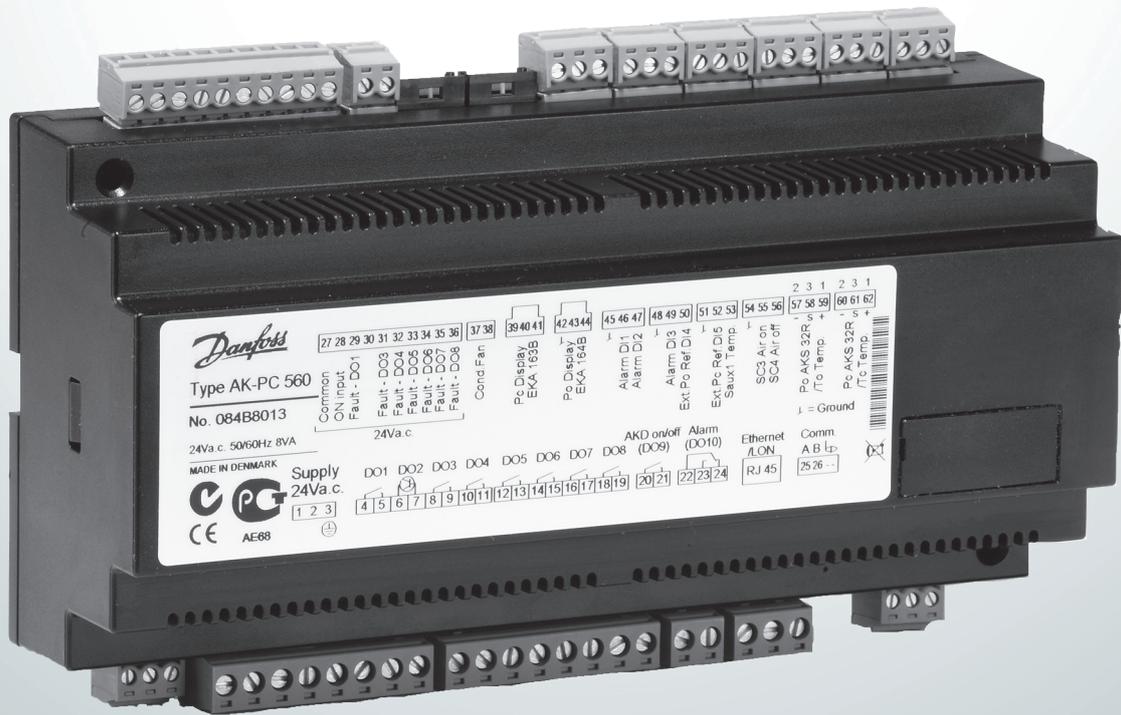


User Guide

# Capacity controller for digital scroll AK-PC 560

ADAP-KOOL® Refrigeration control systems



## Introduction

### Application

The controller is used for capacity regulation of compressors or condensers in small refrigerating systems. Two outputs are dedicated to a digital scroll compressor. The other compressors and condensers can be connected, as required. If more outputs than the 8 on the controller are required, extra ones can be connected via an external relay module.

### Advantages

- Digital scroll compressor control
- Sequential or cyclic operation
- Possibility of suction pressure optimization 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.

- Pressure regulation P0
- Pressure regulation Pc
- Pressure regulation with variable reference (Sc3)

### Functions

- Pulse width modulated signal for controlling a digital scroll compressor
- 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
- Temperature monitoring of the digital scroll compressor
- 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 164 or EKA 165.

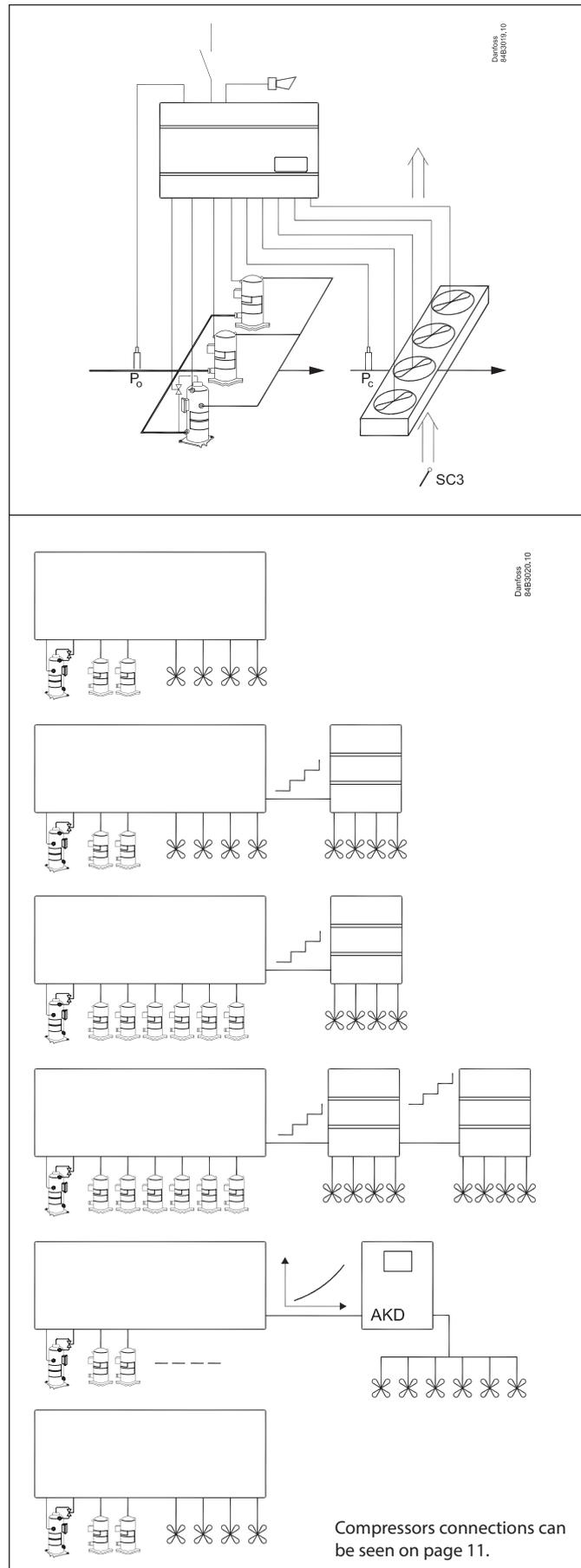
### Combinations

The controller has ten relay outputs two of which have been reserved for the digital scroll and two other for the alarm function and for the "AKD start/stop" 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 "AKD start/stop" function are left out, all ten relay outputs may be used for compressors and fans (but max. seven for compressors and max. eight fans).



## Function

### Capacity regulation

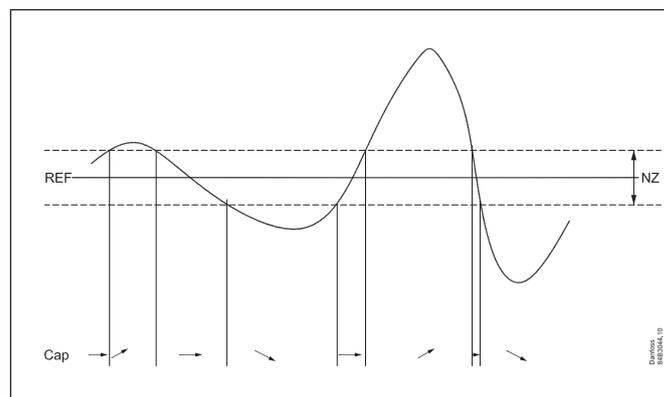
The cut-in capacity is controlled by signals from the connected pressure transmitter and the set reference.

Outside the reference a neutral zone is set.

The digital scroll compressor controls the capacity in the neutral zone in order to maintain the pressure. When the digital scroll compressor can no longer maintain the pressure within the neutral zone, the controller will cut out or cut in the next compressor in the row.

When extra capacity is either cut out or cut in, the capacity from the digital scroll will be modified accordingly to maintain the pressure within the neutral zone.

- When the pressure is higher than the "reference + half neutral zone", cut-in of the next compressor (arrow up) is permitted.
- When the pressure is lower than the "reference - half neutral zone", cut-out of a compressor (arrow down) is permitted.
- When the pressure is within the neutral zone, the process continues with the compressors already cut in, and the digital scroll will modulate the capacity.

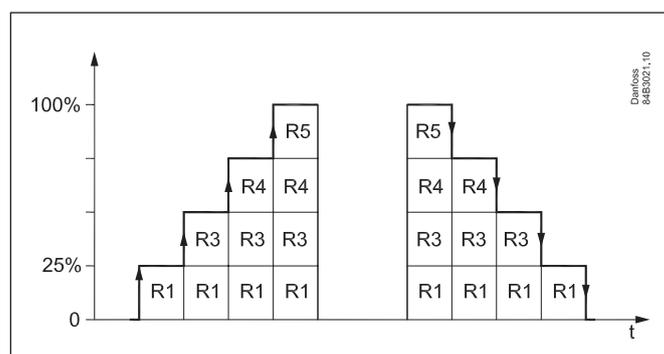


Cutin of steps can be defined for either sequential or cyclic.

### Sequential (first in - last out)

The relays are here cut in in sequence – first relay number 1, then 3, etc.

Cutout takes place in the opposite sequence, i.e. the last cut-in relay will be cut out first.

