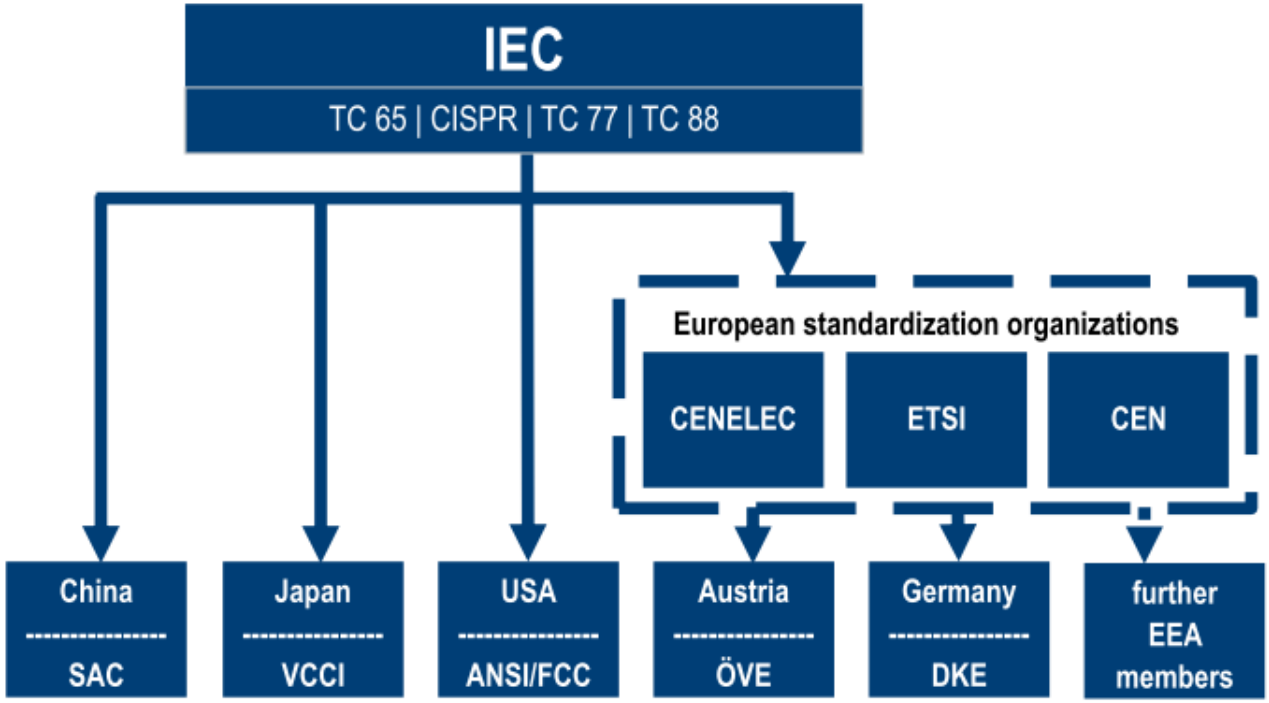
EMC 2

[R&S_EMC_overview]

Introduction

- EMC testing is all about standards
- Whether you are developing 5G products, automotive equipment, military equipment or just an ordinary table lamp, *your device must meet the requirements set by standardization* organizations such as IEC, CISPR, ISO, IEEE, CENELEC, ETSI, FCC, ANSI, RTCA or the MIL-STD committee
- Standards are all about committees



Standards

Commercial standards	CISPR	CENELEC (Europe)	FCC (USA)	METI (Japan)
Industrial, scientific and medical equipment	11	EN 55011	Part 18, C	J55011
Vehicles, boats and internal combustion engines	12/25	EN 55012 EN 55025	SAEJ551 J1113	JASO D001-82
Electrical devices, household appliances and tools	14-1	EN 55014-1	-	J55014-1
Electrical lightning	15	EN 55015	-	J55015
Multimedia equipment	32	EN 55032	Part 15, B	J55032
Military equipment	MIL-STD-461			
Aviation	DO-160			

Different types of standards include basic standards, generic standards and product or product family standards

Basic standards

- Basic standards define requirements on the measurement apparatus, measurement methods, measurement uncertainty and test facilities
- These standards do not include limits. Therefore, they cannot be applied to a specific product or product family for testing
  - a basic standard come into force by a normative reference in the relevant test standard,
  - e.g. the product standard CISPR 32 on emission measurements for multimedia equipment is referring to the basic standard CISPR 16-1-1 on the applicable measurement apparatus
- Most test standards have dated references, that means a specific edition of the basic standard applies
  - however, if the reference is undated, the latest revision of the basic standards applies

Generic standards

- Generic standards apply for all cases for which no specific EMC standards yet exist
- They are related to a *specific operating environment*
  - they include EMC requirements and test procedures that are applicable to all products that would need to operate in the described environment
  - for example, IEC 61000-6-3 describes the required emission measurements for equipment to be used in residential environments

Product standards

- Product family standards apply to specific products, or product families.
  - they define the applicable measurement methods with corresponding EMC limits for the products that are within the scope of that standard
  - they also define product-specific requirements, such as operation and arrangement of the equipment/device under test (EUT/DUT)
- The product (family) standards are divided into
  - standards limiting low-frequency and high-frequency *emission* and
  - standards defining the requirements of *immunity* to electromagnetic emission.

