

# GUARDIAN

# IPC-14

## Industrial Plantroom Controller for Refrigerated Coldstores

- Discharge pressure controller for water cooling pump and condenser fans
- Cooling Tower water temperature controller for pump, fans and heater
- Alarm, and trip monitoring
- Local panel operation and setup of timers, limits and configuration
- Remote RS485 monitoring and setup

## Operation and Setup Manual

GUARDIAN IPC-14 Controller is a mains powered, rail-mounted industrial plant room controller to provide flexible control and monitoring for ammonia plant room auxiliary devices such as water and air condensers, pumps, levels and heaters. It is configurable as:-

- **CFAn** - Condenser Pump and Fan Controller. (Pressure Control)
- **tFAn** - Cooling Tower Pump and Fan Controller. (Temperature Control)
- **AFAN** - Condenser Pump and Fan Controller. (Pressure Control + Summer / Winter)
- **rFAN** - Condenser Pump and Fan Controller. (2 Speed Fans on Pressure Control)

Local temperature and pressure displays and modification of all alarms and control settings is available when the unit is connected to the optional GUARDIAN SKD.9 Serial Keypad Display.

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# Getting Started

Guardian Controllers provide refrigeration engineers with

- **ULTIMATE FLEXIBILITY**
- **ASSURED MONITORING**
- **RELIABLE ALARMS**

This manual provides refrigeration designers, installers, service mechanics and supermarket personnel with the necessary information to achieve the above objectives.

All users require to know a few basic facts about this controller before successfully starting to perform their design, commissioning, maintenance or operating functions.

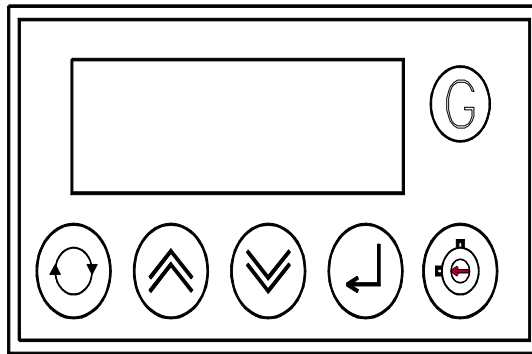
- a) All GUARDIAN controllers need to be set up with a unit model selection and other basic settings for setpoints, timers and addresses. All these settings need to be done using the SKD.9 Keyswitch Display, so the understanding of the button operation of this unit is essential.
- b) The shorthand used in the following chapters for concisely expressing button pressing and selection sequences to do all this setup needs to be understood.
- c) Mains power input voltage and hardware switch and link option selections (if any are required) must correspond to the selected unit model configuration.
- d) Since each controller can be configured in a number of different ways to perform flexible refrigeration control then an understanding of how to find out what unit model is currently selected, what it does and how it is connected, is also necessary.

## SKD.9 KEYSWITCH DISPLAY OPERATION

GUARDIAN controllers require a SKD.9 Keyswitch Display unit to be plugged into the telephone jack socket in the controller before any settings can be changed.

The SKD.9 is connected to the GUARDIAN controller via a 6-core telephone cable.

The SKD.9 Keyswitch/Display comprises a plastic enclosure housing a PCB with four membrane pushbuttons, four LED displays and a 2-position Keyswitch.



SKD.9 buttons have the following functions when pressed:

- |   |                            |  |
|---|----------------------------|--|
| @ | 'next' button              | displays next value or menu selection in sequence.                                       |
| / | 'raise' button             | raises a menu settings value or menu item selection.                                     |
| < | 'lower' button             | decreases a menu settings value or item selection.                                       |
| ? | 'accept' or 'enter' button | accepts any alarm and is used for entering a menu selection or settings value data entry |

The two position **keyswitch** may be used to toggle display case control status from OFF to FANS only and back to AUTO

The Keyswitch is not used on any IPC-14 controllers.

