LOGO! 8
Heater and
Fan Control
(CO2 and %RH)
for KNX

LOGO! 8, LOGO! CMK2000

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Table of Contents

1 Introduction

This application example offers you a complete heater and fan control function for LOGO! 8. It is a solution approach that you can easily modify or expand using the LOGO! 8 functions.

The integrated functions of a LOGO! 8 offer many options for quick and easy solutions for automation tasks. Pre-programmed function blocks support you when creating a project, e.g. week timer, pulse generator, astro timer, yearly timer, stopwatch and simple logic gates.

The LOGO! text display unit (TDE) and the integrated LOGO! 8 web server offer additional options for control and monitoring with function keys and message texts.

The communication module CMK2000 from Siemens provides a solution for communication in building automation with LOGO! 8. The communication module enables communication between a LOGO! 8 and any KNX device via the KNX building system bus.

Figure 1-1: Hardware setup for the application example
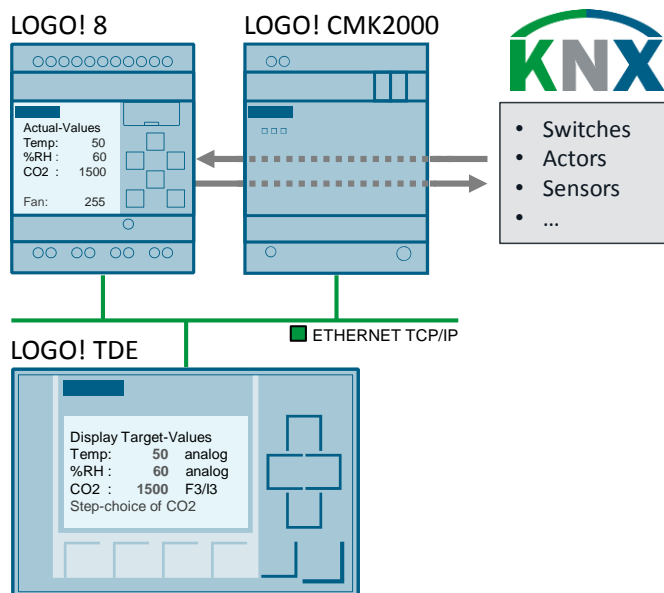
Advantages

The combination of the logic function in LOGO! 8 and the CMK2000 module offers you the following advantages:

- Task can easily be expanded with additional functions
- This task can be combined with other independent tasks
- Integration of LOGO! inputs and output into a KNX system

Target group

This application example is aimed at experienced KNX users who seek to expand their KNX system with the functionalities of a LOGO! 8.

1.1 Task definition and functional description

This application example combines a heater and fan control.

Both controllers require the evaluation of the difference between actual value and setpoint value.

This means a heater is switched on until the room temperature has reached the set temperature.

A room of 15 °C (actual value) and a set temperature of 25 °C (setpoint value) results in a difference of +10 °C. An actual value of 30 °C and a setpoint value of 20 °C results in a difference of -10 °C. As a heater cannot lower the room temperature, the output value is set to 0 in case of a negative difference. You can expand the application example with an air conditioning system to lower the room temperature.

In the same manner, negative deviations for the CO_2 ratio and for the ratio of the relative air humidity are set to 0. Relative humidity will be abbreviated "%RH".

The fan controller lowers the CO_2 content and the relative humidity until a comfortable room climate is achieved.
Table 1-1 shows the setting range for the setpoint value specifications of the room air parameters and a proposed comfort level according to Leusden and Freymark.

The fan is to be operated with four speed levels. The speed level depends on the deviation of the CO_2 value and the deviation of the relative humidity. The fan control, however, only observes the room air parameter with the bigger deviation. This ratio is referred to as priority logic in the switching program.

From a CO_2 value of 4000 ppm (parts per million), an alarm message is to be output.

Table 1-1: Value ranges for the room air parameters to be set

Room air parameters	Setpoint value range	Note
Temperature	10–30 °C	Heater is on until the actual value reaches the setpoint value
Relative air humidity	20–80 %	Fan speed depends on the two room air parameters.
CO_2 value of room air	400– 1000 ppm	
The higher the room temperature, the lower the air humidity should be set. Comfort values according to Leusden and Freymark Room temperature: 18 °C - 25 °C Relative humidity: 70 % - 30 %		

Note	The comfort limit according to Leusden and Freymark show a curve between the room temperature and the relative humidity. The correlations contained in the chart are not part of this application example.

1.2   Components used

This application example was created with the components from .

Sensor (AQR2535) was used as a KNX room sensor. This sensor determines the relative humidity of the room air, but not the CO_2 value. To do this, you need sensor version (AQR2576).

The CO_2 value is implemented in the LOGO! switching program via an analog input of the LOGO!.

In the application example, the temperature sensor of the KNX room control unit is used. The KNX room sensor has its own temperature sensor which is not used, however.