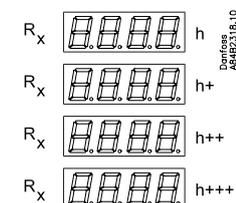


### Cyclic (first in - first out)

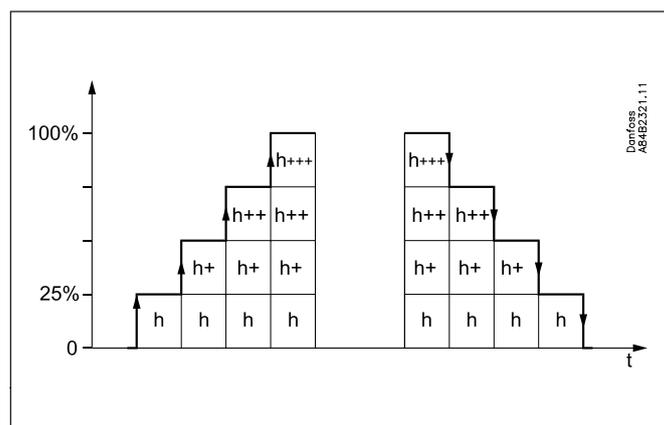
The relays are coupled here so that the operating time of the individual relays will become equalised.

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.



R<sub>x</sub> = random relay (3 - 8)  
h = number of hours



## Suvey of functions

The total function content is shown below – not all functions are present at the same time. The setting of o61 determines which functions are present.

The menu overview on page 14 shows the various functions and settings.

| Function  | Parameter  | Parameter by operation via data communication                           |
|---|------------|---|
| <b>Normal display</b>   |            |   |
| If the two displays are mounted:<br>P0 will be shown on EKA 165 (the one with buttons)<br>Pc will be shown on EKA 163. Both readouts will be in temperature or in bar.  |            | P0 °C or P0 b<br>Pc °C or Pc b  |
| <b>Compressor regulation reference</b>  |            | <b>Compressor control</b>   |
| <b>P0 setpoint</b><br>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 system units override function.   | r23        | P0Set Point °C / P0Set Point b  |
| <b>Offset</b><br>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).<br>(Cf. also Definition of DI4 input).  | r13        | Night offset  |
| <b>Night setback</b><br><b>OFF:</b> No change of the reference<br><b>ON:</b> Offset value forms part of the reference   | r27        | NightSetBack  |
| <b>Reference</b><br>The regulation reference is shown here  | r24        | P0 ref. °C / P0 ref. b  |
| <b>Set point limitation</b><br>With these settings the setpoint can only be set between the two values.<br>(This also apply if regulation with displacements of the reference).<br>Max. permissible set point value.<br>Min. permissible set point value.   | r25<br>r26 | P0RefMax °C / P0RefMax b<br>P0RefMin °C / P0RefMin b                    |
| <b>Neutral zone</b><br>There is a neutral zone around the reference. See also page 3.   | r01        | Neutral zone  |
| <b>Correction of pressure measurement</b><br>An offset adjustment of the registered pressure can be made.   | r04        | AdjustPOSens  |
| <b>Unit</b><br>Here you can select whether the display is to indicate in SI units or US units.<br><b>0:</b> SI (°C / bar)<br><b>1:</b> US (°F / psig)   | r05        | Unit<br><br>(In AKM only SI (bar and °C) is used, whatever the setting) |
| <b>Start/stop of refrigeration</b><br>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 <b>must</b> be wired).  | r12        | Main Switch   |
| <b>Condenser regulation reference</b>   |            | <b>Condenser control</b>  |
| <b>Pc set point</b><br>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 system units override function.  | r28        | PcSet Point °C / PcSet Point b  |
| <b>Offset</b><br>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        | PcRefOffset   |
| <b>Pc reference variation.</b> See also page 22<br>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).<br><b>1:</b> No change of the reference. Regulation based on set set point. And offset with the DI5 function is allowed.<br><b>2:</b> 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.<br>Here is offset with the DI5 function not allowed. At DI5 signal the reference will change to the set set point.<br>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.<br><b>3:</b> As 1, but with P regulation (xp-band)<br><b>4:</b> As 2, but with P regulation (xp-band) | r33        | Pc mode   |
| <b>Condenser reference</b><br>The regulation reference is shown here.   | r29        | Pc ref. °C / Pc ref. b  |

|   |     |   |
|---|-----|---|
| <b>Set point limitation</b><br>With these settings the set point can only be set between the two values.<br>(This also applies to regulations where the Xp band lies above the reference).  |     |   |
| Max. permissible set point value.   | r30 | PcRefMax °C / PcRefMax b                            |
| Min. permissible set point value.   | r31 | PcRefMin °C / PcRefMin b                            |
| <b>Correction of pressure measurement</b><br>An offset adjustment of the registered pressure can be made.   | r32 | AdjustPcSens  |
| <b>Dimensioning temperature Dim tm</b><br>The mean temperature difference across the condenser at maximum load (tm difference at max. load). This is the temperature difference between the air and condensing temperature.   | r35 | Dim tm K  |
| <b>Dimensioning temperature Min tm</b><br>The mean temperature difference across the condenser at the lowest relevant compressor capacity (tm difference at min. load). This is the temperature difference between the air and condensing temperature.  | r56 | Min tm K  |
| <b>Compressor capacity</b>  |     | <b>Compressor pack config.</b>                      |
| <b>Running time</b><br>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.  | c01 | Min.ON time   |
| Min. time period between cutin of same relay.   | c07 | Recycle time  |
| <b>Pump down limit</b><br>The factory setting for this function is OFF.<br>Activate by setting a value corresponding to pressure under the regulation area and over the P0 min. limit.<br>The function keeps the last capacity step going until the pressure comes down to the pump down limit. When this value is reached the last compressor will cut out.<br>Do not reconnect capacity until the pressure is once more above the neutral zone. | c33 | PumpDownLim.  |
| <b>Compressor configuration</b><br>Here you set the of number of compressors<br><b>1</b> = One compressor, <b>2</b> = two compressors <b>3</b> =3, <b>4</b> =4, <b>5</b> =5, <b>6</b> =6, <b>7</b> =7.<br>See survey on page 11   | c16 | Compr mode  |
| <b>Selection of coupling mode</b> (See also the overview page 11)<br><b>1.</b> S. Sequential: First relay 1 cuts in, then relay 3, etc. Cutout takes place in the opposite sequence. ("First in, last out").<br><b>2.</b> Cyclic: An automatic operating time equalisation is arranged between the remaining compressors.   | c08 | Step mode   |
| <b>Manual control of compressor capacity</b><br>This sets the capacity that is to be cut in when switching to manual control.<br>(c01 and c07 will still apply)   | c31 | CmpManCap%  |
| <b>Manual control</b><br>Manual control of the compressor capacity is enabled here.<br>When set to ON, the capacity that is set in "c31" is cut in.   | c32 | CmpManCap   |
| <b>Time delay for incorrect cut-out</b><br>Applies to compressor 1  | c77 | C1 fault del  |
| <b>Time delay for incorrect cut-out</b><br>Applies to the other compressors   | c78 | Cx fault del  |
| <b>Pulse width period for the capacity modulation</b><br>The digital scroll compressor's by-pass valve can be turned on and off during this period, but only one sequence.<br>This is where you set how often the by-pass valve is to be activated  | c79 | DS PWM per  |
| <b>Max. capacity in the pulse width period</b><br>It is possible to limit the capacity for the period here. If the setting is 100%, then there is no limit.   | c80 | PWM Max cap   |
| <b>Min. capacity in the pulse width period</b><br>A minimum capacity for the period must be set here. Without this minimum capacity the compressor will not be cooled.  | c81 | PWM Min cap   |
| <b>Kp factor</b><br>For PI regulation of the digital scroll   | c82 | DS Kp   |
| <b>Tn factor</b><br>For PI regulation of the digital scroll   | c83 | DS Tn   |
| <b>Compressor conditions</b><br>This is where the size of the digital compressor's capacity is set in relation to the capacity of one of the other compressors. Setting range = 100 to 200%.  | c84 | DS Size   |
|   |     | -- - Comp. Cap %<br>Read cut-in compressor capacity |

