LaurTec

EMC Testing

CISPR regulations

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Abstract

Introducing an electronic system within the European market is getting challenging from the design perspective. Indeed it is not enough to design a working system, the system must comply with several regulations. In particular what is required for a certain product is defined by the European directives. The European directives are publicly available and can be found online by Euro Lex. The directives are very high level regulations but are a "must to be compliant" with. For an engineer looking for numbers, the directives are not the answer they may search for. Indeed the directives describe general needs that a system may support, but not how to achieve it or test it to make sure that you are compliant. The directives only require the designer to test the product with the "state of the art" knowledge, but do not specify what those are. Once you are compliant with the directives you may apply the CE marching on the product that can be sold in the European market. It is important to highlight that multiple directives generally apply to the same product, thus some time may be needed to understand which ones really apply to the product and which not.

Harmonized standards

The answer to the questions that an engineer are searching for, such as:

- What are the requirements I need to fulfill?
- What are the limits I can use for a specific requirement?

can be found within the harmonized standards. These are released by the European Standards Organization CEN, CENELEC or ETSI, which are recognized to be knowledgeable on certain topics. The regulations released by those bodies are considered to be the "state of the art", thus using their standards help to be compliant with a certain European directive. Unfortunately the harmonized standards are not for free and each one may cost a few hundreds Euros. Not a big deal, but a product may need to be compliant with more standards and each standard may require instruments that may cost many thousands euros. The loop of being compliant may need a big wallet. The trick that many companies use, it is based on the fact that the European directives let the manufacturer decide whether or not to use the harmonized standards. If you use it, you can easily show that you are "compliant". If you do not use it, you need to test your system the right way, showing each detail of your test and why you have used it. Using the harmonized standards does not guaranty that you are compliant, since each product is different, thus the harmonized standards are just the guide for testing your product. You, as manufacturer, may still need to do more to prove that you can release your system within the European market. Even if you test your system within a certified test house, the system manufacturer will be the responsible person for choosing the right tests that apply to the product.

On the other hand, applying a CE marking is just a matter of two letters, and some companies just put it on the system, add a label and write a few numbers on it. This scenario makes the competition within the European market not fair, thus there are market supervisors that try to identify manufactures that try the "short way".

One of the most challenging directive for an electronic system is the EMC Directive: **Directive 2014/30/EU** which are meant for systems that are not supposed to be Radio Equipment, in which case there is also the RED (Radio Equipment Device) directive **Directive 2014/53/EU**. As mentioned the directives are very generic and not really product specific. To get the recommended tests to be compliant with a certain directive, you need to search the specific harmonized standards which are more product specific. In particular for the EMC Directive the regulations that are product specific are the EN 550xx, which are considered to be equivalent to the CISPR xx standards.
A brief description of the CISPR xx Standards equivalent to the EN 550xx are shown within Table 1.

CISPR	Description
CISPR 11	Industrial, scientific and medical equipment –Radio Frequency disturbance characteristics –Limits and methods of measurement
CISPR 12	Vehicles, boats and internal combustion engines -Radio disturbance characteristics -Limits and methods of measurement for the protection of off-board receivers
CISPR 14-1	Electromagnetic compatibility –Requirements for household appliances, electric tools and similar apparatus –Part 1: Emission
CISPR 14-2	Electromagnetic compatibility –Requirements for household appliances, electric tools and similar apparatus –Part 2: Immunity
CISPR 15	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
CISPR 20	Sound and television broadcast receivers and associated equipment –Immunity characteristics –Limits and methods of measurement (*withdrawn in August 2020 – replaced by CISPR 35*).
CISPR 20	Information technology equipment –Immunity characteristics –Limits and methods of measurement. (*withdrawn in August 2020 – replaced by CISPR 35*).
CISPR 25	Vehicles, boats and internal combustion engines -Radio disturbance characteristics -Limits and methods of measurement for the protection of on-board receivers
CISPR 32	EMC of multimedia equipment-emission requirements (*replaced CISPR 22*)
CISPR 35	EMC of multimedia equipment-immunity requirements

Table 1: *CISPR standards summary.*

IEC organization

Why the EN 550xx are equivalent to the CISPR standard? The reason goes beyond the European market. Indeed the CISPR standards are made by IEC (International Electrotechnical Commission) which are recognized worldwide as an international body. In particular the CISPR is a committee within the IEC organization as depicted within Figure 1. TC77 is another committee that has issued the famous IEC 61000-x series, which are used as reference by the CISPR committee as well. To avoid any conflict among the standards there is also the ACEC (Advisor Committee on EMC).