## BUTTON OPERATION SHORTHAND

To assist in easy setup of control setpoints, delays, timers and other configuration settings, the sequence of button presses and subsequent displays will be shown in this handbook as below:

- ii) A button symbol means press that button
- iii) A display box shows the result of the last button press on the SKD.9 display.

### EXAMPLES

@ Auto @ OFF = ? - OFF is shorthand for

Press '**next**' button which then displays AUTO

Press '**next**' button which then displays OFF

Then press '**enter**' button which changes the control mode to OFF and displays -OFF

@: @ Auto ?

Press '**next**' repeatedly until **Auto** is displayed then press '**enter**'.

Suct 4. 8b

means the display alternates between the value identifier tag and the latest value.

di Sc =0c= FAI L

means the display alternately flashes between the value identifier tag (discharge temperature), the measured value ( open circuit ) and the alarm or trip message.

## HARDWARE CONFIGURATION CHECKS

Prior to switching on the GUARDIAN controller check that the hardware unit is the correct type for the incoming mains voltage

Models with **BLUE** labels and suffix '**L**' (**LOW VOLTAGE**) operate at **24vac**

Models with **BLACK** labels and no suffix (**NORMAL 230vac**) operate at **230vac**

### **230vac MAINS SUPPLY WILL DAMAGE A BLUE LABEL CONTROLLER !!!**

A **BLACK** label controller will not work with a 24vac supply

When satisfied that the correct type of controller is available then the following checks should be made prior to controller installation or replacement

- a) Ensure mains supply is wired correctly to the appropriate **TERMINAL WIRING** drawing for the model selected.
- b) Ensure that any transducer selector switches specified on the **TERMINAL WIRING** diagram are in the correct state.
- c) Ensure any shorting link selector pins specified on the **TERMINAL WIRING** diagram are correctly fitted.
- d) Ensure that probes are wired to the terminal **WIRING DIAGRAM** and the correct type of thermistor or pressure transducer probes are fitted.
- e) The SKD.9 Keypad/display unit is fitted correctly in its 6-way telephone socket.
- f) The RS485 highway connections (if required) are wired to the correct terminals and the screen drain wire is continuous to earth.

## CONFIGURE UNIT MODEL, SYSTEM No & ADDRESS

### Enter Passcode PP05 for normal changes

Before any permanent change of controller settings are made then the correct entry of the appropriate passcode is necessary.

Most normal system settings require entry of passcode PP05

@: @ SEt= ? PP00 /: / PP05 ?

Press 'next' repeatedly until **SEt** is displayed then press 'enter'. **PP00** is displayed.  
Press 'raise' repeatedly until **PP05** is displayed and then press 'enter'.

### Select Unit Model

@: @ SEt= ? PP00 /: / PP05 ?

Enter Passcode PP05 as button sequence above

@: @ Uni t ? 9Pc= /: / OCuF ? OCuF

Press 'next' repeatedly until **Unit** is displayed and then press 'enter'

**Display shows unit model currently selected which may be wrong.**

Press 'raise' repeatedly until correct model is displayed (e.g. OCuF) and then press 'enter' which causes the display to wink briefly and display the new unit model selection ( e.g. OCuF)

### Select System No and Address

e.g. setup unit for system 60 at address 180

Enter Passcode as button sequence as above

@: @ Uni t

@: @ Sn01 /: / Sn60 ? Sn60

@ A001 /: < A180 ? A180

@: @ End= ? ==26

### RS485 Communications

When the correct system number, case/compressor number and highway address have been entered as above then the controller can communicate with the GUARDIAN AutoGraph Terminal PC for central alarm monitoring and temperature display. Control setpoints, defrost times and alarm limits may then be sent to the controller from the PC rather than using the SKD.9 Keyswitch display. For further details see page 25

## UNIT MODELS

Guardian controllers may be configured in a number of different ways dependent on unit model selection. Each unit model fulfils a different refrigeration temperature monitoring and control requirement. In order to perform the required refrigeration control then each model has different uses for the controller's input output signals. This section gives details of all the model variations available for the controller and the way to connect the wiring to the plant devices and measuring transducers.