IEC

IEC - *International Electrotechnical Commission* - is the global leader in publishing consensus-based international standards and manages conformity assessment systems for electric and electronic products, systems and services

- IEC publications serve as a basis for national standards and as a reference when drafting international tenders and contracts
- IEC standards on EMC are mostly part of the IEC 61000 family With few exceptions IEC 61000 family is developed by IEC Technical Committee TC77
- Besides standards (e.g. IEC 61000-1-2), there are also technical reports (e.g. IEC TR 61000-1-1) and technical specifications (e.g. IEC TS 61000-3-4)
- https://www.iec.ch/publications

CISPR

CISPR - *International Special Committee on Radio Interference* - sets standards for protecting radio reception from interference by electrical or electronic appliances and systems in the electromagnetic environment and is a part of IEC

- CISPR standards are used when measuring radiated and conducted interference, and immunity for some products
- CISPR develops generic standards for emission measurements
- Besides standards (e.g. CISPR 16-1-1 or IEC 61000-6-3), there are also technical reports (e.g. IEC TR 16-2-5)
- https://www.iec.ch/publications

ISO

International Organization for Standardization (ISO) is an international standards organization that develops standards in all technology areas requested by industry

- Members are the national standard bodies
- ISO standards on EMC are most relevant for
  - road vehicles
  - earthmoving, agricultural and forestry machinery
  - wheelchairs, lifts, escalators and passenger conveyors
  - active implantable medical devices
- E.g. ISO 7637
- https://www.iso.org/standards.html

IEEE EMC Society

IEEE EMC Society is the world's largest organization dedicated to the development and distribution of information, tools and techniques for reducing electromagnetic interference

- E.g. Std.139-1988
- https://s3.us-east-2.amazonaws.com/ieeesdecom/Standards_Matrix.pdf

In Europe: CEN, CENELEC and ETSI

- In Europe, EMC is regulated through
  - the European Commission's EMC Directive 2014/30/EU
  - for radio equipment through Radio Equipment Directive 2014/53/EU
- These directives rely for their operation on *Harmonised Standards* developed by CEN, CENELEC and ETSI
  - they form the *European system for technical standardization*
- Harmonised Standards define technical characteristics that can be used to demonstrate compliance with the essential requirements of the directive
- E.g. EN 617:2001+A1:2010
- https://ec.europa.eu/docsroom/documents/51315 and 51936
- https://single-market-economy.ec.europa.eu/single-market/european-standards/harmonised-standards/electromagnetic-compatibility-emc_en

CEN, CENELEC and ETSI

- CENELEC (*European Committee for Electrotechnical Standardization*) is responsible for standardization in the *electrotechnical engineering* field for European countries
  - European Standards (EN)
  - voluntary standards, which help
    - facilitate trade between countries, create new markets, cut compliance costs and support the development of a Single European Market
    - but also at international level, adopting international standards wherever possible, through its close collaboration with the IEC, under the Frankfurt Agreement
- ETSI (*European Committee for Standardization*) produces standards for *Information and Communications Technologies* (ICT)
- CEN (*European Committee for Standardization*) produces standards for *other technical areas*

USA Dept. Of Defense (DoD)

The United States Department of Defense issued several military standards to integrate electromagnetic compatibility into the research and development stage for defense communications technology

- MIL-STD 461 is addressing EMC for subsystem and components
  - e.g. CE101, CS103, RE101, RS105
- MIL-STD 464 is addressing EMC for systems
- MIL-STD 469 is for all new military radar equipment and systems operating between 100 MHz and 100 GHz

RTCA

RTCA Inc. (formerly known as Radio Technical Commission for Aeronautics) is a United States not-for-profit organization with the mission of finding consensus among diverse, competing interests for critical aviation modernization issues

- RTCA products serve as the basis for government equipment certification used by aircrafts
- RTCA works with the Federal Aviation Administration (FAA) to develop comprehensive, industry-vetted and endorsed standards for compliance with FAA regulations
  - EMC and electromagnetic co-existence are vital for ensuring the near 100 % correct, predictable, and safe operation of aircraft electrical systems
- RTCA DO-160 is addressing environmental conditions and test procedures for airborne equipment

FCC

FCC - Federal Communications Commission - regulates interstate and international radio, television, wire, satellite and cable communications in the USA and US territories

- As independent US government agency overseen by Congress, the commission is the primary US authority for communications laws, regulations and technological innovations
- The FCC regulations are detailed in CFR 47 (Code of Federal Regulations)
- For EMC measurement methods and associated measurement equipment, the FCC is referring to standards published by the American National Standards Institute (ANSI)

ANSI - American National Standards Institute

EMC standards are defined in bulletins and reports of the FCC's Office of Engineering and Technology (OET) and when accepted are published by ANSI

- EMC is in responsibility of Committee ANSI C63
- E.g. C63.2-2016
- https://www.c63.org/documents/misc/matrix/c63_standards.htm