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 **NO** or **NC**.

The plant inputs are electrically isolated. A line voltage should be connected for the logical conditions **lighting override** and **shutdown.** The terminals marked **C** should be connected to the supply voltage neutral.

CE Conformance

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

Inputs

Input (CON 2)

I1	INPUT 1	(LINE)	SHUTDOWN
C		(NEUTRAL)	
I2	INPUT 2	(LINE)	LIGHTING
C		(NEUTRAL)	OVERRIDE

Temperatures and Pressure (CON 4)

1, 2	AIR ON TEMP
3, 4	AIR OFF TEMP
5, 6	SUCTION LINE
7, 8	EVAPORATOR
9, 10	ENERGY SAVING OR TERMINATION
11, 12	AIR ON 2 TEMP
13, 14	SUCTION PRESSURE - +

Outputs

Outputs (CON 3)

1 NO	OUTPUT 1	(N/O LOAD)	LIGHTING & BLINDS
1 LN		(LINE)	CONTACTOR
2 NO	OUTPUT 2	(N/O LOAD)	FANS / HEATERS
2 LN		(LINE)	
3 NO	OUTPUT 3	(N/O LOAD)	TRIM HEATER
3 LN		(LINE)	
4 NO	OUTPUT 4	(N/O LOAD)	DEFROST
4 LN		(LINE)	
4 NC		(N/C LOAD)	
5 NO	OUTPUT 5	(N/O LOAD)	PULSED EXPANSION
5 LN		(LINE)	VALVE

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 31 to -20.0   press:
[ITEM] [3] [1] [ENTER] [SET] [-] [2] [0] [0] [ENTER]

To correct errors press: [CANCEL]

To select next or previous   items press: [ ] [ ]

Initial Commissioning and Bitswitch Settings

The controller has 4 sets of data built in to its program for use during commissioning. These can be accessed by setting the bitswitches as shown in the table overleaf and then setting item 9 to 1234. From v0.01.3 this controller has virtual bitswitches which replace the physical bitswitches. The virtual bitswitches are set using item 966. 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.

Second Case Option

From v0.01.1 firmware the controller can control and monitor a single evaporator half glass door (HGD) and well case. This option is selected on item 500.

Where the second case option is selected the second case unit number should be set on item 501.

Temperature Display

The temperature displayed is computed from the air on and air off temperatures. A factor is used to proportion the air off and air on temperatures. The temperature can be displayed in Celsius or Fahrenheit as selected by item 122.

The LAPI controller will drive the following JTL displays when used with the CAB55 extension cable.

Display	Cable	Switch
LCD8	CAB55	None
LCD9	CAB55	3 position

Where the second case option is selected, 2 displays can be driven. This is selected using item 502. If this option is selected a JTL display splitter is required. Either of the displays support the keyswitch function but it is not recommended that both displays be keyswitch type.

The LCD9 display incorporates a keyswitch. This switch can be used to select various functions as described below. A maximum of 2 additional functions can be selected. On LCD9 if only one additional function is selected, then it is available in either of the extra 2 positions.

The CAB55 cable is available in various lengths.

Refrigerant Type

This controller will operate for Carbon Dioxide (R744) and various HFC refrigerants as well as HCFC type R408A. The refrigerant choice is made on item 157. CO_2 (R744) operation is only allowed for frozen food applications and requires the pressure transducer to be selected as -1 to 34 bar (item 175 set to 3). Other refrigerants require the transducer to be -1 to 7 bar (item 175 set to 4).

Control Strategy

The controller can control to the cabinet temperature or the air off temperature selected using item 275.

The control strategy for HGD/well operation is that the temperature is controlled to the worst case of the 2 sections. Each case section has its own temperature factor to enable the case temperature to be calculated from the air on and air off temperatures.

The air off temperature is controlled to a computed setpoint shown on item 28, by controlling pulsed expansion valve.

