



Capacity controller EKC 531D1

Introduction

Application

The controller is used for capacity regulation of compressors or condensers in small refrigerating systems. Numbers of compressors and condensers can be connected, as required. There are eight outputs and more can be added via an external relay module.

Advantages

- Patented neutral zone regulation
- Many possible combinations for compressor constellations
- Sequential or cyclic operation
- Possibility of suction pressure optimisation via the data communication

Regulation

Regulation is based on signals from one pressure transmitter for the compressor regulation and one pressure transmitter for the condenser regulation plus one temperature sensor for the air temperature before the condenser. The two pressure transmitters can be replaced by two temperature sensors when regulation has to be carried out on brine systems.

Functions

- Relays for compressor and condenser regulation
- Voltage output for capacity regulation of condenser
- Status inputs. An interrupted signal indicates that the safety circuit has been activated and the respective circuit stopped
- Contact inputs for indication of alarms
- Contact inputs for displacement of references or for indication of alarms
- Alarm relay
- External start/stop of regulation
- Possibility of data communication

Operation

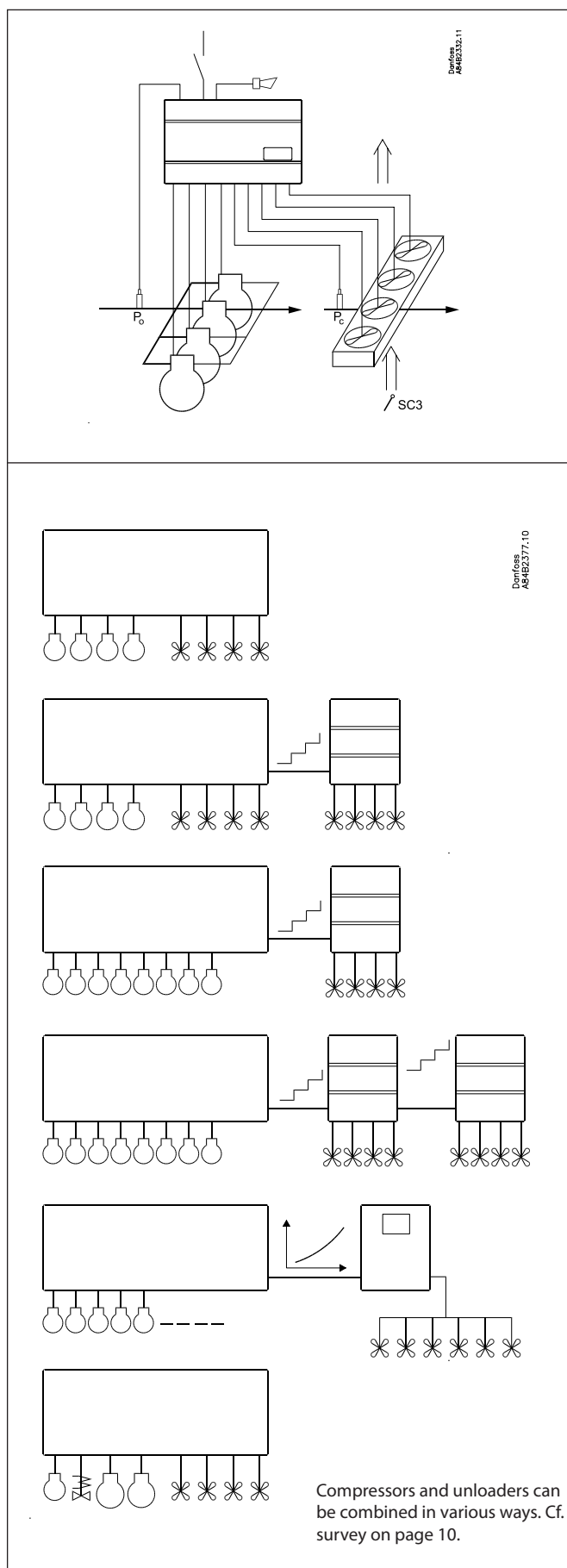
All operation takes place either via data communication or via connection of a display type EKA 162. The display can be disconnected after the installation.

Combinations

The controller has ten relay outputs two of which have been reserved for the alarm function and for the "Inject ON" function. For a start relays are reserved for compressor capacities starting from DO1, DO2, etc.

The remaining relays up to and including DO8 will then be available for fans. If more are required, one or more relay modules type EKC 331 with max. eight steps can be connected. The signals to these modules are to be taken from the controller's analog output. Another solution could be that the fan speed is controlled via the analog output and a frequency converter.

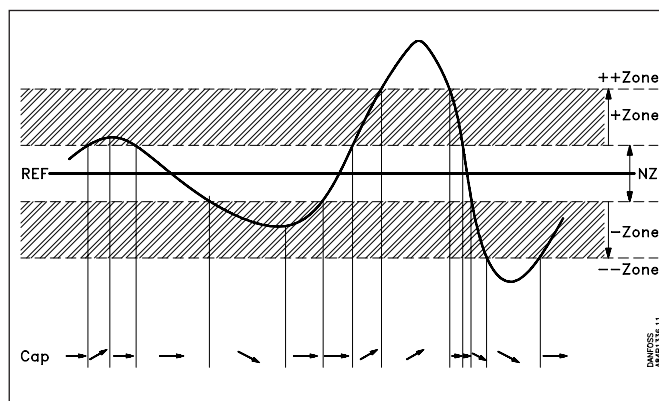
If the alarm function and the "Inject ON" function are left out, all ten relay outputs may be used for compressors and fans (but max. eight for compressors). The reconfiguration must take place via systems software type AKM and performed in the menu named "For Danfoss only".



Function

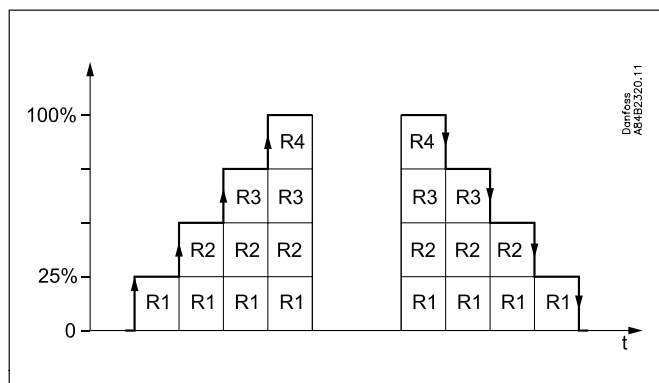
Capacity regulation

The cut-in capacity is controlled by signals from the connected pressure transmitter and the set reference. Outside the reference a neutral zone is set where the capacity will neither be cut in nor out. Outside the neutral zone (in the hatched areas named +zone and -zone) the capacity will be cut in or out if the regulation registers a change of pressure "away" from the neutral zone. Cutin and cutout will take place with the set time delays. If the pressure however "approaches" the neutral zone, the controller will make no changes of the cut-in capacity. If regulation takes place outside the hatched area (named ++zone and --zone), changes of the cut-in capacity will occur somewhat faster than if it were in the hatched area. In order also to obtain good regulation at low capacity requirement the controller will gradually increase the neutral zone at capacity requirements below 50%. The change is greatest at 0% where it amounts to half a neutral zone. Cutin of steps can be defined for either sequential, cyclic, binary or "mix & match" operation.



