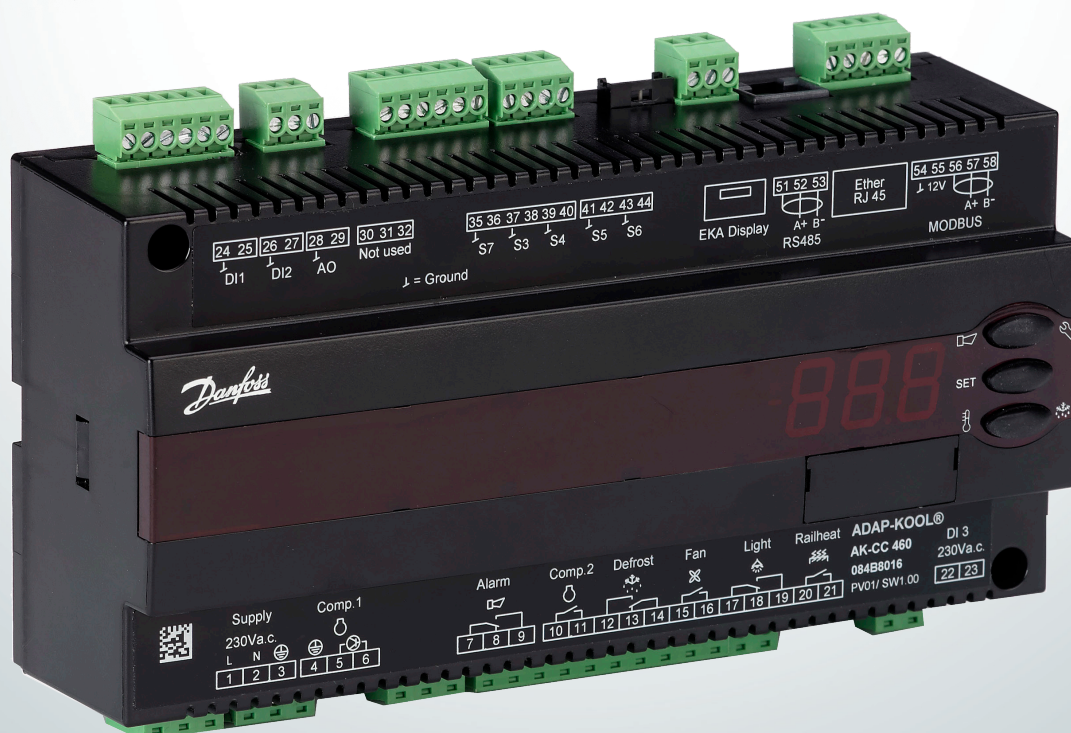


# Controller for SemiPlugin appliance

## AK-CC 460



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## Introduction

### Application

Complete refrigeration appliance control for SemiPlugin refrigeration appliances.

- Where condensation heat is removed using brine
- Flammable refrigerants supported
- The total amount of refrigerant can be distributed across more circuits
- Variable speed compressor control

### Advantages

- Energy optimisation of the whole refrigeration appliance
- One controller for several different refrigeration appliances
- Integrated display at the front of the controller
- Built-in data communication
- Built-in clock function with power reserve

### Principle

The temperature in the appliance is registered by one or two temperature sensors which are located in the air flow before the evaporator (S3) or after the evaporator (S4) respectively. A setting for thermostat, alarm thermostat and display reading determines the influence the two sensor values should have for each individual function.

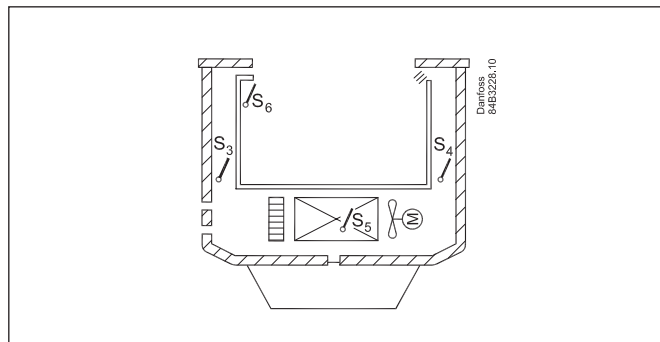
In addition product sensor S6, which can be optionally placed in the appliance, can be used to register the temperature near the required product in a certain place within the appliance.

The temperature of the evaporator is registered with the S5 sensor which can be used as a defrosting sensor.

In addition to the output for the compressors, the controller has 5 relay outputs for dedicated applications.

### Functions

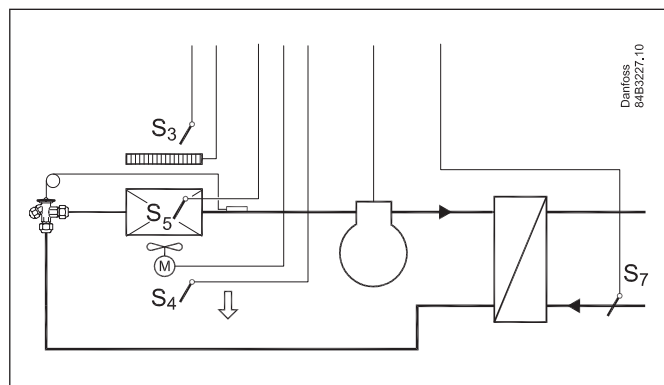
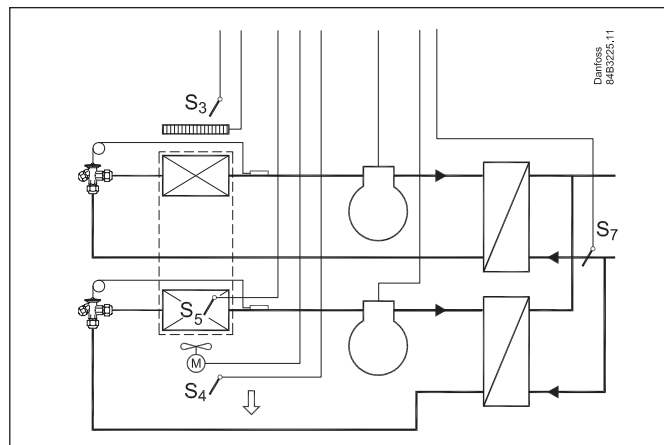
- Day/night thermostat
- Product sensor S6 with separate alarm limits
- Switch between thermostat settings via digital input
- Start of defrost via schedule, digital input or network
- Natural or electric defrost
- Stop of defrost on time and/or temperature
- Coordination of defrost across several controls
- Pulsing of fans when thermostat is satisfied
- Case cleaning function for documentation of HACCP procedure
- Rail heat control via day/night load or dew point
- Door function
- Control of two compressors or one variable speed compressor
- Control of night blinds and light
- Factory calibration that will guarantee a better measuring accuracy than stated in the standard EN ISO 23953-2 without subsequent calibration (Pt 1000 ohm sensor)
- Integrated MODBUS communication with the option of mounting a LonWorks or DANBUSS



## Applications

The controller supports the following 3 control modes:

- Sequential On/Off control of 2 compressors.  
Output 1 will form the base load, and output 2 will connect a lower capacity so that the variation of the cabinet temperature is kept to a minimum.  
The compressors are coupled sequentially. Compressor 1 is first in and last out.
- Cyclic On/Off control of 2 compressors.  
Here the compressors must be of equal size, and they are coupled cyclic.  
The runtimes are equalized.
- Variable speed control of one compressor  
Here one compressor output is used together with the analogue 0 – 10 V signal.  
Enables a very precise control of the cabinet temperature.



### Control with two compressors

When the controller calls for refrigeration, compressor 1 will be cut in to the circuit first.

After the delay time, compressor 2 will be coupled to the circuit. When the temperature has reached the middle of the differential, compressor 2 will be cut out.

Compressor 1 will continue until the temperature has reached the cut-out value. Then it will cut out. When the temperature again reaches the middle of the differential, compressor 1 will be cut in to the circuit again.

If compressor 1 cannot maintain the temperature within the differential, compressor 2 will also be cut in to the circuit.

The compressor's settings for "Min On time" and "Min Off time" will always have top priority during normal regulation. But if one of the override functions is activated, the "Min On time" will be disregarded.

With cyclic control the compressor with the lowest runtime will be started first.

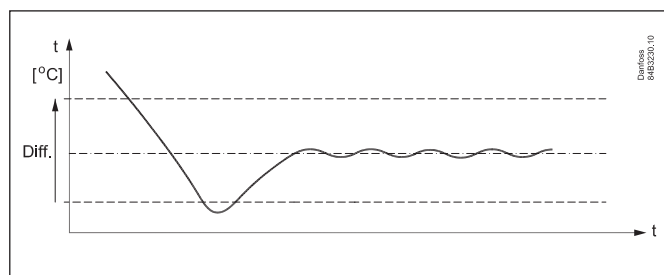
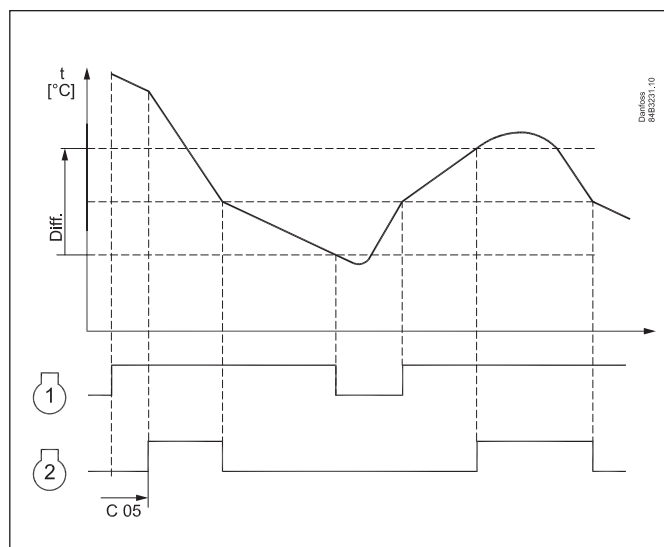
If one of the compressors has been running continuously for two hours, the compressors will be alternated to assure runtime equalization.

### Variable speed control

Here the compressor will be started when the controller requests cooling.

The analogue output will then be used to control the speed so that the temperature is kept very accurate at the reference.

The actual reference is the set cut-out temperature plus half the set difference.



### Temperature control

The temperature in the appliance is registered by one or two temperature sensors which are located in the air flow before the evaporator (S3) or after the evaporator (S4) respectively. A setting for the thermostat, alarm thermostat and display reading determines how much the two sensor values should influence each individual function, e.g. 50% will produce an equal value from both sensors.

There are separate settings for day operation and night operation.

### Temperature monitoring

Just as it is possible for the thermostat, the alarm monitoring can be set with a weighting between S3 and S4 so that you can decide how much the two sensor values should influence the alarm monitoring. Minimum and maximum limits can be set for alarm temperature and time delays. A longer time delay can be set for high temperature alarms after defrosting, appliance cleaning or start-up.

### Thermostat bands

Thermostat bands can be used beneficially for appliances where different product types are stored which require different temperature conditions. It is possible to change between the two different thermostat bands via a contact signal on a digital input. Separate thermostat and alarm limits can be set for each thermostat band – also for the product sensor.

