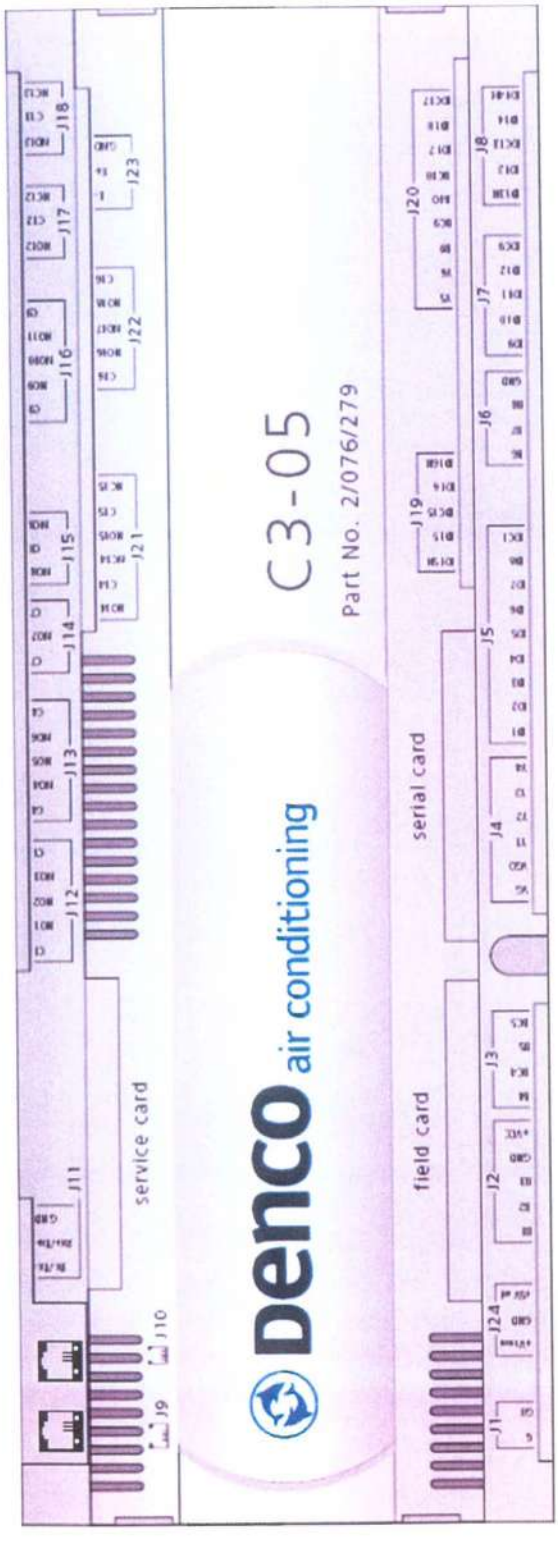
denco

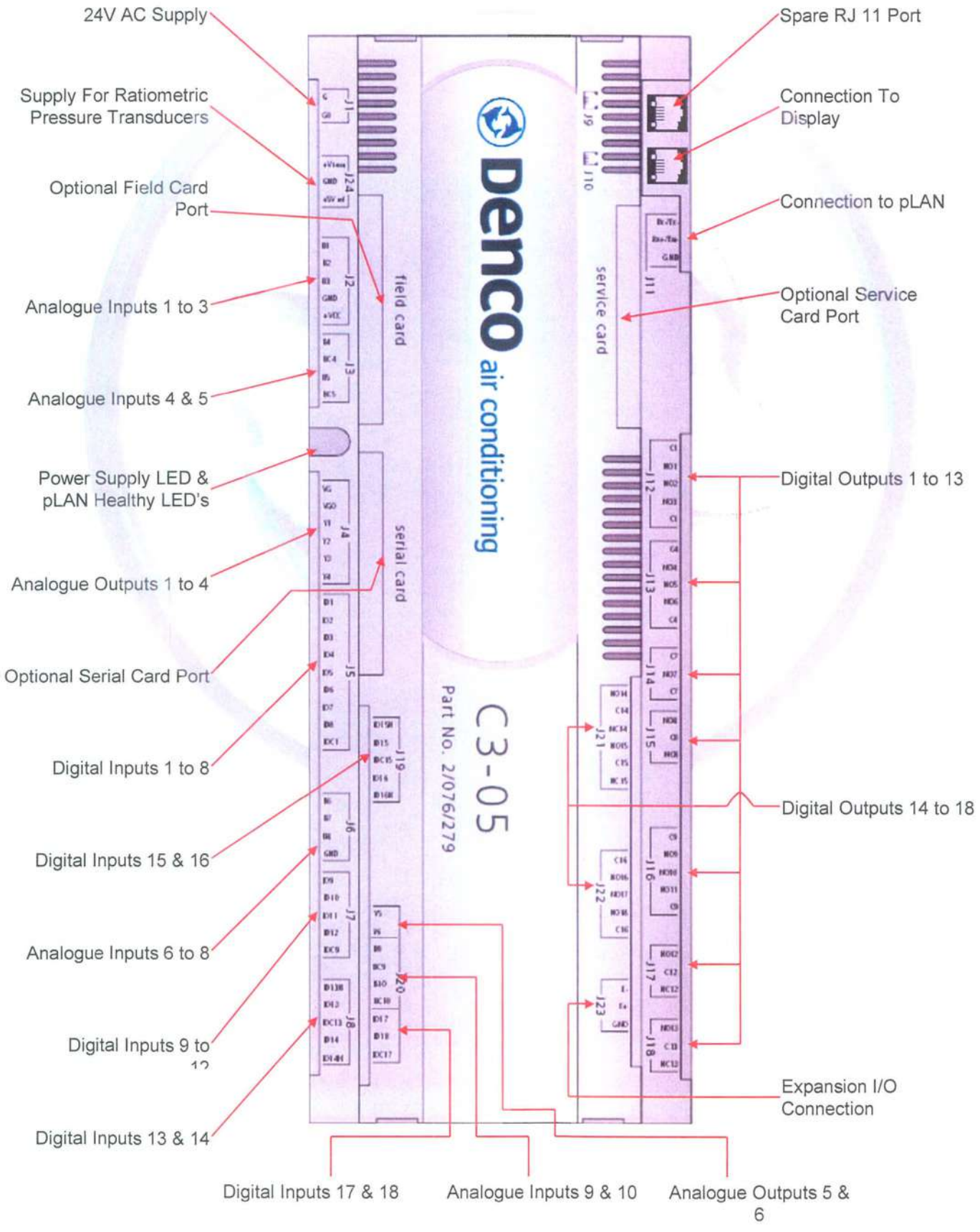


C3-05 Operation Manual

Contents

denco air conditioning

Hardware Structure



Serial Data Interface(s)

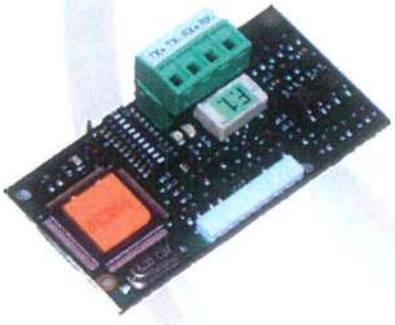
pLAN

pLAN = **p** Local **A**rea **N**etwork.
The pLAN network identifies a physical connection between the boards and the external terminals.
Boards connected in pLAN network allows exchanging variables from a board to another, according to a logic established by the program, to make them work together in a functional way.
The variables exchanged among the boards are already established by the program, as well as the direction they must follow and from which they come. Therefore they cannot be programmed by the user, who must execute the electrical connections only. A typical example of this type of network is the Denconet functionality.

Trend Interface Card

The Trend interface is a small pcb which can be plugged into the C3-05 controller to provide it with Trend network capability.
The interface needs to be configured in order that the required controller variables are linked to appropriate Trend parameters; these then become accessible via the Trend network using standard Trend (text) communications. The interface provides CNC functionality.

- Flexible number of configuration modules
- Peer to peer communications (IC Comms)
- Suitable for field installation
- Display and directory modules

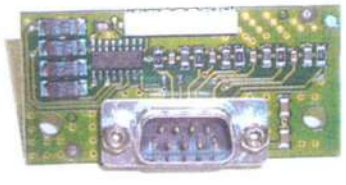


RS232 Serial Card

The RS232 Serial Card is used to interface the C3-05 controller directly to a standard HAYES modem. The following hardware signals can be managed:

- Output, "request to send" (RTS) in parallel to "data terminal ready" (DTR).
- Input, "carrier detected" (CD).

The maximum baud rate is 19200.



Serial Data Interface(s) (cont)

RS485 Serial Card

The RS485 Serial Card is used to interface the C3-05 controller to an RS485 network.
The card guarantees the optical isolation of the controller from the RS485 serial network. The maximum baud rate is 19200 (adjustable in software).

LonWorks Serial Card

The LonWorks Serial Card is used to interface the C3-05 controller to a Lonworks network.
The type of interface on the LonWorks network side is:

- PCO20000F0 – interface to FTT-10A 78 Kbs (TP/FT-10).

The baud rate of the C3-05 controller must be set to 4800.

PCOWeb Interface

The pCOWeb Interface allows connection to TCP/IP and SNMP protocols on the Ethernet standard and BACnet both on the Ethernet and EIA485 standards.

Handling Static Sensitive Devices

Note: It is very important that the following procedures are adhered to. Failure to do so may cause the Unit to malfunction, and will invalidate any warranty on the controller and associated boards.

The controller, graphical displays, network and interface boards contain devices sensitive to body static discharges. If they have to be removed and handled, follow the procedure given below:

- ☐ Discharge body static by wearing anti-static wrist straps (or similar suitable grounding straps) connected to earthed (grounded) metal.
- ☐ Ensure that an anti-static bag is ready to hand.
- ☐ Switch off at the display ON/OFF switch. Turn the unit isolator to the "OFF" position.
- ☐ Wait at least 30 seconds for the voltages on the controller to decay.
- ☐ Remove component board and place into anti-static bag.
- ☐ Repeat procedure when installing replacement boards.

Inputs and Outputs

Base Controller

The following inputs and outputs are available on the Base Controller:

INPUTS			
Digital			
ID1	Unit Remote On/Off	24V AC	
ID2	Airflow Fail	24V AC	
ID3	Filter Blocked	24V AC	
ID4	Klixon Trip	24V AC	
ID5	HP Trip Comp 1 (Or Tandem Circuit 1)	24V AC	
ID6	HP Trip Comp 2 (Or Tandem Circuit 2)	24V AC	
ID7	LP Trip Comp 1 (Or Tandem Circuit 1)	24V AC	
ID8	LP Trip Comp 2 (Or Tandem Circuit 2)	24V AC	
ID9	Water On Floor / Drip Tray Detection	24V AC	
ID10	Humidifier Water Level	24V AC	
ID11	Aux Alarm	24V AC	
ID12	Generator Run	24V AC	
ID13	Combicool Change-over	24V AC	
ID14	Damper Open	24V AC	
ID15	HP Trip Comp 3	24V AC	
ID16	HP Trip Comp 4	24V AC	
ID17	LP Trip Comp 3	24V AC	
ID18	LP Trip Comp 4	24V AC	
Analogue			
B1	Return Air Hum	Sensor type:	4 – 20 mA (Selectable)
B2	Condensing Pressure 1	Sensor type:	0 – 5V (Selectable)
B3	Condensing Pressure 2	Sensor type:	0 – 5V (Selectable)
B4	Return Air Temp	Sensor type:	NTC (Selectable)
B5	Supply Air Temp	Sensor type:	NTC (Selectable)
B6	Supply Air Humidity	Sensor type:	4-20 mA (Selectable)
B7	Humidifier Conductivity	Sensor type:	0 – 1V
B8	Humidifier Current	Sensor type:	0 – 1V
B9	Freecool / CW Temperature	Sensor type:	NTC (Selectable)

Notes:

(i) A high digital input condition will be within the voltage band –25% to +20% 50 Hz or 60 Hz. (High > 18.5V, Low < 16.5V).
(ii) All digital inputs are opto-isolated complete with reverse voltage protection diodes.
(iii) HP / LP 3 and 4 Alarm inputs only available when C3-05 large controller fitted.