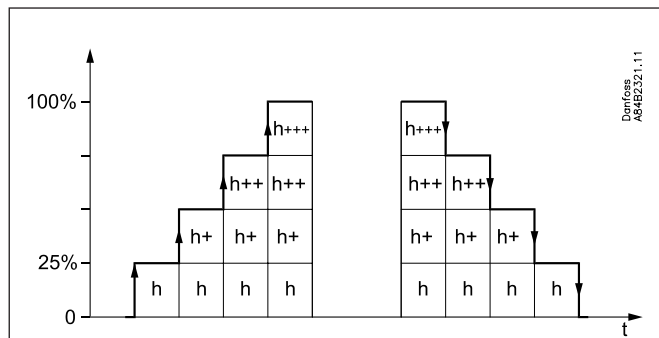
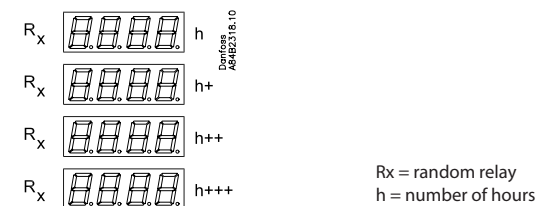
Sequential (first in - last out)

The relays are here cut in in sequence – first relay number 1, then 2, etc. Cutout takes place in the opposite sequence, i.e. the last cut-in relay will be cut out first.

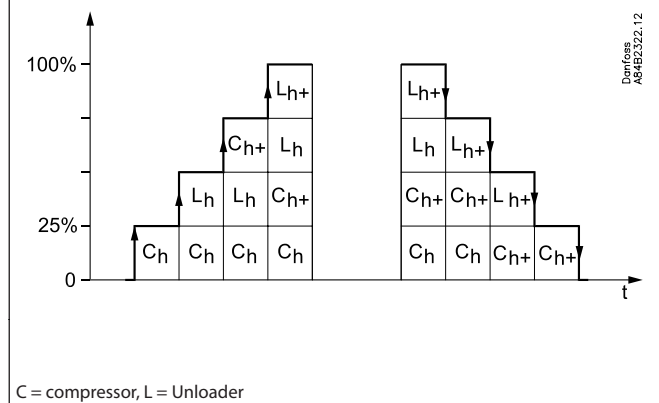
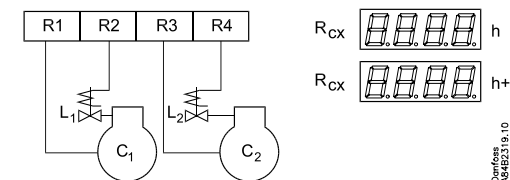


Cyclic (first in - first out)

The relays are coupled here so that the operating time of the individual relays will become equalised. At each cutin the regulation scans the individual relays' timer, cutting in the relay with least time on it. At each cutout a similar thing happens. Here the relay is cut out that has most hours on the timer.



If capacity regulation is carried out on two compressors with one unloader each, the following function can be used: Relays 1 and 3 are connected to the compressor motor. Relays 2 and 4 are connected to the unloaders. Relays 1 and 3 will operate in such a way that the operating time for the two relays will become equalised.



Suvey of functions

Function	Parameter	Parameter by operation via data communication
Normal display		
If the two displays are mounted: P0 will be shown on EKA 162 (the one with buttons) Pc will be shown on EKA 161. Both readouts will be in temperature.		P0 °C Pc °C
Compressor regulation reference		Compressor control
P0 setpoint Regulation is based on the set value plus an offset, if applicable. An offset can be created from night setback r13 and/or from a master gateway's override function.	r23	Set Point °C
Offset The set reference may be displaced with a fixed value when a signal is received at the DI4 input or from the function "Night setback" (r27). (Cf. also Definition of DI4 input).	r13	Night offset
Night setback OFF: No change of the reference ON: Offset value forms part of the reference	r27	NightSetBack
The regulation reference is shown here	r24	Comp ref. °C
Set point limitation With these settings the setpoint can only be set between the two values. (This also apply if regulation with displacements of the reference).		
Max. permissible setpoint value.	r25	P0RefMax °C
Min. permissible setpoint value.	r26	P0RefMin °C
Neutral zone There is a neutral zone around the reference. See also page 3.	r01	Neutral zone
Correction of pressure measurement An offset adjustment of the registered pressure can be made.	r04	AdjustSensor
Unit Here you can select whether the display is to indicate pressure and temperatures in °C or °F. 0: Will give °C. 1: Will give °F.	r05	(In AKM only bar or °C is used, whatever the setting)
Start/stop of refrigeration With this setting the refrigeration can be started and stopped. Start/stop of refrigeration may also be performed with an external contact function connected to the input named "ON input". (The input must be wired).	r12	Main Switch
Condenser regulation reference		Condenser control
Pc setpoint Regulation is based on the set value plus an offset, if applicable. An offset can be created via the "r34" function and/or from a master gateway's override function.	r28	Set Point °C
Offset The set reference may be displaced with a fixed value when a signal is received at the DI5 input. (Cf. also Definition of DI5 input).	r34	Press.offset
Pc reference variation Regulation with setting 1 (or 2 if the reference is to vary with the outdoor temperature) will give the best regulation if the system is in balance. But if a lot of condenser steps are cut in and out and the compressor capacity often becomes low, it will be necessary to select setting 3 instead (or 4, if there is regulation with the outdoor temperature). (Settings 3 and 4 will generally be preferable if a Pc-offset at max. compressor capacity can be accepted). 1: No change of the reference. Regulation based on set setpoint. And offset with the DI5 function is allowed. 2: Outdoor temperature forms part of the reference. The outdoor temperature is measured with Sc3. When the outdoor temperature drops one degree, the reference is lowered one degree. Setting 1 and 2 operate with a PI regulation, but if the system is unstable and the PI regulation not satisfactory the I element may be left out, so that the controller will be with P regulation only. 3: As 1, but with P regulation (xp-band) 4: As 2, but with P regulation (xp-band) 5 and 6 may only be used if regulation is carried out with the heat recovery function via the DI5 input; (5: as "2". 6: as "4"). When the DI5 input is cut in, the reference changes over to the fixed value, as in "1".	r33	Pc mode