Table 1-2: Hardware and software components for the application example

Component	Number	Article number	Note
LOGO! Soft Comfort V8.1	1	6ED1058-0BA08-0YA1	Upgrade to V8.1 can be found at http://www.siemens.com/logo
ETS5 Demo A maximum of 5 KNX devices per project	1	Download	https://www.knx.org/knx-en/software/ets/download/index.php
LOGO! Power	1	6EP3332-6SB00-0AY0	-
LOGO! 8 12/24 RCE	1	6ED1052-1MD00-0BA8	-
LOGO! CMK2000	1	6BK1700-0BA20-0AA0	Product data base ETS5: http://www.siemens.com/gamma-td
LOGO! TDE	1	6ED1055-4MH00-0BA1	Optional components
Siemens GAMMA KNX Power Supply	1	5WG1 125-1AB12	-
Siemens GAMMA KNX bus coupler	1	5WG1 117-2AB12	-
Siemens GAMMA KNX room control unit	1	5WG1 2272AB11	Product data base ETS5: http://www.siemens.com/gamma-td
Siemens GAMMA KNX 3-Gang Button	1	5WG1 223-2DB13	Product data base ETS5: http://www.siemens.com/gamma-td
Siemens GAMMA KNX/IP interface	1	5WG1 148-1AB12	Required for programming the KNX devices. Alternatively: USB interface
In-wall room sensor KNX AQR257 basic module AQR253 front module (CO2 only AQR 2576)	1	HVAC AQR257 HVAC AQR253 Without CO_2 AQR2535 With CO_2 AQR2576	Product data base ETS5: http://www.siemens.com/gamma-td

This application example consists of the LOGO! and ETS programs.

Table 1-3: Components for the application example

Component	File name	Note
Documentation	109745699_LOGO8_Heat-_CO2-%RH-FanControl_DOC_en.pdf	-
LOGO! 8 programs	109745699_LOGO8_Heat-_CO2-%RH-FanControl.lsc	Requirement: LOGO! Soft Comfort V8.1
ETS5 projects	109745699_LOGO8_Heat-_CO2-%RH-FanControl_en.knxproj	Requirement ETS5 software

1.3 Hardware setup

Figure 1-2 shows the hardware setup for this application example. The assignment of the digital input and output signals of LOGO! 8 can be found in Table 1-5.

The assignment of the KNX communication objects and the group addresses can be found in Table 1-6.

Figure 1-2: Hardware configuration for the heater and fan control
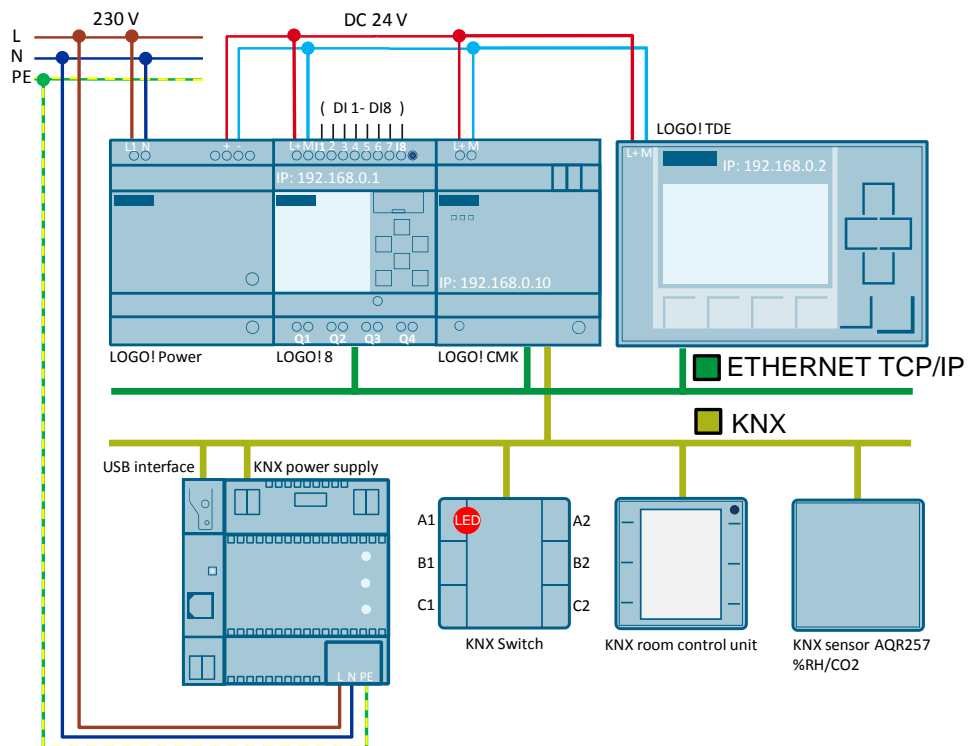
Note	LOGO! TDE is an optional component. You can also use its functions (message texts and function buttons) via the integrated LOGO! web server.

