ABB i-bus® KNX
Intelligent Installation Systems
System description

Power and productivity
for a better world™

Contents

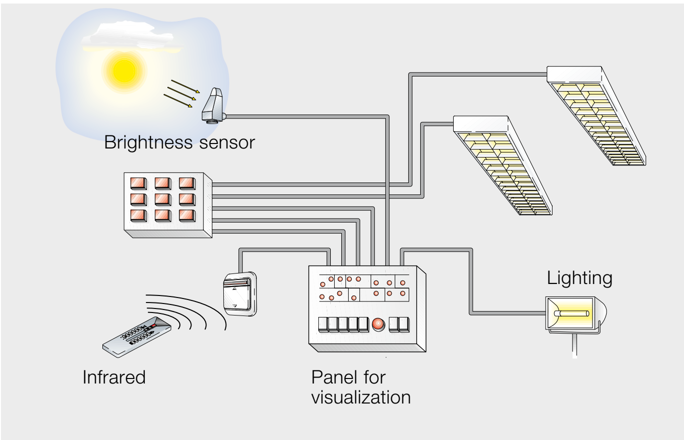
1. Difference compared to the conventional electrical installation

The so-called conventional electrical installation requires not only

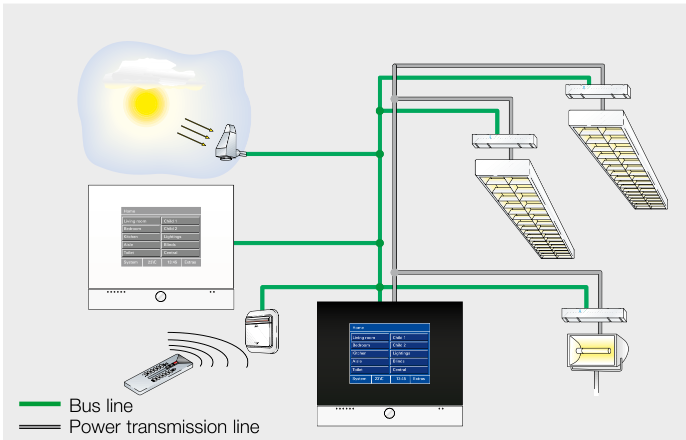
- supply lines for power transmission, but also a separate line or wire
- for every switching command,
- or every measurement,
- for every message,
- for every controller or regulator.

! All lines which are not required for power transmission are replaced by a bus line in the ABB i-bus® KNX system.

Without KNX

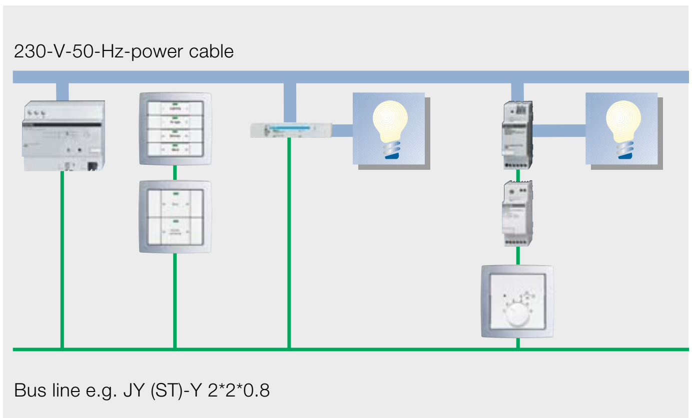


With KNX

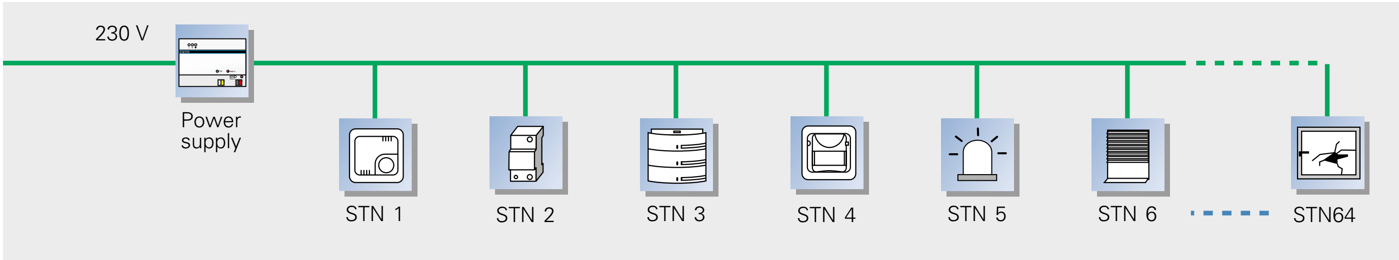


The following illustration makes this clear:

- The bus line is connected to an KNX power supply and all the other stations (STN).
- The 230 V line (or the 400 V line) is not required for the control stations (STN) (sensors). It is only required for the power supply to the consumers.
- As a consequence, there are 2 supply systems; one for power transmission and one for information transmission.



2. ABB i-bus® KNX System Overview
2.1 General



2.1 General

! The KNX system operates decentrally and does not require a PC or any other special control unit after start-up. The “intelligence” or rather the programmed functions are stored in the stations (STN) themselves.

Each STN can exchange information with any other STN by means of telegrams. The lowest configuration level is referred to as a line. A max. of 64 stations (STN) can be used in one line. The actual number of stations (STN) depends on the selected power supply and the power consumption of the individual STN.

There are four types of devices

- **System devices:**
  Power supply and USB-interfaces. Connectors, choke, line couplers and area couplers.
- **Sensors:**
  Pushbuttons, transducers (wind, rain, light, heat, etc.), thermostats, analogue inputs
- **Actuators:**
  Switching actuators, dimming actuators, actuators for blinds, heating actuators
- **Controllers:**
  Sensors and actuators can be logically connected together by means of controllers (logic unit, logic module or similar) for more complex functions.

2 STN can collaborate with a power supply via the bus line in the smallest configuration. The installation bus progressively adapts itself to the size of the system and the required functions and can be extended to more than 57,000 STN.

2. ABB i-bus® KNX System Overview
2.2 Typical distribution structure for one line

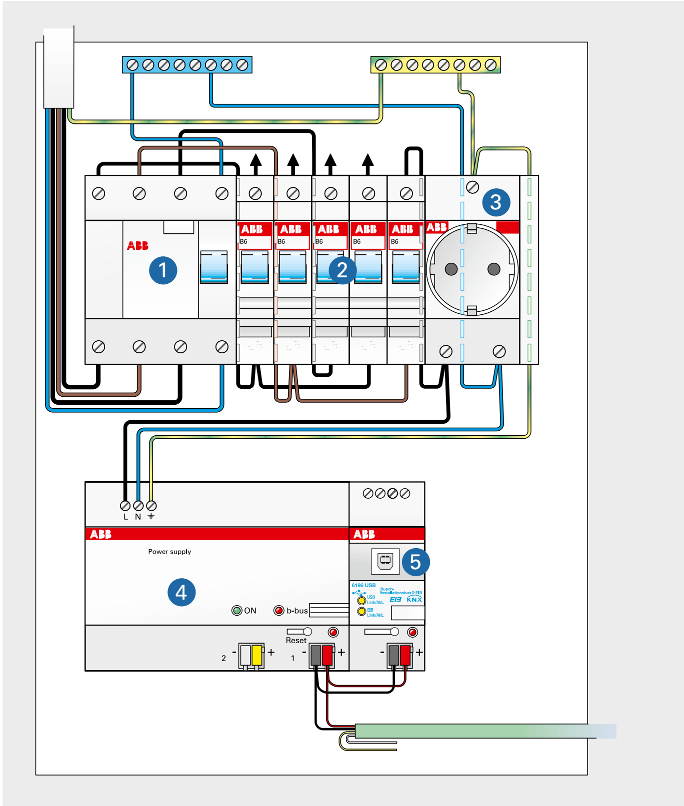
2.2 Typical distribution structure for one line

Description of the device:

1. Residual-current-operated circuit breaker for STN-distribution board
2. Miniature circuit-breakers; reserve one for the KNX and the service socket
3. Socket for service work, e.g. for a laptop
4. KNX power supply (SV/S 30.640.5)
5. USB-Interface for service work with the laptop (USB/S1.1)

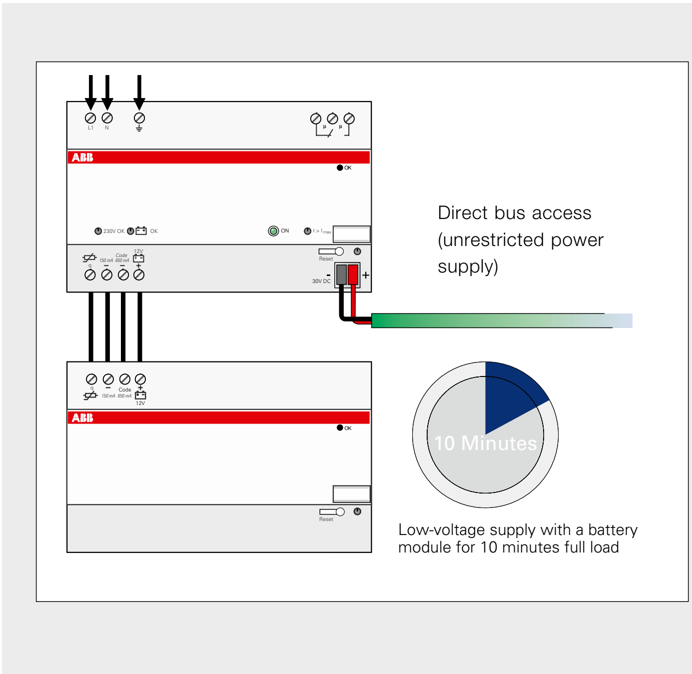
Explanation of the structure:

There are 2 power supplies of different sizes: 320 mA and 640 mA. In case of doubt, the larger power supply with 640 mA should be selected because there are some KNX users that consume double or many times the power. The connection is made on the one hand to the low-voltage network (L, N, PE) and, on the other hand, to the bus line (24 V). All users belonging to the line and the power supply are connected via this bus line.



