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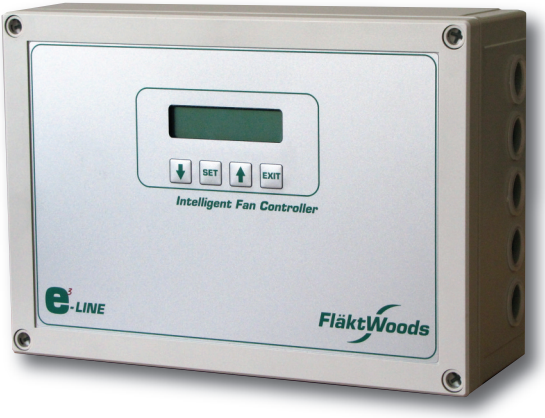
Intelligent Control Module (ICM1)

1.6H – 430743 Generation 2



Safety, Installation, Operation and Maintenance Instructions

Part No.430743

FläktWoods

CONTENTS

INSTALLATION

The intelligent fan module delivery consists of:
- Fan unit
- Intelligent control module
- Sensors, switches and heaters (ancillaries) if purchased with ICM1
- Manual (ancillaries have their own datasheets)

1.1 General

Opening the ICM1 cover is not an operation that occurs in normal usage.
Opening should only be carried out by qualified electricians or trained maintenance persons who are aware of the safety regulations related to low voltage installations (including 240V AC inside box, sensors 24V).
When installing and connecting electrical devices there is always a risk of electrical shock. When wiring and servicing the ICM1 and instrumentation the electrical supply must be switched off and isolated.

1.2 Unpacking

Check that all the equipment that has been ordered has been delivered.
Check visually that all equipment is undamaged.

2 OPERATION METHOD

2.1 Operation Options

The iFan ICM1 is suitable for operating a number of different fan configurations.
These include:
Twin exhaust fans
Single exhaust fans
Single supply fans without heater
Single supply fans with heater

The iFan ICM1 is supplied unconfigured (No Application) and the desired configuration must be entered into it during the commissioning process.

2.2 Control Options

The ICM1 can receive signals from a BMS, switches and/or sensors which determine the operation of the Intelligent fan module.

BMS has the highest priority and no locally connected switches or sensors are active if a signal is received from the BMS.

The switches have the second highest priority. At least one switch must be active for the ICM1 to receive signals from sensors. All the switches have equal mutual priority.

The sensors have the lowest priority. After a switch is active the fan is enabled to respond to a sensor signal. All the sensors have equal mutual priority.

2.2.1 BMS Control

The signal received from the BMS has the highest priority over the operation of the fan. However, when the voltage signal is less than 0.5 V, the controller is locally controlled by the various sensors and switches. When the voltage is between 0.5 V and 1.5 V the fan is either stopped or in trickle ventilation depending on the selected trickle mode. Signals from sensors and switches are not considered. When the BMS signal is between 2 V and 10 V the speed varies proportionally between the maximum and minimum speeds and signals from sensors and switches are not considered.

2.2.2 Local Control

In local control the ICM1 operates according to signals received from the sensors and switches. In local control mode there are two control cases; room control and duct pressure control. The control case is selected during commissioning from the ICM1 display.

2.2.2.1 Indoor Climate Control:

The fan speed is controlled based on signals from switches and sensors. There are sensors for temperature, humidity and CO_2. There are switches for temperature, humidity, and occupancy.

2.2.2.2 Pressure control:
The fan speed is controlled based on the duct pressure measurement so that the fan maintains a constant pressure in the ductwork.

2.2.3 Trickle Ventilation
If no switch is active or if the room sensors give less than minimum speed command to the fan then the fan operation mode is selected by the trickle ventilation mode. If trickle mode is selected the fan will operate on minimum speed. If not selected the fan will stop.

