Controller for temperature control of unpacked food products - EKC 367

REFRIGERATION AND AIR CONDITIONING

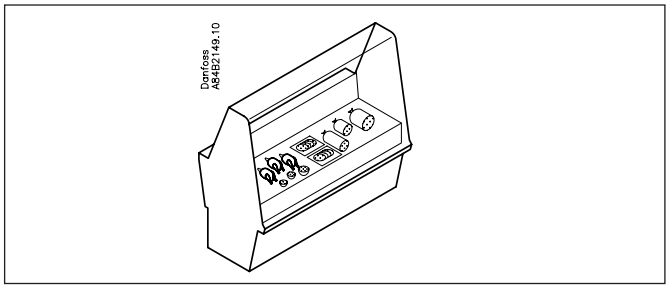
Manual

Introduction

Application

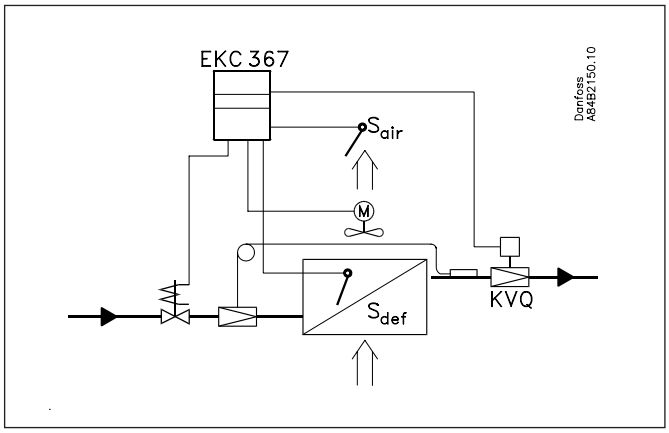
Controller and valve are used where there are high requirements to refrigeration of unpacked food products, e.g.:

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



System

A KVQ valve is used. The capacity determines the size of it.
When refrigeration is stopped or there is power failure, the valve will be completely open.
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.

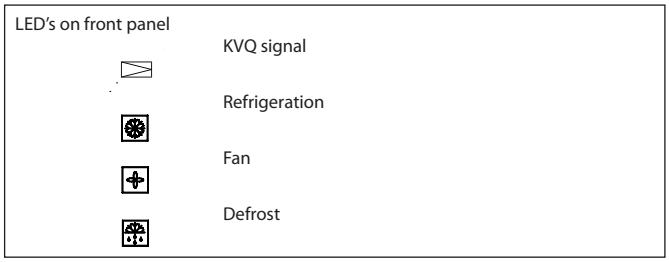


Advantages

- Wastage is reduced because the air humidity around the products is kept as high as possible.
- The temperature is kept within an accuracy of ±0.25°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.
- Frost protection
- PID regulation

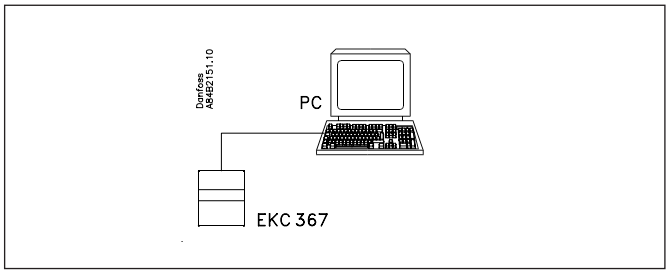
Functions

- 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



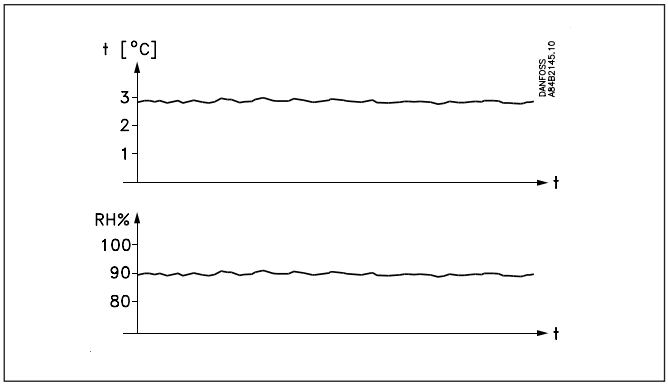
Extra options

- 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.