### Available unit models (IPC-14)

IPC -14 'CFAn'	Condenser Pump and Fan Controller.
IPC -14 'AFAN'	Condenser Pump and Fan Controller.
IPC -14 'tFAn'	Cooling Tower Pump and Fan Controller.
IPC -14 'rFAN'	Condenser Pump and Fan Controller.

## GENERAL SPECIFICATION

<b>Power</b>	110 / 230 Vac 50 hz 10VA
<b>Operation</b>	0 to 55°C
<b>Approx. dimensions</b>	Width 70 x length 100 x height off rail 110mm.

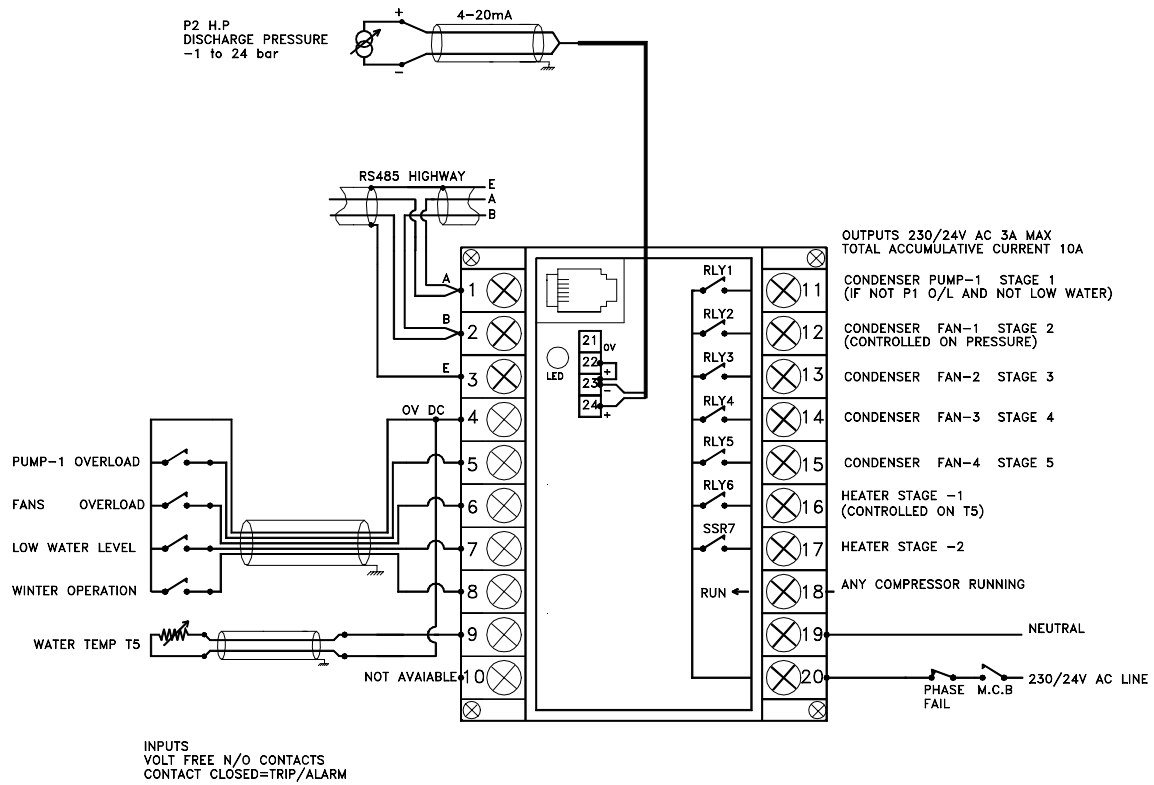
The IPC-14 controller is housed in a DIN rail mounting enclosure with 20 screw clamp connectors.