1.4 LOGO! program

The LOGO! program consists of individual controls for the operation of the heater and fan.

Individual functions and the message texts were moved to other program pages in the switching program of the LOGO! Soft Comfort to ensure readability in the switching program. Use the LOGO! Soft Comfort simulation function for a graphic display of the dependencies in the switching program for a better understanding. Active connections (high signals) are displayed in red, passive connections in blue.

<table>
<tr>
<td>Note</td>
<td>A functional description of the logic function can be found as a comment of the switching program under LOGO! Soft Comfort:
> "Tools" > "Select Hardware" > "Offline settings" > "Comment".

Tip: Activate the "Comment" option box under "Tools" > "Options" > "Print" for the function description to be printed together with the program.</td>
</tr>
</table>

Switch-on function and setpoint value specification

Figure 1-4 shows the central switch-on function of the overall control at position (1). If, for example, you want to switch on the control while you are on the move, then use the [F2] button via the LOGO! web server. The connection of KNX button A1 is configured via the flag [M41].

Select the input mode for entering the setpoint value at position (2).
If the current surge relay [B036] is deactivated, set the setpoint values via the KNX or analog value inputs. In case of an active signal to [B036], enter the setpoint values directly at the LOGO! TDE or the web server. The input mode is changed and the background lighting of the LOGO! display and the LOGO! TDE turns yellow.

Figure 1-3: LOGO! switching program (central control and setpoint value input)
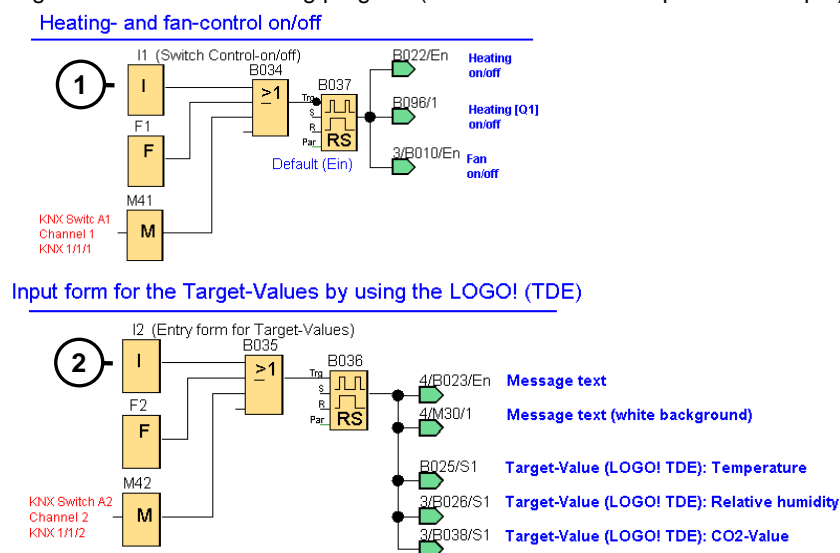
Temperature control

The switching program in LOGO! Soft Comfort Figure 1-4 (top right) was divided at position (A) for a better overview.

The actual value of the temperature control is recorded by an external sensor at position (1). This signal is recorded in the switching program by the KNX room control unit via KNX at the analog network input [NAI1]. The setpoint value is set at the KNX room control unit and recorded at [NAI4].

Block [B001] generates a temperature difference signal and forwards this via (A) to block [B022]. This temperature difference can be individually modified by the arithmetic function.

The subsequent threshold switches (2) limit the temperature difference to a value range between 0°C and 100°C. Only a positive difference is therefore output at [AM21]. This value can be further processed via KNX. In the switching program, this value is sent to the KNX room control unit (3) for display.

Output [Q1] is set until the actual temperature reaches the setpoint temperature.

