JTL SYSTEMS LIMITED

COMPRESSOR PACK CONTROLLERS
EPLT, CPLT & EPLA

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INTRODUCTION

JTL Systems provides a range of controllers and monitors which are compatible and which also connect to central communications units.

JTL provides software which runs on IBM compatible personal computers, which displays the current and historic status of the controllers, monitors and other associated equipment. When a modem is used to connect the communications controller to the public telephone network the information can also be accessed from remote locations.

Throughout this manual where detailed reference is made to various data item numbers, they are shown thus: (item n). In each case 'n' refers to the item number on the maintenance unit which displays the particular data. For full details on operation of the maintenance unit see the relevant chapter of the manual.

Full item number information, including ranges and default values, are available in the item number manual for this product.

1. CONTROLLER FUNCTION

The controller is for controlling compressor packs with up to 3 controlled suction pressures.

The controller controls the refrigeration and defrost functions of the central refrigeration compressor pack for display cabinets and coldstores used in supermarkets and other food storage installations.

The compressor pack controller is a modular system with a central processor unit and individual interface cards for each compressor and condensing unit. The individual interface cards can be mounted with the control electronics or with the related electrical control gear.

The controller controls up to 10 single step compressors starting on or off load as required and 12 condenser fans.

Each compressor has a single fault input. The compressor is not allowed to run if the associated fault input is present.

The controller can be used for controlling various pack configurations such as a high temperature pack with controlled satellites, a low temperature pack with controlled satellite or an externally compounded high/low temperature pack with controlled satellites.

Each compressor can be assigned to work as a high temperature, low temperature, or satellite compressor.

The controller also provides local alarm facilities. When used with a JTL Systems communications controller, it also provides data logging and remote communications.

In addition to the compressor and condenser control function the EPLT & CPLT controllers can control up to 28 defrost systems, via JTL network communications.

2. CONTROLLER DESCRIPTON

2.1 CENTRAL CONTROL UNIT

Each compressor pack is fitted with its own central controller. This controller has its own microprocessor and is capable of operating either totally independently or as part of an integrated system. The controller has the following features:

a) Pressure conversion circuits
b) Temperature conversion circuits
c) Display driving circuits
d) Contact inputs
e) Relay outputs
f) Serial format plant interface
g) Microprocessor, program and working memory
h) Maintenance unit interface
i) Remote communications interface
j) Real time clock/calendar (battery packed)
k) Data logging memory (battery backed)
l) Default data set-up switches
m) Non-volatile set-up data memory
n) Watchdog to ensure reliable operation
o) Rechargeable battery and charging circuit

2.2 DIGITAL DISPLAY

Four 4 digit digital displays are provided which indicate the following information:

Low temperature suction pressure
High temperature suction pressure
Satellite suction pressure
Discharge pressure
Number of steps of condensing
Number of compressors running
Systems on defrost

The display is mounted in the central controller enclosure.

The enclosure displays are also used in an alphanumeric mode to display limited text messages which indicate the alarm or operating status as necessary.

2.3 COMPRESSOR INTERFACE UNIT

The compressor interface card can handle up to 7 compressors. The card has 7 outputs to the 7 run contactor.

The safety interlocks and trips on the compressor control gear are monitored. There is one 'ready to run' input for each compressor.

This contact is constantly checked and the compressor is not allowed to run unless this is healthy. If this input is not present a compressor fault alarm is given.

2.4 CONDENSER FAN INTERFACE UNIT

Each condensing unit has its own interface card. This drives the fan contactors.

The condenser fan interface board drives up to 7 outputs.

The condenser sequence can be programmed to run 7 sequencial stages of condensing.

There are 8 inputs on the condenser interface card, 7 of these are used to monitor the fan motor overload status on the condenser control gear.

2.5 INTERFACE CARD FEATURES

2.5.1 Control Gear

The interface cards interface directly with the compressor and condenser control gear. The cards are designed to be mounted with the control gear. Each card requires its own power supply.