|  |     |  |
|--|-----|--|
|  |     | Actuel zone state:<br>0=off. 2=-zone. 3=Neutral zone.<br>4=+zone.    |
| <b>Condenser capacity</b>  |     |  |
| <b>Definition of condenser and number of fans</b><br>Here you set the number of fan steps with which regulation has to be carried out (but max. eight).<br><b>1-8:</b> 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 12.<br><b>9:</b> All fans controlled via the analog output and a frequency converter.<br><b>10:</b> Not used<br><b>11-18:</b> Total number of fan relays (as 1-8), but here the starting sequence is altered after each time all fans are stopped. | c29 | Fan mode   |
| <b>Read temperature at sensor Sc3</b>  | u44 | Sc3 temp   |
| <b>Read temperature at sensor Sc4</b> (sensor is only used for monitoring)   | u45 | Sc4 temp   |
|  | -   | - - - Fan Cap %<br>Read cut-in condenser capacity                    |
| <b>Regulation parameters for the condenser regulation</b>  |     |  |
| <b>Proportional band xp (P = 100/Xp)</b><br>If the Xp value is increased, the regulation becomes steadier  | n04 | Xp K / Xp b  |
| <b>I: Integration time Tn</b><br>If the Tn value is increased, the regulation becomes steadier   | n05 | Tn s   |
| <b>Manual control of condenser capacity</b><br>This sets the capacity that is to be cut in when switching to manual control.   | n52 | FanManCap%   |
| <b>Manual control</b><br>Manual control of the condenser capacity is enabled here.<br>When set to ON, the capacity that is specified in "n52" is cut in.   | n53 | FanManCap  |
| <b>Speed control start value</b><br>Speed control will only be activated when the capacity requirement reaches this value.   | n54 | StartSpeed   |
| <b>Speed control stop value</b><br>Speed control will be stopped when the capacity requirement falls below this value.   | n55 | MinSpeed   |
| <b>Alarm</b>   |     | <b>Alarm settings</b>  |
| The controller can give alarm in different situations. When there is an alarm the light-emitting diodes (LED) will flash on the display and the alarm relay will cut in. (In AK-PC 560 the alarm relay may be used for a fan, if required).  |     |  |
| <b>P0 min.</b> (Alarm and safety function, see also page 20.)<br>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.°C / Min. P0. b  |
| <b>Alarm delay P0 alarm</b><br>The time delay is set in minutes. At min. setting the alarm is cancelled.   | A44 | P0AlrmDelay  |
| <b>Pc max.</b> (Alarm and safety function, see also page 20.)<br>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.°C / Max. Pc. b  |
| <b>Alarm delay Pc alarm</b><br>The time delay is set in minutes. At min. setting the alarm is cancelled.   | A45 | PcAlrmDelay  |
| <b>Alarm delay DI1 (an interrupted input will give alarm).</b><br>The time delay is set in minutes. At max. setting the alarm is cancelled.  | A27 | DI1AlrmDelay   |
| <b>Alarm delay DI2 (an interrupted input will give alarm).</b><br>The time delay is set in minutes. At max. setting the alarm is cancelled.  | A28 | DI2AlrmDelay   |
| <b>Alarm delay DI3 (an interrupted input will give alarm).</b><br>The time delay is set in minutes. At max. setting the alarm is cancelled.  | A29 | DI3AlrmDelay   |
| <b>Alarm limit for high temperature of the "Saux1" sensor</b><br>If an alarm is generated the digital scroll stops. With setting = Off the alarm has been opted out.   | A32 | Saux Al Lim  |
| <b>Alarm delay from "Saux1" (A32)</b><br>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<br>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. |
| <b>Miscellaneous</b>  |                   | <b>Miscellaneous</b>   |
| <b>Choice of application</b><br>The controller can be configured in two ways.<br>The functions for the two applications can be viewed on page 14.<br><i>This menu must be set as the first of all menus, as it enables the associated settings to be set.</i><br>1: Show temperature<br>2: Show pressure  | o61               | This setting cannot be made via data communication. It must be set directly on the controller.   |
| <b>Sensor type</b><br>This is where you set which temperature sensor is connected to the Saux input.<br>The sensor measures the discharge gas temperature in the digital scroll compressor.<br>1: Built-in NTC sensor in the digital scroll. (A resistor must also be fitted here across terminals 51-53 in order for the reading to be registered correctly. The resistor enables the measuring range to be optimised between 80 and 140°C.)<br>2: Pt 1000 ohm sensor, e.g. AKS 21 | o06               | Sensor type  |
| <b>Display connection</b><br>This is where you define the type of display that is connected to the controller<br>Off: EKA 164<br>On: EKA 165. The extended display with LEDs.   | o82               | DisplaySel   |
| <b>Pressure transmitter's working range</b><br>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<br>The values must be set in bar if display in °C has been selected. And in psig, if °F has been selected.  |                   | 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   |
| <b>Use of DI1 input</b><br>The digital input can be connected to a contact function, and the contact can now be used for one of the following functions:<br>Setting / function:<br><b>0:</b> DI input not used<br><b>1:</b> Fan alarm when contact cuts out. Alarm "A34" is given.<br><b>2:</b> Alarm function when the contact cuts out. Alarm "A28" is given.<br>There is time delay for the alarm. Setting in "A27".   | o78               | DI1 control  |
| <b>Use of DI4 input</b><br>The digital input can be connected to a contact function, and the contact can now be used for one of the following functions:<br>Setting / function:<br><b>0:</b> DI input not used<br><b>1:</b> Regulation reference P0 displaced when contact is cut in<br><b>2:</b> Alarm function when the contact cuts out. Alarm "A31" is given. There is no time delay.   | o22               | DI4 control  |
| <b>Use of DI5 input</b><br>The digital input can be connected to a contact function, and the contact can now be used for one of the following functions:<br>Setting / function:<br><b>0:</b> DI input not used<br><b>1:</b> Regulation reference Pc displaced when contact is cut in<br><b>2:</b> Alarm function when the contact cuts out. Alarm "A32" is given. There is no time delay  | o37               | DI5 control  |
| <b>Operating hours</b><br>The operating hours for the compressor relays can be read and set 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.   |                   | (In the AKM display the hour number has not been multiplied)   |
| Value for relay number 1, 3 and 4   | o23<br>o25<br>o26 | DO1 run hour.....<br>DO3 run hour<br>DO4 run hour  |
| Value for relay number 5 to 8   | o50-<br>o53       | DO5 run hour .....<br>DO8 run hour   |

|  |     |   |
|--|-----|---|
| <b>Refrigerant setting</b><br>Before refrigeration is started, the refrigeration must be defined. You may choose between the following refrigerants:<br>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. 31=R422A, 32=R413A. 33=R422D. 34=R427A. 35=R438A. 36=XP10. 37=R407F.<br>Warning: Wrong selection of refrigerant may cause damage to the compressor.<br>Other refrigerants: Select setting 13 here, and subsequently three factors have to be set – fac1, fac2 and fac3 – via AKM. | o30 | Refrigerant   |
| <b>Manual control</b> (stopped regulation only)<br>From this menu the relays can be cut in and out manually. <b>0</b> gives no override, but a number between 1 and 10 will cut in a belonging relay. <b>1</b> will cut in relay number 1, <b>2</b> relay 2, etc.<br><b>11-18</b> will produce voltage on the analog output. In this way the relays on the external relay module can be activated. Setting <b>11</b> will give a voltage of 1.25 V, setting <b>12</b> will give 2.5 V, etc.  | o18 | Manual control  |
| <b>Frequency</b><br>Set the net frequency.   | o12 | 50 / 60 Hz<br>(50=0, 60=1)  |
| <b>Address</b><br>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.<br>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.<br>This installation is mentioned in a separate document "RC8AC".  |     | 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 240 (gateway determined)  | o03 |   |
| The address is sent to the gateway when the menu is set in pos. ON   | o04 |   |
| <b>Access code</b><br>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 |   |
| <b>Special settings</b><br>Outputs DO9 and DO10 are normally used for the "AKD start/stop" function and for the alarm function, but they may be redefined in special cases.  |     |   |
| DO9 function:<br>0: AKD Start/stop<br>1: Inject-on function (see drawing below)<br>2: Boost ready function (see drawing below)<br>3: Fan relay   | o75 | DO9 function  |
| DO10 function:<br>0: Alarm relay<br>1: Fan relay   | o76 | DO10 function   |
| <b>Status on the digital inputs</b><br>The signal on the DI inputs can be read in the following menus:   |     |   |
| Status on DI 1   | u10 | DI 1 Status   |
| Status on DI 2   | u37 | DI 2 Status   |
| Status on DI 3   | u87 | DI 3 Status   |
| Status on DI 4   | u88 | DI 4 Status   |
| Status on DI 5   | u89 | DI 5 Status   |
| <b>Temperature read outs</b>   |     |   |
| Read temperature at sensor Saux (discharge gas temperature)  | u03 | Saux temp   |
| Read temperature at sensor "Sc3" (outdoor temperature)   | u44 | Sc3 temp  |
| Read temperature at sensor "Sc4"   | u45 | Sc4 temp  |
| <b>Capacity from the digital scroll</b>  |     |   |
| Read off the control capacity in % on the digital scroll   | U28 | DS PWM cap  |

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

Warning ! Direct start of compressors \*

To prevent compressor breakdown parameter c01 and c07 should be set according to suppliers requirements or in general :

Hermetic Compressors c07 min. 5 minutes

Semihermetic Compressors c07 min. 8 minutes and c01 min. 2 to 5 minutes ( Motor from 5 to 15 KW )

\* ) Direct activating of solenoid valves does not require settings different from factory (0)

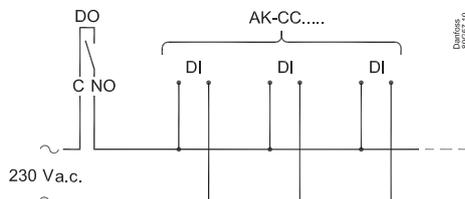
### DO9 function:

#### Inject-on function

DO9 is here used for the Inject ON function. Here all the electronic expansion valves are closed when all the compressors are **stopped** and **P0 > +Zone**.

Wiring is carried out as shown below.

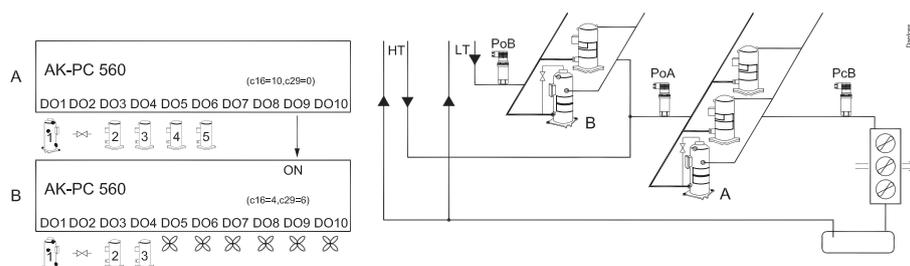
The function may however also be generated via data communication. In this way the relay output is made available for other applications.