### Night setback of thermostat value

In refrigeration appliances there may be big load differences between the shop's opening and closing hours, especially if night lids/blinds are used. The thermostat reference may be raised here without it having any effect on the product temperature. Change-over between day and night operation can take place, as follows:

- via an external switch signal.
- via a signal from the data communication system.

### Product sensor

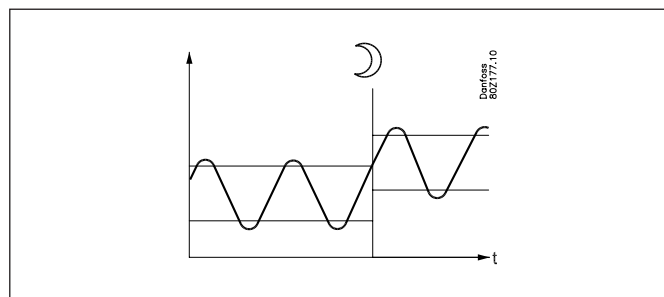
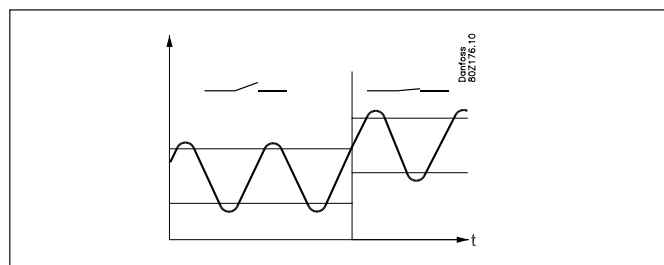
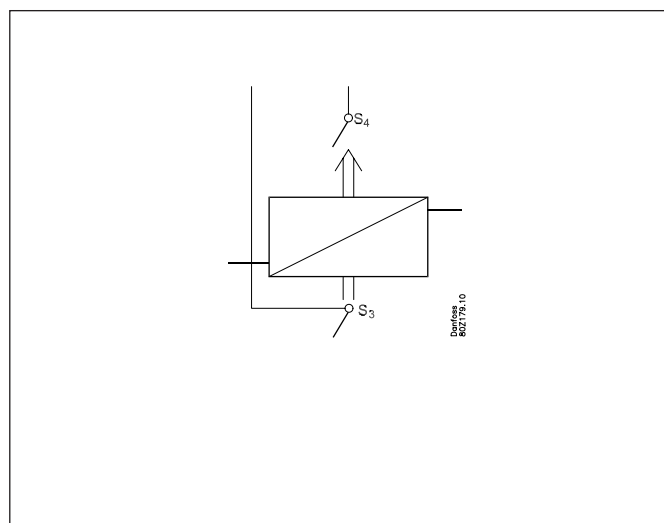
A separate optional product sensor S6, which may be placed in the appliance, can also be used and which can register and monitor the temperature in the warmest part of the appliance. There are separate alarm limits and time delays for the product sensor.

### S7 brine sensor

The temperature at the brine inlet is monitored by the S7 temperature sensor. If the temperature gets higher than the set value, the controller will reduce the cooling capacity, so that the load on the heat exchanger is reduced.

For two-compressor operation, compressor 2 will be taken out of operation.

With variable speed control the compressor speed will be reduced to the value defined by parameter "c93".




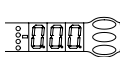


### Appliance cleaning

This function makes it easy for the shop's staff to carry out a cleaning of the appliance according to a standard procedure. Appliance cleaning is activated via a signal – as a rule via a key switch placed on the appliance.

Appliance cleaning is carried out via three phases:

- 1 - at the first activation the refrigeration is stopped, but the fans keep on operating in order to defrost the evaporators. "Fan" is shown on the display.
- 2 - at the second activation the fans are also stopped and the appliance can now be cleaned. "OFF" is shown on the display.
- 3 - At the third activation refrigeration is recommenced. The display will show the actual appliance temperature (o97 setting).

			
-	+	+	°C
1	÷	+	Fan
2	÷	÷	Off
3	+	+	°C

### Documentation

When appliance cleaning is activated a cleaning alarm is transmitted to the normal alarm recipient. A later processing of these alarms will document that the appliance has been cleaned as often as planned.

### Alarm monitoring

There are no temperature alarms during appliance cleaning.

### Defrost

Depending on the application you may choose between the following defrost methods:

- Natural: Here the fans are kept operating during the defrost  
 Electric: The heating element is activated

### Defrost sequence

- 1) Defrost
- 2) Waiting position after defrost
- 3) Drip off
- 4) Delay of fan

### Start of defrost

A defrost can be started in different ways

Interval: Defrost is started at fixed time intervals, say, every eighth hour. An interval must ALWAYS be set to a "higher" value than the period set between two defrostings when a schedule or network signal is used.

Refrigeration time: Defrost is started at fixed refrigeration time intervals, in other words, a low need for refrigeration will "postpone" the defrost

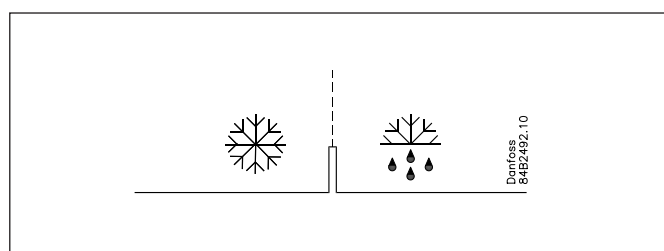
Schedule: Here defrost can be started at fixed times of the day and night. However, max. 6 times

Contact: Defrost is started with a contact signal on a digital input

Network: The signal for defrost is received from a system unit via the data communication

Manual: An extra defrost can be activated from the controller's lower-most button

All the mentioned methods can be used at random – if any of them is activated a defrost will be started.



### Stop of defrost

Defrosting can be stopped by either:

- Time
- Temperature (with time as safety).

### *Coordinated defrost*

There are two ways in which coordinated defrost can be arranged. Either with wire connections between the controllers or via data communication

#### *Wire connections*

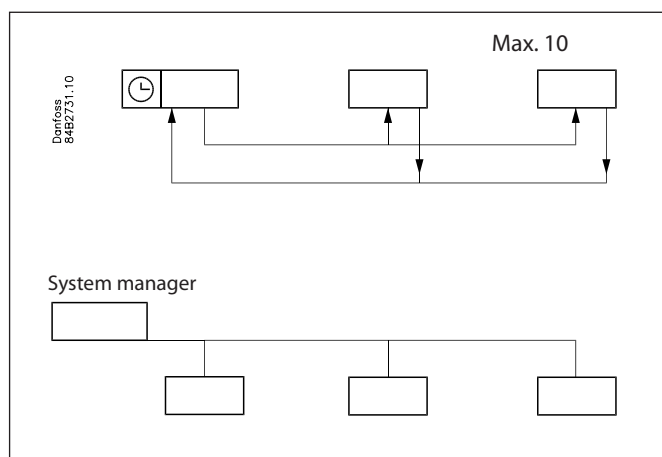
The digital input DI2 is connected between the current controllers. When one controller starts a defrost all the other controllers will follow suit and likewise start a defrost. After the defrost the individual controllers will move into waiting position. When all are in waiting position there will be a change-over to refrigeration.

#### *Coordination via data communication*

Here the system unit handles the coordination.

The controllers are gathered in defrosting groups and the system unit ensures that defrosting is started in the group according to a weekly schedule.

When a controller has completed defrosting, it sends a message to the system unit and then goes into a waiting position. When every controller in the group is in a waiting position, refrigeration is again permitted in all the individual controllers.



### *Defrost on demand*

Based on refrigeration time

When the aggregate refrigeration time has passed a fixed time, a defrost will be started.

### **Melting function**

This function will stop the air flow in the evaporator from being reduced by frost created by uninterrupted operation for a long time. The function is activated if the thermostat temperature has remained in the range between -5°C and +10°C for a longer period than the set melting interval. The refrigeration will then be stopped for the set melting period. The frost will be melted so that the air flow and hence the evaporator's capacity will be greatly improved.

### **Real-time clock**

The controller has a built-in real-time clock which can be used to start defrosts. This clock has a power reserve of four hours.

If the controller is equipped with data communication, the clock will automatically be updated from the system unit.

## Railheat

It is possible to pulse-control the power to the rail heat in order to save energy. Pulse control can either be controlled according to day/night load or dew point.

### Pulse control according to day and night

Various ON periods can be set for day and night operation. A period time is set as well as the percentage part of the period in which the rail heat is ON.

### Pulse control according to dew point

In order to use this function a system manager of the type AK-SM is required which can measure dew point and distribute the current dew point to the appliance controllers. For this the rail heat's ON period is controlled from the current dew point.

Two dew point values are set in the appliance control:

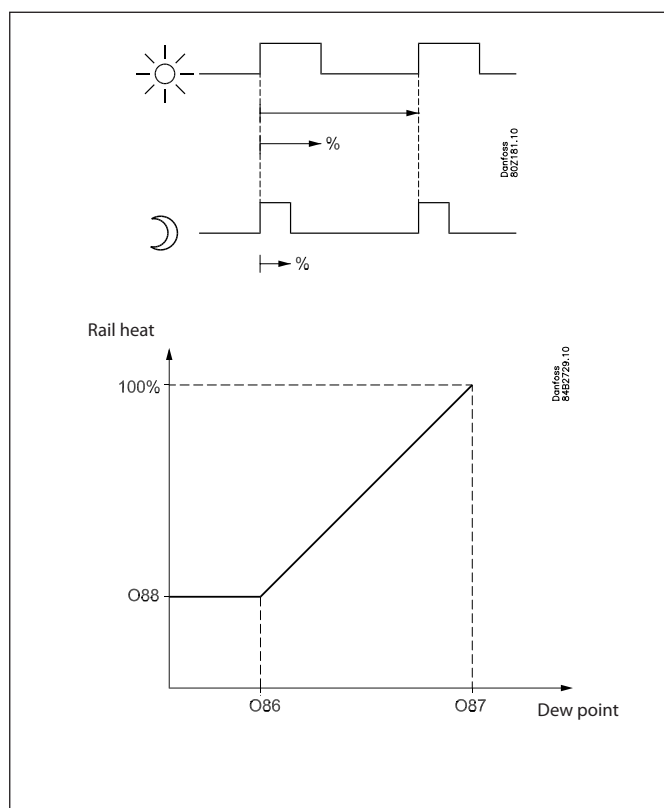
- One where the effect must be max. i.e.100%. (o87)
- One where the effect must be min. (o86).

At a dew point which is equal to or lower than the value in o86, the effect will be the value indicated in o88.

In the area between the two dew point values the controller will manage the power to be supplied to the rail heat.

### During defrosting

During defrosting the rail heat will be controlled by the setting in "d27" (Off, On or pulsing).



## Fan

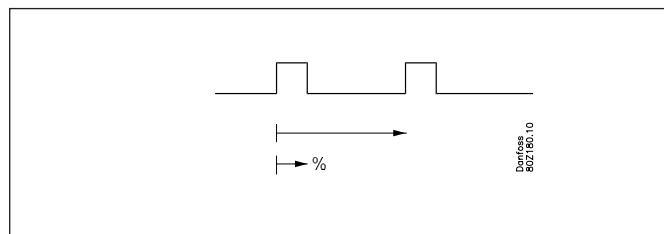
### Pulse control

To obtain energy savings it is possible to pulse control the power supply to the evaporator fans.

