TECHNICAL REPORT

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Lifts, escalators and passenger conveyors — Comparison of worldwide standards on electromagnetic interference/electromagnetic compatibility

Ascenseurs, escaliers mécaniques et trottoirs roulants — Comparaison des normes mondiales relatives à l'interférence électromagnétique/la compatibilité électromagnétique

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 16764 was prepared by Technical Committee ISO/TC 178, *Lifts, escalators, passenger conveyors*.

0 Introduction

0.1 Background

International standardizing bodies such as IEC, ISO, CISPR, CENELEC, have been involved in drawing up common normative and technical documents to bring international markets closer together.

At the 1996 plenary meeting of ISO/TC 178, it was decided to carry out a comparison between various national and international electrical requirements applicable to lifts (elevators) and escalators. The first objective was to identify and compare the major EMC requirements applicable in the countries of the Working Group members (Resolution 1996/134).

The content of this Technical Report is based on the information provided by ISO/TC 178/WG 8 members.

0.2 Understanding electromagnetic interference/electromagnetic compatibility (EMI/EMC)

An electromagnetic disturbance (noise that is not sinusoidal or unwanted signal) is any electromagnetic phenomenon which may degrade the performance of a device, equipment or system. Electromagnetic interference (EMI) is the degradation in the performance of a device, equipment or system caused by an electromagnetic disturbance. The cause of EMI is unplanned coupling between a source and a receptor by means of a transmission path. Transmission paths may be conducted or radiated. See, for example, Figure 1.

The ability of the device, equipment or system to function satisfactorily in an electromagnetic environment, without introducing intolerable disturbances to that environment is called electromagnetic compatibility (EMC).

EMC has three elements:

a) a source of energy

b) a receptor that is disrupted by this energy

c) a coupling path between the source of energy and receptor.

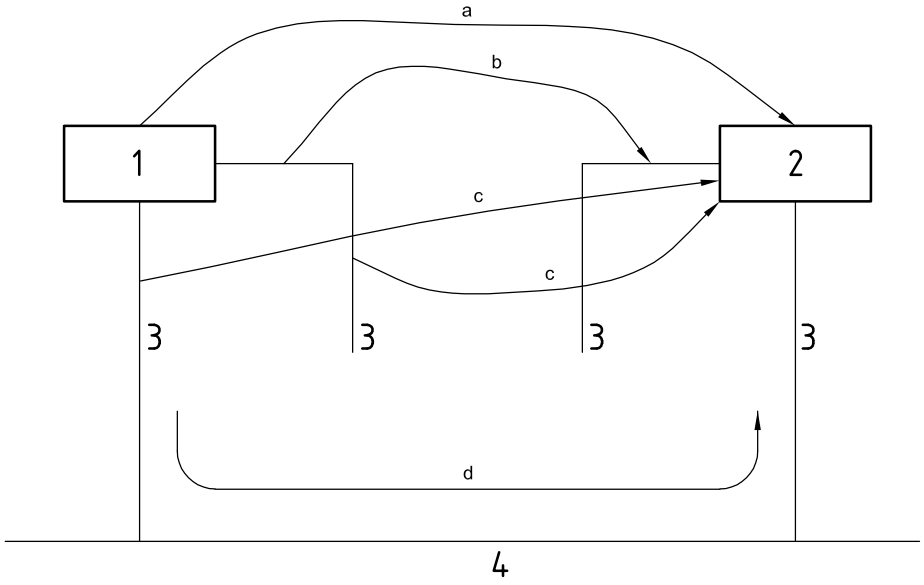
Methods of coupling electromagnetic energy from a source to a receptor fall into one of four categories:

a) conducted (electric current)

b) inductively coupled (magnetic field)

c) capacitively coupled (electric field)

d) radiated (electromagnetic field).



Key

1 source
2 receptor
3 cable
4 power line

a Path 1: direct radiation from source to receptor.

b Path 2: direct radiation from source, picked up by cables (power, signal and control) connected to the receptor, which reaches the receptor via conduction path.

c Path 3: EMI radiated by cables (power, signal or control) of the source.

d Path 4: EMI conducted from source to receptor via cables (common power supply, signal/control).