#### 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:



| <b>Operating status</b>  |                              |
|--|------------------------------|
| 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                    |
| S0: Regulation   | 0                            |
| 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                            |
| S10: Regulation stopped with the internal og external start/stop   | 10                           |
| S25: Manual regulation of outputs  | 25                           |
| S34: Safety cutout. Setting A30 is exceeded  | 34                           |
| <b>Alarm messages</b>  | <b>Alarms "Destinations"</b> |
| A2: Low P0   | A02 Low P0 alarm             |
| A11: No refrigerant has been selected (cf. o30)  | A11 No RFG Sel               |
| A17: High Pc   | A17 Hi Pc alarm              |
| A19 ..... A25: Compr. fault. Interrupted signal on actual input (terminal 29-36)   | A19 ..... A25 Comp_ fault    |
| A27: High temperature alarm from sensor "Saux". The digital scroll is stopped.   | A27 Saux high                |
| A28 ..... A32: External alarm. Interrupted signal on input "DI1" /2/3/4/5  | A28 ..... A32 DI_ Alarm      |
| A34: Fan alarm. There is no signal on DI1 input  | A34 Fan fault                |
| A45: Regulation stopped with setting or with external switch   | A45 Stand by                 |
| E1: Error in the controller  | E1 Ctrl. fault               |
| E2: Control signal outside the range (short-circuited/interrupted)<br>At water cooler management without frost protection may alarm from a not mounted P0 input suppressed by connecting the signal from the PC (terminal 61) to P0 (terminal 58).   | E2 Out of range              |

**Compressor configuration when o61 = 1 or 2** (This is where you can choose between the options shown.)

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 |               |              |
| 1                      |   |   |   |   |   |   |   | 1             | -            |
| 1                      |   | 2 |   |   |   |   |   | 2             | -            |
| 1                      |   | 2 | 3 |   |   |   |   | 3             | 1 / 2        |
| 1                      |   | 2 | 3 | 4 |   |   |   | 4             | 1 / 2        |
| 1                      |   | 2 | 3 | 4 | 5 |   |   | 5             | 1 / 2        |
| 1                      |   | 2 | 3 | 4 | 5 | 6 |   | 6             | 1 / 2        |
| 1                      |   | 2 | 3 | 4 | 5 | 6 | 7 | 7             | 1 / 2        |

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**Capacity step**

All capacity steps are presumed to be identical.

**Coupling mode**

Coupling mode 1 = *sequential* operation.

Compressor 1 will be the first to start. Then compressor 2 and so on.

Coupling mode 2 = *cyclic* operation.

Compressor 1 will always be in operation when cooling is required. After this the compressor with the lowest number of operating hours will be started.

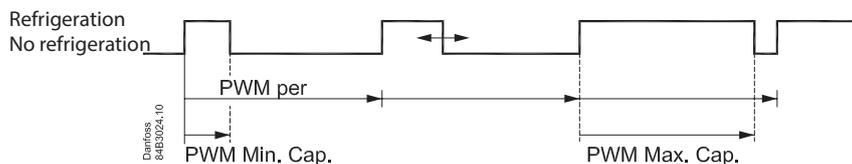
**The capacity from the digital scroll compressor**

The capacity is divided into period times as "PWM per". 100% capacity is delivered when cooling takes place for the whole period. An off time is required by the by-pass valve within the period and an on time is also permitted. There is "no cooling" when the valve is on.

The controller itself calculates the capacity needed and will then vary it according to the cut-in time of the by-pass valve.

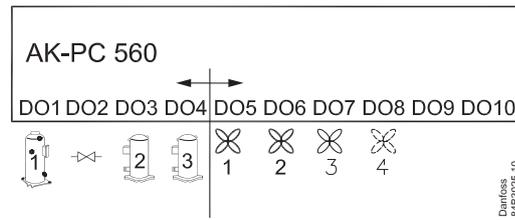
A limit is introduced if low capacity is needed so that the cooling does not go below 10%. This is because the compressor can cool itself. This value can be increased if necessary.

The capacity can similarly be limited so that the compressor cannot deliver 100% capacity. It is not normally necessary to limit this max. capacity.

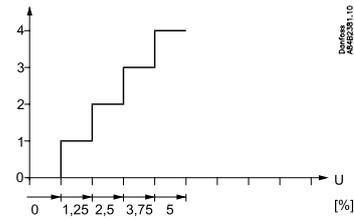


## Condenser couplings

When the compressor relays have been established the turn comes to the fan relays.  
 The first vacant relay (DO3-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:

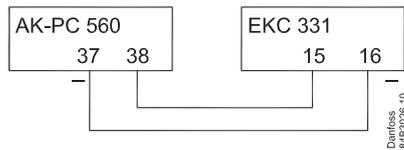


If there are up to four external fans on an EKC 331:

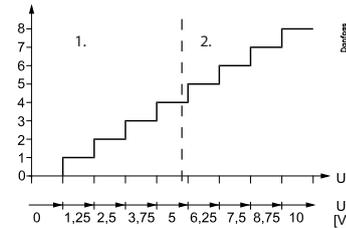


Output signal from AK-PC 560  
 In EKC 331 the voltage range must be set to 0-5 V ("o10" = 6).  
 In EKC 331 the number of steps must be set to 4 ("o19" = 4) (also when fewer fans are connected).

Connection

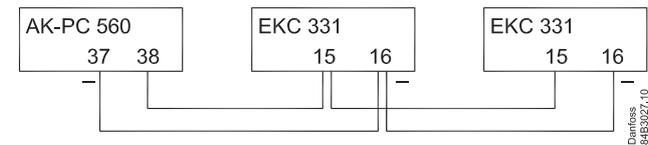


If there are more than four external fans on two EKC 331 units:



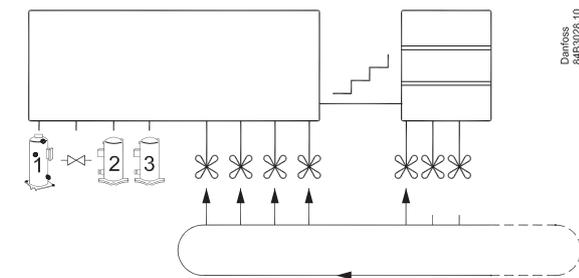
Output signal from AK-PC 560  
 In the first EKC 331, set 0-5 V ("o10" = 6).  
 In the second EKC 331, set 5-10 V ("o10" = 7).  
 In **both** EKC's the number of steps must be set to 4 ("o19" = 4) (also when fewer fans are connected to the second EKC).

Connection

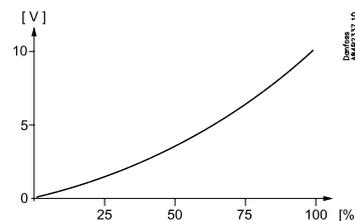


Alternating start-up of fans (only if c29 is 11 to 18)

The fans can be defined to start alternately when they have all been stopped.  
 The first time regulation is started, fan 1 will be started first – the regulation determines whether additional fans will be started.  
 After the next time all fans are stopped, fan 2 will be the first to be started, and so on.  
 Fan 1 will again be the first fan to be started when the rotation has been through the total number of fans.  
 If there is more than one fan on an EKC 331, it will not be possible to start the other fans first. Here, the fan with the lowest voltage step will **always** be the one which is started first.



If the entire condenser capacity is to be controlled by a frequency converter, AK-PC 560 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

### Data communication

If the controller is extended with data communication, the operation can be performed from a system unit. The parameter names for the functions can be viewed in the right-hand column on pages 4–10.

The importance of the alarms that are sent can be defined with the setting: 1 (High), 2 (Medium), 3 (Low) or 0 (No alarm).

### Operation via external display

The values will be shown with three digits, and with a setting you can determine whether the pressures are to be shown in SI units (°C / bar) or US units (°F / psig.).

There are three options for the display.

P0 is over the neutral zone

P0 is under the neutral zone

1: Relay digital scroll  
2: Relay comp. 2  
3: Relay comp. 3  
.  
.  
.  
10: Capacity form the digital scroll

EKA 165

EKA 163

EKA 164

**EKA 165**

To operate the controller and view the evaporation pressure. If the lowermost key is pressed, the condensation pressure will be shown briefly in the display. (If regulation is based only on the condensation pressure, the display will always show Pc).

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

Second highest : Over neutral zone  
"None" : Neutral zone  
Second lowest : Under neutral zone

The other LEDs on the display will show the functions that are active:

- Relays for compressors
- The capacity can be read from the digital scroll compressor
- Relays for fans
- Input signals for the digital inputs
- The optimization LED will light up when the reference is 2 K or more over the set point.

**EKA 163**

If the condensation pressure is to be shown constantly, a display without operating keys can be connected.

**EKA 164**

To operate the controller and view the evaporation pressure. If the lowermost key is pressed, the condensation pressure will be shown briefly in the display. Like the EKA 165, the LEDs in the display will show where the regulation is located.

### The buttons on the display

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

Or short:

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

(A brief pushing will show the active alarm codes. See page 17.)