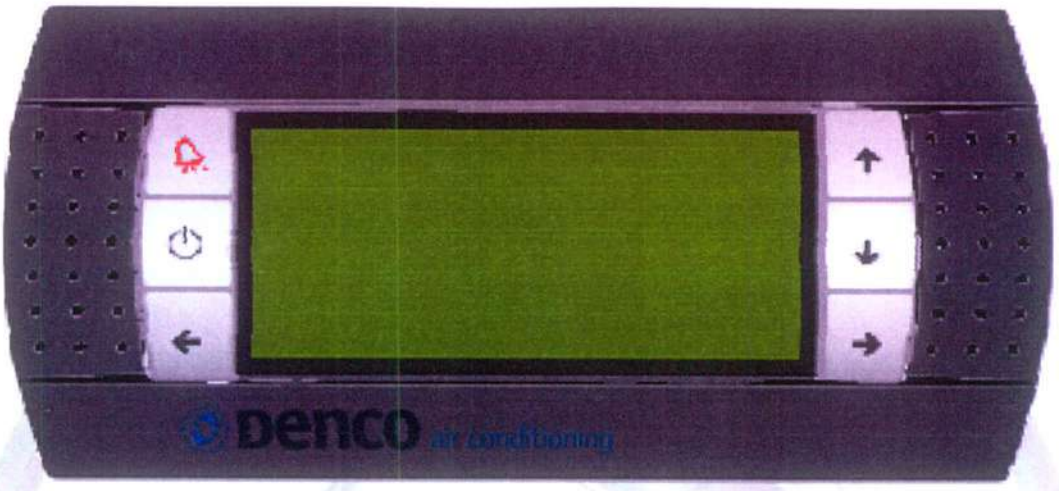
Inputs and Outputs (cont)

OUTPUTS		
Digital		
NO1	Unit Fan	Relay Output Normally Open Contact
NO2	Dehumidification	Relay Output Normally Open Contact
NO3	Heater 1 / DODC Heat Open / Thyristor Enable	Relay Output Normally Open Contact
NO4	Heater 1 / DODC Heat Close	Relay Output Normally Open Contact
NO5	Compressor 1 / DODC Cool Open / Combicool Secondary CW Open	Relay Output Normally Open Contact
NO6	Compressor 2 / DODC Cool Close / Combicool Secondary CW Close	Relay Output Normally Open Contact
NO7	Compressor 3	Relay Output Normally Open Contact
NO8	Compressor 4	Relay Output Normally Open Contact
NO9	Humidifier Power Contactor	Relay Output Normally Open Contact
NO10	Hum Fill Valve	Relay Output Normally Open Contact
NO11	Hum Drain Valve	Relay Output Normally Open Contact
NO12	Critical Alarm	Relay Output Normally Open Contact
NO13	Maintenance Alarm	Relay Output Normally Open Contact
NO14	Freecool / Combicool Primary CW DODC Open	Relay Output Normally Open Contact
NO15	Freecool / Combicool Primary CW DODC Close	Relay Output Normally Open Contact
NO16	Dry Cooler Fan 1	Relay Output Normally Open Contact
NO17	Dry Cooler Fan 2	Relay Output Normally Open Contact
Analogue		
Y1	Fan 1	0 – 10 VDC
Y2	Heating	0 – 10 VDC
Y3	Cooling / Condenser Fan	0 – 10 VDC
Y4	Hum	0 – 10 VDC

Notes:

(i) All digital outputs are relay contacts rated at 24 VDC – 240 VAC 10A fitted with surge suppressor network.
(ii) All PCB tracks rated to withstand let through energy of a 24 VAC control fuse (10A).
(iii) All output relay contacts common to 24 VAC (except alarm relays).
(iv) Valve open / close on heating / cooling / freecool outputs refer to drive open / drive close valves only.
(v) Drycooler fans and Freecool Valve open / close outputs only available when C3-05 large controller fitted.
(vi) The fan output is to operate concurrently with the cooling, heating, humidification and dehumidification demands.
(vii) Cooling and heating outputs shall operate concurrently with digital / DODC outputs according to the demand calculations.

Display Information



Graphical Display comprises:

- ❒ Unit ON/OFF key, providing "master" control of the local unit.
- ❒ Graphical liquid crystal display, providing icon status of the unit functions, parameter menus, historic data logging, alarm buffer and access to other controllers via the network system.
- ❒ Four programming keys, providing access to display features.
- ❒ Alarm key to view active alarms.

Graphical Display Icons and Functions

Unit Functions are indicated via icons. These are:

UNIT RUN - shown when Unit fan(s) are running

COOL - shown when cooling demand is greater than 0%.

HEAT - shown when heating demand is greater than 0%.

HUMIDIFY - shown when humidification demand is greater than 0%.

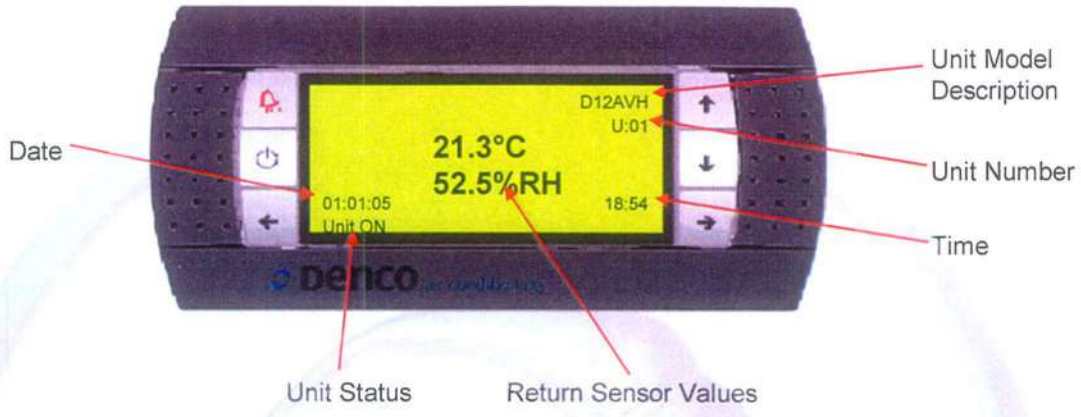
DEHUMIDIFY - shown when dehumidification demand is greater than 0%.

The 8 row LCD indicates Unit Function via the icons on rows 1 and 2. The remaining rows show the selected data, updated in real time.

The programming keys (↓ ↑ ← →) have to be pressed in a coded sequence in order to enter or change the function currently being accessed.

Current Alarm status can be reviewed by using the ← key to access the Alarm Buffer from the time-out display.

Time Out Display



The time-out display is the controllers' standard display at power up, during normal unit running conditions or the default display from all software levels given that no key had been pressed for a five minute period.

When in Time Out Display, pressing the left (←) arrow key allows entry into the Alarm Buffer display. Alternatively pressing the right (→) arrow key allows entry into the Main Menu display.

When in Time Out Display, pressing the down arrow (↓) key allows entry into four additional unit information pages. These are set out as follows: -

Timeout Page

↓

Temp Setpoint	22.0°C
Hum Setpoint	50.0%RH
Cooling Demand	000.0%
Heating Demand	000.0%
Hum Demand	000.0%
Dehum Demand	000.0%

↓

AMBICOOL STATUS

A.cool Demand	000.0%
Freecool Temp	00.0°C

HUMIDIFIER STATUS

Conduct.	0000us/cm
Current	000.0A

↓

COMBICOOL STATUS

Primary Cooling ☐

Secondary Cooling ☐

Changeover By DI ☐

↓

Supply Temp	00.0°C
Supply Hum	00.0%RH
Cond. Press1	00.0Bar
Cond. Press2	00.0Bar

Alarms and Interlocks

Occurrence of alarms will cause the alarm key to illuminate red.
Pressing the alarm key will then display any active alarms.

To reset an alarm when viewing the active alarms, press the alarm key.

Pressing the ← key when in the time-out display will show any alarms held in the Alarm Buffer, which is capable of holding 70 possible alarms complete with the time and date of the alarm generated in the sequence they occurred. The 71st alarm will replace the 1st alarm data.

No.	Description	Interlock	Relay	Detail
1	Return Air Temperature Sensor Failure	Y	Critical	Disables Temperature Outputs
2	Return Air Humidity Sensor Failure	Y	Critical	Disables Humidity Outputs
3	Circuit 1 Condenser Pressure Sensor Failure	Y	-	-
4	Circuit 2 Condenser Pressure Sensor Failure	Y	-	-
5	Water Temperature Sensor Failure	Y	-	-
6	Supply Air Temperature Sensor Failure	N	-	-
7	Supply Air Humidity Sensor Failure	N	-	-
8	Airflow Failure	Y	Critical	Disable All Outputs Exc. Unit Run
9	Filter Blocked	N	C / M	Relay Selectable Via Software
10	Water Detection	Y	Critical	Disable Humidifier
11	Auxiliary Alarm	N	C / M	Relay Selectable Via Software
12	High Control Air Temperature Alarm	N	Critical	-
13	Low Control Air Temperature Alarm	N	Critical	-
14	High Control Air Humidity Alarm	N	Critical	-
15	Low Control Air Humidity Alarm	N	Critical	-
16	Low Supply Air Temperature Alarm	N	Critical	Reduce Cooling Demand
17	High Supply Air Humidity Alarm	N	Critical	Reduce Humidification Demand
18	Klixon Trip	Y	Critical	Disable Heater Outputs
19	Compressor 1 HP Trip Alarm	Y	Critical	Disable Cool 1 Output
20	Compressor 2 HP Trip Alarm	Y	Critical	Disable Cool 2 Output
21	Compressor 3 HP Trip Alarm	Y	Critical	Disable Cool 3 Output
22	Compressor 4 HP Trip Alarm	Y	Critical	Disable Cool 4 Output
23	Circuit 1 HP Trip Alarm	Y	Critical	Disable Cool Outputs 1 & 2
24	Circuit 2 HP Trip Alarm	Y	Critical	Disable Cool Outputs 3 & 4
25	Compressor 1 LP Trip Alarm	N	Critical	Disable Cool 1 Output
26	Compressor 2 LP Trip Alarm	N	Critical	Disable Cool 2 Output
27	Compressor 3 LP Trip Alarm	N	Critical	Disable Cool 3 Output
28	Compressor 4 LP Trip Alarm	N	Critical	Disable Cool 4 Output
29	Circuit 1 LP Trip Alarm	N	Critical	Disable Cool Outputs 1 & 2
30	Circuit 2 LP Trip Alarm	N	Critical	Disable Cool Outputs 3 & 4
31	Denconet Communication Alarm	N	-	-
32	High Current Alarm (Cylinder Off)	Y	-	Stops production
33	Lack Of Water Alarm (Cylinder Off)	Y	-	Will clear automatically if water detected
34	Low Current Alarm (Cylinder Off)	Y	-	Stops production
35	Clock Alarm	N	-	Internal clock battery defective
36	EEV Driver 1 Sensor Fail	Y	Critical	Disable Cool 1 Output
37	EEV Driver 1 EEPROM Error	Y	Critical	Disable Cool 1 Output
38	EEV Driver 1 Step Motor Error	Y	Critical	Disable Cool 1 Output

Alarms and Interlocks (cont)

No.	Description	Interlock	Relay	Detail
39	EEV Driver 1 Battery Error	N	-	-
40	EEV Driver 1 High Evaporating Pressure	N	-	-
41	EEV Driver 1 Low Evaporating Pressure	N	-	-
42	EEV Driver 1 Low Superheat	Y	Critical	Disables Cool 1 Output
43	EEV Driver 1 Valve Not Closed During Power OFF	Y	Critical	Disables Cool 1 Output
44	EEV Driver 1 High Suction Temperature	N	-	-
45	EEV Driver 2 Sensor Fail	Y	Critical	Disables Cool 2 Output
46	EEV Driver 2 EEPROM Error	Y	Critical	Disables Cool 2 Output
47	EEV Driver 2 Step Motor Error	Y	Critical	Disables Cool 2 Output
48	EEV Driver 2 Battery Error	N	-	-
49	EEV Driver 2 High Evaporating Pressure	N	-	-
50	EEV Driver 2 Low Evaporating Pressure	N	-	-
51	EEV Driver 2 Low Superheat	Y	Critical	Disables Cool 2 Output
52	EEV Driver 2 Valve Not Closed During Power OFF	Y	Critical	Disables Cool 2 Output
53	EEV Driver 2 High Suction Temperature	N	-	-
54	High Conductivity Alarm	Y	-	Disable Humidifier Output
55	High Conductivity Warning	N	-	Signal Only
56	Low Production Alarm	Y	-	Disable Humidifier Output
57	Drain Alarm	Y	-	Disable Humidifier Output
58	Humidifier Cylinder Full Alarm	Y	-	Disable Humidifier Output
59	Warning Pre-Exhaustion Cyl.	N	-	Signal Only
60	Warning Foam Presence	N	-	Signal Only
61	Warning Cylinder Exhaustion	N	-	Signal Only
62	Alarm Humidifier Cylinder Mandatory Maintenance	Y	C / M	Disable Humidifier Output
63	Warning Humidifier Cylinder Maintenance Recommended	N	-	Signal Only

Notes

1. C/M Refers to the users choice of critical or maintenance relay which can be selected in level 3 alarm setup

Software Menu Structure

The parameters held in the three software levels are listed below. A more comprehensive listing is shown in the following Software Level Flowcharts.

MAIN MENU

- Level 1
- Level 2
- Level 3
- Historic Data

LEVEL 1

- Setpoints
- Software Version
- Time Control
- Set Clock

LEVEL 2

- Cooling / Heating Control Parameters
- Humidity / Dehum Control Parameters
- Ambicool / Combicool Control Parameters
- Temperature / Humidity Alarm Bands
- Logging Interval
- Hours Run Reset

LEVEL 3

Factory Settings	Control Sensors / Type
	Cooling / Heating Type
	Humidifier Type
	Load Defaults
Alarm Settings	Auxiliary Alarm Input
	Filter and Humidifier Cylinder Alarms
	Critical Alarm Settings
	Maintenance Alarm Settings
Languages	
Denconet Controls	Type
	Stand Alone / Network
Calibration	Return Air Temperature / Humidity
	Supply Air Temperature / Humidity
	Freecool Temperature
Control Strategy	P, PI, selection
	Integral Time
Dehum Parameters	Control
	Interlocks
	Stages / Percentage Assigned
Time Delays	Start
	Function
	LP

Software Menu Structure (cont)

LEVEL 3 continued	
Software HOA	Heat, Cool, Hum, Dehum Ambicool
Test Display Icons	
Inputs / Outputs	Digital Inputs, Analogue Inputs, Digital Outputs, Analogue Outputs

HISTORIC DATA	
Display History	Return Air Temperature/Humidity Supply Air Temperature/Humidity Output Demands