There are power options for the interface cards, for 230 Vac, 110 Vac and 24 Vac operation.

2.5.2 Communications To The Compressor Controller

The interface cards communicate with the central compressor controller using a common wire low voltage RS485 connection. The interface units can be mounted remote from the central unit.

The input and output data to/from the individual interface units is transmittedin serial format on the 4 wire link. The interface cards interpret the received data, energise the appropriate relays and send the input data back to the entral controller.

2.5.3 Interface Identification

Since all the interface cards reside on a common serial data bus each card has its own identification number. Note on legacy interfaces type IF1/7 this is set on a rotary switch on the card. The switches are set as follows:

			LEGACY INTERFACE IF1/7				
Card Function	**IF11**		**Switch SW1**	**Switch SW2**			
	Item 31	**Item 30**		**4**	**3**	**2**	**1**
Compressor 1 - 7	3	1	1	x	C	O	O
Compressor 8 - 10 Through to	3	2	2				
Condenser outputs 1 - 7	4	0	0	x	O	C	C
Condenser outputs 8 - 14	5	0	0	x	0	C	O

Note x = don't care O = open C = closed
for switches without the dot showing = closed

2.5.4 Interface Watchdog

To ensure fail safe operation, each interface card has a watchdog timer. When the data messages are received from the central controller unit the watchdog timer is reset.

In normal operation the watchdog timer should not time out. In this state the active (red) indicator on the card should be on. The watchdog time out period is approximately 90 secs.

If the watchdog timer does time out then the indicator will be extinguished and the card reverts to standby mode. In standby mode all outputs can be directly operated by bitswitches SW1 (IF11) or SW3 (IF1/7) mounted on the interface card.

There is one bitswitch for each relay output. These bitswitches should be set to a particular combination for failsafe control in the event of a breakdown. When the switch is closed, the relay is energised. For switches without text when the dot is showing, the switch is closed.

While the watchdog has not timed out the bitswitches are inoperative.

On power up the watchdog is reset to the start of the timeout period. This allows 90 secs for the central controller to establish control before the standby mode isselected.

2.5.5 Standby Mode Switch Designations

Interface Type	**No of Outputs**	**No of Inputs**	**SW1 (IF11)** **SW3 (IF1/7 Legacy)**	**Output function**
Compressor	7	8	1 (Top or right hand) 2 3 4 5 6 7 8	Run compressor 1 Run compressor 2 Run compressor 3 Run compressor 4 Run compressor 5 Run compressor 6 Run compressor 7 Unused

Condenser	7	8	1 (Top or right hand) 2 3 4 5 6 7 8 (Left hand)	Output 1 (8) Output 2 (9) Output 3 (10) Output 4 (11) Output 5 (12) Output 6 (13) Output 7 (14) Unused

3. PRESSURE & TEMPERATURE MONITORING

3.1 PRESSURE TRANSDUCERS

Pressure measurement is undertaken using pressure transducers mounted on the compressor pack. There are four transducers. These are:

Pressure	Data Item	Selection item
LT Suction gas	21	121
HT Suction gas	22	122
Discharge gas	23	123
Satellite Suction gas	24	124

The LT suction and Satellite transducers can be selected for gauge or absolute type. Absolute transducers allow the suction pressures to control correctly in a vacuum condition. Selection is on items 126 and 128.

3.2 TEMPERATURE MONITORING

Temperature monitoring is available for up to 7 temperature sensors associated with the compressors and condensing units. These temperatures are:

Temperature	Data Item	Selection Item
LT Suction gas	31	131
HT Suction gas	32	132
Discharge gas	33	133
Satellite Suction gas	34	134
Subcooled liquid	35	135
Saturated gas	36	136
Plant room	37	137

4. COMPRESSOR CONTROL

4.1 CAPACITY CONTROL

The compressor capacity for each stage of the pack (HT, LT or satellite) is controlled by measuring the relevant suction gas pressure and attempting to maintain this at a constant set value within certain constraints. The suction pressure for each stage of the compressor pack is controlled by varying the number of steps of compression in each stage.

