

GUARDIAN RCU-20X

Refrigeration Control Unit for Air Handlers & Coldstores

- Cold Freezium 3-way valve valve evaporator control
- Liquid solenoid valve and fan speed control
- Hot Freezium Defrost control of evaporators
- Refrigeration temperature & Humidity monitor
- Fan-fail and coldstore door alarms
- Humidity, heater and fan control
- Local panel value display and setup remote
- RS485 communications

Operation and Setup Manual

The GUARDIAN RCU-20X Refrigeration Controller is a rail-mounted, mains-powered, flexible, refrigeration temperature and defrost sequence controller using hot and cold freezium to control for a coldstore zone or production area Air Handler Unit

Local temperature displays and modification of all defrost times, alarms and control settings is available when the unit is connected to the optional GUARDIAN SKD-9 Serial Keyswitch Display.

The RCU-20X communicates with a GUARDIAN Consultant PC Terminal which provides remote central alarm monitoring, data recording, graphs and setting changes via a RS485 serial link.

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Getting Started

Guardian Controllers provide refrigeration engineers with

- **ACCURATE CONTROL**
- **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.

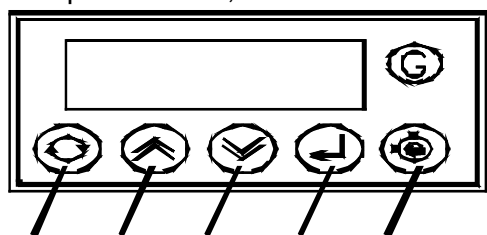
- a) All GUARDIAN controllers need to be set up with a unit model selection and other basic settings for setpoints, timers and addresses. All these settings need to be done using the SKD.9 Keyswitch Display, so the understanding of the button operation of this unit is essential.
- b) The shorthand used 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.



next raise lower enter 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 HVAC or compressor 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 48b

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

di Sc =oC= 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 ? SALE /: / HUAC ? HUAC

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. ru14) and then press 'enter' which causes the display to wink briefly and display the new unit model selection(e.g. ru14)

Select System No and Address

e.g. setup unit for system 60 case 1 at address 180

Enter Passcode as button sequence as above

@: @ Uni t ?

@: @ Sn01 /: / Sn60 ? Sn60

@ Cn01 ? Cn01

@ 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 SKD9 Keyswitch display. For further details see page **Error! Bookmark not defined.**

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 (RCU-14)

The RCU 20X can be configured for control of

- a) 'EVAP' used for industrial coldstores.
- b) 'AHU' used for conditioning room control.

GENERAL SPECIFICATION

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

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

CONTROL PARAMETER DEFINITIONS.

The following list of parameters may be accessed using the Sd9 display unit. Parameters are grouped under menu headings and may only be changed under pass-code control,(see page for a guide to using the Sd9 to access and navigate the menus).

(PRODUCTION AHU)

MENU: UNIT

(Unit as displayed on Sd9).

Menu item	Sd9 Display	Menu item description
1.	Prod	Controller input/output configuration
2.	i def Fans Off auto	Operation mode. Initiate a defrost cycle. Run Fans only. All other control items are stopped. Off mode. All control items are stopped. Auto mode. Return to automatic control.
3.	Sn01	System number, used for RS485 communications.
4.	A003	Address, used for RS485 communications.
5.	Agt none	Communications protocols. Microm Agt/Consultant. No comms. Prevents PC Fail message on SD9 display.

Setting Temperature control?

MENU: Cooling Coil.

(Cool as displayed on Sd9)

Pass-code level PP05.

This set of parameters configures the way the controller responds to changes in temperature to modulate the 3-way cooling valve.

Menu ref.	Sd9 Display	Menu item descriptions
1.	tL10	Low limit of temperature control band. Below this value the control valve will be in full bypass.
2.	tH12	High limit of temperature control band. Above this value the control valve will be in fully open.
3.	cat cLt cHt	Control type. Control on Average of temperature sensors. Control on Lowest of temperature sensors. Control on Highest of temperature sensors.
4.	Pos nEg	Analogue output Polarity Valve 100%, analogue output is at 10vdc. Valve at 0%, analogue output is at 10vdc.
5.	CPO. 2	Cooling period. Rate at which analogue output to valve is updated.

