

COMPRESSOR PAKS TYPE XL AND MINI-PAKS (No Damper Control)
SOFTWARE VERSION 4.XX, 6.XX

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COMPRESSOR PAKS - TYPE XL AND MINI PAK (No Damper Control)
SOFTWARE VERSION 4.XX 6.XX

1 INTRODUCTION

Compressor controllers are linked to the front end. The following maximum configuration can be controlled by a compressor controller:

- (1) Four compressors (two 3-stage, and two 2-stage).
- (2) One air-cooled condenser with up to four fans.
- (3) One liquid injection valve.
- (4) One gas dump valve.

The controller needs a data input for the required configuration to be selected. This is achieved by setting the appropriate bit switches on the CPU board and using the hand held unit to force load the corresponding parameters into the controller.

Drawing SK330 is a schematic representation of the system. SK331 gives a schematic representation of the input/output system.

The capacity of the system can be adjusted in small stages by increasing or decreasing the number of cylinders in operation. The cylinders are each controlled by a valve. When the valve is energised it unloads the cylinder and reduces the capacity.

2 FUNCTIONAL DESCRIPTION

2.1 REFRIGERATION ROUTE

2.1.1 Normal

The compressor discharge is generally taken via check valves and an oil separator to the condenser from where the condensed liquid refrigerant is returned to the common receiver.

The liquid from the receiver is taken to each of the individual cabinets in parallel. Each cabinet controls its own demand for refrigerant by its own internal valves.

The return suction lines from the cabinets are taken to a suction header from where the refrigerant is returned to the low pressure side of the compressors.

2.1.2 Bypass

There are two other major routes for the refrigerant:

- (1) It is occasionally necessary to cool the compressor down. This is achieved by injecting liquid refrigerant into the suction header using the liquid injection valve.
- (2) It is also occasionally necessary to dump saturated vapour from the top of the liquid receiver into the suction header during the period when there is only one compressor stage running on the entire pak. This is done using the Gas Dump Valve, and prevents all compressors stopping on light load conditions, such as when hot gas defrosting is required.

3 OPERATIONAL DESCRIPTION

3.1 PRESSURE AND TEMPERATURE

3.1.1 Suction Pressure

NOTE: NOT UNDER DOCUMENTATION CONTROL

As cabinet and cold store temperatures fall, the pak suction pressure reduces, and conversely as the temperatures rise so does the suction pressure.

This relationship is used to control the flow of refrigerant to the various units by increasing the compressor capacity when the pressure rises and reducing the capacity as the pressure falls.

If the suction pressure exceeds a preset level an alarm is generated (see para 4.1, Table 2).

3.1.2 Discharge pressure

The monitoring of discharge pressure provides control for the fans supplying the air flow through the condenser.

3.2 PAK CONTROL AND MONITORING

3.2.1 Control Objectives

The main objective is to maintain a constant suction pressure into the pak.

Secondary objectives are to:

- (1) Balance the load between compressor stages.
- (2) Balance compressor run times.

3.2.2 Control Constraints

The following constraints apply:

- (1) Compressors are not to be short-cycled.
- (2) Discharge pressure must not be excessive.
- (3) Individual compressors must not be overloaded (ie: draw excessive current).

3.2.3 Control Parameters

Capacity Increase/Decrease Demand

The controller continuously monitors the suction pressure transducer reading and, using set parameters, decides whether more or less capacity than that currently on-line is required.

The state of this process is displayed using two LED's on the main display panel (see drawing SK332). The parameters used are (F50) to (F56), and their functions are explained in drawing SK333. High discharge pressure will force a decrease in demand.

Short Cycling Inhibit

A fixed timer is included in the compressor control software which does not allow starts within seven minutes of each other; this condition overrides demand increases.

The current value of each timer can be displayed on the (F18, 28, 38 and 48 for compressors 1, 2, 3 and 4 respectively).

Condenser Fan Control (Version 4.01 software)

Parameters (F60) to (F67) are used for fan control. Each fan is switched on when the appropriate discharge pressure is reached and switched off again when the pressure falls below further set values.

If the discharge pressure reading exceeds the value set by (F76) on the hand held unit, an immediate decrease will be demanded. This overrides all other considerations.

Hold Off

NOTE: NOT UNDER DOCUMENTATION CONTROL

When the suction pressure increases, the pak capacity is also increased.

