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**.

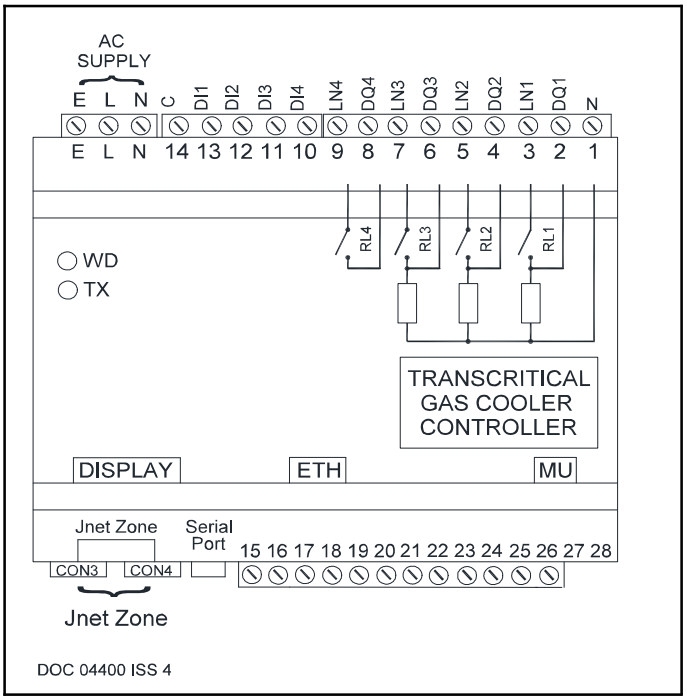
The plant inputs are electrically isolated. A volt free contact should be connected for the logical conditions stated below between the input and common **C** (14).

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				
1	LN DQ	3 2	Suppressed	Not used
2	LN DQ	5 4	Suppressed	Enable High Pressure Valve
3	LN DQ	7 6	Suppressed	Watchdog
4	LN DQ	8 9	Unsuppressed	High Pressure Safety Interlock
Digital Inputs				
1		14 13	Volt Free	Auto
2		14 12	Volt Free	Not used
3		14 11	Volt Free	Fans Healthy
4		14 10	Volt Free	HP Valve Healthy
Analogue OUTPUT				
1	+ -	19 20	0-10 V	Cooler Fan Speed
2	+ -	17 20	4-20mA	High Pressure Valve
		26 16	0V +24v	External Supply
Analogue INPUT				
1	+ -	21 22	5k Thermistor	Cooled Gas Temperature
2	+ -	21 23	5k Thermistor	Ambient Air Temperature
	+ -	15 24	4-20 mA	Cooler Exit Pressure
	+ -	17 20	4-20mA	Cooler Inlet 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 22 press: ITEM 2 2 ENTER

To set item 50 to 650 Press:

ITEM 5 0 ENTER SET 6 5 0 ENTER

To correct errors press: CANCEL

To select next or previous items press: + and −

Initial Commissioning Settings

The controller has 1 set of data built in to its program for use during commissioning. Initialize to this data by setting item 9 to 1234. This loads into the controller a suitable set of data, adjustments should then be made as necessary.

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 MPa as selected by item 9393.

The HP350 controller drives the JTL LCD14 display using a CAB75 cable. Various cable lengths are available.

Transcritical CO2 Operation
When the external ambient reaches a certain level the CO2 becomes supercritical. At this point the CO2 gas cooling strategy has to change as the condenser changes over to being a gas cooler.

The decision to switch to supercritical control from conventional subcritical control is made using the 'adjusted ambient temperature' (item 35).

The adjusted ambient temperature is calculated by taking the difference between the CO2 gas temperature (item 31) and the ambient temperature (item 32). This difference is then limited to 10K and multiplied by a percentage factor (item 36). The result is added to the ambient temperature to produce the adjusted ambient temperature.

When this value exceeds its setpoint (item 37) then supercritical mode control is put into operation. There is a deadband value (item 38) to control switching back to subcritical mode control.