Software Level Entry Codes / Passwords

Software Level 1: ↓ ↑ ↓ ↑ ↓ ↑ ↓ →

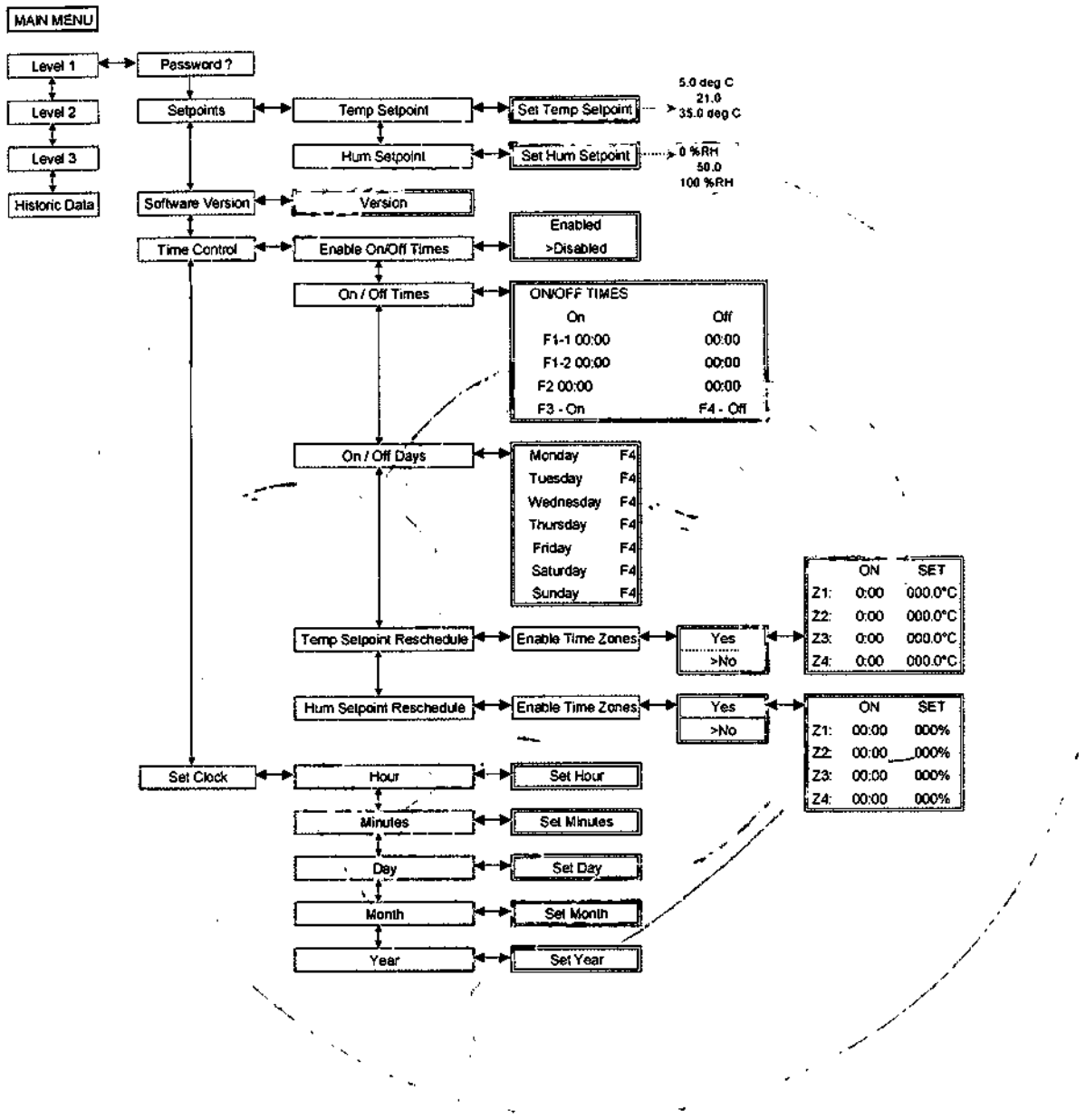
Software Level 2: ↓ ↓ ↑ ↑ ↓ ↓ ↑ ↑ →

Software Level 3: ↓ ↓ ↓ ↑ ↑ ↑ ↓ ↓ →

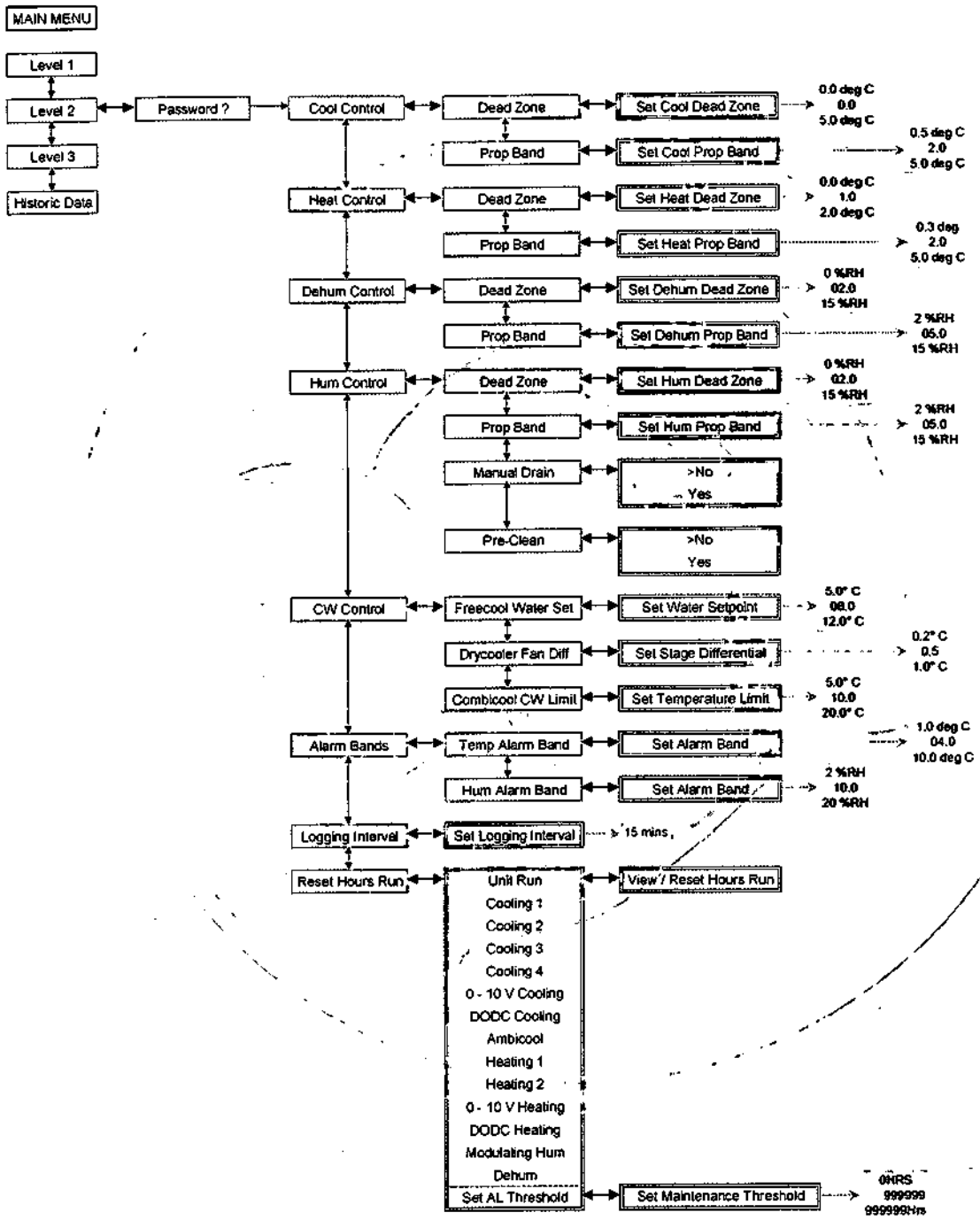
Software Level 3 - Factory Settings: ↑ ↑ ↑ → [requires prior use Software Level 3 entry code]

The display will revert to the time-out display from all software levels if a key is not pressed in a five minute period.

