CONTROL PANEL OPERATING MANUAL

AIR COOLED SCREW CHILLER GLOBAL DESIGN
Software version *ASDU01A and later*

TABLE OF CONTENTS

1 CONTENTS 5
1.1 Installation Precautions 5
1.2 Temperature and Humidity considerations 5
1.3 Associated literature 5
2 GENERAL DESCRIPTION 6
3 MAIN FEATURES OF CONTROL SOFTWARE 7
4 SYSTEM ARCHITECTURE 8
4.1 Control Panel 10
4.2 Main board 12
4.3 pCO^e Expansion 13
4.4 EEXV Valve Driver 15
4.4.1 Meaning of the EEXV Driver status LEDs 15
4.5 Addressing of pLAN/RS485 16
4.6 Software 16
4.6.1 Version identification 17
5 FINAL PHYSICAL INPUTS AND OUTPUTS 19
5.1 Controller #1 – Control of base unit and compressors #1 & #2 19
5.2 Controller #2 – Control of compressors #3 & #4 20
5.3 pCOe expansion #1 – Additional hardware 21
5.3.1 Expansion connected to controller #1 21
5.3.2 Expansion connected to controller #2 21
5.4 pCO^e expansion #2 – Heat recovery or heat pump control 23
5.4.1 Heat recovery option 23
5.4.2 Heat pump option 23
5.5 pCOe expansion #3 – Water pump control 24
5.6 pCOe expansion #4 – Additional Fan step control 25
5.6.1 Expansion connected to controller #1 25
5.6.2 Expansion connected to controller #2 25
EXV Driver 25
6 MAIN CONTROLLER FEATURES 26
6.1 Controller purpose 26
6.2 Unit enabling 26
6.3 Unit modes 26
6.4 Set-points management 27
6.4.1 4-20mA set-point override 28
OAT set-point override 28
6.4.2 Return set-point override 29
6.5 Compressors capacity control 30
6.5.1 Slide valve analogue position signal (optional) for automatic control 30
6.5.2 Manual Control 33
6.5.3 Ice mode automatic control 36
6.6 Compressors timing 36

6.7 Compressors protection **36**
6.8 Compressors start-up procedure **36**
6.8.1 Pre-purge procedure with electronic expansion 37
6.8.2 Pre-purge procedure with thermostatic expansion 37
6.8.3 Oil heating 37
6.9 Pump-down **37**
6.10 Low ambient temperature start **37**
6.11 Compressors and unit trips **38**
6.11.1 Unit trips 38
6.11.2 Compressors trip 39
6.11.3 Other trips 41
6.12 Switch between cooling and heating mode **41**
6.13 Defrost procedure **41**
6.14 Liquid injection **42**
6.15 Heat Recovery procedure **42**
6.15.1 Recovery pump 42
6.15.2 Recovery control 43
6.16 Compressor capacity limitation **44**
6.17 Unit limitation **44**
6.18 Evaporator pumps **45**
6.18.1 Inverter pump 45
6.19 Fans control **46**
6.19.1 Fantroll 47
6.19.2 Fan Modular 49
6.19.3 Variable Speed Driver 49
6.19.4 Speedtroll 51
6.19.5 Double VSD 51
6.20 Other functions **51**
6.20.1 Hot Chilled Water Start 51
6.20.2 Fan Silent Mode 51
6.20.3 Double evaporator units 51
7 START-UP SEQUENCE **52**
7.1 Unit start-up and shut-down flowcharts **52**
7.2 Heat recovery start-up and shut-down flowcharts **55**
8 USER INTERFACE **58**
8.1 Form tree **61**
8.2 Languages **63**
8.3 Units **63**
8.4 Default passwords **64**
9 APPENDIX A: DEFAULT SETTINGS **65**
10 APPENDIX B: SOFTWARE UPLOAD TO THE CONTROLLER **71**
10.1 Direct upload from PC **71**
10.2 Upload from programming key **72**
11 APPENDIX C: PLAN SETTINGS **73**

12 REMARK: IT IS POSSIBLE, AFTER RESTART, THAT THE TERMINAL IS STUCK ON A UNIT. THIS IS DUE TO THE FACT THAT THE MEMORY OF THE DRIVERS REMAINS FED BY THE BUFFER BATTERY AND RETAINS THE DATA OF THE PRECEDING CONFIGURATION. IN THIS CASE, WITH THE SYSTEM NOT FED, IS SUFFICIENT TO DISCONNECT BATTERIES FROM ALL THE DRIVERS AND THEN CONNECT THEM AGAIN APPENDIX D: COMMUNICATION 74

12.1 Output variables 74

12.1.1 Variable Chiller Status description 75

12.1.2 Description of variable sent on index I22 (Modbus register 40151)........ 76

12.2 Input variables 77

12.3 Configuration variables........ 78

12.4 Alarms........ 78

12.4.1 Alarm words I1 – I16 78

1 CONTENTS

This manual provides installation, setup and troubleshooting information for the ASDU01A controller.

Any operational description contained in this manual is based on control software version ASDU01A and following revisions.

Chiller operating characteristics and menu selections may be different from other versions of the control software. Contact Daikin for software update information.

1.1 Installation Precautions

Warning

Electric shock hazard. Injury to personnel or damage to equipment may occur. This equipment must be properly grounded. Connections and service of the control panel must be performed only by personnel that are knowledgeable in the operation of the equipment being controlled.

Caution

Static sensitive components. A static discharge while handling electronic circuit boards can cause damage to the components. Discharge any static electrical charge by touching the bare metal inside the control panel before performing any service work. Never unplug any cables, circuit board terminal blocks, or power plugs while power is applied to the panel.

1.2 Temperature and Humidity considerations

The controller is designed to operate within an ambient temperature range of –40°C to +65°C with a maximum relative humidity of 95% (non-condensing).

Please refer to ref. 1 for operating limits.

1.3 Associated literature

Carel - pCO^2 electronic programmable controller – User Manual

2 GENERAL DESCRIPTION

The control panel contains a microprocessor-based controller which provides all monitoring and control functions required for the safe and efficient operation of the chiller. The operator can monitor all the operating conditions by using the built in 4-line, 20-character display and the 6-key keypad or by using an additional (optional) remote semi-graphical display or an IBM compatible computer running a Daikin-compatible monitoring software.

If a fault condition arises, the controller will shut down the system and activate an alarm output. Important operating conditions at the time the alarm occurs are recorded in the controller's memory to aid in troubleshooting and fault analysis.

The system is protected by a password scheme, which allows access only to authorized personnel. The operator must enter a password into the panel keypad before any configuration may be changed.

3 MAIN FEATURES OF CONTROL SOFTWARE

- Management of air-cooled chillers and heat pumps equipped with step-less screw compressors.
- Control of evaporator outlet temperature within a ± 0.1°C deviation range (under stable load conditions).
- Management of sudden load drops of up to 50% with max 3°C controlled temperature oscillation.
- Readout of all the main operating parameters of the unit (temperatures, pressures, etc.).
- Fans control (for condensation control in chiller units and evaporation control in heat pump units) with step logic (Fantroll configuration), single or double fan speed controllers (VSD and double VSD configuration), and combined step + speed control (Speedtroll configuration).
- Condensation (or evaporation) control for efficient operation. This control is based on either the condensation (evaporation) saturated temperature or the compressor pressure ratio.
- Double set-point –with local or remote switch- for water outlet temperature.
- Setpoint override using an external signal (4-20 mA) –either evaporator return temperature or outside ambient temperature-.
- Adjustable max pull-down rate to reduce undershooting during system load drops.
- Hot water Start function that allows to start the unit even under high temperature conditions of the chilled water through the evaporator.
- SoftLoad feature that reduces electrical consumption and peak demand costs during loop pull-down.
- Power limiting feature, that allows to limit the electrical consumption of the unit, based on either current consumption (current limit) or capacity demand (demand limit).
- Fan Silent Mode that allows to reduce the noise of the unit by limiting fans speed in accordance with a time schedule.
- Management of two evaporator water pumps.
- Keypad for a user-friendly interface. The operator can log the operating conditions of the chiller on the 4-line, 20-column backlight display.
- Three levels of security protection against unauthorized access.
- Diagnostic system which stores last 10 alarms with date, time, and working conditions at the time the alarm occurred.
- Weekly and yearly start-stop time schedule
- Easy integration into building automation systems via separate digital connection for unit start/stop and 4-20 mA signals for chilled water temperature set-point and limitation of demand
- Communications capabilities for remote monitoring, set-point modification, trend logging, alarm and event detection, via a compatible IBM-PC.
- BAS communication capability via selectable protocol (Protocol Selectability) or Communication Gateway.
- Remote communication capabilities via analogue or GSM Modem.

4 SYSTEM ARCHITECTURE

***Possible configuration modular architecture is based on the use of the control.

In particular, a base controller (large version, built-in display, or, optionally, semi graphical additional display) is used to control the basic unit functions and to manage the first two compressors; a second controller (large version) is used to manage the third and fourth compressor if they are present.

Up to four pCO^e expansion boards for each controller can be used to add optional features to the control.

Drivers for electronic expansion valve are optional.

The overall architecture is shown in fig. 1.

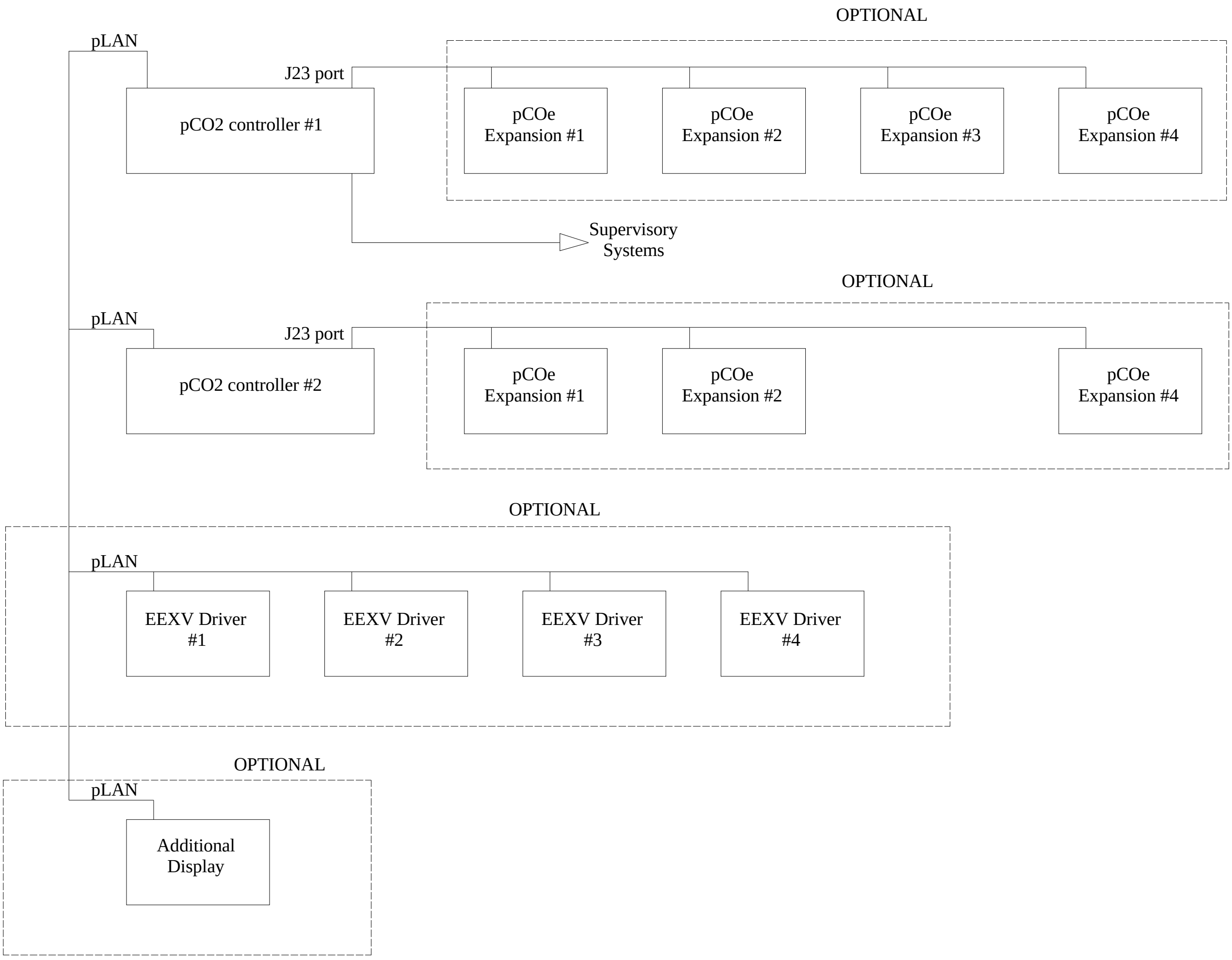


Figure 1 – Controller architecture

J23 port	J23 port
OPTIONAL	OPTIONAL
pCO2 controller #1	pCO2 controller #1
pCOe Expansion #1	pCOe Expansion #1
Supervisory systems	Supervisory systems
EEXV Driver #1	EEXV Driver #1

Additional display	Additional display

ASDU01A controllers, electronic expansion valves drivers and the additional display are connected through the pLAN network of ASDU01A controls while pCO^e expansion boards are connected to ASDU01A controllers through the RS485 expansion network.

Table 1 - Hardware configuration

Board	Type	Function	Mandatory
Controller #1	Large Built-in display (*)	Unit control Control of compressors #1 & #2	Y
Controller #2	Large	Control of compressors #3 & #4	Only in units with 3 or 4 compressors
pCO^e #1	-	Additional hardware for compressors #1 & 2 or for compressors #3 & #4 (**)	N
pCO^e #2	-	Heat recovery or Heat pump control (***)	N
pCO^e #3	-	Water pump control	N
pCO^e #4	-	Additional hardware for compressors #1 & 2 or for compressors #3 & #4 (**)	N
EEXV driver #1	EVD200	Control of electronic expansion valve for compressor #1	N
EEXV driver #2	EVD200	Control of electronic expansion valve for compressor #2	N
EEXV driver #3	EVD200	Control of electronic expansion valve for compressor #3	N
EEXV driver #4	EVD200	Control of electronic expansion valve for compressor #4	N
Additional display	PGD	Special characters or additional display	N

(*) Concurrence of built-in display and additional PGD may be accepted.
(**) Depending on the pLAN address of the controller to which the expansion is connected.
(***) Connection of pCO^e #2 to controller #2 is intended only for heat pump control.

4.1 Control Panel

The Control Panel consists of a 4-line by 20-character backlit display with a 6-key keypad whose functions are described below.

This display can be either a built-in component of the master controller (standard option) or a separate optional device based on PGD serigraphic technology.

Figure 2 - Control panel – PGD option and built-in display

No setting is required for the built-in display, while PGD device requires addressing based on a procedure through keypad (see the appendix on pLAN settings for details).

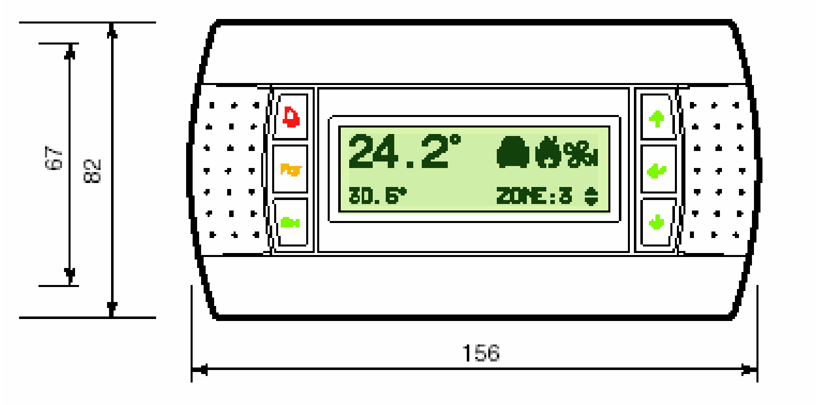
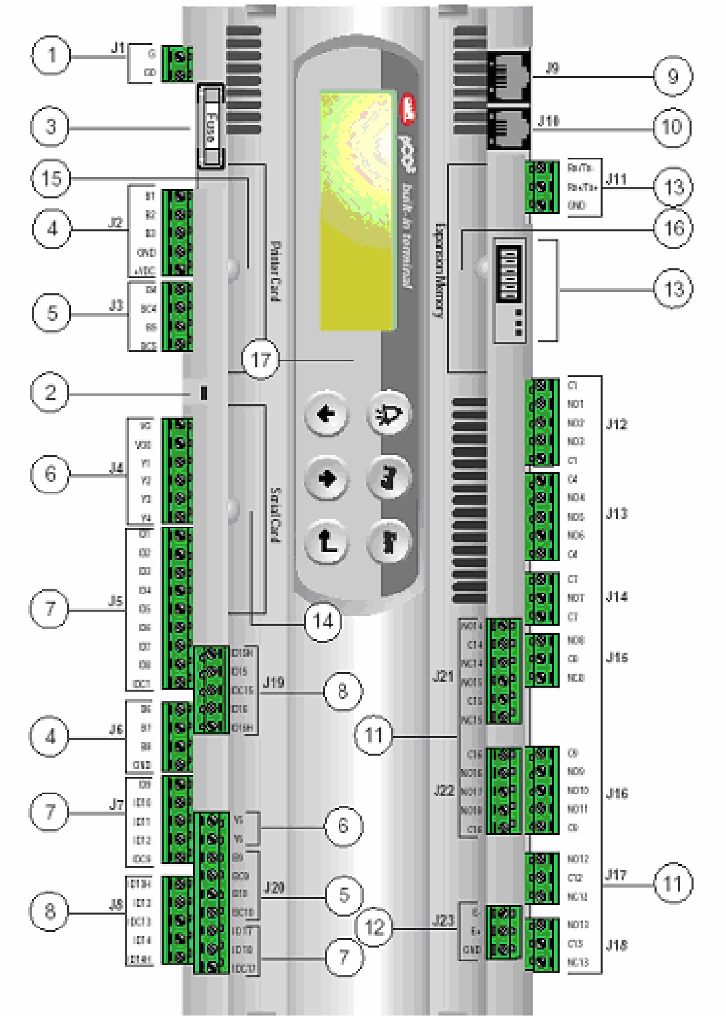


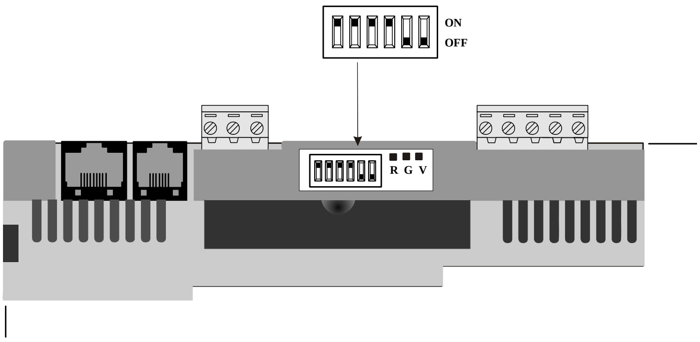
Figure 3 – PGD Display

4.2 Main board

The control board contains the hardware and the software necessary to monitor and to control the unit.



