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 **door closed**, **defrost on** or **plant alarm**. 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 C	INPUT 1	(LINE) (NEUTRAL)	DOOR CLOSED
I2 C	INPUT 2	(LINE) (NEUTRAL)	Selectable from: DEFROST ON PLANT ALARM SHUTDOWN MAN TRAPPED
Temperatures and Pressure (CON 4)			
1, 2 3, 4 5, 6 7, 8 9, 10 11, 12 13, 14	AIR ON TEMP AIR OFF TEMP SUCTION LINE EVAPORATOR TERMINATION UNUSED SUCTION PRESSURE – +		

Outputs

Outputs (CON 3)			
1 NO 1 LN	OUTPUT 1	(N/O LOAD) (LINE)	PAN HEATER
2 NO 2 LN	OUTPUT 2	(N/O LOAD) (LINE)	FANS
3 NO 3 LN	OUTPUT 3	(N/O LOAD) (LINE)	NOT USED
4 NO 4 LN 4 NC	OUTPUT 4	(N/O LOAD) (LINE) (N/C LOAD)	DEFROST
5 NO 5 LN	OUTPUT 5	(N/O LOAD) (LINE)	PULSED EXPANSION VALVE or LIQUID SOLENOID 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: + and –

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. 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.

Temperature Display
The temperature displays the coldroom temperature. The temperature can be displayed in Celsius or Fahrenheit as selected by item 122.

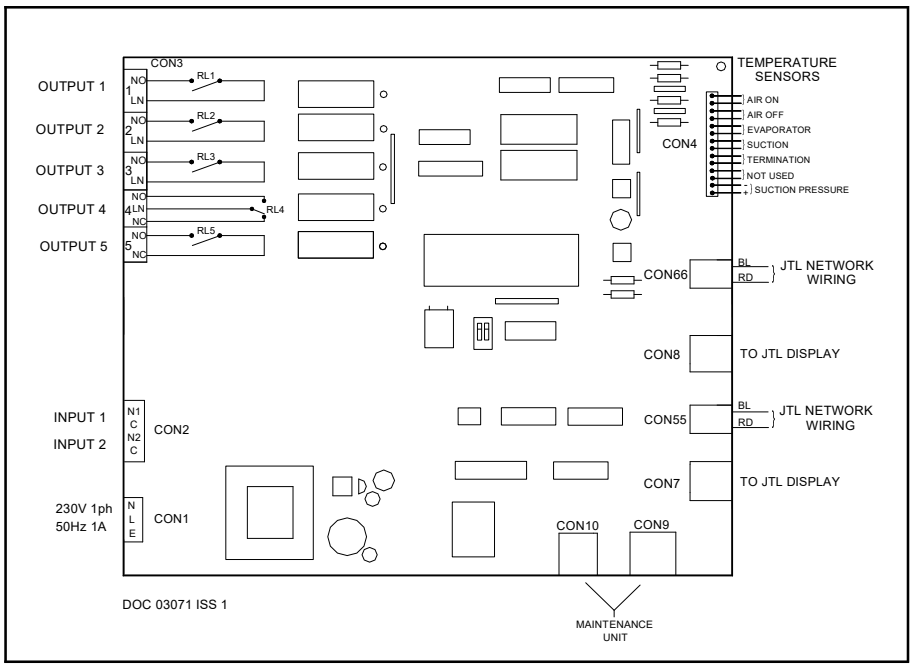
The LACE controller drives the JTL LED5 display using a CAB34 cable. Various cable lengths are available.

Control Strategy
The air off temperature is controlled to a computed setpoint shown on item 28, by controlling either a pulsed expansion valve or a liquid line solenoid valve with a mechanical expansion valve. The choice is made on item 160.

The computed air off temperature setpoint is calculated by comparing the displayed temperature with the temperature setpoint. The computed air off setpoint is raised or lowered depending on whether the air on temperature is below or above the temperature setpoint. The computed air off setpoint cannot go more than 4°C below the air on setpoint.

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

On PEV control, 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.

For liquid solenoid control, if the air off temperature falls below the computed setpoint the liquid valve is closed. There is a deadband of ± 0.2°C.

Defrost Initiation Strategies
The defrost strategy can be initiated in 4 fundamental ways using item 107. Defrost initiation can be by real time clock, by deduction from the suction temperature, by command on the JTL communications network, or by contact input.

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

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 timed defrost or 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.

NOTE: No suction initiated defrost can be detected within 3 hours of the previous defrost.

