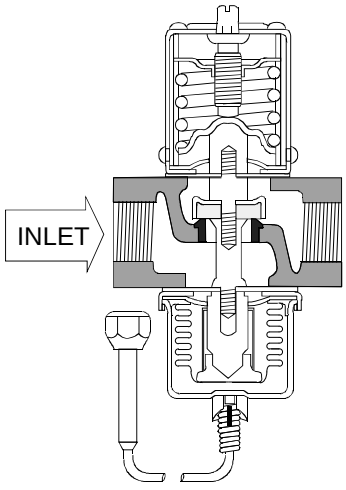


Figure 2: Threaded Type Direct-Acting Valve Cross Section

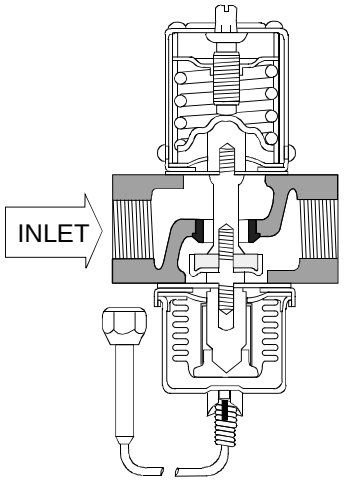


Figure 3: Threaded Type Reverse-Acting Valve Cross Section

Valve Sizing

Follow Steps 1 through 3, and use the information obtained to locate a point on one of the flowcharts found under *V46 Flowcharts* that satisfies all three steps.

1. Determine maximum water flow required using tables provided by the manufacturer of the condensing unit, or calculate the flow using the following formula:

$$\text{Flow (GPM)} = \frac{\text{Tons of Refrigeration x 15,000}}{\text{500 x (Outlet - Inlet Temperature)}}$$

   Note: If the outlet water temperature is unknown, assume it to be 10°F below the condensing temperature.

   Example: A 9 ton capacity system has an inlet water temperature of 65°F and an outlet water temperature of 95°F. The maximum required water flow is:

$$\text{Flow (GPM)} = \frac{9 \text{ x } 15{,}000}{500 \text{ x } (95 - 65)} = 9 \text{ GPM}$$

2. Determine refrigerant head pressure rise above the valve opening point.

   a. Valve closing point (to assure closure under all conditions) must be the refrigerant pressure equivalent to the highest ambient air temperature the equipment will be subjected to in the off cycle. Read this in psig from a "Saturated Vapor Table" for the refrigerant selected.

b. To determine the valve opening point, add about 7 psig (48 kPa) to the closing point.

c. From the same table, read the operating head pressure corresponding to the selected condensing temperature.

d. Subtract the valve opening point from the operating head pressure. This gives the head pressure rise.

3. Determine water pressure drop across the valve. This is the pressure actually available to force water through the valve.

   a. Determine minimum water pressure available from city mains or other sources.

   b. From condensing unit manufacturer's tables, read the pressure drop through condenser corresponding to the required flow.

   c. To the value found in 3b, add the estimated or calculated drop through installed piping.

   d. Subtract the total condenser, piping, and static head (if applicable) pressure drop from the available water pressure found in 3a. This is the available pressure drop across the valve.

4. Select the proper valve size from the V46 flowcharts by locating a point on a chart that will satisfy the flow, the head pressure rise above opening point, and the pressure drop across the valve.

Example: The required flow for a low-range system is found to be 27 GPM. Condensing pressure is 125 psig, and the maximum ambient temperature is estimated at 86°F. City water pressure is 40 psig and the manufacturer's table gives a pressure drop through the condenser and the accompanying piping and valves at 15 psi. Drop through the installed piping is approximately 4 psi.

Step 1: 27 GPM

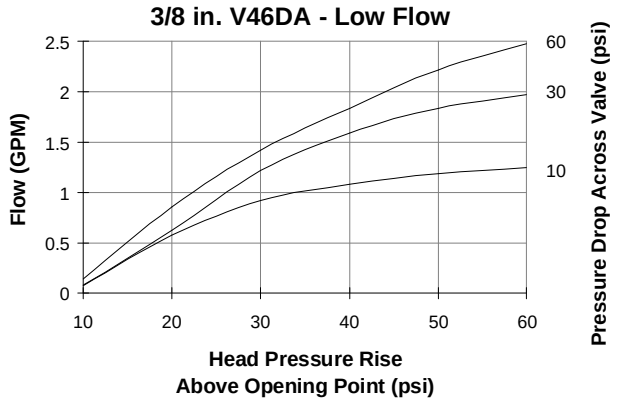
Step 2: Closing point is pressure of refrigerant corresponding to 86°F = 93 psig
Opening point = 93+7 = 100 psig
Operating head pressure = 125 psig
Head pressure rise = 125-100 = 25 psi

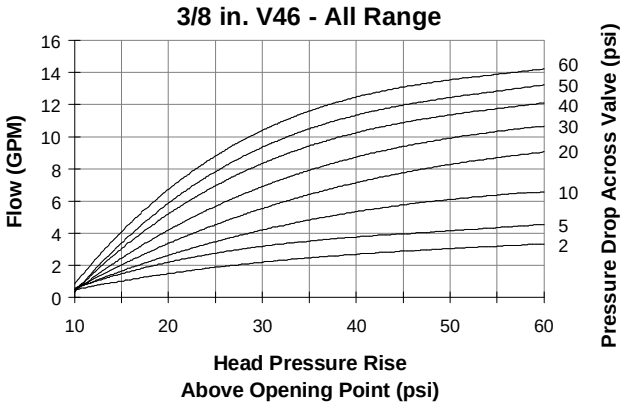
Step 3: Minimum pressure = 40 psig
Pressure drop through condenser = 15 psi
Combined pressure drop = 15+4 = 19 psi
Pressure drop across valve = 40-19 = 21 psi

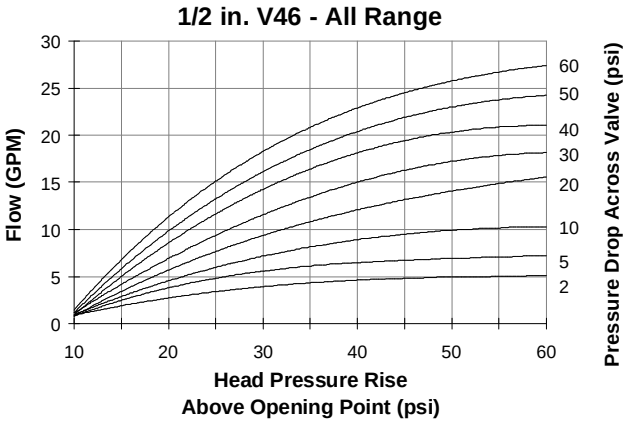
Using a flow of 27 GPM, a head pressure rise of 25 psi, and a pressure drop across the valve of 21 psi, the only valve that satisfies all three criteria is a **1-1/4** in. valve. See the 1-1/4 in. V46 - All Range chart on the next page.

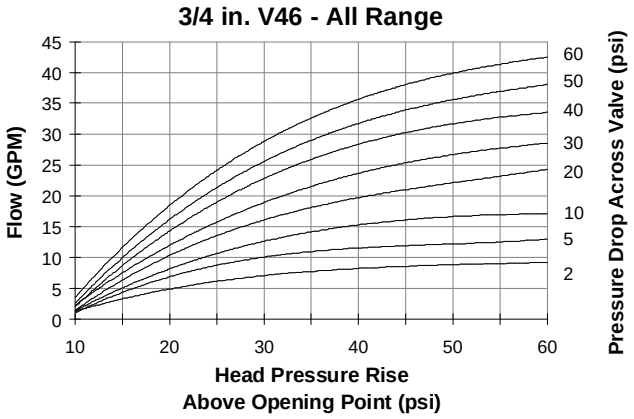
V46 Flowcharts

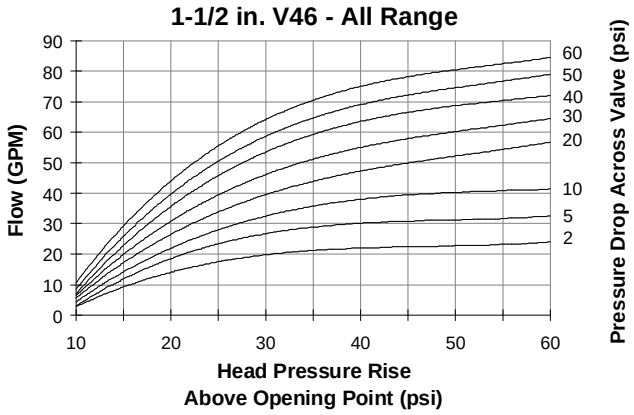
Note: The maximum differential water pressure across a valve is 60 psi.

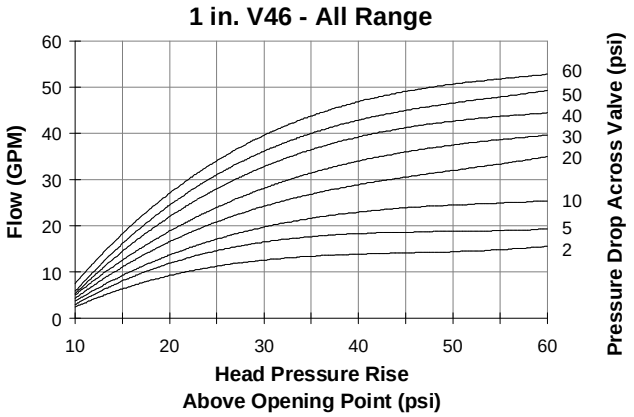


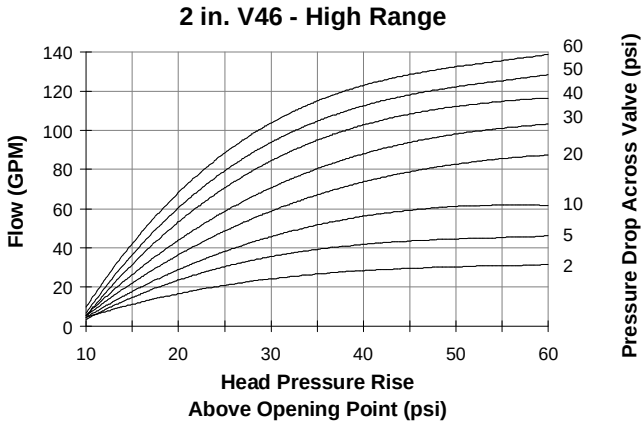


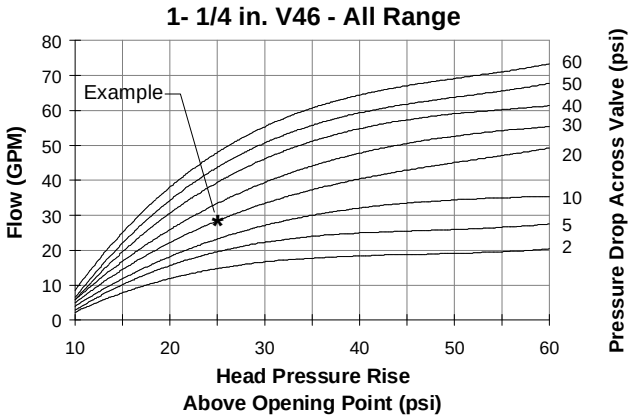


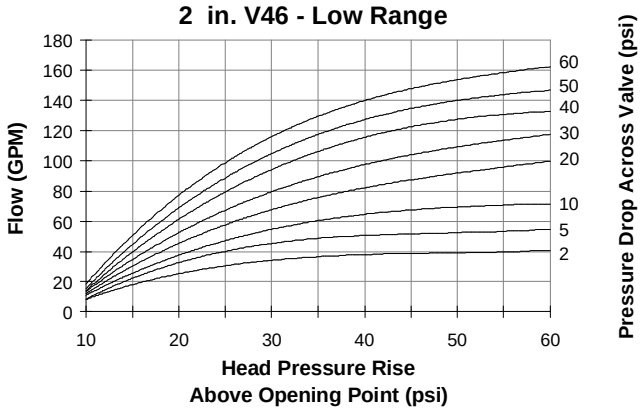

3/4 in. V46 - All Range
Flow (GPM)
0
5
10
15
20
25
30
35
40
45
10
20
30
40
50
60
Head Pressure Rise
Above Opening Point (psi)
60
50
40
30
20
10
5
2
Pressure Drop Across Valve (psi)

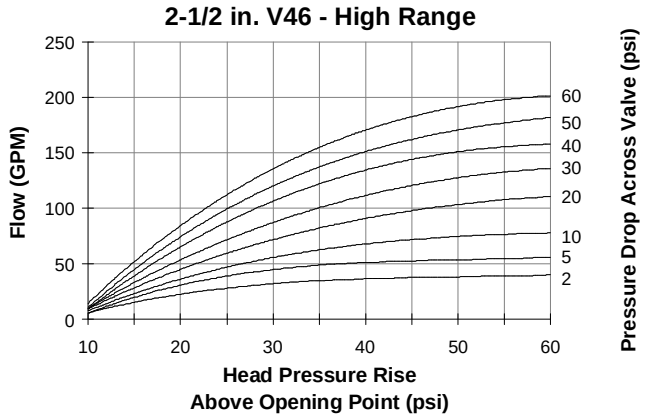

1-1/2 in. V46 - All Range
Flow (GPM)
0
10
20
30
40
50
60
70
80
90
10
20
30
40
50
60
Head Pressure Rise
Above Opening Point (psi)
60
50
40
30
20
10
5
2
Pressure Drop Across Valve (psi)

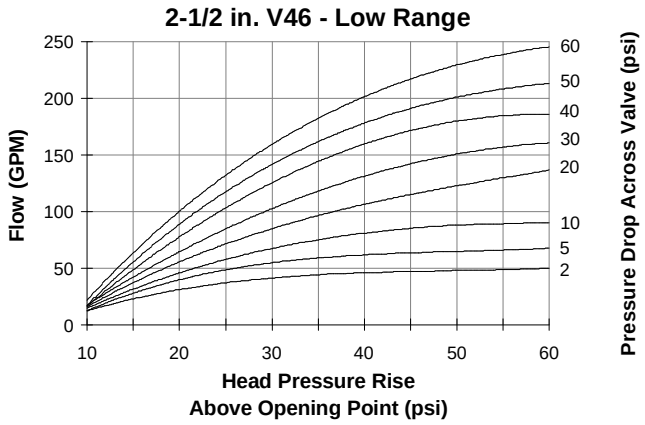

1 in. V46 - All Range
Flow (GPM)
0
10
20
30
40
50
60
10
20
30
40
50
60
Head Pressure Rise
Above Opening Point (psi)
60
50
40
30
20
10
5
2
Pressure Drop Across Valve (psi)


2 in. V46 - High Range
Flow (GPM)
0
20
40
60
80
100
120
140
10
20
30
40
50
60
Head Pressure Rise
Above Opening Point (psi)
60
50
40
30
20
10
5
2
Pressure Drop Across Valve (psi)


1- 1/4 in. V46 - All Range
Example
Flow (GPM)
0
10
20
30
40
50
60
70
80
10
20
30
40
50
60
Head Pressure Rise
Above Opening Point (psi)
60
50
40
30
20
10
5
2
Pressure Drop Across Valve (psi)


2 in. V46 - Low Range
Flow (GPM)
0
20
40
60
80
100
120
140
160
180
10
20
30
40
50
60
Head Pressure Rise
Above Opening Point (psi)
60
50
40
30
20
10
5
2
Pressure Drop Across Valve (psi)





Dimensions

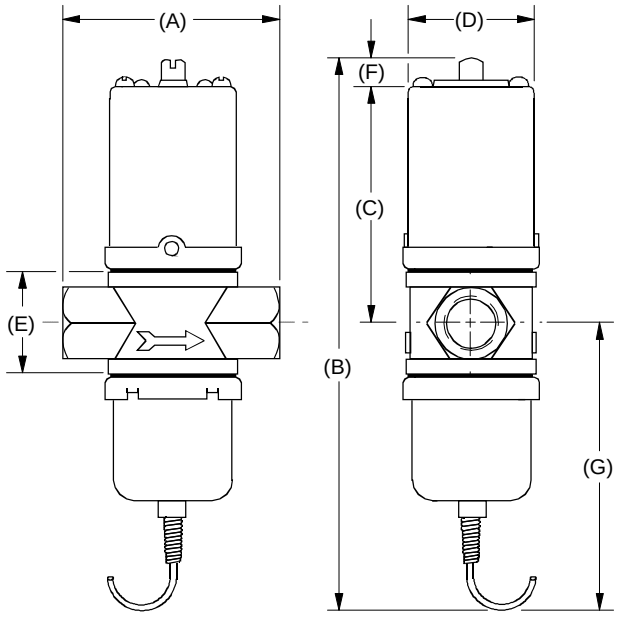


Figure 4: Threaded Type Valves

Table 1: Commercial Service V46 Threaded Connection Dimensions

Dimensions in Inches							
Valve Size	**A**	**B**	**C**	**D**	**E**	**F**	**G**
3/8 in.	2-5/8	6-3/4	3-1/8	1-1/2	1-1/4	13/32	3-7/32
1/2 in.	3-1/8 (3-1/4)*	7-13/32	3-3/8	1-27/32	1-1/2	13/32	3-5/8
3/4 in.	3-3/8 (3-5/8)*	7-7/8	3-7/8	2-1/32	1-3/4	13/32	3-21/32
1 in.	4-1/2 (4-7/8)*	10-3/4	5-1/2	2-25/32	2	1/2	4-3/4
1-1/4 in.	4-7/8	11-1/8	5-3/4	2-5/8	2-3/8	1/2	4-29/32

*Note: Values in parenthesis are for maritime valves. All other dimensions remain the same.

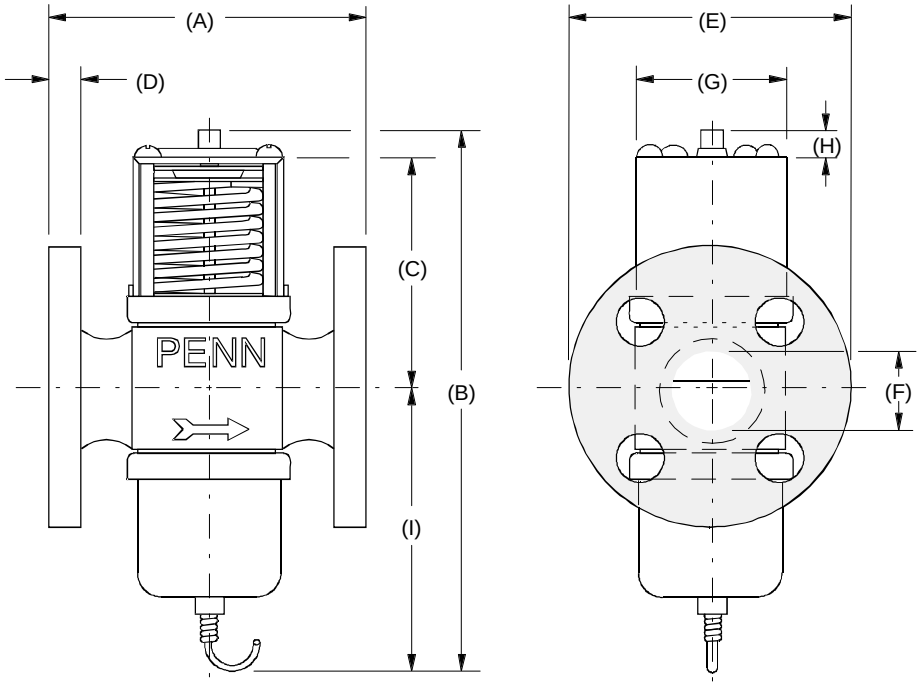


Figure 5: Flange Type Valves

Table 2: Commercial Service: V46 Flange Connection Dimensions

Dimensions in Inches									
Valve Size	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
1-1/2 in.	5-5/16	11-1/8	5-3/4	9/16	5	1-7/8	2-5/8	1/2	4-29/32
2 in.	6-5/8	13	6-15/32	5/8	6	2-1/4	3-1/2	1/2	6-1/8
2-1/2 in.	6-3/4	13-1/2	6-3/8	3/4	7	2-23/32	3-1/2	1-1/32	6-3/32

Flange Specifications			
Valve Size	**No. of Holes**	**Hole Size**	**Bolt Circle**
1-1/2 in.	4	5/8	3-7/8
2 in.	4	3/4	4-3/4
2-1/2 in.	4	3/4	5-1/2

Table 3: Maritime Service: ASME Flange Connection Dimensions

Dimensions									
Valve Size	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
1-1/2 in.	5-5/16	10-1/2	5-5/8	9/16	5	1-7/8	2-5/8	1/2	5
2 in.	6-3/8	13-1/8	6-1/2	1/2	6	2-3/4	3-1/2	5/8	6
2-1/2 in.	6-3/4	13-1/8	6-1/2	11/16	7	2-3/4	3-1/2	5/8	6

Maritime Service: ASME Flange Specifications			
Valve Size	**No. of Holes**	**Hole Size**	**Bolt Circle**
1-1/2 in.	4	5/8	3-7/8
2 in.	4	3/4	4-3/4
2-1/2 in.	4	3/4	5-1/2

Table 4: Navy "BuShips" Service: Navy Flange Connection Dimensions

Dimensions in Inches									
Valve Size	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
3/4 in.	4-3/16	7-3/4	4	7/16	3-13/16	1-1/8	2-1/32	1/2	3-5/16
1 in	5-5/16	9	4-1/2	1/2	4-1/4	1-1/4	2-5/8	1/2	4
1-1/4 in.	5-5/16	9-11/32	4-11/16	1/2	4-1/2	1-5/8	2-5/8	1/2	4-5/32
1-1/2 in.	5-5/16	10-7/32	5-3/4	1/2	5-1/16	1-7/8	2-5/8	1/2	4
2 in.	6-3/8	14-1/8	6-13/32	1/2	5-9/16	2-3/4	3-1/2	7/16	7-9/32
2-1/2 in.	6-3/8	14-5/16	6-1/2	1/2	6-1/8	2-3/4	3-1/2	5/8	7-3/16

Navy Flange Specifications			
Valve Size	**No. of Holes**	**Hole Size**	**Bolt Circle**
3/4 in.	4	9/16	2-11/16
1 in	4	9/16	3-1/8
1-1/4 in.	4	9/16	3-3/8
1-1/2 in.	6	9/16	3-15/16
2 in.	6	9/16	4-7/16
2-1/2 in.	6	9/16	5

*M*ounting

CAUTION: **Equipment Damage Hazard.** To prevent damage to the capillary, avoid sharp bends or kinks in the capillary. Coil and secure excess capillary at the valve end to avoid tube breakage due to vibration. Because harmonic vibration can also break the tube, some slack must be left in the capillary. Do not permit the tubing to rub against metal surfaces where friction can damage the capillary.

Flush water lines to clear any foreign matter that may interfere with valve operation. Mount valves vertically on the inlet side of the condenser with spring housing up. If it is necessary to keep the condenser flooded with coolant, the valve can be mounted on the outlet side. When mounting the valve in a position other than vertical, follow the instructions of the equipment in which the valve will be installed. Make refrigerant head pressure connection to bellows. If additional capillary tubing is required, use 1/4 in. O.D. tubing or larger.

*A*djustment

Valves may be adjusted with standard service valve wrenches or screwdrivers, see Table 5. All range valve settings can be changed quickly from low-range refrigerants such as R134 to high-range refrigerants such as R22 or vice versa. To raise the valve opening point, turn the adjusting screw, located at the top of range spring housing, counterclockwise. See Figure 8. Turn the adjusting screw clockwise to lower the opening point. Exact settings can be made using a pressure gauge in the refrigerant line to determine the throttling point. Put the system under normal operating load and adjust to the desired operating pressure. See Table 14 for pressure range specifications.

Table 5: Range Adjustment Screw

Valve Size (in.)	Range Adjusting Screw
3/8, 1/2, 3/4	1/4 in. square head adjusting screw with a screwdriver slot
1, 1-1/4, 1-1/2	5/16 in. square head adjusting screw
2, 2-1/2	1/2 in. square head adjusting screw and a slotted cam

If the compressor operates in high ambient temperatures, head pressures may remain high enough during off cycles to prevent the valve from closing completely. In such instances, the opening point of the valve should be raised just enough to cause the valve to close during compressor standby periods. This will also raise the throttling point.

Manual Flushing

To clear any sediment that might accumulate, valves may be manually flushed. Insert screwdrivers under both sides of the valve spring guide and lift upwards to flush the valve. See Figure 6. Manual flushing does not affect valve adjustment.

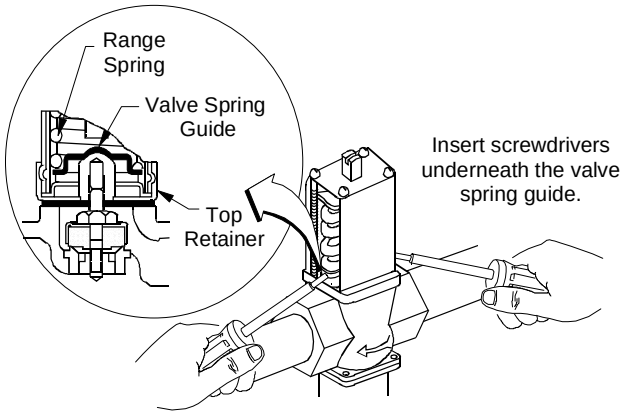


Figure 6: Manual Flushing

Repair Data

Replacement of the sensing element, internal parts, and the rubber diaphragm can be made. For a replacement valve or replacement parts kit, contact the nearest Johnson Controls/PENN distributor. For replacement part kit numbers, refer to Tables 9 through 13. For replacement kit instructions and details refer to the following bulletins: *V46, V47, V48, and V49 Sensing Element Replacement* and *V46, V47, 246, and 247 Repair Parts and Service Instructions.*

Ordering Information

When ordering water valves, specify the following:

1. Complete product number.
2. If product number is not known, answer the following questions and select a valve using Tables 9 through 13.
   a. What is the valve size needed? See *Valve Sizing* section.
   b. What refrigerant will be used in the system? See *Table 14: Pressure Range Specifications*.

      Note: 3/8 in. through 1-1/2 in. valves are supplied with all range construction, allowing a single valve to be used for either low or high range refrigerants.

   c. Is a standard open high, or reverse action close high valve required? See *Table 7: Type Number Selection Matrix.*
   d. Is a commercial, maritime, or Navy service valve needed? Maritime and Navy valves have bronze bodies and monel internal parts.
3. Companion flange kit by part number, if required. See section below and *Table 6: Companion Flange Kits*.
4. Mounting bracket (3/8 in. and 1/2 in. valve sizes only) if required, and its position on valve. See *Table 8: Pressure Connection Styles*.

Companion Flanges and Gaskets

Kits are available, at additional cost, for 1-1/2, 2, and 2-1/2 in. flange connection (ASME specifications) valves only. Each flange kit contains two ring gaskets, two cast iron flanges, eight machine bolts, and eight hex nuts.

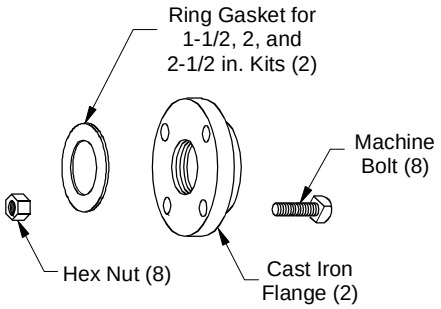


Figure 7: Flange Kit

Table 6: Companion Flange Kits

Kit Number	Water Valve Size
KIT 14A-612	1-1/2 in.
KIT 14A-613	2 in.
KIT 14A-614	2-1/2 in.

Product Number Selection

For applications that call for valves not listed in Tables 9 through 13, *Table 7: Type Number Selection Matrix* can be used to specify a custom valve.

Example: To order a direct-acting, commercial valve with a 1-1/4 in. NPT threaded connection, specify a V46AE.

For more information, contact Application Engineering at (414) 274-5535.

Table 7: Type Number Selection Matrix

V46	A		Open on Rise, Commercial
	B		Open on Rise, Maritime
	C		Open on Rise, Navy
	D		Open on Rise, Commercial Low Flow
	E		Open on Rise, Commercial with High Pressure Bellows
	F		Open on Rise, Maritime with High Pressure Bellows
	G		Open on Rise, Navy with High Pressure Bellows
	L		Open on Rise, Commercial Low Flow No-Repair
	N		Open on Fall, Commercial
	P		Open on Fall, Maritime
	Q		Open on Fall, Commercial Low Flow with High Pressure Bellows
		A	3/8 in. NPT Threaded
		B	1/2 in. NPT Threaded
		C	3/4 in. NPT Threaded
		D	1 in. NPT Threaded
		E	1-1/4 in. NPT Threaded
		F	1-1/2 in. NPT Threaded
		G	9/16–18 Threaded
		H	3/8 in. Sweat
		J	1/2 in. Sweat
		K	3/4 in. Sweat
		L	1 in. Sweat
		M	1-1/4 in. Sweat
		N	3/4 in. Flange
		P	1 in. Flange
		Q	1-1/4 in. Flange
		R	1-1/2 in. Flange
		S	2 in. Flange
		T	2-1/2 in. Flange

Table 8: Pressure Connection Styles

Valve	Style No.	Description
Commercial Service: Non-corrosive Refrigerant		
1-1/2 in. and Smaller	45	30 in. (762 mm) copper capillary with 1/4 in. flare nut and valve depressor
	5*	1/4 in male flare fitting
	34*	30 in. (762 mm) copper capillary with 1/4 in. section for sweat or flare connection
2 in. and 2-1/2 in.	5	1/4 in. male flare fitting
Commercial Service: Ammonia		
1/2 in. to 2-1/2 in.	15	1/4 in. female NPT
Navy and Marine Service		
All Sizes	34	30 in. (762 mm) copper capillary with 1/4 in. section for sweat or flare connection

*Optional, quantity orders only.

*O*ptions

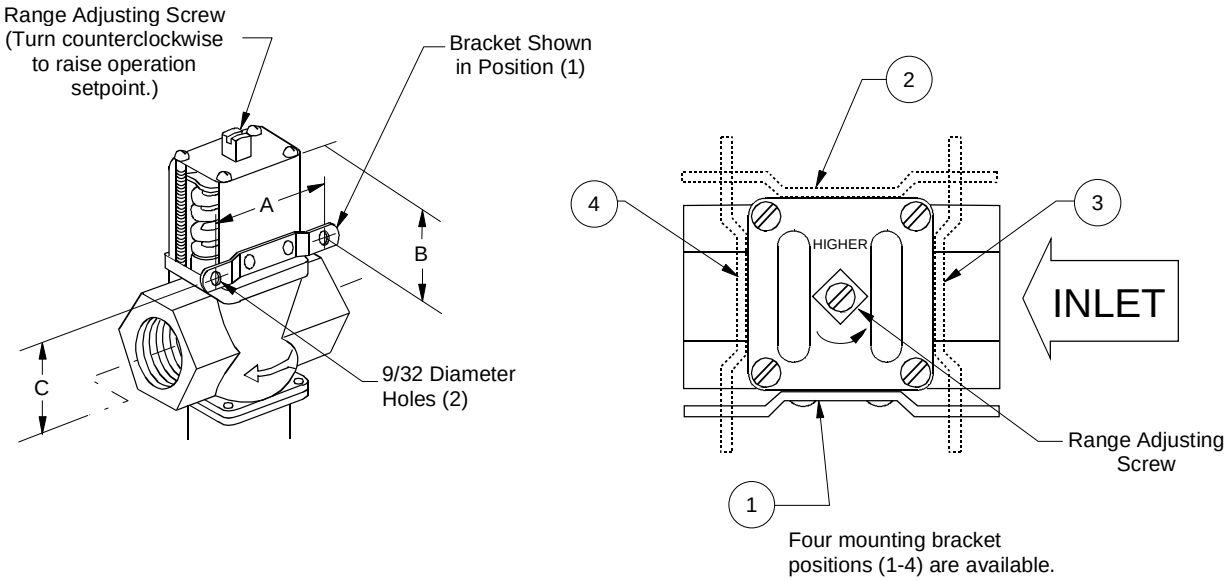
Capillary Tubing Length

Standard length is 30 in. on valves 1-1/2 in. and smaller. Optional 48 in. (1219 mm) capillary can be furnished at additional cost, when specified.

Mounting Bracket

A mounting bracket as illustrated in Figure 8, is available on 3/8 in. and 1/2 in. valves only when specified. Desired bracket position must also be specified.

Other styles of brackets on 3/8 in. and 1/2 in. valves available on quantity orders. For more information, contact Application Engineering at (414) 274-5535.



Dimensions: in. (mm)			
Valve Size	**A**	**B**	**C**
3/8	2 (51)	1.25 (32)	1.38 (35)
1/2	2 (52)	1.85 (47)	1.52 (39)

Figure 8: Mounting Bracket for 3/8 in. and 1/2 in. Valves

Table 9: Direct-Acting Commercial Type - Non-corrosive Refrigerants

Product	Size (in.)	Inlet and Outlet	Service	Element Style	Shipping Weight lb (kg)	Seat Repair Kit	Replacement Power Element
V46AA-1	3/8 NPT	Threaded	All Range	45	2.3 (1.0)	STT14A-600R	SEP91A-600R and SEC37A-601R*
V46DA-2	3/8 NPT	Threaded	Extended All Range**	45	2.3 (1.0)	STT14A-603R	SEP91A-600R and SEC37A-601R*
V46AB-1	1/2 NPT	Threaded	All Range	45	3.3 (1.5)	STT15A-602R	SEP91A-602R and SEC37A-602R*
V46AC-1	3/4 NPT	Threaded	All Range	45	4.3 (2.0)	STT16A-601R	SEP91A-601R and SEC37A-602R*
V46AD-1	1 NPT	Threaded	All Range	45	9.3 (4.0)	STT17A-609R	SEP91A-603R and SEC37A-600R*
V46AE-1	1-1/4 NPT	Threaded	All Range	45	10.0 (4.5)	STT17A-610R	SEP91A-603R and SEC37A-600R*
V46AR-1	1-1/2 NPT	4 Hole ASME Flange	All Range	45	13.1 (6.0)	STT17A-610R	SEP91A-603R and SEC37A-600R*
V46AS-1	2	4 Hole ASME Flange	Low Range	5	25.5 (11.6)	STT18A-600R	SEP81A-602R†
V46AS-2	2	4 Hole ASME Flange	High Range	5	25.5 (11.6)	STT18A-600R	SEP81A-601R
V46AT-1	2-1/2	4 Hole ASME Flange	Low Range	5	29.5 (11.6)	STT18A-601R	SEP81A-602R†
V46AT-2	2-1/2	4 Hole ASME Flange	High Range	5	29.5 (11.6)	STT18A-601R	SEP81A-601R

† Non-stock item, built to order.

* Replacement element supplied with 1/4 in. SAE connector. Order SEC37A capillary kit with flare nuts separately, if needed. Use only on valves specified.

** Maximum opening point of 70 to 300 psi (483 to 2068 kPa), maximum permissible refrigerant pressure of 440 psi (3034 kPa).

Table 10: Commercial Type - Ammonia

Product	Size (in.)	Inlet and Outlet	Service	Element Style	Shipping Weight lb (kg)	Seat Repair Kit	Replacement Power Element
V46AB-11†	1/2 NPT	Threaded	Ammonia	15	3.2 (1.5)	STT15A-602R	SEP70A-603R†
V46AC-8†	3/4 NPT	Threaded	Ammonia	15	4.2 (1.9)	STT16A-601R	SEP70A-601R
V46AD-4†	1 NPT	Threaded	Ammonia	15	7.7 (3.5)	STT17A-609R	SEP70A-604R
V46AE-4†	1-1/4 NPT	Threaded	Ammonia	15	9.2 (4.2)	STT17A-610R	SEP70A-604R
V46AR-2†	1-1/2	4 Hole ASME Flange	Ammonia	15	12.3 (5.6)	STT17A-610R	SEP70A-604R
V46AS-3	2	4 Hole ASME Flange	Ammonia	15	25.5 (11.6)	STT18A-600R	SEP70A-605R†
V46AT-3	2-1/2	4 Hole ASME Flange	Ammonia	15	29.5 (11.6)	STT18A-601R	SEP70A-605R†

† Non-stock item, built to order.

Table 11: Reverse Acting Commercial Type - Non-corrosive Refrigerants

Product	Size (in.)	Inlet and Outlet	Service	Element Style	Shipping Weight lb (kg)	Seat Repair Kit	Replacement Power Element
V46NA-1†	3/8 NPT	Threaded	All Range	45	2.3 (1.0)	STT14A-600R	SEP91A-600R and SEC37A-601R*
V46NB-1†	1/2 NPT	Threaded	All Range	45	3.6 (1.6)	STT15A-602R	SEP91A-602R and SEC37A-602R*
V46NB-2	1/2 NPT	Threaded	Low Range	45	3.6 (1.6)	STT15A-602R	SEP91A-602R and SEC37A-602R*
V46NC-1†	3/4 NPT	Threaded	All Range	45	4.5 (2.0)	STT16A-601R	SEP91A-601R and SEC37A-602R*
V46NC-2	3/4 NPT	Threaded	Low Range	45	4.5 (2.0)	STT16A-601R	SEP91A-601R and SEC37A-602R*
V46ND-1†	1 NPT	Threaded	All Range	45	7.5 (3.4)	STT17A-609R	SEP91A-603R and SEC37A-600R*
V46ND-2	1 NPT	Threaded	Low Range	45	7.5 (3.4)	STT17A-609R	SEP91A-603R and SEC37A-600R*
V46NE-1†	1-1/4 NPT	Threaded	All Range	45	8.8 (4.0)	STT17A-610R	SEP91A-603R and SEC37A-600R*
V46NE-2†	1-1/4 NPT	Threaded	Low Range	45	8.8 (4.0)	STT17A-610R	SEP91A-603R and SEC37A-600R*

† Non-stock item, built to order.

* Maximum bellows pressure is 320 psig (2206 kPa). Replacement element supplied with 1/4 in. SAE connector. Order SEC37A capillary kit with flare nuts separately, if needed. Use only on valves specified.

Table 12: Maritime Type - Non-corrosive Refrigerants

Product	Size (in.)	Inlet and Outlet	Service	Element Style	Shipping Weight lb (kg)	Seat Repair Kit	Replacement Power Element
V46BA-2†	3/8 NPT	Threaded	All Range	34	2.3 (1.0)	STT14A-610R	SEP13A-602R
V46BB-2†	1/2 NPT	Threaded	All Range	34	3.3 (1.5)	STT15A-603R†	SEP13A-600R†
V46BC-2	3/4 NPT	Threaded	All Range	34	4.3 (2.0)	STT17A-613R	SEP13A-603R
V46BD-2	1 NPT	Threaded	All Range	34	9.5 (4.3)	STT17A-611R†	SEP50A-600R
V46BE-2	1-1/4 NPT	Threaded	All Range	34	10.3 (4.7)	STT17A-612R	SEP50A-600R
V46BS-4	2	4 Hole ASME Flange	High Range	34	25.5 (11.6)	STT18A-602R	SEP50A-601R†
V46BT-4†	2-1/2	4 Hole ASME Flange	High Range	34	29.5 (13.4)	STT18A-602R	SEP50A-601R†

† Non-stock item, built to order.

Table 13: Navy Type - Non-corrosive Refrigerants

Product	Size (in.)	Inlet and Outlet	Service	Element Style	Shipping Weight lb (kg)	Seat Repair Kit	Replacement Power Element
V46CJ-2†	1/2	Sweat Connector	All Range	34	3.6 (1.6)	STT15A-603R†	SEP13A-600R†
V46CN-2†	3/4	4 Hole Navy Flange	All Range	34	7.1 (3.2)	STT17A-613R	SEP13A-603R
V46CP-2†	1	4 Hole Navy Flange	All Range	34	12.0 (5.4)	STT17A-611R†	SEP50A-600R
V46CQ-2†	1-1/4	4 Hole Navy Flange	All Range	34	10.3 (4.7)	STT17A-612R	SEP50A-600R
V46BR-2†	1-1/2	4 Hole ASME Flange	All Range	34	13.5 (6.1)	STT17A-612R	SEP50A-600R
V46CR-2†	1-1/2	4 Hole Navy Flange	All Range	34	13.8 (6.3)	STT17A-612R	SEP50A-600R
V46BS-3†	2	4 Hole ASME Flange	Low Range	34	25.5 (11.6)	STT18A-602R	SEP50A-601R†
V46CS-3†	2	4 Hole Navy Flange	Low Range	34	24.4 (11.1)	STT18A-602R	SEP50A-601R†
V46CS-4†	2	4 Hole Navy Flange	Low Range	34	24.4 (11.1)	STT18A-602R	SEP50A-601R†
V46BT-3†	2-1/2	4 Hole ASME Flange	Low Range	34	29.5 (13.4)	STT18A-602R	SEP50A-601R†
V46CT-3†	2-1/2	4 Hole Navy Flange	Low Range	34	25.5 (11.6)	STT18A-602R	SEP50A-601R†
V46CT-4†	2-1/2	4 Hole Navy Flange	High Range	34	25.5 (11.6)	STT18A-602R	SEP50A-601R†

† Non-stock item, built to order.

Table 14: Pressure Range Specifications

Refrigerant	Maximum Opening Point psig (kPa)*	Modulation Start Point psig (kPa)*	Maximum Permissible Pressure psig (kPa)	
	V46A, B, C, D	V46N	Water	Refrigerant
All Range R12, R22, R134a, R502, R404a, R507	70 to 260 (483 to 1793)	90 to 280 (621 to 1931) 40 to 100 (276 to 690)**	150 (1034)	320 (2206)
All Range with High Overpressure	70 to 260 (483 to 1793)	_____	150 (1034)	370 (2551)
3/8 in. Extended All Range	70 to 300 (483 to 2068)	_____	150 (1034)	440 (3034)
2 and 2-1/2 in. Low Range R12, R134a	70 to 170 (483 to 1172)	100 to 200 (690 to 1379)	150 (1034)	230 (1586)
2 and 2-1/2 in. High Range R22, R502, R404a, R507	160 to 260 (1103 to 1793)	180 to 280 (1241 to 1931)	150 (1034)	320 (2206)
Ammonia R717	100 to 200 (690 to 1379)	130 to 230 (896 to 1586)	150 (1034)	320 (2206)

* V46A, B, C direct acting valve ranges indicate the valve opening point, V46N reverse acting valve ranges indicates the modulation start point.

** For heat pump applications (3/8 in. through 1-1/2 in. sizes only).

Notes

Specifications

Product	V46 Series Pressure Actuated Valve	
Body Material	**Commercial:**	3/8, 1/2, or 3/4 in. Sizes Have Cast Brass Bodies, Other Commercial Types Have Cast Iron Bodies with Rust Resisting Finish
	Navy and Maritime:	Cast Naval Bronze
Extension Sleeve, Disc,	**Commercial:**	Brass; Monel is Available at Additional Cost
Stud, Disc Holder Material	**Navy and Maritime:**	Monel
Valve Seat Material	**Commercial:**	Aluminum Bronze; Monel is Available at Additional Cost
	Navy and Maritime:	Monel
Valve Disc	Buna-N	
Diaphragm	Nylon Reinforced Buna-N	
Water Supply Pressure	150 psig (1034 kPa) Maximum	
Water Supply Temperature	170°F (77°C) Maximum	
Sensing Element	**Non-corrosive Refrigerants:**	Brass and Phosphor Bronze Bellows in Brass Cup
	Navy and Maritime:	Monel Bellows in Brass Cup
	2 and 2-1/2 in. High Range Service:	Monel Bellows in Brass Cup
	Ammonia Service:	Stainless Steel Bellows in Brass Cup
Pressure Range	See *Table 14: Pressure Range Specifications.*	
Shipping Weight	See Tables 9-13.	

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

JOHNSON CONTROLS

Controls Group
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

Printed in U.S.A.

Appendix I Johnson's Control Antifreeze Thermostat

(Page Left Blank Intentionally)

Series 270XT
Freeze Protection Thermostats

Introduction

These controls are designed for protection against freeze-up of hydronic heating coils, cooling coils and similar application.

Description

Sensing element is 3 or 6 meters long to permit attaching across the surface of a coil to guard against freezing at any point. When any 30 cm or more of this element senses a temperature as low as the control setpoint, it will "switch off".

A special version is available with bulb and 2 m capillary, range -24/+18°C for clamp-on or immersion purposes.

SPDT change over contacts permit the use of an alarm signal.

Note

These controls are designed for use only as operating controls. Where an operating control failure would result in personal injury or loss of property it is the responsibility of the installer to add devices or systems that protect against, or warn of, control failure.

270XT-95008
(with 6 m 'wrap-around' capillary)

Feature and Benefits	
❑ **Dust tight Pennswitch**	Prevent pollution of the contacts by electrostatic influences
❑ **SPDT contacts**	Change-over contacts permits the use of an alarm signal
❑ **270XTAN provided with trip-free manual reset**	Safety lock-out, override is not possible in the control function
❑ **Controls have adjustable range**	Suitable for several applications

Mounting

The control can be wall mounted either by using two screws through the holes in the back of the case or using the standard mounting bracket. The control must be mounted in that position where the sensing element is downside the control.

Note

The control should be installed where the ambient temperature surrounding the case and bellows is always higher than the control setting. If the ambient temperature around the enclosure drops below the control setting the bellows rather than the sensing element will operate the control.

Adjustment

The controls have a field adjustable setting and a fixed differential. A low limit stop, factory setting at 3 °C can be supplied at additional cost for quantity orders only.

Contact functions

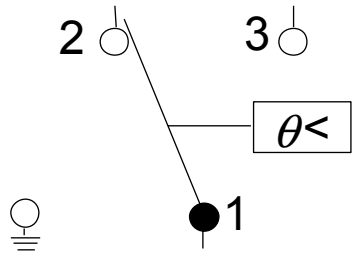


Fig. 1
1-2 open on temperature decrease

Repair and replacement

Repair is not possible. In case of an improperly functioning control, please check with your nearest supplier. When contacting the supplier for a replacement you should state the type/model number of the control. This number can be found on the data plate or cover label.

Type number selection table

Range °C	Diff. °C	Bulb and capillary	Bulb well no (not incl.)	Sensing element	Max. bulb temp. °C	Order number
-10 to +12	3 fixed	3 m cap. style 9**	-	3.2 mm x 3 m	200	**270XT-95078**
-10 to +12	manual reset	3 m cap. style 9**	-	3.2 mm x 3 m	200	**270XTAN-95088**
-10 to +12	3 fixed	6 m cap. style 9**	-	3.2 mm x 6 m	200	**270XT-95008**
-10 to +12	manual reset	6 m cap. style 9**	-	3.2 mm x 6 m	200	**270XTAN-95008**
-24 to +18	4 fixed	2 m cap. style 1*	WEL14A602R	9.5 x 77 mm bulb and 2 m cap.	120	**270XT-95068**
-24 to +18	manual reset	2 m cap. style 1*	WEL14A602R	9.5 x 77 mm bulb and 2 m cap.	120	**270XTAN-95048**

** With 7.5 cm bulb support to apply packing nut FTG13A-600 for direct immersion applications.*
*** With 6 m "wrap-around" capillary, when any 30 cm or more of this element senses a temperature as low as the cut-out point, the contact will open.*

Optional accessories (for 270XT and 270XTAN, with "wrap-around" cap.

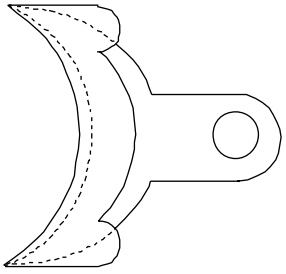


Fig. 2
Bracket:
Order number **KIT012N600** (6 pcs)

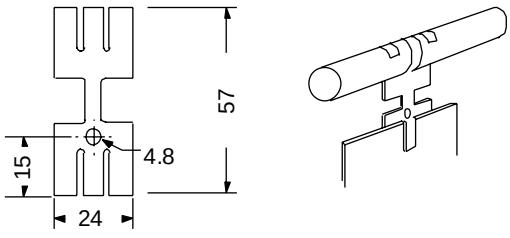
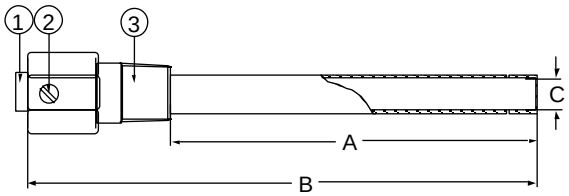


Fig. 3
Mounting clip:
Order number **T-275-101**

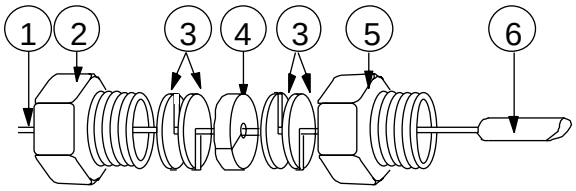
Optional accessories (for 270XT and 270XTAN with 2 m capillary and bulb)



Order no.	DIM.'A'	DIM.'B'	DIM. 'C' Internal
WEL14A602R	125 mm	171 mm	10mm

Fig. 4
Bulb well

1. Bushing
2. Set screw
3. Adapter, 1/2 "- 14 NPT



1. Style 1b bulb support tube
2. Packing nut
3. Washer
4. Packing
5. Adapter, 1/2 "- 14 NPT
6. Bulb

Fig. 5
Closed-tank-connector
Order number **FTG13A-600R**

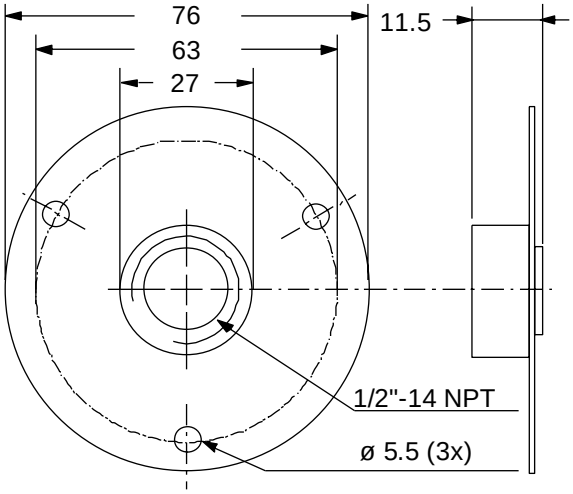


Fig. 6
Duct flange
Order number **T-752-1001**

Dimensions (mm)

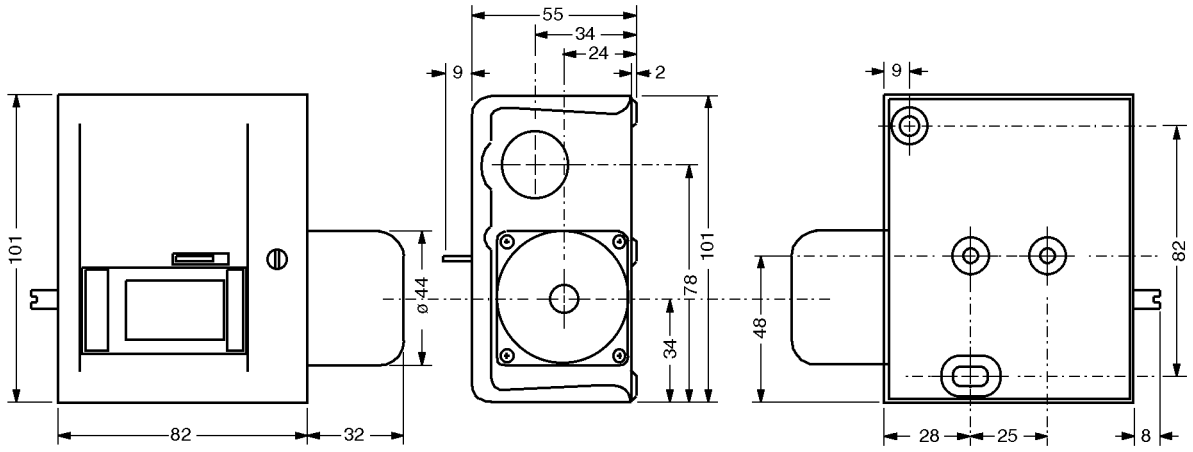


Fig. 7

Specifications

Product type	**270XT / 270XTAN**		
Operating range	-24 to + 18 °C (refer to type number selection table)		
Differential	fixed (refer to type number selection table)		
Range adjustment	Screwdriver, external scale		
Electrical rating	~15(8)A, 230V		
Contact function	SPDT		
CE Conformity	According to low voltage directive and EMC directive		
Max. ambient temperature	55 °C **Note:** The operating ambient temperature of the control should always be higher than the sensing element temperature		
Material	**Case**	Cold-rolled zinc plated steel	
	Cover	blue coloured cold-rolled steel	
Enclosure (protection class)	IP30		
Dimensions (HxWxD)	82 x 101 x 53 mm (excl. bellows)		
Shipping weight	Individual pack standard		
Ind. pack	**270XT-95078/270XTAN-95088**	1.00 Kg	
	270XT-95008/270XTAN-95008	1.15 Kg	
	270XT-95068/270XTAN-95048	0.9 Kg	
Overpack	**270XT-95078/270XTAN-95088**	13	Kg (13 pcs.)
	270XT-95008/270XTAN-95008	15	Kg (13 pcs.)
	270XT-95068/270XTAN-95048	12	Kg (13 pcs.)

The performance specifications are nominal and conform to acceptable industry standards. For applications at conditions beyond these specifications, consult the local Johnson Controls office or representative. Johnson Controls shall not be liable for damages resulting from misapplication or misuse of its products.

JOHNSON CONTROLS

Johnson Controls International, Inc.

Headquarters: Milwaukee, Wisconsin, USA
European Customer Service Center: Westendhof 3, D-45143 Essen, Germany
European Factories: Essen (Germany), Leeuwarden (The Netherlands) and Lomagna (Italy)
Branch Offices: Principal European Cities.
This document is subject to change

Printed in Europe

Appendix J Danfoss LP and HP Compressor Control

(Page Left Blank Intentionally)

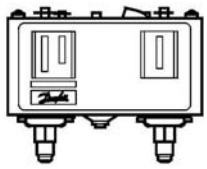
Instructions

060R9753

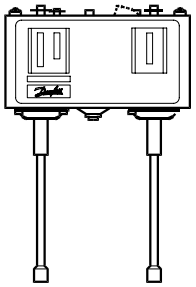
060R9753

Pressure Controls
KP 15, KP 15A, KP 17W, KP 17B, KP 17WB

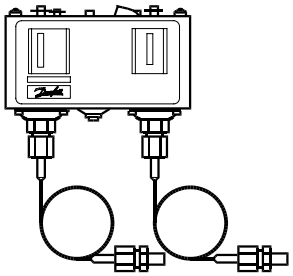
KP 15, 17W, 17B, 17WB: CFC, HFC, HCFC
KP15A: R717(NH_3)



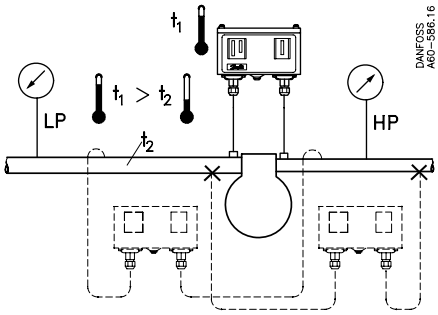
KP 15, 17



KP 15, 17

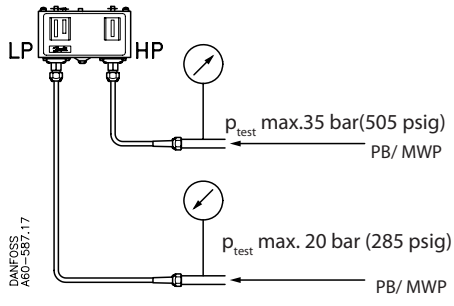


KP 15A

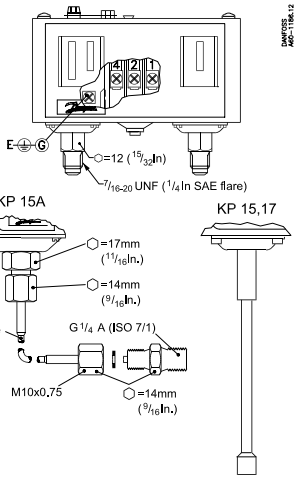


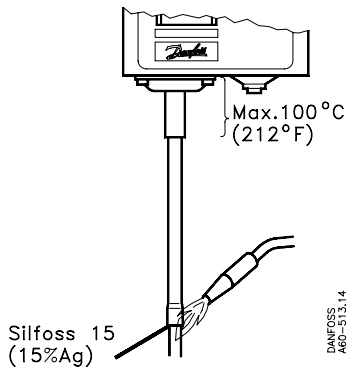
Relative humidity RH:
30 to 98%
Vibration resistance:
4g (10-1000 Hz)

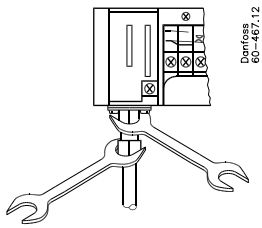
t_1 min. KP 15: –40°C (–40°F)
KP 17: –25°C (–13°F)
t_1 max. 65°C (150°F)

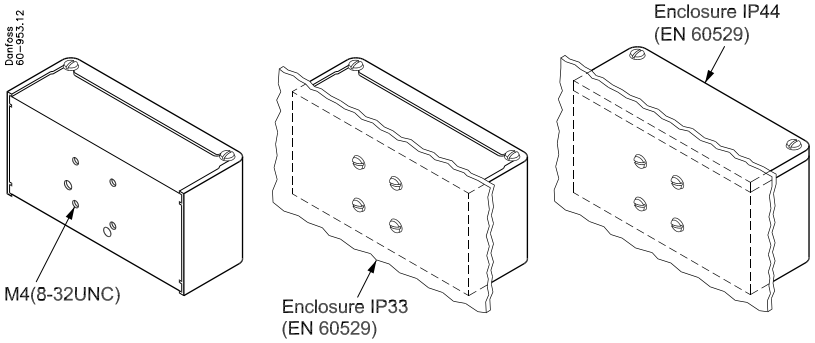


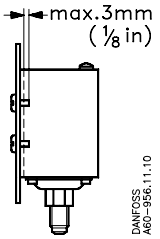
Type	Range	Max working pressure PB/MWP	
KP 15	LP: -0.2 → 7.5 bar HP: 8 → 32 bar	17 bar 35 bar	250 psi 505 psi
KP 15 LP man. reset	LP: -0.9 → 7 bar HP: 8 → 32 bar	17 bar 35 bar	250 psi 505 psi
KP 17	LP: -0.2 → 7.5 bar HP: 8 → 32 bar	17 bar 35 bar	250 psi 505 psi

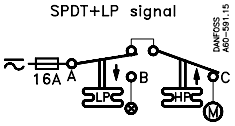


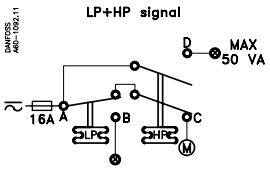












LP side: A-C opens on pressure drop
HP side: A-C opens on pressure rise

Electrical rating - General

LR 112A	AC1 16 A AC3 16 A AC15 10 A	400 V~	DC 13 12 W 220 V~

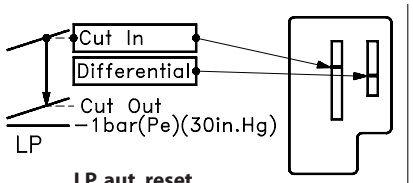
Short circuit protection:
Fuse 16 Amp

When used acc. to UL regulations

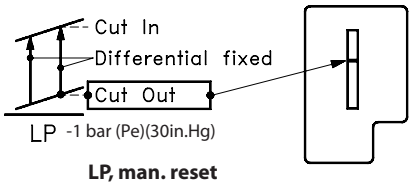
Listed refrigeration controller 61B5

Contacts	Voltage AC	Voltage DC	FL A	LR A	Resist. load	Pilot duty
A-B A-C	240		8	48	8A	3A
	120		16	96	16A	
		240				12 W
A-D	240					50 VA

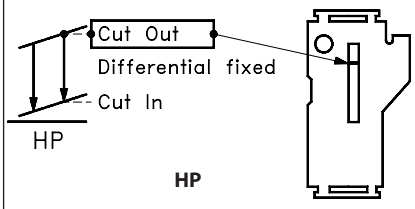
Use copper wire only
Tightening torque 20 lb. in.



LP, aut. reset

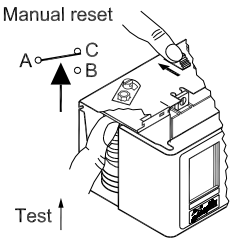


LP, man. reset

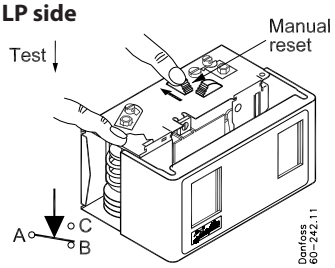


HP

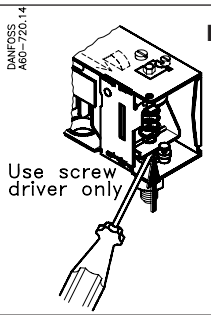
Manual test



LP side

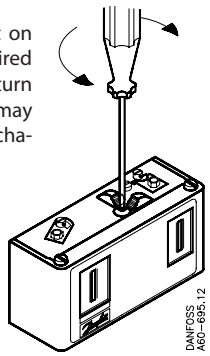


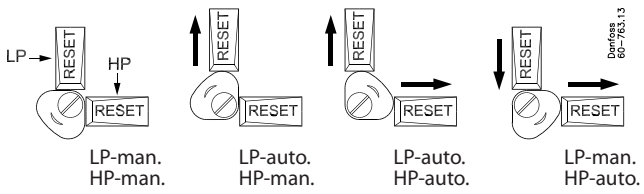
HP side



Convertible reset
KP15: LP/HP convertible, KP17WB: HP convertible

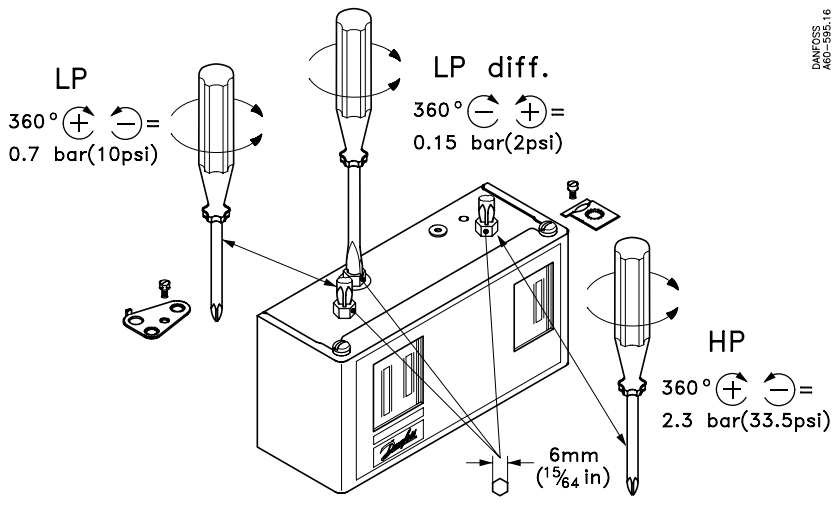
Insert a screwdriver into the slot on the lock disc and turn it to desired reset configuration. Do not turn the screw on the lock disc as it may damage the convertible reset mechanism.





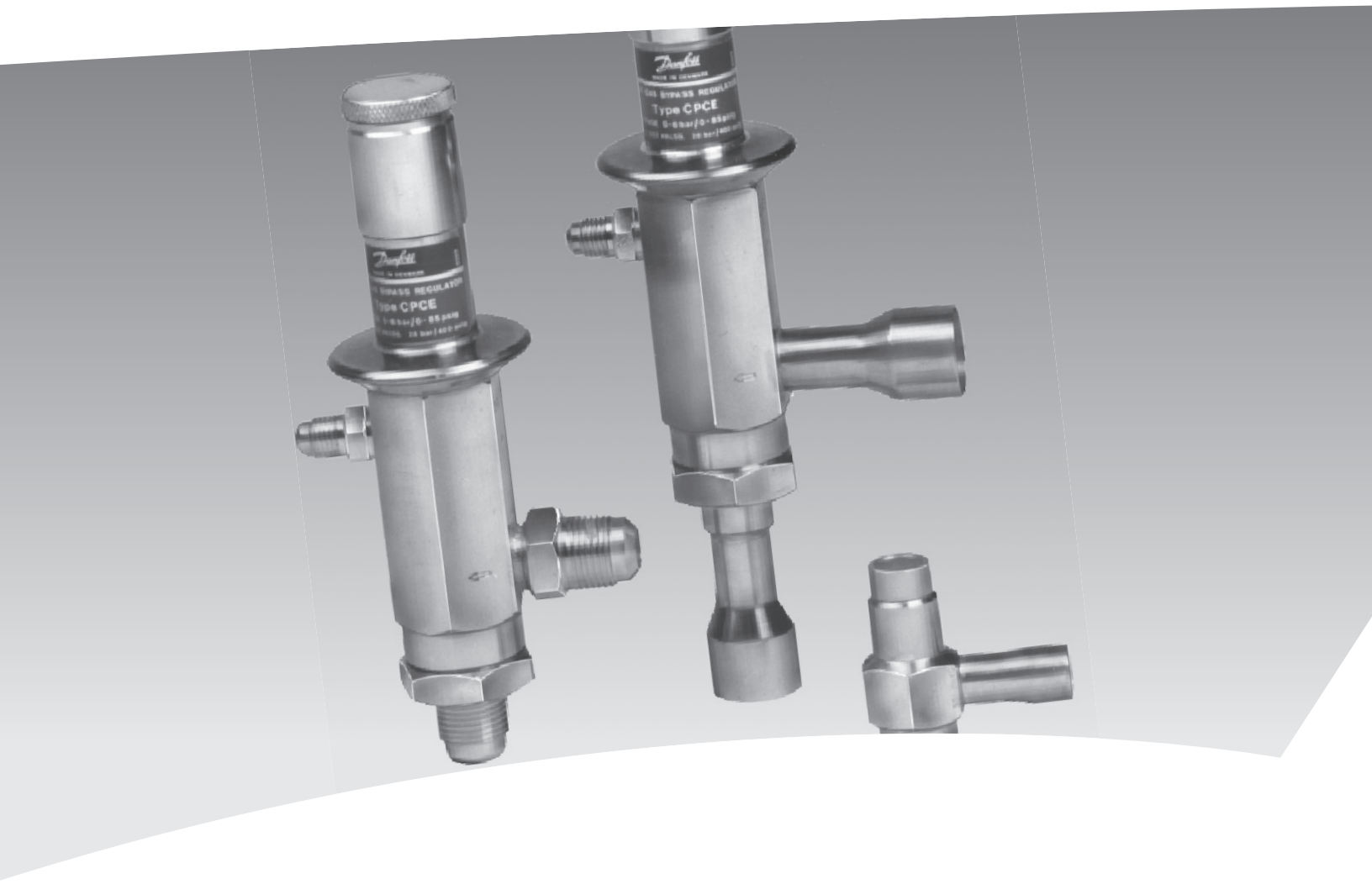
LP-man. HP-man. | LP-auto. HP-man. | LP-auto. HP-auto. | LP-man. HP-auto.

Note: Do not select automatic reset if safety of the system requires manual reset.
Note: Selected reset configuration may be protected against unauthorized actions applying a seal.



Appendix K Capacity Regulator

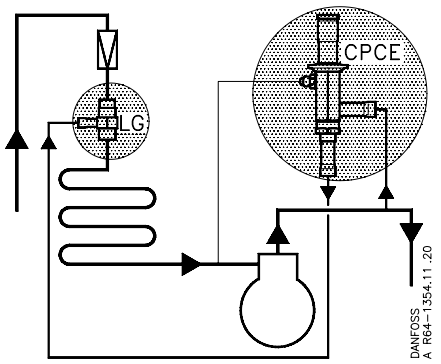
(Page Left Blank Intentionally)



Capacity regulators, type CPCE and LG

REFRIGERATION AND
AIR CONDITIONING

Technical leaflet



Introduction

CPCE capacity regulator are used to adapt compressor capacity to actual evaporator load. It is installed in a bypass line between the high and low pressure sides of the refrigeration system and is designed for hot gas injection into the evaporator just after the expansion valve. Liquid-gas mixer type LG can be used at the point of injection to assure a proper mixture.

Features

CPCE Hot gas capacity valve

- Superior control accuracy
- Provides protection against too low an evaporator temperature
- Direct connection to system suction line
- For use with CFC, HCFC and HFC refrigerants

LG Liquid gas mixer

- LG provides homogenous mixture of liquid and hot gas refrigerant in the evaporator
- Can be used for hot gas defrosting or reverse cycle systems

Approvals

UL listed, file SA7200

CSA approved

Technical data

Refrigerants
CFC, HCFC, HFC

Regulation range
p_e = 0 to 85 psig
Factory setting = 5.8 psig

Maximum working pressure
MWP = 400 psig

Maximum differential pressure
Δp = 260 psig

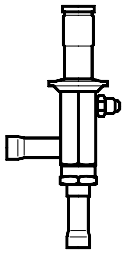
Maximum test pressure
p' = 450 psig

Maximum media temperature
285°F

Minimum media temperature
–50°F

Metric conversions
1 psi = 0.07 bar
$^5/_9$ (t_1°F – 32) = t_2°C

Ordering



Capacity regulator

Type	Connection				Rated capacity[1) tons				Code no.
	Flare		Solder - ODF		R22	R134a	R404A/R507	R407C	
	in.	mm	in.	mm					
CPCE 12	1/2	12			6.2	4.3	6.3	6.7	**034N0081**
CPCE 12			1/2	12	6.2	4.3	6.3	6.7	**034N0082**
CPCE 15			5/8	16	9.2	6.3	9.1	9.9	**034N0083**
CPCE 22			7/8	22	12.2	8.4	12.1	13.2	**034N0084**

1) Rated capacity is based on:
Minimum suction temperature t_s = 15°F
Condensing temperature t_c = 100°F
Superheat of expansion valve Δt_s = 7°F

Liquid - gas mixer

Type	Connection						Code no.
	For expansion valve ODM		For hot gas ODF		For liquid distributor ODF		
	in.	mm	in.	mm	in.	mm	
LG 12-16	5/8	16	1/2	12	5/8	16	**069G4001**
LG 12-22	7/8	22	1/2	12	7/8	22	**069G4002**
LG 16-28	1 1/8	28	5/8	16	1 1/8	28	**069G4003**
LG 22-35	1 3/8	35	7/8	22	1 3/8	35	**069G4004**

Sizing

For optimum performance, it is important to select a CPCE valve according to system conditions and application.
The following data must be used when sizing a CPCE valve:

- Refrigerant: CFC, HCFC or HFC
- Minimum suction temperature t_s in °F
- Compressor capacity at minimum suction temperature Q_1 in tons
- Evaporator load at minimum suction temperature Q_2 in tons
- Superheat setting of expansion valve in °F
- Condensing temperature t_c in °F
- Connection type flare or solder

Selection

Example

When selecting the appropriate valve it may be necessary to convert the actual capacity using a corrections factors. This is required when your system conditions are different than the table conditions.
The following examples illustrate how this is done.