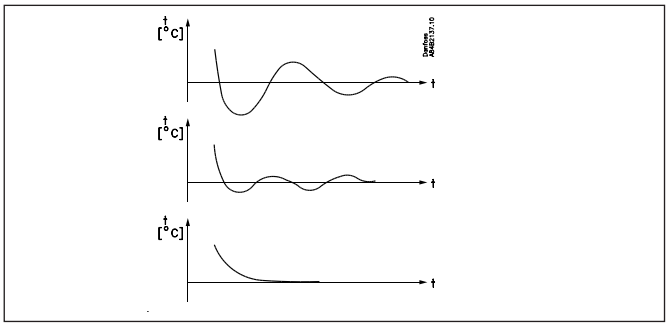
Function

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.

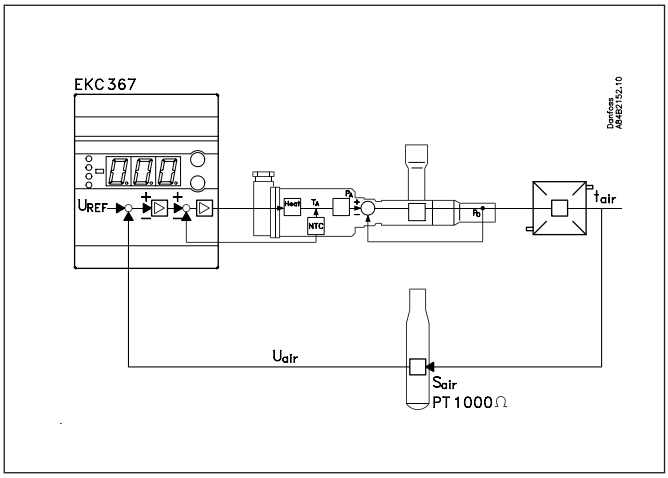


High air humidity
As the evaporating temperature is constantly adapted to the refrigeration needs and will always be as high as possible with very small temperature fluctuations, the relative air humidity in the room will be kept at a maximum.
Drying-out of products will therefore be reduced to a minimum.

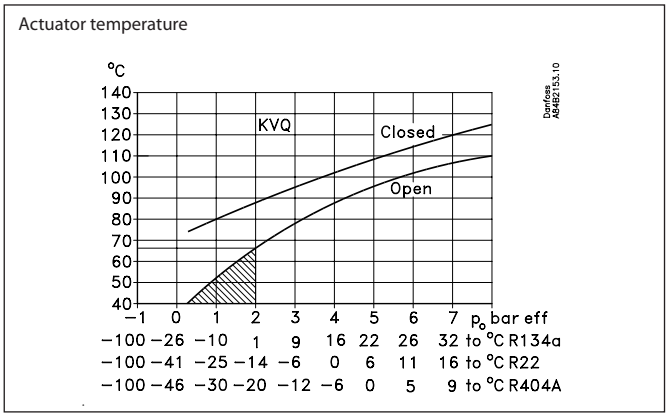
Temperature is quickly attained
With the built-in PID control and the possibility of choosing between three transient phenomena, the controller can be adapted to a kind of temperature performance that is optimum for this particular refrigerating plant.
- **Fastest** possible cooling
- Cooling with **less** underswing
- Cooling where underswing is **unwanted**



Regulation
The controller receives signals from room sensor S_{air}. This room sensor must be placed at the air outlet from the evaporator to obtain the best possible regulation. The controller sees to it that the required room temperature is maintained.
Built-in between the controller and the actuator is a so-called inner control loop which constantly checks the temperature (pressure) in the actuator's pressure vessel. In this way a very stable control system is obtained.
If there is a deviation between the required and the registered temperature the controller will immediately send more or fewer pulses to the actuator to counteract the error. A change of the number of pulses will act on the temperature and hence the pressure in the pressure vessel. The charging pressure and evaporating pressure p_0 go hand in hand. A changed charging pressure will produce the effect that the valve's opening degree will change.
The pressure in the evaporator is maintained whatever pressure changes there may be on the suction side (at the KVQ valve's outlet).



Evaporating pressure limitation (p_0 limitation)
The inner control loop mentioned above also causes the evaporating pressure to be limited in the downward direction. In this way the system is safeguarded against a too low supply air temperature (frost protection).
It offers the following advantages:
- High-temperature systems can be connected to low-temperature compressor units
- Protection against icing on evaporator



Survey of functions

Function	Para-meter	Parameter by operation via data communication
Normal display		
Normally the temperature value is shown from room temperature Sair.		Air temp.
The temperature at the defrost sensor can be displayed by giving the lower button a brief push (1s).		Temp. SDef
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).	-	SP Temp.
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	Ext. Ref.offset K
Correction of signal from Sair (Compensation possibility through long sensor cable).	r09	Adjust SAir K
Correction of signal from Sdef (Compensation possibility through long sensor cable).	r11	Adjust SDef K
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 deviation
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 deviation
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	Temp alarm delay
		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.

