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- For KNX beginners and advanced
- Simple implementation of the learned with the help of numerous pictures and practical tips
- Contains a variety of templates for everyday use

KNX programming made easy

The practice book for learning and looking up

Current version

ETS3
ETS4
ETS5

EBOOK24-7
The side that creates knowledge

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1.3 Determining the bus participants

It is now time to put together the switching actuators and the push button sensors. To do this, you need to know the number of dimmed circuits (consider power per channel), the number of normal circuits, if present the number of conventional switching devices to be integrated by 230 V binary inputs (push button, 230 V motion detector, limit switch, etc.) and if available, the number of alarm contacts which are implemented in 24 V technology and integrated in the bus by means of 24 V / DC binary inputs.

I have designed a form for this, called the list of devices (see appendix), you should have a good amount of these printed out. Here you list the planned switching actuators and push button sensors as well as all other bus participants, and note the function you assign to each channel and the location of the circuit. For push button sensors, please also consider the assignment of the push button areas and note this in the form. Thus, you already have an overview of the number of required KNX devices needed for this project. Based on this, you also know if and how many couplers you have to use or how many power supplies you need. Do not forget at least one USB interface and, possibly when using a visualisation via network, an IP router and its power supply.

At this point, you may notice that there are some providers on the internet who offer such forms with far more functionalities as software, which also makes it easier to list the required devices. You are right, but here is a question from me: Do you always take your laptop to the construction site? Because in most cases you walk around the construction shell with the customer and talk with him about the items and circuits to be installed.
In my experience, using a writing pad and multiple form sheets in the construction site will give you more flexibility than a laptop.

So far, we have not talked about the building structure. So let us get to it. By now you know which actuators and sensors go in each distribution board or room. And at this point, there are different ways of proceeding. There are programmers who generally add and parameterise the devices in KNX only in the topology view. This can work for small projects and remains an option to program quickly. However, as the number of devices increases, the clarity of the arrangement is soon negatively affected.

That is why I recommend this structured way.

2.2.2 Creating links to the group addresses

The next step is to create the links. Links can be imagined as the connection terminals in the junction box in a conventional installation.
The corresponding communication objects (functions) of the actuators and sensors are stored in a group address. Each bus participant has different objects.

There are a number of communication objects. Just to name a few:

- Switching
- Reporting switching
- Locking
- Dimming
- Brightness value
- Reporting brightness value
- Long-term operation
- Short-term operation
- Position blind
- Position slat
- Feedback blind position
- Feedback slat position
- etc.

The largest three-level group address is 15/7/255
This means that there are: 32.768 Group addresses

16 main groups (0 – 15)
8 middle groups per each main group (0 - 7)
256 group addresses per each middle group (0 – 255)

The largest two-level group address is 15/2047
This means that there are: 32.768 Group addresses

16 main groups (0 – 15)
2048 group addresses per each main group (0 - 2047)

Both types of display allow up to 32,768 group addresses in a project. Whoever reaches this limit must have a huge project;
I would say that he has found his life's work.

2.7 Line lengths

The following line lengths are permitted for each line:

- ≤ 350 m from the power supply to the participant
- ≤ 700 m from participant to participant
- ≤ 1000 m total line length
- ≥ 200 m minimum distance from two power supplies on one line

