

# GUARDIAN 635 and 515

## Refrigeration Control Units for Display Cabinets & Coldstore Coolers

- AKV10/20 expansion valve control using temperature or pressure
- Liquid valve and Defrost control
- Hotgas, Trim heater & Fan control
- Suction valve & Lighting control
- Control-air temperature alarms
- Fan-fail & coldstore door alarms
- PT1000 or Thermistor probes
- Local panel display and set-up
- Remote RS485 communications

## Operation and Set-up Manual

GUARDIAN 635 and 515 Refrigeration Controllers are mains-powered, universal, refrigeration temperature and defrost sequence controllers for supermarket display cases and coldrooms using liquid valve or AKV10/20 expansion valve control.

Both models communicate with the GUARDIAN Autograph Terminal and the Woodley System 5 which provide remote central alarm monitoring, data recording and graphs.

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

GUARDIAN  
Tel. +44 (0) 1270 760599  
Fax. +44 (0) 1270 766804  
Email: [sales@Guardian-controls.com](mailto:sales@Guardian-controls.com)  
[www.Guardian-controls.com](http://www.Guardian-controls.com)

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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.

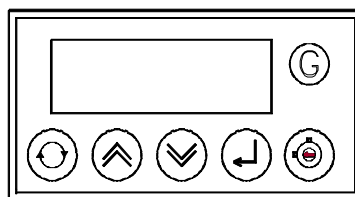
- a) All GUARDIAN controllers need to be set up with a unit model selection and other basic settings for setpoints, timers and addresses. All these settings need to be done using the SKD.9 Keyswitch Display, so the understanding of the button operation of this unit is essential.
- b) The shorthand used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

- |   |                                   |  |
|---|-----------------------------------|--|
| @ | <b>'next' button</b>              | displays next value or menu selection in sequence.                                       |
| / | <b>'raise' button</b>             | raises a menu settings value or menu item selection.                                     |
| < | <b>'lower' button</b>             | decreases a menu settings value or item selection.                                       |
| ? | <b>'accept' or 'enter' button</b> | 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 compressor controllers.

## BUTTON OPERATION SHORTHAND

To assist in easy set-up 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**'.

rEt= =- 17

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

rEt= =OC= FAI L

means the display alternately flashes between the value identifier tag (return air 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

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 ? 635 /: / =515 ? =515

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. 515) and then press 'enter' which causes the display to wink briefly and display the new unit model selection( e.g. 515)

### Select System No and Address

e.g. set-up 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 33

## 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 for the 635 and 515

- 635 LSoL** Standard liquid line solenoid valve control.
- 635 EEt** Electronic expansion valve using coil in and coil out temperatures.
- 635 EEP** Electronic expansion valve using coil out temperature and pressure.
  
- 515 LSoL** Standard liquid line solenoid valve control
- 515 EEt** Electronic expansion valve using coil in and coil out temperatures

## GENERAL SPECIFICATION

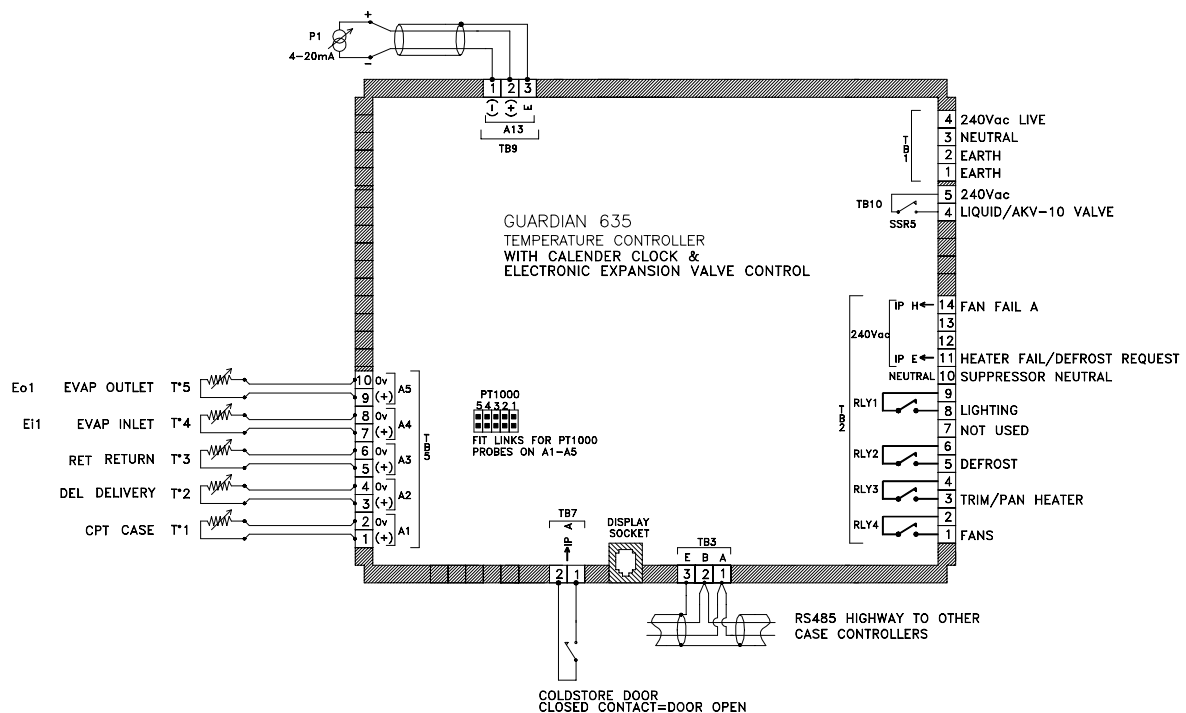
<b>Power</b>	110 / 230 Vac 50 Hz 10VA
<b>Operation</b>	0 to 55°C
<b>Approx. dimensions</b>	
<b>board</b>	Width 150 x length 193 x height 36mm.
<b>enclosure</b>	Width 200 x length 250 x height 65mm.

## 635

### 635 Input/Output Signals

Analogue Inputs ( thermistor) -40 to +50°C (or PT1000 resistance thermometer)		
Cpt	1	Case or calculated product temperature Evaporator defrost termination if <b>Stor defrost</b>
DEL	2	Discharge air temperature
rET	3	Return air temperature
Ei1	4	Evaporator inlet temperature
Eo1	5	Evaporator outlet temperature
PrES	10	Suction pressure (4-20ma, -1.0 ,24 bar)
Status Inputs (12vdc 10 ma per input)		
	1A	Coldstore Door contact
	1B	Not Used
	1C	Not Used
	1D	Not Used
Alarm Trip Input (230vac only)		
	1E	Trim Heater fail/defrost request input
	1H	Fans circuit fail
Relay output (5 Amp 230VAC n/o with suppressors)		
L	R1	Lighting control/1085 LSV (n/o)
d	R2	Defrost Heater control (n/o)
h	R3	Trim heater control (n/o) Pan Heater if <b>Stor</b> (n/o)
F	R4	Fan control
Solid State Relay outputs (230VAC 0.5 AMP)		
C	SSR5	SSR5 Liquid valve control (n/o)
Communications		
		RS485 serial link at 9600 baud

