Data sheet

Electronic media temperature controller Type EKC 368

The EKC 368 controller and KVS electric suction modulating valve are used where there are high requirements to refrigeration of unpacked food products, e.g.:

- Delicatessen appliances
- Cold rooms for meat products
- Cold rooms for fruits and vegetables
- Containers
- Air conditioning plant

Features

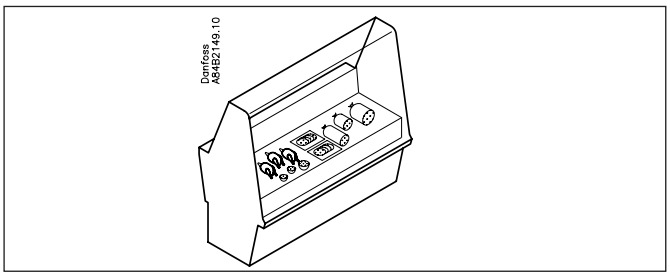
- The temperature is kept within an accuracy of ±0.5°C or better after a transient phenomenon.
- A transient phenomenon can be controlled with the adaptive function so that temperature variations is kept on a minimum.
- Defrost sensor, so that the defrost time will be as short as possible.
- PID regulation.

Introduction

Application

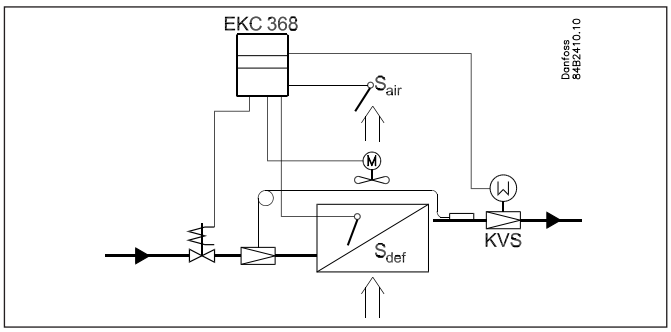
Controller and valve are used where there are high requirements to refrigeration of unpacked food products, e.g.:

- Delicatessen appliances
- Cold rooms for meat products
- Cold rooms for fruits and vegetables
- Containers
- Air conditioning plant



System

A KVS valve is used. The capacity determines the size of it.
A solenoid valve is mounted in the liquid line which is to close when the controller stops refrigeration.
Sensor S_{air} must be placed in the cold air current after the evaporator.

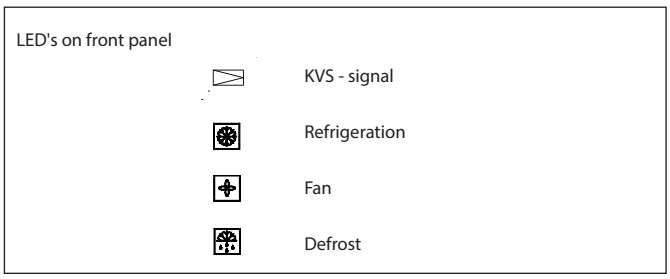


Advantages

- Wastage is reduced because the air humidity around the products is kept as high as possible
- The temperature is kept within an accuracy of ±0.5°C or better after a transient phenomenon
- A transient phenomenon can be controlled with the adaptive function so that temperature variations is kept on a minimum
- Defrost sensor, so that the defrost time will be as short as possible
- PID regulation

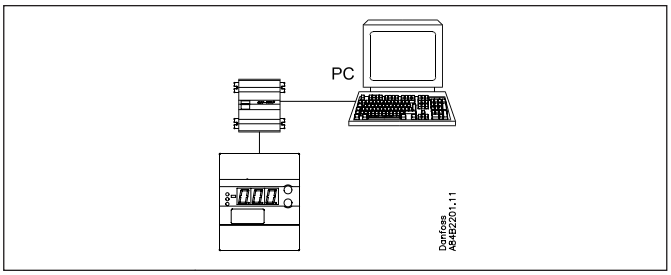
Functions

- Modulating temperature control
- Defrost function: electricity, hotgas or natural
- Alarm if the set alarm limits are exceeded
- Relay outputs for defrost function, solenoid valve, fan and alarmgiver
- Input signal that can displace the temperature reference