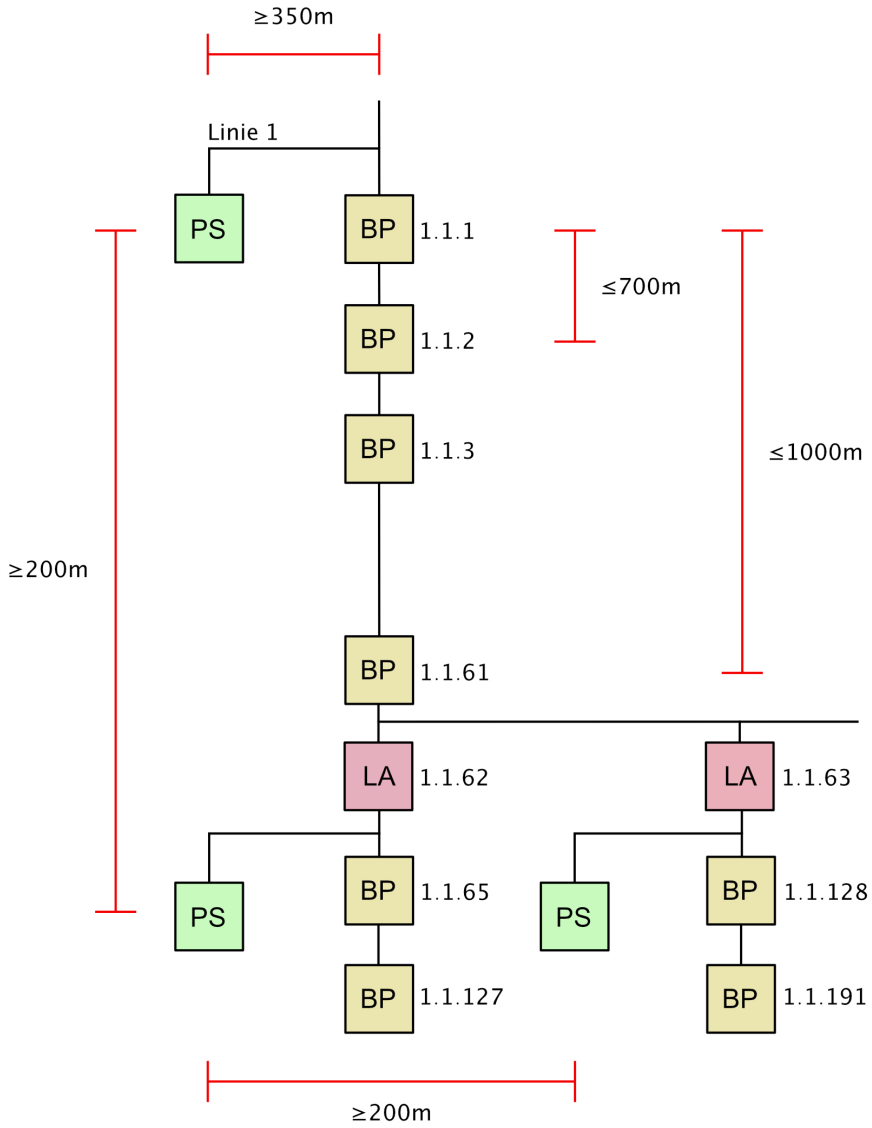

Fig. 8 Line lengths of a line

2.8 Routing counter

I would like to explain the function of the routing counter in detail, because it is related to the topology..

In a KNX system, all bus devices “listen« to all telegrams. There are no secrets. B When transferring the telegrams from one line to another one via a coupler, however, telegrams can be filtered out.

The bus participants check whether the received telegram has a meaning for them. If so, the content of the telegram is processed accordingly by the application of the device and the device acknowledges the telegram positively if it has been received correctly. If the telegram could not be received correctly, it will be acknowledged negatively. This indicates to the sender that he must resend it. If the sender does not receive an acknowledgment at all, he resends the telegram two more times.
If the content of a telegram has no meaning for a device, it is discarded.

Telegrams contain a routing counter, which the sender sets to “6”. Each time a coupler (line coupler, backbone coupler or line amplifier) passes through, the routing counter is decreased by “1”. If the coupler has reached “0”, the telegram is no longer forwarded. This prevents a telegram from “circling” due to a wiring error in the system.
The routing counter therefore limits the number of telegrams. Thus, the routing counter prevents circling telegrams in the case of a cross-line “loop”, which is not permitted in a KNX system.