Setting Humidity control?

MENU: Heating Coil.

(Heat as displayed on Sd9)

Pass-code level PP05.

This set of parameters configures the way the controller responds to changes in humidity to modulate the 3-way heating valve.

Menu ref.	Sd9 Display	Menu item descriptions
1.	hL10	Low limit of Humidity control band. Below this value the control valve will be in full bypass.
2.	hH12	High limit of Humidity control band. Above this value the control valve will be in fully open.
3.	Pos nEg	Analogue output Polarity Valve 100%, analogue output is at 10vdc. Valve at 0%, analogue output is at 10vdc.
4.	hPO. 2	Heating period. Rate at which analogue output to valve is updated.
5.	dd02	Washdown delay. Time after wash-down is complete before normal control resumes.

Setting defrost schedule?

MENU: DEFROST.

(dEFr As displayed on Sd9)

Pass-code level PP05

This set of parameters configures the parameters associated with defrosting the cooling coil.

Menu item	Sd9 Display	Menu item description
1.	dn04	Number of defrosts per day. This sets the interval between defrosts.
2.	1H01	First defrost hours. Combined with item 3 gives the time of the first defrost.
3.	1t00	First defrost minutes. Combined with item 2 gives the time of the first defrost. In this example it will be at 01:00, with defrosts occurring at 6 hour intervals.
4.	dP20	Defrost Period. Time in minutes of defrost.
4.	Fd03	Fan Delay. Time in minutes after defrost period, with cooling solenoid open, before fans start and defrost mode is finished.

Checking control relays?

MENU: TEST.

(tEst As displayed on Sd9)

Pass-code level PP05

Menu item	Sd9 Display	Menu item description
1.	1oFF 1 on	Force relay output. This state is changed by pressing the 'Enter' key on the Skd9. Relay off. Relay on.
2.	2oFF	As item 1
3.	3oFF	As item 1
4.	4oFF	As item 1
5.	5oFF	As item 1
6.	6oFF	As item 1
7.	7oFF	As item 1
8.	----	Input States. A vertical line indicates that the input is on. Inputs are displayed from left to right, inputs 1 to 6.

Setting Alarm Limits?

MENU:ALARMS.

Differential Pressure 1 alarm limits.

(dp1 As displayed on Sd9)

Pass-code level PP07

Menu item	Sd9 Display	Menu item description
1.	H50	High alarm limit. Above this limit a 'Hi' alarm is generated on the Sd9 and PC.
2.	L100	Low alarm limit. Below this limit a 'Lo' alarm is generated on the Sd9 and PC.
3.	t 50	Alarm Guardtime. Time delay in minutes before high/low alarms are generated.

This menu is repeated for the following inputs :-

Differential Pressure 2 alarm limits. dp2

Differential Pressure 3 alarm limits. dp3

Control temperature (This is a calculated value). tC

Temperature Sensor 1. t1

Temperature Sensor 2. t2

The above limits are accessed by repeatedly pressing 'next'.

Setting the time?

MENU: REAL TIME CLOCK

(r tC As displayed on Sd9)

Pass-code level PP11

Menu item	Sd9 Display	Menu item description
1.	r h11	Hours now.
2.	r t30	Minutes now.

Setting pressure transducer scaling?

MENU: SCALING.

(sCAL As displayed on Sd9)

Pass-code level PP11

P1 Humidity transducer Scaling.

Menu item	Sd9 Display	Menu item description
1.	LOO	Scaling low limit. Humidity represented by 4mA.
2.	H100	Scaling high limit. Humidity represented by 20mA.

P2 Differential pressure transducer 1 Scaling

Menu item	Sd9 Display	Menu item description
1.	LOO	Scaling low limit. Differential pressure represented by 4mA.
2.	H100	Scaling high limit. Differential pressure represented by 20mA.