Pulse control can be accomplished in one of the following ways:

- during the thermostat's cutout period (cold room)
- during night operation and during the thermostat's cutout period (appliance with night lid /blind)

A period of time is set as well as the percentage of this period of time where the fans have to be operating.



### Cutout of fans during plant breakdowns

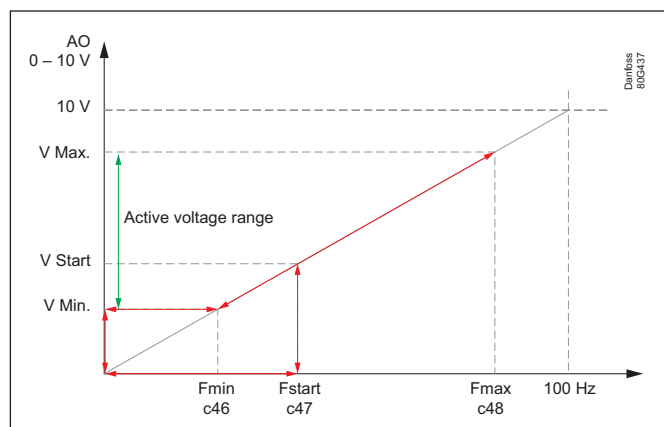
If the refrigeration in a breakdown situation stops, the temperature in the refrigeration appliance may rise as a result of the power supply from fans. In order to prevent this situation the controller can stop the fans if the temperature at S5 exceeds a set limit value.

## Variable speed compressor control

The variable speed compressor control is using these 3 settings:

- Start speed - c47. After starting the compressor, this speed will be maintained for 10 seconds. Hereafter the speed can vary between min. and max speed
- Max. speed - c48. The max allowed speed for the compressor
- Min. speed - c46. At low requested capacity, the set minimum speed will be maintained until the compressor is cut out.

**Note:** the voltage on the analogue output is scaled for the maximum frequency range from min. speed to 100 Hz, meaning that if the max. speed is set lower than 100 Hz, the max. output voltage will be below 10 V.





**Light function**

The function can be used for controlling the light in a refrigeration appliance or in a coldroom. It can also be used for controlling a motorised night blind.

The light function can be defined in three ways:

- the light is controlled via a signal from a door contact. Together with this function a time delay can be set so that the light is kept on for 2 minutes after the door has been closed.
- the light is controlled via the day/night function
- the light is controlled via the data communication from a system unit.

Here there are two operational options if data communication should fail:

- The light can go ON
- The light can stay in its current mode.

The light load must be connected to the NC switch on the relay. This ensures that the light remains on in the appliance if power to the controller should fail.

The light is switched off when "r12" (Main switch) is set to off (see o98).

**Night blind**

Motorised night blind can be controlled automatically from the controller. The night blinds will follow the status of the light function. When the light is switched on, the night blinds opens and when the light is switched off, the night blinds close again. When the night blinds are closed, it is possible to open them and switch on the light using a switch signal on the digital input. If this input is activated, the night blinds will open and the refrigeration appliance can be filled with new products. If the input is activated again, the blinds close again.

A night blind is open and light is switch on when the appliance cleaning function is activated.

A setting can define that the night blind is open when "r12" (Main switch) is set to off (see o98).

When the night blind rolls down, the fans can be stopped so that the air circulation does not interrupt the positioning of the blind. The desired stop time must be set in P65.

The motor for the night blinds must be connected to the same relay as the light function.

**Door contact**

The door contact function can via the digital inputs be defined for two different applications:

**Alarm monitoring**

The controller monitors the door contact and delivers an alarm message if the door has been opened for a longer period than the set alarm delay.

**Alarm monitoring and stop of refrigeration**

When the door is opened the refrigeration is stopped and the fan are stopped and light switch on.

If the door remains open for a longer time than the set restart time, refrigeration will be resumed. This will ensure that refrigeration is maintained even if the door is left open or if the door contact should be defective. If the door remains open for a longer period than the set alarm delay an alarm will also be triggered.

**Digital inputs**

There are two digital inputs DI1 and DI2 with contact function and one digital input DI3 with high voltage signal.

DI1 and DI2 input can be used for the following functions:

- Retransmission of contacts position via data communication
- Door contact function with alarm
- Starting a defrost
- Main switch - start/stop of cooling
- Night setback
- Thermostat bands switch
- General alarm monitoring
- Case cleaning
- Override of night blinds
- Case shut down
- Coordinated defrost (DI2 only)

DI3 is predefined as input from the safety circuit for the compressors. When the voltage on the input is interrupted, the compressors will stop, and the alarm "A97 - Comp.Safety" will be activated.



### Data communication

The controller has fixed built-in MODBUS data communication.

If there is a requirement for a different form of data communication, a Lon RS 485 or DANBUSS module can be inserted in the controller.

The connection must then be to terminal RS 485.

(To use a Lon RS 485 module and gateway type AKA 245 the Gateway software must be Version 6.20 or higher.)

### Display

The controller has one plug for a display. Here display type EKA 163B or EKA 164B (max. length 15 m) can be connected.

EKA 163B is a display for readings.

EKA 164B is both for readings and operation.

The connection between display and controller is with a cable which has a plug at both ends.

If the distance between display and controller is greater than 15 m, the connection must take another form.

An extra module must also be mounted in the controller if data communication is used.

The built-in MODBUS data communication is used so that the display connection and the data communication to the other controllers must take place via a module. The module can be: Lon RS 485, DANBUSS or MODBUS.

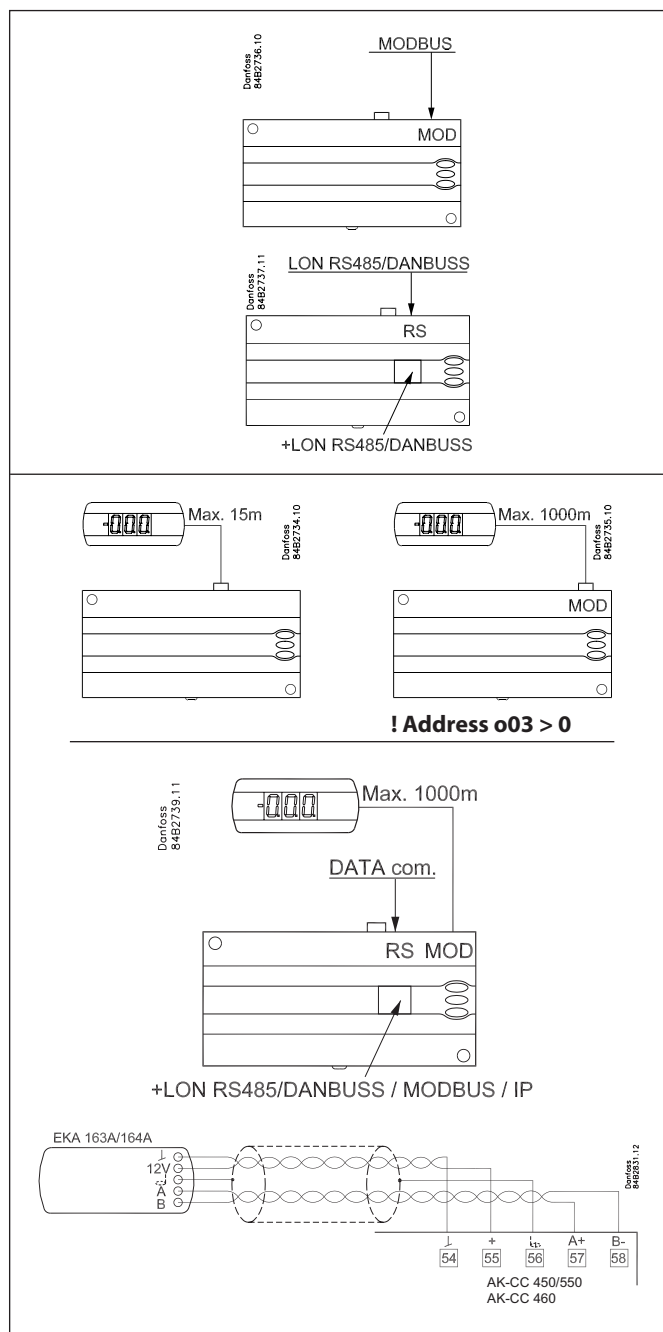
When a display is to be connected to the built-in MODBUS, the display can advantageously be changed to a type with screw terminals. I.e. the type EKA 163A or EKA 164A.

If connection of two displays is required, one must be connected to the plug (max. 15 m) and the other must then be connected to the fixed data communication.

The controllers address must be set higher than 0 in order for the display to be able to communicate with the controller.

### Important

All connections to the data communication MODBUS, DANBUSS and RS 485 must comply with the requirements for data communication cables. See literature: RC8AC.

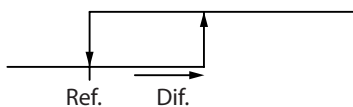


### Override

The controller contains a number of functions which can be used together with the override function in the master gateway/system manager.

Function via data communication	Function in gateway/system manager	Used parameters in AK-CC 460
Start of defrosting	Defrost control / Time schedule / Defrost group	--- Def start
Coordinated defrost	Defrost control / Defrost group	--- HoldAfterDef / --- DefrostState
Prevent defrost start		--- Disable Def
Day/Night schedule	Day/Night control / Time schedule / Light zone	--- Night setback
Light control	Day/Night control / Time schedule	o39 light Remote
Railheat link to dew point	/ Enhanced railheat	--- Dew point