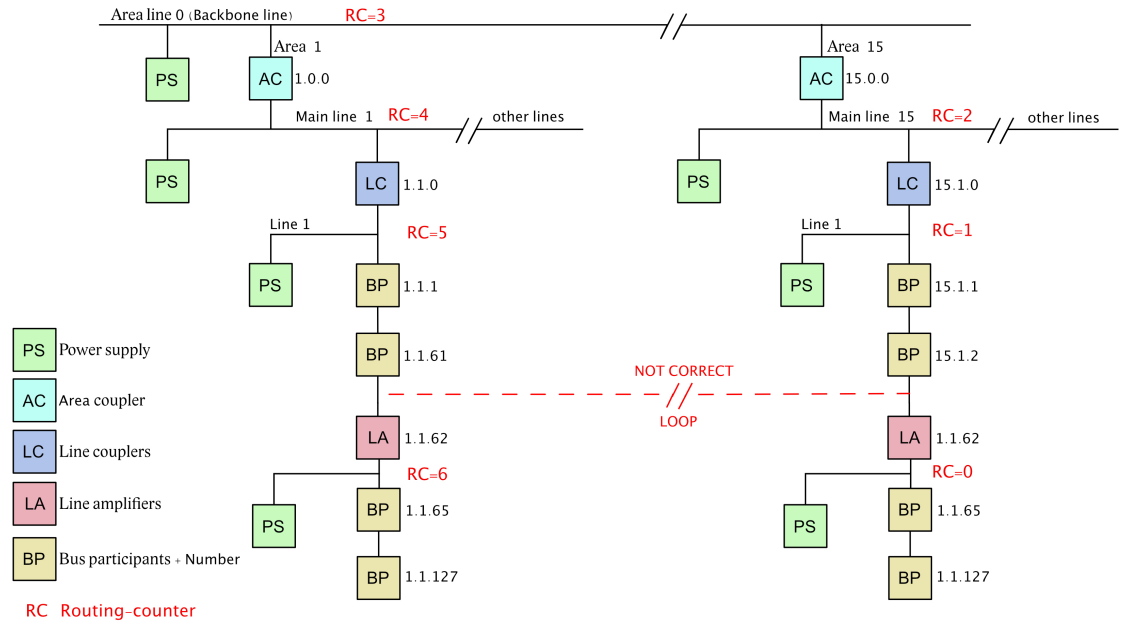

Fig. 9 Routing counter

2.13 The flags

Flags can be set for each bus user. When the device is delivered, flags are already set so that the KNX device functions optimally, and should only be modified in exceptional cases.
By setting the flags, the behaviour of the bus device can be modified.

The flags can be set in an object's properties window. You can access the properties window by right-clicking on a communication object of a KNX device. In the window that opens, select the "Properties" menu item. The properties window opens.

You can set or delete the flags in the properties window. Whether a flag is set or not is also shown in the overview window, in the corresponding column for each communication object.

Specifically, these flags mean:

2.14 The communication flag (C flag)

If this flag is set, the participant is connected with the bus and responds to incoming telegrams. If the flag is disabled, the station acknowledges a telegram, but does not change its communication object.

2.15 The reading flag (R flag)

If this flag is set, the object value of one participant can be read out by another participant.
If this flag is disabled, then it is not possible.

This flag is usually set in the context of a visualisation. This means that a visualisation during the start-up phase asks all participants what their status is. Participants respond by setting the reading flag and thus sending their object values. The visualisation knows whether a participant is switched on or not, and can represent this graphically.

From ETS4 onwards, the programming states are indicated by a grey (ETS4) or green (ETS 5) dot with a checkbox. A set dot means that the settings have been successfully transferred to the KNX device. An unchecked dot means that something has been modified in the corresponding settings, but that these settings have not yet been transferred.

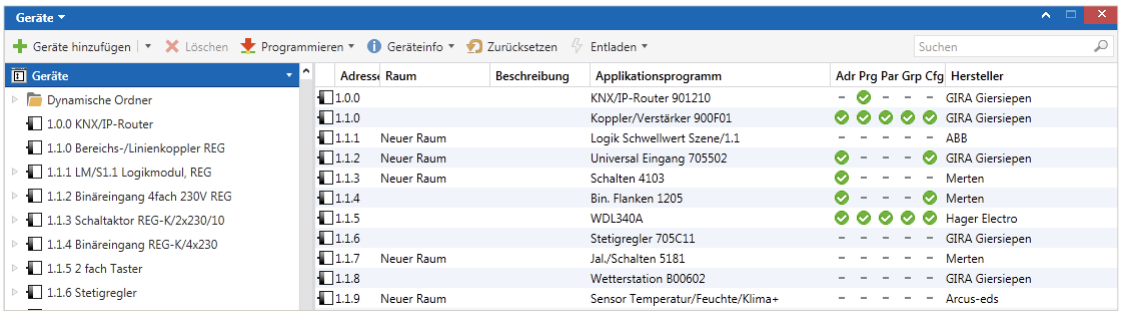

Fig. 20 ETS5 – Programming states of KNX devices

Fig. 21 ETS4 – Programming states of KNX devices

What they mean:

- Addr: Physical address
- Prg: Application
- Par: Parameter settings
- Grp: Group addresses
- Cfg: Media-specific settings (which are set during the programming of the physical address)

3.6 Unloading participants

If you suspect that a KNX device is not functioning as expected and you are 100% sure that the assignments of the group addresses and parameterisation of the device are correctly set, then you can unload and reprogram the faulty device.
It may well happen that, while the parameters are correctly set, for some reason, some old parameter settings remain in the device and cannot be overwritten. This can lead to unexplained malfunctions.

If you switch on the LED of a KNX device with the “On” button, then the KNX device is in programming mode. If you forget to switch off the LED, and then program another device, it may cause a malfunction.