Refrigerant: R404A
Minimum suction temperature t_s: –20°F
Compressor capacity at minimum suction temperature Q_1: 22.5 tons
Evaporator load at minimum suction temperature Q_2: 17 tons
Superheat setting of expansion valve: 9°F
Condensing temperature t_c: 90°F
Connection type: solder

Step 1

Determine the replacement capacity. This is done by taking the compressor capacity at minimum suction temperature Q_1 minus evaporator load at minimum suction temperature Q_2.
$Q_1 - Q_2 = 22.5 - 17 = 5.5$ tons.

Metric conversions
1 psi = 0.07 bar
$^5/_9 (t_1°F - 32) = t_2°C$
1 ton = 3.5 kW

Selection *(continued)*

Step 2

Determine the corrections factor for the expansion valve superheat setting.

From the correction factors table (see below) a superheat setting of 9°F, R404A corresponds to a factor of 1.3.

Correction factors

Suction temp. t_s after reduction °F	Refrigerant	Superheat of expansion valve Δt_s °F						
+50	R134a	0.1	0.5	0.9	1.0	1.0	1.0	1.0
	R22, R404A, R507, R407C	0.3	0.9	1.0	1.0	1.0	1.0	1.0
+30	R134a	0.1	0.3	0.7	1.0	1.0	1.0	1.0
	R22, R404A, R507, R407C	0.2	0.9	1.0	1.0	1.0	1.0	1.0
+15	R134a	0.1	0.3	0.6	1.0	1.3	1.4	1.4
	R22, R404A, R507, R407C	0.1	0.5	1.0	1.0	1.0	1.0	1.0
–5	R134a	0.1	0.3	0.6	1.0	1.5	2.2	2.4
	R22, R404A, R507, R407C	0.1	0.3	0.7	1.0	1.0	1.0	1.0
–20	R134a	0.1	0.3	0.6	1.0	1.5	2.2	2.9
	R22, R404A, R507, R407C	0.1	0.3	0.6	1.0	1.3	1.4	1.4
–40	R22, R404A, R507, R407C	0.1	0.3	0.6	1.0	1.5	2.0	2.2

Step 3

Corrected replacement capacity is
Q = 1.3 x 5.5 = 7.2 tons

Step 4

Now select the appropriate capacity table and choose the column for minimum suction temperature t_s and the column for condensing temperature t_c.
Using the corrected replacement capacity, select a valve that provides an equivalent or greater capacity.

A CPCE 22 delivers a replacement capacity of 8.0 ton at a minimum suction temperature of –20°F and a condensing temperature of 90°F.

Step 5

CPCE 22, $^7/_8$ in. solder connection,
code no. 034N0084.

Metric conversions
1 psi = 0.07 bar
$^5/_9$ (t_1°F – 32) = t_2°C
1 ton = 3.5 kW

Capacity

Type	Minumum suction temperature t_s after pressure/temperature reduction °F	Regulator capacity Q tons at condensing temperature t_c °F				
		70	90	100	120	140
R22						
CPCE 12	+50	2.2	4.6	6.1	7.6	9.5
	+30	3.7	4.9	6.2	7.7	
	+15	3.9	4.9	6.2	7.8	
	–5	3.9	5.0	6.3	7.9	
	–20	2.3	3.1	4.2	5.3	
	–40	1.2	1.6	2.2		
CPCE 15	+50	3.3	6.8	9.0	11.2	13.9
	+30	5.3	7.2	9.1	11.3	
	+15	5.7	7.3	9.2	11.4	
	–5	5.7	7.3	9.3	11.6	
	–20	3.3	4.5	6.0	7.7	
	–40	1.7	2.2	3.0		
CPCE 22	+50	4.3	9.0	11.9	14.9	18.4
	+30	7.1	9.5	12.0	15.0	
	+15	7.5	9.7	12.2	15.2	
	–5	7.6	9.7	12.2	15.3	
	–20	4.4	6.0	8.0	10.2	
	–40	2.3	3.0	4.1		
R134a						
CPCE 12	+50	0.9	4.2	5.8	7.2	9.1
	+30	3.1	4.5	5.8	7.3	9.1
	+15	2.3	3.2	4.3	5.8	7.3
	–5	1.4	1.8	2.5	3.3	4.2
	–20	0.9	1.1	1.5	2.0	2.5
CPCE 15	+50	0.9	6.1	8.5	10.7	13.4
	+30	4.6	6.7	8.5	10.7	13.4
	+15	3.3	4.7	6.3	8.5	10.7
	–5	1.9	2.7	3.5	4.8	6.1
	–20	1.1	1.4	2.0	2.6	3.2
CPCE 22	+50	1.3	8.2	11.2	14.1	17.7
	+30	6.1	8.9	11.3	14.1	17.7
	+15	4.4	6.1	8.4	11.2	14.1
	–5	2.6	3.5	4.7	6.3	8.2
	–20	1.5	2.0	2.8	3.6	4.5
R404A/R507						
CPCE 12	+50	2.2	4.6	6.2	7.7	9.6
	+30	3.6	5.0	6.2	7.7	
	+15	3.9	5.0	6.3	7.7	
	–5	4.0	5.0	6.3		
	–20	3.1	4.2	5.4		
	–40	1.7	2.2	2.9		
CPCE 15	+50	3.3	6.8	9.1	11.3	14.1
	+30	5.4	7.3	9.1	11.3	
	+15	5.7	7.3	9.1	11.3	
	–5	5.7	7.3	9.1		
	–20	4.5	6.1	7.9		
	–40	2.4	3.2	4.1		
CPCE 22	+50	4.4	9.0	12.1	15.0	18.7
	+30	7.2	9.6	12.1	15.0	
	+15	7.6	9.6	12.1	15.1	
	–5	7.6	9.8	12.1		
	–20	5.9	8.0	10.5		
	–40	3.2	4.3	5.4		

The capacities are based on:
Liquid temperature ahead of expansion valve t_l = 100°F

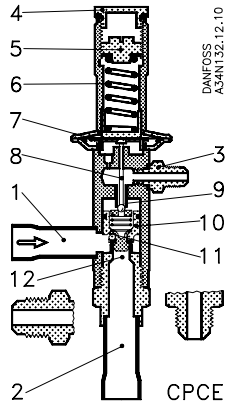
Metric conversions
1 psi = 0.07 bar
$^5/_9$ (t_1°F – 32) = t_2°C
1 ton = 3.5 kW

Capacity *(continued)*

Type	Minimum suction temperature t_s after pressure/temperature reduction °F	Regulator capacity Q tons at condensing temperature t_c °F				
		70	90	100	120	140
						R407C
CPCE 12	+50	2.4	5.0	6.6	8.2	10.3
	+30	4.0	5.3	6.7	8.3	
	+15	4.2	5.3	6.7	8.4	
	–5	4.2	5.4	6.8	8.5	
	–20	2.5	3.3	4.5	5.7	
	–40	1.3	1.7	2.4		
CPCE 15	+50	3.6	7.3	9.7	12.1	15.0
	+30	5.7	7.8	9.8	12.2	
	+15	6.2	7.9	9.9	12.3	
	–5	6.2	7.9	10.0	12.5	
	–20	3.6	4.9	6.5	8.3	
	–40	1.8	2.4	3.2		
CPCE 22	+50	4.6	9.7	12.9	16.1	19.9
	+30	7.7	10.3	13.0	16.2	
	+15	8.1	10.5	13.2	16.4	
	–5	8.2	10.5	13.2	16.5	
	–20	4.8	6.5	8.6	11.0	
	–40	2.5	3.2	4.4		

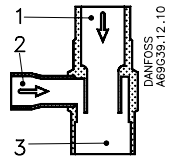
The capacities are based on:
Liquid temperature ahead of expansion valve t_l = 100°F

Design and Function



CPCE

1. Inlet
2. Outlet
3. Pilot pressure connection
4. Protective cap
5. Setting screw
6. Main spring
7. Diaphragm
8. Pressure pin
9. Pilot orifice
10. Servo piston
11. Pressure equalizing hole
12. Main orifice



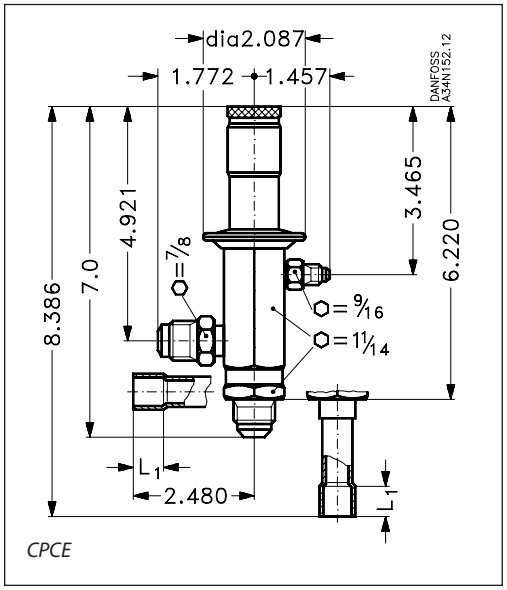
LG

1. Liquid inlet
2. Hot gas inlet
3. Outlet

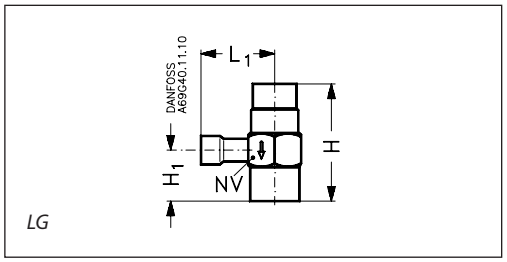
Capacity regulator type CPCE is a servo-operated valve. The diaphragm (7) is acted on by two forces: The spring force (6) and the force created from the pilot pressure (3) (suction pressure). When the pilot pressure falls below the valves setting, the throttling ball (6) is forced away from the pilot orifice (9) by the spring pressure transfered through the pressure pin (8).
The pressure over the servo piston (10) is then relieved through the pilot connection allowing the differential pressure across the inlet and outlet to open the valve allowing the flow of hot gas into the evaporator.
When the pilot pressure (suction pressure) rises above the valves setting, the throttling ball seals off the piston chamber where high pressure begins to build through the equalization hole (11) causing the valve to close.

Metric conversions
1 psi = 0.07 bar
$^5/_9$ (t_1°F – 32) = t_2°C
1 ton = 3.5 kW

Dimensions and weights



CPCE



LG

Type	L_1 in.	Weight lbs
CPCE 12	0.375	2
CPCE 15	0.5	2
CPCE 22	0.669	2

Type	H in.	H_1 in.	L_1 in.	NV in.	Weight lbs
LG 12-16	2.125	0.875	1.563	0.938	0.2
LG 12-22	2.438	1.031	1.688	1.125	0.4
LG 16-28	3.125	1.375	1.875	1.438	0.7
LG 22-35	3.500	1.563	2.625	1.625	0.9

Metric conversions
1 in. = 25.4 mm
1 lb = 0.454 kg

Appendix L Expansion Valve

(Page Left Blank Intentionally)

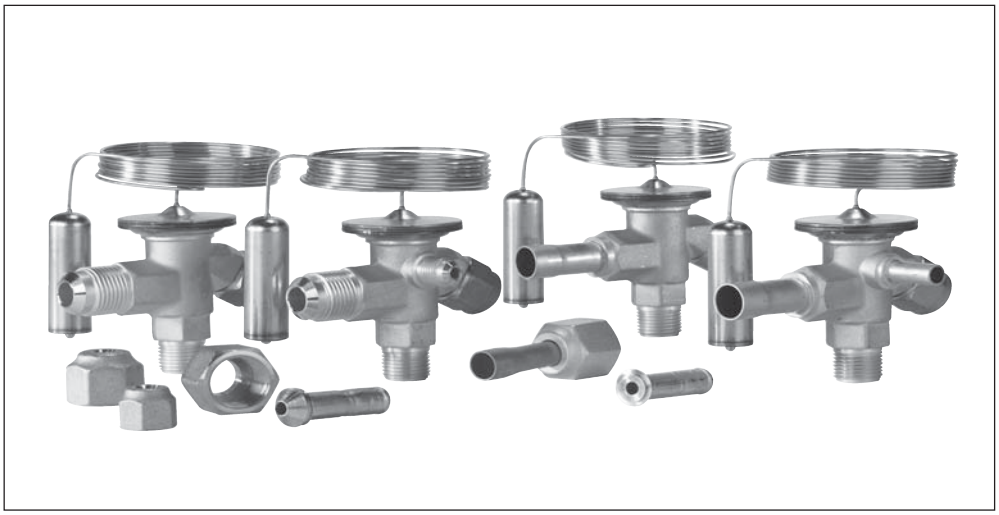
MAKING MODERN LIVING POSSIBLE

Thermostatic expansion valves
T2/ TE2

Technical brochure

Contents **Page**

Introduction



Thermostatic expansion valves regulate the injection of refrigerant liquid into evaporators. Injection is controlled by the refrigerant superheat. Therefore the valves are especially suitable for liquid injection in "dry" evaporators where the superheat at the evaporator outlet is proportional to the evaporator load.

Features

- *Large temperature range*
  Equally applicable to freezing, refrigeration and air conditioning applications.
- *Interchangeable orifice assembly*
  - easier stocking
  - easy capacity matching
  - better service.
- *Rated capacities from 0.5 to 15.5 kW (0.15 to 4.5 TR) for R22.*
- *Can be supplied with MOP*
  (Max. Operating Pressure)
  Protects the compressor motor against excessive evaporating pressure during normal operation.
- *Stainless steel bulb*
  Fast and easy to install.
  Good temperature transfer from pipe to bulb.
- *Valves for special temperature ranges can be supplied.*

Technical data

Max. temperature
Bulb, when valve is installed: 100°C
Bulb, element not mounted: 60°C

Min. temperature
T 2 → TE 2: –60°C

Max. test pressure
PT = 38 bar

Max. working pressure
PS/MWP = 34 bar

MOP-points

Refrigerant	Range N –40°C → +10°C	Range NM –40°C → –5°C	Range NL –40°C → –15°C	Range B –60°C → –25°C
	MOP-point in evaporating temperature t_e and evaporating pressure p_e			
	+15°C / +60°F	0°C / +32°F	–10°C / +15°F	–20°C / –4°F
R22	100 psig/6.9 bar	60 psig/4.0 bar	35 psig/3.5 bar	20 psig/1.5 bar
R407C	95 psig/6.6 bar			
R134a	55 psig/5.0 bar	30 psig/3.1 bar	15 psig/2.1 bar	
R404A/R507	120 psig/9.3 bar	75 psig/6.2 bar	50 psig/4.4 bar	30 psig/3.1 bar

Superheat

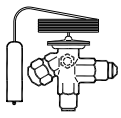
SS = static superheat
OS = opening superheat
SH = SS + OS = total superheat
Q_{nom} = rated capacity
Q_{max} = maximum capacity

Static superheat SS can be adjusted with setting spindle.

The standard superheat setting SS is 5 K for valves without MOP and 4 K for valves with MOP.
The opening superheat OS is 6 K from when opening begins to where the valve gives its rated capacity $Q_{nom.}$

Example
Static superheat SS = 5 K
Opening superheat OS = 6 K
Total superheat SH = 5 + 6 = 11 K

Ordering, components with flare × flare connection



Thermostatic element with sensor band, without orifice, filter cone, nuts

Refrigerant	Valve type	Pressure equalization[1]	Capillary tube	Connection		Code no.					
				Inlet × outlet [1]		Range N –40 to +10°C		Range NM –40 to –5°C	Range NL –40 to –15°C	Range B –60 to –25°C	
			m	in. × in.	mm × mm	Without MOP	With MOP	With MOP	With MOP	Without MOP	With MOP
R22	TX 2	Int.	1.5	3/8 × 1/2	10 × 12	**068Z3206**	**068Z3208**	**068Z3224**	**068Z3226**	**068Z3207**	**068Z3228**
	TEX 2	Ext.	1.5	3/8 × 1/2	10 × 12	**068Z3209**	**068Z3211**	**068Z3225**	**068Z3227**	**068Z3210**	**068Z3229**
R407C	TZ 2	Int.	1.5	3/8 × 1/2	10 × 12	**068Z3496**	**068Z3516**				
	TEZ 2	Ext.	1.5	3/8 × 1/2	10 × 12	**068Z3501**	**068Z3517**				
R134a	TN 2	Int.	1.5	3/8 × 1/2	10 × 12	**068Z3346**	**068Z3347**	**068Z3393**	**068Z3369**		
	TEN 2	Ext.	1.5	3/8 × 1/2	10 × 12	**068Z3348**	**068Z3349**	**068Z3392**	**068Z3370**		
R404A/ R507	TS 2	Int.	1.5	3/8 × 1/2	10 × 12	**068Z3400**	**068Z3402**	**068Z3406**	**068Z3408**	**068Z3401**	**068Z3410**
	TES 2	Ext.	1.5	3/8 × 1/2	10 × 12	**068Z3403**	**068Z3405**	**068Z3407**	**068Z3409**	**068Z3404**	**068Z3411**

[1]) See the section "Flare connections".

Flare connections

Connection for copper tubing with outside diameter		Reducer for copper tubing with outside diameter		**Code no.**
in.	mm	in.	mm	
1/4	6			**011L1101**
3/8	10			**011L1135**
1/2	12			**011L1103**
		1/4	6	**011L1107**

Example

A TE 2 thermostatic expansion valve consists of two elements + flare nuts if required:
- 1 thermostatic element
- 1 orifice assembly and flare nuts

When ordering one thermostatic expansion valve, TEX 2 with orifice 01, five code numbers are required:
- 1-off thermostatic element, **068Z3209**
- 1-off orifice assembly 01, **068-2010**
- 1-off 3/8 in. flare nut, **011L1135**
- 1-off 1/2 in. flare nut, **011L1103**
- 1-off 1/4 in. flare nut, **011L1101**

Orifice assembly with filter

Range N: –40 to +10°C

Orifice no.	Rated capacity in tons (TR)				Rated capacity in kW				**Code no.**[2])
	R22	R407C	R134a	R404A R507	R22	R407C	R134a	R404A R507	
0X	0.15	0.16	0.11	0.11	0.50	0.50	0.40	0.38	**068-2002**
00	0.30	0.30	0.25	0.21	1.0	1.1	0.90	0.70	**068-2003**
01	0.70	0.80	0.50	0.45	2.5	2.7	1.8	1.6	**068-2010**
02	1.0	1.1	0.80	0.60	3.5	3.8	2.6	2.1	**068-2015**
03	1.5	1.6	1.3	1.2	5.2	5.6	4.6	4.2	**068-2006**
04	2.3	2.5	1.9	1.7	8.0	8.6	6.7	6.0	**068-2007**
05	3.0	3.2	2.5	2.2	10.5	11.3	8.6	7.7	**068-2008**
06	4.5	4.9	3.0	2.6	15.5	16.7	10.5	9.1	**068-2009**

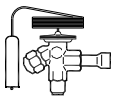
Range B: –60 to –25°C

Orifice no.	Rated capacity in tons (TR)		Rated capacity in kW		**Code no.**[2])
	R22	R404A R507	R22	R404A R507	
0X	0.15	0.11	0.50	0.38	**068-2002**
00	0.20	0.21	0.70	0.70	**068-2003**
01	0.30	0.45	1.0	1.6	**068-2010**
02	0.60	0.60	2.1	2.1	**068-2015**
03	0.80	1.0	2.8	3.5	**068-2006**
04	1.2	1.4	4.2	4.9	**068-2007**
05	1.5	1.7	5.2	6.0	**068-2008**
06	2.0	1.9	7.0	6.6	**068-2009**

The rated capacity is based on:
Evaporating temperature t_e = +5°C for range N and
t_e = –30°C for range B
Condensing temperature t_c = +32°C
Refrigerant temperature ahead of valve t_l = +28°C

[2])These orifice assemblies cannot be used together with solder adapters. Please see adapter information on next page.

Ordering, components with flare × solder connection



Thermostatic element with sensor band, without orifice, filter cone, nuts

Refrigerant	Valve type	Pressure equalization[3])	Capillary tube	Connection			Code no.				
				Inlet Flare	Outlet ODF solder		Range N –40 to +10°C		Range NL –40 to –15°C	Range B –60 to –25°C	
			m	in. / mm	in.	mm	Without MOP	MOP +15°C	Mop –10°C	Without MOP	MOP –20°C
R22	TX 2	Int.	1.5	3/8	1/2		**068Z3281**	**068Z3287**		**068Z3357**	**068Z3319**
	TX 2	Int.	1.5	10		12	**068Z3302**	**068Z3308**	**068Z3366**	**068Z3361**	**068Z3276**
	TEX 2	Ext.	1.5	3/8	1/2		**068Z3284**	**068Z3290**		**068Z3359**	**068Z3320**
	TEX 2	Ext.	1.5	10		12	**068Z3305**	**068Z3311**	**068Z3367**	**068Z3363**	**068Z3277**
R407C	TZ 2	Int.	1.5	3/8	1/2			**068Z3329**			
	TZ 2	Int.	1.5	10		12	**068Z3502**	**068Z3514**			
	TEZ 2	Ext.	1.5	3/8	1/2		**068Z3446**	**068Z3447**			
	TEZ 2	Ext.	1.5	10		12	**068Z3503**	**068Z3515**			
R134a	TN 2	Int.	1.5	3/8	1/2		**068Z3383**	**068Z3387**			
	TN 2	Int.	1.5	10		12	**068Z3384**	**068Z3388**			
	TEN 2	Ext.	1.5	3/8	1/2		**068Z3385**	**068Z3389**			
	TEN 2	Ext.	1.5	10		12	**068Z3386**	**068Z3390**			
R404A/ R507	TS 2	Int.	1.5	3/8	1/2		**068Z3414**	**068Z3416**	**068Z3429**	**068Z3418**	**068Z3420**
	TS 2	Int.	1.5	10		12	**068Z3435**	**068Z3423**	**068Z3436**	**068Z3425**	**068Z3427**
	TES 2	Ext.	1.5	3/8	1/2		**068Z3415**	**068Z3417**	**068Z3430**	**068Z3419**	**068Z3421**
	TES 2	Ext.	1.5	10		12	**068Z3422**	**068Z3424**	**068Z3437**	**068Z3426**	**068Z3428**

[3])TE valves with inch outlet have 1/4 inch pressure equalization. TE valves with mm outlet have 6 mm pressure equalization.

Solder adaptor

The adaptor is for use with thermostatic expansion valves T 2 and TE 2 with flare × solder connections. When the adaptor is fitted correctly it meets the sealing requirements of DIN 8964.

The adaptor offers the following advantages:

- The orifice assembly can be replaced.
- The filter can be cleaned or replaced.

When using the solder adapter, a special orifice assembly is required. Please use the following tables to select both the appropriate adapter and orifice asembly.
Only in this way can the sealing requirements of DIN 8964 be fulfilled.
Solder adaptor for filter drier (FSA) may not be used in the T 2 inlet.

Solder adaptor without orifice assembly and filter

Connection ODF solder	**Code no.**
1/4 in.	**068-2062**
6 mm	**068-2063**
3/8 in.	**068-2060**
10 mm	**068-2061**

Filter for solder adaptor

Description	**Code no.**
Filter excl. orifice assembly	**068-0015**

Flare connections
See previous page.

Orifice assembly with filter for solder adaptor

Orifice no.	**Code no.**
0X	**068-2089**
00	**068-2090**
01	**068-2091**
02	**068-2092**
03	**068-2093**
04	**068-2094**
05	**068-2095**
06	**068-2096**

For capacities see previous page.

Capacity

R22

Capacity in kW for range N: –40°C to +10°C

Valve type	Orifice no.	Pressure drop across valve Δp bar								Pressure drop across valve Δp bar							
		2	4	6	8	10	12	14	16	2	4	6	8	10	12	14	16
		Evaporating temperature +10°C								**Evaporating temperature 0°C**							
TX 2/TEX 2-0.15	0X	0.37	0.48	0.55	0.60	0.63	0.65	0.65	0.67	0.37	0.48	0.55	0.59	0.63	0.65	0.66	0.66
TX 2/TEX 2-0.3	00	0.87	1.1	1.2	1.3	1.4	1.4	1.4	1.5	0.84	1.0	1.2	1.3	1.3	1.4	1.4	1.4
TX 2/TEX 2-0.7	01	2.2	2.8	3.2	3.4	3.6	3.7	3.8	3.8	1.9	2.4	2.7	3.0	3.1	3.2	3.3	3.3
TX 2/TEX 2-1.0	02	3.0	4.0	4.7	5.1	5.4	5.6	5.8	5.8	2.6	3.4	4.0	4.3	4.6	4.8	4.9	5.0
TX 2/TEX 2-1.5	03	5.4	7.2	8.3	9.1	9.7	10.0	10.2	10.3	4.6	6.1	7.1	7.8	8.2	8.5	8.7	8.8
TX 2/TEX 2-2.3	04	8.1	10.8	12.5	13.8	14.5	15.0	15.4	15.5	6.9	9.1	10.5	11.5	12.2	12.7	13.0	13.2
TX 2/TEX 2-3.0	05	10.2	13.6	15.7	17.2	18.3	18.9	19.3	19.5	8.8	11.6	13.3	14.6	15.5	16.1	16.4	16.6
TX 2/TEX 2-4.5	06	12.6	16.7	19.3	21.0	22.3	23.1	23.5	23.7	10.8	14.2	16.3	17.8	18.9	19.6	20.0	20.2
		Evaporating temperature –10°C								**Evaporating temperature –20°C**							
TX 2/TEX 2-0.15	0X	0.37	0.47	0.53	0.57	0.60	0.63	0.64	0.64		0.44	0.50	0.54	0.57	0.59	0.61	0.61
TX 2/TEX 2-0.3	00	0.79	0.96	1.1	1.2	1.2	1.3	1.3	1.3		0.88	1.0	1.1	1.1	1.2	1.2	1.2
TX 2/TEX 2-0.7	01	1.6	2.0	2.3	2.5	2.6	2.7	2.8	2.8		1.7	1.9	2.0	2.2	2.3	2.3	2.3
TX 2/TEX 2-1.0	02	2.2	2.9	3.3	3.6	3.8	4.0	4.1	4.1		2.4	2.7	2.9	3.1	3.2	3.3	3.3
TX 2/TEX 2-1.5	03	3.9	5.1	5.9	6.4	6.8	7.1	7.3	7.3		4.2	4.8	5.2	5.5	5.8	5.9	6.0
TX 2/TEX 2-2.3	04	5.8	7.6	8.7	9.5	10.1	10.5	10.8	10.9		6.2	7.1	7.7	8.2	8.5	8.7	8.8
TX 2/TEX 2-3.0	05	7.4	9.6	11.0	12.0	12.8	13.3	13.6	13.8		7.9	9.0	9.8	10.3	10.8	11.0	11.2
TX 2/TEX 2-4.5	06	9.1	11.8	13.5	14.7	15.6	16.2	16.6	16.8		9.6	11.0	11.9	12.6	13.1	13.5	13.7
		Evaporating temperature –30°C								**Evaporating temperature –40°C**							
TX 2/TEX 2-0.15	0X		0.40	0.45	0.49	0.52	0.55	0.56	0.57			0.42	0.45	0.48	0.50	0.52	0.53
TX 2/TEX 2-0.3	00		0.79	0.90	0.96	1.0	1.1	1.1	1.1			0.80	0.86	0.92	0.95	0.98	0.99
TX 2/TEX 2-0.7	01		1.4	1.5	1.7	1.8	1.8	1.9	1.9			1.3	1.4	1.4	1.5	1.5	1.6
TX 2/TEX 2-1.0	02		1.9	2.2	2.7	2.5	2.6	2.6	2.7			1.7	1.9	2.0	2.0	2.1	2.1
TX 2/TEX 2-1.5	03		3.4	3.9	4.2	4.4	4.6	4.7	4.8			3.1	3.4	3.5	3.7	3.8	3.8
TX 2/TEX 2-2.3	04		5.0	5.7	6.2	6.5	6.8	7.0	7.1			4.6	4.9	5.2	5.4	5.6	5.7
TX 2/TEX 2-3.0	05		6.4	7.2	7.8	8.3	8.6	8.8	9.0			5.8	6.3	6.6	6.9	7.1	7.2
TX 2/TEX 2-4.5	06		7.8	8.8	9.6	10.1	10.5	10.8	11.0			7.1	7.7	8.1	8.4	8.7	8.8

Capacity in kW for range B: –60°C to –25°C

Valve type	Orifice no.	Pressure drop across valve Δp bar								Pressure drop across valve Δp bar							
		2	4	6	8	10	12	14	16	2	4	6	8	10	12	14	16
		Evaporating temperature –25°C								**Evaporating temperature –30°C**							
TX 2/TEX 2-0.2	00	0.69	0.83	0.94	1.0	1.1	1.1	1.1	1.2	0.66	0.79	0.89	0.96	1.0	1.1	1.1	1.1
TX 2/TEX 2-0.3	01	1.2	1.5	1.7	1.9	2.0	2.0	2.1	2.1	1.1	1.4	1.5	1.7	1.8	1.8	1.9	1.9
TX 2/TEX 2-0.6	02	1.7	2.1	2.4	2.6	2.8	2.9	2.9	3.0	1.5	1.9	2.2	2.3	2.5	2.6	2.6	2.7
TX 2/TEX 2-0.8	03	3.0	3.8	4.3	4.7	5.0	5.2	5.3	5.3	2.7	3.4	3.9	4.2	4.4	4.6	4.7	4.8
TX 2/TEX 2-1.2	04	4.4	5.6	6.4	6.9	7.3	7.6	7.8	7.9	3.9	5.0	5.7	6.2	6.5	6.8	7.0	7.1
TX 2/TEX 2-1.5	05	5.6	7.1	8.1	8.7	9.3	9.6	9.9	10.0	5.0	6.4	7.2	7.8	8.3	8.6	8.8	9.0
TX 2/TEX 2-2.0	06	6.8	8.7	9.8	10.7	11.3	11.8	12.1	12.3	6.1	7.8	8.8	9.6	10.1	10.5	10.8	11.0
		Evaporating temperature –40°C								**Evaporating temperature –50°C**							
TX 2/TEX 2-0.2	00	0.60	0.71	0.80	0.86	0.92	0.95	0.98	0.99	0.54	0.65	0.72	0.78	0.82	0.85	0.87	0.88
TX 2/TEX 2-0.3	01	0.90	1.1	1.3	1.4	1.4	1.5	1.5	1.6	0.74	0.92	1.0	1.1	1.2	1.2	1.3	1.3
TX 2/TEX 2-0.6	02	1.2	1.6	1.7	1.9	2.0	2.1	2.1	2.1	1.0	1.3	1.4	1.5	1.6	1.7	1.7	1.7
TX 2/TEX 2-0.8	03	2.2	2.8	3.1	3.4	3.5	3.7	3.8	3.8	1.8	2.3	2.6	2.7	2.9	3.0	3.1	3.1
TX 2/TEX 2-1.2	04	3.2	4.0	4.6	4.9	5.2	5.4	5.6	5.7	2.6	3.3	3.7	4.0	4.2	4.4	4.5	4.6
TX 2/TEX 2-1.5	05	4.1	5.1	5.8	6.3	6.6	6.9	7.1	7.2	3.4	4.2	4.7	5.1	5.4	5.6	5.8	5.9
TX 2/TEX 2-2.0	06	5.0	6.3	7.1	7.7	8.1	8.4	8.7	8.8	4.1	5.1	5.8	6.2	6.6	6.9	7.1	7.2
		Evaporating temperature –60°C															
TX 2/TEX 2-0.2	00	0.50	0.60	0.66	0.71	0.75	0.77	0.79	0.80								
TX 2/TEX 2-0.3	01	0.64	0.79	0.88	0.95	1.0	1.0	1.1	1.1								
TX 2/TEX 2-0.6	02	0.9	1.1	1.2	1.3	1.4	1.4	1.4	1.4								
TX 2/TEX 2-0.8	03	1.6	1.9	2.2	2.3	2.4	2.5	2.6	2.6								
TX 2/TEX 2-1.2	04	2.2	2.8	3.1	3.4	3.6	3.7	3.8	3.9								
TX 2/TEX 2-1.5	05	2.9	3.6	4.0	4.3	4.6	4.8	4.9	5.0								
TX 2/TEX 2-2.0	06	3.5	4.4	4.9	5.3	5.6	5.8	6.0	6.1								

Correction for subcooling Δt_{sub}

Note:
Insufficient subcooling can produce flash gas.

The evaporator capacities used must be corrected if subcooling deviates from 4 K. The corrected capacity can be obtained by dividing the required evaporator capacity by the correction factor below. Selections can then be made from the tables above.

Δt_u	4 K	10 K	15 K	20 K	25 K	30 K	35 K	40 K	45 K	50 K
Correction factor	1.00	1.06	1.11	1.15	1.20	1.25	1.30	1.35	1.39	1.44

Example
Refrigerant = R22
Evaporator capacity Q_e = 5 kW
Subcooling = 10 K

Correction factor from table = 1.06
Corrected capacity = 5 : 1.06 = 4.72 kW

Capacity

R407C

Capacity in kW for range N: –40°C to +10°C

Valve type	Orifice no.	Pressure drop across valve Δp bar								Pressure drop across valve Δp bar							
		2	4	6	8	10	12	14	16	2	4	6	8	10	12	14	16
		Evaporating temperature +10°C								**Evaporating temperature 0°C**							
TZ 2/TEZ 2 - 0.16	0X	0.40	0.50	0.56	0.61	0.63	0.64	0.63	0.64	0.40	0.50	0.56	0.60	0.63	0.64	0.64	0.63
TZ 2/TEZ 2 - 0.30	00	0.90	1.1	1.2	1.3	1.4	1.4	1.4	1.4	0.87	1.0	1.2	1.3	1.3	1.4	1.4	1.3
TZ 2/TEZ 2 - 0.80	01	2.3	2.9	3.3	3.4	3.6	3.6	3.7	3.6	2.0	2.5	2.8	3.0	3.1	3.1	3.2	3.2
TZ 2/TEZ 2 - 1.1	02	3.1	4.1	4.8	5.2	5.4	5.5	5.6	5.6	2.7	3.5	4.1	4.3	4.6	4.7	4.8	4.8
TZ 2/TEZ 2 - 1.6	03	5.6	7.4	8.5	9.2	9.7	9.8	9.9	9.9	4.8	6.3	7.2	7.9	8.2	8.3	8.4	8.4
TZ 2/TEZ 2 - 2.5	04	8.4	11.1	12.8	13.9	14.5	14.7	14.9	14.9	7.2	9.4	10.7	11.6	12.2	12.4	12.6	12.7
TZ 2/TEZ 2 - 3.2	05	10.6	14.0	16.0	17.4	18.3	18.5	18.7	18.7	9.2	11.9	13.6	14.7	15.5	15.8	15.9	15.9
TZ 2/TEZ 2 - 4.9	06	13.1	17.2	19.7	21.2	22.3	22.6	22.8	22.8	11.2	14.6	16.6	18.0	18.9	19.2	19.4	19.4
		Evaporating temperature –10°C								**Evaporating temperature –20°C**							
TZ 2/TEZ 2 - 0.16	0X	0.38	0.48	0.54	0.57	0.60	0.62	0.62	0.61		0.45	0.51	0.54	0.56	0.57	0.59	0.57
TZ 2/TEZ 2 - 0.30	00	0.82	1.0	1.1	1.2	1.2	1.3	1.3	1.2		0.90	1.0	1.1	1.1	1.2	1.2	1.1
TZ 2/TEZ 2 - 0.80	01	1.7	2.0	2.3	2.5	2.6	2.6	2.7	2.7		1.7	1.9	2.0	2.2	2.2	2.2	2.2
TZ 2/TEZ 2 - 1.1	02	2.3	3.0	3.3	3.6	3.8	3.9	4.0	3.9		2.4	2.7	2.9	3.1	3.1	3.2	3.1
TZ 2/TEZ 2 - 1.6	03	4.1	5.2	6.0	6.4	6.8	7.0	7.1	6.9		4.3	4.8	5.2	5.4	5.6	5.7	5.6
TZ 2/TEZ 2 - 2.5	04	6.0	7.8	8.8	9.5	10.1	10.3	10.5	10.4		6.3	7.2	7.7	8.1	8.2	8.4	8.3
TZ 2/TEZ 2 - 3.2	05	7.7	9.8	11.1	12.0	12.8	13.0	13.2	13.1		8.1	9.1	9.8	10.2	10.5	10.6	10.5
TZ 2/TEZ 2 - 4.9	06	9.5	12.0	13.6	14.7	15.6	15.9	16.1	16.0		9.8	11.1	11.9	12.5	12.7	13.0	12.9
		Evaporating temperature –30°C								**Evaporating temperature –40°C**							
TZ 2/TEZ 2 - 0.16	0X		0.41	0.45	0.49	0.51	0.53	0.53	0.53			0.42	0.44	0.46	0.48	0.48	0.49
TZ 2/TEZ 2 - 0.30	00		0.81	0.90	1.0	1.0	1.1	1.0	1.0			0.80	0.84	0.90	0.90	0.90	0.90
TZ 2/TEZ 2 - 0.80	01		1.4	1.5	1.7	1.8	1.7	1.8	1.8			1.3	1.4	1.3	1.4	1.4	1.5
TZ 2/TEZ 2 - 1.1	02		1.9	2.2	2.7	2.5	2.5	2.5	2.5			1.7	1.9	1.9	1.9	2.0	1.9
TZ 2/TEZ 2 - 1.6	03		3.5	3.9	4.2	4.3	4.4	4.5	4.5			3.1	3.3	3.4	3.5	3.5	3.5
TZ 2/TEZ 2 - 2.5	04		5.1	5.8	6.1	6.4	6.5	6.7	6.6			4.6	4.8	5.0	5.1	5.2	5.2
TZ 2/TEZ 2 - 3.2	05		6.5	7.3	7.7	8.1	8.3	8.4	8.4			5.8	6.2	6.3	6.6	6.6	6.6
TZ 2/TEZ 2 - 4.9	06		8.0	8.9	9.5	9.9	10.1	10.3	10.2			7.1	7.5	7.8	8.0	8.1	8.1

Correction for subcooling Δt_{sub}

Note:
Insufficient subcooling can produce flash gas.

The evaporator capacities used must be corrected if subcooling deviates from 4 K. The corrected capacity can be obtained by dividing the required evaporator capacity by the correction factor below. Selections can then be made from the tables above.

Δt_u	4 K	10 K	15 K	20 K	25 K	30 K	35 K	40 K	45 K	50 K
Correction factor	1.00	1.08	1.14	1.21	1.27	1.33	1.39	1.45	1.51	1.57

Capacity

R134a

Capacity in kW for range N: –40°C to +10°C

Valve type	Orifice no.	Pressure drop across valve Δp bar					Pressure drop across valve Δp bar				
		2	4	6	8	10	2	4	6	8	10
		Evaporating temperature +10°C					**Evaporating temperature 0°C**				
TN 2/TEN 2 - 0.11	0X	0.34	0.43	0.47	0.50	0.51	0.33	0.42	0.46	0.47	0.49
TN 2/TEN 2 - 0.25	00	0.71	0.86	0.93	0.97	0.98	0.65	0.78	0.86	0.89	0.91
TN 2/TEN 2 - 0.5	01	1.5	1.9	2.1	2.2	2.2	1.3	1.6	1.7	1.8	1.8
TN 2/TEN 2 - 0.8	02	2.0	2.6	3.0	3.1	3.2	1.7	2.2	2.4	2.6	2.6
TN 2/TEN 2 - 1.3	03	3.6	4.7	5.3	5.6	5.8	3.0	3.9	4.4	4.6	4.7
TN 2/TEN 2 - 1.9	04	5.4	7.0	7.8	8.3	8.6	4.5	5.7	6.4	6.8	7.0
TN 2/TEN 2 - 2.5	05	6.9	8.9	9.9	10.8	10.9	5.7	7.3	8.1	8.6	8.8
TN 2/TEN 2 - 3.0	06	8.4	10.8	12.1	12.8	13.2	7.0	8.9	10.0	10.5	10.8
		Evaporating temperature –10°C					**Evaporating temperature –20°C**				
TN 2/TEN 2 - 0.11	0X	0.30	0.38	0.43	0.44	0.44	0.28	0.35	0.39	0.41	0.42
TN 2/TEN 2 - 0.25	00	0.59	0.70	0.77	0.81	0.82	0.53	0.62	0.69	0.72	0.73
TN 2/TEN 2 - 0.5	01	1.0	1.3	1.4	1.5	1.5	0.81	1.00	1.1	1.2	1.2
TN 2/TEN 2 - 0.8	02	1.4	1.8	2.0	2.1	2.1	1.1	1.4	1.5	1.6	1.7
TN 2/TEN 2 - 1.3	03	2.5	3.1	3.5	3.7	3.8	2.0	2.5	2.8	2.9	3.0
TN 2/TEN 2 - 1.9	04	3.6	4.6	5.1	5.4	5.6	2.9	3.6	4.0	4.3	4.4
TN 2/TEN 2 - 2.5	05	4.6	5.8	6.5	6.9	7.1	3.7	4.6	5.1	5.4	5.5
TN 2/TEN 2 - 3.0	06	5.7	7.1	8.0	8.4	8.6	4.5	5.6	6.2	6.6	6.8
		Evaporating temperature –30°C					**Evaporating temperature –40°C**				
TN 2/TEN 2 - 0.11	0X	0.25	0.32	0.35	0.37	0.38	0.23	0.28	0.32	0.33	0.34
TN 2/TEN 2 - 0.25	00	0.48	0.55	0.61	0.64	0.64	0.44	0.50	0.54	0.56	0.57
TN 2/TEN 2 - 0.5	01	0.66	0.80	0.88	0.93	0.95	0.54	0.65	0.72	0.76	0.77
TN 2/TEN 2 - 0.8	02	0.90	1.1	1.2	1.3	1.3	0.74	0.89	0.98	1.0	1.0
TN 2/TEN 2 - 1.3	03	1.6	2.0	2.2	2.3	2.3	1.3	1.6	1.8	1.9	1.9
TN 2/TEN 2 - 1.9	04	2.3	2.9	3.2	3.3	3.4	1.9	2.3	2.6	2.7	2.7
TN 2/TEN 2 - 2.5	05	3.0	3.6	4.0	4.2	4.3	2.4	2.9	3.2	3.5	3.5
TN 2/TEN 2 - 3.0	06	3.6	4.4	4.9	5.2	5.3	3.0	3.6	4.0	4.2	4.3

Correction for subcooling Δt_{sub}

Note:
Insufficient subcooling can produce flash gas.

The evaporator capacities used must be corrected if subcooling deviates from 4 K. The corrected capacity can be obtained by dividing the required evaporator capacity by the correction factor below. Selections can then be made from the tables above.

Δt_u	4 K	10 K	15 K	20 K	25 K	30 K	35 K	40 K	45 K	50 K
Correction factor	1.00	1.08	1.13	1.19	1.25	1.31	1.37	1.42	1.48	1.54

Capacity

R404A / R507

Capacity in kW for range N: –40°C to +10°C

Valve type	Orifice no.	Pressure drop across valve Δp bar								Pressure drop across valve Δp bar							
		2	4	6	8	10	12	14	16	2	4	6	8	10	12	14	16
		Evaporating temperature +10°C								**Evaporating temperature 0°C**							
TS 2/TES 2 - 0.11	0X	0.28	0.35	0.40	0.42	0.43	0.43	0.42	0.41	0.30	0.37	0.41	0.42	0.43	0.43	0.43	0.41
TS 2/TES 2 - 0.21	00	0.67	0.82	0.90	0.94	0.96	0.96	0.93	0.90	0.68	0.80	0.87	0.90	0.92	0.93	0.91	0.87
TS 2/TES 2 - 0.45	01	1.7	2.1	2.3	2.4	2.5	2.5	2.4	2.3	1.5	1.9	2.0	2.1	2.2	2.2	2.2	2.1
TS 2/TES 2 - 0.6	02	2.3	3.0	3.4	3.6	3.7	3.7	3.7	3.6	2.1	2.6	3.0	3.1	3.2	3.3	3.2	3.1
TS 2/TES 2 - 1.2	03	4.2	5.4	6.0	6.4	6.6	6.7	6.6	6.4	3.7	4.7	5.3	5.6	5.8	5.8	5.7	5.6
TS 2/TES 2 - 1.7	04	6.2	8.1	9.1	9.7	10.0	10.0	9.8	9.6	5.5	7.1	7.9	8.3	8.6	8.6	8.5	8.3
TS 2/TES 2 - 2.2	05	7.9	10.2	11.4	12.2	12.5	12.6	12.3	12.0	7.0	8.9	10.0	10.5	10.8	10.9	10.8	10.4
TS 2/TES 2 - 2.6	06	9.7	12.5	14.0	14.9	15.3	15.3	15.1	14.7	8.6	10.9	12.2	12.9	13.2	13.3	13.1	12.7
		Evaporating temperature –10°C								**Evaporating temperature –20°C**							
TS 2/TES 2 - 0.11	0X	0.30	0.37	0.40	0.42	0.42	0.42	0.41	0.41		0.35	0.38	0.40	0.39	0.40	0.39	0.38
TS 2/TES 2 - 0.21	00	0.65	0.76	0.82	0.84	0.87	0.87	0.85	0.83		0.70	0.75	0.77	0.79	0.79	0.79	0.76
TS 2/TES 2 - 0.45	01	1.3	1.6	1.7	1.8	1.8	1.9	1.8	1.8		1.3	1.5	1.5	1.5	1.5	1.5	1.5
TS 2/TES 2 - 0.6	02	1.8	2.2	2.5	2.6	2.7	2.7	2.7	2.6		1.9	2.0	2.1	2.2	2.2	2.2	2.1
TS 2/TES 2 - 1.2	03	3.1	4.0	4.5	4.7	4.8	4.8	4.8	4.7		3.3	3.7	3.8	3.9	3.9	3.9	3.8
TS 2/TES 2 - 1.7	04	4.7	6.0	6.6	7.0	7.1	7.2	7.1	6.9		4.9	5.4	5.6	5.8	5.8	5.7	5.6
TS 2/TES 2 - 2.2	05	5.9	7.6	8.4	8.8	9.0	9.1	9.0	8.7		6.2	6.9	7.2	7.3	7.3	7.2	7.1
TS 2/TES 2 - 2.6	06	7.3	9.3	10.3	10.8	11.0	11.1	11.0	10.7		7.6	8.4	8.8	8.9	8.9	8.8	8.6
		Evaporating temperature –30°C								**Evaporating temperature –40°C**							
TS 2/TES 2 - 0.11	0X			0.35	0.37	0.36	0.37	0.36	0.35			0.32	0.33	0.33	0.33	0.32	0.32
TS 2/TES 2 - 0.21	00			0.67	0.70	0.70	0.70	0.69	0.67			0.60	0.61	0.62	0.61	0.60	0.59
TS 2/TES 2 - 0.45	01			1.2	1.2	1.2	1.2	1.2	1.2			0.92	0.96	0.97	0.96	0.94	0.91
TS 2/TES 2 - 0.6	02			1.6	1.7	1.7	1.7	1.7	1.6			1.3	1.3	1.3	1.3	1.3	1.2
TS 2/TES 2 - 1.2	03			2.9	3.0	3.1	3.1	3.0	2.9			2.3	2.4	2.4	2.4	2.3	2.2
TS 2/TES 2 - 1.7	04			4.3	4.5	4.5	4.5	4.5	4.4			3.3	3.5	3.5	3.5	3.4	3.3
TS 2/TES 2 - 2.2	05			5.5	5.7	5.7	5.7	5.7	5.5			4.3	4.4	4.5	4.4	4.4	4.2
TS 2/TES 2 - 2.6	06			6.7	6.9	7.0	7.0	6.9	6.8			5.2	5.4	5.5	5.4	5.3	5.2

Capacity in kW for range B: –60°C to –25°C

Valve type	Orifice no.	Pressure drop across valve Δp bar								Pressure drop across valve Δp bar							
		2	4	6	8	10	12	14	16	2	4	6	8	10	12	14	16
		Evaporating temperature –25°C								**Evaporating temperature –30°C**							
TS 2/TES 2 - 0.21	00	0.57	0.67	0.72	0.73	0.74	0.85	0.74	0.71	0.53	0.64	0.67	0.70	0.70	0.70	0.69	0.67
TS 2/TES 2 - 0.45	01	0.98	1.2	1.3	1.5	1.4	1.4	1.4	1.31	0.88	1.07	1.2	1.2	1.2	1.2	1.2	1.2
TS 2/TES 2 - 0.6	02	1.3	1.7	1.8	1.9	1.9	1.9	1.9	1.9	1.2	1.5	1.6	1.7	1.7	1.7	1.7	1.6
TS 2/TES 2 - 1.0	03	2.4	3.0	3.3	3.4	3.5	3.5	3.4	3.3	2.1	2.7	2.9	3.0	3.1	3.1	3.0	2.9
TS 2/TES 2 - 1.4	04	3.5	4.4	4.8	5.0	5.1	5.1	5.1	4.9	3.1	3.9	4.3	4.5	4.5	4.5	4.5	4.4
TS 2/TES 2 - 1.7	05	4.4	5.6	6.1	6.4	6.5	6.5	6.4	6.3	3.9	4.9	5.5	5.7	5.7	5.7	5.7	5.5
TS 2/TES 2 - 1.9	06	5.4	6.8	7.5	7.8	7.9	7.9	7.9	7.6	4.8	6.1	6.7	6.9	7.0	7.0	6.9	6.8
		Evaporating temperature –40°C								**Evaporating temperature –50°C**							
TS 2/TES 2 - 0.21	00		0.56	0.60	0.61	0.62	0.61	0.60	0.59		0.49	0.53	0.54	0.54	0.53	0.52	0.50
TS 2/TES 2 - 0.45	01		0.85	0.92	0.96	0.97	0.96	0.94	0.91		0.51	0.57	0.60	0.60	0.60	0.60	0.59
TS 2/TES 2 - 0.6	02		1.2	1.3	1.3	1.3	1.3	1.3	1.2		0.91	0.99	1.0	1.0	1.0	0.98	0.95
TS 2/TES 2 - 1.0	03		2.1	2.3	2.4	2.4	2.4	2.3	2.2		1.6	1.8	1.8	1.8	1.8	1.8	1.7
TS 2/TES 2 - 1.4	04		3.0	3.3	3.5	3.5	3.5	3.4	3.3		2.4	2.6	2.7	2.7	2.7	2.6	2.6
TS 2/TES 2 - 1.7	05		3.9	4.3	4.4	4.5	4.4	4.4	4.2		3.0	3.3	3.4	3.5	3.4	3.4	3.3
TS 2/TES 2 - 1.9	06		4.7	5.2	5.4	5.5	5.5	5.3	5.2		3.7	4.0	4.2	4.2	4.2	4.1	4.0
		Evaporating temperature –60°C															
TS 2/TES 2 - 0.21	00			0.46	0.48	0.47	0.45	0.45	0.43								
TS 2/TES 2 - 0.45	01			0.58	0.60	0.60	0.58	0.56	0.54								
TS 2/TES 2 - 0.6	02			0.78	0.80	0.80	0.78	0.75	0.72								
TS 2/TES 2 - 1.0	03			1.4	1.4	1.4	1.4	1.4	1.3								
TS 2/TES 2 - 1.4	04			2.0	2.1	2.1	2.1	2.0	2.0								
TS 2/TES 2 - 1.7	05			2.6	2.7	2.7	2.7	2.6	2.5								
TS 2/TES 2 - 1.9	06			3.2	3.3	3.3	3.3	3.2	3.1								

Correction for subcooling Δt_{sub}

Note:
Insufficient subcooling can produce flash gas.

The evaporator capacities used must be corrected if subcooling deviates from 4 K. The corrected capacity can be obtained by dividing the required evaporator capacity by the correction factor below. Selections can then be made from the tables above.

Δt_u	4 K	10 K	15 K	20 K	25 K	30 K	35 K	40 K	45 K	50 K
Correction factor	1.00	1.10	1.20	1.29	1.37	1.46	1.54	1.63	1.70	1.78

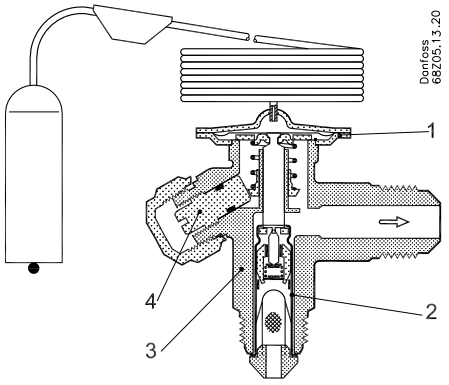
Design
Function

General
T 2 and TE 2 valves have an interchangeable orifice assembly.

For the same valve type and refrigerant, the associated orifice assembly is suitable for all versions of valve body and in all evaporating temperature ranges.
The charge in the thermostatic element depends on the evaporating temperature range.
The valves can be equipped with internal (T 2) or external (TE 2) pressure equalization.

External pressure equalization should always be used on systems with liquid distributors.
The double contact bulb gives fast and precise reaction to temperature changes in the evaporator. It also makes fitting the bulb quick and easy.
The valves are able to withstand the effects that normally occur with hot gas defrosting.

To ensure long operating life, the valve cone and seat are made of a special alloy with particularly good wear qualities.



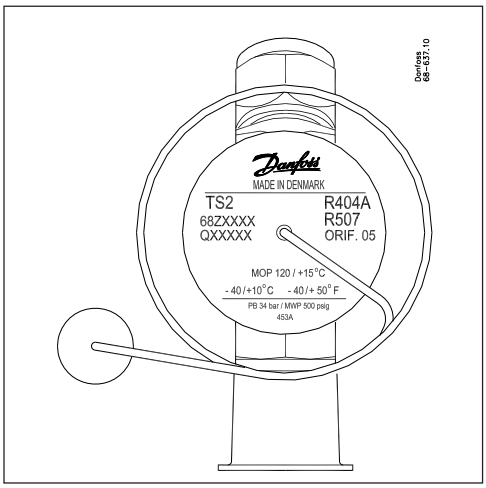
T 2

1. Thermostatic element (diaphragm)
2. Interchangeable orifice assembly
3. Valve body
4. Superheat setting spindle (see instructions)

Identification

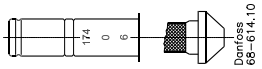
The thermostatic element is fitted with a laser engraving on top of the diaphragm.
This engraving gives valve type (with code number), evaporating temperature range, MOP point, refrigerant, and max. working pressure, PS/MWP.

The code refers to the refrigerant for which the valve is designed:
X = R22
Z = R407C
N = R134a
S = R404A/ R507



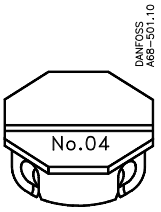
Orifice assembly for T 2 and TE 2
The orifice assembly is marked with the orifice size (e.g. 06) and week stamp + last number in the year (e.g. 174).
The orifice assembly number is also given on the lid of its plastic container.

Orifice assembly and filter for T 2 and TE 2



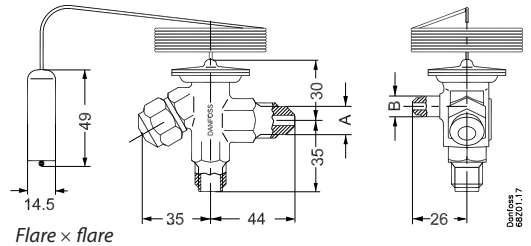
Capillary tube label for T 2 and TE 2
The label gives the orifice size (04) and consists of the lid of the orifice assembly plastic container. It can easily be fastened around the expansion valve capillary tube to clearly identify the valve size.

Capillary tube label T 2 and TE 2

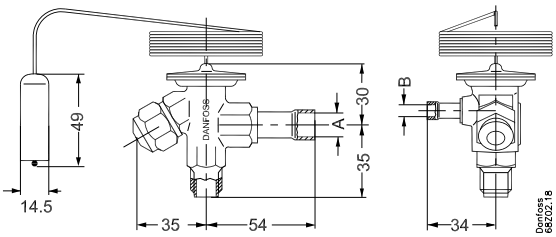


Dimensions and weights

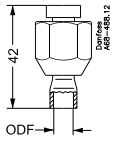
T 2 and TE 2



Flare × flare



Flare × solder



Solder adaptor

Weight: 0.05 kg
0.11 lb

	Outlet A	Equalization B	Weight kg / lb
Flare × flare	1/2" flare	1/4" flare	0.3 / 0.7
Flare × solder	1/2" solder 12 mm solder	1/4" solder 6 mm solder	0.3 / 0.7

ODF	
in.	mm
1/4	6
3/8	10

Appendix M Evaporator

(Page Left Blank Intentionally)

AC50

Brazed plate heat exchanger with single circuit for AC

The AC50 is designed by Alfa Laval for air conditioning and refrigeration applications.

AC50 is a single refrigerant circuit plate developed for chillers AC operating with cooling capacity from 10 – 60 kW.

The plate design have been developed by our R&D department and the heat exchanger have been verified by our laboratory to achieve the highest market performance with HFC refrigerants as R407C and R410a for higher pressure design.

We can say that AC50 confirms our product mission to improve our customers' performance time and time again.

Possible application
- Evaporator/condenser in chiller and heat pump
- Heat recover in chiller
- Liquid cooler in direct system

AC50 has a patented integrated distribution system pressed together with the plate to provide high design quality and heat exchanger performances repeatibility.

AC50 will be available with the major pressure vessel code as CE (Europe); UL (US), KHK (Japan).

Advantages of brazed plate heat exchangers in Industry and HVAC&R
The Alfa Laval brazed plate heat exchangers (BHE) have several advantages over traditional heat exchangers in Industrial and HVAC&R applications:

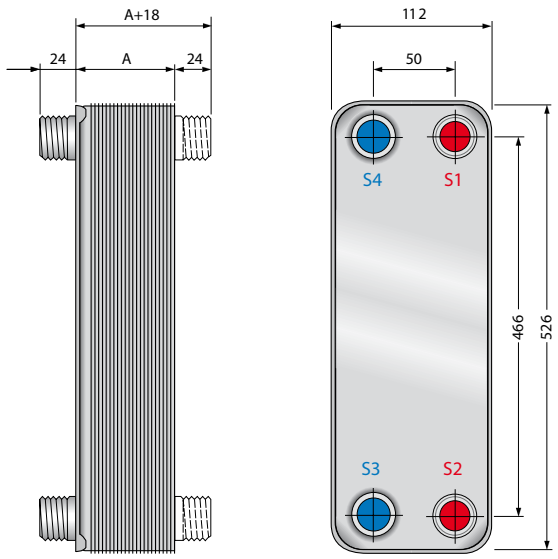
- The high heat transfer efficiency of the BHE makes it extremely compact and also easy to install in places were space is limited.

- The unit has no gaskets and is therefore suitable in applications where temperature and/or pressure is high.

- The Alfa Laval supply system reassures that, no matter where you are in the world, the BHE units are available with a very short delivery time.

Particulars required for quotation
To enable Alfa Laval's representative to make a specific quotation, enquiries should be accompanied by the following particulars:

- flow rates or heat load required
- inlet and outlet temperature
- physical properties of liquids or media
- desired working pressure
- maximum permitted brine pressure drop
- connection types



Dimensions in mm

General data

Design temperature	–50°C / +150°C
Design pressure standard	3.2 MPa
Design pressure special	4.5 MPa
Test pressure	4.83 MPa
Volume per channel	0.094 dm³
Maximum flow rate (water side)	18 m³/h

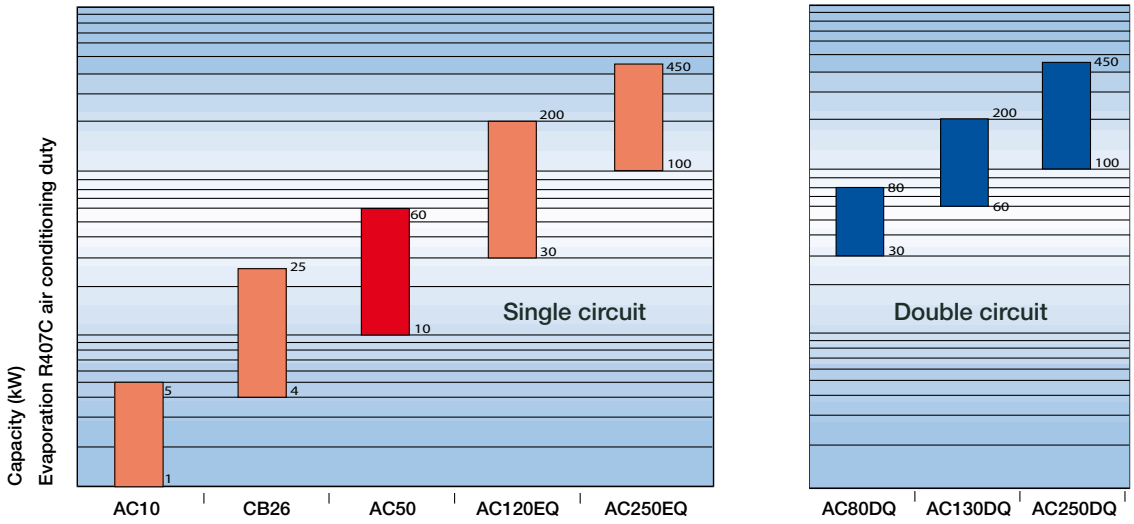
Standard connections

Water/brine side	S1-S2 – T1-T2: 1" 1/4
Refrigerant side	S3: 5/8", 7/8", 1" 1/8
	S4: 1" 1/8, 1" 3/8

Dimensions

A = 10 + n x 2.4 (mm)
Weight = 1.8 + n x 0.23 (kg)
(n = number of plates)

Alfa Laval brazed plate heat exchangers range



How to contact Alfa Laval
Up-to-date Alfa Laval contact details for all countries are always available on our website at www.alfalaval.com

Appendix N Grundfoss Pump CR

(Page Left Blank Intentionally)

CR, CRI, CRN, CRT

Installation and Operating Instructions

Please leave these instructions with
the pump for future reference

SAFETY WARNING

Electrical Work

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

Shock Hazard

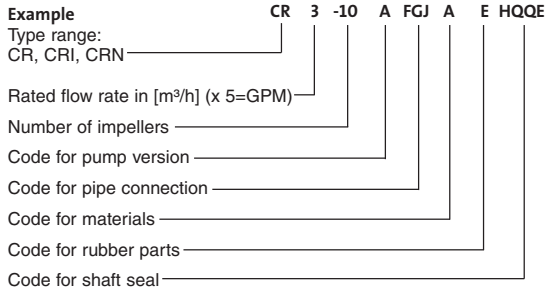
A faulty motor or wiring can cause electrical shock that could be fatal, whether touched directly or conducted through standing water. For this reason, proper grounding of the pump to the power supply's grounding terminal is required for safe installation and operation.

In all installations, the above-ground metal plumbing should be connected to the power supply ground as described in Article 250-80 of the National Electrical Code.

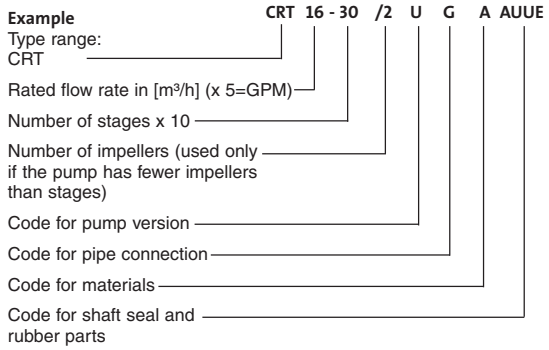
Nameplate Data

Type key

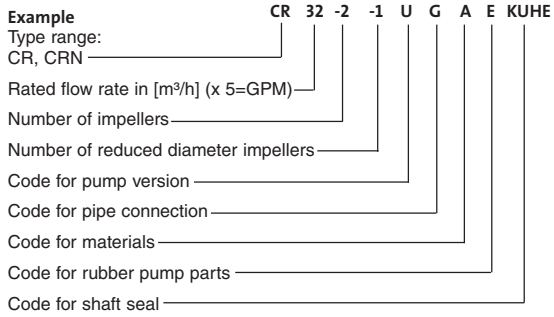
CR, CRI, CRN 1s, 1, 3, 5, 10, 15, and 20

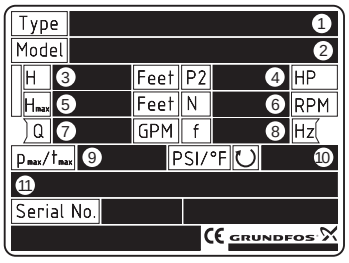


CRT 2, 4, 8 and 16

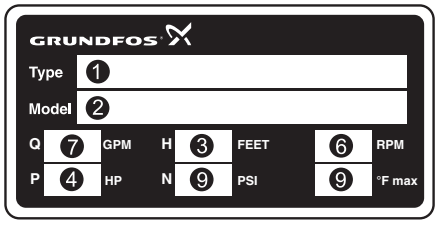


CR, CRN 32, 45, 64, AND 90

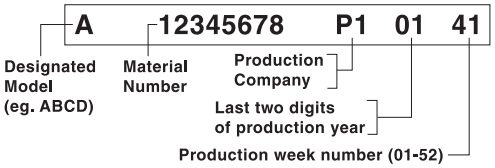




1. Type designation
2. Model, material number, production number
3. Head in feet at nominal flow
4. Nominal motor HP
5. Head at zero flow
6. Rated RPM
7. Nominal flow
8. Rated frequency
9. Maximum pressure and maximum fluid temperature
10. Direction of rotation
11. Production country



Model Key



Codes

Example U FGJ A E HQQE

Pump version

- A *Basic version pump
- U *NEMA version pump
- B Oversize motor, one flange size bigger
- F CR pump for high temperatures (Cool-Top™)
- H Horizontal version
- HS High pressure pump with over-synchronous speed and reversed direction of rotation
- I Different pressure rating
- K Low NPSH
- M Magnetic drive
- P Undersize motor
- R Horizontal version with bearing bracket
- SF High pressure pump with reversed chamber stack and direction of rotation
- T Oversize motor, two flange sizes bigger
- X **Special version

Pipe connection

- A Oval flange
- B NPT thread
- C Clamp coupling
- CA FlexiClamp
- CX TriClamp
- F DIN flange
- G ANSI flange
- J JIS flange
- N Changed diameter of ports
- O Externally threaded, union
- P PJE coupling
- X Special version

Materials

- A Basic version
- D Carbon-graphite filled PTFE (bearings)
- G Stainless steel parts of 316 SS
- GI Base plate and flanges of 316 SS
- I Stainless steel parts of 304 SS
- II Base plate and flange of 304 SS
- K Bronze (bearings)
- S SiC bearing ring + PTFE neck ring (only CR, CRN 32 to 90)
- T Titanium
- X Special version

Code for rubber parts

- E EPDM
- F FXM (Flouraz®)
- K FFKM (Kalrez®)
- V FKM (Viton®)

Shaft seal H Q Q E

- A O-ring seal with fixed driver
- B Rubber bellows seal
- D O-ring seal, balanced
- E Cartridge seal with O-ring
- H Balanced cartridge seal with O-ring
- K Cartridge shaft seal with metal bellows
- O Double seal, back to back
- P Double seal, tandem
- R O-ring seal with reduced face
- X Special version

- B Carbon, synthetic resin-impregnated
- H Cemented tungsten carbide, embedded hybrid
- Q Silicon carbide
- U Cemented tungsten carbide

- E EPDM
- F FXM (Flouraz®)
- K FFKM (Kalrez®)
- V FKM (Viton®)

* In August 2003 the NEMA pump code was discontinued for all material numbers created by GRUNDFOS manufacturing companies in North America. The NEMA version pump code will still remain in effect for existing material numbers. NEMA version pumps built in North America after this change will have either an A or U as the pump version code depending on the date the material number was created.

** If a pump incorporates more than two pump versions, the code for the pump version is X. X also indicates special pump versions not listed above.

Pre-installation Checklist

1. Confirm you have the right pump

Read the pump nameplate to make sure it is the one you ordered.

CR	—	Centrifugal pump with standard cast iron and 304 stainless steel construction
CRI	—	Centrifugal pump; all parts in contact with water are 304 stainless steel construction
CRN	—	Centrifugal pump; all parts in contact with water are 316 stainless steel construction
CRT	—	Centrifugal pump; all parts in contact with water are titanium construction
CRE	—	Centrifugal pump with a Grundfos MLE VFD motor attached

2. Check the condition of the pump

The shipping carton your pump came in is specially designed around your pump during production to prevent damage. As a precaution, the pump should remain in the carton until you are ready to install it. Examine the pump for any damage that may have occurred during shipping. Examine any other parts of the shipment as well for any visible damage.

If the pump is shipped as a complete unit (motor attached to pump end), the position of the coupling (that connects the pump shaft to the motor shaft) is set at factory specifications. No adjustment is required. If the unit is delivered as a pump end only, follow the adjustment procedures on pages 11 - 12.

Pump without Motor (CR(I)(N) 1s, 1, 3, 5, 10, 15, and 20 Only): If you purchased a pump without a motor, the shaft seal has been set by the factory. Do not loosen the three set screws on the shaft seal when attaching the motor.

Pump without Motor (CR(N) 32, 45, 64 & 90 Only): If you purchased a pump without a motor, you must install the seal. The seal is protected in its own sub boxing within the pump packaging crate. To protect the shaft and bearings during shipment, a shaft holder protective device is used. This device must be removed prior to installation of the seal. Read the seal installation instructions which are included in the pump package.

3. Verify electrical requirements

Verification of the electrical supply should be made to be certain the voltage, phase and frequency match that of the pump motor. The proper operating voltage and other electrical information can be found on the motor nameplate. These motors are designed to run on ±10% of the nameplate-rated voltage. For dual-voltage motors, the motor should be internally connected to operate on the voltage closest to the 10% rating, i.e., a 208 voltage motor wired per the 208 volt connection diagram. The wiring connection diagram can be found on either a plate attached to the motor or on a diagram inside the terminal box cover. If voltage variations are larger than ±10%, do not operate the pump.