When a change in compressor capacity is required the controller decides which step of capacity is to be changes. The decision is based on the following:

The maximum number of starts per hour on an individual compressor.

The compressor running hours are balanced.

All machines are run periodically.

Unnecessary starts and stops of the compressors are avoided.

Capacity of compressors when unequal.

4.2 SUCTION PRESSURE SETPOINTS

To achieve the desired control there are a number of suction pressure control setpoints. These are:

CONTROL SETTINGS	ITEM NUMBERS		
	LT	HT	Satellite
Pressure setpoint	40	50	70
Pressure deadband	43	53	73
Capacity increase time constant	44	54	74
Capacity decrease time constant	45	55	75

The suction pressure is maintained within the deadband if sufficient capacity is available. The deadband is positioned symmetrically about the suction pressure setpoint so that for example, if the setpoint is set to 8 psi and the deadband is set to 4 psi, then the bottom of the deadband is 6 psi and the top 10 psi.

Under normal conditions when the suction pressure is within the deadband no increase or decrease in capacity will occur.

4.3 CAPACITY CHANGES

4.3.1 Capacity Increase

When the suction pressure goes above the control deadband the controller will decide when and how an increase in capacity will occur. If capacity is available and the pressure does not return within the deadband a change in capacity will eventually occur.

However, the capacity change does not occur immediately the pressure goes outside the deadband. There is a minimum delay between each increase in capacity regardless of demand.

Next, the size and duration of the difference (or error) between the desired pressure and the actual pressure is taken into account. This error is integrated with respect to time. When the integrated error is large enough a capacity increase will occur.

To put this more simply, if the pressure error is large a capacity change will occur more quickly than if the error is small.

4.3.2 Capacity Increase Response Time

The speed of response of the system can be adjusted using the increase time constant (items 44, 54, 74). The larger the time constant, the longer the time before a capacity increase occurs.

4.3.3 Capacity Decrease

When the suction pressure goes below the control deadband the controller program will decide when and how a decrease in capacity will occur. If the pressure does not return within the deadband a change in capacity will eventually occur.

As for the increase in capacity there is a minimum delay between each decrease in capacity and the pressure error is integrated with respect to time. When the integrated error is large enough a capacity decrease will occur.

4.3.4 Capacity Decrease Response Time

The speed of response of the system can be adjusted using the decrease time constant (items 45, 55, 75). The larger the time constant, the longer the time before a capacity decrease occurs.

The use of separate increase and decrease time constants allows the compressors to unload faster than loading if desired. This feature is of particular benefit on low temperature stages to prevent the suction pressure going into a vacuum.

4.3.5 Change Of Pressure

The change of pressure is also considered. If the pressure is going towards the setpoint fast enough for the suction pressure to reach the deadband in an acceptable time then, no capacity change is made.

4.3.6 Starts Per Hour

Each compressor can be programmed to have a maximum number of starts per hour. The item numbers for this selection are 219 for compressor 1, 229 for compressor 2 up to 309 for compressor 10. Once a compressor has started it is not allowed to restart again until the restart timer, which ensures the starts per hour are observed, has timed out.

4.3.7 Compressor Capacity

Each compressor can be programmed to have a capacity. The items for this data are 216 for compressor 1, 226 for compressor 2 up to 306 for compressor 10.

The capacity control takes account of the capacity that can be started and stopped to ensure optimum control. Where a small capacity change can be made by starting and stopping 2 machines to give a net change in capacity this is done. In this condition the machine to be started always starts before the machine to be stopped regardless of whether capacity is to be increased or decreased.

4.3.8 High Discharge Pressure

If the discharge pressure exceeds the pressure safety level (item 65) then, the compressor capacity is reduced. The reduction in capacity is controlled by the normal sequence of unloading.

When the pressure falls below the safety level the capacity is allowed to increase again according to the normal requirements of the suction pressure.