## Menu survey

### Sequence

1. o61 **must** be set as the first parameter. This parameter determines which of the four operating interfaces (application mode) are activated. This **must** be set via the display keys. It cannot be set via data communication. (Active functions are shown below in shaded fields.)
2. Quick- start  
To get the system up and running quickly so that cooling can be commenced, start it by setting the following parameters (these parameters can only be set when the regulation is stopped, r12=0): r23, r28, c08, c16, c29, o06, o30, o75, o76 **and finally r12=1.**
3. Once the regulation is under way, you can go through the other parameters and adjust them in situ.

SW: 1.0x

| Function  | Para-<br>meter | o61 = |   | Min.               | Max.              | Factory<br>setting |
|---|----------------|-------|---|--------------------|-------------------|--------------------|
|   |                | 1     | 2 |                    |                   |                    |
| <b>Normal display</b>   |                |       |   |                    |                   |                    |
| Shows P0 in EKA 165 (display with buttons)  | -              | °C    | P |                    | °C / bar          |                    |
| Shows Pc in EKA 163   | -              | °C    | P |                    | °C / bar          |                    |
| <b>P0 reference</b>   |                |       |   |                    |                   |                    |
| Neutral zone  | r01            |       |   | 0.1°C / 0.1 bar    | 20°C / 5.0 bar    | 4.0°C / 0.4 bar    |
| Correction of signal from P0 sensor   | r04            |       |   | -50°C / -5.0 bar   | 50°C / 5.0 bar    | 0.0                |
| Select view; SI or US. 0=SI (bar /°C), 1=US (Psig /°F)  | r05            |       |   | 0                  | 1                 | 0                  |
| Start/Stop of regulation  | r12            |       |   | OFF                | ON                | OFF                |
| Reference offset for P0 (see also r27)  | r13            |       |   | -50°C / -5.0 bar   | 50°C / 5.0 bar    | 0.0                |
| Set regulation set point for P0   | r23            |       |   | -99°C / -1 bar     | 30°C / 60.0 bar   | 0.0°C / 3.5 bar    |
| Shows total P0 reference<br>( r23 + various displacements)  | r24            |       |   |                    | °C / bar          |                    |
| Limitation: P0 reference max. value<br>(also applies to regulation with reference displacement)   | r25            |       |   | -99°C / -1.0 bar   | 30°C / 60.0 bar   | 30.0°C / 40.0 bar  |
| Limitation: P0 reference min. value<br>(also applies to regulation with reference displacement)   | r26            |       |   | -99°C / -1.0 bar   | 30°C / 40.0 bar   | -99.9°C / -1.0 bar |
| Displacement of P0 (ON=active "r13")  | r27            |       |   | OFF                | ON                | OFF                |
| <b>Pc reference</b>   |                |       |   |                    |                   |                    |
| Set regulation set point for Pc   | r28            |       |   | -25°C / 0.0 bar    | 75°C / 110.0 bar  | 35°C / 15.0 bar    |
| Shows total Pc reference  | r29            |       |   |                    | °C / bar          |                    |
| Limitation: Pc reference max. value   | r30            |       |   | -99.9°C / -0.0 bar | 99.9°C / 130.0bar | 55.0°C / 60.0 bar  |
| Limitation: Pc reference min. value   | r31            |       |   | -99.9°C / 0.0 bar  | 99.9°C / 60.0 bar | -99.9°C / 0.0 bar  |
| Correction of signal from Pc sensor   | r32            |       |   | -50°C / -5.0 bar   | 50°C / 5.0 bar    | 0.0                |
| Pc reference variation. 1 and 2 are PI-regulation<br>1: Fixed reference. "r28" is used<br>2: Variable reference. Outdoor temperature (Sc3) included in the refer-<br>ence<br>3: As 1, but with P-regulation (Xp-band)<br>4: As 2, but with P-regulation (Xp-band)   | r33            |       |   | 1                  | 4                 | 1                  |
| Reference offset for Pc   | r34            |       |   | -50°C / -5.0 bar   | 50°C / 5.0 bar    | 0.0                |
| The mean temperature difference across the condenser at maximum<br>load (dim tm K)  | r35            |       |   | 3.0                | 50.0              | 10.0               |
| The mean temperature difference across the condenser at the lowest<br>relevant compressor capacity (min tm K)   | r56            |       |   | 3.0                | 50.0              | 8.0                |
| <b>Capacity</b>   |                |       |   |                    |                   |                    |
| Min. ON time for relays   | c01            |       |   | 0 min              | 30 min.           | 0                  |
| Min. time period between cutins of same relay   | c07            |       |   | 2 min.             | 60 min            | 2                  |
| Definition of regulation mode<br>1: Sequential (step mode / FILO)<br>2: Cyclic (step mode / FIFO)   | c08            |       |   | 1                  | 2                 | 1                  |
| Definition of compressor connections.<br>See options on page 11.  | c16            |       |   | 1                  | 7                 | 1                  |
| Definition of condenser:<br><b>1-8:</b> Total number of fan relays or voltage step on the voltage output<br><b>9:</b> Only via analog output and start of frequency converter<br><b>10:</b> Not used<br><b>11- 18:</b> Total number of fan relays which are to be connected with alter-<br>nating start-up. | c29            |       |   | 0/OFF              | 18                | 0                  |
| Cut in compressor capacity with manual control. See also "c32"  | c31            |       |   | 0%                 | 100%              | 0                  |
| Manual control of compressor capacity (when ON, the value in "c31" will<br>be used)   | c32            |       |   | OFF (0)            | ON (1)            | OFF (0)            |

Fortsættes

|  |      |  |  |                    |                   |                   |
|--|------|--|--|--------------------|-------------------|-------------------|
| Pump down limit. Limit value where the last compressor is cut out.   | c33  |  |  | -99.9°C / -1.0 bar | 100°C / 60 bar    | 100°C / 60 bar    |
| Time delay for incorrect cut-out, compressor 1   | c77  |  |  | 0 s                | 240 s             | 60 s              |
| Time delay for incorrect cut-out, compressor x; x=2, 3 and so on.  | c78  |  |  | 0 s                | 240 s             | 60 s              |
| Pulse width period for the digital scroll modulation   | c79  |  |  | 10 s               | 30 s              | 20 s              |
| Max. capacity in the pulse width period  | c80  |  |  | 50 %               | 100 %             | 100 %             |
| Min. capacity in the pulse width period  | c81  |  |  | 10 %               | 50 %              | 10 %              |
| Kp factor for PI regulation of the digital scroll  | c82  |  |  | 2                  | 20                | 5                 |
| Tn factor for PI regulation of the digital scroll  | c83  |  |  | 40 s               | 300 s             | 50 s              |
| The digital scroll's capacity compared to one of the other compressors   | c84  |  |  | 100%               | 200%              | 100%              |
| Proportional band Xp for (P= 100/Xp) condenser regulation  | n04  |  |  | 0.2 K / 0.2 bar    | 40.0 K / 10.0 bar | 10.0 K / 3.0 bar  |
| l: Integration time Tn for condenser regulation  | n05  |  |  | 30 s               | 600 s             | 150               |
| Cutin condenser capacity with manual control. See also "n53"   | n52  |  |  | 0%                 | 100%              | 0                 |
| Manual control of condenser capacity (when ON, the value in "n52" will be used)  | n53  |  |  | OFF (0)            | ON (1)            | OFF (0)           |
| Start speed The voltage for the speed regulation is kept at 0V until the regulation requires a higher value than the value set here.   | n54  |  |  | 0%                 | 75%               | 20%               |
| Min. speed. The voltage for the speed regulation switches to 0V when the regulation requires a lower value than the value set here.  | n55  |  |  | 0%                 | 50%               | 10%               |
| <b>Alarm</b>   |      |  |  |                    |                   |                   |
| Delay time for a A32 alarm   | A03  |  |  | 0 min.             | 90 min.           | 0 min.            |
| Low alarm and safety limit for P0  | A11  |  |  | -99°C / -1.0 bar   | 30°C / 40 bar     | -40°C / 0.5 bar   |
| Delay time for a D11 alarm   | A27  |  |  | 0 min. (-1=OFF)    | 480 min.          | OFF               |
| Delay time for a D12 alarm   | A28  |  |  | 0 min. (-1=OFF)    | 480 min.          | OFF               |
| Delay time for a D13 alarm   | A29  |  |  | 0 min. (-1=OFF)    | 480 min.          | OFF               |
| Upper alarm and safety limit for Pc  | A30  |  |  | -10 °C / 0.0 bar   | 200°C/200 bar     | 60.0°C / 60.0 bar |
| Upper alarm limit for sensor "Saux1" If a higher value is measured then the digital scroll stops.  | A32  |  |  | 1°C (0=OFF)        | 150°C             | 130°C             |
| Delay time for a P0 alarm  | A44  |  |  | 0 min. (-1=OFF)    | 480 min.          | 0 min.            |
| Delay time for a Pc alarm  | A45  |  |  | 0 min. (-1=OFF)    | 480 min.          | 0 min.            |
| <b>Miscellaneous</b>   |      |  |  |                    |                   |                   |
| Controllers address  | o03* |  |  | 1                  | 240               |                   |
| On/off switch (service-pin message)  | o04* |  |  | -                  | -                 |                   |
| Access code  | o05  |  |  | 1 (0=OFF)          | 100               | OFF               |
| Used sensor type for Saux<br>1=Internal Copeland NTC. (A fixed resistor must also be fitted.)<br>2=Pt 1000   | o06  |  |  | 1                  | 2                 | 1                 |
| Set supply voltage frequency   | o12  |  |  | 50 Hz (0)          | 60 H (1)          | 50Hz (0)          |
| Manual control of outputs:<br>0: No override<br>1-10: 1 will cut in relay 1, 2 relay 2, etc.<br>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             | 5 bar             | -1.0              |
| P0 pressure transmitter's working range - max. value   | o21  |  |  | 6 bar              | 199 bar           | 12.0              |
| Use of DI4-input<br>0=not used. 1=P0 displacement. 2=alarm function. Alarm="A31"   | o22  |  |  | 0                  | 2                 | 0                 |
| Operating hours of relay 1 (value time 1000)   | o23  |  |  | 0.0 h              | 99.9 h            | 0.0               |
| Operating hours of relay 3 (value time 1000)   | o25  |  |  | 0.0 h              | 99.9 h            | 0.0               |
| Operating hours of relay 4 (value time 1000)   | o26  |  |  | 0.0 h              | 99.9 h            | 0.0               |
| Setting of refrigerant<br>1=R12. 2=R22. 3=R134a. 4=R502. 5=R717. 6=R13. 7=R13b1. 8=R23.<br>9=R500. 10=R503. 11=R114. 12=R142b. 13=User defined 14=R32.<br>15=R227. 16=R401A. 17=R507. 18=R402A. 19=R404A. 20=R407C.<br>21=R407A. 22=R407B. 23=R410A. 24=R170. 25=R290. 26=R600.<br>27=R600a. 28=R744. 29=R1270. 30=R417A. 31=R422A. 32=R413A.<br>33=R422D. 34=R427A. 35=R438A. 36=XP10. 37=R407F | o30  |  |  | 0                  | 37                | 0                 |
| Use of DI5-input<br>0=not used. 1=Pc displacement. 2=alarm function. Alarm="A32"   | o37  |  |  | 0                  | 2                 | 0                 |
| Pc pressure transmitter's working range - min. value   | o47  |  |  | -1 bar             | 5 bar             | -1.0              |
| Pc pressure transmitter's working range - max. value   | o48  |  |  | 6 bar              | 199 bar           | 34.0              |
| Operating hours of relay 5 (value time 1000)   | o50  |  |  | 0.0 h              | 99.9 h            | 0.0               |
| Operating hours of relay 6 (value time 1000)   | o51  |  |  | 0.0 h              | 99.9 h            | 0.0               |
| Operating hours of relay 7 (value time 1000)   | o52  |  |  | 0.0 h              | 99.9 h            | 0.0               |