NOTE 1 Source: Engineering EMC-IEEE Press.

NOTE 2 EMI carried by power/signal/control cables that are connected to the source can be coupled to the power/signal/control cables of the receptor, especially when cable harnesses are bundled, even when common power/signal/control cables do not exist.

Figure 1 — Mechanisms of electromagnetic interference

Lifts, escalators and passenger conveyors — Comparison of worldwide standards on electromagnetic interference/electromagnetic compatibility

1 Scope

This Technical Report consists of a comparison of electromagnetic interference/electromagnetic compatibility (EMI/EMC) worldwide standards of interest to the lift industry.

2 Electromagnetic interference/electromagnetic compatibility standards

2.1 Background

With the advent of radio broadcast transmission in the 1920s, the interference from radio noise (i.e. electromagnetic noise) became a concern of engineers in Europe and North America and many technical papers were beginning to be published dealing with electromagnetic interference (EMI). Early studies showed that motor driven appliances, switches, automobile ignitions, electric traction and electrical power lines, among other sources, caused radio interference.

2.2 CISPR/IEC

In 1933 the International Special Committee on Radio Interference (CISPR, Comité International Spécial de Perturbations Radioélectriques) was formed as a result of a joint effort of the International Electrotechnical Commission (IEC) and the International Union of Broadcasting. The first meeting of CISPR was held in 1934 to address limits of EMI and methods of measurement. Following World War II, the United States, Canada and Australia started to participate in CISPR. Subsequently countries from Asia and other parts of the world also started participating in CISPR. The emphasis initially was on getting agreement on measurement procedures and instrumentation for the protection of radio services with particular emphasis on radio broadcasting. The subject of acceptable performance limits was left to a later date. IEC/TC 65 was formed in the early 1960s and was also concerned with EMC requirements. In 1974, the IEC established a new technical committee (IEC/TC 77) to cover EMC subjects not generally dealt with by the CISPR, in particular, immunity characteristics of all kinds of equipment and emission phenomena below 9 kHz, the lower end of the radio frequency spectrum. The organization of these committees in the IEC is shown in Figure 2. In formal structure, the CISPR is a separate organization from the IEC. However it should be noted that the plenary is constituted of representation from various international organizations, as well as by the National Committees of the IEC. In the IEC council, only the National Committees are represented. Also, the publications of the CISPR are issued by the IEC, and the operational procedures are identical in most respects.