2.2.4 Other Operational Features

2.2.4.1 Twin Fan Duty Select:
The fan in duty is alternated after 12.5/11.5 hours operation. The fan running time is measured and stored even if the fan is stopped to ensure true duty sharing between the two fans. Fan service interval can be prompted from the volt free terminals marked Fan SVC. The fan total running hours can be viewed from the display at any time.

2.2.4.2 Heater Control
An electrical heater can be used to temper the air entering a building. Two control methods are available for electrical heaters:

- The heater is enabled if the outside temperature falls below a level specified at the ICM1. The heater then heats this air to a temperature which is pre set within the heater itself.

- The supply air temperature is measured. The heater is then proportionally controlled to maintain this temperature to a value set at the ICM1.

2.2.4.3 Damper Control
If a main damper is installed it can be opened by the ICM1 when the fan is started. The damper should be 24V supply. Feedback from the damper is used to indicate that the damper is open before the fan is started. If feedback is not received within a specified time of opening a damper alarm is issued and the fan will not start. The time can be adjusted (see 3.4.5). The damper can be of the type that is opened and closed with a motor or spring return.

2.2.4.4 Fan run indication
Volt free contacts are provided which indicate when a fan is running.

2.2.4.5 Fan fault indication
Volt free contacts are provided which indicate when a fault has occurred.

2.3 Cabling
Diagram 1 located at the back of this document shows the location of the various cable connection points.

2.3.1 Power Supply
The incoming power supply is connected to the ICM1 at the terminals marked L1(live), N (neutral) and earth. If a heater enable cable is used this should be isolated at the ICM1 as the control voltage is 230V.

2.3.2 Connecting ICM1 to Fans
Where supplied loose, it is necessary to connect the ICM1 to the fan(s). Terminate motor 1 using the plug and socket marked 'Motor 1' on the circuit board. Connect the second fan onto 'Motor 2' position (note when using a motor with L N & E the N should be terminated on the 'Nreg' terminal).

2.3.3 Damper

Connection Label	Description
Neutral (22)	Neutral connection to damper
24V0 (23)	24v Output
OPN (24)	Power supply to open damper. 24 V to 1 Amp Max.
CLD (25)	Power supply to close damper. 24 V to 1 Amp Max. Note if the damper is spring return this terminal should be left free
RTN (26)	240 V return signal from damper that indicates damper is open.

2.3.4 Installed Plugs
The Intelligent Control module is supplied with plugs installed to assist in the setting up of the ICM1.

2.3.4.1 BMS Plug Connection
A three pin plug is provided for connection to a BMS input. The connection should be made between the pins labelled 0 V and 10 V.

0 V (39)
0 - 10 V Input (38)
24V Output (not used for BMS) (37)

2.3.5 Switched Live
This option can be enabled from the input display to allow a remote enable facility.

2.3.6 Volt Free Contacts
There are three sets of volt free contacts that may be used to remotely monitor operation of the fan unit. Their operation is described below:

Connection Label	Description
Fan SVC	Contact closes when fan running time exceeds service time, indicating service requirement.
Fan FLT	Contact closes if fan or damper fault occurs indicating a repair is required.
Fan RUN	Contact closes when a fan is running.

2.3.7 Sensors and Switches
Individual data sheets are provided for each device. Each device is provided with a 10m cable terminated in a plug which can be plugged directly into the ICM1.