4.3.9 Low Load Condition

When the refrigeration load is low enough for the compressors to run on 1 step only then, to prevent the last compressor stopping unnecessarily, the deadband lower limit is automatically lowered, reducing the pressure at which the last compressor would be stopped.

In this condition the deadband lower limit is set to the 1st stage hold on pressure setpoint (item 48, 58, 78).

4.3.10 Control during defrost

When the number of defrost systems associated with a group of compressors on one of the suction lines is 2 or less, the control of the compressors is modified during defrost.

When there is only one defrost system associated with the compressor(s), the compressors are stopped during defrost.

When there are 2 defrost systems associated with the compressors, then during defrost the maximum number of compressors allowed to run is reduced to 1. If there are unloaders on the compressors or unequal compressor capacity control this remains operations but limited to a maximum of one compressor.

After defrost the compressor(s) will resume normal control.

4.3.11 Forcing The Compressor To Run

A particular compressor may be forced to run by the maintenance unit (items 217, 227 up to 307) for compressors 1 o 10 respectively.

Any compressor may be forced off by the maintenance unit (items 218, 228 up to 308) for compressors 1 to 10 respectively.

Resulting loading and unloading of the steps of the forced compressor(s) follows all the normal rules specified above except that the controller ignores the suction pressure on the forced compressor(s).

4.4 EXTERNAL COMPOUNDING

4.4.1 HT and LT Interlocking

When the controller is used to control both HT and LT compressors in an externally compounded arrangement, the compressor sequence is interlocked to prevent any LT compressor from running when there is no HT compressor running.

During the pack start up the LT compressors are not allowed to run until the HT suction pressure is within its deadband.

This interlock can be disabled using item 145.

5. CONDENSER FAN CONTROL

5.1 STAGED FAN CONTROL

Staged fan control is selected on item 394.

The condenser capacity is controlled by measuring the common discharge gas pressure and varying the number of condensing steps accordingly.

5.1.1 Discharge Pressure Setpoints

To achieve the desired control there are a two discharge pressure control setpoints. These are:

a) Discharge pressure setpoint (item 60)
b) Discharge pressure deadband (item 63)

5.1.2 Increase Condensing Capacity

The first step of condensing is brought on when the pressure rises above the setpoint, the second when the pressure rises by a further value equal to the deadband. The next step is applied by a further deadband increase, etc. This continues up to a maximum of 14 steps (see extended fan sequence control 5.4).

The controller checks the actual pressure against the setpoint. The difference is then integrated over time and the control setpoint is then adjusted by this value so that the pressure is brought back to the set value. This maintains the discharge pressure a constant level over varying conditions.

There is a minimum time delay between each step of capacity and the demand must be present for a fixed time delay before the capacity is increased.

5.1.3 Decrease Condensing Capacity

For decreasing demand then the sequence is reversed except that each cooling fan is stopped at its starting pressure less the deadband setpoint.

5.1.4 Extended Sequence Fan Control

The basic 7 steps are extended for use with large and split circuit condensers.
There are three sequences that can be programmed into the unit using item 394:

A Split circuit sequence A
B Split circuit sequence B
C Simple staging

On sequences A & B output 7 on the first board is used for operating a split circuit (summer/winter) valve. The sequences below show the sequence for the number of steps programmed on item 390.

Note sequences B & C are only available on later versions of EPLx.

5.1.4.1 Sequence A

For 8 steps programmed:

STEP	OUTPUTS ENERGISED
1	1
2	1,2
3	1,2,3
4	1,2,3,4
5	1,7
6	1,2,7
7	1,2,3,7
8	1,2,3,4,7

For 9 steps programmed:

STEP	OUTPUTS ENERGISED
1	1
2	1,2
3	1,2,3
4	1,2,3,4
5	7
6	1,7
7	1,2,7
8	1,2,3,7
9	1,2,3,4,7

For 10 steps programmed:

STEP	OUTPUTS ENERGISED
1	1
2	1,2
3	1,2,3
4	1,2,3,4
5	1,2,3,4,5
6	1,7
7	1,2,7
8	1,2,3,7
9	1,2,3,4,7
10	1,2,3,4,5,7

For 11 steps programmed:

