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.

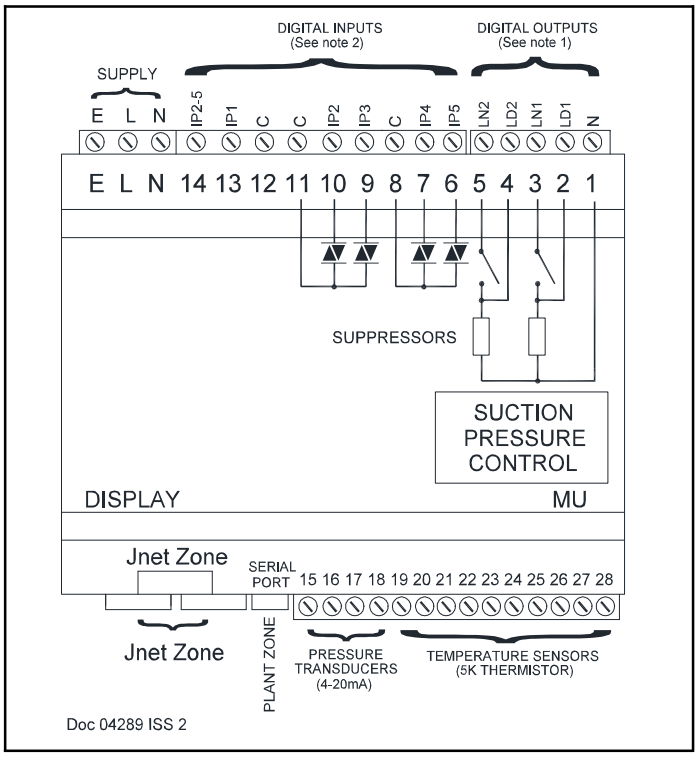
Note 1
The power outputs are fitted with suppressors to protect against electrical interference when switching off solenoid valves or contactors. It is therefore essential to observe the output polarity. The line voltage should be connected to the terminals marked **LN** and the switched loads to **LD.**

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

Note 2
The plant inputs are electrically isolated. Volt free contacts should be connected for the logical conditions stated below. Inputs 2 to 5 use a common input 14. Terminals 12, 11 & 8 (on LP220) must be linked.

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

Digital Output			
1	2 LD1 3 LN1	Suppressed	High Suction Pressure (Alarm)
2	4 LD2 5 LN2	Suppressed	Watchdog
Digital Inputs			
1	12 13	Volt Free	Auto/Manual
2	10 14	Volt Free	High Discharge Pressure
3	9 14	Volt Free	Enable Optimisation
4	7 14	Volt Free	Low Liquid Level (LP220 only)
5	6 14	Volt Free	Low Oil Level (LP220 only)
Analogue INPUT (Pressure)			
18 17	+ -	4-20 mA	Suction Pressure
16 15	+ -	4-20 mA	Not used
Analogue INPUT (Temperature)			
28 27		5k Thermistor	Suction Gas Temperature
26 25		5k Thermistor	Sensor 2
24 23		5k Thermistor	Sensor 3
22 21		5k Thermistor	Sensor 4
20 19		5k Thermistor	Plant Room Temperature



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 3 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 number should be set on item 1.

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

The LP210 & LP220 controller drives the JTL LCD14 display using a CAB75 cable. Various cable lengths are available.

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 controllers can control an inverter trim compressor. When the inverter trim control is available the inverter varies the compressor speed on the trim machine to maintain the pressure. Only when the inverter driven compressor is running at minimum or maximum speed 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)

The stage control is implemented using additional digital interface (IF) modules. One or two IF31 modules are used depending on the number of compressors and stages on the compressors. Up to 8 stages can be controlled using one IF31 module and up to 14 stages can be controlled using IF31 modules.
Note when using two IF31 modules stages 1 -7 are on IF1 & 8-14 on IF2.

The output arrangement for multistage compressors is controlled using item 167.

Compressor output configuration (Note: When compressor 1 is set for 50% unloader then the inverter is disabled) When compressor 1 is not set for inverter control all compressors can be used for stage control.	0 1 2 3 4 5	All compressors 1 stage Compressor 2 50% unload Compressors 2 & 3 50% unload Compressor 1 50% unload Compressors 1 & 2 50% unload Compressors 1 to 3 50% unload

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 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.

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 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 input 2) 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.