Defrost		Defrost
A defrost can be defined in two ways: - via the data communication from a defrost table - via short-circuiting of the Sdef sensor (pulse signal of 2 sec. duration) 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	Def. Off-El-Gas off = 0 El (Electricity) = 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 m
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	Drip-off time m
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	Fan start delay
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	Fan start temp.
Fan cut in during defrost Here you set whether the fan is to operate during defrost.	d09	Fan at defrost
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	Pull down delay
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.		Manual 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).		Temp.SDef

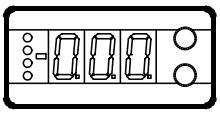
Control parameters		
Actuator's max. temperature Set the temperature the actuator is to have at the limit of the regulating range. The setting ensures that the actuator will not become superheated and work itself away from the regulating range. Due to tolerances in the actuator the value must be set 10K higher than indicated in the curves on page 10.	n01	Q-max. temp.
Actuator's min. temperature Set the temperature the actuator will have at the limit of the regulating range. The setting ensures that the actuator will not become too cold and work itself away from the regulating range. Due to tolerances in the actuator the value must be set 10K lower than indicated in the curves on page 10.	n02	Q-min. temp.
Actuator type Here you define the actuator mounted in the system: 1: CVQ -1-5 bar 2: CVQ 0-6 bar 3: CVQ 1.7-8 bar 4: CVMQ 5: KVQ	n03	Valve type
P: Amplification factor Kp If the Kp value is reduced the regulation becomes slower.	n04	Kp factor
I: Integration time Tn The 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	Q-ctrl. mode
Start-up after hotgas defrost The KVQ 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	Q-OpenTime
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 madewhen a data communication modulehas 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	-

Language This setting is only required when data communication is connected to the controller. Settings: 0=English, 1=German, 2=French, 3=Danish, 4=Spanish, 5=Italian, and 6= Swedish When the controller is operated via data communication, the texts in the right-hand column will be shown in the selected language. When you change the setting to an other language you must activate o04 before "the new language" can be visible from the AKM program.	o11	Language
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 reference
Read valve's actuator temperature	u04	Actuator temp.
Read reference for valve's actuator temperature	u05	Actuator Ref.
Read value of external voltage signal	u07	AI Volt
Read temperature at the Sdef sensor (calibrated value)	u09	Temp. SDef
Read status of input DI (start/stop input)	u10	DI
Read the duration of the ongoing defrost or the duration of the last completed defrost.	u11	Defrost time
	--	DO1 Alarm Read status of alarm relay ON is operating status with alarm
	--	DO2 Cooling Read status of relay for solenoid valve
	--	DO3 Fan Read status of relay for fan
	--	DO4 Defrost 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:		EKC 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
E7		Cut-out Sair
E8		Shortcircuited Sair
E11		Valve's actuator temperature outside its range
E12		Analog input signal is outside the range
A1	**Alarm message**	High-temperature alarm
A2		Low-temperature alarm