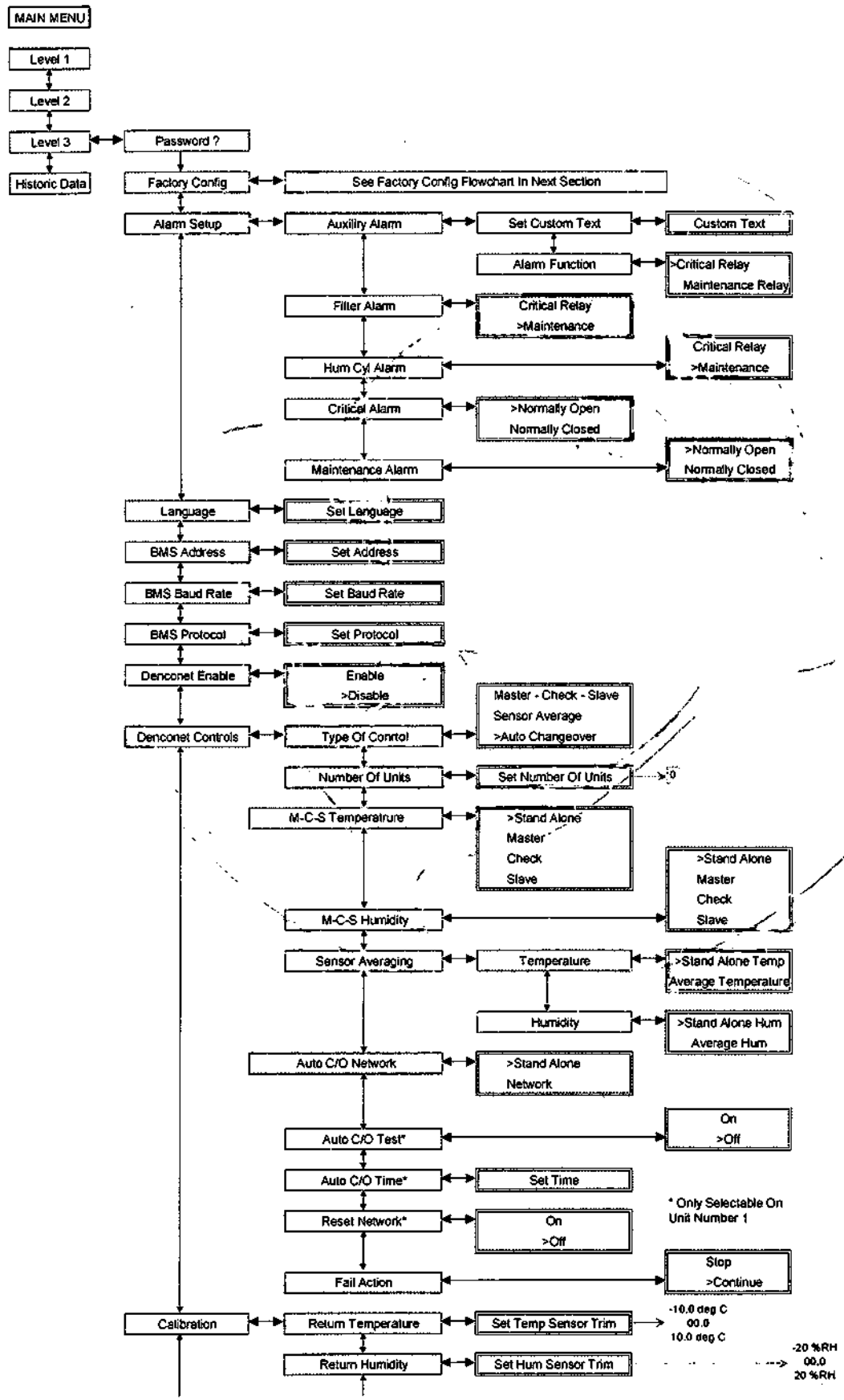
Software Level 1 Flowchart



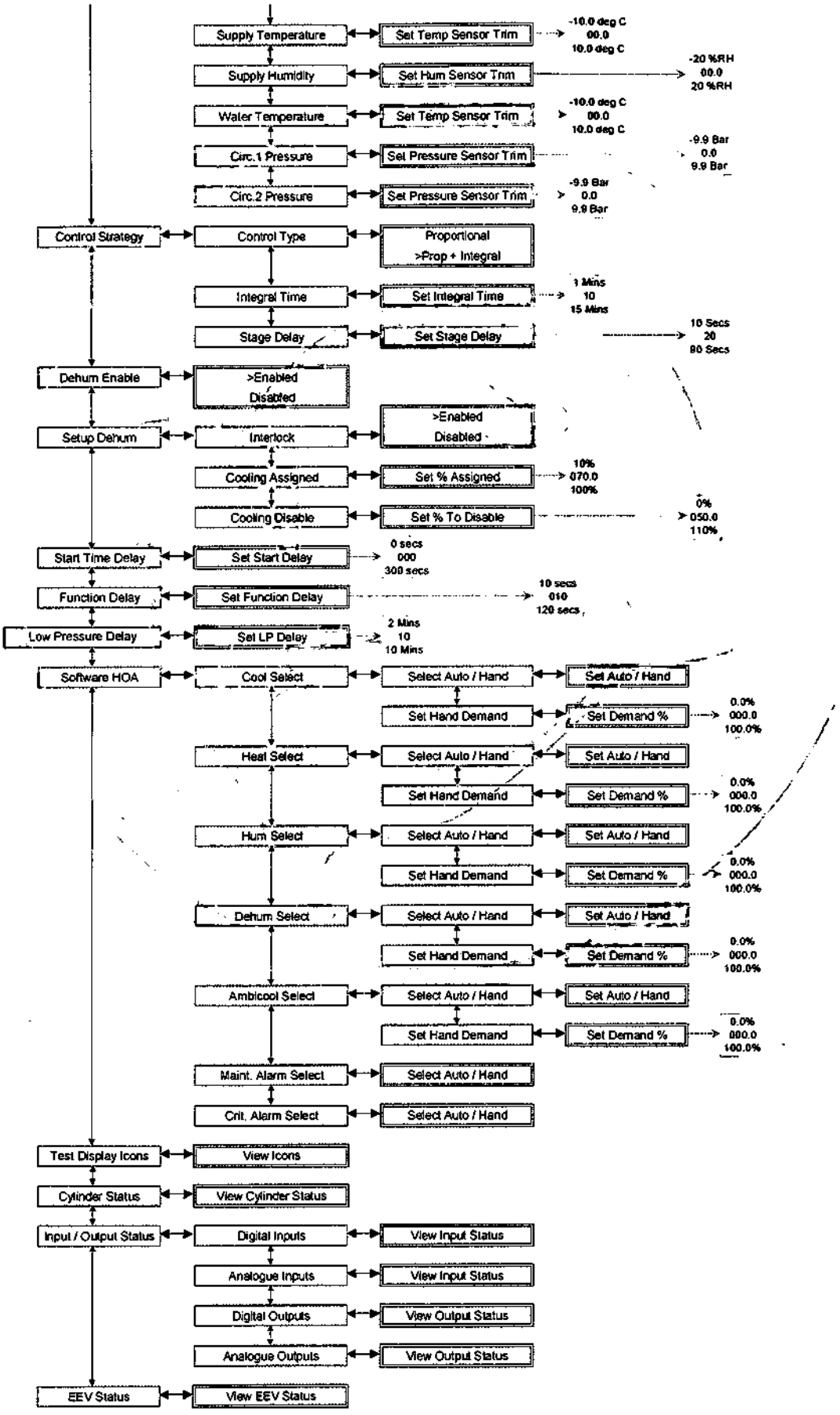
Software Level 2 Flowchart



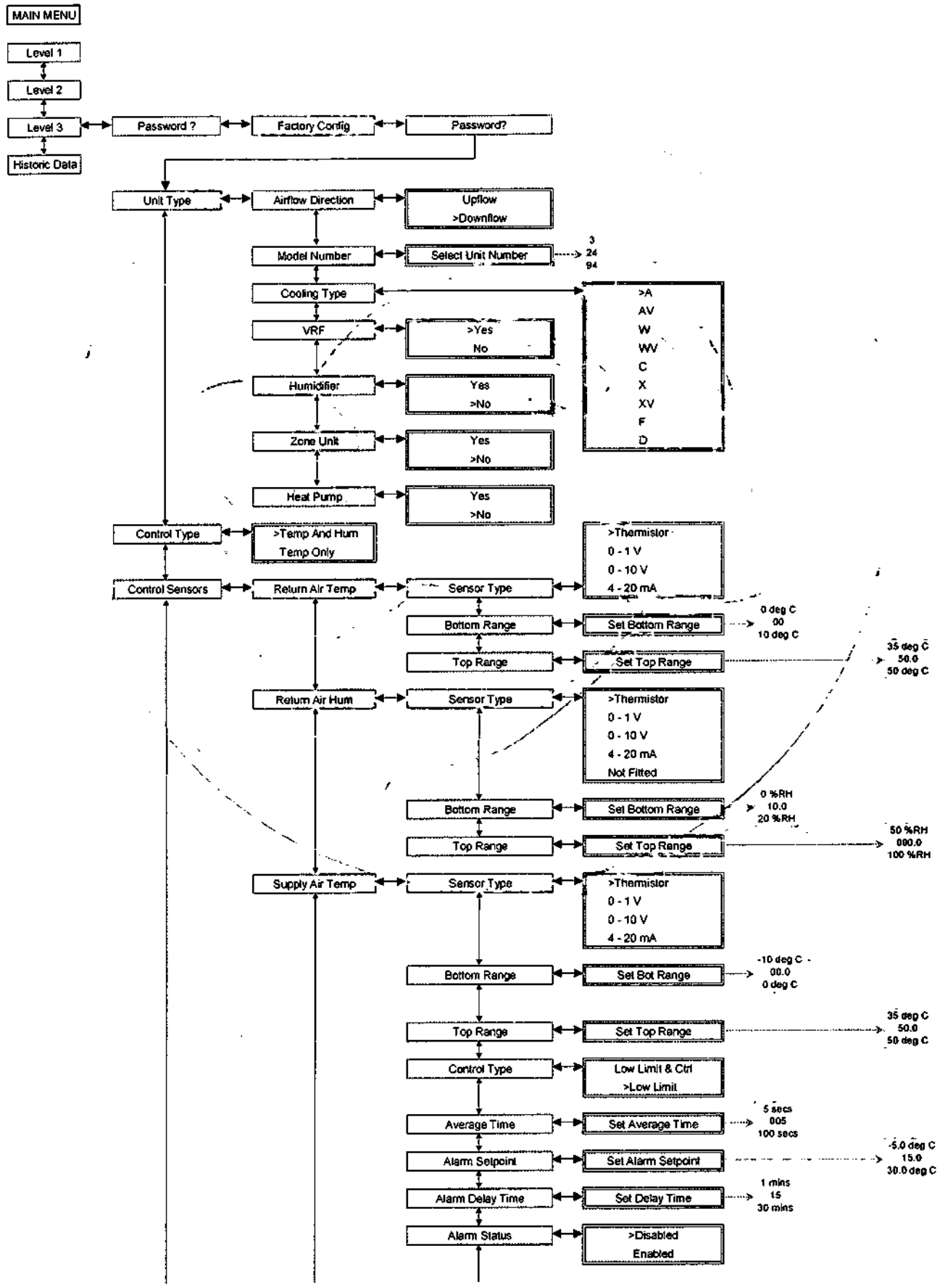
Software Level 3 Flowchart



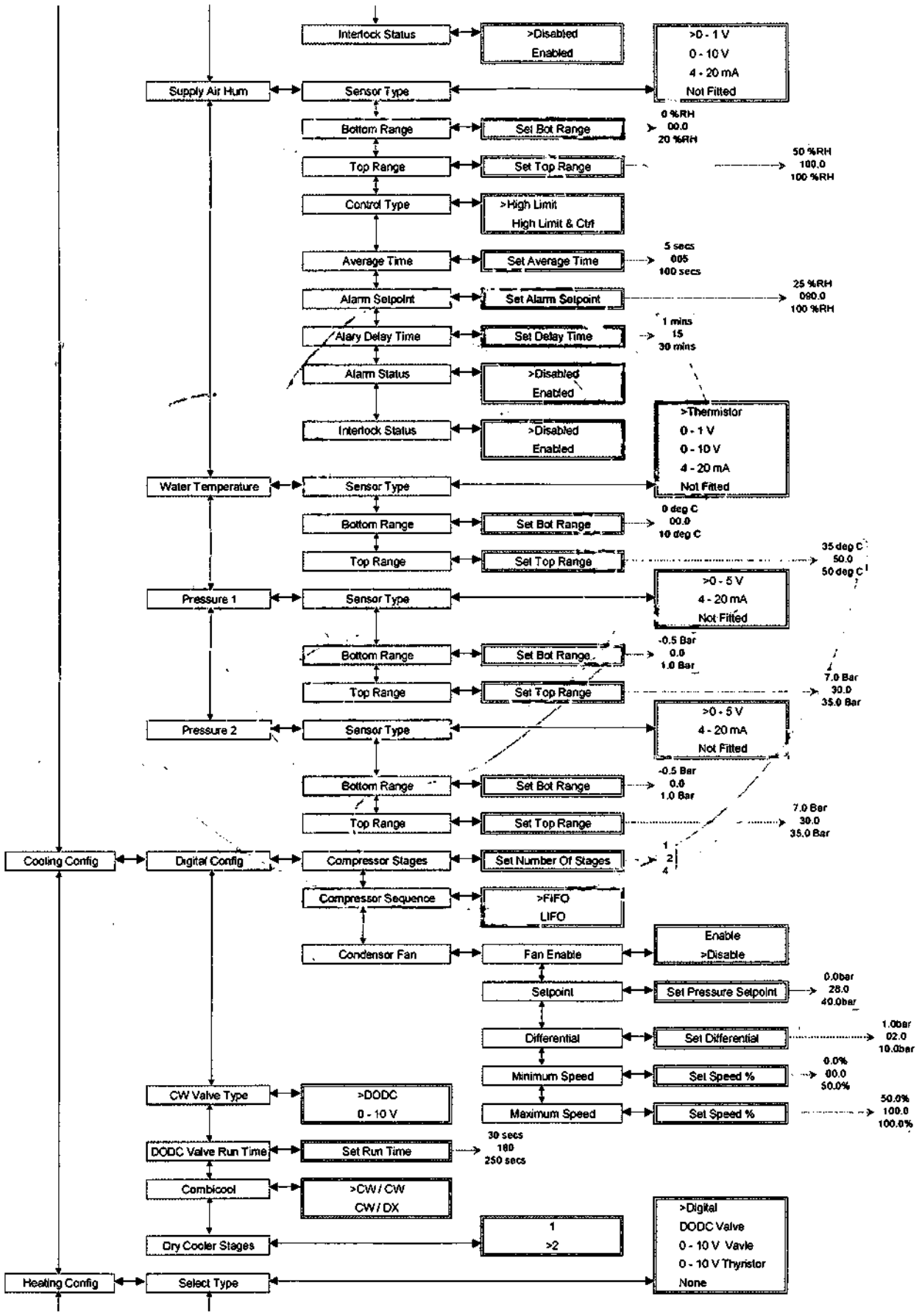
Software Level 3 Flowchart (cont)



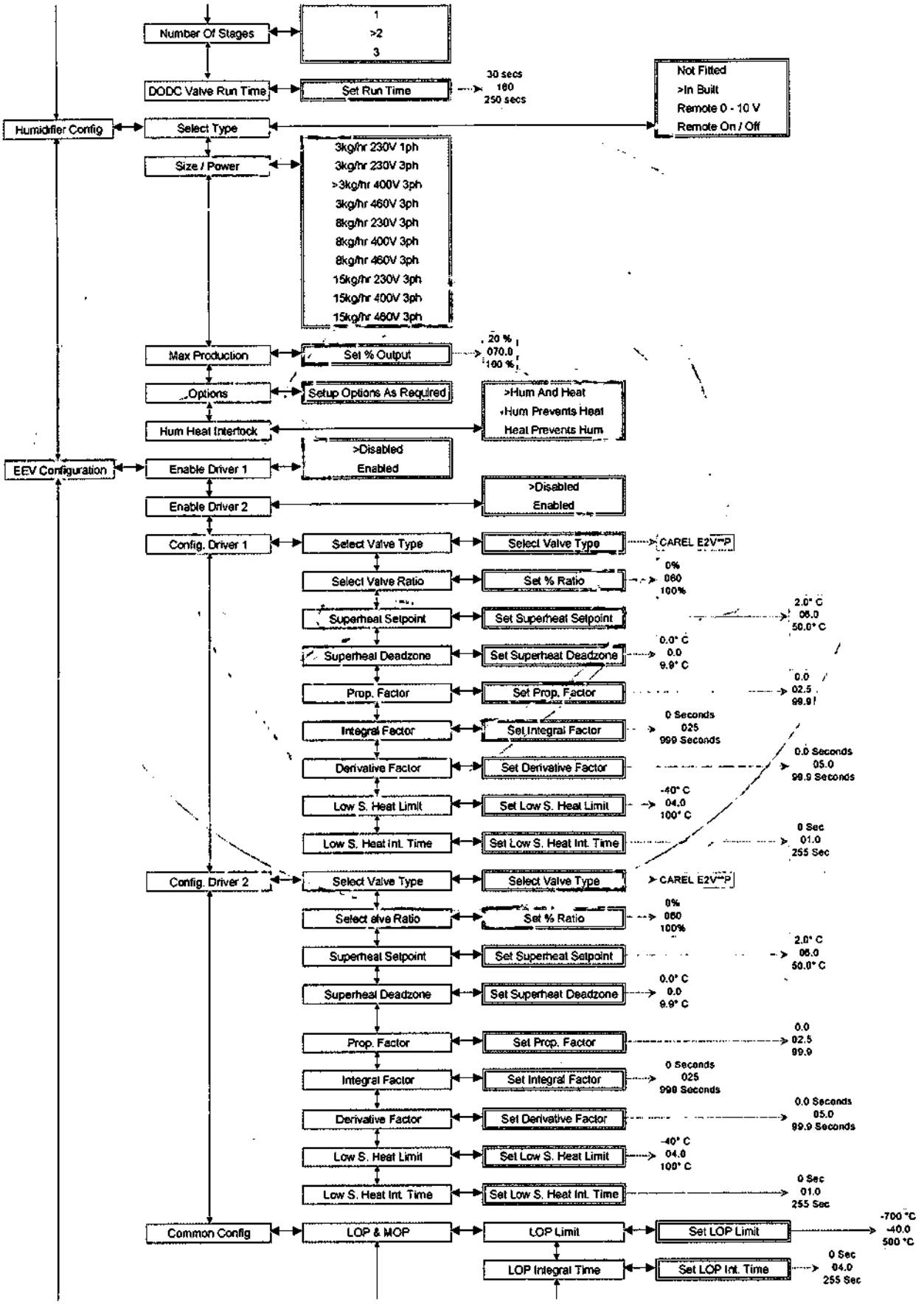
Software Level 3 Factory Config Flowchart



