

Radford Control Systems
SGM22_08_DAC
Compressor / Condenser
Controller Set-up Guide

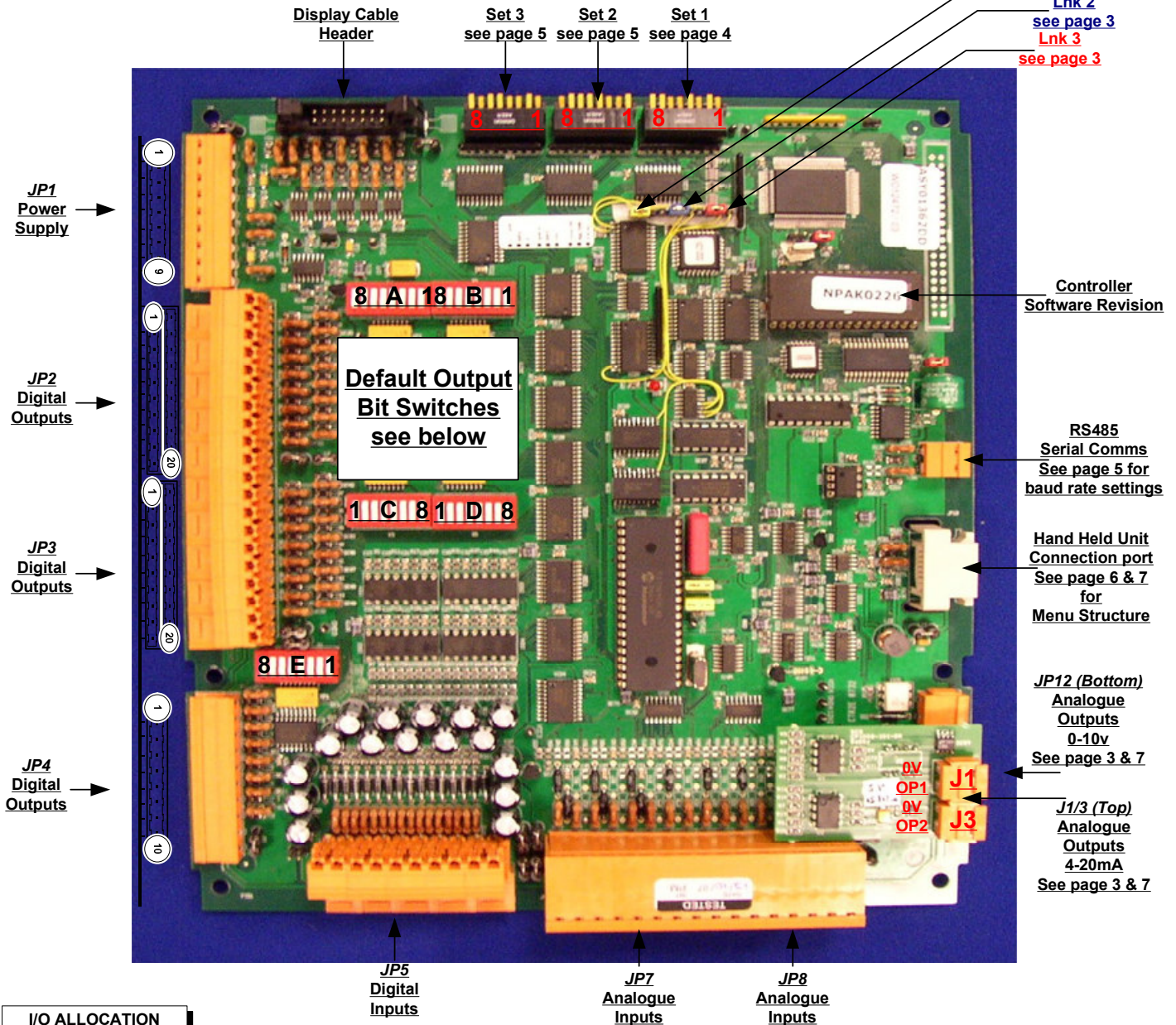
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SPLIT LT / IT PAK CONTROLLER SET UP GUIDE. NPAK0228

BOARD LAYOUT

Configuration Switches

Configuration Links



I/O ALLOCATION

DIGITAL OUTPUTS (Output No / Bit Switch No / Pin)