However, you can also use this function deliberately to assign a different physical address to an already installed and programmed KNX device.

4.7.4 List all addresses of a line

If you want to determine which physical addresses are already assigned in a line, you can display them in the lower window.
To do this, enter the line address that you want to check in the “Line address:” field.
Clicking on the “Search” button will start the search process.
The result is displayed in the window.

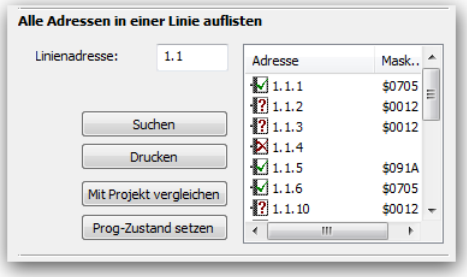

Fig. 58 Display addresses of all lines

Clicking on the “Compare with project” button compares the devices found with those already in the project.

The icons in front of the displayed addresses have the following meaning:

The icon means that the device was found and configured in ETS.
The icon means that the device was found but not configured in ETS.
The icon means that the device was not found, but is configured in ETS.

If “(local)” is displayed behind the physical address of a device found, then this is the data interface.

5.6 Working areas

The working windows serve to display a project in different views and to have multiple windows opened at the same time. The windows can be arranged randomly. Drag & drop makes it easy to create links.

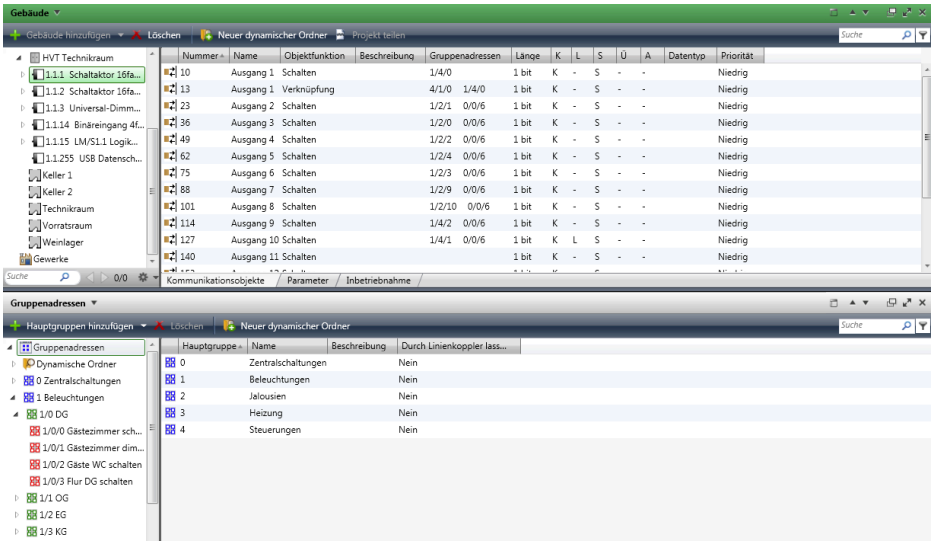

Fig. 126 Working window overview

Open one of the following windows in the “Working area” menu under the “Open new window” menu item or from the “Working area Arbeitsbereich ” toolbar:

- Building
- Group addresses
- Topology
- Entire project
- Devices
- Favourites

Another way to open another working window is to click the arrow next to the current window name. A drop-down menu opens, from which you can select the desired working window. The current window is replaced by this.

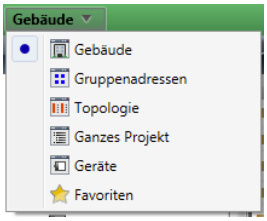

Fig. 127 Drop-down menu

The arrangement of the windows can be defined in the “Window” menu. Choose from:

- Split windows horizontally
- Split windows vertically

5.7 Creating a new project with ETS4

To create a new project with ETS4, switch to the “Projects” tab.
Since the new database is still empty, no projects can be found in it yet. That is why there is not much to see in this view. But we will change that now.