The computed air off temperature setpoint is calculated by comparing the displayed temperature with the cabinet temperature setpoint. The computed setpoint is raised or lowered depending on whether the cabinet temperature is below or above the cabinet temperature setpoint. The computed air off setpoint cannot go below the value set on item 31.

The LAPI controller can be set to operate from 2 cabinet temperature setpoints by setting item 123. The setpoint to be used is then selected using the display keyswitch. The setpoints are set on items 124 and 125 and the current setpoint is displayed on item 30.

Supeheat Control

The superheat control can be set to operate in 3 ways using item 188.

a) SUCCEEDS. In SUCCEEDS strategy the air temperature is controlled and the superheat allowed to float.

The pulsed expansion valve opening is controlled primarily using a PI strategy on the control temperature. The valve is opened and shut over a fixed period of time (6.25 s) to meter the appropriate amount of refrigeration. The proportional gain and the integral time constant for the PI control are adjustable.

b) SUCCEEDS with limit. The superheat is allowed to float to the maximum set on item 189. If the case control temperature error is negative and the superheat is greater that the maximum set on item 189 the expansion valve is closed. It is reopened again with a deadband adjustment on item 140.

c) Fixed. The superheat is controlled using PI control on the superheat temperature. When the case temperature is achieved the PEV is shut. It is reopened again with a deadband adjustment on item 140.

In all cases if the superheat falls below the minimum level set on item 162 or 186, the PEV is progressively shut to effect recovery from excess liquid supply. This is called override.

After override is complete, ie. superheat recovers, PI control will be resumed but with a modified (reduced) value. The modifier is shown on item 190 and the output to the PEV valve is shown on item 168.

The superheat is calculated using the suction pressure and temperature. A backup strategy uses the evaporator and suction line temperatures to calculate the superheat.

Pressure Transducer Failure Strategies

There are 3 strategies (set on item 177):
1. Open circuit. Automatic switch to 2 temperature control and raise transducer fault alarm.
2. Auto zero adjust.
3. Network zero range check against average plant pressure, high pressure gives automatic switch to 2 temperature control. Outside range raise transducer fault alarm.

All 3 strategies are subject to a 5 minute delay timer. The delay is symmetrical i.e. the condition must be present/clear for 5 minutes to set/clear alarm.

7 bar transducers are alarmed at +/- 5 psi and auto zero range limited to +/- 7.5 psi. 34 bar transducers are alarmed at +/- 15 psi and auto zero range limited to +/- 22.5 psi. Auto switch to 2 temperature control is on upper limit of range i.e. +75 and +22.5 psi.

External Shutdown Facilities

If item 273 is set on then when input 1 is energized the expansion valve is closed. This override input is to prevent "flooding back" in the event of plant failure.

There is also a shutdown feature which can be enabled using item 174. High suction pressure on the transducer input can also shut the pulsed expansion valve.

Defrost Initiation Strategies

The defrost strategy can be initiated in 2 fundamental ways using item 107. Defrost initiation can be by real time clock, or by command on the JTL communications network.

Network initiated defrost can be divided into 3 groups; PREDICT, coordinated and scheduled.

This controller uses the PREDICT 1 method which monitors the PEV override operation.

PREDICT defrost requires that a JTL PREDICT defrost coordinator unit is available on the network. This unit receives requests from the PREDICT controllers and coordinates these requests so that the defrosts are organised ensuring the electrical and refrigeration requirements are met. When the controller requests a defrost the PREDICT coordinator will send out a defrost command at a suitable time. If the backup strategy is invoked the controller reverts to real time schedule.

Coordinated timed defrost requires a defrost coordinator to be present in the network. When coordinated timed request is selected then the controller requests a defrost as defined by the number of defrosts a day as set on item 69. The defrost coordinator coordinates the defrost as required. The backup strategy can be chosen to fall to learned defrost schedule or real time backup.

Backup Defrost Initiation Strategies

For network initiated defrost, 2 defrost backup strategies are included. The strategy choice is made on item 107.
For learned backup the last 24 hours defrost operation is continuously monitored and the defrost schedule is learned. For real time backup the defrost schedule as set up for real time defrost on items 51-56 is used.

