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# Radiated electromagnetic emission up to 1 GHz of the KNX fixed installation

***Abstract**. The article presents the results of the electromagnetic emission of a fixed installation model. The tested model was implemented on the basis of intelligent building KNX automation manufactured by Hager.*

***Streszczenie.** W artykule przedstawiono wyniki badań emisyjności elektromagnetycznej modelu inteligentnej instalacji stacjonarnej. Badany model został wykonany w oparciu o automatykę inteligentnego budynku wyprodukowaną przez firmę Hager (**Emisyjność elektromagnetyczna modelu inteligentnej instalacji stacjonarnej**).*

**Keywords:** Electromagnetic compatibility, electromagnetic emission, fixed installations, intelligent building.
**Słowa kluczowe:** Kompatybilność elektromagnetyczna, emisyjność elektromagnetyczna, instalacje stacjonarne, inteligentny budynek.

## Introduction

All products placed on the European Union market must be CE marked. In case of electronic equipment is necessary to fulfil specific requirements of the electromagnetic compatibility (EMC) Directive [1]. Among other things it defines essential requirements related to radiated disturbances emission [8].

The necessity to fulfil the requirements of the EMC does not mean, however, that the product must be tested in an accredited laboratory. The manufacturer (or importer) takes responsibility for compliance with the standards, exposing the relevant declaration of conformity. It is assumed that products with a declaration of conformity fulfil the requirements laid down by EU law, what was proved by the manufacturer in accordance with good engineering practice [8].

The Directive 2004/108/WE does not specify exact technical EMC specification for the electrical installations. It implies only that the essential requirements should be fulfilled by use of good engineering practices [7]. This article is the first attempt to develop one of such practices in case of electromagnetic radiated emission of the intelligent fixed installation.

## Intelligent fixed installation model

The fixed installation is defined as: "particular combination of several types of apparatus and other devices, which are assembled, installed and intended to be used permanently at a predefined location" [1]. In order to perform preliminary research a model of intelligent KNX installation has been developed [3], [5]. Figure 1 presents the electrical distribution board of the model equipped with executive elements building automation.

a)

b)

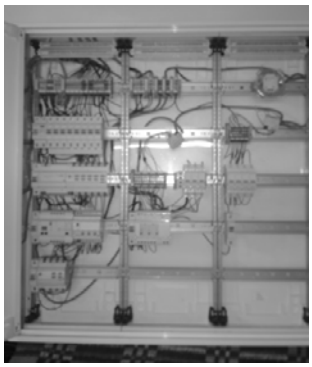

Fig. 1 a) Electrical distribution board of the KNX model equipped with executive elements building automation, b) connection system components in switchboard

## Components of the KNX model

KNX system makes possible to create an intelligent building by integrating the control and monitoring devices such as [3]:

- energy management,
- air conditioning,
- heating,
- ventilation,
- lighting and blinds and awnings,
- household appliances,
- security:
  - the supervision and access control,
  - industrial television,
  - simulation of user presence,
  - detection of the presence of people indoors,
- remote service and management,
- communications with other systems.

These issues permeate each other - it is difficult to determine if the detector of the presence indoors is just a convenience (if the signal is passed to the luminaries, it will not be necessary to manually switching-on the lights), energy management (luminaries will not be enabled when it's not necessary), or it is also an alarm system (for example, during the holidays, when there should not be people in the room) [3], [5].

Standard of KNX is independent of the manufacturer. KNX network device may be constructed of various components. From the 8-bit microcontroller to a standard

PC, depending on the requirements of a particular system implementation. Configuration of KNX system is mainly realized by use of ETS software although some manufacturers give the opportunity of programming by remote control [3], [5].

The basic components used in the model are Hager actuators (fig. 3):

- with a 10-fold binary output - used to switch on and off lights,
- regulating illuminance,
- controlling the work of roller blinds.

Combination of the components is shown in figure 2.

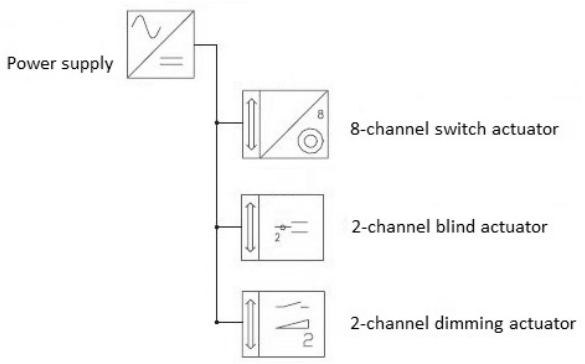


Fig. 2 Schema of connection KNX elements.

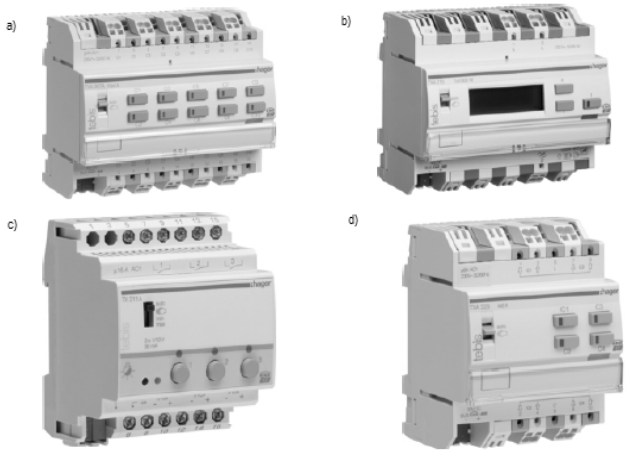


Fig.3 The components used in the model: a)actuator with a 10- fold binary output, b) lluminance regulating iactuator with LCD, c)1-10V illuminance regulating actuator, d) roller blinds controller.