### 635 Termination Wiring



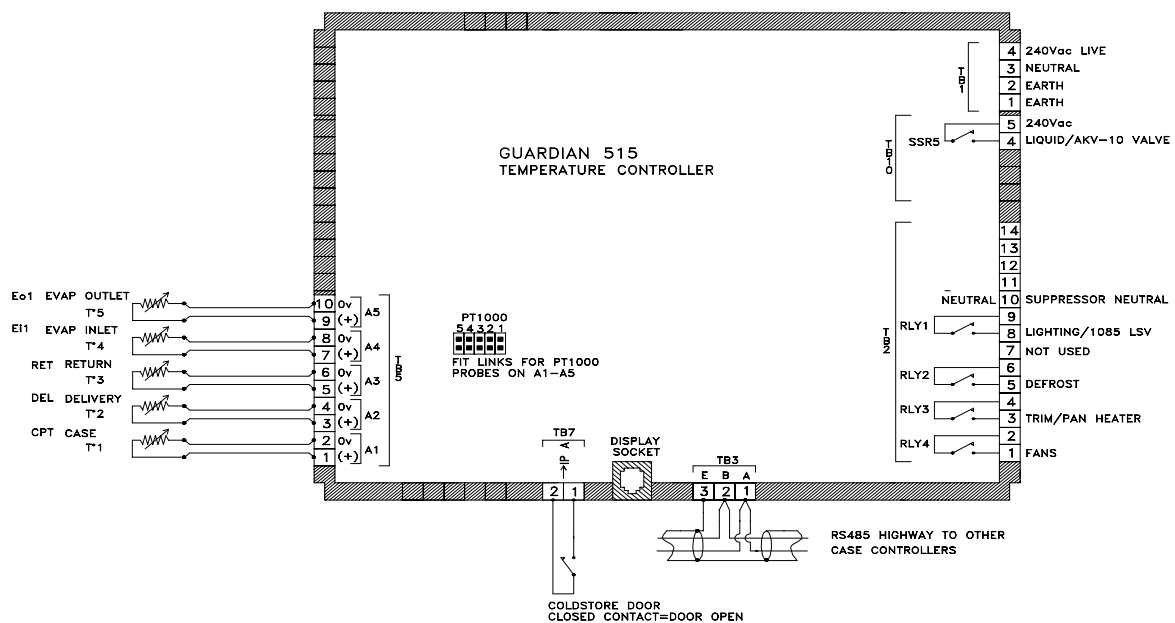


## 515

### 515 Input/Output Signals

Analogue Inputs ( thermistor) -40 to +50°C(or PT1000 resistance thermometer)		
Cpt	1	Case or calculated product temperature Evaporator defrost termination if <b>Stor defrost</b>
DEL	2	Discharge air temperature
rET	3	Return air temperature
Ei1	4	Evaporator inlet 1 temperature
Eo1	5	Evaporator outlet 1 temperature
Status Inputs (12vdc 10 ma per input)		
	1A	Coldstore Door contact
	1B	Not Used
	1C	Not Used
	1D	Not Used
Relay output (5 Amp 230VAC n/o with suppressers)		
L	R1	Lighting control/1085 LSV (n/o)
d	R2	Defrost Heater control (n/o)
h	R3	Trim heater control (n/o) Pan Heater if <b>Stor</b> (n/o)
F	R4	Fan control
Solid State Relay outputs (230VAC 0.5 AMP)		
C	SSR5	SSR5 Liquid valve control (n/o)
Communications		
		RS485 serial link at 9600 baud

### 515 Termination Wiring



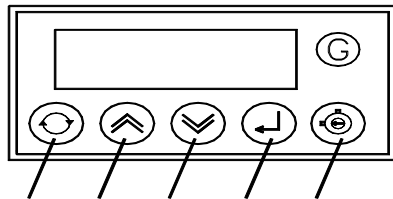
## OPERATION

The SKD.9 Keyswitch display provides a display at the case or coldroom of:  
Case or product temperature display.

Display of other temperatures by pressing 'next' @ button, the values displayed depend on the unit model selected.

Case cleaning operation using the keyswitch.

Passcode protected set-up of controller setpoints, timers and limits.



next raise lower enter keyswitch

## CASE CLEANING OPERATION

### FANS ONLY

To switch from normal automatic control mode to FANS ONLY prior to case cleaning:-  
Insert security Key into the keyswitch on the display unit.

Ensure key turned anti-clockwise

Turn key clockwise.

FANS is now displayed and all control relays are switched off except for the fans relay.

Turn key anti-clockwise.

Remove key until required for OFF selection.

### OFF for cleaning

To switch from FANS mode to OFF prior to case cleaning:-

Insert security Key into the keyswitch on the display unit.

Ensure key turned anti-clockwise

Turn key clockwise.

The display unit now displays -OFF and all control relays are switched off.

Turn key anti-clockwise.

Remove key until required for Auto selection after cleaning is complete.

The case is now safe for cleaning.

### AUTO control after cleaning

To switch from -OFF mode to AUTO after case cleaning:-

Insert security Key into the keyswitch on the display unit.

Ensure key turned anti-clockwise

Turn key clockwise.

The display unit now displays the software version V1.0b followed by AUTO and then after a delay returns to the default temperature display.

Turn key anti-clockwise.

Remove key until required for the next case cleaning.

## **DISPLAY INDICATIONS**

### **Temperature Displays**

Repeated pressing of @ displays next channel identification with the temperature value for the channel. Repeated pressing of @ displays in sequence the points listed below

<b>Identity</b>	<b>Temperature on display</b>
CPt=	Calculated product temperature (control if 'cpon')
DEL=	Delivery air temperature
rEt=	Return air (coldstore control)
Ei 1=	Evaporator inlet coil - 1
EO1=	Evaporator outlet coil - 1
Sh1=	Superheat
=dt=	If coldstore selected then, Sh1 replaced by dt defrost termination on probe 5 or 1.
PrES 2. 35	If EEP selected - suction pressure in gar gauge
E8== -- 17	If EEt selected - equivalent suction temperature dependant on gas type
CdHF	<b>Control relay outputs</b>
C	if Liquid control relay energised      - bar if not.
d	if Defrost relay energised                - bar if not.
H	if Hotgas/trim/pan Heater energised - bar if not.
F	if Fan relay energised                      - bar if not
EEu=	Electronic expansion valve state
SrAE	
S	Superheat alarm                              - bar if not
r	Superheat defrost recovery                - bar if not
A / H	A - valve being modulated automatically H - valve modulation held whilst control air temperature is satisfied or after restart or coil-in temperature is near the evaporating temperature. The last valve percent output is remembered
E	Expansion valve solenoid relay on
PoS <sub>n</sub>	Valve position 0 - 100%
Et <sub>nn</sub>	Elapse time (Defrost mode only) where nn = minutes into defrost
SEt=	Go to Setup Mode when Enter pressed.

### **Status Display**

The controller reverts to the default display if no buttons have been pressed for 3 minutes and displays the calculated product temperature CPT which is derived from an adjustable ratio of the discharge and return air.

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

- dEF	While defrost is in progress
- Pd=	From end of defrost cycle until discharge air temperature is within alarm band after defrost is complete
- FAn	Selected for Fans Only prior to cleaning from local display or switch input
- OFF	Selected OFF for cleaning from local display or switch input
=PC=	FAI L RS485 communications to controller failure. Baud rate set at 9600 and PC is not communicating
635	515= Unit model operation selected -displayed on power on
8888	u2. OA Software version displayed after power on
Auto	After power on or case OFF waiting for restart delay before opening liquid solenoid or AKV valve.

### **Alarm Indications**

Alarms alternately flash with selected temperature channel during Default and Normal operation. a, h, Hi, Lo, OC, SC, nF.

Alarms are not displayed during Setup operation.

All alarms are reset automatically when the fault has disappeared.

#### **Blown Fuse Alarms** (Not available on 515)

Blown fuse Alarms are identified on LED display A-D as below:

a	fan 1	display A
h	trim heater (IF 'Htr' selected for relay 3)	display D

All alarm trips are inhibited when fans only, case off or during defrost.

#### **Control Air alarms (return air if coldstore)**

Discharge (return) Air alarms are indicated on LED displays:

dEL=	=- 13	=Hi =	Hi if discharge air temperature is above the control setpoint plus alarm diff. for longer than the guardtime.
dEL=	=- 28	=LO=	Lo discharge air temperature is below the setpoint minus alarm differential for longer than the guardtime.

Return air not discharge air alarms are given for coldstores.

Temperature alarms are inhibited during defrost cycles and during case cleaning.