If network communication fails, the selected backup strategy is automatically used. The unit reverts to network control whenever the network communications is operational.

The backup strategy is also invoked if the network signals that communications has failed to the defrost scheduler or if there is a fault at the defrost scheduler.

Defrost

The defrost output relay is energised during the defrost period. The liquid solenoid is closed during defrost. The auxiliary output can be selected for fan or heater control. During defrost the fans can be stopped or the auxiliary heater energised.

A pump down delay can be applied (item 61) before the defrost/output and
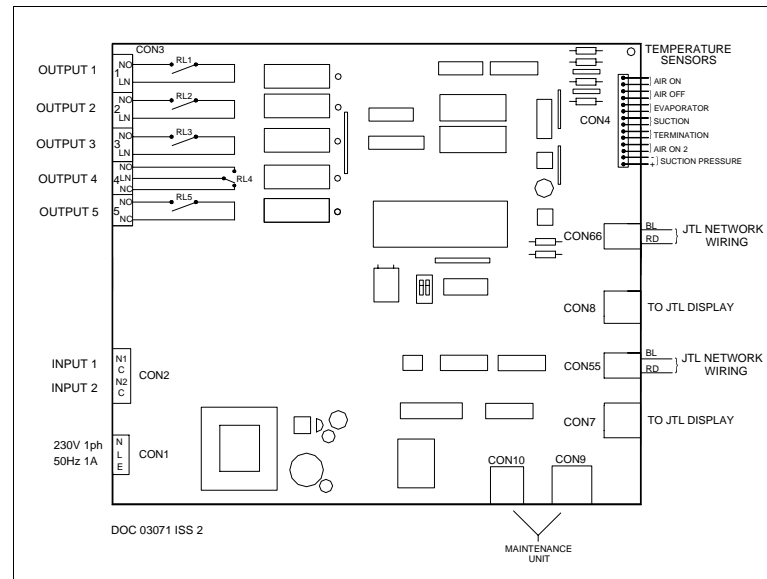
heater are energised. During pump down the PEV output is deenergised.

The display shows "dEF "

Defrost Termination

The controller stays in defrost at least until the minimum defrost time, on item 145, is exceeded. If the termination temperature is reached before the minimum defrost time then the defrost heater is cycled.

Defrost Recovery

When the termination temperature or time is reached the controller enters defrost recovery. The heater is de-energised. The termination method can be chosen using item 144.

A time delay can be applied (item 49) after defrost before the PEV is reopened.

A drain down time delay can be applied (item 59) after defrost before the liquid valve is reopened. During drain down if the auxiliary heater output is selected it is energised.

The display shows "dEF".

Forced Refrigeration and Defrost

The maintenance unit can be used to force controller into a particular mode. This is done using items 77-79. While the maintenance unit is plugged in the controller will remain in the selected mode permanently. Once the maintenance unit is unplugged the controller will revert to normal control after 30 minutes.

When the network initiated defrost strategy is selected, forced defrost will send a command to the JTL defrost scheduler to initiate a defrost and does not act locally.

Fan Control

The fans can be controlled in various ways.

If item 108 is set to "fans off during defrost" then during defrost recovery the fans can be controlled depending on the evaporator temperature or time delay after defrost. If item 109 is set to 00:00 when the evaporator temperature is low enough, the fans start. There is a 5 degree deadband. If item 109 is set to a time then the fans are held off until the time delay has occurred.

If item 108 is set to "fan control during defrost"; the fans are turned off during defrost when the evaporating temperature goes above the setting on item 146. After defrost the fans are turned on when the evaporating temperature falls below the setting on item 150 or the time delay on item 109, if it is not set to 00:00.

