ENGINEERING TOMORROW

Catalogue

Electronic controllers and transmitters for Industrial Refrigeration

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Liquid level controller
EKE 347

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AI190286434038en-000401 | 2016.04

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Liquid level controller
EKE 347

The EKE 347 controller is used for regulation of the liquid level in:
Pump reservoirs

- Separators
- Intermediate coolers
- Economisers
- Condensers
- Receivers

The controller is communicating with a transmitter that continuously measures the liquid level in the actual reservoir.

By comparing the measured value with the level setpoint entered by the customer, the controller dictates the valve to increase or decrease the liquid flow to or from the reservoir.

Features

- Liquid level control
- Alarm if the set alarm limits are exceeded
- Relay outputs for upper and lower level limits and for alarm level
- User friendly and easy setup Wizard for first time configuration
- PI control
- Low or High side control
- When AKV/A is selected, a MASTER / SLAVE system can run up to 3 AKV/A with distributed Opening Degree
- Manual control of output
- Limitation of Opening degree possible
- ON / OFF operation with hysteresis
- Programming menu with 3 access levels and separate passwords
- Connection to other EKE 347 controllers possible
- Wired remote display possible
- BUS communication:
  - CAN Bus (Danfoss internal only)
  - MODBUS RTU RS485 for communication with e.g. PLC

Signaltransmitter

With the guided micro wave rod AKS 4100/4100U it is possible to set the refrigerant level within a wide range.

EKE 347

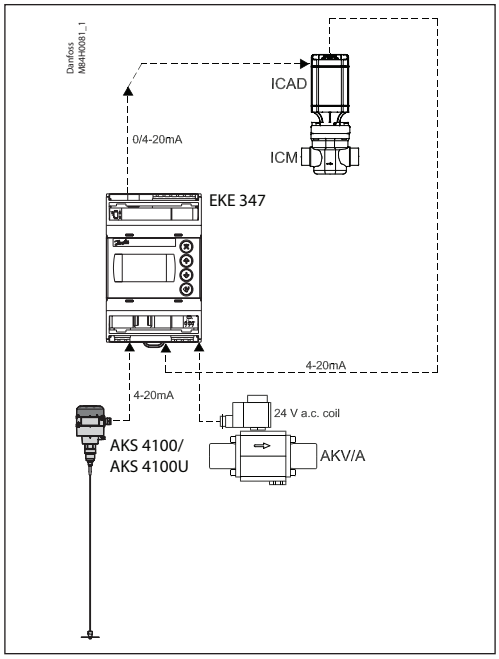
The controller receive a signal which enable it to contol low or high side applications (see page 7).

EKE 347 does support 2 types of Danfoss expansion valves. (see below)
One analog input is available as feed back from ICM in order to indicate opening degree of the ICM.

Expansions valve

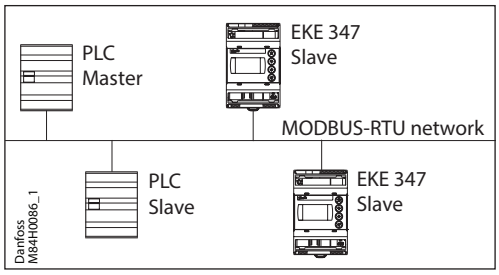
Two types of Danfoss expansion valves can be used

- *ICM*
  ICM are direct operated motorized valves driven by digital stepper motor type ICAD
- *AKV/A*
  AKVA or AKV are pulse-width modulating expansion valves.



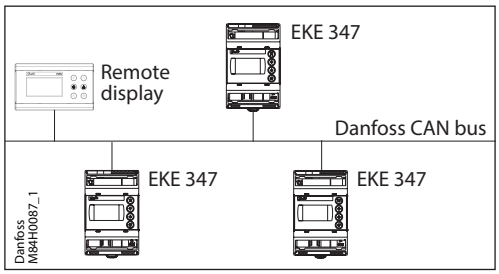
MODBUS communication

EKE 347 include as standard RS 485 based MODBUS-RTU bus communication interface to third party equipment like PLC.
Via the MODBUS it is possible to read and write parameters to the EKE 347
Operation, monitoring and data collection can then be performed via PLC from a SCADA system.



Remote Display - option

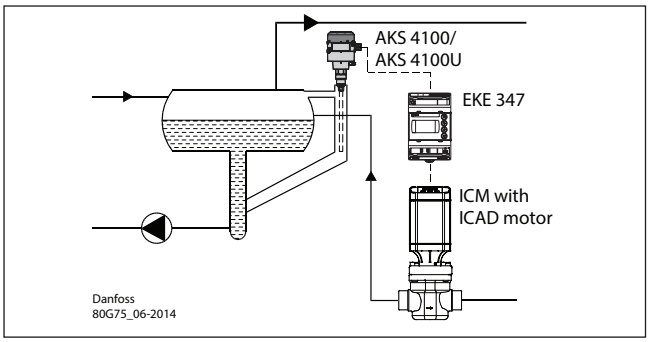
A remote display for panel mounting is available. From the remote display a full overview and access is possible to all individual EKE 347 controllers connected to the internal Danfoss CAN bus.



Application examples

Pump reservoir

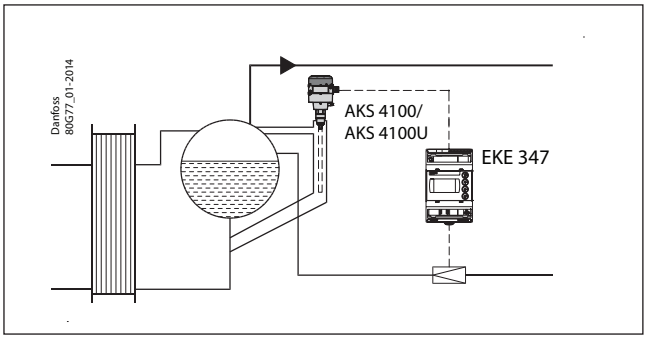
Modulating control of injection for a more stable liquid level and suction pressure.



System configuration ICAD
Regulating principle: Low
Level Signal setup: AKS 4100/U

Separator on flooded evaporator

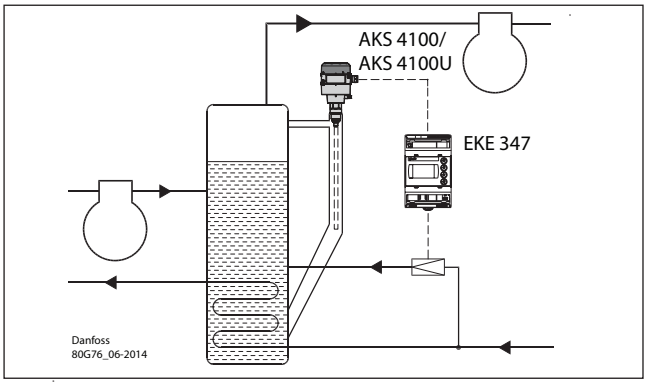
Modulating control and the valve's large capacity range ensure a stable level - even under conditions of quickly changing loads.



System configuration AKV/A
Regulating principle: Low
Level Signal setup: AKS 4100/U

Intermediate cooler

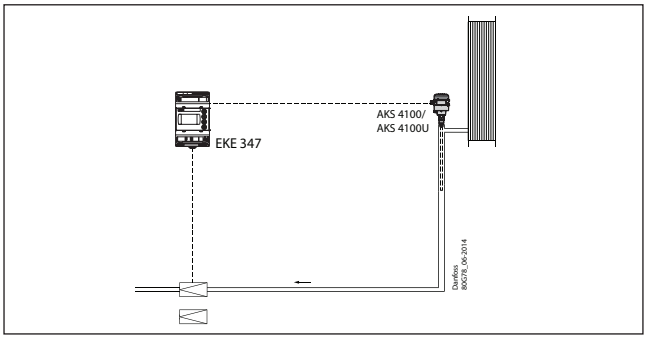
The level transmitter's wide measuring range enables it to monitor the liquid at all levels of the reservoir - and hence to use the signal for safety functions in connection with the max. permissible level



System configuration AKV/A
Regulating principle: Low
Level Signal setup: AKS 4100/U

Receiver / condenser

The control system's short reaction time makes it very suited for high-pressure float systems with small refrigerant charges.



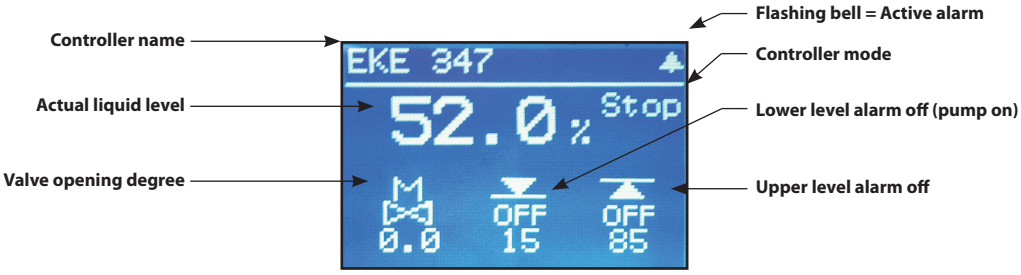
System configuration AKV/A
Regulating principle: High
Level Signal setup: AKS 4100/U

Control Panel

The user interface of the control panel consists of a multiline display and 4 individual push buttons: Enter button, Scroll up button, Scroll down button and Back button.

The figure shows the Home display image, which give the actual overview. This is the starting point for entering into menus, and you will revert to this image by pushing ⊗ 1 – 3 times (depending on actual position).

Display



The display itself show the state of **Liquid level, Controller Mode** (controller On / Off), **Valve opening degree, Lower level alarm** (off = no alarm present) and **Upper level alarm** (off = no alarm present).

Additional to the external connected alarm audio / video sources, a Bell symbol will flash in the upper right corner in case of an alarm.

To see more details on system performance and setting of parameters, 2 different main menu levels can be reached by operation of the push buttons.

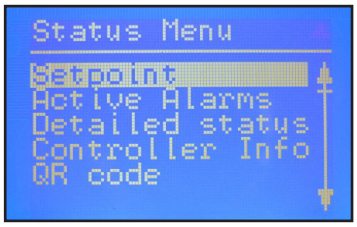
From Home image the **Status menu** can be reached by **1 push** on Enter.
From Home image the **Setup & service menu** can be reached by **1 push and hold** on Enter.
For entrance a Log In is required by the password given during Commisioning.

Menus

Status menu

To enter Status menu from Home image:
Push ⏎ once.

The Status menu is an open menu accessible for all. Therefore only 1 parameter can be changed from here. A selection of other parameters can be seen from the status menu.



Status menu (Open menu)

	Options
Setpoint	
Liquid level setpoint	0 – 100%
Active alarms Example of alarm content. The list will be empty in normal operation as no alarm is active.	
Level signal out of range	hours minutes
Standby mode	hours minutes
Detailed status	
Controller state	Stop, Manual, Auto, Slave, IO
Actual level	0.0 – 100%
Actual reference	0.0 – 100%
Actual OD	0.0 – 100%
Digital input status	On / Off
Actual level signal current	mA
Oscillation amplitude	0.0 – 100%
Oscillation period	sec
Controller Info	
Type	
Name (Controller name)	
SW (Software version)	
Bios (Bios version)	
Adr (Controller address)	
SN (Serial Number)	
PV (Product version)	
Site (Production site)	
QR code	
Code	

Read & Write
Read only

Setup & service menu (Requires log-in password assigned in Commisioning menu)

To enter Setup and service menu from Home image:
Push and hold ⏎.

Maneuvering in the Status menu and the Setup and service menu's are done by use of the 4 push buttons shown on page 8.

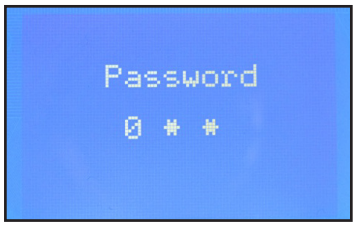
The Setup & service menu is divided into 3 access levels, where personnel have individual authority.

Most advanced level is **Commissioning**, where you have access to change all allowable parameters, including password issuing and re-run of Setup wizard.

Service level is for service personnel and has fewer rights than commissioning.

The lowest level is for **Daily** use, and allows only a few changes.

The table on the next page shows authority given to the Commisioning level.



Setup & service menu - COMMISSIONING

Parameter		Options	Default values
Reference	Main switch	On, Off	Off
	Liquid level setpoint	0 – 100%	50.0%
	Operation mode	Master, IO, Slave	Master
Alarm setup	Lower level limit	0 – 100%	15%
	Upper level limit	0 – 100%	85%
	Level alarm mode	Time, Hysteresis	Time
	Lower delay	0 – 999 sec	10 sec
	Upper delay	0 – 999 sec	50 sec
	Lower level hysteresis	0 – 20%	3%
	Upper level hysteresis	0 – 20%	5%
	Function common alarm	Not follow; Follow up; Follow low; Follow all	Not follow
	Oscillation detect band	0 – 100%	100%
	Oscillation detect timeout	2 – 30 min	20 min
	Force pump OFF in stop mode	Yes / No	No
	IO Lower level limit	0 – 100%	5%
	IO Upper level limit	0 – 100%	95%
	IO Lower level hysteresis	0 – 20%	3%
	IO Upper level hysteresis	0 – 20%	3%
	IO Lower delay	0 – 999 sec	10 sec
	IO Upper delay	0 – 999 sec	50 sec
	IO Level limit	0 – 100%	50%
	IO Level delay	0 – 999 sec	10 sec
	IO Level hysteresis	0 – 20%	3%
	IO Level action	Falling,Rising	Falling
Control	Control Method	On/Off ,P, PI	PI
	Regulating principle	Low, High	Low
	P-band	5 – 200%	30.0%
	Integration time Tn	60 – 600 sec	400 sec
	Neutral zone	0 – 25%	2.0%
	Difference	0,5 – 25%	2%
	Period time for AKV/AKVA	3–15 sec	6 sec
	Minimum OD	0 – 99%	0%
	Maximum OD	1 – 100%	100%
Display	Language	EN,CN,PT,RU,SP,FR,IT, GER, ARAB	EN
	Output indication	level, OD	Level
	Login timeout	1 – 120 min	10 min
	Backlight timeout	0 – 120 min	2 min
	Password daily	3 - digit, 0 – 999	100
	Password service	3 - digit, 0 – 999	200
	Password commission	3 - digit, 0 – 999	300
IO config	System configuration	ICAD+NC, ICAD, AKV/A+NC, AKV/A, NC only	ICAD + NC
	Level signal setup	AKS 4100, AKS 41, Current, Voltage	AKS4100
	Voltage at low liquid level	0 – 10V	0 V
	Voltage at high liquid level	0 – 10V	10 V
	Current at low liquid level	0 – 20 mA	4 mA
	Current at high liquid level	0 – 20 mA	20 mA
	Valve position setup	Not used, Current, Voltage	Not used
	Voltage at closed valve position	0 – 10V	0 V
	Voltage at open valve position	0 – 10V	10 V
	Current at closed valve position	0 – 20 mA	4 mA
	Current at open valve position	0 – 20 mA	20 mA
	Common alarm setup	D04, High alarm, D03, Disp only	High alarm
	Multiple valve setup	Not used, 2 same cap, 2 dif cap, 3 same cap, 3 dif cap	Not used
	Multiple valve pattern	Parallel,Sequence	Parallel
	Valve A capacity	0 – 100%	50%
	Valve B capacity	0 – 100%	50%
	Valve C capacity	0 – 100%	30%
	ICAD takeover OD	0 – 100%	80%
	IO module setup	Used, Not used	Not used
Communication	CAN ID	1 – 127	1
	CAN baudrate	20k, 50k, 125k, 250k, 500k, 1M	500k
	Modbus ID	0 – 120	1
	Modbus baudrate	0, 1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400	19200
	Modbus mode	8N1, 8E1, 8N2	8E1
	Modbus mapping	Operation, Setup	Operation
	Valve B CAN ID	1 – 127	2
	Valve C CAN ID	1 – 127	3
	IO Mod. CAN ID	1 – 127	4

To be continued.....

Setup & service menu - COMMISSIONING *(Continued)*

Parameter		Options	Default values
Service	Controller state		–
	Actual level		–
	Actual referrence		–
	Actual OD		–
	Actual valve position		
	Digital input status		–
	Actual level signal voltage		
	Actual level signal current		–
	Actual position signal voltage		
	Actual position signal current		
	Actual OD A		
	Actual OD B		
	Actual OD C		
	Manual Mode	On, Off	Off
	Manual OD	0 – 100%	50.0%
	Manual low alarm	Off-On	Off
	Manual high alarm	Off-On	Off
	Manual common alarm	Off-On	On
	Apply defaults	None, Factory	None
Setup wizard	Setup wizard	Re-run Setup wizard	–
I/O check	Main switch EKE act:		Off
	AKS 4100 EKE act:		–
	ICAD EKE act:		–
	Nor. Close (NC) EKE act:		–
	Upper lvl (alarm) EKE act:		–
	Lower lvl (alarm) EKE act:		–
Controller name	Controller name	Type in controller name	–

	Read & Write
	Read only

Alarm and error codes

When detecting an alarm from external sources or the flashing bell in the display, the alarm description can be found as a text message in the Status menu under Active alarms.

Both alarms and errors will be shown here.
If more alarms / errors occur simultaneously, they will be shown as subsequent text lines.

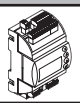
Alarms:

Upper level
Lower level
Standby mode
Valve B CAN ID conflict
Valve C CAN ID conflict
IO module CAN ID conflict
IO module communication
Communication to master lost
Min / max OD conflict
Common alarm HW conflict
Control method conflict
Multiple valve setup conflict
Valve C alarm
Valve B alarm
Oscillation in level signal
Valve position
Multiple valve capacity
Valve C communication
Valve B communication

Errors:

Internal error
Level signal out of range
Valve position signal out of range
Sensor supply overload
AKS 4100 error
Too much current AI3
Too much current AI4
DO4 overload

Ordering

Type		Description	Code No.
EKE 347		Liquid level controller	**080G5000**
MMIGRS2		Remote display, Panel, S	**080G0294**
–		Wire for display unit, L = 1.5 m, 1 pcs.	**080G0075**
–		Wire for display unit, L = 3 m, 1 pcs.	**080G0076**
–		EKE / EKC accessory for panel mounting	**027F0309**

Data

Supply voltage	24 V AC ±20% 50 / 60 Hz or 24 V DC ±20% (the supply voltage is galvanically separated from the input and output signals. Input/output are not individual galvanic isolated)	
Power consumption	Controller 20 W coil for AKV or AKVA	15 VA / 10W 55 VA
Input signal * Ri = 0(4) – 20mA: 33 ohm 0(2) – 10 V: 100 kohm	Level signal *	4 – 20 mA or 0 – 10 V
	ICM valve feedback signal *	From ICAD 0/4 – 20 mA
	Contact function start / stop of regulation	
Relay output	3 pcs. SPDT (Lower level alarm, Upper level alarm, Common alarm / NC Solenoid)	Normally Open: 3 A GP*, 2.2 FLA / 13.2 LRA, 1/6 hp, PD 220 VA, 250 V AC 100 k 3 FLA / 18 LRA, 1/10 hp, PD 150 VA, 125 V AC 100 k Normally Closed: 3 A GP*, 250 V AC 100 k (*GP = General purpose). Max 240 V AC or 24 V AC / DC can be used, but same voltage type must be used on DO3 and DO2
Current output	0 – 20 mA or 4 – 20 mA Max. load: 500 ohm	
Valve connection	ICM - via current output AKV/A- via 24 AC Pulse-Width Modulating output	
Data communication	MODBUS RTU: Communication to system controller, MODBUS on RS485: galvanic isolation (500 V DC) CAN: Communication to other EKE controllers	
Supported Modbus Commands	Supported commands with max of 50 ms response time	03 (0x03) Read Holding Registers 04 (0x04) Read Input Registers 06 (0x06) Write Single Register
	Supported commands without defined max response time	08 (0x08) Diagnostics 16 (0x10) Write Multiple Registers (up to 20 registers) 43 (0x2b) Read Device Identification
Environments	-20 – 55 °C, during operation -30 – 80 °C, during storage	
	90% Rh, not condensed	
	No shock influence / vibrations	
Enclosure	IP 20 / IP 40 for the front mounted into a panel	
Weight	193 g	
Mounting	DIN rail	
Display	Graphical LCD display	
Terminals	plugs 1.5 or 2.5 mm² multicore	
Approvals	EU Low Voltage Directive and EMC demands re CE-marking complied with. LVD-tested acc. to EN 60730-1 and EN 60730-2-9 EMC-tested acc. to EN61000-6-3 and EN 61000-6-2 UL file E31024	

Connection

Necessary connections

Terminals:

28 – 29 Supply voltage 24 V AC or DC
1 – 7 Signal from level transmitter type AKS 4100/4100U **or**
7 – 10 Signal from level transmitter type AKS 41
36 – 37 Expansion valve type AKV or AKVA **or**
23 – 24 Expansion valve type: ICM with ICAD
13 – 14 Switch function for start / stop of controller. If a switch is not connected, terminals 13 and 14 must be short-circuited.

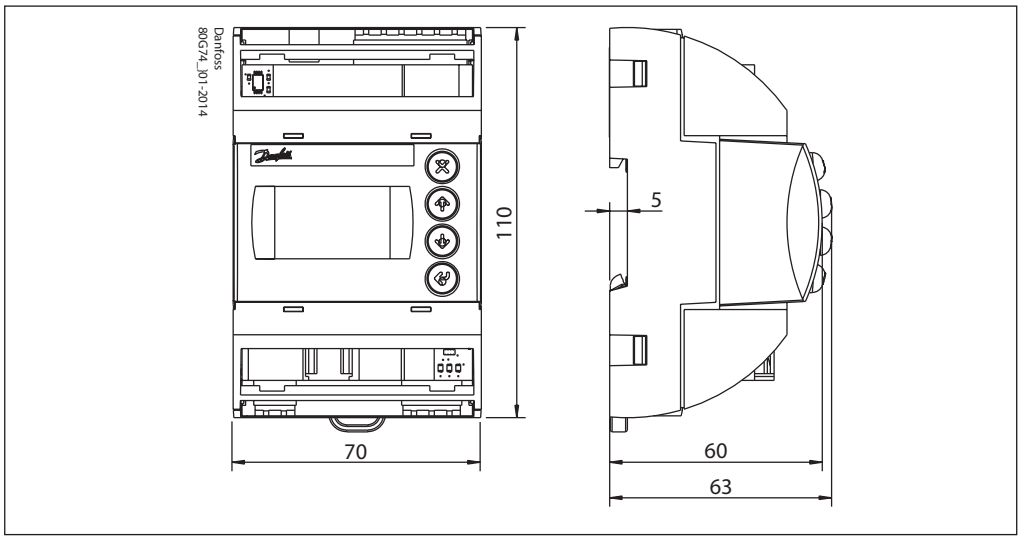
See the figures on the next pages.

Application dependent connections

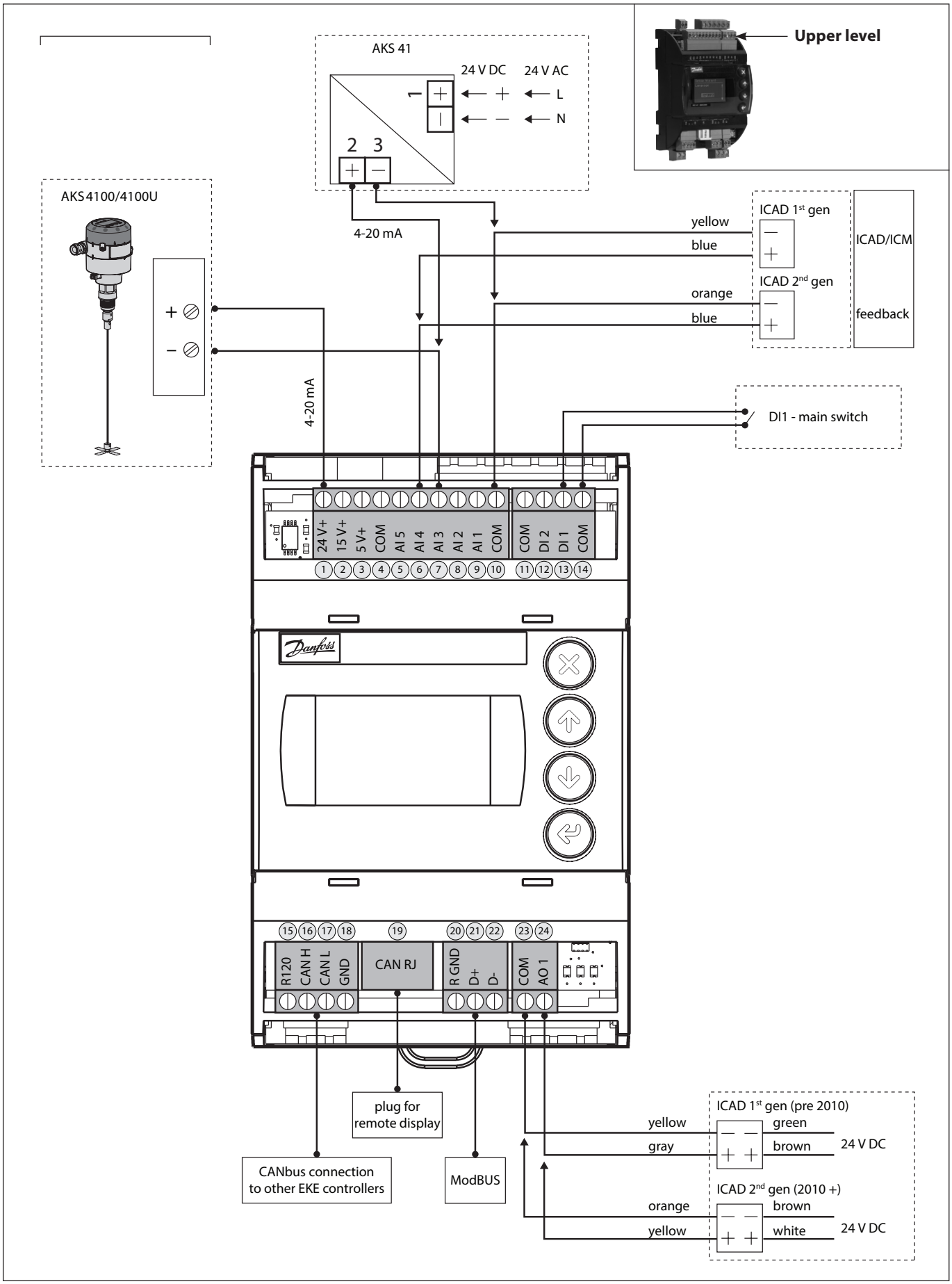
Terminals:

33 – 35 Relay for common alarm.
Installer can choose between Normally Open (33 – 34) or Normally Closed (34 – 35) circuits.
The relay will switch according to the programmed setting.
25 – 27 Relay for low level limit.
Installer can choose between Normally Open (26 – 27) or Normally Closed (25 – 26) circuits.
The relay will switch when the set value is passed.
30 – 32 Relay for upper level limit.
Installer can choose between Normally Open (30 – 31) or Normally Closed (31 – 32) circuits.
The relay will switch when the set value is passed.
6 – 10 ICM valve feedback signal from ICAD 0/4 – 20 mA