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 =1.2x

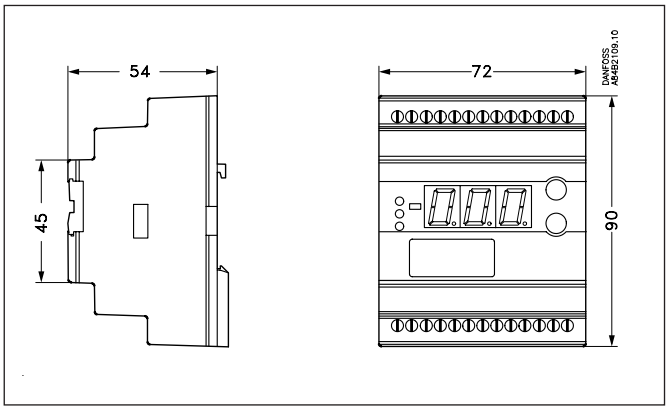
Function	Parameter	Min.	Max.
Normal display			
Shows the temperature at the room sensor	-		°C
Give the lower button a brief push to see the temperature at the defrost sensor	-		°C
Reference			
Set the required room temperature	-	-70°C	160°C
Temperature unit	r05	°C	°F
External contribution to the reference	r06	-50 K	50 K
Correction of the signal from Sair	r09	-10,0 K	10,0 K
Correction of the signal from Sdef	r11	-10,0 K	10,0 K
Start/stop of refrigeration	r12	OFF	On
Alarm			
Upper deviation (above the temperature setting)	A01	0	50 K
Lower deviation (below the temperature setting)	A02	0	50 K
Alarm's time delay	A03	0	180 min
Defrost			
Defrost method (ELECTRICITY/GAS)	d01	off	GAS
Defrost stop temperature	d02	0	25°C
Max. defrost duration	d04	0	180 min
Drip-off time	d06	0	20 min
Delay for fan start or defrost	d07	0	20 min
Fan start temperature	d08	-15	0°C
Fan cut in during defrost (yes/no)	d09	no	yes
Delay for temperature alarm after defrost	d11	0	199 min
Regulating parameters			
Actuator max. temperature	n01	41°C	140°C
Actuator min. temperature	n02	40°C	139°C
Actuator type (1=CVQ-1 to 5 bar, 2=CVQ 0 to 6 bar, 3=CVQ 1.7 to 8 bar, 4= CVMQ, 5=KVQ)	n03	1	5
P: Amplification factor Kp	n04	0,5	20
I: Integration time Tn (600 = off)	n05	60 s	600 s
D: Differentiation time Td (0 = off)	n06	0 s	60 s
Transient phenomenon 0: Fast cooling 1: Cooling with less underswing 2: Cooling where underswing is unwanted	n07	0	2
Start-up time after hotgas defrost	n08	5 min	20 min
Miscellaneous			
Controller's address	o03*	1	60
ON/OFF switch (service-pin message)	o04*	-	-
Define input signal of analog input 0: no signal 1: 0 - 10 V 2: 2 - 10 V	o10	0	2
Language (0=english, 1=German, 2=French, 3=Danish, 4=Spanish, 5=Italian, 6=Swedish) When you change the setting to an other language you must activate o04 before "the new language" can be visible from the AKM program.	011*	0	6
Set supply voltage frequency	o12	50 Hz	60 Hz
Service			
Read temperature at the Sair sensor	u01		°C
Read regulation reference	u02		°C
Read valve's actuator temperature	u04		°C
Read reference of the valve's actuator temperature	u05		°C
Read value of external voltagt 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

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

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 both buttons depressed at the same time as you reconnect the supply voltage

Data

Supply voltage	24 V a.c. +/-15% 50/60 Hz, 80 VA (the supply voltage is galvanically separated from the input and output signals)	
Power consumption	Controller Actuator	5 VA 35 VA (KVQ) 75 VA (CVQ)
Input signal	Voltage signal	0-10 V or 2-10 V
	Digital input from external contact function	
	Short-circuit (pulse signal) of 21-22 will start a defrost	
Sensor input	2 pcs. Pt 1000 ohm	
Relay output	3 pcs. SPST	AC-1: 4 A (ohmic) AC-15: 3 A (inductive)
Alarmrelay	1 pcs. SPST	
Actuator	Input	Temperature signal from sensor in the actuator
	Output	Pulsating 24 V a.c. to actuator
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	



Ordering

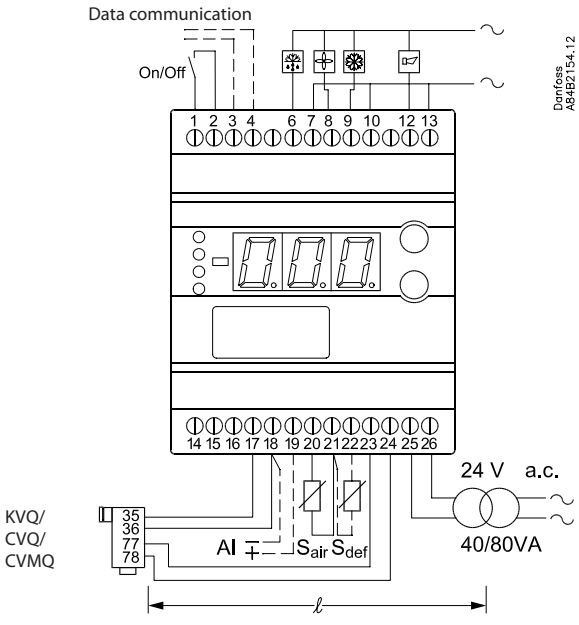
Type	Function	Code No.
EKC 367	Evaporating pressure controller	**084B7083**
EKA 173	Data communication module (accessories), (FTT 10 module)	**084B7092**
EKA 175	Data communication module (accessories), (RS 485 module)	**084B7093**
EKA 174	Data communication module (accessories), (RS 485 module) with galvanic separation	**084B7124**

Temperature sensor Pt 1000 ohm:.....Kindly refer to catalogue RK.00.H...
Valves: .....Kindly refer to catalogue RK.00.H...