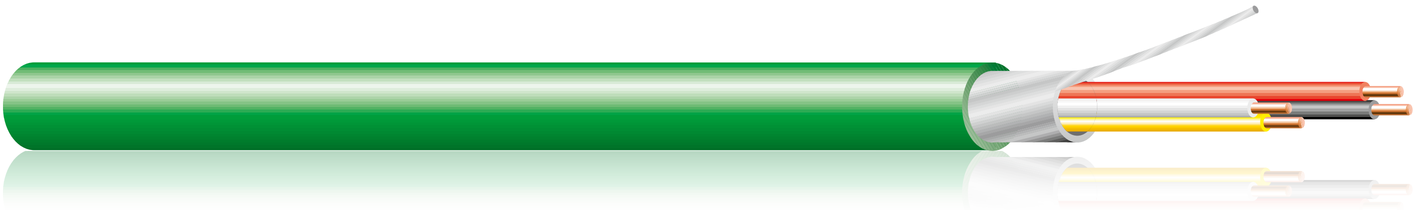
As a third power supply, there is an uninterrupted KNX power supply (SU/S 30.640.1), also 640 mA, which, in conjunction with a battery module (AM/S 12.1), maintains the bus communication for 10 mins under full load.

! The bus users are supplied exclusively. The advantage is that all object values of the users are retained and “settling” of the system is not necessary. The other consumers (lamps, roller blinds, PCs and monitors etc.) must be supplied via a separate UPS.



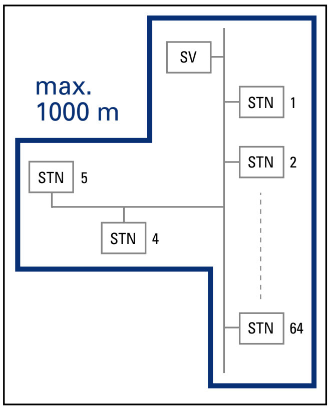
2.3 Line topology

The bus line is led to the remaining stations (STN). We recommend using an KNX-certified bus line. In addition to the requisite physical properties (number of cores, cross-section, isolation voltage, etc.), the bus line can be immediately distinguished from other weak-current lines. (e.g. YCYM 2 x 2 x 0.8 or J-Y (ST) Y 2 x 2 x 0.8).



2.3 Line topology

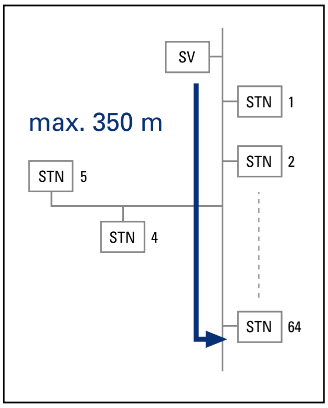
The wire lengths within a line are limited. Total length max. 1000 m



SV = Power supply
STN = Station

Maximum distance

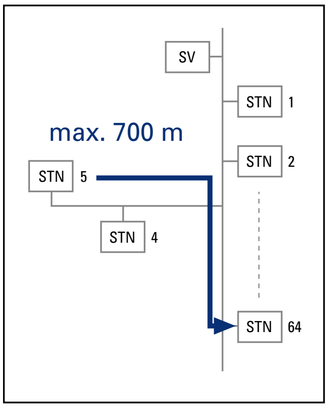
Between power supply and last user: max. 350 m



Maximum distance

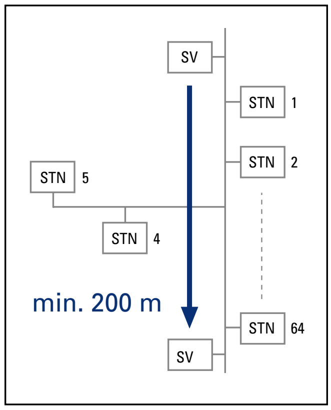
Between two users:

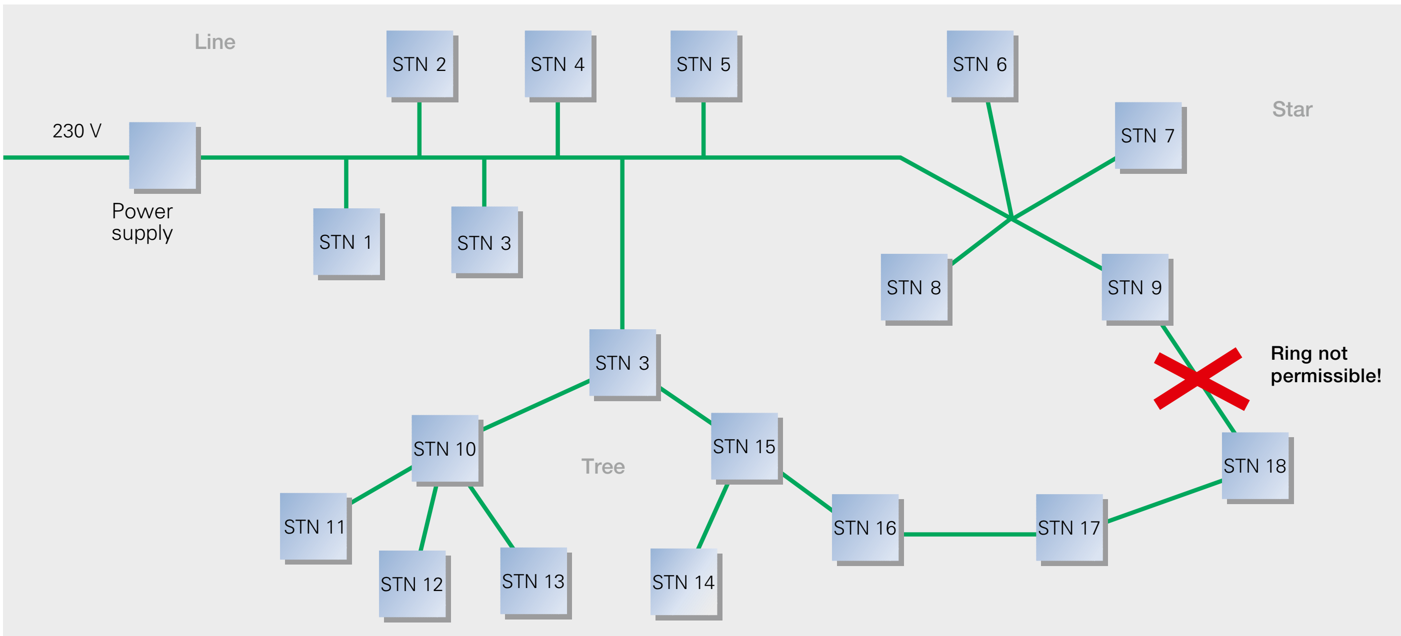
max. 700 m



Minimum distance

Between two power supplies: min. 200 m





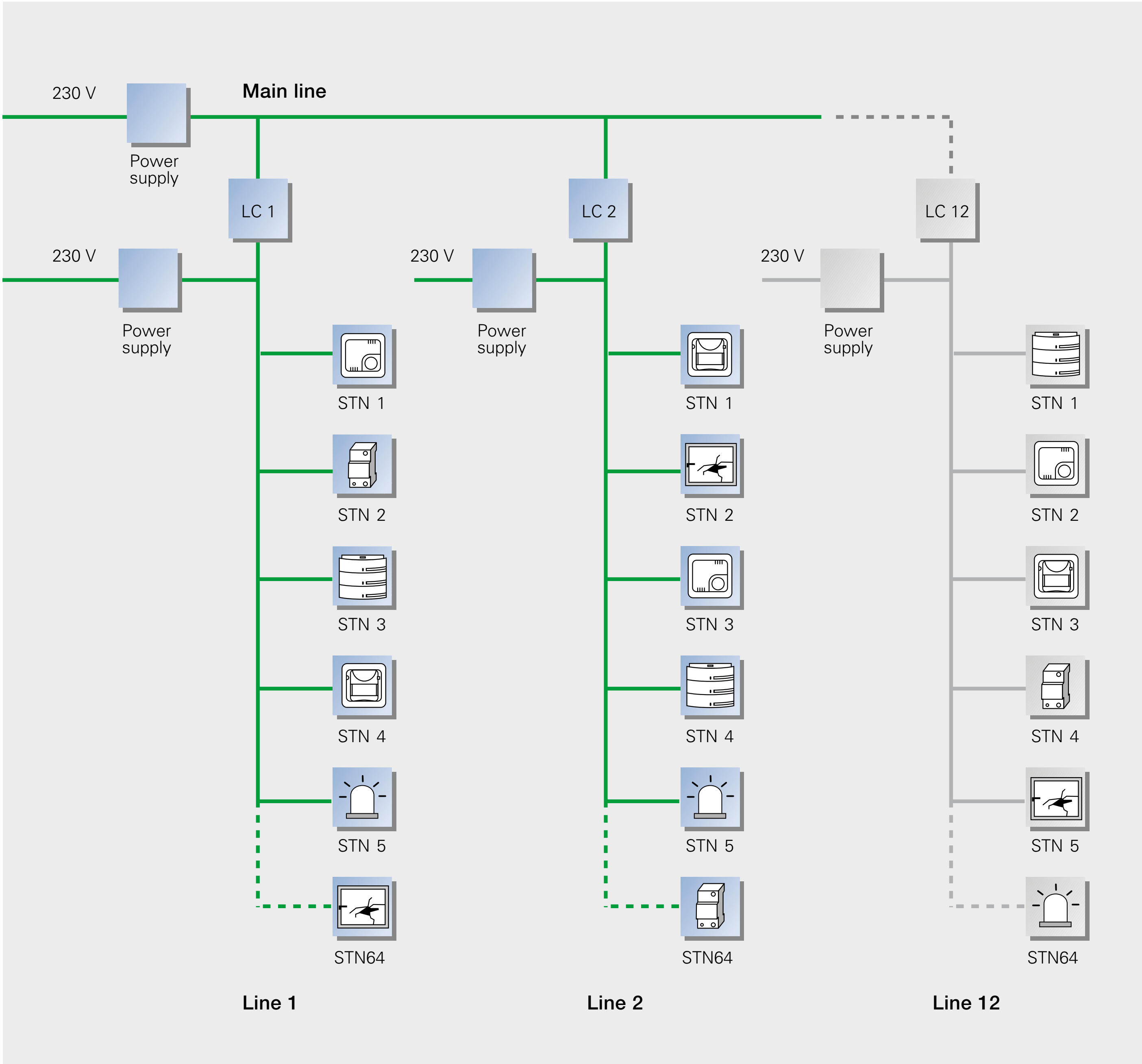
2.4 Distribution structure for several lines

2.4 Distribution structure for several lines

If there are more than 64 STN, or several parts of the building are involved, with the result that it is necessary to bring in at least a second line, the lines are connected together by means of a line coupler. The so-called main line, which also requires a power supply, forms the backbone of the line couplers.

A main line is topologically structured like a line, with the only difference that in a main line there are no sensors and actuators, but only a line coupler. During planning, max. 12 lines should be used. Technically, 15 lines are possible. Lines 13 - 15 should be considered as reserves.

Schematically:



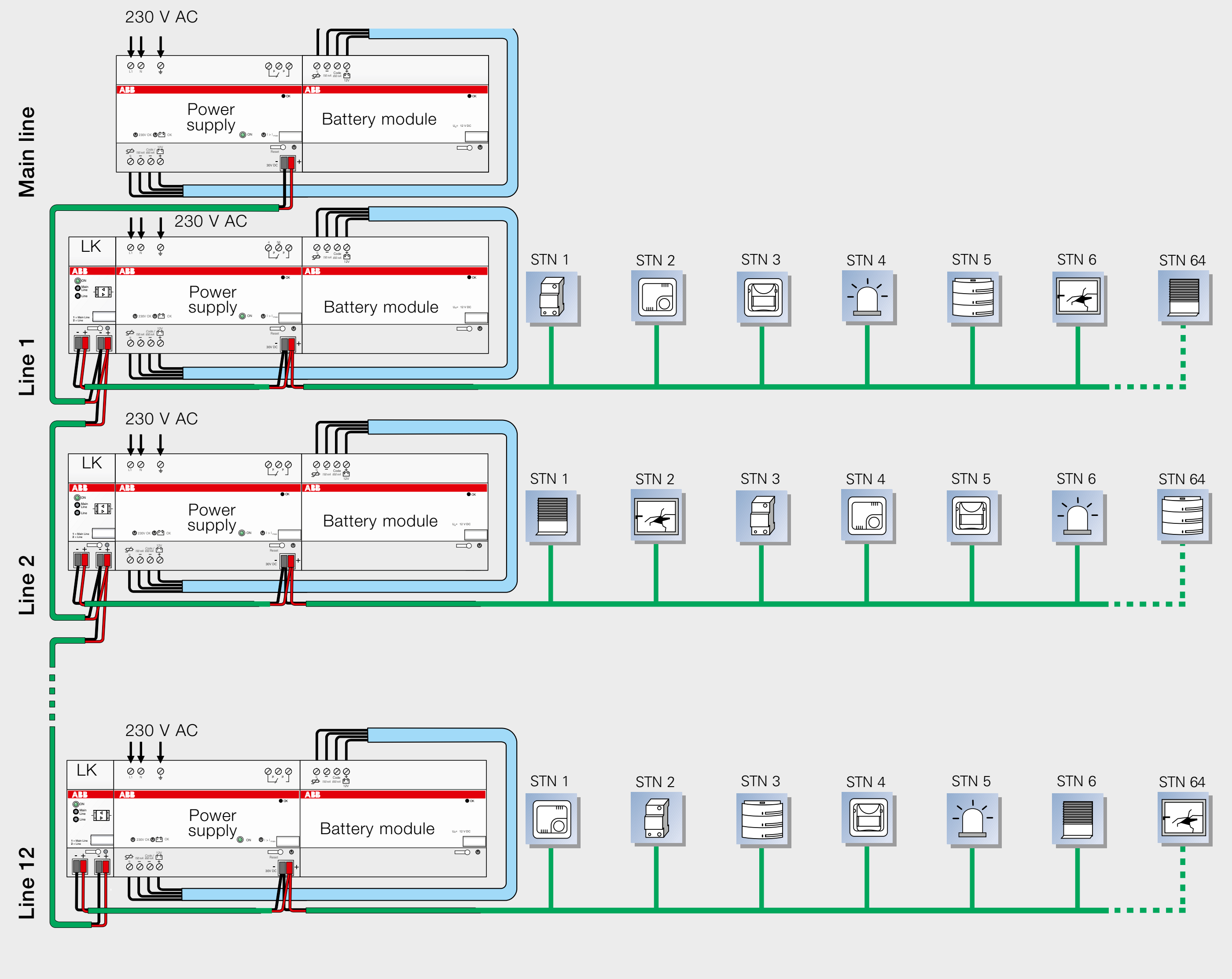
2.4 Distribution structure for several lines

! In practice, a new line should be configured with far less than 64 STN, so that the addition of a single STN does not immediately require the installation of a second line.

The line couplers are connected exclusively via bus terminals, both for the line and for the main line.

Article no.		TE
Uninterrupted power supply 640 mA	SU/S 30.640.1	6 TE
Battery module	AM/S 12.1	8 TE
Line coupler	LK/S 4.1	2 TE

Wiring:



2. ABB i-bus® KNX System Overview
2.4 Distribution structure for several lines

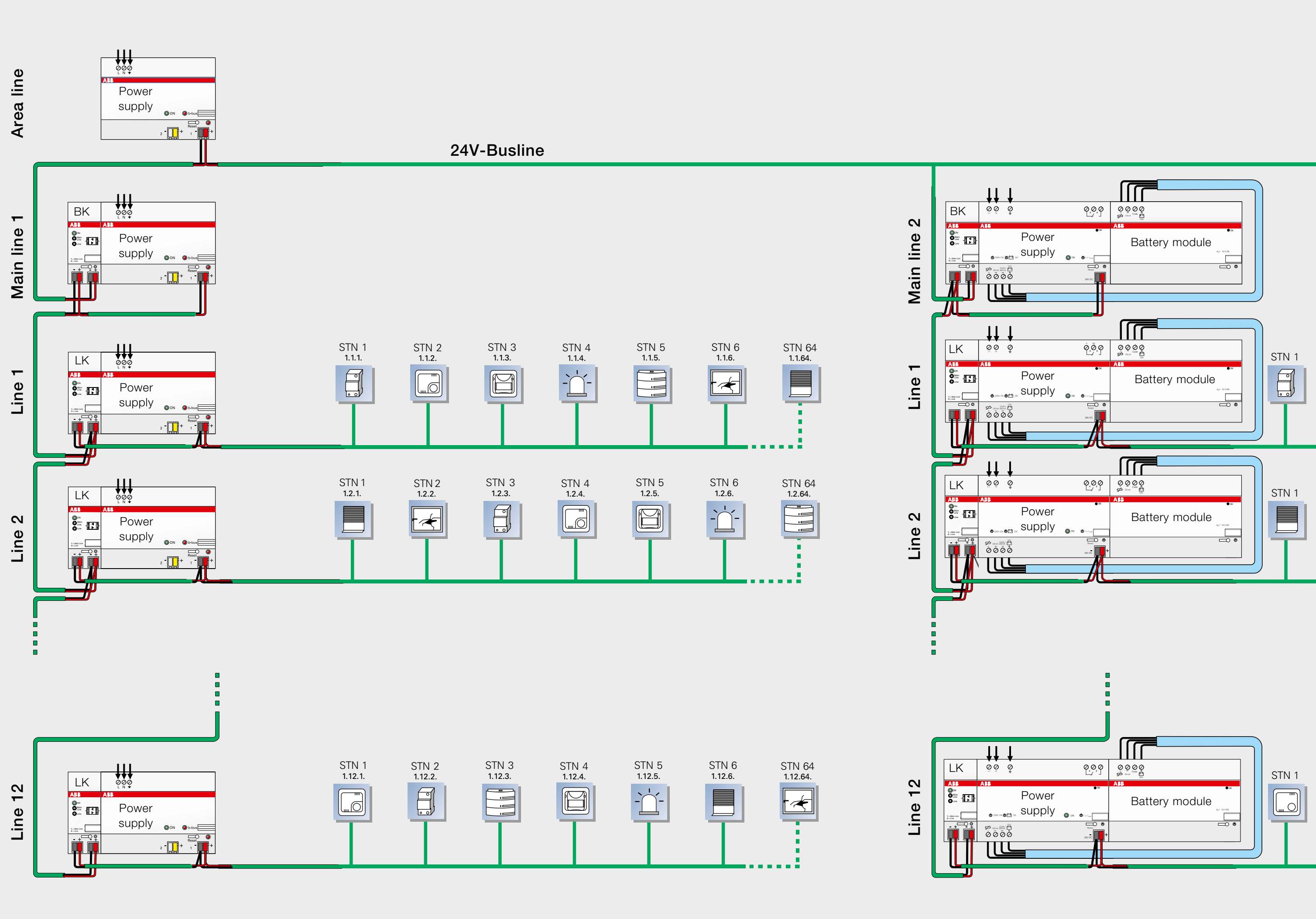
Up to 15 main lines can be combined in an area line if the number of devices required in a project exceeds the capacity of the 12 lines. Line and area couplers are identical units with different designations on account of their use. Generally, they are only referred to as couplers LK/S 4.1.