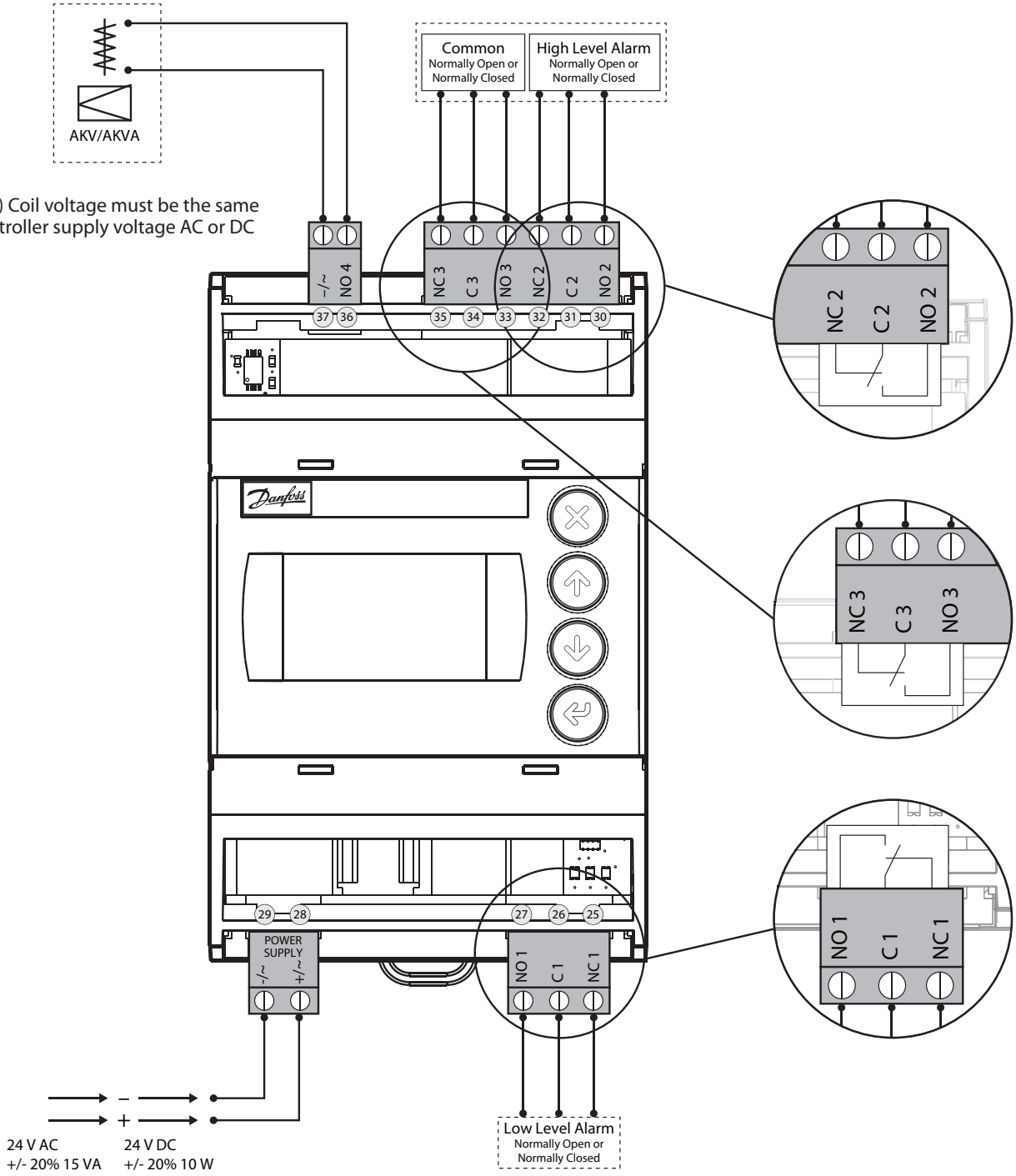
Dimensions



Connections - Upper level



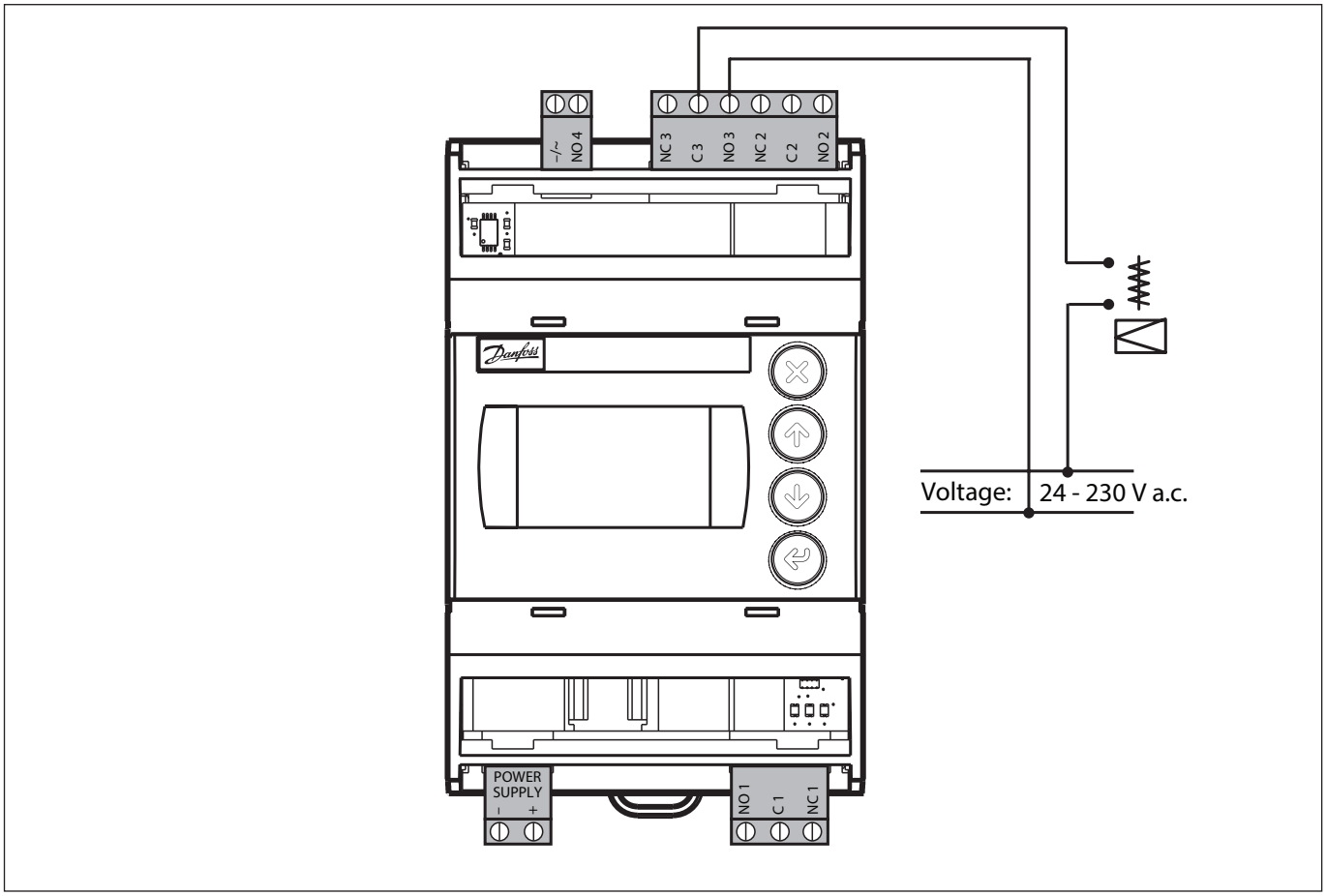
Connections - Lower level



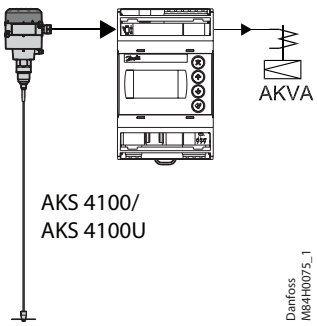
Note:
AKV(A) Coil voltage must be the same as controller supply voltage AC or DC

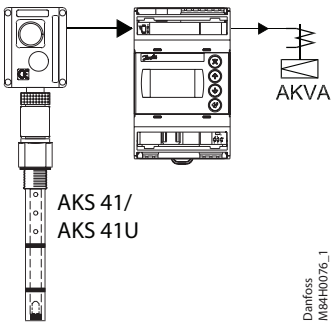
If AKV(A) is used, the power supply must cover the AKV(A) coil wattage additional

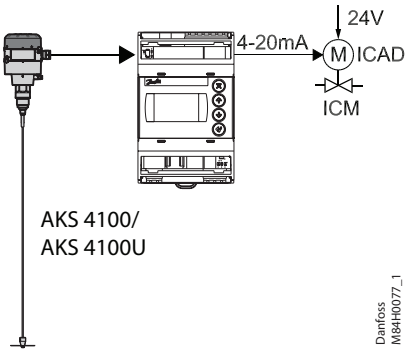
EKE 347 - ON / OFF Application
Open/Close solenoid valve with coil 24 V – 230V

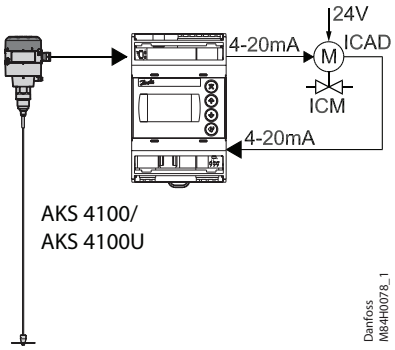


Connection examples

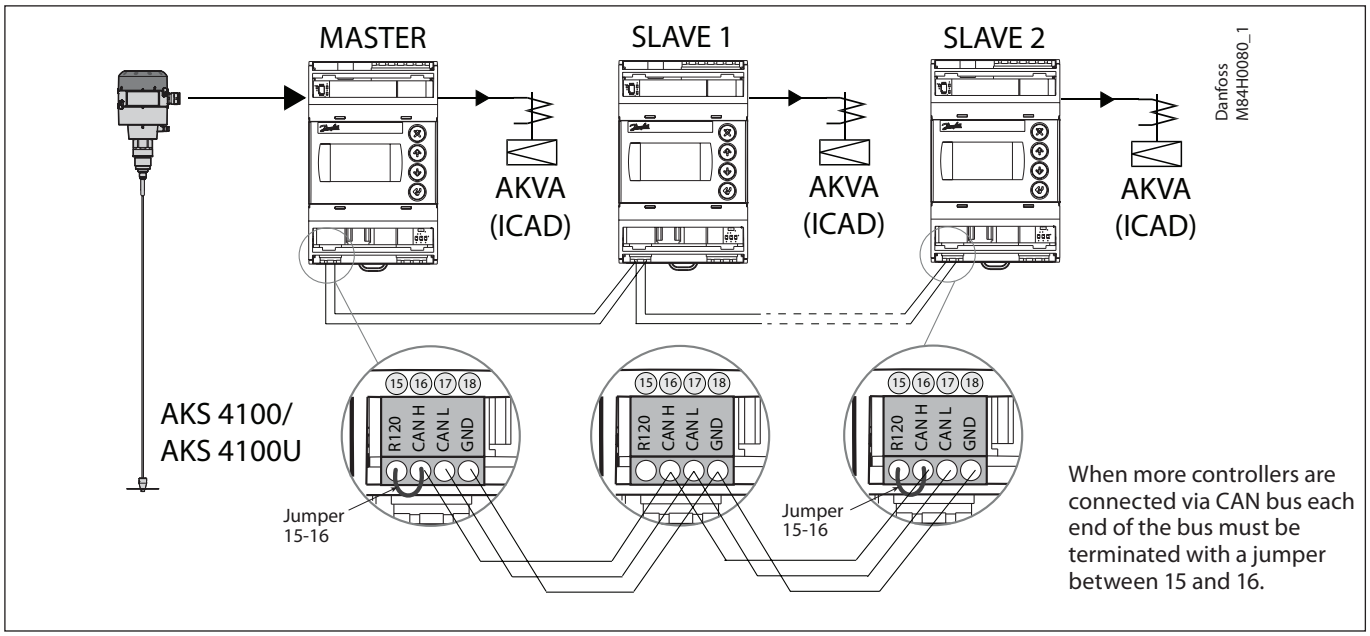








MASTER / SLAVE configuration



Multivalve

If the system capacity requires more than one control valve; up to three valves can be controlled simultaneously in a Master / Slave configuration, where the master and each slave controls one valve respectively.

The configuration is programmed in the master EKE 347 IO config menu - Multiple valve setup - with one of these options:

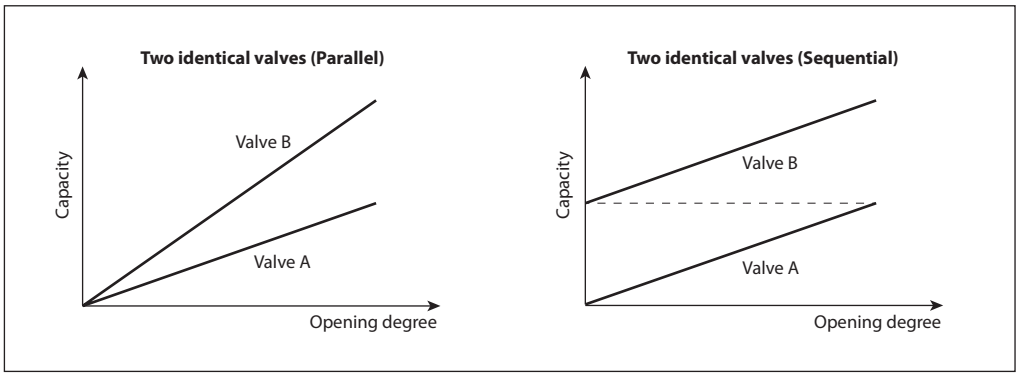
- 2 valves with same capacity
- 2 valves with different capacity
- 3 valves with same capacity
- 3 valves with different capacity

Additionally the master must be programmed in IO config menu - Multiple valve pattern - for either:

- **Valves in parallel**
  (valves regulate simultaneously)
  or
- **Valves sequential**
  (mainly one valve regulating at any time)

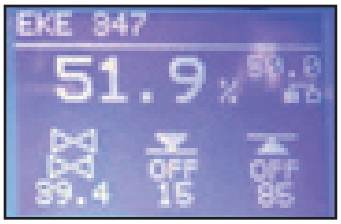
See principle below.

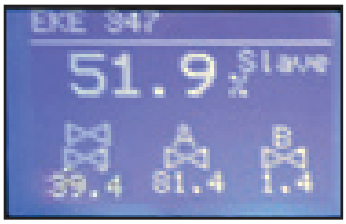
The slave EKE's only need identification of Slave and valve CAN ID (communication menu).



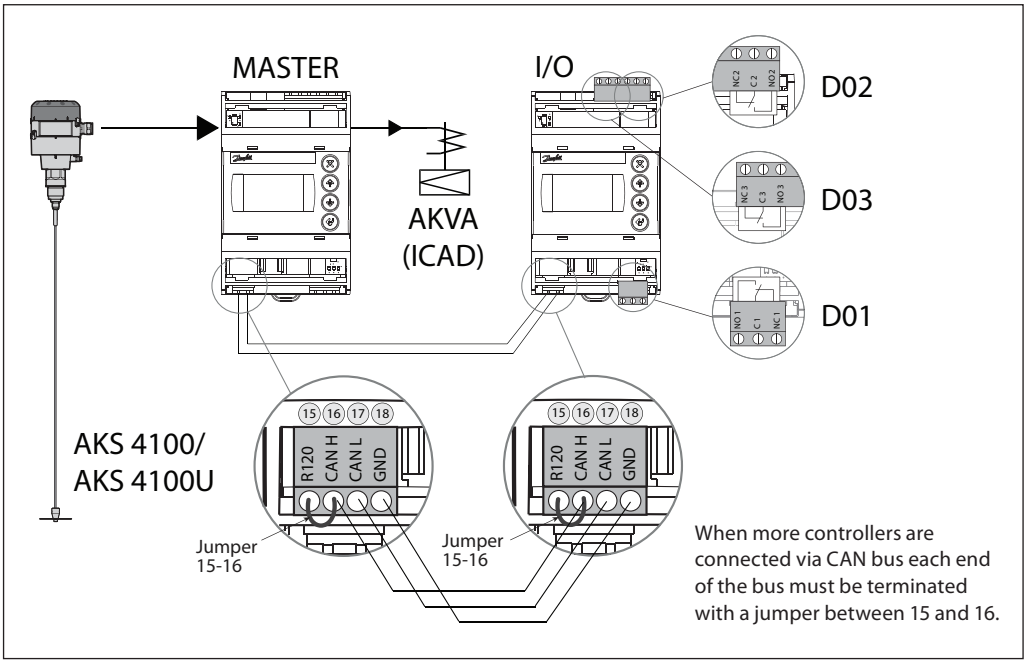
The default display of the master EKE will show the standard information together with a symbol of multiple valves and the actual total opening degree (see below).

The default display of the slave EKE will show the actual liquid level (as the master), symbol of multiple valves, actual total opening degree and the opening degree of the individual valves involved (see below).





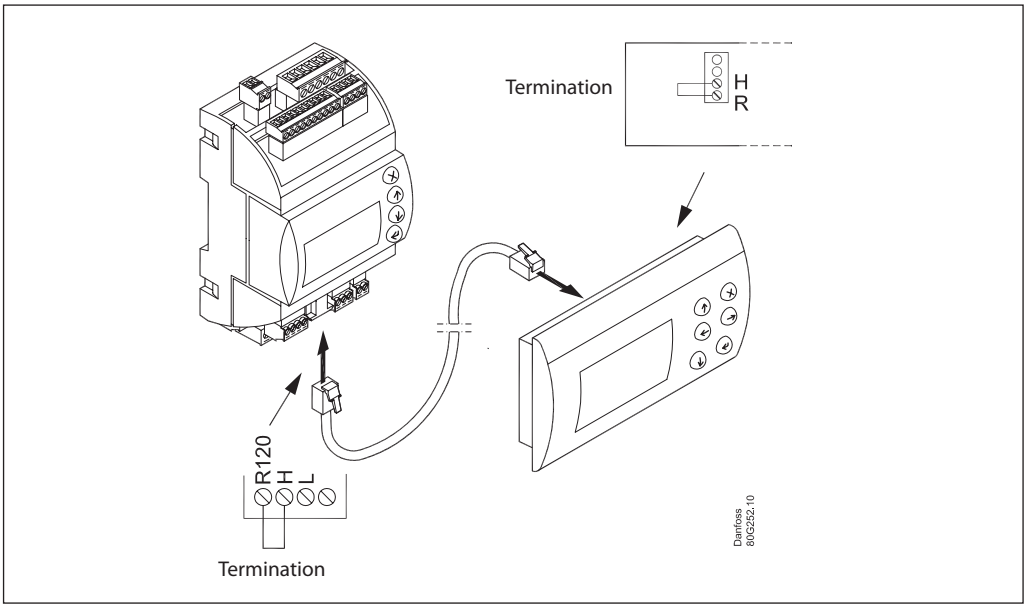
I/O configuration



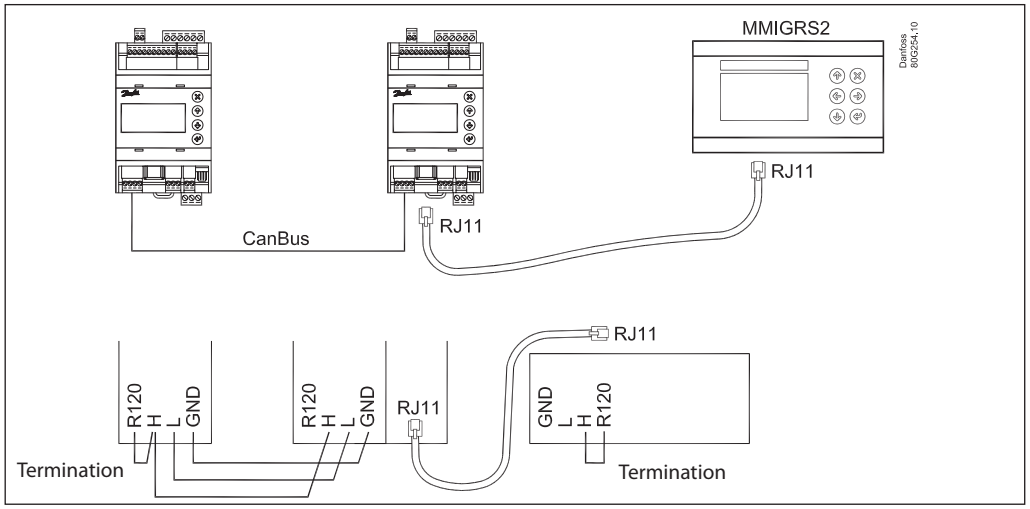
Remote display

The daily operation can be set up directly on the controller or via an external display device.

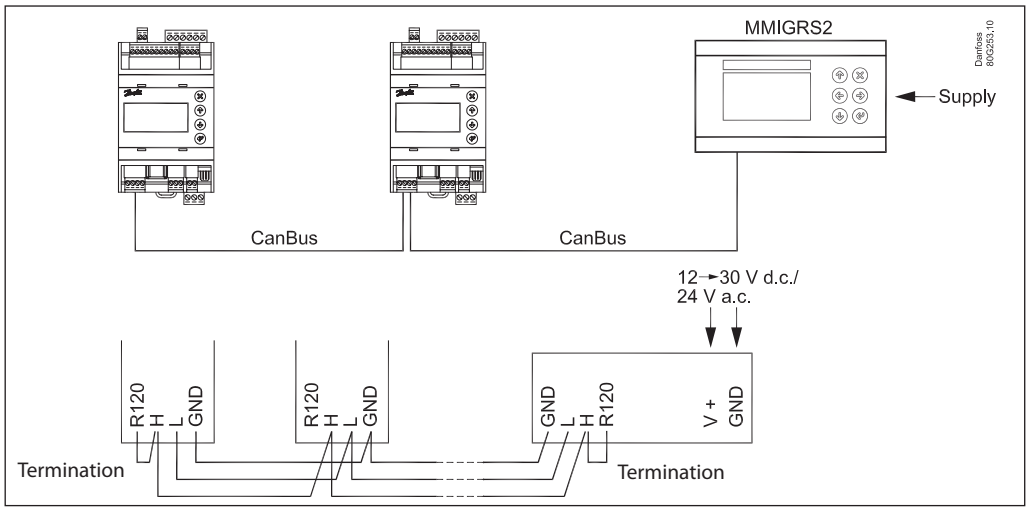
Example 1



Example 2



Example 3



ERR31

Alarm on the external display - MMIGRS2

If the communication to the display is not carried out correctly, it will send an "ERR31" error notification.
This may be caused by the displayed terminations not being installed, or that there have been interruptions in data communication during the time when the display retrieves the basic information from the controller.
Once the terminations have been inspected, you should then check the software version of the external display.
This is done by holding down the Enter key and the X key for 5 seconds, until the Bios menu appears. Next, press the X key and read off the software version in the bottom right corner. The software version must be 1.13 or newer.

Once the display's software version has been checked, check the display's settings as follows:
1. Hold the Enter key and the X key down for 5 seconds, until the Bios menu appears.
2. Select the "MCX selection" menu
   - Select the "Clear UI" line and press Enter
   - Select the "Autodetect" line and press Enter
3. Press the X key to return to the Bios menu
4. Select the "COM selection" menu
   - Select the "CAN" line and press Enter
5. Press the X key to return to the Bios menu
6. Select the "Start up mode" menu
   - Select the "Remote application" line and press Enter
7. Press the X key to return to the Bios menu
8. Select the "CAN" menu
   - Select the "Baudrate" line and then select the "Autobaud" setting and press Enter
   - Select the "Node ID" line and set the value to 126 and press Enter
9. Press the X key to return to the Bios menu
10. Select the "Application" menu and press Enter.

The display will once again retrieve data from the controller. This process will take about 5 minutes.

Modbus parameters
Software version: 1.62.xx

Label	Parameter name	Min value	Max value	Default	Unit	Deci-mals	Modbus PNU	Locked by main switch	EEPROM	Enumeration
r12	Main switch	0	1	0		0	3001	NO	YES	0 = Off | 1 = On
R01	Liquid level setpoint	0	100	50	%	1	3002	NO	YES	
N07	Operation Mode	0	2	0		0	3003	YES	YES	0 = Master | 1 = Slave | 2 = IO
a02	Lower level limit	0	100	15	%	0	3004	NO	YES	
a01	Upper level limit	0	100	85	%	0	3005	NO	YES	
a07	Level alarm mode	0	1	0		0	3006	NO	YES	0 = Time | 1 = Hysteresis
a04	Lower delay	0	999	10	s	0	3007	NO	YES	
a03	Upper delay	0	999	50	s	0	3008	NO	YES	
a06	Lower level hysteresis	0	20	3	%	1	3009	NO	YES	
a05	Upper level hysteresis	0	20	5	%	1	3010	NO	YES	
a08	Function common alarm	0	3	0		0	3011	NO	YES	0 = Not follow | 1 = Follow up | 2 = Follow low | 3 = Follow all
a12	Oscillation detect band	0	100	100	%	0	3012	NO	YES	
a13	Oscillation detect timeout	2	30	20	min	0	3013	NO	YES	
a25	Force pump OFF in stopped mode	0	1	0		0	3117	NO	YES	0 = Off | 1 = On
a14	IO Lower level limit	0	100	5	%	0	3101	NO	YES	
a15	IO Upper level limit	0	100	95	%	0	3102	NO	YES	
a16	IO Lower level hysteresis	0	20	3	%	1	3103	NO	YES	
a17	IO Upper level hysteresis	0	20	3	%	1	3104	NO	YES	
a18	IO Lower delay	0	999	10	s	0	3105	NO	YES	
a19	IO Upper delay	0	999	50	s	0	3106	NO	YES	
a20	IO Level limit	0	100	50	%	0	3107	NO	YES	
a21	IO Level delay	0	999	10	s	0	3108	NO	YES	
a22	IO Level hysteresis	0	20	3		1	3109	NO	YES	
a23	IO Level action	0	1	0		0	3110	NO	YES	0 = Falling | 1 = Rising
N03	Control Method	0	2	2		0	3014	NO	YES	0 = On / off | 1 = P-ctrl | 2 = PI-ctrl
n35	Regulating principle	0	1	0		0	3015	NO	YES	0 = Low | 1 = High
n04	P-band	5	200	30	%	1	3016	NO	YES	
n05	Integration time Tn	60	600	400	s	0	3017	NO	YES	
n34	Neutral zone	0	25	2	%	1	3018	NO	YES	
N06	Difference	0,5	25	2	%	1	3019	NO	YES	
n13	Period time for AKV / AKVA	3	15	6	s	1	3020	NO	YES	
n33	Minimum OD	0		0	%	0	3021	NO	YES	
n32	Maximum OD	1	100	100	%	0	3022	NO	YES	
o11	Language	0	0	0		0	3023	YES	YES	0 = $ActiveLanguageList
o17	Output indication	0	1	0		0	3024	NO	YES	0 = Level | 1 = OD
K04	Login timeout	1	120	10	min	0	3025	NO	YES	
K06	Backlight timeout	0	120	2	min	0	3026	NO	YES	
o05	Password daily	0	999	100		0	3027	NO	YES	
K02	Password service	0	999	200		0	3028	NO	YES	
K03	Password commission	0	999	300		0	3029	NO	YES	
K05	Contrast	0	100	40	%	0	3030	NO	YES	
K01	Brightness	0	100	80	%	0	3031	NO	YES	
I09	System configuration	0	4	0		0	3032	YES	YES	0 = ICAD+NC | 1 = ICAD | 2 = AKV/A+NC | 3 = AKV/A | 4 = NC only
o31	Level signal setup	0	3	0		0	3033	YES	YES	0 = AKS4100 | 1 = AKS41 | 2 = Current | 3 = Voltage
o32	Voltage at low liquid level	0		0	V	1	3034	NO	YES	
o33	Voltage at high liquid level		10	10	V	1	3035	NO	YES	
I06	Current at low liquid level	0		4	mA	1	3036	NO	YES	
I07	Current at high liquid level		20	20	mA	1	3037	NO	YES	
o34	Valve position setup	0	2	0		0	3038	YES	YES	0 = Not used | 1 = Current | 2 = Voltage
I02	Voltage at closed valve position	0		0	V	1	3039	NO	YES	
I03	Voltage at open valve position		10	10	V	1	3040	NO	YES	
I04	Current at closed valve position	0		4	mA	1	3041	NO	YES	
I05	Current at open valve position		20	20	mA	1	3042	NO	YES	
I18	Common alarm setup	0	3	1		0	3043	YES	YES	0 = DO4 | 1 = High Alarm | 2 = DO3 | 3 = Disp only
I08	Multiple valve setup	0	4	0		0	3044	YES	YES	0 = Not used | 1 = 2 same cap | 2 = 2 dif cap | 3 = 3 same cap | 4 = 3 dif cap
I13	Multiple valve pattern	0	1	0		0	3045	NO	YES	0 = Parallel | 1 = Sequence
I10	Valve A capacity	0	100	50	%	0	3046	YES	YES	

I11	Valve B capacity	0	100	50	%	0	3047	YES	YES	
I12	Valve C capacity	0	100	33	%	0	3048	YES	YES	
I17	ICAD takeover OD	0	100	80	%	0	3052	NO	YES	
I19	IO module setup	0	1	0		0	3091	YES	YES	0 = Not used | 1 = Used
G01	CAN ID	1	127	1		0	4032	NO	NO	
G02	Can baudrate	0	5	4		0	4033	NO	NO	0 = 20k | 1 = 50k | 2 = 125k | 3 = 250k | 4 = 500k | 5 = 1M
G06	Modbus ID	0	120	1		0	3055	NO	YES	
G05	Modbus baudrate	0	8	6		0	3056	NO	YES	0 = 0 | 1 = 1200 | 2 = 2400 | 3 = 4800 | 4 = 9600 | 5 = 14400 | 6 = 19200 | 7 = 28800 | 8 = 38400
G08	Modbus mode	0	2	1		0	3057	NO	YES	0 = 8N1 | 1 = 8E1 | 2 = 8N2
G07	Modbus mapping	0	1	0		0	3058	NO	YES	0 = Operation | 1 = Setup
G09	Valve B CAN ID	1	127	2		0	3088	YES	YES	
G10	Valve C CAN ID	1	127	3		0	3089	YES	YES	
G11	IO Mod. CAN ID	1	127	4		0	3090	YES	YES	
B01	Controller state	0	6	0		0	4001	YES	NO	0 = Powerup | 1 = Stop | 2 = Auto | 3 = Manual | 4 = Slave | 5 = IO | 6 = Safe
u01	Actual level	0	100	0	%	1	4002	NO	NO	
u02	Actual reference	0	100	0	%	1	4003	YES	NO	
u24	Actual OD	0	100	0	%	1	4004	NO	NO	
u33	Actual valve position	0	100	0	%	1	4005	NO	NO	
u10	Digital input status	0	1	0		0	4006	NO	NO	0 = Off | 1 = On
u31	Actual level signal voltage	0	100	0	V	1	4007	NO	NO	
u30	Actual level signal current	0	24	0	mA	1	4008	NO	NO	
B02	Actual position signal voltage	0	100	0	V	1	4009	NO	NO	
u32	Actual position signal current	0	100	0	mA	1	4010	NO	NO	
B03	Actual OD A	0	100	0	%	1	4011	NO	NO	
B04	Actual OD B	0	100	0	%	1	4012	NO	NO	
B05	Actual OD C	0	100	0	%	1	4013	NO	NO	
o18	Manual Mode	0	1	0		0	4014	NO	NO	0 = Off | 1 = On
o45	Manual OD	0	100	50	%	1	3059	NO	NO	
B08	Manual low alarm	0	1	0		0	3060	NO	NO	0 = Off | 1 = On
B06	Manual high alarm	0	1	0		0	3061	NO	NO	0 = Off | 1 = On
B07	Manual common alarm	0	1	0		0	3062	NO	NO	0 = Off | 1 = On
B09	Apply defaults	0	1	0		0	3063	YES	NO	0 = None | 1 = Factory
B11	Oscillation amplitude	0	100	0	%	1	4028	YES	NO	
B10	Oscillation period	0	3600	0	s	0	4029	YES	NO	

Label	Alarm name	Modbus PNU	Bit number
A1	Upper level	1901	8
A2	Lower level	1901	9
A92	Oscillation in level signal	1901	10
A96	Valve position	1901	14
A97	Multiple valve capacity	1901	15
E1	Internal error	1901	0
E21	Level signal out of range	1901	1
E22	Valve position signal out of range	1901	2
E96	AKS 4100 error	1901	3
A45	Standby mode	1901	4
A99	Valve B communication	1901	5
A98	Valve C communication	1901	6
A85	Communication to master lost	1901	7
A91	Valve B alarm	1902	8

A90	Valve C alarm	1902	9
A88	Control method conflict	1902	10
A87	Common alarm HW conflict	1902	11
A86	Min / max OD conflict	1902	12
E95	Sensor supply overload	1902	13
E99	DO4 overload	1902	14
E97	Too much current AI3	1902	15
E98	Too much current AI4	1902	0
A89	Multiple valve setup conflict	1902	1
A80	Valve B CAN ID conflict	1902	2
A81	Valve C CAN ID conflict	1902	3
A82	IO module CAN ID conflict	1902	4
A83	IO module communication	1902	5

ENGINEERING TOMORROW

Media temperature controller
EKC 361

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ENGINEERING TOMORROW

Media temperature controller
EKC 361

The controller and valve can be used where there are stringent requirements to accurate temperature control in connection with refrigeration.