\* this setting is only possible if data communication module is mounted in the controller

Continued

|  |     |   |   |       |        |     |
|--|-----|---|---|-------|--------|-----|
| Operating hours of relay 8 (value time 1000)   | o53 |   |   | 0.0 h | 99.9 h | 0.0 |
| Selection of application<br>1. Show temperature and "c16" mode<br>2. Show pressure and "c16" mode  | o61 | 1 | 2 | 1     | 2      | 1   |
| Function for relay output DO9:<br>0. Start / stop of speed regulation<br>1. Inject on signal for evaporator control<br>2. Boost ready (at least one compressor is on)<br>3. Start /stop of condenser fan | o75 |   |   | 0     | 3      | 0   |
| Function for relay output DO10:<br>0. Alarm relay<br>1. Start / stop of condenser fan  | o76 |   |   | 0     | 1      | 0   |
| Definition of alarm message at DI1 signal:<br>0. Not used<br>1. Fan failure (A34)<br>2. DI1 alarm (A28)  | o78 |   |   | 0     | 2      | 0   |
| Display connection<br>Off: EKA 164<br>On: EKA 165 (extended display with light-emitting diodes)  | o82 |   |   | Off   | On     | Off |
| <b>Service</b>   |     |   |   |       |        |     |
| Temperature at Saux (discharge gas temperature)  | u03 |   |   |       |        |     |
| Status on DI1 input  | u10 |   |   |       |        |     |
| Status on DI2 input  | u37 |   |   |       |        |     |
| Read temperature at sensor "Sc3"   | u44 |   |   |       |        | °C  |
| Read temperature at sensor "Sc4"   | u45 |   |   |       |        | °C  |
| Status on DI3 input  | u87 |   |   |       |        |     |
| Status on DI4 input  | u88 |   |   |       |        |     |
| Status on DI5 input  | u89 |   |   |       |        |     |
| Read regulation capacity in % of the digital scroll  | U28 |   |   |       |        |     |

| The controller can give the following messages |                       |  |  |
|--|-----------------------|--|--|
| E1   | <b>Error message</b>  | Fault in controller  |  |
| E2   |                       | Regulation is outside the range, or the control signal is defective          |  |
| A2   | <b>Alarm message</b>  | Low P0   |  |
| A11  |                       | Refrigerant not selected   |  |
| A17  |                       | High Pc  |  |
| A19  |                       | Compressor 1 error (29)  | The actual compressors safety circuit is interrupted. That is to say the signal is missing on one of the terminals 29-36 |
| A20  |                       | Compressor 2 error (31)  |  |
| A21  |                       | Compressor 3 error (32)  |  |
| A22  |                       | Compressor 4 error (33)  |  |
| A23  |                       | Compressor 5 error (34)  |  |
| A24  |                       | Compressor 6 error (35)  |  |
| A25  |                       | Compressor 7 error (36)  |  |
| A27  |                       | Saux discharge gas temperature to high . Digital scroll is stopped           |  |
| 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  |  |
| A34  |                       | Fan alarm. There is no signal on DI1 input                                   |  |
| A45  | Regulation stopped    |  |  |
| S0   | <b>Status message</b> | Regulation   |  |
| S2   |                       | Wait for "c01"   |  |
| S5   |                       | Wait for "c07"   |  |
| S10  |                       | Refrigeration stopped by the internal or external start/stop function        |  |
| S25  |                       | Manual control of outputs  |  |
| S34  |                       | Safety cutout. Setting A30 is exceeded or all safety inputs (29-36) are open |  |
| PS   | <b>Info</b>           | Access code is required before you have access to the settings               |  |

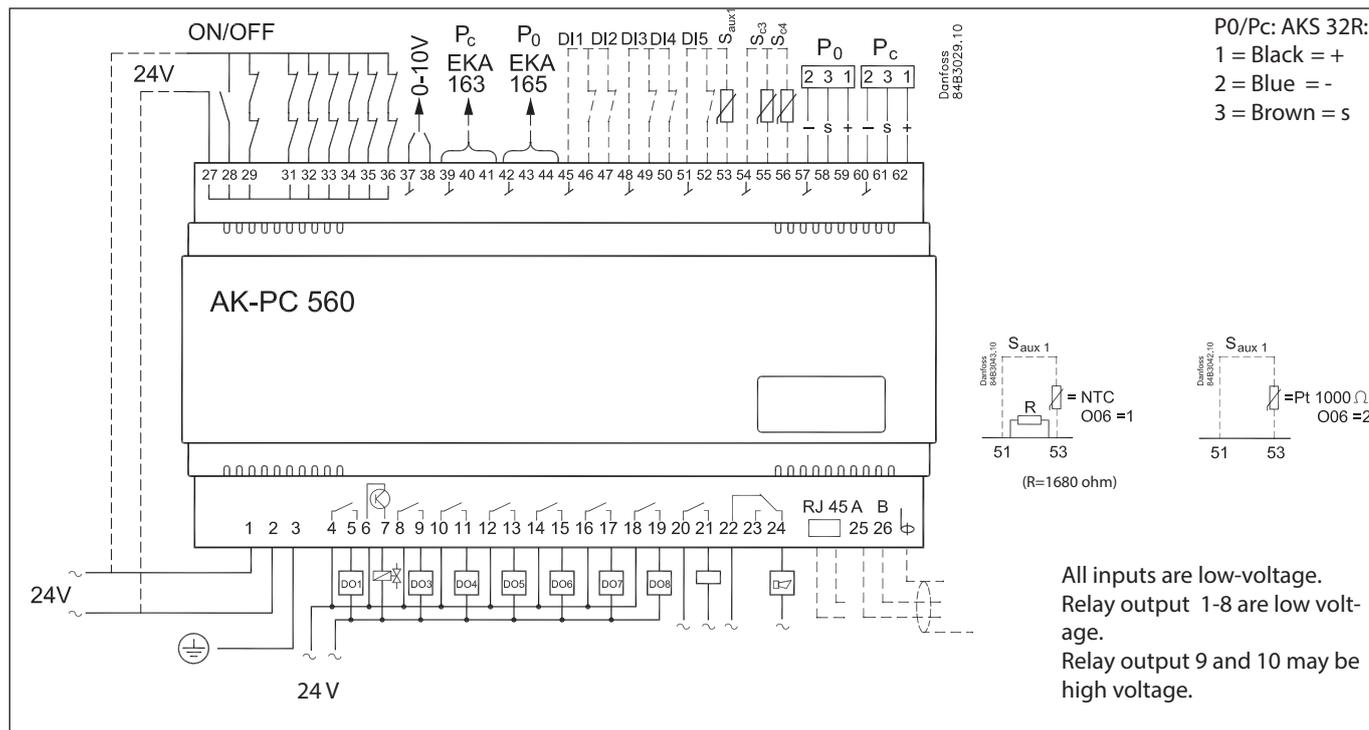
Messages can be brought up on the display by briefly pressing the uppermost key. If there is more than one alarm, they can be scrolled through