$$64\ \frac{\text{Stations (STN)}}{\text{Line}} \times 15\ \frac{\text{Lines}}{\text{Area}} \times 15\ \frac{\text{Areas}}{\text{Installation}} = 14{,}400\ \frac{\text{Stations (STN)}}{\text{Installation}}$$

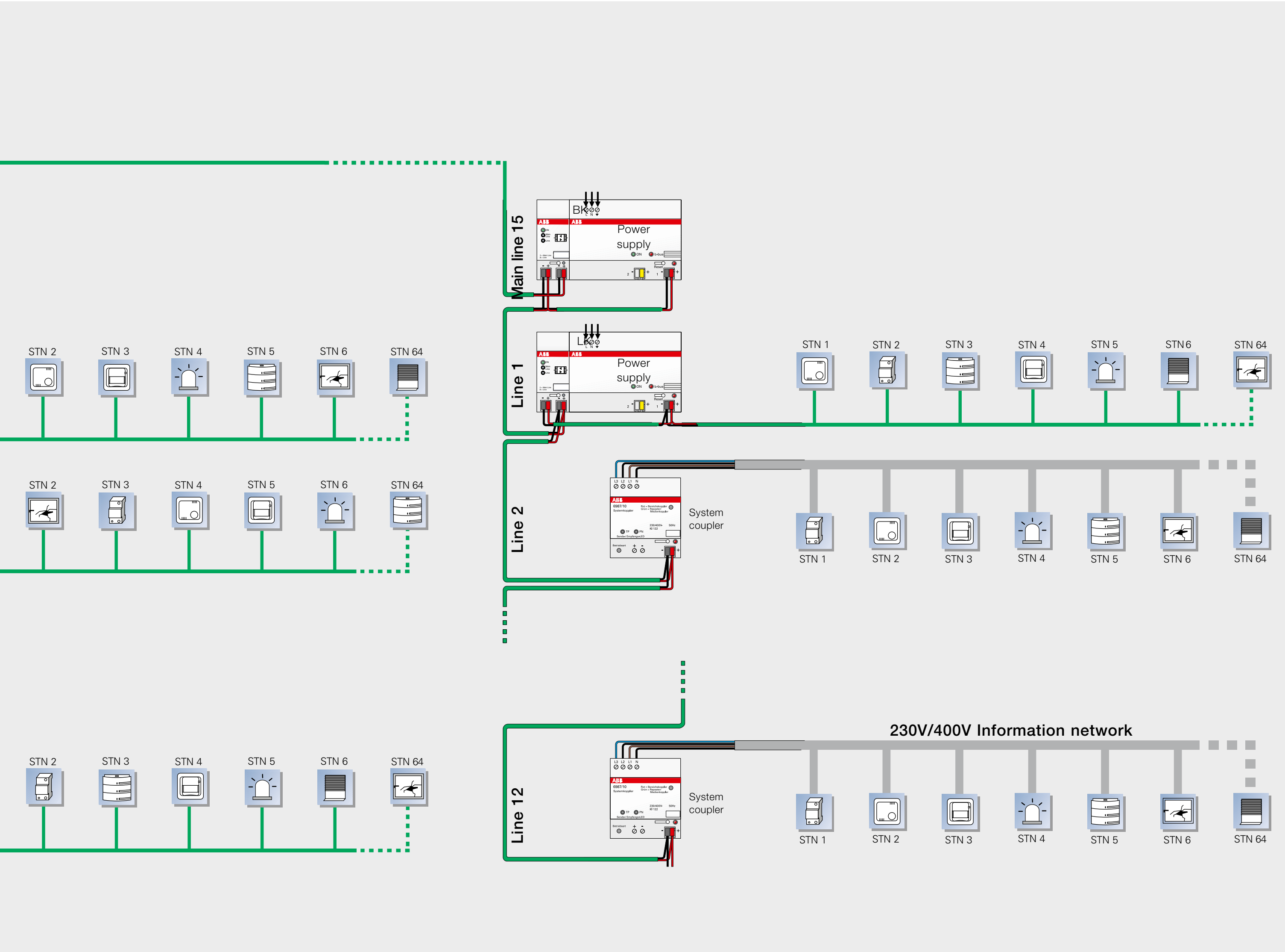
$$255\ \frac{\text{Stations (STN)}}{\text{Line}} \times 15\ \frac{\text{Lines}}{\text{Area}} \times 15\ \frac{\text{Areas}}{\text{Installation}} = 14{,}400\ \frac{\text{Stations (STN)}}{\text{Installation}}$$

! The maximum number of stations (STN) of an KNX installation with 64 or 255 STN per line.

For even larger installations, the topology can extended **through further measures** to a max. of 255 devices per line. Mathematically, this results in a max. number of 57,375 stations (STN):



BK = Area coupler LK = Line coupler STN = Station



Main line 15
Power supply
STN 2
STN 3
STN 4
STN 5
STN 6
STN 64
Line 1
Power supply
STN 1
STN 2
STN 3
STN 4
STN 5
STN 6
STN 64
Line 2
System coupler
STN 1
STN 2
STN 3
STN 4
STN 5
STN 6
STN 64
230V/400V Information network
Line 12
System coupler

3. KNX Cost estimation
3.1 General
3.2 Cost estimation in the preplanning stage
3.3 Cost estimation in the execution planning stage

3.1 General

Simplified cost estimation methods can be applied depending on these construction stages:

- preplanning
- execution planning

The objective is to portray the functionality in relation to cost. The proposed models naturally can not provide exact results that could be used in one form or another in the final calculations. Instead, the models illustrate the ability to estimate cost in comparison with conventional technology or other systems. Experience in the field has demonstrated that the costs for KNX in functional buildings generally are not higher that those of an alternative solution, since, even in buildings of lower standards, the functions have a certain demand for automation.
For private properties, this is usually not the case, which explains the additional cost. In such cases, the end customer has to make a decision by weighting the resulting advantages.

3.2 Cost estimation in the preplanning stage

In terms of the electrical installation, preplanning simply entails estimating the total costs based on the prototype of the building to be constructed.
In doing so, a three-level, flatrate sum based on the squaremetre area of the building is often used to achieve this estimate. The so-called low, middle and raised standards used in this estimation generally do not specify details with regard to the individual assembly groups or their functions. This estimate can be described from the perspective of the constructor or investor as more or less a rough quote of the costs based on the size of the building and the level of the equipment. Independent of the execution level, it can be said for non-residential buildings that the cost of implementing KNX does not differ from that of alternative solutions if KNX is to be used for automation tasks only. In the case of a lower standard, this can of course mean, for example, that only a few central fault messages or timed switch functions can be taken on. Nevertheless, even such limited implementations have proved useful, as unforeseeable changes to the requirements profile are made continuously throughout the construction phase. The adaptability of the KNX is, especially in this case, a great advantage. For private properties, the implementation is worthwhile only if there are increased requirements on the electrical installation. This for example could be the implementation of electric blinds or a high-quality lighting control system with light scenes.

!

- In functional buildings, it is generally possible during the preplanning phase to start at cost neutrality, even if the costs are estimated flat rate and based on squaremetres area.
- For private properties, the implementation of KNX makes financial sense only if there are increased requirements.