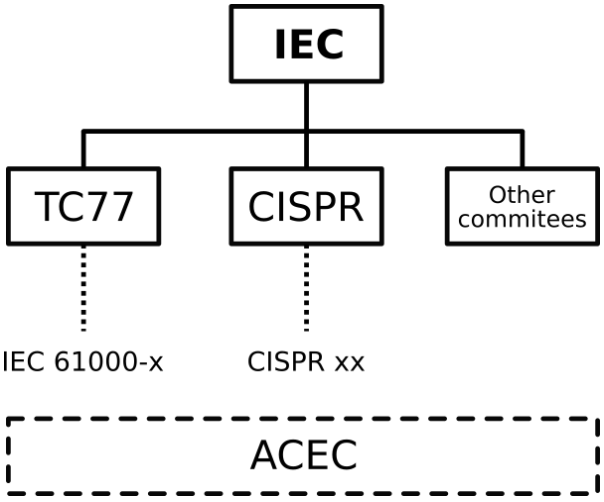

Figure 1 : *IEC high level Organization.*

Making a new regulation (harmonized standard) that reflects an IEC standard, allows to make the new regulation closer to the world wide guidelines, thus the product might be sold world wide with less effort. Nevertheless each country, such as USA, Europe, China, Japan, Australia and others, may have specific regulations that control certain products, thus getting a CE marking for Europe thus not means that you can sell the product within the USA, which requires the FCC logo. Specifically for the EMC regulations both USA and Europe use the CISPR standards as base for their own regulations. Specifically, the USA provides, with open access to it, the FCC requirements for the EMC standard.

Standard classifications

The standards are many, but they can be classified and grouped in the following ways. The definitions are directly out of the "CISPR Guide - 16 September 2019", which has an extended text and also specify which CISPR standard to use for which product. It is highly recommended to read it before purchasing any CISPR xx or EN 550xx standard.

Basic standards

Basic standards are general and hence are not dedicated to specific product families or products; they relate to general information, to the disturbing phenomena and to the measurement or testing techniques.

Generic standards

Generic EMC Standards are standards related to a particular environment, which specify the set of essential EMC requirements and test procedures… Limits are included, and reference is made to the test procedures.

Product standards

Product Standards define specific EM (Electro-Magnetic) requirements, test procedures and limits dedicated to particular products, systems or installations for which specific conditions must be considered.

Among the most important Basic Standards there is the CISPR 16 series, for which a summary is shown within Table 2.

CISPR 16	Description
CISPR 16-1-1	Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus.
CISPR 16-1-2	Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-2: Radio disturbance and immunity measuring apparatus - Coupling devices for conducted disturbance measurements.
CISPR 16-1-3	Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-3: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Disturbance power.
CISPR 16-1-4	Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Antennas and test sites for radiated disturbance measurements.
CISPR 16-1-5	Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-5: Radio disturbance and immunity measuring apparatus - Antenna calibration sites and reference test sites for 5 MHz to 18 GHz.
CISPR 16-1-6	Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-6: Radio disturbance and immunity measuring apparatus - EMC antenna calibration.
CISPR 16-2-1	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-1: Methods of measurement of disturbances and immunity - Conducted disturbance measurements.
CISPR 16-2-2	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-2: Methods of measurement of disturbances and immunity - Measurement of disturbance power.
CISPR 16-2-3	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements.
CISPR 16-2-4	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-4: Methods of measurement of disturbances and immunity - Immunity measurements.

Table 2: *CISPR 16 standards summary.*

CISPR standards are not stand alone standards that can be taken to certify a certain product. Indeed it is not unusual that a product must comply with more CISPR standards to make a reasonable testing coverage. On the other hand, CISPR standards often refer to IEC standards to fully test a certain class of products. The most used IEC standards that are also linked within the CISPR standards are the ones shown within Table 3.

IEC	Description	Details
IEC 61000-1	General document with definitions, terminologies.	Terminology, definitions, assessment of measurements uncertainty.
IEC 61000-2	Description of the environment and compatibility levels.	Describes and classify different environment from EMC perspective.
IEC 61000-3	Emission and Immunity levels.	IEC 61000-3-2 – Limits for harmonics current emission. IEC 61000-3-3 – Limitation for voltage changes (flicker).
IEC 61000-4	Testing and measurements techniques.	IEC 61000-4-2 - Electrostatic Discharge. IEC 61000-4-4 - Electrical fast transient/burst immunity test. IEC 61000-4-5 - Surge Immunity Test. IEC 61000-4-6 - Immunity to conducted disturbances, induced by radio-frequency fields.
IEC 61000-5	Installation and mitigation guide lines.	IEC 61000-6-2 Immunity for industrial environment. IEC 61000-6-3 Emission standards for residential, commercial and light ind. IEC 61000-6-4 Emission standards for industrial environment.
IEC 61000-6	Generic standard.	

Table 3: *IEC standards linked or used together with the CISPR standards .*

Conclusions

The article has summarized different standards from the IEC and CISPR series. The summary has provided a short overview on who does the standard, how they are classified and where those standards apply. In particular the harmonized standards are introduced to better show how European directives can be addressed. All the standards are shown within tables to quickly access and review it.

Bibliography

[1] www.LaurTec.it: official site where you can download the "EMC Testing" series.

History

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25. July 2020	1.1	Mauro Laurenti	Mauro Laurenti	Minor reformatting and typos corrections.
15. May. 2020	1.0	Mauro Laurenti	Mauro Laurenti	Original version.