Electrical Installation Requirements
Care should be taken to separate the power and signal cables to prevent electrical interference and possible damage due to inadvertent connection.

The power outputs are fitted with suppressors to protect against electrical interference when switching off solenoid valves or contactors. It is therefore essential to observe the output polarity. The line voltage should be connected to the terminals marked **LN** and the switched loads to **DQ.**

The plant inputs are electrically isolated. A volt free contact should be connected for the logical conditions stated below between the input and common **C** (21).

The control supply neutral must be connected to terminal 1 for EMC operation.

CE Conformance
This unit conforms with the relevant EU standards when installed according to the JTL Installation Requirements for this product

Digital Output		
DQ1	Unsuppressed	Critical Alarm
DQ2	Unsuppressed	Pulse width modulation
DQ3	Suppressed	Run Compressor 1
DQ4	Suppressed	Run Compressor 2
DQ5	Suppressed	Run Compressor 3
DQ6	Suppressed	Run Compressor 4
Digital Inputs		
DI1	Volt Free	Auto/Manual
DI2	Volt Free	Compressor 1 Available to Run
DI3	Volt Free	Compressor 2 Available to Run
DI4	Volt Free	Compressor 3 Available to Run
DI5	Volt Free	Compressor 4 Available to Run
DI6	Volt Free	Plant Healthy
DI7	Volt Free	Condenser Healthy
DI8	Volt Free	Low Liquid Level
Analogue OUTPUT		
AQ1	0-10 V	Condenser Fan Speed
Analogue INPUT		
AI1	4-20 mA	Suction Pressure
AI2	4-20 mA	Discharge Pressure

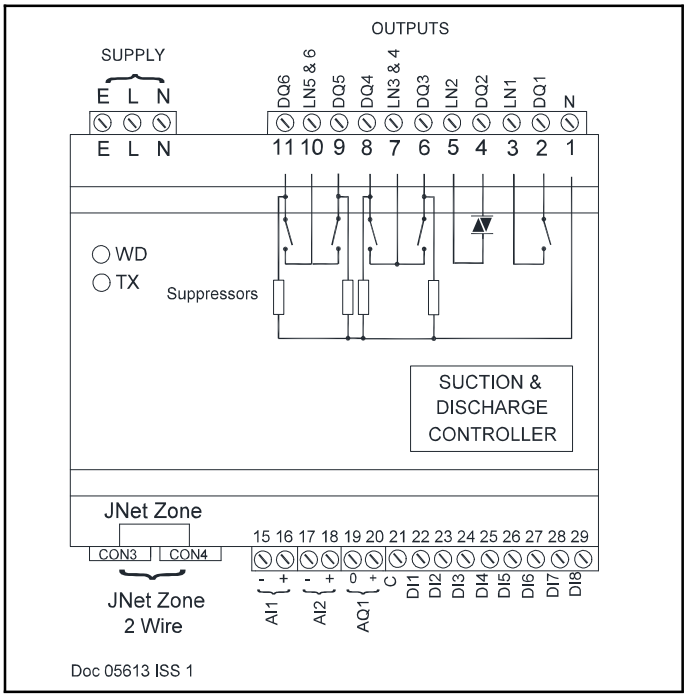
Use of Maintenance Unit
The controller can be checked and the operation adjusted using a JTL portable maintenance unit which plugs into the controller. Each item of information has an item number. The more important items are listed in the tables overleaf.
Examples:
To read item 21 press: ITEM 2 1 ENTER

To set item 41 to –4.0 press:

ITEM 4 1 ENTER SET – 0 4 0 ENTER

To correct errors press: CANCEL

To select next or previous items press: + and –



Initial Commissioning and Bitswitch Settings
The controller has 2 sets of data built in to its program for use during commissioning. These can be accessed by setting the virtual bitswitches as shown in the table overleaf. The virtual bitswitches are set using item 966. Then set item 9 to 1234. This loads into the controller a suitable set of data for the selected type of case. Adjustments should then be made as necessary. The range over which the settings can be adjusted is also defined by the bitswitch setting.

If a JTL communications network is connected to the controller then the unit numbers should be set on item 1 and 190.

Pressure Display
The pressure can be displayed in psi, bar or kPa as selected by item 179.