STEP	OUTPUTS ENERGISED
1	1
2	1,2
3	1,2,3
4	1,2,3,4
5	1,2,3,4,5
6	7
7	1,7
8	1,2,7
9	1,2,3,7
10	1,2,3,4,7
11	1,2,3,4,5,7

For 12 steps programmed:

STEP	OUTPUTS ENERGISED
1	1
2	1,2
3	1,2,3
4	1,2,3,4
5	1,2,3,4,5
6	1,2,3,4,5,6
7	1,7
8	1,2,7
9	1,2,3,7
10	1,2,3,4,7
11	1,2,3,4,5,7
12	1,2,3,4,5,6,7

For 13 steps programmed:

STEP	OUTPUTS ENERGISED
1	1
2	1,2
3	1,2,3
4	1,2,3,4
5	1,2,3,4,5
6	1,2,3,4,5,6
7	7
8	1,7
9	1,2,7
10	1,2,3,7
11	1,2,3,4,7
12	1,2,3,4,5,7
13	1,2,3,4,5,6,7

For programmed steps 1 - 7 the outputs are energised sequencially.

5.1.4.2 Sequence B

For 6 steps programmed:

STEP	OUTPUTS ENERGISED
1	1
2	1,2
3	1,7
4	1,2,7
5	1,2,3,7
6	1,2,3,4,7

For 7 steps programmed:

STEP	OUTPUTS ENERGISED
1	1
2	1,2
3	1,2,3
4	1,2,3,4
5	1,2,7
6	1,2,3,7
7	1,2,3,4,7

For 8 steps programmed:

STEP	OUTPUTS ENERGISED
1	1
2	1,2
3	1,2,3,4
4	1,2,3,4,5
5	1,2,7
6	1,2,3,7
7	1,2,3,4,7
8	1,2,3,4,5,7

For 9 steps programmed:

STEP	OUTPUTS ENERGISED
1	1
2	1,2
3	1,2,3
4	1,7
5	1,2,7
6	1,2,3,7
7	1,2,3,4,7
8	1,2,3,4,5,7
9	1,2,3,4,5,6,7

For 10 steps programmed:

STEP	OUTPUTS ENERGISED
1	1,2
2	1,2,3
3	1,2,3,4
4	1,2,7
5	1,2,3,7
6	1,2,3,4,7
7	1,2,3,4,5,7
8	1,2,3,4,5,6,7
9	1,2,3,4,5,6,7 - 8
10	1,2,3,4,5,6,7 - 8,9

For 12 steps programmed:

STEP	OUTPUTS ENERGISED
1	1,2
2	1,2,3
3	1,7
4	1,2,7
5	1,2,3,7
6	1,2,3,4,7
7	1,2,3,4,5,7
8	1,2,3,4,5,6,7
9	1,2,3,4,5,6,7 - 8
10	1,2,3,4,5,6,7 - 8,9
11	1,2,3,4,5,6,7 - 8,9,10
12	1,2,3,4,5,6,7 - 8,9,10,11

For programmed steps 1 - 5 the outputs 1 to 5 are energised sequencially.

5.1.4.3 Sequence C

The outputs are operated sequentially up to 14.

5.1.4.4 Outputs 8 - 14

For outputs 8 - 14 a second interface is required.

5.2 VARIABLE FAN SPEED CONTROL

Variable fan speed control is selected on item 394.

5.2.1 Discharge Pressure Setpoints

To achieve the desired control there are 3 discharge pressure setpoints.

a) Discharge pressure setpoint (item 60)
b) Analogue speed gain (item 395)
c) Analogue speed time constant (item 64)

5.2.2 Increasing & Descreasing Condensing Capacity

When the pressure rises above the setpoint, the fan speed is increased and when it falls below the setpoint the speed is reduced. The rate of change of pressure is controlled by the gain and time constant. If the gain is too high or the time constant is too small the fan speed will vary erratically.