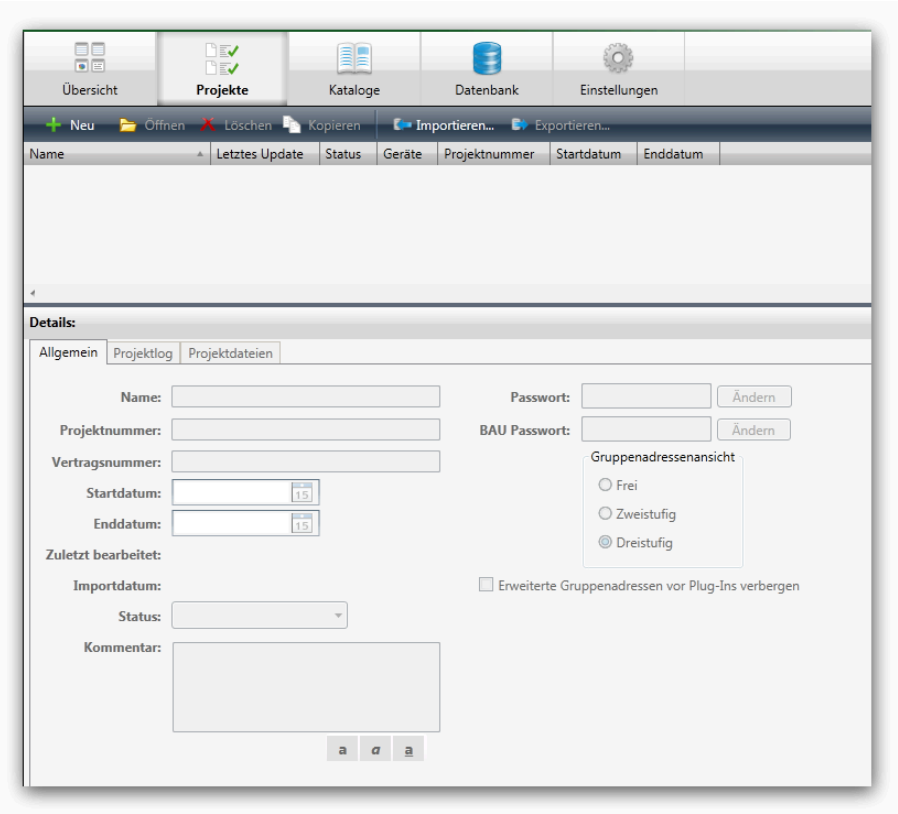

Fig. 135 Project settings

On the toolbar, click on “New” to create a new project.

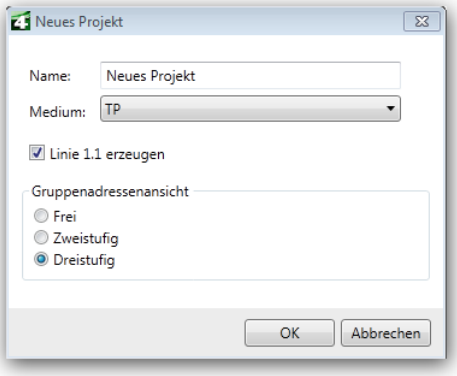

Fig. 136 Create a new project and select the group address views

In the “Name” field, assign an appropriate name for the project. This can be the name of a customer or, if you create several projects for a customer, the name of the corresponding customer project, e.g. Maier House, Office Maier Office Hamburg, Maier Office Berlin, etc.

Column 10
The value of the routing counter is displayed in the “Rout” column. More in Chapter 2.8 Routing counter.

Column 11
The data type of the sent telegram is displayed in the “DPT” column.

Column 12
The “Type” column displays whether it is a write telegram, a read telegram or a response telegram.

A write telegram means that a KNX device is protected by an external influence, e.g. was sent to the bus by the push of a button, a motion detector, a logic function, etc.

A read telegram usually comes from a visualisation. Visualisations require the status of the KNX devices. This ensures that they switch the KNX devices correctly. In order to determine the status of the KNX devices, the visualisations request this on the KNX bus on start-up.

The requested device responds by a response telegram. This tells the visualisation what the requested status or value is. But only if its read flag, also called R flag, is set. What each flag means can be read about in Chapter 2.13 The flags.

6.9.4 Storing telegrams

If you have recorded telegrams in the group monitor, you can save them on a hard disk. To do this, you must stop any active recording of telegrams by clicking on “Stop ”.
You can now save the recorded telegrams by clicking on “Save ”. Windows Explorer opens, in which you can select or enter the storage location and the name. Then, a file with the “.xml” extension is created.

6.9.5 Opening telegrams from a file

If you want to open a stored telegram recording in the group monitor, you must stop any active recording of telegrams in the group monitor by clicking on “Stop ”.
Now you can open a stored telegram recording by clicking on “Open ”. Windows Explorer opens, in which you can specify the path to the desired file. Subsequently, the stored telegrams are displayed in the group monitor.