## Survey of functions

Function	Parameter	Parameter by operation via data communication
<b>Normal display</b>		
Normally the temperature value from one of the two thermostat sensors S3 or S4 or a mixture of the two measurements is displayed. In o17 the ratio is determined. If the S6 temperature is to be shown, this must be defined in setting o97.		Display air (u56)
<b>Thermostat</b>		<b>Thermostat control</b>
<b>Set point</b> Regulation is based on the set value plus a displacement, if applicable. The value is set via a push on the centre button. The set value can be locked or limited to a range with the settings in r02 and r03. The reference at any time can be seen in "u91 Cutout temp".		Cutout °C
<b>Differential</b> When the temperature is higher than the reference + the set differential, the compressor relay will be cut in. It will cut out again when the temperature comes down to the set reference. 	r01	Differential
<b>Setpoint limitation</b> The controller's setting range for the setpoint may be narrowed down, so that much too high or much too low values are not set accidentally - with resulting damages.		
To avoid a too high setting of the setpoint, the max. allowable reference value may be lowered.	r02	Max cutout °C
To avoid a too low setting of the setpoint, the min. allowable reference value may be increased.	r03	Min cutout °C
<b>Correction of the display's temperature</b> If the temperature at the products and the temperature received by the controller are not identical, an offset adjustment of the display temperature can be carried out.	r04	Disp. Adj. K
<b>Temperature unit</b> Set here if the controller is to show temperature values in °C or in °F.	r05	Temp. unit °C=0. / °F=1 (Only °C on AKM, whatever the setting)
<b>Correction of signal from S4</b> Compensation possibility due to long sensor cable	r09	Adjust S4
<b>Correction of signal from S3</b> Compensation possibility due to long sensor cable	r10	Adjust S3
<b>Start / stop of refrigeration</b> With this setting refrigeration can be started, stopped or a manual override of the outputs can be allowed. (For manual control the value is set at -1. Then the valve outlet and the relay outlets can be force-controlled by the respective reading parameters (u58, etc.). Here the read value can be overwritten.) Start / stop of refrigeration can also be accomplished with the external switch function connected to a DI input. Stopped refrigeration will give a "Standby alarm".	r12	Main Switch  1: Start 0: Stop -1: Manual control of outputs allowed
<b>Night setback value</b> The thermostat's reference will be the setpoint plus this value when the controller changes over to night operation. (Select a negative value if there is to be cold accumulation.)	r13	Night offset
<b>Thermostat function</b> Here it is shown how the thermostat is operating. 1 = ON/OFF thermostat. The application mode (o61) is set to 1 or 3. The difference is defined by parameter r01 2 = Modulating thermostat. The application mode (o61) is set to 2, and the temperature reference is cut-out plus half the difference set in r01. Note that when a modulating thermostat is used, it is not recommended to set the difference lower than 2 K.	r14	Therm. mode
<b>Selection of thermostat sensor S4% during day operation</b> Here you define the sensor the thermostat is to use for its control function. S3, S4, or a combination of them. With the setting 0%, only S3 is used (Sin). With 100%, only S4.	r15	Ther. S4 %
<b>Melt function</b> Only for control of refrigeration (-5 to +10°C). The function ensures that the evaporator will not be blocked by frost. Here you set how often the function is to stop the refrigeration and hence transform the frost to water (or ice if there is too much frost).	r16	MeltInterval

<b>Melt period</b> Here you set how long an on-going melt function is to last.	r17	Melt period
<b>Set point 2</b> The thermostat's cutout value when the thermostat band 2 is activated via a digital input.	r21	Cutout2 temp
<b>Correction of signal from S6</b> Compensation possibility due to long sensor cable	r59	Adjust S6
<b>Selection of thermostat sensor S4% during night operation</b> Here you define the sensor the thermostat is to use for its control function. S3, S4, or a combination of them. With the setting 0%, only S3 is used (Sin). With 100%, only S4.	r61	Ther.S4% Ngt
<b>The temperature limit for the S4 temperature</b> If a lower temperature is registered, refrigeration will be stopped. Refrigeration is resumed when the S4 temperature is measured at 2 K above the cut-out value. The function is not used if the setting is set to -50 °C, or if it is set to a value that is higher than the thermostat's cut-out value.	r98	S4MinLimit
		Night setback (start of night signal. 0=Day, 1=Night)
		CaseShutDown (Case shut down without alarm)
<b>Alarm</b>		<b>Alarm settings</b>
The controller can give an alarm in different situations. When there is an alarm all the light-emitting diodes (LED) will flash on the controller front panel, and the alarm relay will cut in.		With data communication the importance of the individual alarms can be defined. Setting is carried out in the "Alarm destinations" menu. (Gateway + AKM)
<b>Alarm delay</b> (short alarm delay on air temperature) If the upper or the lower alarm limit values are exceeded, a timer function will commence. The alarm will not become active until the set time delay has been passed. The time delay is set in minutes.	A03	Alarm delay
<b>Time delay for door alarm</b> The time delay is set in minutes. The door function is defined in o02 or o37.	A04	DoorOpen del
<b>Time delay for cooling</b> (long alarm delay) This time delay is used during start-up, during defrost, immediately after a defrost. There will be change-over to the normal time delay (A03) when the temperature has dropped below the set upper alarm limit. The time delay is set in minutes.	A12	Pulldown del
<b>Upper alarm limit</b> Here you set when the alarm for high temperature is to start. The limit value is set in °C (absolute value). The limit value will be raised during night operation. The value is the same as the one set for night setback, but will only be raised if the value is positive.	A13	HighLim Air
<b>Lower alarm limit</b> Here you set when the alarm for low temperature is to start. The limit value is set in °C (absolute value).	A14	LowLim Air
<b>Upper alarm limit for thermostat 2 (Thermostat band 2)</b> (Same function as for thermostat 1)	A20	HighLim2 Air
<b>Lower alarm limit for thermostat 2 (Thermostat band 2)</b> (Same function as for thermostat 1)	A21	LowLim2 Air
<b>Upper alarm limit for S6 temperature at thermostat 1</b>	A22	HighLim1 S6
<b>Lower alarm limit for S6 temperature at thermostat 1</b>	A23	LowLim1 S6
<b>Upper alarm limit for S6 temperature at thermostat 2 (Thermostat band 2)</b>	A24	HighLim2 S6
<b>Lower alarm limit for S6 temperature at thermostat 2 (Thermostat band 2)</b>	A25	LowLim2 S6
<b>S6 temperature alarm delay</b> The alarm is activated if one of the relevant alarm limits A22, A23, A24 or A25 is exceeded. The time delay is set in minutes. Alarms will not activate when the setting is set to the maximum value.	A26	Al. Delay S6
<b>Delay of a DI1 alarm</b> A cut-out/cut-in input will result in alarm when the time delay has been passed. The function is defined in o02.	A27	Al.Delay DI1
<b>Delay of a DI2 alarm</b> A cut-out/cut-in input will result in alarm when the time delay has been passed. The function is defined in o37	A28	Al.Delay DI2
<b>Signal to the alarm thermostat</b> Here you have to define the ratio between the sensors which the alarm thermostat has to use. S3, S4 or a combination of the two. With setting 0% only S3 is used. With 100% only S4 is used	A36	Alarm S4%

<b>Time delay on S6 (product sensor) for pull-down</b> (long alarm delay) This time delay is used for start-up, during defrosting, immediately after a defrost and after an appliance clean. A change is carried out to standard time delay (A26) when the temperature has reached below the set upper alarm limit. The time delay is set in minutes.	A52	PullD del.S6
<b>Hot brine alarm</b> If the S7 brine temperature gets higher than the set value, an alarm will be delivered. If two compressors are in use, compressor 2 will be stopped for as long as the temperature is too high.	A76	MaxS7BrineT.
<b>Brine alarm differential</b> The alarm is cleared, and operation of compressor 2 allowed again when the S7 temperature is lower than "A76" minus the differential.	A77	S7Brine Diff
		Reset alarm
		Ctrl. Error (EKC error)
Compressor		Compressor control
The compressor relay works in conjunction with the thermostat. When the thermostat calls for refrigeration the compressor relay (relays) will be operated. In Application mode 2 it is only the "Compressor 2" relay that is used as start signal. The capacity is controlled via the 0 - 10 V output.		
<b>Running times</b> To prevent irregular operation, values can be set for the time the compressor is to run once it has been started. And for how long it at least has to be stopped. The running times are not observed when defrosts start.		
Min. ON-time (in minutes)	c01	Min. On time
Min. OFF-time (in minutes)	c02	Min. Off time
<b>Time delay for couplings of two compressors</b> Settings indicate the time that has to elapse from the first relay cuts in and until the next relay has to cut in.	c05	Step delay
<b>VSD min Speed</b> Minimum allowed compressor speed	c46	CompMinSpeed
<b>VSD start speed</b> The requested start speed for the compressor (must be set to a higher value than "VSD min speed"). After start this speed is maintained for 10 seconds before variation is possible	c47	CompStrSpeed
<b>VSD max speed</b> The maximum allowed compressor speed	c48	CompMaxSpeed
<b>Kp factor</b> For the PI control of the variable speed compressor	c82	Comp Kp
<b>Tn factor</b> For the PI control of the variable speed compressor	c83	Comp Tn sec
Compressor on-time at sensor error Output "Compressor 1" only. ("Compressor 2" is off.)	c86	CmpOn T Err
Compressor off-time at sensor error Output "Compressor 1"	c87	CmpOff Err
<b>VSD speed at sensor error</b> The fixed speed at which the compressor will run during error on the control sensor	c93	CmpEmrgSpeed
<b>Slope rate</b> Limitation on how fast the compressor speed can change is set in Hz / second	c96	MaxSlopeRate
<b>Kp max factor</b> Max value for Kp at great deviation from the temperature setpoint for the PI control of the variable speed compressor	n95	Cmp Kp Max
The LED on the controller's front will show whether refrigeration is in progress		Comp Relay / Comp2 Relay Here you can read the status of the compressor relay.

Defrost		Defrost control
<p>The controller contains a timer function that is zeroreset after each defrost start. The timer function will start a defrost if/when the interval time is passed. The timer function starts when voltage is connected to the controller, but it is displaced the first time by the setting in d05.</p> <p>If there is power failure the timer value will be saved and continue from here when the power returns.</p> <p>This timer function can be used as a simple way of starting defrosts, but it will always act as safety defrost if one of the subsequent defrost starts is not received.</p> <p>The controller also contains a real-time clock. By means of settings of this clock and times for the required defrost times, defrost can be started at fixed times of the day.</p> <p>Defrost start can also be accomplished via data communication, via contact signals or manual start-up.</p> <p>All starting methods will function in the controller. The different functions have to be set, so that multiple defrosts are avoided..</p> <p>Defrost can be accomplished with electricity.</p> <p>The actual defrost will be stopped based on time or temperature with a signal from a temperature sensor.</p>		
<p><b>Defrost method</b></p> <p>Here you set whether defrost is to be accomplished with electricity or (none). During defrost the defrost relay will be cut in.</p>	d01	Def. method 0 = none 1 = EI
<p><b>Defrost stop temperature</b></p> <p>The defrost is stopped at a given temperature which is measured with a sensor (the sensor is defined in d10). The temperature value is set.</p>	d02	Def. Stop Temp
<p><b>Interval between defrost starts</b></p> <p>The function is zeroreset and will start the timer function at each defrost start. When the time has expired the function will start a defrost.</p> <p>The function is used as a simple defrost start, or it may be used as a safeguard if the normal signal fails to appear.</p> <p>If master/slave defrost without clock function or without data communication is used, the interval time will be used as max. time between defrosts.</p> <p>If a defrost start via data communication does not take place, the interval time will be used as max. time between defrosts.</p> <p>When there is defrost with clock function or data communication, the interval time must be set for a somewhat longer period of time than the planned one, as the interval time will otherwise start a defrost which a little later will be followed by the planned one.</p> <p>In connection with power failure the interval time will be maintained, and when the power returns the interval time will continue from the maintained value.</p> <p>The interval time is not active when set to 0.</p>	d03	Def Interval (0=off)
<p><b>Max. defrost duration</b></p> <p>This setting is a safety time so that the defrost will be stopped if there has not already been a stop based on temperature or via coordinated defrost.</p>	d04	Max Def. time
<p><b>Time staggering for defrost cutins during start-up</b></p> <p>The function is only relevant if you have several refrigeration appliances or groups where you want the defrost to be staggered in relation to one another. The function is furthermore only relevant if you have chosen defrost with interval start (d03).</p> <p>The function delays the interval time d03 by the set number of minutes, but it only does it once, and this at the very first defrost taking place when voltage is connected to the controller.</p> <p>The function will be active after each and every power failure.</p>	d05	Time Stagg.
<p><b>Drip-off time</b></p> <p>Here you set the time that is to elapse from a defrost and until the compressor is to start again. (The time when water drips off the evaporator).</p>	d06	DripOff time
<p><b>Delay of fan start after defrost</b></p> <p>Here you set the time that is to elapse from compressor start after a defrost and until the fan may start again. (The time when water is "tied" to the evaporator).</p>	d07	FanStartDel
<p><b>Fan start temperature</b></p> <p>The fan may also be started a little earlier than mentioned under "Delay of fan start after defrost", if the defrost sensor S5 registers a lower value than the one set here.</p>	d08	FanStartTemp
<p><b>Fan cut in during defrost</b></p> <p>Here you can set whether fan is to operate during defrost.</p> <p>0: Stopped 1 and 2: Running (stopped during "fan delay")</p>	d09	FanDuringDef