The regulation reference is shown here.	r29	Cond ref. °C
Set point limitation With these settings the setpoint can only be set between the two values. (This also applies to regulations where the Xp band lies above the reference).		
Max. permissible setpoint value.	r30	PcRefMax °C
Min. permissible setpoint value.	r31	PcRefMin °C
Correction of pressure measurement An offset adjustment of the registered pressure can be made.	r32	AdjustSensor
Compressor capacity		Compressor pack config.
Running time To prevent frequent start/stop, values have to be set for how the relays are to cut in and out.		
Min. ON time for relays. (The time is not used if the relay cuts an unloader in or out).	c01	Min.ON time
Min. time period between cutin of same relay. (The time is not used if the relay cuts an unloader in or out).	c07	MinRecyTime
Setting for neutral zone regulation		
Regulation band over the neutral zonen	c10	+ Zone K
Time delay between step cut-ins in the regulation band over the neutral zone	c11	+ Zone m
Time delay between step cut-ins in the regulation band over the "+Zone band".	c12	+ + Zone m
Regulation band under the neutral zone	c13	- Zone K
Time delay between step cut-outs in the regulation band under the neutral zone	c14	- Zone m
Time delay between step cut-outs in the regulation band under the "-Zone band"	c15	-- Zone m
Compressor configuration Here you set the combination of number of compressors and any unloaders. 1 = One compressor, 2 = two compressors, 3 = three, 4 = four. 5 = One compressor + one unloader. 6 = One compressor + two unloaders. For 7 to 26: See survey on page 10 If the compressors are of different sizes the setting must be selected to either 4 or 0. At pos. 0 it is up to you to determine which relays have to be drawn on at each of the required capacity steps. 0= mix and match. This function cuts the relay in and out depending on the definitions in "c17" to "c28".	c16	Compr mode
Selection of coupling mode (See also the overview page 10) 1. Sequential: First relay 1 cuts in, then relay 2, etc. Cutout takes place in the opposite sequence. ("First in, last out"). 2. Cyclic: An automatic operating time equalisation is arranged here, so that all steps with motor connection will have the same operating time 3. Binary and cyclic (only for four compressors with "C16" set to 4.	c08	Step mode
Unloaders' cutin and cutout mode The relays for unloaders can be set to switch on when more capacity is required (setting = 0), or they can switch off when more capacity is called for (setting = 1).	c09	Unloader (switch on = 0) (switch off = 1)
Mix and Match step 1. ("c17" to "c28" only used, if "c16" selected to "0"). (In Mix and Match couplings the settings "c08" and c09" are not used). Here in c17 set the relays to be ON at step 1. Setting takes place with a numerical value representing the combination of relays. See the survey next page. Proceed by defining steps two, three, etc. The definition ends at the first c18 - c28 which is set to "0". The time delays "c01" and "c07" belong to the individual relay outputs. If a relay output is captured by the time delay, a changeover from one step to another will only take place when all the relay outputs concerned have been released. The time delay will not interfere with a relay which is ON in two successive couplings. If a compressor drops out there will be an alarm. The regulation will continue as emergency operation, as if the compressor were present.	c17	M&M Step 1
Step 2. Here you also set a value between 1 and 15. Here in c18 the value will indicate which relays have to be ON at step 2.	c18	M&M Step 2
Step 3. etc.	c19	M&M Step 3
4. Etc.	c20	M&M Step 4
5.	c21	M&M Step 5

6.		c22	M&M Step 6																																																																																																																																																																																				
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12.		c28	M&M Step 12																																																																																																																																																																																				
<table border="1"> <thead> <tr> <th colspan="15">Survey of relays in Mix and Match operation</th> </tr> <tr> <th>Relay no.</th> <th>Calculation value</th> <th colspan="13">Combination of relays that must be cut in</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>1</td><td></td><td>1</td><td></td><td>1</td><td></td><td>1</td><td></td><td>1</td><td></td><td>1</td><td></td><td>1</td> </tr> <tr> <td>2</td> <td>2</td> <td></td><td>2</td><td>2</td><td></td><td></td><td>2</td><td>2</td><td></td><td></td><td>2</td><td>2</td><td></td><td>2</td> </tr> <tr> <td>3</td> <td>4</td> <td></td><td></td><td></td><td>4</td><td>4</td><td>4</td><td>4</td><td></td><td></td><td></td><td></td><td>4</td><td>4</td> </tr> <tr> <td>4</td> <td>8</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>8</td><td>8</td><td>8</td><td>8</td><td>8</td> </tr> <tr> <td colspan="2">The sum of 1-8 is the setting value for each step</td> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td> </tr> <tr> <td colspan="2">Examples:</td> <td colspan="13"></td> </tr> <tr> <td colspan="2">If capacity step 1 has to cut in relay number 3 only, you must set c17 to 4.</td> <td colspan="13"></td> </tr> <tr> <td colspan="2">If capacity step 2 has to cut in relay number 4 only, you must set c18 to 8.</td> <td colspan="13"></td> </tr> <tr> <td colspan="2">If capacity step 3 has to cut in relay numbers 3 and 4, you must set c19 to 12.</td> <td colspan="13"></td> </tr> <tr> <td colspan="2">Continue with a setting for c20 etc. until all capacity steps have been defined.</td> <td colspan="13"></td> </tr> </tbody> </table>		Survey of relays in Mix and Match operation															Relay no.	Calculation value	Combination of relays that must be cut in													1	1	1		1		1		1		1		1		1	2	2		2	2			2	2			2	2		2	3	4				4	4	4	4					4	4	4	8									8	8	8	8	8	The sum of 1-8 is the setting value for each step		1	2	3	4	5	6	7	8	9	10	11	12	13	Examples:															If capacity step 1 has to cut in relay number 3 only, you must set c17 to 4.															If capacity step 2 has to cut in relay number 4 only, you must set c18 to 8.															If capacity step 3 has to cut in relay numbers 3 and 4, you must set c19 to 12.															Continue with a setting for c20 etc. until all capacity steps have been defined.																
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Definition of condenser and number of fans Here you set the number of fan steps with which regulation has to be carried out (but max. eight). 1-8: All fans are cut in and out with relays. The first vacant relay number is assigned to fan 1, the next to number 2, etc. Steps after DO8 must be executed through connection of a relay module type EKC 331 to the analog output. Cf. drawing on page 11.. 9: All fans controlled via the analog output and a frequency converter.		c29	No. of Fans																																																																																																																																																																																				
Read temperature at sensor Sc3		u44	Sc3 temp																																																																																																																																																																																				
Read temperature at sensor Sc4 (sensor is only used for monitoring)		u45	Sc4 temp																																																																																																																																																																																				
		-	--- Comp. Cap % Read cut-in compressor capacity																																																																																																																																																																																				
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Regulation parameters for the condenser regulation																																																																																																																																																																																							
Proportional band xp (P = 100/Xp) If the Xp value is increased, the regulation becomes steadier		n04	Xp K																																																																																																																																																																																				
I: Integration time Tn If the Tn value is increased, the regulation becomes steadier		n05	Tn s																																																																																																																																																																																				
Alarm		Alarm settings																																																																																																																																																																																					
The controller can give alarm in different situations. When there is an alarm all the light-emitting diodes (LED) will flash on the EKA 162, and the alarm relay will cut in. (In EKC 531D1 the alarm relay may be used for a fan, if required).																																																																																																																																																																																							
P0 min. (Alarm and safety function, see also page 18.) Here you set when the alarm at too low suction pressure is to enter into effect. The value is set as an absolute value.		A11	Min. P0. b																																																																																																																																																																																				
Pc max. (Alarm and safety function, see also page 18.) Here you set when the alarm at too high condensing pressure is to enter into effect. The value is set as an absolute value.		A30	Max. Pc. b																																																																																																																																																																																				
Alarm delay DI1 (an interrupted input will give alarm). The time delay is set in seconds. At max. setting the alarm is cancelled.		A27	DI1AlrmDelay																																																																																																																																																																																				
Alarm delay DI2 (an interrupted input will give alarm). The time delay is set in seconds. At max. setting the alarm is cancelled.		A28	DI2AlrmDelay																																																																																																																																																																																				
Alarm delay DI3 (an interrupted input will give alarm). The time delay is set in seconds. At max. setting the alarm is cancelled.		A29	DI3AlrmDelay																																																																																																																																																																																				
Alarm limit for high temperature of the "Saux1" sensor With setting = Off the alarm has been opted out.		A32	Saux1 high																																																																																																																																																																																				
Alarm delay from "Saux1" If the limit value 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	Alarm delay																																																																																																																																																																																				
Give the top button a brief push to zeroset the alarm and to have the message shown on the display.			Reset alarm The function zerosets all alarms when set in pos. ON.																																																																																																																																																																																				
			With data communication the importance of the individual alarms can be defined. Setting is carried out in the "Alarm destinations" menu. See also page 16.																																																																																																																																																																																				