1. Power supply G (+), G0 (-)
2. Status LED
3. Fuse 250Vac
4. Universal analogue inputs (NTC, 0/1V, 0/10V, 0/20mA, 4/20mA)
5. Passive analogue inputs (NTC, PT1000, On-off)
6. Analogue outputs 0/10V
7. 24Vac/Vdc digital inputs
8. 230Vac or 24Vac/Vdc digital inputs
9. Synoptic terminal connection
10. Standard terminal (and program download) connector
11. Digital Outputs (relays)
12. Expansion board connection
13. pLAN connection and micro-switches
    Serial card connection
14. Printer card connection
15. Memory expansion connection
16. Built-in panel

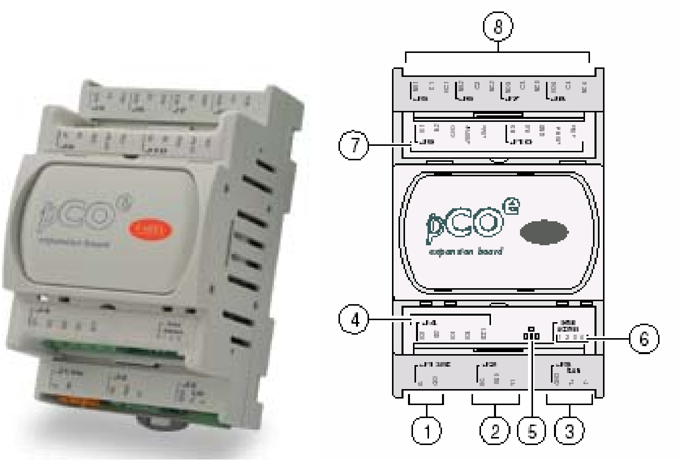


Address Micro-switches

Figure 4 – ASDU01A controller

4.3 pCO^e Expansion

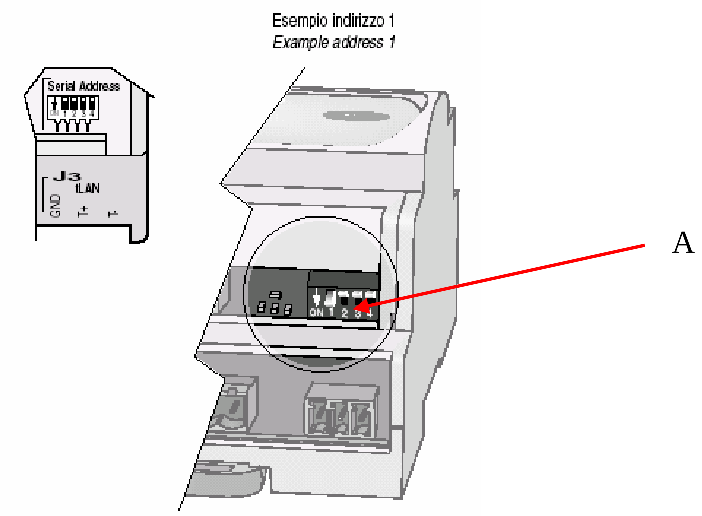
The introduction of additional (optional) functionality in the controller architecture requires the use of the expansion boards shown in figures 5-6.



1. Power supply connector [G (+), G0 (-)]
2. Analogue output 0 to 10 V
3. Network connector for expansions in RS485 (GND, T+, T-) or tLAN (GND, T+)
4. 24Vac/Vdc digital inputs
5. Yellow LED showing power supply voltage and 3 signalling LEDs
6. Serial address
7. Analogue inputs and sensor supply
8. Relay digital outputs

Figure 5 - pCO^e expansion

This device must be addressed to ensure correct communication with controller via RS485 protocol. Addressing micro-switches are placed nearby status LEDs (refer to item ⑥ in figure 5). Once the address is correctly set, the expansion could be linked to the controller board. The correct connection is achieved by connecting pin J23 on the controller to pin J3 on the expansion board (note that the expansion board connector is different from the controller one, but wires must be placed in the same positions of connectors). Expansion boards are only I/O extensions for the controller and don’t need any software.



A. Address switches

Figure 6 – pCO^{e} detail: switches

As shown in figure 6, expansion boards have only four micro-switches to set the net address. For more details on micro-switches configuration refer to next section.

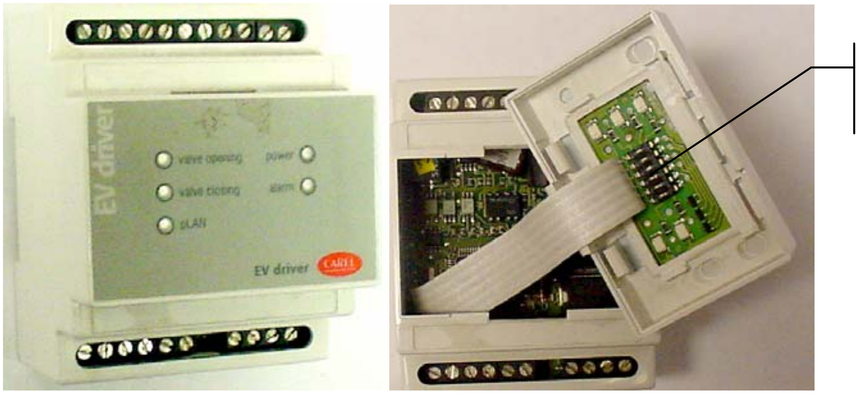
There are three status LEDs, each one indicating a different condition of the expansion board, as follows.

Table 3 – pCO^{e} LEDs meaning

RED	**YELLOW**	**GREEN**	**Meaning**
-	-	**ON**	CAREL /tLAN supervisory protocol active
-	**ON**	-	Sensor/input error
ON	-	-	“I/O mismatch” error caused by the inhibition matrix
flashing	-	-	Communication failure
-	-	-	Waiting for the system start-up by the master (max. 30 s)

4.4 EEXV Valve Driver

The valve drivers contain the software for the control of the electronic expansion valve and are connected to the battery group which provides power to close valve in case of power failure.



A. Address Micro-switches

Figure 7 – EXV driver

4.4.1 Meaning of the EEXV Driver status LEDs

Under normal conditions, five (5) LEDs indicate:

- POWER: (yellow) remains On in presence of supply. Remains Off in case of battery operation
- OPEN: (green) Flashing during the valve opening. On when valve is fully open.
- CLOSE: (green) Flashing during the valve opening. On when valve is fully close.
- Alarm: (red) On or flashing in case of hardware alarm
- pLAN: (green) On during the normal working of pLAN.

In the event of a critical alarm, the malfunction can be identified by observing the status of the LEDs as shown below.

Highest priority is level 7. When more than one alarm occur, only the one with the highest priority level is shown.

Table 4 – Meaning of Driver alarm LEDs

Alarms that will shutdown the system	**PRIORITY**	**LED "OPEN"**	**LED "CLOSE"**	**LED "POWER"**	**LED "ALARM"**
Eprom reading error	7	**Off**	**Off**	**On**	**Flashing**
Valve remains open on power failure	6	**Flashing**	**Flashing**	**On**	**Flashing**
At start up, wait for battery loading (parameter……….)	5	**Off**	**On**	**Flashing**	**Flashing**
Other alarms	**PRIORITY**	**LED "OPEN"**	**LED "CLOSE"**	**LED "POWER"**	**LED "ALARM"**
Motor connection failure	4	**Flashing**	**Flashing**	**On**	**On**
Sensor/input error	3	**Off**	**Flashing**	**On**	**On**
Eeprom writing error	2	-	-	**On**	**On**
Battery error	1	-	-	**Flashing**	**On**

pLAN	**LED pLAN**
Connection OK	On
Driver connection or address error = 0	Off
The Pco Master doesn't answer	Flashing

4.5 Addressing of pLAN/RS485

Each component, as previously described, has a series of micro-switches that must be configured as specified in the following table to set the above listed Lan addressing

Table 5 – Micro-switch settings

pLAN component	Micro-switches					
	1	2	3	4	5	6
COMP. BOARD #1	**ON**	OFF	OFF	OFF	OFF	OFF
COMP. BOARD #2	OFF	**ON**	OFF	OFF	OFF	OFF
DRIVER EXV #1	**ON**	**ON**	OFF	OFF	OFF	OFF
DRIVER EXV #2	OFF	OFF	**ON**	OFF	OFF	OFF
DRIVER EXV #3	**ON**	OFF	**ON**	OFF	OFF	OFF
DRIVER EXV #4	OFF	**ON**	**ON**	OFF	OFF	OFF
Additional DISPLAY	**ON**	**ON**	**ON**	OFF	**OFF**	OFF
RS485 component	**Micro-switch**					
	1	**2**	**3**	**4**		
EXP. BOARD #1	**ON**	OFF	OFF	OFF		
EXP. BOARD #2	OFF	**ON**	OFF	OFF		
EXP. BOARD #3	**ON**	**ON**	OFF	OFF		
EXP. BOARD #4	OFF	OFF	**ON**	OFF		

4.6 Software

Only one control software program is installed for both controllers (if two are present); the unit controller is identified by its pLAN address.

No program is installed on pCO^e boards or EEXV drivers (a factory-installed software is used instead).

A pre-configuration procedure is available in each controller to recognize the whole network hardware configuration; the configuration is stored in the controller in a permanent memory and an alarm is generated if the hardware configuration would change during the operation (network or boards faults or added boards).

The pre-configuration procedure will automatically start at the first boot of the unit (after the software is installed); it is possible to activate it manually (network refresh) if network configuration changes, either if an expansion is permanently removed or if a new expansion is linked after the first software boot.

Changes in the network configuration without network refresh will generate alarms, either if an expansion is removed (or faulted) or if a new expansion is added.

The configuration of functions requiring expansion boards are allowed only if expansion boards have been recognized in the network configuration.

Network refresh is required in case of controller replacement.

Network refresh is not required in case of replacement of a fault expansion board already used in the system.

4.6.1 Version identification

In order to unambiguously identify the software class and version, a string made of four fields is used (this also applies to other Daikin control software):

C_1	C_2	C_3	F	M	M	m

- An identification three-letter code (**$C_1C_2C_3$**) to identify the class of units for which the software is valid

  The first digit **C_1** defines the chiller cooling type and may assume the following values:
  A : for air-cooled chillers
  W : for water-cooled chillers

  The second digit **C_2** defines the compressor type and may assume the following values:
  S : for screw compressors
  R : for reciprocating compressors
  Z : for scroll compressors
  C : for centrifugal compressors
  T : for Turbocor compressors

  The third digit **C_3** defines the evaporator type and may assume the following values:
  D : for direct expansion evaporator
  R : for remote evaporator
  F : for flooded evaporator

- A single-digit code (**F**) to identify the unit range
  Within the scope of this document (screw chillers having a C_2 code value "S") it may have the following values
  A : Frame 3100 range
  B : Frame 3200 range
  C : Frame 4 range
  U : when the software is applicable to all ranges within the class

- A major version two-digit numeric code (**MM**)
- A minor version single-digit numeric code (**m**)

  Within the scope of this document, the first version is:

ASDU01A

Any version is also identified by a release date.

The first three digits of the version string never change (unless a new unit class, and consequently a new software is released).

The fourth digit is changed if a range-specific feature is added which is not applicable to other ranges; in this case the U value may not be used anymore and a software for any range is released. When this happens the version (**MMm**) digit is reset to the lower value.

The major version number (**MM**) is increased any time a completely new function is introduced in the software, or when the minor version digit has reached the maximum allowed value (Z).

The minor version digit (**m**) is increased any time minor modification is introduced in the software without modifying its main working mode (this includes bug fixing and minor interface modifications).

A label is added in the case of engineering versions; it consists of a letter digit E followed by a two-digit number for sequential identification.

Engineering versions are versions preceding final release of the software, they can also be used for field validation.

So the info form will appear as follows for non-engineering version

							M	c	Q	u	a	y							
			I	n	t	e	r	n	a	t	i	o	n	a	l				
					C	o	d	E	:	M	T	M							
	A	S	D	X	X	Y					d	d	/	m	m	/	y	y	

While, for engineering versions it will appear as follows

							M	c	Q	u	a	y							
			I	n	t	e	r	n	a	t	i	o	n	a	l				
					C	o	d	e	:	M	T	M							
	A	S	D	X	X	Y	E	N	N		d	d	/	m	m	/	y	y	

5 FINAL PHYSICAL INPUTS AND OUTPUTS

The following parameters are inputs and outputs of the electronic boards.

They are used internally and/or sent to pLAN and supervisory system depending on software requirements.

5.1 Controller #1 – Control of base unit and compressors #1 & #2

Analogue Input				Digital Input	
Ch.	**Description**	**Type**		**Ch.**	**Description**
B1	Oil Pressure #1	4 -20mA		DI1	On/Off Comp #1 (Cir. #1 Shut-off)
B2	Oil Pressure #2	4 -20mA		DI2	On/Off Comp #2 (Cir. #2 Shut-off)
B3	Suction Pressure #1 (*)	4 -20mA		DI3	Evaporator Flow Switch
B4	Discharge Temperature #1	PT1000		DI4	PVM or GPF Unit or #1 (**)
B5	Discharge Temperature #2	PT1000		DI5	Double set-point
B6	Discharge Pressure #1	4 -20mA		DI6	High Press. Switch #1
B7	Discharge Pressure #2	4 -20mA		DI7	High Press. Switch #2
B8	Suction Pressure #2 (*)	4 -20mA		DI8	Oil Level Switch #1 (**)
B9	Water inlet temp. Sensor	NTC		DI9	Oil Level Switch #2 (**)
B10	Water outlet temp. Sensor	NTC		DI10	1st or 2nd fan speed control fault #1 (**)
				DI11	1st or 2nd fan speed control fault #1 (**)
				DI12	Transition or Solid State Fault #1
				DI13	Transition or Solid State Fault #
				DI14	Overload or Motor Protection #
				DI15	Overload or Motor Protection #
				DI16	Unit On/Off
				DI17	Remote On/Off
				DI18	PVM or GPF #2 (**)

Analogue Output				Digital Output	
Ch.	**Description**	**Type**		**Ch.**	**Description**
AO1	Fan Speed control #1	0-10Vdc		DO1	Start Comp #1
AO2	Second Fan Speed control #1 or Fan Modular output #1	0-10Vdc		DO2	Load Comp #1
AO3	SPARE			DO3	Unload Comp #1
AO4	Fan Speed control #2	0-10Vdc		DO4	Liquid Injection #1
AO5	Second Fan Speed control #2 or Fan Modular output #2	0-10Vdc		DO5	Liquid Line #1 (*)
AO6	SPARE			DO6	1st Fan step #1
				DO7	2nd Fan Step #1
				DO8	3rd Fan Step #1
				DO9	Start Comp #2
				DO10	Load Comp #2
				DO11	Unload Comp #2

			DO12	Evaporator Water Pump
			DO13	Unit Alarm
			DO14	Liquid Injection #2
			DO15	Liquid Line #2 (*)
			DO16	1st Fan step #2
			DO17	2nd Fan Step #
			DO18	3rd Fan Step #

(*) In case EEXV driver is not installed. If EEXV driver is installed, low pressures should be detected through EEXV driver.
(**) Optional

5.2 Controller #2 – Control of compressors #3 & #4

Analogue Input			**Digital Input**	
Ch.	**Description**	**Type**	**Ch.**	**Description**
B1	Oil Pressure #3	4 -20mA	DI1	On/Off Comp #3
B2	Oil Pressure #4	4 -20mA	DI2	On/Off Comp #4
B3	Suction Pressure #3 (*)	4 -20mA	DI3	SPARE
B4	Discharge Temperature #3	PT1000	DI4	PVM or GPF #3 (***)
B5	Discharge Temperature #4	PT1000	DI5	SPARE
B6	Discharge Pressure #3	4 -20mA	DI6	High Press. Switch #3
B7	Discharge Pressure #4	4 -20mA	DI7	High Press. Switch #4
B8	Suction Pressure #4 (*)	4 -20mA	DI8	Oil Level Switch #3 (***)
B9	Water outlet temp., evap. #1 (**)	NTC	DI9	Oil Level Switch #4 (***)
B10	Water outlet temp., evap. #2 (**)	NTC	DI10	Low Press. Switch #3 (***)
			DI11	Low Press. Switch #4 (***)
			DI12	Transition or Solid State Fault #3
			DI13	Transition or Solid State Fault #4
			DI14	Overload or Motor Protection #3
			DI15	Overload or Motor Protection #4
			DI16	1st or 2nd fan speed control fault #3 (**)
			DI17	1st or 2nd fan speed control fault #4 (**)
			DI18	PVM or GPF #4 (***)

Analogue Output			**Digital Output**	
Ch.	**Description**	**Type**	**Ch.**	**Description**
AO1	Fan Speed control #3	0-10Vdc	DO1	Start Comp #3
AO2	Second Fan Speed control #3 or Fan Modular output #3	0-10Vdc	DO2	Load Comp #3
AO3	SPARE		DO3	Unload Comp #3
AO4	Fan Speed control #4	0-10Vdc	DO4	Liquid Injection #3
AO5	Second Fan Speed control #4 or Fan Modular output #4	0-10Vdc	DO5	Liquid Line #3 (*)

AO6	SPARE			DO6	1st Fan step #
				DO7	2nd Fan Step #
				DO8	3rd Fan Step #
				DO9	Start Comp #4
				DO10	Load Comp #4
				DO11	Unload Comp #4
				DO12	SPARE
				DO13	SPARE
				DO14	Liquid Injection #4
				DO15	Liquid Line #4 (*)
				DO16	1st Fan step #
				DO17	2nd Fan Step #
				DO18	3rd Fan Step #

(*) In case EEXV driver is not installed. If EEXV driver is installed, low pressure is detected through EEXV driver.
(**) Only for units with 2 evaporators
(***) Optional

5.3 pCOe expansion #1 – Additional hardware

5.3.1 Expansion connected to controller #1

Analogue Input				**Digital Input**	
Ch.	**Description**	**Type**		**Ch.**	**Description**
B1	Comp. Capacity Sensor #1	4 -20mA		DI1	SPARE
B2	Comp. Capacity Sensor #2	4 -20mA		DI2	SPARE
B3	Suction Temp #1 (**)	NTC		DI3	Low Pressure Switch #1 (*)
B4	Suction Temp #2 (**)	NTC		DI4	Low Pressure Switch #2 (*)

Analogue Output				**Digital Output**	
Ch.	**Description**	**Type**		**Ch.**	**Description**
AO1	SPARE			DO1	Compressor #1 alarm (*)
				DO2	Compressor #2 alarm (*)
				DO3	Economizer #1 (*)
				DO4	Economizer #2 (*)

(*) Optional
(**) In case EEXV driver is not installed. If EEXV driver is installed, suction temperature is detected through EEXV driver.

5.3.2 Expansion connected to controller #2

Analogue Input				**Digital Input**	
Ch.	**Description**	**Type**		**Ch.**	**Description**
B1	Comp. Capacity Sensor #3 (*)	4 -20mA		DI1	SPARE
B2	Comp. Capacity Sensor #4 (*)	4 -20mA		DI2	SPARE
B3	Suction Temp #3 (**)	NTC		DI3	Low Pressure Switch #3 (*)
B4	Suction Temp #4 (**)	NTC		DI4	Low Pressure Switch #4 (*)

Analogue Output				Digital Output	
Ch.	**Description**	**Type**		**Ch.**	**Description**
AO1	SPARE			DO1	Compressor #3 (*)
				DO2	Compressor #4 (*)
				DO3	Economizer #3 (*)
				DO4	Economizer #4 (*)

(*) Optional
(**) In case EEXV driver is not installed. If EEXV driver is installed, suction temperature is detected through EEXV driver.

5.4 pCO^{e} expansion #2 – Heat recovery or heat pump control

Heat recovery and heat pump versions are alternative; one of them excludes the other one; which one is operating is selected by the manufacturer setting.

5.4.1 Heat recovery option

Analogue Input				Digital Input	
Ch.	**Description**	**Type**		**Ch.**	**Description**
B1	Ambient temperature sensor			DI1	Heat Recovery switch
B2	SPARE			DI2	Heat Recovery Flow switch
B3	HR water inlet sensor	NTC		DI3	SPARE
B4	HR water outlet sensor	NTC		DI4	SPARE

Analogue Output				Digital Output	
Ch.	**Description**	**Type**		**Ch.**	**Description**
AO1	Heat Recovery Bypass valve (*)	4 -20mA		DO1	4 Way valve, HR #1
				DO2	4 Way valve, HR #2
				DO3	4 Way valve, HR #3
				DO4	4 Way valve, HR #4

(*) Optional

5.4.2 Heat pump option

5.4.2.1 Expansion connected to controller #1

Analogue Input				Digital Input	
Ch.	**Description**	**Type**		**Ch.**	**Description**
B1	Ambient temperature sensor	NTC		DI1	Heating/Cooling Switch
B2	Defrost Sensor #1 (*)	NTC		DI2	SPARE
B3	Defrost Sensor #2 (*)	NTC		DI3	SPARE
B4	SPARE			DI4	SPARE

Analogue Output				Digital Output	
Ch.	**Description**	**Type**		**Ch.**	**Description**
AO1	Heat Pump Bypass valve	4 -20mA		DO1	4 Way valve Comp #1
				DO2	Suction liquid injection #1
				DO3	4 Way valve Comp #
				DO4	Suction liquid injection #2

(*) In case EEXV driver is not installed. If EEXV driver is installed, defrost temperature should be detected through EEXV driver (suction temperature).
(**) Optional

5.4.2.2 Expansion connected to controller #2

Analogue Input		
Ch.	**Description**	**Type**
B1	SPARE	NTC
B2	Defrost Sensor #3 (*)	NTC
B3	Defrost Sensor #4 (*)	NTC
B4	SPARE	

Digital Input	
Ch.	**Description**
DI1	SPARE
DI2	SPARE
DI3	SPARE
DI4	SPARE

Analogue Output		
Ch.	**Description**	**Type**
AO1	SPARE	4 -20mA

Digital Output	
Ch.	**Description**
DO1	4 Way valve Comp #3
DO2	Suction liquid injection #3
DO3	4 Way valve Comp #4
DO4	Suction liquid injection #4

(*) In case EEXV driver is not installed. If EEXV driver is installed, defrost temperature should be detected through EEXV driver (suction temperature).