Figure 1-4: LOGO! switching program (heater control)
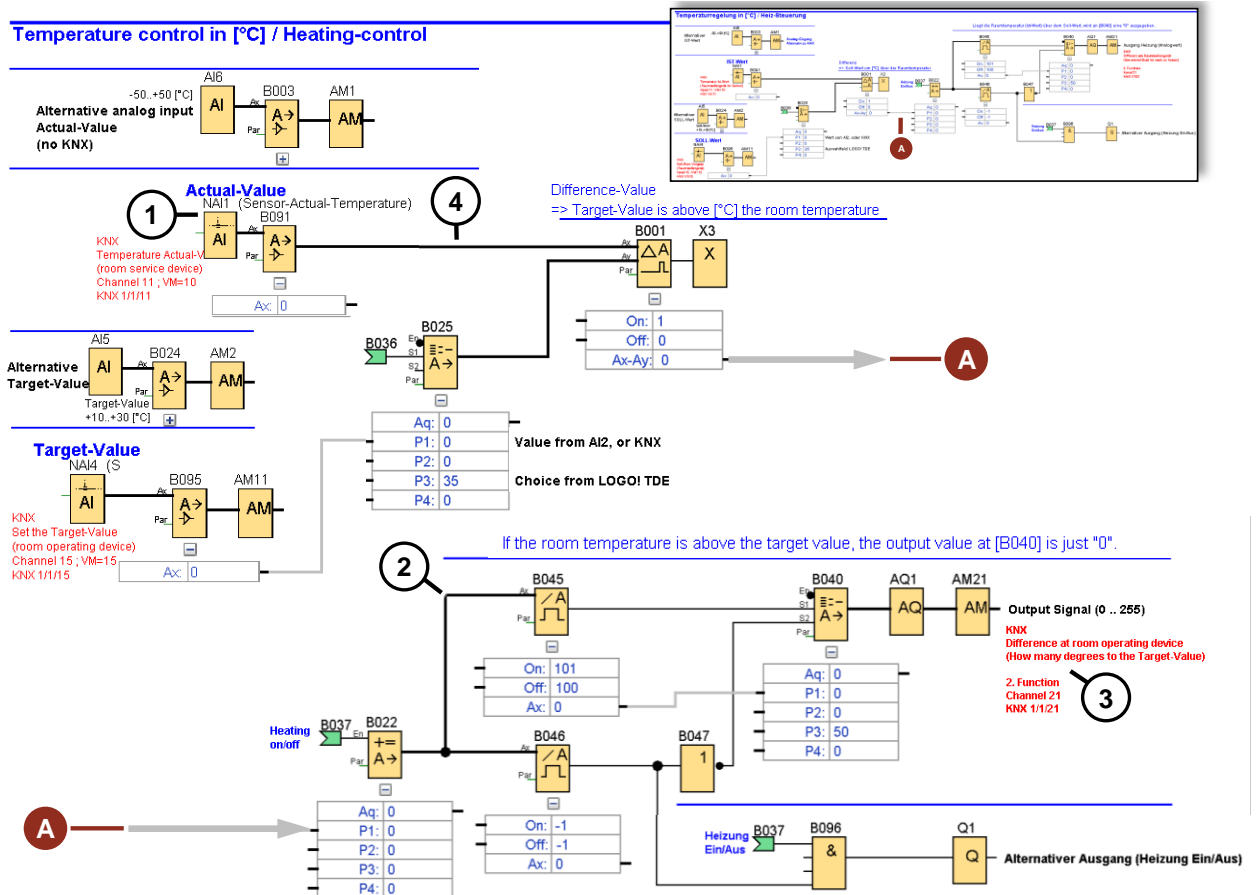
Note	To be able to connect an analog temperature sensor at the input side, you have to disconnect [B091] and [B001] at position (4) in the switching program. Connect the output of [B003] with [B001]. Connect the open output [B091] with the analog flag [AM1].
	The setpoint specification is configured at the room control unit via the freely configurable "1st function".

Fan control

The fan control (Figure 1-5) records the two room air parameters %RH (1) and CO_2 content (2) with sensors.

The actual value for %RH is recorded by the KNX room sensor AQR257 and sent to the LOGO! [NAI2] via KNX. The setpoint value is specified via the analog input [AI1] of the LOGO!.

The actual value of the CO_2 content in the room air is recorded by a sensor at the analog input [AI2] of the LOGO!. The setpoint value is set in steps via jog mode at [I3] or [F3].

The deviations resulting from the actual value minus the setpoint value is processed for both room air parameters. Negative values for the deviation are standardized to 0 in the fan control.

The priority logic (3) compares the two deviations and controls the level of the fan speed (0 to 255) accordingly. For the interrelation, please refer to the task in chapter 1.1.

You can, as with the heater control, connect the input signals via KNX or the analog input in the LOGO! switching program.

