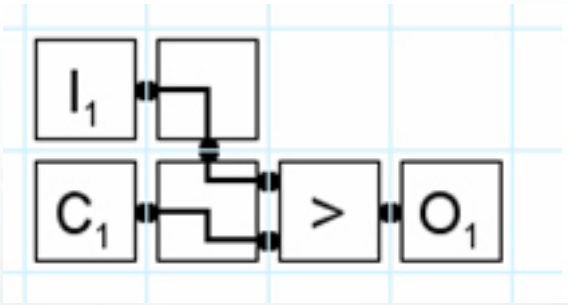ENGINEERING
TOMORROW

Danfoss

User Guide

AK-SM 720 — Boolean logic

ADAP-KOOL® Refrigeration control systems

Application

The function is contained in System manager type AK-SM 720 and can be used for user-defined functions.
The functions can be defined on the basis of the given inputs and outputs, and are limited by the number of the aforementioned inputs and outputs and the grid size.
The user defines the function required. The user must be sufficiently familiar with Boolean logic. Danfoss cannot be held liable for the set-up of the functions.

The logic can be constructed using signals from the following:
- Direct inputs
 • 4 Pressure inputs (AI)
 • 4 Temperature inputs (AI)
 • 2 Voltage inputs (AI)
 • 32 Digital inputs (DI)
- Selected application functions
 • e.g. day/night control, defrosting, light control, etc.
- Internal variables
• 8 Constants
• 16 Temporary variables

The logic can activate the following signals:
- Direct outputs
 • 2 Analogue outputs (AO)
 • 32 Relay outputs (DO)
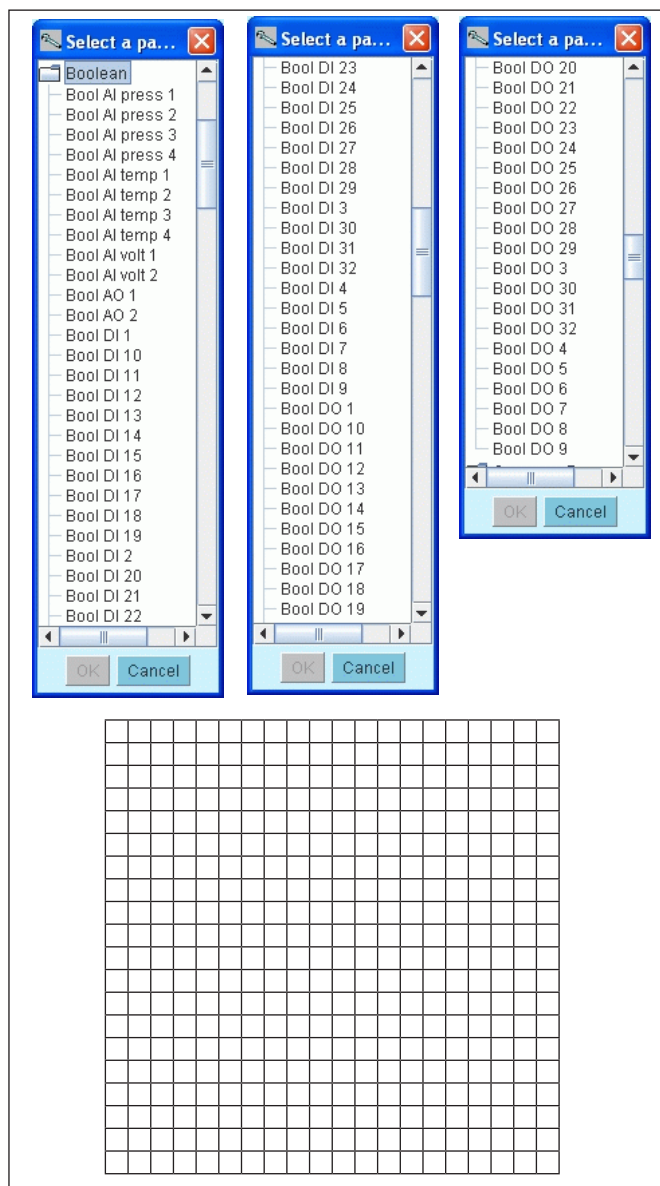*- Selected application settings*

Grid size:
- 20 x 20 fields

Note!
The total number of outputs and Inputs which can be connected to a AK-SM 720 is 80 pcs.
See AK-SM 720 manual for further details.

