

## **KNX Development Getting Started – KNX System components**

# KNX Development Getting Started

## – KNX System components

### Introduction

Since 2006, KNX is a world standard and documented in the ISO/IEC 14543-3-1 to 7 standard. Hence, it is an openly described protocol for home and building control and can thus be used by anyone purchasing a copy of the relevant standard parts in his/her country. However, as time is of the essence, it may not always be a wise decision to start a KNX development from scratch, i. e. with just the international standard or the KNX specifications as a basis. This holds especially true, if one wishes to make use of the infrastructure that makes KNX unique in the world of home and building control, i. e. the manufacturer independent and multiapplication tool, ETS™. A large majority of all KNX devices is commissioned through ETS. These products are referred to as 'S-Mode' (System Mode) products. The ETS is also one of the main topics during the standardized KNX basic courses organized in over 400 independent KNX training centers over the world. For this reason, this brochure first explains what steps are necessary to develop a KNX S-Mode product. In a second part, it explains which types of KNX TP (Twisted Pair) system components and/or communication stacks are available to reduce time to market. In a third part, it explains how products can be developed on the basis of other KNX media like Radio Frequency, Powerline and IP. Last but not least, the brochure gives some background information on what should be taken into account when wishing to start a development of an ETS APP or ETS DCA (Device Configuration App).

### Steps to bring a KNX S-Mode product to the market

The following steps shall be observed when wishing to develop a KNX S-Mode product:

1. The KNX standard foresees a number of KNX system flavors, which amongst others determine the extent of run-time functionality as well as how the device is configured. These are called profiles and are described in Volume 6 of the KNX Specifications. So, depending on the desired functionality and how it shall be configured, the manufacturer has to make a selection of the adequate profile. The selected profile will in turn determine the type of microcontroller platform one is able to use for one's development of the communication stack.
2. Once the profile is fixed, the development of the hardware of the device can start, as well as the software called 'application program'. One will need to find the necessary development tools corresponding to the chosen microcontroller platform (e. g. compiler). The developer will also have to decide on the type of KNX medium the device will use for communication, i. e. Twisted Pair, Powerline, Radio Frequency or IP, the four available KNX media.
3. As the binary code of the application program resulting from the above development cannot be handled by an end user (typically a contractor), the code needs to be 'wrapped up' into a format that is readable by the end user and can be

read by ETS. For this, the manufacturer needs to get hold of the KNX Manufacturer Tool through the KNX Online Shop (<https://my.knx.org>). As any device that is handled by the ETS shall be submitted to KNX certification, it is highly recommended that during the development stage appropriate input is prepared for the later certification test campaign. For this, KNX offers the KNX Interworking Test Tool, also available via MyKNX.

4. Once conformity has been sufficiently checked by the manufacturer himself, the application program can be submitted to KNX for registration. When registering the application program, it will be signed by KNX. Only signed files can be imported into the ETS end user tool and submitted to the KNX accredited test houses for formal KNX certification conformity testing. From registration onwards, the manufacturer is able to market the product branded with the KNX trademark.

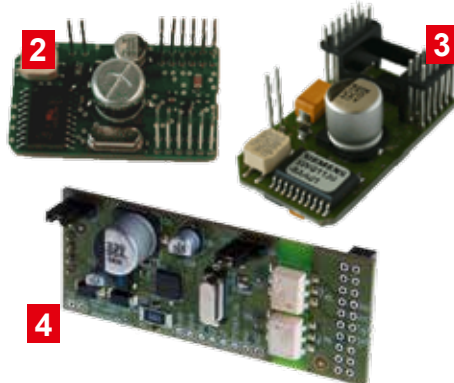
### Starting from scratch or use of available system components?

When starting a development, the KNX manufacturer has the following options:

1. The Manufacturer opts to develop entirely the KNX product on his own. This implies that the only basis for his development is the KNX specifications and that all parts of the product (Physical Layer, Communication Stack, Application Program as well as ETS product entry) need to be developed and certified. This is not



[1] TP-Module-Tapko-SIM



[2] TP-Stack-Siemens-M111-115  
[3] TP-Stack-Siemens-M130-135  
[4] TP-Stack-Weinzierl



[5] TP-Tranceiver IC-ON-NCN5120

an option if one wishes a quick time to market. This however has the advantage that one is totally independent from any supplier. This scenario is thus more suitable for larger companies with a big development capacity aiming at a larger product range.