Figure 1-5: LOGO! switching program (fan control)
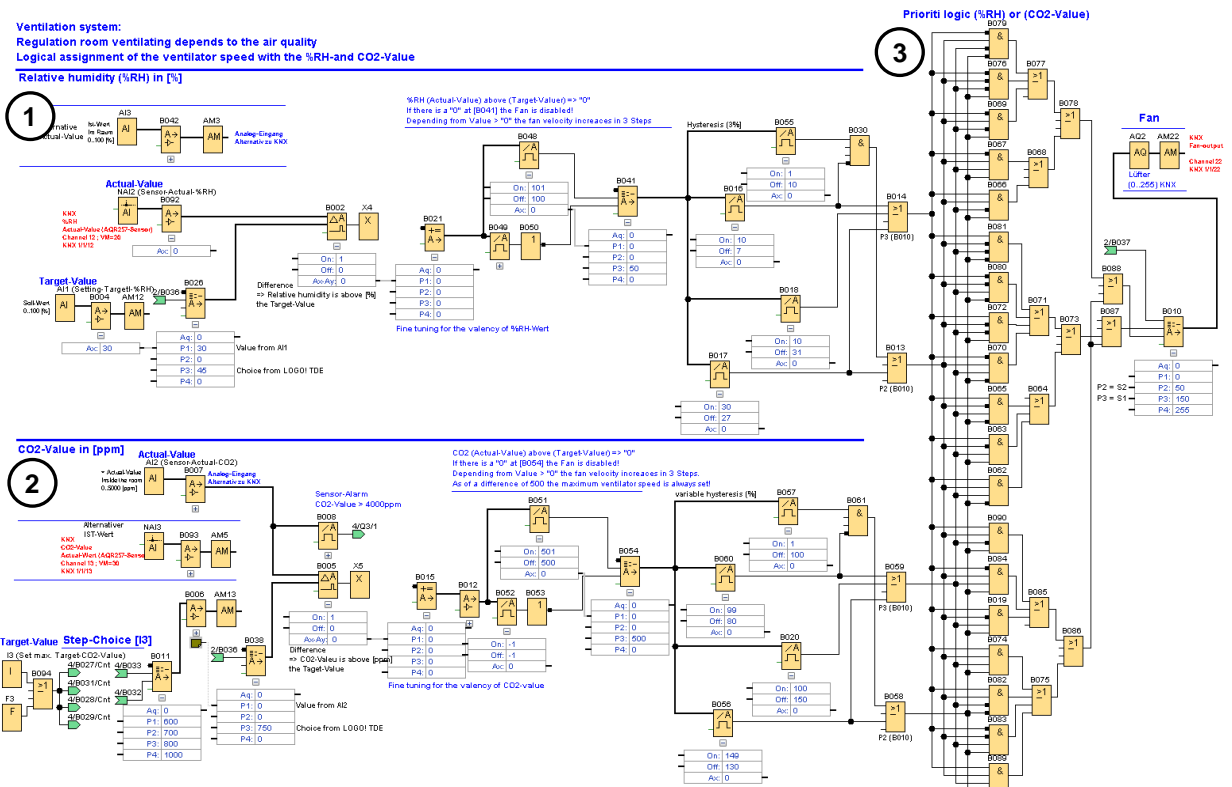
Note	The "difference" was determined for the temperature (setpoint value minus actual value). The "deviation" is used for the %RH/CO_2 control (actual value minus setpoint value).

The deviation (actual value minus setpoint value) is determined for both room air parameters (%RH and CO_2 value). The simplified interconnection Figure 1-6 shows this for the relative humidity using percentage values.

The measured actual value is 71% at position (1) and the setpoint value was set to 40%. This results in a difference value of 31% (2). For difference values %RH>30%, the highest fan stage is set to the maximum value 255 (3).

The switching values of the fan stages are defined in the internal parameters of the threshold value blocks. To avoid constant changes of the fan stage, a switching hysteresis has been set by the switch-off parameters of the blocks. This means the fan stage switches to 255 from 31%, but is only switched back to 150 when below 27%.

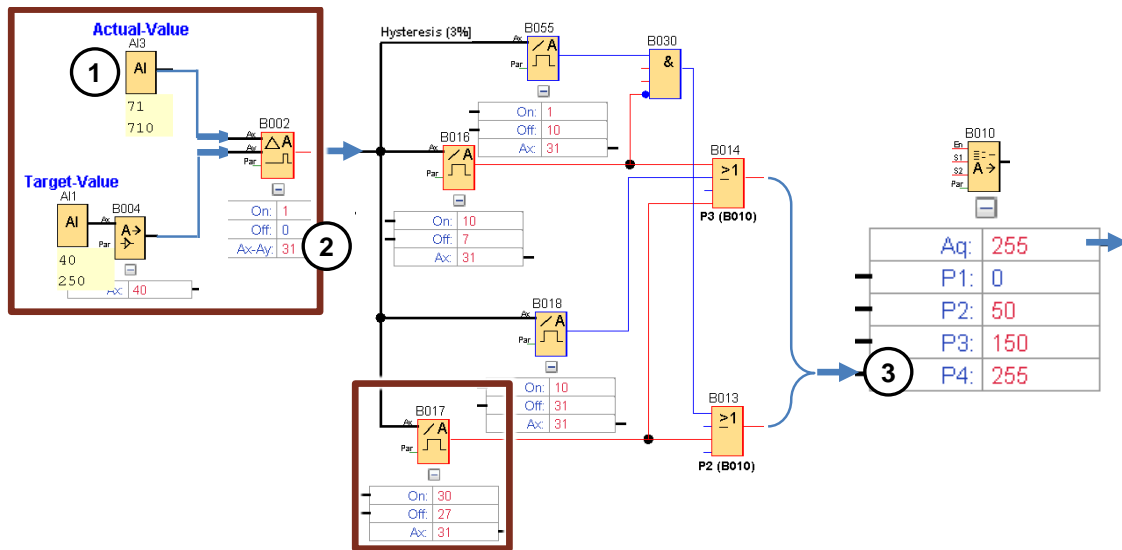Figure 1-6: LOGO! switching program (fan control ratio of the %RH)

