# Technical requirements for Electromagnetic Compatibility of Alarm Systems

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***Abstract*—** Alarm systems and their components as electronic or electrical equipment are products which are the source and receiver of electromagnetic interference too. Alarm systems are deployed to ensure the protection of people and property in the form of an intruder alarm system, hold-up alarm system, CCTV systems, access control systems or social alarm systems. In terms of electromagnetic compatibility is necessary to address issues of the conformity assessment of products, selection of suitable components and in particular method of installation in a specific area of deployment. A major factor is the reduction of the risk of unstable states of the system - change of status, disruption or damage to components. The threat is represented by exposure of technical and natural resources of electromagnetic interference. The aim of the article is definition of legal and basic technical requirements for electromagnetic compatibility of components of Alarm systems.

***Keywords*—** Electromagnetic compatibility, alarm systems, technical standards electromagnetic interference, government regulation, conformity assessment.

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## I. Introduction

Alarm systems and their components as electronic or electrical equipment are products which are the source and receiver of electromagnetic interference too. In terms of technical knowledge, components of alarm systems can be identified especially as receiver interference - potential "victims" on the surrounding noise signals, however due to their design (microcontrollers, power sources, communicators, remote peripherals-detectors, and cable lines) are also sources of electromagnetic interference. Components of security alarm systems as electronic devices must be designed and constructed so that the electromagnetic radiation do not exceed specified levels and to their level of electromagnetic immunity ensure that they operate without unacceptable degradation designated functions. This issue can be classified:

- in terms of a legally mandatory assessment of conformity process as a precondition to edition the EC declaration of conformity and the placing on the market, which manufacturers ensure testing and measurement of its products through accredited testing laboratory,
- for practical design and installation of alarm system, when it is necessary to take into account the technical principles of interconnection, location and installation of individual components and in particular evaluate the possible effects of electromagnetic interference on site.

In accordance with the requirements of technical standards, accredited test laboratories measure and test of alarm systems components connected in the assembly corresponding to the practical deployment and expected operating conditions of alarm system. In case of multiple possible combinations is created the set using the maximum representatives of all types, in practice connectable components (control and indicating equipment CIE + power supply, keypads, sirens, detectors etc.). Producer ensures test and measurement products and assemblies that wishes to market and which therefore needs to make a declaration of conformity. The fact that the individual components or systems meet the requirements of EMI and EMS does not necessarily mean that these components will operate in accordance with the requirements of electromagnetic compatibility on installation site. Alarm systems can then negatively affect every other device, but especially, their activity can be affected by ambient interference. Then electromagnetic immunity of the system is reduced (fault detectors, false alarms, disruption of communication between the individual components, CCTV image disorder etc.) [6]. Such situations may occur in cases where:

- designed alarm system is different from the test set- for example peripherals other types or components from other manufacturers are used (the fact that the system is designed for a variety of elements that meet EMC requirements does not automatically mean that the final installation will meet EMC specifications),
- original components have been replaced during the repair other types of products,
- installation of the system was not made in accordance with the principles of EMC (parallel lines, shielding, grounding, surge protection elements ...),
- sources of electromagnetic interference, whose values exceed the test levels, occur on installation site.

Alarm systems and their components as electronic or electrical equipment are products which are the source and receiver of electromagnetic interference too. Manufacturer or importer cannot know when EMC tests to demonstrate

compliance to an accredited laboratory in which specific environment will be an alarm system installed. [7] EMC technical standards in general distinguish between residential, commercial, light-industrial and industrial environments. For selected tests are specified test levels, depending on the potential deployment environments (environments with low EM radiation, mild EM environment, challenging environment). Therefore definitely will make a difference, whether we install an alarm system in residential areas without significant sources of spurious emissions or, in the case where the same system will be installed for example in the factory or in the area of photovoltaic power plants. In the process of setting up the alarm system is therefore in terms of electromagnetic compatibility must adhere to the following basic principles:

- security assessment of object- electromagnetic interference inside and outside the guarded object,
- selection of components meeting the legislative requirements for products,
- design of alarm system wiring in accordance with manufacturer's recommendations
- design and installation- EMC principles- selection of suitable equipment locations, parallel lines, shielding, grounding, surge protection elements etc.).