Guardtime count is reset each time the discharge air returns within limits.

Alarm states Hi, Lo are automatically reset when the discharge air returns within limits.

***Probe Failure***

dEL= =OC= FAI L open circuit probes indicate OC instead of value  
dEL= =SC= FAI L short-circuit probes indicate SC instead of value  
dEL= =nF= not fitted probes indicate nF (may require 'nF' set-up)

The liquid solenoid /AKV valve is closed on any failure of the control air probe.

***PC FAIL***

If GUARDIAN controllers have not received a RS485 command for 5 minutes then the 'PC FAIL' message is displayed indicating a PC communication failure.

=PC= FAI L

If the controller is on a system which does not have a central PC alarm monitor then the PC FAIL message can be removed by selecting baud '**none**' using passcode 11.(see page 28)  
PC fail messages are also removed by selecting **ndad** or **nda** under unit settings.(see page 28)

## USEFUL BUTTON SEQUENCES

The following button sequences should prove useful during normal service operation

### Check Unit Model

```
@: @ SEt= ? PP00 /: / PP05 ?
@: @ Uni t ? 635 This unit model is '635'
@: @ End= ? = - 26
```

### Select Stub, Case No and Address

e.g. set-up unit for system 60, case 1, at address 180

```
@: @ SEt= ? PP00 /: / PP05 ?
@: @ Sn01 /: / Sn60 ? Sn60
@ Cn01 ? Cn01
@ A001 /: / A180 ? A180
@: @ End= ? = - 26
```

### Cut-in Setpoint for Liquid Valve (c)

To change the cooling cut-in setpoint for the liquid valve the procedure is as follows if the old setpoint is -11 the new setpoint is -17

```
@: @ SEt= ? PP00 /: / PP05 ?
@ CASE ? @ c- 11 /: / c- 17 ?
@: @ End= ? The unit now controls to the new discharge air
cut-in setpoint (-17).
```

### Case FANS only

To switch to FANS ONLY prior to case cleaning an alternative procedure to using the keyswitch is as follows except for Coldstores, which may not be selected for FANS only.

```
@: @ SEt= ? PP00 /: / pp05 ?
@ CASE ? @: @ FAnS ? - FAn
```

When the unit displays -FAn instead of the case temperature, all alarms, liquid valve control, trim heaters and defrost cycles are turned off but the fans are kept running.

FANS mode may be selected remotely via RS485 communication command.

The case is switched OFF by selecting OFF mode.

The case is switched back on by selecting Auto mode.

See also Keyswitch Fans Only selection page 10

### Case OFF for Cleaning

To switch off a case / coldstore for cleaning an alternative procedure to using the keyswitch is as follows:-

```
@: @  SEt=   ?   PPO0  / : /   pp05   ?
      @   CASE   ?   @: @  OFF=   ?   - OFF
```

When the unit displays - OFF instead of the case temperature, all alarms, liquid valve control, trim heaters, defrost cycles and fan outputs are turned off.

OFF mode may be selected remotely via a switch input or a RS485 communication command.

The case is switched back on by selecting Auto mode.

See also Keyswitch Case OFF for cleaning selection page 10

### Case AUTO Mode

To return a case/coldstore back into Auto after cleaning the procedure is as follows:-

```
@: @  SEt=   ?   PPO0  / : /   pp05   ?
      @   CASE   ?   @: @  Auto   ?   Auto
```

When the unit displays Auto instead of the case temperature, all alarms are allowed and fan outputs are turned on. Time scheduled defrosts are restarted immediately if required.

Liquid valve control is inhibited until the restart delay timer has finished.

To prevent overloading the compressor on restart after a total power fail or compressor fault the controllers start sequentially. The restart delay is automatically calculated using the stub number of the case.

When the restart delay is complete, the liquid valve returns to automatic control and the case temperature value is displayed.

See also Keyswitch Case AUTO after cleaning selection page 10

### Initiate DEFROST

To initiate a manual defrost request the procedure is as follows:-

```
@: @  SEt=   ?   PPO0  / : /   pp05   ?
      @   CASE   ?   @: @  i dEF   ?   - dEF
```

When the unit displays -dEF instead of the case temperature, all alarms and liquid valve control are turned off.

The defrost cycle performed is dependent on the DEFROST TYPE selection i.e. Off-Cycle, Hotgas Terminate, Hotgas Cycle, GdFr, or Coldstore.

DEF mode may be selected remotely via a RS485 communication command.

The defrost may be terminated (after draindown delay) by selecting Auto mode.

# SETUP OPERATION

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

During set-up operation, alarms, temperature and defrost controls are inhibited.

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

**SEt =** Press **?**

**PP00** Set passcode PP05, PP07, PP09 or PP11 by using **/** the **<** and pushbuttons

**PP05 ?**

**PP07 ?**

**PP09 ?**

**PP11 ?**

PP11 menu page 28

PP09 menu page 25

PP07 menu page 24

## PP05 Menu

Press **@** to sequence through the Set-up selections

Press **?** to accept the settings

Case	<b>CASE</b>	Change control mode or cooling setpoint Page 17
Defrost	<b>dEFr</b>	Defrost type, times and settings Page 17
Unit	<b>Uni t</b>	Stub and case identity Page 18
Test	<b>tESt</b>	Toggle output relays Faulty valve check. Page 19
End	<b>End =</b>	Return to normal operation Page 12



**CASE**

**CASE**

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

Cut-in setpoint for  
Liquid Valve

**C=nn** nn = -40 to +40°C

Calculated Product  
Temperature

**YYYY** CPon/CPoF select if control on CPT or discharge

YYYY = CPon Control on CPT now on  
CPoF Control on CPT now oFF

i.e. normal control on discharge

The controller can be selected to control on  
Calculated Product Temperature (CPT) instead of  
discharge air for all defrost types except 'Stor' if  
'CPon' is selected.

Coldstore always control on return air.

Mode selection

**YYYY**

yyyy = idEF Initiate defrost (only if in Auto) page xx

FAnS Fans only prior to cleaning (not allowed for  
coldstore) page xx

OFF Select case OFF for cleaning page xx

Auto Return to Automatic control page xx

These selections only operate when keyswitch  
selection for OFF or FAnS are not present.

**dEFr**

**dEFr**

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

Defrost type

**YYYY**

YYYY = O-C Off-cycle defrost

HG-C Hotgas Cycle on differential

HG-t Hotgas terminate on discharge air

Stor Coldstore terminate on probe T1

HGt1 Hotgas terminate on probe T1

For all defrost selections except 'Stor' coldstore, the fans and trim  
heaters defrost state can be selected during defrost as follows:-

Fnon/FnoF Fans on/oFFduring defrost

tron/troF Trim Heaters on/OFF during defrost

Number of defrosts  
per day

**dn=n** n = 0 to 6

First defrost time T1  
hours

**1h=n** n = 0 to 5 hrs

Delay 2nd defrost by n hours if dn=2	d2dn	n = 0 to 9 hrs
First defrost time T1 minutes	1 t nn	nn = 0 to 59 min
Defrost period	dPnn	nn = 0 to 60 min
Defrost termination temperature (not Off- Cycle cases)	d=nn	nn = 0 to +40 °C
Defrost termination differential (for Hotgas Cycle cases only)	ddnn	nn = 1 to +10 °C

**Unit**

**Unit**

Press @ to sequence through the Setup selections  
 Press / or < to change the settings  
 Press ? to accept the settings

Model type selection

YYYY

515  
635

Control Type  
Selection

YYYY

635 and 515  
635 and 515

YYYY = LSOL Liquid solenoid valve control  
 EET Electronic expansion valve control using coil-in and  
 coil-out temperatures

635 only

EEP Electronic expansion valve control using suction  
 pressure and coil-out temperatures