E.g.:
- Cold room for fruits and food products
- Refrigerating systems
- Work premises in the food industry
- Process cooling of liquids

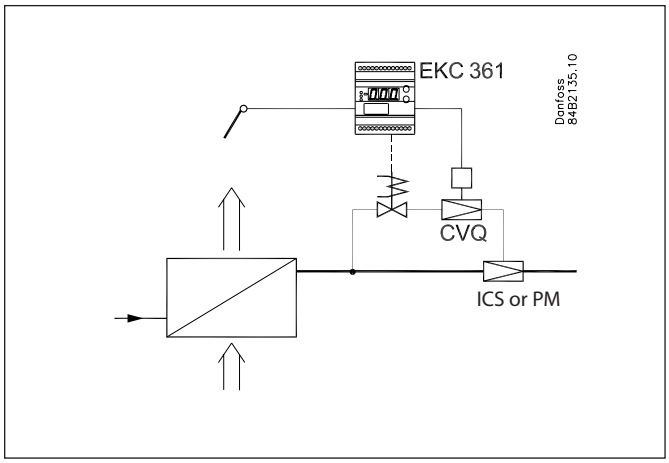
Features

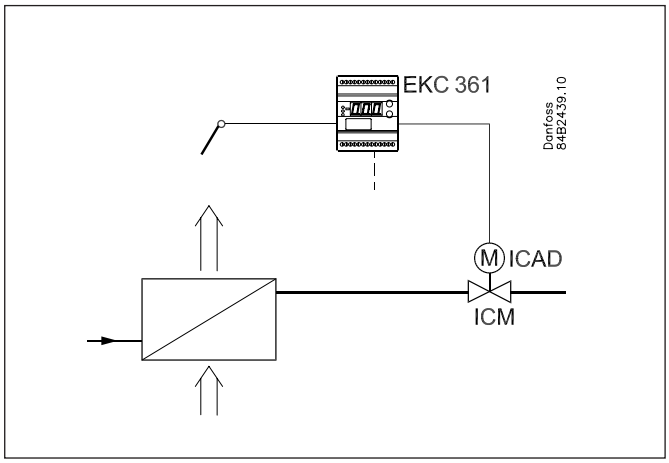
- The temperature is kept within an accuracy of ±0.25 °C or better after a transient phenomenon
- The evaporator's temperature is kept as high as possible, so that the air humidity is kept high and waste is limited
- A transient phenomenon can be controlled with the adaptive function. Select either:
  - Fast build-up where underswings are allowed
  - Not quite so fast build-up where under swings are less pronounced
  - Build-up without underswings
- PID regulation
- p_0 limitation

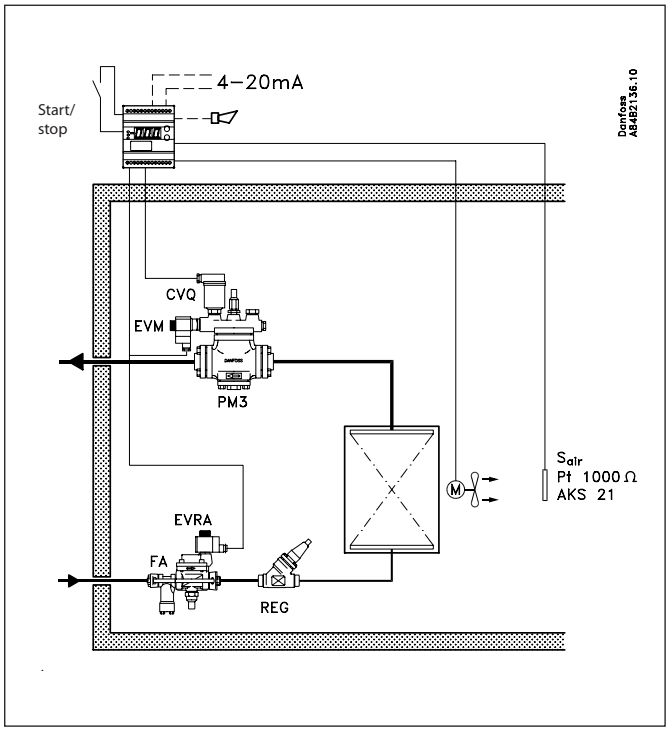
Introduction

Functions

- Modulating temperature control
- Digital ON / OFF input for start / stop of regulation ICS / PM or forced closing of ICM
- Alarm if the set alarm limits are exceeded
- Relay output for fan
- Relay output for solenoid valves
- Analog input signal that can displace the temperature reference
- Analog Output signal corresponding to selecting temperature as running display value. Please observe : Not possible if ICM is selected as valve

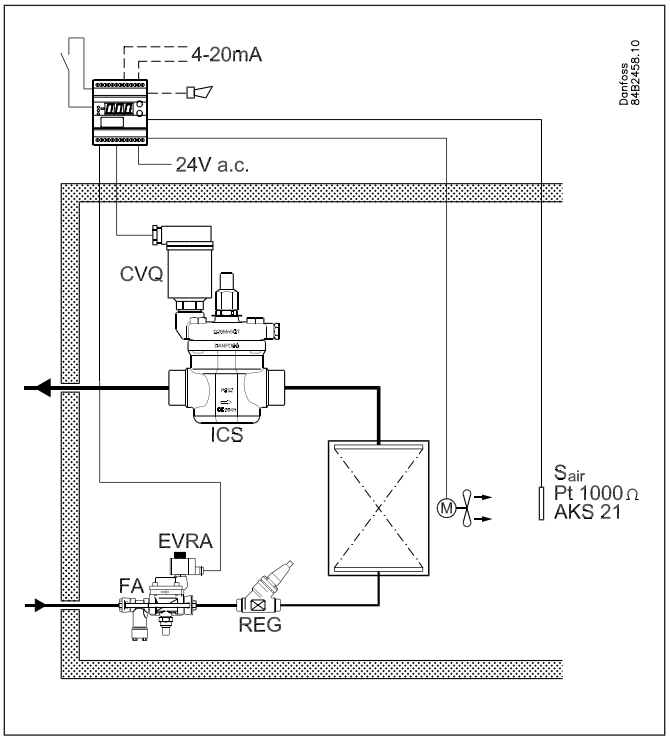




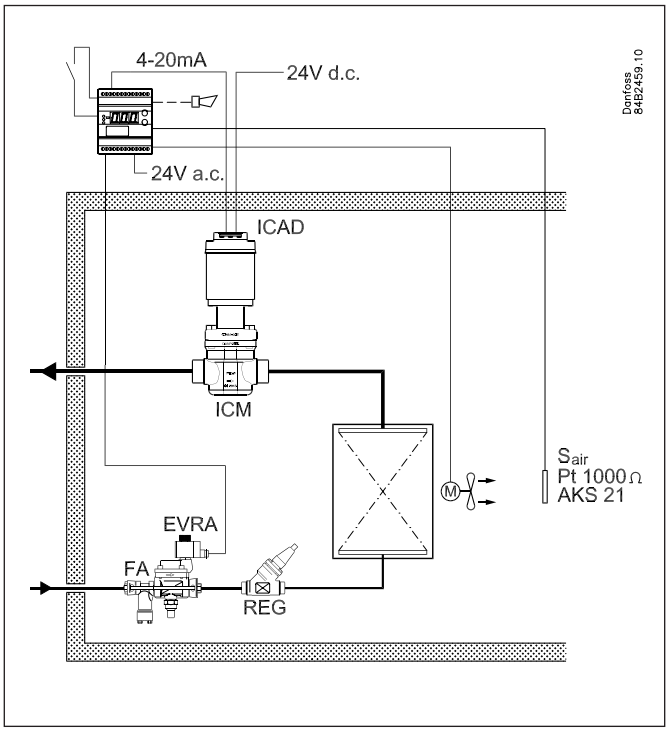


Application examples

ICS / PM
ICS / PM with CVQ is a pilot-operated and pressure-dependent valve for controlling media temperature.
The ICS or PM must be equipped with a CVQ pilot valve in order to position ICS or PM. The CVQ valve is operated by the EKC 361 controller.
Please notice that a power failure will cause the CVQ pilot valve to fully open ICS / PM. If it is required that ICS / PM must close at power failure, the pilot valve type EVM-NC can be installed.
If the Digital Input is ON, it releases the ICS / PM for controlling temperature. If the Digital Input is OFF, if stops controlling PM / ICS, but EKC 361 will maintain a CVQ minimum temperature. (Parameter n02)
Please see separate literature for ICS / PM
ICS : AI241186442033



ICM
ICM is a direct activating and pressure independent valve for controlling media temperature.
When ICM is selected, the ICM is positioned directly via the analog output 0/4 – 20mA output from the EKC 361.
If the Digital Input is ON, it releases the ICM for controlling temperature. If the Digital Input is OFF, the ICM is forced to close.
The opening degree OD 0 – 100% can be limited by parameter n32 and n33.
Please see separate literature for ICM
ICM : AI236186442940



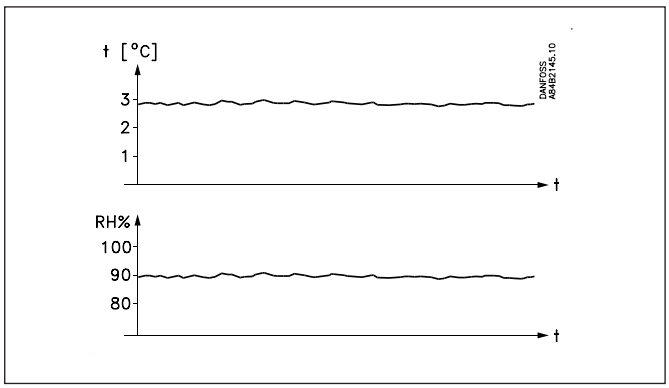
General for ICS / PM and ICM
The EKC 361 can also operate a solenoid valve in the liquid line (Digital output on terminal 9 and 10). It will follow the status of Digital Input, however if a low temperature alarm is detected (A2 alarm) the solenoid valve in the liquid line will be closed.
The EKC 361 can also operate a fan (Digital output on terminal 8 and 10). It will follow the status of Digital Input.
The Parameter (r12) must be ON in order to ensure general operation. If Parameter (r12) is OFF, EKC 361 will operate corresponding to if Digital Input is OFF
As media temperature sensor is S_{air} is used. Please observe that S_{air} can also be used to control liquid.
As option an auxiliary temperature sensor S_{aux} can be installed but only for monitoring.
S_{air} / S_{aux} can both be shown as running display value selected by parameter o17. The selected sensor (S_{air} or S_{aux}) will be sent out on the Analog Output as 0/4 – 20 mA.
Temperature scaling with parameter o27 and o28. Please observe by ICM the Analog Output is not available for sending temperature signals (S_{air} or S_{aux}).
It is normally recommended, on a aircooler, to install S_{air}, at the evaporator air outlet side.

Extra options

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

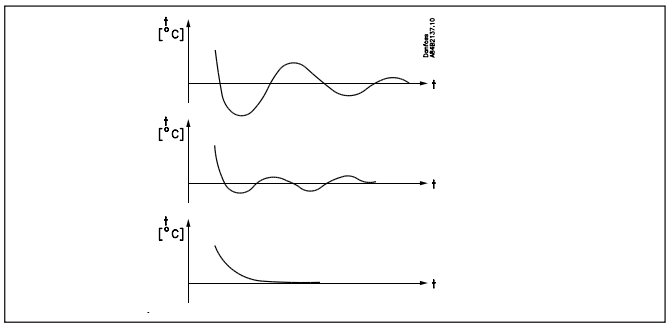
Function

Very accurate temperature control
With this system where controller, pilot valve and main valve have been adapted for optimum use in the refrigerating plant, the refrigerated products may be stored with temperature fluctuations of less than ±0.25 °C.

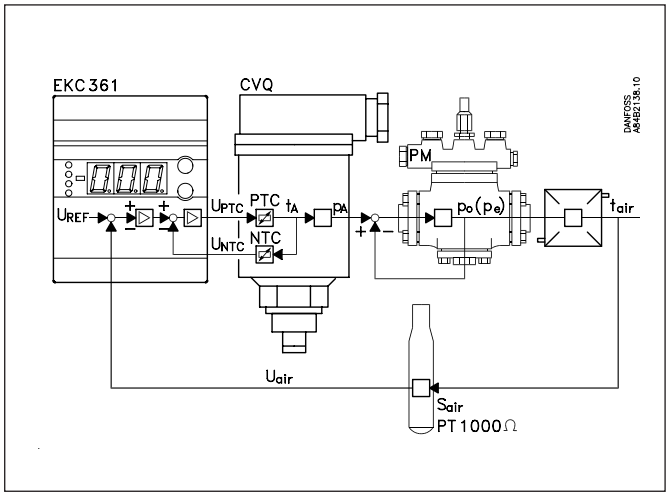


High air humidity
As the evaporating temperature is constantly adapted to the refrigeration needs and will always be as high as possible with a very small temperature fluctuation, the relative air humidity in the room will be kept at a maximum.
Drying-out of the products will in this way be reduced to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

Temperature is quickly attained
With the built-in PID control and the possibility of choosing between three transient phenomena, the controller can be adapted to a kind of temperature performance that is optimum for this particular refrigerating plant. See parameter (n07).
- **Fastest** possible cooling
- Cooling with **less** underswing
- Cooling where underswing is **unwanted.**



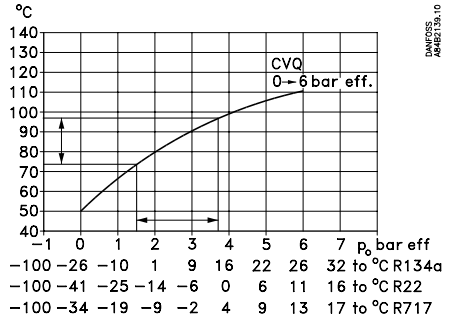
Regulation ICS / PM with CVQ
The controller receives signals from room sensor S_{air}. This room sensor must be placed at the air outlet from the evaporator to obtain the best possible regulation. The controller sees to it that the required room temperature is maintained.
Built-in between the controller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



Evaporating pressure limitation (p_0 limitation)
The inner control loop mentioned above also causes the evaporating pressure to stay within a fixed limit. In this way the system is safeguarded against a too low supply air temperature.
It offers the following advantages:
- High-temperature systems can be connected to low-temperature compressor units
- Protection against icing on evaporator
- Frost protection of liquid coolers

The allowed temperature in the actuator determines the evaporating pressure

Actuator temperature



Regulation with ICM
When using ICM as selected valve the system will still control ICM in order to maintain S_{air} according to entered setpoint.
This system does not include any inner control loop.
It is a direct operating and pressure independent valve for controlling media temperature. (S_{air}).

Survey of functions

Function	Para-meter	Parameter by operation via data com-munication
Normal display		

Normally S_{air} (017=Air) will be shown as running display value. If lower button is activated S_{aux} will be displayed for 5 sec, and then return to S_{air}
 	
If (017=Au) S_{aux} will be shown as running display value. If lower button is activated S_{air} will be displayed for 5 sec, and then return to S_{aux}
 	
If ICM has been selected (n03=6)
If (017=Air) S_{air} (017=Air) will be shown as running display value. If lower button is activated OD (u24) will be displayed for 5 sec, and then return to S_{air}.
If (017=Au) OD (u24) will be shown as running display value. If lower button is activated S_{air} will be displayed for 5 sec, and then return to OD (u24)
		Air temp.

Reference		
Setpoint Regulation is performed based on the set value provided that there is no external contribution (o10). (Push both buttons simultaneously to set the setpoint).	–	SP Temp.
Temperature unit Here you select whether the controller is to indicate the temperature values in °C or in °F. If indication in °F is selected, other temperature settings will also change over to Fahrenheit, either as absolute values or as delta values.	r05	Temp unit °C=0, °F=1 (In AKM only °C is displayed whatever the setting)
External contribution to the setpoint This setting determines how large a contribution (in °C / °F) is to be added to the set setpoint when the input signal is max. (20 mA).	r06	Ext. Ref.off set (°C / °F)
Correction of signal from S_{air} (Compensation possibility through long sensor cable).	r09	Adjust S_{Air} (°C / °F)
Correction of signal from S_{aux} (Compensation possibility through long sensor cable).	r10	Adjust S_{Aux} (°C / °F)
Start / stop of refrigeration With this setting refrigeration can be started and stopped. Start / stop of refrigeration can also be accomplished with the external switch function. See also appendix 1.	r12	Main Switch
Alarm		
The controller can give alarm in different situations. When there is an alarm all the light-emitting diodes (LED) will flash on the controller front panel, and the alarm relay will cut in.		
Alarm for upper deviation The alarm for too high S_{air} temperature is set here. The value is set in Kelvin. The alarm becomes active when the S_{air} temperature exceeds the actual reference plus A01. (The actual reference (SP + r06) can be seen in u02).	A01	Upper deviation
Alarm for lower deviation The alarm for too low S_{air} temperature is set here. The value is set in Kelvin. The alarm becomes active when the S_{air} temperature drops below the actual reference minus A02. If a low temperature alarm is detected (A2 alarm) the solenoid valve in the liquid line (Digital output on terminal 9 and 10) will be closed	A02	Lower deviation
Alarm delay If one of the two limit values is exceeded, a timer function will commence. The alarm will not become active until the set time delay has been passed. The time delay is set in minutes.	A03	Temp alarm delay
		With data communication the importance of the individual alarms can be defined. Setting is carried out in the "Alarm destinations" menu. See also page 34.
Control parameters		
Actuator's max. temperature Set the temperature (°C) the actuator is to have at the limit of the regulating range. The setting ensures that the actuator will not become superheated and work itself away from the regulating range. Due to tolerances in the actuator the value must be set 10K higher than indicated in the curves on page 35.	n01	Q-max. temp.
Actuator's min. temperature Set the temperature (°C) the actuator will have at the limit of the regulating range. The setting ensures that the actuator will not become too cold and work itself away from the regulating range. Due to tolerances in the actuator the value must be set 10K lower than indicated in the curves on page 35.	n02	Q-min. temp.

Actuator type Here you define the actuator mounted in the system: 1: CVQ -1 – 5 bar 2: CVQ 0 – 6 bar 3: CVQ 1.7 – 8 bar 4: CVMQ 5: KVQ 6: ICM	n03	Valve type
P: Amplification factor Kp If the Kp value is reduced the regulation becomes slower.	n04	Kp factor
I: Integration time Tn The I-setting can be cancelled by setting the value to max. (600s). If it is set to 600s, parameter n07 must be set to "0". (If the Tn value is increased the regulation becomes slower).	n05	Tn sec.
D: Differentiation time Td The D-setting can be cancelled by setting the value to min. (0).	n06	Td sec.
Transient phenomenon If the refrigeration requires a very fast transient phenomenon or must not have an underswing or temperature shift, this function can be used. (see page 28) 0: Ordinary regulating technique 1: Fast building-up where a minor underswing is allowed 2: Not quite so fast building-up, but without underswing	n07	Q-ctrl. mode
OD - Opening degree Max. Limitation - ICM only When ICM has been selected (n03=6) the Maximum OD can be entered. ICM will never go above this value. (If n32=n33, ICM is forced to this value)	n32	ICM OD Max.
OD - Opening degree Min. Limitation - ICM only When ICM has been selected (n03=6) the Minimum OD can be entered. ICM will never go below this value. (If n32=n33, ICM is forced to this value)	n33	ICM OD Min.
Miscellaneous		

Output signal
The controller can transmit a current signal via the analog output (terminal 2 and 5). Range of current signal can be selected below:
If (017=Air) S_{air} will send out to the analog output.
If (017=Au) S_{aux} will send out to the analog output
S_{air} / S_{aux} min. value (0 or 4 mA) will correspond to the setting in "o27"
S_{air} / S_{aux} max. value (20 mA) will correspond to the setting in "o28"
 	
If ICM has been selected (n03=6)
OD (u24) to control ICM, is send out to the analog output
(o27) and (o28) is not active
 	
Range for current signal:
0: No output signal
1: 4 – 20 mA
2: 0 – 20 mA
	o09	AO type

Input signal If you wish to connect a signal that is to displace the controller's control reference, the signal must be defined in this menu. 0: No signal 1: 4 – 20 mA 2: 0 – 20 mA (4 or 0 mA will not give a displacement. 20 mA will displace the reference by the value set in menu r06).	o10	AI type
Data communication 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 AN234886440486		Following installation of a data communication module, the controller can be operated on a par with the other controllers in ADAP-KOOL® refrigeration controls.
The address is set between 1 and 60	o03	-
The address is sent to the gateway when the menu is set in pos. ON (The setting will automatically change back to Off after a few seconds.)	o04	-
Language This setting is only required if data communication is connected to the controller. Settings: 0=English, 1=German, 2=French, 3=Danish, 4=Spanish and 6=Swedish When the controller is operated via data communication, the texts in the right-hand column will be shown in the selected language. When you change the setting to an other language you must activate o04 before "the new language" can be visible from the AKM program.	o11	Language
Frequency Set the net frequency.	o12	50 / 60 Hz (50=0, 60=1)

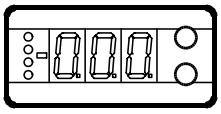
Selection of running display value
If S_{air} (017=Air) will be shown as running display value. If lower button is activated S_{aux} will be displayed for 5 sec, and then return to S_{air}
S_{air} will send out to the analog output. See also (o09),(o27),(o28)
 	
If (017=Au) S_{aux} will be shown as running display value. If lower button is activated S_{air} will be displayed for 5 sec, and then return to S_{aux}
S_{aux} will send out to the analog output. See also (o09),(o27),(o28)
 	
If ICM has been selected (n03=6)
If (017=Air) S_{air} (017=Air) will be shown as running display value. If lower button is activated OD (u24) will be displayed for 5 sec, and then return to S_{air}
 	
If (017=Au) OD (u24) will be shown as running display value. If lower button is activated S_{air} will be displayed for 5 sec, and then return to OD (u24)
	o17	Display Aux / Air
		Aux =0
		Air = 1

(Setting for the function o09) Set the temperature value where the output signal must be minimum (0 or 4 mA)	o27	Temp. at AO min.
(Setting for the function o09) Set the temperature value where the output signal must be maximum (20 mA). (With a temperature range of 50 °C (differential between the settings in o27 and o28) the dissolution will be better than 0.1 °C. With 100°C the dissolution wil be better than 0.2 °C.)	o28	Temp. at AO max.
Service		
A number of controller values can be printed for use in a service situation		
Read the temperature at the S_{air} sensor (calibrated value)	u01	Air temp.
Read the control reference (Setpoint + any contribution from external signal)	u02	Air reference
Read temperature at the S_{aux} sensor (calibrated value) (This showing can also be uploaded from the normal display, if you push the lowermost button for almost a second)	u03	Aux. temp.
Read valve's actuator temperature	u04	Actuator temp.
Read reference for valve's actuator temperature	u05	Actuator Ref.
Read value of external current signal	u06	AI mA
Read value of transmitted current signal	u08	AO mA
Read status of input DI (start / stop input)	u10	DI
ICM opening degree. Only active if (n03)=6	u24	OD%
	--	DO1 Alarm Read status of alarm relay
	--	DO2 Cooling Read status of relay for solenoid valve
	--	DO3 Fan Read status of relay for fan
Operating status		
Operating status of the controller can be called forth in the display. Push briefly (1s) the upper button. If there is a status code, it will be shown on the display. (Status codes have lower priority than alarm codes. In other words, you cannot see a status code, if there is an active alarm). The individual status codes have the following meanings:		EKC State (0 = regulation)
S10: Refrigeration stopped by the internal or external start / stop		10
S12: Refrigeration stopped due to low S_{air}		12

Operation

Display

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



Light-emitting diodes (LED) on front panel

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

The controller can give the following messages:		
E1	**Error message**	Errors in the controller
E7		Cut-out S_{air}
E8		Short circuited S_{air}
E11		Valve's actuator temperature outside its range
E12		Analog input signal is outside the range
A1	**Alarm message**	High-temperature alarm
A2		Low-temperature alarm

The buttons

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

Gives access to the menu (or cutout an alarm)

Gives access to changes

Saves a change

Examples of operations

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

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

Menu survey

SW =1.5x

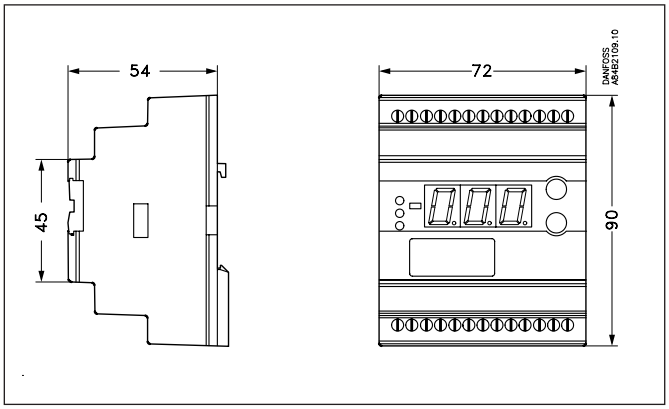
Function	Para-meter	Min.	Max.	Fac. setting
Normal display				
Shows the temperature at the selected sensor At ICM valve OD also can be selected	-		°C	
Reference				
Set the required room temperature	-	-70 °C	160 °C	10 °C
Temperature unit	r05	°C	°F	°C
Input signal's temperature influence	r06	-50 °C	50 °C	0.0
Correction of the signal from S_{air}	r09	-10,0 °C	10,0 °C	0.0
Correction of the signal from S_{aux}	r10	-10,0 °C	10,0 °C	0.0
Start / stop of refrigeration	r12	OFF / 0	On / 1	On / 1
Alarm				
Upper deviation (above the temperature setting)	A01	0	50 K	5.0
Lower deviation (below the temperature setting)	A02	0	50 K	5.0
Alarm's time delay	A03	0	180 min	30
Regulating parameters				
Actuator max. temperature	n01	41 °C	140 °C	140
Actuator min. temperature	n02	40 °C	139 °C	40
Actuator type (1=CVQ-1 to 5 bar, 2=CVQ 0 to 6 bar, 3=CVQ 1.7 to 8 bar, 4= CVMQ, 5=KVQ, 6= ICM)	n03	1	6	2
P: Amplification factor Kp	n04	0,5	50	3
I: Integration time Tn (600 = off)	n05	60 s	600 s	240
D: Differentiation time Td (0 = off)	n06	0 s	60 s	10
Transient phenomenon 0: Ordinary control 1: Underswing minimised 2: No underswing	n07	0	2	2
OD - Opening degree - max. limit - ICM only	n32	0%	100%	100
OD - Opening degree min limit - ICM only	n33	0%	100%	0
Miscellaneous				
Controller's address (0-120)	o03*	0	990	0
ON / OFF switch (service-pin message)	o04*	-	-	
Define output signal of analog output: 0: no signal, 1: 4 - 20 mA, 2: 0 - 20 mA	o09	0	2	0
Define input signal of analog input 0: no signal, 1: 4 - 20 mA, 2: 0 - 20 mA	o10	0	2	0
Language (0=english, 1=German, 2=French, 3=Danish, 4=Spanish and 6=Swedish.)When you change the setting to an other language you must activate o04 before "the new language" can be visible from the AKM program.	011*	0	6	0
Set supply voltage frequency	o12	50 Hz / 0	60 Hz / 1	0
Select of running display value	o17	Au / 0	Air / 1	Air / 1
(Setting for the function o09) Set the temperature value where the output signal must be minimum (0 or 4 mA)	o27	-70 °C	160 °C	-35
(Setting for the function o09) Set the temperature value where the output signal must be maximum (20 mA)	o28	-70 °C	160 °C	15
Service				
Read temperature at the S_{air} sensor	u01		°C	
Read regulation reference	u02		°C	
Read temperature at the S_{aux} sensor	u03		°C	
Read valve's actuator temperature	u04		°C	
Read reference of the valve's actuator temperature	u05		°C	
Read value of external current signal	u06		mA	
Read value of transmitted current signal	u08		mA	
Read status of input DI	u10		on / off	
ICM opening degree. (only at ICM)	u24		%	

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

Factory setting
If you need to return to the factory-set values, it can be done in this way:
- Cut out the supply voltage to the controller
- Keep both buttons depressed at the same time as you reconnect the supply voltage

Data

Supply voltage	24 V AC ±15% 50 / 60 Hz, 80 VA (the supply voltage is galvanically separated from the input and output signals)	
Power consumption	Controller Actuator	5 VA 75 VA
Input signal	Current signal	4 – 20 mA or 0 – 20 mA
	Digital input from external contact function	
Sensor input	2 pcs. Pt 1000 ohm	
Output signal	Current signal	4-20 mA or 0 – 20 mA Max. load: 200 ohm
Relay output	2 pcs. SPST	AC-1: 4 A (ohmic) AC-15: 3 A (inductive)
Alarm relay	1 pcs. SPST	
Actuator	Input	Temperature signal from sensor in the actuator
	Output	Pulsating 24 V AC to actuator
Data communication	Possible to connect a data communication module	
Ambient temperature	During operation During transport	-10 – 55 °C -40 – 70 °C
Enclosure	IP 20	
Weight	300 g	
Mounting	DIN rail	
Display	LED, 3 digits	
Terminals	max. 2.5 mm² multicore	
Approvals	EU Low Voltage Directive and EMC demands re CE-marking complied with. LVD-tested acc. to EN 60730-1 and EN 60730-2-9 EMC-tested acc. to EN50081-1 and EN 50082-2	



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.