Table 1-4: Fan stage and preset switching thresholds in the switching program

Fan stage	Difference value %RH	Difference value CO_2	Comment
50	from 01%	from 001ppm	The room air parameter with a negative evaluation is preferably used for the fan stage due to the priority logic. (See Figure 1-5)
150	from 10%	from 100ppm	
255	from 30%	from 150ppm	

The use of the priority logic Figure 1-5 (3) results in the higher fan stage to be used.

Example 1:

- The difference value of the CO_2 content is at 120ppm, which sets the fan stage to 150. The difference value for the %RH is at 8%, which would correspond to a fan stage of 50. The priority logic keeps the fan stage value at 150.

Example 2:

- If the %RH difference value is at 11% and the difference value of the CO_2 decreases to 0ppm, the fan stage remains at 150. But if the CO_2 difference value rises to 101ppm, the fan stage increases to 255, independent of the value of the %RH.

**Special function and message texts in the switching program**

Figure 1-7 shows a switching example for a value specified by jog mode as a special function.

If [I3] or [F3] are pressed, the four values of analog multiplexers are switched on subsequently one after the other.

These are preset setpoint values for the CO_2 content of the room air. The preset setpoint values are shown in [ppm]:
(P1=600; P2=700; P3=800; P4=1000)

The message texts shows the actual, setpoint and difference values of the room air parameters which are described in detail in chapter 1.5.1.

Figure 1-7: Jog mode (preset CO2 value) and message texts
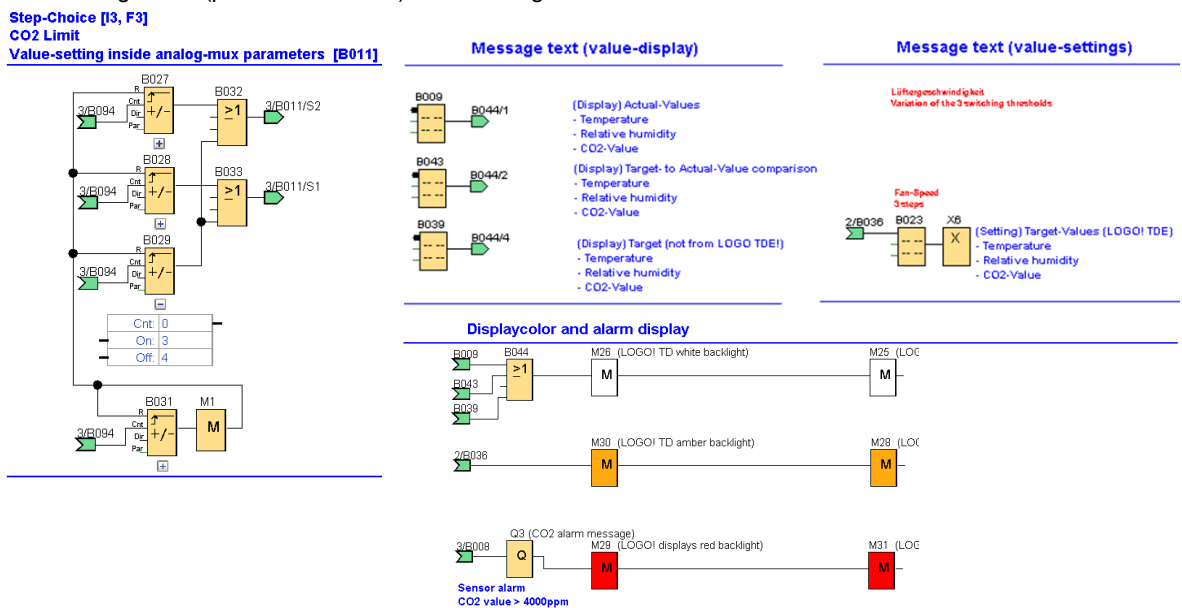
Digital input and output signals in the LOGO!

Table 1-5 shows the digital input and output signals of the switching program.

Table 1-5: Input and output signals in the LOGO! (Basic switching program)

Signals	Description
Input [I1], [F1], [M41]	Heater/fan control ON/OFF [F1]: Function button at the LOGO! TDE or the web server. [M41]: Signal from KNX button A1 to LOGO! (Table 1-6)
Input [I2], [F2], [M42]	Change input format of setpoint values [F2]: Function button at the LOGO! TDE or the web server. [M42]: Signal from KNX button A2 to LOGO! (Table 1-6)
Input [I3], [F3]	CO_2 setpoint specification in jog mode (4 stages)
Output [Q1]	Output signal for heater ON/OFF
Output [Q2]	CO_2 alarm for the room (CO_2 content > 4000 ppm)

1.5 Mounting the LOGO! into KNX

The LOGO! 8 is implemented into a KNX system via the LOGO! communication module CMK2000.