Evaporating  
temperature of pack  
system

E- nn

If EEP or EET then evaporating temperature is displayed:-  
 nn = -40 to 40°C

Evaporating  
temperature  
Differential

Ednn

nn = 5 to 20°C

Pressure Transducer  
20ma high range  
value

Phnn

nn = (1 to 24 bar gauge)

Pressure transducer  
4 ma low range

PL- n

n = (-1, 5)

Gas type

YYYY

YYYY = r22 /NH3/404A  
 Gas type required for calculation of equivalent  
 suction temperature from pressure input value is  
 displayed as Ei1 coil-in temperature

Serial Display

SdY

Y = 9 or 8 where:-  
 Sd9 is SKD9 serial display with keyswitch

Stub number	Snnn	Sd8 is SKD8 serial display nn = 1 to 80
Case number (normally 3 max.)	Cnnn	n = 1 to 4
Woodley MkV address number	Annn	nnn = 1 to 255
Control Relay 3	YYYY	YYYY = Htr Trim heater control Hgas Pack hotgas valve control input 3 Future use Alarm unit (see page 24)
Invert Relay 3 Output	YYYY	YYYY=Pos Relay 3 output Positive YYYY=Neg Relay 3 output Negative (For use when Relay 3 set to <b>Hgas remote input signal</b> and trim heaters still required to be on during refrigeration, then set to <b>Neg</b> )
Product Ratio %	Prnn	nn = 0 to 99 (see page 23)
Temperature Probe Type	YYYY	YYYY = tP22 2.2 Kohm at 25C (standard) tP20 2.0 Kohm at 25C Pt PT1000 resistance thermometer
Digital Alarm Detection and Display	YYYY	YYYY = ndad No digital alarm display nda No digital alarms required dad Digital alarms displayed
<b>tESt</b>		
<b>tESSt</b>		Press @ to sequence through the relay selections Repeatedly press ? to switch the relays on and off
	10FF	1=on Relay R1
	20FF	2=on Relay R2
	30FF	3=on Relay R3
	40FF	4=on Relay R4
	50FF	5=on Relay SSR5
<b>End</b>		All outputs return to automatic control when SETUP is ended Return from Setup to normal operation page xx

## Expansion Valve Setup

For coil temperature control 'EEt' the only parameter that requires setup is the 'E' term for pack evaporating temperature.

Other parameters at their default values should provide adequate electronic expansion valve control.

If a particular case is not controlling efficiently then other parameters may be adjusted dependent on observed performance using passcode PP11.

Expansion valve sizing should give observed valve open % averages between 40% and 60%. to allow sufficient capacity for peak demands such as defrost recovery and initial starting where refrigerant demand may exceed normal cooling by a factor of 2 and as much as 4 on certain low temperature applications.

During restart or defrost recovery the valve is maintained at preset defrost or start-up open positions ( $dr=90\%$  or  $So=80\%$ ) until the coil in temperature is below  $E +5^{\circ}C$  at which point the control mode switches to automatic.

If EET type is selected and the coil in temperature is reading  $5^{\circ}C$  above the E limit then the controller goes into superheat recovery mode.

If EEP type is selected and the saturated evaporating temperature reaches  $Ed^{\circ}C$  above the E limit (plant evaporating setpoint) then the controller will close the valve until the plant can recover. This will help to protect compressors from overload and liquid flooding during fault conditions and. on recovery

### Terminology

Under the Uni t heading in PPO5 the relevant settings are:-

$E = = =$  Evaporating temperature of system.

$Ed = =$  Evaporating temperature differential (the temperature above system setpoint at which protective measures are taken).EEt is fixed at  $5^{\circ}C$  and will switch to superheat recovery mode where the valve will close for  $t F$  time then open for  $t n$  time to  $SO$  value and maintains this cycle until  $Ed$  is restored to normal and superheat is stabilised.

Under EEp  $Ed$  is adjustable between  $5$  and  $20^{\circ}C$  with a default of  $10^{\circ}C$ . If the set value is exceeded the valve will close until  $Ed$  is within limits again and will then go straight back into auto control.

Under the Por t heading in PP11 the relevant settings are:-

$EEU =$  Electronic expansion valve parameters which allows access to all control settings for the valve. The default setting is  $F - EE$  or factory settings which will be sufficient for

most applications. C - EE can be selected which will allow the user to tailor the control to a specific application.

SH == Superheat high is the maximum value the valve is allowed to control at.

SL == Superheat low is the minimum value the valve is allowed to control at.

SA == Superheat alarm (low) limit closes valve for t F period.

Sb == Stable band. If the superheat is maintained within this limit the valve will adjust the superheat control towards SL. If the superheat is not maintained within this limit the valve will adjust the superheat control towards SH.

Sd == Stable band delay. This is the time period over which superheat stability is assessed.

dr == Defrost recovery valve position. This is the % valve opening held for time C t.

SO == Starting output. This is the valve % opening from power on or superheat recovery.

t F == Superheat alarm time off. This is the time duration the valve is closed at the onset of a superheat alarm.

t n == Superheat alarm time on. This is the time duration the valve is held open to enable recovery. The valve is opened to the % before the alarm occurred.

Under LOOP heading in PP11 the relevant settings are only accessed from the serial display:-

bL == Bleed position. This is the minimum % opening the valve will operate at below which it is fully closed.

C t == Coil time. Time period valve is held at SO or dr before switching to automatic mode.

### Product Ratio

635/515 controllers do not have not fitted links.

If probe 1 (case) has no probe wired to it then ' nF ' (not fitted) is set-up under PP07 1-AL (HI/lo/HiLo/None/ nF ) then the default temperature value displayed and logged for probe 1 is the PR% ratio of the discharge and return air.

Pr = 0            If PR% = 0 then the return air value is displayed  
(Use for Coldstore)

Pr 99            If PR% = 99 then the discharge air value is displayed

Pr 50            If PR% = 50 then the mean of discharge and return air value is displayed

The Product Ratio PR = 88% is set-up as follows using passcode 5 under UNIT selection provided PPO7 1-AL has been set to 'nf'.

```
@: @ SEt=    ?    PPO0    / : /    pp05    ?
@: @ Uni t    ?
@: @ Pr00    / : /    Pr88    ?    Pr88
```

If PPO7 1-AL is **not** set to 'nf' then case displays 'oc' and the PR% menu is not displayed. If **Stor** with probe 1 used for defrost termination, if display readout is probe 1 temp then PPO7 1-AL has **not** been set to 'nf'.

By selecting CASE **CPon**, this calculated product temperature can be used for control instead of discharge air on all Defrost types except coldstores.

### Alarm Unit

The 635/515 may be configured as a supermarket central alarm indicator and teledialler unit for systems using the Guardian GUARDIAN M Autograph Terminal.

The required Uni t settings are: -

Sn80	Stub number = 80
Cn=1	Case number = 1
A249	Unit address = 249
ALr.	Alarm selection for relay 3 (only if A = 249)

Any alarm detected and printed by the Autograph Terminal causes the alarm unit to be selected to AUTO which results in:-

Relay 2 (defrost)	Closes n/c contacts for 5 seconds to initiate an alarm via the store teledialler
Relay 3 (Heater)	Flashes the alarm lamp every half second until the ACCEPT pushbutton is pressed when it goes steady.
Relay 4 (fans)	Energises remote flashing beacon in store which stops when ACCEPT pushbutton is pressed.
Input 4 (heater fail)	is used for the ACCEPT pushbutton input.

Any new alarms cause the cycle to be repeated with a contact closure for the teledialler and a flashing alarm lamp and beacon.

The flashing or steady alarm lamp is extinguished when Function key F8 - Accept Alarms is pressed at the Autograph Terminal by switching the alarm unit into OFF mode.

---

The correct unit address 249 must be set-up for stub 80 on the Autograph Terminal to make the system function correctly.

## Setup Functions (level 3) passcode 07

### Alarm Monitor settings

When 635, 515, control is selected these settings are automatically returned to the appropriate control limits.