5.3 FORCING THE NUMBER OF CONDENSER STEPS

The number of condenser steps running may be fixed by the maintenance unit (item 392). Resulting loading and unloading of the steps follows all the normal rules specified above except that the controller ignores the discharge pressure.

6. DEFROST CONTROL

6.1 JTL NETWORK INITIATED DEFROST

The EPLT & CPLT controllers can be used to initiate a defrost at the JTL evaporator controllers via the JTL communications network. The selection of this function is at the evaporator controller, no settings are required at the pack to set up this method of defrost controller. The evaporator controllers must be numbered according to JTL rules. See Appendix 1 - Network Initiated Defrost - Unit Numbering.

6.2 DEFROST TIME SEQUENCE CONTROL

Up to 28 defrost systems can be individually sequenced on a 24 hour time cycle. There are 3 set values for each system. These are:

a) Defrost start time
b) Defrost duration
c) Defrost pattern

The defrost start time specifies the start time of one of the daily defrosts and the duration of the defrosts are also specified.

The defrost pattern essentially specifies the number of defrosts a day i.e.

'1' One defrost at the specified time.
'2' Two defrosts, at the specified time and 12 hours later.

To

'6' Six equally spaced four hourly defrosts.

There are two other patterns numbered '7' and '8'. These give two special patterns as follows:

'7' 2 defrosts at 8 hour intervals with the 3rd defrost omitted.
'8' 3 defrosts at 6 hour intervals with the 4th defrost omitted.

6.3 DEFROST TERMINATION

The defrost normally runs for the full duration. However it is possible for the defrost scheduling to take account of the evaporator termination status using information from the JTL evaporator controllers. For this to occur the evaporator controllers must be numbered according to JTL rules. See Appendix 1 - Network Initiated Defrost - Unit Numbering.

To select defrost termination control for a system, the number of evaporators connected to a system must be programmed. If termination control is not required on a defrost system the number of evaporators should be set to 0.

When the defrost controller puts a refrigeration system onto defrost it sends commands via the JTL network controller and the JTL communications network to instruct appropriate JTL evaporator controllers to go into defrost mode (see 6.1). The JTL units send status messages back via the JTL network to the defrost controller indicating whether or not they have terminated defrost.

The defrost controller waits until it has received defrost termination messages from the network controller for each JTL unit associated with the refrigeration system before ending the defrost at its defrost interface unit (if connected). If all defrost termination messages are not received within the defrost duration time limit, defrost is ended regardless.

An optional drain down period is started at the end of defrost. During the drain down period, commands are sent via the JTL communications network to ensure the JTL units do not demand refrigeration locally until the drain down is complete.

The number of evaporators terminated on a system is visible using the JTL hand unit. The termination sequence can be selected to occur at the start or end of the programmable drain down time using item 406.

6.4 FORCING SYSTEM DEFROST OR REFRIGERATION

The JTL maintenance unit can be used to force a system into permanent defrost or refrigeration mode, for test or servicing purposes.

Setting forced defrost switches to the defrost state regardless of the time clock. This action is permanent while the maintenance unit is plugged in. 30 minutes after the maintenance unit is unplugged the controller reverts to normal control.

This will command the relevant evaporator controllers to go into defrost mode.

Setting inhibit defrost sets refrigeration state while the forcing function remains set.

6.5 DISCHARGE PRESSURE RELIEF VALVE CONTROL

When no gas defrost system is on defrost then the discharge pressure relief valve is energised.

The controller determines when a system is a gas defrost system by checking the set defrost duration for that system against the maximum time for gas defrosts (item 401).

i.e. If the set defrost duration is greater than the maximum time for gas defrosts then it must be an off-cycle defrost, otherwise it is regarded as a gas defrost system.

7. ALARMS & DATALOGGING

7.1 COMPRESSOR FAULTS

The individual compressors are continuously monitored using the compressor interface cards.

The state of these inputs for compressor 1 is shown on item 213 of the maintenance unit. Compressor 2 is on item 223 up to compressor 10 which is shown on item 303.