Select a pa...	Select a pa...	Select a pa...
Boolean	Bool DI 23	Bool DO 20
Bool AI press 1	Bool DI 24	Bool DO 21
Bool AI press 2	Bool DI 25	Bool DO 22
Bool AI press 3	Bool DI 26	Bool DO 23
Bool AI press 4	Bool DI 27	Bool DO 24
Bool AI temp 1	Bool DI 28	Bool DO 25
Bool AI temp 2	Bool DI 29	Bool DO 26
Bool AI temp 3	Bool DI 3	Bool DO 27
Bool AI temp 4	Bool DI 30	Bool DO 28
Bool AI volt 1	Bool DI 31	Bool DO 29
Bool AI volt 2	Bool DI 32	Bool DO 3
Bool AO 1	Bool DI 4	Bool DO 30
Bool AO 2	Bool DI 5	Bool DO 31
Bool DI 1	Bool DI 6	Bool DO 32
Bool DI 10	Bool DI 7	Bool DO 4
Bool DI 11	Bool DI 8	Bool DO 5
Bool DI 12	Bool DI 9	Bool DO 6
Bool DI 13	Bool DO 1	Bool DO 7
Bool DI 14	Bool DO 10	Bool DO 8
Bool DI 15	Bool DO 11	Bool DO 9
Bool DI 16	Bool DO 12	
Bool DI 17	Bool DO 13	OK Cancel
Bool DI 18	Bool DO 14	
Bool DI 19	Bool DO 15	
Bool DI 2	Bool DO 16	
Bool DI 20	Bool DO 17	
Bool DI 21	Bool DO 18	
Bool DI 22	Bool DO 19	
OK Cancel	OK Cancel	

Content

Function units

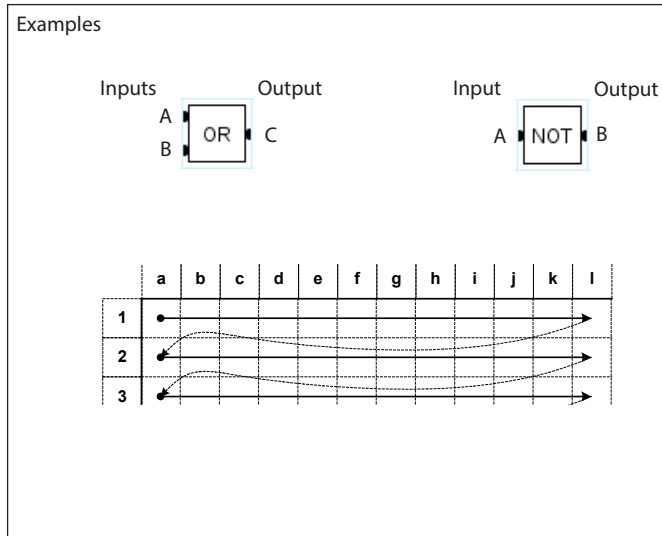Depending on the type, a function unit can:
• Read an input value
• Perform a calculation
• Forward a value
• Save a set (constant) value
• Save a temporary value
• Activate an output

Contact points
A function unit may have several contact points, which function as inputs and outputs depending on the type.

Signal path
The individual function units are assembled to form a collective function in a grid. Each function unit is executed one by one. Reading takes place from left to right and then down. (The program runs through a complete line before it continues onto the next line.)

Inputs

Input signal
E.g. a temperature on an input, a digital signal or the signal from a function.

Internal variable where a temporary calculation can be used. (Boolean or floating point value)

Internal constant (Boolean or floating point value)

Output

Output
E.g. a function, a voltage signal or a relay

Internal variable where a temporary calculation can be saved. (Boolean or floating point value)

Logical calculations

And
C = A AND B

OR
C = A OR B

NOT
B = NOT A

DELAY
Delays a "TRUE" signal for a number of seconds.
The delay period starts every time the input becomes "TRUE".
The input must be "TRUE" throughout the entire delay period in order for the output to become "TRUE".