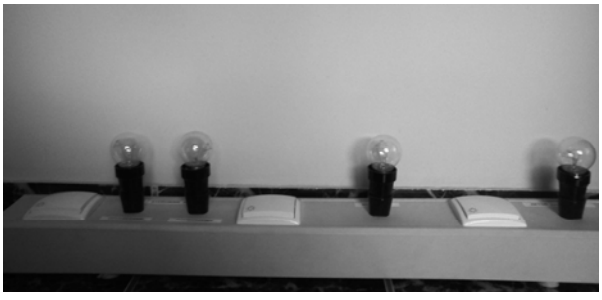

Fig. 4 Control box of KNX model.

The actuators were handled by dedicated control box (fig. 4). It contained the switch on/off buttons and the lights indicating proper operation of the model.

**Electromagnetic emission**

Electromagnetic disturbances in the frequency range from tens of kHz to several GHz in accordance with the requirements of international standards are known as Radio Frequency Interference (RFI). Most disturbances are a side effect, produced unintentionally during the realization of the basic functions of the device (or system). They arise in electrical circuits comprising inductance and capacitance (even when they occur in the form of parasitic parameters), on which there is a sudden change of the current flow, voltage changes, and feedbacks.

Research of electromagnetic emission of electrical and electronic devices regulates Polish Standard PN-EN 55022:2013 - Information technology equipment. Radio disturbance characteristics. Limits and methods of measurement. Limits for **radiated** disturbances emission are shown in Tables 1 and 2 [6]:

Table 1. Limits for radiated disturbance of Class B equipment at a measuring distance of 10 m (below 1 GHz).

| Frequency range [MHz] | Quasi-peak limits [dB(μV/m)] |
|---|---|
| 30 to 230 | 30 |
| 230 to 1000 | 37 |

Table 2. Limits for radiated disturbance of Class B equipment at a measuring distance of 3 m (above 1 GHz).

| Frequency range [GHz] | Average limit [dB(μV/m)] | Peak limit [dB(μV/m)] |
|---|---|---|
| 1 - 3 | 50 | 70 |
| 3 - 6 | 54 | 74 |

In this work measurements of radiated emission within (30-1000) MHz were carried out. Measurements at frequencies above the 1 GHz and conducted emission will be the subject of further studies.

Emission tests were performed in electromagnetic semi-anechoic chamber. To find the maximum field strength readings:

- the antenna was adjusted between 1 and 4 m in height above the ground plane,
- antenna-to-equipment azimuth was varied (by rotate the equipment),
- antenna-to-equipment polarization was also varied (horizontal/vertical).

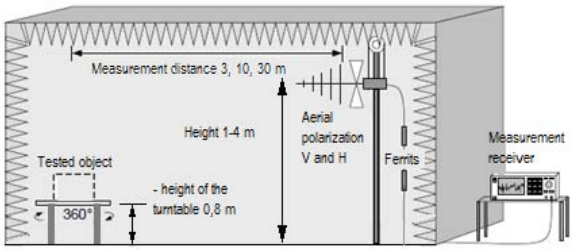


Fig. 5 Semi-anechoic chamber [4].

**Radiated disturbances emission of the intelligent fixed installation model**

Diagrams of radiated disturbances emission of modelled KNX installation are shown in figures 6 and 7.

For frequencies at which peak signal was above the limit line a measurements with quasi-peak detector were carried out.

Short voltage peaks recorded by peak detector above the limit line was caused by electrical fast transients during switching on/off operation of the roller blinds actuator. However final evaluation carried out at these points by use of quasi-peak detector shows that tested model fulfils the standard requirements in terms of electromagnetic emission[6].

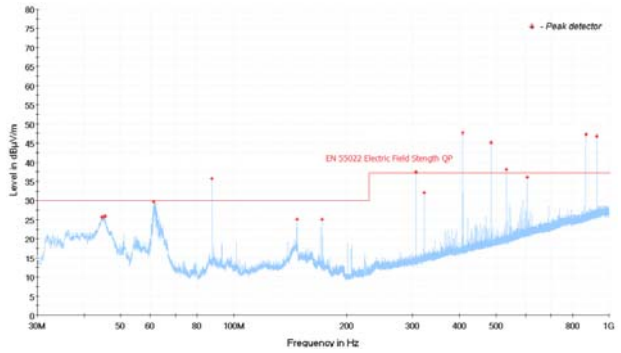


Fig. 6. KNX installation – radiated disturbances emission (peak detector).

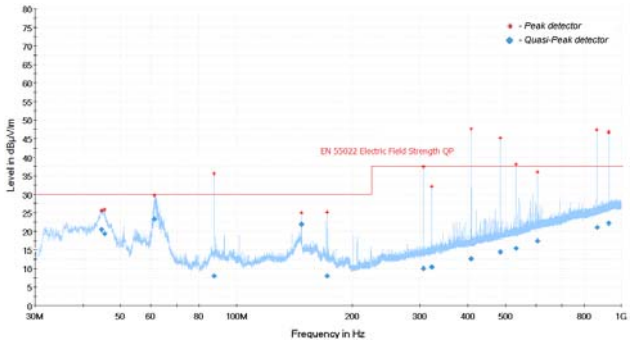


Fig. 7. KNX installation – radiated disturbances emission (quasi-peak detector).

**Summary**

All single Hager components used to build the model of tested KNX installation were CE marked which means that according to the manufacturer they fulfil the normative emission and immunity requirements of EMC Directive. Research carried out in this work showed that all these components connected together as the installation also fulfil the **radiated emission requirements**[6]. So, there is still the issue of electromagnetic immunity tests to determine whether the installation as a whole meats EMC Directive requirements. The results of electromagnetic immunity tests will be presented in the next article.

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