5.5 pCOe expansion #3 – Water pump control

Analogue Input		
Ch.	**Description**	**Type**
B1	SPARE	
B2	SPARE	
B3	SPARE	
B4	SPARE	

Digital Input	
Ch.	**Description**
DI1	First pump Alarm
DI2	Second pump Alarm
DI3	First HR pump Alarm (*)
DI4	Second HR pump Alarm (*)

Analogue Output		
Ch.	**Description**	**Type**
AO1	SPARE	

Digital Output	
Ch.	**Description**
DO1	Second water pump
DO2	SPARE
DO3	First HR pump (*)
DO4	Second HR pump (*)

(*) Optional

5.6 pCOe expansion #4 – Additional Fan step control

5.6.1 Expansion connected to controller #1

Analogue Input				Digital Input	
Ch.	Description	Type		Ch.	Description
B1	Setpoint Override	4 -20mA		DI1	Current Limit Enable
B2	Demand limit	4 -20mA		DI2	External Alarm
B3	SPARE			DI3	SPARE
B4	Unit Amps.	4 -20mA		DI4	SPARE

Analogue Output				Digital Output	
Ch.	Description	Type		Ch.	Description
AO1	SPARE			DO1	4° Fan Step comp. #1
				DO2	5° Fan Step comp. #1
				DO3	4° Fan Step comp. #2
				DO4	5° Fan Step comp. #2

(*) Only if heat pump board is not present

5.6.2 Expansion connected to controller #2

Analogue Input				Digital Input	
Ch.	Description	Type		Ch.	Description
B1	SPARE			DI1	SPARE
B2	SPARE			DI2	SPARE
B3	SPARE	4 -20mA		DI3	SPARE
B4	SPARE	4 -20mA		DI4	SPARE

Analogue Output				Digital Output	
Ch.	Description	Type		Ch.	Description
AO1	SPARE			DO1	4° Fan Step comp. #3
				DO2	5° Fan Step comp. #3
				DO3	4° Fan Step comp. #4
				DO4	5° Fan Step comp. #5

(*) Only if heat pump board is not present

EXV Driver

Analogue Input		
Ch.	Description	Type
B1	Suction temperature #1, #2, #3, #4 (*)	NTC
B2	Suction pressure #1, #2, #3, #4 (*)	4 -20mA

(*) Depending on pLan address of Driver

6 MAIN CONTROLLER FEATURES

6.1 Controller purpose

The system will control the evaporator water outlet temperature to keep it at the set-point value.

The system optimizes the efficiency and reliability of its components.

The system assures a safe operation of the unit and of all components and prevents dangerous situations.

6.2 Unit enabling

The control allows different ways to enable/disable the unit:

Local Switch: when the digital input “Unit On/Off” is open, the unit is in “Local switch Off”; when the digital input “Unit On/Off” is closed, the unit may be in “Unit On” or “Remote switch Off” depending on the “Remote On/Off “ digital input

Remote Switch: when the local switch is On (“Unit On/Off” digital input closed), if the digital input “Remote On/Off “ is closed, the unit status is “Unit On”; when the digital input “Remote On/Off “ is open, the unit is in “Remote switch Off”

Network: a BAS or a Monitoring system may send an On/Off signal trough the serial line connection to put the unit on or in “Rem. Comm. Off”

Time schedule: a timetable allows to program “Time Schedule Off” on a weekly base; several holiday days are included.

Ambient LockOut: the unit is not enabled to operate unless the ambient temperature is higher than an adjustable value (default 15.0°C (59.0 F))

For a “Unit On” condition, all applicable signals must enable the unit.

6.3 Unit modes

The unit can work in the following modes:

- Cooling:
  When this mode is selected the control will operate to cool the evaporator water; the set-point range is 4.4 ÷15.5°C (40 ÷ 60 F), a freeze alarm set-point is set to 2°C (34.6 F) (adjustable by the operator in the range 1÷3°C (33.8 ÷ 37.4 F)), and a freeze prevention set-point is set to 3°C (37.4 F) (adjustable by the operator in the range: “freeze alarm set-point” + 1 ÷ +3 °C (“freeze alarm set-point” + 1.8 F ÷ 37.4 F))

- Cooling/Glycol:
  When this mode is selected the control will operate to cool the evaporator water; the set-point range is -6.7°C ÷ +15.5°C (20 ÷ 60 F), a freeze alarm set-point is set to –10°C (14.0 F) (adjustable by the operator in the range –12°C ÷ -9°C (10.4 ÷ 15.8 F)) and a freeze prevention

set-point is set to –9°C (15.8 F) (adjustable by the operator in the range "freeze alarm set-point" + 1°C ÷ -9 °C ("freeze alarm set-point" + 1.8 F ÷ 15.8 F))

- Ice:
  When this mode is selected the control will operate to cool the evaporator water; the set-point range is -6.7°C ÷ +15.5°C (20 ÷ 60 F), a freeze alarm set-point is set to –10 °C (14.0 F) (adjustable by the operator in the range –12 °C ÷ -9°C (10.4 ÷ 15.8 F)) and a freeze prevention set-point is set to –9°C (15.8 F) (adjustable by the operator in the range "freeze alarm set-point" + 1°C ÷ -9°C ("freeze alarm set-point" + 1.8 F ÷ 15.8 F))
  While working in ice mode, compressors are not allowed to unload but are stopped using a step procedure (see § 6.5.3)

- Heating:
  When this mode is selected the control will operate to heat the evaporator water; the set-point range is +30 ÷ +45°C (86 ÷ 113°C), a hot water alarm set-point is set to 50°C (adjustable by the operator in the range +46 ÷ +55°C (114.8 ÷ 131 F)) and a hot prevention set-point is set to 48°C (118.4 F) (adjustable by the operator in the range +46°C ÷ "hot water alarm set-point" + 1°C (114.8 F ÷ "hot water alarm set-point" + 1.8 F)).

- Cooling + Heat Recovery:
  Set-points and freeze protection are managed as described in the cooling mode; in addition to this, the control will enable the heat recovery input and outputs foreseen on the expansion #2

- Cooling/Glycol + Heat Recovery:
  Set-points and freeze protection are managed as described in the cooling/glycol mode; in addition the control will enable the heat recovery input and outputs foreseen on the expansion #2

- Ice + Heat Recovery:
  Set-points and freeze protection are managed as described in the cooling mode; in addition to this, the control will enable the heat recovery input and outputs foreseen on the expansion #2

The selection between cooling, cooling/glycol and ice mode can be made by the operator using the interface under password.

Switching from cooling to ice and to heating modes causes unit shutdown.

6.4 Set-points management

The control is able to manage the evaporator water outlet temperature on a choice of input signals:

- Changing the set-point from the keypad
- Switching between the main set-point (set through the keypad) and an alternative value (set through the keypad too) which is based on a digital input signal (double set-point function)
- Receiving a set-point from a monitoring system or a BAS connected via serial line
- Resetting a set-point based on analogue inputs

The control shows the source of the used (current) set-point:

- Local : the main set-point set by keypad is being used
- Double: the alternative set-point set by keypad is being used
- Reset : the set-point is being reset by external input

The following set-point reset methods are available to modify the local or double set-point:

- None : local or double set-point based on the double set-point digital input is used. This is called “base set-point”
- 4 -20mA : base set-point will vary according to a user analogue input
- OAT : base set-point will vary as a function of outside ambient temperature (if available)
- Return : base set-point will vary as a function of evaporator water inlet temperature
- Network: the set-point sent by serial line is used

In the case of a failure in the serial connection or in the 4-20mA input, the base set-point is used. In case of a set-point reset, the system display will show the type of reset.

6.4.1 4-20mA set-point override

The base setpoint is modified depending on outside ambient temperature, on maximum reset value, on ambient temperature value where reset starting is required and on ambient temperature where reset value is required to be the maximum one.

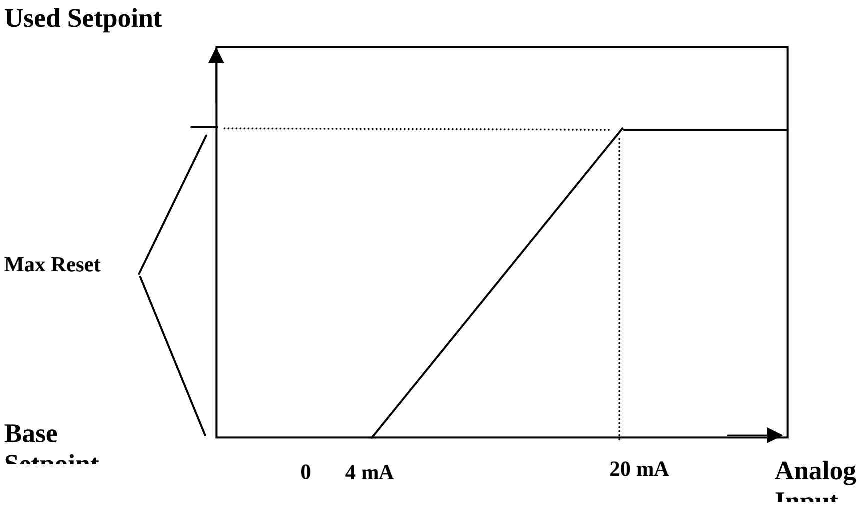


Figure 8 – 4-20mA set-point override

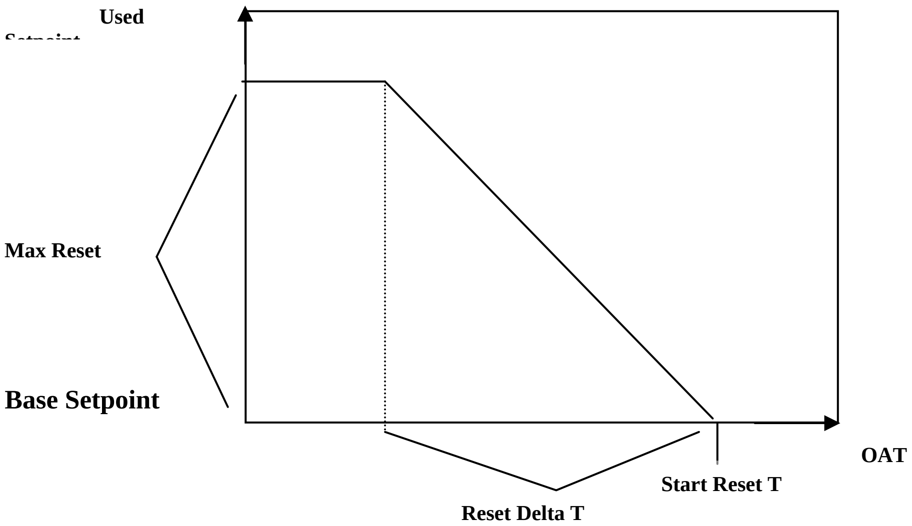
Used Setpoint	Used Setpoint
Max Reset	Max Reset
Base Setpoint	Base Setpoint
Analogue Input	Analogue Input

OAT set-point override

To enable the OAT set-point override, expansion board with the ambient sensor installed is required.

The base set-point will vary as a function of outside ambient temperature, a reset temperature start and of a max reset value, of a value of OAT to start reset and a value of OAT to apply max reset, as shown in fig 9.

Figure 9 – OAT set-point override



Used Setpoint	Used Setpoint
Max Reset	Max Reset
Base Setpoint	Base Setpoint
OAT	OAT
Reset Delta T	Reset Delta T
Start Reset T	Start Reset T

6.4.2 Return set-point override

The base set-point will vary as a function of evaporator ΔT, a reset ΔT start and a max reset value as shown in fig 10, a reset ΔT start and a max reset value

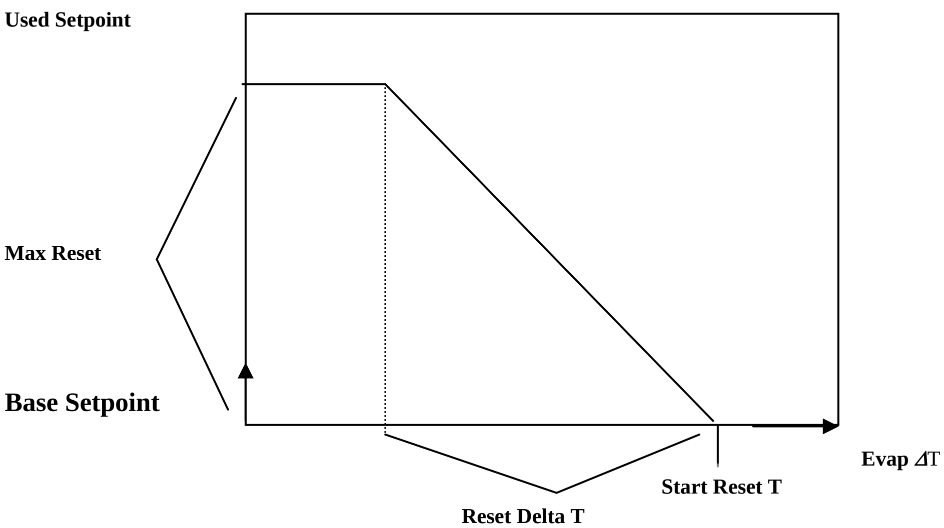


Figure 10 – Return set-point override

Used Setpoint	Used Setpoint
Max Reset	Max Reset
Base Setpoint	Base Setpoint
Evap Delta T	Evap Delta T
Reset Delta T	Reset Delta T
Start Reset T	Start Reset T

6.5 Compressors capacity control

Two types of capacity control are implemented:

- Automatic the compressor start/stop and its capacity are automatically managed by the software in order to keep a set-point value
- Manual the compressor is started by the operator and its capacity is managed by the operator acting on the system terminal. In this case, the compressor will not be controlled by the software to keep a set-point value.

Manual control is automatically switched to Automatic control if any safety action is required on the compressor (safety standby or unloading or safety shutdown). In this case, the compressor remains in Automatic mode and must be re-switched to Manual by the operator if required.

Compressors in manual mode are automatically switched to automatic mode at the time of shutdown.

The compressor load can be evaluated on the base of:

- Calculation of loading and unloading pulses

6.5.1 <u>Slide valve analogue position signal (optional) for automatic control</u>

A specialized PID algorithm is used to determine the magnitude of corrective action on capacity control solenoid.

The compressor loading or unloading is achieved by energising the loading or unloading solenoid valve for a fixed time (pulse duration), while the time interval between two subsequent pulses is evaluated by a PD controller (see fig. 11).

If the output of the PD algorithm does not change, the time interval among pulses is constant; this is the integral effect of the controller: at a constant error the action is repeated at a constant rate (dependant on a variable integral time).

The compressor load value (inferred from the slide valve position or found by calculation[1]) is used to determine whether another compressor should be run or a running one should be stopped.

It is required to define the proportional band and the derivative time of the PD control, together with the pulse duration and a minimum and maximum value for pulse interval.

The minimum pulse interval is applied when the maximum correction action is required, while the maximum interval is applied when the minimum correction action is required.

A dead band is introduced to allow to reach a stable compressor condition.

Figure 12 shows the proportional action of the controller as a function of the input parameters.

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[1] The calculation is based on the load increase (or decrease) associated to each pulse:

$$Load\ Inc\ per\ pulse\ (\%) = \frac{100-25}{n\ load\ pulse} \qquad Load\ Dec\ per\ pulse\ (\%) = \frac{100-25}{n\ unload\ pulse}$$

Being "n load pulses" and "n unload pulses" the number of pulses to load and unload the compressor.
The compressor load is evaluated by counting the number of pulses it is given.

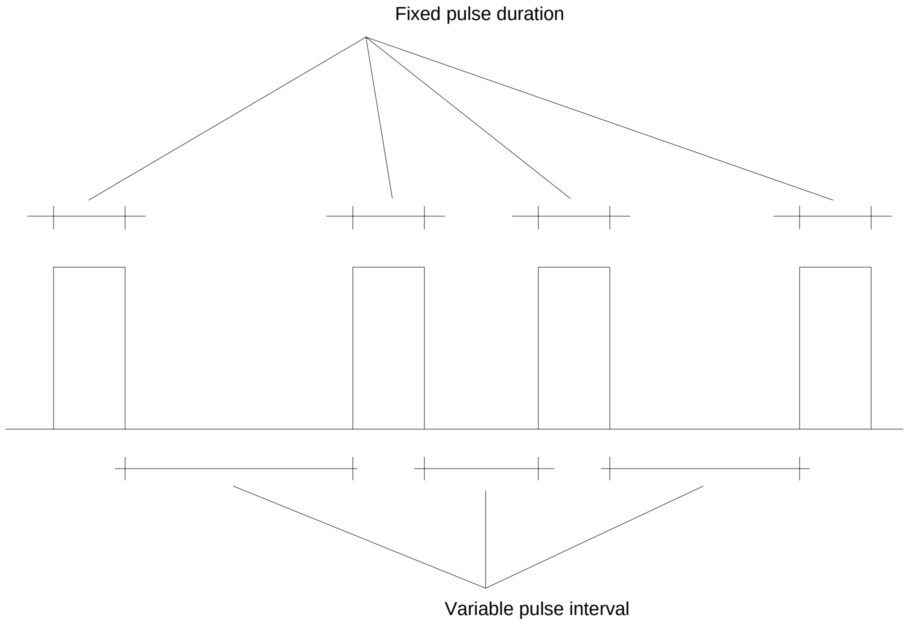


Figure 11 – Loading / unloading pulses

Fixed pulse duration	Fixed pulse duration
Variable pulse interval	Variable pulse interval

The proportional gain of the PD controller is given by:

$$K_p = \text{Max} \cdot \frac{\text{RegBand}}{2}$$

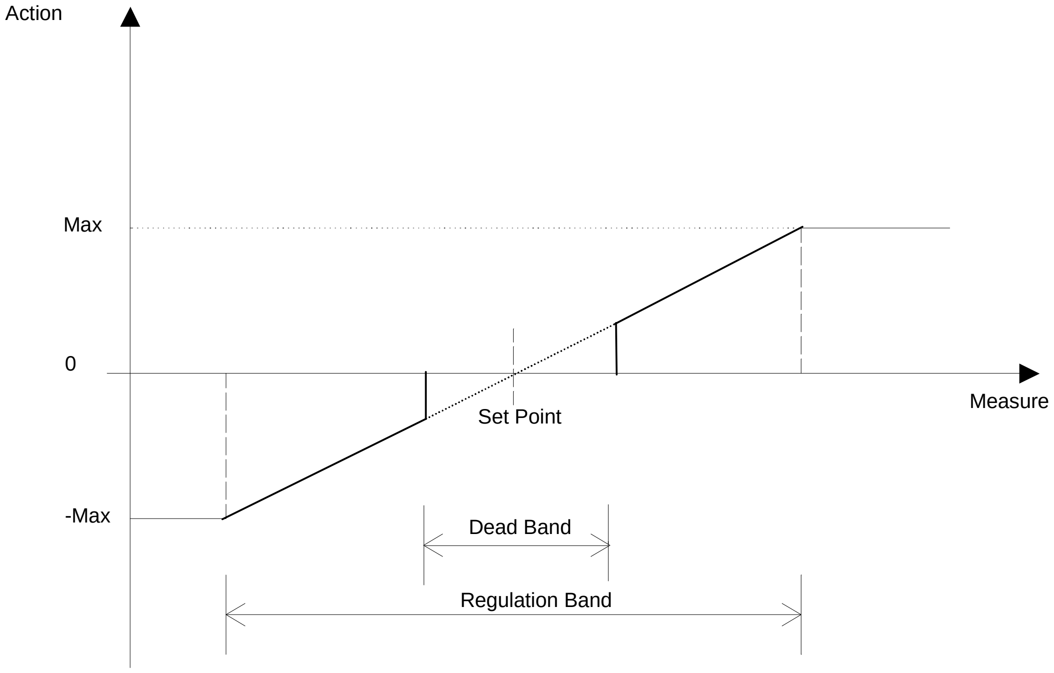


Figure 12 – PD controller proportional action

Action	Action
Measure	Measured value
Set Point	Setpoint
Dead Band	Dead band
Regulation Band	Regulation Band
Max	Max
-Max	-Max

The derivative gain of the PD controller is equal to:

$$K_d = K_p \cdot T_d$$

where T_d is the input derivative time.