1	C1 Start	1	1	9	C3 Start	1	1	17	C5 Start	1	1	25	Heat Reclaim SV	1	1	33	C7 Start	1	1
2	C1 Unload Stage 2	2	2	10	C3 Unload Stage 2	2	2	18	C5 Unload Stage 2	2	2	26	Fan Start 1	2	2	34	C7 Unload Stage 2	2	2
3	C1 Unload Stage 3	3	3	11	C3 Unload Stage 3	3	3	19	C5 Unload Stage 3	3	3	27	Fan Start 2	3	3	35	C7 Unload Stage 3	3	3
4	C2 Start	4	4	12	C4 Start	4	4	20	C6 Start	4	4	28	Fan Start 3	4	4	36	C8 Start	4	4
5	C2 Unload Stage 2	5	5	13	C4 Unload Stage 2	5	5	21	C6 Unload Stage 2	5	5	29	Fan Start 4	5	5	37	C8 Unload Stage 2	5	5
6	C2 Unload Stage 3	6	6	14	C4 Unload Stage 3	6	6	22	C6 Unload Stage 3	6	6	30	Fan Start 5	6	6	38	C8 Unload Stage 3	6	6
7	LT Sub Cooler SV	7	7	15	Inlet Regulator SV	7	7	23	IT Sub Cooler SV	7	7	31	Fan Start 6	7	7	39	/ S/R Dampers (Bit 6, set3)	7	7
8	LT Gas Dump SV	8	8	16	Split SV	8	8	24	IT Gas Dump	8	8	32	OD1 Relay	8	8	40	Liquid Injection	8	8

Default Bit Switch Set A

JP2 (bottom)

Default Bit Switch Set B

JP2 (top)

Default Bit Switch Set C

JP3 (bottom)

Default Bit Switch Set D

JP3 (top)

Default Bit Switch Set E

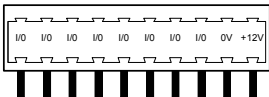
JP4

Vin / TEMP INPUTS

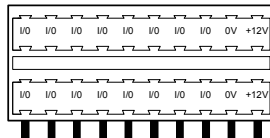
1	Condenser Air On Temp	1 / 2	JP7
2	Condenser Air Off Temp	3 / 4	JP7
3	IT Suction Temp	5 / 6	JP7
4	Combined Discharge Temp	7 / 8	JP7
5	Water In Temp	1 / 2	JP7
6	Water Out Temp	3 / 4	JP7
7	LT Suction Temp	5 / 6	JP7
8	(Unused)	7 / 8	JP7
9	IT Suction Pressure	9 / 10	JP7
10	Discharge Pressure	11 / 12	JP7
11	LT Suction Pressure	13 / 14	JP7

I/O CONNECTORS

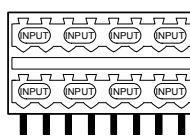
SINGLE (JP4)



DOUBLE (JP2 / JP3 / JP5)



ANALOGUE (JP7 / JP8)



DIGITAL INPUTS (Input No / Pin)

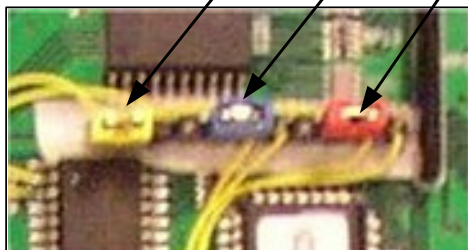
1	Fan Fault	1	9	C1 Compressor Fault	11
2	Low Speed Fans	2	10	C2 Compressor Fault	12
3	Low Level Refrigerant	3	11	C3 Compressor Fault	13
4	BMS	4	12	C4 Compressor Fault	14
5	LT Satellite Running	5	13	C5 Compressor Fault	15
6	LT Satellite Fault	6	14	C6 Compressor Fault	16
7	IT SatelliteRunning	7	15	C7 Compressor Fault	17
8	IT SatelliteFault	8	16	C8 Compressor Fault	18

JP5 (bottom)

JP5 (top)

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Configuration Links Detail



Pak Type	A-O2 Function	A-O1 Function
		
Link Positions shown configure:-		
Output 1 LT C1 VSD		JP12 3-4 (0-10V) J1 1-2(4-20mA)
Output 2 IT C1 VSD		JP12 1-2 (0-10V) J3 1-2(4-20mA)
Pak Type	A-O2 Function	A-O1 Function
		