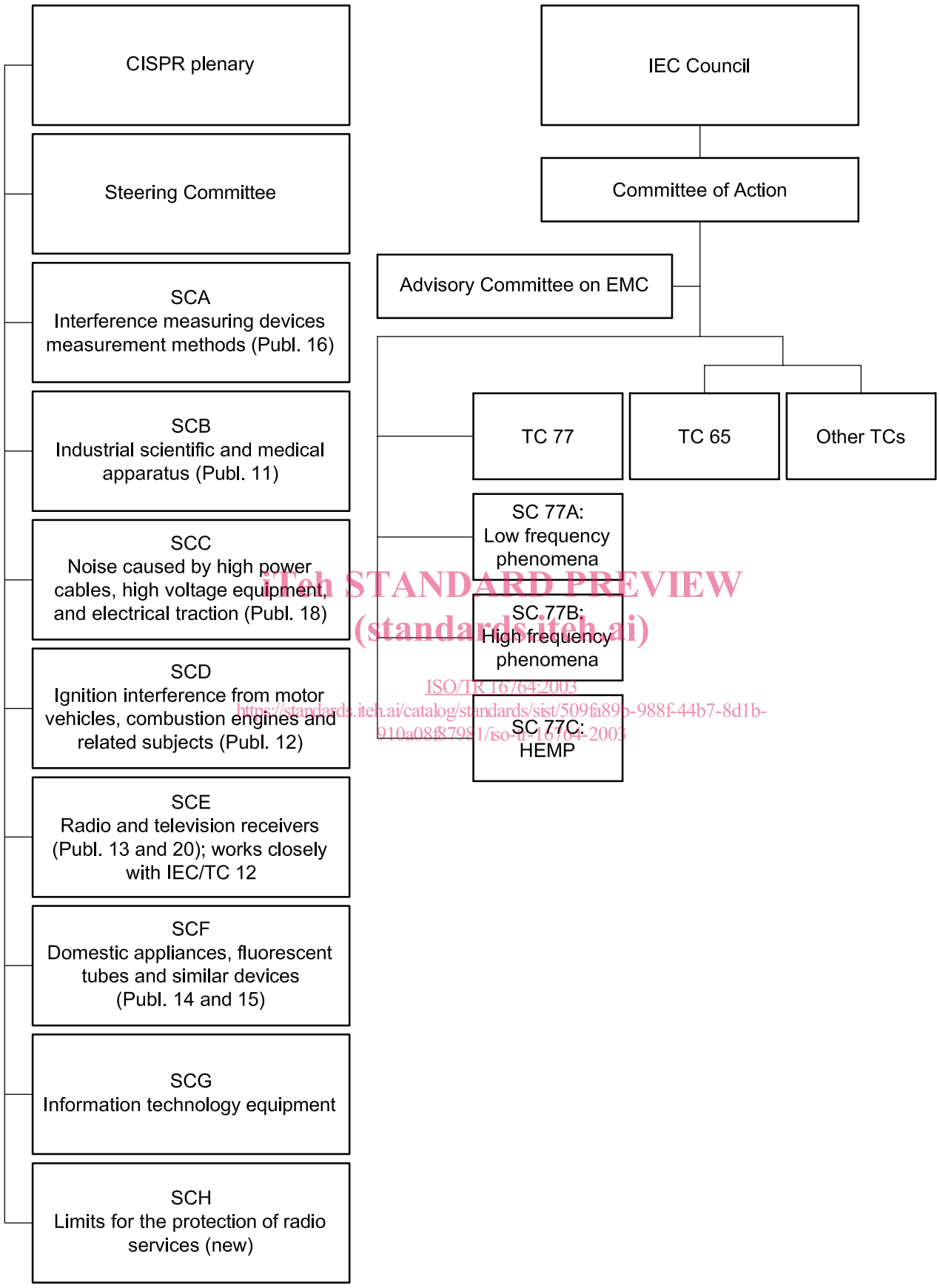


Figure 2 — Organization of CISPR and IEC technical committees responsible for EMI/EMC standards

2.3 National committees/standards

2.3.1 When the CISPR was organized, national regulatory agencies such as the Federal Communications Commission (FCC) in the US, the British Standards Institution (BSI) in the UK, Fernmelde Technisches Zentralamt (FTZ) in Germany, Voluntary Control Council for Interference (VCCI) in Japan and similar institutions in other countries also started promulgating interference control limits applicable in their respective countries.

2.3.2 The China Technical Committee of Standardization of Radio Interference (CTCSRI) was established in 1981 under the leadership of the China State Bureau of Technical and Quality Supervision. One of its tasks is to study the IEC/CISPR EMC/EMI standards and develop China's own EMC/EMI standards. There are eight subcommittees from A to G and S which concern respectively test instrument, ISM equipment, mobile, radio receiver, household appliances and electric tools, office equipment, and radio and non-radio systems. In 1993, GB/T13926 was published which is equivalent to IEC 60801. Currently, there are more than forty EMC/EMI standards published covering limits, test methods and related aspects such as site requirements and personal hazards. There is a concerted effort in China to move towards those of the IEC/CISPR.