3.3 Cost estimation in the execution planning stage

During the execution planning stage, the planner (generally the installer for private properties) determines the functionality of the electrical installation in co-operation with the client or the client‘s agent independent of the system to be used.
The expected costs are then determined based on the functional description determined by the planner and client. Those who are new to KNX frequently find it especially difficult to estimate the costs. A frequent mistake is to base the estimate on individual devices, which, without detailed context, often appear „too expensive."
However, it is possible to come to an estimation that is quite accurate without great effort.
The cost estimate presented here is based on flat rates which have been calculated according to list prices in the € zone.
The estimate is calculated in four steps.

- Determining the costs of active devices
- Determining the costs of system devices including accessories
- Determining the costs of programming and commissioning
- Determining costs for special items

3. KNX Cost estimation
3.1 General
3.2 Cost estimation in the preplanning stage
3.3 Cost estimation in the execution planning stage

An example:

This example is intended to clarify the process of cost estimation. A new school is to be built. A meeting between builders and building planners results in the following requirements profile, which includes the implementation of KNX.

Requirements profile:

In the classrooms, the lighting is to be switched off based upon outside brightness. In order to prevent interruptions, this should occur only during breaks. In laboratories and other special-purpose rooms, electric blinds are to be controlled in addition to the lighting. Likewise, the lighting of a break room is to be switched off when sufficient outside light is present. Furthermore, several messages, which have not yet been detailed, shall be provided.

Room list:	
Standard classrooms	40
Laboratories/special-purpose rooms	10
Break rooms	1
Auditoriums	1
Teacher rooms	2
Offices	5

1. Determining costs for active devices

Active devices are all actuators and sensors that are part of the KNX. Instead of calculating the actual, concrete device that is to be implemented, flat rates that are based on specific functions are used in estimating the costs.

- Switched loads 120 €
- Dimmed loads 220 €
- Groups of blinds 180 €
- Heating circuit
  with continuously regulated valves 400 €
  with electro-thermal valves 260 €
- Message monitoring 60 €

2. Determining costs for system devices

With the presumption that the individual KNX line is equipped with about 50 devices, and while assuming a mean price for active devices, it is possible to assess the costs of the system devices as well.
Costs of system devices = 7% of the cost of active devices

3. Determining the service cost

Based on experience and using flat rates, it is possible to estimate the costs for programming and commissioning.

- Programming 10% of the cost of active devices
- Commissioning 5% of the cost of active devices

! Important: The programming can require significantly more time in private houses because each room can be assigned its own individual functions. Simply copying functions from room to room, as is often possible in commercial projects, frequently can not be done. In cases of complex application, programming costs of up to 20% of the cost of active devices can be reckoned with.

4. Special costs

Special costs include those which can not estimated on a flat-rate basis.

For example:
- Visualisations
- Integration with other systems
- ...

Price example of the German market.

Our example:

Switched loads
50 classrooms each with 3 lighting groups
1 break room with 4 light groups
154 light groups = 18480.00 €
Blinds
10 special-purpose rooms (assuming each has 2 groups of blinds) 1800.00 €
Heating
No heating control with KNX 0.00 €
Message monitoring
Flat rate assuming 5 fault messages 300.00 €
Total active devices **20580.00 €**

System devices
20580 € * 7% = 1440.60 €
Material costs 22020.60 €

Programming
20580 € * 10% = 2058.00 €
Commissioning
20580 € * 5% = 1029.00 €
Service 3087.00 €
Materials + service **25107.60 €**

In our example, visualisation of KNX functions is planned from a central location. Because the requirements profile is not very complex, we have chosen a simple touch screen as the visualisation interface in our example.

Material costs
Touch screen approx. 1000.00 €
Service
Graphic design and integration of the KNX data points approx. 500.00 €
Special costs 1500.00 €

Total cost of our example 26607.60€

4. Physical address and group address
4.1 Physical address
4.2 Group address

Basically there are two different forms of address

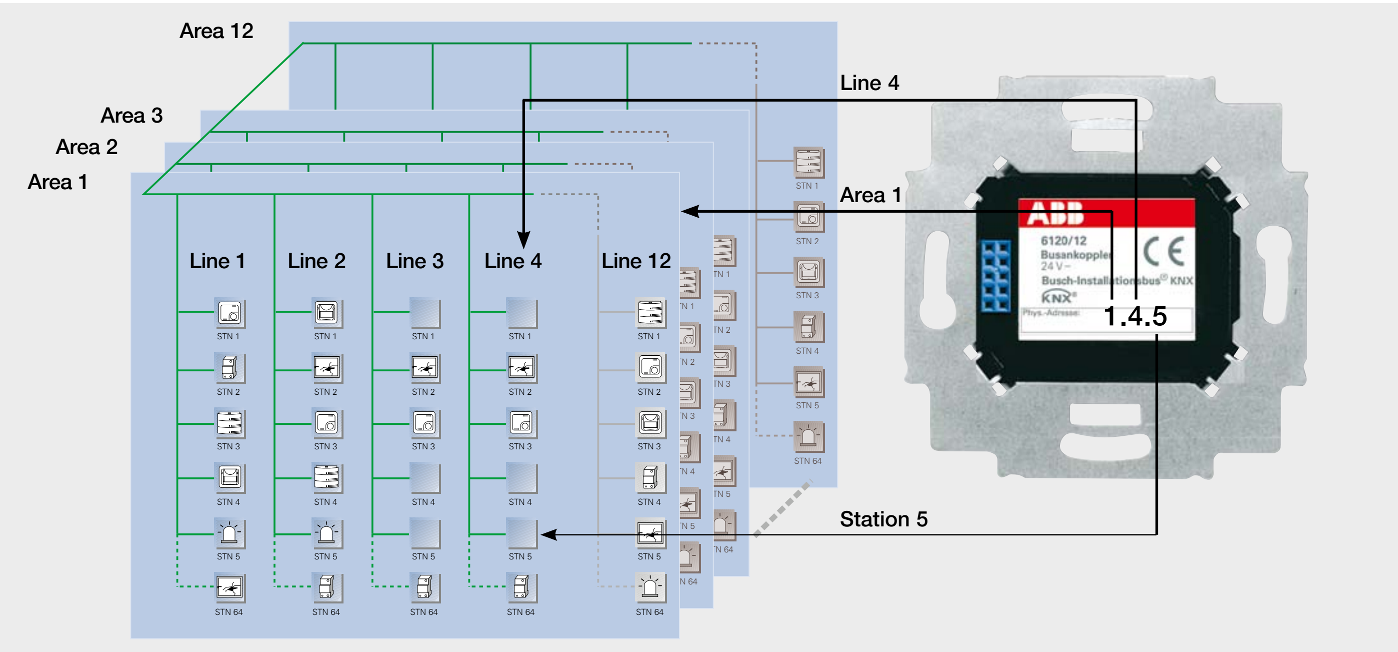
physical address
group address

4.1 Physical address

The physical address resembles a telephone number for each individual participant. Thus, each physical address only occurs once in an KNX project. From the physical address it is also possible to determine the line that the STN can be found in.

The set-up of the physical address is always the same:

Area 1
Line 4 } 1.4.5
Station 5



4.2 Group address

The group address is a numbering of the individual functions. A group address occurs at least twice in one project – once with the sensor and once with the actuator. Since the same group address is allocated to the sensor and the actuator, they are functionally linked together. The group address sent from the sensor is registered by the actuator and the respective switching process is carried out.

! The physical address must be marked on each STN and on each corresponding control cover. If due to renovation work, for example, the control covers are removed from the bus couplings, they can be allocated correctly to the right bus couplings afterwards.

The division into main and STNgroup has become routine. From the ETS 2 onwards a second form of addressing exists on 3 levels, i.e. the main group, middlegroup and lower group. Irrespective of the address form, up to 32,768 different group addresses can be assigned in one project.

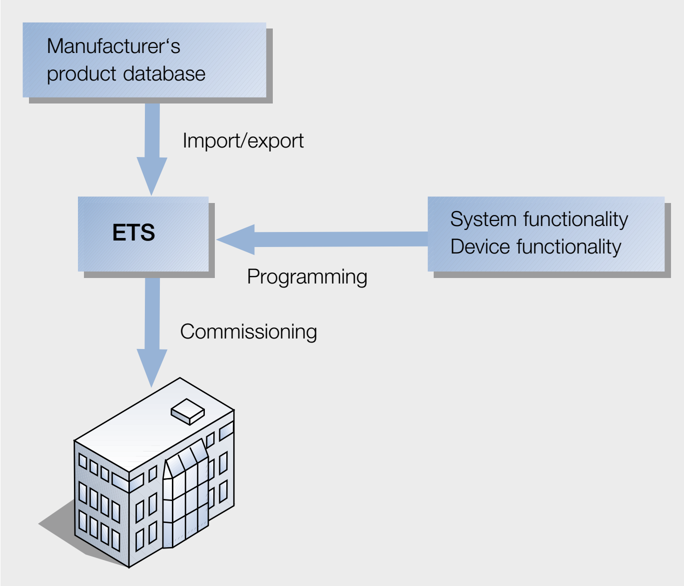
	Addressing on 2 levels	Addressing on 3 levels
Main group	0 – 15 = 16 addresses	0 – 15 = 16 addresses
Middle group		0 – 7 = 8 addresses
Lower group	0 – 2,047 = 2,048 addresses	0 – 255 = 256 addresses
Number of group addresses	**= 32,768 addresses**	**= 32,768 addresses**

5. System Engineering
5.1 The European Tool Software (ETS)
5.2 The programming process

5.1 The European Tool Software (ETS)

The ETS is the standard software used for commissioning the KNX. Unlike other systems, all manufacturers of KNX products use the ETS to commission their devices. This guarantees product compatibility between different manufacturers. The product data can be obtained from the manufacturers free of charge. The product data can be imported into the ETS by the user without a problem.
The ETS is not free of charge and can be purchased through the KNX: **www.knx.org**

Training programmes are offered in many countries through certified training establishments. For more information on training, please ask your representative.