**IPC-14 Model 'CFAn' Input/Output Signals**

<b>CFAn</b>		
<b>Analogue Inputs</b>		
<b>Digital Inputs</b>		
<b>Mains Inputs 230Vac</b>		
<b>Relay Outputs 230/24v AC 3 amp. Maximum Accumulative Current 10 amp.</b>		



## IPC-14 Model 'CFAn' Termination Wiring



CONDENSER RUNS IF RUN SIGNAL FROM ANY HT COMPRESSOR.

PUMP RUNS IF ITS OVERLOAD IS OK AND WATER LEVEL LOW IS NOT PRESENT.

PUMPS AND FANS SEQUENCE UP AND DOWN ON DISCHARGE PRESSURE.

WATER TEMPERATURE T5 STARTS FROST PROTECTION HEATERS 1 & 2 IF NOT LOW WATER.

HEATER 2 STAGES ON AFTER A TIME DELAY WITH T5 < SETPOINT.

PUMP OVERLOAD STOPS PUMP P-1.

FAN OVERLOAD IS ALARM INPUT ONLY.

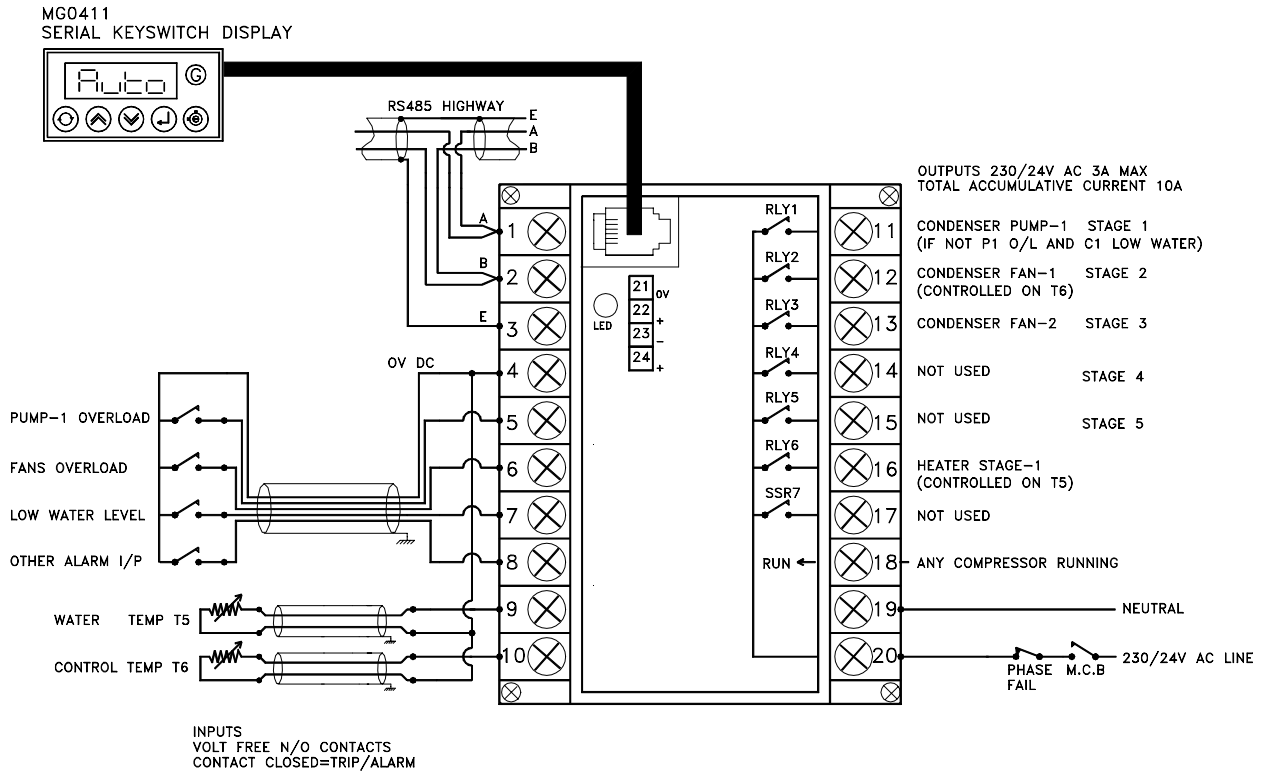
SETPOINT CHANGE 8.0 bar TO 11.0 bar WHILE ANY COOLER IS ON DEFROST, THIS IS DETECTED FROM THE RS485 MONITOR HIGHWAY.