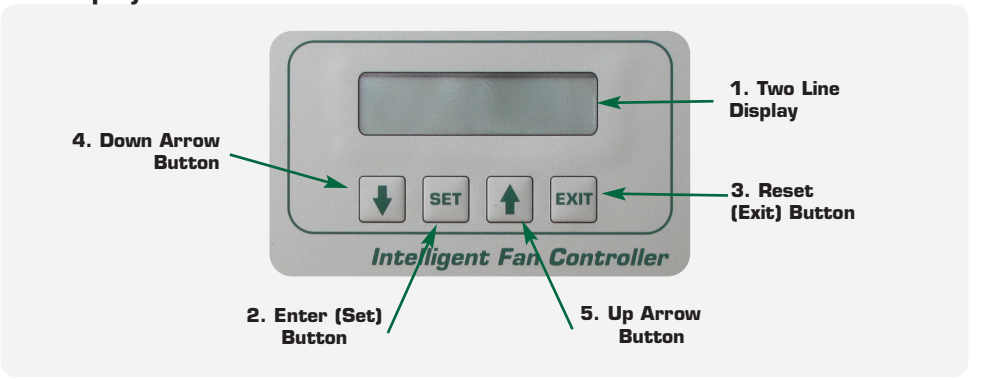
Room Device	Connection Socket
Temperature Switch	Digital
Temperature Sensor	Temp #1
PIR Occupancy	Digital
CO_2 Sensor	0-10 V (analogue)
Relative Humidity Switch	Digital
Relative Humidity Sensor	0-10 V (analogue)
Pressure Sensor	0-10 V (analogue)
Passive Speed Control	Fan Speed Manual

3 OPERATION

3.1 Overview

The ICM1 is a stand alone controller; the operation mode of which can be changed from the display and the operation status of which can be read from the display. The display is used for setting parameters, reading values and for diagnosing reasons for faults.

3.2 Display Front Panel



1. Two line display
   Displays the operating and parameter values and settings.
   Also displays the operating speed as % and current drawn at that point.

2. Enter (Set) Button
   Press enter to read the selected parameter value and enter the written parameter value.

3. Reset (Exit) Button
   Press to reset an alarm. Three seconds validation time.

4. and 5. Arrow Buttons
   Used to browse the parameter list and set the value of the parameter changed.

3.2.1 Toggle function - Twin Fan operation only

By pressing simultaneously both the Up and Down buttons for longer than three seconds the fan in duty is toggled for one minute. This allows the maintenance person to check that both fans will run.

3.3 Setpoints

There are four types of sensor for which it is possible to adjust the setpoint. These are:

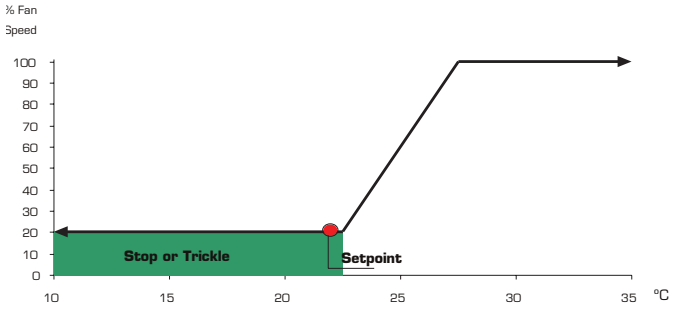
- Temperature
- Relative Humidity (RH)
- CO_2
- Pressure

3.3.1 Temperature Setpoint

The diagram below illustrates the operation of the temperature set point. In this example the set point is 22°C. The application incorporates a "dead" band of 0.5°C. Accordingly measured temperatures lower than 22.5°C will result in the fan being stopped or running at trickle speed, depending on the option selected.

Above the set point + 0.5°C is a proportional band of 5 °C. In this case the proportional band extends to 27.5°C which gives maximum fan speed. Above the proportional band the fan speed remains at maximum.

A further integrating function is also incorporated which used the differences between the temperature setpoint and measured volume to adjust the fan speed. This ensures the set point is reached more quickly. Details on adjusting the set point are given in 3.3.2.