Link Positions shown configure:-		
Output 1 LT C1 VSD		JP12 3-4 (0-10V) J1 1-2(4-20mA)
Output 2 Condenser Fans VSD / EC		JP12 1-2 (0-10V) J3 1-2(4-20mA)
Pak Type	A-O2 Function	A-O1 Function
		
Link Positions shown configure:-		
Output 1 IT C1 VSD		JP12 3-4 (0-10V) J1 1-2(4-20mA)
Output 2 Condenser Fans VSD / EC		JP12 1-2 (0-10V) J3 1-2(4-20mA)
Pak Type	A-O2 Function	A-O1 Function
		
Link Positions shown configure:-		
Output 1 Fresh Air Dampers		JP12 3-4 (0-10V) J1 1-2(4-20mA)
Output 2 Condenser Fans VSD / EC		JP12 1-2 (0-10V) J3 1-2(4-20mA)
Pak Type	A-O2 Function	A-O1 Function
		
Link Positions shown configure:-		
Output 1 Fresh Air Dampers		JP12 3-4 (0-10V) J1 1-2(4-20mA)
Output 2 IT C1 VSD		JP12 1-2 (0-10V) J3 1-2(4-20mA)
IMPORTANT		
Any configuration of link positions other than those shown above should NOT be set and may lead to electronic failure!		

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CONTROLLER CONFIGURATION BIT SWITCHES

Configuration set 1
(Nearest Software Chip)

NUMBER OF COMPRESSORS										
LT	HT	0	1	2	3	4	5	6	7	8
0	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	
1	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	
2	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678		
3	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678		
4	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678		
5	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678		
6	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678		
7	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678		
8	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678 12345678 12345678	12345678		

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CONTROLLER CONFIGURATION BIT SWITCHES Page 2

Configuration set 2 (Middle)

Condenser Fans =2	Single Speed (2 Stages)	
	Dual Speed (4 Stages)	

= OFF

= ON

Condenser Fans =3	Single Speed (3 Stages)	
	Dual Speed (6 Stages)	

Condenser Fans =4	(4 Stages)	
----------------------	------------	--

Condenser Fans =5	(5 Stages)	
----------------------	------------	--

Condenser Fans =6	(6 Stages)	
----------------------	------------	--

Condenser Fans =8	(4 Stages)	
----------------------	------------	--

Condenser Fans =10	(5 Stages)	
-----------------------	------------	--

Condenser Fans =12	(6 Stages)	
-----------------------	------------	--

Fan Fault Input	Fault Low (Open)	
	Fault Hi (Closed)	

Comps Fault Input	Fault Low (Open)	
	Fault Hi (Closed)	

Minimum No. Comps To Run	0 No Dump	
	1 Dump Enabled	

RS485 Baud Rate	600	
	9600	

Configuration set 3 (Nearest Display Header)

Refrigerant	R22	
	R404A	

= OFF

= ON

Pressure Units For Display	PSI	
	Bar	

Mixed Capacity Enabled	On	
	Off	

Pressure Transmitter type in use	Voltage 0-6v	
	Current 4-20mA	

Discharge Pressure Control	Floating SP	
	Fixed SP EC Fans	

Damper Control Enabled	Disabled A-O1	
	Enabled A-O1	

VSD Comps Enabled	Disabled A-O1	
	Enabled A-O1	

Discharge Pressure Override	Disabled	
	Enabled	

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HHU EDITING EXAMPLES

LOADING DEFAULT PARAMETERS

```
→ Menu Select  O/View
Unit Number    1.0
Software NPAK   2.04
Any Alarms?     NO
```

The Load Defaults item is on the Startup list. This list can be accessed from any of the menus.
To reach the currently selected menu from the Power Up list (or from any other list) press 'ESC'.

The Power Up List

```
→IT View      Alarms
LT View
Pak View
Startup
```

Use the arrow keys to move the arrow to 'Startup' and press 'ENT'.
(This example shows the O/View menu, but 'Startup' will appear somewhere whichever menu is selected).

The O/View Menu

```
→ Load Defaults  DONE
Unit Number      301.0
Pak Type         REFRIG
MaxFanStages     4
```

The Load Defaults item is at the top of the list.(Don't be fooled by it saying 'DONE' next to this item...it isn't done yet).
Press 'ENT' to enter this item.