If energy saving is selected using item 130, then the fans will be cycled during normal refrigeration. When the energy saving temperature, item 131, goes below the energy saving setpoint, item 132, the fans stop. There is a deadband of ±0.5°C

Lighting and Night Blind Control

The cabinet lights and night blinds can be sequenced on and off by command from the JTL network. An override switch input facility is provided which raises the blinds and turns the lights on. The lights can be switched off from the display keyswitch if item 119 is set to 1 (enabled). The lights are switched off if either fans only or shutdown are selected.

High Temperature Alarms

The cabinet and air off temperatures are monitored continually. The temperatures are averaged over the period set on item 47. If either of the average temperatures exceeds the alarm level then an alarm is given which is shown on the display and available, for remote indication, on the JTL alarm system. High temperature alarms are cancelled during defrost and defrost recovery.

The cabinet temperature tolerance is set on item 32 and the air off tolerance on item 34. Setting either of these tolerances to 0.0°C disables the relevant alarm.

Excessive Superheat Alarms

If the measured Superheat exceeds 50°C then a sensor fault is assumed and the maximum opening of the expansion valve is reduced to 33% of the maximum allowed. When the measured Superheat is between 30 and 50°C the fault condition is activated if the suction temperature exceeds the air on temperature.

Network Shutdown and Fans Only Mode

This controller supports the JTL Network shutdown and fans only facilities. When these facilities are enabled by item 62. If a shutdown or fans only command is received over the JTL Network, the refrigeration is stopped and alarms are disabled. The high temperature alarm sequence is initialised.

Display Controlled Shutdown

The controller can be shutdown for servicing purposes using the display switch. This feature is enabled by item 138.

DOC 03071 ISS 2

Display Controlled Fans Only Mode
The controller can be put into fans only mode using the display switch. This feature is enabled by item 136.

Suction Pressure Optimisation
When used in conjunction with JTL pack control and suction optimisers this unit is normally included in the suction pressure optimiser algorithm. It can be explicitly excluded by setting item 200 to 1.

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.