Mathematical calculations

Addition
C = A + B

Subtraction
C = A - B

Division
C = A / B

Multiplication
C = A x B

Greater than
If A > B then C = TRUE, else C = FALSE

Greater than or equal to
If A >= B then C = TRUE, else C = FALSE

Min.
The smaller value of two input values is reproduced on the output
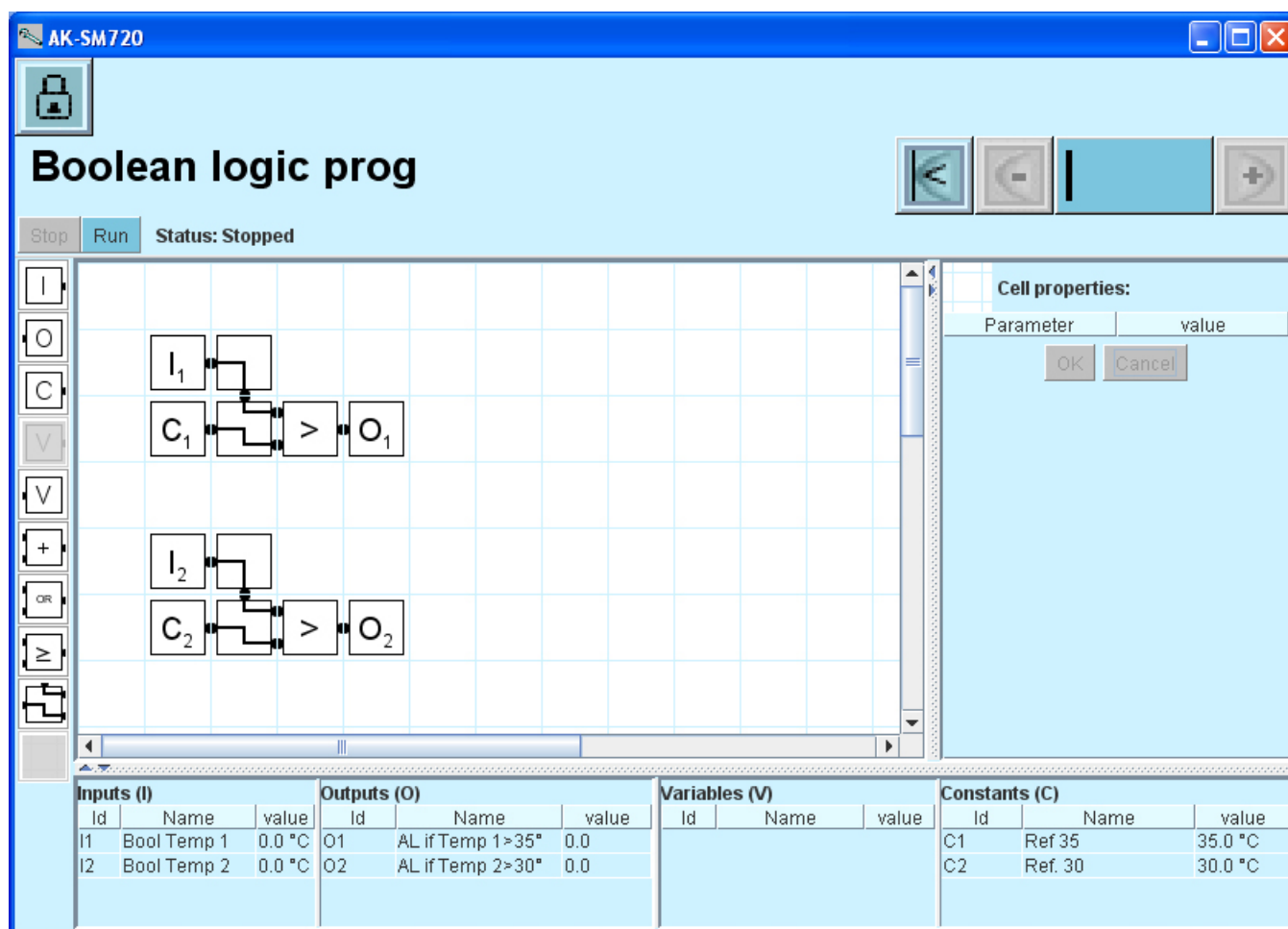If A > B then C = B, else C = A

Max.
The larger value of two input values is reproduced on the output
If A > B then C = A, else C = B

Avg.
The average of two input values is reproduced on the output.
C = (A + B) /2

Configuration

Procedure:

1. Highlight a field

2. Insert one of the elements that are shown in the left-hand column (if you select the wrong element, or later want to move the elements around, you can overwrite an element by inserting the "empty" element in place).

3. The settings for the element must then be made. These settings are performed in the right-hand half of the screen. The next page shows the various settings for the elements.

   Constants can be changed during operation. Everything else can only be changed when the logic is stopped.

4. Finally, the functions must be started when the configuration has been completed. Press the "Run" button at the top of the screen.

At the bottom of the screen you can see the status of all the defined elements.

Units for pressure and temperature
e.g. Bar, °C, Psig, °F
All settings and calculations are performed in bar and °C.
They can then be converted to a different unit at a later date.

There are different settings according to which element is defined.

The program will suggest the next number in the series, but if you want a different reference you can change it here.