Cooler Pressure Calculation
The cooler can have two transducers, one on the inlet and one on the exit. The exit pressure is required for the exit subcooling calculation for subcritical fan speed control.

The inlet pressure is optimal. The operational cooler pressure can be selected to be the exit, inlet or a mixture of the two pressures on item 65.

When the mixture of the pressures is chosen the proportion the two pressures is specified on item 66. 0%=exit 100%=inlet.

Cooler Pressure Control - Subcritical
In subcritical mode the cooler acts as a conventional condenser, the pressure is controlled by the high pressure valve after the condenser using PI control against an optimised pressure setpoint calculated using the external ambient temperature and the design differential temperature for the condenser.

The head pressure (item 22) is floated to give differential temperature above the ambient condition. The differential (item 363) should be set to the condenser design condition to give maximum condenser efficiency.

The outside ambient temperature (item 32) is read from sensor 2. If this is not available then it is read from the JTL network (item 899). If the outside temperature is not available then the ambient temperature is set to 15C.

The CO2 boiling point (item 365) is calculated from the cooler pressure (item 22).

The target temperature (item 364) for the condenser control is calculated from the outside air temperature plus the design differential temperature. (item 32 + item 363).

The floating pressure setpoint (item 370) is calculated from the target temperature (item 364) and the selected refrigerant (item 157).

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.

Cooler Pressure Control - Supercritical
In supercritical mode the high pressure valve is controlled by PI control against a calculated pressure set point (item 370) calculated using a formula which takes a multiple (item 63) of the external ambient temperature (item 32) and adds a constant (item 64).

Cooler Exit Temperature Control - Subcritical
In subcritical mode the cooler fans are controlled by PI control against a calculated temperature setpoint (item140) which endeavouring to maintain the liquid at a set level of subcooling (item144).

The target temperature is calculated either from the condenser pressure, the ambient temperature or the condenser pressure setpoint. The choice is on item 138.

Cooler Exit Temperature Control - Supercritical
In supercritical mode the cooler acts as a gas cooler where the fan speed is controlled by PI control against temperature setpoint calculated using a formula which takes a multiple (item 146) of the external ambient temperature and adds a constant (item 147).

Minimum Cooler Exit Temperature
The cooler exit temperature setpoint is limited to a minimum value calculated from the ambient temperature and a differential value set on item 143.

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

Minimum Fan Speed
There are separate minimum fan speed controls for subcritical and supercritical control. Both minimums have a base speed set value and both can be automatically varied.

In both subcritical and supercritical mode the compressor capacity loaded is used to increase minimum speed. The speed increase is defined by the number of kW loaded to increase the speed by 1%.

In subcritical mode there is also a programmable temperature profile which reduces the minimum speed at low ambient temperature.

If the exit pressure is not being achieved then the minimum fan speed is increased up to a set maximum level.

If the minimum setting is set >0 then, when the minimum speed is reached the fans stay running until the pressure falls below the cut out level (item 357).

The fans can also be stopped or run at a minimum speed if the high pressure valve closes (item 356).

Maximum Fan Speed
If the pressure exceeds a set level then the maximum fan speed is over ridden in an attempt to reduce the pressure.

There is a programmable temperature profile which reduces the maximum fan speed at low ambient temperatures.

There is a separate maximum fan speed setting for nightime operation (item 368). Nightime is determined by a timer on the JTL network selected on item 369.

High Pressure Valve Control
The controller opens the valve using a 4-20mA signal 4mA is for valve closed and 20mA is for valve fully open.

Control Response
The controller uses proportional and integral control algorithms to control the outputs. These require proportional gain and time constant to adjust the response of the control of outputs.

Output smoothing is available to reduce instability of the outputs where necessary.