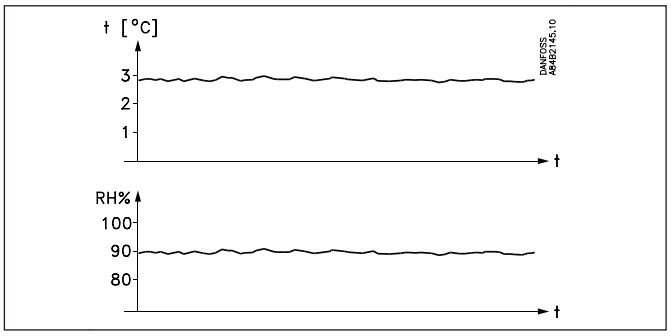
Extra options

- PC operation
  The controller can be provided with data communication, so that it may be hooked up with other products in the ADAP-KOOL® range of refrigeration controls.
  Operation, monitoring and data collection can then be performed from a PC - either in situ or at a service company.



Function

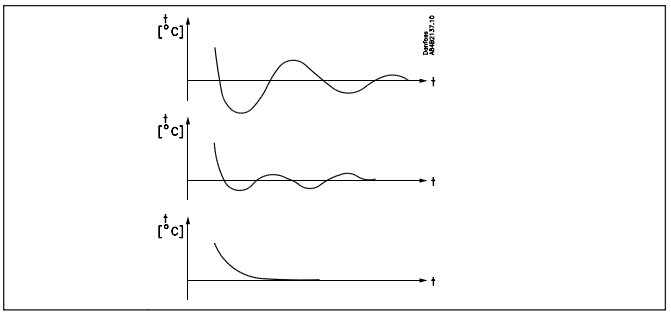
Very accurate temperature control
With this system where controller and valve have been adapted for optimum use in the refrigerating plant, the refrigerated products may be stored with temperature fluctuations of less than ±0.5°C.



High air humidity
As the evaporating temperature is constantly adapted to the refrigeration needs and will always be as high as possible with very small temperature fluctuations, the relative air humidity in the room will be kept at a maximum.
Drying-out of products will therefore be reduced to a minimum.

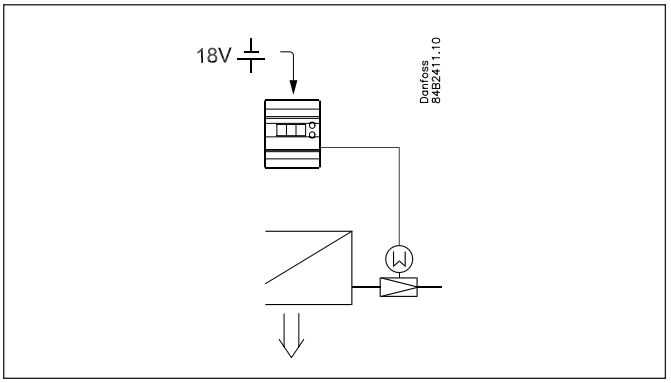
Temperature is quickly attained
With the built-in PID control and the possibility of choosing between three transient phenomena, the controller can be adapted to a kind of temperature performance that is optimum for this particular refrigerating plant.

- **Fastest** possible cooling
- Cooling with less underswing
- Cooling where underswing is **unwanted**



Valve
The valve is an evaporating pressure valve and is available in several capacity sizes.
The valve is mounted on a step engine which receives impulses from the controller.
The controller is adapted to this valve.
There is therefore only very few settings for the valve.

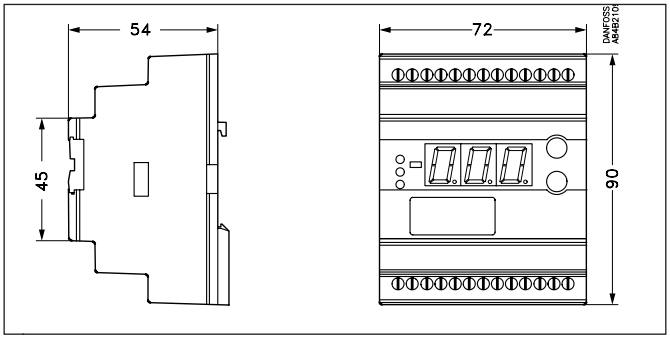
In case of power failure that valve's opening degree will be maintained. If the application requires the valve open in this situation a battery can be connected to the controller.