If it exceeds the set Hold Off pressure (hand held functions (F77) and (F78) for stages 3 and 2 respectively), the capacity of any running compressor(s) may be reduced.

As much of the lost capacity as possible is shared amongst partly-loaded or stationary compressors, starting with the most available.

This prevents compressors from being over-loaded. Any excess capacity which cannot be absorbed by running compressors is ignored.

Load sharing

There is a fixed load sharing timer (F59) which is started under steady state conditions.

When the load share timer reaches zero, if the conditions have not changed, the capacity load is shared efficiently between compressors.

The load share timer is initially set to 30 seconds.

3.2.4 Monitoring

Temperature Monitoring

Six temperature probes are fitted which measure:

- (F00) Air onto condenser
- (F01) Air off of condenser
- (F02) Superheated suction temperature
- (F03) Superheated discharge temperature
- (F04) Water in temperature
- (F05) Water out temperature

Pressure Monitoring

Two pressure transducers are fitted which measure:

- (F08) Suction pressure
- (F09) Discharge pressure

Alarm Monitoring

Two categories of alarms are given:

- (a) System alarms (see Table 2)
- (b) Processor alarms

Processor alarms are generated if any of the following faults are detected:

- (1) Internal power supply fault
- (2) Processor not running correctly
- (3) Program checksum error
- (4) Data memory non-operational

NOTE: NOT UNDER DOCUMENTATION CONTROL

If alarms (1), (2) or (3) occur, the processor will attempt to continue running, unless the fault is so severe as to stop the processor.

The front display panel will then show "HELP" instead of "Suction Pressure" and send an alarm to the front end.

If a fault causes the processor to stop running, the compressor is put directly into a known working state which is set by bit switches on boards O/P 1 and O/P 2 in the compressor controller (See Table 1).

The switch functions are detailed in Table 1, below.

TABLE 1 DEFAULT SWITCH FUNCTIONS

OUTPUT 2				OUTPUT 1			
8	Low level & High suction			8	Liquid injection solenoid		
7	Shop panel alarm			7	Gas dump solenoid		
6	Start fan 1			6	-		
5	Start fan 2			5	-		
4	No air flow indicator			4	Start fan 3		
3	Low refrigerant indicator			3	Start fan 4		
2	Stage 2	unload	compressor 1,(energised)	2	Start compressor 1		
1	Stage 3	unload	compressor 1,(energised)	1	Equalise compressor 1		
8	Start compressor 2			8	Stage 2 indicator compressor 1		
7	Equalise compressor 2			7	Stage 3 indicator compressor 1		
6	Stage 2 indicator compressor 2			6	Stage 2 unload compressor 2, (energised)		
5	Stage 3 indicator compressor 2			5	Stage 3 unload compressor 2, (energised)		
4	Stage 2	unload	compressor 3,(energised)	4	Start compressor 3		
3	Stage 2 indicator compressor 3			3	Equalise compressor 3		
2	Stage 2	unload	compressor 4,(energised)	2	Start compressor 4		
1	Stage 2 indicator compressor 4			1	Equalise compressor 4		

3.3 CONTROL AND OPERATING DATA

The data in the following paragraph refers to the function numbers as displayed on the hand held unit.

3.3.1 Hand held function list (Version 4.XX 6.XX software)

Compressor pak HHU functions (CP 4.XX CP 6.XX)				Defaults			
HHU	Description	Type	Limits/Units	2x3 LT	4x2 LT	2x3 IT	4x2 IT
00	Air on temperature		deg C				
01	Air off temperature		deg C				
02	Superheated suction temp		deg C				
03	Superheated discharge temp		deg C				
04	Water in temp		deg C				
05	Water out temp		deg C				
06	Rate of change of suction pressure		psi/min				
07	-						
08	Suction pressure	D	psi				