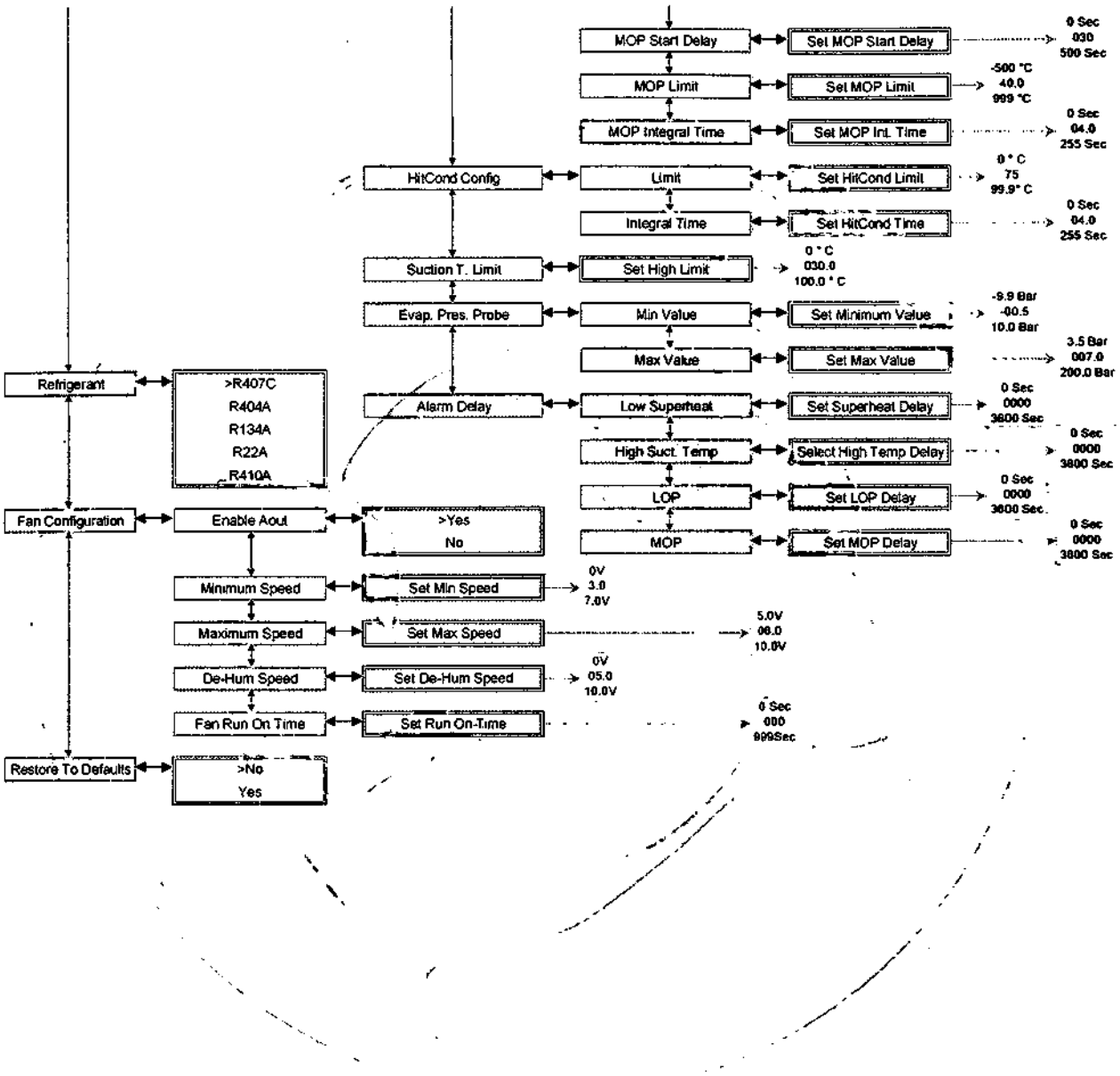
Software Level 3 Factory Config Flowchart (P2)



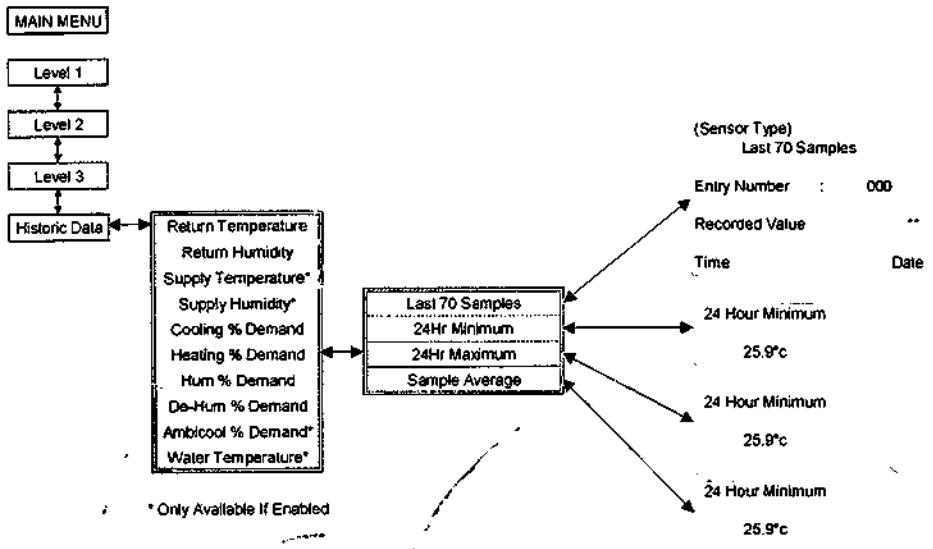
Software Level 3 Factory Config Flowchart (P3)



Software Level 3 Factory Config Flowchart (P4)



Software Historical Data Flowchart



Setting Unit Address

Ensure that the pLAN connection is NOT made when setting controller addresses.

First press the up, down and right keys simultaneously for five seconds to access the following page.

```
Display address
Setting.....: 32

I/O Board address: 1
```

Press the down key to move the cursor to the display address setting. The up key should then be used to change the display address to 0 (Zero). Pressing the down arrow will accept the change and display the following screen.

```
Display address changed
```

While depressing the up and alarm keys, cycle the power supply to the unit off and then on again. You should keep the alarm and up keys depressed until the following screen is shown, around fifteen seconds later.

```
########################
self test
please wait
########################
```

Release the keys.

```
pLAN address: 1
UP:       increase
DOWN:     decrease
ENTER:    save & exit
```

The up and **RIGHT** arrows will alter the pLAN address. The down key will save and exit this screen at which point the display will go blank.

As before, hold the up, down and right keys simultaneously for five seconds to enter this screen.

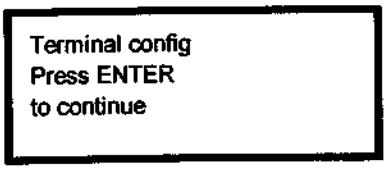
```
Display address
Setting.....: 0

I/O Board address: - -
```

You may now alter the display address as before, this time to your desired value. Pressing the down arrow after changing the display address will cause the display to go blank after displaying "No Link" for five seconds. Again, hold the up, down and right keys for five seconds to bring you back to the address screen.

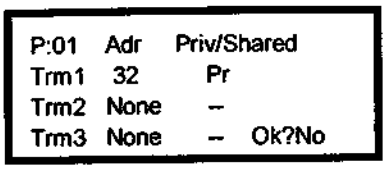
```
Display address
Setting.....: 32

I/O Board address: - -
```

Now press down twice to highlight the I/O Board address and then the up arrow to initialise the selected address. Press the down arrow to reach the next screen.

Networking (cont)



Press the down arrow to display the following page.



Press the down key until the cursor highlights the value after Trm1. Use the up key to change this to the same as your display address. Press the down arrow until the cursor highlights No. Use the up key to toggle this to Yes and the down key will then exit address setup.

NOTES:

- There are a maximum of 32 addresses available on the pLAN. Every controller and every display sharing the pLAN network needs to be assigned a **DIFFERENT** address. No two can be the same.
- A controller has to be assigned a number from 1-8
- A display has to be assigned a number from 25-32

In the event of a communications error, the controller in question will be ignored by the network.

Master Check Slave

Master Temp.

If selected as "MASTER TEMP.", then the temp. sensor value is transmitted to all units on the network that are configured as "SLAVE TEMP." (and "CHECK TEMP."). The "MASTER TEMP." controller and all the "SLAVE TEMP." controllers (and "CHECK TEMP." controller) control to the "MASTER TEMP." sensor value.

Check Temp.

If selected as "CHECK TEMP." in addition to being a slave temp. controller, the "CHECK TEMP." will also address the "MASTER TEMP." every 60 seconds for a sensor fail alarm or comms fail alarm.

If the sensor fail alarm is active, the "CHECK TEMP." becomes "RE-ASSIGNED MASTER TEMP." and "MASTER TEMP." becomes re-assigned as "SLAVE TEMP." and an alarm condition is flagged on the re-assigned "SLAVE TEMP." "RE-ASSIGNED SLAVE SENSOR FAIL".

There will be no re-assigned "CHECK TEMP." upon the sensor fail or comms fail until the system is corrected and reset.

If the sensor fail and comms fail safe, then the "MASTER TEMP." and "CHECK TEMP." remains as assigned.

Slave Temp.

If selected as "SLAVE TEMP.", then the temp. sensor value is received from the "MASTER TEMP." or the "RE-ASSIGNED MASTER TEMP.".

The "SLAVE TEMP." controller controls to the "MASTER/RE-ASSIGNED MASTER TEMP." sensor value.

Stand Alone Temp.

If selected as "STAND ALONE TEMP.", then the temp. sensor value is received from the controller's own sensor input and controls to that value.

Master Check Slave (cont)

Master Hum

If selected as "MASTER HUM", then the hum sensor value is transmitted to all units on the network that are configured as "SLAVE HUM" (and "CHECK HUM"). The "MASTER HUM" controller and all of the "SLAVE HUM" controllers (including "CHECK HUM") control to the "MASTER HUM" sensor value.

Check Hum

If selected as "CHECK HUM" in addition to being a "SLAVE HUM" controller, the "CHECK HUM" will also address the "MASTER HUM" every 60 seconds for a sensor fail or comms fail alarm.

If the sensor fail alarm is active, the "CHECK HUM" becomes "RE-ASSIGNED MASTER HUM" and "MASTER HUM" becomes "RE-ASSIGNED SLAVE HUM" and an alarm condition is flagged on the re-assigned "SLAVE HUM" "SENSOR FAIL".

There will be no re-assigned "CHECK HUM" upon the sensor fail or the comms fail until the system is corrected and reset.

If the sensor fail and comms fail safe, then the "MASTER HUM" and "CHECK HUM" remain as assigned.

Slave Hum

If selected as "SLAVE HUM", then the hum sensor value is received from the "MASTER HUM" or the "RE-ASSIGNED MASTER HUM". The "SLAVE HUM" controller controls to the "MASTER HUM" or the "RE-ASSIGNED MASTER HUM" sensor value.

Stand Alone Hum

If selected as "STAND ALONE HUM", then the hum sensor value is received from the controller's own sensor input and controls to that value.

NOTES

1. It must not be permissible to have two masters (temp. or hum) on the network. If this configuration is inadvertently set, then the master unit with the lowest unit number is set as "Master".

2. It must not be permissible to have two checks (temp. or hum) on the network. If this configuration is inadvertently set, then the check unit with the lowest unit number is set as "Check".

3. A comms error/failure will operate the communication drop out relay and flag a "Network Failure" alarm. A global comms error - then all of the controllers will automatically revert to stand alone temp. and hum control.

4. All slave and check slave units will display the temperature and humidity sensor values of the designated master unit.

All stand alone units will display its local sensor values.

5. When operating as a master check slave, all operating parameters/settings/alarms will function as normal. The temp./hum alarm conditions will be generated only from the master unit (or the re-assigned master). When operating as stand alone, the temp. and hum condition alarm will be active on the local unit. The master unit will be running, otherwise the lowest running unit number will generate the alarm.

6. Normal alarm conditions on the controllers will have no affect upon the network irrelevant of the set configuration.

7. The network mode will allow for only one change of unit configuration on the sensor fail or comms fail.

Sensor Averaging

Average Temp.

If selected as average temp., then the temp. sensor value is transmitted across the network. Each controller configured as "average temp." will calculate the average temp. value and control to that value.

Stand Alone Temp.

If selected as stand alone temp., the controller receives the temp. sensor value from its own integral sensor input and controls to that value. The sensor value is excluded from the averaging calculation.

Average Hum

If selected as average hum, then the hum sensor value is transmitted across the network. Each controller configured as average hum will calculate the average hum value and control to that value.

Stand Alone Hum

If selected as stand alone hum, the controller receives the hum sensor value from its own integral sensor input and controls to that value. The sensor value is excluded from the averaging calculation.

NOTES

1. A sensor failure will be flagged as an alarm condition and the sensor value will not be part of the averaged calculation.

2. A comms failure will be flagged as an alarm condition (network failure). A global comms error - then all of the controllers will automatically revert to stand alone temp. and hum control.

3. Any controllers on the unit in a sensor fail or comms fail mode will not form part of the averaged sensor value.

4. Normal alarm conditions will have no affect upon the network commands irrelevant of the set configuration.

5. All units configured as average temp./hum will display the averaged sensor value. All stand alone units will display the local sensor values.

6. When operating as an averaging controller, all operating parameters/settings/alarms will function as normal. The temp./hum alarm condition will be generated on the lowest unit number selected as averaging. When operating as "stand alone", the temp. and hum condition alarm will be active on the local unit.

Auto Change-Over

Network

If selected as "network mode", the controllers will be automatically sequenced to equalise running hours on all machines. The sequencing time will be set in Level 3 with movements of 168 hours standard. However, there will be a facility in the factory configuration to reduce the sequence time down to 1 hour minimum.

The last unit number of the network is always the standby controller. After the sequence time has elapsed, the controllers on the network are automatically sequenced.

Example of Sequencing of five units

Controller	1	2	3	4	5
Start	Duty	Duty	Duty	Duty	Stand By
1 Seq. Time	Stand By	Duty	Duty	Duty	Duty
2 Seq. Time	Duty	Stand By	Duty	Duty	Duty
3 Seq. Time	Duty	Duty	Stand By	Duty	Duty
4 Seq. Time	Duty	Duty	Duty	Stand By	Duty
5 Seq. Time	Duty	Duty	Duty	Duty	Stand By
REPEAT					

In the event of a critical or maintenance alarm condition of any duty controller, the standby will automatically start. The controller in an alarm condition will also run and the alarm condition will be displayed.

There will still be a facility to stop the failed unit or for the failed unit to continue to run.

In the event of a power failure or a controlled shutdown, the sequence of rotation will be stored in the memory so that the duty controllers at power down will remain the duty controllers at restart. The sequence rotation can be reset at any time to the start sequence accepting the sequence reset in Level 3. During the sequence rotation the duty unit is stopped before the stand-by unit runs.

Stand Alone

If selected as "stand alone", the sequence rotation command is still active but the stand alone setting will have priority. Hence, if the stand alone is reset to "network", the controller will automatically take its position in the sequence rotation.