Data

Supply voltage	24 V AC +/-15% 50/60 Hz, 10 VA (the supply voltage is galvanically separated from the input and output signals)	
Power consumption	Controller KVS-step motor	5 VA 1.3 VA
Input signal ***) Ri = 100 KΩ**	Voltage signal*	0 – 10 V or 2 – 10 V
	Digital input from external contact function	
	Short-circuit (pulse signal) of 18 – 20 will start a defrost	
Sensor input	2 pcs. Pt1000 ohm	
Relay output	3 pcs. SPST	AC-1: 4 A (ohmic) AC-15: 3 A (inductive)
Alarm relay	1 pcs. SPST	
Step motor output	Pulsating 100 mA	
Data communication	Possible to connect a data communication module	
Ambient temperature	During operation During transport	-10 – 55°C -40 – 70°C
Enclosure	IP 20	
Weight	300 g	
Mounting	DIN rail	
Display	LED, 3-digits	
Terminals	max. 2.5 mm² multicore	
Approvals	EU Low Voltage Directive and EMC demands re CE-marking complied with LVD-tested acc. to EN 60730-1 and EN 60730-2-9 EMC-tested acc. to EN50081-1 and EN 50082-2	

If battery backup is used:
Requirements to battery: 18 V DC min. 100 mAh



Ordering

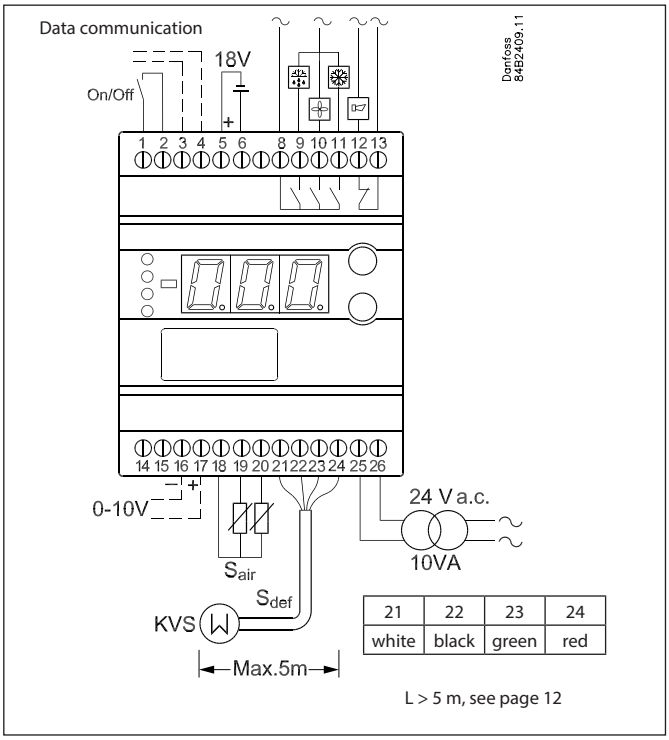
Type	Function	Code No.
EKC 368	Evaporating pressure controller	084B7079
EKA 172	Realtime clock	084B7069
EKA 174	Data communication module (accessories), (RS 485 module) with galvanic separation	084B7124
AKA 211	Filter : 4 x 10 mH	084B2238

Temperature sensor Pt1000 ohm: Kindly refer to catalogue RK0YG...
Valves: Kindly refer to catalogue RK0YG...

Connections

Necessary connections
Terminals:
25 – 26 Supply voltage 24 V AC
18 – 19 Pt1000 sensor at evaporator outlet
21 – 24 Supply to step motor
1 – 2 Switch function for start/stop of regulation. If a switch is not connected, terminals 1 and 2 must be short circuited
5 – 6 Battery (the voltage will open the KVS valve if the controller loses its supply voltage)

Application dependent connections
Terminal:
12 – 13 Alarm relay
There is connection between 12 and 13 in alarm situations and when the controller is dead
8 – 9 Relay switch for start/stop of defrost
8 – 10 Relay switch for start/stop of fan
8 – 11 Relay switch for start/stop of cooling
16 – 17 Voltage signal from other regulation (Ext.Ref.)
If the voltage signal is received from a PLC or the like, a data communication module, if any, must be with galvanic separation.
18-20 Pt1000 sensor for defrost function.
Short-circuit of the terminals for two seconds (pulse signal) will start a defrost
3-4 Data communication
Mount only, if a data communication module has been mounted
It is important that the installation of the data communi cation cable be done correctly.
Cf. separate literature No. RC8AC...