4. Is the application correct for this pump?

Compare the pump's nameplate data or its performance curve with the application in which you plan to install it. Will it perform the way you want it to perform? Also, make sure the application falls within the following limits:

Type	Designed to pump...
CR	Hot and chilled water, boiler feed, condensate return, glycols and solar thermal fluids.
CRI/CRN	Deionized, demineralized and distilled water. Brackish water and other liquids unsuitable for contact with iron or copper alloys. (Consult manufacturer for specific liquid compatibilities.)
CRN-SF	High pressure washdown, reverse osmosis, or other high pressure applications.
CRT	Salt water, chloride based fluids and fluids approved for titanium.

Operating Conditions

Pump	Fluid Temperatures
CR(I)(N) 1s, 3, 5, 10, 15, and 20	-4 to +248°F (-20 to +120°C)
*CR(N) 32, 45, 64, and 90	-22 TO +248°F (-30 TO +120°C)
CRT 2, 4, 8, 16	-4 to +248°F (-20 to +120°C)
CRN-SF	-4 to +221°F (-15 to +105°C)
with Cool-Top™	up to +356°F (+180°C)

All motors are designed for continuous duty in +104°F (+40°C) ambient air conditions. For higher ambient temperature conditions consult Grundfos.

* xUBE Shaft Seals are recommended for temperatures above +200°F. Pumps with hybrid shaft seals can only operate up to +200°F (+90°C). Pumps with xUUE shaft seals can be operated down to -40°F (-40°C) (where "x" is the seal type).

Pre-installation Checklist (continued)

Minimum Inlet Pressures

All CR, CRI, CRN	NPSHR + 2 feet
CRN-SF	29 psi (2 bar)

Maximum Inlet Pressures

Pump Type/Connection	50 Hz Stages	60 Hz Stages	Max. psi /bar
CR, CRI, CRN 1s	2 to 36	2 to 36	145 / 10
		27	217 / 15
CR, CRI, CRN 1	2 to 36	2 to 36	145 / 10
		27	217 / 15
CR, CRI, CRN 3	2 to 29	2 to 15	145 / 10
	31 to 36	17 to 25	217 / 15
CR, CRI, CRN 5	3 to 16	2 to 9	145 / 10
	18 to 36	10 to 24	217 / 15
CR, CRI, CRN 10	1 to 6	1 to 5	116 / 8
	7 to 22	6 to 18	145 / 10
CR, CRI, CRN 15	1 to 3	1 to 2	116 / 8
	4 to 17	3 to 12	145 / 10
CR, CRI, CRN 20	1 to 3	1	116 / 8
	4 to 17	2 to 10	145 / 10
CR, CRN 32	1-1 to 4	1-1 to 2	58 / 4
	5-2 to 10	3-2 to 6	145 / 10
	11 to 14	7-2 to 11-2	217 / 15
CR, CRN 45	1-1 to 2	1-1 to 1	58 / 4
	3-2 to 5	2-2 to 3	145 / 10
	6-2 to 13-2	4-2 to 8-1	217 / 15
CR, CRN 64	1-1 to 2-2	1-1	58 / 4
	2-1 to 4-2	1 to 2-1	145 / 10
	4-1 to 8-1	2 to 5-2	217 / 15
CR, CRN 90	1-1 to 1		58 / 4
	2-2 to 3-2	1-1 to 1	145 / 10
	3 to 6	2-2 to 4-1	217 / 15
CRT 2	2 to 11	2 to 6	145 / 10
	13 to 26	7 to 18	217 / 15
CRT 4	1 to 12	1 to 7	145 / 10
	14 to 22	8 to 16	217 / 15
CRT 8	1 to 20	1 to 16	145 / 10
CRT 16	2 to 16	2 to 10	145 / 10
CRN-SF	all	all	72 / 5*
			362 / 25**

* while pump is off or during start-up

** during operation

Maximum Operating Pressures
at 250°F (194°F for CRN-SF)

Pump Type/Connection	50 Hz Stages	60 Hz Stages	Max. psi /bar
CR, CRI, CRN 1s			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 1			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 3			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 5			
Oval flange	1 to 22	1 to 16	232 / 16
FGJ, PJE	1 to 36	1 to 24	362 / 25
CR, CRI, CRN 10			
Oval flange		1 to 10	145 / 10
Oval flange	1 to 16		232 / 16
FGJ, GJ, PJE	1 to 16	1 to 10	232 / 16
FGJ, GJ, PJE	17 to 22	12 to 17	362 / 25
CR, CRI, CRN 15			
Oval flange	1 to 7	1 to 5	145 / 10
FGJ, GJ, PJE	1 to 10	1 to 8	232 / 16
FGJ, GJ, PJE	12 to 17	9 to 12	362 / 25
CR, CRI, CRN 20			
Oval flange	1 to 7	1 to 5	145 / 10
FGJ, GJ, PJE	1 to 10	1 to 7	232 / 16
FGJ, GJ, PJE	12 to 17	8 to 10	362 / 25
CR, CRN 32	1-1 to 7	1-1 to 5	232 / 16
	8-2 to 12	6-2 to 8	362 / 25
	13-2 to 14	9-2 to 11-2	580 / 40
CR, CRN 45	1-1 to 5	1-1 to 4-2	232 / 16
	6-2 to 9	4-1 to 6	362 / 25
	10-2 to 13-2	7-2 to 8-1	580 / 40
CR, CRN 64	1-1 to 5	1-1 to 3	232 / 16
	6-2 to 8-1	4-2 to 5-2	362 / 25
CR, CRN 90	1-1 to 4	1-1 to 3	232 / 16
	5-2 to 6	4-2 to 4-1	362 / 25
CRT 2	2 to 26	2 to 18	305 / 21
CRT 4	1 to 22	1 to 16	305 / 21
CRT 8	1 to 12	1 to 8	232 / 16
	14 to 20	10 to 16	362 / 25
CRT 16	1 to 8	1 to 8	232 / 16
	10 to 16	10 to 12	362 / 25

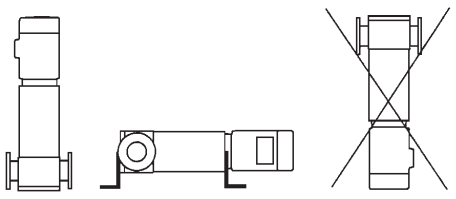
Consult Grundfos for other working conditions.

Select pump location

The pump should be located in a dry, well-ventilated area which is not subject to freezing or extreme variation in temperature. Care must be taken to ensure the pump is mounted at least 6 inches (150 mm) clear of any obstruction or hot surfaces. The motor requires an adequate air supply to prevent overheating and adequate vertical space to remove the motor for repair. For open systems requiring suction lift the pump should be located as close to the water source as possible to reduce piping losses.

Foundation

Concrete or similar foundation material should be used to provide a secure, stable mounting base for the pump. Bolt hole center line dimensions for the various pump types are given in Figure 1, page 6. Secure the pump to the foundation using all four bolts and shim pump base to assure the pump is vertical and all four pads on the base are properly supported. Uneven surfaces can result in pump base breakage when mounting bolts are tightened.



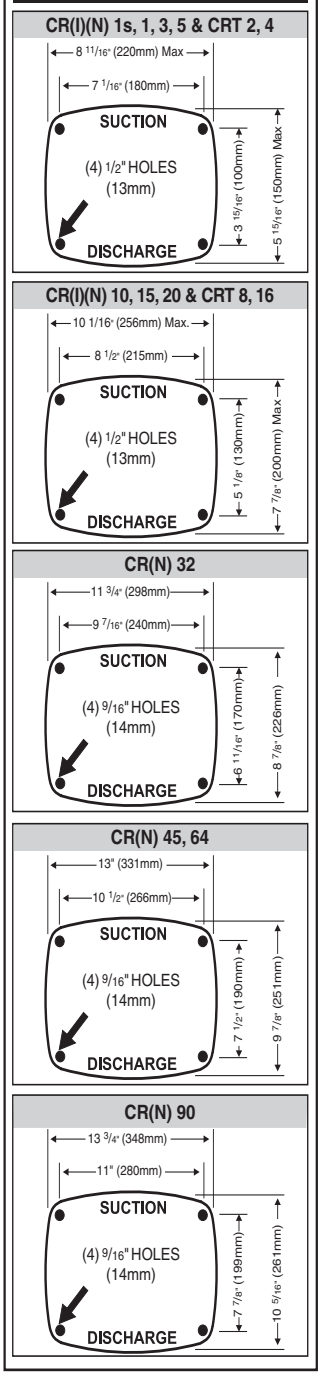
The pump can be installed vertically or horizontally (see drawing at right). Ensure that an adequate supply of cool air reaches the motor cooling fan. The motor must never fall below the horizontal plane.

Arrows on the pump base show the direction of flow of liquid through the pump.

To minimize possible noise from the pump, it is advisable to fit expansion joints on either side of the pump and anti-vibration mountings between the foundation and the pump.

Isolating valves should be fitted either side of the pump to avoid draining the system if the pump needs to be cleaned, repaired or replaced.

Figure 1: Bolt Hole Centers



Pipework

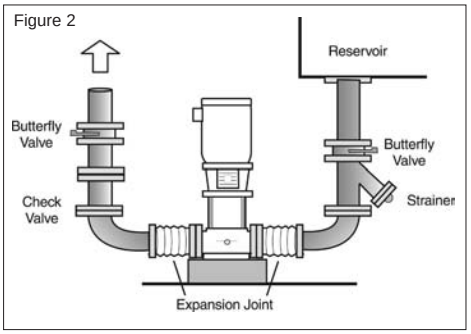
NOTE: The CR, CRI, CRN pumps are shipped with covered suction and discharge. The covers must be removed before the final pipe flange to pump connections are made.

Recommended installation torques

Model	Recommended foundation torque (ft.- lbs)	Recommended flange torque (ft.- lbs)
CR, CRI, CRN 1s/1/3/5, CRT 2/4	30	37 - 44
CR, CRI, CRN 10/15/20, CRT 8/16	37	44 - 52
CR, CRN 32/45/64/90	32	52 - 59

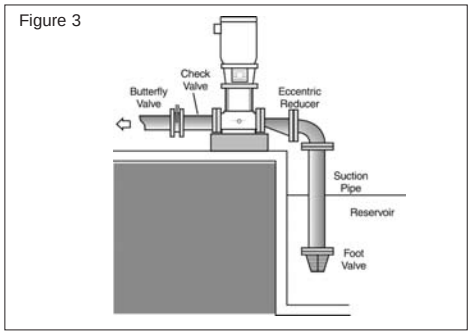
Flooded Suction

Figure 2



Suction Lift*

Figure 3



* CRN-SF pumps cannot be used for suction lift. The suction pipe should have a fitting on it for priming.

Suction pipe

The suction pipe should be adequately sized and run as straight and short as possible to keep friction losses to a minimum (minimum of four pipe diameters straight run prior to the suction flange). Avoid using unnecessary fittings, valves or accessory items. Butterfly or gate valves should only be used in the suction line when it is necessary to isolate a pump because of a flooded suction condition. This would occur if the water source is above the pump. See Figures 2 and 3. Flush piping prior to pump installation to remove loose debris.

Minimum suction pipe sizes

The following recommended suction pipe sizes are the smallest sizes which should be used with any specific CR pump type. The suction pipe size should be verified with each installation to ensure good pipe practices are being observed and excess friction losses are not encountered. High temperatures may require larger diameter pipes to reduce friction and improve NPHSA.

CR(I)(N) 1s, 1, 3, CRT 2	1”	Nominal diameter sch 40 pipe
CR(I)(N) 5, CRT 4	1 1/4”	Nominal diameter sch 40 pipe
CR(I)(N) 10, 15, 20, CRT 8, 16	2”	Nominal diameter sch 40 pipe
CR(N) 32	2 1/2”	Nominal diameter sch 40 pipe
CR(N) 45	3”	Nominal diameter sch 40 pipe
CR(N) 64	4”	Nominal diameter sch 40 pipe
CR(N) 90	4”	Nominal diameter sch 40 pipe

Discharge piping

It is suggested that a check valve and isolation valve be installed in the discharge pipe. Pipe, valves and fittings should be at least the same diameter as the discharge pipe or sized in accordance with good piping practices to reduce excessive fluid velocities and pipe friction losses. **Pipe, valves and fittings must have a pressure rating equal to or greater than the maximum system pressure.** Before the pump is installed it is recommended that the discharge piping be pressure checked to at least the maximum pressure the pump is capable of generating or as required by codes or local regulations.

Whenever possible, avoid high pressure loss fittings, such as elbows or branch tees directly on either side of the pump. The piping should be adequately supported to reduce thermal and mechanical stresses on the pump. Good installation practice recommends the system be thoroughly cleaned and flushed of all foreign materials and sediment prior to pump installation. Furthermore, the pump should never be installed at the lowest point of the system due to the natural accumulation of dirt and sediment. If there is excessive sediment or suspended particles present, it is advised a strainer or filter be used. Grundfos recommends that pressure gauges be installed on inlet and discharge flanges or in pipes to check pump and system performance.

NOTE: To avoid problems with waterhammer, fast closing valves must not be used in CRN-SF applications.

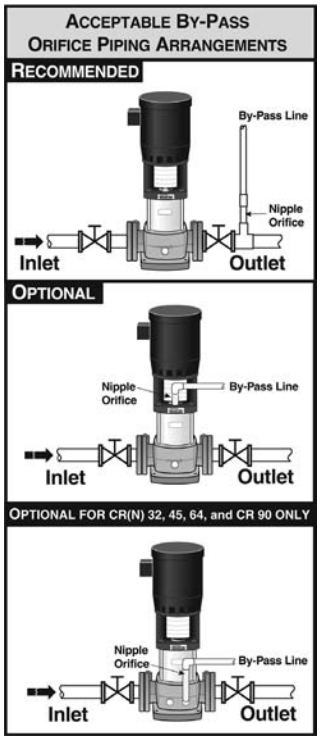


Table A

Minimum Continuous Duty Flow Rates for CR(I)(N)(T)

Pump Type	min°F to 176°F min°C to 80°C	at 210°F at 99°C	at 248°F at 120°C	at 356°F at 180°C
CR, CRI, CRN 1s	0.5	0.7	1.2	1.2*
CR, CRI, CRN 1	0.9	1.3	2.3	2.3*
CR, CRI, CRN 3	1.6	2.4	4.0	4.0*
CR, CRI, CRN 5	3.0	4.5	7.5	7.5*
CR, CRI, CRN 10	5.5	8.3	14	14*
CR, CRI, CRN 15	9.5	14	24	24*
CR, CRI, CRN 20	11	17	28	28*
CR, CRN 32	14	21	35	35*
CR, CRN 45	22	33	55	55*
CR, CRN 64	34	51	85	85*
CR, CRN 90	44	66	110	110*
CRT 2	1.3	2.0	3.3	N/A
CRT 4	3.0	4.5	7.5	N/A
CRT 8	4.0	6.0	10	N/A
CRT 16	8.0	12	20	N/A

*Grundfos Cool-Top is only available in the following pump types.

Pump Type	CR 1s	CR 1	CR 3	CR 5	CR 10	CR 15	CR 20	CR 32	CR 45	CR 64	CR 90
Standard (CR)								●	●	●	●
I Version (CRI)	●	●	●	●	●	●	●				
N Version (CRN)	●	●	●	●	●	●	●	●	●	●	●

Check valves

A check valve may be required on the discharge side of the pump to prevent the pump's inlet pressure from being exceeded. For example, if a pump with no check valve is stopped because there is no demand on the system (all valves are closed), the high system pressure on the discharge side of the pump will "find" its way back to the inlet of the pump. If the system pressure is greater than the pump's maximum inlet pressure rating, the limits of the pump will be exceeded and a check valve needs to be fitted on the discharge side of the pump to prevent this condition. **This is especially critical for CRN-SF applications because of the very high discharge pressures involved. As a result, most CRN-SF installations require a check valve on the discharge piping.**

Bypass

A bypass should be installed in the discharge pipe if there is any possibility the pump may operate against a closed valve in the discharge line. Flow through the pump is required to ensure adequate cooling and lubrication of the pump is maintained. See Table A for minimum flow rates. Elbows should be a minimum of 12" from the orifice discharge to prevent erosion.

Temperature rise

It may sometimes be necessary to stop the flow through a pump during operation. At shut-off, the power to the pump is transferred to the pumped liquid as head, causing a temperature rise in the liquid. The result is risk of excess heating of and consequent damage to the pump. The risk depends on the temperature of the pumped liquid and for how long the pump is operating without flow. (See temperature rise chart.)

Pump Type	Time for Temperature Rise of 18° F (10°C)	
	Seconds	Minutes
CR 1s, 1, 3	210	3.5
CR 5	240	4.0
CR 10	210	3.5
CR 15	150	2.5
CR 20	120	2.0
CR 32, 45, 64, 90	60	1.0

Conditions/Reservations

The listed times are subject to the following conditions/reservations:

- No exchange of heat with the surroundings.
- The pumped liquid is water with a specific heat of 1.0 $\frac{\text{Btu}}{\text{lb.°F}}$ (4.18 $\frac{\text{kJ}}{\text{kg°C}}$).
- Pump parts (chambers, impellers and shaft) have the same thermal capacity as water.
- The water in the base and the pump head is not included.

These reservations should give sufficient safety margin against excessive temperature rise.
The maximum temperature must not exceed the pump maximum rating.

Electrical

WARNING

THE SAFE OPERATION OF THIS PUMP REQUIRES THAT IT BE GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND LOCAL GOVERNING CODES OR REGULATIONS. CONNECT THE GROUND WIRE TO THE GROUNDING SCREW IN THE TERMINAL BOX AND THEN TO THE ACCEPTABLE GROUNDING POINT.

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

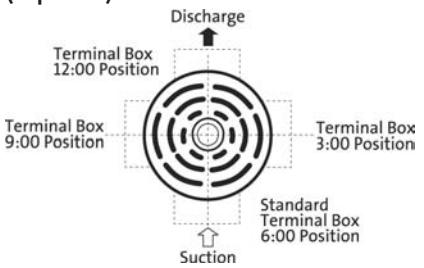
Motor

Grundfos CR pumps are supplied with heavy-duty 2-pole (3600 RPM nominal), ODP or TEFC, NEMA C frame motors selected to our rigid specifications. Motors with other enclosure types and for other voltages and frequencies are available on a special-order basis. CRN-SF pumps are supplied with an IEC (metric) type motor with a reverse thrust bearing. If you are replacing the pumping unit, but are using a motor previously used on another CR pump, be sure to read the "Motor Replacement" section on page 11 for proper adjustment of the coupling height.

Position of Terminal Box

The motor terminal box can be turned to any of four positions in 90° steps. To rotate the terminal box, remove the four bolts securing the motor to the pump but do not remove the shaft coupling; turn the motor to the desired location; replace and securely tighten the four bolts. See Figure 4.

Figure 4
Motor Terminal Box Positions (Top View)



Field Wiring

Wire sizes should be based on the current carrying properties of a conductor as required by the latest edition of the National Electrical Code or local regulations. Direct on line (D.O.L.) starting is approved due to the extremely fast run-up time of the motor and the low moment of inertia of pump and motor. If D.O.L. starting is not acceptable and reduced starting current is required, an auto transformer, resistant starter or soft start should be used. It is suggested that a fused disconnect be used for each pump where service and standby pumps are installed.

Motor Protection

1. **Single-Phase Motors:**

   With the exception of 10 HP motors which require external protection, single-phase CR pumps are equipped with multi-voltage, squirrel-cage induction motors with built-in thermal protection.

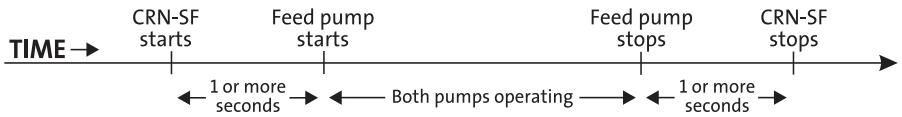
2. **Three-Phase Motors**

   CR pumps with three-phase motors must be used with the proper size and type of motor-starter to ensure the motor is protected against damage from low voltage, phase failure, current imbalance and overloads. A properly sized starter with manual reset and ambient-compensated extra quick trip in all three legs should be used. The overload should be sized and adjusted to the full-load current rating of the motor. Under no circumstances should the overloads be set to a higher value than the full load current shown on the motor nameplate. This will void the warranty. Overloads for auto transformers and resistant starters should be sized in accordance with the recommendations of the manufacturer. Three phase MLE motors (CRE-Pumps) require only fuses as a circuit breaker. They do not require a motor starter. Check for phase imbalance (worksheet is provided on page 17).

   NOTE: Standard allowable phase imbalance difference is 5%.

3. **CRN-SF**

   The CRN-SF is typically operated in series with a feed pump. Because the maximum allowable inlet pressure of the CRN-SF increases from 73 psi (when pump is off and during start-up) to 365 psi (during operation), a control device must be used to start the CRN-SF pump one second before the feed pump starts. Similarly, the CRN-SF must stop one second after the feed pump stops.



Starting the Pump the First Time

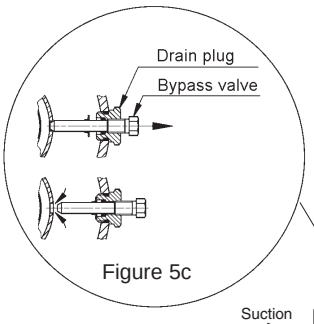


Figure 5c

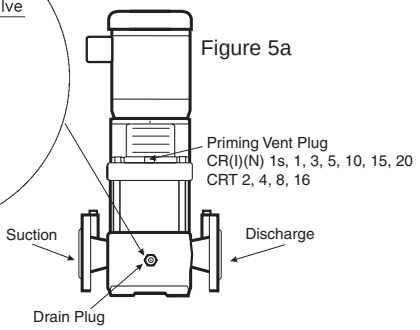


Figure 5a

Priming

To prime the pump in a closed system or an open system where the water source is above the pump, close the pump isolation valve(s) and open the priming plug on the pump head. See Figures 5a, 5b, and 5d. Gradually open the isolation valve in the suction line until a steady stream of airless water runs out the priming port. Close the plug and securely tighten. Completely open the isolation valves. **For pumps with Cool-Top, see page 14.**

In open systems where the water level is below the pump inlet, the suction pipe and pump must be filled and vented of air before starting the pump. Close the discharge isolation valve and remove the priming plug. Pour water through the priming hole until the suction pipe and pump are completely filled with water. If the suction pipe does not slope downward from the pump toward the water level, the air must be purged while being filled. Replace the priming plug and securely tighten.

1. Switch power off.
2. Check to make sure the pump has been filled and vented.
3. Remove the coupling guard and rotate the pump shaft by hand to be certain it turns freely.
4. Verify that the electrical connections are in accordance with the wiring diagram on the motor.
5. Switch the power on and observe the direction of rotation. When viewed from the top, the pump should rotate counter-clockwise (clockwise for CRN-SF).
6. To reverse the direction of rotation, first switch OFF the supply power.
7. On three-phase motors, interchange any two power leads at the load side of the starter. On single-phase motors, see connection diagram on nameplate. Change wiring as required.
8. Switch on the power and again check for proper motor rotation. Once rotation has been verified, switch off power again. Do not attempt to reinstall the coupling guards with the motor energized. Replace the coupling guard if the rotation is correct. After guards are in place the power can be reapplied.

Note - CR, CRI, CRN 1s to 5: For these pumps, it is advisable to open the bypass valve (Figure 5c) during start-up. The bypass valve connects the suction and discharge sides of the pump, thus making the filling procedure easier. When the operation is stable, the bypass valve must be closed.

CR(N) 32, 45, 64 & 90

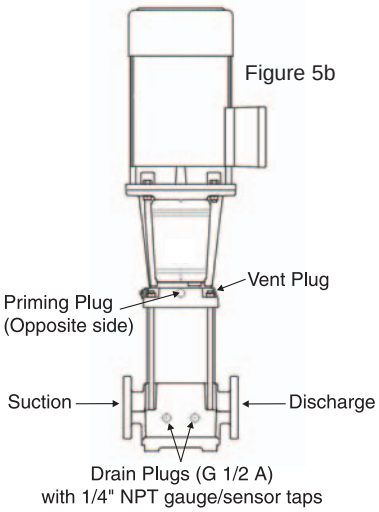


Figure 5b

NOTE: Motors should not be run unloaded or uncoupled from the pump at any time; damage to the motor bearings will occur.

REMINDER: Do not start the pump before priming or venting the pump (Figure 5d). Never operate the pump dry.

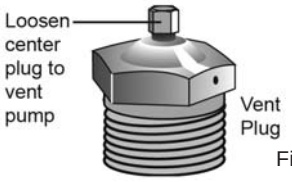


Figure 5d

Operating Parameters

CR multi-stage centrifugal pumps installed in accordance with these instructions and sized for correct performance will operate efficiently and provide years of service. The pumps are water-lubricated and do not require any external lubrication or inspection. The motors may require periodic lubrication as noted in the following Maintenance Section.

Under no circumstances should the pump be operated for any prolonged periods of time without flow through the pump. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed to allow sufficient water to circulate through the pump to provide adequate cooling and lubrication of the pump bearings and seals.

Pump Cycling

Pump cycling should be checked to ensure the pump is not starting more than:

20 times per hour on 1/3 to 5 HP models
15 times per hour on 7 1/2 to 15 HP models
10 times per hour on 20 to 60 HP models

Rapid cycling is a major cause of premature motor failure due to increased heat build-up in the motor. If necessary, adjust controls to reduce the frequency of starts and stops.

Boiler-feed installations

If the pump is being used as a boiler-feed pump, make sure the pump is capable of supplying sufficient water throughout its entire evaporation and pressure ranges. Where modulating control valves are used, a bypass around the pump must be installed to ensure pump lubrication (see “Minimum Continuous Duty Flow Rates”).

Freeze Protection

If the pump is installed in an area where freezing could occur, the pump and system should be drained during freezing temperatures to avoid damage. To drain the pump, close the isolation valves, remove the priming plug and drain plug at the base of the pump. Do not replace the plugs until the pump is to be used again. Always replace the drain plug with the original or exact replacement. **Do not** replace with a standard plug. Internal recirculation will occur, reducing the output pressure and flow.

Motor Inspection

Inspect the motor at regular intervals, approximately every 500 hours of operation or every three months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

WARNING:

DO NOT TOUCH ELECTRICAL CONNECTIONS BEFORE YOU FIRST ENSURE THAT POWER HAS BEEN DISCONNECTED. ELECTRICAL SHOCK CAN CAUSE SERIOUS OR FATAL INJURY. ONLY QUALIFED PERSONNEL SHOULD ATTEMPT INSTALLATION, OPERATION, AND MAINTENANCE OF THIS EQUIPMENT.

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper, pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Use an Ohmmeter ("Megger") periodically to ensure that the integrity of the winding insulation has been maintained. Record the Ohmmeter readings. Immediately investigate any significant drop in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

Motor Lubrication

Electric motors are pre-lubricated at the factory and do not require additional lubrication at start-up. Motors without external grease fittings have sealed bearings that cannot be re-lubricated. Motors with grease fittings should **only** be lubricated with approved types of grease. Do not **over-grease** the bearings. Over greasing will cause increased bearing heat and can result in bearing/motor failure. Do not mix petroleum grease and silicon grease in motor bearings.

Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearings, the speed at which the bearings operate and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program. It should also be noted that pumps with more stages, pumps running to the left of the performance curve, certain pump ranges may have higher thrust loads. Pumps with high thrust loads should be greased according to the next service interval level.

If pump is fitted with a bearing flange that requires grease, see the stickers on either the bearing flange or coupling guards for proper grease type and greasing schedule.

Severity of Service	Ambient Temperature (Maximum)	Environment	Approved Types of Grease
Standard	+104°F (+40°C)	Clean, little corrosion	Grundfos ML motors are greased for life or will have the grease type on the nameplate. Baldor motors are greased with Polyrex EM (Exxon Mobile).
Severe	+122°F (+50°C)	Moderate dirt, corrosion	
Extreme	>+122°F (+50°C) or Class H insulation	Severe dirt, abrasive dust, corrosion	

Motor Lubrication Schedule (for Motors with Grease Nipples)

New motors that have been stored for a year or more should be regreased.

NEMA/(IEC) Frame Size	Standard Service Interval	Severe Service Interval	Extreme Service Interval	Weight of Grease to Add Oz./(Grams)	Volume of Grease to Add In^3/(Teaspoons)
Up through 210 (132)	5500 hrs.	2750 hrs.	550 hrs.	0.30 (8.4)	0.6 (2)
Over 210 through 280 (180)	3600 hrs.	1800 hrs.	360 hrs.	0.61 (17.4)*	1.2 (3.9)*
Over 280 up through 360 (225)	2200 hrs.	1100 hrs.	220 hrs.	0.81 (23.1)*	1.5 (5.2)*
Over 360 (225)	2200 hrs.	1100 hrs.	220 hrs.	2.12 (60.0)*	4.1 (13.4)*

*The grease outlet plug MUST be removed before adding new grease.

Procedure

CAUTION:

TO AVOID DAMAGE TO MOTOR BEARINGS, GREASE MUST BE KEPT FREE OF DIRT. FOR AN EXTREMELY DIRTY ENVIRONMENT, CONTACT GRUNDFOS, THE MOTOR MANUFACTURER OR AN AUTHORIZED SERVICE CENTER FOR ADDITIONAL INFORMATION. MiXING DISSIMILAR GREASE IS NOT RECOMMENDED.

1. Clean all grease fittings. If the motor does not have grease fittings, the bearing is sealed and cannot be greased externally.
2. If the motor is equipped with a grease outlet plug, remove it. This will allow the old grease to be displaced by the new grease.
3. If the motor is stopped, add the recommended amount of grease. If the motor is to be greased while running, a slightly greater quantity of grease will have to be added.

   NOTE: If new grease does not appear at the shaft hole or grease outlet plug, the outlet passage may be blocked. At the next service interval the bearings must be repacked.

   Add grease SLOWLY taking approximately one minute until new grease appears at the shaft hole in the endplate or grease outlet plug. Never add more than 1-1/2 times the amount of grease shown in the lubrication schedule.
4. For motors equipped with a grease outlet plug, let the motor run for 20 minutes before replacing the plug.

Preventative Maintenance

At regular intervals depending on the conditions and time of operation, the following checks should be made:

1. Pump meets required performance and is operating smoothly and quietly.
2. There are no leaks, particularly at the shaft seal.
3. The motor is not overheating.
4. Remove and clean all strainers or filters in the system.
5. Verify the tripping of the motor overload protection.
6. Check the operation of all controls. Check unit control cycling twice and adjust, if necessary.
7. If the pump is not operated for unusually long periods, the unit should be maintained in accordance with these instructions. In addition, if the pump is not drained, the pump shaft should be manually rotated or run for short periods of time at monthly intervals.
8. To extend the pump life in severe duty applications, consider performing one of the following actions:
   - Drain the pump after each use.
   - Flush the pump , through system, with water or other fluid that is compatible with the pump materials and process liquid.
   - Disassemble the pump liquid components and thoroughly rinse or wash them with water or other fluid that is compatible with the pump materials and process liquid.

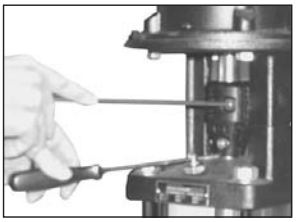
   If the pump fails to operate or there is a loss of performance, refer to the Troubleshooting Section on pages 15 - 16.

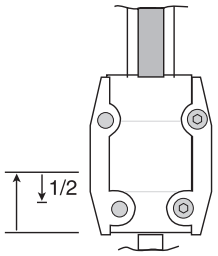
Motor Replacement

If the motor is damaged due to bearing failure, burning or electrical failure, the following instructions detail how to remove the motor for replacement. It must be emphasized that motors used on CR pumps are specifically selected to our rigid specifications. Replacement motors must be of the same frame size, should be equipped with the same or better bearings and have the same service factor. Failure to follow these recommendations may result in premature motor failure.

Figure 6

CRT 2, 4, 8, and 16





- Note the clearance below the coupling
- Raise the coupling higher, as far as it will go.
- Lower it halfway back down (1/2 the distance you just raised it).
- Tighten screws (see torque specifications below)

Disassembly

1. Turn off and lock out power supply. The power supply wiring can not be safely disconnected from the motor wires.
2. Remove the coupling guards.

   CR 1s, 1, 3, 5, 10, 15, and 20: do not loosen the three shaft seal securing allen screws.
3. Using the proper metric Allen wrench, loosen the four cap screws in the coupling. Completely remove coupling halves. On CR1s-CR20, the shaft pin can be left in the pump shaft. CR(N)32, 45, 64 and 90 do not have a shaft pin.
4. With the correct size wrench, loosen and remove the four bolts which hold the motor to the pump end.
5. Lift the motor straight up until the shaft has cleared the motor stool.

Assembly

1. Remove key from motor shaft, if present, and discard.
2. Thoroughly clean the surfaces of the motor and pump end mounting flange. The motor and shaft must be clean of all oil/grease and other contaminants where the coupling attaches. Set the motor on the pump end.
3. Place the terminal box in the desired position by rotating the motor.
4. Insert the mounting bolts, then diagonally and evenly tighten. For 3/8" bolts (1/2 to 2 HP), torque to 17 ft.-lbs., for 1/2" bolts (3 to 40 HP) torque to 30 ft.-lbs., and for 5/8" bolts (50 - 60 HP) torque to 59 ft.-lbs.
5. **CR 1s, 1, 3, and 5:**
   Insert shaft pin into shaft hole. Reinstall the coupling halves onto shaft and shaft pin. Reinstall the coupling screws and leave loose. Check that the gaps on either side of the coupling are even, and that the motor shaft keyway is centered in the coupling half, as shown in Figure 6a, page 12. Tighten the screws to the correct torque.

   CR 10, 15 and 20:

   Insert shaft pin into shaft hole. Insert plastic shaft seal spacer beneath shaft seal collar. Reinstall the coupling halves onto shaft and shaft pin. Reinstall the coupling screws and leave loose. Check that the gaps on either side of the coupling are even and that the motor shaft key way is centered in the coupling half, as shown in Figure 6a, page 12. Tighten the screws to the correct torque. Remove plastic shaft seal spacer and hang it on inside of coupling guard.

   CRT 2, 4, 8 and 16:

   Reinstall coupling halves. Make sure the shaft pin is located in the pump shaft. Put the cap screws loosely back into the coupling halves. Using a large screwdriver, raise the pump shaft by placing the tip of the screwdriver under the coupling and carefully elevating the coupling to its highest point (see Figure 6). Note: the shaft can only be raised approximately 0.20 inches (5mm). Now lower the shaft half way back down the distance you just raised it and tighten the coupling screws (finger tight) while keeping the coupling separation equal on both sides. When the screws are tight enough to keep the couplings in place, then torque the screws evenly in a criss-cross pattern.

CR(N) 32, 45, 64 & CR90:

Place the plastic adjustment fork under the cartridge seal collar (see Figure 7).

Fit the coupling on the shaft so that the top of the pump shaft is flush with the bottom of the clearance chamber in the coupling (see Figure 8).

Lubricate the coupling screws with an anti-seize and lubricating compound. Tighten the coupling screws (finger tight) while keeping the coupling separation equal on both sides and the motor shaft keyway centered in the coupling half as shown in Figure 6a.

When the screws are tight enough to keep the couplings in place, then torque the screws evenly in a crisscross pattern.

Torque coupling screws to 62 ft.-lbs. Remove the adjustment fork from under the cartridge seal collar and replace it to the storage location (see Figure 9).

Torque Specifications CR(I)(N) 1s, 1, 3, 5, 10, 15, and 20 CRT 2, 4, 8, and 16	
Coupling Bolt Size	**Min. Torque Specifications**
M6	10 ft-lbs.
M8	23 ft-lbs.
M10	46 ft-lbs.

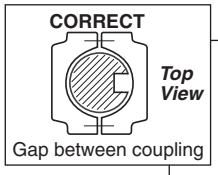
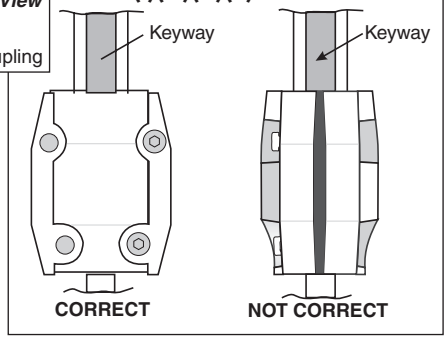
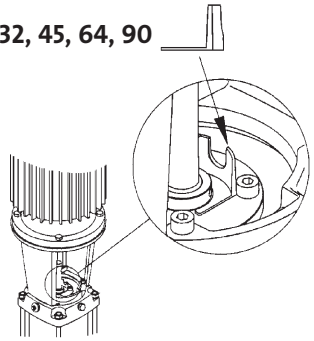


Figure 6a
All CR(I)(N)(X)(T)



6. Check to see that the gaps between the coupling halves are equal. Loosen and readjust, if necessary.
7. Be certain the pump shaft can be rotated by hand. If the shaft cannot be rotated or it binds, disassemble and check for misalignment.
8. Prime the pump.
9. Follow the wiring diagram on the motor label for the correct motor wiring combination which matches your supply voltage. Once this has been confirmed, reconnect the power supply wiring to the motor.
10. Check the direction of rotation, by bump-starting the motor. Rotation must be left to right (counter-clockwise) when looking directly at the coupling.
11. Shut off the power, then re-install the coupling guards. After the coupling guards have been installed the power can be turned back on.

Figure 7
CR(N) 32, 45, 64, 90

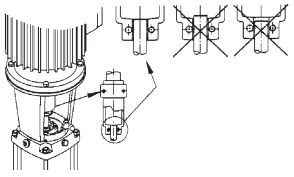


Parts List

For each CR pump model Grundfos offers an extensive **Parts List** and diagram of part used in that pump and is recommended to have on hand for future maintenance. In addition, the listings also provide information about prepackaged **Service Kits** for those pump components most likely to exhibit wear over time, as well as the complete Impeller Stack needed to replace the "guts" of each model. These Parts Lists are available separately from the Grundfos literature warehouse or as a set with extensive service instructions in the Grundfos CR **Service Manuals** (for a small charge).

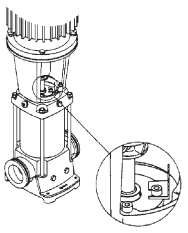
Left, prepackaged impeller stacks ready for immediate installation; right, prepackaged flange kits.

Figure 8



NOTE: To avoid damaging the coupling halves, ensure that no portion of the keyway on the motor shaft lies within the gap between the two coupling halves.

Figure 9



Spare Parts

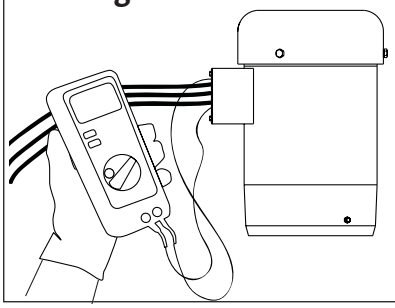
Grundfos offers an extensive list of spare parts. For a current list of these parts, refer to: "All Product Spare Parts/Service Kits" Price List, Form # L-SK-SL-002.

WARNING:

WHEN WORKING WITH ELECTRICAL CIRCUITS, USE CAUTION TO AVOID ELECTRICAL SHOCK. IT IS RECOMMENDED THAT RUBBER GLOVES AND BOOTS BE WORN, AND METAL TERMINAL BOXES AND MOTORS ARE GROUNDED BEFORE ANY WORK IS DONE. FOR YOUR PROTECTION, ALWAYS DISCONNECT THE PUMP FROM ITS POWER BEFORE HANDLING.

Preliminary tests

Supply voltage



How to measure

Use a voltmeter, (set to the proper scale) measure the voltage at the pump terminal box or starter.

On single-phase units, measure between power leads L1 and L2 (or L1 and N for 115 volt units). On three-phase units, measure between:

- Power leads L1 and L2
- Power leads L2 and L3
- Power leads L3 and L1

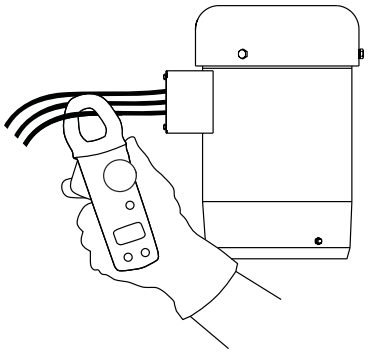
What it means

When the motor is under load, the voltage should be within ±10% of the nameplate voltage. Larger voltage variation may cause winding damage.

Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected.

If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.

Current measurement



How to Measure

Use an ammeter, (set on the proper scale) to measure the current on each power lead at the terminal box or starter. See the motor nameplate for amp draw information.

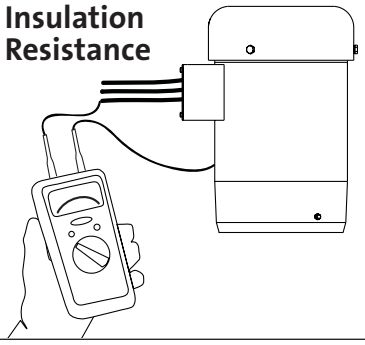
Current should be measured when the pump is operating at constant discharge pressure.

What it Means

If the amp draw exceeds the listed service factor amps (SFA) or if the current imbalance is greater than 5% between each leg on three-phase units, check the following:

1. Burned contacts on motor starter.
2. Loose terminals in starter or terminal box or possible wire defect.
3. Too high or too low supply voltage.
4. Motor windings are shorted or grounded. Check winding and insulation resistances.
5. Pump is damaged causing a motor overload.

Insulation Resistance



How to Measure

Turn off power and disconnect the supply power leads in the pump terminal box. Using an ohm or mega ohm meter, set the scale selector to Rx 100K and zero adjust the meter.

Measure and record the resistance between each of the terminals and ground.

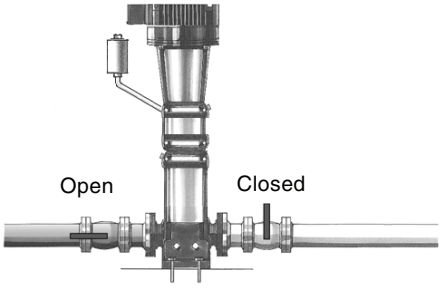
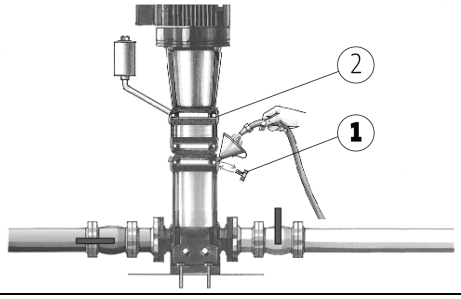
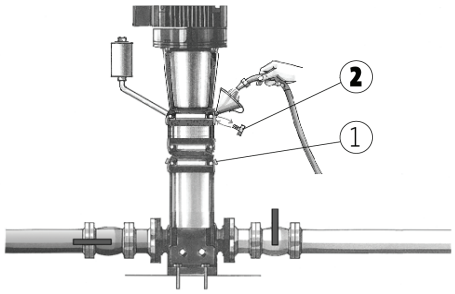
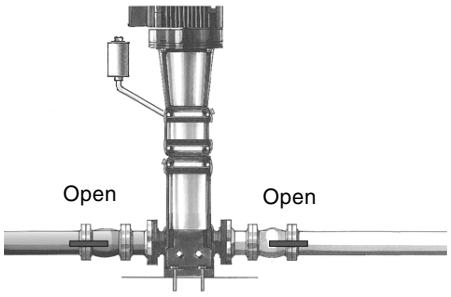
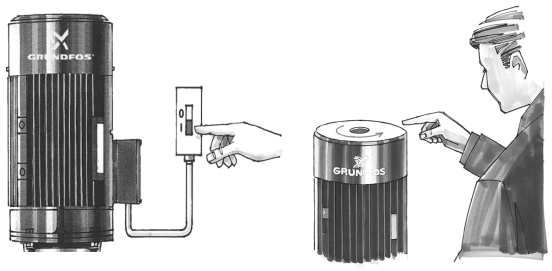
What it Means

Motors of all HP, voltage, phase and cycle duties have the same value of insulation resistance. Resistance values for new motors must exceed 1,000,000 ohms. If they do not, motor should be repaired or replaced.

Startup for Cool-Top (from page 9)

Note: Do not start the pump until it has been filled with liquid and vented.

Pay attention to the direction of the vent hole and take care to ensure that the escaping liquid does not cause injury to persons or damage to the motor or other components.
In hot-liquid installations, special attention should be paid to the risk of injury caused by scalding hot liquid.
It is recommended to connect a drain pipe to the ½" air vent in order to lead the hot water/steam to a safe place.

Step		Action
1	 TM02 4151 5001	**Note:** The air-cooled top should only be started up with cold liquid. Close the isolation valve on the discharge side and open the isolation valve on the suction side of the pump.
2	 TM02 4152 1503	Remove the priming plug from the **pump head** (**1**) and slowly fill the pump with liquid. When the pump is completely filled with liquid, replace the priming plug and tighten securely.
3	 TM02 4153 1503	Remove the priming plug from the **air-cooled chamber** (**2**) and slowly fill the chamber with liquid. When the chamber is completely filled with liquid, replace the priming plug and tighten securely.
4	 TM02 5907 4002	Open the isolation valve on the discharge side of the pump. Valve may have to be partially closed when pump is started if no back pressure is present (i.e. boiler not up to pressure).
5	 TM01 1406 3702 / TM01 1405 4497	Start the pump and check the direction of rotation. See the correct direction of rotation of the pump on the motor fan cover. If the direction of rotation is wrong, interchange any two of the incoming supply wires. After 3 to 5 minutes, the air vent has been filled with liquid. **Note:** During start-up of a cold pump with hot liquid, it is normal that a few drops of liquid are leaking from the sleeve.

Diagnosing specific problems

Problem	Possible cause	Remedy
The pump does not run	1. No power at motor.	Check for voltage at motor terminal box. If no voltage at motor, check feeder panel for tripped circuits and reset circuit.
	2. Fuses are blown or circuit breakers are tripped.	Turn off power and remove fuses. Check for continuity with ohmmeter. Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation, motor and wires must be checked.
	3. Motor starter overloads are burned or have tripped out.	Check for voltage on line and load side of starter. Replace burned heaters or reset. Inspect starter for other damage. If heater trips again, check the supply voltage and starter holding coil.
	4. Starter does not energize.	Energize control circuit and check for voltage at the holding coil. If no voltage, check control circuit fuses. If voltage, check holding coil for shorts. Replace bad coil.
	5. Defective controls.	Check all safety and pressure switches for operation. Inspect contacts in control devices. Replace worn or defective parts or controls.
	6. Motor is defective.	Turn off power and disconnect wiring. Measure the lead to lead resistances with ohmmeter (RX-1). Measure lead to ground values with ohmmeter (RX-100K). Record measured values. If an open or grounded winding is found, remove motor and repair or replace.
	7. Defective capacitor. (Single-phase motors)	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace if defective.
	8. Pump is bound.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
The pump runs but at reduced capacity or does not deliver water	1. Wrong rotation	Check wiring for proper connections. Correct wiring.
	2. Pump is not primed or is airbound.	Turn pump off, close isolation valve(s), remove priming plug. Check fluid level. Refill the pump, replace plug and start the pump. Long suction lines must be filled before starting the pump.
	3. Strainers, check or foot valves are clogged.	Remove strainer, screen or valve and inspect. Clean and replace. Reprime pump.
	4. Suction lift too large.	Install compound pressure gauge at the suction side of the pump. Start pump and compare reading to performance data. Reduce suction lift by lowering pump, increase suction line size or removing high friction loss devices.
	5. Suction and/or discharge piping leaks.	Pump runs backwards when turned off. Air in suction pipe. Suction pipe, valves and fittings must be airtight. Repair any leaks and retighten all loose fittings.
	6. Pump worn.	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shutoff. Convert measured pressure (in PSI) to head (in feet): (Measured PSI x 2.31 ft./PSI = _____ ft.). Refer to the specific pump curve for shutoff head for that pump model. If head is close to curve, pump is probably OK. If not, remove pump and inspect.
	7. Pump impeller or guide vane is clogged.	Disassemble and inspect pump passageways. Remove any foreign materials found.

Diagnosing specific problems

Problem	Possible cause	Remedy
The pump runs but at reduced capacity or does not deliver water (continued)	8. Incorrect drain plug installed.	If the proper drain plug is replaced with a standard plug, water will recirculate internally. Replace with proper plug.
	9. Improper coupling setting.	Check/reset the coupling, see page 11 - 12.
Pump cycles too much	1. Pressure switch is not properly adjusted or is defective.	Check pressure setting on switch and operation. Check voltage across closed contacts. Readjust switch or replace if defective.
	2. Level control is not properly set or is defective.	Check setting and operation. Readjust setting (refer to level control manufacturer's data). Replace if defective.
	3. Insufficient air charging or leaking tank or piping.	Pump air into tank or diaphragm chamber. Check diaphragm for leak. Check tank and piping for leaks with soap and water solution. Check air to water volume. Repair as necessary.
	4. Tank is too small.	Check tank size and air volume in tank. Tank volume should be approximately 10 gallons for each gpm of pump capacity. The normal air volume is 2/3 of the total tank volume at the pump cut-in pressure. Replace tank with one of correct size.
	5. Pump is oversized.	Install pressure gauges on or near pump suction and discharge ports. Start and run pump under normal conditions, record gauge readings. Convert PSI to feet (Measured PSI x 2.31 ft./PSI = _____ ft.) Refer to the specific pump curve for that model, ensure that total head is sufficient to limit pump delivery within its design flow range. Throttle pump discharge flow if necessary.
Fuses blow or circuit breakers or overload relays trip	1. Low voltage.	Check voltage at starter panel and motor. If voltage varies more than ±10%, contact power company. Check wire sizing.
	2. Motor overloads are set too low.	Cycle pump and measure amperage. Increase heater size or adjust trip setting to a maximum of motor nameplate (full load) current.
	3. Three-phase current is imbalanced.	Check current draw on each lead to the motor. Must be within ±5%. If not, check motor and wiring. Rotating all leads may eliminate this problem.
	4. Motor is shorted or grounded.	Turn off power and disconnect wiring. Measure the lead-to-lead resistance with an ohmmeter (RX-1). Measure lead-to-ground values with an ohmmeter (RX-100K) or a megaohm meter. Record values. If an open or grounded winding is found, remove the motor, repair and/or replace.
	5. Wiring or connections are faulty.	Check proper wiring and loose terminals. Tighten loose terminals. Replace damaged wire.
	6. Pump is bound.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
	7. Defective capacitor (single-phase motors).	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace if defective.
	8. Motor overloads at higher ambient temperature than motor.	Use a thermometer to check the ambient temperature near the overloads and motor. Record these values. If ambient temperature at motor is lower than at overloads, especially where temperature at overloads is above +104°F (+40°C), ambient-compensated heaters should replace standard heaters.

Three Phase Motors

Below is a worksheet for calculating current unbalance on a three-phase hookup. Use the calculations below as a guide.

EXPLANATION & EXAMPLES	
Here is an example of current readings at maximum pump loads on each leg of a three-wire hookup. You must make calculations for all three hookups. To begin, add up all three readings for hookup number 1, 2, and 3.	**Hookup 1** T1 = 51 Amps T2 = 46 Amps T3 = 53 Amps TOTAL = 150 Amps
Divide the total by three to obtain the average.	**Hookup 1** 50 Amps 3|150 Amps
Calculate the greatest current difference from the average.	**Hookup 1** 50 Amps – 46 Amps 4 Amps
Divide this difference by the average to obtain the percentage of unbalance. In this case, the current unblanace for hookup number 1 is 8%.	**Hookup 1** .08 or 8% 50| 4.00 Amps

NOTE:
Current unbalance should not exceed 5% at service factor load or 10% at rated input load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the power source. However, if the reading farthest from the averages moves with the same motor lead, the primary source of unbalance is on the "motor side" of the starter. In this instance, consider a damaged cable, leaking splice, poor connection, or faulty motor winding.

FIGURE HERE		
Hookup 1 L_1 to T_1 = _____ Amps L_2 to T_2 = _____ Amps L_3 to T_3 = _____ Amps TOTAL = _____ Amps	**Hookup 2** L_1 to T_3 = _____ Amps L_2 to T_1 = _____ Amps L_3 to T_2 = _____ Amps TOTAL = _____ Amps	**Hookup 3** L_1 to T_2 = _____ Amps L_2 to T_3 = _____ Amps L_3 to T_1 = _____ Amps TOTAL = _____ Amps
Hookup 1 _____ Amps 3| _____ Amps	**Hookup 2** _____ Amps 3| _____ Amps	**Hookup 3** _____ Amps 3| _____ Amps
Hookup 1 _____ Amps – _____ Amps _____ Amps	**Hookup 2** _____ Amps – _____ Amps _____ Amps	**Hookup 3** _____ Amps – _____ Amps _____ Amps
Hookup 1 _____ or _____% _____|_____ Amps	**Hookup 2** _____ or _____% _____|_____ Amps	**Hookup 3** _____ or _____% _____|_____ Amps

LIMITED WARRANTY

Products manufactured by (GRUNDFOS) GRUNDFOS PUMPS CORPORATION are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture. GRUNDFOS' liability under this warranty shall be limited to repairing or replacing at GRUNDFOS' option, without charge, F.O.B. GRUNDFOS' factory or authorized service station, any product of GRUNDFOS' manufacture. GRUNDFOS will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by GRUNDFOS are subject to the warranty provided by the manufacturer of said products and not by GRUNDFOS' warranty. GRUNDFOS will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with GRUNDFOS' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of GRUNDFOS' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact GRUNDFOS or an authorized service station for instructions. Any defective product to be returned to GRUNDFOS or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

ISO 9001 CERTIFIED

L-CP-TL-003 12/05 (US)
Subject to alterations

GRUNDFOS Pumps Corporation
17100 West 118th Terrace
Olathe, Kansas 66061
Telephone: 913 227 3400
Fax: 913 227 3500
www.grundfos.com

GRUNDFOS Canada Inc.
2941 Brighton Road
Oakville, Ontario L6H 6C9 Canada
Telephone: 905 829 9533
Fax: 905 829 9512

Bombas GRUNDFOS de Mexico S.A. de C.V.
Boulevard TLC #15, Parque Stiva Aeropuerto
Apodaca, N.L. 66600 Mexico
Telephone: 52 81 8144 4000
Fax: 52 81 8144 4010

GRUNDFOS

Declaration of Conformity

We **GRUNDFOS** declare under our sole responsibility that the products **CR, CRI** and **CRN**, to which this declaration relates, are in conformity with the Council Directives on the approximation of the laws of the EC Member States relating to

— Machinery (98/37/EC).
Standard used: EN 292.

— Electromagnetic compatibility (89/336/EEC).
Standards used: EN 61 000-6-2 and EN 61 000-6-3.

— Electrical equipment designed for use within certain voltage limits (73/23/EEC) [95].
Standards used: EN 60 335-1 and EN 60 335-2-51.

Konformitätserklärung

Wir **GRUNDFOS** erklären in alleiniger Verantwortung, daß die Produkte **CR, CRI** und **CRN**, auf die sich diese Erklärung bezieht, mit den folgenden Richtlinien des Rates zur Angleichung der Rechtsvorschriften der EG-Mitgliedstaaten übereinstimmen:

— Maschinen (98/37/EG).
Norm, die verwendet wurde: EN 292.

— Elektromagnetische Verträglichkeit (89/336/EWG).
Normen, die verwendet wurden: EN 61 000-6-2 und EN 61 000-6-3.

— Elektrische Betriebsmittel zur Verwendung innerhalb bestimmter Spannungsgrenzen (73/23/EWG) [95].
Normen, die verwendet wurden: EN 60 335-1 und EN 60 335-2-51.

Déclaration de Conformité

Nous **GRUNDFOS** déclarons sous notre seule responsabilité que les produits **CR, CRI** et **CRN** auxquels se réfère cette déclaration sont conformes aux Directives du Conseil concernant le rapprochement des législations des Etats membres CE relatives à

— Machines (98/37/CE).
Standard utilisé: EN 292.

— Compatibilité électromagnétique (89/336/CEE).
Standards utilisés: EN 61 000-6-2 et EN 61 000-6-3.

— Matériel électrique destiné à employer dans certaines limites de tension (73/23/CEE) [95].
Standards utilisés: EN 60 335-1 et EN 60 335-2-51.

Dichiarazione di Conformità

Noi **GRUNDFOS** dichiariamo sotto la nostra esclusiva responsabilità che i prodotti **CR, CRI** e **CRN**, ai quali questa dichiarazione si riferisce, sono conformi alle Direttive del consiglio concernenti il ravvicinamento delle legislazioni degli Stati membri CE relative a

— Macchine (98/37/CE).
Standard usato: EN 292.

— Compatibilità elettromagnetica (89/336/CEE).
Standard usati: EN 61 000-6-2 e EN 61 000-6-3.

— Materiale elettrico destinato ad essere utilizzato entro certi limiti di tensione (73/23/CEE) [95].
Standard usati: EN 60 335-1 e EN 60 335-2-51.

Declaración de Conformidad

Nosotros **GRUNDFOS** declaramos bajo nuestra única responsabilidad que los productos **CR, CRI** y **CRN** a los cuales se refiere esta declaración son conformes con las Directivas del Consejo relativas a la aproximación de las legislaciones de los Estados Miembros de la CE sobre

— Máquinas (98/37/CE).
Norma aplicada: EN 292.

— Compatibilidad electromagnética (89/336/CEE).
Normas aplicadas: EN 61 000-6-2 y EN 61 000-6-3.

— Material eléctrico destinado a utilizarse con determinados límites de tensión (73/23/CEE) [95].
Normas aplicadas: EN 60 335-1 y EN 60 335-2-51.

Declaração de Conformidade

Nós **GRUNDFOS** declaramos sob nossa única responsabilidade que os produtos **CR, CRI** e **CRN** aos quais se refere esta declaração estão em conformidade com as Directivas do Conselho das Comunidades Europeias relativas à aproximação das legislações dos Estados Membros respeitantes à

— Máquinas (98/37/CE).
Norma utilizada: EN 292.

— Compatibilidade electromagnética (89/336/CEE).
Normas utilizadas: EN 61 000-6-2 e EN 61 000-6-3.

— Material eléctrico destinado a ser utilizado dentro de certos limites de tensão (73/23/CEE) [95].
Normas utilizadas: EN 60 335-1 e EN 60 335-2-51.

Δήλωση Συμμόρφωσης

Εμείς η **GRUNDFOS** δηλώνουμε με αποκλειστικά δική μας ευθύνη ότι τα προιόντα **CR, CRI** και **CRN** συμμορφώνονται με την Οδηγία του Συμβουλίου επί της σύγκλισης των νόμων των Κρατών Μελών της Ευρωπαικής Ενωσης σε σχέση με τα

— Μηχανήματα (98/37/EC).
Πρότυπο που χρησιμοποιήθηκε: EN 292.

— Ηλεκτρομαγνητική συμβατότητα (89/336/EEC).
Πρότυπα που χρησιμοποιήθηκαν: EN 61 000-6-2 και EN 61 000-6-3.

— Ηλεκτρικές συσκευές σχεδιασμένες γιά χρήση εντός ορισμένων ορίων ηλεκτρικής τάσης (73/23/EEC) [95].
Πρότυπα που χρησιμοποιήθηκαν: EN 60 335-1 και EN 60 335-2-51.

Overeenkomstigheidsverklaring

Wij **GRUNDFOS** verklaren geheel onder eigen verantwoordelijkheid dat de produkten **CR, CRI** en **CRN** waarop deze verklaring betrekking heeft in overeenstemming zijn met de Richtlijnen van de Raad inzake de onderlinge aanpassing van de wetgevingen van de Lid-Staten betreffende

— Machines (98/37/EG).
Norm: EN 292.

— Elektromagnetische compatibiliteit (89/336/EEG).
Normen: EN 61 000-6-2 en EN 61 000-6-3.

— Elektrisch materiaal bestemd voor gebruik binnen bepaalde spanningsgrenzen (73/23/EEG) [95].
Normen: EN 60 335-1 en EN 60 335-2-51.

Försäkran om överensstämmelse

Vi **GRUNDFOS** försäkrar under ansvar, att produkterna **CR, CRI** och **CRN**, som omfattas av denna försäkran, är i överensstämmelse med Rådets Direktiv om inbördes närmande till EU-medlemsstaternas lagstiftning, avseende

— Maskinell utrustning (98/37/EC).
Använd standard: EN 292.

— Elektromagnetisk kompatibilitet (89/336/EC).
Använda standarder: EN 61 000-6-2 och EN 61 000-6-3.

— Elektrisk material avsedd för användning inom vissa spänningsgränser (73/23/EC) [95].
Använda standarder: EN 60 335-1 och EN 60 335-2-51.

Vastaavuusvakuutus

Me **GRUNDFOS** vakuutamme yksin vastuullisesti, että tuotteet **CR, CRI** ja **CRN**, jota tämä vakuutus koskee, noudattavat direktiivejä jotka käsittelevät EY:n jäsenvaltioiden koneellisia laitteita koskevien lakien yhdenmukaisuutta seur.:

— Koneet (98/37/EY).
Käytetty standardi: EN 292.

— Elektromagneettinen vastaavuus (89/336/EY).
Käytetyt standardit: EN 61 000-6-2 ja EN 61 000-6-3.

— Määrättyjen jänniterajoitusten puitteissa käytettävät sähköiset laitteet (73/23/EY) [95].
Käytetyt standardit: EN 60 335-1 ja EN 60 335-2-51.

Overensstemmelseserklæring

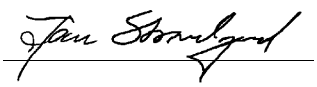
Vi **GRUNDFOS** erklærer under ansvar, at produkterne **CR, CRI** og **CRN**, som denne erklæring omhandler, er i overensstemmelse med Rådets direktiver om indbyrdes tilnærmelse til EF medlemsstaternes lovgivning om

— Maskiner (98/37/EF).
Anvendt standard: EN 292.

— Elektromagnetisk kompatibilitet (89/336/EØF).
Anvendte standarder: EN 61 000-6-2 og EN 61 000-6-3.

— Elektrisk materiel bestemt til anvendelse inden for visse spændingsgrænser (73/23/EØF) [95].
Anvendte standarder: EN 60 335-1 og EN 60 335-2-51.

Bjerringbro, 15th August 2003

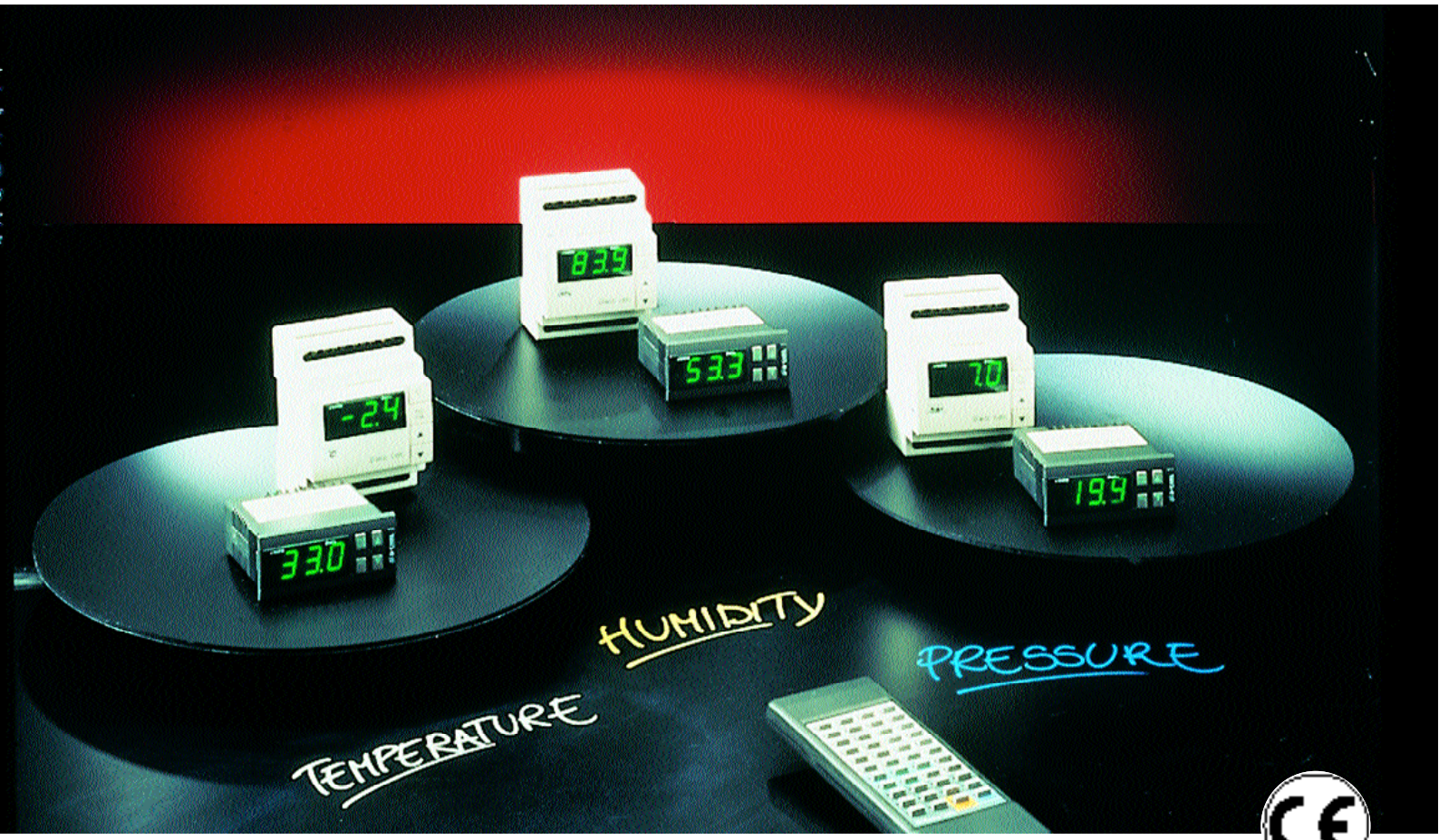


Jan Strandgaard
Technical Manager

Appendix O Controller – Carel IR32

(Page Left Blank Intentionally)

Serie Infrared Universale / Universal Infrared Series



Manuale d'uso

user manual

CAREL

Indice

Contents

1. Introduzione

Gli strumenti della serie Infrared Universale sono stati progettati per il controllo delle principali grandezze fisiche (temperatura, pressione, umidità) in unità di condizionamento, refrigerazione e riscaldamento.

1.1 Caratteristiche principali

Gamma: per soddisfare ogni esigenza di controllo sono a disposizione 41 modelli con diverse uscite e differenti alimentazioni (vedi tabella codici riportata a pagina 76). Inoltre sono disponibili tre moduli opzionali per le versioni D e A in grado di ampliare ulteriormente l'utilizzo degli strumenti**.**

Flessibilità: sono disponibili modelli con alimentazione 12/24 Vac-dc, 24/240 Vac-dc e 110/240 Vac-dc. Possono essere montati a pannello o su guida DIN.

Collegamento seriale: tutti i controlli sono predisposti al collegamento in rete per la realizzazione di sistemi di supervisione e teleassistenza.

Accessori: a richiesta, è disponibile il telecomando per la programmazione e il comando a distanza dei controlli e, inoltre, dei moduli opzionali.

Omologazioni: la qualità e sicurezza dei controlli Infrared Universali sono garantite dal sistema di progettazione e produzione certificato ISO 9001, nonché dal marchio CE.

Applicazioni: sono molteplici. I controlli sono programmati per il funzionamento "Reverse", ma possono essere programmati dall'utente per il funzionamento "Direct".
Nota: per il significato di Reverse e Direct si rimanda al glossario.

1. Introduction to the IR Series

The controllers of the Universal Infrared Series have been specifically designed to control pressure, humidity and temperature in air-conditioning, refrigeration and heating units.

1.1 Main features

Range: *there are 41 models with different outputs and different power supply so as to satisfy any requirement (see table on, page 76). Three optional modules designed to further upgrade the instruments' functions are available for versions A and D.*

Flexibility: *power supply can be 12/24Vac-dc, 24/240Vac-dc and 110/240Vac-dc. The IR range can be panel or DIN Rail mounted.*

Serial Connection: *all IR instruments can be network connected to supervisory and telemaintenance systems.*

Optional units: *remote control, useful to program and control parameters from a distant point; optional modules.*

Approvals: *the quality and safety of the Infrared controllers is guaranteed by the ISO 9001 design and production system. Furthermore they have been certified by the CE mark.*

Applications: *being extremely versatile, the IR instruments offer plenty of applications. They can be programmed to work either in the "Reverse" or in the "Direct" mode.*
Note: *for the Reverse and Direct meaning see Glossary at the end of this manual).*

1.2 Descrizione del frontale degli strumenti

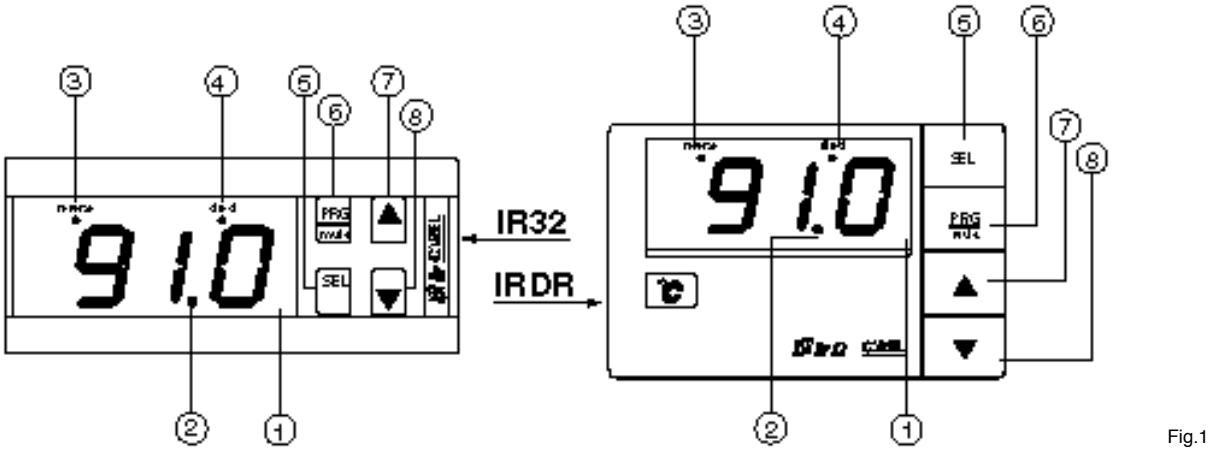


Fig.1

1 – Display: visualizza il valore della sonda collegata. In caso di allarme il valore della sonda viene visualizzato alternativamente ai codici degli allarmi attivi. Durante la programmazione mostra i codici dei parametri ed il loro valore.