NOTE: NOT UNDER DOCUMENTATION CONTROL

09	Discharge pressure	D	psi				
10	Max number of stages comp 1	S	0 to 3	3	2	3	2
11	Total running time comp 1	D	hours				
12	Number of stages on line comp 1	D					
13	Oil pressure comp 1	D	psi				
14	-						
15	-						
16	-						
17	Fault status comp 1	A	0= OK, = alarm				
D = DISPLAY S = SETTABLE A = ALARM							
Compressor pak HHU functions (CP 4.XX CP 6.XX)				Defaults			
HHU	Description	Type	Limits/Units	2x3 LT	4x2 LT	2x3 IT	4x2 IT
18	Time before starting comp 1	D	0 to 7 minutes				
19	-						
20	Max number of stages comp 2	S	0 to 3	3	2	3	2
21	Total running time comp 2	D	hours				
22	Number of stages on line comp 2	D					
23	Oil pressure comp 2	D	psi				
24	-						
25	-						
26	-						
27	Fault status comp 2	A	0= OK, = alarm				
28	Time before starting comp 2	D	0 to 7 minutes				
29	-						
30	Max number of stages comp 3	S	0 to 3	3	2	3	2
31	Total running time comp 3	D	hours				
32	Number of stages on line comp 3	D					
33	Oil pressure comp 3	D	psi				
34	-						
35	-						
36	-						
37	Fault status comp 3	A	0= OK, = alarm				
38	Time before starting comp 3	D	0 to 7 minutes				
39	-						
40	Max number of stages comp 4	S	0 to 3	3	2	3	2
41	Total running time comp 4	D	hours				
42	Number of stages on line comp 4	D					
43	Oil pressure comp 4	D	psi				
44	-						
45	-						
46	-						
47	Fault status comp 4	A	0= OK, = alarm				
48	Time before starting comp 4	D	0 to 7 minutes				
49	-						
50	Dead band upper limit	S	5 to 45 psi	8	8	40	40
51	Dead band	S	1 to 10 psi	2	2	5	5
52	Conditional increase differential	S	0 to 10 psi	3	3	5	5
53	Conditional decrease differential	S	0 to 10 psi	3	3	10	10
54	Change of suction pressure to						

NOTE: NOT UNDER DOCUMENTATION CONTROL

	inhibit decrease	S	0 to 5 psi/min	3	3	3	3
55	Change of suction pressure to inhibit increase	S	0 to -5 psi/min	-3	-3	-3	-3
56	Desired capacity stages	S	0 to 100	100 = automatic			
57	Capacity increase counter	D	Seconds				
58	Capacity decrease counter	D	Seconds				
59	Load share timer	D	Seconds				
60	Discharge pressure to turn fan 1 on	S	150 to 240 psi	190	190	190	190
61	Discharge pressure to turn fan 2 on	S	150 to 240 psi	210	200	210	200
62	Discharge pressure to turn fan 3 on	S	150 to 240 psi	210	210	210	210
63	Discharge pressure to turn fan 4 on	S	150 to 240 psi	210	220	210	220
64	Discharge pressure to turn fan 1 off	S	130 to 220 psi	170	170	170	170
65	Discharge pressure to turn fan 2 off	S	130 to 220 psi	190	180	190	180
66	Discharge pressure to turn fan 3 off	S	130 to 220 psi	190	190	190	190
D = DISPLAY S = SETTABLE A = ALARM							
Compressor pak HHU functions (CP 4.XX CP 6.XX)				Defaults			
HHU	Description	Type	Limits/Units	2x3 LT	4x2 LT	2x3 IT	4x2 IT
67	Discharge pressure to turn fan 4 off	S	130 to 220 psi	190	200	190	200
68	Lower discharge pressure threshold for fan 1 control (only on CP 4.50)	S	100 to 150 psi	125	125	125	125
69	-						
70	Low suction pressure alarm level	S	0 to 30 psi	1	1	25	25
71	High suction pressure alarm level	S	10 to 70 psi	25	25	55	55
72	High discharge pressure alarm level	S	10 to 70 psi	280	280	280	280
73	Discharge pressure to open liquid injection valve	S	100 to 120degC	105	105	105	105
74	Temperature difference to close liquid injection valve	S	1 to 10 deg C	2	2	2	2
75	Discharge pressure to open dump valve	S	130 to 190 psi	155	155	155	155
76	Discharge pressure to force decrease	S	250 to 300 psi	275	275	275	275
77	Suction pressure stage 3 hold off	S	0 to 70 psi	40	40	50	50
78	Suction pressure stage 2 hold off	S	0 to 70 psi	55	55	65	65
79	Sequential start timer	D	seconds				
80	Low air flow alarm	A	0= OK, = alarm				
81	Fan fault	A	0= OK, = alarm				
82	Low refrigerant alarm	A	0= OK, = alarm				
83	Not all data set up	A	0= OK, = alarm				
84	Temperature sensor failure	A	0= OK, = alarm				
85	Backed up data corrupted	A	0= OK, = alarm				
86	Pressure sensor failure	A	0= OK, = alarm				
87	Low suction pressure alarm	A	0= OK, = alarm				
88	High suction pressure alarm	A	0= OK, = alarm				
89	High discharge pressure alarm	A	0= OK, =				