NOTES

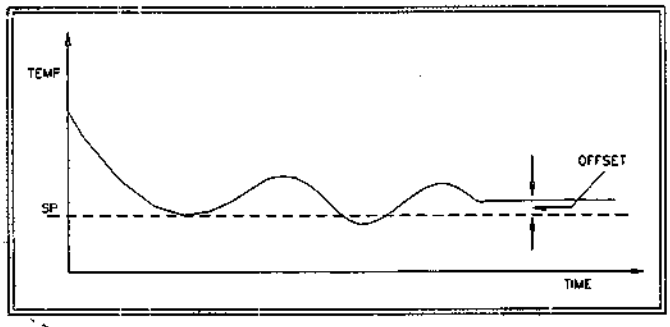
1. A comms failure will be flagged as an alarm condition and then all controllers on the network revert to stand alone operation and all controllers run.
2. There will be a test/commission sequence time of 3 minutes. To prevent this sequence time inadvertently being left set as 3 minutes, after a period of 30 minutes, the sequence rotation time as set will be installed.
3. Normal alarm conditions will have no affect upon the network commands irrelevant of the set configuration.

Controller Operation with Temperature Control

The controller can use proportional or P + I control actions to maintain the temperature setpoint. The integral (I) time constants can be adjusted in software.

Proportional Control

Proportional control is the relationship between the setpoint, proportional band and the actual control air temperature. For a setpoint of 21°C, a proportional band of 2°C and one stage of cooling, to enable the cooling the control air temperature has to rise to setpoint plus proportional band, i.e. 23°C (21 + 2). If the number of cooling stages is increased to two then the first stage would be enabled at setpoint plus (prop. band/2), i.e. 22°C (21 + 2 / 2). Both stages will be enabled at 23°C.



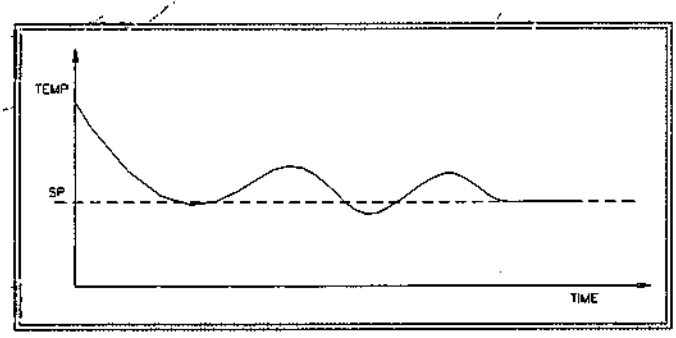
The same theory applies to chilled water outputs. For the valve to be fully open, the control air temperature has to be at setpoint plus the full proportional band.

Adjusting the proportional band will have the following effects:

- A large proportional band will mean a slow system response, i.e. the control air temperature would have to rise to a high level before full cooling is enabled, and subsequent shutting off of the cooling would also be slower. A small or tight proportional band will bring on cooling quicker but would result in system instability or "hunting".
- An optimum proportional band will be set for the room conditions but due to inherent heat generation there will generally be a steady state error or "offset" from the setpoint at which the room conditions are maintained.

Proportional plus Integral Control

To overcome the "offset" above the controller can be set to operate using proportional plus integral (P + I) control to achieve and maintain the control temperature at setpoint. The addition of the integral term has the effect of gradually increasing the output to reduce the offset so that the steady state condition, i.e. heat generation equals cooling input, now occurs at setpoint. The integral action is in effect resetting the proportional band to reduce the steady state error.



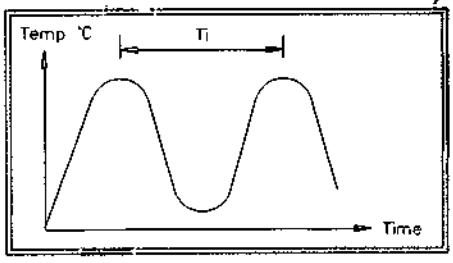
Tuning the Control Loop

The optimum control response for air conditioning equipment is normally acceptable when there is no overshoot and rates of temperature changes are small. Consequently, the tuning methods described below provide only a first approximation to optimum temperature tuning.

The rule-of-thumb of Ziegler and Nichols is by far the simplest procedure for loop tuning. There are two methods, both detailed below:

1. Stability Limit Method

Set the Historic Data Logging sample period to 1 minute.
Set for proportional control only (Level 3).
Set the temperature setpoint (Level 1) so that the cooling will run continuously.
Set the stage delay to 10 seconds (Level 3).
Reduce the cooling proportional band (Level 2) in several successive steps (say 2.0°C, 1.5°C, 1.2°C, 1.0°C etc.), waiting each time to see the result on the control temperature logged values, until the loop reaches the stability limit and thus begins to oscillate, i.e. an oscillation once started does not fade away.



At this point note the cooling proportional band (Cpb) and the period of a complete oscillation (Ti).

Substitute these values in the formulae below:

Optimum Cooling Proportional Band = (100 / Cpb) x 0.45
Optimum Integral Time = 0.83 x Ti

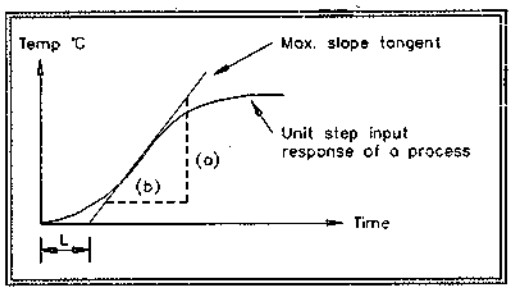
Once the optimum settings have been calculated set for P + I control and enter values accordingly.

2. Step Method

This method avoids the necessity of putting the control loop in oscillation.

Adjust the setpoints such that there are no cooling, heating, hum or dehum outputs, and allow conditions to stabilise.

Manually operate 50% of the cooling capacity and plot the response in the control temperature from the logged values. The result is normally as shown below:



R = slope = Temperature Fall [a] / Time (min) [b]

L = Time Lag (min)

By drawing in the maximum slope, tangent L can be obtained on the time axis and R calculated.

Ziegler and Nichols recommend the following control adjustments be made:

Optimum Cooling Proportional Band = 100 / G where G = 0.9 / (R x L)
Optimum Integral Time = 3.3 x L

Cooling Operation

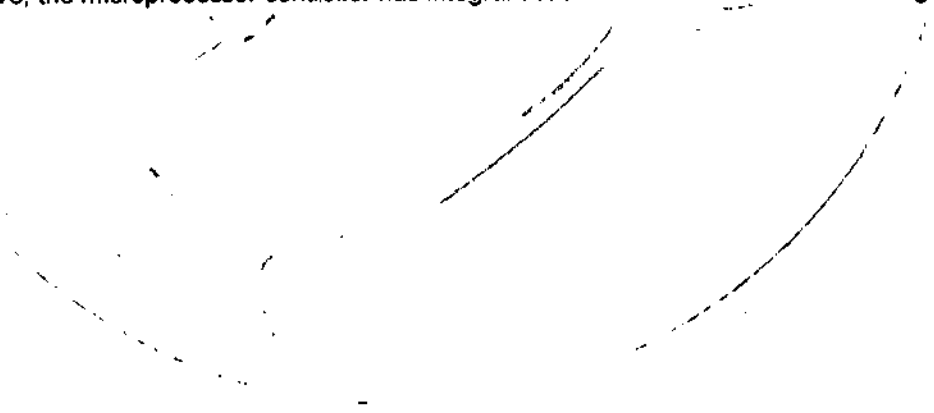
Cooling is achieved by one of two methods, Direct Expansion or Chilled Water in response to a cooling demand from the microprocessor controller. Factors that affect the cooling demand is the relationship of the control air temperature to the temperature setpoint, cooling proportional band and cooling dead zone.

In the case of DIRECT EXPANSION (DX) one, two, three or four stages can be selected (Software Level 3 Factory Settings) to achieve the full (100%) cooling demand. Switch on points for each stage is determined as follows "100% divided by Number of Stages". The stages can be set for automatic sequencing such that the first stage started is the first stage to be stopped to balance running hours and minimize the number of starts. Automatic sequencing of compressors can be disabled via the software to ensure that Cooling Stage 1 is always energised first (used for Hot Gas Re-heat - if fitted).

For CHILLED WATER (CW), the controller drives a valve actuator to position a three-way valve to meet the cooling demand. A unit that is configured for Chilled Water operation will use Cooling outputs 1 and 2 to run the valve actuator, output number 1 will be used to drive the actuator open and output number 2 drive it close. For a valve actuator with a full running time of 150 seconds from fully closed to fully open it can be seen, assuming the valve is fully closed, if output number 1 is energised for 150 seconds the valve will be opened 100%. As the valve actuator running time is not proportional to the amount the valve actuator moves, the controller uses an algorithm to determine the time an output is energised in order to position the valve. Thus to open or close a valve a certain amount the appropriate output will be energised for a certain amount of time. To enable the controller to determine the position of the actuator on start-up (or at any time the AHU is stopped and started) it will initially energise the drive close output for 110% of the valve running time. This ensures the valve is at the fully closed position and any subsequent movement is from a set position. Thus at switch-on the valve may initially be seen to close even though conditions maybe calling for a cooling demand.

The controller can also provide a 0 - 10V DC output to a chilled water valve actuator if required.

In addition to the above, the microprocessor controller has integral action which is added to the cooling demand.



Heating Operation

Heating is achieved in one of two ways, either with Electric Heaters or with Low Pressure Hot Water (LPHW).

In the case of Electric Heating up to a maximum of three stages of heating can be configured in software (Software Level 3 Factory Settings) even though there are only two heating outputs. For this arrangement the electric heaters must be of unequal size (in the ratio of 2:1, output No 1 heater being the smaller). Operation of the outputs is in a binary manner as shown in the table below.

Heating Step	Heater Stage	ON	OFF
1	1	◆	
	2		◆
2	1		◆
	2	◆	
3	1	◆	
	2	◆	

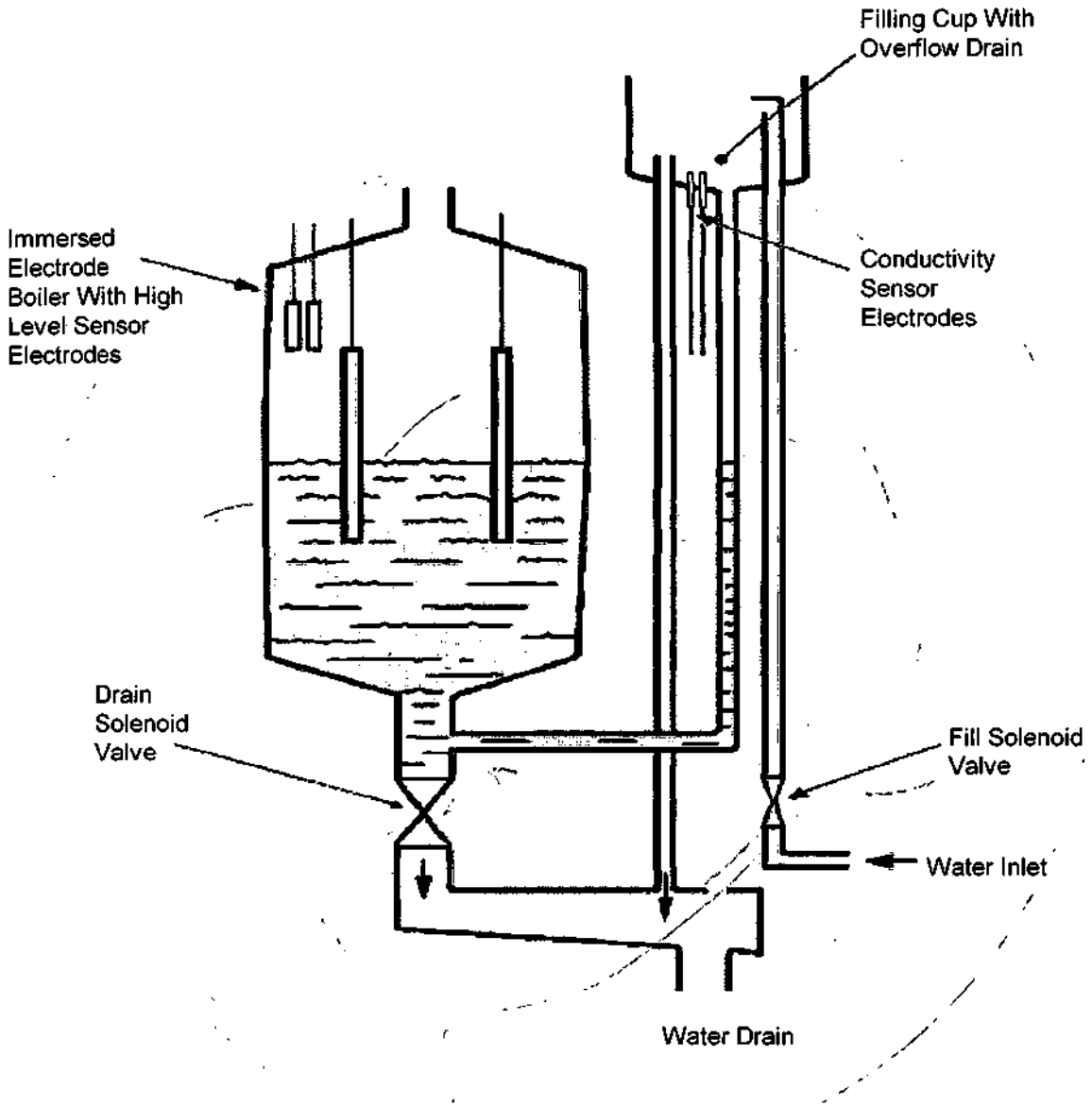
The LPHW output operates a Drive Open / Drive Close valve actuator via the digital outputs in response to heating demands. The operation of the outputs is similar to that for CW control.