2 – LED decimale: viene acceso quando la grandezza controllata è visualizzata con la risoluzione del decimo.

3 – LED Reverse: lampeggia quando almeno un relè con funzionamento “Reverse” è attivo. Il numero di lampeggi indica i relè attivi in Reverse. Tra una fase di lampeggio e la successiva il LED rimane spento per 2 secondi.

4 – LED Direct: lampeggia quando è attivo almeno un relè in funzionamento “Direct”. Valgono le altre considerazioni viste per la funzione “Reverse”.

5 – Tasto SEL: visualizza e/o imposta il set point. Se premuto insieme al tasto PRG/MUTE per 5 secondi permette di inserire la password e di accedere ai parametri di configurazione (parametri con codice tipo “Cxx”).

6 – Tasto PRG/Mute: premuto per 5 secondi dà accesso al menù dei parametri di utilizzo più frequente (codice tipo “Pxx”). In caso di allarme tacita il buzzer. Resetta le altre segnalazioni d’allarme se premuto al cessare della causa. Termina la programmazione fissando in memoria i valori dei parametri modificati.

7 – Tasto ▲ **:** incrementa il valore del set-point o di ogni altro parametro selezionato.

8 – Tasto ▼ **:** decrementa il valore del set-point o di ogni altro parametro selezionato. Nelle versioni con ingresso NTC, se premuto quando sul display è visualizzato il valore della sonda principale, permette la visualizzazione della seconda sonda per il tempo in cui il tasto resta premuto.

Nota: per i codici dei modelli della serie Infrared Universale, fare riferimento alla tabella alla fine del manuale.

1.2 Front panel

1 – Display: *shows the value measured by the connected sensor. In the event of alarm condition the sensor value will be displayed alternately with the codes of the active alarms. When programming the instrument, the display shows the parameter codes being introduced and their values.*

2 – Decimal Point LED: *lights up when the controlled parameter is displayed.*

3 – Reverse LED: *flashes when at least one relay working in the “Reverse” mode is active. The Led flashes as many times as the number of active 'reverse' relays. There is a two seconds' pause between a flashing stage and the next one.*

4 – Direct LED: *flashes when at least one relay working in the “Direct” mode is active. Its working logic is the same as the “Reverse” LED.*

5 – SEL Button: *displays and/or allows you to select the Set-point. If pressed for 5 seconds together with PRG/MUTE it allows you to enter the password and the configuration parameters (having a “Cxx” type code).*

6 – PRG/Mute Button: *if pressed for 5 seconds it allows you to access the menu of the more frequently used parameters (having a “Pxx” type code). In the event of alarm condition, it silences the buzzer and, if pressed after the cause that determined the alarm has disappeared, it resets any other alarm. It completes the programming procedure storing all the values of the modified parameters.*

7 – Button ▲ ***:*** *increases the value of the set-point or that of any other selected parameter.*

8 – Button ▼ ***:*** *decreases the value of the set-point or that of any other selected parameter. In NTC input versions it can display the value of the second sensor (holding “Down” pressed while the display shows the value of the main sensor).*

Nota: per i codici dei modelli della serie Infrared Universale, fare riferimento alla tabella alla fine del manuale.

2. Utilizzo degli strumenti della serie Infrared Universale

Gli strumenti della serie Infrared Universale sono estremamente flessibili e permettono di ottenere prestazioni elevate. Esistono tre tipologie di parametri di programmazione del controllo (1.“set-point”; 2. parametri di tipo “P”, o parametri di uso frequente; 3. parametri di tipo “C” per la configurazione personalizzata del controllo).

A seconda dell’utilizzo, si possono infatti presentare le seguenti situazioni:

1) lo strumento viene utilizzato con l’impostazione prevista in fabbrica (vedi cap. 4).
In tal caso sarà sufficiente verificare ed eventualmente modificare il set-point e i parametri P.
Nota: *nei modelli con ingresso in corrente, tensione o per termocoppia J potrà essere necessario modificare anche alcuni parametri di configurazione. Si veda la descrizione dei parametri C13, C15, C16 e C19.*

2) Lo strumento è destinato ad utilizzi diversi da quelli previsti in fabbrica (vedi cap. 5).
In questo caso la prima operazione da fare è scegliere il **Modo di funzionamento** adatto all’utilizzo.Ciò è possibile modificando un solo parametro di configurazione: il parametro C0. Il parametro C0 può assumere 9 diversi valori, ad ognuno corrisponde un particolare **Modo di funzionamento.** Scelto il **Modo di funzionamento** adeguato alla propria applicazione si potrà poi eventualmente modificare il Set point e i parametri P.

3) Nel caso di applicazioni particolari, può essere necessario modificare anche gli altri parametri di configurazione. Si può, ad esempio, programmare il funzionamento degli ingressi digitali (parametri C29, C30) e definire le tempistiche di attivazione delle uscite (parametri C6, C7, C8, C9). Nei modelli con ingresso NTC è possibile utilizzare una seconda sonda per il funzionamento “differenziale” o in “compensazione”. È addirittura possibile personalizzare il **Modo di funzionamento** (si veda il parametro C33 a pag. 41) creando nuovi “Modi” che si aggiungono ai 9 previsti dal parametro C0.

2. Use of Universal Infrared Instruments

The Infrared instruments are extremely versatile, flexible controllers providing excellent performance. There are three types of programming parameters (1. "set-point"; 2. type "P" parameters, that is frequently used parameters; 3. type "C" parameters, useful to get a customized confi - guration of the instrument).

Consequently the IR can be used as follows:

1) with the factory-set configuration (see chapter 4).
It is enough to check and, if necessary, modify set-point and P parameters.
Note: *in current/voltage input models or thermocouples J, it may be necessary to modify some C parameters (see description of parameters C13, C15, C16 and C19).*

2) the instrument is intended for uses requiring a dif - ferent configuration (see chapter 5).
First of all choose the suitable ***mode of operation*** *of the IR by simply modifying the C0 configuration parameter. C0 can be given 9 different values corresponding to 9 dif - ferent* ***operating modes****. Then, if necessary, modify set-point and P parameters according to your application requirements.*

3) Special configurations *may require the modification of some other configuration parameters. For example, you can program the operating mode of the digital inputs (parameters C29 and C30) and set output energization times (param. C6, C7, C8, C9). Models with NTC input can be connected to a second sensor so as to control the instrument in a "differential" or "compensating" mode. The* ***Mode of Operation*** *itself can be customized (see C33, page 41) thus creating new modes besides the 9 allowa - ble by C0.*

3. Installazione

Per l'installazione del controllo procedere come indicato di seguito, tenedo presente gli schemi di collegamento riportati alla fine del manuale.

1) collegare sonde ed alimentazione: le sonde possono essere remotate fino ad una distanza massima di 100 metri dal controllo purché si usino cavi con sezione minima di 1 mm^2, possibilmente schermati. Per migliorare l'immunità ai disturbi si consiglia di usare sonde con cavo schermato (collegare un solo estremo dello schermo alla terra del quadro elettrico). Nel caso si utilizzino termocoppie è obbligatorio usare cavo compensato con schermo per avere una corretta immunità ai disturbi; le termocoppie possono essere prolungate solo usando oltre ai cavi compensati anche eventuali connettori compensati (per i codici vedi listino Carel).

2) Programmare lo strumento: per una descrizione più approfondita vedere il capitolo "Programmazione" a pag. 11.

3) Collegare gli attuatori: è preferibile collegare gli attuatori solo dopo aver programmato il controllo. Al riguardo si raccomanda di valutare attentamente le portate massime dei relè indicate nelle "caratteristiche tecniche" (pag. 68).

4) Collegamento in rete seriale: se è previsto l'allacciamento alla rete di supervisione tramite le apposite schede seriali (IR32SER per i modelli IR32 e IRDRSER per i modelli IRDR) è necessario curare la messa a terra del sistema. In particolare non dovrà essere collegato a terra il secondario dei trasformatori che alimentano gli strumenti. Nel caso sia necessario collegarsi ad un trasformatore con secondario a terra, dovrà essere interposto un trasformatore di isolamento. È possibile collegare più strumenti allo stesso trasformatore di isolamento, tuttavia è consigliabile utilizzare un trasformatore di isolamento diverso per ogni strumento.

Avvertenze:

Evitare comunque **l'installazione** dei controlli in ambienti con le seguenti caratteristiche:
- umidità relativa maggiore dell'90% o condensante;
- forti vibrazioni o urti;
- esposizioni a continui getti d'acqua;
- esposizione ad atmosfere aggressive ed inquinanti (es: gas solforici e ammoniacali, nebbie saline, fumi) per evitare corrosione e/o ossidazione;
- alte interferenze magnetiche e/o radiofrequenze (evitare quindi l'installazione delle macchine vicino ad antenne trasmittenti);
- esposizioni dei controlli all'irraggiamento solare diretto e agli agenti atmosferici in genere.

Nel **collegamento** dei regolatori:
- utilizzare capicorda adatti per i morsetti in uso;
- allentare ciascuna vite ed inserirvi i capicorda, quindi serrare le viti. Ad operazione ultimata tirare leggermente i cavi per verificarne il corretto serraggio;
- separare quanto più possibile i cavi delle sonde e degli ingressi digitali dai cavi dei carichi induttivi e di potenza per evitare possibili disturbi elettromagnetici;
- non inserire mai nelle stesse canaline (comprese quelle dei quadri elettrici) cavi di potenza e cavi sonde;
- evitare inoltre che i cavi delle sonde siano installati nelle immediate vicinanze di dispositivi di potenza (contattori, interruttori magnetotermici, ecc.);
- evitare di alimentare il controllo con l'alimentazione generale del quadro qualora l'alimentatore debba alimentare diversi dispositivi, quali contattori, elettrovalvole, ecc.).

Attenzione: il non corretto allacciamento della tensione di alimentazione può danneggiare seriamente il sistema. L'utilizzo del regolatore elettronico non esime dal predisporre sull'unità tutti i dispositivi elettromeccanici utili per garantire la sicurezza dell'impianto.

3. How to install the controller

To install the controller follows these indications and respect the connection diagram as indicated at the end of this manual.

1) Connect sensors and power supply: *sensors can be located up to 100 meters distant from the controller provided that you use cables with 1mm^2 min. dia., better if shielded. To improve immunity against noises we recommend using sensors with shielded cables (connect just one end of the shielding to the earth of the electrical panel). When using thermocouples it is compulsory to use compensated shielded cables to ensure protection against noises. Thermocouples can be used with an extension lead provided that you use compensated cables and connectors (for models and codes see Carel price list).*

2) Program the instrument: *see chapter "Programming the instrument" on page 11.*

3) Connect all devices: *connect the other devices after you have programmed the controller. Please check relays power as indicated in the "Technical characteristic" table on page 68.*

4) Link up the IR to serial network: *if the IR controller is to be linked up to a supervisory network through the dedicated serial boards (IR32SER for IR32 models and IRDRSER for IRDR models), it is necessary to pay attention to the earthing of the system. In particular the secondary of the transformers which feed the instruments MUST NOT be earthed. Should you need to connect the IR to a transformer whose secondary is earthed, it is necessary to add an isolating transformer. It is possible to connect several instruments to the same isolating transformer but we suggest using as many isolating transformers as the number of instruments.*

Important:

Avoid installation *in places with the following features:*
- *relative humidity higher than 90% or condensing;*
- *heavy vibrations or shocks;*
- *exposure to continuous jets of water;*
- *exposure to aggressive and polluting environments (e.g.: sulphurous and ammoniacal gases, saline mist, smoke) to avoid corrosion and/or oxidation;*
- *high magnetic and/or radio interferences (avoid installation near transmitter aerials);*
- *exposure of controllers to direct solar radiation and to atmospheric agents in general.*

When ***connecting*** *the regulators follow these instructions:*
- *use appropriate cable-terminals (suitable to the terminals used);*
- *slacken each screw and insert the wire terminals, then tighten the screws again and check by slightly pulling the cables;*
- *keep separate the cables of the sensors and digital inputs from the inductive and power cables, to avoid any electromagnetic interference;*
- *never put power cables and sensor cables in the same channel;*
- *avoid installing sensor cables near power devices (magnetothermic switches or others);*
- *do not power the controller to the general power source of the electrical panel when it has to power several devices (electrovalves, contactors, etc.).*

Important: the uncorrect connection to the power source could damage the system.
With the electronic controller, it is also necessary to add to the unit the electromechanical devices to guarantee the safety of the system.

4. Configurazione di fabbrica

I regolatori della serie Infrared vengono forniti già programmati con impostato il funzionamento Reverse (vedi glossario), che permette il loro utilizzo in diverse applicazioni, a seconda della sonda collegata. I regolatori possono essere collegati a:
sonde di temperatura (NTC, Pt100, termocoppie): controllo di forni, bruciatori, impianti di riscaldamento in genere;

sonde di umidità: controllo di umidificatori e umidificazione in genere;
sonde di pressione: controllo evaporatori e in genere di contrasto alle basse pressioni.

I **valori di fabbrica** del set e degli altri parametri sono:

4. Easy set-up: factory-set configuration

The IR controller is supplied ready for use in the "Reverse" operation mode. The applications available are numerous and vary according to the type of sensor con - nected to the instrument:

***models with temperature sensors (NTC, Pt100, Thermocouples):** control of ovens, burners, heating systems;*
***models with humidity sensors:** control of humidifiers and humidification processes;*
***models with pressure sensors:** control of evaporators and in general low pressure alarms.*

Factory-set values:
It is always possible, however, to modify the factory-set configuration so as to make your instrument fulfil your specific application requirements.

Parametro ***Parameter***	**Codice** ***Code***	**Valore di fabbrica** ***Factory-set value***	**Campo** ***Range***
Set-point *Set-point*	St1	2.0	limite sonda *sensor limit*
Differenziale *Differential*	P1	2.0	0.1/99.9
Calibrazione sonda *Sensor calibration*	P14	0.0	-99/+99
Allarme di bassa *Lower limit alarm*	P25	limite inferiore sonda *sensor lower limit*	-99 / P26
Allarme di alta *Higher limit alarm*	P26	limite superiore sonda *sensor higher limit*	P25/999
Differenziale allarme *Alarm Differential*	P27	2.0	0.1/99.9
Ritardo allarme	P28	60 minuti	

5. I Modi di funzionamento

Prima di analizzare in dettaglio i singoli parametri è necessario descrivere i nove **Modi di funzionamento** previsti, ai quali si accede tramite il parametro C0. L'impostazione dello strumento mediante i modi di funzionamento rappresenta infatti una funzionalità innovativa in strumenti di questo livello di prezzo. Inoltre la scelta del Modo di funzionamento corretto è la prima azione da compiere nel caso in cui la configurazione di fabbrica, ovvero il funzionamento reverse, non sia adatto alla propria applicazione.

Modo 1: funzionamento Direct CO=1
Parametri fondamentali:
– set-point (St1);
– differenziale (P1).
Nel funzionamento Direct il regolatore opera un'azione di contenimento qualora la grandezza regolata sia superiore al valore di set-point. Fissato il punto di lavoro desiderato (St1), le uscite sono attivate una alla volta man mano che la grandezza si scosta da St1. I relè presenti nei modelli con più uscite sono distribuiti equamente all'interno dell'unico differenziale impostato. Quando la grandezza controllata è uguale o superiore a St1+P1 tutte le uscite sono attive. Viceversa, se la grandezza, partendo da valori superiori a St1, inizia a diminuire, eventuali relè attivi vengono spenti man mano che ci si avvicina a St1. Al valore St1 tutte le uscite sono spente. Il LED Direct lampeggia solo se ci sono uscite attive ed il numero di impulsi è pari ai relè inseriti.

5. Modes of operation

*Before examining each single parameter, here is a description of each of the nine **modes of operation** that can be set through C0. Such a function is highly innovative for instruments in this price bracket. Setting the suitable mode of operation is the most important operation you should do when the factory-set configuration does not suit your needs.*

Mode 1: DIRECT control action, C0=1
Main parameters:
– set-point (St1);
– differential (P1).
In the Direct operation mode the controller reduces the value of the controlled parameter when it goes beyond the set-point range. Once the set-point has been set (St1) the outputs will be energized one by one as the parameter deviates from St1. The relays in the models with more outputs are equally distributed within the selected differential. When the controlled value is equal to/higher than St1+P1 all outputs will energize. Vice-versa, when the controlled value starts to decrease, any energized relay will be disenergized as the value approaches St1. When the St1 value is reached, all outputs will disenergize. The Direct LED will flash only in the event of energized outputs; the number of flashings will correspond to the number of relays.

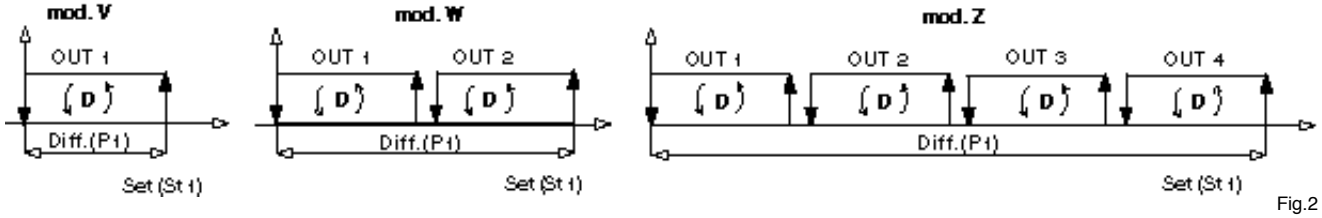


Fig.2

Modo 2: funzionamento Reverse CO=2
È il modo predefinito in fabbrica. I parametri fondamentali di questo tipo di funzionamento sono il set point (St1) e il differenziale (P1).

Mode 2: REVERSE mode C0=2
This is the factory-set mode. The main parameters are set-point (St1) and differential (P1).

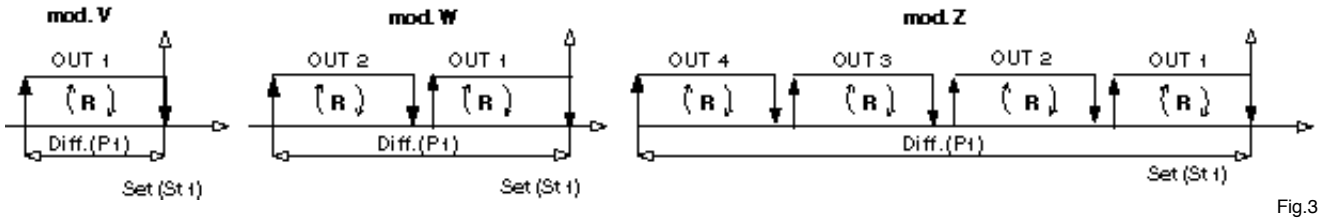


Fig.3

Fissato il punto di lavoro desiderato (St1), le uscite vengono attivate una alla volta man mano che la grandezza si scosta da St1. Nei modelli a più uscite l'attivazione dei relè è equamente distribuita all'interno del differenziale (vedi figura).

Se la grandezza, partendo da valori inferiori a St1, inizia ad aumentare, eventuali relè attivi vengono spenti man mano che ci si avvicina a St1. Al valore St1 tutte le uscite sono spente.
Il LED Reverse lampeggia con un numero di impulsi pari alle uscite attive.

The outputs will be energized one by one as the controlled parameter deviates from the previously selected set-point (St1). In models with more outputs the energization of the relays will occur within the differential (see fig. 3).

When the controlled variable below the set-point begins to increase its value, the energized relays will gradually disenergize as the value approaches St1. When the variable reaches the set-point value, all outputs will disenergize. The Reverse LED will flash; the number of flashings will correspond to the number of energized outputs.

Modo 3: funzionamento ZONA NEUTRA CO=3
Parametri fondamentali:
– set-point (St1);
– differenziale dell'azione Reverse (P1);
– differenziale dell'azione Direct (P2);
– ZONA NEUTRA (P3).
Lo scopo del regolatore è di portare la grandezza misurata all'interno di un intervallo a cavallo del set-point (St1), detto zona morta. L'estensione della zona morta dipende dal valore del parametro P3. All'interno della zona morta lo strumento non richiede l'intervento di alcun dispositivo. Al di fuori della zona morta lo strumento lavora in Modo Direct quando la grandezza controllata aumenta e in Modo Reverse quando diminuisce. A seconda del modello usato, possono esserci uno o più relè nei funzionamenti Direct e Reverse. Tali uscite sono attivate o spente una alla volta secondo le modalità già viste nei modi 1 e 2, in conformità ai valori assunti dalla grandezza controllata, dal valore St1, da P1 e da P2. Il LED Direct e il LED Reverse lampeggiano con le modalità già viste nel paragrafo "descrizione del frontale degli strumenti" a pag.1.
Attenzione: quando lo strumento è fornito di un'unica uscita a relè, essa funziona in Modo Reverse con ZONA NEUTRA.

Mode 3: Dead-Zone mode C0=3
Main parameters:
– set-point (St1);
– differential of the reverse mode (P1);
– differential of the direct mode (P2);
– Dead-zone (P3).
The controller aims at bringing the controlled variable within a limited range, called dead zone, set around the Set-point (St1). As shown in the graph below, the dead zone value depends on the value given to P3. No devices will be actuated within the dead zone. Beyond the dead zone the controller works in the Direct Mode when the controlled variable increases and in the Reverse Mode when it decreases its value. Depending on the model, there can be one or more relays. The outputs will energize or disenergize as described above in mode 1 and 2, depending on the value of the controlled variable, of St1, P1 and P2. The Direct and Reverse LEDs will flash as described on page 1.

Important: *when the instrument has only one relay out - put, it will work in the Reverse mode with dead zone.*

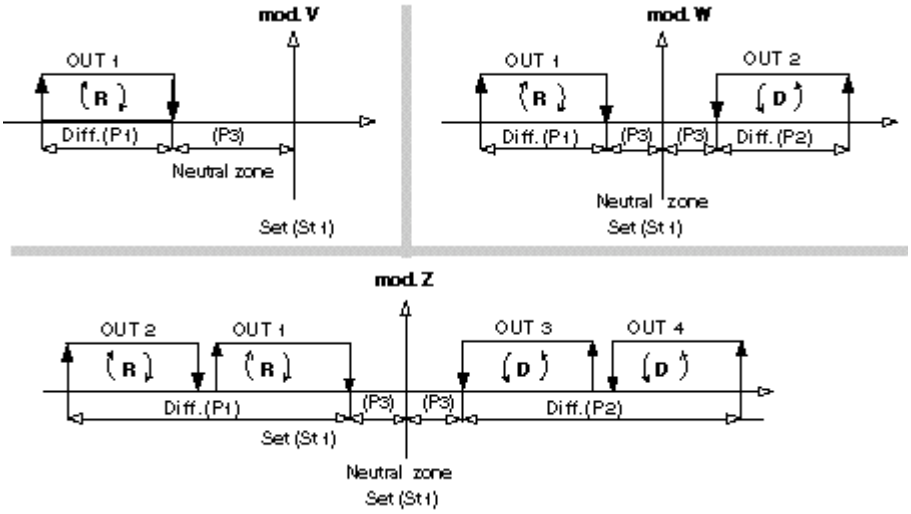


Fig.4

Modo 4: funzionamento PWM CO=4
Parametri fondamentali:
– set-point (St1);
– differenziale dell'azione Reverse (P1);
– differenziale dell'azione Direct (P2);
– ZONA NEUTRA (P3).
La logica di regolazione del Modo 4 è la stessa già vista per il Modo 3. È un funzionamento con ZONA NEUTRA con la sola particolarità che i relè vengono attivati in modo impulsivo in base alla procedura PWM (Pulse Width Modulation, modulazione della larghezza d'impulso). Ogni singolo relè è attivato ogni 20 secondi (periodo eventualmente modificabile tramite il parametro C12, vedi pagina 14) per un tempo da 0,1 a 20 secondi. Il tempo di ON del relè è proporzionale alla posizione occupata dalla grandezza controllata all'interno del differenziale. Per scostamenti contenuti, l'uscita si attiverà per un tempo breve. Al superamento del differenziale, il relè sarà sempre inserito (20 secondi su 20). Il funzionamento PWM permette quindi di inserire in modo "proporzionale" attuatori con funzionamento tipicamente ON/OFF (es. resistenze di riscaldamento) per migliorare il controllo della grandezza regolata. Il funzionamento PWM può essere impiegato anche per ottenere un segnale modulante di comando di tipo 0/10 V o 4/20 mA utilizzando la versione IR con uscite per il comando di relè a stato solido, disponendo della relativa opzione per convertire il segnale (capitolo 12.1). Nel funzionamento PWM i LED Direct/Reverse lampeggiano con un numero di

Mode 4: PWM mode, C0=4
Main parameters:
– set-point (St1);
– differential of the reverse mode (P1);
– differential of the direct mode (P2);
– DEAD ZONE (P3).
The operation logic is the same as in Mode 3. The instru - ment, in fact, bases its action on the dead zone; the relays energize according to the PWM (Pulse Width Modulation) procedure. In practice, each single relay ener - gizes every 20 seconds (this time-delay can be modified through C12, see page 14) from 0.1 to 20 seconds. The relay energization is proportional to the position of the controlled variable within the differential. For slight devia - tions from the set value, the output will energize for a short time. When the value exceeds the differential, the relay will remain energized (for 20 seconds). The PWM mode allows your instrument to energize devices whose mode is typically ON/OFF in a proportional way (e.g. hea - ters). The PWM mode can be used to get a modulating signal 0/10V or 4/20 mA (IR models equipped with out - puts for Solid State Relay and dedicated optional conver - ter, see chapter 12.1). When in the PWM mode, the Direct/Reverse LEDs will flash; the number of flashings will correspond to the number of energized outputs.
If the controller has only one relay, it will work in the Reverse mode with DEAD ZONE.

impulsi pari al numero di uscite (impulsive) attive. Quando lo strumento è fornito di un solo relè, essa funziona in modo Reverse con ZONA NEUTRA.
Attenzione: è assolutamente sconsigliato l'utilizzo PWM con compressori o altri attuatori la cui affidabilità può risentire di inserimenti/spegnimenti troppo ravvicinati. In ogni caso si consiglia di non ridurre a valori minimi il parametro C12, per non compromettere la durata (calcolata in circa 1 milione di attivazioni).

Important: *do not use the PWM mode with compressors or devices requiring frequent On/Off routines. Do not give C12 a minimum value because this might compromise its duration (about 1 million pulses).*

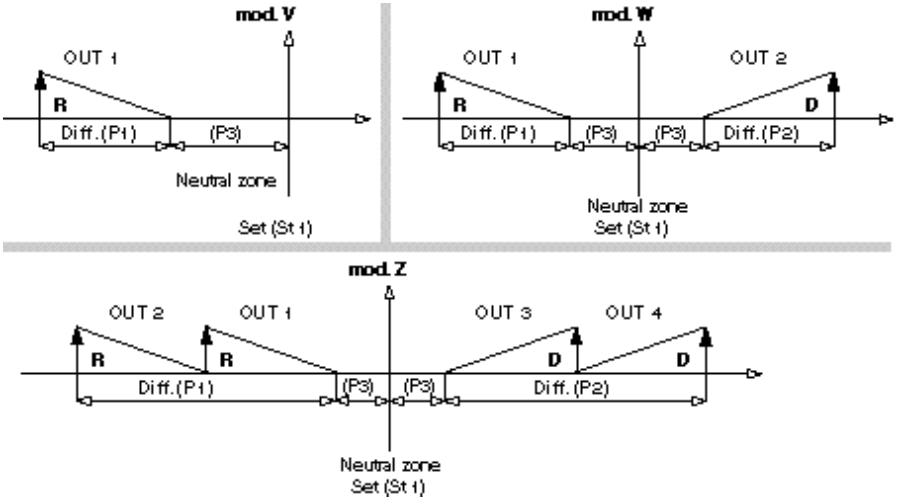


Fig.5

zioni).

Modo 5: funzionamento "ALLARME" CO=5
Parametri fondamentali:
– set-point (St1);
– differenziale dell'azione Reverse (P1);
– differenziale dell'azione Direct (P2);
– ZONA NEUTRA (P3);
– set dell'allarme di "Bassa" (P25);
– set dell'allarme di "Alta" (P26);
– differenziale dell'allarme (P27);
– tempo di ritardo dell'attuazione dell'allarme (P28).
Con il Modo 5 viene uno o più relè vengono attivati per segnalare la presenza di un allarme generico (sonda scollegata o in corto, funzionamento anomalo dell'elettronica) o un allarme di "Alta" o "Bassa". Nelle versioni V e W è previsto un unico relè d'allarme. Nella versione Z ci sono 2 relè: viene attivato il relè 3 per gli allarmi generici e per l'allarme di "Bassa", mentre il relè 4 viene attivato per gli allarmi generici e per l'allarme di "Alta". L'attivazione del relè di allarme si somma alle usuali segnalazioni attive con gli altri modi di funzionamento ovvero codice di allarme sul display e segnale acustico (nelle versioni provviste di buzzer). Nel caso delle versioni W e Z, i relè non utilizzati per la segnalazione degli allarmi sono dedicati alla regolazione con le modalità viste nel Modo 3.

Mode 5: Alarm mode C0=5
Main parameters:
– set-point (St1);
– differential of the reverse mode (P1);
– differential of the direct mode (P2);
– DEAD ZONE (P3);
– set of the lower limit alarm (P25);
– set of the higher limit alarm (P26);
– alarm differential (P27);
– alarm time delays (P28).

In this mode one or more relays energize as soon as there is a generic alarm condition (disconnected or short-circuited sensor, faulty electronics, etc.) or a specific High or Low alarm condition. In versions V and W there is only one alarm relay. Version Z has two: relay no. 3 for generic and low alarm conditions, relay no. 4 for generic and high alarms. In addition to the energization of the relay, the controller displays the alarm code and makes the buzzer sound (in models equipped with acoustic signal). In models W and Z, the relays not used to indicate alarm conditions are dedicated to the regulation as described above for Mode 3.

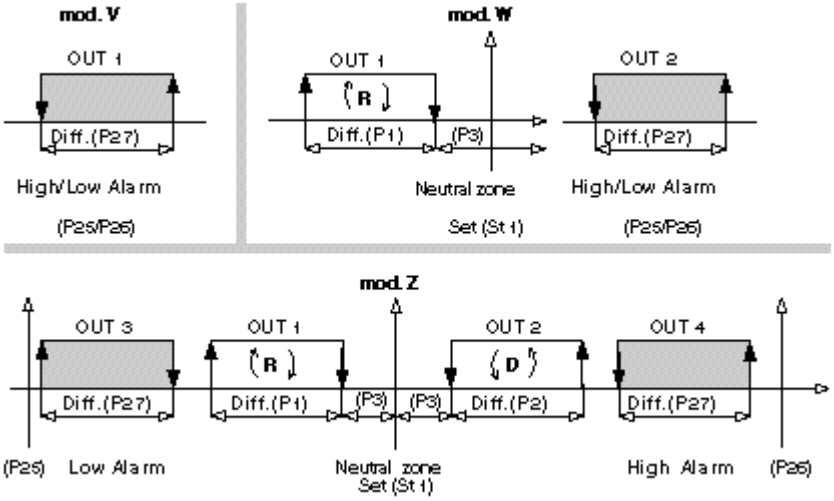


Fig. 6

Modo 6: commutazione Direct/Reverse da ingresso digitale CO=6

Parametri fondamentali:
– set-point 1 (St1);
– differenziale di St1 (P1) dell'azione Direct;
– set-point 2 (St2);
– differenziale di St2 (P2) dell'azione Reverse.

Lo strumento commuta dal funzionamento Direct a quello Reverse (vedi Modo 1 e Modo 2) in funzione dello stato dell'ingresso digitale 1. Più precisamente si ha: funzionamento Direct (St1) quando l'ingresso digitale è aperto, funzionamento Reverse (St2) quando è chiuso.

Mode 6: Direct/Reverse selection from digital input

Main parameter:
– set-point 1 (St1);
– differential of St1 (P1), direct mode;
– set-point 2 (St2);
– differential of St2 (P2), reverse mode.

The instrument changes from Direct to Reverse (see Mode 1 and Mode 2) according to the condition of the digital input no. 1. More precisely: direct mode (St1) when digital input 1 is open; reverse mode (St2) when digital input 1 is closed.

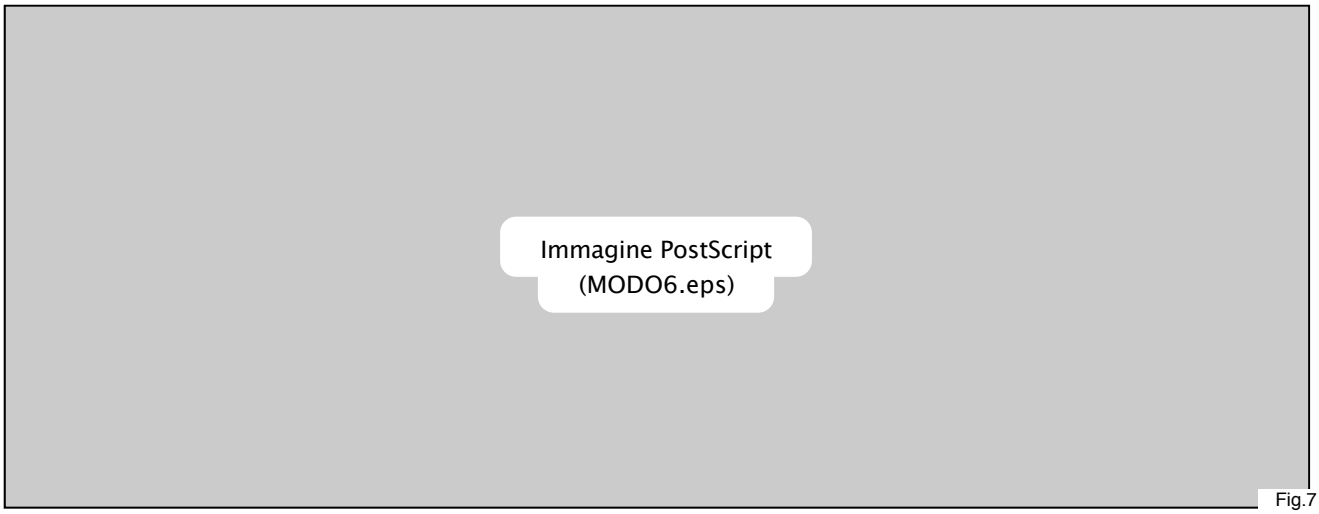


Fig.7

Modo 7: funzionamento Direct con commutazione di set e differenziale da ingresso digitale CO=7

Parametri fondamentali:
– set (St1);
– differenziale di St1 (P1);
– set (St2);
– differenziale di St2 (P2).

Con questo Modo la variazione di stato dell'ingresso digitale 1 (aperto/chiuso) non cambia il tipo di azione (sempre Direct) ma cambia il set-point ed il differenziale. St1 e il differenziale P1 sono attivi quando l'ingresso digitale è aperto; St2 e il differenziale P2 sono attivi quando l'ingresso digitale è chiuso.

Mode 7: Direct mode with change of Set and differential via digital input, C0=7

Main parameters:
– set-point (St1);
– differential (P1);
– set-point (St2);
– differential (P2).

When C0=7 any variation of digital input no. 1 (open/closed) does not change the mode (that remains always Direct) but changes both set-point and differential.
St1 and P1 operate when the digital input is open;
St2 and P2 operate when the digital input is closed.

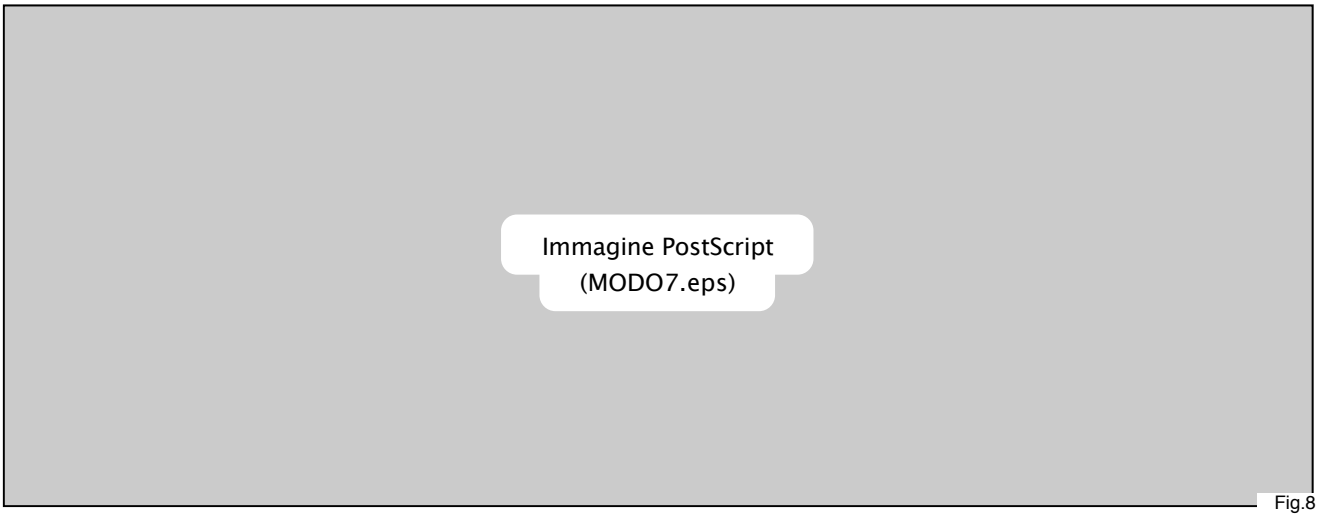


Fig.8

Modo 8: funzionamento Reverse con commutazione di set e differenziale da ingresso digitale CO=8
Parametri fondamentali:
– set (St1);
– differenziale (P1).
Con questo Modo la variazione di stato dell'ingresso digitale 1 (aperto/chiuso) non cambia il tipo di azione (sempre Reverse) ma cambia il set ed il differenziale.
St1 e il differenziale P1 sono attivi quando l'ingresso digitale è aperto ed St2 e il differenziale P2 attivi quando l'ingresso digitale è chiuso.

Mode 8: Reverse mode with set-point and differential change via digital input, C0=8
Main parameters:
– set-point (St1);
– differential (P1).
When C0=8 any variation of digital input no.1 (open/closed) does not change the mode (that remains always Reverse) but changes both set-point and differential.
St1 and P1 operate when the digital input is open; St2 and P2 operate when the digital input is closed.

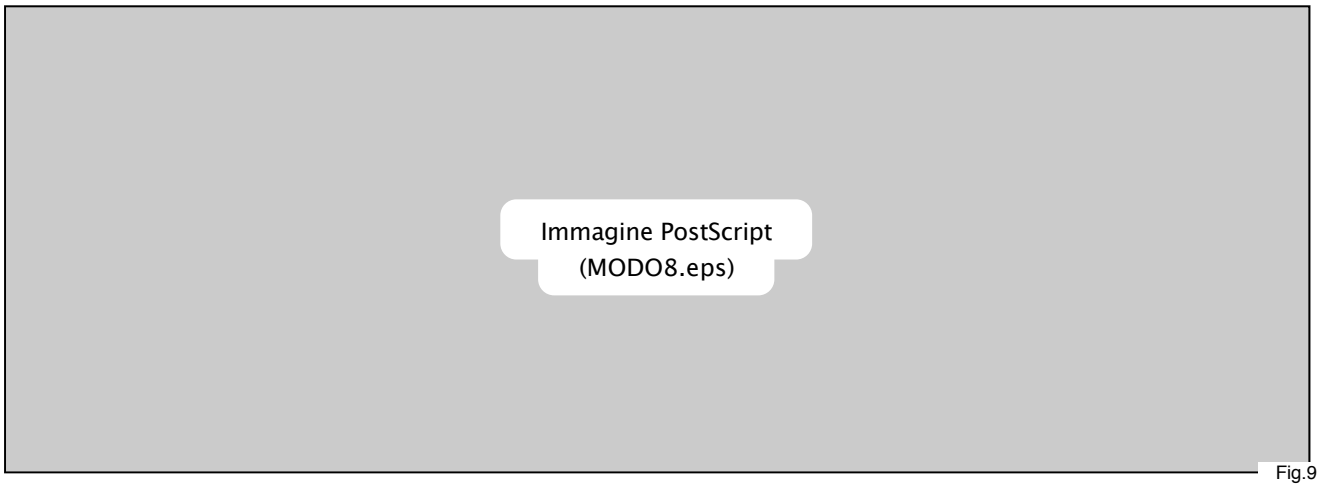


Fig.9

Modo 9: funzionamento con 2 set-point, uno in Direct e uno in Reverse CO=9
Parametri fondamentali:
– set-point 1 (St1);
– differenziale di St1 (P1) dell'azione Reverse;
– set-point 2 (St2);
– differenziale di St2 (P2) dell'azione Direct.
Questo Modo, operativo solo nelle versioni W e Z è simile al Modo 3 (funzionamento con zona neutra), in quanto metà uscite sono attive in Direct e metà in Reverse.
La sua particolarità è che non esiste alcun vincolo nel posizionamento dei set-point delle due azioni, per cui si può operare come se si avessero due strumenti indipendenti che lavorano con la stessa sonda.

Mode 9: 2 set-points, one in Direct and one in Reverse, C0=9
Main parameters:
– set-point 1 (St1);
– differential of St1 (P1), reverse mode;
– set-point 2 (St2);
– differential of St2 (P2), direct mode.
C0 can be set as 9 only in models W and Z. This mode is similar to mode 3 (dead zone control action) as half of the outputs energize in Direct and half in Reverse.
In this mode there is no compulsory positioning of the set-point. Therefore it is as if you had two independent instruments working with the same sensor.

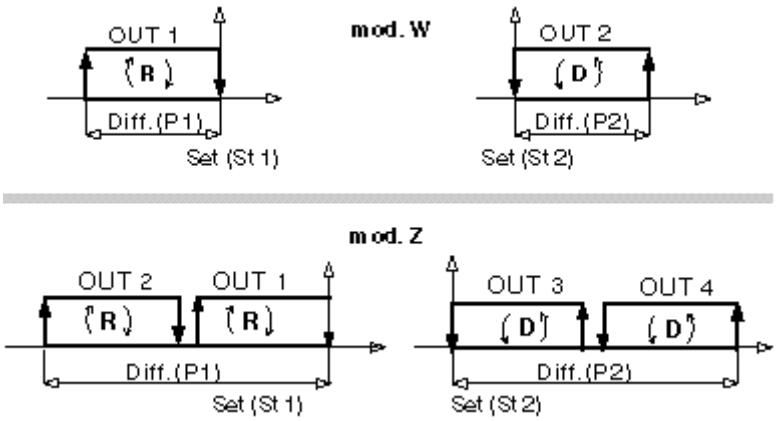


Fig.10

6. Programmazione

I parametri di programmazione del controllo, che abbiamo suddiviso in tre tipologie, 1.“set-point”; 2. parametri di tipo “P”, o parametri di uso frequente; 3. parametri di tipo “C” per la configurazione personalizzata del controllo), possono essere modificati mediante tastiera o telecomando.

6.1 Accesso da tastiera

Per i set-point l’accesso è diretto premendo il tasto SEL; per modificare i parametri “P” è necessario premere il tasto PRG per 5 secondi; tutti i parametri di “TIPO C” sono invece protetti da password: con password = 22 è possibile accedere e modificare i parametri C0 e C13,15,16 oltre a tutti i parametri di tipo “P”; con password = 77 è possibile accedere e modificare tutti i parametri del controllo. Vediamo ora in dettaglio le procedure di modifica.

6.2 Modifica del set-point (St1)

Per modificare il set-point (valore previsto in fabbrica St1=20):

a) premere il tasto “SEL” per qualche secondo: a display compare St1;
b) rilasciare il tasto “SEL”: a display lampeggia il valore attuale del set-point;
c) premere i tasti ▲ o ▼ per raggiungere il valore desiderato;
d) premere “SEL” per confermare il nuovo valore di St1.

6.3 Modifica del secondo set-point (St2)

Nei modi di funzionamento 6, 7, 8 e 9 lo strumento lavora con due set-point. Per modificare entrambi i set-point:

a) premere il tasto “SEL” per qualche secondo: a display compare St1;
b) rilasciare il tasto “SEL”: a display lampeggia il valore attuale del set-point 1;
c) premere i tasti ▲ o ▼ fino a raggiungere il valore desiderato di St1;
d) premere “SEL” per confermare il nuovo valore di St1;
e) dopo aver confermato St1 lo strumento visualizza a display il codice St2 per qualche secondo, dopodiché compare lampeggiante il valore attuale di St2;
f) premere i tasti ▲ o ▼ fino a raggiungere il valore desiderato;
g) premere il tasto “SEL” per confermare il dato St2;
h) a display riappare il valore rilevato dalla sonda principale.

6.4 Modifica dei parametri di tipo “P”

Per modificare il differenziale (valore previsto in fabbrica P1=2) e gli altri parametri “P”:

a) premere il tasto “PRG” per 5 secondi: a display compare “P1”;
b) premere il tasto ▲ o ▼ fino a visualizzare il parametro da modificare;
c) premere il tasto “SEL”: a display compare il valore attuale del parametro;
d) premere “PRG” o ▼ fino a raggiungere il valore desiderato;
e) premere “SEL” per confermare il dato;
f) a display compare il codice per identificare il param. modificato;
g) ripetere le operazioni dal punto b) ad f), se si vogliono modificare altri parametri, altrimenti passare al punto h);
h) premere “PRG” per memorizzare i dati modificati e ritornare al funzionamento normale.

6. Programming

All programming parameters (1.'set-point'; 2. "P" parameters, that is frequently used parameters; 3. “C" parameters to get customized configurations) can be modified via key-pad or remote control.

6.1 Access via keypad

The set-points can be directly displayed by pressing SEL. In order to modify "P" parameters hold down PRG for 5 seconds. All "C" parameters are protected by a password (when password = 22 you can enter and modify parameters C0, C13, 15 and 16 in addition to all "P" parameters; if password = 77 you can enter and modify all parameters).

6.2 Set-point modification (St1)

To modify the factory-set set-point (St1=20) follow these instructions:

a) hold down "SEL" for a few seconds; the display shows St1;
b) release "SEL"; the factory-set value flashes on the display;
c) press ▲ or ▼ until you reach the desired value;
d) press "SEL" to confirm the new St1 value.

6.3 Second set-point modification (St2)

In operating modes 6, 7, 8 and 9 the controller requires two set-points. To modify both of them:

a) hold down "SEL" for a few seconds; the display shows St1;
b) release "SEL"; the actual value of St1 flashes;
c) press ▲ or ▼ until you reach the desired value;
d) press "SEL" to confirm the new St1;
e) after having confirmed St1 the display shows for few seconds St2 then its actual value begins to flash;
f) press ▲ or ▼ until you reach the desired value;
g) press "SEL" to confirm the new St2;
h) the display shows the value measured by the main sensor.

6.4 Modification of “P” parameters

To modify the factory-set differential (P1=2) and "P" parameters:

a) hold down "PRG" for 5 seconds: the display shows “P1”;
b) press ▲ or ▼ until you display the parameter you want to modify;
c) press "SEL" ; the actual value of the chosen parameter appears on the display;
d) press "PRG" or ▼ until you reach the desired value;
e) press "SEL" to confirm the new value;
f) the display shows the code that identifies the modified parameter;
g) repeat operation from point b) to f), should you need to change other values, otherwise go on to point h);
h) press "PRG" to store all modifications and return to normal working operation.

6.5 Modifica dei parametri di tipo “C”

Per modificare i parametri C è necessario:
- premere contemporaneamente i tasti PRG e SEL per cinque secondi;
- a display compare “0”;
- visualizzare a display la password corretta (22 o 77) utilizzando i tasti o ;
- premere il tasto SEL per conferma;
- l’accesso è contraddistinto dalla visualizzazione di C0.

6.6 Parametri “C” per termocoppie, sonde in tensione e in corrente

I modelli con ingresso in corrente hanno un parametro particolare, C13, che permette di scegliere il tipo di ingresso in corrente:
C13=0 per sonde 4/20 mA, valore definito in fabbrica;
C13=1 per sonde 0/20 mA.
Il valore è quindi da modificare solo se si usa una sonda in corrente con segnale 0/20 mA.

Anche i modelli con ingresso per termocoppia utilizzano il parametro C13:
C13=0, predefinito in fabbrica, corrisponde alle termocoppie K;
C13=1 corrisponde alle termocoppia tipo J. Il valore di C13 è quindi da modificare solo se si usano termocoppie tipo J.

I modelli con ingresso in corrente o in tensione hanno due parametri speciali, C15 e C16, che permettono di definire l’intervallo di lavoro della sonda usata, ovvero i valori che corrispondono agli ingressi minimo (C15) e massimo (C16). C15 e/o C16 devono essere modificati solo se la sonda usata ha limiti diversi da quelli predefiniti in fabbrica, C15=0 e C16=100, come ad esempio le sonde di pressione.

Nota: Il parametro C13 è operativo anche per gli strumenti con ingresso NTC. Con C13=1 lo strumento inverte la visualizzazione delle sonde, ossia il display visualizza correntemente la seconda sonda, che chiamiamo NTC2, mentre la sonda di regolazione NTC1 può essere visualizzata premendo il tasto . Con C13=0 la visualizzazione è su NTC1.

Per modificare i parametri C13, C15, C16:
a) premere i tasti “SEL” e “PRG” contemporaneamente per 5 secondi;
b) a display compare 0;
c) impostare la password, premendo il tasto fino a visualizzare 22;
d) premere il tasto “SEL” per confermare la password;
e) se la password impostata è corretta, a display compare il codice “C0”, altrimenti bisogna ripetere le operazioni dal punto a);
f) premere i tasti “ ” e/o fino a visualizzare il parametro desiderato (C13, C15, C16): quando esso compare premere il tasto “SEL”;
g) a display appare il valore associato al parametro: premere i tasti o fino a visualizzare il valore desiderato; premere il tasto “SEL” per confermare;
h) ripetere la procedura dal punto f) per modificare altri parametri;
i) premere il tasto “PRG” per terminare la modifica memorizzando i nuovi valori.

6.5 Modification of “C” parameters

To modify the value of "C" parameters:
- *hold down PRG and SEL simultaneously for 5 seconds;*
- *enter the correct password using the or buttons (22 or 77);*
- *press SEL to confirm;*
- *you are allowed to access this field when C0 appears on the display.*

6.6 “C” parameters for thermocouples, current and voltage sensors

Models with current input have a special parameter, C13, allowing you to choose the type of current input:

C13=0 for 4/20 mA sensors (factory-set);
C13=1 for 0/20 mA sensors
C13 needs to be changed only if you are using a 0/20 mA current sensor.

C13 can be changed also in models equipped with an input for thermocouple:
C13=0 corresponds to K thermocouples (factory-set);
C13=1 corresponds to J thermocouples.
Change C13 only if you are using thermocouples type J.

Models with current or voltage inputs have two special parameters, C15 and C16, allowing you to set the operating range of the sensor (C15=min. value, C16=max. value). C15 and C16 need to be changed only if the sensor you are using has an operating range different from the factory-set one (as in pressure sensors). Factory-set values: C15=0, C16=100.

***Important:** all IR's with NTC input have the C13 parameter. If C13=1 the instrument currently displays the value of the SECOND sensor (NTC2) while the value measured by the main sensor (NTC1) can be displayed by pressing the button. If C13=0, the value being displayed is that of NTC1.*

To modify parameters C13, C15, C16:
a) hold down "SEL" and "PRG" together for 5 seconds;
b) the display shows 0;
c) introduce the password, holding the button until 22 appears on the display;
d) press "SEL" to confirm the password;
e) if the password is correct the display shows “C0”, viceversa you have to repeat all the above operations;
f) press and/or until you see the desired parameter (C13, C15, C16); when it appears press "SEL";
g) the display shows the value corresponding to the parameter; press or until you reach the desired value; press SEL to confirm;
h) to modify the other parameters repeat these operations from point f) or press PRG to end the procedure and store the new values.
i) premere il tasto “PRG” per terminare la modifica memorizzando i nuovi valori.

6.7 Come modificare il Modo (parametro C0)

a) premere i tasti “SEL” e “PRG” contemporaneamente per 5 secondi;
b) a display compare “0”;
c) impostare la password, ovvero premere il tasto e/o fino a visualizzare “22”;
d) premere il tasto “SEL” per confermare la password;
e) se la procedura è stata eseguita in modo corretto, a display compare il codice “C0”, altrimenti premere il tasto “PRG” e ripetere le operazioni dal punto a); C0 è il parametro corrispondente al Modo di funzionamento.

Per caricare sullo strumento uno dei 9 modi descritti è sufficiente assegnare a C0 il numero del Modo scelto, seguendo le seguenti modalità:

f) quando C0 compare sul display, premere il tasto “SEL”;
g) a display appare “2”, che identifica appunto il Modo (C0=2) assegnato in fabbrica;
h) per selezionare un diverso Modo di funzionamento premere i tasti o fino a visualizzare il valore numerico associato al Modo di funzionamento scelto, valore compreso tra 1 e 9; premere “SEL” per confermare il dato;
i) premere il tasto “PRG” per concludere l’operazione e memorizzare definitivamente il nuovo Modo di funzionamento.

6.7 How to modify the mode of operation (parameter C0)

a) hold down “SEL” and “PRG” together for 5 seconds;
b) the display shows “0”;
c) introduce the password (press or until “22” is displayed);
d) press “SEL” to confirm the password;
e) if the procedure has been carried out correctly, the display shows “C0”, otherwise press “PRG” and repeat all above operations; “C0” corresponds to the mode of operation of the controller.

To make the controller work according to one of the 9 desired modes, give C0 the appropriate value:

f) when C0 appears on the display, press “SEL”;
g) the display shows “2”’that identifies the factory-set mode (C0=2);
h) to set a different mode press or until you display the number corresponding to the desired mode (1-9); press SEL to confirm;
i) press “PRG” to end the operation and store the new mode of operation.

6.8 Accesso da telecomando

Il telecomando è stato progettato per rendere più semplice la programmazione dei controlli elettronici. Oltre che programmare a distanza lo strumento, consente una veloce e semplice impostazione dei parametri più comuni e maggiormente usati. È caratterizzato da tre gruppi di tasti:

a) tasti per attivare/disattivare l’uso del telecomando;
b) tasti preprogrammati per la modifica diretta dei parametri principali;
c) tasti per la scansione/modifica di tutti i parametri.

a) tasti per attivare/disattivare l’uso del telecomando
Consentono di attivare la comunicazione con il controllo e di terminarla memorizzando o no i nuovi valori dei parametri.

Tasto “Inizio”: inizia la comunicazione;

Tastiera NUMERICA: imposta l’eventuale password di accesso ai parametri; l’utilizzo della password è consigliato quando più controlli si trovano nel raggio d’azione del telecomando, come nel caso di più controlli posizionati su un quadro elettrico. Selezionando una password diversa per ogni strumento, la modifica dei parametri tramite telecomando potrà essere selettiva, ovvero solo sul controllo desiderato (si veda il capitolo 6.9).

Tasto “ANNULLA”: termina la programmazione annullando le eventuali modifiche;

Tasto “MEMO”: è dedito a due funzioni principali;
1) tacita, eventualmente, il buzzer di allarme;
2) termina la programmazione memorizzando i nuovi valori attribuiti ai parametri.

Tasto “MODE”: visualizza il parametro C0; accesso diretto.

Tasto “SONDA 2”: nei modelli NTC, visualizza il valore della seconda sonda; accesso diretto.

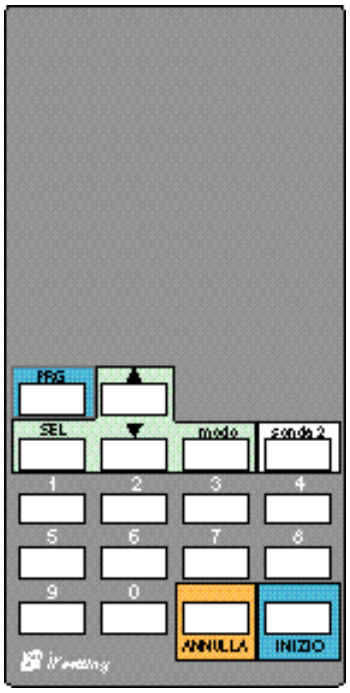


Fig.11

6.8 Programming the controller via remote control

The IR32 Infrared instruments have been designed to be easily and quickly programmed by means of the remote control. The remote control can be used not only to program the controller from a remote position but also to allow the End-User to set the main operation parameters easily and fast. Buttons have been divided into three groups:

a) buttons that operate/deactivate the use of the remote control;
b) pre-programmed buttons for the modification of the values of the main parameters;
c) buttons for scrolling/modifying all parameters.

a) buttons used to activate/deactivate the use of the remote control
These buttons are the remote control ON/OFF buttons. They also allow you to store any new parameter value.

***“Start” Button:** enables the use of the remote control unit;*

***NUMERIC keypad:** allows you to select the access code (password). We advise you to give each controller a specific access code, especially when your control panel includes several IR instruments or when all of them are exposed to the beam of the remote control. In this way it will be possible for you to change exactly the parameter/s you need to change, without interfering with the data of the other controllers (see chapter 6.9).*

***“CANCEL” button:** interrupts the programming procedure without storing any modification.*

“MEMO” button:
1) silences the buzzer;
2) ends the programming procedure and stores the new values given to the parameters;

***“MODE” button:** displays “C0” (direct access).*

***Second “SENSOR”:** displays the value*

b) tasti per la modifica diretta dei parametri principali

I parametri di uso più frequente sono stati riportati direttamente sul telecomando.

Le zone con sfondo diverso identificano:

- parametri relativi alla regolazione;
- parametri relativi alla gestione allarme "Alta" e "Bassa";
- parametri caratteristici delle singole uscite in Modo speciale (C33=1).

of the second sensor (NTC) (direct access).

b) buttons used to modify the main parameters

The most frequently used parameters are directly indicated on the remote control.

They are grouped in three differently coloured zones:

- *regulation parameters;*
- *"high" and "low" temperature alarm parameters;*
- *parameters for the control of each output in the Special Mode (C33=1).*

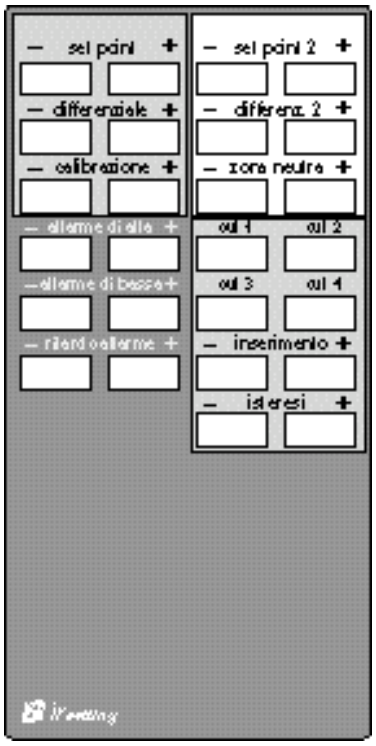


Fig.12

c) tasti per la scansione/modifica di tutti i parametri

La parte evidenziata, che sul telecomando è in verde, riproduce i tasti dello strumento che consentono di scorrere e visualizzare tutti i parametri.

SEL: commuta la visualizzazione del codice parametro al corrispondente valore e viceversa;

TASTO :
1) consente di passare da un parametro al successivo;
2) nella visualizzazione del parametro ne aumenta il valore;

TASTO :
1) consente di passare da un parametro al precedente;
2) nella visualizzazione del parametro ne diminuisce il valore.

c) buttons for scrolling/modifying all parameters

The green zone of the remote control indicates the but - tons that allow you to scroll and modify all parameters.

***SEL:** alternatively displays the code of the parameter and its actual value;*

***BUTTONS** :*
1) goes to the next parameter;
2) increases the displayed value.

***BUTTONS** :*
1) goes to the previous parameter;
2) decreases the displayed value.

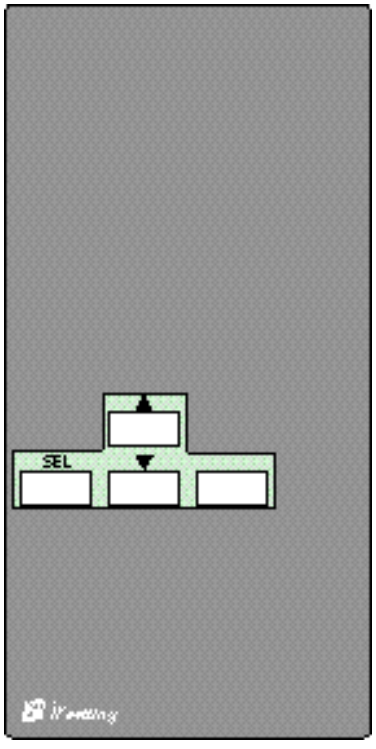


Fig.13

6.9 Modifica parametri da telecomando

Accesso senza codice

1) abilitazione del controllo alla ricezione Infrarosso

- premere il tasto “Inizio” per abilitare l’uso del telecomando;
- sul controllo viene visualizzato il primo parametro disponibile (P1).

2a) modifica dei parametri principali tramite i tasti diretti

- premere ‘+’ o ‘-’ relativo al parametro di cui si vuole modificare il valore. Alla prima pressione, il display visualizza il codice del parametro, alla successiva pressione viene visualizzato il valore del parametro.

A questo punto:

- premendo ‘+’ il valore aumenta;
- premendo ‘-’ il valore diminuisce.

2b) modifica dei parametri per cui non è previsto il tasto diretto

Per i parametri che non sono riproposti direttamente nel telecomando, o, per tutti i parametri in genere, procedere come segue:

- eseguire le operazioni descritte al punto 1 visualizzando il primo parametro P1;
- premere  e  fino a visualizzare sul display il parametro desiderato;
- premere SEL per visualizzare il valore corrispondente al parametro selezionato;
- premere  per aumentarne il valore;
- premere  per diminuirne il valore;
- premere SEL per confermare provvisoriamente il nuovo valore e tornare alla visualizzazione del codice del parametro;
- per modificare un altro parametro ripetere dal secondo punto della presente procedura;
- per uscire dalla programmazione si veda la sezione seguente.

3) Per uscire dalla programmazione:

- premere MEMO per uscire salvando le modifiche;
- premere ANNULLA per uscire senza salvare le modifiche;
- non premere alcun tasto per almeno 60 secondi (uscita per TIME OUT): in questo caso le modifiche apportate ai parametri non vengono salvate.

Accesso con codice

4) abilitazione del controllo all’uso del telecomando.

Qualora nel controllo sia stato inserito un codice di accesso, ovvero C51>0, l’abilitazione è prevista da questa procedura:

- premere il tasto “Inizio” per abilitare la comunicazione;
- il controllo (o tutti i controlli che si trovano nel raggio di azione del telecomando) risponde visualizzando il proprio codice di accesso;
- digitare correttamente tale codice mediante la tastiera numerica del telecomando;
- a codice correttamente digitato il controllo risponde visualizzando il primo parametro P1;
- proseguire ora come elencato ai punti 1, 2 e 3 precedenti.

6.9 How to modify parameters via remote control

Access without code

***1) To enable** the controller to receive the remote control transmission:*

- *press 'START' to operate the remote control;*
- *the first parameter 'P1' appears on the display.*

***2a) To modify** the main parameters using the buttons:*

- *press either the '+' or '-' button of the parameter you want to modify. The display will show the code of the selected parameter.*

Press the button a second time to display its actual value;

- *press + to increase it;*
- *press - to decrease it.*

***2b) To modify** the parameters not directly indicated by a specific button on the remote control:*

- *perform the same operations described in point 1 above until the first parameter 'P1' appears on the display;*
- *press*  *and*  *until the display shows the parameter you want to modify;*
- *press SEL to display the actual value of the parameter;*
- *press*  *to increase its value;*
- *press*  *to decrease its value;*
- *press SEL to confirm temporarily the new value and display again the code of the parameter;*
- *to modify another parameter repeat the operations described above starting from the second point;*
- *exit the programming procedure as described below.*

***3) To exit** the programming procedure:*

- *press MEMO to exit and save all modifications;*
- *press CANCEL to exit without storing the previous modifications;*
- *do not press any button for at least 60 seconds (TIME OUT). In this way the previous modifications will not be stored.*

Access with code (password)

***4) To enable** the controller to receive the remote control transmission mwhen the controller has been given an access code (C51>0), follow these indications:*

- *press “Start” to operate the remote control unit;*
- *all the controllers exposed to the beam of the remote control will display their own access code;*
- *digit the access code on the keypad of the remote control;*
- *the first parameter P1 appears on the display;*
- *perform the same operations described in points 1) 2) and 3) above.*

6.10 Stato della regolazione durante la modifica dei parametri

Durante la modifica del set-point e dei parametri "P" la regolazione continua regolarmente;
In caso di modifica dei parametri "C", gli ingressi e le uscite del regolatore vengono congelati nello stato assunto prima della modifica.
Se si modifica da telecomando, la regolazione viene congelata nello stato precedente fino alla conferma delle modifiche, ottenuta premendo il tasto PRG.

6.11 Validità della modifica parametri

Il nuovo valore dei parametri C è attivo solo alla fine delle operazioni di modifica, dopo aver premuto il tasto PRG. Analogamente il nuovo valore del set-point è attivo solo dopo la conferma con il tasto SEL.
I parametri "P" sono invece attivi fin dal momento della modifica.

6.12 Reset del controllo

Può essere utile riportare lo strumento alla configurazione di fabbrica. Ciò può essere fatto con la seguente procedura di Reset:
1 – togliere tensione allo strumento;
2 – ridare tensione tenendo premuto il tasto 'PRG'.
In questo modo sono annullate tutte le modifiche e ripristinati i valori originari di fabbrica.

6.13 Sistemi avanzati di programmazione e supervisione

– Kit Modì per la modifica dei parametri di funzionamento da PC

Il kit Modì per Personal Computer è la soluzione ideale per produzioni in piccola/media serie. Permette infatti di memorizzare su file eventuali configurazioni 'standard' che possono essere semplicemente e velocemente trasferite agli strumenti tramite un collegamento seriale. In questo modo si evita ogni possibile errore legato alla programmazione manuale dei controlli.

– Sistema di supervisione e teleassistenza EasyData

Carel ha una vasta gamma di programmi software che consentono di risolvere ogni problema di supervisione e teleassistenza. In particolare il pacchetto EasyData permette di gestire fino a 120 strumenti collegati ad un PC in seriale o via Modem. Tra le principali prestazioni:
- monitoraggio di tutte le variabili con memorizzazione dei dati su hard-disk. È possibile visualizzare l'andamento degli ingressi con grafici su base oraria, giornaliera o mensile. I dati memorizzati ed i grafici possono essere stampati;
- rilevazione e registrazione di eventuali allarmi, con data e ora;
- modifica dei principali parametri direttamente da PC.

Per ulteriori informazioni si rimanda agli specifici manuali che si possono richiedere all'Ufficio Commerciale Carel o al proprio agente di zona.

6.10 Performance of the controller during programming procedures

While modifying set-point and "P" parameters the controller goes on working as usual.
While modifying "C" parameters, inputs and outputs remain in the same status as they were before the modification took place.
The same happens when you modify parameters using the remote control: the control action will remain as it was until you confirm any modification by pressing PRG.

6.11 Confirming the newly set values

Remember that all modifications need to be confirmed: parameters C must be confirmed by pressing PRG, the set-point by pressing SEL.
Parameters "P" become effective as soon as they are modified.

6.12 Reset of the control

Should you need to restore the factory-set configuration, follow these guidelines (reset procedure):

1 – cut off power;
2 – supply the instrument again while holding down 'PRG'.

6.13 Advanced programming tools and Supervisory systems

– Modì Kit for parameters modification via PC.

The Modì Kit for Personal Computer is the best solution for small/medium systems. The Modì Kit allows you to store your standard configuration that can therefore be loaded easily and quickly to all the other Infrared instruments. The Modì Kit makes your job easier as it prevents any error that may occur during manual programming operations.

– Easy-Data Package for Supervisory and Telemaintenance Systems

Carel offers a wide range of software programmes available for any type of supervisory and telemaintenance requirements. The Easy-Data package, for example, has been projected to ensure the centralized control of up to 120 instruments linked up to a PC via serial line or via Modem. Among its functions:
- *it monitors and stores all variables on hard-disk (the trend of the variables can be displayed in a graph on a hourly, daily or monthly basis and printed whenever necessary);*
- *it detects and stores any off-normal condition (together with date and time the alarm occurred);*
- *it allows you to modify the main parameters directly via PC.*

For further information on the Easy-Data Package contact Carel or your nearest Agent.

7. Descrizione parametri

St1 set-point principale

Descrizione: St1 è il parametro principale, usato da tutti i modi di funzionamento.

Modalità di accesso:

tastiera	se C50=1 o 3: diretto premendo SEL; se C50=0, 2 e 4 il parametro è solo visibile.
telecomando	se C50=0, 1 o 4: diretto premendo "Inizio", e successivamente i tasti dedicati del telecomando; se C50 = 2, 3 il parametro è solo visibile.

Validità:

versione	tutti i modelli
modi	è presente in tutti i Modi, ovvero qualsiasi sia C0
altri parametri	non è vincolato da nessun altro parametro

Campo di variazione: tra un minimo di C21 e un massimo di C22, con valori compresi tra -99 e +999

Valore preimpostato: 20

St2 set-point secondario

Descrizione: vedere i capitoli che seguono per una descrizione approfondita.

Modalità di accesso:

tastiera	se C50=1 o 3: diretto premendo SEL dopo la modifica di St1; se C50=0, 2 e 4 il parametro è solo visibile.
telecomando	se C50=0, 1 o 4: diretto premendo "Inizio", e i tasti dedicati del telecomando; se C50 = 2, 3 il parametro è solo visibile.

Validità:

versione	tutti i modelli
modi	C0 = 6,7,8,9 o qualsiasi valore di C0 se C33=1 (funzionamento speciale)
altri parametri	se C19=2, 3 o 4, St2 è usato nella compensazione, Modi 1 e 2

Campo di variazione: tra un minimo di C23 e un massimo di C24, con valori compresi tra -99 e +999

Valore preimpostato: 40

Avvertenze particolari: In funzionamento speciale (C33=1), St2 compare in tutti i modi ma è attivo solo per le uscite con dipendenza uguale a 2 (DIPENDENZA 1=2).