<b>Defrost sensor</b> Here you define the defrost sensor. 0: None, defrost is based on time 1: S5 2: S4 3: S5 + S6	d10	DefStopSens.
<b>Pumpdown delay</b> Set the time where the evaporator is emptied of refrigerant prior to the defrost.	d16	Pump dwn del.
<b>Defrost on demand – aggregate refrigeration time</b> Set here is the refrigeration time allowed without defrosts. If the time is passed, a defrost will be started. With setting = 0 the function is cut out.	d18	MaxTherRunT
Define rail heat during defrost: 0: Off 1: On 2: Pulsing	d27	Railh. at def.
<b>Max. duration of -d- on the display</b> Controls the display of "-d-" after defrosting so that "-d-" is displayed until the temperature is okay, the delay in question has expired, or a temperature alarm has been delivered.	d40	Disp. d del.
If you wish to see the temperature at the defrost sensor, push the controller's lowermost button. (May be changed to another function in o92.)		Defrost temp.
If you wish to start an extra defrost, push the controller's lowermost button for four seconds. You can stop an ongoing defrost in the same way		Def Start Here you can start a manual defrost
		Hold After Def Shows ON when the controller is operating with coordinated defrost via data communication.
		Disable def. Defrost in progress can be stopped
		Defrost State Status on defrost 1= shows ongoing defrost
<b>Fan</b>		<b>Fan control</b>
<b>Fan stop temperature</b> The function stops the fans in an error situation, so that they will not provide heat to the appliance. If the defrost sensor registers a higher temperature than the one set here, the fans will be stopped. There will be re-start at 2 K below the setting. The function is not active during a defrost or start-up after a defrost. With setting +50°C the function is interrupted.	F04	FanStopTemp.
<b>Pulse operation of fan</b> 0: No pulse operation 1: Pulse operation when the thermostat does not call for refrigeration 2: Pulse operation when the thermostat does not call for refrigeration, but only during night operation	F05	FanPulseMode
<b>Pulse operation period for fan</b> Here the overall pulse time is set. The sum of ON-to and OFF time.	F06	Fan cycle
<b>ON time for fan</b> Here the % part of the period the fans are to be in operation is set.	F07	Fan ON %
The LED on the controller's front will indicate whether a defrost is going on.		Fan Relay Here you can read the fan relay status, or force-control the relay in "Manual control" mode.
<b>Internal defrosting schedule/clock function</b>		
(Not used if an external defrosting schedule is used via data communication.) Up to six individual times can be set for the defrost start throughout the day.		
Defrost start, hour setting	t01-t06	
Defrost start, minute setting (1 and 11 belong together, etc.) When all t01 to t16 equal 0 the clock will not start defrosts.	t11-t16	
Real-time clock: Setting the clock is only necessary when there is no data communication. In the event of a power failure of less than four hours, the clock function will be saved.		

Clock: Hour setting	t07	
Clock: Minute setting	t08	
Clock: Date setting	t45	
Clock: Month setting	t46	
Clock: Year setting	t47	
<b>Miscellaneous</b>		Miscellaneous
<b>Delay of output signal at start-up</b> When start-up after a power failure the controller's functions can be delayed so that overloading of the electricity supply network is avoided. Here you can set the time delay.	o01	DelayOfOutp.
<b>Digital input signal - DI1</b> The controller has a digital input 1 which can be used for one of the following functions: Off: The input is not used 1) Status display of a contact function 2) Door function. When the input is open it signals that the door is open. The refrigeration and the fans are stopped and light switched on. When the time setting in "A04" is passed, an alarm will be given. The refrigeration will be resumed when time in o89 has passed. 3) Door alarm. When the input is open it signals that the door is open and light on. When the time setting in "A04" is passed, there will be alarm. 4) Defrost. The function is started with a pulse signal. The controller will register when the DI input is activated. The controller will then start a defrost cycle. 5) Main switch. Regulation is carried out when the input is closed, and regulation is stopped when the input is put in pos. OFF. 6) Night operation. When the input is closed, there will be regulation for night operation. 7) Thermostat band changeover. Switch to thermostat 2 (r21) when input is closed. 8) Separate alarm function. Alarm will be given when the input is closed. 9) Separate alarm function. Alarm will be given when the input is opened. 10) Case cleaning. The function is started with a pulse signal. See also description on page 5. 11) Not used 12) Night blinds. Pulse signal activates the night blinds. 13,14) Not used 15) Case Shutdown when input is closed.	o02	DI 1 Config. Definition takes place with the numerical value shown to the left.  (0 = off)  DI state (Measurement) The DI input's present status is shown here. ON or OFF.
If the controller is built into a network with data communication, it must have an address, and the master gateway of the data communication must then know this address.		
<b>Address</b> The address is set between 0 and 240, depending on the system unit and the selected data communication. If the system unit is gateway type AKA 245, the version must be 6.20 or higher.	o03	
<b>Service pin (LON only)</b> The address is sent to the gateway when the menu is set in pos. ON IMPORTANT: Before you set o04, you MUST set o61. Otherwise you will be transmitting incorrect data. (The function is not used when the data communication is MODBUS or DANBUSS)	o04	
<b>Access code 1 (Access to all settings)</b> If the settings in the controller are to be protected with an access code you can set a numerical value between 0 and 100. If not, you can cancel the function with setting 0. (99 will always give you access).	o05	Acc. code
Local readout of Software version	o08	SW version
<b>Network frequency</b> Set the mains supply frequency (50 / 60 Hz). The value is used for variable speed compressor control.	o12	Net Freq
<b>Max. standby time after coordinated defrost</b> When a controller has completed a defrost it will wait for a signal which tells that the refrigeration may be resumed. If this signal fails to appear for one reason or another, the controller will itself start the refrigeration when this standby time has elapsed.	o16	Max HoldTime
<b>Select signal for the display S4%</b> Here you define the signal to be shown by the display. S3, S4, or a combination of the two. With setting 0% only S3 is used. With 100% only S4.	o17	Disp. S4%



<b>Digital input signal - D2</b> The controller has a digital input 2 which can be used for one of the following functions: Off: The input is not used. 1) Status display of a contact function 2) Door function. When the input is open it signals that the door is open. The refrigeration and the fans are stopped. When the time setting in "A04" is passed, an alarm will be given. The refrigeration will be resumed when time in o89 has passed. 3) Door alarm. When the input is open it signals that the door is open. When the time setting in "A04" is passed an alarm will be given. 4) Defrost. The function is started with a pulse signal. The controller will register when the DI input is activated. The controller will then start a defrost cycle. If the signal is to be received by several controllers (coordinated defrost) it is important that ALL connections are mounted the same way (DI to DI and GND to GND). 5) Main switch. Regulation is carried out when the input is closed, and regulation is stopped when the input is put in pos. OFF. 6) Night operation. When the input is closed there will be regulation for night operation. 7) Thermostat band changeover. Switch to thermostat 2 (r21) when the input is closed 8) Separate alarm function. Alarm will be given when the input is closed. 9) Separate alarm function. Alarm will be given when the input is opened. 10) Case cleaning. The function is started with a pulse signal. See also description on page 5. 11) Not used 12) Night blinds. Pulse signal activates the night blinds. 13) The input is used for coordinated defrost in conjunction with other controllers of the same type 14) Not used 15) Case Shutdown when input is closed.	o37	DI2 config.
<b>Configuration of light function</b> 1) Light is controlled via day/night status 2) Light is controlled via data communication and "Light remote o39" 3) Light is controlled by door contact, defined in either o02 or o37 where the setting is selected to either 2 or 3. When the door is opened the relay will cut in. When the door is closed again there will be a time delay of two minutes before the light is switched off. 4) As "2" but if there are any 15-minute network errors, the light will switch on and the night blind will open.	o38	Light config
<b>Activation of light relay</b> The light relay can be activated here, but only if defined in o38 with setting 2.	o39	Light remote
<b>Rail heat during day operation</b> The ON period is set as a percentage of the time	o41	Railh.ON day%
<b>Rail heat during night operation</b> The ON period is set as a percentage of the time	o42	Railh.ON ngt%
<b>Rail heat cycle</b> The period of time for the aggregate ON time + OFF time is set in minutes	o43	Railh. cycle
<b>Case cleaning</b> The status of the function can be followed here or the function can be started manually. 0 = Normal operation (no cleaning) 1 = Cleaning with fans operating. All other outputs are Off. 2 = Cleaning with stopped fans. All outputs are Off. If the function is controlled by a signal at the DI1 or DI2 input, the relevant status can be seen here in the menu.	o46	Case clean
<b>Selection of application</b> The controller can be defined in various ways. Here you select which of the 3 application modes is used: 1: Two compressors – sequential mode 2: One compressor – variable speed controlled 3: Two compressors – cyclic mode <i>This menu can only be set when regulation is stopped, i.e. "r12" is set to 0.</i>	o61	Appl. Mode
<b>Access code 2 (Access to adjustments)</b> There is access to adjustments of values, but not to configuration settings. If the settings in the controller are to be protected with an access code you can set a numerical value between 0 and 100. If not, you can cancel the function with setting 0. If the function is used, access code 1 (o05) <b>must also</b> be used.	o64	Acc. code 2
<b>Save as factory setting</b> With this setting you save the controller's actual settings as a new basic setting (the earlier factory settings are overwritten).	o67	-

<b>Rail heat control</b> The rail heat can be controlled in several ways: 0: The function is not used 1: Pulse control is used with a timer function following the day/night operation (o41 and o42) 2: Pulse control is used with a dew point function. This function requires that a signal is received about the dew point value. The value is measured by a system manager and sent to the controller via the data communication.	o85	Railh. mode
<b>Dew point value where the rail heat is minimum</b> This function is discussed earlier in the manual.	o86	DewP Min lim
<b>Dew point value where the rail heat is maximum</b> This function is discussed earlier in the manual.	o87	DewP Max lim
<b>Lowest permitted rail heat effect</b> Here the % part of the effect to be achieved when the dew point value is minimum.	o88	Rail Min ON%
<b>Start of refrigeration when door is open</b> If the door has been left open, refrigeration must be started after a set time. That time can be set here. (DI config = 2)	o89	DoorInjStart
<b>Alternative display</b> A reading can be displayed on the controller or on the display by pressing the lower button. This reading is set from the factory so that the defrosting stop temperature is displayed. A different setting will give the following reading: 1: (Defrost stop temperature = factory setting) 2: S6 temperature	o92	Displ menu 2
<b>Display of temperature during normal operation</b> 1: Air temperature. Weighted S3 + S4 2: Product temperature S6	o97	Disp. Ctrl.
<b>Light and night blind definition</b> 0: Light is switched off and night blind is open when the main switch is off 1: Light and night blind is independent of main switch.	o98	Light MS = Off
<b>Configuration of the alarm relay</b> The alarm relay will be activated upon an alarm signal from the following groups: 1 - High temperature alarms 2 - Low temperature alarms 4 - Sensor error 8 - Digital input is activated for alarm 16 - Defrost alarms 32 - Miscellaneous The groups that are to activate the alarm relay must be set by using a numerical value which is the sum of the groups that must be activated. (E.g. a value of 5 will activate all high temperature alarms and all sensor errors. 0 will cancel the relay function)	P41	Al.Rel. Conf.
<b>Fan pause while the night blinds are rolling down.</b> Here it is possible to set a pause time for the fans so that the night blinds can roll down into the correct position unobstructed.	P65	BlindFanStop