In addition to the specialized PID controller, a max pull-down-rate is introduced in the control; this means that if the controlled temperature is approaching the set-point at a rate faster than a set value, any loading action is inhibited, even if required by the PID algorithm. This makes the control slower but helps prevent oscillations around set-point.

The controller is designed to act both as a “chiller” and as a “heat pump”; when the “chiller” option is selected, the controller will load the compressor if the measured temperature is above the set-point and will unload the compressor if the measured temperature is below the set-point.

When the “heat pump” option is selected, the controller will load the compressor if the measured temperature is below the set-point and will unload the compressor if the measured temperature is above the set-point.

The starting sequence of compressors is selected on the base of lower running hours (it means that the first compressor to be started is the one with the lowest number of running hour); if two compressors have the same number of running hours, the compressor with the fewest starts will run first.

A manual sequencing of compressors is allowed.

The start of the first compressor is allowed only if the absolute value of the difference between the measured temperature and the set-point exceeds a Start-up ΔT value.

The stop of the last compressor is allowed only if the absolute value of the difference between the measured temperature and the set-point exceeds a Shutdown ΔT value.

A FILO (First In - Last Off) logic is adopted.

The start/loading and unloading/stop sequence will follow the schemes in tables 7 and 8, where RDT is the Reload/Re-unload ΔT, a set value (that represents the minimum difference between the evaporator water outlet temperature and its set-point) that will cause a running compressor to reload when a compressor is shutdown or to unload when a new compressor is started.

This is made to keep the unit total capacity at the same level when the evaporator water outlet temperature is close to the set-point and the number of running compressors changes because one of the compressor stops or starts.

6.5.2 Manual Control

The control applies a fixed duration pulse (the magnitude is the pulse duration set in the automatic control) for each manual (by keyboard) load or unload signal.

In the manual control, the load/unload action follows any pressing of defined up/down keys. (see figure 13).

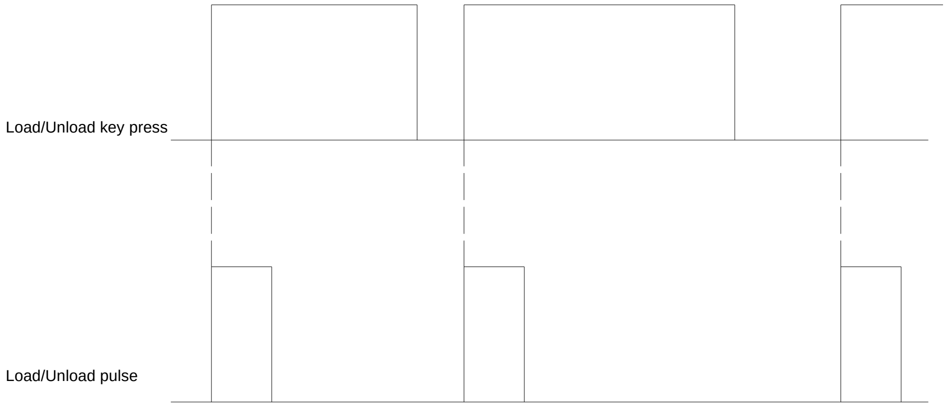


Figure 13 – Compressor manual control

Load/Unload key press	Load/Unload key press
Load/Unload pulse	Load/Unload pulse

Table 7 - Compressors start-up and loading management (4 compressors unit)

Step n.	**Leader Comp.**	**Lag 1 Comp.**	**Lag 2 Comp.**	**Lag 3 Comp.**
0	Off	Off	Off	Off
1	If (T – SetP) < Start-up DT & Cooling or (SetP - T) < Start-up DT & Heating … Waiting …			
2	Start	Off	Off	Off
3	Load up to 75%	Off	Off	Off
4	If T in Regulation Band … Wait inter-stage time …			
5	If T is approaching SetP … Waiting …			
6a SetP-RDT<T< SetP-RDT	Unload up to 50%	Start	Off	Off
6b SetP-RDT<T or T> SetP-RDT	Fixed at 75%	Start	Off	Off
7	Fixed at 75% or 50%	Load up to 50%	Off	Off
8 (if leader at 50%)	Load up to 75%	Fixed at 50%	Off	Off
9	Fixed at 75%	Load up to 75%	Off	Off
10	If T in Regulation Band … Wait inter-stage time …			
11	If T is approaching SetP … Waiting …			
12a SetP-RDT<T< SetP-RDT	Fixed at 75%	Unload up to 50%	Start	Off
12b SetP-RDT<T or T> SetP-RDT	Fixed at 75%	Fixed at 75%	Start	Off
13	Fixed at 75%	Fixed at 75% or 50%	Load up to 50%	Off
14 (if lag1 at 50%)	Fixed at 75%	Load up to 75%	Fixed at 50%	Off
15	Fixed at 75%	Fixed at 75%	Load up to 75%	Off
16	If T in Regulation Band … Wait inter-stage time …			
17	If T is approaching SetP … Waiting …			
18a SetP-RDT<T< SetP-RDT	Fixed at 75%	Fixed at 75%	Unload up to 50%	Start
18b SetP-RDT<T or T> SetP-RDT	Fixed at 75%	Fixed at 75%	Fixed at 75%	Start
17	Fixed at 75%	Fixed at 75%	Fixed at 75% or 50%	Load up to 50%
18 (if lag2 at 50%)	Fixed at 75%	Fixed at 75%	Load up to 75%	Fixed at 50%
19	Fixed at 75%	Fixed at 75%	Fixed at 75%	Load up to 75%
20	Load up to 100%	Fixed at 75%	Fixed at 75%	Fixed at 75%
21	Fixed at 100%	Load up to 100%	Fixed at 75%	Fixed at 75%
22	Fixed at 100%	Fixed at 100%	Load up to 100%	Fixed at 75%
23	Fixed at 100%	Fixed at 100%	Fixed at 100%	Load up to 100%
24	Fixed at 100%	Fixed at 100%	Fixed at 100%	Fixed at 100%

Table 8 - Compressors unloading and shutdown management (4 compressors unit)

Step n.	**Leader Comp.**	**Lag 1 Comp.**	**Lag 2 Comp.**	**Lag 3 Comp.**
0	100%	100%	100%	100%
1	Fixed at 100%	Fixed at 100%	Fixed at 100%	Unload up to 75%
2	Fixed at 100%	Fixed at 100%	Unload up to 75%	Fixed at 75%
3	Fixed at 100%	Unload up to 75%	Fixed at 75%	Fixed at 75%
4	Unload up t75%	Fixed at 75%	Fixed at 75%	Fixed at 75%
5	Fixed at 75%	Fixed at 75%	Fixed at 75%	Unload up to 50%
6	Fixed at 75%	Fixed at 75%	Unload up to 50%	Fixed at 50%
7	Fixed at 75%	Fixed at 75%	Fixed at 50%	Unload up to 25%
8	If T is approaching SetP … Waiting …			
9a SetP-RDT<T< SetP-RDT	Fixed at 75%	Fixed at 75%	Load up to 75%	Stop
9b SetP-RDT<T or T> SetP-RDT	Fixed at 75%	Fixed at 75%	Fixed at	Stop
10 (if lag2 at 75%)	Fixed at 75%	Fixed at 75%	Fixed at	Off
11	Fixed at 75%	Unload up to 50%	Fixed at 50%	Off
12	Fixed at 75%	Fixed at 50%	Fixed at 25%	Off
13	If T is approaching SetP … Waiting …			
14a SetP-RDT<T< SetP-RDT	Fixed at 75%	Load up to 75%	Stop	Off
14b SetP-RDT<T or T> SetP-RDT	Fixed at 75%	Fixed at 50%	Stop	Off
15 (if lag1 at 75%)	Fixed at 75%	Unload up to 50%	Off	Off
16	Unload up to 50%	Fixed at 50%	Off	Off
17	Fixed at 50%	Unload up to 25%	Off	Off
18	If T is approaching SetP … Waiting …			
19a SetP-RDT<T< SetP-RDT	Load up to 75%	Stop	Off	Off
19b SetP-RDT<T or T> SetP-RDT	Fixed at 50%	Stop	Off	Off
20	Unload up to 25%	Off	Off	Off
21	If T is approaching SetP … Waiting …			
22	If (SetP - T) < Shutdown DT & Cooling or (T – SetP) < Shutdown DT & Heating ….Wait….			
23	Stop	Off	Off	Off
24	Off	Off	Off	Off

6.5.3 Ice mode automatic control

Table 9 - Compressors shutdown scheme in Ice mode

Evap water outlet temp.	Compressors status
< SetP > SetP – SDT/n	All compressors allowed to run
< SetP– SDT/n > SetP – 2*SDT/n	(n-1) compressors allowed to run
< SetP – 2*SDT/n > SetP – 3*SDT/n	(n-2) compressors allowed to run
< SetP – 3*SDT/n > SetP – 4*SDT/n	(n-3) compressors allowed to run
> SetP – 4*SDT/n	No compressor allowed to run

6.6 Compressors timing

Compressors operation meet four timer requirements:

- Minimum time between same compressor starts (start to start timer): it is the minimum time between two starts of the same compressor
- Minimum time between different compressor starts: it is the minimum time between starts of two different compressors
- Minimum time compressor on (start to stop timer): it is the minimum time the compressor has to run; the compressor cannot be stopped (unless an alarm occurs) if this timer is not expired
- Minimum time compressor off (stop to start timer): it is the minimum time the compressor has to be stopped; the compressor cannot be start if this timer is not expired

6.7 Compressors protection

To protect compressor against loss of lubrication, the compressor pressure ratio is continuously checked; a minimum value is set for compressor minimum and maximum load; for intermediate compressor loads, a linear interpolation is executed.

The low pressure ratio alarm will occur if pressure ratio remains below the minimum value at rated compressor capacity after an alarm delay has timed out.

6.8 Compressors start-up procedure

During compressor starting, the discharge solenoid valve is kept energized.
At compressor start-up, the control executes a pre-purge procedure to evacuate the evaporator; the pre-purge procedure will depend on the expansion valve type.
A “Pre-purge failed alarm” will occur if the evacuation procedure fails.

Pre-purge procedure is not executed if the evaporating pressure is below the low pressure alarm set-point (vacuum conditions inside the evaporator).

The compressor will not be allowed to load up if the discharge superheat exceeds a set value (default 10 °C, 18 F) for a time longer than a set value (default 150 sec).

6.8.1 Pre-purge procedure with electronic expansion

At the compressor start, the EEXV remains fully closed until the saturated temperature of evaporation reaches –10°C (14 F) (adjustable in the range –12 ÷ -4 °C (10.4 ÷ 24.8 F)), then the valve opens to a fixed position (adjustable by the manufacturer, default being 20% of total valve step) and remains open for a timed interval (default 30 sec); this procedure is repeated for a number of times adjustable by the operator (default is 1 time).

6.8.2 Pre-purge procedure with thermostatic expansion

At compressor start, the liquid line solenoid is fully closed until the saturated temperature of evaporation reaches –10°C (14 F) (adjustable in the range –12 ÷ -4 °C (10.4 ÷ 24.8 F)), then the valve is open during a timed interval; this procedure is repeated for a number of times adjustable by the operator (default is 1 time).

6.8.3 Oil heating

The start-up of compressors will not be allowed if the following formula is not met:

DischTemp – TOilPress > 5°C

Where:
DischTemp is the compressor discharge temperature (corresponding to oil temperature)
TOilPress is the refrigerant saturated temperature at the oil pressure

6.9 Pump-down

When compressor stop request is required (and if the request doesn’t originate from an alarm), before proceeding, the compressor is fully unloaded and operated for a certain amount of time with a closed expansion valve (in the case of electronic expansion valve) or closed liquid line valve (in the case of thermostatic expansion valve).

This operation, known as “pump-down”, is used to evacuate the evaporator avoiding that in a following restart the compressor will aspirate liquid.

Pump-down procedure will end when the saturated evaporation temperature reaches the value of –10°C (adjustable in the range –12 ÷ -4 °C (10.4 ÷ 24.8 F)) or after timer is expired (adjustable, default 30 sec.); in the last case a “failed pump-down” is stored in the alarm log (an active alarm is not given).

After compressor stop the unloading solenoid valve is energized for a time equal to the minimum compressor off time to assure the complete unloading also in case of non-normal stop procedure completion.

6.10 Low ambient temperature start

Units working in cooling, cooling/glycol or ice mode can manage start-up under low outside ambient temperature

A low OAT start is initiated if, at compressor start-up request, the condenser saturated temperature is less than 15.5 °C (60 F).

Once this happens, the circuit is in this low OAT start state for a time equal to the low OAT start timer set-point (set-point has an adjustable range from 20 to 120 seconds, default being 120 sec.). During this time the low-pressure events are disabled.

The absolute low pressure limit of -.5 bar (-7 psi) is still enforced.

At the end of the low OAT start, the evaporator pressure is checked. If the pressure is greater than, or equal to, the evaporator pressure stage down set-point, the start is considered successful. If the pressure is less than this, the start is not successful and the compressor is stopped.

Three start attempts are allowed before tripping on the restart alarm.

The restart counter should be reset when either a start is successful or the circuit is off on an alarm.

6.11 Compressors and unit trips

Below is the list of conditions that cause unit or compressor trips.

In case of unit trips, the whole unit is stopped and no compressor is allowed to start; in case of compressor trips, the relevant compressor is stopped and other compressors may start if required.

6.11.1 Unit trips

Unit trips are caused by:

- Low evaporator flow rate

A "Low evaporator flow rate alarm" trips the whole unit if the evaporator flow switch remains open for more than an adjustable value; the alarm is automatically reset for three times if the evaporator flow switch remains closed for more than 30 seconds. Starting from the fourth alarm it has to be manually reset.

- Low evaporator outlet temperature

A "Freeze alarm" trips the whole unit as soon as the evaporator water outlet temperature (water outlet temperature in the case of single evaporator units or manifold temperature in the case of a double evaporator unit) falls below the freeze alarm set-point.

A manual reset of the alarm is required to restart the unit

- Phase-Voltage Monitor (PVM) or Ground Protection (GPF) failure

A "Bad phase/voltage or Ground protection failure alarm" trips the whole unit as soon as the phase monitor switch opens (if a single phase monitor is used) after the unit start request.

A manual reset of the alarm is required to restart the unit

- External alarm (only if enabled)

A "External alarm" trips the whole unit as soon as the external alarm switch closes after the unit start request, if the unit trip on external alarm has been set.

A manual reset of the alarm is required to restart the unit

- Sensor failure

A "Sensor failure" trips the unit if the reading of one of the following sensors goes out of range for longer than ten seconds.

- Evaporator #1 outlet temperature sensor (on 2 evaporators units)
- Evaporator #2 outlet temperature sensor (on 2 evaporators units)

The faulted sensor is identified on the controller display

6.11.2 Compressors trip

Compressor trips are caused by:

- High pressure (mechanical pressure switch)

A "High pressure switch alarm" trips the compressor as soon as the high pressure switch opens.

A manual reset of the alarm is required to restart the compressor (after the manual reset of the pressure switch).

- High discharge temperature

A "High discharge temperature alarm" trips the compressor as soon as the compressor discharge temperature exceeds the adjustable high temperature set-point.

A manual reset of the alarm is required to restart the compressor

- Low evaporator outlet temperature

A "Freeze alarm evap #..." trips the two compressors connected to the same evaporator -in the case of a double evaporator unit- as soon as the evaporator water outlet temperature falls below the adjustable freeze threshold.

A manual reset of the alarm is required to restart the two compressors

- Low pressure (Mechanical pressure switch)

A "Low pressure switch alarm" trips the compressor if the low pressure switch opens (if pCOe #1 exists) for more than 40 seconds during compressor running.

The "Low pressure switch alarm" is disabled during pre-purge sequence and during pump-down.

At compressor start-up, the "Low pressure switch alarm" is disabled if a low ambient start has been recognized otherwise.

A manual reset of the alarm is required to restart the compressor

- Low suction pressure

A "Low suction pressure alarm" trips the compressor if the compressor suction pressure remains below the adjustable low pressure alarm set-point for longer than the time listed in table 10.

Table 10 – Low suction pressure alarm delay

Low press set-point – Suct press (bar / psi)	**Alarm delay (seconds)**
0.1 / 1.45	160
0.3 / 4.35	140
0.5 / 7.25	100
0.7 / 10.15	80
0.9 / 13.05	40
1.0 / 14.5	0

No delay is introduced if the suction pressure drops below the low pressure alarm set-point by 1 bar or more.

The "Low suction pressure alarm" is disabled during pre-purge sequence and during pump-down.

At compressor start-up the "Low suction pressure alarm" is disabled if a low ambient start has been recognized.

A manual reset of the alarm is required to restart the compressor

- Low oil pressure

A "Low oil pressure alarm" will trip the compressor if the oil pressure remains below the following thresholds for longer than an adjustable time value during compressors running and at compressor start-up

Suction pressure*1.1 + 1 bar	at compressor minimum load
Suction pressure*1.5 + 1 bar	at compressor full load
Interpolated values	at compressor intermediate load

A manual reset of the alarm is required to restart the compressor

- High oil pressure difference

A "High oil pressure difference alarm" trips the compressor if the difference between the discharge pressure and the oil pressure remains over an adjustable set-point (default 2.5 bar) for longer than an adjustable time value

A manual reset of the alarm is required to restart the compressor

- Low pressure ratio

A "Low pressure ration alarm" trips the compressor if the pressure ratio remains below the adjustable threshold at rated compressor load for longer than an adjustable time value

A manual reset of the alarm is required to restart the compressor

- Compressor Start-up failure

A "Failed transition or starter alarm" trips the compressor if the transition/starter switch remains open for more than 10 seconds from compressor start

A manual reset of the alarm is required to restart the compressor

- Compressor overload or motor protection

A "Compressor overload alarm" trips the compressor if the overload switch remains open for more than 5 seconds after the compressor start.

A manual reset of the alarm is required to restart the compressor

- Pre-purge failure

A "Pre-purge failure" trips the compressor if, during pre-purge procedure, the evaporating pressure does not fall below the set-point within the set time.

A manual reset of the alarm is required to restart the compressor

- Slave board failure

A “Unit xx off-line alarm” trips slave compressors (compressors controlled by pCO^2 board #2) if the master board (pCO^2 board #1) cannot communicate with slave boards for a time longer than 30 seconds.

The alarm is automatically reset when the communication is re-established

- Master board failure or network communication

A “Master off-line alarm” trips the slave compressors if slave board cannot communicate with master board for a time longer than 30 seconds.

The alarm is automatically reset when the communication is re-established

- Sensor failure

A “Sensor failure” trips the compressor if the reading of one of the following sensors goes out of range for longer than ten seconds.

- Oil Pressure sensor
- Low Pressure sensor
- Suction temperature sensor
- Discharge Temperature sensor
- Discharge Pressure sensor

The faulted sensor will be identified on the controller display

- Auxiliary signal failure

The compressor is tripped if one of the following digital inputs is opened for longer than an adjustable time (default is 10 s).

- Compressor phase monitor or Ground protection failure
- Variable speed driver alarm

6.11.3 Other trips

Other trips may disable particular functions as described below (e.g. heat recovery trips).

The addition of optional expansion boards will also activate the alarms related to communication with expansion boards and to probes connected to expansion boards.

For units with electronic expansion valve, all driver critical alarms will trip the compressors.

6.12 Switch between cooling and heating mode

Any time the switching of a compressor between cooling (or cooling/glycol or ice) and heating mode is required, either if this is required by unit switching from one mode to another or to start or end defrost, the compressor is first stopped without pump-down and then restarted executing the pre-purge procedure; the four-way valve is energized immediately at the compressor start while the EEXV or the liquid line solenoid valve is closed.

