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The immunity of the KNX model to continuous electromagnetic disturbances

***Abstract**. The article presents the test results of the electromagnetic immunity of an intelligent fixed installation model to electromagnetic continuous disturbances in relation to the standards and regulations in force. The model tested was based on intelligent building automatic devices by Hager.*

***Streszczenie.** W artykule przedstawiono wyniki badań odporności elektromagnetycznej modelu inteligentnej instalacji stacjonarnej na zaburzenia ciągłe w świetle obowiązujących norm i przepisów. Badany model został wykonany w oparciu o automatykę inteligentnego budynku wyprodukowaną przez firmę Hager. (**Odporność modelu KNX na elektromagnetyczne zaburzenia ciągłe**).*

Keywords: Electromagnetic compatibility, fixed installations, electromagnetic continuous disturbances, KNX installations, immunity tests.
Słowa kluczowe: Kompatybilność elektromagnetyczna, instalacje stacjonarne, elektromagnetyczne zaburzenia ciągłe, instalacje KNX, testy odporności.

Introduction

The electromagnetic compatibility (EMC) falls within a discipline that deals with the issues of controlling the emission of electromagnetic disturbances and the immunity to such disturbances with regard to all kinds of electric and electronic devices.

Electromagnetic disturbance is a side effect of the operation of any device using electric energy (power supply, signal processing) and can have different characteristics (continuous disturbances, pulse disturbances, etc). It spreads in various ways including radiation and conduction within the common supply network and signalling system. Additionally, natural phenomena can also be sources of electromagnetic disturbances, for example lightnings [2].

All devices processing electric energy cause radioelectric disturbances - with modern electronic devices becoming unfavourably more susceptible to such disturbances than the ones they supersede. Contemporary electronic technology is increasingly used in the field of the functional safety of people/devices/device assemblies. Resulting from undesirable electromagnetic disturbances errors in the operation of electronic devices may consequently bring about hazards for human lives or cause the devices they control to operate in a dangerous way[1,8].

An intelligent installation model

KNX Association is the creator and owner of the KNX technology – the worldwide STANDARD for all home and building control applications, ranging from lighting and shutter control to various security systems, heating, ventilation, air conditioning, monitoring, alarming, water controlling, energy management, metering as well as household appliances, audio and lots more. The technology can be used in new as well as in existing home and buildings [10].

Fig.1. Intelligent building equipment.

The tested KNX installation model was made out of intelligent building automatic devices from Hager. Amongst others, the installed components were activating and deactivating actuators to control the lighting and roller blinds (fig.1). A control box was used with the actuators equipped with switches to activate operation and bulbs indicating that they operated properly (fig. 2).

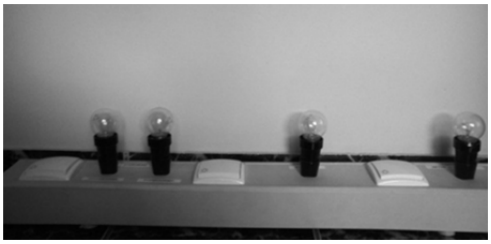

Fig. 2. Control box.

Combination of the components is shown in figure 3 [7].

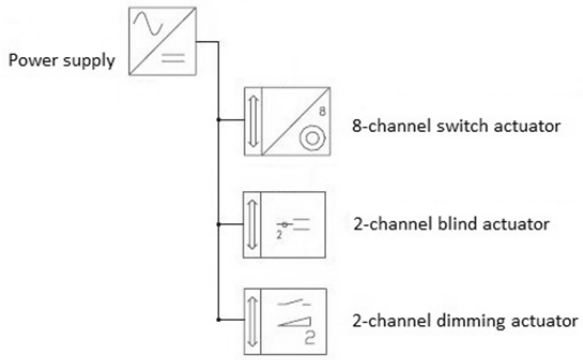

Fig. 3. Schema of connection of KNX elements [7].

The immunity tests of the intelligent installation model to continuous electromagnetic disturbances were carried out in the electromagnetic compatibility laboratory of the Institute of Logistics and Warehousing in Poznan.

Immunity of the model to continuous disturbances in view of European Standards

As used herein, the term „electromagnetic immunity to continuous interference" refers to:

- immunity to radiated radio-frequency electromagnetic field (EN 61000-4-3 [4]),
- immunity to conducted disturbances, induced by radio-frequency fields (EN 61000-4-6 [8]),

- immunity to power frequency magnetic field (EN 61000-4-8 [9]).