	item	Function	Range	LAPI Units
ADJUSTABLE PARAMETERS				**LAPI**
	item	Function	Range	Units
TEMPS & ALARMS	33	Cabinet temperature ratio	20 to 80	hr:mn
	36-39	Sensor selections	0=off 1=on	
	147	Termination sensor selection	0=off 1=on	
	32	Cabinet overtemperature tolerance	0 to +20	K
	34	Air off over temperature tolerance	0 to +30	K
	47	Alarm averaging time	00:30 to 03:00	hr:mn
	533	Cabinet temperature rate (second case)	20 - 100	
	532	Cabinet overtemperature tolerance (second case)	0 - 120	K
CONTROL	275	Control temperature	1=Air off 2=cabinet temp	
	123	Enable 2nd setpoint	0=disabled 1=enabled	
	124	Primary cabinet temperature setpoint	-30 to +10	°C
	125	Secondary cabinet temperature setpoint	-30 to +10	°C
	31	Air off temperature setpoint	-39 to +5	°C
	140	Temperature control deadband	0.4 to 3.0	°C
	106	Auxiliary output selection	0=off 1=Fan 2=Heater	
	500	Enable second case	0=Disabled 1=Enabled	
PULSED EXPANSION VALVE FUNCTIONS	157	Refrigerant type	3 - 9 (R type shown on MU display)	
	158	Pressure transducers zero offset	-7 to +7	psi
	161	Superheat measurement method	1=2 temperature 2=pressure	
	188	Superheat control strategy	0=SUCCEEDS, 1=SUCCEEDS with limit, 2=fixed	
	189	Superheat setpoint	6.0 - 12.0	K
	162	Minimum superheat (pressure)	0 - 10	K
	186	Minimum superheat (2 temperature)	0 - 5	K
	163	Maximum valve opening (pressure)	10 - 100	%
	187	Minimum valve opening (2 temperature)	5 - 50	%
	164	Minimum valve opening	0 -50	%
	170	PEV proportional gain	1 - 100	
	171	PEV integral time constant	1 - 250	
	174	High suction pressure shutdown	0=disabled 1=enabled	
	175	Pressure transducer type	3=-1 to 34 bar 4=-1 to 7 bar	
	177	Auto zero pressure enable	0=disabled 1=auto 2=network	
	179	Pressure display choice	1=psi 2=bar 3=kPa	
	273	PEV override input	0=disable 1=enable	
DEFROST INITIATION	107	Defrost strategy	0=none 2=Network (learned backup)3=Time 5=PREDICT 7=Network (real time backup) 8=Coordinated (learned) 9=Coordinated (real time)	
	69	Number of defrosts expected or required	0 to 12	
	61	Pump down time	00:00 - 00:10	hr:mn
	51-56	Defrost schedule	00:01 - 23:59	hr:mn
	60	Defrost schedule 12/24 hour clock	0=24hr 1=12hr	
	211	Evaporator group	0=none 1=Lt 2=Ht 3=Satellite	
	210	Electrical supply distribution panel no	1 to 15 panel no	
	213	Defrost heater circuit	1-15=circuit	
	214	Defrost method	0=brown phase 1=black phase 2=grey phase 3=3 phase 6=off cycle	
	223	Defrost requirement priority	1 to 8	
	225	PREDICT Minimum time between defrosts	2 to 8	hours
	226	PREDICT Maximum time between defrosts	6 to 72	hours
	242	PREDICT override initiation	0 - 100	%
DEFROST TERMINATION	144	Defrost termination method	1=Evaporator 2= Air off 3=Termination 4=Time only	
	50	Defrost termination temp	0 to +20	°C
	145	Minimum defrost time	00:00 - 00:30	hr:mn
	57	Defrost termination time	00:05 to 00:59	hr:mn
	59	Drain down time	00:00 to 00:10	hr:mn
	49	Refrigeration delay after defrost	00:00 to 00:10	hr:mn
FAN CONTROL	108	Fan control	1=run always 2=off during defrost 3=fan controlled during defrost	
	146	Temperature to turn fans off during defrost	-12 to +20	°C
	109	Fan delay after defrost	00:00 - 00:10	hr:mn
	150	Temperature to turn fans on after defrost	-20 to +5	°C
	130	Fan control sensor selection	0=disabled 1=enabled	
	132	Fan control temperature setpoint	-30 to +8	°C
LIGHTING CONTROL	110	Jnet lighting control selection	0=disabled 1=enabled	
	118	Lighting contractor selection	0=n.o 1=n.c	
	119	Enable lights during shutdown	0=disabled 1=enabled	
Jnet FUNCTIONS	1	Unit number	0.1 - 899.8	
	501	Unit number second case	0.1 - 899.8	
	62	Jnet network shutdown selection	0=disabled 1=enabled	
	133	Enable plant to override temp control	0=off 1=on	
	134	Enable plant to cut off refrigeration	0=disabled 1=enabled	
	200	Exclude from suction optimisation	0=include 1=exclude	
	18	Daylight saving operation	0=standard time 1=daylight saving time	
DISPLAY	122	Temperature display choice	0=Celsius 1=Fahrenheit	
	136	Enable fans only mode from display	0=disabled 1=enabled	
	138	Enable display controlled shutdown	0=Off 1=On	
	502	Enable 2nd display	0=Disabled 1=Enabled	

<u>Bitswitch settings</u>   21, o(CC) Frozen food (CO$_2$), **1(CO)** Frozen food (HFC), **2(OC)** Chillers (HFC), **3(OO)** Produce (HFC), where **C** = closed, **O** = open, closed = dot visible (0 to 3 is the virtual bitswitch setting on item 966)