The state is indicated by the following messages:

rdy	=	ready to run (no faults)
0	=	off

If any compressor is not ready to run then this is indicated as a compressor fault (item 97).

If the compressor interface card is faulty, a compressor interface alarm is given (item 96).

7.2 CONDENSER FAN FAULTS

The condenser fan run is continuously monitored by the condenser fan interface card.

The fan status is compared with the required status if, after a 5 second delay, these are not the same then, the condenser fan alarm is given.

If after a 5 second delay the fans that are requested to run are not running then, a condenser fan alarm is given. No alarm is given if fans are running when not requested.

If the condenser fan interface card is faulty a condenser fan interface alarm is given (item 88).

7.3 PRESSURE ALARMS

The compressor suction pressure is constantly monitored and compared with the high alarm level (items 42, 52, 72).

The compressor discharge pressure is also constantly monitored and compared with its high level (items 62).

If either the current suction or discharge pressure goes outside the set range for a short time period then an alarm is given.

The time delay is achieved by integrating the difference between the required pressure and the actual pressure over a period of 30 seconds. This means that the larger the difference the faster the alarm occurs.

7.4 PRESSURE TRANSDUCER ALARMS

The pressure transducers are constantly checked and if, after a 15 minute time delay, the outputs go outside the acceptable range an alarm is given (item 91).

When there is a pressure transducer fault, action is taken to maintain refrigeration in an acceptable condition.

If there is a suction pressure transducer fault, the number of compression steps is set to the maximum available. Control then reverts to the compressor LP safety switches. All normal sequencing restart delays, etc will be maintained in this mode of operation.

If there is a discharge pressure transducer fault, then the number of fans is set to half the maximum number of fans (item 390) rounded up.

7.5 TEMPERATURE SENSOR FAULT ALARMS

The temperature sensors are thermistors. The thermistors are constantly monitored and if a fault is detected an alarm is given (item 92). If a probe is deselected (items 131 to 137), the fault alarm for that probe is cancelled.

7.6 TEMPERATURE SENSOR POWER SUPPLY FAULT ALARM

The thermistor power supply is constantly monitored and if a fault is deselected an alarm is given (item 93).

7.7 LOW LIQUID LEVEL

An input is available to monitor low liquid level in the Liquid receiver. The input should be shorted out when there is no alarm condition using a voltage free contact. An alarm is given 30 minutes after the contact is opened.

7.8 ALARM DISPLAY

Various alarms are indicated on the pressure displays. Typical messages displayed are:

P.Fld	Plant fault (auto input not present) - (highest priority)
Hi.Lt	High LT suction pressure
Hi.Ht	High HT suction pressure
Hi.St	High Satellite suction pressure
Hi.dP	High discharge pressure
Lo.Li	Low level liquid
Cpr	Compressor fault
FAn	Condenser fan failure (lowest priority)

The alarm conditions are flashed alternately with the pressure. In the event of there being more than one alarm the highest priority alarm is displayed.

7.9 DATA LOGGING

When communications are operational, data logging is provided as a standard feature. The choice and number of temperatures logged is preset in the software. The data logged are:

a) LT suction pressure
b) HT suction pressure
c) Satellite suction pressure
d) Discharge pressure

The log capacity is up to 3600 pressures (900 of each).

Data are logged continuously on the basis of first in 'first out', i.e. when the data buffer is full, each time a new set of data is logged, the oldest set is discarded. This means that at any time a full set of historic data is always available from the controller.

The logging interval is adjustable from 1 to 60 mins.

Logged data are maintained during power down by a battery. Depending on the length of time the unit is powered down then on power up the log is filled with the appropriate number of 'gaps'. This maintains the correct log times.

If on power up the log data are found to be corrupt the log is erased.

8. SERVICE AND COMMISSIONING

8.1 MAINTENANCE UNIT

Local interrogation and adjustment of controllers is made using a hand-held maintenance unit, which plugs into a socket on the controller.