Survey of functions

Function	Parameters	Parameter by operation via data communication
Normal display		
Normally the temperature value is shown from room temperature Sair.		u01 Air temp
The temperature at the defrost sensor can be displayed by giving the lower button a brief push (1s).		u09 Sdef temp
Reference		
Reference Regulation is based on the set value provided that there is no external contribution (o10). (Push both buttons simultaneously to set the setpoint).	-	Temp Setpoint
Temperature unit Here you select whether the controller is to indicate the temperature values in °C or in °F. If indication in °F is selected, other temperature settings will also change over to Fahrenheit, either as absolute values or as delta values.	r05	Temp unit °C = 0, °F = 1 (In AKM only bar is displayed, whatever the setting)
External contribution to the reference This setting determines how large a contribution is to be added to the set reference when the input signal is max. (10 V).	r06	ExtRefOffset
Correction of signal from Sair (Compensation possibility through long sensor cable).	r09	Adjust SAir
Correction of signal from Sdef (Compensation possibility through long sensor cable).	r11	Adjust SDef
Start/stop of refrigeration With this setting refrigeration can be started and stopped. Start/stop of refrigeration can also be accomplished with the external switch function. See also appendix 1.	r12	Main switch
Alarm		
The controller can give 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.		
Alarm for upper deviation The alarm for too high Sair temperature is set here. The value is set in Kelvin. The alarm becomes active when the Sair temperature exceeds the actual reference plus A01. (The actual reference (SP + r06) can be seen in u02).	A01	Upper offset
Alarm for lower deviation The alarm for too low Sair temperature is set here. The value is set in Kelvin. The alarm becomes active when the Sair temperature drops below the actual reference minus A02.	A02	Lower offset
Alarm delay If one of the two limit values is 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	TempAlrmDel
Battery alarm Here it is defined whether the controller has to monitor the voltage from the battery backup. If there is low voltage or none at all an alarm will be given.	A34	Batt. alarm

With data communication the importance of the individual alarms can be defined. Setting is carried out in the "Alarm destinations" menu.
See also page 14.

Survey of functions

Function	Parameters	Parameter by operation via data communication
Defrost		
A defrost can be defined in three ways: - via the data communication from a defrost table - via short-circuiting of the Sdef sensor (pulse signal of 2 sec. duration) - mounting of real time clock module Defrost is stopped when the temperature at the defrost sensor reaches the set value or when the set time expires. Temperature alarms are not active during defrost.		
Defrost method Here you have to set whether defrost is to be carried out with electricity or hotgas. During defrost the defrost relay will be operated and the cold relay cut out. If ELECTRICITY is used, the valve will be open during defrost. When GAS is used, the valve will be closed during defrost.	d01	Defrost mode off = 0 El = 1 Gas = 2
Defrost stop temperature The temperature value is set. If a defrost sensor has not been mounted, defrost will be stopped on the basis of time. See later.	d02	Def. Stop Temp
Max. defrost duration If you have chosen to stop defrost based on temperature, this setting will constitute a safety period where defrost will be stopped, if it has not occurred based on temperature. If you have not mounted a defrost sensor, this setting will be the defrost time.	d04	Max Def.time
Drip-off time Here you set the time that is to elapse from the end of a defrost and until refrigeration is to be resumed. (The time when water is dripping off the evaporator).	d06	DripOfftime
Delayed fan start after defrost Here you set the time to elapse from refrigeration may be started after a defrost and until the fan may be started again. (The time where the water is "*bound*" to the evaporator).	d07	FanStartDel
Fan start temperature The fan may also be started a little earlier than mentioned under "*Delayed fan start after defrost*" if the defrost sensor registers a permissible value. Here you can set the value for when the fan may start.	d08	FanStartTemp
Fan cut in during defrost Here you set whether the fan is to operate during defrost.	d09	FanDuringDef
Delayed temperature alarm after defrost During and immediately after a defrost the temperature is "*too high*". The "*high temperature alarm*" can be suppressed right after a defrost. Here you must set for how long the alarm is to be suppressed. The time counts from the start of refrigeration.	d11	Pulldown del
If you wish to start an extra defrost, push the lower button for seven seconds. If you keep it depressed for seven seconds when a defrost is going on, the defrost will be stopped. The drip-off time and the fan delay will be completed.		Def. start Here you can start a manual defrost
If you wish to see the temperature at the defrost sensor, push the lower button briefly (1s).		u09 Sdef temperature