Ordering

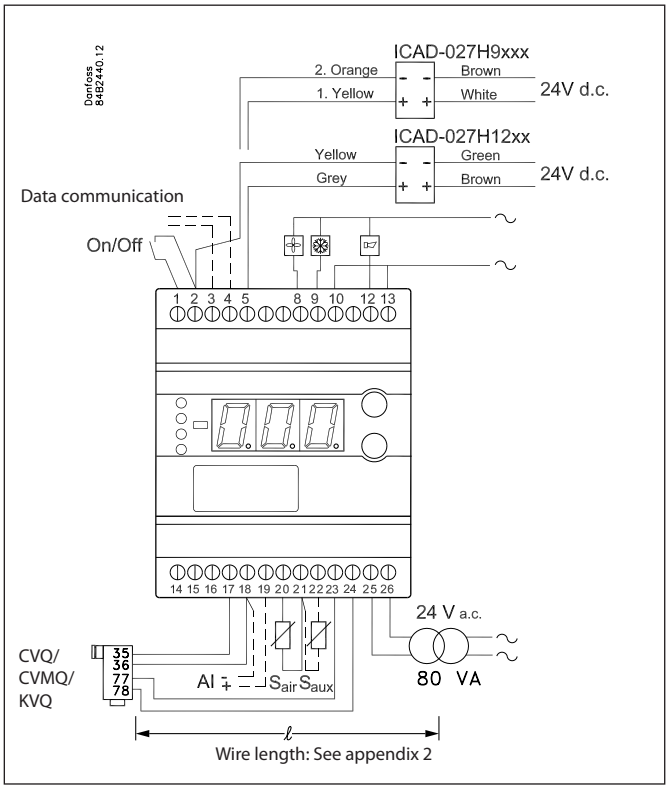
Type	Function	Code No.
EKC 361	Evaporating pressure controller	**084B7060**
EKA 174	Data communication module (accessories), (RS 485 module) with galvanic separation	**084B7124**

Temperature sensor Pt 1000 ohm: Kindly refer to catalogue AF151486422482
Valves: AI236186442940

Connections

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

Application dependent connections
Terminal:
12 – 13 Alarm relay
There is connection between 12 and 13 in alarm situations and when the controller is dead
8 – 10 Relay switch for start / stop of fan
9 – 10 Relay switch for start / stop of solenoid valves
18 – 19 Current signal from other regulation (Ext.Ref.)
21 – 22 Pt 1000 sensor for monitoring
2 – 5 Current output for S_{air} / S_{aux} temperature or ICAD actuator for ICM valve
3 – 4 Data communication
Mount only, if a data communication module has been mounted.
It is important that the installation of the data communication cable be done correctly. Cf. separate literature No. AN234886440486

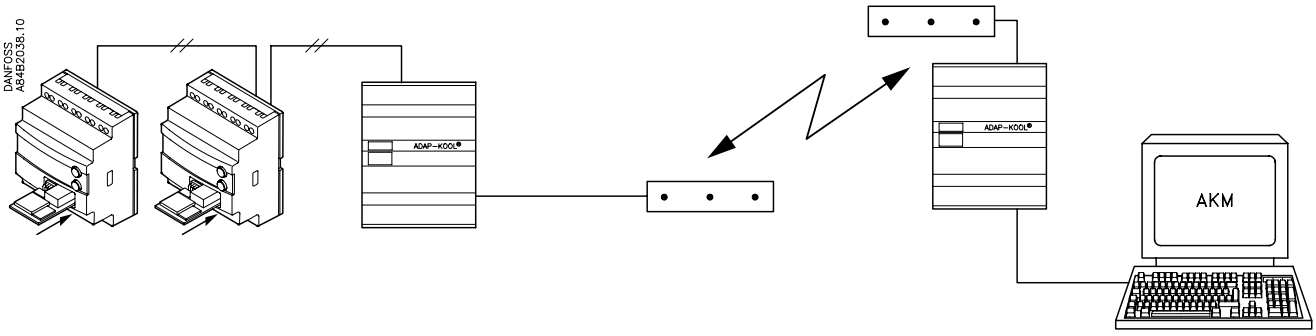


Data communication

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

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

Examples



Each controller is provided with a plug-in module.

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

The cable can be connected to a gateway type AKA 245.

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

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

The gateway can now be connected to a modem.

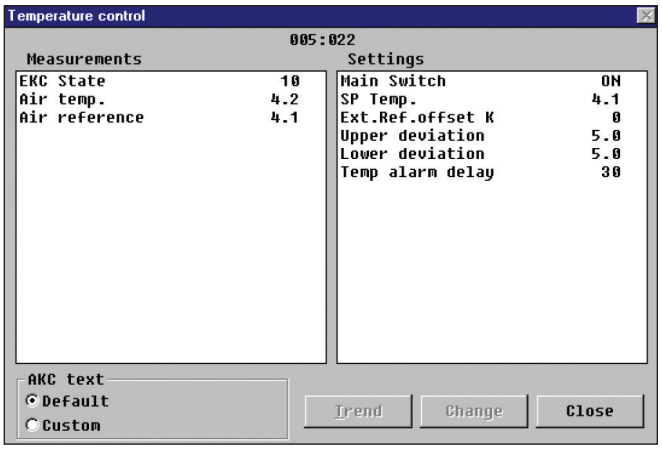
When an alarm occurs from one of the controllers, the gateway will - via the modem - make a phone call to the service company.

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

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

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

Example of menu display



- Measurements are shown at one side and settings at the other.
- You will also be able to see the parameter names of the functions on page 29 – 31.
- With a simple change-over the values can also be shown in a trend diagram.
- If you wish to check earlier temperature measurements, you can see them in the log collection.

Alarms

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

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

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

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

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

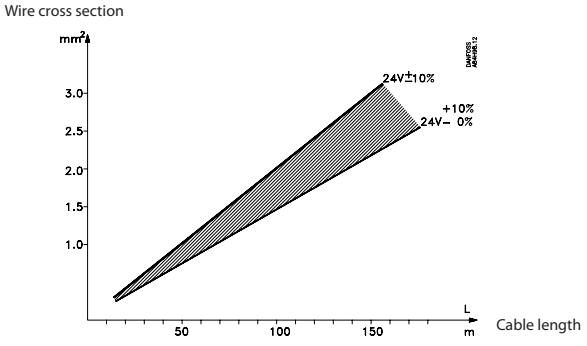
Appendix 1

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

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

Appendix 2

Cable length for the CVQ actuator
The actuator must be supplied with 24 V AC ±10%.
To avoid excessive voltage loss in the cable to the actuator, use a thicker cable for large distances.



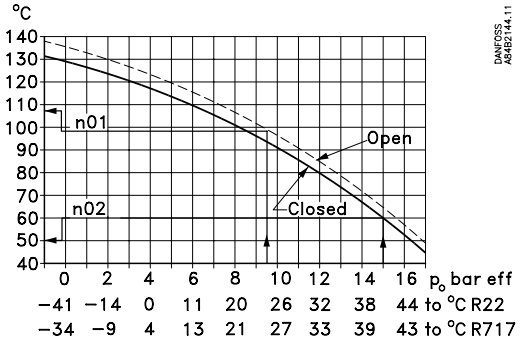
Appendix 3

Connection between the evaporating temperature and the actuator's temperature (the values are approximate).

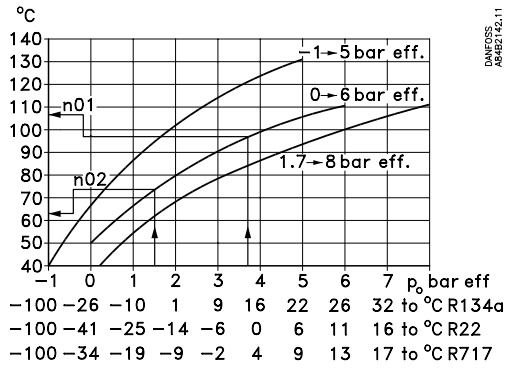
n01: The highest regulated room temperature will have a belonging t_o value which in turn indicates the value of the n01 setting. Due to tolerances in the actuator, the setting value must be 10 K **higher** than shown in the curve.

n02: The lowest occurring suction pressure will have a belonging t_o value which in turn indicates the value of the n02 setting. Due to tolerances in the actuator, the setting value must be 10 K **lower** than shown in the curve.

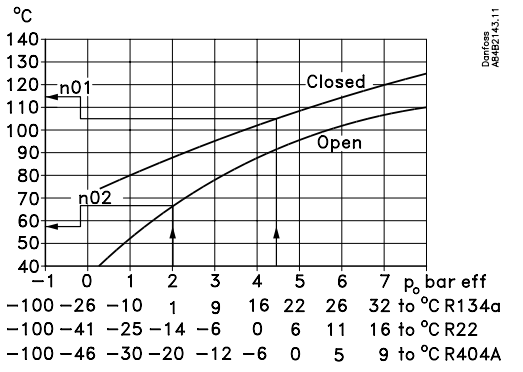
CVMQ



CVQ



KVQ



Start of controller

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

1. Switch off the external ON / OFF switch that starts and stops the regulation.
2. Follow the menu survey on page 32, and set the various parameters to the required values.
3. Switch on the external ON / OFF switch, and regulation will start.
4. If the system has been fitted with a thermostatic expansion valve, it must be set to minimum stable superheating. (If a specific T0 is required for the adjustment of the expansion valve, the two setting values for the actuator temperature (n01 and n02) can be set to the belonging value while the adjustment of the expansion valve is carried out. Remember to reset the values).
5. Follow the actual room temperature on the display. (On terminals 2 and 5 a current signal can be transmitted which represents the room temperature. Connect a data collection unit, if applicable, so that the temperature performance can be followed).

If the temperature fluctuates

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

If the time of oscillation is longer than the integration time:
($T_p > T_n$, (T_n is, say, 4 minutes))
1. Increase T_n to 1.2 times T_p
2. Wait until the system is in balance again
3. If there is still oscillation, reduce K_p by, say, 20%
4. Wait until the system is in balance
5. If it continues to oscillate, repeat 3 and 4

If the time of oscillation is shorter than the integration time:
($T_p < T_n$, (T_n is, say, 4 minutes))
1. Reduce K_p by, say, 20% of the scale reading
2. Wait until the system is in balance
3. If it continues to oscillate, repeat 1 and 2

Trouble shooting - ICS / PM with CVQ

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

Symptom	Defect	Confirmation of defect
Media temperature too low. Actuator feels cold.	Short-circuited NTC resistor in actuator.	If less than 100 ohm is measured across terminals 17 and 18 (disassemble the lead), the NTC or the leads are short-circuited. Check the leads.
	Defective PTC resistor (heating element) in actuator.	If more than 30 ohm or 0 ohm is measured across terminal 23 and 24 (disassemble the lead), either the PTC or the leads are defective. Check the leads.
Media temperature too low. Actuator fells warm.	Undersized cable to CVQ.	Measure voltage across terminals 77 and 78 (min. 18 V AC). Measure resistance in power cables to CVQ (max. 2 ohm)
	Undersized 24 V transformer.	Measure voltage across transformer output terminals (24 V AC +10 / -15%) under all working conditions. If voltage drops under some working conditions the transformer is undersized.
	Loss of charge in actuator.	Replace actuator.
Media temperature too high. Actuator feels cold.	Fault in refrigerant plant.	Examine plant for ther defects.
Media temperature too high. Actuator feels warm.	Cut out NTC resistor in actuator.	If more than 200 kohm is measured across terminals 17 and 18 (disassemble the lead), either the NTC or leads are disconnected. Check the leads.

Fine adjustments

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

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

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

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

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

1. The system is made to regulate the temperature at the required reference with a typical load. It is important that the valve regulates, and that it is not fully open.
2. Parameter u05 is read. The actuator's min. and max. setting is adjusted, so that the average of the min. and max. values is equal to the read u05.
3. The controller is set, so that it will regulate as a P-controller. (Td is set to 0, Tn in pos. OFF (600), and Q-Ctrl.mode is set at 0).
4. The stability of the system is examined by stopping the system for, say, one minute (using the start / stop setting or the switch). Now check how the building-up of the temperature proceeds. If the building-up peters out, raise Kp a little and repeat the start / stop operation. Continue with this until you obtain a building-up which does **not** peter out.
5. Kp is in this case the critical amplification ($Kp_{critical}$) and the building-up time for the continued oscillation is the critical building-up time ($T_{critical}$).
6. Based on these values, the regulating parameters can now be calculated and subsequently set:
   - If PID regulation is required:
     $Kp < 0.6x\ Kp_{critical}$
     $Tn > 0.5x\ T_{critical}$
     $Td < 0.12x\ T_{critical}$
   - If PI regulation is required:
     $Kp < 0.45x\ Kp_{critical}$
     $Tn > 0.85x\ T_{critical}$
7. Reset the values for the controller's min. and max. temperatures and Q-Ctrl.mode.

ENGINEERING
TOMORROW

Interface
EKC 366

Contents **Page**

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ENGINEERING
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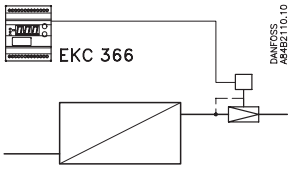
Interface
EKC 366

The controller is used for regulating a valve in a refrigerating system - for example in connection with:

- Long-term storage of fruits and vegetables
- Refrigerating plant
- Brewery systems
- Processing plant

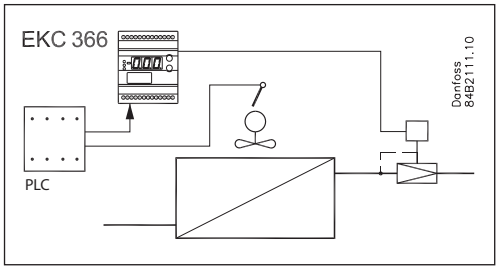


Application

Here the controller has been specially designed for the following functions:

Maintenance of a constant evaporating pressure
A temperature sensor in the valve's actuator will regulate its temperature. This temperature is an indication of the pressure in the valve, and the interface module will keep this temperature constant.

The media temperature is regulated by a PLC or similar device
Here the interface module receives a variable signal from the PLC and will subsequently regulate the valve, so that the refrigeration will be as accurate as possible.



System

The controller must always be used in conjunction with a pilot valve of the types shown here.
The most commonly used one is pilot valve CVQ in conjunction with main valve PM3 (sketched out above).

Valve types:
- CVQ + PM
- KVQ
- TQ
- PHTQ
- TEAQ
- CVMQ

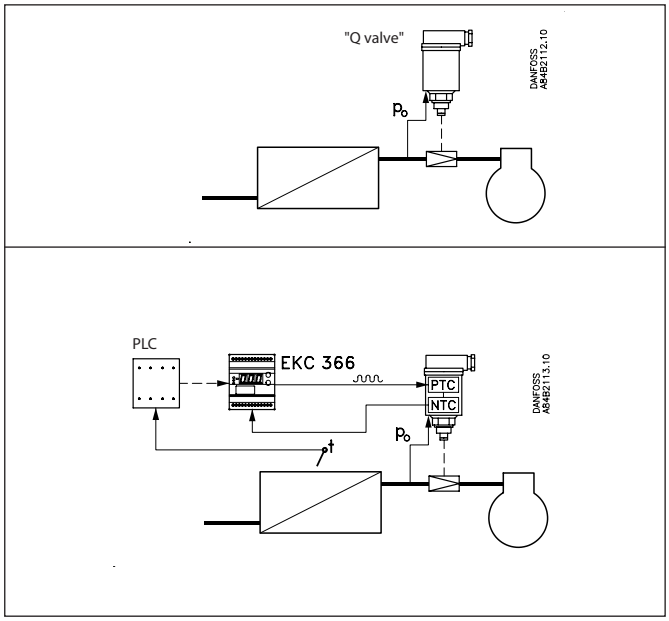
Function

The valve constantly receives feedback of the pressure in the evaporator. Whatever the variations in the suction pressure from the compressor, this feedback will produce the result that the evaporating pressure is kept constant.

In conjunction with the controller, an electronic constant-pressure valve is thus obtained.

Inserted between the controller and the actuator is a so-called inner regulating loop. This loop will - via an NTC resistance - constantly control the temperature in the actuator.

In an application where a PLC or similar device is used for regulating a media temperature, the regulating system will in this way be supplied with an outer regulating loop - which will result in great regulating accuracy.



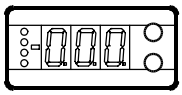
Survey of functions

Function	Para-meter	Parameter by operation via data communication
Temperature **regulation**		**Actuator temperature**
Display of valve temperature The display constantly shows the valve's temperature. The display is filtered over a period of approx. 10 seconds	–	Actuator temp.
Valve's basic temperature reference This temperature setting is the valve's basic setting. At this value no signal must be received from an external regulation. The setting value is taken from one of the curves shown and may be fine-adjusted later when the valve has reached the temperature (read the manometer in the system). (Push both buttons simultaneously to set the menu)	–	SP Temp.
Temperature **uni**t Set here whether the controller is to show the temperature values in °C or in °F. If indication in °F is selected, other temperature settings will also change over to Fahrenheit, either as absolute values or as delta values.	r05	Temp. unit (°C=0, °F=1) (In AKM only °C is displayed, whatever the setting).
Input signal's temperature influence This setting determines how much the input signal has to raise the temperature in the valve. You should aim at selecting the value, so that the valve can close at the highest occurring evaporating pressure when the input signal is maximum (value to be set in Kelvin)	r06	Ext.Ref.offset K
Reference The valve's temperature is regulated on the basis of the basic setting plus the signal from the external regulation. (Reference = SP Temp + percentage of "r06".) The reference can be seen when you push the lower of the two buttons	–	Actuator Ref.
Sundry configurations		**Miscellaneous**
External signal Here you set the signal that is to be connected to the controller. 0: no signal 1: 4 – 20 mA 2: 0 – 20 mA 3: 0 – 10 V 4: 2 – 10 V	o10	AI Type
Frequency Set network frequency	o12	50 / 60 Hz (50=0, 60=1)
Data communication 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 AN234886440486		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	
Language This setting is only required when data communication is connected to the controller. Settings: 0=English, 1=German, 2=French, 3=Danish, 4=Spanish, and 6= Swedish When the controller is operated via data communication, the texts in the right-hand column will be shown in the selected language. When you change the setting to an other language you must activate o04 before "the new language" can be visible from the AKM program.	o11	Language
Service		
The signal will be constantly updated. If you wish to follow the signal beyond the 20 seconds, the time-out period, push one of the two buttons before the time-out period expires		
External current signal Here you can read the value of the current signal received by the controller at its input	u06	AI mA
External voltage signal Here you can read the value of the voltage signal received by the controller at its input	u07	AI Volt

Operation

Display

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



LED's on the front panel

There is one LED on the front panel which will light up when power is sent to the pilot valve.

There are furthermore three LED's which will flash if there is an error in the regulation. In this situation you can show the error code on the display and cut out the alarm by giving the upper button a brief push.

The controller can give the following messages:	
E1	Errors in the controller
E11	Valve's actuator temperature outside its range
E12	Input signal outside its range

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

Gives access to changes

Saves a change

Examples of operations

Set the valve's basic temperature reference
1. Push the two buttons simultaneously
2. Push one of the buttons and select the new value
3. Push both buttons again to conclude the setting

Read the valve's regulating reference
1. Push the lower button
   (After approx. 20 seconds the controller automatically returns to its setting, and it again shows the valve's actual temperature)

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

Menu survey

SW =1.2x

Function	Para-meter	Min.	Max.
Read valve's actual temperature (standard display)	-		°C
Set valve's basic temperature reference	-	40.0 °C	140 °C
Read valve's regulation reference	-		°C
Select temperature unit (°C / °F)	r05	°C	°F
Input signal's temperature influence	r06	-99.9 K	99.9 K
Controller's address	o03*	1	60
ON / OFF switch (service-pin message)	o04*	-	-
Define input signal 0: no signal 1: 4 – 20 mA 2: 0 – 20 mA 3: 0 – 10 V 4: 2 – 10 V	o10	0	4
Language (0=English, 1=German, 2=french, 3=Danish, 4=Spanish, 6=Swedish). When you change this setting you must also activate o04.	011*	0	6
Set supply voltage frequency	o12	50 Hz	60 Hz
Service information			
Read value of external current signal	u06		mA
Read value of external voltage signal	u07		V

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

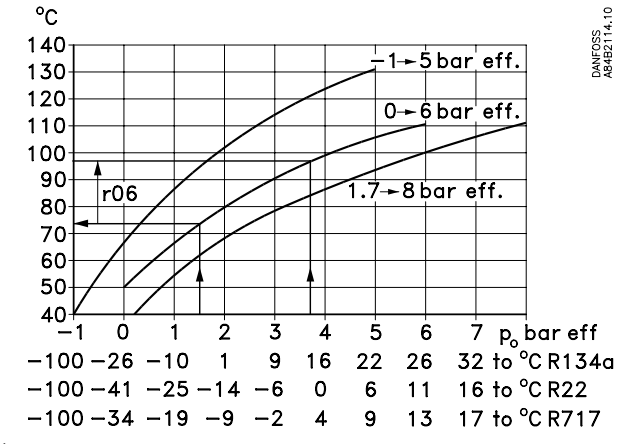
Factory setting
If you need to return to the factory-set values, it can be done in this way:
- Cut out the supply voltage to the controller
- Keep both buttons depressed at the same time as you reconnect the supply voltage

Valve's working temperature

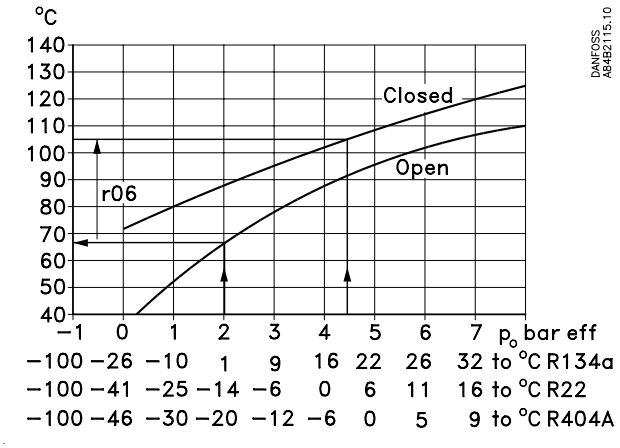
Without external signal
The working temperature must be set on the basis of one of the following curves. Find the actuator temperature corresponding to the required evaporating temperature (push). Set the value in the controller as mentioned under "Set the valve's basic temperature reference".

With external signal
If the valve is to be operated with an external signal, two settings have to be made. One is as mentioned to the left, and the other determines how much the signal must be able to raise the temperature in the valve. This value is also read on one of the following curves.
Set the value in the r06 menu.
If the set value is too low, the valve will not be able to close / open fully.

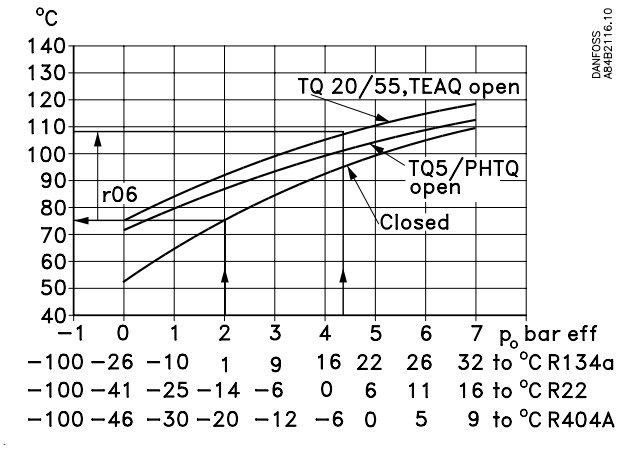
CVQ



KVQ

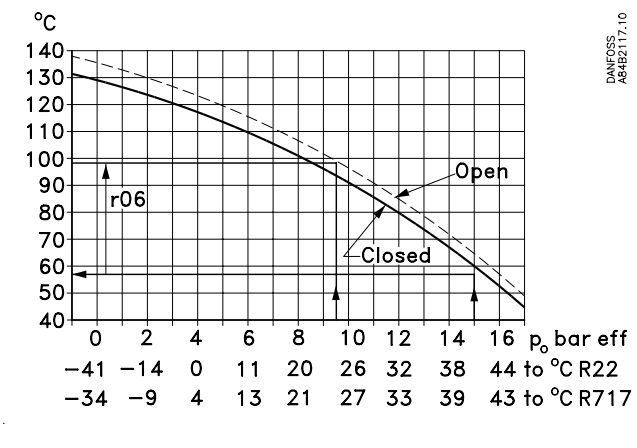


TQ



All the curves shown are approximate.

CVMQ



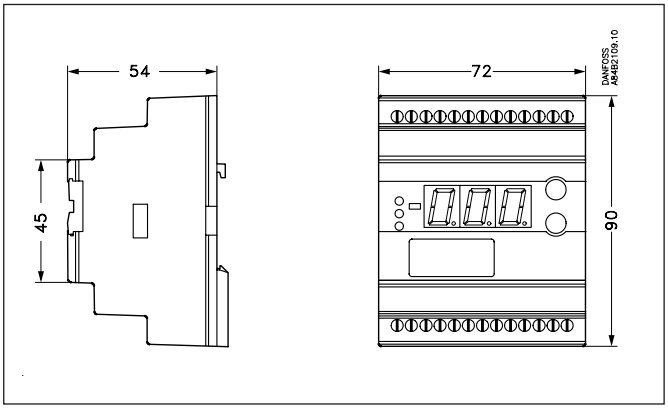
The two curves are shown with the valve's spring setting equal-ling the factory setting. If the spring setting is changed to a higher pressure, the curve will be displaced correspondingly to a higher temperature.

Example
CVQ type = 0 – 6 bar
Refrigerant = R_{717}
A constant evaporating temperature or input pressure to the valve of -9 °C (2 bar) is required.
According to the CVQ curve this will require a temperature in the actuator of 80 °C.
Set the valve's basic temperature reference at 80 °C.

When the valve has reached its working temperature, it may be necessary to fine-adjust the setting from the system's manometer.

Data

Supply voltage	24 V AC ±15% 50 / 60 Hz, 80 VA (the supply voltage is galvanically separated from the input and output signals)	
Power consumption	Controller Valve	5 VA 75 VA
Input signal	4 – 20 mA, 0 – 20 mA, 0 – 10V DC or 2 – 10 V DC	
Actuator	Input	Temperature signal from sensor in actuator
	Output	Pulsating 24 V AC to actuator
Data communication	Possible to connect a data communication module	
Ambient temperature	During operation During transport	-10 – 55°C -40 – 70°C
Enclosure	IP 20	
Weight	300 g	
Mounting	DIN rail	
Display	LED, 3 digits	
Terminals	max. 2.5 mm² multicore	
Approvals	EU Low Voltage Directive and EMC demands re CE-marking complied with. LVD-tested acc. to EN 60730-1 and EN 60730-2-9 EMC-tested acc. to EN 50081-1 and EN 50082-2	



Ordering

Type	Function	Code No.
EKC 366	Interface module	**084B7076**
EKA 174	Data communication module (accessories), (RS 485 module) with galvanic separation	**084B7124**

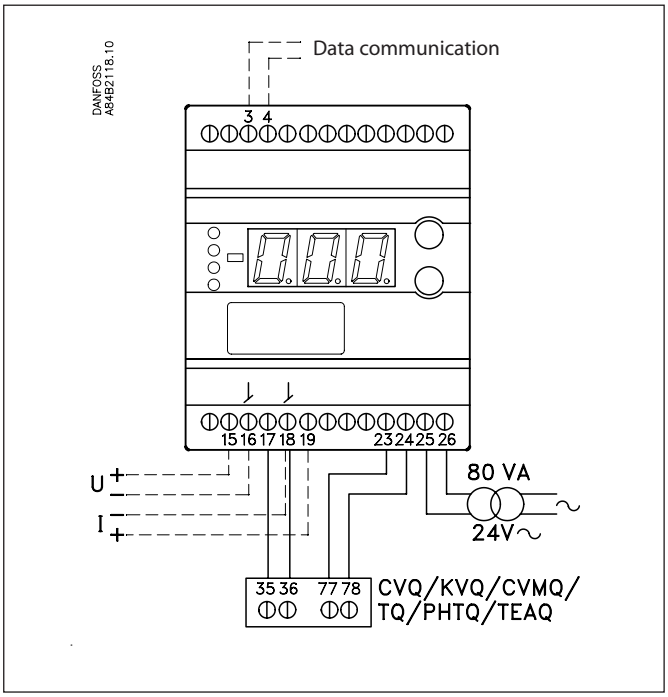
Valves: Kindly refer to catalogue AF151486422482

Connections

Necessary connections
Terminals:
25 – 26 Supply voltage 24 V AC 80 VA
17 – 18 Signal from NTC sensor in valve
23 – 24 Supply to valve's PTC resistance

Control signal, if applicable (see also o10)
Either terminals:
15 – 16 Voltage signal
or
18 – 19 Current signal

Data communication, if applicable
Terminals:
3 – 4 Mount only, if a data communication module has been mounted.
It is important that the installation of the data communication cable be done correctly. Cf. separate literature No. AN234886440486

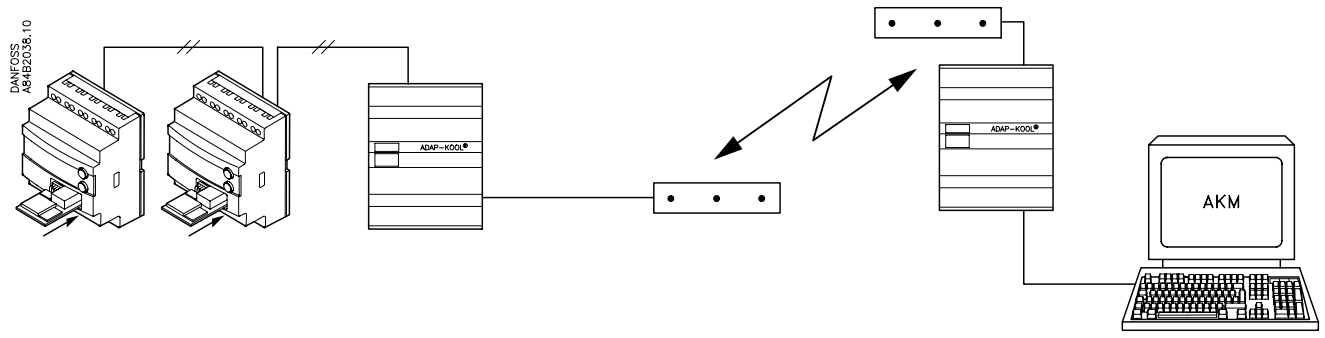


Data communication

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

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

Examples



Each controller is provided with a plug-in module.