7. Description of the parameters

St1, main set-point

Description: *this is the main parameter, used in all modes of operation:*

Access modes:

keyboard	*If C50=1 or 3: direct access by pressing SEL; If C50=0, 2 and 4: the parameter will only be displayed.*
remote control	*If C50=0, 1 or 4: direct access by pressing "Start", and the dedicated buttons on the remote control; If C50=2, 3: the parameter can only be displayed.*

Validity:

version	*all models*
modes	*all modes, that is, for any value of C0*
other param.s	*not bound to any other parameter*

Operating range: *between C21 (min.) and C22 (max.), with values spanning between -99 and +999*

Factory-set value: *20*

St2, second set-point

Description: *see next chapters in this manual.*

Access modes:

keyboard	*If C50=1 or 3: direct access by pressing SEL after St1 has been modified; If C50=0, 2 and 4: the parameter can only be displayed.*
remote control	*If C50=0, 1 or 4: direct access by pressing "Start" and the dedicated buttons on the remote control; If C50=2, 3: the parameter can only be displayed.*

Validity:

version	*all models*
modes	*C0=6, 7,8,9 or any value of C0 if C33=1 (special mode of operation)*
other parame.s	*If C19=2,3 or 4, St2 is used for the offset*

Operating range: *between C23 (min.) and C24 (max.), with values spanning between -99 and +999*

Factory-set value: *40*

Important: *in the special mode of operation (C33=1), St2 appears in all modes but it operates only when the outputs have a dependence equal to 2 (DIPENDENCE 1=2).*

C0 Modo di funzionamento

Descrizione: è il più importante dei parametri di configurazione. CO può assumere 9 diversi valori, ognuno dei quali corrisponde a uno dei 9 Modi di funzionamento.

Modalità di accesso:

tastiera se C50=1 o 3: PRG + SEL per 5", password 22 o 77;
se C50=0, 2 e 4 il parametro è solo visibile.

telecomando se C50=4 diretto premendo "Inizio", e i tasti dedicati del telecomando;
se C50=0,1,2 e 3 è sempre visualizzabile premendo direttamente il tasto "**MODE**" senza premere "**Inizio**".

Validità:

versione tutti i modelli
modi –
altri parametri non dipende da altri parametri

Campo di variazione: tra 1 e 9

C0=1 Direct
C0=2 Reverse
C0=3 ZONA NEUTRA
C0=4 PWM
C0=5 Allarmi
C0=6 St1 in Direct o St2 in Reverse da ingresso digitale
C0=7 St1 in Direct o St2 in Direct da ingresso digitale
C0=8 St1 in Reverse o St2 in Reverse da ingresso digitale
C0=9 St1 in Reverse e ST2 in Direct contemporaneamente (solo modelli W e Z)

Valore preimpostato: 2 = funzionamento Reverse

Si ricordano alcune caratteristiche dei modi:
- C0=1 e 2: per i modelli con ingresso NTC lo strumento può gestire una seconda sonda (vedi C19);
- C0=3, 4 e 5: attivazione della zona neutra: P3;
- C0=6, 7 e 8: l'ingresso digitale 1 commuta il set-point di lavoro. Non è quindi attivo il parametro C29 "gestione ingresso digitale 1";
- C0=9: non operativo per i modelli a una sola uscita (versioni IRDRV, IRDRT, IR32V).

Avvertenze: quando si modifica C0 il valore di C33 deve essere 0. Se C33=1, la modifica di C0 non ha alcun effetto.

C0, mode of operation

Description: *it is the chief configuration parameter. It can be given 9 different values depending on the mode of operation your system requires.*

Access modes:

keyboard *If C50=1 or 3: hold down PRG + SEL for 5", password 22 or 77*
If C50=0, 2 and 4 the parameter will only be displayed

remote control *If C50=4: direct access by pressing "**Start**" and the dedicated buttons on the remote control*
*If C50=0, 1, 2 and 3 it can always be displayed simply by pressing "**MODE**".*

Validity:

version *all models*
modes –
other param.s *not bound to any other parameter*

Operating range: *between 1 and 9*

C0=1 Direct
C0=2 Reverse
C0=3 NEUTRAL ZONE
C0=4 PWM
C0=5 Alarms
C0=6 St1-direct or St2-reverse by digital input
C0=7 St1-direct or St2-direct by digital input
C0=8 St1-reverse or St2-reverse by digital input
C0=9 St1-reverse and ST2-direct simultaneously (models W and Z only)

Factory-set value: *2 = Reverse*

C0 special features:
- *C0=1 and 2: models with NTC input can manage a second sensor (see C19);*
- *C0=3, 4 and 5: activation of neutral zone P3;*
- *C0=6, 7 and 8: digital input 1 changes the operating set-point. Therefore, parameter C29 "digital input 1 management" is not operative;*
- *C0=9 : disabled in single-output models (IRDRV, IRDRT, IR32V).*

Important: *When modifying C0, the value of C33 must be 0. If C33=1 then modifying C0 produces no effects.*

P1 differenziale di St1

Descrizione: P1 definisce l'isteresi di St1. P1 è espresso in valore assoluto ed interessa la zona a destra (post) e a sinistra (pre) di St1. Ciascuna uscita utilizza parte di queste zone a seconda del Modo di funzionamento in uso. Per la rappresentazione grafica si rimanda alla descrizione dei Modi di funzionamento (cap.5).

Modalità di accesso:

tastiera se C50=1 o 3: PRG per 5"
se C50=0, 2 e 4 il parametro è solo visibile
telecomando se C50=0, 1 o 4: diretto premendo "Inizio", e i tasti dedicati del telecomando
se C50=2, 3 il parametro è solo visibile

Validità:

versione qualsiasi modello
modi è presente in tutti i modi, ovvero qualsiasi sia C0
altri parametri –

Campo di variazione: un minimo di 0,1 e un massimo di 99,9

Valore preimpostato: 2.0

P1, differential of St1

Description: *it defines the hysteresis of St1. P1 is an absolute value that can be set either pre or post the set-point. For further details see Operation Modes (chapter 5).*

Access modes:

keyboard *If C50=1 or 3: hold down PRG for 5";*
If C50=0, 2 and 4: the parameter will only be displayed.

remote control *If C50=0, 1 or 4: direct access by pressing "Start" and the dedicated buttons on the remote control;*
If C50 = 2, 3: the parameter will be only displayed.

Validity:

version *all models*
modes *all modes, for any value of C0*
other param.s –

Operating range: *between 0.1 (min.) and 99.9 (max.)*

Factory-set value: *2.0*

P2 differenziale di St2

Descrizione: analogamente a P1, P2 definisce l'isteresi di St2. Valgono le stesse considerazioni fatte per P1.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG per 5" se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=0, 1 o 4: diretto premendo "Inizio", e i tasti dedicati del telecomando se C50=2, 3 il parametro è solo visibile

Validità:

versione	qualsiasi modello
modi	C0=3,4,5,6,7,8,9
altri parametri	attivo anche con altri modi se C33=1 (funzion. speciale) o C19=4 (2ª sonda, solo NTC)

Campo di variazione: tra un min. di 0,1 e un max. di 99,9

Valore preimpostato: 2.0

Avvertenze particolari: si noti che nei Modi 3, 4 e 5, P2 è il differenziale dell'azione Direct e fa riferimento a St1.

P2, differential of St2

Description: *P2 defines the hysteresis of St2. The same considerations made for P1 are also valid for P2.*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG for 5";* *If C50=0, 2, and 4: the parameter will only be displayed.*
remote control	*If C50=0, 1 or 4: direct access by pressing "Start" and the dedicated buttons on the remote control;* *If C50=2, 3: the parameter will only be displayed.*

Validity:

version	*all models*
modes	*C0=3, 4, 5, 6, 7, 8, 9*
other param.s	*active also with other Modes if C33=1 (special mode) or C19=4 (2nd sensor, NTC only).*

Operating range: *between 0.1 (min.) and 99.9 (max.)*

Factory-set value: *2.0*

Important: *remember that in modes 3, 4 and 5, P2 is the differential of St1 (Direct mode).*

P3 differenziale ZONA NEUTRA (o neutra)

Descrizione: nei Modi 3, 4 e 5, P3 definisce una zona di non intervento, ovvero la "ZONA NEUTRA".

Modalità di accesso:

tastiera	se C50=1 o 3 premendo PRG per 5" se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=0, 1 o 4: diretto premendo "Inizio", e i tasti dedicati del telecomando; se C50=2, 3 il parametro è solo visibile.

Validità:

versione	qualsiasi modello. Per C0=5 solo modelli W e Z
modi	C0=3,4 e 5
altri parametri	–

Campo di variazione: tra un min. di 0,0 e un max. di 99,9

Valore preimpostato: 2.0
Per maggiori dettagli e la rappresentazione grafica si riveda la descrizione del Modo 3 (vedi pag. 7).

P3, dead (neutral) zone differential

Description: *in Modes 3, 4 and 5, P3 defines a "NEU - TRAL ZONE", that is, a range in which the controller does not actuate any device.*

Access modes:

keyboard	*If C50=1 or 3, hold down PRG for 5";* *If C50=0, 2 and 4: the parameter will be only displayed.*
remote control	*If C50=0, 1 or 4: direct access by pressing "Start" and the dedicated buttons on the remote control;* *If C50=2, 3: the parameter will only be displayed.*

Validity:

version	*all models; If C0=5, models W and Z only*
modes	*C0=3, 4 and 5*
other param.s	*–*

Operating range: *between 0.0 (min.) and 99.9 (max.)*

Factory-set value: *2.0*
For further information and graphic representation of P3 see description of Mode 3 (see page 7).

C4 Autorità

Descrizione: C4 è attivo in caso di compensazione: rappresenta il coefficiente di variazione di St1 in base allo scostamento della misura rilevata dalla 2ª sonda NTC rispetto al set-point di riferimento St2.
Tradotta in formula: $C4 = \frac{\Delta St1}{\Delta Ntc2} = \frac{St1 finale - St1}{Ntc2 finale - St2}$

Modalità di accesso:

tastiera	se C50=1 o 3 : PRG+SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50 = 0, 1, 2 e 3 il parametro è solo visibile

C4, authority

Description: *C4 operates in the event of offset: it repre - sents the variation coefficient of St1 according to the deviation measured by the second NTC sensor in relation to St2.*
Its formula is: $C4 = \frac{\Delta St1}{\Delta Ntc2} = \frac{final\ St1 - St1}{final\ Ntc2 - St2}$

Access modes:

keyboard	*If C50=1 or 3: hold down PRG+SEL for 5", password 77;* *If C50=0, 2 and 4 the parameter will only be displayed.*
remote control	*If C50=4: press Start, buttons ▲ and ▼;* *If C50 = 0, 1, 2 and 3: the parameter will only be displayed.*

Validità:
versione solo modelli NTC
modi C0=1 e 2
altri parametri C19=2, 3 e 4

Campo di variazione: tra un min. di -2,0 e un max di 2,0

Valore preimpostato: 0,5

Avvertenze particolari: è visualizzabile e impostabile in ogni caso quindi per tutti i modelli, per tutti i C0 e per qualsiasi valore di C19, ma ha validità solo nelle versioni e nei modi su indicati.

C5 P o P+I

Descrizione: C5=1 attiva una regolazione di tipo P+I (proporzionale + integrale). Questa regolazione è utile soprattutto nei regolatori con più uscite. In questo caso il regolatore agisce sul sistema in modo che la grandezza controllata si porti sul valore di set-point o, se abilitato P3, all'interno della zona neutra (leggi Modi 3, 4 e 5).

Modalità di accesso:
tastiera se C50=1 o 3: PRG + SEL per 5", password 77
se C50=0, 2 e 4 il parametro è solo visibile

telecomando se C50=4: premere "Inizio", tasti ▲ e ▼
se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:
versione tutti i modelli
modi tutti i modelli
altri parametri –

Campo di variazione: 0 o 1
C5=0 Regolazione P = Proporzionale
C5=1 Regolazione P+I = Proporzionale+Integrale

Valore preimpostato: 0=P (Proporzionale)

Note:
1) la regolazione P+I richiede, prima di essere applicata, che il funzionamento con regolazione di tipo P non presenti pendolazioni e sia caratterizzata da una buona stabilità nei differenziali di lavoro previsti: solamente partendo da una regolazione P stabile, P+I garantisce la massima efficacia;
2) P+I è attivo solo quando il valore sonda rientra nei differenziali di lavoro P1 o P2 per le condizioni indicate al punto 3;
3) sono considerati due errori integrali (quindi due azioni P+I): uno che si riferisce a St1/P1 e l'altro a St2/P2 in relazione alle uscite ad essi correlate (vedere "DIPENDENZA=1 o 2, al capitolo 8.1, pag. 43);
4) l'azione P+I è annullata quando la misura è al di fuori dalle zone comprese dai differenziali (vedere punto 3);
5) con P+I attivo un'azione efficace è contraddistinta dal valore della grandezza regolata coincidente con il set di riferimento o rientrante all'interno della zona neutra; in queste condizioni si possono riscontrare più uscite attive anche se il diagramma di regolazione di partenza non le prevedeva. Questo è l'effetto più evidente dell'azione P+I;
6) l'azione P+I si esplica in un tempo di integrazione fissato a 600 secondi (non modificabile).

Validity:
version *NTC models only*
modes *C0=1 and 2*
other param.s *C19=2, 3 and 4*

Operating range: *between -2.0 (min.) and 2.0 (max.)*

Factory-set value: *0.5*

Important: *C4 can be displayed and set in all models, for any value of C0 and C19, but it operates only with NTC models and in the modes listed above.*

C5, P or P+I

Description: *C5=1 actuates a P+I control action (proportional + integral), which is particularly useful when using controllers with more than one outputs. The controlled variable will corre - spond to the set-point or will range within the neutral zone (if P3 is operative) (see Modes 3, 4, 5).*

Access mode:
keypad *if C50=1 or 3: press PRG + SEL for 5", password 77;*
if C50=0, 2 and 4 the parameter can only be displayed.

remote control *if C50=4: press "Start",* ▲ *and* ▼
if C50=0, 1, 2, 3 the parameter can only be displayed

Validity:
version *all models*
modes *all modes*
other param.s *–*

Operating range: *0 or 1*
C5=0 P control action (Proportional)
C5=1 P+I control action (Proportional + Integral)

Factory-set value: *0=P (Proportional)*

Important:
1) be sure, before setting a P+I control action, that the Proportional regulation is free from hunting problems and with a good stability as far as the differentials are concerned. If P is steady enough, then P+I will produce the best results.
2) P+I becomes operative only when the value measured by the sensor ranges within the operating differentials P1 or P2 as indicated in point 3) below.
3) St1/P1 and St2/P2 are considered two integral errors (P+I control actions) (see Dependence=1 or 2, chapter 8.1, page 43).
4) P+I is cancelled when the detected value goes beyond the range set by the differentials (see point 3).
5) P+I ensures that the controlled variable reaches the set-point or ranges within the dead zone; to get these conditions more outputs will energize.
6) the P+I integration time is 600 seconds (this value can not be changed).

C6 Ritardo tra gli inserimenti di uscite differenti

Descrizione: nel caso di attivazione di più uscite in sequenza, C6 permette di ritardare l'inserimento delle uscite stesse, e ciò al fine di evitare sovraccarichi della linea a causa di spunti ravvicinati o contemporanei dei carichi. Nei sistemi in cui i tempi di risposta sono relativamente brevi (potenze in gioco grandi rispetto all'inerzia del sistema), si evitano partenze e fermate repentine di tutti i carichi, eliminando quindi fastidiosi problemi di pendolazione (da non confondere con C7 che è il ritardo tra due accensioni di una stessa uscita).

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	modelli W e Z
modi	tutti i C0, tranne C0=4
altri parametri	–

Campo di variazione: minimo 0, massimo o 999 (secondi)

Valore preimpostato: 5 secondi

C7 Tempo minimo tra 2 accensioni successive

Descrizione: C7 stabilisce il tempo minimo (in minuti) che deve trascorrere tra due accensioni della stessa uscita, indipendentemente dalla richiesta della regolazione. Settando questo parametro è possibile limitare il numero di accensioni per ora: è molto utile, ad esempio, per la gestione dei compressori. Se il numero massimo di inserimenti ora raccomandato dal costruttore del compressore è pari a 10, è sufficiente settare C7=6 per garantire il rispetto di questo limite.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	tutti i modelli
modi	tutti i C0, escluso C0=4
altri parametri	–

Campo di variazione: minimo 0, massimo 15 (minuti)

Valore preimpostato: 0: non viene imposto un tempo minimo tra due accensioni.

Avvertenze: C7 non è operativo per le uscite PWM.

C6, delay between energizations of different outputs

Description: *if your system requires the activation of more outputs in sequence, C6 allows you to delay their energisation, so as to avoid line overload due to close or simultaneous inrush of the loads. In systems where reac - tion time are relatively short (great power in relation to the system inertia), the use of C6 avoids any hunting problem.*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG+SEL for 5", password 77;* *If C50=0, 2 and 4: the parameter will only be displayed.*
remote control	*If C50=4: press "Start", ▲ and ▼* *If C50=0, 1, 2 and 3: the parameter will only be displayed*

Validity:

version	*Models W and Z*
modes	*All values of C0 except C0=4*
other param.s	–

Operating range: *Min. 0, Max. 999 (seconds)*

Factory-set value: *5 seconds*

C7, minimum time between 2 successive energizations of the same output

Description: *C7 determines the minimum time-delay (in minutes) between two energisations of the same output. Therefore C7 limits the number of energisations per hour; this function is extremely useful in compressor-based applica - tions where C7 ensures the efficiency of the entire system. If the maximum number of energizations per hour recommen - ded by the compressor manufacturer is 10, just set C7=6.*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG+SEL for 5" password 77;* *If C50=0, 2 and 4: the param. will only be displayed.*
remote control	*If C50=4: press "Start", ▲ and ▼* *If C50=0, 1, 2 and 3: the parameter will only be displayed*

Validity:

version	*All models*
modes	*All values of C0, except C0=4*
other param.s	–

Operating range: *Min. 0, Max. 15 (minutes)*

Factory-set value: *0: the minimum time between two successive energisations is not set.*

Important: *C7 does not operate with PWM outputs.*

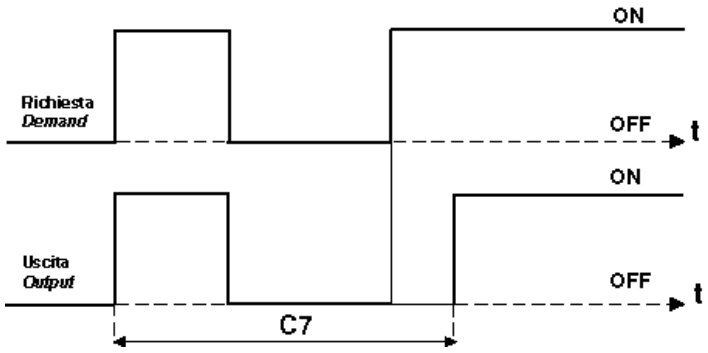


Fig.14

C8 Tempo minimo di spegnimento

Descrizione: C8 stabilisce il tempo minimo di spegnimento in minuti della singola uscita. Ogni uscita non viene riattivata se non è trascorso il tempo C8 dall'ultimo spegnimento, indipendentemente dalla richiesta della regolazione. Questo parametro è utile per garantire l'equalizzazione delle pressioni dopo lo spegnimento nel caso di impianti con capillare e compressori ermetici.

Modalità di accesso:

tastiera se C50=1 o 3: PRG + SEL per 5", password 77
se C50=0, 2 e 4 il parametro è solo visibile

telecomando se C50=4: premere "Inizio", tasti ▲ e ▼
se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione tutti i modelli
modi tutti i C0, escluso C0=4
altri parametri –

Campo di variazione: minimo 0, massimo 15 (minuti)

Valore preimpostato: 0. Non viene imposto un tempo minimo di spegnimento.

Avvertenze: C8 non è operativo per le uscite PWM.

C8, minimum disenergization time-interval

Description: *C8 determines the minimum time (in minutes) during which the output remains disenergised. Each out - put will energize again after the C8 time has passed, inde - pendently of the controller's request. This parameter allows you to equalise pressures in systems equipped with hermetic compressors.*

Access modes:

keyboard *If C50=1 or 3: hold down PRG + SEL for 5", password 77;*
If C50=0, 2, 4: the param. will only be displayed.

remote control *If C50=4: press "Start", ▲ and ▼*
If C50=0, 1, 2 and 3: the param. will only be displayed

Validity:

version *All models*
modes *All values of C0, except C0=4*
other param.s –

Operating range: *Min. 0 , Max. 15 (minutes)*

Factory-set value: *0 (there is no min. factory-set off-time)*

Important: *C8 does not operate with PWM outputs.*

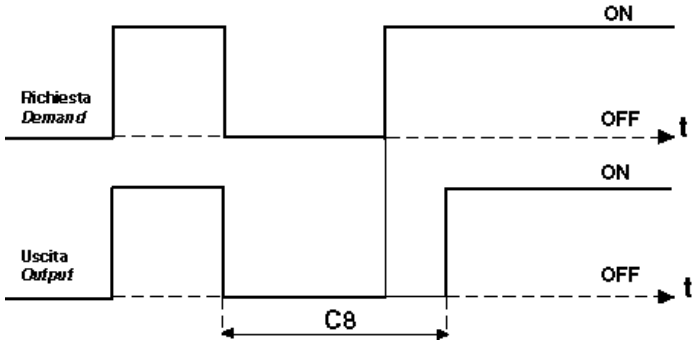


Fig.15

C9 Tempo minimo di attivazione

Descrizione: C9 stabilisce il tempo minimo di attivazione dell'uscita. Questo parametro può essere utile negli impianti frigoriferi con compressori semiermetici per impedire la migrazione dell'olio.

Modalità di accesso:

tastiera se C50=1 o 3: PRG + SEL per 5", password 77
se C50=0, 2 e 4 il parametro è solo visibile

telecomando se C50=4: premere "Inizio", tasti ▲ e ▼
se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione tutti i modelli
modi tutti i C0, escluso C0=4
altri parametri –

Campo di variazione: minimo 0, massimo 15 (minuti)

Valore preimpostato: 0. Non viene imposto un tempo min. di ON

Avvertenze: C9 non è operativo per le uscite PWM.

C9, minimum energization time-interval

Description: *C9 determines the minimum time an output remains energised; This parameter is particularly useful in refrigeration systems equipped with semi-hermetic com - pressors to avoid oil migration.*

Access modes:

keyboard *If C50=1 or 3: hold down PRG + SEL for 5", password 77;*
If C50=0, 2, 4: the param. will only be displayed.

remote control *If C50=4: press Start, ▲ and ▼*
If C50=0, 1, 2 and 3: the parameter will only be displayed

Validity:

version *All models*
modes *All values of C0, except C0=4*
other param.s –

Operating range: *Min. 0 , Max. 15 (minutes)*

Factory-set value: *0 (there is no min. ON-time)*

Important: *C9 does not operate with PWM outputs.*

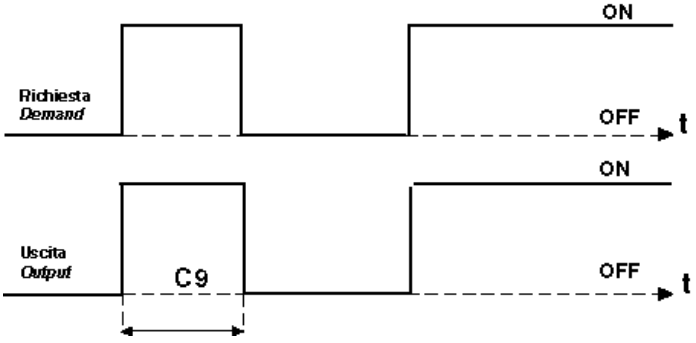


Fig.16

C10 Stato delle uscite in caso di allarme sonda (Er0)

Descrizione: C10 determina l'azione sulle uscite di regolazione nel caso sia attivo l'allarme sonda di regolazione Er0, forzando uno dei quattro stati previsti. Quando viene selezionato lo stato OFF, lo spegnimento è immediato; non è rispettata nessuna temporizzazione. Quando viene selezionato lo stato ON, è invece rispettato il "Ritardo tra due inserimenti di due u s c i t e differenti", (vedi C6). Quando l'allarme Er0 rientra, la regolazione riprende normalmente; e l'eventuale uscita di allarme viene resettata (vedi Modo 5). Rimangono invece attivi sia la segnalazione su display che il buzzer finché non si preme PRG/MUTE.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	tutti i modelli
modi	tutti i C0
altri parametri	–

Campo di variazione: minimo 0, massimo 3

C10=0	OFF: tutte le uscite regolazione OFF
C10=1	ON: tutte le uscite regolazione ON
C10=2	ON: i gradini Direct – OFF i gradini Reverse
C10=3	OFF: i gradini Direct – ON i gradini Reverse

Valore preimpostato: 0. Tutte le uscite vengono forzate ad OFF se Er0

C11 Rotazione

Descrizione: C11 permette alle uscite di regolazione di scambiare la priorità di partenza e di arresto: in relazione alla richiesta dettata dalla regolazione si diseccita l'uscita che da più tempo è attiva o viene attivata l'uscita che da più tempo è disattiva.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	modelli W e Z
modi	C0=1, 2, 6, 7, 8
altri parametri	C33 deve valere 0

Campo di variazione: minimo 0, massimo 7
C11=0 nessuna rotazione;
C11=1 rotazione Standard su tutti i relè (2 o 4 a seconda del modello);
C11=2 rotazione 2+2 su 4 relè; è stata pensata per gestire compressori parzializzati. Le uscite 1 e 3 attivano i compressori, le uscite 2 e 4 le valvole di parzializzazione. La rotazione di priori-tà avviene tra le uscite 1 e 3, mentre le valvole vengono eccitate (relè ON) per permettere il funzionamento dei compressori a massima potenza. La valvola 2 è legata all'uscita 1 e la valvola 4 all'uscita 3.
C11=3 rotazione 2+2 DWM Copeland a 4 relè. È analoga alla rotazione precedente con logica di gestione delle valvole invertita. Le valvole sono infatti normalmente eccitate (compressore parzializzato) e vengono diseccitate (relè OFF) quando è richiesto il funzionamento del compressore a piena potenza. Come in precedenza anche in questo caso le uscite 1 e 3 comandano i compressori, le uscite 2 e 4 le relative elettrovalvole.

C10, outputs status in the event of sensor alarm (Er0)

Description: *C10 determines the status of the outputs in the event of sensor alarm (Er0). Select the OFF status to g e t an immediate disenergisation of the outputs. Time-delays will not be taken into consideration. Select the ON status to maintain the pre-set time-delays between energizations of two different outputs (see C6). When Er0 disappears, the con - trol action will re-start and the alarm output reset (see Mode 5). Instead, the alarm message on the display and the buzzer will remain active until you press PRG/MUTE.*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 77;* *If C50=0, 2 and 4: the param. will only be displayed*
remote control	*If C50=4: press "Start", ▲ and ▼* *If C50=0, 1, 2 and 3: the param. will only be displayed*

Validity:

version	*All models*
modes	*All values of C0*
other param.s	*–*

Operating range: *Min. 0, Max. 3*

C10=0	*OFF: all outputs are disenergised*
C10=1	*ON: all outputs are energised*
C10=2	*Direct steps ON; Reverse steps OFF*
C10=3	*Direct steps OFF; Reverse steps ON*

Factory-set value: *0: all outputs are forced in the OFF status in the event of sensor alarm (Er0).*

C11, Rotation

Description: *C11 allows your controller to disenergize the output that has been energized for the longest time or to energize the output that has been disenergized for the longest time.*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 77;* *If C50=0, 2 and 4: the parameter will only be displayed.*
remote control	*If C50=4: press "Start", ▲ and ▼* *If C50=0, 1, 2 and 3: the parameter will only be displayed*

Validity:

version	*Models W and Z*
modes	*C0 = 1, 2, 6, 7, 8*
other param.s	*C33 must be 0*

Operating range: *Min. 0, Max. 3*
C11=0 *no rotation*
C11=1 *standard rotation on all relays (2 or 4, depending on the model)*
C11=2 *rotation 2+2 on 4 relays (to control capacity-con - trolled compressors). Outputs 1 and 3 actuate the com - pressors, outputs 2 and 4 the valves. Priority is given to outputs 1 and 3; the relays corresponding to the valves energize to make the compressors work at full power. Output 1 corresponds to the second valve; output 3 to the fourth valve.*
C11=3 *rotation 2+2 DWM Copeland, 4 relays. Similar to the previous operating logic but in this case the valves are normally energized (capacity-controlled compressor); they disenergize (relay OFF) when the compressor has to work at full power. Outputs 1 and 3 control the compressors, outputs 2 and 4 the electrovalves.*

Valore preimpostato: 0. No rotazione

Avvertenze:
- il parametro non ha effetto per i regolatori ad un'uscita;
- nei controlli con numero di serie **minore di 100.000** la rotazione è disabilitata nel funzionamento speciale (C33=1) (per i controlli con numero di serie **maggiore di 100.000** vedere nota seguente);
- nei modelli a due uscite(W), la rotazione è standard anche per C11=2 o 3;
- il collegamento nella configurazione 2+2 è il seguente: OUT1 = Comp.1, OUT2 = Valv.1, OUT3 = Comp. 2, OUT4 = Valv. 2.

Nota per la nuova versione

A partire dal numero di serie maggiore di 100.000 sono disponibili altre quattro nuove rotazioni, in aggiunta alle tre già esistenti (attive nei modelli Z e A):

C11=4 ruotano uscite 3 e 4, NON ruotano uscite 1 e 2;
C11=5 ruotano uscite 1 e 2, NON ruotano uscite 3 e 4;
C11=6 ruotano uscite 1 e 2, ruotano uscite 3 e 4;
C11=7 ruotano uscite 2, 3 e 4, NON ruota uscita 1.

Con C33=1 le rotazioni sono valide per tutti i modi. Esse saranno abilitate anche in funzionamento speciale; l'utente dovrà prestare particolare attenzione alla programmazione dei parametri perché il controllo farà ruotare le uscite secondo la logica sopra indicata, indipendentemente dal fatto che esse siano uscite di regolazione (anche PWM) o di allarme.

Esempio a: se si hanno due uscite di allarme e due di regolazione, è necessario scegliere la rotazione in modo tale da far ruotare solamente le uscite di regolazione.

Esempio b: se si vuole controllare un chiller a tre compressori, si potrà utilizzare la rotazione "7", riservando le uscite 2, 3 e 4 ai compressori, mentre l'uscita 1 potrà essere non collegata oppure impiegata come uscita ausiliaria o uscita di allarme.

Factory-set value: *0 (no rotation)*

Important:
- *the parameter does not operate in single-output controllers;*
- *in the controllers with serial number **below 100,000** rotation is not operative in the special mode of operation (C33=1) (for the controllers with serial number **above 100,000** see note below)*
- *in two-output models (W), the rotation is a standard feature also when C11=2 or 3;*
- *connection in the 2+2 configuration is as follows: OUT1 = Comp.1, OUT2 = Valve 1, OUT3 = Comp.2, OUT4 = Valve 2*

Important: new versions

All controllers model Z and A whose serial number is above 100,000 come with the possibility of setting four new rotations besides the existing ones:

C11=4 rotation of outputs 3 and 4, NO rotation for outputs 1 and 2;
C11=5 rotation of outputs 1 and 2; NO rotation of outputs 3 and 4;
C11=6 rotation of output 1 and 2; rotation of output 3 and 4;
C11=7 rotation of output 2, 3 and 4; NO rotation of output 1.

When C33=1 (special mode of operation), rotations beco - me operative for any mode. Pay attention when program - ming the parameters as the controllers make the outputs rotate according to the logic described above, no matter what the outputs are dedicated (control, PWM or alarm outputs).

Example a: *if your instrument has two alarm outputs and two control outputs, the rotation should be selected so as to involve exclusively the control outputs.*

Example b: *if you need to control a three-compressor chiller, you can choose rotation "7" and dedicate outputs 2, 3 and 4 to the compressors. Output 1 can be used as auxiliary or alarm output.*

C12 Tempo di ciclo PWM

Descrizione: C12 rappresenta il tempo totale nel ciclo PWM; in pratica, la somma del tempo di attivazione tON e del tempo di spegnimento tOFF è costante e uguale a C12. Il rapporto tra tON e tOFF è stabilito dall'errore di regolazione, ovvero dallo scostamento della misura dal set point riferito (in percentuale) al differenziale interessato dall'uscita. Per ulteriori dettagli si riveda la descrizione del Modo 4, pag. 7.
Nota: poiché l'azione del funzionamento PWM è modulante, si può sfruttare appieno la regolazione P+I, affinché il valore della grandezza coincida con il valore del set o rientri all'interno della ZONA NEUTRA (vedi parametro C5).

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0,1, 2 e 3 il parametro è solo visibile

Validità:

versione	tutti i modelli
modi	C0=4. Nel funzionamento speciale (C33=1) il parametro C12 è attivo qualsiasi sia il Modo se il parametro TIPO DI USCITA=1 (funzionamento PWM)
altri parametri	TIPO DI USCITA=1

Campo di variazione: minimo 0.2, massimo 999 (secondi)
Valore preimpostato: 20 secondi

C12, PWM cycle time

Description: *C12 determines the total time of the PWM cycle: the time the output remains energised (tON) plus the time the output is disenergised (tOFF) correspond to C12. The relation between tON and tOFF is determined by the control error, that is the deviation of the variable from the set-point with reference to its differential. For further details see Mode 4 on page 7.*
Important: *as the PWM mode produces a modulating action, you can fully exploit the advantages of the P+I control action to make the value of the controlled variable coincide with the set-point or make it range within the dead zone (see parameter C5).*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 77;* *If C50=0, 2 and 4: the param. will only be displayed.*
remote control	*If C50=4: press "Start", ▲ and ▼* *If C50=0, 1, 2; and 3: the parameter will only be displayed*

Validity:

version	*All models*
modes	*C0=4. If C33=1 (special mode of operation); C12 is selectable whatever the mode if Type of Outputs=1(PWM function).*
other param.s	*DEPENDENCE=1*

Operating range: *Min. 0.2, Max. 999 (seconds)*

Factory-set value: *20 seconds*

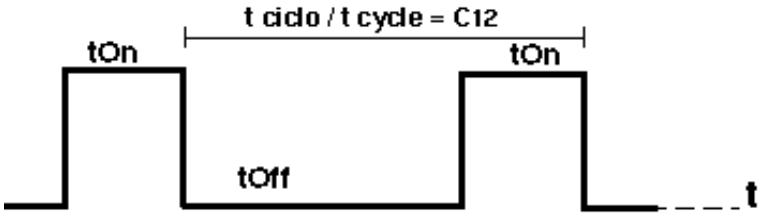


Fig.17

Avvertenze:

- Il tempo di attivazione minimo e la massima definizione ottenibile di tON è 1/100 di C12. (In pratica questo valore corrisponde per ciascuna uscita alla divisione di C12 per i decimi di unità di misura compresi dal suo differenziale), ovvero tradotto in formula:
  tmin[OUTn](s) = C12 / 10xdiff OUTn

- Comando relè a stato solido (SSR): sono disponibili su richiesta due versioni speciali a quattro uscite, senza relè d'uscita, identificati dai codici IR32Ax e IRDRAx (per identificare il codice completo vedere Cap. 1): le quattro uscite forniscono un segnale ON/OFF in tensione continua, 10Vdc, Ri (resistenza interna)= 660Ω. Queste versioni sono state ideate per pilotare relè a stato solido. Per i modelli IR32 esiste anche la versione IR32D con una uscita di comando per SSR.

- Opzioni: è possibile utilizzare il comando PWM per ottenere un segnale di comando di tipo 0-10 V o 4-20 mA; è necessario in questo caso abbinare la versione per il comando di relè a stato solido del tipo sopradescritto, con il relativo Modulo descritto al capitolo 12, pag. 62 ("Moduli opzionali").

Important:

- *The minimum activation time (tON) is 1/100 of C12. Its formula is:*
  tmin (OUTn)(s) = C12 /10 x differential OUTn

- *Solid State Relay command (SSR): two four-output versions without output relay are available upon request (IR32Ax and IRDRAx, see Chapter 1); the four outputs give an On/Off signal (10Vdc, Ri=660). These versions have been specifically desi - gned for use with solid state relays. Among the IR32 models, the IR32D comes complete with one output for SSR.*

- *Options: by using the PWM mode you can obtain a 0-10V or 4-20 mA signal; the version for use with SSR should, in this case, be combined with the dedicated module described in chapter 12, page 62 (Optional Modules).*

C13 Tipo sonda

Descrizione: C13 specifica il tipo di sonda; il significato varia a seconda dei modelli:

ingresso termocoppia:
C13=0 Tc Tipo K
C13=1 Tc Tipo J

ingresso corrente:
C13=0 segnale 4-20 mA
C13=1 segnale 0-20 mA

ingresso NTC:
C13=0 funzionamento normale
C13=1 lo strumento inverte la visualizzazione delle sonde, ovvero il display visualizza NTC2 e premendo il tasto ▼ viene mostrato il valore di NTC1. Niente cambia a livello di regolazione, anche nel caso di compensazione: la sonda principale di regolazione resta NTC1 e la sonda secondaria rimane NTC2. Il parametro C13=1 richiede quindi la seconda sonda NTC2; nel caso in cui NTC2 sia scollegata o in corto, viene attivato l'allarme Er1.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 22 o 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	modelli con ingresso termocoppia, corrente, NTC
modi	è presente in tutti i modi, ovvero qualsiasi sia C0
altri parametri	–

Campo di variazione: 0 o 1

Valore preimpostato: 0. Termocoppia tipo K o segnale in corrente 4-20 mA

P14 Calibrazione

Descrizione: P14 permette di correggere la temperatura mostrata a display aggiungendo un offset alla misura letta: il valore assegnato a questo parametro viene aggiunto alla sonda se positivo o tolto se negativo.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG per 5" se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=0, 1 o 4: diretto premendo "Inizio", e i tasti del telecomando se C50=2, 3 il parametro è solo visibile

Validità:

versione	qualsiasi modello
modi	è presente in tutti i modi, qualsiasi sia C0
altri parametri	–

Campo di variazione: tra un min. di -99 a un max di 99,9

Valore preimpostato: 0. Nessun offset sul valore sonda

Avvertenze:
- la regolazione e la gestione allarmi di "Alta" e "Bassa" sono riferiti al valore corretto da P14;
- nelle versioni NTC, P14 opera esclusivamente sulla sonda principale NTC1 e non interviene su NTC2.

C13, type of sensor

Description: *C13 can indicate different types of sensors, depending on the IR model:*

Thermocouple:
C13=0 Type K Thc
C13=1 Type J Thc

Current Input:
C13=0 4-20 mA signal
C13=1 0-20 mA signal

NTC Input:
C13=0 normal function
C13=1 the instrument inverts the order in which sensors NTC1 and NTC2 are displayed. The display shows the value of NTC2; press ▼ to display NTC1. The controller's regulation logic will remain unchanged: the main sensor remains NTC1, the second sensor NTC2, as usual. When C13=1 the second sensor NTC2 should be used; in the event of sensor alarm (disconnection or short-circuit), the Er1 alarm will be generated.

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 22 or 77* *If C50=0, 2 and 4: the param. will only be displayed*
remote control	*If C50=4: press "Start", ▲ and ▼* *If C50=0, 1, 2 and 3: the parameter will only be displayed*

Validity:

version	*models with Thermocouple, Current and NTC input*
modes	*all modes, that is, for any value of C0*
other param.s	–

Operating range: *0 or 1*

Factory-set value: *0: Type K thermocouple or 4-20mA current signal*

P14, calibration

Description: *this parameter allows you to correct the displayed temperature by adding an offset to the value read by the sensor. The value given to this parameter will be added, if positive, or subtracted, if negative, to the sen - sor signal.*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG for 5" If C50=0, 2 and 4: the param. will only be displayed*
remote control	*If C50=0,1 or 4: direct access by pressing Start and the dedicated buttons on the remote control* *If C50=2, 3: the param. will only be displayed*

Validity:

version	*Any model*
modes	*All modes, that is, for any value of C0*
other param.s	–

Operating range: *between -99 (min.) and 99.9 (max.)*

Factory-set value: *0 (no factory-set offset)*

Important:
- *both control action and High/Low temperature alarms refer to the value modified by P14;*
- *in NTC models, P14 modifies the value of the main sensor (NTC1) but not that of NTC2.*

C15 Valore minimo per ingressi in corrente e tensione

Descrizione: C15 è il valore visualizzato quando all'ingresso c'è il valore minimo, ovvero vi sono 4 mA (4/20) o 0 mA (0/20) nei modelli in corrente, 0 V (nelle versioni -0,4/1V).

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 22 o 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	modelli con ingresso in corrente e in tensione
modi	è presente in tutti i modi, ovvero qualsiasi sia C0
altri parametri	–

Campo di variazione: tra un min. di -99 a un max. di C16

Valore preimpostato: 0
Per ulteriori informazioni vedere la nota posta alla fine del parametro C16, di seguito descritto.

C15, minimum value of voltage and current inputs

Description: *C15 corresponds to the minimum value of the input: 4mA (4-20), 0mA (0-20), 0V (-0.4/1V).*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 22 or 77* *If C50=0, 2 and 4: the parameter will only be displayed*
remote control	*If C50=4: press "Start", ▲ and ▼* *If C50=0, 1, 2 and 3: the parameter will only be displayed*

Validity:

version	*Models with Current and Voltage input*
modes	*All Modes, that is, for any value of C0*
other param.s	–

Operating range: *between -99 (min.) and C16 (max.)*

Factory-set value: *0*
For further details see "Important" at the end of the description of C16.

C16 Valore max. per ingressi in corrente e tensione

Descrizione: C16 è il valore visualizzato quando all'ingresso c'è il valore massimo, ovvero vi sono 20 mA (per i segnali 0/20 o 4/20 mA) o 1 V (nelle versioni -0,4/1 V).

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 22 o 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	modelli con ingresso in corrente e in tensione
modi	è presente in tutti i modi, ovvero qualsiasi sia C0
altri parametri	–

Campo di variazione: tra un min. di C15 a un max di 999

Valore preimpostato: 100

Avvertenze: C15 e C16 corrispondono al campo di misura del trasduttore collegato al regolatore.
Definiti i valori estremi, minimo e massimo, tutti gli altri valori sono derivati in proporzione considerando un funzionamento lineare del trasduttore.

C16, maximum value of voltage and current inputs

Description: *C16 corresponds to the maximum value of the input: 20 mA (0-20 or 4-20mA) or 1V (-0.4/1V).*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 22 or 77* *If C50=0, 2 and 4: the parameter will only be displayed*
remote control	*If C50=4: press "Start", ▲ and ▼* *If C50=0, 1, 2 and 3: the parameter will only be displayed*

Validity:

version	*Models with Current andVoltage input*
modes	*All Modes, that is, for any value of C0*
other param.s	–

Operating range: *between C15 (min.) and 999 (max.)*

Factory-set value: *100*

Important: *C15 and C16 correspond to the limit settings of the sensor linked up to the controller.*
All the other values are calculated in a proportional way, supposing the transducer works linearly.

C17 Filtro sonda

Descrizione: C17 quantifica l'effetto del filtro sulla misura del valore sonda.
Valori bassi di C17: si ha un piccolo effetto filtrante e sono accettate ampie variazioni del segnale d'ingresso. Si ha una lettura pronta alle variazioni del sensore, lettura che però diventa anche più sensibile ai disturbi.
Valori alti di C17: si rallenta la risposta ma si garantisce una maggiore immunità ai disturbi, ovvero una lettura più stabile. Nell'utilizzo di termocoppie o Termoresistenze, generalmente sensibili alle interferenze, si raccomanda un valore alto di C17.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	tutti i modelli
modi	tutti
altri parametri	–

Campo di variazione: tra un minimo di 1 e un massimo di 14

Valore preimpostato: *5*

C17, sensor response

Description: *C17 quantifies the filtering effect on the value measured by the sensor.*
When C17 is given a low value, the filtering effect is low and the instrument accepts wide variations of the input signal.
When C17 is given a high value the response is slowed down but there will be greater immunity against noises. When using thermocouples, easily affected by interferen - ces, we recommend giving C17 a high value.

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 77* *If C50=0, 2 and 4: the param. will be only displayed*
remote control	*If C50=4: press "Start", ▲ and ▼* *If C50=0, 1, 2 and 3: the param. will only be displayed*

Validity:

version	*All models*
modes	*All modes*
other param.s	–

Operating range: *Min. 1, Max. 14*

Factory-set value: 5

C18 Unità di misura per temperatura: °C o °F

Descrizione: C18 seleziona l'unità di misura della temperatura tra gradi Centigradi (°C) e gradi Fahrenheit (°F):
C18=0 temperatura in °C,
C18=1 temperatura in °F.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG+SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	modelli per temp., NTC, Pt100, TcJ e TcK
modi	tutti
altri parametri	–

Campo di variazione: 0 o 1

Valore preimpostato: 0 = lettura a display in °C

Avvertenze:
- modificando C18 non viene convertito automaticamente alcun valore degli altri parametri di regolazione, (i set point St1 e St2, i differenziali P1,P2,P3 i limiti allarme "Bassa" (P25) e "Alta" (P26), la calibrazione della sonda P14); questi parametri perciò devono essere eventualmente aggiornati;
- nei modelli IR**3 e IR**4, C18 appare ma non è operativo: sono C15 e C16 che attuano la conversione mediante i corrispondenti valori dell'unità di misura desiderata.

C18, temperature unit of measure: °C or °F

Description: *C18 allows you to select the temperature measurement unit, in Centigrade degrees (°C) or Fahrenheit degrees (°F):*
C18=0 Temperature in °C
C18=1 Temperature in °F

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 77* *If C50=0, 2 and 4: the parameter will only be displayed*
remote control	*If C50=4: press "Start", ▲ and ▼* *If C50=0, 1, 2 and 3: the parameter will only be displayed*

Validity:

version	*models for temperature, NTC, Pt100, ThcJ and ThcK*
modes	*all modes*
other param.s	–

Operating range: *0 or 1*

Factory-set value: *0 (°C)*

Important:
- *when you modify C18 the other control parameters will NOT be automatically converted (set-points St1 and St2, differentials P1,P2,P3, low alarm threshold (P25) and high alarm threshold (P26), sensor calibration P14); therefore they have to be suitably changed;*
- *in models IR**3 and IR**4, C18 is not operative; therefore avail yourself of C15 and C16.*

C19 seconda sonda NTC

Descrizione: C19 abilita il funzionamento della seconda sonda secondo le descizioni seguenti.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Nota: NTC2 può essere visualizzata a display in ogni momento premendo il tasto ▼ oppure premendo il tasto "sonda 2" sul telecomando.

Validità:

versione	solo nelle versioni NTC
modi	C0=1 e C0=2; NTC2 è operativa. NTC2 può essere visualizzata in tutti i modi.
altri parametri	C13, C21 e C22

Campo di variazione: Min. 0 Max 4

Valore preimpostato: 0 = NTC2 è solo visualizzabile.
C19=0 NTC2 non ha alcun effetto: è visualizzabile con le modalità indicate precedentemente. Se la sonda non è collegata, il controllo può o meno generare l'allarme sonda NTC2 Er1, in funzione di C13. Più precisamente:
C13=0 non è generato l'allarme Er1; il tentativo di visualizzare NTC2 mostra un valore prossimo al fondo scala (circa -62°C);
C13=1 è generato l'allarme Er1. La regolazione e la visualizzazione di NTC1 continuano normalmente.

Funzionamento differenziale C19=1

La regolazione viene fatta confrontando il set point St1 con la differenza delle due sonde. In pratica il regolatore agisce in modo che la differenza 'NTC1-NTC2' sia pari al valore St1. Come anticipato, la gestione della seconda sonda è prevista solo nei Modi C0=1 e 2.
Il funzionamento **Direct** (C0=1), è indicato nelle applicazioni in cui il regolatore deve contrastare la differenza 'NTC1-NTC2' che tende ad aumentare.
Il funzionamento **Reverse** (C0=2), permette invece di contenere la differenza 'NTC1-NTC2' che tende a diminuire.
Di seguito sono proposti degli esempi di applicazioni, per avere un riferimento pratico delle funzioni proposte.

Esempio 1:
Un'unità refrigerante a 2 compressori deve abbassare di 5°C la temperatura dell'acqua.

Introduzione: scelto un regolatore con 2 uscite per gestire i 2 compressori, il primo problema da affrontare è relativo al posizionamento della sonda principale NTC1 e NTC2. Si tenga presente che eventuali allarmi di temperatura possono essere riferiti solo al valore letto dalla sonda NTC1, mentre la visualizzazione delle sonde può essere scambiata con C13.
Ponendo **C13=1** è possibile scambiare la visualizzazione della sonda NTC1 con NTC2, mentre gli allarmi continuano ad essere in funzione di NTC1. Nell'esempio si indicherà con T1 la temperatura di ingresso e con T2 la temperatura di uscita.

Soluzione 1a: si dovrà porre NTC1 sull'ingresso dell'acqua se si ritiene più importante controllare la temperatura di ingresso T1; ciò permetterà di segnalare allarmi, eventualmente ritardati, di "Alta" temperatura all'ingresso T1. Ad esempio con NTC1=T1 il set point corrisponde a

C19, second NTC sensor

Description: *C19 makes possible the use of the second sensor.*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG+SEL for 5", password 77* *If C50=0, 2 and 4 the parameter can be only displayed*
remote control	*If C50=4, press "Start", ▲ and ▼* *If C50=0, 1, 2 and 3 the parameter can be only displayed*

Important: *NTC2 can be displayed at any time by pres - sing ▼ or the dedicated button on the remote control (second sensor).*

Validity:

version	*NTC models only*
modes	*When C0=1 and C0=2 NTC2 is operative. NTC2 can be displayed when working in any mode.*
other param.s	*C13, C21, C22*

Operating range: *between 0 (min) and 4 (max)*

Factory-set value: *0 (NTC2 can only be displayed)*
*When **C19=0**, NTC2 does not produce any effect (can be only displayed as described above). If the sensor is disconnected, the controller might generate the NTC2 alarm (Er1) depending on C13. In particular:*
*when **C13=0**, Er1 does not appear (when you display NTC2, its value approaches the lower limit, about -62°C);*
*when **C13=1**, the controller generates the Er1 alarm. The control action goes on regularly and the display shows the value of NTC1.*

C19=1, differential

The control action is based on the comparison between St1 and the difference between the two sensors, that is NTC1-NTC2 = St1.
It is possible to enable the second sensor only when Mode C0=1 or 2.
*The **Direct** control action (C0=1) is recommended in applications where the controller has to reduce the diffe - rence between 'NTC1 and NTC2', difference that tends to increase.*
*The **Reverse** control action (C0=2) permits to increase the difference between 'NTC1 and NTC2' that tends to decrease (see examples below).*

Example no.1:
a 2-compressor refrigerating unit has to decrease water temperature by 5°C.

Preliminary remarks: *choose a 2-output controller to manage the two compressors, then pay attention to the position of the two sensors NTC1and NTC2. Keep in mind that temperature alarms depends exclusively on the values measured by NTC1, while the visual values of the sensors can be exchanged with C13.*
*If **C13=1** it is possible to swap the visual value of NTC1 with NTC2 but all alarms will depend on NTC1. We will indicate inlet temperature with T1 and outlet temperature with T2.*
Solution 1a: *locate NTC1 on inlet water if you need to keep under control the inlet temperature T1. In this way the controller will signal any "High" temperature alarm at water inlet T1.*

'NTC1-NTC2', ovvero 'T1-T2' e dovrà essere uguale a +5°C (St1=5). Il Modo di funzionamento sarà 'Reverse' (C0=2) visto che il regolatore dovrà attivare le uscite al diminuire del valore 'T1-T2' che tenderà a 0. Scegliendo un differenziale uguale a 2°C (P1=2), una soglia di alta temperatura uguale a 40°C (P26=40) e un ritardo di 30 minuti (P28=30), si avrà il funzionamento descritto nella figura 18.

If NTC1=T1, the set-point will be 'NTC1-NTC2', that is 'T1-T2' which has to be +5°C (St1=+5°C). The 'Reverse' control action will be applied (C0=2) as the controller has to energize outputs as the 'T1-T2' difference decreases (towards 0). If you set differential=2°C (P1=2), high tem - perature threshold=40°C (P26=40) and a 30 minutes' time-delay (P28=30), the operating mode will be as illu - strated in the graph below:

Soluzione 1b: se invece si dà la priorità a T2 (es. soglia di "Bassa" a 6°C con ritardo di un minuto), la sonda principale, NTC1, dovrà essere posizionata all'uscita. I parametri, con queste nuove condizioni, diventano:

Solution 1b: *if you want to give priority to T2 (e.g. low temperature threshold=6°C with one minute's delay) loca - te the main sensor NTC1 at the water outlet. The parame -*

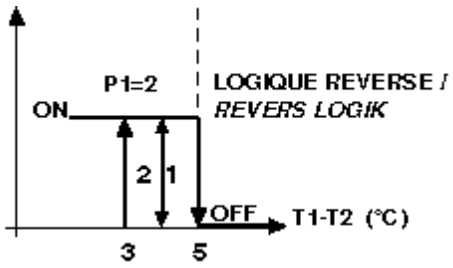


Fig.18

il set point, St1, dato da 'NTC1-NTC2' ovvero 'T2-T1', dovrà ora essere fissato a -5°C. Il Modo di funzionamento sarà Direct (C0=1) visto che il regolatore dovrà attivare le uscite all'aumentare del valore 'T2-T1' che da -5 tende a 0. P25=6 e P28=1 (min) attivano l'allarme di "Bassa" richiesto, come raffigurato nel nuovo diagramma logico di regolazione (figura 19).

ters will be set as follows: St1=-5°C (NTC1-NTC2, that is T2-T1), direct mode (C0=1). P25=6 and P28=1 (min.) allow you to set the low temperature alarm, as shown in the diagram below (fig. 19):

Avvertenze: questo esempio sarà ulteriormente sviluppato nella descrizione del funzionamento speciale (C33=1); (vedere esempio 12 a pag. 41).

Important: *this example will be further developed below, when describing the special mode of operation (C33=1) (see page 41).*

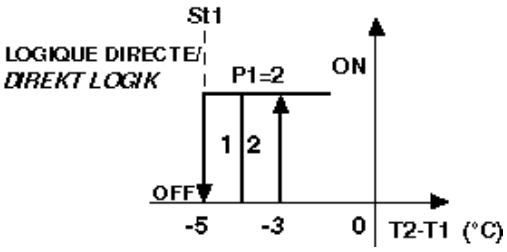


Fig.19

Compensazione C19=2, 3 o 4

La compensazione permette di modificare il set point di regolazione St1 in funzione di NTC2 e dal set point di riferimento St2. La compensazione avrà “peso” pari a C4, detto “Autorità”.

Avvertenza: quando è in atto una compensazione, il valore del parametro St1 rimane quello impostato; cambia invece il valore operativo di St1, che chiameremo St1-effettivo, valore utilizzato dall’algoritmo di regolazione. Anche St1effettivo è vincolato dai limiti C21 e C22 di impostazione (valore minimo e massimo di St1); questi due parametri g a r a n t i-scono che St1 non assuma valori indesiderati. Sono previsti tre tipi di compensazione, in relazione al valore assegnato a C19:

C19=2 COMPENSAZIONE ESTIVA:
St1 varia solo se la temperatura NTC2 supera St2;
se NTC2 è superiore a St2 si avrà:
St1 effettivo = St1 + (NTC2-St2)*C4
se NTC2 è inferiore a St2: St1 effettivo = St1
Nota: la compensazione estiva può indifferentemente aumentare o diminuire il valore di St1 a seconda che C4 sia rispettivamente positivo o negativo. La logica di funzionamento della compensazione estiva è rappresentata in figura 20:

C19=2,3 or 4, offset

C19 allows the instrument to modify St1 when the tempe - rature fluctuations measured by NTC2 deviate from St2. The offfset is related to C4 (authority).

***Important:** during the offset procedure, the value of St1 remains the set one; what changes is the operating value of St1, that is the "actual St1" (this value is used by the control algorithm). The actual St1 is related to C21 and C22 (min. and max. set-point range); these two parame - ters ensure that St1 remains within an acceptable range. There are three types of offset, depending on the value given to C19:*

C19=2, SUMMER OFFSET
St1 varies only if the temperature measured by NTC2 exceeds St2.
*If NTC2 is higher than St2, then: actual St1=St1+(NTC2-St2)*C4.*
If NTC2 is lower than St2, then: actual St1 = St1.
***Important:** the summer offset can increase or decrease St1 depending on the value given to C4 (positive or negative). Fig. 20 shows how the summer offset operates:*

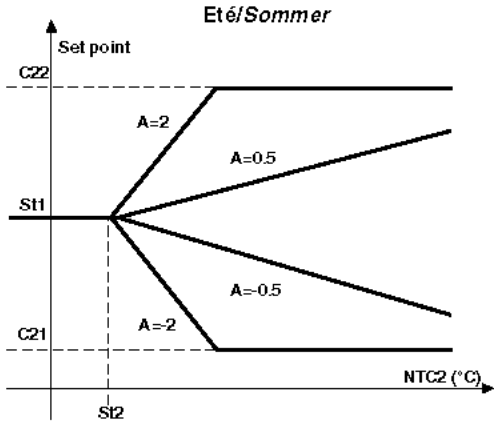


Fig.20

Esempio 2:
si vuole condizionare la temperatura del bar di una stazione di servizio in modo che d’estate la temperatura sia attorno ai 24°C. Per non sottoporre la clientela, che soggiorna solamente per pochi minuti, a forti sbalzi termici, si vuole che la temperatura del locale sia legata alla temperatura esterna, ovvero che aumenti in modo proporzionale fino ad un valore massimo di 27°C raggiunto per una temperatura esterna di 34°C o superiore.

Soluzione: si consideri di controllare con uno strumento Infrared un’unità aria/aria ad espansione diretta. Posta la sonda principale NTC1 nel bar, la regolazione sfrutterà il Modo C0=1 (Direct) con set point=24°C (St1=24) e differenziale, ad es., di 1°C (P1=1). Per sfruttare la compensazione estiva si collocherà poi la sonda NTC2 all’esterno e si selezionerà C19=2. Si dovrà quindi porre St2=24 visto che la richiesta è compensare il set point 1 solo per temperature esterne superiori a 24 °C. L’autorità C4 dovrà essere uguale a 0,3 in modo che per variazioni di NTC2 da 24 a 34°C il St1 vari da 24 a 27°C. Per ultimo di dovrà selezionare C22=27 per imporre il valore massimo di St1effettivo. Il grafico mostra come varia St1 in funzione della temperatura NTC2.

Example no. 2:
suppose you need to control the summer temperature in a bar, keeping it around 24°C. The air-conditioning system has to control temperature so as to avoid sharp changes in temperature for clients going in and out the bar. To do this the room temperature has to be related to external temperature in a proportional way so that the room tempe - rature can rise up to 27°C when the external temperature is 34°C.

***Solution:** use an Infrared controller linked up to an air-to-air direct expansion unit. Locate NTC1 in the bar, set C0=1 (Direct mode), set-point=24°C (St1=24), differen - tial=1°C (P1=1). To enjoy the benefits of the summer off - set locate NTC2 outside and set C19=2 and St2=24. Set C4=0.3 (authority) so that when NTC2 varies from 24 to 34°C, St1 varies from 24 to 27°C. Finally set C22=27 to fix the max. actual St1. The diagram below shows how St1 changes as the temperature measured by NTC2 varies.*

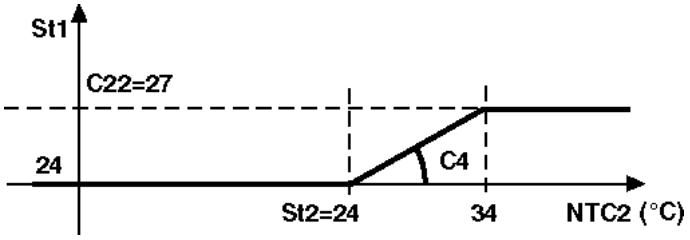


Fig.21

Esempio 3:
Si valuti ora un esempio di compensazione estiva con C4 negativo. Si consideri un sistema di condizionamento costituito da un refrigeratore d'acqua (chiller) e da alcuni ventilconvettori. Per temperature esterne inferiori ai 28°C la temperatura di ripresa del chiller può essere fissata a St1=13°C.
Se la temperatura esterna aumenta, per compensare il maggiore carico termico è utile abbassare linearmente la temperatura di ripresa fino ad un limite minimo di 10°C che sarà raggiunto per temperature uguali o maggiori di 34°C.

Soluzione: i parametri da impostare sul controllo Infrared, ad una o più uscite in relazione alle caratteristiche del chiller, saranno i seguenti:
Modo: C0=1, sonda principale NTC1 sulla ripresa del chiller con un set point di regolazione principale St1=13°C e differenziale P1=2,0°C.
Per la compensazione estiva: C19=2, abilitata per una temperatura esterna, rilevate da NTC2, superiore a 28°C, per cui St2=28. L'autorità, considerato che St1 deve abbassarsi di 3°C a fronte di una variazione su NTC2 di 6°C (34-28), sarà C4= -0,5.
Infine per evitare che la temperatura di ripresa scenda sotto i 10°C si dovrà fissare il limite minimo di St1, p o n e n-do C21=10. Il grafico sottostante mostra l'andamento di St1.

Example no. 3:
Summer offset when C4 is given a negative value.
Suppose you have to control an air-conditioning system comprising a chiller and some fan coils. For external tem - peratures below 28°C, set the chiller's St1=13°C. When the external temperature rises, it is recommended to lower linearly the temperature down to min. 10°C. This value will be reached when the external temperatures are equal or higher than 34°C.

Solution: *use an Infrared controller with one or more out - puts, depending on the chiller's characteristics and set the following parameters:*
Mode: C0=1*, NTC1 on the chiller, main set-point St1=13°C and differential P1=2°C.*
Summer offset: *C19=2 for an external temperature mea - sured by NTC2 above 28°C (St2=28). Authority will be C4=-0.5 because St1 must fall by 3°C as NTC2 varies by 6°C (34-28).*
Finally, to avoid that temperature goes below 10°C, fix the min. set-point threshold for St1 by setting C21=10. The diagram below shows how St1 changes.

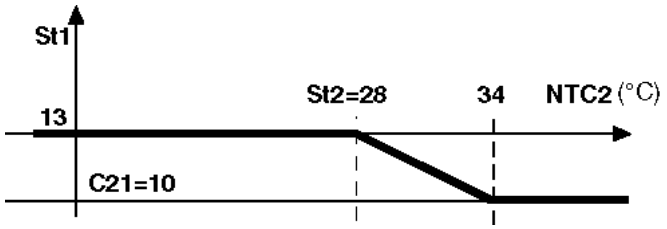


Fig.22

C19 = 3 COMPENSAZIONE INVERNALE:
St1 varia se la temperatura NTC2 è inferiore a St2;
se NTC2 è inferiore a St2, St1effettivo = St1 + (NTC2-St2)*C4
se NTC2 è superiore a St2, St1effettivo = St1
Nota: la compensazione invernale può aumentare o dimi-nuire il valore di St1 a seconda che C4 sia rispettivamente negativo o positivo (per la logica di funzionamento vedere diagramma sottostante).

C19=3, WINTER OFFSET
St1 will vary if the temperature measured by NTC2 is lower than St2.
*If NTC2 is lower than St2, then actual St1=St1+(NTC2-St2)*C4;*
If NTC2 is higher than St2, the actual St1 = St1.
Important: *the winter offset can increase or decrease St1 depending on the value given to C4 (positive or negative) (the diagram below shows how the winter offset operates).*

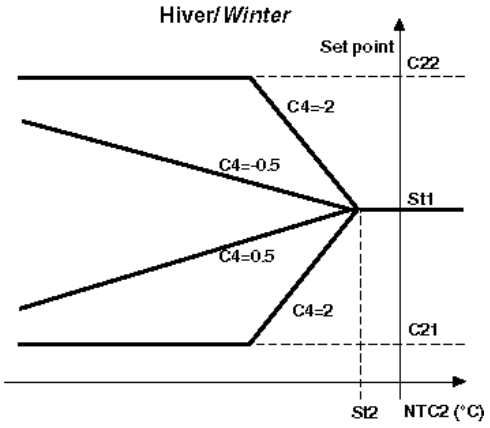


Fig.23

Esempio 4:
Si abbiano le seguenti specifiche di progetto: al fine di ottimizzare il rendimento invernale di una caldaia di un circuito di riscaldamento domestico, si può prevedere una temperatura di esercizio (St1) di 70°C per temperature esterne superiori a 15°C. Quando la temperatura esterna si fa più rigida, quella di esercizio della caldaia deve aumentare in modo proporzionale, fino ad arrivare ad una temperatura massima di 85°C prevista per una temperatura esterna minore o uguale di 0°C.

Soluzione: si potrà utilizzare un regolatore Infrared con la sonda principale NTC1 sul circuito dell'acqua, Modo 2 (riscaldamento), set-point St1=70 e differenziale P1=4. Sarà inoltre necessario utilizzare una sonda NTC2 posta all'esterno, abilitare la compensazione 'INVERNALE' (C19=3) con St2=15 in modo che intervenga solo nel caso di temperature esterne inferiori a 15°C. Per il calcolo dell'autorità si consideri che a fronte di una variazione di NTC2 di -15°C (da +15 a 0°C) St1 deve variare di +15°C (da 70 a 85°C), ne consegue che C4= -1.
Infine dovrà essere fissato il limite massimo del St1, selezionando C22=85. Il grafico di figura 23 mostra come varia St1 al diminuire della temperatura esterna NTC2.

Example no. 4
In order to optimize the efficiency of a domestic boiler, suppose an operating temperature of 70°C (St1) with out - door temperatures above 15°C. When the outdoor tempe - rature falls, the temperature of the boiler has to rise in a proportional way up to max. 85°C in response to external temperatures equal or below 0°C.

***Solution:** use an Infrared controller and locate the main sensor NTC1 on the water circuit. Set Mode 2 (heating), set-point St1=70 and differential P1=4. Use a second sen - sor (NTC2) to be located outside and set winter offset (C19=3) and St2=15. As for the authority, consider that for any variation of NTC2 of -15°C (from +15 to 0°C), St1 must increase of +15°C (from 70 to 85°C). Therefor C4=-1. Finally set the max. St1 limit: C22=85. The diagram below shows how St1 changes as the outdoor temperature mea - sured by NTC2 falls.*

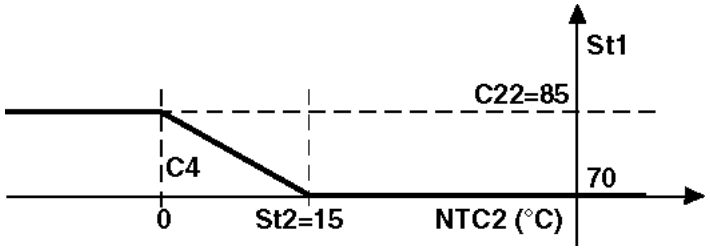


Fig.24

Descrizione C19=4 – COMPENSAZIONE CONTINUA:
la compensazione di St1 è attiva per valori di NTC2 diversi da St2: Con questo valore di C19 si può sfruttare il parametro P2 per definire una zona neutra attorno a St2 in cui la compensazione non è attiva, ovvero quando NTC2 assume valori compresi tra St2-P2 ed St2+P2, viene esclusa la compensazione e St1 non viene modificato:
se NTC2 è superiore a (St2+P2),
St1 effettivo = St1+ [NTC2-(St2+P2)]*C4
se NTC2 è compreso tra (St2-P2) e (St2+P2), St1effettivo=St1
se NTC2 è inferiore a (St2-P2),
St1effettivo = St1+ [NTC2-(St2-P2)]*C4

Nota: la compensazione ottenuta con C19=4 è l'azione combinata della compensazione estiva e di quella invernale viste in precedenza. Nei diagrammi seguenti è rappresentata la compensazione continua per valori di C4 positivi e negativi. Tralasciando l'effetto di P2, se C4 è positivo St1 aumenta quando NTC2>St2 e diminuisce per NTC2<St2. Viceversa, se C4 è negativo St1 diminuisce per NTC2 > St2 e aumenta per NTC2 inferiori a St2.

C19=4, CONTINUOUS OFFSET
The offset of St1 takes place when the temperature mea - sured by NTC2 deviates from St2. When C19=4, you can enjoy the benefits of P2 that allows you to create a neutral zone around St2 in which offset does not occur (that is, when NTC2 detects values ranging between St2-P2 and St2+P2). Therefore St1 will not change.
*If NTC2 rises above (St2+P2), then: actual St1=St1+ [NTC2-(St2-P2)]*C4*
If NTC2 ranges between (St2-P2) and (St2+P2), then: actual St1=St1
If NTC2 falls below (St2-P2), then:
*actual St1 = St1+ [NTC2-(St2-P2)]*C4*

***Important:** the offset action obtained when C19=4 results from the combination of the summer and winter offset.*
The diagram below shows an example of continuous offset where C4 is given both positive and negative values. If C4 is positive, St1 increases when NTC2>St2 and decreases when NTC2<St2. Viceversa, if C4 is negative, St1 decrea - ses when NTC2>St2 and increases when NTC2<St2.

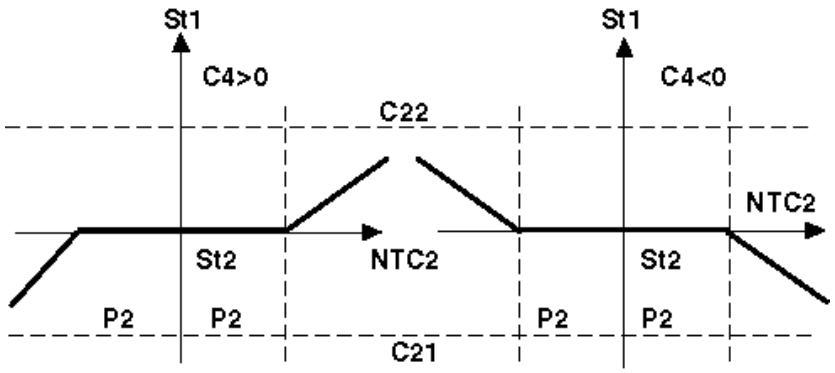


Fig.24/a

C21 Valore minimo ammesso da St1

Descrizione: C21 determina il minimo valore impostabile per St1. In funzionamento con compensazione rappresenta il minimo valore operativo di St1 modificato dalla compensazione (vedere descrizione del parametro C19).

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	tutti i modelli
modi	tutti
altri parametri	–

Campo di variazione: tra un min. di -99 a un max. di C22

Valore preimpostato: versioni NTC -50, corrente -10, tensione -60, TcJ/K -99

C22 Valore massimo ammesso da St1

Descrizione: C22 determina il massimo valore impostabile per St1. In funzionamento con compensazione rappresenta il massimo valore operativo di St1 modificato dalla compensazione (vedere descrizione del parametro C19).