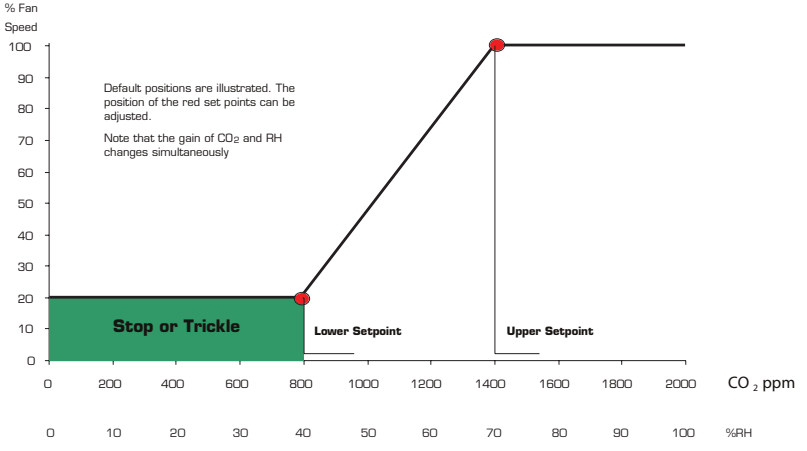


Temperature Setpoint Checklist	
1	Temperature sensor connected to socket marked TEMP #1
2	Configuration parameter set to either Single Fan or Twin Fan
3	Application parameter set to Indoor Climate
4	Temperature setpoint parameter set to desired temperature (default 22°C)

3.3.2 RH and CO_2 Setpoint

The ICM1 is despatched with default settings preprogrammed.

At 800 ppm of CO_2 or 40% RH the fan speed is 20% of maximum. Lower values will result in the fan being stopped or running at trickle speed, depending on the option selected. At 1400 ppm of CO_2 or 70% RH, or higher values, the fan speed is 100%. Between these two sets of values the fan speed will be proportional. It is not possible to select independent RH and CO_2 setpoints. The setpoint values can be altered as per section 3.4.4.



	CO_2 or RH Setpoint Checklist
1	CO_2 sensor connected to socket marked Ain #1 or Ain #2
2	Application parameter set to Indoor Climate
3	Setpoint parameter CO_2 or RH Setpoint Low is set to desired value (default 40%)
4	Setpoint parameter CO_2 or RH Setpoint High is set to desired value (default 70%)

3.3.3 Pressure Setpoint

The intelligent fan module constant pressure system works via a proportional/integral (PI) loop. The commissioning of this type of control loop is part science,part art and all systems will be different.
A pressure sensor should measure the duct pressure close to the fan. The pressure is communicated back to the ICM1. The ICM1 varies the fan speed to maintain a constant pressure in the duct.

The pressure set point must be input to the ICM1. The parameter is called Pressure Set. This is the percentage of the sensor full scale value. The default value is 30, which with the 200 Pa full scale on the pressure sensor equates to 60 Pa. With this set point value and full scale the fan will try to maintain a pressure of 60 Pa by varying the fan speed.

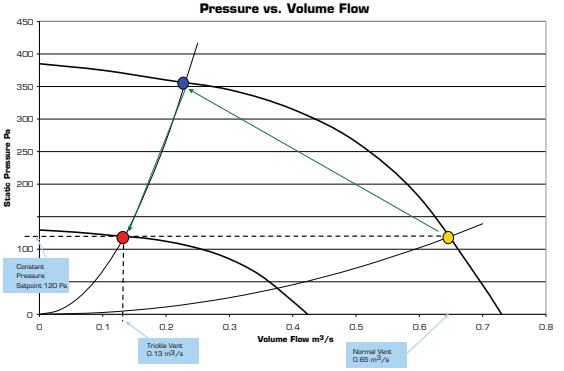
The following is an approximate procedure that may be followed when setting up the ICM1 for pressure control.