INVERTER CONTROL

Inverter Speed Control
The inverter requires the use of an analogue interface module (IF35) which can vary the frequency of the inverter drive is varied using a 0 - 10 signal. The inverter should be set up so that 0 V is for minimum speed and 10 V is maximum speed.

Capacity Control
The controller starts and stops the inverter as required taking account of any other compressors controlled by the same suction pressure. The inverter automatically acts as a trim compressor and all the normal compressor capacity control functions are operational. The capacity of the compressor at minimum and maximum speed is programmed on items 335 and 336.

Minimum Speed
When there are no other compressors running the inverter will stay on at minimum speed until the minimum pressure set on item 341 is achieved.

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

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

MAINTENANCE FACILITY

Forcing a Compressor to Run
A particular compressor may be forced to run by the maintenance unit (MU) (items 217, 227 up to 307) for compressors 1 to 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).

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

ALARMS

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 10 which is shown on item 503.

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

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.

Pressure Transducer Alarm
The pressure transducer is 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.

Low Liquid Level (LP220 only)
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.

Low Oil Level (LP220 only)
An input is available to monitor low oil level in the system. The input should be shortened only when there is no alarm condition. The alarm is given 10 seconds after the input occurs.

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 NETWORK
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.

OTHER USEFUL ITEMS					
Item	Function	Item	Function	Item	Function
	PRESSURE		COMPRESSOR DATA (WHERE x IS		INVERTER
21	Pressure		COMPRESSOR NO.)	345	Current proportional term
146	Average pressure (1hr)	2x3	Status	346	current integral term
31-35	Sensors 1 - 5	2x2	Run hours (10 s of hours)	331	Steps running
	CONTROL	37x	Run time (last 24 hours)	332	Run hours (10s of hours)
151	Optimised LT setpoint	2x4	Restart timer	333	inverter/ compressor status
153	Optimised HT setpoint	35x	Starts per hour (last 24 hours)		
191	Integrated pressure error			344	Capacity loaded
181	Next increase site (kw)		Note compressor 10 uses items		
182	Next decrease step (kw)		300-309, 360-380		
	PACK DATA				
201	No. of steps on load				
202	No. of compressors				
203	running				
	Loaded capacity (kw)				

ADJUSTABLE PARAMETERS				LP210 LP220
	Item	**Function**	**Range**	**Units**
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
	157	Refrigerant type	3 - 15 ® type shown on MU display)	
TEMPERATURES	131-135	Enable sensors 1 to 5	0 - disable 1 - enable	
COMPRESSOR COMMON	200	Number of compressors	1 to 10	
	205	Maximum allowed to run	1 to 10	
	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=2 stages (50/100% (compressor 1-3 only) 3=2 stages (66/100%)(compressors 1-3 only) 4= inverter control (compressor 1 only)	
	2X9	Starts per hours	4-20	
		Note compressor 10 uses items 300-309		
INVERTER	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 steps	1 - 63	
	342	Maximum steps	64 - 127	
	335	Capacity at minimum speed	1 - 100	kW
	346	Capacity at maximum speed	1 - 100	kW
DISPLAY	179	Display units	1 - psi, 2 - bar, 3- kPa	
	189	Display backlight	0 = off 1 - on 2 - off flashing alarm 3 - on flashing for alarm	
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
JNET FUNCTIONS	1	Unit number	0.1 - 899.7	
	18	Daylight saving operation	0= standard time, 1 daylight saving time	
PLANT INTERFACE	909	Interface communications speed	1=1200, 2=2400, 3=4800, 4=9600, 5=19200	
VIRTUAL BITSWITCH	966	Bitswitch Selection	0=Frozen Food (HFC) 1=Chilled (HFC) 2=Frozen Food (CO_2) Where 0-2 is the virtual bitswitch setting on item 966.	

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	Doc No. 03731
Firmware Variations	Doc No. 03732
Connections Diagram (LP210)	Doc No. 03713
Connections Diagram (LP220)	Doc No. 03979
Installation Information	Doc No. 04257
Output Configuration	Doc No. 03867

Note: The information contained in this document applies to the current version of the unit supplied with it. Full operating manuals,

www.jtl.co.uk
JTL Systems Ltd . 41 Kingfisher Court . Hambridge Road . Newbury . Berks . RG14 5SJ Tel: (01635) 263646 Fax: (01635) 263647
JTL Help Desk Tel:08713157535