Adiabatic Cooling
Adiabatic cooling can be energised when the condenser is not performing adequately under normal control. This is determined by measuring the exit temperature of the cooler and comparing it with a target temperature (item 336) which is based on the ambient temperature (item 32) plus a fixed differential (item 335). When the error exceeds a set differential (item 5174) if the ambient temperature is above the set level (item 5173) then the adiabatic cooling is initiated.

There are settable minimum run (item 5172) and minimum off (item 5171) times.

Adiabatic Test
Adiabatic test can automatically be run on a weekly period basis by setting the period between tests (item 5180), the time of day (item 5182) and day of week (item 5181). The test takes into account the time since the adiabatic last ran and the ambient temperature.

The test can be forced using (item 5184).

Pressure Healthy
The HP350 can be used in conjunction with other controllers. There is an output which indicates if the cooler pressure is within acceptable limits which can be connected to other systems. The acceptable cooler exit pressure level is set as item 55 and the acceptable cooler inlet pressure on item 68.

Pressure Data Sets
The cooler exit pressure can be broadcast via IP in up to two data sets. The set numbers are set on items 101 & 102. Setting 0 disables the broadcast.

The cooler inlet pressure can be broadcast via IP in up to two data sets. The set numbers are set on items 103 & 104. Setting 0 disables the broadcast.

Pressure Alarms
The cooler pressure is constantly monitored and compared with the high alarm level and low alarm level. Different alarm levels are available for subcritical and supercritical operation.

The cooler inlet pressure is monitored and compared with a high alarm level.

The cooler differential pressure is monitored and compared with a high alarm level.

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.

Pressure Transducer Alarms
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 pressure transducer fault, the outputs are set to a settable backup value.

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.dP	High cooler pressure
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

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				HP350
	Item	Function	Range	Units
PRESSURE CONTROL	65	Cooler pressure calculation method	0=cooler exit 1=cooler inlet 2=mixture of both	
	66	Cooler pressure ratio	0 - 100	
	50	Pressure setpoint (minimum)	575 to 725	psi
	350	Pressure (maximum)	1200 - 1600	psi
	67	Cooler pressure safety strategy	0=cooler exit 1=cooler inlet 2=both	
	55	Cooler exit safety level	1200 -1600	psi
	68	Cooler inlet safety level	1200 -1600	psi
	73	Maximum cooler inlet pressure	1200 -1500	psi
	74	Minimum cooler exit pressure	500-600	psi
		Subcritical		
	363	Floating cooler temperature differential	5 to 15	K
		Supercritical		
	63	OAT multiplier	0 - 30	
	64	OAT constant	400 - 1400	psi
COOLER EXIT TEMPERATURE CONTROL		Subcritical		
	144	Sub cooling setpoint	0.0 - 10.0	K
	138	Control strategy	0=condenser pressure 1=ambient temperature 2=Condenser pressure setpoint	
		Supercritical		
	146	OAT multiplier	1.0 - 1.6	
	147	OAT constant	0.0 to 10.0	K
PRESSURE ALARM	52	High condensing pressure (subcritical)	725 to 1200	psi
	51	Low condensing pressure (subcritical)	300 to 600	psi
	62	High cooling pressure (transcritical)	1200 - 1600	psi
	61	Low cooling pressure (transcritical)	600 - 200	psi
	72	High cooler inlet pressure	1200 - 1600	
	69	High cooler differential pressure	0 - 500	
PRESSURE TRANSDUCERS	122	Cooler exit transducer	0=Disabled 1=Enabled	
	422	Cooler exit transducer full scale (at 20 mA)	1450 - 1750	psi
	101	Cooler exit pressure data set 1	0 - 9999 (0=not used)	
	102	Cooler exit pressure data set 2	0 - 9999 (0=not used)	
	123	Cooler inlet transducer	0=Disabled 1=Enabled	
	423	Cooler inlet transducer full scale (at 20 mA)	1450 - 1750	psi
	103	Cooler inlet pressure data set 1	0 - 9999 (0=not used)	
	104	Cooler inlet pressure data set	0 - 9999 (0=not used)	
TEMPERATURES	131	Cooler exit temperature sensor	0=disabled 1=enable	
	132	Ambient temperature sensor	0=disabled 1=enable	
	139	Outside ambient temperature source	0-local 1-network	
	136	Met Office temperature preferred	0 - no 1 - yes	
	143	Minimum cooler exit differential	0 - 10	K
	36	Adjusted ambient factor	0 - 50	%
	37	Adjusted ambient setpoint	21 - 27	°C
	38	Adjusted ambient deadband	1 - 4	K