Connections

Necessary connections
Terminals:
25-26 Supply voltage 24 V a.c.
17-18 Signal from actuator (from NTC)
23-24 Supply to actuator
20-21 Pt 1000 sensor at evaporator outlet
1-2 Switch function for start/stop of regulation. If a switch is not connected, terminals 1 and 2 must be shortcircuited.

Application dependent connections
Terminal:
12-13 Alarm relay
There is connection between 12 and 13 in alarm situations and when the controller is dead
6-7 Relay switch for start/stop of defrost
8-10 Relay switch for start/stop of fan
9-10 Relay switch for start/stop of cooling
18-19 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.
21-22 Pt 1000 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 <u>important</u> that the installation of the data communication cable be done correctly. Cf. separate literature No. RC.8A.C...



Wire length: See appendix 2

Appendix 1

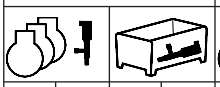
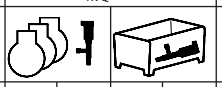
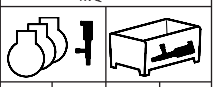
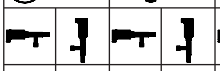
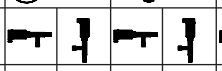
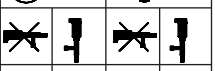
Interaction between internal and external start/stop functions and active functions.

Internal Start/stop	Off	Off	On	On
External Start/stop	Off	On	Off	On
Refrigeration	Off			On
Actuator/ Actuator temperature	Stand-by ("n02")			Regulating ("n02" to "n01")
Fan relay	Of			On
Expansion valve relay	Off			On
Defrost relay	On/off			On/off
Temperature monitoring	No			Yes
Sensor monitoring	Yes			Yes

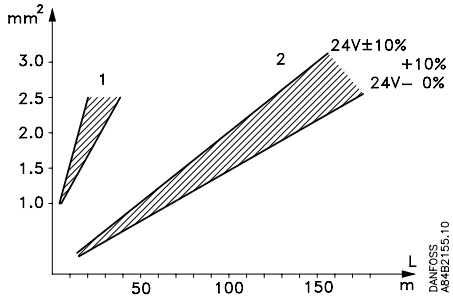
If a start/stop function is put in pos. OFF during a defrost, the defrost will be carried out as planned.

Appendix 2

Cable length for the actuator
The actuator must be supplied with 24 V a.c. ± 10%.
To avoid excessive voltage loss in the cable to the actuator, use a thicker cable for large distances.
If the KVQ valve is mounted lying down, shorter cable lengths are allowed than if it is mounted standing up.
It must not be mounted lying down in connection with hotgas defrost if the temperature around the KVQ-valve is below 0°C.

Defrost											
Electricity				Hotgas							
--				$t_{KVQ} > 0$				$t_{KVQ} < 0$			
											
											
1	2	2	2	1	2	1	2	-	1	-	1

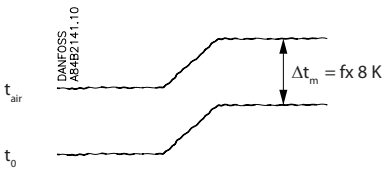
Wire cross section



Cable length

Appendix 3

Connection between the room temperature and the evaporating temperature (t_0).

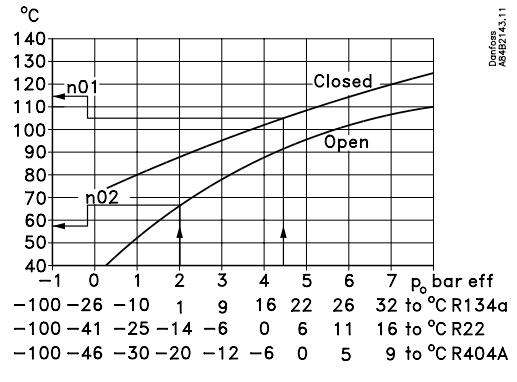


Appendix 4

Possibly contraction of the valves working range.
(A contraction can give a faster valve action).
Connection between the evaporating temperature and the actuator's temperature (the values are approximate).