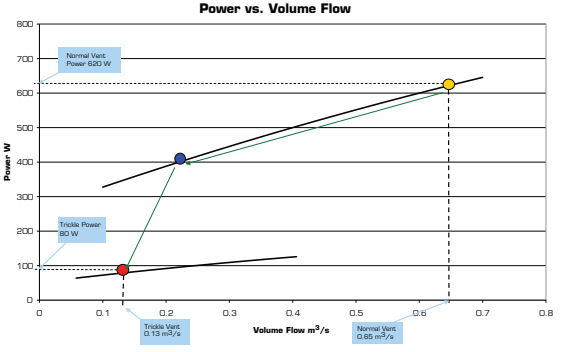
1. Connect the pressure sensor to one of the sockets in the ICM1 marked Ain.
2. Connect the pressure sensor tube to a duct tapping close to the fan.
3. Start the fan.
4. Select the application. Set parameter **Application** to **Pressure Control**.
5. The fan speed will vary to reach a pressure set point . Default value **Pressure Set** is 30%.
6. When the fan first starts up it is common to see a few rapid increases and decreases in fan speed. This is because the ICM1 has no idea of the fan speed required to maintain the pressure setpoint. After a minute or two the fan will settle down to a steady speed.
7. Occasionally the dynamics of the system mean that this equilibrium is not reached and the fan speed continues to increase and decrease rapidly. If this occurs it is necessary to 'tune' the PI loop. There are two parameters to adjust which allow this:
    a) **PI controller P band**, the PI loop proportional band (default 50%)
    b) **PI controller I time**, the PI loop integral band (default 5 secs)

Increasing these values slows down the response of the ICM1 and reduces the rapid speed changes. Too high a value would result in a very slow response to a change in pressure. The best values can only be found by trial and error but it may be worth increasing **P band** first to say 200 and then maybe I time to 7. The process is iterative, a change is made and the result observed. It is necessary to check that the fan starts smoothly once the power is turned on and that the response to a change in pressure when valves open and close is also satisfactory.

8. Consideration should also be given to the **Preset Vent Rate** parameter. This is the speed at which the fan runs when the fan is first started when no value is received from the pressure sensor. If this speed is far different from the speed the fan runs at when the constant pressure is obtained there may be some oscillations in fan speed when the fan is first started. The **Preset Vent Rate** value can be changed to be closer to the steady state speed to reduce this.

A well designed duct system will give a reasonable change in pressure between having the valves open and closed. Unless there is a sufficient change in pressure there will not be a large change in fan speed between having all the valves open and closed. The energy saving is therefore also reduced. The fan performance curve on the next page illustrates this point.





If the change in fan speed between valves open and valves closed is small it is worth checking the operation of the valves. The valve can be adjusted so that in the closed position it is as far shut as possible, giving a high pressure drop. The stroke length of the valve can also be adjusted by two internal switches. If the stroke length is at maximum then the pressure change will also be at a maximum.

Constant Pressure Control Checklist	
1	Pressure sensor connected to socket marked Ain
2	Pressure sensor tube connected to duct or fan pressure tapping
3	Application set to pressure control
4	Pressure Set parameter set to desired value (default 30%)
5	PI loop tuned if necessary using parameters PI Ctrl P Band and PI Ctrl I Time

3.4 Display Architecture

The pages for reading and setting the parameters are divided into five levels.

These are:
Default display
1. (User Level)
2. (Input Display Level)
3. (Commissioning Level)
4. (Restricted Level)

In order for the ICM1 to operate the configuration parameter in the commissioning level must be set. The default configuration is not configured.

3.4.1 Default display
The default display shows the fan speed.
The exit button can be pressed at any time to return to the default.

3.4.2 User Level (1.)
The user level enables reading the running status of the fan.
The user level is accessed by pressing and holding the SET button for 3 seconds.
Release the SET button and use the arrow keys to scroll through the parameters and the SET button to read the value associated with that parameter. All the values at this level are read only.

1. User Level (Press SET for 3 seconds)

Output	Press	Indication	Value
Default		Fan Speed	0 - 100%
	▼		
Duty Fan		Duty Fan	Fan 1 In Duty
			Fan 2 In Duty
	▼		
Master Damper Position		Damper	Open
			Close
	▼		
Total Running Days		Total Run Days	XX Days
			Total running days of the fan
	▼		with the longest run time

3.4.3 Input Display Level (2.)
The input display level is accessed by pressing and holding the SET button for 5 seconds. Release the SET button and use the arrow keys to scroll through the parameters and the SET button to read the value associated with that parameter. All the values at this level are read only.