The heating demand is generated in the same way as the cooling demand, i.e. deviations below setpoint will generate a heating demand relevant to the deadzone and proportional bands set, and operate the heating outputs accordingly.

Integral action has the same effect on the heating demand, thus with no change in the Return Air Temperature and an initial heating demand is present the demand is gradually increased so that the output increases to raise the Return Air Temperature to its' setpoint.

The controller can also provide a 0 - 10V DC output to a LPHW valve actuator if required.

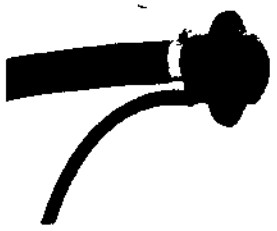
Humidifier Operation



The above diagram shows the basic components of the humidifier assembly, while de-energised. It should be noted that a suitable steam pipe must be used and the system should not be operated with an "open top" as in the diagram.

The 3 kg/hr humidifier uses a steam nozzle (typical shown below) to introduce the steam into the unit airflow, above this capacity a sparge pipe arrangement is utilised.

The position of the nozzle / sparge pipe within the Air Handling Unit has been selected to produce the best distribution of steam into the airflow.



The humidifier operating parameters are selected in software. Voltages, phases and the appropriate steam cylinder size fitted are set in Software Level 3 Factory Configuration. This configuration is set up during factory inspection and testing and will not normally need to be reset. The conductivity sensor incorporated in the design can be used to display supply conductivity, but is primarily used for internal software calculations.

Humidifier Operation (P2)

Steam Output Capacity	3 kg/hr		8 kg/hr		15 kg/hr	
Steam Output Range	0.6 – 3 kg/hr		1.6 – 8 kg/hr		3 – 15 kg/hr	
Humidifier Amps	O.A.	Max.	O.A.	Max.	O.A.	Max.
Supply Voltage Options (V / ph / Hz)						
220 / 1 / 50	10.2	17.3				
230 / 1 / 50	9.8	16.7				
240 / 1 / 50	9.3	15.8				
220 / 3 / 50	5.9	10.0	15.8	26.8	29.5	50.2
380 / 3 / 50	3.6	5.8	9.1	15.5	17.0	29.0
400 / 3 / 50	3.3	5.6	8.7	14.8	16.3	27.7
415 / 3 / 50	3.1	5.3	8.3	14.2	15.6	26.6
440 / 3 / 50	2.9	5.0	7.8	13.4	14.8	25.1
460 / 3 / 50	2.8	4.8	7.5	12.8	14.1	24.0
General Specifications						
Air Duct Pressure	± 400Pa		± 500Pa		± 700Pa	
Ambient Temperature	1 – 40° C					
Operating Pressure	0 bar (pressureless)					
Feed Water Pressure	1 – 10 bar (14.5 – 145 psig)					
Water Conductivity	125 – 1250 microSiemens / cm^3					
Feed Water Connection	15mm O/D Compression Connection					
Drain Water Connection	22mm Copper					

Basic Operation

With a new or empty cylinder being used for the first time it is unlikely that normal operation will occur unless the water supply is particularly conductive. If the water is extremely conductive and the current reaches 170% of nominal working current during the first minute of operation, the microprocessor will initiate an automatic drain and restart normal operation.

If the water has too low a level of dissolved solids for adequate conduction to occur, the bottle will be drained partly and a concentration cycle will run.

Soft Start

When the system starts, if the heater electrode circuit current is below 1/3 of nominal, the system will run a soft start cycle. This cycle contains a series of small evaporating cycles and pre determined fill times. Once the soft start has run, normal operation will be started.

Concentration Cycle

This cycle runs when the high level sensor has been hit as this indicates low conductivity of the water in the cylinder.

The concentration cycle runs a long series of small, low level, evaporation cycles. The target current value is increased incrementally until 100% nominal current is reached at which point normal operation will begin.

This cycle can take several hours. During this cycle the bottle will appear to be running normally, although at a reduced output and lower water level. This process is necessary and should be allowed to complete.

Normal Operation

During normal operation the bottle will fill and boil off water to produce the steam output it is rated at. A normal evaporation cycle will start with the relevant water level to give 110% of nominal current. Due to evaporation this water level will drop and the cycle allows this until 95% of nominal current is reached. At this point the fill value is opened and water is allowed to flow into the bottle until 110% target current is reached again, at which point the cycle repeats.

The system will periodically empty the cylinder and re-fill with fresh water to aid cylinder operation and longevity.

Humidifier Operation (P3)

Cylinder Life

The water hardness and the humidity demand on site will determine the effective life of a steam cylinder. Units located in areas with naturally soft water will experience the longer cylinder life, whilst areas with hard water, a more frequent cylinder exchange must be expected as the whole purpose of the Humidifier is to produce pure steam for humidification at the expense of the disposable steam cylinder.

The electrode boiler humidifiers are designed to cope with a very wide variety of tap waters. Tap water can be used without water treatment, however it is recommended to put a fine filter before the water inlet valve to the humidifier in case the water is hard or contains visible particles.

The range of acceptable water conductivity is from 125 to 1250 microSiemens/cm. The hardness of the water is not such an important criteria because even soft water can have acceptable conductivity. However, it is not recommended to use chemically softened water, because it may cause the water to become aggressive or cause foam in the cylinder.

The hardness is generally indicated in millimol Calcium and Magnesium Ions per litre (mmol / l) or degrees of English hardness.

Soft Water	under 1.3 mmol / l	under 8.75 EH (under 7°DH)
Medium Hard Water	1.3 - 2.5 mmol / l	8.75 - 17.5 EH (7 - 14°DH)
Hard Water	2.5 - 3.8 mmol / l	17.5 - 26.25 EH (14 - 21°DH)
Very Hard Water	over 3.8 mmol / l	over 26.25 EH (over 21°DH)

Average water with a hardness of 18.75 EH (15°DH) has dry mineral residues of around 0.3 g/l.

Procedure for Cylinder Exchange

- ☐ With the power to the unit, completely empty the cylinder by using the manual drain in level 2 of the software menu structure.
- ☐ Isolate the unit from the incoming electrical supply by means of the local mains isolator.
- ☐ Disconnect all electrical circuits connected to the Humidifier before any more work is done.
- ☐ Loosen the hose clamp and disconnect the hose from the top of the steam cylinder.
- ☐ Remove the rubber belt from around the cylinder.
- ☐ Carefully remove the used cylinder from the unit.
- ☐ Insert new cylinder.
- ☐ Re-attach the rubber belt around the cylinder.
- ☐ Reconnect the steam hose.
- ☐ Reconnect electrical circuits to the Humidifier as before.
- ☐ After a cylinder exchange, it is important to replace the cables to their original route.

Steam and Condensate Hoses

The steam, condensate and water hoses used with and in the Humidifier should be inspected at the normal service visits as part of normal maintenance. At the first signs of deterioration, a hose should be removed and replaced with identical hoses.

Heat Pump Operation

When a heat pump is selected, the associated zone unit will be fitted with 0 –10V control evaporator fans. The fan speed will depend on the number of compressors and the required cooling or heating demand.

Number Of Compressors	Cooling Demand	Heating Demand	Fan Speed % / Volts	Compressor Output(s)	Reversing Valve Output
1	0%	-	Min	Off	-
1	100%	-	60% / 6 V	On	-
2	0%	-	Min	1 Off 2 Off	-
2	50%	-	50% / 5 V	1 On 2 Off	-
2	100%	-	60% / 6V	1 On 2 On	-
1	-	0%	Min	Off	De-Energised
1	-	100%	60% / 6V	On	Energised
2	-	0%	Min	1 Off 2 Off	De-Energised
2	-	50%	50% / 5V	1 On 2 Off	Energised
2	-	100%	60% / 6V	1 On 2 On	Energised

For 1 stage heat pump, i.e. 1 compressor output, the following shall apply: -

- If heating demand reaches 100% an electric heating software timer to be enabled
- If heating demand remains above 60% after 5 minutes has elapsed on timer then first stage of electric heating shall be switched on. This switches off at 50% demand
- If heating demand remains above 75% after 10 minutes has elapsed on timer then second stage of electric heating shall be switched on. This switches off at 60% demand

For 2 stage heat pump, i.e. 2 compressor outputs, the following shall apply: -

- If heating demand reaches 100% an electric heating software timer to be enabled
- If heating demand remains above 70% after 10 minutes has elapsed on timer then first stage of electric heating shall be switched on. This switches off at 60% demand
- If heating demand remains above 85% after 15 minutes has elapsed on time then second stage of electric heating shall be switched on. This switches off at 75% demand

Dehumidification Operation

The Dehumidification demand is calculated in a similar way to that of the initial cooling demand.

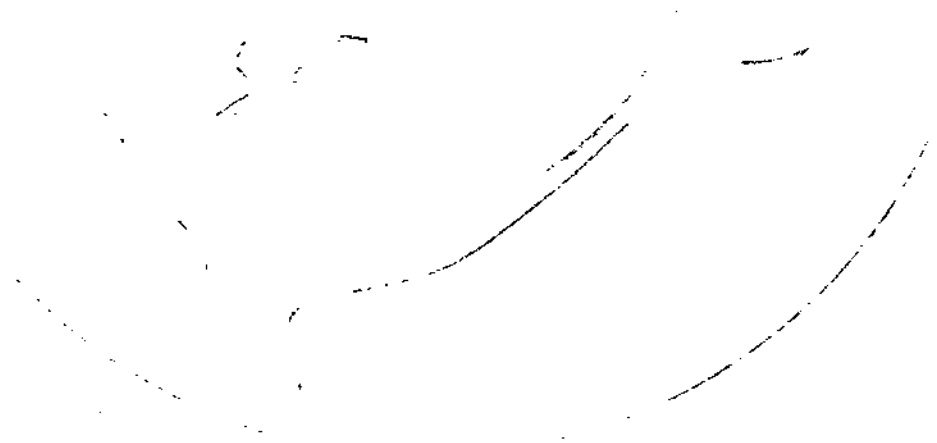
For Dehum with modulating cooling when the demand reaches 100% the controller will run the CW valve for a predetermined amount of time for the % CW Cooling assigned to Dehumidification (set in Software Level 3).

Dehum with DX cooling when the demand reaches 100% the total number of DX stages assigned to dehumidification will energise. Note if two stages are assigned to dehumidification then the stage delay will be applied to prevent both stages energising simultaneously.

The Dehum output can be disabled in several ways even though the Return Air %RH may indicate that dehumidification is required. The disable functions are as follows:

- Disable Dehum altogether - set in Software Level 3.
- Disable Dehum due to Return Air Temperature. When the Return Air Temperature falls to below "Control Air temperature setpoint - (1.5 x (Heating Prop Band + Heating Deadzone))", Dehum is disabled. Re-enabled when Return Air Temperature rises to "Control Air Temperature setpoint - Heating Deadzone".
- For CW systems only disable dehum when cooling demand exceeds a prescribed level - set in Software Level 3 (Dehum % off).
- For DX system if cooling demand is greater than or equal to the dehum demand then the dehum is disabled.

All these interlocks allow dry bulb control to have priority over humidity.



Ambicool Operation

Ambicool is the use of low ambient temperatures cooling a freecooling liquid (typically glycol / water solution) to effect heat extraction from an air conditioned space. Should the ambient temperature rise to a level at which no duty can be achieved by freecooling then DX stages will cool the room air in order to do the cooling duty.

To enable Freecooling two requirements have to be fulfilled. Firstly the Air Handling Unit has to be configured for Ambicool and secondly the freecooling liquid has to be at a certain temperature. The level of this temperature is determined as the "Return Air Temperature minus the Freecooling Liquid Temperature" is equal to or greater than the Freecooling Differential temperature.

Example:

- If Return Air Temperature is 22°C minus Freecooling Liquid Temperature, which is 8°C, equals 14°C and Freecooling Differential is set to 3°C then Freecooling is enabled.

- If Return Air Temperature is 22°C minus Freecooling Liquid Temperature, which is 20°C, equals 2°C and Freecooling Differential is set to 3°C then Freecooling is NOT enabled.

Integral action as described in "Cooling Operation" is also applicable to Ambicool operation.

The Ambicool valve position is determined by the cooling demand multiplied by four.

e.g. 15% cooling demand = 60% valve position
20% cooling demand = 80% valve position
25% cooling demand = 100% valve position

The DX stages of cooling are enabled depending on the number of cooling stages and the demand. The following table illustrates this.

Unit Type	Output	Energise Demand %	De-Energise Demand %
2 Circuit DX	1	62.5	62.5
2 Circuit DX	2	100	25
2 Circuit VRF DX	1	43.75	81.25
2 Circuit VRF DX	2	62.5	62.5
2 Circuit VRF DX	3	81.25	43.75
2 Circuit VRF DX	4	100	25

Supply Air Temperature Interlock with Cooling

The supply air temperature input has the facility for alarm indication and interlock with cooling. If the alarm indication status is enabled an alarm is operated when the supply air temperature falls below an alarm setpoint. A description of how the alarm operates is as follows:

Supply air temperature alarm setpoint = 15°C (adjustable in Software Level 3 Factory Settings)
Supply air temperature alarm time delay = 15 min (adjustable in Software Level 3 Factory Settings)

If the supply air temperature is equal to or less than the alarm setpoint minus 3°C for the alarm time delay the alarm will be activated (note: the 3°C is a fixed value). Thus if the supply air temperature is 12°C (i.e. 15 - 3) or less for alarm delay period the alarm will operate.

If the interlock is enabled then the cooling output is reduced by a reduction factor, where;

Reduction Factor = (Supply Air Alarm Setpoint - Supply Air Temperature) / 2

Supply Air Humidity Interlock with Humidification

The supply air humidity channel has the facility for alarm indication and interlock with humidification. The alarm indication status is actuated if the alarm status is enabled and if the supply air humidity has been greater than the alarm setpoint for the alarm delay period (adjustable in Software Level 3 Factory Settings).