Survey of functions

Function	Parameters	Parameter by operation via data communication
Control parameters		
Actuator type Here you define the actuator mounted in the system: 1: KVS 15 - 22 2: KVS 38 - 35 3: KVS 42 - 54 4: User-defined (engine data can be changed via the AKM programme Danfoss only) Change of setting only when r12 = off.	n03	Valve type
P: Amplification factor Kp If the Kp value is reduced the regulation becomes slower.	n04	Kp factor
I: Integration time Tn IThe I-setting can be cancelled by setting the value to max. (600s). If it is set to 600s, parameter n07 must be set to "*0*". (If the Tn value is increased the regulation becomes slower).	n05	Tn sec.
D: Differentiation time Td The D-setting can be cancelled by setting the value to min. (0).	n06	Td sec.
Transient phenomenon If the refrigeration requires a very fast transient phenomenon or must not have an underswing or temperature shift, this function can be used. 0: Fastest possible cooling 1: Cooling with less underswing 2: Cooling where underswing is unwanted	n07	Ctrl. mode
Start-up after hotgas defrost The KVS valve must be open before the solenoid valve for refrigeration may be opened. Here you set how much time the valve needs for opening. The period of time starts when the drip-off time has ended.	n08	Open time
Miscellaneous		
Input signal If you wish to connect a signal that is to displace the controller's control reference, the signal must be defined in this menu. 0: No signal 1: 0 - 10 V 2: 2 - 10 V (0 or 2 V will not give a displacement. 10 V will displace the reference by the value set in menu r06).	o10	AI type
Frequency Set the net frequency.	o12	50/60 Hz (50 = 0, 60 = 1)
Address 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. These settings can only be made when a data communication module has been mounted in the controller and the installation of the data communication cable has been completed. This installation is mentioned in a separate document "RC.8A.C".		Following installation of a data communication module, the controller can be operated on a par with the other controllers in ADAP-KOOL® refrigeration controls
The address is set between 1 and 60.	o03	
The address is sent to the gateway when the menu is set in pos. ON (The setting will automatically change back to Off after a few seconds).	o04	

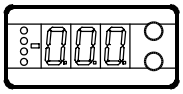
Survey of functions

Function	Parameters	Parameter by operation via data communication
Service		
A number of controller values can be printed for use in a service situation.		
Read the temperature at the Sair sensor (calibrated value).	u01	Air temp.
Read the control reference (Set reference + any contribution from external signal).	u02	Air ref.
Read value of external voltage signal	u07	AI Volt
Read temperature at the Sdef sensor (calibrated value).	u09	Sdef temp
Read status of input DI (start/stop input).	u10	DI status
Read the duration of the ongoing defrost or the duration of the last completed defrost.	u11	Defrost time
Read opening degree of the valve in %	u23	KVS OD %
	--	Alarm relay Read status of alarm relay ON is operating status with alarm
	--	Cooling rel. Read status of relay for solenoid valve
	--	Fan relay Read status of relay for fan
	--	Def. relay Read status of relay for defrost
Operating status		
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. (Status codes have lower priority than alarm codes. In other words, you cannot see a status code, if there is an active alarm). The individual status codes have the following meanings:		Ctrl state (0 = regulation)
S4: Defrost sequence. The evaporator drips off and waits for the time to run out.		4
S10: Refrigeration stopped by the internal or external start/ stop.		10
S12: Refrigeration stopped due to low Sair.		12
S13: Defrost sequence. The KVQ valve is closing.		13
S14: Defrost sequence. Defrost in progress.		14
S15: Defrost sequence. The fan waits for the time to run out.		15

Operation

Display

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



Light-emitting diodes (LED) on front panel

There are LED's on the front panel which will light up when the belonging relay is activated.
The three lowermost LED's will flash, if there is an error in the regulation.
In this situation you can upload the error code on the display and cancel the alarm by giving the uppermost button a brief push.