2. Input Display Level (Press SET for 5 seconds)

Output	Press	Indication	Value
Room Temperature		Room Temp	XX °C
	▼		
Supply Temperature		Supply Temp	XX °C
	▼		
Fan Speed Setpoint		Fan Speed Set	XXX%
	▼		
Outdoor Temperature		Outdoor Temp	XX °C
	▼		
Sensor Value		Sensor Value	XXX%
	▼		
Switch Bus		Switch Bus	Disable
			Enable
	▼		
Switched Live		Switched Live	Disable
			Enable
	▼		
Building Management System		BMS	XXX%
	▼		
Damper Feedback Indicator		Damper	Open
			Close
	▼		

3.4.4 Commissioning Level (3.)

The commissioning level is used for the setting of various modes and set points within the controller. The commissioning level is accessed by pressing and holding the SET button for 10 seconds. Release the button and use the arrow keys to scroll through the parameters and the SET button to read the value associated with that parameter. All the values at this level are read and write.

3. Commissioning Level (Press SET for 10 seconds)

Menu #	Commissioning	Press	Indication	Press	Value	Press	Press
			Text line 1 / 16 car		Text line 2 / 16 car		
3.1	Application		Application	SET	No Application		
					Pressure Control		
					Indoor Climate	▼ ▲	SET
					Default: No Application		
		▼					
3.2	Configuration		Config Heat	SET	No Htr		
					External Htr		
					Proportional Htr	▼ ▲	SET
					Default: No Htr		
		▼					
3.3	Configuration		Config Fan	SET	Not Configured		
					Single Fan		
					Twin Fan	▼ ▲	SET
					Default: Not Configured		
		▼					
3.4	Supply air temp. Setpoint		Supply Air Temp	SET	10 - 40°C	▼ ▲	SET
					Default: 22°C		
		▼					
3.5	Heater enable temp.***)		Htr Enable Temp	SET	10 - 40 C	▼ ▲	SET
					Default: 18°C		
		▼					
3.6	PI controller P band **)		PI Ctrl P Band	SET	50 - 100%	▼ ▲	SET
					Default: 50%		
		▼					
3.7	PI controller I time **)		PI Ctrl I Time	SET	1 - 30 sec	▼ ▲	SET
					Default: 5 sec		
		▼					
3.8	CO_2 or RH Setpoint low *)		CO_2/RH Set Low	SET	0 - 100%	▼ ▲	SET
					Default: 40%		
		▼					
3.9	CO_2 or RH Setpoint high *)		CO_2/RH Set High	SET	0 - 100%	▼ ▲	SET
					Default: 70%		
		▼					
3.10	Pressure setpoint **)		Pressure Set	SET	0 - 100%	▼ ▲	SET
					Default: 30%		
		▼					
3.11	Pre-set ventilation rate **)		Preset Vent Rate	SET	20 - 100%	▼ ▲	SET
					Default: 100%		
		▼					
3.12	Room temp. Setpoint		Room T Set	SET	10 - 40 C	▼ ▲	SET
					Default: 22°C		
		▼					
3.13	Run on time		Run On Time	SET	0 - 60 min.	▼ ▲	SET
					Default: 5 min.		
		▼					
3.14	Stop / Trickle		Stop/Trickle	SET	Trickle ON		
					Trickle OFF	▼ ▲	SET
		▼					
3.15	Fan min		Min. Speed	SET	30 - 50%	▼ ▲	SET
					Default: 30%		
		▼					
3.16	Fan max		Max. Speed	SET	50 - 100%	▼ ▲	SET
					Default: 100%		
		▼					
3.17	Fan Current Limit Set		Fan Current	SET	0.4 A - 6.0 A	▼ ▲	SET
					Default: 2.0 A		
		▼					
3.18	Switch Live input enable		SW Live	SET	Used	▼ ▲	SET
					Ignored		
		▼					
3.19	Airflowswitch enable		AirFlow	SET	Enabled	▼ ▲	SET
		▼			Disabled		

*) Disabled when "Pressure Control" selected (Menu #3.1).
**) Disabled when "Indoor Climate" selected (Menu #3.1).
***) Disabled when "No Htr" selected (Menu #3.2).