2.3.3 In the United States commercial EMC standards activities are coordinated through the efforts of ANSI Accredited Standards Committee C63 for which the Institute of Electrical & Electronic Engineers (IEEE) is the secretariat. Several societies of the IEEE and trade organizations such as EIA, NEMA, SAE and others as well as Accredited Standards Committee C63 have developed standards pertaining to EMC. Except for cases in which commercial standards are referenced in federal (legal) documents, for example C63.4 is called out in FCC requirements, the use of these standards is wholly voluntary in the US. See Figure 3. While there is a concerted effort to move the C63 documents towards those of the IEC/CISPR differences between the IEC/CISPR and the US National standards persist.

Emission requirements in the United States are specified by the Federal Communication Commission (FCC).

The FCC administers civilian use of the frequency spectrum in the USA. Title 47 of the Code of Federal Regulations covers telecommunication and controls the intentional and incidental use of the frequency spectrum. The parts relevant to EMC are contained in Chapter 1: Part 15 — Radio Frequency Devices and Part 18 — Industrial, Scientific and Medical Equipment. FCC Part 15 has extended the measurement range for digital devices or computers up to 5 GHz.

The FCC has participated in the development of CISPR 22, and its requirements are similar to but not identical to those of CISPR 22. The FCC has adopted ANSI C63.4 measurement procedures for testing digital devices and computers. There are two classifications of digital devices:

— Class A: for the use in a commercial, industrial or business environment;

— Class B: for use in a residential environment.