2. The Manufacturer opts to relabel existing KNX end devices of another KNX member with his own brand name. The development effort in this particular case is reduced to nearly zero, as it is limited to the reregistration of existing ETS application programs in the name of the reselling manufacturer. This is an administrative procedure and does not require retesting of the products.
3. The most ideal case for starting manufacturers developing new products is to take recourse to available KNX certified system components and/or stacks or even platforms including certified runtime application blocks. In this way, the development is limited to the design of an application program and the preparation of an ETS product entry. Also only these parts are subject of KNX certification. KNX even offers a Development Cookbook with examples based on existing system components as part of the KNX Standard (Volume 2).

## Existing TP System components

Four solutions based on certified TP system components can be distinguished:

1. Analog Transceivers
2. Digital Transceivers
3. Communication Stacks
4. Modules

Where Bus Modules have the advantage that the needed development effort is minimal, their cost is by far the highest. The cost of the transceivers is the lowest; however de-

velopment and certification effort of a product using them is higher. In other words, the higher the intended volume, the more one will opt for a solution where the needed development effort may be higher but can be divided over a larger intended sales volume. Another factor to take into account may also be the added costs for achieving KNX compatibility compared to the costs of the rest of the hardware.

1. Analog Transceivers represent certified implementations for the physical layer of the KNX communication protocol. The available products can again be split up into three classes:

- a) True analog transceivers like FZE 1066 from SIEMENS AG and NCN 5110/21/30 from ON Semiconductors and E981.33 from Elmos and KITT from STMicroelectronics;
- b) Transceivers that can be used in analogue mode like TP-UART IC & TPUART2 IC from SIEMENS AG, E981.03/23 from Elmos, NCN5120 from ON Semiconductors;
- c) Discrete solutions like KAlphys from Tapko and GIRA.

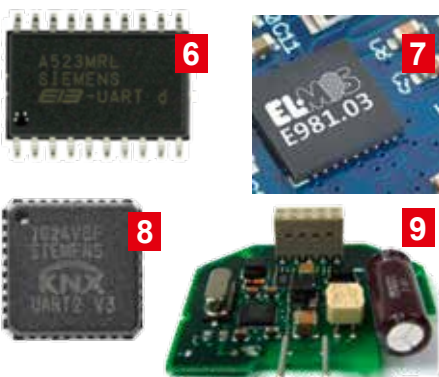
The requirements as regards timing on the used communication stack are somewhat higher than when using digital transceivers.

2. Digital Transceivers represent certified implementations for the physical layer and for (part of) the data link layer of the KNX communication protocol. The available products are: TP-UART2 IC and TP-UART2+ from SIEMENS AG, KAllink from Tapko, MAP from Weinzierl. These solutions don't require TP bit (de)coding. Like the analog transceivers, the communication stack needs to be developed, one can either opt to do this oneself or to take recourse to a microcontroller with embedded stacks offered by SIEMENS AG\*

or license available stacks from the companies Eelectron, Tapko, Weinzierl and ITK. SIEMENS AG moreover offers the flush mounted Bus Transceiver Module, an end device that only contains the TP-UART, on to which application modules can be mounted containing the required microcontroller with system stack and application program.

3. Communication Stacks represent certified implementations for all layers of the KNX communication protocol. The available products are: BIM from SIEMENS AG\*, KAlstack from Tapko supporting all relevant microcontrollers from amongst others Renesas and STMicroelectronics, KNX Stack Classic & KNX Stack NGS from Weinzierl supporting all relevant microcontrollers, a system B stack from ise GmbH supporting 8 to 32 bit microprocessors and the system B Stack KN-briX from ITK Engineering supporting 32 bit microprocessors. A stack is the system software for a KNX device provided as library or as source code. It is typically shipped with a printed circuit board for development puposes. These modules allow integration into developed application hardware via binary or analogue I/O pins. In the case of SIEMENS AG, the core elements of the BIMs are also offered as chip set, i. e. if the layout of an application module would not allow the use of a BIM. Development on the basis of BIM modules only requires the creation of the application program fitting to the onboard microcontroller and the creation of ETS product entry.
4. Modules represent certified implementations of the KNX communication protocol + (part of the) application program. The available products are: SIM-KNX from Tapko supporting a host serial pro-