#### Factory setting

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

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

## Connections



### Necessary connections

#### Terminals:

- 1-2 Supply voltage 24 V a.c.
  - 4-5 Relay outputs for digital scroll compressor
  - 6-7 Solid state relay for digital scroll compressor's unloader
  - 8- 19 Relay outputs for either compressors 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 Digital scroll
- 30 No function
- 27-31 24 V signal from the safety circuit DO 3
- 27-32 24 V signal from the safety circuit DO 4
- 27-33 24 V signal from the safety circuit DO 5
- 27-34 24 V signal from the safety circuit DO 6
- 27-35 24 V signal from the safety circuit DO 7
- 27-36 24 V signal from the safety circuit DO 8
- 57-59 Suction pressure. Voltage signal from AKS 32R \*\*
- 60-62 Condenser pressure. Voltage signal from AKS 32R \*\*

### Application dependent connections

- 20-21 AKD start/stop \*  
The relay cutin when the frequency converter have to start.
- 37-38 Voltage signal to external condenser control (see settings page 12)
- 39-41 Possibility of connecting an external display type EKA 163 or display of Pc
- 42-44 Possibility of connecting an external display type EKA 163 for display of P0, or EKA 165 for operation and display of P0
- 45-46 DI1 - Contact function for alarm signal
- 45-47 DI2 - Contact function for alarm signal
- 48-49 DI3 - Contact function for alarm signal
- 48-50 DI4 - Contact function for displacement of the suction pressure reference or for alarm signal.
- 51-52 DI5 - Contact function for displacement of the condenser pressure reference or for alarm signal.
- 51-53 Separate sensor Saux. Discharge gas temperature. Sensor signal from Pt 1000 (AKS 21) or Copeland-NTC and with supplied resistor mounted.
- 54-55 Outdoor ambient temperature (Sc3). Sensor signal from Pt 1000, AKS 11 or AKS 21 (mounted if r33 = 2 or 4).
- 54-56 Air temperature at condenser outlet. Sensor signal from a Pt 1000, AKS 11 or AKS 21.

### Data communication

- 25-26 Mount only, if a data communication module has been fitted.  
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. RC8AC.

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

\*\*) If the controller has to control only the compressor or the fans, respectively Pc and P0 sensor can be dispensed

## Data

|                                       |   |  |
|---------------------------------------|---|--|
| Supply voltage                        | 24 V a.c. +/-15% 50/60 Hz, 5 VA   |  |
| Input signal                          | 2 pcs. Pressure transmitters type AKS 32R   |  |
|                                       | 3 pcs. temperature sensor input for Pt 1000 ohm/0°C<br>(With NTC and a fixed resistor on Saux, the measuring range becomes 80-140°C.)                           |  |
| Digitale input from contact function. | 1 pcs. for Start/stop of regulation   |  |
|                                       | 7 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  | 7 pcs. SPST   | AC-1: 3 A (ohmic)<br>AC-15: 2 A (inductive)                                    |
| AKD start/stop relæ                   | 1 pcs. SPST   | DO1 - DO8 are low voltage  |
| Digital output for scroll unloader    | Solid State   | 24 V a.c. I <sub>max.</sub> = 500mA<br>I <sub>min.</sub> = 70 mA.<br>Leak <4mA |
| Alarm relay                           | 1 pcs. SPDT   | AC-1: 6 A (ohmic)<br>AC-15: 3 (inductive)                                      |
| Voltage output                        | 0-10 V d.c. Max. 5 mA, R <sub>i</sub> min. 2.2 kohm   |  |
| Display outputs                       | EKA 163   | Pc display   |
|                                       | EKA 165 (164)   | 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 <sup>2</sup> multicore  |  |
| Approvals                             | EU Low voltage Directive and EMC demands re CE-marking complied with.<br>LVD-tested acc. to EN 60730-1 and EN 60730-2-9<br>EMC-tested acc. to EN61000-6-2 and 3 |  |

### Pressure transmitter / temperature sensor

Please refer to catalogue RK0YG...

### Capacitive load

The relays cannot be used for the direct connection of capacitive loads such as LEDs and on/off control of EC motors.  
All loads with a switch mode power supply must be connected with a suitable contactor or similar.

### 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.

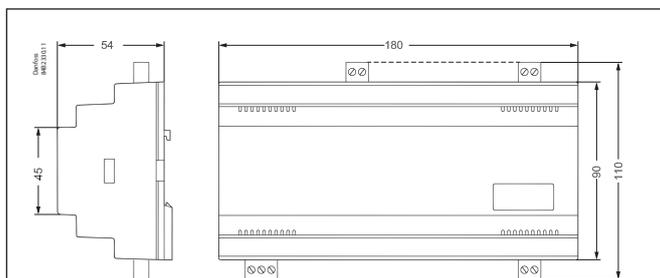
Special reference is made to the necessity of signals to the controller when the compressor is stopped and to the need of liquid receivers before the compressors.

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

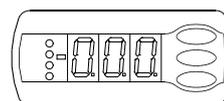
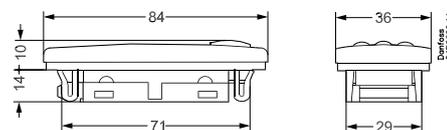
## Ordering

| Type      | Function   | Code no.        |
|-----------|--|-----------------|
| AK-PC 560 | Capacity controller for digital scroll   | <b>084B8013</b> |
| EKA 163B  | Display unit   | <b>084B8574</b> |
| EKA 164B  | Display unit with operation buttons  | <b>084B8575</b> |
| EKA 165   | Display unit with operation buttons and light-emitting diodes for input and output                       | <b>084B8573</b> |
|           | Cable for display unit 2 m, 1 pcs.   | <b>084B7298</b> |
|           | Cable for display unit 6 m, 1 pcs.   | <b>084B7299</b> |
| EKA 175   | Data communication module, RS 485  | <b>084B8579</b> |
| EKA 178B  | Data communication module, MOD-bus   | <b>084B8571</b> |
| EKA 174   | Data communication module, LON RS 485, with galvanic separation (recommended when output 0-10 V is used) | <b>084B7124</b> |

## Dimensions

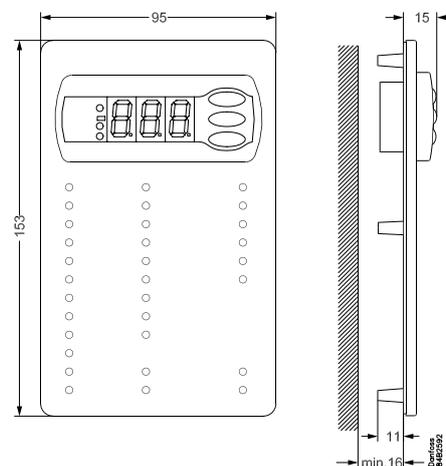


AK-PC 560



Only for front mounting (IP 40)  
Only connection via plugs

Display type EKA 163 / EKA 164



Display type EKA 165

## Safety function

| Criterion  | Compressor control   | Condenser control  |
|--|--|--|
| P0 < P0 min (A11)  | 0% capacity. (Min ON time (c01) overridden)  | No change  |
| P0 signal failure (P0 reading < 5%)                            | Calculated average capacity  | No change.   |
| Pc > Pc max. minus 3 K<br>(The "HP" LED on EKA 165 lights up)  | The capacity changes to 2/3 of the actual capacity. After 30 seconds it changes to half capacity.<br>After a further 30 seconds there is a full cut-out. | 100% capacity  |
| Pc > Pc max. (A30)   | 0% capacity  | 100% capacity  |
| Pc signal failure (Pc reading < 5%)                            | No change  | 100% capacity  |
| Sc3 signal failure (Variable reference (r33) is set to 2 or 4) | No change  | The variable part is omitted.<br>Reference (r29) = Setting (r28) |
| Saux > Saux Al Lim.  | Compressor cut out   | No changes   |

### Exercising fans

On the setting c29 = 1-8 the last fans will hardly be activated during the winter.

To ensure that the fans are 'exercised' a test will be carried out every 24 hours to check whether all relays have been in operation.

The relays that have not been used will now be activated for 30 seconds, but with a pause of one hour between individual relays.

## 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 system units override function | Selection of parameter in AK-PC 560 084B8013 Sw. 1.0x  |
|--|--|--|
| Stop of injection when the compressor is stopped   | Forced Close / Injection ON / AKC ON                       | --- MC Inject ON   |
| Night setback  | Day/night control and time schedule                        | r27 NightSetback   |
| Suction pressure optimisation  | P0 optimisation  | Select controller address<br>(The parameters are found automatically and do not become visible). |
| The system unit 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  |

# Appendix

The regulation functions are explained in more detail below.

## The PC reference

You may choose between four different regulation modes. Basically 1 or 2 are recommended. But if the plant is unstable it may become necessary to change over to 3 or 4.