When used as an alarm monitor the temperature alarm setpoints and contact alarms may be setup as follows: -

### PP07 Menu

Temperature number	n-AL	n = 1 to 9 Press @ to select Temperature (1 to 9) Press ? to display for selected temperature:-
Alarm setpoint (SP) for temperature n	n- tt	tt = -40 to 40°C Change by / or < and then press ?
Alarm type selection	YYYY	YYYY = hi Goes into alarm above SP+Ad after Gt lo Goes into alarm below SP-Ad after Gt both Goes into alarm if hi or lo after Gt nonE Never goes into alarm nF Is not scanned and displays nF
Guardtime	9t nn	nn = 0 to 90 mins
Alarm Differential	Ad nn	nn = 2 to 40 °C
Digital input d	d-AL	d = A to H Press @ to select digital input (A to H) Press ? to display for selected input:-
Digital alarm type selection	YYYY	YYYY = on Goes into alarm if input ON after Gt oFF Goes into alarm if input OFF after Gt roFF Future reset facility nonE Never goes into alarm
Guardtime for input d	d=nn	nn = 0 to 90 mins Change by / or < and then press ?



## Setup Functions (level 2) passcode 09

Normal FACTORY settings

### PP09 Menu

Press @ to sequence through the Setup selections

Press ? to accept the settings

Real time clock	<b>rtc=</b>	Clock settings Page 25
System settings	<b>SYSt</b>	Times and alarms Page 26
End	<b>End=</b>	Return to normal operation Page 12

#### rtc

**rtc=**

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

Real clock time hours	<b>rhnn</b>	nn = 0 to 23 hrs
Real clock time minutes	<b>rtnn</b>	nn = 0 to 59 mins
Weekday	<b>YYYY</b>	YYYY = Sun/nnon/tuES/uued/thu/Fri/SAt
Day of Month	<b>d=nn</b>	nn = 1 to 31
Month	<b>YYY=</b>	Jan to dEC
Year	<b>Y=nn</b>	nn = 0 to 99

**SYSt**

**SYSt**

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

Cooling differential for control	cd=n	n = 0 to 5° C
Defrost pumpdown delay time	Ptn. n	n.n = 0.0 to 9.9 min
Defrost draindown delay time	dtnn	nn = 1 to 20 min
Bypass valve delay after draindown	btn. n	n.n = 0.0 to 9.9 min
Liquid delay after suction	Ltn. n	n.n = 0.0 to 9.9 min
Defrost Fan delay time	Ftnn	nn = 0 to 20 min
Time on for suction valve pulsing during bypass period	tnn. n	n.n = 0.0 to 9.9 min
Time off for suction valve pulsing during bypass period	tFn. n	n.n = 0.0 to 9.9 min
Control air temp. alarm Guardtime	gtnn	nn = 0 to 99 min
Alarm differential control air	Adnn	nn = 2 to 40°C
Calculated defrost times - display only		
Defrost T1 time hours	1hnn	nn = 0 to 23 hrs
Defrost T1 time minutes	1tnn	nn = 0 to 59 min
Defrost T2 time hours	2hnn	nn = 0 to 23 hrs
Defrost T2 time minutes	2tnn	nn = 0 to 59 min
	<b>etc.</b>	
Defrost T6 time hours	6hnn	nn = 0 to 23 hrs
Defrost T6 time minutes	6tnn	nn = 0 to 59 min

## Setup Functions (level 2) passcode 09 - (continued)

### LIGHTING SETUP

tcL1

tCL1

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

1Hnn	Sunday time on Hours nn = 00 to 23
1nnn	Sunday time on minutes nn = 00 to 59
1hnn	Sunday time off hours nn = 00 to 23
1Fnn	Sunday time off minutes nn = 00 to 59
2Hnn	Monday time on hours nn = 00 to 23
2nnn	Monday time on minutes nn = 00 to 59
2hnn	Monday time off hours nn = 00 to 23
2Fnn	Monday time off minutes nn = 00 to 59

etc. to

7Hnn	Saturday time on hours nn = 00 to 23
7nnn	Saturday time on minutes nn = 00 to 59
7hnn	Saturday time off hours nn = 00 to 23
7Fnn	Saturday time off minutes nn = 00 to 59

End

End= Return to normal operation  
Page 12

## Setup Functions (level 4) passcode 11

### PP11 Menu

Press @ to sequence through the following PP11 menu selections:-

Press ? to select the displayed menu

Port	Port	Serial communications port Page 28
Loop	LOOP	Control PID Loop Parameters Page 29
End	End=	Return to normal operation Page 12

### Port

#### Port

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

Communications  
baud rate

YYYY

YYYY = 9600 Baud rate  
nonE Removes PC FAIL if no PC present

Electronic Expansion  
Valve Parameters

YYYY

(Only if EET or EEP selected)

YYYY = F-EE Returns all parameters to default values below.  
F-EE RETURNS TO DEFAULTS

C-EE Allows values to be changed during  
commissioning.

Superheat High.  
Maximum superheat

SHnn

nn = 0 to 99°C

Superheat Low.  
Minimum superheat

SLn. n

n.n = 0.0 to 9.9°C

Superheat Alarm  
Limit at which  
superheat recovery is  
actioned

SAnn

nn = 0 to 99°C

Stable Band.

Sbn. n

nn = 0.0 to 9.9°C

Taken +/- about current superheat setpoint.  
Oscillations of superheat outside Sb cause  
increase in superheat towards SH. If superheat  
remains within Sb then superheat is reduced  
towards SL.( 0 = function not active)

Stable band Delay  
time

Sdnn

nn = 0 to 99 mins

Time after which Sb setpoint change is applied

Defrost Recovery Valve position	dr nn	nn = 0 to 99%
Starting Output	Sonn	nn = 0 to 99% Valve position after power restart or thermostatic cycle of AKV10
Superheat Alarm Time OFF	tFnn	nn = 0 to 15 min Valve is shut for this time after superheat alarm before attempting recovery procedure
Superheat Alarm Time ON	tnnn	nn = 0 to 15 min Valve is open for this time after superheat alarm and TF time above whilst attempting recovery procedure

## LOOP LOOP

Press @ to sequence through the Setup selections

Press / or < to change the settings

Press ? to accept the settings

Change Settings	YYYY	Factory / Commissioning change Settings
	YYYY = F-LP	Returns all parameters to default values below. F-LP RETURNS TO DEFAULTS
	C-LP	Allows values to be changed during commissioning.
Proportional Gain	P=n. n	n.n = 0 to 9.9
Integral Gain	i n. nn	n.nn = 0.00 to 0.99
Differential Gain	d=n. n	n.n = 0.0 to 9.9
Bleed position	bLnn	nn = 0 to 99% Sets minimum valve position
Ramp rate	r=n. n	n.n = 0.0 to 9.9°C Sets rate of change of superheat from SH to SL
Integral Time	i tnn	nn = 0 to 99 mins Delayed time for loop integral action
Loop Period	Pdnn	nn = 0 to 99 secs
Coil Time	ctnn	nn = 0 to 99 mins Time delay to establish coil-in/coil-out temperatures before control action starts
Ramp Time	r tnn	nn = 0 to 99 secs Time at which ramp rate, r, is applied
End	End=	Return to normal operation Page xx