Figure 1 shows an example of pre-compliance measurement of electromagnetic emission of the relay modul. Relay module is controlled by signals from the control panel of alarm system and is designed to control non-alarm applications (lighting, blinds, heating, pumps, etc.). The differences in the measurement values were due to the different number of the connected electrical load. Higher values of EMI were measured at connect two electrical load on the relay module. This is due to the addition of cabling.

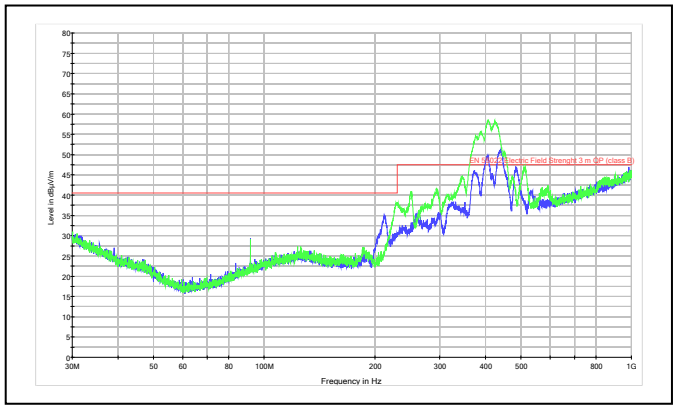


Fig. 1. The results of measurements of electromagnetic radiation according to EN 55022 ed. 3, Article 6.1.

## II. Procedure Legislative Requirements for Electromagnetic Compatibility of Alarm Systems

The basic legislative framework in the field of technical requirements for products is Act No. 22/1997 Coll. on technical requirements for products [2]. Components of alarm systems include due to their construction (as electronic / electrical equipment) between the products, which could at an increased rate threaten the health or safety of persons, property or the environment (specified products). Based on this fact, such products may be marketed only if they comply with the technical requirements, which are specified in government regulations, issued for each group specified products. For the components of alarm systems are assigned the following government regulations issued to implement the Act on technical requirements for products:

- Czech Republic. Government Decree No. 616/2006 Coll. on technical requirements for products in terms of electromagnetic compatibility, (2004/108/EC),
- Czech Republic. Government Decree No. 17/2003 Coll., technical requirements for low voltage electrical equipment, (2006/95/EC),
- Czech Republic. Government Decree No. 426/2000 Coll., technical requirements for radio equipment and telecommunications terminal equipment, (1999/5/EC).

Figure 2 shows a basic definition of terms in the field of the requirements for EMC products. In terms of testing EMS is necessary to distinguish between apparatus and fixed installation.

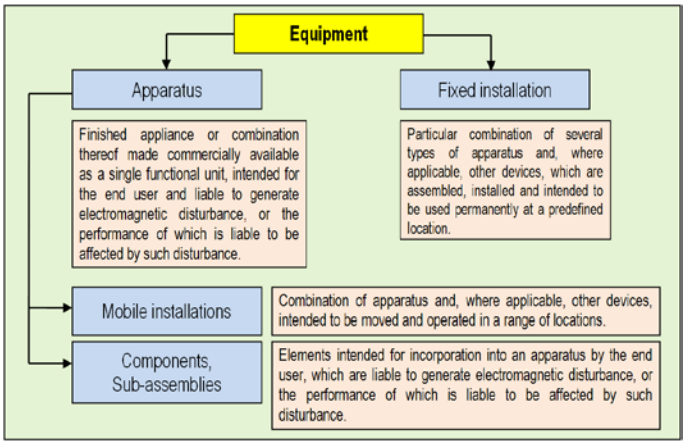


Fig. 2: Basic definitions of terms in the field of the requirements for EMC products [5] (modified Valouch, 2013)