6.13 Defrost procedure

In units configured as heat pumps running in heating mode, defrost procedure is executed when required.

Two compressors will not execute the defrost procedure at the same time.

A compressor will not perform the defrost procedure unless an adjustable timer (default 30 min) is expired since its start-up, and will not perform a second defrost before another adjustable timer (default 30 min) is expired.

The defrost procedure is based on the values of ambient temperature (Ta) and suction temperature (Ts) measured by the EEXV driver (or by the defrost sensors in the case of thermostatic expansion valve). When Ts remains below Ta by an amount greater than a value -dependant on ambient temperature and coil design- for longer than an adjustable time (default 5 min), the defrost will start.

The formula to evaluate needs for defrost is:

$Ts < 0.7*Ta - \Delta T$ & $Ssh < 10$ °C (adjustable value)

Where ΔT is the adjustable design approach (default=12°C) for the condenser coils and Ssh is the suction superheat.

Defrost procedure will never be executed if Ta > 7 °C (adjustable under maintenance password).
Defrost procedure will never be executed if Ts > 0 °C (adjustable under maintenance password).

During defrost, the circuit is switched to “cooling mode” for an adjustable time (default 10 min) if Ta < 2 °C (adjustable under maintenance password), otherwise the compressor is stopped and fans are kept at maximum speed for another adjustable time (default 15 min).

Defrost procedure is stopped if evaporator outlet temperature drops below a set value or if discharge pressure reaches a set value.
During defrost procedure “Low pressure switch alarm” and “Low suction pressure alarm” are disabled.

6.14 Liquid injection

Liquid injection in the discharge line is activated both in cooling/ice and heating mode if the discharge temperature exceeds an adjustable value (default 85°C).

Liquid injection in the suction line is activated, only in heating mode, if the discharge superheat exceeds an adjustable value (default 35°C).

6.15 Heat Recovery procedure

The heat recovery procedure is available only in chiller units (not available for heat pumps).

The manufacturer selects the circuits equipped with heat recovery.

6.15.1 Recovery pump

When heat recovery is activated the control will start the recovery pump (if a second pump has been anticipated in the control system, the pump with lower number of running hours is selected, otherwise, manual pump sequencing is to be used); within 30 sec, a recovery system flow switch must close or a "Recovery Flow Alarm" will occur that will disable the heat recovery function; the alarm is automatically reset for three times provided that the evaporator flow switch remains closed for more than 30 seconds. After the third alarm, (fourth alarm and subsequent), it has to be reset manually.

No recovery circuit can be activated if a flow switch alarm occurs.

In case of a flow switch alarm during recovery circuit operation, the relevant compressor will trip and the alarm reset will not be allowed until the flow is recovered (otherwise recover heat exchanger freeze will occur).

6.15.2 <u>Recovery control</u>

When heat recovery is activated, the control activates or deactivates recovery circuits with a step logic.

In particular, a further heat recovery stage is activated (a new heat recovery circuit is put in operation) if the heat recovery water outlet temperature remains below the set-point by an amount greater than an adjustable regulation band for longer than an adjustable time value (heat recovery inter-stage).

Likewise, a heat recovery stage is deactivated (a heat recovery circuit is put out of service) if the heat recovery water outlet temperature remains above the set-point by an amount greater than an adjustable dead regulation band for longer than a previously defined time value.

A high temperature alarm set-point is active in the recovery loop; it will disable recovery circuits.

A three-way valve is used to increase recovery water temperature at start-up; a proportional control is used to establish valve position; at low temperature, the valve will re-circulate recovery water, while at higher temperatures, the valve will bypass a portion of the flow.

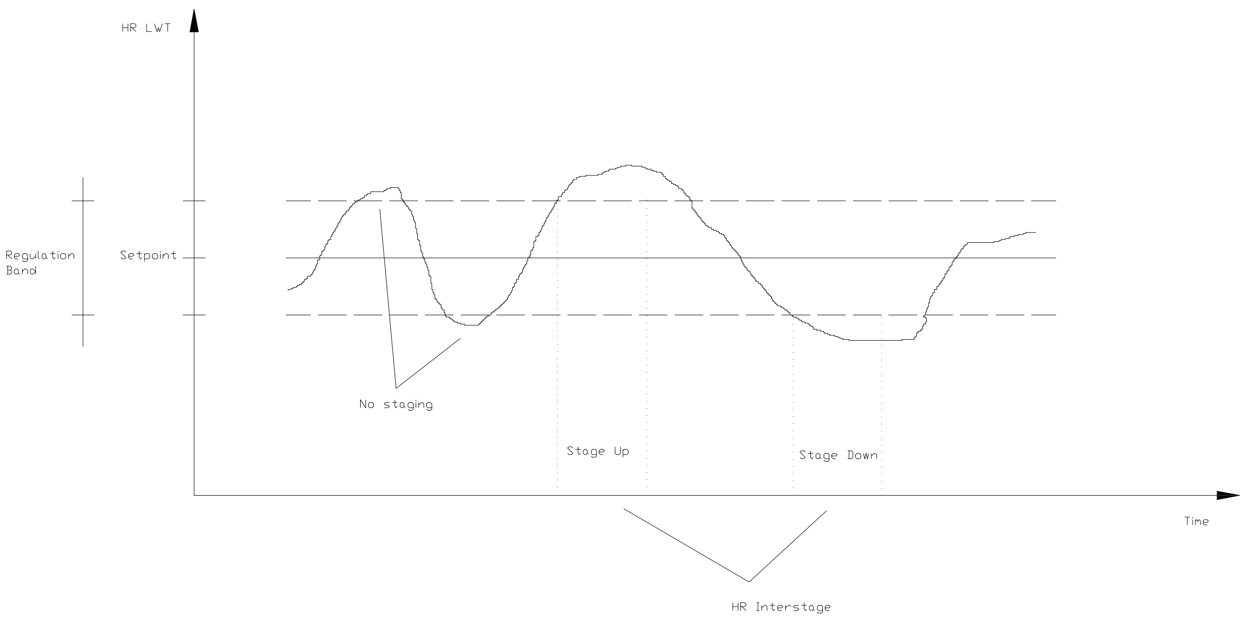


Figure 14 – Heat recovery inter-stage

HR LWT	HR LWT
Time	Time
Regulation band	Regulation band
Setpoint	Setpoint
No staging	No staging
Stage up	Stage up
Stage down	Stage down
HR Inter-stage	HR Inter-stage

6.16 Compressor capacity limitation

Two types of limitation are included in the control:

- Load inhibit : The load is not allowed; another compressor may start or may be loaded
- Forced unload : The compressor is unloaded; another compressor may start or may be loaded

The parameters that can limit compressors are:

- Suction pressure
  The compressor load is inhibited if the suction pressure is lower than a “stage-hold” set-point
  The compressor is unloaded if the suction pressure is lower than a “stage-down” set-point

- Discharge pressure
  The compressor load is inhibited if the discharge pressure is higher than a “stage-hold” set-point
  The compressor is unloaded if the discharge pressure is higher than a “stage-down” set-point

  The discharge pressure stage-down set-point is a function of suction pressure according to the following table:

Table 11 – High pressure stage-down

Suction pressure	**Discharge pressure Stage-down set-point**
-10 °C (14 F)	50 °C (122 F)
0 °C (32 F)	68 °C (154.4 F)
10 °C (50F)	68 °C (154.4 F)
10 °C (50F)	55 °C (154.4 F)

The discharge pressure stage-hold set-point is obtained by the stage-down set-point minus an input deltaT

- Evaporator outlet temperature
  The compressor is unloaded if the evaporator outlet temperature is lower than a “stage-down” set-point

6.17 Unit limitation

Unit load may be limited by the following inputs:

- Unit current

The unit load is inhibited if the absorbed current is close to a maximum current set-point (within -5% from set-point)
The unit is unloaded if the absorbed current is higher than a maximum current set-point

- Demand limit
  The unit load is inhibited if the unit load (measured by slide valve sensors or calculated as described) is close to a maximum load set-point (within -5% from set-point)
  The unit is unloaded if the unit load is higher than the maximum load set-point.

  The maximum load set-point may be received via a 4-20 mA input (4mA -> limit=100%; 20 mA -> limit=0%); or via a numeric input coming from monitoring system (network demand limit).

- SoftLoad
  At unit start-up (when the first compressor starts), a temporary demand limit may be set for a certain time.

6.18 Evaporator pumps

An evaporator pump is anticipated to be part of the base configuration, while a second pump is optional.

When both pumps are selected, the system will automatically start the pump with a lower number of running hours each time a pump has to be started. A fixed starting sequence may be set.

A pump is started at the "Unit On" status rising; within 30 sec an evaporator flow switch must close otherwise an "Evaporator Flow Alarm" will rise. The alarm is automatically reset for three times if the evaporator flow switch closes for more than 30 seconds. Starting from the fourth alarm it has to be reset manually.

6.18.1 Inverter pump[2]

Inverter pump is used to modify water flow through the evaporator in order to keep evaporator water ΔT at the rated value (or close to it) even if the required capacity is reduced due to the switching off of some units. In fact, in this case the water flow across the remaining ones increases and so does the pressure drop and the head required by the pump.

So the pump speed is reduced to reduce the water pressure drops across units to the rated value.

Since a minimum flow through the evaporator is required (about 50% of rated flow) and the inverter pumps might not run at low frequency, a minimum flow bypass is managed.

The flow control is based on the measurement of pressure difference across the pump (pump head) and will act on the pump speed and on the bypass valve position.

Both actions are executed by 0-10V analogue output.

In particular, since pressure drops across evaporators and piping change with flow while pressure drops across terminal units are flow-independent, the pump required head (head set-point) is a function of the flow:

[2] Inverter pump is not included in Ver ASDU01A; it will be in a following version.

$$\Delta h = (\Delta h_r - \Delta P_t) \cdot \left(\frac{f}{f_r} \right)^2 + \Delta P_t$$

being

Δh = required pump head at the supply frequency f (pump head target)
Δh_r = pump head at rated flow (pump head set-point)
ΔP_t = terminal units pressure drop at rated flow
f = pump required supply frequency
f_r = pump supply frequency at rated flow

A tuning procedure is available to allow the setting of Δh_r.

This procedure has to be activated with unit on, both compressors running at 100% and all terminal units on. When this procedure is active, the pump speed may be adjusted manually from 70% to 100% (35 to 50Hz) and the bypass valve is completely closed (0V output) and the evaporator water ΔT is shown. The operator will establish the correct water ΔT by adjusting the pump speed, and then he or she will stop the setup procedure and the pump head will be chosen as Δhr (head set-point).

If the setup procedure has not been executed, the system will work with 100% pump speed and bypass valve completely closed and a “No pump VFD calibration alarm” will rise (delayed by 30 minutes) without stopping the unit.

During the operation, a PID controller acts on the pump speed to keep the pump head on the target value Δh (reducing the speed as the head increases) and keeping the bypass valve completely closed; the PID controller will never reduce the pump speed below 70% (35Hz) since this is the operating limit of inverter pump, if this set is reached and the head continues to increase a PID controller will start to open the bypass valve.

The reverse occurs when pump head decreases; the controller will start to close the valve and when it is completely closed it will start to speed-up the pump.

Pump speed and bypass valve will never move together (to avoid flow instability); pump will be adjusted from 100% to minimum flow, valve will be used when required flow is below the minimum.

At the unit start-up, the pump will start at nominal frequency (50 Hz) with the bypass valve completely closed.

Then it will start to regulate pump head in accordance with above procedure; the compressors start will be enabled once the target pump head is reached (within a 10% tolerance).

6.19 Fans control

Fans are used to control condensing pressure in cooling, cooling/glycol or ice mode or to control evaporating pressure in heating mode.

In both cases the fans may be managed to control:

- Condensation or evaporation pressure
- Pressure ratio

Four control methods are available:

- Fantroll
- FanModular
- Variable speed driver
- Speedtroll

6.19.1 Fantroll

A step control is used; fan steps are activated or deactivated to keep compressor operation conditions within allowable limits.

Fan steps are activated or deactivated keeping condensing (or evaporating pressure) change to a minimum; to do this one network fan is started or stopped at a time.

Fans are connected to steps (digital outputs) according to the scheme in table 12

Table 12 – Fan step connection

	N° of fans per circuit							
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Step	**Fans on the step**							
1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2
3		3	3,4	3,4	3,4	3,4	3,4	3,4
4				5	5,6	5,6	5,6	5,6
5						7	7,8	7,8,9

Fan steps are activated or deactivated on the base of the staging table 13

Table 13 – Steps staging

	N° of fans per circuit							
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Stage	**Active step**							
1	1	1	1	1	1	1	1	1
2	1+2	1+2	1+2	1+2	1+2	1+2	1+2	1+2
3		1+2+3	1+3	1+3	1+3	1+3	1+3	1+3
4			1+2+3	1+2+3	1+2+3	1+2+3	1+2+3	1+2+3
5				1+2+3+4	1+3+4	1+3+4	1+3+4	1+3+4
6					1+2+3+4	1+2+3+4	1+2+3+4	1+2+3+4
7						1+2+3+4+5	1+3+4+5	1+2+3+5
8							1+2+3+4+5	1+3+4+5
9								1+2+3+4+5

6.19.1.1 Fantroll in cooling mode

6.19.1.1.1 Control of condensing pressure

A stage up is executed (the next stage is activated) if the condensing saturated temperature (saturated temperature at discharge pressure) exceeds the target set-point (default 40 °C (104 F)) by an amount equal to a stage up dead band for a time depending on the difference between the reached values and the target set-point plus stage up dead band (high condensing temperature error).

In particular, the stage up is executed when the integral of the high condensing temperature error reaches the value 10 °C x sec (18 Fxsec).

In the same way, a stage down is executed (the previous stage is activated) if the condensing saturated temperature falls below the target set-point by an amount equal to a stage down dead band for a time depending on the difference between the reached target set-point minus the stage down dead band values and the reached value (low condensing temperature error).

In particular the stage down is executed when the integral of the low condensing temperature error reaches the value 10 °Cxsec (18 Fxsec).

The condensing temperature error integral is reset to zero when condensing temperature is within the dead band or a new stage is activated.

Each fan stage will have its own adjustable stage up and stage down dead band.

6.19.1.1.2 Control of pressure ratio

The control will operate to keep pressure ratio equal to a target adjustable value (default 2.8)

A stage up is executed (the next stage is activated) if the pressure ratio exceeds the target pressure ratio by an amount equal to an adjustable stage up dead band by a time depending on the difference between the reached values and the target value plus stage up dead band (high pressure ratio error).

In particular the stage up is executed when the integral of the pressure ratio error reaches the value 25 sec.

In the same way, a stage down is executed (the previous stage is activated) if the pressure ratio falls below the target set-point by an amount equal to a stage down dead band depending on the difference between the target set-point minus the stage down dead band values and the reached value (low pressure ratio error).

In particular the stage down is executed when the integral of the low pressure ratio error reaches the value 10 sec.

The pressure ratio error integral is reset to zero when condensing temperature is within the dead band or a new stage is activated.

Each fan stage will have its own adjustable stage up and stage down dead band.

6.19.1.2 Fantroll in heating mode

6.19.1.2.1 Control of evaporation pressure

A stage up is executed (the next stage is activated) if the evaporating saturated temperature (saturated temperature at suction pressure) is below the target set-point (default 0 °C (32 F)) by an amount equal to a stage up dead band for a time depending on the difference between the reached values and the target set-point plus stage up dead band (high condensing temperature error).

In particular the stage up is executed when the integral of the high condensing temperature error reaches the value 10 °C x sec (18 F x sec).

In the same way, a stage down is executed (the previous stage is activated) if the evaporating saturated temperature exceeds the target set-point by an amount equal to a stage down dead band for a time depending on the difference between the reached target set-point minus the stage down dead band values and the reached value (low condensing temperature error).

In particular the stage down is executed when the integral of the low condensing temperature error reaches the value 10 °C x sec (18 Fxsec).

The condensing temperature error integral is reset to zero when condensing temperature is within the dead band or a new stage is activated.

Each fan stage will have its own adjustable stage up and stage down dead band.

6.19.1.2.2 Control of pressure ratio

The control will operate to keep pressure ratio equal to a target adjustable value (default 2.8)

A stage up is executed (the next stage is activated) if the pressure ratio exceeds the target pressure ratio by an amount equal to an adjustable stage up dead band for a time depending on the difference between the reached values and the target value plus stage up dead band (high pressure ratio error).

In particular the stage up is executed when the integral of the pressure ratio error reaches the value 25 sec.

In the same way, a stage down is executed (the previous stage is activated) if the pressure ratio falls below the target set-point by an amount equal to a stage down dead band depending on the difference between the target set-point minus the stage down dead band values and the reached value (low pressure ratio error).

In particular the stage down is executed when the integral of the low pressure ratio error reaches the value 10 sec.

The pressure ratio error integral is reset to zero when condensing temperature is within the dead band or a new stage is activated.

Each fan stage will have its own adjustable stage up and stage down dead band.

6.19.2 Fan Modular

The Fan Modular method will work in the same way than Fantroll method (staging sequence), but instead of using digital outputs, it will use an analogue output.

In particular the analogue output will assume a value, in volts, equal to the stage number (at stage 2, the output is 2V, at stage 3, 3V and so on).

6.19.3 Variable Speed Driver

A continuous control is used; fans speed is modulated to keep saturated condensation pressure at a set-point; a PID control is used to allow a stable operation.

A Fan Silent Mode function (FSM) is implemented on unit with Variable Speed Driver (VSD) to keep fan speed below a set value during some periods.

6.19.3.1 VSD in cooling, cooling glycol or ice mode

When the system is operating in cooling mode, either if it is controlling the condensation pressure or the pressure ratio, the PID proportional gain is positive (the higher the input, the higher the output).

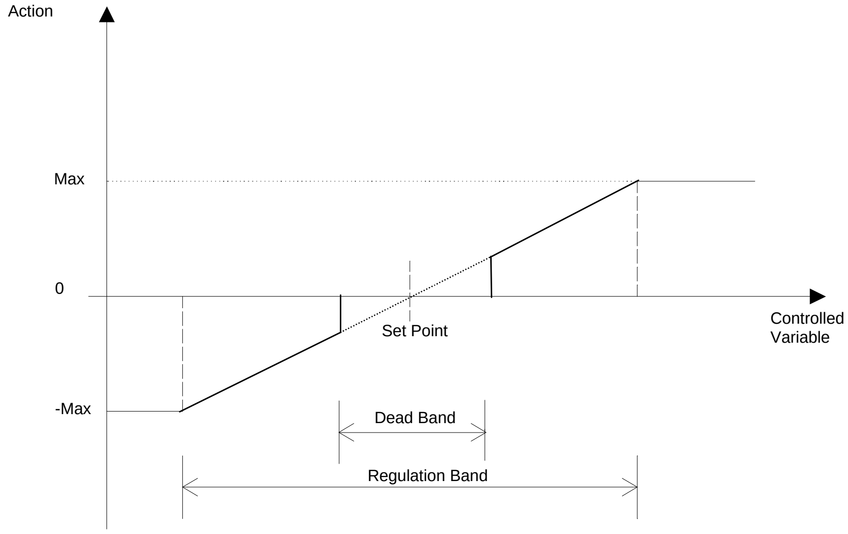


Figure 15 – Proportional action of VSD PID in cooling/ice mode

Action	Action
Controlled variable	Controlled variable
Set Point	Set Point
Dead Band	Dead Band
Regulation Band	Regulation Band
Max	Max
-Max	-Max

6.19.3.2 VSD in heating mode

6.19.3.2.1 Control of evaporation temperature

When the system is operating in heating mode to control the evaporation temperature, the proportional gain is negative (the higher the input, the lower the output).