Miscellaneous		Miscellaneous
<p>Sensor type (Sc3, Sc4 and "Saux1") Normally a Pt1000 sensor with great signal accuracy is used for temperature measurement and AKS 32R for pressure measurement. But a PTC sensor may also be used (r25 = 1000) in special situations. All temperature sensors must be of the same kind. In brine cooling the pressure measurements are replaced by temperature measurements. The following settings are possible: 0=PT1000. 1=PTC1000. 2=PT1000 on sensors and on Po. 3=PTC1000 on sensors and on Po. 4=PT1000 on sensors and on Pc. 5=PTC1000 on sensors and on Pc. 6=PT1000 on sensors, on Po and on Pc. 7=PTC1000 on sensors, on Po and on Pc. (If a temperature sensor is mounted on P0 or Pc, the respective settings in o20, 21, 47 and 48 will not be required).</p>	o06	Sensor type
<p>Pressure transmitter's working range Depending on the pressure, a pressure transmitter with a given working range is used. This working range must be set in the controller (e.g.: -1 to 12 bar The values must be set in bar if display in °C has been selected. And in psig, if °F has been selected.</p>		If the values are to be set from the AKM programme, they must be set in bar.
P0-Min. value	o20	P0MinTrsPres
P0-Max. value	o21	P0MaxTrsPres
Pc-Min. value	o47	PcMinTrsPres
Pc-Max. value	o48	PcMaxTrsPres
<p>Use of DI4 input The digital input can be connected to a contact function, and the contact can now be used for one of the following functions: Setting / function: 0: DI input not used 1: Regulation reference P0 displaced when contact is cut in 2: Alarm function when the contact cuts out. Alarm "A31" is given when the time delay has elapsed.</p>	o22	Di4 control
<p>Use of DI5 input The digital input can be connected to a contact function, and the contact can now be used for one of the following functions: Setting / function: 0: DI input not used 1: Regulation reference Pc displaced when contact is cut in 2: Alarm function when the contact cuts out. Alarm "A32" is given when the time delay has elapsed.</p>	o37	Di5 control
Read temperature at sensor "Saux1"	o49	Saux1 temp
<p>Operating hours The operating hours for the compressor relays can be read in the following menus. The read value is multiplied by 1000 to obtain the number of hours (f.ex. shows 2.1 for 2100 hours). On reaching 99.9 hours the counter stops and must now be reset to, say, 0. There will be no alarm or error message for counter overflow.</p>		(In the AKM display the hour number has not been multiplied)
Value for relay number 1	o23	DO1 run hour
Value for relay number 2	o24	DO2 run hour
Value for relay number 3	o25	DO3 run hour
Value for relay number 4	o26	DO4 run hour
Value for relay number 5 to 8	o50- o53	DO5 run hour DO8 run hour
<p>Refrigerant setting Before refrigeration is started, the refrigeration must be defined. You may choose between the following refrigerants: 1=R12. 2=R22. 3=R134a. 4=R502. 5=R717. 6=R13. 7=R13b1. 8=R23. 9=R500. 10=R503. 11=R114. 12=R142b. 13=User defined. 14=R32. 15=R227. 16=R401A. 17=R507. 18=R402A. 19=R404A. 20=R407C. 21=R407A. 22=R407B. 23=R410A. 24=R170. 25=R290. 26=R600. 27=R600a. 28=R744. 29=R1270. 30=R417A Warning: Wrong selection of refrigerant may cause damage to the compressor. Other refrigerants: Select setting 13 here, and subsequently three factors have to be set – fac1, fac2 and fac3 – via AKM.</p>	o30	Refrigerant

Manual control (stopped regulation only) From this menu the relays can be cut in and out manually. 0 gives no override, but a number between 1 and 10 will cut in a belonging relay. 1 will cut in relay number 1, 2 relay 2, etc. 11-18 will produce voltage on the analog output. In this way the relays on the external relay module can be activated. Setting 11 will give a voltage of 1.25 V, setting 12 will give 2.5 V, etc.	o18	---
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	o04	
Access code If the settings in the controller are to be protected by a numerical code, you can set a numerical value between 0 and 100. If not, you can cancel the function with setting OFF.	o05	
For Danfoss only		
Outputs DO9 and DO10 are normally used for the "Inject ON" function and for the alarm function, but they may be redefined via a setting in AKM.		DO9 function: 0: AKD Start/stop 1: Inject-on function 2: Boost ready function 3: Fan relay DO10 function: 0: Alarm relay 1: Fan relay

Configuration settings (compressor and fan definitions, coupling mode and refrigerant) can only take place when regulation is stopped.

DO9 function:

Inject-on function
 Normally DO9 is used for the Inject ON function. Here all the electronic expansion valves are closed when all the compressors are stopped. Wiring is carried out as shown below.
 The function may however also be generated via data communication. In this way the relay output is made available for other applications.

Boost ready function
 If two controllers are to capacity regulate the high-temperature part and the low-temperature part, respectively, they must be connected in such a way that low-temperature regulation cannot be started until the high-temperature part is operating. The signal can be taken from DO9 of one controller and received on the ON input of the other controller.
 Example:

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. The individual status codes have the following meanings		EKC state (0 = regulation)
S2: When the relay is operated, it must be activated for min. x minutes (cf. c01)		2
S5: Renewed cutin of the same relay must not take place more often than every x minutes (cf. c07)		5
S8: The next relay must not cut in until x minutes have elapsed (cf.c11-c12)		8
S9: The next relay must not cut out until x minutes have elapsed (cf. c14-c15)		9
S10: Regulation stopped with the internal og external start/stop		10
Alarm messages		Alarms "Destinations"
A2: Low P0		--- Low P0 alarm
A11: No refrigerant has been selected (cf. o30)		--- No RFG Sel
A17: High Pc		--- Hi Pc alarm
A19-26: Compr. fault. Interrupted signal on input "Comp 2" /2/3/4/5/6/7/8		--- Comp_fault
A27: High temperature alarm for sensor "Saux1"		--- Saux1 temp
A28 - 32: External alarm. Interrupted signal on input "DI1" /2/3/4/5		--- DI_Alarm
A45: Regulation stopped with setting or with external switch		A45 Stand by
E1: Error in the controller		Ctrl. fault
E2: Control signal outside the range (short-circuited/interrupted)		Out of range

Compressor configuration

Setting "C16" will define the configuration.

Setting "C08" will define coupling mode.

Compressor connections										Coupling mode	
Relay no.										Set "C16" to	Set "C08" to
1	2	3	4	5	6	7	8	9	10		
										1	1
										2	1 / 2
										3	1 / 2
							Binary			4	1 / 2 / 3
										5	1
										6	1
										7	1
										8	1 / 2
										9	1 / 2
										10	1 / 2
										11	1 / 2
										12	1 / 2
										15	1 / 2
										16	1 / 2
										17	1 / 2
										18	1 / 2
										19	1 / 2
							4 x 25 %			21	1
							6 x 16,6%			22	1 / 2
							8 x 12,5 %			23	1 / 2
							6 x 16,6 %			24	1
							9 x 11 %			25	1 / 2
							12 x 8,3 %			26	1 / 2
User-defined combination.							Mix & match			0	1

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AD462303.11

Capacity step

All capacity steps are presumed to be identical. The only exception is the settings C16 = 0, 4, and 21 to 26.

