

Spectrum Management

Electromagnetic Compatibility Advisory Bulletin

Criteria for Resolution of Immunity Complaints Involving Fundamental Emissions of Radiocommunications Transmitters

Introduction

The Radiocommunication Act provides enabling powers to the Minister beyond those previously applicable under the Radio Act. Specifically, Section 5(1)(l) states, in part:

"... the Minister may, taking into account all matters that the Minister considers relevant for ensuring the orderly establishment or modification of radio stations and the orderly development and efficient operation of radiocommunication in Canada,... ...make determinations as to the existence of harmful interference and issue orders to persons in possession or control of radio apparatus, interference-causing equipment or radio-sensitive equipment that the Minister determines to be responsible for the harmful interference to cease or modify the operation of the apparatus or equipment until such time as it can be operated without causing or being affected by harmful interference"....

These powers permit the Minister to make determinations regarding immunity-related interference complaints involving both Radio Apparatus and Radio-Sensitive Equipment (RSE) and to issue orders to resolve them.

The purpose of this bulletin is to advise concerned parties of the purely technical criteria upon which such decisions will generally be based, should it be necessary for the Minister to intercede in the resolution of an immunity problem. It does not in any way limit the scope of the Minister's powers under the Act, nor should it be interpreted as restricting the extent of the *"matters that the Minister considers relevant"* to strictly technical matters. The technical criteria themselves represent an essential guideline for the Department's inspectors, vital to ensuring consistent treatment of immunity problems country-wide.

Background

The communication needs of Canada have seen a rapid increase in the last twenty years and as a result, the number of licensed radio stations has risen significantly. Because of this growth, the density of radio signal sources has increased notably, especially in urban areas. Moreover, the rapid introduction of personal portable radio transmitters has added a new dimension to the traditional pattern of electromagnetic fields. Where the fields of sufficient magnitude to cause concern were once characterized as being confined to relatively well defined, large areas surrounding high powered, fixed transmitters, that environment is now augmented by the fields from many low power portable transmitters. While these fields are both spatially small and fleeting, they have become much more numerous and are scattered throughout the urban areas where electronic equipment may be found. Furthermore, the current rapid rate of expansion of these services is expected to continue into the next decade.

During the same period, the electrical/electronic devices available in the market have also seen an explosive growth in their adoption and use by Canadians. Normally, these devices function effectively in a variety of applications ranging from simple diversion to the monitoring and control of life-sustaining systems. But, ironically, the characteristics of these devices which have made them economically and conveniently attractive to the public at large: low power usage and signal levels, light plastic cases, high speed digital

microprocessor technology and even portability, have also contributed to their being susceptible to the effects of external electromagnetic fields. In addition, in their search for economy in building such devices, designers have often overlooked or ignored the electromagnetic environment in which the equipment may be expected to operate. As a result, when these devices are exposed to the electromagnetic signals in the vicinity of radio transmitters, they may malfunction.

Each of these technological developments is patently in the public interest, but when the systems involved share a common environment, and adequate preventive measures are not taken, a potential for incompatible operation occurs. When such cases of incompatibility arise, there is a need for some measure against which to judge the cause of the problem, which can be applied equitably and uniformly on a nation-wide basis.

There are two opposing perspectives on the nature of the immunity problem. To the owner of a piece of electronic equipment, whether radio or non-radio, it often appears that the problem only arises when a radio transmitter is turned on and, consequently, prohibiting such a transmission is the logical solution to the problem. On the other side is the opinion that any electronic device that is not the intended receiver for a radio transmission has no place responding to that transmission, and obviously should have been designed and built so as not to interact with the environment in which it is placed. Any effective resolution must be based upon a compromise between these two positions.

Interference criteria

As a start, it must be recognized that there are two classes of electronic equipment to be dealt with under the Radiocommunication Act. The first is RSE as defined in the Act: *"radio-sensitive equipment means any device, machinery or equipment, other than radio apparatus, the use or functioning of which is or can be adversely affected by radiocommunication emissions"*. The second arises because the above definition excludes Radio Apparatus. Radio Apparatus can also suffer from a lack of immunity to radio signals falling outside of the band it is intended to receive. For signals in or near the passband of a radio receiver, interference problems are not viewed as an immunity issue, but rather as characteristics of the radio receiver's selectivity and sensitivity. As such these latter responses are treated as subject to any radio apparatus regulations and standards that may be applicable and problems resolved through frequency assignment processes. A sub-class of equipment requiring special treatment is conventional home entertainment audio and video devices. Although they are generally accepted to be included in the definition of RSE, they are almost invariably found in association with or, more commonly, plugged into, broadcast sound and television receivers. As a result, they have been treated in the international immunity standards as if they were radio apparatus, lumped in with broadcasting receivers. To avoid confusion arising from this inconsistency, they will be treated, for the purposes of this document, as a separate class of apparatus.