P7 Differential pressure transducer 2 Scaling

Menu item	Sd9 Display	Menu item description
1.	LOO	Scaling low limit. Differential pressure represented by 4mA.
2.	H100	Scaling high limit. Differential pressure represented by 20mA.

P8 Differential pressure transducer 2 Scaling

Menu item	Sd9 Display	Menu item description
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1.	LOO	Scaling low limit. Differential pressure represented by 4mA.
2.	H100	Scaling high limit. Differential pressure represented by 20mA.

(ZONE AHU)

The following list of parameters may be accessed using the Sd9 display unit. Parameters are grouped under menu headings and may only be changed under pass-code control,(see page for a guide to using the Sd9 to access and navigate the menus).

Commissioning the controller?

MENU: UNIT

(Unit as displayed on Sd9).

Menu item	Sd9 Display	Menu item description
1.	ZonE	Controller input/output configuration
2.	i def Fans Off auto	Operation mode. Initiate a defrost cycle. Run Fans only. All other control items are stopped. Off mode. All control items are stopped. Auto mode. Return to automatic control.
3.	Sn01	System number, used for RS485 communications.
4.	A003	Address, used for RS485 communications.
5.	Agt none	Communications protocols. Microm Agt/Consultant. No comms. Prevents PC Fail message on SD9 display.

Setting Cooling 3 way valve control?

MENU: Cooling Coil.

(Cool as displayed on Sd9)

Pass-code level PP05.

This set of parameters configures the way the controller responds to changes in freezium temperature to modulate the 3-way cooling valve.

Menu ref.	Sd9 Display	Menu item descriptions
1.	td03	Maximum temperature differential across the cooling coil. Above this value the control valve will be fully Open. At a td of zero the valve will be in full bypass.
4.	Pos nEg	Analogue output Polarity Valve 100%, analogue output is at 10vdc. Valve at 0%, analogue output is at 10vdc.
5.	cPO. 2	Cooling period. Rate at which analogue output to valve is updated.

Setting Zone temperature control?

MENU: Fan speed control.

(FAnC as displayed on Sd9)

Pass-code level PP05.

This set of parameters configures the way the controller responds to changes in zone temperature to modulate variable speed fans.

Menu ref.	Sd9 Display	Menu item descriptions
1.	tL10	Low limit of temperature control band. Below this value the fan speed will be at minimum.
2.	tH12	High limit of temperature control band. Above this value the fan speed will be at maximum.
3.	cat cLt cHt	Control type. Control on Average of temperature sensors. Control on Lowest of temperature sensors. Control on Highest of temperature sensors.
4.	Pos nEg	Analogue output Polarity Valve 100%, analogue output is at 10vdc. Valve at 0%, analogue output is at 10vdc.
5.	FPO. 2	Fan speed period. Rate at which analogue output to valve is updated.

Setting defrost schedule?

MENU: DEFROST.

(dEFr As displayed on Sd9)

Pass-code level PP05

This set of parameters configures the parameters associated with defrosting the cooling coil.

Menu item	Sd9 Display	Menu item description
1.	dn04	Number of defrosts per day. This sets the interval between defrosts.
2.	1H01	First defrost hours. Combined with item 3 gives the time of the first defrost.
3.	1 t00	First defrost minutes. Combined with item 2 gives the time of the first defrost. In this example it will be at 01:00, with defrosts occurring at 6 hour intervals.
4.	dP20	Defrost Period. Time in minutes of defrost.
4.	Fd03	Fan Delay. Time in minutes after defrost period, with cooling solenoid open, before fans start and defrost mode is finished.

Checking control relays?

MENU: TEST.