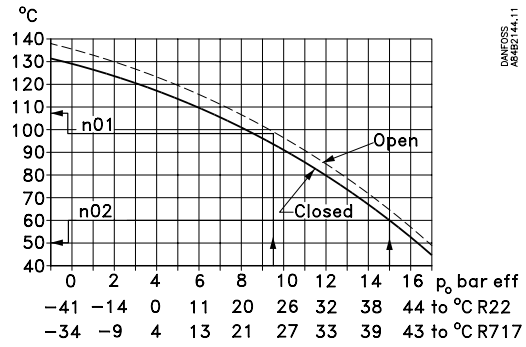
n01: The highest regulated room temperature is used as t_o which in turn indicates the value of the n01 setting. Due to tolerances in the actuator, the setting value must be 10 K **higher** than shown in the curve.
n02: The lowest occurring suction pressure indicates also the value of the n02 setting. Due to tolerances in the actuator, the setting value must be 10 K **lower** than shown in the curve.

KVQ

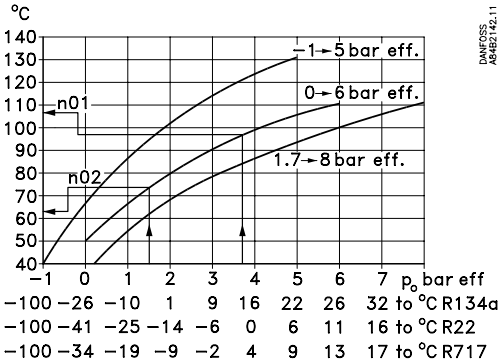


Other valves
All data in this manual are given for applications with a KVQ valve but the controller may in special cases be used in conjunction with valves of the types CVMQ or CVQ.

CVMQ



CVQ



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. (If a specific T0 is required for the adjustment of the expansion valve, the two setting values for the actuator temperature (n01 and n02) can be set to the belonging value while the adjustment of the expansion valve is carried out. Remember to reset the values).
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 T_n, 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.

Adjustment of the actuator's min. and max. temperatures
At the first setting these values were set to 10 K outside of the expected temperature in order to eliminate the tolerances in the actuator. By adjusting the two values to the values where the valve is exactly in mesh, the valve will all the time remain active in its regulation.
If the actuator is replaced at a later date, this procedure must be repeated for the new actuator.

Min.
By adjusting the actuator's min. temperature you obtain a limit for how low a pressure can occur in the evaporator (the point is where the valve starts a limitation of the refrigerant flow).
The system must be put in an operating situation where max. capacity is called for (large refrigeration need).
The min. temperature must now be changed upwards step by step, at the same time as the evaporating pressure is read on the system's manometer.
When a change of the evaporating pressure is registered, this is the point where the valve is exactly in mesh. (If frost protection is required for the system, the value can be raised to the belonging value).

Max.
By adjusting the actuator's max. temperatur you obtain a limit for how high a pressure can occur in the evaporator (the refrigerant flow is blocked completely).
The system is put in an operating situation where there is no call for refrigeration capacity (no refrigerant flow).
The max. temperature is now changed downwards step by step, at the same time as the evaporating pressure is read on the system's manometer.
When a change of the evaporating pressure is registered, this is the point where the valve opens. Adjust the setting a little upwards, so that the valve will again close completely for the refrigerant flow. (If the actual application has a requirement regarding max. evaporating pressure, a lower setting may of course be selected, so that the pressure is limited).

Method for fixing Kp, Tn and Td
Described below is a method (Ziegler-Nichols) for fixing Kp, Tn and Td.

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.
2. Parameter u05 is read. The actuator's min. and max. setting is adjusted, so that the average of the min. and max. values is equal to the read u05.
3. The controller is set, so that it will regulate as a P-controller. (Td is set to 0, Tn in pos. OFF (600), and Q-Ctrl.mode is set at 0).
4. 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 Kp a little and repeat the start/stop operation. Continue with this until you obtain a building-up which does **not** peter out.
5. Kp is in this case the critical amplification ($Kp_{critical}$) and the building-up time for the continued oscillation is the critical building-up time ($T_{critical}$).
6. Based on these values, the regulating parameters can now be calculated and subsequently set:
   - If PID regulation is required:
     $Kp < 0.6x\ Kp_{critical}$
     $Tn > 0.5x\ T_{critical}$
     $Td < 0.12x\ T_{critical}$
   - If PI regulation is required:
     $Kp < 0.45x\ Kp_{critical}$
     $Tn > 0.85x\ T_{critical}$
7. Reset the values for the controller's min. and max. temperatures and Q-Ctrl.mode.