IF WINTER OPERATION INPUT IS NOT PRESENT THEN FAN STAGES 2-4 ARE INHIBITED.

**IPC-14 Model 'tFAn' Input/Output Signals**

<b>tFAn</b>		
<b>Analogue Inputs</b>		
<b>Digital Inputs</b>		
<b>Mains Inputs 230Vac</b>		
<b>Relay Outputs 230/24v AC 3 amp. Maximum Accumulative Current 10 amp.</b>		

## IPC-14 Model 'tFAn' Termination Wiring



COOLING TOWER RUNS IF RUN SIGNAL FROM ANY HT COMPRESSOR.

PUMP RUNS IF ITS OVERLOAD IS OK AND WATER LEVEL LOW IS NOT PRESENT.

PUMP AND FANS SEQUENCE UP AND DOWN ON WATER TEMPERATURE T6.

WATER TEMPERATURE T5 STARTS FROST PROTECTION HEATERS 1 IF NOT LOW WATER LEVEL.

PUMP OVERLOAD STOPS PUMP P-1

FAN OVERLOAD IS ALARM INPUT ONLY.

OTHER ALARM IS ALARM INPUT ONLY.

**IPC-14 Model 'AFAN' Input/Output Signals**

<b>AFAN</b>		
<b>Analogue Inputs</b>		
<b>Digital Inputs</b>		
<b>Mains Inputs 230Vac</b>		
<b>Relay Outputs 230/24v AC 3 amp. Maximum Accumulative Current 10 amp.</b>		

**IPC-14 Model 'AFAN' Termination Wiring**

## CONDENSER PUMP and FAN CONTROLLER (CFAn, AFAn)

When setup as 'CFAN', the controller reverts to the default display if no buttons have been pressed for 3 minutes and displays the discharge pressure.

The default display is replaced by a status message if any of the following conditions occur:-

	8888	After power on restart
	CFAN	Unit Model Selected
	u1.09	Software version displayed after power on or after OFF
	Auto	Restart routine in progress
	OFF=	AFAN selected OFF mode from PC or local display
PunP	triP	Pump Overload tripped
=FAn	triP	Fan Overload Tripped
Lo-A	Leu	Water Low Level alarm
	12.5	Discharge Pressure

### DEFAULT DISPLAYS (CFAn, AFAn)

The following displays are available by repeatedly pressing the @ button.

The Value displays are alternated with an identification tag (e.g. diSc)

	Tag	Value
Discharge Pressure	di Sc	=nn. n Pressure is displayed in Bar gauge.
Condenser Control Setpoint	SetP	=nn. n in Bar gauge.
Water Temperature	uutr	=nnn nnn = Degrees centigrade
Auto Control Mode	Auto	Pressing ? gives Auto
Off Control Mode	OFF=	Pressing ? gives OFF
Hand Control Mode	hAnd	Pressing ? gives HAND
Fan Output Status	Cond	=== A vertical indicates a condenser stage is on RLY1 to RLY5.
Fan Trip Status	tri P	=== A vertical indicates tripped.
Heater Stages Running	HEAt	=== A vertical indicates a heater stage is on. RLY6 to RLY7
Control input states	i nPt	r === Condenser run input. Usually taken from any compressor running.
	Set=	Go to Setup Mode when ? press

### COOLING TOWER PUMP and FAN CONTROLLER (tFAn, rFAn)

When setup as 'tFAn', the controller reverts to the default display if no buttons have been pressed for 3 minutes and displays the control temperature.