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

Up to 60 controllers may be connected to one cable.

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

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

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

The gateway can now be connected to a modem.

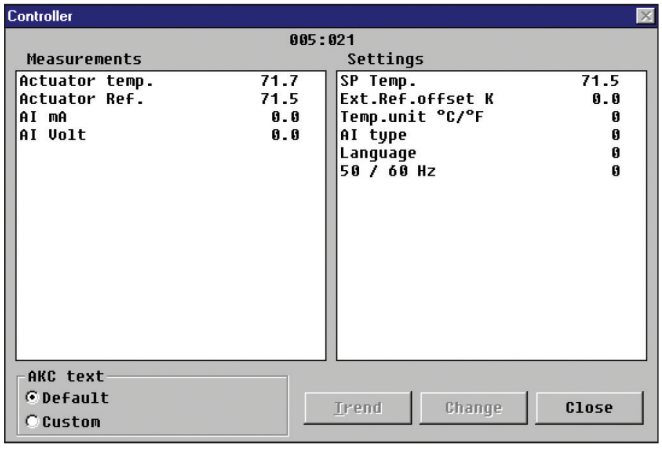
When an alarm occurs from one of the controllers, the gateway will - via the modem - make a phone call to the service company.

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

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

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

Example of menu display



Measurements are shown at one side and settings at the other.

You will also be able to see the parameter names of the functions on page 43.

With a simple change-over the values can also be shown in a trend diagram.

If you prefer to see the earlier temperature measurements, you may upload a 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.

ENGINEERING
TOMORROW

Superheat controller
EKC 315A

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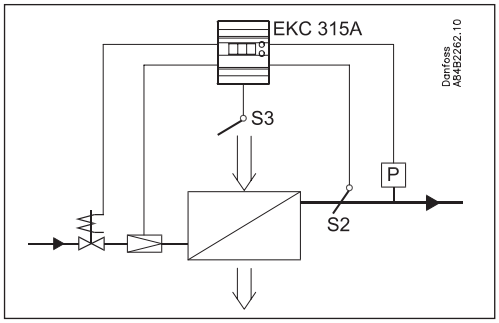
ENGINEERING TOMORROW

Superheat controller
EKC 315A

The controller and valve can be used where there are requirements to accurate control of superheat and temperature in connection with refrigeration.
E.g.:
- Cold store (air coolers)
- Processing plant (water chillers)
- A/C plant

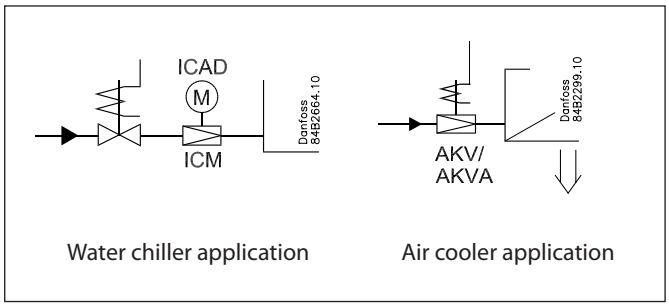
Advantages

- The evaporator is charged optimally – even when there are great variations of load and suction pressure
- Energy savings – the adaptive regulation of the refrigerant injection ensures optimum utilisation of the evaporator and hence a high suction pressure
- Exact temperature control – the combination of adaptive evaporator and temperature control ensures great temperature accuracy for the media
- The superheating is regulated to the lowest possible value at the same time as the media temperature is controlled by the thermostat function



Introduction

Functions
- Regulation of superheat
- Temperature control
- MOP function
- ON / OFF input for start / stop of regulation
- Input signal that can displace the superheat reference or the temperature reference
- Alarm if the set alarm limits are exceeded
- Relay output for solenoid valve
- PID regulation
- Output signal following the temperature showing in the display



Water chiller application | Air cooler application

System
The superheat in the evaporator is controlled by one pressure transmitter P and one temperature sensor S2.
The valve can be one of the following types:
- ICM
- AKV (AKVA)

ICM is an electronically, directly run engine valve, controlled by an ICAD type actuator. It is used with a solenoid valve in the liquid line.
TQ valve
The controller can also control a TQ type valve. This valve has been discontinued from the product range, but the settings are still described in this manual.
AKV is a pulsating valve.
Where the AKV valve is used it also functions as solenoid valve.
Temperature control is performed based on a signal from temperature sensor S3 which is placed in the air current before the evaporator. Temperature control is in the shape of an ON / OFF thermostat that shuts off the liquid flow in the liquid line.

Operation

Superheat function
You may choose between two kinds of superheat, either:
- Adaptive superheat or
- Load-defined superheat

MOP
The MOP function limits the valve's opening degree as long as the evaporating pressure is higher than the set MOP value.

Override function
Via the analog input a displacement can be made of the temperature reference or of the superheat reference. The signal can either be a 0 – 20 mA signal or a 4 – 20 mA signal. The reference can be displaced in positive or negative direction.

External start / stop of regulation
The controller can be started and stopped externally via a contact function connected to input terminals 1 and 2. Regulation is stopped when the connection is interrupted. The function must be used when the compressor is stopped. The controller then closes the solenoid valve so that the evaporator is not charged with refrigerant.

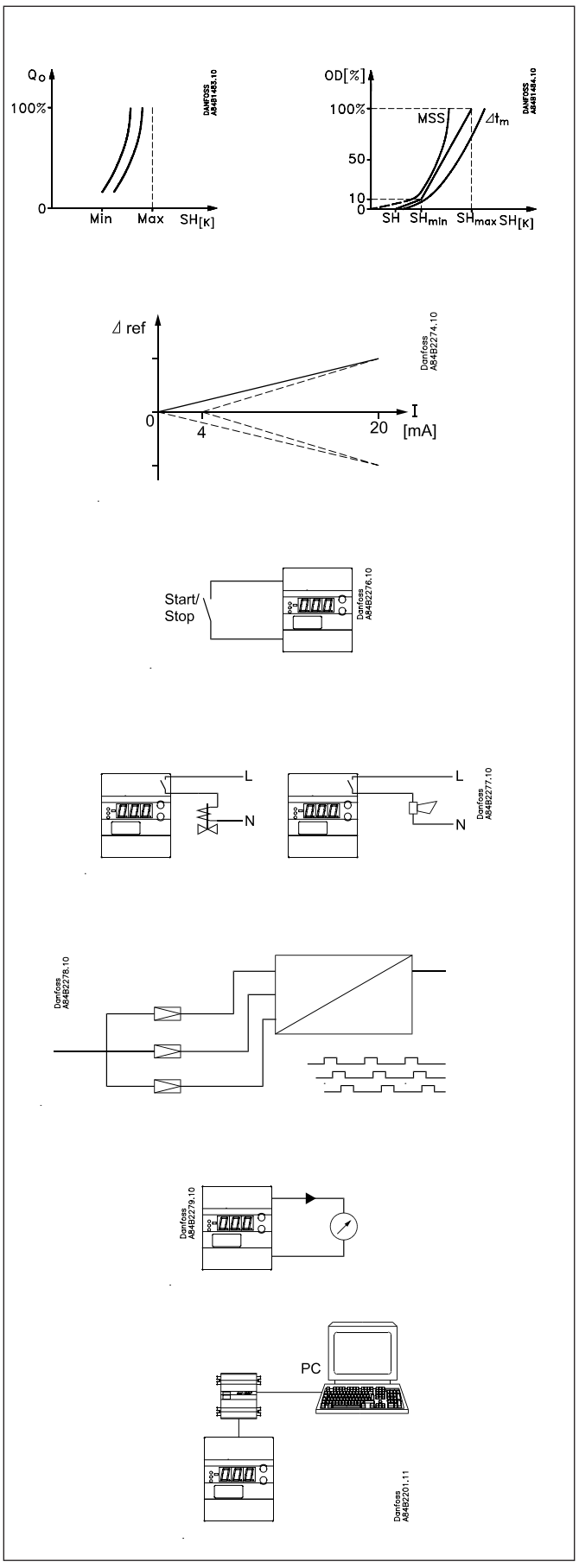
Relays
The relay for the solenoid valve will operate when refrigeration is required. The relay for the alarm function works in such a way that the contact is cut-in in alarm situations and when the controller is de-energised.

Modulating / pulsating expansion valve
In 1:1 systems (one evaporator, one compressor and one condenser) with small refrigerant charge ICM is recommended.

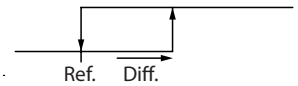
In a system with an AKV valve the capacity can be distributed by up to three valves if slave modules are mounted. The controller will displace the opening time of the AKV valves, so that they will not pulsate at the same time.
Used as slave module is a controller of the type EKC 347.

Analog output
The controller is provided with an analog current output which can be set to either 0 – 20 mA or 4 – 20 mA. The signal will either follow the superheat, opening degree of the valve or the air temperature.
When an ICM valve is in use, the signal is used for control of the valve via the ICAD actuator.

PC operation
The controller can be provided with data communication so that it can be connected to other products in the range of ADAP-KOOL® refrigeration controls. In this way operation, monitoring and data collection can be performed from one PC – either on the spot or in a service company.



Survey of functions

Function	Para-meter	Parameter by operation via data communication
Normal display		
Normally the superheat is shown (but the valve's opening degree or air temperature may also be selected. See o17).		SH / OD% / S3 temp
Reference		
Se point Regulation is performed based on the set value provided that there is no external contribution (o10). (Push both buttons simultaneously to set the setpoint).	-	TempSetpoint.
Differential When the temperature is higher than the reference plus the set differential, the solenoid valve's relay will be activated. It will become deactivated when the temperature drops below the set reference.  	r01	Differential
Unit Here you select whether the controller is to indicate the temperature values in °C or in °F. If indication in °F is selected, other temperature settings will also change over to Fahrenheit, either as absolute values or as delta values The combination of temperature unit and pressure unit is depicted to the right.	r05	Units 0: °C + bar 1: °F + psig (in AKM only °C + bar – is displayed – whatever the setting).
External contribution to the reference This setting determines how large a contribution is to be added to the set setpoint when the input signal is max. (20 mA). See o10.	r06	ExtRefOffset
Correction of signal from S2 (Compensation possibility through long sensor cable).	r09	Adjust S2
Correction of signal from S3 (Compensation possibility through long sensor cable).	r10	Adjust S3
Start / stop of refrigeration With this setting refrigeration can be started and stopped. Start / stop of refrigeration can also be accomplished with the external switch function. See also appendix 1.	r12	Main Switch
Define thermostat function 0: No thermostat function. Only the superheat is regulated 1: Thermostat function as well as regulation of superheat.	r14	Therm. Mode
Alarm		
The controller can give alarm in different situations. When there is an alarm all the light-emitting diodes (LED) will flash on the controller front panel, and the alarm relay will cut in.		
Alarm for upper deviation The alarm for too high S3 temperature is set here. The value is set in Kelvin. The alarm becomes active when the S3 temperature exceeds the actual reference plus A01. (The actual reference can be seen in u28).	A01	Hgh.TempAlrm
Alarm for lower deviation The alarm for too low S3 temperature is set here. The value is set in Kelvin. The alarm becomes active when the S3 temperature drops below the actual reference minus A02.	A02	Low.TempAlrm
Alarm delay If one of the two limit values is exceeded, a timer function will commence. The alarm will not become active until the set time delay has been passed. The time delay is set in minutes.	A03	TempAlrmDel
		With data communication the importance of the individual alarms can be defined. Setting is carried out in the "Alarm destinations" menu.

Control parameters		
P: Amplification factor Kp If the Kp value is reduced the regulation becomes slower.	n04	Kp factor
I: Integration time Tn If the Tn value is increased the regulation becomes slower	n05	Tn sec.
D: Differentiation time Td The D-setting can be cancelled by setting the value to min. (0).)	n06	Td sec.
Max. value for the superheat reference	n09	Max SH
Min. value for the superheat reference Warning! Due to the risk of liquid flow the setting should not be lower than approx. 2 – 4 K.	n10	Min SH
MOP If no MOP function is required, select pos. Off.	n11	MOP (Bar) (A value of 60 bar corresponds to Off)
AKV valve's time period in seconds Should only be set to a lower value if it is a decentralised plant and the suction pressure fluctuates a lot and in line with the opening of the AKV valve.	n13	AKV per. time
Stability factor for regulation of superheat With a higher value the control function will allow a greater fluctuation of the superheat before the reference is changed. The value should only be changed by specially trained staff.	n18	Stability
Damping of amplification near reference value This setting damps the normal amplification Kp, but only just around the reference value. A setting of 0.5 will reduce the KP value by half. The value should only be changed by specially trained staff.	n19	Kp Min
Amplification factor for the superheat (only in 1:1 plant) This setting determines the ICM or AKV valve's opening degree as a function of the change in evaporating pressure. An increase of the evaporating pressure will result in a reduced opening degree. When there is a drop-out on the low-pressure thermostat during start-up the value must be raised a bit. If there is pendling during start-up the value must be reduced a little. The value should only be changed by specially trained staff.	n20	Kp T0
Definition of superheat regulation (Ref. appendix 6) 1: Lowest permissible superheat (MSS). Adaptive regulation. 2: Load-defined superheat. The reference is established based on the line formed by the three points: n09, n10 and n22.	n21	SH mode
Value of min. superheat reference for loads under 10% (The value must be smaller than "n10").	n22	SH Close
Standby temperature when valve closed (TQ only) The TQ actuator is kept warm when the valve reaches its closing point. As the closing point cannot be defined completely accurately due to tolerances and pressure variations, the setting can be changed, as required (how "tightly"/securely the valve is to close). See also appendices 1 and 5.	n26	TQ Kmin
Standby temperature when valve open (TQ only) The TQ actuator's temperature is kept low when the valve reaches its fully open position. Here you set how many degrees the temperature is to be above the expected open temperature in completely open position. The greater the value, the surer it is that the valve will be open, but it will also react more slowly when it has to close again.	n27	TQ Kmax
Max. opening degree The ICM or AKV valve's opening degree can be limited. The value is set in %. The value should only be changed by specially trained staff.	n32	OD Max
Min. opening degree The ICM or AKV valve's opening degree can be set to a specified min. value, disabling full closure. The value should only be changed by specially trained staff.	n33	OD Min

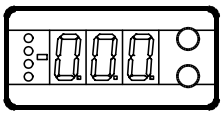
Miscellaneous		
Address If the controller is built into a network with data communication, it must have an address, and the master gateway of the data communication must then know this address. These settings can only be made when a data communication module has been mounted in the controller and the installation of the data communication cable has been completed. This installation is mentioned in a separate document AN234886440486		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 0 and 119	o03	-
The address is sent to the gateway when the menu is set in pos. ON (The setting will automatically change back to Off after a few seconds.)	o04	-
Valve and output signal Define here the valve that is to regulate and the current signal to be transmitted to the analog output "AO". The current signal will show the superheat if o17=1. Or opening degree of the valve, if O17=2. Or the S3 temperature if o17=3 0:Off 1: TQ valve and 0 – 20 mA 2: TQ valve and 4 – 20 mA 3: AKV valve and 0 – 20 mA 4: AKV valve and 4 – 20 mA 5: AKV valve and signal for an other controller. See appendix 3. 6: ICM and ICM OD% /0 – 20 mA 7: ICM and ICM OD% /4 – 20 mA	o09	Valve / AO type
Input signal for reference displacement Definition of function and signal range. 0: No signal 1: Displacement of temperature reference with 0 – 20 mA 2: Displacement of temperature reference with 4 – 20 mA 3: Displacement of superheat reference with 0 – 20 mA 4: Displacement of superheat reference with 4 – 20 mA (4 or 0 mA will not give a displacement. 20 mA will displace the reference by the value set in menu r06)	o10	AI A type
Frequency Set the net frequency.	o12	50 / 60 Hz (50=0, 60=1)
Select signal for showing display Here you can select the signal to be shown in the normal display. The signal is also transmitted to the analog output. See O09. 1: Superheat 2: Valve's opening degree 3: Air temperature (If you during operation give the lower button a brief push, you can see the following: The S3 temperature, if 1 has been selected. The superheat, if 2 has been selected. Temperature reference if 3 has been selected).	o17	Display mode
Manual control of outputs For service purposes the individual relay outputs and the AKV/A output can be forced into position ON. However only when regulation has been stopped. OFF: No override 1: Relay to the solenoid valve is ON. 2: AKV/A output is ON. 3: Alarm relay is activated (connection established between terminals 12 and 13).	o18	-
Working range for pressure transmitter Depending on the application a pressure transmitter with a given working range is used. This working range (say, -1 – 12 bar) must be set in the controller. The min. value is set.	o20	MinTrans Pres.
The max. value is set	o21	Max TransPres.
(Setting for the function o09 and only if the valve is TQ or AKV) Set the temperature value or opening degree of the valve where the output signal must be minimum (0 or 4 mA)	o27	AO min. value
(Setting for the function o09 and only if the valve is TQ or AKV) Set the temperature value or opening degree of the valve where the output signal must be maximum (20 mA). (With a temperature range of 50 K (differential between the settings in o27 and o28) the dissolution will be better than 0.1 K. With 100 K the dissolution wil be better than 0.2 K.)	o28	AO max. value

Refrigerant setting Before refrigeration can be started, the refrigerant must be defined. You can select 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. 31=R422A. 32=R413A. 33=R422D. 34=R427A. 35=R438A (Warning: Wrong selection of refrigerant may cause damage to the compressor).	o30	Refrigerant
Service		
A number of controller values can be printed for use in a service situation		
Read valve's actuator temperature (TQ)	u04	Actuator temp.
Read reference for valve's actuator temperature (TQ)	u05	Actuator Ref.
Read value of external current signal (AIA)	u06	AI A mA
Read value of transmitted current signal	u08	AO mA
Read status of input DI (start / stop input)	u10	DI
Read the ongoing cutin time for the thermostat or the duration of the last completed cutin	u18	Ther. RunTime
Read the temperature at the S2 sensor	u20	S2 temp.
Read superheat	u21	SH
Read the control's actual superheat reference	u22	SH ref.
Read the valve's opening degree	u24	OD%
Read evaporating pressure	u25	Evap. pres. Pe
Read evaporating temperature	u26	Evap. temp Te
Read the temperature at the S3 sensor	u27	S3 temp.
Read control reference (Set setpoint + any contribution from external signal)	u28	Temp. ref
Read value of current signal from pressure transmitter (AIB)	u29	AI B mA
	--	DO1 Alarm Read status of alarm relay
	--	DO2 Liq. Valv Read status of relay for solenoid valve
Operating status		
The controller's operating status can be called forth by a brief (1s) activation of the upper button. If a status code exists it will be shown. (Status codes have lower priority than alarm codes. This means that status codes cannot be seen if there is an active alarm code. The individual status codes have the following meanings:		EKC State (0 = regulation)
S10: Refrigeration stopped by the internal or external start/ stop.		10
S11: Thermostat is cutout		11

Operation

Display

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



Light-emitting diodes (LED) on front panel

There are LED's on the front panel which will light up when the belonging relay is activated.
The upper LED will indicate the valve's opening degree. A short pulse indicates a small liquid flow and a long pulse a heavy liquid flow. The other LED will indicate when the controller calls for refrigeration.
The three lowermost LED's will flash, if there is an error in the regulation.
In this situation you can upload the error code on the display and cancel the alarm by giving the uppermost button a brief push.

The buttons

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

Gives access to the menu (or cutout an alarm)

Gives access to changes

Saves a change

Examples of operations

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

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

Menu survey

SW =1.4x

Function	Para-meter	Min.	Max.	Factory setting
Normal display				
Shows the actual superheat / valve's opening degree / temperature Define view in o17	–		K	
Temperature, superheating, or the temp. reference is displayed if the bottom button is pressed briefly. Define view in o17	–		%	
Reference				
Set the required set point	-	-60 °C	50 °C	10
Differential	r01	0.1 K	20 K	2.0
Units (0=°C+bar / 1=°F+psig)	r05	0	1	0
External contribution to the reference	r06	-50 K	50 K	0
Correction of signal from S2	r09	-50.0 K	50.0 K	0.0
Correction of signal from S3	r10	-50.0 K	50.0 K	0.0
Start / stop of refrigeration	r12	OFF	On	0
Define thermostat function (0= no thermostat function, 1=On/off thermostat)	r14	0	1	0
Alarm				
Upper deviation (above the temperature setting)	A01	3.0 K	20 K	5.0
Lower deviation (below the temperature setting)	A02	1 K	10 K	3.0
Alarm's time delay	A03	0 min.	90 min.	30
Regulating parameters				
P: Amplification factor Kp	n04	0.5	20	3.0
I: Integration time T	n05	30 s	600 s	120
D: Differentiation time Td (0 = off)	n06	0 s	90 s	0
Max. value of superheat reference	n09	2 K	50 K	6
Min. value of superheat reference	n10	1 K	12 K	4
MOP (max = off)	n11	0.0 bar	60 bar	60
Period time (only when AKV/A valve is used)	n13	3 s	10 s	6
Stability factor for superheat control. Changes should only be made by trained staff	n18	0	10	5
Damping of amplification around reference value Changes should only be made by trained staff	n19	0.2	1.0	0.3
Amplification factor for superheat Changes should only be made by trained staff	n20	0.0	10.0	0.4
Definition of superheat control 1=MSS, 2=LOADAP	n21	1	2	1
Value of min. superheat reference for loads under 10%	n22	1	15	2
Standby temperature when valve closed (TQ valve only) Changes should only be made by trained staff	n26	0 K	20 K	0
Standby temperature when valve open (TQ valve only) Changes should only be made by trained staff	n27	-15 K	70 K	20
Max. opening degree Changes should only be made by trained staff	n32	0	100	100
Min. opening degree Changes should only be made by trained staff	n33	0	100	0
Miscellaneous				
Controller's address	o03*	0	119	-
ON/OFF switch (service-pin message)	o04*	-	-	-
Define valve and output signal: 0: Off 1: TQ. AO: 0 – 20 mA 2: TQ. AO: 4 – 20 mA 3: AKV, AO: 0 – 20 m 4: AKV, AO: 4 – 20 mA 5: AKV, AO: EKC 347 – SLAVE 6: ICM, AO: 0 – 20 mA / ICM OD% 7: ICM, AO: 4 – 20 mA / ICM OD%	o09	0	7	0

Define input signal on the analog input AIA: 0: no signal, 1: Temperature setpoint. 0 – 20 mA 2: Temperature setpoint. 4 – 20 mA 3: Displacement of superheat reference. 0 – 20 mA 4: Displacement of superheat reference. 4 – 20 mA	o10	0	4	0
Set supply voltage frequency	o12	50 Hz	60 Hz	0
Select display for "normal picture" (Display the item indicated in parenthesis by briefly pressing the bottom button) 1: Superheat (Temperature) 2: Valve's opening degree (Superheat) 3: Air temperature (Temperature reference)	o17	1	3	1
Manual control of outputs: OFF: no manual control 1: Relay for solenoid valve: select ON 2: AKV/A output: select ON 3: Alarm relay activated (cut out)	o18	off	3	Off
Working range for pressure transmitter – min. value	o20	-1 bar	60 bar	-1.0
Working range for pressure transmitter – max. value	o21	-1 bar	60 bar	12
(Setting for the function o09, only AKV and TQ) Set the temperature value or opening degree where the output signal must be minimum (0 or 4 mA)	o27	-70°C	160°C	-35
(Setting for the function o09, only AKV and TQ) Set the temperature value or opening degree where the output signal must be maximum (20 mA)	o28	-70°C	160°C	15
Refrigerant setting 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	o30	0	35	0

Service		
TQ valve's actuator temperature	u04	°C
Reference of the valve's actuator temperature	u05	°C
Analog input AIA (18 – 19)	u06	mA
Analog output AO (2 – 5)	u08	mA
Read status of input DI	u10	on/off
Thermostat cut-in time	u18	min.
Temperature at S2 sensor	u20	°C
Superheat	u21	K
Superheat reference	u22	K
Read AKV valve's opening degree	u24	%
Read evaporating pressure	u25	bar
Read evaporating temperature	u26	°C
Temperature at S3 sensor	u27	°C
Temperature reference	u28	°C
Read signal at pressure transmitter input	u29	mA

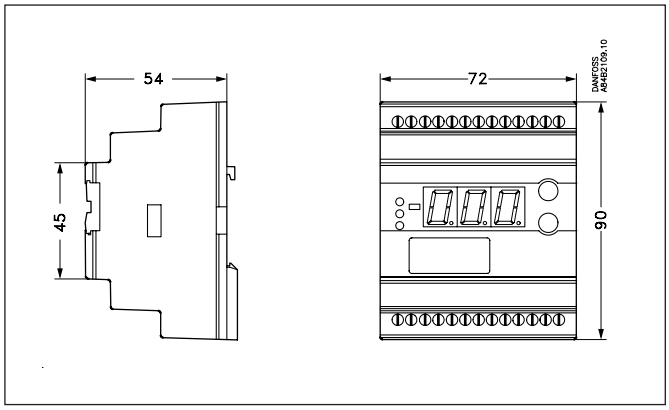
*) This setting will only be possible if a data communication module has been installed in the controller.

The controller can give the following messages:		
E1	**Error message**	Fault in controller
E11		Valve's actuator temperature outside its range
E15		Cut-out S2 sensor
E16		Shortcircuited S2 sensor
E17		Cut-out S3 sensor
E18		Shortcircuited S3 sensor
E19		The input signal on terminals 18-19 is outside the range.
E20		The input signal on terminals 14-15 is outside the range (P0 signal)
A1	**Alarm message**	High-temperature alarm
A2		Low-temperature alarm
A11		No refrigerant has been selected

Factory setting
If you need to return to the factory-set values, it can be done in this way:
- Cut out the supply voltage to the controller
- Keep both buttons depressed at the same time as you reconnect the supply voltage

Data

Supply voltage	24 V AC ±15% 50 / 60 Hz, (80 VA) (the supply voltage is galvanically separated from the input and output signals)	
Power consumption	Controller TQ actuator AKV coil	5 VA 75 VA 55 VA
Input signal	Current signal	4 – 20 mA or 0 – 20 mA
	Pressure transmitter	4 – 20 mA from AKS 33
	Digital input from external contact function	
Sensor input	2 pcs. Pt 1000 ohm	
Output signal	Current signal	4 – 20 mA or 0 – 20 mA
	Load	Max. 200 ohm
Relay output	1 pcs. SPST	250 V AC AC-1: 4 A (ohmic) AC-15: 3 A (inductive)
Alarm relay	1 pcs. SPST	
Actuator	Input (from TQ)	Temperature signal from sensor in the TQ actuator
	Output (AKV, TQ)	Pulsating 24 V AC to actuator
	Output ICAD mounted on ICM	Current signal 4 – 20 mA or 0 – 20 mA
Data communication	Possible to connect a data communication module	
Environments	0 – 55 °C, during operations -40 – 70 °C, during transport	
	20 – 80% Rh, not condensed	
	No shock influence / vibrations	
Enclosure	IP 20	
Weight	300 g	
Mounting	DIN rail	
Display	LED, 3 digits	
Terminals	max. 2.5 mm² multicore	
Approvals	EU Low Voltage Directive and EMC demands re CE-marking complied with. LVD-tested acc. to EN 60730-1 and EN 60730-2-9 EMC-tested acc. to EN50081-1 and EN 50082-2	



Ordering

Type	Function	Code no.
EKC 315A	Superheat controller	**084B7086**
EKA 175	Data communication module (accessories), (RS 485 module)	**084B7093**
EKA 174	Data communication module (accessories), (RS 485 module) with galvanic separation	**084B7124**

Temperature sensor Pt 1000 ohm / Pressure transmitter type AKS 33 / TQ
Valves / AKV valves: .... Kindly refer to catalogue AF151486422482
ICM/ICAD valves: ..... Kindly refer to AI236186442940

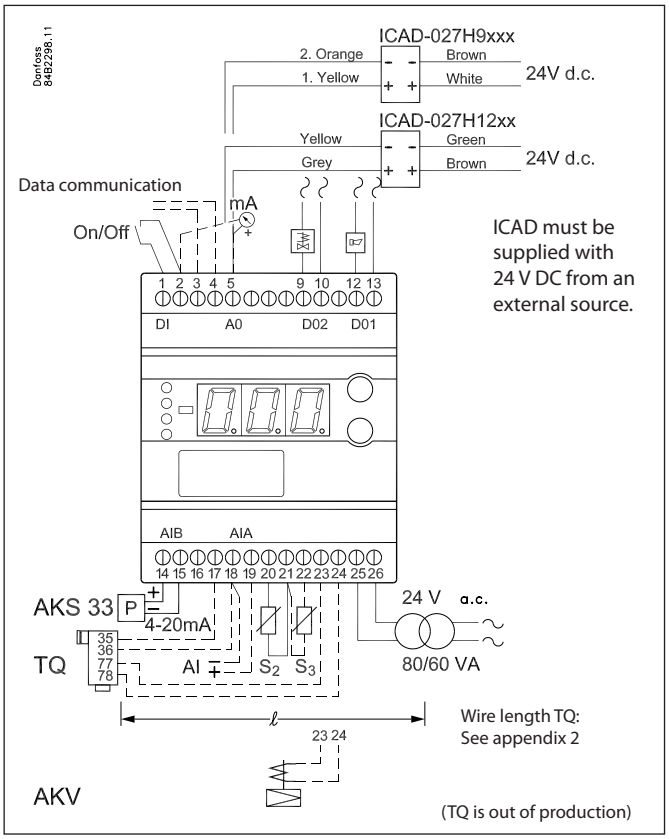
Connections

Necessary connections

Terminals:
25 – 26 Supply voltage 24 V AC
17 – 18 Only at TQ actuator: Signal from actuator
20 – 21 Pt 1000 sensor at evaporator outlet (S2)
14 – 15 Pressure transmitter type AKS 33
9 – 10 Relay switch for start / stop of solenoid valve
1 – 2 Switch function for start / stop of regulation. If a switch is not connected, terminals 1 and 2 must be shortcircuited.