Service		Service
Temperature measured with S5 sensor	u09	S5 temp.
Status on DI1 input. on/1=closed	u10	DI1 status
Read the duration of the ongoing defrost or the duration of the last completed defrost.	u11	Defrost time
Temperature measured with S3 sensor	u12	S3 air temp
Status at the day-/night operation (night operation: on/off)	u13	Night Cond.
Temperature measured with S4 sensor	u16	S4 air temp
Thermostat temperature	u17	Ther. air
Read the ongoing cutin time for the thermostat or the duration of the last completed cutin	u18	Ther runtime
Read the temperature at the S6 sensor	u36	S6 temp
Status on DI2 input. on/1=closed	u37	DI2 status
Readout of the actual compressor capacity in %	u52	CompCap %
Air temperature. Weighted S3 +S4	u56	Display air
Measured temperature for alarm thermostat	u57	Alarm air

Status on relay for cooling	u58	Comp1/LLSV
Status on relay for fan	u59	Fan relay
Status on relay for defrost	u60	Def. relay
Status on relay for railheat	u61	Railh. relay
Status on relay for alarm	u62	Alarm relay
Status on relay for light	u63	Light relay
Status on relay for compressor 2	u67	Comp2 relay
Readout of the actual rail heat effect in %	u85	Rail DutyC %
Readout of which thermostat used for regulation: 1= Thermostat 1, 2= Thermostat 2	u86	Ther. band
Status on input DI3 (on/1 = 230 V)	u87	DI3 status
Readout of the actual cutin value for the thermostat	u90	Cutin temp.
Readout of the actual cut out value for the thermostat	u91	Cutout temp.
Temperature measured by S7 brine sensor	u98	S7 temp.
Readout of the voltage signal on the analogue output	U44	AO_1 Volt

**Forced control**

If you need to force-control an output, you should set r12 to -1 (manual mode). You should then select the relevant relay function, e.g. u58. Go to the function by pressing the middle button. Select On.

Operating status		(Measurement)
The controller goes through some regulating situations where it is just waiting for the next point of the regulation. To make these “why is nothing happening” situations visible, you can see an operating status on the display. Push briefly (1s) the upper button. If there is a status code, it will be shown on the display. The individual status codes have the following meanings:		Ctrl. state: (Shown in all menu displays)
Normal regulation	S0	0
Waiting for end of the coordinated defrost	S1	1
When the compressor is operating it must run for at least x minutes.	S2	2
When the compressor is stopped, it must remain stopped for at least x minutes.	S3	3
The evaporator drips off and waits for the time to run out	S4	4
Refrigeration stopped by main switch. Either with r12 or a DI-input	S10	10
Refrigeration stopped by thermostat	S11	11
Refrigeration has been stopped by the S4 limit	S12	12
Defrost sequence. Defrost in progress	S14	14
Defrost sequence. Fan delay — water attaches to the evaporator	S15	15
Door is open. DI input is open	S17	17
Melt function in progress. Refrigeration is interrupted	S18	18
Modulating thermostat control	S19	19
Emergency cooling due to sensor error *)	S20	20
Manual control of outputs	S25	25
Case cleaning	S29	29
Delay on outputs during start-up	S32	32
Case shutdown	S45	45
<i>Other displays:</i>		
The defrost temperature cannot be displayed. There is stop based on time	non	
Defrost in progress / First cooling after defrost	-d-	
Password required. Set password	PS	
Regulation is stopped via main switch	OFF	

\*) Emergency cooling will take effect when there is lack of signal from a defined S3 or S4 sensor. The regulation will continue with a registered average cutin frequency. There are two registered values – one for day operation and one for night operation.

**Fault message**

In an error situation the LED's on the front will flash and the alarm relay will be activated. If you push the top button in this situation you can see the alarm report in the display.

There are two kinds of error reports - it can either be an alarm occurring during the daily operation, or there may be a defect in the installation.

A-alarms will not become visible until the set time delay has expired.

E-alarms, on the other hand, will become visible the moment the error occurs.

(An A alarm will not be visible as long as there is an active E alarm).

Here are the messages that may appear:

Code / Alarm text via data communication	Description	Alarm relay groups (P41)
A1/--- High t.alarm	High temperature alarm	1
A2/--- Low t. alarm	Low temperature alarm	2
A4/--- Door alarm	Door alarm	8
A5/--- Max hold time	The "o16" function is activated during a coordinated defrost	16
A13/--- High temp S6	Temperature alarm. High S6	1
A14/--- Low temp S6	Temperature alarm. Low S6	2
A15/--- DI1 alarm	DI1 alarm	8
A16/--- DI2 alarm	DI2 alarm	8
A45/--- Standby mode	Standby position (stopped refrigeration via r12 or DI input)	-
A59/--- Case clean	Case cleaning. Signal from DI input	-
A97/--- Comp. Safety	Compressor safety. Signal from DI3 input is interrupted	8
AA3/--- High brine temp.	High brine temperature alarm	8
E1/--- Ctrl. error	Faults in the controller	32
E6/--- RTC error	Check clock	32
E25/--- S3 error	Error on S3 sensor	4
E26/--- S4 error	Error on S4 sensor	4
E27/--- S5 error	Error on S5 sensor	4
E28/--- S6 error	Error on S6 sensor	4
E50/--- S7 error	Error on S7 sensor	4
--- Max Def.Time	Defrost stopped based on time instead of, as wanted, on temperature	16

**Data communication**

The importance of individual alarms can be defined with a setting. The setting must be carried out in the group "Alarm destinations"

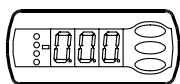
Settings from System manager AK-SM 720	Settings from AKM (AKM destination)	Send via Network
High	1	X
Middle	2	X
Low	3	X
Log only		
Disabled		

(not in AK-SM 800 serie)

## Operation




### Controller/Display

The values will be shown with three digits, and with a setting you can determine whether the temperature is to be shown in °C or in °F.



### Light-emitting diodes (LED) on front panel

The LED's on the front panel will light up when the relevant relay is activated.

-  = Refrigeration
-  = Defrost
-  = Fan running

The light-emitting diodes will flash when there is an alarm. In this situation you can download the error code to the display and cancel/accept the alarm by giving the top button a brief push.

### The buttons

When you want to change a setting, the upper and the lower buttons will give you a higher or lower value depending on the button you are pushing. But before you change the value, you must have access to the menu. You obtain this by pushing the upper button for a couple of seconds - you will then enter the column with parameter codes. Find the parameter code you want to change and push the middle button until value for the parameter is shown. When you have changed the value, save the new value by once more pushing the middle button.

### Examples

#### Set menu

1. Push the upper button until a parameter r01 is shown
2. Push the upper or the lower button and find that parameter you want to change
3. Push the middle button until the parameter value is shown
4. Push the upper or the lower button and select the new value
5. Push the middle button again to set the value.

#### Cutout alarm relay / receipt alarm/see alarm code

- A short press of the upper button  
If there are several alarm codes they are found in a rolling stack. Push the uppermost or lowermost button to scan the rolling stack.

#### Set temperature

1. Push the middle button until the temperature value is shown
2. Push the upper or the lower button and select the new value
3. Push the middle button again to conclude the setting.

#### Reading the temperature at defrost sensor (Or product sensor, if selected in o92.)

- A short press of the lower button

#### Manual start or stop of a defrost

- Push the lower button for four seconds.

### Get a good start

With the following procedure you can start regulation very quickly:

- 1 Open parameter r12 and stop the regulation (in a new and not previously set unit, r12 will already be set to 0 which means stopped regulation.)
- 2 Select electrical connection based on the drawings on page 26
- 3 Open parameter o61 and set the electric connection number in it
- 4 Open parameter r12 and start the regulation
- 5 Go through the survey of factory settings. Make any necessary changes in the respective parameters.
- 6 For network. Set the address in o03
- 7 Send address to system unit:
  - MODBUS: Activate scan function in system unit
  - If another data communication card is used in the controller:
    - LON RS485: Activate the function o04

## Menu survey

SW = 1.2x

Parameter			Wiring diagram		Min. value	Max. value	Factory setting	Actual setting
Function		Code	1 & 3	2				
Normal operation								
Temperature (setpoint)		---	1	1	-50 °C	50 °C	2	
Thermostat								
Differential		r01	1	1	0.1 K	20 K	2	
Max. limitation of setpoint setting		r02	1	1	-49 °C	50 °C	50	
Min. limitation of setpoint setting		r03	1	1	-50 °C	49 °C	-50	
Adjustment of temperature indication		r04	1	1	-10	10	0	
Temperature unit (°C/°F)		r05	1	1	0/°C	1/F	0/°C	
Correction of the signal from S4		r09	1	1	-10 K	10 K	0	
Correction of the signal from S3		r10	1	1	-10 K	10 K	0	
Manual service, stop regulation, start regulation (-1, 0, 1)		r12	1	1	-1	1	0	
Displacement of reference during night operation		r13	1	1	-50 K	50 K	0	
Define thermostat function 1=ON/OFF 2=Modulating		r14	1	2	— — —			
Definition and weighting, if applicable, of thermostat sensors - S4% (100%=S4, 0%=S3)		r15	1	1	0 %	100 %	100	
Time between melt periods		r16	1	1	0 hrs	10 hrs	1	
Duration of melt periods		r17	1	1	0 min.	30 min.	5	
Temperature setting for thermostat band 2 . As differential use r01		r21	1	1	-50 °C	50 °C	2	
Correction of the signal from S6		r59	1	1	-10 K	10 K	0	
Definition and weighting, if applicable, of thermostat sensors when night cover is on. (100%=S4, 0%=S3)		r61	1	1	0 %	100 %	100	
S4 min. limit. Frost protection. Cooling is stopped.		r98	1	1	-50 °C	20 °C	-50 °C	
Alarms								
Delay for temperature alarm		A03	1	1	0 min.	240 min.	30	
Delay for door alarm		A04	1	1	0 min.	240 min.	60	
Delay for temperature alarm after defrost		A12	1	1	0 min.	240 min.	90	
High alarm limit for thermostat 1		A13	1	1	-50 °C	50 °C	8	
Low alarm limit for thermostat 1		A14	1	1	-50 °C	50 °C	-30	
High alarm limit for thermostat 2		A20	1	1	-50 °C	50 °C	8	
Low alarm limit for thermostat 2		A21	1	1	-50 °C	50 °C	-30	
High alarm limit for sensor S6 at thermostat 1		A22	1	1	-50 °C	50 °C	8	
Low alarm limit for sensor S6 at thermostat 1		A23	1	1	-50 °C	50 °C	-30	
High alarm limit for sensor S6 at thermostat 2		A24	1	1	-50 °C	50 °C	8	
Low alarm limit for sensor S6 at thermostat 2		A25	1	1	-50 °C	50 °C	-30	
S6 alarm time delay With setting = 240 the S6 alarm will be omitted		A26	1	1	0 min.	240 min.	240	
Alarm time delay or signal on the DI1 input		A27	1	1	0 min.	240 min.	30	
Alarm time delay or signal on the DI2 input		A28	1	1	0 min.	240 min.	30	
Signal for alarm thermostat. S4% (100%=S4, 0%=S3)		A36	1	1	0 %	100 %	100	
Delay for S6 (product sensor alarm) after defrost		A52	1	1	0 min.	240 min.	90	
Alarm limit for max. S7 brine temperature		A76	1	1	-50 °C	50 °C	8°C	
Differential for S7 brine alarm		A77	1	1	0.1 K	10 K	3.0 K	
Compressor								
Min. ON-time		c01	1	1	0 min.	30 min.	0	
Min. OFF-time		c02	1	1	0 min.	30 min.	0	
Time delay for cutin of comp.2		c05	1		0 sec	999 sec	5	
Min. speed for compressor		c46		1	25 Hz	70 Hz	30	
Start speed for compressor. Must be set higher than Min. speed		c47		1	30 Hz	70 Hz	50	
Max. speed for compressor		c48		1	50 Hz	100 Hz	100	
Kp factor for compressor PI control		c82		1	3	30	20	
Tn for compressor PI control		c83		1	30 sec	360 sec	60	