The bi-directional data exchange between LOGO! and the KNX devices is made via configurable communication channels of the LOGO! CMK2000. For the channels, you parameterize inputs and outputs, flags or variable memories (VM) as signals in the LOGO!.

The following Table 1-6 shows the signals of the LOGO! for this application example and the communication direction between LOGO! and KNX for the two switching programs in this application example. The ETS5 project included in the delivery contains the LOGO! CMK2000 configured for use with a specific KNX button.

Table 1-6: KNX group addresses and LOGO! channels for communication

Signals in the LOGO!	KNX Group address	Channel Communication between LOGO! and KNX	Description
Central switching and input format of setpoint specification			
Flags [M41]	1/1/1	KNX to LOGO! (Channel 1)	Heater/fan control ON/OFF KNX button A1 (upper left)
Flags [M42]	1/1/2	KNX to LOGO! (Channel 2)	Change input format of setpoint values KNX button A2 (upper right)
Temperature control / heater control			
[NAI1] VM10 (variable memory 10)	1/1/11	KNX to LOGO! (Channel 11)	Actual temperature value delivers sensor in KNX room control unit (Alternatively via AQR257)
[NAI4] VM15 (var. memory)	1/1/15	KNX to LOGO! (Channel 15)	Setpoint temperature value Input at KNX room control unit (1st function at room control unit)
Analog flag [AM21]	1/1/21	LOGO! to KNX (channel 21)	Difference value of the temperature (Only positive values, i.e. by how many degrees must be heated until setpoint value is reached) 2nd function at room control unit Value output (0 to 255)
Relative humidity and CO2 value / fan control			
[NAI2] VM20 (var. memory)	1/1/12	KNX to LOGO! (Channel 12)	Relative air humidity (actual value) at KNX sensor AQR257
[NAI2] VM30 (var. memory)	1/1/13	KNX to LOGO! (Channel 13)	CO_2 value (actual value) at KNX sensor AQR257
Analog flag [AM22]	1/1/22	LOGO! to KNX (channel 22)	LMX output for the fan Value output (0..255)

Note	In this application example, a 3-gang button with status LEDs and a room control unit with configurable functions are used for switching and displaying KNX signals.
	The setpoint temperature is specified via the KNX room control unit. The setpoint value of the %RH is specified at input [AI1]. The setpoint CO_2 value is specified at the digital input [I3] in jog mode.

1.5.1 Configuration of LOGO! CMK2000

Note In this application example, the KNX devices and the LOGO! communication module CMK2000 have been integrated into the ETS software as "devices".

The basic prerequisites for the signal exchange between LOGO! 8 and the KNX system bus are shown below.

The LOGO! CMK2000 communication module is configured via the ETS software.

Configuration of LOGO! CMK2000:

- General settings for LOGO! CMK2000 and the settings for the channels for the communication between LOGO! 8 and KNX are made in the "Parameters" window.

- Select the LOGO! basic module with which the signal and data exchange is to be performed in the general parameters.

- You have to assign valid IP addresses for the LOGO! base module and the LOGO! CMK2000.

- Enter a password for the web interface.

- One channel of the CMK2000 is configured in the ETS software for the direction "from LOGO! to KNX" and one for the direction "from KNX to LOGO!".

- The LOGO! CMK2000 communication channels must be connected with the group addresses of the KNX devices in the "Communication objects" window.

1.6   Message texts

In the message texts, you can place parameters of individual function blocks to view or configure them via the LOGO! display of the LOGO! basic module, the LOGO! TD or, as an option, via the web server.

The message texts in Figure 1-8 are designed with the LOGO! TDE placed beside the LOGO!. This means the actual values are displayed in the LOGO! display and the setpoint values are displayed in the LOGO! TDE for comparison.

The LOGO! arrow keys (up/down) are used to change the view in the LOGO! display to a comparison of the difference value between setpoint and actual value. For the temperature, the difference required until the room is heated up is displayed. For the %RH and the CO_2 value, the respective deviation is shown by which the actual value must be decreased to reach the setpoint value.

- The first message text (1) of the application example shows the actual values of the sensors.

- The second message text (2) shows the currently set values.

- The third message text (3) shows the difference values.