7.1 Project description

For our project, I have created a small floor plan from the ground floor of a sample house. Here I have drawn the lights, sockets that are switched, electric roller shutters and the positions of the push button sensors.
I assign numbers to all circuits. With the associated switch or sensor, I enter the number of the circuit that the switch or the sensor should switch.

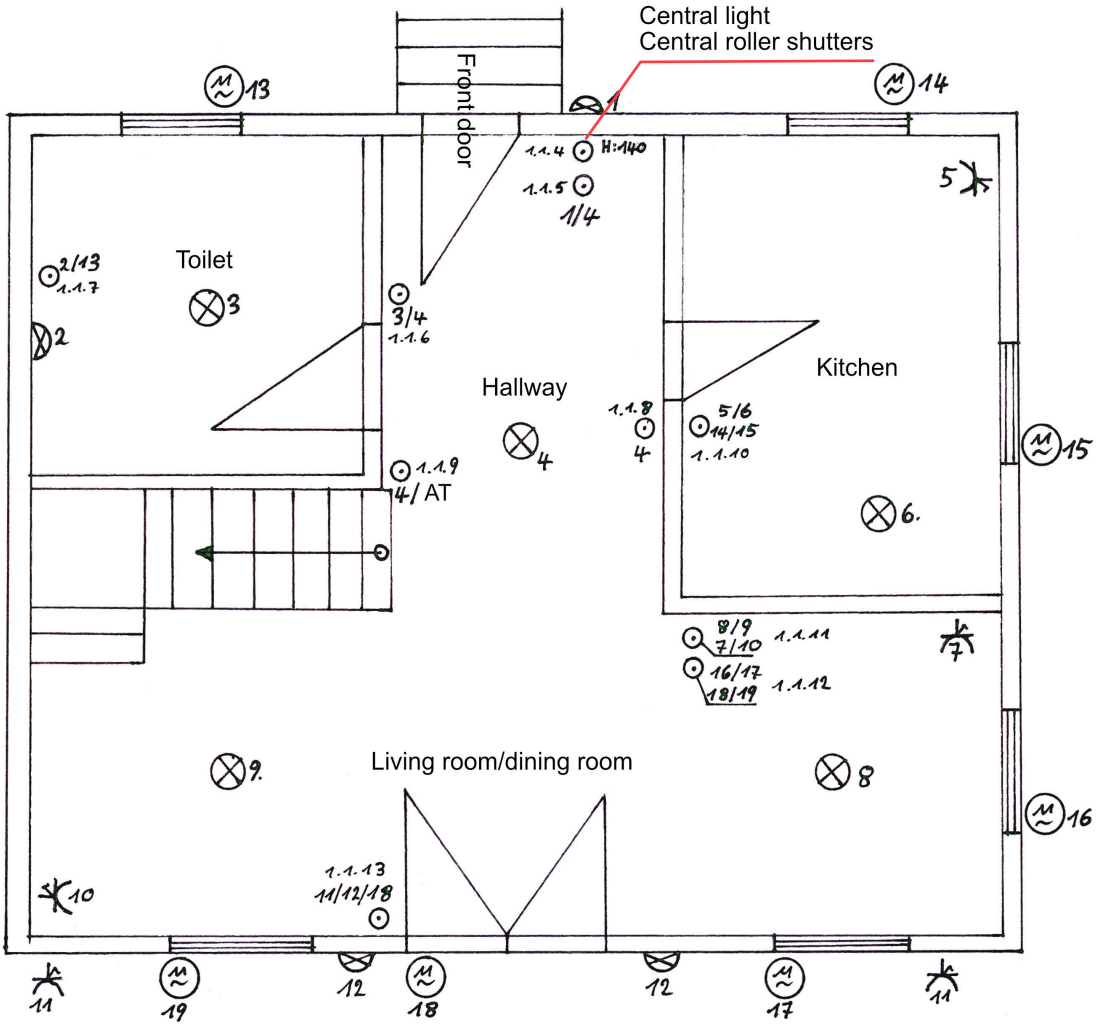

Fig. 184 Floor plan of the sample house

In addition, I enter the associated physical address next to each sensor. Of course, this can only be entered later, i.e. when the devices have been added in ETS or in the building structure and assigned a physical address.

At the entrance of the apartment there are two tactile sensors at different heights. The sensor at 1.40 m has a special function. It should act as a central switch for the lighting and roller shutters.

7.3 Creating a building structure

It is now time to start creating our project in ETS.