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	tutti i modelli
modi	tutti
altri parametri	–

Campo di variazione: tra un minimo di C21 a un massimo di 999

Valore preimpostato: NTC 90, Corr./Tens. 110, PT100 600, TcJ/K 999

C23 Valore minimo ammesso da St2

Descrizione: C23 determina il valore min. impostabile per St2.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	tutti i modelli
modi	C0=6,7,8,9 e SPE (Special) con C33=1
altri parametri	C19 = 2, 3 e 4 con C0 =1 o 2

Campo di variazione: tra un min. di -99 a un max. di C24

Valore preimpostato: versioni NTC -50, corrente -10, tensione -60, TcJ/K -99

C21, minimum value of St1

Description: *C21 determines the minimum selectable value of St1. If the offset is operative, it indicates the mini - mum operational value of St1 modified by the offset (see description of C19).*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 77* *If C50=0, 2 and 4: the parameter will only be displayed*
remote control	*If C50=4: press "Start",* ▲ *and* ▼ *If C50=0, 1, 2 and 3: the parameter will only be displayed*

Validity:

version	*All models*
modes	*All modes*
other param.s	–

Operating range: *between -99 (min.) and C22 (max.)*

Factory-set value: *NTC-50, current -10, voltage -60, Thc J/K -99*

C22, maximum value of St1

Description: *C22 determines the maximum selectable value of St1. If the offset is operative, C22 indicates the maximum operational value of St1 modified by the offset (see description of C19).*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 77* *If C50=0, 2 and 4: the param. is only displayed*
remote control	*If C50=4: press "Start",* ▲ *and* ▼ *If C50=0, 1, 2, 3: the param. is only displayed*

Validity:

version	*All models*
modes	*All modes*
other param.s	–

Operating range: *between C21 (min.) and 999 (max.)*

Factory-set value: *NTC 90, current/voltage 110, PT100 600, ThcJ/K 999*

C23, minimum value of St2

Description: *C23 determines the minimum selectable value of St2.*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 77* *If C50=0, 2, 4: the param. will only be*

displayed remote controlIf C50=4: press "Start", ▲ *and* ▼
If C50=0, 1, 2 and 3: the parameter will only be displayed

Validity:

version	*All models*
modes	*C0=6,7,8,9 and special mode of operation (C33=1)*
other param.s	*C19 = 2, 3, 4 and C0 =1 or 2*

Operating range: *between -99 (min.) and C24 (max.)*

Factory-set value: *NTC version -50, current -10, voltage -60, TcJ/K -99*

C24 Valore massimo ammesso da St2

Descrizione: C24 determina il valore max. impostabile per St2.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	tutti i modelli
modi	C0=6,7,8,9 e funzionamento speciale (C33=1)
altri parametri	C19=2, 3 e 4 con C0 =1 o 2

Campo di variazione: tra un min. di C23 a un max. di 999

Valore preimpostato: NTC 90, Corr./Tens. 110, PT100 600, TcJ/K 999

P25 SET Allarme di "Bassa"

Descrizione: P25 rappresenta, in valore assoluto, l'effettivo valore di intervento dell'allarme di "Bassa". P25 è continuamente confrontato con il valore rilevato dalla sonda. Il parametro P28 rappresenta in minuti il "ritardo di attivazione allarme"; l'allarme di "Bassa" si attiva solo se la misura resta inferiore a P25 per un tempo superiore a P28. Il valore di P25 è un valore assoluto: nel caso si vari il punto di lavoro è necessario verificare che il nuovo intervallo di funzionamento non giunga oltre i limiti di allarme. Set point di allarme relativo: il parametro P27 può abilitare la gestione di allarme con set point relativi. (Vedi anche P27).

Modalità di accesso:

tastiera	se C50=1 o 3: PRG per 5" se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=0, 1 o 4: diretto premendo "Inizio", e i tasti dedicati del telecomando se C50=2, 3 il parametro è solo visibile

Validità:

versione	qualsiasi modello
modi	qualsiasi C0
altri parametri	–

Campo di variazione: tra un minimo di -99 a un massimo pari al valore di P26

Valore preimpostato: versioni NTC -50, corrente -10, tensione -60, TcJ/K -99

P26 SET Allarme di ALTA

Descrizione: P26, analogamente a P25, rappresenta in valore **assoluto** l'effettivo valore di intervento dell'allarme di "Alta". P26 è continuamente confrontato con il valore rilevato dalla sonda (e visualizzato a display).
Qualora quest'ultimo superi P26 per un tempo superiore a P28, il controllo attiva Er4, l'allarme di "Alta". Anche per P26, come per P25, vale la raccomandazione di verificarne il valore affinché non si attivino allarmi di "Alta" durante il funzionamento normale. Set point di allarme **relativo**: il parametro P27 può abilitare la gestione di allarme con set point relativi. (Vedi P27).

C24, maximum value of St2

Description: *C24 determines the maximum value of St2.*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 77* *If C50=0, 2 and 4 the parameter will be only displayed*
remote control	*If C50=4: press "Start", ▲ and ▼* *If C50=0, 1, 2 and 3 the parameter will be only displayed*

Validity:

version	*All models*
modes	*C0=6,7,8,9 and special mode of operation (C33=1)*
other param.s	*C19=2, 3 and 4 with C0 =1 or 2*

Operating range: *from C23 (min.) to 999 (max.)*

Factory-set value: *NTC 90, Current/Voltage 110, Pt100 600, thcJ/K 999*

P25, low temperature set-point

Description: *P25 is the absolute value that causes the controller to respond to a low temperature condition. The value given to P25 is constantly compared with the readouts detected by the sensor. The low temperature alarm is detected only when the temperature value goes below the P25 value for a time-interval longer than that selected through P28. Should you modify the set-point, remember to check the alarm limits. Relative alarm set-point: to enable alarm management with* ***relative*** *set-points use parameter P27.*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG for 5"* *If C50=0, 2 and 4, the parameter will be only displayed*
remote control	*If C50=0, 1 or 4: direct access by pressing "Start" and the dedicated buttons on the remote control* *If C50=2, 3: you can only display the parameter*

Validity:

version	*Any model*
modes	*Any value of C0*
other param.s	*–*

Operating range: *from -99 (min.) to P26 (max.)*

Factory-set value: *NTC-50, current -10, voltage -60, Thc J/K -99*

P26, high temperature set-point

Description: *similarly to P25, P26 is the* ***absolute*** *value that causes the controller to respond to a high temperature condition. The value given to P26 is constantly compared with the readouts detected by the sensor (you can read these values on the display). As soon as the sensor measures a value higher than P26 for a time-interval longer than that set through P28, the controller will generate the high temperature alarm (Er4). As P26 is an absolute value, check its value so as to avoid "High" temperature alarms during normal operation. Relative alarm set-point: to enable alarm management with* ***relative*** *set-points use parameter P27.*

Modalità di accesso:

tastiera se C50=1 o 3: PRG per 5"
se C50=0, 2 e 4 il parametro è solo visibile

telecomando se C50=0, 1 o 4: diretto premendo "Inizio", e i tasti dedicati del telecomando
se C50=2, 3 il parametro è solo visibile

Validità:

versione qualsiasi modello
modi qualsiasi C0
altri parametri –

Campo di variazione: tra un minimo pari al valore di P25 a un massimo di 999

Valore preimpostato: NTC 90, Corrente/Tensione 110, PT100 600, TcJ/K 999

Access modes:

keyboard *If C50=1 or 3: hold down PRG for 5"*
If C50=0, 2 and 4: the parameter will be only displayed

remote control *If C50=0, 1 or 4: direct access by pressing "Start" and the dedicated buttons on the remote control*
If C50=2, 3 the parameter is only displayed

Validity:

version *Any model*
modes *Any value of C0*
other param.s –

Operating range: *from P25 (min.) to 999 (max.)*

Factory-set value: *NTC 90, current/voltage 110, PT100 600, ThcJ/K 999*

P27 differenziale ALLARME: reset

Descrizione: l'allarme di "Bassa" (Er5) e di "Alta" (Er4) sono a reinserzione automatica. P27 determina l'isteresi tra il valore di attivazione dell'allarme e il valore di disattivazione. Si veda il grafico qui riportato, in cui i punti A e B rappresentano i valori di disattivazione rispettivamente degli allarmi di "Bassa" e "Alta". In ogni caso, anche se la misura non è ancora rientrata dalle zone di disattivazione (zone in grigio), è possibile annullare la segnalazione di allarme di "Alta" e "Bassa" premendo il tasto PRG/mute. Se si pone P27 a valori 'molto' alti (ovviamente in relazione al set-point di lavoro e al range di variazione della misura nell'applicazione considerata), si rende praticamente impossibile il rientro dalla condizione di allarme per cui il Reset dell'allarme di "Alta" e "Bassa" diventa solo Reset manuale. Questa particolarità può essere sfruttata in molte applicazioni in cui non si desidera perdere traccia di eventuali allarmi di "Alta" e/o "Bassa", per cui è richiesto il Reset manuale.

Nota: se si preme PRG/mute quando la misura è oltre una delle soglie, si spegne immediatamente il buzzer, mentre l'indicazione del codice di allarme e l'eventuale uscita di allarme, permarranno attivi fino a che la misura rientra dalla soglia di attivazione.

Modalità di accesso

tastiera se C50=1 o 3: PRG per 5"
se C50=0, 2 e 4 il parametro è solo visibile

telecomando se C50=0, 1 o 4: premendo "Inizio", tasti ▲ e ▼
se C50=2, 3 il parametro è solo visibile

Validità:

versione qualsiasi modello
modi qualsiasi C0
altri parametri –

Campo di variazione: tra un min. di 0,1 a un max di 99,9

Valore preimpostato: 2,0

P27, alarm differential: reset

Description: *both the LOW and the HIGH temperature alarms (Er5 and Er4) reset automatically. P27 determines the range of the hysteresis, that is, the limit points that determine the activation of the alarm and its de-activation. In the diagram below points A and B indicate the values making the low and high temperature alarms stop. It is always possible, however, to reset the low/high tempera - ture alarms manually, by simply pressing PRG/mute. If you give P27 quite a high value (in relation to the set-point and to the variation range of the variable being controlled in a specific application), you will have to reset the high/low alarms manually. This feature proves to be parti - cularly useful in all those applications in which it is prefer - red to reset any alarm condition manually.*

Important: *if you press PRG/mute when the temperature value has exceeded its limits, the buzzer can be immedia - tely silenced. Instead, the alarm code will remain displayed and the output energized until the temperature value returns within the set range.*

Access modes:

keyboard *If C50=1 or 3: hold down PRG for 5"*
If C50=0, 2 and 4: the parameter can only be displayed

remote control *If C50=0, 1 or 4: direct access by pressing "Start", ▲ and ▼*
If C50=2, 3: the parameter can only be displayed

Validity:

version *Any model*
modes *Any value of C0*
other param.s –

Operating range: *from 0.1 (min.) to 99.9 (max.)*

Factory-set value: *2.0*

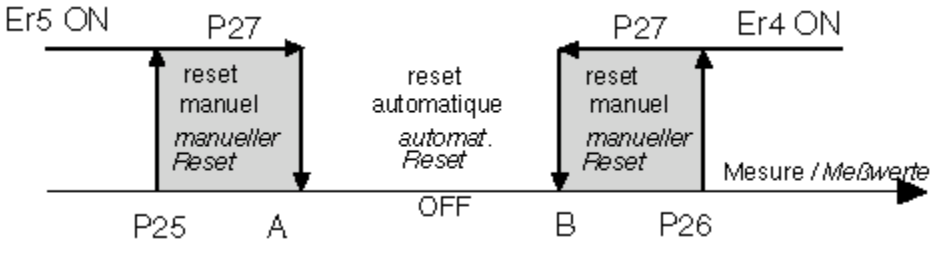


Fig.25

Nota per la nuova versione

Allarme relativo:
Nei controlli con numero di serie **maggiore di 100.000**, è possibile impostare il set di allarme ("Alta" e "Bassa") anche di tipo relativo (oltre che assoluto), selezionabile tramite il parametro P27.
L'impostazione di P27 stabilisce il tipo di allarme:
P27 negativo – soglie di allarme relativo;
P27 positivo – soglie di allarme assoluto.

Il differenziale è nei due casi pari al valore assoluto del valore impostato. Qualora si utilizzino soglie di allarme relative, prestare attenzione anche ai segni di P25 e P26: infatti il segno negativo indica l'intervento del rispettivo allarme prima del set-point (valido quindi per una soglia di "Bassa", P25), mentre il segno positivo indica l'intervento dopo il set-point (normalmente utilizzato per l'"Alta", P26).

In modo particolare ricordare che:
- il segno di P27 non cambia il tipo di azione sul rientro dell'allarme:
  automatico con P27 piccolo in valore assoluto;
  manuale con P27 grande in valore assoluto.
- P27 non deve essere impostato 0;
- con C0= 6, 7, 8 i set di allarme sono relativi a St1 se l'ingresso digitale è aperto, mentre sono relativi a St2 se l'ingresso digitale è chiuso.

New versions

Relative alarm:
*Controllers having a serial number **above 100,000** allow you to set also a relative High/Low alarm set-point through P27:*
***P27 negative** = relative alarm thresholds*
***P27 positive** = absolute alarm thresholds*

The differential corresponds to the absolute value of the selected value. When setting relative alarm thresholds remember to pay attention to the values given to P25 and P26: the negative sign makes the alarm appear for values lower than the set-point ("Low" temperature threshold, P25); the positive sign generates an alarm condition for values higher than the set-point ("High" temperature thre - shold, P26).

- *the sign of P27 (+ or -) does not change the type of alarm reset: automatic reset when P27 is given a small absolute value; manual reset when P27 is given a great absolute value.*
- *P27 must not be 0;*
- *when C0= 6, 7, 8 the alarm set-points refer to St1 if the digital input is open, they refer to St2 if the digital input is closed.*

Esempio 5: allarme di "Bassa" assoluto
Supponiamo di dover controllare una cella alla temperatura di 10 °C, con un allarme di "Bassa" a 3 °C e rientro a 5 °C. I parametri impostati saranno i seguenti: P25=3, P27=2

Example no. 5: Absolute Low Temperature Alarm
Suppose your IR controller has to manage a cold storage room with a temperature of 10°C. The low temperature alarm has been set at 3°C. The alarm condition will disappear when the temperature rises to 5°C.
In short: P25=3, P27=2.

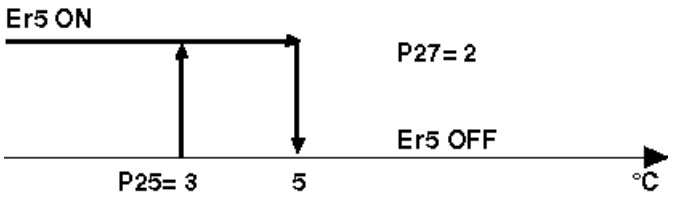


Fig.26

Esempio 6: Allarme di "Bassa" relativo
Lo stesso risultato dell'esempio superiore, può essere ottenuto con una gestione di allarme di tipo relativo. In questo caso i valori da impostare saranno i seguenti: set=10 °C, P25=-7 e P27=-2.

Example no. 6: Relative Low Temperature Alarm
The same result can be obtained setting a relative alarm threshold:
Set-point =10 °C, P25=-7, P27=-2.

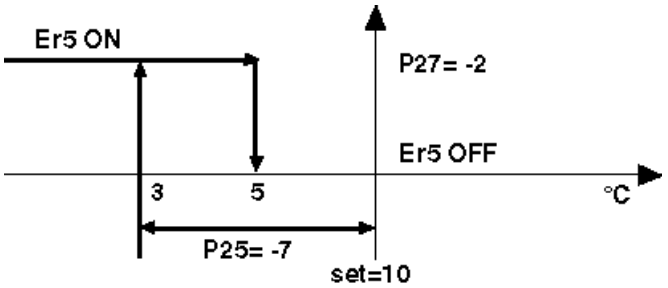


Fig.27

Avvertenza: come si può notare dagli esempi sopra riportati, il risultato ottenuto è lo stesso. Esiste però una differenza sostanziale: nel primo caso l'allarme impostato è totalmente indipendente dal set, mentre nel secondo la soglia di allarme ne è strettamente legata, seguendone le eventuali variazioni.

***Important:** as you can note, the two examples above produce the same results. In the first one, however, the selected alarm threshold is completely independent from the value g i v e n to the set-point while in the second example the alarm thre - shold depends entirely on it and changes as the set-point varies.*

P28 Ritardo attivazione allarme

Descrizione: P28 fissa il tempo minimo necessario per generare un allarme di “Alta” (Er4) o “Bassa” (Er5) o da ingresso digitale (Er3) (vedere i parametri P25, P26, C29 e C30). Per generare un allarme, il valore rilevato dalla sonda (per le versioni NTC intendiamo la sonda principale NTC1) deve permanere sotto la soglia di “Bassa” (P25) o sopra la soglia di “Alta” (P26) per un tempo superiore al valore di P28.

Nel caso di allarme da ingresso digitale (C29, C30=3), il contatto deve permanere aperto per un tempo maggiore di P28. In caso di superamento di una soglia o di apertura del contatto, parte istantaneamente un conteggio che genera un allarme qualora raggiunga P28.
Se durante il conteggio la misura rientra o il contatto si chiude, l’allarme non viene segnalato e il conteggio è annullato. In presenza di una nuova condizione di allarme il conteggio di P28 ripartirà da 0.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG per 5”
	se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=0, 1 o 4: diretto premendo il tasto d’accesso diretto (vedere capitolo 15)
	se C50=2, 3 il parametro è solo visibile

Validità

versione	qualsiasi modello
modi	qualsiasi C0
altri parametri	–

Campo di variazione: tra un min. di 0 a un max di 120 (minuti)

Valore preimpostato: 60 (minuti)
Avvetenza: si consiglia di imporre sempre un minimo ritardo per la segnalazione degli allarmi al fine di eliminare falsi allarmi dovuti a interferenze sul segnale della sonda e/o a situazioni limitate nel tempo (es. variazione della temperatura dovuta alla momentanea apertura della porta di una cella).

P28, delayed alarm

Description: *P28 indicates the minimum time-interval before the high temperature alarm (Er5), the low tempera - ture alarm (Er4) or the digital input alarm (Er3) go off (see parameters P25, P26, C29, C30). Before an alarm condi - tion is generated, the temperature measured by the main sensor (NTC1) must remain below the low temperature threshold (P25) or above the high temperature threshold (P26) for a time-interval longer than that selected through P28.*

In the event of digital input alarm (C29, C30=3), the con - tact must remain open for a time-interval longer than P28. If the above mentioned thresholds are exceeded after the P28 time has passed, the relative alarm will be immedia - tely generated. Should the temperature return within its normal range, no alarm will be generated.

Access modes:

keyboard	*If C50=1 or 3: hold down PRG for 5”*
	If C50=0, 2 and 4: the parameter will be only displayed
remote control	*If C50=0, 1 or 4: direct access by pressing the dedicated button (see chapter 15)*
	If C50=2, 3: the parameter will be only displayed

Validity:

version	*Any model*
modes	*Any value of C0*
other param.s	–

Operating range: *from 0 (min.) to 120 minutes (max.)*

Factory-set value: *60 minutes*

Important: *always set a minimum time-interval to delay an alarm condition so as to eliminate false alarms due to interferences on the sensor signal and/or temporary faulty conditions (eg: temperature variation following the opening of the door of the walk-in refrigerator).*

C29 Gestione ingresso digitale 1

Descrizione: C29 stabilisce la funzione dell’ingresso digitale 1 qualora non sia già usato nei modi 6, 7 e 8. Quando previsto come ingresso di allarme, ovvero per C29=1,2,3, verificata la condizione di allarme, sono attivate una o più uscite di allarme secondo quanto previsto dal Modo usato (vedere Modo 5) mentre l’azione sulle uscite di regolazione è definita da C31.

C29=0 ingresso non attivo

C29=1 allarme esterno immediato con Reset Automatico.
La condizione di allarme si ha con contatto aperto.
Al cessare della condizione di allarme (chiusura del contatto) la regolazione riprende regolarmente e un’eventuale uscita di allarme rientra. Restano attivi la segnalazione acustica e il codice d’allarme Er3, azzerabili solamente con la pressione del tasto “PRG/mute”.

C29= 2 allarme esterno immediato con Reset Manuale.
La condizione di allarme si ha con contatto aperto. Al cessare della condizione di allarme (chiusura del contatto) la regolazione non riprende automaticamente e restano attivi la segnalazione acustica, il codice d’allarme Er3 e l’eventuale uscita di allarme. La regolazione può ripartire solo un Reset Manuale, ovvero dopo la pressione del tasto “PRG/mute”.

C29, digital input no. 1

Description: *digital input no.1 can be used to perform different functions, depending on the value given to C29. When the digital input is used as alarm input (C29=1,2,3), in the event of off-normal condition a certain number of outputs will energise depending on the selected Mode of Operation (see Mode 5). The control outputs are determi - ned by C31.*

C29=0 Idle input

C29=1 Immediate external alarm with automatic reset
The alarm condition will be generated by an open contact. When the contact closes (end of the off-normal condition), the control action will re-start automatically. Press “PRG/mute” to silence the buzzer and cancel the alarm code Er3 on the display.

C29= 2 Immediate external alarm with manual reset
The alarm condition occurs when the contact is open. When the contact closes (end of the off-normal condition), the control action will not re-start till you press “PRG/mute” (manual reset); this button also silences the buzzer and cancels the alarm code (Er3) on the display.

C29=3 allarme esterno RITARDATO (ritardo = P28) con Reset Manuale

La condizione di allarme si ha se il contatto rimane aperto per un tempo superiore a P28. Attivato l'allarme Er3, se cessa la condizione di allarme (chiusura del contatto) la regolazione non riprende automaticamente e restano attive le segnalazione acustica il codice d'allarme Er3 e l'eventuale uscita di allarme. La regolazione può ripartire s o l o dopo la pressione del tasto 'PRG/mute (Reset Manuale).

C29=4 ON/OFF

L'ingresso digitale stabilisce lo stato della macchina:
- con l'ingresso digitale chiuso la regolazione è attiva (ON).
- con l'ingresso digitale aperto la regolazione viene disattivata (OFF) e:

• a display vengono visualizzati tre tratti orizzontali alternati al valore della sonda e ad eventuali con codici di allarme attivi prima dello spegnimento;
• le uscite di regolazione vengono spente (OFF) rispettando comunque l'eventuale tempo minimo di attivazione (vedere C9);
• le uscite di allarme e la segnalazione del buzzer, se attive non vengono alterate da un eventuale stato di OFF;
• non vengono segnalati nuovi allarmi che dovessero apparire in questo stato, tranne Er0 (allarme sonda);
• il tasto PRG è comunque attivo per essere impiegato come tacitazione del buzzer e per resettare un eventuale allarme sonda Er0 nel frattempo rientrato.

Avvertenze: il parametro C29 non è operativo per C0=6, 7, 8. Questi modi di funzionamento sfruttano infatti l'ingresso digitale 1 per commutare il set-point e/o la logica di funzionamento, pertanto ogni modifica del valore di tale parametro è ininfluente.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 77 se C50=0, 2 e 4 il parametro è visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	tutti i modelli
modi	C0=1, 2, 3, 4, 5, 9
altri parametri	C31

Campo di variazione: tra un minimo di 0 a un massimo di 4

Valore preimpostato: 0 (ingresso digitale 1 non attivo)

C29=3 Delayed external alarm with manual reset (P28)

The alarm condition will be detected if the contact of the digital input remains open for a time-interval longer than that set through P28. When the contact closes (end of the off-normal condition), the control action will not re-start till you press PRG/mute (manual reset); this button also silences the buzzer and cancels the alarm code (Er3) on the display.

C29=4 ON/OFF

- When the digital input is closed, the control action is in progress (ON);
- when the digital input opens, the control action stops (OFF). During the OFF status:

• *the display shows three dashes that alternate with the value detected by the sensor or with the last alarm code (if any) which occurred before the Off status;*
• *all control outputs disenergise, but the previously-set min. On time (see C9) will be taken into consideration;*
• *alarm outputs and buzzer will not be deactivated if they are indicating an off-normal condition at the moment the controller is turned in the Off status;*
• *during the Off status the controller does not generate any alarm except Er0 (sensor alarm);*
• *PRG/mute is operative and can be used to silence the buzzer or reset the Er0 alarm.*

Important: *C29 does not operate when C0=6,7,8 (these modes of operation, in fact, make use of the digital input no.1 to change the set-point and/or the operating logic of the instrument).*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 77* *If C50=0, 2 and 4: the parameter will be only displayed*
remote control	*If C50=4: press "Start", ▲ and ▼* *If C50=0, 1, 2 and 3: the parameter will only be displayed*

Validity:

version	*All models*
modes	*C0=1, 2, 3, 4, 5, 9*
other param.s	*C31*

Operating range: *0 (min.) - 4 (max.)*

Factory-set value: *0 (digital input no. 1 idle)*

C30 Gestione ingresso digitale 2

Descrizione:

- il parametro C30 è presente anche nelle versioni da pannello (IR32) ma non può essere gestito non essendo riportato in morsettiera. Porre C30 diverso da 0 nei modelli IR32 equivale perciò a generare gravi malfunzionamenti;
- C30 ha significato e funzioni analoghe a C29; quest'ultimo ha però priorità su C30. Questo significa che se C29=1, 2 o 3, il parametro C30 può assumere solo i valori 0, 4. Viceversa se C29=4, il parametro C30 può assumere solo i valori 0, 1, 2, e 3. Porre C29 = C30 (=1, 2, 3, 4) equivarrebbe a non abilitare la funzione prevista dall'ingresso digitale 2.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	C30=1,2,3 e 4: solo versioni IRDR
modi	Tutti i C0
altri parametri	–

Campo di variazione: tra un minimo di 0 a un massimo di 4.

Valore preimpostato: 0 (ingresso digitale 2 non attivo)

Avvertenze: nei modelli IRDR il parametro C30 è relativo al secondo ingresso digitale che, con i valori 0, 1, 2, 3 e 4, ha gli stessi significati del parametro C29, a cui si rimanda.

C31 Stato uscite con allarme da ingresso Digitale

Descrizione: C31 determina l'azione sulle uscite di regolazione nel caso sia attivo l'allarme di ingresso digitale Er3 (vedere C29 e C30).
Quando viene selezionato lo stato OFF, lo spegnimento è immediato, dunque non è considerata alcuna temporizzazione.
Quando viene selezionato lo stato ON, è invece rispettato il 'Ritardo tra due inserimenti di due uscite diverse', (vedi C6).
Se l'allarme da ingresso digitale ha la disinserzione automatica (C29, C30=1), al ritorno delle condizioni normali (contatto esterno chiuso) l'eventuale uscita di allarme (vedi C0=5) viene ripristinata e la regolazione riprende normalmente.
Rimangono invece attivi la segnalazione Er3 su display e il buzzer finché non si preme PRG/MUTE.

Modalità di accesso:

tastiera	se C50=1 o 3: PRG + SEL per 5", password 77 se C50=0, 2 e 4 il parametro è solo visibile
telecomando	se C50=4: premere "Inizio", tasti ▲ e ▼ se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione	tutte; (per le versioni IR32, il parametro non è operativo per C0=6, 7 e 8)
modi	tutti
altri parametri	C29 (o C30 per IRDR)=1, 2 e 3

Campo di variazione: da 0 a 3

C31=0	OFF tutte le uscite regolazione
C31=1	ON tutte le uscite regolazione
C31=2	OFF solo i gradini con funzionamento Reverse, non interessati gli altri **(*)**
C31=3	OFF solo i gradini con funzionamento Direct, non interessati gli altri **(*)**

(*) solo per i controlli con numero di serie maggiore di 100.000: nelle versioni precedenti "gli altri" sono posti ON.

Valore preimpostato: 0. Tutte le uscite vengono forzate ad OFF in caso di Er3

C30, digital input no. 2

Description:

- *C30 is strictly connected to the value given to C29: if C29=1,2,3, C30 can only be given 0 or 4.Viceversa, if C29=4, C30 can be given 0, 1, 2, 3. If C29=C30 (1,2,3,4) the function of the second digital input is not enabled.*
- *C30 appears in all IR32 panel mounted models but can not be used as it does not appear on the terminal block. C30 must therefore be set to 0: a different value would damage the controller.*

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 77* *If C50=0, 2 and 4: the param. will be only displayed*
remote control	*If C50=4: press "Start", ▲ and ▼* *If C50=0, 1, 2 and 3: the param. will only be displayed*

Validity:

version	*C30=1, 2, 3 and 4 IRDR only*
modes	*Any value of C0*
other param.s	*–*

Operating range: *0 (min.) - 4 (max.)*

Factory-set value: *0 (digital input no. 2 idle)*

Important: *In IRDR models, C30 refers to the second digital input. When C30=1,2,3,4, it assumes the same meaning as C29.*

C31, outputs status in the event of alarm via Digital input

Description: *C31 determines the outputs status in the event of alarm 'Er3' (see C29 and C30).*
Select the OFF status to get an immediate disenergisation of the outputs without taking into consideration the pre - viously set time-delays.
Select the ON status to respect the 'time-delay between two energisations of two different outputs' (see C6).
When the "Er3" alarm condition disappears, regulation will be resumed automatically only if you have previously selected such option (C29, C30=1). The alarm output will reset (C0=5) as well. The alarm message on the display (Er3) and the buzzer will remain active till you press PRG/mute.

Access modes:

keyboard	*If C50=1 or 3: hold down PRG + SEL for 5", password 77* *If C50=0,2,4: the param. will only be displayed*
remote control	*If C50=4: press "Start", ▲ and ▼* *If C50=0,1,2,3: the param. will only be displayed*

Validity:

version	*All models (IR32s do not feature this param. when C0=6,7,8)*
modes	*All modes*
other param.s	*C29 (or C30 for IRDR)=1, 2, 3*

Operating range: *0 - 3*

C31=0	*OFF: all outputs disenergised*
C31=1	*ON: all outputs energised*
C31=2	*OFF: only steps working in the Reverse mode **(*)***
C31=3	*OFF: only steps working in the Direct mode **(*)***

(*) only for the controllers whose serial number is above 100,000 (the other versions have the remaining steps in the ON status).

Factory-set value: *0. All outputs forced in the OFF status in the event of Er3.*

C32 Indirizzo seriale

Descrizione: C32 assegna allo strumento un indirizzo per il collegamento seriale del controllo ad un sistema di supervisione e/o teleassistenza.

Modalità di accesso:

tastiera se C50=1 o 3: PRG + SEL per 5", password 77
se C50=0, 2 e 4 il parametro è solo visibile

telecomando se C50=4: premere "Inizio", tasti ▲ e ▼
se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione presente in tutte le versioni. Gli strumenti necessitano dell'apposita scheda seriale (non inseribile nei modelli IR32VxU e IRDRTE).
modi tutti i C0
altri parametri –

Campo di variazione: tra 1 e 16

Valore preimpostato: 1

C32, Serial address

Description: *C32 allows you to give your IR controller a specific address, necessary when linking up the instru - ment to a supervisory and/or telemaintenance network.*

Access modes:

keyboard *If C50=1 or 3: hold down PRG + SEL for 5", password 77*
If C50=0, 2 and 4: the parameter will only be displayed

remote control *If C50=4: press "Start", ▲ and ▼*
If C50=0, 1, 2 and 3: the parameter will only be displayed

Validity:

version *Available on all models (complete with dedicated serial board), except models IR32VxU and IRDRTE*
modes *Any value of C0*
other param.s –

Operating range: *1-16*

Factory-set value: *1*

C33 Funzionamento "speciale"

Descrizione: C33 consente di espandere le programmazioni previste dai nove Modi predefiniti utilizzando altri 16 parametri, da C34 a C49 (vedere capitolo 8, pag. 43).

Modalità di accesso:

tastiera se C50=1 o 3: PRG + SEL per 5", password 77
se C50=0, 2 e 4 il parametro è solo visibile

telecomando se C50=4: premere "Inizio", tasti ▲ e ▼
se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione tutte
modi tutti i C0
altri parametri –

Campo di variazione: 0 o 1 (C33=1 funzionamento speciale)

Valore preimpostato: 0 (il Modo è standard).

Avvertenza: con C33=0 questi parametri non sono visibili e sono automaticamente programmati dai 9 Modi di funzionamento. La personalizzazione della programmazione non interesserà il cliente o l'utilizzo "normale" dello strumento. Creato l'algoritmo personalizzato, all'utente finale non resta che modificare i parametri di utilizzo più frequente, come set-point e differenziale.

C33, "special" mode of operation

Description: *in addition to the nine Modes of Operation, C33 allows you to enhance the performance of your con - troller by making use of other 16 parameters, from C34 to C49 (see chapter 8, page 43).*

Access modes:

keyboard *If C50=1 or 3: hold down PRG + SEL for 5", password 77*
If C50=0, 2 and 4: the parameter will only be displayed

remote control *If C50=4: press "Start", ▲ and ▼*
If C50=0, 1, 2 and 3: the parameter will only be displayed

Validity:

version *All models*
modes *Any value of C0*
other param.s –

Operating range: *0 or 1 (C33=1, Special mode)*

Factory-set value: *0 (Standard mode)*

Important: *when C33=0 these parameters are not directly displayed and are automatically programmed by the 9 main Modes. The End-User can not customize his/her controller but can modify all most frequently used parame - ters (e.g. set-point and differential).*

C50 Abilitazione tastiera e/o telecomando

Descrizione: utilizzando il parametro C50 è possibile limitare e/o impedire la modifica del set e degli altri parametri a personale non autorizzato. Ciò è utile, ad esempio, quando lo strumento è posto in zone accessibili al pubblico.

Modalità di accesso:

tastiera se C50=1 o 3: PRG + SEL per 5", password 77
se C50=0, 2 e 4 il parametro è solo visibile

telecomando se C50=4: premere "Inizio", e i tasti ▲ e ▼
se C50=0, 1, 2 e 3 il parametro è solo visibile

Validità:

versione tutte
modi tutti i C0
altri parametri –

Campo di variazione: da 0 a 4

Valore preimpostato: 4 (tastiera e telecomando abilitati)

Note:

- Tastiera disabilitata: non è possibile modificare i set-point ed i parametri di regolazione; è però sempre possibile visualizzarne il valore. L'unico parametro modificabile è C50, accessibile con la password 77.
- Telecomando disabilitato: è solo possibile vedere il valore dei parametri abilitati, ma non modificarli.

Importante: con C50=0 o 1 sono accessibili da telecomando solo i parametri P e St1 e St2. Per accedere/modificare tutti i parametri con il telecomando impostare C50=4 da tastiera. Se telecomando e tastiera sono entrambi disabilitati (C50=2) è possibile entrare alla programmazione/modifica solo del parametro C50 utilizzando la tastiera e la password 77. I tasti "MODO" e "Seconda sonda" sono sempre v i s u alizzabili con telecomando, qualsiasi sia il valore di C50.

C51 Telecomando: codice abilitazione

Descrizione: il parametro C51 attribuisce al controllo un codice per abilitare l'accesso ai parametri da telecomando. Ciò rende possibile l'utilizzo del telecomando quando vi siano più controlli presenti sullo stesso pannello elettrico, eliminando il problema delle interferenze. È possibile assegnare ad ogni controllo un codice di accesso diverso da 1 a 120. Se C51=0 (valore di default) si accede direttamente ai parametri premendo il tasto "Inizio". Quando C51=1, 2,...120, dopo aver premuto il tasto "Inizio" sul telecomando, il controllo visualizza sul display il proprio codice di accesso. Solo digitando quel numero sul telecomando è possibile accedere ai parametri del controllo tramite il telecomando stesso. Nel caso che più di nove controlli siano contigui si raccomanda di selezionare come codice di accesso a ciascuno, valori superiori al 13.

Modalità di accesso:

tastiera se C50=1 o 3: PRG + SEL per 5", password 77
se C50=0, 2 e 4 solo visibile

telecomando se C50=4: premere "Inizio", tasti ▲ e ▼
se C50=0, 1, 2 e 3 solo visibile

Validità:

versione tutte, esclusi i modelli IR32VxE privi di ricevitore infrared.
modi tutti i C0
altri parametri –

Campo di variazione: da 0 a 120

Valore preimpostato: 0

C50, operating keypad and/or remote control

Description: *C50 allows you to limit and/or avoid any modification of both set-point and operating parameters by non-authorised personnel. This safety function protects your instrument, especially when it is placed in an easily accessible area.*

Access modes:

keyboard *If C50=1 or 3: hold down PRG + SEL for 5", password 77*
If C50=0,2,4: the param.will be only displayed

remote control *If C50=4: press Start, ▲ and ▼*
If C50=0,1,2,3: the param. will only be displayed

Validity:

version *All models*
modes *Any value of C0*
other param.s –

Operating range: *From 0 to 4*

Factory-set value: *4 (keypad and remote control operative)*

Notes:

- *When the keypad is idle you are not allowed to modify the set-points nor any control parameters but you will be allowed to display their values. The only parameter you can change is C50, accessible via password 77.*
- *When the remote control is idle you can display all parameters but you are not allowed to modify their values.*

Important: *When C50=0 or 1, the remote control allows you to enter 'P' parameters and the two set-points only (St1 and St2). If you want to access/modify all the parameters via remote con - trol, set C50=4 (via keypad). If both remote control and keypad are in the Off status (C50=2) you can only enter the program - ming/modification field of C50 by digiting '77' on the keypad. The values corresponding to 'Mode' and "Second sensor" can always be displayed, independently of the value given to C50.*

C51, operating the remote control

Description: *C51 indicates the controller's code allowing you to enter the programming field via remote control. This function proves particularly useful when you need to program more controllers installed on the same control panel. C51, in fact, allows you to give each single control - ler a specific access code (from 1 to 120) which therefore eliminates any possible interference among units when programming them. If C51=0 (default value) parameters can be directly accessed by pressing "Start". If C51=1,2,... 120 press "Start" to make the controller display its own code then digit it using the buttons of the remote control to be allowed to enter the parameters field. Should you have more than 9 controllers next to each other, give each of them an access code above '13'.*

Access modes:

keyboard *If C50=1 or 3: hold down PRG + SEL for 5", password 77*
If C50=0, 2, 4: the param. will be only displayed

remote control *If C50=4: press "Start", ▲ and ▼*
If C50=0,1,2,3: the param. will only be displayed

Validity:

version *All models, except IR32VxE without infrared receiver*
modes *Any value of C0*
other param.s –

Operating range: *from 0 to 120*

Factory-set value: *0*

8. Descrizione funzionamento speciale

Con **C33=1** diventano accessibili 16 ulteriori parametri, detti parametri speciali, con codice che va da C34 a C49. Ogni uscita è in pratica caratterizzata da 4 parametri, come illustra lo schema riportato qui sotto.

Parametri 'speciali' e loro corrispondenza con le varie uscite

	out1	**out2**	**out3**	**out4**
Dipendenza / *Dependence*	C34	C38	C42	C46
Tipo di uscita / *Type of output*	C35	C39	C43	C47
Inserzione / *Energization*	C36	C40	C44	C48
Differenziale/Logica / *Differential/Logic*	C37	C41	C45	C49

8.1 Descrizione DIPENDENZA: C34, C38, C42, C46

È il parametro che determina la specifica funzione di ciascuna uscita. Lega una uscita a un set-point (uscita di regolazione) o a un allarme specifico (uscita di allarme). DIPENDENZA si identifica con C34 per l'out1, C38 per l'out2, C42 per l'out3 e C46 per l'out 4: i possibili valori sono sintetizzate nella tabella successiva.

8. Special mode of operation

*Setting **C33=1** allows you to make use of other 16 parameters (from C34 to C49) to program your IR controller. Each output can be given 4 parameters, as specified below:*

Special parameters and outputs

8.1 DEPENDENCE: C34, C38, C42, C46

DEPENDENCE determines the specific function of each single output. This parameter links the output to a specific set-point (control output) or to a specific alarm (alarm output). Dependence corresponds to C34 for out1, C38 for out2, C42 for out3, C46 for out4. The table below shows the values which can be given to dependence.

Valore di DIPENDENZA ***DependenceValue***	**Tipo di dipendenza** ***Type of Dependence***	**Stato del relè di allarme in condizioni normali** ***Alarm relay in normal operating conditions***
0	non attiva / *idle*	–
1	relativa a St1 / *refers to St1*	–
2	relativa a St2 / *refers to St2*	–
3	attiva in caso di allarme generico *active in the event of general alarm*	OFF
4	attiva in caso di allarme generico *active in the event of general alarm*	ON
5	attiva in caso di allarme grave e in caso di allarme di "Alta" (Er4) *active in the event of serious alarm and HIGH temperature alarm (Er4)*	OFF
6	attiva in caso di allarme grave e in caso di allarme di "Alta" (Er4) *active in the event of serious alarm and HIGH temperature alarm (Er4)*	ON
7	attiva in caso di allarme grave e in caso di allarme di "Bassa" (Er5) *active in the event of serious alarm and LOW temperature alarm (Er5)*	OFF
8	attiva in caso di allarme grave e in caso di allarme di "Bassa" (Er5) *active in the event of serious alarm and LOW temperature alarm (Er5)*	ON
9	attiva in caso di allarme di "Bassa" (Er5) *active in the event of LOW temperature alarm (Er5)*	OFF
10	attiva in caso di allarme di "Bassa" (Er5) *active in the event of LOW temperature alarm (Er5)*	ON
11	attiva in caso di allarme di "Alta" (Er4) *active in the event of HIGH temperature alarm (Er4)*	OFF
12	attiva in caso di allarme di "Alta" (Er4) *active in the event of HIGH temperature alarm (Er4)*	ON
13	attiva in caso di allarme grave *active in the event of serious alarm*	OFF
14	attiva in caso di allarme grave *active in the event of serious alarm*	ON
15	funzionamento TIMER / *TIMER function*	–

OFF= normalmente disattivata; viene eccitata in caso di allarme

On= normalmente attiva; viene diseccitata in caso di allarme

OFF= normally disenergized; energizes in the event of off-normal condition

ON= normally energized; disenergizes in the event of off-normal condition

Avvertenze:

- con DIPENDENZA=0 l'uscita non è abilitata: è il valore impostato nelle versioni V e W per le uscite non presenti (ovvero 2, 3 e 4 per le versioni V, 3 e 4 per le versioni W).
- Con DIPENDENZA=1 e 2 l'uscita è di REGOLAZIONE: fa riferimento rispettivamente a St1/P1 e St2/P2. Con i successivi parametri speciali, TIPO DI USCITA, INSERZIONE e DIFFERENZIALE/LOGICA sarà possibile definire completamente il funzionamento dell'uscita.
- Con DIPENDENZA=3, 4,...,14 l'uscita è associata ad uno o più allarmi. Per 'gravi' si intendono tutti gli allarmi esclusi quelli di "Alta" (Er4) e "Bassa" (Er5); cioè l'allarme sonda principale (Er0), l'allarme sonda NTC2 (Er1), l'allarme ingresso digitale (Er3). Si ricorda che l'allarme dati in memoria (Er2), genera in ogni caso il blocco totale del regolatore.
- Nella 3a colonna è indicata la logica dell'uscita di allarme. Con ON il relè è normalmente attivo: viene disattivato in caso di allarme. Si tratta di un funzionamento a sicurezza intrinseca in quanto il contatto commuta, e quindi segnala allarme, anche nel caso di eventuali cadute di tensione, guasti gravi al controllore o di allarme Er2.
- Con DIPENDENZA=15 l'uscita diventa a funzionamento ciclico, che chiamiamo TIMER: si rimanda al paragrafo successivo per spiegazioni più dettagliate.

8.2 Funzionamento TIMER

Con DIPENDENZA=15, l'uscita diventa indipendente dalla misura, set, differenziali, ecc. e continua a commutare periodicamente con periodo=C12 (T ciclo). Il tempo di ON (T ON) è definito dal parametro INSERZIONE come percentuale del tempo di ciclo impostato. Se si verifica una situazione di allarme o il controllo viene posto in stato di OFF, il funzionamento TIMER viene disattivato. Per ulteriori informazioni si rimanda alla descrizione dei parametri TIPO DI USCITA, INSERZIONE e all'esempio 8 trattato a pag. 44.

8.3 Descrizione TIPO DI USCITA: C35, C39, C43, C47

Vale se l'uscita è di regolazione (DIPENDENZA=1,2) oppure TIMER, (DIPENDENZA=15).
TIPO DI USCITA si identifica con C35 per l'OUT1, C39 per l'OUT2, C43 per l'OUT3 e C47 per l'OUT4.

L' uscita di regolazione può essere di tipo ON/OFF o PWM:
TIPO DI USCITA=0 l'uscita è ON/OFF;
TIPO DI USCITA=1 l'uscita è PWM (o TIMER).
Fuzionamento TIMER abbinato a DIPENDENZA=15.
Per ulteriori spiegazioni del significato PWM si veda la descrizione del Modo 4, a pagina 4. Si ricorda che il tempo di ciclo PWM è selezionato con il parametro C12.

8.4 Descrizione INSERZIONE: C36, C40, C44, C48

Questo parametro è attivo solo se l'uscita è abilitata per la regolazione, ovvero DIPENDENZA=1, 2 oppure TIMER con DIPENDENZA=15. INSERZIONE si identifica con C36 per l'OUT1, C40 per l'OUT2, C44 per l'OUT3 e C48 per l'OUT4. Con DIPENDENZA=1 o 2 esso rappresenta, nel caso di funzionamento ON/OFF, il punto di attivazione dell'uscita mentre, nel caso di funzionamento PWM, indica il punto in cui l'uscita assume il valore massimo. Il parametro INSERZIONE è espresso in valore percentuale, varia da -100 a +100 e fa riferimento al differenziale di lavoro e al set-point da cui dipende l'uscita. Se l'uscita è riferita a St1 (DIPENDENZA=1) INSERZIONE è relativo al valore percentuale di P1; se l'uscita è riferita a St2 (DIPENDENZA= 2), INSERZIONE è relativo al valore percentuale di P2. Se il valore di INSERZIONE è positivo, il punto di attivazione è a 'destra' del set-point, se negativo è a 'sinistra'.

Important:

- *If DEPENDENCE=0 the output remains idle. This is the factory-set value in modelsV and W which lack the following outputs: no. 2, 3, 4 forV models; no. 3 and 4 for W models.*
- *If DEPENDENCE=1 and 2, the CONTROL output refers to St1/P1 and to St2/P2 respectively. The other features as TYPE OF OUTPUT, ENERGIZATION and DIFFERENTIAL/LOGIC will contribute to specify the output function.*
- *If DEPENDENCE=3, 4,...,14 the output is associated with one or more ALARMS. When talking about "serious" alarms, we mean all alarms*
- *Er0, Er1, Er3 - except high temperature alarm (Er4) and low temperature alarm (Er5).*
  In the event of data memory alarm (Er2) the unit will block immediately.
- *The third column of the table above shows the logic of t the alarm output. When On, the relay is normally energized but disenergizes in the event of off-normal condition (power fluctuation, serious damage to the controller, Er2 alarm).*
- *If DEPENDENCE=15, the output assumes a cyclic logic (TIMER); see paragraph below.*

8.2 TIMER

If DEPENDENCE=15 the output is independent from set-point, differential, etc. In fact the output operates as a timer with period (T cycle)=C12; the On time (T On) is a percentage of the set time and is defined by the parame - ter ENERGIZATION. In the event of off-normal condition or when the controller is forced into the off status, the TIMER will be disenabled. For further information see 'Type of Output' and 'Energization' below (page 44).

8.3 TYPE OF OUTPUT: C35, C39, C43, C47

Valid with control outputs only (DEPENDENCE=1, 2) or Timer (DEPENDENCE=15).
The TYPE OF OUTPUT corresponds to C35 for out1, C39 for out2, C43 for out3 and C47 for out 4.

The control output can be either ON-OFF or PWM:
TYPE OF OUTPUT=0 *ON-OFF output*
TYPE OF OUTPUT=1 *PWM output (or timer)*
For further information on PWM mode see 'Mode 4'. The PWM cycle is set through the C12 parameter.

8.4 ENERGIZATION: C36, C40, C44, C48

This parameter operates only with control outputs, that is when DEPENDENCE=1, 2, or when DEPENDENCE=15 (Timer). ENERGIZATION corresponds to C36 for out1, C40 for out2, C44 for out3 and C48 for out4. In the ON/OFF mode of operation, DEPENDENCE=1 or 2 determines the energization point of the output, whilst in the PWM logic, it determines the point when the output assumes its max. value. ENERGIZATION is a percentage ranging from -100 to +100; it refers to the differential and set-point of the output. If the output is related to St1 (DEPENDENCE=1), ENER - GIZATION will depend on the percentage value of P1; if the output is related to St2 (DEPENDENCE=2), ENERGI - ZATION will depend on the percentage value of P2. If ENERGIZATION is a positive value, the energization point will stand on the right of the set-point; if it is negative, the energization point will stand on the left of the set-point.

TIMER: con DIPENDENZA=15 e TIPO DI USCITA=1, il parametro INSERZIONE definisce il tempo di ON come percentuale del periodo (C12); in questo caso INSERZIONE deve assumere solo valori positivi (tra 1 e 99).

Esempio 7: Inserzione
Nel figura sottostante sono raffigurati i punti di intervento di un controllo con 2 uscite, con questi parametri di lavoro:
St1=10, St2=20, P1=P2=6
OUT1 (punto A): DIPENDENZA=C34=1,
INSERZIONE= C36=-100;
OUT2 (punto B): DIPENDENZA=C38=2,
INSERZIONE= C40= +75.

TIMER: *when DEPENDENCE=15 and type of output=1, ENERGIZATION defines the On time as a percentage of C12: in this case ENERGIZATION will assume positive values only (1-99).*

Example no. 7: Energization
The diagram below shows the energization points of a two-output controller with the following setting:
St1=10, St2=20, P1=P2=6
OUT1 (point A): DEPENDENCE=C34=1,
ENERGIZATION=C36= -100;
OUT2 (point B): DEPENDENCE=C38=2,
ENERGIZATION=C40=+75.

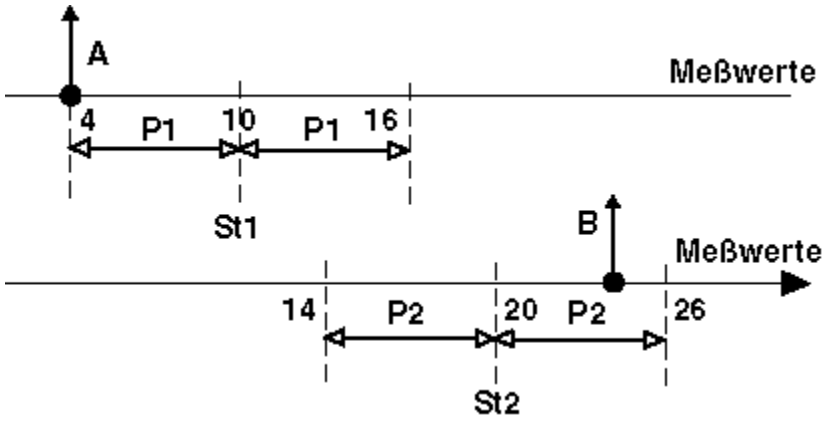


Fig.28

Esempio 8: Timer
Un'uscita TIMER è selezionata da DIPENDENZA=15, TIPO DI USCITA=1 e da INSERZIONE (percentuale ON) compresa tra 1 e 99 in un tempo ciclico fissato da C12 (s). Qui sotto vengono proposte OUT1 e OUT2 come uscite TIMER con C36 maggiore di C40, esempio:
OUT1 C34=15, C35=1, C36=50;
OUT2 C38=15, C39=1, C40=25.

Example no. 8: Timer
TIMER is given by DEPENDENCE=15, TYPE OF OUT - PUT=1 and ENERGIZATION ranging between 1 and 99 in a cyclic time set by C12 (s). The graph below shows OUT1 and OUT2 working as TIMER outputs with C36>C40:
OUT1 C34=15, C35=1, C36=50;
OUT2 C38=15, C39=1, C40=25.

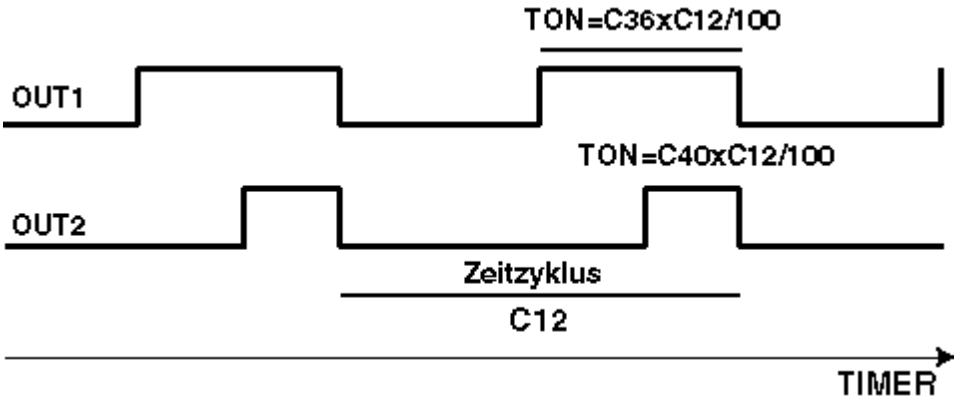


Fig.29

8.5 Descrizione DIFFERENZIALE/LOGICA: C37, C41, C45, C49

Questo parametro è attivo solo se l'uscita è abilitata per la regolazione, ovvero DIPENDENZA=1 o 2. DIFFERENZIALE/ LOGICA si identifica con C37 per l'OUT 1, C41 per l'OUT 2, C45 per l'OUT 3 e C49 per l'OUT 4. Esso permette di definire l'isteresi dell'uscita ovvero, nel caso di funzionamento ON/OFF, il punto di spegnimento dell'uscita o, nel caso di funzionamento PWM, il punto in cui l'uscita assume il valore minimo (tempo di ON=0): DIFFERENZIALE/LOGICA con il parametro precedente, INSERZIONE identifica la banda proporzionale di regolazione. Il parametro DIFFERENZIALE/LOGICA è espresso in valore percentuale, varia da -100 a +100 del differenziale di lavoro e, cosa importante da ricordare, é legato al punto di 'attacco' definito da INSERZIONE (si ricorda che INSERZIONE invece é legato al set). Il suo valore è il reale valore del differenziale dell'uscita in esame. Vale da se che:

- se l'uscita è riferita a St1 (DIPENDENZA= 1) DIFFERENZIALE /LOGICA è relativo al valore di P1; se l'uscita è riferita a St2 (DIPENDENZA= 2) DIFFERENZIALE/LOGICA è relativo al valore di P2.
- con DIFFERENZIALE/LOGICA positivo il punto di disattivazione è superiore al punto di attacco e si crea una logica di tipo Reverse. Viceversa, con DIFFERENZIALE/ LOGICA negativo, il punto di disattivazione è a livello inferiore del punto di attacco, si crea una logica di tipo Direct.

Nota: come per il parametro INSERZIONE, anche per DIFFERENZIALE/LOGICA la scelta di un valore percentuale è stata dettata dall'esigenza di poter creare la logica della regolazione. L'utente per modificare i punti di attacco e di stacco non dovrà intervenire direttamente su questi parametri ma sul set-point e/o differenziale.

Esempio 9:
Nel disegno viene completato l'esempio 7 aggiungendo i punti di disattivazione A' e B'. Per la prima uscita si richiede un funzionamento Reverse e il differenziale pari a P1; per la seconda una logica Direct e il differenziale pari a metà P2.

8.5 DIFFERENTIAL/LOGIC: C37, C41, C45, C49

This parameter operates only with control outputs, that is when DEPENDENCE=1 or 2. DIFFERENTIAL/LOGIC corresponds to C37 for out1, C41 for out2, C45 for out3 and C49 for out4. DIFFERENTIAL/LOGIC determines the hysteresis of the output, that is, in ON/OFF logic, the disenergisation point of the output, and, in PWM logic, the minimum value of the output (ON time=0): DIFFERENTIAL/LOGIC, as well as ENERGIZATION, identifies the proportional control zone. Differential/Logic is a percentage ranging from -100 to +100 of the operating differential and it is linked to the energization point defined by ENERGIZATION (ENERGIZATION is linked to the set-point):

- *If the output is related to St1 (DEPENDENCE=1), DIFFERENTIAL/LOGIC depends on P1; if the output is related to St2 (DEPENDENCE=2),*
- *DIFFERENTIAL/LOGIC depends on P2. When Differential/logic is given a positive value, the disenergization point is higher than the activation point (REVERSE logic). Viceversa, when Differential/Logic is a negative value, the disenergization point is lower than the activation point (DIRECT logic).*

***Important:** as for ENERGIZATION, DIFFERENTIAL/ LOGIC allows you to define the operating logic (Direct or Reverse) by giving this parameter a percentage value. This ensure an easy and straightforward modification of the energization/disenergization points by simply modifying set-point and/or differential.*

Example no. 9:
The graph below completes example no. 7 above with the addition of disenergization points A' and B'. The first output operates in the Reverse mode with differential=P1. The second output operates in the Direct mode with differential=P2.

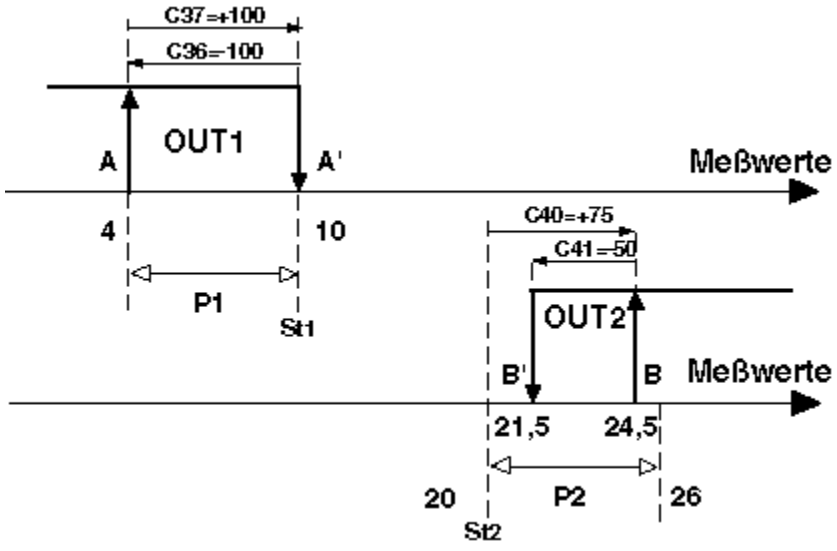


Fig.30

I parametri di funzionamento sono:
St1=10, St2=20, P1=P2=6
OUT1: DIPENDENZA=C34=1, e INSERZIONE=C36= -100 (A), DIFFERENZIALE/LOGICA=C37=+100 (A')
OUT2: DIPENDENZA=C38=2 e INSERZIONE=C40= +75 (B), DIFFERENZIALE/LOGICA=C41= -50 (B').
A titolo esemplificativo, vediamo cosa succede alla logica di regolazione dell'esempio precedente invertendo i valori di DIFFERENZIALE/LOGICA per le due uscite, ovvero ponendo C37= -50 e C41=+100. A" e B" sono i nuovi punti di disinserzione.

Operating parameters:
St1=10, St2=20, P1=P2=6
***OUT1:** DEPENDENCE=C34=1, ENERGIZATION=C36= -100 (A), DIFFERENTIAL/LOGIC=C37=+100 (A')*
***OUT2:** DEPENDENCE=C38=2, ENERGIZATION=C40= +75 (B), DIFFERENTIAL/LOGIC=C41= -50 (B')*

Let's analyse what happens by inverting the DIFFEREN - TIAL/LOGIC values of the two outputs, that is, C37= -50 and C41=+100. A' and B' are the two new disenergization points.

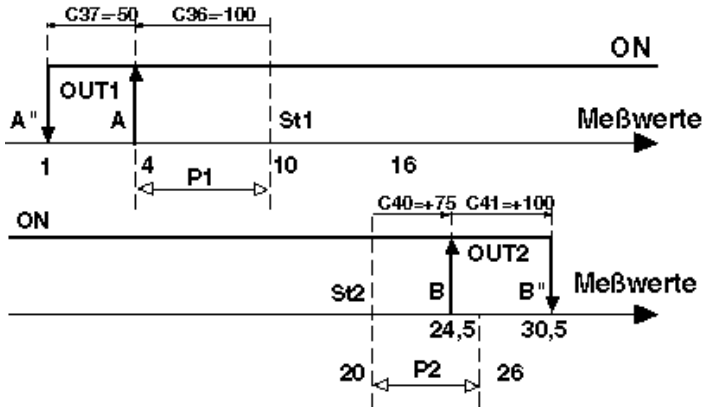


Fig.31

8.6 Note integrative al funzionamento speciale

1- Zona neutra P3
Nei Modi 3, 4 e 5 è presente una zona neutra la cui dimensione è definita da P3. All'interno della zona morta non possono essere posizionati punti di attivazione o disattivazione: se questi sono individuati in zone precedenti e successive al Set lo strumento provvede automaticamente ad aumentare l'isteresi dell'uscita interessata del valore 2* P3. Un esempio è riportato nel disegno sottostante:

8.6 Further information on the special mode of operation

1 - Neutral zone P3:
In Modes 3, 4, 5 there is a neutral zone whose range depends on the value given to P3. Within the neutral zone there are no energisation/disenergisation points. In the event of energisation/disenergisation points beyond the set-point range, the controller will automatically develop corrective action, increasing the output hysteresis by 2 P3 as shown in the graph below:*

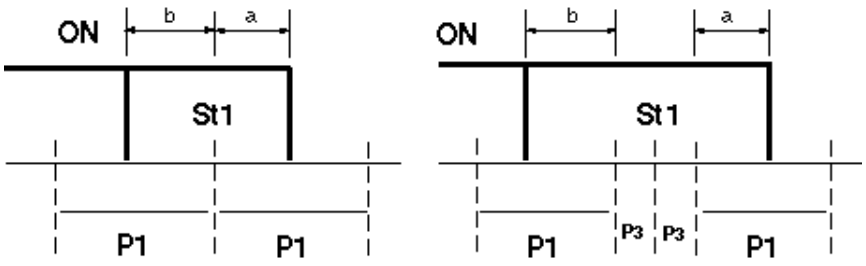


Fig.32

- Eventuali uscite PWM (o analogiche) sovrapposte al set e quindi alla zona Neutra avranno il funzionamento indicato in figura. In pratica nella zona neutra l'uscita mantiene inalterato il livello di attivazione.

- In the event of PWM (or analogue) outputs overlaying the set-point and the neutral zone, the operating logic will be as follows (within the neutral zone the output maintains the energization point unchanged):

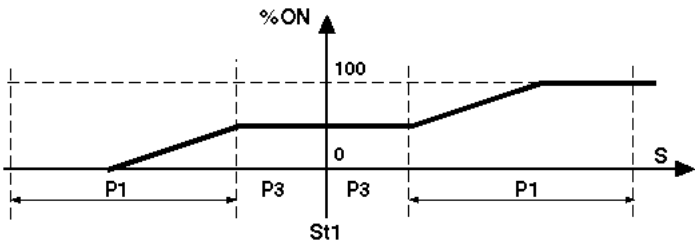


Fig.33

2- Nei Modi 3, 4 e 5, ponendo C33=1 la regolazione si sdoppia come rappresentato in figura 34.
Questo perché al fine di ottenere differenziale distinti per le uscite Direct e Reverse, i modi 3, 4 e 5 fissano in origine la dipendenza (DIPENDENZA) a St1 per le uscite Reverse e a St2 per le uscite Direct utilizzando così i due differenziali P1 e P2. St2 non é visibile e viene imposto sempre uguale a St1. Questo non è più vero con C33=1: St2 é visibile e svincolato richiedendo di essere impostato dall'utente.

2 - In Modes 3, 4 and 5, *if C33=1, the control action modifies as shown in the graph below (fig. 34):*
Modes 3, 4, 5 determine Dependence=St1 for Reverse outputs and DEPENDENCE=St2 for Direct outputs so as to get different differentials. St1 always corresponds to St2 except when C33=1. In this case St2 can be displayed and has to be set by the User.

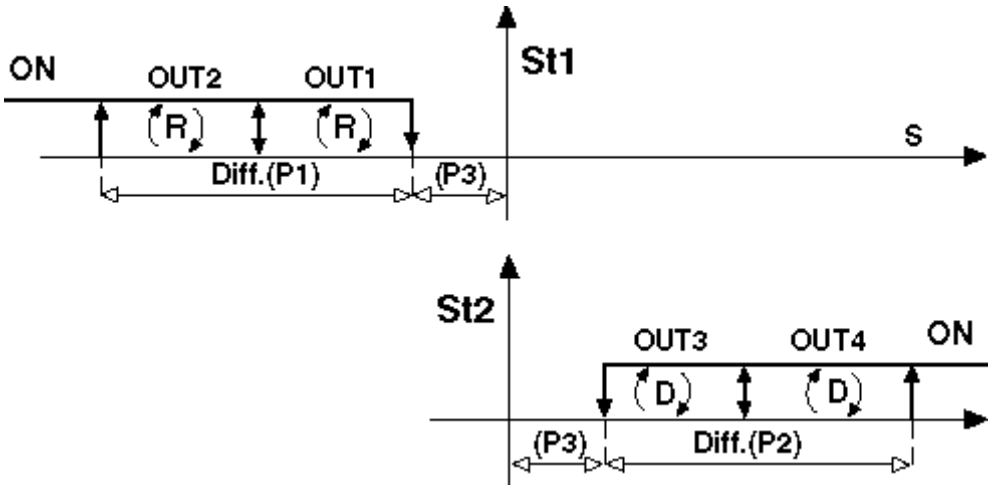


Fig.34

3- Il Modo 6 dispone le uscite legate a St1 con logica Direct (INSERZIONE positivi e DIFFERENZIALE/LOGICA negativi) con contatto digitale aperto. La chiusura del contatto all'ingresso digitale forza le uscite a dipendere da St2 e P2 e la logica diventa Reverse grazie all'inversione di segno dei parametri INSERZIONE e DIFFERENZIALE/LOGICA (un'eventuale verifica del valore dei parametri non dipende dallo stato dell'ingresso digitale: essi cambiano solo a livello di algoritmo). Posto **C33=1**:

- possono essere programmate uscite Direct e Reverse tramite INSERZIONE e DIFFERENZIALE/LOGICA. La logica costruita é valida a contatto aperto, si invertono le singole logiche con la chiusura del contatto, con l'avvertenza che segue:
- se si seleziona DIPENDENZA=2 l'uscita relativa sarà sempre legata a St2/P2; in pratica non cambia la dipendenza al commutare dell'ingresso digitale. Continuerà invece a cambiare la logica da Direct a Reverse, ovvero vengono sempre invertiti i segni dei parametri INSERZIONE e DIFFERENZIALE/LOGICA. La figura sottostante rappresenta un esempio di quanto sopra descritto. Le uscite di allarme (DIPENDENZA=3, 4...14), non dipenderanno dall'ingresso digitale.

3 - In Mode 6, *when the digital contact is open, the out - puts will depend on St1 and will operate in the DIRECT logic (ENERGIZATION positive and DIFFERENTIAL/LOGIC negative). Closing the contact causes the outputs to depend on St2 and P2; the opera - ting logic will be Reverse because the sign of ENERGIZA - TION and DIFFERENTIAL/LOGIC has changed.*
*When **C33=1**:*

- *you can program Direct and Reverse outputs by ENERGIZATION and DIFFERENTIAL/LOGIC when the contact is OPEN. The logic changes when the contact closes. In this case note that:*
- *if DEPENDENCE=2 the relative output will always be linked to St2/P2 (the dependence does not change when the digital input status changes).*
  The operating logic, however, will continue to change, from direct to reverse as the signs of ENERGIZATION and DIFFERENTIAL are continually being inverted.
  In the graph below the alarm outputs (Dependence=3,4,...,14) do not depend on the digital input:

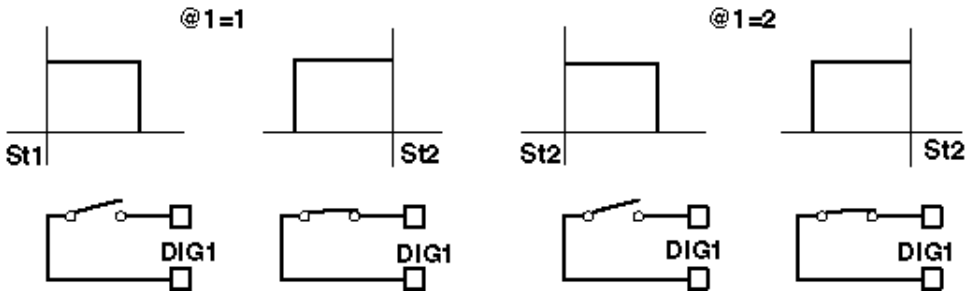


Fig.35

4- Modi 7 e 8. Per le uscite con dipendenza 2 (DIPENDENZA=2) la commutazione dell'ingresso digitale non avrà più alcun effetto sul set di lavoro che rimane St2 ne tantomeno sulla logica (questi modi infatti non prevedono modiche alla logica). Le uscite di allarme (DIPENDENZA=3, 4...14), non dipenderanno dall'ingresso digitale.

5- Modi 1 e 2 in funzionamento differenziale (C19=1)
Nel funzionamento differenziale St1 deve confrontarsi con 'NTC1-NTC2' anzichè con NTC1. In funzionamento speciale (C33=1) le uscite si possono programmare con DIPENDENZA=2: perdono così il funzionamento differenziale e sono legate a St2/P2 confrontandosi con NTC1.
Con DIPENDENZA=3, 4...14 si ottiene una uscita di allarme: gli allarmi di "Alta" (Er4) e di "Bassa" (Er5) sono sempre riferiti alla sonda principale NTC1.

6- Modi 1 e 2 con funzionamento COMPENSAZIONE (C19=2, 3, 4)
Analogamente al caso precedente, con C33=1 le uscite con dipendenza 2 (DIPENDENZA=2) saranno legate a St2/P2; la regolazione é sul confronto di NTC1 senza la compensazione in funzione della sonda NTC2.
Con DIPENDENZA=3, 4...14 si ottiene una uscita allarme che si confronta con la sonda principale NTC1.

Visualizzazione: con C33=1 lo strumento visualizza sempre i parametri St2, P2 e P3 non previsti inizialmente dal modo in uso.

Rotazione: con C33=1 viene inibito qualsiasi tipo di rotazione.

Nota per la nuova versione

Nelle versioni con numero di serie superiore a 100.000 vengono mantenute le rotazioni previste (vedere parametro C11, pag. 23).