In terms of the requirements for EMC alarm system is a basic national legal document Government Decree No. 616/2006 Coll. on technical requirements for products in terms of electromagnetic compatibility [1]. Czech Republic adopted by issue GOD No. 616/2006 Coll. into its national legislation system the Directive of the European Parliament and Council Directive 2004/108/EC on the approximation of the laws of Member States relating to electromagnetic compatibility [5]. Government Decree No. 616/2006 Coll. regulates:

- basic technical requirements for products,
- conformity assessment procedure of devices,
- the conditions for authorization of legal entities.

Technical requirements for products are generally

determined with respect to the basic principles of electromagnetic compatibility- equipment must be designed and constructed so that:

- the electromagnetic disturbance generated does not exceed the level above which radio and telecommunications equipment or other equipment cannot operate as intended,
- it has a level of immunity to the electromagnetic disturbance to be expected in its intended use which allows it to operate without unacceptable degradation of its intended use.

Further requirements for EMC regulate the area of fixed installations, when these installations must be implemented using good engineering practices and respecting the parameters of the individual components. In this context, it is important to define what is considered a fixed installation, mobile installation, equipment, apparatus, device, component or subassembly (see Fig. 2).

Due to the definition of requirements for EMC does not matter whether we are talking about the apparatus, device, component or fixed installation, because all of them fall under the designation equipment and therefore the requirements are mandatory for all such products. An important exception is a provision regulates apparatus intended solely for installation in fixed installations which are not separately marketed. Such apparatus need not then meet selected requirements of GR No. 616/2006 Coll. (EMI, EMS, conformity assessment and CE marking) if accompanying documentation contains the identification of the fixed installations for which the device is intended, the characteristics of the electromagnetic compatibility and the measures to be taken for the incorporation of the apparatus into the fixed installation to compliance with the EMC.

Components of alarm systems (CIE, detector, keypad, card reader, camera etc.) as well as complete systems (IHAS, HAS, CCTV, ACCESS, SAS) are considered apparatus. [8] If we incorrectly regarded alarm systems as fixed installations, it would be theoretically possible to implement them an individual apparatus that do not meet the basic requirements of the EMC products. In this case, the operator or owner of the installation would be required to carry out conformity assessment (including ensuring measurement EMI and EMS testing on site). However, in cases where we propose to install an alarm system in an environment where it is reasonable to expect higher levels of electromagnetic interference should be done in this area of EMI measurements and based on its results to adapt the selection of alarm system components, their location and installation.

Conformity assessment as a necessary process for placing the product on the market can perform manufacturer or the notified body (legal person who was by Member State of the European Union notified to authorities of the European Community and to all Member States of the European Union as a person authorized by a Member State of the European Union's to activities in conformity assessment products with technical requirements [2]). Documents on conformity assessment include:

- the EC declaration of conformity,
- the technical documentation.

The requirements for products relating to their electromagnetic compatibility shall be deemed to be met if they are in accordance with the harmonized European standards or with harmonized Czech standards or foreign standards which transpose harmonized European standards. Here, it is evident how (in this case by provisions of the law) otherwise generally unbinding Czech technical standards becoming compulsory. Demonstrate that the individual components of alarm systems or complete systems meet the requirements for electromagnetic compatibility in accordance with the wording of the Government Regulation No. 616/2006 Coll. requires practical perform measurement of electromagnetic radiation and testing of electromagnetic immunity of the product [7]. Such measurements and testing, including the release of the test report, are realizable by accredited bodies, in this case EMC testing laboratories that have the appropriate technical equipment and professional staff. [9] Currently (October 2014), the following entities are authorized for activities in conformity assessment of products in terms of their electromagnetic compatibility in the Czech Republic (these are also within the EU Notified Bodies):

- AO 201 - Electrotechnical Testing Institute,
- AO 202 - Engineering Test Institute,
- AO 211 - TÜV SÜD Czech,
- AO 224 - Institute for Testing and Certification,
- AO 266 - Military Technical Institute.