## Control

FIG.1 LIQUID VALVE CONTROL

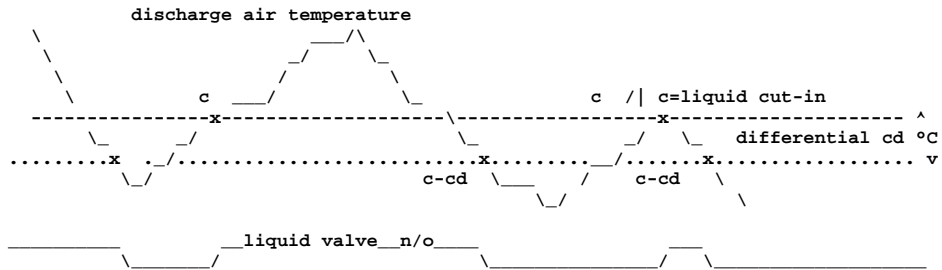
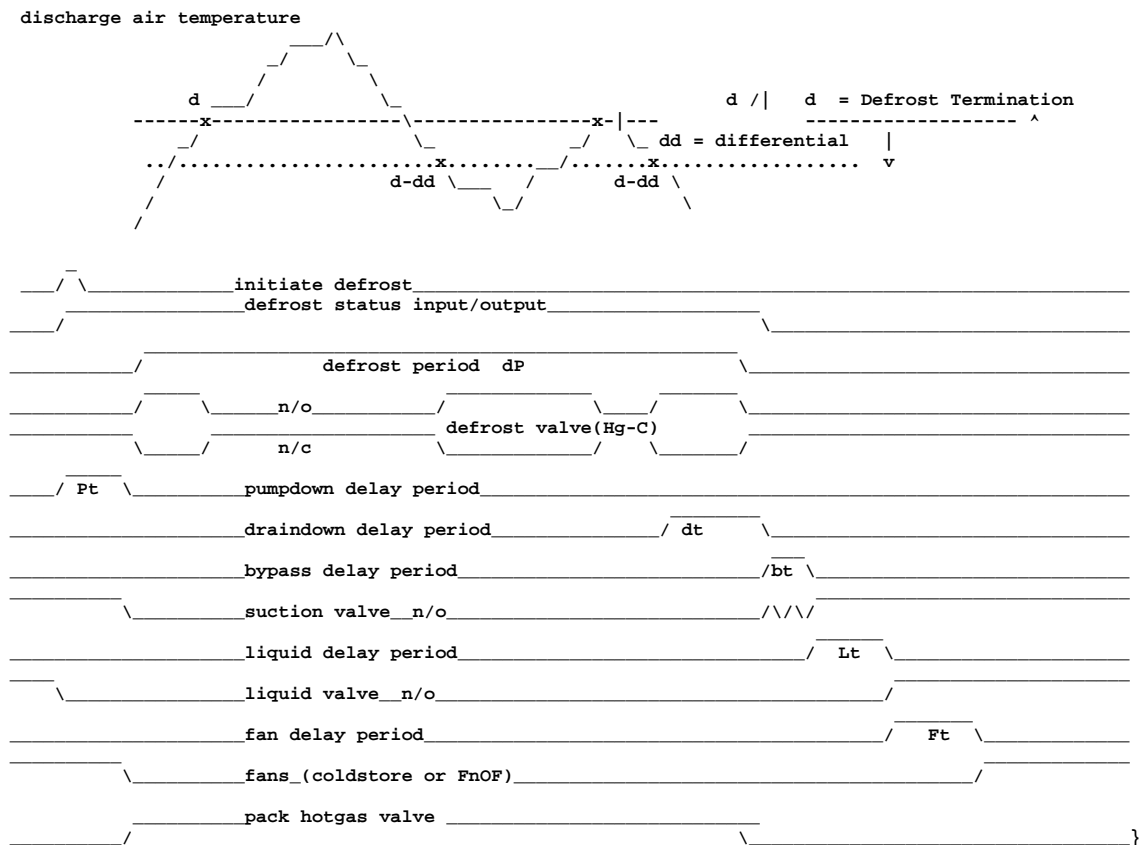


FIG.2 DEFROST CYCLE VALVE CONTROL



## DEFROST CONTROLS

### Hg-C - Hotgas Cycle

```

request ____/\_____
**** PACK ****
Hotgas valve_/_____ hot gas _____ \_____ shut _____
Suction valve\_____ shut _____ /_____ open _____
bypass valve _____ /_____ \_____ open _____
**** CASE ****
FANS-1,2,3 _____ run _____
Trim Heaters _____ on _____
LV _____ \_____ shut _____ /_____ open _____
HG1 _____ /_____ open _____ \_____ \_____ \_____ \_____ \_____ \_____
draindown _____ ..... defrost time-1..... / dt \_____
liquid delay _____ /_____ Lt \_____

```

### Hg-t - Hotgas Terminate

```

request ____/\_____
defrost status _____ defrost any case in stub _____ \_____ stub done _____
input/output_/_____
PACK
Hotgas valve_/_____ hot gas _____ \_____ coolant _____
Suction valve\_____ shut _____ /_____ open _____
bypass valve _____ /_____ \_____ open _____
run ( if FnOn)
FANS-1,2 \ .....stop ( if FnOF)...../
on ( if trOn)
Trim Heaters \.....off.( if trOF)...../
LV1 _____ \_____ shut _____ /_____ open _____
open
HG1 _____ /_____ open _____ \_____
defrost time-1.....
terminate case 1 .....x
draindown delay 1 _____ /dt 1 \_____
liquid delay 1 _____ / Lt1 \_____
open
LV2 _____ \_____ shut _____ /_____
open
HG2 _____ /_____ open _____ \_____
defrost time-2.....
terminate case 2 .....x
draindown delay 2 _____ / dt2 \_____
liquid delay 2 _____ / Lt2 \_____

```

### O-C Off-Cycle Defrost

```

request ____/\_____

PACK
3-way valve - not used
                run_____
FANS 1,2
LV1 _____ \      shut_____ /      open_____
HG1  __ not used
..... defrost time-1.....
Liquid delay 1 _____ / Lt1 \ _____
LV2 _____ \      shut_____ / _____
HG2  __ not used
..... defrost time-2....
Liquid delay2 _____ / Lt2 \ _____
  
```

### Stor - Coldstore Defrost

(Similar to Hotgas terminate HG-T except FANS are switched off)  
 Coldstores control the liquid valve on the return air probe and NOT on discharge probe.  
 Coldstores terminate defrost on probe 1 and NOT on discharge probe.  
 Coldstore door input is monitored by **voltfree** contact TB7  
 Door closed = contact open  
 Door open = contact closed  
 Coldstores fans are switched off until fan delay is complete

```

request ____/\_____

LIQUID _____ \      off_____ /      on_____
                On_____
DEFROST_off _____ /      ..... defrost time-1.....
Pan Heater _____ /      on_____ \      off_____
pumpdown ____ / Pt \ _____
terminate on probe 1
draindown delay _____ / dt \ _____
bypass delay _____ / bt \ _____
Liquid delay _____ / Lt \ _____
fan start delay _____ / Ft \ _____
                run_____
FANS-1 _____ \ stop_____ / _____
  
```

(Probe 1 **MUST** be set as not fitted "nF" in PP07 1-AL)



# COMMUNICATIONS

Communication facilities are available for interrogation of temperatures, status and modification / display of setpoints, limits and timeclock settings. All communication is via a daisy chain 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.

Each GUARDIAN controller has a unique unit number address UU/u which is used to select the appropriate unit for interrogation or modification.

UU is stub no. 1-80  
u is case / coldstore number 1-3.  
i.e. case 3 stub 56 has address 56/3  
and coldstore stub 45 has address 45/1

Some communication commands may use 'wildcard' stub number 99 and 'wildcard' case number 9 to access all stubs on the highway or all cases in a stub.

GUARDIAN controllers are inactive until they are addressed.

When the organisation of commands on the RS485 highway is under the control of a Woodley Mk V then GUARDIAN units only accept status requests which transmit case, discharge and return air temperatures and defrost status.