If the interlock function is enabled then the humidifier output demand will start to decrease when the supply air humidity is Alarm Setpoint minus 10%. Should the supply air humidity reach the alarm setpoint then the humidifier output would be 0%.

Heater / Humidifier Interlocks

The software has the facility to select one of a series of interlocks, which affect the operation of electric heaters and the humidifier. In the majority of cases the electrical supply to an Air Handling Unit is sufficient to enable both the heating and the humidifier to run at the same time, should operating conditions require so. However, there are cases when only one function or the other can be run at any one time, thus the software can be set so that one function has priority over the other.

There are three options available, as follows:
(1) **Heat and Hum** - This option allows both functions to operate simultaneously.
(2) **Heat prevents Hum** - This option will give priority to the heating function. Should heating be called for the humidifier will be disabled even though there maybe demand for humidification.
(3) **Hum prevents Heat** - This option is the opposite of (2) where the heating is disabled when the humidifier is enabled by demand.

The options are selected in Software Level 3 Factory Settings, with option (1) normally set during the factory testing and inspection before shipment of the Air Handling Unit.

With option (2) or (3) selected, the interlock remains active even if the software output forcing routines are applied.

Servicing: Check List

Item	Frequency	Action	Notes
1	2 Monthly	Completely check control settings and operation.	Use Software Level 3 to test outputs.
2	2 Monthly	Check that all sensors are secure and sensing correctly.	-
3	2 Monthly	Check that all terminals are tight.	-

Due attention should be paid to the notes on servicing the microprocessor. Any servicing is to be carried out by a QUALIFIED CONTROLS ENGINEER.

Commissioning / Controller Set Up

Note: Paragraphs 6,7 & 8 are only applicable when changing a controller.

At initial commissioning or when changing a controller all operational parameters will be set to default. (See Software Levels for values.) These will have to be changed as appropriate to meet site requirements. Also, when changing a controller, the Factory Configuration of the controller will have to be set for the AHU it is being fitted to.

Note: please refer to "Handling Static Sensitive Devices" prior to servicing the controller and its associated interface cards.

1. Ensure that the Mains supply is isolated.

2. Identify the means of cooling, heating, hum and de-hum.

3. Switch all MCB's, except the single phase Controls power supply MCB, to the "OFF" position.

4. Ensure that the display ON / OFF switch is "OFF".

5. Switch on the mains supply. Check the "Power On" LED or liquid crystal display are illuminated. The liquid crystal display will show the Software Levels display.

6. Use the programming keys to select Software Level 3. Using the appropriate coded key presses enter Software Level 3 Factory Settings.

7. Using the Factory Settings table, set the values as appropriate to the Air Handling Unit, as identified in 2.

8. If any operating parameters are different to default values enter the appropriate Software Level and change as required. For explanation of time-out displays, input / output status and control types see the previous sections.

9. Switch unit "ON" and reset any alarms. Switch on fan(s) with the fan MCBs. Check the rotation of fan(s) and set airflow switch as required. Using the software H/O/A switches test the function of individual output stages. Remember to reset MCBs as they are used. On completion reset all H/O/A switches to "AUTO".

Controller Removal and Replacement

Note: please refer to "Handling Static Sensitive Devices" prior to servicing the controller and its associated interface cards.

It is recommended to read these instructions first before changing the controller.

The controller is replaced as follows:

(1) Switch off Air Handling Unit at the display ON/OFF switch. Enter Software Levels and note any parameters that are different to default settings, also check the Factory Settings. If for any reason access to the Software Levels cannot be made check the electrical drawing configuration tables, commissioning sheets or contact the contracts engineer.

(2) Switch off power supply.

(3) Remove all inputs and output connections by unplugging the terminals from controller.

(4) Disconnect the display cable from the controller board.

(5) Remove controller from DIN rail.

(6) Fit new controller as a reversal of the above procedure.

(7) Switch on mains supply. Set software Factory Settings as appropriate, see Software Level 3. Also set up any parameters as noted previously.

(8) Switch on Air Handling Unit using the display ON/OFF switch, and check operation of the unit.

Display Removal and Replacement

Note: please refer to "Handling Static Sensitive Devices" prior to servicing the controller and its associated interface cards.

It is recommended to read these instructions first before changing the display.

The display is replaced as follows:

(1) Switch off Air Handling Unit at the display ON/OFF switch.

(2) Switch off power supply, then remove display fascia.

(3) Remove the two screws connecting display to door panel.

(4) Disconnect the display cable from the display board.

(5) Fit new display as a reversal of the above procedure.

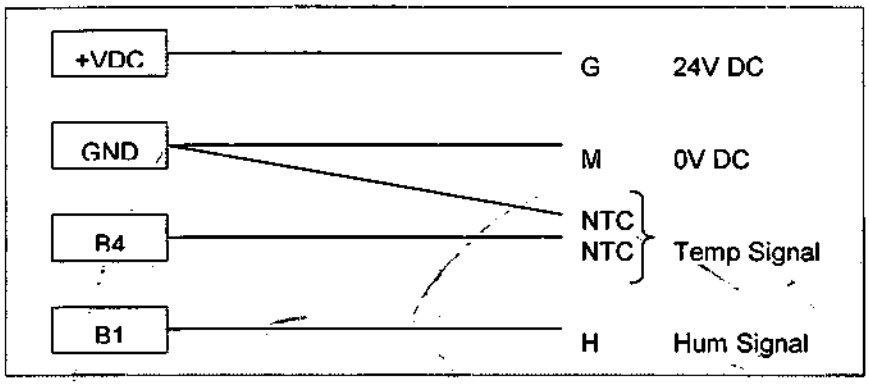
(6) Switch on mains supply.

(7) Switch on Air Handling Unit using the display ON/OFF switch, and check operation of the unit.

Combined Temperature and Humidity Sensor

The Combined Temperature and Humidity Sensor uses NTC resistive output signal for temperature indication. The humidity sensor is an active sensor using a 24V DC supply and produces a 0 - 1V DC signal proportional to the % relative humidity. The range of the sensor is 0 - 100 %RH, thus at 0 %RH it produces a signal of 0V and at 100 %RH a signal of 1V.

Sensor adjustment (monitored with a calibrated instrument) can be made in Software Level 3 Calibration.



Ambient Temperature and Humidity Range

Operating: 0°C to 50°C 10 - 90 %RH Non Condensing

Fault Finding: Controls

As it will be necessary for panels to be worked on "live" for fault finding **only QUALIFIED and COMPETENT STAFF** should be used on this section. Refer to "The Electricity at Work Regulations" for guidance.

Always fault find with relevant schematic wiring diagrams and panel layouts at hand. Always modify diagrams if any modifications are made (subject to confirmation with the Denco Technical Department).

Always replace relays, contactors or any other components with those of the same make, type and rating. Failure to do so may invalidate the warranty.

It is necessary to ensure that all isolators are in the "OFF" position before any covers are removed.

Fault Finding: Use of Sheets

In the following tables it is assumed that the mechanical and electrical services to which these refer have been commissioned correctly and run without significant faults for a reasonable period since the commissioning, i.e., the design settings were correct, and the plant is of the correct size for the application.

Any repeated faults in the initial warranty period should be relayed to the contractor and consultant.

Plant settings should not be altered as the balance of the complete system can be affected resulting in a costly re-balancing operation. Re-balancing should only be carried out by a COMPETENT ENGINEER.

Carrying out maintenance as described in the servicing sections can cut down significantly nuisance fault finding problems, however maintenance should be carried out by competent and trained staff - bad maintenance is often worse than no maintenance all.

The fault finding tables have been prepared in logical sequence, with the most likely faults first.

Ensure that the person(s) fault finding are competent in attending to all aspects of the equipment and that they know the location of all items of plant.

Fault Finding: Controls (P2)

Fault	Possible Cause	Remedy
(A) Control failure	1. No mains or failure of supply phase.	Check for fault on phase concerned after checking all isolators between mains and panel OK.
	2. Control circuit MCB tripped.	Reset and if it trips again check for fault. Could be loose wiring or coil fault to earth.
	3. 24V AC Power Supply Fuse ruptured.	Check for reason of ruptured fuse. When satisfied, replace fuse.
	4. Control circuit relay problem.	If other parts of circuit operating, work from this part in a logical sequence.
	5. External controls.	An external control could affect control circuit. Check in conjunction with schematic drawing.
(B) Relay [KA] or contactor [KM] not operating	1. No supply to coil	(a) Check 24V AC supply and stage supply fuses on controller. (b) Check control wiring to coil.
	2. Faulty coil.	Check and replace.
	3. Faulty/tripped overload.	Check whether tripped. If faulty replace.
(C) Airflow Alarm	1. Broken fan belt.	Change belts, where applicable.
	2. Fan Failure	Replace fan(s).
(D) Incorrect temperature or humidity indication	1. Defective connections on Sensor.	See appropriate Sensor servicing.
	2. Microprocessor is being corrupted	See Section (E).
	3. Sensor calibration incorrect.	Refer to Service section for sensor values. Use Sensor Trim in Software Level 3 to adjust value.
	4. Loose connections.	Check that the Sensor is securely located on the sensor holder and retaining screw is tight. Ensure good sensor connections on controller.
	5. Sensor positioned incorrectly.	If the Sensor is positioned outside the Air Handling Unit it should be aspirated and mounted in a position that is representative of the room conditions.
	6. Earth screen on sensor cable ineffective.	The sensor wiring must be screened and fully segregated from wiring carrying mains potential. The screen should be terminated to earth at one end only.
	8. Power supply to sensor failure.	Check supply connections from controller.

Fault Finding: Controls (P3)

Fault	Possible Cause	Remedy
(E) Corruption of Controller	Usually manifests itself as: (a) Inappropriate characters on the display. (b) False alarms on the display. (c) Software configured parameters revert to default parameters.	Causes: 1. Ineffective segregation of signal and mains potential wiring. Pay particular attention to field wiring, any site modifications within the Air Handling Unit or Condensing Units etc. and any remote interlocks. 2. Humidifier bottle is very dirty and arcing is occurring within the bottle, change bottle immediately. 3. Sensor cable ineffectively screened, refer to relevant temperature and humidity sensors in service section.
(F) Unit fails to start when switched on via ON /OFF switch.	1. One or more of the run days (Software Level 1) set to OFF 2. 24 hour time clock set (Software Level 1) 3. Switched off remotely/manually, by monitoring system or fire alarm activated	Firstly check that this is not a required feature before re-setting all run days to ON. Firstly check that this is not a required feature before re-setting time clock. Set both on and off times to 00:00 hours to prevent time clock from functioning. Enable remote signal. NOTE: Never link out fire alarm interlock without written consent.
(G) Display blank	1. Extreme temperatures around unit. 2. Display cable disconnected.	No direct remedy. Reconnect cable.

Fault Finding: Controls (P4)

Fault	Possible Cause	Remedy
(H) Dehum not functioning with a demand for dehumidification	1. Dehum function disabled in Software Level 3.	Ensure that this is not a design feature before enabling.
	2. Dehum interlock with return air temperature disabled in Software Level 3. (Dehum is disabled if return air temperature falls below a predetermined value).	Ensure that this is not a design feature before disabling interlock in Software Level 3.
	3. Cooling demand greater than dehum demand.	Ensure that this is not a design feature before disabling interlock in Software Level 3.
(I) Cooling not functioning with a cooling demand	1. Supply air temperature interlock enabled. When the supply air temperature interlock is enabled cooling is disabled or reduced if the supply air temperature falls below a predetermined value.	Ensure that this is not a design feature before disabling supply air temperature interlock in Software Level 3 Factory Settings.
(J) Cooling DX stages not energising	1. HP or LP alarm / trip.	Check for cause. Reset as required.
(K) Logged averages of temperature and humidity display 0° C and 0 %RH respectively. No recorded samples on any of the logging channels.	1. Alteration of sample frequency.	Always register all required samples before setting/re-setting sample frequency.
(L) Heating outputs not energised with a demand for heating	1. Heater Klixon activated.	Investigate why Klixon has operated. Reset via display keys. The Klixon is an auto-reset device.
	2. Fan Failure Alarm	Investigate why fan(s) have failed. Reset via display keys.
	3. Hum prevents Heat Interlock.	Ensure that this is not a design feature before disabling interlock in Software Level 3 Factory Settings.
(M) Outputs remain constantly energised or de-energised	1. Software Hand/Off/Auto switches not set to AUTO.	Ascertain reason why output is in HAND or OFF before setting to AUTO control.

Fault Finding: Controls (P5)

Fault	Possible Cause	Remedy
(N) Humidifier output not functioning with a demand for humidification	1. Humidifier alarm. 2. Water alarm. 3. Fan Failure Alarm.	Check alarm and cause of alarm. Investigate why water alarm has been activated. Reset via front panel keys. Investigate why fan(s) failed. Reset via display keys.
(O) Auxiliary alarms: displaying irregular alarm messages when activated	1. Alarm text message altered or set to customers requirements in Software Level 3.	Set alarm text message as required.
(P) Auxiliary alarm(s) fail to activate critical alarm relay	1. Mode of operation set to activate alarm relay in Software Level 3.	Ensure that this is not a customer requirement before setting to operate the critical alarm relay.
(Q) 0 - 10V DC modulating output not operating correctly(CW cooling / LPHW heating /remote humidifier)	1. 24V AC supply to valve lost. 2. Valve running time incorrect. 3. Incorrectly set for cool / heat / hum output in Software Level 3 Factory Settings	Check / replace cabling to valve. Check VRT and adjust if required. Set for correct output.
(R) Drive Open / Drive Close modulating cooling not operating correctly	1. Digital cooling set in Software Level 3 Factory Settings. 2. 24V AC supply to valve lost. 3. Digital outputs damaged (Cool 1/2)	Set to DODC cooling Check / replace cabling to valve. Check outputs for 24V AC when operated.
(S) Drive Open / Drive Close modulating heating not operating correctly	1. Digital heating set in Software Level 3 Factory Settings. 2. 24V AC supply to valve lost.	Set to DODC heating Check / replace cabling to valve.