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
There is a choice of 2 methods of defrost operation, termination or control, using item 75. In termination mode the defrost output relay is energised during defrost recovery period and at any time when the termination temperature is exceeded. In control mode the defrost output relay is energised during the defrost period.

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

For network, real time and contact initiated defrost a pump down delay can be applied (item 61) before the defrost/output and heater are energised. During pump down the liquid outputs are 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.

For network, real time and contact initiated defrost a time delay can be applied (item 49) after defrost before the liquid valve 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.

High Temperature Alarms
The coldroom temperature is monitored continually. The temperature is averaged over the period set on item 47. If the average temperature 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 temperature tolerance is set on item 32. Setting the tolerance to 0.0°C disables the alarm.

Excessive Superheat Alarms (PEV control only)
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.

Inputs
Input 2 function can be selected using item 138. The selection allows for Plant alarm, Shutdown control or Man trapped alarm. The input status is shown on item 139. NOTE when item 107 is set to 4 (contact initiated defrost), this input is assigned as a defrost input.

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.

Coldstore Door Functions
When the coldstore door is opened, refrigeration is stopped by shutting the liquid solenoid valve and stopping the evaporator fans. If the door remains open for a time longer than the value set on item 64 then refrigeration is restarted. If the door remains open for a time longer than set on item 33 then an alarm is given. The door open alarm can be set to be critical using item 126.

Coldroom Isolation
The controller can be isolated for standby operations using item 67. When isolated, all output relays are de-energised and the alarms disabled.

Switch Controlled Shutdown
The controller can be shutdown for servicing purposes using an external switch. This feature is enabled by item 138.

Plant Alarm
A general purpose alarm input is available for alarm indication on the JTL network. The input can be configured as normally open or closed on item 66. This function is enabled using item 138.

Man Trapped Alarm
A man trapped alarm input is available for alarm indication locally and on the JTL network. The alarm is activated when there is no input and is selected using item 138.

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.

ADJUSTABLE PARAMETERS — LACE

	item	Function	Range	Units
TEMPS & ALARMS	36-39	Sensor selections	0=off 1=on	
	147	Termination sensor selection	0=off 1=on	
	32	Overtemperature tolerance	0 to +20	°C
	47	Alarm averaging time	00:30 to 03:00	hr:mn
CONTROL	30	Temperature setpoint	-30 to +25	°C
	48	Compressor starts/hour	unlimited /10/15/20	
	75	Defrost control mode	0=termination 1=control	
	106	Auxiliary output selection	0=off 1=Fan 2=Heater	
	67	Isolate coldroom	0=normal 1=isolated	
PULSED EXPANSION VALVE FUNCTIONS	157	Refrigerant type	0 - 6 ® type shown on MU display)	
	158	Pressure transducers zero offset	-7 to +7	psi
	160	Control valve	0=Liquid solenoid 1=PEV	
	161	Control strategy	1=2 temperature 2=pressure	
	162	Minimum superheat (pressure)	0 - 10	°C
	186	Minimum superheat (2 temperature)	0 - 5	°C
	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	
	177	Auto zero pressure enable	0=disabled 1=enabled	
	179	Pressure display choice	1=psi 2=bar 3=kPa	
DEFROST INITIATION	107	Defrost strategy	0=none 1=Suction 2=Network (learned backup)3=Time 4=Contact 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	
	58	Defrost initiation temp (suction)	-5 to +20	°C
	65	Invert defrost input	0=no 1=yes	
	211	Evaporator group	0=none 1=Lt 2=Ht 3=Satellite	
	213	Defrost heater circuit	0=none 1-7=circuit	
	214	Defrost method	0=red phase 1=yellow phase 2=blue phase 3=3 phase 4=2 pipe gas 5=3 pipe gas 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
	227	PREDICT Sample discard list	0 to 3	
	228	PREDICT volatility setpoint	2 to 12	
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	
	146	Temperature to turn fans off during defrost	-12 to +20	°C
	109	Fan delay after defrost	00:00 - 00:10	hr:mn
DOOR FUNCTIONS	128	Select door functions	0=off 1=on	
	126	Door alarms critical	0=not critical 1=critical	
	33	Door open alarm delay	00:00 to 00:30	hr:mn
	64	Door open refrigeration delay	00:00 to 00:30	hr:mn
Jnet FUNCTIONS	1	Unit number	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	
INPUTS	138	Input 2 function NOTE defrost when 107 set to 4	0=Unused 1=Shutdown 2=Plant alarm 3=Man trapped	
	66	Input plant alarm input	0=Alarm when input present 1=Alarm when input absent	