The Startup List

```
Edit: Load Defaults
                     DONE
```

It says done... but it still isn't.
Press the down arrow key until this item says 'BEGIN'.

The Load Defaults Item

```
Edit: Load Defaults
                     BEGIN
```

With the item set to 'BEGIN' press 'ENT' to cause default parameters to be loaded.
(Pressing 'ESC' twice at this point would return you to the Startup list without loading default parameters).

The Load Defaults Item

```
→ Load Defaults  DONE
Unit Number      0.0
Pak Type         REFRIG
MaxFanStages     4
```

The Startup list reappears, and all parameters have been set to their default values.
(Note that since Unit Number is a parameter it has returned to its default value of 0.0: Unit Number must always be set up again after loading defaults).

The Startup List

SETTING UP MAXIMUM COMPRESSOR STAGES

```
→ Menu Select  O/View
Unit Number    1.0
Software NPAK   2.04
Any Alarms?     NO
```

The desired items (C1 Max Stages etc) are on the Pak Setup list which is accessed via the Pak menu.

With the arrow pointing at the Menu Select item on the Power Up list, press 'ENT'.

The Power Up List

```
Edit: Menu Select
                     O/View
```

The O/View Menu is selected. Press the up or down arrows until this says 'Pak'.
Once 'Pak' is showing, press 'ENT' to select it followed by 'ESC' to actually go to the menu.

Changing the Selected Menu

```
→PakSetup      E Alarms
SatComps       Startup
IO 1 Lst       Alarms
IO 2 Lst
```

From this menu there are seven possible lists that can be accessed.

Press 'ENT' with the arrow pointing at 'PakSetup'. This takes you to the Pak Setup List.

The Pak Menu

```
→ CondImpOffset 5.0
Fan On Range    3.40
Fan Off Range    2.04
LastFanOnMax    17.69
```

The Pak Setup List appears with the arrow pointing at the first item.

Pressing the down arrow key scrolls the arrow down the list.

The Pak Setup List

```
HighDPWarning 220.0
→ C1 Stages    3
C2 Stages      3
C3 Stages      3
```

Once the required item is reached, press 'ENT' to edit it.

(For a brief description of the item you are pointing at press the 'F1 HELP' key).

Pak Setup List (after scrolling)

```
Edit: C1 Stages
Max Value: 3
Min Value: 0
```

You can now change the value for this parameter using the numeric keys, or the up and down arrow keys.

If you make a mistake, press 'ESC' and the item returns to its original value. Once you are happy with your changes press 'ENT' to confirm them.

Editing the C1 Stages Parameter

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Explanation of new control strategies & recommended commissioning parameters

Discharge Pressure Control	Floating SP	1 2 3 4 5 6 7 8
	Fixed SP	1 2 3 4 5 6 7 8
	EC Fans	1 2 3 4 5 6 7 8

When selected the following HHU parameters are significant:-

STARTUP MENU - **ECFanOvrOfst** = If the discharge pressure is below this setpoint (default value 290.0psi) the analogue output 2 (JP12 1-2 0-10V or J3 1-2 4-20mA) will vary linearly between 0 and 70% of the full scale. When the discharge pressure rises above the **ECFanOvrOfst** the scale of analogue output 2 operates linearly between 0 and 100%.

STARTUP MENU - **ECFanOvrDdnd** = This is the deadband (default value 10.0psi) that determines at which pressure the analogue output returns to 0-70% of full scale. Therefore using the default values mentioned in text above, the output will operate at 0-70% until the discharge pressure exceeds 290.0psi at which point the output will operate between 0-100% and remain so until the discharge pressure fall below the **ECFanOvrOfst** (290.0) minus the **ECFanOvrDdnd** (10.0) i.e. 280.0psi.

Discharge Pressure Override	Disabled	1 2 3 4 5 6 7 8
	Enabled	1 2 3 4 5 6 7 8

When selected the following HHU parameters are significant:-

STARTUP MENU - **DP Override** = Indicates the state of the discharge pressure override output (Formally the slow fans output - see I/O allocation table on page 2)

PAKSETUP MENU - **HighDPWarning** = This is the Setpoint at which the DP Override output will be switched on. Once this pressure has been exceeded the override output will remain on until the discharge pressure falls below the last fan on pressure.