The following sections require use of the maintenance unit. For full details on operation of the maintenance unit see the relevant manual or maintenance unit User Guide.

8.2 FORCING FUNCTIONS

It is possible on most JTL controllers to force the controller into conditions that would not be the normal operating state. This is done using the maintenance unit.

For example, on a display cabinet controller type EC, setting item 77 to '1' will give a forced defrost. This function shuts the liquid solenoid valve and leaves the gas defrost open, regardless of temperature.

Forced functions are maintained for 30 minutes after the maintenance unit is unplugged, but after that time the forced functions are automatically cancelled. If at any time during the 30 minutes the maintenance unit is plugged back into the controller, the time delay is reset to 30 minutes until it is again plugged.

For full details of the forcing functions see the appropriate sections of the manual.

8.3 INITIAL COMMISSIONING OR DEFAULT DATA

Each controller generally has one or more sets of default operating data stored in its program memory. All controllers are supplied with the working memory set to one of these default sets of data.

During commissioning, the Installation Engineer should check if the data are suitable for the required application and, if not, load an appropriate set of data into the controller's parameter memory. This is done by setting the bitswitches on the controller to the pattern for the required type of unit and then setting item 9 to '1' or '1,2,3,4', using the plug-in maintenance tool.

This means that to complete the commissioning, only certain items of data may need to be adjusted or trimmed.

The parameter memory is non-volatile, which means that the data are not lost when the power supply is removed. No batteries are involved, so the power can be off indefinitely without loss of data.

8.4 PARAMETER DATA LOSS

In the event of a loss of operating data due to failure of the non-volatile parameter memory of the controller, the appropriate default data are automatically loaded into the working memory, depending on the controller bitswitch setting.

This allows the unit to operate in a sensible manner until the correct operating data are reinstated manually.

8.5 REPLACING AN EXISTING CONTROLLER

The bitswitches on the replacement controller must be set in the same way as on the controller being replaced. If the bitswitches have to be adjusted, then the replacement controller should be recommissioned by setting the default values (item 9) on the maintenance unit. The operating data should be checked against the original commissioning data and changed if necessary.

Finally, the maintenance unit is used to set the controller unit number (item 1) to the correct number.

8.6 ELECTRONIC FAULT ALARMS

The microprocessor is continuously monitoring its own program and memory operation. In the event of a fault, an alarm is logged.

The faults are divided into two groups: catastrophic and advisory. If the fault is regarded as catastrophic, the controller is restarted as if it had just been powered up. If the fault is regarded as advisory, no action is taken.

The alarms logged are as follows:

Catastrophic

a) Program counter outside range (item 12)
b) Stack memory pointer outside range (item 13)
c) Background loop counter fault (item 14)
d) Invalid instruction code (item 16)

Advisory

a) Working memory [RAM] check fault (item 11)
b) Program memory [PROM] checksum fault [item 15]
c) Non-volatile setpoint memory fault (item 17)

All these processor faults are alarms are retained in memory for 15 minutes to allow the communications controller to access the alarm.

8.7 DISPLAY TEST

The displays can normally be tested by setting maintenance unit item 99 to 1. For full details refer to the item number data for the controller.

8.8 SOFTWARE VERSION

The software version number is available on item 19 of the maintenance unit.

9. COMMUNICATIONS

9.1 ZONE COMMUNICATIONS

Communication to remote locations is achieved using the JTL network controller. Up to 31 display cabinets or other units can be connected to the communications controller using a single pair of wires.

One JTL network controller can be connected to up to 5 such groups (zones) of units giving a total capacity of 155.

Communications between the controllers and the JTL network controller is in serial format either at 600 Baud (bits/second), 4800 Baud or 38, 400 Baud. All network products despatched from JTL Systems on or after the 1st October 1989 can run at dual speed. Prior to this date only 600 Baud is available.

All controllers on one zone must run at the same speed.

The communications speed for each zone is selected by a setting in the JTL network controller. The speed selection at the controllers is automatic.

On dual speed controllers the active communications speed is shown on the maintenance unit on item 6.