5.2 The programming process

Programming the system in the ETS requires several steps.

Create the building structure (optionally)
Building, storeys and rooms/distributors of the project are defined in the form of a tree structure.

Create the devices of the project
The devices required are added into the rooms/distributors and their parameters are defined. Unique „physical addresses“ are assigned to the devices (see diagram on the right)

Define the functions in the project
Each function is given a name, which serves as the so-called group address (see diagram on the right)

Create the interconnections
Devices are linked via the group addresses, which is comparable to the layout and connection of control lines in the conventional technology.

6. The commissioning process 7. Tips and Tricks

6. The commissioning process

To commission the system, the programmer's local computer has to be connected to the KNX installation. The following options can be used to achieve the connection:

• Serial COM port
• USB port (with ETS3 and later)
• LAN/ISDN gateway (remote maintenance)

Once one of these connections has been established, the next step is to load the physical addresses into the device. This requires pressing a programming button on the device once. After this is done, the so-called applications (which comprise the actual device program) can be loaded. This takes place via the bus, without having to access the device manually.

7. Tips and Tricks

1. To avoid having to set up a new line straight away if more stations (STN) are added, do not plan more than 40 to 45 station (STN) per line for the ABB i-bus® KNX.

2. Adapt the bus structure to the building, e.g. one line for each floor. This increases the clarity of a project.

3. The certified bus line has two pairs of wires. The first pair (black and red) is needed immediately; the second pair can be used later, or if necessary, for another purpose. Therefore it is advisable to wire this second pair of wires straight away in all the branching boxes, etc..

4. In larger ABB i-bus® KNX systems, is it recommendable to create several programming possibilities. This means providing a serial interface in several places (for the bus connection) and a socket (if necessary, for the laptop).

5. Use a certified bus line that has the necessary physical properties on the one hand (number of wires, cross-section, insulating voltage) and is easy to distinguish from other weak-current lines, on the other. Possible cable types are: JY (ST)Y 2x2x0.8 or PYCYM 2x2x0.8.

6. Basically, there are two possibilities for placing the actuators in a building - either decentrally in suspended ceilings, or centrally in STN-distributions. Both possibilities have their advantages:

Decentral

- less installation work
- fewer lines, which means
- lower fire load and smaller cable runs
- smaller STN-distributions

Central

- the devices are more easily accessible
- the devices are clearly positioned

8. Planning support Busch-triton®

Room:	

Installation location:	

Switch rocker functions:

Switch rocker 1	
Switch rocker 2	
Switch rocker 3	
Switch rocker 4	
Switch rocker 5	

☐ 1gang		☐ Socket outlet
☐ 3gang	☐ Infrared	☐ Socket outlet
☐ 3gang RTR	☐ Infrared	☐ Socket outlet
☐ 5gang	☐ Infrared	
☐ 5gang RTR	☐ Infrared	

Other remarks:

9. Electrical Design (Consulting)
9.1 General
9.2 Installation sheets

9.1 General

Planning with KNX differs little from planning based on conventional techniques. There are two differences, however, which the planner needs to consider.

1.The specification (bid) should include a detailed functional description, as the functionality generally can not be determined from the bid devices. This functional description allows the tendering company (usually the installer) to estimate the input required for programming the building being constructed.

2.The layout of the KNX should be illustrated in a diagram. This provides additional information on time and cost requirements and illustrates the planned structure of the project.
(Refer to „Topology“.)

! Note: Programming the devices generally is not included in the planning. Instead, this service is provided by the company carrying out the installation or by a specialised service provider.

Recommendations for planning with KNX:

Field experience has shown that the less experienced tend to offer the KNX as a separate item. This leads to the following disadvantages:

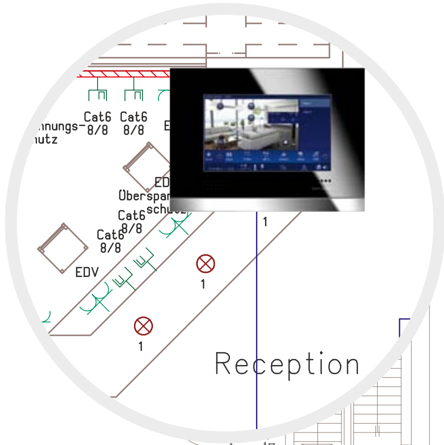
- Only with difficulty can the tendering installer make correlations between the various assembly groups.
- The constructor gets the impression that the KNX is an optional item that can be removed from the bid. This of course is the case only if an alternative system is implemented (which often requires further measures) or if the parties renounce agreed solutions.

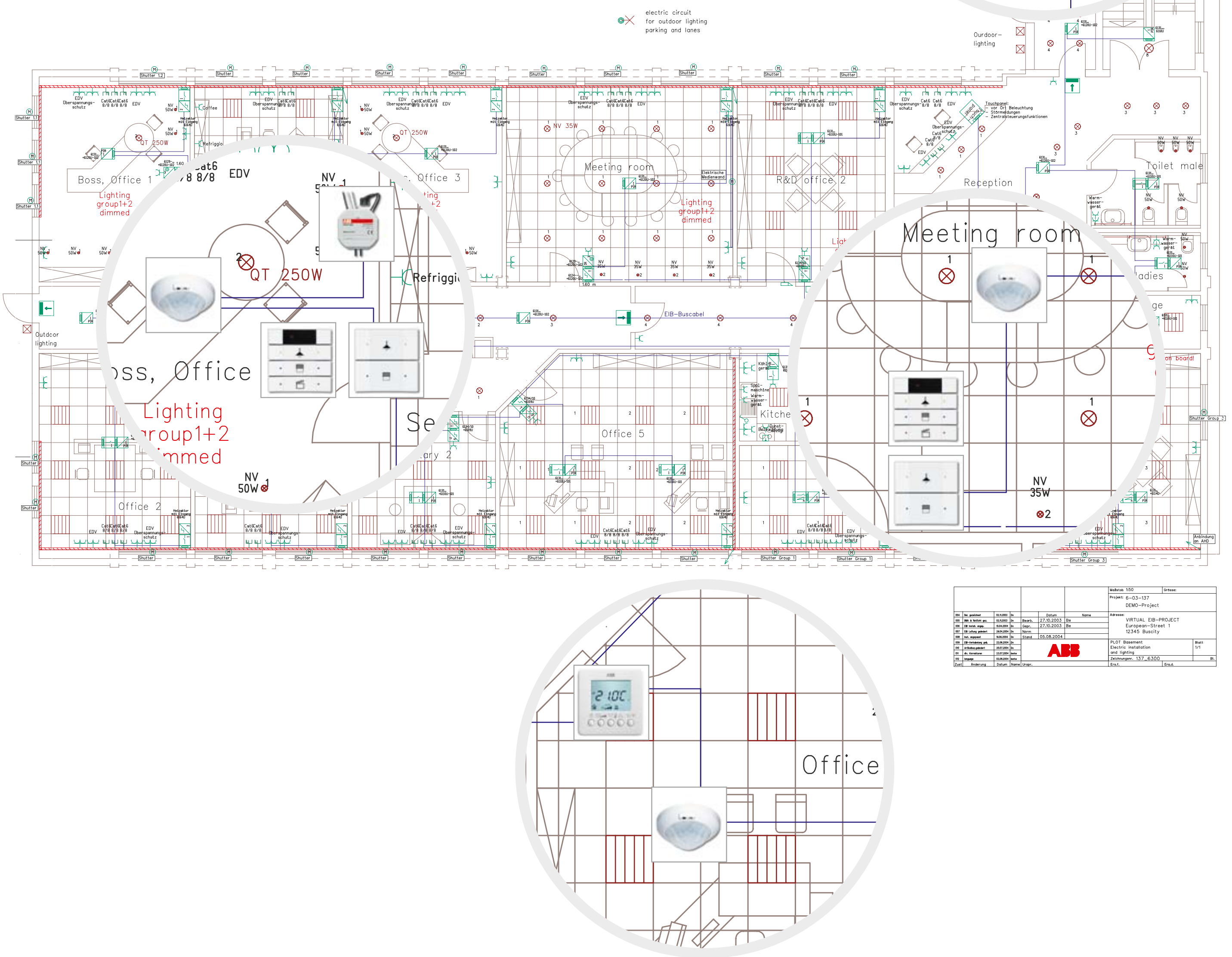
This can be avoided by integrating the planned implementation into the standard segmentation of the specification (e.g. lighting, heating...) bid.