The controller can give the following messages

E1	**Error message**	Errors in the controller
E6		Change battery in timer. Set the timer
E7		Cut-out Sair
E8		Short circuited Sair
E12		Analog input signal is outside the range
A1	**Alarm message**	High-temperature alarm
A2		Low-temperature alarm
A43		Check supply voltage for the step engine
A44		Battery alarm (no voltage or too low voltage)

The buttons

When you want to change a setting, the two 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 two buttons simultaneously. When you have changed the value, save the new value by once more pushing the two buttons simultaneously.

Gives access to the menu (or cutout an alarm)

Gives access to changes

Saves a change

Examples of operations

Set reference temperature

1. Push the two buttons simultaneously
2. Push one of the buttons and select the new value
3. Push both buttons again to conclude the setting

Set one of the other menus

1. Push the upper button until a parameter is shown
2. Push one of the buttons and find the parameter you want to change
3. Push both buttons simultaneously until the parameter value is shown
4. Push one of the buttons and select the new value
5. Push both buttons again to conclude the setting

Menu survey

SW = 1.6x

Function	Param.	Min.	Max.	Fac. setting
Normal display				
Shows the temperature at the room sensor	-	°C		
Give the lower button a brief push to see the temperature at the defrost sensor	-	°C		
Reference				
Set the required room temperature	-	-70°C	160°C	10
Temperature unit	r05	°C	°F	°C
External contribution to the reference	r06	-50 K	50 K	0
Correction of the signal from Sair	r09	-10.0 K	10.0 K	0
Correction of the signal from Sdef	r11	-10.0 K	10.0 K	0
Start/stop of refrigeration	r12	OFF	On	On
Alarm				
Upper deviation (above the temperature setting)	A01	0	50 K	5
Lower deviation (below the temperature setting)	A02	0	50 K	5
Alarm's time delay	A03	0	180 min	30
Monitoring of battery	A34	Off	On	Off
Defrost				
Defrost method (ELECTRICITY/GAS)	d01	Off	GAS	Off
Defrost stop temperature	d02	0	25°C	6
Max. defrost duration	d04	0	180 min	45
Drip-off time	d06	0	20 min	0
Delay for fan start or defrost	d07	0	20 min	0
Fan start temperature	d08	-15°C	0°C	-5
Fan cut in during defrost (yes/no)	d09	no	yes	no
Delay for temperature alarm after defrost	d11	0	199 min	90
Regulating parameters				
Actuator type: 1 = KVS15-22, 2 = KVS28-35, 3 = KVS42-54 4 = User defined via AKM / For Danfoss only Setting of menu only when r12 = off.	n03	1	4	1
P: Amplification factor Kp	n04	1	50	4
I: Integration time Tn (600 = off)	n05	60 s	600 s	120
D: Differentiation time Td (0 = off)	n06	0 s	60 s	0
Transient phenomenon 0: Fast cooling 1: Cooling with less underswing 2: Cooling where underswing is unwanted	n07	0	2	1
Start-up time after hotgas defrost	n08	0 min	20 min	1
Miscellaneous				
Controller's address	o03*)	1	60	0
ON/OFF switch (service-pin message)	o04*)	-	-	Off
Define input signal of analog input 0: no signal 1: 0 – 10 V 2: 2 – 10 V	o10	0	2	0
Set supply voltage frequency	o12	50 Hz	60 Hz	50
Service				
Read temperature at the Sair sensor	u01	°C		
Read regulation reference	u02	°C		
Read value of external voltage signal	u07	V		
Read temperature at the Sdef sensor	u09	°C		
Read status of input DI	u10	on/off		
Read duration of defrost	u11	m		
Opening degree of the valve	u23	%		

**) This setting will only be possible if a data communication module has been installed in the controller.*

Start of controller

When the electric wires have been connected to the controller, the following points have to be attended to before the regulation starts:

1. Switch off the external ON/OFF switch that starts and stops the regulation
2. Follow the menu survey on page 8, and set the various parameters to the required values
3. Switch on the external ON/OFF switch, and regulation will start
4. If the system has been fitted with a thermostatic expansion valve, it must be set to minimum stable superheating
5. Follow the actual room temperature on the display. (Use a data collection system, if you like, so that you can follow the temperature performance)

If the temperature fluctuates
When the refrigerating system has been made to work steadily, the controller's factory-set control parameters should in most cases provide a stable and relatively fast regulating system.
If the system on the other hand oscillates, you must register the periods of oscillation and compare them with the set integration time Tn, and then make a couple of adjustments in the indicated parameters.

If the time of oscillation is longer than the integration time:
($T_p > T_n$, (T_n is, say, 4 minutes))

1. Increase T_n to 1.2 times T_p
2. Wait until the system is in balance again
3. If there is still oscillation, reduce K_p by, say, 20%
4. Wait until the system is in balance
5. If it continues to oscillate, repeat 3 and 4

If the time of oscillation is shorter than the integration time:
($T_p < T_n$, (T_n is, say, 4 minutes))

1. Reduce K_p by, say, 20% of the scale reading
2. Wait until the system is in balance
3. If it continues to oscillate, repeat 1 and 2

Fine adjustments

When the system has been operating for a while, it may be required for some systems to optimise some of the adjustments. Below we have a look at settings having an influence on the speed and accuracy of the regulation.

Method for fixing K_p, T_n and T_d
Described below is a method (Ziegler-Nichols) for fixing K_p, T_n and T_d.

1. The system is made to regulate the temperature at the required reference with a typical load. It is important that the valve regulates, and that it is not fully open
   The controller is set, so that it will regulate as a P-controller. (T_d is set to 0, T_n in pos. OFF (600), and Q-Ctrl.mode (n07) is set at 0)
   The stability of the system is examined by stopping the system for, say, one minute (using the start/stop setting or the switch). Now check how the building-up of the temperature proceeds. If the building-up peters out, raise K_p a little and repeat the start/stop operation. Continue with this until you obtain a building-up which does not peter out
2. K_p is in this case the critical amplification ($K_{pcritical}$) and the building-up time for the continued oscillation is the critical building-up time ($T_{critical}$)
3. Based on these values, the regulating parameters can now be calculated and subsequently set:

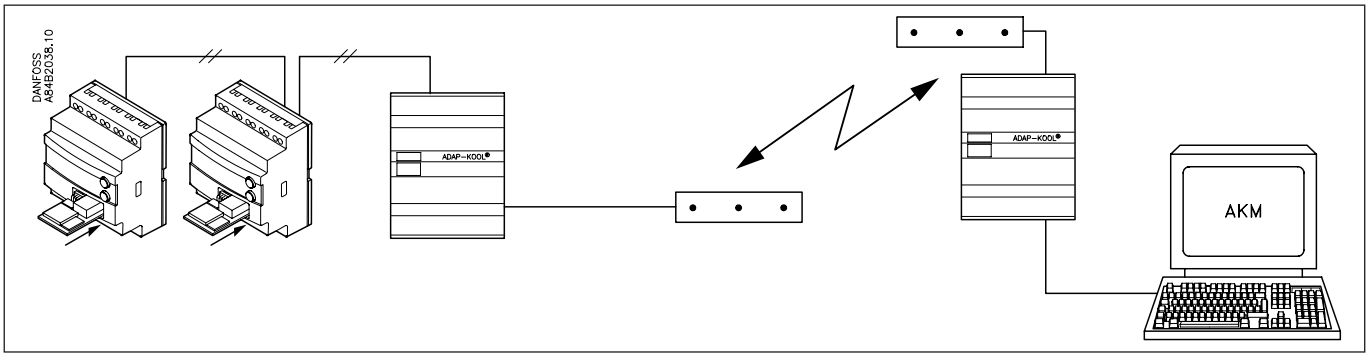
- If PID regulation is required:
  $Kp < 0{,}6x\ K_{pcritical}$
  $Tn > 0{,}5x\ T_{critical}$
  $Td < 0{,}12x\ T_{critical}$
- If PI regulation is required:
  $Kp < 0{,}45x\ K_{pcritical}$
  $Tn > 0{,}85x\ T_{critical}$

6. Reset value for "Q-Ctrl.mode" (n07)

Data communication

This page contains a description of a few of the possibilities you will have when the controller is provided with data communication.