Application dependent connections

Terminals:
21 – 22 Pt 1000 sensor for measuring air temperature (S3)
12 – 13 Alarm relay
There is connection between 12 and 13 in alarm situations and when the controller is dead
18 – 19 Current signal from other regulation (Ext.Ref.)
23 – 24 Supply to actuator AKV / TQ
2 – 5 Current output for showing superheat or air temperature. Or for signal to a slave module. Or control from ICM valve.
3 – 4 Data communication
Mount only, if a data communication module has been mounted.
It is important that the installation of the data communication cable be done correctly. Cf. separate literature No. AN234886440486



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 wil 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.
Particular attention is drawn to the need for a "force closing" signal to controllers in the event of compressor stoppage, and to the requirement for suction line accumulators.

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

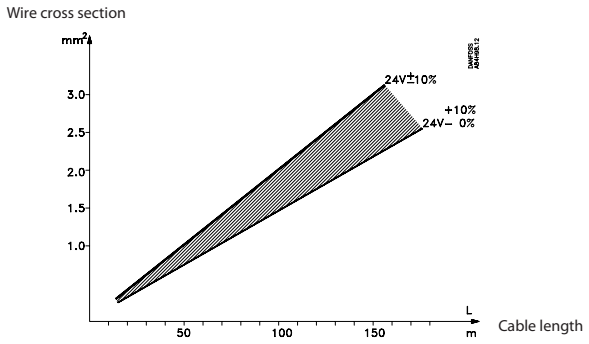
Appendix 1

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

Internal Start / stop	Off	Off	On	On
External Start / stop (DI)	Off	On	Off	On
Refrigeration (DO2)	Off			On
TQ actuator	Standby temperature			Regulating
Expansion valve relay	Off			On
Temperature monitoring	No			Yes
Sensor monitoring	Yes			Yes
ICM	Closed			Regulating

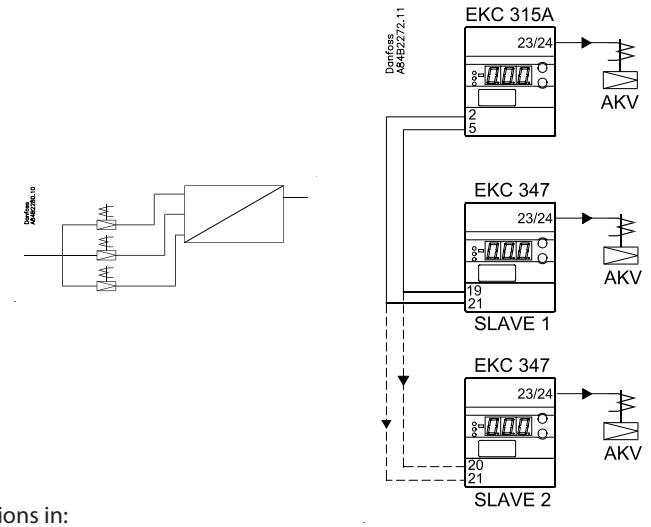
Appendix 2

Cable length for the TQ actuator
The actuator must be supplied with 24 V AC ± 10%.
To avoid excessive voltage loss in the cable to the actuator, use a thicker cable for large distances.



Appendix 3

If the flow of refrigerant is to be distributed to several expansion valves, this can be accomplished by using AKV valves and EKC controllers as slave modules.

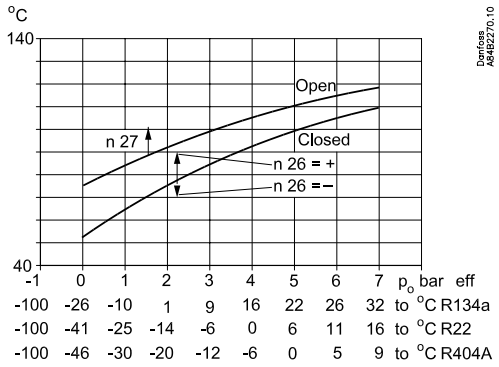


Remember to open the functions in:
- EKC 315A's menu o09
- EKC 347's menu o09

Appendix 5

Standby temperatures for TQ valves.

TQ valve
The valve's actuator temperature is limited, both when regulation is stopped and when the valve is right out at the opening point and closing point.
(The opening and closing points may fluctuate a couple of degrees up or down, depending on pressures and tolerances).



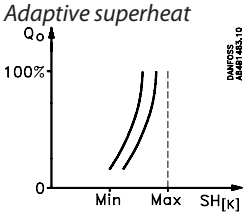
n26
The setting is based on the TQ valve's closing curve. With a plus value the valve can be kept slightly open. With a minus value the valve can be closed completely. If the minus value is high you can be sure that the valve will close, but then it will also react slowly when it has to open again.

n27
This setting defines the number of degrees the actuator has to be warmer when the valve is completely open. If the value is high you can be sure that the valve is completely open, but then it will also react slowly when it has to close again.

Appendix 6

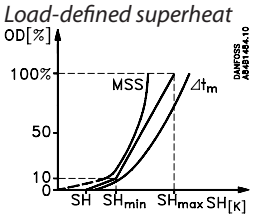
The two types of regulation for superheat are, as follows:

Adaptive superheat



Regulation is here based on the evaporator's load by means of MSS search (MSS = lowest permissible superheat).
(The superheat reference is lowered to the exact point where instability sets in).
The superheat is limited by the settings for min.and max. superheat.

Load-defined superheat



The reference follows a defined curve.This curve is defined by three values: the closing value, the min. value and the max. value. These three values must be selected in such a way that the curve is situated between the MSS curve and the curve for average temperature difference ΔTm (temperature difference between media temperature and evaporating temperature. Setting example = 4, 6 and 10 K).

Start of controller

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

1. Switch off the external ON / OFF switch that starts and stops the regulation.
2. Follow the menu survey on page 58, and set the various parameters to the required values.
3. Switch on the external switch, and regulation will start.
4. Follow the actual room temperature or superheat on the display.
   (On terminals 2 and 5 a current signal can be transmitted which represents the display view. Connect a data collection unit, if applicable, so that the temperature performance can be followed).

If the superheating fluctuates

When the refrigerating system has been made to work steadily, the controller's factory-set control parameters should in most cases provide a stable and relatively fast regulating system.
If the system however fluctuates this may be due to the fact that too low superheat parameters have been selected:

If adaptive superheat has been selected:
Adjust: n09, n10 and n18.

If load-defined superheat has been selected:
Adjust: n09, n10 and n22.

Alternatively it may be due to the fact that the set regulation parameters are not optimal.

If the time of oscillation is longer than the integration time:
($T_p > T_n$, (T_n is, say, 240 seconds))
1. Increase T_n to 1.2 times T_p
2. Wait until the system is in balance again
3. If there is still oscillation, reduce K_p by, say, 20%
4. Wait until the system is in balance
5. If it continues to oscillate, repeat 3 and 4

If the time of oscillation is shorter than the integration time:
($T_p < T_n$, (T_n is, say, 240 seconds))
1. Reduce K_p by, say, 20% of the scale reading
2. Wait until the system is in balance
3. If it continues to oscillate, repeat 1 and 2.

If the superheat has excessive underswing during start-up

If you regulate with valve type ICM or AKV:
Adjust n22 a little bit up and / or n04 a little bit down.

If you regulate with valve type TQ:
Adjust n26 a littlle bit down

ENGINEERING
TOMORROW

Temperature controller
EKC 319A

Contents **Page**

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ENGINEERING TOMORROW

Temperature controller
EKC 319A

The controller limits the pressure gas temperature in compressors by opening up for liquid injection in the suction line.

System

A temperature sensor will register the pressure gas temperature.
If the temperature reaches the set temperature value, opening of the valve will be commenced.
A PI regulation will adapt the opening degree of the valve so that the temperature will be limited.

Temperature sensor

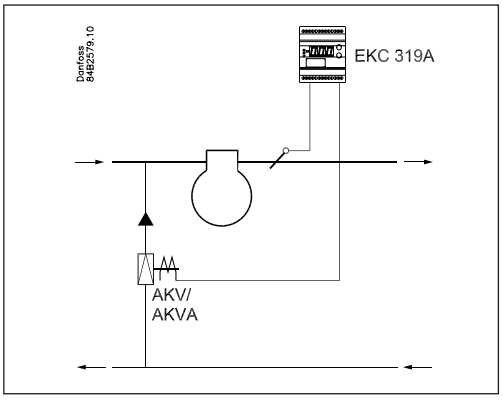
Type AKS 21 can be used. It can stand the high temperature.

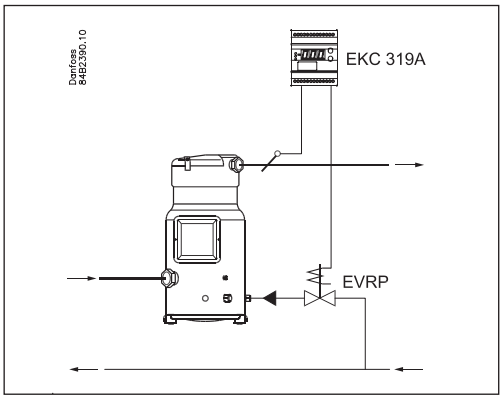
Valve

If the liquid injection is carried out directly in the suction line an expansion valve type AKV, or a type AKVA (for NH_3), is used. The capacity requirement is determined by the size of the valve. If the compressor is provided with a connection for liquid injection a pulse solenoid valve type EVRP is used in the liquid supply.

Alarm function

The controller will sound an alarm if the set alarm limit is exceeded.
The alarm will activate the alarm relay.

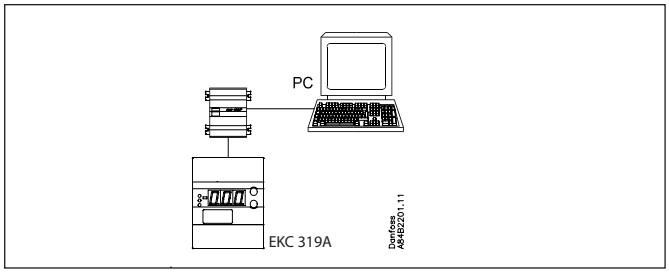




Extra options

PC operation

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



Literature survey:

Manual for EKC 319A.....BC000086420244
Instructions for EKC 319A.....AN000086419141
Installation guide, "Data communication link for ADAP-KOOL® ".....AN234886440486

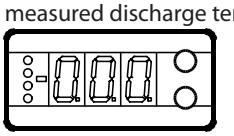
Survey of functions

Function	Para-meter	Parameter by operation via data communication
Normal display		
The temperature sensor registers the discharge gas temperature. The value is shown in the display.	–	Temperature
The valve's actual opening degree can be displayed by giving the lower button a brief push (1s). Cf. also o17.	–	OD %
Reference		**Temperature control**
Reference The liquid injection starts when the set value is passed. Push both buttons simultaneously to set the setpoint.	–	Temperature Ref
Start / stop of regulation With this setting the regulation can be started and stopped. Start / stop can also be performed with the external contact function. Regulation is stopped if just one of them is OFF.	r12	Main Switch
Alarm		
The controller can give alarm in different situations. When there is an alarm the three lowest LED's at the front of the controller will flash, and the alarm relay is cut in. See also A19.		
Alarm limit A temperature limit can be set where the alarm is to be activated.	A16	Limit Alarm
Time delay for alarm When the temperature value is exceeded a timer function will start. The alarm will not become activated until the set time delay has been passed. The time delay is set in seconds.	A17	Limit Alm. delay
Activation of the alarm relay Set here whether the alarm relay is to be activated when the time delay has been passed: 0: Alarm relay active 1: Alarm relay not active	A19	Alarm type (With setting = 0 the alarm is also transmitted via the data communication)
		With data communication the importance of the individual alarms can be defined. Setting is carried out in the "Alarm destinations" menu.
Control parameters		**Control Settings**
P - band If the value is reduced the regulating range will be reduced. (The P-band will be over the reference).	n04	Kp factor
I: Integration time Tn The I-link can be made passive by setting the value at max. (600s) (If the Tn value is increased the regulation becomes slower).	n05	Tn sec.
Periode time The valve is operated with pulses of a given length. The length depends on the opening degree required. If a large opening degree is required, the pulse will last for an entire period time. A period time will thus comprise both open and closed valve.	n13	Period time
Miscellaneous		**Miscellaneous**
Address If the controller is built into a network with data communication, it must have an address, and the master gateway of the data communication must then know this address. These settings can only be madewhen a data communication modulehas been mounted in the controller and the installation of the data communication cable has been completed. This installation is mentioned in a separate document AN234886440486		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 (119)	o03	–
The address is sent to the gateway when the menu is set in pos. ON (The setting will automatically change back to Off after a few seconds.)	o04	–
Frequency Set the net frequency.	o12	50 / 60 Hz (50=0, 60=1)

Selection of display The normal display can be defined to show either: 0: Discharge gas temperature 1: Opening degree of valve Later during the regulation: If the second display is to be read, the controller's lowermost button must be activated briefly. After five seconds the normal display will reappear.	o17	Display
Manual control of outputs In connection wit service the alarm relay and the valve output can be put in pos. ON. But not until regulation has been stopped. OFF: No override 1: Valve output is ON 2. Alarm relay is activated (terminals 12 and 13 will be cutin)	o18	-
Service		**Service**
A number of controller values can be printed for use in a service situation		
Read discharge gas temperature	u01	Temperature
Read the temperature reference	u02	Temperature ref
Read status of input DI (start / stop input)	u10	DI
Read valve's opening degree	u24	OD %
	--	DO1 limit alarm Read status of alarm relay ON is operating status with alarm
Operating status		
Operating status of the controller can be called forth in the display. Push briefly (1s) the upper button. If there is a status code, it will be shown on the display. (Status codes have lower priority than alarm codes. In other words, you cannot see a status code, if there is an active alarm). The individual status codes have the following meanings:		EKC Status (0 = regulation)
S10: The regulation stopped by the internal or external start / stop		10

Operation

Display
The values will be shown with three digits, and after an operation the controller will return to its standard mode and show the measured discharge temperature.



Light-emitting diodes (LED) on front panel
There are LED's on the front panel which will light up when the corresponding relay is activated.
The upper LED will indicate the valve's opening degree. A short pulse indicates a slow liquid flow and a long pulse a fast liquid flow.
The three lowest LED's will flash, if there is an error in the regulation.
In this situation you can upload the error code on the display and cancel the alarm by giving the uppermost button a brief push.

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

Gives access to the menu (or cutout an alarm)

Gives access to changes

Saves a change

Examples of operations

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

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

Error messages

The controller can give the following messages:		
E1		Errors in the controller
E17	**Error message**	The temperature sensor is disconnected
E18		The temperature sensor is shortcircuited
A3	**Alarm message**	Alarm temperature limit is reached

Menu survey

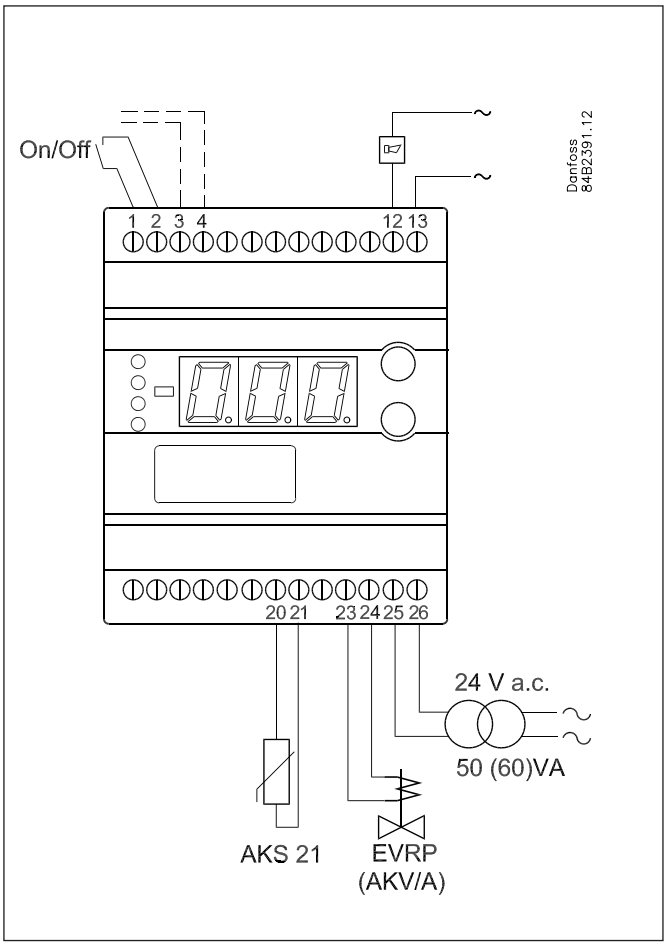
SW = 1.1x

Function	Para-meter	Min.	Max.	Fac. setting
Normal display				
Read the measured discharge gas temperature	-		°C	
If you wish to see the actual opening degree, give the lower button a brief push	-		%	
If you wish to set the temperature reference you obtain access by pushing both buttons simultaneously	-	-70°C	160 °C	125
Display / Control				
Select unit (0=°C, 1=°F)	r05	0	1	0
Start / stop of regulation	r12	OFF	ON / on	on
Alarm				
Alarm limit	A16	-50 °C	150 °C	135
Time delay for alarm	A17	0 s	999 s	0
Function of the alarm relay when the tempera-ture exceed the alarm limit 0: Alarm relay active 1: Alarm relay not active	A19	0	1	1
Regulating parameters				
Proportionale factor Kp	n04	0,5	30	15
I: Integration time Tn	n05	60 s	600 s / Off	120
Periode time	n13	3 s	10 s	3
Miscellaneous				
Controller's address	o03*	0	119	-
ON/OFF switch (service-pin message)	o04*	OFF	ON	-
Set supply voltage frequency	o12	0 / 50 Hz	1 / 60 Hz	50
Select the showing of the "normal display": 0: Discharge gas temperature is shown 1: Valve's opening degree is shown	o17	0	1	0
Manual control of outputs: OFF: No manual control 1: Valve output put in pos. ON 2: Alarm relay activated (cut out)	o18	OFF	2	off
Service				
Read discharge gas temperature	u01		°C	
Read temperature reference	u02		°C	
Read status of input DI	u10			
Read valve's opening degree	u24		%	

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

Factory setting
If you need to return to the factory-set values, it can be done in this way:
- Cut out the supply voltage to the controller
- Keep both buttons depressed at the same time as you reconnect the supply voltage

Connnections



Necessary connections

Terminals:

25-26 Supply voltage 24 V AC

20-21 Signal from temperature sensor

23-24 Solenoid valve type EVRP / expansion valve type AKV or AKVA

1-2 Switch function for start / stop of regulation. If a switch is not connected, terminals 1 and 2 must be shortcircuited.

Application dependent connections

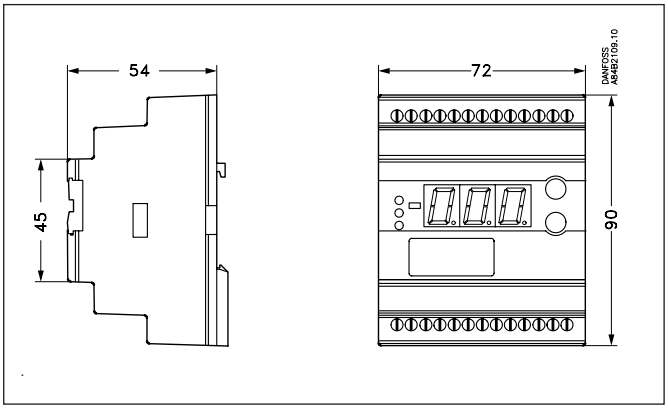
Terminal:

12-13 Alarm relay.
There is connection between 12 and 13 in alarm situations and when the supply voltage to the controller is interrupted

3-4 Data communication
Mount only, if a data communication module has been mounted.
It is important that the installation of the data communication cable be done correctly. Cf. separate literature No. AN234886440486

Data

Supply voltage	24 V AC ±15% 50 / 60 Hz, 60 VA (the supply voltage is galvanically separated from the input and output signals. Input/output are not individual galvanic isolated)	
Power consumption	Controller 20 W coil for AKV / A Coil for EVRP	5 VA 55 VA 40 VA
Input signal	Temperature sensor	Pt 1000 ohm / 0 °C
	Contact function start/stop of regulation	
Alarm relay	SPST	AC-1: 4 A (ohmic) AC-15: 3 A (inductive)
Valve connection	AKV, AKVA or EVRP via 24 AC Pulse-Width Modulating output	
Data communication	Possible to connect a data communication module	
Environments	0 – 55 °C, during operation -40 – 70 °C, during transport	
	20 - 80% Rh, not condensed	
	No shock influence / vibrations	
Enclosure	IP 20	
Weight	300 g	
Montage	DIN Rail	
Display	LED, 3-digits	
Terminals	max. 2.5 mm² multicore	
Approvals	EU Low Voltage Directive and EMC demands re CE-marking complied with. LVD-tested acc. to EN 60730-1 and EN 60730-2-9 EMC-tested acc. to EN50081-1 and EN 50082-2	



Ordering

Type	Function	Code no.
EKC 319A	Temperature controller	**084B7251**
EKA 175	Data communication module (accessories), (RS 485 modul)	**084B7093**

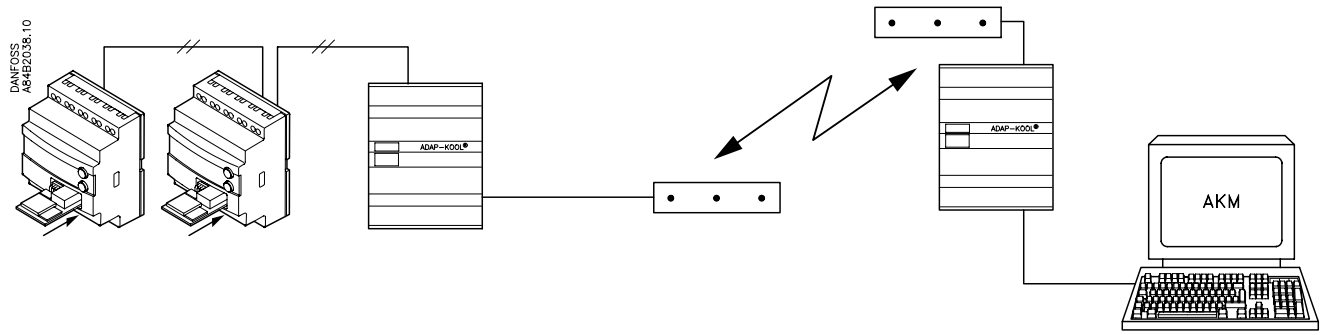
Temperature sensor.....Kindly refer to catalogue AF151486422482
AKV / AKVA Valves.....Kindly refer to catalogue AF151486422482
EVRP valves.....Kindly refer to data sheet AI226086443404

Data communication

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

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

Examples



Each controller is provided with a plug-in module.

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

The cable can be connected to a gateway type AKA 245.

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

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

The gateway can now be connected to a modem.

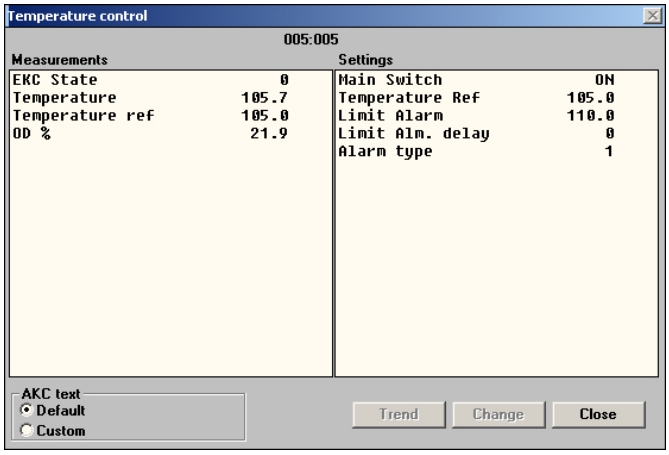
When an alarm occurs from one of the controllers, the gateway will - via the modem - make a phone call to the service company.

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

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

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

Example of menu display



- Measurements are shown at one side and settings at the other.
- You will also be able to see the parameter names of the functions on page 69 – 70.
- 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.

ENGINEERING
TOMORROW

Capacity controller
EKC 331

Contents **Page**

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ENGINEERING
TOMORROW

Capacity controller
EKC 331

The controller is used for capacity regulation of compressors or condensers in small refrigerating systems.

Advantages

- Patented neutral zone regulation
- Sequential or cyclic operation

Function

Regulation

- Regulation with up to four relay outputs can be carried out. Regulation takes place with a set reference which is compared to a signal from a pressure transmitter.

Relay module

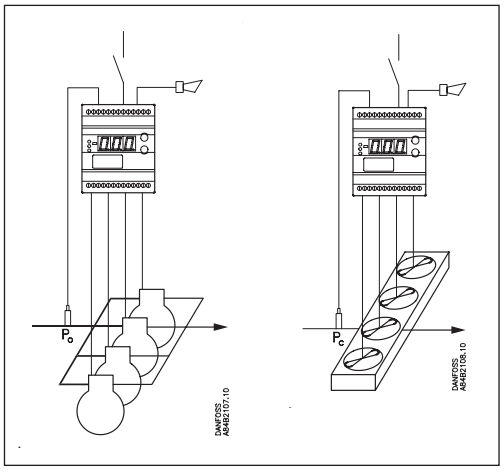
- It is possible to use the controller as relay module, so that the relays are cut in or out by means of an external voltage signal.

Alarmfunction

- A relay becomes activated when the set alarm limits are exceeded.

Digital input

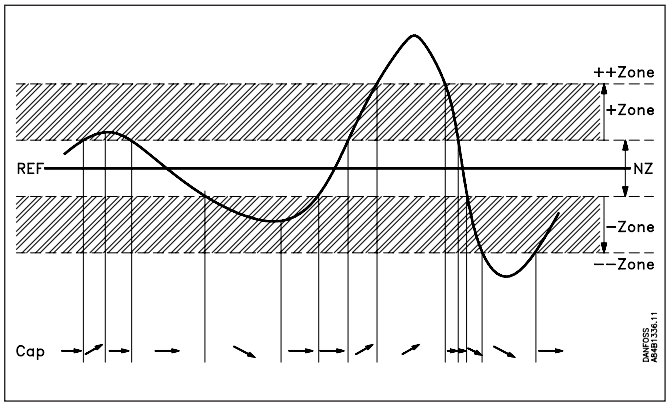
- The digital input can be used for:
  - *night operation where the suction pressure is raised*
  - *heat recovery where the condensing pressure is raised*
  - *external start / stop of the regulation.*



Function

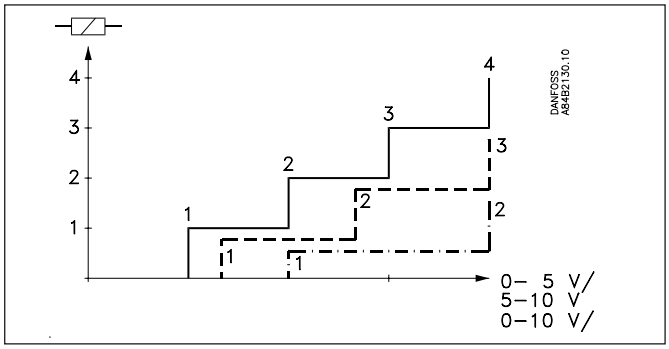
Capacity regulation

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.
The size of the +zone and -zone is identical and defined to be constantly 0.7 times the set value of the neutral zone.
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. The set time delays will here be reduced by factor 0.3.
Cutin of steps can be defined for either sequential or cyclic operation.



Relay module

The controller can also be used as a relay module where the relays in the module will then be controlled by the received voltage signal.
Depending on the definition of the signal and the number of relays used, the relays will be "distributed" over the signal.
A hysteresis around the individual cutin and cutout points will ensure that the relay will not cut in or out when it is not called for.