	OTHER USEFUL ITEMS							
Item	Function	Item	Function	Item	Function	Item	Function
	TEMPERATURES		**PULSED EXPANSION VALVE FUNCTIONS**		**MODE INPUTS & OUTPUTS**		**DEFROST**
20	Cabinet temperature	154	Force pressure average to current reading	70	Operating mode	40	Duration of last defrost
21	Air on temperature	155	Suction pressure	274	PEV override input state	41	Time since end of last defrost
22	Air off temperature	156	Superheat	72	Defrost output state	42	Duration of this defrost
23	Evaporator temperature	159	Auto zero offset	74	Auxiliary output state	46	Communications defrost command
24	Suction line temperature	166	Force PEV opening (%)		**LIGHTING**	77	Forced defrost
520	Cabinet temperature (second case)	168	PEV valve opening (%)	111	Communications lighting command	78	Inhibit defrost
521	Air on temperature (second case)	169	PEV status			79	Forced refrigeration
131	Energy saving temperature	181	Time since last override (hr:mn)	112	Lighting override input state	261-272	Learned defrost schedule
141	Termination sensor temperature	182	Duration of last override (sec)	113	Lighting output state	219	Defrost arrangement from network
	CONTROL	190	Modifier output (%)	114	Force lights on	221	Forced defrost requirement
30	Cabinet temperature setpoint			115	Force lights off	222	Enable forced defrost requirement
28	Effective air off setpoint					243	PREDICT override average (%)
240	Liquid valve open %						**Jnet NETWORK FUNCTIONS**
241	Average liquid valve open %					63	Network shutdown and fans only command states
						203	Associated plant suction lin

OUTPUT STATE DIAGRAM FOR JTL CONTROLLER				LAPI

MODE OF OPERATION	OUTPUT & FUNCTION (See note 5)				
	RL2		RL3	RL4	RL5
	AUXILIARY (N/O) can be set to run always [108] See Note 2		TRIM HEATER (N/O)	DEFROST (C/O)	PULSED EXPANSION VALVE (N/O) Solid state output
	Heater	Fans			
NORMAL REFRIGERATION CYCLE — **REFRIGERATION**	OFF	ON (See note 3)	ON	OFF	CYCLES ON AIR OFF TEMPERATURE
PUMP DOWN Adjustable time [61]	OFF	OFF	ON	OFF	OFF
DEFROST Time/temp terminated [57]/[50]	ON	OFF	ON	CYCLES ON TERMINATION TEMP	OFF
DRAIN DOWN Adjustable time [59]	ON	OFF	ON	OFF	OFF
LIQUID HOLD OFF Adjustable time [49]	OFF	OFF	ON	OFF	OFF
RECOVERY TIME Time/temp terminated	OFF	TEMPERATURE OR TIME CONTROLLED (See Note 6)	ON	OFF	CYCLES ON TEMPERATURE
REFRIGERATION	OFF	ON (See note 3)	ON	OFF	CYCLES ON TEMPERATURE
PLANT FAULT	OFF	OFF	ON	OFF	OFF
UNIT SHUTDOWN	OFF	OFF	OFF	OFF	OFF
FANS ONLY SHUTDOWN	OFF	ON	OFF	OFF	OFF
FORCED DEFROST	ON	ON	ON	ON	OFF
FORCED REFRIGERATION	OFF	ON	ON	OFF	CYCLES ON TEMPERATURE
INHIBIT DEFROST	OFF	ON	ON	OFF	CYCLES ON TEMPERATURE

NOTE 2: CAN BE SET TO OFF USING ITEM 106
NOTE 5: RL1 IS FOR LIGHTING CONTROL
NOTE 6: FANS OFF UNTIL TIME SET ON ITEM 109 REACHED.

NOTE 3: CAN CYCLE ON ENERGY SAVING TEMPERATURE (SELECTED BY ITEM 130)

Relay Output Rating
5A resistive.

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

SUCCEEDS® is the patented JTL algorithm for control of liquid injection into an evaporator using electronic expansion valves.

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

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 your supplier or JTL Systems.

Applicable Documentation
Item Numbers	Firmware Variations	Connections Diagram
Doc No. 03396	Doc No. 03404	Doc No. 03408
Evaporator Manual	Installation Requirements	Schematic Diagram
Doc No. 01923	Doc No. 03036	Doc No. 03491