GUARDIAN Autograph or RM-256 Refrigeration Monitor Communication commands available are: -

- a) Transmit Unit Status      which replies with command plus stub status & case temperature
- b) Transmit Values          which replies with stub address plus latest signed temperature values, time, trip states, relay states and internal status
- c) Transmit Setpoints        which replies with setpoints and limits.  
System Sn and unit Addresses Axxx may not be changed via the RS485 serial link
- d) Receive setpoints with new setpoint values
- e) Receive Time and Date with new hours and minutes, day, month and year for real time clock
- f) Initiate/Terminate a hot gas or off-cycle defrost
- g) ON auto / FANS only / case OFF selection for case cleaning

**AUTOGRAPH FORMATS**

*F2 Stub Detail Display*

Microm Electronics - Guardian AutoGraph Terminal v5.0f1														
COLES OCEAN GROVE			STUB DETAILS			14:31:41 Fri Mar 07 1997								
Stub	name	Status	Case_1	Case_2	Case_3	Case_4								
2	A1 13DOOR F/FOOD		-3.5	-7.5	-8.0									
DEFROST TIMES														
Stub	Type	Status	T1	T2	T3	T4	T5	T6	Per(m)					
2	A1 13DOOR F/FOOD	gdFr	0130	1330	0000	0000	0000	0000	45					
SETTINGS														
Stub	Control	Prod	Rly3	Type	no/day	Defrost	Term	dif	per	delays		Liq	Fan	Alarm
2	-23	99	HTR	gdFr	2	01 30	25	2	45	1	1	90	8	
TEMPERATURES														
Stub	n/f	Avg.	T1	T2	T3	T4	T5	off_sw	n/f	Status				
Case	c	d	r	i	o	off	S/H	SH-SP	U%	Input	Output	Alarm		
2/1	-3.5	-3.5	2.0	-23.0	-2.5	o/c	20.5	5.0	100.0	....	C.3F	Alarm		
2/2	-7.0	-7.5	1.0	-24.0	-3.5	o/c	20.5	5.0	100.0	....	C.3F	Alarm		
2/3	-8.0	-8.0	-2.0	-28.5	-6.5	o/c	22.0	5.0	100.0	....	C.3F	Alarm		
											F9	F10		
											Next Page	Done		

*F7 Setpoints Display page 1*

Microm Electronics - Guardian AutoGraph Terminal v5.0f1															
SAFEWAY CAMBERWELL			STUB SETTINGS			10:02:41 Mon Mar 17 1997									
4	SYS A2 24FT F/F		1	2	3	4									
c	Control cutin	-27	Time:	1001											
pr	Product Ratio	50		-27											
	Relay 3 Type	HTR		50											
	Defrost Type	HG-T		HTR											
dn	No. of defrosts/day	2		HG-T											
1H	First defrost hours	2		2											
1t	First defrost mins	0		0											
d	Termination temp.	15		15											
dd	Termination diff.	5		5											
dP	Defrost Period (m)	35		35											
Lt	Liquid Draindown (m)	1		1											
Ft	Fan delay (m)	1		1											
Gt	Alarm Guardtime (m)	90		90											
Ad	Alarm differential	12		12											
DEFROST TIMES															
4	SYS A2 24FT F/F	Type	Status	T1	T2	T3	T4	T5	T6	Per(m)					
		HG-T		0200	1400	0000	0000	0000	0000	35					
F1	F2	F3	F4							F9	F10				
Edit	Transfer	Name	Setup							Next Page	Done				

*F7 EET Settings page 2*

[Microm Electronics - Guardian AutoGraph Terminal v5.0f]				
COLES OCEAN GROUE		STUB SETTINGS		14:32:23 Fri Mar 07 1997
2 Al 13DOOR F/FOOD		1	2	3
		4		
Unit Type	RCU	Time: 1431	1431	1431
Control Type	EET	RCU	RCU	RCU
sh SuperHeat High	9	EET	EET	EET
sl SuperHeat Low	5	9	9	9
sa SuperHeat Alarm	0	5	5	5
sb Stable Band	0	0	0	0
sd Stable Delay (m)	20	0	0	0
E Evaporating Temp.	-15	20	20	20
dr Defrost Recovery %	65	-15	-15	-15
so Start Output %	65	65	65	65
tf Time oFF (m)	1	65	65	65
tn Time oN (m)	2	1	1	1
ot Fan off time(m)	0.0	2	2	2
bt Bypass Time (m)	0.0	0.0	0.0	0.0
Pt Pumpdown Time(m)	0.0	0.0	0.0	0.0
St Suction Time (m)	0.0	0.0	0.0	0.0

F1	F2	F3	F4	F9	F10
Edit	Transfer	Name	Setup	Next Page	Done

## Setup / commissioning Parameters

### PP05 Normal Menu Settings

		unit	ACTUAL settings	Default setting	Min. setting	Max. setting
CASE	Control probe CpoF=control on air off Cpon=control on product ratio(see unit menu) (not available on stor defrost)			CpoF	CpoF	
	Cut-in setpoint for Liquid valve	°C	<b>c</b>	c-25	c-40	c 40
	Mode Selection idEF FAnS OFF Auto			Auto		
DEFr	Defrost type Hgt8 O-C Hg-C Hg-t Stor					
	Number of defrosts per day		<b>dn</b>	dn 4	dn00	dn06
	First defrost time T1 hours	hrs	<b>1h</b>	1h01	1h00	1h05
	Delay 2nd defrost by n hours if dn=2	hrs	<b>d2d</b>	d2d0	d2d0	d2d9
	First defrost time T1 minutes	mins	<b>lt</b>	lt30	lt00	lt59
	Defrost period	mins	<b>dP</b>	dP15	dP02	dP60
	Defrost term temp (not Off-Cycle cases)	°C	<b>d</b>	d 15	d 00	d 40
	Defrost term differential (Hotgas-Cycle only)	°C	<b>dd</b>	dd01	dd01	dd10
	Fans on/off during defrost Fnon/FnoF		<b>Fn</b>	Fnon	FnoF	
	Trim heaters on/off during defrost		<b>tr</b>	tron	troF	
	Uni t	Model type selection 635 1085 1088 1080 975 1297 1289				
Control type selection LSoL EEt EEP						
Evaporating temp of pack system ( <b>EEt</b> at 5°C above valve enters auto control)		°C	<b>E</b>	E -10	E -40	E 40
Evaporating temperature differential EEP adjustable EEt fixed at 5		°C	<b>Ed</b>	Ed10	Ed05	Ed20
Pressure Transducer 20ma high range		bar.	<b>P</b>	P24	-1	50
Pressure Transducer 4 ma low range		bar.	<b>P</b>	P-1	-1	50
Gas type 404a r22 nh3				404a		
Serial display			<b>Sd</b>	Sd9	Sd8	Sd9
Stub number			<b>Sn</b>	Sn01	Sn 0	S255
Case number (normally 3 max.)			<b>Cn</b>	Cn1	Cn 0	Cn 4
Woodley MkV address number			<b>A</b>	A3	A 0	A255
Control relay 3 <b>Htr HgAS</b>				Htr		
Invert Relay 3 Output ( Hgas input )				Pos	Pos	neg
Product ratio %			<b>Pr</b>	Pr50	Pr00	Pr99
Temperature probe type				Pt	tP20	tP22
Digital alarm detection and display				ndAd	ndAd	dAd