The default display is replaced by a status message if any of the following conditions occur:-

	8888	After power on restart
	tFAn	Unit Model Selected
	u1.09	Software version displayed after power on or after OFF
	Auto	Restart routine in progress
	OFF=	tFAn selected OFF mode from PC or local display
=P-1	tri P	Pump overload tripped
=FAn	tri P	Fan overload tripped

Water temperature.      ==nn      nn =degrees Centigrade

**DEFAULT DISPLAYS (tFAn, rFAn)**

The following displays are available by repeatedly pressing the @ button.  
The Value displays are alternated with an identification tag (e.g. ctt)

	Tag	Value
Tower control temperature T6	ctt=	=nnn nnn = Degrees centigrade
Tower Control Setpoint	SEtP	=nn nn = Degrees centigrade
Reservoir Water Temperature T5	uutr	=nnn nnn = Degrees centigrade
Auto Control Mode	Auto	Pressing ? gives <b>Auto</b>
Off Control Mode	OFF=	Pressing ? gives - <b>OFF</b>
Hand Control Mode	hAnd	Pressing ? gives <b>HANd</b>
Fan Output Status	Cond	==== A vertical indicates a condenser stage is on RLY1 to RLY3
Trip Status	triP	==== A vertical indicates pump/fan overload present.
Heater Stages Running	HEAt	==== A vertical indicates heater stage is on RLY6
control input States	inPt	rL== r =any compressor running L =reservoir water low level
	SEt=	Go to Setup Mode when ? press

### Alarm Indications

Alarms are not displayed during Setup operation.  
All alarms are reset automatically when the fault has disappeared.

**IF no RS485 highway is connected then the PC FAIL message can be removed by selecting setup as follows:-**

```
@: @ SEt= ? PP00 /: / PP05 ?  
Uni t ? tFAn @: @ A9t= /: / nonE ?  
@: @ End= ? ==24
```



## USEFUL BUTTON SEQUENCES

The following button sequences should prove useful during normal service operation

### Check Unit Model

```
@: @ SEt= ? PP00 /: / PP05 ?
@: @ Uni t ? CFan This unit model is CFAn'
@: @ End= ? ==23
```

### Select System No and Address

e.g. setup unit for system 60 at address 180

```
@: @ Uni t ?
@: @ Sn01 /: / Sn60 ? Sn60
@ A001 /: < A180 ? A180
@: @ End= ? ==26
```

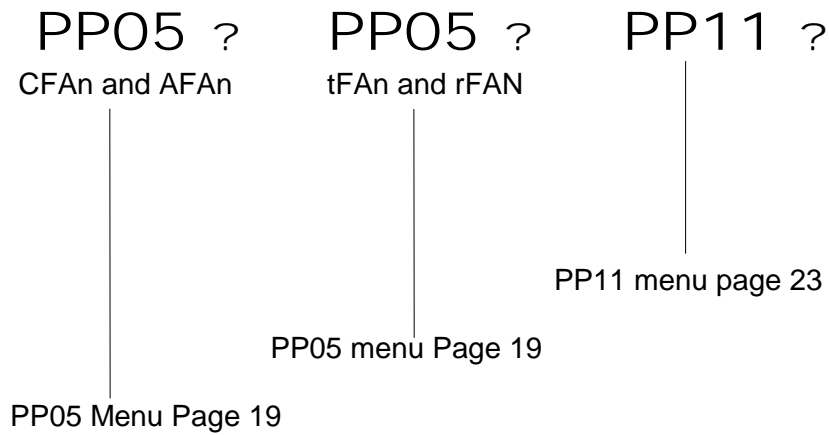
# SETUP OPERATION

Setup operation lasts for a maximum of 5 minutes after being activated by pressing ? with SEt on the display panel.