Continued		code	Wiring diagram		Min.	Max.	Fac.	Actual
Comp. on time when sensor fault		c86	1		0 min	240 min	15	
Comp. off time when sensor fault		c87	1		0 min	240 min	30	
Emergency speed for compressor if sensor error		c93		1	25 Hz	100 Hz	60	
Max. slope rate (max allowed speed change per second)		c96		1	0.1 Hz/s	5 Hz/s	1	
Max. proportional factor (Kp) for PI control		n95		1	5	50	20	
<b>Defrost</b>								
Defrost method: 0=Off, 1= EL		d01	1	1	0/Off	1/EL	1/EL	
Defrost stop temperature		d02	1	1	0 °C	50 °C	6	
Interval between defrost starts		d03	1	1	0 hrs/Off	240 hrs	8	
Max. defrost duration		d04	1	1	0 min.	360 min.	45	
Displacement of time on cutin of defrost at start-up		d05	1	1	0 min.	240 min.	0	
Drip off time		d06	1	1	0 min.	60 min.	0	
Delay for fan start after defrost		d07	1	1	0 min.	60 min.	0	
Fan start temperature		d08	1	1	-50 °C	0 °C	-5	
Fan cutin during defrost 0: stopped 1 and 2: Running		d09	1	1	0	2	1	
Defrost sensor: 0 =Stop on time, 1=S5, 2=S4, 3=S5 and S6		d10	1	1	0	3	0	
Pump down delay		d16	1	1	0 min.	60 min.	0	
Max. aggregate refrigeration time between two defrosts		d18	1	1	0 hrs	48 hrs	0/OFF	
Rail heat during defrost 0: off 1: on 2: Pulsing		d27	1	1	0	2	2	
Max. duration of -d- in display		d40	1	1	5 min.	240 min.	30 min.	
<b>Fan</b>								
Fan stop temperature (S5)		F04	1	1	-50 °C	50 °C	50	
Pulse operation on fans: 0=No pulse operation, 1=At thermostat cuts out only, 2= Only at thermostat cut outs during night operation		F05	1	1	0	2	0	
Period time for fan pulsation (on-time + off-time)		F06	1	1	1 min.	30 min.	5	
On-time in % of period time		F07	1	1	0 %	100 %	100	
<b>Real time clock</b>								
Six start times for defrost. Setting of hours. 0=OFF		t01 - t06	1	1	0 hrs	23 hrs	0	
Six start times for defrost. Setting of minutes. 0=OFF		t11 - t16	1	1	0 min.	59 min.	0	
Clock - Setting of hours		t07	1	1	0 hrs	23 hrs	0	
Clock - Setting of minute		t08	1	1	0 min.	59 min.	0	
Clock - Setting of date		t45	1	1	1 day	31 day	1	
Clock - Setting of month		t46	1	1	1 mon.	12 mon.	1	
Clock - Setting of year		t47	1	1	0 year	99 year	0	
<b>Miscellaneous</b>								
Delay of output signals after power failure		o01	1	1	0 sec	600 sec	5	
Input signal on DI1. Function: 0=not used. 1=status on DI1. 2=door function with alarm when open. 3=door alarm when open. 4=defrost start (pulse-signal). 5=ext.main switch. 6=night operation 7=Thermostat band changeover (activate r21). 8=alarm function when closed. 9=alarm function when open. 10=case cleaning (pulse signal). 12=night cover. 15=application shutdown		o02	1	1	0	15	0	
Network address (0= off)		o03	1	1	0	240	0	
On/Off switch (Service Pin message) IMPORTANT! o61 <b>must</b> be set prior to o04 (used at LON 485 only)		o04	1	1	0/Off	1/On	0/Off	
Access code 1 (all settings)		o05	1	1	0	100	0	
Software Version		o08	1	1				
Setting of mains supply frequency		o12		1	50 Hz	60 Hz	50	
Max hold time after coordinated defrost		o16	1	1	0 min.	360 min.	20	

Continued		code	Wiring diagram		Min.	Max.	Fac.	Actual
Select signal for display view. S4% (100%=S4, 0%=S3)		o17	1	1	0 %	100 %	100	
Input signal on DI2. Function: (0=not used. 1=status on DI2. 2=door function with alarm when open. 3=door alarm when open. 4=defrost start (pulse-signal). 5=ext. main switch 6=night operation 7=Thermostat band changeover (activate r21). 8=alarm function when closed. 9=alarm function when open. 10=case cleaning (pulse signal). 12=night cover, 13=coordinated defrost). 15=application shutdown		o37	1	1	0	15	0	
Configuration of light function: 1=Light follows day /night operation, 2=Light control via data communication via 'o39', 3=Light control with a DI-input, 4=As "2", but light switch on and night cover will open if the network cut out for more than 15 minutes.		o38	1	1	1	4	1	
Activation of light relay (only if o38=2) On=light		o39	1	1	0/Off	1/On	0/Off	
Rail heat On time during day operations		o41	1	1	0 %	100 %	100	
Rail heat On time during night operations		o42	1	1	0 %	100 %	100	
Rail heat period time (On time + Off time)		o43	1	1	6 min.	60 min.	10	
Case cleaning. 0=no case cleaning. 1=Fans only. 2=All output Off.	***	o46	1	1	0	2	0	
Selection of Application mode. See overview on page 26. 1 = Two compressor sequential mode 2 = One compressor with variable speed control 3 = Two compressors cyclic mode	*	o61	1	1	1	3	1	
Access code 2 (partial access)	***	o64	1	1	0	100	0	
Replace the controllers factory settings with the present settings		o67	1	1	0/Off	1/On	0/Off	
Rail heat control 0=not used, 1=pulse control with timer function (o41 and o42), 2=pulse control with dew point function		o85	1	1	0	2	0	
Dew point value where the rail heat is minimum		o86	1	1	-10 °C	50 °C	8	
Dew point value where the rail heat is 100% on		o87	1	1	-9 °C	50 °C	17	
Lowest permitted rail heat effect in %		o88	1	1	0 %	100 %	30	
Time delay from "open door" refrigeration is started		o89	1	1	0 min.	240 min.	30	
Definition of readings on lower button: 1=defrost stop temperature, 2=S6 temperature		o92	1	1	1	2	1	
Display of temperature 1= u56 Air temperature 2= u36 product temperature		o97	1	1	1	2	1	
Light and night blinds defined 0: Light is switch off and night blind is open when the main switch is off 1: Light and night blind is independent of main switch		o98	1	1	0	1	0	
Configuration of alarm relay The alarm relay will be activated upon an alarm signal from the following groups: 1 - High temperature alarms 2 - Low temperature alarms 4 - Sensor error 8 - Digital input is activated for alarm 16 - Defrost alarms 32 - Miscellaneous The groups that are to activate the alarm relay must be set by using a numerical value which is the sum of the groups that must be activated. (E.g. a value of 5 will activate all high temperature alarms and all sensor errors). 0 = Cancel relay function		P41	1	1	0	63	47	
Stop time for fans while the night blinds are rolling down		P65	1	1	0 min.	5 min.	0 min.	

Service				
Temperature measured with S5 sensor		u09	1	1
Status on DI1 input. on/1=closed		u10	1	1
Actual defrost time (minutes)		u11	1	1
Temperature measured with S3 sensor		u12	1	1
Status on night operation (on or off) 1=on		u13	1	1
Temperature measured with S4 sensor		u16	1	1
Thermostat temperature		u17	1	1
Run time of thermostat (cooling time) in minutes		u18	1	1
Temperature measured with S6 sensor (product temperature)		u36	1	1
Status on DI2 output. on/1=closed		u37	1	1
Readout of the actual compressor capacity in %		u52		1
Air temperature. Weighted S3 + S4 (o17)		u56	1	1
Measured temperature for alarm thermostat Weighted S3+S4 (A36)		u57	1	1
Status on relay for compressor 1	**	u58	1	
Status on relay for fan	**	u59	1	1
Status on relay for defrost	**	u60	1	1
Status on relay for rail heat	**	u61	1	1
Status on relay for alarm	**	u62	1	1
Status on relay for light	**	u63	1	1
Status on relay for compressor 2	**	u67	1	1
Readout of the actual rail heat effect		u85	1	1
1: Thermostat 1 operating, 2: Thermostat 2 operating		u86	1	1
Status on high voltage input DI3		u87	1	1
Readout of thermostats actual cut in value		u90	1	1
Readout of thermostats actual cut out value		u91	1	1
Readout the brine temperature S7		u98	1	1
Readout of the voltage signal on the analogue output		U44		1

\*) Can only be set when regulation is stopped (r12=0)

\*\*) Can be controlled manually, but only when r12=-1

\*\*\*) With access code 2 the access to these menus will be limited

### Forced control

If you need to force-control an output, you should set r12 to -1 (manual mode).

You should then select the relevant relay function, e.g. u58. Go to the function by pressing the middle button. Select On.