This output is intended to remove the necessity for refrigeration contractors to fit additional pressure safety switches for the control of condenser backup systems.

Damper Control Enabled	Disabled A-O1	1 2 3 4 5 6 7 8
	Enabled A-O1	1 2 3 4 5 6 7 8

When selected the following HHU parameters are significant:-

F3 - **AOffSpt** = The condenser air off temperature setpoint that the controller is attempting to maintain via damper actuation and fan control. (Default value 30DegC)

F3 - **AOffCtlBnd** = The deadband associated with the condenser air off setpoint over which the controller allows the air off temperature to rise before fresh air dampers are modulated. (Default value 2DegC). Therefore using the default parameter values mentioned above the condenser air off temperature will be maintained by the controller within the band of 30DegC to 32DegC.

F3 - **SplyRrcrcOfst** = The offset from the lower limit of the condenser air off setpoint at which fresh air dampers are closed fully and the recirc damper is opened. The motorised supply dampers are closed in this state. (Default value is 4DegC).

VSD Comps Enabled	Disabled A-O1	1 2 3 4 5 6 7 8
	Enabled A-O1	1 2 3 4 5 6 7 8

When selected the following HHU parameters are significant:-

(LT and IT VSD parameters are located within the LT and IT setup menus). Examples used below are for IT

IT SETUP - **IT VSD Spt** = The target suction pressure setpoint that the controller maintains by modulating the analogue output to the variable speed drive on the first compressor. (Default is 45.0psi)

IT SETUP - **IT VSD CtlBd** = The deadband associated with the VSD SETPOINT. (default is 4.0psi) The deadband is positioned equally either side of the VSD setpoint. Therefore using the default values identified above the suction pressure will be maintained within a band of 47.0psi to 43.0psi.

Recommended commissioning values:-

	R134A	R404A	R22
IT VSD Setpoint	16.0psi	48.5psi	36.0psi
IT VSD Deadband	4.0psi	4.0psi	4.0psi
LT VSD Setpoint	-----	8.0psi	5.5psi
LT VSD Deadband	-----	4.0psi	4.0psi
Lt / IT Restart periods	04:00		
IT Deadband Upperlim	18.5	51.0	38.5
IT SP Deadband Width	5.0	5.0	5.0
LT Deadband Upperlim	-----	10.5	8.0
LT SP Deadband Width	-----	5.0	5.0

Floating Head Pressure Fan Control in the Split LT/IT Pak Controller

INTRODUCTION

Fixed Head Pressure Control

Previous versions of the Split LT/IT Pak Controller attempted to maintain a fixed discharge pressure. The First Stage On Setpoint parameter specified the discharge pressure at which the first fan stage was brought on whilst the Fan On Range and Fan Off Differential parameters specified how 'tight' or 'loose' the control was. A high Fan On Range, for example, allowed the discharge pressure to rise further above the First Stage On Setpoint before bringing on more fan stages.

This control strategy worked well but there was a problem on very hot days. Fans were being brought on to cool the condenser and hence lower the discharge pressure but - once the condenser had been cooled to the temperature of the outside air - blowing more air onto it was achieving no further effect. In other words the controller was wasting electricity trying to maintain a discharge pressure which, given the temperature outside, could not possibly be maintained. There was also a missed opportunity on very cold days when the controller could easily have maintained a lower discharge pressure.

Floating Head Pressure Control

Floating Head Pressure control addresses this problem and exploits this opportunity by allowing the controller to adjust it's first stage on pressure according to the outside temperature instead of having it set up as a parameter.

Instead of trying to maintain a particular fixed discharge pressure the controller now attempts to maintain a discharge pressure that corresponds to a condenser temperature which is a small fixed offset above the current outside air temperature. This means that the controller is always trying to maintain a reasonably low discharge pressure, but one that is still achievable given the outside air temperature.