If the correct passcode is not entered then setup values may be displayed but any attempted changes are ignored.

SEt / Press ?

PP00 Set passcode PP05, or PP11 by using the / and < pushbuttons



## PP05 Menu (CFAn, AFAn)

Press @ to sequence through the following PP05 menu selections

Press ? to select the displayed menu

Uni t	IPC-14 Unit Identity Page 20
Cond	Condenser Configuration; Number of condenser stages. Page 21
FANS	Fan Control set point and deadband. Page 21
HEAt	Heater Control Settings Page 21
dELy	Delays between condenser stages Page 22
FAnP	Pressure alarm and trip limits. Page 22
tESt	Relay Tests Page 22
End/	Return to normal operation

## Unit

### Unit

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

Model Type Selection

YYYY

YYYY = CFAn Condenser Pump and Fan Controller

tFAn Cooling Tower Pump and Fan Controller

AFAN Condenser Pump and Fan Controller

rFAn Cooling Tower Pump and Fan Controller

Unit Hardware Type

i P14

Type 14 for CFAn, tFAn , AFAN and rFAn models

System Number

Snnn

nnn = 0 to 255

Monitor Address

Annn

nnn = 0 to 255

Communications  
Protocol

YYYY

YYYY = A9t Autograph Terminal

SYS5 Woodley System 5

LocL Local Highway only

nonE None

If LocL or nonE is selected the PC / FAiL message is not displayed

## Condenser configuration

### Cond

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

Number of Stages  
(including pump)

Fnnn nn = 01 to 09

## Fan control settings

### FANS

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

Fan Control Setpoint  
During defrost

Hnn. n nn.n = 1.0 to 20.0 Bar

Fan Control Setpoint

Lnn. n nn.n = 1.0 to 20.0 Bar

Control Deadband

dbn. n n.n = 0.1 to 5.0 Bar plus and minus setpoint

Fast Response  
Deadband

Fbn. n n.n = 0.1 to 5.0 Bar plus and minus setpoint

Stage up Control  
Algorithm

FAun n = 0 to 9 Higher n gives faster response when pressure is above setpoint + Fb

Stage Down Control  
Algorithm

FAdn n = 0 to 9 Higher n gives faster response when pressure is below setpoint - Fb

## Heat

### HEAt

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

Control setpoint for  
Water heaters

C=nn nn = -40 to 40 C

## Delay

### DELY

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

Stage delay

f dn. n     n.n = 0.1 to 3.0 tenths of minutes.(0.1=6 seconds)

Time delay for  
second heater stage

Hdnn     nn = 00 to 99 minutes

## FAnP

### FAnP

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

Fan Pressure Alarm

Hnn. n     Discharge Pressure Hi-alarm limit  
nn.n = 1.0 to 20.0

Fan Pressure Trip

t nn. n     Discharge Pressure Hi-trip limit  
nn.n = 1.0 to 20.0

## tESt

### tESt

Press @ to sequence through the relay selections

Repeatedly press ? to switch the relays on and off

Relay R1

1OFF     1/on

Relay R2

2OFF     2/on

etc. to

Relay d

dOFF     d/on

All outputs return to automatic control when SETUP is ended

## End

### End/

Return from Setup to normal operation

## PP11 Menu

Press @ to sequence through the following PP11 menu selections

Press ? to select the displayed menu

Communications	conn	Page 23
Real time clock	rtc/	Page 23
Pressure Transducer Scaling	SCAL	Page 24
	End/	Return to normal operation

## Communications

### conn

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

Lowest address to be monitored for defrost status	Lnnn	nnn = 00 to 255
Highest address to be monitored for defrost status	Hnnn	nnn = 00 to 255

### rtc

### rtc/

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

Real clock time hours	rhnn	nn = 0 to 23 hrs
Real clock time minutes	rtnn	nn = 0 to 59 mins

## Pressure Transducer Scaling

### SCAL

Press **?** at each Pn display to further display the L and H values  
Press the **/** or **<** to change the L settings then press **?** to confirm the changes. Press **@**

Press the **/** or **<** to change the H settings then press **?** to confirm the changes. Press **@** to sequence to the next Pn

Pressure Transducer 1 =P1=

Pressure at 4 mA                      L=nn      nn = -1 to 24 Bar

Pressure at 20 mA                    H=nn      nn = -1 to 24 Bar

And so on to...