## III. Technical Requirements for Electromagnetic Compatibility of Alarm Systems

Technical requirements for EMC of alarm systems and its components can be divided into the following areas:

- methods of spurious emissions measurement,
- methods for testing immunity to disturbance,
- limits of spurious emissions,
- test level of testing immunity
- criteria functionality of equipment under test,
- conditions for measurement and testing,
- test setup,
- arrangement of equipment under test,
- operating conditions of equipment under test,
- requirements for measuring devices,
- requirements for the testing laboratory,
- testing on site,
- records measurement, measurement uncertainty,
- requirements for the test report.

The content of each of the above areas is defined in a wide range of relevant technical standards. In determining the appropriate requirements should be based on a range of application standards of alarm systems (EN 50130 to 50136) and from the relevant EMC basic, generic and/or product

standards, which are legislative and technical support to meet the requirements for the products in accordance with the provisions of Government Regulation No. 616/2006 Coll. In this context it should be to realize that the verification of the parameters for EMC of alarm systems and its components (as well as other electronic and electrical equipment), it is never sufficient to use a single technical standard. It is always necessary to study and subsequent application of the requirements set by out more types of standards that are mutually "linked" by reference.

The basic EMC standards that are applicable to the components of alarm systems include (for example):

- EN 61000-4-2 ed. 2 Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test.
- EN 61000-4-3 ed. 3 Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test.
- EN 61000-4-4 ed. 2 Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test.
- EN 61000-4-5 ed. 2 Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test.
- EN 61000-4-6 ed. 3 Electromagnetic compatibility (EMC) - Part 4- 6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields.
- EN 61000-4-8 ed. 2 Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test.
- EN 61000-4-11 ed. 2 Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests.

The group of EMC generic standards for components of alarm systems include (for example):

- 61000-6-1 ed. 2 Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments.
- EN 61000-6-3 ed. 2 Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments.

Components of alarm systems belong to the group of products on which the applicable requirements of product standards:

- EN 55022 ed. 3 Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement.
- EN 50130-4 ed.2 Alarm systems - Part 4: Electromagnetic compatibility - Product family standard: Immunity requirements for components of fire, intruder, hold up, CCTV, access control and social alarm systems.
- EN 55024 ed. 2 Information technology equipment - Immunity characteristics - Limits and methods of measurement.
- ETSI EN 301 489-7 V1.3.1 Electromagnetic compatibility and Radio spectrum Matters (ERM) - Electromagnetic Compatibility (EMC) standard for radio equipment and services - Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS).

Table 1 shows a summary of selected application (branch) technical standards of alarm system and indicating the standards of electromagnetic compatibility to which these application standards refer.

Table 1. Applications of technical standards for requirements for electromagnetic compatibility of alarm systems in accordance with application standards (EN 50130 to EN 50136).

| Technical Standards - EMC / Technical Standards - Alarm Systems (short title) | ČSN EN 50130-4 | ČSN EN 55022 | ČSN EN 61000-6-1 | ČSN EN 61000-6-2 | ČSN EN 61000-6-3 | ČSN EN 61000-6-4 | ČSN EN 61000-4-X... | ČSN EN 61000-2-2 | ČSN ETSI EN 301489-1 | ČSN ETSI EN 300 220-2 | ČSN ETSI EN 300 339 | GR No 616/2006 Col. | Directive 2004/ 108/ EC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ČSN EN 50130-4 (EMC immunity) | | | | | | | x | x | x | | x | | |
| ČSN EN 50130-5 (Environment) | x | | | | | | | | | | | | |
| ČSN EN 50131-1 (IHAS) | x | | | | x | | | | | | | | |
| ČSN EN 50131-2-2 (PIR) | x | | | | | | | | | | | | |
| ČSN EN 50131-3 (CIE) | x | | | | | | | | | | | x | x |
| ČSN EN 50131-6 (Power supply) | x | | | | x | | | | | | | | |
| ČSN EN 50131-5-3 (RF techniques) | | | | | | | | | x | | | | |
| ČSN EN 50131-8 (FOG System) | x | | | | x | | | | | | | | |
| ČSN EN 50132-1 (CCTV) | x | | | | x | | | | | | | | |
| ČSN EN 50133-1 (ACCESS) | x | x | x | x | x | x | | | | | | | |
| ČSN EN 50134-5 (SAS) | x | | | | | | | | | x | | | |
| ČSN EN 50136-2-1 (ATS) | | x | x | | | | x | | | | | | |