Coupling mode

Coupling mode 1 = *sequential* operation.
Coupling mode 2 = *cyclic* operation.
Coupling mode 3 = *cyclic* and binary operation where the compressor capacities are, as follows:

- 1: 9%
- 2: 18%
- 3: 36%
- 4: 36%

There is cyclic coupling at 3 and 4, and binary on 1, 2 and 3/4. (for c16=4 only)

Couplings

When there is cyclic operation and connections with unloaders there will in some capacity cutins and cutouts be overlappings where the unloaders from either one compressor or another may be active.
In such cases the unloaders on the compressor with the lowest number of hours will be cut in, and the others cut out.

The changeover will take place at 6-second intervals.

Equalised operation

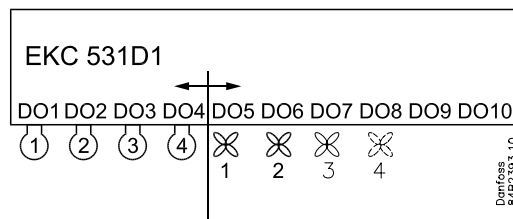
When C16 = 21 to 26, compressor 1 + belonging unloader must have the same capacity as each of the subsequent compressors. The unloading function will equalise the cut-in capacity when the subsequent compressors are cut in and out. Compressor 1 will always be operating.

Condenser couplings

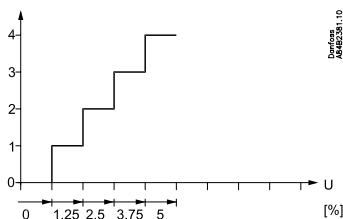
When the compressor relays have been established the turn comes to the fan relays.

The first vacant relay (DO1-DO8) will become the first fan relay.

It will be followed by the subsequent relays. If more relays are required than the vacant DO relays, a relay module can be connected to the analog output. The function is, as follows:



If there are up to four external fans on an EKC 331:

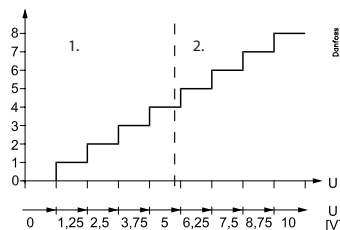


Output signal from EKC 531D1

In EKC 331 the voltage range must be set to 0-5 V ("o10" = 6).

In EKC 331 the number of steps must be set to 4 ("o19" = 4) (also when fewer fans are connected).

If there are more than four external fans on two EKC 331 units:



Output signal from EKC 531D1

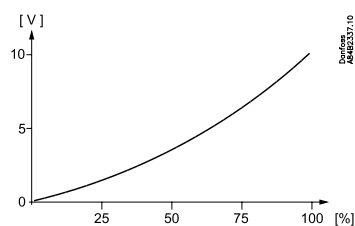
In the first EKC 331, set 0-5 V ("o10" = 6).

In the second EKC 331, set 5-10 V ("o10" = 7).

In both EKC's the number of steps must be set to 4 ("o19" = 4) (also when fewer fans are connected to the second EKC).

If the entire condenser capacity is to be controlled by a frequency converter, EKC 531D1 must send an analog signal about the required capacity ("c29" = 9).

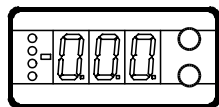
The signal varies from 0 to 10 V. Signal and capacity have the following context.



Operation

Display

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



EKA 162

For operation and display of evaporating pressure. The light-emitting diodes on the left-hand side flash when there is an alarm.

During normal operation the light-emitting diodes will indicate where regulation is taking place.

Highest	+	second highest	:	++Zone
		second highest	:	+Zone
"None"			:	Neutral zone
		second lowest	:	-Zone
Lowest	+	second lowest	:	-- Zone

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

Operation

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

Quick-start

If you wish to start the system in a hurry so that refrigeration can be commenced you can set the following eight parameters: r23 – r28 – c08 – c09 – c16 – c29 – o30, and finally r12.

When regulation has then started you can go through the remaining parameters and adjust these.

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

Menu survey EKC 531D1

SW: 1.2x

Function	Parameter	Min.	Max.	Factory setting
Normal display				
Shows P0 in EKA 162 (display with buttons)	-	°C		
Shows Pc in EKA 161	-	°C		
P0 reference				
Neutral zone	r01	0.1 °C	20 °C	4.0
Correction of signal from P0 sensor	r04	-10 °C	10 °C	0.0
Select unit (0=bar and °C, 1=Psig and °F)	r05	0	1	0
Start/Stop of regulation	r12	OFF	ON	1
Reference offset for P0	r13	-20 °C	20 °C	0.0
Set regulation setpoint for P0	r23	-99 °C	30 °C	0.0
Shows total P0 reference	r24		°C	0.0
Limitation: P0 reference max. value *	r25	-99 °C	30 °C	30.0
Limitation: P0 reference min. value *	r26	-99 °C	0 °C	-99.9
Displacement of P0 (ON=active "r13")	r27	OFF	ON	0
Pc reference				
Set regulation setpoint for Pc	r28	-25 °C	75 °C	35
Shows total Pc reference	r29		°C	10
Limitation: Pc referencen max. value	r30	-99 °C	99 °C	10
Limitation: Pc referencen min. value	r31	-99 °C	99 °C	-10
Correction of signal from Pc sensor	r32	-10 °C	10 °C	0.0
Pc reference variation.1 and 2 are P-regulation 1: Fixed reference. "r28" is used 2: Variable reference. Outdoor temperature (Sc3) included in the reference 3: As 1, but with P-regulation (Xp-band) 4: As 2, but with P-regulation (Xp-band) 5: As 2, and with heat recovery 6: As 4 and with heat recovery	r33	1	6	1
Reference offset for Pc	r34	-20 °C	20 °C	10
Capacity				
Min. ON time for relays	c01	0 min	30 min.	0
Min. time period between cutins of same relay	c07	0 min.	60 min	4
Definition of regulation mode 1: Sequential (step mode / FILO) 2: Cyclic (step mode / FIFO) 3: Binary and cyclic	c08	1	3	1
If a regulation mode with unloaders is selected, the relay must be defined to: 0: Cut in when more capacity is required 1: Cut out when more capacity is required	c09	0	1	0
Regulation parameter for + Zone	c10	0.1 K	2 K	5.0
Regulation parameter for + Zone min.	c11	0.1 min	60 min	5.0
Regulation parameter for ++ Zone seconds	c12	0.1 min.	3.0 min	1.0
Regulation parameter for - Zone	c13	0.1 K	2 K	2.0
Regulation parameter for - Zone min.	c14	0.1 min.	60 min	1.0
Regulation parameter for -- Zone seconds	c15	0.1 min.	10 min	0.5
Definition of compressor connections. See options on page 10.	c16	0	26	0
The following "c17" to "c28" is only relevant if "c16" has been selected to 0. A code will then have to be set for the relays that are to be ON at the different steps: Step 1 (M&M operation) Step 2 (M&M operation)	c17	0	15	0
	c18	0	15	0