Pressure Transducer 4 =P4=

Pressure at 4 mA                      L=nn      nn = -1 to 24 Bar

Pressure at 20 mA                    H=nn      nn = -1 to 24 Bar

### End

End/                      Return from Setup to normal operation



---

# COMMUNICATIONS

Communication facilities are available for interrogation of pressures, temperatures, status and modification/display of setpoints, limits and loop settings. All communication is via a multi-drop RS485 link which connects all IPC-14 units in series with all other Guardian units.

Communications commands and replies are checked for parity and block length and automatically retransmit if errors are detected.

Each IPC-14 has a unique unit number address Annn and System Number Snn which is used to select the appropriate unit for interrogation or modification.

Snn is system no. 1-80

Annn is address 1-255

Some communication commands may use 'wildcard' stub number 99 and 'wildcard' case number 9 to access all systems on the highway or all addresses within a system.

IPC-14 units are inactive until they are addressed.

GUARDIAN Autograph Refrigeration Monitor Communication commands available are:-

- a) Transmit Unit Status which replies with command plus humidity, status & air temperature.
- b) Transmit Values which replies with address plus latest signed temperature values ,time, trip states, relay states and internal status.
- c) Transmit Set points, which replies with set points and limits

Uuu addresses may not be changed via the link.

- d) Receive set points with new set point values from controller

# Setup / commissioning Parameters

IPC14 Condenser fan settings.

## PP05 Normal Menu Settings

Unit		unit	ACTUAL settings	Default setting	Min. setting	Max. setting
Unit	Model type selection CFAn=Condenser Fan control			iuC	iuC	rfaN
	Hardware type CFAn=iP14			iP20	iP20	iP14
	Stub number		<b>Sn</b>	Sn 01	Sn 01	Sn 80
	Case number (normally 1.)		<b>Cn</b>	Cn 01	Cn 01	Cn 04
	Autograph address number		<b>A</b>	A255	A 00	A255
	Monitor Comms Protocol			Agt	Agt	none

Cond	Condenser settings	unit	ACTUAL settings	Default setting	Min. setting	Max. setting
Cond	Number of fan stages		<b>Fn</b>	2	1	3

fAns		unit	ACTUAL settings	Default setting	Min. setting	Max. setting
fAns	Pressure setpoint during defrosting	bar	<b>H</b>	11.0	0	20.0
	Pressure setpoint normal operation	bar	<b>L</b>	8.0	0	20.0
	Pressure dead band	bar	<b>db</b>	0.1	0.0	5.0
	Pressure Fast band	bar	<b>Fb</b>	0.1	0.0	5.0
	Fast algorithm for stage up	bar	<b>Fau</b>	0	0	9
	Fast algorithm for stage down	bar	<b>FAu</b>	0	0	9

HEAt	Water heater setpoint	C	<b>c</b>	3	-40	40
	Heater stage delay	mins	<b>Hd</b>	5	0	99

dELy	Fan stage delay	mins	<b>Fd</b>	0.5	0.0	3.0
	Water Heater stage delay	mins	<b>Hd</b>	1	0	99
	Low differential delay	mins	<b>Pd</b>	0	0	9.9

FAnP	Pressure High Alarm	bar	<b>H</b>	14	0.0	20.0
	Pressure High Trip	bar	<b>t</b>	20.0	0	20.0

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