FAN SPEED CONTROL	54	Time constant (subcritical)	1 - 250	
	56	Time constant (supercritical)	1 - 250	
	395	Proportional gain (subcritical)	5 - 200	
	396	Proportional gain (supercritical)	5 - 200	%
	359	Maximum cooler fan speed	50 - 100	%
	358	Minimum cooler fan speed (subcritical)	0 - 25	psi
	351	Minimum fan speed (supercritical)	0 - 50	%
	327	Minimum fan speed reduction temp (high)	0 - 25	%
	328	Mnimum fan speed reduction temp (low)	-10 - 10	
	324	Compressor capacity loaded		
	325	Compressor capacity data set	0 - 9999	
	352	Compressor capacity to increase supercritical fan speed by 1%	0 - 20	kW
	329	Compressor capacity to increase subcritical fan speed by 1%	0 - 20	kW
	323	Default compressor capacity	0 - 100	kW
	357	Discharge pressure cut out	0 - 20	
	356	Fans strategy when high pressure valve shut	0=normal 1=stop 2=minimum speed	°C
	360	Maximum fan speed reduction temp (high)	5 - 20	°C
	361	Maximum fan speed reduction temp (low)	-5 - 10	%
	368	Maximum speed at night	50 - 100	
	369	Timer for nightime operation	0 - 8	
	397	No of steps in backup	0 - 100	
	389	Fan output smoothing	0 - 5 0=Disabled	
HIGH PRESSURE VALVE CONTROL	374	Time constant (subcritical)	1 - 250	
	375	Proportional gain (subcritical)	5 - 200	
	376	Time constant (supercritical)	1 - 250	
	377	Proportional gain (supercritical)	5 - 200	
	379	Valve output smoothing	0 - 5 0=Disabled	
Adiabatic Control	5170	Adiabatic control	0=disabled 1=enabled	min
	5171	Minimum off time	2 - 10	min
	5172	Minimum run time	5 - 30	°C
	5173	Minimum ambient temperature to enable cooling	2 - 10	°C
	5174	Exit temperature error to run cooling	1 - 5	min
	5175	Trigger delay	1 - 10	week
	5180	Period between automatic tests	0 - 4	
	5181	Test day of week	0=sun, 1=mon, 2=tues, 3=wed, 4=thurs, 5=fri, 6=sat, 7=any day	hr:min
	5182	Test time of day		
	5183	Test cycles	1 - 5	
DISPLAY	9393	Display units - pressure	0 - MPa 1 - psi, 2 - bar, 3 - hPa, 4 - barA	
	9392	Display units - temperature	0 - Celsius 1 =Fahrenheit	
	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	

OTHER USEFUL ITEMS

Item	Function	Item	Function
	PRESSURE		FAN SPEED CONTROL
22	Cooler Pressure	391	Speed (%)
23	Cooler inlet pressure	392	Forced speed
24	Cooler exit pressure	899	Outside Temperature
148	Average cooler pressure (1hr)	324	Compressor capacity loaded
370	Active pressure setpoint		HP VALVE CONTROL
364	Cooler target temperature	371	Output (%)
365	Refrigerant boiling point	372	Forced output
			TEMPERATURES
		31	Cooler exit
		32	Ambient
		35	Adjusted ambient
		820	Met Office 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)

Applicable Documentation

Item Numbers	Firmware Variations	Connections Diagram
Doc No. 05076	Doc No. 05077	Doc No. 05071

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

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

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