* also applies to regulation with reference displacement

To be continued

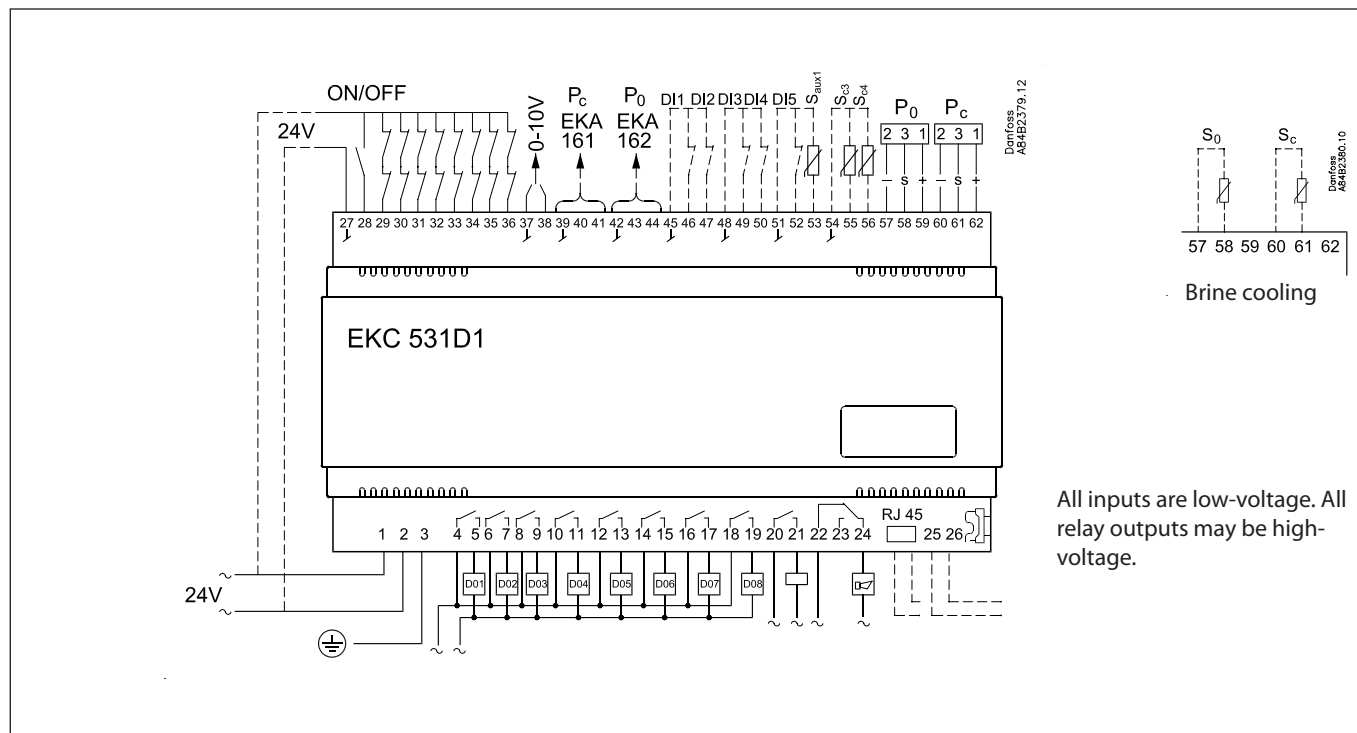
Step 3 (M&M operation)	c19	0	15	0
Step 4 (M&M operation)	c20	0	15	0
Step 5 (M&M operation)	c21	0	15	0
Step 6 (M&M operation)	c22	0	15	0
Step 7 (M&M operation)	c23	0	15	0
Step 8 (M&M operation)	c24	0	15	0
Step 9 (M&M operation)	c25	0	15	0
Step 10 (M&M operation)	c26	0	15	0
Step 11 (M&M operation)	c27	0	15	0
Step 12 (M&M operation)	c28	0	15	0
Definition of condenser: 1-8: Total number of fan relays 9: Only via analog output and start of frequency converter	c29	0/OFF	9	0
Proportional band Xp for (P= 100/Xp) condenser regulation	n04	0.2 K	40 K	10
I: Integration time Tn for condenser regulation	n05	30 s	600 s	150
Alarm				
Delay time for a "Saux1" alarm	A03	0 min.	90 min	30
Low alarm and safety limit for PC	A11	-1 bar	40 bar	-40
Delay time for a DI1 alarm	A27	0 s	600 s /off	600
Delay time for a DI2 alarm	A28	0 s	600 s /off	600
Delay time for a DI3 alarm	A29	0 s	600 s /off	600
Upper alarm and safety limit for Pc	A30	0 °C	99 °C	60.0
Upper alarm limit for sensor "Saux1"	A32	0 °C /off	99°C	0.0
Miscellaneous				
Controllers address	o03*	1	60	
On/off switch (service-pin message)	o04*	-	-	
Access code	o05	off(-1)	100	
Used sensor type for Sc3, Sc4 and "Saux1" 0 =PT1000, 1 =PTC1000 2-7=variations with temperature sensor on P0 and Pc. See earlier in the manual.	o06	0	7	0
Set supply voltage frequency	o12	50 Hz	60 H	0
Manual control of outputs: 0: No override 1-10: 1 will cut in relay 1, 2 relay 2, etc. 11-18: Gives voltage signal on the analog output. (11 gives 1.25 V, and so on in steps of 1.25 V	o18	0	18	0
P0 pressure transmitter's working range - min. value	o20	-1 bar	0 bar	-1.0
P0 pressure transmitter's working range - max. value	o21	1 bar	40 bar	12.0
Use of DI4-input 0 =not used. 1 =P0 displacement. 2 =alarm function. Alarm="A31"	o22	0	2	0
Operating hours of relay 1 (value time 1000)	o23			h 0.0
Operating hours of relay 2 (value time 1000)	o24			h 0.0
Operating hours of relay 3 (value time 1000)	o25			h 0.0
Operating hours of relay 4 (value time 1000)	o26			h 0.0
Setting of refrigerant 1=R12. 2=R22. 3=R134a. 4=R502. 5=R717. 6=R13. 7=R13b1. 8=R23. 9=R500. 10=R503. 11=R114. 12=R142b. 13=User defined. 14=R32. 15=R227. 16=R401A. 17=R507. 18=R402A. 19=R404A. 20=R407C. 21=R407A. 22=R407B. 23=R410A. 24=R170. 25=R290. 26=R600. 27=R600a. 28=R744. 29=R1270. 30=R417A	o30	0	30	0
Use of DI5-input 0 =not used. 1 =Pc displacment. 2 =alarm function. Alarm="A32"	o37	0	2	0

Pc pressure transmitter's working range - min. value	o47	-1 bar	0 bar	-1.0
Pc pressure transmitter's working range - max. value	o48	1 bar	60 bar	34.0
Read temperature at sensor "Saux1"	o49		°C	22.3
Operating hours of relay 5 (value time 1000)	o50		h	
Operating hours of relay 6 (value time 1000)	o51		h	
Operating hours of relay 7 (value time 1000)	o52		h	
Operating hours of relay 8 (value time 1000)	o53		h	
Service				
Read temperature at sensor "Sc3"	u44		°C	41.1
Read temperature at sensor "Sc4"	u45		°C	20.1

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

The controller can give the following messages		
E1	Error message	Fault in controller
E2		Regulation is outside the range, or the control signal is defective
A2	Alarm message	Low P0
A11		Refrigerant not selected
A17		High Pc
A19		Compressor 1 alarm. Terminal 29 is open
A20		Compressor 2 alarm. Terminal 30 is open
A21		Compressor 3 alarm. Terminal 31 is open
A22		Compressor 4 alarm. Terminal 32 is open
A23		Compressor 5 alarm. Terminal 33 is open
A24		Compressor 6 alarm. Terminal 34 is open
A25		Compressor 7 alarm. Terminal 35 is open
A26		Compressor 8 alarm. Terminal 36 is open
A27		Room temperature alarm (housing temp.)
A28		DI 1 alarm. Terminal 46 interrupted
A29		DI 2 alarm. Terminal 47 interrupted
A30		DI 3 alarm. Terminal 49 interrupted
A31		DI 4 alarm. Terminal 50 interrupted
A32		DI 5 alarm. Terminal 52 interrupted
A45	Regulation stopped	
S2	Status message	Wait for "c01"
S5		Wait for "c07"
S8		Wait for "c11" or "c12"
S9		Wait for "c14" or "c15"
S10		Refrigeration stopped by the internal or external start/stop function