(tEst As displayed on Sd9)

Pass-code level PP05

Menu item	Sd9 Display	Menu item description
1.	1oFF 1 on	Force relay output. This state is changed by pressing the 'Enter' key on the Skd9. Relay off. Relay on.
2.	2oFF	As item 1
3.	3oFF	As item 1
4.	4oFF	As item 1
5.	5oFF	As item 1
6.	6oFF	As item 1
7.	7oFF	As item 1
8.	----	Input States. A vertical line indicates that the input is on. Inputs are displayed from left to right, inputs 1 to 6.

Setting Alarm Limits?

MENU:ALARMS.

Control temperature alarm limits.

(tC As displayed on Sd9)

Pass-code level PP07

Menu item	Sd9 Display	Menu item description
1.	H50	High alarm limit. Above this limit a 'Hi' alarm is generated on the Sd9 and PC.
2.	L100	Low alarm limit. Below this limit a 'Lo' alarm is generated on the Sd9 and PC.
3.	t 50	Alarm Guardtime. Time delay in minutes before high/low alarms are generated.

This menu is repeated for the following inputs :-

Temperature Sensor 1. t1

Temperature Sensor 2. t2

Temperature Sensor 3. t3

Temperature Sensor 4. t4

Freezium flow Sensor FFt

Freezium return Sensor Frt

The above limits are accessed by repeatedly pressing 'next'.

Setting the time?

MENU: REAL TIME CLOCK

(r tC As displayed on Sd9)

Pass-code level PP11

Menu item	Sd9 Display	Menu item description
1.	r h11	Hours now.
2.	r t30	Minutes now.

Setting pressure transducer scaling?

MENU: SCALING.

(sCAL As displayed on Sd9)

Pass-code level PP11

P1 Humidity transducer Scaling.

Menu item	Sd9 Display	Menu item description
1.	LOO	Scaling low limit. Humidity represented by 4mA.
2.	H100	Scaling high limit. Humidity represented by 20mA.

SD9 DISPLAY INDICATIONS

Production AHU

The following displays are available by repeatedly pressing @ Value displays are alternated with an identification Tag (ie 'Suct') which is displayed for a quarter time:- All pressures are followed by 'b' to denote bar gauge

Tag	Value	
=tC=	=2. 4	Control Temperature(Average, Lowest or Highest of temperature sensors).
=t1=	=2. 7	Temperature sensor 1, (C)
=t2=	=2. 1	Temperature sensor 2, (C)
=rH=	=56	Relative Humidity, (%).
dp1=	=106	Filter differential pressure 1.(Pascals)
dp2=	=052	Filter differential pressure 2.(Pascals)
dp3=	=203	Filter differential pressure 3.(Pascals)
rEL1	12- -	Relay states R1 to R4. Horizontal line means that the relay is in the normally open state. A number in the segment display means that the corresponding relay is closed.
rEL2	5- 7-	Relay states R1 to R7.
i nP1	Ab- -	Input states A to D. Horizontal line means that the input is in the normally open state. A letter in the segment display means that the corresponding input is closed.
i nP2	EF- -	Input states E to F.
cFoP	=052	Cold Freezium valve position, (%).

hFoP =078 Hot Freezium valve position, (%).

=SEt Request parameter change.

ZONE AHU

The following displays are available by repeatedly pressing @ Value displays are alternated with an identification Tag (ie 'Suct') which is displayed for a quarter time:- All pressures are followed by 'b' to denote bar gauge

Tag	Value	
=tC=	=2. 4	Control Temperature(Average, Lowest or Highest of temperature sensors).
=t1=	=2. 7	Temperature sensor 1, (C)
=t2=	=2. 6	Temperature sensor 2, (C)
=t3=	=2. 2	Temperature sensor 3, (C)
=t4=	=2. 1	Temperature sensor 4, (C)
=rH=	=56	Relative Humidity, (%).
FFt=	-07. 6	Freezium Flow temperature, (C)
Fr t=	-05. 6	Freezium Return temperature, (C)
rEL1	12- -	Relay states R1 to R4. Horizontal line means that the relay is in the normally open state. A number in the segment display means that the corresponding relay is closed.
rEL2	5- 7-	Relay states R1 to R7.
i nP1	Ab- -	Input states A to D. Horizontal line means that the input is in the normally open state. A letter in the segment display means that the corresponding input is closed.
i nP2	EF- -	Input states E to F.
cFoP	=052	Cold Freezium valve position, (%).
FnoP	=078	Variable speed Fan output, (%).
=SEt		Request parameter change

Default Display Messages.