The following chapter shows the test setups and the results of immunity testing of the model to continuous disturbances.

According to the Standards the performance of the equipment under test was classified on the following criteria:

a) normal performance within limits specified by the manufacturer, requestor or purchaser;
b) temporary loss of function or degradation of performance which ceases after the disturbance ceases, and from which the equipment under test recovers its normal performance, without operator intervention;
c) temporary loss of function or degradation of performance, the correction of which requires operator intervention;
d) loss of function or degradation of performance which is not recoverable, owing to damage to hardware or software, or loss of data.

Immunity test to radiated radio-frequency electromagnetic field

The immunity to an electromagnetic field defined by the EN 61000-4-3 Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test, should be carried out in test setup shown in figure 4.

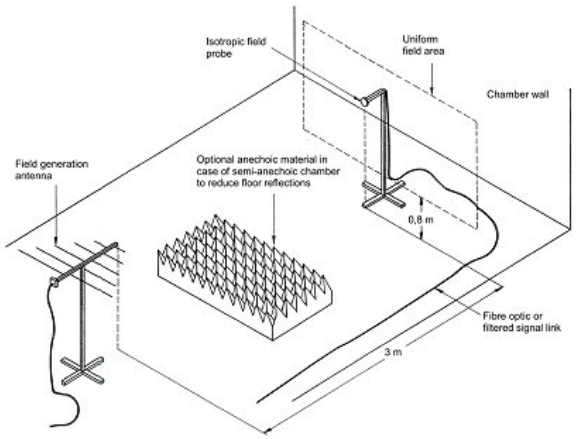

Fig. 4. Immunity to radiated electromagnetic field test setup [4].

Testing of the immunity to a radio-frequency electromagnetic field relies on checking that a given device operates properly when exposed to a field strength of 3 or 10 V/m. Two positions of the antenna should be provided (for vertical and horizontal polarization). The uniformity of the field should be achieved [5], [6]. Figure 5 shows the model during the test. The test results are shown in table 1.

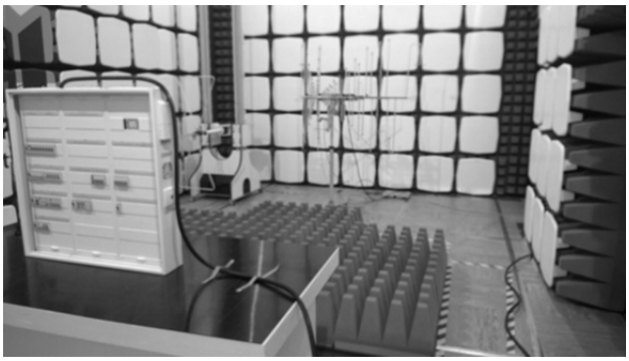

Fig. 5. The KNX model during the immunity test to radiated electromagnetic field.

Table 1. Results of immunity test to radiated radio-frequency electromagnetic field.

Field strength [V / m]	Frequency range [MHz]	Stated performance criterion
3	80 ÷ 1000	a
10	80 ÷ 1000	a

For both levels of field strengths the KNX model worked with proper performance with no degradation nor loss of function. So the model was immune to radiated radio-frequency electromagnetic field.

Immunity test to conducted disturbances, induced by radio-frequency fields

An electromagnetic field emitted by radio transmitters may cause interferences in electronic equipment, because this field may affect the whole length of the wires connected to the device. The input and output wires (e.g. power adapters, communication lines, interface conductors) act like system of passive antennas receiving RF signal[8].

This testing method relies on exposing a tested device to disturbances by use of coupling-decoupling devices simulating disturbances coming from external radio transmitters. Figure 6 shows a connection diagram of the devices tested for the immunity to conducted disturbances [5]. Figure 7 shows the model during the test.

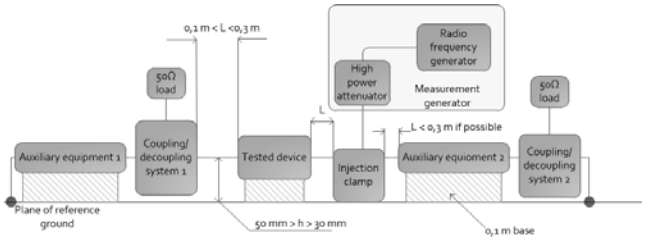

Fig. 6. System diagram of test setup for the immunity to conducted disturbances test [8].

The device should be tested within the range of 150 kHz and 80 MHz with appropriate voltage level modulated by 1 kHz sinusoidal signal (AM depth 80%). The test results are shown in table 2.