Bitswitch settings 21, CC Frozen food, CO Ice cream, OC Chillers, OO Produce, where C = closed, O = open, closed = dot visible

OTHER USEFUL ITEMS

Item	Function	Item		Item	Function	Item	Function
	TEMPERATURES		**PULSED EXPANSION VALVE FUNCTIONS**		**MODE INPUTS & OUTPUTS**		**DEFROST**
20	Coldroom temperature	154	Force pressure average to current reading	70	Operating mode	40	Duration of last defrost
21	Air on temperature	155	Suction pressure	71	Door 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	73	Liquid valve output state	46	Communications defrost command
24	Suction line temperature	166	Force PEV opening (%)	74	Auxiliary output state	77	Forced defrost
141	Termination sensor temperature	168	PEV valve opening (%)	139	Input 2 state	78	Inhibit defrost
		169	PEV status		**Jnet NETWORK FUNCTIONS**	79	Forced refrigeration
	CONTROL	181	Time since last override (hr:mn)	63	Network shutdown and fans only command states	261-272	Learned defrost schedule
28	Effective air off setpoint	182	Duration of last override (sec)			219	Defrost arrangement from network
240	Liquid valve open %	190	Modifier output (%)	203	Associated plant suction line	221	Forced defrost requirement
241	Average liquid valve open %				**DOOR FUNCTIONS**	222	Enable forced defrost requirement
				34	Time door presently open		
				35	Time door has been open in last 24 hours		

OUTPUT STATE DIAGRAM FOR JTL CONTROLLER — LACE

MODE OF OPERATION		OUTPUT & FUNCTION				
		RL1	RL2	RL4		RL5
		PAN HEATER (N/O)	FANS (N/O)	DEFROST (C/O) ITEM 75		LIQUID SOLENOID OR PULSED EXPANSION VALVE (N/O) Solid state output See Note 1
				CONTROL	TERMINATION	
NORMAL REFRIGERATION CYCLE	**REFRIGERATION**	OFF	ON	OFF	ON ABOVE TERMINATION TEMP	CYCLES ON AIR OFF TEMPERATURE
	PUMP DOWN Adjustable time [61]	OFF	OFF	OFF	OFF	OFF
	DEFROST Time/temp terminated [57]/[50]	ON	OFF	CYCLES ON TERMINATION TEMP	OFF	OFF
	DRAIN DOWN Adjustable time [59]	ON	OFF	OFF	ON	OFF
	LIQUID HOLD OFF Adjustable time [49]	OFF	OFF	OFF	ON	OFF
	RECOVERY TIME Time/temp terminated	OFF	TEMPERATURE OR TIME CONTROLLED (See Note 2)	OFF	ON	CYCLES ON AIR OFF TEMPERATURE
	REFRIGERATION	OFF	ON	OFF	ON ABOVE TERMINATION TEMP	CYCLES ON AIR OFF TEMPERATURE
PLANT FAULT		OFF	OFF	OFF	ON	OFF
ISOLATED		OFF	OFF	OFF	OFF	OFF
UNIT SHUTDOWN		OFF	OFF	OFF	OFF	OFF
FANS ONLY SHUTDOWN		OFF	ON	OFF	OFF	OFF
FORCED DEFROST		ON	OFF	ON	OFF	OFF
FORCED REFRIGERATION		OFF	ON	OFF	ON	PEV CYCLES (see note 3) ON AIR OFF TEMPERATURE
INHIBIT DEFROST		OFF	ON	OFF	ON	CYCLES ON AIR OFF TEMPERATURE

NOTE 1: SOLENOID OR PULSED EXPANSION VALVE IS OPERATED DEPENDING ON SETTING [160
NOTE 2: FANS OFF UNTIL TIME SET ON ITEM 109 REACHED.
IF 109 SET TO 00:00 FANS CYCLE ON EVAPORATOR TEMPERATURE
NOTE 3: LIQUID SOLENOID OPERATION: ON DURING FORCED REFRIGERATION

Relay Output Rating
5A resistive.

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

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

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 Doc No. 03060	Firmware Variations Doc No. 03061	Connections Diagram Doc No. 03063
Evaporator Manual Doc No. 01923	Installation Information Doc No. 03036	Schematic Diagram Doc No. 03062

LACE userguide.wpd Issue 5 Nov 2018 Doc No. 03095
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