Figure 1-8: Message text structure
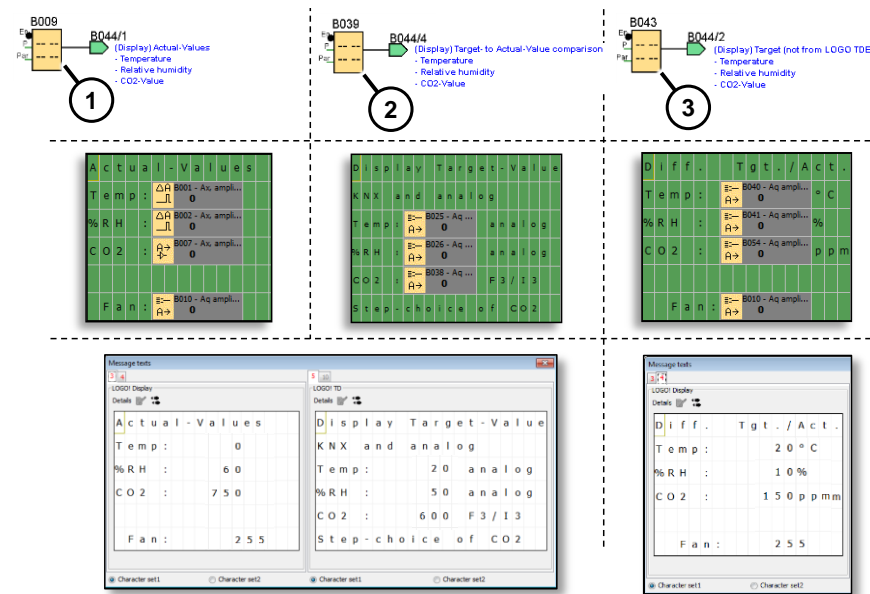
Use [I2], the LOGO TDE button [F2] or the KNX button A2 to change the input mode for the heater and fan control, as shown in Figure 1-9.

The setpoint value specification via KNX or analog input is ignored in this input mode. The modes are toggled.

Figure 1-9: Setpoint value specification through alternative input at the LOGO! TDE
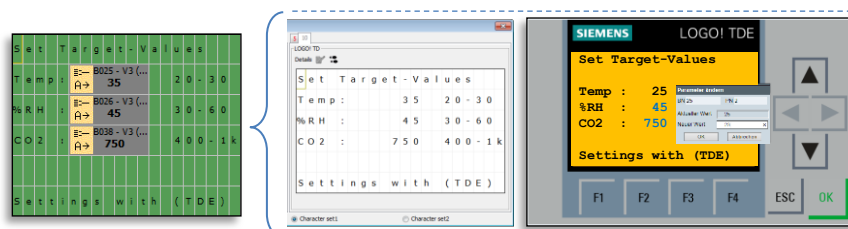
2 Commissioning

Proceed as follows to commission the application example:

LOGO!

1. Start LOGO! Soft Comfort V8.1
2. Open the LOGO! example program included in the delivery:
   "109748588_LOGO8-KNX_Heat-_CO2-%RH-FanControl_en.lsc"
3. Load the program to the LOGO!

Note	In this application example, the LOGO! IP address has been preconfigured as 192.168.0.1.
	How to set the IP address of a LOGO! 8 can be found in the manual in chapter: 3.8.1 "Configuring network settings"

KNX

The following requirements apply to the KNX application:

- The physical addresses "1.1.1" and "1.1.2" are freely available in your KNX system.
- The communication interface has been defined in the ETS software.
  (Menu bar: "ETS > Bus")
- The bus connection with KNX participants has been established.
  (e.g.: via the USB interface or the IP interface).

1. Start the ETS software.
2. Click "ETS" in the ETS menu bar.
3. Select the "Overview" tab.
4. Click on the "Import project" symbol.
5. Navigate to the path of the KNX project:
   "109748588_Heat-_CO2-%RH-FanControl_en.knxproj"
6. In the "Devices" window, select the button and the LOGO! CMK2000.
7. Click the "Download" button and select "Download all".
8. Follow the instructions in the container "Pending Operations" and press the programming button of the respective device.

Note	Further information on the programming button can be found in the "LOGO! CMK2000" manual: https://support.industry.siemens.com/cs/ww/en/view/109481657
	Technical product information GAMMA KNX 3-Gang Button: https://support.industry.siemens.com/cs/ww/en/view/87668166 (in the manual called Commissioning key "F9")

You can check the actual values of the room parameters using the message texts from the switching program.

3 Appendix

3.1 Service and support

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3.2 Links and Literature

Table 3-1: Links and literature

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	This entry https://support.industry.siemens.com/cs/ww/en/view/109748588
\3\	LOGO! 8 Manual https://support.industry.siemens.com/cs/ww/en/view/109741041
\4\	LOGO! CMK2000 Manual https://support.industry.siemens.com/cs/ww/en/view/109481657
\5\	Technical product information GAMMA KNX 3-Gang Button https://support.industry.siemens.com/cs/ww/en/view/87668166

3.3 Change documentation

Table 3-2: Document version and change history

Version	Date	Modifications
V1.0	07/2017	First version