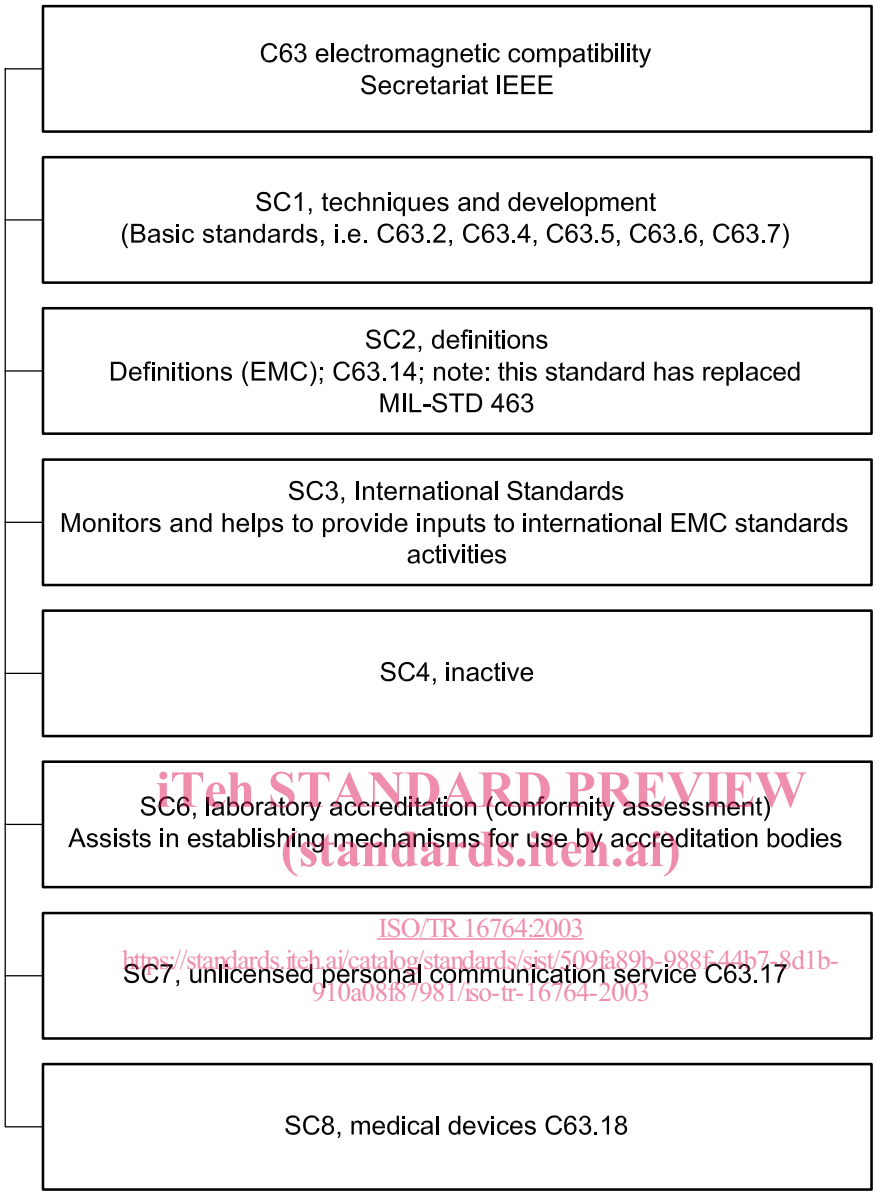


Figure 3 — Structure of American National Standards Committee C63

Harmful interference is defined as any emission, radiation or induction that may endanger the functioning of a radio navigation service or other safety services or which seriously degrades, obstructs or repeatedly interrupts a radio communications service operating in accordance with the regulations.

Although there are no requirements for **susceptibility** the “parties responsible for equipment compliances” are advised to consider susceptibility to interference (e.g. by proximity to high power broadcast stations).

Devices are required to bear the following statement (**label**):

> “This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.”

ANSI standards: Although the American national standards are based on broad consensus of the manufacturers and users, they are nevertheless only recommendations. There is no provision to enforce compliance on a mandatory basis.

2.4 CENELEC

Within the European Community, the European Standards Committee for Electrical Products [CENELEC Comité Européen de Normalisation Électrotechnique], set up in 1973, is responsible for bringing out harmonized European standards for electrical products. The CENELEC EMC standards are generally identical to CISPR and IEC/TC77 recommendations or contain usually minor “common modifications”. CENELEC implements IEC results in Europe in a uniform manner by common agreement of its members. The subcommittee responsible for EMC is IEC/TC 210.

2.5 Military

Military interest in the field of electromagnetic interference and techniques to control it, has led to important advances in understanding EMI and the technology to achieve EMC. Although the armed forces in several countries documented and published their own standards for limiting EMI, the work by the US military (MIL standards) continues to lead the way in this field.

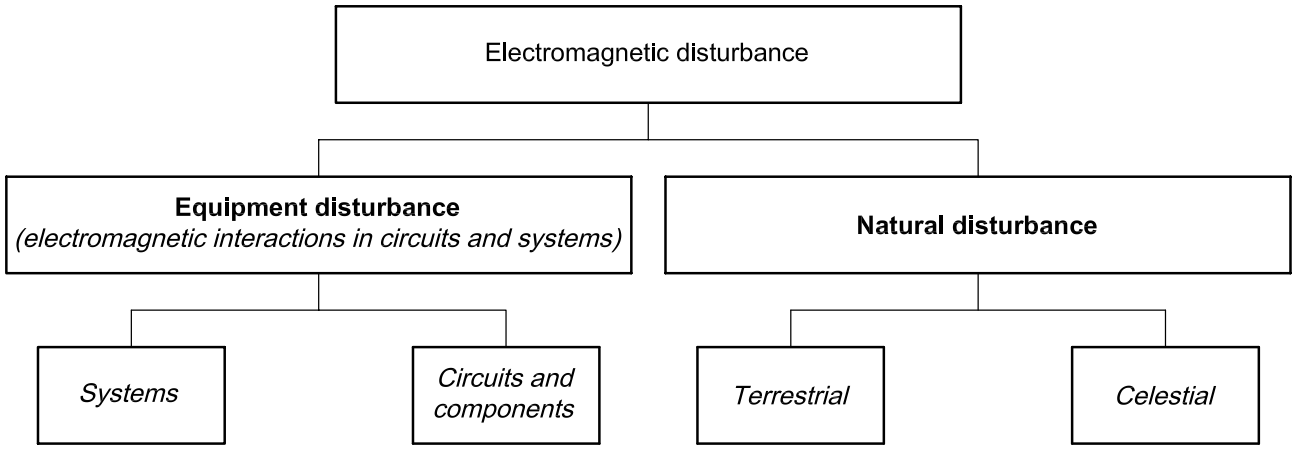
3 Sources of electromagnetic disturbances

3.1 General

Electromagnetic disturbances can be generated intentionally (e.g. telecommunication equipment), non-intentionally (e.g. interactions in circuits and systems) or by natural sources (e.g. atmospheric lightning, electrostatic discharge).