From the above data it is clear that the EMC requirements for alarm systems generally are regulated by product standard ČSN EN 50130-4 ed. 2 Alarm systems - Part 4: Electromagnetic compatibility - Product family standard: Immunity requirements for components of fire, intruder, hold

up, CCTV, access control and social alarm systems [3] and by generic standard ČSN EN 61000 -6-3 ed. 2 Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light -industrial environments. However, in case of measurement EMI of alarm systems is currently applied product standard ČSN EN 55022 ed. 3 Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement [4].

Table 2. Examples of applications requirements of technical standards for selected components of alarm systems

| Technical Standards / Components of Alarm systems (short title) | ČSN EN 50130-4 | ČSN EN 55022 | ČSN EN 61000-6-1 | ČSN EN 61000-6-3 | ČSN EN 61000-4- x... | ČSN EN 61000-3-2, 3 | ČSN ETSI EN 301489-7 | ČSN ETSI EN 301489-3 | ČSN ETSI EN 301489-1 | ČSN EN 61204-3 | ČSN ETSI EN 300 683 | ČSN ETSI EN 300 330-2 | ČSN EN 55024 | ČSN EN 55014-1,2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CIA (PBX) - wired | x | x | | | | | | | | | | | | |
| CIA (PBX) - RF | x | x | | | | | | | | | | | | |
| GSM communicator | x | x | | | | | x | | | | | | | |
| PIR detector | x | x | | | | | | | | | | | | |
| IR barrier | x | x | | | | | | | | | | | | |
| Power supply | | x | x | x | | x | | | | x | | | | |
| Auxiliary relay | | | x | | | | | | | | | | | |
| Magnetic contact | x | | | | | | | | | | | | | |
| Receiver hold-up alarm signal | | | | | | | | | | | x | | | |
| Recording card PC (CCTV) | | x | | | x | x | | | | | | | x | |
| IP camera | x | x | | | x | x | | | | | | | x | |
| Network video recorder (CCTV) | | x | | | | x | | | | | | | x | |
| Digital video recorder (CCTV) | | x | | | | x | | | | | | | x | |
| Card reader (ACCESS) | x | x | | | | | | x | x | | | x | | |
| Fingerprint reader (ACCESS) | | | | | | | | | | | | | | x |
| Panic alarm (hold-up alarm) | | | | | | x | | | | | | | | x |
| GSM camera | | | | | | | x | | x | | | | | |
| Telephone communicator | x | x | | | | | | | | | | | | |

We can classify most of the components within the product group identified as information technology equipment (ITE). Components of alarm systems are tested according to specific technical standards in relation to the requirements for placing on the market. The manufacturer is obliged to state specific standards to the EC declaration of conformity. Table 2 shows a selection of examples of individual components and identifies relevant technical standards EMC, as reported to the EC declaration of conformity. In practice differently references to standards are listed in the EC declaration of conformity for the same products. These differences depend on the body of the EC declaration of conformity is issued. Some producers declare eg. for PIR detectors only application standard (EN 50131-2-2). However, from these examples, it is clear that most often correctly product conformity cited with standards EN 50130-4 (EMS) and EN 55022 (EMI).