\*through the distributor Opternus



[6] TP-Tranceiver IC-Siemens-UART  
 [7] TP-Tranceiver IC-Elmos-E981.xx  
 [8] TP-Tranceiver IC-Siemens-UART2  
 [9] TP-Tranceiver PCB-Siemens-UART2



[10] TP-Tranceiver PCB-Tapko-KAlphys



[11] TP-Tranceiver IC-Infineon-FZE 1066

protocol based on ASCII, KIMaip from Tapko supporting a host serial protocol based on I2C, BAOS from Weinzierl supporting a host serial protocol based on FTI.2 frames and ise smart connect KNX Programmable from ise GmbH supporting to develop KNX applications in C#/VB.Net communicating in addition via IP and/or USB port. Eelectron is offering custom modules, called KNX\_to\_SERIAL\_Interface. For all four solutions, generic or specific ETS product entries are available and/or can be developed.

### Development of KNX RF devices

Three solutions based on certified RF system components can be distinguished:

1. Transceivers
  2. Communication Stacks
  3. Modules
1. Transceivers are required to implement the physical layer of KNX RF. As for KNX RF no dedicated KNX components are required, most standard ISM transceivers can be used as far as they comply with the KNX RF requirements.
  2. Communication Stacks represent certified implementations for all layers of the KNX communication protocol. The available products are: KAlstack from Tapko respectively KNX Stack NGS from Weinzierl supporting many different microcontrollers and a System B stack from ise GmbH supporting 8 to 32 bit microprocessors.
  3. Modules represent certified implementations of the KNX communication protocol + (part of the) application program. The available product is: SIM-KNX from Tapko supporting a host serial protocol based on I2C, BAOS from Weinzierl supporting a host serial protocol based on FTI.2 frames, ise KNX-RF module from

ise GmbH running a System B stack supporting many different I/O features and the Hager KNX RF module, supporting 433 and 866 MHz transmission, KNX E and S-Mode as well as other protocols like Bluetooth and Sigfox.

The KNX RF Physical Layer is specified as a single band single channel or a multi-channel solution using the 868 MHz band. RF single channel solutions are suitable for most environments, multi-channel solutions are an advantage in environment with expected disturbances. Thanks to a defined compatibility scheme, multi- and single channel KNX RF solutions are fully compatible. Multi-channel RF solutions are able to jump to another channel if having to cope with disturbances. Multi-channel devices can use up to five channels, three fast and two slow channels. Multi-channel devices also have the possibility to go into sleep mode to considerably reduce power consumption and can optionally offer the possibility to check the correct reception of data by up to 64 KNX RF receivers by a Fast Immediate Acknowledge, even in an installation with up to two re-transmitters in case of RF Multi. In case a Fast Immediate Acknowledge is missing, telegrams are automatically retransmitted. Last but not least, KNX RF checks whether another KNX RF transmission is ongoing before starting its own transmission, thus considerably reducing the amount of possible collisions. As for TP, solutions can be developed from scratch. For KNX RF, no dedicated chip is necessary. Based on the reference design of the chip manufacturer, a circuit consisting of the selected chip and a number of passive components can be designed and optimized for the KNX RF requirements. However, also for KNX RF, certified physical layer solutions, system stacks and RF modules are available and offered by Radiocrafts, Tapko, Weinzierl and ise GmbH. Earlier KNX RF solutions use KNX Easy Configuration Mode (mostly Push Button Mode) for linking and para-

meterization. However from ETS5 onwards, also linking and parameterization with ETS of KNX RF devices is possible, if supporting S-Mode.

### Development of Energy Harvesting (RF) devices

Thanks to recent developments, it is now possible to develop KNX devices that need no external supply of power during runtime. A solution based on certified RF system components is KAlstack from Tapko. This product represents a certified implementation for all layers of the KNX communication protocol and is S-Mode featured, which means that such devices can be commissioned with ETS (ETS5 onwards).

### Development of KNX PL devices

For KNX PL – based on FSK (Frequency Shift Keying) – currently no certified PL modules or Physical Layer solutions exist. Communication stacks can be licensed via Weinzierl Engineering, while Physical Layer solutions need to be developed by the respective manufacturer.