Connections



Necessary connections

Terminals:

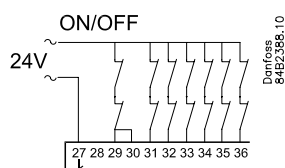
- 1-2 Supply voltage 24 V a.c.
- 4- 19 Relay outputs for either compressors, unloaders or fan motors
- 22-24 Alarm relay *
There is connection between 22 and 24 in alarm situations and when the controller is dead
- 27-28 24 V signal to start / stop of regulation
- 27-29 24 V signal from the safety circuit compressor 1
- 27-30 24 V signal from the safety circuit compressor 2
- 27-31 24 V signal from the safety circuit compressor 3
- 27-32 24 V signal from the safety circuit compressor 4
- 27-33 24 V signal from the safety circuit compressor 5
- 27-34 24 V signal from the safety circuit compressor 6
- 27-35 24 V signal from the safety circuit compressor 7
- 27-36 24 V signal from the safety circuit compressor 8
- 57-59 Suction pressure. Voltage signal from AKS 32R **
- 60-62 Condenser pressure. Voltage signal from AKS 32R **
- 54-55 Out temperature (Sc3). Sensor signal from AKS 11, AKS 12 or EKS 111

Application dependent connections

- 20-21 Inject On function *
The relay cuts out when all compressor relays are cut out. The signal must be received by evaporator controls.
- 37-38 Voltage signal to external condenser control
- 39-41 Possibility of connecting an external display type EKA 161 for display of Pc
- 42-44 Possibility of connecting an external display type EKA 161 for display of P0, or EKA 162 for operation and display of P0
- 45-46 Contact function for alarm signal
- 45-47 Contact function for alarm signal
- 48-49 Contact function for alarm signal
- 48-50 Contact function for displacement of the suction pressure reference or for alarm signal.
- 51-52 Contact function for displacement of the condenser pressure reference or for alarm signal.
- 51-53 Separate sensor Saux1. Sensor signal from AKS 11, AKS 12 or EKS 111
- 54-56 Air temperature at condenser outlet. Sensor signal from AKS 11, AKS 12 or EKS 111

Data communication

- 25-26 Mount only, if a data communication module has been mounted.
For ethernet communication the plug connection RJ45 must be used. (LON FTT10 can also be connected in this way.
It is important that the installation of the data communication cable be done correctly. Cf. separate literature No. RC.8A.C...
The termination bracket is placed to the right of terminal 26.



*) Relays DO9 and DO10 may in special cases be reconfigured so that they can be used as fan relays. See also page 8.

***) In brine systems temperature measurement at terminals 57-58 and 60-61 may be used instead of pressure measurement with AKS 32R. See also o06.

Data

Supply voltage	24 V a.c. +/-15% 50/60 Hz, 5 VA	
Input signal	2 pcs. Pressure transmitters type AKS 32R (temperature sensor in brine systems)	
	3 pcs. temperature sensor input for PT 1000 ohm/0°C or PTC 1000 ohm/25°C	
Digitale input from contact function.	1 pcs. for Start/stop of regulation	
	8 pcs. for monitoring of safety circuits	
	3 pcs. for alarm function	
	2 pcs. for alarm function or for displacement of references	
Relay output for capacity regulation	8 pcs. SPST	AC-1: 3 A (ohmic) AC-15: 2 A (inductive)
"Inject-on" relay	1 pcs. SPST	
Alarm relay	1 pcs. SPDT	AC-1: 6 A (ohmic) AC-15: 3 (inductive)
Voltage output	0-10 V d.c.	
Display outputs	EKA 161	Pc display
	EKA 162	Operation, P0 display and LED
Data communication	Possible to connect a data communication module	
Environments	0 - 55°C, during operation	
	-40 - 70°C, during transport	
	20 - 80% Rh, not condensing	
	No shock influence / vibrations	
Enclosure	IP 20	
Weight	0.4 kg	
Mounting	DIN rail or on wall	
Terminals	max. 2.5 mm ² 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 EN61000-6-2 and 3	

Pressure transmitter / temperature sensor

Please refer to catalogue RK0YG...

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.

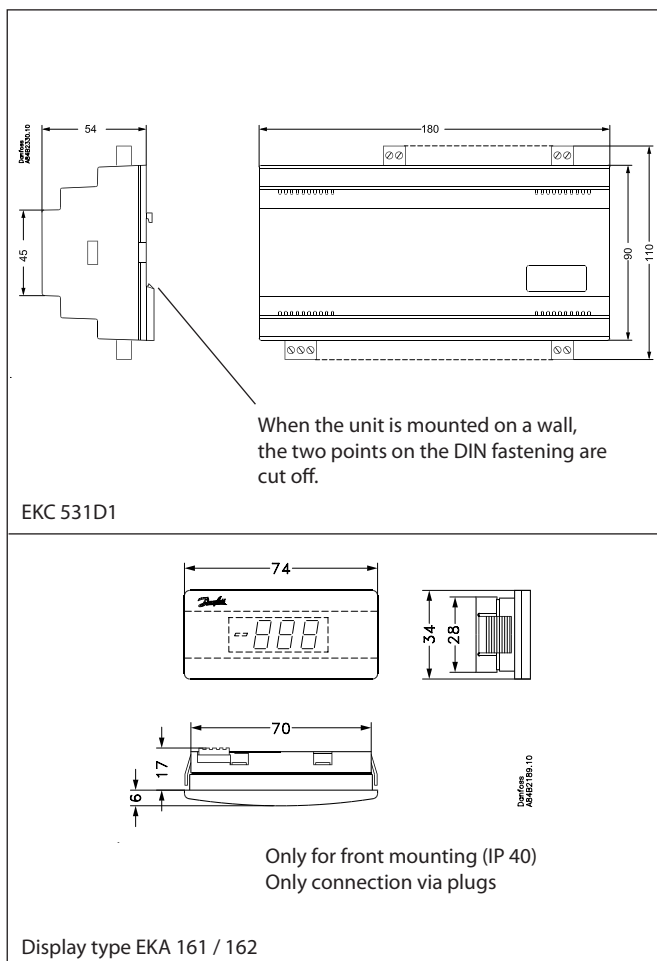
Your local Danfoss agent will be pleased to assist with further advice, etc.

Ordering

Type	Function	Code no.
EKC 531D1	Capacity controller	084B8007
EKA 161	Display unit	084B7019
EKA 162	Display unit with operation buttons	084B7062 *
	Cable for display unit 2 m, 1 pcs.	084B7298
	Cable for display unit 6 m, 1 pcs.	084B7299
EKA 173	Data communication module, FTT 10	084B7092
EKA 175	Data communication module, RS 485	084B7093
EKA 177	Data communication module, Ethernet	084B8202

*) Neutral version. There are no icons at light-emitting diodes.