7.3.1 Adding a building

To do this, go to the “Buildings” view, right click on “Buildings / systems” and select “Add building” from the context menu. In the window that opens, “New: buildings”, enter an appropriate name under the “Name” field. For our example, enter “Residential house”.

7.3.2 Adding building parts

Of course, this house also has floors. To add them to the project, right click on “Residential house” and select “Add building parts...” from the context menu. IIn the window that opens, “New: building part”, enter an appropriate name for the building part under the “Name” field. For our example, assign the name “1 AT” for attic.
Repeat this procedure to add several floors; “2 FF” for first floor, “3 GF” for ground floor and “4 BA” for basement.

Are you wondering why a number goes before each name?

The numbers have the following meaning:
The structure of a building is as follows: basement (BA), ground floor (GF), first floor (FF) and attic (AT). If we labelled the floors without a number and sort the list alphabetically, the building would look like this after sorting:
AT (attic), BA (basement), FF (first floor) and GF (ground floor). This order does not match that of an actual building; the ground floor comes at the end instead of at second position, before the basement, where it should actually be. To prevent this from happening, AT is assigned the number 1, followed by 2 for FF, etc.
If the list is now sorted alphabetically, the order of the floors will be corresponding to the actual building. First “1 AT”, second “2 FF”, third “3 GF” and last “4 BA”.

7.3.3 Adding rooms

Now, the individual floors have rooms. To add a room, right click on the “ GF” building part and select “Add rooms” from the context menu. In the “New: room” window that appears, enter an appropriate name under the “Name” field (kitchen, for example). In this way, you can create the corresponding rooms for each floor.

9.6 Logic function

Logic functions can solve a wide variety of tasks. To this end, logic functions that are partially integrated into switching actuators can be used. For more complex tasks, however, the logic functions of switching actuators are usually not enough and you must resort to a special KNX device that provides the logic functions needed.

I In the following examples, I would like to introduce you to such a special KNX device. The LM / S 1.1 logic module from ABB provides you with a large number of logic functions, which, in combination with others, allow you to handle rather complex tasks.

9.6.1 Two workstations, three lights

I once had a customer who had a T-shaped table arrangement in his office (see figure below). There were two employees working at this table. A suspended light was mounted above each table, i.e. a total of three.

The following task was requested:
If a person switches the lighting of workstation 1 on, lights 1 and 3 should also switch on.
If a person switches the lighting of workstation 2 on, lights 2 and 3 should also switch on.

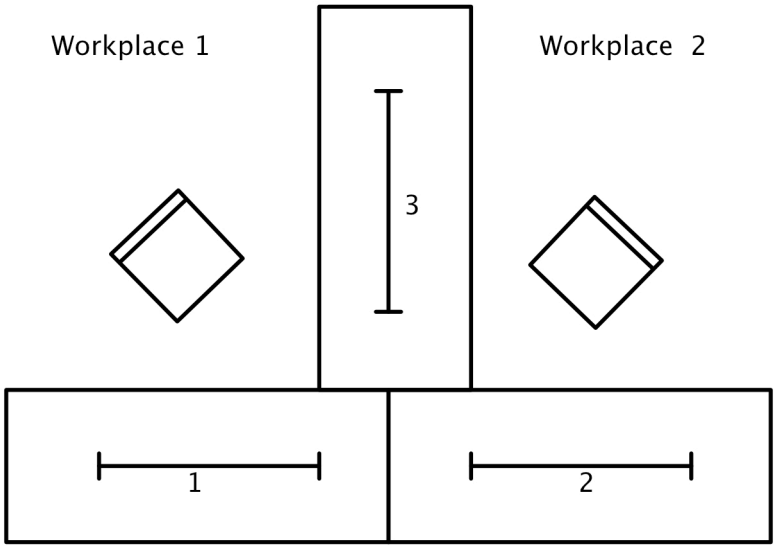

Fig. 237 Task

That sounds easy, right?

9.7 Individual room temperature control

A room thermostat ensures a constant room temperature around the clock. For this purpose, the sensor integrated in most controllers or via an external temperature sensor records the current room temperature and adapts it to the target specifications of the inhabitants.

Most room temperature controllers have a large number of settings that enable a comfortable and cost-efficient individual room temperature control via KNX. But discussing all these settings in this e-book would go beyond the scope.

9.7.1 2-point controller

The simplest type of room temperature control is the 2-point control. A room temperature sensor records the room temperature and compares it with the set base temperature. Depending on the result, a telegram is sent to the bus, which opens or closes a valve. The room temperature is verified at cyclic intervals.