The specific components are subject to the requirements of other standards, such as GSM devices (ETSI EN 301489-7). Due to the installation, it is possible in selected components of the alarm system to apply the requirements of other standards such as the standards for security systems on railways (IEC EN50121-4 Railway applications - Electromagnetic compatibility - Part 4: Emission and immunity of the signaling and telecommunications apparatus).

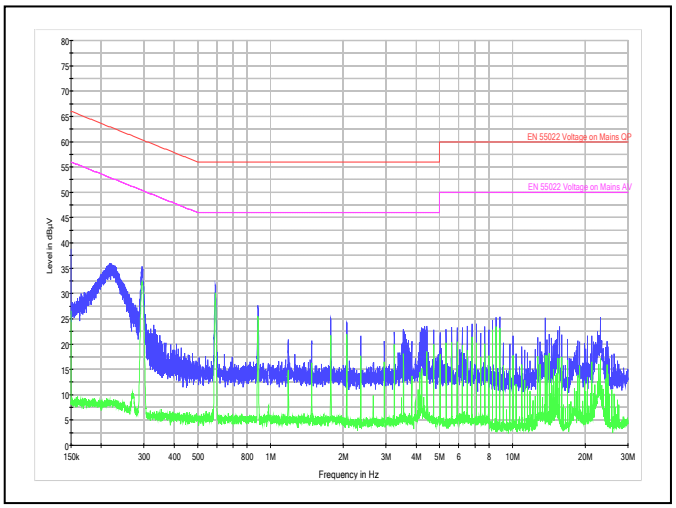


Fig. 3. The result of measurement of electromagnetic interference on the line terminals according to EN 55022 ed. 3, Article 5.1.

Figure 3 shows an example of pre-compliance measurement of electromagnetic interference on the line terminals of the relay module. The differences in the measurement values were due to the different number of the connected electrical load. Higher values of EMI were measured at connect two electrical load on the relay module.

## IV. Conclusion

The use of alarm systems must be with respect to their correct operation to take into account in terms of EMI and EMS not only unintentional interference sources but also threats of intentional-action on alarm systems by technical resources of electromagnetic interference to compromising their function (increased incidence of false alarms, failure of communications, failure or destruction of electronic parts). In this context, it is necessary to ensure compliance with legislative and technical requirements for the individual components of alarm systems and not only because of the possibility of placing on the market, but mainly because of their subsequent reliable operation of the installation site.

The correct orientation in the individual technical standards in relation to the classification of individual components into product groups, determining the environment in which it is expected to use the alarm system, application testing EMI, EMS and their scope and selection of test signals and limits is a prerequisite for compliance with legislative requirements under the placing products on the market (manufacturer, laboratory testing), but it is especially important from the design phase, construction, manufacturing functional model or

prototype of the product in the implementation of necessary diagnostic measurements and pre-compliance testing as an important condition to meet the technical requirements in the field of electromagnetic compatibility including compliance testing.

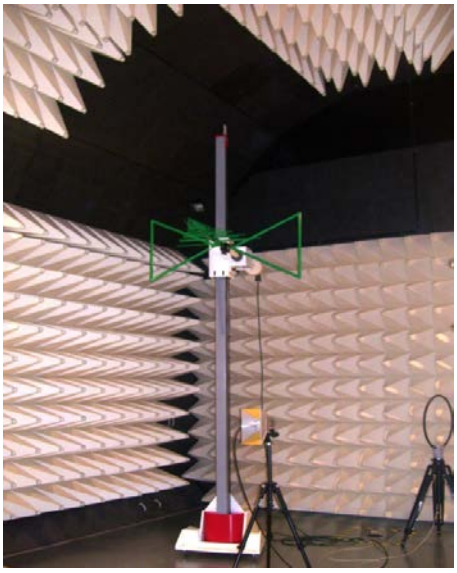

Fig. 4. Semianechoic chamber for measuring EMI and EMS testing, Tomas Bata University in Zlin

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