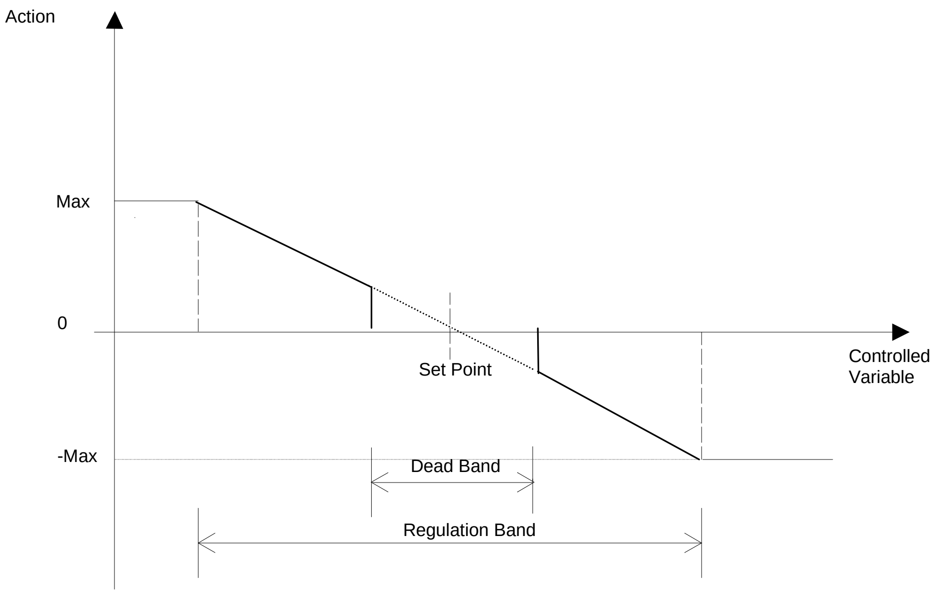


Figure 16 – Proportional action of VSD PID in heating mode

Action	Action
Controlled variable	Controlled variable
Set Point	Set Point
Dead Band	Dead Band
Regulation Band	Regulation Band
Max	Max
-Max	-Max

6.19.3.2.2 Control of pressure ratio

When the system is operating in heating mode to control the pressure ratio, the proportional gain is positive (the higher the input, the higher the output).

6.19.4 Speedtroll

A mixed step-VSD control is used; the first fans step are managed using a VSD (with related PID control), next steps are activated as in the step control, only if the cumulated stage-up and stage-down error is reached and the VSD output is at maximum or minimum respectively.

6.19.5 Double VSD

Two VSD are managed to keep controlled parameter at a set-point; the second VSD are activated when the first one reaches the maximum speed and the PID control requires greater air flow.

6.20 Other functions

The following functions are implemented.

6.20.1 Hot Chilled Water Start

This feature allows the unit to start smoothly even under high temperature condition of evaporator water.

It will not allow the compressors loading above an adjustable value until the evaporator water outlet temperature drops below an adjustable value; another compressor is enabled to start when the others are limited.

6.20.2 Fan Silent Mode

This feature will allow to reduce unit noise by limiting fans speed (only in case of VSD fan control) on the base of a time schedule.

6.20.3 Double evaporator units

This feature will allow to limit freezing problems on units with two evaporators (3 and 4 compressors units).

In this case, compressors are started alternatively on the two evaporators.

7 START-UP SEQUENCE

7.1 Unit start-up and shut-down flowcharts

Unit start-up and shutdown will follow the sequence shown in figures 17 and 18.

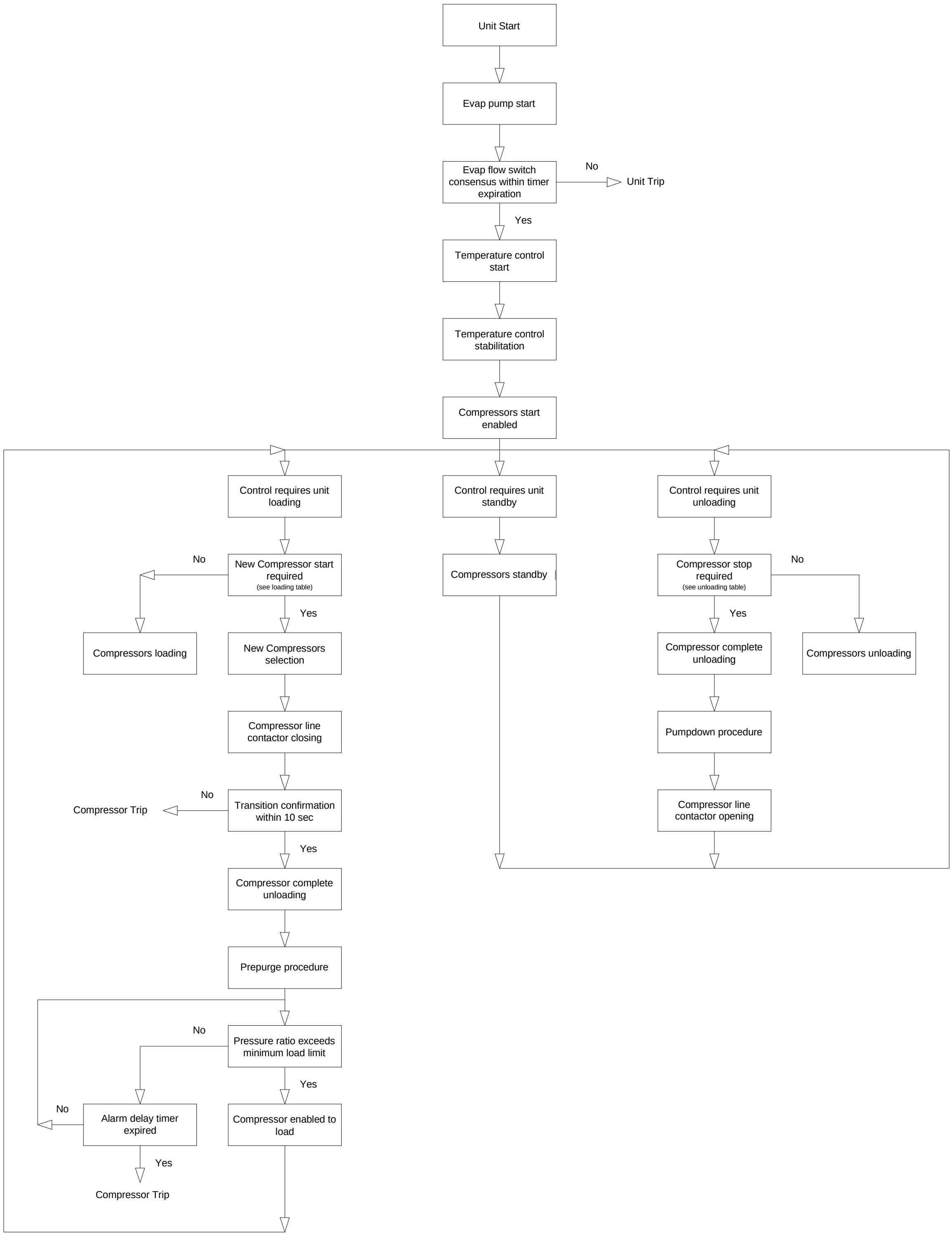


Figure 17 – Unit start-up sequence

Unit Start	Unit Start
Evap pump start	Evap pump start
Evap flow switch consensus within timer expiration	Evap flow switch Ok within timer expiration
No	No
Unit Trip	Unit Trip
Yes	Yes
Temperature control start	Temperature control start
Temperature control stabilisation	Temperature control stabilisation
Compressors start enabled	Compressors start enabled
Control requires unit loading	Control requires unit loading
New Compressor start required (see loading table)	New Compressor start required (see loading table)
No	No
Compressors loading	Compressors loading
Yes	Yes
New Compressors selection	New Compressors selection
Compressor line contactor closing	Compressor line contactor closing
Transition confirmation within 10 sec	Transition confirmation within 10 sec
No	No
Compressor Trip	Compressor Trip
Yes	Yes
Compressor complete unloading	Compressor complete unloading
Pre-purge procedure	Pre-purge procedure
Pressure ratio exceeds minimum load limit	Pressure ratio exceeds minimum load limit
No	No
Alarm delay timer expired	Alarm delay timer expired
Yes	Yes
Compressor Trip	Compressor Trip
Yes	Yes
Compressor enabled to load	Compressor enabled to load
Control requires unit standby	Control requires unit standby
Compressors standby	Compressors standby
Control requires unit unloading	Control requires unit unloading
Compressor stop required (see unloading table)	Compressor stop required (see unloading table)
No	No
Compressors unloading	Compressors unloading
Yes	Yes
Compressor complete unloading	Compressor complete unloading
Pump-down procedure	Pump-down procedure
Compressor line contactor opening	Compressor line contactor opening

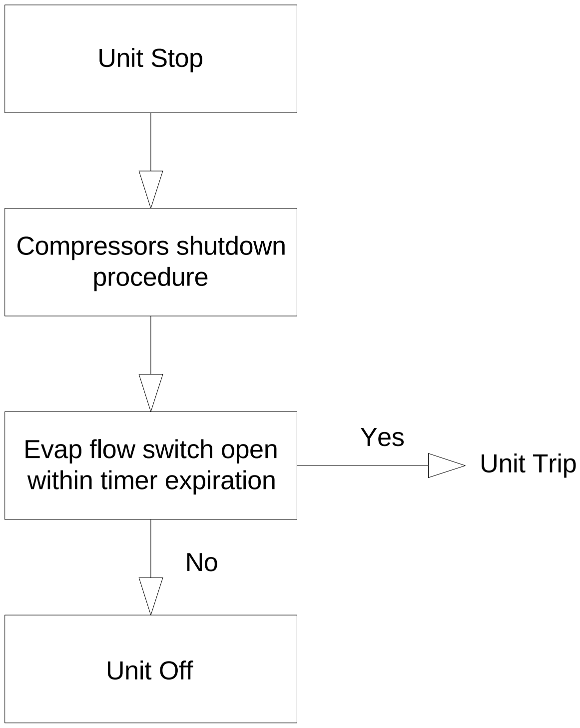


Figure 18 – Unit shutdown sequence

Unit Stop	Unit Stop
Compressors shutdown procedure	Compressors shutdown procedure
Evap flow switch open within timer expiration	Evap flow switch open within timer expiration
Yes	Yes
Unit Trip	Unit Trip
No	No
Unit Off	Unit Off

7.2 Heat recovery start-up and shut-down flowcharts

Unit start-up and shutdown will follow the sequence shown in figures 19 and 20.

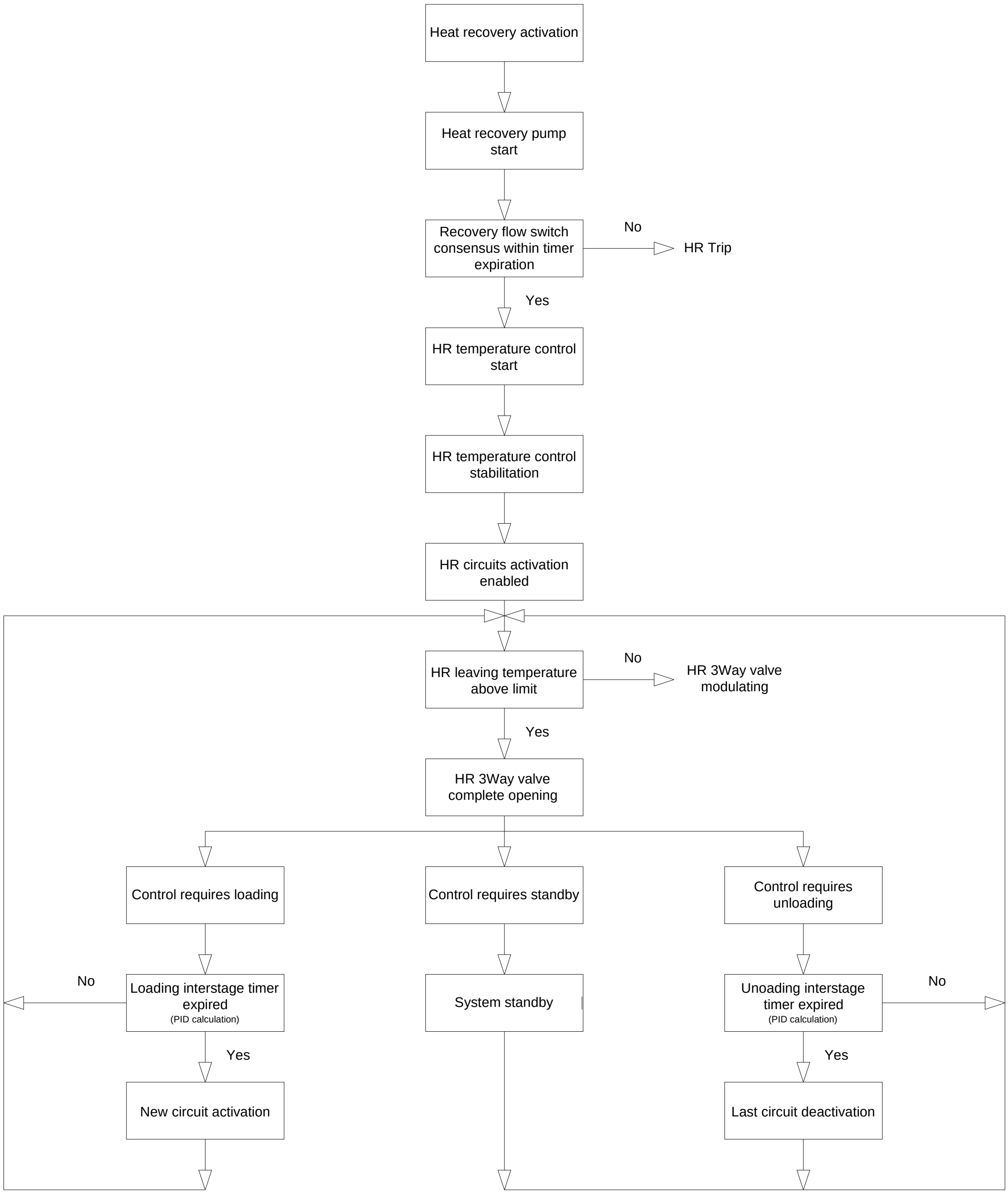


Figure 19 – Heat recovery start-up sequence

Heat recovery activation	Heat recovery activation
Heat recovery pump start	Heat recovery pump start
Recovery flow switch consensus within timer expiration	Recovery flow switch Ok within timer expiration
No	No
HR Trip	HR Trip
Yes	Yes
HR temperature control start	HR temperature control start
HR temperature control stabilisation	HR temperature control stabilisation
HR circuits activation enabled	HR circuits activation enabled
HR leaving temperature above limit	HR leaving temperature above limit
No	No
HR 3-way valve modulating	HR 3-way valve modulating
Yes	Yes
HR 3-way valve complete opening	HR 3-way valve complete opening
Control requires loading	Control requires loading
No	No
Loading inter-stage timer expired (PID calculation)	Loading inter-stage timer expired (PID calculation)
Yes	Yes
New circuit activation	New circuit activation
Control requires standby	Control requires standby
System standby	System standby
Control requires unloading	Control requires unloading
No	No
Unloading inter-stage timer expired (PID calculation)	Unloading inter-stage timer expired (PID calculation)
Yes	Yes
Last circuit deactivation	Last circuit deactivation

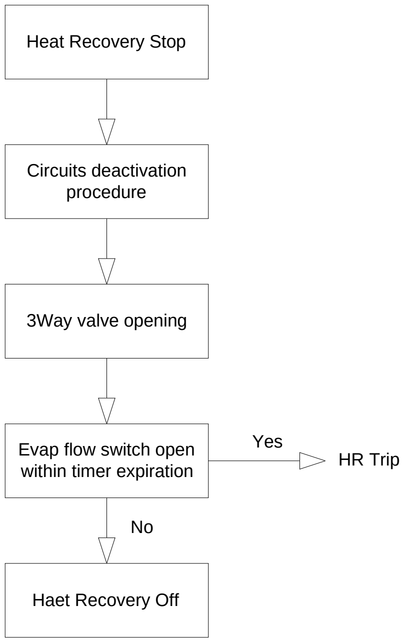


Figure 20 – Heat recovery shutdown sequence

Heat Recovery Stop	Heat Recovery Stop
Circuits deactivation procedure	Circuits deactivation procedure
3-way valve opening	3-way valve opening
Evap flow switch open within timer expiration	Evap flow switch open within timer expiration
Yes	Yes
HR Trip	HR Trip
No	No
Heat Recovery Off	Heat Recovery Off

8 USER INTERFACE

Two types of user interface are implemented in the controller software: built-in display and PGD; the PGD display is used as optional remote display.

Both interfaces have a 4x20 LCD display and a 6-key keypad.

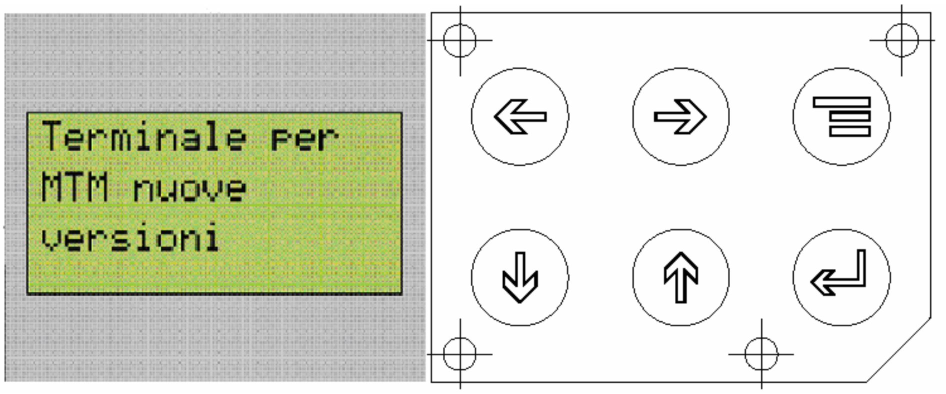


Figure 21 – Built-In Display

Figure 22 – PGD Display

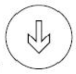
In particular, from the main menu, that can be accessed using  (MENU key), 4 different menu sections are addressable. Each section may be accessed using the relevant key:

 (*ENTER* key) is used to access the Unit status loop from every menu form.

 (*LEFT* key) access the section listed on the first row of the list

 (*RIGHT* key) access the section listed on the second row of the list

 (*UP* key) access the section listed on the third row of the list

 (*DOWN* key) access the section listed on the fourth row of the list

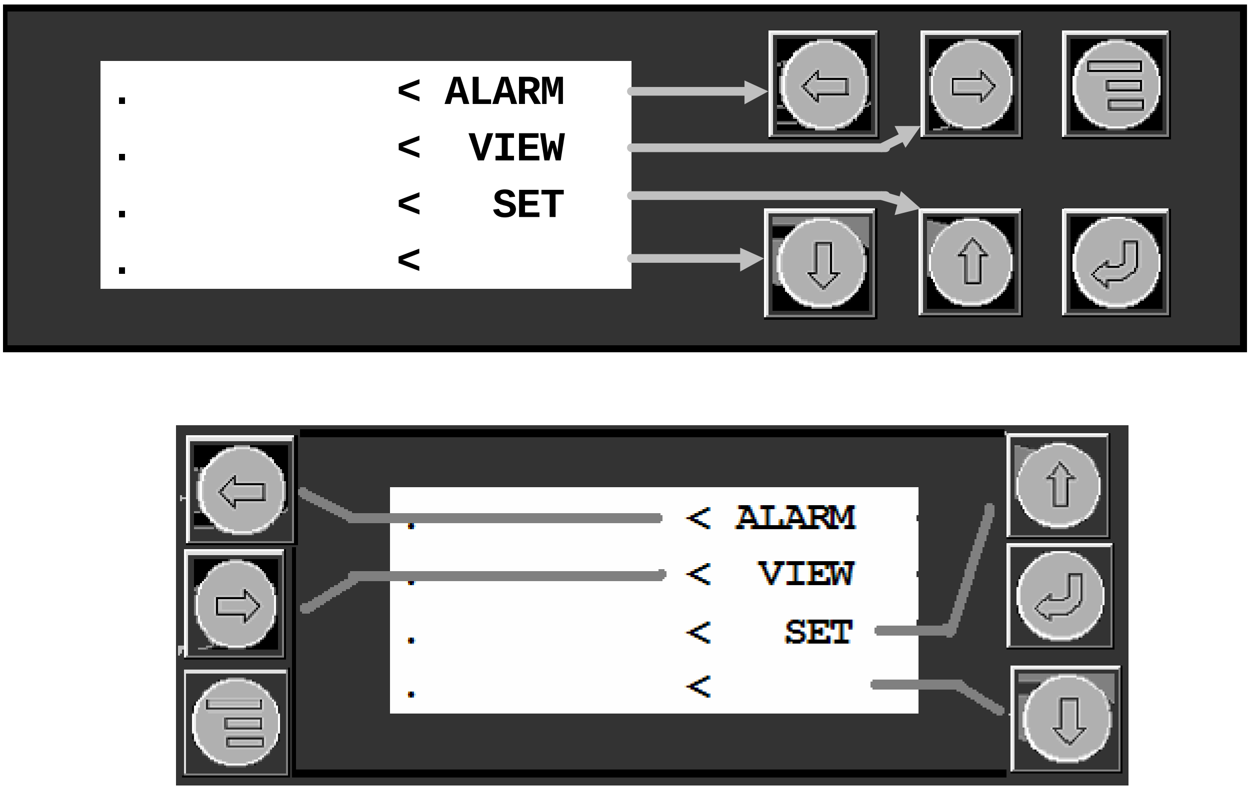


Figure 23 – Built-In & PGD navigation

In case of different key labels (this may happen if a standard Carel controller is used instead of one with Daikin customized keypad) please refer to key position to access the same function.