9. Electrical Design (Consulting)
9.1 General
9.2 Installation sheets

9.2 Installation sheets

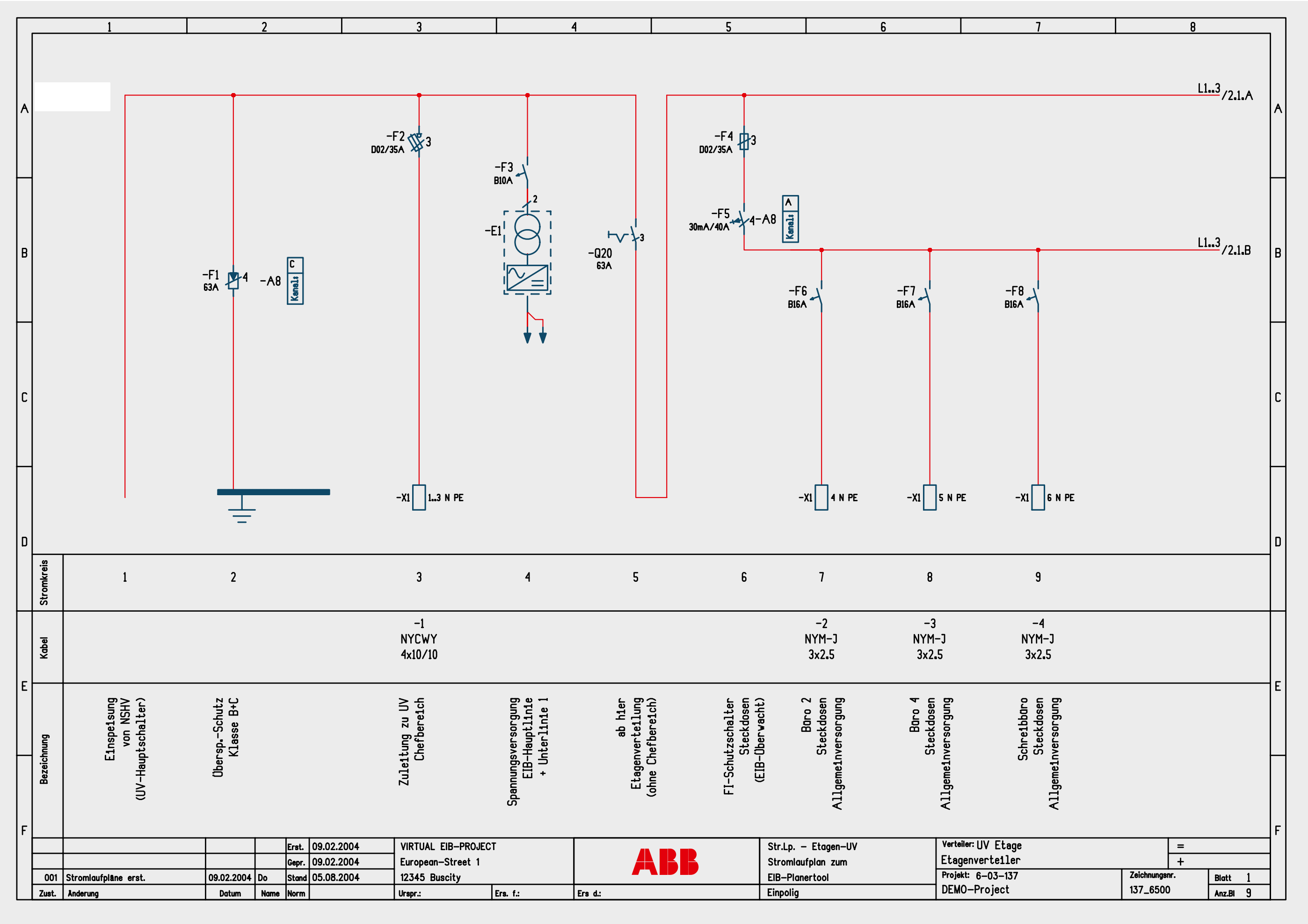
Like planning using conventional technology, the installation plan provides information on the special positioning of the installation devices, the function can not be mirrored in the plan because the function is ultimately determined when the devices are programmed, not when they are installed.