### Factory setting

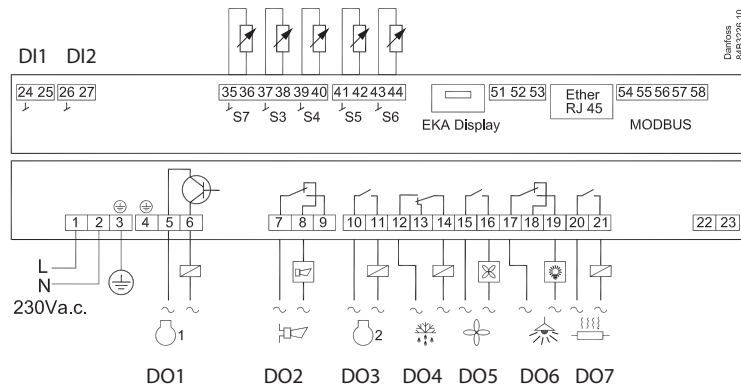
If you need to return to the factory-set values, it can be done in this way:

- Cut out the supply voltage to the controller
- Keep upper and lower button depressed at the same time as you reconnect the supply voltage

## Connections

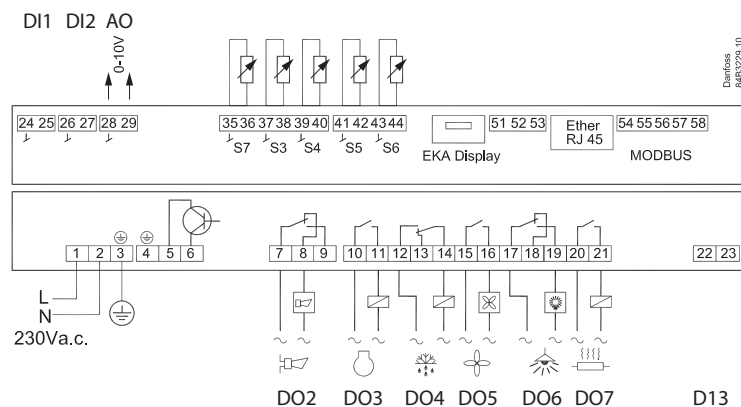
Application	DO1	DO2	DO3	DO4	DO5	DO6	DO7	DI1	DI2	DI3	AI1	AI2	AI3	AI4	AI5	AI6	AO
1 and 3	1	2	2	2	2	2	2	●	●	●		S7	S3	S4	S5	S6	
2		2	2	2	2	2	2	●	●	●		S7	S3	S4	S5	S6	0-10V

### Application 1 and 3



In application 1, the compressors are controlled sequentially. Compressor 1 is first in and last out.  
In application 3, the compressors are controlled cyclically.

### Application 2



#### DI1

Digital input signal.  
The defined function is active when the input is short-circuited/ opened. The function is defined in o02.

#### DI2

Digital input signal.  
The defined function is active when the input is short-circuited/ opened. The function is defined in o37.

#### AO

Analogue output (only application 2) 0 - 10 V signal for variable speed compressor control.

#### S7, S3, S4, S5, S6

Pt 1000 ohm  
S7, brine sensor, should be placed at the cold inlet to the heat exchanger  
S3, air sensor, placed in the warm air before the evaporator  
S4, air sensor, placed in the cold air after the evaporator  
(the need for either S3 or S4 can be deselected in the configuration)  
S5, defrost sensor, placed on the evaporator  
S6, product sensor

#### EKA Display

If there is external reading/operation of the controller, display type EKA 163B or EKA 164B can be connected.

#### RS485 (terminal 51, 52, 53)

For data communication, but only if a data communication module is inserted in the controller. The module can be a LON RS485, DANBUSS or a MODBUS.

Terminal 51 = screen

Terminal 52 = A (A+)

Terminal 53 = B (B-)

(For LON RS485 and gateway type AKA 245 the gateway must be version 6.20 or higher.)

#### RJ45

For data communication, but only if a TCP/IP module is inserted in the controller. (OEM)

#### MODBUS

For data communication.

Terminal 56 = screen

Terminal 57 = A+

Terminal 58 = B-

(Alternatively the terminals can be connected to an external display type EKA 163A or 164A, but then they cannot be used for data communication. Any data communication must then be carried out by one of the other methods.)

## Supply voltage

230 V AC

### DO1

*Compressor 1 (only application 1 and 3)*

Connection of relay for compressor. The coil must be a 230 V AC coil.

### DO2

*Alarm*

There is a connection between terminal 7 and 8 in alarm situations and when the controller is without power.

### DO3

*Compressor 2,*

There is connection between terminal 10 and 11 when the compressor must be active

In application 2 this output is used for compressor start signal

### DO4

*Defrost*

There is connection between terminal 12 and 14 when defrosting takes place.

### DO5

*Fan*

There is connection between terminal 15 and 16 when the fan is on.

### DO6

*Light relay*

There is connection between terminal 17 and 18 when the light must be on. If night blinds are used, they should be connected here.

### DO7

*Rail heat*

There is connection between terminal 20 and 21, when the rail heat is active.

## DI3

*Digital input signal.*

Compressors safety circuit (OK at 230V)

The signal must have a voltage of 0 / 230 V AC.

## Data communication

If data communication is used, it is important that the installation of the data communication cable is performed correctly.

See separate literature No. RC8AC...

## Electric noise

Cables for sensors, DI inputs and data communication must be kept separate from other electric cables:

- Use separate cable trays
- Keep a distance between cables of at least 10 cm
- Long cables at the DI input should be avoided

## Installation considerations

Accidental damage, poor installation, or site conditions, can give rise to malfunctions of the control system, and ultimately lead to a plant breakdown.

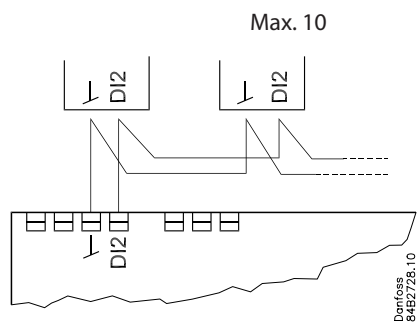
Every possible safeguard is incorporated into our products to prevent this. However, a wrong installation, for example, could still present problems. Electronic controls are no substitute for normal, good engineering practice.

Danfoss will not be responsible for any goods, or plant components, damaged as a result of the above defects. It is the installer's responsibility to check the installation thoroughly, and to fit the necessary safety devices.

Special reference is made to the necessity of signals to the controller when the compressor is stopped and to the need of liquid receivers before the compressors.

Your local Danfoss agent will be pleased to assist with further advice, etc.

## Coordinated defrost via cable connections

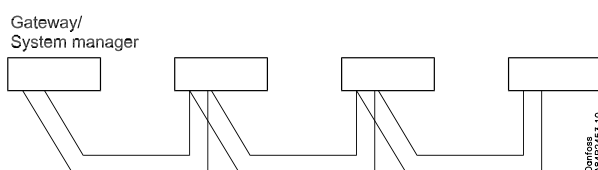


The following controllers can be connected up in this way:

EKC 204A, AK-CC 210, AK-CC 250, AK-CC 450, AK-CC 460, AK-CC 550,

Refrigeration is resumed when all controllers have "released" the signal for defrost.

## Coordinated defrost via data communication



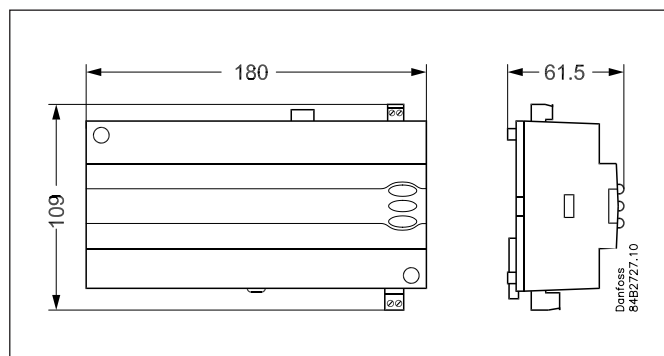
The setting of controllers to coordinate their defrosting takes place in the gateway/system manager.

Refrigeration is resumed when all controllers have "released" the signal for defrost.

## Data

Supply voltage	230 V AC +10/-15 %. 5 VA, 50/60 Hz	
Sensors	S3, S4, S5, S6, S7 Pt 1000 ohm	
Accuracy	Measuring range	-60 – 120 °C
	Controller	±1 K below -35 °C ±0.5 K between -35 – 25 °C ±1 K above +25°C
	Pt 1000 sensor	±0.3 K at 0°C ±0.005 K per grad
Display	LED, 3-digits	
External display	EKA 163B or 164B. (any EKA 163A or 164A)	
Digital inputs DI1, DI2	Signal from contact functions Requirements to contacts: Gold plating Cable length must be max. 15 m Use auxiliary relays when the cable is longer	
Digital input DI3	230 V AC	
Electrical con- nection cable	Max. 1.5 mm <sup>2</sup> multi-core cable	
Solid state output	DO1 (for coil)	Max. 240 V AC , Min. 28 V AC Max. 0.5 A Leak < 1 mA Max. 1 pcs. coil
Analogue output	AO	0 – 10 V signal for variable speed control
Relays*		CE (250 V AC) IBExU approved
	DO3, DO4	4 (3) A
	DO2, DO5, DO6, DO7	4 (3) A
Environments	0 – 55 °C, During operations	
	-40 – 70 °C, During transport	
	20 - 80% Rh, not condensed	
	No shock influence / vibrations	
Density	IP 20	
Mounting	DIN-rail or wall	
Weight	0.4 Kg	
Data communication	Fixed / Build-in	MODBUS
	Extension options	LON RS485
		DANBUSS
		TCP/IP (OEM)
		MODBUS
	The controller cannot be hooked up with a monitor- ing unit type m2.	
Power reserve for the clock	4 hours	
Approvals	EU Low Voltage Directive and EMC demands re CE- marking complied with LVD tested acc. EN 60730-1 and EN 60730-2-9, A1, A2 EMC tested acc. EN 61000-6-2 and EN 61000-6-3 Relays are tested acc. to IEC 60079-15	

\* DO3 and DO4 are 16 A relays. DO2, DO5, DO6 and DO7 are 8 A relays. Max. load must be observed.



## Ordering

Type		Function	Code no.
AK-CC 460		Case controller with MODBUS data communication	<b>084B8016</b>
EKA 175		Data communication module LON RS 485	<b>084B8579</b>
EKA 178B		Data communication module MODBUS	<b>084B8571</b>
EKA 176		Data communication module DANBUSS + Gateway	<b>084B8583</b>
EKA 176A		Data communication module DANBUSS + AK-PI 200	<b>084B8591</b>
EKA 163B		External display with plug for direct connection	<b>084B8574</b>
EKA 164B		External display with operation buttons and plug for direct connections	<b>084B8575</b>
EKA 163A		External display with screw terminals	<b>084B8562</b>
EKA 164A		External display with operation buttons and screw terminals	<b>084B8563</b>

## Examples of order

Installation	Data communication	Connection	Code no.
	MODBUS		<b>084B8016</b> (AK-CC 460)
	LON		<b>084B8016</b> 084B8579
	DANBUSS		<b>084B8016</b> 084B8583
 L < 15 m	MODBUS		<b>084B8016</b> 084B8574 (Display) 084B7299 (Cable, 6 m)
	LON / DANBUSS		<b>084B8016</b> 084B8574 (Display) 084B7299 (Cable, 6 m) 084Bxxxx (Data module)
 L > 15 m	MODBUS / LON / DANBUSS		<b>084B8016</b> 084B8562 (Display) 084Bxxxx (Data module)