If you want to know more about operation of controllers via PC, you may order additional literature.



Each controller is provided with a plug-in module.

The controllers are then connected to a two-core cable.

Up to 60 controllers may be connected to one cable.

This cable is also connected to a gateway type AKA 243.

This gateway will now control the communication to and from the controllers.

It will collect temperature values and it will receive alarms. When there is an alarm the alarm relay will be activated for two minutes.

The gateway can now be connected to a modem.

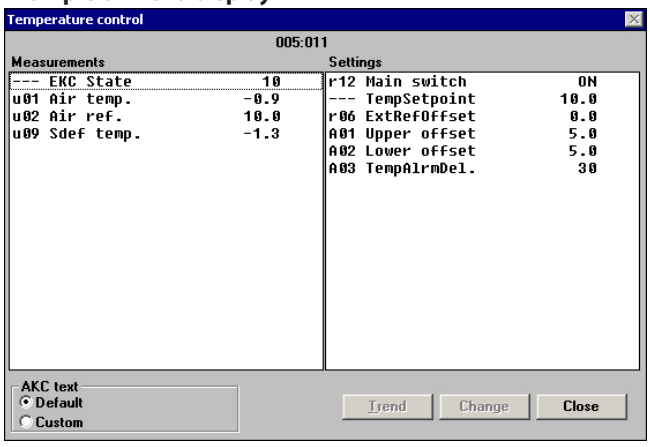
When an alarm occurs from one of the controllers, the gateway will, via the modem, make a phone call to the service company.

At the service company a modem, gateway and PC with system software type AKM have been installed.

All the controllers' functions can now be operated from the various menu displays.

The programme will for example upload all the collected temperature values once a day.

Example of menu display



- Measurements are shown at one side and settings at the other
- You will also be able to see the parameter names of the functions on page 4 – 7
- With a simple change-over the values can also be shown in a trend diagram
- If you wish to check earlier temperature measurements, you can see them in the log collection

Alarms
If the controller is extended with data communication, it will be possible to define the importance of the transmitted alarms.
The importance is defined with the setting: 1, 2, 3 or 0.
When the alarm then arises at some time, it will result in one of the following activities:

1 = Alarm
The alarm message is sent off with alarm status 1.
This means that the gateway that is the master in the system will have its alarm relay output activated for two minutes. Later, when the alarm ceases, the alarm text will be retransmitted, but now with status value 0.

2 = Message
The alarm text is transmitted with status value 2.
Later, when the "*message*" lapses, the alarm text is retransmitted, but now with status value 0.

3 = Alarm
As "*1*", but the master gateway's relay output is not activated.

0 = Suppressed information
The alarm text is stopped at the controller.
It is transmitted nowhere.

Trouble shooting

In addition to the error messages transmitted by the controller, the table below may help identifying errors and defects.

Symptom	Defect	Confirmation of defect
Evaporator blocked with ice. Defrost function in order	Defrost set incorrectly, or placing of Sdef is not correct	Check setting / check sensor location
Evaporator blocked with ice. Defrost function not in order	Defrost sensor Sdef cut out	Check sensor
	Defrost sensor Sdef is short-circuited	Check if the function that starts defrost is stuck
	Heating element is not cut in	Check the heating element and the defrost relay
Defrost period too long	Defrost set incorrectly	Check setting of the stop temperature
	Defrost continues beyond the set stop temperature	Check location of Sdef

Appendix 1

Interaction between internal and external start/stop functions and active functions.

Internal Start/stop	Off	Off	On	On
External Start/stop	Off	On	Off	On
Refrigeration	Off			On
Fan relay	Off			On
Expansion valve relay	Off			On
Defrost relay	On/off			On/off
Temperature monitoring	No			Yes
Sensor monitoring	Yes			Yes
If a start/stop function is put in pos. OFF during a defrost, the defrost will be carried out as planned				

KVS connection

If the distance between EKC 368 and the KVS valve exceeds 5 m a filter must be mounted to obtain the correct valve function.