• Select Input reference
• Type in name
• Select parameter
• Set "Refresh rate"
• Select Unit
• Press OK
• Remember also to set I/O configuration

During I/O configuration, the position of the connection must be defined.

• Select Output reference
• Type in name the name is also entered in the output reference)
• Press OK
• Remember also to set I/O configuration

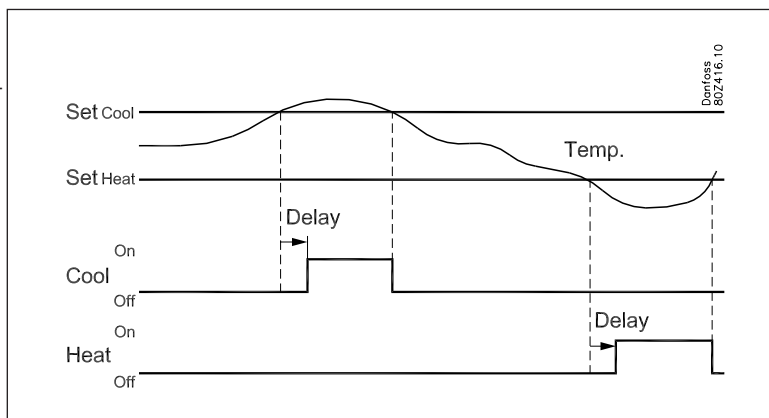During I/O configuration, the position of the output must be defined.

• Type in name
• Select unit (if necessary)
• Press OK

• Type in name
• Select unit
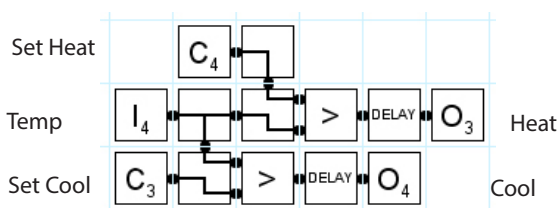• Set value
• Press OK

Examples

Thermostat (heating and cooling)

• If the temperature becomes higher than the set tempera-
  ture for cooling, the relay for cooling will be activated.
• If the temperature becomes lower than the set tempera-
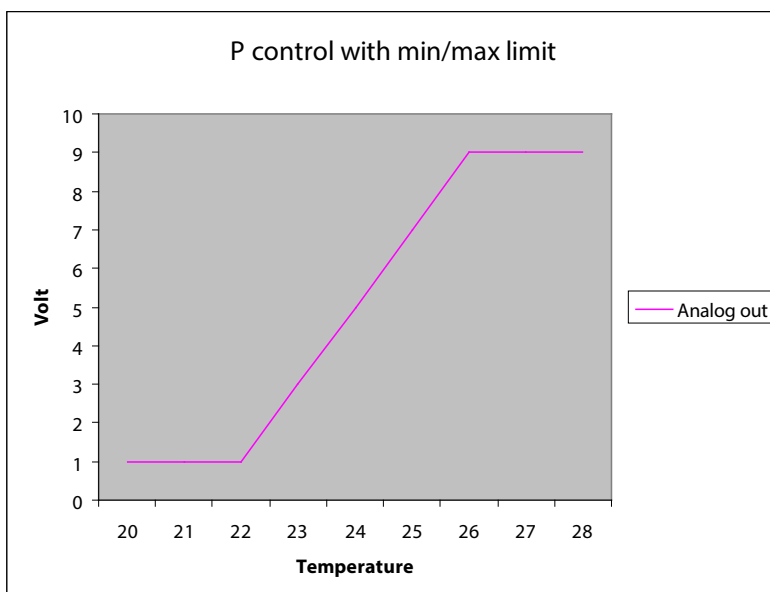 ture for heating, the relay for heating will be activated.

Ref.	Parameter	Unit	Value	I/O
I$_4$	Bool AI temp 1	Temp		x.x
C$_3$		Temp	30	
C$_4$		Temp	2	
O$_3$	Bool DO 1			x.x
O$_4$	Bool DO 2			x.x
Delay			120 sec	
Delay			180 sec.	

Convert a sensor signal to a voltage signal

I3 temperature (AI1)
C3 reference (22ºC)
C4 amplification (2)
C5 minimum lower voltage (1)
C6 maximum upper voltage (9)
O9 analog output 0-10 V (1-9 V)

P control with min/max limit

Ref.	Parameter	Unit	Value	I/O
I_3	Bool AI temp 1	Temp		x.x
C_3		Temp	22	
C_4		None	2	
C_5		None	1	
C_6		None	9	
O_9	Bool AO 1			x.x