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
Media temperature too low. Actuator feels cold.	Short-circuited NTC resistor in actuator.	If less than 100 ohm is measured across terminals 17 and 18 (remove wire), the NTC or the leads are short-circuited. Check the leads.
	Defective heating element in actuator	Across terminals 23 and 24 (re-move wire) the resistance must be 18 ohm ±2 ohm + the wire resistance. If not, the heating element or the supply cable is defective.
	Cut out Sair-sensor.	Measure the temperature and compare it with the values in a Pt 1000 ohm table
Media temperature too low. Actuator feels warm.	Dirt in valve seat.	
	P0 outside the regulating range 0 to 7 bar.	Check whether the evaporating pressure is within the regulating range (0 to 7 bar) of the valve at min. and max. load.
	Lost charge in actuator.	Replace actuator.
Media temperature too high. Actuator feels cold.	Defect in refrigeration plant.	Examine refrigeration plant for other defects.
	Evaporator blocked with ice.	Check the defrost function. Cf. also the trouble-shooting table for defrost.
	Valve sticks.	Replace valve
	Is gasket between valve and actuator mounted (shows up im-mediately on start-up).	
Media temperature too high. Actuator feels warm.	Cut out NTC resistor in actuator.	If more than 200 kohm is measured across terminals 17 and 18 (remove wire), the NTC or leads are disconnected. Check the leads.

Defrost function

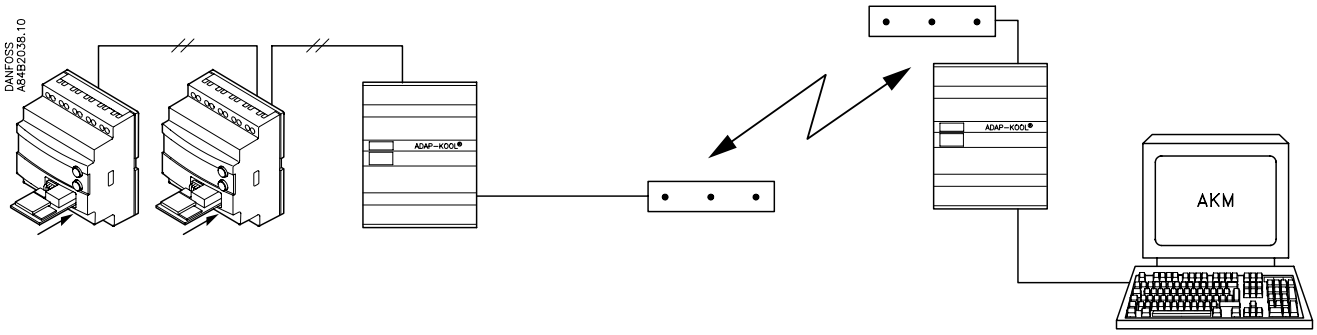
Symptom	Defect	Confirmation of defect
Evaporator blocked with ice. Defrost function in order.	Defrost set incorrectly, or placing of Sdef is not correct	Check setting / check sensor location
Evaporator blocked with ice. Defrost function not in order.	Defrost sensor S_{def} cut out.	Check sensor
	Defrost 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

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.

Examples



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.

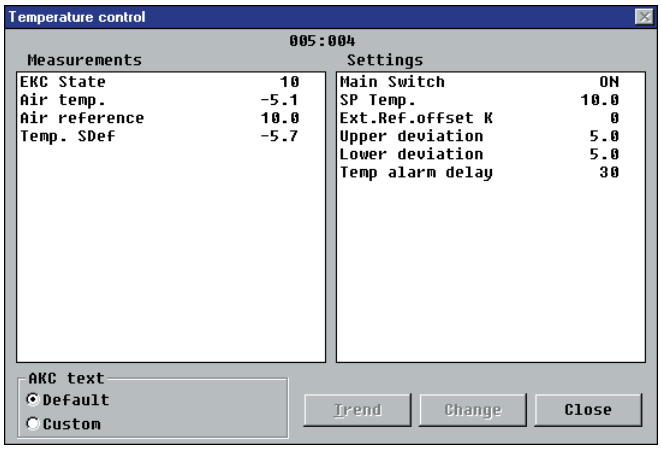
When an alarm occurs from one of the controllers, the gateway will - via the modem - make a phone call to the service company.