The UP120 controller drives JTL LCD14 displays using a CAB75 cable. Various cable lengths are available.

One or two displays can be driven. When 2 displays are required and an additional interface unit type CONVD2A.

SUCTION CONTROL

Suction Pressure Control Strategy
The compressor capacity is controlled by measuring the suction gas pressure (item21) and attempting to maintain this at a constant set value within certain constraints. The suction pressure of the compressor pack is controlled by varying the number of steps of compression. The UP120 can control digital scroll trim compressor. When the trim control is available the compressor capacity on the trim machine is controlled to maintain the pressure. Only when the trim compressor is running at minimum or maximum output will the other compressors be stopped or started as required.

When a change in compressor capacity is required the controller decides which step of capacity is to be changed. 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.

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 staged capacity will occur.

Suction Pressure Optimisation
When used in conjunction with a JTL suction pressure optimiser (SPO) and appropriate JTL evaporator controllers/monitors, the suction pressure can be optimised to save energy.

The optimiser monitors the evaporator conditions and sets the suction pressure to the appropriate level to maintain the evaporator at the optimiser level to achieve the desired temperatures at the lowest energy.

The allowed range of pressure is set on items 40 (minimum) and 152 (maximum) optimisation is enabled on item 150.

CAPACITY CHANGES (STAGE CONTROL)

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.

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.

Capacity Increase Response Time
The speed of response of the system can be adjusted using the increase time constant (item 44). The larger the time constant, the longer the time before a capacity increase occurs.

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.

Capacity Decrease Response Time
The speed of response of the system can be adjusted using the decrease time constant (item 45). 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 too low.

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.

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 249 for compressor 4. 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.

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 246 for compressor 4.

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 two 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.

High Discharge Pressure
If the discharge pressure exceeds the pressure safety level (on item 55) then, the compressor capacity is reduced. There is a choice of two actions in this condition on item 197 either the reduction in capacity is controlled by the normal sequence of unloading or all compressors are stopped immediately.

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

Low load Condition
When the refrigeration load is low enough for the compressors to run on 1 step only (including the trim compressor) 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).

There is a very low suction pressure setting (item 196) below which, if enabled by item 195, will stop all compressors instantly.

DIGITAL SCROLL COMPRESSOR CONTROL

Variable Capacity Control
The capacity of the digital scroll compressor is varied by a pulse width modulating (PWM) output. The period of the PWM output can be set on item 332. When, for example, a capacity of 20% is required this output will be on for 20% of the period.

The controller starts and stops the compressor as required taking account of any other compressors controlled by the same suction pressure. The control automatically acts as a trim compressor and all the normal compressor capacity control functions are operational. The capacity of the compressor at full output is used to determine the variable capacity when not at full output.

Minimum Output
When there are no other compressors running the variable capacity compressor will stay on at a minimum output until the minimum pressure set on item 341 is achieved.

Control Response
The controller uses proportional and integrated control algorithms to control the variable capacity compressor. These require gain (item 339) and time constant (item 340) to adjust the response of the control of variable capacity.

Capacity Output Limits
The output can be limited at both maximum and minimum. The settings for the limits are item 342 for maximum and item 343 for minimum capacity.

FORCING COMPRESSOR TO RUN
A particular compressor may be forced to run by the maintenance unit (MU) (items 217, 227 up to 247) for compressors 1 to 4 respectively.

Any compressor may be forced off by the maintenance unit (items 218, 228 up to 248) for compressors 1 to 4 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).

Forced functions remain in operation for 30 minutes after the MU is unplugged, after which time the controller will reset to normal control.

COMPRESSOR FAULTS
The individual compressors are continuously monitored. 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 4 which is shown on item 243.

The state is indicated by the following messages:

rdy	=	ready to run (no faults)
0	=	not ready (fault)

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

DISCHARGE CONTROL

Discharge Pressure Control Strategy
The discharge pressure is controlled against a fixed or dynamic setpoint, the floating discharge pressure setpoint, which is calculated based on the ambient and plant conditions.

The head pressure is floated to give fixed differential temperature above the ambient condition. This should be set to the condenser design condition (item 363) to give maximum condenser efficiency. Setting 0.0 disables floating head (FH) control.

The minimum pressure setpoint (item 50) is used when floating head is disabled or when the outside air temperature is not available.