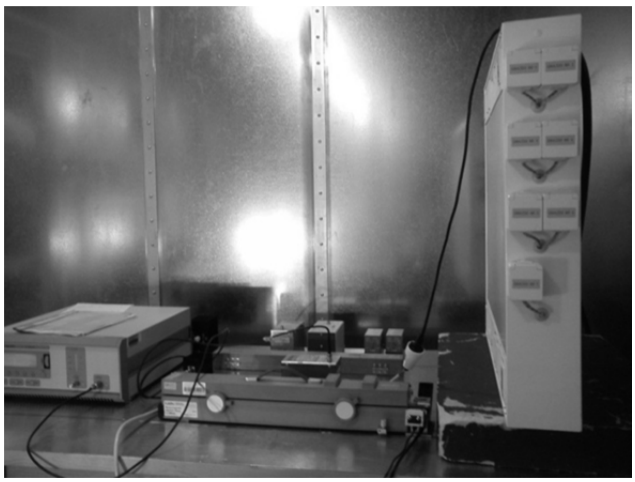

Fig. 7. The KNX model during the immunity to conducted disturbances test.

Table 2. Results of immunity test to conducted disturbances, induced by radio-frequency fields for power input port

Port	Voltage [V]	Frequency range [MHz]	Stated performance criterion
$230V_{AC}$	3	0,15 ÷ 80	a

As we can see in table 2 during the entire test, installation worked properly, so the model was immune to conducted disturbances induced by radio-frequency fields.

Immunity test to power frequency magnetic field

A power frequency magnetic field is generated by mains frequency current flowing in the conductors affecting the nearby device under test.

Depending on the influence of the closely running conductors, it is advisable to distinguish between:

- a current that in normal operating conditions causes relatively small fixed magnetic fields,
- a current that in emergency conditions causes relatively strong short-lived magnetic fields that last until protective devices start to operate.

The test setup [9] consists of the following parts (Fig. 8):

- reference ground plane,
- induction coil,
- test generator.

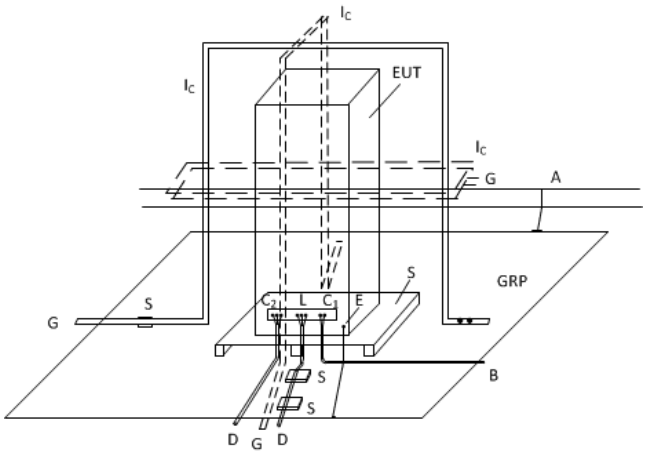

Fig. 8. Immunity to the power frequency electromagnetic field test setup, where*: GRP- reference ground, A- protective grounding, S- insulated factor, EUT- device under test, I_C- inductive coil, E- protective clamp, C_1- power supply circuit, C_2- signal circuit, L- communication line, B- to power supply, D- to supply source, G- to the testing generator [9]*

The immunity of the KNX model to the power frequency magnetic field was carried out according to the standard. The device has been exposed to a magnetic field with an strength of 30 A/m. The disturbances did not affect the proper work of the tested model. The results of the test is shown in table 3.

Table 3. Results of immunity test to power frequency magnetic field

Field strength [A/m]	Position of the coil	Stated performance criterion
30	horizontal, position in half height of the loop antenna	a
30	vertical, position in half height of the loop antenna	a

Summary

Electromagnetic disturbances are divided into continuous and pulse phenomena. The aim of this work was to verify the immunity of the set of devices to continuous electromagnetic disturbances. It was an initial stage of electromagnetic compatibility testing of fixed installations. As such, the apparatus selected is a simplified model of a fixed installation. The immunity tests to pulse disturbances will be described in a separate article.

It turned out that the tested KNX model is fully immune to continuous disturbances. Such experiment may be used for improving and verification of modules consisting fixed installation before its final evaluation after installation in intelligence building, especially each installation operates in unique and particular conditions [3].

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