Note 1
The trickle function enables the fan to operate at a minimum speed when there is no external demand for ventilation. With the stop function enabled the fan stops when there is no external demand for ventilation.

Note 2
If the fan is to be used with the pressure sensor this function should be enabled.
A switching device (e.g. PIR) should be in place.

Note 3
The preset vent rate is the % speed that the fan runs at when no external sensors are connected to the ICM1 and the fan is started from a switch device or switched live.

Note 4
The run on time is the duration the fan runs for after an enabling switch has opened (from ON to OFF transition). An example is a room occupancy sensing device. After the occupants have left the room the sensing device switches to OFF but the fan continues to run for the duration of the run on time.

3.4.5 Restricted Level (4.)

The restricted window is intended for the use of Fläkt Woods only. The window is accessed by pressing and holding the enter and reset buttons for longer than 10 seconds.

The display returns automatically to the default display after about 10 seconds without any buttons being pressed.

Commissioning	Press	Indication	Press	Value	Press	Press
Offset Correction to Room		Room Temp Offset	SET	+/- 5.0°C	↓	SET
Temperature Measurement				Default: 0.0°C		
	↓				↓	
Damper Opening Time		Damper Open Time	SET	30 - 180 Secs		SET
				Default: 90 Secs		
	↓					
Software Version Number		SW Version No		XXXX		
	↓					

Note 1
The temperature display may not indicate the correct temperature value on the ICM1, particularly if there are long cable runs to the sensor. If this occurs an offset can be input to correct the displayed temperature.

4 HEATER OPTIONS

The ICM1 can be used to control a heater that is used to temper air being supplied to a building. Note this option is only available with single supply fans and cannot be used with twin fan units.

The required heater type would be a thyristor controlled electrical heater.

4.1 Thyristor control

In this mode of operation the heater heats cold outside air entering the building to a pre determined setpoint. The ICM1 enables the heater once the outside air temperature falls below a set level.
The heater is then controlled internally to maintain an outlet temperature which is set within the heater.
Fläkt Woods offer a range of thyristor controlled heaters. Complete instructions for their use are supplied with the heaters. The heater enable control signal may however be used on any heater.
The heater enable connection is volt free and labelled EXT HEATER on the PCB within the controller. In the case of the thyristor heater the connection to the heater is described in the heater O&M.
Outdoor air temperature is measured using a temperature sensor mounted in the duct, upstream of the heater. This is connected to the ICM1 by fitting the pre-fitted plug into the socket within the ICM1 marked 'TEMP #1'.

Note: the voltage from the heater is 240V and should be isolated with the incoming supply to the ICM1.

A temperature value is assigned to the parameter Htr Enable Temp in the commissioning menu of the ICM1. This is the temperature value below which the heater will operate to heat the air entering the building. If the supply temperature is higher than the entered value the heater does not start.
The heater air outlet temperature is not controlled by the ICM1. The heater has an internal temperature sensor and the outlet temperature setpoint is adjusted within the heater itself.
The air temperature to which the heater heats the air is set during commissioning on the dial on the heater terminal box lid. This may be covered by an adhesive label which should be removed to gain access.

5.0 FAULTS AND ALARMS

5.1 Overview

A professional maintenance person should attend to all alarms. The ICM1 will indicate when a fault occurs. Critical faults will result in an alarm, in which case the display will pulse. The alarm volt free contact will also close. A fan service requirement is also considered as a fault, however as this is not considered critical the display will not pulse and the alarm contact will not be made.

5.1.1 Alarms

Possible faults that cause an alarm include:
Single fan failure
Failure of either/both fans in a twinfan
Damper fault/failure

The origin of the alarm can be seen from the display, it will show either FF (fan fault / failure) or DF (damper fault/failure). If an alarm occurs because of a fault on a fan, the other fan will, if possible, run. If a damper alarm occurs neither fan will run.