4 - Modes 7 and 8: *when outputs have DEPENDEN - CE=2, changing the status of the digital input will not have any effect on the set-point (St2) nor on the operating logic. Alarm outputs (Dependence=3,4,...,14) will NOT depend on the digital input.*

5 - Modes 1 and 2 with DIFFERENTIAL function (C19=1)
In the differential function St1 will be compared with 'NTC1-NTC2' instead of NTC1. In the special mode of operation (C33=1), if DEPENDENCE=2, the differential function will be lost and the outputs will depend on St2 and P2 that operate according to the value of NTC1. When Dependence=3, 4,...14, you will get an alarm out - put: both high temperature alarms (Er4) and low tempera - ture alarms (Er5) will refer to the main sensor NTC1.

6- Modes 1 and 2 with OFFSET function (C19= 2, 3, 4)
Similarly to the previous case, when C33=1 and Dependence=2 the outputs will refer to St2/P2; the control action will be based on NTC1 without the offset related to NTC2. If DEPENDENCE=3, 4...14 the value of the alarm output will depend on the main sensor NTC1.

Display: *when C33=1, the controller will always display St2, P2 and P3.*

Rotation: *when C33=1 there is no rotation.*

Important:

In versions having serial number above 100,000, the rotation will be maintained *(see C11 on page 23).*

8.7 Suggerimenti per scegliere il modo di partenza

Come anticipato, C33 offre la possibiltà di creare una logica di funzionamento personalizzata. La logica che si crea può essere una semplice modifica o uno stravolgimento di uno dei nove modi. In ogni caso una logica nuova si basa su un modo di partenza con **funzioni caratteristiche** che possono essere cosi riassunte:

- Modi 1, 2, 9: sono tra loro equivalenti. Non prendono in considerazione la zona neutra P3 nella commutazione della logica da ingresso digitale.

- Modi 3, 4, 5: sono tra loro equivalenti. Rendono attivo il differenziale di zona neutra P3. Non prevedono la commutazione della logica da ingresso digitale.

- Modo 6: non considera il differenziale P3. Per le uscite di regolazione con dipendenza 1 (DIPENDENZA=1) l'ingresso digitale attua la commutazione a St2 con logica invertita (l'uscita dipenderà da St2 con l'inversione dei segni INSERZIONE e DIFFERENZIALE/LOGICA, ovvero con l'inversione della logica Direct/Reverse e viceversa).

Per le uscite con DIPENDENZA=2 é attivo solamente lo scambio di logica ovvero la chiusura del contato digitale mantiene la Dipendenza St2 ma inverte la logica scambiando i segni di INSERZIONE e DIFFERENZIALE/LOGICA.

- Modi 7, 8: sono equivalenti. Non é valido P3. L'ingresso digitale opera per le sole uscite di regolazione con dipendenza 1 (DIPENDENZA=1) lo spostamento del riferimento da St1/P1 a St2/P2, mantenendo la logica della regolazione (INSERZIONE e DIFFERENZIALE/LOGICA non cambiano segno). L'ingresso digitale non ha alcuna funzione sulle altre uscite di regolazione, ovvero con DIPENDENZA=2 e di allarme.
Nota: con modi equivalenti si ottengono identiche funzioni. Vale a dire che a parità di impostazione dei vari parametri speciali la logica che si ottiene sarà identica.
Cambiano ovviamente i valori di partenza da modificare: questo è l'unico motivo per preferire un Modo di partenza rispetto al suo equivalente.

Prima di selezionare C33=1: qualora sia individuato un modo di partenza diverso da C0=2 di fabbrica, questo dovrà essere impostato prima di abilitare il funzionamento speciale (C33=1): **è necessario memorizzare la modifica di C0 premendo PRG**.

Con C33=1 la modifica di C0 non attiva più alcuna modifica ai parametri speciali. Ovvero, é fattibile la modifica di C0 ma la reimpostazione dei parametri speciali (da C34 a C49) e le funzioni caratteristiche sono congelati al Modo precedente a C33=1: se per i parametri si può ricorrere alla singola impostazione, le funzioni caratteristiche non sono attivabili. Concludendo, solo dopo aver impostato e salvato il Modo di partenza si rientrerà in modifica parametri per porre C33=1.

Nel caso sia necessario modificare il MODO dopo che C33 è stato posto a 1 è necessario riportare C33=0, premere il tasto PRG per conferma, impostare il Modo desiderato e registrare la modifica (PRG), ritornare quindi in funzionamento speciale con C33=1.
Riportando C33 da 1 a 0 il regolatore annulla tutte le modifiche sui 'parametri speciali' che torneranno ad assumere i valori dettati da C0.

8.7 Hints for choosing the right mode

*C33 allows you to customize the operating mode of your controller by simply modifying some of the factory-set parameters or one of the nine operation modes. The new operating logic has **specific features** that can be summarized as follows:*

***- Modes 1, 2, 9:** they are equivalent. They do not take into consideration the neutral zone P3 nor the switchover via digital input.*

***- Modes 3, 4, 5:** they are equivalent. They operate the differential of the neutral zone P3. No switchover via digital input.*

***- Mode 6:** differential P3 is not taken into consideration. For control outputs with DEPENDENCE=1, the digital input switches over St2 with inverted logic (the output will depend on St2, ENERGIZATION and DIFFERENTIAL/LOGIC will change their signs thus changing the operating logic, from Direct/Reverse and viceversa).*

With outputs having DEPENDENCE=2, the switchover is maintained (closing the digital contact maintains Dependence St2 but inverts the logic by changing the signs of ENERGIZATION and DIFFERENTIAL/LOGIC).

***- Modes 7, 8:** are equivalent. P3 is not valid. The digital input operates exclusively on the control outputs with DEPENDENCE=1 changing from St1/P1 to St2/P2. The control action remains as it is (ENERGIZATION and DIFFERENTIAL/LOGIC do not change their sign). The digital input does not affect the other control and alarm outputs (DEPENDENCE=2).*
***Important:** equivalent modes produce equivalent functions (operating logic). What makes you prefer one mode instead of another are the starting values to be modified.*

Before setting the special mode of operation C33=1** select the desired Mode of operation you want to use instead of the factory-set one (C33=1). **Press PRG to store the modification of the C0 parameter.

*Once you have set C33=1, modifying C0 does not permit any modification of the special parameters.
Should you need to modify the MODE after having set C33=1, you have to reset C33 to 0, press PRG to confirm, select the new Mode and press PRG again to confirm the new value. Then return to the special mode of operation by setting C33=1.*

***Remember that when changing C33 from 1 to 0,** all the modifications concerning the 'special parameters' will be lost. The special parameters will be automatically given values as determined by C0.*

8.8 Esempi di utilizzo del funzionamento speciale

Esempio 10
In un'applicazione di raffreddamento si vuole avere l'isteresi centrata sul set-point St1.

Soluzione: ciò è possibile partendo dal Modo 1 modificando il parametro INSERZIONE. Il controllo ha di default C0=2, quindi porre C0=1 ed uscire dalla programmazione premendo PRG. Rientrare in programmazione con P.W.77 apportando queste modifiche: C33=1 (funzionamento speciale), DIPENDENZA=C34 e TIPO DI USCITA=C35 restano invariati, rispettivamente a 1 e 0.

Il punto di attacco INSERZIONE=C36 deve passare da +100 a +50; **il punto di stacco DIFFERENZIALE/LOGICA=C37** rimane invariato a -100. In figura 36 è raffigurata la nuova logica ottenuta.

8.8 Some examples about the "Special Mode of Operation"

Example no. 10
Setting the hysteresis around the Set-point (St1) in a central position in a refrigeration system.

Solution: *set Mode 1 and modify parameter ENERGIZATION. As the factory-set value of C0 is 2, it is necessary to set C0=1. Exit the programming field by pressing PRG, then enter again (password 77) and modify the parameters as follows: C33=1 (special mode of operation), DEPENDENCE=C34 and TYPE OF OUTPUT=C35.*

The energization point (ENERGIZATION=C36) *must be decreased, from +100 to +50;* ***the disenergization point (DIFFERENTIAL/LOGIC=C37)*** *remains unchanged (-100). The graph below shows how the controller works:*

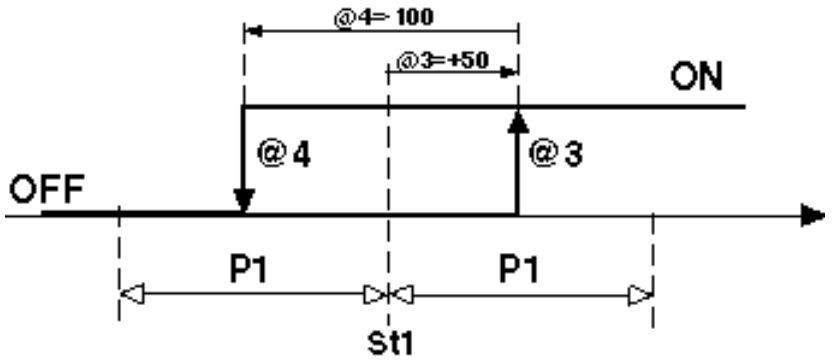


Fig.36

Esempio 11
Si deve gestire una unità refrigerante avente due compressori il primo di taglia doppia rispetto al secondo.
In particolare, è richiesto che il compressore più potente parta sempre per primo ed abbia un differenziale di lavoro doppio rispetto al secondo compressore.

Soluzione: il modo di partenza può essere uno dei modi 1, 2, 9 Si ricordi che il controllo ha di serie C0=2. Utilizzando C0=2 entrando con P.W.77, si andrà a modificare C33=1.

Supposto di usare un controllo con due uscite, le modifiche da apportare a INSERZIONE e DIFFERENZIALE/ LOGICA sono:

Example no. 11:
Control and regulation of a refrigeration system equipped with two compressors of different capacity. Specifically, the first compressor is twice the size of the second one. In addition, the most powerful compressor should always be the first to be actuated and its differential should be twice the range of the second one.

Solution: *the starting mode can be 1, 2, 9 (factory-set C0=2).*
If C0=2, digit password 77 and set C33=1.

Supposing you are using a two-output controller, modify ENERGIZATION and DIFFERENTIAL/LOGIC as follows:

OUT1	OUT2
DIPENDENZA=C34 invariato a 1	DIPENDENZA=C38 invariato a 1
DEPENDENCE=C34 unchanged (1)	*DEPENDENCE=C38 unchanged (1)*
TIPO DI USCITA=C35 invariato a 0	TIPO DI USCITA=C39 invariato a 0
TYPE OF OUTPUT=C35 unchanged (0)	*TYPE OF OUTPUT=C39 unchanged (0)*
INSERZIONE=C36 +66 / *ENERGIZATION=C36 +66*	INSERZIONE=C40 +100 / *ENERGIZATION=C40 +100*
DIFFER./LOGICA=C37 -66 / *DIFFER./LOGIC=C37 -66*	DIFFER./LOGICA=C41 -34. / *DIFFER./LOGIC=C41 -34.*

In figura 37 è rappresentata la nuova logica di funzionamento.

The diagram below shows the new control logic:

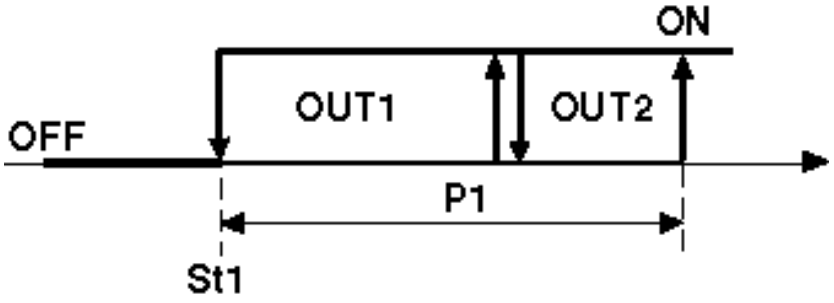


Fig.37

Esempio 12

Si riprende la soluzione 1b di pag. 29 visto con il parametro C19. L'obiettivo è abbassare l'acqua di ingresso di 5°C (T2 deve essere 5°C inferiore a T1). La sonda principale è posta in uscita (T2 =NTC1).

Si vogliano soddisfare queste ulteriori specifiche:

- la temperatura in uscita T2 deve mantenersi sopra gli 8°C;
- se T2 resta sotto i 6°C per più di un minuto deve essere segnalato un allarme di "Bassa" temperatura.

Example no. 12

You want to lower the inlet water temperature by 5°C in an application similar to that illustrated in the example 1b on page 29 (parameter C19). T2 must be 5°C lower than T1. The main sensor is at the water outlet (T2=NTC1). Further specifications to be fulfilled:

- *the outlet temperature (T2) must remain above 8°C;*
- *if T2 remains below 6°C for more than 1 minute, the low temperature alarm must be generated.*

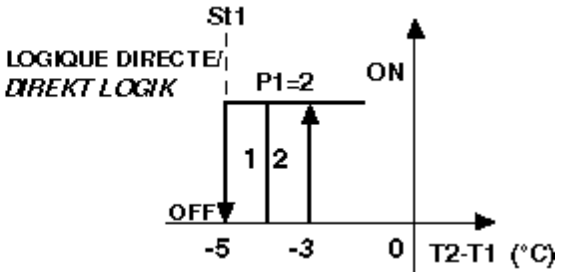


Fig.38

Soluzione: si utilizzerà un controllo a 4 uscite (IRxxZ); si sfrutteranno due uscite per la regolazione (OUT3 e OUT4), e una per la remotazione dell' allarme (OUT1). L'uscita OUT2 sarà utilizzata per disattivare le uscite OUT3 e OUT4 quando T2< 8°C. Per far ciò è sufficiente, a livello di collegamento elettrico, porre OUT2 in serie con OUT3 e OUT4, quindi rendere attiva OUT2 solo quando NTC1 (T2) è superiore a 8°C; (vedere schema sottostante fig. 39).

Solution: *use a 4-output controller (IRxxZ); two outputs will be used as control outputs (OUT3 and OUT4) and one to connect a remote alarm indication (OUT1). OUT2 will be used to disenergize outputs OUT3 and OUT4 when T2< 8°C. To do so, connect OUT2 in series with OUT3 and OUT4 so that OUT2 will energize only when NTC1 (T1) detects values above 8°C. See the graph below:*

The main parameters to be set are:

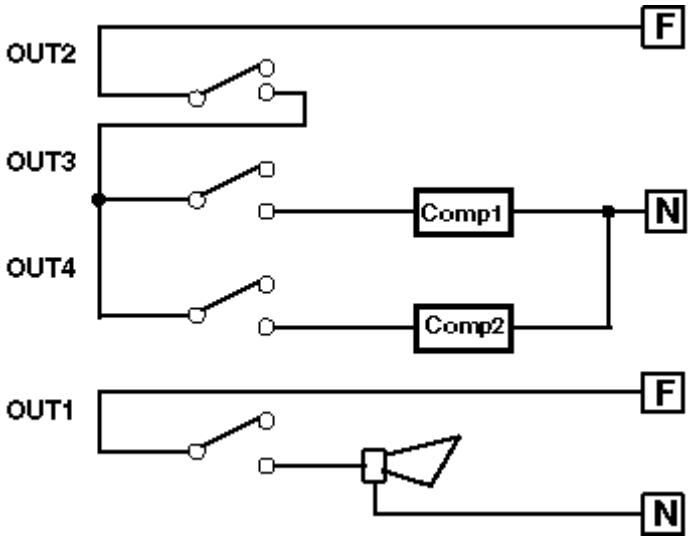


Fig.39

I principali parametri riprendono la soluzione 1b di pag. 29:

Set-point	St1=-5
MODO / *MODE*	C0=1
differenziale totale per le due uscite / *Total differ. for both outputs*	P1=2
funzionamento DIFFERENZIALE / *DIFFERENTIAL function*	C19=1
allarme di "Bassa" a 6°C / *LOW temp. alarm at 6°C*	P25=6
con ritardo di 1 minuto / *one minute's delay*	P28=1 (min).

Il differenziale dell'allarme (P27) sarà selezionato stretto se si vuole Reset automatico o 'largo' se si vuole Reset manuale. Impostati questi parametri è necessario uscire dalla programmazione, premendo PRG, in modo da salvare i nuovi valori prima di attivare il funzionamento "speciale" (C33=1). Rientrando con P.W.77 si attiverà C33=1: le modifiche da apportare ai parametri speciali sono:

The alarm differential (P27) will be given a small value if you want the alarm to be reset automatically, a greater value if you prefer resetting the alarm manually.
After having modified the above parameters, confirm them and exit the programming field pressing PRG. Then set the special mode (C33=1) and modify the special parameters as follows:

OUT1: deve essere programmata come uscita di allarme attiva solo in caso di allarme di “Bassa”. Si deve quindi modificare la dipendenza DIPENDENZA=C34 che passa da 1 a 9 (o 10 se si vuole lavorare con relè normalmente ON). I parametri C35, C36, C37 non hanno più rilevanza e restano invariati.

OUT2: si svincolerà dal funzionamento DIFFERENZIALE cambiando la DIPENDENZA da 1 a 2: quindi DIPENDENZA=C38=2. La logica è di tipo Direct e comprende tutto P2, quindi INSERZIONE=C40 diventa 100, e DIFFERENZIALE/LOGICA=C41 diventa -100. St2 sarà ovviamente impostato a 8 e P2 rappresenta la variazione minima necessaria per riavviare l’unità, una volta che si è arrestata per “Bassa” temperatura, es P2=4.

OUT3 e OUT4: negli strumenti con 4 uscite, il Modo 1 assegna ad ogni uscita una isteresi pari al 25% del differenziale P1. Nell’esempio considerato le uscite effettivamente utilizzate per la regolazione sono 2, per cui si vuole che l’isteresi di ogni uscita sia il 50% di P1. È necessario quindi cambiare i parametri INSERZIONE e DIFFERENZIALE/ LOGICA delle uscite indicate in modo che si adattino alla nuova situazione.

In pratica si dovrà porre:

OUT3:
INSERZIONE=C44 passa da 75 a 50
DIFFERENZIALE/LOGICA=C45, passa da -25 a -50.

OUT4:
INSERZIONE=C48 resta a 100
DIFFERENZIALE/LOGICA = C49 passa da -25 a -50.

Il disegno riassume la logica di funzionamento della regolazione:

OUT1: *program it as active alarm output to be used in the event of low temperature alarm; in this case modify dependence (DEPENDENCE=C34) from 1 to 9 (or 10 if you want normally open relays). You do not need to modify C35, C36, C37.*

OUT2: *in order to make idle the DIFFERENTIAL function, change DEPENDENCE from 1 to 2: DEPENDENCE=C38=2. The controller will perform in the DIRECT logic and will include the entire value of P2: Therefore old ENERGIZATION= C40 becomes C40=100, and old DIFFERENTIAL/LOGIC=C41 becomes C41=-100. Set St2=8. P2 indicates the minimum variation necessary to re-start the unit following a low tem - perature condition (e.g. P2=4).*

OUT3 and OUT4: *when using 4-output controllers, setting Mode 1 means to give each output a hysteresis corresponding to 25% of the differential P1. In the example shown below, there are 2 actual control outputs (OUT3 and OUT4) so the hysteresis of each output should correspond to 50% o f P1. It is therefore necessary to change ENERGIZATION and DIFFERENTIAL/LOGIC referrring to the indicated output so as to meet the new application requirements.*
In short:

OUT3:
ENERGIZATION=C44 changes from 75 to 50
DIFFERENTIAL/LOGIC=C45 changes from -25 to -50.

OUT4:
ENERGIZATION=C48 remains 100
DIFFERENTIAL/LOGIC=C49 changes from -25 to -50.

The graph below shows the new control logic:

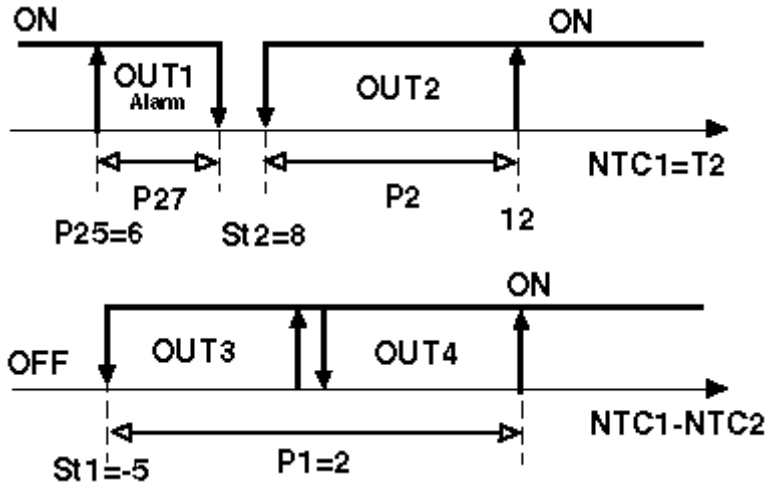


Fig.40

Esempio 13
Si vuole pilotare 3 bruciatori di una caldaia per portare l’acqua alla temperatura St1. È richiesta un’uscita di allarme che deve essere attivata nel caso in cui l’acqua superi un limite di “Alta” temperatura o in caso sia segnalato un blocco dell’impianto.

Soluzione: supposto che il segnale di blocco sia disponibile come contatto pulito, si potrà utilizzare l’ingresso digitale per la sua gestione. Si dovrà poi configurare un’uscita come allarme (DIPENDENZA=5 o 6).
Il Modo di partenza può essere lo standard, ovvero C0=2.

Example no. 13
Control and regulation of 3 boiler burner units so as to bring the water temperature to St1. You need one alarm output that will energise in the event the water temperatu - re rises above the “High” temperature threshold or in the event the system locks.

Solution: *Use the digital input (voltage-free contact) to regulate the 'system lock' signal. Then configure another output as alarm output (DEPENDENCE=5 or 6).*
As for the Mode, there is no need to change its standard setting, that is C0=2.

Le modifiche da apportare sono:

Modo di partenza: C0=2
ingresso digitale 1: gestione allarme con blocco uscite e attivazione uscita di allarme.
C29=2 allarme immediato con Reset manuale;
C31=0 in caso di allarme da ingresso digitale tutte le uscite vengono spente.

OUT1:
uscita ON/OFF per comando del primo bruciatore: INSERZIONE=C36=-33 DIFFERENZIALE/LOGICA=C37=33 (DIPENDENZA e TIPO DI USCITA invariati)

OUT2:
uscita ON/OFF per comando del secondo bruciatore: INSERZIONE=C40=-66 DIFFERENZIALE/LOGICA=C41=33 (DIPENDENZA e TIPO DI USCITA invariati)

OUT3:
uscita ON/OFF per comando del terzo bruciatore: INSERZIONE=C44=-100 DIFFERENZIALE/LOGICA=C45=34 (DIPENDENZA e TIPO DI USCITA invariati)

OUT4:
uscita ON/OFF d'allarme di "Alta" e da blocco esterno.
DIPENDENZA C46=5 (o 6 se si preferisce il relè normalmente eccitato)
P26 = livello di "Alta" temperatura richiesto (Es. 90°C)
P27 = differenziale allarme (visto che l'allarme deve essere assoluto, P27 deve essere positivo)
P28 = eventuale ritardo allarme temperatura e blocco

Il grafico raffigura la logica di funzionamento selezionata.

In short:

Starting Mode: C0=2;
Digital input no.1: alarm management with output disenergization and energization of the alarm output;
C29=2: immediate alarm, manual reset;
C31=0: in the event of off-normal condition, all outputs will disenergise;

OUT1:
ON/OFF output to control the first burner unit ENERGIZATION=C36=-33 DIFFERENTIAL/LOGIC=C37=33 (Dependence and Type of Output remain unchanged).

OUT2:
ON/OFF output to control the second burner unit ENERGIZATION=C40=-66 DIFFERENTIAL/LOGIC=C41=33 (Dependence and Type of Output remain unchanged).

OUT3:
ON/OFF output to control the third burner unit ENERGIZATION=C44=-100 DIFFERENTIAL/LOGIC=C45=34(Dependence and Type of Output remain unchanged).

OUT4:
ON/OFF output for high temperature alarm and external system lock.
DEPENDENCE C46=5 (or 6 if you prefer a normally energized relay);
P26=sets the required high temperature level (e.g. 90°C);
P27=alarm differential (P27 must be a positive value);
P28=time-delay (if any) before the activation of the temperature/system lock alarm.

The graph below illustrates the new control logic:

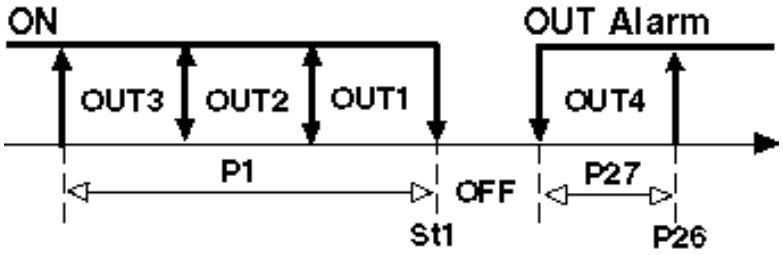


Fig.41

Esempio 14
In un impianto di stagionatura si controlli la temperatura tramite un compressore (generatore di freddo) ed una resistenza elettrica (generatore di calore). Il controllo deve agire con una zona neutra di 3 °C attorno ad un set di 5 °C. Il comando della resistenza dovrà essere di tipo PWM per un inserimento proporzionale della potenza.

Soluzione: Modo di partenza: C0=3 salvare la modifica uscendo dalla programmazione con PRG, rientrare in programmazione, P.W.77, ponendo C33=1;
St1=5°C – P3=1,5°C P1 e P2 stabiliranno il differenziale di lavoro rispettivamente della resistenza e del compressore.

OUT1: comando della resistenza con funzionamento PWM; TIPO DI USCITA=C35=1, per funzionamento PWM (DIPENDENZA, INSERZIONE e DIFFERENZIALE/LOGICA invariati).

OUT2: uscita ON/OFF per comando del compressore: resta invariata.

Example no. 14
Control and regulation of the temperature of a cold storage room by means of a compressor (cooling function) and an electric heater (heating function). The controller will develop corrective action in response to deviation from the desired conditions, according to the set values, that is neutral zone=3°C and set-point=5°C. The heater operates in the PWM logic so as to obtain a proportional operating logic.

Solution: *Starting Mode: C0=3: Confirm the modification by exiting the programming field through PRG, then enter again (password 77) and set C33=1; St1=5°C – P3=1.5°C P1 and P2 represent the operating differential of heater and compressor respectively.*

OUT1: *Control of the heater, PWM logic; TYPE OF OUTPUT=C35=1, PWM function (DEPENDENCE, ENERGIZATION and DIFFERENTIAL/LOGIC remain unchanged).*

OUT2: *ON/OFF output for the control of the compressor (unchanged)*

Nota: nel Modo 3 se si pone C33=1, l'uscita 1 continua a riferirsi a St1 (e P1), mentre l'uscita 2 si riferisce a St2 (e P2) che è ora impostabile distintamente.

Il disegno a fianco raffigura la **nuova logica**.

Note: *when working in Mode 3, setting C33=1 implies that the first output will be directly related to St1 (and P1) whilst output 2 will be related to St2 (and P2) whose value can be directly selected.*

The graph below illustrates the **new operating logic**.

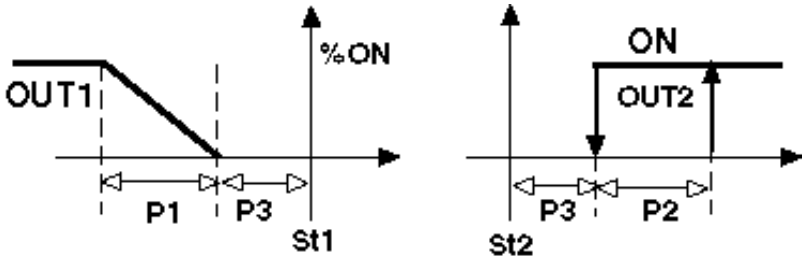


Fig.42

Da notare che:

1- La stessa funzionalità si sarebbe ottenuta partendo da Modo 4, modificando "TIPO DI USCITA di OUT2"=C39 da 1 a 0, in modo che l'OUT2 diventasse da "tipo" PWM a "tipo" ON/OFF.

2- Nel caso si voglia mantenere un unico set point di regolazione si devono mantenere le due uscite dipendenti da St1. Riprendendo l'esempio precedente basta porre DIPENDENZA di OUT2=C38 =1. La figura 33 mostra il nuovo diagramma di regolazione (si noti che i differenziali di lavoro per OUT1 e per OUT2 fanno riferimento entrambi a P1).

Please note that:

1- *the same regulation logic might be achieved starting from Mode 4 and modifying the TYPE OF OUTPUT relati - ve to OUT2 as follows: TYPE OF OUTPUT=C39=0, (set - ting 0 instead of 1 causes the output to work in the ON/OFF instead of the PWM logic).*

2- *if you want to maintain only one set-point, the two out - puts must be related to St1. Set Dependence of Out2=C38=1. Fig. 33 shows the new control graph (diffe - rentials for OUT1 and OUT2 refer to P1).*

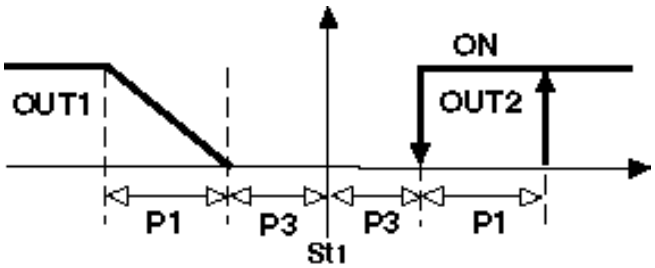


Fig.43

Esempio 15

Si vuole gestire in una cella il comando compressore ed avere una uscita di allarme.

Soluzione 1: si può utilizzare un regolatore a 2 uscite nel Modo 5: di fabbrica OUT2 gestisce l'allarme ed OUT1 una logica di comando Reverse. Sarà sufficiente modificare la logica di OUT1 per soddisfare la richiesta. St1, P1 e P3 definiscono la regolazione finale.

Modo di partenza: C0=5 salvare la modifica uscendo dalla programmazione e rientrare in programmazione, con Passwod 77, ponendo C33=1.

OUT1: uscita ON/OFF che deve passare da logica Reverse a logica Direct.
INSERZIONE = C36 passa da -100 a +100
DIFFERENZIALE/LOGICA = C37 passa da +100 a -100
(DIPENDENZA e TIPO DI USCITA invariati).

OUT2: già uscita di allarme, restano invariati i parametri. I parametri P25, P26, P27 e P28 completeranno la programmazione di allarme temperatura.

In figura 44 è rappresentata la logica ottenuta.

Example no. 15:

Control of a single-compressor cold storage room with one alarm output.

Solution 1: *use a two-output controller and set Mode 5 so that OUT2 will manage the alarm and OUT1 the REVER - SE mode. To meet the above application requirement, all you have to do is modify the control logic of OUT1.*

Starting Mode: *C0=5; confirm the variation by exiting the programming field, then enter again (password 77) and set C33=1.*

OUT1: *ON/OFF output, from Reverse to Direct mode ENERGIZATION = C36 changes from -100 to +100 DIFFERENTIAL/LOGIC = C37 changes from +100 to -100 (Dependence and Differential/Logic unchanged)*

OUT2: *used as alarm output (parameters remain unchan - ged). P25, P26, P27 and P28 allow you to complete the programming step by setting the temperature alarms.*

The graph below (fig. 44) shows the new control logic:

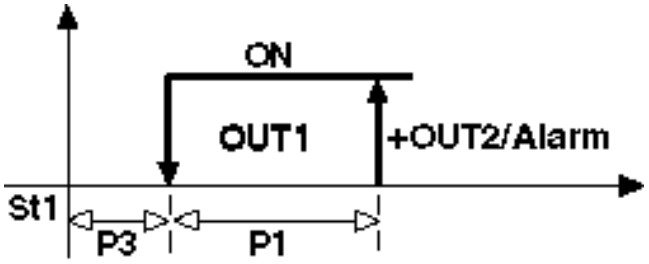


Fig.44

Soluzione 2: questa applicazione può essere sviluppata dal modo di partenza, ovvero da C0=2, disinteressando così il Differenziale di zona NEUTRA P3. Di seguito elenchiamo la lista dei parametri speciali che si vanno a modificare, partendo senza alterare C0=2, entrando direttamente con Password 77 su C33=1: C36=+100, C37=-100 e C38=3 (inalterati gli altri). P25, P26, P27 e P28 completano la programmazione delle uscite di allarme. Il disegno della figura 45 mostra la logica che si ottiene con questa soluzione:

Solution 2: *set C0=2 so that the Differential of NEUTRAL zone P3 will not be considered. Special parameters to be modified when C0=2 (use password 77). C33=1: C36=+100, C37=-100, C38=3 (the other parameters remain unchanged). P25, P26, P27 and P28 allow you to complete the programming step by setting the temperature alarms. The graph below (fig. 45) shows this control logic:*

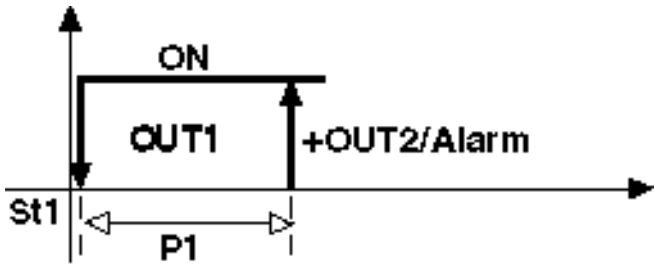


Fig.45

Esempio 16
Un'unità di condizionamento ha una resistenza per riscaldare e 3 compressori per raffreddare. Uno dei 3 compressori ha potenza doppia rispetto agli altri due. Inoltre si richiede di gestire la resistenza con logica PWM.

Soluzione: si utilizzerà un controllo a 4 uscite, OUT1 per comandare la resistenza con funzionamento PWM, OUT2 per comandare il compressore maggiore e per il quale si vuole un'isteresi doppia rispetto agli altri due. OUT3 e OUT4 pilotano gli altri due compressori.

Modo di partenza: si può partire dal modo standard C0=2 con P.W.77 modificare C33=1. Vediamo come strutturare i parametri affinché resistenza e compressori siano dipendenti da due set point e differenziali distinti.

OUT1:
uscita ON/OFF per comando della resistenza in PWM
DIPENDENZA=C34=1 resta invariato,
TIPO DI USCITA=C35=1, INSERZIONE=C36=-100
DIFFERENZIALE/LOGICA=C37=+100

OUT2:
uscita ON/OFF per comando del compressore maggiore
DIPENDENZA=C38 passa da 1 a 2 (l'uscita si riferisce ora a St2)
TIPO DI USCITA=C39=0 resta invariata,
INSERZIONE=C40=+50, DIFFERENZIALE/LOGICA=C41=-50

OUT3:
uscita ON/OFF per comando del secondo compressore
DIPENDENZA=C42=2, TIPO DI USCITA=C43=0, INSERZIONE=C44=+75, DIFFERENZIALE/LOGICA=C45=-25

OUT4:
uscita ON/OFF per comando del terzo compressore
DIPENDENZA=C46=2, TIPO DI USCITA=C47=0, INSERZIONE=C48=+100, DIFFERENZIALE/LOGICA=C49=-25

Il grafico rappresenta la logica di funzionamento selezionata. L'azione del riscaldamento è in funzione di St1, P1 e C12. La gestione dei compressori dipende da St2 e P2.

Example no. 16
Control of an air-conditioning unit equipped with one heater and 3 compressors. The capacity of one of the compressors is twice the capacity of the other two. PWM logic is required to control the heater.

Solution: *use a 4-output controller. OUT1 will control the heater in PWM, OUT2 the main compressor whose hysteresis has to be twice the size of the other two. OUT3 and OUT4 will control the other two compressors.*

Starting Mode: *standard C0=2 (password 77). Then set C33=1. Set the other parameters so that heater and compressors will depend on two different set-points and differentials.*

OUT1:
ON/OFF output to control the heater with PWM logic
DEPENDENCE=C34=1 unchanged
TYPE OF OUTPUT C35=1, ENERGIZATION C36=-100
DIFFERENTIAL/LOGIC C37=+100

OUT2:
ON/OFF output to actuate the main compressor
DEPENDENCE=C38 changes from 1 to 2
(as the output must refer to St2)
TYPE OF OUTPUT=C39=0 unchanged
ENERGIZATION=C40=+50
DIFFERENTIAL/LOGIC=C41=-50

OUT3:
ON/OFF output to actuate the second compressor
DEPENDENCE=C42=2 TYPE OF OUTPUT=C43=0
ENERGIZATION=C44=+75 DIFFERENTIAL/LOGIC=C45=-25

OUT4:
ON/OFF output to actuate the third compressor
DEPENDENCE=C46=2 TYPE OF OUTPUT=C47=0
ENERGIZATION=C48=+100 DIFFERENTIAL/LOGIC=C49=-25

The graph shows the control logic described above. Heating depends on St1, P1 and C12. Cooling depends on St2 and P2.

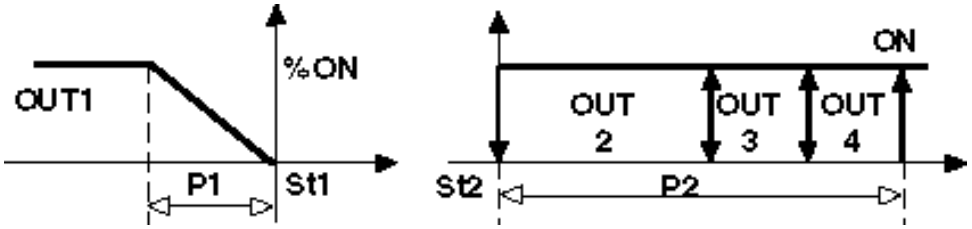


Fig.46

Esempio 17:
Si vuole comandare un condizionatore; il comando del compressore e della resistenza devono fare riferimento ad un set diurno ed ad un set notturno tramite un timer esterno. Questo esempio potrebbe essere valido anche per il controllo di una cella climatica.

Soluzione: si può fare riferimento ad uno strumento IR a due uscite. La programmazione avrà come Modo base C0=7 (o C0=8). Quindi modificato C0=7 si salveranno i nuovi parametri speciali e funzioni caratteristiche, uscendo con PRG successivamente. Con P.W.77 si andrà a modificare C33=1: fissando ad esempio OUT1 per la gestione della resistenza e OUT2 per il compressore.

Questa è la configurazione:

OUT1:
DIPENDENZA=C34=1, TIPO DI USCITA=C35=0 (ON/OFF) o 1 (PWM)
INSERZIONE=C36=-100,
DIFFERENZIALE/LOGICA=C37=+100

OUT2:
DIPENDENZA=C38=1,
TIPO DI USCITA=C39=0,
INSERZIONE=C40=100,
DIFFERENZIALE/LOGICA=C41=-100

St1-P1 caratterizzano il funzionamento con contatto esterno aperto, mentre St2-P2 con contatto chiuso secondo i diagrammi sotto esposti:

Example no. 17:
Control of an air-conditioner. Compressor and heater will work according to different set-points (one for daytime, the other for the night) on the basis of an external timer.

Solution: *you can use a two-output IR controller. Set C0=7 (or C0=8) and modify the special parameters; then exit pressing PRG. Use password 77 to set C33=1 so as to use OUT1 for the heater and OUT2 for the compressor.*

The configuration is as follows:

OUT1:
DEPENDENCE=C34=1, TYPE OF OUTPUT=C35=0 (ON/OFF) or 1 (PWM)
ENERGIZATION=C36=-100,
DIFFERENTIAL/LOGIC=C37=+100

OUT2:
DEPENDENCE=C38=1,
TYPE OF OUTPUT=C39=0,
ENERGIZATION=C40=100,
DIFFERENTIAL/LOGIC=C41=-100

St1-P1 determines an external open contact operating mode; St2-P2 determines an external closed contact operating mode:

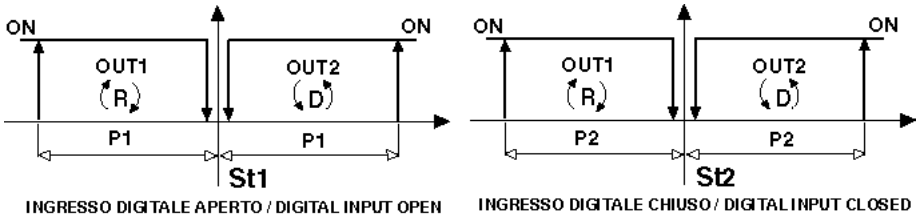


Fig.47

Nota: qualora si voglia introdurre una zona neutra tra l'azione di OUT1 e OUT2 con eventualmente differenziali diversi basterà ridurre il valore assoluto di DIFFERENZIALE/ LOGICA di una o entrambe le uscite eventualmente modificando il punto di attacco tramite INSERZIONE. Vediamo ad esempio come varia lo schema di regolazione con C37=+50 e C41=-50 (non si può sfruttare P3 in quanto il Modo 7 di partenza non lo gestisce).

Important: *if you need to introduce a neutral zone between OUT1 and OUT2 and different differentials, just decrease the absolute value of DIFFERENTIAL/LOGIC of one or both the outputs. If necessary modify the energization point through ENERGIZATION.*
Let's see how the control action varies when C37=+50 and C41=-50 (P3 can not be used with Mode 7).

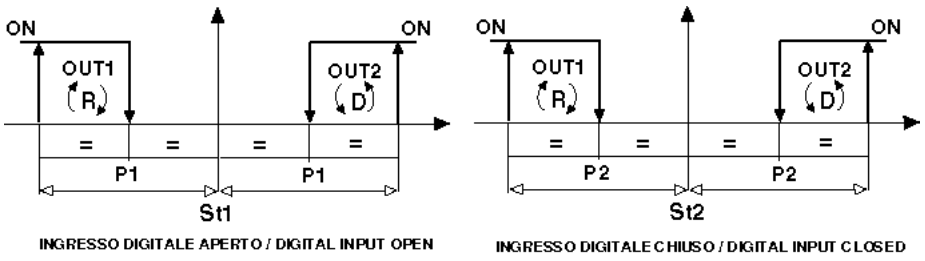


Fig.48

9. Lista completa dei parametri / *9. Advanced set-up: list of the parameters*

Si riporta di seguito la lista completa di tutti i parametri disponibili sulla serie Infrared (tipo P e C). Per accedere alla lista completa dei parametri seguire la procedura indicata a pag. ***, utilizzando come password il numero '77'.
Per la visualizzazione del valore dei parametri e la sua eventuale modifica seguire le modalità già viste sempre a pag. ***.
*The table below lists all the standard parameters of the Infrared controllers (P and C models). To enter the parameter field follow the instructions on page *** and use password 77. To display the value given to each parameter and modify it, see the indications on page ***.*

Par.	Descrizione */ Description*	Min.	Max	Default
St1	Set Point 1	min. sonda *min.sensor*	max sonda *max.sensor*	20
St2	Set Point 2 (Modi Funz. / *Modes* 6,7,8,9)	min. sonda *min.sensor*	max sonda *max.sensor*	40
C0	Modo di Funzionamento / *Mode of operation*	1	9	2
	Selezione dei Differenziali / *Setting Differentials*			
P1	Differenziale Set Point 1 (valore assoluto) / *Diff. of Set Point 1 (absolute value)*	0.1	99.9	2.0
P2	Differenziale Set Point 2 / *Diff. of Set Point 2*	0.1	99.9	2.0
P3	Differenziale zona Neutra (Modi 3,4,5) (valore assoluto) *Dead-zone Diff. (Modes 3,4,5) (absolute value)*	0	99.9	2.0
C4	Autorità. Attiva solo nei modelli NTC, con Modo 1 o 2 e C19=2, 3 o 4 *Authority. NTC models only with Mode 1 or 2 and C19=2, 3 or 4*	-2.0	2.0	0.5
C5	Tipo di regolazione: 0=Proporzionale, 1= P+I *Control action: 0=Proportional (P) 1=Prop+Integral (P+I)*	0	1	0
	Parametri relativi alle uscite / *Outputs*			
C6	Ritardo tra gli inserimenti di 2 relè diversi *Delay between energizations of 2 different relays*	0	999"	5"
C7	Tempo minimo tra le accensioni dello stesso relè *Minimum time between energizations of the same relay*	0	15'	0
C8	Tempo minimo di spegnimento dello stesso relè *Minimum off time of the same relay*	0	15'	0
C9	Tempo minimo di accensione dello stesso relè *Minimum on time of the same relay*	0	15'	0
C10	Stato relè di regolazione in caso di allarme sonda: *Status of the outputs in the event of sensor alarm:* 0 = tutti i relè spenti / *all relays* 1 = tutti i relè accesi / *all relays energised* 2 = accesi i relè in Direct, spenti gli altri / *relays in Direct mode energised, disenergized the others* 3 = accesi i relè in Reverse, spenti gli altri / *relays in Reverse energised, disenergized the others*	0	3	0
C11	Rotazione uscite (solo Modi 1, 2, 6, 7 e 8) / *Output rotation: (Modes 1,2,6,7,8 only)* 0 = rotazione non attiva / *no rotation* 1 = rotazione standard / *standard rotation* 2 = rotazione/*rotation* 2+2 (compressori su relè 1 e 3)/*(compr. on relays 1 & 3)* 3 = rotazione/*rotation* 2+2 **... e solo per modelli a 4 uscite (Z e A) / *output models only (A and Z)*** 4 = routano uscite 3 e 4, non routano 1 e 2 / *rotation of outputs 3 and 4 (no rotation for 1 and 2)* 5 = ruotano uscite 1 e 2, non ruotano 3 e 4 / *rotation of outputs 1 and 2 (no rotation for 3 and 4)* 6 = ruotano separatamente le coppie 1–2 (tra loro) e 3–4 / *separate rotation of coupled outputs: 1-2 and 3-4* 7= ruotano le uscite 2, 3 e 4, non ruota l'uscita 1 / *rotation of outputs 2,3,4 (no rotation for out 1)*	0	7	0
C12	Tempo di ciclo funzionamento PWM (s) / *time of PWM cycle (s)*	0.2"	999"	20"
	Parametri sonda / *Sensor*			
C13	Tipo sonda / *Sensor type:* 0=4-20, 1=0-20; / *0=4-20, 1=0-20;* 0=Tc K, 1=tc J; / *0=K T/c, 1= J T/c* NTC: se C13=1 viene visualizzato NTC2 con regolazione sempre su NTC1 *NTC: if C13=1 the instrument displays NTC2 but the control action depends on NTC1*	0	1	0
P14	Calibrazione sonda o offset / *Sensor calibrat. or offset*	-99	+99.9	0.0
C15	Valore minimo per ingresso I e V / *Min.value for inputs I andV*	-99	C16	0.0
C16	Valore massimo per ingresso I e V / *Max.value for inputs I andV*	C15	999	100
C17	Filtro sonda antidisturbi / *Sensor filter (noise filter)*	1	14	5
C18	Selezione unità temperatura: 0=°C, 1=°F / *Temperature units: 0=°C, 1=°F*	0	1	0
C19	Funzion. 2° sonda: solo vers. NTC, Modo 1 o 2 / *2nd sensor: NTC only, Mode 1 or 2* 0 = nessuna modifica al funz. Standard / *no modification of the Standard Mode* 1 = funzionamento differenziale (NTC1 - NTC2) / *differential mode (NTC1 - NTC2)* 2 = compensazione estiva / *summer offset* 3 = compensazione invernale / *winter offset* 4 = compensazione sempre attiva con zona morta P2 / *active offset with Dead-zone P2*	0	4	0

Parametri set				
C21	Valore minimo set-point 1 / *Minim. Set-point 1 limit*	-99	C22	min. sonda *min. sensor*
C22	Valore max set-point 1 / *Maxim. Set-point 1 limit*	C21	999	max sonda *max sensor*
C23	Valore minimo set-point 2 / *Minim. Set-point 1 limit*	-99	C24	min. sonda *min. sensor*
C24	Valore max set-point 2 / *Maxim. Set-point 1 limit*	C23	999	max sonda *max sensor*
Parametri di allarme / *Alarms*				
P25	Set allar. di "Bassa" / *Low temp. alarm set-point*	-99	P26	min. sonda min. sensor
P26	Set allar. di "Alta" / *High temp. alarm set-point*	P25	999	max sonda max sensor
P27	Differenziale allarme (valore assoluto) / *Alarm differential (absolute value)*	-99.0	99.0	2.0
P28	Tempo ritar. attuaz. allarme (min.) / *Alarm Delay (min.)*	0	120'	60'
C29	Ingresso digit.1 (valido se C0 è diverso da 6, 7 e 8) *of dig. input 1(C0 different from 6,7,8)* In caso di allarme, lo stato dei relè dipende da C31 *In the event of alarm the status of relays depends on C31* 0 = ingresso non attivo / *idle input* 1 = allarme est. immediato, Reset automatico / *immediate external alarm with automatic Reset* 2 = allarme est. immediato, Reset manuale / *immediate external alarm with manual Reset* 3 = allarme est. con ritardo (P28), Reset manuale / *external delayed alarm (P28) with manual Reset* 4 = ON/OFF regolazione in relazione stato ingresso digitale / *on/off depending on the status of the Digital input*	0	4	0
C30	Gestione ingresso digitale 2 (solo IRDR) / *Digital Input 2 (IRDR only)* Per i significati vedi C29 / *See C29*	0	4	0
C31	Stato uscite in caso di allarme da ingresso digitale *Outputs status in the event of alarm condition detected via digital input* 0 = tutte le uscite OFF / *all outputs OFF* 1 = tutte le uscite ON / *all outputs ON* 2 = OFF le uscite con funzion. Reverse, inalteratre le altre / *outputs in Reverse OFF, unchanged the others* 3 = OFF le uscite con funzionamento Direct, inalteratre le altre / *outputs in Direct OFF, unchanged the others*	0	3	0
Altre predisposizioni / *Others*				
C32	Indirizzo per connessione seriale / *Address of unit for serial connection*	1	16	1
Parametri funzionamento "speciale" / *Special parameters*				
C33	funzionamento speciale 0=no, 1=sì / s*pecial Mode of Operation: 0=no, 1=yes* Prima della modifica accertarsi di aver selezionato e programmato il Modo di partenza (C) desiderato *Before modifying C33 be sure you have set and programmed the Starting Mode C0*	0	1	0
C34	OUT1: DIPENDENZA / *DEPENDENCE*	0	15	– (*)
C35	OUT1: TIPO DI USCITA / *TYPE OF OUTPUT*	0	1	– (*)
C36	OUT1: INSERZIONE / *ENERGIZATION*	-100	+100	– (*)
C37	OUT1: DIFFER./LOGICA / *DIFFERENTIAL/LOGIC*	-100	+100	– (*)
C38	OUT2: DIPENDENZA / *DEPENDENCE*	0	15	– (*)
C39	OUT2: TIPO DI USCITA / *TYPE OF OUTPUT*	0	1	– (*)
C40	OUT2: INSERZIONE / *ENERGIZATION*	-100	+100	– (*)
C41	OUT2: DIFFER./LOGICA / *DIFFERENTIAL/LOGIC*	-100	+100	– (*)
C42	OUT3: DIPENDENZA / *DEPENDENCE*	0	15	– (*)
C43	OUT3: TIPO DI USCITA / *TYPE OF OUTPUT*	0	1	– (*)
C44	OUT3: INSERZIONE / *ENERGIZATION*	-100	+100	– (*)
C45	OUT3: DIFFER./LOGICA / *DIFFERENTIAL/LOGIC*	-100	+100	– (*)
C46	OUT4: DIPENDENZA / *DEPENDENCE*	0	15	– (*)
C47	OUT4: TIPO DI USCITA / *TYPE OF OUTPUT*	0	1	– (*)
C48	OUT4: INSERZIONE / *ENERGIZATION*	-100	+100	– (*)
C49	OUT4: DIFFER./LOGICA / *DIFFERENTIAL/LOGIC*	-100	+100	– (*)
(*) dipendono dal modello e dal modo di partenza / *(*) depends on the model and starting mode*				
Predisposizioni per abilitazione telecomando/tastiera / *Use via remote control/keypad*				
C50	abilitazione tastiera/*activation of keypad* (TS) e telecomando/*and Remote Control* (TC) 0 =TS Off, TC On (solo parametri di Tipo P) / *TS off, TC on (only type P parameters)* 1=TS On, TC On (solo parametri di Tipo P) / *TS on, TC on (only type P parameters)* 2 = TS Off, TC Off / *TS off, TC off* 3 = TS On, TC Off / *TS off, TC off* 4 = TS On, TC On (tutti i parametri) / *TS on, TC on (all param.s)*	0	4	4
C51	Codice per l'abilitazione del telecomando / *Code to activate the remote control* 0 = Password inserita / *password entered*	0	120	0

10. Ricerca e eliminazione dei guasti (strumento e telecomando)

–**problema:**
la tastiera e/o il telecomando non accendono/modificano i parametri;
verifica:
• si veda parametro C50 (da tastiera)

–**problema:**
la misura oscilla continuamente;
verifica:
• la misura può essere influenzata da disturbi elettromagnetici; verificare cavo sonda: deve essere schermato (con schermo collegato a terra). A volte può essere utile collegare la calza (solo) al riferimento interno dello strumento, indicato con "Com.". La calza non deve mai essere collegata a terra ad entrambi gli estremi.
• il parametro C17 (filtro sonda) ha valori troppo bassi.
• controllare che nella stessa canalina non vi siano i cavi sonda e i cavi di potenza

– **problema:**
gli allarmi di "Alta" e/o "Bassa" non sono segnalati;
verifica:
• è in atto un ritardo d'allarme o vi è una non corretta impos.
• vedere parametri P25, P26, P27 e P28.

– **problema:**
le uscite non vengono attivate;
verifica:
• le tempistiche di protezione delle uscite, parametri C6, C7, C8
• verificare i set point e relativi differenziali

–**problema:**
le uscite vengono attivate troppo frequentemente;
verifica:
• il differenziale è troppo stretto.
• Aumentarlo e/o modificare le tempistiche di protezione sulle uscite, parametri C6, C7 e C8

– **problema:**
la misura non raggiunge mai il valore di set-point;
verifica:
• escludendo problemi di dimension. dell'impianto, il differenziale, P1 o P2, è troppo largo o la zona neutra P3 è eccessiva.

– **problema:**
la misura visualizzata a display non corrisponde al valore reale;
verifica:
• può essere un problema di installazione del sensore o di set-up sonda. Nelle versioni con ingresso in corrente, in tensione o J/K, Tc, si veda il paragrafo 6.6, pag.*** "parametri "C" per termocoppie, ..". È possibile una correzione del valore tramite il param. P14.

–**problema:**
le uscite di allarme non si attivano pur essendo segnalato un allarme di temperatura;
verifica:
• non sono state predisposte correttamente le uscite di allarme.
• verificare Modo (C0) e nel funzionamento speciale il relativo parametro DIPENDENZA.

–**problema:**
il telecomando non funziona
verifica:
• controllare che ci siano le batterie e che siano inserite correttamente, o che non siano scariche;
• non vi devono essere ostacoli tra il telecom. e il controllo;
• il trasmettitore posto sul telecom. e il ricevitore posto sul controllo non devono essere sporchi;
• a distanza tra telecomando e controllo non deve essere superiore ai 3 metri.
• parametro C50

10. Troubleshooting - Reset of controller and remote control

–***problem:***
keypad/remote control unit does not work/does not modify any parameter.
check
• parameter C50 (via keypad)

–***problem:***
value changes repeatedly.
check
• possible electromagnetic noise; check the sensor cable (use shielded cables. Sometimes it can be useful to connect the braiding to the internal reference of the instrument (indicated by "Com"). The braiding must never be earthed at both ends.
• modify parameter C17 (increase its value).
• check that sensor cables and power cables are NOT in the same duct.

– ***problem:***
high/low alarms are not detected.
check
• alarm delay in progress or wrong time-delay selection.
• check parameters P25, P26, P27, P28.

– ***problem:***
outputs do not energize.
check
• time delays of the outputs; par. C6, C7, C8.
• set-points and their differentials.

– ***problem:***
outputs energize too frequently.
check
• increase the value of the differential and/or modify time delays (parameters C6, C7, C8)

– ***problem:***
the variable never reaches the set-point.
check
• the differential P1 or P2 should be decreased as well as the dead-zone P3.

– ***problem:***
the value displayed does not correspond to the actual value.
check
*• the position of the sensor. For models with current, voltage or J/K Tc input see paragraph 6.6 on page *** (Parameters "C" for Thermocouples).*
Use P14 to correct the measured value.

– ***problem:***
alarm outputs do not energize even if the off-normal condition has been regularly detected.
check
• alarm outputs have not been appropriately set.
• the Mode (C0) and, in the special mode of operation, the dedicated parameter "Dependence".

– ***problem:***
the remote control does not work.
check
• that batteries are correctly aligned and not run-down.
• be sure there are no obstacles between controller and remote control unit.
• be sure there is no dust or dirt on the transmitter of the remote control and on the receiver of the controller.
• The distance between controller and remote control unit should not exceed 3 meters.
• check C50.

11. Condizioni di allarme, cause e rimedi / *11. Alarm conditions, causes and remedies*

Messag. ***Message***	**Descrizione** ***Description***	**Causa** ***Cause***	**Effetti sulla regolazione** ***Consequences on control action***	**Reset** ***Reset***	**Verifiche/Rimedi** ***Remedies***
Er0	errore sonda *sensor error*	sonda guasta *faulty sensor*	dipende dal parametro C10 *depends on C10*	R: automatico V: manuale *R: automatic* *V: manual*	verifica dei collegamenti verifica del segnale sonda (es.: NTC=10kΩ 25°C *check connections* *check sensor signal (eg.: NTC=10k 25°C)*
Er1	errore sonda NTC2 *sensor NTC2 error*	come Er0 *like Er0*	se C19=1 e modo 1, 2 come er0, altrimenti non blocca la regolazione *if C19=1 and mode 1, 2 see Er0, viceversa control action goes on normally*	come Er0 *like Er0*	come Er0 *like Er0*
Er2	errore memoria *memory error*	caduta di tensione durante la program. memoria danneggiata da interferenze elettromagnetiche *voltage drop during programming stage memory damaged by electromagnetic interferences*	blocco totale *stoppage*	R: automatico V: manuale *R: automatic* *V: manual*	ripristinare i valori di fabbrica spegnere lo strumento e accenderlo con 'PRG' premuto; se persiste, sostituire lo strumento *reset factory-set values, turn off the controller, turn it on again holdin down PRG;*
Er3	allarme da contatto esterno su ingresso digitale *alarm via external contact on digital input*	è aperto il contatto collegato all'ingresso digitale *the contact linked to the digital input is open*	in base al parametro C31 *depending on C31*	R: dipende da C29 e C30 V: manuale *R: depends on C29 and C30* *V: manual*	verifica parametri C29, C30 C31 e P28 verificare il comando del contatto esterno *check C29, C30, C31 and P28; check the external contact Er4*
Er4	allarme di ALTA *HIGH temperature alarm*	l'ingresso ha superato P26 per un tempo>P28 *P26 has been exceeded for a time-interval > P28 unchanged*	nessun effetto *control action goes on regularly*	R:automatico V:automatico (*) *R: automatic* *V: manual*	verifica dei parametri P26, P27 e P28 *check P26, P27, P28*
Er5	allarme di BASSA *LOW temperature alarm*	l'ingresso è sceso sotto P25 per un tempo>P28 *P25 has been below P28 for a time-interval > P28 unchanged*	nessun effetto *control action goes on regularly*	R:automatico V: automatico (*) *R: automatic* *V: automatic (*)*	verifica dei parametri P26, P27 e P28 *check P26, P27, P28*

R = Regolazione / *R = Control action*
Il Reset regolazione è inteso come il ripristino delle condizioni di normale funzionamento della regolazione una volta cessata la condizione di allarme.
Resetting the instrument means to restore normal operating conditions after the cause that determined the alarm has disappeared.
V = Visualizzazione / *V = Display*
Il display e buzzer. Il reset visualizzazione è inteso come il ripristino della visualizzazione normale
Display reset means that normal display of usual values is restored.

(*) = per ottenere il Reset di allarme di tipo manuale, è sufficiente impostare il differenziale di allarme (P27) ampio
(*) = To get a manual alarm reset, just give P27 (alarm differential) a high value.

12. Moduli opzionali

Per le versioni IR32 con uscite a 10 VAc per relè a stato solido (SSR), leggi IR32A/D o IRDRA, vi è la possibilità di ottenere uscite di tipo ON/OFF e/o analogiche/modulanti. Questo è possibile con l'abbinamento degli appositi moduli dedicati. È previsto un ulteriore modulo convertitore alimentatore per tutti i modelli con ingresso in tensione ed in corrente.

12.1 Modulo uscita analogica – cod. CONV0/10A0

Questo modulo converte un segnale PWM 0/10 Vdc per relè a stato solido in un segnale analogico lineare 0/10 Vdc e 4/20 mA. L'abbinamento quindi è possibile ai soli strumenti IR32D, IR32A e IRDRA.

Programmazione: per ottenere il segnale modulante in uscita si sfrutta la regolazione fornita durante il funzionamento PWM (vedere C12 a pag. 25). Il segnale ad impulsi PWM, viene esattamente riprodotto come segnale analogico: la percentuale di ON, corrisponderà alla percentuale del massimo segnale in uscita previsto. Il modulo opzionale CONV0/10A0 effettua una operazione di integrazione sul segnale fornito dal regolatore: è necessario ridurre il tempo di ciclo (C12) al valore minimo impostabile, ovvero **C12=0,2 s**.
L' utilizzo del tempo minimo impostabile limita l'uso delle uscite adibite per i relè a stato solido assieme a uscite modulanti. Risulta comunque sempre valido l'abbinamento di una o più uscite analogiche (o per relè a stato solido) con uscite di tipo ON/OFF tradizionale a relè. Per quel che concerne la logica di regolazione (Direct=freddo, Reverse=caldo), valgono le stesse considerazioni viste per il funzionamento PWM (vedere Modo 4): la logica dell'attivazione in PWM è riprodotta fedelmente come segnale analogico. Se invece si necessita di una configurazione personalizzata, fare riferimento ai paragrafi relativi alla configurazione speciale (parametri TIPO DI USCITA, INSERZIONE, DIFFERENZIALE/LOGICA ai paragrafi 8.3, 8.4, 8.5 pp. 44/46).

Connessioni elettriche: per le connessioni fare riferimento al disegno sottostante e alle relative descrizioni. Il segnale di comando ai morsetti 3 e 4 è optoisolato. Questo permette che l'alimentazione G,G0 (24 Vac) possa essere in comune all'alimentazione dell'IR.

12. Optional modules

For IR32 versions with 10Vac outputs for solid state relay (SSR), (IR32A/D or IRDRA), it is possible to obtain ON/OFF and/or analogue/modulating outputs combining specific dedicated modules. There is a power supply con - verter module specifically designed for all models equip - ped with current and voltage input.

12.1 Analogue output module - code CONV0/10A0

This module converts a PWM 0/10Vdc signal for solid state relay (SSR) into an analogue linear signal 0/10Vdc and 4/20mA. It is possible to combine this module with the IR32D, IR32A, IRDRA.

***Programming procedure:** to get a modulating output signal use PWM operating logic (see C12 on page 25). The PWM signal is reproduced exactly as an analogue signal. The CONV0/10A0 optional module integrates the signal provided by the controller: it is necessary to reduce the cycle time (C12) to its min. value (**C12=0.2 s**.).
Using the minimum selectable time for C12 limits the use of the outputs corresponding to the solid state relays and that of the modulating outputs. It is always possible, however, to combine one or more analogue outputs (or for solid state relays) with ON/OFF relay outputs.
As for the control logic (Direct=Cooling, Reverse=Heating) follow the same indications given for PWM (see Mode 4). Should you need a tailor-made configuration, see TYPE OF OUTPUT, ENERGIZATION, DIFFERENTIAL/LOGIC on pages 44/46.*

***Electrical connections:** see diagram and instructions listed below. The command signal to terminals 3 and 4 is optoisolated. Therefore power source G, G0 (24 Vac) can be shared with the IR.*

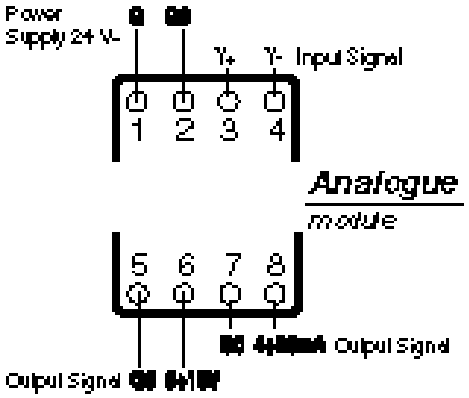


Fig.49

Descrizione della morsettiera
1 (G) = alimentazione 24 V~
2 (G0) = riferimento 24 V~ alimentazione e del sistema
3 (Y+) = "+" segnale di comando dall'IR
4 (Y-) = "-" segnale di comando dall'IR
5,7 (G0) = riferimento uscite analogiche
6 (0/10 V) = uscita (+ o Y) modulante 0/10 V
8 (4/20 mA) = uscita (+ o Y) modulante 4/20 mA

Terminal block:
1 (G) = power supply 24V~
2 (G0) = reference 24V~ power supply
3 (Y+) = "+" command signal from IR
4 (Y-) = "-" ommand signal from IR
5,7 (G0) = analogue outputs reference
6 (0/10V) = modulating output 0/10V (+ or Y)
8 (4/20mA) = modulating output 4/20mA (+ or Y)

Caratteristiche tecniche

Alimentazione
tensione: 24 V~ ±10% 50/60 Hz
assorbimento massimo: 50 mA

Ingresso PWM
impedenza d'ingresso: 200 Ω
minima corrente di ingresso: 10 mA
massima corrente d'ingresso: 20 mA
periodo max segnale PWM di comando: 0,2 s
periodo minimo segnale PWM di comando: 8 ms

Uscita in tensione
standard elettrico: 0/10 Vdc
tempo di risalita tipico (10% - 90%): 1,2 s
ripple massimo d'uscita: 100 mV
corrente massima d'uscita: 5 mA
valore uscita a 10 V nominali: 10/10,45 Vdc
valore uscita a 0 V nominali: 0/0,2 Vdc
sovraelongazione a 10 V: 0,15 Vdc

Uscita in corrente
standard elettrico: 4/20 mA
tempo di risalita tipico (10% - 90%): 1,2 s
ripple massimo d'uscita:350 µA
tensione massima di uscita: 7 Vdc
massima impedenza di carico: 280 Ω
valore uscita a 20 mA nominali: 20/20,8 mA
valore uscita a 4 mA nominali: 3,5/4 mA
sovraelongazione: 0,3 mA

Caratteristiche meccaniche
protezione: IP20
dimensioni: 87x36x60 mm (2 moduli DIN)
montaggio: a guida DIN
sezione minima cavi di collegamento: 0,75 mm^2
sezione massima cavi di collegamento: 2,5 mm^2
distanza massima collegamenti agli ingressi: 3 m
distanza massima collegamenti alle uscite: 50 m
temperatura e umidità di immagazzinamento:
-10T70 °C/90% U.R.
temperatura e umidità di esercizio: 0T50 °C / 90% U.R.
limiti di temperatura delle superfici:
come temp. di esercizio
inquinamento ambientale: normale

Nota per il collegamento agli attuatori: qualora gli attuattori siano anch'essi alimentati a 24Vac, è preferibile che l'alimentazione attuatore e modulo sia la medesima. Il riferimento G0 deve corrispondere tra Modulo e Attuatore, eventualmente può essere collegato a terra.

Technical characteristics

Power supply
voltage: 24V~ ±10%, 50/60Hz
maximum absorption: 50mA

PWM input
input impedence: 200 Ω
minimum input voltage: 10mA
maximum input voltage: 20mA
maximum time for PWM signal: 0.2s
minimum time for PWM signal: 8ms

Voltage output
electrical standard: 0/10Vdc
typical response time (10% - 90%): 1.2s
maximum output ripple: 100mV
maximum output voltage: 5mA
rated output value at 10V: 10/10.45Vdc
rated output value at 0V: 0/0, 2Vdc
overshoot at 10V: 0.15Vdc

Current output
electrical standard: 4/20mA
typical response time (10% - 90%): 1.2s
maximum output ripple: 350µA
maximum output voltage: 7V
max. load impedence: 280Ω
rated output value at 20mA: 20/20.8mA
rated output value at 4 mA: 3.5/4mA
overshoot: 0.3mA

Mechanical characteristics
protection index: IP20
dimensions: 87x36x60mm (2 DIN modules)
mounting: DIN rail
min. section of connection cables: 0.75mm^2
max. section of connection cables: 2.5mm^2
max. distance for connections to inputs: 3m
max. distance for connections to outputs: 50m
storage temperature and humidity: -10T70°C / 90% rH
operating temperature and humidity: 0T50°C/90% rH
extreme surface temperature conditions: as operating temperature
environmental pollution: normal

Important: *if the actuators are powered 24Vac, it is better to use the same power source to feed both actuators and module. G0 must be between Module and Actuator, otherwise earth it.*

12.2 Modulo ON/OFF – cod. CONVONOFF0

Questo modulo permette di convertire un gradino di regolazione dal segnale di comando a 10 Vdc fornito dalle versioni per relè a stato solido in una uscita ON/OFF da relè. Risulta estremamente utile quando si intende utilizzare uno strumento IR32A o IRDRA con una o più uscite per comandare relè a stato solido (o uscite analogiche) e sia necessario utilizzare una o più uscite ON/OFF di regolazione o di allarme.

Programmazione: nella programmazione l'unica attenzione è rivolta alla tipologia dell'uscita che normalmente non è di tipo PWM, ma bensì ON/OFF (nella configurazione di queste uscite si dovrà imporre TIPO DI USCITA=0, vedere parametri speciali al paragrafo 8.3). Per quanto concerne la logica di regolazione ON/OFF, valgono le stesse considerazioni viste precedentemente per i vari Modi standard; per la configurazione particolare (Direct o Reverse), si rimanda alla descrizione della configurazione speciale (cap. 8, pag. 43) e all'esempio seguente. Per gestioni di allarme, l'uscita che pilota tale modulo dovrà essere programmata con la dipendenza appropriata (vedi Modo 5 e valore di DIPENDENZA compreso tra 3 e 14).

12.2 ON/OFF module (code CONVONOFF0)

It allows you to convert a 10Vdc signal (SSR versions) into an On/Off output via relay. This module is particularly useful when using an IR32A or IRDRA instrument with one or more outputs to control solid state relays (or analogue outputs) and one or more ON/OFF control/alarm outputs.