Survey of functions

Function	Para-meter	Parameter by operation via data communication
Normal display		
Normally the signal from the pressure transmitter is shown. If the controller is used as relay module, U_{in} will appear on the display.		Pressure
Pressure regulation		**Reference**
Regulation reference Regulation is based on the set value. A change of the set value can be limited / locked with the settings in r02 and r03 (Push both buttons simultaneously to set the menu.)	-	Press. set point
Neutral zone There is a neutral zone around the reference. See also page 78.	r01	Neutral zone
Displacement of reference The set reference may be displaced with a fixed value when a signal is received at the DI input. Regulation will then be based on the set reference plus the value set here.	r13	Pressure offset
The total reference can be seen when you push the lower of the two buttons. (Cf. also Definition of DI input).		Reference
Reference limitation The controller's setting range for the reference can be narrowed down, so that you cannot accidentally set a too high or too low value - that may result in damage to the system. With these settings the reference can only be set between the two values.		
Max. permissible reference value.	r02	Max. set point
Min. permissible reference value.	r03	Min. set point
Pressure unit Here you can select whether the controller is to indicate the pressure in bar or psig. (When psig is selected, the settings must also be in psig).	r05	Unit bar=0 psig=1 (In AKM only bar is used, whatever the setting).
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 controller front panel, and the alarm relay will cut in.		
Upper deviation Here you set when the alarm at high pressure is to enter into effect. The value is set as an absolute value. See also emergency procedure page 81.	A10	Max. pressure
Lower deviation Here you set when the alarm at low pressure is to enter into effect. The value is set as an absolute value. See also emergency procedure page 81.	A11	Min. pressure
Alarm delay If one of the two limit values is exceeded, a timer function will commence. The alarm will not become active until the set time delay has been passed. The time delay is set in seconds.	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.
		Alarm relay Here you can read the status of the alarm relay. (ON indicates operation with alarm).
		With data communication the importance of the individual alarms can be defined. Setting is carried out in the "Alarm destinations" menu. See also page 84.

Capacity		Capacity
Running time To prevent irregular operation, values have to be set for how the relays are to cut in and out.		
Min. ON time for relays.	c01	Min.ON time
Time delay for cutin of relays.	c05	Step delay inc.
Time delay for cutout of relays.	c06	Step delay dec.
Min. time period between cutin of same relay.	c07	Min recycle time
Coupling Cutin and cutout can take place in three ways: 1. Sequential: First relay 1 cuts in, then relay 2, etc. Cutout takes place in the opposite sequence. 2. Cyclic: An automatic operating time equalisation is arranged here, so that all steps will have the same operating time. (The relay with the fewest number of operating hours cuts in or out before the others). 3. Cyclic with unloader: The function can only be used when there are two compressors with one unloader each. The cyclic operation is performed on relays 1 and 3. The unloaders are mounted on relays 2 and 4 (relays 1 and 2 belong to the first compressor, relays 3 and 4 to the other). The above mentioned "Min. ON time for relays" is not used by the two unloaders. In connection with cutout, the two unloaders are cut out before the compressors are cut out.	c08	Step mode
Unloaders' cutin and cutout mode (Only in connection with cutin / cutout mode 3. See above). The relays for the two 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)
Miscellaneous		**Miscellaneous**
External signal Here you set the signal to be connected to the controller. 0: No signal / regulation stopped (display will then show OFF) 1: 4 – 20 mA from pressure transmitter for compressor regulation 2: 4 – 20 mA from pressure transmitter for condenser regulation 3: Pressure transmitter type AKS 32R for compressor regulation 4: Pressure transmitter type AKS 32R for condenser regulation 5: 0 – 10 V from other regulation 6: 0 – 5 V from other regulation 7: 5 – 10 V from other regulation	o10	Application mode
Number of relays Depending on the application, up to four relays may be used. This number must be set in the controller. (The relays are always used in numerical sequence).	o19	Number of steps
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).		
Min. value	o20	Min. trans. press
Max. value	o21	Max trans. press
Use of DI 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 displaced when contact is cut in 2: Regulation is started and stopped when the contact is cut in and out, respectively.	o22	Di input control
Operating hours The operating hours for the four relays can be read in the following menus. The read value is multiplied by 10 to obtain the number of hours. On reaching 999 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	o23	DO 1 run hour
Value for relay number 2	o24	DO 2 run hour
Value for relay number 3	o25	DO 3 run hour
Value for relay number 4	o26	DO 4 run hour

Manual control From this menu the relays can be cut in and out manually. OFF gives no override, but a number between 1 and 4 will cut in a corresponding number of relays. Cutins and cutouts always take place from relay number 1. When there is manual operation, the display will show "- - x". Where x is 0 - 4.	o18	Manual control Only when "Manual control" has been put in pos. ON will it be possible to operate the individual relays. DO relay 1 DO relay 2 DO relay 3 DO relay 4 Alarm relay set When this function is used, the buttons on the controller cannot be used.
Language This setting is only required when data communication has been connected to the controller. Settings: 0=English, 3=Danish. When the controller is operated via data communication, the texts in the right-hand column will be shown in the selected language. When you change the setting to an other language you must activate o04 before "the new language" can be visible from the AKM program.	o11	Language
Frequency Set the net frequency.	o12	Main freq (50=0, 60=1)
Address If the controller is built into a network with data communication, it must have an address, and the master gateway of the data communication must then know this address. These settings can only be madewhen a data communication modulehas been mounted in the controller and the installation of the data communication cable has been completed. This installation is mentioned in a separate document AN234886440486		Following installation of a data communication module, the controller can be operated on a par with the other controllers in ADAP-KOOL® refrigeration controls.
The address is set between 1 and 60	o03	
The address is sent to the gateway when the menu is set in pos. ON (The setting will automatically change back to Off after a few seconds.)	o04	
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	
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		2
S5: Renewed cutin of the same relay must not take place more often than every x minutes		5
S8: The next relay must not cut in until x minutes have elapsed		8
S9: The next relay must not cut out until x minutes have elapsed		9
S16: Regulation is stopped due to manual operation via o18		16

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)

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

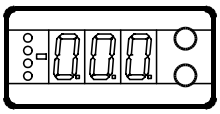
For compressor regulation:
- If the signal from the pressure transmitter becomes smaller than expected, the controller will continue operating with the average capacity that has been cut in during the past 60 minutes. This cut-in capacity will gradually decline as time passes.
- If the signal for the 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 A10, the entire capacity will instantly be cut in.

Operation

Display

The values will be shown with three digits, and with a setting you can determine whether the pressure are to be shown in bar or in psig.



Light-emitting diodes (LED) on front panel

There are four LED's on the front panel which will light up when the relays are operated.
All LED's will flash if there is an error in the regulation. In this situation you can upload the error code on the display and cancel the alarm by pushing the top button briefly.

The controller can give the following messages:		
E1	**Error message**	Errors in the controller
E2		Regulation out of range or control signal is defect.
A1	**Alarm message**	High pressure alarm
A2		Low pressure alarm

The buttons

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

Gives access to the menu (or cutout an alarm)

Gives access to changes

Saves a change

Examples of operations

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

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

Menu survey

SW: 1.1x

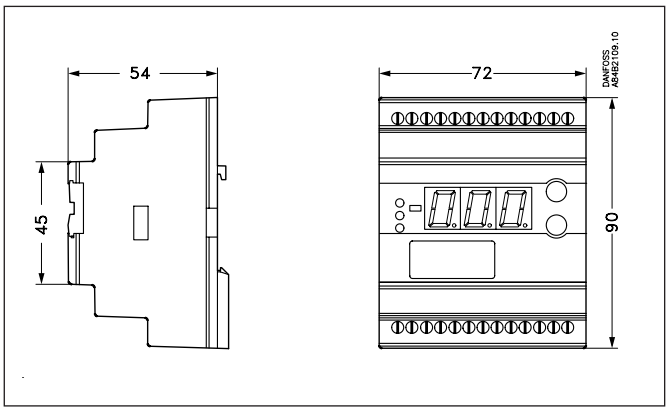
Function	Parameter	Min.	Max.
Normal display			
Shows the signal from the pressure transmitter	-		bar
Reference			
Set the regulation's pressure reference	-	-1 bar	40 bar
Neutral zone	r01	0,1 bar	5 bar
Max. limitation of pressure setting	r02	-1 bar	40 bar
Min. limitation of pressure setting	r03	-1 bar	40 bar
Select unit (0=bar / 1=psig)	r05	0	1
Reference displacement by signal at DI input	r13	-5 bar	5 bar
Alarm			
Upper alarm limit (absolute value)	A10	-1 bar	40 bar
Lower alarm limit (absolute value)	A11	-1 bar	40 bar
Alarm's time delay	A03	1 s	300 s
Capacity			
Min. ON time for relays	c01	0 s	900 s
Time delay for cutin of relays (+Zone)	c05	5 s	900 s
Time delay for cutout of relays (-Zone)	c06	5 s	900 s
Min. time period between cutins of same relay	c07	0 s	900 s
Definition of regulation mode 1: Sequential 2: Cyclic 3: Cyclic with unloaders	c08	1	3
If the regulation mode 3 has been selected, the relays for the unloaders can be defined to: 0: Cut in when more capacity is required 1: Cut out when more capacity is required	c09	0	1
Miscellaneous			
Controllers address	o03*	1	60
On / off switch (service-pin message)	o04*	-	-
Access code	o05	off(-1)	100
Define input signal and application: 0: no signal / regulation stopped 1: 4 – 20 mA pressure transmitter - compressor reg. 2: 4 – 20 mA pressure transmitter - condenser reg. 3: AKS 32R pressure transmitter - compressor reg. 4: AKS 32R pressure transmitter - condenser reg. 5: 0 – 10 V relay module 6: 0 – 5 V relay module 7: 5 – 10 V relay module	o10	0	7
Language (0=english, 3=danish). When you change this setting you must also activate O04.	011*	0	3
Set supply voltage frequency	o12	50 Hz	60 Hz
Manual operation with "x" relays	o18	0	4
Define number of relay outputs	o19	1	4
Pressure transmitter's working range - min. value	o20	-1 bar	0 bar
Pressure transmitter's working range - max. value	o21	1 bar	40 bar
Define DI input: 0: not used 1: Contact displaces reference 2: Contact starts and stops regulation	o22	0	2
Operating hours of relay 1 (value times 10)	o23	0 h	999 h
Operating hours of relay 2 (value times 10)	o24	0 h	999 h
Operating hours of relay 3 (value times 10)	o25	0 h	999 h
Operating hours of relay 4 (value times 10)	o26	0 h	999 h

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

Factory setting
If you need to return to the factory-set values, it can be done in this way:
- Cut out the supply voltage to the controller
- Keep both buttons depressed at the same time as you reconnect the supply voltage

Data

Supply voltage	230 V AC ±15% 50 / 60 Hz, 5 VA	
Input signal	Pressure transmitter*) with 4 – 20 mA or voltage signal (0 – 5 V, 0 – 10 V or 5 – 10 V)	
	Digital input to external contact function	
Relay output	4 pcs. SPST	AC-1: 4 A (ohmic) AC-15: 3 A (inductive)
Alarmrelay	1 pcs. SPST	AC-1: 4 A (ohmic) AC-15: 1 A (inductive)
Data communication	Possible to connect a data communication module	
Ambient temperature	During operation During transport	-10 – 55 °C -40 – 70 °C
Enclosure	IP 20	
Weight	300 g	
Mounting	DIN rail	
Display	LED, 3 digits	
Terminals	max. 2,5 mm² multicore	
Approvals	EU Low voltage Directive and EMC demands re CE-marking complied with. LVD-tested acc. to EN 60730-1 and EN 60730-2-9 EMC-tested acc. to EN61000-6-3 and EN 61000-4-(2-6,8,11)	



***) Pressure transmitter**
As pressure transmitter can be used AKS 3000 or AKS 33 (AKS 33 has a higher accuracy than AKS 3000).
It is also possible to use an AKS 32R. This pressure transmitter is only supplied in large quantities as per arrangement with Danfoss. Please refer to catalogue AF151486422482

Ordering

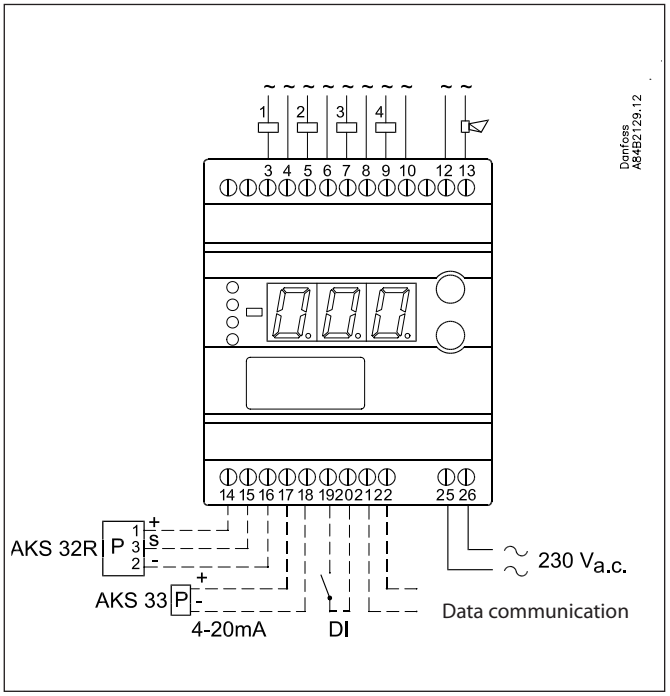
Type	Function	Code No.
EKC 331	Capacity controller	**084B7104**
EKA 175	Data communication module (accessories), (RS 485 module)	**084B8579**

Connections

Necessary connections
Terminals:
25 – 26 Supply voltage 230 V AC
3 – 10 Relay connections no. 1, 2, 3 and 4
12 – 13 Alarm relay
There is connection between 12 and 13 in alarm situations and when the controller is dead
Control signal (see also o10)
Either terminals:
14 – 16 Voltage signal from AKS 32R
or
17 – 18 Current signal from AKS 3000 or AKS 33
or
15 – 16 Voltage signal from an other regulation.

External contact function, if applicable
19 – 20 Contact function for displacement of reference or start / stop of the regulation.

Data communication, if applicable
21 – 22 Mount only, if a data communication module has been mounted.
It is important that the installation of the data comm unication cable be done correctly. Cf. separate literature No. AN234886440486

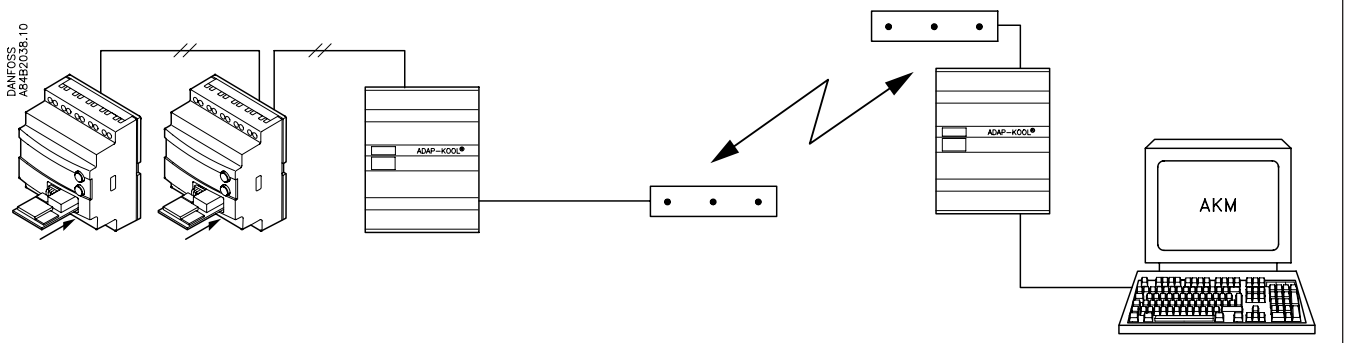


Data communication

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

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

Example



Each controller is provided with a plug-in module.

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

Up to 60 controllers may be connected to one cable.

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

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

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

The gateway can now be connected to a modem.

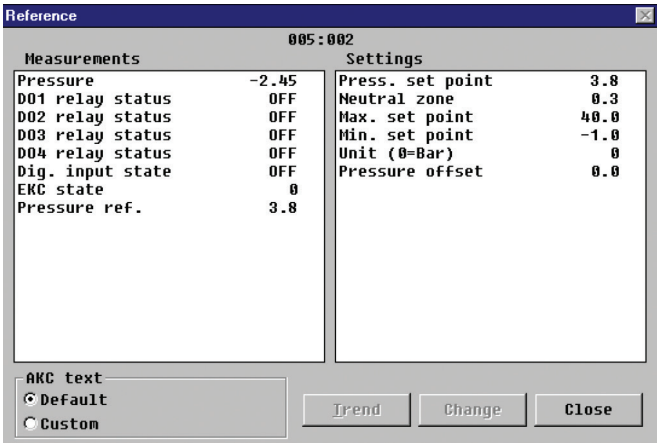
When an alarm occurs from one of the controllers, the gateway will - via the modem - make a phone call to the service company.

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

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

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

Example of menu display



Measurements are shown at one side and settings at the other.

You will also be able to see the parameter names of the functions on page 79 – 81.

With a simple change-over the values can also be shown in a trend diagram.

If you wish to check earlier pressure 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.

ENGINEERING
TOMORROW

Capacity controller
EKC 331T

Contents **Page**

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ENGINEERING
TOMORROW

Capacity controller
EKC 331T

The controller is used for capacity regulation of compressors or condensers in small refrigerating systems.
Regulation can be carried out with up to four identical capacity steps.

Advantages
- Patented neutral zone regulation
- Sequential or cyclic operation

Function

Regulation
- Regulation with up to four relay outputs can be carried out. Regulation takes place with a set reference which is compared to a signal from a pressure transmitter or a temperature sensor.

Relay module
- It is possible to use the controller as relay module, so that the relays are cut in or out by means of an external voltage signal.

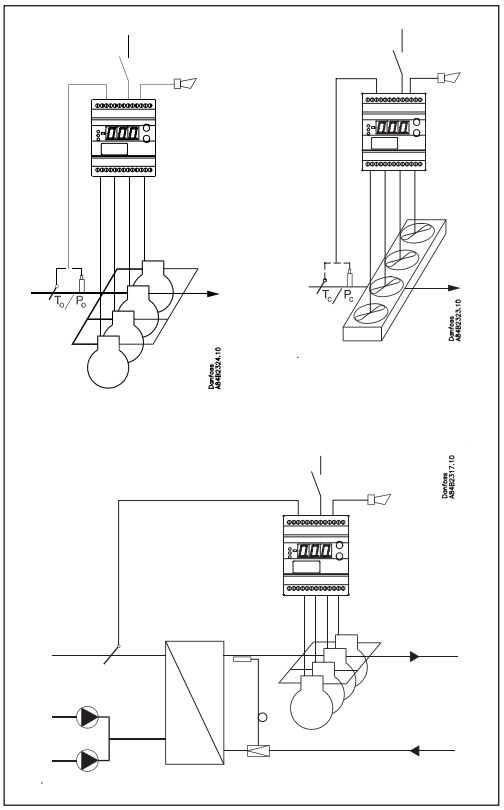
- *Alarm function*
- A relay becomes activated when the set alarm limits are exceeded.

Digital input
- The digital input can be used for:
  - *night operation where the suction pressure is raised*
  - *heat recovery where the condensing pressure is raised*
  - *external start/stop of the regulation.*
  - *Monitoring of safety circuit*

Reverse function
- The regulation can be reversed so that the relays are activated in case of falling temperature, rather than by the rising temperature.

Possibility of data communication

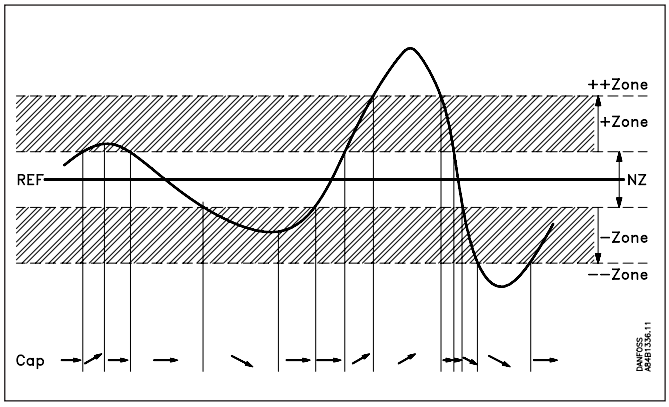
Display
A signal from a pressure transmitter will always be converted and shown as a temperature value.
Settings are made as for temperature values.



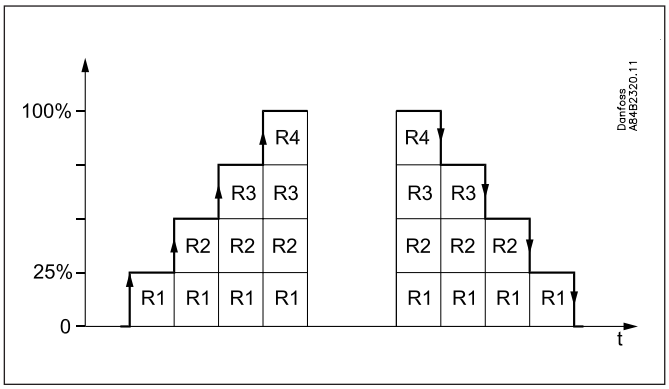
Function

Capacity regulation

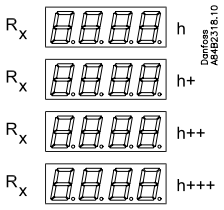
The cut-in capacity is controlled by signals from the connected pressure transmitter (temperature sensor) and the set reference.
Outside the reference a neutral zone is set where the capacity will neither be cut in nor out.
Outside the neutral zone (in the hatched areas named +zone and -zone) the capacity will be cut in or out if the regulation registers a change of pressure (the temperature) "away" from the neutral zone. Cutin and cutout will take place with the set time delays.
If the pressure (the temperature) 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.
Cutin of steps can be defined for either sequential or cyclic operation.



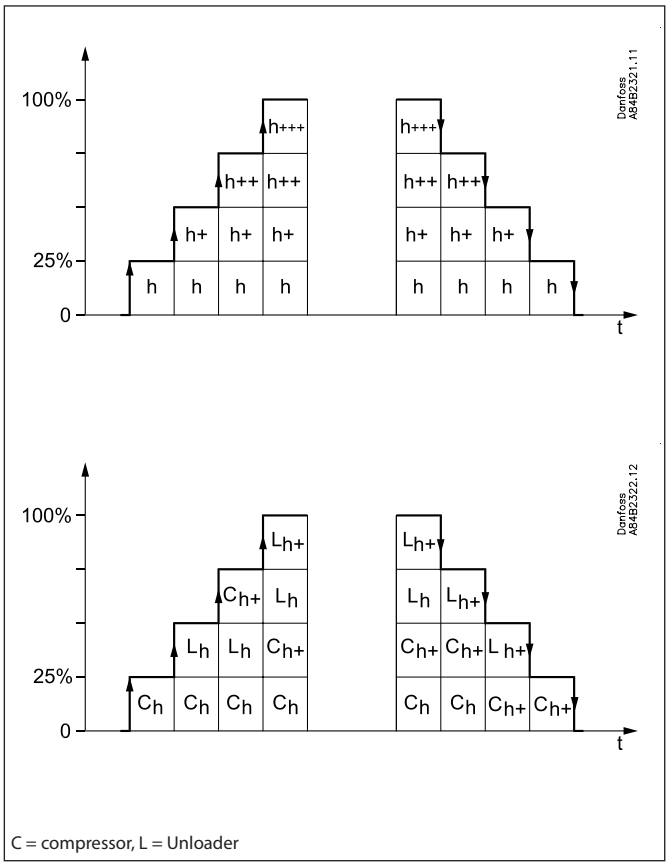
Sequential
The relays are here cut in in sequence – first relay number 1, then 2, etc.
Cutout takes place in the opposite sequence, i.e. the last cut-in relay will be cut out first.



Cyclic
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.

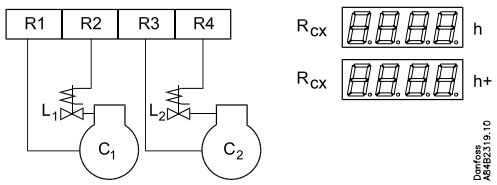


Rx = random relay
h = number of hours

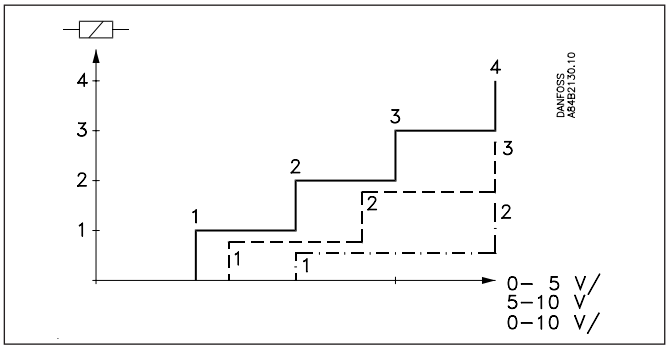


C = compressor, L = Unloader

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.



Relay module
The controller can also be used as a relay module where the relays in the module are operated by the received voltage signal. The signal must be connected to terminal 15 – 16.
Depending on the definition of the signal and the number of relays used, the relays will be "distributed" over the signal.
A hysteresis at the individual coupling points will ensure that the relay will not cut in or out when not required.



Suvey of functions

Function	Para-meter	Parameter by operation via data communication
Normal display		
Normally the signal from the pressure transmitter / temperature sensor is shown If the controller is used as relay module, U_{in} will appear on the display.		Pressure / Temp °C
Pressure regulation		**Reference Settings**
Regulation setpoint Regulation is based on the set value. A change of the set value can be limited / fixed by means of the settings in r02 and r03. (Push both buttons simultaneously to set the menu.)	-	Set point °C
Neutral zone There is a neutral zone around the reference. See also page 88.	r01	Neutral zone
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 "DI".	r12	Main switch
Reference The set reference may be displaced with a fixed value when a signal is received at the DI input. Regulation will then be based on the set point plus the value set here. (Cf. also Definition of DI input).	r13	Ref. offset
Night setback **OFF:** No change of the reference **ON:** (1) Offset value in "r13" forms part of the reference	r27	NightSetback
The total reference can be seen when you push the lower of the two buttons	-	Reference
Reference 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 reference value.	r25	Max. reference
Min. permissible reference value.	r26	Min. reference
Correction of temperature measurement An offset adjustment of the registered temperature can be made. The function is used if correction for a too long sensor cable has to be made.	r04	Adjust sensor
Unit Here you can select whether the display is to indicate SI units or US units (°C and bar or °F and psig) Setting = "C-b" will give °C and bar Setting = "F-P" will give °F and psig. All settings made in ° C or ° F. Excluding o20 and o21, which is set in the bar / PSIG.	r05	(In AKM only °C and bar is used, whatever the setting)
Capacity		**Capacity Settings**
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.	c01	Min.ON time
Min. time period between cutin of same relay.	c07	Recycle time
Coupling (compressor and condensor) Cutin and cutout can take place in three ways: 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 will have the same operating time. (The relay with the fewest number of operating hours cuts in or out before the others) (Or put differently: ”First in, last out”). 3. Compressor(s) with unloader: The cyclic operation is performed on relays 1 and 3. The unloaders are mounted on relays 2 and 4 (relays 1 and 2 belong to the first compressor, relays 3 and 4 to the other). The above mentioned ”Min. On-time” and "Min. recycle time" are not used for unloaders. In connection with cutout, the two unloaders are cut out before the compressors are cut out.	c08	Step mode
Unloaders' cutin and cutout mode (Only in connection with cutin / cutout mode 3. See above). The relays for the two unloaders can be set to switch on when more capacity is required (setting = no), or they can switch off when more capacity is called for (setting = nc).	c09	Unloader (switch on = 0) (switch off = 1)

Setting for neutral zone regulation Regulation band under the neutral zone	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 s
Regulation band over 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 s
Manual control of compressor capacity This sets the capacity that is to be cut in when switching to manual control.	c31	ManualCap %
Manual control Manual control of the compressor capacity is enabled here. When set to ON, the capacity that is set in "c31" is cut in.	c32	ManualCap
	-	Capacity % Read cut-in compressor capacity
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 controller front panel, and the alarm relay will cut in.		
Upper deviation Here you set when the alarm at high temperature / pressure is to enter into effect. The value is set as an absolute value. See also emergency procedure page 93.	A10	Max. Al. limit
Lower deviation Here you set when the alarm at low temperature / pressure is to enter into effect. The value is set as an absolute value. See also emergency procedure page 93.	A11	Min. Al. limit
Alarm delay If one of the two limit values is exceeded, a timer function will commence. The alarm will not become active until the set time delay has been passed. The time delay is set in minutes.	A03	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.
Miscellaneous		**Miscellaneous**
External signal Here you set the signal to be connected to the controller. 0: No signal / regulation stopped (display will then show OFF) 1: 4 – 20 mA from pressure transmitter for compressor regulation 2: 4 – 20 mA from pressure transmitter for condenser regulation 3: Pressure transmitter type AKS 32R for compressor regulation 4: Pressure transmitter type AKS 32R for condenser regulation 5: 0 – 10 V from other regulation 6: 0 – 5 V from other regulation 7: 5 – 10 V from other regulation 8: Pt1000 ohm temperature sensor for compressor regulation 9: Pt1000 ohm temperature sensor for condenser regulation 10: PTC1000 ohm temperature sensor for compressor regulation 11: PTC1000 ohm temperature sensor for condenser regulation	o10	Application mode
Number of relays Depending on the application, up to four relays may be used. This number must be set in the controller. (The relays are always used in numerical sequence).	o19	Number of steps
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 – 12 bar) The values must be set in bar if display in °C has been selected. And in psig, if °F has been selected.		If the two values are to be set from the AKM programme, they must be set in bar.
Min. value	o20	Min. Trs. pres
Max. value	o21	Max Trs. pres

Use of DI 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 displaced when contact is cut in 2: Regulation is started and stopped when the contact is cut in and out, respectively. 3: Monitoring of the compressor's safety circuit. When the contact on the DI input cuts out, all relay outputs will immediately be cut out. At the same time the alarm will sound.	o22	Di control
Operating hours The operating hours for the four relays can be read in the following menus. The read value is multiplied by 1000 to obtain the number of hours. On reaching 999 hours the display 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	o23	DO 1 run hour
Value for relay number 2	o24	DO 2 run hour
Value for relay number 3	o25	DO 3 run hour
Value for relay number 4	o26	DO 4 run hour
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. 31=R422A. 32=R413A. 33=R422D. 34=R427A. 35=R438A. 36=XP10. 37=R407F. Warning: Wrong selection of refrigerant may cause damage to the compressor.	o30	Refrigerant
Manual control From this menu the relays can be cut in and out manually. OFF gives no override, but a number between 1 and 4 will cut in a corresponding relay. The other relays will be off.	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 AN234886440486		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	
Cooling or heating Cooling: Relays are cut in when the temperature is above the reference. Heating: Relays are cut in when the temperature is below the reference.	o07	Refg. / Heat

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 Ctrl. 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
S20: Emergency control		20
S25: Manual regulation of outputs		25
PS: Password required. Set password		PS
Alarm messages		**Alarms**
A1: High temperature alarm (cf. A10)		High temp. alarm
A2: Low temperature alarm (cf. A11)		Low temp. alarm
A11: No refrigerant has been selected (cf. o30)		RFG not selected
A12: Regulation stopped due to interrupted signal on the DI input		DI Alarm
A45: Regulation stopped with setting or with external switch		A45 Stand by
E1: Error in the controller		Controller fault
E2: Control signal outside the range (short-circuited / interrupted)		Out of range
Service		
u07: Voltage signal on the analogue input		
u10: Status on DI- input		
u15: Status on relay output DO1		
u25: Signal on pressure transmitter input (bar / PSIG)		
u58: Status on relay output DO2		
u59: Status on relay output DO3		
u60: Status on relay output DO4		
u62: Status on relay output "alarm"		

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)

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

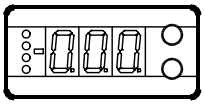
For compressor regulation:
- If the signal from the temperature sensor / pressure transmitter becomes smaller than expected, the controller will continue operating with the average capacity that has been cut in during the past 60 minutes. This cut-in capacity will gradually decline as time passes.
-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

For condenser regulation:
- If the signal from the temperature sensor / pressure transmitter becomes smaller than expected, or if the condensing pressure becomes bigger than the set value of A10, the entire capacity will instantly be cut in.