Therefore, for the application of criteria for the determination of cause, three categories of electronic equipment will be considered. One will consist of equipment for the reception of broadcast sound and television signals. The second will include associated

equipment such as audio and video recorders and playback devices, amplifiers and the like (see the Annex for a more complete list of devices.). The third will incorporate all other non-radio electronic equipment. These categories will be referred to as Broadcast Receivers, Associated Equipment and Radio-Sensitive Equipment (RSE), respectively.

The criterion selected for the determination of cause is based upon the principle of minimum overall impact for the users of both radio transmitters and electronic equipment. The method used to do this was to arrive at a limiting value of field strength which balanced the existing characteristics of the electromagnetic environment against reasonably attainable immunity characteristics of electronic equipment. A variety of sources were referenced in arriving at the values chosen, including the results of both immunity and environmental measurements, and the immunity standards currently in force in other countries¹ and in the international arena. In the end, the criteria cited in this document were based directly upon the limits for radiated immunity prescribed by the immunity standards currently in effect or under development in the International Electrotechnical Commission^{2,3}, the competent international standards-writing body.

It should be noted that the mechanism for coupling of electromagnetic fields with RSE is not normally by direct pickup of the radiation by the device's circuitry. At the frequencies in question, the most common form of ingress is through conduction along the signal, control and power leads which act as antennas to conduct the radio signals into the equipment. As a result, the most effective means to resolve immunity problems is often the introduction of filtering at the input ports of the affected device. It may be argued therefore, that an immunity criterion should be based upon the voltage level at the terminals of the device. However, the coupling between the equipment leads and the ambient electric field is critically dependent upon the configuration of the leads themselves, and this configuration is beyond the influence of the transmitter operator, but may be altered at will by the owner of the affected equipment. As it would appear unreasonable to establish a criterion which could place an onus upon one of the parties to a dispute which was subject to adjustment by the other party at any time, this approach has been dismissed. Nevertheless, the extent of the filtering required is directly proportional to the level of the electric field to which the device, and hence its connecting wires, is exposed. As a result, a field strength criterion remains an effective measure of the radio transmitter's contribution to the problem, while providing a stable framework

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- 1 European Committee For Electrotechnical Standardization (CENELEC) -- Standard EN 50082-1: Generic residential equipment, Standard EN 55020: Broadcasting receivers and associated equipment.
 - 2 International Electrotechnical Commission -- International Special Committee on Radio Interference (CISPR) Publication 20 -- *Limits and methods of measurement of immunity characteristics of sound and television receivers and associated equipment.*
 - 3 International Electrotechnical Commission -- Technical Committee 77 -- Committee Draft 77(Secretariat)141 -- *Generic immunity standard for the residential, commercial and light-industrial environments.*

within which each party to a dispute can make adjustments without affront to the other.

The Minister's determination of cause will be based upon the values of field strength shown in the table below. Departmental staff will be provided with a standard procedure laying out the measurement methods and instrumentation to be used in performing field strength measurements.

TYPE OF EQUIPMENT	FIELD STRENGTH CRITERION	
	dB μ V/m	V/m
Broadcasting Receivers	125	1.83
Associated Equipment	125	1.83
Radio-Sensitive Equipment	130	3.16

If the level of the transmitted signal exceeds the applicable field strength value on the premises of the affected equipment, it will be deemed that the transmission is the cause of the problem. If the field strength is less than the applicable value, the affected equipment's lack of immunity will be judged the cause.

These criteria are not applicable to incidents involving the transmissions of AM, FM or TV broadcasting transmitters. Those occurrences are subject to the provisions incorporated in the Broadcast Regulations and Procedures.

Issued under the authority of
Industry Canada

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Annex

Associated Equipment

Associated Equipment means radio sensitive equipment which is often, or sometimes exclusively, used in association with radio apparatus, typically forming part of a multipurpose home entertainment system. Because this equipment, although not radio apparatus in its own right, is usually connected to radio apparatus components, such as broadcasting tuners or receivers, or may incorporate a tuner as one aspect of its function, it is usually afforded, in immunity standards, the same treatment as the broadcasting receivers with which it is associated. For this reason, the criterion which has been applied to it for the purpose of resolving immunity problems is identical to that applied to broadcasting receivers. However, because it is defined under the Radiocommunications Act as Radio Sensitive Equipment, rather than Radio Apparatus, it has been treated here as a separate category for the purposes of clarity.

Examples of equipment which fall into this category are:

- Video Recorders
- Audio Tape Recorders
- Record Players
- Cable Television Broadcasting Converters
- Audio Amplifiers
- Compact Disc Players