The maximum pressure setpoint (item 350) for the condenser is used to limit the floating head pressure.

The refrigerant type for the plant (item 157) is used to convert pressures to temperatures and vice versa.

The outside ambient temperature from the JTL network (item 899). If the outside temperature is not available FH control is disabled.

The condenser exit temperature (item 365) is calculated from the discharge pressure and the refrigerant type.

The target temperature for the condenser control is calculated from the outside air temperature plus the design differential temperature. (item 899 + item 363).

The floating discharge pressure setpoint (item 370) is calculated from the target temperature and the selected refrigerant, limited by the minimum and maximum values above.

Fan Speed Control
The controller can vary the speed of the fans using a 0 - 10 signal. 0 V is for minimum speed and 10 V is maximum speed.

There is a minimum fan speed control setting on Item 352. When this is set >0 then there is also a minimum pressure cutout setting on Item 357. When the fans reach minimum speed they stay running until the cutout level is reached.

Control Response
The controller uses proportional and integrated control algorithms to control the fan speed. These require speed gain (item 395) and time constant (item 54) to adjust the response of the control.

COMMON FUNCTIONS

Pressure Alarms
The compressor suction pressure is constantly monitored and compared with the high alarm level (item 42).

If the current suction 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 alarm level and the actual pressure over a period of 30 seconds. This means that the larger the difference the faster the alarm occurs.

The discharge suction pressure is constantly monitored and compared with the high alarm level (item 52) and low alarm level (item 51).

If the current 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 alarm level and the actual pressure over a period of 30 seconds. This means that the larger the difference the faster the alarm occurs.

The low level alarm can be delayed for up to 20 minutes.

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

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, the output is settable backup value.

Low Liquid Level
An input is available to monitor low liquid level in the receiver. The input should be shorted out when there is no alarm condition. An alarm is given after an adjustable delay (item 175) the contact is opened.

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

P.Flt	Plant fault (auto input not present) - (highest priority)
Hi.Sp	High suction pressure
Hi.dP	High discharge pressure
Lo.Li	Low level liquid
Cpr	Compressor fault - (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

Daylight Saving
When connected to a JTL network this controller can operate by displaying daylight saving time for its time and defrost schedule. Daylight saving operation is selected by setting item 18. The connected network controller then adjusts the times automatically during the daylight saving period.