### PP07 (level 3) Menu Settings

	unit	ACTUAL settings	Default setting	Min. setting	Max. setting
Temp number 1 Alarm type	Hi, Lo ,HiLo, nonE, nF	<b>1-AL</b>	HiLo	nF	Hi
Alarm Limits	°C	<b>1</b>	-40	-40	40
Temp number 2 Alarm type	Hi, Lo, HiLo, nonE, nF	<b>2-AL</b>	HiLo	nF	Hi
Alarm Limits	°C	<b>2</b>	-25	-40	40
Temp number 3 Alarm type	Hi, Lo, HiLo, nonE, nF	<b>3-AL</b>	HiLo	nF	Hi
Alarm Limits	°C	<b>3</b>	-40	-40	40
Temp number 4 Alarm type	Hi, Lo, HiLo, nonE, nF	<b>4-AL</b>	HiLo	nF	Hi
Alarm Limits	°C	<b>4</b>	-40	-40	40
Temp number 5 Alarm type	Hi, Lo, HiLo, nonE, nF	<b>5-AL</b>	HiLo	nF	Hi
Alarm Limits	°C	<b>5</b>	-40	-40	40
Temp number 6 Alarm type	Hi, Lo, HiLo, nonE, nF	<b>6-AL</b>	HiLo	nF	Hi
Alarm Limits	°C	<b>6</b>	-40	-40	40
Temp number 7 Alarm type	Hi, Lo, HiLo, nonE, nF	<b>7-AL</b>	HiLo	nF	Hi
Alarm Limits	°C	<b>7</b>	-40	-40	40
Temp number 8 Alarm type	Hi, Lo, HiLo, nonE, nF	<b>8-AL</b>	HiLo	nF	Hi
Alarm Limits	°C	<b>8</b>	-40	-40	40
Temp number 9 Alarm type	Hi, Lo, HiLo, nonE, nF	<b>9-AL</b>	HiLo	nF	Hi
Alarm Limits	°C	<b>9</b>	-40	-40	40
Guardtime	mins	<b>gt</b>	gt 45	gt 00	gt 99
Alarm differential	°C	<b>Ad</b>	Ad 05	Ad 02	Ad 40
Digital input - A Alarm type		<b>A-AL</b>	nonE	on	nonE
Guardtime for input A	mins	<b>A</b>	00	00	99
Digital input - b Alarm type		<b>b-AL</b>	nonE	on	nonE
Guardtime for input b	mins	<b>b</b>	00	00	99
Digital input - c Alarm type		<b>c-AL</b>	nonE	on	nonE
Guardtime for input c	mins	<b>c</b>	00	00	99
Digital input - d Alarm type		<b>d-AL</b>	nonE	on	nonE
Guardtime for input d	mins	<b>d</b>	00	00	99
Digital input - E Alarm type		<b>E-AL</b>	nonE	on	nonE
Guardtime for input E	mins	<b>E</b>	00	00	99
Digital input - F Alarm type		<b>F-AL</b>	nonE	on	nonE
Guardtime for input F	mins	<b>F</b>	00	00	99
Digital input - g Alarm type		<b>g-AL</b>	nonE	on	nonE
Guardtime for input g	mins	<b>g</b>	00	00	99
Digital input - h Alarm type		<b>h-AL</b>	nonE	on	nonE

Guardtime for input h	mins	<b>h</b>	00	00	99
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### PP09 (level 2) Settings

	unit	ACTUAL settings	Default setting	Min. setting	Max. setting
rtc=	Real clock time hours	hrs	<b>rh</b>	rh00	rh23
	Real clock time minutes	mins	<b>rt</b>	rt00	rt59
	Weekday	day		Sun	SAt
	Day of Month	no.	<b>dn</b>	1	31
	Month				
	Year				
SYSt	Cooling differential for control Cut-Out ( 0 = 1°C )	°C	<b>cd</b>	cd 0	cd 5
	Defrost pumpdown delay time	min	<b>Pt</b>	Pt1.0	Pt0.0 Pt9.9
	Defrost draindown delay time	min	<b>dt</b>	dt 01	dt 00 dt 10
	Bypass valve delay after draindown	min	<b>bt</b>	bt 0.2	bt 0.0 bt 9.9
	Liquid delay after suction	min	<b>Lt</b>	Lt1.0	Lt0.0 Lt9.9
	Defrost Fan delay time	min	<b>Ft</b>	Ft02	Ft00 Ft10
	Time on for suction valve pulsing during bypass period	min	<b>tn</b>	tn0.1	tn0.0 tn9.9
	Time off for suction valve pulsing during bypass period	min	<b>tF</b>	tF0.1	tF0.0 tF9.9
	Control air temp. alarm Guardtime	min	<b>gt</b>	gt45	gt00 gt99
	Alarm differential control air	°C	<b>Ad</b>	Ad05	Ad02 Ad40
	Defrost T1 time hours				
	Defrost T1 time minutes				
	Defrost T2 time hours				
	Defrost T2 time minutes				
	Defrost T3 time hours				
	Defrost T3 time minutes				
	Defrost T4 time hours				
	Defrost T4 time minutes				
	Defrost T5 time hours				
	Defrost T5 time minutes				
Defrost T6 time hours					
Defrost T6 time minutes					

tCL1

Sunday Time On Hours		<b>1H</b>	9	0	23
Sunday Time On Minutes		<b>1n</b>	30	0	59
Sunday Time Off Hours (1 <sup>st</sup> Off time)		<b>1h</b>	16	0	23
Sunday Time Off Mins (1 <sup>st</sup> Off time)		<b>1F</b>	30	0	59
Monday Time On Hours		<b>2H</b>	7	0	23
Monday Time On Minutes		<b>2n</b>	30	0	59
Monday Time Off Hours		<b>2h</b>	22	0	23
Monday Time Off Minutes		<b>2F</b>	30	0	59
Tuesday Time On Hours		<b>3H</b>	7	0	23
Tuesday Time On Minutes		<b>3n</b>	30	0	59
Tuesday Time Off Hours		<b>3h</b>	22	0	23
Tuesday Time Off Minutes		<b>3F</b>	30	0	59
Wednesday Time On Hours		<b>4H</b>	7	0	23
Wednesday Time On Minutes		<b>4n</b>	30	0	59
Wednesday Time Off Hours		<b>4h</b>	22	0	23
Wednesday Time Off Minutes		<b>4F</b>	30	0	59
Thursday Time On Hours		<b>5H</b>	7	0	23
Thursday Time On Minutes		<b>5n</b>	30	0	59
Thursday Time Off Hours		<b>5h</b>	22	0	23
Thursday Time Off Minutes		<b>5F</b>	30	0	59
Friday Time On Hours		<b>6H</b>	7	0	23
Friday Time On Minutes		<b>6n</b>	30	0	59
Friday Time Off Hours		<b>6h</b>	22	0	23
Friday Time Off Minutes		<b>6F</b>	30	0	59
Saturday Time On Hours		<b>7H</b>	7	0	23
Saturday Time On Minutes		<b>7n</b>	00	0	59
Saturday Time Off Hours		<b>7h</b>	22	0	23
Saturday Time Off Minutes		<b>7F</b>	30	0	59
N.B. Set To 0Hrs/0Mins If NOT USED					
Sunday Time Off Hours (2 <sup>nd</sup> Off time)		<b>8h</b>	0	0	23
Sunday Time Off Mins (2 <sup>nd</sup> Off time)		<b>8F</b>	0	0	59

### PP11 (level 3) Settings

	unit	ACTUAL settings	Default setting	Min. setting	Max. setting
Port			9600	none	9600
EEu=			F-EE	C-EE	C-EE
			F-EE=default settings	C-EE=user defined	
	°C	<b>SH</b>	SH08	SH00	SH40
	°C	<b>SL</b>	SL3	SL0	SL99
	°C	<b>SA</b>	SA1	SA0	SA40
	°C	<b>Sb</b>	Sb1.0	Sb0.0	Sb9.9
	min	<b>Sd</b>	Sd15	Sd00	Sd99
	%	<b>dr</b>	dr90	dr00	dr99
	%	<b>So</b>	So80	So00	So99
	min	<b>tF</b>	tF01	tF00	tF15
	min	<b>tn</b>	tn03	tn00	tn15
LOOP			F-LP	C-LP	C-LP
			F-LP=default settings	C-LP=user defined	
		<b>P</b>	30	0	255
		<b>I</b>	1	0	255
		<b>d</b>	0	0	255
	%	<b>bL</b>	bL10	bL00	bL99
	°C	<b>r</b>	r 00	r 00	r 40
		<b>it</b>	it02	it00	it99
		<b>Pd</b>	Pd02	Pd00	Pd99
		<b>ct</b>	ct01	ct01	ct99
		<b>rt</b>	rt12	rt00	rt99



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