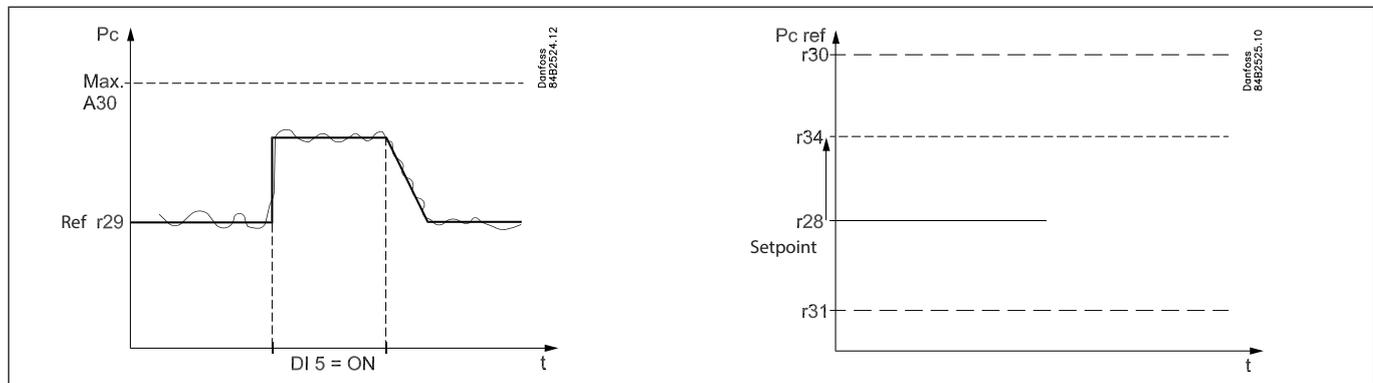
1. PI regulation. Fixed reference i.e. constant condensing pressure.
2. PI regulation. Floating reference with outdoor temperature i.e. variable condensing pressure.
3. As "1", but with P regulation. A somewhat higher condensing pressure than indicated by the reference must be accepted here.
4. As "2", but with P regulation. A somewhat higher condensing pressure than indicated by the reference must be accepted here.

To limit the variation in the reference, if floating reference is chosen (mode 2 & 4), two limit values will have to be set. A max. limit (r30) and a min. limit (r31). The total regulation reference (r29) will not be able to go beyond these limits.

As a safeguard against too high condenser temperature a Pc max. value (A30) also has to be set. If the temperature approaches this value a cutout of the compressor will be started.

The different regulation modes are as follows:

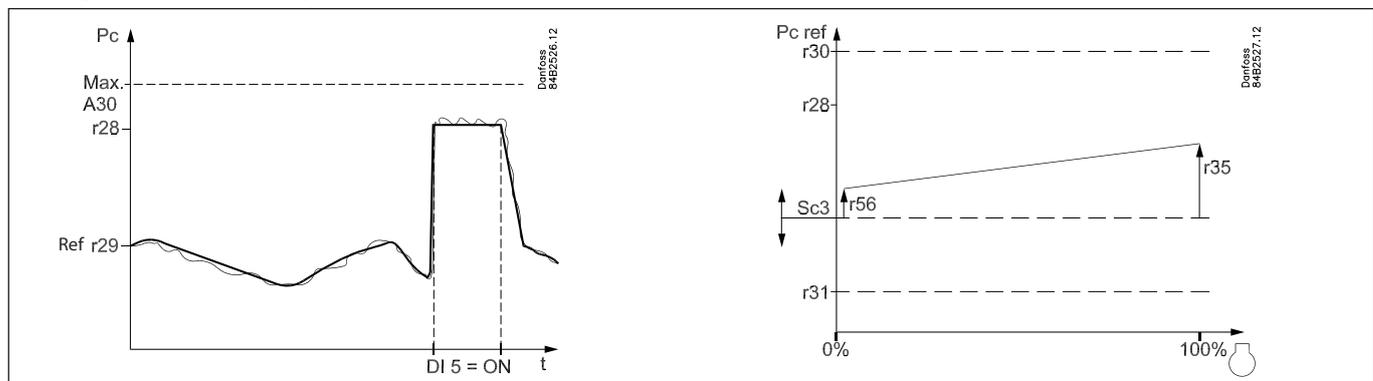
### 1. PI regulation with fixed reference



The reference at any time, on the basis of which the controller regulates, can be seen in "r29". A reference (r28) is set here which with certainty can cope with all kinds of loads.

If you need to raise the condensing temperature for, say, heat recovery, an offset value (r34) has to be set. The DI5 function must be defined to 1. When a signal is subsequently received on the DI5 input the reference will be raised.

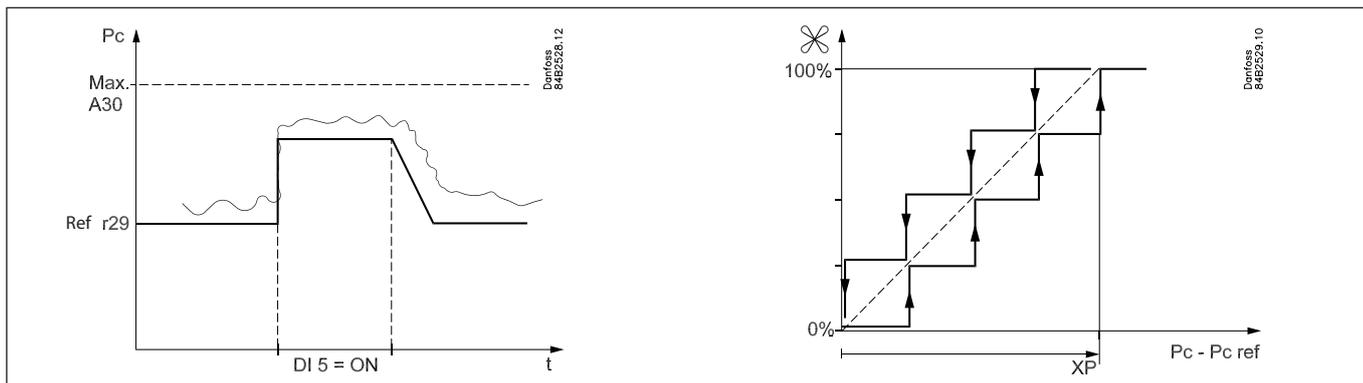
### 2. PI regulation with floating reference



The reference follows the outdoor temperature Sc3. If the outdoor temperature drops one degree the reference will also drop one degree. The reference is adjusted according to the compressor capacity with max. Xp value. If you need to raise the condensing temperature for, say, heat recovery, the setpoint (r28) must be set to this temperature.

The DI5 function must be defined to 1. When a signal is subsequently received on the DI5 input the reference will be changed to the r28 setting. The reference at any time, on the basis of which the controller regulates, can be seen in "r29". If there is sensor failure on the outdoor temperature sensor the reference will change over to the r28 setting.

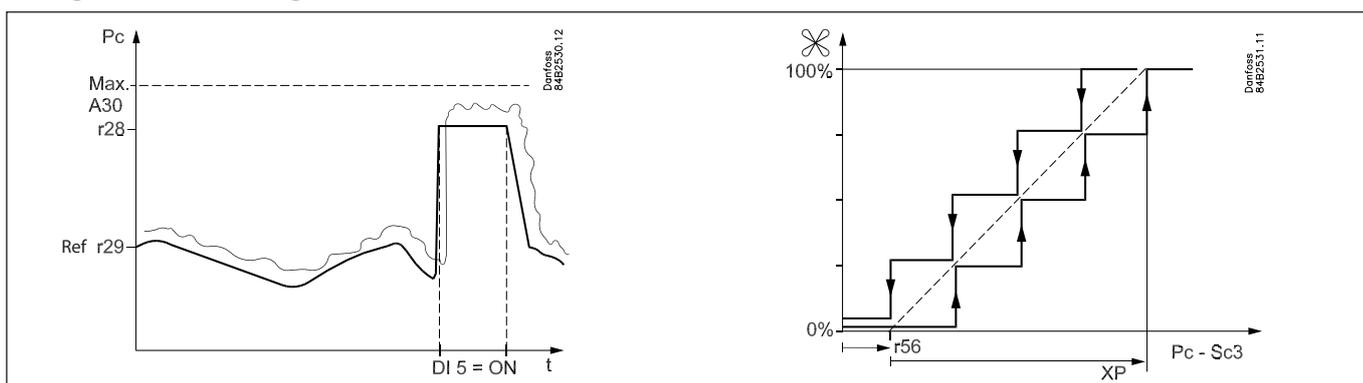
### 3. P regulation with fixed setting



As "1", but an increasing deviation from the reference must be accepted as the controller uses the difference between the actual condenser temperature and the set reference for indicating the number of fans that has to be cut in.

The number of fan steps is divided up based on the  $X_p$  value. Recommended setting for  $X_p$  is the  $\Delta T$  of the condenser, typically 10 to 15 K. The cutin and cutout of fans are shown in the drawing. If the entire condenser capacity is controlled by speed regulation, the capacity will be indicated on the broken line.

### 4. P regulation with floating reference



As "2", but an increasing deviation from the reference must be accepted as the controller uses the difference between the actual condenser temperature and the actual outdoor temperature for indicating the number of fans that has to be cut in. (The first "r56-degrees" are left out, as there must be a possibility of cooling via the condenser).

The number of fan steps is divided up based on the  $X_p$  value. Recommended setting for  $X_p$  is the  $\Delta T$  of the condenser, typically 10 to 15 K. The cutin and cutout of fans are shown in the drawing. If the entire condenser capacity is controlled by speed regulation, the capacity will be indicated on the broken line.

### Important settings for avoiding unwanted alarms

When  $r_{33} = 1$  or  $2$ :  
Set  $P_c\ ref\ max.$  to at least 5 K under  $P_c\ max.$  ( $A_{30}$ ).

When  $r_{33} = 3$  or  $4$ :  
Set  $P_c\ ref\ max.$  to at least  $(X_p\ value + 5)$  K under  $P_c\ max.$  ( $A_{30}$ ).

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## List of literature

Installation guide for extended operation RC8AC--

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