ADJUSTABLE PARAMETERS					UP120
		Item	Function	Range	Units
SUCTION CONTROL	PRESSURE CONTROL	40	Suction pressure setpoint (minimum)	0 to 60, 100 to 200	psi
		150	Suction optimisation	0=Disabled 1=Enabled	
		152	Suction pressure (maximum)	5 to 60, 175 to 225	psi
		43	Deadband	0 to 20	
		44	Increase time constant	1 to 60	
		45	Decrease time constant	1 to 60	
		48	1st stage and fast unload set point	-8 to 60, 100 to 150	psi
		195	Low suction pressure safety	0=Disabled 1=Enabled	
		196	Low suction pressure safety level	-5 to 40, 50 to 150	psi
		197	Instant high discharge pressure shutdown	0=Disabled 1=Enabled	
	PRESSURE ALARM	42	High suction pressure	10 to 80, 200 to 300	psi
		41	Low suction pressure	-5 to 40, 100 to 150	psi
	PRESSURE TRANSDUCER	121	Transducer	0=Disabled 1=Enabled	
		421	Transducer full scale (at 20mA)	50 to 200, 300 to 500	psi
		426	Transducer zero scale (at 4mA)	-15 to 0	psi
	COMPRESSOR COMMON	200	Number of compressors	1 to 3	
		205	Maximum allowed to run	1 to 3	
		208	Minimum stop time	0 to 240	sec
	COMPRESSOR (WHERE X IS COMPRESSOR)	2x5	Isolation	0= not in use 1= in use	
		2x6	Capacity	1-100	kW
		2x0	Control	0= not stage controlled. 1= stage controlled, 2= digital scroll control (compressor 1 only)	
		2x9	Starts per hours	4- 20	
	DIGITAL SCROLL	330	Select	0=Disabled 1=Enabled	
		341	Minimum pressure	-8 to 40, 100 to 150	psi
		340	Time constant	1 - 240	
		339	Gain	1 - 250	
		343	Minimum capacity	1 - 50	%
		342	Maximum capacity	50 - 100	%
	COMPRESSOR ALARMS	206	Fault alarm delay	0 - 10	min
		158	Fault alarm repeat delay	00:01 - 24:00 (00:00 off)	hr:min
		175	Low refrigerant alarm delay	15 - 240	min
DISCHARGE	PRESSURE CONTROL	394	Discharge pressure control	0=Disabled 1=Enabled	
		50	Discharge pressure setpoint (minimum)	100 to 250	psi
		350	Discharge pressure (maximum)	175 to 380	psi
		157	Refrigeration type	3=404A, 4=407A, 5=407B, 6=507, 7=408, 11=407F 13=407C, 14=448A, 15=449A	
		363	Floating discharge temperature differential	0 - 15	K
		55	Discharge safety level	140 - 400	psi
	PRESSURE ALARM	52	High discharge pressure	140 to 300	psi
		51	Low discharge pressure	100 to 200	psi
		362	Low discharge pressure alarm delay	0 to 20	mins
	PRESSURE TRANSDUCERS	122	Discharge transducer	0=Disabled 1=Enabled	
		422	Discharge transducer full scale (at 20 mA)	300 to 500	psi
		426	Discharge transducer zero scale (at 4mA)	-15 to 0	psi
	FANS SPEED CONTROL	54	Time constant	0 - 250 %	
		395	Gain	0 - 100	
		359	Maximum fan speed	50 - 100	%
		368	Maximum speed at night	50 - 100	%
		369	Timer for nighttime operation	0=disabled 1-8=timer selection	
		358	Minimum fan speed	0 - 25	%
		397	No of steps in backup	0 - 100	%
		357	Discharge pressure cut out	100 - 200	psi
DISPLAY		179	Display units	1 - psi, 2 - bar, 3- kPa	
		189	Backlight control	0 - off 1 - on 2 - off flashes alarm 3 - on flashes alarm	
JNET FUNCTIONS		1	Unit number	0.1 - 899.7	
		18	Daylight saving operation	0= standard time, 1 daylight saving time	

VIRTUAL BITSWITCH	966	Bitswitch Selection	0=Frozen Food (HFC) 1=Chilled (HFC) Where 0-1 is the virtual bitswitch setting on item 966.	

OTHER USEFUL SUCTION ITEMS					
Item	Function	Item	Function	Item	Function
	PRESSURE		**COMPRESSOR DATA (WHERE x IS COMPRESSOR NO.)**		**VARIABLE CAPACITY**
21	Pressure			345	Current proportional term
146	Average pressure (1hr)	2x3	Status	346	current integral term
	CONTROL	2x2	Run hours (10 s of hours)	331	Capacity running (%)
151	Optimised LT setpoint	37x	Run time (last 24 hours)	332	Run hours (10s of hours)
153	Optimised HT setpoint	2x4	Restart timer		
191	Integrated pressure error	35x	Starts per hour (last 24 hours)	344	Capacity loaded (kW)
181	Next increase site (kW)				
182	Next decrease step (kW)				
	PACK DATA				
201	No. of steps on load				
202	No. of compressors running				
203	Loaded capacity (kW)				

OTHER USEFUL DISCHARGE ITEMS			
Item	Function	Item	Function
	PRESSURE		**SPEED CONTROL**
22	Discharge Pressure	391	Steps running (%)
148	Average discharge pressure (1hr)	392	Forced speed
370	Optimised setpoint		
364	Discharge temperature setpoint		
365	Condenser exit temperature		
899	Outside Temperature		

Relay Output Rating
2A resistive

Supply Requirements
230 V ac 48-62 Hz Supply 6 VA maximum inputs
2 mA maximum

24 Vac (optional)

CE This unit conforms with the relevant EU standards when fitted in accordance with its installation instructions.

PREDICT® is the patented JTL pattern recognition algorithm for providing defrost on demand for the cabinets on a system.

Applicable Documentation

Item Numbers	Firmware Variations	Connections Diagram
Doc No. 05609	Doc No. 05610	Doc No. 05611

Installation Information
Doc No. 04256

Note: The information contained in this document applies to the current version of the unit supplied with it. Full operating manuals, item number and software variation information can be obtained from the supplier JTL Systems.

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