If other sections are entered, other menus or form loops are shown.

From every loop with MENU key, it is possible to access the parent menu and so on until main menu is reached.

Horizontal navigation has been introduced in each loop. By using *LEFT* and *RIGHT* keys it is possible to move between forms of similar usage (i.e. from View Unit loop is possible to move to View Compressor #1 loop; from Unit Configuration loop is possible to move to Unit Setpoint loop and so on, refer to Forms Tree).

In a form with different I/O fields, with *ENTER* key is possible to access the first one, then with *UP* and *DOWN* it is possible to increase and decrease respectively the value, with *LEFT* it is possible to reload the default value and with *RIGHT* it is possible to skip leaving the value unchanged.

The possibility of changing values is subordinated to passwords of different levels depending on the sensibility of the value.

When a password is active, it is possible to reset all passwords by pressing *UP+DOWN* (to access protected values not accessible anymore without re-entering the password).

In any main loops, it is possible to change the password for the corresponding level (Unit Config. for Tech password, User Setpoint for Operator password and Maint Setpoint for Manager password).

When required, the ***"enter"*** button has to be pressed on the last digit and then pressed again to make the password accepted.

When display is not included, it is possible to scroll menu by up and down keys and to select items in the menu by enter key.

8.1 Form tree

Figure 23 shows the structure of the form tree.

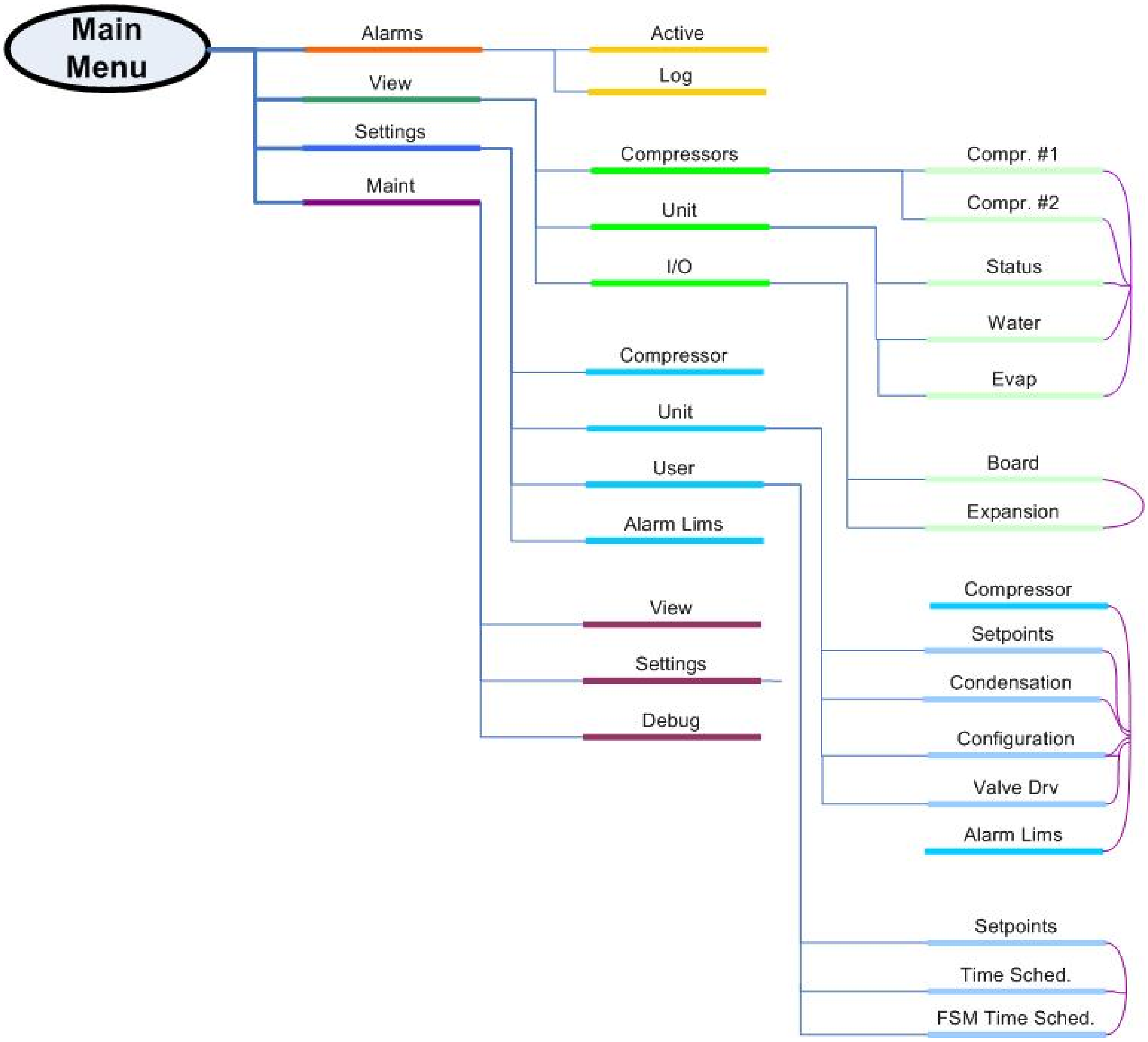


Figure 23 – Form tree structures

Main menu	Main menu
Alarms	Alarms
Active	Active
Log	Log
View	View
Compressors	Compressors
Compr. #1	Compr. #1
Compr. #2	Compr. #2
Unit	Unit
Status	Status
Water	Water
Evap	Evap
I/O	I/O
Board	Board
Expansion	Expansion
Settings	Settings
Compressor	Compressor
Unit	Unit
Compressor	Compressor
Set-points	Set-points
Condensation	Condensation
Configuration	Configuration
Valve Drv	Valve Drv
Alarm Lims	Alarm Lims
User	User
Set-points	Set-points
Time Sched.	Time Sched.
FSM Time Sched.	FSM Time Sched.
Alarm Lims	Alarm Lims
Maint	Maint
View	View
Settings	Settings
Debug	Debug

8.2 Languages

User interface multi-language; the user can select the language to be used.
The following languages must be implemented in the base configuration[3]:

- English
- Italian
- German
- French
- Spanish

Chinese language implemented on additional display (semi-graphic display)

8.3 Units

The interface is able to work using SI and Imperial units (IP).

In the SI system the following units are used:

Pressure	:	bar
Temperature	:	°C
Time	:	sec

In the Imperial system the following units are used:

Pressure	:	psi
Temperature	:	°F
Time	:	sec

When it comes to pressure, the interface shows if shown data are gauge or absolute using the postfix “g” or “a” respectively.

The user may select different units for User interface and for BAS communication.

[3] Just English is available on ver. ASDU01A; other languages will be available in following versions

8.4 Default passwords

Several levels of passwords for each subsection are available. Subsections are listed in the table below.

Section	Password
Technician	01331 07211
Manager	02001
Operator	00100

9 APPENDIX A: DEFAULT SETTINGS[4]

Menu	Section	Subsection	Form	Parameter	Value	Notes
SETTINGS	UNIT	CONFIGURATION	Expansion valve	Expansion valve	Electronic or Thermostatic	
				Gas Type	R134a	
			Unit config	N. of comps	2	
				N. of pump	2	Only if pCO[e]#3 is present
			Condensation fans number	Circuit #1	2 or 3 or 4	Rela number of fans
				Circuit #2	2 or 3 or 4	
			Low Press Transd limits	Min	-0.5 barg	
				Max	7.0 barg	
			Pumpdow config	Enable	Y	
				Max Time	120 s	
				Min Press	1 bar	
			Condensation	Control var.	Press	
				Type	Fantroll	LN and XN units
					VSD	XXN units
					SPEDTROLL	When specified
					DOUBLE VSD	When specified
				Update values	Y	When values are changed
			Oil heating	Enable	Y	
			RS485 Net	time check	30	Y only if expansion boards are changed
				Refresh	N	
			Economizer	Enabled	Y	Only on units with Economizer and expansion board add 2
			Econ Settings	Econ thr	65°C	
				Econ diff	5 °C	
				Econ On	90%	
				Econ Off	75%	
			Supervisory	Remote on/off	N	
				Remote heat/cool	N	
			Auto re-start	Auto re-start after power fail	Y	
			Switch off	Switch off on ext alarm	N	
			Communication	Communication	Supervisor	
			Reset values	Reset all values to default	N	Change to Y at the first unit start
			Password Technician			To change password
SETTINGS	UNIT	SET-POINTS	Pre-purge	N. of pre-purge cycles	1	
				Valve steps	2500	Only for EEXV
				Prep on time	2s	
				Evap T Thr	-10 °C	
			Pre-purge	Pre-purge time-out	120 s	
			Liquid	LI Disc setp	85 °C	

[4] Default settings are for McEnergy chillers only.

				LI Disc diff	10 °C	
			Low ambient start-up	Cond. Sat. T	15.5 °C	
				Lp Al thr	-0.5 barg	
				L.Amb.Timer	120 s	
			Temperature regulation	Der. Time	60 s	
SETTINGS	UNIT	CONDENSATION	Setpoint	Setpoint	40.0 °C	
			FanTroll set-point	StageUP Err	10 °Cs	
				StageDW Err	10 °Cs	
			FanTroll dead band n. 1	Stage Up	See fantroll table	
				Stage down		
			FanTroll dead band n. 2	Stage Up	See fantroll table	
				Stage down		
			FanTroll dead band n. 3	Stage Up	See fantroll table	
				Stage down		
			FanTroll dead band n. 4	Stage Up	See fantroll table	
				Stage down		
			Inverter config (only for VSD, SpeedTroll or Double VSD config)	Max speed	10.0 V	LN and XN units
					6.0 V	XXN units
				Min speed	1.5 V	
				Speed up time	01 s	
			Cond regulation (only for VSD, SpeedTroll or Double VSD config)	Reg. Band	10 °C	Speedtroll
					30 °C	VSD
				Neutral Band	1 °C	
			Cond regulation (only for VSD, SpeedTroll or Double VSD config)	Integral time	150 s	
				Derivative time	001 s	
SETTINGS	UNIT	VALVE DRIVER (Only Units with EEXV)	Pre-opening	Valve Pre-opening	20%	
			EXV Settings #1	Warning	NO WARNING	
			EXV Settings #2	Warning	NO WARNING	
			EXV Settings #1	Act. Pos.	0000	With comp. Off
				Man. Posiz	0500	
				En. EXV Man	N	
			EXV Settings #2	Act. Pos.	0000	With comp. Off
				Man. Posiz	0500	
				En. EXV Man	N	
			Valve type	Valve Type	Sporland 50-SEH 250	
			Settings	Opening Extra steps	Y	

				Closing Extra steps	Y	
				Time extra steps	0 sec	
			Settings	Super Heat set-point	6 °C	
				Dead Band	0 °C	
			Settings	Proportional factor	80	
				Integral factor	30	
				Differential factor	0.5	
			Settings	Low SH protection set-point	1.0 °C	
				Low SH protection integral time	1 sec	
			Settings	LOP set-point	-30 °C	
				LOP Integral time	0 sec	
			Settings	MOP set-point	12 °C	
				MOP Integral time	4 sec	
			Settings	MOP start-up delay	90 sec	
			Settings	High Cond temp protection set-point	90 °C	
				High Cond temp protection Integral time	4 sec	
			Settings	Suction temperature High limit	60 °C	
			Pressure probe #1 settings	Min	-0.5 bar	
				Max	7.0 bar	
			Pressure probe #2 settings	Min	-0.5 bar	
				Max	7.0 bar	
			EXV settings #1	Battery present	Y	
				pLan present	Y	
			EXV settings #2	Battery present	Y	
				pLan present	Y	
SETTINGS	COMPRESSOR	-	Timing	Min T same comp starts	600 s	
				Min time diff comp starts	120 s	
			Timing	Min time comp on	30 s	
				Min time comp off	180 s	

			Timing	Inter-stage time	120 s	
			Press prot	Evap T hold	0.0 °C	
				Evap T down	-3.0 °C	
				DT HP decr	3 °C	
			Dish SH prot	Disc. SH thr	11 °C	
				Disc SH Time	150 s	
			Comp Loading/unloading	N load Pulse	10	
				N unload Pulse	10	
			Loading	Pulse time	0.1 s	
				Min pulse period	5 s	
				Max pulse period	90 s	
			Unloading	Pulse time	0.1 s	
				Min pulse period	1 s	
				Max pulse period	90 s	
SETTINGS	USER	SET-POINTS	Set-points	Cooling set-point	as required	
			Double set-point	Enabled	N	
			Double set-point	Cooling double set-point	as required	Only if double set-point enabled
			LWT reset	Ldg water temp set-point reset	NONE	
			Working mode	Working mode	Cooling	
			Softload	Enable Softload	N	
			Demand limit	Enable supervisory demand limit	N	
			Sequencing	Comp sequence	AUTO	
			Supervisor	Protocol	LOCAL	
				Comm Speed	19200	
				Ident	001	
			Units	Interface Units	SI	
				Supervisory units	SI	NOT IMPLEMENTED YET
			Language	Choose language	English	Other languages NOT IMPLEMENTED YET
			Passwords	Change passwords		
SETTINGS	**USER**	**Time Sch**	Enable	Enable Time Sch	N	
SETTINGS	**USER**	**FSM**	Enable	Enable Fan Silent Mode	N	
SETTINGS	**USER**	**Clock**	Settings	Set Clock		
SETTINGS	ALARMS		AntiFreeze Alarm	Setpoint	2°C	
				Diff	1°C	

			Oil Low pressure alarm delay	Start-up delay	300 s	
				Run delay	90 s	
			Saturated disch temperature alarm	Setpoint	70.5 °C	
				Diff	12.0 °C	
			Saturated suction temperature alarm	Setpoint	-4.0 °C	
				Diff	5..0 °C	
			Oil Press Diff.	Alarm Setp	2.5 bar	
			Phase monitor type	PVM or GPF type	Unit	
			Evap flow switch alarm delay	Start-up delay	20 s	
				Run delay	5 s	
MAINT	SETTING		Evap pump h. counter	Thresh	010x1000	
				Reset	N	
				Adjust		Current running hours
			Comp h. counter #1	Thresh	010x1000	
				Reset	N	
				Adjust		Current running hours
			Comp starts counter #1	Reset	N	
				Adjust		Current running Starts
			Comp h. counter #2	Thresh	010x1000	
				Reset	N	
				Adjust		Current running hours
			Comp starts counter #2	Reset	N	
				Adjust		Current running Starts
			Temp Regulation	Regul. Band	3.0 °C	
				Neutr. Band	0.2 °C	
				Max Pull Down rate	1.2 °C/min	
			Start-Up/Shutdown	Start-Up DT	2.6 °C	
				Shutdown DT	1.7 °C	
			High CLWT start	LWT	25 °C	
				Max Comp Stage	70%	
			Slide valve position			NOT USED
			ChLWT limits	Low	4.4	Cooling Mode
					-6.7	Cooling/glycol or Ice mode
				high	15.5	
			Probes enable			Refer to wiring diagram
			Input probe offset			Depending on actual readings
			DT reload	Dt to reload comp	0.7 °C	
			Reset Alarm Buffer	Reset	N	

			Change password		

Fantroll settings				
		2 Fans circuit	3 Fans circuit	4 Fan Circuit
FanTroll dead band n. 1	Stage Up	3 °C	3 °C	3 °C
	Stage down	10 °C	10 °C	10 °C
FanTroll dead band n. 2	Stage Up	15 °C	6 °C	5 °C
	Stage down	3 °C	6 °C	5 °C
FanTroll dead band n. 3	Stage Up		10 °C	8 °C
	Stage down		3 °C	4 °C
FanTroll dead band n. 4	Stage Up			10 °C
	Stage down			2 °C

10 APPENDIX B: SOFTWARE UPLOAD TO THE CONTROLLER

It is possible to upload the software into the controller using two different ways: using the direct download from a personal computer or using the Carel programming key.

10.1 Direct upload from PC

To upload the program, it is necessary:

- To install in the PC the program Winload supplied by Carel and available on the web site ksa.carel.com. It may also be requested to Daikin.
- to connect the PC, by means of a RS232 serial cable, to the Carel RS232/RS485 adapter (code 98C425C001)
- to connect the RS485 adapter port to the controller terminal port (J10) using a 6 wire phone cable (terminal cable)
- to disconnect the controller from pLAN and to set the net address to 0.
- Switch on the controller and run Winload, select the correct serial port number you are using and wait (a few tenths of a second) for the "ON LINE" status (this means that the program is connected to the controller).
- Then select the "Upload" folder and the "Application" section and select all program files supplied by Daikin (one file in the "blb files" box and one or more files in the "iup files" box).
- Then press the "Upload" button and wait until the transfer is completed; the program shows the progress of the transfer phase in a window and when the process is completed the "UPLOAD COMPLETED" message will appear.
- Finally turn off the controller, disconnect it from the PC, reconnect the pLAN and set the right net address.

This procedure has to be applied to all controllers on the unit with the exception of pCO[e] boards and EEXV drivers.

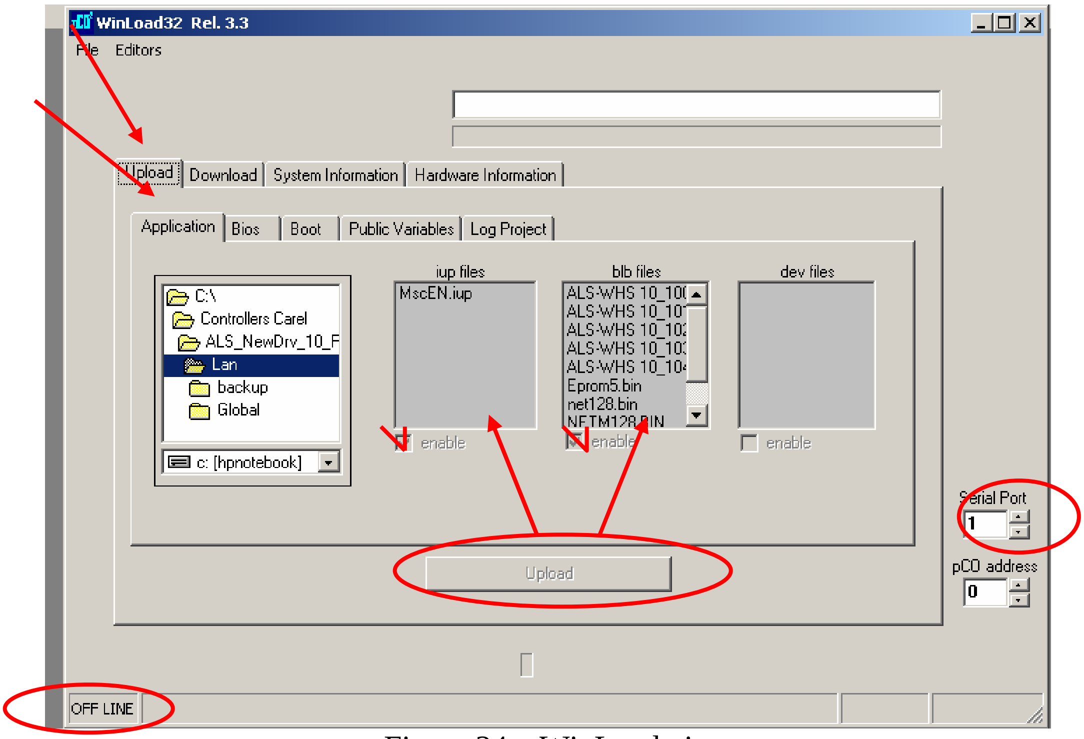


Figure 24 – WinLoad view

10.2 Upload from programming key

To upload the program using the Carel programming key, it is necessary to first upload the program to the key and then download it on one or more controllers. The same procedure has to be used for both operations, just selecting the right position of the key switch:

Key switch position	Transfer type
1 (green light)	key programming from pCO²
2 (red light)	pCO² programming from key

The procedure is described as follows.