Fault and Alarm Summary			
Fault Description	Fault Type	Fan Operation	Display Code
Fan Fault	Critical	Other fan will attempt to run if available	Fan Fault
Damper Fault	Critical	Fan stopped	Damper Fault
Fan Service	Non Critical	Fan runs	Fan Service

5.1.2 Service Requirement

A fan service requirement will indicated on the display. It will not cause an alarm and the fan will continue to run. Pressing simultaneously the set and exit buttons for longer than 10 seconds cancels a service alarm and resets the running hours counter.

5.2 Alarm Management

When a fault occurs, the nature of the fault is displayed as above. The highest priority alarm is displayed first, alternating with a numeric value of fan speed. From this alarm display page it is possible to access all the other pages in order to diagnose the problem. Once the alarm page has been left it can only be returned to by switching the power supply on and off to reset the unit and thus initiate the alarm again. If more than one alarm occurs at the same time, only the highest priority alarm is displayed. After the reason for this alarm is repaired the controller must be reset by switching the power supply on and off in order to display the next alarm.

Alternatively, if only one alarm is present; switching the power supply on and off once the fault is repaired will cancel the alarm.

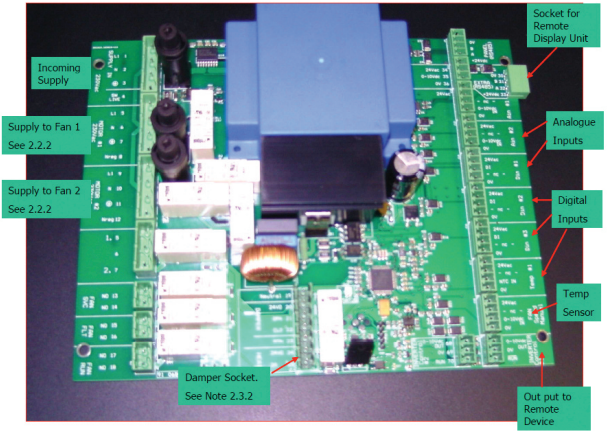
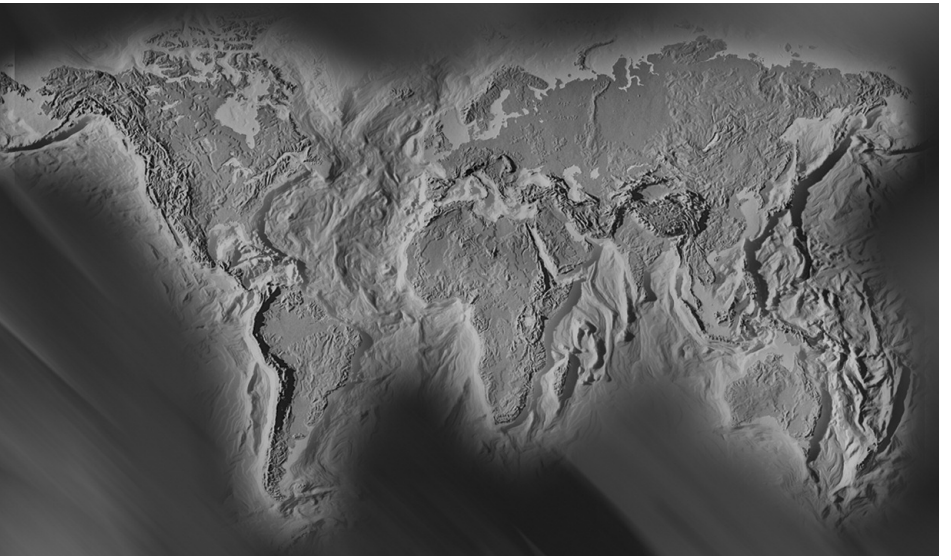


Diagram 1

We Bring Air to Life



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