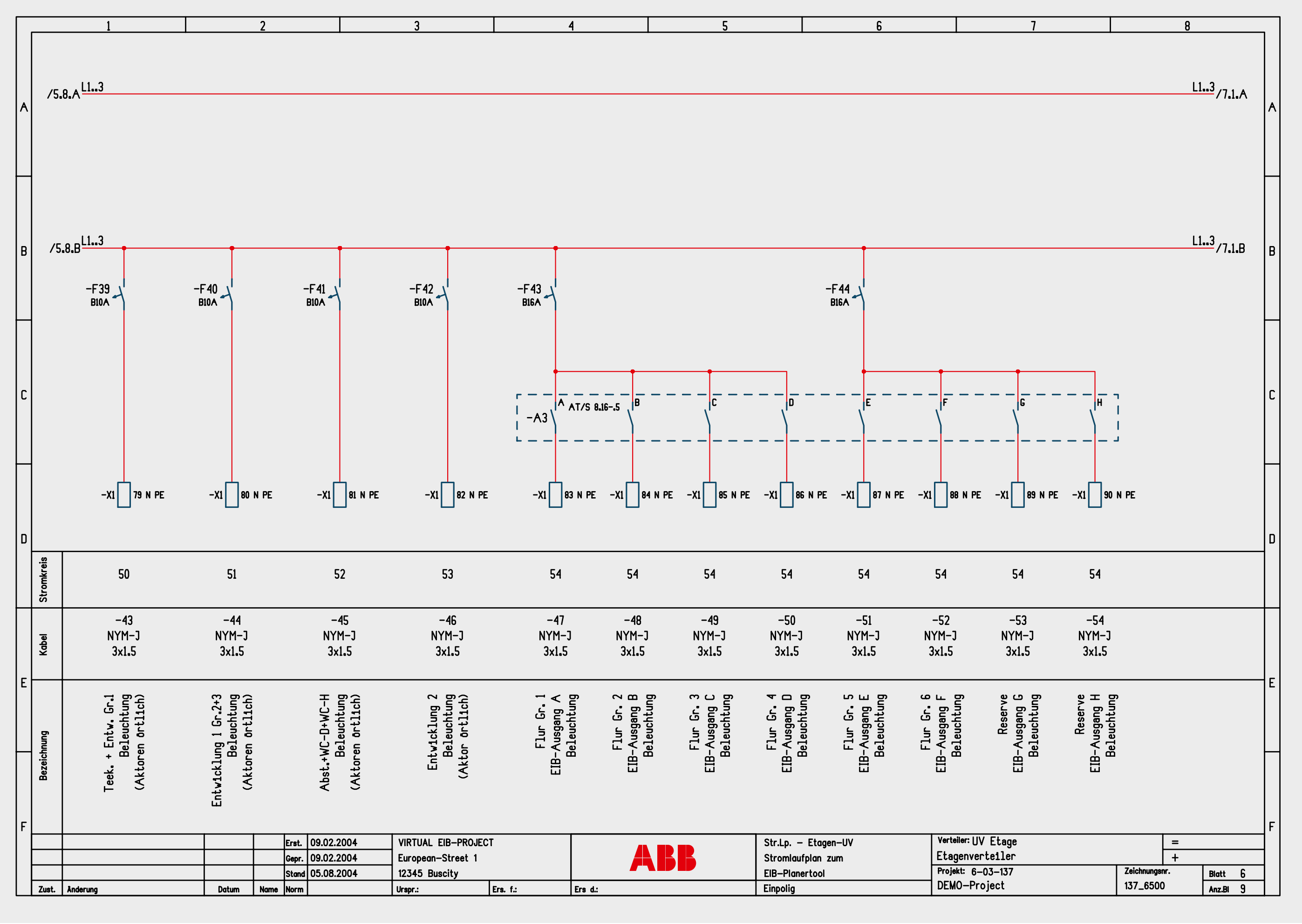




9.3 Circuit diagram

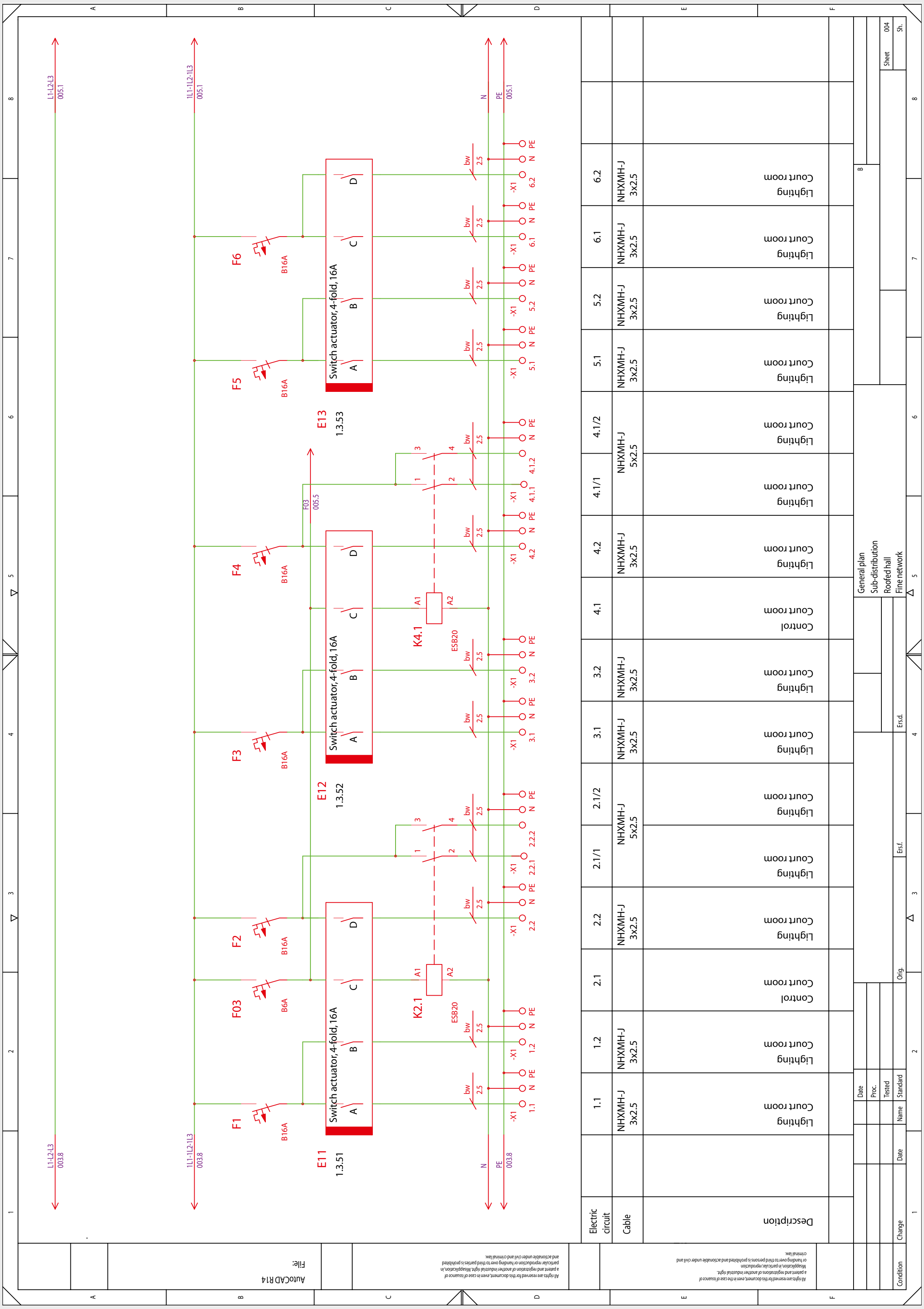
The KNX distributor devices are represented in the circuit diagrams by block symbols. The single-line diagram is the most common in the plan. Multiline diagrams are needed only in special cases and in revision plans.



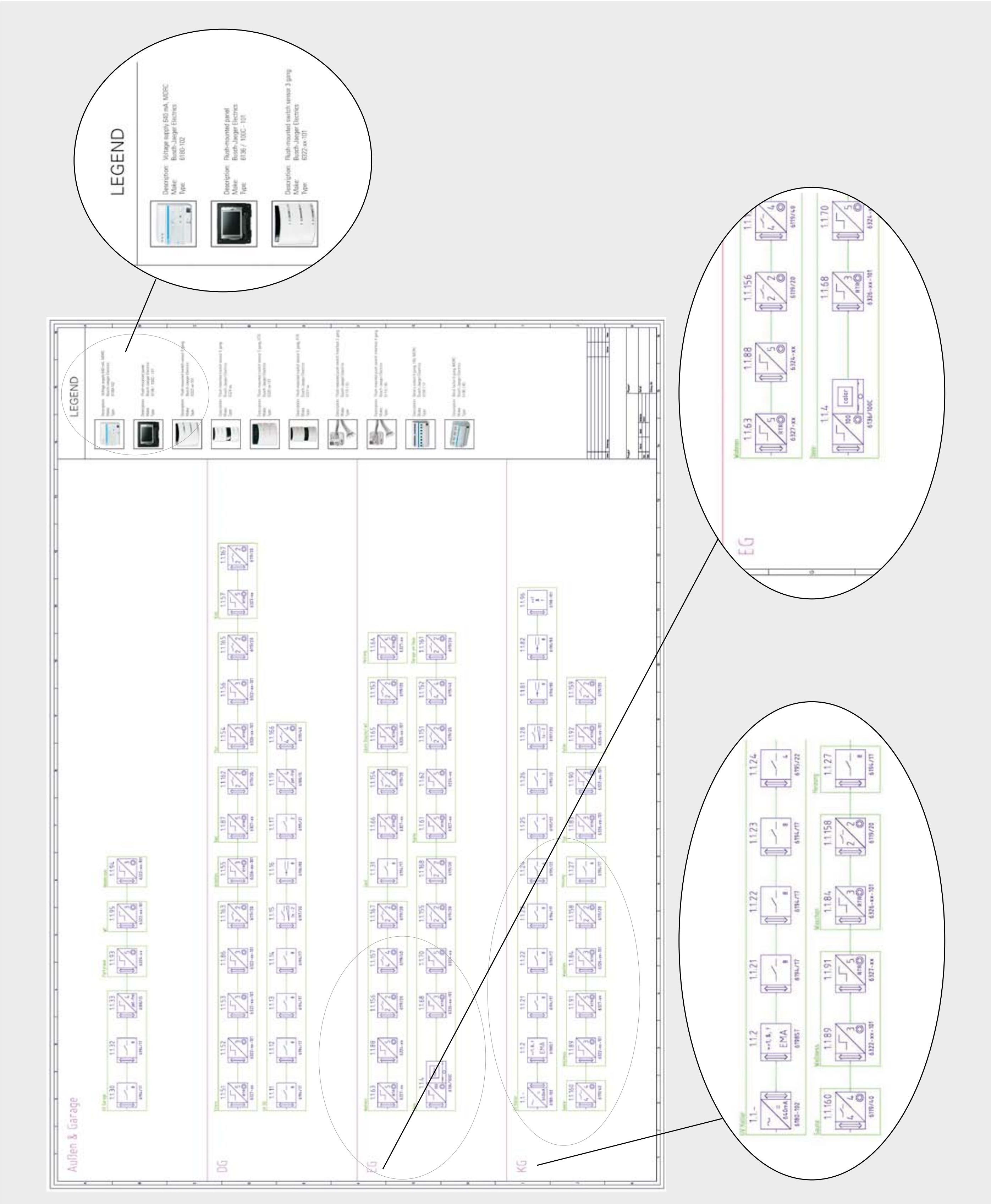


/5.8.A L1..3
L1..3 /7.1.A
/5.8.B L1..3
L1..3 /7.1.B
-F39 B10A
-F40 B10A
-F41 B10A
-F42 B10A
-F43 B16A
-F44 B16A
-A3 AT/S 8.16-.5
-X1 79 N PE
-X1 80 N PE
-X1 81 N PE
-X1 82 N PE
-X1 83 N PE
-X1 84 N PE
-X1 85 N PE
-X1 86 N PE
-X1 87 N PE
-X1 88 N PE
-X1 89 N PE
-X1 90 N PE
Stromkreis
Kabel
Bezeichnung
50 51 52 53 54 54 54 54 54 54 54 54
-43 NYM-J 3x1.5
-44 NYM-J 3x1.5
-45 NYM-J 3x1.5
-46 NYM-J 3x1.5
-47 NYM-J 3x1.5
-48 NYM-J 3x1.5
-49 NYM-J 3x1.5
-50 NYM-J 3x1.5
-51 NYM-J 3x1.5
-52 NYM-J 3x1.5
-53 NYM-J 3x1.5
-54 NYM-J 3x1.5
Teek. + Entw. Gr.1 Beleuchtung (Aktoren örtlich)
Entwicklung 1 Gr.2+3 Beleuchtung (Aktoren örtlich)
Abst.+WC-D+WC-H Beleuchtung (Aktoren örtlich)
Entwicklung 2 Beleuchtung (Aktor örtlich)
Flur Gr. 1 EIB-Ausgang A Beleuchtung
Flur Gr. 2 EIB-Ausgang B Beleuchtung
Flur Gr. 3 EIB-Ausgang C Beleuchtung
Flur Gr. 4 EIB-Ausgang D Beleuchtung
Flur Gr. 5 EIB-Ausgang E Beleuchtung
Flur Gr. 6 EIB-Ausgang F Beleuchtung
Reserve EIB-Ausgang G Beleuchtung
Reserve EIB-Ausgang H Beleuchtung
Erst. 09.02.2004
Gepr. 09.02.2004
Stand 05.08.2004
VIRTUAL EIB-PROJECT
European-Street 1
12345 Buscity
Urspr.:
Ers. f.:
Ers d.:
Zust. Änderung Datum Name Norm
ABB
Str.Lp. - Etagen-UV
Stromlaufplan zum
EIB-Planertool
Einpolig
Verteiler: UV Etage
Etagenverteiler
Projekt: 6-03-137
DEMO-Project
Zeichnungsnr. 137_6500
Blatt 6
Anz.Bl 9

10. Documentation Examples
10.1 Distribution plan



10. Documentation examples
10.2 General plan



Contact us

A member
of the ABB Group

Busch-Jaeger Elektro GmbH
P.O.Box
58505 Lüdenscheid

Freisenbergstraße 2
58513 Lüdenscheid
Germany

www.BUSCH-JAEGER.com
info.bje@de.abb.com

Central sales service:
Phone: +49 (2351) 956-0
Fax: +49 (2351) 956-1380

BJE 0001-0-0156/2.11/0502-D, dpi 405739

Power and productivity
for a better world™