NOTE: NOT UNDER DOCUMENTATION CONTROL

			alarm				
90	RAM fail alarm	A	0= OK, = alarm				
91	PROM checksum fail	A	0= OK, = alarm				
92	PC out of range	A	0= OK, = alarm				
93	SP out of range	A	0= OK, = alarm				
94	Background not executing	A	0= OK, = alarm				
95	WPRAM fail	A	0= OK, = alarm				
96	NOVRAM fail	A	0= OK, = alarm				
97	Software version number	D					
98	Force data set up from bit switches			301	305	302	306
99	Unit number	S	300.0 to 319.9	300			
D = DISPLAY S = SETTABLE A = ALARM							

3.4 COMMISSIONING

3.4.1 Default conditions

The compressor pak controller has default conditions which can be selected for the application.

Default values are automatically selected when the compressor controller is powered up, or if a total data loss occurs. This allows operation to continue in the event of a malfunction in the front end, or in the data communications between the front end and the compressor controller.

3.4.2 Battery Supported Memory

All parameters are stored in battery supported memory for normal use, as a protection against power failure.

This data is continuously checked by the processor for corruption. If the data is found to be corrupted, the current set of parameters is automatically down-loaded from the front end to the controller.

3.4.3 Non-Volatile Memory Access

As well as battery backed memory, all parameters are also stored in non-volatile memory (NOVRAM). In the event of data corruption the battery memory is automatically refreshed from the NOVRAM.

The NOVRAM is updated when parameters are changed externally and its contents are checked for corruption prior to use.

3.4.4 Commissioning procedure

To commission a compressor pak, proceed as follows:

- (1) With the compressor pak controller isolated from mains power, set the CPU bit switches 1, 2 and 3 according to the following table:

Configuration	Switch 1	Switch 2	Switch 3
All parameters nulled	Closed	Closed	Closed

NOTE: NOT UNDER DOCUMENTATION CONTROL

2 x 3 stage LT pak	Open	Closed	Closed
2 x 3 stage IT pak	Closed	Open	Closed
All parameters nulled	Open	Open	Closed
All parameters nulled	Closed	Closed	Open
4 x 2 stage LT pak	Open	Closed	Open
4 x 2 stage IT pak	Closed	Open	Open
All parameters nulled	Open	Open	Open

- (2) Set switches 4 to 8 to OFF (OPEN).
- (3) Apply mains power to the compressor controller.
- (4) Plug in hand held unit, set function (F98) and press the red SET button.
- (5) Enter the required unit number, using hand held function (F99).
- (6) Unplug the hand held unit from the compressor pak controller.

The set up from the bit switches will then be stored in the front end.

4 MAINTENANCE

4.1 **HANDHELD UNIT FUNCTIONS**

The hand held unit provides facilities to monitor status and change operating conditions of the compressor pak controller. The hand held can also be used to diagnose fault conditions.

4.2 **SYSTEM ALARMS**

Table 2 below gives a list of system faults, and indications given on the display panel. The appropriate hand held function numbers are also given.

TABLE 2 SYSTEM ALARM INDICATIONS

Faults	Display Panel	HHU	Comments
Comp 1 fault	LED 3	17	Latched for 10 minutes
Comp 2 fault	LED 5	27	Latched for 10 minutes
Comp 3 fault	LED 7	37	Latched for 10 minutes
Comp 4 fault	LED 9	47	Latched for 10 minutes
Low air flow	Lamp on panel	80	
Fan fault	Discharge pressure reading flashes	81	Reflects I/P
Low refrigerant *	Lamp on panel	82	
Temp probe fault		84	Temperature sensor
Transducer failure		86	Pressure sensor
Low suction pressure	Flash "LO" on display	87	Reading < HHU set 70
High suction pressure *	Flash "HI" on display	88	Reading > HHU set 71
High discharge pressure	Flash "HI" on display	89	Reading > HHU set 72
* Activates dial-out alarm via hard-wired output			

NOTE: NOT UNDER DOCUMENTATION CONTROL