Montage

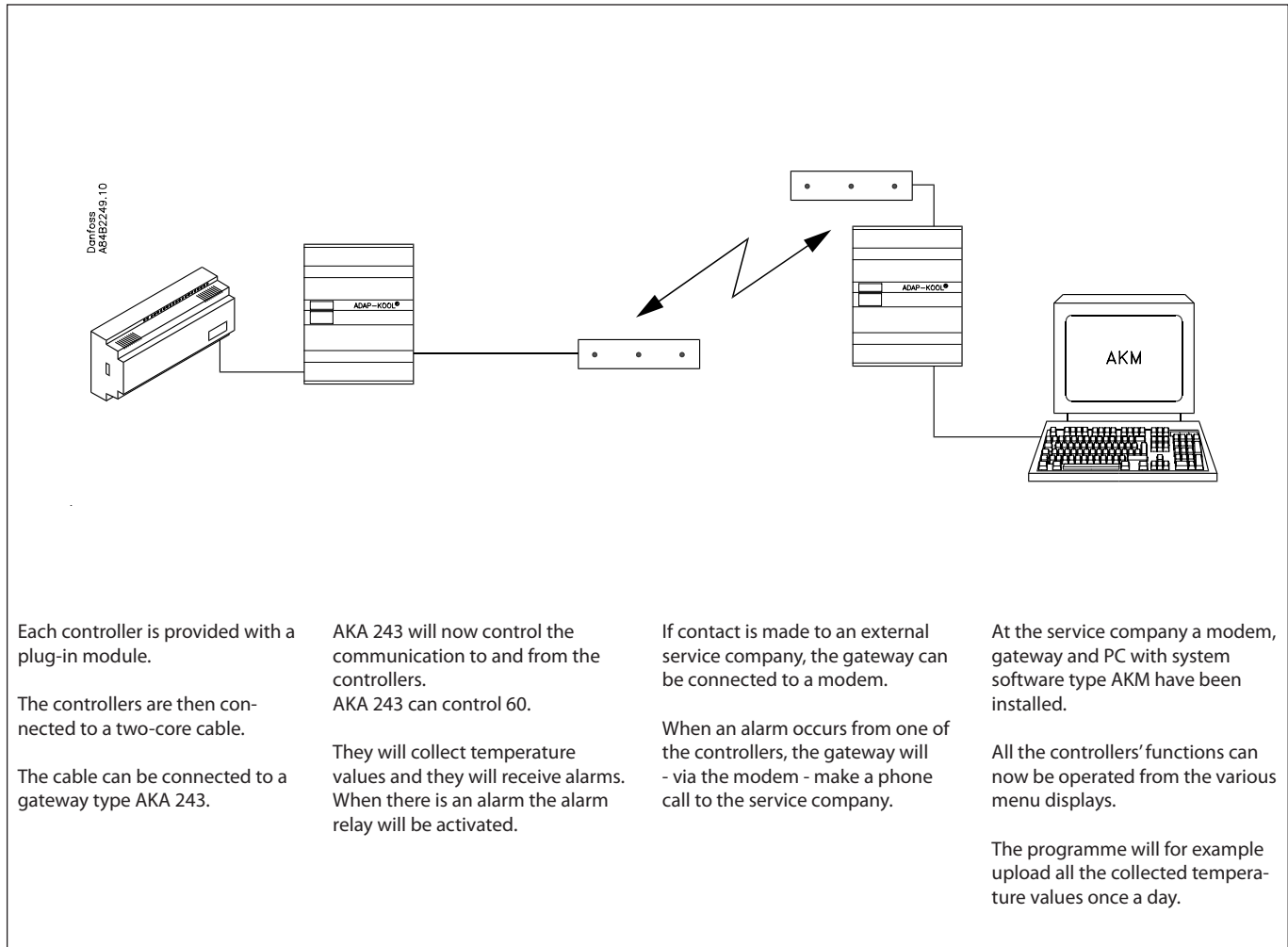


Data communication

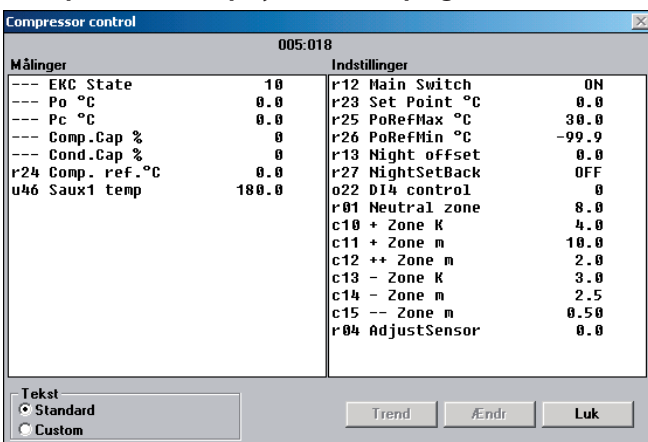
This page contains a description of a few of the possibilities you will have when the controller is provided with data communication.

It is important that the installation of the data communication cable is carried out correctly. Please refer to separate literature No. RC.8A.C

Example



Example of menu display in the AKM-programm



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 - 8.

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.

Override

The controller contains a number of functions that can be used together with the override function in the master gateway. They can therefore only be used in combination with data communication.

Function via data communication	Functions to be used in the gateway's override function	Selection of parameter in EKC 531AD1 084B8007 Sw.1.2x
Stop of injection when the compressor is stopped	AKC ON	--- MC Inject ON
Night setback	Day/night control and time schedule	r27 NightSetback
Suction pressure optimisation	P0 optimisation	Select controller address (The parameters are found automatically and do not become visible).
EKC 531D1 registers the refrigeration point which handles the largest capacity (requires the lowest suction pressure). The parameter may be logged for use in a service situation.		--- MLC

Safety function

Monitoring of maximum discharge pressure

The function cuts in all condenser steps and gradually cuts out compressor steps, if the condensing pressure exceeds the permitted value. The cutout limit is the setting in "A30".

The function starts at a value that is 3 K below the set value. At this point the entire condenser capacity is cut in at the same time as 33% of the compressor capacity is cut out. (however min. one step). This is repeated for each 30-second interval. The alarm function is activated.

If the temperature (pressure) rises to the set limit value, the following happens:

- all compressor steps are immediately cut out
- the condenser capacity remains cut in

The alarm ceases when the temperature (pressure) has dropped to the 3 K below the limit value for 60 seconds.

Renewed cut in of compressor steps is allowed when the temperature (pressure) has dropped to the 3 K below the limit value. Restart of the compressor is dependent on expiry of the restart timer.

Monitoring of minimum suction pressure

The function immediately cuts out all compressor steps if the suction pressure becomes lower than the permitted value. The cut out limit is the setting in "A11".

Cut outs activate the alarm function.

The alarm ceases when the pressure (temperature) is above the cut out limit.

Renewed cut in of compressor steps is allowed when the alarm has stopped (the time delay has expired).

Emergency procedure

If the controller registers irregularities in the registered signals, it will start an emergency procedure:

For compressor regulation:

- If the signal from the pressure transmitter becomes smaller than expected, the controller will continue operating with the average capacity that has been cut in during the past 60 minutes. This cut-in capacity will gradually decline as time passes.
- If the signal for the suction pressure becomes smaller than the set value of A11, the capacity will instantly be cut out.

For condenser regulation:

- If the signal from the pressure transmitter becomes smaller than expected, or if the condensing pressure becomes bigger than the set value of A30, the entire capacity will instantly be cut in.

List of literature

Instructions RI.8H.U.-- (extract from this manual).

Here you can see how controllers are mounted and programmed.

Installation guide for extended operation RC.8A.C

Here you can see how a data communication connection to ADAP-KOOL® Refrigeration controls can be established.