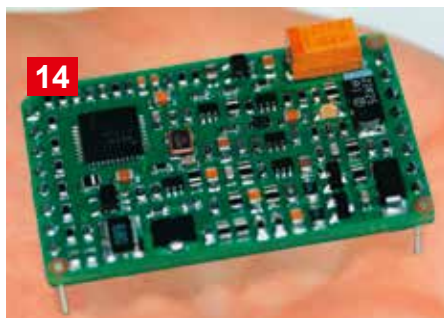
### Development of KNX IP devices

Two solutions based on certified IP system components can be distinguished:

1. Communication Stacks
  2. Modules
1. Communication Stacks represent certified implementations for all layers of the KNX communication protocol. The available products are: KAlstack from Tapko respectively KNX Stack NGS from Weinzierl supporting many types of different microcontrollers.
  2. Ready-made hardware in DIN rail housing with ethernet interface from Tapko where



[12] TP-Module-Weinzierl-BAOS-830  
[13] TP-Module-Weinzierl-BAOS-832



[14] TP-Module-Tapko-KIMaip



[15] Hager KNX Smart RF Module

the application is downloaded into the device via bootloader. Weinzierl provides a set of platforms in DIN rail housing with Ethernet connection and integrated KNX IP stack.

Weinzierl or ise GmbH. For the IP stack one may also opt to make use of more powerful operating systems like Linux, which basically contain an IP stack with UDP.

The transmission of KNX telegrams via Ethernet is laid down in the KNXnet/IP specifications. The specifications allow the use of the medium for PC interfaces and for routers. IP Routers are similar to TP line couplers, except that they use Ethernet for the main line. However, it is also possible to directly integrate KNX end devices via IP, making Ethernet respectively IP (Internet Protocol) a KNX medium in its own right. The development of KNX IP devices does not require specific KNX components. The system software of a KNX IP device consists of two protocol stacks. Communication via Ethernet requires an IP Stack with UDP as KNXnet/IP is based on connectionless communication. KNX Unicast as well as multicast telegrams are transmitted via UDP. The KNX Stack is put on top of the IP/UDP Stack. Either these stacks are developed from scratch or recourse is taken to available certified solutions from Tapko,

### Development of an ETS APP or DCA

An ETS APP is a project design or diagnostic extension to the ETS tool, where an ETS DCA (Device Configuration App) is a product specific configuration extension to ETS. In both cases, it is obligatory to become a KNX member to be able to start a development. Once an appropriate agreement has been signed, the KNX member gets access to the ETS APP development documentation and an administrator account in MyKNX. Once the development of the ETS APP is finalized and has been checked via the ETS APP Validation Tool, the APP needs to be validated by KNX before it can be sold on the market, however at least via MyKNX. The documentation for ETS DCA development is contained in the KNX manufacturer tool. Developed ETS DCAs need to go through the same validation process as normal ETS Apps.

### Contact Information

- Eelectron SpA  
[www.eelectron.com](http://www.eelectron.com)
- ELMOS Semiconductor AG  
[www.elmos.de](http://www.elmos.de)
- Hager Vertriebsgesellschaft mbH & Co. KG  
[www.hager.com](http://www.hager.com)
- ise  
[www.ise.de](http://www.ise.de)
- Individuelle Software-Entwicklung GmbH  
[www.ise.de](http://www.ise.de)
- ITK Engineering GmbH  
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- ON Semiconductor  
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[www.st.com](http://www.st.com)
- Tapko Technologies GmbH  
[www.tapko.de](http://www.tapko.de)
- Weinzierl Engineering GmbH  
[www.weinzierl.de](http://www.weinzierl.de)



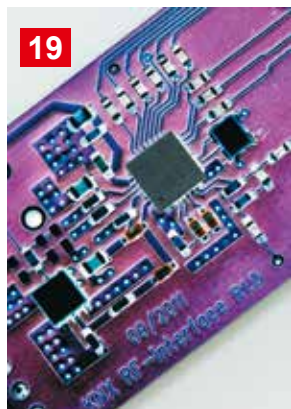
[16] TP-Module-ise



[17] RF-Module-ise



[18] KNbriX\_KNX\_Stack



[19] RF-Stack-Tapko



[20] RF-Stack-Weinzierl



[21] IP-Stack-Weinzierl



[22] TP-Module-Eelectron



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