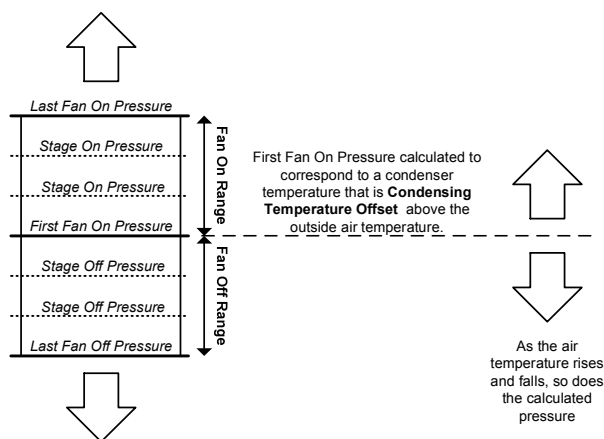
The calculated pressure to maintain is called the First Stage On Pressure. It can be seen - but not adjusted - on the hand held unit.

Control During BMS Heat Reclaim

On sites where there is a BMS heat reclaim system the controller still needs to maintain a higher discharge pressure when heat reclaim is active. On these sites the controller uses floating head pressure control when heat reclaim is inactive, but switches to a higher fixed discharge pressure to maintain whenever heat reclaim is active.

ILLUSTRATION (Parameters Shown In Bold)

Last Fan On Maximum



Last Fan Off Minimum

The entire fan control band 'floats' so that the first fan stage is always brought on when the discharge pressure indicates that the condenser temperature is now more than the **Condensing Temperature Offset** above the outside air temperature.

The control band is not, however, allowed outside of the limits set by **Last Fan On Maximum** and **Last Fan Off Minimum**.

PARAMETERS

CONDENSING TEMPERATURE OFFSET (degrees)

Range: 0 to 20 degrees
Default: 5 degrees

The temperature above outside air temperature that the controller attempts to maintain in the condenser. It is added to the air on temperature to give the absolute temperature that the controller will attempt to maintain, and the controller then calculates a discharge pressure corresponding to this temperature which it uses as First Fan On Pressure.

FAN ON RANGE (PSIG)

Range: 10 to 100 PSIG (subject to parameter limiting)
Default: 50 PSIG

The pressure range over which the available fan stages will be brought on once the discharge pressure has exceeded First Fan On Pressure.

FAN OFF RANGE (PSIG)

Range: 10 to 70 PSIG (subject to parameter limiting)
Default: 30 PSIG

The pressure range over which the available fan stages will be turned off once the pressure falls below First Fan On Pressure.

LAST FAN ON MAX (PSIG)

Range: 150 to 300 PSIG (subject to parameter limiting)
Default: 260 PSIG

Limit which Last Fan On Pressure must not exceed. If the calculated First Fan On Pressure becomes so high that Last Fan On Pressure reaches this limit it will not be allowed to rise any further, even if the outside air temperature rises.

LAST FAN OFF MIN (PSIG)

Range: 100 to 200 PSIG (subject to parameter limiting)
Default: 140 PSIG

Limit which Last Fan Off Pressure must not fall below. If the calculated First Fan On Pressure becomes so low that Last Fan Off Pressure reaches this limit it will not be allowed to fall any further, even if the outside air temperature falls.

FIRST FAN ON HEAT (PSIG)

Range: 210 to 240 PSIG
Default: 230 PSIG

The fixed discharge pressure which the controller attempts to maintain on BMS sites when heat reclaim is active.

PARAMETER LIMITING

The controller allows a wide range of settings for the floating head pressure parameters. Because of this flexibility it must make sure that the floating head pressure parameter settings "make sense" and disallow settings which do not. Specifically, the controller can only accept parameter settings which meet the following condition:

Fan On Range plus Fan Off Range

must be no greater than

Last Fan On Maximum minus Last Fan Off Minimum

In other words, the control band (Fan On Range + Fan Off Range) must not be so wide that it cannot fit inside the limits placed on its movement by Last Fan On Maximum and Last Fan off Minimum. To make set up easy set Last Fan On Maximum to its maximum and Last Fan off Minimum to its minimum. Set the fan ranges and then the Last Fan On Maximum and Minimum to limit the float range.

WHENEVER YOU CHANGE A PARAMETER THAT IS SUBJECT TO PARAMETER LIMITING, EXIT AND RE-ENTER THE HHU LIST IT IS ON BEFORE CHANGING ANOTHER ONE.

To reduce the float to zero, deduce the desired Last Fan On Maximum, Minimum and the First Fan On Pressure. Set the Fan On Range to Last Fan On Maximum Minus First Fan On Pressure. Set the Fan Off Range to First Fan On Pressure minus Last Fan On Minimum.

Condenser Analogue Output Operation

Analogue Output