Production AHU.

The default display will normally display the control temperature. When a change in the operating mode of the controller occurs or an alarm condition is present then the following messages are displayed:

8888	During restart
Prod	Unit model configuration selected, , during restart only
u1. 0A	Software version, during restart only.
012. 8	During normal operation the control temperature is displayed
-dEF	If unit in Defrost cycle.
-OFF	If unit selected OFF mode.
-FAn	If unit selected Fan only mode.
shdn	If unit is in Wash-down.
=PC=	FAi L if RS485 comms watchdog fail
dP1=	FAi L if differential pressure transducer 1 has failed.
dP2=	FAi L if differential pressure transducer 2 has failed.
dP3=	FAi L if differential pressure transducer 3 has failed.
=t1=	FAi L if temperature transducer 1 has failed.
=t2=	FAi L if temperature transducer 2 has failed.
=rH=	FAi L if humidity transducer has failed.
=Hi =	012. 8 if an alarm high limit has been exceeded. To find which sensor is in high alarm, press the next button until 'Hi' is displayed between the sensor tag and value.

=Lo=	012.8	if an alarm low limit has been exceeded. To find which sensor is in low alarm, press the next button until 'Lo' is displayed between the sensor tag and value.
	FAn1	if a fan 1 overload has occurred.
	FAn2	if a fan 2 overload has occurred.
	dAPF	if a damper motor fail has occurred.

Zone AHU.

The default display will normally display the control temperature. When a change in the operating mode of the controller occurs or an alarm condition is present then the following messages are displayed:

	8888	During restart
	2onE	Unit model configuration selected, , during restart only
	u1. 0A	Software version, during restart only.
	012. 8	During normal operation the control temperature is displayed
	- dEF	If unit in Defrost cycle.
	- OFF	If unit selected OFF mode.
	- FAn	If unit selected Fan only mode.
=PC=	FAi L	if RS485 comms watchdog fail
=t1=	FAi L	if temperature transducer 1 has failed.
=t2=	FAi L	if temperature transducer 2 has failed.
=t3=	FAi L	if temperature transducer 3 has failed.
=t4=	FAi L	if temperature transducer 4 has failed.
=rH=	FAi L	if humidity transducer has failed.
=Hi =	012. 8	if an alarm high limit has been exceeded. To find which sensor is in high alarm, press the next button until 'Hi' is displayed between the sensor tag and value.
=Lo=	012. 8	if an alarm low limit has been exceeded. To find which sensor is in low alarm, press the next button until 'Lo' is displayed between the sensor tag and value.
	FAn1	if a fan 1 overload has occurred.

FAn2	if a fan 2 overload has occurred.
FAn3	if a fan 3 overload has occurred.
FAn4	if a fan 4 overload has occurred.
dAPF	if a damper motor fail has occurred.
usdF	if a fan variable speed drive fail has occurred.

PC-FAIL ALARM

If the RCC12 unit is in '**Auto**' mode and a valid status request has not been received for 60 seconds via the RS485 highway then a Watchdog timer '**PC/FAIL**' message is displayed. This alarm is reset if 485 communications are restored or the AGT/SYS5/LocI/nonE is set to '**LocL**' or '**nonE**' in unit settings.

=PC= F A I L if RS485 comms watchdog fail

COMMUNICATIONS

Communication facilities are available for interrogation of temperatures, status and modification / display of setpoints, limits and timeclock settings. All communication is via a RS485 link which connects all GUARDIAN controllers units in series.

Communication commands and replies are checked for parity and block length and automatically re-transmit if errors are detected.

GUARDIAN controllers are inactive until they are addressed.

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