As an example, the following devices are added to the project:

6-fold heating actuator from Gira with the item number: 1018 00
Continuous controller from Gira with the item number: 2100 xx

9.7.1.1 Parameter settings for the heating actuator

For our example, the parameter settings in the “General”, “Monitoring” and “Emergency” windows do not need to be adjusted.

Output parameter window
If valves are used in the project that are “de-energised closed”, then you can leave the parameter settings in the “Valve in de-energised state” field at the default value.
However, if valves are in use, which are “de-energised open”, then this parameter must be modified. To do this, open the parameter window and select the output to which a valve is connected.

9.8 The safety object with a weather station

The safety objects of some switching and blind actuators can help you protect outside components such as awnings, blinds, external blinds or skylights from wind and rain. To achieve this, a weather station is needed. Manufacturers usually also offer a suitable sensor for your weather station, which contains wind, rain, brightness and twilight functions. Alternatively, analogue sensors with 0-10 V technology can be connected to most weather stations. However, they require a slightly greater effort, since the individual sensors must be adapted to the weather stations.

In the following example, I would like to show you how to protect an awning from wind and rain.
This requires a blind actuator that has the required safety objects and a weather station.
In the example, I use the 16-fold switching actuator with the 103800 item number and the weather station comfort with the 101000 item number. Both devices are from Gira.

9.8.1 Parameterisation of the switching actuator

F Add the switching actuator to your project and open the parameter window.
Under “Blind outputs safety”, set the following:
First, in the “Safety functions” field, select “enable”. As a result, further input fields are unlocked or visible below the field.
Under “Wind alarm 1”, set “enable”.
Under “Rain alarm”, set “enable”.
The remaining settings are left at their default values.

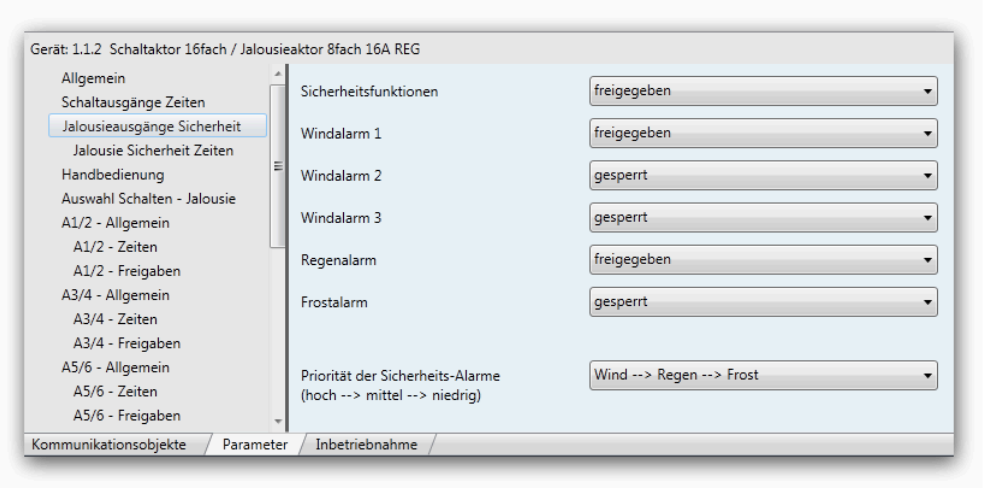

Fig. 291 Parameter settings for “Blind outputs safety” of the blind actuator

10. KNX security

Many readers keep asking me how secure the KNX system is. Unfortunately, I currently only have a bad answer:

“KNX, as the worldwide standard for building technology, is vulnerable.”

10.1 Smarthome security

The time of classic wiring is long gone. In contemporary architecture the and high-end residential construction industry, a building management system is already standard. EIB, or its successor KNX, has established itself as a pan-European or even worldwide standard.

In addition to the basic wiring, the connection of the building to the EDP has become much easier. It is now no longer rocket science to monitor and control a building on a PC, tablet or smartphone. And it is possible from any place in the world! But what are the pitfalls of this change?

10.2 What are the weaknesses of the system?

In principle, there are 2 main weaknesses of KNX; the bus itself and the controlling EDP or access via PC or the internet. Both need to be taken into account when considering the overall security. The following areas should be looked at carefully:

EDP

- Network architecture
- Network isolation
- Network access control
- Firewall
- Visualisation access

The bus

- Network architecture
- Network isolation
- Network access control

Attacks on IT infrastructures are the order of the day and thus well-known; they should be avoided or at least limited by a variety of measures. By contrast, things are different in the world of the KNX bus.