Potential sources of electromagnetic compatibility problems include radio transmitters, power lines, electronic circuits, lightning, lamp dimmers, electric motors, arc welders, solar flares and just about anything that utilizes or creates electromagnetic energy.

An overview of electromagnetic sources is shown in Figure 4.



Systems	Circuits and components	Terrestrial	Celestial
Communication/ Radar/Navigation equipment	Oscillators	Atmospherics	Cosmic/Galactic noise
Fluorescent tube lights	Switches	Lightning	
Automobile ignition	Motors		
	Filters	Electrostatic discharge	Solar noise
Industrial equipment such as arc welders, heaters, etc.	Relays		
	Nonlinear circuit elements		
Electric traction	Circuit breakers		
	Magnetic armatures		
Appliances such as microwave ovens, mixers, vacuum cleaners, electric shavers	Latching contactors		
	Logic and digital circuits		
Power supplies	Arcing due to improper contacts		
Disk drives	Corona		

NOTE Source: Engineering EMC-IEEE Press.

Figure 4 — Electromagnetic disturbance

3.2 Classification of electromagnetic interference (EMI)

3.2.1 As previously discussed, EMI can be either conducted or radiated.

Some typical examples of EMI are

— picking up a CB radio conversations on your stereo;

— telephone is damaged by lightning-induced surges on the phone line;

— the screen on video display jitters when the fluorescent lights are on;

— new memory board is destroyed by an unseen discharge as you install it;

— the clock on VCR resets everytime your air conditioner kicks in;

— laptop computer interferes with your aircraft's rudder control;

— the airport radar interferes with laptop computer display;

— pacemaker picks up cellular telephone calls;

— a hospital's electrocardiogram machine picks up a television channel.

3.2.2 Conducted interferences are disturbances not intentionally generated and are commonly present on lines connected to power supply networks. Conducted interferences may also appear on data, telephone lines or other metallic paths connecting the source of the interference and the susceptor. Some complex equipment can generate conducted interference well up into the gigahertz frequency range. Different types of equipment that commonly generate conducted interference are shown in Table 1.

Table 1 — Sources of conducted interference

Source	Spectrum
Circuit Breaker Cam Contacts	10 MHz to 20 MHz
Command Programmer	
Signal lines	0,1 MHz to 25 MHz
Power lines	1 MHz to 25 MHz
Computer Logic Box	50 kHz to 20 MHz
Corona	0,1 MHz to 10 MHz
Fluorescent Lamps	0,1 MHz to 3 MHz
Heater Circuits (Contact Cycling)	50 kHz to 25 MHz
Latching Contactor	50 kHz-25 MHz
Motor Armatures	2 MHz to 4 MHz
Mercury Arc Lamps	0,1 MHz to 1,0 MHz
Power Controller	2 kHz to 15 kHz
Power Supply Switching Circuit	0,5 MHz to 25 MHz
Power Transfer Controller	50 kHz to 25 MHz
Vacuum Cleaner	0,1 MHz to1,0 MHz
NOTE Source: Leland H. Hemming. *Architectural EM Shielding Handbook*, IEEE Press.	

3.2.3 Radiated interferences are disturbances appearing as electromagnetic fields.

Radiated interference is caused by atmospheric disturbances, cosmic noise, solar radiation, and manmade sources such as automobiles, industrial, commercial and medical equipment.

3.3 Typical EMC phenomena

3.3.1 General

The following classifications of EMC phenomena provide information to define measurements for the test requirements listed in Clause 5.