***Programming procedure:** as the output is an ON/OFF type (not PWM), set Type of Output=0 (see Special Parameters, paragraph 8.3). As for the ON/OFF control action, see the standard Modes of operation.*
For specific configurations (Direct or Reverse), see Special Configuration (chapter 8 on page 43).
To manage any alarm condition, set appropriate Dependence (see Mode 5 and DEPENDENCE ranging between 3 and 14).

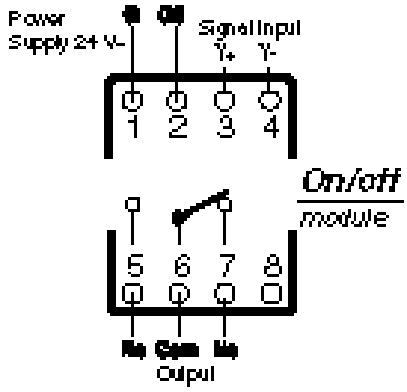


Fig.50

Descrizione della morsettiera
1 (G) = alimentazione 24 V~
2 (G0) = riferimento 24V~ alimentazione e del sistema
3 (Y1) = "+" segnale di comando
4 (Y2) = "-" segnale di comando

Relè uscita
5 (No) = contatto normalmente aperto
6 (Com) = comune
7 (Nc) = contatto normalmente chiuso
8=non connesso

Nota: il segnale di comando ai morsetti 3 e 4 è optoisolato. Questo permette che l'alimentazione G, G0 possa essere comune all' alimentazione dell' IR.

Caratteristiche tecniche

Alimentazione
tensione: 24 V~ ±10% 50/60 Hz
assorbimento: 30 mA

Ingresso di comando
impedenza d'ingresso: 200 Ω
minima corrente d'ingresso: 10 mA
massima corrente d'ingresso: 20 mA
periodo minimo medio di ripetizione del comando di attivazione/disattivazione relè (funzionamento in PWM): 30 s

Uscita a relè
massima tensione: 250 Vac
massima corrente in AC1: 10 A
massimo carico induttivo comandabile: 1/3 HP
tipo di contatto: SPDT

Terminal block
1 (G) = power supply 24V~
2 (G0) = reference 24V~ power source
3 (Y+) = "+" command signal
4 (Y-) = "-" command signal

Output relay
5 (No) = normally open contact
6 (Com) = common
7 (Nc) = normally closed contact
8 = not connected

***Note 1:** the command signal to terminals 3 and 4 is optoisolated.Therefore power source G, G0 (24Vac) can be shared with the IR.*

Technical characteristics

Power supply
voltage: 24V~ ±10%, 50/60Hz
absorption: 30mA

Command input
input impedence: 200Ω
minimum input voltage: 10mA
maximum input voltage: 20mA
min. average time before repetition of the relay energization/disenergization (PWM): 30s

Relay output
max. voltage: 250Vac
max. current in AC1: 10A
max. inductive load: 1/3HP
type of contact: SPDT

Caratteristiche meccaniche
protezione: IP20
dimensioni: 87x36x60 mm (2 moduli DIN)
montaggio: a guida DIN
sezione minima cavi di collegamento: 0,75 mm²
sezione massima cavi di collegamento: 2,5 mm²
distanza massima collegamenti agli ingressi: 3 m
temperatura e umidità di immagazzinamento:
-10T70 °C / 90% U.R.
temperatura e umidità di esercizio: 0T50 °C / 90% U.R.
inquinamento ambientale: normale
limiti di temperaturasuperfici: come temperatura di esercizio
isolamento: rinforzato
tipo di contatti: 1 c

Mechanical characteristics
protection index: IP20
dimensions: 87x36x60mm (2 DIN modules)
mounting: DIN rail
min. section of connection cables: 0.75mm²
max. section of connection cables: 2.5mm²
max. distance of connections to the intputs: 3m
storage temperature and humidity: -10T70 °C / 90%rH
operating temperature and humidity: 0T50°C / 90%rH
environmental pollution: normal
extreme surface temperature conditions: as operating temperature
insulation: reinforced
contact type: 1c

Esempio di utilizzo combinato dei moduli
Si voglia gestire la regolazione di un sistema utilizzando due set-point, uno per il controllo del riscaldamento e l'altro per il controllo del raffreddamento mediante due valvole modulanti con segnale 0/10 V. Qualora l'azione della valvola di raffreddamento non riesca a frenare l'innalzamento della temperatura, il sistema dovrà attivare un circuito frigorifero ulteriore. Si richiede, inoltre, una segnalazione di allarme generale.

Soluzione: in questo caso sarà necessario impiegare la versione per relè a stato solido a 4 uscite (versione IR32A o IRDRA); la programmazione dello strumento potrà essere eseguita utilizzando i parametri speciali partendo dal Modo preprogrammato, C0=2.

Practical examples: Using different modules
Control of a system with two set-points, one for heating, the other for cooling through 2 modulating 0/10V valves. Should the action of the valves be not sufficient to keep the temperature within the set threshold, the system will actuate a refrigerating circuit. The system should also be equipped with a general alarm signal.

Solution: *use a 4-output model (IR32A or IRDRA). Program the instrument using the special parameters; start from the factory-set C0=2.*

Proponiamo lista dei parametri di configurazione da modificare (PW77): C12=0,2 C33=1

per	OUT1:	C34=2	C35=1	C36=50	C37=-50
per	OUT2:	C38=2	C39=0	C40=100	C41=-50
per	OUT3:	C42=1	C43=1	C44=-100	C45=100
per	OUT4 :	C46=3	inalterati gli altri		

Here is the list of the configuration parameters to be modified (password 77): C12=0.2 C33=1

OUT1:	*C34=2*	*C35=1*	*C36=50*	*C37=-50*
OUT2:	*C38=2*	*C39=0*	*C40=100*	*C41=-50*
OUT3:	*C42=1*	*C43=1*	*C44=-100*	*C45=100*
OUT4:	*C46=3*	*remaining parameters unchanged*		

La logica di regolazione ottenuta è raffigurata in questo disegno.

The graph below shows the new control logic:

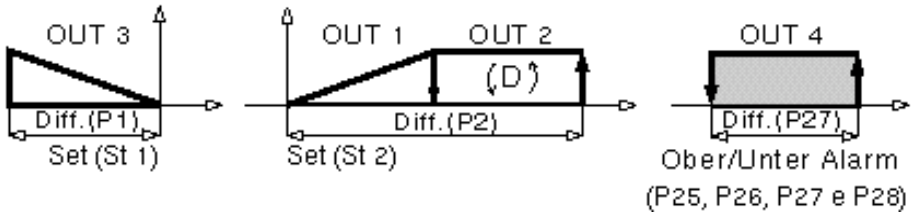


Fig.51

Per il collegamento:
ci serviamo di due moduli CONVONOFF0 per la gestione dell'uscita di allarme e del compressore, mentre due moduli CONV0/10A0 gestiranno le uscite delle due rampe analogiche.
Tutti i moduli (e l'IR) possono essere alimentati da un unico trasformatore a 24 Vac, necessitano di 24 Vac di alimentazione. Si dovrà alimentare il modulo COV0/10A0 e valvola con lo stesso trasformatore rispettando la polarità di G0. In questo caso dal traformatore il G0 di alimentazione ai moduli dovrà corrispondere il G0 alla valvola (in alcuni casi si può chiamare L2 o N). Si omette il collegamento del G0 in uscita del modulo con la valvola, in quanto è il trasformatore a collegare il riferimento del segnale analogico tramite appunto la connessione G0. Al trasformatore la connessione a terra del secondario può essere fatta al polo identificato G0.
Per il collegamento dei vari IR ai moduli basterà collegare i "+" e "-" delle uscite dell'IR ai rispettivi Y+ e Y- dei corrispondenti moduli.

Connections:
Use two modules CONVONOFF0 to manage alarm and compressor outputs. Other two CONV0/10A0 modules will manage the analogue outputs.
All modules and the IR can be powered from the same 24Vac transformer.
Power the COV0/10A0 module and the valve from the same transformer respecting the G0 polarity.
In this case the power supply G0 from transformer to modules must correspond to the G0 to the valve (sometimes indicated with L2 or N).
Earth the secondary of the transformer at point identified with G0.
To link up the various IR instuments to the modules, connect the outputs' "+" and "-" to the dedicated Y+ and Y- on the corresponding modules.

12.3 Modulo Alimentatore/Convertitore cod. CONV0/1L00

Alimentatore: il modulo fornisce in uscita (morsetti 3 e 4) una tensione di 24 Vdc (max 40 mA) galvanicamente isolata dalla tensione di ingresso (morsetti 1 e 2) di 24 Vac. Questo permette di collegare sonda e regolatore alla stessa alimentazione di 24 Vac come indicato nelle figure 53 e 54.
Convertitore: Il modulo permette di convertire un segnale modulante di tipo 0/10 Vdc (normalmente fornito da una sonda o da un'altro regolatore) nello standard 0/1 Vdc utilizzato dalla maggior parte degli strumenti Carel.

12.3 Power supply/Converter module (code CONV0/1L00)

Power supply: *this module provides a 24Vdc (max 40mA) output voltage (terminals 3 and 4) galvanically isolated from the 24Vac input voltage (terminals 1 and 2). This allows you to connect sensor and regulator to the same 24Vac power source as shown below in fig. 53 and 54.*
Converter: *this module permits to convert a modulating 0/10V signal (normally supplied by a sensor or a second controller) into the standard 0/1V commonly used by most of Carel instruments.*

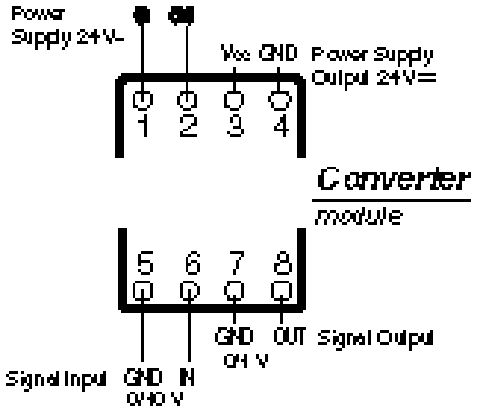


Fig.52

Descrizione della morsettiera
1 (G) = alimentazione 24 V~
2 (G0) = riferimento 24Vac alimentazione e del sistema
3 (Vcc) = positivo alimentazione moduli esterni 24 Vdc
4 (GND) = riferimento alimentazione esterna (connesso anche con 5 e 7)
5 (GND) = riferimento segnale in ingresso 0/10 Vdc
6 (IN) = ingresso segnale 0/10 Vdc
7 (GND) = riferimento segnale in ingresso 0/1 Vdc
8 (OUT) = uscita segnale 0/1 Vdc

Terminal block
1 (G) = power supply 24V~
2 (G0) = reference 24V~ power supply
3 (Vcc) = positive power supply to external modules 24Vdc
4 (GND) = external power supply reference (connected to 5 and 7)
5 (GND) = input signal reference 0/10Vdc
6 (IN) = input signal 0/10Vdc
7 (GND) = input signal reference 0/1Vdc
8 (INP) = output signal 0/1Vdc

Caratteristiche tecniche
Alimentazione
tensione: 24 V~ ±10% 50/60 Hz
assorbimento massimo: 180 mA
Uscita 24 Vdc
tensione di uscita: 24 Vdc ±20%
corrente massima di uscita: 40 mA
Ingresso in tensione
standard elettrico: 0/10 V
impedenza d'ingresso: 140 KΩ ±10%
minima tensione di ingresso: 0 V
massima tensione d'ingresso: 15 V
Uscita in tensione
standard elettrico: 0/1 V
massima corrente d'uscita: 1 mA
tempo di risalita tipico: (10% – 90%): <1 ms
errore massimo: 3,5% f.s.
valore uscita 1 V nominale: 1/1,005 V
valore uscita 0 V nominale: 0/0,009 V

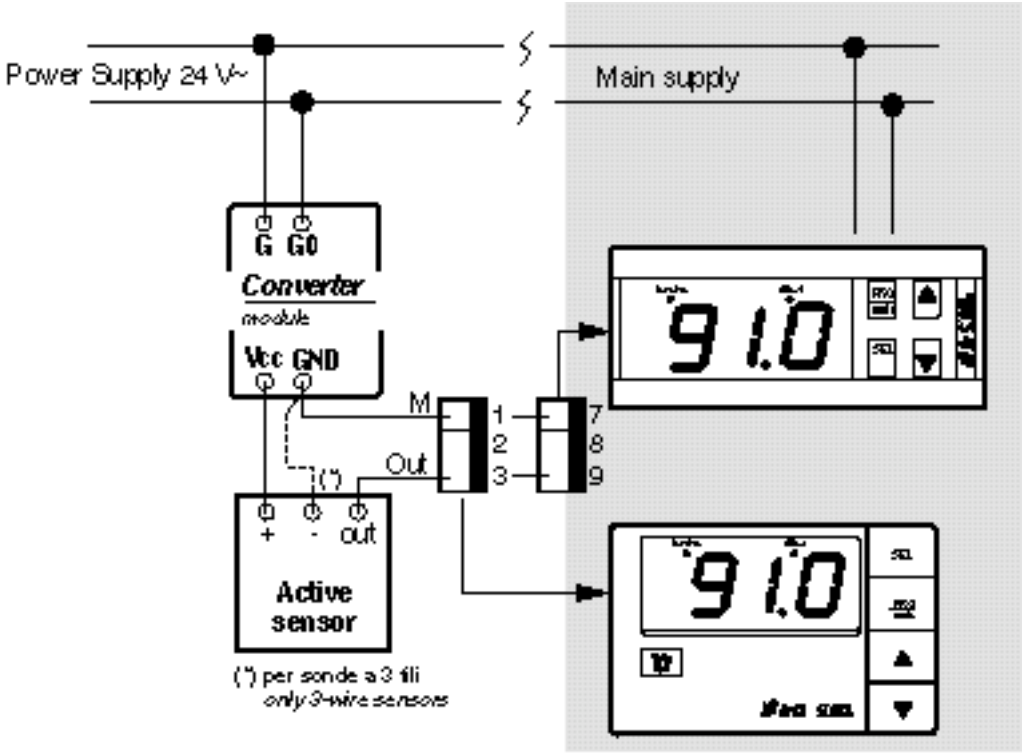
Technical characteristics
Power supply
voltage: 24V~ ±10% 50/60Hz
max. absorption: 180mA
24Vdc Output
output voltage: 24Vdc ±20%
maximum output voltage: 40mA
Voltage input
electrical standard: 0/10V
input impedence: 140KΩ ±10%
minimum input voltage: 0V
maximum input voltage: 15V
Voltage output
electrical standard: 0/1V
maximum output voltage: 1mA
typical response time: (10% - 90%): <1ms
maximum error: 3.5% full scale
rated 1V output: 1-1.005V
rated 0V output: 0/0.009V

Caratteristiche meccaniche
protezione: IP20
dimensioni: 87x36x60 mm (2 moduli DIN)
montaggio: a guida DIN
sezione minima cavi di collegamento: 0,75 mm²
sezione massima cavi di collegamento: 2,5 mm²
distanza massima collegamenti agli ingressi/uscite : 3 m
temperatura e umidità di immagaz.: -10T70 °C / 90% U.R.
temperatura e umidità di esercizio: 0T50 °C / 90% U.R.
inquinamento ambientale: normale
limiti di temperatura superfici: come la temp. di esercizio

Mechanical characteristics
protection index: IP20
dimensions: 87x36x60mm (2 DIN modules)
mounting: DIN rail
min. section of connecting cables: 0.75mm²
max. section of connecting cables: 2.5mm²
maximum distance of connections to outputs/inputs: 3m
storage temperature and humidity: -10T70 °C/90% rH
operating temperature and humidity: 0T50°C/90% rH
environmental pollution: normal
extreme surface temper. conditions: as operating temper.

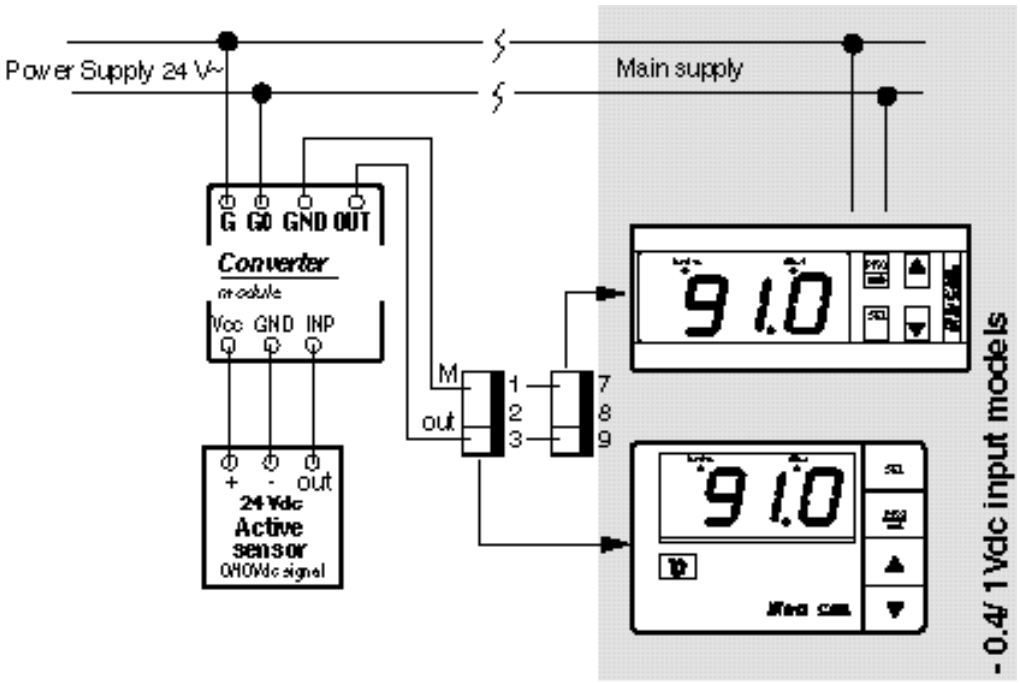
I diagrammi sottostanti rappresentano due tipici esempi del collegamento della sezione alimentatore e alimentatore/ convertitore con una sonda esterna.

The figures below show two typical connections between power supply and power supply/converter to an external sensor.



Lo schema è valido per sonde alimentabili a 24 Vdc, con segnali in tensione (IR con ingresso -0,4/1 Vdc) e in corrente (IR con ingresso 0/20–4/20 mA).
This diagram is effective for both dc voltage signal, with power supply 24Vdc (IR-0.4/1 Vdc input) and current signal (IR - 0/20–4/20mA input) sensors.

Fig.53



Lo schema è valido per sonde 0/10 Vdc, 3 fili, alimentabili a 24 Vdc.
This diagram is effective for probes 0/10Vdc, 3 wires, with power supply 24Vdc.

Fig.54

13. Caratteristiche tecniche dei modelli serie Infrared Universale

Ingressi:
a seconda del modello
temperatura: NTC, Pt100, termocoppie K/J
in corrente: 4/20 mA o 0/20 mA
in tensione: -0,4/1 Vdc

Campo di funzionamento:
NTC: -50/90 °C,
Pt100: -100/600 °C,
TcK: -100/999 °C,
TcJ: -100/800 °C
corrente e tensione: -99/999

Risoluzione:
0,1 da -9,9 a 99,9
1 nel campo restante

Precisione controllo:
± 0,5 % del fondo scala

Alimentazione:
tensione:
IR32V, D, W, Z e A: da 12 a 24 Vac-dc ±10%
IRDRV e W: 24 Vac ±10% e 220/240Vac ±10%
IRDRTE: 220/240Vac ±10%
IRDRZ e IRDRA: da 12 a 24 Vac-dc, ±10%

assorbimento:
IR32V: 2 VA
IR32W e Z: 3 VA
IRDRTE, IRDRV, IRDRW: 3 VA
IRDRZ: 4 VA

uscita alimentazione sonda:
10 Vdc, max 30mA (8 Vdc per IRDRW)

Condizioni di utilizzo:
temperatura di lavoro: 0/50 °C
temperatura immagazzinamento: -10/70 °C
umidità relativa ambientale: inferiore al 90% U.R., non condensante inquinamento ambientale: normale

Isolamenti:
Le parti in "Bassa" tensione presentano un isolamento principale rispetto alle parti in bassissima tensione. Fra le parti in bassissima tensione e il frontale esiste un isolamento supplementare. I particolari in bassissima tensione (ingresso sonde, ingresso digitale e uscite 10 Vdc per SSR - relè a stato solido, collegamento seriale e alimentazione*), non presentano alcun isolamento.
***Nota:** per l'alimentazione sono esclusi i modelli IRDRV, IRDRW e IR32*H, che presentano un isolamento principale.

Uscite:
Numero relè (a seconda del modello):
IR32 per NTC: 1, 2 o 4 relè SPDT altri IR32V: 1 relè SPST
IR32W: 1 relè SPST + 1 SPDT
IR32Z: 1 relè SPST + 3 SPDT
IRDRTE, IRDRV e W: 1 o 2 relè SPDT
IRDRZ: 1° e 2° relè SPDT, 3° e 4° relè SPST

Uscite per SSR (Relè stato solido)
Numero uscite (a seconda del modello):
IR32D: 1
IR32A e IRDRA: 4

13. Technical specifications of Universal Infrared Instruments

Inputs:
depending on the model
temperature: NTC, Pt100, K/J Thermocouples
current 4/20mA or 0/20mA
voltage -0,4/+1Vdc

Operating range:
NTC: -50/90 °C;
Pt100: -100/600 °C,
ThcK: -100/999 °C;
ThcJ: -100/800 °C
***current/voltage:** -99/999*

Resolution:
0.1 from -9.9 to 99.9
1 in the remaining field

Accuracy:
±0.5%

Power supply:
voltage:
IR32V,D,W,Z,A: from 12 to 24Vac-dc ±10%
IRDR V & W: 24Vac ±10% and 220/240Vac ±10%
IRDRTE: 220/240Vac ±10%
IRDRZ, IRDRA: from 12 to 24Vac-dc, ±10%

power consumption:
IR32V: 2VA;
IR32W and IR32Z: 3VA
IRDRTE, IRDRV, IRDRW: 3VA
IRDRZ: 4VA

sensor power supply output:
10Vdc, max 30mA (8Vdc for IRDRW)

Operating conditions:
working temperature: 0/50°C
storage temperature: -10/70°C
ambient relative humidity: lower than 90%rH, not condensing
ambient pollution: normal

Insulation:
low voltage sections have a main insulation in comparison with the very low voltage ones.
There is extra insulation between very low voltage sec - tions and the front panel of the instrument. Very low volta - ge components (sensor inputs, digital input, 10Vdc out - puts for SSR, serial connection and power supply) do not have any insulation.*
****Important:** except models IRDRV, IRDRW and IR32*H, complete with main insulation.*

Outputs:
Number of relays (depending on the model):
IR32 for NTC: 1, 2 or 4 SPDT relays, other IR32V: 1 SPST relay;
IR32W: 1 SPST relay + 1 SPDT;
IR32Z: 1 SPST relay + 3 SPDT;
IRDRTE, IRDRV & W: 1 or 2 SPDT relays
IRDRZ: 1st & 2nd relay SPDT, 3rd & 4th SPST

Outputs for Solid State Relays:
Number of outputs (depending on the model):
IR32D: 1
IR32A e IRDRA: 4

Caratteristiche relè (tutti i modelli):
max. tensione 250 Vac, max. potenza 2000 VA
max. corrente di spunto 10 A

Caratteristiche segnale per SSR (Relè stato solido):
Tensione uscita: 10 Vdc
Resistenza uscita: 660 Ω
Massima corrente uscita: 15 mA

Disconnessione:
di tipo 1C secondo norme ECC EN 60730-1

Caratteristiche meccaniche:
Connessioni strumento:
IR32: montaggio a pannello con staffa
IRDR: montaggio su guida DIN

Contenitori:
plastici, autoestinguenza IR32 secondo UL94-VO

Grado di protezione:
IR32: IP65 con strumento montato a pannello
IRDR: IP40 con strumento montato a quadro

Collegamenti:
tramite morsetti a vite sezione massima 1,5 mm^2

Collegamento seriale*:
IR32: tramite accessorio IR32SER
IRDR: tramite accessorio IRDRSER
*non possibile con i modelli IRDRTE, IR32V*H

Modifica parametri:
da tastiera, da seriale e da telecomando (per il telecomando vedere listino)

Avvertenze: i cavi usati devono resistere alla massima temperatura d'esercizio, ovvero alla massima temperatura ambiente prevista tenendo presente l'autoriscaldamento del controllo pari a 20 °C con le uscite tutte alla massima portata.

Relay features (all models):
Max. voltage 250Vac, max. power 2000VA,
Max. inrush current 10A.

Signal for SSR:
Output voltage: 10Vdc
Output resistance: 660
Max. outputs voltage: 15mA

Disconnection:
Type 1C according to ECC EN 60730-1 standards

Mechanical features:
Connections:
IR32: panel mounted with hanger
IRDR: DIN rail mounted

Cases:
Plastic, IR32 autoextinguishing according to UL94-40 standards

Protection index:
IR32: IP65 with panel mounted instrument
IRDR: IP40

Connections:
Through screw terminals max. sect. 1.5mm^2

Serial connection*:
IR32: through IR32SER accessory
IRDR: through IRDRSER accessory
**not available in IRDRTE, IR32V*H*

Parameters modification
via keyboard, serial connection and remote control (for remote control see price-list).

Important: *cables should resist to the maximum ambient temperature, keeping in mind that the controllers are subject to self heating up to 20°C when all outputs are energized.*

13.1 Caratteristiche tecniche del telecomando

alimentazione: n. 2 batterie alkaline stilo da1,5 V (tipo UM-4 AAA, IEC R03)
contenitore: plastico
dimensioni: 60x160x18 mm
immagazzinamento: -25 °C/+70 °C
temperatura di lavoro: 0 °C/50 °C
tipo di trasmissione: Infrarosso
peso: 80 g (privo di batterie)

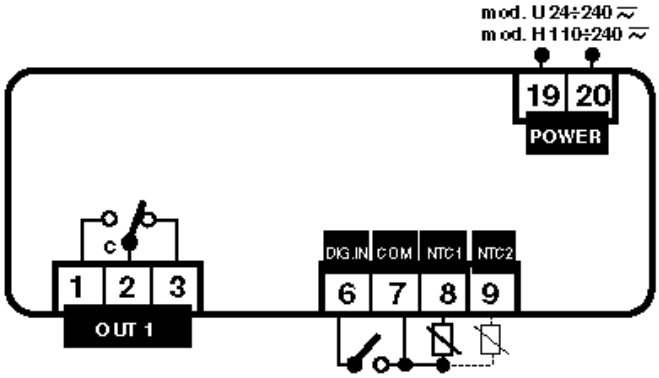
13.1 Technical specifications of the remote control

power supply: 2 alkaline batteries, 1.5V (type UM-4 AAA, IEC R03)
case: plastic
dimensions: 60x160x18mm
storage temperature: -25 °C/+70 °C
operating temperature: 0-50 °C
transmission: infrared
weight: 80g (without batteries)

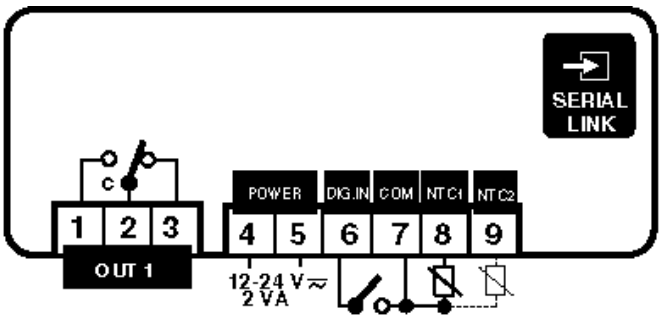
14. Schemi di collegamento

14.1 IR32 versioni con ingresso NTC

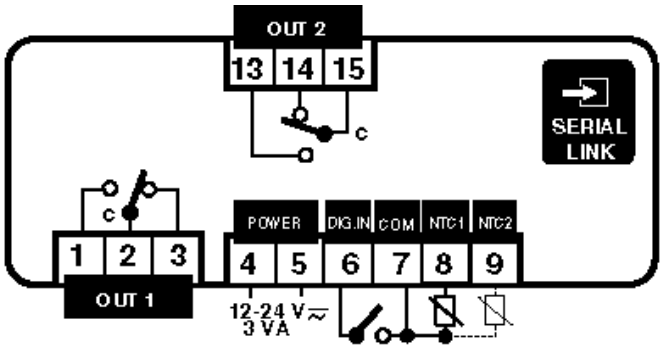
IR32V – NTC: Versione V, alimentazione 24/240 o 110/240 Vac-dc



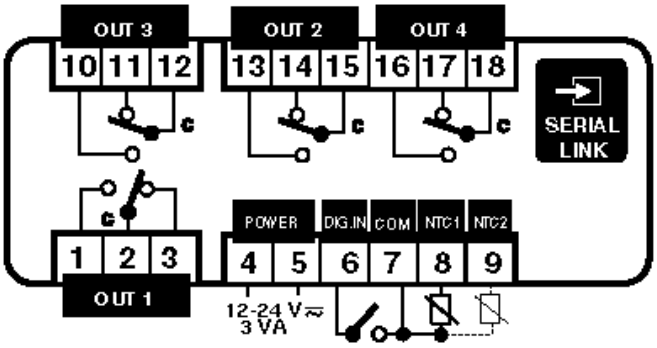
IR32V – NTC: con alimentazione 12/24 Vac-dc



IR32W – NTC:, con alimentazione 12/24 Vac-dc



IR32Z – NTC:, con alimentazione 12/24 Vac-dc



14. Wiring diagrams

14.1 IR32 with NTC input

IR32V - NTC: *V version, power supply 24/240 or 110/240Vac-dc*

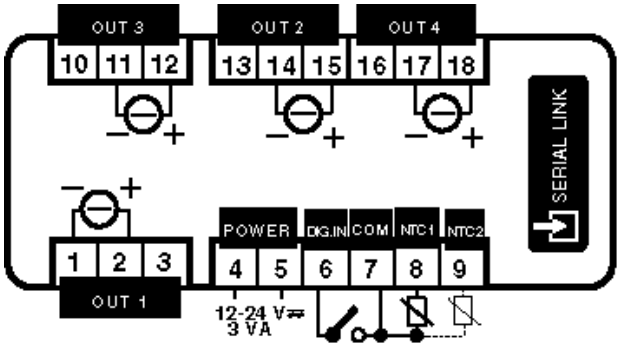
IR32V - NTC: *power supply 12/24Vac-dc*

IR32W - NTC: *power supply 12/24Vac-dc*

IR32Z - NTC: *power supply 12/24Vac-dc*

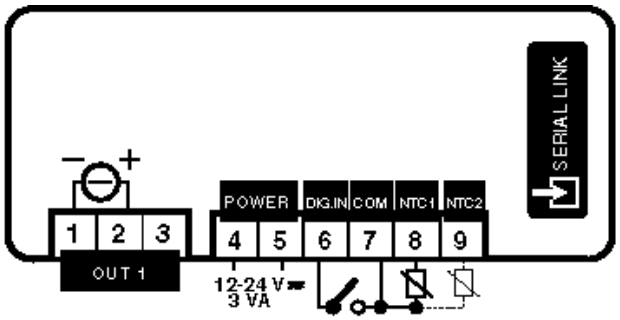
IR32A – NTC: alimentazione 12/24 Vac-dc

IR32A - NTC: *power supply 12/24Vac-dc*



IR32D – NTC: alimentazione 12/24 Vac-dc

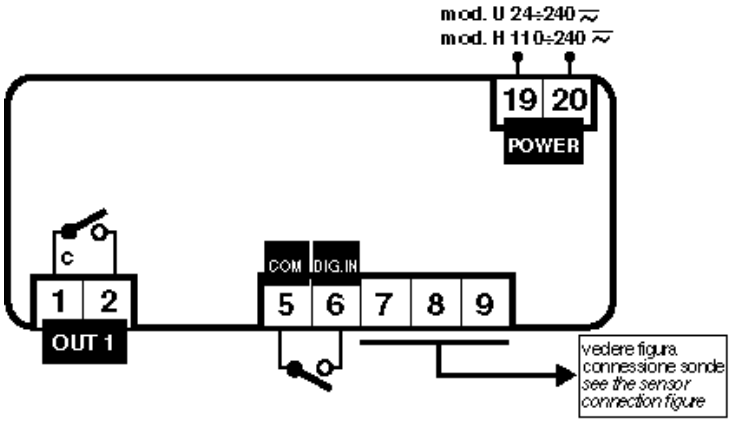
IR32D - NTC: *power supply 12/24Vac-dc*



14.2 IR32 versioni con ingresso Pt100, Tc J/K o V, I

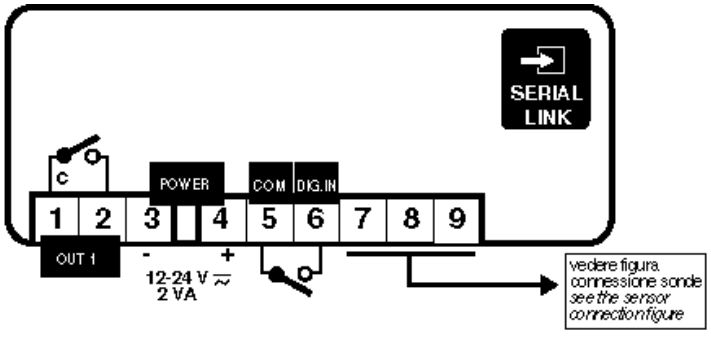
14.2 IR32 with Pt100, J/K tc or V/I input

IR32V: *power supply 12/24Vac-dc*



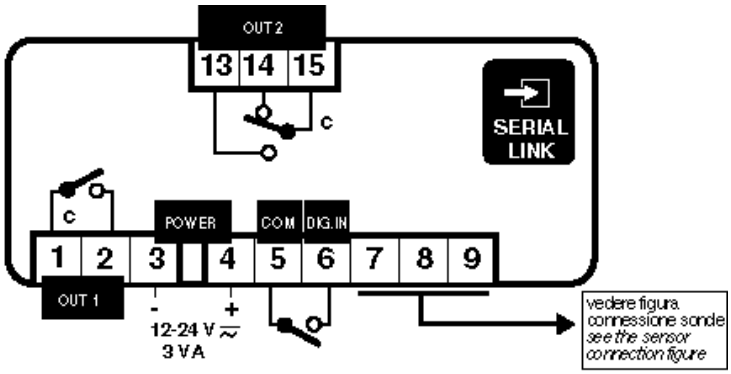
IR32V: con alimentazione 24/240 o 110/240 Vac-dc

IR32W: *power supply 12/24Vac-dc*



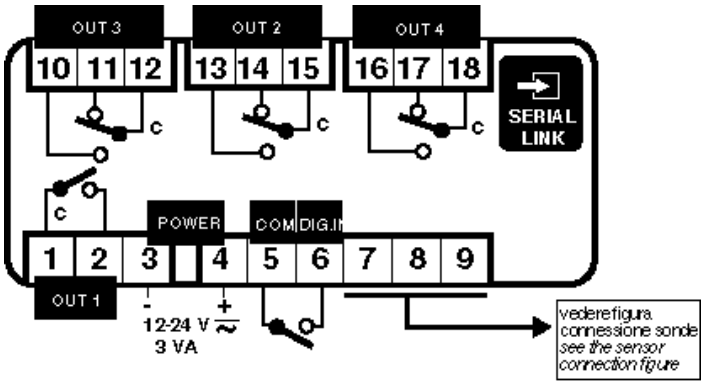
IR32V: con alimentazione 12/24 Vac-dc

IR32W: *power supply 12/24Vac-dc*



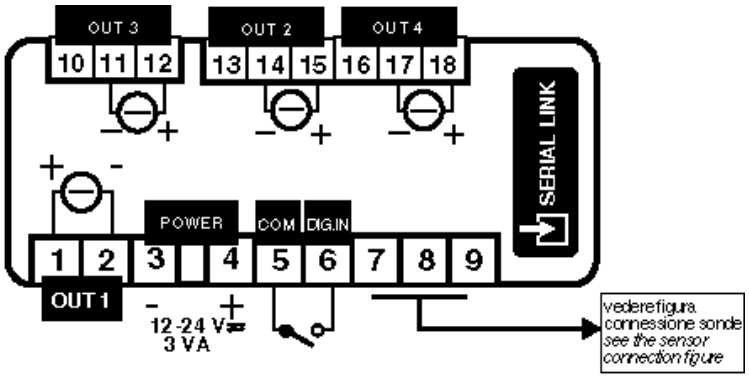
IR32W: con alimentazione 12/24 Vac-dc

IR32Z: *power supply 12/24Vac-dc*



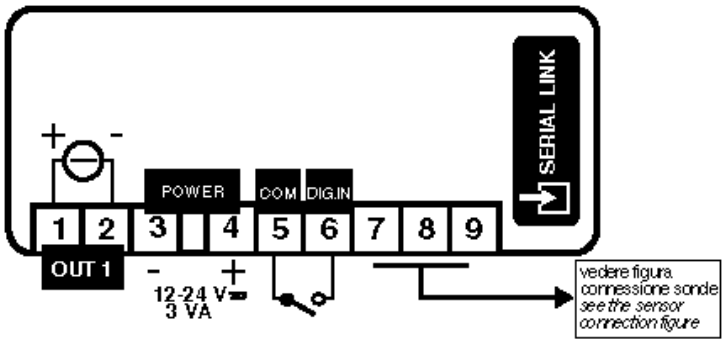
IR32Z: con alimentazione 12/24 Vac-dc

IR32A: *power supply 12/24Vac-dc*



IR32A: con alimentazione 12/24 Vac-dc

IR32D: *power supply 12/24Vac/dc*



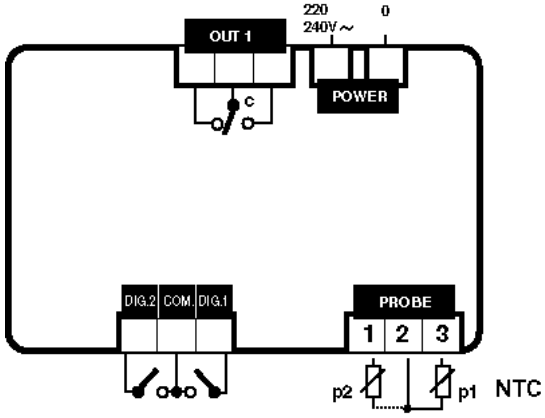
IR32D: alimentazione 12/24 Vac-dc

14.3 Versioni IRDR

14.3 IRDR Versions

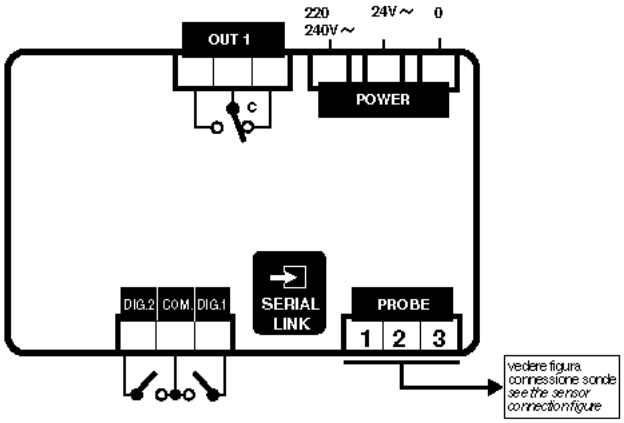
IRDRTE – NTC: alimentazione 220/240 Vac, ingresso NTC

IRDRTE – NTC: *power supply 220/240Vac, NTC input*



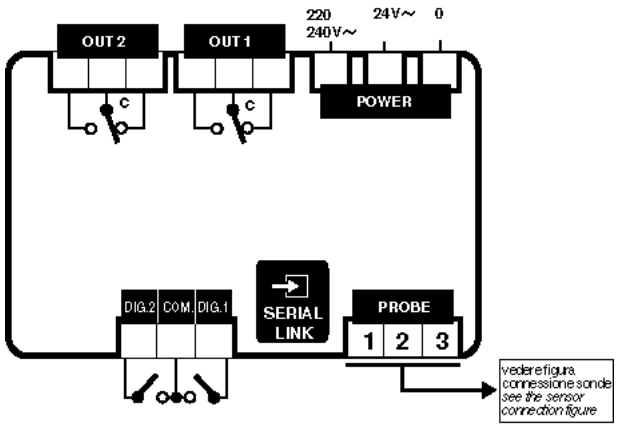
IRDRV: con alimentazione 24 Vac o 220/240 Va c, ingresso NTC, Pt100, J/K, V, I

IRDRV: *power supply 24Vac or 220/240Vac, NTC/Pt100/J-K Tc/V/I input*



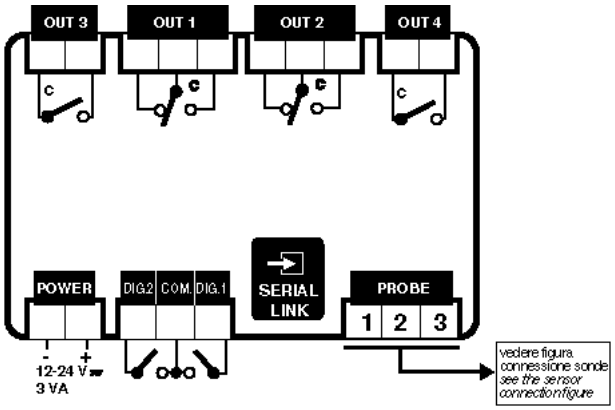
IRDR W: con alimentazione 24 o 220/240 Vac, ingresso NTC, Pt100, Tc J/K, V, I

IRDRW: *power supply 24 or 220/240Vac, NTC/Pt100/J-K Tc/V/I input*



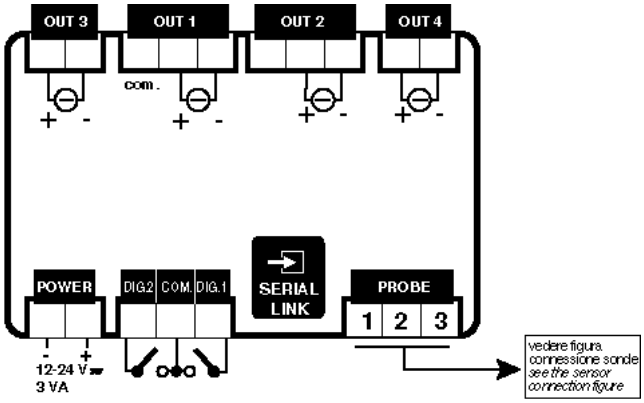
Versione IRDRZ, con alimentazione 12/24 Vac, ingresso NTC, Pt100, Tc J/K, V/I

IRDRZ: *power supply 12/24Vac, NTC/Pt100/J-K Tc/V/I input*



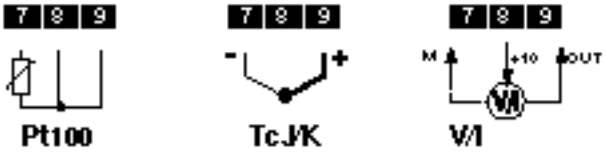
Versione IRDRA: alimentazione 12/24 Vac-dc, **i**ngresso NTC, Pt100, Tc J/K, V, I

IRDRA: *power supply 12/24Vac-dc, NTC/Pt100/J-K Tc/V/I input*

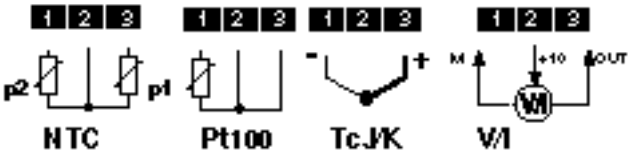


14.4 Connessione sonde

IR32 (*)



IRDR (*)



(*) ad ogni tipo di sonda corrisponde uno specifico modello

Note:

1) nel caso di sonde Pt100 a 2 fili cortocircuitare i morsetti 8 e 9 (IR32) o 2 e 3 (IRDR);
2) collegare l'eventuale schermatura della sonda alla terra del quadro elettrico. Nel caso di termocoppie, è necessario usare sonde con cavo compensato schermato per avere una corretta immunità ai disturbi;
3) per le sonde in tensione o corrente considerare che la massima tensione fornita è 10 Vdc @ 30 mA (max 8Vdc per IRDRW).

14.4 Sensor connection diagrams

IR32 (*)

IRDR (*)

(*) each sensor corresponds to a specific model

Important:

1) *When using 2-wire Pt100 sensors, short circuit terminals 8 and 9 (IR32) or 2 and 3 (IRDR).*
2) *Connect the sensor shielding to the earth of the electrical panel. When using thermocouples, use sensors with shielded cables to avoid noises.*
3) *When using voltage or current sensors consider that the maximum voltage output is 10 Vdc @ 30mA (max 8Vdc for IRDRW).*

Glossario

Calibrazione sonda: permette di variare l'indicazione visualizzata dallo strumento per compensare errori o differenze con altri strumenti. Ciò è permesso tramite il parametro P14.
Differenziale o isteresi: permette di regolare l'inserimento delle uscite quando la grandezza regolata si scosta dal set. Senza differenziale si passerebbe repentinamente da uscite tutte OFF (grandezza uguale al SET) a uscite tutte ON (grandezza diversa dal SET). Il differenziale permette un inserimento graduale delle uscite, che saranno inserite solo quando la differenza tra grandezza regolata e il set supera il valore del differenziale. Normalmente un differenziale 'stretto' mantiene la grandezza regolata molto vicino al set, ma può provocare frequenti accensioni/spegnimenti dei dispositivi controllati e pendolazioni. Nel caso sia richiesta una regolazione molto precisa, invece di selezionare un differenziale stretto, si può attivare la regolazione P+I.
Differenziale allarme: è l'isteresi prevista per gli allarmi. Un differenziale anche minimo è necessario per evitare pendolazioni, ovvero inserimenti e disinserimenti successivi degli allarmi dovuti a piccole variazioni della grandezza misurata. I regolatori della Serie Infrared escono di fabbrica con il differenziale allarmi impostato a "2". Gli allarmi di "Alta" e "Bassa" sono a reinserimento automatico, ovvero quando la grandezza misurata "rientra" di un valore pari al differenziale, l'allarme viene automaticamente annullato.
Direct (Azione direct): un regolatore agisce in Direct quando opera un'azione di contenimento sulla grandezza che sta aumentando. Il funzionamento Direct è tipico, ad es., degli impianti di refrigerazione: all'aumentare della temperatura misurata aumenta la potenza frigorifera prodotta e ciò al fine di far diminuire la temperatura stessa.
Punto di lavoro o set-point (o set): si tratta del valore che deve essere mantenuto dalla grandezza fisica controllata, ad esempio il valore della temperatura a cui si vuole far lavorare un forno. Quando la grandezza regolata arriva al valore di set, tutte le uscite sono disattivate.
Reverse (Azione reverse) : si parla invece di funzionamento Reverse quando l'azione tende a contrastare la diminuzione della grandezza regolata. Ciò avviene ad esempio negli impianti di riscaldamento dove si deve contrastare la diminuzione di temperatura attivando la produzione di calore.
Set allarme di "Alta" e set allarme di "Bassa": è possibile controllare la grandezza regolata all'interno di un limite inferiore e un limite superiore. Quando lo strumento rileva un valore esterno ai limiti impostati visualizza un codice di allarme e genera un allarme sonoro (nei modelli provvisti di buzzer). I valori di "Alta" e "Bassa", nella configurazione di fabbrica, sono considerati come valori assoluti e quindi, per evitare che i limiti di allarme intervengano durante la normale regolazione, essi devono essere esterni all'intervallo individuato dai due set-point e differenziale. Per le versioni con numero di serie superiore a 100.000, il set di allarme può essere impostato anche relativo. Si rimanda alla spiegazione del parametro P27 per ulteriori spiegazioni.
Set points multipli: esistono applicazioni con 2 set-point: è il caso, ad esempio, di un impianto di riscaldamento che lavori con due diversi set-point, uno per il funzionamento diurno ed uno per quello notturno, oppure un impianto di condizionamento con un set estivo ed uno invernale. I regolatori della serie Infrared possono gestire anche 2 set-point.
Tempo di ritardo attuazione allarme: permette di ritardare la se- gnalazione dell'allarme. Il regolatore attiva l'allarme solo se le condizioni di allarme permangono per il ritardo selezionato (vedi P28).
Zona neutra o zona morta: indica un intervallo attorno al set-point in cui la grandezza regolata può oscillare senza che sia necessario inserire alcuna uscita. Il concetto è ripreso nella descrizione dei Modi 3, 4 e 5.

Glossary

Sensor calibration: *allows you to vary the value indicated on the display of the instrument in order to compensate errors or deviations from other instruments. To do this use parameter P14.*

Differential or hysteresis: *as the controller makes the outputs energize any time the controlled variable deviates from the set-point, setting the differential avoids sudden energizations and disenergizations of the outputs (that would occur any time the controlled variable deviates from the set-point). The differential makes the outputs energize only when the difference between the controlled variable value and the set-point goes beyond the differential itself. A narrow differential range keeps the controlled variable very near the set-point but can cause frequent energiza - tions/disenergizations of the connected devices as well as hunting problems. Should you need a very precise control action, use the P+I control logic.*

Alarm differential: *it is the hysteresis concerning alarms. Setting an alarm differential, although narrow, is neces - sary to avoid too frequent energizations/disenergizations of the alarm outputs due to any slight variation of the con - trolled variable. The Infrared Controllers come with a fac - tory-set alarm differential=2. "High" and "Low" temperature alarms reset automatically (when the controlled variable returns within the set differential range, the alarm is auto - matically cancelled).*

Direct control action: *the instrument reduces the control - led variable when it increases too much. The direct control action is the typical operating logic in refrigeration systems: when the measured temperature rises, the con - troller will actuate the appropriate devices to make the temperature fall.*

Set-point: *the point at which the desired value of the con - trolled variable (e.g. temperature) is set. When the control - led variable reaches the set-point, all outputs disenergize.*

Reverse control action: *the instrument increases the controlled variable when it decreases too much. This occurs in heating systems when the temperature is lower than the temperature for which the instrument is set.*

High and Low temperature alarm set-point: *higher and lower status point representing the threshold of an OFF- normal condition. When the instrument detects a value that goes beyond the selected range, it will alert the ope - rator by a signal both visual (alarm code) and audible (in models equipped with buzzer). The factory-set "High" and "Low" thresholds are absolute values; therefore they should be set beyond the differential range so as to avoid alarm conditions being detected during normal operation. In versions having serial number above 100,000, alarm set-points can also be relative values (for further informa - tion see parameter P27).*

Multiple set-points: *some applications can be based on two set-points (e.g. heating systems working with two dif - ferent set-points, one for the day, the other for the night or air-conditioning systems with a summer and a winter set- point). All Infrared Controllers can work with two set-points.*

Time-delay before alarm activation: *the alarm signal is delayed for a T time, as selected through P28.*

Dead (or neutral) zone: *the range of values around the set-point within which a variable can be varied without energizing any output. (See Modes 3, 4, 5).*

Tabella codici dei modelli serie Infrared universale / *Codes of the Universal Infrared Models*

DESCRIZIONE / *DESCRIPTION*	**CODICE / *CODE***
Termostati 1 relè, montaggio a pannello, alimentazione 12÷24 Vac/dc, predisposti per il collegamento seriale	
Single-relay thermostat, panel mounted, power supply 12÷24Vac/dc, optional serial connection	
IR32V0E: 3 cifre, 2 ingressi per sonda NTC / *3 digits, 2 inputs for NTC sensor*	IR32V0E000
R32V1E: 3 cifre, 1 ingresso per sonda PT100 / *3 digits, 1 input for PT100 sensor*	IR32V1E000
IR32V2E: 3 cifre, 1 ingresso per termocoppia J/K / *3 digits, 1 input for J/K thermocouple*	IR32V2E000
IR32V3E: 3 cifre, 1 ingresso per sonda 4÷20 mA / *3 digits, 1 input for 4÷20mA sensor*	IR32V3E000
IR32V4E: 3 cifre, 1 ingresso per sonda -0,5÷1 Vcc / 3 digits, 1 input for -0,5÷1Vcc sensor	IR32V4E000
Termostati 1 relè, montaggio a pannello, alimentazione 12÷24 Vac/dc con buzzer, predisposti per seriale e telecomando	
Single-relay thermostat, panel mounted, power supply 12÷24Vac/dc with buzzer, optional serial connection and remote con - trol	
IR32V0L: 3 cifre, 2 ingressi per sonda NTC / *3 digits, 2 inputs for NTC sensor*	IR32V0L000
IR32V1L: 3 cifre, 1 ingresso per sonda PT100 / *3 digits, 1 input for PT100 sensor*	IR32V1L000
IR32V2L: 3 cifre, 1 ingresso per termocoppia J/K / *3 digits, 1 input for J/K thermocouple*	IR32V2L000
IR32V3L: 3 cifre, 1 ingresso per sonda 4÷20 mA / *3 digits, 1 input for 4÷20mA sensor*	IR32V3L000
IR32V4L: 3 cifre, 1 ingresso per sonda -0,5÷1 Vcc / *3 digits, 1 input for -0,5÷1Vcc sensor*	IR32V4L000
Termostati 1 relè, montaggio a pannello, alimentazione 110÷230 Vac/dc con buzzer e predisposti per telecomando	
Single-relay thermostat, panel mounted, power supply 110÷230Vac/dc with buzzer, optional remote control	
IR32V0H: 3 cifre, 2 ingressi per sonda NTC / *3 digits, 2 inputs for NTC sensor*	IR32V0H000
IR32V1H: 3 cifre, 1 ingresso per sonda PT100 / *3 digits, 1 input for PT100 sensor*	IR32V1H000
IR32V2H: 3 cifre, 1 ingresso per termocoppia J/K / *3 digits, 1 input for J/K thermocouple*	IR32V2H000
IR32V3H: 3 cifre, 1 ingresso per sonda 4÷20 mA / *3 digits, 1 input for 4÷20mA sensor*	IR32V3H000
IR32V4H: 3 cifre, 1 ingresso per sonda -0,5÷1 Vcc / *3 digits, 1 input for -0,5÷1Vcc sensor*	IR32V4H000
Termostati 2 relè, montaggio a pannello, alimentazione 12÷24 Vac/dc con buzzer, predisposti per seriale e telecomando	
2-relay thermostat, panel mounted, power supply 12÷24Vac/dc with buzzer, optional serial connection and remote control	
IR32W0: 3 cifre, 2 ingressi per sonda NTC / *3 digits, 2 inputs for NTC sensor*	IR32W00000
IR32W1: 3 cifre, 1 ingresso per sonda PT100 / *3 digits, 1 input for PT100 sensor*	IR32W10000
IR32W2: 3 cifre, 1 ingresso per termocoppia J/K / *3 digits, 1 input for J/K thermocouple*	IR32W20000
IR32W3: 3 cifre, 1 ingresso per sonda 4÷20 mA / *3 digits, 1 input for 4÷20mA sensor*	IR32W30000
IR32W4: 3 cifre, 1 ingresso per sonda -0,5÷1 Vcc / *3 digits, 1 input for -0,5÷1Vcc sensor*	IR32W40000
Termostati 4 relè, montaggio a pannello, alimentazione 12÷24 Vac/dc con buzzer, predisposti per seriale e telecomando	
4-relay thermostat, panel mounted, power supply 12÷24Vac/dc with buzzer, optional serial connection and remote control	
IR32Z0: 3 cifre, 2 ingressi per sonda NTC / *3 digits, 2 inputs for NTC sensor*	IR32Z00000
IR32Z1: 3 cifre, 1 ingresso per sonda PT100 / *3 digits, 1 input for PT100 sensor*	IR32Z10000
IR32Z2: 3 cifre, 1 ingresso per termocoppia J/K / *3 digits, 1 input for J/K thermocouple*	IR32Z20000
IR32Z3: 3 cifre, 1 ingresso per sonda 4÷20 mA / *3 digits, 1 input for 4÷20mA sensor*	IR32Z30000
IR32Z4: 3 cifre, 1 ingresso per sonda -0,5÷1 Vcc / *3 digits, 1 input for -0,5÷1Vcc sensor*	IR32Z40000
Termostato 1 relè, montaggio su guida DIN, alimentazione 230 Vac, predisposti per telecomando	
Single-relay thermostat, DIN rail mounted, power supply 230Vac, optional remote control	
IRDRTE: 3 cifre, 2 ingressi per sonda NTC / *3 digits, 2 inputs for NTC sensor*	IRDRTE0000
Termostati 1 relè, montaggio su guida DIN, alimentazione 24 e 230 Vac, predisposti per seriale, buzzer e telecomando	
Single-relay thermostat, DIN rail mounted, power supply 24 and 230Vac, optional serial connection, buzzer and remote control	
IRDRV0: 3 cifre, 2 ingressi per sonda NTC / *3 digits, 2 inputs for NTC sensor*	IRDRV00000
IRDRV1: 3 cifre, 1 ingresso per sonda PT100 / *3 digits, 1 input for PT100 sensor*	IRDRV10000
IRDRV2: 3 cifre, 1 ingresso per termocoppia J/K / *3 digits, 1 input for J/K thermocouple*	IRDRV20000
IRDRV3: 3 cifre, 1 ingresso per sonda 4÷20 mA / *3 digits, 1 input for 4÷20mA sensor*	IRDRV30000
IRDRV4: 3 cifre, 1 ingresso per sonda -0,5÷1 Vcc / *3 digits, 1 input for -0,5÷1Vcc sensor*	IRDRV40000
Termostati 2 relè, montaggio su guida DIN, alimentazione 24 e 230 Vac con buzzer, predisposti per seriale e telecomando	
2-relay thermostat, DIN rail mounted, power supply 24 and 230Vac, with buzzer, optional serial connection and remote control	
IRDRW0: 3 cifre, 2 ingressi per sonda NTC / *3 digits, 2 inputs for NTC sensor*	IRDRW00000

IRDRW1: 3 cifre, 1 ingresso per sonda PT100 / *3 digits, 1 input for PT100 sensor*	IRDRW10000
IRDRW2: 3 cifre, 1 ingresso per termocoppia J/K / *3 digits, 1 input for J/K thermocouple*	IRDRW20000
IRDRW3: 3 cifre, 1 ingresso per sonda 4÷20 mA / *3 digits, 1 input for 4÷20mA sensor*	IRDRW30000
IRDRW4: 3 cifre, 1 ingresso per sonda -0,5÷1 Vcc / *3 digits, 1 input for -0,5÷1Vcc sensor*	IRDRW40000

Termostati 4 relè, montaggio su guida DIN, alimentazione 12÷24 Vac/dc con buzzer, predisposti per seriale, telecomando
4-relay thermostat, DIN rail mounted, power supply 12÷24Vac/dc, with buzzer, optional serial connection and remote control

IRDRZ0: 3 cifre, 2 ingressi per sonda NTC / *3 digits, 2 inputs for NTC sensor*	IRDRZ00000
IRDRZ1: 3 cifre, 1 ingresso per sonda PT100 / *3 digits, 1 input for PT100 sensor*	IRDRZ10000
IRDRZ2: 3 cifre, 1 ingresso per termocoppia J/K / *3 digits, 1 input for J/K thermocouple*	IRDRZ20000
IRDRZ3: 3 cifre, 1 ingresso per sonda 4÷20 mA / *3 digits, 1 input for 4÷20mA sensor*	IRDRZ30000
IRDRZ4: 3 cifre, 1 ingresso per sonda -0,5÷1 Vcc / *3 digits, 1 input for -0,5÷1Vcc sensor*	IRDRZ40000

Termostati con 1 uscita 10 Vdc per comando Relè Stato Solido (SSR), montaggio a pannello, alimentazione 12÷24 Vac/dc con buzzer, predisposti per seriale e telecomando
10Vdc single-output thermostat to actuate Solid State Relay (SSR), panel mounted, power supply 12÷24Vac/dc with buzzer, optional serial connection and remote control

IR32D0L: 3 cifre, 2 ingressi per sonda NTC / *3 digits, 2 inputs for NTC sensor*	IR32D0L000
IR32D1L: 3 cifre, 1 ingresso per sonda PT100 / *3 digits, 1 input for PT100 sensor*	IR32D1L000
IR32D2L: 3 cifre, 1 ingresso per termocoppia J/K / *3 digits, 1 input for J/K thermocouple*	IR32D2L000
IR32D3L: 3 cifre, 1 ingresso per sonda 4÷20 mA / *3 digits, 1 input for 4÷20mA sensor*	IR32D3L000
IR32D4L: 3 cifre, 1 ingresso per sonda -0,5÷1 Vcc / *3 digits, 1 input for -0,5÷1Vcc sensor*	IR32D4L000

Termostati con 4 uscite 10 Vdc per comando Relè Stato Solido (SSR), montaggio a pannello, alimentazione 12÷24 Vac/dc con buzzer, predisposti per seriale e telecomando
4-output thermostat to actuate Solid State Relay (SSR), panel mounted, power supply 12÷24Vac/dc with buzzer, optional serial connection and remote control

IR32A0: 3 cifre, 2 ingressi per sonda NTC / *3 digits, 2 inputs for NTC sensor*	IR32A00000
IR32A1: 3 cifre, 1 ingresso per sonda PT100 / *3 digits, 1 input for PT100 sensor*	IR32A10000
IR32A2: 3 cifre, 1 ingresso per termocoppia J/K / *3 digits, 1 input for J/K thermocouple*	IR32A20000
IR32A3: 3 cifre, 1 ingresso per sonda 4÷20 mA / *3 digits, 1 input for 4÷20mA sensor*	IR32A30000
IR32A4: 3 cifre, 1 ingresso per sonda -0,5÷1 Vcc / *3 digits, 1 input for -0,5÷1Vcc sensor*	IR32A40000

Termostati con 4 uscite 10 Vdc per comando Relè Stato Solido (SSR), montaggio su guida DIN, alimentazione 12÷24 Vac/dc con buzzer, predisposti per seriale e telecomando
10Vdc 4-output thermostat to actuate Solid State Relay (SSR), panel mounted, power supply 12÷24Vac/dc with buzzer, optional serial connection and remote control

IRDRA0: 3 cifre, 2 ingressi per sonda NTC / *3 digits, 2 inputs for NTC sensor*	IRDRA00000
IRDRA1: 3 cifre, 1 ingresso per sonda PT100 / *3 digits, 1 input for PT100 sensor*	IRDRA10000
IRDRA2: 3 cifre, 1 ingresso per termocoppia J/K / *3 digits, 1 input for J/K thermocouple*	IRDRA20000
IRDRA3: 3 cifre, 1 ingresso per sonda 4÷20 mA / *3 digits, 1 input for 4÷20mA sensor*	IRDRA30000
IRDRA4: 3 cifre, 1 ingresso per sonda -0,5÷1 Vcc / *3 digits, 1 input for -0,5÷1Vcc sensor*	IRDRA40000

Tabella codici dei modelli del telecomando / *1.4 Codes of Remote Control Models*

Telecomando versione in lingua italiana / *Remote control in Italian*	IRTRUI0000
Telecomando versione in lingua inglese / *Remote control in English*	IRTRUE0000
Telecomando versione in lingua francese / *Remote control in French*	IRTRUF0000
Telecomando versione in lingua tedesca / *Remote control in German*	IRTRUD0000

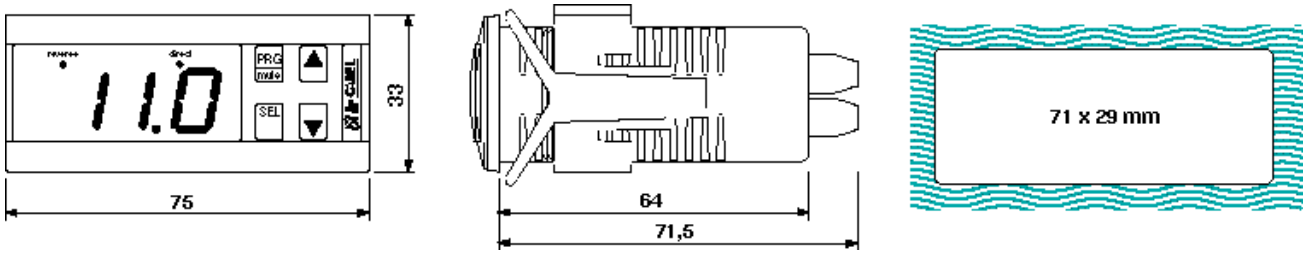
Tabella codici moduli opzionali / *1.5 Codes of Optional Modules*

Modulo per conversione segnale PWM in uscita analogica 0/10 V o 4/20 mA *Module for PWM signal conversion into analogue output 0/10V or 4/20 mA*	CONV0/10A0
Modulo alimentatore (da 24 Vac a 24 Vdc) e convertitore di segnale da 0/10 Vdc a 0/1 Vdc *Power Supply module (from 24Vac to 24Vdc) and signal converter (from 0/10Vdc to 0/1Vdc)*	CONV0/1L00
Modulo per conversione segnale PWM in uscita ON/OFF a relè *Module for PWM signal conversion into ON/OFF relay output*	CONV0N0FF0

Dimensioni:

Dimensions

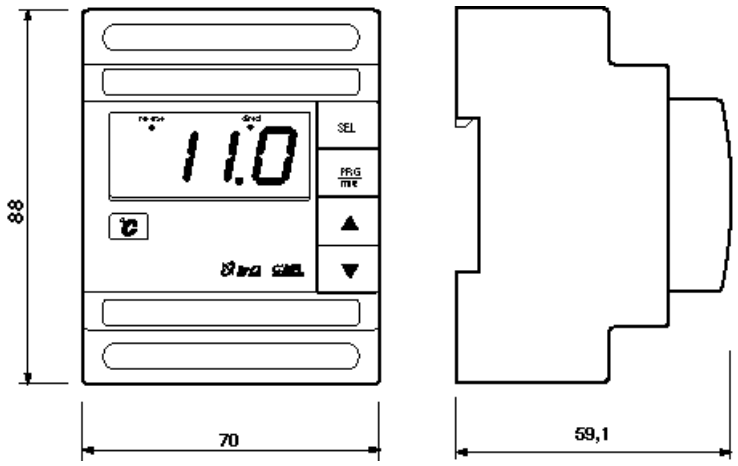
IR32 - montaggio da pannello



IR32 - Panel mounting

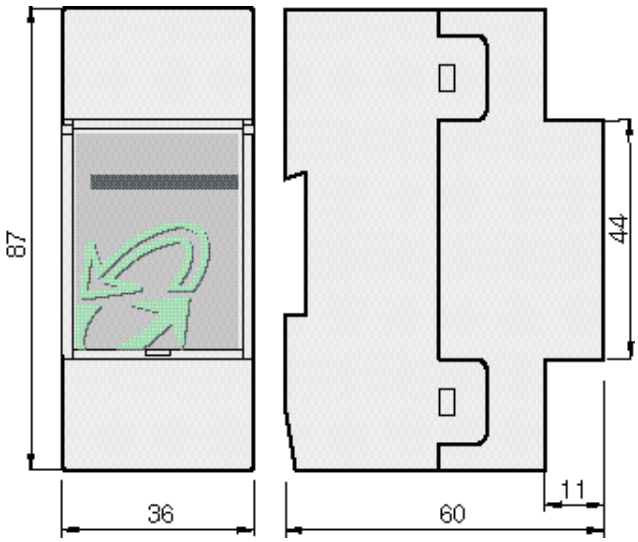
IRDR - montaggio da guida DIN

IRDR - Din rail mounting



Moduli opzionali

Optional modules



CAREL srl
Via dell'Industria, 11 - 35020 Brugine - Padova (Italy)
Tel. (+39) 049.9716611 Fax (+39) 049.9716600
http://www.carel.com – e-mail: carel@carel.com

Agenzia:

Cod. +030220160 rel. 2.1 – 27/05/2005

Appendix P Required Condenser Cooling Water Flow Rate

The graph shows the required cooling water flow rate depending on the cooling water temperature.

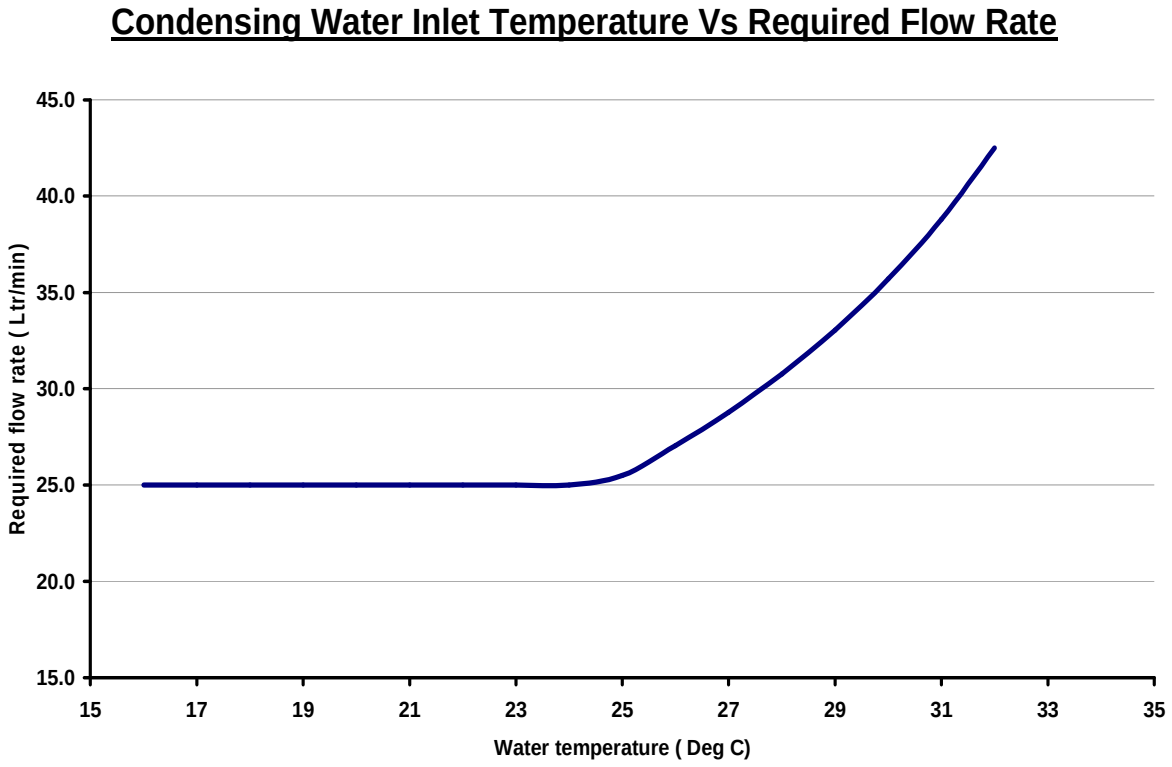


Figure 10 Graph of Condenser cooling water temperature vs. cooling water flow rate