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.

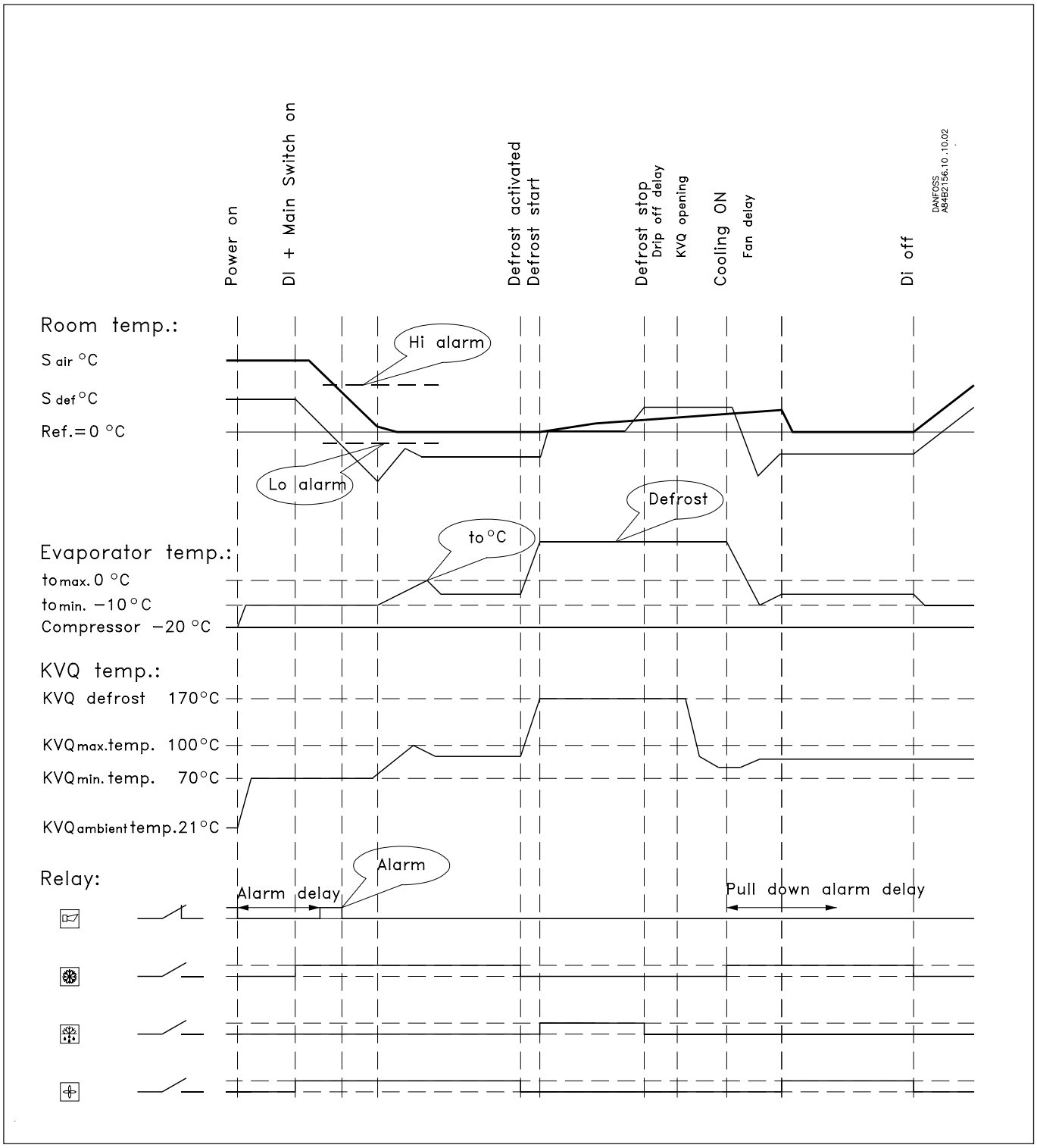
2 = Message
The alarm text is transmitted with status value 2. Later, when the "message" lapses, the alarm text is retransmitted, but now with status value 0.

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.

Appendix 5

Example of refrigeration performance with hotgas defrost



RC-ET