Operation

Display

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



Light-emitting diodes (LED) on front panel

There are four LED's on the front panel which will light up when the relays are operated.
All LED's will flash if there is an error in the regulation. In this situation you can upload the error code on the display and cancel the alarm by pushing the top button briefly.

The controller can give the following messages:		
E1	**Error message**	Errors in the controller
E2		Regulation out of range or control signal is defect.
A1	**Alarm message**	High pressure alarm
A2		Low pressure alarm
A11		No refrigerant selected
A12		Regulation stopped due to interrupted signal on the DI input
A45		Regulation is stopped
PS		Password is required

The buttons

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

Gives access to the menu (or cutout an alarm)

Gives access to changes

Saves a change

Examples of operations

Set the regulation's set point
1. Push the two buttons simultaneously
2. Push one of the buttons and select the new value
3. Push both buttons again to conclude the setting

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

Menu survey

SW: 2.0x

Function	Parameter	Min.	Max.	Factory setting
Normal display				
Shows the signal from the temperature sensor / pressure transmitter	–		°C	–
Reference				
Set the regulation's set point	-	-60 °C	170 °C	3
Neutral zone	r01	0,1 K	20 K	4.0
Correction of signal from the sensor	r04	-20 K	20 K	0.0
Select SI or US display: 0=SI (bar / °C). 1=US (Psig / °F)	r05	c-b	F-P	c-b
Start / stop of regulation (0=off)	r12	0	1	0
Reference displacement by signal at DI input	r13	-50 K	50 K	0
Reference limitation. Max. value	r25	-50 °C	170°C	50 °C
Reference limitation. Min. value	r26	-60 °C	50°C	-60 °C
Displacement of reference (On=activ "r13")	r27	Off	On	Off
Capacity				
Min. ON time for relays	c01	0 min.	30 min	2
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: Compressor with unloader	c08	1	3	1
If the regulation mode 3 has been selected, the relays for the unloaders can be defined to: no: Cut in when more capacity is required nc: Cut out when more capacity is required	c09	no	nc	no
Regulation parameter for + Zone	c10	0,1 K	20 K	3
Regulation parameter for + Zone min.	c11	0,1 min.	60 min.	2
Regulation parameter for ++ Zone seconds	c12	1 s	180 s	30
Regulation parameter for - Zone	c13	0,1 K	20 K	3
Regulation parameter for - Zone min.	c14	0,1 min.	60 min.	1
Regulation parameter for - - Zone seconds	c15	1 s	180 s	30
Cutin capacity at manual control. See also "c32"	c31	0%	100%	0%
Manual control of capacity (when On the value in "c31" will be used*)	c32	Off	On	Off
Alarm				
Alarm time delay	A03	1 min.	90 min.	30
Upper alarm limit (absolute value)	A10	-60 °C	170 °C	50
Lower alarm limit (absolute value)	A11	-60 °C	120 °C	-60
Miscellaneous				
Controllers address	o03*	1	240	0
On/off switch (service-pin message)	o04*	–	–	–
Access code	o05	off(-1)	100	-
Inverse function (HE: heating at relays = on)	o07	rE	HE	rE
Define input signal and application: 0: no signal / regulation stopped 1: 4 – 20 mA pressure transmitter - compressor reg. 2: 4 – 20 mA pressure transmitter - condenser reg. 3: AKS 32R pressure transmitter - compressor reg. 4: AKS 32R pressure transmitter - condenser reg. 5: 0 – 10 V relay module 6: 0 – 5 V relay module 7: 5 – 10 V relay module 8: Pt 1000 ohm sensor - compressor reg. 9: Pt 1000 ohm sensor - condenser reg. 10: PTC 1000 ohm sensor - compressor reg. 11: PTC 1000 ohm sensor - condenser reg.	o10	0	11	0
Set supply voltage frequency	o12	50 Hz	60 Hz	50
Manual operation with "x" relays	o18	0	4	0

Continued

Define number of relay outputs	o19	1	4	4
Pressure transmitter's working range - min. value	o20	-1 bar	5 bar	-1
Pressure transmitter's working range - max. value	o21	6 bar	199 bar	12
Define DI input: 0: not used 1: Contact displaces reference 2: Contact starts and stops regulation 3: Interrupted contact will cut out the capacity, and alarm will be given.	o22	0	3	0
Operating hours of relay 1 (value times 1000)	o23	0 h	99,9 h	0
Operating hours of relay 2 (value times 1000)	o24	0 h	99,9 h	0
Operating hours of relay 3 (value times 1000)	o25	0 h	99,9 h	0
Operating hours of relay 4 (value times 1000)	o26	0 h	99,9 h	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. 31=R422A. 32=R413A. 33=R422D. 34=R427A. 35=R438A. 36=XP10. 37=R407F.	o30	0	37	0

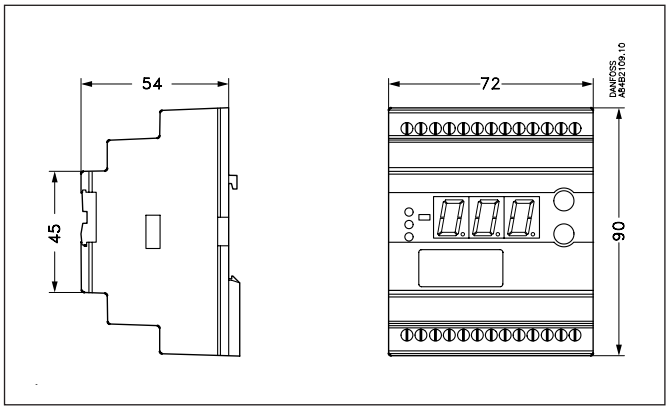
*) This setting will only be possible if a data communication moduel has been installed in the controller.

Service	
Voltage on the analogue input	u07
Status on DI- input	u10
Status on relay output DO1	u15
Signal on pressure transmitter input (bar / PSIG)	u25
Status on relay output DO2	u58
Status on relay output DO3	u59
Status on relay output DO4	u60
Status on relay output "alarm"	u62

Factory setting
If you need to return to the factory-set values, it can be done in this way:
- Cut out the supply voltage to the controller
- Keep both buttons depressed at the same time as you reconnect the supply voltage

Data

Supply voltage	230 V AC ±15% 50 / 60 Hz, 5 VA	
Input signal	Pressure transmitter*) with 4 – 20 mA or temperature sensor Pt 1000 ohm or temperature sensor PTC 1000 ohm or voltage signal (0 – 5 V, 0 – 10 V or 5 – 10 V)	
	Digital input to external contact function	
Relay output	4 pcs. SPST	AC-1: 4 A (ohmic) AC-15: 3 A (inductive)
Alarmrelay	1 pcs. SPST	AC-1: 4 A (ohmic) AC-15: 1 A (inductive)
Data communication	Possible to connect a data communication module	
Environments	-10 – 55 °C, during operation -40 – 70 °C, during transport	
	20 – 80% Rh, not condensed	
	No shock influence / vibrations	
Enclosure	IP 20	
Weight	300 g	
Mounting	DIN rail	
Display	LED, 3 digits	
Terminals	max. 2.5 mm² multicore	
Approvals	EU Low voltage Directive and EMC demands re CE-marking complied with. LVD-tested acc. to EN 60730-1 and EN 60730-2-9 EMC-tested acc. to EN 61000-6-3 and EN 61000-4-(2-6,8,11)	



***) Pressure transmitter**
As pressure transmitter can be used AKS 3000 or AKS 33
(AKS 33 has a higher accuracy than AKS 3000).
It is also possible to use an AKS 32R.
Please refer to catalogue AF151486422482

Ordering

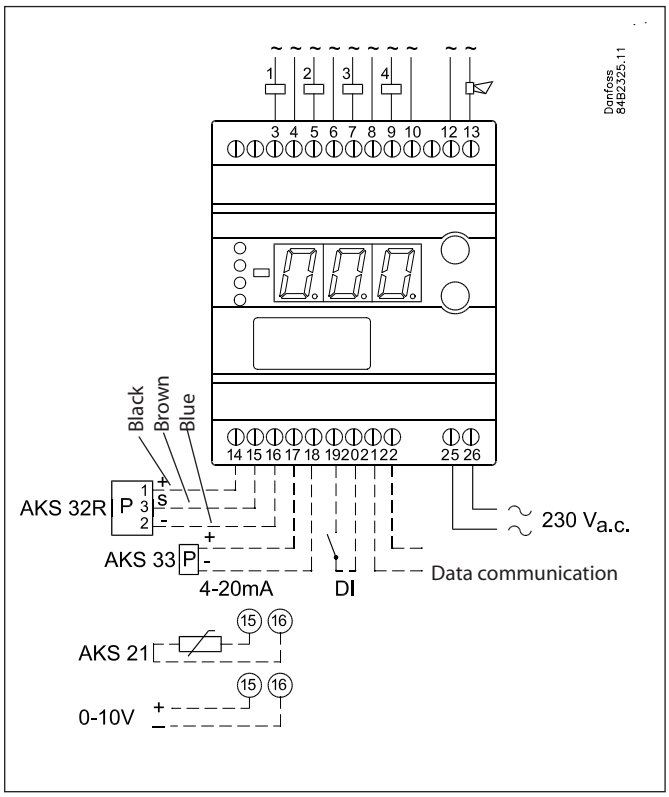
Type	Function	Code No.
EKC 331T	Capacity controller	**084B7105**
EKA 175	Data communication module (accessories), (RS 485 module)	**084B8579**

Connections

Necessary connections
Terminals:
25 – 26 Supply voltage 230 V AC
3 – 10 Relay connections no. 1, 2, 3 and 4
12 – 13 Alarm relay
There is connection between 12 and 13 in alarm situations and when the controller is dead
Control signal (see also o10)
Either terminals:
14 – 16 Voltage signal from AKS 32R
or
17 – 18 Current signal from AKS 3000 or AKS 33
or
15 – 16 Sensor signal from AKS 21, AKS 12 or EKS 111
or
15 – 16 Voltage signal from an other regulation.

External contact function, if applicable
19 – 20 Contact function for displacement of reference or start / stop of the regulation or for monitoring of safety circuit.

Data communication, if applicable
21 – 22 Mount only, if a data communication module has been mounted.
It is <u>important</u> that the installation of the data communication cable be done correctly. Cf. separate literature No. AN234886440486



ENGINEERING
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Temperature sensors
AKS 11, AKS 12, AKS 21, AK-HS 1000

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ENGINEERING TOMORROW

Temperature sensors
AKS 11, AKS 12, AKS 21, AK-HS 1000

These sensors are recommended for accurate temperature measurement in applications such as superheating, food safety logs, and other important temperature measurement applications.

Functional description
The sensor unit consists of a platinum element the resistance value of which changes proportionally with the temperature.
Pt 1000 ohm sensor (1000 ohm at 0 °C).
The sensors are adjusted and meet the tolerance requirements of EN 60751 Class B.

Technical data and ordering

Type	Description	Temperature range [°C]	Sensor / sensor body	Connection / cable	Enclosure	Time constant [s]	Cable length [m]	Qty	Code
AKS 11 *)	Surface and duct sensor for control and monitoring	-50 – 100	Top: PPO (Noryl) Bottom: stainless steel	PVC cable, 2 x 0.2 mm²	IP 67	3 [1] 10 [2] 35 [3]	3.5 m	1	084N0003
							3.5 m + AMP	110	084N0050
							5.5 m	1	084N0005
							5.5 m + AMP	70	084N0051
							8.5 m	1	084N0008
							8.5 m + AMP	50	084N0052
AKS 12	Air temperature sensor for monitoring	-40 – 100	18/8 stainless steel	PVC cable 2 x 0.22 mm²	IP 67	15 [2]	1.5 m	1	084N0036
								30	084N0035
							3.5 m	30	084N0039
							5.5 m	30	084N0038
							5.5 m + AMP	30	084N0037
AKS 21A **)	Surface sensor with clip	-70 – 180	18/8 stainless steel	Fire-resistant silicone rubber cable, 2 x 0.2 mm²	IP 67	6 [1] 14 [2] 35 [3]	2.5 m	1	084N2007
							5.0 m	1	084N2008
	Surface sensor with shielded cable and clip	-70 – 180					2.0 m	1	084N2024
AKS 21M	Multipurpose sensor	-70 – 180					2.5 m	1	084N2003
AKS 21W	Immersion sensor with cable and sensor pocket, welded version	-70 – 180	Immersion sensor, 18/8 stainless steel tube	Fire-resistant silicone rubber cable, 2 x 0.2 mm²	IP 56	18 [1]	2.5 m	1	084N2017
			Weld nipple: 18/8 stainless steel						
			Thread nipple: free cutting steel						
AK-HS 1000	Product sensor for HACCP logging	-30 – 50	ABS and PC	PVC cable 2 x 0.25 mm²	IP 54	180-900 [3]	5.5 m	1	084N1007

*) Recommended for measuring superheat
**) Recommended for hot gas systems

[1]) Agitated liquid.
[2]) Clamped to pipe.
[3]) Air 4 m/s.

Dimensioning

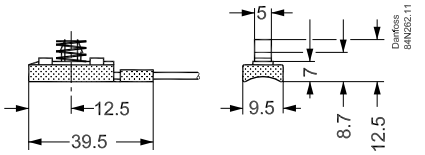
AKS 11, AKS 12, AKS 21, AK-HS 1000

°C	ohm	°C	ohm
0	1000.0		1000.0
1	1003.9	-1	996.1
2	1007.8	-2	992.2
3	1011.7	-3	988.3
4	1015.6	-4	984.4
5	1019.5	-5	980.4
6	1023.4	-6	976.5
7	1027.3	-7	972.6
8	1031.2	-8	968.7
9	1035.1	-9	964.8
10	1039.0	-10	960.9
11	1042.9	-11	956.9
12	1046.8	-12	953.0
13	1050.7	-13	949.1
14	1054.6	-14	945.2
15	1058.5	-15	941.2
16	1062.4	-16	937.3
17	1066.3	-17	933.4
18	1070.2	-18	929.5
19	1074.0	-19	925.5
20	1077.9	-20	921.6
21	1081.8	-21	917.7
22	1085.7	-22	913.7
23	1089.6	-23	909.8
24	1093.5	-24	905.9
25	1097.3	-25	901.9
26	1101.2	-26	898.0
27	1105.1	-27	894.0
28	1109.0	-28	890.1
29	1112.8	-29	886.2
30	1116.7	-30	882.2
31	1120.6	-31	878.3
32	1124.5	-32	874.3
33	1128.3	-33	870.4
34	1132.2	-34	866.4
35	1136.1	-35	862.5
36	1139.9	-36	858.5
37	1143.8	-37	854.6
38	1147.7	-38	850.6
39	1151.5	-39	846.7
40	1155.4	-40	842.7
41	1159.3	-41	838.8
42	1163.1	-42	835.0
43	1167.0	-43	830.8
44	1170.8	-44	826.9
45	1174.7	-45	822.9
46	1178.5	-46	818.9
47	1182.4	-47	815.0
48	1186.3	-48	811.0
49	1190.1	-49	807.0
50	1194.0	-50	803.1

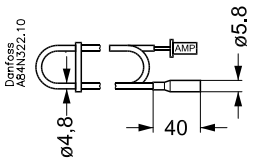
approx. 3.9 ohm/K

The tolerance of a Pt 1000 sensor is less than ±(0.3 + 0.005 T).
This translates into a temperature error of less than 0.5 degree for refrigeration control.

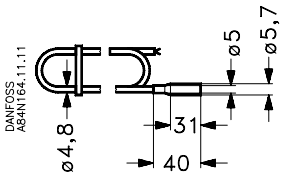
AKS 11



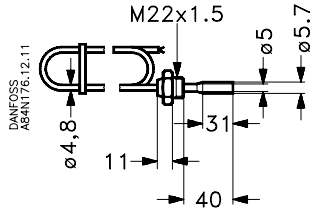
AKS 12



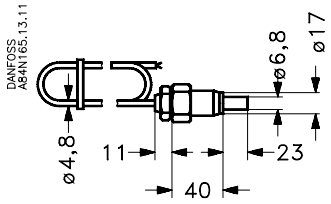
AKS 21A,
AKS 21M



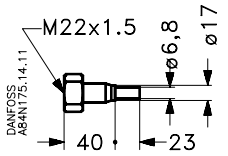
AKS 21W



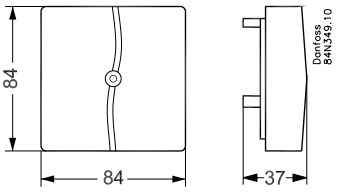
AKS 21W
welded version



Pocket in welded version
for AKS 21W



Product sensor
for HACCP
AK-HS 1000



Sensors with AMP plug:
connector type AMP ital mod 2, housing 280 358,
crimp contacts type 280 708-2

ENGINEERING
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Pressure transmitters
AKS 32, AKS 33, AKS 32R, AKS 2050

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Pressure transmitters
AKS 32, AKS 33, AKS 32R, AKS 2050

Introduction

AKS 32 and AKS 33 are pressure transmitters that measure a pressure and convert the measured value to a standard signal:
- 1 → 5 V DC for AKS 32
- 4 → 20 mA for AKS 33

AKS 32R and AKS 2050 are ratiometric pressure transmitters that convert the measured pressure to a linear output signal. The minimum value of the output signal is 10% of the actual supply voltage. The maximum value is 90% of the actual supply voltage.

With a supply voltage of 5 V, this yields a linear output signal with a value of:
- 0.5 V at the minimum pressure of the pressure transmitter;
- 4.5 V at the maximum pressure of the pressure transmitter.

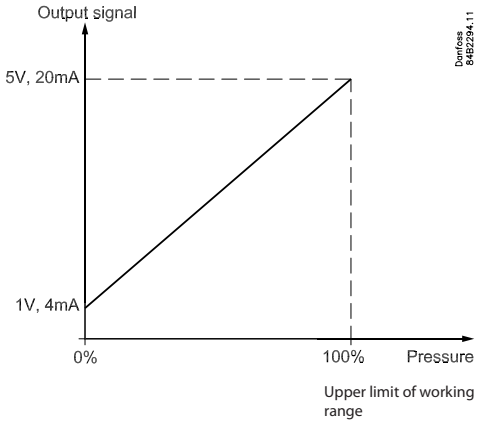
Application
- A/C systems
- Refrigeration systems
- Process control
- Laboratories

Advantages

- Advanced sensor technology enables high pressure control accuracy, which essential for precise and energy-efficient capacity regulation in refrigeration systems
- Temperature compensation for low-pressure and high-pressure pressure transmitters specifically designed for refrigeration systems:
  - *Low pressure:*
    -30 – 40 °C (≤16 bar)
  - *High pressure:*
    0 – 80 °C (>16 bar)
- Compatible with all refrigerants, including ammonia, for reduced parts inventory and greater application flexibility
- Effective moister protection allows the sensors to be used in very harsh environments, such as a suction line surrounded by ice
- Robust construction provides protection against mechanical factors as shock, vibration, and pressure surges. AKS sensors can be fitted directly on the system components
- No adjustment is necessary. Thanks to the advanced sensor technology and sealed gauge construction, the accuracy of the factory calibration is maintained regardless of changes in ambient temperature and atmospheric pressure. This is essential for reliable control of evaporating pressure in air conditioning and refrigeration systems
- Built-in voltage regulator
- EMC protection compliant with the EU EMC Directive (CE marking)
- UL approved

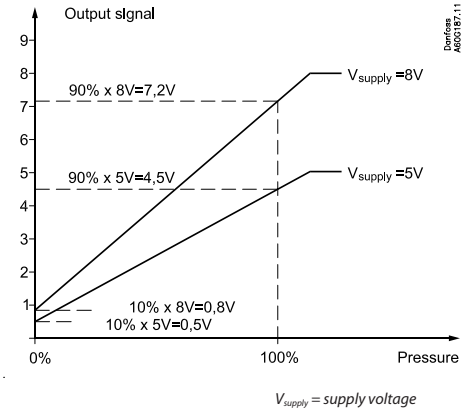
Output signal

AKS 32, AKS 33



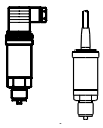
AKS 32R, AKS 2050

The plot shows the relationship between the AKS 32R (or AKS 2050) output signal from , the supply voltage and the pressure.

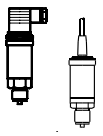


Ordering data

AKS 32, version 1 – 5 V

	Operating range [bar]	Allowable working pressure PB [bar]	Compensated temperature range [°C]	Code no.		
				EN 175301-803 plug Pg 9		
				¼ NPT [1]	G ⅜ A [2]	¼ flare [3]
	-1 – 6	33	-30 – 40	**060G2000**	**060G2004**	**060G2068**
	-1 – 12	33	-30 – 40	**060G2001**	**060G2005**	**060G2069**
	-1 – 20	40	0 – 80	**060G2002**	**060G2006**	**060G2070**
	-1 – 34	55	0 – 80	**060G2003**	**060G2007**	**060G2071**
	-1 – 50	100	0 – 80			**060G2155**

AKS 33, version 4 – 20 mA

	Operating range [bar]	Allowable working pressure PB [bar]	Compensated temperature range [°C]	Code no.					
				EN 175301-803 plug Pg 9			Cable		
				¼ NPT [1]	G ⅜ A [2]	¼ flare [3]	¼ NPT [1]	G ⅜ A [2]	¼ flare [3]
	-1 – 5	33	-30 – 40	**060G2112**	**060G2108**	**060G2047**			
	-1 – 6	33	-30 – 40	**060G2100**	**060G2104**	**060G2048**		**060G2120**	
	-1 – 9	33	-30 – 40	**060G2113**	**060G2111**	**060G2044**			**060G2062**
	-1 – 12	33	-30 – 40	**060G2101**	**060G2105**	**060G2049**	**060G2117**		
	-1 – 20	40	0 – 80	**060G2102**	**060G2106**	**060G2050**	**060G2118**		
	-1 – 34	55	0 – 80	**060G2103**	**060G2107**	**060G2051**	**060G2119**		**060G2065**
	0 – 16	40	0 – 80	**060G2114**	**060G2109**				
	0 – 25	40	0 – 80	**060G2115**	**060G2110**	**060G2045**		**060G2127**	**060G2067**

Pressure transmitters, types AKS 32, AKS 33, AKS 32R, AKS 2050

AKS 32R, AKS 2050

	Type	Operating range [bar]	Allowable working pressure PB [bar]	Compensated temperature range [°C]	Code no.				
					1/4 NPT 1)	G 3/8 A 2)	1/4 flare 3)	3/8 solder	1/4 female flare 4)
	AKS 32R	-1 – 12	33	-30 – 40	**060G1037**	**060G1038**	**060G1036**	**060G3551**	**060G6323**
		-1 – 34	55	0 – 80			**060G0090**	**060G3552**	**060G6341**
	AKS 2050	-1 – 59	100	-30 – 40	**060G6342**	**060G5750**		**060G6408**	
		-1 – 99	150	-30 – 40	**060G6343**	**060G5751**			
		-1 – 159	250	0 – 80	**060G6344**	**060G5752**			
	Mating plug with 5 m cable (rated IP 67 when fitted to pressure transmitter)				**060G1034**				
	Plug Pg 9				**060G0008**				

1) 1/4 – 18 NPT.
2) Thread ISO 228/1 - G 3/8 A (BSP).
3) 7/16 – 20 UNF.
4) With depressor pin for Schraeder valve. 7/16 – 20 UNF.

Compact pressure transmitter for CO_2

Advantage:
- Designed for CO_2 plants
- Compact design
- High accuracy

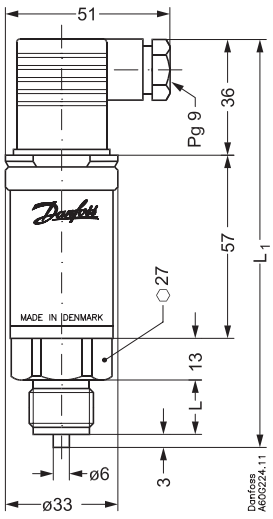
Additional information available:
Technical brochure: AI225286434835

MBS 8250	Operating range [bar]	Allowable working pressure PB [bar]	Compensated temperature range [°C]	Signal	Code no.
					1/4 NPT 1)
	-1 – 159	250	-20 – 100	Ratiometric	**064G1131**
				4 – 20 mA	**064G1132**
	Round Packard Metri-Pack. Connection plug with 10 m cable				**064G0910**

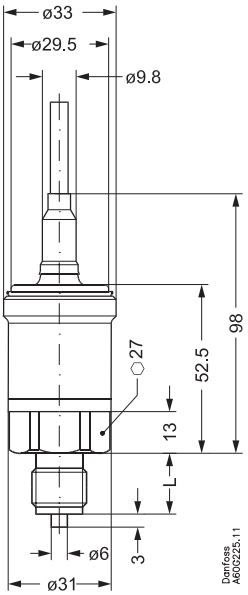
Dimensions and weights

AKS 32, AKS 33

Version with EN 175301-803 plug Pg 9



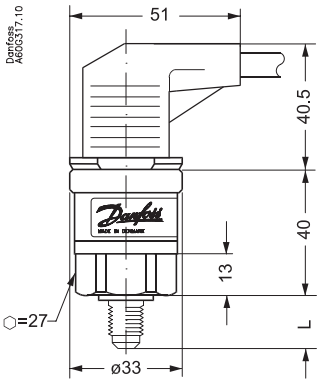
Cable version

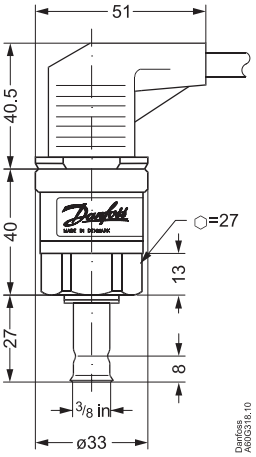


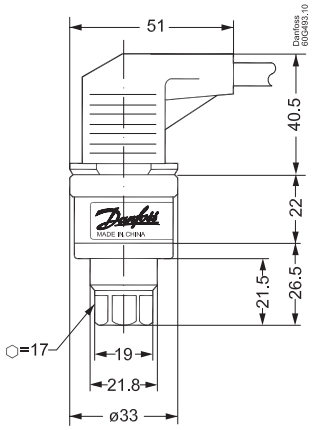
Pressure connection	¼ – 18 NPT	G ⅜ A ISO 228/1	¼ in. flare 7/16 – 20 UNF
L_1 [mm]	122	127	122.5
L [mm]	16	18	16.5

Weight approx. 0.3 kg

AKS 32R, AKS 2050







Pressure connection	¼ – 18 NPT	G ⅜ A ISO 228/1	¼ in. flare 7/16 – 20 UNF	⅜ Solder
L [mm]	16	21	16.5	30

Weight approx. 0.15 kg

Additional information available:
AKS 32 and AKS 33
Technical brochure: AI191486421667
AKS 32R and AKS 2050
Technical brochure: AI215486424533

MBS 8250
Technical brochure: AI225286434835