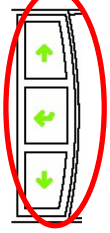
- disconnect the controller from pLAN and set the net address to 0.
- select the right key switch position
- insert the key in the “expansion memory” connection (remove the cover if necessary)
- press “up” and “down” keys at the same time and switch on the controller
- press “enter” key to confirm the operation
- wait until the controller boots up
- turn off the controller
- remove the key.

In case no controller with an installed programme is available, the key may be programmed using the same procedure described for the direct upload from a PC. In this case, with the key inserted in the controller and the key switch in position 2 (red light), the program will be written on the key instead of on the controller.

11 APPENDIX C: PLAN SETTINGS

Such operation must be performed if a terminal is added to the pLAN or if settings are changed.

1. Keep the keys "Up", "Down" and "Enter" pressed for at least 10 seconds



2. A screen will appear with the terminal address and with the address of the board in examination

```
Terminal  Adr: 7
I/O Board Adr: n
```

Using the "Up" and "Down" keys, it is possible to choose the different board (1, 2, 3, 4 for the compressors and 5, 7, 9, 11 for the electronic valve drivers)

Select 1 for "I/O Board Adr" (Board with address 1) and push "Enter". In about two seconds the following screen will appear:

```
Terminal Config

Press ENTER
To continue
```

3. Push "Enter" again; the following screen will appear:

```
P:01  Adr     Priv/Shared
Trm1  7       Sh
Trm2  None      --
Trm3  None      -- Ok? No
```

If you had to add a second terminal (remote terminal), change the line "Trm2 None –" with the line "Tmr2 17 sh". To enable the new configuration put the pointer on "No" (using the key "Enter") and with "Up" and "Down" change it to "Yes" and push "Enter". The operations from 1. to 3. must be repeated for all the compressor boards ("I/O Board" from 1 through 4)

At the end of operations turn off and restart the system.

12 REMARK: IT IS POSSIBLE, AFTER RESTART, THAT THE TERMINAL IS STUCK ON A UNIT. THIS IS DUE TO THE FACT THAT THE MEMORY OF THE DRIVERS REMAINS FED BY THE BUFFER BATTERY AND RETAINS THE DATA OF THE PRECEDING CONFIGURATION. IN THIS CASE, WITH THE SYSTEM NOT FED, IS SUFFICIENT TO DISCONNECT BATTERIES FROM ALL THE DRIVERS AND THEN CONNECT THEM AGAIN APPENDIX D: COMMUNICATION

The control supports communication on the serial port with the following protocols:

- Carel proprietary protocol (local and remote)
- FTT10A (chiller profile)
- BACnet MS/TP & IP (single master points list)

Carel and Modbus protocols require just the communication card (RS485, 422 or 232) Lonwork requires a dedicated communication card and BACnet requires communication card and a translation gateway.

Below is the data point list.

12.1 Output variables

Variable Description	*Variable Name*	*SNVT Index*	*Notes*	*Carel Variable Input(I) Output(O)*	*Modbus Register*
Active Setpoint	nvoActiveSetpt	105		A2(O)	40003
Actual Capacity	nvoActCapacity	81		A10(O)	40011
Capacity Limit (Output)	nvoCapacityLim	81		A42(O)	40043
Chiller Limited	nvoChillerStat	127	Limited=1 Not Limited=0	D6(O)	7
Chiller Local/Remote	nvoChillerStat	127	Local=1 Remote=0	D5(O)	6
Chiller On Off	nvoOnOff	6	0=Chiller Off 1=Chiller On	D2(O)	3
Chiller Status	nvoChillerStat	127	See next table	N/A	N/A
Compressor Discharge Temperature	nvoCompDisTemp	105		A19(O)	40020
Compressor Percent RLA	nvoCompPercRLA	81		A25(O)	40026
Compressor Run Hours	nvoCompHrs	8		I46(O)	40175
Compressor Starts	nvoCompStarts	8		I45(O)	40174
Compressor Suction Line Temperature	nvoSuctionTemp	105		A15(O)	40016
Condenser Refrigerant Pressure Condenser Refrigerant Pressure	nvoCondRefPress nvoCondRefPress	30 30		A21(O) A21(O)	40022 40022
Condenser Saturated Refrigerant Temperature	nvoSatCndRefTemp	105		A20(O)	40021

Evaporator Entering Water Temperature	nvoEntCHWTemp	105		A4(O)	40043
Evaporator Flow Switch Status	nvoChWFlow	95	0=No Flow 1=Flow	D7(O)	8
Evaporator Leaving Water Temperature for Unit	nvoLvgCHWTemp	105		A6(O)	40007
Evaporator Pump Run Hours	nvoEvapPumpHrs	8		I47(O)	40176
Evaporator Refrigerant Pressure	nvoEvapRefPress	30		A17(O)	40018
Evaporator Saturated Refrigerant Temperature	nvoSatEvpRefTemp	105		A16(O)	40017
Evaporator Water Pump Status	nvoChWPump	95	0=Pump Commanded off 1=Pump Commanded On	D29(O)	30
Heat Recovery Entering Water Temperature	nvoEntHRWTemp	105		A22(O)	40023
Heat Recovery Leaving Water Temperature	nvoLvgHRWTemp	105		A23(O)	40024
Oil Feed Pressure	nvoOilFeedPress	30		A32(O)	40033
Outdoor Air Temperature	nvoOutdoorTemp	105		A39(O)	40040
Run Enabled	nvoChillerStat	127	0=Run Disabled 1=Run Enabled	D2(O)	3

12.1.1 Variable Chiller Status description

Variable Description Chiller Status

Variable Name NvoChillerStat

SNVT Index	***Notes***				***Carel Variable Input(I) Output(O)***	***Modbus Register***
127	3 bytes long					
	Byte #	***Description***	***Field Name***	***Notes***		
	1	Chiller Run Mode	chlr_run_mode	0=Off 1=Start 2=Run	D2(O)	
	2	Chiller Operating Mode	chlr_op_mode	0=Auto 1=Heat 3=Cool 6=Off 11=Ice	I19(O)	40148
	3(bit 0)	Alarm Flag	in_alarm	0=No Alarm 1=Alarm	D3(O)	4
	3(bit 1)	Chiller Run Enable	run_enabled	0=Not Enabled 1=Enabled	D4(O)	5

3(bit 2)	Chiller Local/Remote	Local	0=Remote 1=Local	D5(O)	6
3(bit 3)	Chiller Limited	Limited	0=Not Limited 1=Limited	D6(O)	7
3(bit 4)	Evaporator Flow Switch Status	chw_flow	0=No Flow 1=Flow	D7(O)	8

12.1.2 Description of variable sent on index I22 (Modbus register 40151)

Variable Name	nvoSequenceStat			**Carel Variable Input(I) Output(O)**	**Modbus Register**
SNVT Index	**Notes**				
165	8 bytes long				
	Byte #	**Description**	**Notes**		
	1	N/A			
	2(bit 0)	Chiller Full Load	0=Not at Full Load 1=Full Load	I22(O)	40151
	2(bit 1)	Circuit/Compressor1 Availability	0=Not Available 1=Available		
	2(bit 2)	Circuit/Compressor2 Availability	0=Not Available 1=Available		
	2(bit 3)	Circuit 3 Availability	0=Not Available 1=Available		
	2(bit 4)	Circuit 4 Availability	0=Not Available 1=Available		
	2(bit 5 to 7)	N/A			
	3 to 8	N/A			

Circuit/Compressor Availability Definition:

All compressors (or circuits) on a chiller are unable to run. The compressor controllers send a signal; AVAILABLE (1) if the supervisory system can influence its stop/start operation. The indicator is cleared (0) when the following conditions exist:

IF Compressor is OFF because of an alarm
OR
If Compressor is OFF due to the Pump Down Switch
OR
The Unit is OFF because of a Unit alarm
OR

The Unit has been disabled at the keypad display
OR
The Remote Switch has disabled the Unit
OR
The Control Source does not = BAS Network
OR
The front panel switch has disabled the Unit
OR
The compressor switch has disabled the Compressor
OR
An air-cooled unit is below it's outside air temperature set-point and all compressors are off
OR
The Compressor is in the Waiting Low Sump Temperature State
OR
The Compressor is in the Anti-recycle State (start-start, stop-start, etc.)

For example, if a chiller has a Fault alarm, the alarm must be cleared; if a chiller remote stop switch input is opened, the input must be closed again; if a chiller is set for a local source to enable it, it must be returned to network control.

12.2 Input variables

Variable Description	***Variable Name***	***SNVT Index***	***Notes***	***Default Value***	***Carel Variable Input(I) Output(O)***	***Modbus Register***
Capacity Limit Setpoint	nviCapacityLim	81		100%	A3(I)	40004
Chiller Enable	nviChillerEnable	95	0=Chiller Disable 1=Chiller Enable	0	D1(I)	2
Chiller Mode Setpoint	nviMode	108	1=HVAC_HEAT, 3=HVAC_COOL, 11=HVAC_ICE	3	I17(I)	40146
Compressor Select	nviCompSelect	8	See Worksheet nviCompSelect	1	I32(I)	40161
Cool Setpoint	nviCoolSetpt	105		7.2°C	A47(I/O)	40048
Heat Setpoint	nviHeatSetpt	105		35°C	A50(I/O)	40051
Ice Setpoint	nviIceSpt	105		-3.9°C	A48(I/O)	40049

Variable Description	***Variable Name***	***SNVT Index***	***Notes***	***Default Value***
Compressor Select	nviCompSelect	8		1
			1=Compressor #1/Circuit #1	
			2=Compressor #2/Circuit #2	
			3=Compressor #3/Circuit #3	
			4=Compressor #4/Circuit #4	

Below is the list of variables that change with respect to the value of the Compressor Select variable.

- Compressor Discharge Temperature
- Compressor Percent RLA
- Compressor Run Hours
- Compressor Starts
- Compressor Suction Temperature
- Condenser Refrigerant Pressure
- Condenser Saturated Refrigerant Temperature
- Evaporator Refrigerant Pressure
- Evaporator Saturated Refrigerant Temperature
- Oil Pressure

12.3 Configuration variables

SCPT_Reference	***SCPT Index***	***Notes***	***Default Value***	***Carel Variable Input(I) Output(O)***	***Modbus Register***
SCPT_limitChlrCap	81	0% to 160%.	100%	I20(I)	
SCPT_pwrUpState	73	0=Request Chiller Off 1=Request Chiller Auto (run)	0	D9(I)	40010
SCPT_CoolSetpoint	75	–40°C to 93°C	7.2° C	A11(I)	40012
SCPT_HeatSetpoint	78	-40–93°C	37.8° C	A12(I)	40013
SCPT_HVACmode	74	1=HVAC_HEAT, 3=HVAC_COOL, 11=HVAC_ICE	3	I21(I)	40150

12.4 Alarms

Variable Description	***Variable Name***	***SNVT Index***	***Description***	***Carel Variable Input(I) Output(O)***	***Modbus Register***
Current Alarm	nvoAlarmDescr	36	Alarm Text (30 ASCII characters max)	I1 to I16(O)	40130 to 40145
Network Clear Alarm	nviClearAlarm	95	0=Neutral, 1=Clear Alarm	A10(O)	40011

12.4.1 Alarm words I1 – I16

Carel Variable	***Bit #***

	LonWorks Message		
1	Reserved	Integer #1	0
2	Not used		1
3	Not used		2
4	Not used		3
5	Not used		4
6	WARN-Pwr Loss While Running		5
7	Not used		6
8	Not used		7
9	Not used		8
10	Not used		9
11	NO START - Ambient Temp Low		10
12	NO LOAD - Cond Press High #1		11
13	NO LOAD - Cond Press High #2		12
14	NO LOAD - Cond Press High #3		13
15	NO LOAD - Cond Press High #4		14
16	Not used		15
17	UNLOAD - Cond Press High #1	Integer #2	0
18	UNLOAD - Cond Press High #2		1
19	UNLOAD - Cond Press High #3		2
20	UNLOAD - Cond Press High #4		3
21	PUMP ON - Cond Water Freeze #1		4
22	PUMP ON - Cond Water Freeze #2		5
23	PUMP ON - Cond Water Freeze #3		6
24	PUMP ON - Cond Water Freeze #4		7
25	Not used		8
26	Not used		9
27	Not used		10
28	Not used		11
29	Not used		12
30	Not used		13
31	NO RESET-Evap EWT Sensor Fail		14
32	Not used		15
33	NO LOAD - Evap Press Low #1	Integer #3	0
34	NO LOAD - Evap Press Low #2		1
35	NO LOAD - Evap Press Low #3		2
36	NO LOAD - Evap Press Low #4		3
37	Not used		4
38	UNLOAD - Evap Press Low #1		5
39	UNLOAD - Evap Press Low #2		6
40	UNLOAD - Evap Press Low #3		7
41	UNLOAD - Evap Press Low #4		8
42	Not used		9
43	Not used		10
44	Not used		11
45	Not used		12
46	PUMP ON - Evap Water Freeze #1		13
47	PUMP ON - Evap Water Freeze #2		14
48	PUMP ON - Evap Water Freeze #3		15

49	PUMP ON - Evap Water Freeze #4	Integer #4	0
50	START#2 - Evap Pump Fail #1		1
51	START#1 - Evap Pump Fail #2		2
52	Not used		3
53	UNIT STOP-AmbAirTempSensorFail		4
54	Not used		5
55	Not used		6
56	Not used		7
57	Not used		8
58	Not used		9
59	Not used		10
60	Not used		11
61	Not used		12
62	Not used		13
63	Not used		14
64	Not used		15
65	Not used	Integer #5	0
66	Not used		1
67	Not used		2
68	Not used		3
69	COMP STOP - Motor Temp High #1		4
70	COMP STOP - Motor Temp High #2		5
71	COMP STOP - Motor Temp High #3		6
72	COMP STOP - Motor Temp High #4		7
73	COMP STOP - Phase Loss #1		8
74	COMP STOP - Phase Loss #2		9
75	COMP STOP - Phase Loss #3		10
76	COMP STOP - Phase Loss #4		11
77	Not used		12
78	Not used		13
79	Not used		14
80	Not used		15
81	Not used	Integer #6	0
82	Not used		1
83	Not used		2
84	Not used		3
85	Not used		4
86	Not used		5
87	Not used		6
88	Not used		7
89	Not used		8
90	COMP STOP-CondPressSensFail #1		9
91	COMP STOP-CondPressSensFail #2		10
92	COMP STOP-CondPressSensFail #3		11
93	COMP STOP-CondPressSensFail #4		12
94	Not used		13
95	Not used		14
96	COMP STOP - Cond Press High #1		15
97	COMP STOP - Cond Press High #2	Integer #7	0
98	COMP STOP - Cond Press High #3		1
99	COMP STOP - Cond Press High #4		2
100	Not used		
101	Not used		4

102	Not used		5
103	Not used		6
104	COMP STOP-DischTempSensFail #1		7
105	COMP STOP-DischTempSensFail #2		8
106	COMP STOP-DischTempSensFail #3		9
107	COMP STOP-DischTempSensFail #4		10
108	COMP STOP-DischargeTempHigh #1		11
109	COMP STOP-DischargeTempHigh #2		12
110	COMP STOP-DischargeTempHigh #3		13
111	COMP STOP-DischargeTempHigh #4		14
112	Not used		15
113	COMP STOP-Evap Water Flow Loss	***Integer #8***	0
114	COMP STOP - Evap Water Freeze		1
115	Not used		2
116	COMP STOP - Evap Press Low #1		3
117	COMP STOP - Evap Press Low #2		4
118	COMP STOP - Evap Press Low #3		5
119	COMP STOP - Evap Press Low #4		6
120	Not used		7
121	COMP STOP-EvapPressSensFail #1		8
122	COMP STOP-EvapPressSensFail #2		9
123	COMP STOP-EvapPressSensFail #3		10
124	COMP STOP-EvapPressSensFail #4		11
125	Not used		12
126	Not used		13
127	Not used		14
128	Not used		15
129	COMP STOP-Lift Pressure Low #1	***Integer #9***	0
130	COMP STOP-Lift Pressure Low #2		1
131	COMP STOP-Lift Pressure Low #3		2
132	COMP STOP-Lift Pressure Low #4		3
133	Not used		4
134	Not used		5
135	Not used		6
136	Not used		7
137	Not used		8
138	Not used		9
139	Not used		10
140	Not used		11
141	Not used		12
142	Not used		13
143	Not used		14
144	Not used		15
145	Not used	***Integer #10***	0
146	UNIT STOP-Evap LWT Sensor Fail		1
147	COMP STOP-EvapLWT SensFail #1		2
148	COMP STOP-EvapLWT SensFail #2		3
149	Not used		4
150	Not used		5
151	Not used		6
152	COMP STOP-MechHighPressTrip #1		
153	COMP STOP-MechHighPressTrip #2		8

154	COMP STOP-MechHighPressTrip #3		9
155	COMP STOP-MechHighPressTrip #4		10
156	Not used		11
157	Not used		12
158	Not used		13
159	Not used		14
160	Not used		15
161	Not used	Integer #11	0
162	Not used		1
163	Not used		2
164	Not used		3
165	Not used		4
166	Not used		5
167	Not used		6
168	Not used		7
169	Not used		8
170	Not used		9
171	Not used		10
172	COMP STOP - Oil Level Low #1		11
173	COMP STOP - Oil Level Low #2		12
174	COMP STOP - Oil Level Low #3		13
175	COMP STOP - Oil Level Low #4		14
176	COMP STOP-Oil Filter DP High#1		15
177	COMP STOP-Oil Filter DP High#2	Integer #12	0
178	COMP STOP-Oil Filter DP High#3		1
179	COMP STOP-Oil Filter DP High#4		2
180	COMP STOP-OilFeedPrsSensFail#1		3
181	COMP STOP-OilFeedPrsSensFail#2		4
182	COMP STOP-OilFeedPrsSensFail#3		5
183	COMP STOP-OilFeedPrsSensFail#4		6
184	Not used		7
185	Not used		8
186	Not used		9
187	Not used		10
188	Not used		11
189	Not used		12
190	Not used		13
191	Not used		14
192	Not used		15
193	Not used	Integer #13	0
194	Not used		1
195	Not used		2
196	Not used		3
197	COMP STOP-NoStartrTransition#1		4
198	COMP STOP-NoStartrTransition#2		5
199	COMP STOP-NoStartrTransition#3		6
200	COMP STOP-NoStartrTransition#4		7
201	COMP STOP-OilPressLow/Start #1		8
202	COMP STOP-OilPressLow/Start #2		9
203	COMP STOP-OilPressLow/Start #3		10
204	COMP STOP-OilPressLow/Start #4		11
205	Not used		
206	Not used		13

207	Not used		14
208	Not used		15
209	Not used	Integer #14	0
210	Not used		1
211	Not used		2
212	Not used		3
213	Not used		4
214	Not used		5
215	Not used		6
216	Not used		7
217	COMP STOP-SuctnTmpSensorFail#1		8
218	COMP STOP-SuctnTmpSensorFail#2		9
219	COMP STOP-SuctnTmpSensorFail#3		10
220	COMP STOP-SuctnTmpSensorFail#4		11
221	Not used		12
222	Not used		13
223	Not used		14
224	Not used		15
225	FAULT (Check Unit for Detail)	Integer #15	0
226	COMP SHUTDOWN-Comp Fault #1		1
227	COMP SHUTDOWN-Comp Fault #2		2
228	COMP SHUTDOWN-Comp Fault #3		3
229	COMP SHUTDOWN-Comp Fault #4		4

Daikin units comply with the European regulations that guarantee the safety of the product.

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